Quick-Mini

SERIES 700

A compact comparator designed for carrying convenience is suited for quick inspection of paper thickness, leather, wires, plastic parts, etc. The digital display provides error-free reading with 0.01mm / .0005" resolution.

FEATURES

- Measuring force less than 2N.
- Notifications for:
  - Low battery voltage
  - Scale surface contamination
  - overflow
- Supplied in fitted plastic case.

700-118-20

Technical Data

Accuracy:	Refer to the list of specifications.
Resolution:	0.01mm or .0005"/0.01mm
Display:	LCD
Battery:	SR44 (1 pc.), **938882**
Battery life:	Approx. 5 years under normal use

Function

Zero-setting, Data hold, Power ON/OFF, inch/mm conversion (on inch/metric models only)

SPECIFICATIONS

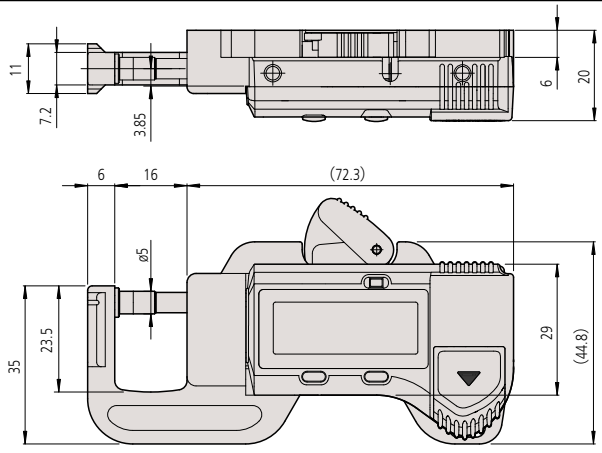
Metric

Range	Order No.	Accuracy
0 - 12mm	**700-119-30**	±0.02mm

Inch/Metric

Range	Order No.	Accuracy
0 - .5"/0 - 12.7mm	**700-118-30**	±.001"

DIMENSIONS AND MASS



700-118-20 / 700-119-20
MASS: 70g

Digimatic Caliper Gages

SERIES 209 — Internal Tube Thickness Measurement

Versatile ID measuring gages for hole diameters, groove thickness, tube diameter and hard-to-reach dimensions. The Digimatic Caliper Gages provide error-free LCD readings, as well as data output for SPC analysis.

Internal measurement type

209-552

IP67

Technical Data

Accuracy:	Refer to the list of specifications
Resolution:	.001", .0005", or .0002" 0.01mm, 0.02mm, or 0.005mm
Display:	LCD Analog / Digital
Power Supply:	AAA Battery (2 pcs.)
Battery life:	Approx. 350 hours
Measuring Force:	0.9 - 1.8N
Dust/Water protection level:	IP67

Provided with inspection certificate.

Function

Zeroset, Preset, Auto power off, Inch/Metric, conversion Data hold, Max/Min value holding, Data output

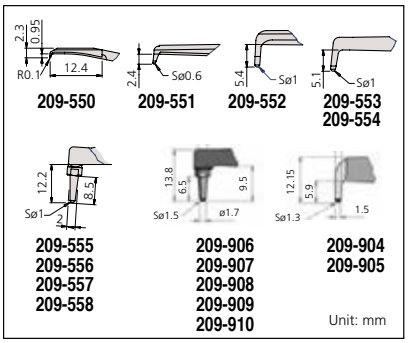
Optional Accessories

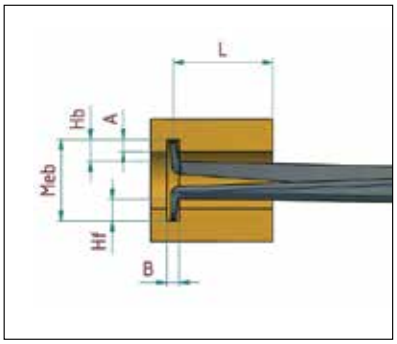
KPL1961-09: SPC Adapter
937387 Digimatic cable (1m)
965013 Digimatic cable (2m)
KPL8004-50 Holder for stand

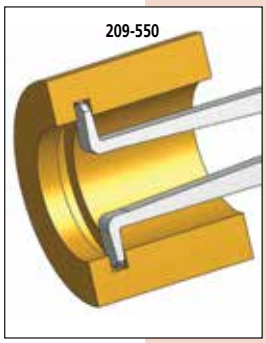
SPECIFICATIONS

Inch / Metric

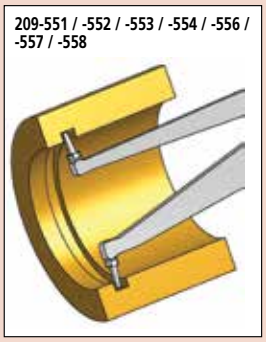
Range	Order No.	Resolution	Accuracy	Max. Measuring Depth L	Max. Groove Depth A	Min. Groove Width B	Type of Measuring Contact	Mass(g)
.10 -.49"/ 2.5 -12.5mm	**209-550**	.0002"/ 0.005mm	.0008"/ 0.015mm	.47"/ 12mm	.027"/0.7mm	.023"/ 0.5mm	Chisel R .0039"/ 0.1mm	225
.20 -.59"/ 5 -15mm	**209-551**	.0002"/ 0.005mm	.0008"/ 0.015mm	1.37"/ 35mm	.09"/ 2.3mm	.032"/ 0.8mm	Ball .024"/ 0.6mm dia.	230
.39 -1.18"/ 10-30mm	**209-552**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.19"/ 5.2mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	250
.79 -1.58"/ 20-40mm	**209-553**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.26"/ 7mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	250
1.18 -1.97"/ 30-50mm	**209-554**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.26"/ 7mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	255
1.58 -2.36"/ 40-60mm	**209-555**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.31"/ 8.3mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	265
1.97 -2.75"/ 50-70mm	**209-556**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.31"/ 8.3mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	265
2.36 -3.15"/ 60-80mm	**209-557**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.31"/ 8.3mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	270
2.75 - 3.54"/ 70-90mm	**209-558**	.0005"/ 0.01mm	.0015"/ 0.03mm	3.3"/ 85mm	.31"/ 8.3mm	.06"/ 1.2mm	Ball .04"/ 1mm dia.	270
0.51 - 1.69"/13-43mm	**209-904**	.001"/0.02mm	.002"/0.04mm	5.0"/127mm	.177"/4.5mm	.079"/2.0mm	Ball Ø.05"/1.3mm	360
1.18 - 2.36"/ 30-60mm	**209-906**	.001"/0.02mm	.002"/0.04mm	5.2"/132mm	.256"/6.5mm	.098"/2.5mm	Ball Ø.06"/1.5mm	370
1.97 - 3.15"/ 50-80mm	**209-907**	.001"/0.02mm	.002"/0.04mm	5.2"/132mm	.335"/8.5mm	.098"/2.5mm	Ball Ø.08"/2mm	370
2.76 - 3.94"/ 70-100mm	**209-908**	.001"/0.02mm	.002"/0.04mm	5.2"/132mm	.335"/8.5mm	.098"/2.5mm	Ball Ø.08"/2mm	375
3.54 - 4.72"/ 90-120mm	**209-909**	.001"/0.02mm	.002"/0.04mm	5.2"/132mm	.335"/8.5mm	.098"/2.5mm	Ball Ø.08"/2mm	380
0.59 - 2.56"/ 15-65mm	**209-905**	.001"/0.02mm	.0024"/0.06mm	7.4"/188mm	.196"/5mm	.087"/2.2mm	Ball Ø.06"/1.5mm	415
1.57 - 3.54"/ 40-90mm	**209-910**	.001"/0.02mm	.0024"/0.06mm	7.56"/192mm	.315"/8mm	.098"/2.5mm	Ball Ø.08"/2mm	420







Edge R 0.1 mm



Ball ø 0.6mm, ø 1mm, ø 1.3mm ø 1.5mm and ø 2mm

Digimatic Caliper Gages

SERIES 209 — External Tube Thickness Measurement

Versatile OD measuring gages for groove thickness, tube thickness and hard-to-reach dimensions. Digimatic Caliper Gages provide error-free LCD readings, as well as data output for SPC analysis.

External measurement type

209-572

Technical Data

Accuracy:	Refer to the list of specifications
Resolution:	.001", .0005", or .0002" 0.01mm, 0.02mm, or 0.005mm
Display:	Analog / Digital
Power Supply:	AAA Battery (2 pcs.)
Battery life:	Approx. 350 hours
Measuring Force:	0.8 - 1.7N
Dust/Water protection level:	IP67
Provided with inspection certificate.	

Function

Zeroset, Preset, Auto power off, Inch/Metric conversion, Data hold, Max/Min value holding, Data output
* Contact type 3, 4 does not have max. min. value hold.

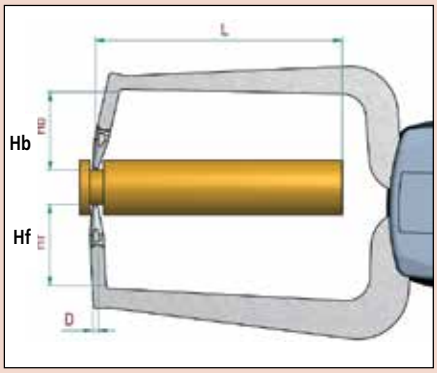
SPECIFICATIONS

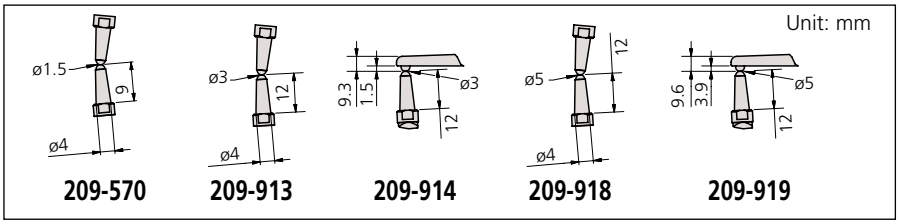
Inch / Metric

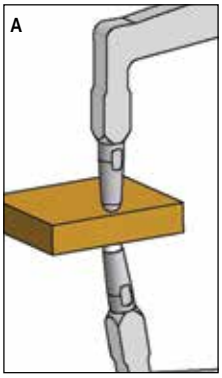
Range	Order No.	Resolution	Accuracy	Max. Measuring Depth L	Measuring Contact length Hb	Measuring Contact length Hf	Type of Measuring Contact/type of set up	Mass(g)
0 - .39"/ 0-10mm	**209-570**	.0002"/0.005mm	.0008"/ 0.05mm	1.37"/35mm	.75" /19.1mm	.73"/ 18.6mm	Ball .059"/1.5mm dia. Both/ A	240
0 - .39"/ 0-10mm	**209-571**	.0002"/0.005mm	.001"/ 0.02mm	1.37"/35mm	.85"/21.7mm	.58"/ 14.8mm	Desc .24"/ 6mm dia. Both/ C	175
0 - .78"/ 0-20mm	**209-572**	.0005"/0.01mm	.0015"/ 0.03mm	3.2"/85mm	.97"/24.7mm	.97"/ 24.6mm	Ball .059"/1.5mm dia. Both/ A	280
0 - .78"/ 0-20mm	**209-573**	.0005"/0.01mm	.0015"/ 0.03mm	3.2"/80mm	.97"/24.7mm	.10"/ 2.5mm	Ball .059"/1.5mm dia. Both/ B	270
0-1.18"/0-30mm	**209-913**	.001"/0.02mm	.002"/0.04mm	4.5"/114mm	1.17"/30mm	1.17"/30mm	Ball Ø.12"/3mm A	430
0-1.18"/0-30mm	**209-914**	.001"/0.02mm	.002"/0.04mm	4.58"/116mm	1.17"/30mm	.16"/4mm	Ball Ø.12"/3mm B	410
0-1.18"/0-30mm	**209-915**	.001"/0.02mm	.002"/0.04mm	4.56"/116mm	1.42"/36mm	.94"/24mm	Disc Ø1.97"/50mm D	430
0-1.97"/0-50mm	**209-918**	.001"/0.02mm	.002"/0.04mm	6.57"/167mm	1.17"/30mm	1.17"/30mm	Ball Ø.12"/3mm A	490
0-1.97"/0-50mm	**209-919**	.001"/0.02mm	.0024"/0.06mm	6.57"/167mm	1.17"/30mm	.18"/4.6mm	Ball Ø.12"/3mm B	460
0-1.97"/0-50mm	**209-920**	.001"/0.02mm	.003"/0.08mm	6.57"/167mm	1.42"/36mm	.94"/24mm	Disc Ø1.97"/50mm both/D	500

Optional Accessories

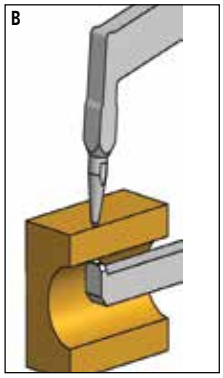
KPL1961-09: SPC Adapter
937387 Digimatic cable (1m)
965013 Digimatic cable (2m)
KPL8004-50 Holder for stand



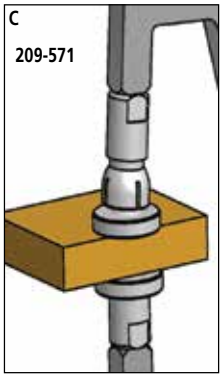




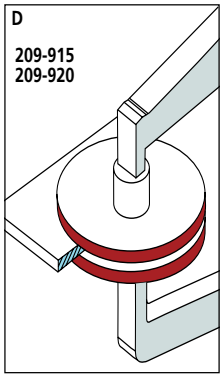
Ball ø 1.5 and 3mm for wall thickness



Ball ø 1.5 and 3mm for min. wall thickness ø3mm / 9mm



Disk ø6mm for flat surfaces



Disk ø50mm for flat surfaces

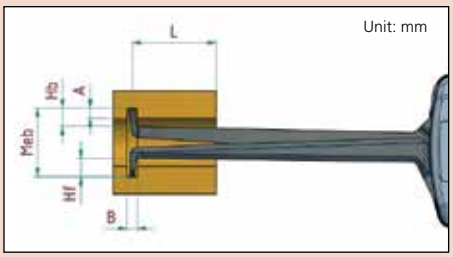
Dial Caliper Gages

SERIES 209 — Internal Measurement

The caliper is spring loaded and makes point contact at a constant measuring pressure.

IP65

DIMENSIONS



SPECIFICATIONS

Inch

Measuring Range	Order No.	Graduation	Accuracy	Max. Measuring Depth L	Max. Groove Depth A	Min. Groove Width B	Measuring Contact Type	Size (mm)	Mass (g)
.10 - .50"	**209-350**	.0002"	± .0008"	.47"	.027"	.023"	A	R0.1	200
.20 - .60"	**209-351**	.0002"	± .0008"	1.37"	.09"	.032"	B	ø0.6	200
.40 - 1.2"	**209-352**	.0005"	± .0015"	3.3"	.19"	.06"	B	ø1	200
.80 - 1.6"	**209-354**	.0005"	± .0015"	3.3"	.26"	.06"	B	ø1	200
1.2 - 2"	**209-355**	.0005"	± .0015"	3.3"	.26"	.06"	B	ø1	200
1.6 - 2.4"	**209-356**	.0005"	± .0015"	3.3"	.31"	.06"	B	ø1	200
2 - 2.8"	**209-357**	.0005"	± .0015"	3.3"	.31"	.06"	B	ø1	200
2.4 - 3.2"	**209-358**	.0005"	± .0015"	3.3"	.31"	.06"	B	ø1	250
2.8 - 3.6"	**209-359**	.0005"	± .0015"	3.3"	.31"	.06"	B	ø1	250
3.2 - 4"	**209-360**	.0005"	± .0015"	3.3"	.31"	.06"	B	ø1	250
2 - 4"	**209-361***	.0005"	± .0015"	3.3"	.31"	.06"	C	ø1	250
3.6 - 5.6"	**209-362***	.0005"	± .0015"	3.3"	.31"	.06"	C	ø1	250
5.2 - 7.2"	**209-363***	.0005"	± .0015"	3.3"	.31"	.06"	C	ø1	250

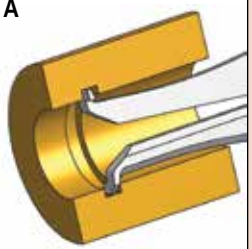
*Interchangeable contact points (additional anvil 4 pcs.) with ball point .04" dia. These Dial Caliper Gages are used only as comparison gages and should be used along with a setting ring or a micrometer.

Metric

Measuring Range	Order No.	Graduation	Accuracy	Max. Measuring Depth L	Max. Groove Depth A	Min. Groove Width B	Measuring Contact Type	Size (mm)	Mass(g)
2.5 - 12.5mm	**209-300**	0.005mm	±0.015mm	12mm	0.7mm	0.5mm	A	R0.1	155
5 - 15mm	**209-301**	0.005mm	±0.015mm	35mm	2.3mm	0.8mm	B	ø0.6	160
10 - 30mm	**209-302**	0.01mm	±0.03mm	85mm	5.2mm	1.2mm	B	ø1	180
20 - 40mm	**209-303**	0.01mm	±0.03mm	85mm	7mm	1.2mm	B	ø1	180
30 - 50mm	**209-304**	0.01mm	±0.03mm	85mm	7mm	1.2mm	B	ø1	185
40 - 60mm	**209-305**	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	B	ø1	195
50 - 70mm	**209-306**	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	B	ø1	195
60 - 80mm	**209-307**	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	B	ø1	200
70 - 90mm	**209-308**	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	B	ø1	200
80 - 100mm	**209-309**	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	B	ø1	200
50 - 100mm	**209-310***	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	C	ø1	220
90 - 140mm	**209-311***	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	C	ø1	230
130 - 180mm	**209-312***	0.01mm	±0.03mm	85mm	8.3mm	1.2mm	C	ø1	240
15-65mm	**209-901**	0.05mm	±0.05	188	5	1.9	B	ø1.5mm	355
40-90mm	**209-902**	0.05mm	±0.05	192	8.5	2.4	B	ø2mm	370
70-120mm	**209-903**	0.05mm	±0.05	192	8.5	2.4	B	ø2mm	380

*Interchangeable contact point (additional anvil 5pcs.) with ball point 1mm dia These Dial Caliper Gages are used only as comparison gages and should be used along with a setting ring or a micrometer.

A



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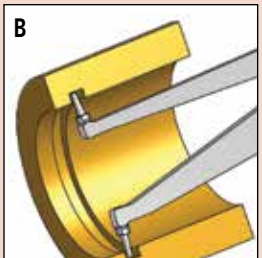

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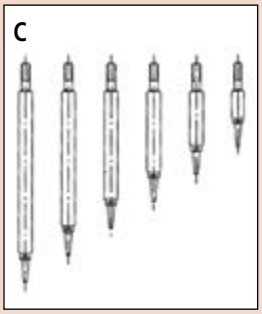
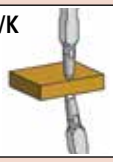


Type of Contact Points

S

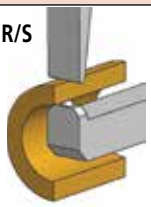
Upper / Lower contact point
R0.4 / R0.4: **209-454, 209-405**
R0.75 / R0.75: **209-921**

K/K



Upper / Lower contact point
ø2.0 / ø2.0 ball: **209-911, 209-916, 209-789**
ø1.5 / ø1.5 ball: **209-450, 209-455, 209-402, 209-404**

R/S

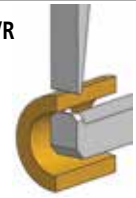


R0.4 / ø1.5 carbide ball: **209-406, 209-453**

RK/K

Upper / Lower contact point
ø1.5 / ø1.5 ball: **209-407, 209-452, 209-456**

S/R

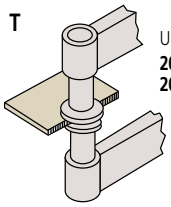


Upper / Lower contact point
R0.75 / ø2 ball: **209-922**

R

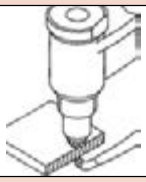
Upper / Lower contact point
ø2 / ø2.5 ball: **209-912, 209-917**

T



Upper / Lower contact point
209-451:
209-403:

PR



Upper / Lower contact point
ø2 / R0.5: **209-790, 209-603**

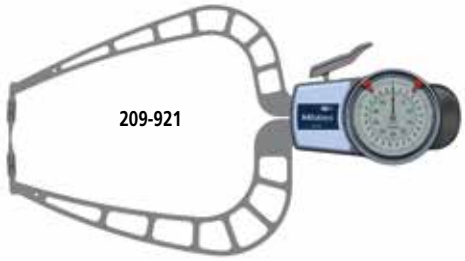
PK

Upper / Lower contact point
209-789:
209-843:

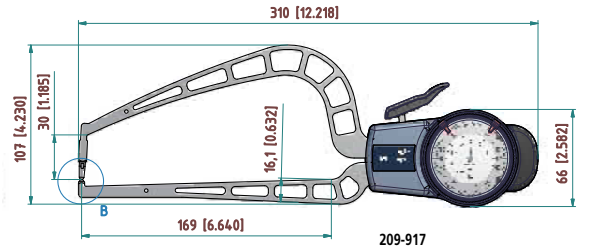
Dial Caliper Gages

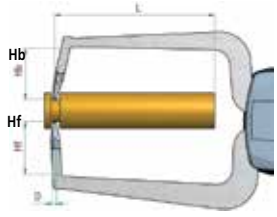
SERIES 209 — External Measurement

IP65



DIMENSIONS





Unit: mm

SPECIFICATIONS

Inch

Measuring Range	Order No.	Graduation	Accuracy	Max. Measuring Depth L	Length Hb	Length Hf	Measuring Contact Type	Size (mm)	Mass (g)
0 - .40"	**209-450**	.0002"	± .0008"	1.37"	.75"	.75"	K/K	ø1.5	170
0 - .40"	**209-451**	.0002"	±- .001"	1.37"	.85"	.58"	T	ø6	175
0 - .40"	**209-452**	.0002"	± .0008"	1.37"	.75"	.035"	RK/K	ø1.5	165
0 - .40"	**209-453**	.0002"	± .0008"	1.37"	.75"	.035"	R/S	Chisel R0.4, ø1.5	165
0- .50"	**209-789**	.005"	± .005"	1.38"	-	-	PK	ø2, Chisel R0.5	40
0- .50"	**209-790**	.005"	± .005"	1.38"	-	-	PR	ø2	40
0 - .80"	**209-454**	.0005"	±- .0015"	3.2"	.97"	.97"	S	Chisel R0.4	210
0 - .80"	**209-455**	.0005"	± .0015"	3.2"	.97"	.97"	K/K	ø1.5	210
0 - .80"	**209-456**	.0005"	± .0015"	3.2"	.97"	.10"	RK/K	ø1.5	200
0 - .80"	**209-457**	.0005"	± .0015"	3.2"	.97"	.10"	R/S	Chisel R0.4, ø1.5	200
0 - 2.0"	**209-916**	.001"	± .002"	6.6"	1.2"	1.2"	K/K	ø3	430
0 - 2.0"	**209-917**	.001"	± .002"	6.6"	1.2"	.18"	RK/K	ø3	400

Metric

Measuring Range	Order No.	Graduation	Accuracy	Max. Measuring Depth L	Length Hb	Length Hf	Measuring Contact	Size (mm)	Mass (g)
0 - 10mm	**209-402**	0.005mm	±0.015mm	35mm	19.1mm	18.6mm	K/K	ø1.5	240
0 - 10mm	**209-403**	0.005mm	±0.02mm	35mm	21.7mm	14.8mm	T	ø6	175
0 - 20mm	**209-404**	0.01mm	±0.03mm	85mm	7mm	24.6mm	K/K	ø1.5	210
0 - 20mm	**209-405**	0.01mm	±0.03mm	85mm	7mm	24.6mm	S	R 0.4	210
0 - 20mm	**209-406**	0.01mm	±0.03mm	80mm	7mm	2.5mm	R/S	Chisel R0.4, ø1.5	200
0 - 20mm	**209-407**	0.01mm	±0.03mm	80mm	7mm	2.5mm	RK/K	ø1.5	200
0 - 10mm	**209-843**	0.1mm	±0.1mm	36mm	-	-	PK	ø2, Chisel R0.5	40
0 - 10mm	**209-603**	0.1mm	±0.1mm	33mm	-	-	PR	ø2	40
0 - 50mm	**209-911**	0.05mm	±0.05mm	167mm	30mm	30mm	KK	Ball Ø3mm	430
0 - 50mm	**209-912**	0.05mm	±0.05mm	169mm	30mm	4.5mm	RK/K	Ball Ø3mm	400
0 - 50mm	**209-921**	0.05mm	±0.05mm	167mm	30mm	30mm	S	Chisel R0.75	490
0 - 50mm	**209-922**	0.05mm	±0.05mm	169mm	30mm	4.5mm	R/S	ø3, Chisel R0.75	400

Mitutoyo

Dial Tension Gages

SERIES 546

FEATURES

- Can measure dynamic tension in Newton (N) units.
- Dial Tension Gages are widely used to determine the contact force of other measuring instruments, as well as that of electrical relays, micro-switches, valves and precision springs.
- Convenient peak-hold type gages are also available.

546-112
Standard

546-119
Standard

546-137
Peak hold

SPECIFICATIONS

Standard

Range	Order No.	Minimum reading
6mN - 50mN	**546-112**	2mN
10mN - 100mN	**546-113**	5mN
30mN - 300mN	**546-114**	10mN
0.06N - 0.5N	**546-115**	0.02N
0.1N - 1N	**546-116**	0.05N
0.15N - 1.5N	**546-117**	0.05N
0.3N - 3N	**546-118**	0.1N
0.6N - 5N	**546-119**	0.2N

Peak hold

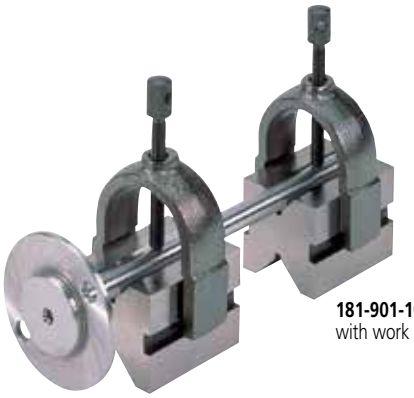
Range	Order No.	Graduation
10mN - 100mN	**546-133**	5mN
30mN - 300mN	**546-134**	10mN
0.06N - 0.5N	**546-135**	0.02N
0.1N - 1N	**546-136**	0.05N
0.15N - 1.5N	**546-137**	0.05N
0.3N - 3N	**546-138**	0.1N
0.6N - 5N	**546-139**	0.2N

V-Block Sets

SERIES 181

FEATURES

- Two V-blocks per set.
- Magnetic type is available. (The magnetic V-block is not provided with a workpiece clamp.)



181-901-10
with work piece

SPECIFICATIONS

Inch

Max. workpiece dia.	Order No.	Thread Size	Remarks	Mass(g)
1″	**181-901-10**	UNC 1/4″-20	With clamp	750
2″	**181-904-10**	5/16″-18NC	With clamp	3600

Magnetic V-Block

SERIES 181

SPECIFICATIONS

Metric

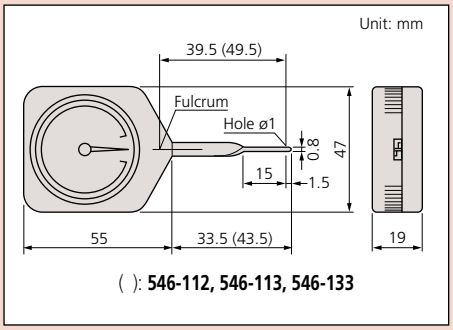
Max. workpiece dia.	Order No.	Magnetic Pull	Remarks
50mm	**181-146**	60 kg	1 Piece

181-146

Application

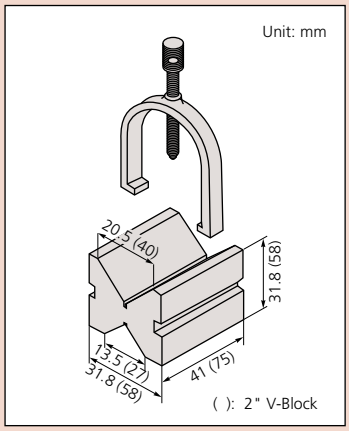
Measuring contact force of relay

DIMENSIONS



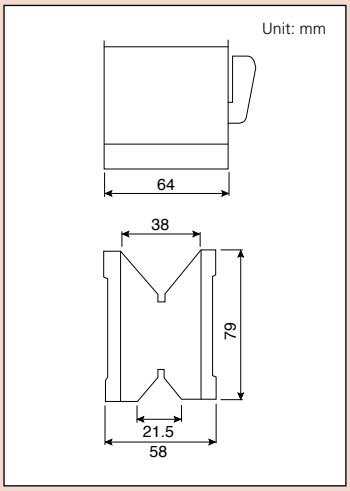
( ): **546-112, 546-113, 546-133**

DIMENSIONS



( ): 2" V-Block

DIMENSIONS



Dial Snap Gages

SERIES 201

Technical Data

Accuracy:	Refer to the list of specifications
Anvil retracting stroke:	.078″ / 2mm
Anvil positioning range:	1″ / 25mm
Anvil flatness:	.00004″ / 1µm

FEATURES

- Designed for quick go/no-go judgment of diameters of cylinders and shafts in machining processes.
- Dial or Digital indicators are optional.
- Anvil retracting stroke: .078″ / 2mm
- Anvil positioning range: 1″ / 25mm
- Wide (.53 x .47″ / 13.5 x 12mm), flat carbide anvils
- Both front edges of the anvil are chamfered for easy insertion.

201-101
with optional dial indicator 2046SB

SPECIFICATIONS

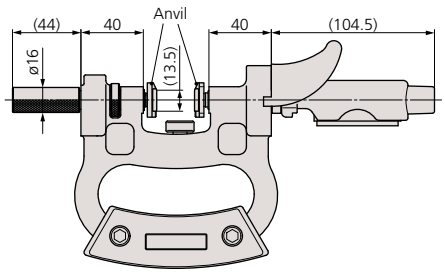
Metric Gage stem diameter 8mm

Range	Order No.	Parallelism	Measuring force	Recommended dial indicator (optional)
0 - 25mm	**201-101**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
25 - 50mm	**201-102**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
50 - 75mm	**201-103**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
75 - 100mm	**201-104**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
100 - 125mm	**201-105**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
125 - 150mm	**201-106**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
150 - 175mm	**201-107**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
175 - 200mm	**201-108**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
200 - 225mm	**201-109**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
225 - 250mm	**201-110**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
250 - 275mm	**201-111**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)
275 - 300mm	**201-112**	5µm or less	15N±3N	**2046SB** (0.01mm reading), **2109SB-10** (0.001mm reading)

Inch Gage stem diameter 3/8"

Range	Order No.	Parallelism	Measuring force	Recommended dial indicator (optional)
0 - 1″	**201-151**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
1 - 2″	**201-152**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
2 - 3″	**201-153**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
3 - 4″	**201-154**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
4 - 5″	**201-155**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
5 - 6″	**201-156**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
6 - 7″	**201-157**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
7 - 8″	**201-158**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
8 - 9″	**201-159**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
9 - 10″	**201-160**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
10 - 11″	**201-161**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)
11 - 12″	**201-162**	.00025″ or less	15N±3N	**2803SB-10** (.0001″ reading)

DIMENSIONS



Unit: mm

Mitutoyo

Dial/Test Indicator & Magnetic Stand Sets

SERIES 7

513-907

64PKA079

SPECIFICATIONS

Set No.	Included in set
64PKA078*	2804S-10, 7010S
64PKA079*	2416S, 7010S
513-907-10E	513-402-10E, 7014E-10
513-908-10E	513-404-10E, 7014-10

*Supplied with collar **02AZC291**

Magnetic Stands

SERIES 7

Mitutoyo's Magnetic Stands accept all dial indicators and dial test indicators. The On-Off switch offers instant mounting and dismounting without any adverse effect to the indicators or workpiece surface.

7010S

7011BN

7031B

7032B

7033B

7012-10

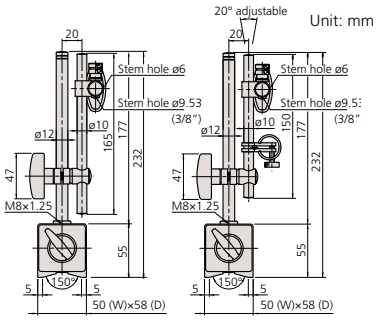
7014-10 / 7014E-10
No magnet force On/Off

SPECIFICATIONS

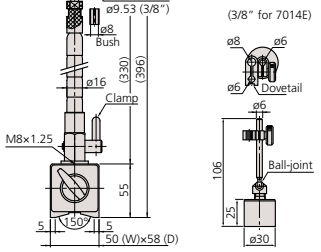
Order No.	Description	Applicable holding stem dia.	Dovetail groove	Remarks
7010S	Magnetic stand	ø8mm*, ø9.53mm (3/8")	—	—
7011BN	Magnetic stand	ø6mm, ø8mm*, ø9.53mm (3/8")	—	With fine adjustment
7011S-10	Magnetic stand	ø4mm, ø8mm, ø9.53mm (3/8")	—	With fine adjustment
7012-10	Magnetic flexi-stand	ø6mm, ø8mm*, ø9.53mm (3/8")	—	For dial test indicator
7014-10	Mini magnetic stand	ø6mm, ø8mm	Provided	Without magnet ON/OFF
7014E-10	Mini magnetic stand	ø6mm, ø8mm*, ø9.53mm (3/8")	Provided	Without magnet ON/OFF
7031B	Universal magnetic stand	ø6mm, ø8mm, ø9.53mm (3/8")	Provided	With mechanical locking system
7032B	Universal magnetic stand	ø6mm, ø8mm, ø9.53mm (3/8")	Provided	With mechanical locking system
7033B	Universal magnetic stand	ø6mm, ø8mm, ø9.53mm (3/8")	Provided	With mechanical locking system

*Supplied with collar **02AZC291**

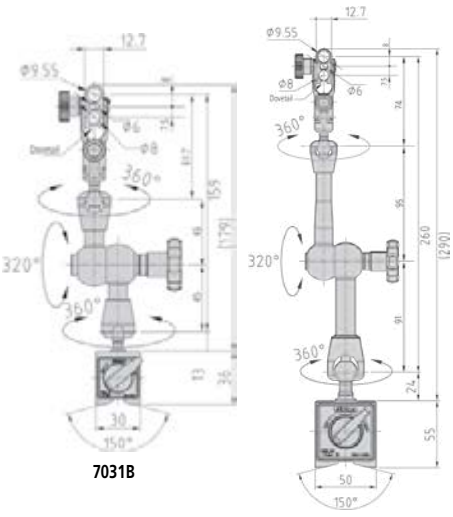
DIMENSIONS



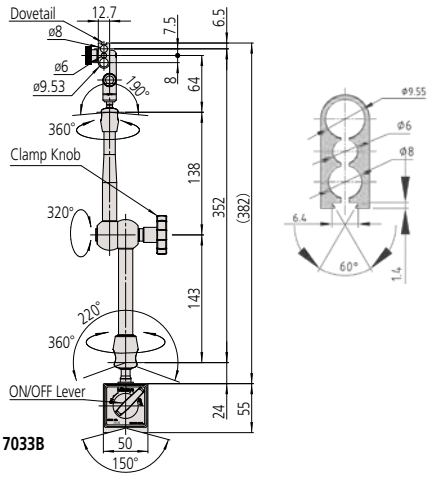
7010S 7011BN



7012-10 7014-10/7014E-10



7031B 7032B



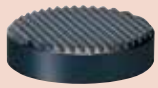
7033B

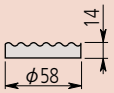
Dial Gage Stands

SERIES 7

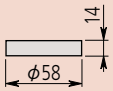
Optional Accessories

101461: Hardened-steel flat anvil
101462: Hardened-steel serrated anvil
101463: Hardened-steel domed anvil*
*Not available for **7007-10**.

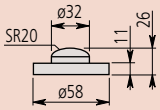




No.101462
Hardened steel



No.101461
Hardened steel



No.101463
Hardened steel

FEATURES

- Dial Gage Stands are designed for comparison measurements of size using a dial indicator or Digimatic Indicator.
- Anvil of 7001-10 and 7002-10: ø58mm
  Anvil of 7007-10: 90mm square
- Vertical fine adjustment is available with one-touch control thanks to the parallel spring suspension.

7001-10
(with ø58mm serrated anvil)

7002-10
(with ø58mm flat anvil)

7007-10
(with 90mm square anvil)

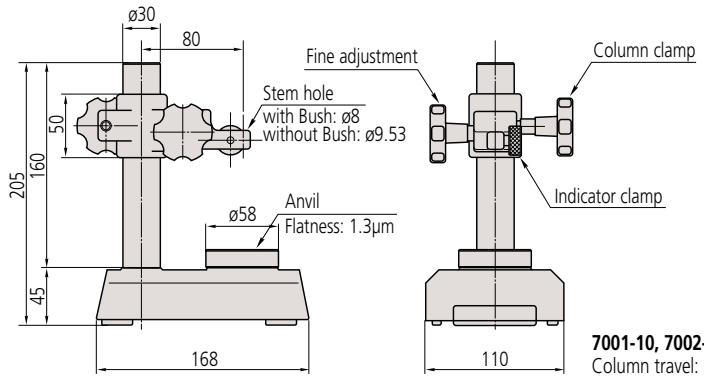
SPECIFICATIONS

Metric

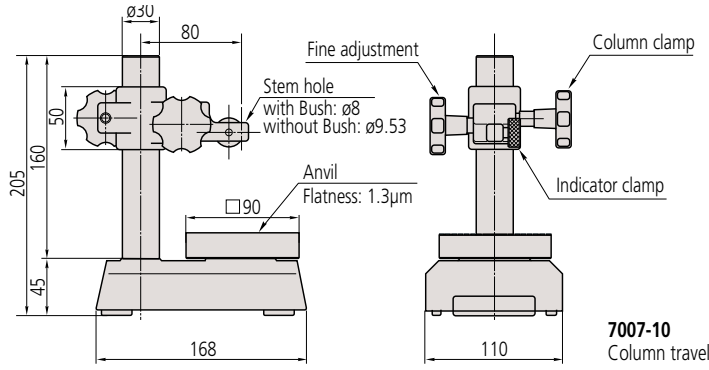
Order No.	Stem hole	Remarks	Mass(g)
7001-10	ø8mm, ø9.53mm	With serrated anvil (**101462**)	4
7002-10	ø8mm, ø9.53mm	With flat anvil (**101461**)	4
7007-10	ø8mm, ø9.53mm	With square anvil	5

DIMENSIONS

Unit: mm



7001-10, 7002-10
Column travel: 0 - 95mm



7007-10
Column travel: 0 - 90mm

Mitutoyo

Transfer Stands

SERIES 519

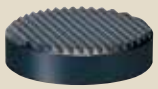
FEATURES

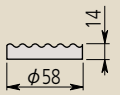
- Transfer Stands are designed for comparison measurements of size using a dial indicator or Digimatic Indicator.

519-109-10
(with a serrated anvil)

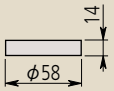
Optional Accessories

101461: Hardened-steel flat anvil
101463: Hardened-steel domed anvil

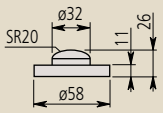




No.101462
Hardened steel



No.101461
Hardened steel



No.101463
Hardened steel

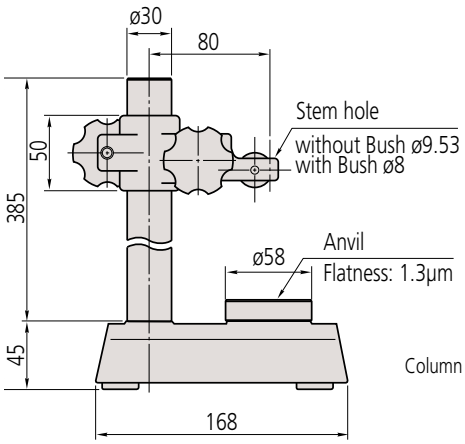
SPECIFICATIONS

Metric

Order No.	Stem hole	Remarks
519-109-10	ø8mm, ø9.53mm	With serrated anvil (**101462**)

DIMENSIONS

Unit: mm



Column travel: 0 - 320mm

Granite Comparator Stands

SERIES 215

FEATURES

- Easy maintenance due to the non-rusting base.
- The rigid granite base is free from burrs and pileups due to its fine-grain composition and less viscousness compared with casting iron. The flatness is always accurate and the workpiece is free from damage.

215-151-10

215-153-10

215-156-10

Optional Accessories

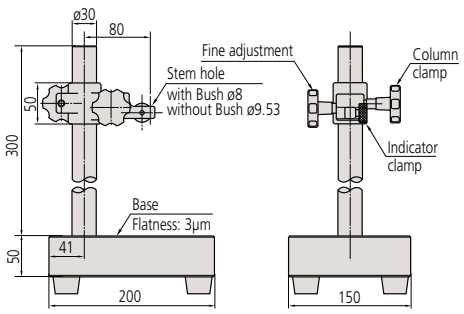
21JAA329: ø8mm bush
21JAA330: ø9.53mm bush
21JAA331: ø15mm bush
only available for **215-156-10**

SPECIFICATIONS

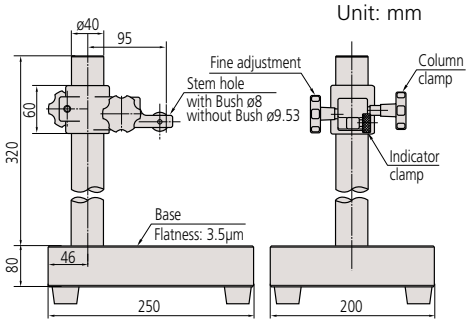
Order No.	Granite base size (W x D x H)	Column travel	Stem hole	Remarks
215-151-10	150 x 200 x 50mm	250mm	ø8mm, ø9.53mm	With fine adjustment of 1mm range
215-153-10	200 x 250 x 80mm	260mm	ø8mm, ø9.53mm	With fine adjustment of 1mm range
215-156-10	300 x 250 x 80mm	275mm	ø8mm, ø9.53mm, ø20mm	With fine adjustment over the entire travel

DIMENSIONS

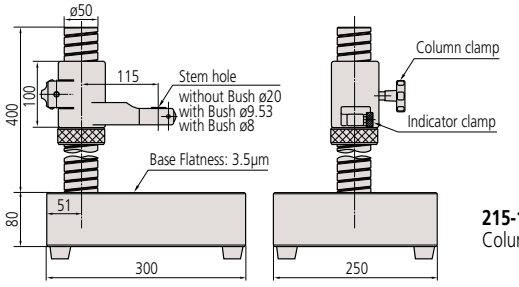
Unit: mm



215-151-10
Column travel: 0 - 250mm



215-153-10
Column travel: 0 - 260mm



215-156-10
Column travel: 0 - 275mm

Mitutoyo

Comparator Stands

SERIES 215

FEATURES

- Comparator Stands have a stable, cast-iron base which enables precise measurement.
- The partially serrated anvil prevents flat workpieces from wringing to it and the 2.3µm flatness (or better) promotes accurate measurement.
- The **215-505-10** model has a threaded column which enables easy and precise coarse adjustment.
- Serrated anvils 110×110mm are supplied with **215-405-10**, and 150×150mm with **215-505-10** models.

215-405-10

Application example using Digimatic Indicator ID-H.

SPECIFICATIONS

Order No.	Square anvil size (W x D)	Column travel	Stem hole	Remarks
215-405-10	110 x 110mm	235mm	ø8mm, ø9.53mm	With fine adjustment of 1mm range
215-505-10	150 x 150mm	275mm	ø8mm, ø9.53mm, ø20mm	With fine adjustment over the entire travel

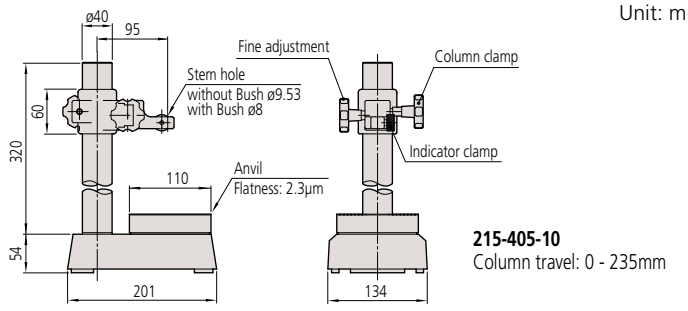
* Perpendicularity of the mounting hole to the anvil: less than 0.4mm/100mm

Optional Accessories

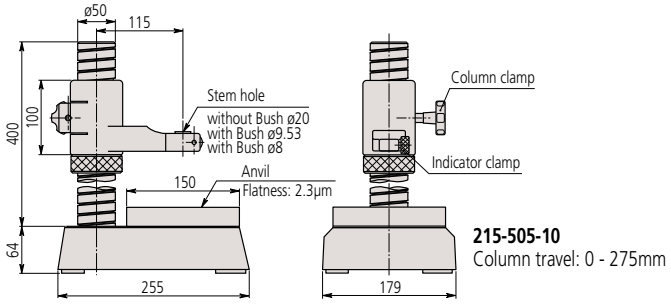
21JAA329: ø8mm bush*
21JAA330: ø9.53mm (3/8″) bush*
21JAA331: ø15mm bush*
* Only available for **215-505-10**.

DIMENSIONS

Unit: mm



215-405-10
Column travel: 0 - 235mm



215-505-10
Column travel: 0 - 275mm

Precision Granite Stands (with black granite bases)

SERIES 517

FEATURES

Mitutoyo's Granite Comparator Stands are basic building blocks for the assembly of special purpose, precision measuring equipment. By mounting precision measuring instruments such as Digimatic indicators, Mu-Checker Cartridge Heads and Linear Gages on the stands, it is possible to satisfy all manners of measuring assignment. The rigid granite base is free from burrs, pileups and rust, thereby preventing deterioration over time.

Optional Accessories

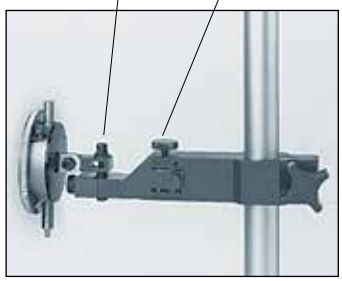
012580: Holder for Lug-Back indicator

517-891

517-892

SPECIFICATIONS

Order No.	Base	Column Diameter	Column Height	Throat Clearance	Table Flatness	Table Thickness	Weight
517-890	6 x 8″	1.181″	6″	4.375″	.0001″	2″	18 lbs
517-891	6 x 8″	1.181″	8″	4.375″	.0001″	2″	19 lbs
517-892	6 x 8″	1.181″	12″	4.375″	.0001″	2″	20 lbs
517-893	6 x 8″	1.181″	18″	4.375″	.0001″	2″	21 lbs
517-895	8 x 12″	1.181″	6″	5.8″	.0001″	2″	29 lbs
517-896	8 x 12″	1.181″	8″	5.8″	.0001″	2″	30 lbs
517-897	8 x 12″	1.181″	12″	5.8″	.0001″	2″	31 lbs
517-898	8 x 12″	1.181″	18″	5.8″	.0001″	2″	32 lbs
517-899	8 x 12″	1.181″	24″	5.8″	.0001″	2″	35 lbs



Mitutoyo

MITUTOYO INSTITUTE OF METROLOGY

The Mitutoyo Institute of Metrology, the educational department of Mitutoyo America, provides unrivaled educational seminars, courses and on-demand resources for a wide variety of metrology and measurement-related topics such as basic inspection techniques, principles of dimensional metrology, calibration methods and GD&T. This comprehensive curriculum meets the educational needs of manufacturing, quality and measurement professionals. These popular courses are scheduled regularly throughout the year.

The calibration expertise of Mitutoyo America is now available on-demand for anybody through our On-Demand Portal. Here, you can access metrology educational materials that leverages the available American National Standards in dimensional metrology.

Mitutoyo now offers online courses introducing important concepts in general calibration of micrometers and calipers. Mitutoyo also offers the first certified credentials in dimensional calibration in the United States, addressing both theory (Level 1 credential) and hands-on performance skills (Level 2 credential). These credentials satisfy auditors' requirements.

If you have any questions or would like more information regarding Mitutoyo Institute of Metrology, contact: **MIM@Mitutoyo.com**

Mitutoyo
Institute of Metrology

Linear Gages

Mu-checker

Laser Scan Micrometers

Linear Gage LGK

Laser Scan Micrometer LSM-500S

INDEX

Mitutoyo

Gage Heads / Display Units

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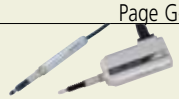
0.001mm	**LGK** series Page G-4 **LGF** series • 0.5µm high-resolution type Page G-5		**542-156** **542-161**  Page G-4 and G-5	**542-162**  Page G-5	
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Gage Heads			Display unit		
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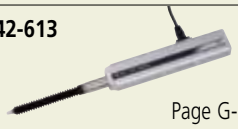
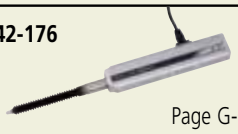
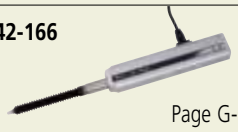
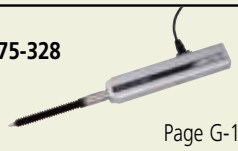
	542-613  Page G-5		**EG Counter** **542-015**  Page G-21		
	542-176  Page G-6		**EG Counter** **542-017**  Page G-21	**EH Counter** **542-073A**  Page G-19	**EV Counter** **542-067**  Page G-23 and G-24
	542-166  Page G-6		**EB Counter** **542-094-2**  Page G-22		
	575-328  Page G-12		**EC Counter** **542-007A**  Page G-20	**EH Counter** **542-072A**  Page G-19	**EV Counter** **542-064**  Page G-23 and G-24
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Mitutoyo

Linear Gage LGK – Slim, Robust

Series 542 — Resolutions: 0.1µm, 0.5µm, 1µm

- Ideal for integration into harsh environments such as automation applications.
- Compact model offers the vibration/shock resistance of the proven LGF series at 1/5 the size compared to LGF-110L-B. Cross-sectional area is approx. 1/5 compared to LGF-110L-B.
- Resolution of each model can be selected from 0.1µm, 0.5µm, or 1µm.
- Excellent sliding durability improved to remain serviceable for at least 15 million cycles (in-house testing).
- Excellent shock resistance, 100g/11ms (IEC 60068-2-27).

542-158

IP66

542-157

IP66

542 -156

IP66

SPECIFICATIONS

Order No.		542-158	542-157	542-156
Measuring range		10mm (.4")		
Resolution		0.1µm (.000005")	0.5µm (.000020")	1µm (.000050")
Measuring accuracy (20°C)		(0.8+L/50) µm (L=mm)	(1.5+L/50) µm (L=mm)	
Quantizing error		±1 count		
Measuring force	Contact point upward	0.7N or less		
	Contact point horizontal	0.75N or less		
	Contact point downward	0.8N or less		
Position detection method		Photoelectric linear encode		
Response speed*1		400mm/s	1500mm/s	
Output signal		90° phase difference, differential square wave (RS-422A equivalent), minimum edge intervals: 200ns for 0.1µm model, 200ns for 0.5µm model, 400ns for 1µm model		
Output signal pitch		0.4µm	2µm	4µm
Mass		Approx. 175g		
Dust/water resistance*2		Equivalent to IP66 (only gage head)		
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point **No.901312**		
Stem dia.		ø8mm		
Bearing type		Linear ball bearing		
Output cable length		2m (directly from casing)		
Connector		Plug: RM12BPE-6PH (HIROSE), Compatible receptacle: RM12BRD-6S (HIROSE)		
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)		
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)		
Standard Accessories		Wrench for contact point: **No.538610**		
Remarks		Gold banded	Blue banded	Green banded

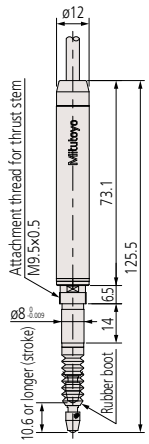
*1: When the spindle speed exceeds 1500mm/s (400mm/s for 0.1µm model), an alarm signal will be output. Also, if using Mitutoyo counter, an error message will be displayed. If using counters made by other companies, please inquire separately for the alarm signals. For the models of 0.1µm resolution, note that over-speed error may occur depending on the impact amount when releasing the contact point freely.

*2: IP Code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the kind of liquid.

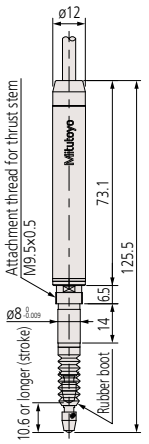
DIMENSIONS

Unit: mm

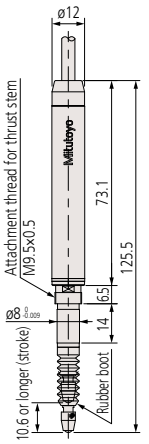
542-158



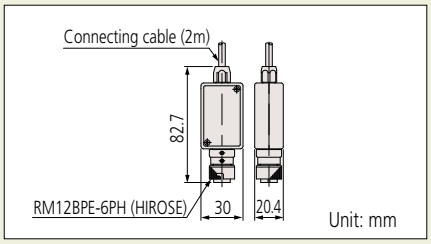
542-157



542-156



Connector



Optional Accessories

- Air lifter 10: **No.02ADE230**

* Required air pressure: 0.2 to 0.4MPa
* Spindle extends when air is supplied.

- Rubber boot: **No.238772** (spare)
  Thrust stem set: ***No.02ADB680**
  Thrust stem: **No.02ADB681**
  Clamp nut: **No.02ADB682**
  Spanner wrench: **No.02ADB683**

* A thrust stem set is a combination of thrust stem and a clamp nut. A special spanner is required for tightening. If using multiple gages, a thrust stem set for each gage and one special spanner are required.

Extension cable (5m): **902434**
Extension cable (10m): **902433**
Extension cable (20m): **902432**

Applicable Counters

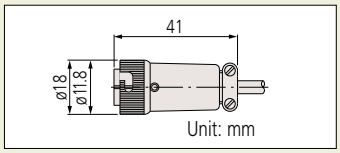
542-075A EH-101P
542-071A EH-102P
64PKA131 EG-101P
64PKA134 EB-11P
64PKA137 EV-16P (not compatible with 542-158)

Linear Gage LGF – Standard Dimensions, Robust

Series 542 — Resolutions: 0.5µm, 1µm, 5µm

- Excellent vibration/shock resistance due to the design of the spindle guide section.
- Sliding durability improved to remain serviceable for at least 15 million cycles (in-house testing).
- Shock resistance, 100g/11ms (IEC 60068-2-27)
- LGF-Z series, which is equipped with reference point mark on the linear encoder (refer to page G-7), and 0.1µm resolution type (refer to page G-16) are also available.

Connector



Optional Accessories

- Air drive unit
  For 10mm range models: **No.02ADE230**
  For 25mm range models: **No.02ADE250**
  For 50mm range models: **No.02ADE270**

* Required air pressure: 0.2 to 0.4MPa
* Spindle extends when air is supplied.

- Rubber boot (spare)
  For 10mm range models: **No.238772**
  For 25mm range models: **No.962504**
  For 50mm range models: **No.962505**
- Thrust stem set
  For 10mm range models: **No.02ADB680**
  Thrust stem: **No.02ADB681**
  Clamp nut: **No.02ADB682**
  For 25/50mm range models: **No.02ADN370**
  Thrust stem: **No.02ADN371**
  Clamp nut: **No.02ADB692**

* External dimensions are described in the dimensional drawing of the product.
* A thrust stem set is a combination of thrust stem and a clamp nut. A special spanner is required for tightening. If using multiple gages, a thrust stem set for each gage and one special spanner are required.

- Spanner wrench
  For 10mm range models: **No.02ADB683**
  For 25/50mm range models: **No.02ADB693**

Extension cable (5m): **902434**
Extension cable (10m): **902433**
Extension cable (20m): **902432**

Applicable Counters

542-075A EH-101P
542-071A EH-102P
64PKA131 EG-101P
64PKA134 EB-11P
64PKA137 EV-16P (not compatible with 542-158)

542-171, -161

542-172, -162

542-173, -163

542-612, -613

SPECIFICATIONS

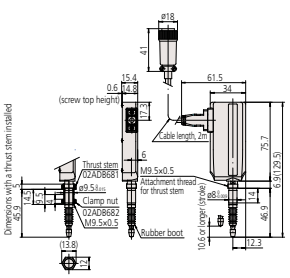
Order No.		542-171	542-161	542-172	542-162	542-612	542-173	542-163	542-613
Measuring range		10mm (.4")		25mm (1")			50mm (2")		
Resolution		0.5µm (.000020")	1µm (.000050")	0.5µm (.000020")	1µm (.000050")	5µm (.0002")	0.5µm (.000020")	1µm (.000050")	5µm (.0002")
Measuring accuracy (20°C) L=arbitrary measuring length (mm)		(1.5+L/50) µm				(7.5+L/50) µm	(1.5+L/50) µm		(7.5+L/50) µm
Quantizing error		±1 count							
Measuring force	Contact point upward	1.0N or less		4.0N or less			4.9N or less		
	Contact point horizontal	1.1N or less		4.3N or less			5.3N or less		
	Contact point downward	1.2N or less		4.6N or less			5.7N or less		
Position detection method		Photoelectric linear encoder							
Response speed*1		1500mm/s							
Output		90° phase difference, differential square wave (**RS-422A** equivalent), minimum edge intervals: 1000ns for 5µm model, 500ns for 1µm model, 250ns for 0.5µm model							
Output square wave pitch		2µm	4µm	2µm	4µm	20µm	2µm	4µm	20µm
Mass		Approx. 260g		Approx. 300g			Approx. 400g		
Dust/water resistance		Equivalent to IP66 (only gage head)							
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)x5), standard contact point **No.901312**							
Stem dia.		ø8mm		ø15mm					
Bearing type		Linear ball bearing							
Output cable length		2m (directly from casing)							
Connector		Plug: RM12BPE-6PH (HIROSE), Compatible receptacle: RM12BRD-6S (HIROSE)							
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)							
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)							
Standard accessories		Wrench for contact point: **No.538610**		Wrench for contact point: **No.04GAA857**					

*1: When the spindle speed exceeds 1500mm/s, an alarm signal will be output. Also, if using a Mitutoyo counter, an error message will be displayed. If using counters made by other companies, please inquire separately for the alarm signals. For the models using 50mm stroke gage, note over-speed speed error may occur depending on the impact amount when releasing the contact point freely.
*2: IP Code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the kind of liquid.

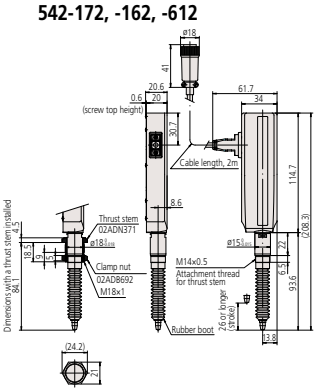
DIMENSIONS

Unit: mm

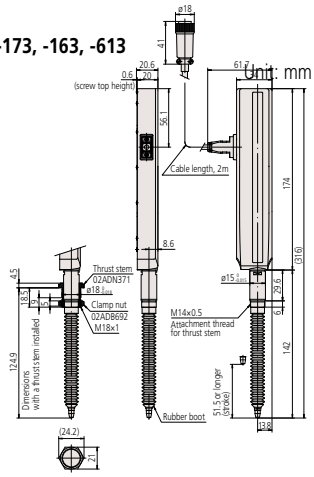
542-171, -161



542-172, -162, -612



542-173, -163, -613



Linear Gage LGF-Z – with Reference Point, Standard Dimensions, Robust

Series 542 — Resolutions: 0.5µm, 1µm

- LGF series with reference point signal output function.
  The master setting to use it, incorporated in the unit, is easy to operate. The origin point can be easily detected even when a fault, such as over-speed error, etc. occurs.
- Sliding durability improved to remain serviceable for at least 15 million cycles (in-house testing).
- Shock resistance, 100g/11ms (IEC 60068-2-27).
- Resolutions are available in 0.5µm or 1µm.

542-174, -164

542-175, -165

542-176, -166

SPECIFICATIONS

Order No.		542-174	542-164	542-175	542-165	542-176	542-166
Measuring range		10mm (.4")		25mm (1")		50mm (2")	
Resolution		0.5µm (.000020")	1µm (.000050")	0.5µm (.000020")	1µm (.000050")	0.5µm (.000020")	1µm (.000050")
Measuring accuracy (20°C)		(1.5+L/50)µm (L= measuring length (mm))					
Quantizing error		±1 count					
Measuring force	Contact point upward	1.0N or less		4.0N or less		4.9N or less	
	Contact point horizontal	1.1N or less		4.3N or less		5.3N or less	
	Contact point downward	1.2N or less		4.6N or less		5.7N or less	
Position detection method		Photoelectric linear encoder					
Reference mark position		3mm from contact point tip (lowest rest point)		5mm from contact point tip (lowest rest point)			
Reference mark repeatability (20°C): σ		σ≤0.5µm (at a constant reference point passing speed less than 300mm/s in the same direction)					
Response speed*1		1500mm/s					
Output signal		90° phase difference, differential square wave (RS-422A equivalent), minimum edge intervals: 250ns for 0.5µm model, 500ns for 1µm model					
Output square wave pitch		2µm	4µm	2µm	4µm	2µm	4µm
Mass		Approx. 260g		Approx. 300g		Approx. 400g	
Dust/water resistance*2		Equivalent to IP66 (only gage head)					
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point **No.901312**					
Stem dia.		ø8mm		ø15mm			
Bearing type		Linear ball bearing					
Output cable length		2m (directly extended from the main unit)					
Connector		Plug: PRC05-P8M (TAJIMI), Compatible receptacle: PRC05-R8F (TAJIMI)					
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)					
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)					
Standard accessories		Wrench for contact point: **No.538610**		Wrench for contact point: **No.04GAA857**			
Remarks		w/ origin point mark					

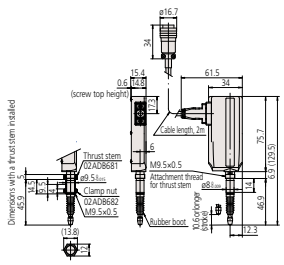
*1: When the spindle speed exceeds 1500mm/s, an alarm will signal. For use of alarm signals, please inquire separately. For models with 50mm stroke, note that over-speed error may occur depending on the impact amount when releasing the contact point freely.

*2: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the kind of liquid.

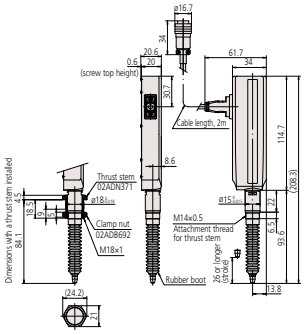
DIMENSIONS

Unit: mm

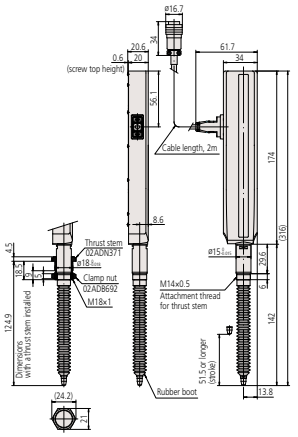
542-174, -164



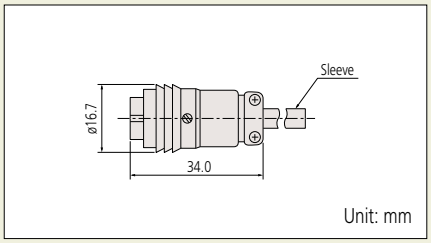
542-175, -165



542-176, -166



Connector



Unit: mm

Optional Accessories

- Air drive unit
  For 10mm range models: **No.02ADE230**
  For 25mm range models: **No.02ADE250**
  For 50mm range models: **No.02ADE270**

* Required air pressure: 0.2 to 0.4MPa
* Spindle extends when air is supplied.

- Rubber boot (spare)
  For 10mm range models: **No.238772**
  For 25mm range models: **No.962504**
  For 50mm range models: **No.962505**
- Thrust stem set
  For 10mm range models: **No.02ADB680**
  Thrust stem: **No.02ADB681**
  Clamp nut: **No.02ADB682**
  For 25/50mm range models: **No.02ADN370**
  Thrust stem: **No.02ADN371**
  Clamp nut: **No.02ADB692**

* External dimensions are described in the dimensional drawing of the product.
* Thrust stem set is a combination of thrust stem and a clamp nut. A special spanner is required for tightening. If using multiple gages, a thrust stem set for each gage and one special spanner are required.

- Spanner wrench
  For 10mm range models: **No.02ADB683**
  For 25/50mm range models: **No.02ADB693**

Extension cable (5m): **02ADF260**
Extension cable (10m): **02ADF280**
Extension cable (20m): **02ADF300**

Applicable Counters

542-073A EH-102Z
64PKA133 EG-101Z
64PKA136 EB-11Z
64PKA139 EV-16Z

Linear Gage LGB - Slim

Series 542 — Resolution: 1µm

- Compact form (ø8mm straight stem) is an optimal choice as a built-in type sensor.
- The spindle guide uses high-precision linear ball bearings for extremely smooth movement and exceptional durability.
- Nut clamp type is also available (LGB2: refer to page G-9).

542-204
IP54

542-222, 542-222H, 542-224
IP54

542-230
IP54

Optional Accessories

- Rubber boot (spare)
  For 5mm range models: **No.238773**
  For 10mm range models: **No.238772**
- Extension cable (5m): **902434**
- Extension cable (10m): **902433**
- Extension cable (20m): **902432**

Applicable Counters

542-075A	EH-101P
542-071A	EH-102P
64PKA131	EG-101P
64PKA134	EB-11P
64PKA137	EV-16P
542-074A	EH-1025 (for sine wave gages only)

Refer to No. (E13007) for more details.

SPECIFICATIONS

Type		L-shaped	Straight		Low measuring force	Air-driven contact point *1
Order No.		**542-204**	**542-222**	**542-222H**	**542-224**	**542-230***2
Measuring range		5mm (.2")	10mm (.4")			
Resolution		1µm (.000050")				
Measuring accuracy (20°C)		2µm		1µm	2µm	
Quantizing error		±1 count				
Measuring force*4	Contact point upward	Approx. 0.55N or less	Approx. 0.7N or less		Approx. 0.5N or less	Approx. 0.7N or less
	Contact point horizontal	Approx. 0.6N or less	Approx. 0.75N or less		Approx. 0.55N or less	Approx. 0.45N or less
	Contact point downward	Approx. 0.65N or less	Approx. 0.8N or less		Approx. 0.6N or less	Approx. 0.8N or less
Protection level		Equivalent to IP54 (only gage head)				
Mass		145g	150g			165g

*1: Required air pressure: 0.3 to 0.4MPa
*2: Spindle extends when air is supplied.
*3: Spindle retracts when air is supplied.
*4: Depends on the settings of the connected counter. Potential resolution down to 1µm.

Slim-head low-measuring force series (made to order)

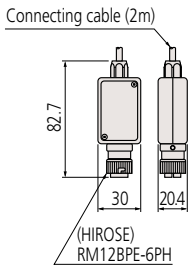
- Low measuring force, suitable for measurement of soft material workpieces.

Model		LGB-105L-1	LGB-110A-1/LGB-110AR-1*2
Measuring range		5mm	10mm
Resolution		1µm	1µm
Measuring force*1	Contact point upward	Approx. 0.4N or less	Approx. 0.5N or less
	Contact point horizontal	Approx. 0.45N or less	Approx. 0.55N or less
	Contact point downward	Approx. 0.5N or less	Approx. 0.6N or less

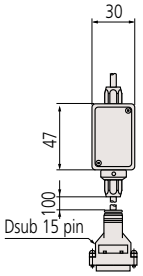
*1: Measuring force at the retraction of the spindle
*2: The "R" suffix indicates air retracted spindle

The LGB-□□□-1 is la low measuring force model. Depending on the operating method, the spindle forward speed may become slow compared to the standard model. Please check if this restriction is compatible with the application. Please contact Mitutoyo to verify the application.

Connector



Unit: mm



Unit: mm

External dimensions: refer to page G-9.

Mitutoyo

Linear Gage LGB2 – Slim, w/Clamp Nut

Series 542 — Resolution: 1µm

- Slim design, nut clamp type (Stem dia. is ø9.5mm)
- The spindle guide uses high precision linear ball bearings for extremely smooth movement and exceptional durability.

542-244

IP54

542-262/542-262H
542-264

IP54

542-270

IP54

SPECIFICATIONS

Type		L-shaped	Straight		Low measuring force	Air-driven contact point*1
Order No.		**542-244**	**542-262**	**542-262H**	**542-264**	**542-270***2
Measuring range		5mm (.2")	10mm (.4")			
Resolution		1µm (.000050")				
Measuring accuracy (20°C)		2µm	1µm			2µm
Maximum response speed		900mm/s				
Measuring force	Contact point upward	Approx. 0.55N or less	Approx. 0.7N or less		Approx. 0.5N or less	Approx. 0.7N or less
	Contact point horizontal	Approx. 0.6N or less	Approx. 0.75N or less		Approx. 0.55N or less	Approx. 0.75N or less
	Contact point downward	Approx. 0.65N or less	Approx. 0.8N or less		Approx. 0.6N or less	Approx. 0.8N or less
Protection level*4		IP54				
Mass		160g	170g			170g

*1: Required air pressure: 0.3 to 0.4MPa
*2: Spindle extends when air is supplied.
*3: Depends on the settings of the connected counter. Potential resolution down to 1µm.
*4: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

Slim head low measuring force series (made to order)

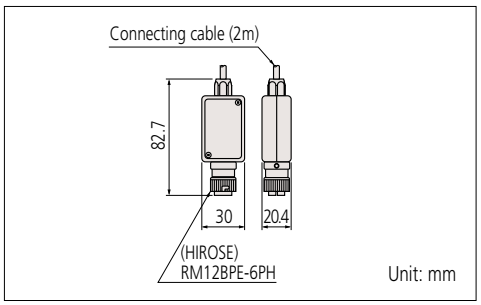
- Low measuring force, suitable for measurement of soft-material workpieces.

Model		LGB2-105L-1	LGB2-110AR-1
Measuring range		5µm	10µm
Resolution		1µm	1µm
Measuring force*	Contact point upwards	Approx. 0.4N or less	Approx. 0.5N or less
	Contact point horizontal/ Contact point upwards	Approx. 0.45N or less	Approx. 0.55N or less
	Contact point downwards	Approx. 0.5N or less	Approx. 0.6N or less

* Measuring force at the retraction of the spindle

The LGB2-□□□-1 is a low measuring force model. Depending on the operating method, the spindle forward speed may become slow compared to the standard model. Please check if this restriction is compatible with the application. Please contact Mitutoyo to verify the application

Connector



External dimensions: refer to page G-9.

Optional Accessories

- Rubber boot (spare)
  For 5mm range models: **No.238773**
  For 10mm range models: **No.238772**
- Extension cable (5m): **902434**
- Extension cable (10m): **902433**
- Extension cable (20m): **902432**

Applicable Counters

542-075A EH-101P
542-071A EH-102P
64PKA131 EG-101P
64PKA134 EB-11P
64PKA137 EV-16P
542-074A EH-1025 (for sine wave gages only)

Linear Gage LGB2 – Slim

Series 542 — Resolution: 1µm

Applicable Counters

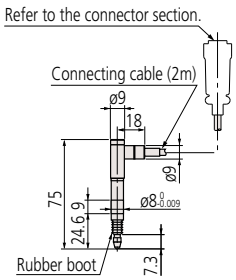
542-075A EH-101P
542-071A EH-102P
64PKA131 EG-101P
64PKA134 EB-11P
64PKA137 EV-16P
542-074A EH-1025 (for sine wave gages only)

Refer to No. (E13007) for more details.

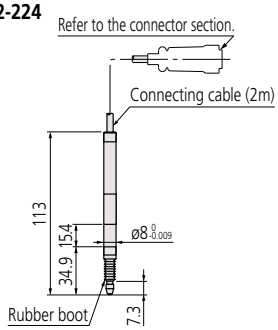
DIMENSIONS

Unit: mm

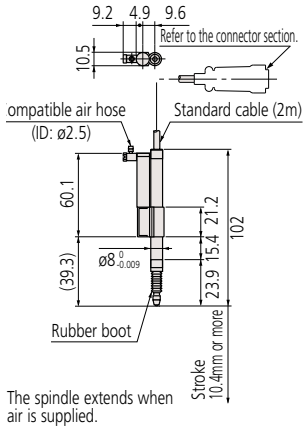
542-204



542-222/No.542-222H
542-224

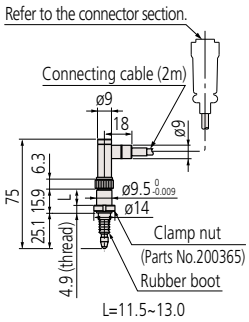


542-230

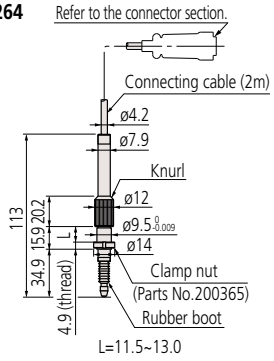


The spindle extends when air is supplied.

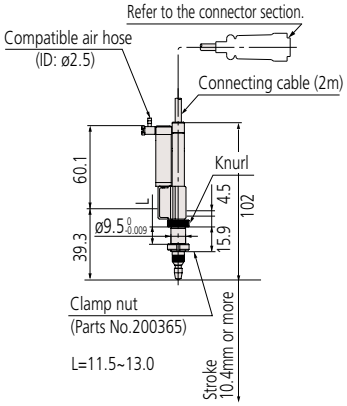
542-244



542-262/542-262H
542-264



542-270



The spindle extends when air is supplied.

Mitutoyo

Linear Gage LG – Long Range

Series 542 — Resolutions: 0.1µm, 1µm

- A series to cover maximum measuring range, 100mm.
- Three versions are available; standard model, low measuring force model, and rubber boot type (made to order).
- The resolution of each model can be selected from 0.1µm and 1µm.

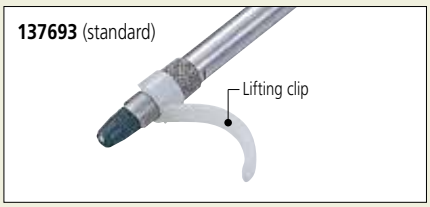
542-312

SPECIFICATIONS

Type		Standard spar type	Low measuring force	Rubber boot type	Standard spar type	Low measuring force	Rubber boot type
Order No.		**542-312**	**542-316**	**542-314**	**542-332**	**542-336**	**542-334**
Measuring range		100mm (4")					
Resolution		0.1µm (.000005")			1µm (.000050")		
Measuring accuracy (20°C)		(2+L/100)µm≤2.5µm L= measuring length (mm)			(2.5+L/100) µm ≤ 3µm L= measuring length (mm)		
Quantizing error		±1 count					
Measuring force	Contact point downward	Approx. 8.0N or less	Approx. 3.0N or less	Approx. 8.0N or less	Approx. 8.0N or less	Approx. 3.0N or less	Approx. 8.0N or less
	Contact point horizontal	Approx. 6.5N or less	—	Approx. 6.5N or less	Approx. 6.5N or less	—	Approx. 6.5N or less
	Contact point upward	Approx. 5.0N or less	—	Approx. 5.0N or less	Approx. 5.0N or less	—	Approx. 5.0N or less
Position detection method		Photoelectric linear encoder					
Response speed*1 (max. electrical response speed)		Approx. 400mm/s			Approx. 800mm/s		
Output signal		90° phase difference, differential squarewave (RS-422A equivalent)					
Spindle drive		Helical extension spring					
Spindle guide		Bearing guide					
Stem diameter		ø20mm					
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5) Standard contact point No.901312					
Shock resistance		60g (in-house testing)					
Cable length		Approx. 2m (directly extended from the gage unit)					
Spindle sealing method		Scraper type		Rubber boot type	Scraper type		Rubber boot type
Dust/water resistance*2		Equivalent to IP54		Equivalent to IP66	Equivalent to IP54		Equivalent to IP66
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)					
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)					
Input/output connector		For calculation: RM12BPE-6PH (HIROSE) Compatible receptacle: RM12BRD-6S (HIROSE)					
Mass (including cables)		Approx. 750g		Approx. 780g	Approx. 750g		Approx. 780g
Standard accessories		Wrench for contact point: **No.04GAA857** Hexagon socket head cap screw, M4×0.7×35, 2 pcs. (for gage fixing) Round flat washer, nominal 4, 2 pcs. (for gage fixing) Lifting clip: **No.137693** Fixing holder: **02ADG181** (for fixing lifting lever)					
Remarks		Standard	Low measuring force	w/ rubber boot	Standard	Low measuring force	w/ rubber boot

*1: Note that over-speed error may occur depending on the indentation amount when releasing the contact point freely after indentation.
*2: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the kind of liquid. (Only gage head)

Lifting clip attachment



Optional Accessories

- Rubber boot: **02ADA004** (for rubber boot type)

Extension cable (5m): **902434**
Extension cable (10m): **902433**
Extension cable (20m): **902432**

Applicable Counters

For **542-312, 542-316, 542-314**

542-075A	EH-101P
542-071A	EH-102P
64PKA131	EG-101P
64PKA134*	EB-11P

For **542-332, 542-336, 542-334**

542-075A	EH-101P
542-071A	EH-102P
64PKA131	EG-101P
64PKA134*	EB-11P
64PKA137*	EV-16P

* Not for use with 0.1µm resolution gages.

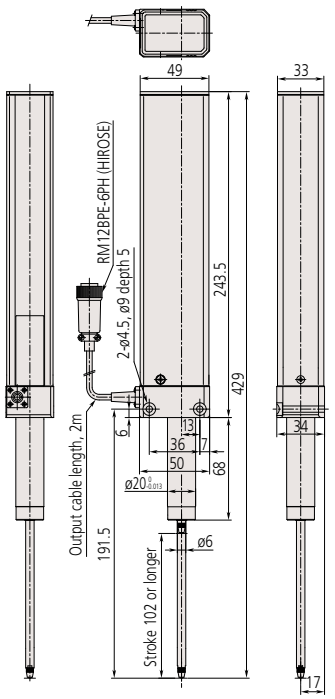
Linear Gage LG – Long Range

Series 542 — Resolutions: 0.1µm, 1µm

DIMENSIONS

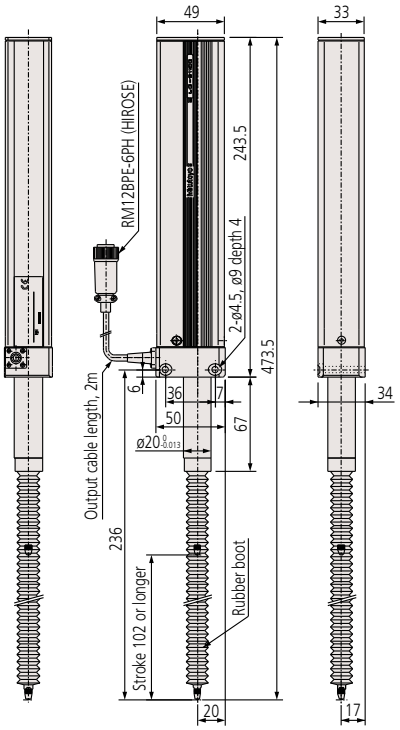
542-312, -316, -332, -336

Unit: mm



542-314, -334

Unit: mm



Refer to No. (E13007) for more details.

Mitutoyo

Linear Gage LGD – Absolute, Standard Dimensions, Robust

Series 575 — Resolution: 10µm

- Absolute position detection makes it possible to maintain the reference point even when the power is switched off.
- Excellent protection against dust and splashing water (IP66) on the factory floor.
- Ultra-compact design enables installation in very tight spaces.
- The spindle guide uses high-precision linear ball bearings for extremely smooth movement and exceptional durability.
- Sliding durability improved to remain serviceable for at least 15 million cycles (in-house testing).
- Shock resistance, 100g/11ms (IEC 60068-2-27)

575-326 IP66

575-327 IP66

575-328 IP66

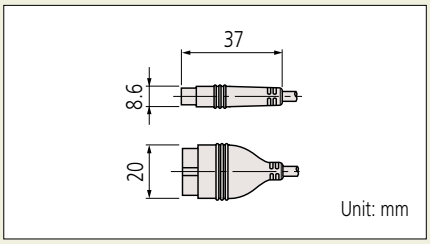
SPECIFICATIONS

Order No.*1		575-326	575-327	575-328
Measuring range		.4" / 10mm	1" / 25mm	2" / 50mm
Resolution		.0005" / 10µm		
Measuring accuracy (20°C)		.001" / 20µm		30µm
Quantizing error		±1 count		
Measuring force	Contact point upward	1.0N or less	4.0N or less	4.9N or less
	Contact point horizontal	1.1N or less	4.3N or less	5.3N or less
	Contact point downward	1.2N or less	4.6N or less	5.7N or less
Position detection method		ABSOLUTE electrostatic capacitance-type linear encoder		
Response speed		Unlimited (not applicable to scanning measurement)		
Output		Digimatic output		
External input		Reference-setting signal (Absolute reference position*2) can be changed externally.		
Mass*3		Approx. 260g	Approx. 300g	Approx. 400g
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point No.901312		
Stem dia.		ø8	ø15	
Bearing type		Linear ball bearing		
Dust/water resistance*4		Equivalent to IP66 (only gage head)		
Output cable length (directly extended from the main unit)		2m, 3m, 5m, 7m		
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)		
Storage temperature(humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)		
Standard Accessories		Wrench for contact point: **No.538610**	Wrench for contact point: **No.04GAA857**	

*1: The last number of the Code No. represents special cable length. (meters)
*2: The absolute reference point is near the lowest rest point at shipment.
*3: Mass including 2m cable.
*4: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

ABSOLUTE™

Connector



Optional Accessories

- Air drive unit
  For 10mm range models: **No.02ADE230**
  For 25mm range models: **No.02ADE250**
  For 50mm range models: **No.02ADE270**
  * Required air pressure: 0.2 to 0.4MPa
  * Spindle extends when air is supplied.
- Rubber boot (spare)
  For 10mm range models: **No.238772**
  For 25mm range models: **No.962504**
  For 50mm range models: **No.962505**
- Thrust stem set
  For 10mm range models: **No.02ADB680**
  Thrust stem: **No.02ADB681**
  Clamp nut: **No.02ADB682**
  For 25/50mm range models: **No.02ADN370**
  Thrust stem: **No.02ADN371**
  Clamp nut: **No.02ADB692**
  * External dimensions are described in the dimensional drawing of the product.
  * Thrust stem set is a combination of thrust stem and a clamp nut. A special spanner is required for tightening. If using multiple gages, a thrust stem set for each gage and one special spanner are required.
- Spanner wrench
  For 10mm range models: **No.02ADB683**
  For 25/50mm range models: **No.02ADB693**

SPC cable extension adapter: **02ADF640**
Extension cable (0.5m): **02ADD950**
Extension cable (1m): **936937**
Extension cable (2m): **965014**
*when connecting an extension cable, an SPC cable extension adapter is required (02ADF640)
Power supply and origin setter **21EZA345A**

Digimatic cable extension adapter 02ADF640

Applicable Counters

542-007A	EC-101D Counter, 120V
64PKA132	EG-101D
64PKA135	EB-11D
542-072A	EH-102D
542-064	EV-16D COUNTER

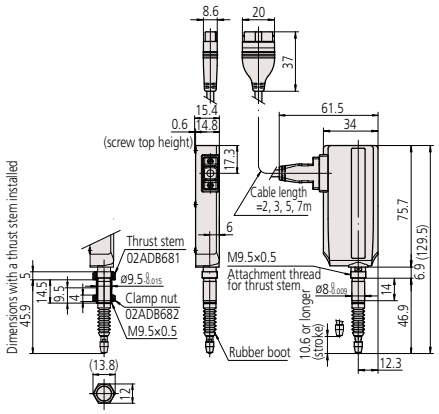
Linear Gage LGD – Absolute, Standard Dimensions, Robust

Series 575 — Resolution: 10µm

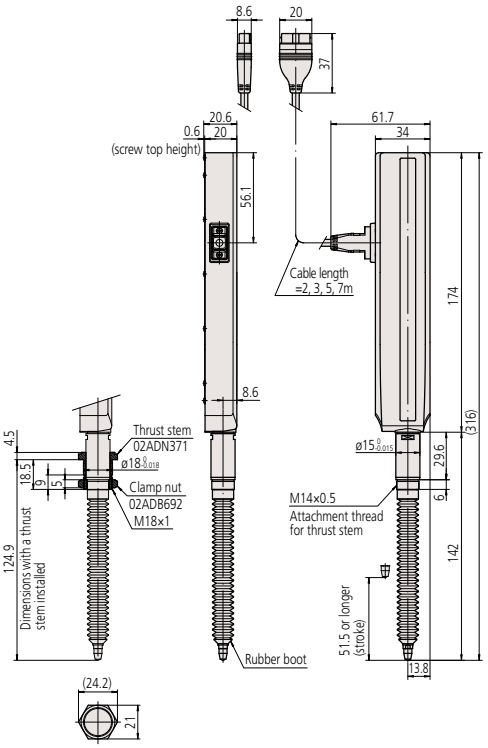
DIMENSIONS

Unit: mm

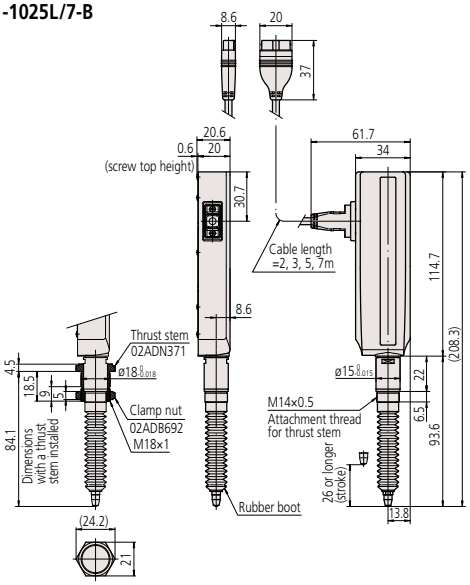
575-326



575-328



575-327
LGD®-1025L-B, -1025L/3-B, -1025L/5-B, -1025L/7-B



Applicable Counters

542-007A	EC-101D Counter, 120V
64PKA132	EG-101D
64PKA135	EB-11D
542-072A	EH-102D
64PKA138	EV-16D COUNTER

3D models available on request.

Mitutoyo

Linear Gage LGS – Absolute

Series 575 — Resolution: 10µm

- ABSOLUTE electrostatic capacitance-type encoder makes it possible to maintain the reference point even when the power is switched off.
- Excellent protection against dust and splashing water (IP66) on the factory floor.

ABSOLUTE™

SPECIFICATIONS

Metric

Order No.		**575-303**
Measuring range		12.7mm
Resolution		10µm
Measuring accuracy (20°C)		15µm
Quantizing error		±1 count
Measuring force	Contact point upward	1.6N or less
	Contact point horizontal	1.8N or less
	Contact point downward	2N or less
Position detection method		ABSOLUTE electrostatic capacitance-type linear encoder
Response speed		Unlimited (not applicable to scanning measurement)
Output		Digimatic output
Mass		Approx. 190g
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5) Standard contact point **No.901312**
Stem dia.		ø8mm
Bearing type		Slide bearing
Dust/water resistance		Equivalent to IP66 (only gage head)
Output cable length		2m (directly extended from the main unit)
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)

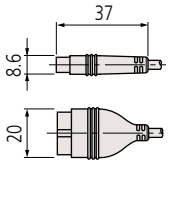
* IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

Inch

Order No.		**575-313**
Measuring range		.5"
Resolution		.0005"
Measuring accuracy (20°C)		.0008"
Quantizing error		±1 count
Measuring force	Contact point upward	1.6N or less
	Contact point horizontal	1.8N or less
	Contact point downward	2N or less
Position detection method		ABSOLUTE electrostatic capacitance-type linear encoder
Response speed		Unlimited (not applicable to scanning measurement)
Output		Digimatic output
Mass		Approx. 190g
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5) Standard contact point **No.901312**
Stem dia.		ø9.52=3/8"
Bearing type		Slide bearing
Dust/water resistance		Equivalent to IP66 (only gage head)
Output cable length		2m (directly extended from the main unit)
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)

* IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

Connector



Unit: mm

Optional Accessories

- Rubber boot: **No.238774** (spare)
- Air drive unit (metric): **No.903594**
- Air drive unit (inch): **No.903598**
- SPC cable extension adapter: **No.02ADF640**
- Extension cable (0.5m): **No.02ADD950**
- Extension cable (1m): **No.936937**
- Extension cable (2m): **No.965014**
- Power supply and origin setter **21EZA345A**

* When connecting an extension cable, an SPC cable extension adapter is required. **(0ZADF640)**

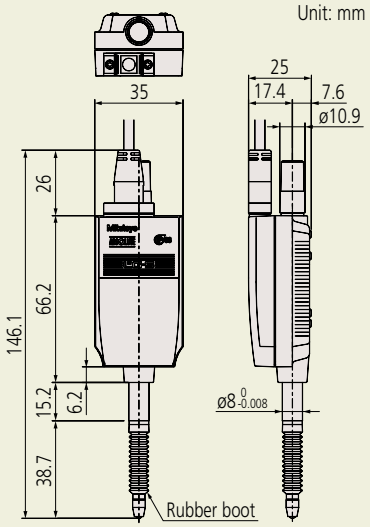
Digimatic cable extension adapter 02ADF640

Applicable Counters

542-007A	EC-101D Counter, 120V
64PKA132	EG-101D
64PKA135	EB-11D
542-072A	EH-102D
64PKA138	EV-16D COUNTER

DIMENSIONS

Unit: mm



Linear Gage LGF – High Resolution, Standard Dimensions, Robust

Series 542 — Resolution: 0.1 µm

- 0.1µm resolution type of reliable LGF series gage.
- Excellent protection against dust and splashing water (IP66) on the factory floor.

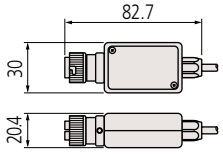
542-181

IP66

542-182

IP66

Connector



RM12BPE-6PH (HIROSE)

Unit: mm

Optional Accessories

- Rubber boot (spare)
  For 10mm range models: **No.238772**
  For 25mm range models: **No.962504**
  For 50mm range models: **No.962505**
- Thrust stem set
  For 10mm range models: **No.02ADB680**
  Thrust stem: **No.02ADB681**
  Clamp nut: **No.02ADB682**
  For 25mm range models: **No.02ADN370**
  Thrust stem: **No.02ADN371**
  Clamp nut: **No.02ADB692**

* External dimensions are described in the dimensional drawing of the product.

* Thrust stem set is a combination of thrust stem and a clamp nut. A special spanner is required for tightening. If using multiple gages, a thrust stem set for each gage and one special spanner are required.

- Wrench
  For 10mm range models: **No.02ADB683**
  For 25mm range models: **No.02ADB693**
- Extension cable (5m): **902434**
- Extension cable (10m): **902433**
- Extension cable (20m): **902432**
- Air drive unit
  For 10mm range models: **No.02ADE230**
  For 25mm range models: **No.02ADE250**
  For 50mm range models: **No.02ADE270**

* Required air pressure: 0.2 to 0.4MPa

* Spindle extends when air is supplied.

Applicable Counters

542-075A EH-101P
542-071A EH-102P

SPECIFICATIONS

Order No.		542-181	542-182
Measuring range		10mm (.4")	25mm (1")
Resolution		0.1µm (.000005")	
Measuring accuracy (20°C)		(0.8+L/50) µm (L=arbitrary measuring length (mm))	
Quantizing error		±1 count	
Measuring force	Contact point upward	1.0N or less	4.0N or less
	Contact point horizontal	1.1N or less	4.3N or less
	Contact point downward	1.2N or less	4.6N or less
Position detection method		Photoelectric linear encoder	
Response speed*1		400mm/s	
Output signal		90° phase difference, differential squarewave (RS-422A equivalent) Minimum edge-to-edge interval, 200ns	
Output signal pitch		0.4µm	
Mass		Approx. 310g	Approx. 350g
Dust/water resistance*2		Equivalent to IP66 (only gage head)	
Stylus		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point **No.901312**	
Stem dia.		ø8	ø15
Bearing type		Linear ball bearing	
Output cable length		2m (directly extended from the main unit)	
Connector		Plug: RM12BPE-6PH (HIROSE), Compatible receptacle: RM12BRD-6S (HIROSE)	
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)	
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, no condensation)	
Standard accessories		Wrench for contact point: **No.538610**	Wrench for contact point: **No.04GAA857**

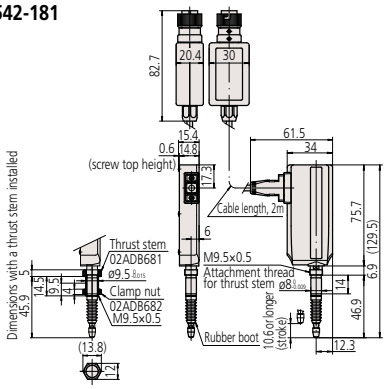
*1: When the spindle speed exceeds 400mm/s, an alarm will signal. Also, if using a Mitutoyo counter, an error message will be displayed. If using counters made by other companies, please consult your local Mitutoyo office. Note that over-speed error may occur depending on the impact amount when releasing the contact point freely.

*2: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

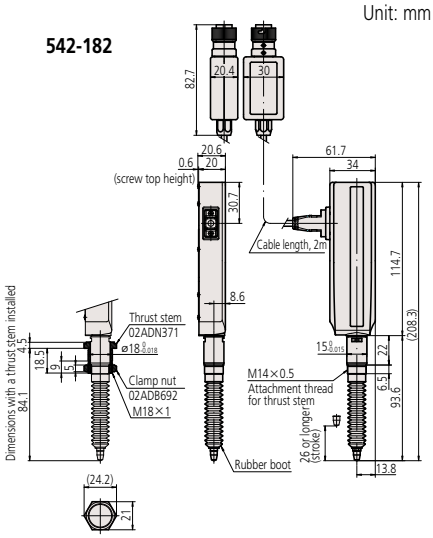
DIMENSIONS

Unit: mm

542-181



542-182



Mitutoyo

Linear Gage LGB2 – High Resolution, Slim, with Clamp Nut

Series 542 (0.1µm resolution)

- Slim type high-precision linear gage with resolution of 0.1µm. It is an optimal choice as a built-in type sensor.
- High-precision linear ball bearings are used in the spindle guide for extremely smooth movement and exceptional durability.

542-246

IP54

Optional Accessories

- Rubber boot: **No.238773** (spare)
- Extension cable (5m): **902434**
- Extension cable (10m): **902433**
- Extension cable (20m): **902432**

Applicable Counters

542-075A	EH-101P
542-071A	EH-102P

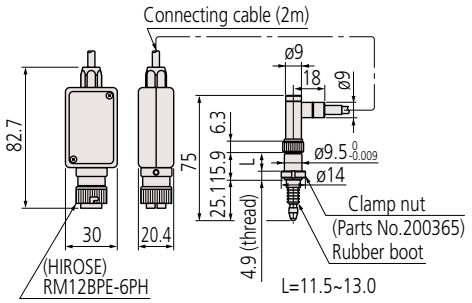
SPECIFICATIONS

Order No.		**542-246**	
Measuring range		5mm (.2")	
Resolution		0.1µm (.000005")	
Measuring accuracy (20°C)		0.8µm	
Measuring force	Contact point upward	Approx. 0.55 or less	
	Contact point horizontal	Approx. 0.6N or less	
	Contact point downward	Approx. 0.65 or less	
Output signal		90° phase difference, differential square wave (RS-422A equivalent)	
Position detection method		Photoelectric linear encoder	
Response speed		380mm/s	
Mass		160g	
Dust/water resistance*		Equivalent to IP54 (only gage head)	
Contact point		Carbide ball (M2.5x0.45)	Steel ball (4-48UNF)
Stem dia.		ø9.5mm	
Bearing type		Linear ball bearing	
Output cable length		2m	
Connector		Plug: RM12BPE-6PH (HIROSE), Compatible receptacle: RM12BRD-6S (HIROSE)	
Operating temperature (humidity) range		10 to 30°C (RH 20 to 80%, no condensation)	
Standard accessories		Wrench for contact point: **No.538610**	Wrench for contact point: **No.538610**, Stem bushing

*1: IP code is a standard which classifies and rates the degree of protection provided against the intrusion of solid objects and water. This may not be applicable depending on the type of liquid.

DIMENSIONS

Unit: mm



Linear Gage LGH – High Resolution, High Accuracy

SERIES 542 (0.01µm resolution)

- A gage head featuring a very accurate, ultra-high-resolution photoelectric linear encoder that approaches laser interferometer performance over its measuring range of 10mm. This head is suitable for measuring high-precision components and inclusion in high-accuracy positioning applications.
- Relatively long range, very high accuracy and extreme resolution enable the head to act as a master gage for measuring-instrument calibration in many instances.
- The compact design contributes to reducing measuring system costs and permits downsizing entire system configurations.
- Linear encoder is highly resistant to being affected by unfavorable environmental conditions, such as drafts and rapid atmospheric pressure, temperature and humidity changes.
- A low measuring force model is available (**542-716A**). As low as 0.12N can be selected, which enables measurement of easily-deformed workpieces or thickness of delicate films.
- Responsivity has been improved by 2.8 times (250mm/s => 700mm/s) compared to the previous model.
- Every **LGH** series gage is bundled with a dedicated counter.

Gage Head

542-715A

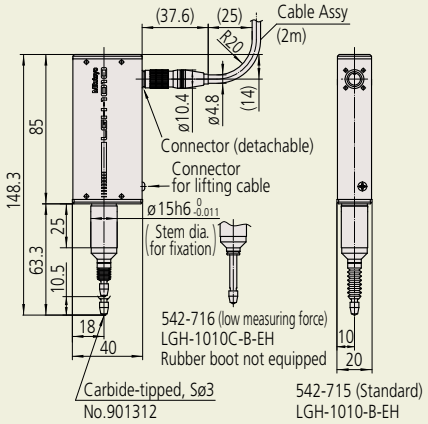
Dedicated Counter

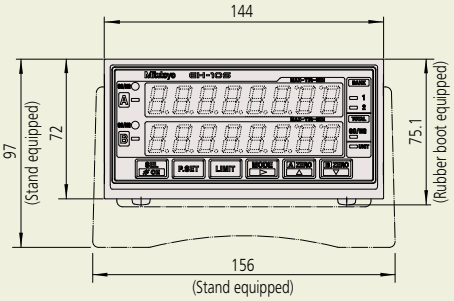
Optional Accessories

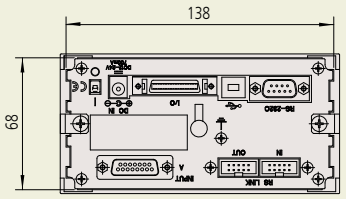
- LGH stand: **971750**
- Stem fixture for fixing to top surface: **971751**
- Stem fixture for fixing to bottom surface: **971752**
- Spindle lifting cable: **971753**
- Rubber boot: **238772** (spare for **542-715**)
- I/O output connector (with cover): **02ADB440**

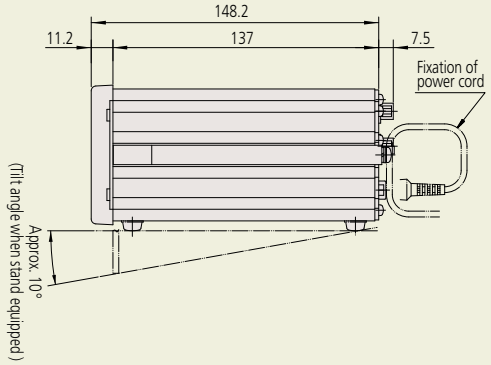
DIMENSIONS

Unit: mm









SPECIFICATIONS

Linear gage		Standard	Low measuring force
Order No.		**542-715A**	**542-716A**
Measuring range		10mm	
Resolution		0.01µm (0.05µm, 0.1µm, 0.5µm, 1µm can be selected from the counter)	
Measuring accuracy (20°C)*		0.2µm	
Repeatability (20°C)*		0.1µm (2σ)	
Retrace error (20°C)*		0.1µm	
Measuring force	Contact point downwards	0.65N or less	Approx. 0.12N
	Contact point horizontal	0.55N or less	Not applicable
	Contact point upwards	0.45N or less	Not applicable
Position detection method		Photoelectric reflection type linear encoder	
Detectable operation speed		In normal measurement: 700mm/sec; for peak detection: 120mm/sec	
Mass of gage head		220g (excluding cable of approx. 150g)	
Contact point		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5)	
Stem		ø15mm	
Bearing		Linear ball type	
Output cable length		Approx. 2m	
Operating temperature/humidity		0 to 40°C/RH 20 to 80% (no condensation)	
Storage temperature		-10 to 60°C/RH 20 to 80% (no condensation)	
Counter			
Quantizing error		±1 count	
Display range		±999.99999mm	
Functions		Presetting, tolerance judgment, peak measurement, analog output	
Interface		RS-232C/Digimatic/USB (only for SENSORPAK)	
Power supply		Supplied AC Adapter, or +12 to 24 V DC, max. 700mA	
Current Consumption		8.4W (MAX 700mA) (Ensure at least 1A power supply per unit.)	
External dimensions		144(W)×157(D)×75(H)	
Mass		Approx. 900g (AC Adapter excluded)	
Standard accessories		Wrench for contact point, rubber boot, stand, washer (for counter), AC Adapter, AC cord, DC plug, user's manual, inspection certificate	

*Indication accuracy applies when used with counters.

Laser Hologage LGH – High Resolution, High Accuracy

Series 542 — Resolution: 0.005µm

- The Mitutoyo Laser Hologage is a high-end digital gaging system that employs laser beam interference to make highly accurate and repeatable measurements.
- The compact gage head reduces the cost required for assembling the laser scale unit for each device. The head can also contribute to downsizing the entire system. The master gage is the best tool available for measuring tools or for a length measurement sensor of the control unit, as well as for measuring high-precision components.

LGH-110

EH-102S

- High resolution and high accuracy.
  Highly accurate measurement due to an ultra-high resolution of 0.000005mm (0.005µm), which is close to the performance of laser interferometers.
- Excellent measuring stability.
  The design is also highly resistant to unfavorable environmental conditions such as air movement and atmospheric pressure changes.
- Low measuring force models are also available.
  Low measuring force models are available for easily deformed precision workpieces.
- High reliability and excellent durability.
  High-precision linear ball bearings are used in the spindle guide for extremely smooth movement and exceptional durability.
- 0.005µm resolution LGH is for use with counter EH-102S.

SPECIFICATIONS

Code No.		542-720A	542-721A
Configuration		Set of 1-axis gage head and display unit	Set of 1-axis gage head and display unit
Measuring range		10mm	
Resolution		0.005µm (.5 microinch)	
Measuring accuracy (20°C)		0.1µm*1	
Repeatability (2σ)		0.02µm	
Retrace error		0.05µm	
Measuring force	Contact point upward	Approx. 0.65N or less	Approx. 0.12N
	Contact point horizontal	Approx. 0.55N or less	—
	Contact point downward	Approx. 0.45N or less	—
Stylus		ø3mm carbide-tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point No.120058	
Output cable length		2m	
Display range		± 99.999995mm	
Minimum reading		0.01µm	
Operating temperature (humidity) range		15 to 25°C (RH 30-60%, no condensation)	
Storage temperature (humidity) range		–10 to 60°C (RH 20 to 80%, (no condensation) The temperature and humidity range for storage after unpacking is the same as that for operation.	
Standard accessories		Wrench for contact point: **No. 538610** AC adapter: **No. 357651** AC cable (USA): **No.02ZAA010***	
Mass (gage head + display unit)		1400g	

*1: Indication accuracy applies when used with counters.

Laser Beam Safety Precautions

This system uses a low-power invisible laser beam (780nm) which corresponds to a CLASS 1 (invisible radiation) of IEC60825-1 for measurement. The CLASS 1 laser warning label as shown below is attached to the main unit.

CLASS 1 LASER PRODUCT

Refer to Bulletin No. (2263) for more details.

PROPRIETARY INSPECTION CERTIFICATE

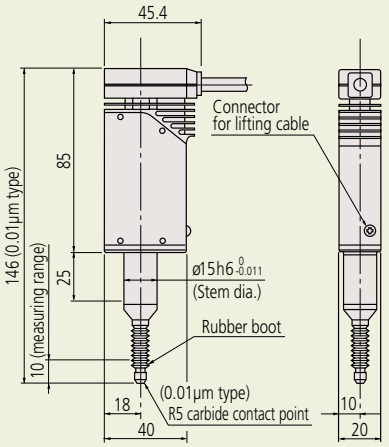
Mitutoyo guarantees the product specifications. Mitutoyo guarantees the product quality.

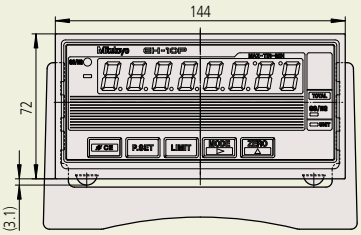
Optional Accessories

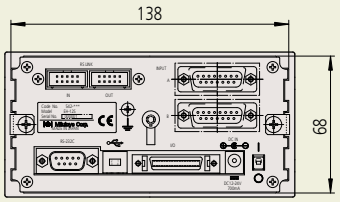
- Laser hologage stand: **No.971750**
- Stem fixture for fixing to top surface: **No.971751**
- Stem fixture for fixing to bottom surface: **No.971752**
- Spindle lifting cable: **No.971753**
- Rubber boot: **No.238772** (spare)

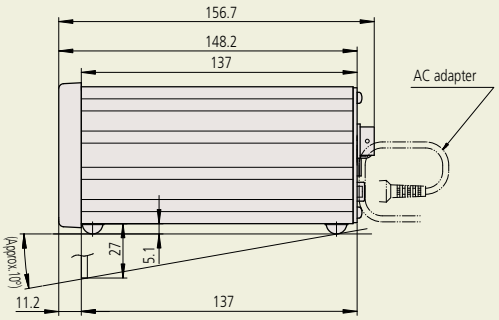
DIMENSIONS

Unit: mm









EH Counter – Multi-function Type

Series 542 — Versatile, Multi-function Displays for all Linear Gage Formats

Optional Accessories

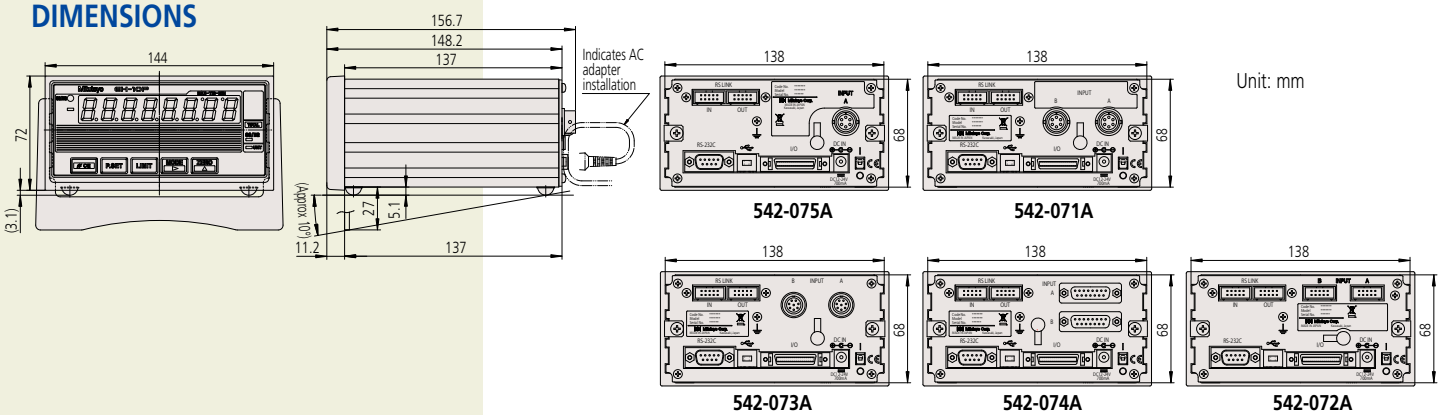
• I/O output connector (with cover): **No.02ADB440**

- Two types are available for this model: a 1-axis display and a 2-axis display, which enables addition or subtraction calculations between two gages.
- Multifunctional counter equipped with zero-setting, presetting and tolerance judgment.
- RS-232C and USB are equipped as standard. Data transfer to a PC is possible. (*USB is supported only by Mitutoyo SENSORPAK.)
- A multi-point (max. 12 points) measuring system can easily be configured with the built-in RS link networking function. Refer to "Quick Guide to Precision Measuring Instruments" on page G-32 for details of the RS link.
- Employs DIN size (144x72mm) and mount-on-panel configuration to facilitate system integration.
- Peak mode feature: Max, Min, and TIR (can be toggled)

SPECIFICATIONS

Order No.		542-075A	542-071A	542-073A	542-074A	542-072A
Applicable gage head		**LGE**, **LGF**, **LGK**, **LGB**, **LGM**, **LG**, **LGH** (not compatible with LGH-110, reference point, or sine wave models)		**LGF** with reference point mark	**LGB** sine wave output / Linear scale sine wave output	**LGD**, **LGS**, **ID**, **SD**
Number of gage inputs		1	2			
Number of axes to be displayed		1 axis	2 axes			
Quantizing error		±1 count				
Maximum input frequency		2.5MHz (2-phase square wave)			1MHz (2-phase sine wave)	—
Resolution		0.01mm (±9999.99mm) / .0005" (±99.9995") 0.001mm (±999.999mm) / .00005" (±9.99995") 0.0001mm (±99.9999mm) / .000005" (±.999995") [Parameter set]				Automatic setting by gage
		—			0.01 / 0.001µm	
Display		Sign plus 8 digits (Green LED)				
Tolerance judgment display		LED display (3 steps: Amber, Green, Red/ 5 steps: Amber, Amber flashing, Green, Red flashing, Red)				
Interface		RS-232C/USB/parameter selection via digimatic (only DP-1VR, digimatic mini-processor can be connected) (USB used only with SENSORPAK.) Selection by parameter from 3-step, 5-step, or digit BCD Total tolerance judgment output (when tolerance function is enabled) Analog output (1V-4V)				
Input/output	Control output	Normal operation signal (NOM): open collector				
	Control input	Display BANK switching, peak mode, presetting, display hold, hold per axis: open-collector or no-voltage contact signal (with/without contact point)				
Rating	Power supply voltage	Supplied AC adapter, or 12 - 24V DC				
	Power consumption	8.4W (max. 700mA) Ensure at least 1A is available per unit.				
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)				
Storage temperature (humidity) range		–10 to 50°C (RH 20 to 80%, no condensation)				
External dimensions		144 (W) ×72 (H) ×156.7 (D) mm				
AC adapter / AC cable (standard accessory)		AC adapter: **No. 357651** / AC cable (USA): **No.02ZAA010***,				
Applicable input		Differential square-wave			Differential sine-wave	Digimatic code output
Mass		Approx. 760g	Approx. 800g	Approx. 800g	Approx. 900g	Approx. 800g

DIMENSIONS



Unit: mm

Mitutoyo

EC Counter – Single-function Type

Series 542 — Simple Display for LGD, LGS, or other Digimatic Gages, Go/NG Judgment and Output

- Produces 3-step/5-step, 3 types of tolerance output and BCD output.
- Employs DIN size (96×48mm) and mount-on-panel configuration to facilitate system integration.

542-007A

Function

- Preset
- Tolerance judgment (3/5-step, 3 types)
- Zero

Optional Accessories

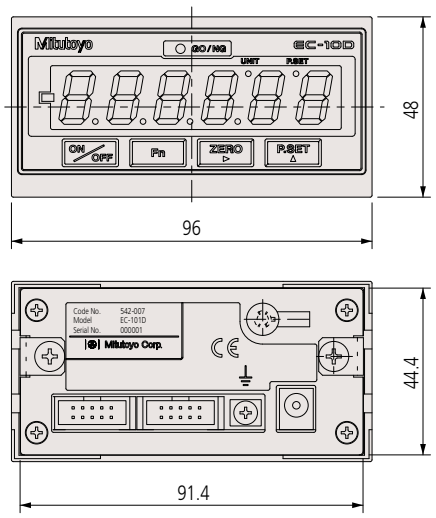
- Connecting cable for digimatic mini-processor: **No.936937** (1m), **No.965014** (2m)
- DC plug PJ-2: **No.214938**
- I/O cable (2m): **No.C162-155**

SPECIFICATIONS

Order No.		**542-007A**
Applicable head/input		**LGD**, **LGS**, **ID**, **SD,** Digimatic code (SPC)
Number of gage inputs		1
Resolution		0.01mm (±9999.99) / .0005" (±99.9995") / .001" (±999.999") 0.001mm (±9999.999) / .00005" (±9.99995") / .0001" (±99.999") [automatic setting by gage]
Display		Sign plus 6 digits (Green LED)
Tolerance judgment display		LED display (3 steps: Amber, Green, Red)
External output (switching type)	Tolerance judgment output	Go/No-Go (open-collector)
	Data output	Digimatic output
Control input		External PRESET, external HOLD
Rating	Power supply voltage	Supplied AC adapter, or 9 - 12V DC
	Power consumption	4.8W (max. 400mA) Ensure at least 1A is available per unit.
Operation/storage temperature range		Operation: 0 - 40°C / Storage: –10 to 50°C
External dimensions		96 (W) x 48 (H) x 84.6 (D) mm
Standard accessories		AC adapter: **No.06AEG302JA**
Mass		220g

DIMENSIONS

Unit: mm



EG Counter – Single-function Type

Series 542 — Simple Display, Multi-Step Go/No Go Judgment and Output, BCD Output, Open Collector

Function

- Preset
- Direction switch
- Tolerance judgment (3/5-step, 3 kinds)
- Peak (max., min., runout) measurement
- Constant number
- Smoothing
- Error display/output
- Key protection

Optional Accessories

- I/O output connector (with cover): **No. 357651**
- AC adapter: **No.357651 ***
- AC cable (USA): **02ZAA010***
- Terminal connecting cable: **No.02ADD930***

* Included in package Order No.

- Produces 3-step/5-step, 7 types of tolerance output and limit value output independently for each of 7 channels.
- Comes with serial BCD output capability, for connection to a programmable controller or personal computer, etc.
- Employs DIN size (96×48mm) and mount-on-panel configuration to facilitate system integration.

542-015

542-017

542-016

SPECIFICATIONS

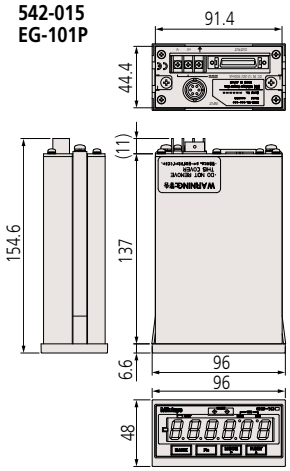
Order No. (counter only)		542-015	542-017	542-016
Package No. (counter w/AC adapter)		64PKA131A	64PKA133A	64PKA132A
Applicable gage head		**LGE**, **LGF**, **LGK**, **LGB**, **LGM**, **LG**, **LGH** (Not compatible with LGH110, reference point or sine wave models)	**LGF** with reference point mark **(LGF-Z)**	**LGD**, **LGS**, **ID**, **SD**
Number of gage inputs		1		
Quantizing error		±1 count		
Maximum input frequency		1.25MHz, response speed depends on gage specification.		—
Resolution		0.01mm (±9999.99mm) / .0005" (±99.9995") / .001" (±999.999") 0.005mm (±9999.995mm) / .00005" (±9.99995") / .0001" (±99.999") 0.001mm (±999.999mm) / .00005" (±9.99995") / .0001"(±99.999") 0.0005mm (±99.9995mm) / .000005" (±.999995") / .00001" (±9.99999") 0.0001mm (±99.9999mm) / .000005" (±.999995") / .00001" (±9.99999")*		0.01mm (±9999.99mm) / .0005" (±99.9995") / .001" (±999.999") 0.001mm (±999.999mm) / .00005" (±9.99995") / .0001" (±99.999") [Automatic setting by gage]
Display		Sign plus 6 digits (Green LED)		
Tolerance judgment display		LED display (3 steps: Amber, Green, Red/ 5 steps: Amber, Amber flashing, Green, Red flashing, Red)		
Tolerance judgment output		L1 to L5 (Open-collector / Switchover between L1 to L5 and BCD output with parameter)		
Control output		Normal operation signal (NOM): open-collector		
BCD output		Open-collector / Switchover between 6-digit (positive/negative-true logic) and tolerance judgment output with parameter		
Control input		Presetting, display hold, peak value clear, tolerance judgment BANK switch		
Rating	Power supply voltage	12 - 24V DC		
	Power consumption	6W or less (500mA max.) Ensure at least 1A is available per unit.		
Operating temperature range		0 to 40°C (RH 20 to 80%, no condensation)		
Storage temperature range		–10 to 50°C (RH 20 to 80%, no condensation)		
External dimensions		96 (W) × 48 (H) × 156 (D) mm		
Applicable input		Differential square-wave	Differential square-wave with origin point mark	Digimatic code (SPC)
Number of gage inputs		1		
Mass		Approx. 400g		

* range is limited when using 0.0001 mm gages

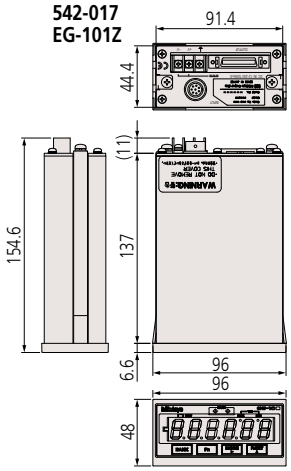
DIMENSIONS

Unit: mm

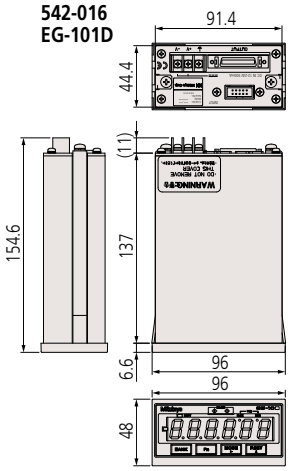
542-015
EG-101P



542-017
EG-101Z



542-016
EG-101D



Mitutoyo

EB Counter – Single-function Type

Series 542 — Simple Display, Multi-Step Go/No-Go Judgment, BCD Output and Analog Output

- Produces 3-step/5-step, 7 types of tolerance output and limit value output independently for each of 7 channels.
- Comes with serial BCD output capability, for connection to a programmable controller or personal computer, etc.
- Dynamic measurement possible with simplified analog output.
- Employs DIN size (96×48mm) and mount-on-panel configuration to facilitate system integration.

542-092-2

542-094-2

542-093-2

SPECIFICATIONS

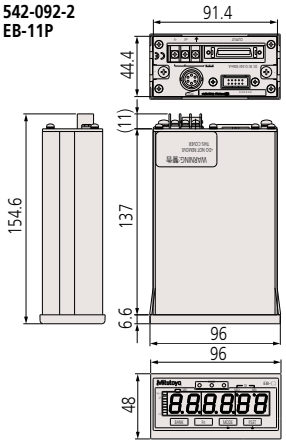
Order No. (counter only)		542-092-2	542-094-2	542-093-2
Package No. (counter w/AC Adapter)		64PKA134A	64PKA136A	64PKA135A
Applicable gage head		**LGF**, **LGK**, **LGE**, **LGB** (not compatible with reference point or sine wave output type models)	**LGF** with reference point mark **(LGF-Z)**	**LGS**, **LGD**, **LGD-M**
Number of gage inputs		1		
Quantizing error		±1 count		
Maximum input frequency		1.25MHz (2-phase square wave), response speed depends on gage specification.		Response speed depends on gage specification.
Resolution		0.01mm (±9999.99mm) / .0005" (±99.9995") 0.005mm (±9999.995mm) / .00005" (±9.99995") 0.001mm (±999.999mm) / .00005" (±9.99995") 0.0005mm (±99.9995mm) / .000005" (±.999995") 0.0001mm (±99.9999mm) / .000005" (±.999995")*		0.01mm (±9999.99mm) / .0005" (±99.9995") 0.005mm (±9999.995mm) / .00005" (±9.99995") 0.001mm (±999.999mm) / .00005" (±9.99995") 0.0005mm (±99.9995mm) / .000005" (±.999995") 0.0001mm (±99.9999 mm) / .000005" (±.999995")
Display		Sign plus 6 digits (Green LED)		
Tolerance judgment display		LED display (3 steps: Amber, Green, Red / 5 steps: Amber, Amber flashing, Green, Red flashing, Red)		
Input/output	Tolerance judgment output	L1 to L5, open-collector		
	Control output	Normal operation signal (NOM), open-collector		
	Control input	Presetting, display hold, peak value clear, tolerance judgment BANK switch, open-collector or no-voltage contact signal (with/without contact point)		
Interface	Serial BCD	Bit serial format, open-collector		
	Analog output	2.5V+Counting value× Voltage resolution (25mV/2.5mV): Full-scale 0 to 5V		
	Digimatic input/output	• Connecting to the external switch box (**No.02ADF180**) makes it easy to enter tolerance limits and preset values. Note: This function is not available when the gage is connected to **DP-1VR**, Digimatic Mini-Processor. • Can be connected to Digimatic peripherals that have Data (poll) button • Number of tolerance steps can be expanded by assembling **EB-D** counters.		
Rating	Power supply voltage	12 - 24V DC		
	Power consumption	6W or less (50mA max.) Ensure at least 1A is available per unit.		
Operating temperature range		0 to 40°C (RH 20 to 80%, no condensation)/ –10 to 50°C (RH 20 to 80%, no condensation)		
External dimensions		96(W)×48(H)×156(D)mm		
Applicable input		Differential square-wave	Differential square-wave with origin point mark	Digimatic code (SPC)
Mass		Approx. 400g	Approx. 400g	Approx. 400g

* range is limited when using 0.0001 mm gages

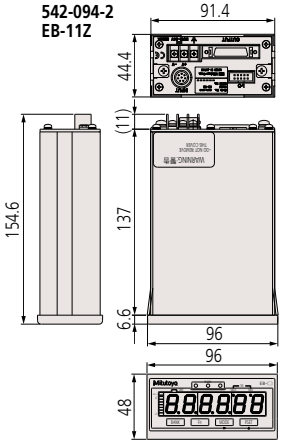
DIMENSIONS

Unit: mm

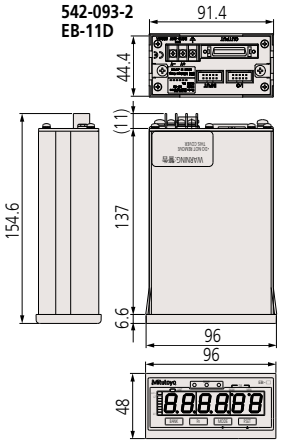
542-092-2
EB-11P



542-094-2
EB-11Z



542-093-2
EB-11D



Function

- Preset
- Tolerance judgment output (3/5-step, 7 types)
- Limit value output (2 types independently for each of the 7 channels)
- Peak (max., min., runout) measurement
- Diverse data output

(Serial BCD, Simplified analog, Digimatic)

Optional Accessories

- I/O output connector (with cover): **No.02ADB440**
- AC adapter: **No.357651** *
- AC cable (USA): **02ZAA010***
- Terminal connecting cable: **No.02ADD930***

* Included in package Order No.
The tolerance values or preset values can be easily input.
No.02ADF180 (with 2m cable)

EV Counter – Multi-function, Multiple Input Type

Series 542 — Processor (Optional Display), Multi-function/output

- Up to six gages can be connected to one unit, extendable up to 10 units (60 gages at maximum) using the RS Link function* to facilitate the configuration of a multi-point measurement system.

* Refer to "Quick Guide to Precision Measuring Instruments" on page G-32 for details of the RS link.

- A range of output modes to choose from: I/O output for tolerance judgment and segment output, BCD data output and RS-232C output are available.
- Other than normal measurement, peak measurement or differential measurement between gages are available.

542-063

542-067

542-064

Function

- External Control (Zero-set, Preset etc.)
- Direction switch
- Error display
- Tolerance judgment output
- Diverse data output (RS-232C, BCD, Segment)
- Peak measurement

Maximum value, minimum value, runout, and differential measurement between two gages
Addition, averaging, maximum value, minimum value, and maximum width

Optional Accessories

- D-EV External display unit: **No.02ADD400**
- SPC cable (0.5m): **No.02ADD950**
- SPC cable (1m): **No.936937**
- SPC cable (2m): **No.965014**
- AC adapter: **No.357651** *
- AC cable (USA): **02ZAA010***
- Terminal connecting cable: **No.02ADD930***

* Included in package Order No.

SPECIFICATIONS

Order No.		542-063	542-067	542-064
Pkg No.(counter w/AC adapter)		64PKA137A	64PKA139A	64PKA138A
Applicable gage head		**LGE**, **LGF**, **LGK**, **LGB**, **LGM**, **LG** not compatible with reference point mark, sine wave output type or 0.1µm resolution models.	**LGF** with reference point mark **(LGF-Z)**	**LGD**, **LGS**
Number of input channels		6		
Maximum input frequency		1.25MHz (2-phase square wave), response speed depends on gage specification. Max. counting speed: 5MHz	1.25MHz (2-phase square wave), response speed depends on gage specification. Max. counting speed: 5MHz	Response speed depends on gage specification.
Quantizing error		±1 count		
Resolution		10µm (±999999.99mm) / .0005" (±9999.9995") 5µm (±999999.995mm) / .00005" (±999.99995") 0.5µm (±9999.9995mm) / .000005" (±.99.999995")*1 [Parameter set]	10µm (±999999.99mm) / .0005" (±9999.9995") 5µm (±999999.995mm) / .00005" (±999.99995") 1µm (±99999.999mm) / .00005" (±999.99995") 0.5µm (±9999.9995mm) / .000005" (±.99.999995") [Parameter set]	Depends on gage specification.
LED display		8 digits for parameter display (displays settings), 1 for error display		
Error message		Overspeed, gage error etc.		
External display		Dedicated external display unit D-EV (optional) can be connected.		
Number of input switches		4		
Function of input switches		Measurement mode switching, parameter setting		
Input/ output	Tolerance judgment output	1 to 6 channels (L1, L2, L3), open-collector		
	BCD output	Parallel BCD output (positive/negative-true logic), open-collector		
	Segment output	Function to set on only the terminals corresponding to the counting values, open-collector		
	Control output	Normal operation signal (NOM), open-collector		
	Control input	Output channel designation (segment, in the BCD mode), presetting, peak value clear, range changeover (at segment output), holding counting value open-collector or no-voltage contact signal (with/without contact point)		
Interface	RS-232C	Measurement data output and control input EIA RS-232C-compatible Use cross cables for home position, DTE (terminal definition).		
	RS link	Max. connecting unit: 10 (6 when using EF counter) Connecting cable length: Max. 10m (sum of link cable length) Data transfer time: 1sec./60ch (when transmission rate is 19200bps)		
Rating	Power supply voltage	12 - 24V DC, terminal block (M3 screw)		
	Power consumption	8.4W or less (700mA max.) Ensure at least 1A is available per unit.		
Operating temperature (humidity) range		0 to 40°C (RH 20 to 80%, no condensation)		
Storage temperature (humidity) range		–10 to 50°C (RH 20 to 80%, no condensation)		
External dimensions		144 (W) x 72 (H) x139 (D) mm		
Mass		Approx. 910g	Approx. 910g	Approx. 830g
Standard accessories		Fixing foot (4), connecting bracket (4), fixing screw M4×12 (8)		
Applicable input		Differential square-wave		Digimatic code (SPC)

*1: Available when using D-EV.
*2: D-EV is required when selecting 0.1µm resolution.

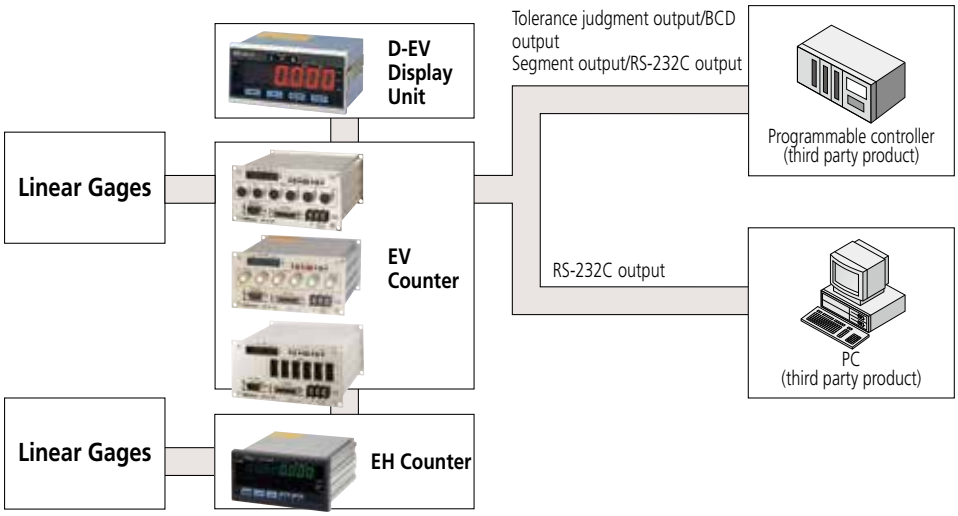
Mitutoyo

EV Counter System Configuration

Series 542 — Processor (Optional Display), Multi-function/output

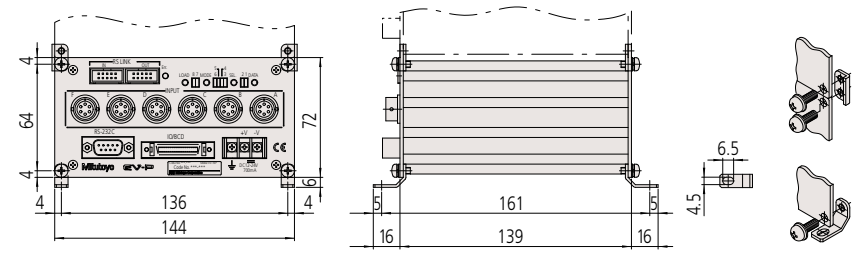
System Configuration

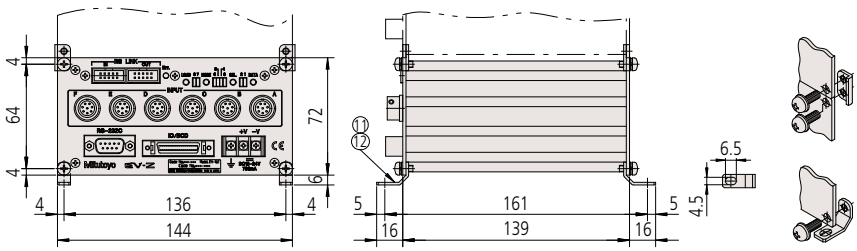
A counter system performs output and display for connected Mitutoyo linear gages.

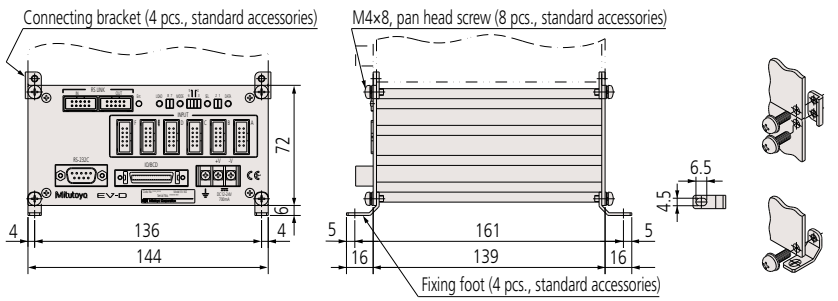


DIMENSIONS

Unit: mm







D-EV Display Unit for EV Counter

- Display unit for the EV counter.
- Allows set up of EV counter without a personal computer or other equipment.
- Able to display each gage measurement value and go/no-go judgment result, total go/no-go judgment result for all gages, setting details and errors.

02ADD400

Function

- External Control (Zero-set, Preset etc.)
- Direction switch
- Error display
- Tolerance judgment output
- Data output
  (RS-232C, BCD, Segment)
- Peak measurement

Maximum value, minimum value, runout, and differential measurement between two gages
Addition, averaging, maximum value, minimum value, and maximum width

Optional Accessories

- SPC cable (0.5m): **No.02ADD950***1
- SPC cable (1mm): **No.936937***1
- SPC cable (2m): **No.965014***1
- AC adapter: **No.357651**
- AC cable (USA): **02ZAA010***2
- Terminal connecting cable: **02ADD930***2

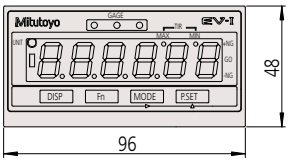
*1: Required when connecting with **EV-16P/D/Z**.
*2: Required when using AC adapter.
Note: AC adapters may not be needed if using power from EV counter to power the D-EV.

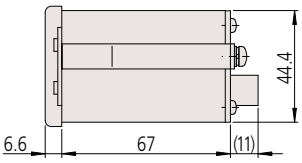
SPECIFICATIONS

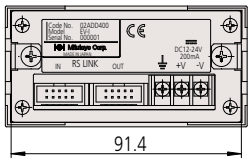
Order No.	**02ADD400**
Number of connections	1 EV counter per unit
Number of digits	Sign plus 6 digits (8 digits internal to EV counter)
LED	Channel display (also for judgment result display): 3 (3-color LED) Measurement mode display (current data, maximum value, minimum value, runout): 2 Status display: 1 (2 colors)
Operation switches	4
Function of operation switch	Channel switching, measurement mode switching (current data, maximum value, minimum value, runout), parameter setting, presetting, tolerance setting
Input/output	RS Link connectors: 1 each for IN, OUT
Error message	Overspeed, gage error etc.
Power supply	Terminal block (M3 screw), 12 - 24V DC, 200mA
Operating temperature (humidity) range	0 to 40°C (RH 20 to 80%, no condensation)
Storage temperature(humidity) range	–10 to 50°C (RH 20 to 80%, no condensation)
External dimensions	96(W)×48(H)×84.6(D)mm

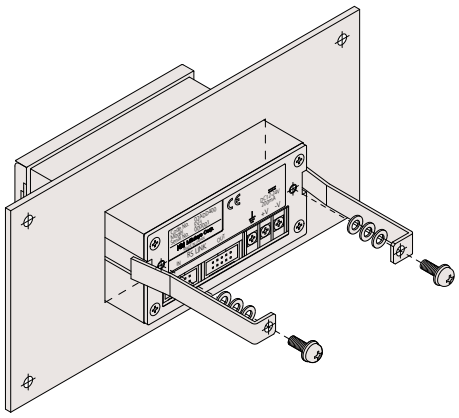
DIMENSIONS

Unit: mm









Sensorpak Software

Dynamically Displays Positions, Tolerances and Calculations, and Acquires Basic Data from EH, EV Counters and Litematics

- This software facilitates loading measurement data onto a personal computer from a linear gage counter with RS-232C output (EH, EV), with USB output (EH), or from a Litematic display (VL).
- 60 channels (max.) of measurement data can be processed.
- Arithmetical calculations and maximum width calculations can be performed using the measurement data.
- Exporting measurement data into MS-Excel format is supported.
- Real-time graphical display by means of bar-graph or meter is provided.
- Any gage that can be connected to an EH or EV counter can be used in Sensorpak.

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
SENSOR

Meter screen

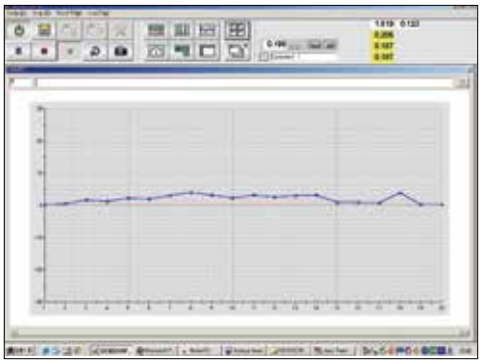


Chart screen

Measurement screen

SPECIFICATIONS

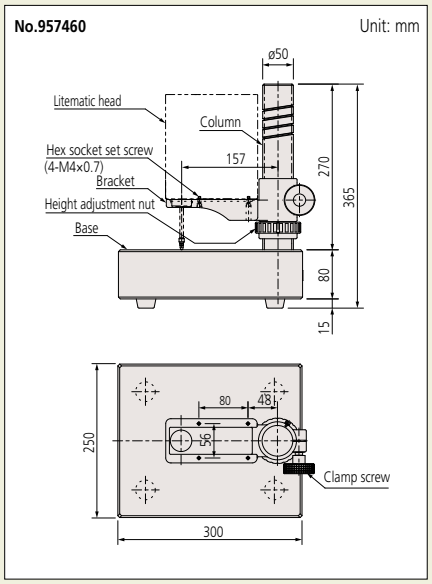
Order No.	**02NGB073** (Software v 3.0 plus I/O cable)
Display function	Display type: Counter, bar graph, meter, chart (capable of simultaneous display) Tolerance judgment result: Color display (green/red) Connectable gages: max. 60 gages
Calculation functions	Calculation items: Sum, difference, total, average, maximum, minimum, range (maximum–minimum), calculation with a constant Connectable gages: Max. 30 calculation functions (between two gages)
Total tolerance judgment	Go/No-go judgment (by specifying gages to be used for total tolerance judgment) Go/No-go signal output with optional I/O cable
Input function	Trigger function: by means of key, timer or external TRG (with optional I/O cable) Data input frequency: Max. 9999 times (with 60 gages connected) to 60000 times (with 6 gages connected)
Output function	Direct output to EXCEL spreadsheet, CSV file output (compatible with MeasurLink)
Connectable items	EF, EH, EV, Litematic (RS Link ready products)
System requirements	CPU: DOS/V PC (w/ RS-232C) 2GHz or more OS: Windows 7(32/64 bit), Windows 8.1(32/64 bit), windows 10(64bit) Memory: 2GB or more USB Com: USB 2.0 Display: 1024 x 786 or more Excel: 2007, 2010, 2013

Currently supported languages: English, German, French, Spanish
User's manual: English

Optional Accessory

21HZA137: Connecting Cable
- Counter connection (9pin D-SUB)
- PC connection (9-pin D-SUB)
- PLC connection (5-pin DIN)

Optional Stand for VL-50S-B



Optional Accessories

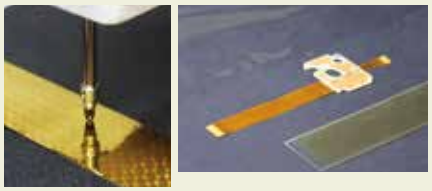
- Foot switch: **No.937179T**
- Dedicated stand: **No.957460***4
- SPC cable (1m): **No.936937***5
- SPC cable (2m): **No.965014***5
- Weight set: **No.02AZE375***6
- Recommended contact point:
  Shell type
  Carbide-tipped spherical contact point, ø7.5
  Carbide-tipped spherical contact point, ø10.5
  Carbide-tipped needle contact point, ø0.45

*4: Only available for **VL-50S** models
*5: Refer to page G-32 for details of the RS link.
*6: Not applicable to **VL-50-100-B**, **VL-50S-100-B**.

Measurement Examples

Glass dimensional measurement

Thin sheet metal thickness



Thickness measurement of non-metallic sheet

Laser Beam Safety Precautions

This system uses a low-power invisible laser beam (780nm) which corresponds to a CLASS 1 (invisible radiation) of IEC60825-1 for measurement. The CLASS 1 laser warning label as shown below is attached to the main unit.

CLASS 1 LASER PRODUCT

Litematic – Low-Force Measurement

Series 318 — Low Force, High-resolution, Motorized Measurement of Easily-deformed Parts

- The Litematic is designed for measuring easily deformed workpieces and high-precision parts, with extra-low measuring force of 0.01N.
- 0.15N and 1N types are capable of measuring at a certain measuring force by using a Litematic feature, while the 0.01N type is suitable for measuring delicate workpieces.

*0.15N, 1N types are factory-installed option.

- The motor-driven spindle moves up/down and stops when the contact point touches the workpiece. Then the maximum, minimum values and runout value are measured under a constant force.
- High resolution of 0.01µm, and wide measuring range of 50mm.
- Measuring system VL-50-B, integrated display type, and VL-50S-B, a separate display type, are available.
- The measuring table supplied with VL-50-B is ceramic and corrosion-free for easier maintenance and storage.
- The spindle is made of low thermal-expansion material.

318-221A

318-226A

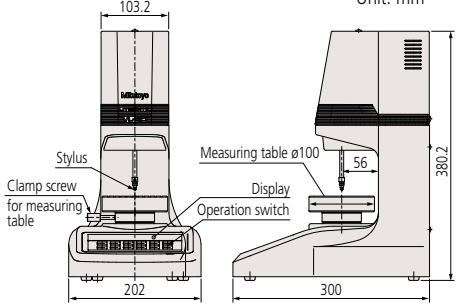
SPECIFICATIONS

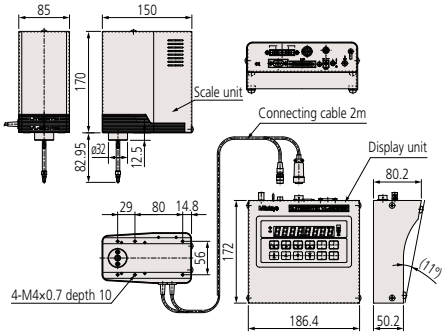
Order No.		318-221A	318-222A	318-223A	318-226A	318-227A	318-228A
Model		VL-50-B	VL-50-15-B	VL-50-100-B	VL-50S-B	VL-50S-15-B	VL-50S-100-B
Measuring range		0 to 50mm (0-2")					
Resolution		0.01/0.1/1.0µm (.0000005"/.000005"/.00005")					
Display unit		8 digits/14mm (.6") character height (without signs)					
Detection method		Reflection-type linear encoder					
Stroke		51.5mm (.2") (when using a standard contact point)					
Indication accuracy (20°C)*1		(0.5+L/100)µm L=arbitrary measuring length (mm)					
Accuracy guaranteed temperature*2		20 ± 1°C					
Repeatability*1		σ=0.05µm					
Measuring force*1		0.01	0.15N*3	1N*3	0.01N	0.15N*3	1N*3
Feed speed	Measurement	Approx. 2mm/s (.08"/s) or 4mm/s (.16"/s) (changeable by parameter)					
	Fast feed	Approx. 8mm/s (.3"/s)					
Standard contact point		ø3mm carbide tipped (fixing screw: M2.5 (P=0.45)x5) **No.901312**					
Measuring table		ø100 (ceramic, grooved, removable)			—		
Input		Foot switch input (when optional foot switch is used) External control					
Output		Digimatic output/RS-232C output (changeable by parameter)					
Rating	Power supply	85 - 264V AC (depends on AC adapter)					
	Power consumption	Max. 12 W (12V, 1A)					
Standard accessories		AC adapter: **No.357651**, Power cable/grounding wire: **No.02ZAA000**, AC cable (USA): **No.02ZAA010*** Hex wrench (2 pcs, for fixing contact point and for removing fixing bracket)					

*1: Normal measurement using standard contact point.
*2: Or less temperature change. Hot or cold direct air flow should be avoided.
*3: 0.15N, 1N types are factory-installed option.

DIMENSIONS

Unit: mm



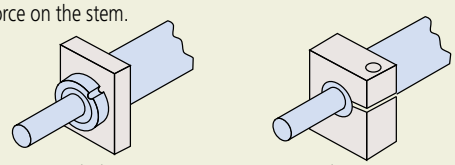


Mitutoyo

Head

Plain Stem and Stem with Clamp Nut

The stem used to mount a linear gage head is classified as a plain type or clamp nut type as illustrated below. The clamp nut stem allows fast and secure clamping of the linear gage head. The plain stem has the advantage of wider application and slight positional adjustment in the axial direction on final installation, although it does requires a split-fixture clamping arrangement or adhesive fixing. However, take care so as not to exert excessive force on the stem.



Stem locknut type　　Plain stem

Measuring Force

This is the force exerted on a workpiece during measurement by the contact point of a linear gage head, at its stroke end, expressed in newtons.

Comparative Measurement

A measurement method where a workpiece dimension is found by measuring the difference in size between the workpiece and a master gage representing the nominal workpiece dimension.

Ingress Protection Code

IP54 protection code

Type	Level	Description
Protects the human body and protects against foreign objects	5: Dust protected	Protection against harmful dust
Protects against exposure to water	4: Splash-proof type	Water splashing against the enclosure from any direction shall have no harmful effect.

IP66 protection code

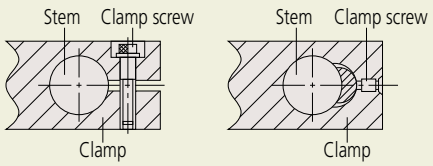
Type	Level	Description
Protection against contact with the human body and foreign objects	6: Dust tight	Protection from dust ingress Complete protection against contact
Protects against exposure to water	6: Water-resistant type	Water jets directed against the enclosure from any direction shall have no harmful effect.

Precautions in Mounting a Gage Head

- Insert the stem of the gage into the mounting clamp of a measuring unit or a stand and tighten the clamp screw.
- Notice that excessively tightening the stem can cause problems with spindle operation.
- Never use a mounting method in which the stem is clamped by direct contact with a screw.
- Never mount a linear gage by any part other than the stem.
- Mount the gage head so that it is in line with the intended direction of measurement. Mounting the head at an angle to this direction will cause an error in measurement.
- Exercise care so as not to exert a force on the gage through the cable.

Precautions in Mounting a Laser Hologage

To fix the Laser Hologage, insert the stem into the dedicated stand or fixture.



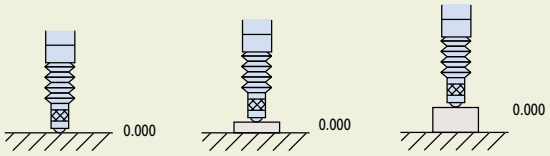
Recommended hole diameter on the fixing side: 15mm +0.034/-0.014

- Machine the clamping hole so that its axis is parallel with the measuring direction. Mounting the gage at an angle will cause a measuring error.
- When fixing the Laser Hologage, do not clamp the stem too tightly. Over-tightening the stem may impair the sliding ability of the spindle.
- If measurement is performed while moving the Laser Hologage, mount it so that the cable will not be strained and no undue force will be exerted on the gage head.

Display Unit

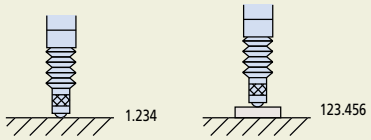
Zero-setting

A display value can be set to 0 (zero) at any position of the spindle.



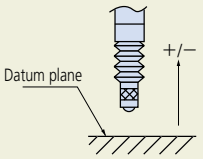
Presetting

Any numeric value can be set on the display unit for starting the count from this value.



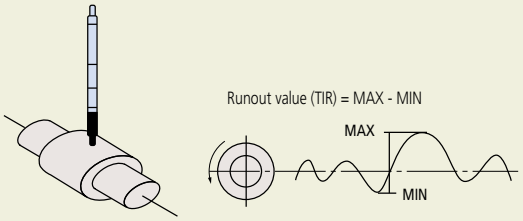
Direction Changeover

The measuring direction of the gage spindle can be set to either plus (+) or minus (-) of count.



MAX, MIN, TIR Settings

The display unit can hold the maximum (MAX) and minimum (MIN) values, and MAX - MIN value during measurement.



Tolerance Setting

Tolerance limits can be set in various display units for automatically indicating if a measurement falls within those limits.

Open Collector Output

An external load, such as a relay or a logic circuit, can be driven from the collector output of an internal transistor which is itself controlled by a tolerance judgement result, etc.

Relay output

Contact signal that outputs the open/closed status.

Digimatic Code

A communication protocol for connecting the output of measuring tools with various Mitutoyo data processing units. This allows output connection to a Digimatic Mini Processor DP-1VR for performing various statistical calculations and creating histograms, etc.

BCD Output

A system for outputting data in binary-coded decimal notation.

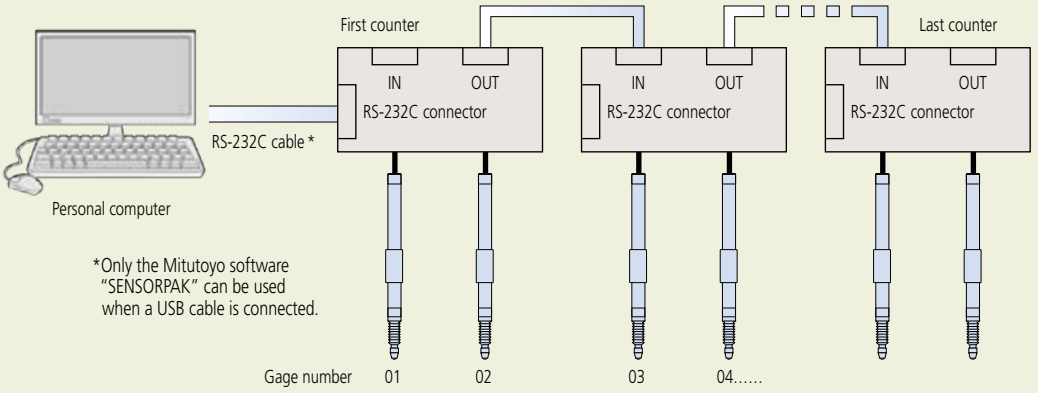
RS-232C Output

A serial communication interface in which data can be transmitted bi-directionally under the EIA Standards.
For the transmission procedure, refer to the specifications of each measuring instrument.

RS Link Function Multi-point measurement can be performed by connecting multiple EH or EV counters with RS Link cables.

RS Link for EH Counter

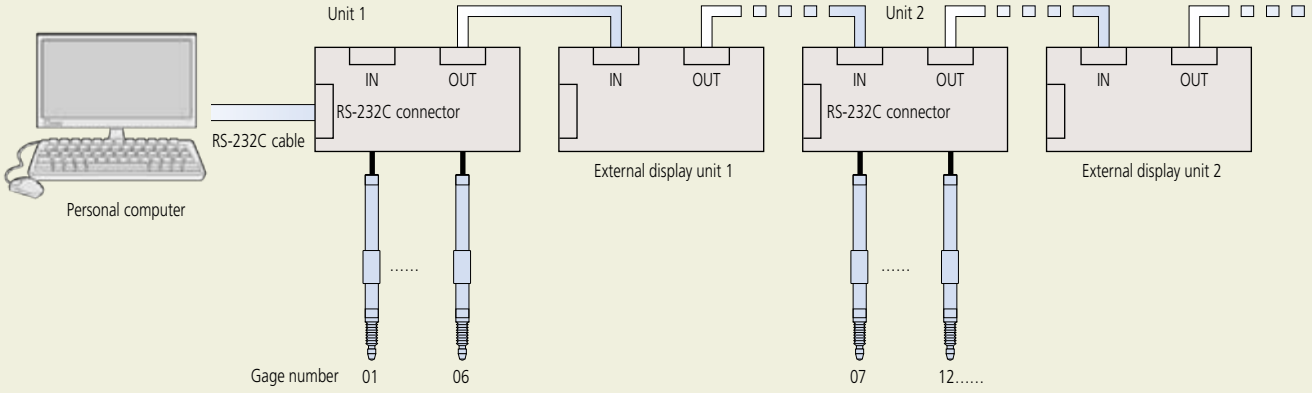
It is possible to connect a maximum of 10 counter units and handle up to 20 channels of multi-point measurement at a time.
For this connection use a dedicated RS Link cable **No.02ADD950** (0.5m), **No.936937** (1m) or **No.965014** (2m).
(The total length of RS Link cables permitted for the entire system is up to 10m.)



RS Link for EV Counter

It is possible to connect a maximum of 10* counter units and handle up to 60 channels of multi-point measurement at a time.
For this connection use a dedicated RS Link cable **No.02ADD950** (0.5m), **No.936937** (1m) or **No.965014** (2m).
(The total length of RS Link cables permitted for the entire system is up to 10m.)

* The maximum number of counter units that can be connected is limited to 6 (six) if an EH counter is included in the chain.



Mu-checker Probes

SERIES 519 Mu-checker Probes (Lever head)

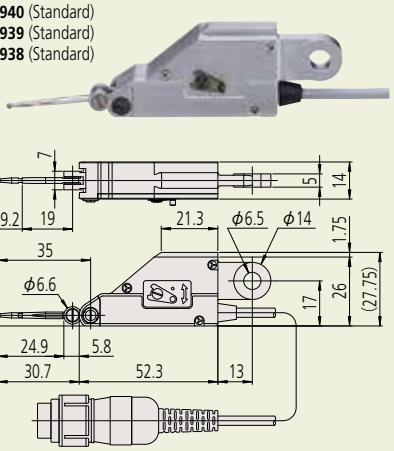
SPECIFICATIONS
Lever heads

Order No.	519-521	519-522	519-326*	519-327
Measuring range (mm)	±0.5			
Stroke (mm)	±0.6			±0.65
Measuring force (N)	Approx. 0.2	Approx. 0.02	Approx. 0.15	
Linearity (%)	±0.3			±0.5
Stylus support	Pivot bearing	Pivot bearing	Parallel-leaf spring	Pivot bearing

Note: A ø2mm ball-ended stylus is supplied as standard with all probes.
* This model is immune to cosine error.

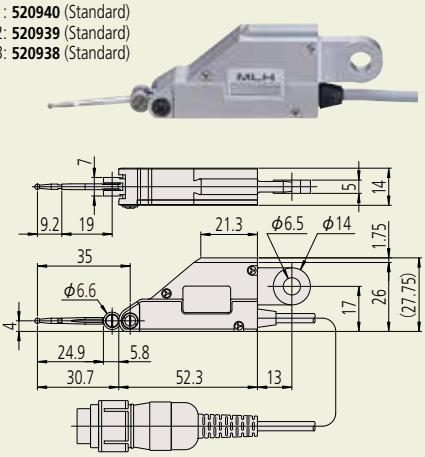
519-521

• Interchangeable styli:
ø1: **520940** (Standard)
ø2: **520939** (Standard)
ø3: **520938** (Standard)



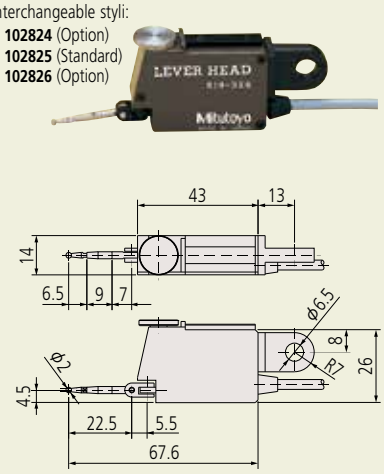
519-522

• Interchangeable styli:
ø1: **520940** (Standard)
ø2: **520939** (Standard)
ø3: **520938** (Standard)



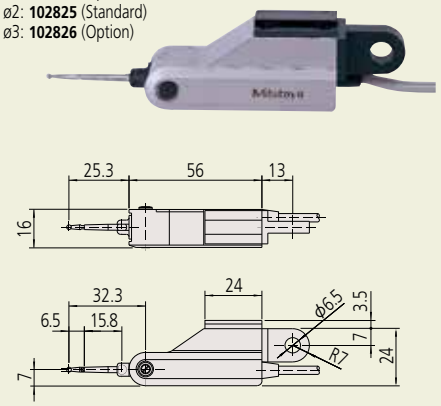
519-326

• Interchangeable styli:
ø1: **102824** (Option)
ø2: **102825** (Standard)
ø3: **102826** (Option)



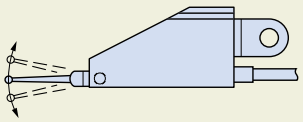
519-327

• Interchangeable styli:
ø1: **102824** (Option)
ø2: **102825** (Standard)
ø3: **102826** (Option)

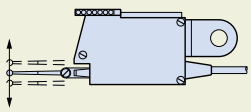


Common specifications
- Connection: Half-bridge
- Cable length: 2m
- Connector type: **MAS-5100** (DIN5P) or equivalent

Lever probes
Lever probes are available in two types. The most common type uses a pivoted stylus so the contact point moves in a circular arc; this type is subject to cosine effect and, therefore, measurements may require linearity correction if the direction of measurement is much different to the direction of movement of the contact point. The less common type uses a parallel translation leaf-spring mechanism so contact point movement is linear; this type requires no correction.



Pivoted stylus type
519-521 (measuring direction can be switched with the up/down lever)
519-522 (measuring direction is not switchable, low force)
519-327 (Clutchless)



Parallel translation type
519-326 (measuring direction can be switched with the upper dial)

Refer to Bulletin No. (2215) for more details.

Lever-head mounting brackets (optional)

Optional accessories for Mitutoyo test indicators can be used.

Stems

ø4 dovetail-grooved stem
21CZB131

ø6 dovetail-grooved stem
21CZB128

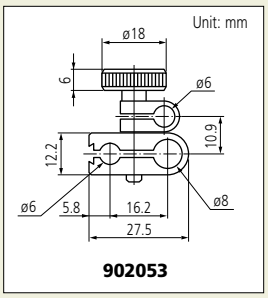
ø8 dovetail-grooved stem
21CZB129

ø3/8" dovetail-grooved stem
21CZB130

Clamp

Clamp for ø6mm, 8 dovetail-grooved stem
902053

Clamp for ø6mm, 3/8" dovetail-grooved stem
900320



902053

Holder

Holding arm (Square 9x9, Length 100)
900209

Holding arm (ø8, Length 115)
900211

Holding arm (.25" x .5", Length 4")
900306

SERIES 519 Mu-checker Probes (Cartridge head)

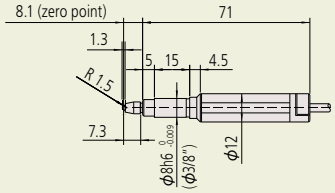
SPECIFICATIONS

Cartridge heads

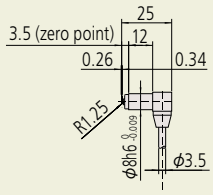
Order No.	519-331	519-332	519-346	519-347	519-385	519-341	519-348
Measuring range (mm)	±0.5	±0.5	±0.25	±0.5	±1.5	±2.5	±1.0
Stroke (mm)	±0.65	±0.65	+0.34 −0.26	+0.85 −0.65	+2.35 −1.65	+3.2 −2.8	+1.35 −1.15
Measuring force (N)	Approx. 0.25	Approx. 0.25	Approx. 0.7	Approx. 0.7	Approx. 0.7	Approx. 0.9	Approx. 0.7
Stem Dia. (mm)	ø8	ø3/8"	ø8	ø8	ø8	ø8	ø8
Linearity (%)	±0.5	±0.5	±0.3	±0.3	±0.3	±0.5	±0.3
Plunger support	Plain bearing		Linear ball-bearing				

519-331/(519-332)

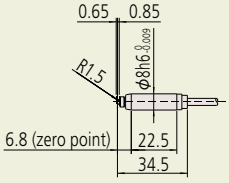
• M2.5×5 (4-48 UNF) interchangeable contact points for dial indicators can be used.



519-346

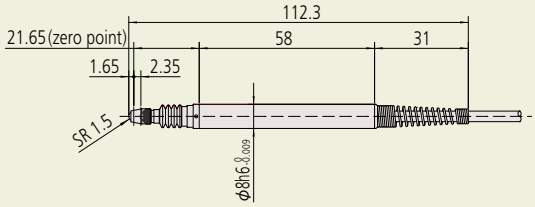


519-347



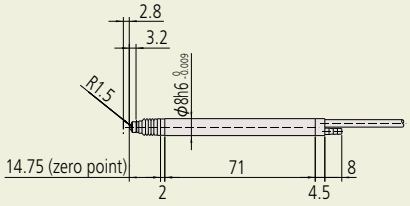
519-385

• M2.5×5 interchangeable contact points for dial indicators can be used.



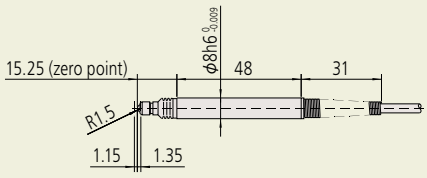
519-341

• M2.5×5 interchangeable contact points for dial indicators can be used.



519-348

• M2.5×5 interchangeable contact points for dial indicators can be used.



Mitutoyo

Mu-checker

SERIES 519 Mu-checker
(Analog/Digital electronic micrometer)

- Single touch zero-set function is standard.
- Switchable measurement ranges make the Mu-checker suitable for a range of applications.

Analog Mu-checker

Standard type
519-552A

Differential type
519-554A

SPECIFICATIONS

Order No.	519-552A	519-554A
Type	Standard type (one probe required)	Differential type (one/two probes required)
Display range	±5µm/±15µm/±50µm/±150µm/±500µm/±1500µm ±.00015"/±.0005"/±.0015"/±.005"/±.015"/±.05"	
Resolution	0.1µm/0.5µm/1µm/5µm/10µm/50µm .000005"/.00001"/.00005"/.0001"/.0005"/.001"	
Differential mode	±A	±A, ±B, ±A±B
Display accuracy (linearity)	±1% / ±full scale	
Analog output	±1V ±full scale	
Analog output accuracy	±0.1% Within ±full scale (excluding probe)	
Zero-setting adjustment range	Manual Instant zero setting: 1/3 of full scale for each range	
External dimensions	134(W) x 183(D) x 208(H) mm	
Mass	2.4kg	
Power input	AC adapter 100, 120, 220, 240VAC 50/60Hz	
Probe	Various probes (refer to page G-33 and G-34)	

Digital Mu-checker

- Single touch zero-set function is standard.
- Switchable measurement ranges make the Mu-checker suitable for a range of applications.
- Dual input.

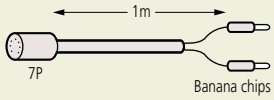
Digital Mu-checker
519-562A

SPECIFICATIONS

Order No.	519-562A
Type	Differential type digital Mu-Checker (2 connecting heads)
Display range	±2.000mm/±0.2000mm/±.08"/±.008"
Resolution	0.001mm/0.0001mm/.00005"/.000005"
Differential mode	±A, ±B, ±A±B
Measurement mode	ABS/CMP
Analog output	±1V ±Full scale
Digital output	Digimatic code out
External dimension	134(W) x 183(D) x 208(H) mm
Mass	Approx. 2.6kg
Power input	AC adapter 100, 120, 220, 240VAC 50/60Hz
Probe	Various probes (refer to page G-33 and G-34)

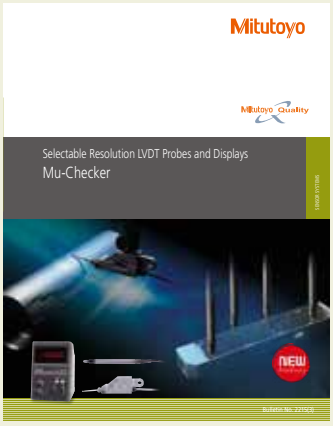
Optional Accessories

- SPC Cable for connecting digital Mu-checker (**936937**)
  Used for connecting to the digimatic mini-processor.
- Output cable A (**934795**)
  Used for connecting to external devices, such as data recorders, etc.



- Analog, limit out (7P) connector (**529035**)
  Used for output to external data recorders, sequencers, etc.

- Foot Switch: **937179T**
- SPC Cable, 1m: **936937**
- SPC Cable, 2m: **965014**
  Note: for Digital Mu-Checker only



Refer to Bulletin No. (2215) for more details.

SERIES 519 6CH Mu-checker Counter EV-16A

Main features

- External control (Zero-set, Preset etc.)
- Direction switching
- Error messaging
- Tolerance judgment output
- Each data output (RS-232C, BCD, segment)
- Peak measurement (maximum value, minimum value, runout) and arithmetic operation (addition, average, maximum value, minimum value, maximum width) between axes

Optional Accessories

- I/O output connector: **02ADB440**
- D-EV external unit: **02ADD400**
- SPC cable, 0.5m: **02ADD950**
- SPC cable, 1m: **936937**
- SPC cable, 2m: **965014**

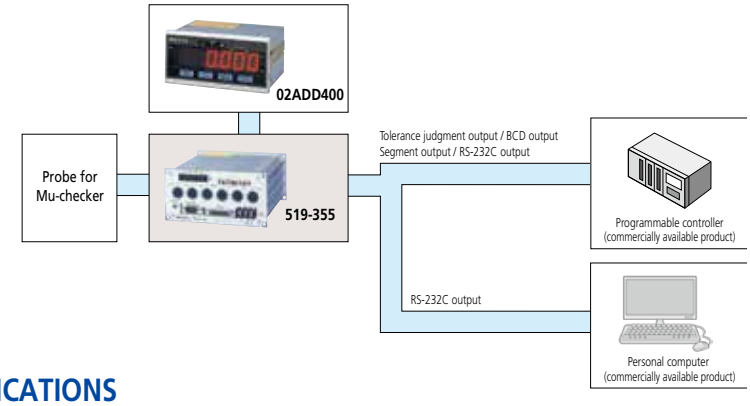
Note 1: To perform calibration a **D-EV (02ADD400)** display unit is required.
At least one **D-EV (02ADD400)** unit is required when using multiple **EV-16A (519-355)**.

Note 2: As a power supply is not supplied as standard. An appropriate power supply with a current capacity of 1A or more must be provided for each **EV-16A (519-355)**.

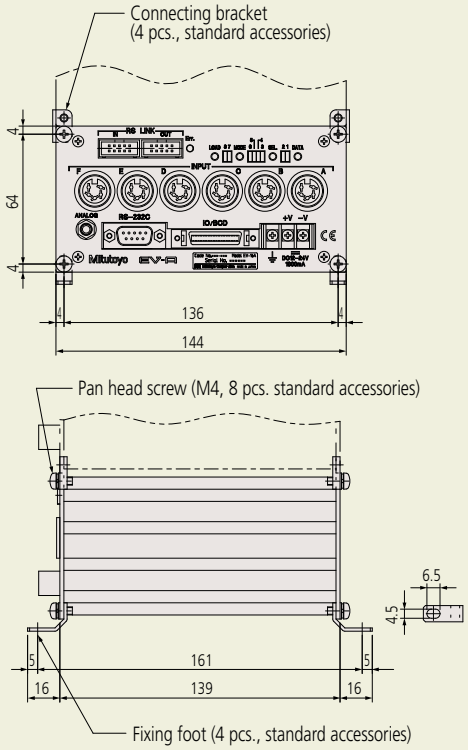
- The EV-16A counter unit provides multi-channel electronic micrometer functionality but without a display of the measurement results, which must be purchased separately. (See below.)
- Up to six probes can be connected to one unit. Up to ten counters can be connected to one personal computer using the RS Link function to enable the configuration of a multi-point measurement system comprising a maximum of 60 gages.
- I/O outputs for RS-232C, BCD, tolerance judgment and segment output are available.
- Maximum, minimum and runout measurement between channels (in the same unit) is possible in addition to normal measurement on individual channels.

SYSTEM CONFIGURATION

Mitutoyo probes, EV-16A counters and D-EV display units combined with commercial controllers and personal computers enable construction of a powerful, multi-channel system that can be built to meet the needs of almost any measurement application.



DIMENSIONS



SPECIFICATIONS

Order No.		519-355
Number of gage inputs		Six
Display range (mm)		±2.000, ±0.200
Resolution (mm)		0.001, 0.0001
Display processing		8 digits for parameters (display setting), 1 for error display
Error messaging		Power supply voltage error, Gage error, etc.
External display		Dedicated external display unit D-EV (optional) can be connected
Number of input switches		4
Input switch function		Measurement mode switching, Parameter settings
I/O	Tolerance judgment output	1 to 6 gages (L1, L2, L3), open-collector
	BCD output	Parallel BCD output (positive/negative-true logic), open-collector
	Segment output	A function to enable only output from the terminal corresponding to the counting values, open-collector
	Control output	Normal operation signal (NOM), open-collector
	Control input	Output channel designation (segment, in BCD mode), presetting, peak value clear, range changeover (at segment output), holding counting value, open-collector or no-voltage contact signal (with/without contact point)
Interface	RS-232C	Measurement data output and control input, EIA RS-232C-compatible Use cross cables for home position DTE (terminal definition)
	RS link	Max. connected units: 10 (6 when using EF counter) Connecting cable length: Max. 10m (sum of link cable length) Data transfer time: 1.1 sec./60ch (when transmission rate is 19200 bps)
Rating	Power supply voltage	Terminal (M3 screw), 12-24VDC
	Current consumption	1A
Operating temperature (humidity) range		0 to 40 °C (RH 20 to 80%, no condensation)
Storage temperature (humidity) range		-10 to 50 °C (RH 20 to 80%, no condensation)
External dimensions		144(W) × 72(H) × 139(D) mm
Mass		Approx. 1000 g
Standard accessories		Fixing foot (4), connecting bracket (4), fixing screw M4 × 8 (8)
Applicable probes		For probes, refer to 519 series Mu-checker probes

Laser Scan Micrometer Selection Guide

MEASURING UNITS

Appearance	Model	Laser Classification	Measuring Range	Resolution (Selectable)
	**LSM-6902H***	**Visible** (650nm), IEC Class 2/ FDA Class II	0.1 - 25mm (.004" - 1.0")	0.01µm - 10µm (.000001" - .0005")
	**LSM-500S**	**Visible** (650nm), IEC Class 2/ FDA Class II	0.005 - 2mm (.0002" - .08")	0.01µm - 10µm (.000001" - .0005")
	**LSM-501S**	**Visible** (650nm), IEC Class 2/ FDA Class II	0.05 - 10mm (.002" - .4")	0.01µm - 10µm (.000001" - .0005")
	**LSM-503S**	**Visible** (650nm), IEC Class 2/ FDA Class II	0.3 - 30mm (.012" - 1.18")	0.02µm - 100µm (.000001" - .005")
	**LSM-506S**	**Visible** (650nm), IEC Class 2/ FDA Class II	1 - 60mm (.04" - 2.36")	0.05µm - 100µm (.000002" - .005")
	**LSM-512S**	**Visible** (650nm), IEC Class 2/ FDA Class II	1 - 120mm (.04" - 4.72")	0.1µm - 100µm (.000005" - .005")
	**LSM-516S**	**Visible** (650nm), IEC Class 2/ FDA Class II	1 - 160mm (.04" - 6.30")	0.1µm - 100µm (.000005" - .005")
 With display unit	**LSM-9506** Measuring unit - display unit one-piece structure for bench-top use only	**Visible** (650nm), IEC Class 2/ FDA Class II	0.5 - 60mm (.02" - 2.36")	0.05µm - 100µm (.000002" - .005")

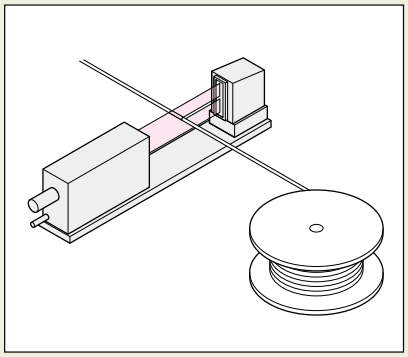
DISPLAY UNITS

Appearance	Model	Type	Application	Interface Units Equipped
	**LSM-6200** **LSM-6902H***	Multi-function type	Bench-top use	• RS-232C • I/O • Analog output
	**LSM-5200****	Compact type (Low cost)	Assembly/ bench-top use (DIN size)	• RS-232C • I/O • Analog output • USB***

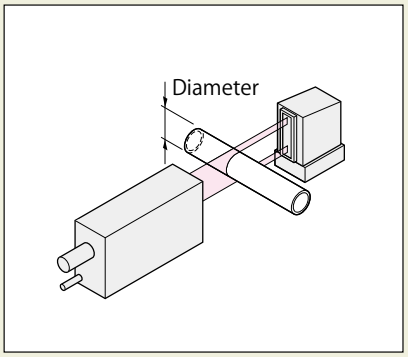
*LSM-902 and LSM-6902H are factory-set package.
**When connecting with the LSM-500S series, the scanning speed becomes 1600 scans/sec.
***USB connectivity for use with Quicktool and LSM Pak.

Measurement Examples

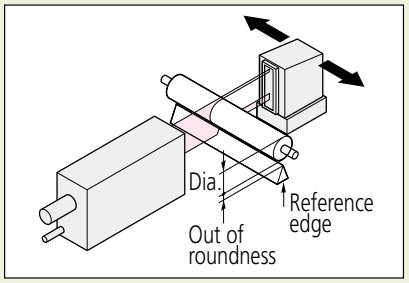
In-line measurement of glass fiber or fine wire diameter



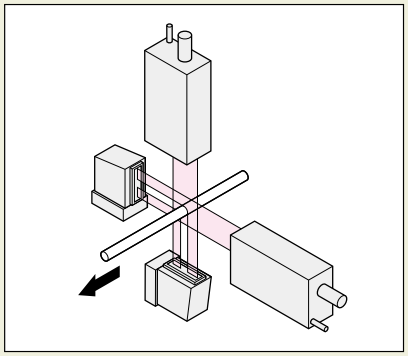
Measurement of outer diameter of cylinder



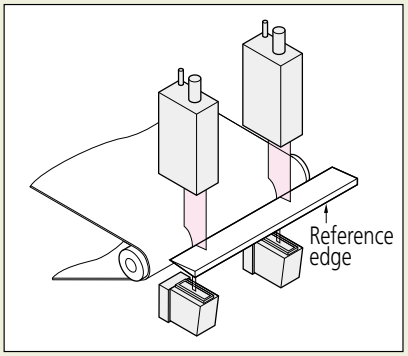
Measurement of outer diameter and roundness of cylinder



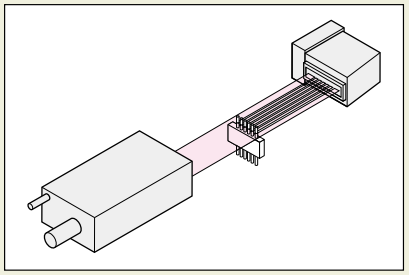
X- and Y-axis measurement of electric cables and fibers



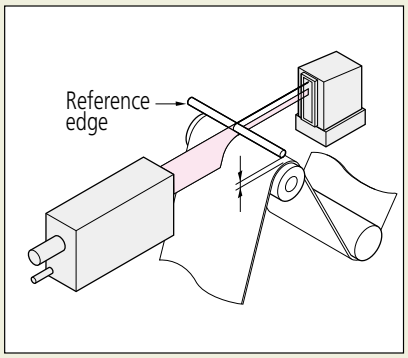
Measurement of thickness of film and sheet



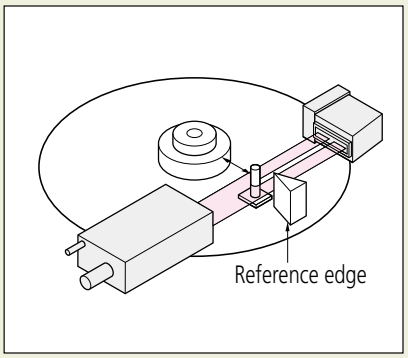
Measurement of spacing of IC chip leads



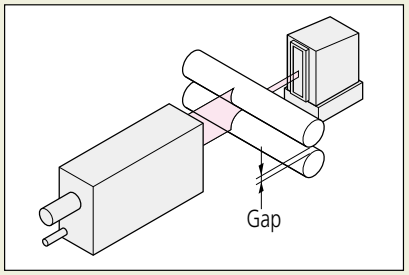
Measurement of film sheet thickness



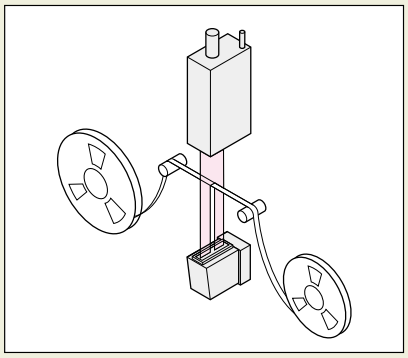
Measurement of laser disk and magnetic disk head movement



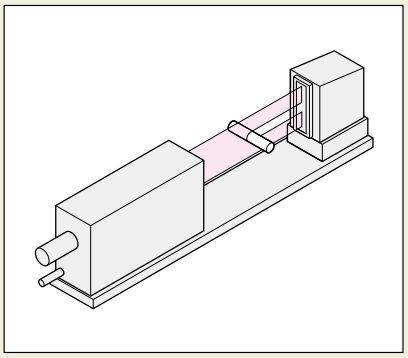
Measurement of gap between rollers



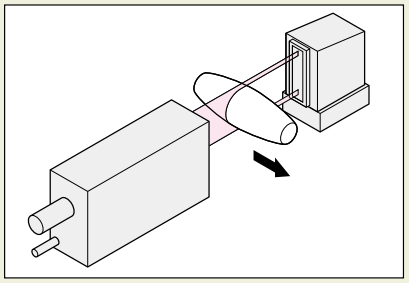
Measurement of tape width



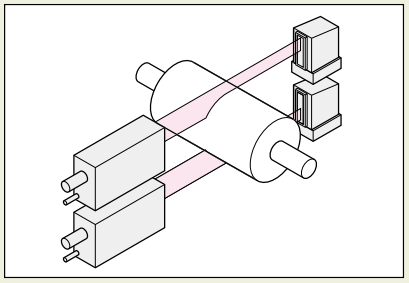
Measurement of outer diameter of optical connector and ferrule



Measurement of form



Dual system for measuring a large outside diameter



Mitutoyo

Laser Scan Micrometer LSM-6902H

SERIES 544 — Ultra-high Accuracy Non-contact Measuring System

- Non-contact laser-based measuring system, mainly for outside diameter measurement. Suitable for delicate or moving workpieces.
- Accuracy of ±0.5µm in the ø0.1 - ø25mm range can be achieved. It is suitable for pin gage measurement.
- Narrow range accuracy of ±(0.3+0.1ΔD)µm for high-precision measurement.
- Ultra-high repeatability of ±0.05µm.
- The system consists of a measuring unit and a display unit.

SPECIFICATIONS

Set Order No.		544-499A
Measuring unit		
Type		inch/mm
Measuring range		0.1 to 25mm (.004 - 1.0")
Resolution		0.01 to 10µm (selectable) (.000001 - .0005")
Repeatability*1	Whole range	±0.045µm (±0.0000018 in) (ø25mm)
	Narrow range	±0.03µm (±0.0000012 in) (ø10mm)
Accuracy*2 (20°C)	Whole range	±0.5µm (±.000020")
	Small range	±(0.3+0.1ΔD) [D:mm]*5 ±(.000012+.001ΔD) [D:inch]
Positional error*3		±0.5µm (±.000020")
Measuring area*4		±1.5×25mm (±0.6x1.0")
Scanning rate		800 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		56m/s (2240"/sec)
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)

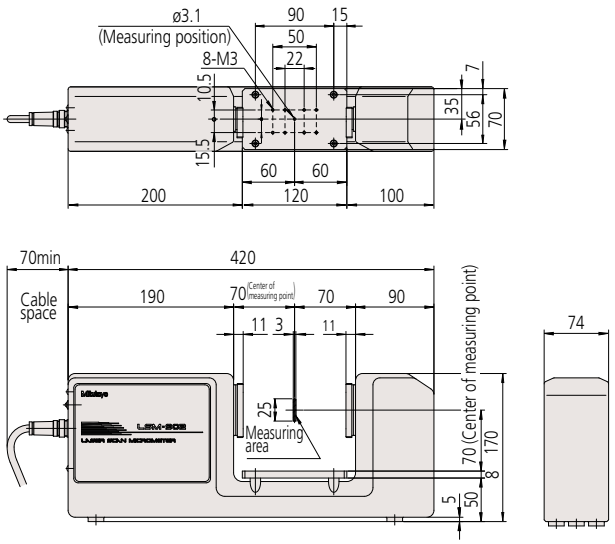
*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø25mm at the interval of 1.28 sec. (average 1024 times).
*2: At the center of the measuring range.
*3: An error due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*4: The area given by [optical axis direction]×[scanning direction]
*5: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm)

Display unit

Display	16-digit plus 11-digit fluorescent display, and guide message LED
Segment	1 to 7 (1 to 3, transparent) or 1 to 255 edges
Averaging times	Arithmetic average: per 1 to 2048/ Moving average: per 32 to 2048
Judgment	Selection from target value + tolerance, lower tolerance + upper tolerance, or 7 classes multi-limit tolerance zone.
Measurement mode	Standby, Single measurement, Continuous measurement
Statistical analysis	Maximum, Minimum, Average, Dispersion, σ(S.D)
External dimensions	335 (W)×134 (H)×250 (D)mm
Power supply	120 V AC ±10%, 50W, 60Hz
Standard I/F	RS-232C, Analog I/O
Optional I/F	Digimatic code output unit (2-ch), 2nd I/O analog I/F, BCD I/F
Operating environment	0 to 40°C, RH 35 to 85% (no condensation)
Others	Nominal setting, sample setting, selection of unnecessary digits, transparent object measurement, automatic measurement in edge mode, output timer, abnormal data elimination, SHL change, group judgment, simultaneous measurement, statistical processing, mastering, buzzer function, automatic workpiece detection (dimension/position), zero-set/offset * Measuring unit dual connection, extra-fine line measurement, and some of the communication commands are not available.

Measuring Unit External Dimensions

Unit: mm



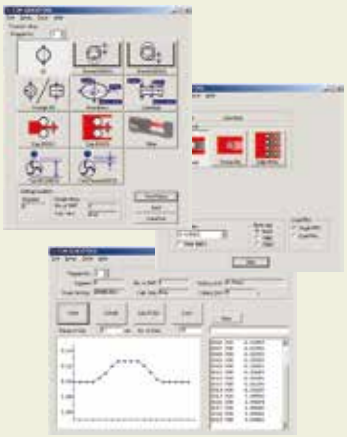
Optional Accessories

(Refer to page G-46 for details.)

- Calibration gage set (ø1.0, ø25.0) : **No.02AGD180**
- Workstage : **No.02AGD270**
- Adjustable workstage : **No.02AGD280**
- Digimatic code output unit (2-ch) : **No.02AGC840**
- 2nd I/O analog interface unit : **No.02AGC880**
- BCD interface unit : **No.02AGC910**
- Printer & cable set (120V AC C-type plug) : **No.02AGD600B**
- Printing paper TP411-28CL / 1Pack = 10pcs : **No.223663**
- Foot switch : **No.937179T**

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Laser Scan Micrometer LSM-500S

SERIES 544 — High Accuracy Non-contact Measuring System

- Capable of measuring down to 5µm outside diameter*1.
- Provides ultra-high accuracy of ±0.3µm over the entire measuring range (5µm to 2mm).
- Ultra-high speed measurement of 3200 scan/sec.
  Suitable for high-speed lines or in applications subject to vibration.

IP64

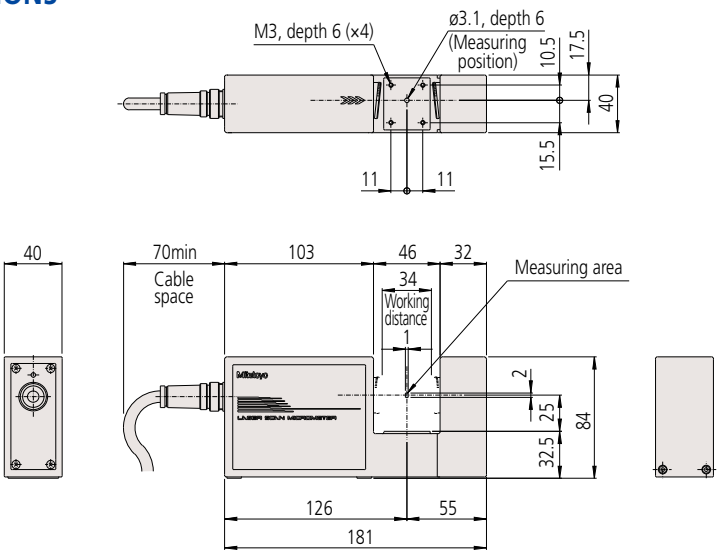
SPECIFICATIONS

Order No. (Laser only)		**544-532**
Package No. (with LSM 6200 Display)		**64PKA117**
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.0002" to .080" (0.005 to 2mm)*1
Resolution		.000001" to .0005" (0.01 to 10µm) (selectable)
Repeatability*2		±0.03µm
Accuracy (20°C)*3		±0.3µm
Positional error*4		±0.4µm
Measuring area*5		1×2mm (0.005 to 2mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		76m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection Level		IP64*6

*1: The measuring range for the transparent object will be 0.05mm to 2mm. Please consult your local Mitutoyo office for objects smaller than 0.05mm.
The measuring range will be 0.1mm to 2mm in the 1 to 255 edge measurement mode or when activating the automatic workpiece detection.
If using the optional dual-connection unit for LSM-6200, the measuring range will be 0.05mm to 2mm.
*2: Determined by the value of ±2σ (σ: standard deviation) when measuring ø2mm at the interval of 0.32 sec. (average 1024 times).
*3: Center of the measuring range for cylindrical workpieces outside diameter.
*4: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.
Note: When using extra-fine line measurement function (FINE), guide messages for setting the following will not be displayed: dual-measurement, segment designation, automatic workpiece detection and group judgment.

DIMENSIONS

Unit: mm



Optional Accessories

• Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

• Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

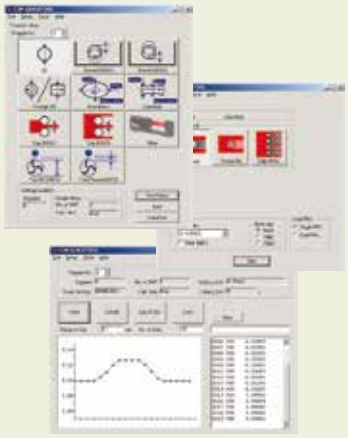
* AC adapter not included

• Calibration gage set (ø0.1, ø2.0)
• Guide pulley : **No.02AGD110**
• Air blower/purge : **No.02AGD200**
• Extension signal cables: : **No.02AGD220**

Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Mitutoyo

Laser Scan Micrometer LSM-501S

SERIES 544 — High-accuracy Non-contact Measuring System

- Provides ultra-high accuracy of ±0.5µm over the entire measuring range (0.05 to 10mm).
- Narrow range accuracy of ±(0.3+0.1ΔD)µm for high-precision measurement.
- Ultra-high speed measurement of 3200 scan/sec.
  Suitable for high-speed lines or in applications subject to vibration.

IP64

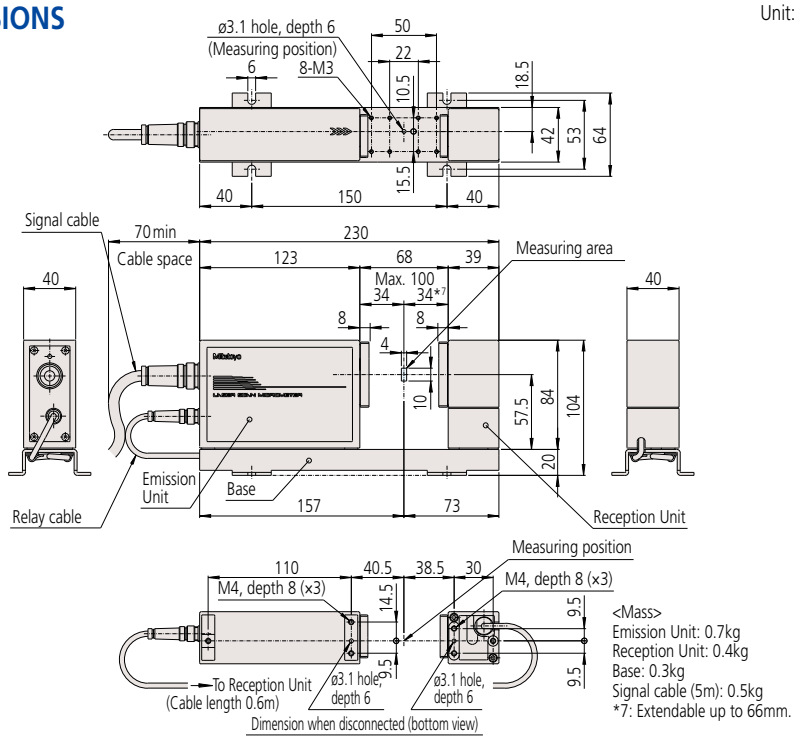
SPECIFICATIONS

Order No. (Laser only)		544-534
Package No. (Laser w/LSM 6200 display)		64PKA118
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.002" to .4" (0.05 to 10mm)
Resolution		.000001" to .0005" (0.01 to 10µm) (selectable)
Repeatability*1		±0.04µm
Accuracy*2 (20°C)	Whole range	±0.5µm
	Small range	±(0.3+0.1ΔD)µm*3
Positional error*4		±0.5µm
Measuring area*5		2×10mm (ø0.05 to ø0.1mm) 4×10mm (ø0.1 to ø10mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		113m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection Level		IP64*6

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø10mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm)
*4: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: The protection level provided for the interior. If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.

DIMENSIONS

Unit: mm



<Mass>
Emission Unit: 0.7kg
Reception Unit: 0.4kg
Base: 0.3kg
Signal cable (5m): 0.5kg
*7: Extendable up to 66mm.

Optional Accessories

- Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

- Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

* AC adapter not included

- Calibration gage set (ø0.1, ø10.0) : **No.02AGD120**
- Wire guiding pulley : **No.02AGD210**
- Adjustable workstage : **No.02AGD400**
- Air blower/purge : **No.02AGD230**
- Workstage : **No.02AGD270**
- Extension signal cables

Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m

- Extension relay cables

Order No.	Cable length
02AGC150A	1m

QUICKTOOL

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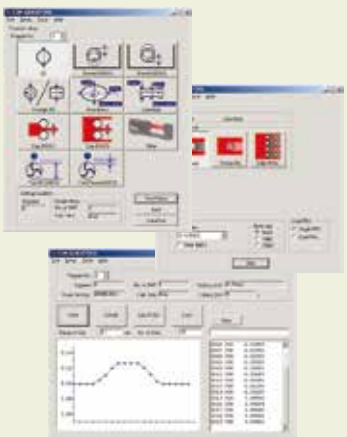
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Laser Scan Micrometer LSM-503S

SERIES 544 — High-accuracy Non-contact Measuring System

- Ensures ±1.0μm accuracy over the entire measuring range (0.3 to 30mm).
- Narrow range accuracy of ±(0.6+0.1ΔD)μm for high-precision measurement.
- Ultra-high speed measurement of 3200 scan/sec.
  Suitable for high-speed lines or in applications subject to vibration.

IP64

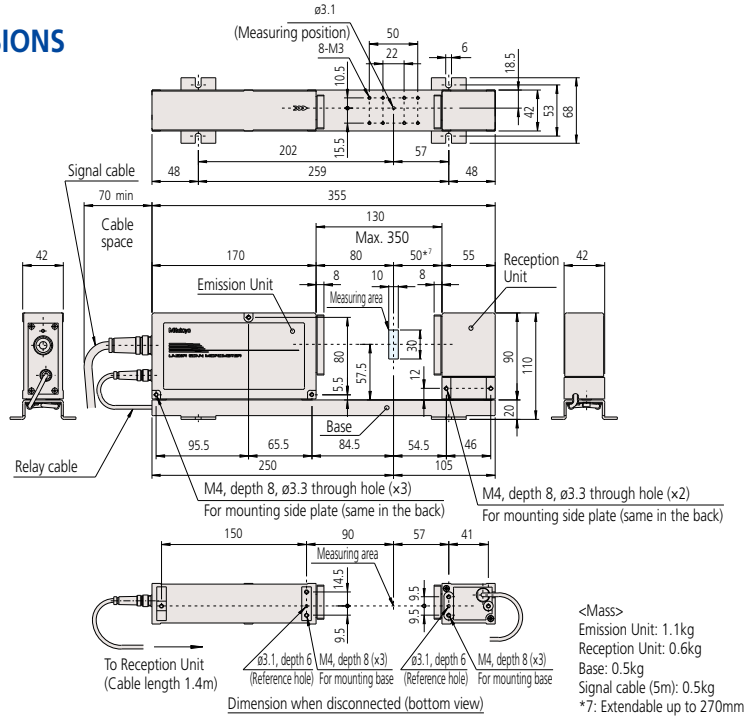
SPECIFICATIONS

Order No. (Laser only)		544-536
Package No. (Laser w/LSM 6200 display)		64PKA119
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.012" to 1.18" (0.3 to 30mm)
Resolution		.000001" to .005" (0.02 to 100μm) (selectable)
Repeatability*1		±0.11μm
Accuracy*2 (20°C)	Whole range	±1.0μm
	Small range	±(0.6+0.1ΔD)μm*3
Positional error*4		±1.5μm
Measuring area*5		10×30mm (0.3 to 30mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		226m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection Level		IP64*6

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø30mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm).
*4: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: The protection level provided for the interior. If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.

DIMENSIONS

Unit: mm



<Mass>
Emission Unit: 1.1kg
Reception Unit: 0.6kg
Base: 0.5kg
Signal cable (5m): 0.5kg
*7: Extendable up to 270mm

Optional Accessories

• Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

• Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

* AC adapter not included

• Calibration gage set (ø0.1, ø30.0) : **No.02AGD130**
• Adjustable workstage : **No.02AGD490**
• Air blower/purge : **No.02AGD240**
• Workstage : **No.02AGD270**
• Extension signal cables

Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m
02AGN780D	20m

• Extension relay cables

Order No.	Cable length
02AGC150A	1m
02AGC150B	3m
02AGC150C	5m

QUICKTOOL

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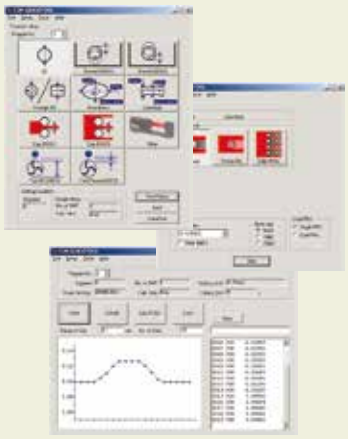
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Mitutoyo

Laser Scan Micrometer LSM-506S

SERIES 544 — High-accuracy Non-contact Measuring System

- Ensures ±3µm accuracy over the entire measuring range (1 to 60mm).
- Narrow range accuracy of ±(1.5+0.5ΔD)µm for high precision measurement.
- Ultra-high speed measurement of 3200 scan/sec. Suitable for high-speed lines or in applications subject to vibration.

IP64

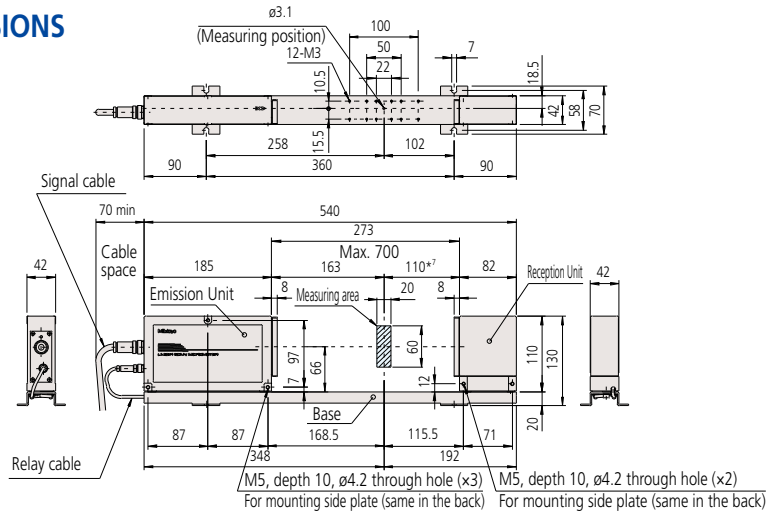
SPECIFICATIONS

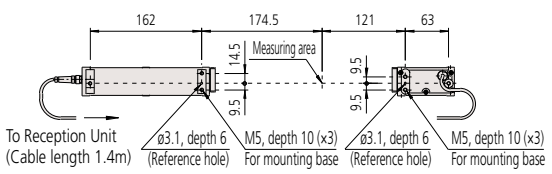
Order No. (Laser only)		544-538
Package No. (Laser w/ LSM 6200 display)		64PKA120
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.040" to 2.36" (1 to 60mm)
Resolution		.000002" to .005" (0.05 to 100µm) (selectable)
Repeatability*1		±0.36µm
Accuracy*2 (20°C)	Whole range	±3µm
	Small range	±(1.5+0.5ΔD)µm*3
Positional error*4		±4µm
Measuring area*5		20×60mm (1 to 60mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		452m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection Level		IP64*6

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø60mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm)
*4: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: The protection level provided for the interior. If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.

DIMENSIONS

Unit: mm





Dimension when disconnected (bottom view)

<Mass>
Emission Unit: 1.4kg
Reception Unit: 0.8kg
Base: 0.8kg
Signal cable (5m): 0.5kg
*7: Extendable up to 537mm

Optional Accessories

- Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

- Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

* AC adapter not included

- Calibration gage set (ø1.0, ø60.0) : **No.02AGD140**
- Adjustable workstage : **No.02AGD520**
- Air blower/purge : **No.02AGD250**
- Extension signal cables

Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m
02AGN780D	20m

- Extension relay cables

Order No.	Cable length
02AGC150A	1m
02AGC150B	3m
02AGC150C	5m

QUICKTOOL

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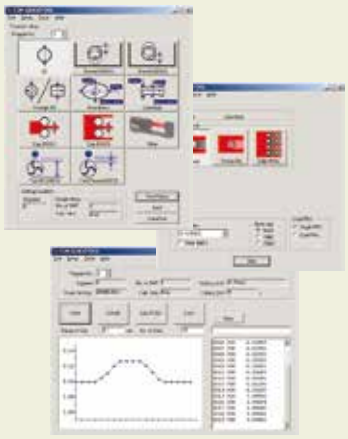
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Laser Scan Micrometer LSM-512S

SERIES 544 — High-accuracy Non-contact Measuring System

- Ensures ±6μm accuracy over the entire measuring range (1 to 120mm).
- Narrow range accuracy of ±(4.0+0.5ΔD)μm for high-precision measurement.
- Ultra-high speed measurement of 3200 scan/sec. Suitable for high speed-lines or in applications subject to vibration.

IP64

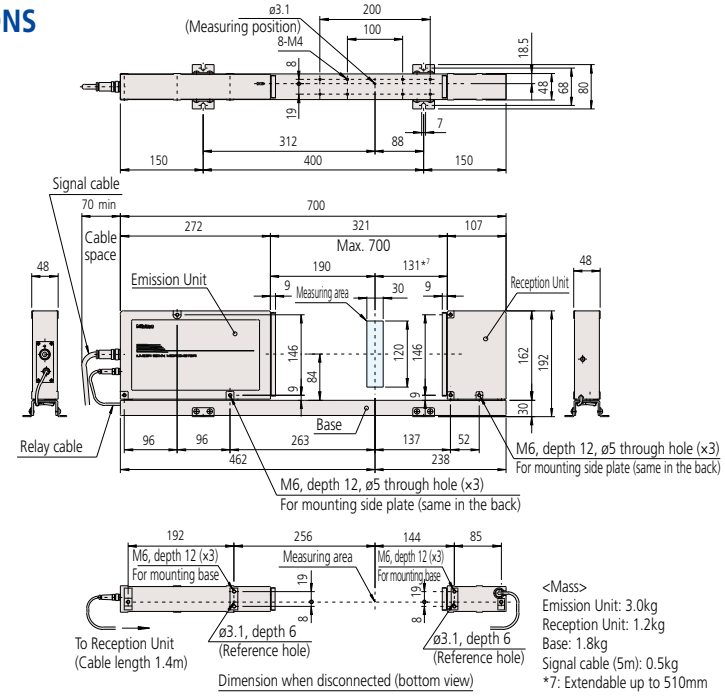
SPECIFICATIONS

Order No. (Laser only)		544-540
Package No. (Laser w/ LSM 6200 display)		64PKA121
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.040" to 4.72" (1 to 120mm)
Resolution		.000005" to .005" (0.1 to 100μm) (selectable)
Repeatability*1		±0.85μm
Accuracy*2 (20°C)	Whole range	±6μm
	Small range	±(4.0+0.5ΔD)μm*3
Positional error*4		±8μm
Measuring area*5		30×120mm (1 to 120mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		904m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection level		IP64*6

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø120mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm)
*4: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: The protection level provided for the interior. If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.

DIMENSIONS

Unit: mm



<Mass>
Emission Unit: 3.0kg
Reception Unit: 1.2kg
Base: 1.8kg
Signal cable (5m): 0.5kg
*7: Extendable up to 510mm

Optional Accessories

• Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

• Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

* AC adapter not included

• Calibration gage set (ø20.0, ø120.0) : **No.02AGD150**
• Air blower/purge : **No.02AGD260**
• Extension signal cables

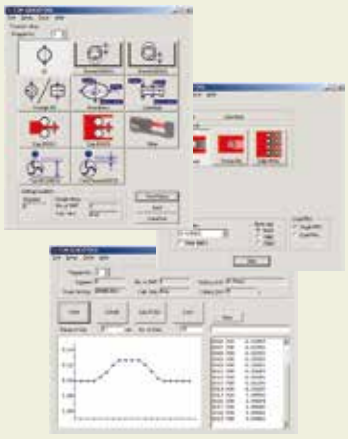
Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m
02AGN780D	20m

• Extension relay cables

Order No.	Cable length
02AGC150A	1m
02AGC150B	3m
02AGC150C	5m

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Mitutoyo

Laser Scan Micrometer LSM-516S

SERIES 544 — High-accuracy Non-contact Measuring System

- Ensures ±7µm accuracy over the entire measuring range (1 to 160mm).
- Narrow range accuracy of ±(4.0+2.0ΔD)µm for high-precision measurement.
- Ultra-high speed measurement of 3200 scan/sec.
  Suitable for high-speed lines or in applications subject to vibration.

IP64

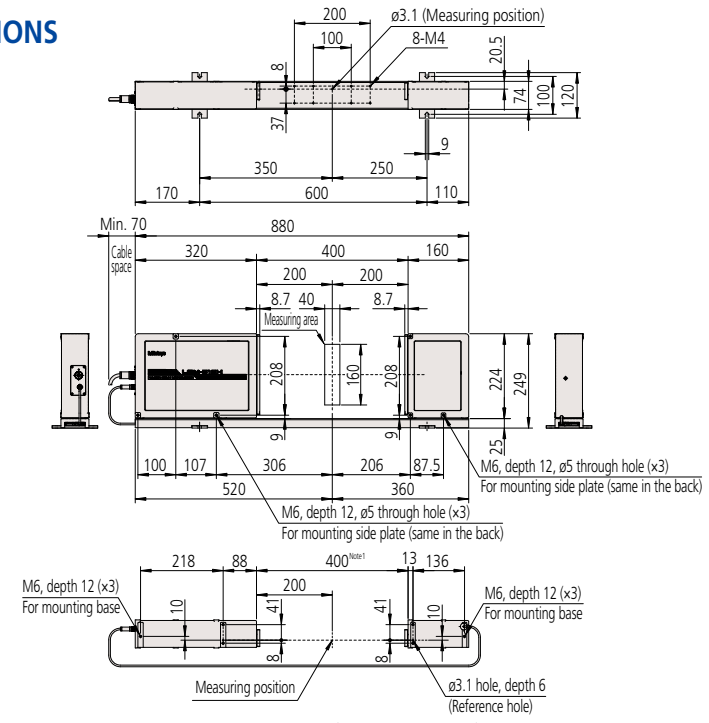
SPECIFICATIONS

Order No. (Laser only)		**544-542**
Package No. (Laser w/ LSM 6200 display)		**64PKA122**
Applicable laser standards		IEC, FDA
User's manual		English version
Measuring range		.040" to 6.3" (1 to 160mm)
Resolution		.000005" to .005" (0.1 to 100µm) (selectable)
Repeatability*1		±1.4µm
Accuracy*2 (20°C)	Whole range	±7µm
	Small range	±(4.0+2.0ΔD)µm*3
Positional error*4		±8µm
Measuring area*5		40×160mm (1 to 160mm)
Scanning rate		3200 scans/s
Laser wavelength		650nm (Visible)
Laser scanning speed		1206m/s
Operating environment	Temperature	0 to 40°C
	Humidity	RH 35 to 85% (no condensation)
Protection level		IP64*6

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø160mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: ΔD=Difference in diameter between the master gage and workpiece (Unit: mm)
*4: An error of the outside diameter due to variation in cylinder position either in the optical axis direction or in the scanning direction.
*5: The area given by [optical axis direction]×[scanning direction].
*6: The protection level provided for the interior. If the workpiece or glass of the measuring unit window is soiled by water or dust, the unit may malfunction.

DIMENSIONS

Unit: mm



Note1: Distance between emission unit and reception unit: 400mm to 800mm

Optional Accessories

- Multifunctional display unit, **LSM-6200***:

Order No.	Display type	Remarks
544-072A	English mm/inch	English user's manual

* Included in packages

- Easy-to-operate display unit, **LSM-5200**:

Order No.	Remarks
544-047*	English user's manual

* AC adapter not included

- Calibration gage set (ø20, ø160) : **No.02AGM300**
- Extension signal cables

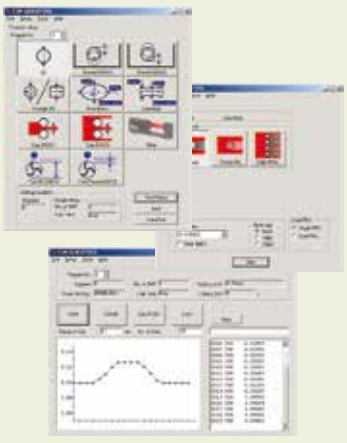
Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m
02AGN780D	20m

- Extension relay cables

Order No.	Cable length
02AGC150A	1m
02AGC150B	3m
02AGC150C	5m

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

Laser Scan Micrometer LSM-9506

SERIES 544 — Bench-top Type Non-contact Measuring System

- Bench-top type with integrated display unit includes many functions equivalent to the multi-function display unit.

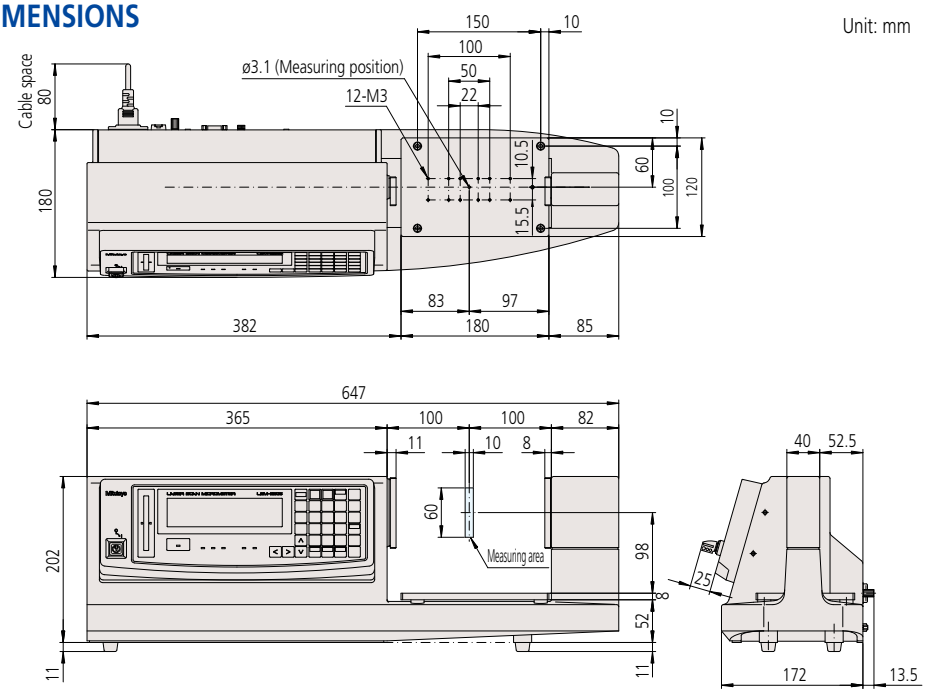
SPECIFICATIONS

Order No.	**544-116-1A**
Type	inch/mm
Measuring range	.02" - 2.36"/ 0.5 - 60mm
Resolution	.000002" - .005"/ 0.00005 - 0.1mm
Repeatability*1	±0.6µm (±.00003")
Accuracy*2 (20°C)	±2.5µm (±.0001")
Positional error*3 (optical axis/scanning direction)	±2.5µm (±.0001") L: Displacement between workpiece center and optical axis center
Measuring area*4	±5x60mm (±.2x2.36")
Scanning rate	1600 scans/s
Laser wavelength	650nm (Visible)*5
Laser scanning speed	226m/s (8900" / s)
Display unit	16-digit dot matrix (upper column) + 7 segment 11-digit (lower column),guidance LEDs
Standard interface	RS-232C, Digimatic code output unit (1ch)
Optional interface	No
Power supply	120 V AC ±10%, 40VA, 60Hz
Operating environment	0 to 40°C, RH 35 to 85% (no condensation)

*1: Determined by the value of ±2σ (σ: standard deviation) when measuring ø10mm at the interval of 0.32 sec. (average 1024 times).
*2: Center of the measuring range for cylindrical workpieces outside diameter.
*3: An error of the outside diameter due to variation in workpiece position either in the optical axis direction or in the scanning direction.
*4: The area given by [optical axis direction]×[scanning direction].
*5: FDA Class II (544-116-1A)/IEC Class 2 semiconductor laser for scanning. (Maximum power: 1.0mW)

DIMENSIONS

Unit: mm



Optional Accessories

02AGD170
Calibration gage set (ø1.0mm, ø60mm)

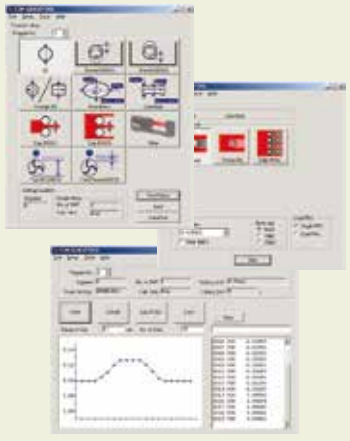
02AGD680 Adjustable workstage
02AGD580 Center support*
02AGD590 Adjustable V-block*
936937 SPC output cable (1m)
937179T Footswitch
264-016 USB input tool for spreadsheets (SPC cable also required)

*Use with an adjustable workstage.

*1: Determined by the value for ±2σ at the measurement interval of 0.32 sec.
*2: At the center of the measuring region.
*3: An error due to workpiece shift either in the optical axis direction or in the scanning direction. L= Distance between the center of workpiece and the center of optical axis (in mm or inches).
*4: The area given by measuring range on the optical axis x measuring range in the scanning direction.
*5: FDA Class II (**544-116-1A**) semiconductor laser for scanning (Maximum power: 1.0mW)

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



Laser safety

Mitutoyo Laser Scan Micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the Laser Scan Micrometers as is appropriate.

LSM-6200 Display Unit

SERIES 544 — Standard Display Unit for Laser Scan Micrometer

- 2-axis display unit enables 2 items to be displayed simultaneously.
- Capable of statistical analysis such as: average, maximum value, minimum value, range (max. - min.) and more.
- Segment measurement (7 points) or edge measurement (1 to 255 edge) can be selected.
- A function to eliminate abnormal values is standard.
- 100 tolerance values, preset values or settings can be stored.

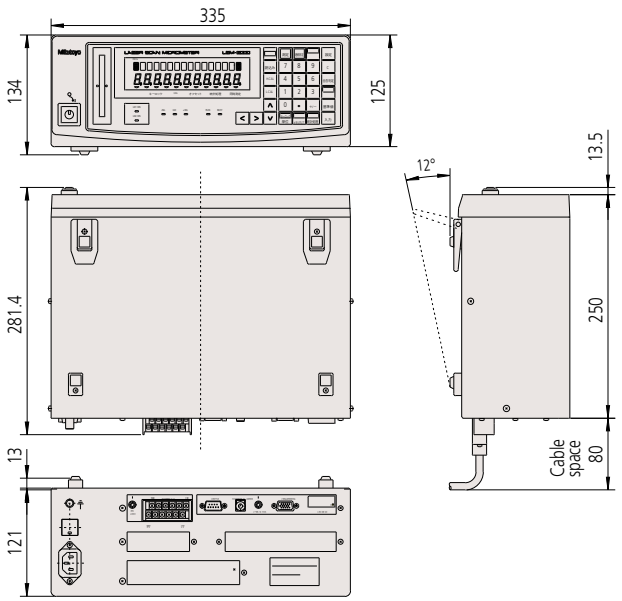
SPECIFICATIONS

Order No.	**544-072A**
Type	inch/mm
Display	16-digit plus 11-digit fluorescent display and guide message LED
Segment	1 to 7 (1 to 3, transparent) or 1 to 255 edges*1
Averaging method	Arithmetic average: per 8 to 2048/ Moving average: per 32 to 2048 (Arithmetic average is per 16 to 2048 when using **544-531**, **544-532**)
Judgment	Selection from target value + tolerance, lower tolerance + upper tolerance, or 7 classes multi-limit tolerance zone.
Measurement mode	Standby, Single measurement, Continuous measurement
Statistical analysis	Maximum, Minimum, Average, Dispersion, σ (S.D)
Size	335 (W)×134 (H)×250 (D)mm
Power supply	120 V AC ±10%, 40VA, 60Hz
Standard I/F	RS-232C, Analog I/O
Optional I/F	Digimatic code output unit (2-ch), 2nd I/O analog I/F, BCD I/F
Operating environment	0 to +45°C, RH 35 to 85% (no condensation)
Others	Nominal setting, sample setting, selection of unnecessary digits, transparent object measurement*2, measurement of odd fluted parts, automatic measurement in edge mode, output timer, abnormal data elimination, SHL change, group judgment, simultaneous measurement, statistical processing, mastering, buzzer function, automatic workpiece detection (dimension/position)*1, zero-set/offset, dual measurement (optional)

*1: The measuring range will be 0.1mm to 2mm in the 1 to 255 edge measurement mode or when activating the automatic workpiece detection with **544-531**, **544-532**.
Each function has its combination limit.
*2: The measuring range is 50µm to 2mm when using **544-531**, **544-532**. For smaller range, contact your local Mitutoyo sales office.
** Cannot be connected to **544-499A** .
** Previous models such as **544-451** cannot be connected.

DIMENSIONS

Unit: mm

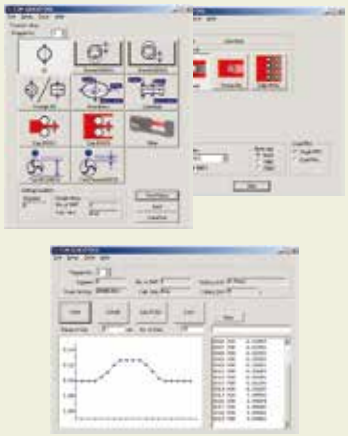


Optional Accessories

12AAA807 Serial cable (RS-232C null)
937179T Footswitch
02AGN780A, B, C, D Extension Signal Cables
02AGC840 Digimatic output card
02AGP150 Dual Input Card
02AGC910 BCD output
02AGC880 2nd analog output card
02AGD600B Printer

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



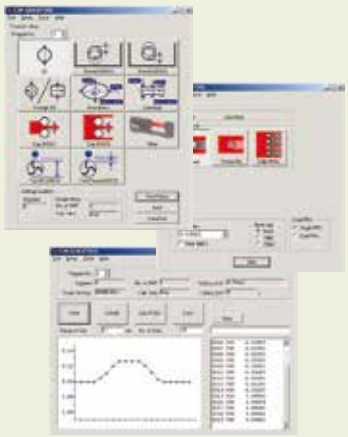
LSM-5200 Display Unit

SERIES 544 — Compact Display Unit for Real-time Multi-channel Measurement

- A compact controller which could be used for multi-unit system configurations.
- Capable of simple connection to a PC via USB.
- A panel-mount type display unit designed for the LSM-S series.
- Analog I/O and RS-232C is standard.
- Measurement of odd fluted parts, and simultaneous measurement / 2-program function included.

QUICKTOOL

QUICKTOOL is a free downloadable software program that makes programming the LSM-6200 quick and easy.
Basic data acquisition is also possible.
(Connecting cables to PC are optional)



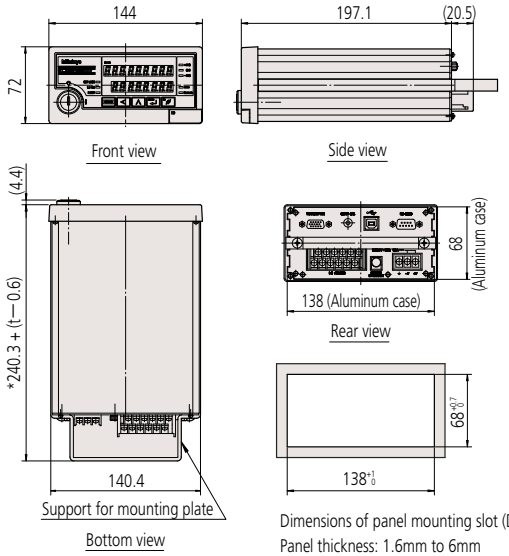
SPECIFICATIONS

Order No.	**544-047**
Display	9 digits plus 8 digits LED, guide message LED
Segment	1 to 7 (1 to 3, transparent) or 1 to 255 edges*1
Averaging method	Arithmetic average: from 4 to 2048; Moving average: from 32 to 2048 (Arithmetic average is from 16 to 2048 when using LSM-500S.)
Judgment	Selecting from target value ± tolerance value or lower limit/upper limit.
Measurement mode	Standby, Single measurement, Continuous measurement
Statistical analysis	Calculation result is output via USB or RS-232C.
External dimensions	144 (W)×72 (H)×197.1 (D)mm
Power supply*3	24V DC±10%, 1.3A or more (AC adapters are optional)
Standard I/F	USB2.0, RS-232C, I/O analog
Operating environment	0 to 40°C, RH 35 to 85% (no condensation)
Preservation environments	–20 to 70°C, RH 35 to 85% (no condensation)
Others	Measurement of odd fluted parts, simultaneous measurement, nominal setting, sample setting, selection of unnecessary digits, transparent object measurement*2 Automatic workpiece detection (dimension/position detected)*1, abnormal data elimination, mastering, statistical processing (when using USB, RS-232C), output timer, automatic measurement in edge mode, presetting note that every function is limited in its combination possibilities. See the user manual for details.
Mass	1.4 kg

*1: The measuring range will be 0.1mm to 2mm in the 1 to 255 edge measurement mode or when activating the automatic workpiece detection with **544-531**, **544-532**.
Each function has its combination limit.
*2: The measuring range is 50µm to 2mm when using **544-531**, **544-532**. For smaller ranges, contact your local Mitutoyo sales office.
*3: DC24V external power supply (commercial item) is required separately.
Note 1: Cannot be connected to **544-499A** .
Note 2: Previous models such as **544-451** cannot be connected.
Note 3: For USB communication with a PC, a dedicated device driver is required. For details, contact your local Mitutoyo sales office.

DIMENSIONS

Unit: mm



Panel thickness: 1.6mm to 6mm

Dimensions of panel mounting slot (DIN 43 700-144x76)
Panel thickness: 1.6mm to 6mm
Mass: 1.4kg

Mitutoyo

Laser Scan Micrometer

SERIES 544 Optional Accessories

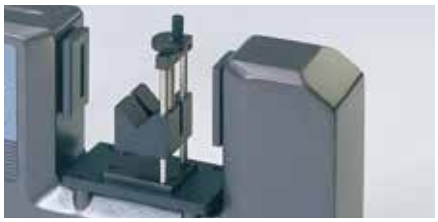
Calibration Gage Set

- Standard cylinder gage set suitable for calibration of Laser Scan Micrometers.
- Nominal gage diameters (1 to 160mm) are as given in specifications.

SPECIFICATIONS

For calibrating models		544-499A	544-532	544-534	544-536	544-538	544-540	544-542	544-116-1A
		LSM-6902H	LSM-500S	LSM-501S	LSM-503S	LSM-506S	LSM-512S	LSM-516S	LSM-9506
Set No.		02AGD180	02AGD110	02AGD120	02AGD130	02AGD140	02AGD150	02AGM300	02AGD170
Configuration (Order No.)	Stand	02AGD181	02AGD111	02AGD121	02AGD131	02AGD141	02AGD151	02AGM320	02AGD171
	Gages	ø1: 02AGD920 ø25: 02AGD963	ø0.1: 958200 ø2 : 958202	ø0.1: 958200 ø10: 229317	ø1: 02AGD920 ø30: 02AGD961	ø1: 02AGD920 ø60: 02AGD962	ø20: 229730 ø120: 234072	ø20: 229730 ø160: 02AGM303	ø1: 02AGD920 ø60: 02AGD962
	Carrying case	02AGD190	958203	958203	02AGD980	02AGD980	02AGD990	02AGM310	02AGD970

Workstage



Installation example

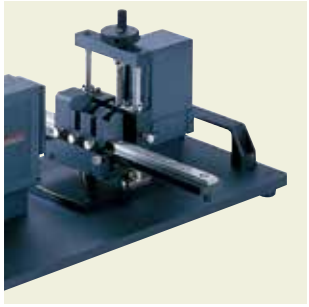
- Easy set-up and height adjustment enables high-precision measurement.

SPECIFICATIONS

Model	544-534 544-536 544-499A
Order No.	02AGD270

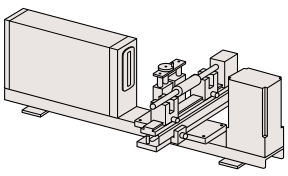
Adjustable workstage

- Vertical/horizontal slide mechanism enables easy measurement of various workpiece diameters.
- Best suited for quality assurance of high-precision pin gages.

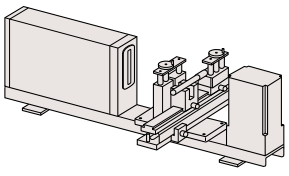


Measurement Examples

- Roller of copying machine



- Pin gage or plug gage



Basic configuration

Basic set	Order No.	Applicable model	Standard accessories	Measuring range (mm)	Horizontal stroke (mm)	Vertical stroke (mm)
(1) Main unit (2) V-block (3) Stop	02AGD280	544-499A	V-block (02AGD420), 2 pcs Stopper (02AGD430), 1 pc	0.1 - 25	130	47
	02AGD400	544-534		0.05 - 10	130	32
	02AGD490	544-536		0.3 - 30	200	35
	02AGD520	544-538	V-block A (02AGD550), 2 pcs V-block B (02AGD550), 1 pc V-block C (02AGD570), 1 pc	1 - 60	300	45
	02AGD370	544-116-1A		0.5 - 60	200	45
	02AGD680			0.5 - 60	300	45

* The stop is not included in the basic set for **544-538**, **544-116**.

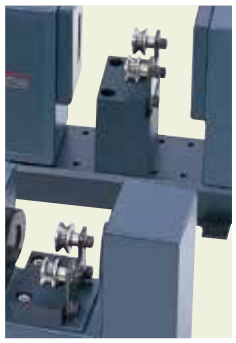
- Optional parts for the adjustable workstage, such as center support, adjustable V-block (up/down) etc., are available.

Laser Scan Micrometer

SERIES 544 Optional Accessories

Guide pulley

- Used for supporting measurement of outside diameter of fine wire-like materials such as magnetic wire or fiber.



SPECIFICATIONS

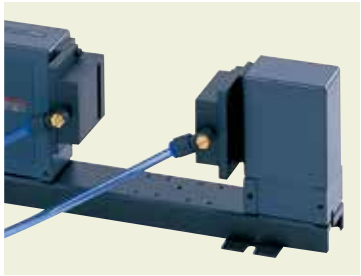
Model	544-532	544-534
Order No.	02AGD200	02AGD210

Each measurement range is as follows:
544-532: ø5µm to ø1.6mm
544-534: ø50µm to ø2mm

For calibration, the calibration gage set for **544-532** (**No.02AGD110**) is required.

Air shield driven by air supply unit

- Air blows from the air outlet installed on the laser section to clear dust from adhering to the laser window.



SPECIFICATIONS

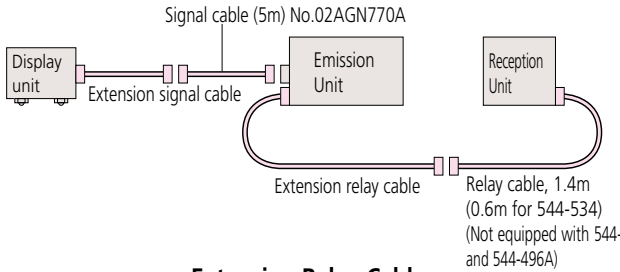
Air supply unit	Air shield	Applicable models
No.957608	**No.02AGD220**	**544-532**
	No.02AGD230	**544-534**
	No.02AGD240	**544-536**
	No.02AGD250	**544-538**
	No.02AGD260	**544-540**

Air shield	Quantity
No.02AGD220/No.02AGD230	6
No.02AGD240	3
No.02AGD250/No.02AGD260	1

*1: Air shield and air supply unit are sold separately. An air supply unit includes a flow regulating valve and filter. Note, however, that clean air should be supplied.
*2: Air shield is supplied with 5m air tube (Outside diameter: 6mm).
*3: Air supply unit is compatible with air tube of 9mm internal diameter.

Extension Signal Cable / Extension Relay Cable

- Extension signal cables are necessary when the measuring unit and display unit are separated in operation. Extension relay cables are necessary when the optical section is separated in operation.



SPECIFICATIONS

Extension Signal Cable

Order No.	Cable length
02AGN780A	5m
02AGN780B	10m
02AGN780C	15m
02AGN780D	20m

Extension Relay Cable

Order No.	Cable length
02AGC150A	1m
02AGC150B	3m
02AGC150C	5m

* For **544-532** and **544-534** the allowable maximum length for signal cable is 20m; relay cable is 2m.
* For **544-536**, **544-538**, **544-540** and **544-542** the allowable maximum length for signal cable is 30m; relay cable is 5m.
* The maximum extension length of the signal cable and relay cable is 32m in total.
* Cannot be used with **544-499A** .

Laser Scan Micrometer

SERIES 544 Optional Accessories

Thermal printer DPU-414

- Measurement data can be printed.

SPECIFICATIONS

Order No.	**02AGD600B**
Printing method	Thermal dot matrix
Printing capacity	40 Columns (Normal)
Character configuration	9×8 dot matrix
Printing direction	Bidirectional
Interface	RS-232C
Power supply	AC 100-240V 50/60Hz (AC adapter)
Standard accessories	Printer cable 2m (**02AGD620A**), Printer paper 1 roll, AC adapter
Printer paper (optional)	Order **No.223663** (10-roll set)

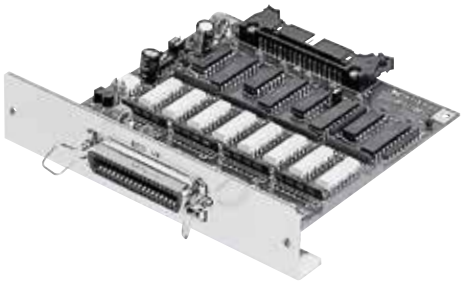
Foot switch

- **937179T**
- For LSM order **544-072A**, **544-499A** , **544-116-1A**

Interface for LSM6200, 6900

Optional Accessories

BCD Interface



- Outputs measurement data in BCD output (7-digit) or HEX output.
- Data logic can be switched.
- Isolated I/O circuitry
- Available for **544-072A**, **544-499A** .

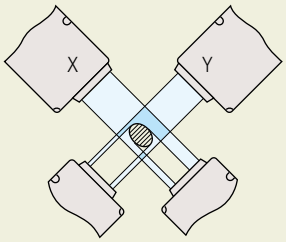
SPECIFICATIONS

Order No.	**02AGC910**
Standard accessories	Connector (DDK) **57-30360** (**No.214188**)

Laser Scan Micrometer

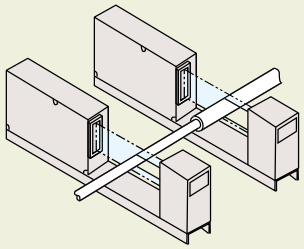
SERIES 544 Optional Accessories

XY Measurement

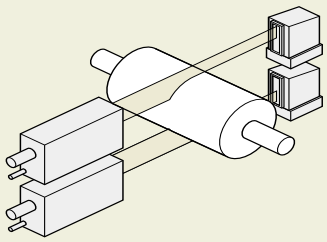


(X–Y): flatness
(X+Y)/2: average
* XY requires 10mm-interval.

Parallel Measurement



Large-diameter Measurement



Digimatic Code Output Unit

- 2-channel digimatic code output
- In simultaneous measurement, measurement data are output as follows:
  Program No.0 to No.4 in OUTPUT-1
  Program No.5 - No.9 in OUTPUT-2 (10 programs operated)
- 10 pin MIL type connector.
- Output cable is not supplied.
  Connecting cable (optional) 1m (**No.936937**)
- Available for **544-072A**, **544-499A** .

* Output is 6 digits of measurement data.
* Displaying 6th and 7th digit after the decimal point is not supported.

SPECIFICATIONS

Order No.	02AGC840

Dual Connection Unit

- Enables second unit connection to the **544-072A**. (both units must be the same model)

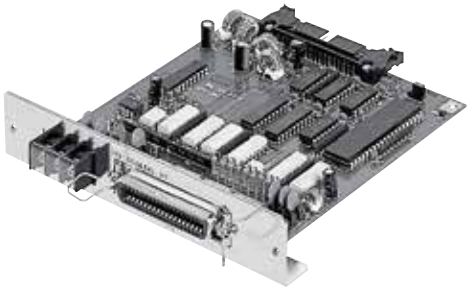
* Cannot be used for **544-499A** .

- Depending on the layout of the two measuring units, large-diameter measurement, XY measurement and parallel measurement are possible.
- Both of the measuring units and display units can be simultaneously operated.

SPECIFICATIONS

Order No.	02AGP150

2nd I/O Analog I/F



- I/O, analog output.
- Simultaneous measurement is supported by two pairs of go/no-go judgment outputs.
- Available for **544-072A**, **544-499A** .

SPECIFICATIONS

Order No.	02AGC880
Standard accessories	Connector (DDK) **57-30360** (**No.214188**)

Cable for BCD and 2nd I/O Simultaneous Mount

- Both BCD (**No.02AGC910**) and 2nd I/O analog I/F (**No.02AGC880**) can be mounted on **544-072A**, **544-499A** using this cable.

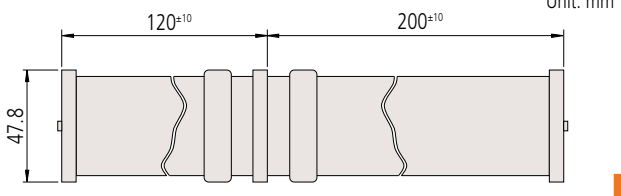
* If using this cable, the dual-connection unit (**No.02AGP150**) cannot be used.

SPECIFICATIONS

Order No.	02AGE060

DIMENSIONS

Unit: mm



Mitutoyo

Compatibility

Your laser scan micrometer has been adjusted together with the ID unit, which is supplied with the measuring unit. The ID unit, which has the same code number and the same serial number as the measuring unit, must be installed in the display unit. This means that if the ID unit is replaced, the measuring unit can be connected to another corresponding display unit.

The workpiece and measuring conditions

Depending on whether the laser is visible or invisible, the workpiece shape, and the surface roughness, measurement errors may result. If this is the case, perform calibration with a master workpiece which has dimensions, shape and surface roughness similar to the actual workpiece to be measured.
If measurement values show a large degree of dispersion due to the measuring conditions, increase the number of scans for averaging to improve the measurement accuracy.

Electrical interference

To avoid operational errors, do not route the signal cable and relay cable of the laser scan micrometer alongside a high voltage line or other cables capable of inducing noise current in nearby conductors. Ground all appropriate units and cable shields.

Connection to a computer

If the laser scan micrometer is to be connected to an external personal computer via the RS-232C interface, ensure that the cable connections conform to the specification.

Laser safety

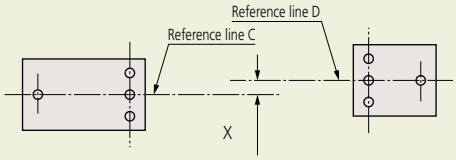
Mitutoyo laser scan micrometers use a low-power visible laser for measurement. The laser is a CLASS 2 EN/IEC60825-1 (2007) device. Warning and explanation labels, as shown below, are attached to the laser scan micrometers as appropriate.

Re-assembly after removal from the base

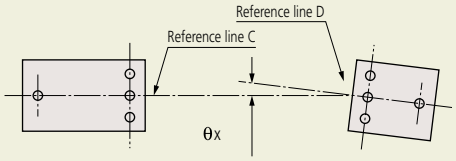
Observe the following limits when re-assembling the emission unit and reception unit to minimize measurement errors due to misalignment of the laser's optical axis with the reception unit.

Alignment within the horizontal plane

a. Parallel deviation between reference lines C and D:
X (in the transverse direction)

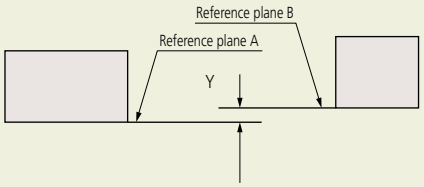


b. Angle between reference lines C and D: θx (angle)

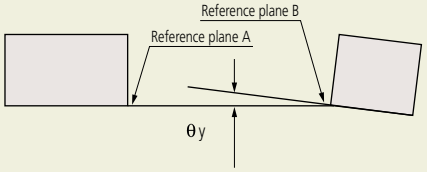


Alignment within the vertical plane

c. Parallel deviation between reference planes A and B: Y (in height)



d. Angle between reference planes A and B: θy (angle)



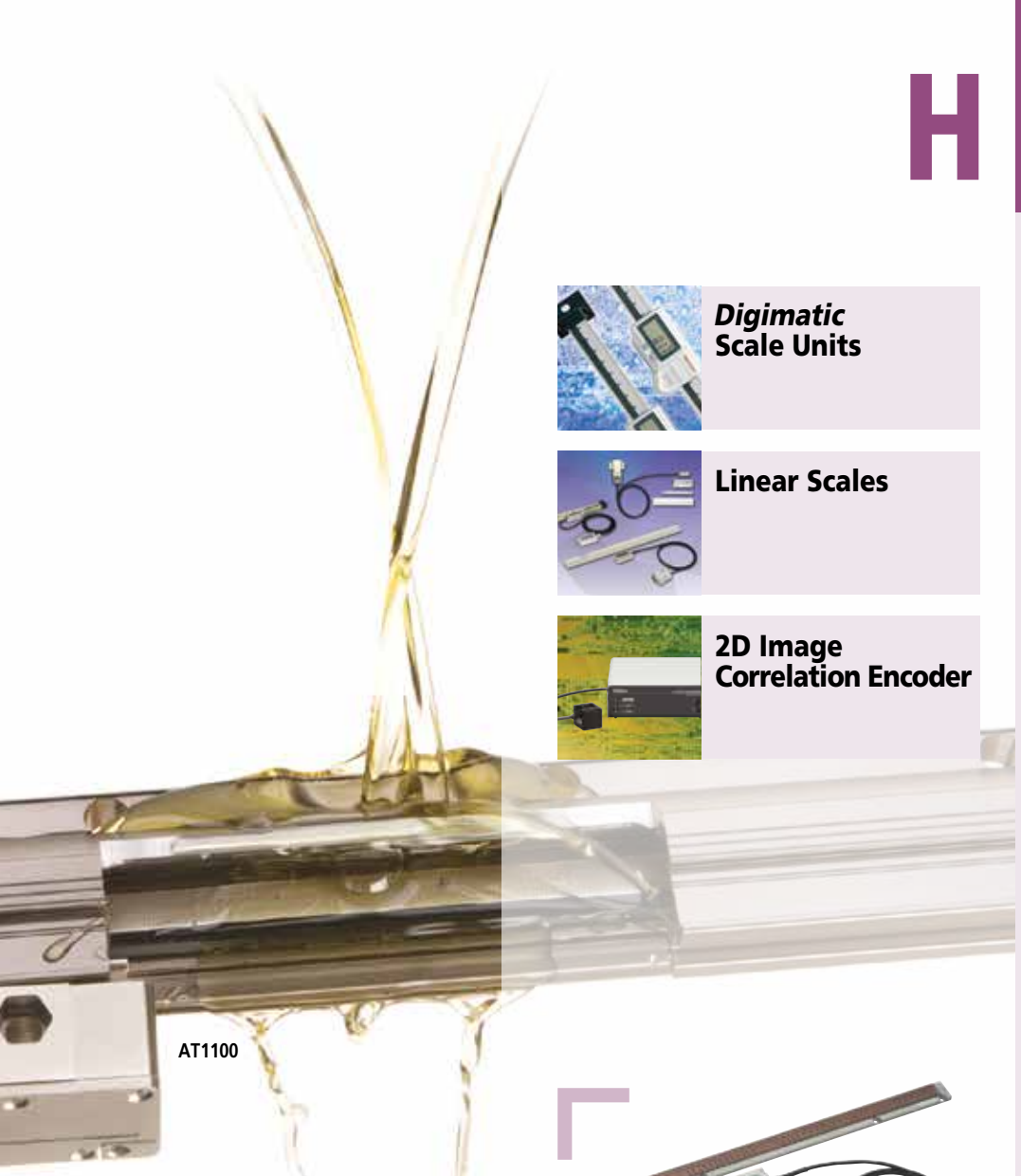
Allowable limits of optical axis misalignment

Model	Distance between Emission Unit and Reception Unit	X and Y	θx and θy
544-533, 544-534	68mm (2.68") or less	within 0.5mm (.02")	within 0.4° (7mrad)
	100mm (3.94") or less	within 0.5mm (.02")	within 0.3° (5.2mrad)
544-535, 544-536	130mm (5.12") or less	within 1mm (.04")	within 0.4° (7mrad)
	350mm (13.78") or less	within 1mm (.04")	within 0.16° (2.8mrad)
544-537, 544-538	273mm (10.75") or less	within 1mm (.04")	within 0.2° (3.5mrad)
	700mm (27.56") or less	within 1mm (.04")	within 0.08° (1.4mrad)
544-539, 544-540	321mm (12.64") or less	within 1mm (.04")	within 0.18° (3.6mrad)
	700mm (27.56") or less	within 1mm (.04")	within 0.08° (1.4mrad)
544-541, 544-542	800mm (31.50") or less	within 1mm (.04")	within 0.09° (1.6mrad)

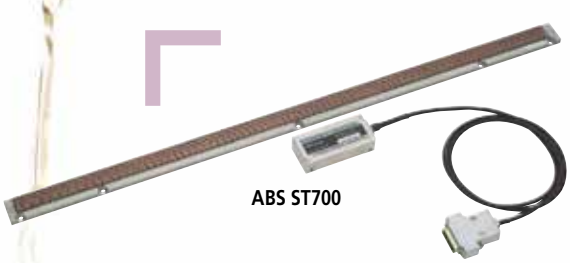
Digimatic Scale Units

Linear Scales

2D Image Correlation Encoder



AT1100



ABS ST700

MICSYS-SA1

ST-F11
Fiber Scale

INDEX

ABS AT500-S

ABS AT500-H

Mitutoyo

SD ABSOLUTE Digimatic Scale Units

SERIES 572

IP66 Horizontal single-function type (Water-proof type)
572-602 SD-20G

Horizontal single-function type
572-202-20 SD-20DX

Horizontal multi-function type
572-461 SD-15E

Vertical single-function type
572-303-10 SDV-30D

Vertical multi-function type
572-561 SDV-15E

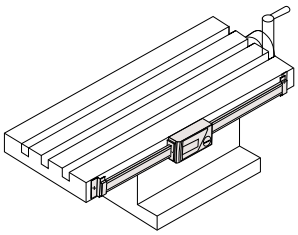
ABSOLUTE™

PROPRIETARY INSPECTION CERTIFICATE

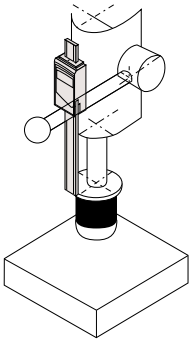
- **SD** series facilitates mounting on jigs, tools and small machine tools to enable accurate positioning.
- Built-in absolute scale including the ABS point requires no zero-set every time the power is turned on. In addition, reliability has improved thanks to elimination of overspeed errors.
- Horizontal or vertical display according to the scale mounting direction.
- The dust resistance and the environmental resistance of the display has improved. The **SD-G** series offers dust/water protection level IP66.
- Long battery life for easier maintenance.
- **EC** counters are available as external display units.
- Equipped with an output port to transfer measurement data. This allows implementation in control systems and gaging systems.

Applications

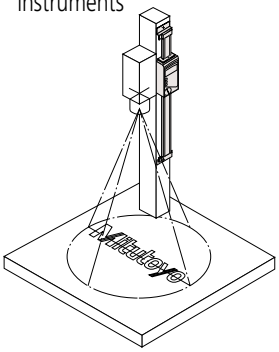
Machine table position



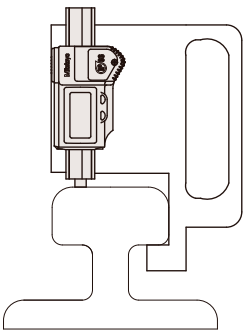
Drilling machine stroke position



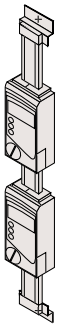
Focus setting on optical instruments



Special applications



As a measurement jig for outdoor use (SD-G)



Detector head mechanism

Please contact Mitutoyo for other special orders.

Functions

- **ABS** (Absolute) measurement function
- **INC** (Incremental) measurement function
- Zero-setting function
- Presetting function (2 preset values can be set. Not available for **SD-G**, **SD-D**, **SDV-D**)
- Double reading function (Available only for **SD-F** or **SDV-F**)
- Direction switch function
  Not available for **SD-G**, **SD-D**, **SDV-D**, **SD-F**, **SDV-F**)
- Hold function*
- Measurement value composition error alarm
- Low-battery alarm
- Output function

* To activate the hold function when using **SD-D** or **SDV-D**, an optional hold unit is required. Simultaneous activation with the output function is not available. **SD-G** are also available to special order.

* These units use 1.5V silver oxide cells for the power supply. Therefore, when the units are directly fixed to the frame of a machine tool that requires a high voltage, malfunction such as display digit fluctuations and errors may occur. The countermeasure examples are described in the user manuals provided.

System Diagram

[Scale units]

Single-function type with high dust/water resistance

SD-G

*2

Single-function type

SD-D (Horizontal)

SDV-D (Vertical)

Multi-function type

SD-E (Horizontal)

SDV-E (Vertical)

Multi-function type (double reading)

SD-F (Horizontal)

SDV-F (Vertical)

[Display units]

EC Counter*3

No. 542-007A

Refer to page G-20 for details.

Tolerance judgment output*1

*3

Digimatic mini-processor

DP-1VA

No. 264-505A

Palm-sized printer for printing and statistical analysis

*3

Multiplexer

MIG-4USB

No. 64AAB387

Interface unit for the RS-232C/USB conversion and output RS-232C/USB output

RS-232C/USB output

*3

Input Tool (USB keyboard signal conversion model)

No. 264-016-10

USB Interface unit that converts and transfers data into spreadsheets

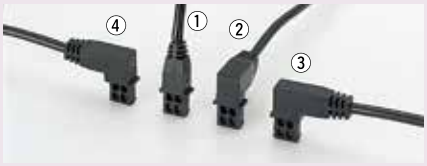
USB keyboard signal conversion

* Connection to an RS-232C conversion type (**IT-007R**) or a PS/2 keyboard signal conversion type (**IT-005D**) input tool is also available.

Connecting cable with the water-proof type output switch*2 40″/ 1m : **No.05CZA624**
80″/ 2m : **No.05CZA625**

Connecting cable with the output switch 1m : **No.959149**
2m : **No.959150**

Connecting cable with the output switch



① 40″/ 1m : **No.905338**
80″/ 2m : **No.905409**

② 40″/ 1m : **No.905689**
80″/ 2m : **No.905690**

③ 40″/ 1m : **No.905691**
80″/ 2m : **No.905692**

④ 40″/ 1m : **No.905693**
80″/ 2m : **No.905694**

Connecting cable 40″/ 1m : **No.936937**
80″/ 2m : **No.965014**

* 1: Select the tolerance judgment output or digimatic output when setting the parameters.
* 2: Connecting cable with the water-proof type output switch can be used only for **SD-G** or Water-proof Digital Caliper **CD-15/20/30PM** equipped with external output function.
* 3: Connecting of **SD** series and **DP-1VR/MIG-UUSB/IT-012U** is also available without passing through the EC counter.
In this case, connect these units and **SD** series with the cables used for the connection with the **EC** counter.

Mitutoyo

ABSOLUTE Digimatic Scale Units

SERIES 572

SPECIFICATIONS

Type	Unit spec.	Order No.	Model	Range	Resolution	Accuracy	Repeatability	Battery life
Horizontal single-function type (Water-proof type)	Metric	**572-600**	**SD-10G**	0-100mm	0.01mm	0.03mm	.0005"/ 0.01mm	Approx. 13000 hours
		572-601	**SD-15G**	0-150mm				
		572-602	**SD-20G**	0-200mm				
	Inch/Metric	**572-613**	**SD-4"/10G**	0-4"/0-100mm	0.0005"/0.01mm	0.03mm/.001"		
		572-614	**SD-6"/15G**	0-6"/0-150mm				
		572-615	**SD-8"/20G**	0-8"/0-200mm				
Horizontal single-function type	Metric	**572-200-20**	**SD-10DX**	0-100mm	0.01mm	0.03mm		Approx. 20000 hours
		572-201-20	**SD-15DX**	0-150mm				
		572-202-20	**SD-20DX**	0-200mm				
		572-203-10	**SD-30D**	0-300mm		0.04mm		
	Inch/Metric	**572-210-20**	**SD-4"DX**	0-4"/0-100mm	0.0005"/0.01mm	0.03mm/.001"		
		572-211-20	**SD-6"DX**	0-6"/0-150mm				
		572-212-20	**SD-8"DX**	0-8"/0-200mm				
		572-213-10	**SD-12"D**	0-12"/0-300mm		0.04mm/.002"		
Horizontal multi-function type	Metric	**572-460**	**SD-10E**	0-100mm	0.01mm	0.03mm		Approx. 5000 hours
		572-461	**SD-15E**	0-150mm				
		572-462	**SD-20E**	0-200mm				
		572-463	**SD-30E**	0-300mm		0.04mm		
		572-464	**SD-45E**	0-450mm				
		572-465	**SD-60E**	0-600mm		0.05mm		
		572-466	**SD-80E**	0-800mm		0.06mm		
		572-467	**SD-100E**	0-1000mm		0.07mm		
	Inch/Metric	**572-470**	**SD-4"E**	0-4"/0-100mm	0.0005"/0.01mm	0.03mm/.001"		
		572-471	**SD-6"E**	0-6"/0-150mm				
		572-472	**SD-8"E**	0-8"/0-200mm				
		572-473	**SD-12"E**	0-12"/0-300mm		0.04mm/.002"		
		572-474	**SD-18"E**	0-18"/0-450mm				
		572-475	**SD-24"E**	0-24"/0-600mm		0.05mm/.002"		
		572-476	**SD-32"E**	0-32"/0-800mm		0.06mm/.0025"		
		572-477	**SD-40"E**	0-40"/0-1000mm		0.07mm/.0025"		
Horizontal multi-function type (equipped with double reading function)	Metric	**572-480-10**	**SD-10F**	0-100mm	0.01mm	0.03mm		Approx. 5000 hours
		572-481-10	**SD-15F**	0-150mm				
		572-482-10	**SD-20F**	0-200mm				
		572-483-10	**SD-30F**	0-300mm		0.04mm		
		572-484-10	**SD-45F**	0-450mm				
		572-485-10	**SD-60F**	0-600mm		0.05mm		
		572-486-10	**SD-80F**	0-800mm		0.06mm		
		572-487-10	**SD-100F**	0-1000mm		0.07mm		
	Inch/Metric	**572-490-10**	**SD-4"F**	0-4"/0-100mm	0.0005"/0.01mm	0.03mm/.001"		
		572-491-10	**SD-6"F**	0-6"/0-150mm				
		572-492-10	**SD-8"F**	0-8"/0-200mm				
		572-493-10	**SD-12"F**	0-12"/0-300mm		0.04mm/.002"		
		572-494-10	**SD-18"F**	0-18"/0-450mm				
		572-495-10	**SD-24"F**	0-24"/0-600mm		.002"/0.05mm		
		572-496-10	**SD-32"F**	0-32"/0-800mm		.0025"/0.06mm		
		572-497-10	**SD-40"F**	0-40"/0-1000mm		.0025"/0.07mm		
Vertical single-function type	Metric	**572-300-10**	**SDV-10D**	0-100mm	0.01mm	0.03mm		Approx. 20000 hours
		572-301-10	**SDV-15D**	0-150mm				
		572-302-10	**SDV-20D**	0-200mm				
		572-303-10	**SDV-30D**	0-300mm		0.04mm		
	Inch/Metric	**572-310-10**	**SD-4"D**	0-4"/0-100mm	0.0005"/0.01mm	0.03mm/.001"		
		572-311-10	**SD-6"D**	0-6"/0-150mm				
		572-312-10	**SD-8"D**	0-8"/0-200mm				
		572-313-10	**SD-12"D**	0-12"/0-300mm		0.04mm/.002"		
Vertical multi-function type	Metric	**572-560**	**SDV-10E**	0-100mm	0.01mm	0.03mm		Approx. 5000 hours
		572-561	**SDV-15E**	0-150mm				
		572-562	**SDV-20E**	0-200mm				
		572-563	**SDV-30E**	0-300mm		0.04mm		
		572-564	**SDV-45E**	0-450mm				
		572-565	**SDV-60E**	0-600mm		0.05mm		
		572-566	**SDV-80E**	0-800mm		0.06mm		
		572-567	**SDV-100E**	0-1000mm		0.07mm		
	Inch/Metric	**572-570**	**SDV-4"E**	0-4"/0-100mm	0.0005"/0.01mm	.001"/0.03mm		
		572-571	**SDV-6"E**	0-6"/0-150mm				
		572-572	**SDV-8"E**	0-8"/0-200mm				
		572-573	**SDV-12"E**	0-12"/0-300mm		.002"/0.04mm		
		572-574	**SDV-18"E**	0-18"/0-450mm				
		572-575	**SDV-24"E**	0-24"/0-600mm		.002"/0.05mm		
		572-576	**SDV-32"E**	0-32"/0-800mm		.0025"/0.06mm		
		572-577	**SDV-40"E**	0-40"/0-1000mm		.0025"/0.07mm		
Vertical multi-function type (equipped with double reading function)	Metric	**572-580-10**	**SDV-10F**	0-100mm	0.01mm	0.03mm		Approx. 5000 hours
		572-581-10	**SDV-15F**	0-150mm				
		572-582-10	**SDV-20F**	0-200mm				
		572-583-10	**SDV-30F**	0-300mm		0.04mm		
		572-584-10	**SDV-45F**	0-450mm				
		572-585-10	**SDV-60F**	0-600mm		0.05mm		
		572-586-10	**SDV-80F**	0-800mm		0.06mm		
		572-587-10	**SDV-100F**	0-1000mm		0.07mm		
	Inch/Metric	**572-590-10**	**SDV-4"F**	0-4"/0-100mm	0.0005"/0.01mm	.001"/0.03mm		
		572-591-10	**SDV-6"F**	0-6"/0-150mm				
		572-592-10	**SDV-8"F**	0-8"/0-200mm				
		572-593-10	**SDV-12"F**	0-12"/0-300mm		.002"/0.04mm		
		572-594-10	**SDV-18"F**	0-18"/0-450mm				
		572-595-10	**SDV-24"F**	0-24"/0-600mm		.002"/0.05mm		
		572-596-10	**SDV-32"F**	0-32"/0-800mm		.0025"/0.06mm		
		572-597-10	**SDV-40"F**	0-40"/0-1000mm		.0025"/0.07mm		

Note: Response speed is unlimited

Type

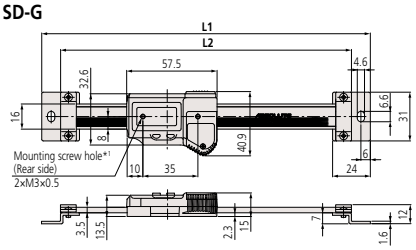
Horizontal type example

Vertical type example

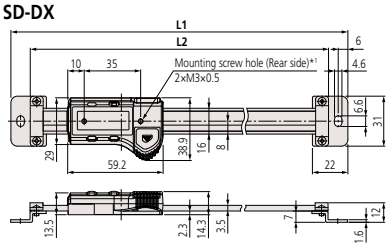
DIMENSIONS

Unit: mm

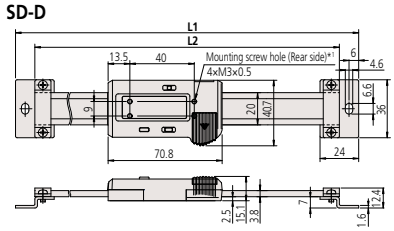
SD-G



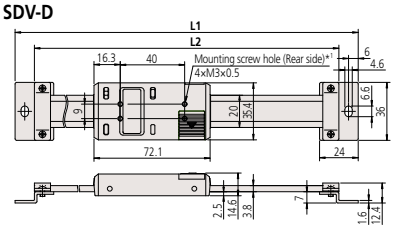
SD-DX



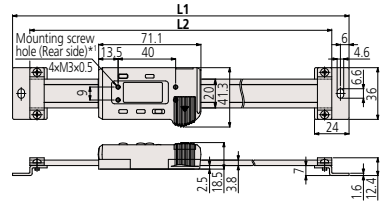
SD-D



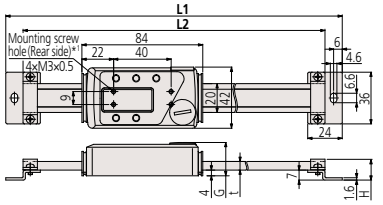
SDV-D



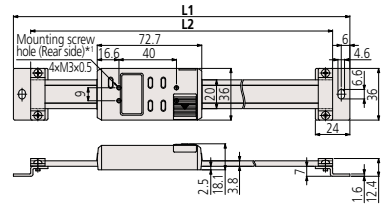
SD-E (to 300mm) / **SD-F** (to 300mm)



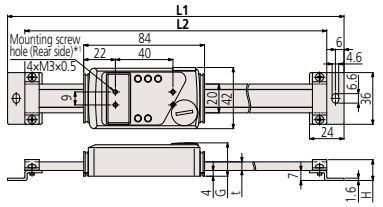
SD-E (450 to 1000mm) / **SD-F** (450 to 1000mm)



SDV-E (to 300mm) / **SDV-F** (to 300mm)



SDV-E (450 to 1000mm) / **SDV-F** (450 to 1000mm)



*1: Inch/Metric models have 5-40 UNC threaded rear holes. Refer to the dimension table for details of the depth including the screw on the rear of the display.

SPECIFICATIONS

Model	Range (mm)	Dimensions(mm)					Depth including the screw on the rear of the display	Mass (g)
		L1	L2	t	G	H		
SD-G	100	209	185	—	—	—	Less than 2mm	390
	150	259	235	—	—	—		410
	200	311	287	—	—	—		430
SD-DX	100	209	185	—	—	—		230
	150	259	235	—	—	—		250
	200	311	287	—	—	—		270
SD-30D	300	444	420	—	—	—		370
SD-E **SD-F**	100	244	220	—	—	—		250
	150	294	270	—	—	—		280
	200	344	320	—	—	—		310
	300	444	420	—	—	—		370
	450	594	570	6	23.2	14.6	Less than 3mm	760
	600	774	750					900
	800	974	950	10	27.2	18.6		1710
	1000	1174	1150					2040
SDV-D	100	244	220	—	—	—	Less than 2mm	250
	150	294	270	—	—	—		280
	200	344	320	—	—	—		310
	300	444	420	—	—	—		370
SDV-E **SDV-F**	100	244	220	—	—	—		250
	150	294	270	—	—	—		280
	200	344	320	—	—	—		310
	300	444	420	—	—	—		370
	450	594	570	6	23.2	14.6	Less than 3mm	760
	600	774	750					900
	800	974	950	10	27.2	18.6		1710
	1000	1174	1150					2040

Mitutoyo

Quill Kit with ABSOLUTE Encoder

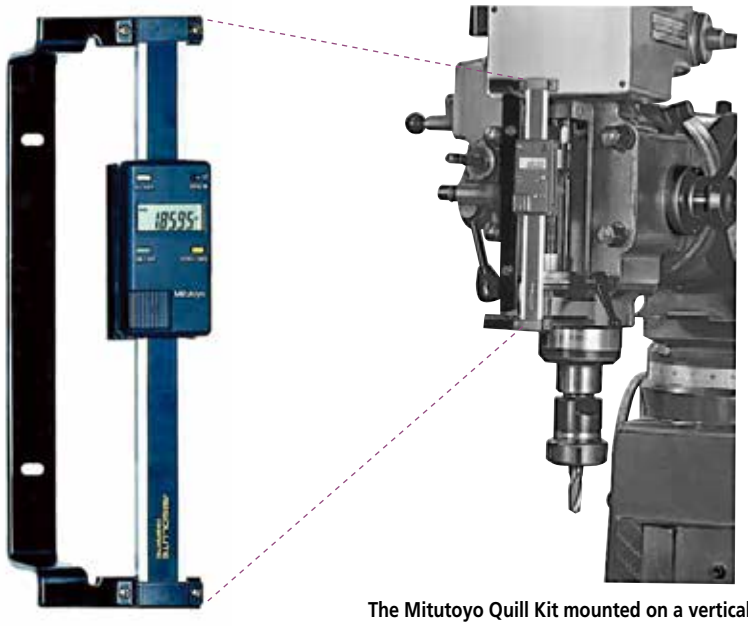
Easy Installation Fits Most Vertical Knee Mills

FEATURES

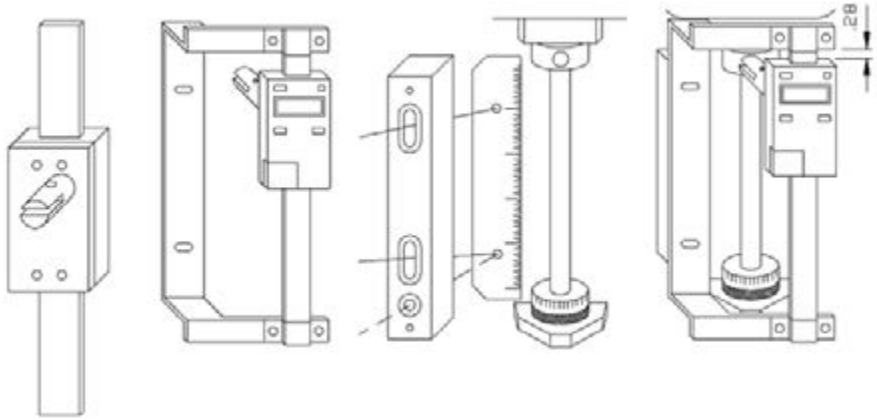
- Easy to read LCD with resolution of .0005"/0.01mm. 0 -5" travel inch/mm
- Push button controls for inch/mm, zero-set and on/off.
- Powered by a single SR-44 battery which lasts about 1 year with normal use.
- SPC Output for data transmission to data processors or a remote display.

SPECIFICATIONS

Order No.	Description
053906B	Digimatic Quill Kit complete with brackets & scale for Bridgeport-type machines.



The Mitutoyo Quill Kit mounted on a vertical mill.



Optional Accessories

905338: SPC cable (40" / 1m standard)
905409: SPC cable (80" / 2m standard)
264-504-5A: DP-1VR data processor, 120V AC
02AZD810D: U-Wave-R (wireless receiver)
02AZD730D: U-Wave-T/IP67 type (wireless transmitter)
02AZD790F: U-Wave connecting cable F
02AZE200: U-Wave-T installation brackets kit

KA-200 Counter

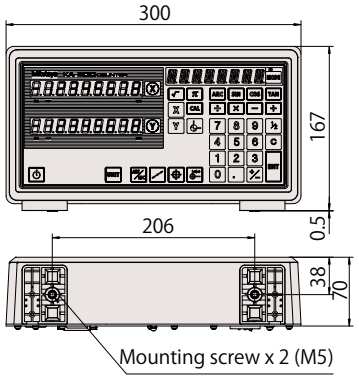
SERIES 174 — Standard Type

- High performance, low cost 2 & 3 axis counter
- Absolute and incremental modes (10 presets each)
- Non-linear and linear error compensation
- Adjustable high-brightness, high-refresh rate LED displays
- Calculator function
- Outputs data into spreadsheets (optional USB card)

174-183A

DIMENSIONS

Unit: mm



SPECIFICATIONS

Order No.	174-183A	174-185A
Model	2-axis KA-212 Counter	3-axis KA-213 Counter
Resolution	With AT100 Series: 0.05 - 0.0001 mm, .02" - .000005" With AT715: 0.01 - 0.0005 mm, .02" - .000020"	
Scale input ports	2 or 3*	
Display type / digit	7-segment, 8-digit + sign + 8-character alphabet LED display, 14.2mm character height	
Output (optional)	RS-232C / USB	
Macro functions	Rectangular drilling and round milling newly added	
Main features	Feed speed display; taper machining function; tool data; multi-point compensation; scale check function; calculation function	
Dimensions	Size (W×D×H) 30×168×70mm	

*2nd and 3rd axis display can be disabled

Standard Accessories

Power cable
Ground lead
Dust cover
Alternate button labels for lathe mode
Connector cap (Dsub-15)
User's manual
Warranty card

Optional Accessories

06AET993	Code out unit - USB output, RS232C output, Digimatic Input
06ACB393	Adapter for Linear gages with origin
06ACB913	Adapter for Linear gages without origin
06ACB391	Adapter for AT211 Linear Scales
06ACB392	Adapter for ST Series
09CAB231	Adapter for micrometer head
09AAA207	Adapter for previous model 6 pin linear scales
937179T	Foot switch to trigger USB output (06AET993 needed)
64AAB336	Foot switch to trigger RS-232C output (06AET993 needed)
06ACF941	Extension cable for remote load & zero (06AET993 needed)
965004	Foot switch to trigger RS-232C output (for 06ACF941 only)
937328	External load box (06AET993 & 06ACF941 needed)
936553	External zero box (06AET993 & 06ACF941 needed)
09EAA094	Counter cable RS232C for DP-1VR
64AAB519	RS232C output cable 6-ft. (25-9 pin)

KLD200 Counter

SERIES 174 — Special Purpose Type with Limit Signal Output

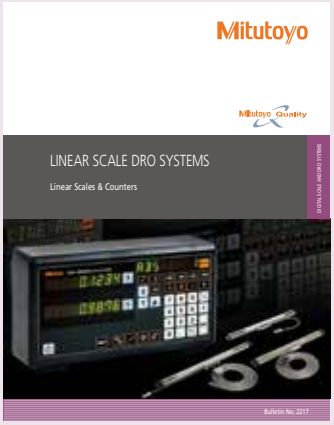
- Counter designed to signal when a linear scale displacement value and a preset limit value coincide.
- Two types of limit settings are available: 2-step (**KLD-212**) and 4-step (**KLD-214**).

174-147A
KLD-214

SPECIFICATIONS

Order No.	174-146A	174-147A
Model	KLD-212	KLD-214
Number of axes to be displayed	1 axis	
Number of limit values to be set	2	4
Resolution	(Changeable according to the parameter) When **AT100** series is connected: 0.05 to 0.0001mm When **AT715** is connected: 0.01 to 0.001mm	
Output	RS-232C (provided as standard)	
Display	7-segment LCD/ 7 digit*1	
Power supply voltage	120V AC, 60Hz	
Power consumption	25 VA	
Operating temperature/humidity range	0 to 45°C/ 20 to 80%	
Dimensions	13.1"(W)×6.42"(D)×8.1"(H) / 332 (W)×163 (D)×204 (H) mm	
Mass	6.62 lb. / 3.0kg	6.84 lb. / 3.1kg

*1: Count range when the minimum reading is 0.001mm: 99999.999 to –9999.999
Count range when the minimum reading is 0.005mm: 99999.995 to –9999.995



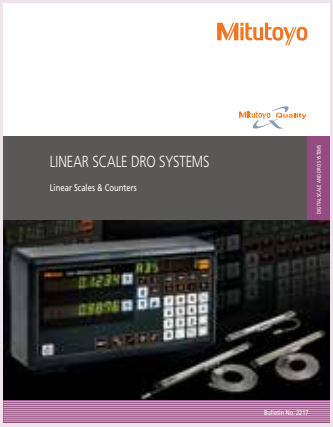
Refer to Bulletin No. (2217) for more details.

Linear Scale Counter

FUNCTIONS

Function \ Counter	KA-200 Counter	KLD-200 Counter
		
Zero-setting	●	●
Preset	●	●
Resolution setting	●	●
Measurement direction setting	●	●
mm/inch conversion	●	●
Diameter display	●	●
Scale reference point setting-1	●	●
1/2 calculation	●	●
Coordinate system switching	●	—
Bolt-hole circle machining	●-2	—
Pitch machining	●	—
Zero approach machining (INC mode)	●	—
Addition of 2-scale data	●-3	—
Linearity error compensation	●	●
Pitch error compensation	●-1	—
Smoothing	●	●
Memory backup	●	●
Expansion/contraction coefficient setting	—	●
Lower digit blanking out	●	●
External zero-setting	▲-4	●
RS-232C interface unit	▲-4	●
USB output	▲-5	—
Limit signal output	—	●
Error message	●	●

●: Standard function, ▲: Optional function, —: Not available
-1: Only available when connecting with AT100 series.
-2: Not available in single-axis use
-3: Only available for 3-axis model
-4: Code out unit (**06AET993**) is required.
-5: Text can be output by interface unit and foot switch



Refer to Bulletin No. (2217) for more details.

Adapter Cross Reference

(For adapting old linear scales to new counters, or new linear scales to old counters)

	Linear Scale Series No's.	Adapter No.	Counters
Old linear scales with 6 pin round connectors	FOR AT2-N, AT2, AT-11N, AT11, AT12N (529 Series)	**09AAA207**	All KA, KS, KC, UDR Series Counters with 15 pin connectors. (All 174 Series)
New linear scales w/15 pin D-Sub connectors	FOR AT102, AT103, AT111, AT112, AT113, AT115, AT116, AT181	**09AAA181**	For all .0001" resolution counters with seven pin round connectors
		09AAA181V*	APL Counter **164-660***, **164-661***, **164-662*** MPK-2L **983-352**
		09AAA198	For all .0005" resolution counters with six pin round connectors
		09AAA198V*	APL Counter **164-660***, **164-661***, **164-662***, **164-563***, **164-664***, **164-665*** PL and PL Zero Output Counter **164-252A**, **164-254A**, **164-295A**

* V = Vertical type
When only replacing one linear scale, you can use either horizontal or vertical type adapter.

09AAA207

09AAA198

Digital Readout/DRO packages
2-Axis/3-Axis Travels

For Milling, Lathes & Surface Grinding Systems

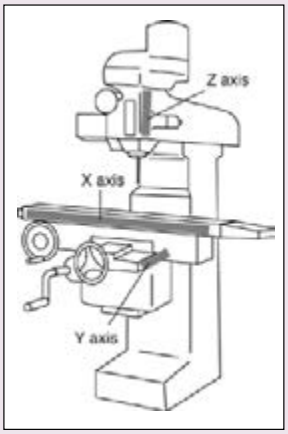
2-Axis, KA Counter Milling System

Package includes:
- KA-200 counter
- AT715 electromagnetic absolute linear scales
- Brackets for linear scales
- Display arm kit

X Axis Travel (AT715 Slim Electromagnetic)	Y Axis Travel (AT715 Slim Electromagnetic)			
	12" (539-805)	14" (539-806)	16" (539-807)	18" (539-808)
30" (539-814)	**64PKA058A**	**64PKA060A**	–	–
36" (539-816)	**64PKA059A**	–	**64PKA062A**	–
40" (539-817)	–	**64PKA061A**	**64PKA063A**	**64PKA064A**

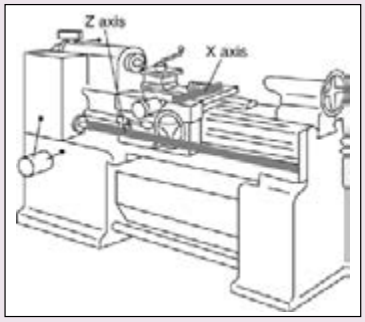
3-Axis Milling Package (Z Axis: 6" Travel AT715)

Order No.	Description
64PKA065A	MILL pkg, 3-axis, ABS Scales, 12" x 30" x 6", w/3 axis KA Counter (174-185A)
64PKA066A	MILL pkg, 3-axis, ABS Scales, 12" x 36" x 6", w/3 axis KA Counter (174-185A)
64PKA067A	MILL pkg, 3-axis, ABS Scales, 16" x 36" x 6", w/3 axis KA Counter (174-185A)

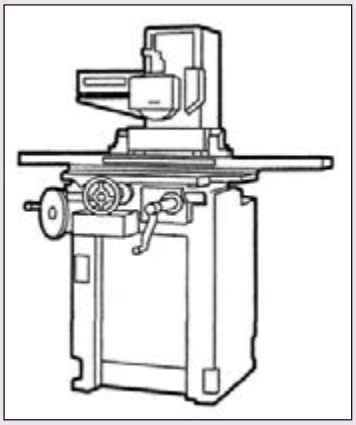


2-Axis Lathe Package

Package includes:
- KA-200 counter
- AT116 and AT715 linear scale combinations (with cables)
- Mounting bracket kit
- Counter tray
- Additional extension cable (2m) included in 60" and 72" packages



Z-axis travel	X Axis Travel (AT116 Slim Glass Scale)					
	6"(539-272-30)	8"(539-273-30)	10"(539-274-30)	12"(539-275-30)	14"(539-276-30)	16"(539-277-30)
28" (539-813)	**64PKA035A**	–	–	–	–	–
30" (539-814)	**64PKA036A**	–	–	–	–	–
36" (539-816)	**64PKA037A**	–	–	–	–	–
40" (539-817)	**64PKA038A**	**64PKA039A**	**64PKA042A**	**64PKA046A**	**64PKA052A**	–
44" (539-818)	–	**64PKA040A**	**64PKA043A**	**64PKA047A**	**64PKA053A**	–
48" (539-819)	–	**64PKA041A**	**64PKA044A**	**64PKA048A**	**64PKA054A**	–
52" (539-820)	–	–	–	**64PKA049A**	**64PKA055A**	–
60" (539-822)	–	–	**64PKA045A**	**64PKA050A**	**64PKA056A**	**64PKA057A**
72" (539-825)	–	–	–	**64PKA051A**	–	–



2-Axis, KA Counter Grinder System

Package includes:
- KA-200 counter
- AT116 glass linear scales
- Mounting bracket kit
- Display arm kit

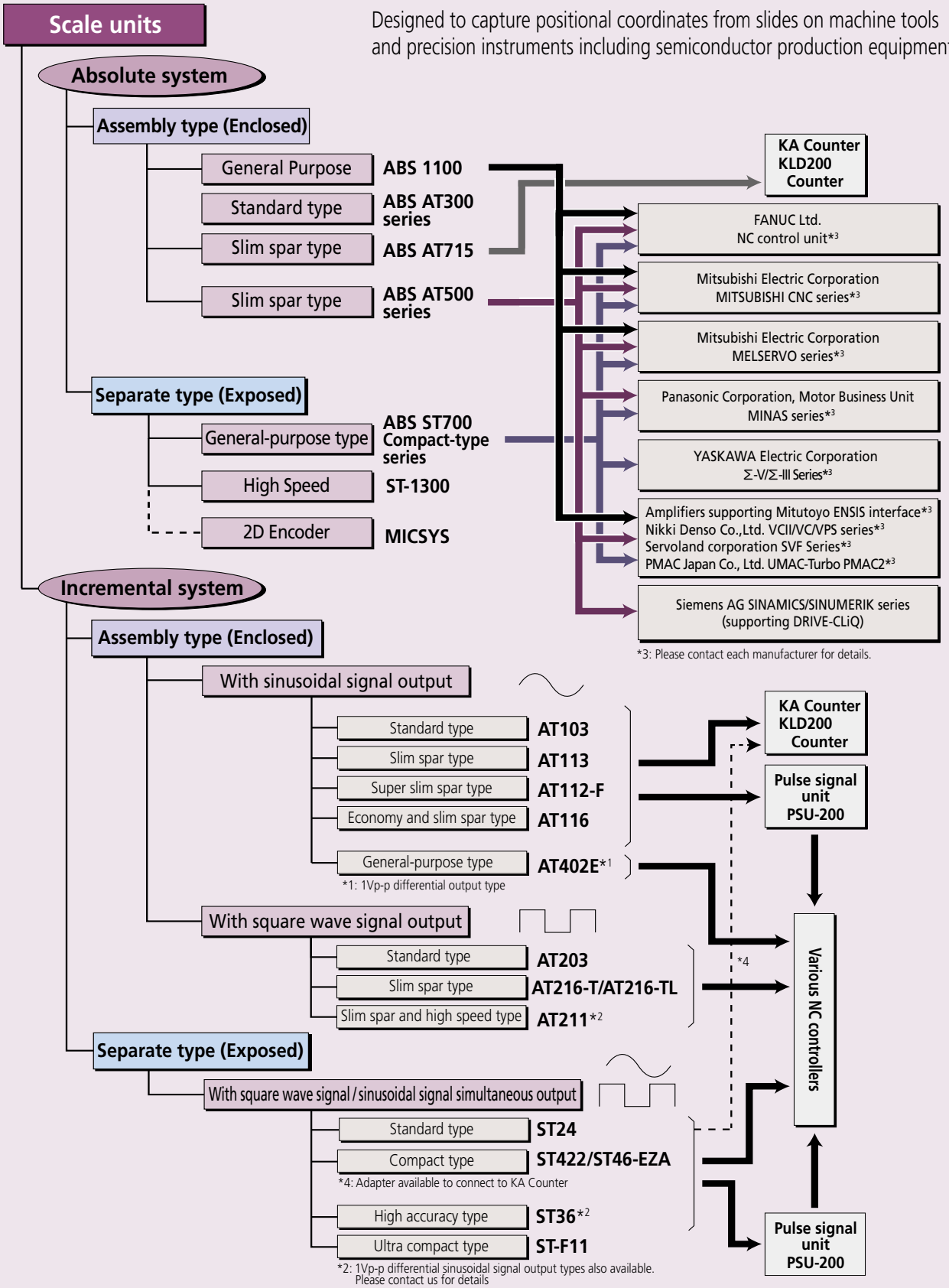
Vertical	Cross Side (AT116 Slim Glass Scale)			
	6" (539-272-30)	8" (539-273-30)	10" (539-274-30)	12" (539-275-30)
12"(539-275-30)	**64PKA026A**	**64PKA028A**	–	–
14"(539-276-30)	**64PKA027A**	**64PKA029A**	–	–
16"(539-277-30)	–	**64PKA030A**	–	–
18"(539-278-30)	–	–	**64PKA031A**	**64PKA033A**
20"(539-279-30)	–	–	–	**64PKA034A**
24"(539-281-30)	–	–	**64PKA032A**	–

Mitutoyo

Linear Scales

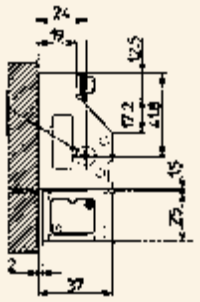
Linear Scale System Diagram

Designed to capture positional coordinates from slides on machine tools and precision instruments including semiconductor production equipment.

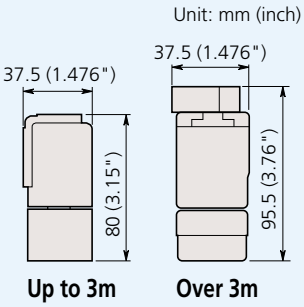


Name	Type	Page
AT1100	General-purpose Spar	H-12
AT300	Standard Spar	H-13
AT-715	Slim Spar (IP67)	H-14
AT500	Slim Spar	H-15
ABS ST700	General Purpose Compact type (Exposed)	H-16
ST1300	High Seep High Accuracy (Exposed)	H-17
MICSYS	2D Image Encoder (Exposed)	H-18
AT103	Standard	H-19
AT113	Slim Spar type	H-20
AT112-F	Super Slim part type	H-21
AT116	Economy and Slim Spar	H-22
AT402E	General-purpose	H-23
AT203	Standard type	H-24
AT216T/AT217-TL	Slim Spar	H-25
AT211	Slim spar type high speed	H-26
ST24	Standard Type (Exposed)	H-27
ST422/ST46-EZA	Compact type (Exposed)	H-28-29
ST36	High Accuracy type (Exposed)	H-30
ST-F11	Ultra Compact-Fiber scale (Exposed)	H-31-32

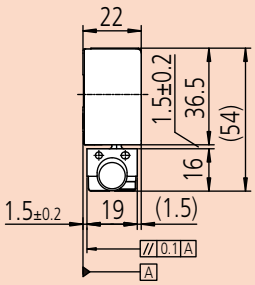
AT1100



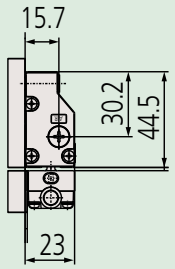
AT103 / AT300 / AT203



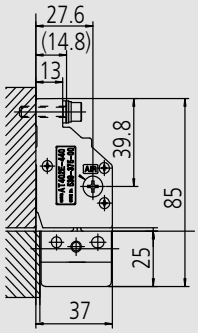
AT715



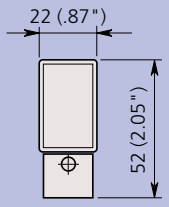
AT500



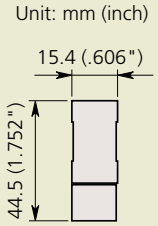
AT402E



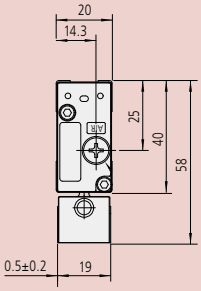
AT113 / AT116 / AT216T / AT217TL



AT112F



AT211



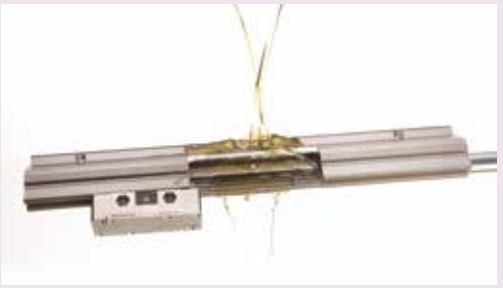
Mitutoyo

Linear Scales ABS AT1100

SERIES 539 — General Mount Type, robust dustproof / waterproof structure

PROPRIETARY INSPECTION CERTIFICATE

ABSOLUTE™

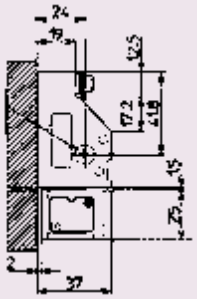


SPECIFICATIONS

Model	ABS AT1100
Detection method	Electromagnetic induction
Maximum effective range	3040mm
Resolution	0.05μm
Accuracy (at 20 °C)	(3+5L/1000)μm L= 140 to 2040mm (5+5L/1000)μm L= 2240 to 3040mm
Maximum response speed	3 m/s
Cross-section size	85×37 (mm)
Thermal expansion coefficient	≈ 8±1.5x10^{-6} / K
Vibration resistance (at 55 to 2000Hz)	20g
Impact resistance (at 11ms, 1/2sin)	35g L=140 to 2040mm 30g L=2240 to 3040mm
Compatible interfaces *1	FANUC Corporation's Serial αi Interface (AT1153)
	Mitsubishi Electric Corporation's High-speed Serial Interface (AT1143)

*1: For details about connection of any applicable system, please be sure to contact each manufacturer for confirmation.

- Electromagnetic induction principle means scales are unaffected by most contamination.
- Absolute scales have eliminated the need for origin restoration and drastically reduced power consumption.
- Drawings are available on request.



AT1100 Mounting Dimensions

FANUC		Mitsubishi		Siemens		Effective Range (mm)
Order No.	Model	Order No.	Model	Order No.	Model	
559-100-53	AT1153-140	**559-100-43**	AT1143-140	**559-100-23**	AT1123-140	140
559-101-53	AT1153-240	**559-101-43**	AT1143-240	**559-101-23**	AT1123-240	240
559-102-53	AT1153-340	**559-102-43**	AT1143-340	**559-102-23**	AT1123-340	340
559-103-53	AT1153-440	**559-103-43**	AT1143-440	**559-103-23**	AT1123-440	440
559-104-53	AT1153-540	**559-104-43**	AT1143-540	**559-104-23**	AT1123-540	540
559-105-53	AT1153-640	**559-105-43**	AT1143-640	**559-105-23**	AT1123-640	640
559-106-53	AT1153-740	**559-106-43**	AT1143-740	**559-106-23**	AT1123-740	740
559-107-53	AT1153-840	**559-107-43**	AT1143-840	**559-107-23**	AT1123-840	840
559-108-53	AT1153-940	**559-108-43**	AT1143-940	**559-108-23**	AT1123-940	940
559-109-53	AT1153-1040	**559-109-43**	AT1143-1040	**559-109-23**	AT1123-1040	1040
559-110-53	AT1153-1140	**559-110-43**	AT1143-1140	**559-110-23**	AT1123-1140	1140
559-111-53	AT1153-1240	**559-111-43**	AT1143-1240	**559-111-23**	AT1123-1240	1240
559-112-53	AT1153-1340	**559-112-43**	AT1143-1340	**559-112-23**	AT1123-1340	1340
559-113-53	AT1153-1440	**559-113-43**	AT1143-1440	**559-113-23**	AT1123-1440	1440
559-114-53	AT1153-1540	**559-114-43**	AT1143-1540	**559-114-23**	AT1123-1540	1540
559-115-53	AT1153-1640	**559-115-43**	AT1143-1640	**559-115-23**	AT1123-1640	1640
559-116-53	AT1153-1740	**559-116-43**	AT1143-1740	**559-116-23**	AT1123-1740	1740
559-117-53	AT1153-1840	**559-117-43**	AT1143-1840	**559-117-23**	AT1123-1840	1840
559-118-53	AT1153-2040	**559-118-43**	AT1143-2040	**559-118-23**	AT1123-2040	2040
559-119-53	AT1153-2240	**559-119-43**	AT1143-2240	**559-119-23**	AT1123-2240	2240
559-120-53	AT1153-2440	**559-120-43**	AT1143-2440	**559-120-23**	AT1123-2440	2440
559-121-53	AT1153-2640	**559-121-43**	AT1143-2640	**559-121-23**	AT1123-2640	2640
559-122-53	AT1153-2840	**559-122-43**	AT1143-2840	**559-122-23**	AT1123-2840	2840
559-123-53	AT1153-3040	**559-123-43**	AT1143-3040	**559-123-23**	AT1123-3040	3040

Linear Scales ABS AT300

SERIES 539 — Standard Type

ABSOLUTE™

- ABSOLUTE linear encoder incorporates both our unique electrostatic capacity and photoelectric technology.
  *Refer to page H-34 "Quick Guide to Precision Measuring Instruments" for details of the principle of the absolute linear scale.
- Drastically reduced power consumption since there are no backup batteries.
- Easy operation because no recalibration is required at startup or after a power failure.
- Suitable for position feedback in machinery requiring high-accuracy, high-speed control.
- Improved environmental resistance against mechanical vibration and noise.

SPECIFICATIONS

Model	ABS AT353	ABS AT343	ABS AT343A	ABS AT303	ABS AT303A
Applicable system	FANUC Ltd. NC Control unit	Mitsubishi Electric Corporation MITSUBISHI CNC series	Mitsubishi Electric Corporation MR-J3	Amplifiers supporting Mitutoyo ENSIS interface	
Resolution	0.05µm				
Maximum response speed	120m/min				
Effective range	4 to 120" / 100 to 3000mm				
Accuracy (20°C)*	(3+3L0/1000)µm, (5+5L0/1000)µm when the effective range is 1600mm or more				
Protection level	IP53				

* The indication accuracy does not include quantizing error. L0: Effective range (mm)
* A wide variety of special orders are available.

Dimensions

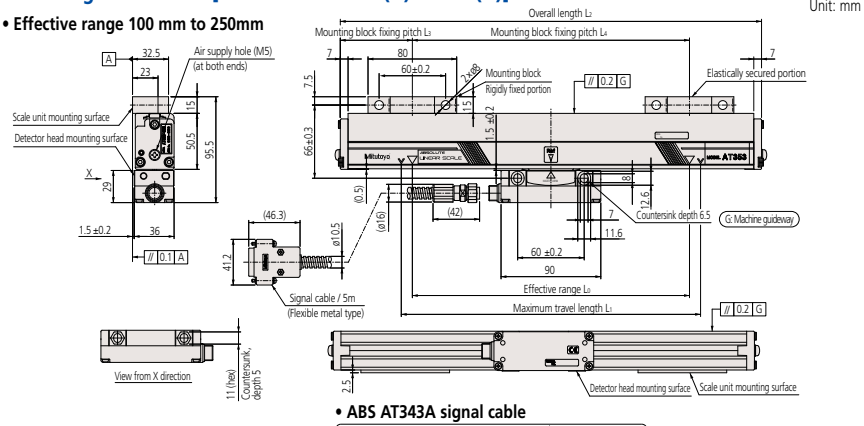
Effective range L0 (mm)	Maximum travel length L1 (mm)	Overall length L2 (mm)	Mounting block pitch L3 (mm)	Mounting block pitch L4 (mm)	No. of mounting blocks
100	120	230	65	100	2
150	170	280	65	150	
200	220	330	65	200	
250	270	380	65	250	
300	330	440	220	150	3
350	380	490	245	175	
400	430	540	270	200	
450	480	590	295	225	
500	540	650	325	250	
600	650	760	380	300	
700	760	870	435	350	
750	810	920	460	375	
800	860	970	485	400	
900	960	1070	535	450	
1000	1060	1170	585	500	

Effective range L0 (mm)	Maximum travel length L1 (mm)	Overall length L2 (mm)	Mounting block pitch L3 (mm)	Mounting block pitch L4 (mm)	No. of mounting blocks
1100	1160	1270	635	275	5
1200	1260	1370	685	300	
1300	1360	1470	735	325	
1400	1460	1570	785	350	
1500	1560	1670	835	375	
1600	1690	1800	900	400	
1700	1790	1900	950	425	
1800	1890	2000	1000	450	
2000	2100	2210	1105	335	7
2200	2300	2410	1205	370	
2400	2500	2610	1305	400	
2500	2600	2710	1355	315	9
2600	2700	2810	1405	325	
2800	2900	3010	1505	350	
3000	3050	3210	1605	375	

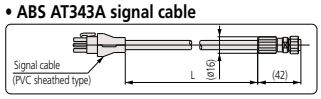
Mounting dimensions [ABS AT353/AT343(A)/AT303(A)]

Unit: mm

• Effective range 100 mm to 250mm

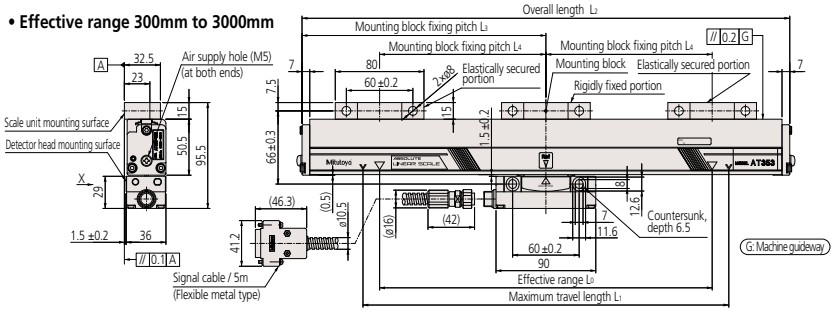


• ABS AT343A signal cable



*The signal cable has set options.
(Part No.09BAA598A - C: 0.2m, 2m, 3m)

• Effective range 300mm to 3000mm



Mitutoyo

Linear Scales ABS AT715

SERIES 539 — Slim Spar Type

ABSOLUTE™

PROPRIETARY INSPECTION CERTIFICATE

- Electromagnetic induction principle means scales are unaffected by contamination.
- Absolute scales have eliminated the need for origin restoration and drastically reduced power consumption.
- Suitable for milling machines, XY tables, jigs, etc.

SPECIFICATIONS

Model	ABS AT715	
Detection method	Electromagnetic induction	
Resolution	.000020" - .001" (0.0005mm to 0.01mm) (on the **KA/KLD200** counter)	
Effective range	100 to 3000mm	
Accuracy (20°C)	±5μm (Lo: 100 to 500mm), ±7μm (Lo: 600 to 1800mm), ±10μm (Lo: 2000 to 3000mm) Lo: Effective range (mm)	
Maximum response speed	50m/min	
Protection level	IP67	
Sliding force	5N or less	
Signal cable	Standard accessory Refer to the dimension table shown below for the length.	
Extension cable (optional)	Length	Order No.
	2m 5m 7m	**09AAB674A** **09AAB674B** **09AAB674C**
Connectable counter	**KA** Counter/ **KLD200** Counter	

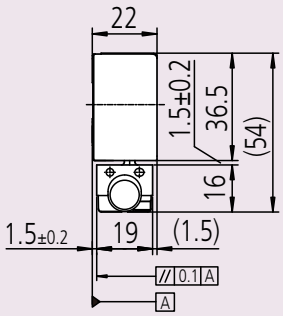
AT715		Effective range Lo inch/mm	Signal cable length (m)
Order No.	Model		
539-801	**ABS AT715-100**	4" /100mm	3.5
539-802	**ABS AT715-150**	6" /150mm	
539-803	**ABS AT715-200**	8" /200mm	
539-804	**ABS AT715-250**	10" /250mm	
539-805	**ABS AT715-300**	12" /300mm	
539-806	**ABS AT715-350**	14" /350mm	
539-807	**ABS AT715-400**	16" /400mm	
539-808	**ABS AT715-450**	18" /450mm	
539-809	**ABS AT715-500**	20" /500mm	
539-811	**ABS AT715-600**	24" /600mm	
539-813	**ABS AT715-700**	28" /700mm	
539-814	**ABS AT715-750**	30" /750mm	
539-815	**ABS AT715-800**	32" /800mm	
539-816	**ABS AT715-900**	36" /900mm	
539-817	**ABS AT715-1000**	40" /1000mm	5
539-818	**ABS AT715-1100**	44" /1100mm	
539-819	**ABS AT715-1200**	48" /1200mm	
539-820	**ABS AT715-1300**	52" /1300mm	
539-821	**ABS AT715-1400**	56" /1400mm	
539-822	**ABS AT715-1500**	60" /1500mm	
539-823	**ABS AT715-1600**	64" /1600mm	
539-824	**ABS AT715-1700**	68" /1700mm	
539-825	**ABS AT715-1800**	72" /1800mm	
539-860	**ABS AT715-2000**	80" /2000mm	
539-861	**ABS AT715-2200**	88" /2200mm	
539-862	**ABS AT715-2400**	96" /2400mm	7*1
539-863	**ABS AT715-2500**	100" /2500mm	
539-864	**ABS AT715-2600**	104" /2600mm	
539-865	**ABS AT715-2800**	112" /2800mm	
539-866	**ABS AT715-3000**	120" /3000mm	

*1: Combination of a 5m signal cable and a 2m extension cable

Optional Accessories

09AAB674A Extension cable 2m
09AAB674B Extension cable 5m
09AAB674C Extension cable 7m
174-183A 2-Axis KA Counter
174-185A 3-Axis KA Counter

174-183A



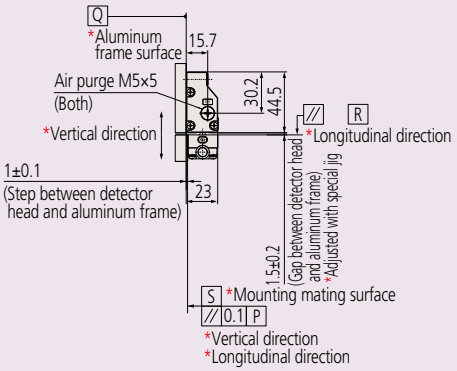
ABSOLUTE™

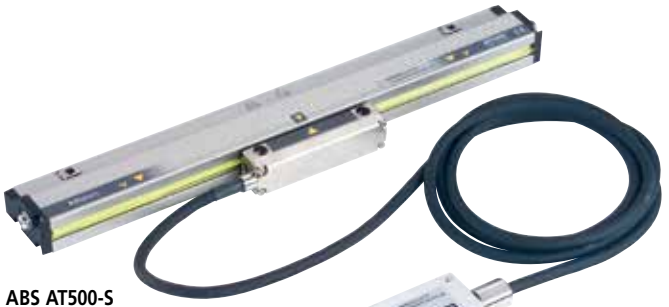
Linear Scales ABS AT500

SERIES 539 — Slim Spar Type

- Slim shape is suitable for space-saving designs.
- The high-rigidity **ABS AT500-S** series has vibration resistance, shock resistance and temperature control. The **ABS AT500-H** series offers excellent temperature control and high accuracy.
- Scale alarm display LED allows for easy maintenance.
- Supports the interfaces of various manufacturers, allowing a variety of system configurations.

SC Type





ABS AT500-S

IP53

ABS AT500-H

SPECIFICATIONS

	High-rigidity type	High-accuracy type	
Model	**ABS AT500-SC**	**ABS AT500-HC**	**ABS AT500-HL/HR**
Resolution	0.005μm*1/0.05μm		
Maximum response speed	150m/min (72m/min for the H series whose resolution is 0.005μm)		
Effective range	100 to 2200mm	100 to 1000mm	100 to 350mm
Accuracy (20°C)*2	(3+3L0/1000)μm	(2+2L0/1000)μm	
Reference point of expansion influenced by the temperature fluctuation	Center of the effective measuring length		Edge of the effective measuring length HL: "+" side of the absolute value HR: "−" side of the absolute value
Protection level	IP53		

*1: The exact value is 0.0048828125μm since the 20μm signal is divided by 4096.

Meaning of Model No.

ABS AT5□□□ - □□□ - □□

Resolution/Applicable system

Effective range

Reference point of expansion on the scale unit influenced by temperature fluctuation*
C: Center of the effective range
L: "+" side of the absolute value
R: "−" side of the absolute value
* "**L**" or "**R**" is marked only for the high accuracy type.

Type of the scale unit
S: High rigidity type
H: High accuracy type
Note: "Reference point of expansion"
The scale unit expands or contracts influenced by the temperature fluctuation.
The mechanical reference point of expansion is defined as the reference point.

Model	Resolution	Applicable system
ABS AT553	0.05μm	FANUC Ltd. NC Control unit
ABS AT555	0.005μm	
ABS AT543	0.05μm	Mitsubishi Electric Corporation MITSUBISHI CNC series
ABS AT545	0.005μm	
ABS AT543A	0.05μm	Mitsubishi Electric Corporation MELSERVO series
ABS AT545A	0.005μm	
ABS AT573A	0.05μm	Panasonic Corporation, Motor Business Unit MINAS series*1
ABS AT503	0.05μm	Amplifiers supporting Mitutoyo ENSIS interface*1 (Nikki Denso Co., Ltd., Servoland corporation, PMAC Japan Co., Ltd.)
ABS AT503A		
ABS AT505	0.005μm	
ABS AT505A		
ABS AT524	0.01μm	Siemens AG SINAMICS/SINUMERIK series (supporting DRIVE-CLiQ)
ABS AT527	0.001μm	

*ABS AT5 □□□
Transmission method
Nothing: Full duplex communication
A: Half-duplex communication

*1: Please contact each manufacturer for details.

Mitutoyo

Linear Scales ABS ST700

SERIES 579 — General-purpose Type

Scale base type

ABSOLUTE™

PROPRIETARY INSPECTION CERTIFICATE

- Absolute measurement with exposed scales.
- Non-contact detection is optimal for high-speed and high-acceleration devices such as linear motors.
- Electromagnetic induction principle means scales are unaffected by water and oil contamination.
- The detector head is approximately 1/3 the previous model size: 50mm (W) × 28mm (D) × 11mm (H).
- Cable outlets can be in four directions, with mounting holes on the top and sides.
- Accuracy (5+5L/1000)µm, glass scale: (3+3L/1000)µm (previous models: (8+5L/1000)µm) L: Effective range (mm).
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces).
- Signal adjustment at installation is automatically performed with dedicated software.

SPECIFICATIONS

Model	**ABS ST700**
Scale type	Scale base type
Resolution	0.1µm (0.05µm to special order)
Detection method	Electromagnetic induction ABS linear encoder
Max. effective range	6000mm
Accuracy (20°C)	5+(5L/1000)µm L: Effective range (mm)
Maximum response speed	5m/s
Linear expansion coefficient	$(12.0\pm1.5)\times10^{-6}$/°C (When the material of the mounting components is steel or equivalent.)
Power supply voltage	5V±10% (at the detection head) (Ripple + spike noise component should be less than 100mV.)
Operating temperature/humidity range	0 to 50°C, RH 20 to 80%
Storage temperature/humidity range	–20 to 70°C, RH 20 to 80%

Meaning of Model No.

ABS ST7 0 8 A L - 100 A - R

Absolute type

Series name
Separate Type ABSOLUTE Linear Scale
ABS ST700 Compact-type series (Effective range ≤ 3m)
ABS ST700 Compact-type series (3.2m ≤ Effective range ≤ 6m)

Interface specification[*1]
0:Supports Mitutoyo ENSIS high-speed interface
ABS ST708A, **ST708AL**
4:Supports Mitsubishi Electric Corporation high-speed serial interface
ABS ST748, **ST748AL**, **ABS ST748**, **ST748L**
5:Supports FANUC Ltd. high-speed serial interface
ABS ST758, **ST758L**
7:Supports Panasonic Corporation, Motor Business Unit high-speed serial interface
ABS ST778A, **ST778AL**
8:Supports YASKAWA Electric Corporation high-speed serial interface
ABS ST788A, **ST788AL**

Detection head form and resolution
8: Form: 50mm (W)×28mm (D)×11mm (H)
Resolution: 0.1µm
9: 0.05µm resolution (to special orders)

Transmission method
A: 2-wire system
Nothing: 4-wire system

Nothing: 100mm to 3000mm
L: 3200mm to 6000mm

Effective range: 100mm to 6000mm

A: Scale base type

Head cable outlet direction
R: Right side
L: Left side
U: Upper side
D: Lower side

Available Interfaces[*1]

FANUC Ltd. FS-i Series, Power Mate i Series
Mitsubishi Electric Corporation MELSERVO MR-J4/MR-J3 Series
Mitsubishi Electric Corporation CNC Series, MDS-D/MDS-DH Series
YASKAWA Electric Corporation Σ-V,Σ-III Series
Panasonic Corporation, Motor Business Unit MINAS-A5, A5L, A5N, A5NL, MINAS-A4, A4P, A4N, A4NL Series
Mitutoyo ENSIS[*2] Nikki Denso Co.,Ltd. VCII/VC/VPS series Servoland Corporation SVF Series PMAC Japan Co. Ltd. UMAC-Turbo PMAC2

*1 Be sure to contact each manufacturer for details of the applicable systems (availability of connection).
*2 ENSIS is a registered trademark of Mitutoyo Corporation.

Feedback cable

- Yaskawa Electric Corporation serial cable can be used as the feedback cable to connect to a Yaskawa Electric Corporation servo amplifier.
  Cable model number : JZSP-CLP- (03, 05, 10, 15, 20)
- For the feedback cable to connect to a Mitsubishi Electric Corporation MR-J2S/MR-J3, contact Mitutoyo with the following code numbers.

For the MR-J2S	5m :	No.06ACF116A
	10m :	No.06ACF116B
For the MR-J3	5m :	No.06ACF117A
	10m :	No.06ACF117B

ABSOLUTE™

Linear Scale ABS ST1300

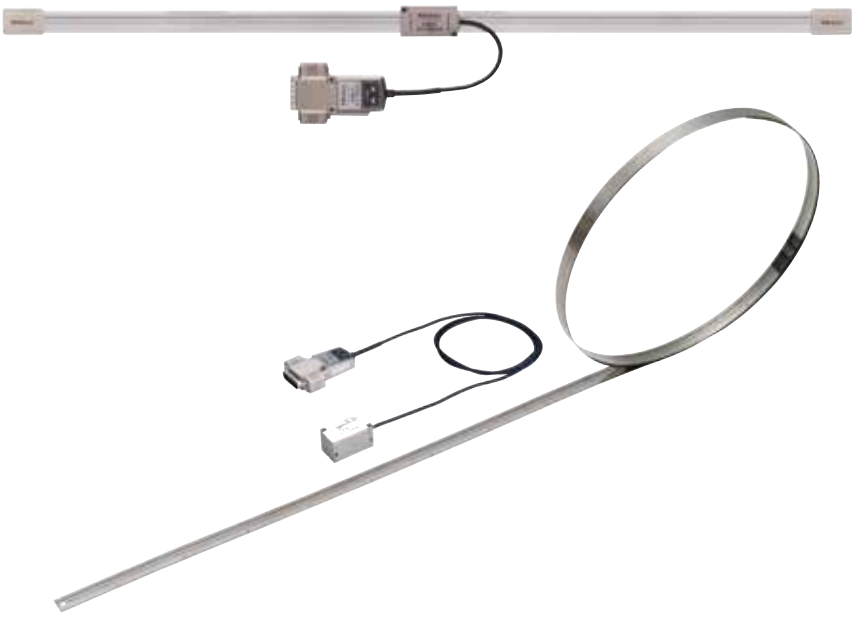
SERIES 579 — High-speed, High-resolution Absolute Tape Scale

- 12m maximum effective length, 8-m/s max. response speed and 1nm minimum resolution.
- Extensive interface compatibility. See specifications below.
- Outstanding robustness against contamination compared to earlier photoelectric types by using a new detection principle.
- Choice between double-sided tape and tension mounting methods.
- Signal validation program facilitates mounting adjustment and maintenance.
- Applicable Interfaces: FANUC; Mitsubishi Electric; Yaskawa Electric; Panasonic; Mitutoyo ENSIS standard interface

- Any scale size drawings are available on request.

Double-end tension version

Double-sided adhesive mounting version



SPECIFICATIONS

Model	ABS ST1300
Range	max. 12 m
Accuracy	10 µm/m (± 5µm)
Max. Response Speed	8 m/s (Varies according to the interface)
Min. Resolution	1 nm / 10 nm
Scale Specifications	Metal tape
Applicable Interfaces	FANUC; Mitsubishi Electric; Yaskawa Electric; Panasonic; Mitutoyo ENSIS standard Interface

Mitutoyo

MICSYS

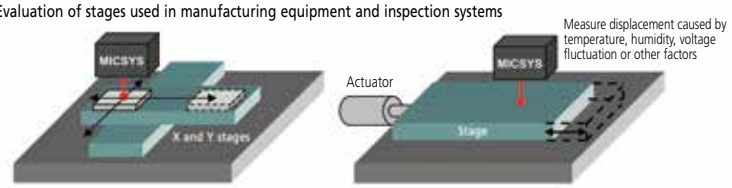
SERIES 549 High-accuracy, Non-contact 2D Encoder

SPECIFICATIONS

Order No.	**549-701A**
Model	**MICSYS-SA1**
Detection method	Laser speckle image correlation
Effective range	±100μm (2D)
Resolution	1 nm
Accuracy (20°C)	±100 nm
Data update period	20Hz

Applications

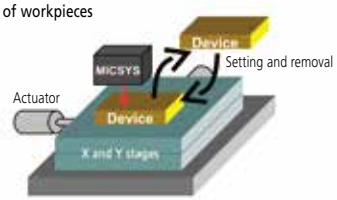
1. Evaluation of stages used in manufacturing equipment and inspection systems



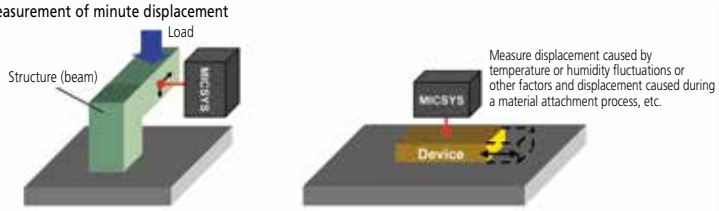
a) Evaluation of position repeatability

b) Evaluation of standstill stability and drift

2. Highly accurate positioning of workpieces



3. Measurement of minute displacement

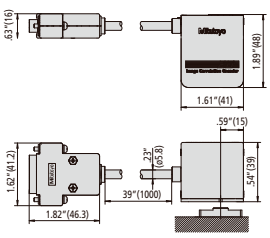


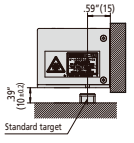
a) Measurement of minute displacement of a structure

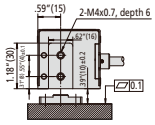
b) Measurement of minute displacement of a workpiece

DIMENSIONS

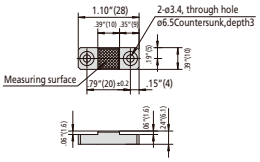
Detector Mass : 300g



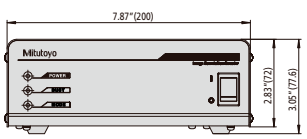


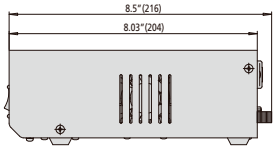


Standard target Mass : 10g



I/F unit Mass : 1700g





FEATURES

- Simultaneous, non-contact measurement of X-Y position.
- Nano-resolution measurement.
- Suitable for applications such as stage position repeatability, strain measurement, deflection measurement, etc.
- Applies the image correlation of a speckle pattern.
- No scales needed—can detect on any optically rough surface.
- Detector can be completely removed from surface and replaced to continue reading.
- Drawings are available on request.

Linear Scales AT103

SERIES 539 — Standard Type

IP53

FEATURES

- Enhanced vibration-resistance and durability.
- The innovative rubber lips keep out contaminants.
- An armored signal cable is used to connect the scale unit to the DRO counter for safe operation in harsh shop environments.
- The signal cable outlet can be positioned on either side of the detector head, allowing the signal cable to be connected from either direction.
- A wide variety of measuring ranges are available in this standard type scale unit.
- Connectable to the **KA** counter, **KLD** counter, or **PSU-200**.

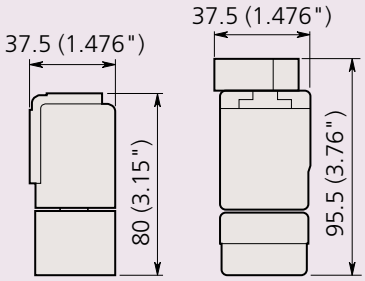
Optional Accessories

09AAA033A: Extension cable (80" / 2m)
09AAA033B: Extension cable (200" / 5m)
09AAA033C: Extension cable (280" / 7m)

174-183A 2-Axis KA Counter
174-185A 3-Axis KA Counter

174-183A

Unit: mm (inch)



Up to 3m **Over 3m**

SPECIFICATIONS

Model	AT103
Effective range	4" to 240" / 100 to 6000mm (42 models)
Resolution	.001" to .000005" / 0.01 to 0.0001mm
Accuracy (20°C)	Effective range 100 to 3000: (5+5L₀/1000)µm Effective range 3250 to 6000: (5+8L₀/1000)µm
Output signal	Two 90° phase-shifted sinusoidal signals
Maximum response speed	120m/min (50m/min when the effective measuring length is 3250 to 6000mm)
Signal output pitch	20µm
Scale reference point	Output in 50mm pitch
Protection level	IP53
Operating temperature	0 to 45°C

*High-precision model **AT103F** (JIS Class 0, (3+3L₀/1000)µm) is also available to special order for the effective range of 100 to 2000mm.
*Ultrahigh-precision model **AT103S** (2+2L₀/1000)µm is also available to special order for the effective range of 100 to 500mm.

AT103				Effective range L₀ inch / mm	Signal cable length (m)
Order No. (standard)	Model (standard)	Order No. (high accuracy)	Model (high accuracy)		
539-111-30	**AT103-100**	**539-111-40**	**AT103-100F**	4" /100mm	3
539-112-30	**AT103-150**	**539-112-40**	**AT103-150F**	6" /150mm	
539-113-30	**AT103-200**	**539-113-40**	**AT103-200F**	8" /200mm	
539-114-30	**AT103-250**	**539-114-40**	**AT103-250F**	10" /250mm	
539-115-30	**AT103-300**	**539-115-40**	**AT103-300F**	12" /300mm	
539-116-30	**AT103-350**	**539-116-40**	**AT103-350F**	14" /350mm	
539-117-30	**AT103-400**	**539-117-40**	**AT103-400F**	16" /400mm	
539-118-30	**AT103-450**	**539-118-40**	**AT103-450F**	18" /450mm	
539-119-30	**AT103-500**	**539-119-40**	**AT103-500F**	20" /500mm	
539-121-30	**AT103-600**	**539-121-40**	**AT103-600F**	24" /600mm	
539-123-30	**AT103-700**	**539-123-40**	**AT103-700F**	28" /700mm	
539-124-30	**AT103-750**	**539-124-40**	**AT103-750F**	30" /750mm	
539-125-30	**AT103-800**	**539-125-40**	**AT103-800F**	32" /800mm	
539-126-30	**AT103-900**	**539-126-40**	**AT103-900F**	36" /900mm	
539-127-30	**AT103-1000**	**539-127-40**	**AT103-1000F**	40" /1000mm	5
539-128-30	**AT103-1100**	**539-128-40**	**AT103-1100F**	44" /1100mm	
539-129-30	**AT103-1200**	**539-129-40**	**AT103-1200F**	48" /1200mm	
539-130-30	**AT103-1300**	**539-130-40**	**AT103-1300F**	52" /1300mm	
539-131-30	**AT103-1400**	**539-131-40**	**AT103-1400F**	56" /1400mm	
539-132-30	**AT103-1500**	**539-132-40**	**AT103-1500F**	60" /1500mm	
539-133-30	**AT103-1600**	**539-133-40**	**AT103-1600F**	64" /1600mm	
539-134-30	**AT103-1700**	**539-134-40**	**AT103-1700F**	68" /1700mm	
539-135-30	**AT103-1800**	**539-135-40**	**AT103-1800F**	72" /1800mm	
539-136-30	**AT103-2000**	**539-136-40**	**AT103-2000F**	80" /2000mm	
539-137-30	**AT103-2200**	—	**AT103-2200F**	88" /2200mm	
539-138-30	**AT103-2400**	—	**AT103-2400F**	96" /2400mm	7
539-139-30	**AT103-2500**	—	**AT103-2500F**	100" /2500mm	
539-140-30	**AT103-2600**	—	**AT103-2600F**	104" /2600mm	
539-141-30	**AT103-2800**	—	**AT103-2800F**	112" /2800mm	
539-142-30	**AT103-3000**	—	**AT103-3000F**	120" /3000mm	
539-143-30	**AT103-3250**	—	**AT103-3250F**	130" /3250mm	10
539-144-30	**AT103-3500**	—	**AT103-3500F**	140" /3500mm	
539-145-30	**AT103-3750**	—	**AT103-3750F**	150" /3750mm	
539-146-30	**AT103-4000**	—	**AT103-4000F**	160" /4000mm	
539-147-30	**AT103-4250**	—	**AT103-4250F**	170" /4250mm	
539-148-30	**AT103-4500**	—	**AT103-4500F**	180" /4500mm	
539-149-30	**AT103-4750**	—	**AT103-4750F**	190" /4750mm	15
539-150-30	**AT103-5000**	—	**AT103-5000F**	200" /5000mm	
539-151-30	**AT103-5250**	—	**AT103-5250F**	210" /5250mm	
539-152-30	**AT103-5500**	—	**AT103-5500F**	220" /5500mm	
539-153-30	**AT103-5750**	—	**AT103-5750F**	230" /5750mm	
539-154-30	**AT103-6000**	—	**AT103-6000F**	240" /6000mm	

Linear Scales AT113

SERIES 539 — Slim Spar Type

- Slim spar type with unit sectional dimensions of 22×35mm.
- Connectable to the **KA** counter, **KLD** counter or **PSU-200**.
- Dimensionally compatible with **AT116** linear scale units.

SPECIFICATIONS

Model	AT113
Effective range	4" to 60" / 100 to 1500mm (20 models)
Resolution	.001" to .000005" / 0.01 to 0.0001mm
Accuracy (20°C)	Standard: (5+5L₀/1000)μm, High accuracy: (3+3Lo/1000)
Output signal	Two 90° phase-shifted sinusoidal signals
Maximum response speed	120m/min
Signal output pitch	20μm
Scale reference point	Output in 50mm pitch
Protection level	IP53
Operating temperature	0 to 45°C

* High-precision model **AT113F** (JIS Class 0, 3+3L₀/1000)μm is also available to special order.
* Ultrahigh-precision model **AT113S** (2+2L₀/1000)μm is also available to special order for the effective range 100 to 500mm.

AT113				Effective range	Signal cable length(m)
Order No. (standard)	Model	Order No. (High accuracy)	Model	L₀ inch / mm	
539-201-30	**AT113-100**	**539-201-40**	**AT113-100F**	4" /100mm	3
539-202-30	**AT113-150**	**539-202-40**	**AT113-150F**	6" /150mm	
539-203-30	**AT113-200**	**539-203-40**	**AT113-200F**	8" /200mm	
539-204-30	**AT113-250**	**539-204-40**	**AT113-250F**	10" /250mm	
539-205-30	**AT113-300**	**539-205-40**	**AT113-300F**	12" /300mm	
539-206-30	**AT113-350**	**539-206-40**	**AT113-350F**	14" /350mm	
539-207-30	**AT113-400**	**539-207-40**	**AT113-400F**	16" /400mm	
539-208-30	**AT113-450**	**539-208-40**	**AT113-450F**	18" /450mm	
539-209-30	**AT113-500**	**539-209-40**	**AT113-500F**	20" /500mm	
539-211-30	**AT113-600**	**539-211-40**	**AT113-600F**	24" /600mm	
539-213-30	**AT113-700**	**539-213-40**	**AT113-700F**	28" /700mm	
539-214-30	**AT113-750**	**539-214-40**	**AT113-750F**	30" /750mm	
539-215-30	**AT113-800**	**539-215-40**	**AT113-800F**	32" /800mm	
539-216-30	**AT113-900**	**539-216-40**	**AT113-900F**	36" /900mm	
539-217-30	**AT113-1000**	**539-217-40**	**AT113-1000F**	40" /1000mm	5
539-218-30	**AT113-1100**	**539-218-40**	**AT113-1100F**	44" /1100mm	
539-219-30	**AT113-1200**	**539-219-40**	**AT113-1200F**	48" /1200mm	
539-220-30	**AT113-1300**	**539-220-40**	**AT113-1300F**	52" /1300mm	
539-221-30	**AT113-1400**	**539-221-40**	**AT113-1400F**	56" /1400mm	
539-222-30	**AT113-1500**	**539-222-40**	**AT113-1500F**	60" /1500mm	

PROPRIETARY INSPECTION CERTIFICATE

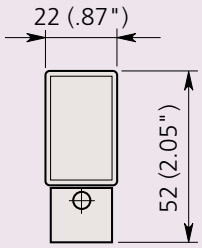
Optional Accessories

09AAA033A: Extension cable (80" / 2m)
09AAA033B: Extension cable (200" / 5m)
09AAA033C: Extension cable (280" / 7m)

174-183A 2-Axis KA Counter
174-185A 3-Axis KA Counter

174-183A

Unit: mm (inch)



Linear Scales AT112-F

SERIES 539 — Super Slim Spar Type

- Super slim spar type with unit sectional dimensions of 15.4×30mm.
- Connectable to the **KA** counter, **KLD** counter or **PSU-200**.

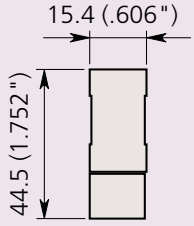
Optional Accessories

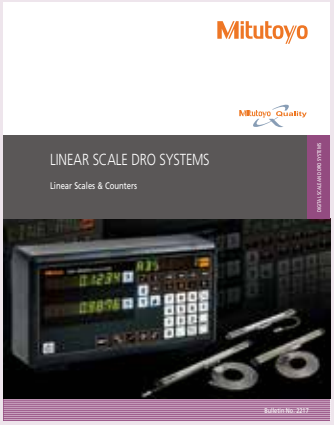
09AAA033A: Extension cable (80" / 2m)
09AAA033B: Extension cable (200" / 5m)
09AAA033C: Extension cable (280" / 7m)

174-183A 2-Axis KA Counter
174-185A 3-Axis KA Counter

174-183A

Unit: mm (inch)





Refer to Bulletin No. (2217) for more details.

SPECIFICATIONS

Model	**AT112-F** (High Accuracy)
Effective range	1.5" to 40" / 50 to 1020mm (19 models)
Resolution	.001 to .000005" / 0.01mm to 0.0001mm
Accuracy (20°C)	(3+3L₀/1000)µm
Output signal	Two 90° phase-shifted sinusoidal signals
Maximum response speed	50m/min
Signal output pitch	20µm
Scale reference point	Output in 50mm pitch*1
Protection level	IP53
Operating temperature	0 to 45°C

* Ultra-high precision model **AT112S** (2+2L₀/1000)µm is also available to special order for the effective range 50 to 320mm.
*1: Models whose effective range is 50mm or 70mm: Center point
Models whose effective range is 120mm or more: 50mm pitch starting at a point 35mm from the "▼" mark on the left seen from the front.

AT112-F		Effective range L₀ inch / mm	Signal cable length (m)
Order No.	Model		
539-251-10	**AT112-50F**	1.5" /50mm	
539-252-10	**AT112-70F**	2.5" /70mm	
539-253-10	**AT112-120F**	4.5" /120mm	
539-254-10	**AT112-170F**	6.5" /170mm	
539-255-10	**AT112-220F**	8.5" /220mm	
539-256-10	**AT112-270F**	10.5" /270mm	
539-257-10	**AT112-320F**	12.5" /320mm	
539-258-10	**AT112-370F**	14.5" /370mm	
539-259-10	**AT112-420F**	16.5" /420mm	
539-260-10	**AT112-470F**	18.5" /470mm	3
539-261-10	**AT112-520F**	20" /520mm	
539-262-10	**AT112-570F**	22" /570mm	
539-263-10	**AT112-620F**	24" /620mm	
539-264-10	**AT112-670F**	26" /670mm	
539-265-10	**AT112-720F**	28" /720mm	
539-266-10	**AT112-770F**	30" /770mm	
539-267-10	**AT112-820F**	32" /820mm	
539-268-10	**AT112-920F**	36" /920mm	
539-269-10	**AT112-1020F**	40" /1020mm	

Linear Scales AT116

SERIES 539 — Economy and Slim Spar Type

PROPRIETARY INSPECTION CERTIFICATE

FEATURES

- Suitable for milling machines, XY tables, jigs, etc.
- Dimensionally compatible with **AT113** linear scale units.
- Connectable to the **KA** counter, **KLD** counter or **PSU-200**.

SPECIFICATIONS

Model	AT116
Effective range	4" to 60" / 100 to 1500mm (20 models)
Resolution	0.01 to 0.0001mm (.001" to .000005")
Accuracy (20°C)	(5+5L₀/1000)µm
Output signal	Two 90° phase-shifted sinusoidal signals
Maximum response speed	50m/min
Signal output pitch	20µm
Scale reference point	Output in 50mm pitch
Protection level	IP53
Operating temperature	0 to 45°C

AT116		Effective range L₀ inch / mm	Signal cable length (m)
Order No.	Model		
539-271-30	**AT116-100**	4" /100mm	3.5
539-272-30	**AT116-150**	6" /150mm	
539-273-30	**AT116-200**	8" /200mm	
539-274-30	**AT116-250**	10" /250mm	
539-275-30	**AT116-300**	12" /300mm	
539-276-30	**AT116-350**	14" /350mm	
539-277-30	**AT116-400**	16" /400mm	
539-278-30	**AT116-450**	18" /450mm	
539-279-30	**AT116-500**	20" /500mm	
539-281-30	**AT116-600**	24" /600mm	
539-283-30	**AT116-700**	28" /700mm	
539-284-30	**AT116-750**	30" /750mm	
539-285-30	**AT116-800**	32" /800mm	
539-286-30	**AT116-900**	36" /900mm	
539-287-30	**AT116-1000**	40" /1000mm	5
539-288-30	**AT116-1100**	44" /1100mm	
539-289-30	**AT116-1200**	48" /1200mm	
539-290-30	**AT116-1300**	52" /1300mm	
539-291-30	**AT116-1400**	56" /1400mm	
539-292-30	**AT116-1500**	60" /1500mm	

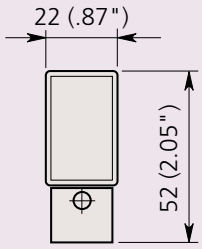
Optional Accessories

09AAB674A: Extension cable (2m / 80")
09AAB674B: Extension cable (5m / 200")
09AAB674C: Extension cable (7m / 280")

174-183A 2-Axis KA Counter
174-185A 3-Axis KA Counter

174-183A

Unit: mm (inch)



Linear Scales AT402E

SERIES 539 — General-purpose Type

- Ideal for machine tools for heavy cutting, as well as linear motors.
- Multi-point elastic fixing for excellent vibration resistance (200m/s^2), shock resistance (400m/s^2) and temperature characteristics.
- The Absolute Interval Code allows for a simplified, low-cost ABS system.
- High accuracy of ±2µm (up to 540mm)

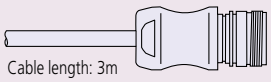
SPECIFICATIONS

Model	AT402E
Effective range	5.6" to 121.6" / 140 to 3040mm (24 models)
Accuracy (20°C)	Effective range: 140 to 540mm: ±2µm Effective range: 640 to 940mm: ±3µm Effective range: 1040 to 3040mm: ±3µm/m
Output signal	Signal: 1Vp-p differential sinusoidal signal Differential reference point pulse: **Absolute Interval Code** compatible
Maximum response speed	120m/min (With sinusoidal signal amplitude of –3dB)
Signal output pitch	20µm
Protection level	IP53
Operating temperature	0 to 45°C
Cable configuration	Type A: 3m flying lead cable Type B: 3m cable with European CNC connectors Type C: 3m cable with FANUC connectors

Cable A: Lead wires type

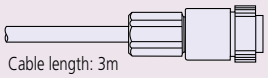
Cable length: 3m

Cable B: Connectable to Euro controller



Cable length: 3m

Cable C: Connectable to FANUC serial board C



Cable length: 3m

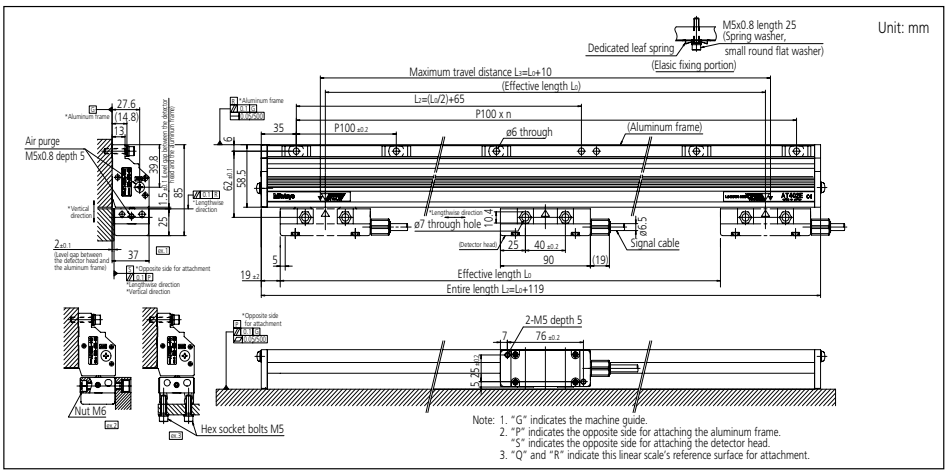
AT402E		Effective range
Order No.	**Model**	L_0 inch / mm
539-371- □□	**AT402E-140**	5.6" /140mm
539-373- □□	**AT402E-240**	9.6" /240mm
539-374- □□	**AT402E-340**	13.6" /340mm
539-375- □□	**AT402E-440**	17.6" /440mm
539-376- □□	**AT402E-540**	21.6" /540mm
539-377- □□	**AT402E-640**	25.6" /640mm
539-378- □□	**AT402E-740**	29.6" /740mm
539-379- □□	**AT402E-840**	33.6" /840mm
539-380- □□	**AT402E-940**	37.6" /940mm
539-381- □□	**AT402E-1040**	41.6" /1040mm
539-382- □□	**AT402E-1140**	45.6" /1140mm
539-383- □□	**AT402E-1240**	49.6" /1240mm

AT402E		Effective range
Order No.	**Model**	L_0 inch / mm
539-384- □□	**AT402E-1340**	53.6" /1340mm
539-385- □□	**AT402E-1440**	57.6" /1440mm
539-386- □□	**AT402E-1540**	61.6" /1540mm
539-387- □□	**AT402E-1640**	65.6" /1640mm
539-388- □□	**AT402E-1740**	69.6" /1740mm
539-389- □□	**AT402E-1840**	73.6" /1840mm
539-390- □□	**AT402E-2040**	81.6" /2040mm
539-391- □□	**AT402E-2240**	89.6" /2240mm
539-392- □□	**AT402E-2440**	97.6" /2440mm
539-393- □□	**AT402E-2640**	105.6" /2640mm
539-394- □□	**AT402E-2840**	113.6" /2840mm
539-395- □□	**AT402E-3040**	121.6" /3040mm

Signal cable length: 3m

* The indication of " □□ " in the code numbers will be **01** for Type A, **02** for Type B, **03** for Type C, and **00** for no cable

DIMENSIONS



Linear Scales AT203

SERIES 539 — Standard Type

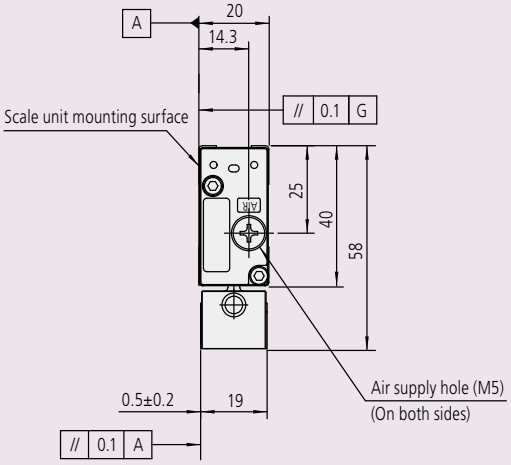
PROPRIETARY INSPECTION CERTIFICATE

- The travel length of the linear scale is output with 2-phase square wave signals, which can be used as a feedback signal for NC machine tools.
- The pulse signal unit (PSU) is no longer needed, and the **AT203** can be directly connected to an NC machine tool.

SPECIFICATIONS

Model	AT203
Effective range	4" to 240" / 100 to 6000mm (42 models)
Accuracy (20°C)	Effective range: 100 to 1500mm (3+3L₀/1000)µm Effective range: 1600 to 3000mm (5+5L₀/1000)µm Effective range: 3250 to 6000mm (5+8L₀/1000)µm
Output signal	Two 90° phase-shifted square wave signals
Maximum response speed	120m/min (50m/min when the effective range is 3250 to 6000mm)
Resolution	0.1/0.5/1µm (Switchable by the DIP switches)
Scale reference point	Output in 50mm pitch
Protection level	IP53
Operating temperature	0°C to 45°C

AT203		Effective range	Signal cable length
Order No.	Model	L₀ inch / mm	(m)
539-411-30	**AT203-100**	4" /100mm	
539-412-30	**AT203-150**	6" /150mm	
539-413-30	**AT203-200**	8" /200mm	
539-414-30	**AT203-250**	10" /250mm	
539-415-30	**AT203-300**	12" /300mm	
539-416-30	**AT203-350**	14" /350mm	
539-417-30	**AT203-400**	16" /400mm	
539-418-30	**AT203-450**	18" /450mm	
539-419-30	**AT203-500**	20" /500mm	
539-421-30	**AT203-600**	24" /600mm	
539-423-30	**AT203-700**	28" /700mm	
539-424-30	**AT203-750**	30" /750mm	
539-425-30	**AT203-800**	32" /800mm	
539-426-30	**AT203-900**	36" /900mm	
539-427-30	**AT203-1000**	40" /1000mm	
539-428-30	**AT203-1100**	44" /1100mm	
539-429-30	**AT203-1200**	48" /1200mm	
539-430-30	**AT203-1300**	52" /1300mm	
539-431-30	**AT203-1400**	56" /1400mm	
539-432-30	**AT203-1500**	60" /1500mm	
539-433-30	**AT203-1600**	64" /1600mm	5
539-434-30	**AT203-1700**	68" /1700mm	
539-435-30	**AT203-1800**	72" /1800mm	
539-436-30	**AT203-2000**	80" /2000mm	
539-437-30	**AT203-2200**	88" /2200mm	
539-438-30	**AT203-2400**	96" /2400mm	
539-439-30	**AT203-2500**	100" /2500mm	
539-440-30	**AT203-2600**	104" /2600mm	
539-441-30	**AT203-2800**	112" /2800mm	
539-442-30	**AT203-3000**	120" /3000mm	
539-443-30	**AT203-3250**	130" /3250mm	
539-444-30	**AT203-3500**	140" /3500mm	
539-445-30	**AT203-3750**	150" /3750mm	
539-446-30	**AT203-4000**	160" /4000mm	
539-447-30	**AT203-4250**	170" /4250mm	
539-448-30	**AT203-4500**	180" /4500mm	
539-449-30	**AT203-4750**	190" /4750mm	
539-450-30	**AT203-5000**	200" /5000mm	
539-451-30	**AT203-5250**	210" /5250mm	
539-452-30	**AT203-5500**	220" /5500mm	
539-453-30	**AT203-5750**	230" /5750mm	
539-454-30	**AT203-6000**	240" /6000mm	



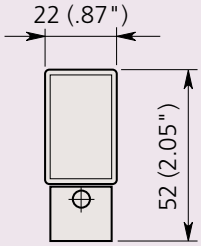
- Any scale size drawings are available on request.

Linear Scales AT216-T / AT217-TL

SERIES 529 — Slim, Sealed Type

- Slim, sealed type incremental linear scales suitable for feedback systems in NC machine tools.
- Direct connection with NC machine tools is possible.
- Square wave RS-422A, 1µm/0.5µm & 5µm resolution.
- Armored cable included (unless otherwise specified)

Unit: mm (inch)



- Any scale size drawings are available on request.

5µm resolution

AT216-T		Effective range Lo inch / mm	Signal cable length (m)
Order No.	Model		
529-431-3	**AT216-100T**	4" /100mm	5
529-432-3	**AT216-150T**	6" /150mm	
529-433-3	**AT216-200T**	8" /200mm	
529-434-3	**AT216-250T**	10" /250mm	
529-435-3	**AT216-300T**	12" /300mm	
529-436-3	**AT216-350T**	14" /350mm	
529-437-3	**AT216-400T**	16" /400mm	
529-438-3	**AT216-450T**	18" /450mm	
529-439-3	**AT216-500T**	20" /500mm	
529-441-3	**AT216-600T**	24" /600mm	
529-443-3	**AT216-700T**	28" /700mm	
529-444-3	**AT216-750T**	30" /750mm	
529-445-3	**AT216-800T**	32" /800mm	
529-446-3	**AT216-900T**	36" /900mm	
529-447-3	**AT216-1000T**	40" /1000mm	
529-448-3	**AT216-1100T**	44" /1100mm	
529-449-3	**AT216-1200T**	48" /1200mm	
529-450-3	**AT216-1300T**	52" /1300mm	
529-451-3	**AT216-1400T**	56" /1400mm	
529-452-3	**AT216-1500T**	60" /1500mm	

1µm/0.5µm resolution

AT217-TL		Effective range Lo inch / mm	Signal cable length (m)
Order No.	Model		
529-461-5 (-7)	**AT217-100TL**	4" /100mm	5
529-462-5 (-7)	**AT217-150TL**	6" /150mm	
529-463-5 (-7)	**AT217-200TL**	8" /200mm	
529-464-5 (-7)	**AT217-250TL**	10" /250mm	
529-465-5 (-7)	**AT217-300TL**	12" /300mm	
529-466-5 (-7)	**AT217-350TL**	14" /350mm	
529-467-5 (-7)	**AT217-400TL**	16" /400mm	
529-468-5 (-7)	**AT217-450TL**	18" /450mm	
529-469-5 (-7)	**AT217-500TL**	20" /500mm	
529-471-5 (-7)	**AT217-600TL**	24" /600mm	
529-473-5 (-7)	**AT217-700TL**	28" /700mm	
529-474-5 (-7)	**AT217-750TL**	30" /750mm	
529-475-5 (-7)	**AT217-800TL**	32" /800mm	
529-476-5 (-7)	**AT217-900TL**	36" /900mm	
529-477-5 (-7)	**AT217-1000TL**	40" /1000mm	
529-478-5 (-7)	**AT217-1100TL**	44" /1100mm	
529-479-5 (-7)	**AT217-1200TL**	48" /1200mm	
529-480-5 (-7)	**AT217-1300TL**	52" /1300mm	
529-481-5 (-7)	**AT217-1400TL**	56" /1400mm	
529-482-5 (-7)	**AT217-1500TL**	60" /1500mm	

(-7) : option for unarmored cable

Mitutoyo

Linear Scales AT211

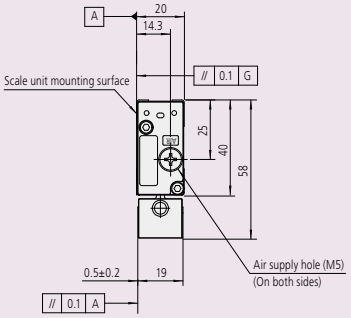
AT211-A (Multipoint mounting), AT211-B (Double-end mounting)

SERIES 539 — Slim Spar and High-speed Type

FEATURES

- High-resolution, high-accuracy sealed type linear scales. Ideal for feedback control in positioning a semiconductor manufacturing system, CNC machine tool, etc.
- Two types of models are available: the AT211-A, the multiple-point installation type designed for improved resistance against vibration and shock; and the AT211-B, which attaches to a machine at both ends. The AT211-B is compatible with the AT113/AT116 slim type in size.

- This is a slim, sealed, 2-phase, square-wave scale that can be directly connected to a control unit.
- Scale alarm display LED allows for easy maintenance.
- A wide range of specifications to best suit your application.
- Suitable for the control of semiconductor manufacturing systems and NC machine tools.



- Any scale size drawings are available on request.

Common specification

Model	AT211
Effective range*	4 to 60" / 100 to 1500mm (20 models)
Accuracy (20°C)*	(3+3L₀/1000)µm L₀: effective range (mm)
	(2+2L₀/1000)µm (L₀≤500mm)
Output signal	Two 90° phase-shifted square wave signals
Maximum response speed*	5.4 to 120m/min (varies depending on the resolution or minimum edge interval)
Resolution*	0.1/ 0.2/ 0.5/ 1.0/ 2.5/ 5.0µm
Scale reference point*	50mm/Center point/Left-edge point/Right-edge point
Protection level	IP53
Operating temperature	0 to 45°C

* Desired specification is selectable.

Meaning of Model No.

AT211 - 0100 A 1 S - P 1 - A B

- Effective range: 100 to 1500mm
- Mounting method: Multipoint mounting/Double-end mounting
- Scale reference point: 50mm/ Center point/ Left edge point/ Right edge point
- Indication accuracy: (3+3L₀/1000)µm / (2+2L₀/1000)µm
- Resolution/ Minimum edge-to-edge interval: 0.1 to 5µm / 125 to 1000ns, 22 types
- Direction: PA/PB phase
- Head cable: 0.3 to 9m, 9 types
- Signal cable: 3 to 7m / None, 10 types

Linear Scales ST422

SERIES 579 — Compact Type

*1:

Effective range	Accuracy
300mm or less	±1µm
500mm or less	±2µm
1000mm or less	±3µm
3000mm or less	±3µm/m

- The maximum response speed is 5000mm/s. (When resolution is 1µm and the minimum edge interval is 125ns.)
- Ultra-compact detector control unit allows use in applications where space-saving design is important.
- The maximum effective measurement length of 3000mm enables use on large machines.
- Simultaneous output of 2-phase square wave signals (maximum resolution: 0.2µm) and 2-phase sinusoidal wave signals (main signal: 40µm) is available.
- LED function for indicating signal errors.
- Equipped with scale reference point output.

SPECIFICATIONS

Model	ST422
Detection method	Reflective photoelectric linear encoder
Output signal	2-phase sinusoidal signals, 2-phase square wave signals
Main scale grating pitch	40µm
Signal output pitch	40µm
Effective range	10 to 3000mm
Accuracy (20°C)*1	±1µm, ±2µm, ±3µm(/m)
Resolution	0.2µm/ 0.5µm/ 1µm/ 5µm (Selectable with internal switch)
Scale reference point	Center point (10 to 75mm)/ 50mm pitch (100mm or more)
Maximum response speed	5000mm/s (varies depending on the setting)
Minimum edge-to-edge interval	125ns/ 250ns/ 500ns/ 1µs (selectable with internal switch)
Operating temperature/ humidity range	0 to 40°C, RH 20 to 80% (no condensation)
Storage temperature/ humidity range	–20 to 60°C, RH 20 to 80% (no condensation)
Head cable length	1m

Dimensions of scale units

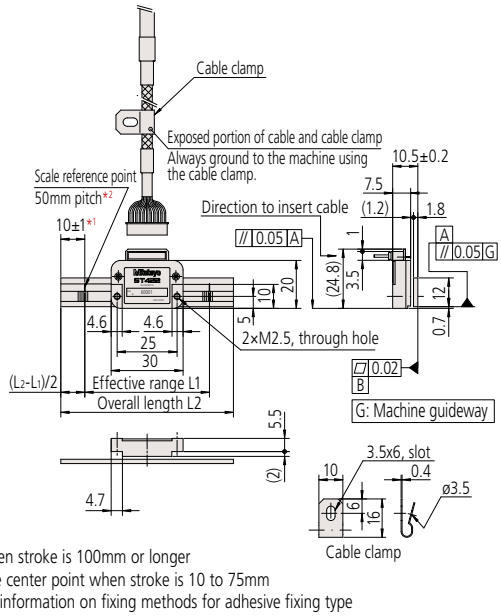
Order No.	Code	Effective range L1 (mm)	Overall length L2 (mm)	Scale fixing pitch L3 (mm)	Retaining spring A	Retaining spring B
579-631	ST422-10	10	30	—	—	—
579-632	ST422-25	25	45	—	—	—
579-633	ST422-50	50	70	—	—	—
579-634	ST422-75	75	95	—	—	—
579-635	ST422-100	100	120	—	—	—
579-636	ST422-150	150	170	—	—	—
579-637	ST422-200	200	220	—	—	—
579-638	ST422-250	250	270	—	—	—
579-639	ST422-300	300	320	—	—	—
579-640	ST422-350	350	370	—	—	—
579-641	ST422-400	400	440	100	1 pc.	4 pcs.
579-642	ST422-450	450	490	75	1 pc.	6 pcs.
579-643	ST422-500	500	540	80	1 pc.	6 pcs.
579-644	ST422-600	600	640	100	1 pc.	6 pcs.
579-645	ST422-700	700	740	85	1 pc.	8 pcs.
579-646	ST422-800	800	840	100	1 pc.	8 pcs.
579-647	ST422-900	900	940	90	1 pc.	10 pcs.

Order No.	Code	Effective range L1 (mm)	Overall length L2 (mm)	Scale fixing pitch L3 (mm)	Retaining spring A	Retaining spring B
579-648	ST422-1000	1000	1040	100	1 pc.	10 pcs.
579-649	ST422-1100	1100	1140	90	1 pc.	12 pcs.
579-650	ST422-1200	1200	1240	100	1 pc.	12 pcs.
579-651	ST422-1300	1300	1340	130	1 pc.	10 pcs.
579-652	ST422-1400	1400	1440	100	1 pc.	14 pcs.
579-653	ST422-1500	1500	1540	125	1 pc.	12 pcs.
579-654	ST422-1600	1600	1640	100	1 pc.	16 pcs.
579-655	ST422-1700	1700	1740	120	1 pc.	14 pcs.
579-656	ST422-1800	1800	1840	100	1 pc.	18 pcs.
579-657	ST422-2000	2000	2040	100	1 pc.	20 pcs.
579-658	ST422-2200	2200	2240	100	1 pc.	22 pcs.
579-659	ST422-2400	2400	2440	100	1 pc.	24 pcs.
579-660	ST422-2500	2500	2540	95	1 pc.	26 pcs.
579-661	ST422-2600	2600	2640	100	1 pc.	26 pcs.
579-662	ST422-2800	2800	2840	100	1 pc.	28 pcs.
579-663	ST422-3000	3000	3040	100	1 pc.	30 pcs.

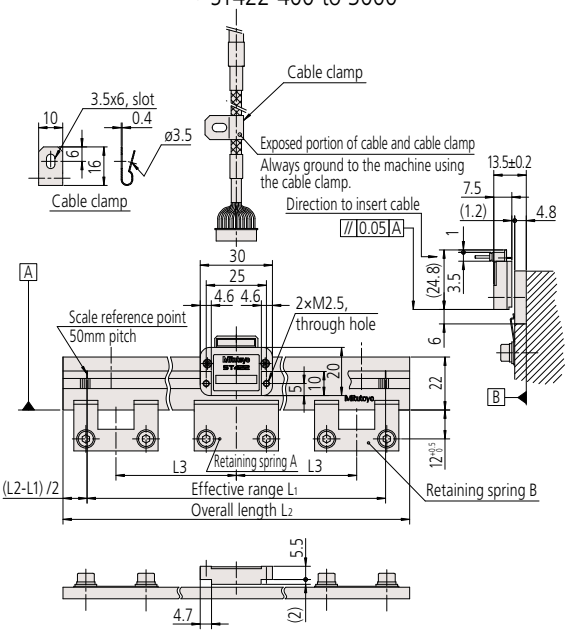
ST422 Scale unit mounting dimensions

Unit: mm

• ST422-10 to 350 (Adhesive fixing type) *3



• ST422-400 to 3000

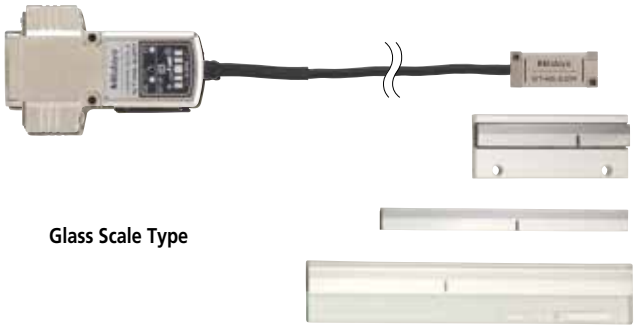


*1 When stroke is 100mm or longer
*2 One center point when stroke is 10 to 75mm
*3 For information on fixing methods for adhesive fixing type

• Any scale size drawings are available on request.

Linear Scales ST46-EZA

SERIES 579 — Compact Type

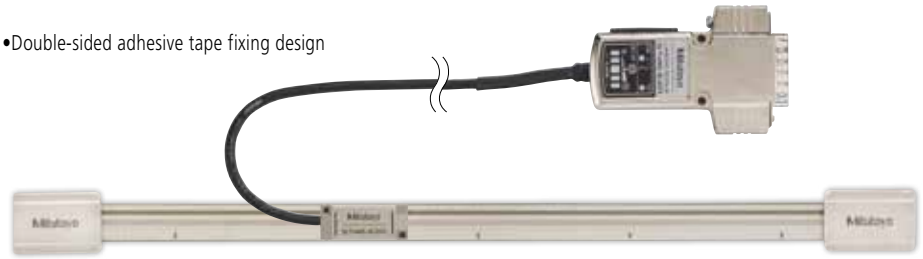


Glass Scale Type

Metal Tape Scale Type

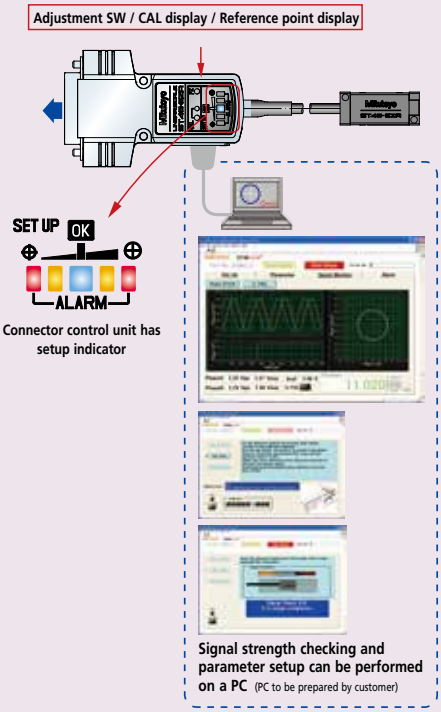
•Double-end fixing tentioned design

•Double-sided adhesive tape fixing design



NC side

- Includes an automatic adjusting function for the signal (EZA function) at the push of a button.
- Detector head mounting and signal adjustment possible without oscilloscope or PC.
- A setup indicator for checking signal strength is included.
- I/F circuit integrated in connector shell reduces volume to 60% compared to conventional interface.
- Self-diagnosis function with USB connectivity facilitates signal strength checking and parameter setup.
- Glass and metal tape scales are available.
- The thickness of the detector head is only 7.5 mm. The metal tape scale type has a mounting surface area of 12.5 by 9.325 mm, allowing use in applications where a space-saving design is important.
- Drawings are available on request



SPECIFICATIONS

Model	ST46-EZA	
Detection method	Reflective photoelectlic linear encoder	
Scale type	Glass	Metal tape
Main scale grating pitch	20μm	
Output signal	Type B: 2-phase square wave signals, reference point pulse, external reset input. Type C: 2-phase square wave signals, reference point pulse, 2-phase sinusoidal signals.	
Effective range	10 to 3000mm	
Resolution	0.05μm to 5 μm	
Accuracy (20°C)	Effective range 10 to 300mm: ±1μm Effective range 350 to 500mm: ±2μm Effective range 600 to 1000mm: ±3μm Effective range 1100 to 3000mm: ±3μm/m	Effective range 10 to 1000mm: ±5μm Effective range 1100 to 3000mm: ±5μm/m (The above accuracy applies to individual scales. For double-end fixing designs, perform point-to-point correction after ensuring the metal tape is tensioned correctly.)
Maximum response speed	2.6m/s (With sinusoidal signal amplitude of -3dB)	
Scale reference point	50mm pitch, 10 to 80mm: Center point	
Power supply voltage	5VDC±5%	
Operating temperature/humidity range	0 to 40°C, RH 20 to 80% (no condensation)	
Storage temperature/humidity range	–20 to 60°C, RH 20 to 80% (no condensation)	

Linear Scales ST36

SERIES 579 — High-accuracy Type

- Outputs two-phase sinusoidal wave signal, two-phase pulse signal, and 1Vp-p at 4µm pitch.
- High-accuracy type, 0.5µm class (effective range up to 300mm)
- Has a thinner detector head (thickness 11.5mm).
- The maximum effective measurement range of 3000mm allows use on large machines.
- Four types available for each signal output specification.
- LED function for indicating signal errors.
- Along with the output specifications of 2-phase sinusoidal wave and 2-phase square wave, the output specification of 1Vp-p wave is available.

- Any scale size drawings are available on request.

SPECIFICATIONS

Model	ST36
Detection method	Reflective photoelectric linear encoder
Output signal	**ST36A**: 2-phase sinusoidal signals **ST36B**: 2-phase square wave signals, alarm reset input **ST36C**: 2-phase square wave signals, 2-phase sinusoidal signals **ST36D**: 1Vp-p differential sinusoidal signals
Main scale grating pitch	8µm
Signal output pitch	4µm
Effective range	10 to 3000mm
Resolution	0.01, 0.02, 0.05, 0.1µm
Accuracy (20°C)*1	±0.5µm, ±1µm, ±2µm(/m)
Maximum response speed*2	1200mm/s
Scale reference point	Center point (10 to 80mm) 50mm pitch (100 to 3000mm)
Power supply voltage	DC5V ±5%
Operating temperature/humidity range	0 to 40°C/ 20 to 80% (no condensation)
Storage temperature/ humidity range	–20 to 60°C/ 20 to 80% (no condensation)
Head cable length	1m (high-flex connecting cable)

*1:

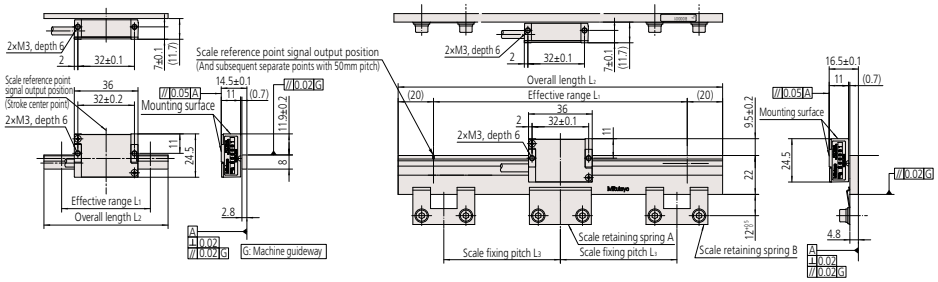
Effective range	Accuracy
300mm or less	±0.5µm
500mm or less	±1µm
1000mm or less	±2µm
3000mm or less	±2µm/m

*2: Maximum response speed when the sinusoidal signals are output

Mounting dimensions

Unit: mm

- 10 to 80mm (Adhesive fixing type)
- 100 to 3000mm



Dimensions of scale units

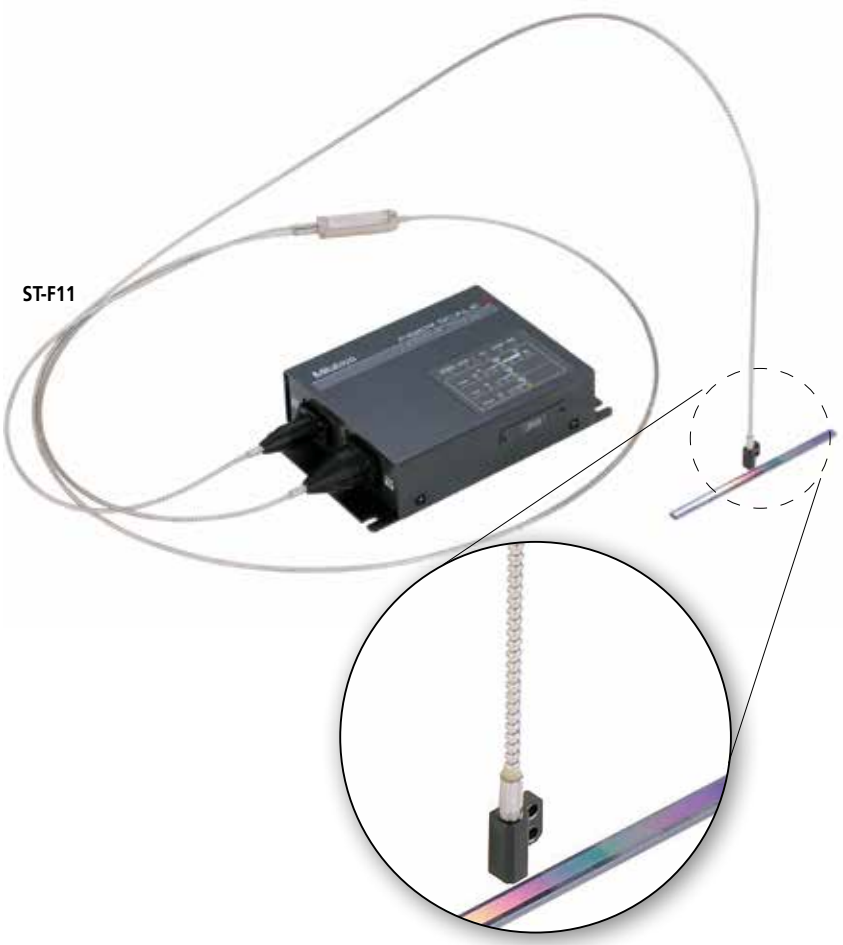
Order No.*	Code*	Effective range L1 (mm)	Overall length L2 (mm)	Scale fixing pitch L3 (mm)	Retaining spring A	Retaining spring B
579-501-0☐	ST36◇-10	10	30	–	–	–
579-502-0☐	ST36◇-25	25	45	–	–	–
579-503-0☐	ST36◇-50	50	70	–	–	–
579-504-0☐	ST36◇-75	75	90	–	–	–
579-505-0☐	ST36◇-80	80	100	–	–	–
579-506-0☐	ST36◇-100	100	140	50	1 pc.	2 pcs.
579-507-0☐	ST36◇-150	150	190	75	1 pc.	2 pcs.
579-508-0☐	ST36◇-200	200	240	100	1 pc.	2 pcs.
579-509-0☐	ST36◇-250	250	290	60	1 pc.	4 pcs.
579-510-0☐	ST36◇-300	300	340	75	1 pc.	4 pcs.
579-511-0☐	ST36◇-350	350	390	85	1 pc.	4 pcs.
579-512-0☐	ST36◇-400	400	440	100	1 pc.	4 pcs.
579-513-0☐	ST36◇-450	450	490	75	1 pc.	6 pcs.
579-514-0☐	ST36◇-500	500	540	80	1 pc.	6 pcs.
579-515-0☐	ST36◇-600	600	640	100	1 pc.	6 pcs.
579-516-0☐	ST36◇-700	700	740	85	1 pc.	8 pcs.
579-517-0☐	ST36◇-800	800	840	100	1 pc.	8 pcs.

Order No.*	Code*	Effective range L1 (mm)	Overall length L2 (mm)	Scale fixing pitch L3 (mm)	Retaining spring A	Retaining spring B
579-518-0☐	ST36◇-900	900	940	90	1 pc.	10 pcs.
579-519-0☐	ST36◇-1000	1000	1040	100	1 pc.	10 pcs.
579-520-0☐	ST36◇-1100	1100	1140	90	1 pc.	12 pcs.
579-521-0☐	ST36◇-1200	1200	1240	100	1 pc.	12 pcs.
579-522-0☐	ST36◇-1300	1300	1340	130	1 pc.	10 pcs.
579-523-0☐	ST36◇-1400	1400	1440	100	1 pc.	14 pcs.
579-524-0☐	ST36◇-1500	1500	1540	125	1 pc.	12 pcs.
579-525-0☐	ST36◇-1600	1600	1640	100	1 pc.	16 pcs.
579-526-0☐	ST36◇-1700	1700	1740	120	1 pc.	14 pcs.
579-527-0☐	ST36◇-1800	1800	1840	100	1 pc.	18 pcs.
579-528-0☐	ST36◇-2000	2000	2040	100	1 pc.	20 pcs.
579-529-0☐	ST36◇-2200	2200	2240	100	1 pc.	22 pcs.
579-530-0☐	ST36◇-2400	2400	2440	100	1 pc.	24 pcs.
579-531-0☐	ST36◇-2500	2500	2540	95	1 pc.	26 pcs.
579-532-0☐	ST36◇-2600	2600	2640	100	1 pc.	26 pcs.
579-533-0☐	ST36◇-2800	2800	2840	100	1 pc.	28 pcs.
579-534-0☐	ST36◇-3000	3000	3040	100	1 pc.	30 pcs.

* The above code numbers are for recommended items marked with ● / ◎ symbols.
If recommended specifications meet your requirements, use these code numbers to order.
* The ☐ and ◇ symbols in the tables above have the following meanings:
◇→A (2-phase sinusoidal signals): ☐→1
◇→B (2-phase square wave signals + reset input): ☐→2
◇→C (2-phase sinusoidal signals + 2-phase square wave signals): ☐→3
◇→D (1Vp-p differential): ☐→4

Fiber Scale ST-F11

SERIES 579 — Ultra Compact Linear Scale



FEATURES

- Ultra-compact detector head: 5mm width (S-Type)
- High resolution: 100 nm (0.1µm), 50 nm (0.05µm), 10 nm (0.01µm)
- Isolated heat source. No heat source at the detector head.
- Immune to EMI.
- Easy installation. LEDs on the processor indicate which direction to adjust the detector head when mounting.

Processor LED Indicators

SPECIFICATIONS

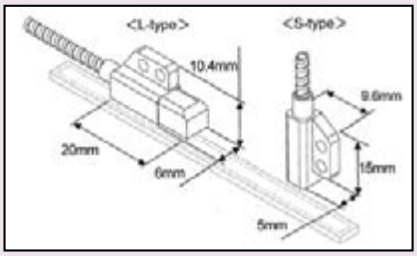
Model	ST- F11B	ST- F11C
Detection method	Diffraction interference , reflection-type linear encoder	
Grating pitch for the main scale	4 µm	
Signal output pitch	2 µm	
Output signal	2-phase-shifted square wave (+ reset input)	2-phase-shifted square wave 2-phase-shifted sine wave
Resolution	10 nm / 50 nm / 100 nm (switchable)	
Effective length	4" / 100 mm	
Accuracy at 20°C	±1 µm, ±2 µm (custom-holder type)	
Maximum response speed	800 mm/s (For the sine wave)	
Read head size (Selectable)	Perpendicular (S-Type) 5x9.6x12 Parallel (L-Type) 6x17x10	
Main scale material (Selectable)	Quartz glass (expansion coefficient: 0.5 x10^{-6}) (LTE) Low thermal expansion glass (expansion coefficient: 0±0.02 x10^{-6})	
Fiber length (Selectable)	2, 3, 5, 10 m (20, 30m: custom-order)	
Maximum consumption current / operating voltage	350 mA / DC5V±5%	
Operating temperature and humidity	0~40°C 20~80%RH (no condensation)	
Storage temperature and humidity	-20~60°C 20~80%RH (no condensation)	
Functions	Alarm output, read-head attitude confirmation, signal-confirmation function	

- Any scale size drawings are available on request.

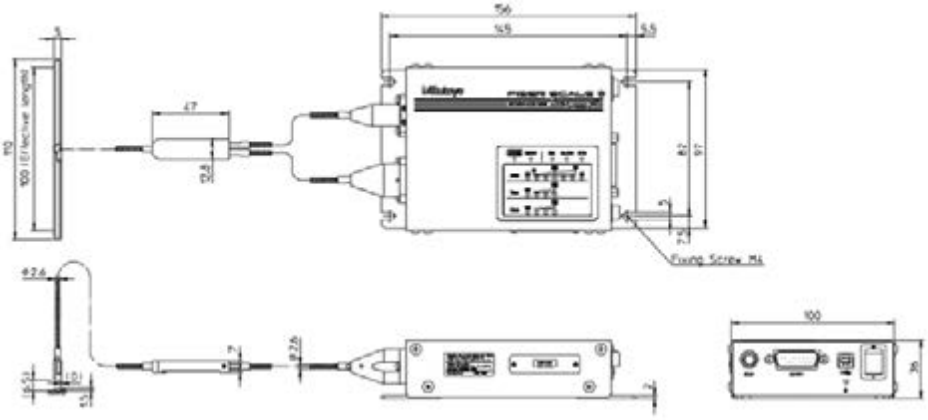
Fiber Scale ST-F11

SERIES 579 — Ultra Compact Linear Scale

Dimensions of Detector Heads



Dimensions of Processor



SPECIFICATIONS

Order Number	Model Number	Output Signal	Scale Material	Detector Orientation to Scale	Fiber Length
579-701-11	ST-F11B-100A-S02	2 Phase Square	Quartz Glass	Parallel	2m
579-702-11	ST-F11B-100A-S03	2 Phase Square	Quartz Glass	Parallel	3m
579-703-11	ST-F11B-100A-S05	2 Phase Square	Quartz Glass	Parallel	5m
579-704-11	ST-F11B-100A-S10	2 Phase Square	Quartz Glass	Parallel	10m
579-701-12	ST-F11B-100B-S02	2 Phase Square	LTE Glass	Parallel	2m
579-702-12	ST-F11B-100B-S03	2 Phase Square	LTE Glass	Parallel	3m
579-703-12	ST-F11B-100B-S05	2 Phase Square	LTE Glass	Parallel	5m
579-704-12	ST-F11B-100B-S10	2 Phase Square	LTE Glass	Parallel	10m
579-701-21	ST-F11C-100A-S02	2 Phase Square / 2 phase sine	Quartz Glass	Parallel	2m
579-702-21	ST-F11C-100A-S03	2 Phase Square / 2 phase sine	Quartz Glass	Parallel	3m
579-703-21	ST-F11C-100A-S05	2 Phase Square / 2 phase sine	Quartz Glass	Parallel	5m
579-704-21	ST-F11C-100A-S10	2 Phase Square / 2 phase sine	Quartz Glass	Parallel	10m
579-701-22	ST-F11C-100B-S02	2 Phase Square / 2 phase sine	LTE Glass	Parallel	2m
579-702-22	ST-F11C-100B-S03	2 Phase Square / 2 phase sine	LTE Glass	Parallel	3m
579-703-22	ST-F11C-100B-S05	2 Phase Square / 2 phase sine	LTE Glass	Parallel	5m
579-704-22	ST-F11C-100B-S10	2 Phase Square / 2 phase sine	LTE Glass	Parallel	10m
579-711-11	ST-F11B-100A-L02	2 Phase Square	Quartz Glass	Perpendicular	2m
579-712-11	ST-F11B-100A-L03	2 Phase Square	Quartz Glass	Perpendicular	3m
579-713-11	ST-F11B-100A-L05	2 Phase Square	Quartz Glass	Perpendicular	5m
579-714-11	ST-F11B-100A-L10	2 Phase Square	Quartz Glass	Perpendicular	10m
579-711-12	ST-F11B-100B-L02	2 Phase Square	LTE Glass	Perpendicular	2m
579-712-12	ST-F11B-100B-L03	2 Phase Square	LTE Glass	Perpendicular	3m
579-713-12	ST-F11B-100B-L05	2 Phase Square	LTE Glass	Perpendicular	5m
579-714-12	ST-F11B-100B-L10	2 Phase Square	LTE Glass	Perpendicular	10m
579-711-21	ST-F11C-100A-L02	2 Phase Square / 2 phase sine	Quartz Glass	Perpendicular	2m
579-712-21	ST-F11C-100A-L03	2 Phase Square / 2 phase sine	Quartz Glass	Perpendicular	3m
579-713-21	ST-F11C-100A-L05	2 Phase Square / 2 phase sine	Quartz Glass	Perpendicular	5m
579-714-21	ST-F11C-100A-L10	2 Phase Square / 2 phase sine	Quartz Glass	Perpendicular	10m
579-711-22	ST-F11C-100B-L02	2 Phase Square / 2 phase sine	LTE Glass	Perpendicular	2m
579-712-22	ST-F11C-100B-L03	2 Phase Square / 2 phase sine	LTE Glass	Perpendicular	3m
579-713-22	ST-F11C-100B-L05	2 Phase Square / 2 phase sine	LTE Glass	Perpendicular	5m
579-714-22	ST-F11C-100B-L10	2 Phase Square / 2 phase sine	LTE Glass	Perpendicular	10m

Pulse Signal Interface Unit PSU-200

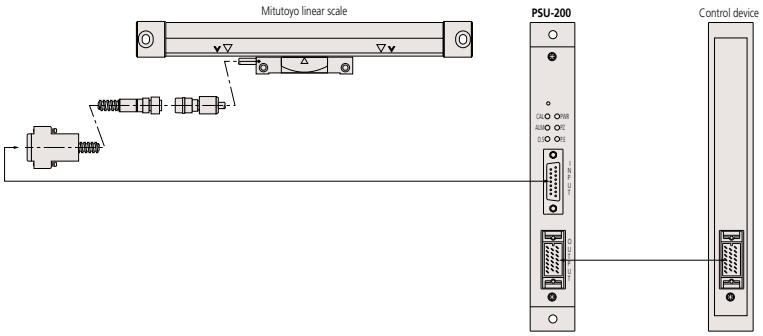
SERIES 539

- The **PSU-200** splits the sinusoidal signal output by Mitutoyo linear scales into a minimum of four and a maximum of 200 divisions, and converts the signal to a square-wave signal so that NC feedback systems, measurement control devices, etc., can be used with linear scales in order to achieve highly accurate positioning.

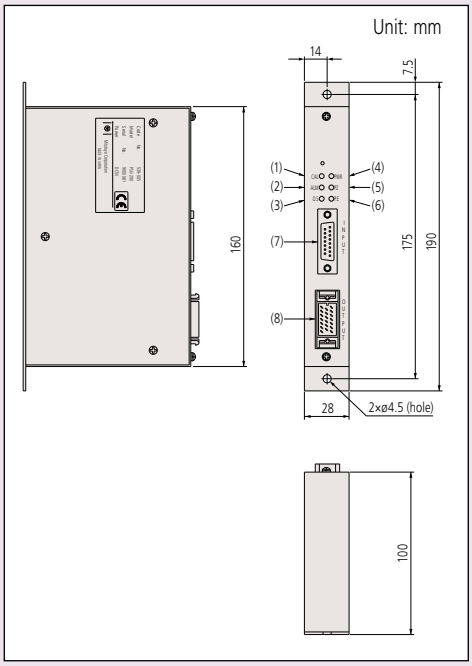
SPECIFICATIONS

Order No.	**539-005**
Model	**PSU-200**
Number of axes	1 axis
Input	Input connector DA-15S-N (JAE) or equivalent Input signal: 2-phase sinusoidal and the reference voltage, reference point, scale alarm
Output	Output connector: MR-20RMA (HONDA TSUSHIN KOGYO CO., LTD.) Output signal: 2-phase square wave signals (PA, PB), reference point (PZ), alarm, alarm reset, photo-coupler
Number of splits	4, 8, 10, 20, 40, 80, 100, 200 (Selectable with the switch)
Function	Setting the number of slits, setting the minimum edge interval, and maximum response speed. Detection of broken wires or short circuits and abnormalities (alarm), detection of signal errors (alarm). Power supply voltage low-alarm (warning light only), switching between high-impedance mode and alarm-signal output mode. Reference position detection light, hysteresis width settings (directly linked to No. of divisions), external alarm reset input (photocoupler), switching directions
Power supply voltage	5VDC ±5%
Current consumption	200mA
Storage temperature range	–20°C to 70°C
Operating temperature range	0°C to 40°C
Dimensions	160(W)×100(D)×28(H)mm
Mass	Approx. 620g

System configuration



DIMENSIONS



Signal Conversion Adapter PSU-400E

SERIES 539 — Interface Unit (Optional accessories)

FEATURES

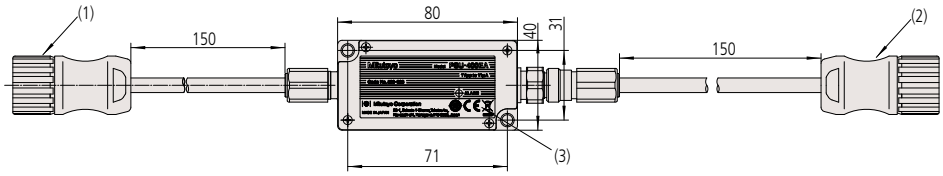
- The PSU-400E series interface unit converts the 1Vp-p differential signal output by AT402E, so that NC feedback systems or measurement control devices can be used with linear scales in order to achieve highly accurate positioning.
- PSU-400EA interface unit converts the 1Vp-p differential signal output by AT402E to the 11µA differential signal.
- PSU-400EV interface unit splits the 1Vp-p differential signal output by AT402E into a minimum of 20 and a maximum of 4000 divisions, and converts the signal to a square wave.

SPECIFICATIONS

Order No.	539-008	539-009
Items	PSU-400EA	PSU-400EV
Input signal	1Vpp differential Sinusoidal signal (AT402E)	
Output signal	11µA sine wave signal	TTL signal (RS422)
Output signal: Division number (Resolution)	—	TTL X5 (1µm), TTL X10 (0.5µm), TTL X20 (0.25µm), TTL X25 (0.2µm), TTL X50 (0.1µm), TTL X100 (0.05µm), TTL X250 (0.1µm), TTL X500 (0.01µm), TTL X1000 (0.005µm)
Minimum edge intervals	—	62.5,125,250,500,1000,2000 [ns]
Maximum current consumption	60mA	130mA
Power supply	DC5V±5%	
Storage temperature	-20 to 70°C 20 to 80%RH	
Operating temperature	0 to 50°C 20 to 80%RH	
External dimension	80(W)×40(D)×20(H)	
Status LED	Simple error display (without error output)	Error display (with error output)
Response speed	120m/min (100kHz)	It depends on number of interpolation and minimum edge intervals (Max: 100kHz)

TIP: Signal cable Type B is connectable.

DIMENSIONS



No.	Name	
(1)	INPUT connector	Connector for connecting with Linear Scale AT402E
(2)	OUTPUT connector	Connector for connecting with external device
(3)	ALM lamp	Lights red when alarming (Normally lights green)

Tests for Evaluating Linear Scales

1. Testing within the service temperature range
Confirms that there is no performance abnormality of a unit within the service temperature range and that data output is according to the standard.

2. Temperature cycle (dynamic characteristics) test
Confirms that there is no performance abnormality of a unit during temperature cycling while operating and that data output is according to the standard.

3. Vibration test (Sweep test)
Confirms that there is no performance abnormality of a unit while subject to vibrations of a frequency ranging from 30Hz to 300Hz with a maximum acceleration of 29.42m/s^2.

4. Vibration test (Acceleration test)
Confirms that there is no performance abnormality of a unit subject to vibrations at a specific, non-resonant frequency. (Approx. 98.07m/s^2)

5. Noise test
The noise test conforms to EMC Directive EN61326-1+A1:1998.

6. Package drop test
This test conforms to JIS Z 0200 (Heavy duty material drop test)

Glossary

Absolute system
A measurement mode in which every point measurement is made relative to a fixed origin point.

Incremental system
A measurement mode in which every point measurement is made relative to a certain stored reference point.

Origin offset
A function that enables the origin point of a coordinate system to be translated to another point offset from the fixed origin point. For this function to work, a system needs a permanently stored origin point.

Restoring the origin point
A function that stops each axis of a machine accurately in position specific to the machine while slowing it with the aid of integrated limit switches.

Sequence control
A type of control that sequentially performs control steps according to a prescribed order.

Numerical control
A way of controlling the movements of a machine by encoded commands created and implemented with the aid of a computer (CNC). A sequence of commands typically forms a 'part program' that instructs a machine to perform a complete operation on a workpiece.

Binary output
Refers to output of data in binary form (ones and zeros) that represent numbers as integer powers of 2.

RS-232C
An interface standard that uses an asynchronous method of serial transmission of data over an unbalanced transmission line for data exchange between transmitters located relatively close to each other. It is a means of communication mainly used for connecting a personal computer with peripherals.

Line driver output
This output features fast operating speeds of several tens to several hundreds of nanoseconds and a relatively long transmission distance of several hundreds of meters. A differential-voltmeter line driver (RS422A compatible) is used as an I/F to the NC controller in the linear scale system.

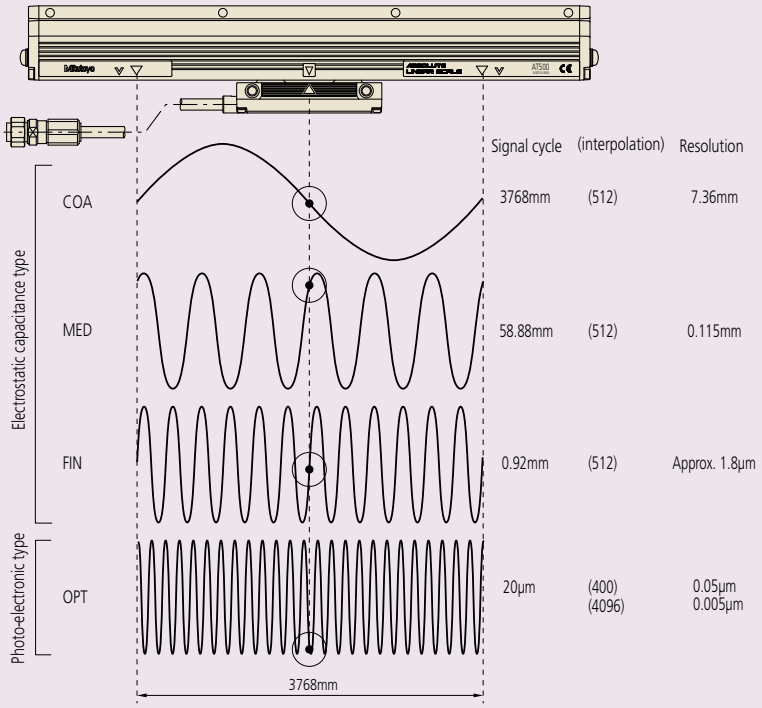
BCD
A notation of expressing the numerals 0 through 9 for each digit of a decimal number by means of four-bit binary sequence. Data transmission is one-way output by means of TTL or open collector.

RS-422
An interface standard that uses serial transmission of bits in differential form over a balanced transmission line. RS-422 is superior in its data transmission characteristics and in its capability of operating with only a single power supply of +5V.

Accuracy
The accuracy specification of a scale is given in terms of the maximum error to be expected between the indicated and true positions at any point, within the range of that scale, at a temperature of 20ºC. Since there is no international standard defined for scale units, each manufacturer has a specific way of specifying accuracy. The accuracy specifications given in our catalog have been determined using laser interferometry.

Narrow range accuracy
Scale gratings on a scale unit normally adopt 20µm pitch though it varies according to the kind of scale. The narrow range accuracy refers to the accuracy determined by measuring one pitch of each grating at the limit of resolution (1µm for example).

Principle of the Absolute Linear Scale (Example: ABS AT300, 500-S/H)

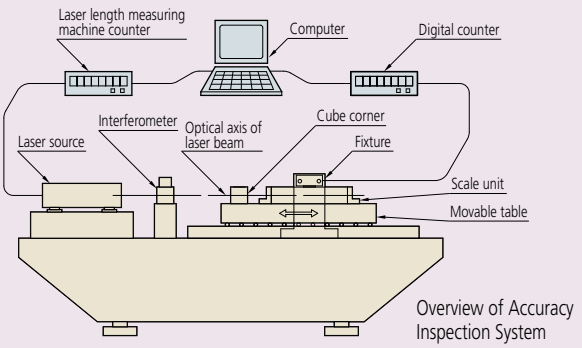


Upon supply of power to a linear scale, position readings from three capacitance-type sub-scales (COArse, MEDium and FINe) and one from a photoelectric sub-scale (OPTical) are taken. These sub-scales use such a combination of pitches, and are so positioned relative to each other, that the readings at any one position form a unique set and allow a microprocessor to calculate the position of the read head on the scale to a resolution of 0.05µm (0.005µm).

Specifying Linear Scale Accuracy

Positional Indication accuracy

The accuracy of a linear scale is determined by comparing the positional value indicated by the linear scale with the corresponding value from a laser length measuring machine at regular intervals using the accuracy inspection system as shown in the figure below. As the temperature of the inspection environment is 20˚C, the accuracy of the scale applies only in an environment at this temperature. Other inspection temperatures may be used to comply with internal standards.



Overview of Accuracy Inspection System

The accuracy of the scale at each point is defined in terms of an error value that is calculated using the following formula:

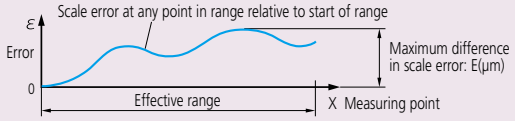
Error = Value indicated by laser inspection system – Corresponding value indicated by the linear scale

A graph in which the error at each point in the effective positioning range is plotted is called an accuracy diagram.
There are two methods used to specify the accuracy of a scale, unbalanced or balanced, described below.

(1) Unbalanced accuracy specification - maximum minus minimum error

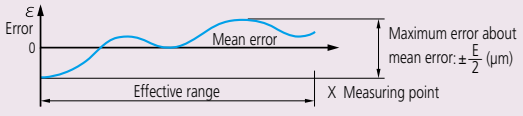
This method simply specifies the maximum error minus the minimum error from the accuracy graph, as shown below. It is of the form: $E = (\alpha + \beta L)$µm. L is the effective range (mm), and α and β are factors specified for each model.

For example, if a particular type of scale has an accuracy specification of $(3 + \frac{3L}{1000})$µm and an effective range of 1000mm, E is 6µm.



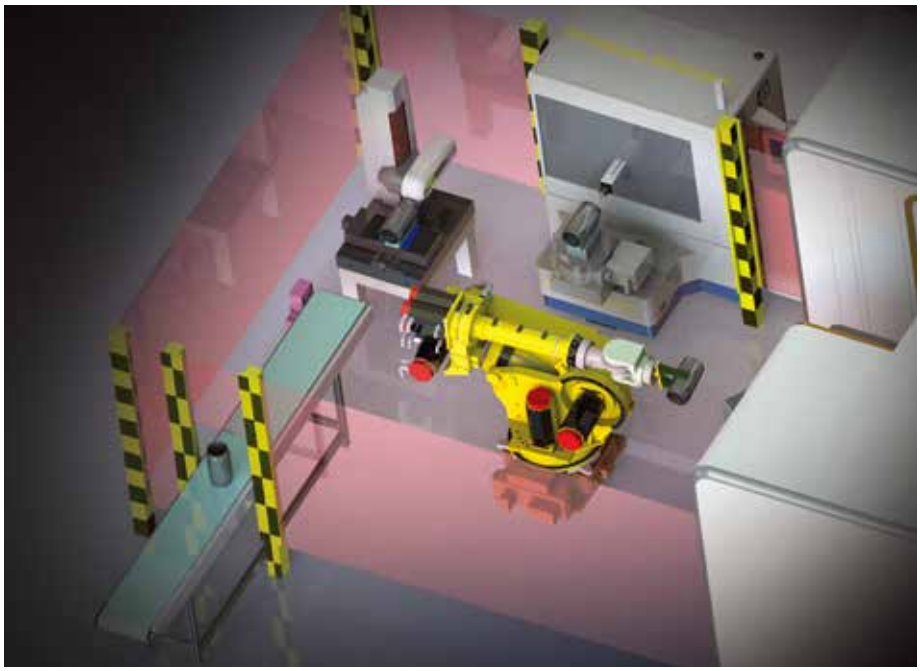
(2) Balanced accuracy specification - plus and minus about the mean error

This method specifies the maximum error relative to the mean error from the accuracy graph. It is of the form: $e = \pm \frac{E}{2}$ (µm). This is mainly used in separate-type (retrofit) scale unit specifications.



A linear scale detects displacement based on graduations of constant pitch. Two-phase sinusoidal signals with the same pitch as the graduations are obtained by detecting the graduations. Interpolating these signals in the electrical circuit makes it possible to read a value smaller than the graduations by generating pulse signals that correspond to the desired resolution. For example, if the graduation pitch is 20µm, interpolated values can generate a resolution of 1µm. The accuracy of this processing is not error-free and is called interpolation accuracy. The linear scale's overall positional accuracy specification depends both on the pitch error of the graduations and interpolation accuracy.

MITUTOYO CUSTOM SOLUTIONS



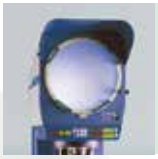
Mitutoyo Custom Solutions helps businesses in a wide range of industries achieve higher quality products, parts and machines with custom precision measurement tools and equipment.

Mitutoyo's highly skilled engineers specialize in designing and building custom measurement systems, applications and software to bring value-added solutions to resolve nearly every measurement need for customers with unique applications.

Custom Solutions & Services Include:

- Inline/near line part inspection and gaging
- Factory automation
- Data management
- Fixture design/build
- 3D CAD concepts/renderings
- Turnkey capital projects
- Product implementation
- Custom styli/accessories
- "Green button" technology

If you have any questions or would like more information regarding Mitutoyo Custom Solutions, contact: **solutions@mitutoyo.com**



Profile Projectors

Microscopes

MF-B3017D

MF-UB4020D

INDEX

WIDE VMU-V

VMU-LB

VMU-L4B

Mitutoyo

PJ-A3000

SERIES 302 — Vertical Profile Projectors

FEATURES

- The PJ-A3000 Series vertical profile projectors are medium-size 11.8" (300mm) models that feature high versatility and easy operation.
- Easy-to-read digital XY counter is located near the projection screen to minimize eye movement.
- Digital readout protractor screen facilitates angle measurement.

PJ-A3010F-200

PJ-A3005D-50

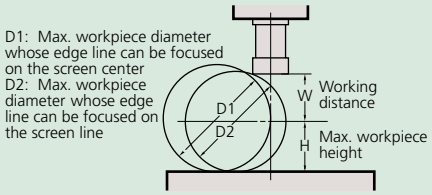
PJ-A3010F-100

PJ-A3005F-150

PJ-A3010F-200

Refer to Bulletin No. (2021) for more details.

Projection Capacity



		Magnification			
		10X	20X	50X	100X
View field		ø31.5	ø15.7	ø6.3	ø3.1
W		66 (20)	32.5 (2)	12.6	5
H	-50 models*	123.5	123.5	123.5	123.5
	-100 models	91	91	91	91
	-150 models	103.5	103.5	103.5	103.5
	200 models	92.5	92.5	92.5	92.5
D1	-50 models*	224 (198)	87 (61)	27	10
	-100 models	182	87 (61)	27	10
	-150 models	207 (198)	87 (61)	27	10
	200 models	185	87 (61)	27	10
D2		154 (120)	69 (23)	25	10

( ): When using surface illumination

Optional Accessories

172-202: 10X projection lens set (Standard accessory)
172-203: 20X projection lens set
172-223: 10X projection lens
172-224: 20X projection lens
172-204: 50X projection lens
172-207: 100X projection lens
172-229: Oblique illumination mirror for 10X lens
172-230: Oblique illumination mirror for 20X lens
172-116: Standard scale (50mm)
172-117: Standard scale (2")
172-118: Reading scale (200mm)
172-161: Reading scale (300mm)
172-119: Reading scale (8")
172-162: Reading scale (12")
172-160-2: Green filter (for PJ-A3000, -50 models)
172-160-3: Green filter (for -100, -150, -200 models)
512305: Halogen bulb (24V, 150W)
383876: Vinyl cover (standard accessory)

Fixture and Stage Accessories
176-106: Rotary table (Effective diameter: 66mm)
172-196: Rotary table (Effective diameter: 100mm)
172-198: Rotary table with fine feed wheel (Effective diameter: 4" / 100mm)
176-105: Swivel center support (Max. workpiece dia.: 2.7" / 70mm)
172-197: Swivel center support (Max. workpiece dia.: 3.1" / 80mm)
176-107: Holder with clamp
172-378: V-block with clamp (Max. workpiece dia.: 1" / 25mm)
176-317: Stage adapter C
64PMI167: Stand 22.4 x 20 x 32" (WxDxH)

Availability	PJ-A3005D-50	PJ-A3005F-150	PJ-A3010F-100 PJ-A3010F-200
176-106	✔	✔	
172-196		✔	✔*
172-198		✔	✔*
176-105	✔		
172-197		✔	✔*
176-107	✔	✔	✔*
172-378	✔	✔	✔*

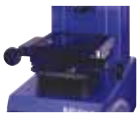
* Stage adapter C (**176-317**) is required for PJ-3010F-200

QM-Data200
264-155A: Stand-mount type
264-156A: Arm-mount type
2-D data processing unit.
(Refer to page I-25 for more details.)

332-151: Optoeye
Edge detection system for QM-Data200
12AAE671: Detector Attachment

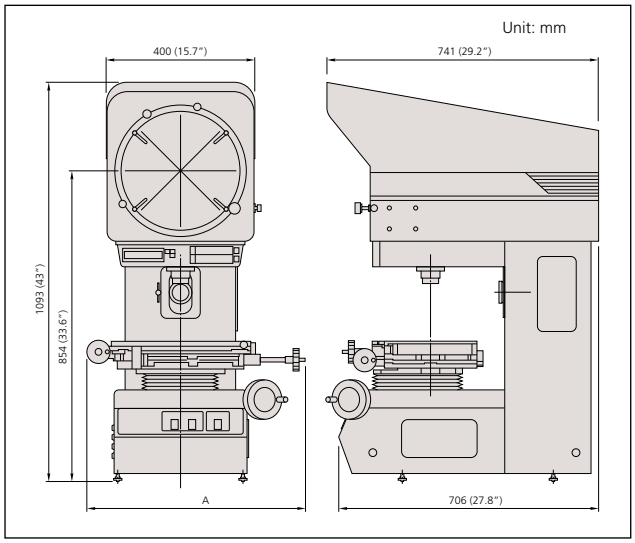
SPECIFICATIONS






		PJ-A3010F-200	PJ-A3005F 150	PJ-A3010F-100	PJ-A3005D-50
	Order No.	**302-701A**	**302-702A**	**302-703A**	**302-704A**
Projected image		Inverted image			
Protractor screen	Effective diameter	12.4" / 315mm			
	Screen material	Fine ground glass			
	Reference line	Cross hair line			
	Angle display (LED)	Resolution: 1° or 0.01° (switchable), Range: ±360° Functions: Absolute/incremental mode switching, Zero Set			
Projection lens		Standard Accessory 10X (**172-202**)			
Magnification accuracy	Contour illumination	±0.1% or less			
	Surface illumination	±0.15% or less			
Contour illumination	Light source	Halogen bulb (24V, 150W)			
	Optical system	Telecentric system			
	Functions	2-stage brightness switch, Heat-absorbing filter			
Surface illumination	Light source	Halogen bulb (24V, 150W)			
	Optical system	Vertical illumination with a half-reflection mirror			
	XY range	8" x 4" (200 x 100mm)	6" x 2" (150 x 50mm)	4"x 4 " (100x100mm)	2" x 2" (50 x 50mm)
	Resolution	.0001" / 0.001mm	.0001" / 0.001mm	.0001" / 0.001mm	.0001"/0.001mm
	Measuring Unit	Built-in linear scales	Built-in linear scales	Built-in linear scales	Digimatic mic heads
	Table size	14.96x9.84" (380x250mm)	11.02x5.98" (280x152mm)	9.84x9.84" (250x250mm)	5.98x5.98" (152x152mm)
	Effective table area	10.47x6.69" (266x170mm)	7.24x3.23" (184x82mm)	5.6x5.6" (142x142mm)	3.23x3.23" (82x82mm)
	Max. workpiece height	3.64" (92.5mm)	4.07" (103.5mm)	3.58" (91mm)	4.86" (123.5mm)
	Functions	± direction switching, SPC output zero-setting	Zero-setting, ± direction switching, SPC output	Zero-setting, ± direction switching, SPC output	± direction switching, SPC output zero-setting
Power supply		120V AC, 50/60Hz			
Mass		308 lbs. (140kg)	255 lbs. (116kg)	246 lbs. (112kg)	235 lbs. (107kg)
Standard accessories		10X projection lens set, masking shield, power cord, halogen bulb, fuse, grounding wire, allen wrench, vinyl cover			

DIMENSIONS



Model	PJ-A3005D-50	PJ-A3010F-100	PJ-A3005F-150	PJ-A3010F-200
A	17.9" / 455mm	16.8" / 427mm	17.6" / 446mm	23.3" / 593mm

PJ-H30

SERIES 303 — High-Accuracy Profile Projectors

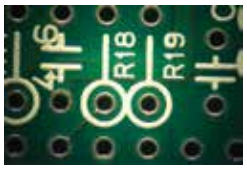
By separating axial motion, and stabilizing the XY measuring table in the vertical direction, high measuring accuracy of (3+0.02L)µm has been achieved on the PJ-H30 Series Profile Projectors. Focusing is accomplished by moving the screen head itself up and down with the hand wheel or motorized unit. The power focusing (PJ-H30D type) provides higher performance.

FEATURES

- Newly designed optical system with high NA lenses provides drastically brighter and clearer screen images during surface illumination.
- The three-lens mounting turret includes a 10X lens as standard. Four types of projection lenses (5X, 20X, 50X, 100X) are available.

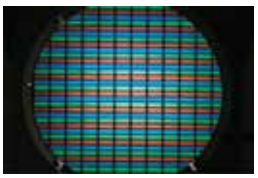
Switchable surface illumination: vertical or oblique

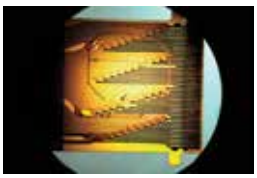
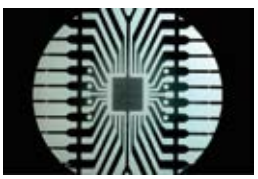
Vertical illumination



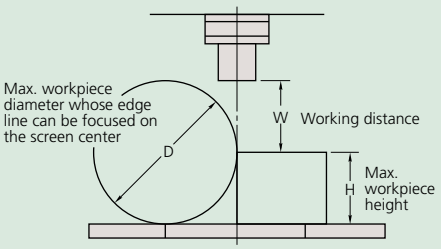
Oblique illumination

PJ-H30A3017B
XY stage travel range: 12x7" / 300x170mm



Projection Capacity



Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	ø61.2	ø30.6	ø15.3	ø6.12	ø3.06
H	105	105	105	105	105
W	66	70.5	56.5	50	50
D	148	197	137	114	114

Optional Accessories

172-271: 5X projection lens
172-472: 10X projection lens (standard accessory)
172-473: 20X projection lens
172-474: 50X projection lens
172-475: 100X projection lens
172-116: Standard scale (50mm)
172-117: Standard scale (2")
172-118: Reading scale (200mm)
172-161: Reading scale (300mm)
172-119: Reading scale (8")
172-162: Reading scale (12")
12AAG981: Green filter
172-269: Machine stand
512305: Halogen bulb (24V, 150W) (standard accessory)
383876: Vinyl cover (standard accessory)

Fixture and Stage Accessories

172-198: Rotary table (Effective diameter: 4" / 100mm)
176-305: Rotary table (Effective diameter: 7.2" / 183mm)
176-306: Rotary table (Effective diameter: 9.4" / 240mm)
176-105: Swivel center support (Max. workpiece dia.: 2.8" / 70mm)
172-197: Swivel center support (Max. workpiece dia.: 3.1" / 80mm)
176-107: Holder with clamp
172-378: V-block with clamp (Max. workpiece dia.: 1" / 25mm)
176-317: Fixture mount adapter C
176-304: Fixture mount adapter A

Availability	Models	
	PJ-H30A1010B	PJ-H30A2017B
	PJ-H30D1010B	PJ-H30D2017B
	PJ-H30A2010B	PJ-H30A3017B
	PJ-H30D2010B	PJ-H30D3017B
172-198	✔**	✔****
176-305	✔**	
176-306		✔****
176-107 *	✔**	✔****
172-378 *	✔**	✔****
172-197 *	✔**	✔****
176-105	✔***	✔***

*: Able to attach to a Rotary table 172-198 or 176-305 (172-197 can only attach to 176-305).
**: Fixture mount adapter C (176-317) is required.
***: Rotary table (172-198) is required.
****: Fixture mount adapter A (176-304) is required.

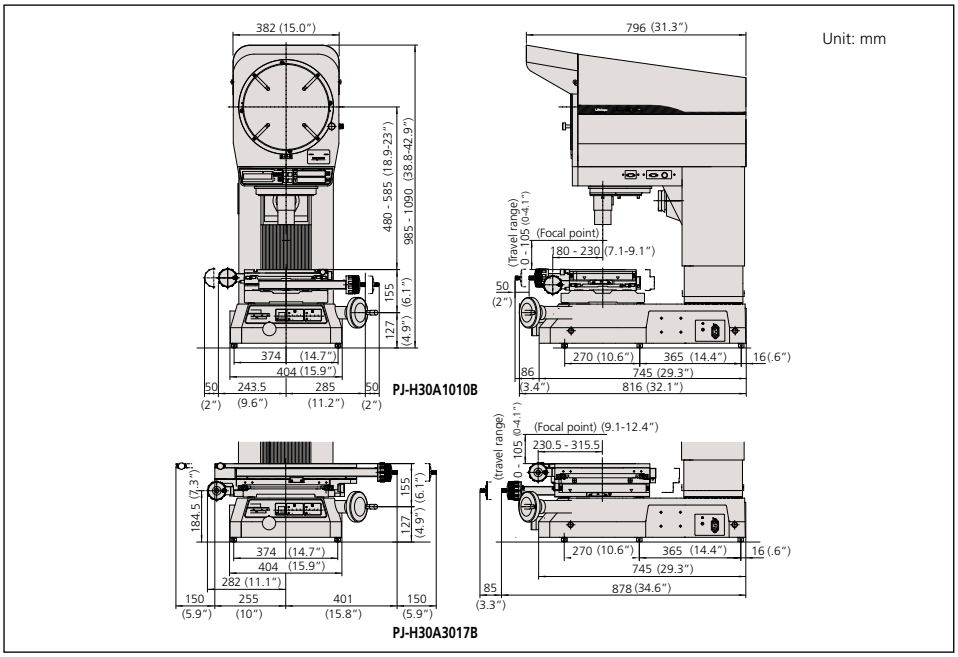
QM-Data200
264-155A: Stand-mount type
264-156A: Arm-mount type*
*Attachment stand (12AAG982) is required.
2-D data processing unit.
(Refer to page I-25 for more details.)

332-151: Optoeye
Edge detection system for QM-Data200
12AAE671: Detector Attachment

Manual Focus type	Model No.	PJ-H30A1010B	PJ-H30A2010B	PJ-H30A2017B	PJ-H30A3017B
	Order No.	**303-712-1A**	**303-713-1A**	**303-714-1A**	**303-715-1A**
Power Focus, built-in OPTOEYE type	Model No.	PJ-H30D1010B	PJ-H30D2010B	PJ-H30D2017B	PJ-H30D3017B
	Order No.	**303-732-1A**	**303-733-1A**	**303-734-1A**	**303-735-1A**
Projected Image		Erect image			
Protractor screen	Effective diameter	12" / 306mm			
	Screen material	Fine ground glass			
	Reference line	Cross hair line			
	Screen rotation	±360°, fine feed and clamp			
	Angle display (LED)	Resolution: 1° or 0.01° (switchable), Range: ±370°, Functions: Absolute/incremental mode switching, Zero set			
Projection lens		Standard accessory: 10x (172-472), Optional accessories: 2X, 5X, 20X, 50X, 100X			
Lens mount		3-lenses mounting turret			
Magnification accuracy	Contour illumination	±0.1% or less			
	Surface illumination	±0.15% or less			
Contour illumination	Light source	Halogen bulb (24V 150W)			
	Optical system	Zoom telecentric system			
	Functions	Brightness adjustment, Heat-absorbing filter, Cooling fan			
Surface illumination	Light source	Halogen bulb (24V 150W)			
	Optical system	Vertical / Oblique illumination with an adjustable condenser lens			
	Functions	Non-stepped brightness adjustment, Heat-absorbing filter, Cooling fan			
	XY Range	4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 6.7" 200 x 170mm	12 x 6.7" 300 x 170mm
	Resolution	.0001" / 0.001mm			
	Measuring unit	Built-in Linear scale			
	Table size	11.8 x 9.4" 300 x 240mm	13.8 x 11" 350 x 280mm	16.1 x 13.5" 410 x 342mm	20 x 13.5" 510 x 342mm
	Effective table area	7.1 x 5.9" 180 x 150mm	9.8 x 5.9" 250 x 150mm	10.6 x 9.4" 270 x 240mm	14.6 x 9.4" 370 x 240mm
	Max. workpiece ht.	4.1" / 105mm			
	Max. workpiece load	22lbs / 10kg	22lbs / 10kg	44 lbs / 20kg	44 lbs / 20kg
Power supply		120V AC, 50/60Hz			
Mass		391lbs / 176kg	396lbs / 178kg	556lbs / 205kg	471lbs / 212kg
Standard accessories		10X projection lens set, masking shield, power cord, halogen bulb, tube fuse, grounding wire, allen wrench, vinyl cover			

DIMENSIONS

Unit: mm



PV-5110

SERIES 304 — Profile Projectors

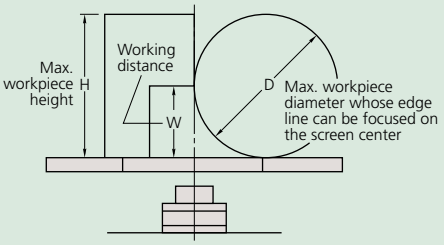
FEATURES

- Large 500mm screen
- Floor model uses a downward illumination system.
- Digital readout protractor screen (including zero-setting, ABS/INC coordinate switching functions) for easy and error-free angle measurement.
- Angled screen allows projected images to be easily traced or compared with a template.
- The oblique surface illumination system provides clear and bright images, allowing easy inspection of non-reflective workpieces such as plastic parts or printed materials.

PV-5110

PV-5110

Projection Capacity



Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	ø101.6	ø50.8	ø25.4	ø10.16	ø5.08
H	125	181	206	87	87
W	60 (27)	60	60	32.4	22.5
D	120	120	120	64.8	45

( ): When using surface illumination

Optional Accessories

172-401: 5X projection lens set
172-406: 5X projection lens
172-402: 10X projection lens set (standard accessory)
172-409: 10X projection lens
172-403: 20X projection lens set
172-411: 20X projection lens
172-404: 50X projection lens set
172-413: 50X projection lens
172-405: 100X projection lens set
172-415: 100X projection lens
172-422: Surface illumination unit (standard accessory)
172-116: Standard scale (50mm)
172-117: Standard scale (2")
172-118: Standard scale (200mm)
172-119: Standard scale (8")
172-161: Reading scale (300mm)
172-329: Reading scale (600mm)
172-162: Reading scale (12")
172-160-2: Green filter (standard accessory)
172-319: Canopy
512305: Halogen bulb (24V, 150W) (standard accessory)
510189: Vinyl cover

Fixture and Stage Accessories

172-196: Rotary table*
(Effective diameter: 4" / 100mm)
172-198: Rotary table with fine feed wheel*
(Effective diameter: 4" / 100mm)
172-197: Swivel center support*
(Max. workpiece dia.: 3.1" / 80mm)
176-107: Holder with clamp*
172-378: V-block with clamp*
(Max. workpiece dia.: 1" / 25mm)
*Stage adapter C (**176-317**) is required.

KA Counter (174-183A)
(Refer to page H-7 for more details.)

QM-Data200
264-155A: Stand-mount type
264-156A: Arm-mount type
2-D data processing unit.
(Refer to page I-25 for more details.)

332-151: **Optoeye**
Edge detection system for QM-Data200
12AAE672: Detector Attachment (B)

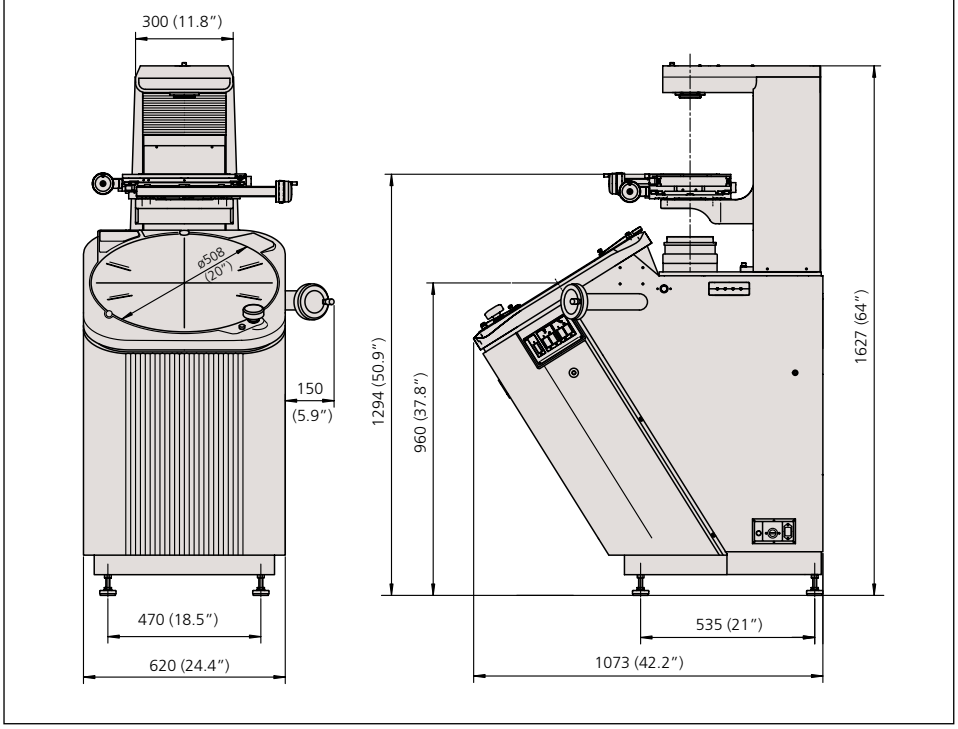
SPECIFICATIONS

Model No.		PV-5110
Order No.		**304-919A***
Projected image		Invert image
Protractor screen	Effective diameter	20" / 508mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display (LED)	Resolution: 1' or 0.01°(switchable), Range: ±370°, Functions: Absolute/incremental mode switching, Zero set
Projection lens		Standard accessory: 10x(172-472), Optional accessories: 5X, 20X, 50X, 100X
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	Light source	Halogen bulb (24V 150W)
	Optical system	Telecentric system
	Functions	2-step brightness switch, Heat-absorbing filter, Cooling fan
Surface illumination	Light source	Halogen bulb (24V 150W)
	Optical system	Vertical illumination
	Functions	Adjustable condenser lens. Oblique illumination (for 5X, 10X, and 20X), 2-step brightness switch, Heat-absorbing filter, Cooling fan
	XY Range	8 x 4" / 200 x 100mm
	Resolution	.0001" / 0.001mm*
	Measuring unit	Built-in Linear scale
	Table size	15 x 9.8" / 380 x 250mm
	Effective table area	10.5 x 6.7" / 266 x 170mm
	Max. workpiece height	See (H) on page I-6
	Max. workpiece load	17.6 lbs / 8kg
Power supply		120V AC, 50/60Hz
Mass		467lbs / 210kg
Standard accessories		200x100mm (8" x 4") stage, 10X projection lens set, Surface illumination unit. Counter stand for KA counter, power cord, halogen bulb, fuse, grounding wire, allen wrench

* Counter not included

DIMENSIONS

Unit: mm



PH-A14

SERIES 172 — Profile Projector

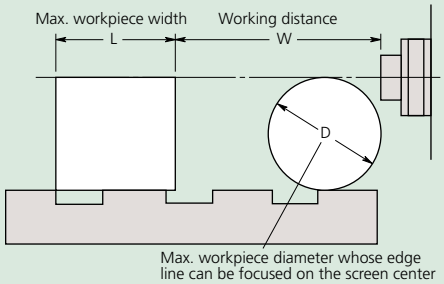
FEATURES

- Benchtop model uses a horizontal optical system.
- Suitable for thread pitch measurements—blurred or distorted images will not be produced when workpiece is angled.
- Inverted image on the day-bright screen.
- 14" (356mm) diameter vernier protractor screen with solid line cross-hairs for easy alignment.
- Heavy-duty workpiece table incorporates linear scales for fast, accurate measurement.

PH-A14

PH-A14 with touch screen M2 geometric measurement display

Projection Capacity



PH-A14 Unit: mm

	Magnification			
	10X	20X	50X	100X
View field	35.6	17.8	7.12	3.56
L	235	235	109	109
W	93	40	14.6	9.5
D	130	116	31.3	19.2

KA Counter (174-183A)
(Refer to page H-7 for more details.)
64AAB149: Counter stand

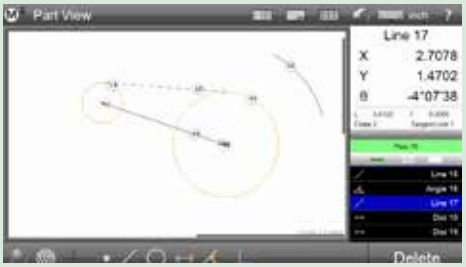
QM-Data200
2-D data processing unit.
264-155A: Stand mount type
264-156A: Arm mount type
(Refer to page I-25 for more details.)

332-151: **Optoeye**
Edge detection system for QM-Data 200
12AAE671: Detector attachment (A)

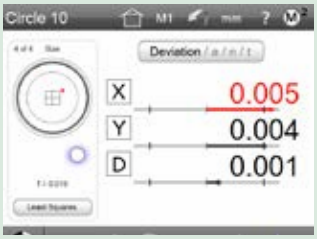
Optional Accessories

172-011: 10X projection lens (standard accessory)
172-012: 20X projection lens
172-013: 50X projection lens set
172-014: 100X projection lens set
172-116: Standard scale (50mm)
172-117: Standard scale (2")
172-118: Reading scale (200mm)
172-161: Reading scale (300mm)
172-119: Reading scale (8")
172-162: Reading scale (12")
172-286: Green filter
512305: Halogen bulb (24V, 150W) (standard accessory)

Fixture and Stage Accessories
172-142: Center support
172-143: Center support riser
172-144: Rotary vise
(Max. workpiece dia.: 2.4" / 60mm)
172-234: V-block with clamp
(Max. workpiece dia.: 2" / 50mm)
172-132: Vertical holder
64AAA129B: Machine stand 23"W x 45" D x 20"H



Graphics-based "Part View"constructions
Generate popular construction types, like Distances and Tangent Lines, from within the graphical part view.



Geometric tolerancing
Measure features, set nominals, apply tolerances and view deviation results with only a few quick clicks.

Reports Flexibility for report contents and formatting allows for full customization of the data format, header information, and header and footer graphics.

SPECIFICATIONS

Model No.		PH-A14
Order No.		**172-810-10A***
Package No.		**64PKA087** PH-A14 with QM Data Arm Mount
		64PKA086A PH-A14 with KA Counter and Tray
Projected image		Inverted image
Protractor screen	Effective diameter	14" /356mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display	Vernier reading, Resolution: 2'
Projection lens		Standard accessory: 10X (172-011), Optional accessories: 20X, 50X, 100X
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	Light source	Halogen bulb (24V 150W)
	Optical system	Telecentric system
	Functions	Heat-absorbing filter, Cooling fan
Surface illumination	Light source	Halogen bulb (24V 150W)
	Optical system	Twin fiber optic illumination
XY Stage	Table travel (X-axis)	8" / 203.2mm
	Table size (X, Z)	16 x 6" / 407 x 153mm
	Vertical travel (Y-axis)	4" / 101.6mm
	Resolution	.00005" / 0.001mm*
	Measuring unit	Built in Linear scale
	Max. workpiece width	See (L) on page I-10
	Max. workpiece load	100lbs / 45kg
Power supply		120V AC, 50/60Hz
Mass		308lbs / 140kg
Standard accessories		10x projection lens set, work stage, power cord, halogen bulb, fuse, grounding wire, allen wrench

*Counter not included

PH-A14 Packages with M2 Geomentric Display

Order No.	Description
64PKA154A	PH-A14 PROFILE PROJECTOR - WITH TOUCH SCREEN M2 GEOMETRIC DISPLAY
64PKA155A	PH-A14 PROFILE PROJECTOR - WITH OPTICAL EDGE DETECTION AND TOUCH SCREEN M2 GEOMETRIC DISPLAY

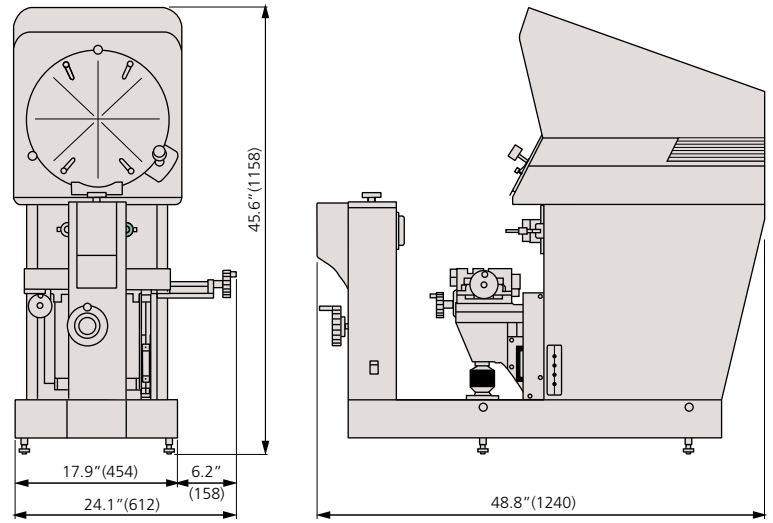
M2 Geometric Display Retrofit Packages

Order No.	Description
64PKA156A	M2 2D Data Processing Unit with software and hardware including a tablet PC. Also includes installation and calibration on the customer's existing PH-A14
64PKA157A	M2 2D Data Processing Unit with Edge Detection software and hardware including a tablet PC. Also includes installation and calibration on the customer's existing PH-A14

DIMENSIONS

PH-A14

Unit: mm



PH-3515F

SERIES 172 — Profile Projector

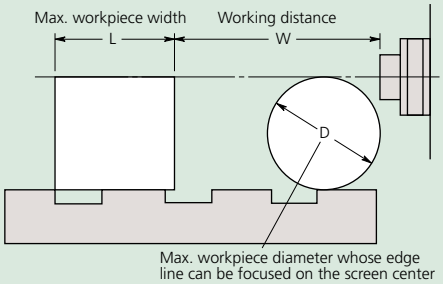
FEATURES

- Benchtop model uses a horizontal optical system.
- Suitable for thread pitch measurements—blurred or distorted images will not be produced when workpiece is angled.
- Erect image on the day-bright screen.
- Standard twin fiber-optic illumination.
- 14" (353mm) diameter protractor screen with cross-hairs and staggered lines for easy alignment.
- Digital angle measurement to 1' or 0.01°.
- Heavy-duty workpiece table incorporates linear scales for fast, accurate measurement.
- Built-in linear scales for use with optional display counters.

PH-3515F

Refer to Bulletin No. (2210) for more details.

Projection Capacity



PH-3515F Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	70.6	35.3	17.65	7.06	3.5
L	175	235	235	80	109
W	160 (64)	93 (41)	40	14.6	9.5
D	152.4	152.4	116	30.4	19

( ): When using surface illumination

Optional Accessories

172-145: 5X projection lens set
172-175: 5X projection lens
172-184: 10X projection lens set (standard accessory)
172-011: 10X projection lens
172-173: 20X projection lens set
172-165: 50X projection lens set
172-174: 50X projection lens
172-166: 100X projection lens set
172-116: Standard scale (50mm)
172-117: Standard scale (2")
172-118: Reading scale (200mm)
172-161: Reading scale (300mm)
172-119: Reading scale (8")
172-162: Reading scale (12")
172-286: Green filter
515530: Halogen bulb (24V, 150W) (standard accessory)
172-423 Twin surface illumination
12BAA637 Halogen reflector lamp (standard accessory)
64AAB176 Machine stand
383228: Vinyl cover (standard accessory)

Fixture and Stage Accessories*
172-142: Center support
172-143: Center support riser
172-144: Rotary vise (Max. workpiece dia.: 2.3" / 60mm)
172-234: V-block with clamp
(Max. workpiece dia.: 2" / 50mm)
172-132: Vertical holder
172-001: Tipped-saw support stand
172-002: Cutter support stand
* See page I-13 for details

KA Counter (174-183A)
(Refer to page H-7 for more details.)
64AAB149: Counter stand

QM-Data200
2-D data processing unit.
264-155A: Stand mount type
264-156A: Arm mount type
(Refer to page I-25 for more details.)

332-151: **Optoeye**
Edge detection system for QM-Data200
12AAE671: Detector attachment (A)

SPECIFICATIONS

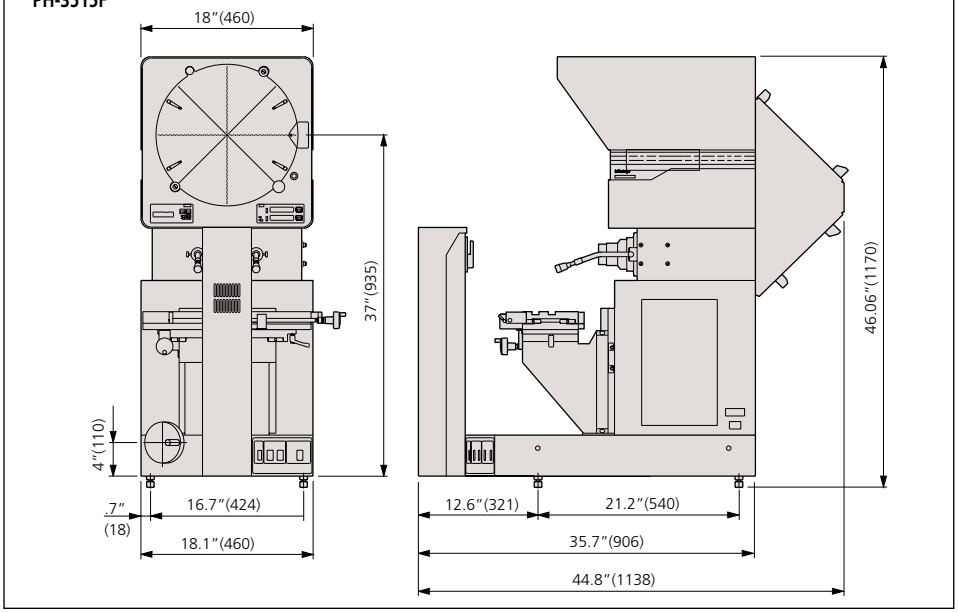
Model No.		PH-3515F
Order No.		**172-868A***
Projected image		Erect image
Protractor screen	Effective diameter	14" / 353mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display (LED)	Resolution: 1' or 0.01° (switchable), Range: ±370°, Functions: Absolute/ incremental mode switching, Zero set
Projection lens		Standard accessory: 10X (172-184), Optional accessories: 5X, 20X, 50X, 100X
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	Light source	Halogen bulb (24V 150W)
	Optical system	Telecentric system
	Functions	2-step brightness switch, Heat-absorbing filter, Cooling fan
Surface illumination (Optional accessories)	Light source	Halogen bulb (24V 150W)
	Functions	Adjustable condenser lens. Heat-absorbing filter, Cooling fan
XY Stage	Table travel (X-axis)	10" / 254mm
	Table size (X, Z)	17.7"x5.7" / 450x146mm
	Vertical travel (Y-axis)	6" / 152mm
	Resolution	0.001mm/.00005"*
	Measuring Unit	Built-in Llnear scale
	Max. workpiece width	See (L) on page I-10
	Max. workpiece load	100lbs / 45kg
Power supply		120V AC, 50/60Hz
Mass		333lbs / 150kg
Standard accessories		10X projection lens set, work stage, power cord, halogen bulb, tube fuse, grounding wire, allen wrench, Vinyl cover

* Counter not included

DIMENSIONS

Unit: mm

PH-3515F



Accessories for Profile Projectors

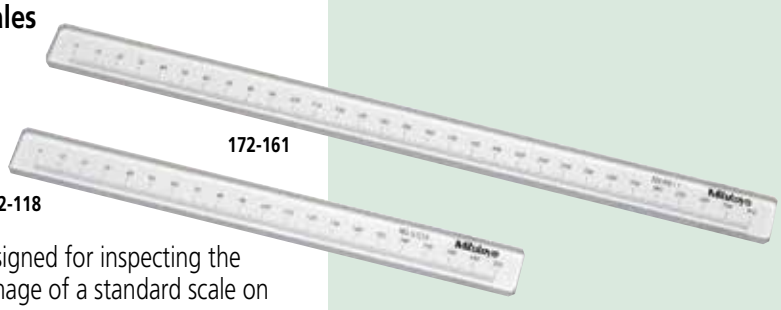
SERIES 172 — Profile Projector

Standard Scales

172-116

- Used for checking magnification accuracy.

Reading Scales



172-161

172-118

- Specially designed for inspecting the magnified image of a standard scale on the projection screen.

SPECIFICATIONS

Metric

Graduation	Range	Order No.	Accuracy (20°C)*
0.1mm	50mm	**172-116**	(3+5L/1000)µm
0.1mm	80mm	**172-330**	(3+5L/1000)µm

*L = Measured length (mm)

Inch

Graduation	Range	Order No.	Accuracy (20C)
.01"	2"	**172-117**	.00013"

SPECIFICATIONS

Metric

Graduation	Range	Order No.	Accuracy
0.5mm	200mm	**172-118**	18µm (15+15L/1000)µm
0.5mm	300mm	**172-161**	19.5µm (15+15L/1000)µm
0.5mm	600mm	**172-329**	24µm (15+15L/1000)µm

Inch

Graduation	Range	Order No.	Accuracy
.02"	8"	**172-119**	.00071"
.02"	12"	**172-162**	.00077"

Micrometer Heads

for Profile Projectors and Toolmakers' Microscopes

Micrometer Heads for XY Stage

FEATURES

- Non-rotating device is provided.
- The thimble reading can be zero-set at any spindle position.
- Black and red figures of the bi-directional graduation allow easy reading in both directions.
- Clamping stem diameter: 18mm

SPECIFICATIONS

Metric

Graduation	Range	Order No.	Accuracy	Remarks
0.005mm	25mm	**152-390**	±2µm	for X-axis
0.005mm	25mm	**152-389**	±2µm	for Y-axis

Inch

Graduation	Range	Order No.	Accuracy	Remarks
.0001"	1"	**152-391**	±.0001"	for X-axis
.0001"	1"	**152-392**	±.0001"	for Y-axis

Adjustable Micrometer Heads for XY Stages

FEATURES

- The adjustable spindle can be fed under the thimble clamped at any reading, allowing easy reference point setting.
- The spherical measuring face is carbide-tipped.
- Clamping stem diameter: 18mm

152-390

SPECIFICATIONS

Metric

Graduation	Range	Order No.	Accuracy	Remarks
0.001mm*	25mm	**152-402**	±2µm	for X-axis
0.001mm*	25mm	**152-401**	±2µm	for Y-axis

*Obtained using vernier.

Digimatic Micrometer Heads

FEATURES

- Large LCD digits for error-free reading.
- The display rotates 330° for easy viewing.
- The spindle does not rotate.
- With SPC data output.

SPECIFICATIONS

Inch/Metric

Resolution	Range	Order No.	Accuracy
.00005"/0.001mm	2" (50mm)	**164-164**	±.00015"

Optional Accessories

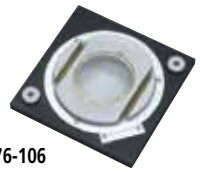
959149: SPC cable for series 164 (1m)
959150: SPC cable for series 164 (2m)

164-164

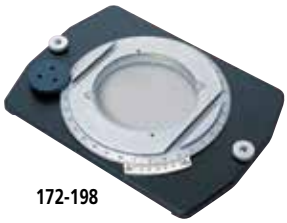
Workpiece Fixtures

for Profile Projectors and Measuring Microscopes

Rotary Tables



176-106



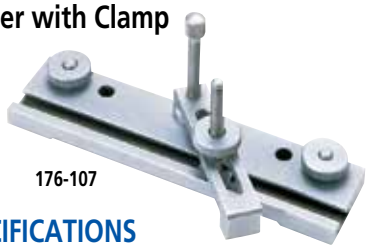
172-198

SPECIFICATIONS

Order No.	176-106	172-198
Effective glass dia.	66mm	100mm
Angle reading	6'	2' (w/ fine adjustment)
Mass	1.7kg	2.5kg

Note: Holder with clamp (**176-107**) can be mounted.

Holder with Clamp

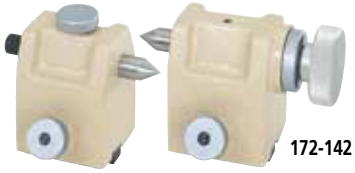


176-107

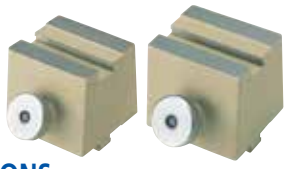
SPECIFICATIONS

Order No.	176-107
Max. workpiece height	35mm
Mass	0.42kg

Center Support



172-142



172-143

SPECIFICATIONS

Order No.	172-142
Max. workpiece height	120mm (240mm)*
Mass	3.3kg

*When using a center support riser (**172-143**)

Rotary Vise

172-144

SPECIFICATIONS

Order No.	172-144
Max. workpiece height	60mm
Width of jaw	40mm
Angle reading	5°
Mass	2.5kg

Swivel Center Supports

176-105

172-197

SPECIFICATIONS

Order No.	176-105	172-197
Max. workpiece dia.	70mm (45mm)*	80mm (65mm)*
Max. workpiece length	140mm	140mm
Swivel range	±10°	±10°
Mass	2.4kg	2.5kg

*When swiveled 10°

V-Block with Clamp

172-234

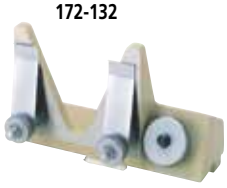
172-378

SPECIFICATIONS

Order No.	172-234	172-378
Max. workpiece dia.	50mm	25mm
Width of block	60mm	41mm
Mass	1.24kg	0.8kg

Vertical Holder

172-132



SPECIFICATIONS

Order No.	172-132
Mass	1.3kg

Mitutoyo

Overlay Chart Set

- Makes inspection of projected images an easy process.
- Twelve different patterns are available in the set.
- Designed for use with profile projectors whose screen diameter is 300mm or larger.

Overlay chart set (12 sheets)
Order No.: 12AAM027

12AAM587
Protractor (1°-grad. radial index) and radius (1mm-radius increment concentric semicircles)

12AAM588
Radius (0.1cm-reading scales and 5mm-radius increment concentric circles)

12AAM589
Radius (1X, 10X, 20X, 50X)

12AAM590
1mm-reading scales (20X, 50X)

12AAM591
10x10mm sections

12AAM592
0.5mm-reading scales

12AAM593
1x1mm sections

12AAM594
Protractor (1°-grad. diametral index)

12AAM595
1mm-reading vertical scale

12AAM596
Protractor (1°-grad. diametral index) and radius (1mm-radius increment concentric circles)

12AAM597
Metric, Unified, and Whitworth screw threads (20X)

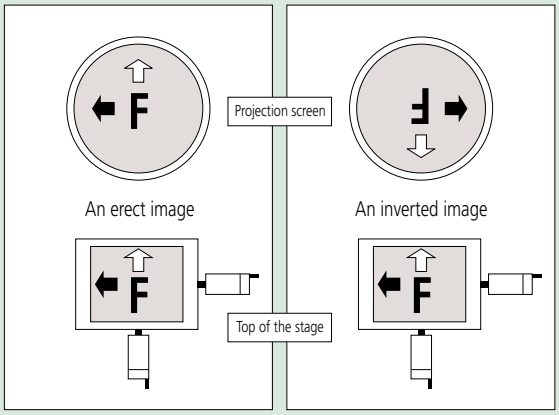
12AAM598
Metric screw thread (100X) and 20° and 14.5° gear teeth (20X)

Quick Guide to Precision Measuring Instruments

Profile Projectors

Erect Image and Inverted Image

An image of an object projected onto a screen is erect if it is orientated the same way as the object on the stage. If the image is reversed top to bottom, left to right and by movement with respect to the object on the stage (as shown in the figure below) it is referred to as an inverted image (also known as a reversed).



F Workpiece
⬅ X-axis movement
⇦ Y-axis movement

Magnification Accuracy

The magnification accuracy of a projector when using a certain lens is established by projecting an image of a reference object and comparing the size of the image of this object, as measured on the screen, with the expected size (calculated from the lens magnification, as marked) to produce a percentage magnification accuracy figure, as illustrated below. The reference object is often in the form of a small, graduated glass scale called a `stage micrometer' or `standard scale', and the projected image of this is measured with a larger glass scale known as a `reading scale'.

(Note that magnification accuracy is not the same as measuring accuracy.)

$$\Delta M(\%) = \frac{L - \ell M}{\ell M} \times 100$$

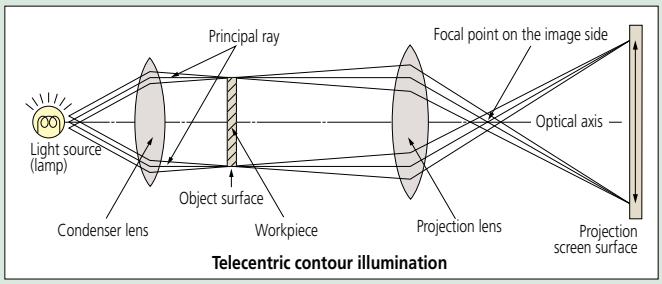
ΔM(%): Magnification accuracy expressed as a percentage of the nominal lens magnification
L : Length of the projected image of the reference object measured on the screen
ℓ : Length of the reference object
M : Magnification of the projection lens

Type of Illumination

- Contour illumination: An illumination method to observe a workpiece by transmitted light and is used mainly for measuring the magnified contour image of a workpiece.
- Coaxial surface illumination: An illumination method whereby a workpiece is illuminated by light transmitted coaxially to the lens for the observation/measurement of the surface. (A half-mirror or a projection lens with a built-in half-mirror is needed.)
- Oblique surface illumination: A method of illumination by obliquely illuminating the workpiece surface. This method provides an image of enhanced contrast, allowing it to be observed three-dimensionally and clearly. However, note that an error is apt to occur in dimensional measurement with this method of illumination.
  (An oblique mirror is needed. Models in the PJ-H30 series are supplied with an oblique mirror.)

Telecentric Optical System

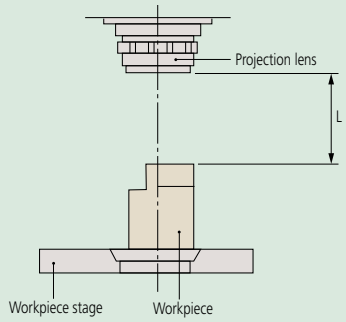
An optical system based on the principle that the primary ray is aligned parallel to the optical axis by placing a lens stop on the focal point on the image side. Its functional feature is that the image will not vary in size even though the image blurs as the object is shifted along the optical axis.
For measuring projectors and measuring microscopes, an identical effect is obtained by placing a lamp filament at the focal point of a condenser lens instead of a lens stop so that the object is illuminated with parallel beams. (See the figure below.)



Telecentric contour illumination

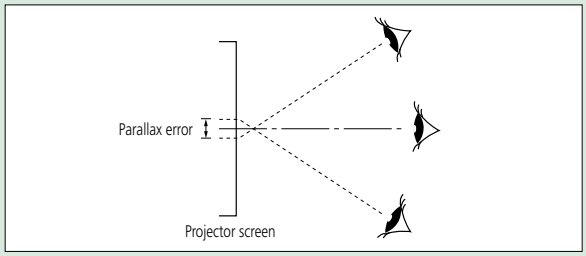
Working distance

Refers to the distance from the face of the projection lens to the surface of a workpiece in focus. It is represented by L in the diagram below.



Parallax error

This is the displacement of an object against a fixed background caused by a change in the observer's position and a finite separation of the object and background planes.



Field of view diameter

The maximum diameter of the workpiece that can be projected using a particular lens.

$$\text{Field of view diameter (mm)} = \frac{\text{Screen diameter of profile projector}}{\text{Magnification of projection lens used}}$$

Example: If a 5X magnification lens is used for a projector with a screen of ø500mm:
Field of view diameter is given by $\frac{500\text{mm}}{5} = 100\text{mm}$

Mitutoyo

TM-505B/1005B

SERIES 176 — Toolmakers' Microscopes

The Mitutoyo TM Series is a toolmakers' microscope well suited for measuring dimensions and angles of machined metals. It also can be used to check the shape of screws and gears by attaching an optional reticle. The compact body makes it ideal for use on shop floors with limited space.

FEATURES

- Angle measurement is performed easily by turning the angle scale disc to align the cross-hair reticle with the workpiece image.
- Illumination intensity can be adjusted.
- Included standard accessories create an overall magnification of 30X. Magnifications can be changed from 20 - 200X by using optional objectives and/or eyepieces.

TM-A505B

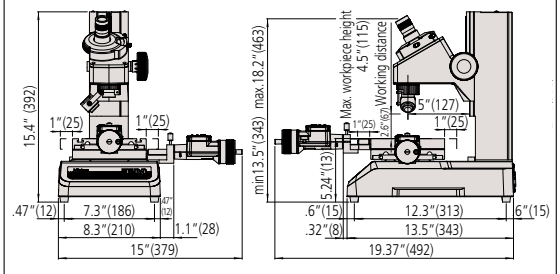
SPECIFICATIONS

Model No.		TM-505B	TM-A505B	TM-1005B	TM-A1005B
Order No.		176-818A	176-820A	176-819A	176-821A
Objective lens		Standard accessory: 2X, Options: 5X, 10X			
Microscope head	Maximum height of workpiece	4.53" / 115mm		4.21" / 107mm	
Illumination unit	Transmitted illumination	Stepless brightness adjustment, White LED light source, With green filter			
	Surface illumination	Oblique single-source type, Stepless brightness adjustment, White LED light source			
Cross-travel stage	Measuring range	2" x 2" / 50×50mm		4" x 2" / 100×50mm (An optional 2"/50mm gauge block is required to cover full range. A CERA block is recommended.)	
	Table size	6" x 6" / 152×152mm		9.44" x 6" / 240×152mm	
	Usable area of the stage glass	3.8" x 3.8" / 96×96mm		6" x 3.8" / 154×96mm	
Linear measurement method		Micrometer heads optional	Micrometer heads included	Micrometer heads optional	Micrometer heads included
Resolution		N/A	.00005"/1µm	N/A	.00005"/1µm
Micrometer head travel range		N/A	2"/50mm	N/A	2"/50mm

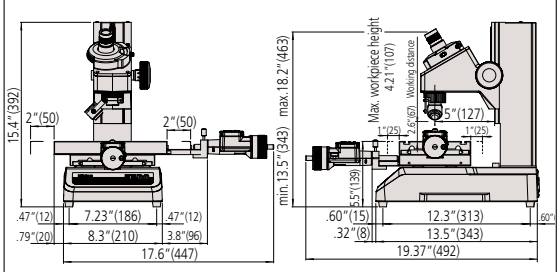
DIMENSIONS

Unit: Inch(mm)

TM-505B



TM-1005B



Technical Data

Optical tube	• Monocular with 30° depression angle • 90° broken cross-hair reticle (176-126) • Erect image • Diopter adjustable
Eyepiece protractor	• Graduation: 1° • Protractor range: 360° • Minimum reading by vernier: 6′
Eyepiece (176-116)	• Magnification: 15X • Field number: 13
Objective (176-138)	• Magnification: 2X • Working distance: 2.638" (67mm) • Numerical aperture: 0.07
Total magnification	• 30X
Transmitted illumination	• 3W LED • GIF (green) filter • Stepless intensity adjustment
Reflected illumination	• 3W LED • Stepless intensity adjustment • Adjustable position
Power supply	120 V AC, 50/60Hz
Power consumption	4.2W
Mass	TM-505B: Approx. 30.8 lbs. (14kg) TM-1005B: Approx. 33 lbs. (15kg)

Optional Accessories

176-115: 10X eyepiece (field number: 13mm)
176-116: 15X projection lens set (standard accessory)
176-117: 20X eyepiece (field number: 10mm)
176-138: Objective, 2X (W.D. 67mm, N.A. 0.07) (standard accessory)
176-139: Objective, 5X (W.D.: 33mm, N.A.: 0.10)
176-137: Objective, 10X (W.D.: 14mm, N.A.: 0.14)
164-163: Digimatic micrometer head (range: 50mm, reading: 0.001mm)
164-164: Digimatic micrometer head (range: 2"/50mm, reading: .00005"/0.001mm)
152-390: Micrometer head for X-axis (range: 25mm, reading: 0.005mm)
152-389: Micrometer head for Y-axis (range: 25mm, reading: 0.005mm)
152-392: Micrometer head for Y-axis (range: 1", reading: .0001")
152-391: Micrometer head for X-axis (range: 1", reading: .0001")
611201-531: Rectangular gauge block (1")
611202-531: Rectangular gauge block (2")
176-204: Dial indicator attachment for Z-axis measurement
959149: SPC cable (2m) for Digimatic micrometer head

Fixture and Stage Accessories

990561: Workpiece clip (2pcs./set)
176-106: Rotary table for TM-505B (effective dia.: 66mm)
172-196: Rotary table for TM-1005B (effective dia.: 100mm)
176-105: Swivel center support for TM-505B (max. workpiece dia.: 2.7" / 70mm)
172-197: Swivel center support for TM-1005B (max. workpiece dia.: 3.1" / 80mm)
172-378: V-block with clamp (max. workpiece dia.: 1" / 25mm)
176-107: Holder with clamp

Illumination Units

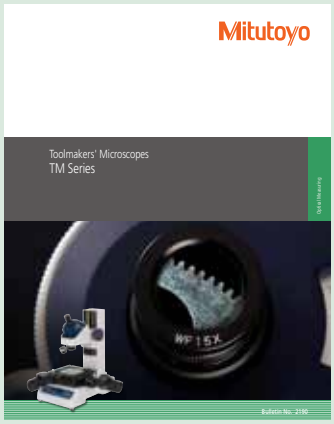
176-344A: Bifurcated fiber illuminator
64AAB214: LED variable ring light
176-208A: LED circular illumination

Reticles

176-126: Broken cross-hair (90°) (standard accessory)
176-111: Concentric circles (up to ø4mm, 0.05mm increment)
176-135: Concentric circle (up to ø.2", .01" increment)
176-114: 60° angle

Protractor eyepiece

LED ring light 64AAB214



Refer to Bulletin No. (2190) for more details.

MF

SERIES 176 — Measuring Microscopes

The MF measuring microscopes can be combined with Mitutoyo's vision unit to boost its performance and data management on a PC, further improving measuring efficiency and productivity.

FEATURES

- Observation with a crisp and high-resolution erect image and a wide field of view
- Measuring accuracy that is highest in its class (and conforms to JIS B 7153)
- ML series, high-NA objectives that are specially designed for the MF series (long working distance type)
- Illumination unit (reflected/transmitted) selectable from a high-intensity LED or halogen bulb (selection required)
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction
- Variety of standardized stages in sizes up to 400×200mm
- Quick-release mechanism useful for moving the stage quickly when measuring workpieces that are large in size or quantity
- Coarse/fine feed handles equipped as standard on both sides allow precise focus and observation measurement regardless of handedness
- High-magnification eyepiece observation up to 2000×
- Standard measuring microscope has a wide variety of optional accessories including a vision unit and various digital CCD cameras

MF-B2017D
XY stage travel range: 8 x 6.6" / 200 x 170mm
(with optional binocular tube)

Using optional slide-type nosepiece with 2-lens mount (factory set option)

Technical Data

Optical tube	• Monocular or Binocular **(Must Choose)** • 25° depression angle • 90° broken cross-hair reticle (12AAG836) • Erect image • TV Mount 50/50
Observation image	• Erect Image
Observation type	• Bright Field
Eyepiece lens	• 10x (Included w/Tube) • 15x (Optional) • 20x (Optional)
Objective	• Magnification: 3X (Included) • W.D.: 3.03" (77mm); N.A.: .09 • Optional: 1x, 5x, 10x, 20x, 50x, 100x
Light source	• Halogen or LED **(Must Choose)** • Adjustable aperture diaphragms • Light intensity infinitely adjustable
Transmitted illumination	• Telecentric illumination
Reflected illumination	• Koehler illumination
Display Unit	
Number of axis	• 2 axes (MF-A Type) or 3 axes (MF-B Type)
Resolution	• 0.0001" / 0.00005" / 0.00001" (0.001 mm / 0.0005 mm / 0.0001 mm)
Functions	•Data output, Axis linear compensation, Metric or English Units, and more
Stage	• Precision travel (2.2+0.02L)µm accuracy • High-accuracy linear glass scales • Quick-release floating mode • Zero-set button
Power consumption	45W LED, 160W Halogen, 120V AC, 50/60 Hz
Mass	• 1010D - 148 lbs. / 67 kg • 2010D - 157 lbs. / 71 kg • 2017D - 326 lbs. / 148 kg • 3017D - 344 lbs./ 156 kg • 4020D - 357 lbs. / 162 kg

LED and Halogen Light Options for Transmitted and Reflected Illumination
(Common to MF D and MF-U D)

Transmitted LED illumination unit (Common to MF/MF-U Series) | Reflected LED illumination unit (for MF Series) | Reflected LED illumination unit (for MF-U Series)

LED illumination | Halogen illumination

High Visibility Digital Display
(Common to MF D and MF-U D)

Front of display | Rear of display

Selection of XY stage by travel range

1010D: 4 x 4" / 100 x 100mm

2010D: 8 x 4" / 200 x 100mm

2017D: 8 x 6.7" / 200 x 170mm

3017D: 12 x 6.6" / 300 x 170mm

4020D: 16 x 8" / 400 x 200mm

Mitutoyo

MF

SERIES 176 — Measuring Microscopes

SPECIFICATIONS

Model No. (XY stage size)		1010D	2010D	2017D	3017D	4020D
Order No.	MF-A	**176-861-10**	**176-862-10**	**176-863-10**	**176-864-10**	**176-865-10**
	MF-B	**176-866-10**	**176-867-10**	**176-868-10**	**176-869-10**	**176-870-10**
XY stage travel range		4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 7" 200 x 170mm	12 x 7" 300 x 170mm	16 x 8" 400 x 200mm
Z-axis travel range		6" / 150mm		8.7" / 220mm		
Focusing method		Manual focusing (Coarse focusing: 30mm/rev., Fine focusing: 0.2mm/rev.)				
Measurement method		Linear encoder (2-axis model: X / Y-axis, 3-axis model: X / Y / Z-axis)				
Resolution (switchable)		.0001" / .00005" / .00001" (0.001mm / 0.0005mm / 0.0001mm)				
Measuring accuracy (at 20˚C)		XY-axis: (2.2+0.02L)µm, L = Measuring length (mm) when not loaded, JIS B 7153				
Indication accuracy (at 20˚C)		Z-axis: (5+0.04L)µm, L = Measuring length (mm), (MF-B type)				
Floating function		X and Y axes with Quick-release mechanism				
XY stage top size		11 x 11" 280 x 280mm	14 x 11" 350 x 280mm	16.1 x 13.4" 410 x 342mm	20.07 x 13.4" 510 x 342mm	24" x 13.4" 610 x 342mm
Effective glass size		7 x 7" 180 x 180mm	10 x 6" 250 x 150mm	10.6 x 9.4" 270 x 240mm	14.5 x 9.4" 370 x 240mm	17.3 x 9.4" 440 x 240mm
Swivel function		—		±5˚ (left)		±3˚ (left)
Max. stage loading		22lbs / 10kg		44lbs / 20kg		33lbs / 15kg
Max. workpiece height		6" / 150mm		8.7" / 220mm		

MF Selection of Machine Type (must select)

↓	1010	2010	2017	3017	4020	Counter	Motorized stage	Optics
A	**176-861-10**	**176-862-10**	**176-863-10**	**176-864-10**	**176-865-10**	X,Y	Manual	BF
B	**176-866-10**	**176-867-10**	**176-868-10**	**176-869-10**	**176-870-10**	X,Y,Z	Manual	BF
J	-	-	**176-891A**	**176-892A**	**176-893A**	X,Y,Z	Z only	BF

Example: MF-A1010D results in part number 176-861-10

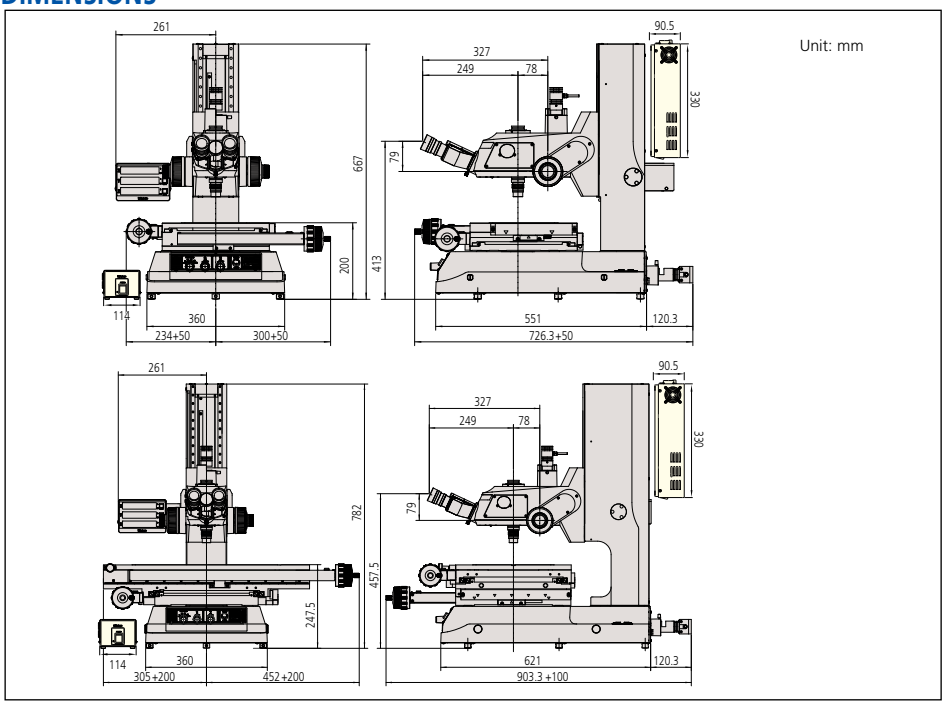
Illumination Unit (must select)

Applicable Illumination Unit	LED	Halogen
Order No.	176-445A	176-447A

Eye Tube Selection (must select)

Monocular with 10X eyepiece	176-392
Binocular with 10X eyepiece	176-393

DIMENSIONS



Optional Accessories

176-392: Monocular tube with 10X eyepiece
176-393: Binocular tube with 10X eyepiece set
378-866: 10X eyepiece set (view field dia.: 24mm)
378-857: 15X eyepiece set (view field dia.: 16mm)
378-858: 20X eyepiece set (view field dia.: 12mm)
375-043: Protractor eyepiece (10X)
176-313: Digital protractor eyepiece (10X)
375-036-2: 1X objective (W.D.: 61mm, N.A.: 0.03)
375-037-1: 3X objective (W.D.: 77mm, N.A.: 0.09) (std. accessory)
375-034-1: 5X objective (W.D.: 61mm, N.A.: 0.13)
375-039: 10X objective (W.D.: 51mm, N.A.: 0.21)
375-051: 20X objective (W.D.: 20mm, N.A.: 0.42)
375-052: 50X objective (W.D.: 13mm, N.A.: 0.55)
375-053: 100X objective (W.D.: 6mm, N.A.: 0.7)
176-370-1: Slide-type nosepiece (2-mount, parfocal)
176-370-2: Slide-type nosepiece (2-mount, mag. adjusted)
12AAA643: ND2 color filter (transmitted / surface)
12AAA644: ND8 color filter (transmitted / surface)
12AAA645: GIF filter (transmitted / surface) (std. accessory)
12AAA646: LB80 color filter (transmitted / surface)
375-054: 0.5X camera adapter (with C-mount adapter)
970441: C-mount adapter
513667: Halogen bulb (12V, 50W)
12BAB345: Halogen bulb (long life type, 12V, 50W)
176-308: Vibration damping stand
176-309: Mounting stand
375-056: Stage micrometer
12AAA165: Lens cleaning kit
12AAA846: Foot switch
382951: Vinyl cover (standard accessory) 2010 or less
12BAM841: Vinyl cover 2017 or greater

Illumination Units
176-367-2A: LED ring illuminator
176-343A: Twin fiber-optics illuminator
176-366A: Ring fiber-optics illuminator
12AAG806: GIF color filter (for fiber-optics illuminator)
12AAG807: LB80 color filter (for fiber-optics illuminator)

Fixture and Stage Accessories
176-107: Holder with clamp
172-378: V-block with clamp (max. workpiece dia.: 1" / 25mm)
172-197: Swivel center support[1] (max. workpiece dia.: 3.1" / 80mm)
176-305: Rotary stage with fine feed knob for 1010D/2010D models
176-306: Rotary stage with fine feed knob for 2017D/3017D/4020D models

[1] Fixture mount adapter (**176-310**) is required for 2010D models.
Fixture mount adapter (**176-304**) is required for 2017D/3017D/4020D models.

QM-Data200
2-D data processing unit
264-155A: Stand-mount type
12AAA807: Connecting cable set

Focus pilot FP-05
Focus assisting system

Vision Unit
PC-based vision measuring system
359-763

MF Motorized

SERIES 176 — Motorized Type Measuring Microscopes

Refer to No. (E14003) for more details.

- Motorized model of the MF Series. The Z-axis is motorized, and the stage can be operated using a remote box.
- Using the optional vision unit enables the image AF function.
- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb (selection required).
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- A wide variety of optional accessories are offered.
- ML series, high-NA objectives that are specially designed for the MF series (long-working distance type).
- High-magnification observation up to 2000X.

MF-J2017D

* The binocular tube, eyepieces, and LED illumination unit are optional accessories.

SPECIFICATIONS

	Model No.	MF-J2017D	MF-J3017D	MF-J4017D
	Order No.	**176-891A**	**176-892A**	**176-893A**
Observation image		BF (Bright field)/Erect image		
Eyepiece	Diopter adjustment	10X (field number: 24), 15X, 20X Note: Monocular unit: a 10X eyepiece (standard accessory), Binocular tube: two 10X eyepieces (standard accessory)		
Objective lens		ML series 3X objective lens (standard accessory), 1X, 5X, 10X, 20X, 50X, 100X		
Illumination unit (One of the two options must be selected.)	LED illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, White LED light source, stepless light intensity control, with cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, White LED light source, stepless light intensity control Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector		
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, with cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (12V, 50W), stepless light intensity control, with cooling fan Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector		
Vision AF *1		Available Option		
XY-axis Vision	Measuring range	200×170mm	300×170mm	400×200mm
Z-axis	Measuring range	220mm		
Measuring accuracy *2	(When no load is put on the X- or Y-axis)	(2.2+0.02L) μm L: Measuring length (mm)		
Digital counter	Resolution	1/0.5/0.1μm .0001"/.00005"/.00001" switchable		

*1: Vision Unit **359-763** and an image AF cable **12AAN358** are sold separately.
*2: Measuring method complies with JIS B7153.

Bulb replacement for transmitted/reflected illumination Standard: Halogen bulb (12V, 50W) (**No.513667**)
Bulb life: 1,100 hours

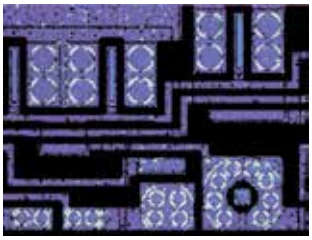
MF-U

SERIES 176 — High-power Multi-function Measuring Microscopes

FEATURES

- Observation with a clear and flareless erect image and a wide field of view
- Measuring accuracy that is highest in its class (and conforms to JIS B 7153)
- Proven high-NA objectives from the FS optical system (long-working distance type)
- Integration of metallurgical and measurement microscope functions provides high-resolution observation and high-accuracy measurement solution
- Illumination unit (reflected/transmitted) selectable from a high-intensity LED or halogen bulb (required)
- Variable aperture diaphragm (reflected/transmitted) allows for contrast adjustment
- Variety of standardized stages in sizes up to 400 × 200 mm
- Quick-release mechanism useful for moving the stage quickly when measuring workpieces that are large in size or quantity
- High-magnification eyepiece observation up to 4000X

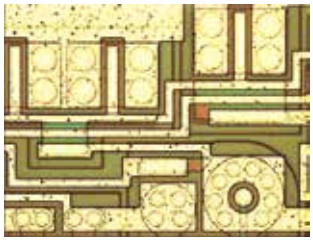
MF-UB3017D
XY stage travel range: 12 x 6.7″ / 300 x 170mm
(with optional turret, objective and fiber illumination)



Polarized light observation:
Observing only the filtered light that vibrates in one direction. Used for observing materials with special optical characteristics, such as mineral and liquid crystal.

Differential interference contrast (DIC) observation:
Effective in detecting fine scratches and steps on the surface of metal, liquid crystal, and semiconductors.

Dark field (DF) observation:
Observing only the scattered light by shutting down the direct light to the objectives. The scratches and dust that cannot be viewed in the bright view field can be observed by this method in high-contrast.



Bright field (BF) observation:
Most common method of observation. Observing directly the light reflected from the surface of the workpiece.

Technical Data

Observation image:	Erect image
Optical tube:	Siedentoph type (pupil distance adjustment: 51 - 76mm), 1X tube lens, Binocular tube (depression: 30˚), Reticle projection method, with TV mount, Optical path ratio (eyepiece/TV mount: 50/50)
Eyepiece lens:	10X (field No.: 24mm), Optional: 15X, 20X
Turret (optional):	Manual or power
Objective (optional):	M / BD Plan Apo objective from 1X to 200X
Transmitted illumination	
• Light source:	Halogen bulb (12V, 50W) or LED
• Optical system:	Telecentric illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Surface illumination	
• Light source:	Optional halogen illumination unit (fiber-optic cold light illumination) or LED
• Optical system:	Koehler illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Display unit:	
• No. of axis:	2 axes or 3 axes
• Resolution:	.0001″ / .00005″ / .00001″ / 0.001mm / 0.0005mm / 0.0001mm
• Functions:	Zero-setting, Direction switching, Data output (via RS-232C interface)
Power supply:	120V AC, 50/60Hz
Mass:	148lbs/67kg (1010D) / 157lbs/71kg (2010D) / 326lbs/148kg (2017D) / 344lbs/156kg (3017D) / 357lbs/162kg (4020D)

Selection of XY stage by travel range

1010D: 4 x 4″ / 100 x 100mm

2010D: 8 x 4″ / 200 x 100mm

2017D: 8 x 6.7″ / 200 x 170mm

4020D: 16″ x 8″ / 400 x 200mm

MF-U

SERIES 176 — High-Power Multi-Function Measuring Microscopes

Optional Accessories

378-866: 10X eyepiece set (view field dia.: 24mm) (standard accessory)
378-857: 15X eyepiece set (view field dia.: 16mm)
378-858: 20X eyepiece set (view field dia.: 12mm)

Turret (Nosepiece) **must select**
378-018: Adjustable manual BF turret (4 port)
378-216A: Adjustable power BF turret (5 port)
176-211: Adjustable manual BF/DF turret (4 port)
176-212A: Adjustable power BF/DF turret (4 port)

Objectives
See page I-28 for objective selection

Manual and Power Turrets

Filters
378-092: Polarization unit
378-076: DIC unit for 100X, SL80X, SL50X objective
378-078: DIC unit for 50X, SL20X objective
378-079: DIC unit for 20X objective
378-080: DIC unit for 10X, 5X objective
12AAA643: ND2 color filter (for halogen illuminator, **176-448A**)
12AAA645: GIF filter (standard accessory)
12AAA646: LB80 color filter (for halogen illuminator, (**176-448A**)

Camera Mounts
375-054: 0.5X camera adapter (with C-mount adapter)
970441: C-mount adapter

Bulbs
513667: Halogen bulb (12V, 50W)
12BAB345: Halogen bulb (long life type, 12V, 50W)
517181: Halogen bulb (12V, 100W)
12BAD602: High intensity halogen bulb (12V, 100W)

Illumination Units
176-315A: Halogen illumination unit (12V, 100W)
176-316A: Halogen illumination unit (12V, 150W)
176-343A: Twin fiber-optics illuminator
12AAG806: GIF color filter (for **176-315A** and **176-343A**)
12AAG807: LB80 color filter (for **176-315A** and **176-343A**)

Fixture and Stage Accessories
176-107: Holder with clamp
172-378: V-block with clamp (max. workpiece dia.: 1" / 25mm)
172-197: Swivel center support* (max. workpiece dia.: 3.1" / 80mm)
176-305: Rotary stage with fine feed knob for 1010D/2010D models
176-306: Rotary stage with fine feed knob for 2017D/3017D/4020D models
*Fixture mount adapter (**176-310**) is required for 2010D models.
Fixture mount adapter (**176-304**) is required for 2017D/3017D/4020D models.

Misc.
176-308: Vibration damping stand
176-309: Mounting stand
375-056: Stage micrometer
937179T: Foot switch
Reticle See page I-21

SPECIFICATIONS

Model No. (XY stage size)		1010D	2010D	2017D	3017D	4020D
Order No.	MF-UA	**176-871-10**	**176-872-10**	**176-873-10**	**176-874-10**	**176-875-10**
	MF-UB	**176-876-10**	**176-877-10**	**176-878-10**	**176-879-10**	**176-880-10**
	MF-UC	**176-881-10**	**176-882-10**	**176-883-10**	**176-884-10**	**176-885-10**
	MF-UD	**176-886-10**	**176-887-10**	**176-888-10**	**176-889-10**	**176-890-10**
XY stage travel range		4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 6.7" 200 x 170mm	12 x 6.7" 300 x 170mm	16 x 8" 400 x 200mm
Z-axis travel range		6" / 150mm		8.7" / 220mm		
Focusing method		Manual focusing (coarse focusing: 10mm/rev., fine focusing: 0.1mm/rev.)				
Measurement method		Linear encoder (2-axis model: X / Y-axis, 3-axis model: X / Y / Z-axis)				
Resolution (switchable)		.0001" / .00005" / .00001" (0.001mm / 0.0005mm / 0.0001mm)				
Measuring accuracy (at 20˚C)		XY-axis: (2.2+0.02L)µm, L = Measuring length (mm) when not loaded, JIS B 7153				
Indication accuracy (at 20˚C)		Z-axis: (5+0.04L)µm, L = Measuring length (mm)				
Floating function		X and Y axes with Quick-release mechanism				
XY stage top size		11 x 11" 280 x 280mm	14 x 11" 350 x 280mm	16 x 13.6" 410 x 342mm	20 x 13.6" 510 x 342mm	24 x 13.6" 610 x 342mm
Effective glass size		7.1 x 7.1" 180 x 180mm	10 x 6" 250 x 150mm	10.6 x 9.6" 270 x 240mm	14.6 x 9.6" 370 x 240mm	17.3 x 9.6" 440 x 240mm
Swivel function		—		±5˚ (left)		±3˚ (left)
Max. stage loading		22lbs / 10kg		44lbs / 20kg		33lbs / 15kg

Selection of machine type

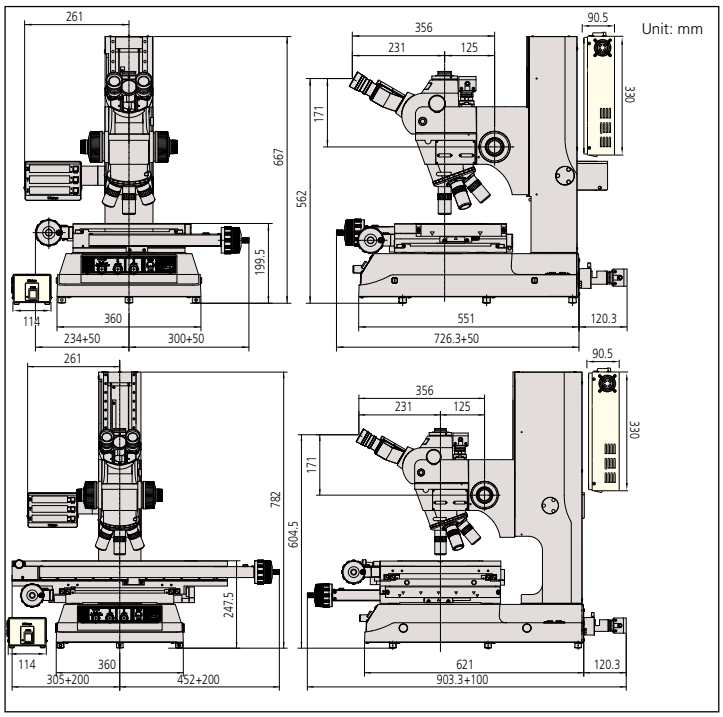
Machine type	MF-UA	MF-UB	MF-UC	MF-UD
Observation type	Bright field (BF)	Bright field (BF)	Bright / Dark field (BF/DF)	Bright / Dark field (BF/DF)
Measurement system	X and Y-axis (2 axes)	X, Y and Z-axis (3 axes)	X and Y-axis (2 axes)	X, Y and Z-axis (3 axes)

Illumination Unit (must select LED or Halogen illumination unit)

Applicable Illumination Unit	LED	Halogen
Order No.	**176-446A** (transmitted & reflected)	**176-448A** (transmitted)
		176-316A (reflected)

Note: illumination unit not included. If halogen transmitted illumination is selected, then either 176-315A or 176-316A must be chosen.

DIMENSIONS



MF-U Motorized

SERIES 176 — Motorized-Type Universal Measuring Microscopes

- Motorized model of the MF-U Series. The Z-axis is motorized, and can be operated using a remote box.
- Using the optional vision unit enables the image AF function.
- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb (required).
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- A wide variety of optional accessories are offered.
- Proven high-NA objectives from the FS optical system (long working distance type).
- Integration of metallurgical and measurement microscope functions provide high-resolution observation and a high-accuracy measurement solution.
- High-magnification observation up to 4000X.

MF-UJ2017D

* The turret, objectives, and LED illumination unit are sold separately.

MF-U Selection of Machine Type

↓	2017	3017	4020	Counter	Motorized stage	Optics
J	176-894A	176-895A	176-896A	X,Y,Z	Z only	BF
K	176-897A	176-898A	176-899A	X,Y,Z	Z only	BF/DF

SPECIFICATIONS

BF (Bright field)	Model No.	**MF-UJ2017D**	**MF-UJ3017D**	**MF-UJ4020D**
	Order No.	**176-894A**	**176-895A**	**176-896A**
BD (Bright / Dark field)	Model No.	**MF-UK2017D**	**MF-UK3017D**	**MF-UK4020D**
	Order No.	**176-897A**	**176-898A**	**176-899A**
Observation image		BF (Bright field), DF (Dark field) , Polarization, Differential Interference Contrast (DIC) / Erect image		
Eyepiece	Diopter adjustment	10X (standard accessory) (Field number: 24), 15X, 20X		
Objective lens (optional)	BF (Bright field)	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo		
	BD (Bright / Dark field)	BD Plan Apo, D Plan Apo HR, BD plan Apo SL		
Illumination unit (One of the two options must be selected.)	LED illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, White LED light source, stepless light intensity control, with cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, White LED light source, Non-step light intensity control Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector		
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, with cooling fan Reflected: BF/BD Kohler illumination with adjustable aperture diaphragm, 12V100W or 12V15W halogen lamp (selectable), external fiber illumination, stepless brightness adjustment Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector		
Vision AF *1		✓		
XY-axis	Measuring range	8×6.7" / 200×170mm	12×6.7" / 300×170mm	16×8" / 400×200mm
Z-axis	Measuring range	8.7" / 220mm		
Measuring accuracy	(When no load is put on the X- or Y-axis)	(2.2+0.02L) µm L: Measuring length (mm)		
Digital counter	Resolution	1/0.5/0.1µm .0001"/.00005"/.00001" switchable		

*1: Vision unit and an image AF cable are separately required.
*2: Measuring method complies with JIS B7153.

Bulb replacement for transmitted illumination Standard: Halogen bulb (12V, 50W) (**No.513667**), Bulb life: 1,100 hours
For replacement for reflected illumination (from separate light source) Standard: Halogen bulb (12V, 100W) (**No.517181**),
High-intensity bulb (12V, 100W) (**No.12BAD602**)
*At the time of purchase, a standard bulb and a high-intensity bulb are provided. (Only for the reflected illumination models.)

Accessories for Measuring Microscope

Stage Micrometer

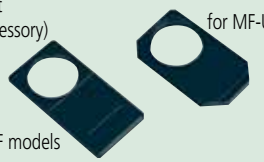
SPECIFICATIONS

Order No.	375-056
Range	1mm
Graduations	0.01mm
Accuracy (at 20˚C)	(1+L)µm, L = Measuring length (mm)
Dimensions (WxD)	3" x 1" / 76 x 26mm
Mass	16g

Optional Reticles

12AAG838 (12AAG878): Cross-hair (7µm width)
12AAG836 (12AAG877)*: Cross-hair (5µm width)
12AAG873 (12AAG876): Cross-hair (3µm width)
12AAG839 (12AAG879): Cross-hair and 45˚ angle
12AAG840 (12AAG880): Broken cross-hair and 60˚ angle
12AAG841 (12AAG881): Zeiss type chart
12AAG842: 20mm scale (0.1mm reading)
12AAG843: Concentric circle (ø1.2 - ø18mm)
12AAG844: 10mm scale (0.1mm reading)
12AAG845: 5mm scale (0.05mm reading)
12AAG846: 10x10mm section (1mm min.)
12AAG847: Metric screw thread (P = 0.25-1.0)
12AAG848: Metric screw thread (P = 1.25-2.0)
12AAG849: Involute gear tooth (14.5˚), module = 0.1 - 1.0
12AAG850: Involute gear tooth (20˚), module = 0.1 - 1.0
12AAG851: Unified screw thread (80 - 28TPI)
12AAG852: Unified screw thread (24 - 14TPI)
12AAG853: Unified screw thread (13 - 10TPI)
12AAG854: Concentric circle (ø.01" - ø.2")
( ): for MF-U models,
* Standard accessory

Reticle mount
(standard accessory)



for MF-U models

for MF models

Cross-hair and 90˚ angle
(standard accessory)

Focus Pilot FP-05

FEATURES

- By installing this system on the camera mount of an MF series measuring microscope and projecting the focusing chart onto the workpiece surface, the focal point can be detected with high accuracy and high repeatability.
- The brightness of the chart can be adjusted.
- A wide view field observation on the monitor is made possible with the use of a CCD camera (C-mount adapter is included.)
- Four types of chart patterns are available.* The pattern should be selected in accordance with the type of workpiece surface texture.

* Factory installed option

Concentric circle

Slit

SPECIFICATIONS

Order No.	375-057A	375-058A	375-067A	375-068A
Applicable microscopes	MF D models		MF-U D models	
Light source	Green LED	Red LED	Green LED	Red LED
Magnification	0.5X, Accuracy: 0.1%**			
Camera adapter	C-mount (provided)			
Applicable CCD camera	Up to 2/3-inch			
Mass	4lbs / 1.8kg			

** Within 2/3 area from the center of view field

Manual and Power Turrets

SPECIFICATIONS

Order No.	176-211	378-018	176-212A	378-016A	378-216A
Observation type	BD	BF	BD	BF	BF
No. of objective mounts	4-mount	4-mount	4-mount	4-mount	5-mount
Driving method	Manual		Motor		
Dimensions (W x D x H)	—	—	Turret: 6.5 x 2.6 x 5.4" 164 x 65 x 137		
			Control Box: 4.1 x 3 x 7.6" 108 x 72 x 193		

Mitutoyo

Accessories for Measuring Microscope

Twin fiber-optics illuminator

SPECIFICATIONS

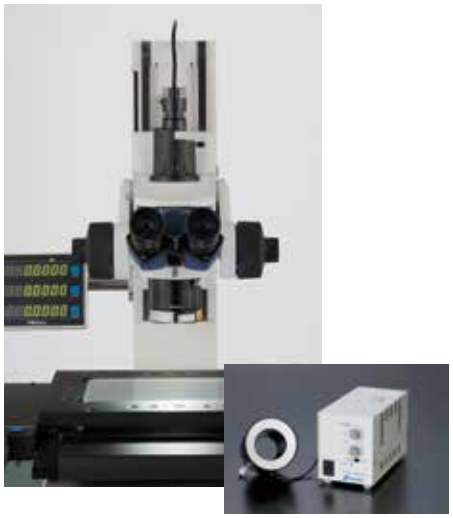
Order No.	176-343A
Applicable microscopes	MF, MF-U models
Length of fiber cable	28" / 700mm
Light source	Halogen bulb (12V, 100W) (**517181**: halogen bulb)
Dimensions (W x D x H)	Light unit: 9.3 x 3 x 4.7" 235 x 76 x 120mm

Ring fiber-optics illuminator

SPECIFICATIONS

Order No.	176-366A
Applicable microscopes	MF models (ML 10X or lower)
Length of fiber cable	40" x 1000mm
Light source	Halogen bulb (12V, 100W) (**517181**: halogen bulb)
Dimensions (W x D x H)	Light unit: 9.3 x 3 x 4.7" 235 x 76 x 120mm

LED Ring Illuminator



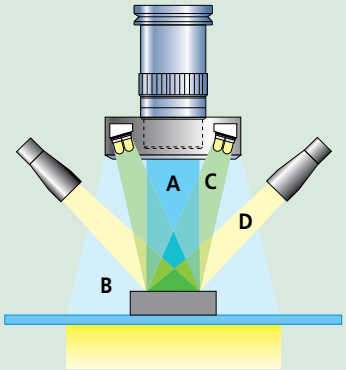
SPECIFICATIONS

Order No.	176-367-2A
Applicable microscopes	MF models with 1X/3X/5X/10X objective
Light source	White LED
Length of LED cable	59" / 1500mm

LED Ring Light (for sliding nosepiece)

SPECIFICATIONS

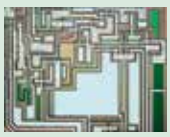
Order No.	176-371A
Applicable microscopes	MF models with 1X/3X/5X/10X objective
Light source	LED



A: Vertical surface illumination (Halogen)


PCB


HDD suspension


IC circuit

B: Ring fiber optics illumination


Flexible PCB


PCB


Electric parts

C: LED ring illumination


HDD suspension


PCB


Black resin molded parts

D: Twin fiber-optics illumination

IC package


Garnet


PCB

QM-Data200

SERIES 264 — 2-D Data Processing Unit

Technical Data

Resolution:	0.0001mm
Program functions:	Part program creation, execution, editing
Statisical processing:	Number of data, maximum value, minimum value, mean value, standard deviation, range, histogram
Element memory:	Maximum of 1000 elements
Element recall:	Point, line, circle, distance, ellipse, rectangular hole, slotted hole, intersection and intersecting angle
Element key-in:	Point, line, circle
Display system:	Monographic LCD (320 x 240 dots, with back light)
Measurement result file output:	RS-232C/USB output (CSV format, MUX-10F format)
Display language:	Japanese/English/German/French/ Italian/Spanish/Portuguese/Swedish/ Polish/Dutch/Hungarian
Data input:	RS-232C/USB, X/Y/Z-axis signal, Footswitch
Data output:	RS-232C/USB
Power supply	120V AC, 50/60Hz
Mass	2.2kg (stand-mount type) 2.1kg (arm-mount type)

QM-Data200
Order No.: 264-155A (stand-mount type)
Order No.: 264-156A (arm-mount type)

The QM-Data200 is a geometric readout/ analysis unit for optical instruments like profile projectors. This features powerful 2-D coordinate measurement capabilities with unmatched simple key operation. The QM-Data200 improves operator productivity, minimizes errors, and saves measurement time and production cost.

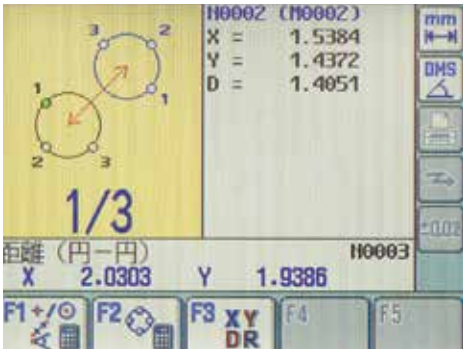
FEATURES

- Various graphic displays on the large colored LCD screen for easy measurement operations.
- One-key operation for combined measurements that are often used (circle-circle distance, etc.)
- The AI measurement function (automatic identification of measuring item) eliminates switching between the measurement command keys.
- Equipped with the measurement procedure teaching function and the measuring position navigation in Repeat mode.
- The user menu function allows user to register measurement commands or part programs to create his own menu.
- Tolerance zone measurement of data processing result and various statistical processing for each item is available.
- Measurement result output to "MS-Excel" in spreadsheet (CSV) format.
- The measurement procedure and measurement result can be saved, using a USB drive.
- Two models available: a stand-alone type with tilt system and a flexible-arm type that can be mounted on a profile projector.

QM-Data 200
Stand-mount type

• Intuitive panel design
The QM-Data200 employs Geometry Keys to accelerate the measurement process. The probing routine of standard geometric features and combinations are designed with Geometry Keys on the front panel. Click the key you need and capture features to complete the measurement quickly and accurately. This improves operator productivity, reduce errors, and saves operation time and cost.

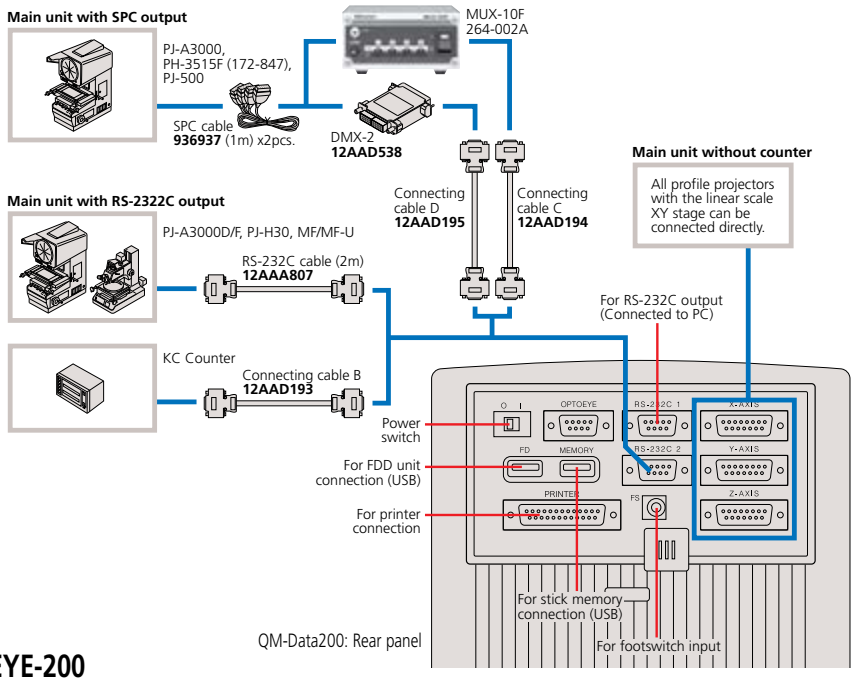
• Graphic display
Measurement information and data are visualized on the back-lit colored LCD with graphical interfaces. The geometric feature selected is displayed with the probing navigator. The measurements map and blink indication show the probing points and sequences. This improves operation accuracy and reduces errors and time.



QM-Data200

SERIES 264 — 2-D Data Processing Unit

SYSTEM DIAGRAM



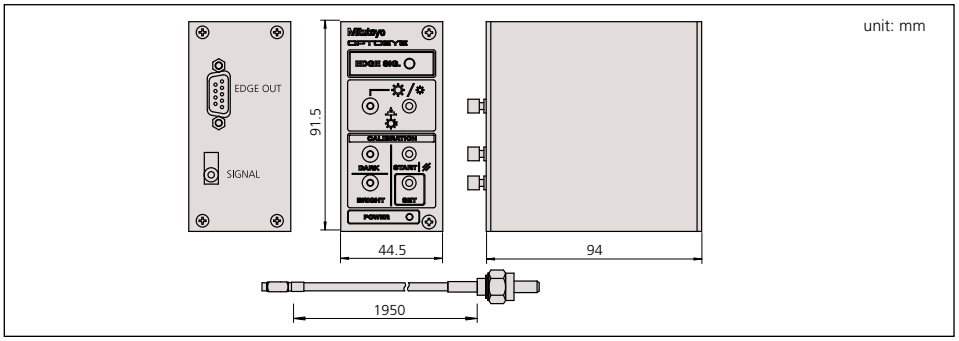
OPTOEYE-200

The OPTOEYE-200 Image Edge Sensor eliminates human errors, ensuring speedy, accurate and consistent measurements, regardless of operator's skill.

FEATURES

- OPTOEYE-200 adopts a thin fiber-optic cable for detector connection for easy set-up and smart operation without obstructing your view.
- Bright and dark buttons allow easy calibration.
- OPTOEYE can be powered by QM-Data200 via the connecting cable. No AC adapter is required.
- The brightness of the chart can be adjusted.

DIMENSIONS



Optional Accessories

12AAD034: Receipt printer (for 120V)
223663: Printer paper for receipt printer
12AAA804: Printer cable (2m)
937179T: Foot switch
12AAD193: Connection cable B
12AAD194: Connection cable C
12AAD195: Connection cable D
12AAA807: RS-232C cable (2m)
12AAA808: RS-232C cable (4m)

Technical Data

Image detection
- Directivity: Non-direction
- Min. diameter: ø2mm on the screen
- Min. width: 1mm on the screen
- Max. moving speed: 1000mm/s

Applicable illumination
- Type: Surface / Contour illumination
- Range: 30Lx to 1500Lx on the screen
  Bright-Dark field difference: 20Lx

Repeatability: 1µm in contour illumination
Function: Error in detection of illumination change
Supporting a contour illumination brightness selector switch of projector

Optional Accessories

12AAE671:
Detector attachment (A)
PJ-A3000, PJ-H30, PH-3515, PH-A14 series
(Adaptation diameter of a screen:
10" / ø250 to 14" / ø350mm)

12AAE672:
Detector attachment (B)
PJ-500, PV-5110, PV-600A series
(Adaptation diameter of a screen:
20" / ø500 to 24" / ø600mm)

Refer to Bulletin No. (2222) for more details.

Vision Unit

SERIES 359 — Vision System Retrofit for MF and MF-U Microscopes

SPECIFICATIONS

Projected Image	Inverted Image
Onscreen Magnification	19x-1900x (22" Monitor)
Camera Unit	
Image Sensor Size	1/2" Color CMMOS
Image Sensor Resolution	3 MP
Interface	USB 2.0
Dimensions (WxDxH)	2.28 x 2.32 x 3.27" 58 x 59 x 83mm
Adapter Unit	
Measurement Software	QSPak VUE (optional)
Dimensions (DXH)	1.77 x 4.84" / 45 x 123mm
Magnification	0.5x
Optional Accessory:	Foot Switch **(12AAJ088)**

QSPAK, optional software

For observation/comparison of form

- Template matching function
- Manual pattern matching function

For simple measurement

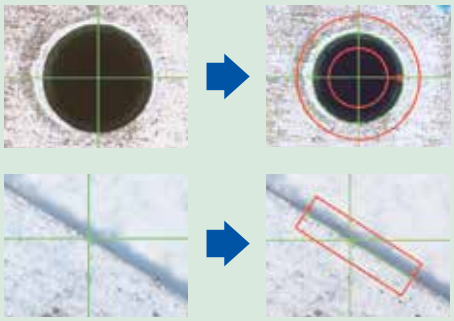
- One-click edge detection tool function
- Smart tool function
- User macro function

For repeated measurement/ auto-measurement

- Quick navigation function
- Playback function
- Graphic function
- External data output function
- Statistical calculation function

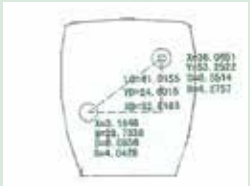
One-click Edge Detection

By clicking the mouse near the edge of a workpiece, QSPAK automatically scans the edge and detects it, showing its coordinates. This function also works with the point tool, box tool, circle tool and auto-focus tool.



Graphic Window

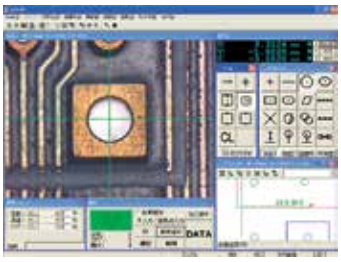
The measurement results and measured elements are plotted in the graphic window in real-time. By using this function, the user can check the current measuring position at a glance. The graphic window can be used for geometrical calculation.



FEATURES

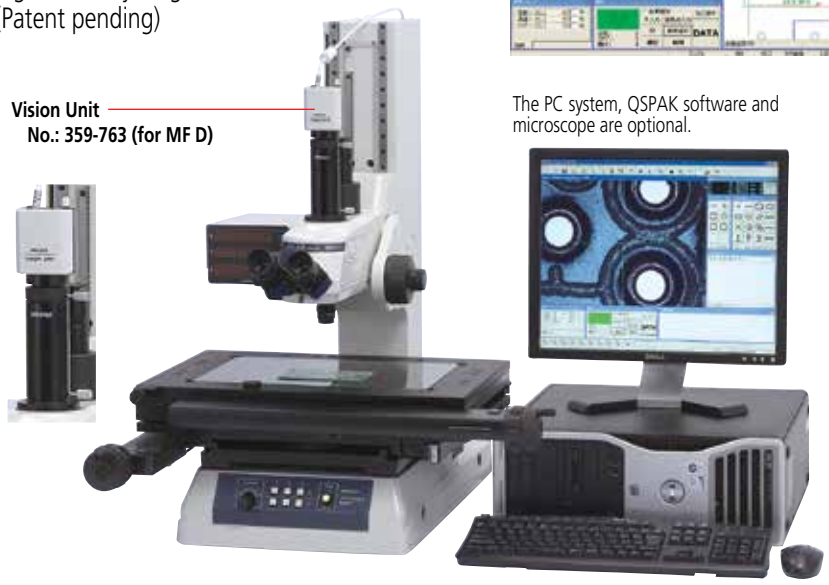
- The automatic edge-detection tools and various macro icons allow measurement in one easy step.
- The graphics and measurement navigation functions facilitate operation.
- Image data input/storage function.
- Measurement results are output in CVS format. This lets the user generate an inspection table in MS-Excel®.
- Allows the tolerance zone measurement of measurement results and various types of statistical processing for each item.
- Combined use with the focus pilot provides high-accuracy height measurements. (Patent pending)
- A series of measuring operations can be performed using just one screen display.
- The auto-brightness control function reproduces the type and degree of illumination required. (This function is limited to the MF/MF-U series.)

QSPAK Measurement Window

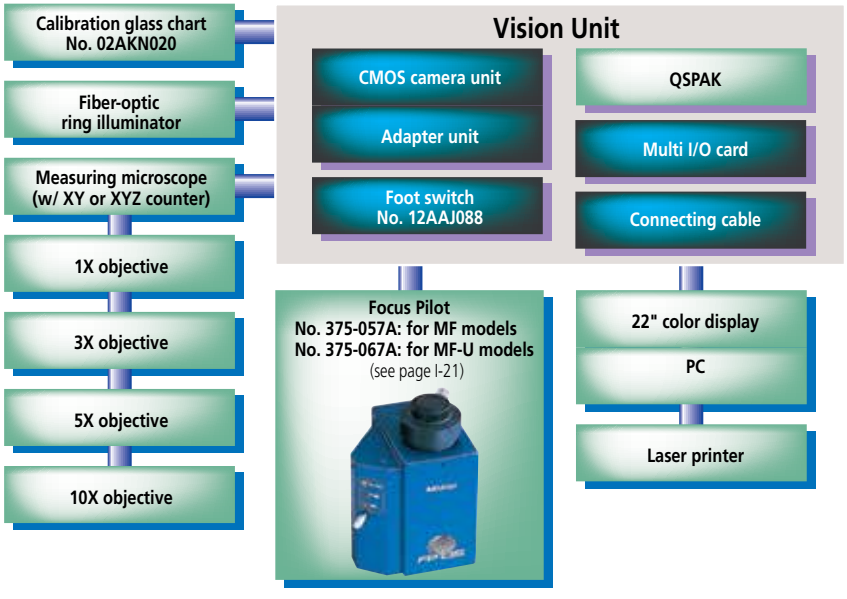


Vision Unit
No.: 359-763 (for MF D)

The PC system, QSPAK software and microscope are optional.



: Optional accessory



Mitutoyo

FS-70

SERIES 378 — Microscope Unit for Semiconductor Inspection

FEATURES

- The optical system that was developed for the best-selling FS 60 models was further enhanced for the FS70 models. It is ideal as a microscope unit of a prober station for semiconductors. (All models CE marked.)
- The FS70L supports three types of YAG laser wavelength ranges (1064nm, 532nm and 355nm), while the FS70L4 supports two types of wavelength ranges (532nm and 266nm), thus expanding a scope of laser applications, allowing laser-cutting of thin-films used in semiconductors and liquid crystal substrates. However, Mitutoyo assumes no responsibility for the performance and/or safety of the laser system used with Mitutoyo microscopes. Careful examination is recommended in selecting a laser-emission unit.
- Bright field, differential interference contrast (DIC) and polarized observations are optional with FS70Z and FS70. The FS70L and FS70L4 do not support the DIC method.
- By employing an inward revolver, the long working distance objectives provide excellent operability.
- An ergonomic design with superb operability: the FS70 employs the erect-image optical system (the image in the field of view has the same orientation as the specimen) and enlarged fine focus adjustment wheel with rubber-grip coarse adjustment knob.

FS70Z

FS70L

FS70L4

SPECIFICATIONS

Model No. **Order No.**	FS70 **378-184-1**	FS70-TH **378-184-3**	FS70Z **378-185-1**	FS70Z-TH **378-185-3**	FS70L **378-186-1**	FS70L-TH **378-186-3**	FS70L4 **378-187-1**	FS70L4-TH **378-187-3**

Short base model No. **Order No.**	FS70-S **378-184-2**	FS70-THS **378-184-4**	FS70Z-S **378-185-2**	FS70Z-THS **378-185-4**	FS70L-S **378-186-2**	FS70L-THS **378-186-4**	FS70L4-S **378-187-2**	FS70L4-THS **378-187-4**
Focus adjustment	50mm travel range with concentric coarse (3.8mm/rev) and fine (0.1mm/rev) focusing wheels (right / left)							
Image	Erect image							
Pupil distance	Siedentopf type, adjustment range: 2 - 3" / 51 - 76mm							
Field number	24							
Tilt angle	—	0° - 20°	—	0° - 20°	—	0° - 20°	—	0° - 20°
Optical pass ratio	50/50	100/0 or 0/100	50/50	100/0 or 0/100	100/0 or 0/100		100/0 or 0/100	
Protective filter	—		—		Built-in laser beam filter		Built-in laser beam filter	
Tube lens	1X		1X - 2X zoom		1X		1X	
Applicable laser	—		—		1064/532/355nm		532/266nm	
Camera mount	C-mount (using optional adapter B)				Use a laser with TV port.		C-mount receptacle (with green filter switch)	
Illumination system, optional	Reflective illumination for bright field (Koehler illumination, with aperture diaphragm) 12V 100W fiber optics, non-stepped adjustment, light guide length: 1.5m, power consumption 150W							
Objective, optional (for observation)	M Plan Apo, M Plan Apo SL, G Plan Apo							
Objective, optional (for laser-cutting)	—				M/LCD Plan NIR, M/LCD Plan NUV		M Plan UV	
Loading weight*	32lbs/14.5kg	30lbs/13.6kg	31lbs/14.1kg	29lbs/13.2kg	31lbs/14.2kg	30lbs/13.5kg	31lbs/13.9kg	29lbs/13.1kg
Mass (main unit)	13lbs/6.1kg	15.5lbs/7.1kg	14.5lbs/6.6kg	16.5lbs/7.5kg	14lbs/6.4kg	15.5lbs/7.2kg	14.5lbs/6.7kg	16.5lbs/7.5kg

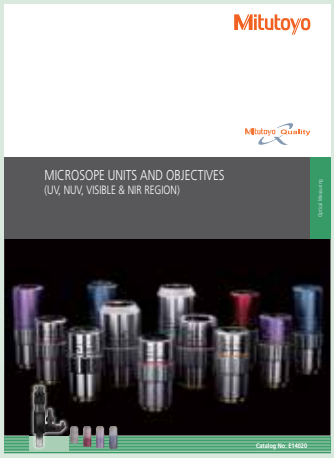
*Loading weight on optical tube excluding weight of objective lenses and eyepieces.

Technical Data

Focus Adjustment Method:	With concentric coarse and fine focusing wheels (right and left)
Range:	50mm travel range 0.1mm/rev. for fine adjustment, 3.8mm/rev. for coarse adjustment
Trinocular tube Image:	Erect image
Pupil distance:	Siedentopf type, adjustment range: 2-3" / 51-76mm
Field number:	24
Tilt angle:	0° - 20° (only -TH, -THS models)
Illumination system:	Reflective illumination for bright field (Koehler illumination, with aperture diaphram)
Light source (optional):	12V100W fiber optics, non-stepped adjustment, light guide length 1.5m, power consumption 150W
Objectives (optional):	M Plan Apo, M Plan Apo SL, G Plan Apo

Optional Accessories

For a complete listing of accessories see Microscope Units and Objectives brochure, E4191-378



Refer to No. (E14020) for more details.

VMU

SERIES 378 — Video Microscope Unit

The VMU is a compact, light-weight, and easy-to-install microscope unit for CCD camera monitoring in semiconductor fabrications.

FEATURES

- The rigidity and general performance of the VMU-LB & VMU-L4B have been enhanced compared to previous models.
- The optical system features ultra-long working distance objectives and correction for the wide range of radiation.
- The fiber-optic reflected illumination keeps the workpiece free from thermal expansion caused by heat. The fiber-optic illuminator is required for the light source.
- Also available with a laser mount or revolving nosepiece (objective mount).

SPECIFICATIONS

Magnification of tube		1X
Applicable wavelength	378-505, 378-506	Near-infrared and visible radiation
	378-507 378-513	Near-infrared —visible— near-ultraviolet radiation
	378-508	Visible and ultraviolet radiation
	378-514	Near-infrared to ultraviolet
Objective		(Optional) see pg. I-28 thru I-32
Reflected illumination		• Telecentric system with aperture stop system. • Fiber-optic illuminator (optional) is required.
Light source		Halogen bulb (21V, 150W) (optional)
Mass		**378-505**: 570g **378-506**: 590g **378-507**: 980g **378-508**: 1010g **378-513**: 1300g **378-514**: 1300g

Selection Guide of System Configuration

Order No. (Depends on each system configuration)	VMU-V **378-505**	VMU-H **378-506**	VMU-L **378-507**	VMU-L4 **378-508**	VMU-LB **378-513**	VMU-L4B **378-514**
Vertical CCD camera mount	●		●	●	●	●
Horizontal CCD camera mount		●				
YAG laser mount			●	●	●	●
Fiber-optic illumination unit	▲	▲	▲	▲	▲	▲
M Plan Apo, M Plan Apo SL, G Plan Apo objectives for bright field observation	▲	▲	▲	▲	▲	▲
M Plan Apo NIR, LCD Plan Apo NIR, M Plan Apo NUV and LCD Plan Apo NUV objectives for laser cutting			▲		▲	▲
M Plan UV objectives for laser machining				▲		▲

●: Provided, ▲: Available as optional accessory

Wide VMU:

FEATURES

- Offers approximately 7 times larger inspection area.
- Increases throughput by allowing for batch measurements.
- BD models can accommodate darkfield optics.

378-515 WIDE VMU-V
378-516 WIDE VMU-H
378-517 WIDE VMU-BDV
378-518 WIDE VMU-BDH

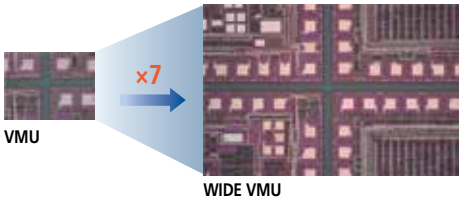
Technical Data

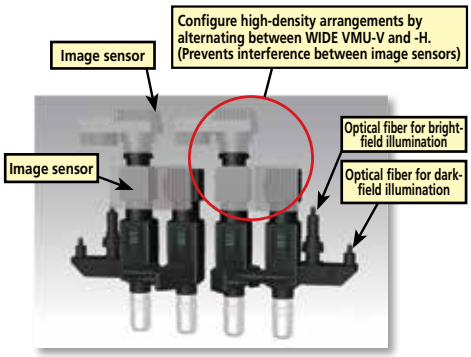
FOV in Camera Port	30mm Diameter
Camera Mount	F Mount (with C mount Adapter)
Example Sensor Size	APS-C format (2 inches)

Wide VMU Accessories

378-724	BF Revolver
378-725	BD Revolver
378-726	BF Motorized Revolver
378-727	BD Motorized Revolver

WIDE VMU-V WIDE VMU-H





Mitutoyo

Eyepieces
SERIES 378

FEATURES
- The field of view is extra wide.
- Optional reticles are available.

378-866 **378-857** **378-858**

SPECIFICATIONS

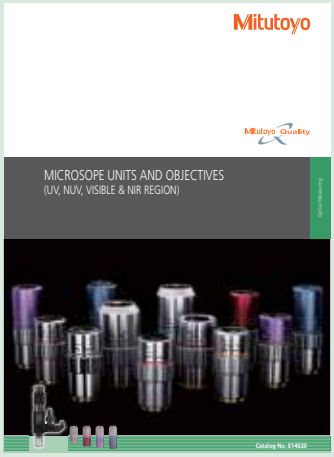
Order No. (2pcs. set)	Magnification	Field number	Mass	Individual order No.
378-866	10X	24	85g	**378-856-5**
378-857	15X	16	40g	**378-857-5**
378-858	20X	12	55g	**378-858-5**

Reticles (optional)
516848: Cross-hair
516576: Broken cross hair (90° and 60°)
516578: Concentric circle (Diametric increment: 1.2mm)
516577: 20mm scale (Minimum reading: 0.1mm) with cross hair
516849: 10mm scale (Minimum reading: 0.1mm)
516850: 5mm scale (Minimum reading: 0.05mm)

Objectives
SERIES 378

The Mitutoyo 378 Series objectives have the world's longest working distance and an infinity correction optical system. These objectives provide flexible observation at high magnifications and independent correction of chromatic aberration.

FEATURES
- The long working distance objectives provide excellent clearance between the lens surface and the workpiece surface in focus, making it possible to observe workpieces which are usually hard-to-focus because of awkward projections.
- The metallurgical plan apochromatic (M Plan Apo) objective provides a flat, chromatic aberration-free image throughout the field of view, making it suitable for any type of microscope.
- Specially designed objectives also are available with correction for near-infrared radiation, near-ultraviolet radiation, and ultraviolet radiation, or various thicknesses of LCD screen glasses.
- The mounting screw threads of objectives are designed to conform to JIS B-7141-1988.



Refer to No. (E14020) for more details.

M Plan Apo and M Plan Apo SL objectives for bright field observation

BD Plan Apo and BD Plan Apo SL objectives for bright/dark field observation

Near-infrared radiation corrected M Plan Apo NIR objectives

Near-ultraviolet radiation corrected M Plan Apo NUV objectives

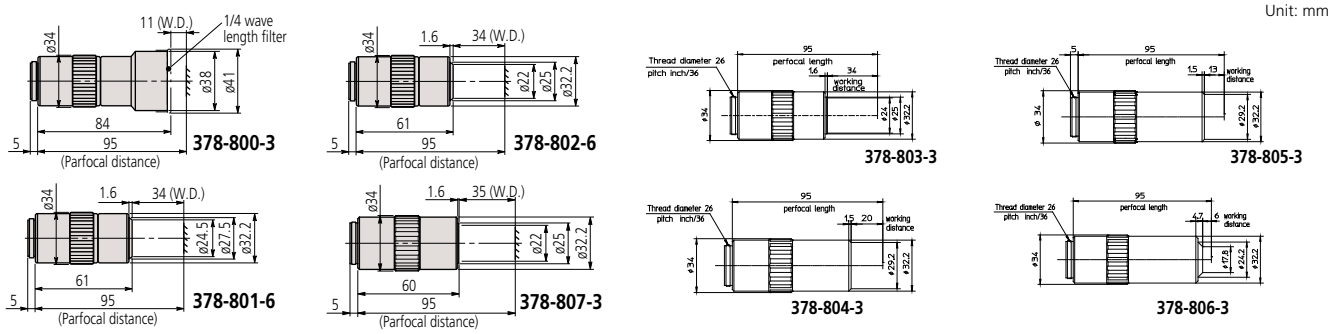
Ultraviolet radiation corrected M Plan UV objectives

M Plan Apo for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-800-3	1X	0.025	11.0mm	200mm	11.0μm	440μm	ø24mm	4.8x6.4mm	300g
378-801-6	2X	0.055	34.0mm	100mm	5.0μm	91μm	ø12mm	2.4x3.2mm	220g
378-802-6	5X	0.14	34.0mm	40mm	2.0μm	14.0μm	ø4.8mm	0.96x1.28mm	230g
378-807-3	7.5X	0.21	35.0mm	26.67mm	1.3μm	6.2μm	ø3.6mm	0.64x0.85mm	240g
378-803-3	10X	0.28	34.0mm	20mm	1.0μm	3.5μm	ø2.4mm	0.48x0.64mm	240g
378-804-3	20X	0.42	20.0mm	10mm	0.7μm	1.6μm	ø1.2mm	0.24x0.32mm	270g
378-805-3	50X	0.55	13.0mm	4mm	0.5μm	0.9μm	ø0.48mm	0.10x0.13mm	290g
378-806-3	100X	0.70	6.0mm	2mm	0.4μm	0.6μm	ø0.24mm	0.05x0.06mm	320g

DIMENSIONS

Unit: mm



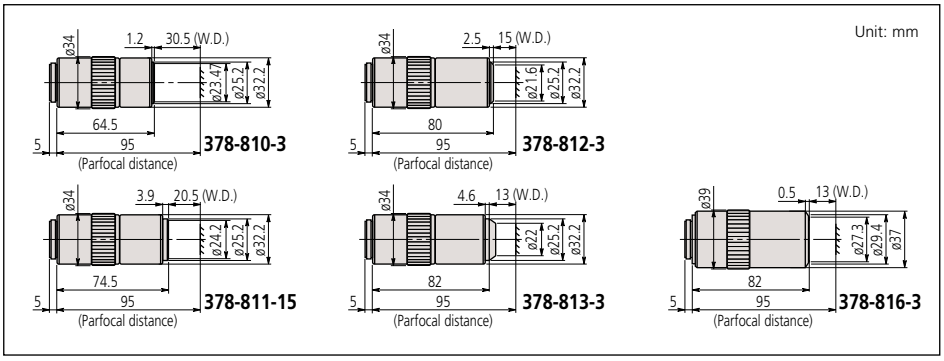
Note:
These objectives offer extra-long working distance.

M Plan Apo SL for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-810-3	20X	0.28	30.5mm	10mm	1.0μm	3.5μm	ø1.2mm	0.24x0.32mm	240g
378-811-15	50X	0.42	20.5mm	4mm	0.7μm	1.6μm	ø0.48mm	0.10x0.13mm	280g
378-812-3	80X	0.50	15.0mm	2.5mm	0.6μm	1.1μm	ø0.3mm	0.06x0.08mm	280g
378-813-3	100X	0.55	13.0mm	2mm	0.5μm	0.9μm	ø0.24mm	0.05x0.06mm	290g
378-816-3	200X	0.62	13.0mm	1mm	0.4μm	0.7μm	ø0.12mm	0.025x0.03mm	490g

DIMENSIONS

Unit: mm



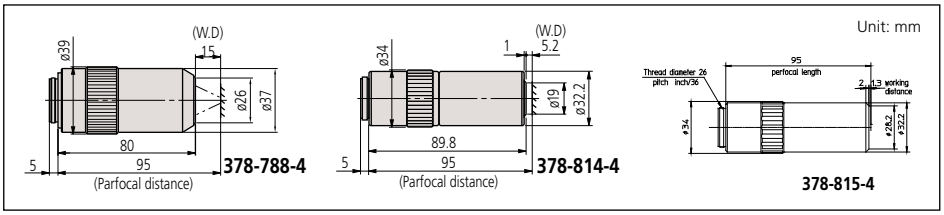
Note:
These objectives offer extra-high resolving power.

M Plan Apo HR for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-787-4	5X	0.21	25.5mm	40mm	1.3μm	6.2μm	ø4.8mm	0.96x1.28mm	285g
378-788-4	10X	0.42	15mm	20mm	0.7μm	1.6μm	ø2.4mm	0.48x0.64mm	460g
378-814-4	50X	0.75	5.2mm	4mm	0.4μm	0.49μm	ø0.48mm	0.10x0.13mm	400g
378-815-4	100X	0.90	1.3mm	2mm	0.3μm	0.34μm	ø0.24mm	0.05x0.06mm	410g

DIMENSIONS

Unit: mm



Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1:
Field of view when using ø24mm eyepiece
View field 2:
Field of view when using 1/2" CCD camera

Mitutoyo

Glass Thickness (t = 3.5mm) Corrected
G Plan Apo for Bright Field Observation

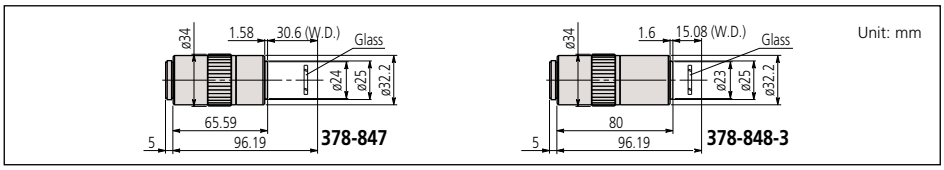
Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-847	20X	0.28	29.42mm*	10mm	1.0μm	3.5μm	ø1.2mm	0.24x0.32mm	270g
378-848-3	50X	0.50	13.89mm*	4mm	0.6μm	1.1μm	ø0.48mm	0.10x0.13mm	320g

*In air

Note:
The G Plan Apo Series are designed for observing a workpiece through BK-7 glass (thickness = 3.5mm).

DIMENSIONS

Unit: mm

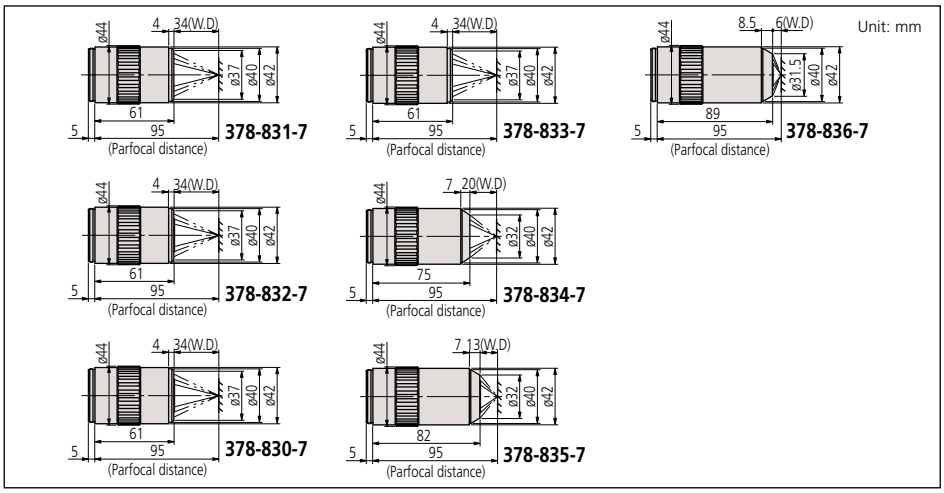


BD Plan Apo for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-831-7	2X	0.055	34.0mm	100mm	5.0μm	91μm	ø12mm	2.4x3.2mm	340g
378-832-7	5X	0.14	34.0mm	40mm	2.0μm	14.0μm	ø4.8mm	0.96x1.28mm	350g
378-830-7	7.5X	0.21	34.0mm	26.67mm	1.3μm	6.2μm	ø3.6mm	0.64x0.85mm	350g
378-833-7	10X	0.28	34.0mm	20mm	1.0μm	3.5μm	ø2.4mm	0.48x0.64mm	350g
378-834-7	20X	0.42	20.0mm	10mm	0.7μm	1.6μm	ø1.2mm	0.24x0.32mm	400g
378-835-7	50X	0.55	13.0mm	4mm	0.5μm	0.9μm	ø0.48mm	0.10x0.13mm	440g
378-836-7	100X	0.70	6.0mm	2mm	0.4μm	0.6μm	ø0.24mm	0.05x0.06mm	460g

DIMENSIONS

Unit: mm



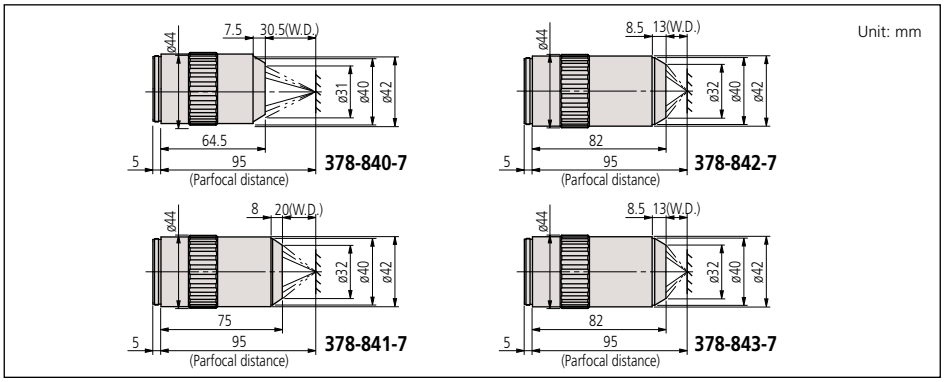
BD Plan Apo SL for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-840-7	20X	0.28	30.5mm	10mm	1.0μm	3.5μm	ø1.2mm	0.24x0.32mm	350g
378-841-7	50X	0.42	20.0mm	4mm	0.7μm	1.6μm	ø0.48mm	0.10x0.13mm	410g
378-842-7	80X	0.50	13.0mm	2.5mm	0.6μm	1.1μm	ø0.3mm	0.06x0.08mm	430g
378-843-7	100X	0.55	13.0mm	2mm	0.5μm	0.9μm	ø0.24mm	0.05x0.06mm	440g

Note:
These objectives offer extra-long working distance.

DIMENSIONS

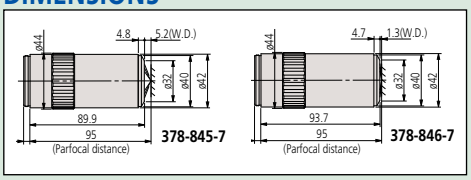
Unit: mm



Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1: Field of view when using ø24mm eyepiece
View field 2: Field of view when using 1/2" CCD camera

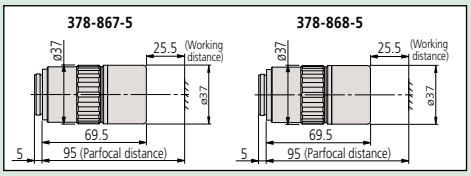
DIMENSIONS

Unit: mm



DIMENSIONS

Unit: mm



Note:
These objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength is changed anywhere from the visible range (l = 480nm) up to near-infrared range (l = 1800nm). Therefore, the M Plan NIR Series are suitable for laser repair. However, when the wavelength used exceeds 1100nm, the focusing position may slightly deviate from that in the visible range due to changes in glass dispersion and refractive index.

Note:
These objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength is changed anywhere from the visible range (l = 620nm) to the near-ultraviolet range (l = 355nm). Therefore The M Plan NUV Series are suitable for laser repair using a high frequency laser beam.

Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1: Field of view when using ø24mm eyepiece
View field 2: Field of view when using 1/2" CCD camera

BD Plan Apo HR for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-845-7	50X	0.75	5.2mm	4mm	0.4µm	0.49µm	ø0.48mm	0.10x0.13mm	530g
378-846-7	100X	0.90	1.3mm	2mm	0.3µm	0.34µm	ø0.24mm	0.05x0.06mm	545g

Note: These objectives offer extra-high resolving power.

M Plan Apo NIR B

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550nm)	R (µm) (λ=550nm)	±DOF (µm)	View field 1	View field 2	Mass (g)
378-867-5	20X	0.40	25.5	10	0.7	1.7	1.2	0.24×0.32	350
378-868-5	50X	0.42	25.5	4	0.7	1.6	0.48	0.10×0.13	375

> A high-transmission laser type objective suited to the fundamental and second harmonic of the YAG laser. Corrected over the visible (420nm) to near-infrared (1064nm) spectrum.
> This series of objective has greatly improved in operability thanks to the achievement of an ultra-long working distance of 25.5mm while maintaining the NA of the NIR series 20X/50X.

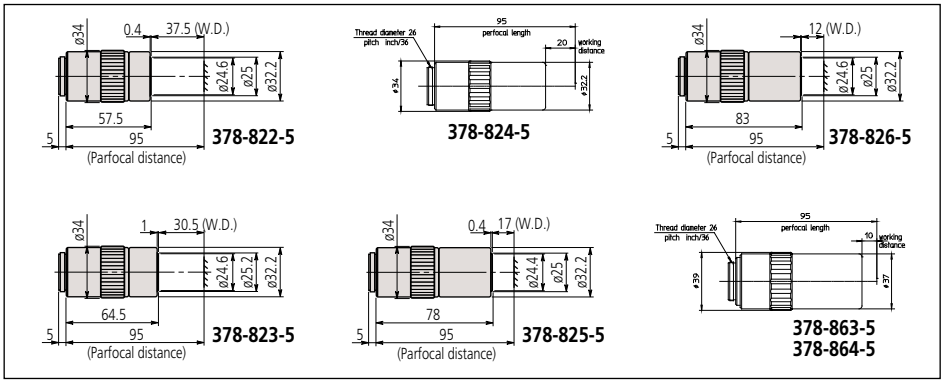
Near-infrared Radiation Corrected M Plan Apo NIR for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-822-5	5X	0.14	37.5mm	40mm	2.0µm	14.0µm	ø4.8mm	0.96x1.28mm	220g
378-823-5	10X	0.26	30.5mm	20mm	1.1µm	4.1µm	ø2.4mm	0.48x0.64mm	250g
378-824-5	20X	0.40	20.0mm	10mm	0.7µm	1.7µm	ø1.2mm	0.24x0.32mm	300g
378-825-5	50X	0.42	17.0mm	4mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	315g
378-826-15	100X	0.50	12.0mm	2mm	0.6µm	1.1µm	ø0.24mm	0.05x0.06mm	335g
378-863-5*	50X	0.65	10mm	4mm	0.4µm	0.7µm	ø0.48mm	0.10x0.13mm	450g
378-864-5*	100X	0.70	10mm	2mm	0.4µm	0.6µm	ø0.24mm	0.05x0.06mm	450g

* High Resolution (HR objectives)

DIMENSIONS

Unit: mm



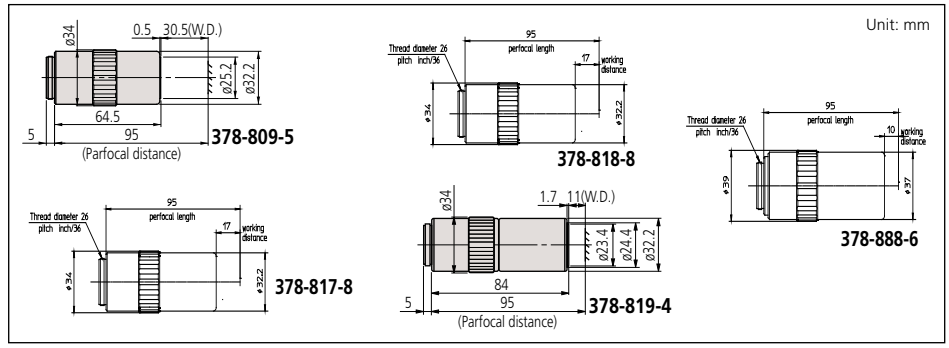
Near-ultraviolet Radiation Corrected M Plan Apo NUV for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-809-5	10X	0.28	30.5mm	20mm	1µm	3.5µm	ø2.4mm	0.48x0.64mm	255g
378-817-8	20X	0.42	17.0mm	10mm	0.7µm	1.7µm	ø1.2mm	0.24x0.32mm	340g
378-818-8	50X	0.44	15.0mm	4mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	350g
378-819-4	100X	0.50	11.0mm	2mm	0.6µm	1.1µm	ø0.24mm	0.05x0.06mm	380g
378-888-6*	50X	0.65	10.00mm	4mm	0.42µm	0.65µm	ø0.48mm	0.10x0.13mm	500g

*High resolution (HR objective)

DIMENSIONS

Unit: mm



Mitutoyo

Near-Infrared Radiation and LCD Glass Thickness (t = 1.1mm or 0.7mm) Corrected LCD Plan Apo NIR for Bright Field Observation

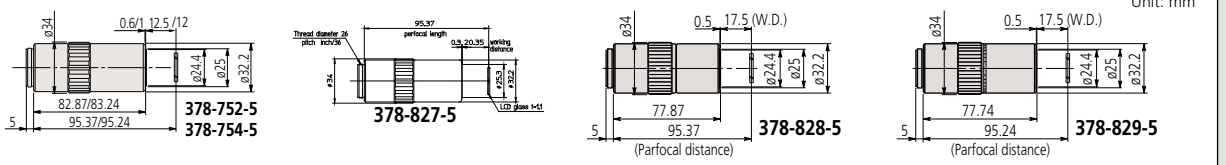
Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-821-5	20X (t0.7)	0.40	19.98mm*	10mm	0.7µm	1.7µm	ø1.2mm	0.24x0.32mm	305g
378-827-5	20X (t1.1)	0.40	19.98mm*	10mm	0.7µm	1.7µm	ø1.2mm	0.24x0.32mm	305g
378-828-5	50X (t1.1)	0.42	17.13mm*	3.9mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	320g
378-829-5	50X (t0.7)	0.42	17.26mm*	3.9mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	320g
378-752-15	100X (t1.1)	0.50	12.13mm*	2mm	0.6µm	1.1µm	ø0.24mm	0.05x0.06mm	335g
378-754-15	100X (t0.7)	0.50	12.06mm*	2mm	0.6µm	1.1µm	ø0.24mm	0.05x0.06mm	335g

*In air

Note:
These near-infrared (l = 1800nm) corrected objectives are designed for observing a workpiece through LCD glass (thickness = 1.1mm (**378-827-5**, **378-828-5, 378-752-5**) or 0.7mm (**378-829-5**, **378-754-5**) and for laser repair.

DIMENSIONS

Unit: mm



Near-ultraviolet Radiation and LCD Glass Thickness (t = 0.7mm) Corrected LCD Plan Apo NUV for Bright Field Observation

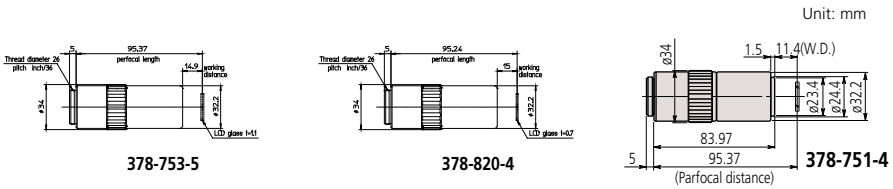
Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-890-8	20X (t0.7)	0.42	16.96mm*	10mm	0.7µm	1.7µm	ø1.2mm	0.24x0.32mm	340g
378-891-6**	50X (t0.7)	0.65	9.76mm*	4mm	0.42µm	0.65µm	ø0.48mm	0.10x0.13mm	500g
378-820-6	50X (t0.7)	0.44	14.76mm*	4mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	310g
378-753-8	50X (t1.1)	0.42	14.53mm	4mm	0.7µm	1.6µm	ø0.48mm	0.10x0.13mm	310g
378-751-4	100X(t1.1)	0.50	11.03mm	2mm	0.6µm	1.1µm	ø0.24mm	0.05x0.06mm	380g

* In air
** High-Resolution (HR Objectives)

Note:
These near ultraviolet corrected objectives are designed for observing a workpiece through LCD glass (thickness = 1.1mm (**378-753-6, 378-751-4**) or 0.7mm (**378-820-6**) and for laser repair.

DIMENSIONS

Unit: mm



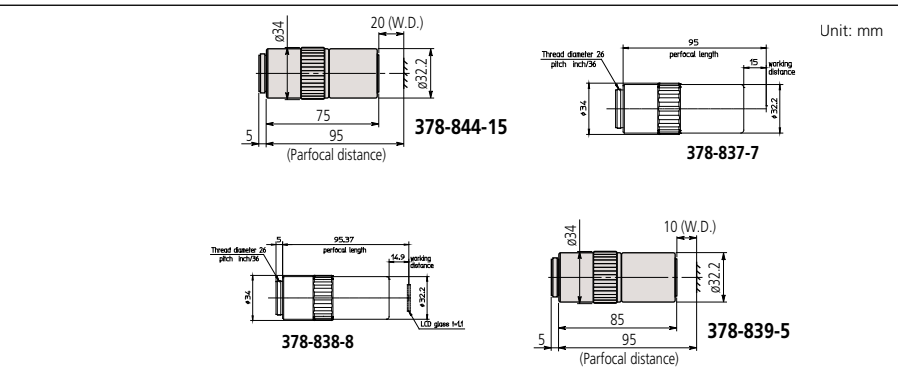
Ultraviolet Radiation Corrected M Plan UV for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-844-15	10X	0.25	20mm	20mm	1.1µm	4.4µm	ø2.4mm	0.48x0.64mm	310g
378-837-7	20X	0.37	15.0mm	10mm	0.8µm	2.1µm	ø1.2mm	0.24x0.32mm	330g
378-838-8	50X	0.41	12.0mm	4mm	0.7µm	1.7µm	ø0.48mm	0.10x0.13mm	400g
378-839-5	80X	0.55	10.0mm	2.5mm	0.5µm	0.9µm	ø0.3mm	0.06x0.08mm	380g

Note:
These ultraviolet corrected objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength is changed anywhere from the visible range (l = 550nm) to the ultraviolet range (l = 266nm). Therefore the M Plan UV Series are suitable for laser repair using a high-frequency laser beam.

DIMENSIONS

Unit: mm



Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1: Field of view when using ø24mm eyepiece
View field 2: Field of view when using 1/2" CCD camera

MSM-400

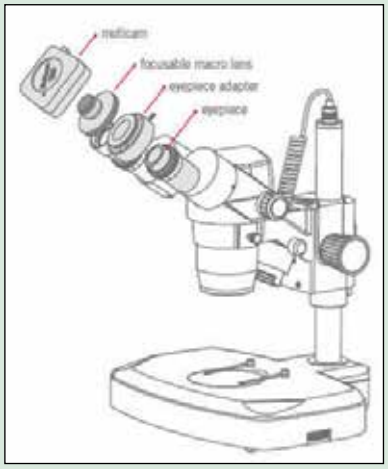
SERIES 377 — Stereo Microscopes

Digital Imaging with Software

Order No.	Description
64AAB429	MOTICAM 2, 2.0 MEGAPIXEL-1/3" CMOS, USB
64AAB529	MOTICAM 3+, 3.0 MEGAPIXEL-1/2" CMOS, USB
64AAB431	MOTICAM 5, 5.0 MEGAPIXEL-1/2.5" CMOS, USB
64AAB526	MOTICAM 1080, 2.0 MEGAPIXEL-1/2.8" CMOS, USB/HDMI

Optional Accessories

Order No.	Description
64AAB214	LED Variable Ring Light



FEATURES

- Continuous 1X - 4X magnification
- Image always in focus throughout zoom range
- Crisp, erect images with high resolution and excellent stereoscopic effect
- Stereo-tube can be rotated a full 360°, for viewing at any angle
- Bilateral zoom control knob adds convenience and increases operator efficiency
- Diopter adjustment for both eyepieces
- Binocular tube inclination: 45°
- Focusing range: 1.46" (37mm)
- Interpupillary adjustable range: 2.12" - 2.99" (54mm - 76mm)
- Optional zoom ranges from 2.5X - 10X to 30X - 120X

The MSM-414L is a traditional binocular stereo microscope for industrial, medical and classroom applications. It is ideal for electrical small part inspection, assembly, and medical/ biological dissection.

Optional Accessories

Illuminated Stand

Order No.	Description
377-412	Pole-Type Stand (top: 12V/10W flat filament tungsten, bottom: 5W fluorescent
377-413*	Pole-Type Stand (top: 12V/10W flat filament tungsten, bottom: 12V/10W halogen with intensity control)
377-414	Fixed-Arm Stand (top: 12V/10W flat filament tungsten, bottom: 5W fluorescent)
377-415	Fixed-Arm Stand (top: 12V/10W flat filament tungsten, bottom: 12V/10W halogen with intensity control)
377-416	Fixed-Arm Stand (top: 5W fluorescent, bottom: 5W fluorescent)

*Standard Accessory

377-972A

SPECIFICATIONS

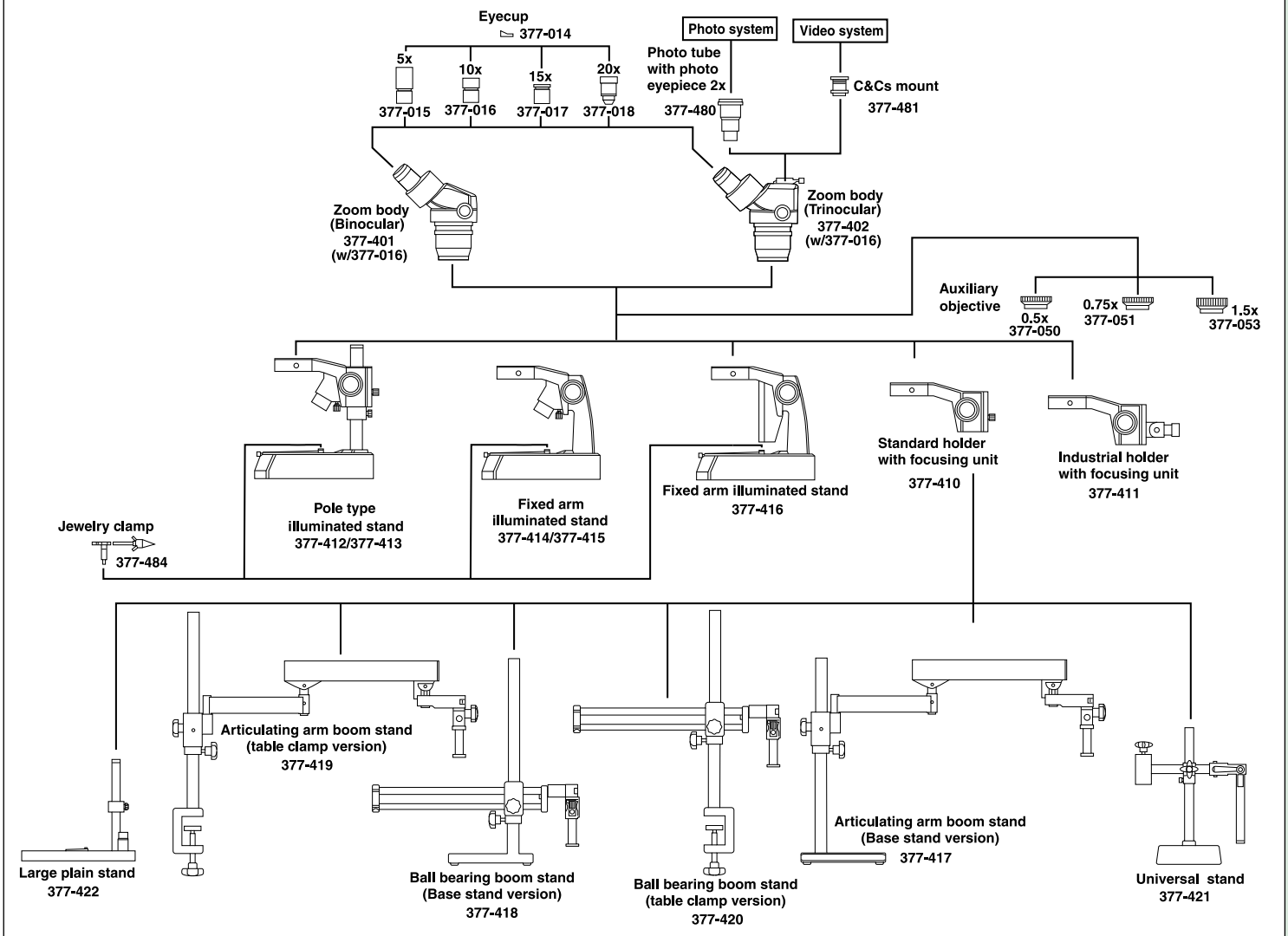
Model.	MSM-414L	MSM-414TL
Order No.	**377-972A**	**377-974A**
Optical tube	Binocular	Trinocular
Total magnification	10X - 40X	
Eyepiece	10X (377-016)	
Objective	1X - 4X	
Working distance	80mm	
Field of view	20mm - 5mm	
Dimensions	H=13.2"x W=6.7"x D=9.3"	
Mass	13.2 lbs (6kg)	

Mitutoyo

Stereo Microscopes

SERIES 377

377-972A/377-974A SYSTEM DIAGRAM



MSM-400

SERIES 377 — Stereo Microscopes

FEATURES

- Superior quality optics provide high-resolution
- Crystal sharp, high-color contrast image with excellent depth of field
- Always in sharp focus at all magnifications
- The Parfocal Optical System allows relaxed strain-free viewing
- Long working distance
- Extreme large field of view (23mm diameter)

The MSM-465L, Order No. 377-990A, is a high-accuracy four-step magnification stereo microscope. With a horizontal changer allowing 6X, 12X, 25X, and 50X magnifications with a standard 1X objective and 10X eyepieces, the MSM-465L has limitless capabilities for electrical small part inspection.

The MSM-464L, Order No. 377-991A, with its vertical five-step magnification changer is ideal for small part assembly. This stereo microscope with standard 6.4X, 10X, 16X, 25X, and 40X magnifications, has flexibility from 3.2X to 160X magnifications.

Optional Accessories

Video System

Order No.	Description
377-488	Video System* for 377-990A
377-489	Video System* for 377-991A

* Converts Binocular to Trinocular

Accessories

Order No.	Description
64AAB214	LED variable ring light

MSM-465L
377-990A

MSM-464L
377-991A

Digital Imaging with Software

Order No.	Description
64AAB429	MOTICAM 2, 2.0 MEGAPIXEL-1/3" CMOS, USB
64AAB529	MOTICAM 3+, 3.0 MEGAPIXEL-1/2" CMOS, USB
64AAB431	MOTICAM 5, 5.0 MEGAPIXEL-1/2.5" CMOS, USB
64AAB526	MOTICAM 1080, 2.0 MEGAPIXEL-1/2.8" CMOS, USB/HDMI

SPECIFICATIONS

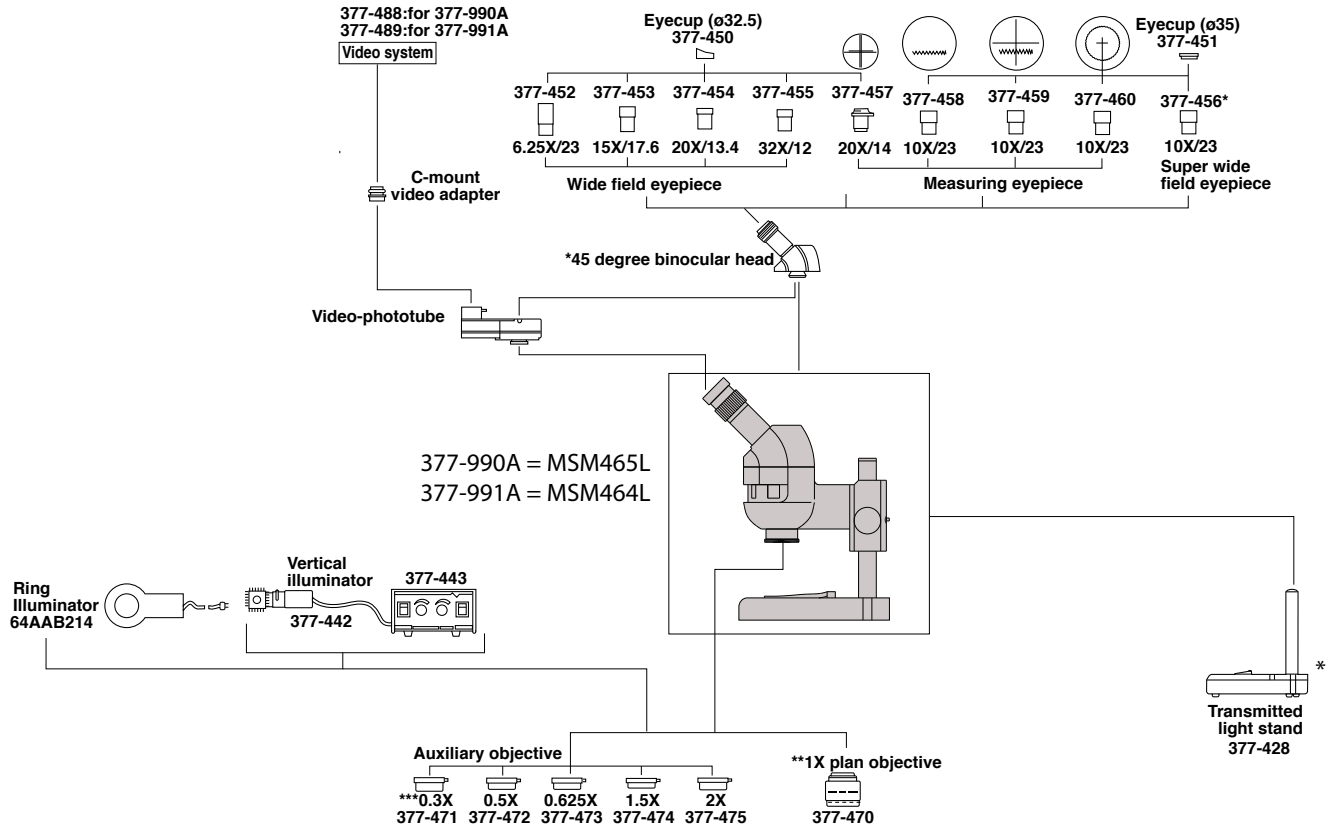
Model. Order No.	MSM-465L 377-990A	MSM-464TL 377-991A
Optical tube	Binocular*	Binocular*
Total magnification	6X - 50X	6.4X - 40X
Eyepiece	10X (377-456)	10X (377-456)
Objective	.6X, 1.2X, 2.5X, 5X	.6X, 1X, 1.6X, 2.5X, 4X
Working distance	89mm	89mm
Field of view	23mm (w/377-456)	23mm (w/377-456)
Dimensions	H=14.6"x W=13"x D=11"	H=14.3"x W=13"x D=11"
Mass	15.5 lbs (7kg)	15.5 lbs (7kg)
Stand	Transmitted Light Stand (377-428)	Transmitted Light Stand (377-428)

* For Video System, see upper left table (optional accessories)

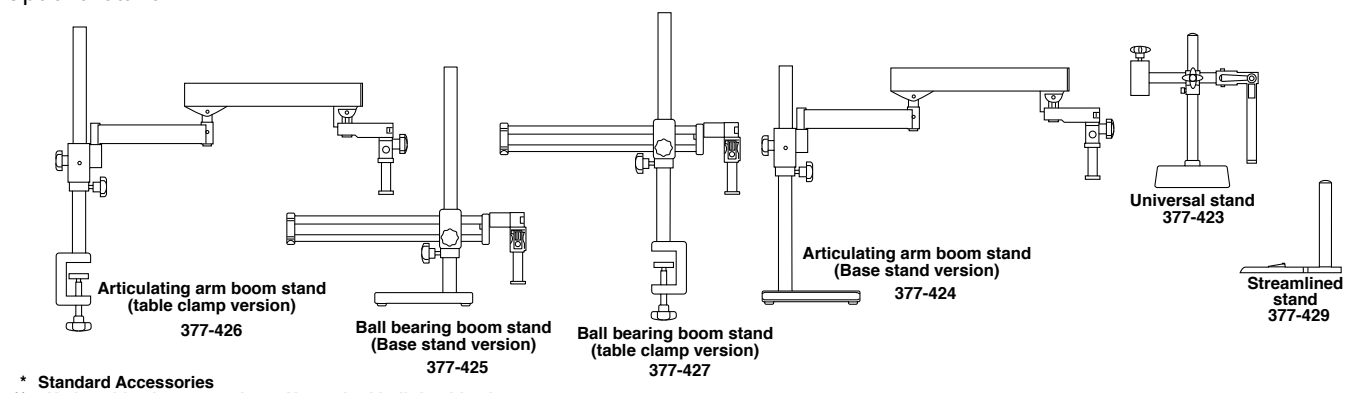
Stereo Microscopes

SERIES 377

377-990A/377-991A SYSTEM DIAGRAM



Optional Stand



* Standard Accessories
** 1X plan objective can replace 1X standard built-in objective
*** 350mm long stand post is required. (377-431)

Pocket Magnifiers

SERIES 183

FEATURES

- Suitable for inspecting metal surfaces.

SPECIFICATIONS

Magnification	Order No.	Remarks
25X	**183-201**	Pen type
	183-202	With stand
50X	**183-203**	With stand

183-201

183-202

183-203

Pocket Comparators

SERIES 183

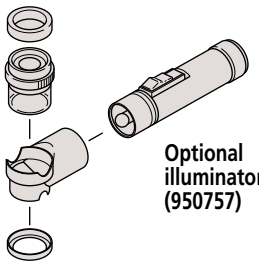
FEATURES

- By replacing optional reticles, dimensional, angle and other types of measurements can be performed.
- Illuminator (**950757**) is available.

SPECIFICATIONS

Magnification	Order No.	Remarks
8X	**183-101**	Optional reticles available
10X	**183-131**	Optional reticles available

183-101



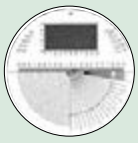
Optional illuminator (950757)

Optional Reticles for Pocket Comparators

183-102

183-103

183-104



183-105

183-106

183-107

183-108

183-109

183-110

183-111

183-112

183-113

183-114

183-115

Pocket Comparator 8X with Reticles Set

Set No.	
183-901	183-101, 183-106
183-902	183-101, 183-102, 183-106, 183-107, 183-112, 183-113, 183-114
183-903	183-101, 183-102, 183-106, 183-107, 183-109, 183-113, 183-115
183-904	183-101, 183-102

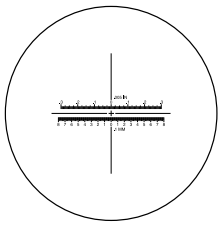
Zoom Loupe

SERIES 183

FEATURES

- Allows the user 8X - 16X zoom observation.
- Magnification indicator is provided for 8X, 10X, 12X, 14X and 16X observation.
- Metric and inch scales are provided for measuring.
- Comes with a carrying case.

183-304



Reticle provided

SPECIFICATIONS

Magnification	Order No.	Remarks
8X - 16X	**183-304**	With reticle (Scale graduation: 0.1mm, .005"

Clear Loupe

SERIES 183

183-301

183-302

183-303

SPECIFICATIONS

Magnification	Order No.	Remarks
7X	**183-301**	Drawtube removable
10X	**183-302**	Drawtube removable
15X	**183-303**	Drawtube removable

Mitutoyo

Quick Guide to Precision Measuring Instruments

Microscopes

Numerical Aperture (NA)

The NA figure is important because it indicates the resolving power of an objective lens. The larger the NA value the finer the detail that can be seen. A lens with a larger NA also collects more light and will normally provide a brighter image with a narrower depth of focus than one with a smaller NA value.

$$NA = n \cdot \sin\theta$$

The formula above shows that NA depends on n, the refractive index of the medium that exists between the front of an objective and the specimen (for air, n=1.0), and angle θ, which is the half-angle of the maximum cone of light that can enter the lens.

Resolving Power (R)

The minimum detectable distance between two image points, representing the limit of resolution. Resolving power (R) is determined by numerical aperture (NA) and wavelength (λ) of the illumination.

$$R = \frac{\lambda}{2 \cdot NA} \ (\mu m)$$

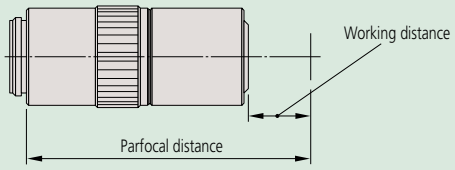
λ = 0.55μm is often used as the reference wavelength

Working Distance (W.D.)

The distance between the front end of a microscope objective and the surface of the workpiece at which the sharpest focusing is obtained.

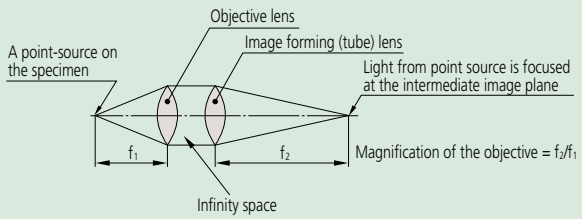
Parfocal Distance

The distance between the mounting position of a microscope objective and the surface of the workpiece at which the sharpest focusing is obtained. Objective lenses mounted together in the same turret should have the same parfocal distance so that when another objective is brought into use the amount of refocusing needed is minimal.



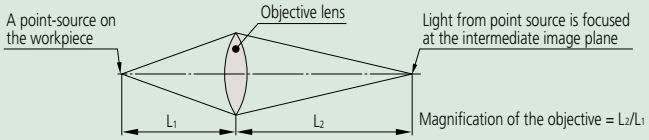
Infinity Optical System

An optical system where the objective forms its image at infinity and a tube lens is placed within the body tube between the objective and the eyepiece to produce the intermediate image. After passing through the objective the light effectively travels parallel to the optical axis to the tube lens through what is termed the infinity space within which auxiliary components can be placed, such as differential interference contrast (DIC) prisms, polarizers, etc., with minimal effect on focus and aberration corrections.



Finite Optical System

An optical system that uses an objective to form the intermediate image at a finite position. Light from the workpiece passing through the objective is directed toward the intermediate image plane (located at the front focal plane of the eyepiece) and converges in that plane.



Focal Length (f)

unit: mm

The distance from the principal point to the focal point of a lens: if f1 represents the focal length of an objective and f2 represents the focal length of an image forming (tube) lens then magnification is determined by the ratio between the two. (In the case of the infinity-correction optical system.)

$$\text{Objective magnification} = \frac{\text{Focal length of the image-forming (tube) lens}}{\text{Focal length of the objective}}$$

Example: $1X = \frac{200}{200}$ Example: $10X = \frac{200}{20}$

Focal Point

Light rays traveling parallel to the optical axis of a converging lens system and passing through that system will converge (or focus) to a point on the axis known as the rear focal point, or image focal point.

Depth of Focus (DOF)

unit: mm

Also known as depth of field, this is the distance (measured in the direction of the optical axis) between the two planes which define the limits of acceptable image sharpness when the microscope is focused on an object. As the numerical aperture (NA) increases, the depth of focus becomes shallower, as shown by the expression below:

$$DOF = \frac{\lambda}{2 \cdot (NA)^2}$$ λ = 0.55μm is often used as the reference wavelength

Example: For an **M Plan Apo 100X** lens (**NA = 0.7**)
The depth of focus of this objective is

$$\frac{0.55\mu m}{2 \times 0.7^2} = 0.6\mu m$$

Bright-field Illumination and Dark-field Illumination

In brightfield illumination a full cone of light is focused by the objective on the specimen surface. This is the normal mode of viewing with an optical microscope. With darkfield illumination, the inner area of the light cone is blocked so that the surface is only illuminated by light from an oblique angle. Darkfield illumination is good for detecting surface scratches and contamination.

Apochromat and Achromat Objectives

An apochromat objective is a lens corrected for chromatic aberration (color blur) in three colors (red, blue, yellow).
An achromat objective is a lens corrected for chromatic aberration in two colors (red, blue).

Magnification

The ratio of the size of a magnified object image created by an optical system to that of the object. Magnification commonly refers to lateral magnification although it can mean lateral, vertical, or angular magnification.

Principal Ray

A ray considered to be emitted from an object point off the optical axis and passing through the center of an aperture diaphragm in a lens system.

Aperture Diaphragm

An adjustable circular aperture which controls the amount of light passing through a lens system. It is also referred to as an aperture stop and its size affects image brightness and depth of focus.

Field Stop

A stop which controls the field of view in an optical instrument.

Telecentric System

An optical system where the light rays are parallel to the optical axis in object and/or image space. This means that magnification is nearly constant over a range of working distances, therefore, almost eliminating perspective error.

Erect Image

An image in which the orientations of left, right, top, bottom and moving directions are the same as those of a workpiece on the workstage.

Field number (FN), real field of view, and monitor display magnification

unit: mm

The observation range of the sample surface is determined by the diameter of the eyepiece's field stop. The value of this diameter in millimeters is called the field number (FN). In contrast, the real field of view is the range on the workpiece surface when actually magnified and observed with the objective lens.
The real field of view can be calculated with the following formula:

(1) The range of the workpiece that can be observed with the microscope (diameter)

$$\text{Real field of view} = \frac{\text{FN of eyepiece}}{\text{Objective lens magnification}}$$

Example: The real field of view of a 1X lens is $24 = \frac{24}{1}$

The real field of view of a 10X lens is $2.4 = \frac{24}{10}$

(2) Monitor observation range

$$\text{Monitor observation range} = \frac{\text{The size of the camera image sensor (diagonal length)}}{\text{Objective lens magnification}}$$

• Size of image sensor

Format	Diagonal length	Length	Height
1/3″	6.0	4.8	3.6
1/2″	8.0	6.4	4.8
2/3″	11.0	8.8	6.6

(3) Monitor display magnification

$$\text{Monitor display magnification} = \text{Objective lens magnification} \times \frac{\text{Display diagonal length on the monitor}}{\text{Diagonal length of camera image sensor}}$$

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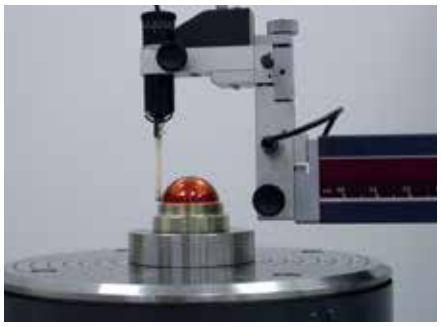
MITUTOYO CALIBRATION SERVICES



Mitutoyo America has expanded three-dimensional calibration and inspection services at our new precision measurement facility located in our corporate headquarters in Aurora, IL. Equipped with multiple Mitutoyo Legex CMMs, along with high-accuracy vision and form measuring instruments, our laboratory offers accredited dimensional measurement services with uncertainty as low as 0.25 µm (10 µinches). And for form measurement, our uncertainty goes as low as 5 nanometers (0.2 µinches).

Our experienced staff is ready for your challenges – we specialize in specialty gage calibration, complex prototype or master parts, specialty and custom-built 3D gages, and long length standards such as ball bars, step gages and gage blocks. We can also assist you in the validation of your measurement processes by providing accredited reference values on your parts.

Mitutoyo America calibration and inspection services are accredited to ISO/IEC 17025 by A2LA (Certificate 0750.01). We welcome customer tours of our laboratory.

If you have any questions or would like more information regarding Mitutoyo Calibration Services, contact: **mim@mitutoyo.com**

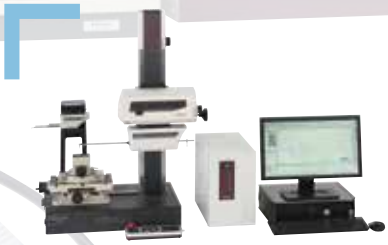
Mitutoyo
CALIBRATION
SERVICES

Surftest

Formtracer

Contracer

Roundtest



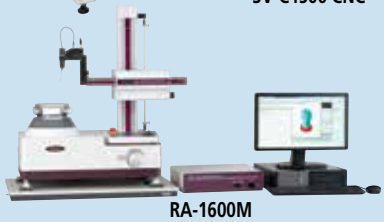
SV-C3200 / SV-C4500

CV-2100

SJ-410

INDEX

SV-C4500 CNC



RA-1600M

Mitutoyo

Surftest SJ-210/SJ-310

SERIES 178 — Portable Surface Roughness Tester

Surftest SJ-210

FEATURES

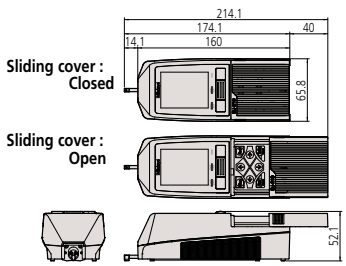
- The 2.4-inch color graphic LCD provides excellent readability and an intuitive display that is easy to use. The LCD also includes a backlight for improved visibility in dark environments.
- The Surftest SJ-210 can be easily operated using the buttons on the front of the unit and under the sliding cover.
- Up to 10 measurement conditions and one measured profile can be stored in the internal memory.
- An optional memory card can be used as an extended memory to store large quantities of measured profiles and conditions.
- Access to each feature can be password-protected, which prevents unintended operations and allows you to protect your settings.
- The display interface supports 16 languages, which can be freely switched.
- An alarm warns you when the cumulative measurement distance exceeds a preset limit.
- The Surftest SJ-210 complies with the following standards: JIS (JIS-B0601-2001, JIS-B0601-1994, JIS B0601-1982), VDA, ISO-1997, and ANSI.
- In addition to calculation results, the Surftest SJ-210 can display sectional calculation results and assessed profiles, load curves, and amplitude distribution curves.

SPECIFICATIONS/CONFIGURATION

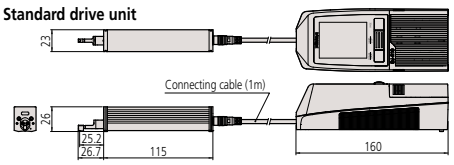
Model No.	SJ-210					
Order No. (inch/mm)	**178-561-01A**	**178-561-02A**	**178-563-01A**	**178-563-02A**	**178-565-01A**	**178-565-02A**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-387**)	4mN type (**178-386**)
Display unit	Compact type (178-253A)					
Detector: Tip angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2µm	5µm	2µm	5µm	2µm	5µm
Detector measuring force	0.75mN	4mN	0.75mN	4mN	0.75mN	4mN
Standard accessories	**12BAA303** Connecting cable **178-602** Roughness specimen (Ra 3.00µm) **12BAK699** Carrying case **12BAK700** Calibration stage **12BAK820** Protective sheets for display AC Adapter Operation manual Quick reference manual Warranty				**12BAA303** Connecting cable **178-606** Roughness specimen (Ra 1.00µm) **12AAE643** Point-contact adapter **12AAE644** V-type adapter **12BAK699** Carrying case **12BAK700** Calibration stage **12BAK820** Protective sheets for display AC Adapter, Operation manual Quick reference manual, Warranty	

DIMENSIONS Display unit, Drive unit

Drive unit inside display unit (Standard detector installed in drive unit) SJ-210 series

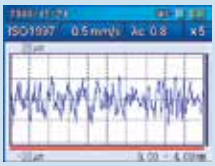


Standard drive unit



Drive unit not stored inside display unit (Standard detector installed in drive unit) SJ-210 series
Standard drive unit
*** For Retractable and Transverse type drive units, please see pg. J-3.**

Unit: mm



Technical Data: SJ-210

X axis (drive unit)
- Measuring range: .70"(17.5mm) .22"(5.6mm) Transverse type
- Measuring speed: .01, .02, .03"/s (0.25, 0.5, 0.75mm/s) .039"/s (1mm/s) (Returning))

Detector:
- Range / Resolution: Auto / depending on the measurement range 14400 µin / .8 in (360 µm / 0.02 µm) 4000 µin / .2 µin (100 µm / 0.006 µm) 1000 µin / .08 µin (25 µm / 0.002 µm)
- Measuring method: skidded
- Measuring force: 4mN (0.75mN)
- Stylus tip: Diamond, 90° / 5µmR (60° / 2µmR)
- Skid radius of curvature: 40mm
- Skid force: less than 400mN
- Type: Differential inductance

Power supply: Two-way power supply: battery (rechargeable Ni-MH battery) and AC adapter
- Charging time: about 4 hours (may vary due to ambient temperature)
- Endurance: about 1000 measurements (differs slightly due to use conditions/ environment)

External I/O: USB I/F, Digimatic Output, Printer Output, RS-232C I/F, Foot SW I/F

Data storage: Micro SD card w/ adapter (4GB) (option **12AAL069**)

Dimensions (W x D x H)
- Display unit: 2.05x2.59x6.3"(52.1 x 65.8 x 160mm)
- Drive Unit: 4.5x.9x1"(115 x 23 x 26mm)

Mass: About 1.1lb (0.5kg) (Display unit + Drive unit + Standard detector)

Evaluation Capability: SJ-210

Applicable standards:
JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA

Assessed profiles:
Primary profile, Roughness profile, DF profile, Roughness profile-Motif

Evaluation parameters:
Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Rsk, Rku, Rc, RPc, Rsm, Rz1max, S, HSC, RzJIS, Rppi, RΔa, RΔq, Rlr, Rmr, Rmr(c), RδC, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Vo, Rpm, tp, Htp, R, Rx, AR, Possible Customize

Analysis graphs: Bearning area curve / Amplitude distribution curve

Digital filters: Gaussian , 2CR75 , PC75

Cut off length: λc: .003, .01, .03, .1" (0.08, 0.25, 0.8, 2.5mm) λs: .1, .3"(2.5, 8µm)

Sampling length: .003, .01, .03, .1" or arbitrary (0.08, 0.25, 0.8, 2.5mm) or arbitrary

Number of sampling lengths (x n):
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to16.0mm: 0.01mm interval)
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6mm: 0.01mm interval)*
* Only for Transverse tracing drive unit type

Function: SJ-210

Customization: Desired parameters can be selected for calculation and display.

Go/no-go judgment: By max value / 16% / Standard dev.
Storage of measurement condition: Save the conditions at power OFF

Storage: Internal memory: Measurement condition (10 sets), Measured profile (1set)
Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images
Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve)

Calibration: Auto-calibration with the entry of numerical value / Average calibration with multiple measurement (Max.5 times) is available

Surftest SJ-210/SJ-310

SERIES 178 — Portable Surface Roughness Tester

Surftest SJ-310

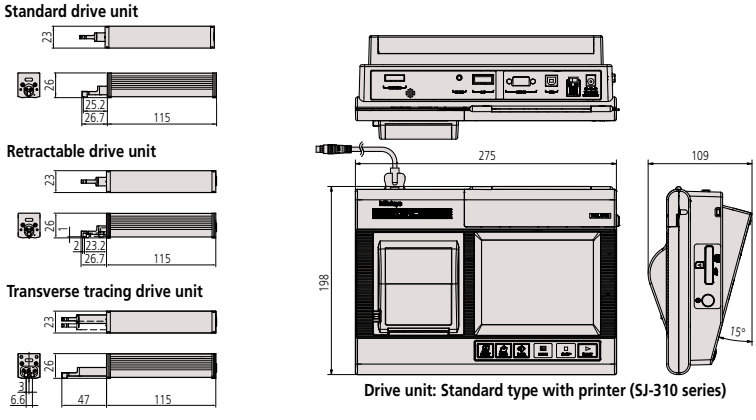
FEATURES

- The data processing unit offers large 5.7-inch color graphic LCD touch-panel for superior readability and operability.
  The LCD also includes a backlight for improved visibility in dark environments.
- The excellent user interface provides intuitive and easy-to-understand operability.
- Complies with the following standards: JIS (JIS-B0601-2001, JIS-B0601-1994, JIS B0601-1982), VDA, ISO- 1997, and ANSI.
- The Measure-Start and other frequently used buttons are strengthened to resist wear and the detrimental effects of workshop contaminants.
- Equipped with a large-capacity battery allowing approximately 1500 measurements when fully charged.
- Includes convenient carrying case for protection in the field.
- A high-speed printer is built into the main unit. Either landscape or portfolio mode can be selected according to the application. Paper saving mode is supported.
- The display interface supports 16 languages, which can be easily switched.
- 10 sets of measurement conditions can be saved in the measurement unit–an optional memory card can save measurement conditions and the measured profile.

SPECIFICATIONS/CONFIGURATION

Model No.	SJ-310					
Order No. (inch/mm)	**178-571-01A**	**178-571-02A**	**178-573-01A**	**178-573-02A**	**178-575-01A**	**178-575-02A**
Drive unit	Standard type (**178-230-2**)		Retractable type (**178-235**)		Transverse tracing type (**178-233-2**)	
Detector	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-296**)	4mN type (**178-390**)	0.75mN type (**178-387**)	4mN type (**178-386**)
Display unit	Standard type with printer					
Detector: Tip angle	60°	90°	60°	90°	60°	90°
Stylus tip radius	2µm	5µm	2µm	5µm	2µm	5µm
Detector measuring force	0.75mN	4mN	0.75mN	4mN	0.75mN	4mN
Standard accessories	**12AAM475** Connecting cable **12AAA217** Nosepiece for plane surface **12AAA218** Nosepiece for cylinder **12AAA216** Supporting leg **12BAK700** Calibration stage **12BAG834** Stylus pen **12BAL402** Protection sheet **270732** Printer paper (5 pieces) **12BAL400** Carrying case **178-602** Roughness reference specimen (Ra 3µm), AC adapter, Philips screwdriver, Strap for stylus pen, Operation manual, Quick reference manual, Warranty				**12AAM475** Connecting cable **12AAE643** Point-contact adapter **12AAE644** V-type adapter **12BAK700** Calibration stage **12BAG834** Stylus pen **12BAL402** Protection sheet **270732** Printer paper (5 pieces) **12BAL400** Carrying case **178-606** Roughness reference specimen (Ra 1µm), AC adapter, Philips screwdriver, Strap for stylus pen, Operation manual, Quick reference manual, Warranty	

DIMENSIONS Display unit, Drive unit



Drive unit: Standard type with printer (SJ-310 series)

Technical Data: SJ-310

X axis (drive unit)
- Measuring range: .70"(17.5mm) .22"(5.6mm) Transverse type
- Measuring speed: .01, .02, .03"/s (0.25, 0.5, 0.75mm/s) .039"/s(1mm/s) Returning

Detector:
- Range / Resolution: Auto / depending on the measurement range 14400 µin / .8 in (360 µm / 0.02 µm) 4000 µin / .2 µin (100 µm / 0.006 µm) 1000 µin / .08 µin (25 µm / 0.002 µm)
- Measuring method: skidded
- Measuring force: 4mN (0.75mN)
- Stylus tip: Diamond, 90° / 5µmR (60° / 2µmR)
- Skid radius of curvature: 40mm
- Skid force: less than 400mN
- Type: Differential inductance

Power supply: Two-way power supply: battery (rechargeable Ni-MH battery) and AC adapter

Battery
- Charging time: 4 hours maximum
- Recharge cycles: Approximately 1500 times (slightly varies with the usage and environmental conditions)

External I/O: USB I/F, Digimatic Output, RS-232C I/F, External SW I/F

Data storage: Micro SD card w/ adapter (4GB) (option **12AAA841**)

Dimensions (W x D x H)
- Control unit: 10.8x4.29x7.8" (275 x 109 x 198mm)
- Drive unit: 4.5x.9x1"(115 x 23 x 26mm)

Mass
- Display unit: Approx. 3.7lb (1.7kg)
- Drive unit: .4lb (0.2kg)

Evaluation Capability: SJ-310

Applicable standards:
JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA

Assessed profiles:
P (primary profile), R (roughness profile), DIN4776, roughness motif, waviness motif

Evaluation parameters:
Ra, Ry, Rz, Rt, Rp, Rq, Rv, Rsk, Rku, Rc, RSm, S, RPc, R3z, Rmr(c), Rpk, Rvk, Rδc,, Rk, Mr1, Mr2, Lo, Rppi, R, AR, Rx, A1, A2, Vo, HSC, Rmr, SK, Ku, RΔa, RΔq, Rlr, λa, λq, Rpm, RzJIS (JIS'01), tp (ANSI), Htp (ANSI), Wte, Wx, W, AW, Rz1max (ISO), Rmax (VDA, ANSI, JIS'82), Possible Customize

Analysis graphs:
Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)

Digital filter: 2CR, PC75, Gaussian

Cutoff length: λc: .003, .01, .03, .1, .3" (0.08, 0.25, 0.8, 2.5, 8mm) λs: .1, .3"(2.5, 8µm)

Sampling length: .003, .01, .03, .1, .3" or arbitrary (0.08, 0.25, 0.8, 2.5, 8mm) or arbitrary

Number of sampling lengths (x n):
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to16.0mm: 0.01mm interval)
x1, x2, x3, x4, x5, x6, x7, x8, x9, x10 arbitrary length (0.3 to 5.6mm: 0.01mm interval)*
* Only for Transverse tracing drive unit type

Printer: Thermal type

Printing width: 48mm (paper width: 58mm)

Recording magnification:
Vertical magnification: 10X to 100,000X, Auto
Horizontal magnification: 1X to 1,000X, Auto

Function: SJ-310

Customization: Desired parameters can be selected for calculation and display.

Statistical processing: Maximum value, minimum value, mean value, standard deviation, pass rate, histogram of each parameter

Go/no-go judgment: maximum value rule, 16% rule, average value rule, standard deviation (1σ, 2σ, 3σ)

Storage: Internal memory: Measurement condition (10 sets)

Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images, Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve), 500 statistical data, etc.

Calibration: Auto-calibration with the entry of numerical value / Average calibration with multiple measurement (Max.12 times) is available.

Power-saving function: Auto-sleep-function, Auto light-off of Backlight by ECO mode.

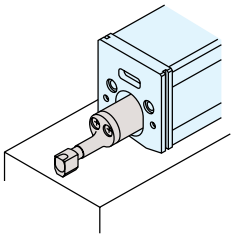
Mitutoyo

Surftest SJ-210 / SJ-310

SERIES 178 — Optional Accessories

Detectors

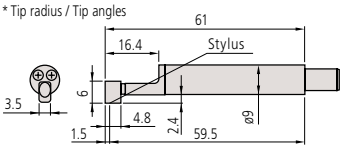
Unit: mm

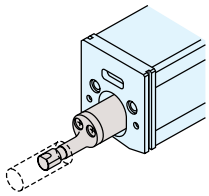


Standard detectors

Order No.	Measuring force	Stylus profiles*	Remarks column
178-296	0.75mN	2µmR/60°	Dedicated to the standard/ retractable drive unit
178-390	4 mN	5µmR/90°	
178-387	0.75mN	2µmR/60°	Dedicated to the transverse tracing drive unit
178-386	4 mN	5µmR/90°	
178-395	0.75mN	2µmR/90°	Dedicated to the standard/ retractable drive unit
178-391	4 mN	10µmR/90°	

* Tip radius / Tip angles

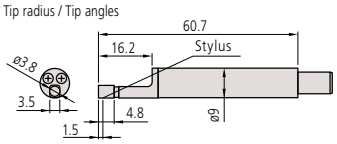


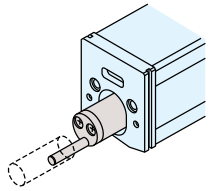


Small hole detectors

Order No.	Measuring force	Stylus profiles*	Remarks column
178-383	0.75mN	2µmR/60°	Minimum measurable hole diameter: ø4.5mm
178-392	4 mN	5µmR/90°	

* Tip radius / Tip angles

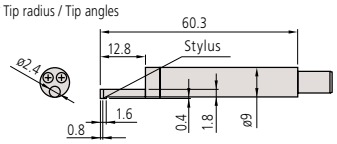


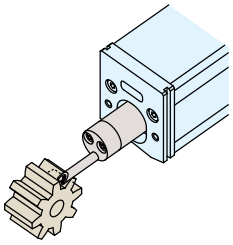


Extra small hole detectors

Order No.	Measuring force	Stylus profiles*	Remarks column
178-384	0.75mN	2µmR/60°	Minimum measurable hole diameter: ø2.8mm
178-393	4 mN	5µmR/90°	

* Tip radius / Tip angles

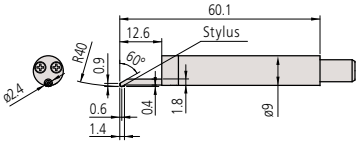


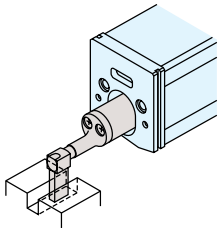


Gear-tooth surface detectors

Order No.	Measuring force	Stylus profiles*
178-388	0.75mN	2µmR/60°
178-398	4 mN	5µmR/60°

* Tip radius / Tip angles

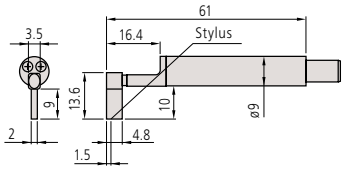




Deep groove detectors

Order No.	Measuring force	Stylus profiles*	Remarks column
178-385	0.75mN	2µmR/60°	Not available for the transverse tracing drive unit
178-394	4 mN	5µmR/90°	

* Tip radius / Tip angles



SJ-Printer for SJ-210

Assessed profiles and calculation results and curves can be printed out by connecting the SJ-210-dedicated printer, which is palm sized (W x D x H: 93x125x70mm) and can run on an internal battery.

- Power supply can be selected. (AC adapter or battery pack)
- Printable items: Measurement conditions, calculation results, assessed profile, bearing area curve (BAC), amplitude distribution curve (ADC), and environment settings.

178-421A

*Not compatible with older **SJ-201** models.

Example of the connection with **SJ-210**

Durable Printer paper (25m, 5 rolls/set): **12AAA876**

Printer paper (5 packs): **270732**

RS-232C cable: **12AAL067**

DP-1VA

It is possible to process Digimatic data output from the Surftest SJ series with the DP-1VA. This compact, hand-held device can provide printouts of measurement data and various statistical analyses results such as histograms, D-charts, and Xbar-R control charts. With optional output cables, DP-1VA is also capable of RS-232C output of measurement data to a PC (cable **09EAA084**) and go/no-go condition output (cable **965516**).

264-505A

Connecting cable: **936937** 40"(1m)
Connecting cable: **965014** 80" (2m)
AC adapter: **06AEG180JA**
Printer paper: **09EAA082**

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Free Communication Software

SJ-Tools

This program can be downloaded for FREE from the Mitutoyo website. http:www.mitutoyo.com

Output software based on Microsoft-Excel* for controlling the devices and reproducing and storing the measurement data.

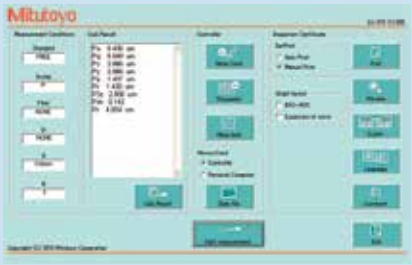
* Microsoft-Excel is not included in the scope of supply.

Complete with exclusive accessories.

- Measurement device control
- Definition of measurement variables
- Graphic representation of the profile
- Storage of measurement records
- Documentation of measurement results
- Connecting cable

Optional cables (Required for software communication)

12AAL068: USB PC connecting cable (USB cable) for SJ-210
12AAD510: USB PC connecting cable (USB cable) for SJ-310/410
12AAL067: RS-232C cable for SJ-210
12AAA882: RS-232C cable for SJ-310/410
12AAH490: USB PC connecting cable for SJ-500/SV-2100

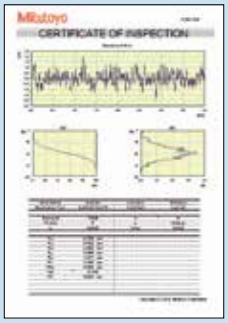


SJ-Tools input mask for Surftest SJ series

Required environment*:

- OS:
  Windows XP-SP3
  Windows Vista
  Windows 7/8/10
- Spreadsheet software:
  Microsoft Excel 2000/2002/2003/2007/2010/2013/2016

* Windows OS and Microsoft Excel are products of Microsoft Corporation.



SJ-Tools output record from MS-Excel

Optional Accessories

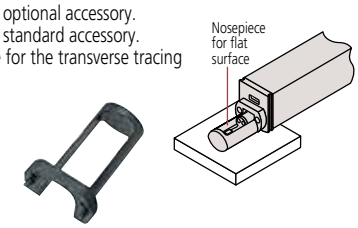
12AAL272: SJ-210 Replacement Battery Pack
12AAN046: SJ-310 Replacement Battery Pack
12BAK820: SJ-210 Display Protection Sheet (1pc.)
12AAL066: SJ-210 Display Protection Sheet (5pcs.)
12BAL402: SJ-310 Display Protection Sheet (1pc.)
12AAN040: SJ-310 Display Protection Sheet (10pcs.)
178-601: Precision Reference Specimen (Ra 3.00 µm)
178-602: Precision Reference Specimen (Ra 119 µin / 3.00 µm)
178-603: Precision Reference Specimen – 2 values (GAR)
178-604: Precision Reference Specimen – 2 Values (MIT)
178-606: Precision Reference Specimen for Transverse Drive (Ra 39.5 µin /1.0 µm)
178-029: Manual Column Stand, must use adapter 12AAA221 to mount SJ drive unit.

Nosepiece, Adapter

Nosepiece for flat surfaces

12AAA217

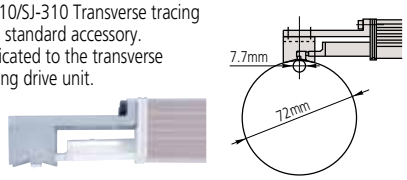
- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the transverse tracing drive unit.



V-type adapter

12AAE644

- SJ-210/SJ-310 Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.

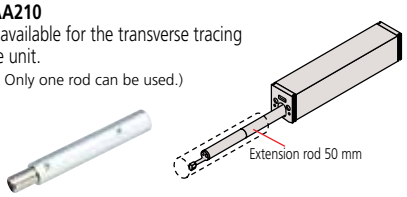


Extension rod (50mm)

12AAA210

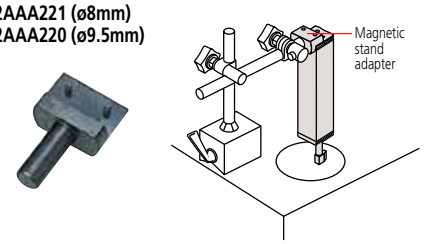
- Not available for the transverse tracing drive unit.

(Note: Only one rod can be used.)



Magnetic stand adapter

12AAA221 (ø8mm)
12AAA220 (ø9.5mm)



Extension cable (1m)

12BAA303

- Only one cable can be used.

Nosepiece for cylindrical surfaces

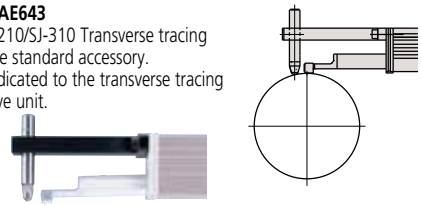
12AAA218

- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the transverse tracing drive unit.
- ø30mm or smaller workpiece

Point-contact adapter

12AAE643

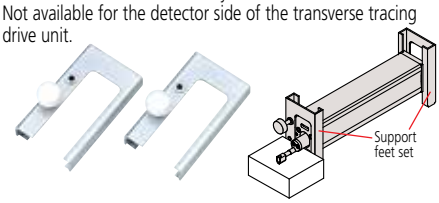
- SJ-210/SJ-310 Transverse tracing type standard accessory.
- Dedicated to the transverse tracing drive unit.



Support feet set

12AAA216

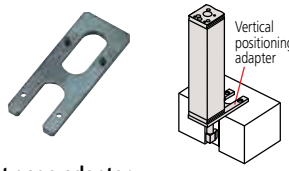
- SJ-210/210R optional accessory.
- SJ-310/310R standard accessory.
- Not available for the detector side of the transverse tracing drive unit.



Vertical positioning adapter

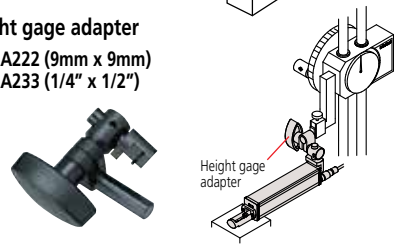
12AAA219

- Not available for the transverse tracing drive unit.



Height gage adapter

12AAA222 (9mm x 9mm)
12AAA233 (1/4" x 1/2")



Setting attachments

* Not available for the transverse tracing drive unit

Improves measurement efficiency by allowing the setup of workpieces of the same type and the positioning of hard-to-access features of a workpiece.

No. 178-033

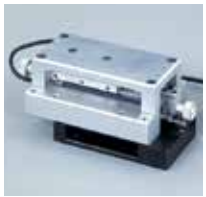
V-type for measuring in the cylinder axis direction

The V-width is adjustable to the cylinder diameter facilitating axial measurement of a wide range of cylinder diameters.

- Adjustable range: ø 5 - 150mm

No. 178-034

Setting attachment: Magnetic slider type



Best suited for measurement of the flat surface of a workpiece that has partial indentions and steps and that is hard to set the drive unit. Combination use with the magnet type specimen holder (Option No. 12AAA910) further improves the ease of operation.

No. 178-035

Setting attachment: Inside diameter type

Greatly facilitates measurement of internal wall surfaces of, for example, cylinder-block bores.

- Applicable diameter: ø75 - ø95mm
- Accessible depth: 30 - 135mm

Mitutoyo

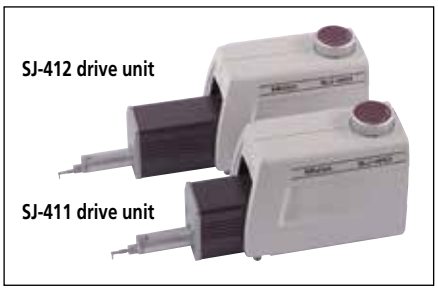
Surftest SJ-410

SERIES 178 — Portable Surface Roughness Tester

FEATURES

- Both skidded and skidless measurement are possible with this series. Equipped with 46 roughness parameters that conform to the latest ISO, DIN, ANSI, and JIS standards.
- A wide-range, high-resolution detector and a drive unit provide superior high-accuracy measurement in its class.

Detector
Measuring range: 800µm
Resolution: 0.000125µm (at 8µm range)
Drive unit
Straightness/traverse length
SJ-411: 0.3µm/25mm
SJ-412: 0.5µm/50mm



- A skidless detector and a curved surface compensation function provide efficient evaluation of cylinder surface roughness.
- Ultra-fine steps, straightness and waviness can be measured by using the skidless measurement function.
- The handheld data processing unit and the 5.7-inch color graphic LCD touch-panel provides superior readability and operability. The LCD also includes a backlight for improved visibility in dark environments.
- The excellent user interface provides intuitive and easy-to-understand operability.
- Measured data can be output to a PC with optional RS-232C or USB cable.
- Digital filter function for non-distorted roughness profiles.
- Go/no-go judgment function.
- Auto-calibration function.
- The display interface supports 16 languages, which can be freely switched.
- Simplified contour analysis function supports the four types of measurement: step, level change, area and coordinate difference.
- Access to each feature can be password-protected, which prevents unintended operations and allows you to protect your settings.
- The optional attachments for mounting on a column stand significantly increase the operability.

Skidless measurement

Surftest SJ-411

SPECIFICATIONS

Model No.		SJ-411	SJ-411	SJ-412	SJ-412
Order No. (inch/mm)		**178-581-01A**	**178-581-02A**	**178-583-01A**	**178-583-02A**
Detector measuring force		0.75mN	4mN	0.75mN	4mN
Evaluation range		25mm	25mm	50mm	50mm
Stylus tip	Tip angle	60°	90°	60°	90°
	Tip radius	2µm	5µm	2µm	5µm

Technical Data: X axis (drive unit)

Measuring range: 1"(25mm) (SJ-411), 2"(50mm) (SJ-412)
Measuring speed: .002, .004, .008, .02, .04"/s (0.05, 0.1, 0.5, 1.0mm/s)
Return speed: .02, .04, .08"/s (0.5, 1.0, 2.0mm/s)
Traversing direction: Backward
Traverse linearity: 12 µin / 1"(0.3µm/25mm) (SJ-411), 20 µin / 2"(0.5µm/50mm) (SJ-412)
Positioning: ±1.5° (tilting), 10mm (up/down)
Detector Range / resolution: 800µm / 0.0125µm, 80µm / 0.00125µm, 8µm / 0.000125µm (up to 2400µm with an optional stylus)
Measurement method: Skidless / skidded
Measuring force: 0.75mN (4mN)
Stylus tip: Diamond, 60° / 2µmR (90° / 5µmR)
Skid radius of curvature: 40mm
Type: Differential inductance
Power supply: Via AC adapter / rechargeable battery
Battery life: Max. app. 1000 measurements (w/o printing)
Recharge time: 4 hours Data output Via USB interface / RS-232C interface / SPC output
Storage:Internal memory: Measurement condition (10 sets)
Memory card (Option): 500 measurement conditions, 10,000 measured profiles, 500 display images, Text file (Measurement conditions / Measured profile / Assessed profile / Bearing area curve / Amplitude distribution curve), 500 statistical data, etc.
Dimensions (W x D x H)
Display unit: 10.8x4.3x7.8"(275x109 x198mm)
Height-tilt adjustment unit: 5.16x2.48x3.9"(131x63x99mm)
Drive unit: 5.04x1.41x1.83"(128x36x47mm)(SJ-411), 6.1x1.41x1.83"(155x36x47mm) (SJ-412)
Mass Control unit: Approx. 3.75lb (1.7kg)
Height-tilt adjustment unit: Approx. .9lb (0.4kg)
Drive unit: 1.3lb(0.6kg) (SJ-411), 1.5lb(0.7kg)(SJ-412)

Evaluation Capability

Applicable standards: JIS'82, JIS'94, JIS'01, ISO'97, ANSI, VDA, Free
Assessed profiles: P (primary profile), R (roughness profile), DF (DF profile), W (filtered waviness profile), roughness motif, waviness motif
Evaluation parameters: Ra, Rq, Rz, Ry, Rp, Rv, Rt, R3z, Rsk, Rku, Rc, RPc, RSm, Rmax(VDA, ANSI), Rz1max(ISO'97), S, HSC, RzJIS(JIS'01), Rppi, RΔa, RΔq, Rlr, Rmr, Rmr(c), Rδc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Vo, λq, Lo, Rpm, tp(ANSI), Htp(ANSI), R, Rx, AR, W, AW, Wx, Wte
Analysis graphs: Bearing Area Curve (BAC), Amplitude Distribution Curve (ADC)
Digital filter: 2CR, PC75, Gaussian
Cutoff length: λc: .003, .01, .03, .1, .3" (0.08, 0.25, 0.8, 2.5, 8mm)
λs: 100, 320, 1000µin (2.5, 8, 25µm)(Availability of switching depends of the selected standard.)
Sampling length: 0.08, 0.25, 0.8, 2.5, 8, 25*mm; or arbitrary length in range 0.1 to 25mm (0.1 to 50mm: SJ-412) in 0.01mm increments
Number of sampling lengths: 1, 2, 3, ~20 (limited by traverse range)
Printer: Thermal type
Printing width: 48mm (paper width: 58mm)
Recording magnification
Vertical magnification: 10X to 100,000X, Auto
Horizontal magnification: 1X to 1,000X, Auto
Function
Customize: Selection of display/evaluation parameter
Data compensation: R-surface, Tilt compensation
Ruler function: Step, level change, area and coordinate difference
D.A.T. function: Helps to level workpiece prior to skidless measurement displacement detection mode enables the stylus displacement to be input while the drive unit is stopped.
Statistical processing: Max. value, Min. value, Mean value, Standard deviation (s), Pass ratio, Histogram
GO/NG judgement: Maximum value rule, 16% rule, average value rule, standard deviation (1σ, 2σ, 3σ)
Calibration: Auto-calibration with the entry of numerical value /average calibration with multiple measurement (Max.12 times) is available.
Power saving function: Auto-sleep-function, Auto light-off of Backlight by ECO mode.

* Only for SJ-412

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Free Communication Software

SJ-Tools

This program can be downloaded for FREE from the Mitutoyo website. http:www.mitutoyo.com

Output software based on Microsoft-Excel* for controlling the devices and reproducing and storing the measurement data.
*Microsoft-Excel is not included in the scope of supply.

Complete with exclusive accessories.

- Measurement device control
- Definition of measurement variables
- Graphic representation of the profile
- Storage of measurement results
- Documentation of measurement results

Optional cables (Required for software communication)
12AAD510: USB PC connecting cable (USB cable)
12AAA882: RS-232C connecting cable

Optional Accessories

178-611: Step gage (2µm, 10µm)
178-612: Step gage (2µm, 10µm, 79µin, 394µin)
178-610: Step gage (step: 1µm, 2µm, 5µm, 10µm)
12AAM556: Height/tilt adjustment unit for SJ-410
178-039: Manual column stand (granite base) (vertical travel: 250mm)
178-010: Auto-set unit for **178-039**
178-020: X axis adjustment unit for **178-039**
178-030: Tilting adjustment unit (Inclination adjustment unit) for **178-039**
12AAB358: Cylindrical surface adapter (workpiece dia.: 15 - 60mm)
178-016: Leveling table (tilting: ±1.5°, max. loading: 15kg)
178-048: Leveling table with D.A.T function (mm) (tilting: ±1.5°, max. loading: 15kg)
178-058: Leveling table with D.A.T function (inch) (tilting: ±1.5°, max. loading: 15kg)
178-043-1: XY leveling table (25 x 25mm) (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-053-1: XY leveling table (1" x 1") (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-042-1: Digital XY leveling table (25 x 25mm) (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-052-1: Digital XY leveling table (1" x 1") (tilting: ±1.5°, max. loading: 15kg, swiveling: ±3°)
178-049: Digital XY leveling table (25 x 25mm) (max. loading: 15kg)
178-059: Digimatic XY leveling table (1" x 1") (max. loading: 15kg)
178-019: Precision vise for XY leveling table (jaw opening: 36mm)
998291: Precision V-block for XY leveling table (workpiece dia.: 1 - 160mm)
12AAL069: Micro SD card w/adapter (4GB)
965014: SPC cable (2m)
264-012-10: Input tool (USB type)
264-505A: DP-1VA
———: Detectors, Styli, and nosepieces (See pg. J-22/23.)

Consumables

12AAN040: LCD protective sheet (10 sheets/set)
12AAA876: Durable printer paper (25m, 5 rolls/set)
270732: Printer paper (5 pack)
12AAN046: Replacement battery
12AAJ088: Footswitch

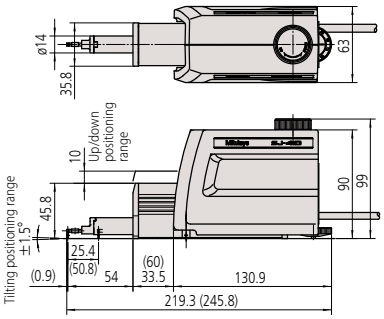
Surftest SJ-410

SERIES 178 — Portable Surface Roughness Tester

DIMENSIONS

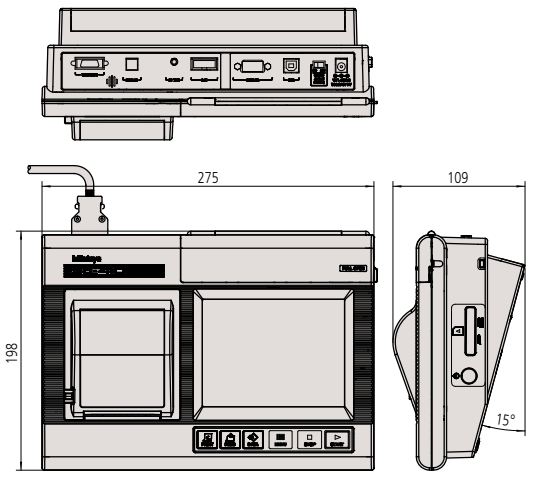
Unit: mm

Drive unit

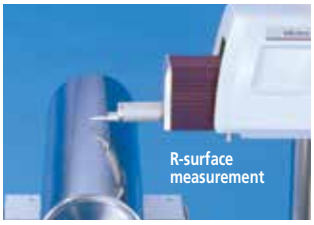


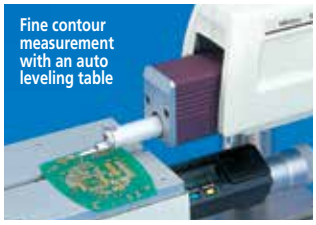
( ): Referring to dimensions when a 50mm drive is mounted to SJ-412.

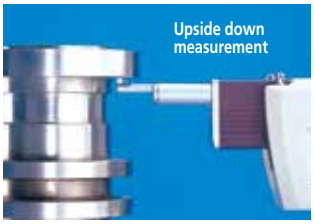
Display unit

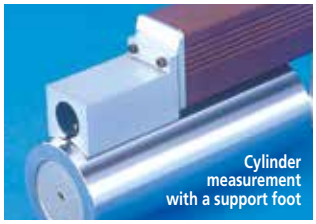


MEASUREMENT APPLICATIONS









Carrying case is a standard accessory.

Manual column stand **178-039**

With optional accessories.

178-010: Auto-set unit
178-020: X-axis adjustment unit
178-030: Tilting adjustment unit

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Surftest SJ-500/P, SV-2100

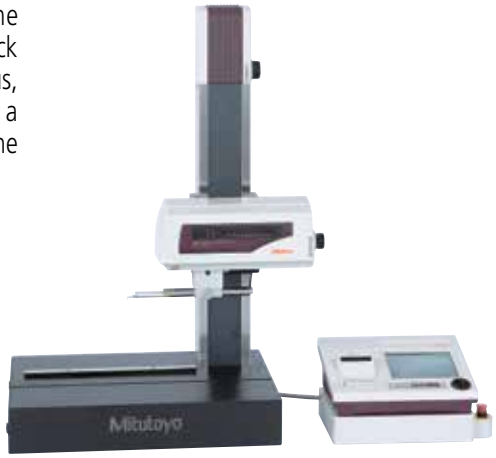
SERIES 178 — with Dedicated Control / PC System / Display Unit

High-precision and high-performance surface roughness tester with a dedicated control unit, achieving user-friendly display and simple operation.

FEATURES

- User-friendly display and simple operation equipped with a highly visible color 7.5-inch TFT LCD.
- Easy positioning. A joy stick built in the dedicated control unit allows easy and quick positioning. Fine positioning of a small stylus, required for measuring the inner side of a small hole, easily can be made using the manual knob.
- Easy setting of measuring conditions for surface roughness. Equipped with simple input function allows inputs according to drawing instruction symbols of ISO/JIS roughness standards. Troublesome measuring condition settings can be easily input by directly selecting a drawing instruction symbol for surface roughness from the menu.

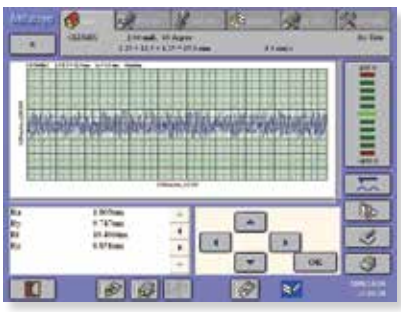
SJ-500



SV-2100S4

SJ-500P

SURFPAK-EZ: Easy-to-use task-focused software



Measurement and results display screen

User-friendly graphical display and button layout allows intuitive operation. Simplified fine-contour analysis provided as standard, including step, area, angle, and circle calculation.

Technical Data: SJ-500

X-axis (drive unit)
- Measuring range: 1.97" (50mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - .78"/s (0 - 20mm/s)
- Measuring speed: .00078 - .2"/s (0.02 - 5mm/s)
- Traversing direction: Backward
- Traverse linearity: 7.8µin/1.97" (0.2µm / 50mm)
- Positioning: ±1.5° (tilting, with DAT function)
  1.18" (30mm) (up/down)

Detector
- Resolution / Range: .4µin/32000µin, .04µin/3200µin, .004µin/320µin
  0.01µm (800µm), 0.001µm (80µm), 0.0001µm (8µm)
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN (0.75mN) (low force type)
- Stylus tip: Diamond, 90° / 5µmR
  (60° / 2µmR: low force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Control unit
- Display: 7.5" color TFT with backlight
- Printer: Built-in thermal printer
- Magnification: Horizontal: X10 to X500,000, Auto
  Vertical: X0.5 to X10,000, Auto
- Drive unit control: Joystick operation with manual knob

Technical Data: SV-2100

X-axis (drive unit)
- Measuring range: 3.94" (100mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - 1.57"/s (0 - 40mm/s)
- Measuring speed: .00078 - .197"/s (0.02 - 5mm/s)
- Traversing direction: Pull
- Traverse linearity: 6µin/4" (0.15µm / 100mm)

Z2-axis (column)
- Type: Manual operation or power drive
- Vertical travel: 13.8" or 21.6" (350mm or 550mm*)
- Resolution*: 1µm
- Measurement method*: Rotary encoder
- Drive speed*: 0 - .78"/s (0 - 20mm/s)

*Only for power-drive type

Detector
- Resolution / Range : .4µin/32000µin, .04µin/3200µin, .004µin/320µin
  0.01µm / 800µm , 0.001µm / 80µm, 0.0001µm / 8µm
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN or 0.75mN (low force type)
- Stylus tip: Diamond, 90° / 5µmR
  (60° / 2µmR: low force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Control unit
- Display: 7.5" color TFT with backlight
- Printer: Built-in thermal printer
- Magnification: Horizontal: X10 to X500,000, Auto
  Vertical: X0.5 to X10,000, Auto
- Drive unit control: Joystick operation with manual knob

Evaluation Capability

Cutoff length
ls: 0.25µm, 0.8µm, 2.5µm, 8µm, 25µm, 250µm, no filter
lc*: 0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm
lf: 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm, no filter

Sampling length (L)*
0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm, 80mm (SV-2100 only)

Data compensation functions
Parabola compensation, hyperbola compensation, ellipse compensation, R-plane (curved surface) compensation, conic compensation, tilt compensation

*Arbitrary length can be specified in the range from 0.02mm to 50mm.

12AAA876: High durable printer paper (5 Rolls/set)
270732: Standard type printer paper (5pcs.)
12AAA841: Compact Flash memory card (128 MB)

Surftest SJ-500/P, SV-2100

SERIES 178 — with Dedicated Control / PC System / Display Unit

SPECIFICATIONS

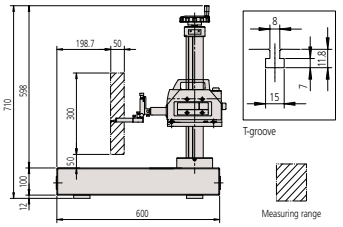
Model no.	SJ-500P	SJ-500	SV-2100M4	SV-2100S4	SV-2100H4	SV-2100W4
Type of Data processing	PC System	Dedicated Data Processor	Dedicated Data Processor			
Order No. (inch)	**178-531-02A**	**178-533-02A**	**178-637-01A**	**178-681-01A**	**178-683-01A**	**178-685-01A**
Measuring force of detector	4mN	4mN	0.75mN			
X-axis measuring range	2" (50mm)		4" (100mm)			
Vertical travel	Optional stand		13.8" (350mm) manual column	13.8" (350mm) power column	21.6" (550mm) power column	
Granite base size (WxD)	Optional stand		23.6 x 17.7" (600 x 450mm)			39.4 x 17.7" (1000 x 450mm)
PC I/F Unit	13.7 x 10.4 x 3.4" (350 x 263 x 86mm)	NA	NA	NA	NA	NA
Dimensions (main unit, WxDxH)	16.7 x 3.7 x 6.3" (425 x 94 x 160mm)		28.2 x 17.7 x 34" (716 x 450 x 863mm)	28.2 x 17.7 x 38" (716 x 450 x 966mm)	28.2 x 17.7 x 46" (716 x 450 x 1166mm)	44 x 17.7 x 46.3" (1116 x 450 x 1176mm)
Main unit Mass	5.9 lbs. (2.7 kg)		308.6 lbs. (140 kg)	308.6 lbs. (140 kg)	330 lbs. (150 kg)	485 lbs (220 kg)
Assessed profiles	Dedicated data processor type: P (primary profile), R (roughness profile), WC, envelope residual profile, roughness motif, waviness motif PC system type: P (primary profile), R (roughness profile), WC, WCA, WE, WEA, DIN4776 profile, E (envelope residual profile), roughness motif, waviness motif					
Evaluation parameters	Dedicated data processor type: Ra, Rc, Ry, Rz, Rq, Rt, Rmax, Rp, Rv, R3z, Sm, S, Pc, mr (c),δc, mr, tp, Htp, Lo, lr, Ppi, HSC, Δa, Δq, Ku, Sk, Rpk, Rvk, Rk, Mr1, Mr2, A1, A2, Vo, λa, λq, R, AR, Rx, W, AW, Wx, Wte, (43 parameters), Customization PC system type: Pa, Pq, Psk, Pku, Pp, Pv, Pz, Pt, Pc, PSm, PΔq, Pmr (c), Pmr, Pδc, Ra, Rq, Rsk, Rku, Rp, Rv, Rz, Rt, Rc, RSm, RΔq, Rmr (c), Rmr, Rδc, Wa, Wq, Wsk, Wku, Wp, Wv, Wz, Wt, Wc, WSm, WΔq, Wmr (c), Wmr, Wδc, Rk, Rpk, Rvk, Mr1, Mr2, A1, A2, Rx, AR, R, Wx, AW, W, Wte, Ry, RyDIN, RzDIN, R3y, R3z, S, HSC, Lo, lr, Δa, λa, λq, Vo, Htp, NR, NCRX, CPM, SR, SAR, NW, SW, SAW					
Analysis graphs	Dedicated data processor type: ADC, BAC, power spectrum graph PC system type: ADC, BAC Graph, power spectrum graph, auto-correlation graph, Walsh power spectrum graph, Walsh auto-correlation graph, slope distribution graph, local peak distribution graph, parameter distribution graph					
Curved surface compensation	Dedicated data processor type: Parabolic compensation, Hyperbolic compensation, Elliptical compensation, Circular compensation Conic compensation, Inclination (Entire, Arbitrary) PC system type: Parabolic compensation, Hyperbolic compensation, Elliptical compensation, Circular compensation, Conic compensation, Inclination (Entire, Arbitrary), Polynomial compensation					
Contour analysis	Dedicated data processor type: Area, Circle, Angle, Coordinate difference, Step, Inclination PC system type (SURFPAK-EZ): Area, Circle, Angle, Coordinate difference, Step, Inclination					
Filters	Dedicated data processor type: 2CR-75%, 2CRPC-75%, Gaussian, Robust-spline PC system type: 2CR-75%, 2CR-50%, 2CRPC-75%, 2CRPC-50%, Gaussian, Robust-spline					

Manual column stand options: 178-085 and 178-089 (for SJ-500)

Suitable for desktop use in inspection rooms and such.

No.178-085* Does not include measuring unit
Vertical adjustment range: 11.8" (300mm)
Dimension (W × D × H): 23.6" x 17.7" x 28"
(600 × 450 × 710mm)
Weight: 242 lbs (110kg)
No.178-089* Does not include measuring unit
Vertical adjustment range: 9.8" (250mm)
Dimension (W × D × H): 15.7 x 9.8 x 2.4"
(400 × 250 × 60mm)
Weight: 44 lbs (20kg)

Dimensions of SJ-500 w/ manual column stand **178-085**



Unit: mm

Auto-leveling table: 178-081 (for SJ-500 / SV-2100M4), 178-083 (for SV-2100S4 / H4 / W4)

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this tedious operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	15.4 lbs (7kg)
Table dimensions	5.12 x 3.94"(130x100mm)
Mass	7.7lbs (3.5kg)

Mitutoyo

Surftest SV-3200

SERIES 178 — Surface Roughness Testers

SV-3200L4 (with options)

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

*Shown with optional accessories.

SV-3200H4 with PC

The Surftest SV-3200 Series provide high-accuracy, high-level analysis and multi-functionality in measurement of surface roughness.

FEATURES

- Mitutoyo's Surftest SV-3200 Series provides high-accuracy, high-level analysis and multi-functionality in three-dimensional analysis and measurement of fine contour, as well as the conventional type surface roughness measurement.
- Peripheral devices such as the auto-leveling table are available to enhance operability and to enable automatic measurement.
- FORMTRACEPAK V5, dedicated data-analyzing software, is installed. This software allows data management in a consistent format, from the work site to the laboratory.
- Ceramic, which is known for its superb anti-abrasive property, is used as the X-axis drive unit guide. No lubrication of the guide is required.
- High-accuracy glass scales are built-in on X-axis (resolution: 1.97µin (0.05µm) and Z2-axis (column, resolution: 39.4µin (1µm) to ensure high-accuracy positioning.

The SV-3200 series manifest high-reliability especially in the horizontal roughness parameters (S, Sm), that require high-accuracy of the X-axis travel.

- When equipped with high accuracy Y-axis table and 3D surface analysis software MCubeMap, this offers CNC type capabilities usually performed on Extreme series machines.
- Various optional detector holders such as Crank Rotary type and Manual Rotary type make this versatile for many different applications.
- New optional Digital Automatic Tilt (DAT) function is best suited for workpieces that are too large for leveling tables.

Technical Data

X-axis
- Measuring range: 4" or 8" (100mm or 200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Linear encoder
- Drive speed: 0 - 3.1"/s (0 - 80mm/s)
- Measuring speed: .00078 - .78"/s (0.2 - 20mm/s)**
- Traversing direction: Backward
- Traverse linearity: 4": (2+L)µin (0.05+0.001L)µm*
  8": 20µin / 8"(0.5µm/200mm)

Z2-axis (column)
- Vertical travel: 12", 20"or 27.6" (300mm, 500mm or 700mm) power drive
- Resolution: 39.4µin (1µm)
- Measurement method: ABSOLUTE linear encoder
- Drive speed: 0 - 1.2"/s (0 - 30mm/s)

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {(800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm) (up to 2400µm with an optional stylus)}
- Detecting method: Skidless / skid measurement
- Measuring force: 0.75mN (low force type)
- Stylus tip: Diamond, 60°/2µmR (low-force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Base size (W x H): 23.6 x 17.7" (600 x 450mm) or 39.4 x 17.7" (1000 x 450mm)

Base material: Granite

*L = Measured length inch (mm)
**Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Evaluation Capability: FORMTRACEPAK V5

Assessed profiles
P (primary profile), R (roughness profile), WC, WCA, WE, WEA, DIN4776 profile, envelope residual profile, roughness motif, waviness motif

Evaluation parameters
Ra, Rq, Rz, Ry, Rz(JIS), Ry(DIN), Rc, Rp, Rpmax, Rpi, Rv, Rvmax, Rvi, Rt, Rti, R3z, R3zi, R3y, S, Pc (Ppi), Sm, HSC, mr, δc, plateau ratio, mrd, Rk, Rpk, Rvk, Mr1, Mr2, Δa, Δq, λa, λq, Sk, Ku, Lo, Lr, A1, A2
Roughness motif parameters: Rx, R, AR, SR, SAR, NR, NCRX, CPM
Waviness motif parameters: Wte, Wx, W, AW SW, SAW, NW

Analysis graphs
ADC, BAC1, BAC2, power spectrum chart, auto-correlation chart, Walsh power spectrum chart, Walsh auto-correlation chart, slope distribution chart, local peak distribution chart, parameter distribution chart

Digital filter 2CR-75%, 2CR-50%, 2CR-75% (phase corrected), 2CR-50% (phase corrected), Gaussian-50%

Cutoff length*
λc: .001, .003, .01, .03, .1, .3, 1" (0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)
fl: .001, .003, .01, .03, .1, .3, 1" (0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)
fh: .001, .003, .01, .03, .1, .3, 1" (0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm)

Sampling length (L)*.001, .003, .01, .03, .1, .3, 1" (0.025mm, 0.08mm, 0.25mm, 0.8mm, 2.5mm, 8mm, 25mm)

Data compensation functions
Tilt compensation, R-plane (curved surface) compensation, ellipse compensation, parabola compensation, hyperbola compensation, quadric curve automatic compensation, polynomial compensation, polynomial automatic compensation

*Arbitrary length can be specified in the range from .001" (0.025mm) to the maximum traverse length.

Surftest SV-3200

SERIES 178 — Surface Roughness Testers

SPECIFICATIONS

Models without X-axis inclination function

Model No.	SV-3200S4	SV-3200H4	SV-3200W4	SV-3200L4
Order No. (inch)	**178-424-11A**	**178-425-11A**	**178-426-11A**	**178-464-11A**
Order No. (inch)	**178-444-11A**	**178-445-11A**	**178-446-11A**	**178-484-11A**
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
X-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	29.8 x 19.0 x 38.0" (756 x 482 x 966mm)	29.8 x 19.0 x 45.9" (756 x 482 x 1166mm)	45.5 x 19.0 x 46.3" (1156 x 482 x 1176mm)	45.5 x 19.0 x 56.5" (1156 x 482 x 1436mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	SV-3200S8	SV-3200H8	SV-3200W8	SV-3200L8
Order No. (inch)	**178-427-11A**	**178-428-11A**	**178-429-11A**	**178-465-11A**
Order No. (inch)	**178-447-11A**	**178-448-11A**	**178-449-11A**	**178-485-11A**
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
X-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Vertical travel	12" (300mm) power column	20"(500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7"(1000 x 450mm)	39.4 x 17.7"(1000 x 450mm)
Dimensions (main unit, WxDxH)	30.2 x 19.0 x 38.0" (766 x 482 x 966mm)	30.2 x 19.0 x 45.9" (766 x 482 x 1166mm)	45.9 x 19.0 x 46.3" (1166 x 482 x 1176mm)	45.5 x 19.0 x 56.5" (1156 x 482 x 1436mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Optional Accessories

178-602-1: Reference Specimen (Supports ISO)

178-611: Reference Step Specimen (2µm, 10µm)
178-612: Reference Step Specimen (2µm, 10µm, 79µin, 394µin)
178-610: Step gage (1µm, 2µm, 5µm, 10µm)
178-047: Three-axis adjustment table (including 998291 precision V-block.)
178-016: Leveling table
178-042-1: Digimatic XY leveling table (25 x 25mm)
178-052-1: Digimatic XY leveling table (1 x 1")
178-043-1: XY leveling table (25 x 25mm)
178-053-1: XY leveling table (1 x 1")
178-019: Precision vise*
998291: Precision V-block*
181-902-10: V-block set with clamp (Max. workpiece dia.: 25mm)
181-901-10: V-block set with clamp (Max. workpiece dia.: 1")

(See page J-22/23.) Detectors, styli, and nosepieces
*Use with an XY leveling table

Optional Accessories

A wide range of peripherals are available to support various challenging measurement needs.

Y-axis Table
178-097 for multiple workpiece measurement
178-096 for 3D measurement
*Not a measuring axis, only for positioning.

3D-Auto Leveling Table
178-077
*Used together with **178-096**

Digital Advanced Tilting Unit
178-040
*Contact Sales Rep for details. Recommend to be installed in manufacturer's facility.

(See page J-25 for more accessories.)

178-071 (S-3000)
Standard Detector Holder

178-075 (S-3000CR)
Crank Rotary Type Detector Holder

178-074 (S-3000C)
Crank Type Detector Holder

178-076 (S-3000MR)
Manual Rotary Type Detector Holder

Mitutoyo

Surftest Extreme SV-3000CNC

SERIES 178 — CNC Surface Measuring Instruments

FEATURES

- High-accuracy CNC surface roughness measuring instrument allows surface roughness measurement in both axes.
- Each axes has the maximum drive speed of 200 mm/s, which permits high-speed positioning that may result in a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- For models with the α-axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the drive unit.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Using optional rotary table θ1 and θ2 designed to use with the CNC models enables it to expand the CNC measurement application range.
- Inclined plane measurements is possible through 2-axis simultaneous control in the X- and Y-axis directions.
- Since the detector unit incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with a workpiece or fixture.
- Supplied with an easy-to-operate Remote Box. The user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Communication with the data processing/ analysis section is via USB.

SV-3000CNC w/ PC system and software
PC stand is not included, isolation stand is optional

SPECIFICATIONS

Model No.	SV-3000CNC		SV-3000CNC	
Order No. (100V - 120V)	**178-508-13**	**178-528-13**	**178-509-13**	**178-529-13**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	20" (500mm)	12" (300mm)	20" (500mm)
Y-axis table unit	Installed	Installed	Installed	Installed
α-axis unit	—	—	Installed	Installed

Technical Data: SV-3000CNC

X1-axis
- Measuring range: 8" (200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (CNC, max.)
  0 - 2.0"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078 - .078"/s (0.02 - 2mm/s)
- Traversing direction: Backward
- Traverse linearity: 20 µin/8" (0.5µm/200mm)

α-axis**
- Inclination angle: -45° to +10°
- Resolution: 0.000225°
- Rotating speed: 1rpm

Z2-axis (column)
- Vertical travel: 12" (300mm) 20"*(500mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 2.4"/s (0 - 60mm/s) (joystick)
- Base size (W x H): 29.5 x 23.6" (750 x 600mm)
- Base material: Granite

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin,
  320 µin / .004µin
  (up to 96,000 µin with an optional stylus)
  {(800µm / 0.01µm, 80µm / 0.001µm,
  8µm / 0.0001µm)
  (up to 2400µm with an optional stylus)}
- Measuring force: 4mN (0.75mN) (low-force type)
- Stylus tip: Diamond, 90°/5µmR
  (60°/2µmR: low-force type)

Dimension (W x D x H): 31.5 x 24.4 x 39.4"
(800 x 620 x 1000mm)
31.5 x 24.4 x 47.2"
(800 x 620 x 1200mm)*

Mass 529 lbs (240kg) 551lbs (250kg)*
*High-column model

Y-axis table unit**
- Measuring range: 8" (200mm)
- Minimum reading : 1.97µin (0.05µm)
- Scale unit: Reflective-type Linear Encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 2.4"/s (0 - 60mm/s) (joystick)

Maximum loading capacity: 44 lbs (20kg)
Traverse linearity 20µin/8" (0.5µm/200mm)
Linear displacement accuracy (at 20°C):
± (80+2L/4)µin {± (2+2L/100) µm}
L: Dimension between two measured points (mm)
- Table size: 7.87 x 7.87" (200 x 200mm)
- Dimensions (W x D x H): 12.6 x 25.4 x 4.1"
  (320 x 646 x 105mm)
- Mass: 77 lbs (35kg)

**Y-axis table included only as a factory installed option.

Optional Accessories

Vibration isolation stand
Vibration isolation mechanism: Diaphragm air spring
- Natural frequency : 2.5 - 3.5Hz
- Damping mechanism: Orifice
- Leveling mechanism: Automatic control with mechanical valves
- Air supply pressure: 0.4MPa

Allowable loading capacity: 772 lbs (350kg)
- Dimensions (W x D x H): 39.4 x 35.2 x 28.1"
  (1000 x 895 x 715mm)
- Mass: 617 lbs (280kg)

Surftest Extreme SV-M3000CNC

SERIES 178 — CNC Surface Measuring Instruments

SV-M3000CNC with personal computer system and software

* PC stand not included

Technical Data: SV-M3000CNC

X1-axis
- Measuring range: 8" (200mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 1.97"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078 - .08"/s (0.02 - 2mm/s)
- Traverse linearity: 20µin/8" (0.5µm/200mm)
  28µin/8" (0.7µm/200mm) (long-type detector)
  20µin/8" (0.5µm/200mm) (rotary-type detector, up/down direction)
  28µin/8" (0.7µm/200mm) (long-type detector, foward/backward direction)

α-axis
- Inclination angle: -45° to +10°
- Resolution: 0.000225°
- Rotating speed: 1rpm

Z2-axis (column)
- Vertical travel: 20"(500mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (CNC, max.)
  0 - 1.97"/s (0 - 50mm/s) (joystick)

Y-axis
- Measuring range: 32" (800mm)
- Resolution: 1.97µin (0.05µm)
- Measurement method: Reflective-type linear encoder
- Drive speed: 7.87"/s (200mm/s) (max., CNC)
  0 - 1.97"/s (0 - 50mm/s) (joystick)
- Measuring speed: .00078- .08"/s (0.02 - 2mm/s)
- Traverse linearity: 20µin/2" (0.5µm/50mm), 80µin/32" (2µm/800mm) 28µin/2" (0.7µm/50mm), 120µin/32" (3µm/800mm) (long-type detector) 28µin/2" (0.7µm/50mm), 120µin/32" (3µm/800mm) (rotary-type detector, up/down direction)

Base unit
- Size (W x H): 23.6 x 59.1" (600 x 1500mm)
- Material: Steel
- Loading capacity: 661 lbs (300kg)

Detector
- Range / resolution: 32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96,000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
- Detecting method: Skidless / skid measurement
- Measuring force: 4mN or 0.75mN (low-force type)
- Stylus tip: Diamond, 90°/5µmR (60°/2µmR: low-force type)
- Skid radius of curvature: 1.57" (40mm)
- Detecting method: Differential inductance

Dimension (W x D x H): 42.7 x 66.7 x 75.7" (1085 x 1695 x 1922mm)

Mass: 3527 lbs (1600Kg) (including vibration isolating unit)

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the standard in world metrology software
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Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html","mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.

Contour Measurement & Surface Roughness Measurement Screen

Report Layout Screen

FEATURES

- CNC Surface Roughness Tester covers measurement of large/heavy workpieces such as engine blocks, crankshafts, etc.
- In combination with the surface roughness detector rotating unit, S-3000AR (optional), it can perform continuous measurement over the bottom, top and side surfaces of a workpiece.
- Compatible with the optional large table for supporting a load of 220 lbs (100 kg) or a large θ2 table. Enables continuous automatic measurement of large-size workpieces.
- Suitable for automatic surface roughness measurement on large and heavy workpieces.
- Employs the column-moving type configuration that is not restricted by workpiece size. This is advantageous for measuring heavy workpieces, such as engine blocks, crankshafts, etc.
- Provides 31.5" (800mm) of Y-axis stroke. This makes it possible to measure multiple profiles on large workpieces.
- Load table has a self-contained structure to ensure that various size workpieces, jigs, auto-feed devices, etc., are easily accommodated and can be specified, if required, by special order.

SPECIFICATIONS

Model No.	SV-M3000CNC
Order No. (100V - 120V)	**178-549-1**
X1-axis measuring range	8" (200mm)
Z2-axis column travel range	20" (500mm)
Y-axis travel range	32" (800mm)
α-axis inclination angle	-45° (CCW), +10° (CW)

Mitutoyo

Formtracer SV-C3200 / SV-C4500

SERIES 525 — Surface Roughness / Contour Measuring System

SV-C3200L4 (with options)

SV-C3200S4 with personal computer system and software

FEATURES

- Dramatically increased drive speed (X axis: 3.1"/s (80mm/s), Z2 axis column: 1.2"/s (30mm/s) further reduces total measurement time.
- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- The drive unit (X-axis) and column (Z2-axis) are equipped with a high-accuracy linear encoder (ABS type on Z2-axis). This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.

Automatic Measurement

- A wide range of optional peripherals are available to support quick and easy CNC operation.

Y-axis Table

Rotary Table θ1

Rotary Table θ2

Surface Roughness Measurement

- Traverse linearity: (2+1L)µin (±(0.05+0.001L) µm*)
  Designed to handle workpieces calling for high accuracy.
  *S4, H4, W4 types, L = Drive length inch (mm)
- Compliant with JIS '82/'94/'01, ISO, ANSI, DIN, VDA, and other international surface roughness standards.
- Equipped with a standard high accuracy detector (0.75mN/4mN measuring force) providing a resolution down to 0.004µin (0.0001µm).

Contour Drive Measurement

- X axis accuracy: ± (31.5+10L)µin (±(0.8+0.01L)µm*)
  Z1-axis accuracy: ± (31.5+l20Hl)µin (±(0.8+l2Hl/100)µm*)
  Designed to handle workpieces calling for high accuracy.
  * SV-C4500S4, H4, W4 types, L = Drive length, H = Measurement height inch (mm)
- The contour drive unit of SV-C4500 series instruments can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece, when combined with the double cone-end stylus (a new product with contact points in the upward and downward directions).

Technical Data: Common

Power supply:	100 – 240VAC ±10%, 50/60Hz
Power consumption:	400W (main unit only)

Technical Data: Contour Measurement

X-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	3.1"/s (80mm/s) and manual
Measuring speed:	.00078 - .78"/s (0.02 - 20mm/s)*

*Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Measuring direction:	Forward/backward
Traverse linearity:	32µin/4"(0.8µm/100mm) 79µin/8" (2µm/200mm) *with the X axis in horizontal orientation
Linear displacement:	±(32+10L)µin (±0.8+0.01L) µm (SV-C3200S4, H4, W4)
accuracy (at 20°C)	±(32+10L)µin (±0.8+0.01L)µm (SV-C4500S4, H4, W4) ±(32+20L)µin (±0.8+0.02L)µm (SV-C3200S8, H8, W8) ±(32+20L)µin (±0.8+0.02L)µm SV-C4500S8, H8, W8) * L = Drive length inch (mm)
Inclination range:	±45°

Z2-axis (column)

Vertical travel:	12"(300mm) or 20"(500mm)
Resolution:	39.4µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	1.57µin (0.04µm) (SV-C3200 series), .78µin (0.02µm) (SV-C4500 series)
Measurement method:	Linear encoder (SV-C3200 series), Laser hologage (SV-C4500 series)
Linear displacement:	±(63+l20lH) µin (±(1.4+l2Hl/100)µm) (SV-C3200 series)
accuracy (at 20°C)	±(31.5+l20Hl) µin (±(0.8+l2Hl/100)µm) (SV-C4500 series) *H: Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Upward/downward (SV-C3200) Upward/downward (Direction switch by Formtracepak) (SV-C4500)
Measuring force:	30mN (SV-C3200) 10, 20, 30, 40, 50mN (SV-C4500) * As for SV-C4500, set the measurement force with Formtracepak.
Traceable angle:	Ascent: 77°, descent: 83° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip

Technical Data: Surface Roughness Measurement

X1-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Linear encoder
Drive speed:	3.1"/s (80mm/s)
Traversing direction:	Backward
Traverse linearity:	(2+1L) µin (0.05+1L/1000)µm (S4, H4, W4 types) 20µin/8"(0.5µm/200mm) (S8, H8, W8 types)

Z2-axis (column)

Vertical travel:	12" (300mm) or 20" (500mm)
Resolution:	39.4 µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Detector

Range / resolution:	32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
Detecting method:	Skidless / skid measurement
Measuring force:	0.75mN (low force type)
Stylus tip:	Diamond 60°/2µmR (low force type)
Skid radius of curvature:	1.57" (40mm)
Detecting method:	Differential inductance

Formtracer SV-C3200 / SV-C4500

SERIES 525 — Surface Roughness / Contour Measuring System

SPECIFICATIONS

Model No.	SV-C3200S4	SV-C3200H4	SV-C3200W4	SV-C3200L4
Order No. (inch)	**525-491-11A**	**525-492-11A**	**525-493-11A**	**525-494-11A**
Model No.	SV-C4500S4	SV-C4500H4	SV-C4500W4	SV-C4500L4
Order No. (inch)	**525-451-11A**	**525-452-11A**	**525-453-11A**	**525-454-11A**
X1-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	39.2 x 22.6 x 38.0" (996 x 575 x 966mm)	39.2 x 22.6 x 46.3" (996 x 575 x 1176mm)	55.4 x 22.6 x 46.3" (1396 x 575 x 1176mm)	55.4 x 22.6 x 56.1" (1396 x 575 x 1426mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	SV-C3200S8	SV-C3200H8	SV-C3200W8	SV-C3200WL8
Order No. (inch)	**525-496-11A**	**525-497-11A**	**525-498-11A**	**525-499-11A**
Model No.	SV-C4500S8	SV-C4500H8	SV-C4500W8	SV-C4500L8
Order No. (inch)	**525-456-11A**	**525-457-11A**	**525-458-11A**	**525-459-11A**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	4" (100mm)
Measuring force of detector	0.75mN	0.75mN	0.75mN	0.75mN
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	39.6 x 22.6 x 38.0" (1006 x 575 x 966mm)	39.6 x 22.6 x 46.3" (1006 x 575 x 1176mm)	55.4 x 22.6 x 46.3" (1406 x 575 x 1176mm)	55.4 x 22.6 x 56.1" (1396 x 575 x 1426mm)
Mass (main unit)	308 lbs (140kg)	330 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

MiCAT
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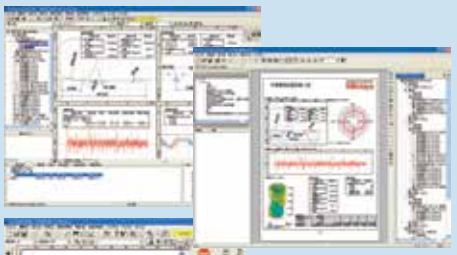
the standard in world metrology software
FORM

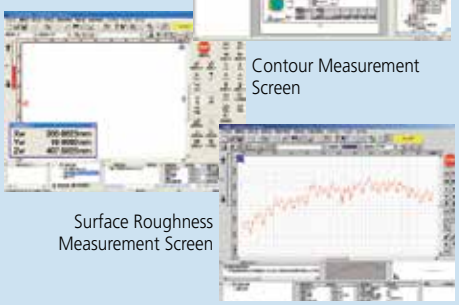
Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.



Contour Measurement Screen



Surface Roughness Measurement Screen

Optional Accessories

A wide range of peripherals are available to support various challenging measurement needs.

Y-axis Table
178-097 for multiple workpiece measurement
178-096 for 3D measurement
*Not a measuring axis, only for positioning.

3D-Auto Leveling Table
178-077
*Used together with **178-096**

(See page J-25 for more accessories.)

178-071 (S-3000)
Standard Detector Holder

178-091 (S-3000CR)
Crank Rotary Type Detector Holder

178-074 (S-3000C)
Crank Type Detector Holder

178-092 (S-3000MR)
Manual Rotary Type Detector Holder

Mitutoyo

Formtracer Extreme SV-C4500CNC

SERIES 525 — Surface Roughness/Form Measuring Instrument

SV-C4500CNC with recommended machine vibration stand

* PC stand not included

Surface roughness detector

Contour Z-axis detector

FEATURES

- High-accuracy CNC surface roughness/form measuring instrument allows both measurement of surface roughness and form/contour with one unit.
- Each axes has the maximum drive speed of 7.87"/s (200 mm/s), which permits high-speed positioning that may result in a large increase in the throughput of multiple-profile/multiple-workpiece measurement tasks.
- For models with the α axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the detector unit.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- When combined with the double cone-end stylus (a new product with diametrically opposed contact points), the instrument can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece fixturing.
- The measuring force can be switched among five levels (upward and downward) from the data-processing program (Formtracepak).
- Enables inclined plane measurements through 2-axis simultaneous control in the X- and Y-axis directions.
- When the detector for form/contour measurement is replaced with that for surface roughness measurement, or vice versa, it is a simple, one-touch replacement without re-routing of the connecting cables.
- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with a workpiece or fixture.
- Supplied with an easy-to-operate Remote Box. The user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Communication with the Data Processing/Analysis section is via USB.

Technical Data: Common

Base size (W x H):	31 x 39.4" (800 x 1000mm) Type S 34 x 47.2" (800 x 1200mm) Type H
Base material:	Granite
Mass:	529 lbs (240kg) Type S 551 lbs (250kg) Type H
Power supply:	100 – 120VAC ±10%, 50/60Hz
Power consumption:	500W (main unit only)

Technical Data: Contour Measurement

X1-axis

Measuring range:	8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)
Measuring speed:	.00078 - .08"/s (0.02 - 2mm/s)
Measuring direction:	Forward / Backward
Traverse linearity:	80µin / 8"(2µm/200mm) *with the X axis in horizontal orientation
Linear displacement accuracy (at 20°C):	±(0.8+4L/200)mm) * L = Drive length (mm)

α-axis* Depends on Code #

Inclination angle:	-45° to +10°
Resolution:	0.000225°
Rotating speed:	1rpm

Z2-axis (column)

Vertical travel:	12" or 20" (300mm or 500mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2."/s (0 - 50mm/s) (joystick)

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	.787µin (0.02µm)
Measurement method:	Reflective Type detector unit
Linear displacement:	
Accuracy (at 20°C)	±(32+110H)µin (±(0.8+l2Hl/100)µm) *H: Measurement height from the horizontal position (mm) w/o α-axis: ±(1.5+10Hl/1000)µm
Stylus up/down operation:	Arc movement
Face of stylus:	Downward
Measuring force:	10, 20, 30, 40, 50mN
Traceable angle:	Ascent: 70°, descent: 70° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip

Technical Data: Surface Roughness Measurement

X1-axis

Measuring range:	8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)
Measuring speed:	.00078 - .08"/s (0.02 - 2mm/s)
Traversing direction:	Pulling
Traverse linearity:	20µin/8" (0.5µm/200mm)

α-axis* Depends on Code #

Inclination angle:	-45° to +10°
Resolution:	0.000225°
Rotating speed:	1rpm

Z2-axis (column)

Vertical travel:	12" or 20" (300mm or 500mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	7.87"/s (200mm/s) (max., CNC) 0 - 2"/s (0 - 50mm/s) (joystick)

Detector (optional)

Range / resolution:	32000 µin / .4 µin, 3200µin / .04µin, 320 µin / .004µin (up to 96000 µin with an optional stylus) {800µm / 0.01µm, 80µm / 0.001µm, 8µm / 0.0001µm (up to 2400µm with an optional stylus)}
Detecting method:	Skidless / skid measurement
Measuring force:	0.75mN
Stylus tip:	60°/2µmR
Skid radius of curvature:	1.57" (40mm)
Detecting method:	Differential inductance

Formtracer Extreme SV-C4500CNC

SERIES 525 — Surface Roughness/Form Measuring Instrument

Y-axis table unit**

Measuring range: 8" (200mm)
Minimum reading : 1.97µin (0.05µm)
Scale unit: Reflective-type linear encoder
Drive speed: 200mm/s (max., CNC)
0 - 2"/s (0 - 50mm/s) (joystick)
Maximum loading capacity: 44 lbs (20kg)
Traverse linearity 20µin/8" (0.5µm/200mm) Surface roughness
80µin/8" (2µm/200mm) contour
Linear displacement accuracy (at 20°C):
± (80+20L)µin{± (2+2L/100) µm}
contour mode
L: Dimension between two measured points (mm)
Table size: 7.8 x 7.8"(200 x 200mm)
Dimensions (W x D x H): 2.6 x 25.4 x 4.1"
(320 x 646 x 105mm)
Mass: 77 lbs (35kg)

**Y-axis table included only as a factory installed option.

Optional Accessories

Machine vibration stand: 12AAE032

Vibration isolation mechanism: Diaphragm air spring
Natural frequency : 2.5 - 3.5Hz
Damping mechanism: Orifice
Leveling mechanism: Automatic control with mechanical valves
Air supply pressure: 0.4Mpa
Allowable loading capacity: 772 lbs (350kg)
Dimensions (W x D x H): 39.4 x 35.2 x 28.1"
(1000 x 895 x 715mm)
Mass: 617 lbs (280kg)

MiCAT
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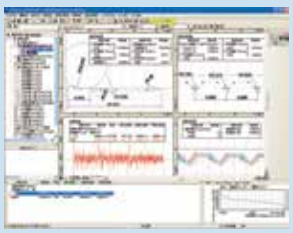
the standard in world metrology software
FORM

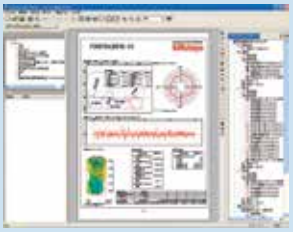
Software

FORMTRACEPAK V5

Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.



Contour Measurement and Surface Roughness Measurement Screen



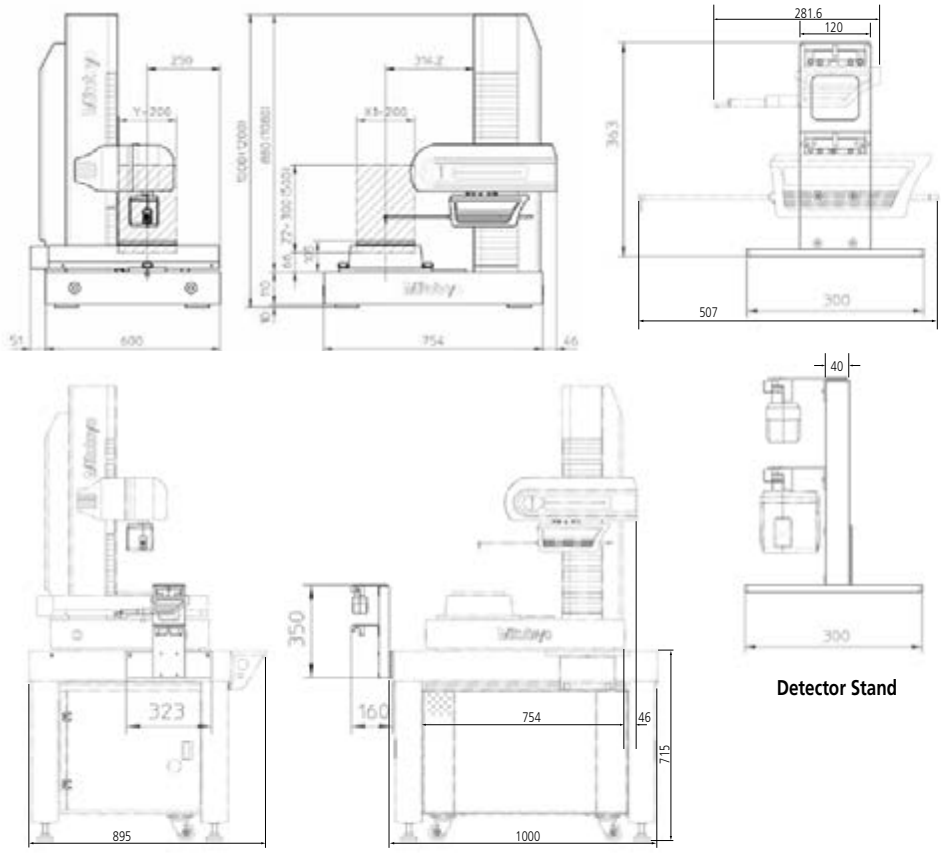
Report Layout Screen

SPECIFICATIONS

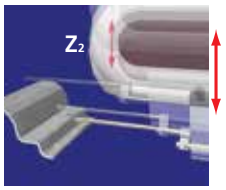
Model No.	SV-C4500S CNC	SV-C4500H CNC
Order No. (100V - 120V)	**525-674-1**	**525-694-1A**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	20"(500mm)
Y-axis table unit	Installed	Installed
α-axis unit	Installed	Installed
Granite base size (WxD)	29.5 x 23.6"(750 x 600mm)	29.5 x 23.6"(750 x 600mm)
Dimensions (main unit, WxDxH)	31.5 x 24.4 x 39.4"(800 x 620 x 1000mm)	31.5 x 24.4 x 47.2"(800 x 620 x 1200mm)
Mass (main unit)	529 lbs (240kg)	551 lbs (250kg)

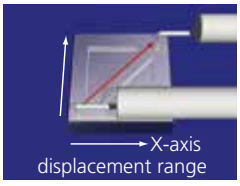
DIMENSIONS

Unit: mm



Detector Stand





Mitutoyo

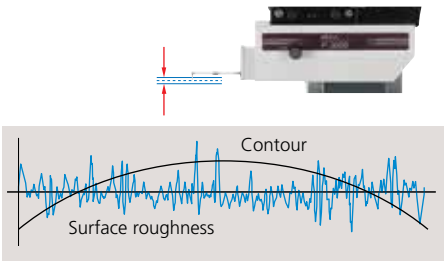
Formtracer CS-3200

SERIES 525 — Form Measuring Instruments

CS-3200S4 with personal computer system and software
* PC stand not included.

FEATURES

- Highest measurement accuracy in its class.
  X axis: ±(1+0.01L)µm
  Z1 axis: ±(1.5+l2Hl/100)µm
- To detect surface roughness and contour in a single measurement the Z1-axis detector unit of CS-3200S4 has a wide measuring range and high resolution of 5mm / 0.08µm to 0.05mm / 0.0008µm.



- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- Drastically increased drive speed further reduces total measurement time.
  X axis: 80mm/s, Z2 axis: 20mm/s
- To enhance safety during fast traverse, the Z-axis detector unit incorporates a safety device (Automatic Stop-On-Collision Mechanism).
- The detector unit can be extended to avoid interference between the drive unit and workpiece. The measuring range is shifted to the left by 2.76" (70mm).

- Incorporation of an ABS scale in the Z2 axis eliminates the need for origin point re-setting conventionally required for every step of repeated measurements over step or multiple sections.
- Small holes and inclined planes can be efficiently measured using the inclined X-axis drive unit and fine-feed handles on the X and Z2 axes.
- All detector and drive unit cables are housed inside the main unit to eliminate any risk of abrasion and guarantee trouble-free, high-speed operation.
- Orientation of the drive unit can be inclined by ±45°. This allows CS-3200 to measure an inclined surface quickly.

ABSOLUTE®
Absolute System Patented by MITUTOYO

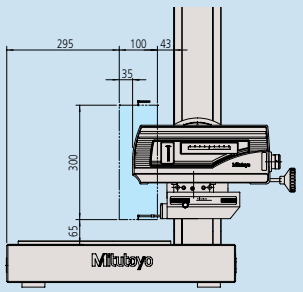
Technical Data: Contour Measurement

X1-axis	
Measuring range:	4" (100mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	0 - 3.1"/s (0 - 80mm/s) and manual
Measuring speed:	.00078 - .00787"/s (0.02 - 0.2mm/s) (surface roughness) 0.00078 - 0.0787"/s (0.02 - 2mm/s) (contour)
Measuring direction:	Forward / Backward
Traverse linearity:	8µin/4" (16µin/4") [0.2µm/100mm (0.4µm/100mm)] ( ): at the protruded detector position *with the X axis in horizontal orientation
Linear displacement accuracy (at 20°C):	± (32+10L)µin {±(0.8+0.01L)µm} * L = Drive length (mm)
Inclination range:	±45°
Z2-axis (column)	
Vertical travel:	12" (300mm)
Resolution:	39.4µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - .78"/s (0 - 20mm/s) and manual
Z1-axis (detector unit)	
Measuring resolution / range:	3µin/.2", .3µin/.02", .03µin/.002" (0.08µm/5mm, 0.008µm/0.5mm, 0.0008µm/0.05mm)
Measurement method:	Differential inductance method
Linear displacement Accuracy (at 20°C)	±(60+20H)µin ±(1.5+2H/100)µm *H: Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Downward
Measuring force:	0.75mN
Traceable angle:	Ascent: 65°, descent: 65° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 2µm, diamond
Base size (W x H):	23.6 x 17.7" (600 x 450mm)
Base material:	Granite
Mass:	309 lbs (140kg) (main unit)
Power supply:	100 – 240VAC ±10%, 50/60Hz
Power consumption:	400W (main unit only)

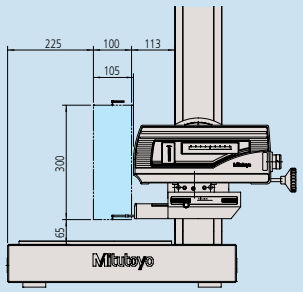
Protrusion of Detector Position

Normal detector position

Unit: mm



When detector is maximally extended
(Extended by 70mm from normal position)



Formtracer CS-3200

SERIES 525 — Form Measuring Instruments

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

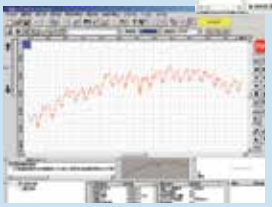
Software

FORMTRACEPAK6000

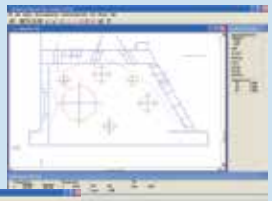
Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, you can create an original inspection certificate by setting the print format to suit your particular requirements.

Measuring instrument control

Contour analysis



Surface roughness analysis



Design data creation (CAD file import)

Contour verification

Inspection certificate creation

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation.

SPECIFICATIONS

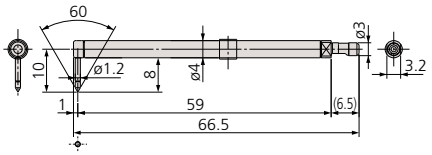
Model No.	CS-3200S4
Order No. (inch)	**525-411A**
X1-axis measuring range	4" (100mm)
Z2-axis vertical travel	12" (300mm)

Stylus

(Unit: inch (mm))

Standard stylus: No. 12AAD554

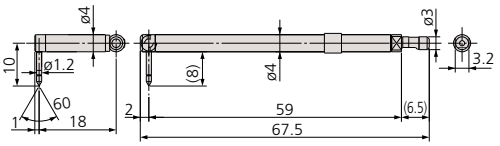
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .28" (7mm) max.

Eccentric stylus: No. 12AAD558

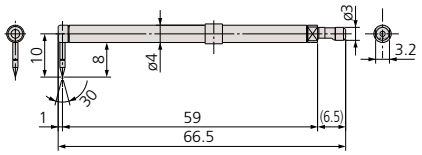
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable offset length: .60" (15mm)

Cone stylus: No. 12AAD552

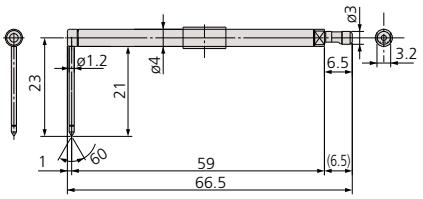
Tip radius: 25 µm
Tip angle: 30° cone
Tip material: Sapphire



For contour measurement
Measurable depth: .28" (7mm) max.

Deep Groove stylus: No. 12AAD560

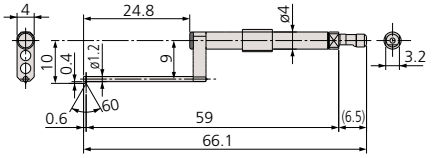
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .79" (20mm) max.

Small hole stylus: No. 12AAD556

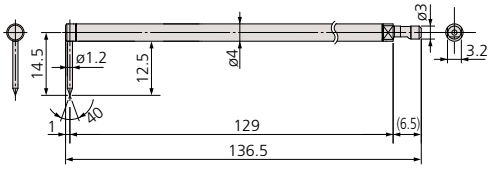
Tip radius: 2 µm
Tip angle: 60° cone
Tip material: Diamond



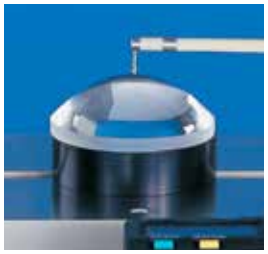
For contour/surface roughness measurement
Applicable hole: ø.08" (ø2mm) min.

2x-long stylus: No. 12AAD562

Tip radius: 5 µm
Tip angle: 40° cone
Tip material: Diamond



For contour/surface roughness measurement
Measurable depth: .39" (10mm) max.



Measuring lens

Measuring ball screw

Measuring bearing ring

Mitutoyo

Formtracer Extreme CS-5000CNC / CS-H5000CNC

SERIES 525 — CNC Form Measuring Instruments

CS-H5000CNC with personal computer system and software

* PC stand not included

Remote box

Wide range detector employing active control technology

FEATURES

- High-accuracy stylus-type CNC surface measuring instrument allows simultaneous measurement of surface roughness and form/contour.
- The X1 axis has a maximum drive speed of 1.57"/s (40 mm/s) and Z2 axis has a maximum drive speed of 7.87"/s (200 mm/s). This permits high-speed positioning that may result in a large increase in the throughput of multiple-profile / multiple-workpiece measurement tasks.
- A Mitutoyo Laser Holoscale is incorporated in the X1 axis and Z1 axis so that high resolution (X1 axis: 6.25nm, Z1 axis: 4nm/8nm) is achieved and batch measurement of form / contour and surface roughness can be made.
- The active control method is employed for the Z1-axis detector to implement a wide-range measurement capability wherein the variation in dynamic measuring force is restricted.
- Since the Z1-axis detector incorporates an anti-collision safety device, the detector unit will automatically stop even if its main body collides with a workpiece or fixture.
- For models with the α-axis, it is possible to perform continuous measurement over horizontal and inclined surfaces by power-tilting the X1 axis.
- For models with the Y-axis table, it is possible to expand the measuring range for multiple workpieces, etc., through positioning in the Y-axis direction.
- Supplied with the easy-to-operate Remote Box, the user can make any movement by selecting the required axis using the two joysticks. The current axis selection is easily identified by the icon on the key top.
- Uses USB for communicating with the Data Processing / Analysis Unit (optional).

Technical Data:

X1 axis

Measuring range:	8" (200mm)
Resolution:	0.25µin (0.00625µm)
Measurement method:	Laser Holoscale
Drive speed:	Max. 1.57"/s (40mm/s) (in CNC mode) 0 - 1.57"/s (0 - 40mm/s) (in joystick control mode)
Measuring speed:	.0008 - .008"/s (0.02 - 0.2mm/s) (surface roughness) .0008 - .08"/s (0.02 - 2mm/s) (form/contour)
Measuring direction:	Forward / Backward
Traverse linearity:	(4+1.5L)µin {(0.1+0.0015L)µm} with standard stylus (8+1.5L)µin {(0.2+0.0015L)µm} with 2X-long stylus
*Traverse linearity:	(2+3L)µin {(0.05+0.0003L)}µm with standard stylus (4+1.5L)µin {(0.1+0.0015L)}µm with 2X-long stylus
Linear displacement accuracy ±(20°C):	±(12+2L)µin {±(0.3+0.002L)µm}
*Linear displacement accuracy ±(20°C):	±(2.8+6.3+L)µin {±(0.16+0.001L)µm} L = Measured length inch (mm)

Z1 axis

Measuring range:	.47" (12mm) (with standard stylus) .94" (24mm) (with 2X-long stylus)
Resolution:	.16µin (0.004µm) (with standard stylus) .32µin (0.008µm) (with 2X-long stylus)
*Resolution:	.03µin (0.0008µm) (with standard stylus) .06µin (0.0016µm) (with 2X-long stylus)
Stylus up/down:	Arc movement
Measurement method:	Transmission-type laser linear encoder
Linear displacement accuracy (20°C):	±(12+120H)µin {±(0.3+I0.02HI)µm}
*Linear displacement accuracy (20°C):	±(2.8+120H)µin {±(0.07+I0.02HI)µm} H = Measured height inch (mm)
Measuring force:	4mN (with standard stylus) 0.75mN (with 2X-long stylus)
Traceable angle:	60° for ascent, 60° for descent (Depending on the workpiece surface condition)
Stylus tip: (ball stylus)	Radius: 5µm, angle: 40°, diamond (Radius: 0.25mm, sapphire)
Face of stylus:	Downward

Z2 axis (column unit)

Measuring range:	12" (300mm) (20" (500mm) high column type)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	Max. 7.87"/s (200mm/s) (in CNC mode) 0 - 1.97"/s (0 - 50mm/s) (in joystick control mode)
Base size (W x D):	29.5 x 23.6" (750 x 600mm)
Base material:	Granite
Dimension (W x D x H):	31.5 x 24.4 39.4" (800 x 620 x 1000mm) 31.5 x 24.4 x 47.2" (800 x 620 x 1200mm: high column type)
Mass:	529 lbs (240kg) 551 lbs (250kg): high column type))

*CS-H5000CNC model in red.

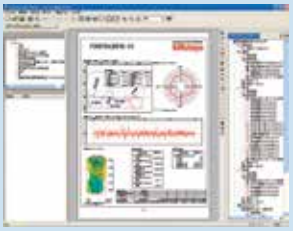
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Software

FORMTRACEPAK V5
Enables control of the optional motor-driven Y-axis table and rotary table for realizing efficient measurement automation. You can also perform contour evaluation that allows free analysis of level differences, angle, pitch, area and other characteristics based on surface roughness data. In addition, analysis results can be saved in the "html", "mhtml" or pdf format which allows Internet Explorer or MS-Word compatibility, allowing PC without layout editing programs to view analysis results.

Contour Measurement and Surface Roughness Measurement Screen

Report Layout Screen



ASLPAK (optional software)
Aspherical lens analysis program recommended to be used with CS-H5000CNC and CS-5000CNC models. To make full use of software functions, optional accessories such as y-axis table, 3DALT and theta θ-1 table are required. The functions can be restricted without the optional accessories.

Formtracer Extreme CS-5000CNC / CS-H5000CNC

SERIES 525 — CNC Form Measuring Instruments

SPECIFICATIONS

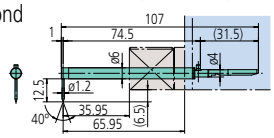
Model No.	CS-5000CNC	CS-5000CNC
Order No. (100V - 120V)	**525-727-13**	**525-729-13**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	12" (300mm)
Y-axis table unit	—	Installed
α-axis unit	Installed	Installed

Model No.	CS-5000CNC	CS-5000CNC
Order No. (100V - 120V)	**525-747-13**	**525-749-13**
X1-axis measuring range	8" (200mm)	8" (200mm)
Z2-axis vertical travel	20" (500mm)	20" (500mm)
Y-axis table unit	—	Installed
α-axis unit	Installed	Installed

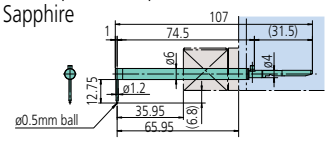
Model No.	CS-H5000CNC	CS-H5000CNC	CS-H5000HCNC	CS-H5000HCNC
Order No. (100V - 120V)	**525-776-13**	**525-777-13**	**525-706-13**	**525-707-13**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Z2-axis vertical travel	12" (300mm)	12" (300mm)	20" (500mm)	20" (500mm)
Y-axis table unit	—	Installed	—	Installed

Stylus

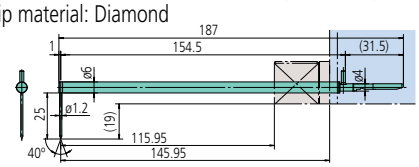
12AAD543*1**:** Standard-length stylus (tip radius: 5µm)
12AAJ037*2**:** For CS-H5000CNC (tip radius: 5µm)
Tip material: Diamond



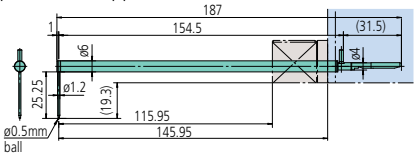
12AAD544*1*2**:** Standard-length ball stylus (tip radius: 5µm)
Tip material: Sapphire



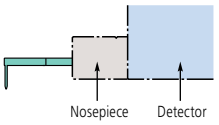
12AAD545*1**:** Double-length stylus (tip radius: 5µm)
12AAJ039*2**:** For CS-H5000CNC (tip radius: 5µm)
Tip material: Diamond



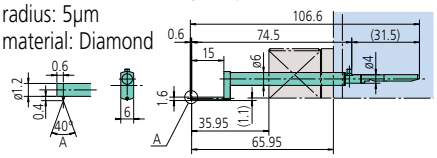
12AAD546*1*2**:** Double-length ball stylus
Tip material: Sapphire



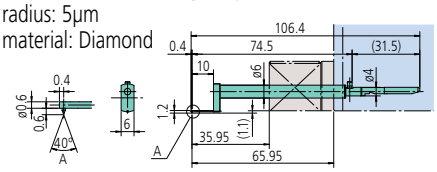
*1: Standard accessory of CS-5000CNC
*2: Standard accessory of CS-H5000CNC



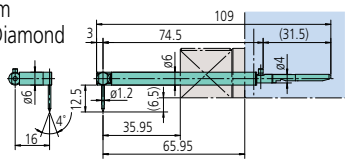
12AAD651: Standard-length stylus for small hole
Tip radius: 5µm
Tip material: Diamond



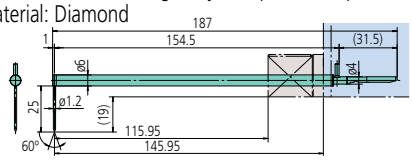
12AAD652: Standard-length stylus for extra-small hole
Tip radius: 5µm
Tip material: Diamond



12AAD653: Standard-length eccentric stylus
Tip radius: 5µm
Tip material: Diamond



12AAJ041*2**:** Double-length stylus (tip radius: 2µm)
Tip material: Diamond



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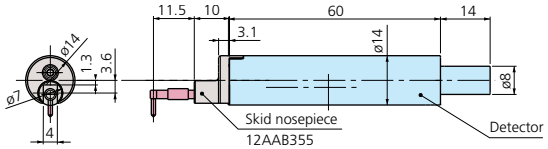
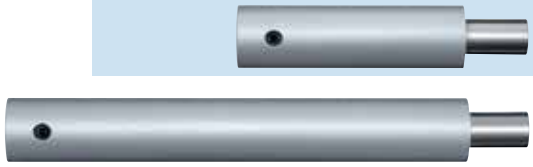
Optional Styli for Surface Roughness Measurement

Compatible with SJ-410, SJ-500, SV-2100, SV-3100, SV-3000CNC, SV-M3000CNC, SV-C3200, SV-C4500 Series



Detector (0.75mN): **178-396-2**
Detector (4mN): **178-397-2**

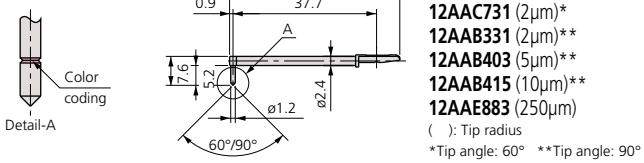


Extension rods
(12AAG202: 50mm, 12AAG203: 100mm)

Styli

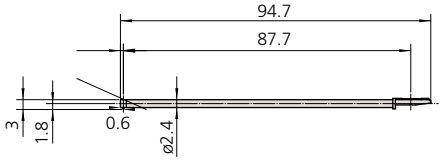
Unit: mm

Standard stylus



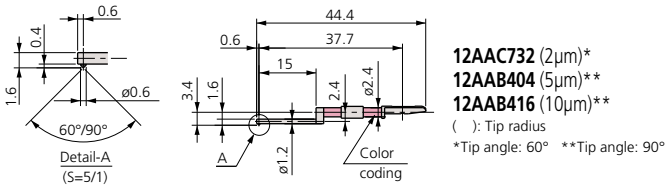
12AAE882 (1µm)*
12AAE924 (1µm)**
12AAC731 (2µm)*
12AAB331 (2µm)**
12AAB403 (5µm)**
12AAB415 (10µm)**
12AAE883 (250µm)
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

2X long for deep hole



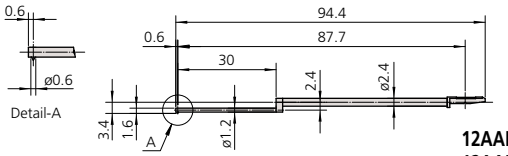
12AAE898 (2µm)*
12AAE914 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole



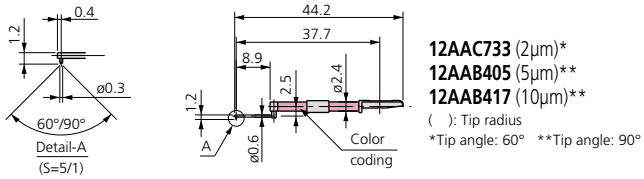
12AAC732 (2µm)*
12AAB404 (5µm)**
12AAB416 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole/2X long for deep hole



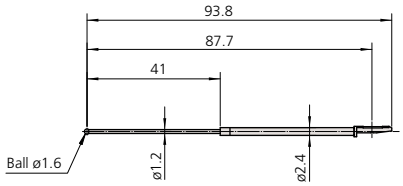
12AAE892 (2µm)*
12AAE908 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For extra-small hole



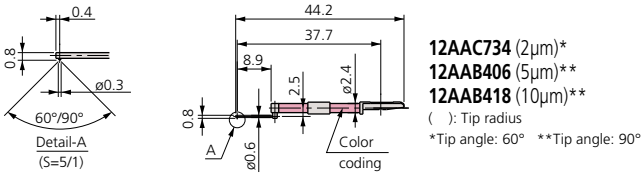
12AAC733 (2µm)*
12AAB405 (5µm)**
12AAB417 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small hole*2



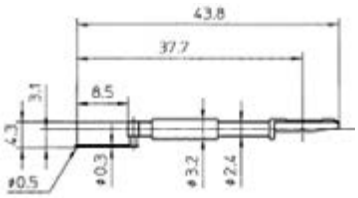
12AAE884 (0.8mm)
( ): Tip radius

For extra-minute hole



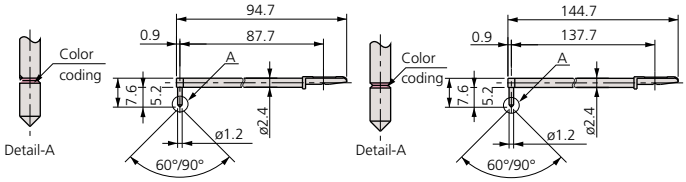
12AAC734 (2µm)*
12AAB406 (5µm)**
12AAB418 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For ultra-small hole *1*2



12AAJ662 (0.25mm)
( ): Tip radius

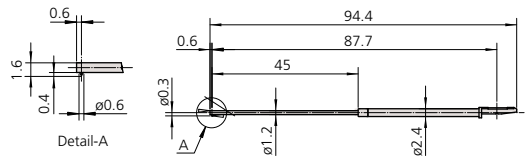
For deep hole (2X long and 3X long)



2X stylus
12AAC740 (2µm)*
12AAB413 (5µm)**
12AAB425 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

3X stylus
12AAC741 (2µm)*
12AAB414 (5µm)**
12AAB426 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For small-slotted hole



12AAE938 (2µm)*
12AAE940 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

*1: For downward-facing measurement only
*2: Used for calibration, a standard step gauge (No.178-611, option) is also required.

Tip radius	1µm	2µm	5µm	10µm	250µm
Color coding	White	Black	No color	Yellow	No notch or color

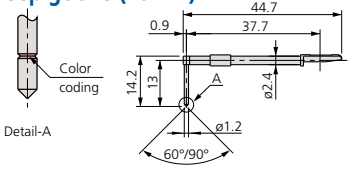
Optional Styli for Surface Roughness Measurement

Compatible with SJ-410, SJ-500, SV-2100, SV-3200, SV-3000CNC, SV-M3000CNC, SV-C3200, SV-C4500 Series

Styli

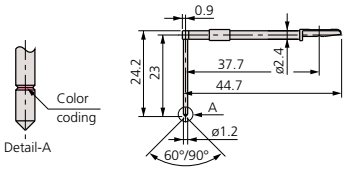
Unit: mm

For deep goove (10mm)



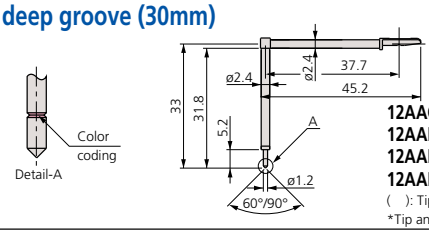
12AAC735 (2µm)*
12AAB409 (5µm)**
12AAB421 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (20mm)



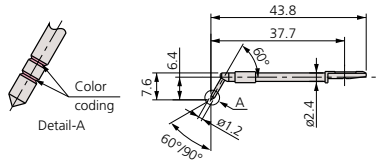
12AAC736 (2µm)*
12AAB408 (5µm)**
12AAB420 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (30mm)



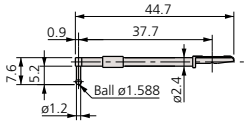
12AAC737 (2µm)*
12AAB335 (2µm)**
12AAB407 (5µm)**
12AAB419 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For gear tooth



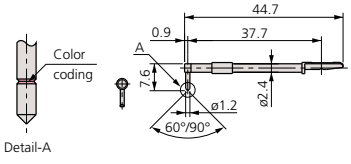
12AAB339 (2µm)*
12AAB410 (5µm)**
12AAB422 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For rolling circle waviness surface*2



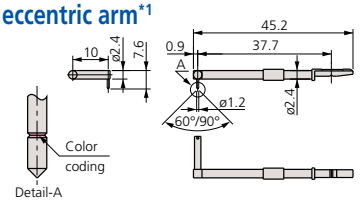
12AAB338 (0.8mm)
( ): Tip radius

For knife-edge detector



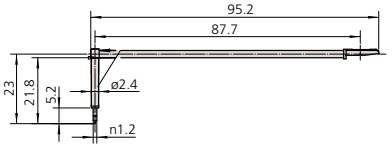
12AAC738 (2µm)*
12AAB411 (5µm)**
12AAB423 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For eccentric arm*1



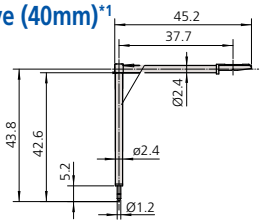
12AAC739 (2µm)*
12AAB412 (5µm)**
12AAB424 (10µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (20mm)*1/2X Long for deep hole



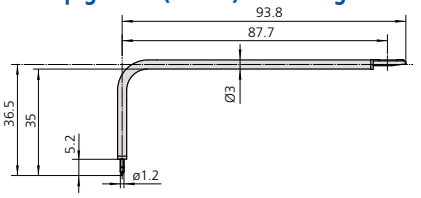
12AAE893 (2µm)*
12AAE909 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (40mm)*1



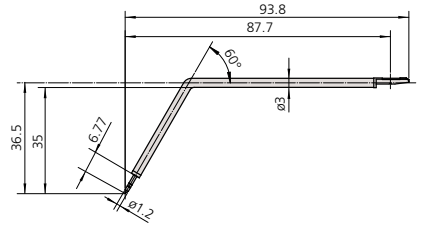
12AAE895 (2µm)*
12AAE911 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For deep groove (30mm)*1/2X Long for deep hole



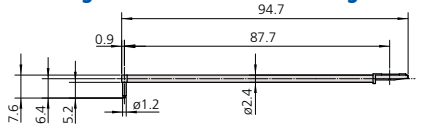
12AAE894 (2µm)*
12AAE910 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For gear tooth*1/2X Long for deep hole



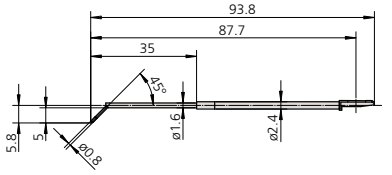
12AAE896 (2µm)*
12AAE912 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For rolling circle waviness*1/2X Long for deep hole*2



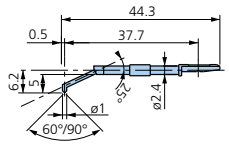
12AAE886 (0.25mm)
( ): Tip radius

For corner hole*1/2X Long for deep hole



12AAM601 (2µm)*
12AAM603 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

For bottom surface



12AAE899 (2µm)*
12AAE915 (5µm)**
( ): Tip radius
*Tip angle: 60° **Tip angle: 90°

Tip radius	1µm	2µm	5µm	10µm	250µm
Color coding	White	Black	No color	Yellow	No notch or color

*1: For downward-facing measurement only
*2: Used for calibration, a standard step gauge (No.178-611, option) is also required.

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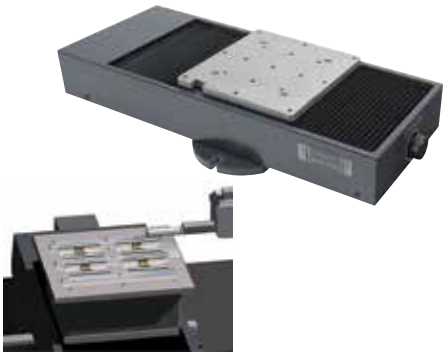
Optional Accessories for Automatic Measurement

Compatible with SV-3200, SV-C3200, SV-C4500, CS-3200 and CNC Models

Y-axis table*: 178-097

A Y-axis table for both positioning and capable of 3D surface roughness measurement when used withoptional software FTPK-PRO or MCubeMap.**

* Not supporting Y-axis measurements. ** Only for **178-096**



	178-097	178-096
Travel range	8" (200mm)	4" (100mm)
Resolution	1.97µin (0.05µm)	1.97µin (0.05µm)
Positioning accuracy	±3µm	±1µm
Drive speed	Max. 3.15"/s (80mm/s)	Max. .78"/s (20mm/s)
Maximum load	110 lbs (50kg)	33 lbs (50kg)
Mass	62 lbs (28kg)	68 lbs (31kg)

θ2-axis table: 178-078*

You can measure multiple points on a cylindrical workpiece and automate front/rear-side measurement.

* θ2-axis mounting plate (**12AAE718**) is required when directly installing on the base of the SV-3100.

Displacement	360°
Resolution	0.0072°
Maximum load (loading moment)	8.8 lbs (4kg) (343 N•cm or less)
Rotational speed	Max. 18°/s
Mass	11 lbs (5kg)

Quick chuck: 211-032

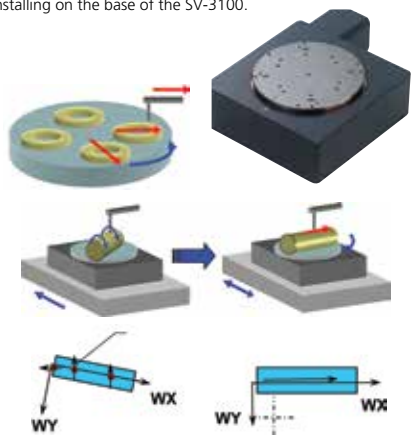
This chuck is useful when measuring small workpieces. You can easily clamp them with its knurled ring.

Retention range	Inner latch	OD: ø.04 - 1.42" (1 - 36mm)
	Inner latch	ID: ø.55 - 2.76" (14 - 70mm)
	Outer latch	OD: ø.04 - 2.95" (1 - 75mm)
Dimensions		ø 4.65 x 1.61" (118 x 41mm)
Mass		2.6 lbs (1.2kg)

θ1-axis table: 12AAD975*

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.

* θ1-axis mounting plate (**12AAE630**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.004°
Maximum load	26.5 lbs (12kg)
Rotational speed	Max. 10°/s
Mass	15 lbs (7kg)

Auto-leveling table: 178-087

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	15 lbs (7kg)
Table dimensions	5.1 x 3.9"(130 x 100mm)
Mass	7.7 lbs (3.5kg)

Micro-chuck: 211-031

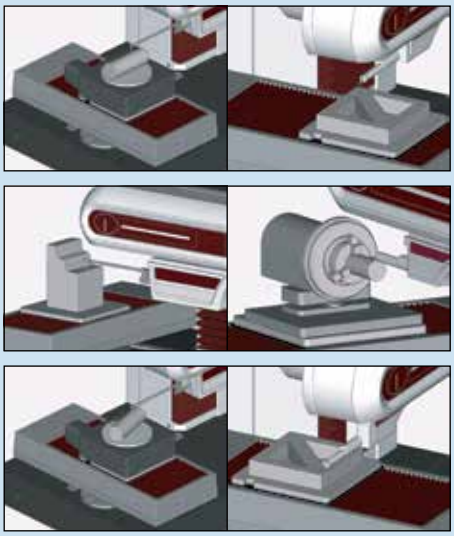
This chuck is suitable for clamping extra-small diameter workpieces (ø1mm or less), which cannot be retained with the centering chuck.

Retention range	OD: ø 0 - .06" (0 - 1.5mm)
Dimensions	ø 4.65 x 1.9" (118 x 48.5mm)
Mass	1.3 lbs (0.6kg)

Examples of optimal combinations of accessories for CNC models

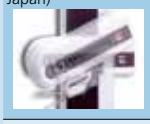
Optional accessory / Function	Y-axis Table	θ1 Table	θ2 Table
Automatic leveling	—	—	—
Automatic alignment (Patent registered: Japan)	●	●	—
Multiple workpiece batch measurement	▲	—	—
Measurement in the Y-axis direction	●	—	—
Oblique measurement of XY plane **	●	—	—
Outside 3D surface roughness measurement/evaluation **	●	—	—
Multiple-piece measurement in the Y-axis direction (Positioning in the Y-axis direction)	●	—	—
Multiple-piece measurement in the radius direction (Positioning in the rotating direction of XY plane)	▲	●	—
Tracking measurement in the Z-axis direction *	—	—	—
Inclined surface measurement in the X-axis direction	▲	—	—
Inclined hole inside measurement in the X-axis direction	▲	—	—
Multiple cylinder generatrix line measurement	▲	—	●
Measurement of both top and bottom surfaces	▲	—	●
Rotary positioning of large workpiece ***	—	—	—
Upward/downward and frontward/backward measurement of large workpiece ***	—	—	—

* : Applicable only to form/contour measurement
** : Applicable only to surface roughness measurement
*** : Applicable only for SV-M3000CNC

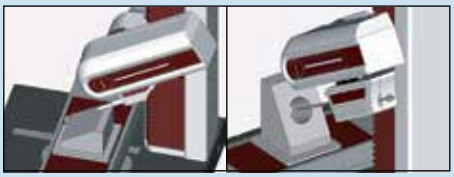


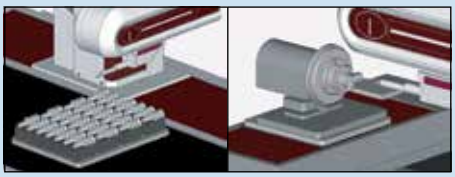
Optional Accessories for Surftest / Formtracer

Compatible with Desktop Models of Surftest and Formtracer

Drive unit tilting function (Patent pending: Japan)	Large θ Table	Rotary-type detector holder
		
●	—	—
▲	—	—
—	—	—
—	—	—
—	—	—
▲	—	—
—	—	—
—	—	—
—	—	—
●	—	—
●	—	—
—	—	—
—	—	—
—	●	—
—	—	●

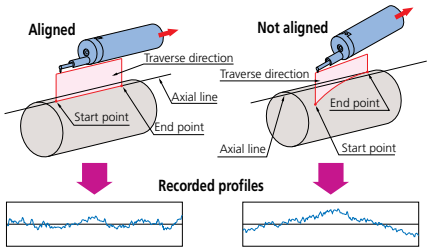
●: Essential ▲: Recommended
—: Not necessary





3-axis adjustment table

This table helps make the required alignment adjustments when measuring cylindrical surfaces. The corrections for the pitch angle and the swivel angle are determined from a preliminary measurement and the Digimatic micrometers are adjusted accordingly. A flat-surfaced workpiece also can be leveled with this table.



178-047

Leveling table

178-043-1 (mm), **178-053-1** (inch)
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- XY travel: ±12.5mm

Digital leveling table

178-042-1 (mm)
178-052-1 (inch)
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- XY travel: ±12.5mm

Leveling table

178-016
- Table top: 130 x 100mm
- Leveling range: ±1.5°
- Height: 40mm

Calibration stand *1

12AAM100

Calibration stand *2

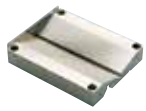
12AAG175

Calibration stand *3

12AAM309

V-block

998291
- Workpiece diameter: 1mm to 160mm
- Can be mounted on a leveling table



Precision vise

178-019
- Max. workpiece size: 36mm
- Can be mounted on a leveling table.

Cross-travel table

218-001 (mm),
218-011 (inch)
- Table top: 280 x 180mm
- XY travel: 100 x 50mm

Cross-travel table

218-041 (mm),
218-051 (inch)
- Table top: 280 x 152mm
- XY travel: 50 x 25mm

Rotary vise

218-003
- Two-slide jaw type.
- Max. workpiece size: ø60mm
- Minimum reading: 1°

Center support

172-142
- Max. workpiece dia.: 120mm
- 60mm riser is optional

Center support riser

172-143
- Used with a center support.
- Max. workpiece dia.: 240mm

Swivel center support

172-197
- Max. workpiece dia.: 80mm*
  *65mm when swiveled 10°
- Max. workpiece length: 140mm

Holder with clamp

176-107
- Used with a cross-travel table or rugged table.
- Max. workpiece height: 35mm

172-234 172-378

V-block with clamp

172-234, 172-378
- Used with a cross-travel table or rugged table.
- Max. workpiece dia.: 50mm (**172-234**), 25mm (**172-378**)

*1: Required for calibrating upward measurement of **CV-3200** series.
*2: Required for calibrating in bulk by mounting straight arm/small-hole stylus arm without using cross-travel table and Y-axis table.
*3: Required for calibrating in bulk by mounting straight arm/eccentric arm/small-hole stylus arm without using cross-travel table and Y-axis table.

Mitutoyo

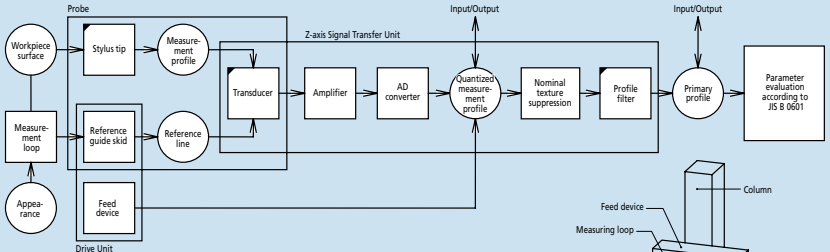
Quick Guide to Precision Measuring Instruments

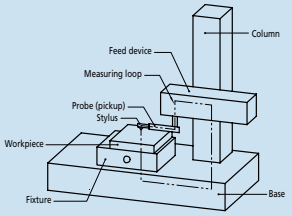
Surftest (Surface Roughness Testers)

- JIS B 0601:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Terms, definitions, and surface texture parameters
- JIS B 0632:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Metrological characterization of phase-correct filters
- JIS B 0633:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Rules and procedures for the assessment of surface texture
- JIS B 0651:2001 Geometric Product Specifications (GPS) –Surface Texture: Profile method– Nominal characteristics of contact (stylus) instruments

Nominal Characteristics of Contact (Stylus) Instruments

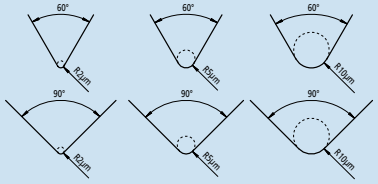
JIS B 0651: 2001 (ISO 3274: 1996)





Stylus Shape

A typical shape for a stylus end is conical with a spherical tip.
Tip radius: r_{tip} = 2 µm, 5 µm or 10 µm
Taper angle of cone: 60°, 90°
In typical surface roughness testers, the taper angle of the stylus end is 60° unless otherwise specified.



Static Measuring Force

Nominal radius of curvature of stylus tip: µm	Static measuring force at the mean position of stylus: mN	Tolerance on static measuring force variations: mN/µm
2	0.75	0.035
5	0.75 (4.0) Note 1	0.2
10		

Note 1: The maximum value of static measuring force at the average position of a stylus is to be 4.0mN for a special structured probe including a replaceable stylus.

Relationship between Cutoff Value and Stylus Tip Radius

The following table lists the relationship between the roughness profile cutoff value λc, stylus tip radius r_{tip}, and cutoff ratio λc/λs.

λc mm	λs µm	λc/λs	Maximum r_{tip} µm	Maximum sampling length µm
0.08	2.5	30	2	0.5
0.25	2.5	100	2	0.5
0.8	2.5	300	2 Note 1	0.5
2.5	8	300	5 Note 2	1.5
8	25	300	10 Note 2	5

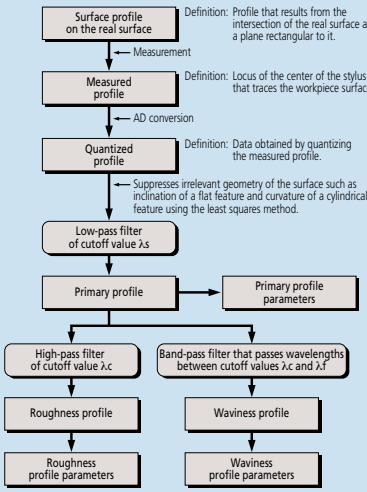
Note 1: For a surface with Ra>0.5µm or Rz>3µm, a significant error will not usually occur in a measurement even if r_{tip}= 5µm.
Note 2: If a cutoff value λs is 2.5µm or 8µm, attenuation of the signal due to the mechanical filtering effect of a stylus with the recommended tip radius appears outside the roughness profile pass band. Therefore, a small error in stylus tip radius or shape does not affect parameter values calculated from measurements. If a specific cutoff ratio is required, the ratio must be defined.

Metrological Characterization of Phase Correct Filters

JIS B 0632: 2001 (ISO 11562: 1996)

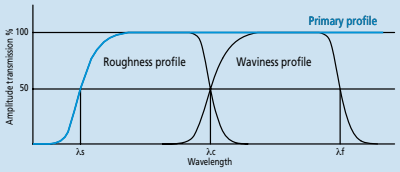
A profile filter is a phase-correct filter without phase delay (cause of profile distortion dependent on wavelength).
The weight function of a phase-correct filter shows a normal (Gaussian) distribution in which the amplitude transmission is 50% at the cutoff wavelength.

Data Processing Flow



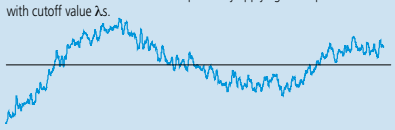
Surface Profiles

JIS B 0601: 2001 (ISO 4287: 1997)



Primary Profile

Profile obtained from the measured profile by applying a low-pass filter with cutoff value λs.

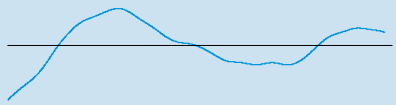


Roughness Profile

Profile obtained from the primary profile by suppressing the longer wavelength components using a high-pass filter of cutoff value λc.

Waviness Profile

Profile obtained by applying a band-pass filter to the primary profile to remove the longer wavelengths above λf and the shorter wavelengths below λc.



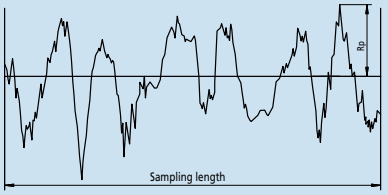
Definition of Parameters

JIS B 0601 : 2001 (ISO 4287 : 1997)

Amplitude Parameters (peak and valley)

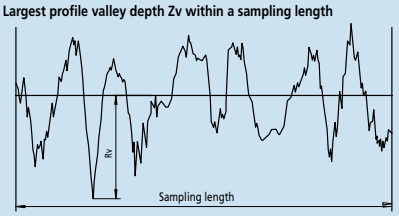
Maximum peak height of the primary profile Pp
Maximum peak height of the roughness profile Rp
Maximum peak height of the waviness profile Wp

Largest profile peak height Zp within a sampling length



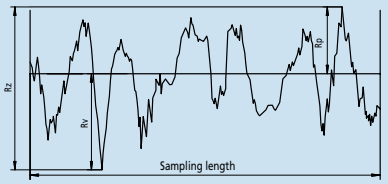
Maximum valley depth of the primary profile Pv
Maximum valley depth of the roughness profile Rv
Maximum valley depth of the waviness profile Wv

Largest profile valley depth Zv within a sampling length



Maximum height of the primary profile Pz
Maximum height of the roughness profile Rz
Maximum height of the waviness profile Wz

Sum of height of the largest profile peak height Zp and the largest profile valley depth Zv within a sampling length

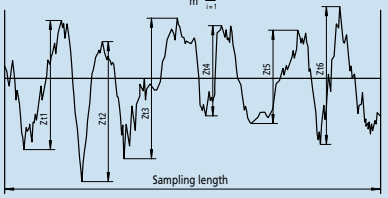


In Old JIS and ISO 4287-1: 1984, Rz was used to indicate the "ten point height of irregularities." Care must be taken because differences between results obtained according to the existing and old standards are not always negligibly small. (Be sure to check whether the drawing instructions conform to existing or old standards.)

Mean height of the primary profile elements Pc
Mean height of the roughness profile elements Rc
Mean height of the waviness profile elements Wc

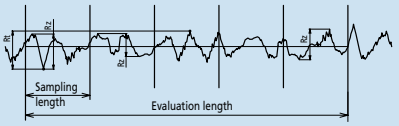
Mean value of the profile element heights Zt within a sampling length

$$Pc, Rc, Wc = \frac{1}{m}\sum_{i=1}^{m} Zt_i$$



Total height of the primary profile Pt
Total height of the roughness profile Rt
Total height of the waviness profile Wt

Sum of the height of the largest profile peak height Zp and the largest profile valley depth Zv within the evaluation length



Amplitude Parameters (average of ordinates)

Arithmetical mean deviation of the primary profile Pa
Arithmetical mean deviation of the roughness profile Ra
Arithmetical mean deviation of the waviness profile Wa

Arithmetic mean of the absolute ordinate values Z(x) within a sampling length

$$Pa, Ra, Wa = \frac{1}{l}\int_0^l |Z(x)|dx$$

with l as lp, lr, or lw according to the case.

Root mean square deviation of the primary profile Pq
Root mean square deviation of the roughness profile Rq
Root mean square deviation of the waviness profile Wq

Root mean square value of the ordinate values Z(x) within a sampling length

$$Pq, Rq, Wq = \sqrt{\frac{1}{l}\int_0^l Z^2(x)dx}$$

with l as lp, lr, or lw according to the case.

Skewness of the primary profile Psk
Skewness of the roughness profile Rsk
Skewness of the waviness profile Wsk

Quotient of the mean cube value of the ordinate values Z(x) and the cube of Pq, Rq, or Wq, respectively, within a sampling length

$$Rsk = \frac{1}{Rq^3}\left[\frac{1}{lr}\int_0^{lr} Z^3(x)dx\right]$$

The above equation defines Rsk. Psk and Wsk are defined in a similar manner. Psk, Rsk, and Wsk are measures of the asymmetry of the probability density function of the ordinate values.

Kurtosis of the primary profile Pku
Kurtosis of the roughness profile Rku
Kurtosis of the waviness profile Wku

Quotient of the mean quartic value of the ordinate values Z(x) and the fourth power of Pq, Rq, or Wq, respectively, within a sampling length

$$Rku = \frac{1}{Rq^4}\left[\frac{1}{lr}\int_0^{lr} Z^4(x)dx\right]$$

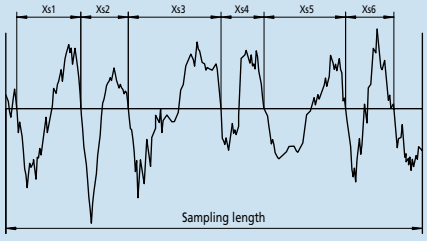
The above equation defines Rku. Pku and Wku are defined in a similar manner. Pku, Rku, and Wku are measures of the sharpness of the probability density function of the ordinate values.

Spacing Parameters

Mean width of the primary profile elements PSm
Mean width of the roughness profile elements RSm
Mean width of the waviness profile elements WSm

Mean value of the profile element widths Xs within a sampling length

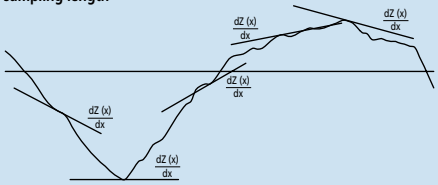
$$PSm, RSm, WSm = \frac{1}{m}\sum_{i=1}^{m} X_{si}$$



Hybrid Parameters

Root mean square slope of the primary profile PΔq
Root mean square slope of the roughness profile RΔq
Root mean square slope of the waviness profile WΔq

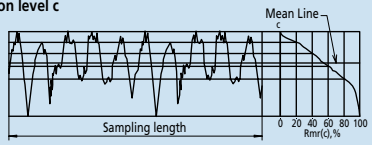
Root mean square value of the ordinate slopes dZ/dX within a sampling length



Curves, Probability Density Function, and Related Parameters

Material ratio curve of the profile (Abbott-Firestone curve)

Curve representing the material ratio of the profile as a function of section level c



Material ratio of the primary profile Pmr(c)
Material ratio of the roughness profile Rmr(c)
Material ratio of the waviness profile Wmr(c)

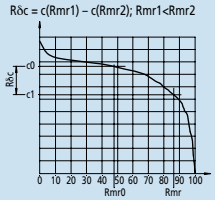
Ratio of the material length of the profile elements Ml(c) at a given level c to the evaluation length

$$Pmr(c), Rmr(c), Wmr(c) = \frac{Ml(c)}{ln}$$

Section height difference of the primary profile Pdc
Section height difference of the roughness profile Rdc
Section height difference of the waviness profile Wdc

Vertical distance between two section levels of a given material ratio

$R\delta c = c(Rmr1) - c(Rmr2);\ Rmr1<Rmr2$



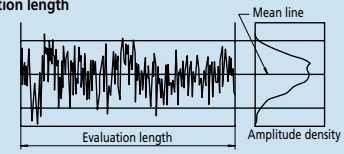
Relative material ratio of the primary profile Pmr
Relative material ratio of the roughness profile Rmr
Relative material ratio of the waviness profile Wmr

Material ratio determined at a profile section level Rδc (or Pδc or Wδc), related to the reference section level c0

Pmr, Rmr, Wmr = Pmr(c1), Rmr(c1), Wmr(c1)
where c1 = c0 – Rδc(Rδc, Wδc)
c0 = c(Pm0, Rmr0, Wmr0)

Probability density function
(profile height amplitude distribution curve)

Sample probability density function of the ordinate Z(x) within the evaluation length

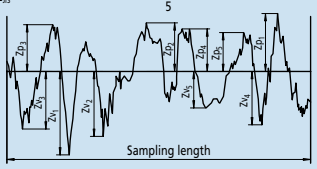


JIS Specific Parameters

Ten-point height of irregularities, Rz_{JIS}

Sum of the absolute mean height of the five highest profile peaks and the absolute mean depth of the five deepest profile valleys, measured from the mean line within the sampling length of a roughness profile. This profile is obtained from the primary profile using a phase-correct band-pass filter with cutoff values of lc and ls.

$$Rz_{JIS} = \frac{|Zp_1+Zp_2+Zp_3+Zp_4+Zp_5| + |Zv_1+Zv_2+Zv_3+Zv_4+Zv_5|}{5}$$



Symbol	Used profile
RzJIS82	Surface profile as measured
RzJIS94	Roughness profile derived from the primary profile using a phase-correct high-pass filter

Arithmetic mean deviation of the profile Ra_{75}

Arithmetic mean of the absolute values of the profile deviations from the mean line within the sampling length of the roughness profile (75%). This profile is obtained from a measurement profile using an analog high-pass filter with an attenuation factor of 12db/octave and a cutoff value of λc.

$$Ra_{75} = \frac{1}{ln}\int_0^{ln} |Z(x)|dx$$

Sampling Length for Surface Roughness Parameters

JIS B 0633: 2001 (ISO 4288: 1996)

Table 1: Sampling lengths for aperiodic profile roughness parameters (Ra, Rq, Rsk, Rku, RΔq), material ratio curve, probability density function, and related parameters

Ra μm	Sampling length lr mm	Evaluation length ln mm
(0.006)<Ra≤0.02	0.08	0.4
0.02 <Ra≤0.1	0.25	1.25
0.1 <Ra≤2	0.8	4
2 <Ra≤10	2.5	12.5
10 <Ra≤80	8	40

Table 2: Sampling lengths for aperiodic profile roughness parameters (Rz, Rv, Rp, Rc, Rt)

Rz Rz1max μm	Sampling length lr mm	Evaluation length ln mm
(0.025)<Rz, Rz1max≤0.1	0.08	0.4
0.1 <Rz, Rz1max≤0.5	0.25	1.25
0.5 <Rz, Rz1max≤10	0.8	4
10 <Rz, Rz1max≤50	2.5	12.5
50 <Rz, Rz1max≤200	8	40

1) Rz is used for measurement of Rz, Rv, Rp, Rc, and Rt.
2) Rzlmax only used for measurement of Rzlmax, Rvlmax, Rplmax, and Rclmax.

Table 3: Sampling lengths for measurement of periodic roughness profile roughness parameters and periodic or aperiodic profile parameter Rsm

Rsm mm	Sampling length lr mm	Evaluation length ln mm
0.013 <Rsm≤0.04	0.08	0.4
0.04 <Rsm≤0.13	0.25	1.25
0.13 <Rsm≤0.4	0.8	4
0.4 <Rsm≤1.3	2.5	12.5
1.3 <Rsm≤4	8	40

Procedure for determining a sampling length if it is not specified

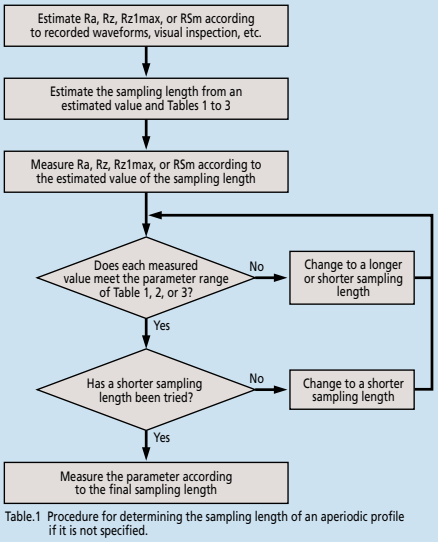


Table.1 Procedure for determining the sampling length of an aperiodic profile if it is not specified.

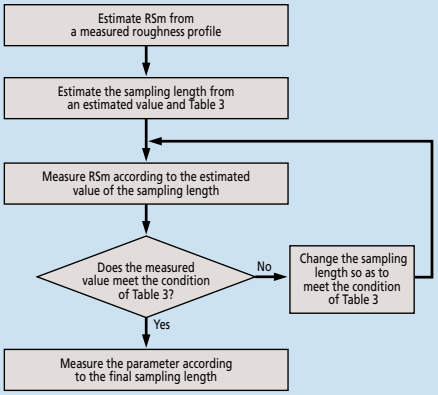


Table 2. Procedure for determining the sampling length of a periodic profile if it is not specified.

Mitutoyo

Contracer CV-2100

SERIES 218 — Contour Measuring Instruments

FEATURES

- Newly designed high-precision digital ARC scale improves the Z-axis accuracy and resolution.
- Quick-release grip handle allows for rapid traverse in column Z-axis for CV-2100M4.
- Key operation buttons are now mounted onto the X-axis drive unit, eliminating wired remote box.
- X-axis traverse speed has been greatly improved to 20mm/s allowing quick positioning and set-up time.
- New added function for automatic stylus up/down means high-volume repetitive measurements are now capable with part programming.
- Z-axis detector measuring range has been improved to 50mm for both models.
- CV-2100N4 model can be mounted to optional manual column stand or custom fixture supplied by end user.

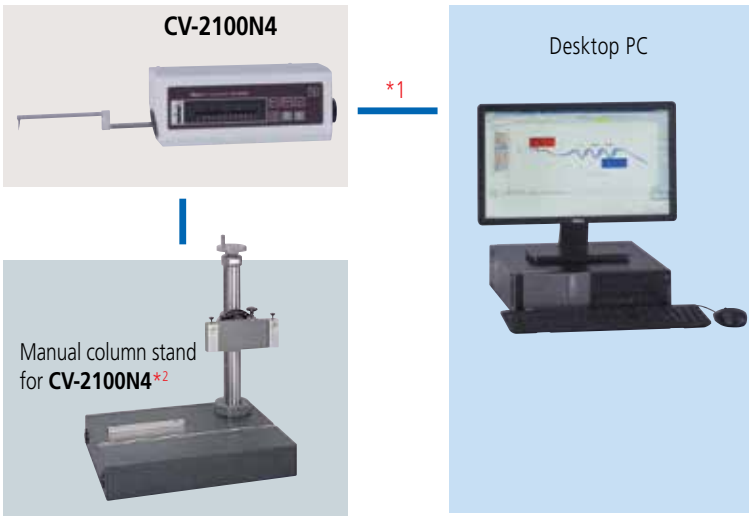
CV-2100M4 with personal computer system and software

Connected to a personal computer, the FORMTRACEPAK V5 contour analysis program provides various modes of measurement and analysis.
*Printer not included


Centralized front control panel


Quick-vertical motion handle


X-axis jog shuttle



*1: If the **CV-2100N4** is operated without the dedicated manual stand, the measuring range of the Z-axis might be reduced, depending on the installation conditions. If you are considering using the **CV-2100N4** without the stand, contact your local Mitutoyo sales office for advice.

*2: Optional accessory **218-042** manual column stand

Technical Data

X1-axis
- Measuring range: 4" (100mm) (CV-2100)
- Resolution: 3.93µin (0.1µm)
- Measurement method: STVC-10Z
- Drive speed: 0-.79"/s (0-20mm/s)
- Measuring speed: .000787"/s, .2"/s (.02, 5mm/s)
- Measuring direction: Forward / Backward
- Traverse linearity: 98.4µin/4" (2.5µm/100mm) (CV-2100)
- Linear displacement: ±(100+20L)µin ±(2.5+2L/100)µm
  * L = Drive length (mm)
- Inclining range: ±45°

Z2-axis (column)
- Column type: Manual (M4 type)
- Vertical travel: 13.8" (350mm) (M4 type)

Z1-axis (detector unit)
- Measuring range: 2" (50mm)
- Resolution: 3.93µin (0.1µm)
- Measurement method: Digital arc scale
- Linear displacement: ±(100+100h)µin ±(2.5+l0.1Hl)µm
- Accuracy (at 20°C) *H: Measurement height from the horizontal position within ±1" (±25mm)
- Stylus up/down operation: Arc movement
- Face of stylus: Downward
- Measuring force: 30±10mN (3gf)
- Traceable angle: Ascent: 77°, descent: 87° (using the standard stylus provided and depending on the surface roughness)

Stylus tip: Radius: 25µm, carbide tip
Base size (W x H): 23.6 x 17.7" (600 x 450mm)
Base material: Granite
Mass: 321 lbs (145.8kg) (CV-2100M4),
Power supply: 100 – 240VAC ±10%, 50/60Hz
Power consumption: 30W (main unit only)

Highly accurate arc scale

This scale directly tracks the arc trajectory of the stylus tip so that the most accurate compensation can be applied to the scale output, which leads to higher accuracy and resolution.

Contracer CV-2100

SERIES 218 — Contour Measuring Instruments

Optional Accessories

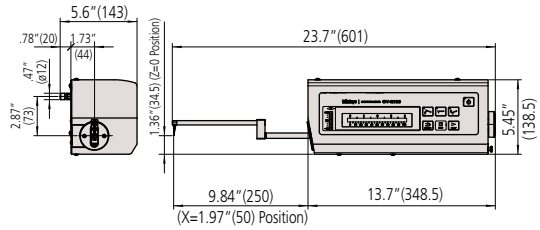
218-042: Column stand for CV-2100N4 (vertical travel: 250mm, inclination: ±45°)
218-001: Cross-travel table (XY range: 100 x 50mm)
218-011: Cross-travel table (XY range: 4″ x 2")
218-041: Cross-travel table (XY range: 50 x 25mm)
218-051: Cross-travel table (XY range: 2″ x 1")
218-002: Rugged table
176-107: Holder with clamp
218-003: Rotary vise (heavy-duty type)
172-144: Rotary vise
172-234: V-block with clamp (Max. workpiece dia.: 50mm)
172-378: V-block with clamp (Max. workpiece dia.: 25mm)
172-197: Swivel center support
172-142: Center support
172-143: Center support riser
998862: Pin gage unit for calibration (mm)
998861: Pin gage unit for calibration (inch)
———: Arms and styli (See page J-32/33.)
12AAG175: Calibration table
178-047: 3-axis adjustment table

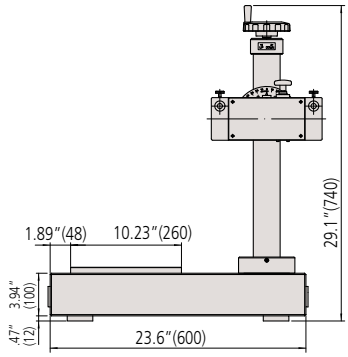
SPECIFICATIONS

Model		CV-2100M4	CV-2100N4
Order No.		**218-643A**	**218-623A**
Measurement range	X-axis	4"(100mm)	
	Z1-axis (detector unit)	2"(50mm)	
Z2-axis (column) travel range		13.8"(350mm)	—
X-axis inclination angle		±45°	—
Resolution	X-axis	3.93µin (0.1µm)	
	Z1-axis	3.93µin (0.1µm)	
Drive method	X-axis	Motorized drive 0 - 0.79in/s (0 - 20mm/s)	
	Z2-axis (column)	Manual (quick up-and-down motion, fine feed)	—
Measuring speed		.00078 - .2"/sec (0.02 - 5mm/s)	
Linearity accuracy (X-axis horizontal orientation)		98.4µin/4in (2.5µm/100mm)	
Accuracy (20°C)	X-axis	±(100+20L) µin [±(2.5+0.02L) µm)] L = Measurement Length (mm)	
	Z1-axis	±(100+|100H|µin) [±(2.5+|0.1H|) µm] H = Measurementt height from horizontal position within 1"(±25mm)	
Measurement direction		Forward / Backward	
Measurement surface direction		Downward	
Measuring force		(3gf) (30±10mN)	
Stylus traceable angle (Standard accessory stylus)		Ascent 77°, Descent 87° (Depends on the surface condition)	
External dimensions (W×D×H)		29.3 x 17.7 x 34.8" (745×450×885mm)	25.6 x 5.63 x 5.45" (651×143×138.5mm)
Mass		321.43 lbs (145.8 kg)	12.78 lbs (5.8 kg)

DIMENSIONS

CV-2100N4

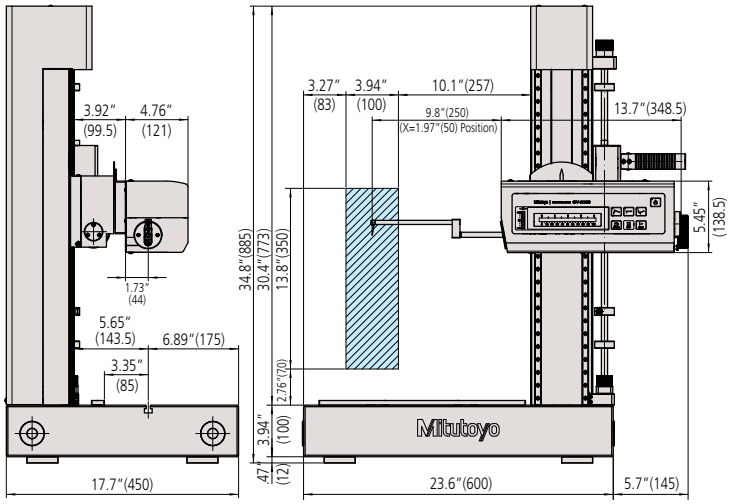




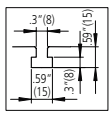
Optional Manual Column Stand for CV-2100N4

CV-2100M4

Unit: inch(mm)



Measuring area



T-groove dimensions (**CV-2100M4**)

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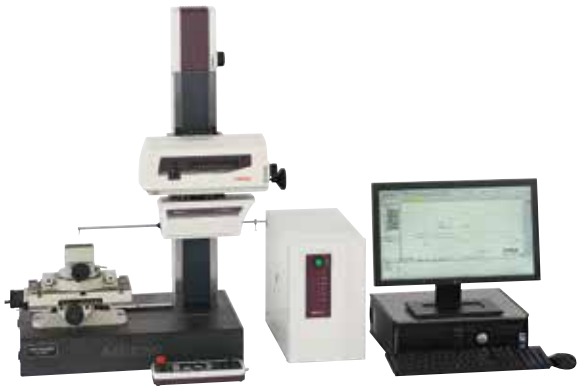
Contracer CV-3200 / CV-4500

SERIES 218 — Contour Measuring Instruments

CV-3200L4 (with options)



CV-3200S4 with personal computer system and software

CV-3200 FEATURES

- Dramatically increased drive speed (X axis: 80 mm/s, Z2 axis: 20 mm/s) further reduces total measurement time.
- In order to maintain the traverse linearity specification for an extended period of time, Mitutoyo has adopted highly rigid ceramic guides that combine the characteristics of smallest secular change and remarkable resistance to abrasion.
- With the support for a wide range of optional peripherals designed for use with the CNC models enables simplified CNC measurement.
- The drive unit (X-axis) and column (Z2-axis) are equipped with a high-accuracy linear encoders (ABS type on Z2-axis). This improves reproducibility of continuous automatic measurement of small holes in the vertical direction and repeated measurement of parts which are difficult to position.
- A newly designed straight arm reduces interference on the workpiece and expands the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.
- X1-axis accuracy: ±(0.8+0.01L)µm*
  Z1-axis accuracy: ±(1.6+l2Hl/100)µm
  Designed to handle workpieces calling for high accuracy.

* CV-3200S4, H4, W4 types, L = Drive length, H = Measurement height (mm)

With the addition of a new function for continuously measuring top and bottom faces, the variable measuring force function has become more useful, enabling a wide variety of efficient, high-precision measurements.

CV-4500 FEATURES

- When combined with the double cone-end stylus (a new product with diametrically opposed contact points), the instrument can continuously measure in the upward and downward directions without the need to change the arm orientation or reset the workpiece fixturing.
- The measuring force can be switched among five levels (upward and downward) from the data-processing program (Formtracepak).
- High-precision and high-speed drive has been achieved, significantly improving measurement efficiency.
- A newly designed straight arm has reduced interference on the workpiece and expanded the measurement range in the Z1 axis (height) direction.
- One-touch mounting and removal of the arm.

Technical Data

X-axis

Measuring range:	4" (100mm) or 8" (200mm)
Resolution:	1.97µin (0.05µm)
Measurement method:	Reflective-type linear encoder
Drive speed:	3.15"/s (80mm/s) and manual
Measuring speed:	.0008 - .79"/s (0.02 - 20mm/s)*

*Recommended speed: under 5mm/s
If using higher speed, stylus tip may be chipped and/or accuracy may be worse, depending on surface condition.

Measuring direction:	Forward / Backward
Traverse linearity:	32µin/4", 80µin/8" (0.8µm/100mm, 2µm/200mm) *with the X axis in horizontal orientation
Linear displacement accuracy (at 20°C)	(31.5+10L)µin {±(.8+0.01L)µm} (CV-3200S4, H4, W4, L4) (32+10L)µin {±(0.8+0.01L)µm} (CV-4500S4, H4, W4, L4) (31.5+20L)µin {±(0.8+0.02L)µm} (CV-3200S8, H8, W8, L8) (32+20L)µin {±(0.8+0.02L)µm} (CV-4500S8, H8, W8, L8) * L = Drive length (mm)
Inclining range:	±45°

Z2-axis (column)

Vertical travel:	10" (300mm) or 20" (500mm)
Resolution:	39.4µin (1µm)
Measurement method:	ABSOLUTE linear encoder
Drive speed:	0 - 1.2"/s (0 - 30mm/s) and manual

Z1-axis (detector unit)

Measuring range:	±1.2" (±30mm)
Resolution:	1.57µin (.04µm) (CV-3200 series), .78µin (0.02µm) (CV-4500 series)
Measurement method:	Rotory arc encoder (CV-3200 series), (CV-4500 series)
Linear displacement Accuracy (at 20°C):	±(63+l20Hl)µin {±(1.4+l2Hl/100)µm} (CV-3200 series) ±(32+l20Hl)µin {±(0.8+l2Hl/100)µm} (CV-4500 series) *H: Measurement height from the horizontal position (mm)
Stylus up/down operation:	Arc movement
Face of stylus:	Upward/downward
Measuring force:	30mN (CV-3200)
Measuring force:	10, 20, 30, 40, 50mN (CV-4500) (Specified from the data-processing program Formtracepak)
Traceable angle:	Ascent: 77°, descent: 83° (using the standard stylus provided and depending on the surface roughness)
Stylus tip	Radius: 25µm, carbide tip
Base size (W x H):	17.7 x 23.6" (450 x 600mm) or 39.4 x 17.7" (1000 x 450mm)
Base material:	Granite
Power supply:	100 – 240VAC ±10%, 50/60Hz
Power consumption:	400W (main unit only)

Refer to Bulletin No. (2177) for more details.

Contracer CV-3200 / CV-4500

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SPECIFICATIONS

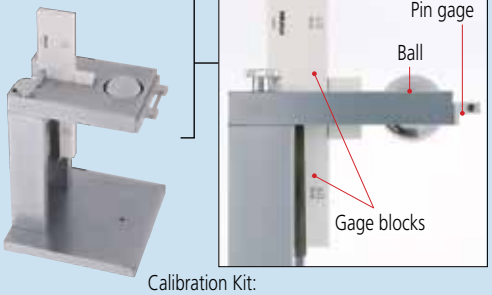
Model No.	CV-3200S4	CV-3200H4	CV-3200W4	CV-3200L4
Order No. (inch)	**218-491-10A**	**218-492-10A**	**218-493-10A**	**218-494-10A**
Model No.	CV-4500S4	CV-4500H4	CV-4500W4	CV-4500L4
Order No. (inch)	**218-451-10A**	**218-452-10A**	**218-453-10A**	**218-454-10A**
X1-axis measuring range	4" (100mm)	4" (100mm)	4" (100mm)	4" (100mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7" (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	29.2 x 17.7 x 35.6" (741 x 450 x 905mm)	29.2 x 17.7 x 43.5" (741 x 450 x 1105mm)	45.5 x 19 x 46.3" (1156 x 482 x 1176mm)	45.5 x 19.4 x 56.5" (1156 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Model No.	CV-3200S8	CV-3200H8	CV-3200W8	CV-3200L8
Order No. (inch)	**218-496-10A**	**218-497-10A**	**218-498-10A**	**218-499-10A**
Model No.	CV-4500S8	CV-4500H8	CV-4500W8	CV-4500L8
Order No. (inch)	**218-456-10A**	**218-457-10A**	**218-458-10A**	**218-459-10A**
X1-axis measuring range	8" (200mm)	8" (200mm)	8" (200mm)	8" (200mm)
Vertical travel	12" (300mm) power column	20" (500mm) power column	20" (500mm) power column	27.6" (700mm) power column
Granite base size (WxD)	23.6 x 17.7" (600 x 450mm)	23.6 x 17.7" (600 x 450mm)	39.4 x 17.7 (1000 x 450mm)	39.4 x 17.7" (1000 x 450mm)
Dimensions (main unit, WxDxH)	30.2 x 19 x 38" (767 x 482 x 966mm)	30.2 x 19 x46" (767 x 482 x 1166mm)	45.9 x 19 x 46.3" (1166 x 482 x 1176mm)	45.9 x 19.4 x 56.5" (1166 x 492 x 1436mm)
Mass (main unit)	309 lbs (140kg)	331 lbs (150kg)	485 lbs (220kg)	595 lbs (270kg)

Collective Calibration Function

- A dedicated calibration gage enables the user to calibrate the instrument for Z-axis gain, symmetry, stylus-tip radius, etc., in a single procedure.

Calibration kit for CV-4500 series



Calibration Kit:
CV-4500: **12AAQ491**
CV-3200: **12AAQ489** (not shown)

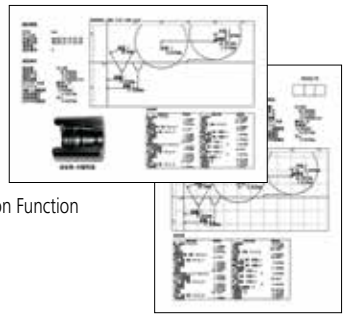
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Software

FORMTRACEPAK V5

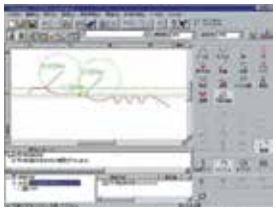
Measurement Control Screen

Profile Analysis Screen

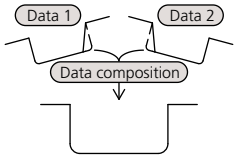


Report Creation Function

Automatic Circle/Line Application Function



Data Composition Function



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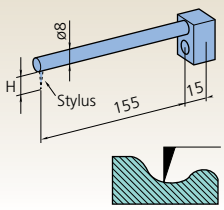
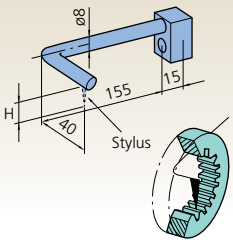
Optional Arms and Styli for Contour Measurement

For CV-2100

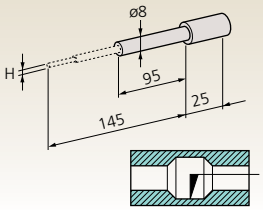
Straight type



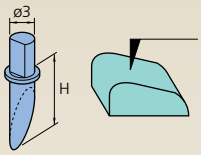
Eccentric type



For small-hole stylus

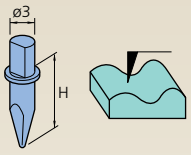


Single bevel



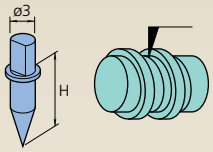
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

Cross ground



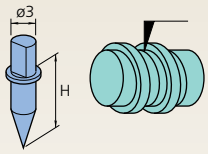
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Cone



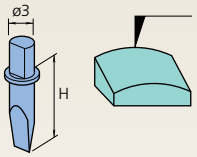
Tip angle: 30°/50°*
Tip radius: 25µm
Tip material: Carbide, Sapphire, Diamond*

Cone



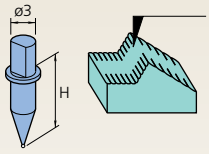
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Knife edge



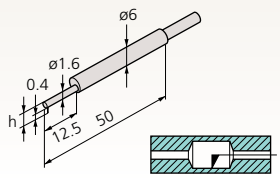
Tip angle: 20°
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

Ball



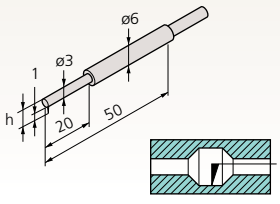
Ball dia: 1mm
Tip material: Carbide

Small hole: 932693 / 12AAE873



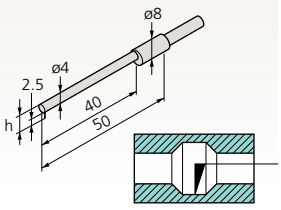
	932693	12AAE873
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

Small hole: 932694 / 12AAE874



	932694	12AAE874
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

Small hole: 932695 / 12AAE875



	932695	12AAE875
Tip shape:	Single bevel	Cone
Tip angle:	20°	30°
Tip radius:	25µm	25µm
Tip material:	Carbide	Carbide

List of Applicable Arms

Arm name	Order No.	Compatible stylus height
Straight type	935111	H = 6mm
	935112	H = 12mm
	935113	H = 20mm
	935114	H = 30mm
	935115	H = 42mm
Eccentric type	935116	H = 6mm
	935117	H = 12mm
	935118	H = 20mm
	935119	H = 30mm
	935120	H = 42mm
Small hole	935110	H = 0.4, 1, 2.5mm

List of Applicable Styli

Stylus name	Order No.	Stylus height
Single-bevel stylus carbide-tipped	354882	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	354887	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	12AAE865	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	354892	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
	354896	H = 42mm
Cone stylus carbide-tipped tip angle 30°	12AAA566	H = 6mm
	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	354897	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
Ball stylus carbide-tipped	354902	H = 6mm
	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm
Small-hole stylus carbide-tipped single bevel	932693	H = 2mm
	932694	H = 4mm
	932695	H = 6.5mm
Small-hole stylus carbide-tipped cone	12AAE873	H = 2mm
	12AAE874	H = 4mm
	12AAE875	H = 6.5mm

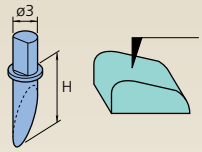
Optional Styli for Contour Measurement

CV-2100, CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC

List of Applicable Styli

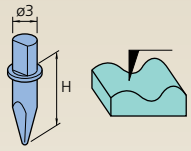
Stylus name	Order No.	Stylus height
Single-bevel cut stylus carbide-tipped	**354882**	H = 6mm
	354883	H = 12mm
	354884	H = 20mm
	354885	H = 30mm
	354886	H = 42mm
Cross-ground stylus carbide-tipped	**354887**	H = 6mm
	354888	H = 12mm
	354889	H = 20mm
	354890	H = 30mm
	354891	H = 42mm
Cone stylus carbide-tipped tip angle 20°	**12AAE865**	H = 6mm
	12AAE866	H = 12mm
	12AAE867	H = 20mm
	12AAE868	H = 30mm
	12AAE869	H = 42mm
Cone stylus sapphire tipped tip angle 30° *Diamond tipped *tip angle 50°	**354892**	H = 6mm
	354893	H = 12mm
	354894	H = 20mm
	355129*	H = 20mm
	354895	H = 30mm
	354896	H = 42mm
Cone stylus carbide-tipped tip angle 30°	**12AAA566**	H = 6mm
	12AAA567	H = 12mm
	12AAA568	H = 20mm
	12AAA569	H = 30mm
	12AAA570	H = 42mm
Knife-edge stylus carbide-tipped	**354897**	H = 6mm
	354898	H = 12mm
	354899	H = 20mm
	354900	H = 30mm
	354901	H = 42mm
Ball stylus carbide-tipped	**354902**	H = 6mm
	354904	H = 20mm
	354905	H = 30mm
	354906	H = 42mm

Single-bevel



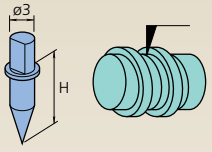
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

Cross-ground



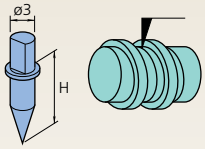
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Cone



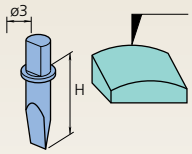
Tip angle: 30°/50°*
Tip radius: 25µm
Tip material: Carbide, Sapphire, Diamond*

Cone



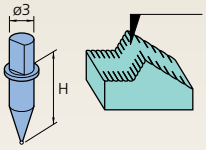
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

Knife edge



Tip angle: 20°
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

Ball



Ball dia: 1mm
Tip material: Carbide

• Any specified arm and stylus other than above listed can be custom-made for special order.

Arm and Stylus set: 12AAR588

Set for CV-4500 / SV-C4500 / SV-C4500CNC		
Part	**Part No.**	Part Description
Arm	**12AAQ762**	Eccentric arm
	12AAM103	Small-hole arm
Stylus	**354889**	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus
	12AAM096	Double-sided cone stylus
	12AAM097	Double-sided cone stylus
Integrated arm and stylus	**12AAM109**	Double-sided small hole arm stylus

Arm and Stylus set: 12AAR587

Set for CV-3200 /CV-4500 / SV-C3200 / SV-C4500 / SV-C4500CNC		
Part	**Part No.**	Part Description
Arm	**12AAQ762**	Eccentric arm
	12AAM103	Small-hole arm
Stylus	**354889**	Cross-ground stylus
	354882	Single-bevel cut stylus
	12AAA568	Cone stylus
	12AAM104	Small hole stylus
	12AAM106	Small hole stylus

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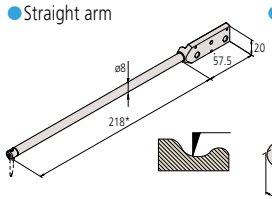
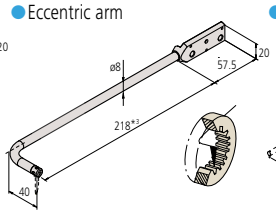
Optional Arms and Styli for Contour Measurement
For CV-3200, CV-4500, SV-C3200, SV-C4500 and SV-C4500CNC

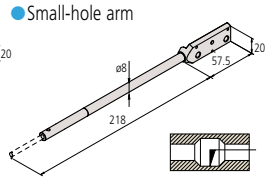
● Straight arm



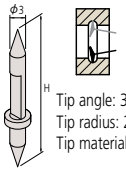
● Eccentric arm



● Small-hole arm

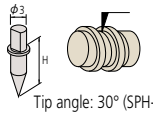


● Double cones



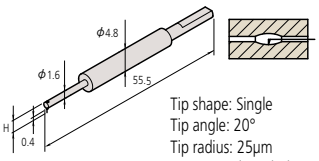
Tip angle: 30°
Tip radius: 25µm
Tip material: Carbide

● Cone



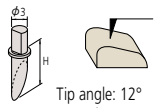
Tip angle: 30° (SPH-79: 50°)
Tip radius: 25µm
Tip material: Carbide,Sapphire
(SPH-79: Diamond)

● Small hole: **12AAM104**



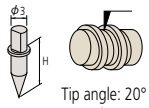
Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Single bevel



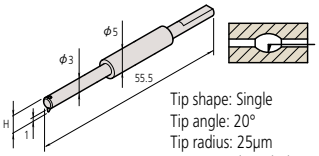
Tip angle: 12°
Tip radius: 25µm
Tip material: Carbide

● Cone



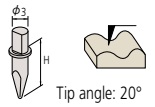
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Small hole: **12AAM105**



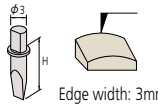
Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Cross ground



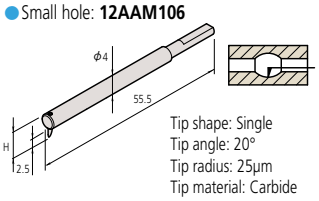
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Knife-edge



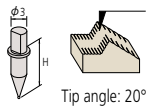
Edge width: 3mm
Tip radius: 25µm
Tip material: Carbide

● Small hole: **12AAM106**



Tip shape: Single
Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

● Cone Knife-edge Ball



Tip angle: 20°
Tip radius: 25µm
Tip material: Carbide

List of Applicable Arms

Arm Name	Order No.
Straight type	**12AAM101**
Eccentric type	**12AAQ762**
Small hole	**12AAM103**

*1: Standard accessory
*2: Stylus for **CV-4500** series
*3: One-sided cut stylus **SPH-71**(standard accessory) mounting

List of Applicable Styli

Stylus Name	Order No.	H (mm)
Double cones stylus *4	**12AAM095** *5	20
	12AAM096	32
	12AAM097	48
Single-bevel stylus carbide-tipped	**354882**	6
	354883	12
	354884 *6	20
	354885	30
	354886	42
Cross-ground stylus carbide-tipped	**354887**	6
	354888	12
	354889	20
	354890	30
	354891	42
Cone stylus sapphire-tipped tip angle 30°	**354892**	6
	354893	12
	354894	20
	354895	30
	354896	42
Cone stylus carbide-tipped tip angle 30°	**12AAA566**	6
	12AAA567	12
	12AAA568	20
	12AAA569	30
	12AAA570	42
Cone stylus carbide-tipped tip angle 20°	**12AAE865**	6
	12AAE866	12
	12AAE867	20
	12AAE868	30
	12AAE869	42
Cone stylus diamond-tipped tip angle 50°	**355129**	20
Knife-edge stylus carbide-tipped	**354897**	6
	354898	12
	354899	20
	354900	30
	354901	42
Ball stylus carbide-tipped	**354902**	6
	354904	20
	354905	30
	354906	42
Small-hole stylus *7	**12AAM104**	2
	12AAM105	4
	12AAM106	6.5

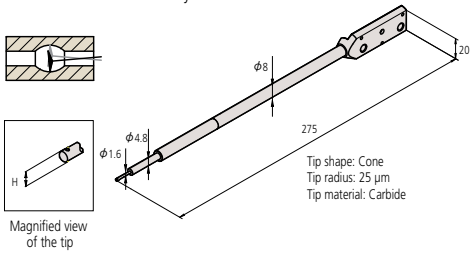
*4: Stylus for **CV-4500** series
*5: Standard accessory of **CV-4500** series
*6: Standard accessory of **CV-3200** series
*7: Styli **SPH-21, 22,** and **23** for **CV-3100/4100** series are not available.

Arm stylus (integrated arm and stylus) only for CV-4500

Arm stylus name	Order No.	H (mm)	Tip angle
Double small-hole arm stylus *8	**12AAT469**	2.4	20°
	12AAT470	5	20°
	12AAM108	2.4	30°
	12AAM109	5	30°
	12AAM110	9	30°

*8: Arm Stylus for **CV-4500, SV-C4500 and SV-C4500CNC series.** series

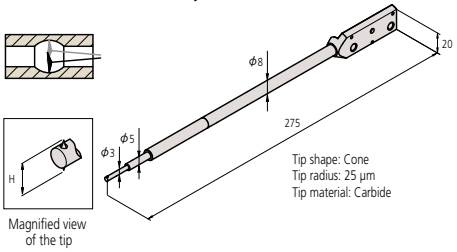
● Double small-hole arm stylus: **12AAM108/12AAT469**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

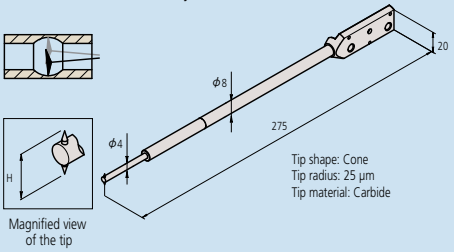
● Double small-hole arm stylus: **12AAM109/12AAT470**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

● Double small-hole arm stylus: **12AAM110**



Tip shape: Cone
Tip radius: 25 µm
Tip material: Carbide

Magnified view of the tip

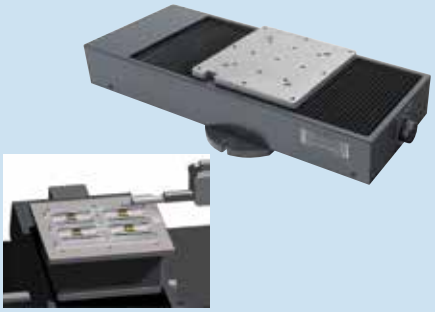
Optional Accessories for Automatic Measurement

Compatible with CV-3200, CV-4500 and CNC Models

Y-axis table*: 178-097

A Y-axis table for both positioning and capable of 3D surface roughness measurement when used withoptional software FTPK-PRO or MCubeMap.**

*Not supporting Y-axis measurements. ** Only for **178-096**

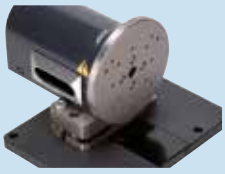


	178-097	178-096
Travel range	8" (200mm)	4" (100mm)
Resolution	1.97µin (0.05µm)	1.97µin (0.05µm)
Positioning accuracy	±3µm	±1µm
Drive speed	Max. 3.15"/s (80mm/s)	Max. .78"/s (20mm/s)
Maximum load	110 lbs (50kg)	33 lbs (50kg)
Mass	62 lbs (28kg)	68 lbs (31kg)

θ2-axis table: 178-078*

You can measure multiple points on a cylindrical workiece and automate front/rear-side measurement.

*θ2-axis mounting plate (**12AAE718**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.0072°
Maximum load (loading moment)	4kg (343N•cm or less)
Rotational speed	Max. 18°/s
Mass	11 lbs (5kg)

Quick chuck: 211-032

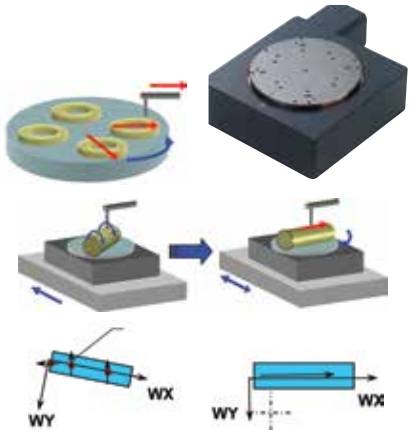
This chuck is useful when measuring small workpieces. You can easily clamp them with its knurled ring.

Retention range	Inner latch	OD: ø .04 - 1.42" (1 - 36mm)
	Inner latch	ID: ø .55 - 2.76" (14 - 70mm)
	Outer latch	OD: ø .04 - 2.95" (1 - 75mm)
Dimensions		ø 4.65 x 1.61" (118 x 41mm)
Mass		2.65 lbs (1.2kg)

θ1-axis table: 12AAD975*

For efficient measurement in the axial/transverse directions. When measuring a cylindrical workpiece, automatic alignment can be performed in combination with the Y-axis table.

*θ1-axis mounting plate (**12AAE630**) is required when directly installing on the base of the SV-3100.



Displacement	360°
Resolution	0.004°
Maximum load	26.5 lbs (12kg)
Rotational speed	Max. 10°/s
Mass	15 lbs (7kg)

Automatic-leveling table:178-087 (SV, CV, CS3200)
Automatic-leveling table:178-037 (CNC Models)

This is a stage that performs fully automatic leveling as measurement starts, freeing the user from this troublesome operation. Fully automatic leveling can be done quickly by anyone. In addition, the operation is easy and reliable.

Inclination adjustment angle	±2°
Maximum load	7kg
Table dimensions	130 x 100mm
Mass	7.7lbs (3.5kg)

Micro-chuck: 211-031

This chuck is suitable for clamping extra-small diameter workpieces (ø1 mm or less), which cannot be retained with the centering chuck.

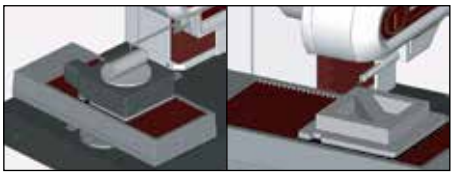
Retention range	OD: ø 0 -.06"(0 - 1.5mm)
Dimensions	ø 4.65" x 1.9" (118 x 48.5mm)
Mass	1.32 lbs (0.6kg)

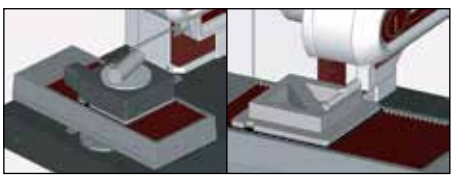
Examples of optimal combinations of accessories for CNC models

Optional accessory / Function	Y-axis Table	θ1 Table	θ2 Table
Automatic alignment (Patented: Japan)	●	●	—
Multiple workpiece batch measurement	▲	—	—
Multiple-piece measurement in the Y-axis direction (Positioning in the Y-axis direction)	●	—	—
Multiple-piece measurement in the radius direction (Positioning in the rotating direction of XY plane)	▲	●	—
Tracking measurement in the Z-axis direction *	—	—	—
Inclined surface measurement in the X-axis direction	▲	—	—
Inclined hole inside measurement in the X-axis direction	▲	—	—
Multiple cylinder generatrix line measurement	▲	—	●
Measurement of both top and bottom surfaces	▲	—	●
Rotary positioning of large workpiece **	—	—	—
Upward/downward and frontward/backward measurement of large workpiece **	—	—	—

* : Applicable only to form/contour measurement
** : Applicable only for SV-M3000CNC

▲ Recommended ● Essential — Not necessary





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Optional Accessories for Contracer / Formtracer

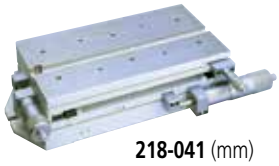
Compatible with Desktop Models of Contracer and Formtracer

Cross-travel table

- Table top: 11″ x 7″(280 x 180mm)
- XY travel: 3.94″ x 1.97″(100 x 50mm)
- Max. load 110 lbs (50kg)

218-001 (mm)
218-011 (inch)

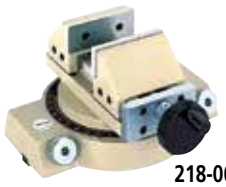
- Table top: 11″ x 5.98″(280 x 152mm)
- XY travel: 1.97″ x .98″(50 x 25mm)
- Max. load 44 lbs (20kg)



218-041 (mm)
218-051 (inch)

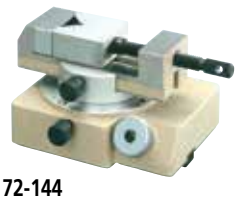
Rotary vise

- Two-slide jaw type.
- Max. workpiece size: ø 2.36″ (60mm)
- Minimum reading: 1°



218-003

- One-slide jaw type.
- Max. workpiece size: ø 2.36″ (60mm)
- Minimum reading: 5°



172-144

Leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- Height: 1.57″ (40mm)

178-016

V-block with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece diameter:1.97″(50mm)
- Max. workpiece diameter: .98″ (25mm)

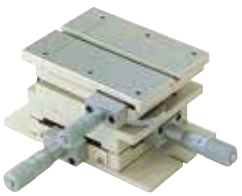
172-378
172-234

- Workpiece diameter: 0.039″ to 6.3″ (1mm to 160mm)
- Can be mounted on a leveling table

998291

Leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- XY travel: .49″ ±(12.5mm)



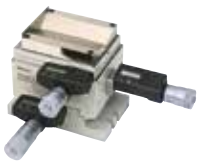
178-043-1 (mm)
178-053-1 (inch)

Digital leveling table

- Table top: 5.12″ x 3.94″(130 x 100mm)
- Leveling range: ±1.5°
- XY travel: .49″ ±(12.5mm)

178-042-1 (mm)

Three-axis adjustment table



178-047
(V-block not included)

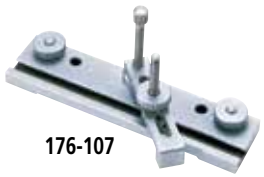
Precision vise

- Max. workpiece size: 1.42″ (36mm)
- Can be mounted on a leveling table.

178-019

Holder with clamp

- Used with a cross-travel table or rugged table.
- Max. workpiece height: 1.38″ (35mm)



176-107

Swivel center support

- Max. workpiece diameter: 3.15″ (80mm)*
  *2.56″ (65mm) when swiveled 10°
- Max. workpiece length: 5.51″(140mm)

172-197

Center support

- Max. workpiece diameter: 4.72″(120mm)
- 2.36″ (60mm) riser is optional (**172-143**)

172-142

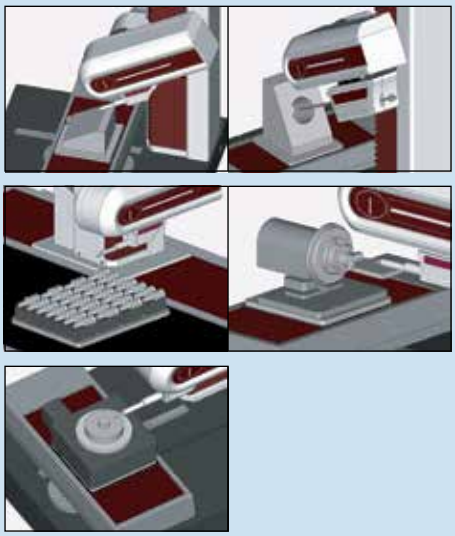
Center support riser

- Used with a center support.
- Max. workpiece diameter: 9.45″ (240mm)

172-143

Drive unit tilting function (Patent pending: Japan)	Large θ Table	Rotary-type detector holder
▲	—	—
—	—	—
—	—	—
—	—	—
—	—	—
●	—	—
●	—	—
—	—	—
—	—	—
—	●	—
—	—	●

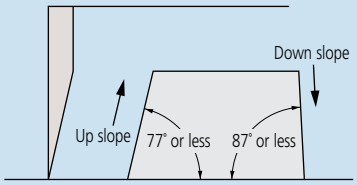
●: Essential ▲: Recommended
—: Not necessary



Three-axis adjustment table

Order No.	178-047
Table top	5.11 x 3.94" (130 x 100mm)
Workpiece weight	33lbs. (15kg) at max.
Workpiece diameter	.04 - 6.3" (1 - 160mm)
Leveling range	±1.5°
Swivel range	±2°
Y-axis adjustment	±0.5" (±12.5mm)
Height	6" (152.5mm)
Mass	19.8lbs. (9kg)
Remarks	V-block (**998291**) not included

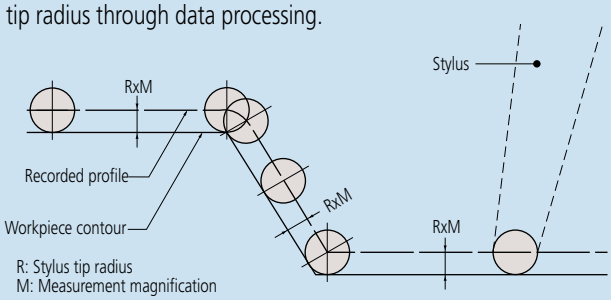
Traceable Angle



The maximum angle at which a stylus can trace upward or downward along the contour of a workpiece, in the stylus travel direction, is referred to as the traceable angle. A one-sided sharp stylus with a tip angle of 12° (as in the above figure) can trace a maximum 77° of up slope and a maximum 87° of down slope. For a conical stylus (30° cone), the traceable angle is smaller. An up slope with an angle of 77° or less overall may actually include an angle of more than 77° due to the effect of surface roughness. Surface roughness also affects the measuring force.
For model CV-3200/4500, the same type of stylus (SPH-71: one-sided sharp stylus with a tip angle of 12°) can trace a maximum 77° of up slope and a maximum 83° of down slope.

Compensating for Stylus Tip Radius

A recorded profile represents the locus of the center of the ball tip rolling on a workpiece surface. (A typical radius is 0.025mm.) Obviously this is not the same as the true surface profile so, in order to obtain an accurate profile record, it is necessary to compensate for the effect of the tip radius through data processing.



If a profile is read from the recorder through a template or scale, it is necessary to compensate for the stylus tip radius beforehand, according to the applied measurement magnification.

Compensating for Arm Rotation

The stylus is carried on a pivoted arm so it rotates as the surface is traced and the contact tip does not track purely in the Z direction. Therefore, it is necessary to apply compensation in the X direction to ensure accuracy. There are three methods of compensating for arm rotation.

1: Mechanical compensation
2: Electrical compensation
3: Software processing. To measure a workpiece contour that involves a large displacement in the vertical direction with high accuracy, one of these compensation methods needs to be implemented.

Accuracy

As the detector units of the X and Z axes incorporate scales, the magnification accuracy is displayed not as a percentage but as the linear displacement accuracy for each axis.

Overload Safety Cutout

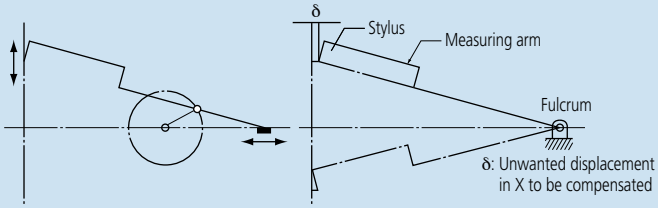
If an excessive force (overload) is exerted on the stylus tip due, perhaps, to the tip encountering a too-steep slope on a workpiece feature, or a burr, etc., a safety device automatically stops operation and sounds an alarm buzzer. This type of instrument is commonly equipped with separate safety devices for the tracing direction (X axis) load and vertical direction (Y axis) load.
For model CV-3200/4500 a safety device functions if the arm comes off the detector mount.

Simple or Complex Arm Guidance

In the case of a simple pivoted arm, the locus that the stylus tip traces during vertical movement (Z direction) is a circular arc that results in an unwanted offset in X, for which compensation has to be made. The larger the arc movement, the larger the unwanted X displacement (δ) that has to be compensated. (See figure below.) The alternative is to use a complex mechanical linkage arrangement to obtain a linear translation locus in Z, and, therefore, avoid the need to compensate in X.

Z-axis Measurement Methods

Though the X axis measurement method commonly adopted is by means of a digital scale, the Z axis measurement divides into analog methods (using a differential transformer, etc.) and digital scale methods.
Analog methods vary in Z-axis resolution depending on the measurement magnification and measuring range. Digital scale methods have fixed resolution.
Generally, a digital scale method provides higher accuracy than an analog method.



Contour Analysis Methods

You can analyze the contour with one of the following two methods after completing the measurement operation.

1. Data processing section

The measured contour is input into the data processing section in real time and a dedicated program performs the analysis using the mouse and/or keyboard. The angle, radius, step, pitch and other data are directly displayed as numerical values.

2. Analysis program

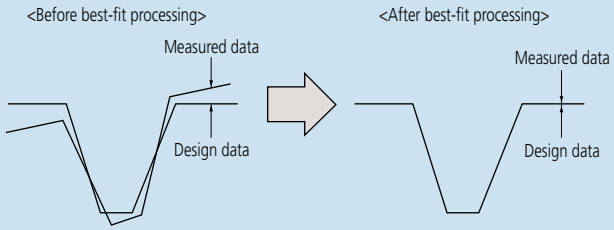
Analysis combining coordinate systems can be easily performed. The graph that goes through stylus radius correction is output to the printer as the recorded profile.

Tolerancing with Design Data

Measured workpiece contour data can be compared with design data in terms of actual and designed shapes rather than just analysis of individual dimensions. In this technique each deviation of the measured contour from the intended contour is displayed and recorded. Also, data from one workpiece example can be processed so as to become the master design data to which other workpieces are compared. This function is particularly useful when the shape of a section greatly affects product performance, or when its shape has an influence on the relationship between mating or assembled parts.

Best-fitting

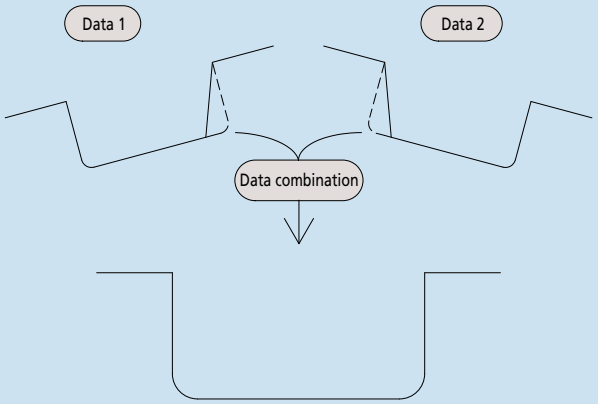
If there is a standard for surface profile data, tolerancing with design data is performed according to the standard. If there is no standard, or if tolerancing only with shape is desired, best-fitting between design data and measurement data can be performed.



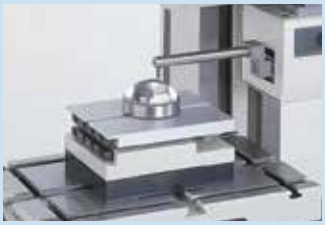
The best-fit processing algorithm searches for deviations between both sets of data and derives a coordinate system in which the sum of squares of the deviations is a minimum when the measured data is overlaid on the design data.

Data Combination

Conventionally, if tracing a complete contour is prevented by stylus traceable-angle restrictions then it has to be divided into several sections that are then measured and evaluated separately. This function avoids this undesirable situation by combining the separate sections into one contour by overlaying common elements (lines, points) onto each other. With this function the complete contour can be displayed and various analyses performed in the usual way.



Measurement Examples

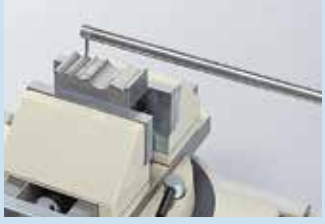

Aspheric lens contour


Inner/outer ring contour of a bearing


Internal gear teeth


Female thread form


Male thread form


Gage contour

Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

Technical Data

Turntable
- Rotational accuracy: Radial: (0.04+6H/10000)µm (H: Probing height (mm))
  Axial: (0.04+6X/10000)µm (X: Distance from rotation center)
- Rotating speed: 6rpm
- Table top diameter: ø 1.96" (150mm)
- Centering range: ±.12" (3mm)
- Leveling range: ±1°
- Maximum probing diameter: ø 11" (280mm)
- Maximum workpiece diameter: ø 17.3" (440mm)
- Maximum workpiece weight: 55 lbs (25kg)

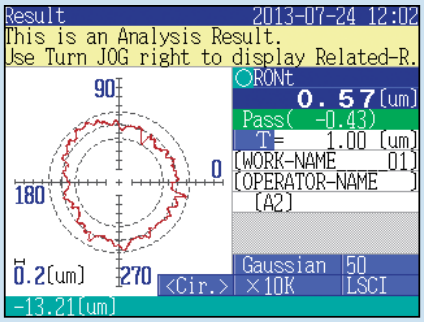
Vertical column (Z-axis)
- Vertical travel: 11" (280mm)
- Feeding: 1.18" (30mm)/rev. (coarse), 0.039" (1mm)/rev. (fine)
- Maximum probing height: 11" (280mm) from the turntable top
- Maximum probing depth: 3.94" (100mm) (min. ID: 1.18"(30mm)

Horizontal arm (X-axis)
- Horizontal travel: 65" (165mm) (Including a protrusion of 1" (25mm) the turntable rotation center)

Probe and stylus
- Measuring range: ±1000µm
- Measuring force: 100mN±30mN
- Standard stylus: 12AAL021, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

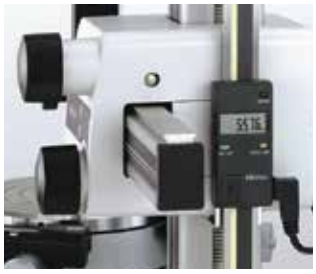
Data analysis unit:
- Processing unit: Built-in (PC with Roundpak)*
- Data sampling points: 3,600 points/rotation
- Data analysis items:
  Roundness, Coaxiality, Concentricity, Flatness, Circular runout (radial), Circular runout (axial), Squareness (against axis), Squareness (against plane), Thickness deviation, Parallelism
- Reference circles for roundness evaluation:
  LSC, MZC, MIC, MCC
- Recording device:
  Built-in thermal line printer (optional external printer)*
- Recording magnification:
  X5 to X200,000, Auto (X1 to X500,000)*
- Roughness component reduction:
  Low pass filter, band pass filter
- Filter type:
  2CR-75%, 2CR-50%, 2CRPC-75% (phase corrected), 2CRPC-50% (phase corrected), Gaussian, filter OFF
- Cutoff value;
  15upr, 50upr, 150upr, 500upr, 15-150upr, 15-500upr, 50-500upr, Manual setting*
- Number of measuring sections
  Max. 5-section (100-section)*

*RA-120P



Large color LCD display for RA-120 models

The Roundtest RA-120 / 120P are a compact, affordable, and simple-to-use device for measuring part geometry on the shop floor. It also provides such superb data analysis capabilities as required with laboratory roundness measuring instruments and has a ±1000µm wide range detector and precision turntable with excellent rotation accuracy.



Z-axis scale unit

Optional X-axis stop

The RA-120 is a dedicated processor-based model which controls all operations via the control panel incorporated in the main unit.

RA-120

Order No.: 211-544A (with mechanical mic-heads)
Order No.: 211-543A (with DAT function, inch/mm)

SPECIFICATIONS

Model No.	RA-120*	RA-120D	RA-120P	RA-120PD
Order No.	**211-544A**	**211-543A**	**211-547A**	**211-546A**

* Does not include Z-axis scale unit.

The RA-120P is a PC-based model which controls all operations via ROUNDPAK software (optional).

RA-120P

Order No.: 211-547A (with mechanical mic-heads)
Order No.: 211-546A (with DAT function, inch/mm)

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM

Mitutoyo

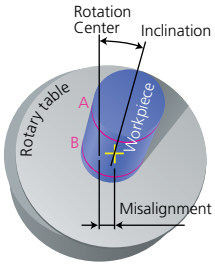
Roundtest RA-120 / 120P

SERIES 211 — Roundness Measuring Instruments

DAT (Digital Adjustment Table) function

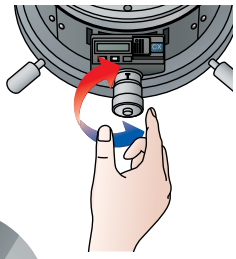
The turntable digitally displays the centering and leveling adjustments, turning what used to be a difficult task into one that is simple enough for even new operators to perform.

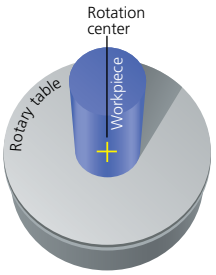
1. Preliminary measurement of two cross sections: A and B.



2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

3. Manipulate the digital micrometer heads of the rotary table so that the adjustment values displayed on the monitor are realized.





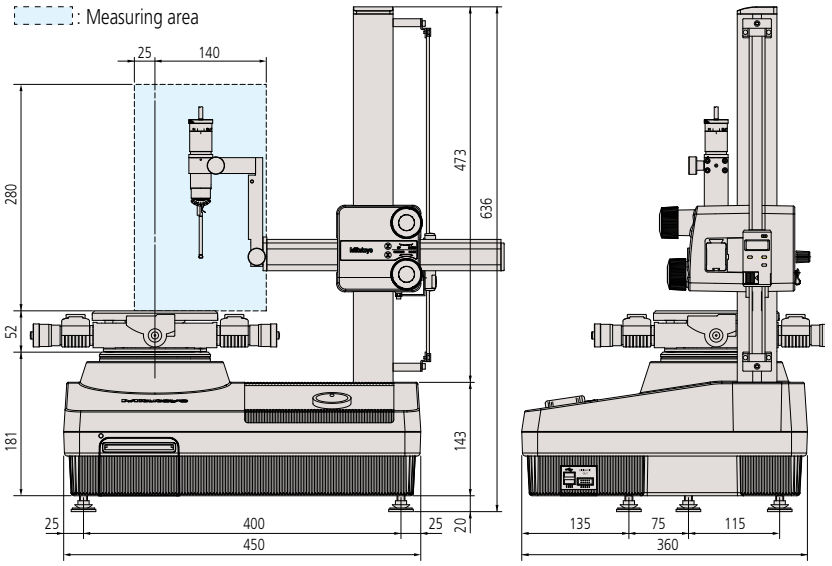
4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°

DIMENSIONS

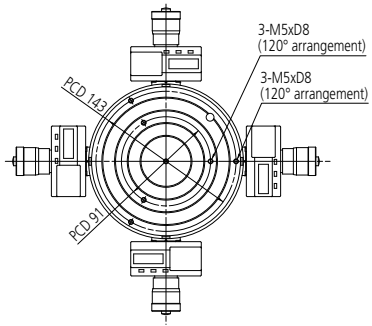
External dimensions

Unit: mm

: Measuring area

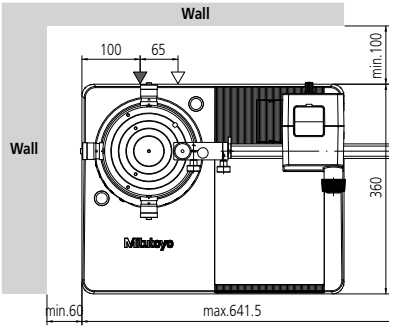


Turntable top view



Installation floor plan

▼Power inlet
▽Air inlet



Functions
- Notched workpiece measurement
- Recalculation of datum/measured data
- Limaçon function compensates for eccentricity
- Rotation of 3D display**
- Real-time display**
- Simplified layout (divided layout)**
- Hair line, auxiliary line, hidden line, fill line**
- Color setting of measured data**
- Offsetting of recorded profile generation**
- Zooming of recorded profile**
- Data deletion**
- Graph analysis (displacement/angle between measured points)**
- Power spectrum analysis**
- Gear tooth analysis**
- Harmonic analysis**
- Text data output (via CSV format)**

**Function of ROUNDPAK software

Air supply
Air pressure: 390kPa
Air consumption: 30L/min.
Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 17.7" x 14.2" x 25" (450 x 360 x 636mm)
Mass: 70.5 lbs (32kg) (main unit), 4.4 lbs (2kg) (air regulator)

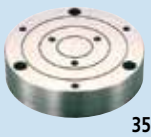
Optional Accessories

211-032:	Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-014:	Three-Jaw chuck (OD: 2 - 78mm, ID: 25 - 68mm)
211-031:	Micro-chuck (OD: 1.5mm max.)
356038:	Auxiliary stage for a low-height workpiece
211-016:	Reference hemisphere
211-045:	Magnification checking gage
997090:	Gage block set for calibration
12AAH320:	X-axis stop
211-013:	Vibration damping stand
12AAH433:	Z-axis scale unit for RA-120
——:	Interchangeable styli (See page J-49.)

211-032

211-014

211-031

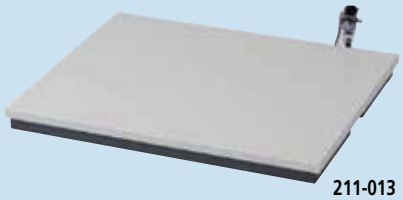


356038

211-016

997090

211-045



211-013

CONSUMABLE PARTS

12AAH181:	Printer paper	10 rolls/set
358592:	Element for air filter	1 pc./set
358593:	Element for air regulator	10 pcs./set

Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

Technical Data

Turntable
- Rotational accuracy (radial): (0.02+6H/10000)µm (RA-1600)
- Rotational accuracy (axial): (0.02+6X/10000)µm (RA-1600)
- Rotational accuracy (radial): (0.03+6H/10000)µm (RA-1600M)
- Rotational accuracy (axial): (0.03+6X/10000)µm (RA-1600M)

  H: Probing height (mm), X: Probing radius (mm)
- Rotational speed: 4, 6, 10rpm
- Table top diameter: ø5.9"(150mm)
- Centering range: ±3mm (with DAT function)
- Leveling range: ±1° (with DAT function)
- Maximum probing diameter: ø11"(ø280mm)
- Maximum workpiece diameter: ø22"(ø560mm)
- Maximum table loading: 55lbs (25kg)

Vertical column (Z-axis)
- Vertical travel: 11.8"(300mm)
- Straightness (in narrow range: 0.20µm / 100mm (RA-1600)
- Straightness (in entire range): 0.30µm / 300mm (RA-1600)
- Straightness (in narrow range: 0.40µm / 100mm (RA-1600M)
- Straightness (in entire range): 0.80µm / 100mm (RA-1600M)
- Parallelism with turntable axis: 1.5µm / 300mm
- Positioning speed: Max. 15mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height (ID/OD): 11.8"(300mm)*1
- Maximum probing depth: 91mm (over ø32)
  3.6"(over ø1.26")((91mm (over ø32))
  1.97"(over ø0.27")((50mm (over ø7))

Horizontal arm (X-axis)
- Horizontal travel: 6.5"(165mm) (From table axis -1~±5.5" ((-25mm – ±140mm))
- Positioning speed: Max. 15mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- X-axis straightness: 2.7µm/140mm (RA-1600)
- X-axis parallelism to turntable axis: 1.6µm/140mm (RA-1600)

Probe and stylus
- Measuring range: ±400µm / ±40µm / ±4µm
- Measuring force: 10–50mN (5 level switching)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Bi-directional
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 0.39MPa (4kgf/cm²)
- Air consumption: 22L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

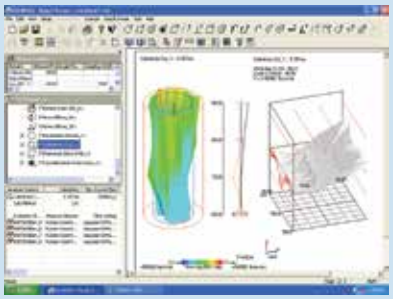
Dimensions (W x D x H): 35 x 19.3 x 33"(890 x 490 x 840mm)

Mass: 375lbs (170kg)

*1 Use an optional auxiliary stage for measuring a workpiece whose height is 20mm or less.

ROUNDPAK

The latest roundness/cylindrical form analysis program



MiCAT
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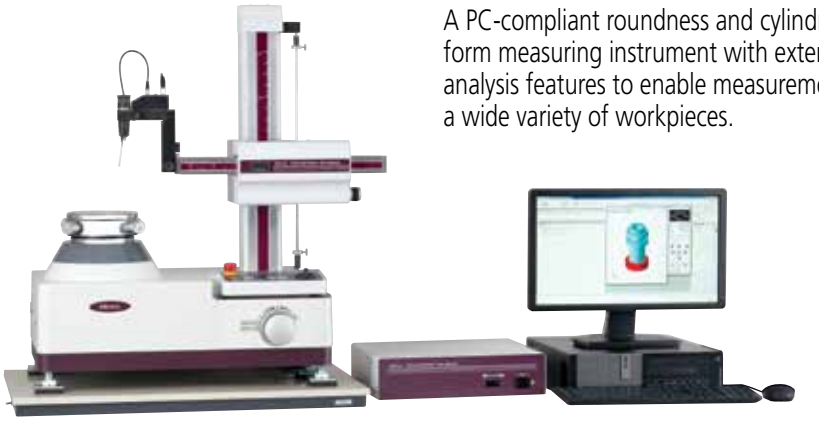
the standard in world metrology software
FORM

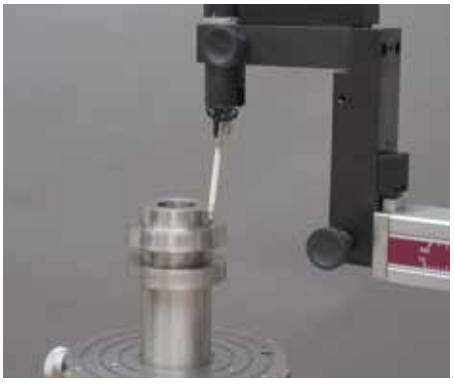


RA-1600 / RA-1600M
with personal computer system and software

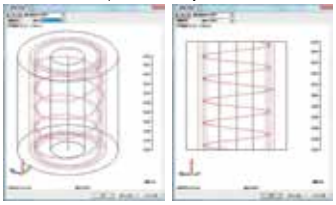
A PC-compliant roundness and cylindrical-form measuring instrument with extensive analysis features to enable measurement of a wide variety of workpieces.

Spiral Measurement/Analysis

The spiral-mode measurement function combines table rotation and rectilinear action allowing cylindricity, coaxiality, and other measurement data to be loaded as a continuous data set.



Spiral-mode cylinder measurement



Safety mechanism provided as a standard feature

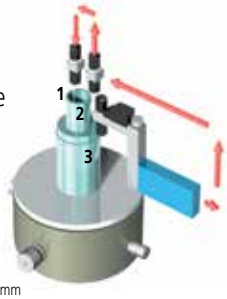
A collision-sensing function has been added to the detector unit (when it is in the vertical orientation) to prevent collision in the Z-axis direction. Additionally, an accidental collision prevention function, which stops the system when the detector displacement exceeds its range, has been added. When an accidental touch is detected, the dedicated analysis software (ROUNDPAK) senses the error and automatically stops the system.

Measurement Through X-axis Tracking

Measurement while tracing is possible through a built-in linear scale in the X-axis. This type of measurement is useful when displacement due to form variation exceeds the measuring range of the detector, and X-axis motion is necessary to maintain contact with the workpiece surface.

Continuous Internal/External Diameter Measurement

Continuous internal/external diameter measurement is possible without changing the detector position.



1), 2) : External diameter measurement
3) : Internal diameter measurement
➡ : Displacement
3) = inner diameter: Up to ø50 mm

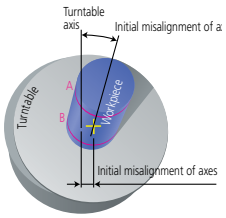
Mitutoyo

Roundtest RA-1600 / RA-1600M

SERIES 211 — Roundness/Cylindricity Measuring System

Centering and Leveling Function

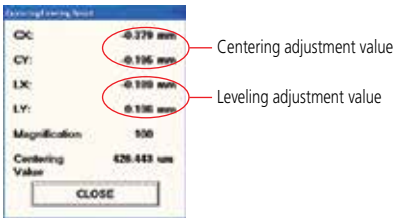
The turntable displays centering and leveling adjustments digitally, making this challenging task simple enough for even a new operator to perform.



1. Preliminary measurement of two cross sections: A and B.

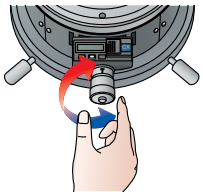
2. Following preliminary measurement, the centering and leveling adjustment values are displayed on the monitor.

For RA-1600

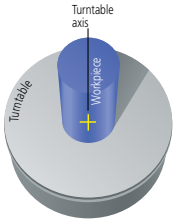


For RA-1600M

3. By adjusting the micrometer heads for the rotary table, the adjustment values or level meter displayed on the monitor can be achieved.



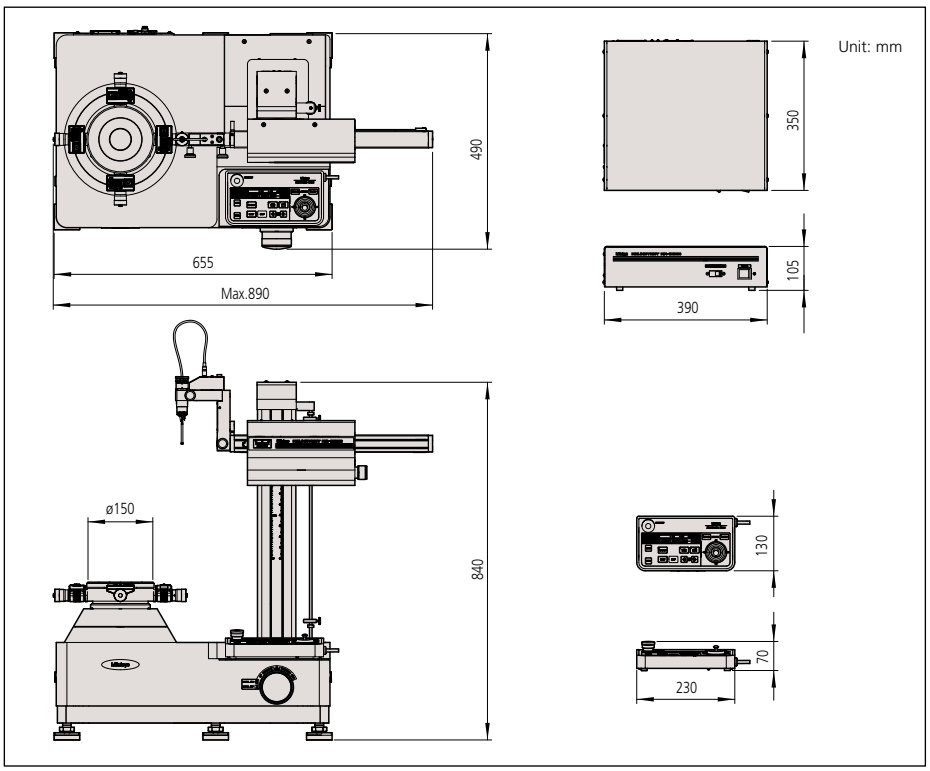
4. Centering and leveling are complete.
   Centering range: ±3mm
   Leveling (inclination) range: ±1°



SPECIFICATIONS

Model No.	RA-1600	RA-1600M
Order No. (inch/mm)	**211-733A**	**211-724A**
Mic Heads	Digimatic	Mechanical

DIMENSIONS



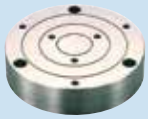
Optional Accessories

350850: Cylindrical square
356038: Auxiliary stage for a low-height workpiece
12AAF203: 2x extension detector holder
12AAF204: Auxiliary detector holder for a large-diameter workpiece
12AAL090: Sliding detector holder
211-045: Magnification checking gage
211-014: Chuck (OD: ø2 - 78mm, ID: ø25 - 68mm)
211-032: Quick chuck (OD: ø1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: ø0.1 - 1.5mm max.)
178-025: Vibration isolator (Desktop type)
64AAB213: Vibration isolation workstation
12AAL019: Side table for PC
———: Interchangeable styli (See page J-49.)


211-032


211-014


211-031


356038

350850


211-045

Sliding detector-unit holder (Option) 12AAL090

The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4" (112mm)

The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements.
Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.

Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

The RA-2200 provides high accuracy, high speed and high performance in roundness measurement. The fully-automatic, or DAT (Digital Adjustment Table), function-aided manual workpiece centering and leveling turns what used to be a difficult task into one that is simple enough for even new users to perform. This facilitates substantial reductions in overall measurement time. The RA-2200 system comes complete with powerful data analysis software ROUNDPAK, which requires only simple manipulation using a mouse and icons, achieving enhanced functionality and ease of operation.

RA-2200AS with personal computer system and software

* Shown with optional vibration isolator and side table for PC

Technical Data

Turntable
Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
Rotational accuracy (axial): {(0.02+3.5R/10000)µm}
H: Probing height (mm), R: Probing radius (mm)
- Rotating speed: 2, 4, 6, 10rpm
- Tabletop diameter: ø9.2" (235mm) AS / AH models; ø 7.9" (200mm) DS / DH models
- Centering range: ±3mm (±5mm: DS / DH models)
- Leveling range: ±1°
- Maximum probing diameter: ø 11.8" (300mm)
- Maximum workpiece diameter: ø22.8" (580mm)
- Maximum workpiece weight: 66 lbs (30kg)

Vertical column (Z-axis)
- Vertical travel: 11.8" (300mm) (22.8" (500mm): AH/DH models)
- Straightness (λc2.5): 0.10µm / 100mm, 0.15µm / 300mm (0.25µm / 500mm: AH / DH models)
- Parallelism with rotating axis: 0.7µm / 300mm (1.2µm / 500mm: AH / DH models)
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 11.8" (300mm) (OD / ID) [22.8" (500mm): AH / DH models)
- Maximum probing depth: over ø32: 85mm (w/standard stylus) over ø7: 50mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 6.9" (175mm) (Including a protrusion of 1" (25mm) the turntable rotation center)
- Straightness (λc2.5): 0.7µm / 150mm
- Squareness with rotating axis: 1.0µm / 150mm
- Positioning speed: Max. 30mm/s with joystick operation
- Measuring speed: 0.5, 1, 2, 5mm/s

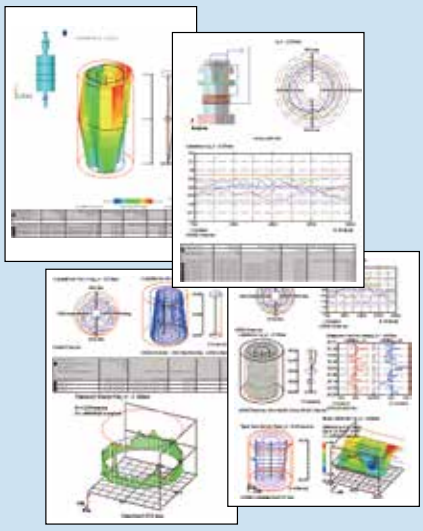
Probe and stylus
- Measuring range: ±400µm/±40µm/±4µm (±5mm: tracking range)
- Measuring force: 10mN~50mN (in 5 steps)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis system
- Analysis software: Roundpak
- Filter type: 2CRPC-75%, 2CRPC-50%, 2CR-75% (non-phase corrected), 2CR-50% (non-phase corrected), Gaussian, filter OFF
- Cutoff value; 15upr, 50upr, 150upr, 500upr, 1500upr, 15-150upr, 15-500upr, 15-1500upr, 50-500upr, 50-1500upr, 150-1500upr, Manual setting
- Reference circles for roundness evaluation: LSC, MZC, MIC, MCC

Air supply
- Air pressure: 390kPa (4kgf/cm²)
- Air consumption: 30L/min.

Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 26.3 x 20 x 35.4" (667 x 510 x 900mm); 26.3 x 20 x 43.3" (667 x 510 x 1100mm: AH / DH models)
Mass: 396 lbs (180kg); 440 lbs (200kg) AH / DH models

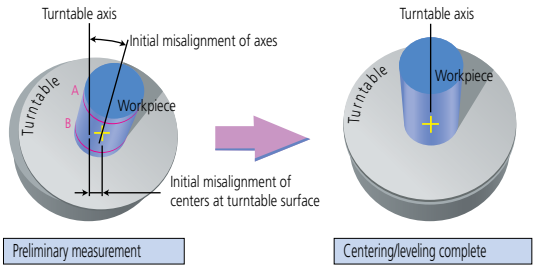
Printout



Highly accurate and easy-to-use turntable

With extremely high rotational accuracy, both in the radial and axial directions, the turntable allows high accuracy flatness testing to be performed in addition to roundness and cylindricity measurements.

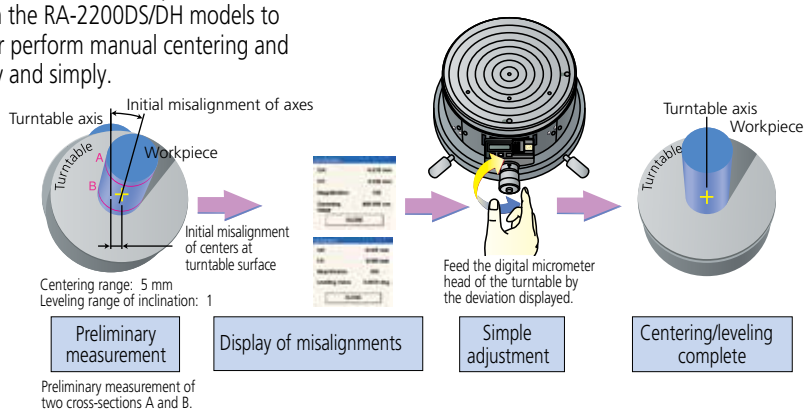
Incorporating an automatic centering/leveling turntable (A.A.T.), the top-of-the-line RA-2200AS/AH models relieve the operator of the bothersome task of workpiece centering and leveling.



Preliminary measurement of two cross-sections A and B.

Preliminary measurement is followed by automatic centering and leveling.

A guidance system (D.A.T.) is incorporated into the turntables on the RA-2200DS/DH models to help the operator perform manual centering and leveling smoothly and simply.



Preliminary measurement of two cross-sections A and B.

Mitutoyo

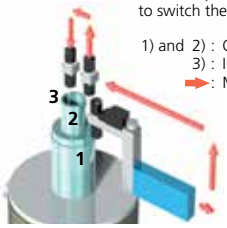
Roundtest RA-2200AS / DS / AH / DH

SERIES 211 — Roundness / Cylindricity Measuring System

Greater productivity by continuous measurement

Both the OD and ID of a workpiece* can be measured in succession without the need for changing the traverse direction of the stylus.

*Inside diameter up to 50 mm.



Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2) : OD measurement
3) : ID measurement
➡: Movement

Highly repeatable measurements with high-accuracy scales Mitutoyo linear scales are used in the X/Z drive unit to guarantee the high precision positioning so vital for repetitive measurement.

Surface roughness measurement function (Surface roughness unit: option)

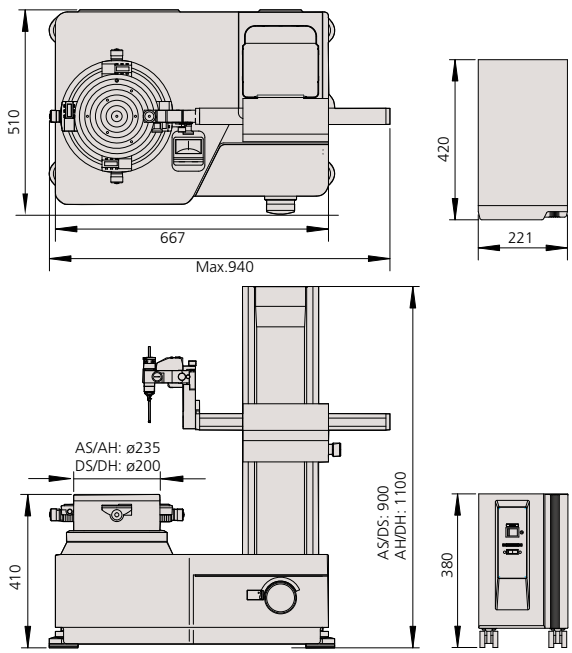
A surface roughness detector, compliant with the relevant International Standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/ cylindricity of a surface but also the roughness of that surface as well.

SPECIFICATIONS

Model No.	RA-2200AS	RA-2200DS	RA-2200AH	RA-2200DH
Order No.	**211-511A** (mm/inch)	**211-514A** (inch)	**211-512A** (mm/inch)	**211-516A** (inch)
Effective table diameter	9.25" (235mm)	8" (200mm)	9.25" (235mm)	8" (200mm)
Centering/leveling adjustment	A.A.T.	D.A.T.	A.A.T.	D.A.T.
Centering range	±0.118" (±3mm)	±0.197" (±5mm)	±0.118" (±3mm)	±0.197" (±5mm)
Column travel	12" (300mm) (standard column)		20" (500mm) (high column)	
Basic unit mass	396 lbs. (180kg)		440 lbs. (200kg)	

DIMENSIONS

Unit: mm



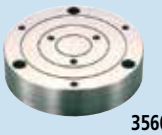
Optional Accessories

350850: Cylindrical square
356038: Auxiliary stage for a low-height workpiece
12AAF203: Extension probe holder (2X higher)
12AAF204: Auxiliary probe holder for a large diameter workpiece
211-045: Magnification checking gage
211-014: Chuck (OD: 1 - 85mm, ID: 33 - 85mm)
211-032: Quick chuck (OD: 1 - 75mm, ID: 14 - 70mm)
211-031: Micro-chuck (OD: 1.5mm max.)
178-025: Vibration isolator
178-024: Stand for vibration isolator
———: Interchangeable styli (See page J-49.)
12AAK110: Vibration isolator
12AAK120: Monitor arm
12AAL019: Side table for PC
12AAF353: Surface roughness detector holder


211-032


211-014


211-031


356038


211-045


350850

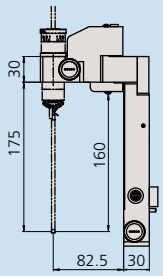
Sliding detector-unit holder (Standard) 12AAL090

The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4"(112mm)

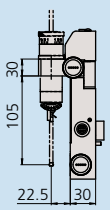
The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.



12AAF203

Unit: mm



12AAF204

Roundtest RA-H5200AS / AH

SERIES 211 — Roundness / Cylindricity Measuring System

Technical Data

Turntable
Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
Rotational accuracy (axial): {(0.02+3.5X/10000)µm}
H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Table top diameter: ø 11.8" (300mm)
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø 15.7" (400mm)
- Maximum workpiece diameter: ø 26.8" (680mm)
- Maximum workpiece weight: 176 lbs (80kg)
  143 lbs (65kg): auto-centering

Vertical column (Z-axis)
- Vertical travel: 13.8" (350mm), (21.7" (550mm): AH model)
- Straightness (λc2.5): 0.05µm / 100mm, 0.14µm / 350mm
  (0.2µm / 550mm: AH model)
- Parallelism with rotating axis: 0.2µm / 350mm
  (0.32µm / 550mm: AH model)
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.8" (350mm) (OD / ID)
  [21.7" (550mm) (OD / ID): AH model)
- Maximum probing depth: over ø32: 85mm (w/standard stylus)
  over ø7: 50mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 8.9" (225mm)
- Straightness (λc2.5): 0.4µm / 200mm
- Squareness with rotating axis: 0.5µm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm (±5mm: tracking range)
- Measuring force: 10mN~50mN (in 5 steps)
- Standard stylus: **12AAL021**, carbide ball, ø1.6mm
- Measuring direction: Two directional
- Stylus angle adjustment: ±45° (with graduations)

Data analysis system
- Analysis software: Roundpak
- Filter type:
  2CRPC-75%, 2CRPC-50%, 2CR-75% (non-phase corrected), 2CR-50% (non-phase corrected), Gaussian, filter OFF
- Cutoff value;
  15upr, 50upr, 150upr, 500upr, 1500upr, 15-150upr, 15-500upr, 15-1500upr, 50-500upr, 50-1500upr, 150-1500upr, Manual setting
- Reference circles for roundness evaluation:
  LSC, MZC, MIC, MCC

Air supply
- Air pressure: 390kPa (4kgf/cm^2)
- Air consumption: 45L/min.

Power supply: 100V AC – 240V AC, 50/60Hz
Dimensions (W x D x H): 49.6 x 28.0 x 66.9"
(1260 x 710 x 1700mm)
49.6 x 28.0 x 74.8"
(1260 x 710 x 1900mm: AH model)
Mass: Main unit: 1433lbs. (650kg)
1477lbs. (670kg): AH model
Vibration isolator: 375 lbs (170kg)

RA-H5200AS / AH, a roundness/cylindricity measuring system developed to combine world-class accuracy with maneuverability/ high-analysis capability.

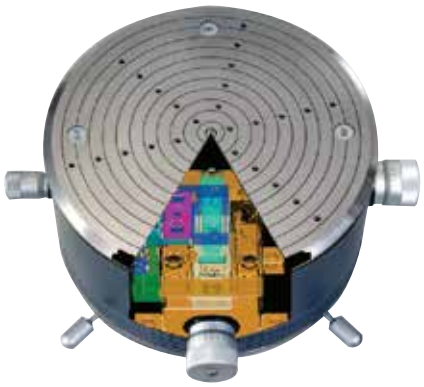
Enhanced detector safety functions, such as accidental touch and collision detection, is installed to minimize damage to both machine and workpieces.

RA-H5200AS with personal computer system and software

* Shown with optional side table for PC.

High-accuracy automatic centering/leveling turntable

A highly accurate, highly rigid turntable has been achieved through exceptional manufacturing accuracy of the critical components, such as the rotor and stator, in addition to an air-bearing incorporating a complex aperture that provides superior rigidity and uniform pressure distribution. As a result, the rotational accuracy (radial), which is the heart of the roundness/ cylindricity measuring system, is a world-class (0.02 +3.5H/10000)µm.



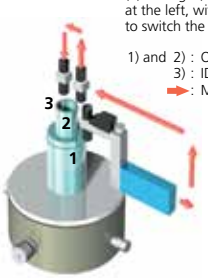
Automatic continuous OD/ID measurement

Automatic measurement can be performed continuously from external diameter to internal diameter without having to change the probe position. This not only reduces measurement time, but eliminates the error factors otherwise involved in changing the probe position, greatly facilitating high-accuracy measurement.

The automatic centering/leveling mechanism incorporates a high-precision glass scale on each axis of the turntable. This allows feedback to be generated that prevents positioning errors from affecting centering/leveling adjustments. The high-speed, automatic, centering/leveling capability achieved greatly contributes to reducing the total measurement time from workpiece setting to workpiece measurement.

Continuous measurement is possible as shown in steps (1) through (3) on the figure at the left, without having to switch the probe direction.

1) and 2) : OD measurement
3) : ID measurement
→ : Movement



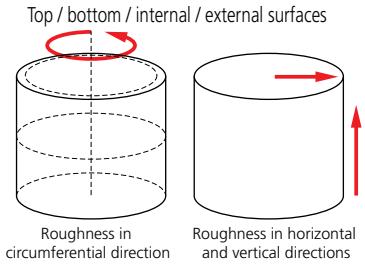
Mitutoyo

Roundtest RA-H5200AS / AH

SERIES 211 — Roundness / Cylindricity Measuring System

X-axis tracking measurement
Because of the linear scale incorporated into the X-axis, measurement can be performed by tracking the workpiece surface (tracking range: ±5mm). This function is effective for measuring a workpiece with a displacement that exceeds the detection range of the probe in measuring roundness/cylindricity or a taper that is determined with slider/column movement.

Surface roughness measurement function (Surface roughness unit: option)
A surface roughness detector, compliant with the relevant international standards, can be mounted in place of the roundness measuring detector. This creates a multiple sensor system that can not only test the geometrical roundness/cylindricity of a surface, but also the roughness of that surface.

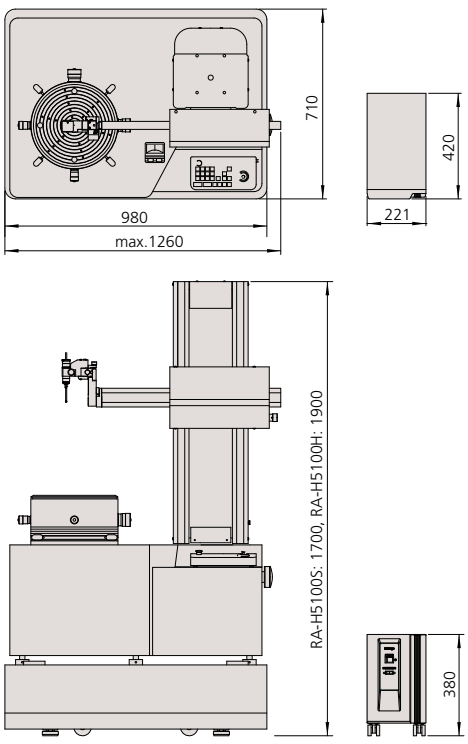


SPECIFICATIONS

Model No.	RA-H5200AS	RA-H5200AH
Order No. * with vibration isolating stand	**211-531A**	**211-532A**
Column travel	13.77" (350mm) (standard column)	21.65" (550mm) (high column)

DIMENSIONS

Unit: mm



Optional Accessories

350850: Cylindrical square
12AAF203: Extension probe holder (2X higher)
12AAF205: Extension probe holder (3X higher)
12AAF204: Auxiliary probe holder for a large diameter workpiece
211-045: Magnification calibration gage
211-014: Chuck (OD: 2 - 78mm, ID: 25 - 68mm)
211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: 0.1~1.5mm max.)
12AAB598: Protective shield
———: Interchangeable styli (See page J-49.)
12AAL019: Side table for PC

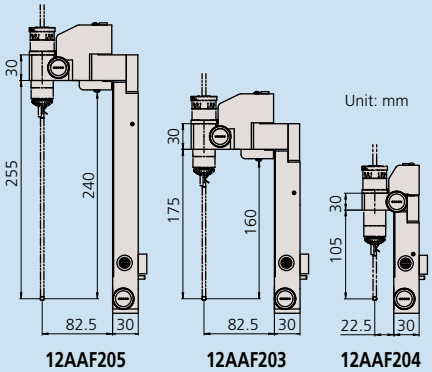
Sliding detector-unit holder (Standard) 12AAL090
The detector-unit holder is equipped with a sliding mechanism, enabling one-touch measurement of a workpiece with a deep hole having a thick wall, which has been difficult with the conventional standard arm.

Sliding distance: 4.4" (112mm)

The detector-unit holder can be stopped at a position sufficiently higher than the workpiece along the Z-axis, and then lowered and positioned to make measurements. Furthermore, internal/external diameters can be easily measured with the continuous internal/external diameter measurement function*.

*: See page 41 for details about the continuous ID and OD measuring function.

Unit: mm



Roundtest Extreme RA-2200CNC / RA-H5200CNC

SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System

Mitutoyo offers innovative roundness/ cylindricity measuring systems capable of automated measurement with independent/ simultaneous multi-axis CNC control. In addition to high measuring accuracy and reliability, these CNC models provide excellent inspection productivity. Roundness and surface roughness measurements are both available from a single measuring system so workpiece resetting for roughness measurement is not required. Roughness measurement is possible in the axial and circumferential directions.

Holder-arm orientation switching (vertical position - horizontal position)

Detector rotation mechanism (0 to 290°, in increments of 1°)

RA-2200H CNC
with personal computer system and software

* Shown with optional vibration isolator and side table for PC.

RA-H5200H CNC
with personal computer system and software

* Shown with optional side table for PC.

Technical Data: RA-2200CNC

Turntable
- Rotational accuracy (radial): {(0.02+3.5H/10000)µm}
- Rotational accuracy (axial): {(0.02+3.5X/10000)µm}
  H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm
- Tabletop diameter: ø 9.25" (235mm)
- Centering range: ±3mm
- Leveling range: ±1°
- Maximum probing diameter: ø 10.1" (256mm)
- Maximum workpiece diameter: ø 22.8" (580mm)
- Maximum workpiece weight: 66 lbs (30kg)

Vertical column (Z-axis)
- Vertical travel: 11.8" (300mm) 19.7" (500mm: 2200H model)
- Straightness (c2.5): 0.10µm / 100mm, 0.15µm / 300mm (0.25µm / 500mm: 2200H model)
- Parallelism with rotating axis: 0.7µm / 300mm (1.2µm / 500mm: 2200H model)
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 11.8" (300mm) (OD / ID) [19.7" (500mm) (OD / ID): 2200H model]
- Maximum probing depth: over ø32: 104mm (w/standard stylus) over ø12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 6.9" (175mm) (Including a protrusion of 1" (25mm) the turntable rotation center)
- Straightness (c2.5): 0.7µm / 150mm
- Squareness with rotating axis: 1.0µm / 150mm
- Positioning speed: Max. 30mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm/±40µm/±4µm (±5mm: tracking range)
- Measuring force: 40mN (not adjustable)
- Standard stylus: **12AAE301**, carbide ball, ø1.6mm
- Measuring direction: one direction
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 390kPa (4kgf/cm^2)
- Air consumption: 30L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

Dimensions (W x D x H): 26.3 x 20 x 35.4" (667 x 510 x 900mm) (26.3 x 20 x 43.3" (667 x 510 x 1100mm): 2200H model)

Mass: 397 lbs (180kg) (441 lbs (200kg): 2200H model)

Technical Data: RA-H5200CNC

Turntable
- Rotational accuracy (radial): (.8+.35H)µin {(0.02+3.5H/10000)µm}
- Rotational accuracy (axial): (.8+.35X)µin {(0.02+3.5X/10000)µm}
  H: Probing height (mm), X: Distance from the turntable axis (mm)
- Rotating speed: 2, 4, 6, 10rpm (20rpm: auto-centering)
- Table top diameter: ø300mm
- Centering range: ±5mm
- Leveling range: ±1°
- Maximum probing diameter: ø14" (356mm)
- Maximum workpiece diameter: ø 26.8" (680mm)
- Maximum workpiece weight: 176 lbs (80kg) 143 lbs (65kg): auto-centering

Vertical column (Z-axis)
- Vertical travel: 13.7" (350mm) 21.7" (550mm): H5200H model
- Straightness (λc2.5): 0.05µm / 100mm, 0.14µm / 350mm (0.2µm / 550mm: H5200H model)
- Parallelism with rotating axis: 0.2µm / 350mm (0.32µm / 550mm: H5200H model)
- Positioning speed: Max. 60mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s
- Maximum probing height: 13.7" (350mm) (OD / ID) [21.7" (550mm) (OD / ID): H5200H model)
- Maximum probing depth: over ø32: 104mm (w/standard stylus) over ø12.7: 26mm (w/standard stylus)

Horizontal arm (X-axis)
- Horizontal travel: 8.8" (225mm)
- Straightness (λc2.5): 0.4µm / 200mm
- Squareness with rotating axis: 0.5µm / 200mm
- Positioning speed: Max. 50mm/s
- Measuring speed: 0.5, 1, 2, 5mm/s

Probe and stylus
- Measuring range: ±400µm (±5mm: tracking range)
- Measuring force: 40mN (not adjustable)
- Standard stylus: **12AAE301**, carbide ball, ø1.6mm
- Measuring direction: one direction
- Stylus angle adjustment: ±45° (with graduations)

Air supply
- Air pressure: 390kPa (4kgf/cm^2)
- Air consumption: 45L/min.

Power supply: 100V AC – 240V AC, 50/60Hz

Dimensions (W x D x H): 49.6 x 28.0 x 66.9" (1260 x 710 x 1700mm) 49.6 x 28.0 x 74.8" (1260 x 710 x 1900mm: H5200H model)

Mass: Main unit: 1433 lbs (650kg) 1477 lbs (670kg): H5200H (model)

Vibration isolator: 375 lbs (170kg)

Mitutoyo

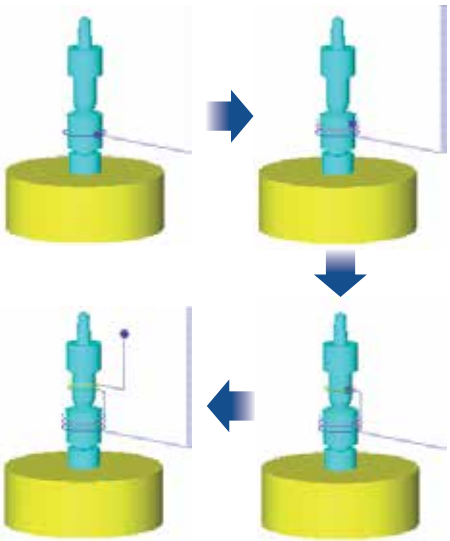
Roundtest Extreme
RA-2200CNC / RA-H5200CNC

SERIES 211 — CNC Roundness, Cylindricity and Surface Roughness Measuring System

ROUNDPAK

Off-line measurement procedure programming function

On-screen virtual 3D simulation measurements can be performed with the incorporated off-line teaching function that allows a part program (measurement procedure) to be created without an objective workpiece. The probe and the holder unit of the Roundtest Extreme can be precisely represented and an alarm can be raised to indicate that there is a collision risk predicted by the simulation.



3D simulation screens (work-view windows) can be generated after entering CAD data (in IGES, DXF form) and text data.

SPECIFICATIONS

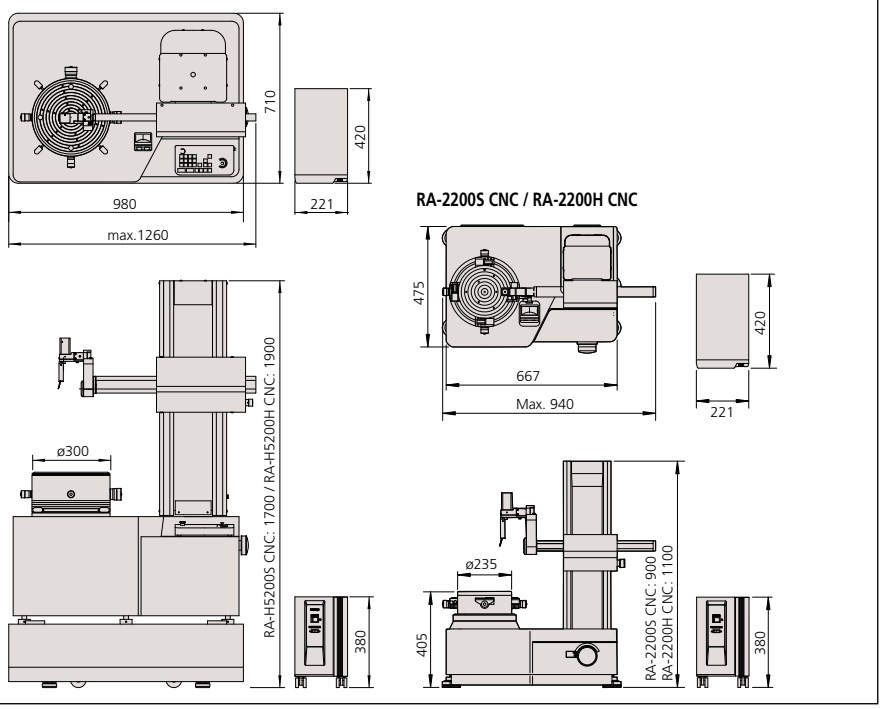
Model No.	EXTREME RA-2200S CNC	EXTREME RA-2200H CNC
Order No.	**211-517A**	**211-518A**
Column travel	11.8″ (300mm) (standard column)	19.7″ (500mm) (high column)

Model No.	EXTREME RA-H5200S CNC	EXTREME RA-H5200H CNC
Order No. with vibration isolating stand	**211-533A**	**211-534A**
Column travel	13.77″ (350mm) (standard column)	21.65″ (550mm) (high column)

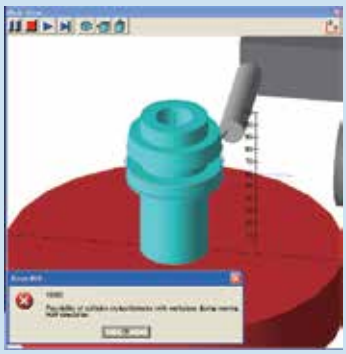
DIMENSIONS

RA-H5200S CNC / RA-H5200H CNC

Unit: mm



MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
FORM



Optional Accessories

350850: Cylindrical square
211-045: Magnification calibration gage
211-014: Chuck (OD: 1 - 78mm, ID: 25 - 68mm)
211-032: Quick chuck (OD: 1 - 79mm, ID: 16 - 69mm)
211-031: Micro-chuck (OD: 0.1~1.5mm max.)
12AAB598: Protective shield (RA-H5200 only)
———: Interchangeable styli (See page J-49.)
12AAK110: Vibration isolator (RA-2200 only)
12AAK120: Monitor arm (RA-2200 only)
12AAL019: Side table for PC
12AAG419: Surface roughness detector for RA-CNC

64AAB573 Workstation

Dimensions

Overall: 36 x 30 x 24-32″ (W x D x H)
Cord Bin: 4″h x 5-3/8″d (width is 10″ less than table width)
Distance From Front Edge to Cord Bin: 30″d table – 15-1/2″d
Distance Between Legs: 10″ less than the overall table width

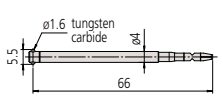
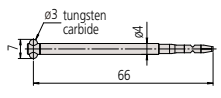
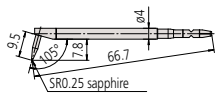
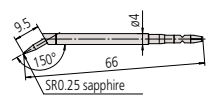
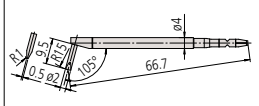
Work surface feature a 1″, 45 lb density, furniture board substrate with attractive Gray laminate tabletop brimmed with bullnose edge band in Quartz gray color. Work surface is height adjustable in one inch increments from 24″ to 32″.

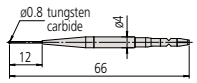
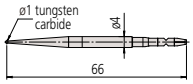
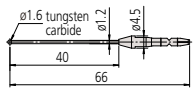
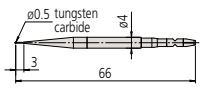
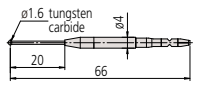
Tabletop incorporates metal threaded inserts on the underside to affix the leg assemblies for added strength and durability. Table comes with 4″ casters with two as locking type for stationary placement.

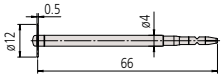
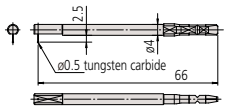
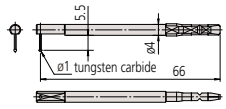
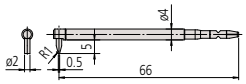
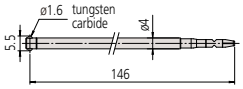
*Laptop PC not included with table.

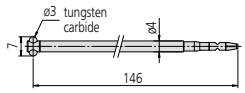
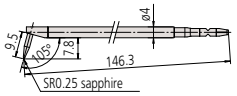
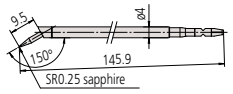
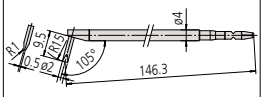
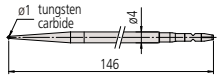
Optional Styli for Roundtest

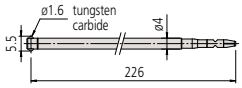
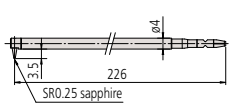
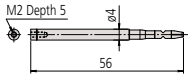
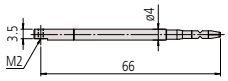
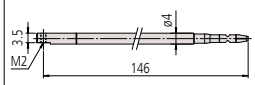
Interchangeable Styli for RA-120, RA-120P, RA-1600/M, RA-2200, RA-H5200

Application/Type	Standard (Standard accessory)	Notch	Deep groove	Corner	Cutter mark
Order No.	**12AAL021***	**12AAL022**	**12AAL023**	**12AAL024**	**12AAL025**
Stylus tip	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide	SR0.25mm sapphire	SR0.25mm sapphire	tungsten carbide
Dimensions (mm)		 Included in 5-pcs. styli set No. 12AAL020	 Included in 5-pcs. styli set No. 12AAL020		

Application/Type	Small hole (ø0.8)	Small hole (ø1.0)	Small hole (ø1.6)	Extra small hole (Depth 3mm)	ø1.6 mm ball
Order No.	**12AAL026**	**12AAL027**	**12AAL028**	**12AAL029**	**12AAL030**
Stylus tip	ø0.8 mm tungsten carbide	ø1 mm tungsten carbide	ø1.6 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)		 Included in 5-pcs. styli set No. 12AAL020			 Included in 5-pcs. styli set No. 12AAL020

Application/Type	Disk	Crank (ø0.5)	Crank (ø1.0)	Flat surface	2X-long type**
Order No.	**12AAL031**	**12AAL032**	**12AAL033**	**12AAL034**	**12AAL035**
Stylus tip	ø12 mm tungsten carbide	ø0.5 mm tungsten carbide (Depth 2.5 mm)	ø1 mm tungsten carbide (Depth 5.5 mm)	tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)					 Included in 5-pcs. styli set No. 12AAL020

Application/Type	2X-long type notch**	2X-long type deep groove**	2X-long type corner**	2X-long type cutter mark**	2X-long type Small hole**
Order No.	**12AAL036**	**12AAL037**	**12AAL038**	**12AAL039**	**12AAL040**
Stylus tip	ø3 mm tungsten carbide	SR0.25 mm sapphire	SR0.25 mm sapphire	tungsten carbide	ø1 mm tungsten carbide
Dimensions (mm)					

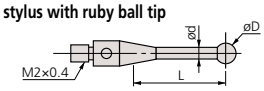
Application/Type	3X-long type**	3X-long type deep groove**	Stylus shank	Stylus shank (standard groove)	Stylus shank (2X-long groove)**
Order No.	**12AAL041**	**12AAL042**	**12AAL043**	**12AAL044**	**12AAL045**
Stylus tip	ø1.6 mm tungsten carbide	SR0.25 mm sapphire	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)	For mounting CMM stylus (mounting thread M2)
Dimensions (mm)					

* **12AAL021** is a standard accessory for all Roundtest models.
** Not available for RA-10, RA-120/P and RA-220
Measuring is only in the vertical direction. Measuring magnification of 20000X is available using the 2X-long stylus.
Customized special interchangeable styli are available on request. Please contact any Mitutoyo office for more information.
† New design for holding styli is not shown in above illustrations.
New styli for RA-2200 / H5200 are compatible with old RA-2100 / H5100 detectors.
Old styli for RA-2100 / H5100 are NOT compatible with new RA-2200 / H5200 detectors.

5 pc. Stylus set: 12AAL020

Part No.	Part Description
12AAL022	Stylus for notched workpiece
12AAL023	Stylus for deep groove
12AAL027	Stylus for small hole (1.0mm)
12AAL030	1.6mm ball stylus
12AAL035	2X-long type stylus

M2 CMM stylus with ruby ball tip



Unit: mm

K651276
D = ø0.5, d = ø0.34, L = 3.0, Mass = 0.3g

K651236
D = ø0.7, d = ø0.5, L = 4.0 , Mass = 0.3g

K651012
D = ø1.0, d = ø0.7, L = 4.5, Mass = 0.3g

K651013
D = ø1.5, d = ø0.7, L = 4.5, Mass = 0.3g

K651014
D = ø2.0, d = ø1.0, L = 6.0, Mass = 0.3g

K651016
D = ø3.0, d = ø1.5, L = 7.5, Mass = 0.4g

K651017
D = ø4.0, d = ø1.5, L = 10.0, Mass = 0.4g

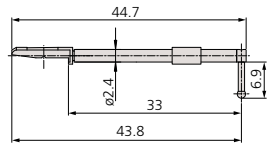
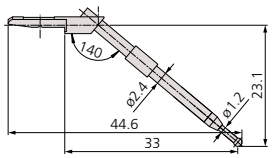
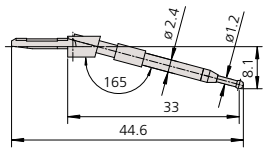
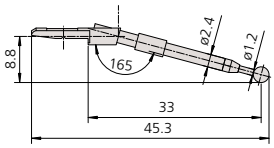
K651018
D = ø5.0, d = ø2.5, R = 10.0, Mass = 0.7g

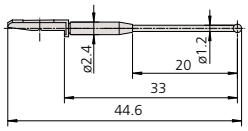
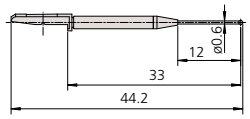
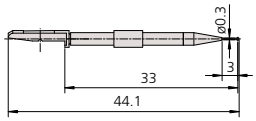
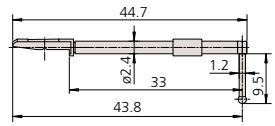
K651024
D = ø6.0, d = ø2.5, R = 10.0, Mass = 0.9g

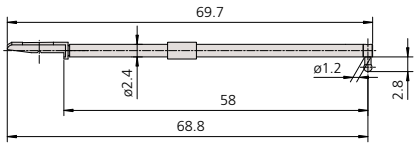
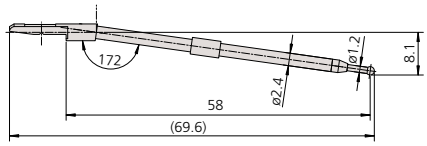
K651025
D = ø8.0, d = ø2.5, R = 11.0, Mass = 1.5g

Optional Styli for Roundtest

Interchangeable Styli for RA-2200 CNC, RA-H5200 CNC

Application/Type	Groove	Flat surface	General purpose	Notch
Order No.	**12AAE310**	**12AAE302**	**12AAE301**	**12AAE309**
Stylus tip	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide	ø3 mm tungsten carbide
Dimensions (mm)				

Application/Type	ø1.6 mm ball	ø0.8 mm ball	ø0.5 mm ball	Deep groove
Order No.	**12AAE303**	**12AAE304**	**12AAE305**	**12AAE308**
Stylus tip	ø1.6 mm tungsten carbide	ø0.8 mm tungsten carbide	ø0.5 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)				

Application/Type	Deep hole A	Deep hole B
Order No.	**12AAE306**	**12AAE307**
Stylus tip	ø1.6 mm tungsten carbide	ø1.6 mm tungsten carbide
Dimensions (mm)		

Analysis options		RA-H5200CNC/ RA-H5200	RA-2200CNC/ RA-2200	RA-1600	RA-1600M	RA-120P	RA-120
Roundness	○	●	●	●	●	●	●
Cylindricity	⌭	●	●	●	●	—	—
Concentricity	◎	●	●	●	●	●	●
Coaxiality	axis-element	◉	●	●	●	●	●	●
	Axis-axis		●	●	●	●	●	—
Flatness	▱	●	●	●	▲	●	●
Parallelism	//	●	●	●	▲	●	●
Perpendicularity	⊥	●	●	●	●	●	●
Runout	↗	●	●	●	●	●	●
Total runout	⌰	●	●	●	▲	—	—
Straightness	—	●	●	●	▲	—	—
Inclination	∠	●	●	●	▲	—	—
Taper	/\	●	●	●	▲	—	—

● Full measurment capability
▲ Limited measurement capability; R-Axis must be stationary.

Usage examples of styli


Cutter mark

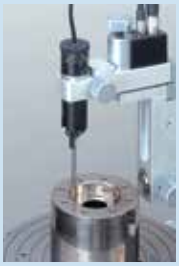

Corner


Small hole


Small hole


Flatness measurement


Notched workpiece measurement


ID measurement

Optional Accessories for Roundtest

Centering chuck (ring operated)
211-032
Suitable for holding small parts with easy-to-operate knurled-ring clamping.
- Holding capacity:
  Internal jaws: OD = 1-36 mm, ID = 14-70 mm.
External jaws: OD = 1-75 mm.
- External dimensions: ø118x41 mm
- Mass: 1.2kg

Centering chuck (key operated)
211-014
Suitable for holding longer parts and those requiring a relatively powerful clamp.
- Holding capacity:
  Internal jaws: OD = 1 - 35mm, ID = 33 - 85mm
  External jaws: OD = 30-80mm.
- External dimensions: ø157 x 76mm
- Mass: 3.8kg

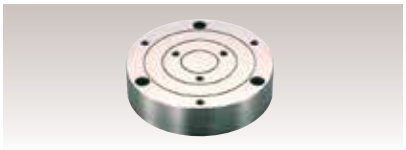
Vibration Isolated frame with work surface

Code No.	Dimensions	Load Capacity
64AAB357	30 x 48 x 30"	1300 lbs

Cylindrical square
350850
- Used for checking and aligning table rotation axis parallel to the Z-axis column.
- Squareness: 3µm
- Straightness: 1µm
- Cylindricity: 2µm
- Roundness: 0.5µm
- Mass: 7.5kg

Micro-chuck
211-031
Used for clamping a workpiece (less than ø1 mm dia.) that the centering chuck cannot handle.
- Holding capacity: up to ø1.5 mm
- External dimensions: ø118x48.5 mm
- Mass: 0.8kg

Magnification calibration gage
211-045
Used for normalizing detector magnification by calibrating detector travel against displacement of a micrometer spindle.
- Maximum calibration range: 400µm
- Graduation: 0.2µm
- Mass: 4kg



Auxiliary workpiece stand
356038
- Used for measuring a workpiece whose diameter is 20mm or shorter and whose height is 20mm or lower.

Magnification checking kit*
997090
- A combination of gage blocks and an optical flat.

* Standard accessory for RA-2200, RA-2200CNC, RA-H5200 and RA-H5200CNC

Origin-point gage*
998382
- A gage for zero setting of the R-axis and Z-axis.

* Standard accessory for RA-2200 and RA-H5200

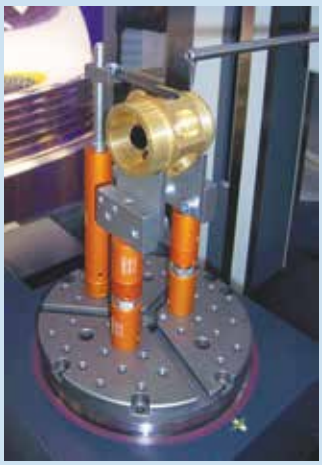
211-016
Reference Hemisphere

Mitutoyo

Eco-Fix Kit Form-S

Mitutoyo ECO-FIX Kit Fixture Systems

Part No.	Qty.	Part name	Part No.	Qty.	Part name
K551038	1	Adaptor plate ø 150mm	**K551069**	1	Flat top ø 12mm
K551024	1	Location pin ø 12 X 13mm	**K550262**	1	V-block mini
K551025	1	Location pin ø 12 X 25mm	**K550261**	2	Cone receiver mini
K551026	1	Location pin ø 12 X 50mm	**K550250**	1	Stopper element mini
K551027	1	Location pin ø 12 X 100mm	**K550247**	1	Back square mini
K551028	1	Location pin ø 20 X 13mm	**K550888**	2	Straight pin Ø 6mm x 20mm
K551029	1	Location pin ø 20 X 25mm	**K550889**	2	Straight pin Ø 6mm x 30mm
K551030	1	Location pin ø 20 X 50mm	**K550890**	2	Straight pin Ø 6mm x 40mm
K551031	1	Location pin ø 20 X 100mm	**K551046**	1	Slotted nut for receiver bracket h=12mm
K551035	1	Receiver bracket small	**K551050**	1	Allen key 2mm
K551036	1	Receiver bracket large	**K551051**	1	Allen key 3mm
K551040	1	Adjustable location pin ø 20mm	**K551052**	1	Allen key 4mm
K551041	1	Adjustable location pin ø 12mm	**K551053**	1	Allen key 5mm
K551042	3	Location pin ø 12mm with bore ø 6mm	**K551054**	1	Double open ended spanner 10-17
K551044	1	Receiver bracket L=90; ø 12mm	**K550591**	1	Washer ø 6,4mm / ø 17mm
K550716	1	Straight pin with thread	**K550110**	8	Cylinder head screw M6 x 20mm
K550279	1	Spring clip, d= 8mm, L= 60mm	**K550563**	6	Cylinder head screw M6 x 25mm
Kit Part No.			**K551133**		



Eco-Fix Kit Form-L

Part No.	Qty.	Part name	Part No.	Qty.	Part name
K551039	1	Adaptor plate ø 200mm	**K550247**	1	Back square mini
K551024	1	Location pin ø 12 X 13mm	**K550058**	1	V-block
K551025	1	Location pin ø 12 X 25mm	**K550365**	2	Cone receiver
K551026	1	Location pin ø 12 X 50mm	**K550982**	1	Stopper element
K551027	2	Location pin ø 12 X 100mm	**K550248**	1	Back square
K551028	2	Location pin ø 20 X 13mm	**K550888**	2	Straight pin Ø 6mm x 20mm
K551029	2	Location pin ø 20 X 25mm	**K550889**	2	Straight pin Ø 6mm x 30mm
K551030	2	Location pin ø 20 X 50mm	**K550890**	2	Straight pin Ø 6mm x 40mm
K551031	1	Location pin ø 20 X 100mm	**K550000**	2	Straight pin Ø 8mm x 30mm
K551035	1	Receiver bracket small	**K550001**	2	Straight pin Ø 8mm x 50mm
K551036	1	Receiver bracket large	**K550002**	2	Straight pin Ø 8mm x 95mm
K551040	2	Adjustable location pin ø 20mm	**K551046**	1	Slotted Nut for receiver bracket h= 12mm
K551041	1	Adjustable location pin ø 12mm	**K551047**	1	Slotted Nut for receiver bracket h= 15mm
K551042	2	Location pin ø 12mm with bore ø 6mm	**K551050**	1	Allen key 2mm
K551043	3	Location pin ø 20mm with bore ø 8mm	**K551051**	1	Allen key 3mm
K551044	1	Receiver bracket L=90; ø 12mm	**K551052**	1	Allen key 4mm
K551045	1	Receiver bracket L=120; ø 20mm	**K551053**	1	Allen key 5mm
K550279	2	Spring clip, d= 8mm, L= 60mm	**K550591**	1	Washer ø 6,4mm / ø 17mm
K550262	1	V-block mini	**K550110**	12	Cylinder head screw M6 x 20mm
K550261	2	Cone receiver mini	**K550563**	6	Cylinder head screw M6 x 25mm
K550250	1	Stopper element mini			
Kit Part No.			**K551134**		

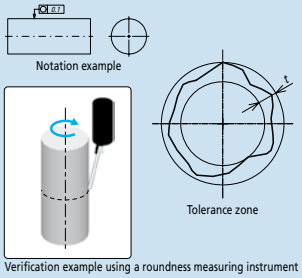
Quick Guide to Precision Measuring Instruments

Roundtest (Roundform Measuring Instruments)

- **JIS B 7451-1997: Roundness measuring instruments**
- **JIS B 0621-1984: Definition and notation of geometric deviations**
- **JIS B 0021-1998: Geometric property specifications touching of products – Geometric tolerance Roundness Testing**

Roundness

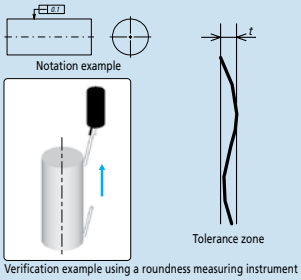
Any circumferential line must be contained within the tolerance zone formed between two coplanar circles with a difference in radii of t



Verification example using a roundness measuring instrument

Straightness

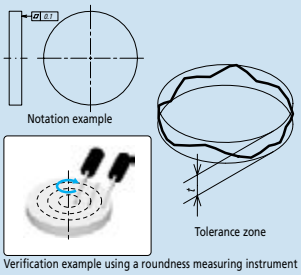
Any line on the surface must lie within the tolerance zone formed between two parallel straight lines a distance t apart and in the direction specified



Verification example using a roundness measuring instrument

Flatness

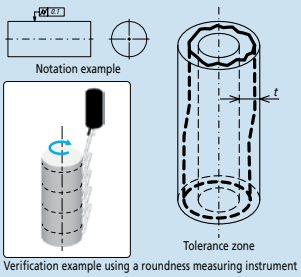
The surface must be contained within the tolerance zone formed between two parallel planes a distance t apart



Verification example using a roundness measuring instrument

Cylindricity

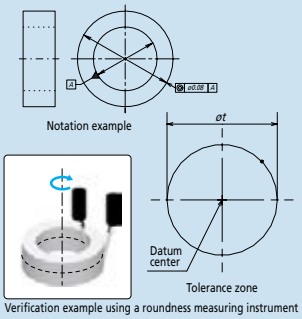
The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t



Verification example using a roundness measuring instrument

Concentricity

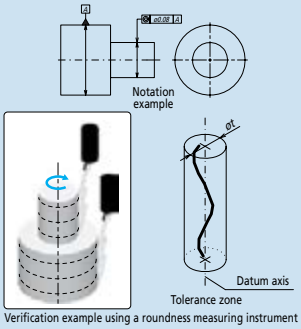
The center point must be contained within the tolerance zone formed by a circle of diameter t concentric with the datum



Verification example using a roundness measuring instrument

Coaxiality

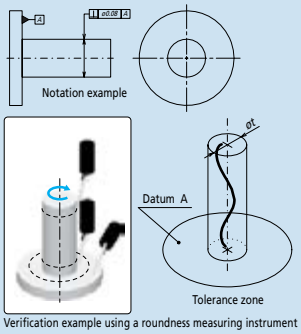
The axis must be contained within the tolerance zone formed by a cylinder of diameter t concentric with the datum



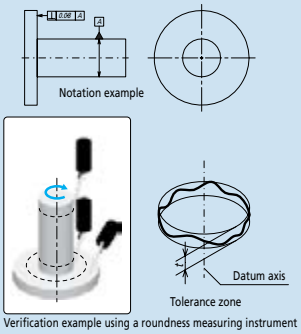
Verification example using a roundness measuring instrument

Perpendicularity

The line or surface must be contained within the tolerance zone formed between two planes a distance t apart and perpendicular to the datum



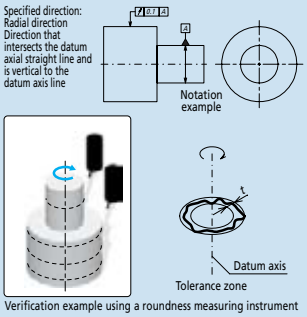
Verification example using a roundness measuring instrument



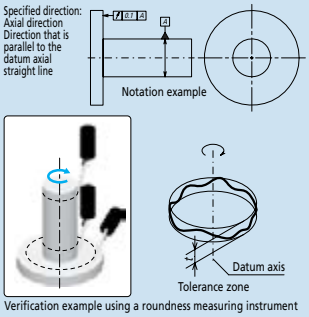
Verification example using a roundness measuring instrument

Circular Runout

The line must be contained within the tolerance zone formed between two coplanar and/or concentric circles a distance t apart concentric with or perpendicular to the datum



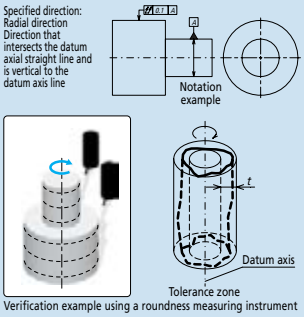
Verification example using a roundness measuring instrument



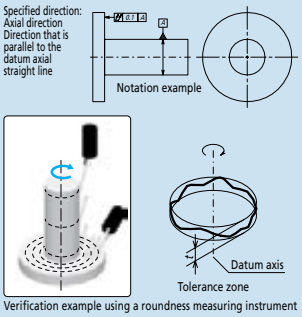
Verification example using a roundness measuring instrument

Total Runout

The surface must be contained within the tolerance zone formed between two coaxial cylinders with a difference in radii of t, or planes a distance t apart, concentric with or perpendicular to the datum



Verification example using a roundness measuring instrument

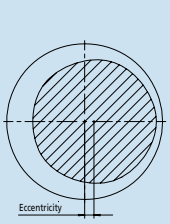


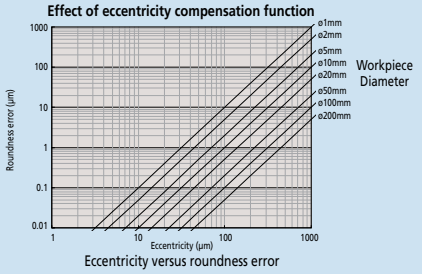
Verification example using a roundness measuring instrument

Adjustment prior to Measurement

Centering

A displacement offset (eccentricity) between the Roundtest's rotary table axis and that of the workpiece results in distortion of the measured form (limaçon error) and consequentially produces an error in the calculated roundness value. The larger the eccentricity, the larger is the error in calculated roundness. Therefore the workpiece should be centered (axes made coincident) before measurement.
Some roundness testers support accurate measurement with a limaçon error correction function.
The effectiveness of this function can be seen in the graph below.

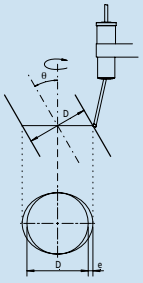


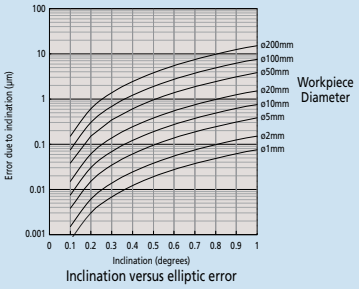


Eccentricity versus roundness error

Leveling

Any inclination of the axis of a workpiece with respect to the rotational axis of the measuring instrument will cause an elliptic error. Leveling must be performed so that these axes are sufficiently parallel.





Inclination versus elliptic error

Effect of Filter Settings on the Measured Profile

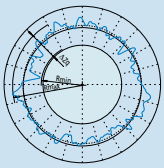
Roundness values as measured are greatly affected by variation of filter cutoff value. It is necessary to set the filter appropriately for the evaluation required.

Evaluating the Measured Profile Roundness

Roundness testers use the measurement data to generate reference circles whose dimensions define the roundness value. There are four methods of generating these circles, as shown below, and each method has individual characteristics so the method that best matches the function of the workpiece should be chosen.

Least Square Circle (LSC) Method

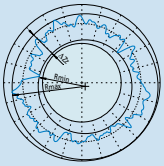
A circle is fitted to the measured profile such that the sum of the squares of the departure of the profile data from this circle is a minimum. The roundness figure is then defined as the difference between the maximum departures of the profile from this circle (highest peak to the lowest valley).



ΔZq = Rmax-Rmin

Minimum Zone Circles (MZC) Method

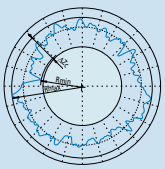
Two concentric circles are positioned to enclose the measured profile such that their radial difference is a minimum. The roundness figure is then defined as the radial separation of these two circles.



ΔZz = Rmax-Rmin

Minimum Circumscribed Circle (MCC) Method

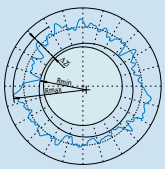
The smallest circle that can enclose the measured profile is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the 'ring gage' circle.



ΔZc = Rmax-Rmin

Maximum inscribed Circle (MIC) Method

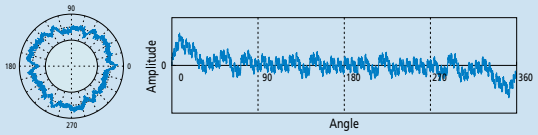
The largest circle that can be enclosed by the profile data is created. The roundness figure is then defined as the maximum departure of the profile from this circle. This circle is sometimes referred to as the `plug gage' circle.



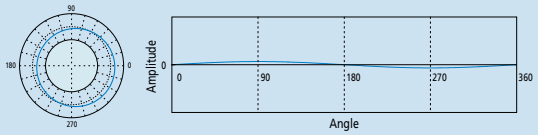
ΔZi = Rmax-Rmin

Undulations Per Revolution (UPR) data in the roundness graphs

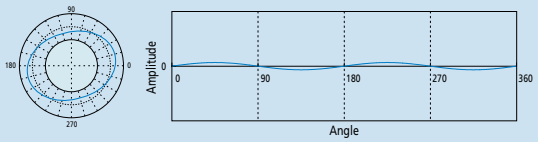
Measurement result graphs



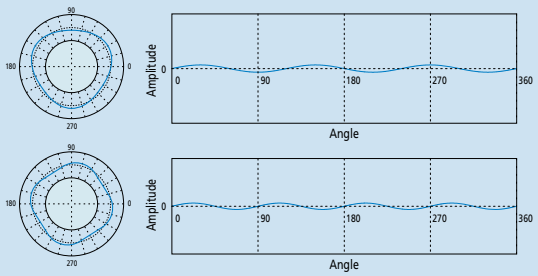
A 1 UPR condition indicates eccentricity of the workpiece relative to the rotational axis of the measuring instrument. The amplitude of undulation components depends on the leveling adjustment.



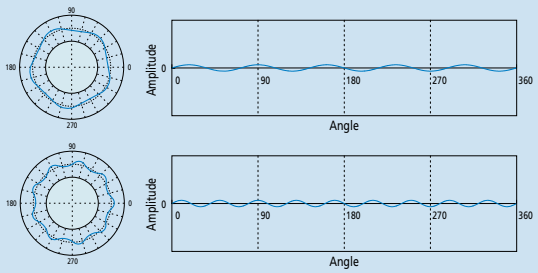
A 2 UPR condition may indicate: (1) insufficient leveling adjustment on the measuring instrument; (2) circular runout due to incorrect mounting of the workpiece on the machine tool that created its shape; (3) the form of the workpiece is elliptical by design as in, for example, an IC-engine piston.



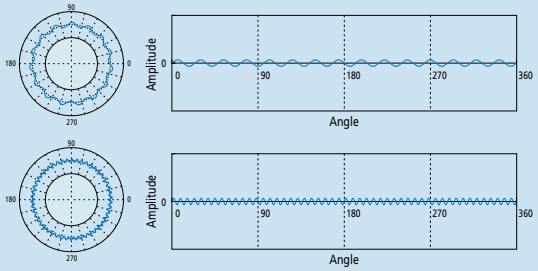
A 3 to 5 UPR condition may indicate: (1) Deformation due to over-tightening of the holding chuck on the measuring instrument; (2) Relaxation deformation due to stress release after unloading from the holding chuck on the machine tool that created its shape.



A 5 to 15 UPR condition often indicates unbalance factors in the machining method or processes used to produce the workpiece.



A 15 (or more) UPR condition is usually caused by tool chatter, machine vibration, coolant delivery effects, material non-homogeneity, etc., and is generally more important to the function than to the fit of a workpiece.



K

Micro Hardness Testing Machines

Rockwell Hardness Testing Machines

Micro Zone Test System

Portable Hardness Testing Instruments

Hardmatic HH-411

HM-210D/220D

INDEX

HV110 Type B

HH-300 Durometers

Mitutoyo

Lineup of Hardness Testing Machines

Hardness testing machines provide the simplest and most economical testing methods among many material testing machines, playing an important role in research activities, production activities, and commercial transactions. Mitutoyo offers a choice of standard hardness testing machines that are optimal for hard materials such as metals to soft materials such as plastic and rubber, as well as custom-designed testers such as in line-type automatic machines and labor-saving machines required on the shop floor.

Microhardness
(Micro-Vickers)

Automatic Vickers
Hardness Testing

Vickers

Rockwell

Rockwell Superficial

Rebound type
portable

For rubber
and plastic

Technical Data

Test force range:
HM-210A: 9 steps + arbitrary test force
HM-220A: 19 steps + arbitrary test force
Load dwell time: 0 - 999s
Manual XY stage unit
Stage size: 100x100mm
Travel range: 25x25mm
with Digimatic in/mm micrometer heads
Resolution: 0.001mm
Max. specimen height: 133mm (Stage size: 25 x 25mm)
Max. specimen height: 121mm (Stage size: 50 x 50mm)
Max. specimen depth: 160mm (from the center of indenter)
Optical path: 4-port objectives switching system of Infinity-correction optical system
Resolution: 0.01µm (When using objectives of X40 or more)
Data output: Serial interface (RS-232), Digimatic interface, USB 2.0
Power supply: 39VA 100-125/220-240V AC, 50/60Hz
Dimensions: (W x D x H): 315x671x595mm
Mass: 43kg

Optional Accessories (Factory-installed option)

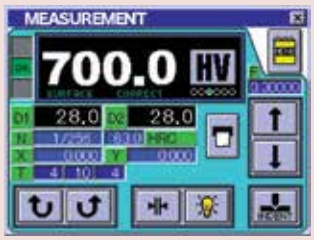
11AAC104: Objective lens unit 2X
11AAC105: Objective lens unit 5X
11AAC106: Objective lens unit 10X
11AAC107: Objective lens unit 20X
11AAC108: Objective lens unit 100X
11AAC129: Measuring microscope (Digital ocular)
11AAC109: Knoop Indenter Assembly (HM-210 Series)
11AAC110: Knoop Indenter Assembly (HM-220 Series)

Optional Accessories

810-454A: TV camera unit (8.4 inch LCD)
19BAA058: Diamond indenter for Vickers (HM210 Series standard test force)
19BAA059: Diamond indenter for Vickers (HM220 Series low test force)
19BAA061: Diamond indenter for Knoop (HM210 Series)
19BAA062: Diamond indenter for Knoop (HM220 Series)
810-013: Specimen (thin plate) holder
810-014-1: Specimen (wire) holder
810-015-1: Specimen (wire or ball) holder
810-016: 50 mm Vise
810-017: 100 mm Vise
810-019: Specimen tilting holder
810-020: Universal specimen holder
810-018: Rotary table
810-084: Rotatable universal specimen holder
810-085: Adjustable specimen (thin plate) holder
810-095: Rotatable specimen stage
375-056: Stage Micrometer (glass) Micro-scale
810-650-1: Resin mold specimen stage ø25.4
810-650-2: Resin mold specimen stage ø30
810-650-3: Resin mold specimen stage ø31.75
810-650-4: Resin mold specimen stage ø38.1
810-650-5: Resin mold specimen stage ø40
810-641: Vibration Isolator
810-870A: Sample Heating Device HST-250
810-420: 25x25mm stage (metric only)
810-423: 50x50mm stage (metric only)
810-424: 1"x1" in/mm stage (standard)
810-427: 2"x2" in/mm stage

Power turret with up to 2 indenter mounts and 4 objective mounts (manual operation possible)

Touch-screen type control panel



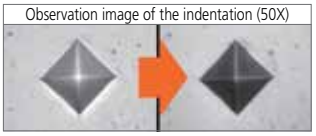
HM-210 / 220 Type A

SERIES 810 — Micro Vickers Hardness Testing Machines

FEATURES

- The electromagnetic force motor used in the loading mechanism enables the test force to be freely selected (see test force specifications) over the wide range of 0.4903mN to 19610mN (0.05gf to 2 kgf). It is also possible to freely set load dwell times. Now your desire for absolute control over the indentation size in Vickers hardness testing can be satisfied. The HM-200 series always offers the test force most appropriate for the specimen material and shape.
- The long working distance objectives used enable a comfortable working distance between the objective and the specimen surface. This greatly reduces the possibility of collision between the specimen and the objective during focusing operations. (e.g. for 50X objectives: 1.1mm for conventional models, 2.5mm for HM-200 series)
- Newly-designed 'MH Plan' objectives are optimized for measuring indentation images. The lineup includes 6 types of long working distance objectives: 10X, 20X, 50X and 100X for measuring indentation images, and 2X and 5X for enabling wide-range measurement around indentations.
- LEDs, which have a longer life, produce less heat, consume less power and are more energy efficient than incandescent bulbs, are employed for the illumination system.
- The motorized turret allows for up to 4 objective lenses and 2 indenter assemblies to be mounted at the same time.

Observation image of the indentation (50X)



Stray light reduction around the indentation

HM-210A

SPECIFICATIONS **TYPE A** Digital Hardness Tester

Model No.	HM-210 Type A	HM-210 Type A V/K	HM-220 Type A	HM-220 Type A V/K
Part No.	**64AAB305P**	**64AAB306P**	**64AAB307P**	**64AAB308P**
Fixed test force (mN)	98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807 (10gf-1000gf)		0.4903, 0.9807, 1.961, 2.942, 4.903, 9.807, 19.61, 29.42, 49.03, 98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807, 19610 (0.05 gf-2kgf)	
Arbitrary test force	≤100 gf in 1 gram increments, > 100gf in 10 gram increments		< 1 gf in .1 gf increments, ≤100 gf in 1 gram increments, > 100gf in 10 gram increments	
Test force control	Force generation by electromagnetic and automatic control (load, dwell, unload)			
Control unit	Color LCD Touch Screen			
Loading rate	60 µ/ sec		60µm/s, Variable between 2 and 60µm/s. ≤ 30 gf.	
Load dwell time	0-999 sec			
Indenter	Vickers	Vickers and Knoop	Vickers	Vickers and Knoop
Objective lenses	10x, 50x	10x, 20x, 50x	10x, 50x, 100x	10x, 50x, 100x
Objective turret	Motor driven and manual operation			
Filar eye piece	Dual Line, 10X, .01µ min			

With TV camera unit 810-454A (selectable with HM-210A/220A)

Measurement of indentation dimensions on a TV monitor reduces eye fatigue, which leads to improvement in operation efficiency in multi-point testing.

Mitutoyo

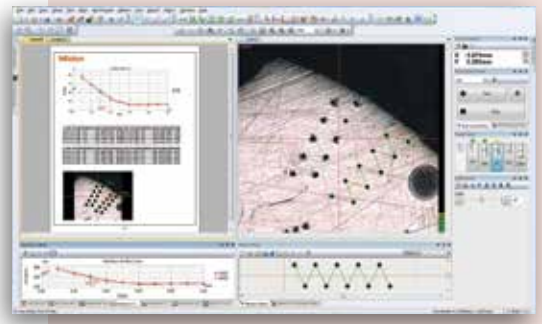
HM-200 Series with AVPAK software

For semi and fully automatic Type B and D Systems

System B (HM-210B/220B)

System B is equipped with **AVPAK-10**, a the software package that automatically measures the diagonal length of an indentation and calculates the corresponding hardness value. This means that measurement error caused by variation in operator interpretation is eliminated, thereby reducing costs.

Automatic measurement of indentation/ manual stage



AVPAK Software

Indentation-reading example

System D (HM-210D/220D)

In addition to the functions of System B, System D is equipped with the autofocus function and motorized x-y stage. This function allows for automatic hardness testing, thereby increasing efficiency and reducing labor costs.

Automatic measurement of indentation / motorized XY stage / Autofocusing

System D Technical Data

Motorized X-Y Stage	Travel Max	50 x 50 mm*
	Travel Min	1µ
	Table Size	130 x 130mm
	Speed Max	25mm/ sec
Motorized Focusing Stage	Max Range	1.4mm
	Min Unit	.1µ
	Max Speed	1mm/ sec
Joystick Controller Functions	Functions	X and Y Lock out
	Axis	X, Y and Z (Focus)
	Speed Control	Adjustable H,M,L
	Tester Control	Indent, Turret Position
	Other	Emergency Stop

*Optional 100 x 100 mm

SPECIFICATIONS

TYPE B PC-Driven Test System **TYPE D** PC-Driven Test System with motorized stage and auto focus

Model No.	HM-210 Type B	HM-210 Type B V/K	HM-220 Type B	HM-220 Type B V/K
Part No.	**64AAB323P**	**64AAB324P**	**64AAB325P**	**64AAB326P**
Model No.	HM-210 Type D	HM-210 Type D V/K	HM-220 Type D	HM-220 Type D V/K
Part No.	**64AAB380P**	**64AAB381P**	**64AAB382P**	**64AAB383P**
Fixed test force (mN)	98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807 (10gf-1000gf)		0.4903, 0.9807, 1.961, 2.942, 4.903, 9.807, 19.61, 29.42, 49.03, 98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807, 19610 (0.05 gf-2kgf)	
Arbitrary test force	≤100 gf in 1 gram increments, > 100gf in 10 gram increments		< 1 gf in .1 gf increments, ≤100 gf in 1 gram increments, > 100gf in 10 gram increments	
Test force control	Force generation by electromagnetic and automatic control (load, dwell, unload)			
Control unit	None, By PC*			
Loading rate	60 µ/ sec		60µm/s, Variable between 2 and 60µm/s. ≤ 30 gf.	
Load dwell time	0-999 sec			
Indenter	Vickers	Vickers and Knoop	Vickers	Vickers and Knoop
Objective lenses	10x, 50x	10x, 20x, 50x	10x, 50x, 100x	10x, 50x, 100x
Objective turret	Motor-driven and manual operation			
Filar eye piece	None			
CCTV camera	3 megapixel, 1/2"		3 megapixel, 1/2"	
Software	AV Pak		AV Pak	

*Must use specified PC

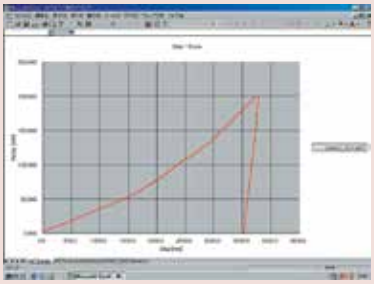
MZT-500

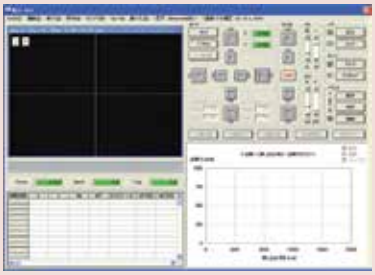
SERIES 810 — Micro Zone Test System

FEATURES

When it comes to evaluating mechanical properties of ultra-small regions of ultra-fine specimens, the MZT-500 Series models are exceptionally powerful tools in the fields of research and development and quality control. The MZT-500 can evaluate mechanical properties, which conventional hardness testing machines for fine specimens cannot measure, such as various CVD and PVD-deposited or generated films, including ion-plated films; hardness of ultra-fine cross-sections; bonding mechanical properties; and mechanical wear properties of carbon fibers, glass fibers, whiskers, etc.

- Test data
  The indentation factor can be obtained, which is related to the hardness value (partially) shown in Martens hardness test (ISO14577) and Young's modulus. Deformation characteristics in the load, dwell, and unload phases are also obtainable for use in determining properties of the specimen material.
- Hardness tests such as Vickers and Knoop hardness tests are supported.
- The balance lever vibration isolation mechanism reduces the effect of external vibrations on measurements.
- Indenter indentation depth can be measured up to a maximum of 20μm with a resolution of 0.1nm.
- Test forces between 0.1mN and 1000mN can be applied electromagnetically for evaluation of material properties in submicroscopic areas.
- Field-compatible form with cover for protection against dust and wind.





SPECIFICATIONS

Model No.	MZT-500L	MZT-500P
Order No.	**810-813A**	**810-814A**
Basic system	✔	✔
Data analysis / control device	✔	✔
Manual type XY stage (Travel range 25x25mm)	✔	—
Automatic XY stage (Travel range: 50x50mm)	—	✔

Test force loading device	Test force range: 0.1 to 1000mN
	Control resolution: 0.916μN
	Loading speed: 0.01 to 100mN/s
Indentation depth measurement	Range: 0 to 20μm
	Resolution: 0.1nm
Indenter	Type: Bercovich triangular pyramid indenter
Sample surface observation method	Camera: 1/3 inch black and white (410,000 pixels)
	Objective (monitor magnification): 100X (2500X), Optional: 10X (250X), 40X (1000X)
Specimen dimensions	Maximum height: 90mm
	Maximum depth: 90mm (From the center of the indenter axis)
Test type	Indentation test (with preliminary test force)
	Indentation test (without preliminary test force)
	Indentation depth setting test, continuous indentation test, repeated indentation test

Mitutoyo

HV110 / HV120

Series 810—Vickers Hardness Testing Machines – Type A

FEATURES

- Heavy load Vickers testing machines feature motorized force selection from 1-50kgf or .3 to 30kgf. Fully adjustable long-life LED illumination runs cool.
- A dual-line filar eyepiece combines with a color touch-screen LCD to create accurate measurements with the touch of a button.
- The motorized turret can accommodate up to 3 long working distance objective lenses for an even wider range of materials and a wide variety of anvils and x-y stages are also available.

HV120 show with optional
810-454A CCTV Camera

SPECIFICATIONS

Model	HV110	HV120
Order No.	**810-441A**	**810-446A**
Test force	9.807N (1kgf),19.61N (2kgf),29.42N (3kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf)294.2N (30kgf), 490.3N (50kgf)	2.942N (0.3kgf),4.903N (0.5kgf), 9.807N (1kgf),24.51N (2.5kgf),49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf)294.2N (30kgf)
Supported test method	HV, HK, HB (Light Force*), Kc	
Test force selection	Motorized	
Loading accuracy	±1%	
Load control	60µ/s, 150µ/s Automatic (loading, duration, unloading)	
Load rate	5~999 sec.	
Objective lens	2X, 5X, 10X (standard), 20X, 50X, 100X	
Measuring microscope	10X Dual-line filar	
Total magnification	20-1000X (100X Standard)	
Field of view	1,400µ (10X Lens) Type A	
Minimum reading	< 50x = 0.1µm, ≥50x = 0.01µm	
Display	Color LCD touch-screen	
Scaled conversion:	8 Types (ASTM, ISO, JIS, SAE and BS)	
Statistics:	N, Max., Min., Average, Range, High, Low, Good, Over, Under, SD(n-1), SD(n-1), SD(n) go/no-go judgment,	
Curvature correction;	0.01 to 200.00mm	
Maximum sample height	210mm Type A	
Maximum sample depth	160mm	
Maximum sample weight	20 Kg Anvil, 10 Kg with x-y Stage	
Optical path	100% Eyetube or Camera	
Output	Rs232, SPC, USB2.0	
Power supply	120 Volt AC/ 60 Hz	
Dimensions main unit (WxDxH)	9.9"x 24.7"x30.7 " (252x627x781mm)	
Mass	110lbs. (50kg)	

* Optional test forces may be required.

Optional Accessories

Lens:
11AAC712 OBJECTIVE LENS 2X
11AAC713 OBJECTIVE LENS 5X
11AAC714 OBJECTIVE LENS 20X
11AAC715 OBJECTIVE LENS 50X
11AAC716 OBJECTIVE LENS 100X

Stage
810-423 MANUAL STAGE 50X50
810-427 MANUAL STAGE 2"X 2"(In/mm)

959149 SPC cable (1m / 40")

Optical
11AAC711 "C" mount CAMERA ADAPTER
810-454A CCTV System

Indenters
19BAA060 DIAMOND INDENTER (VICKERS TYPE)
19BAA063 KNOOP DIAMOND INDENTER
19BAA281 CARBIDE-ALLOY BALL 1MM DIA.
11AAD469 CARBIDE-ALLOY INDENTER, 1MM DIA.
19BAA283 CARBIDE-ALLOY BALL, 2.5MM DIA.
11AAD470 CARBIDE-ALLOY INDENTER, 2.5MM DIA.

Additional Test Force
11AAC697 0.5 kg Brinell Weight
11AAC698 1.25 kg Brinell Weight
11AAC699 5.625 kg Brinell Weight
11AAC700 12.5 kg Brinell Weight

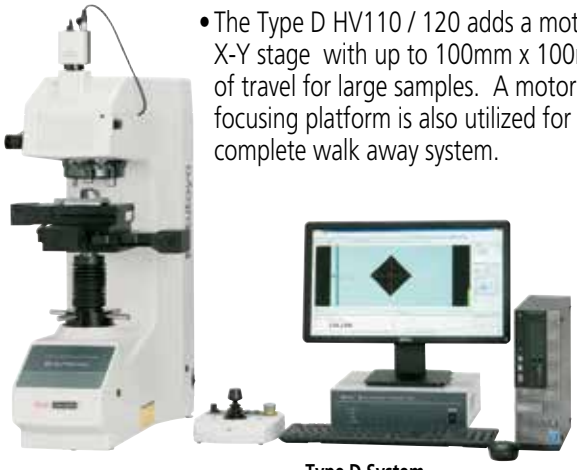
HV110 / HV120

Series 810—Vickers Hardness Testing Machines – Type B / D

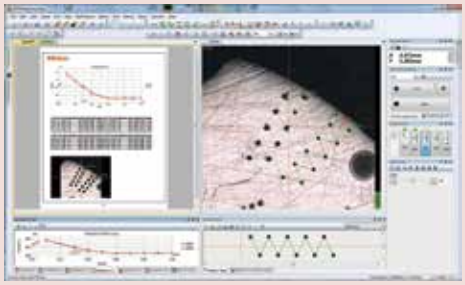
FEATURES

- The Type B HV110/ HV120 Vickers hardness testers add computer control to make measurements even more repeatable.
- A high-resolution 3 mega-pixel camera produces crisp images that are automatically measured in less than .3 seconds.
- Various software functions such as automatic light intensity, simple to use report generator and programming wizards make tedious and repetitive testing requirements more accurate than manual testing and eliminates common operator errors.
- The Type D HV110 / 120 adds a motorized X-Y stage with up to 100mm x 100mm of travel for large samples. A motorized focusing platform is also utilized for a complete walk away system.

Type B System
show with optional PC



Type D System
show with optional PC



SPECIFICATIONS

Model	HV110 Main Unit Only	HV120 Main Unit Only
Order No.	**810-443A**	**810-448A**
Test force	9.807N (1kgf),19.61N (2kgf),29.42N (3kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf)294.2N (30kgf), 490.3N (50kgf)	2.942N (0.3kgf),4.903N (0.5kgf), 9.807N (1kgf),24.51N (2.5kgf),49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf)294.2N (30kgf)
Supported test method	HV, HK, HB (Light Force**), Kc	
Measuring microscope	Optional	
Field of View w/ 10X Lens	590 x 443 µm	
Display	Via PC	
Curvature correction;	0.01 to 200.00mm	
Maximum sample height	172mm Type B, 132mm Type D	
Maximum sample depth	160mm	
Maximum sample weight	10 Kg Type B, 3 kg Type D	
Optical path	100% Eyetube or Camera	
Output	USB2.0	
Mass	110lbs. (50kg)	

*Other specifications as Type A testers
** Optional test forces may be required

Basic Configuration	Type B	Type D
Main Unit	810-443A or 810-448A	810-443A or 810-448A
AVPak-10 Software	11AAC664	11AAC664
PC***	***	***
Automatic Focus Stage		810-465
Motorized X-Y Stage 50x50		810-461A
Motorized X-Y Stage 100x100		810-462A

*** PC not included

Mitutoyo

Optional Accessories

Micro-Vickers/Vickers Hardness Testing Machine

Test Blocks

Order No.	Description	Load
64BAA173	Vickers 100HV Test Block	100gf
64BAA174	Vickers 200HV Test Block	100gf
64BAA175	Vickers 300HV Test Block	100gf
64BAA176	Vickers 400HV Test Block	100gf
64BAA177	Vickers 500HV Test Block	100gf
64BAA178	Vickers 600HV Test Block	100gf
64BAA179	Vickers 700HV Test Block	100gf
64BAA180	Vickers 800HV Test Block	100gf
64BAA181	Vickers 900HV Test Block	100gf
64BAA182	Vickers 100HV Test Block	500gf
64BAA183	Vickers 200HV Test Block	500gf
64BAA184	Vickers 300HV Test Block	500gf
64BAA185	Vickers 400HV Test Block	500gf
64BAA186	Vickers 500HV Test Block	500gf
64BAA187	Vickers 600HV Test Block	500gf
64BAA188	Vickers 700HV Test Block	500gf
64BAA189	Vickers 800HV Test Block	500gf
64BAA190	Vickers 900HV Test Block	500gf
64BAA191	Vickers 100HV Test Block	1000gf
64BAA192	Vickers 200HV Test Block	1000gf
64BAA193	Vickers 300HV Test Block	1000gf
64BAA194	Vickers 400HV Test Block	1000gf
64BAA195	Vickers 500HV Test Block	1000gf
64BAA196	Vickers 600HV Test Block	1000gf
64BAA197	Vickers 700HV Test Block	1000gf
64BAA198	Vickers 800HV Test Block	1000gf
64BAA199	Vickers 900HV Test Block	1000gf
64BAA200	Knoop 200HK Test Block	100gf
64BAA201	Knoop 300HK Test Block	100gf
64BAA202	Knoop 400HK Test Block	100gf
64BAA203	Knoop 500HK Test Block	100gf
64BAA204	Knoop 600HK Test Block	100gf
64BAA205	Knoop 700HK Test Block	100gf
64BAA206	Knoop 800HK Test Block	100gf
64BAA207	Knoop 250HK Test Block	500gf
64BAA208	Knoop 300HK Test Block	500gf
64BAA209	Knoop 400HK Test Block	500gf
64BAA210	Knoop 500HK Test Block	500gf
64BAA211	Knoop 600HK Test Block	500gf
64BAA212	Knoop 700HK Test Block	500gf
64BAA213	Knoop 800HK Test Block	500gf
64BAA214	Knoop 250HK Test Block	1000gf
64BAA215	Knoop 300HK Test Block	1000gf
64BAA216	Knoop 400HK Test Block	1000gf
64BAA217	Knoop 500HK Test Block	1000gf
64BAA218	Knoop 600HK Test Block	1000gf
64BAA219	Knoop 700HK Test Block	1000gf
64BAA220	Knoop 800HK Test Block	1000gf

*Other hardness ranges and test forces available

Indenters

Order No.	Type	Model
19BAA058	Vickers Indenter	H, HM Standard Series
19BAA059	Vickers Indenter	MVK-H2, H3, HM114, HM220
19BAA061	Knoop Indenter	H, HM Standard Series
19BAA062	Knoop Indenter	MVK-H2, H3, HM114, HM220
19BAA060	Vickers Indenter	HV, AVK-C Series
19BAA063	Knoop Indenter	HV, AVK-C Series

Universal Specimen Holder

Used to secure a specimen that has a measuring surface that is hard to stabilize, perpendicular to the indenter axis.

810-020

Mounted Specimen Vise

1.5" (39mm) Max Height	Diameter	
810-650-1	1"	25.4mm
810-650-2		30mm
810-650-3	1.25"	31.75mm
810-650-4	1.5"	38.1mm
810-650-5		40mm

50x50mm travel stage

Manual XY Stage Unit 50 x 50
Manual XY Stage Unit 2"x 2"
810-423 Metric
810-427 Inch/Metric

Bulbs

Order No.	Description
513667	Bulb, 12v/50w, halogen double pin type, HM series with box style illuminators
19BAA219	Bulb, 6v/20w, halogen double pin type, Later H series
19BAA095	Bulb, 6v/15w, halogen bayonet type, all E, G and early H series testers

Clamping devices (Vises)

Vise
Max. opening: 3.94"(100mm)
810-017

Vise
Max. opening: 2"(51mm)
810-016

Rotary Table

Rotary Table
810-018

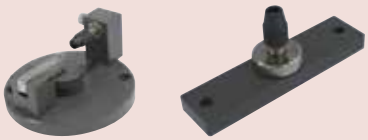
Round Tables

Dimensions: 7.08"(180mm)
810-037

Specimen (thin plate) Holder

Secures a plate with a thickness of .197"(5mm) or less, or foil-like specimens.
810-013

Specimen (wire) Holder



Used to horizontally or vertically secure a wire or needle specimen that has a diameter of .126"(3.2mm) or less.
810-014-1 horizontal
810-015-1 vertical

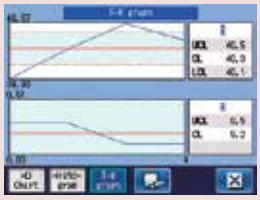
HR-530/530L

SERIES 810 — Rockwell Type Hardness Testing Machines

HR-530
(810-237)

Standard operating display

Graphic display of statistical calculation results and X̄-R control charts



Fine-adjustment table for Jominy testing
810-700

Optional Accessories: See page K-11, 12

Function: Touch-screen type
- Touch-screen operation with a back-lit LCD graphic display.
- Remote selection of the test force linked to the hardness scale selection.
- Choice of message language in English, German, French, Spanish, Italian and Japanese.
- Cylindrical and spherical surface compensation.
- Data offset.
- Conversion to other hardness scales.
- Powerful statistical processing with flexible data point editing and 1024 data memory.
- Measured data editing
- Go/no-go tolerance judgment.
- Statistical processing, histogram and x̄-R chart

FEATURES

- Closed Loop Test Force Control allows for a wide variety of hardness testing including Rockwell, Superficial and Light Force Brinell (6.25 to 187.5 kgf).
- Hardness testing of plastics according to ASTM D785 (Proceedure A and B) and ISO2039-2 are also possible.
- Projected nose type tester allows testing of interior parts down to 40mm or 22mm with optional 19BAA292 indenter
- 5 display formats are possible to show you the information you need. Statistics and graphs can also be displayed on the color touch screen control panel.
- Simple to use automatic brake-start system begins the test automatically when initial force is reached
- The HR-530 is available in 9.8" (250mm) or 15.5" (395mm) height capacity models.
- Complete with a combination diamond indenter, a 1/16" carbide ball indenter, one flat and one V anvil, 2 HRC, 1 HRBW, 1 HR30TW and 1 HR30N test block.

5.7-inch color LCD

SPECIFICATIONS

Order No.		810-237	810-337
Model		HR-530	HR-530L
Hardness testing methods		Rockwell/Rockwell Superficial/Brinell/Plastics hardness	
Initial test force (N)		29.42N (3kgf), 98.07N (10kgf)	
Test force (N)	Rockwell Superficial	147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf)	
	Rockwell	588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf)	
	Light Force Brinell	61.29 (6.25kgf), 98.07 (10kgf), 153.2 (15.625kgf), 245.2 (25kgf), 294.2 (30kgf), 306.5 (31.25kgf), 612.9 (62.5kgf), 980.7 (100kgf), 1226 (125kgf), 1839 (187.5kgf)	
Test force control		Automatic (load/hold/unload)	
Table up/down mechanism		Manual (automatic braking and load sequencing)	
Control unit		Color touch-panel	
Test force switching		Operated with the display unit	
Test force hold time		1 to 120s (Selectable in units of 1s)	
Maximum specimen size		Height: 9.8" (250 mm) Depth: 5.9" (150 mm)	Height: 15.5" (395 mm) Depth: 5.9" (150 mm)
Permissible inside diameter of a tube specimen		Minimum hole diameter: 1.38" (35 mm) (when using the special indenter: .87" (22 mm))	
Maximum table loading		45 lb (20 kg)	
Ball indenter		Tungsten carbide ball indenter	
Unit (display unit)		inch	
Display		Hardness value, test condition, go/no-go judgment result, statistical calculation result, X-R control chart, hardness conversion value	
		Conversion function [HV, HK, HR (Rockwell hardness A, B, C, D, F, G / Rockwell Superficial 15T, 30T, 45T, 15N, 30N, 45N), HS, HB, tensile strength]	
		Go/no-go judgment function	
		Continuous test function (for specimens with the same thickness)	
		Cylindrical correction, spherical correction, offset correction, multi-point correction functions	
		Statistical calculation function (maximum value, minimum value, mean value, standard deviation, upper limit value, lower limit value, go count, range, no-go count)	
		Graph generation function (X-R control chart)	
Language support		Japanese, English, German, French, Italian, Spanish, Korean, Chinese (simplified characters/traditional characters), Turkish, Portuguese, Hungarian, Polish, Dutch and Czech	
External data output		RS-232C, SPC, USB2.0	
Power supply		AC120V	
External dimensions	Main unit	9.84" x 26.38" x 23.82" (250(W)×667(D)×621(H) mm)	11.8" x 26.2" x 30.1" (300(W)×667(D)×766(H) mm)
	Touch-panel display	191(W)×147(D)×71(H) mm	
Mass		Approx. 60 kg	Approx. 69 kg

Note: Plastic testing may not be enabled, depending on the material.

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HR-523/523(L)

SERIES 810 — Rockwell Type Hardness Testing Machines

FEATURES

- Multiple test force generation for Rockwell, Rockwell Superficial and Light Force Brinell hardness.
- Dolphin-nose indenter arm for easy reach of interior (min. ø40mm/ø22mm*) and exterior surfaces.
  *When using an optional diamond indenter (**19BAA292**).
- Real-time electronic test force control for accurate loading. This eliminates load force overshooting.
- Indenter escape function for continuous testing at fixed table position. This eliminates instability caused by the table retraction.
- Auto-stop elevation table and automatic preliminary test force loading to provide stable test force generation.
- Complete with one flat and V anvil, diamond and 1/16" carbide ball indenters, 2 HRC and 1 HRBW Rockwell test blocks and an HR30N and HR30TW test block.

HR-523
810-204-03A

SPECIFICATIONS

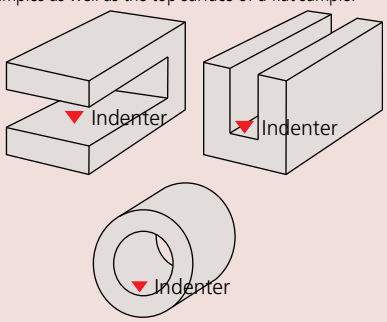
Model		HR-523	HR-523L
Order No.		**810-204-03A**	**810-207-03A**
Preliminary Test Force		29.42N (3kgf), 98.07N (10kgf)	
Test Force	Rockwell	588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf)	
	Rockwell Superficial	147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf)	
	Light Force Brinell	61.29 (6.25kgf), 98.07 (10kgf), 153.2 (15.625kgf), 245.2 (25kgf), 294.2 (30kgf), 306.5 (31.25kgf), 612.9 (62.5kgf), 980.7 (100kgf), 1226 (125kgf), 1839 (187.5kgf)	
Force Control		Automatic control (unloading/duration/unloading) with closed-loop feed back	
Console/Display Unit		Touch-screen operation with back-lit LCD graphic display	
Test Force Selection		By touch screen	
Table up/down drive		Power-Drive (for full-automatic measurement)	
Load Duration		0 to 120 sec. (1 sec. step)	
Maximum Specimen Height		8.1" (205mm)	15.5" (395mm)
Maximum Specimen Depth		5.9" (150mm)	
Display Indication Functions		Hardness value, Converted hardness value, Test conditions, go/no-go tolerance judgment, statistical processing result Rockwell/Rockwell superficial hardness testing. Continuous testing. Cylindrical/spherical surface compensation, data offset. Hardness conversion (HV, HK, HRA/B/C/D/F/G/15T/30T/45T/15N/30N/45N, HS, HB, HBW, tensile strength) Go/no-go tolerance judgment, measured data editing, data memory (max 1024 data) SPC calculation (No. of data, max/min/mean values, range, upper/lower limit values, standard deviation, No. of passing/defective) Histogram, x̄-R chart	
Data Output		RS-232C, SPC, Centronics	
Dimensions (W x D x H)		9.84" x 26.38" x 23.82" (250 x 670 x 605mm)	
Mass		60kg (133lb)	63kg (139lb)

Technical Data

Preliminary test force:	29.42N, 98.07N
Test force	
Rockwell superficial:	147.1, 294.2, 441.3N
Rockwell:	588.4, 980.7, 1471N
Brinell*:	
Test force setting:	By control unit
Load control:	Automatic (loading, duration, unloading)
Load duration:	0s - 120s (1s increments)
Max. specimen height:	205mm (for standard flat anvil)
Max. specimen depth:	150mm (from the center of indenter shaft)
Stage elevation:	Manual or power drive
Control unit: type	Sheetswitch type or touch-screen
Data output:	RS-232C, Digimatic code (SPC) and Centronics
Power supply:	120V AC, 50/60Hz
Dimensions (W x D x H)	
Main unit:	250 x 670 x 605mm
Control unit:	165 x 260 x 105mm

Optional Accessories: See page K-11, 12

Various shapes of specimen can be measured. (Nose-type indenter axis mechanism has been adopted.)
The nose-type indenter mechanism allows measurement of pipe samples as well as the top surface of a flat sample.



Function: Touch-screen type
- Touch-screen operation with a back-lit LCD graphic display.
- Remote selection of the test force linked to the hardness scale selection.
- Choice of message language in English, German, French, Spanish, Italian and Japanese.
- Cylindrical and spherical surface compensation.
- Data offset.
- Conversion to other hardness scales.
- Powerful statistical processing with flexible data point editing and 1024 data memory.
- Measured data editing
- Go/no-go tolerance judgment.
- Statistical processing, histogram and x̄-R chart

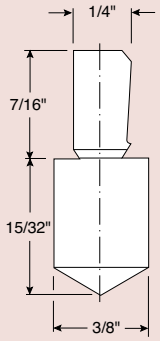
Optional Accessories

For Rockwell/Rockwell Superficial Type Hardness Testing machine

Calibration Set

Order No. 64BAA241 C Scale Set	Order No. 64BAA242 B Scale Set
Test Blocks	Test Blocks
64BAA125	64BAA126
64BAA124	64BAA132
64BAA158	64BAA135
Indenter	Indenter
64BAA072	64BAA078
Order No. 64BAA243 30N Scale Set	**Order No. 64BAA244 30T Scale Set**
Test Blocks	Test Blocks
64BAA128	64BAA129
64BAA165	64BAA140
64BAA167	64BAA130
Indenter	Indenter
64BAA073	64BAA078

Rockwell Type Diamond Indenters



Order No.	Scale
64BAA072	C
64BAA073	N
64BAA086	A
64BAA071	C & N

Order No.	Hardness
64BAA159	HRA81/86 Rockwell Test Block
64BAA160	HRA75/79 Rockwell Test Block
64BAA161	HRA70/73 Rockwell Test Block
64BAA162	HRA65/68 Rockwell Test Block
64BAA163	HRA60/62 Rockwell Test Block
64BAA249	HRBW95/100 Rockwell Test Block
64BAA126	HRBW90/95 Rockwell Test Block
64BAA131	HRBW80/85 Rockwell Test Block
64BAA132	HRBW70/75 Rockwell Test Block
64BAA133	HRBW60/65 Rockwell Test Block
64BAA134	HRBW50/55 Rockwell Test Block
64BAA135	HRBW40/45 Rockwell Test Block
64BAA127	HRBW30/35 Rockwell Test Block
64BAA136	HRBW20/25 Rockwell Test Block
64BAA137	HRBW10/15 Rockwell Test Block
64BAA138	HRBW0/5 Rockwell Test Block
64BAA125	HRC60/65 Rockwell Test Block
64BAA157	HRC50/55 Rockwell Test Block
64BAA124	HRC40/45 Rockwell Test Block
64BAA123	HRC30/35 Rockwell Test Block
64BAA158	HRC20/25 Rockwell Test Block

Order No.	Hardness
64BAA129	HR30T74/79 Rockwell Test Block
64BAA139	HR30T70/73 Rockwell Test Block
64BAA140	HR30T63/67 Rockwell Test Block
64BAA141	HR30T56/60 Rockwell Test Block
64BAA142	HR30T49/53 Rockwell Test Block
64BAA130	HR30T43/47 Rockwell Test Block
64BAA143	HR30T36/39 Rockwell Test Block
64BAA144	HR30T29/33 Rockwell Test Block
64BAA145	HR30T22/26 Rockwell Test Block
64BAA146	HR30T15/18 Rockwell Test Block
64BAA147	HR15T90/92 Rockwell Test Block
64BAA148	HR15T86/69 Rockwell Test Block
64BAA149	HR15T83/85 Rockwell Test Block
64BAA150	HR15T80/82 Rockwell Test Block
64BAA151	HR15T77/79 Rockwell Test Block
64BAA152	HR15T72/74 Rockwell Test Block
64BAA153	HR15T70/72 Rockwell Test Block
64BAA154	HR15T68/69 Rockwell Test Block
64BAA155	HR15T64/66 Rockwell Test Block
64BAA156	HR15T61/63 Rockwell Test Block

Order No.	Hardness
64BAA222	HR45N65/70 Rockwell Test Block
64BAA223	HR45N55/60 Rockwell Test Block
64BAA224	HR45N45/50 Rockwell Test Block
64BAA225	HR45N35/40 Rockwell Test Block
64BAA226	HR45N25/30 Rockwell Test Block
64BAA128	HR30N64/69 Rockwell Test Block
64BAA164	HR30N68/73 Rockwell Test Block
64BAA165	HR30N59/64 Rockwell Test Block
64BAA166	HR30N50/55 Rockwell Test Block
64BAA167	HR30N40/45 Rockwell Test Block
64BAA168	HR15N90/93 Rockwell Test Block
64BAA169	HR15N85/88 Rockwell Test Block
64BAA170	HR15N80/83 Rockwell Test Block
64BAA171	HR15N75/77 Rockwell Test Block
64BAA172	HR15N69/72 Rockwell Test Block

Carbide Ball Indenters

Order No.	Description
11AAD465	1/16″ Carbide ball indenter
11AAD466	1/8″ Carbide ball indenter
11AAD467	1/4″ Carbide ball indenter
11AAD468	1/2″ Carbide ball indenter
19BAA507	1/16″ Carbide ball (1pc.)
19BAA508	1/8″ Carbide ball (1pc.)
19BAA509	1/4″ Carbide ball (1pc.)
19BAA510	1/2″ Carbide ball (1pc.)

Steel Ball Indenters

Order No.	Description
11AAD461	1/16″ diameter steel ball indenter
19BAA078	1/16″ diameter steel ball indenter (auto-discrimination type)
11AAD462	1/8″ diameter steel ball indenter
64BAA079	1/8″ diameter steel ball indenter (auto-discrimination type)
11AAD463	1/4″ diameter steel ball indenter
64BAA080	1/4″ diameter steel ball indenter (auto-discrimination type)
11AAD464	1/2″ diameter steel ball indenter
64BAA081	1/2″ diameter steel ball indenter (auto-discrimination type)
64BAA082	1/16″ diameter spare steel ball (10 pcs)
64BAA083	1/8″ diameter spare steel ball (10 pcs)
64BAA084	1/4″ diameter spare steel ball (10 pcs)
64BAA085	1/2″ diameter spare steel ball (10 pcs)

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Optional Accessories

For Rockwell/Rockwell Superficial Type Hardness Testing machine

Round table
810-038 Outside ø250 mm

For large specimens such as molded items

Round table
810-037 Outside ø180 mm

For large specimens such as molded items

V-anvil (large)
810-040
(Outside ø40 mm,
Groove width 30 mm)

For round specimens (max. ø60 mm)

V-anvil (small)
810-041
(Outside ø40 mm,
Groove width 6 mm)

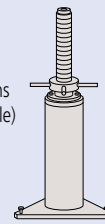
For shaft materials (max. ø8.4 mm)

Spot anvil
810-043
(Outside ø12 mm)

Spot anvil
810-044
(Outside ø5.5 mm)

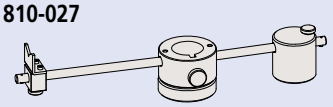
For sheet specimens

Jack rest
810-028
For supporting long specimens
(Used with anvil or round table)



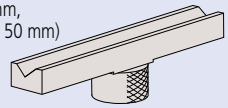
EXPAK Data processing software
11AAC236 HR530 and HM200 Series
11AAC237 HR523 Series

VARI-REST
810-027



For testing long specimens (commonly used for the anvil)

Special V-anvil
810-029
(Length 400 mm,
Groove width 50 mm)



For round specimens ø14-98 mm

Diamond-spot anvil
810-030
(Outside ø10 mm)
For sheet specimens

*Dedicated to the Rockwell Superficial hardness test

Small V-anvil
810-042
(Outside ø10 mm)

For round specimens (max. ø16 mm)

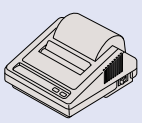
Testing machine table
11AAD186
Supplied with
stability bracket

Testing machine table

Vibration isolator
810-643
Only for mounting hardness testing machines

Foot switch
11AAD537

Printer
DPU-414
02AGD600B
with connection cable



Digimatic mini-processor
DP-1VA
264-505A

Connection cable not supplied. (To be ordered separately.)

937386

936937

Optional Accessories

HR523 and most older models:

06AFM380E: USB input tool – Tester to PC
937386: Tester to DP1-VA Printer

HM200 and HR-530 Series:

06AFM380D: USB input tool – Tester to PC
936937: Tester to DP1-VA Printer

Refer to Bulletin No. (2255) for more details.

Hardmatic HH-411

SERIES 810 — Impact Type Hardness Testing Unit

HH-411 is a rebound-type portable hardness tester for metal with a compact body and high operability. It allows anyone to perform hardness testing easily at the touch of a key, so it can be used widely on various components in the field.

810-298-10: ASTM standard
Including the display unit, D type impactor (**810-287-10**) and carbide ball (**19BAA457**).

Technical Data

Impactor:	Impact hammer with integrated detector and carbide-ball tip (D type: conforming to ASTM A 956)
Display unit:	7-segment LCD
Functions:	Auto angle compensation, Offset, go/no-go judgment, Hardness scale conversion Data storage (1800 data entries) Statistical analysis (Average, Maximum, Minimum, Dispersion) Auto sleep function Impact counter display function
Testable workpiece	
Thickness:	Minimum 5mm or more
Mass:	5kg or more in mass
Test points:	5mm or more from the edge of the sample, 3mm or more to each of the tested points.
Surface roughness:	Ra 10μm or less
Power supply:	Lithium AA battery 2pcs or optional AC adapter (battery life: 70 hours)

Standard Accessories

19BAA265 Test Block HLD800
810-291-10 Display Unit
810-287-10 Detector
19BAA460 Cable
Battery AA (Lithium) 2pcs.

Optional Accessories

264-505A: Digimatic Mini-Processor DP-1VR
937387: Connecting cable for
09EAA082: Printer paper (10 rolls/set)
810-622A: Thermal printer DUP-414
19BAA285: Thermal printer connecting cable
19BAA157: Thermal printer paper
19BAA238: RS-232C connecting cable for PC
06AEG302JA: AC adapter of display unit
19BAA243: Hardness test block (880HLD)
19BAA244: Hardness test block (830HLD)
19BAA245: Hardness test block (730HLD)
19BAA246: Hardness test block (620HLD)
19BAA247: Hardness test block (520HLD)
19BAA248: Support ring for convex surface of cylinder (R10 - R20)
19BAA249: Support ring for convex surface of cylinder (R14 - R20)
19BAA250: Support ring for convex surface of sphere (R10 - R27.5)
19BAA251: Support ring for concave surface of sphere (R13.5 - R20)
19BAA457: Carbide ball for D, DC, D+15 type impactors
19BAA458: Ball shaft for DL type impactor
810-287-10: D type impactor UD-411
810-288-10: DC type impactor UD-412
810-289-10: D+15 type impactor UD-413
810-290-10: DL type impactor UD-414

SPECIFICATIONS

Model	HH-411		
Order No.	**810-298-10**		
Hardness Range	L-Value (ASTM A956)		
Detector	Input device D (carbide ball)		
Display	**Hardness**	**Range**	**Resolution**
	HL	1-999 HL	1 HL
	HV	43-950 HV	1 HV
	HB	20-894 HB	1 HB
	HRC	19.3-68.2 HRC	0.1 HRC
	HRB	13.5 - 101.7 HRB	0.1 HRB
	HS	13.2 - 99.3 HS	0.1 HS
	HTN	499 - 1996 Mpa	1 Mpa
Functions	Conversions: HL,HV, HB, HRC, HRB, HS, HTN Judgment: go/no go Offsetting Memory: 1,800 data		
Indentation Direction	Any direction		
Output	RS-232C, SPC		
Power supply	Lithium AA Battery 2pcs.		
Dimensions	Detector: (Dia. X H) 1.10" x 6.89" (28 x 175mm) Display: (W x D x H) 2.76" x 4.33" x 1.38" (70 x 110 x 35mm)		
Mass	Detector: .26lbs (120g) Display: .44lbs (200g)		

Impactors (Optional accessories)

Various impactors can be connected to the display unit.

810-288-10
Use for inner walls of cylinders. The grip is short to allow easy positioning within a cylinder.

810-289-10
Use for concave workpieces such as gear teeth, ball bearing races, etc.

810-290-10
Use for gear teeth, welded corners, etc.

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Hardmatic HH-300

SERIES 811 — Durometers for Rubber and Plastics Hardness Testing

FEATURES

Digital / Dial Durometers are suitable for testing the nature of the following materials — natural rubber, neoprene, polyesters, P.V.C., leather, nitrite rubber, wax, vinyl, cellulose acetates, glass polystyrene, etc.

Compact Digital **811-336-10**
Compact Dial **811-335-10**

Long Leg Digital **811-332-10**
Long Leg Dial **811-331-10**

Technical Data

- Designed in accordance with the ASTM D 2240, ISO868, ISO 7619, DIN 53 505, JIS K 6253, and JIS K 7215 specifications.
- Units are available in both Shore A and Shore D scales, and will test a wide variety of applications.
- The Digital Durometer is provided with data hold function, permitting the operator to make an error-free reading on the LCD screen.
- The Dial Durometer is provided with a peak retaining hand for error-free reading.

SPECIFICATIONS

Order No.	Digital	**811-330-10**	**811-336-10**	**811-336-11**	**811-332-10**	**811-338-10**	**811-338-11**	**811-334-10**
	Dial	**811-329-10**	**811-335-10**	**811-335-11**	**811-331-10**	**811-337-10**	**811-337-11**	**811-333-10**
Model No.	Digital	HH-330	HH-336	HH-336	HH-332	HH-338	HH-338	HH-334
	Dial	HH-329	HH-335	HH-335	HH-331	HH-337	HH-337	HH-333
Scale		Shore E	Shore A			Shore D		
Applications		Soft Rubber, Sponge, Felt, Hard Foam	Natural rubber, soft elastomers, etc.			Hard elastomers, plastics, hard rubber, ebonite, etc.		
Resolution		0.1 (digital) or 1 (dial)				0.1 (digital) or 1 (dial)		
Range		HA: 10 - 90				HD: 20 - 90		
Standards	ASTM D 2240	—	✓	✓		✓	✓	
	ISO 868	—	✓	✓		✓	✓	
	ISO 7619	—	✓	✓		✓	✓	
	DIN 53 505	—	—	✓		—	✓	
	JIS K 6253	✓	✓	✓		✓	✓	
	JIS K 7215	—	✓	✓		✓	✓	
Pressure foot		44 x 18mm	44 x 18mm	ø18mm		44 x 18mm	ø18mm	
Spring force (mN)		WE=550+HE	WA=550+75HD (HA:Reading 10-90)			WD=444.5HD (HD:Reading 20-90)		
Indenter		Sphere (Tip diameter: 0.79mm)	Blunt taper (Tip diameter: 0.79mm)			Sharp point (Tip curvature: 0.1±0.01mm)		
Tip angle		—	35°±0.25°			30°±0.5°		
Indenter diameter		5mm	1.25mm					
Indenter protrusion		2.5mm						
Functions		Digital: Data hold, Zero -setting, SPC output, Power ON/OFF (Power supply: SR44 x 1pc.) Analog Durometer: Peak retaining hand						
Type		Compact	Compact		Long-leg	Compact		Long-leg
Dimensions (WxDxH)	Digital	60 x 28.5 x 151	60 x 28.5 x 151mm		60 x 28.5 x 193mm	60 x 28.5 x 151mm		60 x 28.5 x 193mm
	Dial	56 x 33.5 x 144mm	56 x 33.5 x 144mm		56 x 33.5 x 186mm	56 x 33.5 x 144mm		56 x 33.5 x 186mm
Mass	Digital	290g	290g		310g	290g		310g
	Dial	300g	300g		320g	300g		320g

Hardmatic HH-300

Test Block Set

64AAA964

64AAA963

905693

811-332-10

264-505A

Testing stand applications

These stands are used to mount Durometers. They allow constant-pressure hardness measurement by pressing the Durometer vertically on a workpiece.

- Anyone can perform repeatable hardness measurement due to fewer possibilities of human error and measurement variations.
- The supplied weights can be attached directly to a Durometer and allow constant-pressure hardness measurement of large samples for which a stand cannot be used.
- The supplied weights are used for calibrating the spring tension of Durometers.

Item No.	Description
64AAA964	Calibration Set (Shore A Scale) Test Block 30* DURO (Blue) Test Block 60* DURO (Yellow) Test Block 90* DURO (Gray) Mahogany Box
64AAA590	Calibration Set (Shore D Scale) Test Block 20* DURO (Blue) Test Block 40* DURO (Gray) Test Block 80* DURO (Black)
64AAA962	"A" Scale Durometer Stand
64AAA794	"A" Scale Durometer Stand with Air Damper
64AAA796	Combination "D" & "A" Scale Durometer Stand
64AAA963	O-Ring Fixture Set 1/16", 3/32", 1/8", 3/16" and 1/4" O-Ring cross sections
264-505A	Digimatic Miniprocessor with printer
905693	Connecting Cable 40" (1m) for Durometer and Digimatic Miniprocessor

* Values shown are nominal only. Test Block Size 2" x 2" x 1/4"

Mitutoyo

Hardness Testing Machines

Hardness Test Methods and Guidelines for Selection of a Hardness Testing Machine

Material / Test Method	Micro Vickers	Micro surface material characteristics	Vickers	Rockwell	Rockwell Superficial	Durometer	Rebound type portable	Brinell	Shore
IC wafer	●	●							
Carbide, ceramics (cutting tool)		▲	●	●					
Steel (heat-treated material, raw material)	●	▲	●	●	●		●		●
Non-ferrous metal	●	▲	●	●	●		●		
Plastic		▲		●		●			
Grinding wheel				●					
Casting								●	
Sponge, rubber						●			
Shape									
Thin metal sheet (safety razor, metal foil)	●	●	●		●				
Thin film, plating, painting, surface layer (nitrided layer)	●	●							
Small parts, acicular parts (clock hand, sewing-machine needle)	●	▲							
Large specimen (structure)							●	●	●
Metallic material configuration (hardness for each phase of multilayer alloy)	●	●							
Plastic plate	▲	▲		●		●			
Sponge, rubber plate						●			
Inspection, judgment									
Strength or physical property of materials	●	●	●	●	●	●	▲	●	●
Heat treatment process	●		●	●	●		▲		▲
Carburized case depth	●		●						
Decarburized layer depth	●		●		●				
Flame or high-frequency hardening layer depth	●		●	●					
Hardenability test			●	●					
Maximum hardness of a welded spot			●						
Weld hardness			●	●					
High-temperature hardness (high-temperature characteristics, hot-workability)			●						
Fracture toughness (ceramics)	●		●						

Key: ● Well-suited ▲ Reasonably suited

Methods of Hardness Measurement

(1) Vickers

Vickers hardness is a test method that has the widest application range, allowing hardness inspection with an arbitrary test force. This test has an extremely large number of application fields particularly for hardness tests conducted with a test force less than 9.807N (1kgf). As shown in the following formula, Vickers hardness is a value determined by dividing test force F (N) by contact area S (mm^2) between a specimen and an indenter, which is calculated from diagonal length d (mm, mean of two directional lengths) of an indentation formed by the indenter (a square pyramidal diamond , opposing face angle θ=136°) in the specimen using a test force F (N). k is a constant ($1/g$=1/9.80665).

$$HV=k\frac{F}{S}=0.102\frac{F}{S}=0.102\frac{2F\sin\frac{\theta}{2}}{d^2}=0.1891\frac{F}{d^2}$$

F:N
d:mm

The error in the calculated Vickers hardness is given by the following formula. Here, Δd_1, Δd_2, and 'a' represent the measurement error that is due to the microscope, an error in reading an indentation, and the length of an edge line generated by opposing faces of an indenter tip, respectively. The unit of $\Delta\theta$ is degrees.

$$\frac{\Delta HV}{HV}\fallingdotseq\frac{\Delta F}{F}-2\frac{\Delta d_1}{d}-2\frac{\Delta d_2}{d}-\frac{a^2}{d^2}\ 3.5\times10^{-3}\Delta\theta$$

(2) Knoop

As shown in the following formula, Knoop hardness is a value obtained by dividing test force by the projected area A (mm^2) of an indentation, which is calculated from the longer diagonal length d (mm) of the indentation formed by pressing a rhomboidal diamond indenter (opposing edge angles of 172°30' and 130°) into a specimen with test force F applied. Knoop hardness can also be measured by replacing the Vickers indenter of a microhardness testing machine with a Knoop indenter.

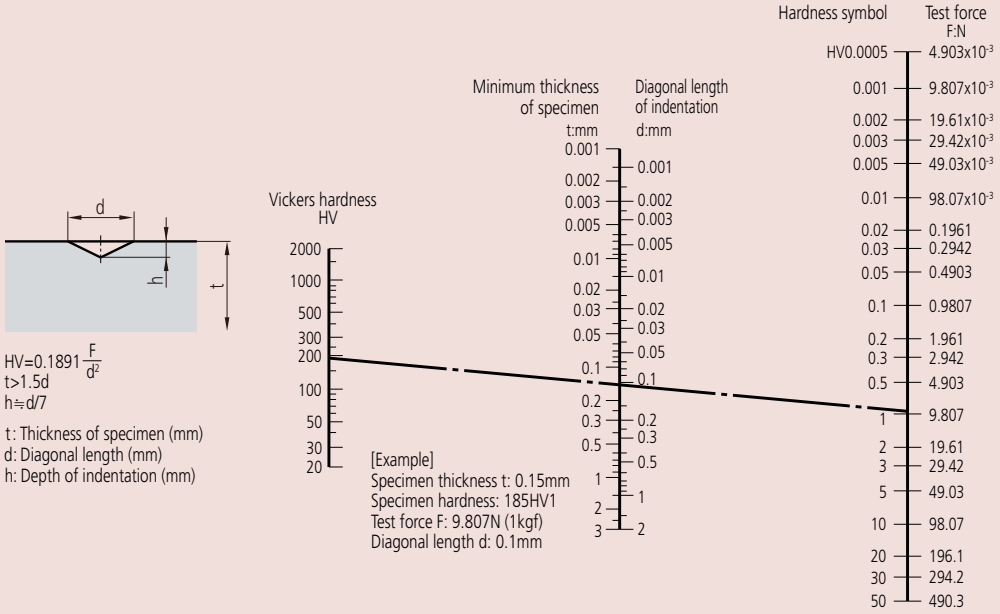
$$HK=k\frac{F}{A}=0.102\frac{F}{A}=0.102\frac{F}{cd^2}=1.451\ \frac{F}{d^2}$$

F:N
d:mm
c:Constant

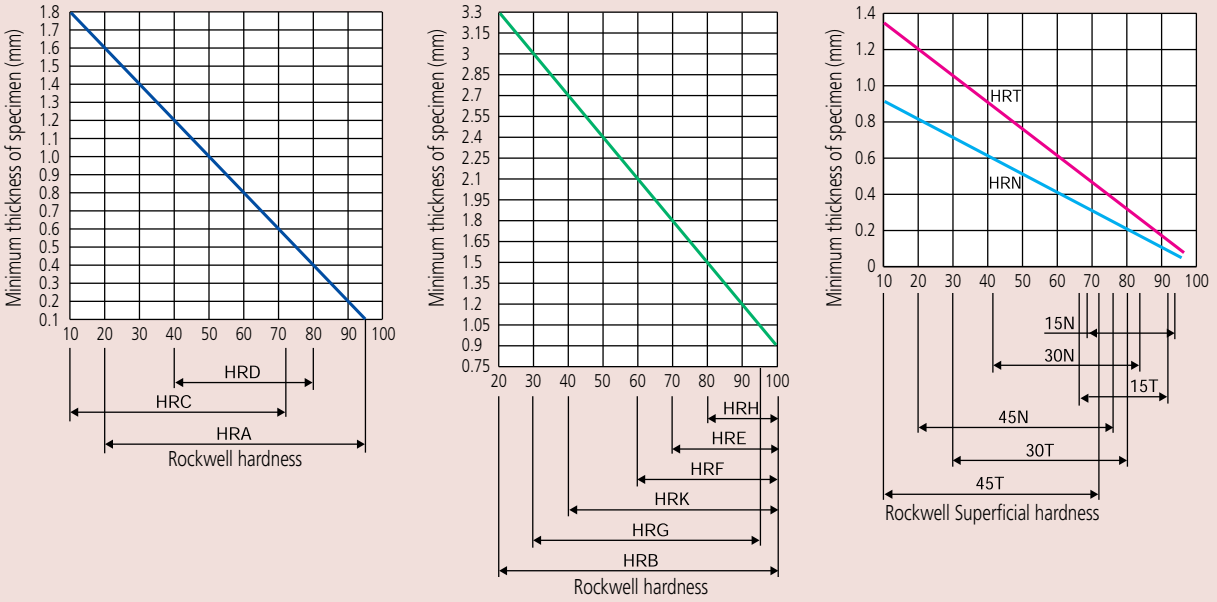
(3) Rockwell and Rockwell Superficial

To measure Rockwell or Rockwell Superficial hardness, first apply a preload force and then the test force to a specimen and return to the preload force using a diamond indenter (tip cone angle: 120°, tip radius: 0.2mm) or a sphere indenter (steel ball or carbide ball). This hardness value is obtained from the hardness formula expressed by the difference in indentation depth h (μm) between the preload and test forces. Rockwell uses a preload force of 98.07N, and Rockwell Superficial 29.42N. A specific symbol provided in combination with a type of indenter, test force, and hardness formula is known as a scale. Japanese Industrial Standards (JIS) define various scales of related hardness.

Relationship Between Vickers Hardness and the Minimum Allowable Thickness of a Specimen



Relationship Between Rockwell/Rockwell Superficial Hardness and the Minimum Thickness of a Specimen



Rockwell Hardness Scales

Scale	Indenter	Test force	Application
A	Diamond	588.4N	Carbide, sheet steel
D		980.7N	Case-hardened steel
C		1471N	Steel (100HRB or more to 70HRC or less)
F	Sphere of 1.5875mm diameter	588.4N	Bearing metal, annealed copper
B		980.7N	Brass
G		1471N	Hard aluminum alloy, beryllium copper, phosphor bronze
H	Sphere of 3.175mm diameter	588.4N	Bearing metal, grinding wheel
E		980.7N	Bearing metal
K		1471N	Bearing metal
L	Sphere of 6.35mm diameter	588.4N	Plastic, lead
M		980.7N	
P		1471N	
R	Sphere of 12.7mm diameter	588.4N	Plastic, lead
S		980.7N	
V		1471N	

Rockwell Superficial Hardness Scales

Scale	Indenter	Test force	Application
15-N	Diamond	147.1N	Thin surface-hardened layer on steel such as carburized or nitrided
30-N		294.2N	
45-N		441.3N	
15-T	Sphere of 1.5875mm diameter	147.1N	Sheet of mild steel, brass, bronze, etc.
30-T		294.2N	
45-T		441.3N	
15-W	Sphere of 3.175mm diameter	147.1N	Plastic, zinc, bearing alloy
30-W		294.2N	
45-W		441.3N	
15-X	Sphere of 6.35mm diameter	147.1N	Plastic, zinc, bearing alloy
30-X		294.2N	
45-X		441.3N	
15-Y	Sphere of 12.7mm diameter	147.1N	Plastic, zinc, bearing alloy
30-Y		294.2N	
45-Y		441.3N	

MITUTOYO INSTITUTE OF METROLOGY

The Mitutoyo Institute of Metrology, the educational department of Mitutoyo America, provides unrivaled educational seminars, courses and on-demand resources for a wide variety of metrology and measurement-related topics such as basic inspection techniques, principles of dimensional metrology, calibration methods and GD&T. This comprehensive curriculum meets the educational needs of manufacturing, quality and measurement professionals. These popular courses are scheduled regularly throughout the year.

The calibration expertise of Mitutoyo America is now available on-demand for anybody through our On-Demand Portal. Here, you can access metrology educational materials that leverages the available American National Standards in dimensional metrology.

Mitutoyo now offers online courses introducing important concepts in general calibration of micrometers and calipers. Mitutoyo also offers the first certified credentials in dimensional calibration in the United States, addressing both theory (Level 1 credential) and hands-on performance skills (Level 2 credential). These credentials satisfy auditors' requirements.

If you have any questions or would like more information regarding Mitutoyo Institute of Metrology, contact: **MIM@Mitutoyo.com**

Mitutoyo
Institute of Metrology

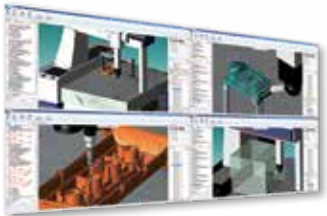
L

Coordinate Measuring Machines

NEW-STYLE
Vision Measuring Systems

SurfaceMeasure Probes
(Laser scanning probes—non-contact)

CRYSTA-Apex EX 500T w/PH-20 Probe



MiCAT Planner

LEGEX 574

INDEX

Surftest Probe
(surface finish)

MACH Kogame

Mitutoyo

Mitutoyo CMM Accuracy Statements

The accuracy statements specified on the following pages for Mitutoyo CMM's are based on ISO standards. The following is a brief description of these standards.

Performance Assessment Method of Coordinate Measuring Machines

CMM accuracy is specified in accordance to international standards, the ISO 10360 series of standards, and entitled "Acceptance and Reverification Test for CMMs." ISO 10360 consists of multiple parts, with each part describing tests that apply to various configuration and components of CMMs.

Table 1 JIS B 7440 (2003) Series

	Item	JIS Standard No.	Year of issue
1	Terms	ISO 10360-1	2000
2	Dimensional measurement	ISO 10360-2	2009
3	Rotary table-equipped CMM	ISO 10360-3	2000
4	Scanning measurement	ISO 10360-4	2000
5	Probing systems	ISO 10360-5	2010

Maximum Permissible Measuring Error $E_{0,MPE}$ ISO 10360-2:2009

This volumetric test procedure requires that a coordinate measuring machine (CMM) is made to perform a series of five different length measurements in each of seven directions, as shown in Figure 1, to produce a set of 35 measurements. This sequence is then repeated twice more to produce 105 measurements in all. If these test values are equal to or less than the limits specified by the manufacturer, then the performance of the CMM has been determined to meet its specification. This test procedure is a part of Mitutoyo America Corporation's A2LA-accredited calibration of Mitutoyo CMMs.

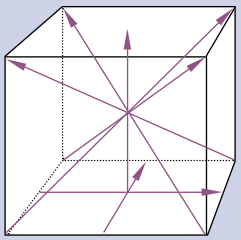


Figure 1 Typical test measurement directions within the CMM measuring volume

Maximum Permissible Measuring Error $E_{150,MPE}$ ISO 10360-2:2009

This test is an extension of the E0 test but uses a probe tip that is offset a default length of 150 mm perpendicular to the ram axis of the CMM (typically the Z-axis). Five different lengths are measured along two different planar diagonals to produce 10 measurements. This sequence is then repeated twice more to produce 30 measurements in all. If these test values are equal to or less than the specified limits, then the performance of the CMM has been determined to meet its specification.
This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

Maximum Permissible Limit Repeatability of the Range $R_{0,MPL}$ ISO 10360-2:2009

This test of repeatability is not a separate test but is determined directly from the E0 test values. For each of the 35 sets of three repeated length measurements, the difference between the maximum and minimum of the three test values is calculated. If these 35 calculated test values are equal to or less than the specified limits, then the CMM has been determined to meet its specification.
This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

Maximum Permissible Scanning Probing Error MPE_{THP} ISO 10360-4:2000

This is the accuracy standard for a CMM if equipped with a scanning probe. The test procedure under this standard is to perform a scanning measurement of 4 planes on the standard sphere and then, for the least squares sphere center calculated using all the measurement points, calculate the range (dimension 'A' in Figure 2) in which all measurement points exist. Based on the least squares sphere center calculated above, calculate the distance between the calibrated standard sphere radius and the maximum measurement point or minimum measurement point, and take the larger distance (dimension 'B' in Figure 2). If both calculated values are less than the specified limits, this scanning probe test is passed.

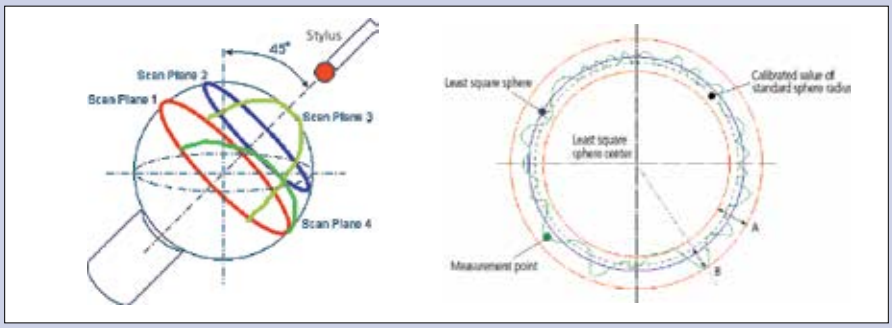


Figure 2 Target measurement planes for the maximum permissible scanning probing error and its evaluation concept

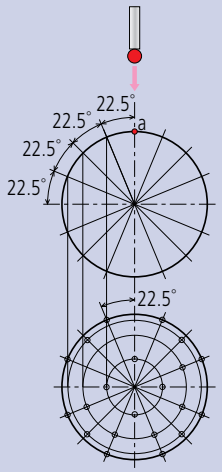


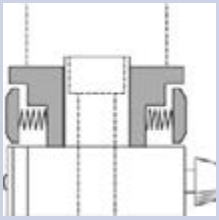
Figure 3 Target points on standard sphere for determining the Maximum Permissible Probing Error

Maximum Permissible Probing Error $P_{FTU,MPE}$ ISO 10360-5:2010

The test procedure under this standard is that a probe is used to measure defined target points on a standard sphere (25 points, as in Figure 3) and the result used to calculate the position of the sphere center by a least squares method. Then the distance R from the sphere center for each of the 25 measurement points is calculated, and the radius difference Rmax - Rmin is computed. If this final calculated value is equal to or less than the specified value, the probe has passed the test.

CRYSTA-Plus M

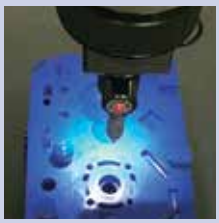
SERIES 196 — Manual Floating CMM



Ergonomically designed guide grip on Z-axis for reliable measurement
(only for Crysta-Plus M776 and M7106)

One-touch air clamp and fine feed for rapid and easy positioning

Crysta-Plus M443



Probe illumination (optional) to illuminate the probe and styli directly and brighten the working field

Manual floating CMMs were developed in quest for high-accuracy, low-cost and easy operation. The Crysta-Plus M is suitable to measure a wide range of applications from a simple dimension to a complex form. The scale systems on Mitutoyo high-precision models use a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been used in the structure, part processing and assembly to provide high-accuracy measurement.

The Crysta-Plus M700 series has a large main unit and is equipped with a mobile clamp so that one-touch clamping on each axis can be performed by hand. Continuous fine feed over the entire measuring range can be performed.

FEATURES

- Smooth operation utilizing high-precision air bearings and lightweight moving members.
- Continuous fine feed over the entire measuring range.
- One-touch air clamp for each axis.

Crysta-Plus M574

MH20i
see page L-20

Crysta-Plus M7106

SPECIFICATIONS

Type: Bridge	Model No.	Crysta-Plus M443	Crysta-Plus M574	Crysta-Plus M7106
Range	X axis	15.74″ (400mm)	19.68″ (500mm)	27.55″ (700mm)
	Y axis	15.74″ (400mm)	27.55″ (700mm)	39.36″ (1000mm)
	Z axis	11.81″ (300mm)	15.74″ (400mm)	23.62″ (600mm)
Resolution		0.000019″ (0.0005mm)		
Work table	Material	Granite		
	Size	24.56″ x 31.69″ (624mm x 805mm)	30.07″ x 46.25″ (764mm x 1175mm)	35.43″ x 68.50″ (900mm x 1740mm)
	Tapped insert	M8 x 1.25mm		
Workpiece	Max. height	18.89″ (480mm)	23.22″ (590mm)	31.49″ (800mm)
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)
Mass (incl. stand)		793 lbs. (360kg)	1,424 lbs. (646kg)	3,968 lbs. (1800kg)
Dimensions W x D x H		38.62 x 41.22 x77.44″ (981 x 1047 x 1967mm)	56.45 x 44.17 x 89.25″ (1434 x 1122 x 2267mm)	57.48 x 79.40 x 111.81″ (1460 x 2017 x 2840mm)
Air Supply	Pressure	50.7 PSI (0.35MPa)		58.0 PSI (0.4MPa)
	Consumption	1.76CFM (50L/min)		
	Source	3.53CFM (100L/min)		
ISO-10360-2: 2001				
19-21°C (66.2-69.8°F)	TP20: E	(3.0+4.0L/1000)µm	(3.5+4.0L/1000)µm	(4.5+4.5L/1000)µm
	TP20: R	4µm		5µm

Stylus Configurations for ISO Tests	
TP20:	Ø4mm x L10mm

Environment	19-21°C (66.2-69.8°F)
Rate of change	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

See page L-2 for explanation of ISO accuracy statements

Mitutoyo

CRYSTA-Apex S 500/700/900/1200

High-performance, low-price CNC Coordinate Measuring Machine that meets global standards

SERIES 191 — Standard CNC CMM

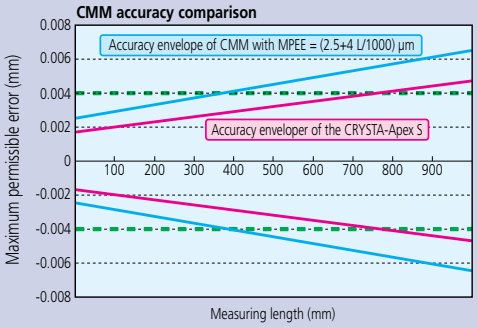
High accuracy in the 1.7µm class

The CRYSTA-Apex S is a high-accuracy CNC coordinate measuring machine that guarantees a maximum permissible error of $*E_{0,MPE}$ = (1.7+3L/1000)µm [500/700/900 Series]. Comparing the CRYSTA-Apex S with CMMs offering $*E_{0,MPE}$ of approximately (2.5+4L/1000)µm where a required tolerance on a dimension is ±0.02 mm, then the measuring machine uncertainty should be no more than one-fifth (ideally one-tenth) of that, i.e. 4µm. This means that with a general purpose CMM, when the measured length exceeds 14.8"(375mm), machine uncertainty exceeds one-fifth of the dimension tolerance in this case. In contrast, as shown in the figure on the right, with the CRYSTA-Apex S the measurement uncertainty remains within one-fifth of the dimension tolerance up to 30.2" (766mm). The higher accuracy specification of the CRYSTA-Apex S, therefore, gives it more than double the effective measuring range in terms of accuracy-guarantee capability in this case.

**ISO 10360-2:2009*

Surftest
(surface finish)
See page L-27

CRYSTA-Apex S 544 **CRYSTA-Apex S 776** **CRYSTA-Apex S 9106**



SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 544	CRYSTA-Apex S 574	CRYSTA-Apex S 776	CRYSTA-Apex S 7106	CRYSTA-Apex S 9106	CRYSTA-Apex S 9166	CRYSTA-Apex S 9206
Range	X axis	19.68" (500mm)		27.55" (700mm)		35.43" (900mm)		
	Y axis	15.74" (400mm)	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)	78.73" (2000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)				
Resolution		0.000004" (0.0001mm)						
Guide Method		Air bearing on each axis						
Maximum Drive Speed 3D		20.43"/s (519mm/s)						
Maximum Acceleration 3D		0.23G (2,309mm/s²)						
Work table	Material	Granite						
	Size	25.11 x 33.86" (638 x 860mm)	25.11 x 45.67" (638 x 1160mm)	34.64 x 55.90" (880 x 1420mm)	34.64 x 67.71" (880 x 1720mm)	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.08" (1080 x 2720mm)
	Tapped insert	M8 x 1.25mm						
Workpiece	Max. height	21.45" (545mm)		31.49" (800mm)				
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)	2,204 lbs. (1000kg)	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)
Mass (incl. stand & controller)		1,135 lbs. (515kg)	1,377 lbs. (625kg)	3,692 lbs. (1675kg)	4,301 lbs. (1951kg)	4,918 lbs. (2231kg)	6,322 lbs. (2868kg)	8,624 lbs. (3912kg)
Dimensions W x D x H		42.60x46.88x86.02" (1082x1191x2185mm)	42.60x60.94x86.02" (1082x1548x2185mm)	57.87x66.92x107.48" (1470x1700x2730mm)	57.87x78.73x107.48" (1470x2000x2730mm)	65.74x78.73x107.48" (1670x2000x2730mm)	65.74x107.87x107.48" (1670x2740x2730mm)	65.74x126.77x107.48" (1670x3220x2730mm)
ISO-10360-2:2009 $E_{0,MPE}$								
18-22°C (64.4-71.6°F)	TP200:	(1.9+3L/1000)µm						
	MPP310/SP25:	(1.7+3L/1000)µm						
16-26°C (60.8-78.8°F)	TP200:	(1.9+4L/1000)µm						
	MPP310/SP25:	(1.7+4L/1000)µm						
ISO-10360-2:2009 $E_{150,MPE}$ †								
18-22°C (64.4-71.6°F)	TP200:	(2.4+3L/1000)µm						
	MPP310/SP25:	(1.7+3L/1000)µm						
16-26°C (60.8-78.8°F)	TP200:	(2.4+4L/1000)µm						
	MPP310/SP25:	(1.7+4L/1000)µm						
ISO-10360-2:2009 $R_{0,MPL}$ †								
	TP200:	1.5µm		1.9µm				
	MPP310/SP25:	1.3µm						
ISO-10360-4 MPE_{THP}/MPT_{THP} †								
	SP25:	2.3µm/50sec						
	SP80:	N/A		2.0µm/50sec				
	MPP310:	1.8mm/90sec			1.8mm/80sec			
ISO-10360-5: 2010 $P_{FTU,MPE}$								
	TP200:	1.9µm						
	SP25:	1.7µm						
	MPP310:	1.5µm		1.7µm				

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	500	700/900
Pressure	58.0 PSI (0.4MPa)	
Consumption	1.76CFM (50L/min)	2.11CFM (60L/min)
Source	3.53CFM (100L/min)	

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

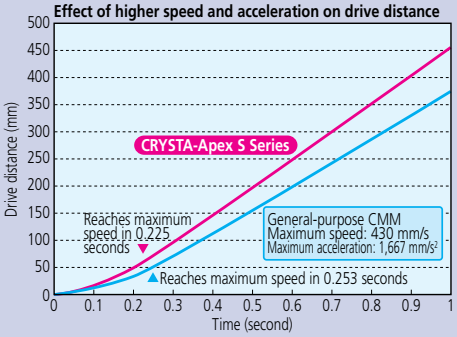
† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements

CRYSTA-Apex S 500/700/900/1200

SERIES 191 — Standard CNC CMM

Integrated Y-Axis in Granite Table



Designed for high rigidity

As is the case with Mitutoyo's conventional CMMs, various structures are employed in the CRYSTA-Apex S in order to give the body higher rigidity. The Y-axis guide rail, which is attached to one side of the granite surface plate, shows very little deterioration with use, and thus promises to maintain high accuracy for a long time. The air bearings located on the bottom face, in addition to those at the front, rear, and upper surfaces of the slider unit of the X-axis, minimize vibration even during high-speed, high-acceleration movement, thus ensuring stable linear motion.

Supported Probe Systems			
Type	**Probe**	**AS500**	**AS700/900/1200**
TOUCH TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	—	●
LASER PROBES	SM606	▲	●
	SM606T	▲	●
	SM610	▲	●
	SM1010	▲	●
SURFACE FINISH	SurfTest	●	●
OPTICAL	QVP	▲	●
	CF20	●	●

● Supported ▲ Not Recommended — Not supported

See page L-20 through L-27 for probe system information

CRYSTA-Apex S 122010

SP25 Probe
(Scanning)
See page L-21

Quick Vision Probe
(Optical probe–non-contact)
See page L-26

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 9108	CRYSTA-Apex S 9168	CRYSTA-Apex S 9208	CRYSTA-Apex S 121210	CRYSTA-Apex S 122010	CRYSTA-Apex S 123010
Range	X axis	35.43" (900mm)			47.24" (1200mm)		
	Y axis	39.36" (1000mm)	62.99" (1600mm)	78.73" (2000mm)	47.24" (1200mm	78.73" (2000mm)	118.1" (3000mm)
	Z axis	31.49" (800mm)			39.36" (1000mm)		
Resolution		0.000004" (0.0001mm)					
Guide Method		Air bearing on each axis					
Maximum Drive Speed 3D		20.43"/s (519mm/s)			27.28"/s (693mm/s)		
Maximum Acceleration 3D		0.17G (1732mm/s²)					
Work table	Material	Granite					
	Size	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.08" (1080 x 2720mm)	55.90 x 67.71" (1420 x 2165mm)	55.90 x 116.73" (1420 x 2965mm)	55.90 x 156.10" (1420 x 3965mm)
	Tapped insert	M8 x 1.25mm					
Workpiece	Max. height	39.36" (1000mm)			47.24" (1200mm)		
	Max. load	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)	4,409 lbs. (2000kg)	5,511 lbs. (2500kg)	6,613 lbs. (3000kg)
Mass (incl. stand & controller)		4,985 lbs. (2261kg)	6,389 lbs. (2898kg)	8,691 lbs. (3942kg)	8,928 lbs. (4050kg)	13,558 lbs. (6150kg)	20,084 lbs. (9110kg)
Dimensions W x D x H		65.74x78.73x123.22" (1670x2000x3130mm)	65.74x107.87x123.22" (1670x2740x3130mm)	65.74x126.77x123.22" (1670x3220x3130mm)	86.61x102.16x143.50" (2200x2595x3645mm)	86.61x133.66x143.50" (2200x3395x3645mm)	86.61x173.03x143.50" (2200x4395x3645mm)
ISO-10360-2:2009 $E_{0,MPE}$							
18-22°C (64.4-71.6°F)	TP200:	(1.9+3L/1000)µm			(2.5+3L/1000)µm		
	MPP310/SP25/SP80:	(1.7+3L/1000)µm			(2.3+3L/1000)µm		
16-26°C (60.8-78.8°F)	TP200:	(1.9+4L/1000)µm			(2.5+4L/1000)µm		
	MPP310/SP25/SP80:	(1.7+4L/1000)µm			(2.3+4L/1000)µm		
ISO-10360-2:2009 $E_{150,MPE}$ †							
18-22°C (64.4-71.6°F)	TP200:	(2.4+3L/1000)µm			(3.0+3L/1000)µm		
	MPP310/SP25/SP80:	(1.7+3L/1000)µm			(2.3+3L/1000)µm		
16-26°C | (60.8-78.8°F)	TP200:	(2.4+4L/1000)µm			(3.0+4L/1000)µm		
	MPP310/SP25/SP80:	(1.7+4L/1000)µm			(2.3+4L/1000)µm		
ISO-10360-2:2009 $R_{0,MPL}$ †							
	TP200:	1.9µm			2.0µm		
	MPP310/SP25/SP80:	1.3µm			1.9µm		
ISO-10360-4 MPE_{THP}/MPT_{THP} †							
	SP25:	2.3µm/60sec			2.8µm/50sec		
	SP80:	2.3µm/60sec			2.5µm/50sec		
	MPP310:	1.8µm/80sec			2.3µm/80sec		
ISO-10360-5: 2010 $P_{FTU,MPE}$							
	TP200:	1.9µm			2.2µm		
	MPP310/SP25/SP80:	1.7µm			2.0µm		

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	900	1200
Pressure	58.0 PSI (0.4MPa)	
Consumption	2.11CFM (60L/min)	3.53CFM (100L/min)
Source	4.23CFM (120L/min)	5.29CFM (150L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements

Mitutoyo

CRYSTA-Apex EX 500T/700T/900T

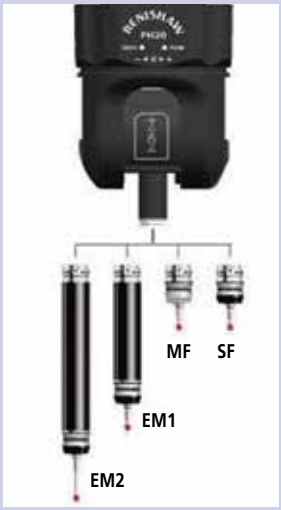
SERIES 191 — PH20 Equipped 5-Axis CNC CMM

The CRYSTA-Apex EX 500T/700T/900T series are CNC CMMs equipped with the PH20 5-axis control touch-trigger probe. The 5-axis operation reduces the time required for probe rotational movements and allows more flexible positioning. This also ensures easy access to complex workpieces and saves time both during programming and measurement.
In addition to 3-axis point measurement similar to conventional coordinate measuring machines, the PH20 probe head also supports head-touch operation for quick point measurement using the two rotational axes of the probe only, with no movement required along the CMM axes.
The PH20 incorporates a TP20 probe and allows use of modules designed for the TP20. Automatic probe changes with a module changer is also supported with the use of the TCR20 change rack (option).

FEATURES

- Incorporates PH20 5-axis touch-trigger probe
- Ultra-high speed 5-axis control touch-trigger probe
- Smooth 5-axis control drastically reduces measurement time (typically 40-65%) for probe rotation
- 5-axis design provides highly efficient measurement method of head touch for point measurement by moving the probe head only in two axes

CRYSTA-Apex EX 544T



Specifications PH20

Rotation angle (Pitch angle)	Vertical (A-axis)	-115° to +115° (0.08sec)
	Horizontal (B-axis)	∞ (0.08sec)
Stylus	Maximum length	50mm

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex EX 544T	CRYSTA-Apex EX 574T	CRYSTA-Apex EX 776T	CRYSTA-Apex EX 7106T	CRYSTA-Apex EX 9106T	CRYSTA-Apex EX 9166T	CRYSTA-Apex EX 9206T
Range	X axis	19.68" (500mm)		27.55" (700mm)		35.43" (900mm)		
	Y axis	15.74" (400mm)	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)	78.73" (2000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)				
Resolution		0.000004" (0.0001mm)						
Guide Method		Air bearing on each axis						
Work table	Material	Granite						
	Size	25.11 x 33.86" (638 x 860mm)	25.11 x 45.67" (638 x 1160mm)	34.64 x 55.90" (880 x 1420mm)	34.64 x 67.71" (880 x 1720mm)	42.51 x 67.71" (1080 x 1720mm)	42.51 x 91.33" (1080 x 2320mm)	42.51 x 107.0" (1080 x 2720mm)
	Tapped insert	M8 x 1.25mm						
Workpiece	Max. height	21.45" (545mm)		31.49" (800mm)				
	Max. load	396 lbs. (180kg)		1,763 lbs. (800kg)	2,204 lbs (1000kg)	2,645 lbs. (1200kg)	3,306 lbs. (1500kg)	3,968 lbs. (1800kg)
Mass (incl. stand & controller)		1,181 lbs. (536kg)	1,424 lbs. (646kg)	3,739 lbs. (1696kg)	4,347 lbs. (1972kg)	4,964 lbs. (2252kg)	6,369 lbs. (2889kg)	8,670 lbs. (3933kg)
Dimensions W x D x H		42.60x46.88x86.02" (1082x1191x2185mm)	42.60x60.94x86.02" (1082x1548x2185mm)	57.87x66.92x107.48" (1470x1700x2730mm)	57.87x78.73x107.48" (1470x2000x2730mm)	65.74x78.73x107.48" (1670x2000x2730mm)	65.74x107.87x107.48" (1670x2740x2730mm)	65.74x126.77x107.48" (1670x3220x2730mm)
ISO-10360-2:2009 $E_{0,MPE}$								
18-22°C (64.4-71.6°F)		(2.2+3L/1000)µm						
16-26°C (60.8-78.8°F)		(2.2+4L/1000)µm						
ISO-10360-2:2009† $R_{0,MPL}$		1.8µm		2.2µm				
ISO-10360-5: 2010 $P_{FTU,MPE}$		2.2µm						

Stylus Configurations for ISO Tests	
TP20:	Ø4mm x L12mm

Air Supply	500	700/900
Pressure	58.0 PSI (0.4MPa)	
Consumption	1.76CFM (50L/min)	2.11CFM (60L/min)
Source	3.53CFM (100L/min)	4.23CFM (120L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	2.0C° or less per hour 2.0C° or less per day	2.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

CRYSTA-Apex EX 1200R

SERIES 191 — REVO-Equipped 5-Axis CNC CMM

The CRYSTA-Apex EX 1200R series is advanced CNC CMMs equipped with the REVO 5-axis scanning probe head. The 5-axis operation reduces the time required for probe repositioning movements and allows for more flexible positioning. This also facilitates access to complex workpieces and saves time both during programming and measurement.
The ultra-high speed 5-axis scanning (max. 500mm/s) surpasses conventional 3-axis control, supporting high-speed sampling of up to 4,000 points per second and allowing data acquisition of densely spaced measurement points, even during high-speed scanning.
The internal implementation of laser sensing technology ensures high-accuracy measurement, even with long styli (up to 500 mm as measured from probe rotation center to stylus tip). Two types of scanning probes are supported:

- RSP2 for 5-axis scanning
- RSP3 probe (SP25M type), allowing the use of a cranked stylus

Automatic changeover of these probes with an auto probe changer is possible, enabling fully automated measurement of parts with diverse shapes. Probe calibration of RSP2 requires only about 20 minutes to enable use of the full angular range. Compared to conventional scanning probes, this reduces preparation time.

FEATURES

- Equipped with REVO 5-axis scanning probe head
- Ultra-high speed 5-axis scanning

SPECIFICATIONS

Type: BRIDGE	Model No.	Crysta-Apex EX 121210R	Crysta-Apex EX 122010R	Crysta-Apex EX 123010R
Range	X axis		47.24″ (1200mm)	
	Y axis	47.24″ (1200mm)	78.73″ (2000mm)	118.10″ (3000mm)
	Z axis		39.36″ (1000mm)	
Resolution			0.000004″ (0.0001mm)	
Guide Method			Air bearing on each axis	
Work table	Material		Granite	
	Size	55.11″ x 85.23″ (1400mm x 2165mm)	55.11″ x 116.73″ (1400mm x 2965mm)	55.11″ x 156.10″ (1400mm x 3965mm)
	Tapped insert		M8 x 1.25mm	
Workpiece	Max. height		45.66″ (1160mm)	
	Max. load	4,409 lbs. (2000kg)	5,511 lbs. (2500kg)	6,613 lbs. (3000kg)
Mass (incl. stand & controller)		8,928 lbs. (4050kg)	13,558 lbs. (6150kg)	20,084 lbs. (9110kg)
Dimensions W x D x H		86.61 x 102.16 x 143.50″ (2200 x 2595 x 3645mm)	86.61 x 133.66 x 143.50″ (2200 x 3395 x 3645mm)	86.61 x 173.03 x 143.50″ (2200 x 4395 x 3645mm)
ISO-10360-2:2009 $E_{0,MPE}$				
18-22°C (64.4-71.6°F)			(2.9+4L/1000)µm	
16-26°C (60.8-78.8°F)			(2.9+5L/1000)µm	
ISO-10360-5: 2010 $P_{FTU,MPE}$			3.2µm	

Configuration for ISO Tests	
RSP2+RSH250	Ø6mm x L10mm

Air Supply	
Pressure	72.5 PSI (0.5MPa)
Consumption	5.29CFM (150L/min)
Source	8.12CFM (230L/min)

Environment	18-22°C (64.4-71.6°F)	16-26°C (60.8-78.8°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	1.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

Specification of REVO Scanning Probe

Rotation angle (Pitch angle)	Vertical (A-axis)	-5° to +120° (0.08 sec)
	Horizontal (B-axis)	∞ (0.08sec)
Stylus	Maximum length	50mm (Distance from probe rotation center to stylus tip)

See page L-2 for explanation of ISO accuracy statements.

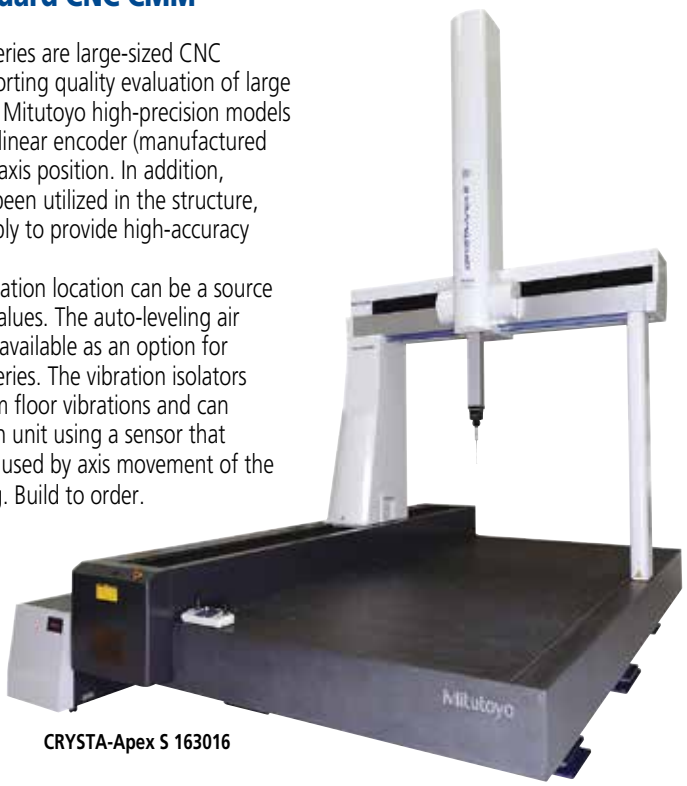
Mitutoyo

CRYSTA-Apex S 1600/2000

SERIES 191 — Standard CNC CMM

Crysta-Apex S1600/2000 series are large-sized CNC CMMs developed for supporting quality evaluation of large parts. The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement.

Floor vibration at the installation location can be a source of variations in measured values. The auto-leveling air spring vibration isolators is available as an option for Crysta-Apex S1600/2000 series. The vibration isolators insulates the main unit from floor vibrations and can quickly level the CMM main unit using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading. Build to order.



CRYSTA-Apex S 163016

SP80 Probe
(Extended reach scanning)
See page L-21

Supported Probe Systems			
Type	**Probe**	**AS1600**	**AS2000**
TOUCH-TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	●	●
LASER PROBES	SM606	●	●
	SM606T	●	●
	SM610	●	●
	SM1010	●	●
SURFACE FINISH	SurfTest	●	▲
OPTICAL	QVP	●	●
	CF20	●	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information.

SPECIFICATIONS

Type: BRIDGE	Model No.	CRYSTA-Apex S 162012 [CRYSTA-Apex S 162016]	CRYSTA-Apex S 163012 [CRYSTA-Apex S 163016]	CRYSTA-Apex S 164012 [CRYSTA-Apex S 164016]	CRYSTA-Apex S 203016	CRYSTA-Apex S 204016
Range	X axis	62.99" (1600mm)			78.73" (2000mm)	
	Y axis	78.73" (2000mm)	118.10" (3000mm)	157.47" (4000mm)	118.10" (3000mm)	157.47" (4000mm)
	Z axis	47.24" (1200mm) [62.99" (1600mm)]			62.99" (1600mm)	
Resolution		0.000004" (0.0001mm)				
Guide Method		Air bearing on each axis				
Maximum Drive Speed 3D		27.28"/s (693mm/s)				
Maximum Acceleration 3D		0.14G (1,390mm/s²)				
Work table	Material	Granite				
	Size	70.86" x 126.18" (1800mm x 3205mm)	70.86" x 165.55" (1800mm x 4205mm)	70.86" x 204.92" (1800mm x 5205mm)	86.61" x 165.55" (2200mm x 4205mm)	86.61" x 204.92" (2200mm x 5205mm)
	Tapped insert	M8 x 1.25mm				
Workpiece	Max. height	55.11" (1400mm) [70.86" (1800mm)]			70.86" (1800mm)	
	Max. load	6,613 lbs. (3000kg)	7,716 lbs. (3500kg)	9,920 lbs. (4500kg)	8,818 lbs. (4000kg)	11,023 lbs. (5000kg)
Mass (incl. stand & controller)		20,502 lbs. (9300kg) [20,613 lbs. (9350kg)]	23,368 lbs. (10600kg) [23,479 lbs. (10650kg)]	32,628 lbs. (14800kg) [37,738 lbs. (14850kg)]	31,085 lbs. (14100kg)	42,769 lbs. (19400kg)
Dimensions W x D x H		106.29 x 141.73 x 162.99" (2700 x 3600 x 4140mm) [106.29 x 141.73 x 194.48"] [(2700 x 3600 x 4940mm)]	106.29 x 181.10 x 162.99" (2700 x 4600 x 4140mm) [106.29 x 181.10 x 194.48"] [(2700 x 4600 x 4940mm)]	106.29 x 220.47 x 164.96" (2700 x 5600 x 4190mm) [106.29 x 220.47 x 196.45"] [(2700 x 5600 x 4990mm)]	122.04 x 183.07 x 196.45" (3100 x 4650 x 4990mm)	122.04 x 222.44 x 198.42" (3100 x 5650 x 5040mm)
ISO-10360-2:2009 $E_{0,MPE}$						
18-22°C (64.4-71.6°F)	TP200:	(6+4.5L/1000)µm [(7+5.5L/1000)µm]			(9+8L/1000)µm	
	MPP310/SP25:	(3.3+4.5L/1000)µm [(4.5+5.5L/1000)µm]			(4.5+8L/1000)µm	
16-24°C (60.8-75.2°F)	TP200:	(6+5.5L/1000)µm [(7+6.5L/1000)µm]			(9+9L/1000)µm	
	MPP310/SP25:	(3.3+5.5L/1000)µm [(4.5+6.5L/1000)µm]			(4.5+8L/1000)µm	
ISO-10360-4 MPE_{THP}/MPT_{THP} †						
	MPP310/SP25:	5µm/60sec			6µm/60sec	
ISO-10360-5: 2010 $P_{FTU,MPE}$						
	TP200:	6.5µm [7.5 µm]			9.5µm	
	MPP310/SP25:	5µm [6µm]			6µm	

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm
MPP310Q:	Ø4mm x L18mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	5.29CFM (150L/min)
Source	7.06CFM (200L/min)

Environment	18-22°C (64.4-71.6°F)	16-24°C (60.8-75.2°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	1.0C° or less per hour 5.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal	

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

Supported Probe Systems			
Type	**Probe**	**STRATO Apex 500**	**STRATO Apex 700/900**
TOUCH-TRIGGER PROBES	MH20i	●	●
	TP20	●	●
	TP200	●	●
	TP7	●	●
SCANNING PROBES	SP25	●	●
	MPP	●	●
	SP80	▲	●
LASER PROBES	SM606	▲	●
	SM606T	▲	●
	SM610	▲	●
	SM1010	▲	●
SURFACE FINISH	SurfTest	—	●
OPTICAL	QVP	▲	●
	CF20	●	●

● Supported ▲ Not Recommended — Not supported

See page L-20 thru L-27 for probe system information.

Ultra-high precision glass scales

Internal heat generation minimized

STRATO-Apex 500/700/900

SERIES 355 — High-Accuracy CNC CMM

The STRATO-Apex series is high-accuracy CNC CMMs achieving 0.9µm for the first term. The series guarantees high accuracy and also high-moving speed and acceleration achieved with improved rigid air bearings on all axial guideways. The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo), for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement.

TP7 Probe
(High-precision touch trigger)
See page L-20

STRATO-Apex 574 **STRATO-Apex 776** **STRATO-Apex 9106**

SPECIFICATIONS

Type: BRIDGE	Model No.	STRATO-Apex 574	STRATO-Apex 776	STRATO-Apex 7106	STRATO-Apex 9106	STRATO-Apex 9166
Range	X axis	19.68" (500mm)	27.55" (700mm)		35.43" (900mm)	
	Y axis	27.55" (700mm)		39.36" (1000mm)		62.99" (1600mm)
	Z axis	15.74" (400mm)	23.62" (600mm)			
Resolution		0.0000019" (0.00005mm)	0.00000078" (0.00002mm)			
Guide Method		Air bearing on each axis				
Maximum Drive Speed 3D		20.43"/s (519mm/s)				
Maximum Acceleration 3D		0.17G (2,309mm/s^2)	0.26G (2,598mm/s^2)			
Work table	Material	Granite				
	Size	26.61 x 55.90" (676 x 1420mm)	33.93 x 55.90" (862 x 1420mm)	33.93 x 67.71" (862 x 1720mm)	41.81 x 67.71" (1062 x 1720mm)	41.81 x 91.33" (1062 x 2320mm)
	Tapped insert	M8 x 1.25mm				
Workpiece	Max. height	22.04" (560mm)	30.31" (770mm)			
	Max. load	396 lbs. (180kg)	1,102 lbs. (500kg)	1,763 lbs. (800kg)	1,763 lbs. (800kg)	2,645 lbs. (1200kg)
Mass (incl. stand & controller)		3,373 lbs. (1530kg)	4,177 lbs. (1895kg)	4,806 lbs. (2180kg)	5,313 lbs. (2410kg)	6,801 lbs. (3085kg)
Dimensions W x D x H		49.99x66.92x94.88" (1270x1700x2410mm)	57.48x75.19x111.41" (1460x1910x2830mm)	57.48x87.00x111.41" (1460x2210x2830mm)	65.35x87.00x111.41" (1660x2210x2830mm)	65.35x110.62x111.41" (1660x2810x2830mm)
ISO-10360-2:2009 $E_{0,MPE}$						
	TP200:	(1.4+2.5L/1000)µm*	(1.4+2.5L/1000)µm**		(1.5+2.5L/1000)µm**	
	SP25:	(0.7+2.5L/1000)µm*	(0.9+2.5L/1000)µm**			
ISO-10360-2:2009 $E_{150,MPE}$						
	TP200:	(1.9+2.5L/1000)µm*	(1.9+2.5L/1000)µm**		(2.0+2.5L/1000)µm**	
	SP25:	(0.7+2.5L/1000)µm*	(0.9+2.5L/1000)µm**			
ISO-10360-2:2009 $R_{0,MPL}$	TP200:	1.2µm*	1.2µm**			
	SP25:	0.7µm*	0.8 µm**			
ISO-10360-4 MPE_{THP}/MPT_{THP}	SP25:	1.3µm/40sec*	1.8µm/45sec**			
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP200:	1.8µm*	1.8µm**			
	SP25:	0.7µm*	0.9 µm**			

* 18-22°C (64.4-71.6°F - Strato Apex 574
** 19-21°C (66.2-69.8°F) - Strato Apex 776/7106/9106/9166

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	2.11CFM (60L/min)
Source	4.23CFM (120L/min)

Environment	18-22°C (64.4-71.6°F)	19-21°C (66.2-69.8°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day	
Gradient	1.0C° or less per meter vertical & horizontal	

See page L-2 for explanation of ISO accuracy statements.

Mitutoyo

STRATO-Apex 1600

SERIES 355 — High-Accuracy CNC CMM

The STRATO-Apex 1600 series is a large-sized CNC CMM developed for supporting quality evaluation and assembly of large parts.The scale systems on Mitutoyo high-precision models utilize a high-performance linear encoder (manufactured by Mitutoyo) for detecting axis position. In addition, various technologies have been utilized in the structure, part processing and assembly to provide high-accuracy measurement. Floor vibration at the installation location can be a source of variation in measured values. The auto-leveling air spring vibration isolator is available as an option for STRATO-Apex 1600 series. The vibration isolator insulates the main unit from floor vibrations and can quickly level the CMM main unit using a sensor that detects load fluctuations caused by axis movement of the CMM or workpiece loading. All STRATO-Apex high-precision series CMMs are equipped with temperature compensation and therefore do not require a temperature-controlled room. Accuracy is guaranteed within the range of 16 to 26°C.

STRATO-Apex 1600

Supported Probe Systems		
Type	**Probe**	**STRATO Apex 1600**
TOUCH TRIGGER PROBES	MH20i	●
	TP20	●
	TP200	●
	TP7	●
SCANNING PROBES	SP25	●
	MPP	●
	SP80	●
LASER PROBES	SM606	●
	SM606T	●
	SM610	●
	SM1010	●
SURFACE FINISH	SurfTest	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information

SP80 Probe
(Extended reach scanning)
See page L-21

SPECIFICATIONS

Type: BRIDGE	Model	STRATO-Apex 162012	STRATO-Apex 162016	STRATO-Apex 163012	STRATO-Apex 163016
Range	X axis	62.99″ (1600mm)			
	Y axis	78.73″ (2000mm)		118.10″ (3000mm)	
	Z axis	47.24″ (1200mm)	62.99″ (1600mm)	47.24″ (1200mm)	62.99″ (1600mm)
Resolution		0.0000019″ (0.00005mm)			
Guide Method		Air bearing on each axis			
Maximum Drive Speed 3D		23.85″/s (606mm/s)			
Maximum Acceleration 3D		0.13G (1,350mm/s^2)			
Work table	Material	Granite			
	Size	72.83 x 129.13″ (1850mm x 3280mm)		72.83 x 168.50″ (1850mm x 4280mm)	
	Tapped insert	M8 x 1.25mm			
Workpiece	Max. height	53.14″ (1350mm)	368.89″ (1750mm)	53.14″(1350mm)	68.89″ (1750mm)
	Max. load	7,716 lbs. (3500kg)		8,818 lbs. (4000kg)	
Mass (incl. stand & controller)		24,582 lbs. (11150kg)	24,692 lbs. (11200kg)	33,730 lbs. (15300kg)	33,841 lbs. (15350kg)
Dimensions W x D x H		110.43x147.24x170.86″ (2805x3740x4340mm)	110.43x147.24x202.36″ (2805x3740x5140mm)	110.43x186.61x172.83″ (2805x4740x4390mm)	110.43x186.61x204.33″ (2805x4740x5190mm)
ISO-10360-2:2009 $E_{0,MPE}$ 18-22°C (64.4-71.6°F)					
	TP200:	(3.5+4L/1000)µm	(4.0+4L/1000)µm	(3.5+4L/1000)µm	(4.0+4L/1000)µm
	SP25/SP80:	(2.5+4L/1000)µm	(3.0+4L/1000)µm	(2.5+4L/1000)µm	(3.0+4L/1000)µm
ISO-10360-2:2009 $E_{150,MPE}$ † 18-22°C (64.4-71.6°F)					
	TP200:	(3.5+4L/1000)µm	(4.0+4L/1000)µm	(3.5+4L/1000)µm	(4.0+4L/1000)µm
	SP25/SP80:	(2.5+4L/1000)µm	(3.0+4L/1000)µm	(2.5+4L/1000)µm	(3.0+4L/1000)µm
ISO-10360-2:2009 $R_{0,MPL}$ †					
	TP200:	3.5µm	4.0µm	3.5µm	4.0µm
	SP25:	2.5µm			
ISO-10360-4 MPE_{THP}/MPT_{THP} †					
	SP25/SP80:	2.5µm/60sec	3.0µm/60sec	2.5µm/60sec	3.0µm/60sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP200:	3.5µm	4.0µm	3.5µm	4.0µm
	SP25/SP80:	2.3µm	2.8µm	2.3µm	2.8µm

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm
SP25/SP80:	Ø4mm x L50mm

Air Supply	
Pressure	58.0 PSI (0.4MPa)
Consumption	3.53CFM (100L/min)
Source	8.82CFM (250L/min)

Environment	18-22°C (64.4-71.6°F)
Rate of change	1.0C° or less per hour 2.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

NEW-STYLE
Vision Measuring Systems

FALCIO-Apex 2000/3000

SERIES 355 — High-Accuracy Large CNC CMM

The FALCIO-Apex 2000/3000 series CNC CMMs use Mitutoyo's standard structure for large machines, which are designed for measuring large and heavy workpieces with high accuracy. The measuring accuracy and drive speed are the highest level in the X-axis measuring range of 2000mm and 3000mm for CNC CMMs worldwide. Units are equipped with a system (MOVAC) to automatically restore accuracy deterioration caused by foundation deformation as a standard feature. Safety devices such as Z-axis beam sensor, tape switch and area sensor are available as options. Built to order.

SurfaceMeasure Probes
(Laser scanning probes—non-contact)
See page L-22

FALCIO Apex 305015G

SPECIFICATIONS

Type: SEPARATE GUIDE	Model No.	FALCIO-Apex 203015	FALCIO-Apex 204015	FALCIO-Apex 205015	FALCIO-Apex 305015
Range	X axis	78.73" (2000mm)			118.10" (3000mm)
	Y axis	118.10" (3000mm)	157.47" (4000mm)	196.84" (5000mm)	
	Z axis	59.05" (1500mm)			
Resolution		0.0000039" (0.0001mm)			
Mass (incl. stand & controller)		23,368 lbs. (10600kg)	27,557 lbs. (12500kg)	34,392 lbs. (15600kg)	35,273 lbs. (16000kg)
Dimensions W x D x H		174.40x234.25x184.64" (4430x5950x4690mm)	174.40x273.62x184.64" (4430x6950x4690mm)	174.40x312.99x184.64" (4430x7950x4690mm)	213.77x312.99x184.64" (5430x7950x4690mm)
ISO-10360-2:2009 $E_{0,MPE}$					
18-22°C (64.4-71.6°F)	TP200:	3.5+4L/1000µm			

Supported Probe Systems		
Type	Probe	FALCIO Apex
TOUCH-TRIGGER PROBES	MH20i	●
	TP20	●
	TP200	●
	TP7	●
SCANNING PROBES	SP25	●
	MPP	▲
	SP80	●
LASER PROBES	SM606	●
	SM606T	●
	SM610	●
	SM1010	●
SURFACE FINISH	SurfTest	●

● Supported ▲ Not Recommended

See page L-20 thru L-27 for probe system information.

Stylus Configurations for ISO Tests	
TP200:	Ø4mm x L10mm

See page L-2 for explanation of ISO accuracy statements.

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation. Refer to page VIII for details.

TP200 Probe
(Touch trigger)
See page L-20

Mitutoyo

LEGEX 500/700/900

SERIES 356 — Ultra-high Accuracy CNC CMM

Achieving premium performance, the LEGEX series with its fixed bridge structure and precision air bearings resting on rigid guideways ensures superior stability of motion and ultra-high measuring accuracy. Thorough testing, using FEM structure analysis simulation, guarantees geometric motion accuracy has minimal errors from fluctuations in the load and other variables. LEGEX series CNC CMMs are suitable for complex small- to medium-size workpieces, such as gears, bearings, lens, precision dies or other high-precision workpieces requiring dimensional accuracies with small tolerances.

The LEGEX series incorporates an ultra-high accuracy scale unit with crystallized glass scales (thermal expansion coefficient of 0.01×10^{-6}/K), and a high-resolution, high-performance reflection linear encoder providing premium positioning performance. All LEGEX Ultra-accuracy series CMM's are equipped with temperature compensation and therefore do not require a temperature controlled room. Accuracy is guaranteed within the range of 18 to 22°C.

MPP-310Q

Mitutoyo's MPP-310Q probe can be used for point-to-point measuring and continuous scanning applications. If the workpiece requires the maximum accuracy, the MPP-310Q offers zero-point data acquisition for statistical measurement. In this mode the MPP-310Q obtains the measurement data after all the CMM slides have come to a complete standstill. This statistical measurement is intended to eliminate dynamic effects on measurement. *See page L-21 for MPP-310Q system information.*

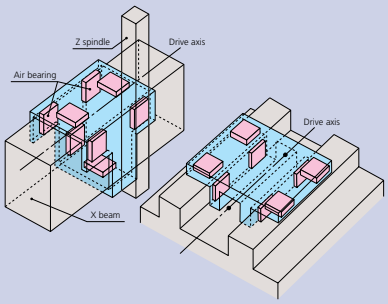
MPP-310Q Specs

- Resolution: 0.01µm
- Measuring Force: 0.20N/mm
- Maximum Stylus Length: 200mm
- Maximum Stylus Weight: 75g

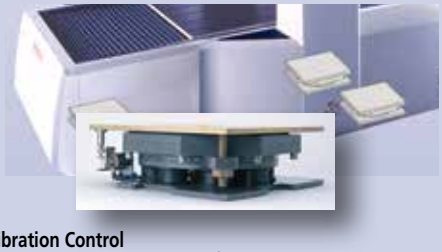
LEGEX 574

LEGEX 776

LEGEX 9106



XY axis independence and center-of-gravity drive system. The fixed-bridge design of the LEGEX allows the axes to operate independently. Movement of the X-axis slide does not change the loading on the Y-axis slide and therefore does not cause deformation. In addition, the center-of-gravity drive system places the drive units near the center of gravity of each slide, allowing high speed and highly accurate measurements by reducing inertia-induced deflections during acceleration and deceleration.



Vibration Control
The LEGEX is hardened against floor-induced vibration by use of air-damped spring isolators with an auto-leveling function, virtually eliminating factory-floor vibrations from the entire machine structure.

Ceramic-coated worktable
Standard feature for corrosion resistance and long life.

SPECIFICATIONS

Type: FIXED BRIDGE	Model No.	LEGEX 574	LEGEX 774	LEGEX 776	LEGEX 9106
Range	X axis	19.68" (500mm)	27.55" (700mm)		35.43" (900mm)
	Y axis	27.55" (700mm)			39.36" (1000mm)
	Z axis	15.74" (400mm)		23.62" (600mm)	
Resolution		0.00000039" (0.01µm)			
Guide Method		Air bearing on each axis			
Maximum Drive Speed 3D		7.8"/s (200mm/s)			
Maximum Acceleration 3D		0.1G (980mm/s²)			
Work table	Material	Cast Iron with Ceramic Coating			
	Size	21.65" x 29.52" (550mm x 750mm)	29.52" x 29.52" (750mm x 750mm)		37.40" x 41.33" (950mm x 1050mm)
	Tapped insert	M8 x 1.25mm			
Workpiece	Max. height	27.55" (700mm)		33.46" (850mm)	
	Max. load	551 lbs. (250kg)	1,102 lbs. (500kg)		1,763 lbs. (800kg)
Mass (incl. stand & controller)		7,716 lbs. (3500kg)	11,023 lbs. (5000kg)	11,243 lbs. (5100kg)	14,330 lbs. (6500kg)
Dimensions W x D x H		62.44 x 95.66 x 103.54" (1470 x 2430 x 2630mm)	65.74 x 95.66 x 103.54" (1670 x 2430 x 2630mm)	65.74 x 94.48 x 115.35" (1670 x 2430 x 2930mm)	73.62 x 119.29 x 120.07" (1870 x 3030 x 3050mm)
ISO-10360-2:2009 $E_{0,MPE}$		19-21°C (66.2-69.8°F)		*18-22°C (64.4-71.6°F)*	
19-21°C (66.2-69.8°F)	MPP310Q:	(0.28+L/1000)µm		*(0.30+L/1000)µm*	
	SP25M:	(0.38+L/1000)µm		*(0.40+L/1000)µm*	
ISO-10360-4 MPE_{THP}/MPT_{THP} †	MPP310Q/SP25M:	1.1µm/60sec			
ISO-10360-5: 2010 $P_{FTU,MPE}$	MPP310Q:	0.40µm			
	SP25M:	0.45µm			

Stylus Configurations for ISO Tests	
MPP310Q:	Ø4mm x L18mm
SP25M:	Ø4mm x L50mm

Air Supply	500/700/1200	900
Pressure	58.0 PSI (0.5MPa)	72.5 PSI (0.4MPa)
Consumption	4.23CFM (120L/min)	
Source	5.65CFM (160L/min)	

Environment	19-21°C (66.2-69.8°F) / 18-22°C (64.4-71.6°F)
Rate of change	0.5C° or less per hour 1.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

MACH-V 9106

SERIES 360 — Inline CNC CMM

MACH-V 9106

The MACH-3A and MACH-V maximize machining operations by performing in-line or near-line high-speed coordinate measuring in conjunction with your CNC machine tools. These high-throughput machines can be incorporated right into the manufacturing line and can provide pre/post machining feedback to your machine tool for machining adjustments.

SPECIFICATIONS

Type: INLINE	Model No.	MACH-V 9106
Range	X axis	35.43" (900mm)
	Y axis	39.36" (1000mm)
	Z axis	23.62" (600mm)
Resolution		0.0000039" (0.0001mm)
Guide Method		Mechanical bearing on each axis
Maximum Drive Speed 3D		34.09"/s (866mm/s)
Maximum Acceleration 3D		0.88g (8660mm/s²)
Work table	Material	Steel
	Size	35.62" x 41.96" (905mm x 1066mm)
	Tapped insert	M8 x 1.25mm
Workpiece	Max. height	31.49" (800mm)
	Max. load	330 lbs. (150kg)
Mass (including controller)		9,105 lbs. (4130kg)
Dimensions W x D x H		58.14 x 115.82 x 114.17" (1477 x 2942 x 2900mm)
ISO-10360-2:2009 $E_{0,MPE}$		
TP7/SP25:	19-21°C (66.2-69.8°F)	(2.5+3.5L/1000)µm
	18-22°C (64.4-71.6°F)	(2.7+3.8L/1000)µm
	15-25°C (59.0-77.0°F)	(2.9+4.3L/1000)µm
	5-35°C (41.0-95.0°F)	(3.6+5.8L/1000)µm
ISO-10360-4 MPE_{THP}/MPT_{THP} †	SP25:	4.0µm/40sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	TP7:	2.2µm
	SP25:	2.2µm

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-21.

Stylus Configurations for ISO Tests	
TP7:	Ø4mm x L20mm
SP25:	Ø4mm x L50mm

Environment	5-35°C (71.6-64.4°F)
Rate of change	2.0C° or less per hour 10.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal

MACH-3A 653

SERIES 360 — Inline CNC CMM

MACH-3A 653

Inline CNC CMM (horizontal type) incorporating the CMM controller and host computer in the main unit results in a compact spacing-saving footprint for the shop floor. This series is designed for 24-hour operation, resulting in stable operation.

SPECIFICATIONS

Type: INLINE	Model No.	MACH-3A 653
Range	X axis	23.62" (600mm)
	Y axis	19.68" (500mm)
	Z axis	11.02" (280mm)
Resolution		0.0000039" (0.0001mm)
Guide Method		Mechanical bearing on each axis
Maximum Drive Speed 3D		47.71"/s (1,212mm/s)
Maximum Acceleration 3D		1.21G (11,882mm/s²)
Mass		8,818 lbs. (4000kg)
Dimensions W x D x H		73.62 x 50.39 x 75.59" (1870 x 1280 x 1920mm)
ISO-10360-2:2009 $E_{0,MPE}$		
SP25:	19-21°C (66.2-69.8°F)	(2.2+3.5L/1000)µm
	15-25°C (66.2-69.8°F)	(2.5+4.2L/1000)µm
	10-30°C (50.0-86.0°F)	(2.9+5.0L/1000)µm
	5-35°C (66.2-95.0°F)	(3.2+5.7L/1000)µm
TP7:	19-21°C (66.2-69.8°F)	(2.5+3.5L/1000)µm
	15-25°C (66.2-69.8°F)	(2.8+4.2L/1000)µm
	10-30°C (50.0-86.0°F)	(3.2+5.0L/1000)µm
	5-35°C (66.2-95.0°F)	(3.5+5.7L/1000)µm
ISO-10360-4 MPE_{THP}/MPT_{THP} †	SP25:	4.0µm/40sec
ISO-10360-5: 2010 $P_{FTU,MPE}$	SP25:	2.2µm
	TP7:	2.5µm

† This test is not part of Mitutoyo America's standard A2LA-accredited CMM calibration procedure and is quoted upon request.

See page L-2 for explanation of ISO accuracy statements.

TP7 Probe
(High-precision tough-trigger)
See page L-20.

Stylus Configurations for ISO Tests	
TP7:	Ø4mm x L20mm
SP25:	Ø4mm x L50mm

Environment	5-35°C (71.6-64.4°F)
Rate of change	2.0C° per hour 10.0C° per day
Gradient	1.0C° or less per meter vertical & horizontal

Mitutoyo

MACH KO-GA-ME

SERIES 360 — Inline CNC CMM

Mitutoyo MACH Ko-ga-me is a compact, 3D CNC measuring system that can be configured to almost any process. Use for stand-alone applications or integrate into cells. If required, the system can measure workpiece features that exceed the Ko-ga-me's X stroke by mounting the workpiece, or the Ko-ga-me, on an auxiliary X axis. Ideal for inspection of large or small workpieces and offers a wide choice of measuring probes including touch-trigger, optical and scanning types. (Note: Probe choice may be restricted, depending on the application.)

SP25 Scanning Probe
See page L-21.

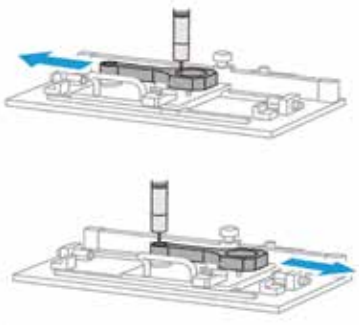
TP200 Touch-Trigger Probe
See page L-20.

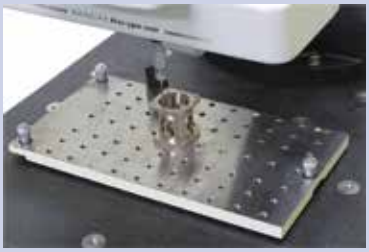
SPECIFICATIONS

Type: INLINE	Model No.	KGM888-B	KGM12128-B
Range	X axis	3.14" (80mm)	4.72" (120mm)
	Y axis	3.14" (80mm)	4.72" (120mm)
	Z axis	3.14" (80mm)	
Resolution		0.00000078" (0.02µm)	
Guide Method		Straight-motion hard bearing	
Maximum Drive Speed 3D		13.38"/s (340mm/s)	
Maximum Acceleration 3D		0.68G (6,750mm/s²)	
Mass: main unit		61.7 lbs. (28kg)	
Dimensions* W x D x H: (height includes Z measuring range)		15.03 x 14.68 x 30.90" (382 x 373 x 785mm)	
Measuring Accuracy (ISO 10360-2:2009)			
TP200/SP25:	19-21°C (66.2-69.8°F)	(2.4+5.7L/1000)µm	
	15-25°C (66.2-69.8°F)	(2.7+6.4L/1000)µm	
	10-30°C (50.0-86.0°F)	(3.1+7.2L/1000)µm	
	10-35°C (50.0-95.0°F)	(3.4+7.9L/1000)µm	
Probing Error (ISO 10360-2:2009)			
	TP200/SP25:	2.0µm	
Scanning probing error (ISO 10360-4:2000)			
	SP25:	2.7µm/(30s)	

Stylus Configurations for Accuracy Tests	
TP200:	Ø3mm x L10mm
SP25:	Ø4mm x L50mm

Environment	10-35°C (50.0-95.0°F)
Rate of Change	2.0C° or less per hour 10.0C° or less per day
Gradient	1.0C° or less per meter vertical & horizontal





See page L-2 for explanation of ISO accuracy statements.

CARBapex / CARBstrato

SERIES 355 — Car Body Measuring System CNC CMM

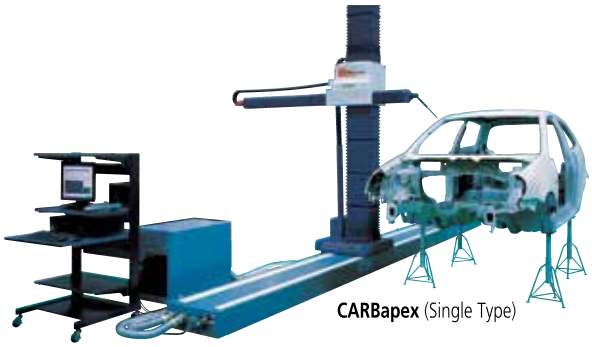
NEW-STYLE
Vision Measuring Systems

SurfaceMeasure Probes
(Laser scanning probes—non-contact)

See page L-22 for probe system information.

The world's largest class
The CARBapex and CABstrato series is a lineup of cost-effective horizontal, large CNC CMMs and offers the world's largest class measurement range, making it possible to measure car bodies.

Single & Dual
Single- and dual-types are available to fit the intended use.
Single type: Measure a workpiece with a single CMM from the CARBstrato series.
Dual type: Measure a workpiece placed between two simultaneously controlled CMMs from the CARBstrato series.

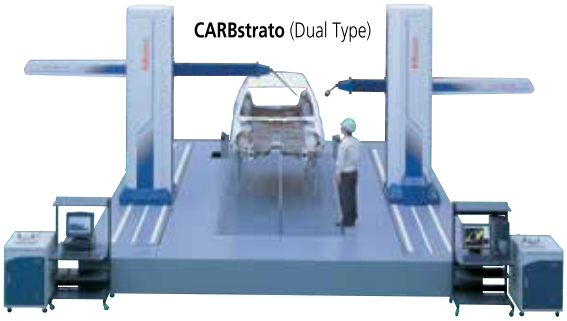


CARBapex (Single Type)

Because the height of the X-axis base of both the single- and the dual-type is set lower, the required depth for the foundation before the installation is relatively shallow.

Remarkable usability
The CARBapex series not only has remarkable usability, but also has the ability to enhance the safety operation by performing the procedures on the shop floor. The Y-axis spindle in the vertical direction is set lower in order to perform measurements at a lower workpiece setting height. In addition, the small cross-section of the Y-axis spindle reduces interference during measurement and expands the measurement area inside a car body.

Safety after installation
Since the height of the X-axis base is set lower, the required depth for the foundation before installation is comparatively shallow. The structure is designed to avoid both long- and short-term problems, such as a aging of the foundation (concrete) or accuracy deterioration resulting in the bimetal phenomenon caused by deformation of the foundation or the X-axis base due to common environmental changes.



CARBstrato (Dual Type)

Options
- Line laser probe for non-contact measurement (SurfaceMeasure).
- Measurement point search function, a necessity for car body measuring, is included in the metrology software.
- A variety of optional safety devices enhance operator safety. Built to order.

Main Unit Startup System

This machine incorporates a startup system (relocation detection system), which disables operation when an unexpected vibration is applied or the machine is relocated. Be sure to contact your nearest Mitutoyo prior to relocating this machine after initial installation.

SPECIFICATIONS

Type: HORIZONTAL ARM	Model No.		CARBapex 601624	CARBstrato 601624
Range	X axis		236.21" (6000mm)	
	Y axis (Single)		62.99" (1600mm)	
	Y axis (Dual)		153.54" (3900mm)	
	Z axis		94.48" (2400mm)	
Resolution			0.0000039" (0.0001mm)	
Mass	Single Arm		4,982 lbs. (2260kg)	13,845 lbs. (6280kg)
	Dual Arm		9,964 lbs. (4520kg)	27,690 lbs. (12560kg)
Dimensions W x D x H	Single Arm		163.18 x 275.58 x 144.33" (4145 x 7000 x 3666mm)	176.10 x 238.34 x 155.62" (4473x 7324 x 3953mm)
	Dual Arm		322.79 x 275.58 x 144.33" (8190 x 7000 x 3666mm)	348.26 x 238.34 x 155.62" (8846x 7324 x 3953mm)
ISO-10360-2:2009 $E_{0,MPE}$ 16-26°C (60.8-78.8°F)	Single Arm	TP20:	(25+28L/1000≤95)µm	(18+20L/1000≤70)µm
		SP25:	(20+28L/1000≤95)µm	(15+20L/1000≤70)µm
	Dual Arm	TP20:	(50+35L/1000≤120)µm	(38+30L/1000≤90)µm
		SP25:	(45+35L/1000≤120)µm	(35+30L/1000≤90)µm
ISO-10360-5: 2010 $P_{FTU,MPE}$	Single Arm	TP20:	20µm	15µm
		SP25:	15µm	13µm
	Dual Arm	TP20:	20µm	15µm
		SP25:	15µm	13µm

Stylus Configurations for ISO Tests	
TP20:	Ø3mm x L10mm
SP25:	Ø4mm x L50mm

See page L-2 for explanation of ISO accuracy statements.

Mitutoyo

MCOSMOS

Software for Manual / CNC Coordinate Measuring Machines

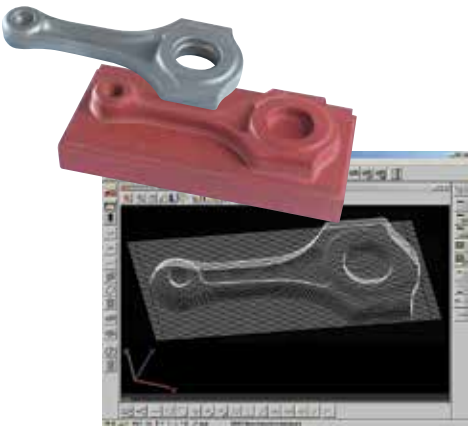
Three levels of module configuration

MCOSMOS has three choices of module configuration. From the basic MCOSMOS-1 to the advanced MCOSMOS-3, choose a configuration for your measurement applications.

MCOSMOS Coordinate Measuring Machine Software				
	CNC			Manual
	MCOSMOS-1	MCOSMOS-2	MCOSMOS-3	MCOSMOS-M
GEOPAK	●	●	●	●
CAT1000P	▲	●	●	—
CAT1000S	▲	●	●	▲
Scanpak	▲	▲	●	▲
Gearpak	▲	▲	●	—
MAFIS*	▲	▲	▲	—

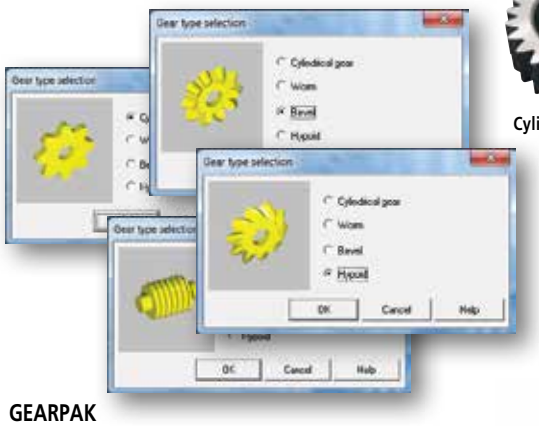
● Standard ▲ Option — Not supported * *Requires Scanpak*

GEOPAK (Basic Geometry Module)
Geopak provides an easy graphical console through the use of tool bars and windows which can be personalized to the operator's preference. Geographically enhanced displays provide step-by-step on-screen wizards that prompt the operator, allowing even inexperienced users to create routines to measure parts. The entry-level MCOSMOS-1 software includes flexible advanced tools demanded by the most experienced operators; e.g. looping, formula calculations or expressions that use variables, libraries of day-to-day subroutines and conditional statements, which can add logic for a variety of applications.



SCANPAK (2D Profile Evaluation Module)
For the scanning and evaluation of workpiece contours (2D), and data transfer to CAD system.

MAFIS (Mitutoyo Airfoil Inspection System)
Evaluation and analysis of airfoil shapes such as turbine blades that require special calculations according to the particular design specifications. The MAFIS system uses cross sectional data of the shape obtained by Scanpak to perform these calculations and outputs the result via the standard geometry program.



GEARPAK
(Gear Measurement and Analysis Module)
Advances in CMM controller techniques make the measurement of gears feasible, and the Gearpak module takes advantage of this to bring sophisticated measurement capabilities within reach.

Cylindrical Gear Spur

Cylindrical Gear Helical

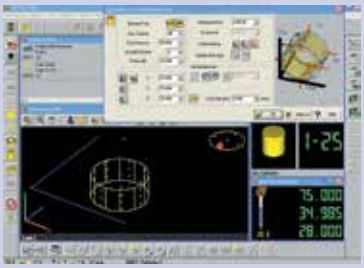
Worm Cylindrical Gear

Hypoid

Straight-Bevel

Spiral-Bevel

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
CMM



Mitutoyo Controlled Open Systems for Modular Operation Support

MCOSMOS by Mitutoyo is a proprietary metrology suite of inter-related modules and dedicated expansion modules for the Microsoft Windows 7 operating system. The world's standard in metrology software, MCOSMOS is supported in 37 locations worldwide and in 12 languages. *(A proud Microsoft Gold Partner.)*

Developed with MiCAT (Mitutoyo Intelligent Computer Aided Technology), your Mitutoyo CMM is streamlined with intuitive user interfaces that provide a familiar look and feel to operate multiple modules. They work together seamlessly for applications throughout the entire production process to put reliable metrology at you fingertips.

MCOSMOS allows integration among a whole series of applications, improving the efficiency of your CMM and the productivity of your quality control functions. Specific expansion modules are available including GEOPAK or for specific applications such as gear measurement, airfoil analysis, reverse engineering and integrating CAD with metrology.

CAT-1000P (Prismatic)
Not available for manual CMMs

CAT1000P significantly facilitates the programming of measurement tasks during the GEOPAK learn mode. All data for measuring parts and tolerance evaluations are taken from the CAD model via pointing device (mouse, trackball, etc.). The same principles apply for programming probe paths (clearance and measurement), while at the same time using the nominal directly from the CAD model for tolerance comparison.

Spatial's 3D InterOp delivers the highest quality data exchange between CAD formats, enabling superior CAD file translation.

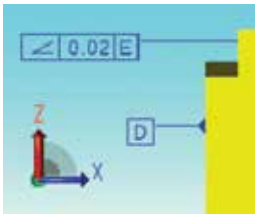
Standard with CAT-1000 is ACIS (*.sat) and STEP AP203, which are both licensed copies from Spatial InterOp.CATIA V5, SolidWorks, NX Siemens (Unigraphics), Parasolids, AutoDesk Inventor, Pro-Engineer and IGES or VDAFS exchange formats are available as an option.

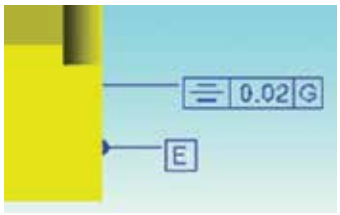
The comprehensive suite of translators provides import/export for all applications, including ACIS, CGM and Parasolid-based applications.

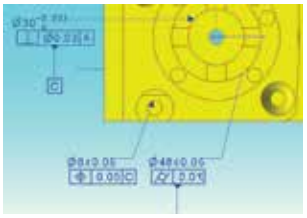
3D InterOp is embedded in many of today's leading design, engineering and manufacturing applications.

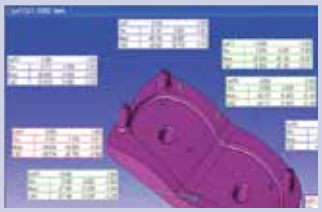
CAT-1000 uses 3D ACIS® Modeler, Spatial's prominent modeling component used in more than 350 customer applications with more than 2 million seats worldwide.

CAT-1000 fully supports and reads PMI (Product Manufacturing Information), which is embedded in the model for datum alignment and GD&T (Geometric Dimensioning and Tolerancing).



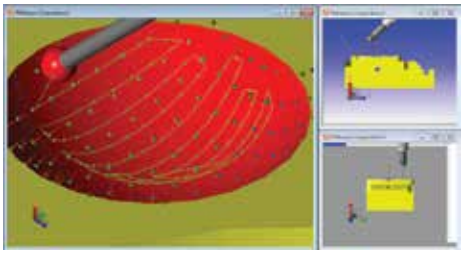






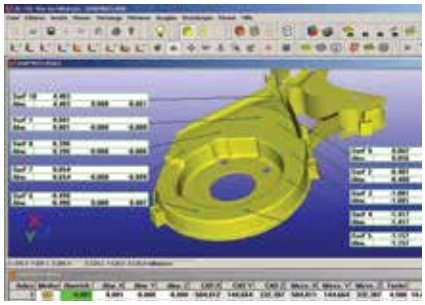
CAT-1000S (Free-form Sculpted)

CAT-1000S is a highly versatile tool that can be used on a manual CMM or a CNC CMM. A coordinate system in GEOPAK is compared to the CAD model. Real-time surface disposition is displayed by showing a color class to determine if there is material to remove or replace.
Surface deviation can be displayed as spherical points or as a gradient surface. Cones also can be used to show the direction of the deviation.
GEOPAK CNC can create grid pattern to verify the surface points. A one-click tool calculates a collision-free probe path to measure a grid of surface points offset from the edge.



If the CAD model has specific points, GEOPAK-CNC can drive the machine to the defined points or vertices.

In addition to the online/offline part program creation, CAD model-based generation of surface measurement points, and comparison of actual/nominal data, with graphical output is available.



MiCAT Planner

Automatic Measurement Program Generation Software

MiCAT Planner is Mitutoyo's latest software development for fast and efficient CMM part programming. Operation of MiCAT Planner is easy and intuitive. Programs are made with a few mouse clicks in jminutes instead of hours or days.

WORKFLOW:

1) Load design model
2) Select target CMM
3) Part placement via virtual alignment
4) Measurement program creation
5) Translate to Geopak MCOSMOS

MiCAT Planner toolbar is workflow based.

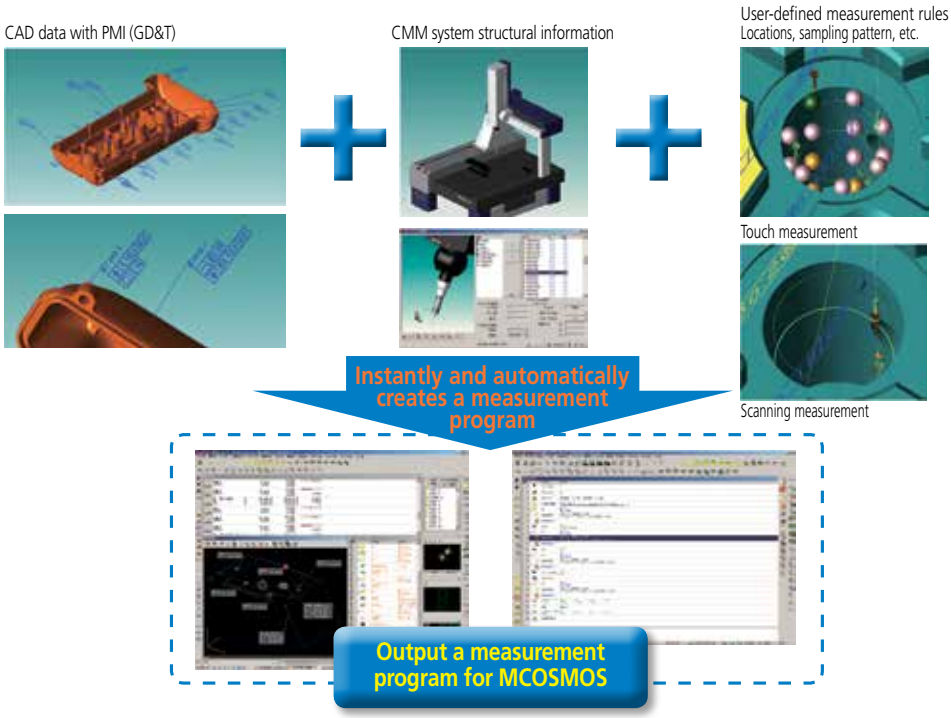
In order to generate a measurement plan, GD&T information attached to the 3D Design Model is needed. Design Model formats marked "w/PMI" will read GD&T information created in the CAD system and stored in the Design Model file. Design Model formats without PMI can be annotated with GD&T in MiCAT Planner.

Design Model Support:

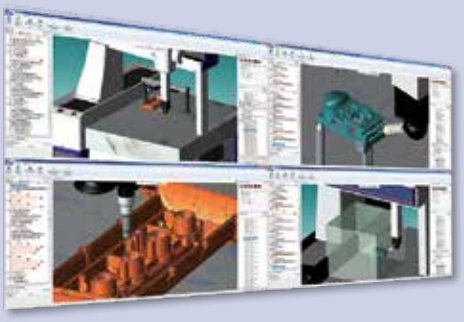
- Siemens NX w/PMI
- CATIA v5 w/PMI
- PRO/E w/PMI
- SOLIDWORKS w/PMI
- ACIS (SAT)

If the Design Model does not contain GD&T information, or the information is incomplete, GD&T information can be added or edited with MiCAT Planner with the following:

- Add new GD&T to an existing feature
- Add GD&T to a new feature
- Edit exiting GD&T information
- Modify display of GD&T in 3D view



MiCAT



Feature/Benefits of MiCAT Planner:

Automatic part program generation
- Up to 90% time savings in CMM part program creation

Collision control
- Minimize potential costly and damaging probe collisions

Program simulation
- Virtual pre-run of measurement program ensures maxim efficiency

Rule editor
- Automatically apply individual or global measurement strategies for all part programs or specific programs

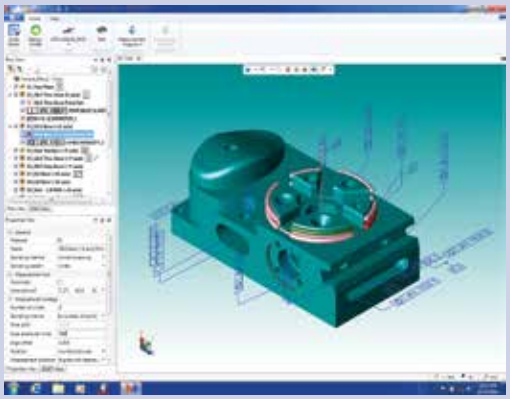
Plan view
- Easy selection of characteristics, features and measurement point sets to include or exclude from the measurement plan

Property pane
- Feature parameter settings for the current selected item can be an exception to a user-defined rule

Direct Help
- Clear, concise explanation for features that can't be measured (missing GD&T, probe angle not defined, etc.)

GD&T Wizard
- The GD&T Wizard enables the use of Design Models that do not include any PMI by allowing the user to add, edit or delete PMI information without modifying the original CAD file. All additions, changes or deletions reside solely within the MiCAT Planner project database. *(See Design Model Support above left for the current list)*

www.mitutoyo.com/MiCAT



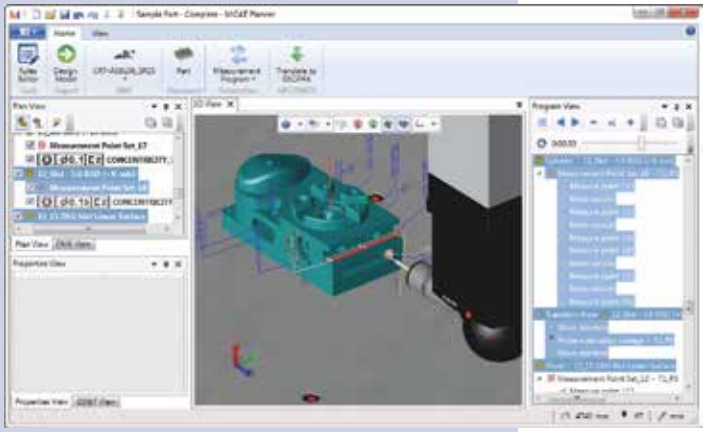
Measurement Plan

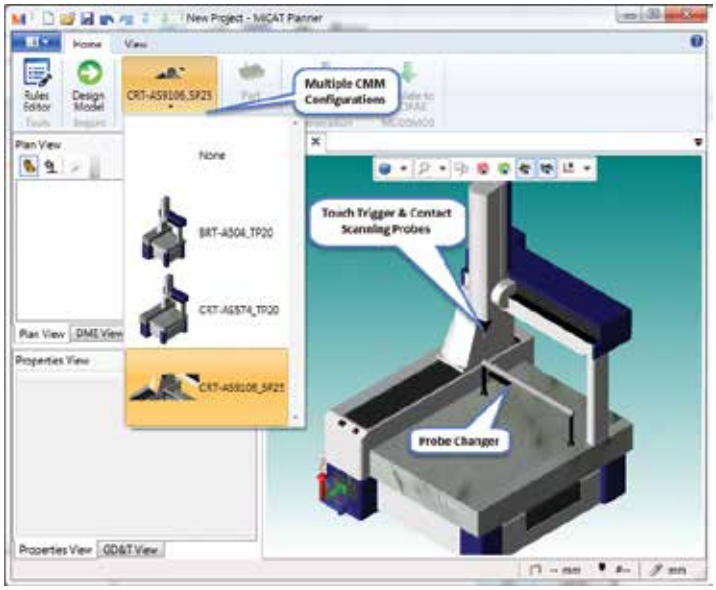
The measurement plan is synchronized with the 3D view and Program View. For example, a feature can be selected in any of the views (Plan View, 3D View, Program View) and is highlighted in the other views. Manual reordering of the feature measurement order is possible by drag and drop of the features in the Plan View. Users can select a feature, characteristic or point set in the Plan View to modify the corresponding properties in the Property View.

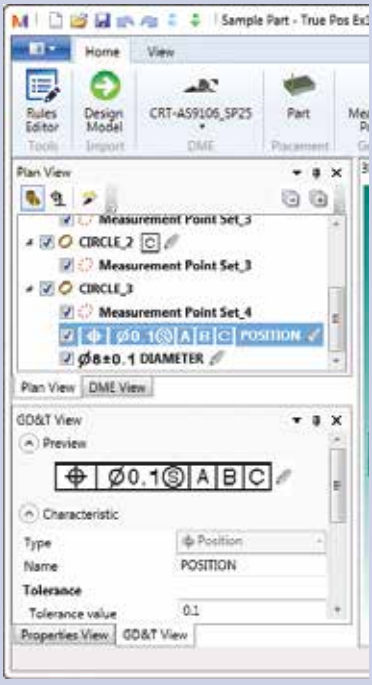
Load and Use MCOSMOS DME Configurations:

(DME: Dimensional Measuring Equipment)

- Load predefined DME configurations from CMM SystemManager
- Default DME is read directly from the MCOSMOS settings
- MiCAT Planner generates a program specifically for the selected DME
- Align DME and Design Model by mating, dragging, center of table or volume, or by direct numerical input
- Import PCS (part coordinate system) information from MCOSMOS

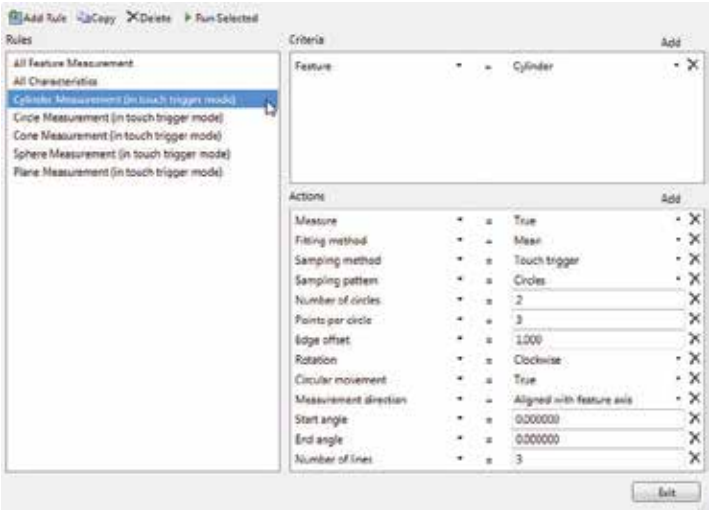






Rules Editor

The Rules Editor allows users to create rules to define measurement approaches, such as number of points per feature, sensor type, fitting method and automatic sensor selection.



Rules are applied during CAD import and can be re-applied after design model import. The Run Selected command automatically updates the measurement plan with the current defined rules and updates changes in the Plan and Program views.

Mitutoyo

CMM Probe & Change Rack Options

Touch-trigger Probe System

MH20i - Manual head **CMM:MANUAL | CNC**

MH20i is a manually adjustable probe head with an integral TP20 kinematic stylus module mount with two-axis indexing. The A-axis rotates through ±180° in the X-Y plane. The B-axis rotates through 90° in the Z plane. A lever locks the head in one of up to 168 repeatable positions, set at 15° increments. Capable of carrying the full range of TP20 modules, which can be changed without re-qualification, providing qualification has taken place in each position with each stylus/module combination.

PH1 - Manual probe head **CMM:MANUAL | CNC**

The PH1 is a general purpose, swivel-type probe head. Its compact design makes it ideally suited to a CMM where manual orientation of an M8 thread-mounted touch-trigger probe is required (TP20, TP200). The PH1 provides two axes of movement. The A-axis allows probe orientation in the vertical plane; the B-axis allows rotational probe orientation. Axis rotation is in relation to the shank mount. Probe re-qualification is required after each re-orientation of the PH1. TP200 not supported on manual CMM..

MIH - Manual indexable probe head **CMM:MANUAL | CNC**

The manually indexable head (MIH) has 720 repeatable positions and features an autojoint probe mount for fast, repeatable probe changing. This probe head is compatible with the TP6A touch probe directly and supports the TP20, andTP200 probe with the use of the autojoint extension bars (e.g. PAA1). An integral LCD enables easy programming with the facility to memorize up to 20 probe positions. Not for use with multi-wire probes.

Probe Mount: M8
Stylus Mount: M2

TP20 - Touch-trigger probe **CMM:MANUAL | CNC**

The TP20 is a compact kinematic touch-trigger probe system featuring a two-piece design, comprising probe body and detachable stylus module(s), connected using a highly repeatable magnetic kinematic coupling. This provides the facility to change stylus configurations either manually or automatically without the need for requalification of the stylus tips. Modules offering a range of trigger forces allow the probe performance to be best matched to the measurement task.

Probe Mount: M8
Stylus Mount: M2

TP200 - Touch-trigger probe **CMM:CNC**

The TP200 features quick-change stylus configurations without the need for requalification, utilizing electronic strain sensing techniques to improve on the form measuring accuracy and operating life that can be achieved when compared with kinematic touch-trigger probes. The TP200 probe is a two-piece design comprising the probe body and a detachable stylus module that holds the stylus assembly.

Probe Mount: Autojoint
Stylus Mount: M4

TP7 - High-accuracy, touch-trigger probe **CMM:CNC**

The TP7M is a high-accuracy touch-trigger probe with a maximum repeatability of $2\sigma \leq 0.25\mu m$. The TP7M can mount a long stylus up to 150mm. In combination with the longest autojoint probe extension of 200mm for direct mounting to the PH10M or PH10MQ, gives the TP7M a maximum access distance of 350mm.

UMAP-CMM - Micro-touch probe **CMM:CNC**

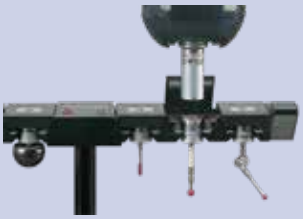
A stylus with an ultra-small diameter of ø0.1mm or ø0.3mm can be used. Measurement of miniscule form and dimensions from practically any direction is possible by mounting on the PH10MQ.

See page L-28 for stylus information.

MCR20 - Module Change Rack (TP20)

The MCR20 is designed to securely hold the stored TP20 probe modules for automatic changing (CNC CMM only) and to protect from airborne contaminants.

SCR200 - Module Change Rack (TP200)



The SCR200 provides automatic, high-speed changing between up to six TP200 stylus modules (CNC CMM only). The SCR200 is powered by the separate probe interface, PI 200, and provides features to facilitate safe stylus changing.

MSR - Manual Storage Rack (TP20/TP200)

The MSR1 manual storage rack holds up to 6 pre-qualified stylus assemblies fitted to TP20 or TP200 probe modules to simplify manual module changing. The MSR1 can be mounted on the CMM table or on a vertical surface.

MAP - Manual Autojoint Probe (TP6A/TP7)

The MAP (manual autojoint probe) stand is a low-cost storage rack capable of holding up to six autojoint mounted probes and extension bars. The MAP stand can be mounted directly on the table of a CMM, cabinet, wall or any vertical surface.

SC6 - Stylus Changer (MPP-310Q)

ACR3 - Autojoint Change Rack (SP25M)

FCR25 - Flexible Change Rack (SP25M)

FCR25-L3 - Flexible Change Rack (SP25M)

FCR25-L6 - Flexible Change Rack (SP25M)

SCP80 - Stylus Change Port (SP80)

CMM Probe & Change Rack Options

Motorized Probe Heads

The range of PH10 PLUS motorized probe heads increases throughput by giving CNC CMMs the added capability of program controlled probe re-orientation. This enables the inspection of features at different angles without the need for frequent, time-consuming stylus cluster changes.

PH10T

Shank-mounted head with two-wired probe capability and an M8 thread supporting TP20, TP200 and TP6 touch-trigger probes.

PH10M/10MQ

The PH10M PLUS can carry long extension bars and multi-wire probes such as QVP, SP25M, SurfaceMeasure, Surftest, UMAP-CMM or TP7M. The highly repeatable autojoint allows rapid probe or extension bar changing without the need for re-qualification. The PH10MQ PLUS is a variant of the PH10M PLUS that allows the motorized head to be attached directly to the quill with the B-axis of the head inside the quill itself. This option provides a neater and shorter probe mount, with only the A-axis protruding from the quill.

PH10M

PH10MQ

Scanning Probe Systems

MPP-310Q Ultra-High Accuracy Scanning

The MPP310Q is a multifunctional measuring head for CNC CMMs. It not only performs continuous contact scanning measurements at V2≤0.3µm, it also allows highly precise point measurements and self-centering measurements. The MPP-310Q incorporates 0.01µm resolution high-precision scales for each axis (XYZ). Air bearings on all axes ensures smooth measuring with minimal measuring force. Software-controlled clamps in each axis eliminate probe deflection while scanning slanted or arched surfaces to reduce measurement errors. The MPP-310Q allows for contact force as low as 0.03 Newtons for sensitive workpieces or when using very small stylus tips. Scanning speed up to 120mm/second can be achieved on known path geometry. Stylus holder changing is supported with the SCR6.

SP25M Compact High-Accuracy Scanning Probe

The SP25 is a compact high-accuracy scanning probe with an outside diameter of ø25 mm. This multi-functional probe is suitable for CNC coordinate measuring machines that perform not only scanning measurement, but also high-accuracy point measurement, as well as data collection from a centering-point measurement. The SP25M measuring head is extremely flexible, in addition to its measuring accuracy at very low contact forces, the SP25M can be used with probe systems ranging in lengths from 20mm (SP25-1) up to 400mm (SP25-4). The SP25M can be used on a fixed probe head (PH6M), or a motorized probe head (PH10M/10MQ). Probe systems, probe module and stylus holder changing is supported with the ACR3 and FCR25 rack changing systems.

SP80 Extended-Length High-Accuracy Scanning

The SP80 scanning measuring head is specially designed for extended length stylus with high-accuracy measurement for lengths up to 500mm (measured in the vertical and horizontal directions). The multifunctional head for CNC CMM' allows not only scanning measurements but also high-precision point measurements and self-centering measurements. Stylus holder changing is supported with the SCP80.

See page L-28 for stylus information.

Mitutoyo

Non-Contact CMM Probe Options

SurfaceMeasure 606/610/1010/606T/201FS

FEATURES

Mitutoyo's line of laser scanning probes automatically adjusts to workpiece surface characteristics to deliver highly efficient measurements. With a conventional laser probe, laser intensity and camera sensitivity must be adjusted according to the environment and workpiece material. In contrast, the SurfaceMeasure line laser probes, which automatically adjust for these factors, enable hassle-free and more reliable laser scanning results.

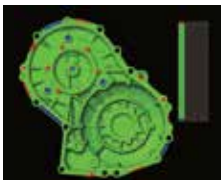
The SurfaceMeasure makes it possible to use coordinate measuring machines as production systems that can be used throughout the entire process, from development and prototyping to production.

Development phase

Optimized design utilizing measurement point cloud data significantly improves the efficiency of the development process, even when no master model or CAD data is available.

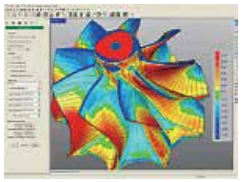
Prototyping phase

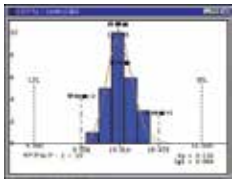
Shortens the entire process from prototyping to mass production because simulations can be used to compare prototypes with CAD data, check for part interference and set clearances, and optimize machine settings.



Production phase

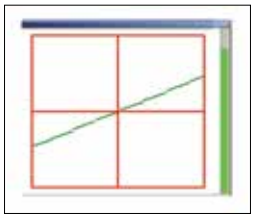
Allows the obtained data to be used for correcting dies, for example, by controlling the variability in mass-produced products, and feeding analysis data back to the preceding process step.



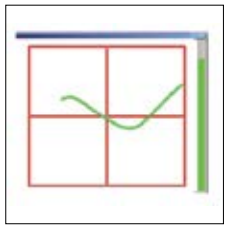


With a conventional laser probe, laser intensity and camera sensitivity must be adjusted according to the environment and the workpiece material. In contrast, the **SurfaceMeasure Series**, which automatically adjusts for these factors, enables simpler and more comfortable laser scanning.

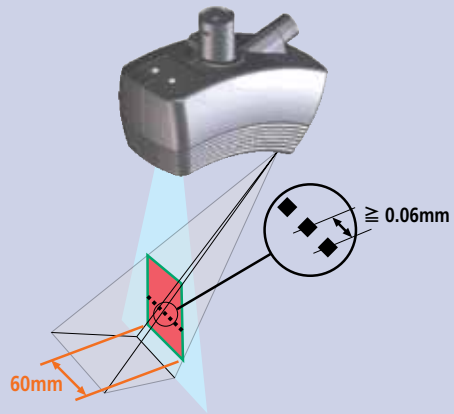
Measuring a color sample plate

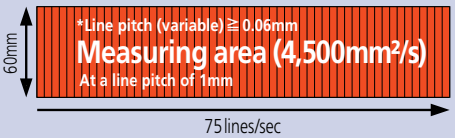


Measuring a glossy object

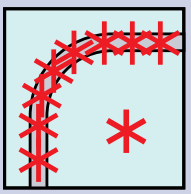


Because the laser intensity and camera sensitivity are automatically adjusted, stable shape data can be obtained even when the workpiece has multiple colors and varying degrees of reflectance.

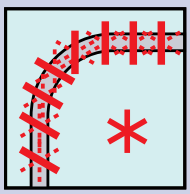




Improvement in measurement efficiency by reducing the frequency of probe attitude change.

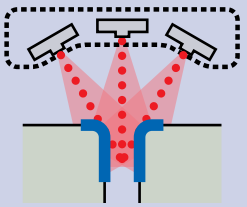


No change of probe attitude



Individual beam selectable

Simultaneous measurement of top and side by concurrently scanning 3-directional laser beams



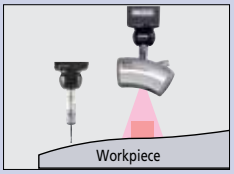
The laser beams converge from 3 directions toward a central point.

The line-laser crossing enables simultaneous scanning by 3 laser beams, thus allowing efficient measurement of complicated shapes.
(Applies to **SurfaceMeasure 606T**)

Non-Contact CMM Probe Options

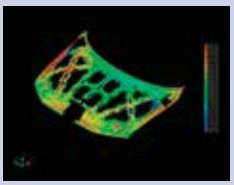
SurfaceMeasure 606/610/1010/606T/201FS

Features of Non-contact CMM



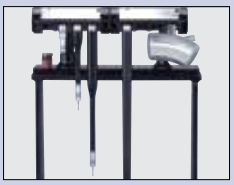
Reliability

- Based on a CMM that supports quality assurance operations.
- Allows the verification of non-contact measurement data with a contact probe.



Hybrid measurement

- Visualizes a shape that was previously invisible by establishing a cutting plane from measured points.
- Allows interchange between contact and non-contact probes according to the required measuring accuracy or workpiece shape.



Fully automatic measurement

- Automatic probe change with a probe changing rack.
- Allows programming a series of jobs from measurement to report creation.

Ultra-high speed data collection

- SurfaceMeasure is a laser probe that collects coordinate values of the surface of the workpiece by moving and irradiating laser light over the workpiece.

* When using SurfaceMeasure 606/610/1010

Advantages of non-contact type

- Non-contact measurement enables measurement of materials that can be easily-deformed by contact measurement, including resin or thin, elastic parts.

Powder-less measurement

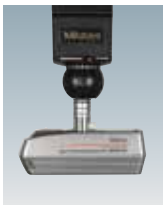
- Automatic configuration of the camera sensitivity and the laser intensity settings according to the environment and materials enable establishing a simple and comfortable laser-scanning environment since measurement is now powder and spray free.

Evaluation cases

- The collected point cloud data can be used by various optional software in a wide range of applications, such as editing, plane creation, comparison using CAD data and more.

606/610/1010

606T



201FS

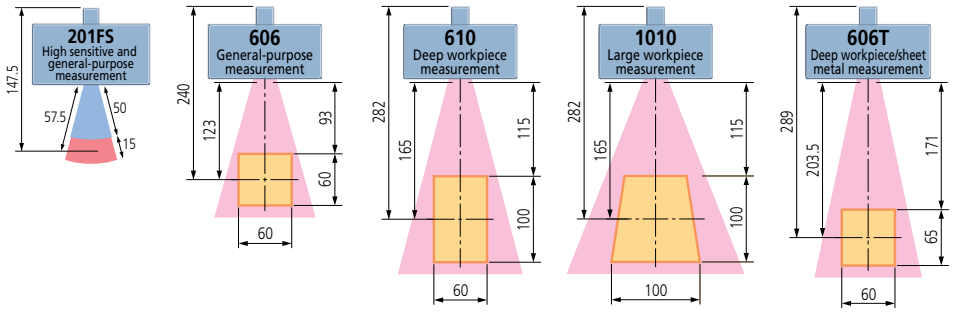
SPECIFICATIONS

Item/Model		SurfaceMeasure 606	SurfaceMeasure 610	SurfaceMeasure 1010	SurfaceMeasure 606T	SurfaceMeasure 201FS
Laser irradiation method		Line Laser (single)			Line Laser (cross)	Flying spot
Max. scan width		2.36" (60mm)	2.36" (60mm)	3.94" (100mm)	.2"×2.56"(3×65mm)	Max. 23mm
Max. scan depth		2.36" (60mm)	3.94" (100mm)	3.94" (100mm)	2.56" (65mm)	15mm
Working distance		3.54" (93mm)	4.53" (115mm)	4.53" (115mm)	6.85" (174mm)	57.5mm
Scanning error *		12µm	15µm	18µm	17µm	1.8µm
Max. Acquisition rate		75,000 points/sec			3×25,000 points/sec	25,000 points/sec.
Mass		0.95 lbs (430g)	0.88 lbs (400g)	0.88 lbs (400g)	1.06 lbs (480g)	500g
Laser Class	EN/IEC	Class2 [EN/IEC 60825-1(2007)]				
	JIS	Class2 [JIS C 6802 : 2011]				
	Laser type	Red semiconductor				Semiconductor
Line Laser	Wavelength	660nm				670nm
	Output	4mW				1 mW
Point Laser	Wavelength	635nm			—	—
	Output	1mW			—	—

*1: Made-to-order models
*2: According to Mitutoyo's acceptance procedure. (1σ/sphere measurement, probe alone)

*	Accuracy inspection environment	Temperature: 20℃±1℃ / Humidity: 50%±10%
	Target workpiece	Specified master ball for inspection (Diameter 30mm)
	Inspection method	According to Mitutoyo's acceptance procedure. (1σ/sphere measurement, probe alone)

MEASURING RANGE



Mitutoyo

MSURF

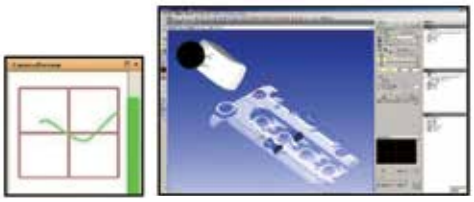
Software for SurfaceMeasure Probe for CNC CMMs

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
CMM

Laser Scanning: MSURF-S

A scanning path can be created by defining a scanning start point, a scanning length and a scanning width.

- Specify the 3 points using the joystick while watching the camera view.
- When a point group or master data exists on the screen, 3 points can be defined by selecting the data using the mouse. Automation of measuring paths from start to finish reduces measuring time.
- Operating of a joystick and buttons enables configuration and execution of a scanning path, and registration to or deletion from a macro. The ability to measure without using a PC has significantly improved operational efficiency, particularly for large-sized CMMs.

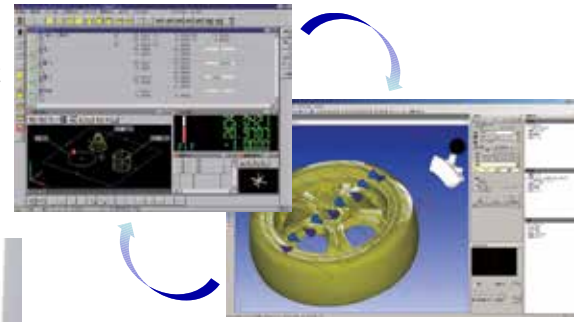


Scanning paths can be registered as a measurement macro.

- The measurement conditions of a measurement macro can be partly or wholly changed by the override function.
- The sub-macro function is effective for measuring multiple identical workpieces.
- A trial calculation of measurement macro execution time is based on the measurement conditions and the specifications of the CMM.

MSURF-S can be started from MCOSMOS.

- A work coordinate system created with MCOSMOS can be used with MSURF-S. Therefore, fully automatic measurement combined with contact measurement/ non-contact measurement can be performed.



Note: If not using ACR3, probe replacement is performed manually.

MSURF software enables users to perform operations from measurement to evaluation on the same platform when the non-contact line laser probe, SurfaceMeasure, is used. Three types of software are provided according to the task:

MSURF-S: Calculates point cloud data measured by CNC CMM with SurfaceMeasure. Generates scanning paths by defining the scanning start position, length and width.

MSURF-I: Conducts analysis or comparison verification of measured point cloud data in reference to nominal data (supporting CAD data import).

MSURF-G: Primarily creates part programs (measurement procedure programs) using CAD data.

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
cmm

Inspection: MSURF-I

CAD data import

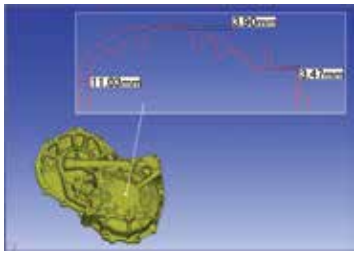
- SAT and STEP format are supported as standard.
- As an option, CATIA V4, CATIA V5, Creo, Unigraphics/NX, IGES, VDAFS, Parasolid, and Solidworks are available.

Comparison by features

- MSURF-I can detect various features from point cloud or mesh data and compare with nominal data. It also can calculate distances between features that have point data such as circle elements.
- Detectable features include basic plane, point, straight line, circle, slot, cylinder, cone, sphere, etc., and also weld bolt, weld nut, cylindrical pin, T-shaped stud and more.

Comparison of cross-sectional shape

- Cut of a point cloud, mesh data or master data allows for comparison of cross-sectional shapes and calculation of angle, distance, radius of curvature and more.
- The turbine blade analysis function enables calculation of LE thickness, TE thickness, maximum thickness, cord length, etc.

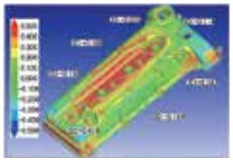


Section evaluation (dimensional calculation)

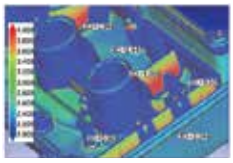
Turbine blade analysis (optional function)

Comparison of plane shape

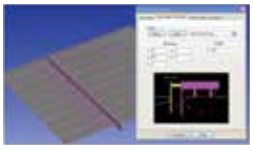
- The plane shape error will be displayed on a color map by comparing a point cloud or mesh data with CAD data.
- Thickness can be displayed on a color map, therefore, it is not necessary to cut a real workpiece.
- Capability of defining the shape of digital calipers enables evaluation of various types of uneven gaps.
- The evaluation of surface curvature can be used for evaluating an angle R within a specified dimensional tolerance.



Error color map



Thickness color map

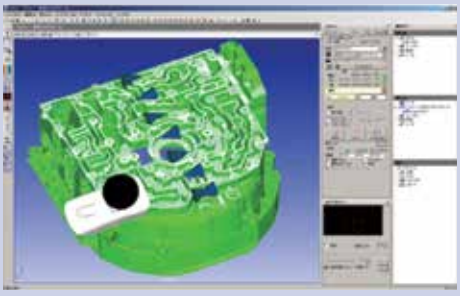


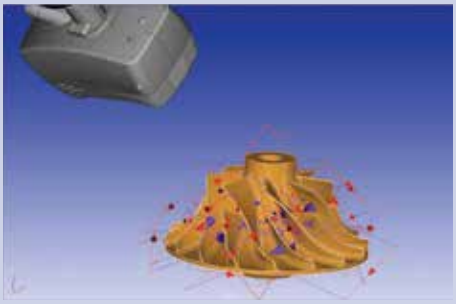
Evaluation of step/clearance

Surface curvature evaluation

Creation of operating procedure macro by automation function

- The automation function allows users to record the operating procedure including execution of a measurement macro.
- A series of operations from measurement to evaluation and report can be automated.





Off-line teaching: MSURF-G

MSURF-G allows users to create measurement macros using model data. Therefore, users can start measurement immediately when a real workpiece is available.
MSURF-G can improve the operating rate of your measuring instrument. Combining it with MSURF-I can reduce the man-hours from measurement to product evaluation.

- CMM time for creating measurement macros can be reduced.
- Measurement macros are created regardless of operator's skill level.
- The workflow from measurement to evaluation can be optimized.

MSURF-PLANNER

MSURF-PLANNER software automatically creates measurement macros (surface form, feature form) for the line laser probe from 3D CAD data.
Optimized data (travel path, number of probe head revolutions, etc.) of a measurement path contributes to improvements in productivity.

*MSURF-PLANNER is optional software for MSURF-S and MSURF-G.

Non-Contact CMM Probe Options

QVP Quick Vision Probe

Provides image measuring capability for coordinate measuring machines.

The QVP probe performs form measurement by image processing micro geometry that cannot be measured by a contact-type probe or flexible bodies that are easily deformed by slight measuring forces. Although the method of microscopic measurement with the centering microscope mounted on the coordinate measuring machine has been used since CMMs came into use in the industry, they have an inherent disadvantage in that the operation of identifying positions is dependent on the operator, possibly resulting in measurement errors. Even with a CNC CMM, manual measurement may still need to be performed, such as with an installed centering microscope. The QVP probe is a vision probe for CMMs and was developed based on Mitutoyo's state-of-the-art technology in order to enable full automation of image measurement with a CNC CMM. This technology was originally developed for Mitutoyo vision measuring machines.

Automatic detection of workpiece edge

The QVP-captured image will have various automatic edge detections performed by the dedicated software, Visionpak, and then various calculation processes (calculation of dimensions and geometrical deviations) will be performed with the general purpose measurement program, Geopak.

Standard provision of white LED illumination

Since the QVP is equipped with the standard co-axial light running through the lens system, as well as white-light LED ring illumination, which is bright and has a long service life, no auxiliary illumination is required. The light volume can be set to between 0 and 100% in 1% increments.

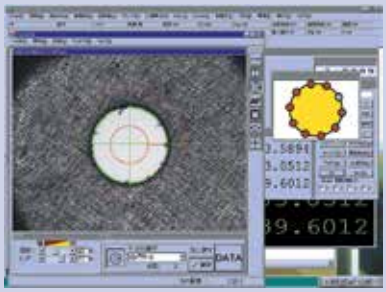
Mounting on the automatic probe changer

The QVP also can be mounted on an automatic probe changer (ACR3), allowing full-automatic measurement including both the contact and non-contact types in combination with the contact-type probes. QVP requires PH10M, PH10MQ or PH6M probe head.

QVP Specifications

QVP Main Unit	CCD Size		1/3 inch (B/W)			
	Optical tube magnification		0.375×			
	Illuminating function	Co-axial	White light LED source (built-in): Power dissipation 5W or less			
		Ring	White light LED source: Power dissipation 10W or less			
	Mass		Automatic-joint type: 315g, shank type: 390g			
	Optical magnification		0.375×	1.125×	1.875×	3.75×
	Observation range (mm)		9.6×12.8	3.2×4.3	1.9×2.6	1×1.3
	Working distance (mm)		61	72.3	61	51
Objective	Magnification		ML1×	ML3×	ML5×	ML10×
			Optional	Standard	Optional	Optional
	Numerical Aperture N.A.		0.03	0.09	0.13	0.21
	Depth of focus (μm)		306	34	16.3	6.2
	Mass		80g	55g	60g	95g
QVP I/F BOX	Supply voltage		AC100 to 240V			
	Frequency		50/60Hz			
	Power capacity		45W			
	Mass		3800g			

Objective ML1X **375-036**
Objective ML5X **375-034**
Objective ML10X **375-035**



VISIONPAK
Dedicated data processing software

VISIONPAK operates using the Microsoft Windows operating system and is a general purpose measurement program for coordinate measuring machines. It displays the image window when it detects a workpiece edge. After detecting an edge, it undertakes various calculations with regular general purpose measurement programs.

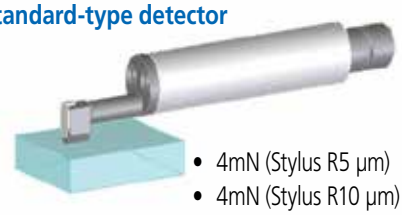
Variety of image processing functions

With the powerful image processing functions (tools), it can detect various forms of edges at high speed. It can measure in the height direction by means of its auto-focus function, and save the captured image as the image data (bitmap format).

Outlier removal function

In ordinary micro-form measurement it is often difficult to remove burrs and dusts from the objective workpiece, resulting in an inevitable measurement error. In contrast, VISIONPAK can recognize, for example, the obstruction as an outlier and bypass it during measurement.

Standard-type detector



- 4mN (Stylus R5 µm)
- 4mN (Stylus R10 µm)

Small hole detector

- 4mN (Stylus R5 µm)

Extra-small hole detector

- 4mN (Stylus R5 µm)

Deep groove detector

- 4mN (Stylus R5 µm)

Gear-tooth surface detector

- 4mN (Stylus R5 µm)

Note: For new purchase of Crysta-AS700 and larger, retrofit of existing Crysta-AS CMM by request.

CMM Surface Roughness Measuring

CMM Surftest Probe

CNC CMMs can be used to measure surface roughness, eliminating workpiece changeover to a second measurement device.

Mitutoyo has developed a range of surface roughness analysis products from handheld portable units to CNC-type Surftest with broader functions and higher accuracy. By utilizing the technologies developed over the years on surface roughness measuring machines, our coordinate measuring machines can execute surface roughness analysis by implementing a Surftest Probe and the dedicated software. The Surftest probe requires PH10M or PH10MQ probe head.

FEATURES

- Can be attached to our CNC CMM. (Retro-fitting is possible depending on the model.)
- The auto joint-probe system allows probe changing automatically between scanning (SP25M) and the CMM Surftest surface analysis probe. The measurement and evaluation of size, shape and roughness, is completely automated with auto joint-probe changing.*
- PH10M(Q) allows surface roughness measurement for features requiring rotation.
- The CMM Surftest Probe is derived from the successful Mitutoyo SJ-210/310 Series of portable surface finish units.

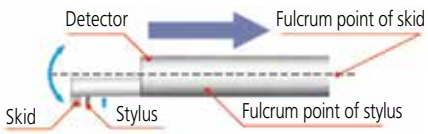
* Requires ACR3 change rack (OPTION)

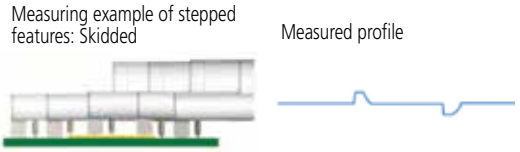
Skid Measurement Specifications

Item		Specifications
Probe (Detector specifications)	Measurement range	AUTO,25,100,360 µm
	Driving range	17.5 mm
	Measurement speed	0.25, 0.5, 0.75 mm/s
	Stylus tip radius	2,5,10*µm *Standard-type detector only
	Measuring force	4mN (Std) , 0.75mN (Opt.)
Evaluation software	Analysis software	SURFPAK-SP
	Control software	MCOSMOS
	Miscellaneous	Multi-wire autojoint probe head required (PH6M, PH10M, PH10MQ)

Skidded Measurement

In skidded measurements, surface features are measured with reference to a skid following close behind the stylus. This cannot measure waviness and stepped features exactly, but the range of movement within which measurement can be made is greater because the skid tracks the workpiece surface contour.





Mitutoyo

CMM Probing Accessories

Mitutoyo Styli Kits

M2

STARTER - K651376

BASIC 1 - K651377

BASIC 2 - K651354

EXPANSION - K651378

PROFESSIONAL - K651379

M3

STARTER - K651380

BASIC 1 - K651381

Carbon Fiber 1 - K651318

Carbon Fiber 2 - K651319

Carbon Fiber 3 - K651320

Materials used for spherical probes

Ruby

As the hardest of all probe element materials, ruby is the perfect all-round material. Spherical probes made of ruby have been used for most standard applications. The low specific density of ruby enables the mass of the stylus tip to be kept as small as possible. This effectively allows the elimination of false triggers caused by mass inertia when the CMM moves.

Zirconium oxide

Because of the specific surface properties of balls made of zirconium oxide - a ceramic compound – it is ideally suited for aggressive scanning of abrasive surfaces, such as workpieces made of cast iron. Zirconium oxide has virtually the same hardness and wear-resistant properties as ruby.

Silicon nitride

Silicon nitride is extremely hard and wear-resistant with the lowest surface roughness of all ball materials. Specific advantage: Silicon nitride is resistant to absorbing aluminum from workpiece surfaces.

Locating Pins 1 - K551123

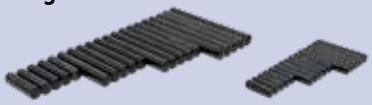
Locating Pins 2 - K551124

Clamping Elements 1 - K551125

Supporting Elements 1 - K551126

Supporting Elements 2 - K551127

Straight Pins - K551128



Receiver Brackets 1 - K551129

Receiver Brackets 2 - K551130

Magnet 1 - K551131

Joints 1 - K551132

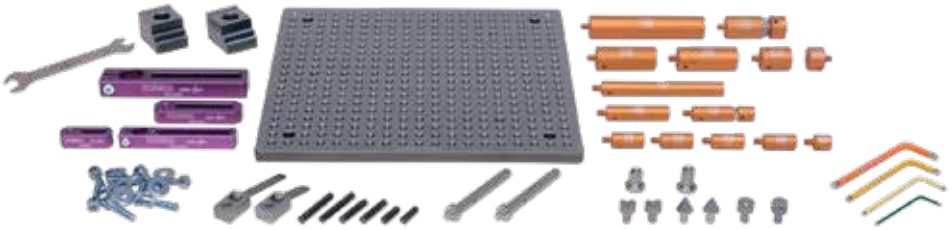
CMM Accessories

Mitutoyo ECO-FIX Kit Fixture Systems

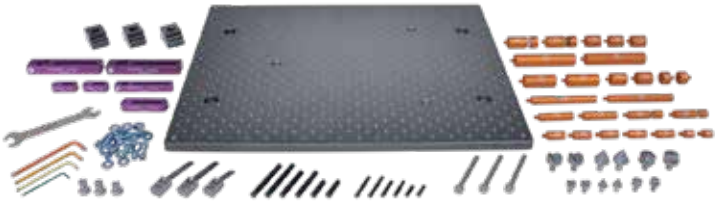
The Mitutoyo Eco-Fix Clamping System for modular CMM and vision product workholding setups work well for different part sizes/types and environments. The design combines operational modularity advances with lower-cost solutions. This can be found both in the reduction or elimination of hard fixturing costs and setup time. This system is comprised of well-marked, color-coded components designed to simplify part measurement requirements. Magnetic or threaded fastening points deliver fast, plug-and-play connectivity. First-time fixturing jobs can be established and reconfigured in a matter of minutes for quick turnaround for future part measurement. Or, as needed, fixtures can be built and stored to meet all common part measurement requirements. Base plates are hard-coated and other components are machined for durability.

The entry-level Mitutoyo Eco-Fix Kit S version is comprised of a 250mm x 250mm base plate footprint and 59 total components in the system. The Eco-Fix Kit L is a larger version and built for more complex part fixturing applications (measuring 500mm x 400mm in base plate footprint and a total of 98 total components in the system).

Eco-Fix Kit - S K551048



Eco-Fix Kit L - K551049

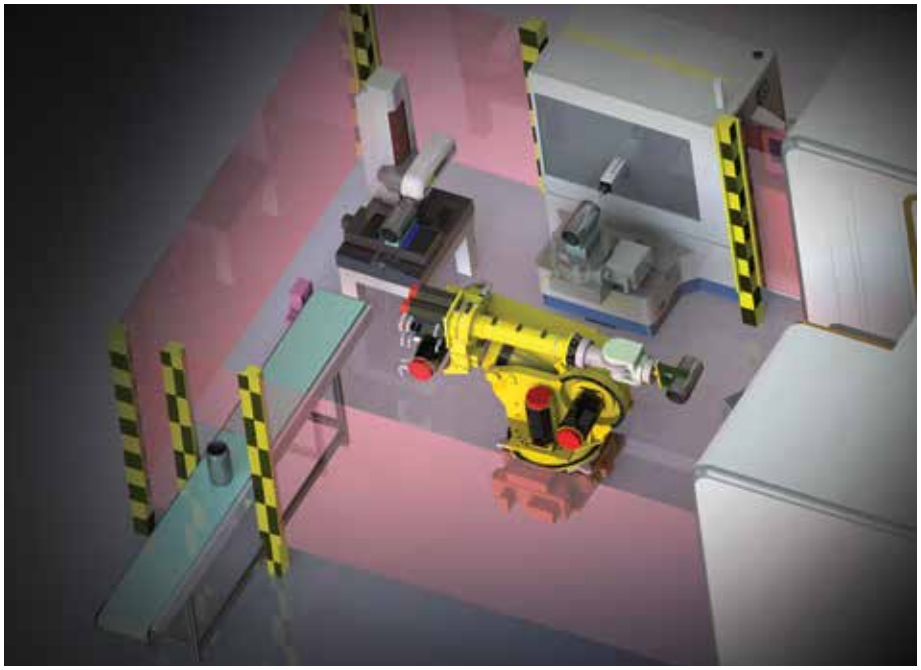


Eco-Fix MAG S - K551089

Eco-Fix MAG L - K551090

Mitutoyo

MITUTOYO CUSTOM SOLUTIONS



Mitutoyo Custom Solutions helps businesses in a wide range of industries achieve higher quality products, parts and machines with custom precision measurement tools and equipment.

Mitutoyo's highly skilled engineers specialize in designing and building custom measurement systems, applications and software to bring value-added solutions to resolve nearly every measurement need for customers with unique applications.

Custom Solutions & Services Include:

- Inline/near line part inspection and gaging
- Factory automation
- Data management
- Fixture design/build
- 3D CAD concepts/renderings
- Turnkey capital projects
- Product implementation
- Custom styli/accessories
- "Green button" technology

If you have any questions or would like more information regarding Mitutoyo Custom Solutions, contact: **solutions@mitutoyo.com**.

Vision Measuring Systems

INDEX

QV H4 606

QV WLI

QV Active 202

Mitutoyo

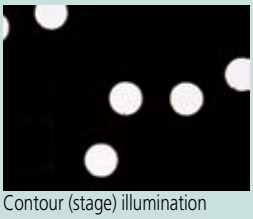
Quick Scope

SERIES 359 — Manual Vision Measuring System

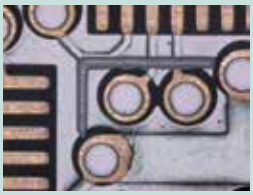
FEATURES

- Surface, contour and fiber-optic ring light illumination options enable users to configure the QS lighting to meet a variety of measurement needs.
- Powerful, Windows®-based QSPAK software offers a spectrum of measuring and analysis capabilities.
- Functions include auto-focus, measurement playback, one-click edge detection, graphic display, 48 different macros and a pattern matching function for several common part features.
- Excellent surface observation model for a variety of workpieces.
- 0.1µm resolution and 150mm Z-axis range.
- Power zoom enables quick magnification changes.
- Fine illumination capability enables lighting changes to match workpiece requirements.
- The quick release system on the stage enables instant switching between coarse and fine movements.
- Quick Navigation function enables the user to repeat measurements quickly.

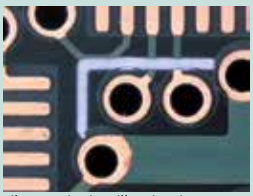
Illumination



Contour (stage) illumination



Surface (coaxial) illumination



Fiber-optic ring illumination

During automatic measurement the part program provides automatic control over the illumination system, thus providing the necessary balance between user-friendliness and high efficiency.

SPECIFICATIONS

Model No.	QS-L2010ZB	QS-L3017ZB	QS-L4020ZB
Range (X-axis / Y-axis / Z-axis)	8" x 4" x 6" / 200 x 100 x 150mm	12" x 6.7" x 6" / 300 x 170 x 150mm	15.7" x 8" X 6" / 400 x 200 x 150mm
Resolution	0.1µm		
Scale type	Linear encoder		
Measuring accuracy (at 20°C and 3.0x magnification)	XY: (2.5+20L/1000)µm Z: (5+40L/1000)µm		
Image detecting unit	1/2" 3 MP Color CMOS camera		
Illumination (Halogen)	Co-axial light, fiber-optic ring light, stage light		
Stage glass size	9.84 x 5.91"(250 x 150 mm)	14.57 x 9.45"(370 x 240 mm)	17.32 x 9.45"(440 x 240 mm)
Max. workpiece height	6" / 150mm		
Max. stage loading	22 lbs / 10 kg	44 lbs / 20 kg	33 lbs / 15 kg
Dimensions (W x D x H)	25" x 30" x 28" / 624 x 769 x 722 mm	27" x 33" x 36" / 682 x 837 x 916 mm	30" x 33" x 37" / 757 x 837 x 930 mm
Mass (main unit)	158.7 lbs / 72 kg	308.6 lbs /140 kg	321.9 lbs / 146 kg

System diagram

Software options

- Measurement support software: **QS-CAD I/F**
- Shape evaluation and analysis software: **FORMPAK-QV**
- Statistical process control software: **MeasurLink**

QS-LZB

PC Set
Standard software
QSPAK

Peripheral options

- Foot switch - standard type (**937179T**)
- Calibration chart (**02AKN020**)

Stage accessory options

- Rotary table
  - ·Rotary table with fine-feed knob (A) (**176-305**) For 2010 size stages
  - ·Rotary table with fine-feed knob (B) (**176-306**) For 3017 or 4020 size stages
- Swivel center support (**172-197**)
- Holder with clamp (**176-107**)
- V-block with clamp (**172-378**)

*1 Adapter B (**176-310**) is required for 2010 models.
Adapter (**176-304**) is required for 3017 and 4020 models.
*2 Can be installed on rotary table with fine-feed knob (A).
Cannot be installed on rotary table with fine-feed knob (B).

Control Box

For **QS-LZB**

Optical system magnification ratios available for QS-LZB

Total magnification Field of View (mm)	29X 8.8x6.6	38X 6.8x5.1	49X 5.2x3.9	58X 4.4x3.3	87X 2.9x2.2	116X 2.2x1.6	145X 1.7x1.3	202X 1.2x0.9
QS-LZB Working distance (mm)	0.75X	0.98X	1.28X	1.5X 55	2.25X	3X	3.75X	5.25X

* Total magnification shown in the above table is a reference value displayed in the default window state when using 22-inch LCD.

Quick Image

SERIES 361 — Non-contact 2-D Vision Measuring System

Double-telecentric optics enable efficient measurement with a wide field of view

Batch measurement with a wide field of view 1.259" x 0.945"(32 x 24mm) realized using a 0.2X magnification model can substantially improve measurement efficiency.
With a 0.5X magnification model, dimensions of very small workpieces and stepped workpieces easily can be measured.

Actual image acquired with a 0.2X magnification model

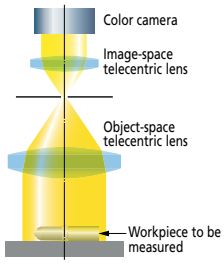
Quick Image is a new concept in 2-D vision measuring instruments. It provides unique features for improving measurement efficiency.

FEATURES

- Long focal depth and wide field of view
- Telecentric optical system
- 3 mega-pixel color CCD camera
- Large quadrant LED ring light
- Single-click measurement execution
- Displays measurement results on video window
- Orientation of part is automatically detected

QI-A2010D

QI-C2010D



SPECIFICATIONS

		Manual stage model					Motorized stage model		
0.2X	Model	QI-A1010D	QI-A2010D	QI-A2017D	QI-A3017D	QI-A4020D	QI-C2010D	QI-C2017D	QI-C3017D
0.5X	Model	QI-B1010D	QI-B2010D	QI-B2017D	QI-B3017D	QI-B4020D			
Measuring range (XxY)		3.94" x 3.94" 100x100mm	7.87" x 3.94" 200x100mm	7.87" x 6.69" 200x170mm	11.8" x 6.69" 300x170mm	15.7" x 7.87" 400x200mm	7.87" x 3.94" 200x100mm	7.87" x 6.69" 200x170mm	11.8" x 6.69" 300x170mm
Effective stage glass size		6.69" x 6.69" 170x170mm	9.53" x 5.51" 242x140mm	10.2" x 9.06" 260x230mm	14.2" x 9.06" 360x230mm	17.3" x 9.13" 440x232mm	9.53" x 5.51" 242x140mm	10.2" x 9.06" 260x230mm	14.2" x 9.06" 360x230mm
Maximum stage loading *1		Approx. 22 lbs.(10kg)		Approx. 44 lbs.(20kg)		Approx. 33 lbs. (15kg)	Approx. 22 lbs. (10kg)	Approx. 44 lbs.(20kg)	
Main unit mass		Approx. 143 lbs. 65kg	Approx. 152 lbs. 69kg	Approx. 330 lbs. 150kg	Approx. 348 lbs. 158kg	Approx. 361 lbs. 164kg	Approx. 158 lbs. 72kg	Approx. 337 lbs. 153kg	Approx. 354 lbs. Approx. 161kg

*1 Does not include extremely offset or concentrated loads

			QI-A / QI-C	QI-B
View field			1.26" x 0.94" (32×24mm)	0.50" x 0.378" (12.8×9.6mm)
Measurement mode			High resolution mode / Normal mode *4	
Travel range (Z axis)			3.94"(100mm)	
Accuracy	Measurement accuracy within the screen *1	High resolution mode	±2μm	±1.5μm
		Normal mode	±4μm	±3μm
	Repeatability within the screen (±2σ) *2	High resolution mode	±1μm	±0.7μm
		Normal mode	±2μm	±1μm
	Measurement accuracy (E1xy) *1		±(3.5+0.02)μm L: arbitrary measuring length (mm)	
Monitor magnification *3			7.6X	18.9X
Optical system	Magnification (Telecentric Optical System)		0.2X	0.5X
	Depth of focus	High resolution mode	±0.6mm	±0.6mm
		Normal mode	±11mm	±1.8mm
	Working distance		3.54"(90mm)	
Camera			3 million pixels, 1/2", full color	
Illumination			Transmitted light: Green LED telecentric illumination Co-axial light: White LED Ring light: 4-quadrant white LED	
Power supply			100-240VAC 50/60Hz	
Accuracy guaranteed temperature range			19-21°C	

*1 Inspected to Mitutoyo standards by focus point position.
*2 The measuring accuracy is guaranteed to be accurate within the depth of focus.
*3 For 1X digital zoom (when using the 22-inch-wide monitor)
*4 Patent registered (Japan)

Mitutoyo

QV Active

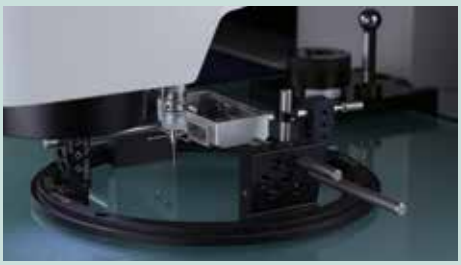
Compact CNC Vision Measuring Systems

FEATURES

- High-quality zoom optics with interchangeable lenses
- High-resolution and high-speed color camera
- Compact design saves significant space—available in two sizes
- Powerful QVPAK 3D vision software
- Contact and noncontact measurement
- Touch-probe retrofittable
- Programmable LED stage, coaxial and 4-quadrant ring light

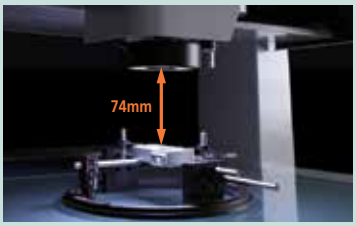
1X, 1.5X and 2X interchangeable lens

QV Active 202



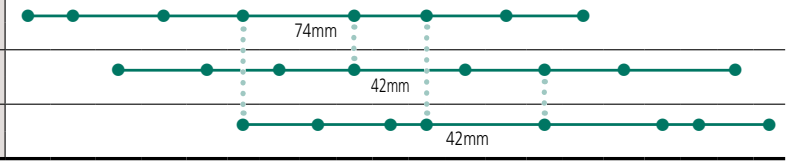
Touch-Probe System

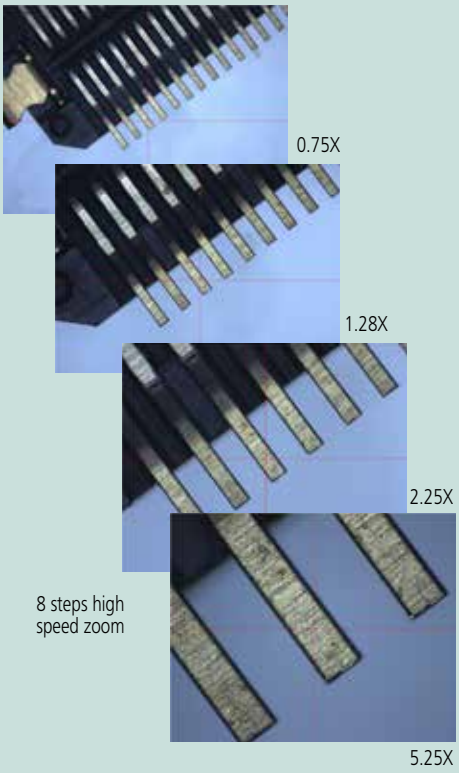
The QV touch-probe system is available on all the models. All touch-probe systems include probes, modules, calibration articles and installed software. (See page M-13)



Long working distance 74mm
*when using Z-objective 1X

Optical magnification	0.5X	0.65X	0.75X	0.85X	0.98X	1X	1.28X	1.3X	1.5X	1.7X	2X	2.25X	2.5X	3X	3.5X	3.75X	4X	5X	5.25X	7X
View field (mm) Horizontal (H)	13.60	10.46	9.07	8.00	6.94	6.80	5.31	5.23	4.53	4.00	3.40	3.02	2.72	2.27	1.94	1.81	1.70	1.36	1.30	0.97
Vertical (V)	10.80	8.31	7.20	6.35	5.51	5.40	4.22	4.15	3.60	3.18	2.70	2.40	2.16	1.80	1.54	1.44	1.35	1.08	1.03	0.77





8 steps high speed zoom

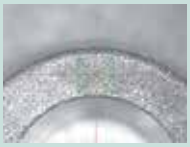
SPECIFICATIONS

Name	Quick Vision Active	
Model No.	**QV Active 202 / QV Active 202 TP**	**QV Active 404 / QV Active 404 TP**
Range (X,Y,Z-axis) with vision head	9.84" x 7.87" x 5.91" 250 x 200 x 150 mm	15.75" x 15.75" x 7.87" 400 x 400 x 200 mm
Resolution	0.1 µm	
Accuracy (µm)*	$E_{1(X,Y)} = (2+3L/1000)$ $E_{1(Z)} = (3+5L/1000)$ $E_{2(X,Y)} = (2.5+4L/1000)$	
Max. stage loading	22 lbs. (10 kg)	44 lbs. (20 kg)
Mass	265 lbs. (120 kg)	606 lbs. (275 kg)
Illumination	(White LED) Contour / Coaxial / 4-quadrant ring light	
Magnification change system	Zoom optical system with 8 positions (Standard 1.5X magnification lens)	
Sensor type	High-resolution CMOS color camera	
Optional objective lenses	1X and 2X magnification	
Factory option	Series 364 (TP) Touch-Probe option (Page M-13)	

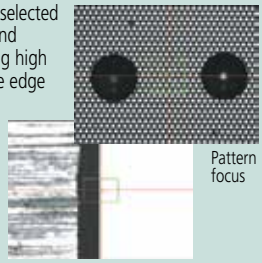
* L is arbitrary length in mm

Image Multi-AutoFocus

The optimal focus can be selected for each surface texture and measured feature, realizing high reproducibility and reliable edge detection.



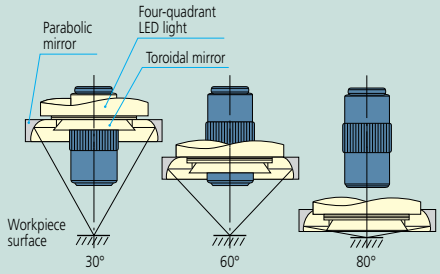
Surface focus



Edge focus

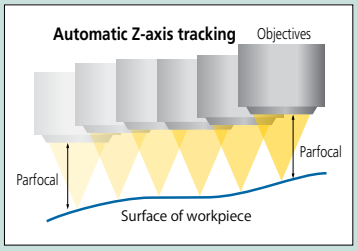
Programmable Ring Light (PRL)

Fine control of obliquity and direction provides illumination optimal for measurement. Obliquity can be arbitrarily set in the range from 30° to 80°. This type of illumination is effective for enhancing the edge of inclined surfaces or very small steps. Illumination can be controlled independently in every direction, front and back, right and left. Measurement with edge enhancement is possible by forming a shadow with lighting from only one direction.



Tracking Auto Focus (TAF)

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface waves and warpage (in the Z axis height direction) improves measurement throughput. The feature also eliminates the hassle of focusing during manual measurement.



Tracking Auto Focus (TAF)

AF principle	Objective coaxial autofocusing (knife-edge method)				
Suitable objectives	QV-HR1x	QV-SL1x	QV-HR2.5x	QV-SL2.5x	QV-5x
Tracking range*2	6.3mm (±3.15mm)	6.3mm (±3.15mm)	1mm (±0.5 mm)	1mm (±0.5 mm)	0.25mm (±0.125mm)
Spot diameter*3	5.2µm	8.0µm	2.1µm	3.1µm	1.5µm
Laser source	Semiconductor laser (peak wavelength: 690nm)				
Laser power	0.9mW				
Laser safety	Class 2 (JIS C6802:2011, EN/IEC 60825-1:2007)				

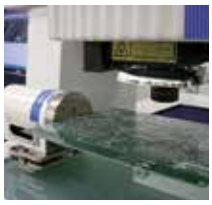
*2 Varies according to workpiece surface texture and reflectance.
*3 These are design values.

Optional Accessories: Refer to page M-14.

QV Apex

SERIES 363 — CNC Vision Measuring System

QV Apex 302 PRO



Optional Index Table*

Automatic multi-plane measurement is possible with the optional index table. Refer to page M-14 for more details.
*Not available with QV ACCEL models

QV Apex 606 PRO

SPECIFICATIONS

Name		Quick Vision Apex		
Model No.		QV Apex 302 PRO	QV Apex 404 PRO	QV Apex 606 PRO
		QV Apex 302 (ISO10360-7)	QV Apex 404 (ISO10360-7)	QV Apex 606 (ISO10360-7)
		QV Apex 302 (w/TAF)	QV Apex 404 (w/TAF)	QV Apex 606 (w/TAF)
Measuring Range	X-axis	11.81" / 300mm	15.75" / 400mm	23.62" / 600mm
	Y-Axis	7.87" / 200mm	15.75" / 400mm	25.59" / 650mm
	Z-Axis	7.87" / 200mm	9.84" / 250mm	9.84" / 250mm
Resolution / Scale Unit		0.1µm / Reflective-type Linear Encoder		
Resolution Z Scale Using Tracking Autofocus (TAF)		0.3 µm		
Laser Auto Focus repeatability σ ≤		0.8 µm		
CCD camera		B & W		
Illumination Unit (LED)	Surface	White LED		
	Contour	White LED		
	Programmable Ring Light	White LED		
Max. Drive Speed	X/Y Axis	300 mm/s	400 mm/s	
	Z-Axis	300 mm/s	300 mm/s	
Measuring Accuracy*	E_{1X},E_{1Y}	(1.5+3L/1000)µm		
	E_{1Z}	(1.5+4L/1000)µm		
	E_{2XY}	(2+4L/1000)µm		
	$E_{U,MPE}$ (ISO10360-7:2011)	3+5.5L/1000, 3+6L/1000**		
	$P_{F2D,MPE}$ (ISO10360-7:2011)	2.3µm		
Magnification Change System		Programmable Power Turret (1x, 2x, 6x)		
Stage Glass Size		15.71" x 10.67" (399 x 271mm)	19.41" x 21.69" (493 x 551mm)	27.44" x 29.84" (697 x 758mm)
Maximum Stage Loading		44 lbs. (20kg)	88 lbs. (40kg)	110 lbs. (50kg)
Dimensions of Main Unit		37.44" x 33.82" x 41.06" (951 x 859 x 1043mm)	55.39" x 40.43" x 54.37" (1407 x 1027 x 1381mm)	78.15" x 51.54" x 61.81" (1985 x 1309 x 1570mm)
Mass of Main Unit (Including Machine Stand)		794 lbs. (360kg)	1276 lbs. (579kg)	3197 lbs. (1450kg)

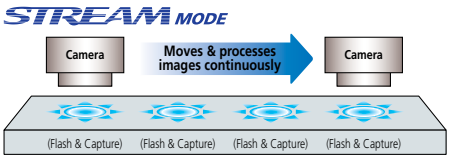
*The measuring accuracy defined under the following conditions:
Programmable Power Turret: 2x Position; Objective Lens: 2.5x (HR or SL); L=Dimension between two arbitrary points (mm)
**Accuracy 3.5+5.5L/1000 for 20 ± 2°C, Accuracy 3+6L/1000 from 18 to 23°C

Mitutoyo

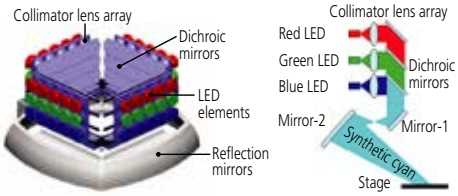
QV Stream Plus

SERIES 363 — CNC Vision Measuring System

QV Stream Plus 606 PRO



High-density mounting of ultra-high intensity LED elements



SPECIFICATIONS

Name		Quick Vision Stream Plus		
Model No.		QV Stream Plus 302 PRO	QV Stream Plus 404 PRO	QV Stream Plus 606 PRO
		QV Stream Plus 302 (w/TAF)	QV Stream Plus 404 (w/TAF)	QV Stream Plus 606 (w/TAF)
Measuring Range	X-axis	11.81" / 300mm	15.75" / 400mm	23.62" / 600mm
	Y-Axis	7.87" / 200mm	15.75" / 400mm	25.59" / 650mm
	Z-Axis	7.87" / 200mm	9.84" / 250mm	9.84" / 250mm
Resolution / Scale Unit		0.1µm / Reflective-type Linear Encoder		
Resolution Z Scale Using Tracking Autofocus (TAF)		0.3 µm		
Laser Auto Focus repeatability σ ≤		0.8 µm		
CCD camera		B & W, Progressive Scanning CCD		
Illumination Unit (C: Continuous; S: Stroboscopic; PRL: Programmable Ring Light)	Surface (C)	Red, Green, Blue & White (LED)		
	Surface (S)	Blue (LED)		
	Contour (C)	Blue (LED)		
	Contour (S)	Blue (LED)		
	PRL (C)	Red, Green, Blue & White (LED)		
	PRL (S)	Blue (LED)		
Max. Drive Speed	X/Y/Z Axis	300 mm/s		
Measuring Accuracy*	E_{1X},E_{1Y}	(1.5+3L/1000)µm		
	E_{1Z}	(1.5+4L/1000)µm		
	E_{2XY}	(2+4L/1000)µm		
Magnification Change System		Programmable Power Turret (1x, 2x, 6x)		
Stage Glass Size		15.71" x 10.67" (399 x 271mm)	19.41" x 21.69" (493 x 551mm)	27.44" x 29.84" (697 x 758mm)
Maximum Stage Loading		44 lbs. (20kg)	88 lbs. (40kg)	110 lbs. (50kg)
Dimensions of Main Unit		37.44" x 33.82" x 41.06" (951 x 859 x 1043mm)	55.39" x 40.43" x 54.37" (1407 x 1027 x 1381mm)	78.15" x 51.54" x 61.81" (1985 x 1309 x 1570mm)
Mass of Main Unit (Including Machine Stand)		794lbs. (360kg)	1276 lbs. (579kg)	3197 lbs. (1450kg)

*The measuring accuracy defined under the following conditions:
Programmable Power Turret: 2x Position; Objective Lens: 2.5x (HR or SL); L=Dimension between two arbitrary points (mm)

FEATURES

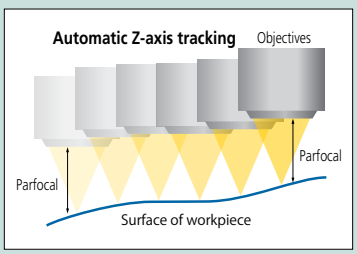
Non-stop Vision Measurement
Extreme Improvement in Throughput*
Conventional vision measuring systems endlessly repeat the cycle of stage displacement, stage stop, measurement, stage start and stage displacement. This mode of operation is a fundamental limitation on improving measurement throughput.
In contrast, the Quick Vision Stream system uses an innovative image capture technique that avoids the need to repeatedly stop the stage, thereby allowing for continuous measurement while still maintaining accuracy.

Measurement Throughput Comparison between QV STREAM and the Conventional System
STREAM PLUS series: more than 5 times faster
* Comparison of measurement throughput using a Mitutoyo sample workpiece with that of conventional Mitutoyo systems.

Newly Developed Stroboscopic Illumination System
The development of a high-intensity LED flash illuminator makes non-stop vision measurement possible. At the precise moment the stage reaches a measurement point, the illuminator creates an extremely short, high-intensity flash that effectively freezes all motion. The illuminator turns on and off so quickly that no image blur occurs, and the image is captured in full and accurate detail.
This innovative design takes full advantage of high-density, high-intensity LED arrays aided by collimating lenses and dichroic mirrors to produce ultra bright, directional and efficient illumination.

Tracking Auto Focus (TAF)

The TAF feature continuously focuses, adjusting to changes in the height of the object being measured. Automatic tracking of surface waves and warpage (in the Z axis height direction) improves measurement throughput. The feature also cuts out the hassle of focusing during manual measurement, reducing the work burden for measuring system operators.



Tracking Auto Focus (TAF)

AF principle	Objective coaxial autofocusing (knife-edge method)				
Suitable objectives	QV-HR1x	QV-SL1x	QV-HR2.5x	QV-SL2.5x	QV-5x
Tracking range*2	6.3mm (±3.15mm)	6.3mm (±3.15mm)	1mm (±0.5 mm)	1mm (±0.5 mm)	0.25mm (±0.125mm)
Spot diameter*3	5.2µm	8.0µm	2.1µm	3.1µm	1.5µm
Laser source	Semiconductor laser (peak wavelength: 690nm)				
Laser power	0.9mW				
Laser safety	Class 2 (JIS C6802:2011, EN/IEC 60825-1:2007)				

*2 Varies according to workpiece surface texture and reflectance.
*3 These are design values.

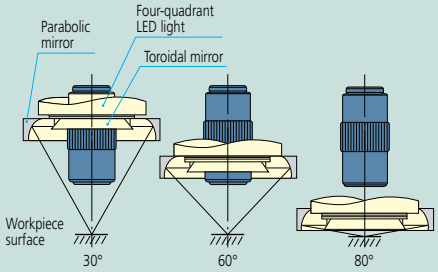
Programmable Power Turret (PPT)

The three tube lens selection provides three magnification levels with the same objective lens. Replacement objective lenses allow a wide range of magnifications to support a variety of measurements.

1X tube lens x 2.5X objective
View field: 2.5 x 1.88 mm

2X tube lens x 2.5X objective
View field: 1.25 x 0.94 mm

6X tube lens x 2.5X objective
View field: 0.41 x 0.31 mm



Programmable Ring Light (PRL)

Fine control of obliquity and direction provides illumination optimal for measurement. Obliquity can be arbitrarily set in the range from 30° to 80°. This type of illumination is effective for enhancing the edge of inclined surfaces or very small steps. Illumination can be controlled independently in every direction, front and back, right and left. Measurement with edge enhancement is possible by forming a shadow by lighting from only one direction.

QV Hyper

SERIES 363 — High-accuracy CNC Vision Measuring System

QV Hyper 404 PRO

SPECIFICATIONS

Name		Quick Vision Hyper		
Model No.		QV Hyper 302 PRO QV Hyper 302 (ISO10360-7) QV Hyper 302 (w/TAF)	QV Hyper 404 PRO QV Hyper 404 (ISO10360-7) QV Hyper 404 (w/TAF)	QV Hyper 606 PRO QV Hyper 606 (ISO10360-7) QV Hyper 606 (w/TAF)
Measuring Range	X-axis	11.81" / 300mm	15.75" / 400mm	23.62" / 600mm
	Y-Axis	7.87" / 200mm	15.75" / 400mm	25.59" / 650mm
	Z-Axis	7.87" / 200mm	9.84" / 250mm	9.84" / 250mm
Resolution / Scale Unit		0.02µm / Reflective-type Linear Encoder		
Resolution Z Scale using Tracking Autofocus (TAF)		0.26 µm		
Laser Auto Focus repeatability σ ≤		0.8 µm		
CCD Camera		B & W		
Illumination Unit (LED)	Surface	White LED		
	Contour	White LED		
	Programmable Ring Light	White LED		
Max. Drive Speed	X/Y/Z-Axis	200mm/s		
Measuring Accuracy*	E_{1X},E_{1Y}	(0.8+2L/1000)µm		
	E_{1Z}	(1.5+2L/1000)µm		
	E_{2XY}	(1.4+3L/1000)µm		
	$E_{U,MPE}$ (ISO10360-7:2011)	2.5+4L/1000, 2.5+4.5L/1000**		
	$P_{F2D,MPE}$ (ISO10360-7:2011)	1.7µm		
Magnification Change System		Programmable Power Turret (1x, 2x, 6x)		
Stage Glass Size		15.71" x 10.67" (399 x 271mm)	19.41" x 21.69" (493 x 551mm)	27.44" x 29.84" (697 x 758mm)
Maximum Stage Loading		44 lbs. (20kg)	88 lbs. (40kg)	110 lbs. (50kg)
Dimensions of Main Unit		37.44" x 33.82" x 41.06" (951 x 859 x 1043mm)	55.39" x 40.43" x 54.37" (1407 x 1027 x 1381mm)	78.15" x 51.54" x 61.81" (1985 x 1309 x 1570mm)
Mass of Main Unit (Including Machine Stand)		794 lbs. (360kg)	1276 lbs. (579kg)	3197 lbs. (1450kg)

*The measuring accuracy defined under the following conditions:
Programmable Power Turret: 2x Position; Objective Lens: 2.5x (HR or SL); L=Dimension between two arbitrary points (mm)
**Accuracy 2.5+4L/1000 for 20 ± 2°C, Accuracy 2.5+4.5L/1000 from 18 to 23°C

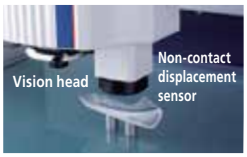
Mitutoyo

QV Hybrid Type 1, Type 4

SERIES 365 — CNC Vision Measuring System with Non-contact Displacement Sensor

FEATURES

The Quick Vision Hybrid is an advanced machine that allows vision measurement with both a CCD camera and high-speed scanning by applying a vision measurement unit in parallel with a non-contact displacement sensor.



Type 4 Displacement Sensor


QVH4 606

FEATURES: Hybrid Type 1

- The focusing point method minimizes the difference in the measuring face reflectance and realizes high measurement reproducibility.
- The double pinhole method (less directivity) is employed as the measurement principle.

CLASS 1 LASER PRODUCT

Safety precautions regarding laser autofocus system (factory-installed option)

This product uses a low-power visible laser (690nm) for measurement. The laser is a CLASS 1 EN/IEC60825-1 (2007) device. A warning and explanation label, as shown above, is attached to the product as appropriate.

SPECIFICATIONS

Name			Quick Vision Hybrid 302		Quick Vision Hybrid 404		Quick Vision Hybrid 606	
Model No.			QVH Apex 302	QV Hyper 302	QVH Apex 404	QV Hyper 404	QVH Apex 606	QV Hyper 606
			QV Apex 302 (ISO10360-7)	QV Hyper 302 (ISO10360-7)	QVH Apex 404 (ISO10360-7)	QV Hyper 404 (ISO10360-7)	QVH Apex 606 (ISO10360-7)	QV Hyper 606 (ISO10360-7)
			QVH STREAM 302		QVH STREAM 404		QVH STREAM 606	
Measuring Range (XxYxZ)	Vision		11.81″ x 7.87″ x 7.87″ (300x200x200mm)		15.75″ x 15.75″ x 9.84″ (400x400x250mm)		23.62″ x 25.59″ x 9.84″ (600x650x250mm)	
	Non-contact Displacement Sensor	TYPE1	7.09″ x 7.87″ x 7.87″ (180×200×200mm)		11.02″ x 15.75″ x 9.84″ (280×400×250mm)		18.90″ x 25.59″ x 9.84″ (480×650×250mm)	
		TYPE4*1	6.92″ x 7.87″ x 7.87″ (176×200×200mm)		10.87″ x 15.75″ x 9.84″ (276×400×250mm)		18.74″ x 25.59″ x 9.84″ (476×650×250mm)	
Measuring Accuracy	(Vision)*2*3	E1X, E1Y	(1.5+3L/1000)µm	(0.8+2L/1000)µm	(1.5+3L/1000)µm	(0.8+2L/1000)µm	(1.5+3L/1000)µm	(0.8+2L/1000)µm
		E1Z	(1.5+4L/1000)µm	(1.5+2L/1000)µm	(1.5+4L/1000)µm	(1.5+2L/1000)µm	(1.5+4L/1000)µm	(1.5+2L/1000)µm
		E2XY	(2.0+4L/1000)µm	(1.4+3L/1000)µm	(2.0+4L/1000)µm	(1.4+3L/1000)µm	(2.0+4L/1000)µm	(1.4+3L/1000)µm
	(Displacement Sensor)*2*3	E1Z	(1.5+4L/1000)µm	(1.5+2L/1000)µm	(1.5+4L/1000)µm	(1.5+2L/1000)µm	(1.5+4L/1000)µm	(1.5+2L/1000)µm
	(ISO10360-7:2011)	$E_{U,MPE}$	3+5.5L/1000*4 3+6.0L/1000*5	2.5+4L/1000*4 2.5+4.5L/1000*5	3+5.5L/1000*4 3+6.0L/1000*5	2.5+4L/1000*4 2.5+4.5L/1000*5	3+5.5L/1000*4 3+6.0L/1000*5	2.5+4L/1000*4 2.5+4.5L/1000*5
		$P_{F2D,MPE}$	2.3µm	1.7µm	2.3µm	1.7µm	2.3µm	1.7µm
Scale Resolution			0.1µm	0.02µm	0.1µm	0.02µm	0.1µm	0.02µm
Max. Drive Speed		X/Y/Z Axis	300 mm/s	200 mm/s	300 mm/s	200 mm/s	300 mm/s	200 mm/s
Stage Glass Size			15.71″ x 10.67″ (399 x 271mm)		19.41″ x 10.67″ (493 x 551mm)		27.44″ x 29.84″ (697 x 758mm)	
Maximum Stage Loading			44 lbs. (20kg)		88 lbs. (40kg)		110 lbs. (50kg)	
Dimensions of Main Unit			37.44″ x 33.82″ x 41.06″ (951 x 859 x 1043mm)		55.39″ x 40.43″ x 54.37″ (1407 x 1027 x 1381mm)		78.15″ x 51.54″ x 61.81″ (1985 x 1309 x 1570mm)	
Mass of Main Unit (Including Machine Stand)			794 lbs. (360kg)		1276 lbs. (579kg)		3197 lbs. (1450kg)	

Name			Quick Vision ACCEL			
Model No.			QVH ACCEL808	QVH ACCEL 1010	QVH ACCEL 1212	QVH ACCEL 1517
Measuring Range (XxYxZ)	Vision		31.50x31.50x5.91″ (800x800x150mm)	39.37x39.37x5.91″ (1000x1000x150mm)	49.21x49.21x3.94″ (1250x1250x100mm)	59.06X68.90X3.94″ (1500x1750x100mm)
	Non-contact Displacement Sensor	TYPE1	26.77x31.50x5.91″ (680x800x150mm)	34.65x39.37x5.91″ (880x1000x150mm)	44.49X49.21X3.94″ (1130x1250x100mm)	54.33x68.90x3.94″ (1380x1750x100mm)
Measuring Accuracy	(Vision)*2*3	E1X, E1Y	(1.5+3L/1000)µm		(2.2+3L/1000)µm	
		E1Z	(1.5+4L/1000)µm		(2.5+5L/1000)µm	
		E2XY	(2.5+4L/1000)µm		(3.5+4L/1000)µm	
	(Displacement Sensor)*2*3	E1Z	(2.5+4L/1000)µm		(3.5+5L/1000)µm	
Scale Resolution			0.1µm			
Max. Drive Speed		X/Y Axis	400 mm/s		300 mm/s	
		Z Axis	150 mm/s		150 mm/s	
Stage Glass Size			34.76″x 37.72″ (883x958mm)	46.69″ x 46.69″ (1186x1186mm)	56.69″x56.69″ (1440x1440mm)	67.48″ x 77.48″ (1714x1968mm)
Maximum Stage Loading			22 lbs. (10kg)	66 lbs. (30kg)		
Dimensions of Main Unit			58.07″ x 73.23″ x 62.13″ (1475 x 1860 x 1578mm)	75.28″ x 84.29″ x 63.11″ (1912 x 2141 x 1603mm)	85.28″ x 93.31″ x 61.18″ (2166 x 2370 x 1554mm)	96.06″ x 114.09″ x 61.18″ (2440 x 2898 x 1554mm)
Mass of Main Unit			4519lbs. (2050kg)	6504 lbs. (2950kg)	7937 lbs. (3600kg)	9921 lbs. (4500kg)

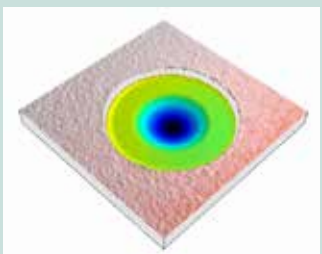
Common Specifications	QV Apex	QV Hyper	QV Accel	QV Stream
CCD camera	Black & White			Black & White; Progressive Scanning
Magnification Change System	Programmable Power Turret (1x, 2x, 6x)			
Guide Method	Linear Motion Hard Bearing			
Illumination (Catalog Page Number Reference)	M-5	M-7	M-12	M-6

* Specification of QVH1 ACCEL

*1 TYPE 4 is not supported by QVH STREAM
*2 L = arbitrary measuring length (mm)
*3 Inspected by Mitutoyo standard
*4 Accuracy for 20 ± 2°C
*5 Accuracy from 18 to 23°C

FEATURES: Hybrid Type 4

- Enables detection of high inclination angles for both mirror and diffused surfaces.
- The automatic lighting adjustment function allows for high-accuracy measurements.
- Thickness measurement of thin and transparent objects such as film.


3-dimensional topographical result, data of plastic package by MCubeMAP

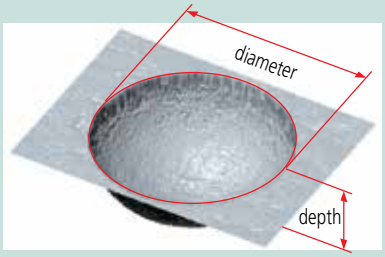
QV WLI

SERIES 363 — CNC Video Measuring System with White Light Interferometry

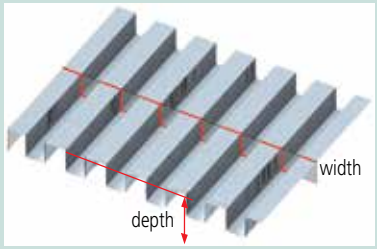
QV WLI 5x objective | QV WLI 10x objective | QV WLI 25x objective

- QV WLI can measure coordinates and dimensions and assess micro-3D forms without contact.
- High-accuracy, dual-head vision measuring system equipped with a white light interferometer.
- The white light interferometer uses a high aspect ratio to accurately measure shapes.
- The standard vision measuring function can continuously perform coordinate, dimension and 3D shape measuring.
- Large work stage accurately handles over-sized work pieces such as a PCB.

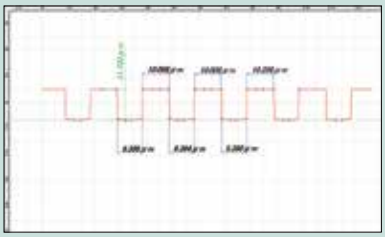
NEW-STYLE Vision Measuring Systems



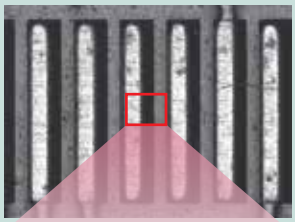
Application view of nano hole



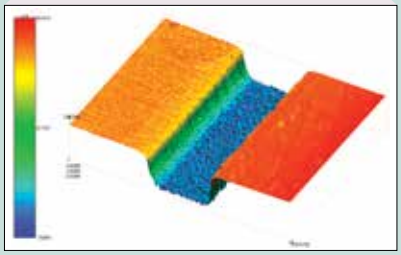
Application view of surface trace



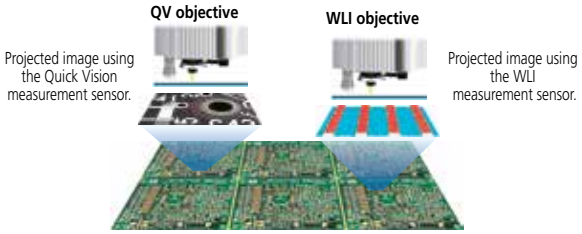
FormTracePak AP



Region of interest evaluation



3-dimensional topographical result, data of micro-circuit



SPECIFICATIONS

Name		QV Hyper WLI 302	QV Hyper WLI 404	QV Hyper WLI 606
Model No.		**QV Hyper WLI 302 (ISO10360-7)**	**QV Hyper WLI 404 (ISO10360-7)**	**QV Hyper WLI 606 (ISO10360-7)**
Measuring Range (X×Y×Z)	Vision Measuring Area	11.81" x 7.87" x 7.48" (300×200×190mm)	15.75" x 1575" x 9.45" (400×400×240mm)	23.62" x 25.59" x 8.66" (600×650×220mm)
	WLI Measuring Area*1	8.46" x 7.87" x 7.48" (215×200×190mm)	12.40" x 15.75" x 9.44" (315×400×240mm)	20.58" x 25.59" x 8.66" (515×650×220mm)
WLI Optical Head Unit				
Field of View (H×V)		5X lens: approx. 0.64x0.48mm / 10X lens: approx. 0.32×0.24mm / 25X lens: approx. 0.13×0.10mm		
Illumination	Co-axial Light	Halogen		
Repeatability		2σ ≤ .08μm		
Z-axis Scanning Range*2		170μm		
Vision Optical Head Unit				
Magnification Change System		Programmable Power Turret (1X-2X-6X)		
Image Detection Method		B&W CCD camera		
Illumination	Co-axial Light	White LED		
	Transmitted Light	White LED		
	Programmable Ring Light	White LED		
Measuring Accuracy	E1X, E1Y	(0.8+2L/1000)μm		
	E1Z	(1.5+2L/1000)μm		
	E2XY	(1.4+3L/1000)μm		
	$E_{U,MPE}$ (ISO10360-7:2011)	2.5+4L/1000		
	$P_{F2D,MPE}$ (ISO10360-7:2011)	1.7μm		
Main Unit				
Resolution		0.01μm		
Max. Stage Loading		33 lbs. (15kg)	55 lbs. (25kg)	77 lbs. (35kg)
Guidance System		Linear Motion Hard Bearing		
Dimensions (W×D×H)		33.82" x 37.40" x 63.23" (859×950×1606mm)	40.43" x 55.39" x 70.11" (1027×1407×1781mm)	51.54" x 78.15" x 70.55" (1309×1985×1792mm)
Mass (Vibration Isolator Stand Included)		Approx. 1080 lbs. (490kg)	Approx. 2557 lbs. (1160kg)	Approx. 2275 lbs. (1031kg)

*1: WLI head is moveable. Multiple fields of view can be stitched together.
*2: In standard mode. Applicable to max. 200μm by modifying scan pitch.

Mitutoyo

ULTRA QV

SERIES 363 — Ultra-high Accuracy CNC Vision Measuring System

FEATURES

- Minimizes straightness errors through the use of a precision air-bearing linear guide system.
- Utilizes a 0.01µm resolution glass scale manufactured at an ultra-precision facility located 11 meters underground.
- In order to minimize error caused by temperature fluctuations, the linear encoder scale is made of special crystallized glass with an expansion coefficient that is almost zero.
- Optimizes the mechanical structure of the main unit in Finite Element Method analysis.
- Stabilizes the geometrical accuracy (i.e. straightness of each axis and perpendicularity) to lessen thermal effects.

ULTRA QV 404 PRO

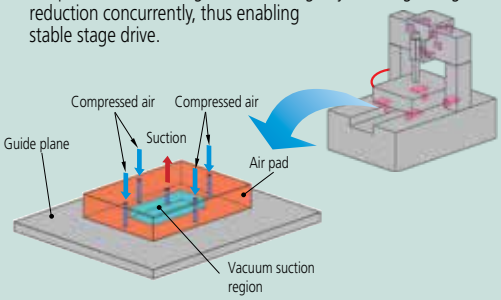
SPECIFICATIONS

Model No.		ULTRA QV 404 PRO ULTRA QV 404 PRO (ISO10360-7:2011)	ULTRA QV 404 PRO w/ TAF ULTRA QV 404 PRO w/ TAF (ISO10360-7:2011)
Range	X x Y x Z	16" x 16" x 8" (400x400x200mm)	
Magnification Change System		Programmable Power Turret (Selectable from Magnifications of 1X, 2X and 6X)	
Resolution / Scale Unit		0.01µm / Linear Encoder*4	
Resolution of Z-Scale Using TAF		–	0.25µm
High-sensitivity CCD Camera		B&W	
Illumination (PRL: Programmable Ring Light)	Surface	Halogen	
	Contour	Halogen	
	PRL	Halogen	
Accuracy*1 (20˚C±0.2˚C)	E1XY	(0.25+L/1000)µm	
	E1Z (50mm Stroke)*2	(1.0+2L/1000)µm	
	E1Z (Full Stroke)	(1.5+2L/1000)µm	
	E2XY Plane	(0.5+2L/1000)µm	
	$E_{U,MPE}$ (ISO10360-7:2011)	1.3+3L/1000, 1.3+3.5L/1000*5	
	$P_{F2D,MPE}$ (ISO10360-7:2011)	1.0µm	
Accuracy Assurance Environments*3	Temperature Range	20±0.2˚C	
	Temperature Variation	0.5˚C/1H	
	Temperature Gradient	1˚C/m	
Repeatability within the Visual Field		3σ=0.2µm	
Repeatability of Auto-focus		σ=0.4µm	
Stage Glass Size		19.4" x 21.7" (493x551mm)	
Max. Stage Loading		88lb (40kg)	
Dimensions (W x D x H)		46" x 68" x 75.2" (1172x1735x1910mm)	
Mass		4464 lb (2025kg)	
Used Air Pressure		0.4MPa*6	
Supplied Air Flow Rate		150L/min*7	

*1: Accuracy when measured at the center of the video screen and in the middle of measuring stroke on a plane using the 5X objective and 1X tube lens
*2: Specified only for factory shipping inspection.
*3: Accuracy assurance environments in the case where no temperature compensation is performed. Those in the case where temperature compensation is performed are as follows.
– Accuracy-assured temperature range: 20±2˚C
– Temperature variation: 0.5˚C/H
– Temperature gradient: 1˚C/m
*4: Thermal expansion coefficient: (0±0.02)X10-6/K
*5: Accuracy 1.3+3L/1000 for 20 ± 2°C, Accuracy 1.3+3.50L/1000 from 18 to 23°C
*6: An air source is required to maintain the original air pressure between 0.5 and 0.9MPa.
*7: Indicates the flow rate under normal conditions.

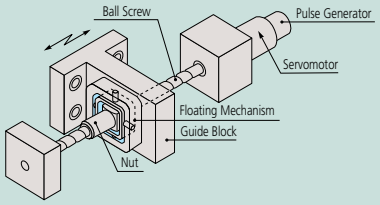
Self-Suction Air Pad

If a normal air pad is used for the Y axis, it is necessary to increase the mass of the work stage to obtain appropriate rigidity. ULTRA QV (Quick Vision) employs a special air pad called a self-suction type that floats the air pad using compressed air and also generates an absorption power with a vacuum zone provided under negative pressure at the center of the pad. This achieves greater Y-axis rigidity and stage weight reduction concurrently, thus enabling stable stage drive.



Ball Screw Floating Mechanism

ULTRA QV employs high-reliability ball screws in the floating mechanism. This floating mechanism will minimize the error due to axial fluctuation that adversely affects kinetic performance, such as straightness, and improves the driving speed.

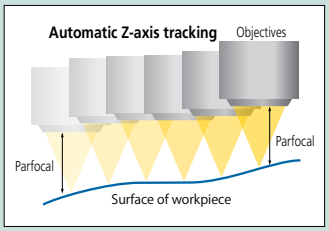


Ultra-high accuracy crystallized glass scale with virtually zero thermal expansion

The ULTRA Quick Vision is equipped with a crystallized glass scale having a resolution of 0.01µm and linear expansion coefficient of ±0.02x10^{-6}/K. Virtually zero thermal expansion means the ULTRA Quick Vision can minimize accuracy fluctuation resulting from thermal changes.

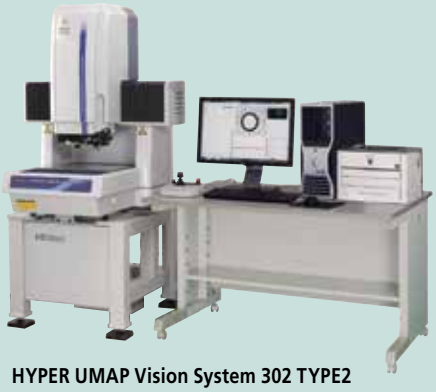
Tracking Auto Focus (TAF)

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface waves and warpage (in the Z axis) improves measurement throughput. The feature also cuts out the hassle of focusing during manual measurement and reduces the burden for the operator.



UMAP Vision System TYPE2

SERIES 364 — Micro-form Measuring System



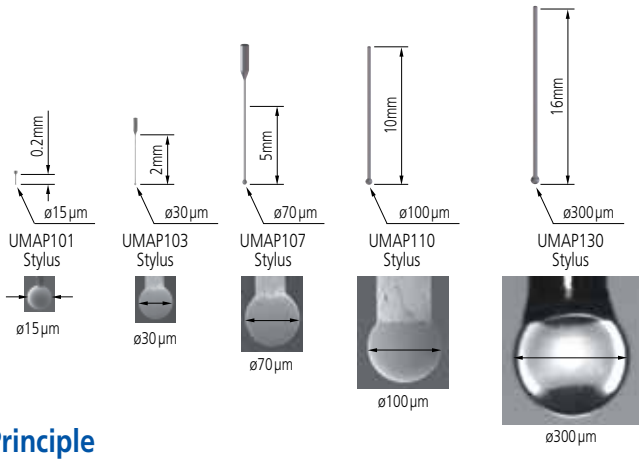
HYPER UMAP Vision System 302 TYPE2

ULTRA UMAP Vision System 404 TYPE2

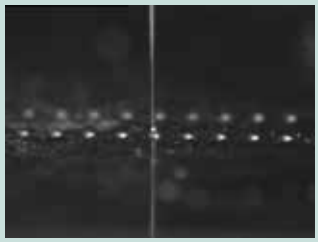
FEATURES

- **Ultrasonic micro probe, UMAP**
  The ultrasonic micro probe (UMAP) has the ability to sense the amplitude variability in a micro area, and the optional contact points (15 to 300µm diameter) provide high-accuracy measurements to meet a variety of specifications.
- **High-accuracy contact and non-contact measurement capabilities in one system**
  This unit includes the UMAP and the non-contact type vision head. Until now, it was difficult to measure minute areas, but it is now possible to do both contact and non-contact measurement on a single platform.

Micro probe, UMAP

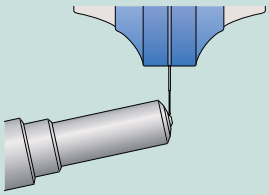


Application examples

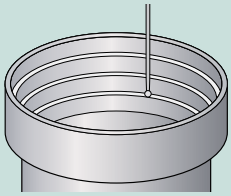


Contour measurement of a ø0.125 hole

Measuring form of micro gear teeth

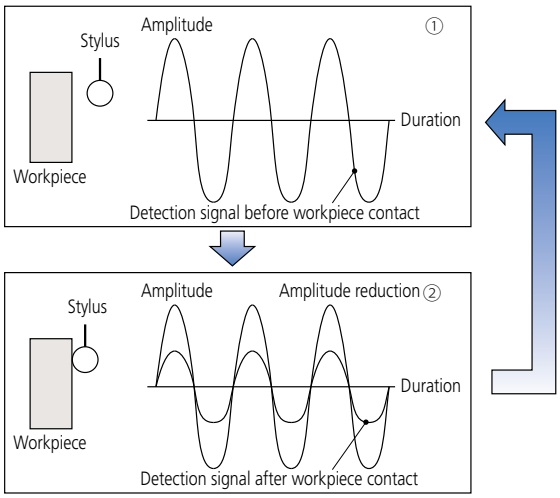


Measurement of a fuel injection nozzle hole's shape



Measurement of a lens barrel's shape

Detection of Surface Principle



① In this drawing, the stylus is vibrating with a micro amplitude. When it does not come into contact with the workpiece, the vibration state is maintained.
② As the stylus comes into contact with the workpiece, the vibration amplitude decreases as the contact increases. When the decreasing amplitude falls below a certain level, a touch-trigger signal is generated.

SPECIFICATIONS

		TYPE2	
		Hyper UMAP302	**ULTRA UMAP404**
Measuring range (common to vision and UMAP)	X-axis × Y-axis	7.28 x 7.87" (185×200mm)	11.22 x 15.75" (285×400mm)
	Z-axis	6.89" (175mm): UMAP101/103 7.07" (180mm): UMAP107/110 7.28" (185mm): UMAP130	
Measuring accuracy (Vision)	E_{1X}, E_{1Y}	(0.8+2L/1000)µm	(0.25+L/1000)µm
	E_{1Z}	(1.5+2L/1000)µm	
Repeatability	UMAP 101/103/107	σ = 0.1µm	σ = 0.08µm
	UMAP 110/130	σ = 0.15µm	σ = 0.12µm

Mitutoyo

QV ACCEL

SERIES 363 — Large-format CNC Vision Measuring System

FEATURES

Moving-bridge type structure

Designed with primary focus on measurement efficiency, the machine drives the X and Y axes at 400mm/s (QV ACCEL808, ACCEL1010).

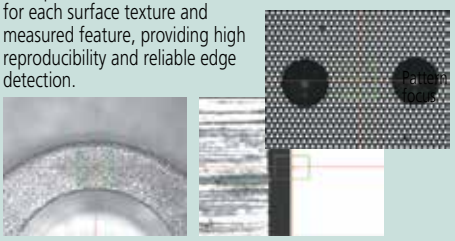
The moving-bridge type structure eliminates the need for a moving stage. This facilitates a more simplified design of the workpiece fixture, resulting in a significant reduction in the man-hours required for fixture fabrication and inspection.

QV ACCEL 808 PRO

QV ACCEL 1212 PRO

Image Multi-AutoFocus

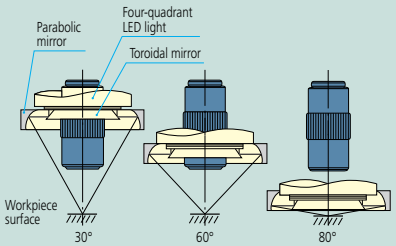
The optimal focus can be selected for each surface texture and measured feature, providing high reproducibility and reliable edge detection.



Surface focus Edge focus

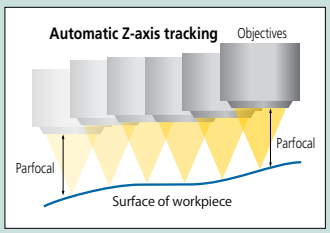
Programmable Ring Light (PRL)

Fine control of obliquity and direction provides illumination optimal for measurement. Obliquity can be arbitrarily set in the range from 30° to 80°. This type of illumination is effective for enhancing the edge of inclined surfaces or very small steps. Illumination can be controlled independently in every direction, back and forth, right and left. Measurement with edge enhancement is possible by forming a shadow with lighting from only one direction.



Tracking Auto Focus (TAF)

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface waves and warpage (in the Z axis) improves measurement throughput. The feature also removes the hassle of focusing during manual measurement.



SPECIFICATIONS

Model No.		QV ACCEL 808 PRO	QV ACCEL 1010 PRO	QV ACCEL 1212 PRO	QV ACCEL 1517 PRO
Range	X-axis	32″ / 800mm	40″ / 1000mm	50″ / 1250mm	60″ / 1500mm
	Y-axis	32″ / 800mm	40″ / 1000mm	50″ / 1250mm	70″ / 1750mm
	Z-axis	6″ / 150mm	6″ / 150mm	4″ / 100mm	4″ / 100mm
Resolution		0.1µm			
Resolution of Z Scale using TAF		0.3µm			
High-sensitivity CCD camera		B&W			
Accuracy*	E_{1XY}	(1.5+3L/1000)µm		(2.2+3L/1000)µm	
	E_{1Z}	(1.5+4L/1000)µm		(2.5+5L/1000)µm	
	E_{2XY}	(2.5+4L/1000)µm		(3.5+4L/1000)µm	
Max. Drive Speed	X/Y-axis	400mm/s		300mm/s	
	Z-axis	150mm/s		150mm/s	
Illumination (PRL: Programmable Ring Light)	Surface	LED, white			
	Contour	LED, white			
	PRL	LED, white (4 divisions)			
Magnification Change System		Programmable Power Turret (1X, 2x, 6x)			
Stage Glass Size		34.8″ x 37.7″ 883 x 958mm	46.7″ x 46.7″ 1186 x 1186mm	56.7″ x 56.7″ 1440 x 1440mm	67.5″ x 77.5″ 1714 x 1968mm
Dimensions (W x D x H)		58 x 67.5 x 62″ 1475x1716x1578mm	75.3 x 82 x 63″ 1912x2086x1603mm	85.3 x 92 x 61″ 2166x2340 x1554mm	96 x 113 x 61″ 2440 x 2868 x 1554mm
Max Stage Loading		22 lbs / 10kg	66.1 lbs / 30kg	66.1 lbs / 30kg	66.1 lbs / 30kg
Mass		5666 lbs / 2570kg	6504 lbs / 2950kg	7937 lbs / 3600kg	9921 lbs / 4500kg

* The measuring accuracy is defined at the following conditions, Programmable power turret: 1X, Objective lens: 2.5X (HR or SL), L = Dimension between two arbitrary points (mm)

Tracking Auto Focus (TAF)

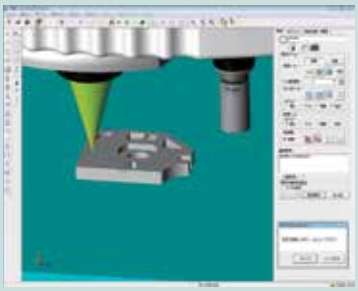
AF principle	Objective Coaxial Autofocusing (Knife-edge method)				
Suitable Objectives	QV-HR1x	QV-SL1x	QV-HR2.5x	QV-SL2.5x	QV-5x
Tracking Range*2	6.3mm (±3.15mm)	6.3mm (±3.15mm)	1mm (±0.5 mm)	1mm (±0.5 mm)	0.25mm (±0.125mm)
Spot Diameter*3	5.2µm	8.0µm	2.1µm	3.1µm	1.5µm
Laser Source	Semiconductor laser (peak wavelength: 690nm)				
Laser Power	0.9mW				
Laser Safety	Class 2 (JIS C6802:2011, EN/IEC 60825-1:2007)				

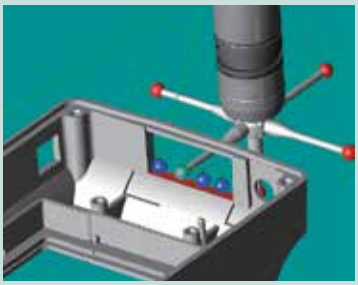
*2 Varies according to workpiece surface texture and reflectance.
*3 Design values.

Quick Vision with Touch-Trigger Probe

QV3DCAD-Online

QV3DCAD-Online uses 3D CAD models to easily create QVPAK part programs. QV measurements can be performed by specifying an element in the CAD data. This improves program creation efficiency more than using a joystick to perform teaching.





The interference check function can be used to prevent problems caused by the probe or objective lens colliding with the workpiece.

Supported CAD Formats

- SAT
- IGES*
- STEP*
- Parasolid*
- SolidWorks*
- Unigraphics*
- CATIA*

* optional

Non-contact and contact measurement with one machine

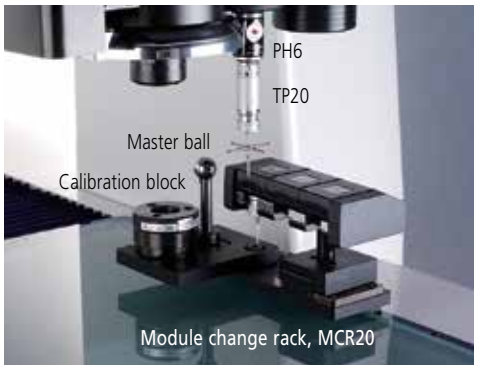
QV touch probe allows both vision measurement and touch-probe measurement.

3D workpiece measurement

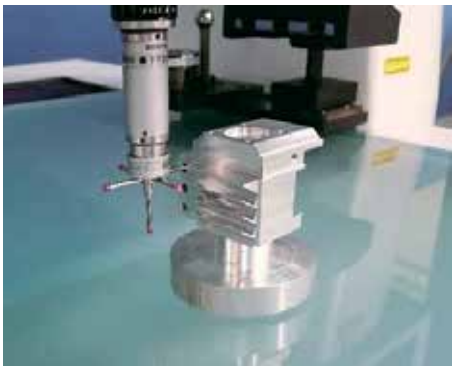
Measures three-dimensional workpieces such as molded products, resin-molded products, machined products and more.

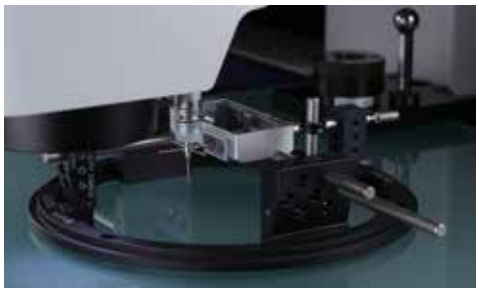
Module change rack available

Easily change between vision and touch-probe measurement with a module change rack.



Module change rack, MCR20





QV Active with optional Opti-fix clamping system

Specifications with Touch-Probe Option

		QV TP Active 202	QV TP Active 404	QV TP Apex302 Hyper QV TP302	QV TP Apex404 Hyper QV TP404	QV TP Apex606 Hyper QV TP606
Measuring Range*1 (XxYxZ)	Vision	250x200x150mm	400x400x200mm	300x200x200mm	400x400x250mm	600x650x250mm
	Touch Probe	131x200x150mm†	284x400x200mm	234x200x200mm	334x400x250mm	534x650x250mm
Measuring accuracy*2 (Touch Probe)	E_{1X}, E_{1Y}, E_{1Z}	(2.4+3L/1000)µm	(2.4 + 3L/1000)µm	QV TP Apex:(1.8+3L/1000)µm Hyper QV TP:(1.7+3L/1000)µm		

		QV TP ACCEL 808	QV TP ACCEL 1010	QV TP ACCEL 1212	QV TP ACCEL 1517
Measuring Range*1 (XxYxZ)	Vision	800x800x150mm	1000x1000x150mm	1250x1250x100mm	1500x1750x100mm
	Touch Probe	734x800x150mm	934x1000x150mm	1184x1250x100mm	1434x1750x100mm
Measuring Accuracy*2 (Touch probe)	E_{1X}, E_{1Y}, E_{1Z}	(1.8+3L/1000)µm	(3+4L/1000)µm	(6+7L/1000)µm	

*1: When a module change rack, a master ball and a calibration ring are mounted, the measurement ranges are smaller than those in the table. Other specifications are the same as those of QV ELF, QV Apex, Hyper QV, and QV ACCEL. Please contact our sales office for more details.

*2: Inspected by Mitutoyo standard. L = length between two arbitrary points (mm)

† : With calibration ring removed.

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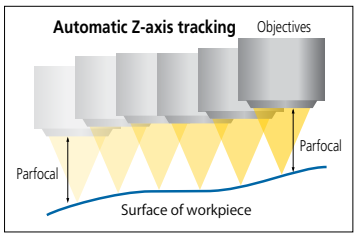
Accessories for Quick Vision

Tracking Auto Focus (TAF)

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface waves and warpage (in the Z axis) improves measurement throughput. The feature eliminates the hassle of focusing during manual measurement.



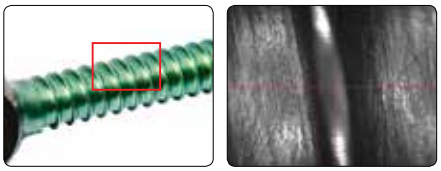
Tracking Auto Focus (TAF)

AF principle	Objective Coaxial Autofocusing (Knife-edge Method)				
Suitable Objectives	QV-HR1x	QV-SL1x	QV-HR2.5x	QV-SL2.5x	QV-5x
Tracking Range*2	6.3mm (±3.15mm)	6.3mm (±3.15mm)	1mm (±0.5 mm)	1mm (±0.5 mm)	0.25mm (±0.125mm)
Spot Diameter*3	5.2µm	8.0µm	2.1µm	3.1µm	1.5µm
Laser Source	Semiconductor laser (peak wavelength: 690nm)				
Laser Power	0.9mW				
Laser Safety	Class 2 (JIS C6802:2011, EN/IEC 60825-1:2007)				

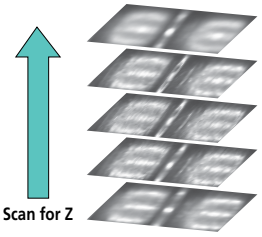
*2 Varies according to workpiece surface texture and reflectance.
*3 Design values.

PFF (Points from Focus)

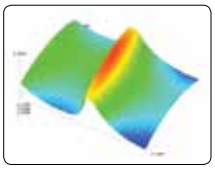
Mitutoyo-developed optical data collection method that stitches images together with high-resolution Z axis data.



Measuring Bone Screw Thread



Acquire Continuously



Form Data

Calibration Glass Chart No. 02AKN020 †

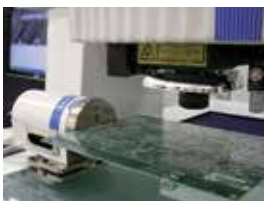
A calibration chart is used to compensate for the pixel size of the CCD chip, autofocus accuracy and the optical axis offset at each magnification of the variable magnification unit (PPT).

Compensation Chart No. 02AKU400*

A compensation chart is used to decrease optical distortion and errors caused by difference of the pattern and texture on the workpiece surface.

QV-Index Head*

Automatic multi-plane measurement is possible with the optional index table.



Max. workpiece diameter	5.51" / 140mm
Max. workpiece mass	4.41 lbs / 2kg
Min. rotation angle	0.1°
Positioning accuracy	±0.5°
Max. rotation speed	10rpm

Capable of Supporting ISO10360-7 Guaranteed Accuracy

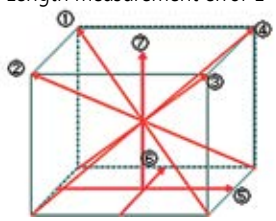
Some models in the Quick Vision Series support the ISO10360-7 guaranteed accuracy specifications.

Contact Mitutoyo for details on applicable models.

Guaranteed accuracies

- Length measurement error $E_{U,MPE}$
- Probing error $P_{F2D,MPE}$

Length measurement error E



Objectives

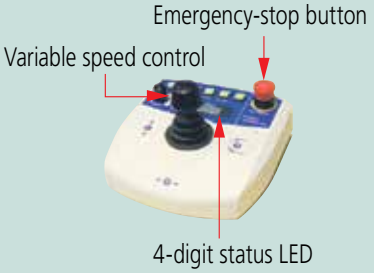
Objective mag.	Turret lens mag.	Monitor mag.	Field of View
0.5X	1X	16X	12.54 x 9.40
	2X	32X	6.27 x 4.70
	6X	96X	2.09 x 1.56
1X	1X	32X	6.27 x 4.70
	2X	64X	3.13 x 2.35
	6X	192X	1.04 x 0.78
2.5X	1X	80X	2.50 x 1.88
	2X	160X	1.25 x 0.94
	6X	480X	0.41 x 0.31
5X	1X	160X	1.25 x 0.94
	2X	320X	0.62 x 0.47
	6X	960X	0.20 x 0.15
10X	1X	320X	0.62 x 0.47
	2X	640X	0.31 x 0.23
	6X	1920X	0.10 x 0.07
25X	1X	800X	0.25 x 0.18
	2X	1600X	0.12 x 0.09
	6X	4800X	0.04 x 0.03

Objective †

Objective	Order No.	Working Distance
QV-SL0.5X	**02AKT199**	30.5mm
QV-HR1X	**02AKT250**	40.6mm
QV-SL1X	**02ALA150**	52.5mm
QV-HR2.5X	**02AKT300**	40.6mm
QV-SL2.5X	**02ALA170**	60mm
QV-5XHR	**02AWD010**	20mm
QV-10XHR	**02AKT650**	20mm
QV-25X	**02ALG020**	13mm

The monitor magnification and field of view values are for the PRO machine.
QV-10X, QV-25X: Depending on a workpiece of illumination may be insufficient at a turret lens magnification of 2X and 6X.
QV-25X: The PRL illumination is restricted in its usable position.

Multi-Function Control Box



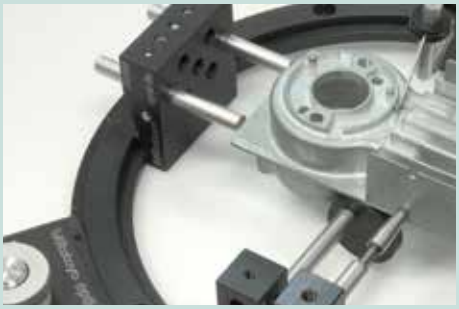
OPTI-FIX Kits

Modular Clamping System for Vision Measuring Systems

The modular opti-fix clamping system has been developed specifically for optical coordinate measuring systems.

Opti-fix guarantees safe part fixturing during measurement. This functional configuration also makes multiple part measurements considerably easier.

In order to reduce errant reflections of lighting systems and ambient light effects to a minimum, all important construction elements are anodized in flat-black or matte finish.

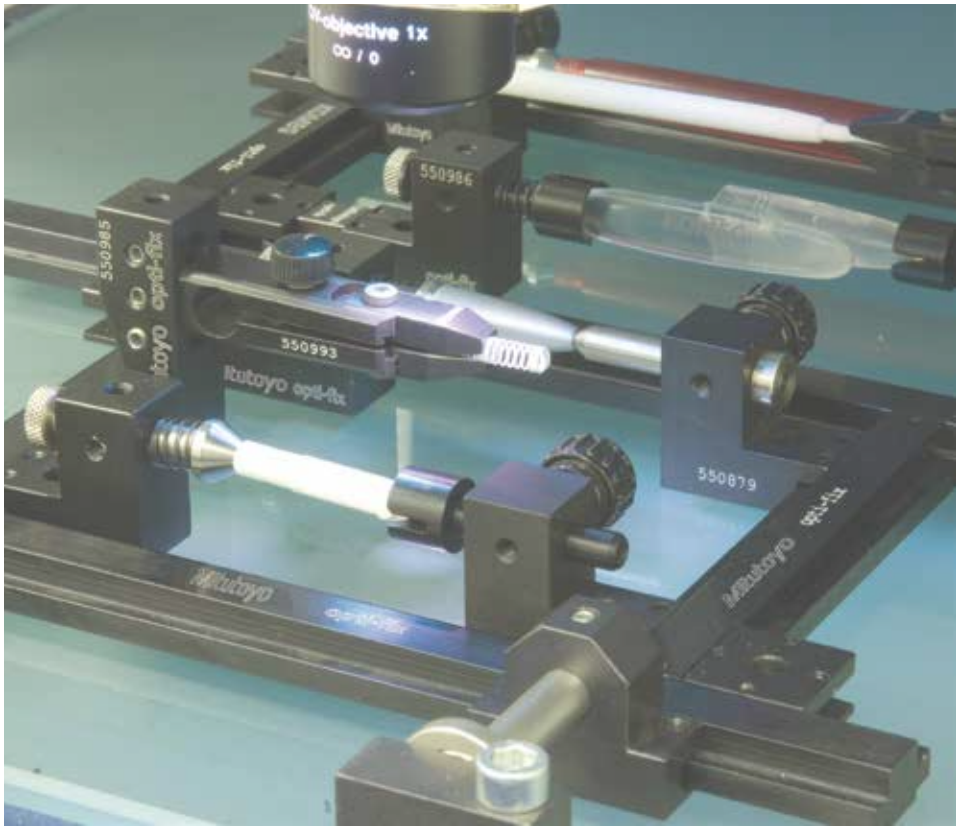


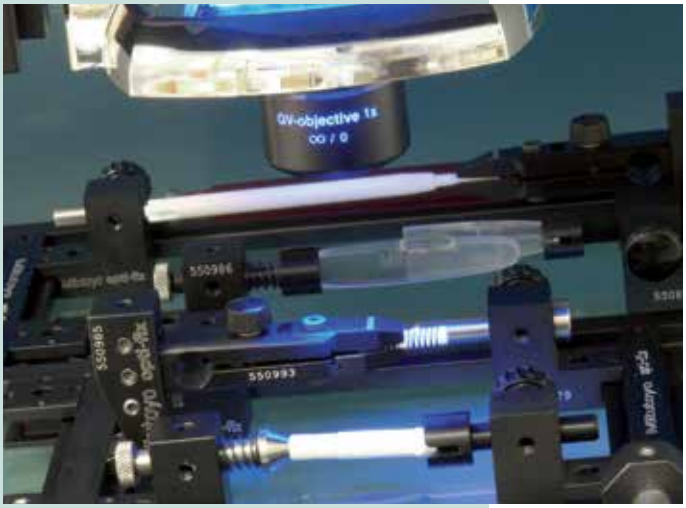
For mounting workpieces on the glass stage, different fixturing methods are available.

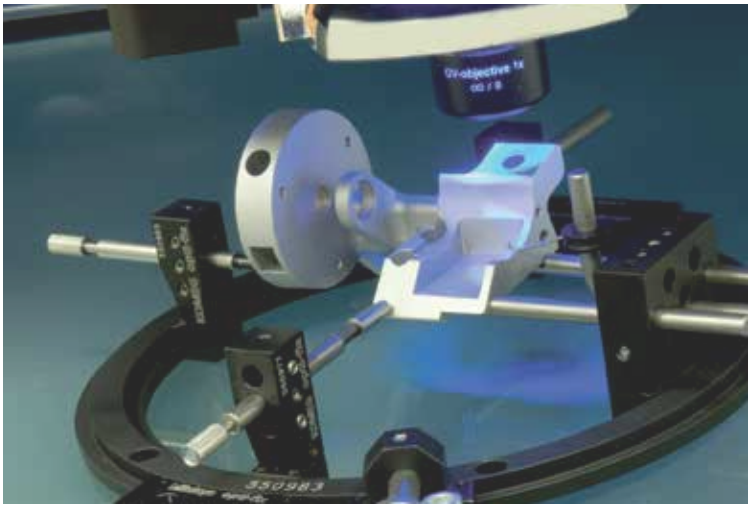
In the case of measuring methods using reflected, as well as transmitted light, for measurement of cubic, rotationally symmetrical and flat workpieces, the use of Opti-fix is a practical solution.

Furthermore, the spring clips and centering pins are integrated into the system to allow for tactile measuring. Opti-fix offers a large number of configurations for part fixturing, from clamping tweezers for miniature parts to a precision vice for large parts.

Fastening brackets, vacuum plates or magnetic holders for mounting the clamping system on the measuring machine, can be ordered separately.







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OPTI-FIX Kits

Opti-Set Start

K551056

For construction of a simple rail system with a length of 250 mm and for fixturing parts with simple part geometry. 16 parts.

Opti-Set Basic

K551057

For construction of a basic frame with the dimensions of 200 mm x 100 mm and for fixturing parts with simple part geometry. 26 parts.

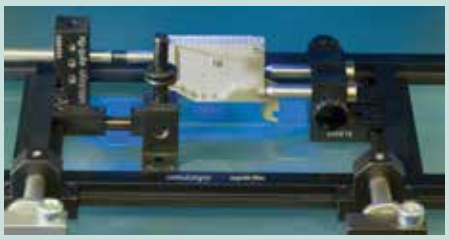
Opti-Set Rotation

K551058

For construction of a basic frame with the dimensions of 250 mm x 200 mm and for fixturing parts that are rotationally symmetric with and without center holes. 23 parts.

OPTI-FIX Kits

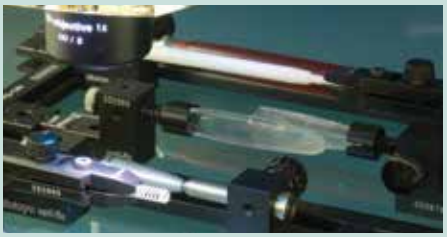
Opti-Set Advanced



K551059

For construction of a basic frame with the dimensions of 400 mm x 250 mm and for fixturing parts with slightly more complex part geometry. 51 parts.

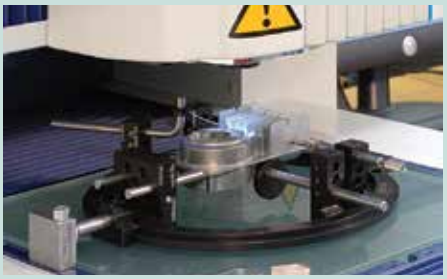
Opti-Set Professional



K551060

For construction of a basic frame with the dimensions of 400 mm x 250 mm and for fixturing parts with complex part geometry. The fixturing of parts with a rotational part geometry is also available. 115 parts.

Opti-Set Round



K550298

With locating and clamping elements, included adaptor plates for adaptation to the basic frame of the rail system. 18 parts.

Mitutoyo

Vision Measurement

Vision measuring machines provide the following processing capabilities.

Edge detection

Detecting/measuring edges in the XY plane

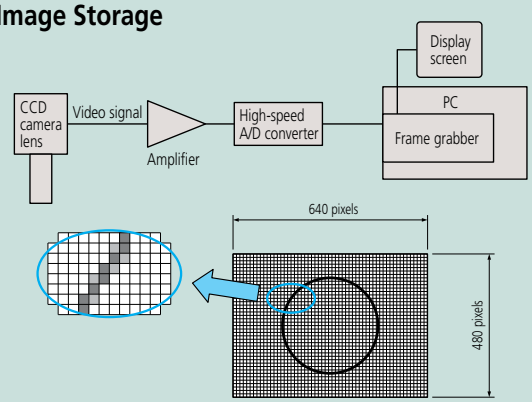
Auto focusing

Focusing and Z measurement

Pattern recognition

Alignment, positioning, and checking the presence of a feature

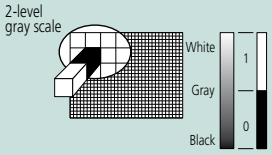
Image Storage



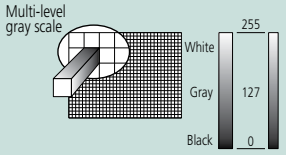
An image is comprised of a regular array of pixels, similar to the process that produces a printed image picture on fine plotting paper with each square solid-filled.

Gray Scale

A PC stores an image after internally converting it to numeric values. A numeric value is assigned to each pixel of an image. Image quality varies depending on how many levels of gray scale are defined by the numeric values. The PC provides two types of gray scale: two-level and multi-level. The pixels in an image are usually displayed as the 256-level gray scale.



Pixels in an image brighter than a given level are displayed as white and all other pixels are displayed as black.



Each pixel is displayed as one of 256 levels between black and white. This allows high-fidelity images to be displayed.

Difference in Image Quality

Difference between 2-level and 256-level gray-scale images

Sample image displayed in 2-level gray scale

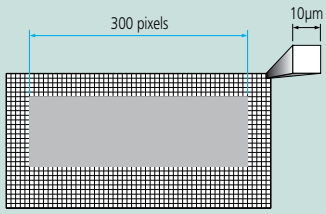
Sample image displayed in 256-level gray scale

Variation in Image Depending on Threshold Level

These three pictures are the same image displayed as 2-level gray scale at different slice levels (threshold levels). In a 2-level gray-scale image, different images are provided as shown above due to a difference in slice level. Therefore, the 2-level gray scale is not used for high-precision vision measurement since numeric values will change depending on the threshold level that is set.

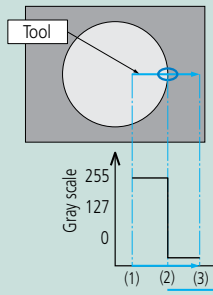
Dimensional Measurement

An image consists of pixels. If the number of pixels in a section to be measured is counted and multiplied by the size of a pixel, then the section can be converted to a numeric value in length. For example, assume that the total number of pixels in the lateral size of a square workpiece is 300 pixels as shown in the figure below. If a pixel size is 10μm under a specific imaging magnification, the total length of the workpiece is given by 10μm x 300 pixels = 3000μm = 3mm.



Edge Detection

How to detect a workpiece edge in an image is described using the following monochrome picture as an example. Edge detection is performed within a given domain. A symbol that visually defines this domain is referred to as a tool. Multiple tools are provided to suit various workpiece geometries or measurement data.



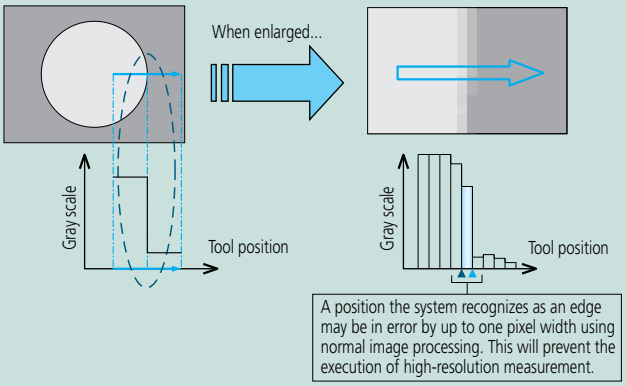
The edge-detection system scans within the tool area as shown in the figure at left and detects the boundary between light and shade.

244	241	220	193	97	76	67	52	53	53
243	242	220	195	94	73	66	54	53	55
244	246	220	195	94	75	64	56	51	50

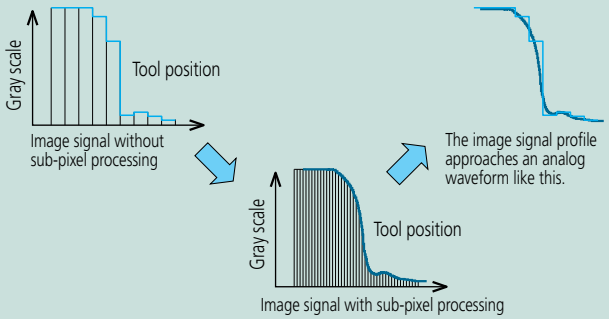
Example of numeric values assigned to pixels on the tool

(1) Scan start position
(2) Edge detection position
(3) Scan end position

High-resolution Measurement

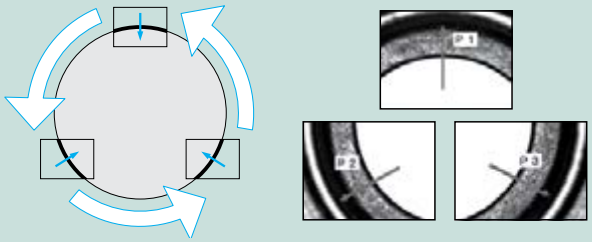


To increase the accuracy in edge detection, sub-pixel image processing is used.
An edge is detected by determining an interpolation curve from adjacent pixel data as shown below.
As a result, it allows measurement with a resolution higher than 1 pixel.

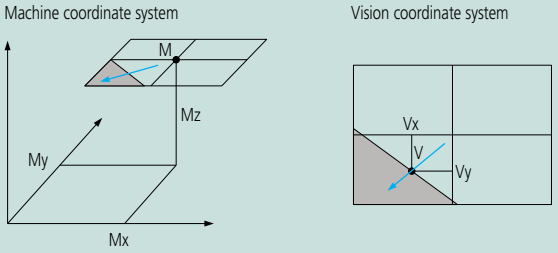


Measurement along Multiple Portions of an Image

Large features that cannot be contained on one screen have to be measured by precisely controlling the position of the CCD sensor and stage so as to locate each reference point within individual images. By this means, the system can measure even a large circle, as shown below, by detecting the edge while moving the stage across various parts of the periphery.



Composite Coordinates of a Point



Measuring machine stage position
M = (Mx, My, Mz)

Detected edge position (from the center of vision)
V = (Vx, Vy)

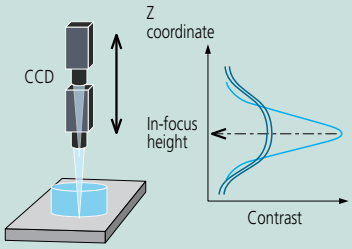
Actual coordinates are given by X = (Mx + Vx), Y = (My + Vy), and Z = Mz, respectively.

Since measurement is performed while individual measured positions are stored, the system can measure dimensions that cannot be included in one screen.

Principle of Auto Focusing

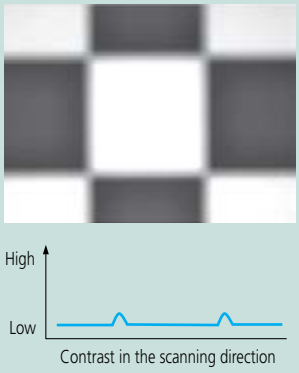
The system can perform XY-plane measurement, but cannot perform height measurement using only the CCD camera image. The system is commonly provided with the Auto Focus (AF) mechanism for height measurement. The following explains the AF mechanism that uses a common image, although some systems may use an AF laser.

The AF system analyzes an image while moving the CCD in the Z axis. In the analysis of image contrast, an image in sharp focus will show a peak contrast and one out of focus will show a low contrast. Therefore, the height at which the image contrast peaks is the just-in-focus height.

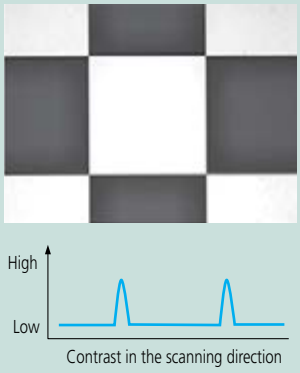


Variation in Contrast Depending on the Focus Condition

Edge contrast is low due to out-of-focus edges.



Edge contrast is high due to sharp, in-focus edges.



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In the Spirit of Mitutoyo

To become a complete man, one must acquire Wisdom, Benevolence and Valor. With Wisdom only, one tends to be cold. Benevolence alone makes one weaker. With valor only, one may reach beyond his capabilities. When the three qualities are combined, however, one will become a complete man. Similarly, success in enterprise lies in the knowledge of Heaven, Earth and Man. Business will succeed only when these factors, "heavensent" chances, natural opportunities, and harmony of man are present. Without even one factor, success is remote. In Buddhism, Butsu (Buddha), Po (Doctrine) and So (Priest) are three principle treasures for its promotion of the teaching. In Christianity, God, Bible and Minister.

The word MITUTOYO signifies three abundances. "Mitsu" means three, while "Toyo" stands for a state of abundance. The name MITUTOYO was selected, with a sincere wish to see more complete men, to create a prosperous enterprise and to introduce righteous religion to all, along with the lasting wish for a peaceful world and fulfillment of meaningful life.

Mitutoyo Quality

Mitutoyo America Corporation

965 Corporate Blvd.
Aurora, Illinois 60502
Phone: (630) 820-9666
Fax: (630) 978-3501
Email: info@mitutoyo.com
www.mitutoyo.com

For customer support call toll free:
1-888-MITUTOYO (1-888-648-8869)

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