

# Linear Gage

Catalog No. E4174-542/572/575



Dimension sensors offering superb durability and environmental resistance, suitable for in-line measurements.

# Features

## 1. A range of models available

The linear gages offer five measuring ranges of 5, 10, 25, 50, and 100mm. Different output modes are also available, including pulse waveform, Digimatic Code (SPC) and sine wave (limited to the LGH with 0.01mm resolution). There are four resolution settings to choose from in pulse waveform output: 0.005, 0.001, 0.0005 and 0.0001mm. Select the model offering specifications best suited for your application.

## 2. Suitable for in-line use

The linear gages offer superb durability and environmental resistance, making them ideal for in-line measurements. Durability is ensured by strong construction and linear ball bearings in the slider unit (except for models LGS and LGD-M), which are designed to last up to 10 million vertical spindle strokes (according to Mitutoyo's internal tests). Moreover, excellent dust/water protection (IP-66) is provided for effective use in severe in-line environments (model LGF and others).

## 3. Space-saving design

The slender design of the gage enables installation in confined spaces. Slim-line models with outside diameters of 8mm are also available for measurements in spaces of 10mm or less. These gages come in two different cable arrangements—vertical and horizontal—to suit the type of fixture used.

## 4. Secured with nuts

The gage can be installed easily and securely by drilling a hole in the flat plate and mounting the gage securely with a nut. (The specification varies by model. The use of a nut is a standard specification with some models, while others require special accessories. Some models cannot be secured with nuts. Check the specifications for each model.)

## 5. Various output functions

The linear gage counters offer a range of output types: I/O, BCD, RS-232C and Digimatic (SPC). The EF/EV counter has a RS link function to be connected with multiple counters for multi-gage measurement (see page 19). Select the output type that meets your specific needs.



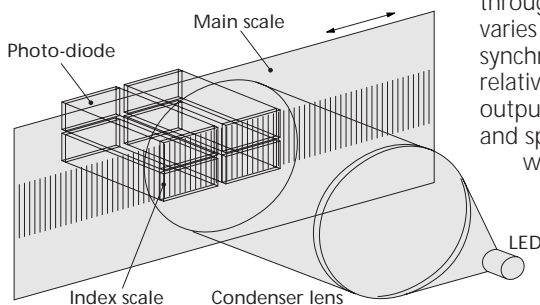
Suitable for in-line use



Space-saving design

## Measurement principle

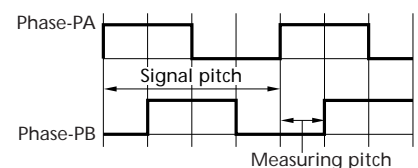
The linear gages mainly use transmission-type photoelectric linear encoders, as shown below. Some linear gages use a capacitance-type linear encoder, or a laser-hologram measurement system (see page 39) as a sensor. These high-precision linear encoders allow high precision measurement over a wide



range. In the transmission-type photoelectric linear encoder shown in the figure, the light source (LED) and the sensor element (photodiode) face each other with the main scale and index scale of 20 $\mu$ m pitch positioned between them. As the scale moves with respect to the detector, the extent of the light passing through the window in the index scale varies constantly. At this time, two synchronized sine-wave signals having a relative 90-degree phase difference are output. These signals are then amplified and split electrically (with additional waveforms inserted) and output as 1 $\mu$ m or 0.5 $\mu$ m square-wave signals.

## Output

The linear gage processes internally detects signals and outputs square-wave signals as shown below. These operating signals, which are square waves having a relative phase difference of 90 degrees, are equivalent to RS-422A signals, allowing for the independent use of the linear gage unit (gage output). However, certain models (LGD, LGD-M and LGS), do not output square-wave signals but generate Digimatic Code output (SPC output) in order to identify the measurement position.



# Technical Information

## What is a hologram?

### 1. Using the wavelength of light as the scale for LGH series

Grids of  $0.5\mu\text{m}$  in pitch are used as scale grids in hologram analysis. These grids are much finer than the conventional lithographic grids used in reduction-exposure systems (only 1/15th to 1/200th the thickness of lithography grids). Hologram technology is essential to achieving high-resolution in measuring scales.

When two parallel laser light beams (a) and (b) intersect each other, as shown in Figure A, three-dimensional light interference is created at the intersection, and bands of interference are generated. The pitch of these bands is roughly the same as the wavelength of the light source. This pitch is set precisely at  $0.5\mu\text{m}$  with Mitutoyo's hologram scales. In other words, the recording of interference bands produces a scale of very fine pitch.

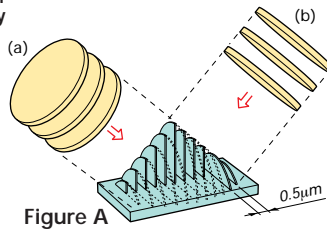


Figure A

### 2. A length-measurement system employing diffraction

The mechanism of light diffraction is used to detect scale displacement as a change in the phase of light. Since the amount of phase change is equivalent to the hologram's grid pitch, an accurate length-measurement system can be created to detect scale displacement at a  $0.5\mu\text{m}$  pitch.

A light beam (a) is diffracted by the hologram grid and becomes a diffracted light beam (b), as shown in Figure B. When the scale moves by a quarter of the hologram's grid pitch, the diffracted light beam (b) shows the equivalent change in the phase of light, as the light beam (b').

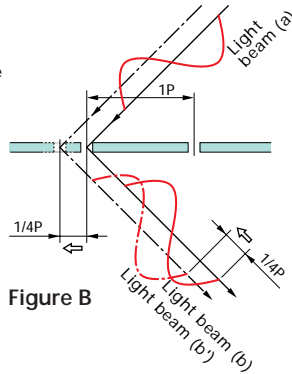


Figure B

### 3. Detection using perfect sine-wave signals

Displacement is detected via the interference of diffracted light, in the form of bright-to-dark signals with a pitch equal to one-half that of the hologram grid ( $0.25\text{mm}$ ).

Since it is difficult with current technology to directly read the phase change in light, two diffracted light beams are caused to interfere with each other in order to generate bright-to-dark signals, as shown in Figure C. The signals are divided into 25 segments in order to measure displacements at  $0.01\mu\text{m}$  resolution. To identify the direction of scale displacement, two light receptors (a) and (b) are installed by which one signal light is detected as a signal having a relative 90-degree phase difference from the other.

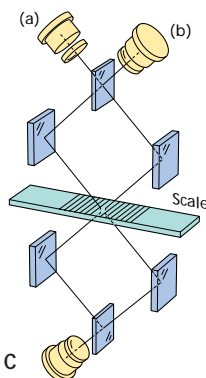
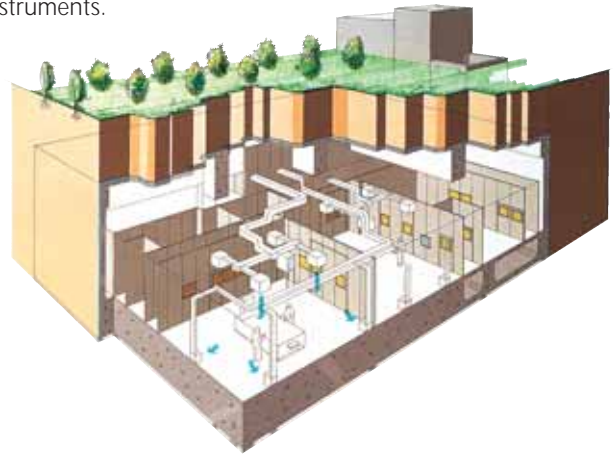


Figure C

## Underground factory

### 4. Leading-edge technologies and facilities supporting super-high accuracy

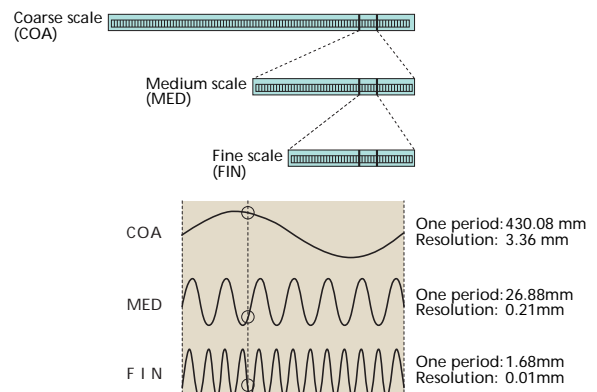
The laser holoscales and all other scales used in Mitutoyo's linear gages are products of comprehensive development capabilities in the fields of optics, electronics and mechanical design. And it is at our state-of-the-art production facilities where these precision instruments are crafted. To further its leading-edge technologies in precision instrument development—a capability fostered through 60 years of experience—Mitutoyo maintains a laboratory located eleven meters underground at its Kiyohara factory in Tochigi Prefecture, the only production factory dedicated for linear scales in Japan. At this underground laboratory, fluctuations in temperature and humidity, as well as the effects of outside vibration, are kept to an absolute minimum. This provides us with a superior environment for the development of precision instruments.



## What is the absolute positional origin?











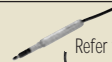

















The absolute positional origin refers to the origin (zero point) that is maintained even when the power is switched off. The LGD series gages are equipped with an absolute scale (ABS scale) that allows the setting of absolute positional origin. Therefore, when the power is turned on again, the contact point's position is always output correctly, according to the previously set origin. This eliminates the need for a master adjustment each time the power is turned on, thus contributing greatly to automated measurements.

- The absolute positional scale uses three internal scales of different wavelengths in order to register an absolute address on the scale.























# All Models of Linear Gage

## Gage Heads

Resolution [Output]	Measuring range			
	5mm (.2")	10mm (.4")	25mm (1")	50mm (2")
0.00001mm (1μinch) [0.25μm pitch sign wave]		<b>Laser Hologage</b>  Refer to p. 10		
0.0001mm (4μinch) [Square wave]	<b>LGB</b>  Refer to p. 11	<b>Laser Hologage</b> <b>LGK</b>  Refer to p. 12 <b>LGF</b>  Refer to p. 14	<b>LGF</b>  Refer to p. 14	
0.0005mm (.00002") [Square wave]		<b>LGK</b>  Refer to p. 12 <b>LGF</b>  Refer to p. 13	<b>LGF</b>  Refer to p. 13	<b>LGF</b>  Refer to p. 13
0.001mm (.00004") [Square wave] [Square/Sine wave]*	<b>LGB*</b>  Refer to p. 16	<b>LGK</b>  Refer to p. 12 <b>LGF</b>  Refer to p. 13 <b>LGB*</b>  Refer to p. 16	<b>LGF</b>  Refer to p. 13	<b>LGF</b>  Refer to p. 13
0.005mm (.0002") [Square wave]		<b>LGE</b>  Refer to p. 17	<b>LGE</b>  Refer to p. 17	<b>LGE</b>  Refer to p. 17
0.0005mm (.00002") [Square wave with origin point mark]		<b>LGF</b>  Refer to p. 15	<b>LGF</b>  Refer to p. 15	<b>LGF</b>  Refer to p. 15
0.001mm (.00004") [Square wave with origin point mark]		<b>LGF</b>  Refer to p. 15	<b>LGF</b>  Refer to p. 15	<b>LGF</b>  Refer to p. 15
0.01mm (.0005") [Digimatic output]		<b>LGD/ LGD-M</b>  Refer to p. 18/19 <b>LGS</b>  Refer to p. 20	<b>LGD</b>  Refer to p. 18	<b>LGD</b>  Refer to p. 18

\*: The resolution shown in inches is a calculated value. The actual resolution in inches is determined by the counter setting.

## Display Units (Counters)

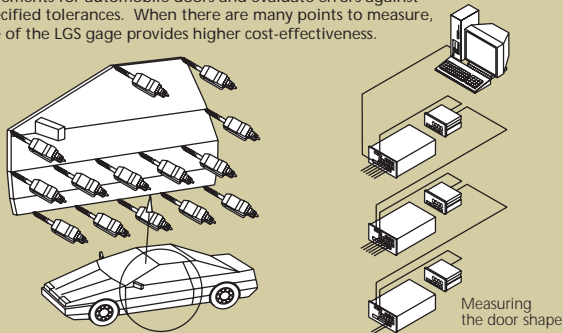
		Single function type	Multi-function type	Multi-gage system
100mm (4")				
		<b>KH Counter</b>  Refer to p. 10		
LG  Refer to p. 21 LGM  Refer to p. 22	<b>EF Counter</b>  Refer to p. 42	<b>EF Counter</b>  Refer to p. 42	<b>EV Counter*</b>  Refer to p. 36 *not available with Laser Hologage	
		<b>EG Counter*</b>  Refer to p. 50 *not available with Laser Hologage		
LG  Refer to p. 21 LGM  Refer to p. 22	<b>EB Counter</b>  Refer to p. 46			
		<b>EG Counter</b>  Refer to p. 50	<b>EF Counter</b>  Refer to p. 42	<b>EV Counter</b>  Refer to p. 36
		<b>EB Counter</b>  Refer to p. 46	 Refer to p. 42	
		<b>EC Counter</b> Refer to p. 52  <b>EG Counter</b> Refer to p. 50  <b>EB Counter</b> Refer to p. 46 	<b>SD-U1</b>  Refer to p. 56	<b>EV Counter</b>  Refer to p. 36



# Applications

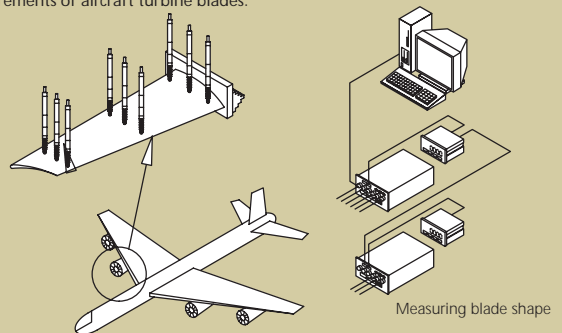
## Multipoint measurement of automobile doors

The linear gage (LGS-1012 with EV counter) can be used to perform multi-point measurements for automobile doors and evaluate errors against the specified tolerances. When there are many points to measure, the use of the LGS gage provides higher cost-effectiveness.



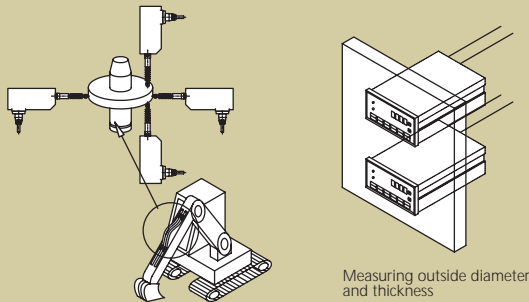
## Multipoint measurement of turbine blades

The linear gage (LGB-110 with EV counter) can be used to perform multi-point measurements of aircraft turbine blades.



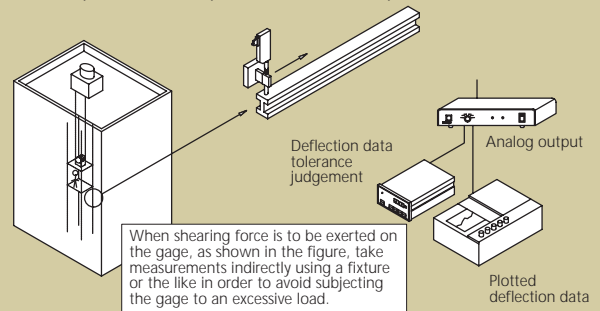
## Measurement of hydraulic coupling dimensions

The linear gage (LGF-110L with EF-12PR counter) can be used to measure the outside diameters and thicknesses of hydraulic couplings used in shovel cars. EF-12PR counter allows for the calculation of sums and differences between two gages.



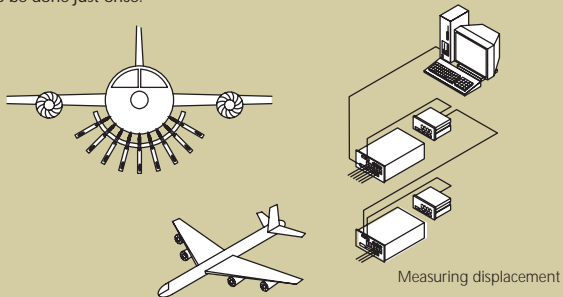
## Measurement of elevator drive-rail deflection

The linear gage (LGF-110L with EF counter) can be used to measure deflection in the drive rail of an elevator. Measured data can be output from the EF counter to a personal computer in order to plot the condition of displacement.



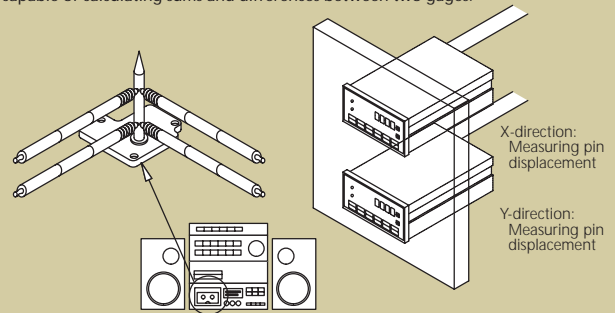
## Measurement of aircraft fuselage distortion

The linear gage (LGD-1010L with EV counter) can be used to measure changes in stress generated in an aircraft fuselage. For the very large workpiece, the use of an absolute type linear gage is recommended, since the master settings then need to be done just once.



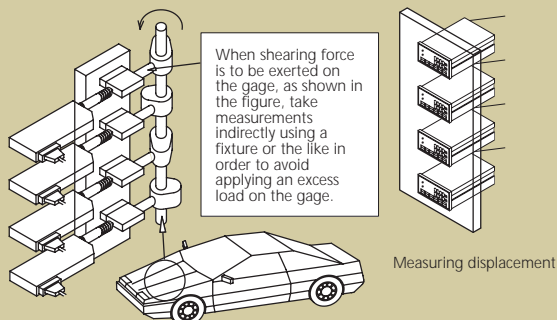
## Measurement of cylindrical pin displacement

The linear gage (LGB-110 with EF-12PR counter) can be used to measure the displacement of tape-winding capstan pins in cassette recorders. EF-12PR counter is capable of calculating sums and differences between two gages.



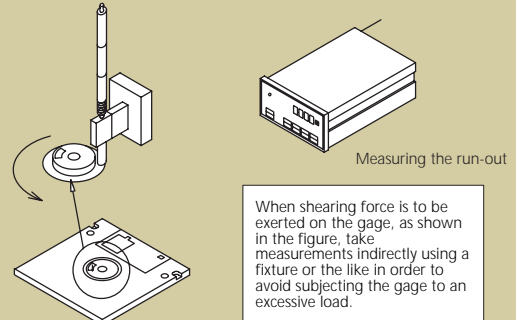
## Measurement of camshaft displacement

The linear gage (LGF-125L with EF counter) can be used to measure camshaft lift. The EF counter is easily installed in the equipment panel.



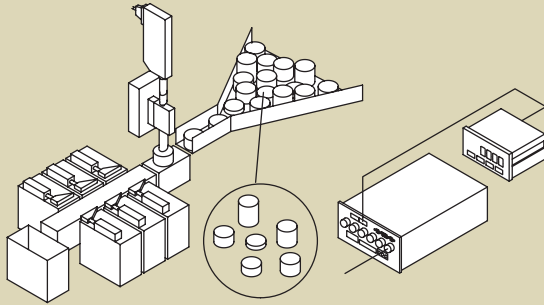
## Measurement of core metal runout for floppy disks

The linear gage (LGB-110 with EF counter) can be used to measure the runout of the disks core metal.



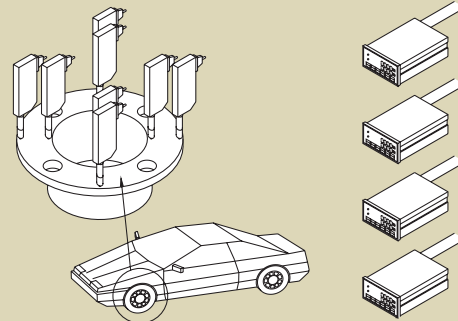
### Sorting of parts

The linear gage (LGF with EV counter) can be used to measure the parts dimension for sorting. The EV counter can divide the dimension into 21-step and output the signal for sorting.



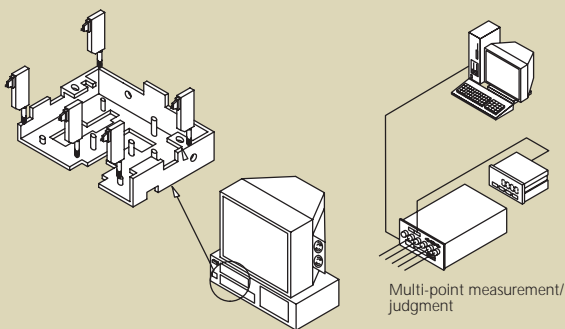
### Multipoint measurement of disc brake

The linear gage (LGD-0510L with EF-12PRH counter) can be used to set the inclination of the target disc brake.



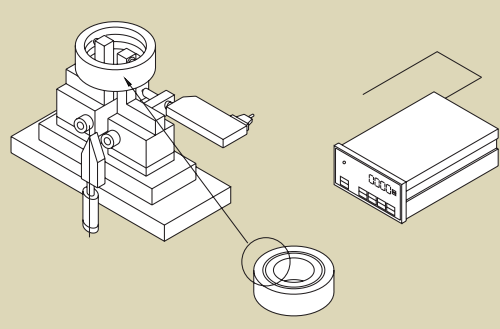
### Multipoint measurement of VTR chassis

The linear gage (LGF-110L with EV counter) can be used to measure VTR components at several points.



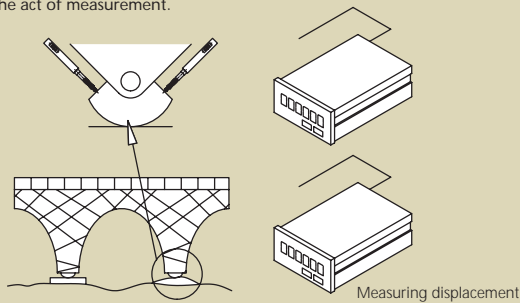
### Built-in sensor for inside diameter measurement tools

The linear gage (LGF-0510L with EF-11PRH counter) can be used to measure the inside diameters.



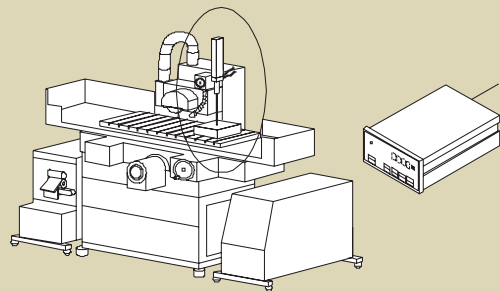
### Measurement of bridge-support joint

The linear gage (LGD-1025L with ES counter) can be used to measure the displacement of the bridge-support joint. Since this measurement is performed over a long period of time, use an absolute-type linear gage that requires power only during the act of measurement.



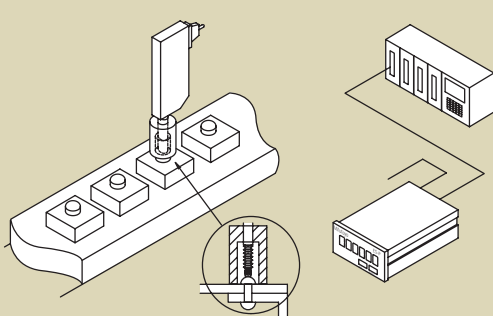
### Built-in sensor for machine tools

The linear gage (LGM-01100P with EF-11PRH counter) can be used to measure a workpiece which has been machined with a surface grinder.



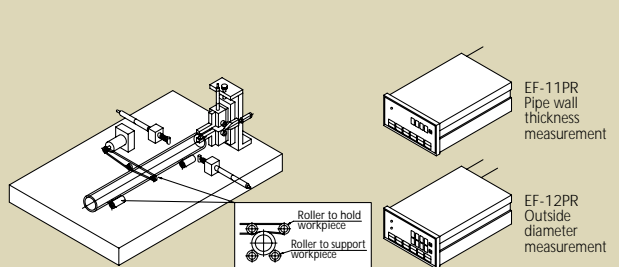
### Inspection of rivet

The linear gage (LGF with ES counter) can be used to inspect the condition of fixing of the rivet or bolt. The inspection of the parts press fitted is also the same way.



### Measurement of pipe wall thickness/outside diameter

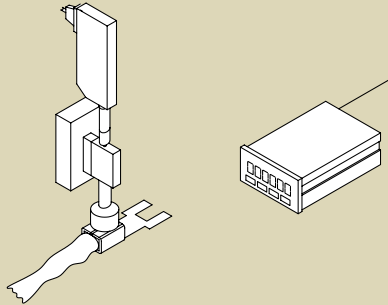
The linear gage (LGF-110L with EF-11PRH/EF-12PRH counter) can be used to measure the wall thickness or outside diameter of the target pipe.



# Applications

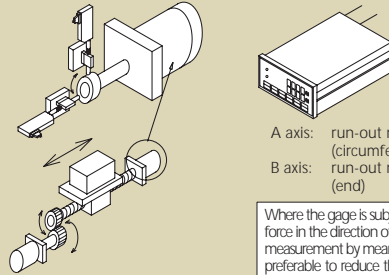
## Measurement of caulking height

The linear gage (LGF-110L with EB-11P counter) can be used to measure the caulking height of a crimp contact, etc.



## Run-out measurement of motor shaft

The linear gage (LGF-110L with EF-12PRH counter) can be used to measure the run-out of motor shafts. EF-12PRH counter can display the two items of measurement at a time.

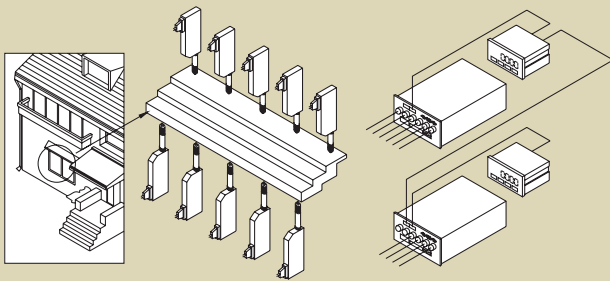


A axis: run-out measurement (circumference)  
B axis: run-out measurement (end)

Where the gage is subjected to a shown force in the direction of shear, an indirect measurement by means of a jig, etc. will be preferable to reduce the load operating onto the gage.

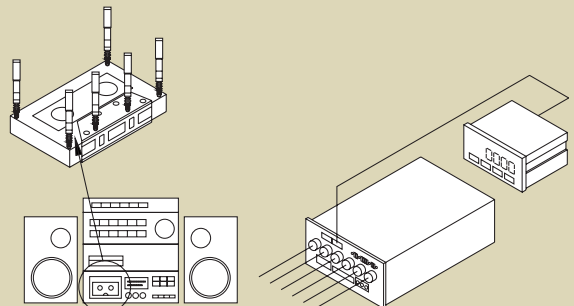
## Measurement of sash rail warp

The linear gage (LGF-110L with EV-16P counter) can be used to measure the warp of sash rails.



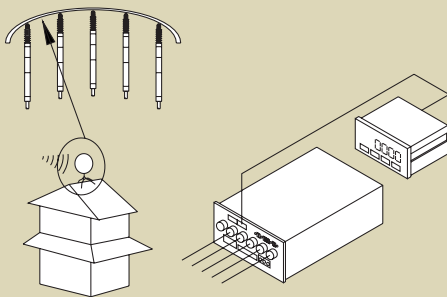
## Flatness measurement of tape cassette

The linear gage (LGK-110 with EV-16P counter) can be used to perform flatness measurement on a tape cassette surface.



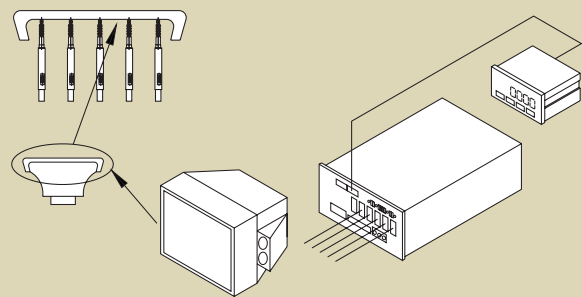
## Multipoint measurement on parabolic antenna

The linear gage (LGB-110 with EV-16P counter) can be used to perform the multi-point measurements on a parabolic antenna surface.



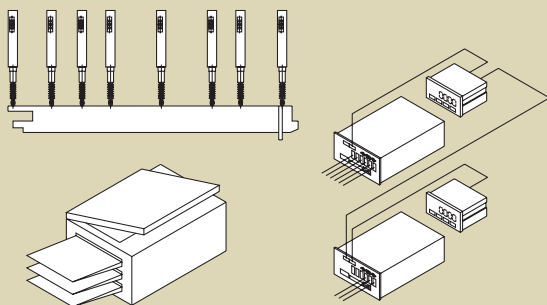
## Contour measurement of CRT panel

The linear gage (LGD-1010ML with EV-16D counter) can be used to measure the surface contour of CRT panels.



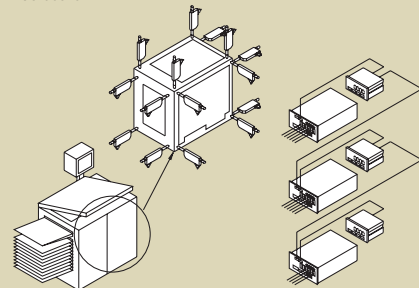
## Parallelism measurement of copying machine parts

The linear gage (LGD-1010L with EV-16D counter) can be used to measure the parallelism of copying machine parts.



## Multipoint measurement on copying machine chassis

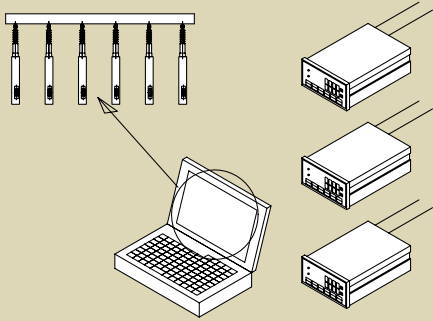
The linear gage (LGD-1010ML with EV-16D counter) can be used to perform multi-point measurement on a copying machine chassis. In the case of bulk workpieces an absolute type that eliminates the necessity of setting a master workpiece will be useful.





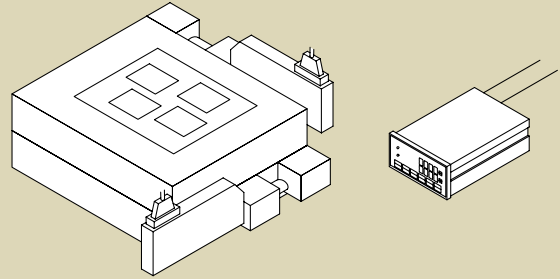
### Multipoint measurement of LCD panel

The linear gage (LGF-0110L with EF-12PRH counter) can be used to measure the distortion of LCD panels.



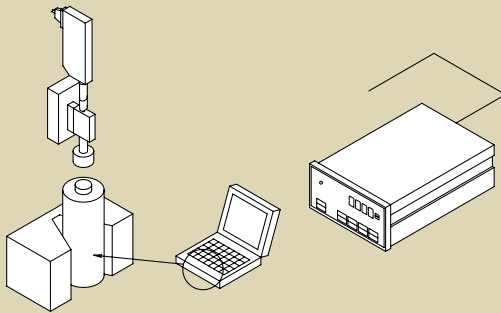
### X-Y stage positioning

The linear gage (LGF-0125L with EF-12PRH counter) can be used to position a precision stage.



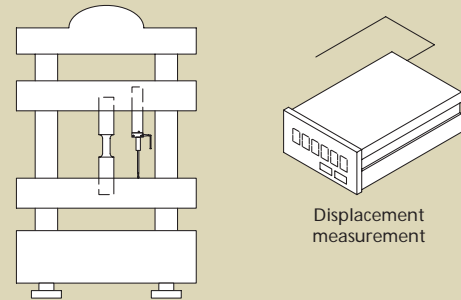
### Height measurement of cell

The linear gage (LGF-110L with EF-11PRH counter) can be used to measure the height of built-in dry cells.



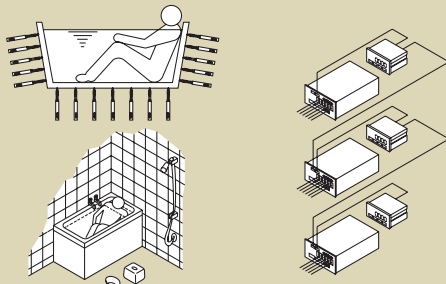
### Built-in sensor for material test machines

The linear gage (LG-01100 with EF-11PRH counter) can be used to measure the displacement at tensile test.



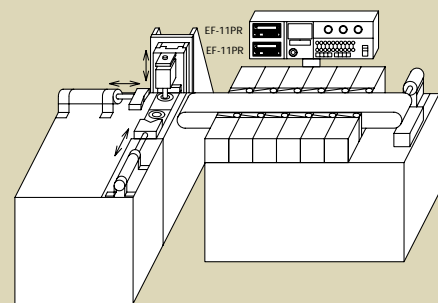
### Deformation measurement of bathtub

The linear gage (LGD-1010L with EV-16D counter) can be used to measure the deformation of bathtubs. An origin setting at the first mounting of linear gage can eliminate the need for subsequent setting of the standard.



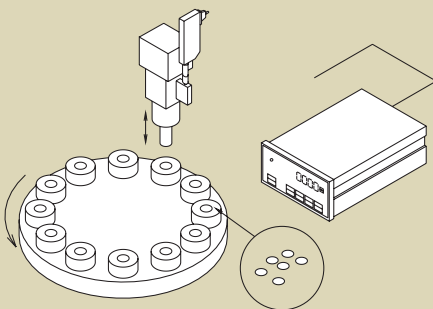
### Incorporation into auto-measurement machine

The linear gage (LGF-110L with EF-11PRH counter) can be incorporated into the auto-measurement unit for outside diameter and/or height measurement.



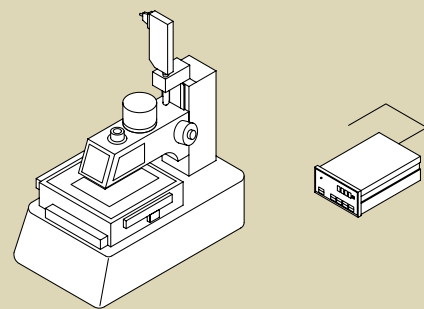
### Built-in sensor for tablet forming machine

The linear gage (LGF-0510L with EF-11PRH counter) can be used to measure the stroke of a tablet forming machine.



### Incorporation into vision measuring machine/microscope

The linear gage (LGF-0510L with EF-11PRH counter) can be incorporated into the measuring machine for height measurement.



# Laser Hologage

0.01 $\mu$ m Reading  
Sign Wave Output

Display unit is provided

The Mitutoyo Laser Hologage is a high-end digital gaging system that employs diffracted laser beam interference to make highly accurate and repeatable measurements. It features ultra-fine diffraction gratings which are holographically recorded on the scale. The Laser Hologage is suitable for measuring ultra-high precision parts, especially those in semiconductor and related industries (See page 3 for explanation on hologram.).



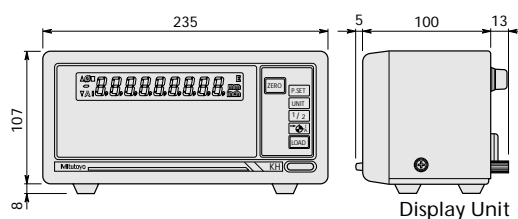
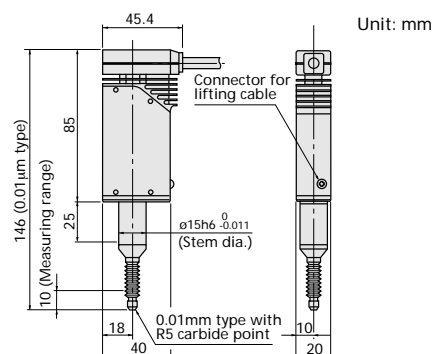
## FEATURES

- Highly accurate measurement due to an ultra-high resolution of 0.00001mm (0.01 $\mu$ m), 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.
- High-precision linear ball bearings are used in the guide for extremely smooth movement and exceptional durability.
- A display unit is provided.

## OPTIONAL ACCESSORIES

Order No.	Description	
09CAA335	Zero-set remote controller	
971751	Stem fixture for Laser Hologage	Refer to p.25
971752	Stem fixture for Laser Hologage	Refer to p.25
971753	Spindle lifting cable for Laser Hologage	Refer to p.28
971750	Laser Hologage stand	Refer to p.28
238772	10mm rubber boot (spare)	Refer to p.28

## Dimensions



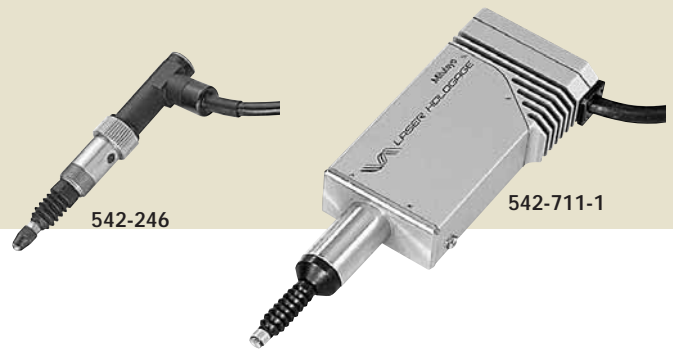
## SPECIFICATIONS

Order No.	100V	542-923-1	542-924-1
(including the display unit)	120V	542-923-1A	542-924-1A
	220V	542-923-1D	542-924-1D
	240V	542-923-1E	542-924-1E
	240V	542-923-1F	542-924-1F
Resolution	0.01 $\mu$ m (1 $\mu$ inch)		
Range	10mm (.4")		
Accuracy (20°C)	0.1 $\mu$ m		
Repeatability (2s)	0.02 $\mu$ m		
Measuring force	Upward (♀)	0.55N or less	0.1N
	Horizontal (+○, ○+)	0.45N or less	—
	Downward (♂)	0.35N or less	—
Dust/Water protection level	Not specified		
Contact point	R5mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm)		
Stem diameter	Ø15mm		
Bearing type	High-precision linear ball bearing		
Position-detection sensor	Laser-hologram measuring sensor		
Max. response speed	250mm/s		
Output signal	0.25mm pitch, 90° phase difference, two-phase sine wave		
Display	8-digit fluorescent tubes and a [-] sign		
Functions	Zero-set, preset, halved reading, double reading (diameter display), ABS/INC coordinate switching, counting direction switching, mm/inch conversion, linear error compensation, error alarm		
Data output	Via RS-232C interface (provided)		
Power supply	100-120V/200-240V AC, 50/60Hz		
Power consumption	Approx. 30VA		
Operating environment	10°C to 30°C (20%RH to 80%RH, without condensation)		
Mass	Laser Hologage: 0.2kg (excluding cable) Display unit: 2kg.		
Standard accessories	Wrench for contact point (538610)		

# LGB, Laser Hologage

## 0.1μm Reading Differential Square-wave Output

These are extra-high accuracy gaging heads provided with resolution up to 0.0001mm. The compact dimensions allow easy installation to very tight spaces. The Laser Hologage employs a unique holography scale as the length standard, ensuring excellent measuring accuracy and repeatability (See page 3 for explanation on hologram.). The dedicated display unit (EF Counter) is optional.

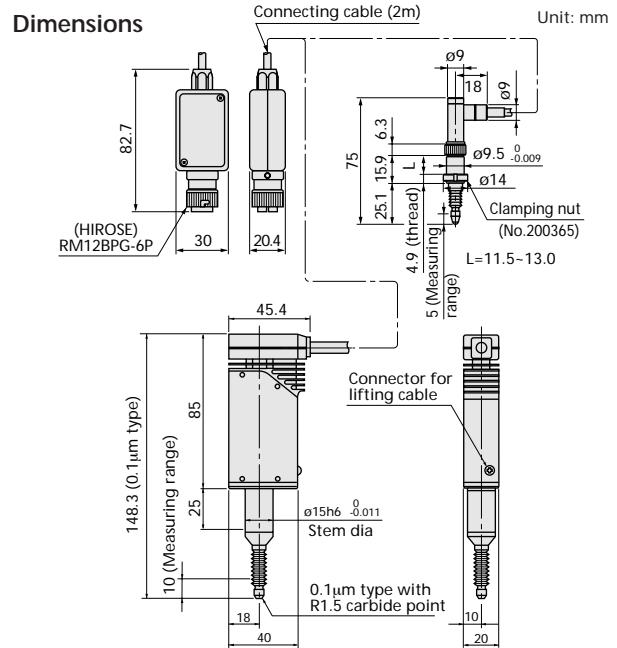


### FEATURES

- A linear ball bearing in the spindle guide provides excellent durability for an extended service life.
- The 0.0001mm reading type LGB linear gage (542-246) comes with a clamping nut on the stem.

### OPTIONAL ACCESSORIES

Order No.	Description	
902434	Extension cable (5m) for LGB	Refer to p.27
902433	Extension cable (10m) for LGB	Refer to p.27
902432	Extension cable (20m) for LGB	Refer to p.27
238773	Rubber boot for LGB (spare)	Refer to p.28
971751	Stem fixture for Laser Hologage	Refer to p.25
971752	Stem fixture for Laser Hologage	Refer to p.25
971753	Spindle lifting cable for Laser Hologage	Refer to p.28
971750	Laser Hologage stand	Refer to p.28



### SPECIFICATIONS

Model No.	LGB	Laser Hologage*1		
Order No.	542-246	542-711-1	542-712-1	
Resolution	0.1μm (.000005")			
Range	5mm	10mm		
Accuracy (20°C)	0.8μm	0.2μm		
Measuring force	Upward ( ♀ )	Approx. 0.65N or less	0.55N or less	0.1N
	Horizontal ( ♂ )	Approx. 0.6N or less	0.45N or less	—
	Downward ( ♂ )	Approx. 0.55N or less	0.35N or less	—
Dust/Water protection level	IP54	Not Specified		
Contact point	R1.5mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm)			
Stem diameter	ø9.5mm	ø15mm		
Bearing type	Linear ball bearing	High-precision linear ball bearing		
Position-detection sensor	Transmission-type photoelectric linear encoder	Laser-hologram measurement sensor		
Max. Response Speed	380mm/sec	250mm/sec		
Output signal	0.4mm pitch, 90° phase difference, differential square wave (RS-422A equivalent)	0.25mm pitch, 90° phase difference, differential square wave (RS-422A equivalent)*2		
Cable length	2m			
Power supply	+5V ± 5% (power-supply ripple 200 mV p-p max.)			
Power consumption	150mA	200mA		
Operating environment	10°C to 30°C (20%RH to 80%RH, without condensation)			
Mass	160g	200g (excluding cable)		
Compatible counter	EF counter with 0.0001mm resolution. [See page 43]			
Standard accessories	Wrench for contact point (538610) Wrench for the nut (200168)	Wrench for contact point (538610)		
Remarks	with a clamping nut on the stem	Low force type		

\*1: Only one laser hologage may be connected to the EF counter. To connect two gages, use a 542-062-1 (without AC adapter) and an external power supply (12 to 24 VDC, 1A or greater).

\*2: The signal output uses a special pitch (intervals) of 0.25mm. The values are converted to 0.0001mm resolution on the counter side.

# LGK

0.1/0.5/1 $\mu$ m Reading  
Differential Square-wave Output



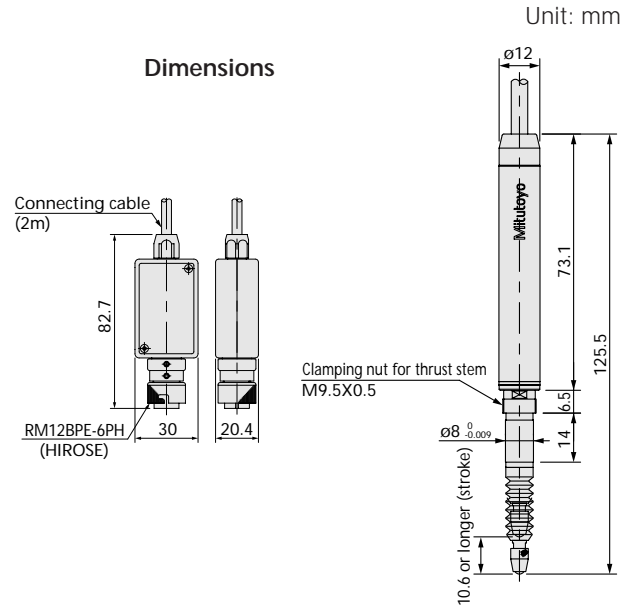
## FEATURES

- A slim-body model which has succeeded the proven LGF series in terms of their vibration-resistant/impact-resistant properties. The sectional area is only a 1/5 compared to that of LGF-110L.
- Provides the resolution of 0.1/0.5/1 $\mu$ m whichever is selectable.

## OPTIONAL ACCESSORIES

Order No.	Description	
238772	10mm rubber boot (spare)	Refer to p.28
02ADB680	Thrust stem set	Refer to p.24
02ADB683	Dedicated wrench	Refer to p.24

## Dimensions



## SPECIFICATIONS

Order No.	542-158	542-157	542-156
Resolution	0.0001mm	0.0005mm	0.001mm
Range	10mm		
Accuracy (20°C)	(0.8+L/50) $\mu$ m (L=mm)		(1.5+L/50) $\mu$ m (L=mm)
Measuring force	Upward (♀)	Approx. 0.8N or less	
	Horizontal (+♂, ♂+)	Approx. 0.75N or less	
	Downward (♂)	Approx. 0.7N or less	
Dust/Water protection level*1	IP66 equivalent		
Contact point	ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>		
Stem diameter	ø8mm		
Bearing type	Stroke ball bearing*2		
Position-detection sensor	Transmission-type photoelectric linear encoder*2		
Max. Response Speed*2	400mm/s	1500mm/sec	
Output signal	90° phase difference, differential square wave (RS-422A equivalent); minimum edge intervals 200ns for 0.1 $\mu$ m model, 250ns for 0.5 $\mu$ m model, and 500ns for 1 $\mu$ m model		
Signal pitch	0.4 $\mu$ m	2 $\mu$ m	4 $\mu$ m
Cable length	2m		
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)		
Mass	250g		
Standard accessory	Wrench for contact point ( <b>538610</b> )		

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

\*2: When the travel speed of spindle exceeds 1500mm/s (400mm/s for the case of 0.1 $\mu$ m model), an alarm signal will be outputted and the error display will result if any Mitutoyo counter is used. For the method of making use of alarm signals where any Mitutoyo counter is not used refer to Page 30. However, note that the spindle's free travel may exceed the given speed limit to cause an error if the contact point is released quickly after it has been pressed in, depending on the amount of over-travel produced.

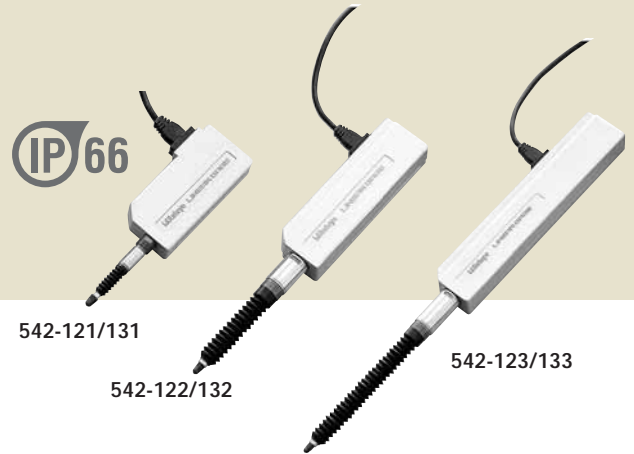
\*3: Patent registered (Application country: Japan)

\*4: Patent registered (Application country: Japan, U.S.A., Germany, U.K.)

# LGF

## 0.5/1μm Reading Differential Square-wave Output

The LGF Linear Gages are Mitutoyo's new, low-cost type electronic gage heads designed to fit into very tight spaces. Employing an improved structure for the spindle guide, the LGF is highly resistant to external shock and vibration.



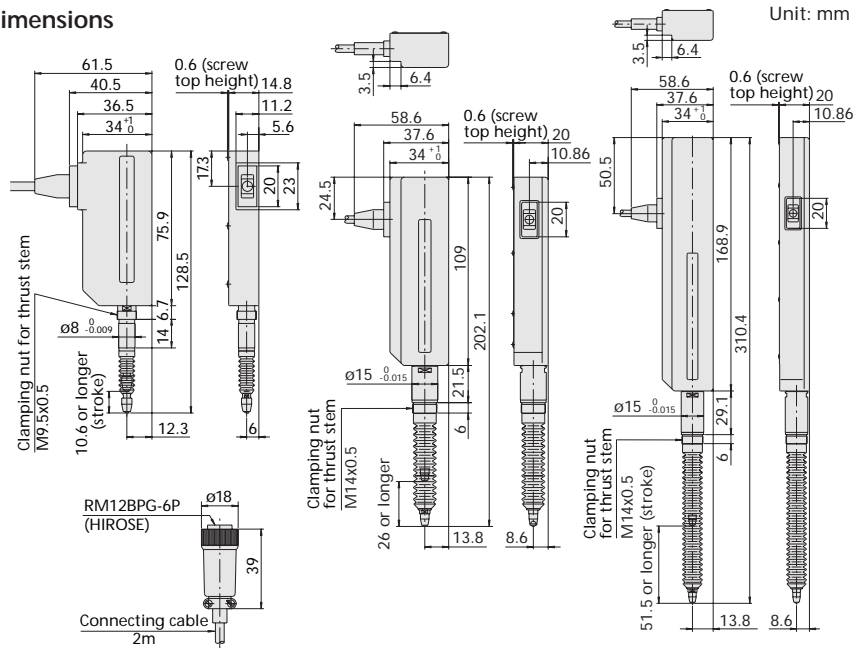
### FEATURES

- Excellent structure of protection against dust and water splash (IP-66) in harsh shop-floor environments.
- Output differential square wave signals for a wide range of applications.
- Use linear stroke bearings on the spindle movement for durability
- Thrust Stem with a clamping nut is optional.

### OPTIONAL ACCESSORIES

Order No.	Description	
902434	Extension cable (5m)	Refer to p.27
902433	Extension cable (10m)	Refer to p.27
902432	Extension cable (20m)	Refer to p.27
238772	10mm rubber boot (spare)	Refer to p.28
962504	25mm rubber boot (spare)	Refer to p.28
962505	50mm rubber boot (spare)	Refer to p.28
02ADB680	Thrust stem set (for 10mm LGF model)	Refer to p.24
02ADB690	Thrust stem set (for 25mm/50mm LGF model)	Refer to p.24

### Dimensions



### SPECIFICATIONS

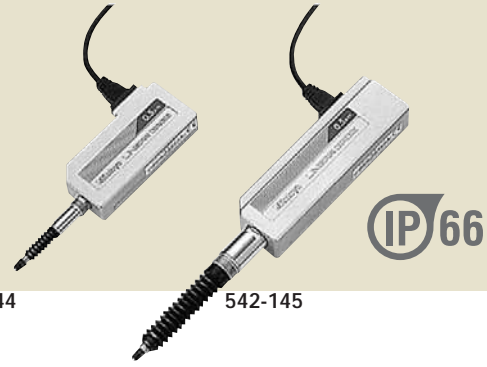
Order No.	542-121	542-131	542-122	542-132	542-123	542-133
Resolution	0.001mm	0.0005mm	0.001mm	0.0005mm	0.001mm	0.0005mm
Measuring range	10mm		25mm		50mm	
Accuracy (20°C)	(1.5+L/50) μm (L=mm)					
Measuring force	Upward ( ♀ )		4.6N or less		5.7N or less	
	Horizontal ( ♂, ◯ )		4.3N or less		5.3N or less	
	Downward ( ♂ )		4.0N or less		4.9N or less	
Dust/water protection*2	IP66 equivalent					
Contact point	ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm) <b>901312</b>					
Stem diameter	ø8mm		ø15mm			
Bearing type	Stroke ball bearing					
Position-detection method	Transmission-type photoelectric linear encoder					
Response speed*1	1500mm/sec					
Output signal	90° phase difference, differential square wave (RS-422A equivalent); minimum edge intervals 500 ns for 1 μm model, 250 ns for 0.5 μm model					
Signal pitch	4μm	2μm	4μm	2μm	4μm	2μm
Cable length	2m					
Power supply	Supply voltage +5V (4.8V to 5.2V), ripple voltage 200mV p-p max.					
Power consumption	Max. 120mA					
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)					
Mass	250g		290g		380g	
Standard accessories	Wrench for contact point ( <b>538610</b> )			Wrench for contact point ( <b>210187</b> )		

\*1: An alarm signal is output when the spindle movement speed reaches 1500mm/s. If a Mitutoyo counter is used, an error will be displayed. For the method of making use of alarm signals where any Mitutoyo counter is not used refer to Page 30. When the LGF-150L is used, releasing the contact point after pushing it in may cause an overspeed error depending on the extent to which the contact point is pushed inward.  
\*2: The IP value is a standard indicating the degree of protection against solid foreign matter and water. Note that the standard may not apply to certain types of liquids.



# LGF

0.1μm Reading  
Differential Square-wave Output



542-144

542-145

IP66

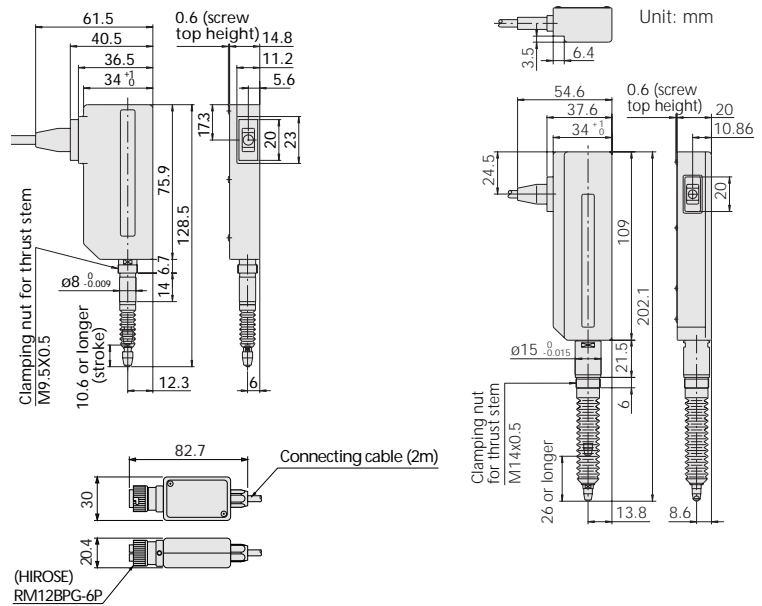
## FEATURES

- Extremely compact design. Available with an outside diameter as small as 8mm.
- The small photoelectric linear encoder assures high precision over the entire stroke range.
- The ball bearings used in the spindle unit ensure superb durability.

## OPTIONAL ACCESSORIES

Order No.	Description	
238772	10mm rubber boot (spare)	Refer to p.28
962504	25mm rubber boot (spare)	Refer to p.28
962505	50mm rubber boot (spare)	Refer to p.28
02ADB680	Thrust stem set (for 10mm LGF model)	Refer to p.24
02ADB690	Thrust stem set (for 25mm/50mm LGF model)	Refer to p.24

## Dimensions



## SPECIFICATIONS

Order No.	542-144	542-145
Resolution	0.0001mm	
Measuring range	10mm	25mm
Accuracy (20°C)	(0.8+L/50)μm (L=mm)	
Measuring force	Upward (♀)	1.2N or less
	Horizontal (♂, ♂)	1.1N or less
	Downward (♂)	1.0N or less
Dust/water protection*1	IP66 equivalent	
Contact point	ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>	
Stem diameter	ø8mm	ø15mm
Bearing type	Stroke ball bearing*3	
Position-detection method	Transmission-type photoelectric linear encoder*4	
Response speed*2	400mm/s	
Output signal	90° phase difference, differential square wave (RS-422A equivalent); minimum edge intervals 200ns	
Signal pitch	0.4μm	
Cable length	2m	
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)	
Mass	250g	290g
Standard accessories	Wrench for contact point ( <b>538610</b> )	Wrench for contact point ( <b>210187</b> )

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

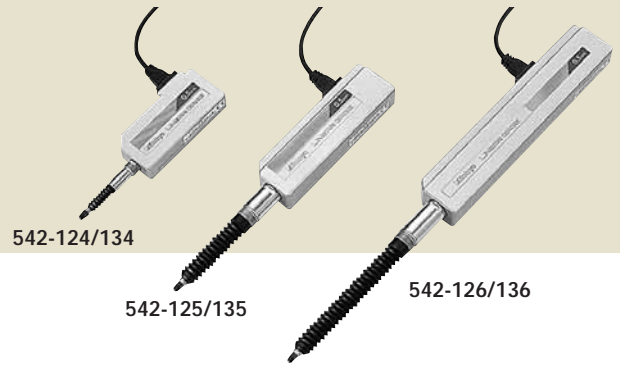
\*2: When the travel speed of spindle exceeds 1500mm/s (400mm/s for the case of 0.1μm model), an alarm signal will be outputted and the error display will result if any Mitutoyo counter is used. For the method of making use of alarm signals where any Mitutoyo counter is not used refer to Page 30. However, note that the spindle's free travel may exceed the given speed limit to cause an error if the contact point is released quickly after it has been pressed in, depending on the amount of over-travel produced.

\*3: Patent registered (Application country: Japan)

\*4: Patent registered (Application country: Japan, U.S.A., Germany, U.K.)

# LGF with Origin Point Mark

0.5/1 $\mu$ m Reading  
Differential Square-wave Output



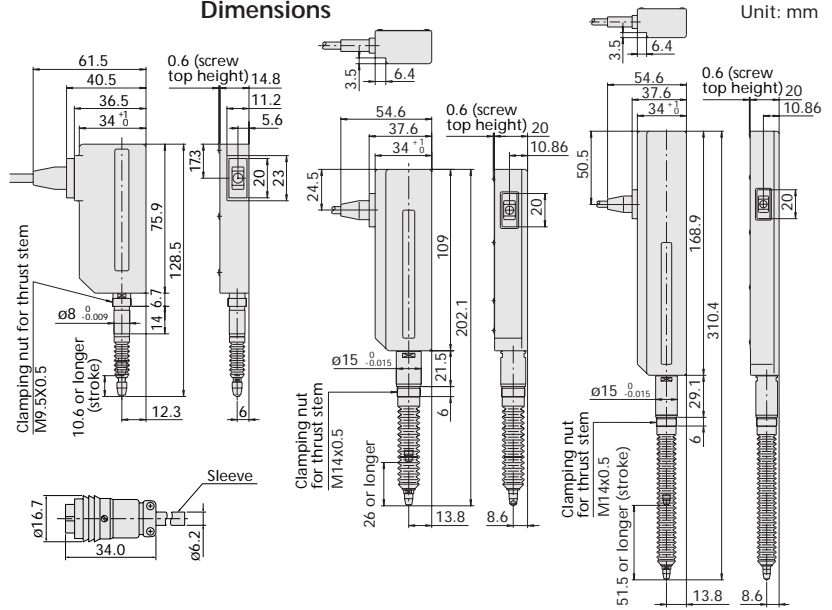
## FEATURES

- The employed origin point signal output function will facilitate the operation of setting the standard when this gage is incorporated for use in the main machine tool. It must be a reliable linear gage, since the origin position can be easily reproduced even when any trouble such as over-speed error, etc. should occur.
- Provides the resolution of 0.5/1 $\mu$ m whichever is selectable.

## OPTIONAL ACCESSORIES

Order No.	Description	
238772	10mm rubber boot (spare)	Refer to p.28
962504	25mm rubber boot (spare)	Refer to p.28
962505	50mm rubber boot (spare)	Refer to p.28
02ADB680	Thrust stem set (for 10mm LGF model)	Refer to p.24
02ADB690	Thrust stem set (for 25mm/50mm LGF model)	Refer to p.24

## Dimensions



## SPECIFICATIONS

Order No.	542-134	542-124	542-135	542-125	542-136	542-126
Resolution	0.0005mm	0.001mm	0.0005mm	0.001mm	0.0005mm	0.001mm
Measuring range	10mm		25mm		50mm	
Accuracy (20°C)	(1.5+L/50) $\mu$ m (L=mm)					
Measuring force	Upward (♀) Horizontal (♂, ♂) Downward (♂)		1.2N or less 1.1N or less 1.0N or less		4.6N or less 4.3N or less 4.0N or less	
Dust/water protection*1	IP66 equivalent					
Resistance to impact	1000mm/s <sup>2</sup> , 11ms (IEC68-2-27)					
Contact point	$\phi$ 3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>					
Stem diameter	$\phi$ 8mm		$\phi$ 15mm			
Bearing type	Stroke ball bearing*3					
Position-detection method	Transmission-type photoelectric linear encoder*4					
Origin point	Approx. 3mm from contact point tip (bottom dead center)			Approx. 5mm from contact point tip (bottom dead center)		
Repeatability of origin point (20°C):	$\leq$ 0.5 $\mu$ m (at a constant origin point position passing speed less than 300mm/s in the same direction)					
Response speed*2	1500mm/s					
Output signal	90° phase difference, differential square wave (RS-422A equivalent); minimum edge intervals 500 ns for 1 $\mu$ m model, 250 ns for 0.5 $\mu$ m model					
Signal pitch	2 $\mu$ m	4 $\mu$ m	2 $\mu$ m	4 $\mu$ m	2 $\mu$ m	4 $\mu$ m
Cable length	2m					
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)					
Mass	250g		290g		380g	
Standard accessories	Wrench for contact point ( <b>538610</b> )			Wrench for contact point ( <b>210187</b> )		

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

\*2: When the travel speed of spindle exceeds 1500mm/s (400mm/s for the case of 0.1 $\mu$ m model), an alarm signal will be outputted and the error display will result if any Mitutoyo counter is used. For the method of making use of alarm signals where any Mitutoyo counter is not used refer to Page 30. However, note that the spindle's free travel may exceed the given speed limit to cause an error if the contact point is released quickly after it has been pressed in, depending on the amount of over-travel produced.

\*3: Patent registered (Application country: Japan)

\*4: Patent registered (Application country: Japan, U.S.A., Germany, U.K.)

# LGB

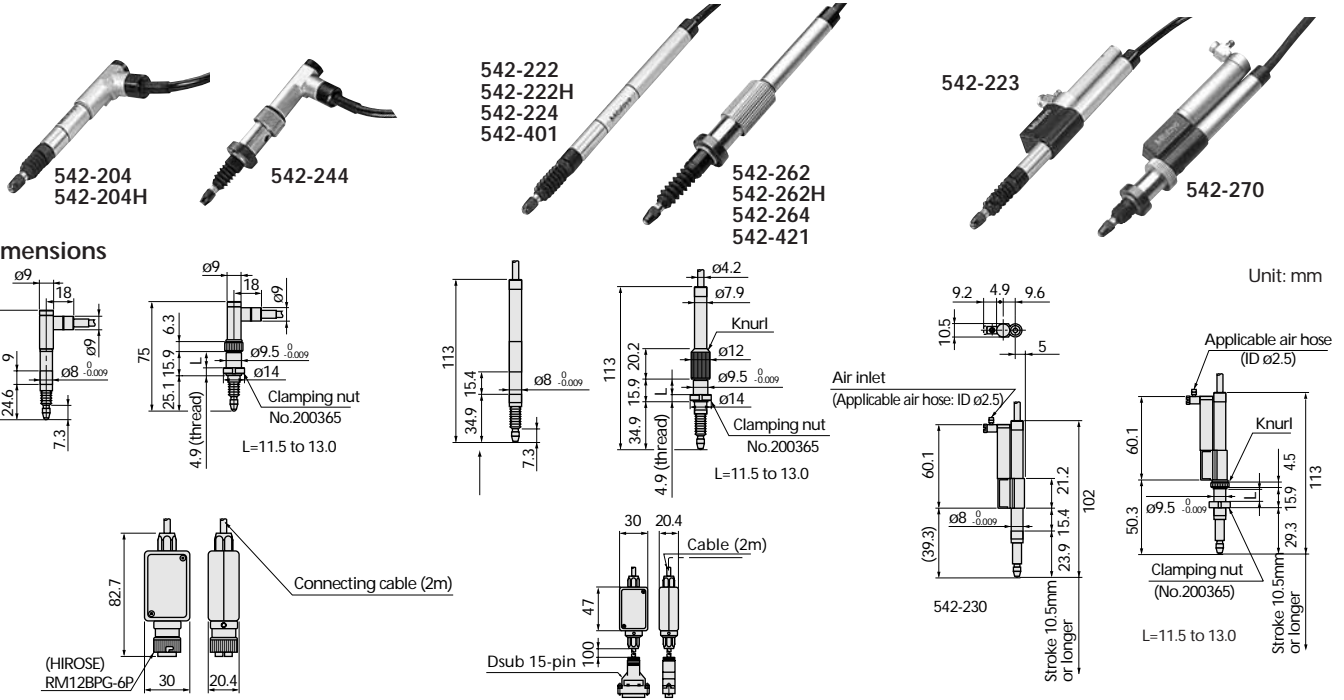
## 0.001mm Reading Differential Square-wave Output Sine-wave Output\*

\*sighn wave output(542-401,542-421)



### FEATURES

- Extremely compact design. Available with an outside diameter as small as 8mm.
- The small photoelectric linear encoder assures high precision over the entire stroke range.
- The ball bearings used in the spindle unit ensure superb durability.



### Individual specifications

Order No.	542-204	542-204H	542-222	542-222H	542-401	542-224	542-230	542-223
Stem	8mm diameter, straight stem							
Order No.	542-244		542-262	542-262H	542-421	542-264	542-270	
Stem	9.5mm diameter, straight stem with nut							
Measuring range	5mm (.2")				10mm (.4")			
Accuracy (20°C)	2 μm	1 μm	2 μm	1 μm	2 μm			
Measuring force	Upward (♀)	Approx. 0.65N or less		Approx. 0.8N or less		Approx. 0.6N or less		Approx. 0.8N or less
	Horizontal (↔)	Approx. 0.6N or less		Approx. 0.75N or less		Approx. 0.55N or less		Approx. 0.75N or less
	Downward (♂)	Approx. 0.55N or less		Approx. 0.7N or less		Approx. 0.5N or less		Approx. 0.7N or less
Mass	145g (542-204) 160g (542-244)	145g	140g (542-222) 150g (542-262)	150g (542-222H) 170g (542-262H)	160g (542-401) 180g (542-421)	150g (542-224) 170g (542-264)	165g (542-230) 170g (542-270)	165g
Air-lifter mechanism	None						Spindle becomes free when air is supplied	Spindle retreats when air is

### Common specifications

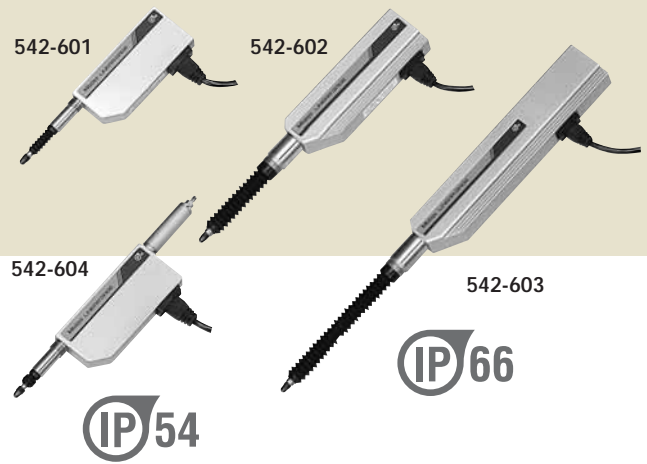
Resolution	0.001mm
Dust/water protection	IP54
Contact point	ø3mm in carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>
Bearing type	Stroke ball bearing
Position-detection method	Transmission-type photoelectric linear encoder
Response speed	900mm/sec
Output signal/signal pitch	4mm pitch, 90° phase difference, differential square wave (RS-422A equivalent)*
Cable length	2m
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)
Required air-pressure range	0.3 to 0.4 MPa (3 to 4kg/cm <sup>2</sup> ) (Required only for models equipped with air lifters)

\*Sign wave: 542-401, 542-424

# LGE

## 0.005mm Reading Differential Square-wave Output

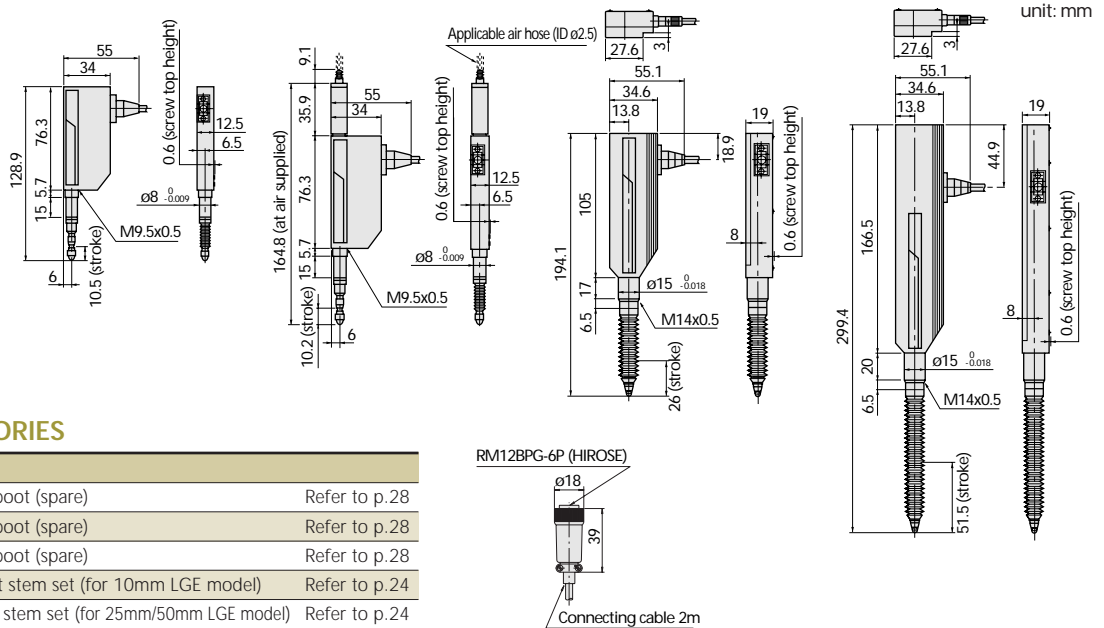
The LGE Series Linear Gages are compact electronic gage heads designed to fit into very tight spaces. Employing linear ball bearings, the LGE is also highly durable for long life.



### FEATURES

- With a rubber boot for use in harsh environments.
- Optional thrust stem and tightening nut facilitate setup of the LGE linear gage in holes of a plate or fixture.

### Dimensions



### OPTIONAL ACCESSORIES

Order No.	Description	
238772	10mm rubber boot (spare)	Refer to p.28
962504	25mm rubber boot (spare)	Refer to p.28
962505	50mm rubber boot (spare)	Refer to p.28
02ADC730	Ø9.5mm Thrust stem set (for 10mm LGE model)	Refer to p.24
02ADC740	Ø18mm Thrust stem set (for 25mm/50mm LGE model)	Refer to p.24

### SPECIFICATIONS

Order No.	542-601	542-604	542-602	542-603
Resolution	0.005mm (5µm)			
Measuring range	10mm (4")		25mm (1")	50mm (2")
Accuracy (20°C)	20µm			
Measuring force	Upward ( ♀ )	Approx. 1.2N or less	Approx. 4.6N or less	Approx. 5.7N or less
	Horizontal ( ⚡, ⚡ )	Approx. 1.1N or less	Approx. 4.3N or less	Approx. 5.3N or less
	Downward ( ♂ )	Approx. 1.0N or less	Approx. 4.0N or less	Approx. 4.9N or less
Dust/water protection*1	IP66 equivalent	IP54 equivalent	IP66 equivalent	
Contact point	ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>			
Stem diameter	ø8mm		ø15mm	
Bearing type	Stroke ball bearing			
Position-detection method	Capacitance-type incremental linear encoder			
Response speed*2	Static: 1400mm/s Dynamic: 17.5mm/s			
Output signal/signal pitch	20mm pitch, 90° phase difference, differential square wave (RS-422A equivalent)			
Output cable length	2m			
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)			
Lifter mechanism	None	Built-in air lifter*3	None	
Mass	200g	220g	250g	300g
Accessories	Wrench for contact point ( <b>538610</b> )		Wrench for contact point ( <b>210187</b> )	

\*1: The IP value given is for water. Note that the unit may not be able to maintain resistance to certain types of liquids.

\*2: Static - The maximum movement speed at which no overspeed error occurs.

Dynamic - The maximum movement speed at which measurement by scanning is possible.

\*3: The air-supply pressure for **542-604** is 0.3 to 0.4 MPa. The spindle moves forward (becomes free) when air is supplied. Use an air hose with an inside diameter of 2.5mm.

# LGD

## 0.01mm/.0005" Reading Digimatic Code (SPC) Output

The LGD is an ultra-compact ABS Linear Gage designed to fit into very tight spaces. It keeps track of its origin point once set.

# ABSOLUTE™

Absolute System Patented by MITUTOYO



### FEATURES

- The use of an absolute scale\* in the sensor makes it possible to maintain the origin setting even when the power is switched off.
- Special linear ball bearings are used for the spindle guide to ensure a long service life.
- Optional thrust stem and tightening nut facilitate setup of the LGD linear gage in holes of a plate or fixture.

\*: See page 3 for an explanation of the absolute scale.

### OPTIONAL ACCESSORIES

Order No.	Description	
238772	Spare rubber boot (for 10mm LGD model)	Refer to p.28
962504	Spare rubber boot (for 25mm LGD model)	Refer to p.28
962505	Spare rubber boot (for 50mm LGD model)	Refer to p.28
02ADC730	Ø9.5mm Thrust stem set (for 10mm LGD model)	Refer to p.24
02ADC740	Ø18mm Thrust stem set (for 25mm/50mm LGD model)	Refer to p.24
965275□*	Digimatic Power Supply Unit	Refer to p.29

\*: □ is left blank or an appropriate suffix (A or E) is inserted, depending on the AC supply voltage (blank - 100V; A - 120V; E - 240V).

### Dimensions

Unit: mm

The dimensions of the LGD is the same as that of the LGE, as indicated on the page at left. The only differences are the shape and size of the connector at the end of the cable.

**575-321/331**: Refer to 542-601  
**575-322/332**: Refer to 542-602  
**575-323/333**: Refer to 542-603  
**575-324/334**: Refer to 542-604

### SPECIFICATIONS

Order No.	575-321	575-331	575-324	575-334	575-322	575-332	575-323	575-333
Resolution	0.01mm	.0005"	0.01mm	.0005"	0.01mm	.0005"	0.01mm	.0005"
Measuring range	10mm	.4"	10mm	.4"	25mm	1"	50mm	2"
Accuracy (20°C)	20µm	.001"	20µm	.001"	20µm	.001"	30µm	.0012"
Measuring force	Upward ( ♀ )	Approx. 1.2N or less			Approx. 4.6N or less		Approx. 5.7N or less	
	Horizontal ( ♂ )	Approx. 1.1N or less			Approx. 4.3N or less		Approx. 5.3N or less	
	Downward ( ♂ )	Approx. 1.0N or less			Approx. 4.0N or less		Approx. 4.9N or less	
Dust/water protection*1	IP-66 equivalent		IP-54 equivalent		IP-66 equivalent			
Contact point	Ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>							
Stem diameter	Ø8mm				Ø15mm			
Bearing type	Stroke ball bearing							
Position-detection method	Capacitance-type absolute linear encoder							
Response speed	Unlimited; measurement by scanning cannot be performed							
Output signal	Digimatic output							
External input	Origin-setting signal (absolute positional origin*3 can be changed externally)							
Output cable length	2m (suffix "-3" for 3m, "-5" for 5m, and "-7" for 7m to each order No.)							
Power supply	Supply voltage 5V (4.5V to 5.5V), ripple voltage 200mV p-p max.							
Power consumption	20mA							
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)							
Lifter mechanism	None	Built-in air lifter*2			None			
Mass	200g	220g			250g	300g		
Standard accessories	Wrench for contact point ( <b>538610</b> )				Wrench for contact point ( <b>210187</b> )			

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid

\*2: The air-supply pressure for **575-324** and **575-334** is 0.3 to 0.4 MPa. The spindle moves forward (becomes free) when air is supplied. Use an air hose with an inside diameter of 2.5mm.



# LGD-M

## 0.01mm/.0005" Reading Digimatic Code (SPC) Output

**ABSOLUTE™**  
Absolute System Patented by MITUTOYO

**IP66**

This LGD-M ultra-compact ABS linear gage maintains the origin once it is set.

Metal bushings have replaced the ball bearings of the original LGD gage for higher cost-effectiveness.



575-325

### FEATURES

- The use of an absolute scale\* in the sensor makes it possible to maintain the origin setting even when the power is cut off.
- The spindle is supported at both ends, improving the accuracy to 15mm.

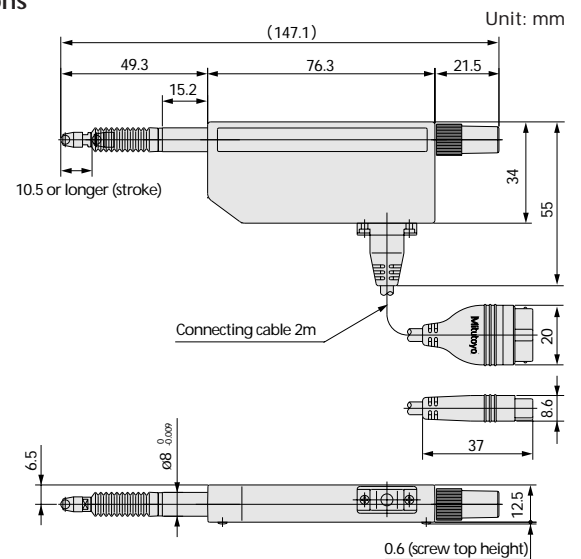
\*: See page 3 for an explanation of the absolute scale.

### OPTIONAL ACCESSORIES

Order No.	Description	
02ACA376	Spare rubber boot	Refer to p.28
965275□*	Digimatic Power Supply Unit	Refer to p.29

\*: □ is left blank or an appropriate suffix (A or E) is inserted, depending on the AC supply voltage (blank - 100V; A - 120V; E - 240V).

### Dimensions



### SPECIFICATIONS

Order No.	575-325	575-335
Resolution	0.01mm	.0005"
Measuring range	10mm	.4"
Accuracy (20°C)	15µm	.0006"
Measuring force	Upward ( ♀ )	2.0N or less
	Horizontal ( ♂ )	1.8N or less
	Downward ( ♂ )	1.6N or less
Dust/water protection*	IP-66 equivalent	
Contact point	Ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>	
Stem diameter	Ø8mm	
Bearing type	Slide-bearing type	
Position-detection method	Capacitance-type absolute linear encoder	
Response speed	Unlimited; measurement by scanning cannot be performed	
Output signal	Digimatic output	
External input	Origin-setting signal (absolute positional origin can be changed externally)	
Output cable length	2m	
Power supply	Supply voltage: 5V (4.5V to 5.5V), Ripple voltage: 200mV p-p max.	
Power consumption	20mA	
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)	
Mass	182g	
Standard accessories	Wrench for contact point ( <b>538610</b> )	

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

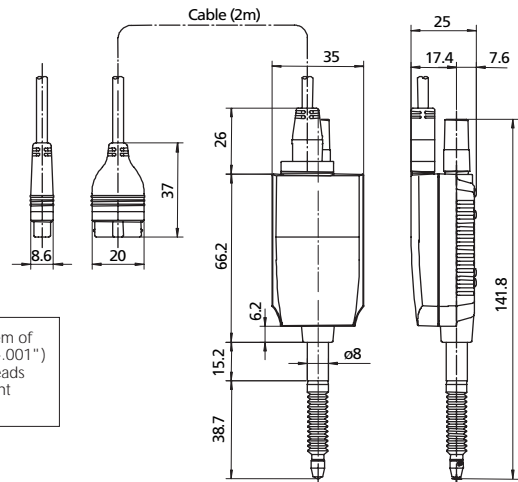
# LGS

0.01mm/.0005" Reading  
Digimatic Code (SPC) Output

**ABSOLUTE™**  
Absolute System Patented by MITUTOYO



## Dimensions



Note: Inch gage has a stem of 3/8" DIA. (Tol. +0/-0.001") and #4-48UNF threads for the contact point mount.

## OPTIONAL ACCESSORIES

Order No.	Description	
238774	Spare rubber boot	Refer to p.28

## SPECIFICATIONS

Order No.	575-303	575-313
Resolution	0.01mm	.0005"
Measuring range	12.7mm	.5"
Accuracy (20°C)	0.015mm	.0006"
Measuring force	Upward ( ♀ )	Approx. 2N or less
	Horizontal ( ←, → )	Approx. 1.8N or less
	Downward ( ♂ )	Approx. 1.6N or less
Dust/water protection*1	IP66	
Contact point	ø3mm carbide (mounting threads: M2.5X0.45mm)	Ø3" (DIA) steel (mounting threads:#4-48unf)
Maximum response speed	Infinite; measurement by scanning cannot be performed	
Stem diameter	ø8mm	ø9.52mm (3/8" DIA)
Bearing type	Slide-bearing type	
Position-detection method	Capacitance-type absolute linear encoder	
Output signal	Digimatic output	
Power supply	Supply voltage: 5V (4.5V to 5.5V), Ripple voltage: 200mV p-p max.	
Cable length	2m	
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)	
Mass	190g (including cable)	

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

# LG

## 100mm Long Stroke Linear Gage

0.1/1 $\mu$ m Reading

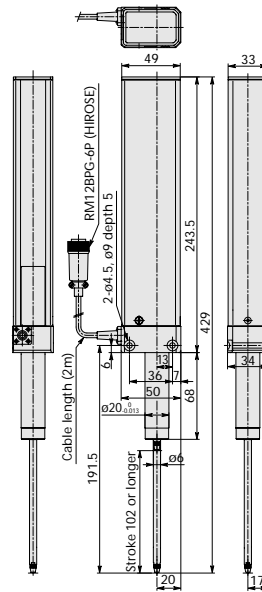
Differential Square-wave Output



IP54

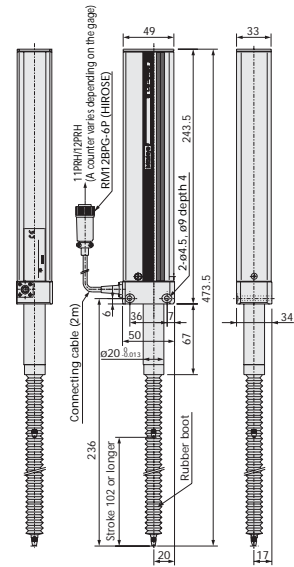
### Dimensions

Standard/Low measuring force type



IP66

Rubber boot type



### FEATURES

- There are three types including the standard model, low measuring force model, and rubber boot model ("model to order" basis) available.
- The resolution of each model can be selected from 0.1 $\mu$ m and 1 $\mu$ m.

### SPECIFICATIONS

Order No.	542-312	542-316	542-314	542-332	542-336	542-334
Type	Standard	Low measuring force	Rubber boot	Standard	Low measuring force	Rubber boot
Resolution	0.0001mm			0.001mm		
Measuring range	100mm					
Accuracy (20°C)	(2+L/100) $\mu$ m $\leq$ 2.5 $\mu$ m (L=mm)			(2.5+L/100) $\mu$ m $\leq$ 3 $\mu$ m (L=mm)		
Measuring force	Upward (♀)	Approx. 8.0N or less	Approx. 3.0N or less	Approx. 8.0N or less	Approx. 3.0N or less	Approx. 8.0N or less
	Horizontal (+O, O+)	Approx. 6.5N or less	-	Approx. 6.5N or less	-	Approx. 6.5N or less
	Downward (♂)	Approx. 5.0N or less	-	Approx. 5.0N or less	-	Approx. 5.0N or less
Dust/water protection*1	IP54 equivalent		IP66 equivalent	IP54 equivalent		IP66 equivalent
Resistance to impact	60G (under the Mitutoyo's corporate test)					
Sealed-spindle method	Scraper type		Rubber boot type	Scraper type		Rubber boot type
Contact point	ø3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>					
Stem diameter	ø20mm					
Position-detection method	Reflection-type photoelectric linear encoder					
Response speed (maximum electrical response speed)*2	400mm/s			800mm/s		
Output signal	90° phase difference, differential square wave (RS-422A equivalent)					
Spindle-driven method	Extension spring					
Spindle-guided method	Bearing guide*3					
Cable length	2m					
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)					
I/O connector	For counted displacement: RM12BPE-6PH (manufacturer: HIROSE) Applicable receptacle: RM12BRD-6S (manufacturer: HIROSE)					
Mass	Approx. 750g		Approx. 780g	Approx. 750g		Approx. 780g

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

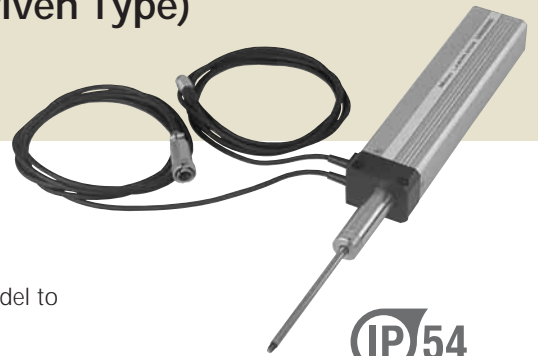
\*2: Note that an over-speed error may occur if the contact point is released quickly after it has been pressed in, depending on the amount of over-travel produced.

\*3: Patent pending (Application country: Japan)

# LGM

## 100mm Long Stroke Linear Gage (Motor-driven Type)

0.1/1 $\mu$ m Reading  
Differential Square-wave Output



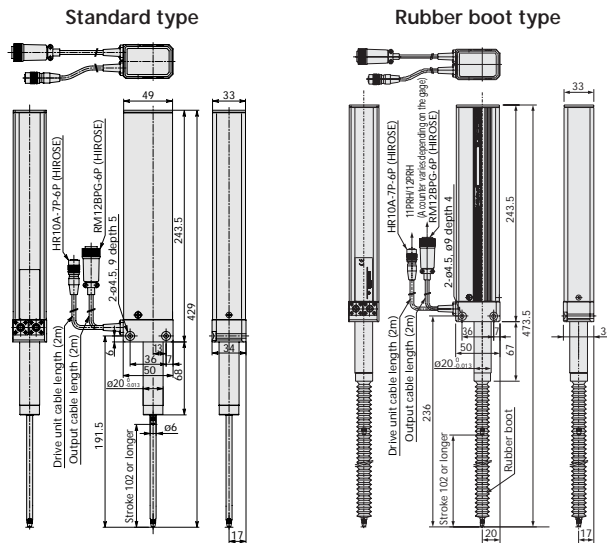
IP54

IP66

### FEATURES

- There are two types including the standard model and rubber boot model ("model to order" basis) available.
- The resolution of each model can be selected from 0.1 $\mu$ m and 1 $\mu$ m.

### Dimensions



### Motor Drive Unit (provided as standard)



### SPECIFICATIONS

Order No.	542-313	542-315	542-333	542-335
Type	Standard	Rubber boot	Standard	Rubber boot
Resolution	0.0001mm		0.001mm	
Measuring range	100mm			
Accuracy (20°C)	(2+L/100) $\mu$ m $\leq$ 2.5 $\mu$ m (L=mm)		(2.5+L/100) $\mu$ m $\leq$ 3 $\mu$ m (L=mm)	
Measuring force*1	Upward (♀)	L3 (approx. 3.0N)	L4 (approx. 4.5N)	L4 (approx. 4.5N)
	Horizontal (♂, ♂)	L7 (approx. 6.5N)	-	L7 (approx. 6.5N)
	Downward (♂)	H4 (approx. 9.5N)	L9 (approx. 6.0N)	H4 (approx. 9.5N)
Dust/water protection*1	IP54 equivalent	IP66 equivalent	IP54 equivalent	IP66 equivalent
Resistance to impact	60G (under the Mitutoyo's corporate test)			
Contact point	$\phi$ 3mm carbide (mounting threads: M2.5 (P = 0.45) X 5mm), <b>901312</b>			
Stem diameter	$\phi$ 20mm			
Position-detection method	Refraction-type photoelectric linear encoder			
Response speed (maximum electrical response speed)*2	400mm/s		800mm/s	
Output signal	90° phase difference, differential square wave (RS-422A equivalent)			
Spindle-driven method	Motor driven			
Spindle-guided method	Bearing guide*3			
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)			
I/O connector	Gage (counted displacement output)	Connector for counted displacement: RM12BPE-6PH (HIROSE) Applicable receptacle: RM12BRD-6S (HIROSE)		
	Gage (input/output for driving)	Gage side plug: HR10A-7P-6P (HIROSE) Motor-driven side receptacle: HR10A-7P-6P (HIROSE)		
	Motor drive unit (for external control)	Motor-driven unit side receptacle: HR10A-10R-10S (HIROSE) Motor-driven unit side plug: HR10A-10R-10P (HIROSE)		
Mass	940g	970g	940g	970g

\*1: IP level is the standard of protection from solids/foreign matters and water. This may not be applicable depending on the kind of liquid.

\*2: Both the travel speed and measuring force of the motor-driven type can be varied with the supplied motor drive unit. Note that the rubber boot type cannot be used in the horizontal positions.

\*3: Patent registered (Application country: Japan)

### FEATURES

Serve as to extend/retract the spindle of motor-driven type linear gages.

- **Measuring force:**  
Can be set appropriately with the rotary switch of the main unit (to one of the combinations of H/L and a number between 0 and 9) depending on the mounting position.
- **Dimensions:**  
90 (W) X 175 (D) X 74 (H/not including the rubber boot) mm
- **External input signal:**  
Spindle being extended  
Spindle being retracted
- **External output signal:**  
Signal of stopping at the upper end of spindle
- **Mass:** Approx. 830g
- **Power supply:** AC100 to 240V

# Operational Guide and Technical Information

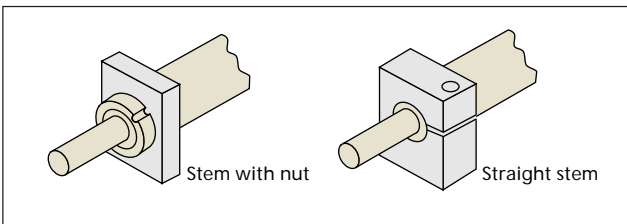
## Installing the gage

### Precautions for installation

- Fasten the stem section onto the gage mount on the measuring instrument or secure it with a stand, etc.
- Be careful not to overly tighten the stem. Doing so may cause problems in gage operation.
- Never fasten the gage by placing the tip of a screw directly against the stem.
- Never fasten the gage by any section other than its stem.
- Mount the gage in such a way that it is perpendicular to the surface to be measured. If installed at an angle, measurement errors may occur.
- Be careful not to exert force on the gage via the cables.

### Straight stem and stem with nut

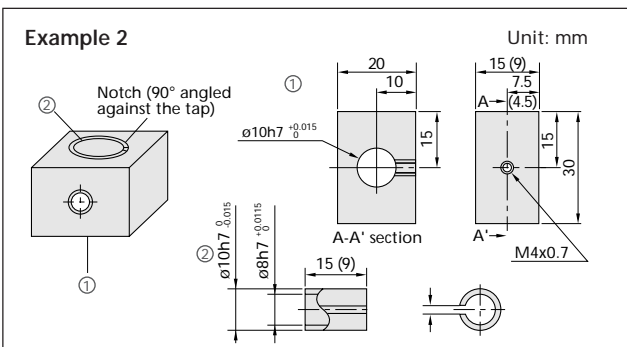
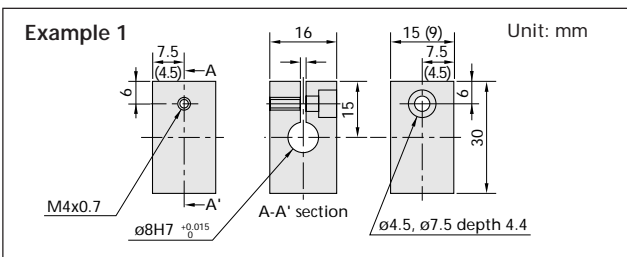
The stem is a part that supports the gage. There are two types of stems: the straight type and the one with a nut. The stem with nut can be mounted easily and ensures that the gage is fastened securely. The straight stem requires extra machining for split-clamping, etc. However, this type can be used in a range of applications and offers the advantage of allowing forward and backward adjustment to a certain degree. Be careful not to overly tighten the straight stem.



See the next page for mounting brackets available for the two stem types.

### Examples of the straight-stem mount

- The recommended clamping torque is 0.4 to 0.5Nm (LGB-0105L: 0.2 to 0.3Nm). Overly tightening the stem will prevent smooth movement of the spindle. Check the movement of spindle after clamping.



### Mounting with a thrust stem

A thrust stem is available as an option for the LGF, LGE and LGD gages (except for LGD-M). Installing a thrust stem on the stem allows direct mounting, just like the stem with nut, simply by drilling a hole in the flat plate. This eliminates the need for an extra stem-clamping mechanism.



(Dimensions when using a thrust stem are shown on the next page.)

#### • How to use a thrust stem with the LGF gages

1. Screw the thrust stem into the stem of the gage. When installing the thrust stem, fix the special wrench on the flat area provided at the upper section of the stem, then hold the wrench in order to prevent force from being applied to the body of the gage.
2. Insert the gage into the mounting hole, then secure the gage by tightening the clamping nut. Use a separate wrench to tighten the clamping nut.

#### • How to use a thrust stem with the LGE/LGD gages

1. Screw the thrust stem into the stem section of the gage by hand.  
(Application of screw lock is recommended to prevent the nut from coming loose.)
2. Insert the gage into the mounting hole, then tighten the clamping nut to secure the gage. In the case of an LGE/LGD gage (10mm), use the special wrench (**200168**) to tighten the nut. If it is a LGE/LGD gage (25/50mm), use a separate 21mm wrench.

#### • Precautions

- Exerting undue force between the gage body and stem may damage the gage. Hold the gage body to avoid exerting excessive force.
- When inserting the gage into the mounting hole, exercise due caution so as not to have the bellows of the gage damaged by burrs along the hole, etc.

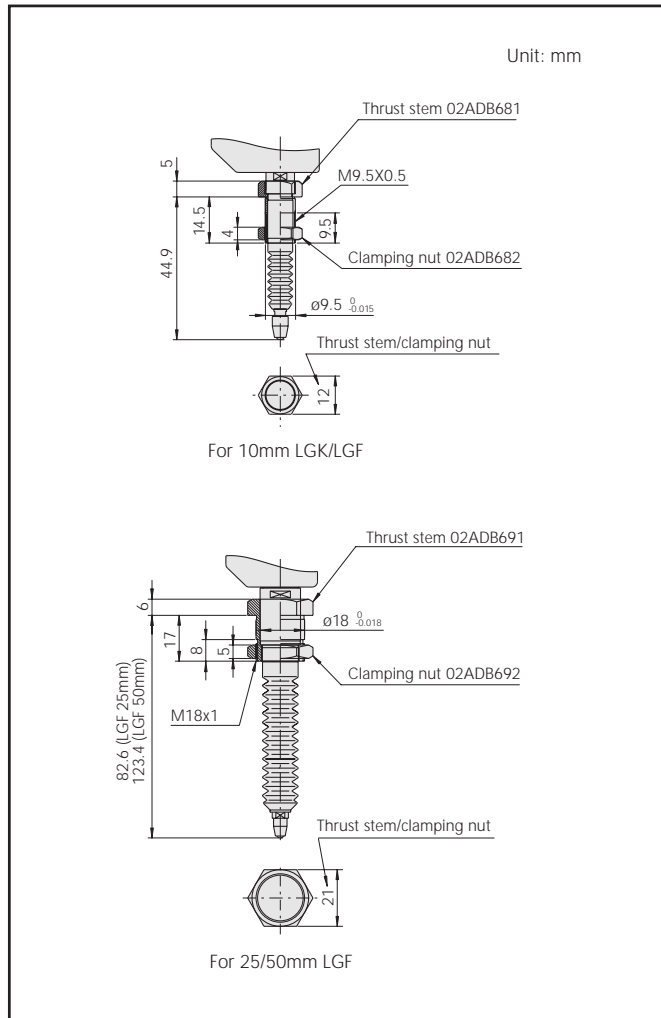


# Operational Guide and Technical Information

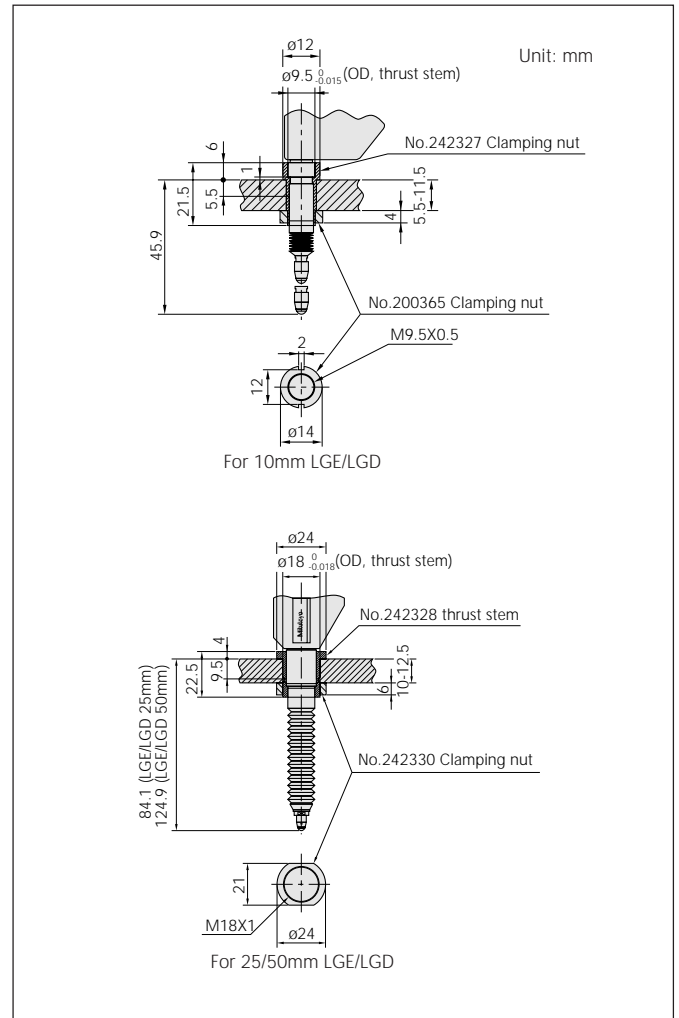
## Installing the gage

### Dimensions when using a thrust stem

#### LGK/LGF



#### LGE/LGD



### Specifications relating to use of the thrust stem

Set order No.	02ADB680	02ADB690	02ADC730	02ADC740
Applicable gage	LGK/LGF 10mm	LGF 25/50mm	LGE/LGD 10mm	LGE/LGD 25/50mm
Applicable gage Code No.	542-156, 542-157, 542-158, 542-121, 542-131, 542-124, 542-134, 542-144	542-122, 542-132 542-123, 542-133	542-601, 542-604 575-321, 575-331 575-324, 575-334	542-602, 542-603 575-322, 575-332 575-323, 575-333
Part No.				
Thrust stem	02ADB683	02ADB683	242327	242328
Clamping Nut	02ADB683	02ADB683	200365	242330
Wrench	02ADB683*	02ADB693*	200168*	—
Gage mounting hole diameter	ø9.5mm	ø18mm	ø9.5mm	ø18mm
Recommended plate thickness (mounting section)	6 to 10.5mm	10 to 12mm	5.5 to 11.5mm	10 to 12.5mm

\*: Not included in the set. It is an optional accessory.

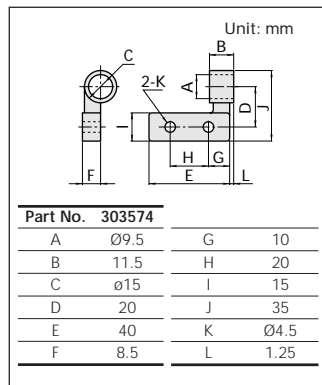
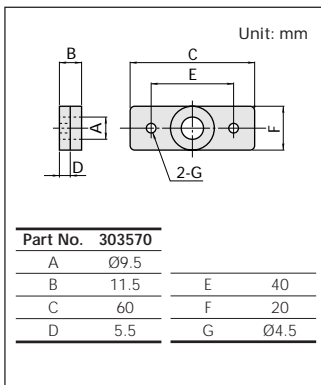
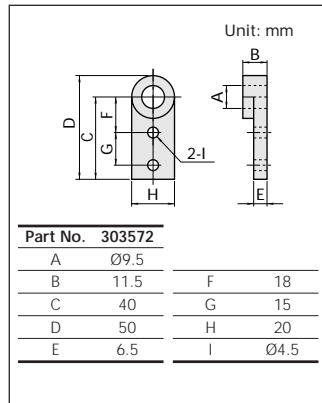
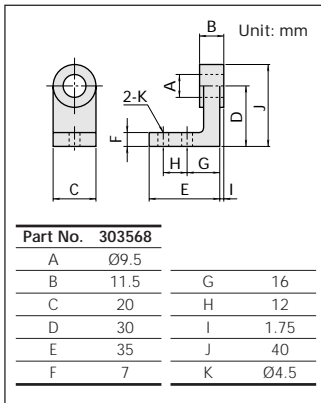
## Installing the gage

### Mounting bracket for the gage head

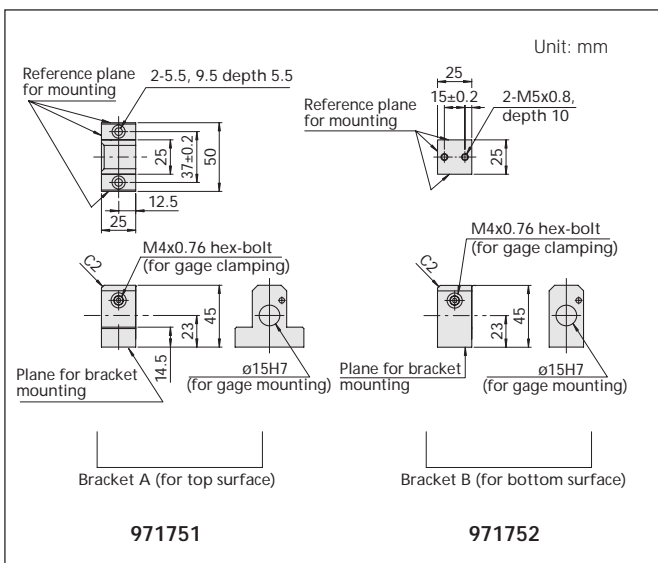
As shown below, a wide range of brackets is available for the Linear gages with stem diameters of 8mm or 9.5mm. Two types of brackets are available for the 15mm diameter stem type.

#### For stem with nut

- A nut-mount type linear gage can be installed without additional parts or machining.

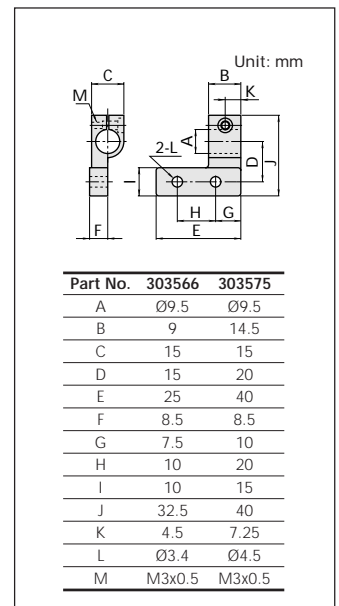
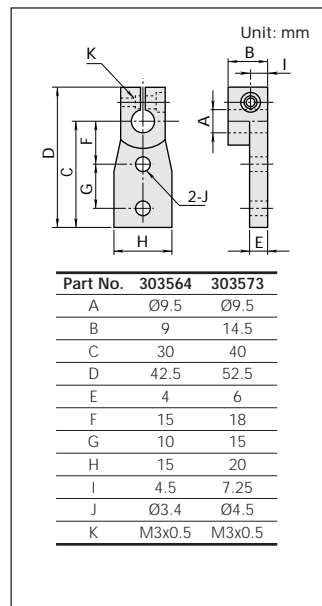
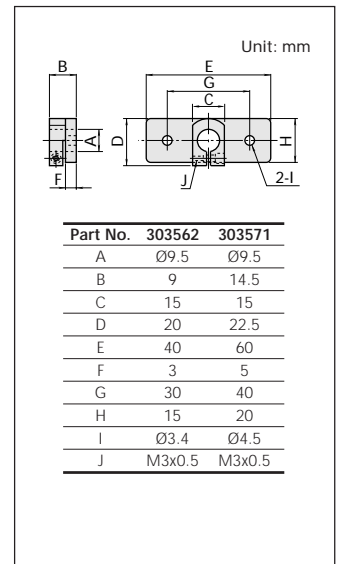
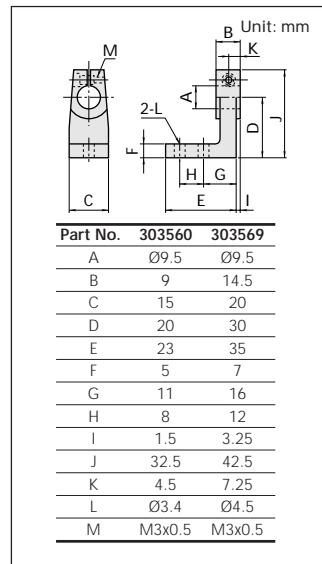
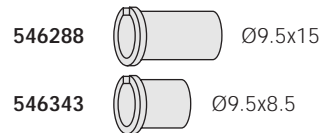


#### For 15 mm diameter stem



#### For the straight stem

- To mount a linear gage with an 8 mm diameter stem, use a 9.5 mm diameter stem bushing.



# Operational Guide and Technical Information

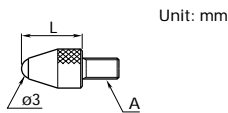
## Interchangeable contact point

Interchangeable contact points for dial gages can be used with linear gages. Shown below are the representative models of interchangeable contact points. With all linear gages, the screw-hole specification for the interchangeable contact point is set at M2.5 (P = 0.45) x 5mm (all in mm), except for the inch versions of the LGS gages (**575-311** and **575-312**) which conform to the UNF thread specification (#4-48 UNF).

### Precautions when replacing contact point

- Place the provided key wrench on the catch (key wrenches are not provided for the LGS and 100mm stroke model) to prevent the spindle from rotating. Then, grab the contact point with pliers to install or remove it. When grabbing the contact point with pliers, insert a piece of felt or other soft cloth in order to prevent the contact point from getting scratched.
- The gage may be damaged if rotational force is exerted on the inside of the gage through the spindle. Exercise due caution and securely hold the spindle with the key wrench before replacing the contact point.
- Pay attention to the angle when installing a flat, knife edge, or blade type contact point, since such contact point needs to be perpendicular to the stem (gage-holding section).

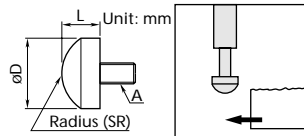
#### Ø3mm Ball Points



L	Material	Order No.	A
7.3	Carbide	901312	M2.5x0.45
		901454	#4-48UNF
	Steel	900030	M2.5x0.45
	Plastic	901994	M2.5x0.45
		902018	#4-48UNF
	Ruby	120047	M2.5x0.45
8.3*	Carbide	902119	M2.5x0.45
	Steel	900986	M2.5x0.45
15	Carbide	120049	M2.5x0.45
	Ruby	120051	M2.5x0.45
20	Carbide	137391	M2.5x0.45
	Ruby	137392	M2.5x0.45
25	Carbide	120053	M2.5x0.45
	Ruby	120055	M2.5x0.45

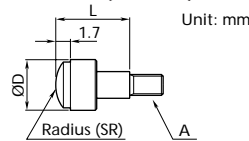
\* For waterproof dial indicators.

#### Spherical Points



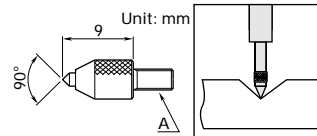
D	L	SR	Order No.	A
10	5	7	101119	M2.5x0.45
12.7	3.18	7	101205	#4-48UNF
9.53	2.38	9	101204	#4-48UNF

#### Spherical Points (Carbide)



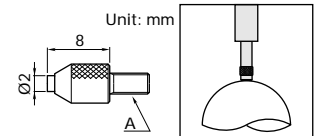
D	L	SR	Order No.	A
5.2	5	5	120058	M2.5x0.45
7.5	10	7	120059	M2.5x0.45
10.5	10	10	120060	M2.5x0.45

#### 90° Conical Points (Carbide)



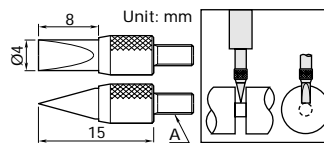
Order No.	A
120057	M2.5x0.45

#### Flat Points (Carbide)

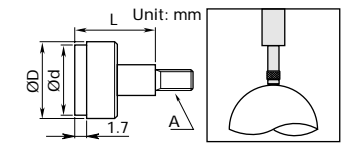


Order No.	A
120056	M2.5x0.45

#### Knife Edge Point (Carbide)

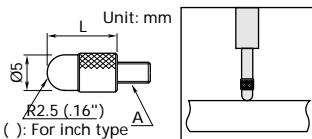


Order No.	A
120067	M2.5x0.45



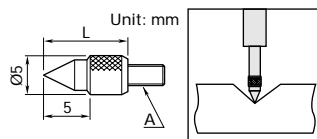
D	d	L	Order No.	A
5.2	4.3	5	120041	M2.5x0.45
7	6.5	10	120042	M2.5x0.45
10.5	9.5	10	120043	M2.5x0.45

#### Shell Type Points



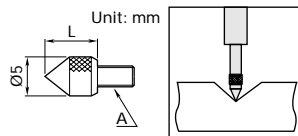
L	Order No.	A
3.97	101184	#4-48UNF
5	101386	M2.5x0.45
10	101118	M2.5x0.45
12.7	101185	#4-48UNF
15	137393	M2.5x0.45
19.05	101186	#4-48UNF
20	101387	M2.5x0.45
25	101388	M2.5x0.45
25.4	101187	#4-48UNF

#### 60° Conical Points



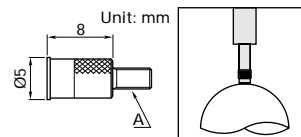
L	Order No.	A
10	101120	M2.5x0.45
12.7	101190	#4-48UNF

#### 90° Conical Points

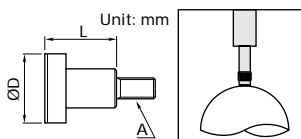


L	Order No.	A
5	101385	M2.5x0.45
7.14	101191	#4-48UNF

#### Flat Points

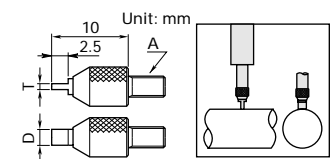


Order No.	A
131365	M2.5x0.45
133017	#4-48UNF



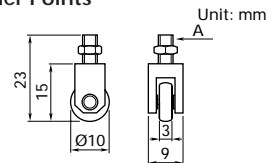
D	L	Order No.	A
10	10	101117	M2.5x0.45
12.7	9.53	101188	#4-48UNF
9.53	9.53	101189	#4-48UNF

#### Blade Points (Carbide)



T	W	Order No.	A
0.4	2	120061	M2.5x0.45
0.6	2	120062	M2.5x0.45
1	4	120063	M2.5x0.45

#### Roller Points



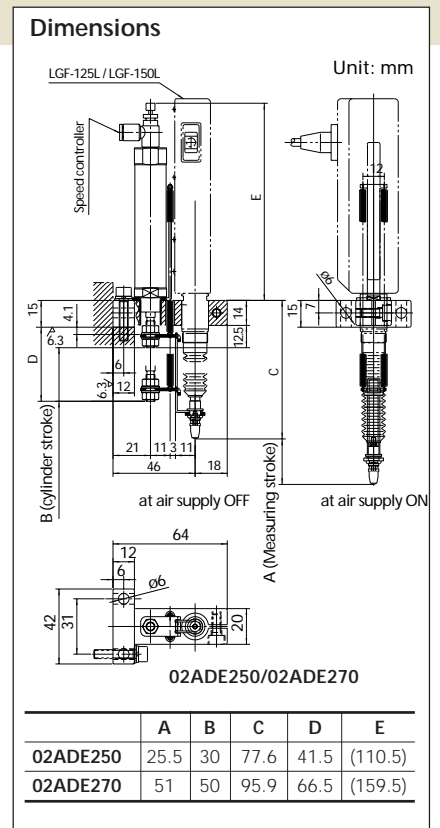
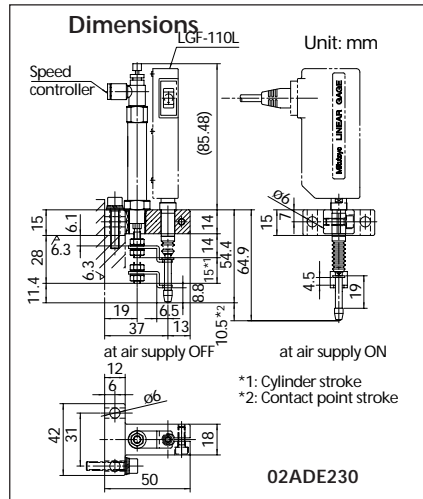
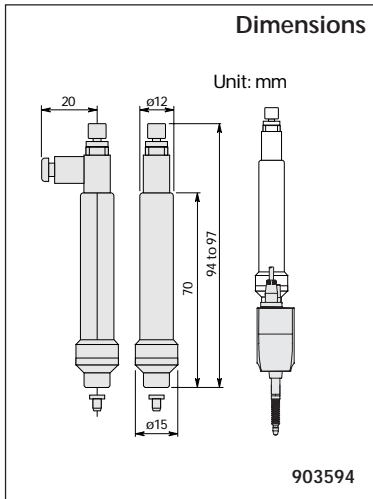
Order No.	A
901954	M2.5x0.45
901991	#4-48UNF

# Optional Accessories for Gage Head

## Air Drive Unit

### FEATURES

- Ascends or descends the spindle of a Linear Gage by the supply and exhaust of air.
- Spindle descending speed can be adjusted by using the speed controller of the drive unit.
- Automatic measurement is possible by using a solenoid valve.



### SPECIFICATIONS

Order No.	903594	903598	02ADE230	02ADE250	02ADE270
Stroke	10mm	.4"	10mm	25mm	50mm
Applicable gage model	LGS		LGF, LGE, LGD		
Air supply	0.49MPa		0.2 to 0.4MPa		
Air horse to be used	Inner diameter : $\phi 2.5$ mm				
Mass	60g		150g	250g	300g

## Extension signal cables



### FEATURES

- The distance between a Linear Gage and the Counter can be extended up to 20m by using these cables.
- Cannot be used for LGS, LGD models, and Laser Hologage.

### SPECIFICATIONS

Order No.	Cable length
902434	5m
902433	10m
902432	20m

## Extension signal cables for LGF with origin point mark



### FEATURES

- A signal cable from the head to the receiver circuitry can be extended.
- Maximum number of connectable cables is limited to 3, and the maximum total extension length is limited to 20m.

### SPECIFICATIONS

Order No.	Cable length
02ADF260	5m
02ADF280	10m
02ADF300	20m

# Optional Accessories for Gage Head

## Measuring stands

Useful for long-stroke LG/LGM.



**Granite comparator stand  
215-156**

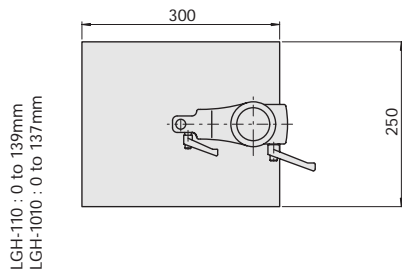


**Comparator stand  
215-505**

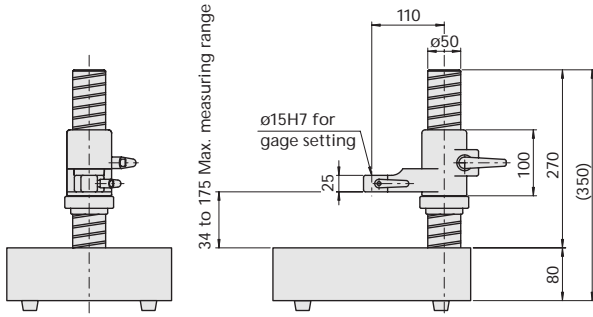
Measuring stand for Laser Hologage used in high-precision measurements.  
Mass: 23 kg

971750

### Dimensions



LGH-110 : 0 to 139mm  
LGH-1010 : 0 to 137mm

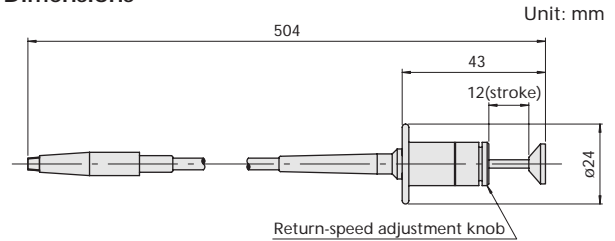


34 to 175 Max. measuring range

Unit: mm

## Release with damper: 971753

### Dimensions



Spindle-lift release for the laser hologage. A sudden drop of the spindle is prevented by the return-speed adjustment knob.  
Mass: 50 g

## Spare Rubber Boots



238772

### FEATURES

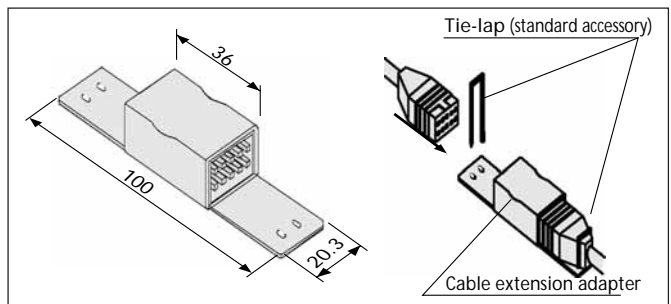
- Protects the spindle of a Linear Gage from dust.
- Dedicated for the following models: LGB, LGD, LGE, and LGF.

### SPECIFICATIONS

Order No.	Applicable Linear Gage
238773	5mm LGB
238772	10mm LGB/LGD/LGE/LGF/LGH
02ACA376	10mm LGD-M
962504	25mm LGD/LGE/LGF
962505	50mm LGD/LGE/LGF
238774	mm/inch LGS

## Digimatic cable extension adapter:

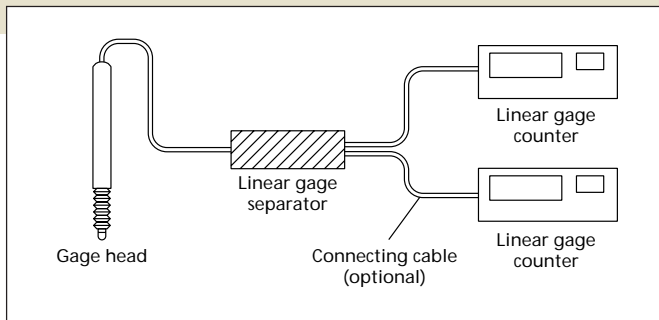
02ADF640



Use this adapter when the LDG-series linear gage is to be connected to any existing counter under such a condition that the available cable length is not sufficient for this connection. Do not joint more than one piece of this product together for use.



## Output separator for multiple linear gages



### FEATURES

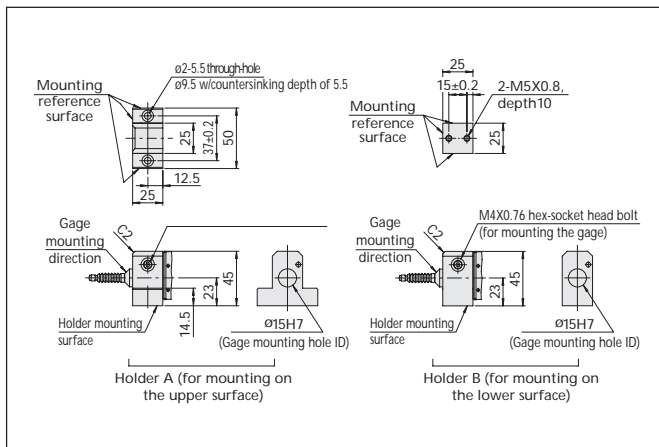
- This is used to separate the output from one head to multiple destinations.

### SPECIFICATIONS

Order No.	No. of output channels
959458 ("made to order" basis)	2ch
958454 ("made to order" basis)	3ch
971790 ("made to order" basis)	4ch

\* For LG, LGB, LGE, LGF, and LGK linear gages.  
(Excluding the LGB linear gages of sine wave output, LGF linear gages with origin point mark, Laser Hologages, and linear gages of Digimatic output)

## Holder A•B



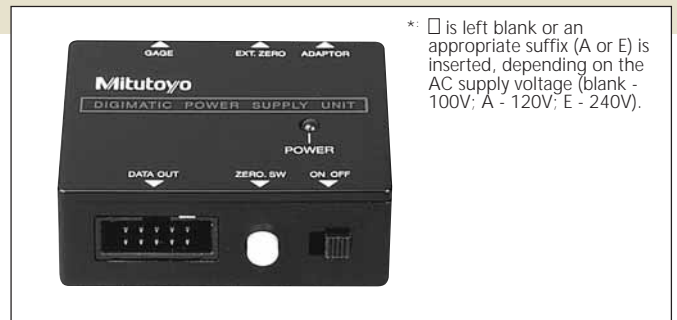
### FEATURES

- Available when the Laser Hologage is mounted with a jig different from the standard stand.

### SPECIFICATIONS

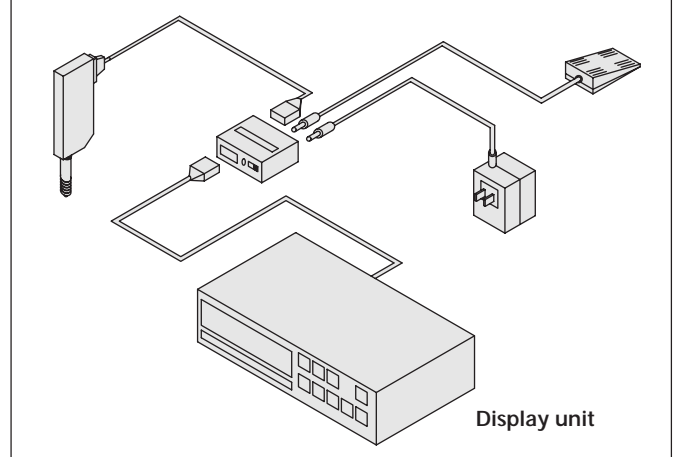
	Order No.	Mass
Holder A	971751	180g
Holder B	971752	250g

## Digimatic external power unit: 965275□\*



Power-supply unit for models LGD, LGD-M and LGS.  
Outer dimensions (W x D x H): 62 x 40 x 20 mm

### Sample application



Sample application 2: Use it for setting the absolute origin when connecting an absolute-type LGD or LGD-M to a display unit other than the ES and EV counters.

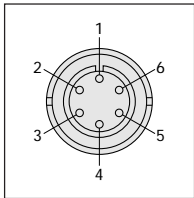
# Gage Output Specifications

## Differential Square Wave

	0.1μm LGB	0.1μm LGK/LGF	0.5μm LGK/LGF	1μm LG/LGB/LGF	5μm LGE
Output signal	90° phase difference, differential square wave (RS-422A equivalent)				
Signal pitch	0.4μm		2μm	4μm	20μm
Minimum edge interval	250nsec.	200nsec.	250nsec.	500nsec.	4μsec.
Output signal level	+5V (4.8 to 5.2V, 80mA) øA, øĀ, øB, øB̄: TTL output, line driver output, AM26LS31 or equivalent				
Connector	RM12BPE-6PH (manufactured by Hirose)				
Applicable receptacle	RM12BRD-6S (manufactured by Hirose)				
Recommended receiver	Differential input, line receiver, AM26LS32 or equivalent				
Gage cable length	2 m; directly connected to the gage				
Maximum extension cable length	20m (extension cables of 5, 10 and 20m in length are available)				
Alarm output*1	A special signal (see the chart below) is output when an alarm detection occurs				
Power supply	+5V (120mA), power supply ripple voltage 200mV p-p max.				

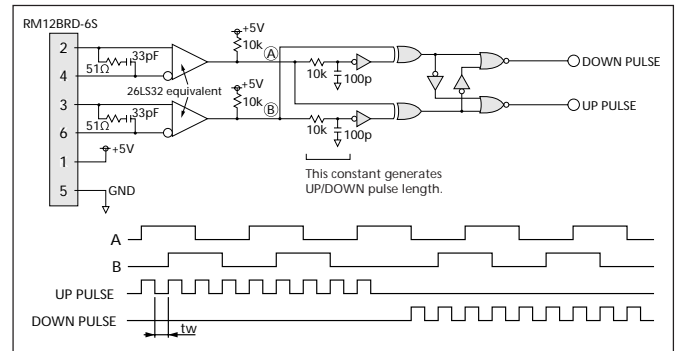
\*1: With an LGF gage, a seventh signal line may be provided to output the error alarm. (Factory option).

### Pin assignment

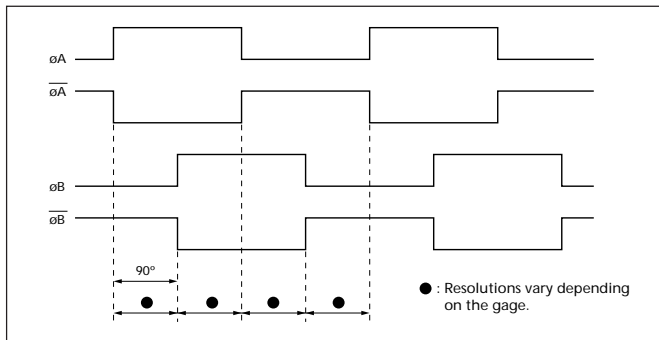


Pin No.	Signal
1	+5V (gage power supply)
2	øA
3	øB
4	øĀ
5	GND
6	øB̄

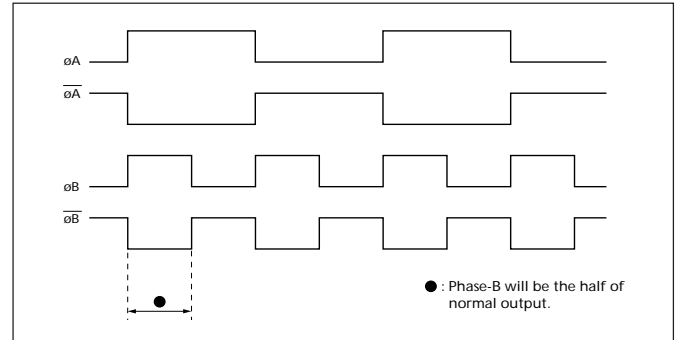
### Recommended processing circuit for received waveform



### Timing chart (normal)



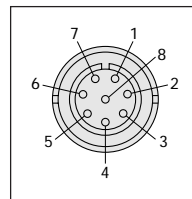
### Timing chart (occurrence of gage alarm)



## Differential Square Wave with LGF Origin Point Mark

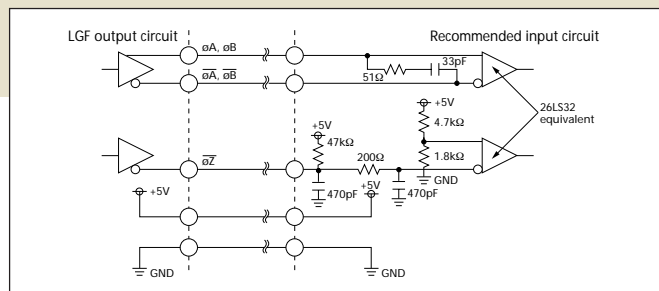
	0.5μm reading	1μm reading
Output signal	Same as above	
Signal pitch	2μm	4μm
Minimum edge interval	250nsec.	500nsec.
Output signal level	+5V (4.8 to 5.2V, 120mA) øA, øĀ, øB, øB̄, øZ: TTL, line driver, AM26LS31 or equivalent	
Connector	PRC05-P8M (manufactured by Tajimi)	
Applicable receptacle	PRC05-R8F (manufactured by Tajimi)	
Recommended receiver	Same as above	
Gage cable length	Same as above	
Maximum extension cable length	Same as above	
Alarm output	Same as above	
Power supply	Same as above	

### Pin assignment

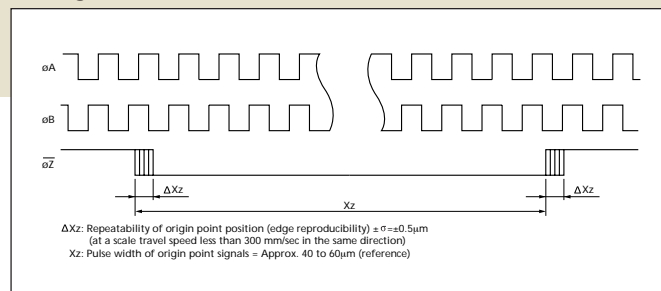


Pin No.	Signal
1	+5V (gage power supply)
2	GND
3	øA
4	øĀ
5	øB
6	øB̄
7	øZ
8	øB

## Input connector and recommended input circuitry



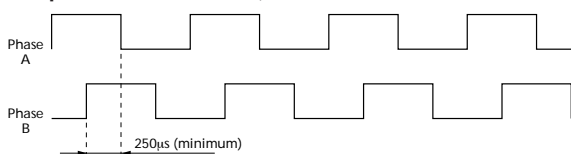
## Timing chart (normal)



## Data Output Timing on LGE Series

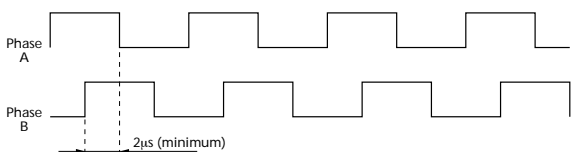
The above listed gages are provided with the following three patterns for their output signals. Therefore, always design the reception circuitry so that it includes an error detecting process making use of these patterns:

### 1) Real-time pulse output (Phase-A wave advances when the spindle is retracted.)



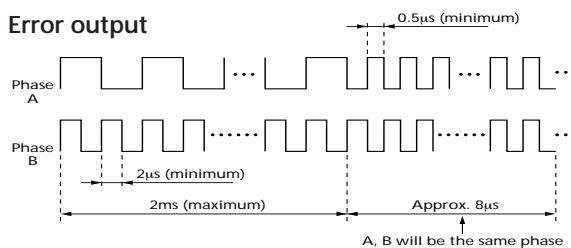
1. Output condition: Spindle moving speed  $\leq 17.5\text{mm/s}$
2. Minimum edge-to-edge interval of output pulses =  $250\mu\text{s}$
3. Output delay time\*1: Max.  $450\mu\text{s}$

### 2) Burst pulse output (Phase-A wave advances when the spindle is retracted.)



1. Output condition:  $17.5\text{mm/s} < \text{Spindle moving speed} \leq 1400\text{mm/s}$
2. Minimum edge-to-edge interval of output pulses =  $2\mu\text{s}$
3. Output delay time\*1: Max.  $500\mu\text{s}$

### 3) Error output



1. Output condition: LGE will be identified as error under the following conditions and produce its output in one of the above described special patterns.
  - $1400\text{mm/s} < \text{Spindle moving speed}$
  - At a disturbance such as interference, vibration, etc.
2. Minimum edge-to-edge interval of output pulses =  $0.5\mu\text{s}$

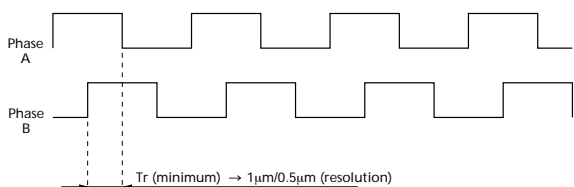
#### [NOTE]

- Since any output during error can not be used as the attribute data, it is necessary to detect the error condition at the reception circuitry side.
- It is recommended to design user circuitry based on an IC chip that is capable of counting at  $2\text{Mcps}$  (equivalent to square wave of  $500\text{kHz}$ ) or greater.

## Data Output Timing on LGB ( $1\mu\text{m}$ reading), LGF ( $1\mu\text{m}/0.5\mu\text{m}$ reading)

The above listed gages are provided with the following three patterns for their output signals. Therefore, always design the reception circuitry so that it includes an error detecting process making use of these patterns:

### 1) Real-time pulse output (Phase-A wave advances when the spindle is retracted.)

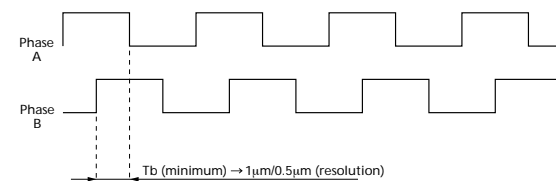


1. Output condition: Spindle moving speed  $\leq 250\text{mm/s}^{*2}$
2. Minimum edge-to-edge interval of output pulses =  $\text{Tr}^{*4}$
3. Output delay time\*1: Max.  $1\mu\text{s}$

### 2) Burst pulse output (Phase-A wave advances when the spindle is retracted.)

When the response speed reaches the speed limit of real-time pulse output, the linear gage will switch its signal output form to that consisting of burst pulses. At this time, these burst pulses will be such 2-phase square wave signals

that are forcibly created from the internal clock so the minimum edge-to-edge interval in their output is smaller than the normal real-time pulse output. The burst pulses will not always be outputted as to exactly reflect the actual motion and the delay in signals also becomes larger, but the counting values will be still valid provided this output form continues.

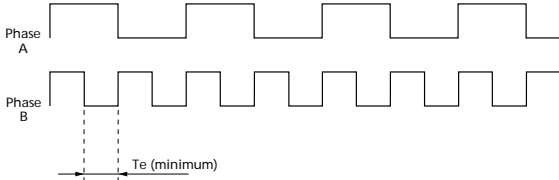


1. Output condition:  $250\text{mm/s}^{*2} < \text{Spindle moving speed} \leq \text{Gage response speed}^{*3}$
2. Minimum edge-to-edge interval of output pulses =  $\text{Tb}^{*4}$
3. Output delay time\*1:
  - At one-way displacement = Max.  $5\mu\text{s}$
  - At two-way displacement (including the reverse direction) = Max.  $10\mu\text{s}$

# Gage Output Specifications

## 3) Error output

The pulse generation circuit may sometimes overstep its response limit, if the output wave is subject to extreme disturbance due to vibration or impact in the gage unit, or if the spindle moves faster beyond the output limit of burst pulses. However, at this timing, as the linear gage will automatically switch its output signal form from burst pulses to error pulses in addition to synchronize Phase A and Phase B of the 2-phase square wave signals, the user can make use of this facility for error detection.



1. Output condition: LGB will be identified as error under the following conditions and produce its output in one the above described special patterns.

- Gage response speed<sup>\*3</sup> < Spindle moving speed
- At a disturbance such as interference, vibration, etc.

2. Minimum pulse width of output pulses =  $Te^{*4}$

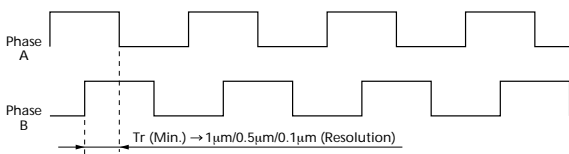
### [NOTE]

- Since any output during error can not be used as the attribute data, it is necessary to detect the error condition at the reception circuitry side.
- It is recommended to design user circuitry based on an IC chip that is capable of counting at 5Mcps (equivalent to square wave of 1.25MHz) or greater.

## Data Output Timing on LGB/LGF (0.1μm reading), LGK (1μm/0.5μm/0.1μm reading) LG/LGM (1μm/0.1μm reading)

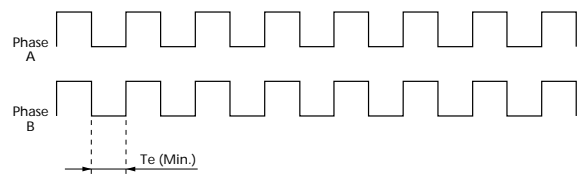
The above listed gages are provided with the following two patterns for their output signals. Therefore, always design the reception circuitry so that it includes an error detecting process making use of these patterns:

### 1) Real-time pulse output (Phase-A wave advances when the spindle is retracted.)



1. Output condition: Spindle moving speed  $\leq$  Gage response speed<sup>\*3</sup>
2. Minimum edge-to-edge interval of output pulses =  $Tr^{*4}$
3. Output delay time<sup>\*1</sup>: Max. 2.5μs

### 2) Burst pulse output (Phase-A wave advances when the spindle is retracted.)



1. Output condition: Linear gages will be identified as error under the following conditions and produce its output in one the above described special patterns.
  - Gage response speed<sup>\*3</sup> < Spindle moving speed
  - At a disturbance such as interference, vibration, etc.
2. Minimum pulse width of output pulses =  $Te^{*4}$

\*1: Output delay time: Time until the counting pulse catches up the spindle position.

\*2: The actual limit of real-time pulse output will be depreciated to this value. This is because actual detection signals unavoidably contain acceleration components in association with the spindle motion as well as error components from a little noise included in the signal itself. As a result, some burst pulses at a speed below the ideal conditions (i.e. ideal signal form at constant speed) may be generated.

\*3: Gage respond speed: Refer to the section of specifications of the User's Manual.

\*4: Minimum edge-to-edge interval/pulse width under each condition

Model	Resolution	Tr (At real-time pulse output)	Tb (At burst pulse output)	Te (At error pulse output)
LGB	1μm	1μs	0.5μs	0.2μs
LGF		0.4μs	-	0.4μs
LGK		0.2μs	-	0.2μs
LG/LGM	0.5μm	1μs	0.2μs	0.2μs
LGF		0.2μs	-	0.2μs
LGB	0.1μm	0.2μs	-	0.2μs
LGF				
LGK				
LG/LGM				

### [NOTE]

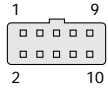
- Since any output during error can not be used as the attribute data, it is necessary to detect the error condition at the reception circuitry side.
- It is recommended to design user circuitry based on an IC chip that is capable of counting at 5Mcps (equivalent to square wave of 1.25MHz) or greater.

# Digimatic Code

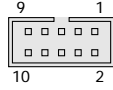
## 1) Applicable receptacle

Sumitomo 3M: V Low-Proheader  
Model: 7610-5002XX or equivalent

## 2) Pin assignments and signals



Gage plug



External device receptacle

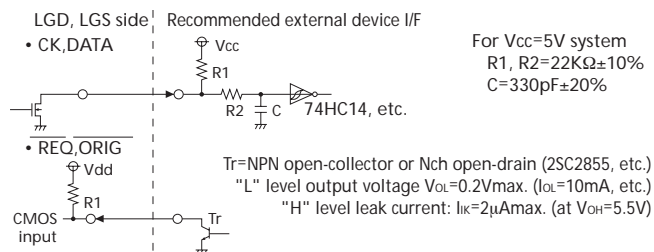
Pin No.	Signal	I/O	LGD, LGD-M, LGS
1	GND	—	Signal ground
2	DATA	Output	Measurement data-output terminal
3	CK	Output	Synchronized clock-output terminal
*14	N.C.	—	Not used
5	REQ	Input	Input terminal for data transmission request from external device
*16	ORIG	Input	Input terminal for absolute-origin setting signal
*17	N.C.	—	Not used
*18	N.C.	—	Not used
*19	+5V	—	Power supply terminal (+5 V $\pm$ 10%)*2
*110	GND(F.G.)	—	Frame ground

\*1: LGD, LGS uses a unique specification.  
All others use the common Digimatic output specification (10-pin, square).  
\*2: Current consumption of LGD,LGS: I<sub>dd</sub> = 20 mA max.

## 3) I/O electrical specifications

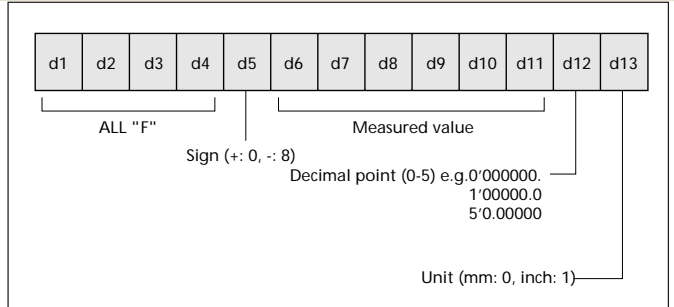
- Output terminal format: CK, DATA  
Nch open drain  
Maximum output current: 400  $\mu$ A max. (when V<sub>ol</sub> = 0.4 V)  
Output withstand voltage: -0.3 V to 7 V
- Input terminal format: REQ, ORIG  
Pull-up CMOS input  
Internal power supply voltage: V<sub>dd</sub> = 1.35 to 1.65 V  
Pull-up resistance: R<sub>1</sub> = 10 to 100 K $\Omega$   
"H" level input voltage: V<sub>IH</sub> = 1.1 V min.:  
"L" level input voltage: V<sub>IL</sub> = 0.3 V max.

## 4) Recommended receiving circuit



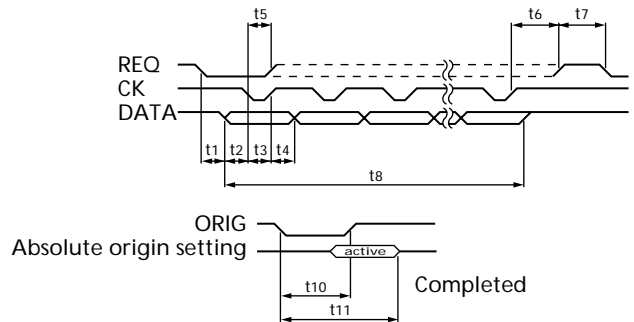
Note: Since the power supply voltages are different between the gage side and the external device side, be sure to use an open collector or open drain circuit. Do not use CMOS output or the like.

## 5) Data format



- Data is output as 13-digit (52-bit) based on 4bits = 1digit.
- Data is output in the order from d1 to d13. Each digit is output in the order from LSB to MSB.
- Measured data is output in the order from MSD to LSD.
- The sign, measured data, decimal position and unit are output by BCD based on positive logic (0 = L, 1 = H).

## 6) Timing chart



SDP standard (for reference only)			LGD, LGS		
Symbol	min.	max.	Symbol	min.	max.
*t1	0 $\mu$ s	2sec	*t1	30 $\mu$ s	95ms
t2	15 $\mu$ s	—	t2	15 $\mu$ s	—
t3	100 $\mu$ s	—	t3	100 $\mu$ s	—
t4	100 $\mu$ s	—	t4	100 $\mu$ s	—
t5	0 $\mu$ s	—	t5	0 $\mu$ s	—
*t6	—	—	*t6	—	100 $\mu$ s
*t7	—	—	*t7	100 $\mu$ s	—
*t8	—	—	*t8	—	30ms
			<b>Symbol min. max.</b>		
*t10	1.5s	—			
*t11	—	4s			

- Note 1: The specifications indicated by an asterisk (\*) are applicable only to LGD, LGS. All other Digimatic output specifications are common to all models.
- Note 2: Read data only when CK is at the "L" level.
- Note 3: Do not input REQ signal (fixed at "H") while the absolute origin is being set (during t11).
- Note 4: If t5, t6 and t7 are satisfied and REQ is continuously input, an output is obtained from LGD, LGS at intervals of approximately 95ms.
- Note 5: Start inputting ORIG and REQ after two or three seconds have elapsed (the estimated time required for internal circuit/sensor to stabilize) following power-on.

# Linear Gage and Counter Connections & Comparisons of Counter Functions

Representative Code No.	KH Counter	EC Counter	EG Counter				EB Counter			EF Counter				EV Counter		
		542-007	542-015	542-017	542-016	542-092	542-094	542-093	542-060	542-065	542-062	542-066	542-063	542-064	542-067	
<b>Applicable gages</b>																
0.00001mm Laser Hologage	●															
0.0001mm Laser Hologage			●						●		●					
0.0001mm LG/LGM			●						●		●					
0.0001mm LGK/LGB/LGF			●						●		●					
0.0005mm LGK/LGF			●					●	●		●		●			
0.0005mm LGF w/origin point mark				●				●		●		●			●	
0.001mm LGF w/origin point mark				●				●		●		●			●	
0.001mm LG/LGM			●					●		●		●				
0.001mm LGK/LGB/LGF			●					●		●		●				
0.005mm LGE			●					●		●		●				
0.01mm LGD/LGD-ML		●			●									●		
0.01mm LGS		●			●									●		
<b>Functions</b>																
Number of connectable gages	1	1	1	1	1	1	1	1	1	1	2	2	6	6	6	
Display	●	●	●	●	●	●	●	●	●	●	●	●	*1	*1	*1	
Zero set	●	●	●	●	●	●	●	●	●	●	●	●	*1	*1	*1	
Presetting	●	●	●	●	●	●	●	●	●	●	●	●	*1	*1	*1	
Direction switch	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GO/±NG indication		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GO/±NG output		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
5-stage tolerance display/output			●	●	●	●	●	●	●	●	●	●				
3-stage tolerance display/output		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
mm/inch switch	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
ABS gage zero set		●			●			●						●	●	
ABS/INC gage changeover		●			●			●						●	●	
Peak hold			●	●	●	●	●	●	●	●	●	●	●	●	●	
Run out (TIR) measurement			●	●	●	●	●	●	●	●	●	●	●	●	●	
Double count	●								●	●	●	●				
Sum/difference calculation											●	●				
Lower digit blank-out		●	●	●	●				●	●	●	●				
External zero set		*2	*2	*2	*2	*2	*2	*2	●	●	●	●	●	●	●	
External preset		*3	●	●	●	●	●	●	●	●	●	●	●	●	●	
External hold		*3	●	●	●	●	●	●	●	●	●	●	●	●	●	
External tolerance set (when a PC is used)									●	●	●	●	●	●	●	
External tolerance memory switch (when I/O is used)			●	●	●	●	●	●								
External peak-hold cancel			●	●	●	●	●	●	●	●	●	●	●	●	●	
Inter-axial calculation function													●	●	●	
<b>Output</b>																
Power-supply voltage error		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Overspeed error			●	●		●	●		●	●	●	●	●	●		
Overflow error		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Gage error		●	●	●	●	●	●	●	●	●	●	●	●	●		
Tolerance setting error		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Communication error									●	●	●	●	●	●	●	
Parallel BCD output			●	●	●								●	●	●	
Serial BCD output						●	●	●								
Simple analog output						●	●	●								
Tolerance judgment output		*3	●	●	●	●	●	●	●	●	●	●	●	●	●	
Limit output						●	●	●								
Segment output													●	●	●	
RS-232C output	●								*3	*3	*3	*3	●	●	●	
Digimatic output		*5				●	●	●	*4	*4	*4	*4				
RS link (Maximum number of gages)									*3 (6)	*3 (6)	*3 (12)	*3 (12)	● (60)	● (60)	● (60)	

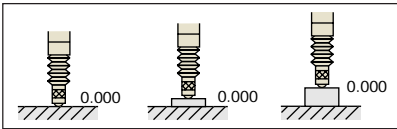
\*1: When an optional D-EV is connected.  
 \*2: Enabled by setting "0" via external presetting.  
 \*3: Switchable between the Digimatic output.  
 \*4: Switchable between the RS-232C output.  
 \*5: Switchable between the tolerance judgment output.



# Explanation of functions

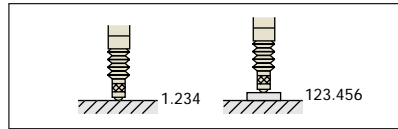
## Zero set

Sets the displayed value to 0 at any position.



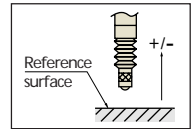
## Preset

Presets the displayed value at any value. Counting begins at the preset value.



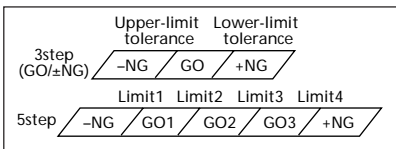
## Direction switch

Selects the counting direction of (+) or (-), whichever is convenient with a given direction of spindle movement.



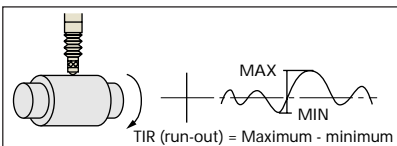
## Tolerance judgment indication/output

Sets two (or four) desired tolerances for three (or five) stages. Judgment results can be output to an external device.



## Peak hold/TIR measurement

Allows switching to the measurement mode for maximum value, minimum value, and run out value (maximum - minimum), in addition to the normal measurement mode.



## Segment output

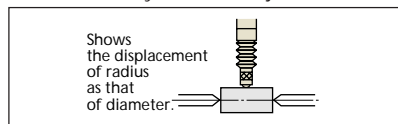
The function used to divide the specified range into 21 equal segments and output where the measured value falls among the 23 segments, including the segments before and after the divided segments.

## Inch/mm switch

Selects mm or inch as the unit of display, and enables the automatic conversion of displayed values according to the selected unit.

## Double count

Displays a value twice the actual count value. Allows the direct reading of diameter for cylindrical objects.



## ABS gage zero set

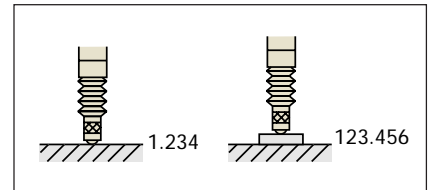
Sets the absolute origin of an LGD gage from the counter side. Once set, the absolute origin will be maintained even during a power failure or when the counter is disconnected.

## ABS/INC gage changeover

Sets the absolute origin of an LGD gage from the counter side. Once set, the absolute origin will be maintained even during a power failure or when the counter is disconnected.

## Sum/difference calculation

Enables measurement of thickness or step using two gages.



## External control

Zero set, preset and display hold can be controlled from the I/O terminals.

## I/O output

For input/output of external control signals and tolerance judgment result to/from the PLCs or other external devices.

## BCD output

The displayed value can be output as one of I/O signal to a sequence, etc.

## Digimatic output

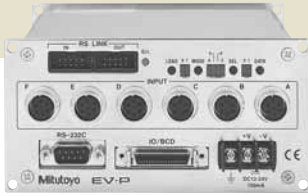
Data can be output to various printers and statistical processing devices, such as DP-1HS and MUX-10, using Digimatic Code (SPC) output.

## Communication via RS-232C interface

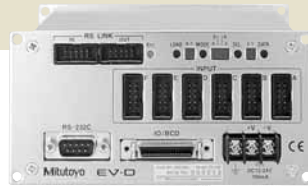
RS-232C allows communication with a personal computer. It allows not only the reading of measured values but also data transmission to the counter and remote operations, such as when changing various settings.

# EV counter

for Multi-gage System  
Multi-function counter



For the gage with differential-square-wave output



For the gage with Digimatic Code output



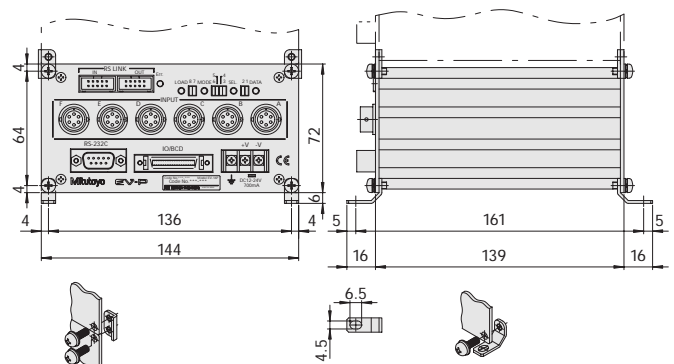
For the gage with scale reference point

## FEATURES

- Up to six gages can be connected to one unit.
- Able to connect up to 10 EV counters to one personal computer using the RS link function to facilitate the configuration of a multi-point measurement system comprising a maximum of 60 gages.
- A range of output modes to choose from; I/O output for tolerance judgment and segment output, BCD data output and RS-232 output are available.
- Peak-hold measurements are possible for maximum value, minimum value, runout (TIR), etc.
- Able to calculate a sum, average, maximum, minimum, maximum difference, etc., between gages connected to the same unit.

## Dimensions

Unit: mm



Interconnecting EV counters

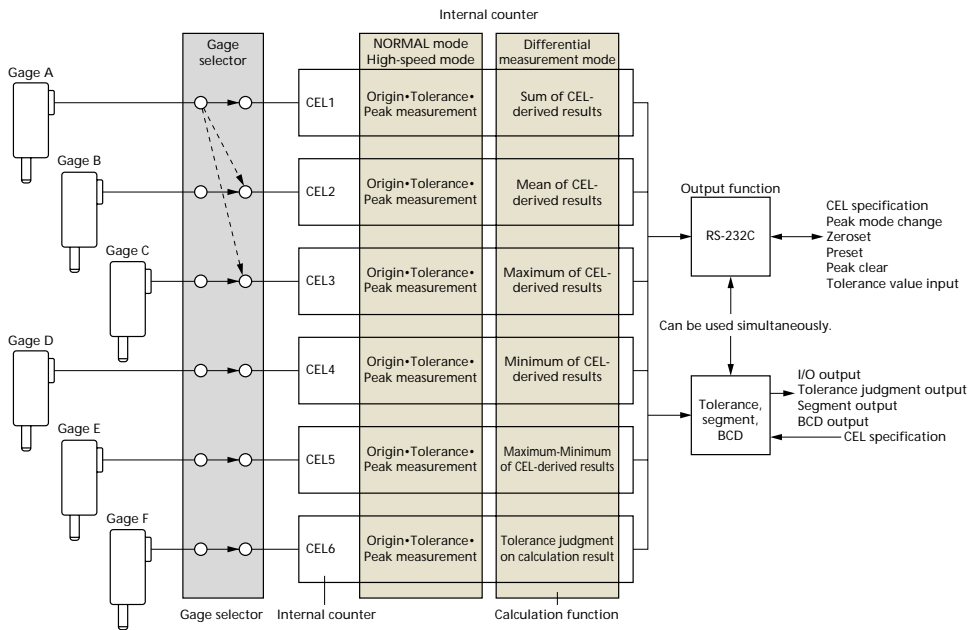
Affixing an EV counter

## SPECIFICATIONS

Order No.	542-063	542-067	542-064
Applicable input	Differential square-wave		Digimatic Code (SPC)
Applicable gage	LGB (ex. 0.0001mm resolution), LGF, LGE, LG	LGF with origin point mark	LGD, LGD-M, LGS
Number of gage input	6		6
Resolution (internal) - no display capability	0.0005mm, 0.001mm, 0.005mm, 0.01mm, .000005", .00005", .0005"		0.001mm*1, 0.01mm, .00005"*, .0005"
Function	GO/±NG judgment, GO/±NG signal output, MAX/MIN/TIR (runout) measurement, counting direction switching, mm/inch switching, calculation of sum, average, maximum, minimum and maximum difference between specified axes, and output-mode selection		
Output	I/O: Normal operation output and GO/±NG signal (three steps), measurement data (BCD code), or 21-stage segment output (selectable) RS-232C: Various measurement data		
External Control	I/O: Axis designation, preset, data hold, and error clear RS-232: Displayed value output command, MAX/MIN/TIR switching and peak value clear, zero set, preset value input, tolerance value input, error clear, and command to output calculated value between specified axes		
RS Link	Up to 10 EV counters may be connected via a single RS-232 port. (daisy chain) EV and EF counters can be mixed (in which case a total of six counters can be connected).		
Error display/output	Power-supply voltage error, overspeed error, overflow error, gage error, communication error, and tolerance setting error		
Maximum input frequency	1.25MHz (differential square-wave): Max counting Speed : 5 MHz		—
Power supply	Terminal block (M3 screws), DC +12 to +24V, 700mA (max.)		
Operating temperature	0°C to 40°C (20%RH to 80%RH, without condensation)		
Mass (main unit only)	910g		830g
Standard accessories	Mounting feet (four pieces), brackets (four pieces), and mounting screws M4 x 8 (eight pieces)		

\*: Will not be indicated when combined with an LG gage.

## INTERNAL BLOCK DIAGRAM



### Gage selector

It is possible to assign gage signals one-to-one or one-to-many to the internal counters through parameter settings. This allows the user to set more than one origin point and/or tolerance limit onto one piece of linear gage.

### Internal counter

To the 6 units of internal counters (CEL1-CEL6) it is possible separately perform the origin setting, peak measurement, and tolerance limit setting.

### Calculation function

Each of the internal counters is assigned a unique calculation function so that various kinds of calculation can be made between the internal counters specified with the parameters.

### Output function

The output type can be selected from RS-232C output, BCD output, tolerance judgment result output, and segment output. The objective CEL of output can be selected with an appropriate RS-232C command or SET signal.

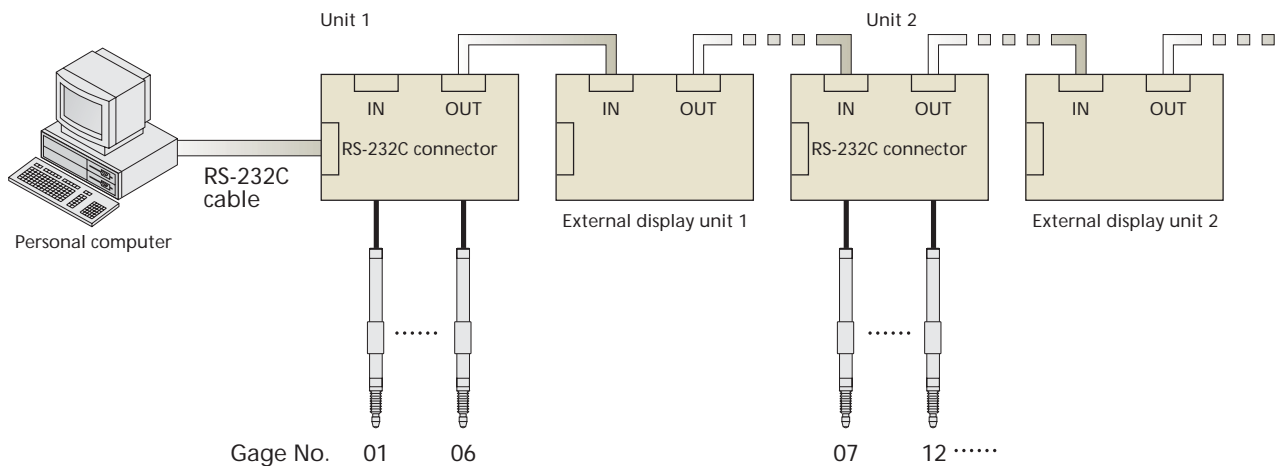
## RS LINK FUNCTION

• Patent registered (Application country: Japan, U.S.), Patent pending (Application country: E.U.)

It is possible to connect maximum 10 counter units and perform maximum 60 channels of multi-point measurement at a time.

For this connection use the dedicated RS link cable; No. 02ADD950 (0.5m), 936937 (1m) or 965014 (2m)

(The maximum total length of RS link cables permitted for the entire system is 10m.)



# EV counter

for Multi-gage System  
Multi-function counter

## RS-232C COMMUNICATION FUNCTION

Makes it possible not only to log measured values but also make various remote settings including the zero-setting of counter, etc.

Command format	Corresponding output	Operation contents
GA**CRLF	G#**, +01234.567CRLF	Outputs the [Displayed value] through RS-232C.
CN**CRLF	CH**CRLF	Switches the display to the [Current value].
CX**CRLF	CH**CRLF	Switches the display to the [Maximum value].
CM**CRLF	CH**CRLF	Switches the display to the [Minimum value].
CW**CRLF	CH**CRLF	Switches the display to the [TIR (runout)].
CR**CRLF	CH**CRLF	Zeraset
CL**CRLF	CH**CRLF	Clears the peak value.
CP**, +01234567CRLF	CH**CRLF	Inputs the preset value and performs presetting.
CD**, +01234567CRLF	CH**CRLF	Inputs lower tolerance value.
CG**, +01234567CRLF	CH**CRLF	Inputs upper tolerance value.
CS**CRLF	CH**CRLF	Cancel the error.
CK**CRLF	CH**, \$CRLF (\$=0 or 1)	Confirms the HOLD state.
CT¥YCRLF	CH¥¥, +01234.567CRLF	Outputs the [Displayed value] through RS-232C.

\*1: [\*\*] denotes a gage channel number between 01 and 99 (\*00\* means all channels).

\*2: [#] denotes the type of data [N: Current value, X: Maximum value, M: Minimum value, W: TIR (runout)].

\*3: CRLF: CR (carriage return), LF (line feed)

\*4: For presetting and tolerance limit setting, enter each value consisting of a sign and 8 digits of numeric value without a decimal point.

\*5: The tolerance limit setting should be performed in the order of CD and CG.

\*6: All-channel specification is not permitted on data-request of calculation values.

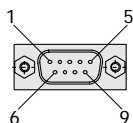
Note 1: The RS communication function will be suspended during key operation (e.g. setting parameters, preset values, or tolerance limits). It automatically resumes the command and data output operation when the gage is recovered to such a condition that the counting is possible.

Note 2: For canceling the counting-standby state, use CS00CRLF (specification of all channels).

## INPUT/OUTPUT SPECIFICATIONS

### ■RS-232C Specifications

- 1) Applicable plug: D-sub9 pin (female), inch thread specification
- 2) Pin assignment



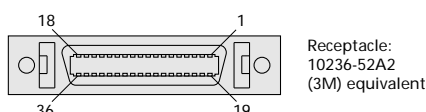
Pin No.	Description	I/O	Contents (application)
2	RXD	IN	Receive data
3	TXD	OUT	Send data
4	DTR	OUT	Data terminal ready
5	GND	-	Ground
6	DSR	IN	Data set ready
7	RTS	OUT	Request to send
8	CTS	IN	Clear to send
1, 9	N.C.	-	Connection impossible

- 3) Communication specifications (conforming to EIA RS-232C)

Home position	DTE (Data Terminal Equipment). Use a cross-type cable.
Communication method	Half-duplex, teletype protocol
Data transfer rate	4800, 9600, 19200bps
Bit configuration	Start bit: 1 Data bits: (7, 8) ASCII, upper-case characters Number of parity bits: None, even, odd Number of stop bits: 2
Setting the communication conditions	Set via parameters.

## ■ I/O Connector Terminal Specifications

- 1) Applicable plug: 02ADB440 (with cover)
- 2) Pin assignment



## ■ Various Output Functions

Select either "Tolerance judgment result output", "Segment output", or "BCD output" depending on the customer needs.

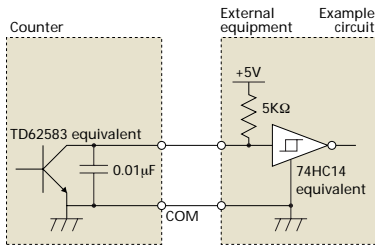
Tolerance judgment result output				Segment output				BCD output		
Pin No.	Description	Contents (application)	I/O	Description	Contents (application)	I/O	Description	Contents (application)	I/O	
1	COM	Common terminal for I/O circuit	-	COM	Common terminal for I/O circuit	-	COM	Common terminal for I/O circuit	-	
2	COM	(to be connected to the internal GND)	-	COM	(to be connected to the internal GND)	-	COM	(to be connected to the internal GND)	-	
3	CEL1_-NG	Tolerance judgment result	O	-OVER	- over-range	O	1X10 <sup>0</sup>	O BCD output will be made through the specified channel.	O	
4	CEL1_GO	output pin (1CH)	O	-L10	O With the specified channels ranges, make output from ±10 divisions.	O	2X10 <sup>0</sup>		O	
5	CEL1_+NG		O	-L9		O	4X10 <sup>0</sup>		O	
6	CEL1_NOM	Outputs "L" where the counting is possible.	O	-L8		O	8X10 <sup>0</sup>		O	
7	CEL2_-NG	Tolerance judgment result	O	-L7		O	1X10 <sup>1</sup>		O	
8	CEL2_GO	output pin (2CH)	O	-L6		O	2X10 <sup>1</sup>		O	
9	CEL2_+NG		O	-L5		O	4X10 <sup>1</sup>	O		
10	CEL2_NOM	Outputs "L" where the counting is possible.	O	-L4	O	8X10 <sup>1</sup>	O			
11	CEL3_-NG	Tolerance judgment result	O	-L3	O	1X10 <sup>2</sup>	O			
12	CEL3_GO	output pin (3CH)	O	-L2	O	2X10 <sup>2</sup>	O			
13	CEL3_+NG		O	-L1	O	4X10 <sup>2</sup>	O			
14	CEL3_NOM	Outputs "L" where the counting is possible.	O	L0	O	8X10 <sup>2</sup>	O			
15	CEL4_-NG	Tolerance judgment result	O	+L1	O	1X10 <sup>3</sup>	O			
16	CEL4_GO	output pin (4CH)	O	+L2	O	2X10 <sup>3</sup>	O			
17	CEL4_+NG		O	+L3	O	4X10 <sup>3</sup>	O			
18	CEL4_NOM	Outputs "L" where the counting is possible.	O	+L4	O	8X10 <sup>3</sup>	O			
19	CEL5_-NG	Tolerance judgment result	O	+L5	O	1X10 <sup>4</sup>	O			
20	CEL5_GO	output pin (5CH)	O	+L6	O	2X10 <sup>4</sup>	O			
21	CEL5_+NG		O	+L7	O	4X10 <sup>4</sup>	O			
22	CEL5_NOM	Outputs "L" where the counting is possible.	O	+L8	O	8X10 <sup>4</sup>	O			
23	CEL6_-NG	Tolerance judgment result	O	+L9	O	1X10 <sup>5</sup>	O			
24	CEL6_GO	output pin (6CH)	O	+L10	O	2X10 <sup>5</sup>	O			
25	CEL6_+NG		O	+OVER	+ over-range	O	4X10 <sup>5</sup>	O		
26	CEL6_NOM	Outputs "L" where the counting is possible.	O	NOM (ANG)	Outputs "L" where the counting is possible.	O	8X10 <sup>5</sup>	O		
27	EXTEND	Output "L" while the RS command is processed.	O	EXTEND	Output "L" while the RS command is processed.	O	SIGN	Sign of the counting value (+="H", -="L")	O	
28	READY	Data confirmation signal	O	READY	Data confirmation signal	O	READY	Data confirmation signal	O	
29	START	First CEL identification signal	O	START	First CEL identification signal	O	START	First CEL identification signal	O	
30	NORMAL	Normal signal	O	NORMAL	Normal signal	O	NORMAL	Normal signal	O	
31	PSET	Preset	I	PSET	Preset	I	PSET	Preset	I	
32	OUTCEL	Set the objective CEL of output.	I	OUTCEL	Set the objective CEL of output.	I	OUTCEL	Set the objective CEL of output.	I	
33	SET1	CEL specification data or segment range data	I	SET1	CEL specification data or segment range data	I	SET1	CEL specification data or segment range data	I	
34	SET2	CEL specification data or segment range data	I	SET2	CEL specification data or segment range data	I	SET2	CEL specification data or segment range data	I	
35	SET3	CEL specification data or segment range data	I	SET3	CEL specification data or segment range data	I	SET3	CEL specification data or segment range data	I	
36	HOLD	Hold/Peak clear	I	HOLD	Hold/Peak clear	I	HOLD	Hold/Peak clear	I	

# EV counter

## for Multi-gage System Multi-function counter

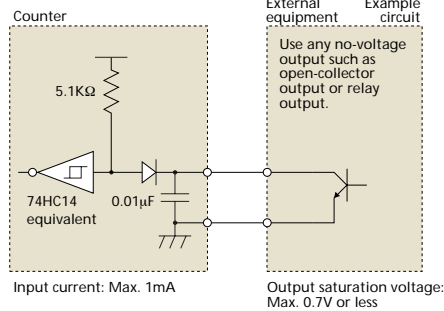
### 3) I/O circuit

- Output circuit: Tolerance judgment result output, NOM, segment output, etc.  
Transistor is "ON" to operate the line to "L" (open-collector output).



Dielectric output voltage: Max. 24V  
Output current: Max. 10mA  
Output saturation voltage: Max. 0.7V

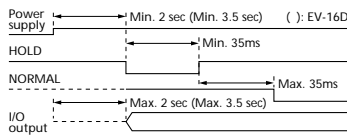
- Input circuit: P.SET, HOLD, SET, etc.  
Input is valid when the line is "L".



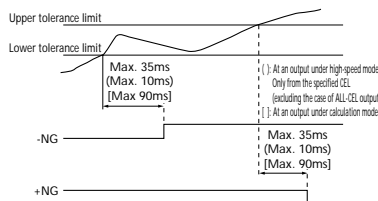
### 4) Timing chart

- Power ON characteristics

Where the RS link is established, the reference counter shall be the one that was powered lastly.



- Tolerance judgment result output period  
All CELs will not output simultaneously.



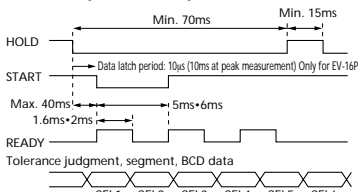
Note: The output period in the case of ED-V counter depends on the gage unit being connected.

### 3. Data output

There are two data output methods; Command mode and Interval mode. Either of them can be set via the I/O output mode parameters.

- Command mode (All-CEL output)

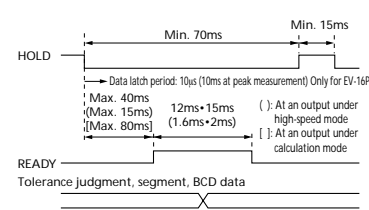
All-CEL data output (specified with SET1 through SET3) while the HOLD and READY lines are synchronously controlled.



\* During HOLD input the UNIT LED (D-EV) will be flashing.

- Command mode (Individual CEL output)

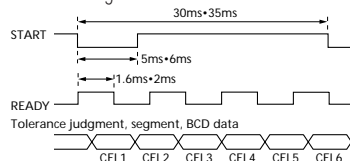
Individual CEL data output (specified with SET1 through SET3) can be performed while the HOLD and READY lines are synchronously controlled.



Note: When it is required to operate in the high-speed mode or All-CEL output mode, always use equipment whose input response time is 1ms or less.

- Interval mode (All-CEL output)

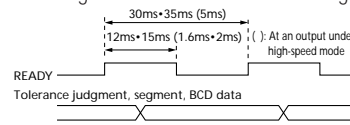
All-CEL data (specified with SET1 through SET3) will be sequentially outputted according to the counter's internal timing.



Note: When it is required to operate in the high-speed mode or All-CEL output mode, always use equipment whose input response time is 1ms or less.

- Interval mode (Individual CEL output)

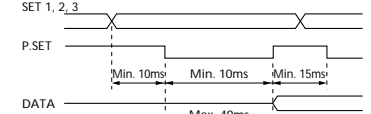
Individual CEL data (specified with SET1 through SET3) will be sequentially outputted according to the counter's internal timing.



Note: The data update time in the case of 542-064 depends on the type of gage being connected. In addition, the same data may be outputted over multiple cycles.

- External presetting

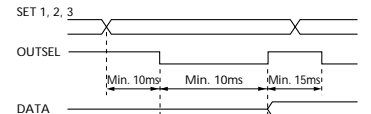
Assume the current value of CEL (which has been specified with SET1 through SET3) as the preset value.



If the presetting is executed, the peak value up until then will be cleared. (Max=Min=Current value, TIR=0)

- Specification of objective CEL of output/

Specification of calculation method  
Assigns the CEL that has been specified with SET1 through SET3 to the data output CEL.

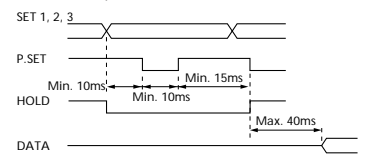


Input with SET3 through SET1 during segment output. This usually operates as the range specification data. (This acts as CEL specification when OUTCEL is inputted.)

- NORMAL, High-speed mode: Specification of the output CEL
- Differential calculation mode: Specification of the calculation method

- Peak clear

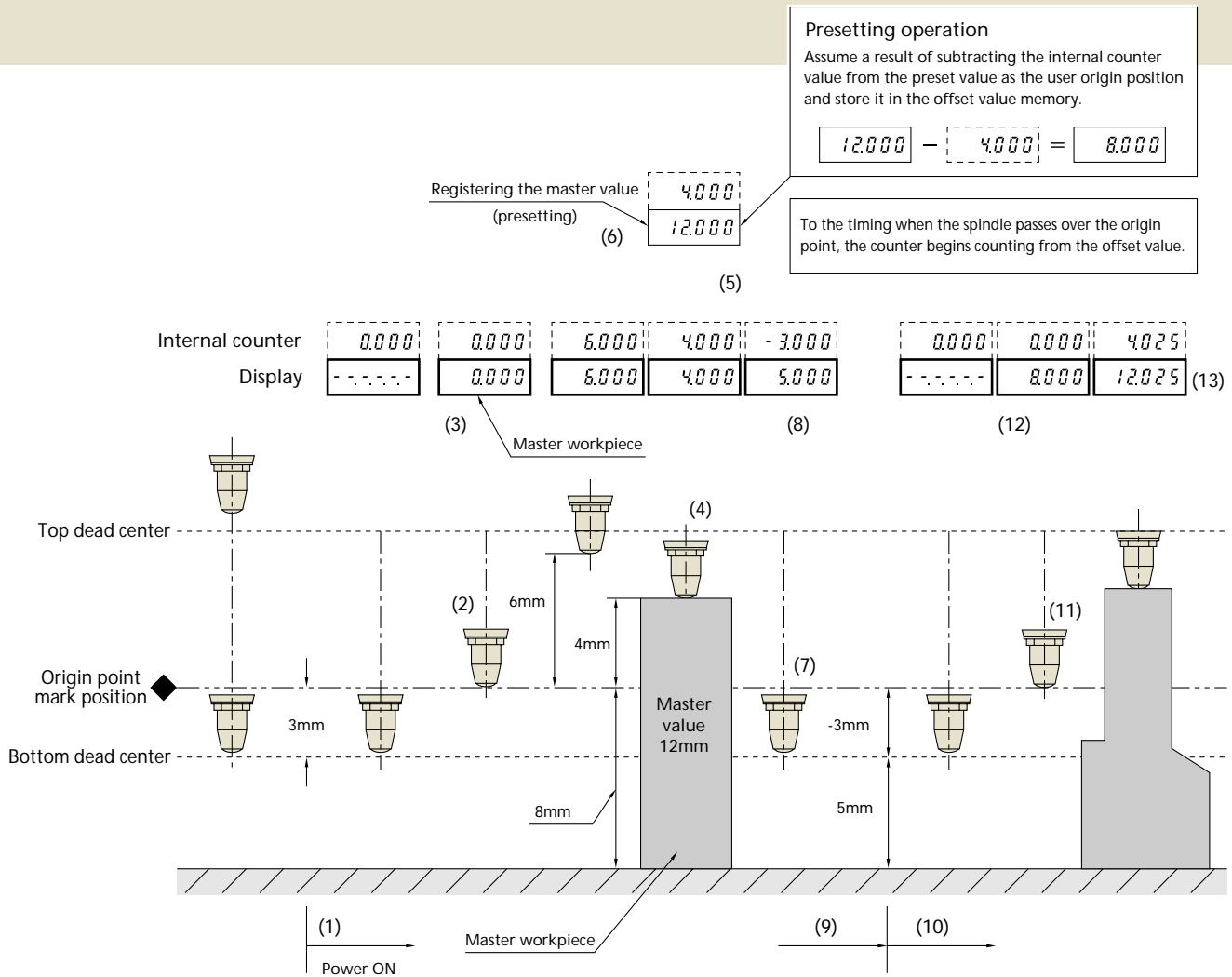
Clears the peak value.



Note: Peak clear takes effect only in the peak mode. (In case of a current value, this effects as presetting operation.)



# Description of the Origin-Point Mark Detecting Operation (Counters for Linear Gages with Origin Point Mark)



Note) The example linear gage used in the above explanation is LGF-0510 (110) ZL. This linear gage has its origin point marked at a position approximately 3mm from the bottom dead center. In the case of 25/50mm-stroke types the origin point mark is placed approximately 5mm from the bottom dead center.

## Procedure of detecting the origin-point mark

1. Turn the power of the counter connected to the linear gage to ON.
2. Displace the linear gage spindle approximately more than 3mm from the bottom dead center position to make it pass over the origin point mark.
3. The counter will automatically read the origin point and zero-set itself.
4. Set the master workpiece in position.
5. The counter displays a displacement from the origin point position.
6. Register the master value (presetting).
7. Remove the master workpiece.
8. The counter displays the relative value from the preset value.
9. Turn off the counter power once.
10. Re-power the counter.
11. Displace the linear gage spindle approximately more than 3mm from the bottom dead center position to make it pass over the origin point mark.
12. The counter will automatically read the origin point and begin counting from the value that is resulted from the previous offset.
13. The counter displays the value of the measured workpiece (measurement).

# EF counter

## Multi-function Type



Single-display type  
(with 1gage input channel)

Double-display type  
(with 2gage input channels)

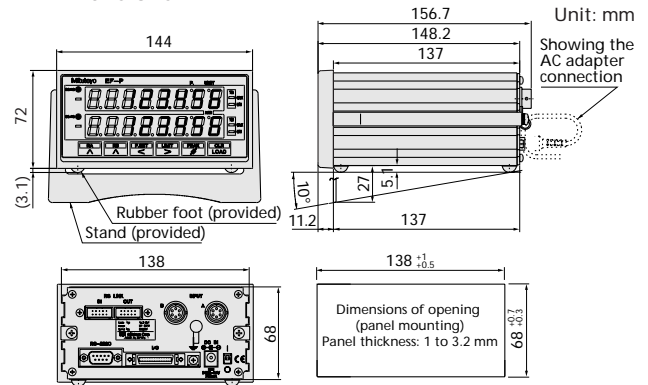
Single-display type for  
LGF with origin point mark  
(with 1gage input channel)

Double-display type for  
LGF with origin point mark  
(with 2gage input channels)

### FEATURES

- DIN compatible Panel-mounting type and DIN size (144 x 72mm). It can be easily incorporated into each system instrument.
- This counter can be used on a desktop by mounting it on the supplied stand leg.
- The standard RS-232C interface allows easy communication with an external PC.
- The RS Link function permits multiple EF counters (6 units maximum) to be connected with daisy chain and data to be input/output from one channel of the terminal RS-232C interface.
- The maximum value, minimum value, and TIR (runout) measurements are possible.
- The 2-gage input type can perform 2-axis display and make addition or subtraction calculations between 2 gages.

### Dimensions



### SPECIFICATIONS

Order No.	100V	542-060	542-062	542-065	542-066
(Order number suffix denotes the AC adaptor type equipped.)	120V	542-060A	542-062A	542-065A	542-066A
	220V	542-060D	542-062D	542-065D	542-066D
	240V	542-060E	542-062E	542-065E	542-066E
	—	542-060-1*1	542-062-1*1	542-065-1*1	542-066-1*1
Applicable input	Differential square-wave				
Applicable gage	LGK, LGF (excluding with scale reference point), LGB (excluding sign wave type), LGE, LGH (excluding sign wave type)		LGF with scale reference point		
Number of gage input	1 (Single-display)	2 (Double-display)	1 (Single-display)	2 (Double-display)	
Resolution (Depending on the linear gage type connected)	0.0001mm, 0.0005mm, 0.001mm, 0.005mm, 0.01mm, .000005", .00005", .0005"		0.0005mm, 0.001mm, 0.005mm, 0.01mm, .000005", .00005", .0005"		
Tolerance judgment display	LED display (3 steps: Amber, Green, Red/5 steps: Amber, Amber flash, Green, Red flash, Red)				
Function	Zeraset, preset, limit setting (3 or 5-step), GO/±NG judgement, GO/±NG signal output, MAX/MIN/TIR (runout) measurement, counting direction switching, double reading, mm/inch switching, sum/difference calculation of 2 gages (542-062, 542-066 only), output mode selection				
Output	I/O: Tolerance judgment output (3/5 stages), normal operation output RS-232C or Digimatic code (selectable): Various measurement data				
External Control	I/O: Preset, Data hold and Error clear RS-232C: Displayed value output, MAX/MIN/TIR switching, Zero set, peak value clear, preset value input, tolerance value input and error clear				
RS Link	Up to six EF counters may be connected via one RS-232C port. (daisy chain)				
Error display/output	Power-supply voltage error, overspeed error, overflow error, gage error, communication error, and tolerance setting error				
Maximum input frequency	1.25MHz (differential square-wave): Max counting Speed : 5MHz				
Power supply	Via AC adaptor (12 - 24V DC, 700mA (max))				
Operating environment	0°C to 40°C (20%RH to 80%RH, without condensation)				
Mass (main unit only)	760g	800g	800g	840g	
Standard accessories	Stand leg (one piece), rubber feet (four pieces), washer for adjusting the mounting plate thickness when securing the plate (six pieces), DC plug (one piece), AC adaptor (excluding model 542-06X-1)				

\*1: An AC adaptor is not required.

\*2: Only one LGH may be connected to one AC adaptor (provided as a standard accessory). To connect two gages, use a 542-062-1 and a separate power supply (12 to 24V DC, 1A or greater).

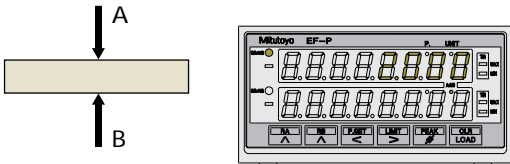


## SUM/DIFFERENCE CALCULATION FUNCTION (only with 542-062, 542-066)

It is possible to perform thickness measurement or step measurement using two gage units in combination.

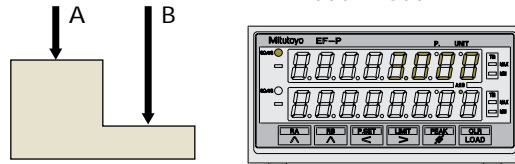
### ■ Measurement example 1

$$\text{Plate thickness measurement} = A+B = 1.000+1.000$$



### ■ Measurement example 2

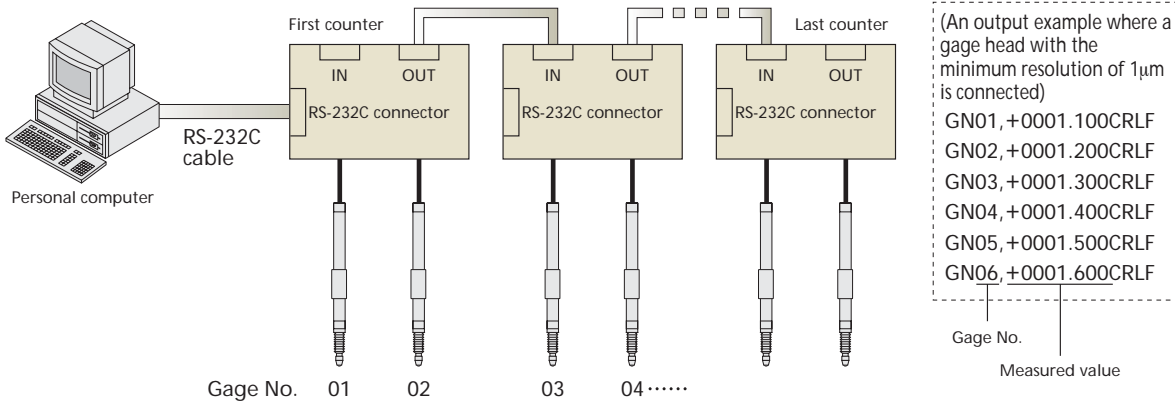
$$\text{Step measurement} = A-B = 1.000+1.000$$



## RS LINK FUNCTION • Patent registered (Application country: Japan, U.S.), Patent pending (Application country: E.U.)

It is possible to connect maximum 5 counter units and perform maximum 12 channels of multi-point measurement at a time.

For this connection use the dedicated RS link cable; No. 02ADD950 (0.5m), 936937 (1m) or 965014 (2m) (The maximum total length of RS link cables permitted for the entire system is 10m.)



(Example) Where 3 units of 542-062 are linked and the logging of display value is commanded through RS-232C.

## RS-232C COMMUNICATION FUNCTION

Makes it possible not only to log measured values but also make various remote settings including the zero-setting of counter, etc.

Command format	Corresponding output	Operation contents
GA**CRLF	G#**, +01234.567CRLF	Outputs the [Displayed value] through RS-232C.
CN**CRLF	CH**CRLF	Switches the display to the [Current value].
CX**CRLF	CH**CRLF	Switches the display to the [Maximum value].
CM**CRLF	CH**CRLF	Switches the display to the [Minimum value].
CW**CRLF	CH**CRLF	Switches the display to the [TIR (runout)].
CR**CRLF	CH**CRLF	Zeraset
CL**CRLF	CH**CRLF	Clears the peak value.
CP**, +01234567CRLF	CH**CRLF	Inputs the preset value.
CD**, +01234567CRLF	CH**CRLF	Inputs tolerance value S1.
CE**, +01234567CRLF	CH**CRLF	Inputs tolerance value S2.
CF**, +01234567CRLF	CH**CRLF	Inputs tolerance value S3.
CG**, +01234567CRLF	CH**CRLF	Inputs tolerance value S4.
CS**, +01234567CRLF	CH**CRLF	Cancel the error.

\*1: [\*\*] denotes a gage channel number between 01 and 99 ("00" means all channels).

\*2: [#] denotes the type of data [N: Current value, X: Maximum value, M: Minimum value, W: TIR (runout)].

\*3: CRLF: CR (carriage return), LF (line feed)

\*4: For presetting and tolerance limit setting, enter each value consisting of a sign and 8 digits of numeric value without a decimal point.

\*5: Perform the tolerance limit setting in the order of CD and CG for the case of 3-step tolerance judgment, and in the order of CD, CE, CF, and CG for the case of 5-step tolerance judgment.

Note 1: The RS communication function will be suspended during key operation (e.g. setting parameters, preset values, or tolerance limits). It automatically resumes the command and data output operation when the gage is recovered to such a condition that the counting is possible.

Note 2: For canceling the counting-standby state, use CS00CRLF (specification of all channels).

# EF counter

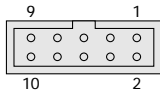
## Multi-function Type

### INPUT/OUTPUT SPECIFICATIONS

#### ■ Digimatic Code Output

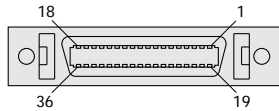
Possible to externally output the measured data and connect with a DP-1HS Digimatic Mini-Processor.

1) Receptacle to be used



#### ■ I/O Connector Terminal Specifications

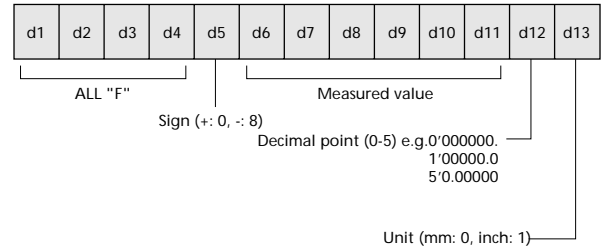
- Applicable plug: **02ADB440** (with cover)
- Pin assignment



Receptacle:  
10236-52A2  
(3M) equivalent

2) Data output format: A total of 13 digits will be outputted as follows.

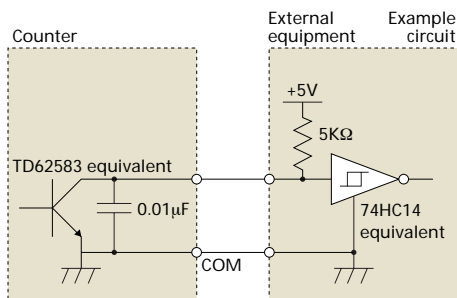
Each digit is represented by a 4-bit binary, and will be outputted beginning with LSB (least significant bit) of the least significant digit in the order of 20 → 21 → 22 → 23.



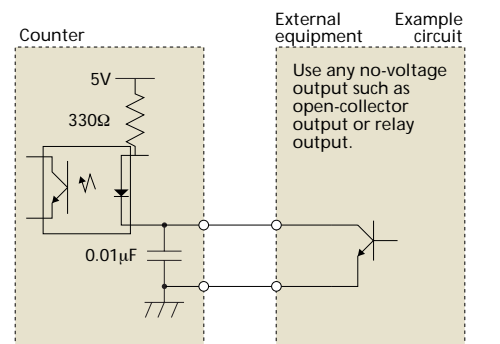
Pin No.	Description	I/O	Contents (application)
1	COM	-	Common terminal for input/output circuit (to be connected to the internal GND)
2	COM	-	
3	AL1	OUT	A-axis tolerance judgment result output pin <ul style="list-style-type: none"> <li>Only the pin that is involved in the judgment will output "L".</li> <li>At an error AL1, AL5 = Output of "L" AL2, AL3, AL4 = Output of "H"</li> </ul>
4	AL2	OUT	
5	AL3	OUT	
6	AL4	OUT	
7	AL5	OUT	
10	NOM	OUT	Outputs "L" where the counting is possible. <ul style="list-style-type: none"> <li>From 542-062, "H" will be outputted when an error occurs on either of A and B axes.</li> </ul>
11	BL1	OUT	B-axis tolerance judgment result output pin <ul style="list-style-type: none"> <li>Only the pin that is involved in the judgment will output "L".</li> <li>At an error BL1, BL5 = Output of "L" BL2, BL3, BL4 = Output of "H"</li> <li>From 542-060, normally outputs "H".</li> </ul>
12	BL2	OUT	
13	BL3	OUT	
14	BL4	OUT	
15	BL5	OUT	
34	HOLD	OUT	<ul style="list-style-type: none"> <li>The display value is held during input.</li> <li>When an error has occurred, the error will be cleared at the rise of this signal.</li> </ul>
35	PA	OUT	<ul style="list-style-type: none"> <li>Perform presetting.</li> <li>Peak clear: Entering a PA signal during input of HOLD signal in the peak mode serves as peak clear.</li> </ul>
36	PB	IN	Presetting or peak clear on B-axis (only with 542-062)
8, 9, 16 - 33	N.C.	IN	Unconnected terminal

#### 3) I/O circuit

- Output circuit: NOM, AL1 to AL5, BL1 to BL5 (only with **542-062**)  
Transistor is "ON" to operate the line to "L" (open-collector output).
- Input circuit: PA, PB (only with **542-062**), HOLD  
Input is valid when the line is "L".



Dielectric output voltage: Max. 24V  
Output current: Max. 10mA  
Output saturation voltage: Max. 0.7V

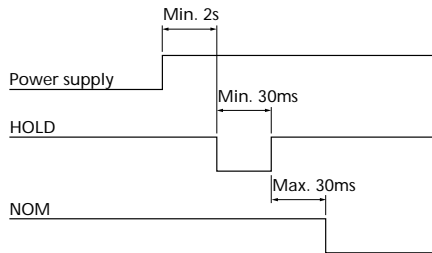


Input current: Max. 15mA

Output saturation voltage:  
Max. 0.7V or less

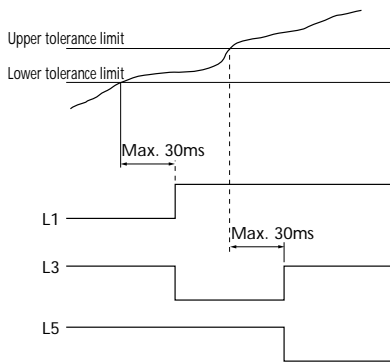
#### 4) Timing chart

##### 1. Power ON characteristics

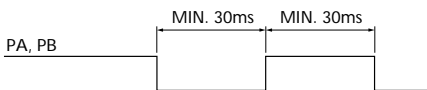


Note: With the RS link established the reference counter will be the one that was powered on lastly.

##### 2. Tolerance judgment result output period

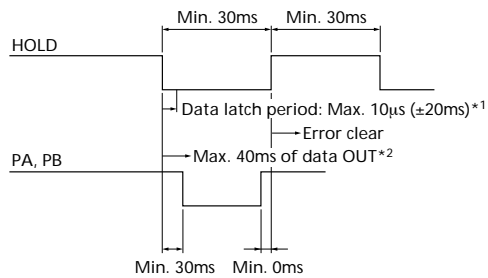


##### 3. External preset (PA, PB) input



Note: Excluding the period during key input, RS-232C communication or Digimatic processing.

##### 4. Peak clear input (After inputting HOLD, or simultaneous input with the preset value)

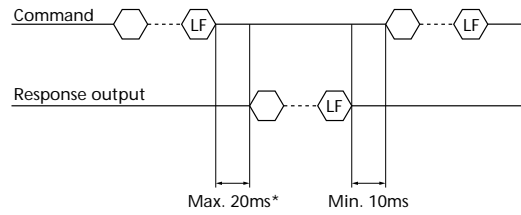


Note 1: ( ) represents the case either in the peak mode or in such the mode that an input of HOLD triggers RS-232C output.

Note 2: Case in such the mode that input of HOLD triggers RS-232C output.

Note 3: The PRESET indicator will be flashing during the input operation of HOLD.

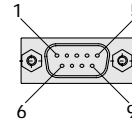
##### 5. RS-232C command input and response output



Note: Excluding the period during key input, RS-232C communication or Digimatic processing.

#### ■ RS-232C Specifications

- 1) Applicable plug: D-sub9 pin (female), inch thread specification
- 2) Pin assignment



Pin No.	Description	I/O	Contents (application)
2	RXD	IN	Receive data
3	TXD	OUT	Send data
4	DTR	OUT	Data terminal ready
5	GND	-	Ground
6	DSR	IN	Data set ready
7	RTS	OUT	Request to send
8	CTS	IN	Clear to send
1, 9	N.C.	-	Connection impossible

##### 3) Communication specifications (conforming to EIA RS-232C)

Home position	DTE (Data Terminal Equipment). Use a cross-type cable.
Communication method	Half-duplex, teletype protocol
Data transfer rate	4800, 9600, 19200bps
Bit configuration	Start bit: 1 Data bits: (7, 8) ASCII, upper-case characters Number of parity bits: None, even, odd Number of stop bits: 2
Setting the communication conditions	Set via parameters.

# EB counter

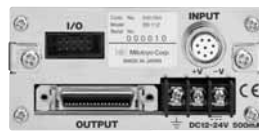
## Assembly Type Display Unit

### FEATURES

- Possible to produce 3-step/5-step X 7 kinds of tolerance output and limit value output independently for each of 7 channels.
- Provided with serial BCD output capability, which makes the connection to a programmable controller or personal computer, etc. possible with the minimum cabling requirement.
- Possible to perform dynamic measurement with the simplified analog output.
- Employed the DIN size (96X48mm) and mount-on-panel configuration, which greatly facilitates the incorporation into a system.



**EB-P Counter 542-092-2**  
For Differential Square-wave  
Output Linear Gage



**EB-Z Counter 542-094-2**  
For Differential Square-wave  
Output Linear Gage with  
Origin Point Mark

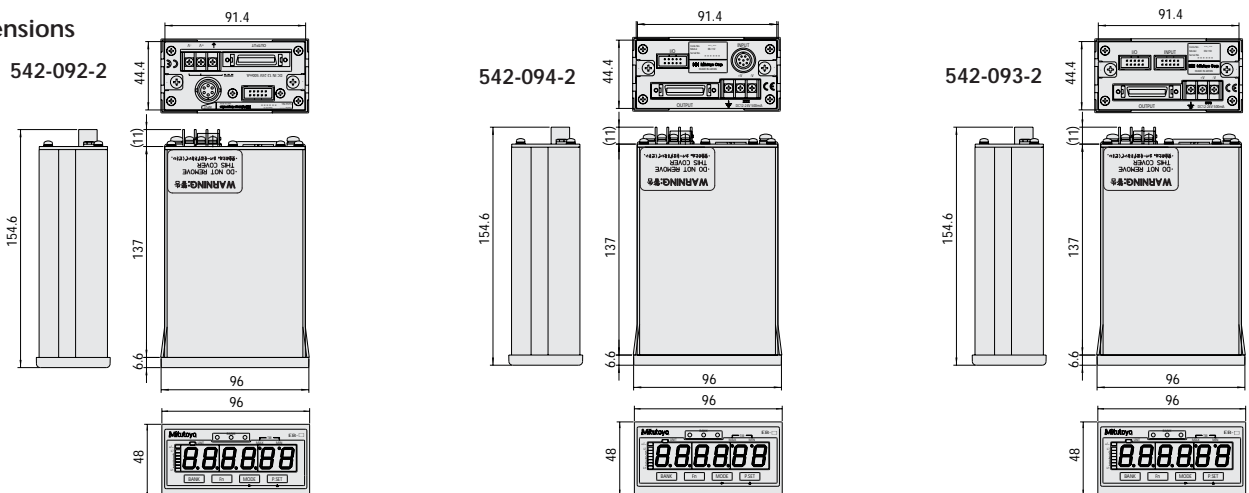


**EB-D Counter 542-093-2**  
For Digimatic Code Output  
Linear Gage

### SPECIFICATIONS

Order No.	542-092-2	542-094-2	542-093-2
Applicable input	Differential square-wave	Differential square-wave w/origin point mark	Digimatic code (SPC)
Applicable gage	L GK, L GF, L GB, L GE	L GF with origin point mark	L GD, L GS
Number of gage input	1		
Resolution	0.01mm, 0.005mm, 0.001mm, 0.0005mm, 0.0001mm		0.01mm, 0.001mm
Tolerance judgment display	LED display (3 steps: Amber, Green, Red/5 steps: Amber, Amber flash, Green, Red flash, Red)		
Function	Preset, tolerance judgment output (3/5-step X 7 kinds), limit value output (2 kinds independently for each of the 7 channels), peak (maximum, minimum, runout) measurement, diverse data output (serial BCD, simplified analog)		
Output	Tolerance judgment	L1 to L5, open-collector	
	Control	Normal operation signal (NORMAL), open-collector	
External control signal input	Preset, 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 X voltage resolution (25mV/2.5mV): Full-scale 0 to 5V	
	Digimatic input/output	<ul style="list-style-type: none"> <li>• Connecting to the external switch box (No. 02ADF180) makes it easy to enter tolerance limits and preset values.</li> <li>Note) This can not be used when the gage is connected to a Mitutoyo DP-1VR Digimatic Mini-Processor</li> <li>• Possible to connect with a Mitutoyo DP-1VR Digimatic Mini-Processor.</li> <li>• Number of tolerance steps can be expanded by making a set of EB-D counters.</li> </ul>	
Quantization error	±1 count		
Maximum input frequency	1.25MHz (The response speed depends on the gage being used.)		The response speed depends on the gage being used.
Power supply voltage	DC+12 to 24V		
Power consumption	6W (500mA) or less (Secure power supply more than 1A for each unit.)		
Operating temperature	0°C to 40°C (20%RH to 80%RH, without condensation)		
Mass	400g		

### Dimensions



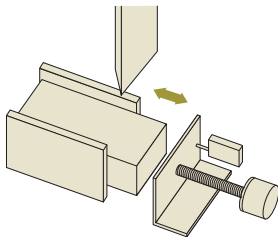


## POWERFUL TOLERANCE JUDGMENT FUNCTION

Keeps 7 pieces of 3-step/5-step tolerance limits in memory.

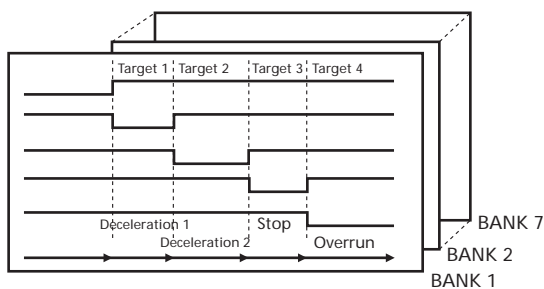
It is possible to switch over these tolerance limits with an appropriate button operation or external signal.

- Stopper position adjustment  
Adjust the stopper position depending on the workpiece type.  
For this control use the tolerance judgment signals.



- Indicator display/output where 3 steps of tolerance limit are set

	GO/NG indicator	LIMIT indicator and I/O output
Measured value < S1	Amber ON	L1
S1 ≤ measured value ≤ S4	Green ON	L3
S4 ≤ measured value	Red ON	L5



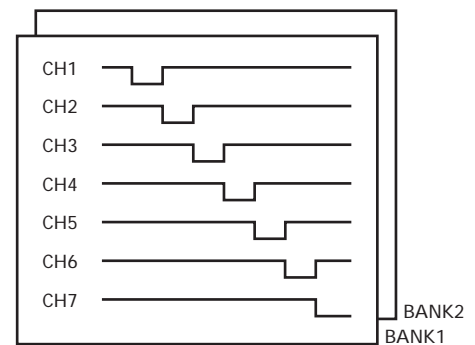
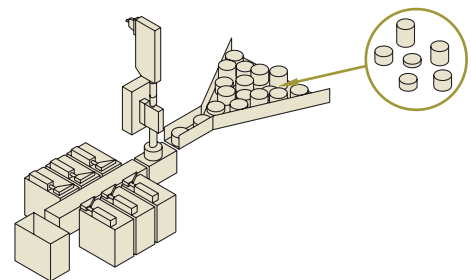
- Indicator display/output where 5 steps of tolerance limit are set

	GO/NG indicator	LIMIT indicator and I/O output
Measured value < S1	Amber ON	L1
S1 ≤ measured value ≤ S2	Amber flash	L2
S2 ≤ measured value ≤ S3	Green ON	L3
S3 ≤ measured value ≤ S4	Red flash	L4
S4 ≤ measured value	Red ON	L5

Possible to selectively keep two of the limit values for 7 channels.

It is possible to switch over these tolerance limits with an appropriate button operation or external signal.

- Sift-out of similarly-formed artifacts by their height  
It is possible to sift out workpieces of which only the height is different from others.

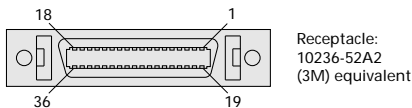


# EB counter

## Assembly Type Display Unit

### INPUT/OUTPUT SPECIFICATIONS

- 1) Applicable plug: **02ADB440** (with cover)
- 2) Pin assignment

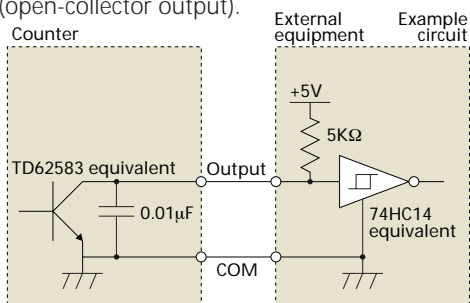


Pin No.	Description	Input/Output	Contents (application)
1	COM	-	Common terminal for input/output circuit (to be connected to the internal GND)
2	COM	-	
3	BANK1/L1	OUT	Tolerance judgment result output • At an error AL1, AL5= Output of "L" AL2, AL3, AL4 = Output of "H"
4	BANK2/L2	OUT	
5	BANK3/L3	OUT	
6	BANK4/L4	OUT	
7	BANK5/L5	OUT	
8	BANK6	OUT	
9	BANK7	OUT	
10	NOM	OUT	
21	BCD_CK	OUT	Serial BCD output
22	BCD_ST	OUT	
23	BCD_DT	OUT	
24	ANALG	OUT	Analog output
25	ANGND	OUT	
26	AREG*	IN	Analog range changeover: Enter in combination with SET
27	SET1	IN	
28	SET2	IN	
29	SET3	IN	BANK: Sets the PSET tolerance to the specified bank. MODE: NOM, MAX, MIN, TIR settings AREG: Analog range specification
30	MODE*	IN	
32	BANK*	IN	
34	HOLD	IN	Peak changeover: Enter in combination with SET. BANK changeover: Enter in combination with SET. • The display value is held during input. • Data output proceeds while the serial BCD interface is used. • When an error has occurred, the error will be cleared at the rise of this signal. • Perform presetting. • Peak clear: When entered during the peak mode, it serves as peak clear.
35	PSET*	IN	Unconnected terminal
11 - 20, 31, 33, 36	N.C.	-	

### 3) I/O circuit

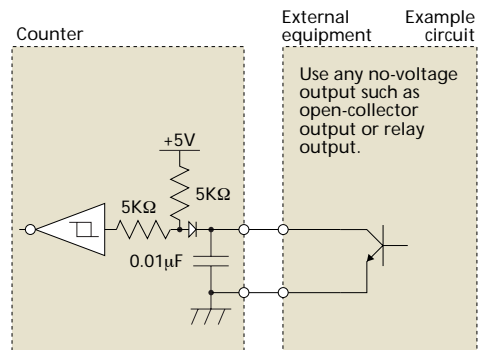
#### 1. Output circuit

Transistor is "ON" to operate the line to "L"  
(open-collector output).



Dielectric output voltage: Max. 24V  
Output current: Max. 10mA  
Output saturation voltage: Max. 0.7V

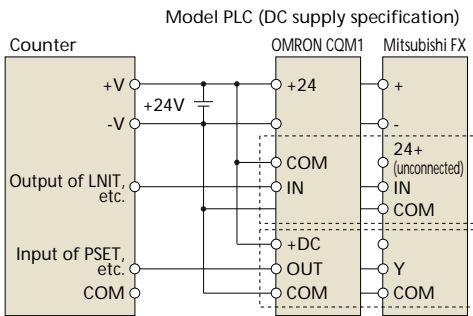
#### 2. Input circuit (SET, MODE, BANK, PSET, HOLD)



Input current:  $I_{MAX}1mA$   
Input voltage: H=4 to 24V  
L=Max. 1V

Output saturation voltage:  
Max. 0.7V or less

- 4) Connection example of external equipment  
This is a connection example to an external programmable controller.



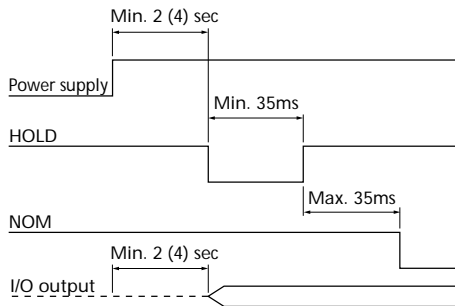
- 5) Sample program for collecting serial BCD outputs  
For OMRON CQM1 (to connect one unit of counter)

LD NOT	0000		P0: Detecting if CK = "H".
AND	0002		
CLC (41)			P2(DATA) = L → CY clear
LD NOT	0000		P0: Detecting if CK = "H".
AND NOT	0002		
STC (40)			P2(DATA) = H → CY clear
LD NOT	0000		P0: Detecting the rise of CK.
@ROL (27)		DM0350	Left-rotate shift with carry
@ROL (27)		DM0351	Right-rotate shift with carry
LD NOT	0001		P1: Detecting if STB = H
@MOV (21)	DM0350	DM0360	Transfers the result.
@MOV (21)	DM0351	DM0361	Transfers the result.

- \* Sequencer's P000: CK should be connected to P0001: STB and P0002: DATA.
- \* Since this is a negative-true logic input, the logics on the program and actual wave form are opposite from each other.
- \* Execute the command with an @ only once provided that the input condition is ON.
- \* The result will be stored in DM0360 and 0361.

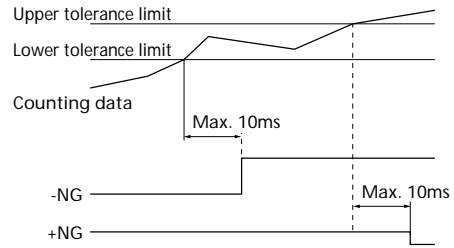
6) Timing chart

1. Power ON characteristics

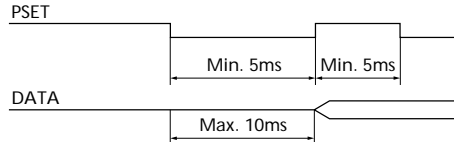


\*( ) represents EB-D.

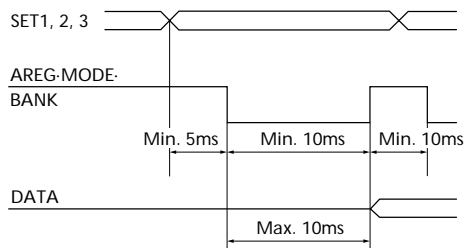
2. Tolerance judgment result output period



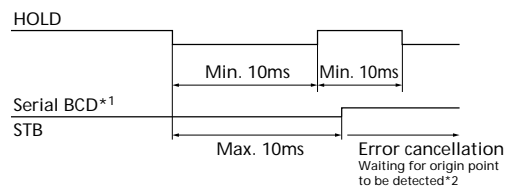
3. External preset/Peak clear



4. Peak mode/BANK specification



5. HOLD timing



- \*1: With the serial BCD unit in the command mode (PNo.35=0)
- \*2: (Only for EV-Z) Resetting of origin point (PNo.42=1)

External switch box (optional)

Makes it easy to enter tolerance settings and preset values.  
Order No. **02ADF180** (with a 2-m cable)

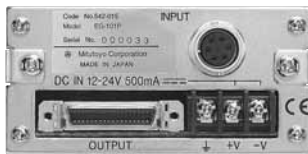


# EG counter

## Assembly Type Display Unit

### FEATURES

- Possible to produce 3-step/5-step X 3 kinds of tolerance output and BCD output.
- The smoothing function can reduce the fluctuation of display digits.
- Employed the DIN size (96X48mm) and mount-on-panel configuration, which greatly facilitates the incorporation into a system.



**542-015**  
For Differential Square-wave  
Output Linear Gage

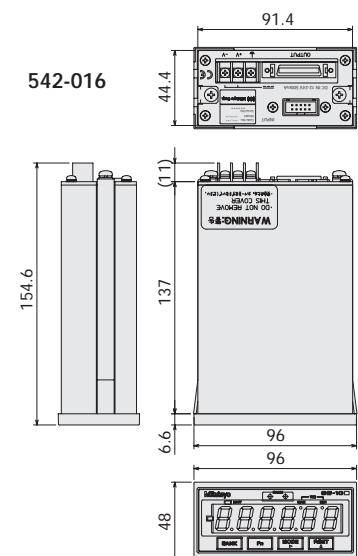
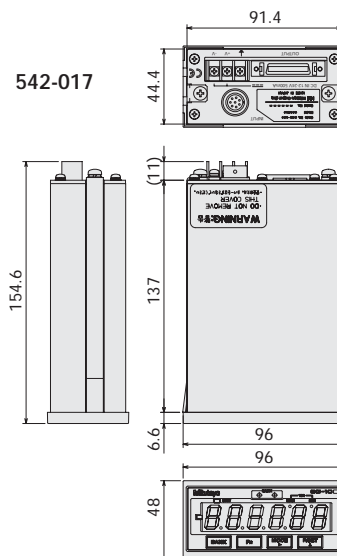
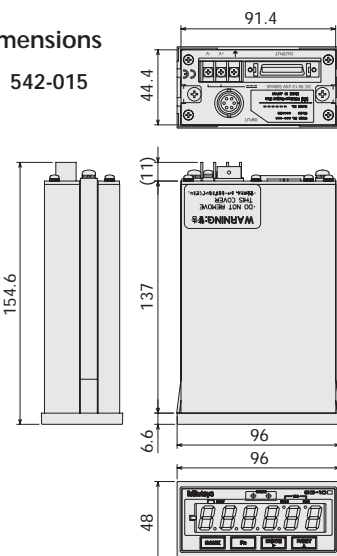
**542-017**  
For Differential Square-wave  
Output Linear Gage with  
Origin Point Mark

**542-016**  
For Digimatic Code Output  
Linear Gage

### SPECIFICATIONS

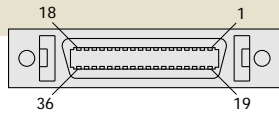
Order No.	542-015	542-017	542-016
Applicable input	Differential square-wave	Differential square-wave w/origin point mark	Digimatic code (SPC)
Applicable gage	LGK, LGF, LGB, LGE, LGM, LGH (excluding with origin point and sign wave types)	LGF with origin point mark	LGD, LGS
Number of gage input	1		
Resolution (Depending on the linear gage type connected)	0.01mm, 0.005mm, 0.001mm, 0.0005mm, 0.0001mm		0.01mm, 0.001mm
Tolerance judgment display	LED display (3 steps: Amber, Green, Red/5 steps: Amber, Amber flash, Green, Red flash, Red)		
Function	Preset, direction switch, tolerance judgment (3/5-step, 3 kinds), peak (max., min., runout) measurement, calculation with a constant, smoothing, error display/output, protection over keys		
Output	Tolerance judgment	L1 to L5 (Switchover between open-collector output and BCD output by means of the parameter)	
	Control	NOM (normal signal) open-collector	
	BCD	6-digit (positive/negative-true logic) open-collector (Switchover between tolerance judgment output by means of the parameter)	
External control signal input	Preset, display hold, peak value clear, tolerance judgment BANK switch		
Quantization error	±1 count		
Maximum input frequency	1.25MHz (The response speed depends on the gage being used.)		-
Power supply voltage	DC+12 to 24V		
Power consumption	6W (500mA) or less (Secure power supply more than 1A for each unit.)		
Operating temperature	0°C to 40°C (20%RH to 80%RH, without condensation)		
Mass	400g		

### Dimensions



## INPUT/OUTPUT SPECIFICATIONS

- 1) Applicable plug: **02ADB440** (with cover)
- 2) Pin assignment



### 1. In the tolerance judgment mode

Pin No.	I/O	Description	Function
1, 2		COM	Connected to the internal GND
3	O	L1	Tolerance output: The relevant output terminal falls to L. At an error display [L1=L5=L]
4	O	L2	
5	O	L3	
6	O	L4	
7	O	L5	
10	O	NOM	Normal output
27	I	SET1	BANK, Peak mode setting: Enter the setting value with SET. Determine the mode and bank to be used with MODE and BANK, respectively.
28	I	SET2	
29	I	MODE	Determining the change of peak value: Combined operation with SET
34	I	HOLD	HOLD input
35	I	PSET	At normal measurement: Preset At peak value measurement: Peak clear
36	I	BANK	Determining the change of BANK: Combined operation with SET
		NC	Other than the above listed shall be unconnected.

### 2. In the BCD output mode

Pin No.	I/O	Description	Pin No.	I/O	Description	Pin No.	I/O	Description
1		COM	13	O	4X10 <sup>2</sup>	25	O	4X10 <sup>5</sup>
2		COM	14	O	8X10 <sup>2</sup>	26	O	8X10 <sup>5</sup>
3	O	1X10 <sup>0</sup>	15	O	1X10 <sup>3</sup>	27	I	SET1
4	O	2X10 <sup>0</sup>	16	O	2X10 <sup>3</sup>	28	I	SET2
5	O	4X10 <sup>0</sup>	17	O	4X10 <sup>3</sup>	29	I	MODE
6	O	8X10 <sup>0</sup>	18	O	8X10 <sup>3</sup>	30	-	NC
7	O	1X10 <sup>1</sup>	19	O	1X10 <sup>4</sup>	31	O	SIGN
8	O	2X10 <sup>1</sup>	20	O	2X10 <sup>4</sup>	32	O	NOM
9	O	4X10 <sup>1</sup>	21	O	4X10 <sup>4</sup>	33	O	READY
10	O	8X10 <sup>1</sup>	22	O	8X10 <sup>4</sup>	34	I	HOLD
11	O	1X10 <sup>2</sup>	23	O	1X10 <sup>5</sup>	35	I	PSET
12	O	2X10 <sup>2</sup>	24	O	2X10 <sup>5</sup>	36	I	INH

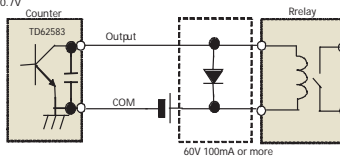
- \* Pin No. 3 to 26, and 31 can be logically inverted via the corresponding parameter.
- \* SIGN: Represents the sign of counting value as either "H" for positive value or "L" for negative value.
- \* READY: It will be "L" during the output data determination.
- \* INH: During input operation each output from Pin No. 3 to 26, and 31 will be "H".
- \* External output terminal is valid at "L".
- \* NOM, HOLD, and PSET function in the same way as in the tolerance judgment mode.
- \* External input uses negative true logic as "L" corresponding to "Valid".

### 3) I/O circuit

#### 1. Output circuit (NOM, L1 to L5)

Transistor is "ON" when the open-collector output is "L".

Dielectric output voltage: Max. 24V  
Output current: Max. 10mA  
Output saturation voltage: Max. 0.7V

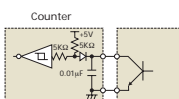


\*Do not connect the relay directly to the counter output terminal.(GO/NG signal etc.) The power surge will damage the counter.

\*Put the protection diode between the counter and the relay.

#### 2. Input circuit (SET, MODE, BANK, PSET, HOLD)

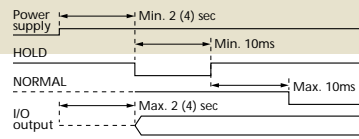
Input current: I<sub>max</sub> 1mA  
Input voltage: H=4 to 24V,  
L=Max. 1V



Example circuit at external user equipment: Design so as to make use of the open-collector

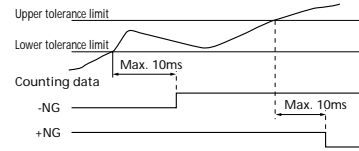
### 4) Timing chart

#### 1. Power ON characteristics



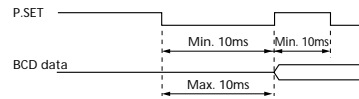
\* ( ) represents EG-D.

#### 2. Tolerance output

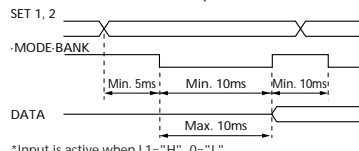


\*EG-D Counter depends on the gage.

#### 3. External preset/Peak clear

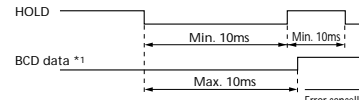


#### 4. Peak mode/BANK specification



\*Input is active when L1="H", 0="L"

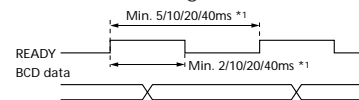
#### 5. HOLD timing



\*1: With the serial BCD unit in the command mode (PNo.35=0)  
\*2: (Only for EG-Z) Resetting of origin point (PNo.42=1)  
Error cancellation Waiting for origin point to be detected \*2

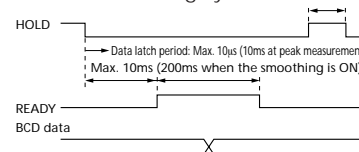
#### 6. Interval mode

The data will be continuously outputted according to the internal timing of the counter.



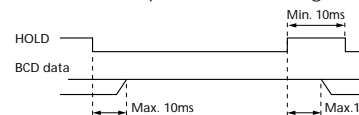
#### 7. Command mode

The data will be outputted with both the HOLD and READY lines being synchronized.



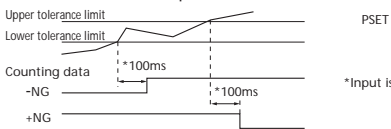
#### 8. INH input

BCD data output is OFF during the input of INH.



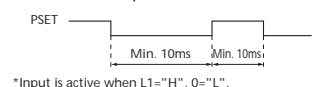
### 5) Timing chart

#### 1. Tolerance output



\*Varies depending on the gage.

#### 2. External preset/HOLD



\*Input is active when L1="H", 0="L".

# EC counter

## Assembly Type Display Unit

### FEATURES

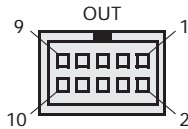
- Employed the DIN size (96X48mm) and mount-on-panel configuration, which greatly facilitates the incorporation into a system.
- Possible to produce either tolerance judgment output or Digimatic output.

### SPECIFICATIONS

Order No.	542-007
Applicable input	Digimatic code (SPC)
Applicable gage	LGD, LGD-L, LGD-ML, LGS
Number of gage input	1
Resolution	0.01mm, 0.001mm (Automatically set depending on the gage.)
Display	6-digit and a negative [-] sign LED (Amber, Green, Red)
Function	Preset, GO/±NG judgment
Output (selectable)	Tolerance judgment -NG, OK, +NG (open-collector) Data Digimatic code
External control signal input	Preset, data hold
Maximum input frequency	-
Power supply	Via AC adaptor
Operating environment	0° to 40°
Mass	220g

### INPUT/OUTPUT SPECIFICATIONS

- 1) Applicable plug: MIL type connector FAS-10-17 (Yamaichi), XG4M-1030-T (OMRON)
- 2) Pin assignment



Pin No.	I/O	Description	Function	Optional I/O cable color
1		COM	Connected to the internal GND	Light brown/black
2	O	+NG	Tolerance output: The relevant output terminal falls to L.	Light brown/red
3	O	GO	At an error display [+NG=-NG=L]	Yellow/black
4	O	-NG		Yellow/red
5	I	HOLD	HOLD input	Bright green/black
6	I	P.SET	PRESET input (to cancel the error)	Bright green/red

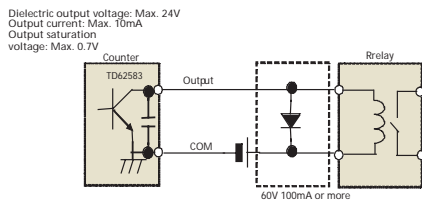
Other than the above listed shall be unconnected.

- \* Output from each pin in the Digimatic output mode may differ from those which are described in the above.
- \* The one end of the I/O cable (2m, optional) consists of separate wires. Fabricate them to an appropriate connection. Connect the cable's F.G wire (with solderless terminal, green) to the grounding terminal of the main unit.

### 3) I/O circuit

#### 1. Output circuit (-NG, GO, +NG)

Transistor is "ON" when the open-collector output is "L".

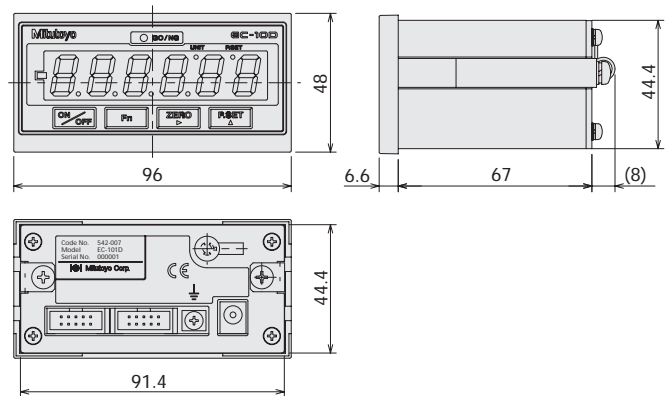


\*Do not connect the relay directly to the counter output terminal.(GO/NG signal etc.)  
The power surge will damage the counter.

\*Put the protection diode between the counter and the relay.

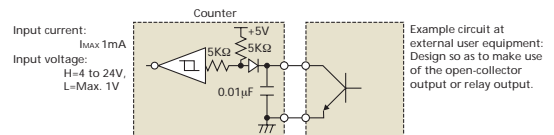


### Dimensions



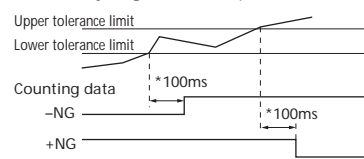
### 2. Input circuit (PSET, HOLD)

Input is valid when the line is "L".



### 4) Timing chart

#### 1. Tolerance judgment output



\*Varies depending on the gage.

#### 2. External preset/HOLD



\*Input is active when L1="H", 0="L".

### 5) Optional I/O cable (2m)





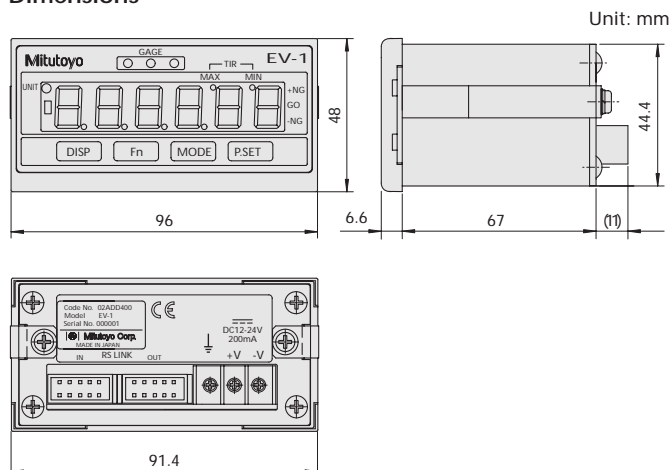
# Optional Accessories for EC/EG/EB/EF/EV Counters

## D-EV Display Unit (02ADD400)



- Display unit for the EV counter.
- Using this display allows various settings for the EV counter without a personal computer or other equipment.
- Able to display each axis measurement value and, GO/NG judgment result, total GO/NG judgment result for all axes, setting details, and errors
- DIN compatible compact panel-mounting - cutout dimensions  $45^{+0.8} \times 92^{-0.8}$
- The required power supply is DC +12 to +24V, 200mA at the terminal block. (AC adapter **02ADD930** and **527428** are available. See below.)

### Dimensions



### SPECIFICATIONS

Number of connectable units	One display unit allows external display and setting for one EV counter.
Displayed digits	It uses a single sign plus six digits (EV counter operates on eight-digit data internally but displays only the last six digits).
LED display	Channel display (also for display of judgment result): 3 (three-color LED) Measurement mode display (current, maximum, minimum, runout): 2 Status display: 1 (two-color)
Operating switches	4
Switches and their functions	Channel switching, measurement mode switching (current value, maximum value, minimum value and runout), parameter setting, preset, and tolerance setting
Input/output	RS Link connectors: 1 in and 1 out.
Error display	Overspeed, gage error and others.
Power supply	Terminal block (M3 screws), DC +12 to +24V, 200mA
Operating temperature (humidity) range	0°C to 40°C (20%RH to 80%RH, without condensation)

### I/O output connector (02ADB440)



This receptacle fits the I/O output plug of EF/EV counters. Refer to the corresponding technical explanations (pages 48 and 49) for pin assignment.

02ADB440

### RS link cable



Used to interconnect EF/EV counters comprising a RS link. Same as the cable used for Digimatic code (SPC) output.

Order No.	Cable length
02ADD950	0.5m
936937	1m
965014	2m

### AC output adapter



02ADD930

Connected to the power supply terminal of EF/EV/D-EV counters. Use a **02ADD930** together with an AC adapter for the applicable line voltage.

Order No.	Description
02ADD930	Three-terminal section only
527428	for 100V AC
527428A	for 120V AC
527428CED	for 220V AC
527428CEE	for 240V AC

### Digimatic Cable



Used to output the measured data from EF counters to Digimatic mini-processors, DP-1VR.

Order No.	Cable Length
936937	1m
965014	2m

# Optional Accessories for EC/EG/EB/EF/EV Counters

## D/A Conversion Unit [LG-DA1]

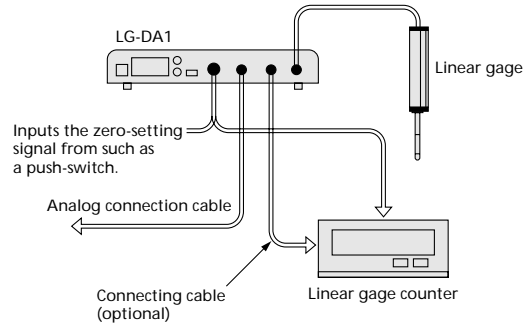
### FEATURES

- This unit consists of the pulse control circuit, counting circuit, and D/A conversion circuit to output the amount of linear gage displacement in the form of analog voltage.



542-003

### CONNECTION EXAMPLE



### SPECIFICATIONS

Power supply	Via AC adaptor (DC9V, 500mA)
Dimensions	236 (W) X 160 (D) X 44.2 (H) mm
Operating environment	0°C to 40°C
Mass	1500g

### D/A CONVERSION RANGE AND RESOLUTION

When connected to a 0.001mm linear gage

Range	Resolution
±1mm	0.001mm
±2mm	0.002mm
±5mm	0.005mm
±10mm	0.01mm
±20mm	0.02mm
±50mm	0.05mm

When connected to a 0.005/0.01mm linear gage

Range	Resolution
±5mm	0.005mm
±10mm	0.01mm
±25mm	0.025mm
±50mm	0.05mm
±100mm	0.10mm
±250mm	0.25mm

### Analog connection cable

Recording measurement	Color	Cable
+	White	Output signal
-	Amber	Signal GND
Earth	Black	Frame GND

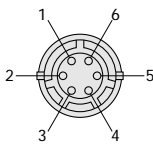
### Output signal

Output voltage	±10V/full-scale
Resolution of output voltage	±1000 steps of full-scale
Linearity of output voltage	1/2LSB

### I/O CONNECTOR SPECIFICATIONS

D/A output (Analog OUT connector pin assignment)

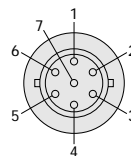
Pin No.	Description
1	Output signal
2	Signal GND
3	Unconnected
4	Unconnected
5	Unconnected
6	Unconnected



A-OUT connector Available receptacle: HR11-9BR-6S (HIROSE)  
Applicable plug: HR11-9B-6P (HIROSE)

Output for counting signals (Pulse OUT connector pin assignment)

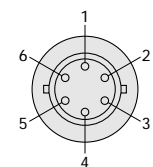
Pin No.	Description
1	Unconnected
2	øA
3	øB
4	øA
5	GND (SG)
6	øB
7	Unconnected



P-OUT connector Available receptacle: RM12BRD-7S (HIROSE)  
Applicable plug: RM12BPG-7P (HIROSE)

Input signal (INPUT connector pin assignment)

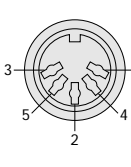
Pin No.	Description
1	+5V
2	øA
3	øB
4	øA
5	GND
6	øB



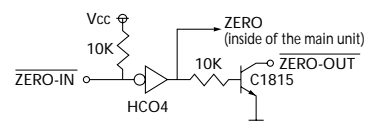
INPUT connector Available receptacle: RM12BRD-6S (HIROSE)

EXT.ZERO connector (External Zero-setting connector pin assignment)

Pin No.	Description
1	ZERO-IN
2	GND
3	ZERO-OUT
4	GND
5	Unconnected



EXT.ZERO connector Available receptacle: TCS4450-01-1011 (HOSHI)  
Applicable plug: E5-701B-00 (CHUO MUSEN)



## Difference/Sum Unit for Differential Square Wave Signal Output Linear Gage [LG-DF]

### FEATURES

- This unit serves to output a differential calculation result (A+B, A-B) or single value (A, B) of the counting values obtained from the linear gages that are connected to A and B input connectors, respectively.
- \* The minimum readings of the linear gages that are connected to A and B input connectors should be identical.



542-004

### SPECIFICATIONS

Response speed	250mm/s (when 5/10 $\mu$ m linear gages are connected) 50mm/s (when 1 $\mu$ m linear gages are connected)
Power supply	Via AC adaptor (DC9V, 500mA)
Power consumption	4.5W
Dimensions	236 (W) X 160 (D) X 44.2 (H) mm
Operating environment	0°C to 40°C
Mass	2000g

### Counter connection cable

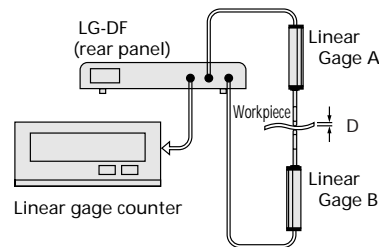
This is used to deliver the pulse output from the Difference/Sum unit (LG-DF) to the counter.

965606 (1.5m)



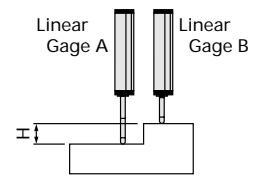
### CONNECTION EXAMPLE

#### Measurement of a curved plate thickness



D=(Displacement of Linear Gage A)+  
(Displacement of Linear Gage B)

#### Step measurement thickness



H=(Displacement of Linear Gage B)-  
(Displacement of Linear Gage A)

#### Over-speed error output and the remedies

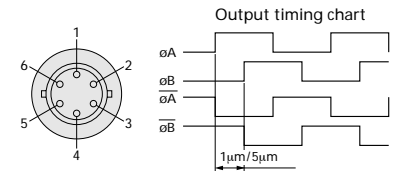
If either of the gages being connected A and B input connectors displaces as to exceed the rated moving speed, the counter will display over-speed error.

### I/O CONNECTOR SPECIFICATIONS

#### A, B signal input INPUT connector pin assignment

Pin No.	Description
1	+5V
2	$\phi$ A
3	$\phi$ B
4	$\overline{\phi}$ A
5	GND
6	$\overline{\phi}$ B

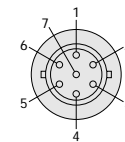
Available receptacle: RM12BRD-6S (HIROSE)  
Applicable plug: RM12BPG-6P (HIROSE)



#### Signal input P-OUT connector pin assignment

Pin No.	Description
1*	Unconnected/+5V
2	$\phi$ A
3	$\phi$ B
4	$\overline{\phi}$ A
5	GND (SG)
6	$\overline{\phi}$ B
7	Unconnected

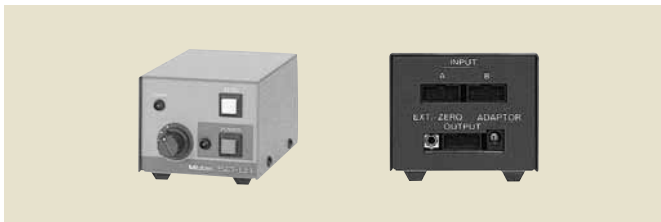
Available receptacle: RM12BRD-7S (HIROSE)  
Applicable plug: RM12BPG-7P (HIROSE)



\* To be made by changing the position of POWER SELECT switch at the rear of the unit.

# Optional Accessories for EC/EG/EB/EF/EV Counters

## Digimatic Difference/Sum Unit [SD-U1]



### FEATURES

- The Digimatic Difference/Sum Unit will add or subtract the measurements from two Digimatic gages and output results to a remote Display Unit or SPC data processor.
- Zero setting can be done at the Difference/Sum Unit or by external foot switch (937179T) and direct measurements from a signal of connected gage can also be passed on without alterations.
- One connecting cable is provided for SPC data output.

### SPECIFICATIONS

Order No.	572-041 (w/100V AC adaptor) 572-041A (w/120V AC adaptor) 572-041D (w/220V AC adaptor) 572-041E (w/240-220V AC adaptor)
Data input port	2
Calculation mode	A+B, A-B, A, B
Functions	•Zero Setting •SPC data output
Power supply	9V DC, 500mA (via AC adaptor)
Dimensions	76 (W) x 120 (D) x 66 (H) mm
Mass	550g

## Digimatic Mini-Processor [DP1-VR]



The DP-1VR Digimatic Mini-Processor is a powerful, yet inexpensive tool for implementing SPC. This compact unit is capable of many functions, including performing calculations for statistical analyses and x-R control charts, generating histograms and individual charts, as well as printing out and outputting measured data via an RS-232C port.

### SPECIFICATIONS

Order No.	264-504 (w/100V AC adaptor) 246-504A (w/120V AC adaptor) 264-504D (w/220V AC adaptor) 264-504E (w/240-220V AC adaptor)
Printing method	Thermal line printer
Processing capacity	•Mode 1/2/3: 9999 data •Mode 0: 100000 data
Printing data	Measurement data, GO/±NG judgment, number of data, max/min value, range, average, standard deviation, number of defective, fraction defective, histogram, D-chart, control chart generation for Xd-bar and control limit data
Dimensions	94 (W) x 201 (D) x 75.2 (H) mm
Mass	390g

# Operational Guide

## Before using the gage

### Avoid installing the gage in the following locations:

- Where the gage will be exposed to direct sunlight, or where the ambient temperature may drop below 0°C or exceed 40°C.
- Where the relative humidity may drop below 20%RH or exceed 80%RH, or where a sudden change in temperature may cause condensation.
- Where the gage would be subject to corrosive gas, or where combustible materials are placed nearby.
- Where the gage is subject to air containing significant amounts of dust, salt or iron powder.
- Where the gage is subject to direct vibration or shock.
- Where the gage may come in contact with splashed water, oil or chemicals. (The gage system components are not designed for protection against water, oil or chemical protection, except for the gage unit.)
- Where electronic noise is likely to affect the gage.

### Noise-prevention measure

- Wiring the sensor cable in the same circuit as high-voltage lines or power lines may cause the gage to malfunction. Be sure to wire the sensor cable separately.

### Power supply to the gage

- If a generic switching regulator is used, provide grounding via the frame's ground terminal or ground terminal of the power supply.
- If a malfunction occurs due to superimposed noise on the power-supply line, use a DC-regulated power supply that incorporates an insulated transformer.

### Handling precautions

- This product is a precision measuring instrument. Do not drop or otherwise subject it to impact.
- The spindle (moving unit) of the gage head is connected to the main unit via a spring. Be careful not to pull the spindle in the extending direction or rotate it with force. Doing so may cause permanent distortion and damage to the spring.
- The gage is shipped with a standard contact point (**901312** or **900032** for the inch version of the LGS) installed on the spindle. This contact point can be replaced with a different type according to the shape of workpiece. (See page 26.)  
When installing or removing the contact point, place the wrench provided on the catch in order to keep the spindle from rotating. Then grab the contact point with pliers to install or remove it.  
When grabbing the contact point with pliers, insert a piece of felt or other soft cloth to prevent the contact point from getting scratched.
- Do not set both ends of the stroke as the origin (zero).

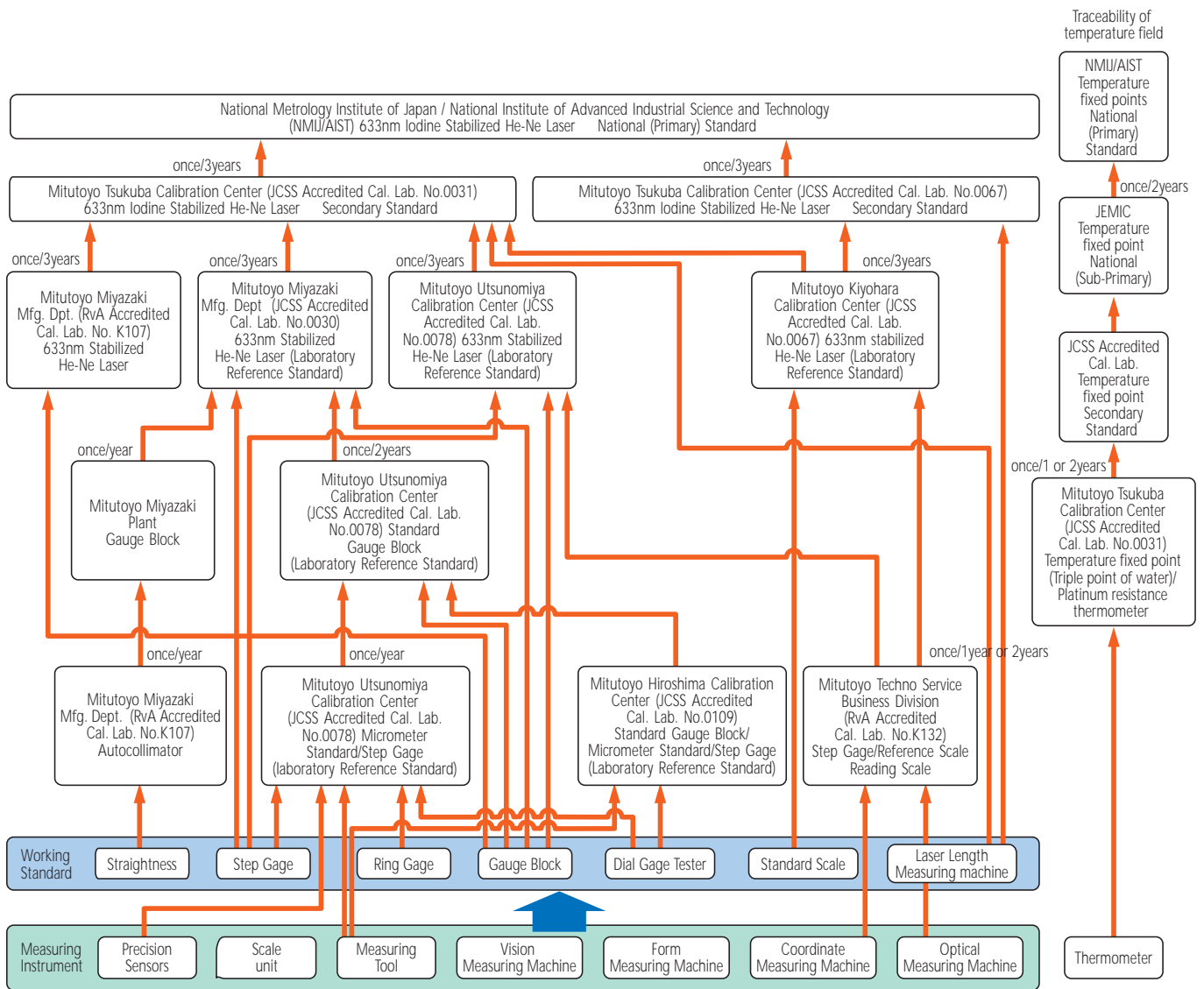
### Dust/water protection

The dust/water protective construction of all gage heads, excluding the LGH and 100mm LG gages, is equivalent to IP-66 or IP-54 (DIN40050/IEC529 standards).

- The preamplifiers and counters are not designed to provide dust or water protection. Install them in places where they will not come in direct contact with water or oil.
- When an extension cable is used, seal the preamplifier connection and connectors completely by making sure no portion is left exposed.
- If the cable cover is broken, water or other liquids may enter the gage through the capillary effect, causing gage failure. When the cable cover is broken, repair it immediately.
- Handle the gage with due caution to make sure that the rubber boots will not be damaged by chipping, etc. If the rubber boots are damaged, the gage can no longer be protected from dust or water. When damage is found, repair or replace the boots immediately.
- The rubber material used for the boots and seals does not provide complete protection against coolants and chemicals, which are becoming increasingly complex in composition. If rubber parts are found to have deteriorated significantly, contact your nearest Mitutoyo office.
- The gage must not be disassembled, since it will break the seals of various components. Never attempt to disassemble the gage. Doing so will prevent the gage from functioning to its original specifications.

# Traceability System to National Standards

## Traceability System of Length Standard



Iodine Absorption Stabilized He-Ne Laser as the standard for length measurement (At Tsukuba Calibration Center)

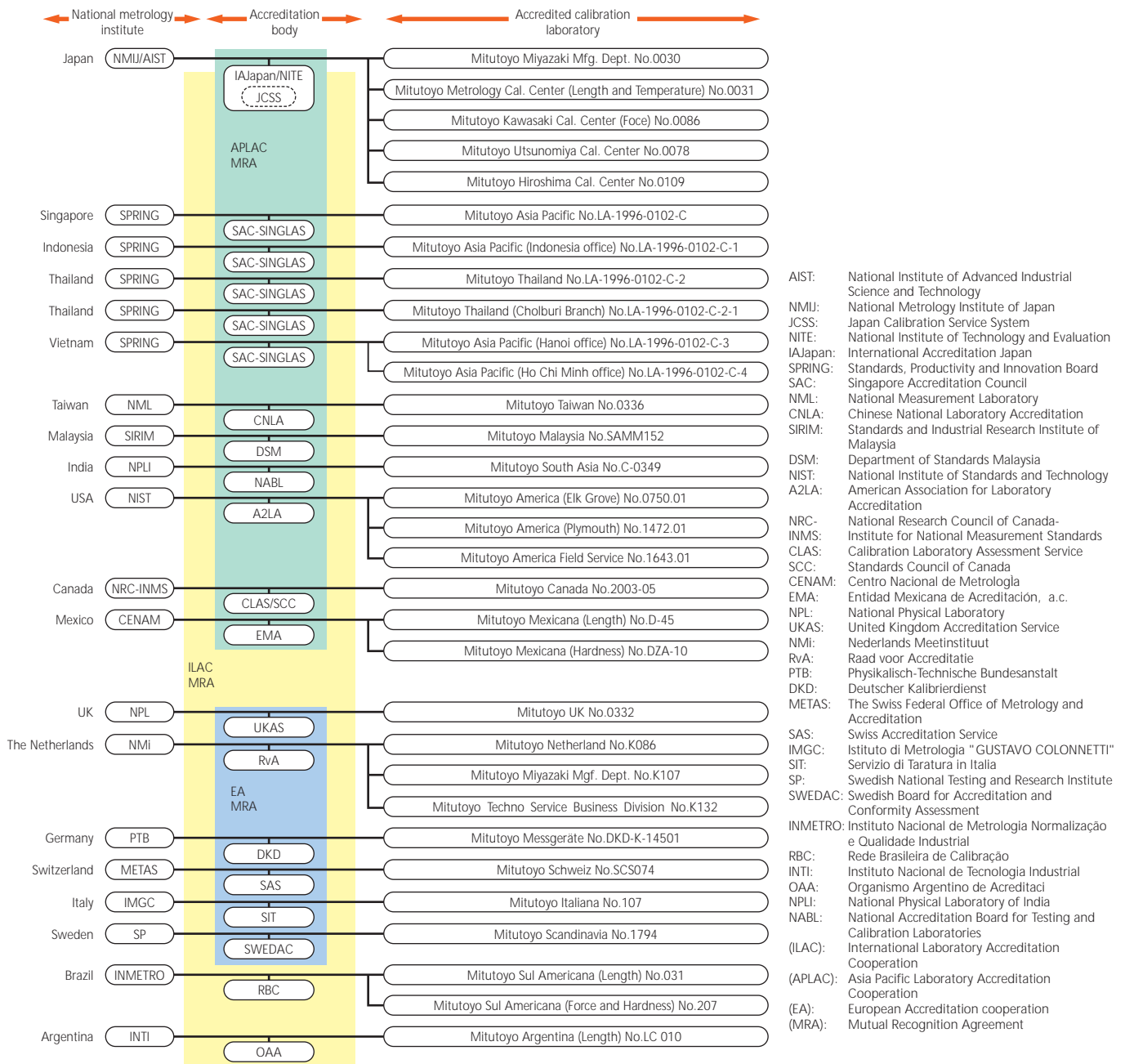


Interferometer as the standard for Gauge Block calibration (At Miyazaki Manufacturing Department)



Interferometer as the standard for Linear Scale calibration (At Kiyohara Manufacturing Department)

## Mitutoyo Group Accredited Calibration Laboratories

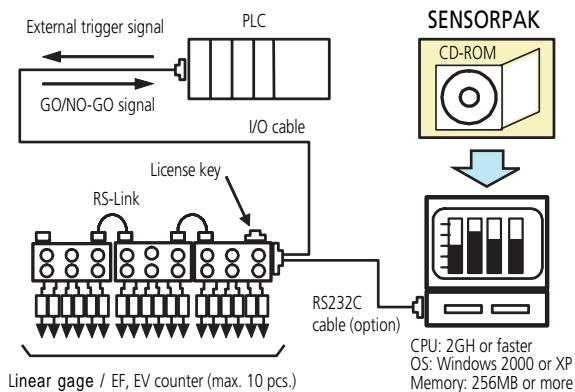


Mitutoyo comprises 24 accredited calibration laboratories posted worldwide as illustrated schematically above, where each of the labs has established and implemented traceability of their reference standards through calibration to nationally or internationally recognized standards. It is with such a traceability system implemented within Mitutoyo that it can contribute to industries worldwide in helping customers implement the base for their quality management and quality assurance program.



## SENSORPAK

This software facilitates the loading of measurement data from a linear gage counter with the RS-232C interface into user's personal computer.



**MiCAT**  
Mitutoyo Intelligent Computer Aided Technology

the standard in world  
metrology software  
**SENSOR**

### FEATURES

- Maximum 60 channels of measuring points can be processed.
- Possible to perform arithmetical calculation and maximum width calculation using the measurement data.
- Possible to export the measurement data into MS-Excel.
- Diverse graphic functions (numeric value display, meter display, bar-graph display, overall judgment display)
- Frequency of data loading: Max. 9999 times (60ch) to 60000 times (6CH)

Coordinate Measuring Machines

Vision Measuring Systems

Form Measurement

Optical Measuring

Sensor Systems

Test Equipment and  
Seismometer

Digital Scale and DRO Systems

Small Tool Instruments and  
Data Management

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