Mitutoyo

LINEAR SCALE DRO SYSTEMS

SCALE UNITS AND DISPLAY COUNTERS

DIGITAL SCALE AND DRO SYSTEMS

PRE1458

Mitutoyo

Accurate, yet affordable, DRO System from Mitutoyo

Mitutoyo's Linear Scale System tightly couples linear scale units with dedicated Digital Readout (DRO) units to offer accurate detection and display of axial displacement for machine tools and measuring equipment. The Linear Scale System can be configured to best meet your specific application, whether it be machining or measuring, just by choosing a suitable combination of scale unit and display unit. Scale units have many measuring length ranges and the display units feature remote zero setting, switchable resolution and multipurpose one-touch macro keys. The Linear Scale System has superior ease-of-use and is reliable, both of which are features that can dramatically improve machining accuracy and efficiency.

Table of Contents

Features of the Linear Scale System

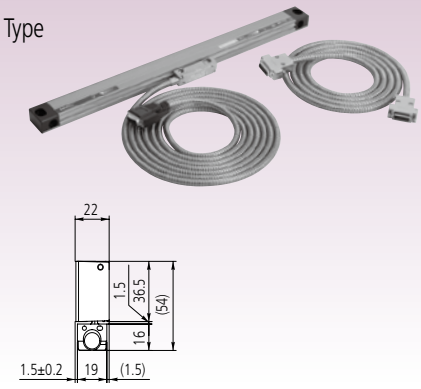
- Digital counter value display allows quick and accurate readout of displacement. Working efficiency thus greatly improved.
- Zero-setting or presetting possible at any position. Versatile functions eliminate calculations or complicated key operations for positioning.
- Various external output features allow output of current display values or various data to external devices such as PCs or sequencers. Easy data processing can be performed.
- Two types of display units available: high-performance type and limit signal type.
- Both linear scale and display units conform to CE marking standards.
- Mitutoyo actively promotes global environment conservation. Our products do not have chemical content in excess of levels permitted in the RoHS Directive as prescribed in the EU. (As of May, 2015)

Ultra Precision Manufacture 11 Meters Underground

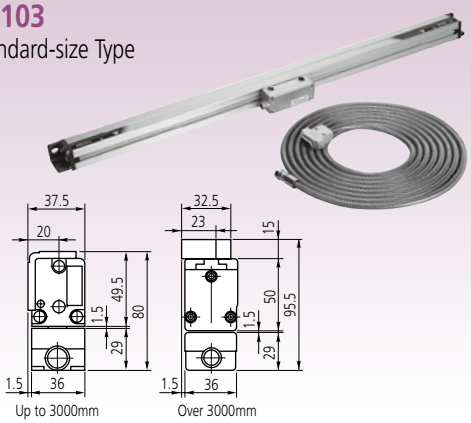
Mitutoyo Kiyohara Plant, which is a factory exclusively for the production of Linear Scales and other precision scales, has a complete system for producing master scales to be used in finished products, such as CMMs, vision measuring systems, profile projectors, and measuring microscopes. To improve the accuracy of scales and quality control technologies, the integral laboratory at the Kiyohara Plant was constructed eleven meters underground. It provides an optimum environment (cleanliness factor: 100) for the ultra-precision manufacture and evaluation of scales. Its unique design and construction isolates the laboratory from external vibrations and ensures minimal variations in temperature and humidity.

Scale Unit Selection Guide

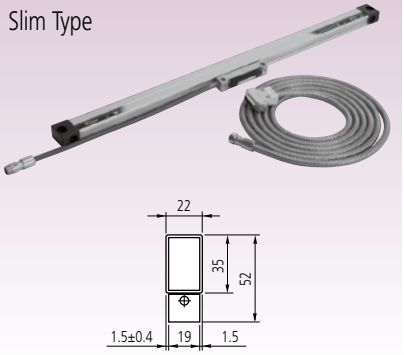
AT715
Absolute Type



AT103
Standard-size Type



AT113
Slim Type



AT116
Economy and Slim Type

AT112-F
Super Slim Type

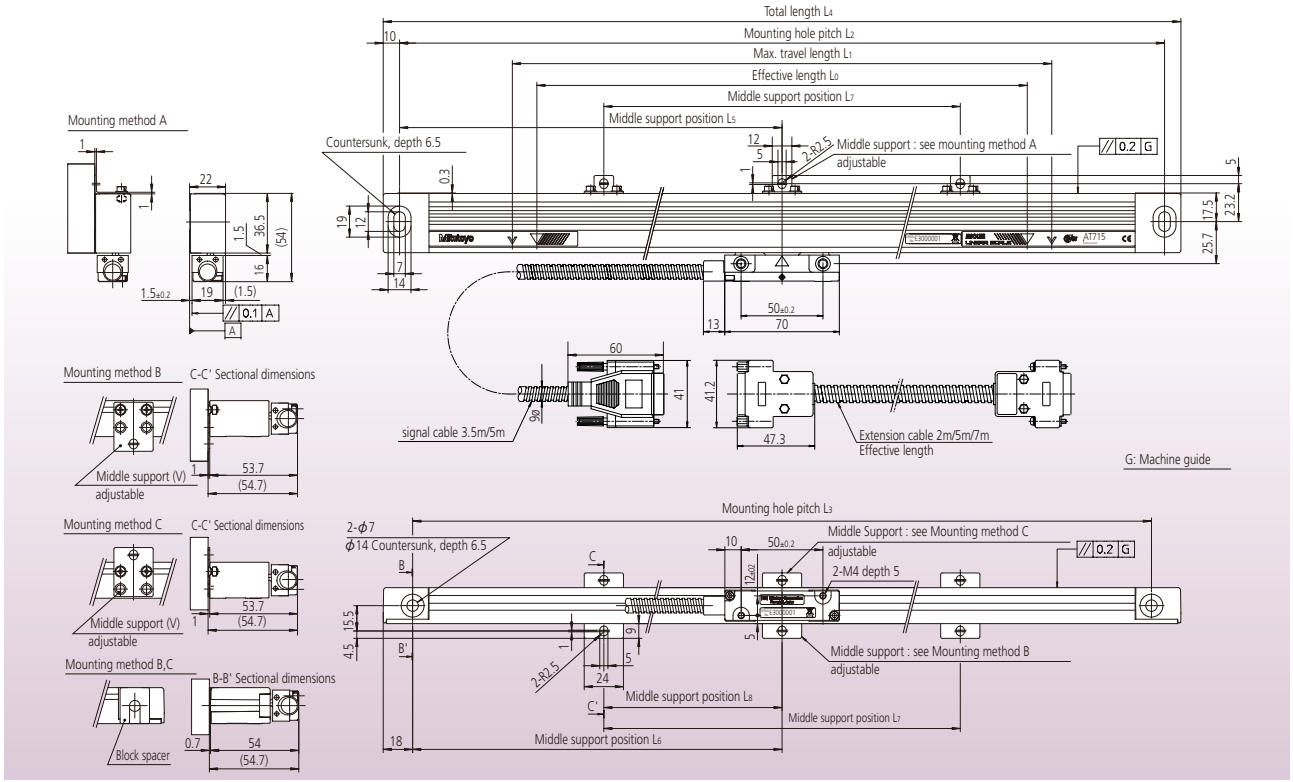
Specifications

Model	AT715	AT103	AT113, AT116	AT112-F
Measurement method	Electromagnetic induction system	Photoelectric (transparent linear encoder)		
Light source	—	LED		
Receptor	—	Phototransistor		
Output wave form	—	2-phase sine curves with a phase difference of 90°		
Effective length (for high accuracy type)	100 - 3000mm	100 - 6000mm (100 - 2000mm)	100 - 1500mm (100 - 1500mm)	50 - 1020mm (50 - 1020mm)
Accuracy* [high accuracy type] * Excluding quantizing error of ±1 count	±5µm (Effective length: 100 - 500mm) ±7µm (Effective length: 600 - 1800mm) ±10µm (Effective length: 2000 - 3000mm)	(5+5L₀/1000)µm*1 [(3+3L₀/1000)µm]	(5+5L₀/1000)µm [(3+3L₀/1000)µm*2]	(5+5L₀/1000)µm [(3+3L₀/1000)µm]
Maximum response speed	50m/min.	120m/min.*3	120m/min. (50m/min.: AT116)	50m/min.
Scale reference point	Incremental system	At every 50mm interval		
Linear expansion coefficient	—	(8±1)x10^{-6}/°C		
Power supply	5V±5% DC	5V±5% DC		
Max, current consumption	70mA	70mA*4 (60mA: AT113, AT116)		
Operating temperature	0°C to 45°C			
Storage temperature	-20°C to 70°C			
Relative humidity	20 - 80%RH			
Head Cable length	—	—	*6	0.3m
Sliding force	5N or less	5N or less		
Single cable*5	Standard accessory (refer to individual specifications for the length)			
Dust/water protection level	IP67	IP53		

*1: (5+8L₀/1000)µm for models over 3250mm effective length *2: not available for AT116 *3: 50m/min. for models over 3250mm effective length *4: 140mA for models over 3250mm effective length
*5: Vinyl-coated type single cable and extension cable are available on request. *6: AT103:0.3m AT116: Without head cable

AT715, ABSOLUTE and High Environmental Resistance Type

Using ABSOLUTE® Electromagnetic Induction System



Order No. and mounting dimensions

mm

Order No. / Model No.	Effective length L0	Maximum travel length L1	Mounting hole pitch L2	Mounting hole pitch L3	Overall length L4	Middle support positions L5	L6	L7	Signal cable length
539-801 / AT715-100	100	120	258	242	278	—	—	—	
539-802 / AT715-150	150	170	308	292	328	—	—	—	
539-803 / AT715-200	200	220	358	342	378	—	—	—	
539-804 / AT715-250	250	270	408	392	428	—	—	—	
539-805 / AT715-300	300	330	468	452	488	—	—	—	
539-806 / AT715-350	350	380	518	502	538	—	—	—	
539-807 / AT715-400	400	430	568	552	588	—	—	—	3500 (137.80)
539-808 / AT715-450	450	480	618	602	638	—	—	—	
539-809 / AT715-500	500	540	678	662	698	339	331	—	
539-811 / AT715-600	600	640	778	762	798	389	381	—	
539-813 / AT715-700	700	740	878	862	898	439	431	—	
539-814 / AT715-750	750	780	918	902	938	459	451	—	
539-815 / AT715-800	800	840	978	962	998	489	481	—	
539-816 / AT715-900	900	940	1078	1062	1098	539	531	—	
539-817 / AT715-1000	1000	1040	1178	1162	1198	589	581	—	
539-818 / AT715-1100	1100	1140	1278	1262	1298	424	416	430	
539-819 / AT715-1200	1200	1240	1378	1362	1398	459	451	460	
539-820 / AT715-1300	1300	1340	1478	1462	1498	494	486	490	
539-821 / AT715-1400	1400	1440	1578	1562	1598	524	516	530	5000 (196.85)
539-822 / AT715-1500	1500	1540	1678	1662	1698	559	551	560	
539-823 / AT715-1600	1600	1640	1778	1762	1798	459	451	430	
539-824 / AT715-1700	1700	1740	1878	1862	1898	479	471	460	
539-825 / AT715-1800	1800	1840	1978	1962	1998	459	451	530	

Extension cable*

Order No.	Cable length
09AAB674A	2m
09AAB674B	5m
09AAB674C	7m

Mounting parts (provided as standard)

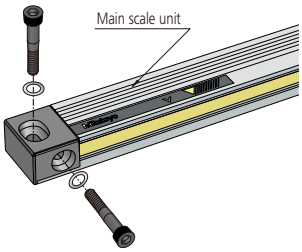
Items included	• Hex-socket head screw (M6x25)	2 pcs.	• Plain washer (4mm nominal)	2 pcs.
	• Hex-socket head screw (M4x25)	2 pcs.	• Cable clip	6 pcs.
	• Hex-socket head screw (M4x8)	6 pcs.	• Spacer (0.3, 0.4, 0.5, 0.6mm)	1 pc. each
	• Plain washer (6mm nominal)	2 pcs.		

*: Use an extension cable so that the total length including the signal cable is less than 15m.

ABSOLUTE® IP67 TÜVRheinland CERTIFIED Safety Dust- and Water-Protected www.tuv.com ID 0000007295

Features

- Employs the ABSOLUTE® electromagnetic induction system* to achieve IP67 environmental resistance.
- Detects and outputs an absolute position - no reference point setup needed at every power-on.
- An abnormal calculation doesn't accumulate even if the calculation mistake is generated by electrical noise.
- It is the most suitable scale to mount on the X-axis of a small lathe.
- Two mounting directions of the main scale unit allows easy mounting on a machine tool with difficult mounting arrangements.



* Patent registered
(Japan, USA, India, China, Germany, UK, France, Switzerland)

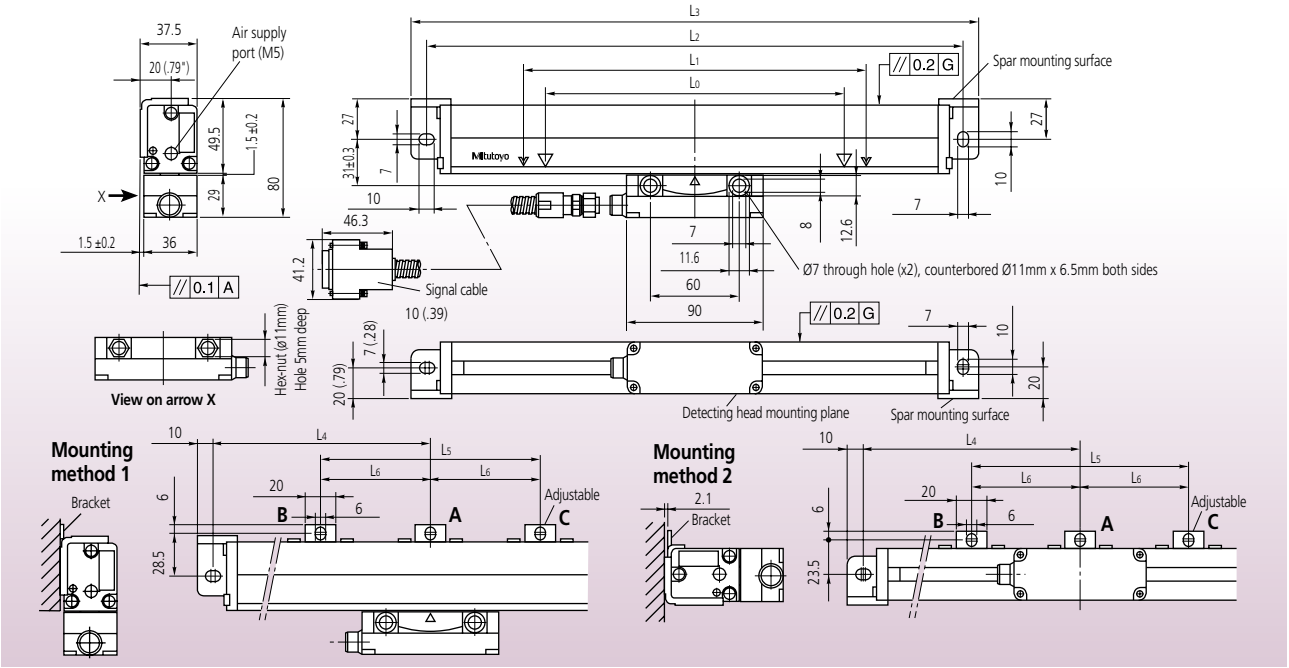
Order No. and mounting dimensions

mm

Order No. / Model No.	Effective length L_0	Maximum travel length L_1	Mounting hole pitch L_2	Mounting hole pitch L_3	Mounting hole pitch L_4	Middle support positions L_5	L_6	L_7	Signal cable length
539-860 / AT715-2000	2000	2040	2178	2162	2198	539	531	550	5000 (196.85)
539-861 / AT715-2200	2200	2240	2378	2362	2398	469	461	480	
539-862 / AT715-2400	2400	2440	2578	2562	2598	509	501	520	7000*1 (275.60)
539-863 / AT715-2500	2500	2540	2678	2662	2698	529	521	540	
539-864 / AT715-2600	2600	2640	2778	2762	2798	549	541	560	
539-865 / AT715-2800	2800	2840	2978	2962	2998	489	481	500	
539-866 / AT715-3000	3000	3040	3178	3162	3198	529	521	530	

*1: Signal cable length is the combination of signal code and extension cable (2m).

AT103, Standard-size Type

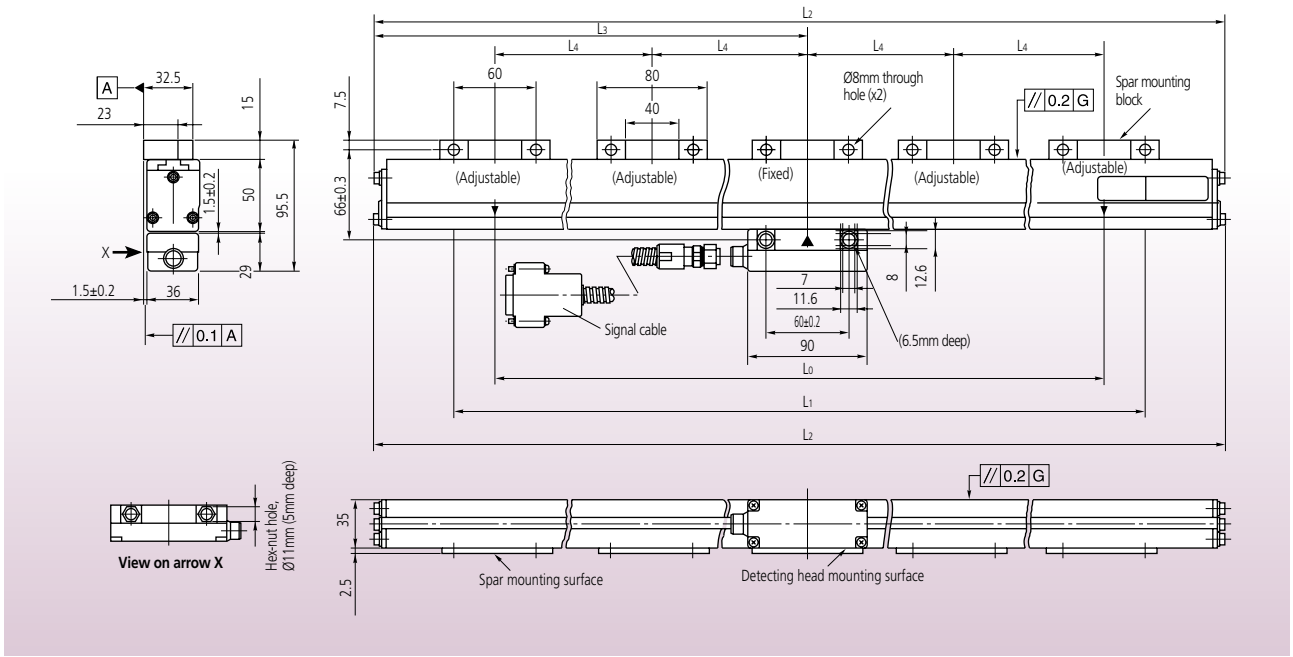


Order No. and mounting dimensions

mm

Order No. / Model No. ( ): suffix for high accuracy type	Effective range L_0	Travel range L_1	Mount interval L_2	Overall length L_3	Supporting bracket position L_4	L_5	L_6	Signal cable length	Mass kg
539-111-30 (-40) / AT103-100 (F)	100	120	248	268	—	—	—	3m	1.5
539-112-30 (-40) / AT103-150 (F)	150	170	298	318	—	—	—	3m	1.6
539-113-30 (-40) / AT103-200 (F)	200	220	348	368	—	—	—	3m	1.7
539-114-30 (-40) / AT103-250 (F)	250	270	398	418	—	—	—	3m	1.8
539-115-30 (-40) / AT103-300 (F)	300	330	458	478	—	—	—	3m	1.9
539-116-30 (-40) / AT103-350 (F)	350	380	508	528	—	—	—	3m	2.0
539-117-30 (-40) / AT103-400 (F)	400	430	558	578	—	—	—	3m	2.1
539-118-30 (-40) / AT103-450 (F)	450	480	608	628	—	—	—	3m	2.2
539-119-30 (-40) / AT103-500 (F)	500	540	668	688	—	—	—	3m	2.3
539-121-30 (-40) / AT103-600 (F)	600	650	778	798	—	—	—	3m	2.6
539-123-30 (-40) / AT103-700 (F)	700	760	888	908	—	—	—	3m	2.8
539-124-30 (-40) / AT103-750 (F)	750	810	938	958	—	—	—	3m	2.9
539-125-30 (-40) / AT103-800 (F)	800	860	988	1008	—	—	—	3m	3.0
539-126-30 (-40) / AT103-900 (F)	900	960	1088	1108	—	—	—	3m	3.3
539-127-30 (-40) / AT103-1000 (F)	1000	1060	1188	1208	594	—	—	5m	3.7
539-128-30 (-40) / AT103-1100 (F)	1100	1160	1288	1308	644	—	—	5m	4.0
539-129-30 (-40) / AT103-1200 (F)	1200	1260	1388	1408	694	—	—	5m	4.2
539-130-30 (-40) / AT103-1300 (F)	1300	1360	1488	1508	744	—	—	5m	4.4
539-131-30 (-40) / AT103-1400 (F)	1400	1460	1588	1608	794	—	—	5m	4.6
539-132-30 (-40) / AT103-1500 (F)	1500	1560	1688	1708	844	—	—	5m	4.8
539-133-30 (-40) / AT103-1600 (F)	1600	1690	1818	1838	—	610	—	5m	5.1
539-134-30 (-40) / AT103-1700 (F)	1700	1790	1918	1938	—	650	—	5m	5.3
539-135-30 (-40) / AT103-1800 (F)	1800	1890	2018	2038	—	670	—	5m	5.5
539-136-30 (-40) / AT103-2000 (F)	2000	2100	2228	2248	—	740	—	5m	6.0
539-137-30 / AT103-2200	2200	2300	2428	2448	—	800	—	5m	6.4
539-138-30 / AT103-2400	2400	2500	2628	2648	1314	1300	650	7m	7.1
539-139-30 / AT103-2500	2500	2600	2728	2748	1364	1340	670	7m	7.3
539-140-30 / AT103-2600	2600	2700	2828	2848	1414	1400	700	7m	7.5
539-141-30 / AT103-2800	2800	2900	3028	3048	1514	1500	750	7m	7.9
539-142-30 / AT103-3000	3000	3100	3228	3248	1614	1600	800	7m	8.3

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).



Order No. and mounting dimensions

mm

Order No. / Model No.	Effective range L_0	Travel range L_1	Overall length L_2	Supporting bracket position L_3	L_4	Signal cable length	Mass kg
539-143-30 / AT103-3250	3250	3350	3464	1725	800	10m	10.8
539-144-30 / AT103-3500	3500	3600	3714	1850	850	10m	11.4
539-145-30 / AT103-3750	3750	3850	3964	1975	930	10m	12.0
539-146-30 / AT103-4000	4000	4100	4214	2100	1000	10m	12.6
539-147-30 / AT103-4250	4250	4350	4464	2225	1050	10m	13.2
539-148-30 / AT103-4500	4500	4600	4714	2350	1100	10m	13.8
539-149-30 / AT103-4750	4750	4850	4964	2475	800	15m	15.2
539-150-30 / AT103-5000	5000	5100	5214	2600	830	15m	15.8
539-151-30 / AT103-5250	5250	5350	5464	2725	870	15m	16.4
539-152-30 / AT103-5500	5500	5600	5714	2850	910	15m	17.0
539-153-30 / AT103-5750	5750	5850	5964	2975	950	15m	17.6
539-154-30 / AT103-6000	6000	6100	6214	3100	1000	15m)	18.2

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Mounting parts (provided as standard)

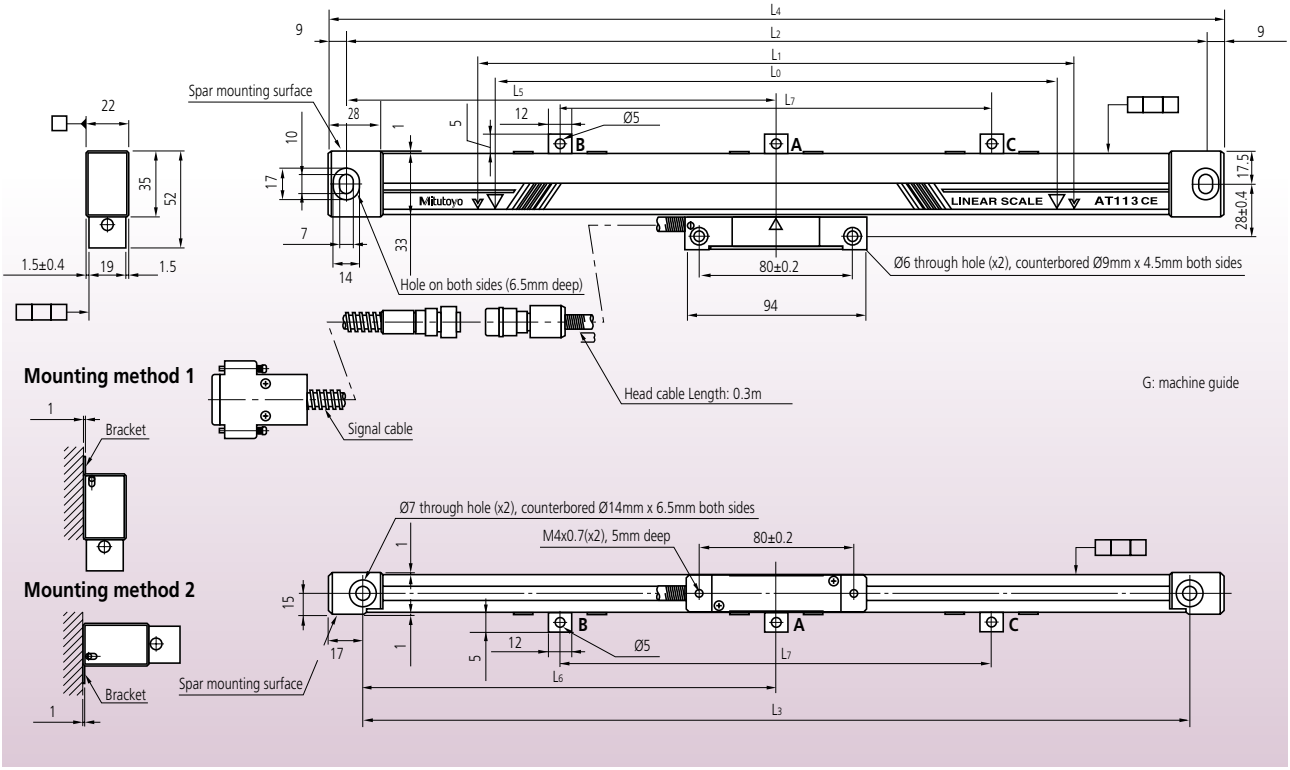
Type of spar	Standard-size	Extra-long
Effective range L_0	100mm - 3000mm	3250mm - 6000mm
Items included	• Hex-socket head screw (M6x1x40) 2 pcs. • Hex-socket head screw (M6x1x16) 2 pcs. • Hex-socket head screw (M4x0.7x8) 6 pcs. • Spring washer (6mm nominal) 2 pcs. • Plain washer (6mm nomina) 2 pcs. • Cable clip 5 pcs. • Spacer (0.3mm) 1 pc. • Spacer (0.4mm) 1 pc. • Spacer (0.5mm) 1 pc. • Spacer (0.6mm) 1 pc.	• Hex-socket head screw (M6x1x40) 2 pcs. • Hex-socket head screw (M6x1x30) 14 pcs. • Hex-socket head screw (M4x0.7x8) 7 pcs. • Spring washer (6mm nominal) 14 pcs. • Plain washer (6mm nomina) 14 pcs. • Cable clip 7 pcs. • Spacer (0.3mm) 1 pc. • Spacer (0.4mm) 1 pc. • Spacer (0.5mm) 1 pc. • Spacer (0.6mm) 1 pc.

Remarks: Dust-proofing and splash-proofing of the AT103 model scale units can be improved by supplying clean and dry air to the main spar.
(Air pressure required: 50kPa, Air flow rate: 10 to 20 normal liters per minute)

Extension cable

Order No.	Cable length
09AAA033A	2m
09AAA033B	5m
09AAA033C	7m

AT113, Slim Type



Order No. and mounting dimensions

mm

Order No. / Model No. ( ): suffix for high accuracy type	Effective range L_0	Travel range L_1	Mount interval L_2	Mount interval L_3	Overall length L_4	Supporting bracket position L_5	L_6	L_7	Signal cable length	Mass kg
539-201-30 (-40) / AT113-100 (F)	100	120	258	242	276	—	—	—	3m	0.9
539-202-30 (-40) / AT113-150 (F)	150	170	308	292	326	—	—	—	3m	0.9
539-203-30 (-40) / AT113-200 (F)	200	220	358	342	376	—	—	—	3m	0.9
539-204-30 (-40) / AT113-250 (F)	250	270	408	392	426	—	—	—	3m	1.0
539-205-30 (-40) / AT113-300 (F)	300	330	468	452	486	—	—	—	3m	1.0
539-206-30 (-40) / AT113-350 (F)	350	380	518	502	536	—	—	—	3m	1.1
539-207-30 (-40) / AT113-400 (F)	400	430	568	552	586	—	—	—	3m	1.1
539-208-30 (-40) / AT113-450 (F)	450	480	618	602	636	—	—	—	3m	1.1
539-209-30 (-40) / AT113-500 (F)	500	540	678	662	696	339	331	—	3m	1.2
539-211-30 (-40) / AT113-600 (F)	600	640	778	762	796	389	381	—	3m	1.3
539-213-30 (-40) / AT113-700 (F)	700	740	878	862	896	439	431	—	3m	1.3
539-214-30 (-40) / AT113-750 (F)	750	780	918	902	936	459	451	—	3m	1.4
539-215-30 (-40) / AT113-800 (F)	800	840	978	962	996	489	481	—	3m	1.4
539-216-30 (-40) / AT113-900 (F)	900	940	1078	1062	1096	539	531	—	3m	1.5
539-217-30 (-40) / AT113-1000 (F)	1000	1040	1178	1162	1196	589	581	—	5m	1.9
539-218-30 (-40) / AT113-1100 (F)	1100	1140	1278	1262	1296	—	—	430	5m	1.9
539-219-30 (-40) / AT113-1200 (F)	1200	1240	1378	1362	1396	—	—	460	5m	2.0
539-220-30 (-40) / AT113-1300 (F)	1300	1340	1478	1462	1496	—	—	490	5m	2.1
539-221-30 (-40) / AT113-1400 (F)	1400	1440	1578	1562	1596	—	—	530	5m	2.2
539-222-30 (-40) / AT113-1500 (F)	1500	1540	1678	1662	1696	—	—	560	5m	2.2

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

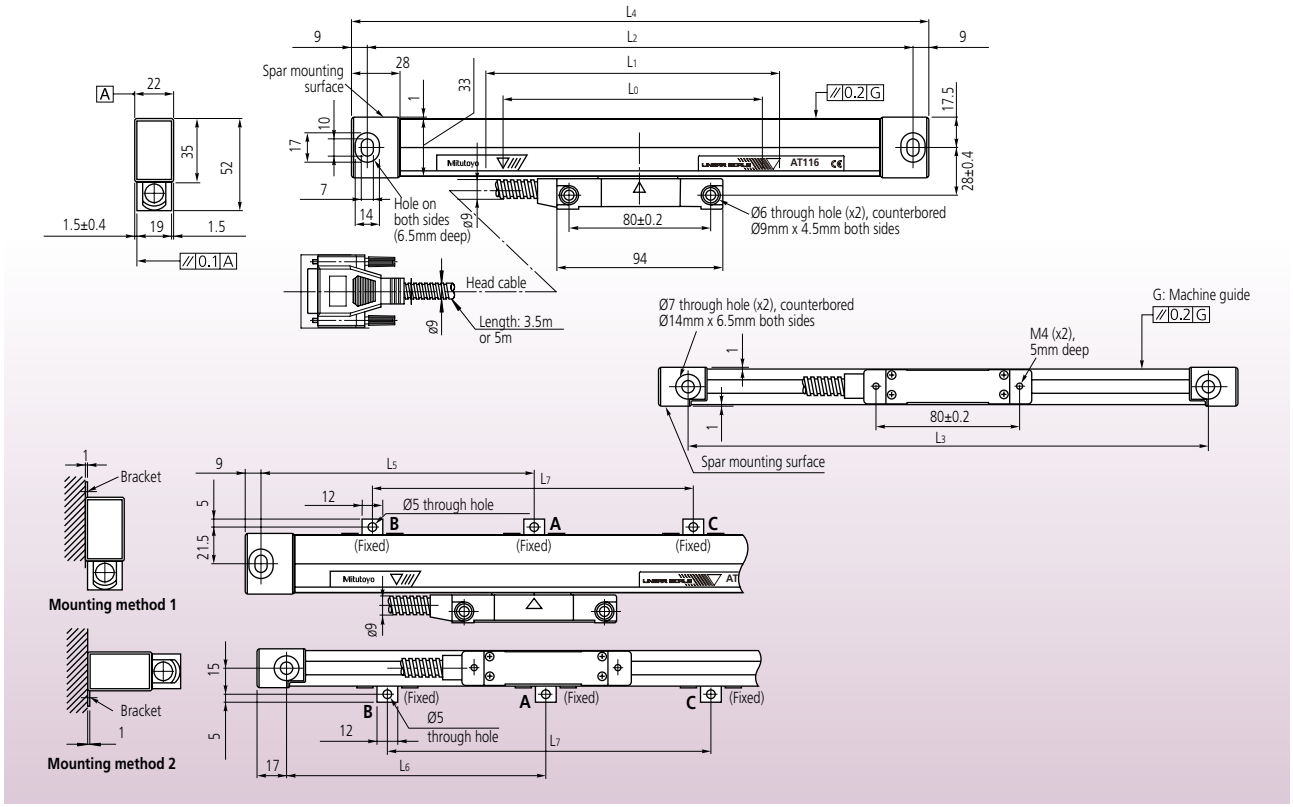
Extension cable

Order No.	Cable length
09AAA033A	2m
09AAA033B	5m
09AAA033C	7m

Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M6x1x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Spring washer (4mm nominal)	2 pcs.
	• Plain washer (4mm nomina)	2 pcs.
	• Cable clip	5 pcs.
	• Connector clamp	1 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

AT116, Slim and Economy Type



Order No. and mounting dimensions

mm

Order No. / Model No.	Effective range L_0	Travel range L_1	Mount interval L_2	Mount interval L_3	Overall length L_4	Supporting bracket position L_5	L_6	L_7	Head cable length	Mass kg
539-271-30 / AT-116-100	100	120	258	242	276	—	—	—	3.5m	0.5
539-272-30 / AT-116-150	150	170	308	292	326	—	—	—	3.5m	0.6
539-273-30 / AT-116-200	200	220	358	342	376	—	—	—	3.5m	0.7
539-274-30 / AT-116-250	250	270	408	392	426	—	—	—	3.5m	0.8
539-275-30 / AT-116-300	300	330	468	452	486	—	—	—	3.5m	0.9
539-276-30 / AT-116-350	350	380	518	502	536	—	—	—	3.5m	1.0
539-277-30 / AT-116-400	400	430	568	552	586	—	—	—	3.5m	1.1
539-278-30 / AT-116-450	450	480	618	602	636	—	—	—	3.5m	1.2
539-279-30 / AT-116-500	500	540	678	662	696	339	331	—	3.5m	1.3
539-281-30 / AT-116-600	600	640	778	762	796	389	381	—	3.5m	1.4
539-283-30 / AT-116-700	700	740	878	862	896	439	431	—	3.5m	1.6
539-284-30 / AT-116-750	750	780	918	902	936	459	451	—	3.5m	1.7
539-285-30 / AT-116-800	800	840	978	962	996	489	481	—	3.5m	1.8
539-286-30 / AT-116-900	900	940	1078	1062	1096	539	531	—	3.5m	2.0
539-287-30 / AT-116-1000	1000	1040	1178	1162	1196	589	581	—	5m	2.3
539-288-30 / AT-116-1100	1100	1140	1278	1262	1296	—	—	430	5m	2.5
539-289-30 / AT-116-1200	1200	1240	1378	1362	1396	—	—	460	5m	2.7
539-290-30 / AT-116-1300	1300	1340	1478	1462	1496	—	—	490	5m	2.9
539-291-30 / AT-116-1400	1400	1440	1578	1562	1596	—	—	530	5m	3.1
539-292-30 / AT-116-1500	1500	1540	1678	1662	1696	—	—	560	5m	3.2

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

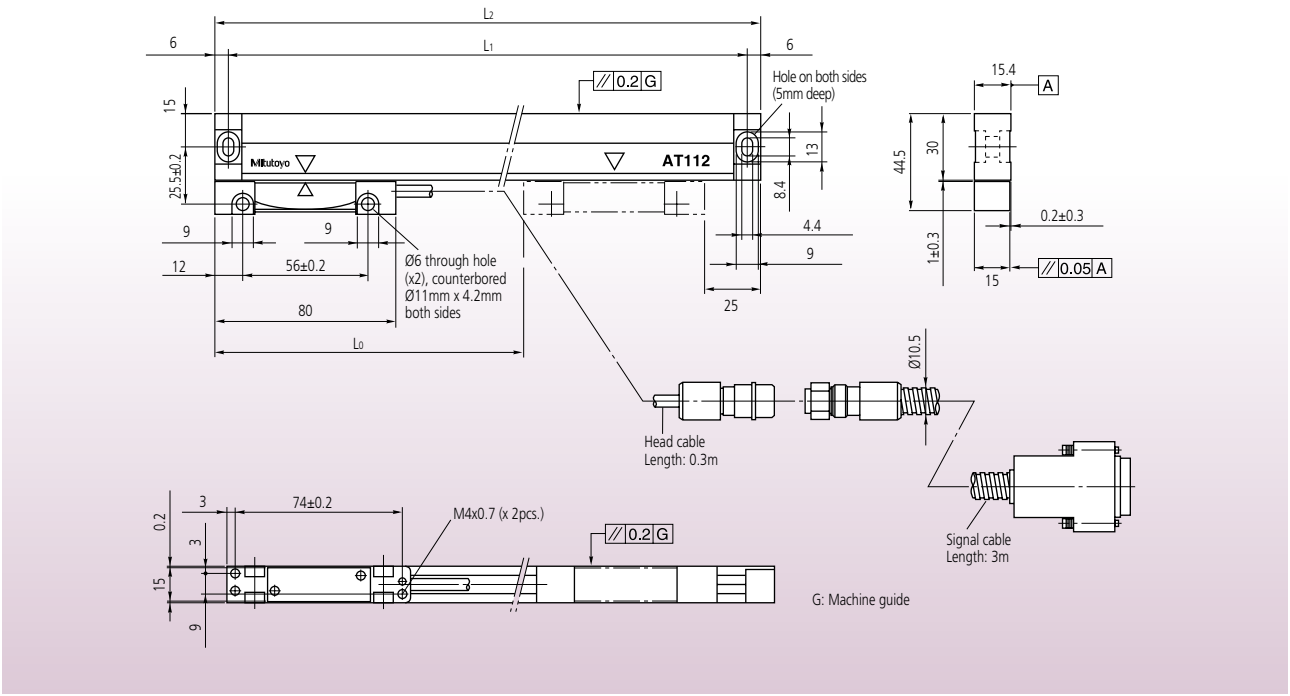
Extension cable

Order No.	Cable length
09AAA720A	2m
09AAA720B	5m
09AAA720C	7m

Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M6x1x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Plain washer (6mm nominal)	2 pcs.
	• Plain washer (4mm nomina)	2 pcs.
	• Connector clamp	6 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

AT112-F, Super Slim Type



Order No. and mounting dimensions

mm

Order No. / Model No.	Effective range L_0	Mount interval L_1	Overall length L_2	Signal cable length	Mass kg
539-251-10 / AT112-50F	50	143	155	3m	0.72
539-252-10 / AT112-70F	70	163	175	3m	0.74
539-253-10 / AT112-120F	120	213	225	3m	0.80
539-254-10 / AT112-170F	170	263	275	3m	0.85
539-255-10 / AT112-220F	220	313	325	3m	0.90
539-256-10 / AT112-270F	270	363	375	3m	0.95
539-257-10 / AT112-320F	320	413	425	3m	1.00
539-258-10 / AT112-370F	370	463	475	3m	1.05
539-259-10 / AT112-420F	420	513	525	3m	1.10
539-260-10 / AT112-470F	470	563	575	3m)	1.15
539-261-10 / AT112-520F	520	613	625	3m	1.20
539-262-10 / AT112-570F	570	663	675	3m	1.25
539-263-10 / AT112-620F	620	713	725	3m	1.30
539-264-10 / AT112-670F	670	763	775	3m	1.35
539-265-10 / AT112-720F	720	813	825	3m	1.40
539-266-10 / AT112-770F	770	863	875	3m	1.45
539-267-10 / AT112-820F	820	913	925	3m	1.50
539-268-10 / AT112-920F	920	1013	1025	3m	1.56
539-269-10 / AT112-1020F	1020	1113	1125	3m	1.62

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Extension cable

Order No.	Cable length
09AAA033A	2m
09AAA033B	5m
09AAA033C	7m

Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M4x0.7x25)	4 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Spring washer (4mm nominal)	4 pcs.
	• Plain washer (4mm nomina)	4 pcs.
	• Cable clip	5 pcs.
	• Connector clamp	1 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

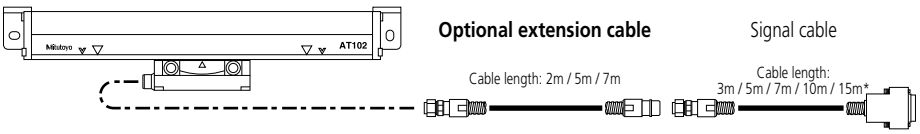
Scale Unit Features

KA-200 Counter, standard type

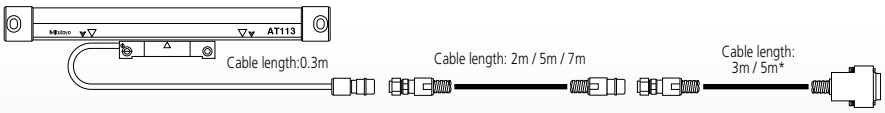
KLD-200 Counter, with limit signal output

When using an optional extension cable

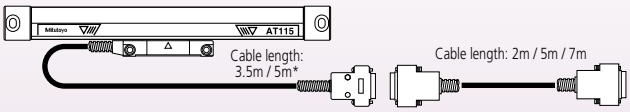
AT103



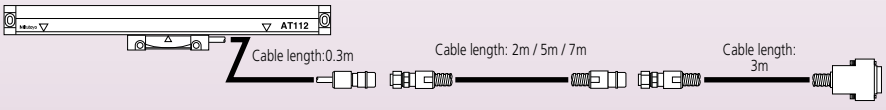
AT113



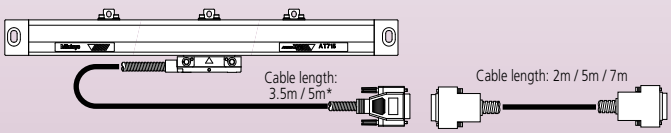
AT116



AT112

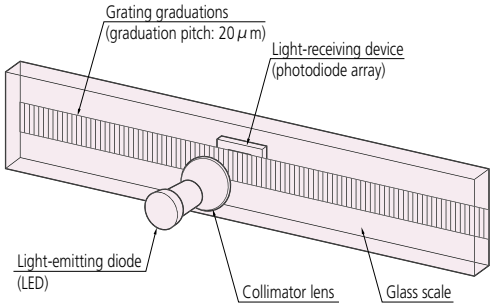


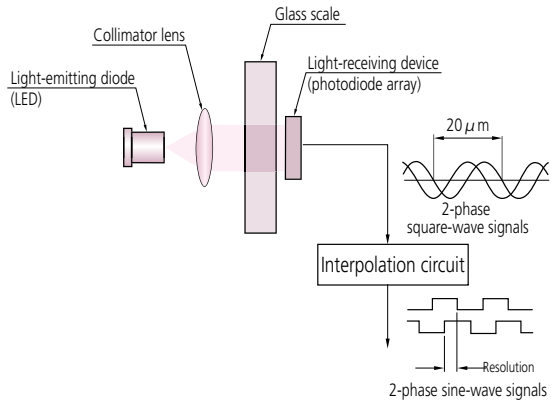
AT715



*Depending on the size of scale unit

Operating Principle of AT103/AT113 Models





The assembly-type Linear Scale® uses a highly accurate glass scale grating pitch of 20 µm as the basic standard of length. The grating is irradiated with parallel light generated with a Light-Emitting Diode (LED) and collimator lens. The parallel light transmitted through the grating generates an interference pattern with the same pitch as that of a grating on the photodiode array of the light-receiving device. The receiver output signal is 2-phase sinusoidal with a wavelength of 20µm, identical to the pitch of the grating graduations, and is electrically converted to 2-phase square-wave signals by the interpolation circuit. The much smaller working resolution is achieved by detecting the cyclic variation in light intensity incident on the receiver array, as the scale is displaced in a measuring direction, and interpolating accordingly to output a corresponding displacement value.

Detecting Principle Added to AT715

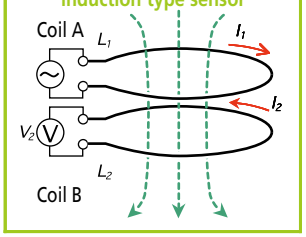
The Absolute system-type linear scale AT715 employs a unique, Mitutoyo-proprietary, electromagnetic induction principle that is highly resistant to environmental contamination.
Achievement of a complete absolute scale with a resolution of 1µm thanks, to a multi-track configuration, enables the user to obtain absolute positional information from the scale immediately power is applied to the counter.

- If time-varying current I1 is applied to coil A, a magnetic flux is generated inside the coil.
- A current I2 is induced in coil B that tends to oppose the build-up of the magnetic flux.

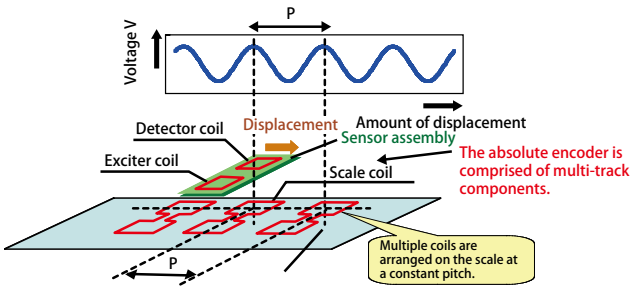
The magnetic permeability between the coils will not vary whether the medium is air, water, or oil.

The electromagnetic induction type sensor has excellent water resistance and oil resistance.

Basic principle of electromagnetic induction type sensor



Operating Principle of Electromagnetic Induction Type Encoder



Display Unit Selection Guide

Functions

Function \ Counter		KA-200 Counter	KLD-200 Counter
			
Zero-setting	ZERO	●	●
Preset	P.SET	●	●
Resolution setting	0.0005 / 0.1	●	●
Measurement direction setting		●	●
mm/inch conversion	mm/inch	●	●
Diameter display	DIA	●	●
Scale reference point setting[-1]	SET	●	●
1/2 calculation	1/2	●	●
Coordinate system switching	N	●	—
Bolt-hole circle machining		●[-2]	—
Pitch machining		●	—
Zero approach machining (INC mode)		●	—
Addition of 2-scale data	Z1+Z2	●[-3]	—
Linearity error compensation		●	●
Pitch error compensation		●[-1]	—
Smoothing	1234	●	●
Memory backup		●	●
Expansion/contraction coefficient setting		—	●
Lower digit blanking out	123	●	●
External zero-setting	ZERO SET IN PUT	▲[-4]	●
RS-232C interface unit	RS-232C OUTPUT	▲[-4]	●
USB output	USB	▲[-5]	—
Limit signal output	LIMIT OUTPUT	—	●
Error message	Error	●	●

●: 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

KA-200 Counter

FEATURES

- Can be used as a "standard counter" or a "lathe counter" by modifying parameters.
- Downsizing, weight saving and multiple function have been realized.
- Sub display for easy operation.
- Text data can be output using the optional USB interface.
- The optional external interface RS-232C enables connection to a PC and a printer.

174-183 (for 1-axis or 2-axis application)

174-185 (for 3-axis application)

SPECIFICATIONS

Model	KA-200 Counter
Resolution	With AT100 Series: 0.05 - 0.0001 mm With AT715: 0.01 - 0.001 mm
Scale input ports	2 or 3
Display type / digit	7-segment, 8-digit + sign + 8-character alphabet LED display
Output (optional)	RS-232C / USB
Macro functions	Rectangular drilling and round milling newly added
Main features	Feed speed display; taper machining function; tool data; multipoint compensation; scale check function; calculation function
Dimensions	Size (W×D×H) 30×168×70mm

Standard Accessories

02ZAA000: 1.8m AC cable (Japan)
02ZAA010: 1.8m AC cable (USA, Canada)
02ZAA020: 1.8m AC cable (Europe)
02ZAA030: 1.8m AC cable (UK)
02ZAA040: 1.8m AC cable (China)
02ZAA050: 1.8m AC cable (Korea)
06AEU075: Dust-proof cover
09CAA985: GND lead wire (4m)
06AEU080: Seal set (1 pc.)
06AFC149: D-SUB15P Connector cap
99MBE083A: User's Manual (1 set)

Optional Accessories

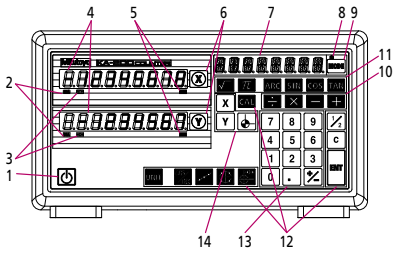
06AET993: Code out unit
06ACF941: External extension cable
937179T: Foot switch for measurement data output (USB interface)

Note: The touch-probe has been discontinued.

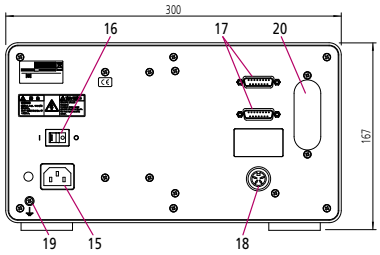
DIMENSIONS

Unit: mm

Front view



Rear view



1: Display ON/OFF switch
2: DIA
3: Scaling
4: Main display
5: Count value unit
6: Zero reset key
7: Sub-display
8: Lock
9: MODE key
10: Four arithmetic operation keys
11: Trigonometric function keys
12: Function keys
13: Numeric keypad
14: Axis/coordinates selection key
15: AC inlet
16: Main swtich
17: Linear scale input connectors
18: Touch signal probe connector
19: Ground terminal
20: Interface unit fixing section

KLD-200 Counter

FEATURES

- A 1-axis counter dedicated to sending signals when a linear scale displacement value and a preset limit value coincide.
- Two types of limit settings are available: 2 step and 4 step.
- For controlling the vertical position of an EDM or grinding machine head.
- Can be connected to a personal computer or a sequencer via an RS-232C interface or limit signal output (standard feature)

SPECIFICATIONS

Order No.	174-146	174-147
Limit signal output	2-step	4-step
Limit value setting method	Digital switch	Digital switch

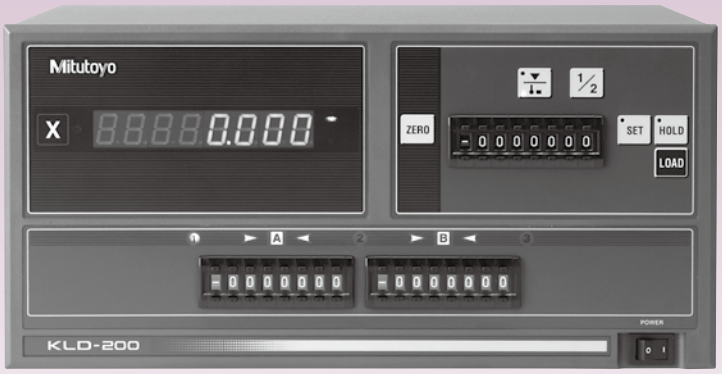
*To denote your AC line voltage add the following suffixes to the order No. (e.g.: **174-146A**): **A** for UL/CSA, **D** for CEE, **E** for BS, **DC** for China, **K** for EK, **No suffix** is required for JIS/100V

Standard Accessories

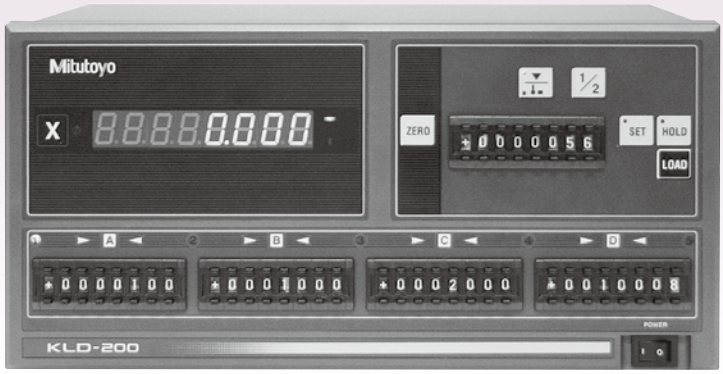
02ZAA000: 1.8m AC cable (Japan)
02ZAA010: 1.8m AC cable (USA, Canada)
02ZAA020: 1.8m AC cable (Europe)
02ZAA030: 1.8m AC cable (UK)
02ZAA040: 1.8m AC cable (China)
02ZAA050: 1.8m AC cable (Korea)
936626: GND lead wire (4m)
06ABZ456: Dust-proof cover
I/O output connector: 2 pcs
Mounting bracket: 1 set
User's Manual: 1 set

Technical Data: Common

Limit signal output: 2-step, 4-step
Scale input ports: 1
Resolution: 0.0005mm, 0.001mm, 0.002mm, 0.005mm. 0.01mm
Display: 9-digit LED and a negative [-] sign
Limit value setting method: Digital switch
Power supply: 100-120V/200-240V AC, 50/60Hz
Mass: 4.5kg



174-146 (2-step model)

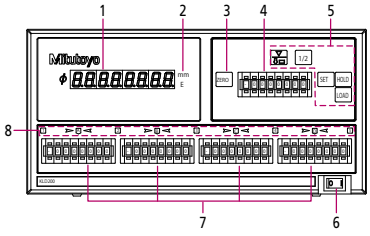


174-147 (4-step model)

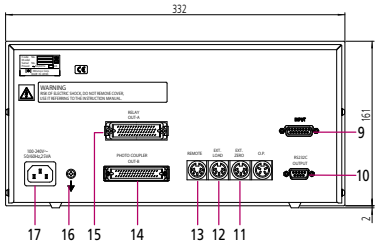
DIMENSIONS

Unit: mm

Front view



Rear view



1: Main display
2: mm/E
3: Zero key
4: Digital switch
5: Function key
6: POWER switch
7: Limit setting switches
8: Limit range display lamps
9: INPUT conncetor
10: OUTPUT connector
11: EXT.ZERO connector
12: EXT.LOAD connector
13: Remote connector
14: OUT-B connector
15: OUT-A connetor
16: Ground pin
17: AC inlet

Display Unit Functions

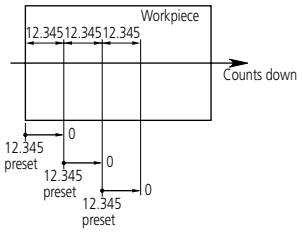
BASIC FUNCTIONS

ZERO Zero-setting

The display can be set to "0" (zero) at any scale position.

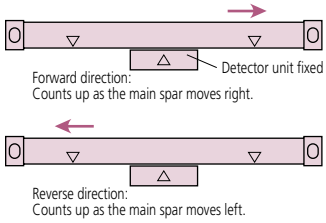
P.SET Preset

This function allows the user to enter a numeric value on the counter display. Any preset value can be retrieved whenever necessary.



Measurement direction setting

The measurement direction can be selected.



123 Lower digit blanking out

Unnecessary lower digits (up to 9 digits of the lowest digits) can be blanked out.

1/2 1/2 calculation

This function halves the display value.

mm/inch mm/inch conversion

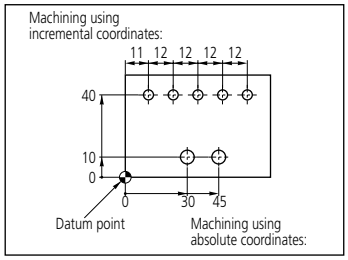
The counting unit can be changed between "mm" and "inch".

0.001 / 0.01 Resolution setting

The most suitable resolution can be selected to meet measuring applications. Available resolutions depend upon the counter to be used.

I/A Absolute/incremental coordinate system switching

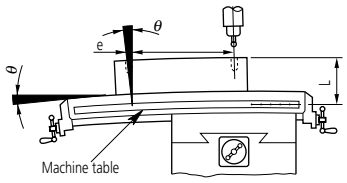
For each axis, the measured value can be obtained in either absolute (ABS) or incremental (INC) coordinates. This function is useful, for example, if the following operation is performed. Set the datum point for a workpiece in the absolute mode. Then, after performing zero setting, presetting, etc., in the incremental mode, return to the absolute mode. In this way the absolute distance from the datum point can be easily displayed.



SPECIAL FUNCTIONS

Linearity error compensation

Machine errors caused due to workpiece weight, inaccurate table adjustment, etc., are linearly compensated to reduce the positioning error.



Display value backup

The displayed value at power-off is preserved in memory and restored at the next power-on.
When an AT715 scale is connected to the counter, the stored display value is corrected appropriately if the detector head is moved during power off so that the display always shows the correct displacement from the origin.

1234 Smoothing Function

Turning on 'smoothing' slows display updating to enable the display to be read more easily when a measurement value is rapidly oscillating due to machine vibration. Measurement speed remains unaffected.

Expansion/contraction coefficient setting

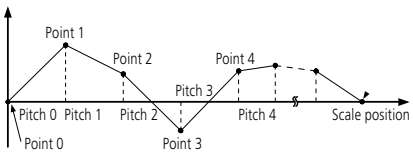
This function multiplies the actual counter measurements by a constant factor. This is useful in, for example, mold manufacture by allowing the mold to be machined to the actual molded component dimensions directly, without having to increase the machining dimensions manually to allow for material shrinkage after molding. Tedious work can thus be reduced and the risk of mistakes in calculation eliminated.

A CLR Parameter All Clear

Clears the setup parameter data and resets to the default data.

Pitch Error Correction (KA-200 Counter & AT100 series)

This function allows correction of machine errors, thus improving positioning accuracy.



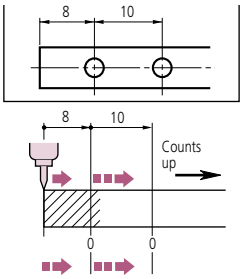
Function Lock (KA-200 Counter)

This function prevents any risk of the operational settings being accidentally changed.

MILLING MACHINE FUNCTIONS

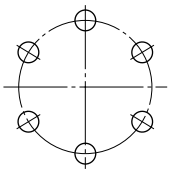
Zero approach machining [INC mode]

Zero approach machining can be repeated at preset intervals. Since the counter keeps the total displacement in absolute coordinates, a positioning error made by the operator at one tooling position has no effect on the remaining positions.



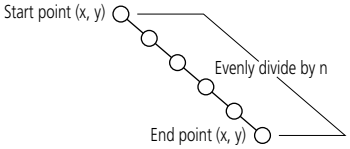
Bolt-hole circle machining

In milling, the drilling positions along the circumference of the base circle in the absolute zero approach mode can be easily displayed by entering the center coordinates, diameter, and number of divisions of the base circle.



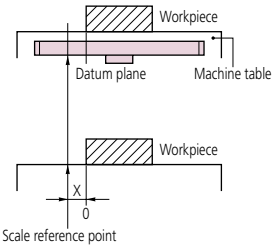
Pitch machining

Bores holes between two arbitrary points on the X-Y plane at equal spaces. By inputting the number of holes and positions of the start and end points, holes can be bored easily at equal spacing. Errors due to table positioning by the machine are automatically corrected to the next target value.



SET Scale reference point setting

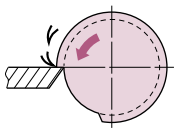
The linear scale has scale reference points at 50mm intervals. When one of the points is detected, the linear scale issues a signal to hold/restart counting. If the distance from a scale reference point to the machine origin is registered as the offset value, it will be retained even when the power is off (hold function). When the power is turned on, the machine origin or machining datum can be easily recalled (set function).



LATHE FUNCTIONS

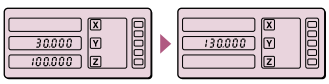
DIA Diameter display

The doubled scale displacement can be displayed. This convenient function can be used to display the diameter of a workpiece during a turning operation.



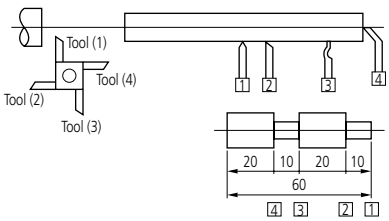
Z1+Z2 Addition of 2-scale data

The sum of the displayed values of two axes can be displayed. If a machine has two feed components, fine feed and coarse feed, each with its own scale, this function can be used to sum the two feed values.



TOOL Memorization of machining reference point for each cutting tool (for KA-200 Counter)

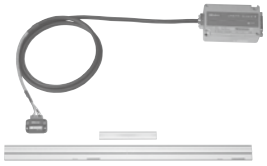
Absolute coordinate and incremental coordinate can be switched by every one of four cutting tools. The counter can memorize the center of a machining workpiece as a reference point and it can display the diameter of the machine workpiece by using absolute coordinate. The counter can zeroset/preset at the arbitrary position by using incremental coordinate.



SPECIAL FUNCTIONS

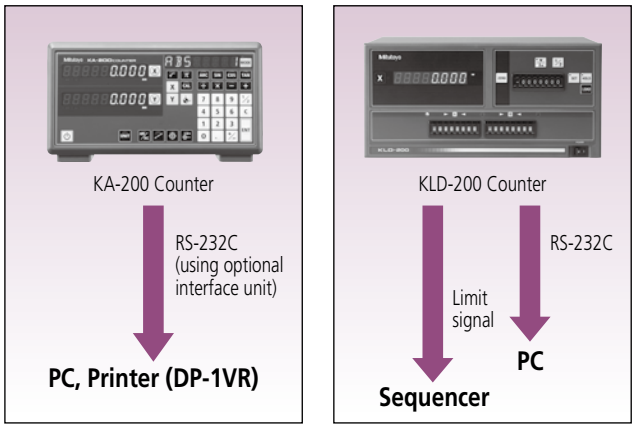
Connection with Line Driver Output Scale/Linear Gage

The KA-200 Counter can also connect with line-driver RS422 output type scale and linear gage.
To connect these sensors use optional LINE conversion adapters.
For detailed information, refer to page 27.



Connecting to External Devices

Mitutoyo's DRO system accurately detects and displays the displacement of machine tool or measuring equipment slideways, and outputs the measurement data and limit signal to a peripheral device such as a PC or Sequencer through a built-in or optional interface.



RS-232C Interface

- The RS-232C interface unit enables measurement data output, as well as zero-setting, by commands from the computer.
- The RS-232 interface unit is standard equipment for the KLD-200 Counter. The KA-200 Counter is available as an optional accessory.

DATA OUTPUT MODE

Trigger Mode (KLD-200 Counter):
Measurement data can be output by signals from a touch-signal probe or commands from a computer.
Interval Mode (KA-200 Counter and KLD-200 Counter):
Measurement data can be output at specific intervals.

SPECIFICATIONS

- Communication specifications

Home position	DCW
Communication method	Half-duplex, nonprocedural
Data transfer speed (Baud rate)	300, 600, 1200, 2400, 4800, 9600, 19200, 38400bps
Bit configuration	Start bit: 1 Data bit*: 7 or 8 Parity bit: 1 (even, odd), 0 (none) Stop bit: 1
Condition setting	By parameter switching.

- Operation for data output
Counter display values can be output in the following ways. Only one signal type can be used for input at any one time.

Method	Counter mode	Output axis	Applicable counters
Data request command X CR LF Y CR LF Z CR LF A CR LF	Normal mode	X-axis Y-axis Z-axis All axes	KA-200 Counter, KLD-200 Counter
External extension cable and external load box	Normal mode	Axes that are selected by the external load box	KA
External extension cable and foot switch	Normal mode	All axes	KA
EXT.LOAD signal input or external load box	Nomal mode	All axes	KLD-200 Counter

The KA-200/KLD-200 Counter can be controlled externally by executing the following commands through a computer, etc. Command codes must be entered in upper-case characters.

Function	Command code from PC
Zero-setting Sets the counter display values to zero.	RX CR LF: for X-axis RY CR LF*: for Y-axis RZ CR LF*: for Z-axis
Error cancelation Has the same effect as the CANCEL key on the counter.	CO CR LF

*Not available for KLD-200 Counter.

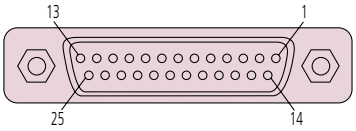
- Error code output
If a data output command is issued when the counter is in an error status, or when an incorrect command is issued, the counter outputs a corresponding error code signal.

Counter display	Code out output
Count overspeed (Error20)	E20
Display overflow (Error30)	E30
Signal error (Error40)	E40
Digital switch setting error (Error50)	E50 (Only for KLD counter)
Internal error (Error60)	No response
Startup display (--------)	E00

Notes

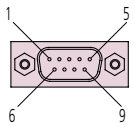
- The output data format is fixed to either 7 or 8 digits, without zero-suppression.
- If data is output from multiple axes, a comma "," is used as a delimiter. e.g. X +12345.678, Y +90123.456 CR LF
- Data is output in the same unit that is used on the counter (mm or inch). However, the unit identifier itself will not be output.

• RS-232C connector
Connector used: 9-pin (KLD-200 Counter*)
25-pin (KA-200 Counter)



Applicable plug (female)
• HDBB-25P (plug / HIROSE)
• HDB-CHT (case / HIROSE)

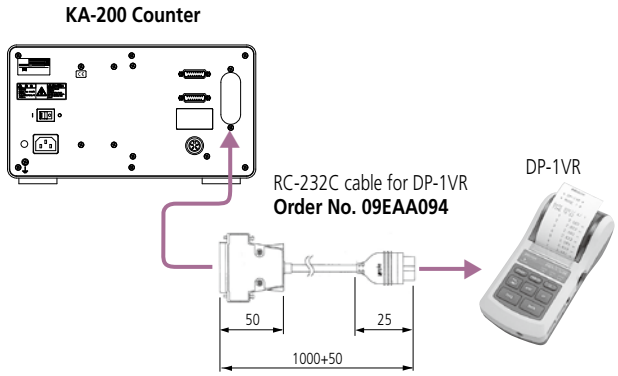
No. of pin	Signal	I/O	Remarks
1	FG	—	Frame grounding
2	SD	Input	Command
3	RD	Output	Data
4	—	—	Not used
5	CS	Output	"H" fixed
6	DR	Output	"H" fixed
7	SG	—	Signal grounding
8 to 12	—	—	Not used
13		Input	X-axis load
14		Input	Y-axis load
15		—	Not used
16		Input	Z-axis load
17 to 22		—	Not used
23		Input	X-axis zero-setting
24		Input	Y-axis zero-setting
25		Input	Z-axis zero-setting



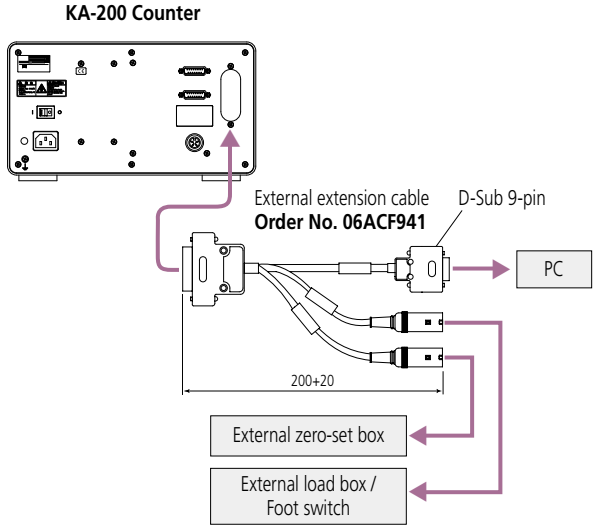
Applicable plug (female)
• HDEB-9S (plug / HIROSE)
• HDE-CHT (case / HIROSE)

No. of pin	Signal	I/O	Remarks
1	—	—	Not used
2	RD	Output	Data
3	SD	Input	Command
4	—	—	Not used
5	SG	—	Signal grounding
6	DR	Output	"H" fixed
7	—	—	Not used
8	CS	Output	"H" fixed
9	—	—	Not used

• Optional RS-232C code out unit for KA-200 Counter: **09CAB217**
The optional code out unit enables measurement data output to a peripheral device such as a PC or DP-1VR, as well as zero-setting by commands from PC or the external zero-set box.



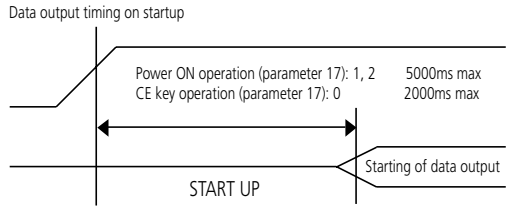
• External extension cable (KA-200 Counter only). By attaching an external extension cable to a KA-200 Counter + RS-232C code out unit, the optional external load box, foot switch and external zeroset box can be connected.
RS-232C outputs can be used together.



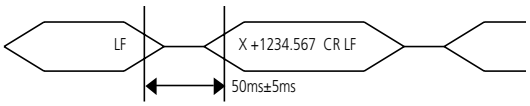
Connecting to External Devices

TIMING CHART

• Interval Mode (KA-200 Counter):
Measurement data can be output at specific intervals.

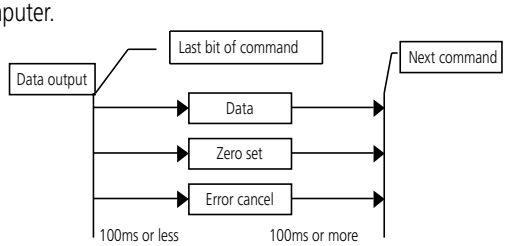


The display mode at startup can be selected with the parameter (KA-200 Counter).



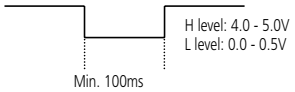
Data will be output with 50ms interval regardless of the transmission speed.

• Trigger Mode (KA-200 Counter and KLD-200 Counter):
Measurement data can be output by commands from the computer.



Each value in the timing chart indicates response time to a command. Consequently, be aware that this command may cause a difference between a detected point and the actual one when the slider is moving.

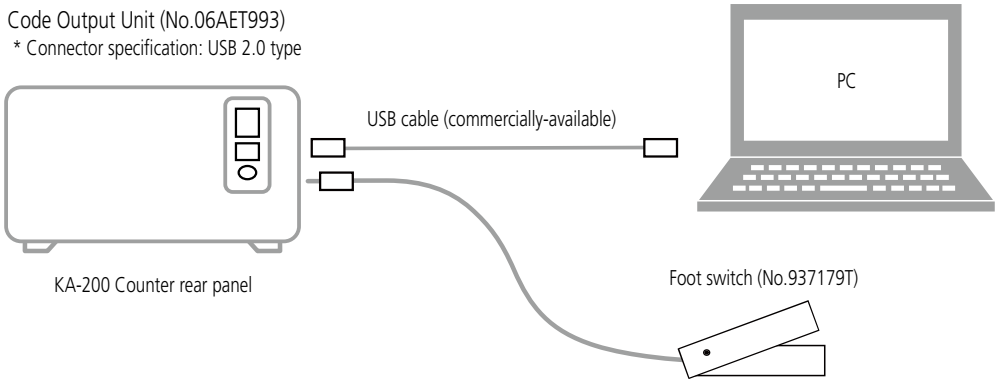
• External zero signal (KA-200 Counter and KLD-200 Counter)



Maintain the low level for 100ms or more.

USB Output

A KA-series counter can output measurement values as USB text data in combination with the optional code output unit and foot switch. These numeric values can be imported to applications such as Excel.



Limit Signal Output

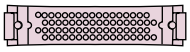
An interface that outputs signals to an external device when the measurement value from the Linear Scale is the same as the preset limit value. Can be used for GO/NG judgment and automatic control of a machine tool.

RELAY SIGNAL OUTPUT (OUT-A)

This connector is used to output relay signals. The limit signals will be output in the format of the relay's ON and OFF signals.

(1) Connector used

- MR-60RM (female)
  [Manufacturer: Honda Tsushin]



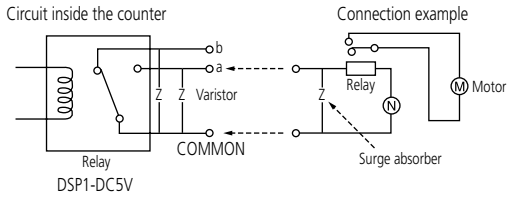
- When an error message is displayed, the alarm output will be set to ON. When this happens all relay outputs are set to ON.
- Limit signals are numbered to correspond with the number of limit steps existing, each using a corresponding set of pins: the 2-step type has up to 2 limit signals; the 4-step type has up to 4 limit signals; and the 8-step type has up to 8 limit signals. The other pins are not assigned.

Note: A connector plug (MR-60LF, Honda Tsushin) is provided as standard.

(2) Pin assignment
(Example of a counter with 8 limit steps)

No. of pin	Signal	
1 - 3	Coincidence:	1= a contact, 2= common, 3= b contact
4 - 6	Alarm:	4= a contact, 5= common, 6= b contact
7 - 9	Limit signal 0:	7= a contact, 8= common, 9= b contact
10 - 12	Limit signal 1:	10= a contact, 11= common, 12= b contact
13 - 15	Limit signal 2:	13= a contact, 14= common, 15= b contact
16 - 18	Limit signal 3:	16= a contact, 17= common, 18= b contact
19 - 21	Limit signal 4:	19= a contact, 20= common, 21= b contact
22 - 60	Not connected	

Notes on the connection of relay signal output



Do not use the limit signal output through the relay of the KLD-200 Counter to directly control other devices such as motors.
Always route the relay output through another relay at the external device side, as shown in the diagram above. Although the relay contact circuit of the counter is equipped with varistors (threshold voltage: 300V), it is advisable to provide a surge absorber on the external device to be connected, which may generate surge current. For example, a varistor is recommended for an AC circuit, and an appropriate diode is recommended for a DC circuit.

Capacity of relay contact inside the counter
5V - 30V AC, 10mA - 500mA
5V - 30V DC, 10mA - 500mA

The external control device should not cause the contact capacity, as stated above, to be exceeded.

Specifications

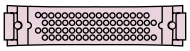
Connectable counter	KLD Counter
Number of output axes	1
Number of output steps	2 or 4
Output	Relay and photocoupler

PHOTOCOUPLER SIGNAL OUTPUT (OUT-B)

This connector is used to output photocoupler signals, which use the same logic as relay signals.

(1) Connector used

- MR-50RM (female)
  [Manufacturer: Honda Tsushin]



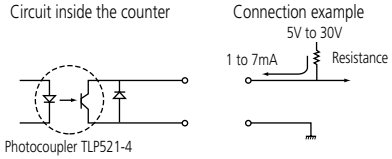
- When an error occurs, the alarm output will be set to ON.

Note: A connector plug (MR-50LF, Honda Tsushin) is provided as standard.

(2) Pin assignment
(Example of a counter with 8 limit steps)

No. of pin	Signal	
1 - 2	Limit signal 0:	1= emitter, 2= collector
3 - 4	Limit signal 1:	3= emitter, 4= collector
5 - 6	Limit signal 2:	5= emitter, 6= collector
7 - 8	Limit signal 3:	7= emitter, 8= collector
9 - 10	Limit signal 4:	9= emitter, 10= collector
11 - 46	Not connected	
47 - 48	Coincidence:	47= emitter, 48= collector
49 - 50	Alarm:	49= emitter, 50= collector

Notes on the connection of photocoupler output

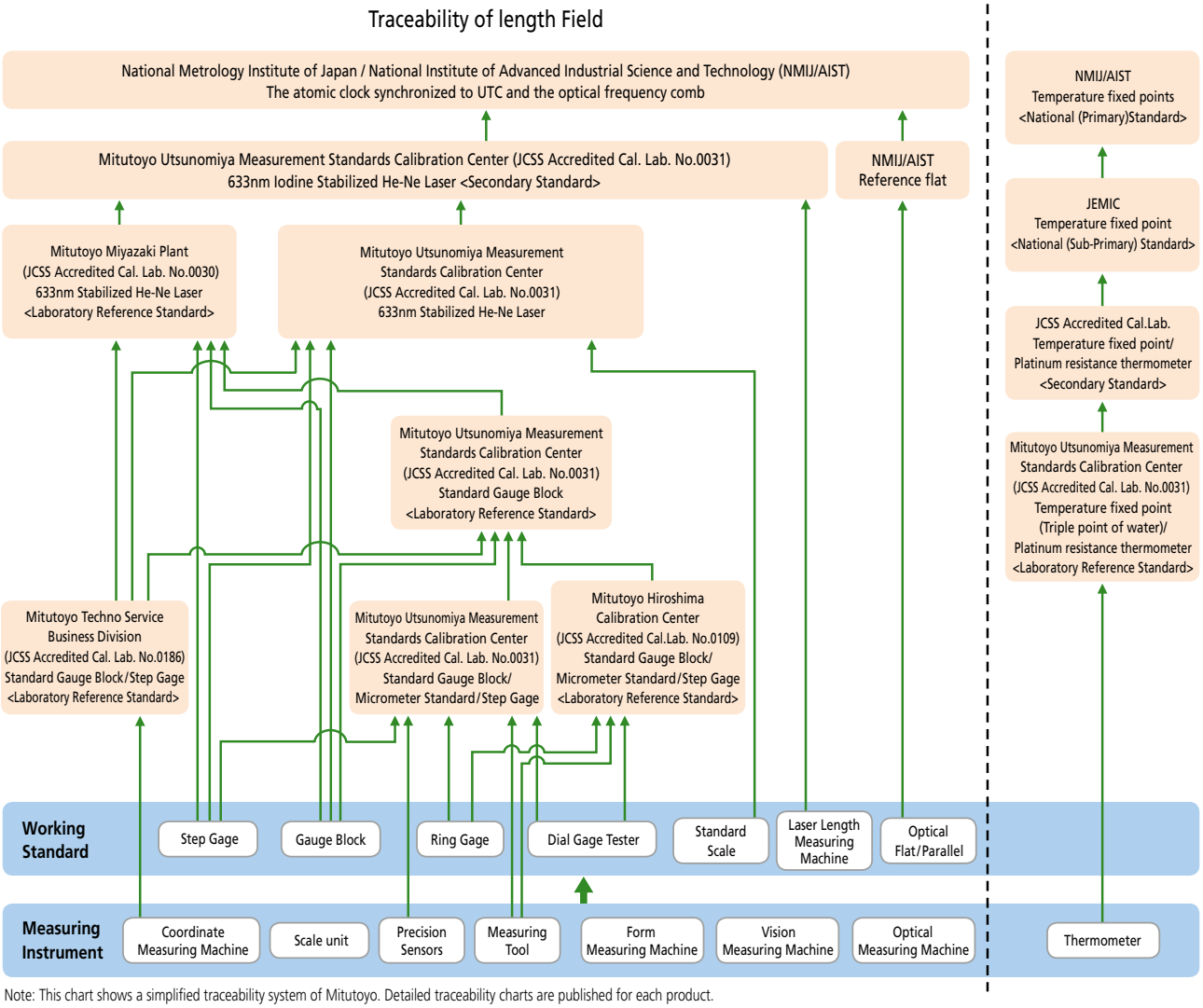


Recommended power supply to the transistor
5V - 30V, 1mA - 7mA

Traceability System

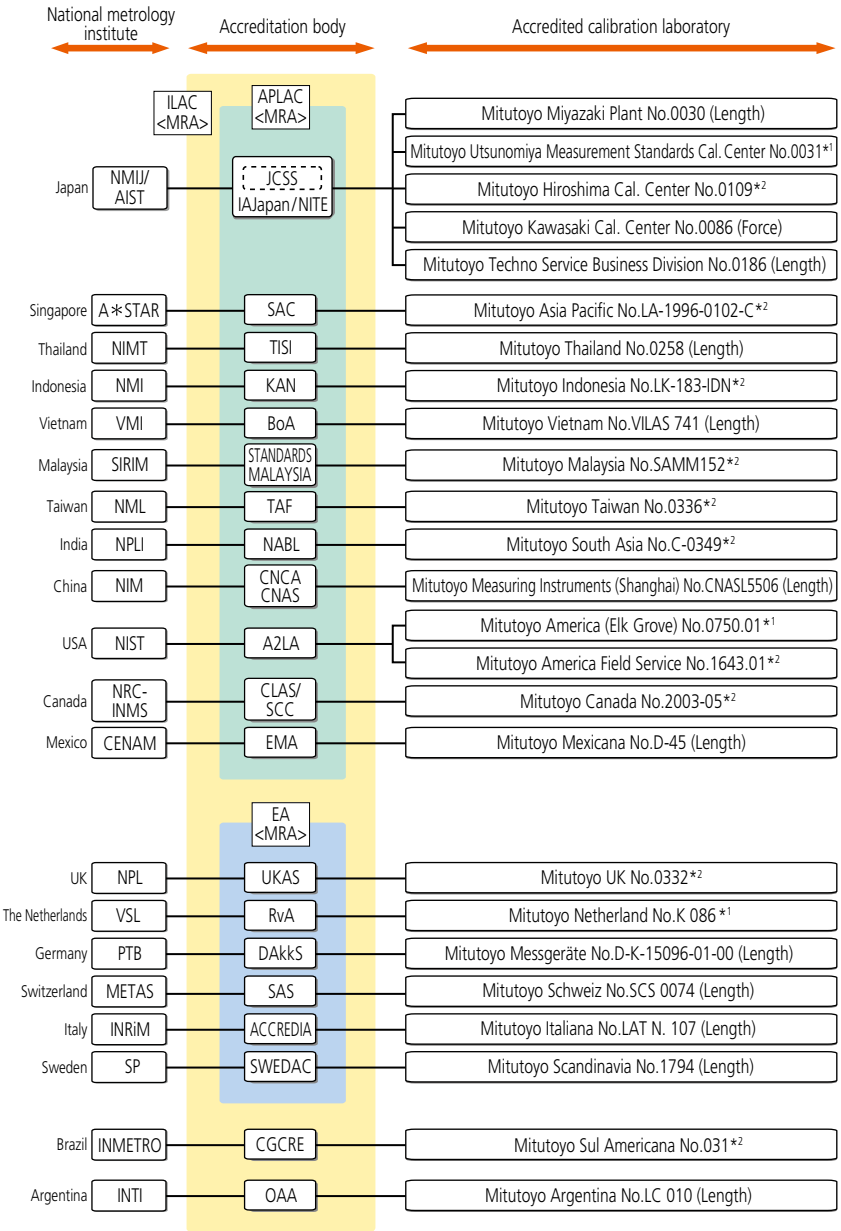
Mitutoyo has a traceability system made possible through an in-house calibration organization certified by the ISO/IEC 17025 international standard, with length standards directly related to the national standards (stabilized He-Ne laser) at the highest level. The stabilized He-Ne laser assures a performance equivalent to that of this national standard.

Further, the national standard is mutually recognized by CIPM, and the certified calibration organization is mutually recognized by ILAC, so that the establishment and maintenance of traceability for Mitutoyo products is achieved both in Japan and overseas.



Note: This chart shows a simplified traceability system of Mitutoyo. Detailed traceability charts are published for each product.

Calibration Laboratories Worldwide



The abovementioned accredited laboratories are authorised to calibrate with respect to length only unless marked as below:

*1 Authorised to calibrate with respect to Length and Temperature

*2 Authorised to calibrate with respect to Length and Hardness

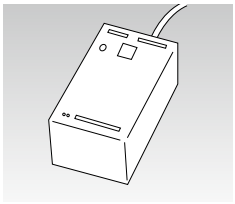
•Japan
AIST :National Institute of Advanced Industrial Science and Technology
NMIJ :National Metrology Institute of Japan
IAJapan :International Accreditation Japan
NITE :National Institute of Technology and Evaluation
JCSS :Japan Calibration Service System
•Singapore
A*STAR :Agency for Science, Technology and Research
SAC :Singapore Accreditation Council
•Thailand
NIMT National Institute of Metrology (Thailand)
TISI Thai Industrial Standard Institute
•Indonesia
NMI :Pusat Penelitian (Puslit) Metrologi LIPI
KAN :Komite Akreditasi Nasional
•Vietnam
VMI :Vietnam Metrology Institute
BoA :BUREAU OF ACCREDITATION
•Malaysia
SIRIM :Standards and Industrial Research Institute of Malaysia
STANDARDS MALAYSIA :Department of Standards Malaysia
•Taiwan
NML :National Measurement Laboratory
TAF :Taiwan Accreditation Foundation
•India
NPLI :National Physical Laboratory of India
NABL :National Accreditation Board for Testing and Calibration Laboratories
•China
NIM :National Institute of Metrology
CNCA :Certification and Accreditation Administration of the people's Republic of China
CNAS :China National Accreditation Service for Conformity Assesment
•USA
NIST :National Institute of Standards and Technology
A2LA :American Association for Laboratory Accreditation
•Canada
NRC-INMS :National Research Council Canada -Institute for National Measurement Standards
CLAS/SCC :Calibration Laboratory Assessment Service / Standards Council of Canada
•Mexico
CENAM :Centro Nacional de Metrología
EMA :Entidad Mexicana de Acreditación, a.c.
•UK
NPL :National Physical Laboratory
UKAS :United Kingdom Accreditation Service
•The Netherland
VSL :Van Swinden Laboratorium
RvA :Raad voor Accreditatie
•Germany
PTB :Physikalisch-Technische Bundesanstalt
DAkkS :Deutsche Akkreditierungsstelle GmbH
•Switzerland
METAS :Federal Institute of Metrology
SAS :Swiss Accreditation Service
•Italy
INRIM :Istituto Nazionale di Ricerca Metrologica
ACCREDIA :L'ENTE ITALIANO DI ACCREDITAMENTO
•Sweden
SP :Swedish National Testing and Research Institute
SWEDAC :Swedish Board for Accreditation and Conformity Assessment
•Brazil
INMETRO :Instituto Nacional de Metrologia Qualidade e Tecnologia
CGCRE :Coordenação Geral de Acreditação do INMETRO
•Algentina
INTI :Instituto Nacional de Tecnologia Industrial
OAA :Organismo Argentino de Acreditación

ILAC :International Laboratory Accreditation Cooperation
APLAC :Asia-Pacific Laboratory Accreditation Cooperation
EA :European Accreditation Cooperation
MRA :Mutual Recognition Arrangement

Optional Accessories

External Load Box

Outputs counter value just by pressing the button when using the counter's data output function.
(For KA-200 Counter (equipped with RS-232C output) and KLD-200 Counter.)

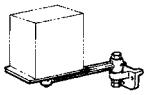


Part No.	Number of axis
937328	3-axis

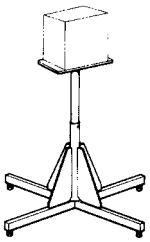
Note 1: Both of the counter and the external zero-set box have to have the same number of axis.
Note 2: When using for KA-200 Counter, a cable for external connection is also required.

Counter Support

Holds on various counters. Desk-top, turnable-arm, turnable-double-arm, stand, and special type are available. (The support type depends on the counter. Please specify your counter so that we can select the appropriate support for you.)



Turnable-arm type



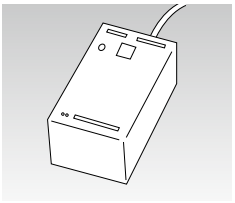
Digimatic Mini-Processor DP-1VR

Prints out the displayed data when connected with RS-232C output of KA-200 Counter. For connection, use RS-232 Counter cable (1m).
(For KA-200 (RS-232C output) Counter.)

Order No.	Product Name
264-504	DP-1VR
Part No.	Product Name
09EAA094	RS-232C counter cable

External Load Box

Outputs counter value just by pressing the button when using the counter's data output function.
(For KA-200 (equipped with RS-232C output) Counter and KLD-200 Counter.)

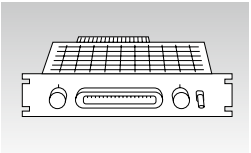


Part No.	Number of axis
936553	3-axis

Note 1: Both of the counter and the external zero-set box have to have the same number of axis.
Note 2: When using for KA-200 Counter, a cable for external connection is also required.

Code Out Unit

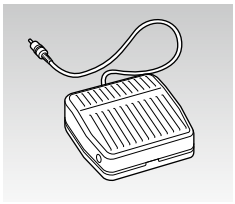
RS-232C unit to be mounted on the counter.
(For KA-200 Counter)



Part No.	Product name
06AET993	Code Out Unit
937179T	Foot switch

External Load Foot Switch

Outputs counter value just by stepping on the switch when using the counter's data output function.
(For KA-200 Counter (equipped with RS-232C output) and KLD-200 Counter.)

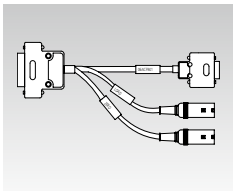


Part No.	965004

Note 1: When using for KA-200 Counter, a cable for external connection is also required.

Cable for External Connection

External zero-set box, external load box and external load foot switch can be used when connected with RS-232C output of KA-200 Counter. Combination use with RS-232C output is available.



Part No.	06ACF941

Note 1: (Refer to Page-19 for details.)

Extension Cable

Extends the cable length of a Linear Scale when there is a distance between the Linear Scale and a counter.

For AT100 Series

Part No.	Cable length
09AAA033A	2m
09AAA033B	5m
09AAA033C	7m

For AT715

Part No.	Cable length
09AAB674A	2m
09AAB674B	5m
09AAB674C	7m

Various Adapters

Mitutoyo provides a variety of adapters, meeting various applications. (Refer to Pages 26 to 27 for details.)

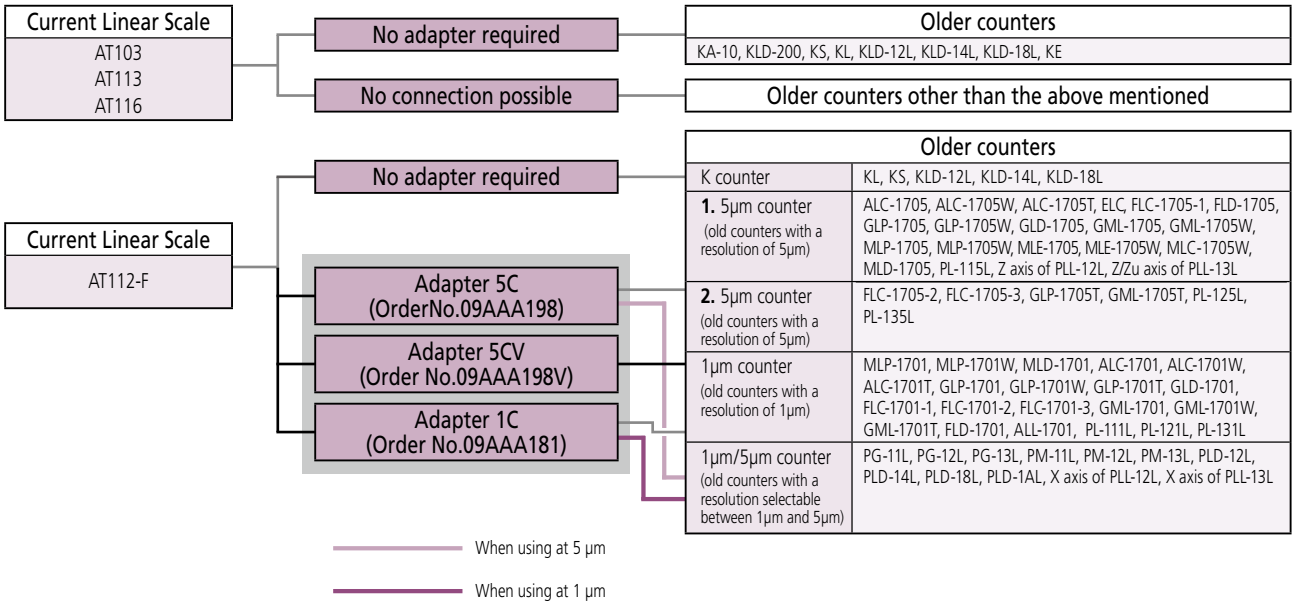
- Connecting adapters for former Linear Scales and existing counters (KA-200 Counter)
- Connecting adapters for existing Linear Scales (AT100 Series) and former counters.
- Adapters for limit signal output to connect with the limit signal output connector after replacing the former limit output counter with the existing KLD-200 Counter.
- Connecting adapters for line-driver-output Linear Scales, various sensors and existing counters (KA-200 Counter)

Optional Adapters

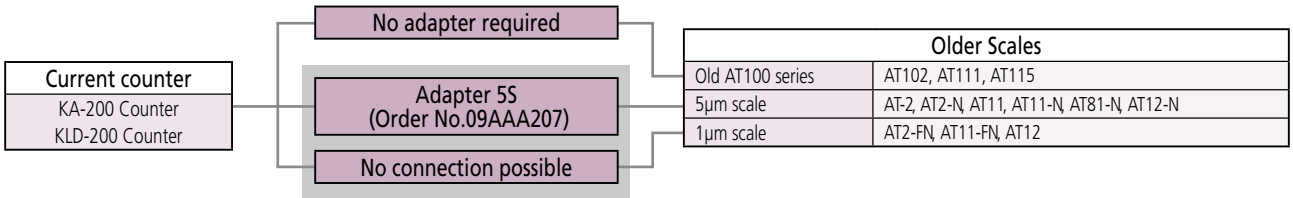
Adapters for Connecting between Older and Current Products

A specific adapter may be required for connecting between an older product and a current product. For applicable connecting adapters, refer to the following configuration diagrams. An adapter is connected to the input connector on a counter.
It is not possible to connect a 1µm scale (old linear scale) and current counter (KA-200 Counter, KLD-200 Counter).
Also, linear scale AT715 and an older counter (other than KA-200 Counter, KLD-200 Counter) cannot be connected.

Adapter configurations for connecting between a current linear scale (AT100 series) and an older counter



Adapter configurations for connecting between a current counter and an older linear scale



Line Conversion Adapter

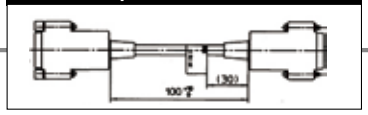
Connects a line-driver-output Linear Scale, a Linear Gage and a KA-200 Counter.

Configuration of line-driver-output models and connecting adapters for the KA-200 Counter

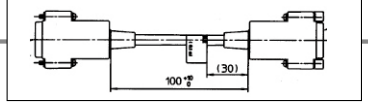
Applicable Models

- Square-wave-signal-output AT Scale: AT211, AT203
- Square-wave-signal-output ST Scale: ST36B, ST36C, ST46B, ST46-EZA, ST24B, ST24C, ST422
- Linear Gage with origin point mark: LGF-ZL series
- Standard type Linear Gage: LGF series, LGK series, LGB series, LG 100mm-stroke type, LGM 100mm-stroke type

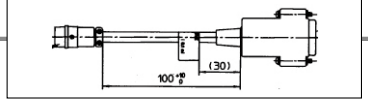
Adapter A: 06ACB391



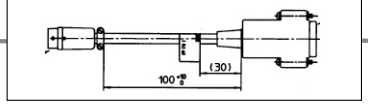
Adapter B: 06ACB392

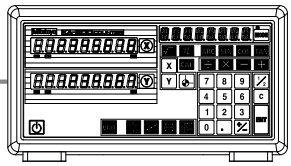


Adapter C: 06ACB393



Adapter D: 06ACB913





KA-200 Counter

Note 1) For details regarding square-wave-signal-output scales and Linear Gages, refer to leaflet No. E13005 "NC Linear Scale Systems" and No. E13007 "LINEAR GAGE".

Note 2) Use an optional connecting cable for ST Series (2m/3m/5m), or make a connecting cable to the counter using a connector provided with a ST Scale as standard. Other adapters than Adapter B can be directly connected to the counters.

CAUTION

When using adapters A to D, maximum response speed is determined by the resolution of the connected models.

When the parameter 96 of the KA-200 Counter is set to 5 (input frequency: 300kHz)

Connected model's resolution	Maximum response speed
1μm	300mm/s
0.5μm	150mm/s
0.2μm	60mm/s
0.1μm	30mm/s

Precautions when mounting and handling Linear Scales

Selecting the scale unit mounting position and mounting method

It is important to keep in mind the following four points when determining the scale unit mounting position and orientation.

Ease of mounting

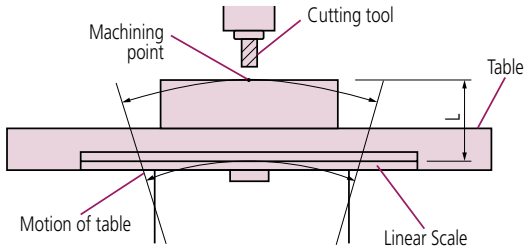
Mount the scale unit making sure that the unit including the detector head and the cables does not interfere with any part of the machine. To facilitate mounting, mount the scale unit and the brackets on machined surfaces wherever possible.

Protection from machining fluids and swarf (mounting orientation)

The scale unit is constructed in such a way that machining fluids and swarf cannot easily enter into the interior of the unit. However, since the openings are protected from entry of foreign material with rubber seals only, avoid directly exposing the scale unit to machining fluids and swarf. Select the mounting orientation of the scale unit after carefully considering the direction in which machining fluids and swarf are sprayed and scattered.

Accuracy considerations

The total system accuracy of the machine on which the scale unit is mounted is not only determined by the scale unit accuracy but by the machine accuracy as well. Particularly for machines with slide tables, geometrical errors may occur, depending on the straightness of moving parts; Thus, the scale unit must be mounted in a way that these errors are minimized. If the slide table moves not linearly but curvilinearly, errors occur in proportion to the distance "L" between the scale unit and the machining point (cutter position). Thus, mount the scale unit in a position that minimizes "L".



Other considerations

- If the detector head moves, the signal cables also move with the slide table. This should be considered when laying out the signal cables. It is therefore recommended to mount the scale unit on the moving part of the machine.
- Mount the scale unit in place where it is not directly subjected to airflow. When removing swarf using an air gun, be careful of flying swarf.
- The scale unit must be mounted in a place where maintenance can be easily performed in case unit trouble occurs.

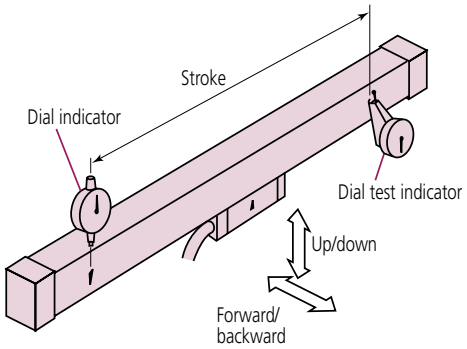
Checking parallelism and adjustment of scale unit

In order to attain maximum accuracy, the scale unit must be mounted parallel to the machine guide (machining axis). Incorrect mounting may cause the scale unit to bend or twist.

Checking parallelism

Use a dial indicator as shown in the figure below. To adjust the parallelism between the scale unit and the machine guide, check the parallelism while manually moving the machine's movable part such as the slide table, or measure the parallelism with reference to the guideways of the machine or equivalent reference surface.

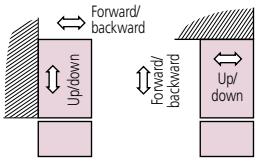
- Parallelism tolerance: Refer to each figure on dimensions.
- Checking direction: Back/forward direction on mounting surface and directions along mounting surface (up and down).
- Checking position: Position of scale unit around the mounting blocks.



Adjusting parallelism

Adjust the parallelism to within 0.2mm. Spacers used in adjustment are not included in the accessories.

- Adjusting the mounting surface back/forward: Readjust the mounting positions of the brackets or place spacers between the scale unit mounting surface and the mounting blocks.
- Adjusting along (up and down) the mounting surface: Adjust the parallelism by sliding the mounting block on the mounting surface.



Information about Air Supply (Improvement in Dust and Oil Resistance)

Feeding clean compressed air into the scale unit is provided as a means of improving the environmental resistance (to coolant and dust) of assembly-type linear scales. This is done by piping air to either of two M5 screw holes situated on the sides of the scale unit.

* AT103 is equipped as standard with an air supply fitting.

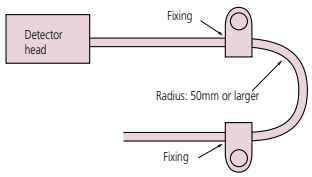
Caution: This air supply method is suggested as optional protection for the scale. The installation of the air supply piping is important and should be implemented as described in the manual. The air should be filtered and the filter replaced periodically, depending on the cleanliness of the air source. Continued use of a heavily contaminated filter may allow contaminants to pass into the scale unit.
For detailed information, contact Mitutoyo Sales Department.

Signal cable layout

It is important to keep in mind the following points when deciding on the layout scheme for signal cables.

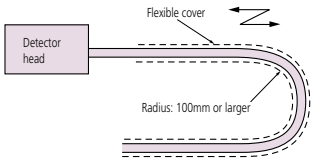
When the cable is fixed

The radius of curvature of the signal cable must be larger than 50mm.



When the cable is movable

When the detector head is the moving element, it carries the signal cable with it during operation. Take care, in such a cable, that the radius of curvature of the signal cable is not smaller than 100mm and excessive force is not applied to the cable. It is a good idea to protect the cable with a flexible support cover.



Note) It is important to ensure that the signal cable does not interfere with, and is not chafed by, any part of the machine.

Other considerations

The signal cable is durable enough to withstand repeated bending up to approximately 2 million times (when the bending radius is limited to more than 100mm). When repeated bending exceeding 2 million times is expected, the signal cable should be considered as a consumable part. In such a case, carrying a spare cable will allow immediate replacement when necessary and so minimize machine downtime.

Precautions when mounting and handling Linear Scales

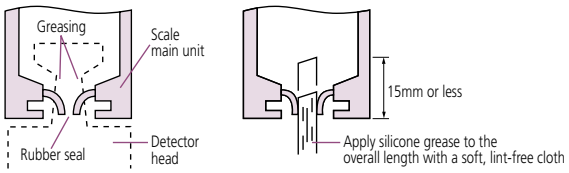
Resonance point of Linear Scale

Each object has a natural frequency, depending on its shape, length, and the type of material. The Linear Scale frame is not an exception. It has its natural frequency and thereby resonates at a certain frequency. In general, this will not cause a problem, since a machine tool and the Linear Scale frame have different natural frequencies under normal machining conditions. However, should the natural frequency of the machine tool body and the Linear Scale coincide, the following counter-measures can be taken:

1. Increase rigidity of the mounting bracket for the scale.
2. Add a mid-support to the middle of the scale to shift its resonance point higher.
3. Mount the Linear Scale at a place where vibrations from the machine tool cannot be easily transmitted.
4. Limit the machine process conditions to be within a specific range in which the natural frequencies of the machine tool and the scale do not coincide.

Maintenance of dust-proof seals

In order to maintain and extend the life of the dust-proof rubber seals, it is recommended that a small amount of silicon lubricant be applied to the contact area between the rubber and the detector head once a year.



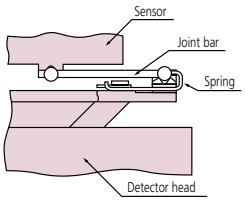
Linear Scale evaluation methods

- **Testing within the operating temperature range**
  Testing has proven that there is no abnormality of functions and signals when the Linear Scale is used within the specified operating temperature range.
- **Temperature cycle (dynamic characteristics) test**
  Testing has proven that there is no abnormality when the Linear Scale is used under the condition where the ambient temperature continuously changes within the specified range.
- **Vibration test (Sweep test)**
  Testing has proven that the Linear Scale functions without abnormality when subject to vibration within the frequency range 30Hz to 300Hz at a maximum acceleration of 3g.
- **Noise test**
  In accordance with the EMC Directives, EN61326-1+A1:1998
- **Crate Drop Test**
  In accordance with the heavy equipment drop test (JISZ0200) specified in the JIS standard.

Constructional features of the Linear Scale

Joint Structure of Detector

A ball joint structure is employed at the contact area between the detector head and the slider (sensor unit) inside the scale. This arrangement prevents the slider movement from deviating from the normal moving directions when the detector head is slightly misaligned transversely, thus providing a normal scale reading and increasing flexibility in the scale installation. In addition, this structure is highly rigid and therefore has excellent durability.



Water-proof Connector

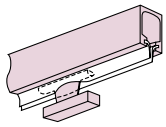
A waterproof/splash-proof connector is used to enable separation of the signal cable. Thus, installation and maintenance of the Linear Scale can be easily performed. (The signal cable on the AT115 cannot be separated.)

Conduit armored type signal cable

The signal cable is protected by the conduit system. Its exterior is made of stainless steel, which is corrosion-resistant and withstands continuous use.

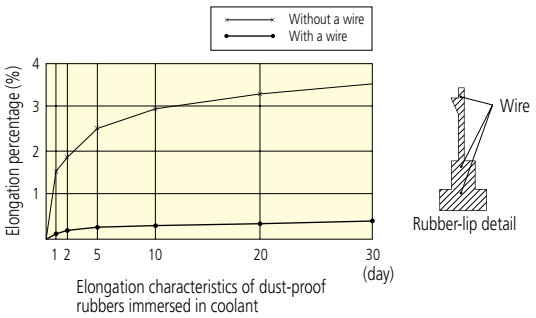
Unique rubber seals

The slider is shaped to glide smoothly through the rubber-seal opening – almost like the keel of a boat through water.



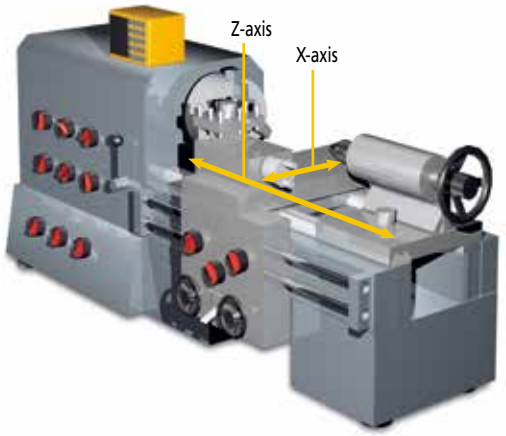
Excellent splash- and dust-proof rubber-seal structure

The rubber seals are made of a strong, special urethane, and wires are inserted in these seals to improve the splash-proofing and dust-proofing of the scale (AT103 only).

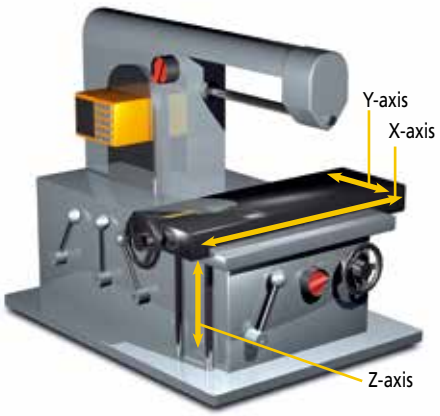


Elongation characteristics of dust-proof rubbers immersed in coolant

Scale systems for various multi-axis machine tools

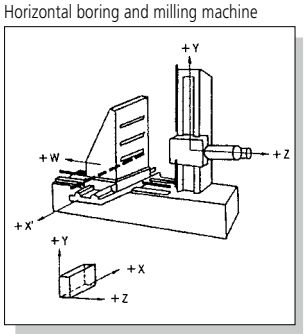


2-axes KA-200 Counter + two scales

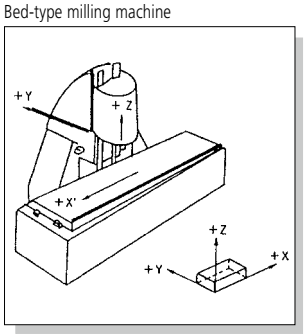


3-axes KA-200 Counter + three scales

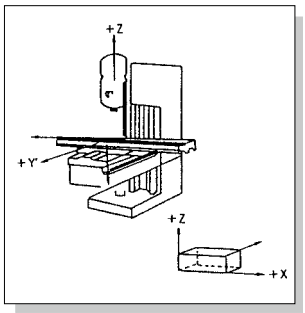
Horizontal boring and milling machine



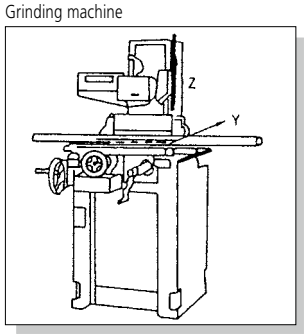
Bed-type milling machine



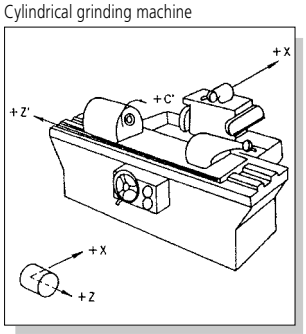
Knee-type milling machine, drilling machine, and jig boring machine



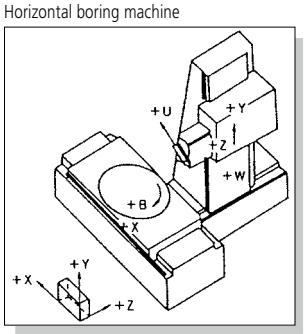
Grinding machine



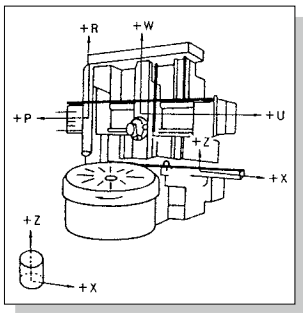
Cylindrical grinding machine



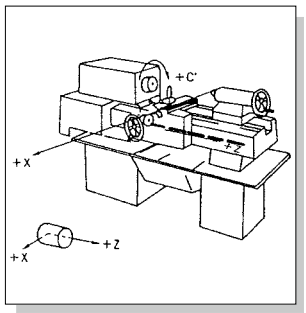
Horizontal boring machine



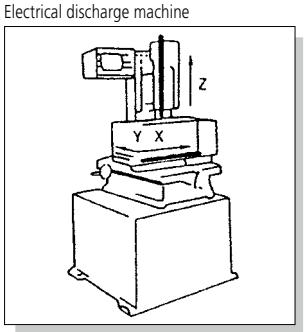
Vertical turret lathe, vertical lathe



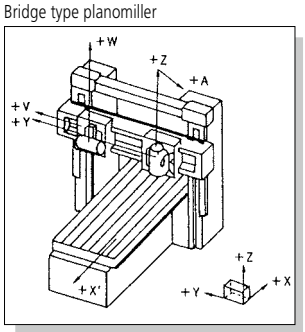
Centre lathe



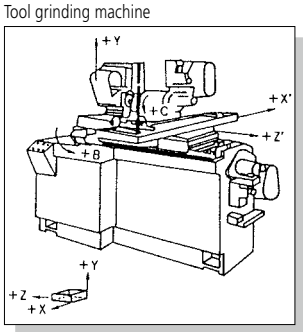
Electrical discharge machine



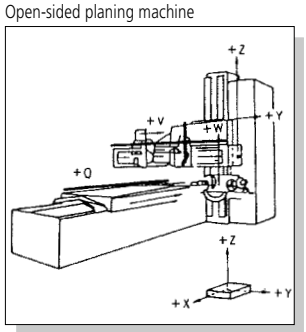
Bridge type planomiller



Tool grinding machine

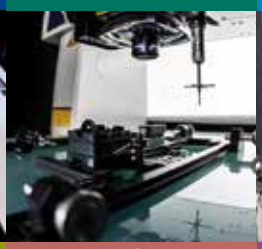


Open-sided planing machine



Coordinate Measuring Machines

Vision Measuring Systems



Form Measurement

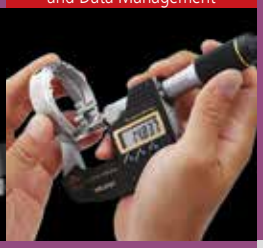
Optical Measuring

Sensor Systems

Test Equipment and Seismometers

Digital Scale and DRO Systems

Small Tool Instruments and Data Management



Whatever your challenges are, Mitutoyo supports you from start to finish.

Mitutoyo is not only a manufacturer of top quality measuring products but one that also offers qualified support for the lifetime of the equipment, backed up by comprehensive services that ensure your staff can make the very best use of the investment.

Apart from the basics of calibration and repair, Mitutoyo offers product and metrology training, as well as IT support for the sophisticated software used in modern measuring technology. We can also design, build, test and deliver bespoke measuring solutions and even, if deemed cost-effective, take your critical measurement challenges in-house on a sub-contract basis.

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