Magnescale

SPEED X PRECISION


Magnescale Co., Ltd.

| | | | |
|---|---|---|---|
| International Sales | : 3-1-4 Edagawa, Koto-ku, Tokyo 135-0051, Japan | TEL.+81(0)3-6632-7924 | E-mail : info-mgs-eng@magnescale.com |
| Magnescale Americas Inc. | : 1 Technology Drive, Suite F217, Irvine, CA 92618, USA | TEL.+1(949)727-4017 | E-mail : info-am@magnescale.com |
| Magnescale Europe GmbH | : Antoniusstrasse 14, 73249 Wernau, Germany | TEL.+49(0)7153-934-291 | E-mail : info-eu@magnescale.com |
| Customer Support | : 45 Suzukawa, Isehara-shi, Kanagawa 259-1146, Japan | TEL.+81(0)463-92-2132 | E-mail : info-css@magnescale.com |

www.magnescale.com



The contents of this literature are as of Mar. 2025. Magnescale reserves the right to change product specifications without prior notice.
This catalog is printed with soy ink.
LS-EA02(01)'C
C.2503.CB.300





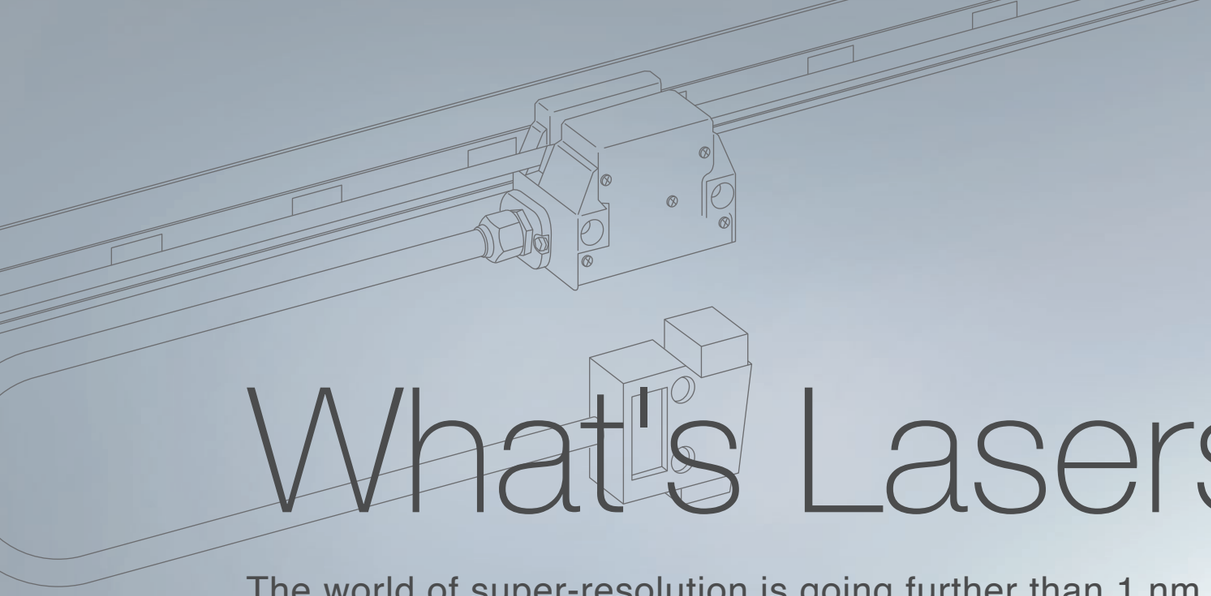
Magnescale

SPEED X PRECISION



# Laserscale

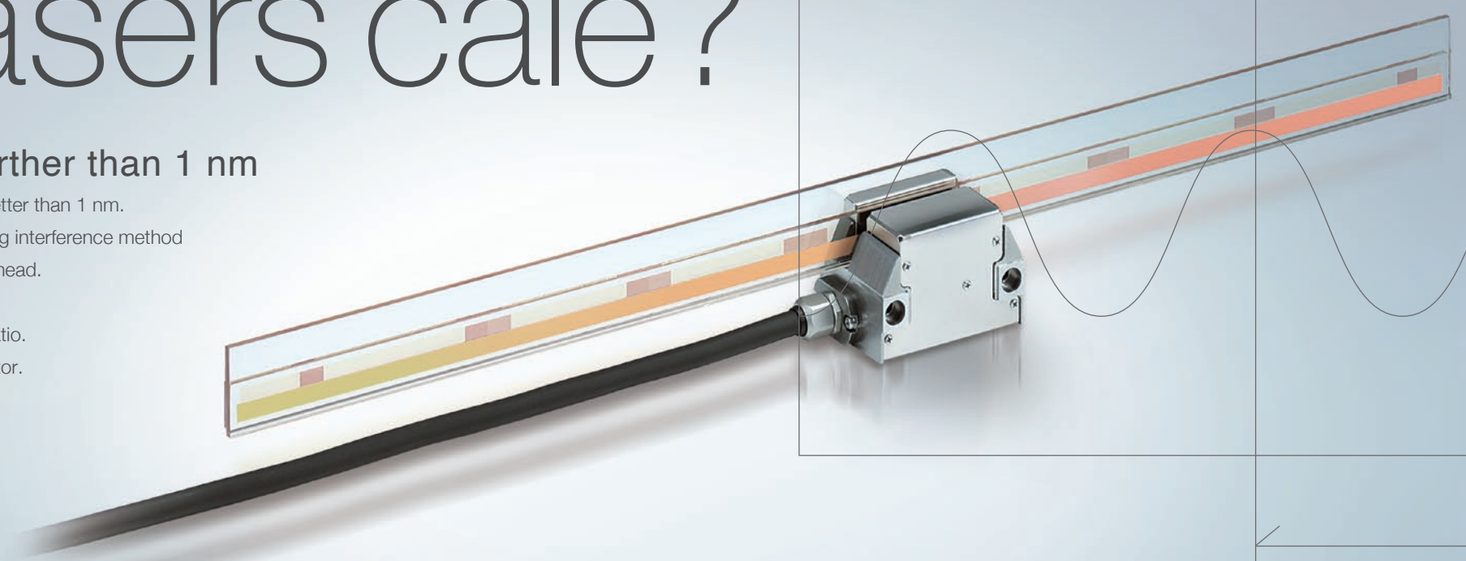
Magnescale Co., Ltd.



# What's Lasers cale?

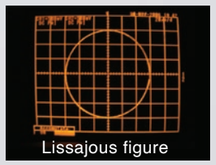
## The world of super-resolution is going further than 1 nm

Laserscale easily achieves measurement and control with ultra high resolution of better than 1 nm.
A sinusoidal wave (approximately 138 nm signal pitch) is generated using the grating interference method by utilizing a holographic scale with high diffraction efficiency and a high resolution head.
The BS series offers strong resistance to disturbance by air pressure or current, and is easy to install. Signal distortion, in principle, remains minimal at a high S/N ratio.
Resolution of 2.1 pm can be achieved using our automatic compensation interpolator.




### High-resolution scale with signal pitch of approx. 138 nm outperforms light wave interferometer systems

**Ultra-high resolution**
Volume holography technology of Laserscale achieves high diffraction efficiency to generate a high S/N signal and a strong output signal.

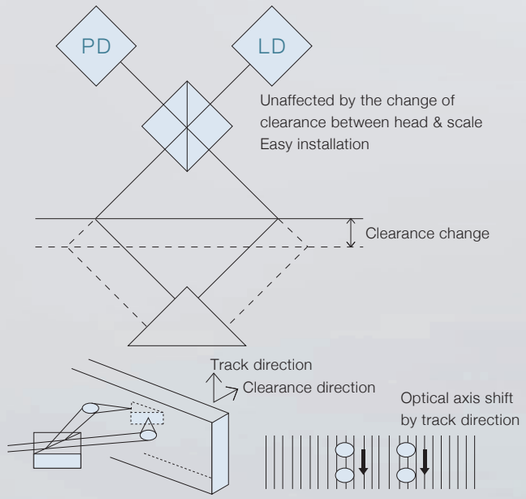

Lissajous figure

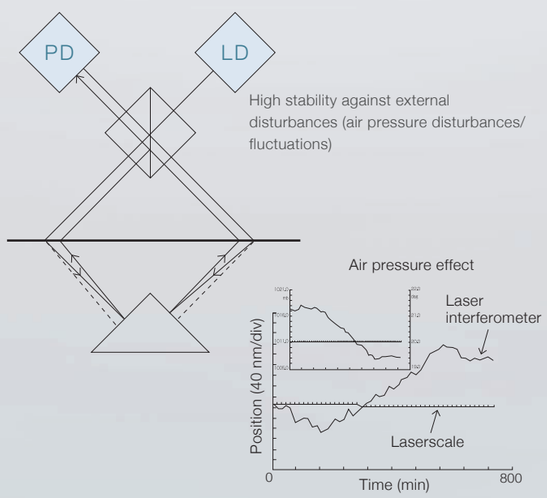
**Best in class 2.1 pm resolution**
One count movement of the 0.55 µm holographic grating pitch diffracts the signal to 4 periods.
The 1/4 of the original signal results in a signal of approximately 0.138 µm. Using our interpolator, this signal can achieve 2.1 pm resolution.

**Ultra-high resolution and high response speed**
Our grating interference principle linear encoders offer a signal pitch of approximately 0.138 µm. That is 1/100 th of a conventional linear encoder with a 20 µm signal pitch. Using our interpolator, 2.1 pm resolution and a response speed of up to 400 mm/s is achievable.

| Model | Output | Max. divisions | Resolutions | | Max. response speed |
|---|---|---|---|---|---|
| BS series Signal pitch : 138 nm | Serial | 65,536 | 21 | pm | 400 mm/s |

### High stability : Free from temperature, air pressure, or air disturbances



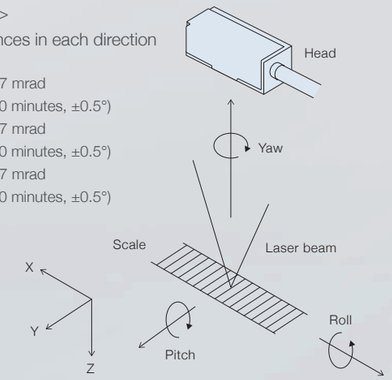

### Easy installation & maintenance

[Easy installation & maintenance]
Large installation tolerances
Easy installation and non-contact detection

<For BL50H>
Angle tolerances in each direction

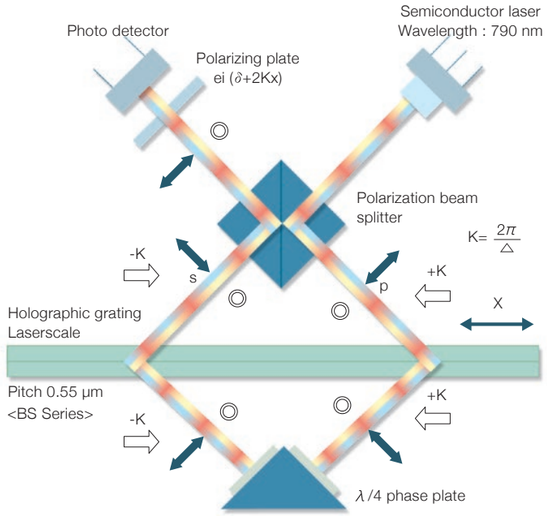
* Yaw : ±8.7 mrad (±30 minutes, ±0.5°)
Pitch : ±8.7 mrad (±30 minutes, ±0.5°)
Roll : ±8.7 mrad (±30 minutes, ±0.5°)

Not composite.



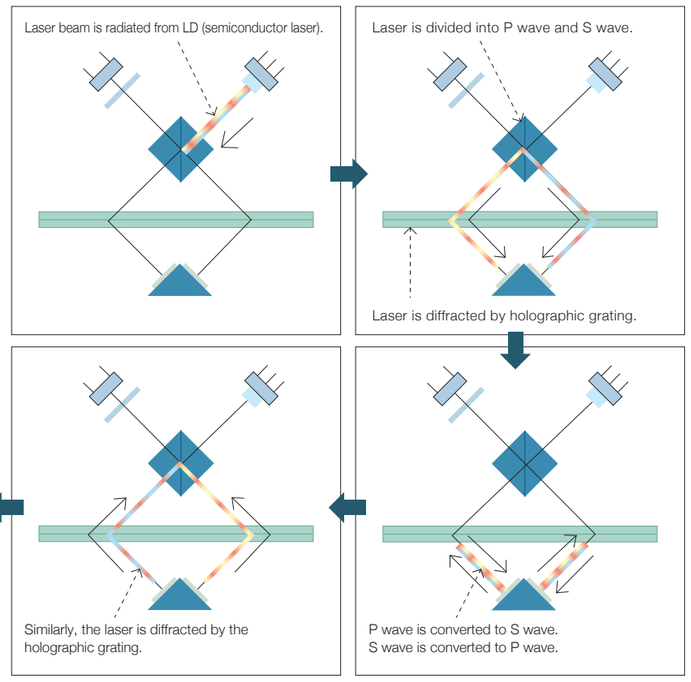
# Principle

A semiconductor laser is incident to a polarizing beam-splitter which then splits it into two polarized beams (S- and P) that are diffracted through a very high efficiency holographic diffraction grating. The two diffracted beams pass through separate quarter-wave plates to a mirror, which then reflect the beams back through the plates again. This process converts the S-polarized beam to P-polarized beam, and vice versa. The two beams are diffracted again through the holographic grating, then superimposed at the polarizing beam-splitter to coherently interfere. The superimposed beam then passes through a polarizer that extracts an interference signal, and is fed into a photo-detector for electrical signal output. The double-diffraction imprints the optical phases of +2Kx and -2Kx to each beam. Therefore, the interference signal experiences 4 phase shift periods for the grating movement of 1 grating pitch. Thus, the grating pitch of 0.55 µm corresponds to a signal pitch of 0.55/4 = approx. 0.138 µm. This optical system liberates us from fluctuations and changes in pressure, as the each beam in the interferometer shifts in phase even in the presence of the shift in laser wavelength. The result in principle is no repeatability or returning errors.

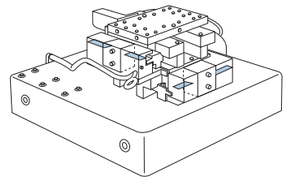



: Direction where light vibrates···Right and left ◎:Direction where light vibrates···Back and forth

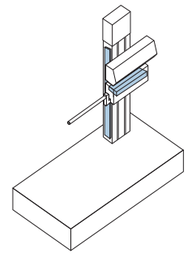
Laser beam passage (Transmission)



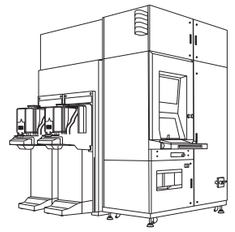

# Application



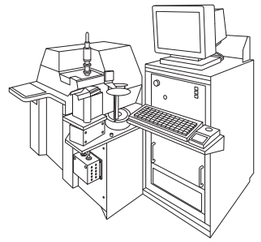
Ultra high precision air stages (vacuum resistant)



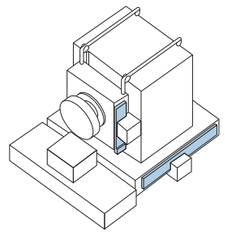
Surface roughness/ contour measuring machines



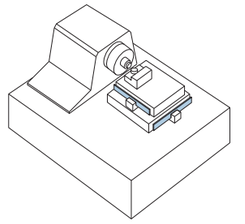
DUV-based automatic wafer defect classification systems



Non-contact measuring machines

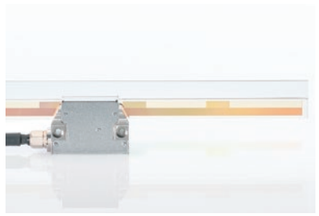
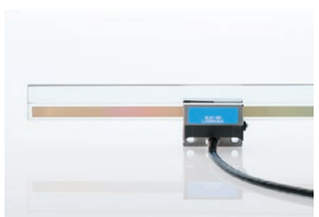


Micro grinders



Aspherical surface machining

# Lineup

| | | Series | Feature | Max. resolution | Scale accuracy | Measuring length | Interpolator | Output | Max. response speed | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| **BS**<br>λ=approx. 138 nm |  | BS78 | Transmission<br><br>Low expansion glass | 2.1 pm | ±0.04 µm<br>(Measuring length 40 mm) | 10 mm to 420 mm | BD700 | Serial | 400 mm/s | P.10 |
| **BH**<br>λ=250 nm |  | BH25-RE/NE | Reflection<br><br>Soda-lime glass<br>Low expansion glass<br>Zero expansion glass<br>Non-alkaline glass | 3.8 pm | ±0.5 µm<br>(30 to 170 mm)<br>±1 µm<br>(220 to 420 mm)<br>±5 µm<br>(470 to 640 mm) | Soda-lime glass<br>Low expansion glass :<br>30 to 420 mm<br>Zero expansion glass<br>Non-alkaline glass :<br>30 to 640 mm | BD700 | Serial | 1,800 mm/s | P.14 |
| |  | BH20-RE/NE | Reflection<br><br>Rotary type<br>302,400 pulses/rotation<br>680,400 pulses/rotation<br>907,200 pulses/rotation<br>1,048,576 pulses/rotation | 0.09 nrad | - | Radius 12.03 mm<br>Radius 27.07 mm<br>Radius 36.10 mm<br>Radius 41.72 mm | BD700 | Serial | 1,428 rpm<br>634 rpm<br>476 rpm<br>411 rpm | P.16 |
| |  | BH200-RE/NE | Reflection<br><br>Rotary type<br>907,200<br>pulse/rotation | 6.93 nrad | ±10 s (excluding eccentricity) | Radius 36.1 mm | None | Clock pulse<br>(LVDS) | 13,000 min$^{-1}$ | P.18 |
| **BL**<br>λ=400 nm |  | BL50H-SZ | Reflection<br><br>Zero expansion glass | 6.1 pm | ±0.5 µm (30 to 120 mm) | 30 to 1,070 mm | BD700 | A/B quadrature<br>Serial<br>Analog | 3,000 mm/s<br>* For max. response speed of 5 m/s, please contact our sales department. | P.20 |
| | | BL50H-SA | Reflection<br><br>Non-alkaline glass | - | ±0.5 µm (30 to 120 mm) | 30 to 1,070 mm | BD700 | Analog 1 Vp-p | 3,000 mm/s | |
| |  | BL57-RE | Transmission<br><br>Low expansion glass<br>Soda-lime glass | 10 nm | ±0.5 µm (30 to 160 mm)<br>±1 µm (210 to 360 mm)<br>±1.5 µm (410 to 1,060 mm) | Low expansion glass : 30 to 410 mm<br>Soda-lime glass : 60 to 1,060 mm<br>* For measuring length exceeding 1,060 mm, please contact our sales department. | Built-in I/F Box | A/B quadrature | 1,500 mm/s<br>(0.1 µm) | P.22 |
| | | | | 0.4 µm (1 Vp-p) | | | None | Analog | 3,000 mm/s | |
| | | BL57-NE | Transmission<br><br>Low expansion glass<br>Soda-lime glass | 10 nm | ±0.5 µm (30 to 170 mm)<br>±1 µm (220 to 370 mm)<br>±1.5 µm (420 to 1,060 mm) | Low expansion glass : 30 to 420 mm<br>Soda-lime glass : 60 to 1,060 mm<br>* For measuring length exceeding 1,060 mm, please contact our sales department. | Built-in I/F Box | A/B quadrature | 1,500 mm/s<br>(0.1 µm) | |
| | | | | 0.4 µm (1 Vp-p) | | | None | Analog | 3,000 mm/s | |

PD

LD

# Laserscale

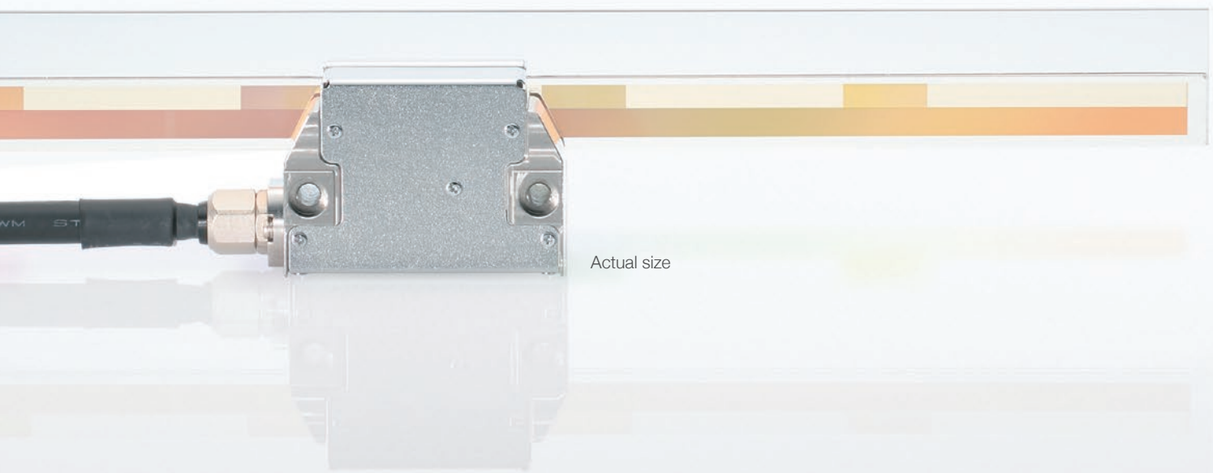


## Contents

# BS

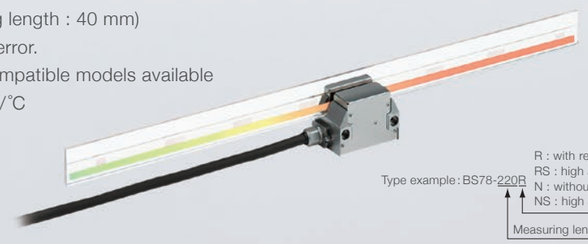
## BS78
(with/without reference point)

High-speed and high-resolution, while maintaining stable, ultraprecision measuring.
Ideal for precision stages, semiconductor inspection/manufacturing systems,
and ultraprecision processing machines.



Actual size

- High-resolution scale with signal pitch of approx. 138 nm, outperforming light wave interferometer systems
- High stability, unaffected by humidity, air pressure and air disturbances
- Reference point accuracy : ±0.1 μm
- Scale accuracy : ±0.04 μm (measuring length : 40 mm)
- Non-contact design eliminates return error.
- Special non-magnetic and vacuum-compatible models available
- Using low expansion glass : $-0.7 \times 10^{-6}$/°C (measuring length : 10 to 420 mm)



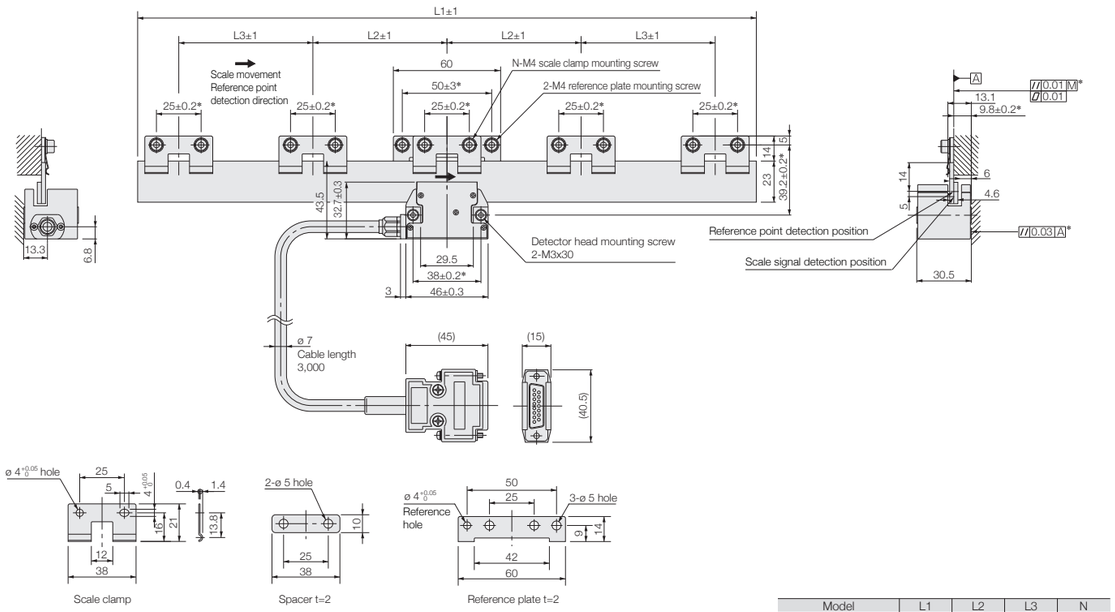
Type example : BS78-220R
- R : with reference point;
- RS : high accuracy with reference point
- N : without reference point;
- NS : high accuracy without reference point

Measuring length



## External Dimensions

### ● BS78-xxxR(RS) (Measuring length : 40/120/170/220/370/420 mm)

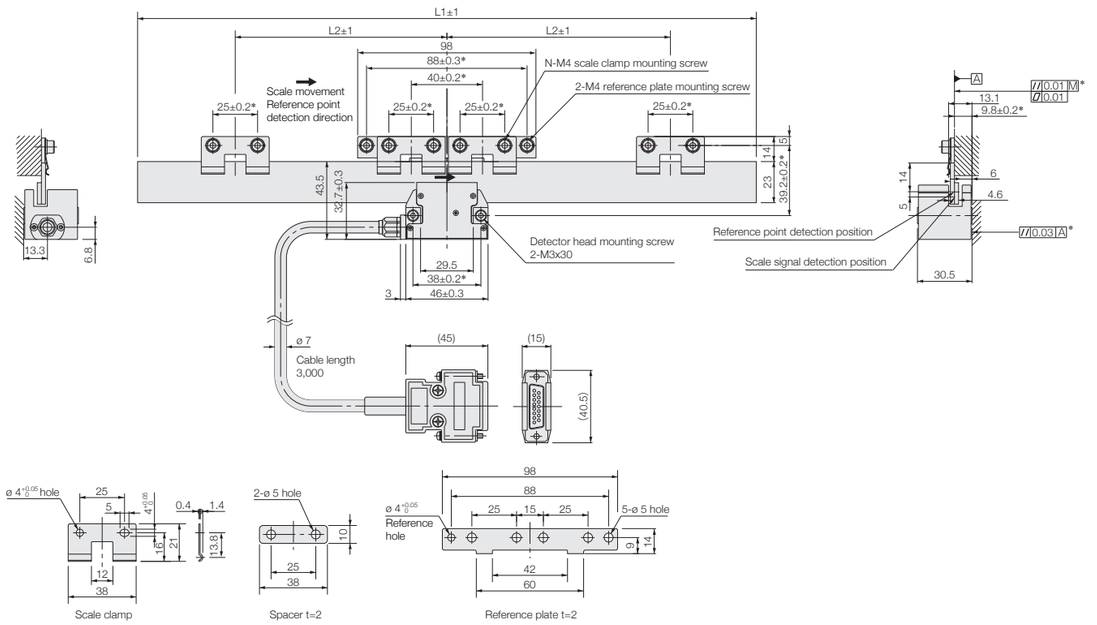



Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.
Note 5 : Mount and adjust the paired reference plates so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.
Note 6 : Reference point detection direction : Standard (Scale movement direction→with the head stationary)

| Model | L1 | L2 | L3 | N |
|---|---|---|---|---|
| BS78-40R (RS) | 66 | — | — | 2 |
| BS78-120R (RS) | 146 | 50 | — | 6 |
| BS78-170R (RS) | 196 | 75 | — | 6 |
| BS78-220R (RS) | 246 | 100 | — | 6 |
| BS78-370R (RS) | 396 | 75 | 75 | 10 |
| BS78-420R (RS) | 446 | 100 | 100 | 10 |

Unit : mm

### ● BS78-xxxR(RS) (Measuring length : 70/270/320 mm)



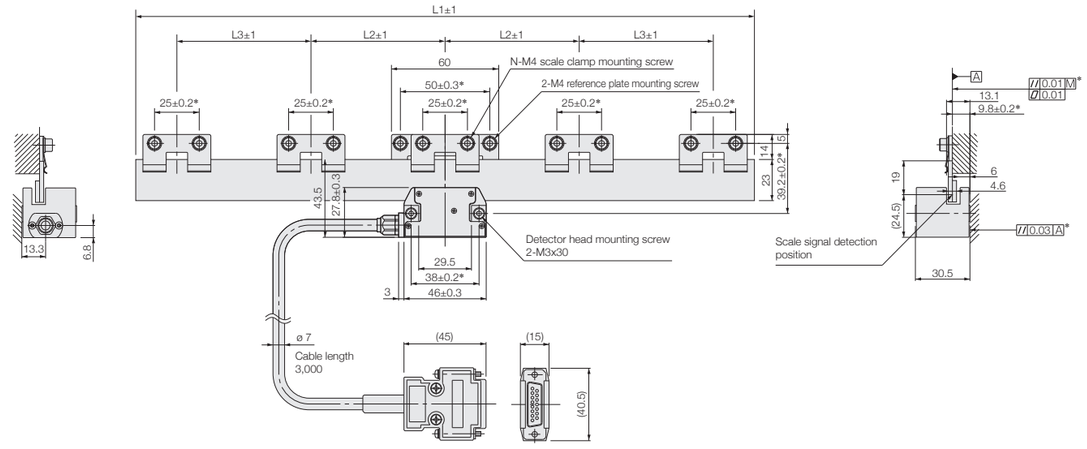

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.
Note 5 : Mount and adjust the paired reference plates so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.
Note 6 : Reference point detection direction : Standard (Scale movement direction → with the head stationary)

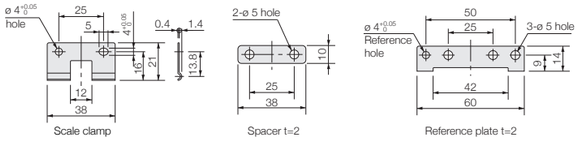
| Model | L1 | L2 | N |
|---|---|---|---|
| BS78-70R (RS) | 96 | — | 4 |
| BS78-270R (RS) | 296 | 120 | 8 |
| BS78-320R (RS) | 346 | 120 | 8 |

Unit : mm

## External Dimensions

### ● BS78-xxxN(NS) (Measuring length : 40/120/170/220/370/420 mm)



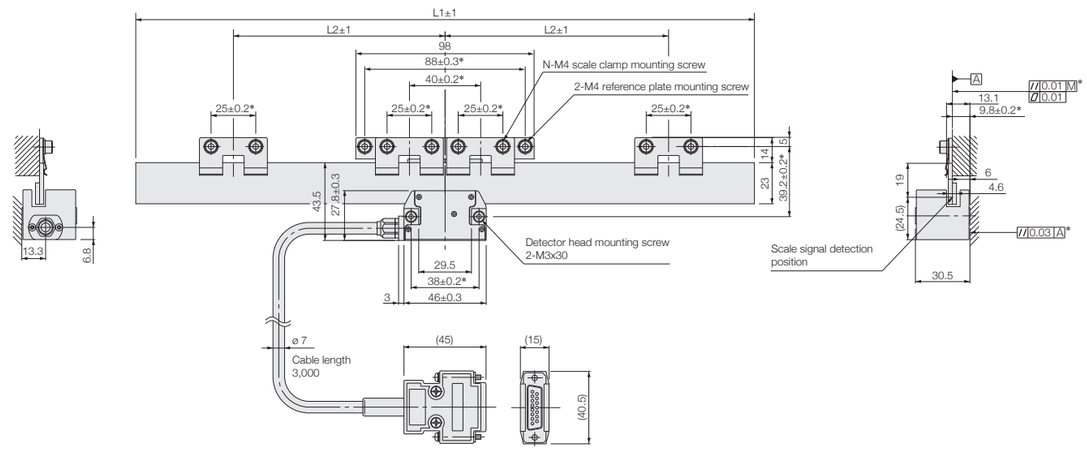



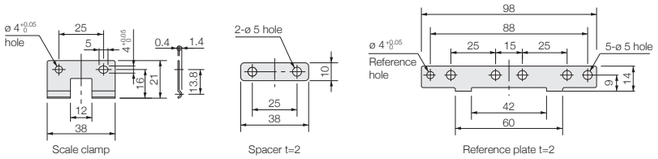

| Model | L1 | L2 | L3 | N |
|---|---|---|---|---|
| BS78-40N (NS) | 66 | — | — | 2 |
| BS78-120N (NS) | 146 | 50 | — | 6 |
| BS78-170N (NS) | 196 | 75 | — | 6 |
| BS78-220N (NS) | 246 | 100 | — | 6 |
| BS78-370N (NS) | 396 | 75 | 75 | 10 |
| BS78-420N (NS) | 446 | 100 | 100 | 10 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.
Note 5 : Mount and adjust the paired reference plates so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.

### ● BS78-xxxN(NS) (Measuring length : 70/270/320 mm)




| Model | L1 | L2 | N |
|---|---|---|---|
| BS78-70N (NS) | 96 | — | 4 |
| BS78-270N (NS) | 296 | 120 | 8 |
| BS78-320N (NS) | 346 | 120 | 8 |

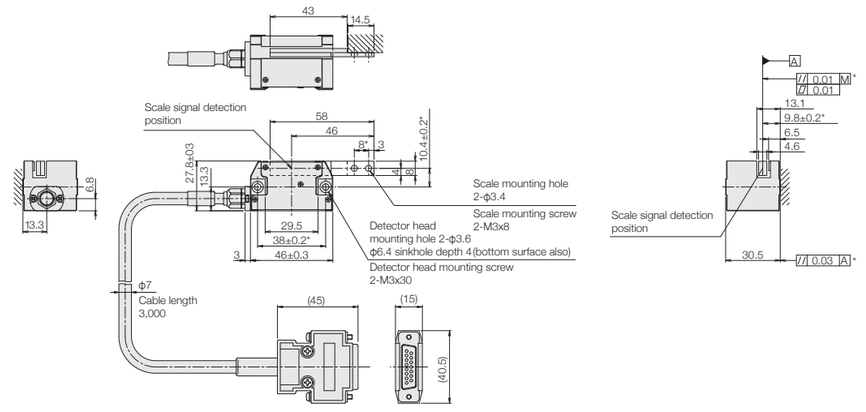
Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 :"M" refers to the machine guide.
Note 5 : Mount and adjust the paired reference plates so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.



## External Dimensions

### ● BS78-10N/NS (Measuring length : 10 mm)




Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.

Unit : mm

## Main Specifications

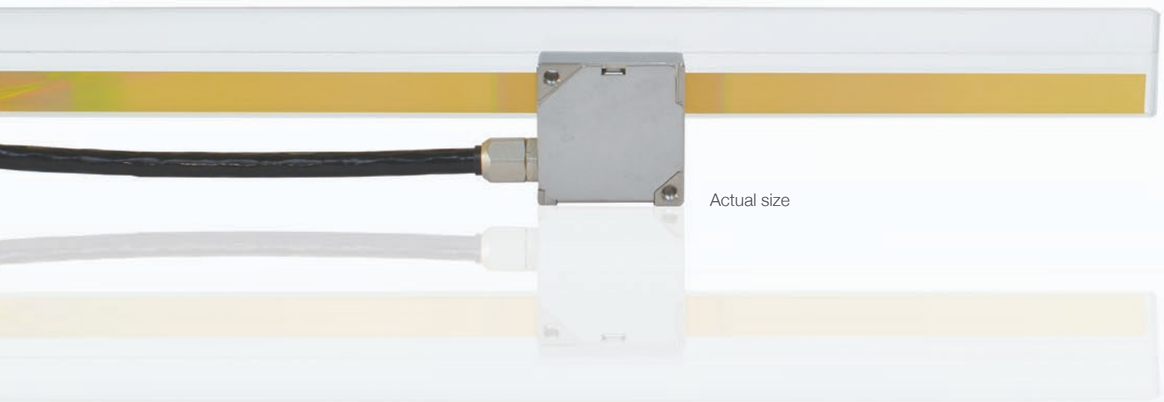
| Model | BS78 | |
|---|---|---|
| Measuring length | 10 (only N/NS)/40/70/120/170/220/270/320/370/420 mm | |
| Overall length | 58 mm (L=10mm : open type scale), L + 26 mm (L= 40 mm to 420 mm) L : Measuring length | |
| Max. travel | L + 2 mm (L=10 mm : open type scale), L +10 mm (L= 40 mm to 420 mm) L : Measuring length | |
| Scale accuracy (at20 ℃) | NS type, RS type :<br>±0.03 µm (L=10 mm : NS type) ±0.25 µm (L=270 mm)<br>±0.04 µm (L=40 mm) ±0.34 µm (L=320 mm)<br>±0.10 µm (L=70/120 mm) ±0.39 µm (L=370 mm)<br>±0.18 µm (L=170/220 mm) ±0.44 µm (L=420 mm)<br>L : Measuring length | N type, R type :<br>±0.06 µm (L=10 mm : N type) ±0.35 µm (L=170/220 mm)<br>±0.08 µm (L=40 mm) ±0.50 µm (L=270 to 370 mm)<br>±0.20 µm (L=70/120 mm) ±0.65 µm (L=420 mm)<br>L : Measuring length |
| Grating pitch | Approx. 0.55 µm | |
| Signal pitch | Approx. 0.138 µm (Approx. 138 nm) | |
| Reference point accuracy | 0.1 µm (Only R/RS type) | |
| Reference point position | At the center, and every 50 mm from the center to the left and to the right (BS78 models with measuring lengths of 320, 370, 420 mm : 20 mm offset from the center at 50 mm intervals) | |
| Reference point detection direction | Single direction | |
| Return error | This is virtually eliminated. | |
| Repeatability | This is virtually eliminated. | |
| Thermal expansion coefficient | $-0.7 \times 10^{-6}$/ ℃ | |
| Light source | Semiconductor laser : Wavelength 790 nm, Output 6 mW | |
| Radiation power | DHHS class 1 | |
| Detection principle | Diffraction grating scanning system | |
| Operating temperature | +10 to +30 ℃ (No condensation) | |
| Storage temperature | -10 to +50 ℃ (Humidity 60 % or less) | |
| Max. response speed | 400 mm/s (When connected with BD700) | |

Magnescale reserves the right to change product specifications without prior notice.

# BH

## BH25-RE / BH25-NE
(with/without reference point)

High-accuracy, reflective Laserscale with signal pitch of 250 nm
Ideal for low-profile stages, semiconductor back-end processing equipment and precision microscopes




- Signal pitch : 250 nm
- High accuracy : ±1 µm / 420 mm (Soda-lime glass, Low expansion glass)
  ±5 µm / 640 mm (Zero expansion glass, Non-alkaline glass)
- High response speed : 1,800 mm/s
- Max. resolution : 3.8 pm
- Available : with/without reference point
- Completely non-contact design : Return error is theoretically eliminated.
- Scale : Soda-lime glass / Low expansion glass / Zero expansion glass / Non-alkaline glass
- Thin head with thickness of 12 mm
- Supporting various resolutions and output modes (Depending on the interpolator connected such as BD700.)
- Special vacuum-compatible models available

Type example : BH25-170REDB

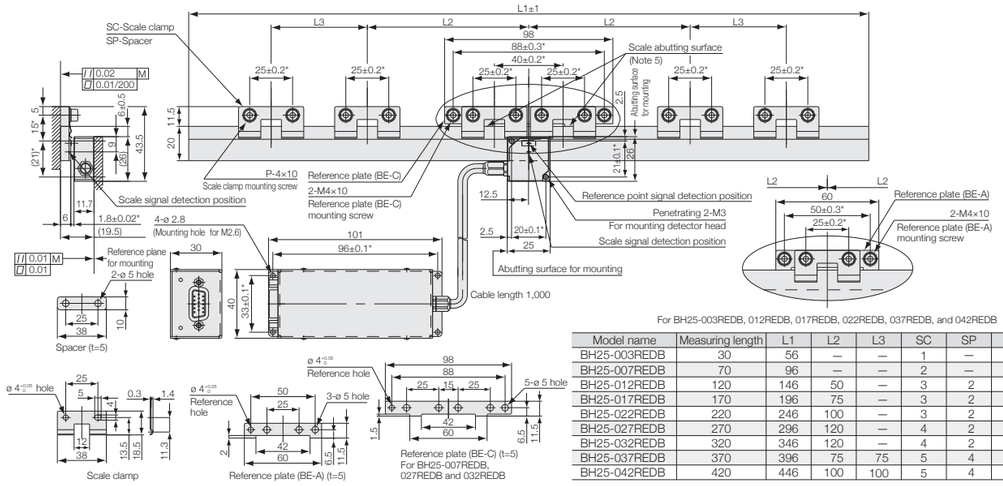
- 170 : Measuring length
- R : with reference point / N : without reference point
- E : Open type scale
- D : BD700 connection
- A : Non-alkaline glass / B : Soda-lime glass / C : Low expansion glass / D : Zero expansion glass

*Contact us directly for detail specifications



## External Dimensions

### ● BH25-xxxREDB (Measuring length : 30 / 70 / 120 / 170 / 220 / 270 / 320 / 370 / 420 mm)




For BH25-003REDB, 012REDB, 017REDB, 022REDB, 037REDB, and 042REDB

| Model name | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BH25-003REDB | 30 | 56 | — | — | 1 | — | 2 |
| BH25-007REDB | 70 | 96 | — | — | 2 | — | 4 |
| BH25-012REDB | 120 | 146 | 50 | — | 3 | 2 | 6 |
| BH25-017REDB | 170 | 196 | 75 | — | 3 | 2 | 6 |
| BH25-022REDB | 220 | 246 | 100 | — | 3 | 2 | 6 |
| BH25-027REDB | 270 | 296 | 120 | — | 4 | 2 | 8 |
| BH25-032REDB | 320 | 346 | 120 | — | 4 | 2 | 8 |
| BH25-037REDB | 370 | 396 | 75 | 75 | 5 | 4 | 10 |
| BH25-042REDB | 420 | 446 | 100 | 100 | 5 | 4 | 10 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 6.3S. Note 4 : "M"refers to the machine guide.
Note 5 : Mount and adjust the reference plate so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.

### ● BH25-xxxREDC (Measuring length : 30 / 70 / 120 / 170 / 220 / 270 / 320 / 370 / 420 mm)




For BH25-003REDC, 012REDC, 017REDC, 022REDC, 037REDC, and 042REDC

| Model name | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BH25-003REDC | 30 | 56 | — | — | 1 | — | 2 |
| BH25-007REDC | 70 | 96 | — | — | 2 | — | 4 |
| BH25-012REDC | 120 | 146 | 50 | — | 3 | 2 | 6 |
| BH25-017REDC | 170 | 196 | 75 | — | 3 | 2 | 6 |
| BH25-022REDC | 220 | 246 | 100 | — | 3 | 2 | 6 |
| BH25-027REDC | 270 | 296 | 120 | — | 4 | 2 | 8 |
| BH25-032REDC | 320 | 346 | 120 | — | 4 | 2 | 8 |
| BH25-037REDC | 370 | 396 | 75 | 75 | 5 | 4 | 10 |
| BH25-042REDC | 420 | 446 | 100 | 100 | 5 | 4 | 10 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 6.3S. Note 4 : "M"refers to the machine guide.
Note 5 : Mount and adjust the reference plate so that their reference surfaces have a parallelism of 0.01 or less with respect to the machine guide.
The above is an example. Please contact us for other external dimensions.
Please contact us for the external dimensions of zero expansion glass and non-alkaline glass.

## Main Specifications

| Model | BH25-RED | BH25-NED |
|---|---|---|
| Measuring length | 30/70/120/170/220/270/320/370/420 mm (Low expansion glass, Soda-lime glass)<br>30/70/120/170/220/270/320/370/420/470/520/570/640 (Zero expansion glass, Non-alkaline glass) | |
| Overall length | Measuring length +26 mm | |
| Max. travel | Measuring length +10 mm | |
| Scale accuracy (at 20˚C) | ±0.5 µm (30 to 170 mm) ±1.0 µm (220 to 420 mm) ± 5.0 µm (470 to 640 mm) | |
| Grating pitch | 1.0 µm | |
| Signal pitch | 0.25 µm (250 nm) | |
| Reference point | With reference point | None |
| Reference point detection direction | Single direction | None |
| Thermal expansion coefficient | -0.7 × $10^{-6}$/˚C (Low expansion glass) 8 × $10^{-6}$/˚C (Soda-lime glass) 0.1×$10^{-6}$/°C (Zero expansion glass) 3.7×$10^{-6}$/°C (Non-alkaline glass) | |
| Light source | Semiconductor laser : Wavelength 790 nm, Output 6 mW | |
| Detection principle | Diffraction grating scanning system | |
| Operating temperature | +10 to +30 ˚C (No condensation) | |
| Storage temperature | -10 to +50 ˚C (Humidity less than 60 %) | |
| Max. response speed | 1,800 mm/s | |
| Output signal | Interpolator BD700 | |
| Resolution | BD700 connection (Depend on the number of divisions) | |

Magnescale reserves the right to change product specifications without prior notice.

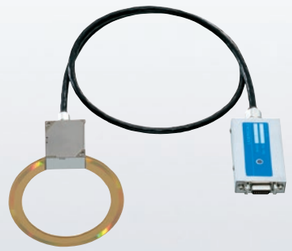
# BH

## BH20-RE / BH20-NE
(with/without reference point)

Compact, reflective rotary Laserscale featuring high accuracy,
high resolution and high response speed.
Ideal for high-resolution angle measuring in HDD manufacturing equipment,
precision measuring instruments, and aspheric surface processing machines.

*Lateral cable exit　　Actual size

- Signal pitch : 250 nm
- High response speed : 1,800 mm/s
  411 rpm (when using r=41 mm scale)
  1,428 rpm (when using r=12 mm scale)
- High resolution : 68,719,476,736 pulses/rotation
  (when using r=41 mm scale, divisions=65,536)
  = 0.09 nrad
- Available with/without reference point
- Thin head with thickness of 12 mm
- Interpolators with various resolutions and output modes available (BD700)
- Special vacuum-compatible models available



Type example : BH20-RED

- D : BD700 Connected type
- E : Open type scale
- R : with reference point; N : without reference point

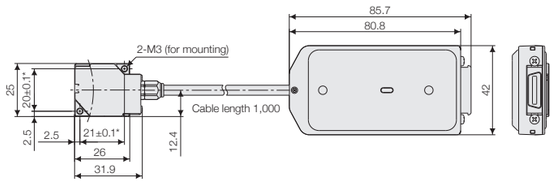
*Contact us directly for detail specifications

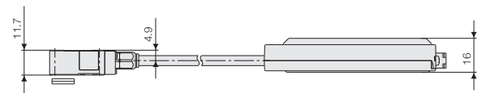


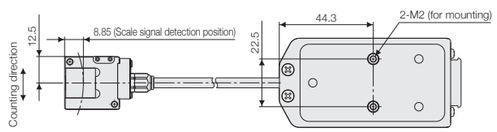
## External Dimensions

**•BH20-NED**

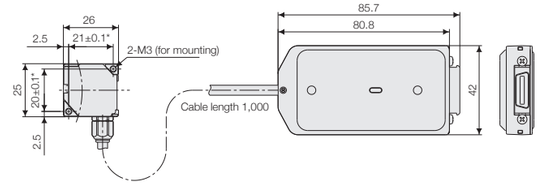
Straight cable exit

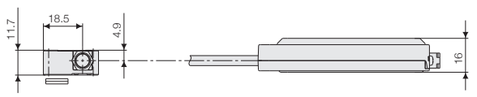


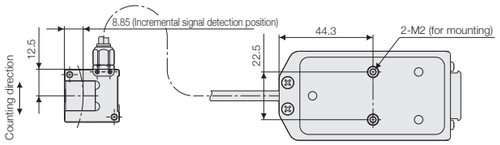




Lateral cable exit




Note : The items marked by an asterisk indicate the machining dimensions on the mounting surface.　　Unit : mm

## Main Specifications

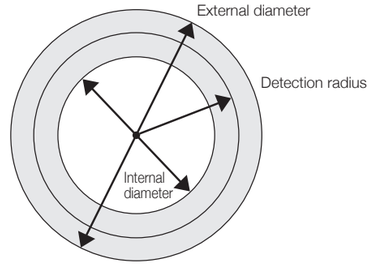
Detector head

| Model | BH20-RED | BH20-NED |
|---|---|---|
| Signal pitch | 250 nm | |
| Reference point | With reference point | None |
| Reference point detection direction | Single direction | None |
| Light source | Semiconductor laser : Wavelength 790 nm, Output 5 mW | |
| Detection principle | Diffraction grating scanning system | |
| Operating temperature | +10 to +30 ˚C (No condensation) | |
| Storage temperature | 0 to +50 ˚C (No condensation) | |
| Max. response speed | 1,800 mm/s | |

Signal scale (BE10)

| Detection radius | | 6.016 mm | 12.032 mm | 27.073 mm | 36.097 mm | 41.723 mm |
|---|---|---|---|---|---|---|
| External form | Internal diameter | Contact us. | 8.5 mm | 37 mm | 57 mm | 68 mm |
| | External diameter | Contact us. | 27 mm | 60 mm | 78 mm | 89 mm |
| Grating pitch | | 1.0 µm | | | | |
| Number of output pulse of one rotation | | 151,200 | 302,400 | 680,400 | 907,200 | 1,048,576 |
| Max. response speed* (Note1) | | 2.854 rpm | 1,428 rpm | 634 rpm | 476 rpm | 411 rpm |

Note 1 : When using cable length 1 m and Analog output. If the maximum cable length is 3 m, the speed will be 1 m cable 2/3.
Note 2 : When the scale and the detector head are purchased separately, signal adjustment is required.
Magnescale reserves the right to change product specifications without prior notice.



# BH

## BH200-RE / BH200-NE
(with/without reference point)

Compact, reflective rotary Laserscale featuring high accuracy,
high resolution, and high-speed response,
Ideal for high-resolution angle measuring in HDD manufacturing equipment
and precision measuring instruments


Actual size

Type example : BH200-RE

- E : Open type scale
- R : with Reference point; N : without Reference point

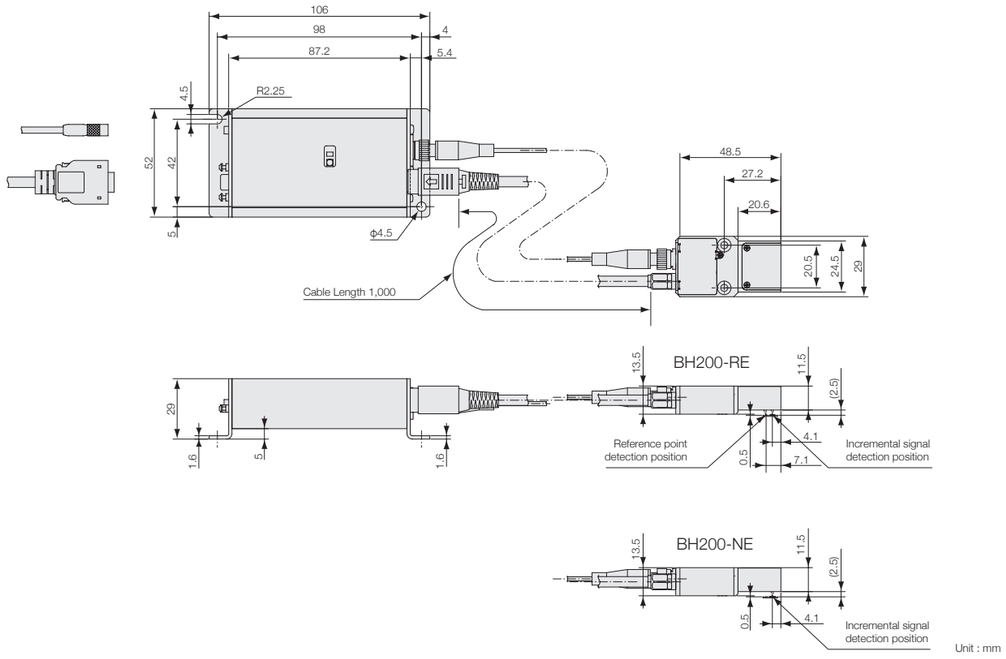
*Contact us directly for detail specifications

- High resolution and high response speed
- (signal pitch : 250 nm)
- Clock generator from 10 to 200 MHz
- 907,200 pulses / Rotation (r=36 mm)
- Completely non-contact remote head
- Available with reference point (BH200-RE) and without reference point (BH200-NE)



## External Dimensions

●**BH200-RE / BH200-NE**




Unit : mm

## Main specifications

| Model | | BH200-RE | BH200-NE |
|---|---|---|---|
| Reference point*1 | | With reference point (asynchronous) | None |
| Reference point detection direction | | Single direction | None |
| Light source | | Semiconductor laser Wavelength : 790 nm Output : 6 mW or less | |
| Pulse number/scale radius | | 907,200 pulses, scale detection radius : 36.1 mm | |
| Detection method | | Grating interferomete | |
| Operating temperature | | +10 to +30 °C (head), 0 to +50 °C (detector) | |
| Storage temperature | | -10 to +50 °C No condensation Avoid operating under high humidity | |
| Max. response speed | | 13,000 rpm | |
| Head angular tolerance | Pitch | ±10 min (output ±40 %) | |
| | Yaw | ±10 min (output ±40 %) | |
| | Roll | ±10 min (output ±40 %) | |
| Head position tolerance | △X | ±70 µm (output ±40 %) | |
| | △Y | ±70 µm (output ±40 %) | |
| | △Z | ±50 µm (output ±40 %) | |
| Output signal | | CLK signal (LVDS), 1/2 or 1/4 CLK signal (LVDS)*2 | |
| Input signal | | Switch over 1/2 or 1/4 (TTL) | |
| Power supply | | DC ±5 V (±5 %) | |
| Max. power consumption | | DC +5V : 400 mA, DC -5V : 200 mA | |
| Jitter (target)*3 | | 0.5 ns, (@5,000 rpm) | |
| Optical fiber minimum bend radius | | 50 mm | |

*1 Reference point signal is asynchronous to CLK, 1/2CLK and 1/4CLK signals. Detection is unidirectional.
*2 1/2 or 1/4 signals to CLK signal frequency. No output with input frequency of 50 MHz or less. 1/2 CLK and 1/4 CLK signals cannot be used simultaneously with CLK signal.
*3 Jitter of CLK signal : Pulse duration variation at 1000 pulses (3σ p-p). Measured by inspection equipment at Magnescale Co., Ltd.

# BL

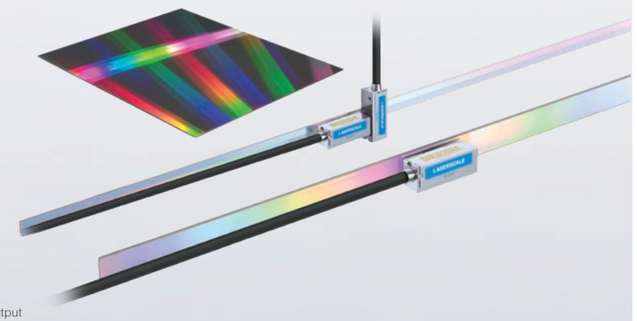
## BL50H
(with/without reference point)

## BL50H-FSE

Laserscale for high resolution and high speed motion control.
It can be used for high-speed control of stages and picometer-level fine control,
as well as a sensor for high-resolution tilt control of tilt tables.

Actual size

- Max. resolution : 6.1 pm
  Max. response speed : 3 m/s
- Wide angle tolerance of ±30 min
- Equipped with a long-life laser diode
- Low noise
- Excellent interpolation accuracy in combination with BD700
- 1.5D and 2D scales are also available



**Scale unit**
Type example : BL50H-SZ032CC

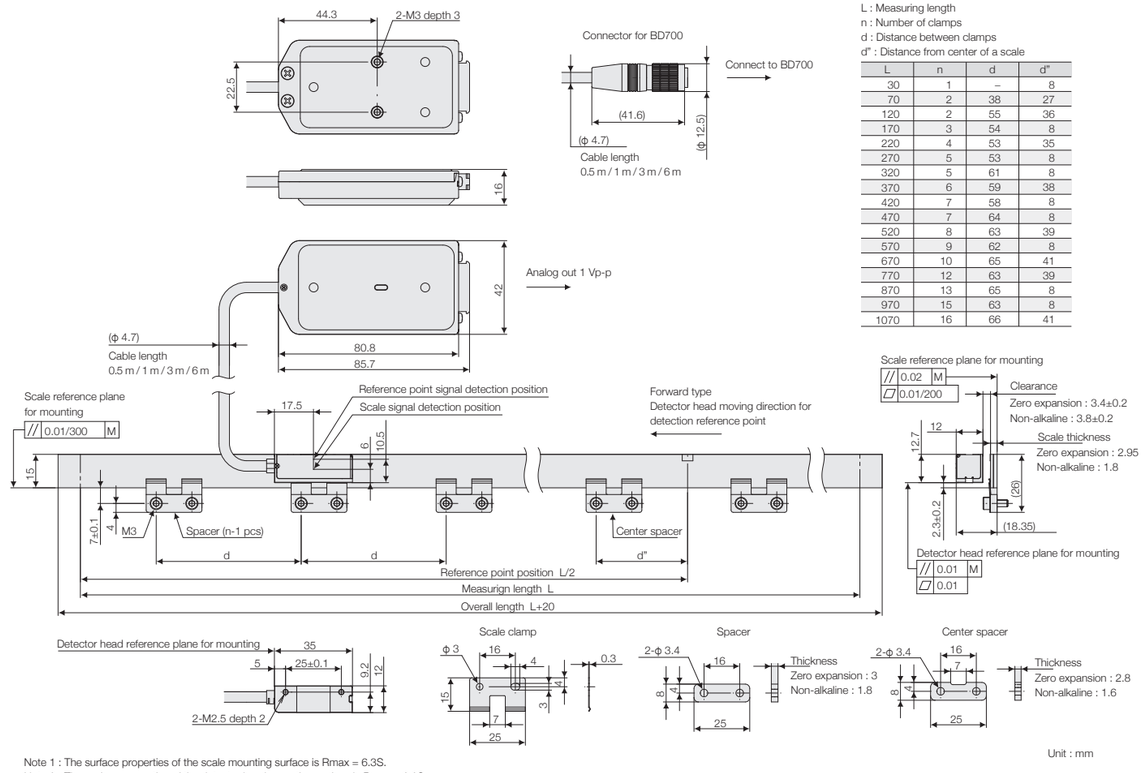
- Mounting method
  C : Clamp
  F : Double-sided tape
  H : Adhesive
- Measuring length (cm)
- Scale material
  Z : Zero expanion glass
  A : Non-alkaline glass

**Head unit**
Type example : BL50H-FSEBFD

- IF type
  H : Analog output
  D : BD700
- Reference signal detection direction (with BD700 : F)
  F : Forward
  R : Reverse
- Cable length
  A : 0.5 m
  B : 1 m
  C : 3 m
  D : 6 m



## External Dimensions




L : Measuring length
n : Number of clamps
d : Distance between clamps
d" : Distance from center of a scale

| L | n | d | d" |
|---|---|---|---|
| 30 | 1 | – | 8 |
| 70 | 2 | 38 | 27 |
| 120 | 2 | 55 | 36 |
| 170 | 3 | 54 | 8 |
| 220 | 4 | 53 | 35 |
| 270 | 5 | 53 | 8 |
| 320 | 5 | 61 | 8 |
| 370 | 6 | 59 | 38 |
| 420 | 7 | 58 | 8 |
| 470 | 7 | 64 | 8 |
| 520 | 8 | 63 | 39 |
| 570 | 9 | 62 | 8 |
| 670 | 10 | 65 | 41 |
| 770 | 12 | 63 | 39 |
| 870 | 13 | 65 | 8 |
| 970 | 15 | 63 | 8 |
| 1070 | 16 | 66 | 41 |

Unit : mm

Note 1 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 2 : The surface properties of the detector head mounting surface is Rmax = 6.3S.
Note 3 : "M" refers to the machine guide.

## Main specifications

Scale unit

| Model | BL50H-SZ＊＊＊＊＊ | BL50H-SA＊＊＊＊＊ |
|---|---|---|
| Scale material | Zero expanion glass 0.1×10-6/ °C | Non-alkaline glass 3.7×10-6/ °C |
| Measuring length | 30 to 1,070 mm [Note 1] | |
| Grating pitch | 1.6 µm | |
| Reference point position | User definable (within the range of measuring length) or None | |
| Accuracy (at 20 °C) | ±0.5 µm/30 to 120 mm, ±1 µm/170 to 270 mm, ±3 µm/320 to 670 mm (±1.5 µm with special specification),<br>±5 µm/770 to 970 mm (±3 µm with special specification), ±5 µm/1,070 mm,<br>±0.2 µm/1,070 mm or less (with BD700 compensation) [Note 1] | |
| Interpolation accuracy | ±50 pm (with interpolator BD700) | |

Head unit

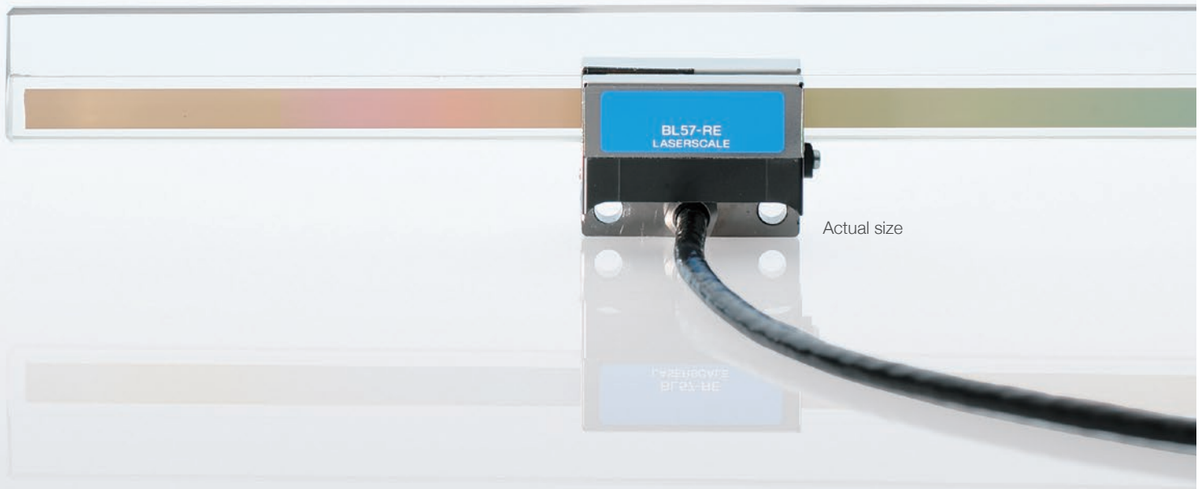
| Model | BL50H-FSE＊＊D | BL50H-FSE＊＊H |
|---|---|---|
| Output signal | Interpolator BD700 connection [Note 2] | Analog 1 Vp-p |
| Signal pitch | 400 nm | |
| Max. resolution | 6.1 pm | – |
| Max. response speed | 3 m/s (5 m/s with special handling) | |
| Clearance | Zero expansion glass : 3.4±0.2 mm Non-alkaline glass : 3.8±0.2 mm | |
| Angle tolerance | Yaw : ±8.7 mrad Pitch : ±8.7 mrad Roll : ±8.7 mrad | |
| Head cable length | 0.5 m, 1 m, 3 m, 6 m | |
| Operating temperature | +10 to +40 °C (No condensation) | |

Note 1 : For measuring length exceeding 570 mm, please contact our sales department.
Note 2 : Converted to A/B quadrature, serial interface of various protocols, and analog output by BD700 interpolator
Magnescale reserves the right to change product specifications without prior notice.

# BL

## BL57-RE / BL57-NE
(with/without reference point)

High accuracy, high response linear scale with signal pitch of 400 nm.
Supports a wide range of applications and offers the highest performance in its class.




Actual size

BL57-RE

- Achieves a measuring length of up to 1,060 mm upon request, and offers the highest-level response speed and accuracy in its class.
- Signal pitch : 400 nm
- Built-in reference point.
  〈Applications〉 Precision measuring equipment, precision stages.

BL57-NE

- Compact size makes machine integration much easier
- Theoretically unaffected by changes in temperature, humidity, air pressure and air movement. Unparalled measuring stability achieved by use of low expansion glass
- Signal pitch : 400 nm
  〈Applications〉 High-accuracy microscopes, measurement equipment.

Type example : BL57-106REFB

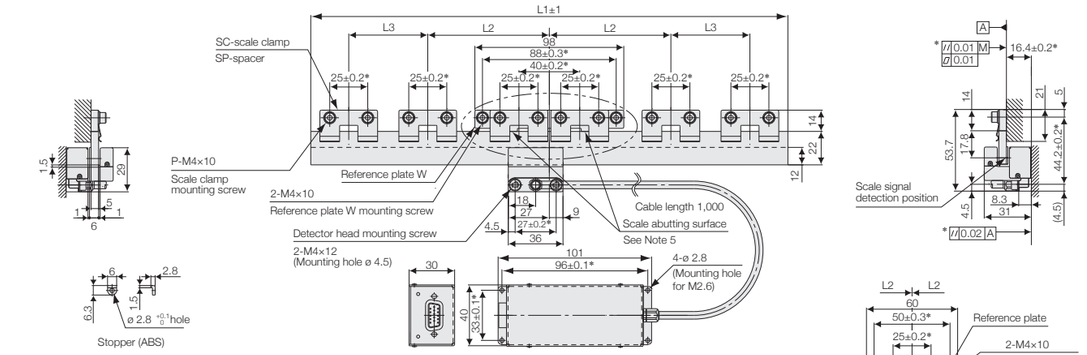
- B : Soda-lime glass
  C : Low expansion glass
- A : 4-split A/B quadrature output
  F : 4-split 8-split A/B quadrature output
  G : 20-split 40-split A/B quadrature output
  H : Analog 1 Vp-p output
- E : Open type scale
- R : with reference point; N : without reference point
- Measuring length

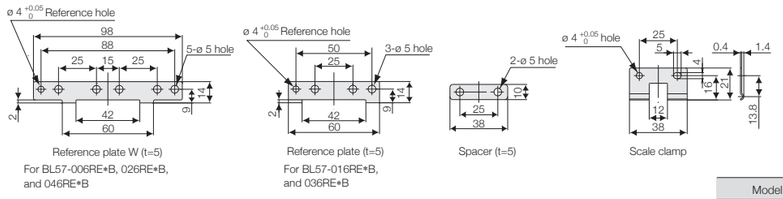
*Contact us directly for connection with BD700



## External Dimensions

### ● BL57-xxxRE*B (Measuring length : 60/160/260/360/460 mm)



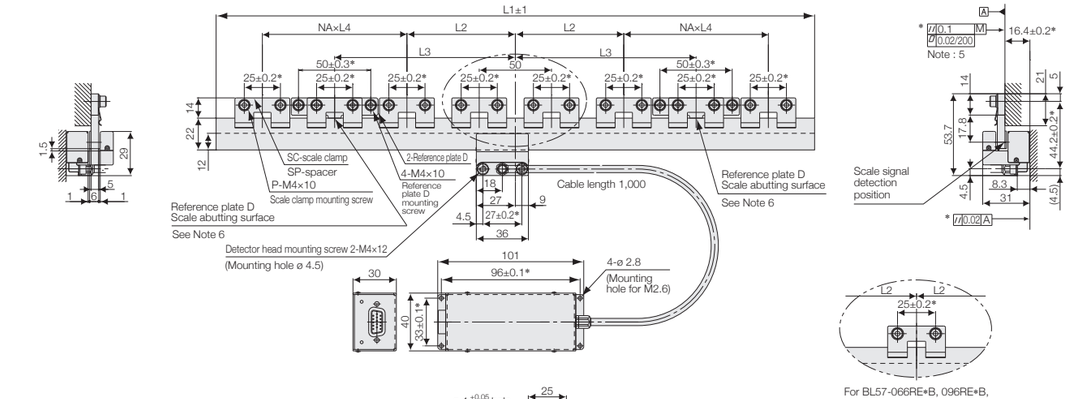




| Model | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BL57-006RE*B | 60 | 96 | — | — | 2 | — | 4 |
| BL57-016RE*B | 160 | 196 | 75 | — | 3 | 2 | 6 |
| BL57-026RE*B | 260 | 296 | 120 | — | 4 | 2 | 8 |
| BL57-036RE*B | 360 | 396 | 75 | 75 | 5 | 4 | 10 |
| BL57-046RE*B | 460 | 496 | 120 | 75 | 6 | 4 | 12 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.
Note 5 : When mounting the reference plate (reference plate W), adjust the plate so that the parallelism between the corresponding scale abutting surface and the machine guide is 0.01 mm or less.

### ● BL57-xxxRE*B (Measuring length : 560/660/760/860/960/1,060 mm)

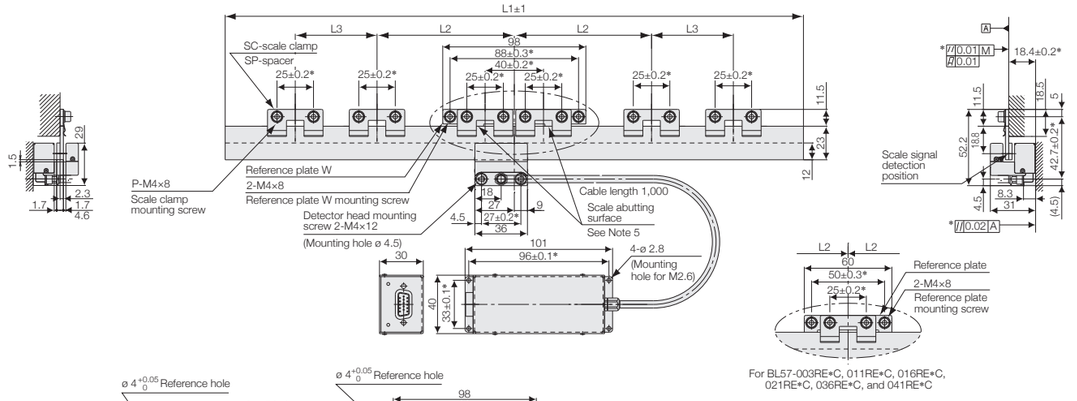


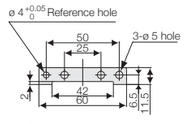

| Model | Measuring length | L1 | L2 | L3 | L4 | NA | SC | SP | P |
|---|---|---|---|---|---|---|---|---|---|
| BL57-056RE*B | 560 | 596 | 100 | 175 | 75 | 2 | 8 | 6 | 16 |
| BL57-066RE*B | 660 | 696 | 75 | 225 | 75 | 3 | 9 | 7 | 18 |
| BL57-076RE*B | 760 | 796 | 100 | 250 | 75 | 3 | 10 | 8 | 20 |
| BL57-086RE*B | 860 | 896 | 100 | 250 | 75 | 4 | 12 | 10 | 24 |
| BL57-096RE*B | 960 | 996 | 75 | 300 | 75 | 5 | 13 | 11 | 26 |
| BL57-106RE*B | 1,060 | 1,096 | 75 | 300 | 75 | 6 | 15 | 13 | 30 |

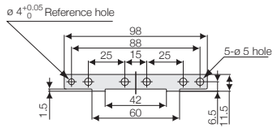
Unit : mm

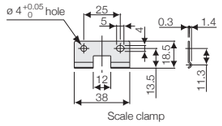
Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface.
Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S.
Note 4 : "M" refers to the machine guide.
Note 5 : The flatness of the scale mounting surface must be within 0.02 over the range of 7 (width) × 200 (length) mm.
Note 6 : Mount and adjust the paired reference plates (D) so that their reference surfaces have a parallelism of 0.1 or less with respect to the machine guide.

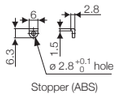
## ● BL57-xxxRE∗C (Measuring length : 30/60/110/160/210/260/310/360/410 mm)

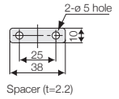






For BL57-003RE∗C, 011RE∗C, 016RE∗C, 021RE∗C, 036RE∗C, and 041RE∗C

| Model | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BL57-003RE∗C | 30 | 66 | — | — | 1 | — | 2 |
| BL57-006RE∗C | 60 | 96 | — | — | 2 | — | 4 |
| BL57-011RE∗C | 110 | 146 | 50 | — | 3 | 2 | 6 |
| BL57-016RE∗C | 160 | 196 | 75 | — | 3 | 2 | 6 |
| BL57-021RE∗C | 210 | 246 | 100 | — | 3 | 2 | 6 |
| BL57-026RE∗C | 260 | 296 | 120 | — | 4 | 2 | 8 |
| BL57-031RE∗C | 310 | 346 | 120 | — | 4 | 2 | 8 |
| BL57-036RE∗C | 360 | 396 | 75 | 75 | 5 | 4 | 10 |
| BL57-041RE∗C | 410 | 446 | 100 | 100 | 5 | 4 | 10 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S. Note 4 : "M" refers to the machine guide.
Note 5 : When mounting the reference plate (reference plate W), adjust the plate so that the parallelism between the corresponding scale abutting surface and the machine guide is 0.01 mm or less.

## Main Specifications [BL57-RE]

| Model | | BL57-xxxREF | BL57-xxxREG | BL57-xxxREH |
|---|---|---|---|---|
| Output signal form | | A/B quadrature output | | Analog output |
| Detection principle | | Diffraction grating scanning system | | |
| Scale length (Low expansion glass) | Measuring length | 30, 60, 110, 160, 210, 260, 310, 360, 410 mm | | |
| | Overall length | Measuring length + 36 mm | | |
| | Max. travel | Measuring length + 10 mm (5 mm on each side) | | |
| Scale length (Soda-lime glass) | Measuring length | 60, 160, 260, 360, 460, 560, 660, 760, 860, 960, 1,060 mm | | |
| | Overall length | Measuring length + 36 mm | | |
| | Max. travel | Measuring length +10 mm (5 mm on each side) | | |
| Scale accuracy (at 20 ˚C) | | ±0.5 µm (30 to 160 mm) / ±1.0 µm (210 to 360 mm) / ±1.5 m (410 mm or more) | | |
| Grating pitch | | 1.6 µm | | |
| Signal pitch | | 0.4 µm (400 nm) | | |
| Output signal | | Differential (compliant with EIA-422) | | Differential (only reference point output are compliant with EIA-422) |
| Resolution | | 0.1/0.05 µm (selectable) | 0.02/0.01 µm (selectable) | 0.4 µm (1 Vp-p) |
| Reference point accuracy (at 20 ˚C) | | ±0.4 µm (depending on machine movement accuracy) | | |
| Reference point position | | User definable (within the range of measuring length) | | |
| Reference point detection direction | | Single direction synchronous reference point | | |
| Thermal expansion coefficient | | Low expansion glass : -0.7×10$^{-6}$/ ˚C, Soda-lime glass : 8×10$^{-6}$/ ˚C | | |
| Light source | | Semiconductor laser : Wavelength 790 nm, Output 6 mW | | |
| Radiation power | | JIS Class 1 equivalent, DHHS Class 1 equivalent | | |
| Operating temperature | | 0 to +40 ˚C (No condensation) | | |
| Storage temperature | | -10 to + 50 ˚C | | |

| Model | | BL57-xxxREF | BL57-xxxREG | BL57-xxxREH |
|---|---|---|---|---|
| Max. response speed | | 1,500 mm/s (0.1 µm) 650 mm/s (0.05 µm) | 300 mm/s (0.02 µm) 120 mm/s (0.01 µm) | 3,000 mm/s (Note1) |
| | | Minimum phase difference : 38 ns | Minimum phase difference : 38 ns | Max 7.5 MHz |
| Alarm | | High impedance, output when max. response speed is exceeded or signal level error detected | | None |
| Head cable | Cable length | 1 m (Note 4) | | |
| | Bending radius | Static : 10 mm | | |
| Output cable length | | 15 m Max (Note 2) (to the electronic control section) | | 15 m Max (Note1) (Note 2) |
| Power supply (Note 3) | | +5 V (±5%) | | |
| Power consumption | | 450 mA (no load), 600 mA (with 120 Ω termination) | | |
| Vibration resistance | | 100 m/s$^2$ (50 to 2,000 Hz) | | |
| Impact resistance | | 200 m/s$^2$ | | |

Note 1 : Max. response speed become limited by output cable length (the part beyond the interface box).

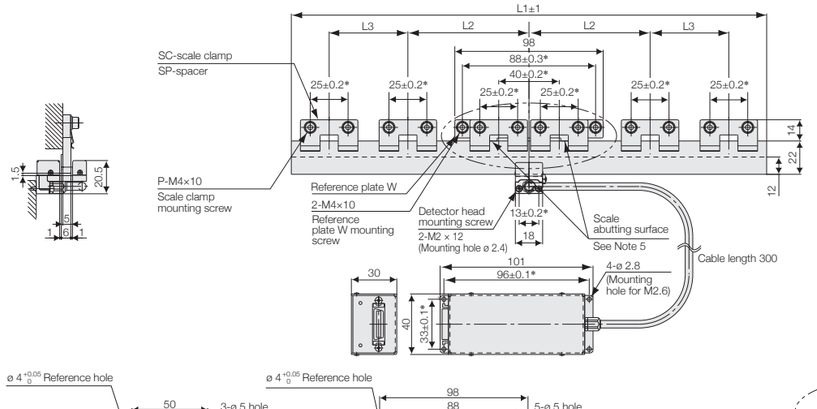
| Cable length (m) | Max. response speed (mm/s) |
|---|---|
| 3 | 3,000 |
| 9 | 2,330 |
| 15 | 1,660 |

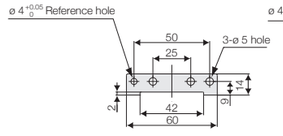
Note 2 : A power supply line longer than 10 m is incompatible with EN61000-6-2. Take surge protection measures upon use.
Note 3 : Satisfy the required specifications at the connector input section.
Note 4 : Special models can support up to 3 m. However, the max. response speed is limited depending on the cable length. (In a 3 m cable, the max. response speed is two-thirds that of a 1 m cable.)
Note 5 : Special models can support a measuring length of 420 mm to 560 mm by low expansion glass and 1,070 mm to 1,260 mm by soda-lime glass.
Magnescale reserves the right to change product specifications without prior notice.

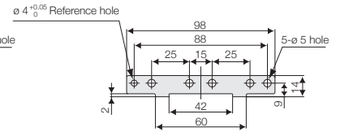


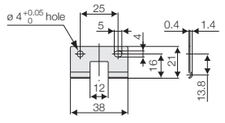


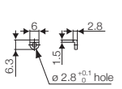
## ● BL57-xxxNE∗B (Measuring length : 60/160/260/360/460 mm)

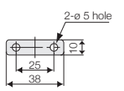


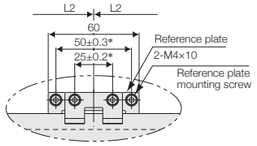



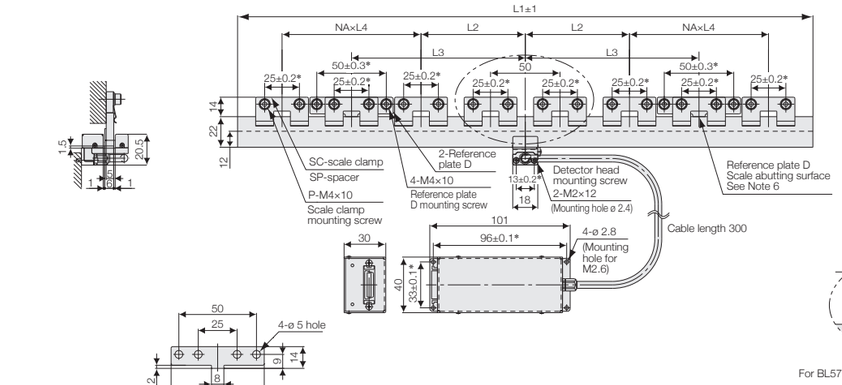

For BL57-016NE∗B and 036NE∗B

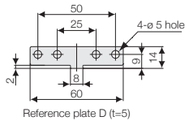
| Model | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BL57-006NE∗B | 60 | 96 | — | — | 2 | — | 4 |
| BL57-016NE∗B | 160 | 196 | 75 | — | 3 | 2 | 6 |
| BL57-026NE∗B | 260 | 296 | 120 | — | 4 | 2 | 8 |
| BL57-036NE∗B | 360 | 396 | 75 | 75 | 5 | 4 | 10 |
| BL57-046NE∗B | 460 | 496 | 120 | 75 | 6 | 4 | 12 |

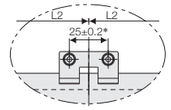
Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S. Note 4 : "M" refers to the machine guide.
Note 5 : When mounting the reference plate (reference plate W), adjust the plate so that the parallelism between the corresponding scale abutting surface and the machine guide is 0.01 mm or less.

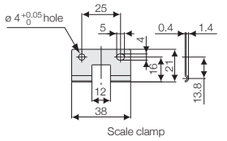
## ● BL57-xxxNE∗B (Measuring length : 560/660/760/860/960/1060 mm)

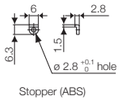


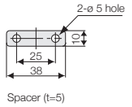




For BL57-066NE∗B, 096NE∗B, and 106NE∗B



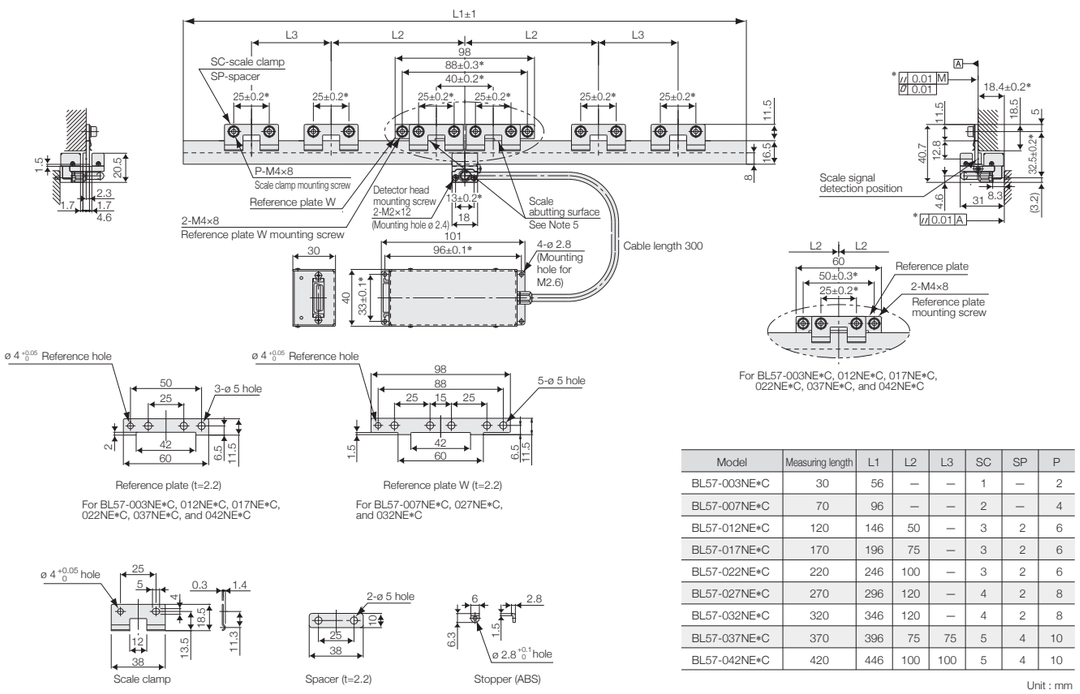

| Model | Measuring length | L1 | L2 | L3 | L4 | NA | SC | SP | P |
|---|---|---|---|---|---|---|---|---|---|
| BL57-056NE∗B | 560 | 596 | 100 | 175 | 75 | 2 | 8 | 6 | 16 |
| BL57-066NE∗B | 660 | 696 | 75 | 225 | 75 | 3 | 9 | 7 | 18 |
| BL57-076NE∗B | 760 | 796 | 100 | 250 | 75 | 3 | 10 | 8 | 20 |
| BL57-086NE∗B | 860 | 896 | 100 | 250 | 75 | 4 | 12 | 10 | 24 |
| BL57-096NE∗B | 960 | 996 | 75 | 300 | 75 | 5 | 13 | 11 | 26 |
| BL57-106NE∗B | 1,060 | 1,096 | 75 | 300 | 75 | 6 | 15 | 13 | 30 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S. Note 4 : "M" refers to the machine guide.
Note 5 : The flatness of the scale mounting surface must be within 0.02 over the range of 7 (width) × 200 (length) mm
Note 6 : Mount and adjust the paired reference plates (D) so that their reference surfaces have a parallelism of 0.1 or less with respect to the machine guide.

## External Dimensions

● **BL57-xxxNE∗C (Measuring length : 30/70/120/170/220/270/320/370/420 mm)**




| Model | Measuring length | L1 | L2 | L3 | SC | SP | P |
|---|---|---|---|---|---|---|---|
| BL57-003NE∗C | 30 | 56 | — | — | 1 | — | 2 |
| BL57-007NE∗C | 70 | 96 | — | — | 2 | — | 4 |
| BL57-012NE∗C | 120 | 146 | 50 | — | 3 | 2 | 6 |
| BL57-017NE∗C | 170 | 196 | 75 | — | 3 | 2 | 6 |
| BL57-022NE∗C | 220 | 246 | 100 | — | 3 | 2 | 6 |
| BL57-027NE∗C | 270 | 296 | 120 | — | 4 | 2 | 8 |
| BL57-032NE∗C | 320 | 346 | 120 | — | 4 | 2 | 8 |
| BL57-037NE∗C | 370 | 396 | 75 | 75 | 5 | 4 | 10 |
| BL57-042NE∗C | 420 | 446 | 100 | 100 | 5 | 4 | 10 |

Unit : mm

Note 1 : The items marked by an asterisk indicate the machining dimensions on the mounting surface. Note 2 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 3 : The surface properties of the detector head mounting surface is Rmax = 12.5S. Note 4 : "M" refers to the machine guide.
Note 5 : When mounting the reference plate (reference plate W), adjust the plate so that the parallelism between the corresponding scale abutting surface and the machine guide is 0.01 mm or less.

## Main Specifications[BL57-NE]

| Model | | BL57-xxxNEA | BL57-xxxNEF | BL57-xxxNEG | BL57-xxxNEH |
|---|---|---|---|---|---|
| Output signal form | | A/B quadrature output | | | Analog output |
| Detection principle | | Diffraction grating scanning system | | | |
| Scale length (Low expansion glass) | Measuring length | 30, 70, 120, 170, 220, 270, 320, 370, 420 mm | | | |
| | Overall length | Measuring length + 26 mm | | | |
| | Max. travel | Measuring length +10 mm (5 mm on each side) | | | |
| Scale length (Soda-lime glass) | Measuring length | 60, 160, 260, 360, 460, 560, 660, 760, 860, 960, 1,060 mm | | | |
| | Overall length | Measuring length + 36 mm | | | |
| | Max. travel | Measuring length +10 mm (5 mm on each side) | | | |
| Scale accuracy (at 20 ℃) | | ±0.5 µm (30 to 170 mm)/ ±1.0 µm (220 to 370 mm)/ ±1.5 µm (420 mm or more) | | | |
| Grating pitch | | 1.6 µm | | | |
| Signal pitch | | 0.4 µm (400 nm) | | | |
| Output signal | | Differential (compliant with EIA-422) | | | Differential |
| Resolution | | 0.1 µm | 0.1/0.05 µm (selectable) | 0.02/0.01 µm (selectable) | 0.4 µm (1 Vp-p) |
| Thermal expansion coefficient | | Low expansion glass : -0.7×10⁻⁶/ ℃, Soda-lime glass : 8×10⁻⁶/ ℃ | | | |
| Light source | | Semiconductor laser : Wavelength 790 nm, Output 6 mW | | | |
| Radiation power | | JIS Class 1 equivalent, DHHS Class 1 equivalent | | | |
| Operating temperature | | 0 to +40 ℃ (no condensation) | | | |
| Storage temperature | | -10 to + 50 ℃ | | | |
| Max. response speed | | 1,000 mm/s | 1,500 mm/s (0.1µm) 650 mm/s (0.05µm) | 300 mm/s (0.02 µm) 120 mm/s (0.01 µm) | 3,000 mm/s (Note 1) |
| | | Minimum phase difference : 80 ns | Minimum phase difference : 38 ns | Minimum phase difference : 38 ns | Max 7.5 MHz |

| Model | | BL57-xxxNEA | BL57-xxxNEF | BL57-xxxNEG | BL57-xxxNEH |
|---|---|---|---|---|---|
| Alarm | | High-impedance A/B quadrature output signals when signal level error detected. | High-impedance output when max. response speed exceeded or signal level error detected. | | None |
| Head cable | Cable length | 300 mm | | | |
| | Bending radius | Static : 10 mm | | | |
| Output cable length | | 15 m Max (Note 2) (to the electronic control section) | | | 15 m Max (Note 1) (Note 2) |
| Power supply (Note 3) | | +5 V (+10 %-5 %) | +5 V (±5%) | | |
| Power consumption | | 200 mA (no load) 250 mA (with 120 Ω termination) | 290 mA (no load) 350 mA (with 120 Ω termination) | | 250 mA (no load,with 120 Ω termination) |
| Vibration resistance | | 100 m/s² (50 to 2000 Hz) | | | |
| Impact resistance | | 200 m/s² | | | |

Note 1 : Max. response speed become limited by output cable length (the part beyond the interface box).

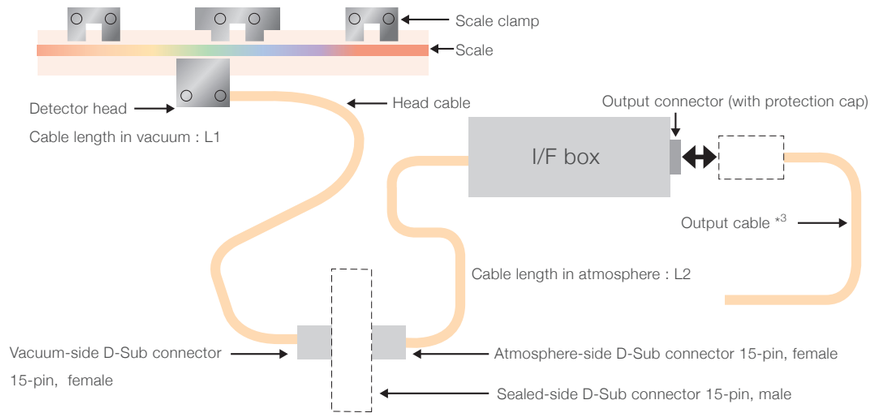
| Cable length (m) | Max. response speed (mm/s) |
|---|---|
| 3 | 3,000 |
| 9 | 2,330 |
| 15 | 1,660 |

Note 2 : A power supply line longer than 10 m is incompatible with EN61000-6-2.
Take surge protection measures upon use.
Note 3 : Satisfy the required specifications at the connector input section.
Magnescale reserves the right to change product specifications without prior notice.



# BL57 supporting vacuum environment (Special models)

Contact us for more information



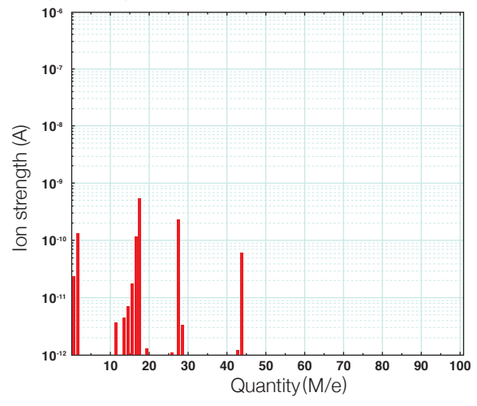

**Vacuum-compatible, open type with reference point. Allowing ultra-precise positioning in a vacuum environment.**

- Ultimate vacuum of $10^{-5}$ Pa class.
- Emitted gas flow rate of $10^{-6}$ Pa・$m^3$ class.
- Signal pitch 0.4 µm
- Built-in reference point.

Applications : Semiconductor inspection systems, length measuring SEM.

*1 : For dimensions of head, scale, and I/F box, see the page on BL57-RE. *2 : Cable length in vacuum and in atmosphere (L1 + L2) is up to 3 m.
*3 : Output cable is not included in the product.

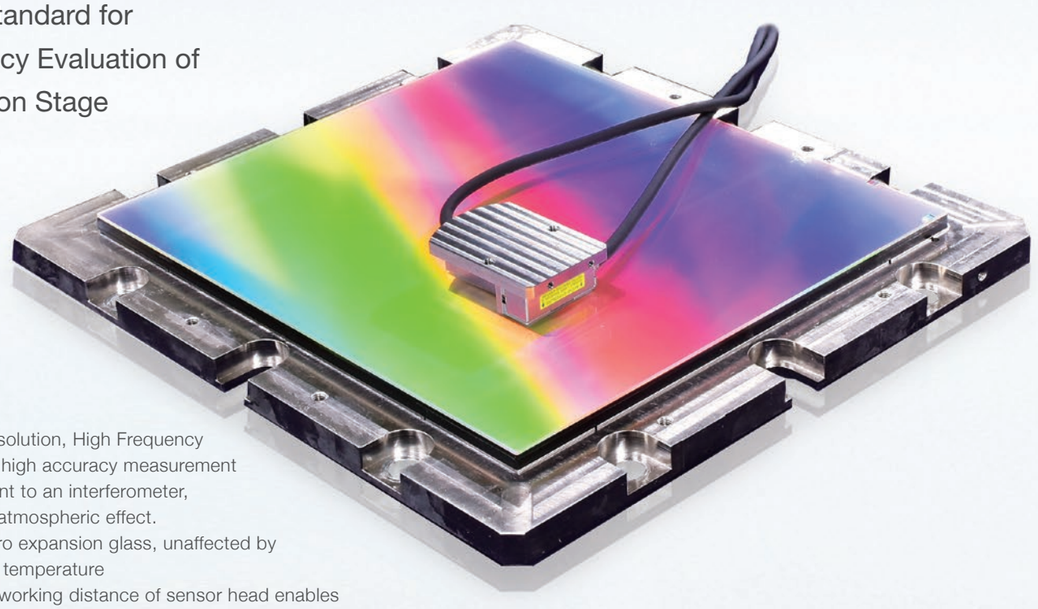
### Outgas analysis chart




# SET-SC

SET-SC2020

New Standard for
Accuracy Evaluation of
Precision Stage

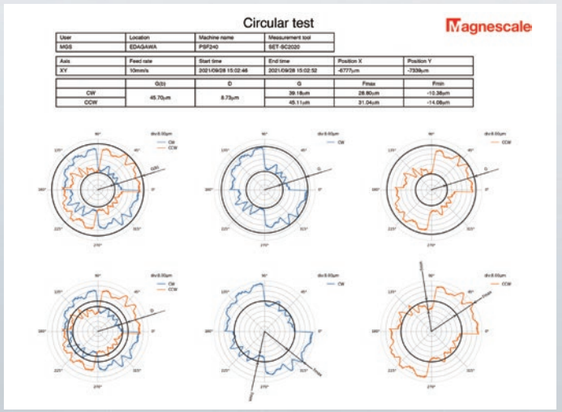


- High Resolution, High Frequency
- Enables high accuracy measurement equivalent to an interferometer, with no atmospheric effect.
- Uses zero expansion glass, unaffected by ambient temperature
- Greater working distance of sensor head enables easy installation. Also enables vertical installation.

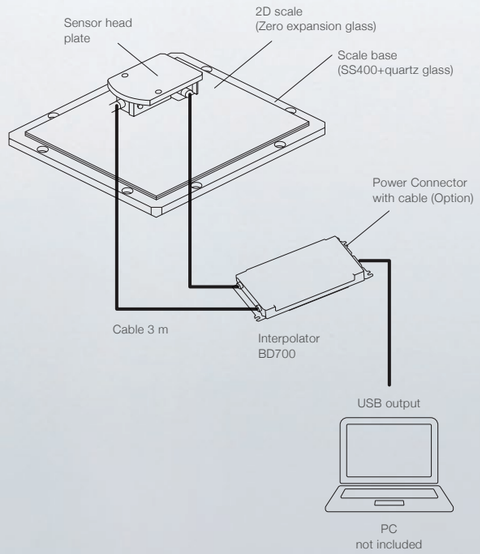
Distance between the sensor head and the scale

2.9 mm ±0.2 mm

Sample of measurement software

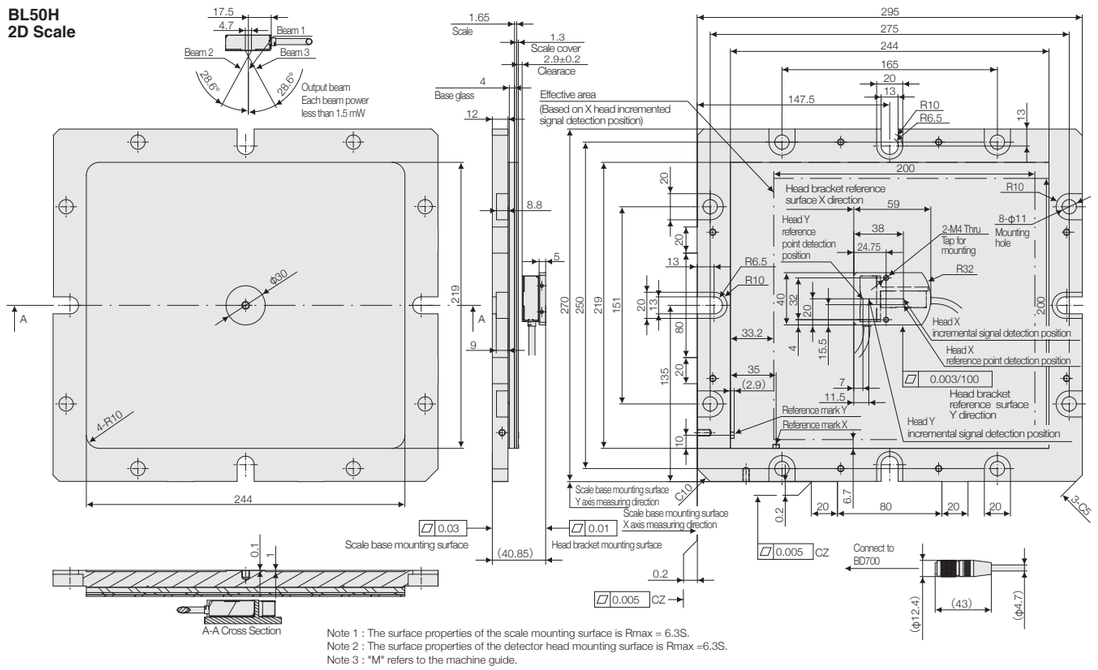



System configuration



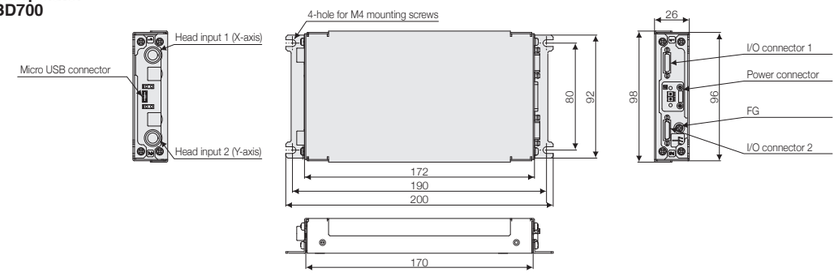

## External Dimensions

**BL50H**
**2D Scale**




Note 1 : The surface properties of the scale mounting surface is Rmax = 6.3S.
Note 2 : The surface properties of the detector head mounting surface is Rmax =6.3S.
Note 3 : "M" refers to the machine guide.

**Interpolator**
**BD700**




Unit : mm

## Main Specifications

| | |
|---|---|
| Model | SET-SC2020 |
| Measuring length | 200 × 200 mm |
| Signal cycle | 400 nm |
| Max. resolution | 10 pm |
| Cumulative accuracy | ±0.5 µm (After compensation, scale measuring length 200 × 200 mm) |
| Working distance | 2.9 ±0.2 mm |
| XY orthogonality | ±0.3 s (After compensation) |
| Scale material and the thermal expansion coefficient | Zero expansion glass : 0.1×10$^{-6}$/°C |
| Scale base material and the thermal expansion coefficient | SS400 : 11.8 × 10$^{-6}$/ °C, Quartz glass : 0.5 × 10$^{-6}$/ °C |
| Measuring speed | 300 mm/s |
| Sensor head mass | 0.2 kg (without cable) |
| Cable length | 3 m |
| Input and output signals | BiSS C for incremental , USB |
| Packaging | With carry case |
| Software | Measurement software (CSV output), roundness measurement software, lissajous monitoring software |

Note 1 : For your safety : Please read "Instruction Manual "carefully before using the product.
Note 2 : This product (and technology) falls under item 16 of the Export Ordinance Appendix 1 (Item 16 of the Foreign Exchange Ordinance Appendix).
Please check with the exporter regarding the necessity of permission from the Ministry of Economy, Trade and Industry under the catch-all control.
Note 3 : For other effective lengths, please contact us.
Magnescale reserves the right to change product specifications without prior notice.

# BN

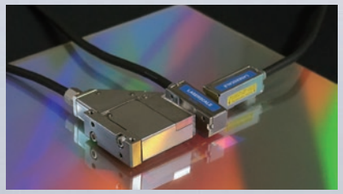
BN Series

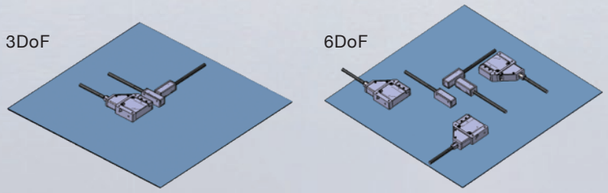
Non-contact displacement sensor

- Principle of grating interference meter
- Signal pitch : 231.5 nm
- Max. resolution : 3.5 pm
- Linearity : ±13 nm/mm
- Wide measurement area and excellent repeatability of measurement
- Less affected by changes in atmospheric pressure and temperature

## Multi DoF Measuerment System

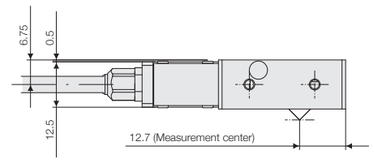
Combination with 2D scales , mirrors, and wafers enables multi Degree-of-Freedom measurement.

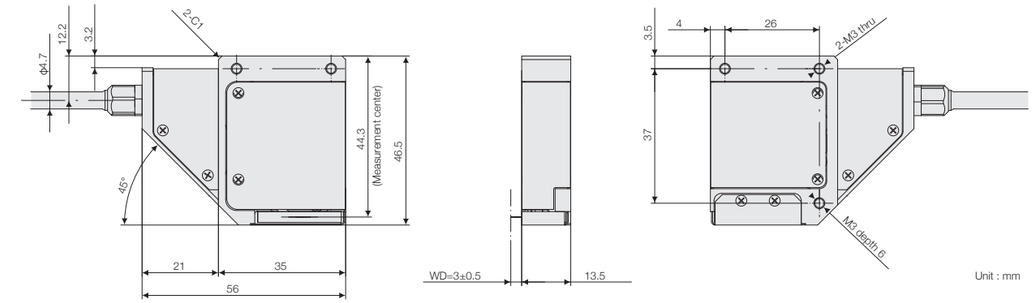







## External Dimensions



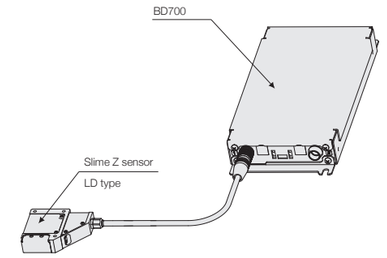



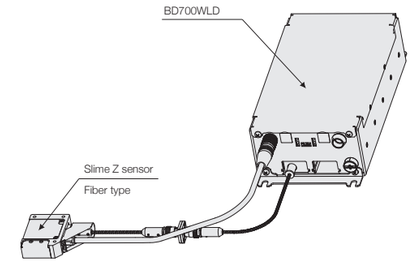

## Main Specifications

| | |
|---|---|
| Model | BN Series |
| Signal pitch | 231.5 nm |
| Resolution | 3.5 pm (with BD700) |
| Noise 3σ (6 kHz LPF) | ±0.14 nm (When measure AL mirror) |
| Target | 2D scales, mirrors, bare wafers, etc. |
| Beam diameter | Φ2 mm |
| Linearity | ±13 nm/mm |
| Measurement area | Working distance 3 mm |
| | Measuring area ±0.5 mm |
| | Pitch ±0.7 mrad |
| | Roll ±3.0 mrad |
| Others | Vacuum environment compatible (Optional) |

Magnescale reserves the right to change product specifications without prior notice.

## Line-up



# BD

## BD700
## Interpolator for Lasersale

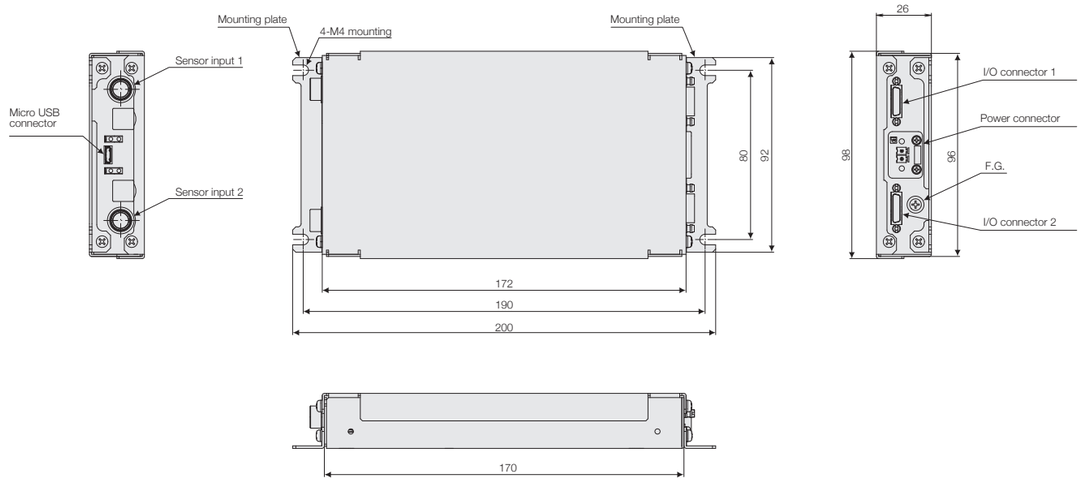
Max. division : 65,536

BD700 outputs synchronized position data for 2 axes

- Max. division : 65,536
  Resolution with combination of BS78 : 2.1 pm
- Interpolation accuracy of ±10 pm achieved by real-time signal correction processing (with BS78)
- Output : Serial (YASKAWA, FANUC, Mitsubishi, BiSS C for INC (MGS), MGS, A/B quadrature,  analog 1 Vp-p or USB
- Compensation in short range accuracy improves cumulative accuracy



## External Dimensions




Unit : mm

## Main Specifications

| Model | BD700 |
|---|---|
| Communication method | Serial : To be certified by each company (YASKAWA, FANUC, Mitsubishi, BiSS C for INC (MGS), MGS [Note 1])<br>1 Simultaneous output of A/B quadrature and analog 1 Vp-p in addition to serial communication<br>In addition to the above, it can be connected to a PC via USB. |
| Max. number of divisions | 65,536 divisions |
| Max. response frequency | 7.5 MHz (12.5 MHz possible as special model) |
| Reference point detection direction | Single direction |
| Alarm | Level down, level over, speed over |
| Accuracy compensation | Ability to correct accuracy in short intervals to improve cumulative accuracy |
| Auto calibration | Automatically adjusts output when scale is installed |
| LD drive current monitoring | Measure drive current for Laser Diode |
| Power supply | DC +4.75 V to DC +9.45 V |
| Current consumption | Max. 2 A |
| Operating temperature | +10 to +35 °C [Note 2] (No condensation) |
| Storage temperature | -10 to +50 °C (Humidity below 60 %) |
| Mass | Approx. 650 g |

Note 1 : Magnescale proprietary serial communication protocol.
Note 2 : Varies depending on installation conditions.
Magnescale reserves the right to change product specifications without prior notice.

# SET-HD

SET-HD100

Self-compensating rotary encoder system that can be used as
a calibration reference for a rotational axis while compensating for
any errors in the installation tolerance.


Interpolator unit
BD350

Scale unit
BE300

Head unit
BH300

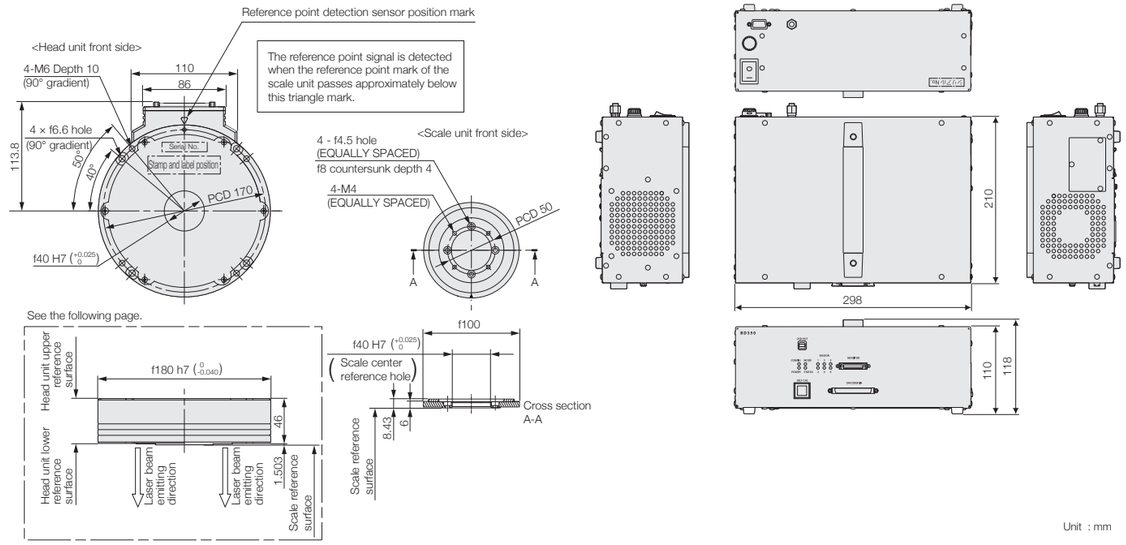
- High angular accuracy [±0.1 arcsec] resulting from a Magnescale algorithm with 0.0012 arcsec resolution
- Measurement traceability : JCSS calibration certificate issued
- High reproducibility : Compensates for mounting errors and other factors to achieve high reproducibility.
- Easy installation
- Extensive software
- Compact and easy to carry

### Metrology Traceability

Magnescale Co., Ltd. is a JCSS registered calibration service provider, which is assessed based on the international standard ISO/ IEC1705. We issue JCSS calibration certificates for all SET-HD100s we sell. This is proof of reliable calibration results that ensure metrological traceability.



## External Dimensions



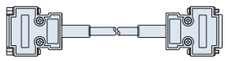

Unit : mm

## Main Specifications

| Model | SET-HD100 |
|---|---|
| Detecting radius | 41.723 mm |
| Max. rotary response speed | 10 min$^{-1}$ |
| Number of source signals | $2^{20}$ (1,048,576) / revolution |
| Source signal resolution | 1.236" arcsec |
| Accuracy | JCSS Calibration : ±0.1" arcsec<br>Installation specification range : ±0.2" arcsec (360° self-calibration)<br>: ±0.3" arcsec (180° self-calibration)<br>: ±1.0" arcsec (preset compensation) |
| Reference point position | With reference point |
| Output format | USB 2.0 |
| Number of interpolations | $2^{10}$ (1,024) / revolution |
| Number of output divisions | $2^{30}$ (1,073,741,824) / revolution |
| Output resolution | 0.0012 arcsec |
| Number of sensor | 6 sensors / unit |
| Light source | Semiconductor laser x 6 |
| | Wave length 790 nm, 5 mW or less / sensor |
| Radiation power | EN60825 : class 3B, JIS：class 3B, DHHS : class IIIb |
| Operating temperature | +10 to +30°C (no condensation) |
| Storage temperature | 0 to +50°C (no condensation) |
| Power supply | DC 20 to 24 V / 5 A (Max. 8 A) |
| Dimension / Mass | Scale unit : Φ100 × H8.5 mm / 300 g or less |
| | Head unit : Φ180 × H46 mm / 3.8 kg or less |
| | Interpolator unit : 298 × 210 × 110 mm / 5 kg or less |
| Software | GUI Application software LS-ARC |
| | API Library SETHDLIB |

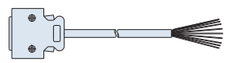
Magnescale reserves the right to change product specifications without prior notice.

# Connection Cable

| Scales | | Extension Cable | | Interpolator |
|---|---|---|---|---|
| Model | Head cable length*1 | | | |
| BS78 | 3 m (Standard) | Robot cable<br>CL13-01 (1.0 m) |  | BD700 |
| | | Robot cable<br>CK-T41 (0.3 m)<br>CK-T67 (1.0 m)<br>CK-T199 (2.0 m)<br>CK-T24 (3.0 m)<br>CK-T168 (4.0 m)<br>CK-T54 (6.0 m)<br>CK-T106 (8.0 m)<br>  | + Robot cable<br>CL13-01 (1.0 m)<br>  | |

*1 Please ask for other length.

The robot cable minimum bending radius : Repeatedly R80 mm, Fixed R10 mm

| Scales | | Extension Cable | | Interpolator |
|---|---|---|---|---|
| Model | Head cable length*1 | | | |
| BL57-NE<br>(A/B quadrature) | 0.3 m (Standard) | Robot cable<br>CE20-03T07 (3.0 m)<br>CE20-05T05 (5.0 m)<br>CE20-10T02 (10.0 m) |  | Built-in I/F Box |
| BL57-RE<br>(A/B quadrature) | 1 m (Standard) | | | |
| BL57-NE<br>(Analog) | 0.3 m (Standard) | Robot cable<br>CE20-03T12 (3.0 m)<br>CE20-07T03 (7.0 m)<br>CE20-12T01 (12.0 m) |  | None |
| BL57-RE<br>(Analog) | 1 m (Standard) | | | |

*1 Please ask for other length.

The robot cable minimum bending radius : Repeatedly R80 mm, Fixed R10 mm

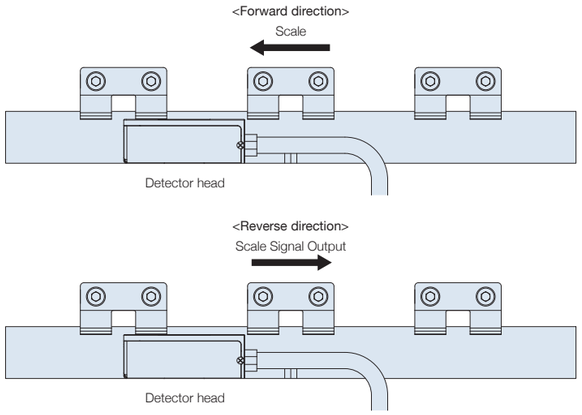


# Technology

## Reference point detection direction

Laserscale reference point detection direction is set to forward as standard product, but for BL50H, it can be switched by the customer. To switch the direction, use the mode switch on the interface unit. (For details, refer to the instruction manual.)
For other products*, please contact before purchase.

Note: The reference point detection is performed relative to the direction of the scale. Reference point accuracy will be reduced if performed in the wrong direction.



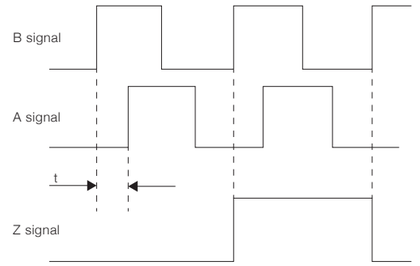

## Scale Signal Output

### A/B quadrature and Alarm Output Specifications

- The output specifications are compliant with TIA/EIA-422.
- A/B quadrature minimum phase difference t : 50 ns

[Note]

- An error of about 50 ns is generated due to the synchronization of the A/B quadrature by the 20 MHz internal clock.
- The minimum phase difference can vary depending on the length of the output cable,cable capacity, receiver load, and other factors.
- When an alarm occurs, the output signal becomes high impedance.

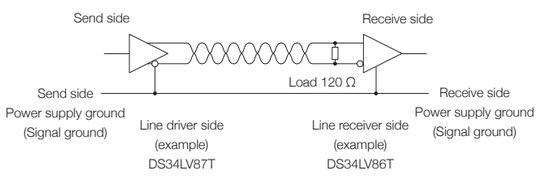



### Connection Specifications

A/B quadrature and Alarm Output Type

The line driver used by Magnescale Co., Ltd. is compliant with TIA/EIA-422. Based on the TIA/EIA-422 standards, the common mode voltage between the line driver and line receiver is stipulated as ±12 V.
(Using the scale when the common mode voltage of ±12 V is exceeded can damage the scale.)
To prevent problems between the control devices connected to this Magnescale Co., Ltd. product, it is recommended that you connect (shared connection) the signal ground (power supply ground) and set the load resistance to 120 Ω.
Twisted pair cables (1 turn/1 inch min.) with a core thickness of at least AWG28 are recommended for the differential signal cables.
(It is even better if the characteristic differential impedance is the same as the load resistance value.)

Commonness



## Analog Output BL50H

### Analog Output specifications

| Item | Symbol | Specifications | | | Units | Remarks |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Output signal amplitude | (+VA) - (-VA), (+VB) - (-VB) | 0.6 | - | 1.3 | Vp-p | Note 1 |
| Output signal phase difference | - | 80 | 90 | 100 | deg | - |
| Center voltage | +VOA, +VOB, -VOA, -VOB | 2.3 | 2.5 | 2.7 | V | - |
| Offset voltage | (+VOA) - (-VOA), (+VOB) - (-VOB) | -50 | 0 | 50 | mV | - |
| Gain unbalance | - | -6 | 0 | 6 | % | System 1 |
| Load resistance | - | 120 | | | Ω | - |

At 20 ±0.1 °C under standard installation conditions

Note 1: When terminator Z0 = 120 Ω supply voltage= 5 V±5 %
(voltage of load resistance at both ends)
The output signal level decreases as the scanning frequency increases.

$$\text{System 1: } \frac{\text{A signal output voltage p-p value - A/B quadrature output average}}{\text{A/B quadrature output average}} \times 100$$

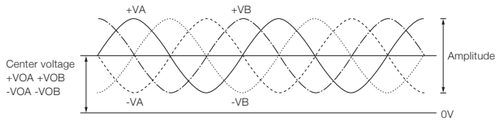
however

$$\text{A/B quadrature output average} = \frac{\text{A signal output voltage p-p value + B signal output voltage p-p value}}{2}$$

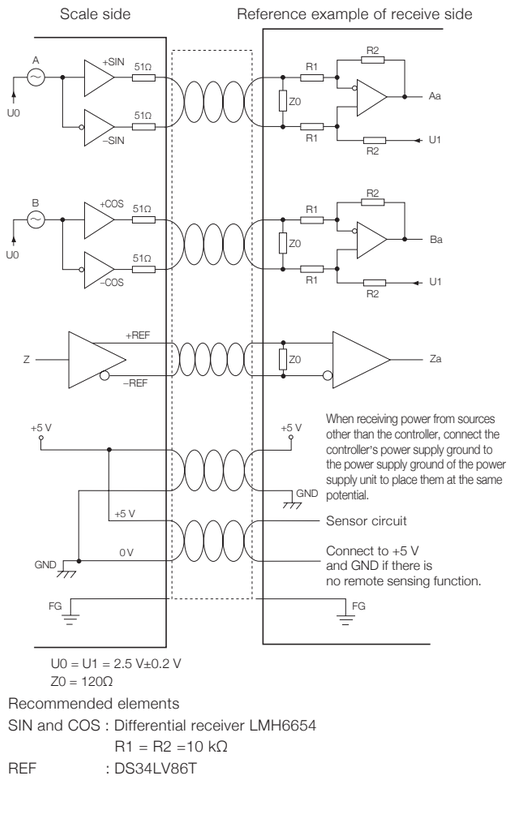
### Output waveform diagram

(When each output is viewed based on 0 V)

The A signal corresponds to SIN,
and the B signal corresponds to COS.




### Example of input circuit




U0 = U1 = 2.5 V±0.2 V
Z0 = 120Ω

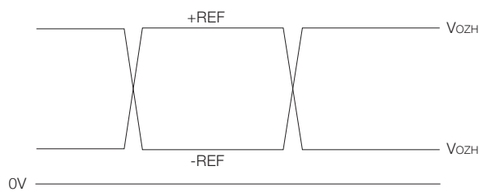
Recommended elements
SIN and COS : Differential receiver LMH6654
R1 = R2 =10 kΩ
REF : DS34LV86T

### Reference point output specifications

The output specifications are compliant with TIA/EIA-422.

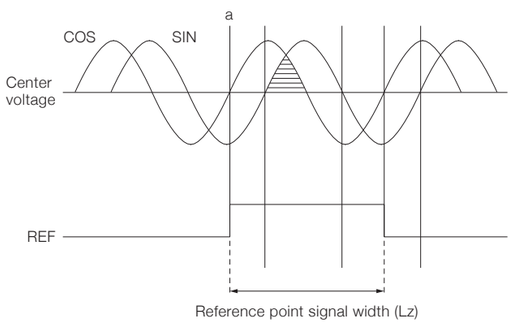
(Over the overall length and the entire operating temperature range)

| Item | Symbol | Specifications | | | Units |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| "H" level output | $V_{OZH}$ | 2.5 | 3.4 | 5 | V |
| "L" level output | $V_{OZL}$ | 0 | 0.3 | 0.5 | V |




Reference point signal and SIN and COS signal phases

| Item | Specifications | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| Reference point signal width (Lz) | 0.32 µm | 0.4 µm | 0.48 µm |
| Position of reference point signal edge a with respect to SIN signal | 0° | | 90° |






# Quality

## No compromise for high-accuracy products

The total quality control system that operates throughout the entire design and production process ensures products with enhanced safety, high quality, and high reliability that match our customers' requirements. The company is certified for length calibration in compliance with the traceability system required by the "Weights and Measures Act," and has been granted ISO 9001 certification, which is the international standard for quality assurance. In addition, we have introduced the highest level EMC (Electromagnetic Compatibility) testing equipment to address the noise problem that is becoming increasingly regulated around the world, and we are taking all possible measures to control quality.

## Our products comply with CE/UKCA requirements, have acquired UL certifications and meet other international standards and regulations.

We have met:

- CE/UKCA Marking (EMC Directives) EMI : EN/BS 61000-6-4, EMS : EN/BS 61000-6-2
- CE/UKCA Marking (RoHS Directives) EN/BS 63000
- FCC regulation FCC Part 15 Subpart B Class A
- ICES regulation ICES-003 Class A

for Products with built-in AC power supply:
- UL/cUL 61010-1 • EN/BS 61010-1

for Products with Laser:
- DHHS (21CFR1040.10) • EN/BS 60825-1 • JIS C 6802

- Safety of Machinery - If the product is used in equipment subject to conformity to the electrical equipment of machinery (EN60204-1), please take measures to ensure conformity to that standard before use.
* Please note that some products may have different standards or may not have been certified in all areas, so please check with our sales department before purchasing.

# Traceability

Traceability Flow Chart (Length)