



Series CEU



Series CEP1

Scale Cylinder & Counter

Series *CE*

CEP1/CEU5

Resolution: 0.01mm (accuracy ± 0.02 mm)

External output function: RS-232C BCD

Multipoint output: 5 points (20 points with bank switching)

31 points (binary output)

23045



High Precision Scale Cylinder/ Series CEP1
Multi Counter/Series CEU5
Upgraded Scale Cylinder/Series CE1

Achieve rationalization A scale cylinder with



Measurement is possible throughout the full stroke range.

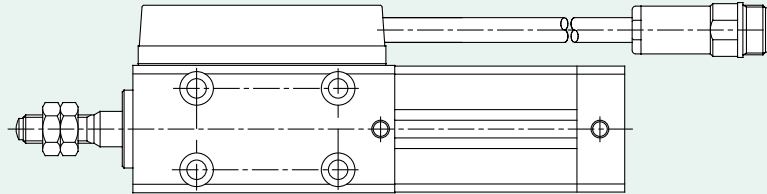
The home position can be anywhere within the cylinder stroke.

→ When the counter is reset by pressing the cylinder rod to the reference plane, that point becomes the home position.

New

High Precision Scale Cylinder (CEP1)

- Resolution: 0.01mm (accuracy $\pm 0.02\text{mm}$)
- Special scraper now standard (IP-67)
- 2 kinds of seal material available (order made)
- Power supply voltage 12 to 24VDC



- Auto switch mounting orientation can be freely selected (3 mounting surfaces)

Upgraded

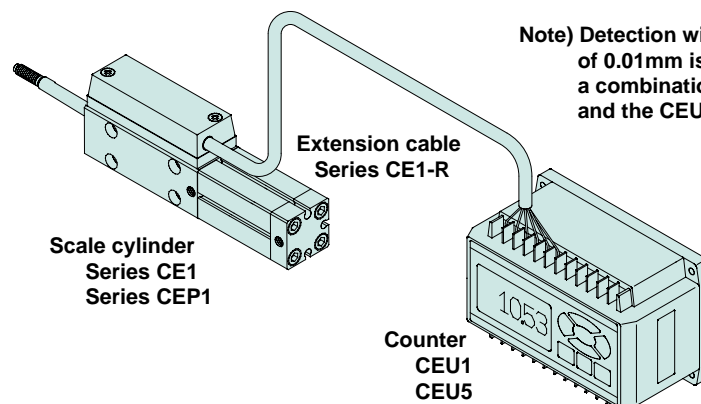
Scale Cylinder (CE1)

- Resolution: 0.1mm (accuracy $\pm 0.2\text{mm}$)
- Water resistance improved by changing the sensor unit filler

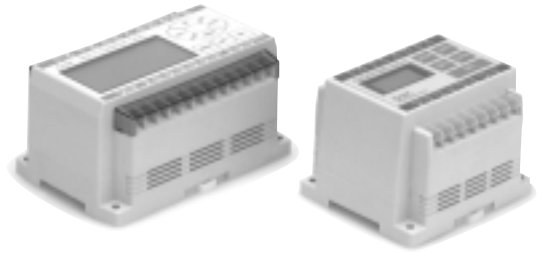


- Power supply voltage 12 to 24VDC
- Abundant stroke variations
- Improved noise resistance

System Configuration



Application of production lines with position feedback



Tolerances of preset values can be set. (CEU1, CEU5)

Tolerances can be set for preset values.

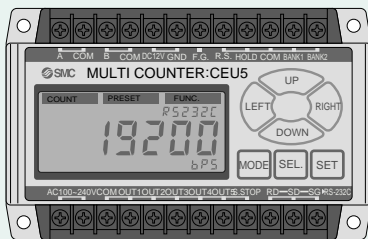
CEU1: ± set tolerance

CEU5: + set tolerance, – set tolerance (separate settings)

Simple operation

New

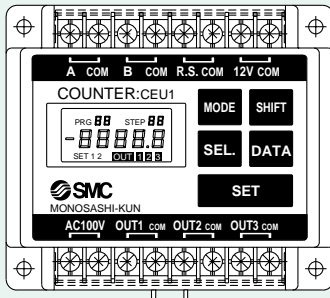
Multi Counter (CEU5)



- Output terminal: 5 points
- Number of output settings: 20 points (bank switching) 31 points (binary output)
- Communication function with RS-232C
- With BCD output (optional)
- Maximum counting speed 100kHz
- Prescale function
- With multiplication switching (1, 2, 4 multiplication)
- DIN rail mountable
- 6 digit counter display

Includes all functions of the CEU1.

3 Point Preset Counter (CEU1)



- Output terminal: 3 points
- DIN rail mountable
- Hold output, Comparison output, One shot output

Series Guide

Series CE1

Bore size (mm)	Standard stroke (mm)											Available stroke range	
	25	50	75	100	125	150	175	200	250	300	400		500
12	●	●	●	●	●	●							25 to 150
20	●	●	●	●	●	●	●						25 to 300
32		●	●	●	●	●	●	●	●				25 to 400
40				●	●	●	●	●	●	●	●		25 to 600
50								●		●		●	25 to 600
63									●		●	●	25 to 600

Series CEP1

Bore size (mm)	Standard stroke (mm)			
	25	50	75	100
12 equiv.	●	●	●	●
20 equiv.	●	●	●	●

CEU1

Power supply voltage	Output transistor system	
	NPN	PNP
100VAC	●	●
24VDC	●	●

CEU5

Power supply voltage	Count data output		Output transistor system	
	RS-232C+BCD	RS-232C	NPN	PNP
100 to 240VAC	●	●	●	●
24VDC	●	●	●	●

Extension cable

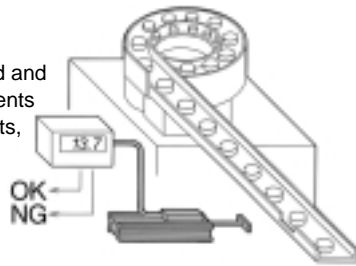
Cable length (m)			
5	10	15	20
●	●	●	●

Series CE

Applications

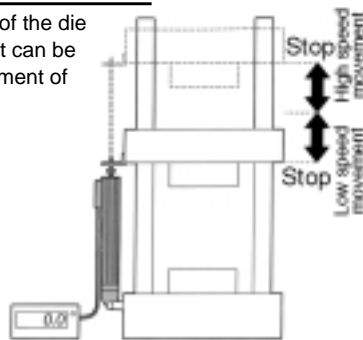
Parts inspection

Measures part dimensions, discriminates between good and defective articles, and prevents the mingling of different parts, etc.



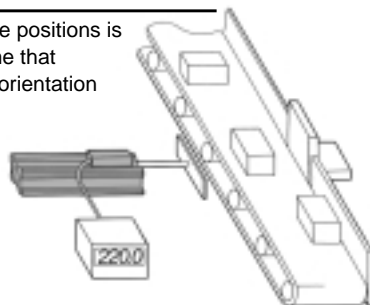
Detection of die assembly's deceleration point

Since the deceleration point of the die assembly can be set at will, it can be easily changed after replacement of the die assembly.



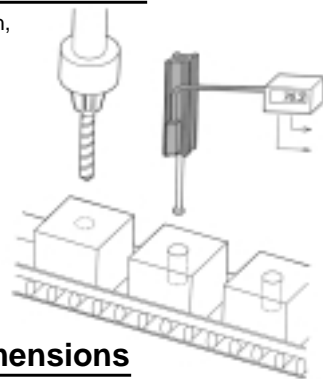
Length/breadth discrimination

Straightening of work piece positions is performed at the same time that longitudinal or transverse orientation is distinguished.



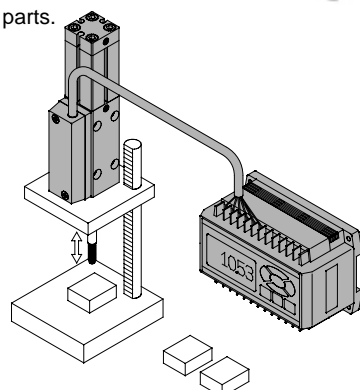
Inspection of machined holes

Can detect machined hole depth, burrs and foreign matter, etc.



Measurement of dimensions

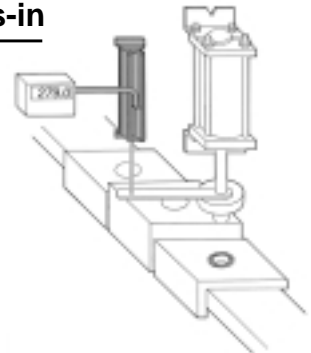
Can measure dimensions of parts.



Confirmation of press-in

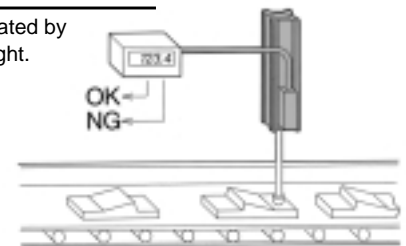
Can confirm the press-in of a hydraulic cylinder by detecting its stroke.

Even if the size of the work piece changes, the point of press-in completion can be easily changed.



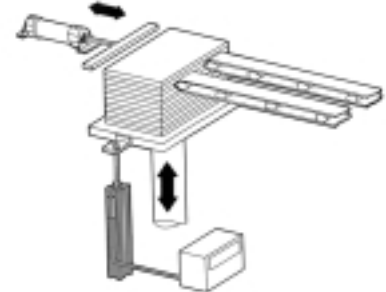
Discrimination of direction

Direction can be discriminated by measuring work piece height.



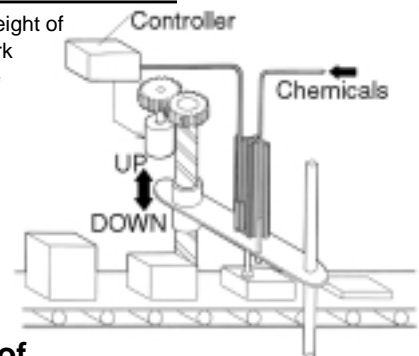
Detection of lifter position

Can continuously monitor a lifter's stroke.



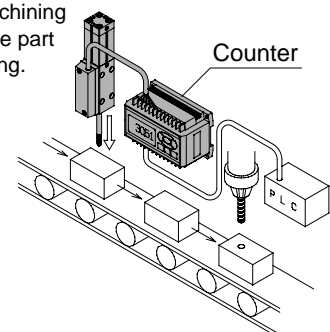
Nozzle height adjustment

Maintains a constant height of the nozzle from the work piece by measuring the work piece height.



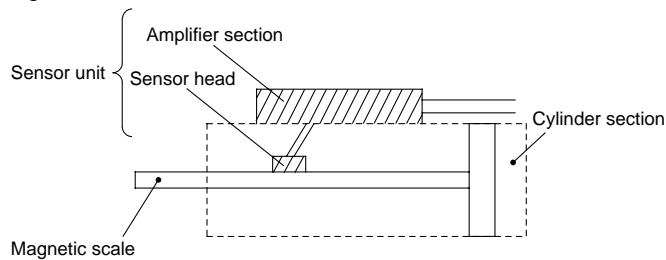
Measurement of machining dimensions

Performs adjustment of machining depth, etc. by measuring the part dimensions before machining.

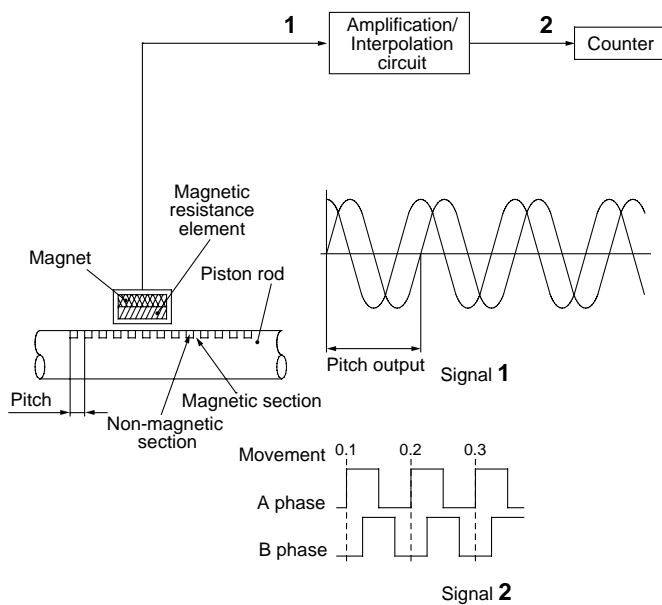


Measurement Principles

The amount of rod movement in the scale cylinder is detected using an MR element (magnetic resistance element) whose resistance value changes due to magnetic force. The detection unit containing this MR element is called the sensor head. An amplifying circuit and a dividing circuit are required to produce output which can be read by the counter, and these are attached to the cylinder case. The sensor head and amplifier section together are referred to as the sensor unit.



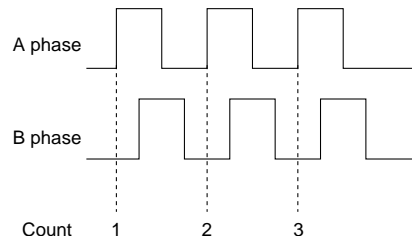
The scale cylinder is equipped with the capability of outputting the piston stroke movement as a pulse signal. The measurement principle is as shown in the drawing below.



- (1) A scale of magnetic layers and non-magnetic layers with a pitch of 0.8mm is cut into the piston rod.
- (2) With movement of the piston rod, a sin, cos 2-phase signal (Signal 1) is received by the magnetic resistance element. For this wave form, 1 pitch (0.8mm) becomes exactly 1 cycle.
- (3) This is amplified and divided into 1/8 parts. As a result, a 90° phase difference pulse signal of 0.1mm/pulse (Signal 2) is output.
- (4) By measuring this pulse signal with the counter, it is possible to detect the piston position with a resolution of 0.1mm.
- (5) In the case of the high precision scale cylinder, the sin, cos 2-phase signal obtained in (2) is amplified and divided into 1/20 parts. As a result, a 90° phase difference pulse signal of 0.04mm/pulse (Signal 2) is output.
- (6) By multiplying this pulse signal by 4 with the counter, it is possible to detect the piston position with a resolution of 0.01mm.

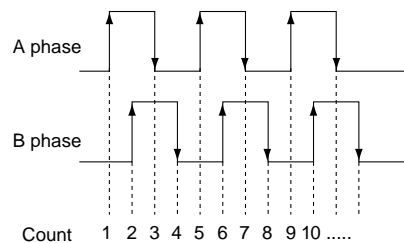
A/B phase difference output (90° phase difference output)

When movement is expressed by a single line of pulses, it is impossible to accurately identify the current position, because pulse waves appear in both upward and downward directions. Accordingly, in A/B phase difference output, two lines of pulses are provided, wherein one line detects the movement and the other distinguishes the direction.



4 times multiplication function

This function increases resolution 4 times by counting 4 for each cycle of pulses, instead of counting 1 for each cycle as is normally the case. In principle, this function counts each time there is a rise or fall in either of the A or B phase pulses.



Counting speed (kHz, kcps)

Counting speed indicates the number of pulses that can be counted per second. If the scale cylinder is operated at high speeds, pulse waves are output in shorter cycles. The counting speed of the counter must be higher than the pulse speed for the maximum piston speed when operating. Since the scale cylinder outputs one pulse for each 0.1mm of movement, 5,000 pulses will be output for each 500mm of movement. Therefore, a speed of 500mm/s is equivalent to 5kcps (kHz), but a counting speed 2 to 3 times greater is recommended for actual operation.

Accuracy

The accuracy is the difference between the dimensions based upon the signals of the scale cylinder and the absolute dimensions.

The maximum display error that will appear on the counter's digital display is equal to twice (± 1 count) the resolution when the home position is reset and when dimensions are measured.

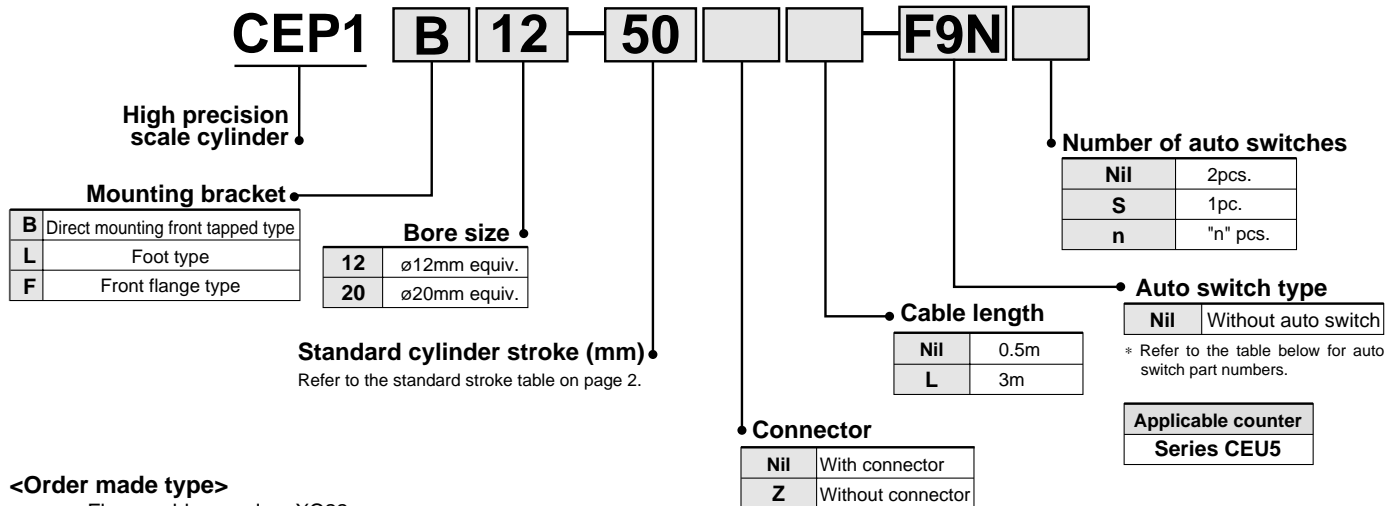
Non-rotating
Type

High Precision Scale Cylinder

Series **CEP1**

ø12, ø20

How to Order



<Order made type>

Fluoro rubber seals: -XC22
(Example) CEP1B12-100-F9N-XC22

<Options>

Extension cable **CE1-R 05 []**

Cable length

05	5m
10	10m
15	15m
20	20m

Cable suffix

Nil	Extension cable
C	Extension cable & connector

Mounting bracket part numbers

Cylinder part no.	Foot	Front flange
CEP1□12	CEP1-L12	CEP1-F12
CEP1□20	CEP1-L20	CEP1-F20

Applicable auto switch types

Type	Special function	Indicator light	Wiring (output)	Load voltage		Electrical entry direction		Lead wire length (m)			Applicable load	Maximum load current & load current range					
				DC	AC	Vertical	Lateral	0.5 (Nil)	3 (L)	5 (Z)							
Reed switch	—	No	2 wire	24V or less	24V or less	A90V	A90	●	●	—	Relay PLC IC circuit	50mA					
				48V or less	48V or less							40mA					
				100V or less	100V or less							20mA					
Solid state switch	—	Yes	3 wire (NPN)	10 to 28V	—	F9NV	F9N	●	●	—	Relay PLC	50mA					
			3 wire (PNP)	10 to 28V	—							●	●	—	Relay PLC	5 to 30mA	
			2 wire	10 to 28V	—											●	●
		Diagnostic indication (2 color indicator)	Yes	3 wire (NPN)	10 to 28V	—	F9NWW	F9NW	●	●	○	Relay PLC	50mA				
				3 wire (PNP)	10 to 28V	—							●	●	○	Relay PLC	50mA
				2 wire	10 to 28V	—							●	●	○	Relay PLC	5 to 30mA
				2 wire	12V, 24V	—							—	F9BA	—	●	○

* Lead wire length symbol 0.5m Nil (Example) F9B 5m Z (Example) F9BZ
3m L (Example) F9BL

* Solid state auto switches marked with a "○" are produced upon receipt of order.

* The standard cable length for F9BA is 3m.

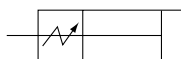
High Precision Scale Cylinder *Series CEP1*

Cylinder Specifications



Action	Double acting single rod (non-rotating piston)	
Fluid	Air	
Proof pressure	1.5MPa {15.3kgf/cm ² }	
Maximum operating pressure	1.0MPa {10.2kgf/cm ² }	
Minimum operating pressure	ø12	ø20
	0.15MPa {1.5kgf/cm ² }	0.1MPa {1.0kgf/cm ² }
Piston speed	50 to 300mm/s	
Ambient & fluid temperature	0°C to 60°C (without freezing)	
Lubrication	Non-lube	
Stroke length tolerance range	0 to +1.0	
Cushion	None	
Rod non-rotating accuracy	ø12	ø20
	±2°	±3°
Mounting	Direct mounting front tapped type (standard), Foot type, Front flange type	
Thread tolerance	JIS Class 2	

Symbol



Sensor Specifications

Cable	ø7, 6-core twisted pair shielded wire (oil, heat & flame resistant) (connector ... made by TAJIMI ELECTRONICS CO., LTD., R04-J8M7.3)
Transmission distance	23m (when using SMC cable and counter)
Position detection system	Magnetic scale rod, sensor head <incremental type>
Magnetic resistance	145 gauss
Power supply	12 to 24VDC (±10%) (power supply ripple: 1% or less)
Current consumption	50mA
Resolution	0.01mm (with 4 times multiplication)
Accuracy (20°C)	±0.02mm ^{Note 1)}
Output type	Open collector (24VDC, 40mA)
Output signal	A/B phase difference output
Insulation resistance	500VDC, 50MΩ or more (between case and 12E)
Vibration resistance	33.3Hz 6.8G 2 hrs. each in X, Y directions 4 hrs. in Z direction based upon JIS D1601
Impact resistance	30G 3 times each in X, Y, Z directions
Enclosure	IP-67 (IEC Standard) ^{Note 2)}
Extension cable (optional)	CE1-R 5m, 10m, 15m, 20m (connector ... made by TAJIMI ELECTRONICS CO., LTD., R04-P8F7.3)

Note 1) This includes the digital display error of the counter (CEU5). Moreover, the overall accuracy after mounting on equipment will vary depending on mounting conditions and the environment. Therefore, the customer should calibrate the equipment as a whole.

Note 2) Except for the connector, the cylinder section is the equivalent of an SMC water resistant cylinder.

Standard Stroke

Model	Cylinder stroke (mm)			
	25	50	75	100
CEP1B12	●	●	●	●
CEP1B20	●	●	●	●

Series CEP1

Weight Table (without Mounting Brackets / Connector)

Unit: kg

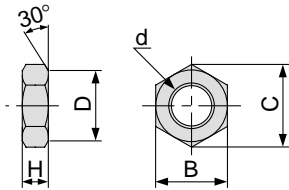
Bore Size (mm)	Cylinder stroke (mm)			
	25	50	75	100
12	0.29	0.33	0.37	0.41
20	0.62	0.68	0.74	0.80

Proper Auto Switch Mounting Position

Refer to p.32 regarding dimensions for the proper auto switch mounting position (stroke end).

Rod End Nut Dimensions

Material: Steel



(mm)

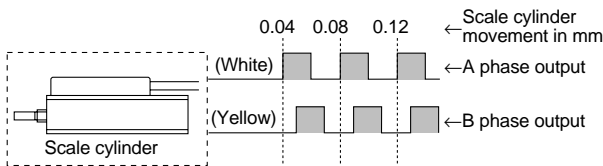
Applicable bore size (mm)	d	H	B	C	D
12	M5 x 0.8	3	8	9.2	7.8
20	M8 x 1.25	5	13	15.0	12.5

Electrical Wiring

Output type

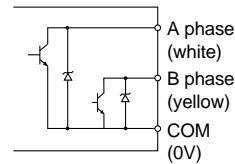
The output signal of the high precision scale cylinder is A/B phase difference output (open collector output) as shown in the figure below.

The relation between the movement distance and the signal output of the high precision scale cylinder is that for each 0.04mm of movement a one pulse signal is output to both output terminals A and B. In order to measure with a discrimination of 0.01mm, a counter with a 4 times multiplication function (CEU5) is required.



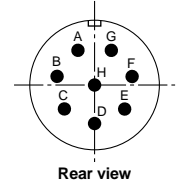
Input/Output

The input/output of the scale cylinder is performed by a $\varnothing 7$ shielded twisted pair wire from the sensor section plus a connector.



Output circuit of scale cylinder (brown, blue)

Connector pin arrangement



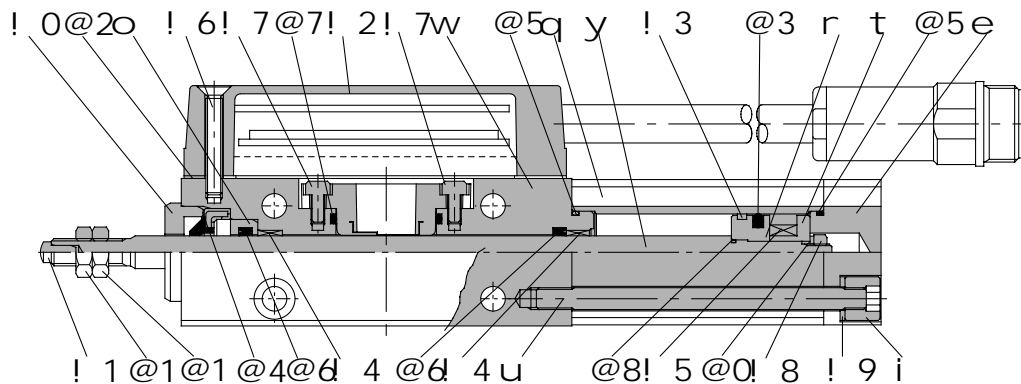
Signal table

Wire color	Signal name	Connector pin symbol
White	A phase	A
Yellow	B phase	B
Brown, Blue	COM(0V)	C, D
Red	12V, 24V (power supply)	E
Black	0V (power supply)	F
(Shield)	Shield	G

High Precision Scale Cylinder *Series CEP1*

Construction

ø12, ø20



Parts list

No.	Description	Material	Note
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Rod cover	Aluminum alloy	Hard chrome plated
3	Head cover	Aluminum alloy	Hard anodized
4	Piston A	Aluminum alloy	Hard anodized
5	Piston B	Aluminum alloy	Hard anodized
6	Piston rod	Carbon steel	Hard chrome plated
7	Tie-rod	Carbon steel	Chromed
8	Tie-rod nut	Carbon steel	Nickel plated
9	Seal ring	Aluminum alloy	White anodized
10	Centering location ring	Aluminum alloy	White anodized
11	Rod end pin	Stainless steel	Quenched
12	Sensor unit	—	With or without connector
13	Wear ring	Special resin	
14	Bushing	Lead-bronze casting	

Parts list

No.	Description	Material	Note
15	Magnet	Rare earth	
16	Cross recessed head machine screw	Chrome molybdenum steel	Nickel plated
17	Hexagon socket head cap screw	Stainless steel	
18	Hexagon nut	Carbon steel	Nickel plated
19	Spring washer	Steel wire	Nickel plated
20	Spring washer	Steel wire	Nickel plated
21	Rod end nut	Steel	
22	Sensor case gasket	NBR	
23	Piston seal	NBR	
24	Scraper	NBR	
25	Tube gasket	NBR	
26	Rod seal	NBR	
27	O-ring	NBR	
28	O-ring	NBR	

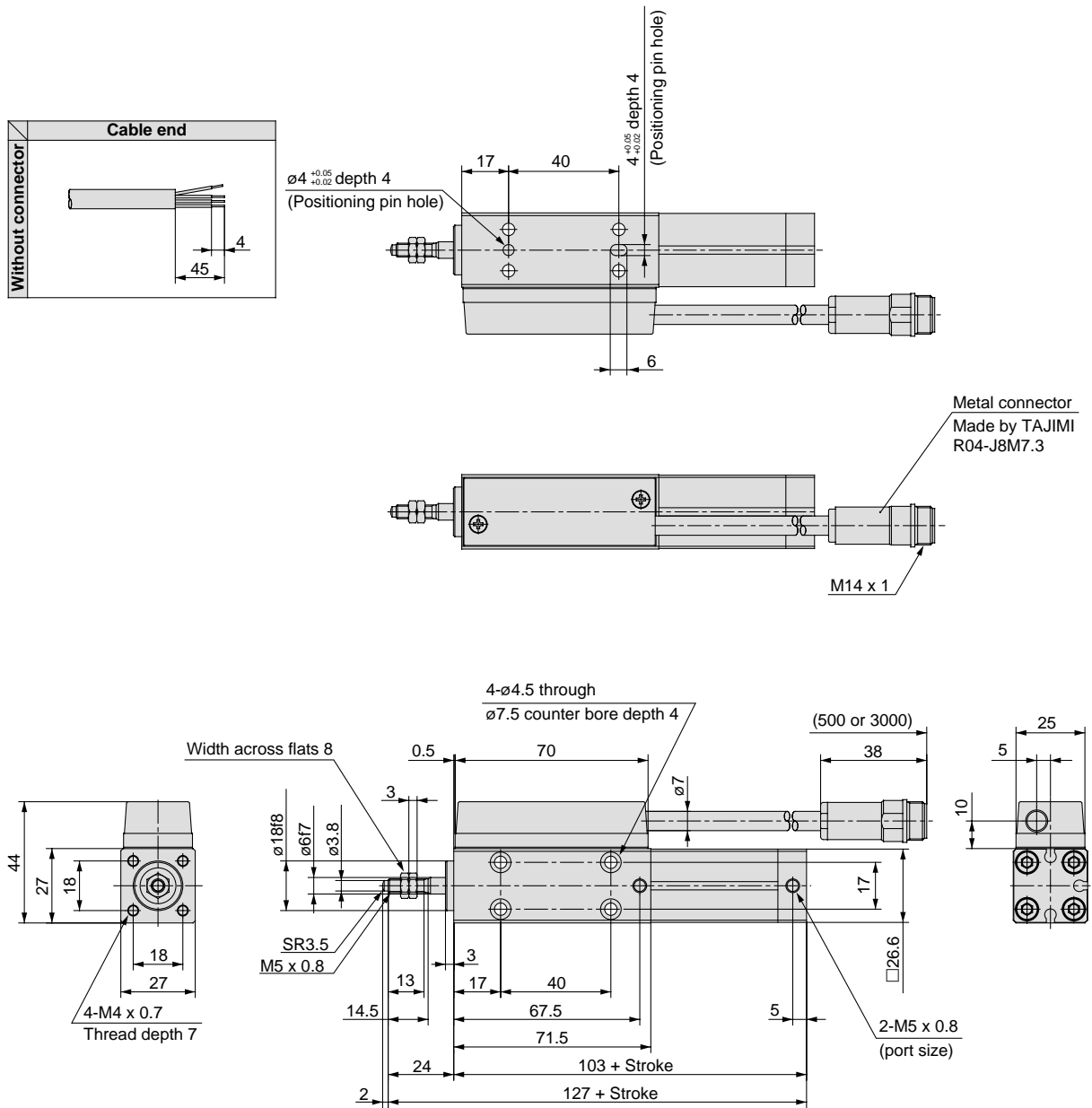
* Since there is a possibility of improper operation, contact SMC regarding the replacement of seals.

Series CEP1

∅12/Dimensions

Direct mounting front tapped type

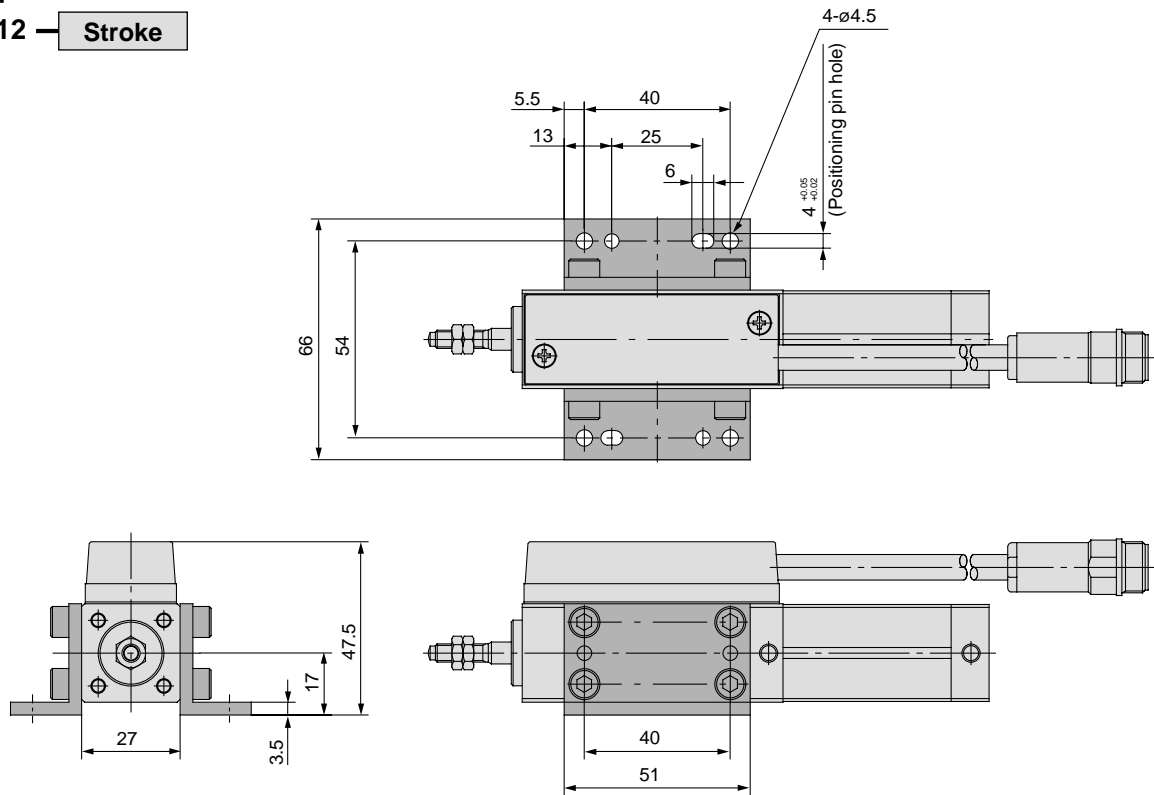
CEP1B12 — Stroke



High Precision Scale Cylinder *Series CEP1*

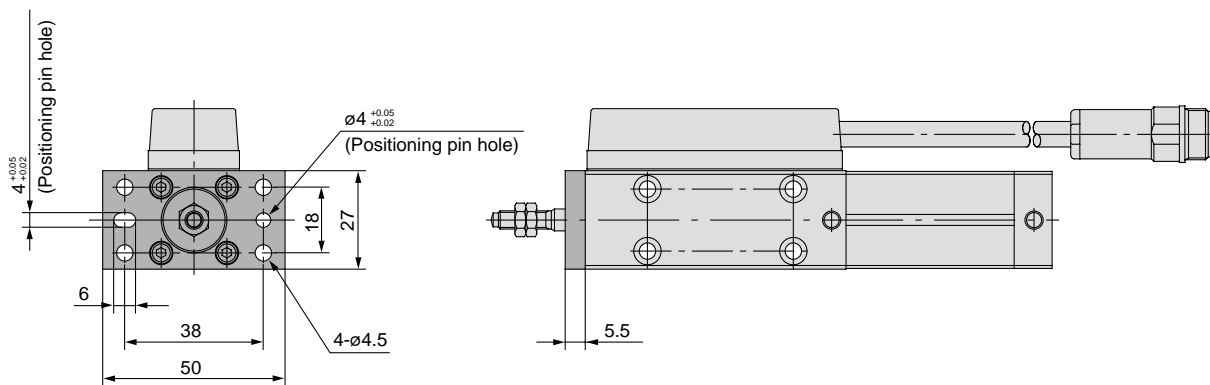
Foot type

CEP1L12 — Stroke



Front flange type

CEP1F12 — Stroke

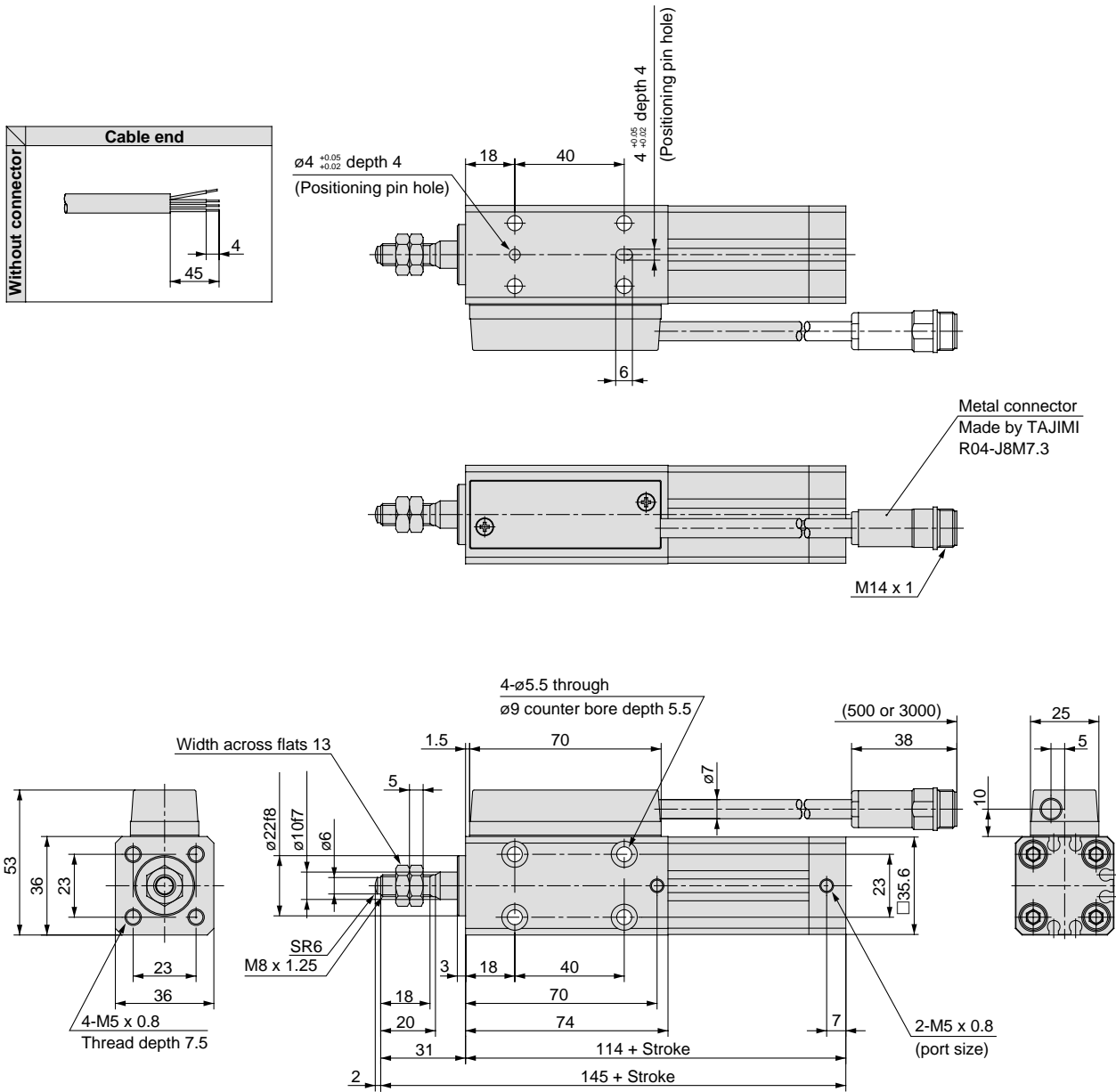


Series CEP1

Ø20/Dimensions

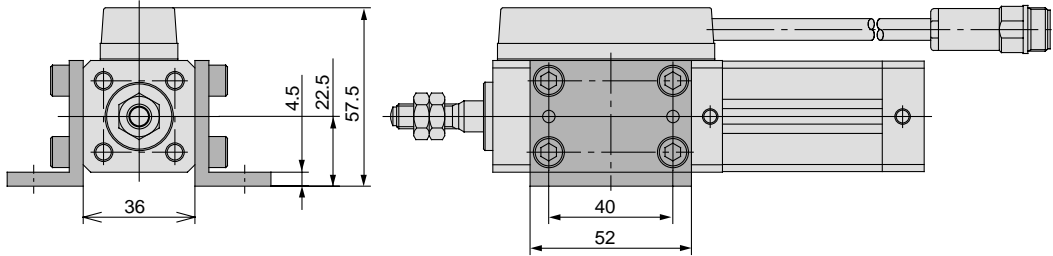
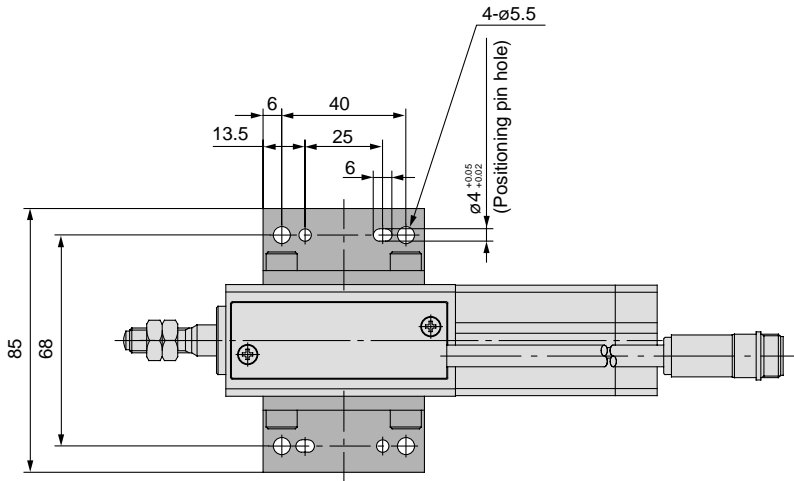
Direct mounting front tapped type

CEP1B20 — Stroke

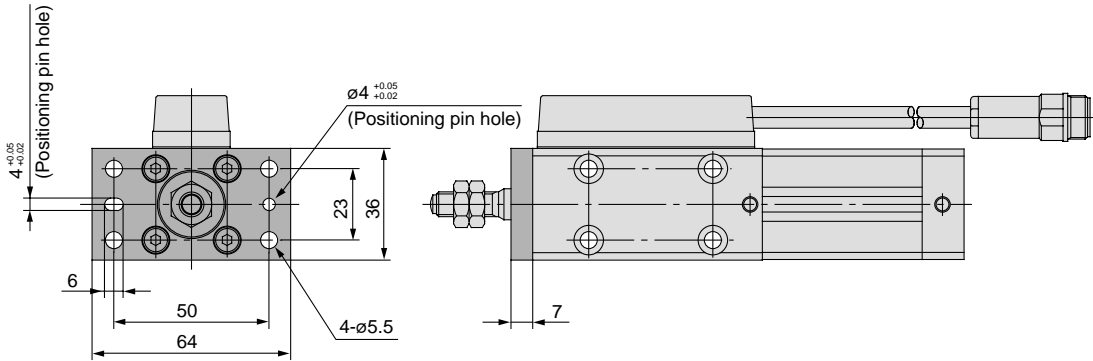


High Precision Scale Cylinder *Series CEP1*

Foot type
CEP1L20 — Stroke



Front flange type
CEP1F20 — Stroke



Scale Cylinder

Series CE1

ø12, ø20, ø32, ø40, ø50, ø63

How to Order

CE1 **L** **32** **200** **Nil** **Nil** **Nil** **Nil** **Nil**

Mounting bracket

B	Double end tapped (standard)
L	Foot type
F	Front flange type
G	Rear flange type
D	Double clevis type

Bore size

12	12mm
20	20mm
32	32mm
40	40mm
50	50mm
63	63mm

Standard cylinder stroke (mm)
Refer to the standard stroke table on page 10.

Cable length

Nil	0.5 m
L	3m

Connector

Nil	With connector
Z	Without connector

Auto switch type

Nil	Without auto switch
------------	---------------------

* Refer to the table below for auto switch part numbers.

Number of auto switches

Nil	2pcs.
S	1pc.
3	3pcs.
n	"n" pcs.

Cushion
(applicable bore size ø40 to ø63)

Nil	Double-side cushion
N	Without cushion
R	Front cushion
H	Rear cushion

Options

Extension cable **CE1-R** **05** **Nil**

Cable length

05	5m
10	10m
15	15m
20	20m

Cable suffix

Nil	Extension cable
C	Extension cable & connector

Applicable counter

Series CEU1
Series CEU5

Applicable auto switch types

Type	Special function	Electrical entry	Indicator light	Wiring (output)	Load voltage		Rail mounting		Direct mounting		*Lead wire length (m)				Applicable load				
					DC	AC	ø12 to ø63		ø32, ø40 only		0.5 (Nil)	3 (L)	5 (Z)	None (N)	IC circuit	Relay PLC			
						Vertical	Lateral	Vertical	Lateral										
Reed switch	-	Grommet	Yes	3 wire (NPN equiv.)	24V	5V	-	-	A76H	A96V	A96	●	●	-	-	IC circuit	-		
								-	A72	A72H	-	-	●	●	-	-	-	-	
								-	A73	A73H	-	-	●	●	●	-	-	-	
		Connector	No	2 wire	24V	5V, 12V	100V or less	-	-	-	A93V	A93	●	●	-	-	IC circuit	-	
										-	A80H	A90V	A90	●	●	●	●	-	-
										-	A73C	-	-	●	●	●	●	-	-
Grommet	Yes	2 wire	24V	5V, 12V	24V or less	-	-	-	A80C	-	-	●	●	●	●	IC circuit	-		
								-	A79W	-	-	●	●	-	-	-	-		
								-	-	-	-	●	●	-	-	-	-		
Solid state switch	-	Grommet	Yes	3 wire (NPN)	24V	5V, 12V	-	-	F7NV	F79	-	-	●	●	○	-	IC circuit	-	
									-	-	F9NV	F9N	●	●	-	-	-	-	
									F7PV	F7P	-	-	●	●	○	-	-	-	
									-	-	F9PV	F9P	●	●	-	-	-	-	
									F7BV	J79	-	-	●	●	○	-	-	-	
									-	-	F9BV	F9B	●	●	-	-	-	-	
		Connector	No	2 wire	24V	5V, 12V	-	-	-	J79C	-	-	-	●	●	●	●	-	-
										F7NWV	-	F9NWV	F9NW	●	●	○	-	-	-
										-	F79W	-	-	●	●	○	-	-	-
										-	F7PW	-	-	●	●	○	-	-	-
										-	-	F9PWV	F9PW	●	●	○	-	-	-
										-	-	F9BWW	F9BW	●	●	○	-	-	-
Grommet	Yes	3 wire (PNP)	24V	5V, 12V	-	-	-	F7BWW	J79W	F9BWW	F9BW	●	●	○	-	-	-		
								-	F7BA	-	F9BA	-	●	○	-	-			
								-	F7NT	-	-	-	●	○	-	-	-		
								-	F79F	-	-	●	●	○	-	-	-		
								-	-	-	-	●	●	○	-	-	-		
								-	F7LF	-	-	●	●	○	-	-	-		

* Lead wire length symbol 0.5m Nil (Example) A80C 5m Z (Example) A80CZ
3m L (Example) A80CL None N (Example) A80CN

* Solid state auto switches marked with a "O" are produced upon receipt of order.

* D-F7□WV types are not compatible with Z (5m) products.

* The standard cable length for F7BA, F9BA and F7NT is 3m. D-F7BAL, D-F9BAL, F7NTL

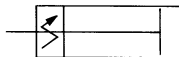
Scale Cylinder Series CE1

Cylinder Specifications



Fluid	Air		
Proof pressure	1.5MPa {15.3kgf/cm ² }		
Maximum operating pressure	1.0MPa {10.2kgf/cm ² }		
Minimum operating pressure	ø12	ø20 to ø63	
	0.07MPa {0.71kgf/cm ² }		0.05MPa {0.51kgf/cm ² }
Piston speed	70 to 500mm/s		
Ambient & fluid temperature	0°C to 60°C (without freezing)		
Humidity	25 to 85% RH (without condensation)		
Lubrication	Non-lube		
Stroke length tolerance range	ø12, ø20: ^{+1.0} / ₀		ø32, ø40, ø50, ø63: ^{+1.6} / ₀
	ø12, ø20, ø32 without		ø40, ø50, ø63 with
Thread tolerance	JIS Class 2		
Rod non-rotating accuracy	ø12	ø20	ø32, ø40, ø50, ø63
	±2°	±1°	±0.8°
Mounting	Double end tapped (standard), Foot type, Flange type, Double clevis type		
Auto switch	Reed type, Solid state type		

Symbol



Bracket Part Nos.

Bore size (mm)	*Foot	Flange	Double clevis
12	CQ-L012	CQ-F012	CQ-D012
20	CQ-L020	CQ-F020	CQ-D020
32	CQ-L032	CQ-F032	CQ-D032
40	CQ-L040	CQ-F040	CQ-D040
50	CQ-L050	CQ-F050	CQ-D050
63	CQ-L063	CQ-F063	CQ-D063

Note 1) When ordering foot type brackets, 2pcs. should be arranged for each cylinder.

Note 2) The following parts are included with each mounting bracket.

Foot, Flange/Body mounting bolts
Double clevis/Clevis pin, C type snap ring for shaft,
Body mounting bolts

Auto switch mounting bracket part nos.

Bore size (mm)	Mounting bracket no.	Note	Applicable switch
12 20	BQ-1	<ul style="list-style-type: none"> Switch mounting screw (M3 x 0.5 x 8) Square nut 	D-A7, A8 D-A7□H, A80H D-A73C, A80C D-A79W
32 40 50 63	BQ-2	<ul style="list-style-type: none"> Switch mounting screw (M3 x 0.5 x 10) Switch spacer Switch mounting nut 	D-F7□V D-F7, J7 D-J79C D-F7□WV D-F79W, J79W

Sensor Specifications

Cable	ø7, 6-core twisted pair shielded wire (oil, heat & flame resistant cable) (Standard with connector ... made by TAJIMI ELECTRONICS CO., LTD., R04-J8M7.3)	
Transmission distance	23m (when using SMC cable and counter)	
Position detection system	Magnetic scale rod	Sensor head <cable length 50cm, 3m> <non-rotating>
		<incremental type>
Magnetic resistance	145 gauss	
Power supply	12 to 24VDC (±10%) (power supply ripple: 1% or less)	
Current consumption	40mA	
Resolution	0.1mm/pulse	
Accuracy	±0.2mm ^{Note 1)}	
Output type	Open collector (24VDC, 40mA)	
Output signal	A/B phase difference output	
Insulation resistance	500VDC, 50MΩ or more (between case and 12E)	
Vibration resistance	33.3Hz, 6.8G 2 hrs. each in X, Y directions 4 hrs. in Z direction based upon JIS D1601	
Impact resistance	30G 3 times each in X, Y, Z directions	
Enclosure	IP65 (IEC Standard) ^{Note 2)}	
Extension cable (optional)	5m, 10m, 15m, 20m	
	(Connector ... made by TAJIMI ELECTRONICS CO., LTD., R04-P8F7.3)	

Note 1) This includes the digital display error of the counter (CEU1).

Note 2) The cylinder section does not have a water resistant enclosure.

Standard Strokes

Bore size (mm)	Stroke (mm)											
	25	50	75	100	125	150	175	200	250	300	400	500
12	●	●	●	●	●	●	—	—	—	—	—	—
20	●	●	●	●	●	●	●	●	—	—	—	—
32	—	●	●	●	●	●	●	●	●	●	—	—
40	—	—	—	●	●	●	●	●	●	●	●	●
50	—	—	—	—	—	—	—	●	—	●	—	●
63	—	—	—	—	—	—	—	●	—	●	—	●

* Contact SMC regarding non-standard strokes.

When the bore size is 12mm and the stroke length is 100mm or more, particular care should be taken regarding an offset load on the rod.

Series CE1

Proper Auto Switch Mounting Position

Refer to p.32 regarding dimensions for the proper auto switch mounting position (stroke end).

Weight Table (without Mounting Bracket/Connector)

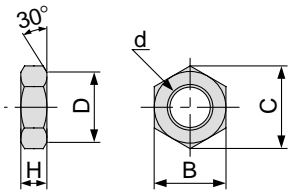
Unit: kg (without brackets)

Bore size (mm)	Cylinder stroke (mm)											
	25	50	75	100	125	150	175	200	250	300	400	500
12	0.29	0.33	0.36	0.4	0.43	0.47	-	-	-	-	-	-
20	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.0	-	-	-	-
32	-	0.94	1.05	1.15	1.26	1.36	1.47	1.58	1.79	2.0	-	-
40	-	-	-	1.7	1.83	1.95	2.08	2.2	2.45	2.7	3.2	3.7
50	-	-	-	-	-	-	-	3.4	-	4.1	-	5.5
63	-	-	-	-	-	-	-	4.2	-	5.0	-	6.6

Rod End Nut Dimensions

(1pc. is included as standard.)

Materials: $\phi 12$, $\phi 20$ Steel
 $\phi 32$ to $\phi 63$ Rolled steel



Part No.	Applicable bore size (mm)	d	H	B	C	D
NTJ-015A	12	M5 x 0.8	4	8	9.2	7.8
NT-02	20	M8 x 1.25	5	13	15.0	12.5
NT-04	32, 40	M14 x 1.5	8	22	25.4	21.0
NT-05	50, 63	M18 x 1.5	11	27	31.2	26

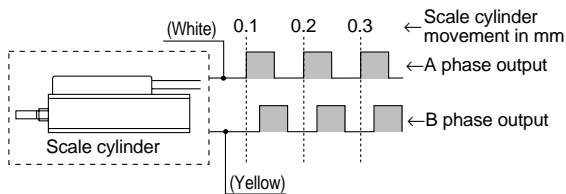
Electrical Wiring

Output type

The output signal of the scale cylinder is A/B phase difference output (open collector output) as shown in the figure below.

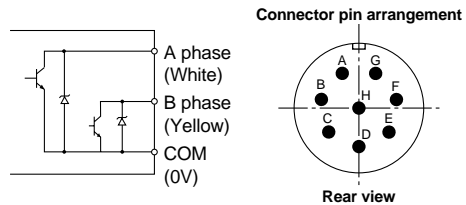
The relation between the movement distance and the signal output of the scale cylinder is that for each 0.1mm of movement a one pulse signal is output to both output terminals A and B.

Furthermore, the maximum response speed of the sensor for the scale cylinder is at a maximum cylinder speed of 1500mm/s (15kcps).



Input/Output

The input/output of the scale cylinder is performed by a $\phi 7$ shielded twisted pair wire from the sensor section plus a connector.



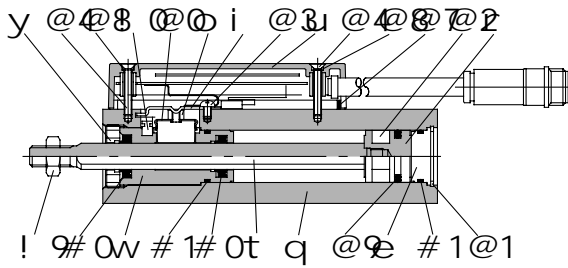
Output circuit of scale cylinder (Brown, Blue)

Signal table

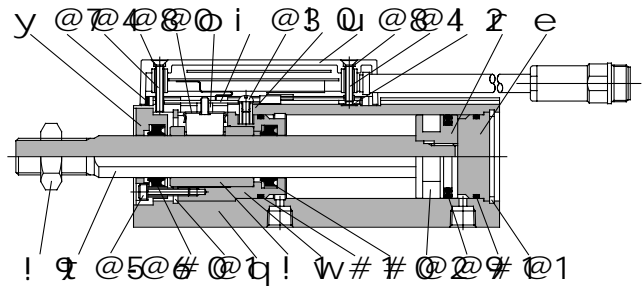
Wire color	Signal name	Connector pin symbol
White	A phase	A
Yellow	B phase	B
Brown, Blue	COM(0V)	C, D
Red	12V, 24V (power supply)	E
Black	0V (power supply)	F
(Shield)	Shield	G

Construction

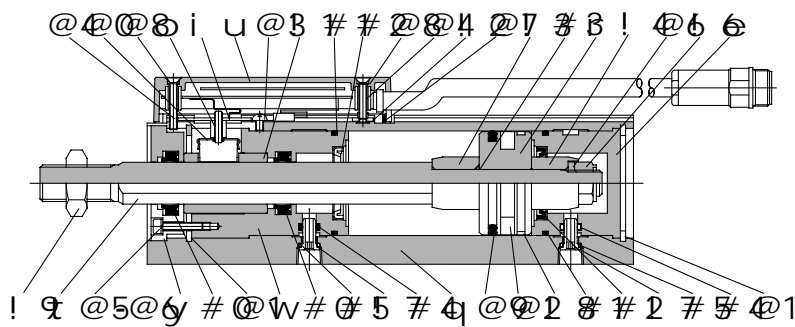
ø12, ø20



ø32



ø40 to ø63



Parts list

No.	Description	Material	Note
1	Cylinder body	Aluminum alloy	
2	Rod cover	Brass	ø12, ø20
		Aluminum alloy	ø32 to ø63
3	Head cover	Aluminum alloy	
4	Piston	Magnetic material	ø12
		Aluminum alloy	ø20 to ø63 (built-in magnet)
5	Piston rod	Stainless steel	
6	Rod cover disk	Aluminum alloy	
7	Sensor unit	—	
8	Sensor setting bracket	Stainless steel	
9	Sensor setting piece assembly	—	ø20 to ø63
10	Pin	Stainless steel	ø12 to ø32
11	Sensor guide	Lead-bronze casting	ø32 to ø63
12	Case setting nut	Carbon steel	ø32 to ø63
13	Cushion ring A	Rolled steel	ø40 to ø63
14	Cushion ring B	Rolled steel	ø40 to ø63
15	Cushion valve	—	ø40 to ø63
16	Piston nut	Rolled steel	ø40 to ø63
17	Port joint	Stainless steel	ø40 to ø63

Parts list

No.	Description	Material	Note
18	Wear ring	Resin	ø40 to ø63
19	Rod end nut	Steel	ø12, ø20
		Rolled steel	ø32 to ø63
20	Sensor setting plate	Cold rolled special steel strip	
21	C type snap ring	Carbon steel	
22	Plastic magnet	—	
23	Cross recessed round head screw	Carbon steel wire	
24	Cross recessed countersunk head screw	Carbon steel wire	
25	Hexagon socket head cap screw	Chrome molybdenum steel	
26	Spring washer	Steel wire	
27	Case gasket	NBR	
28	Case screw gasket	NBR	
29	Piston seal	NBR	
30	Rod seal	NBR	
31	Gasket	NBR	
32	Cushion seal	NBR	
33	Piston gasket	NBR	
34	Port seal	NBR	
35	Joint seal	NBR	
36	Valve seal	NBR	
37	Valve retainer seal	NBR	

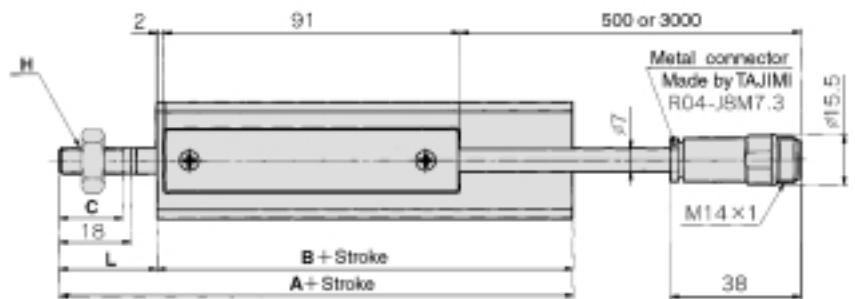
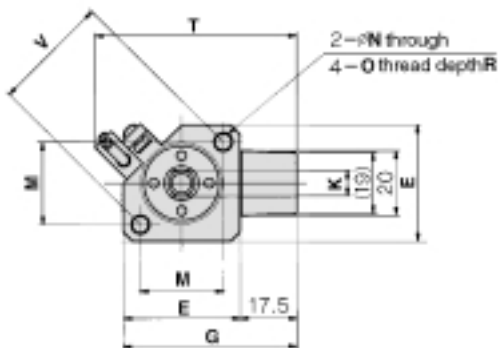
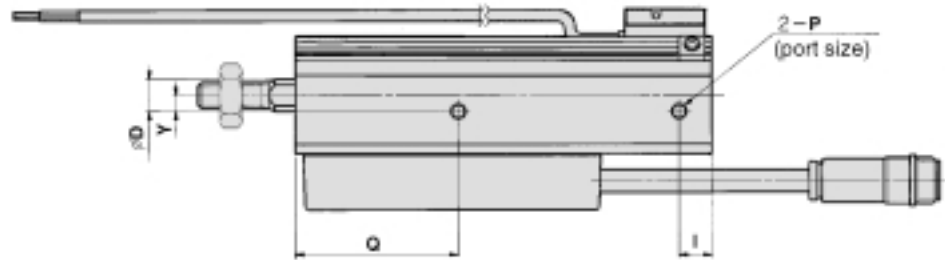
* Since there is a possibility of improper operation, contact SMC regarding the replacement of seals.

Series CE1

Ø12, Ø20/Dimensions

Double end tapped

CE1B Bore size Stroke



Bore size (mm)	Standard stroke	A	B	C	D	E	G	H	I	K	L	M
12	25, 50, 75, 100, 125, 150	94	69	15	6	25	42.5	M5 x 0.8	16	5.2	25	15.5
20	25, 50, 75, 100, 125, 150, 175, 200	106	78	15.5	10	36	53.5	M8 x 1.25	10	8	28	25.5

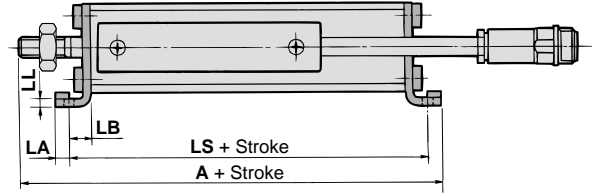
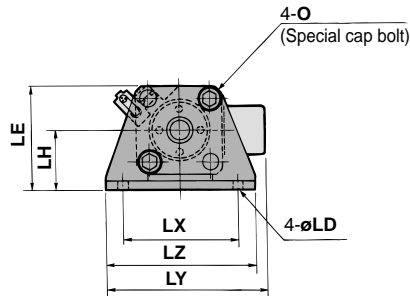
Bore size (mm)	N	O	P	Q	R	*T	V	Y
12	-	M4 x 0.7	M5 x 0.8	47	7	53.5	22	7
20	5.5	M6 x 1	M5 x 0.8	50	15	62.5	36	5

* Refer to page 11 regarding the rod end nut which is included. * Dimensions for auto switch model D-F79W.

Scale Cylinder *Series CE1*

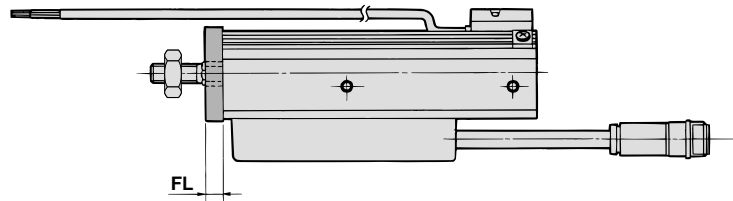
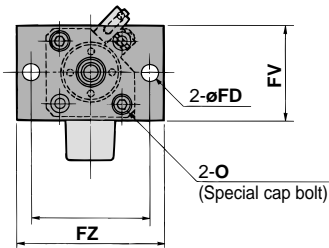
Foot type

CE1L Bore size Stroke



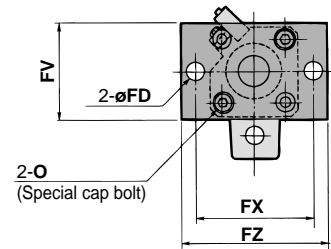
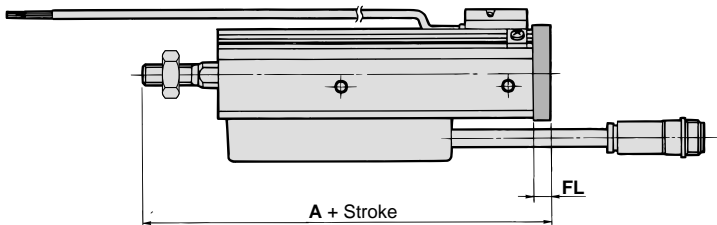
Front flange type

CE1F Bore size Stroke



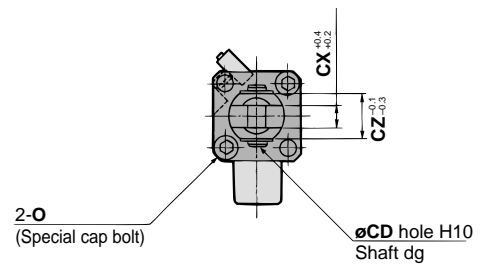
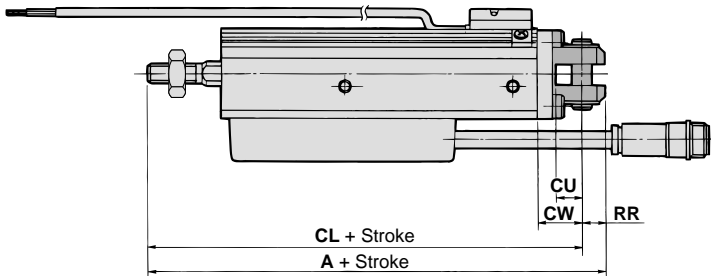
Rear flange type

CE1G Bore size Stroke



Double clevis type

CE1D Bore size Stroke



Bore size (mm)	Foot type												Front flange type, Rear flange type					Rear flange type	Double clevis type						
	A	LA	LB	LD	LE	LH	LL	LS	LX	LY	LZ	FD	FL	FV	FX	FZ	A	A	CD	CL	CU	CW	CX	CZ	RR
12	106.5	4.5	8	4.5	29.5	17	2	85	34	52	44	4.5	5.5	25	45	55	99.5	114	5	108	7	14	5	10	6
20	121	5.8	9.2	6.6	42	24	3.2	96.4	48	66.5	62	6.6	8	39	48	60	114	133	8	124	12	18	8	16	9

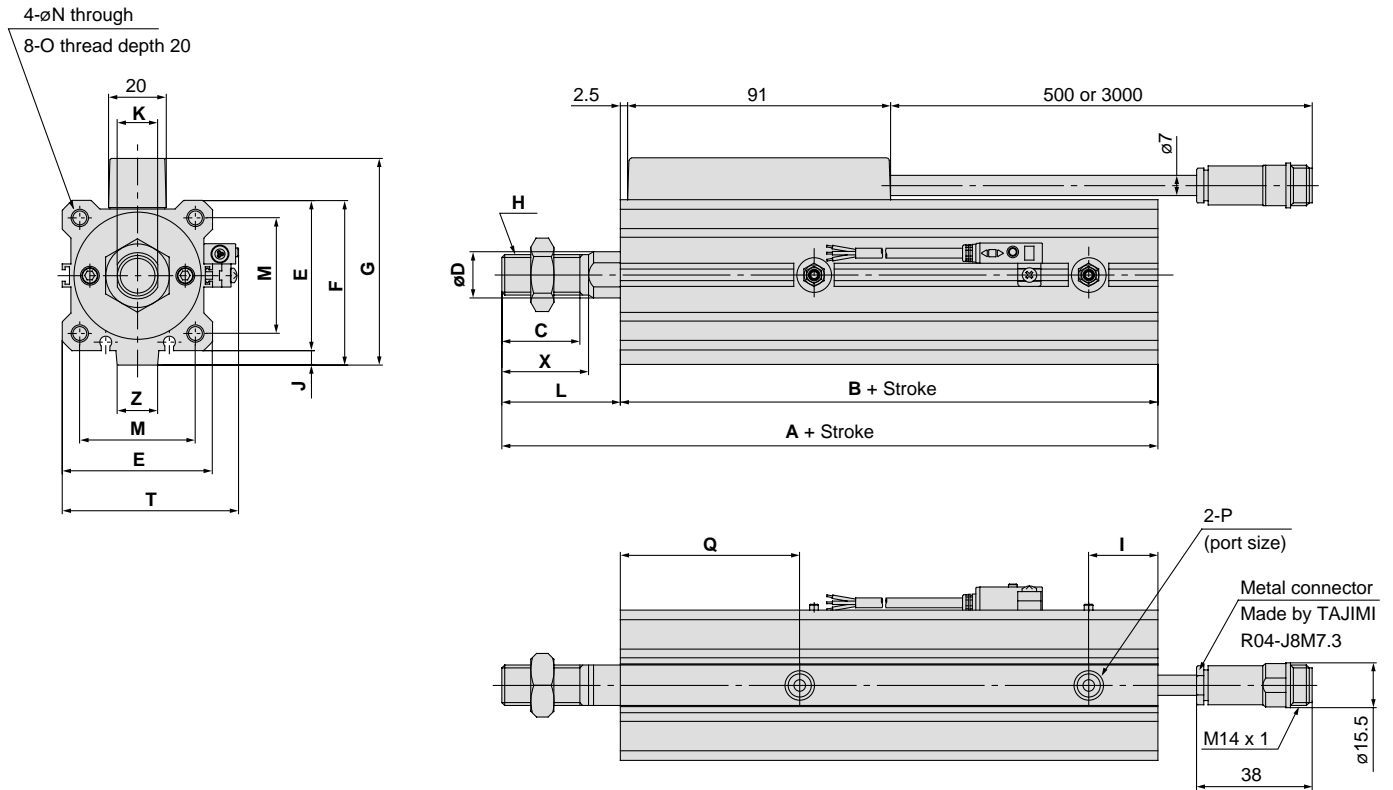
(mm)

Series CE1

ø32, ø40, ø50, ø63/Dimensions

Double end tapped

CE1B Bore size — Stroke



Bore size (mm)	Standard stroke	A	B	C	D	E	F	G	H	I	J	K
32	50, 75, 100, 125, 150, 175, 200, 250, 300	131	90	27	16	45	49.5	64	M14 x 1.5	14	4.5	14
40	100, 125, 150, 175, 200, 250, 300, 400, 500	177	136	27	16	52	57	71.5	M14 x 1.5	24	5	14
50	200, 300, 500	193	144	32	20	64	71	85.5	M18 x 1.5	22.5	7	18
63	200, 300, 500	194	145	32	20	77	84	98.5	M18 x 1.5	21	7	18

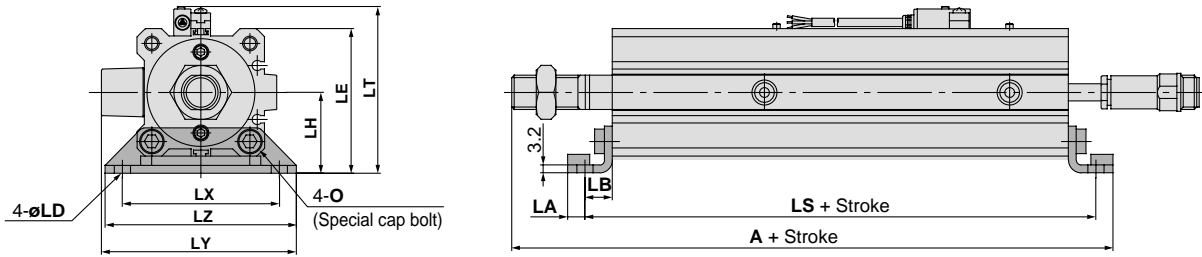
Bore size (mm)	L	M	N	O	P	Q	*T	X	Z
32	41	34	5.5	M6 x 1	Rc(PT) 1/8	56	57.5	30	14
40	41	40	5.5	M6 x 1	Rc(PT) 1/8	62	64.5	30	14
50	49	50	6.6	M8 x 1.25	Rc(PT) 1/4	61.5	76.5	35	19
63	49	60	9	M10 x 1.5	Rc(PT) 1/4	64	89.5	35	19

* Refer to page 11 regarding the rod end nut which is included. * Dimensions for auto switch model D-F79W.

Scale Cylinder *Series CE1*

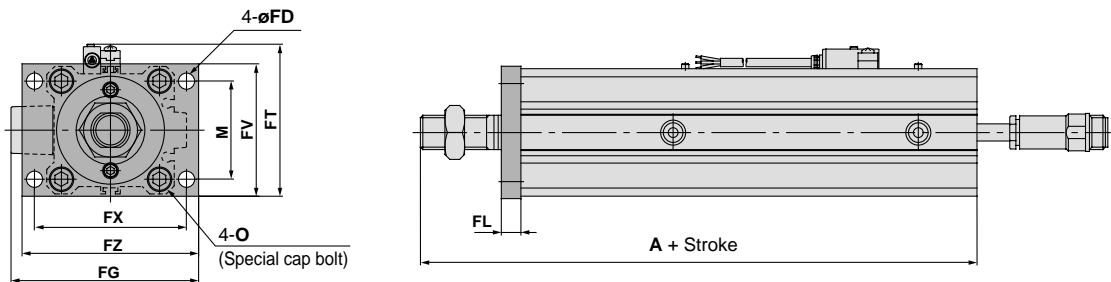
Foot type

CE1L Bore size — Stroke



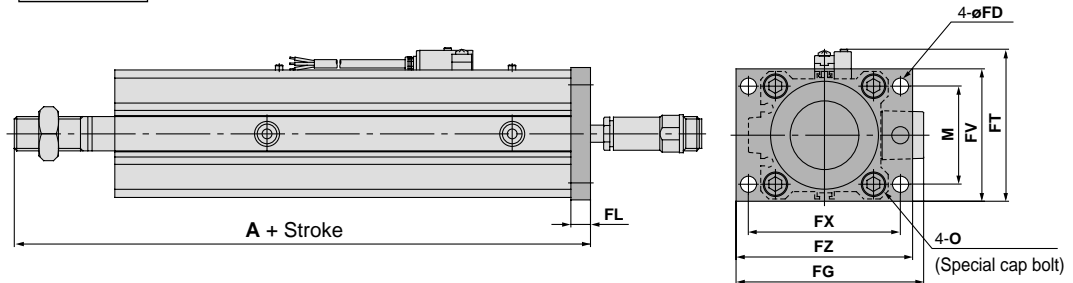
Front flange type

CE1F Bore size — Stroke



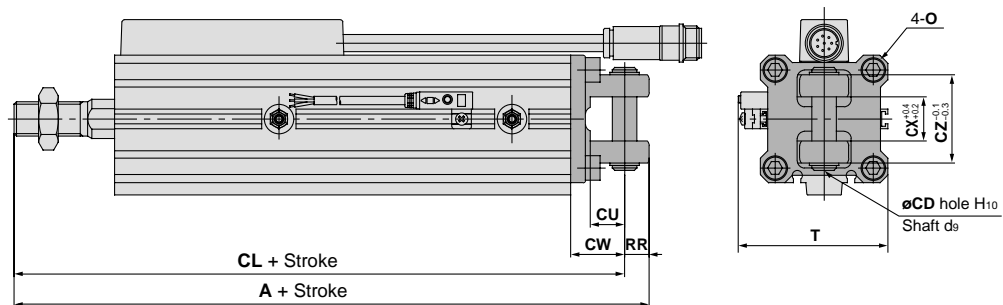
Rear flange type

CE1G Bore size — Stroke



Double clevis type

CE1D Bore size — Stroke



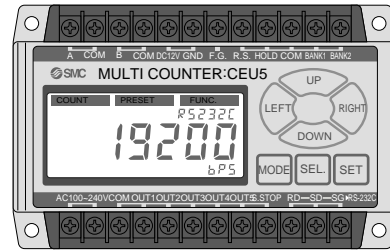
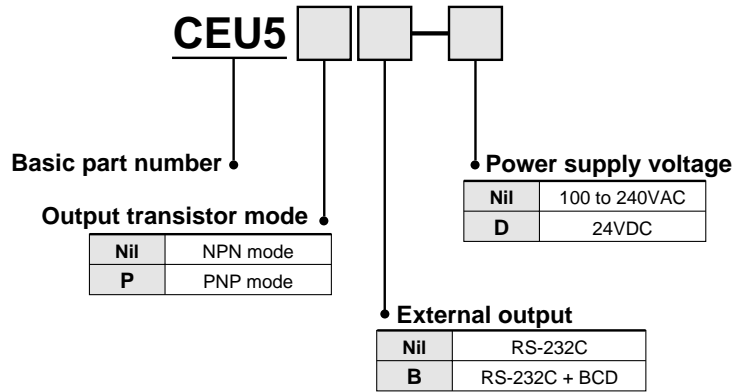
Bore size (mm)	Foot type												Front flange type, Rear flange type								Rear flange type	Double clevis type									
	A	LA	LB	LD	LE	LH	LS	*LT	LX	LY	LZ	FD	FG	FL	*FT	FV	FX	FZ	M	A	CD	CL	CU	CW	CX	CZ	RR	T			
32	148	5.8	11.2	6.6	52.5	30	112.4	65	57	72.5	71	5.5	69.5	8	59	48	56	65	34	139	161	10	151	14	20	18	36	10	57.5		
40	195.2	7	11.2	6.6	59	33	158.4	71.5	64	79.5	78	5.5	76.5	8	65.5	54	62	72	40	185	209	10	199	14	22	18	36	10	64.5		
50	215.7	8	14.7	9	71	39	173.4	83.5	79	94	95	6.6	91	9	78	67	76	89	50	202	235	14	221	20	28	22	44	14	76.5		
63	219.2	9	16.2	11	84.5	46	177.4	97	95	109.5	113	9	107	9	91	80	92	108	60	203	238	14	224	20	30	22	44	14	89.5		

* Dimensions for auto switch model D-F79W.

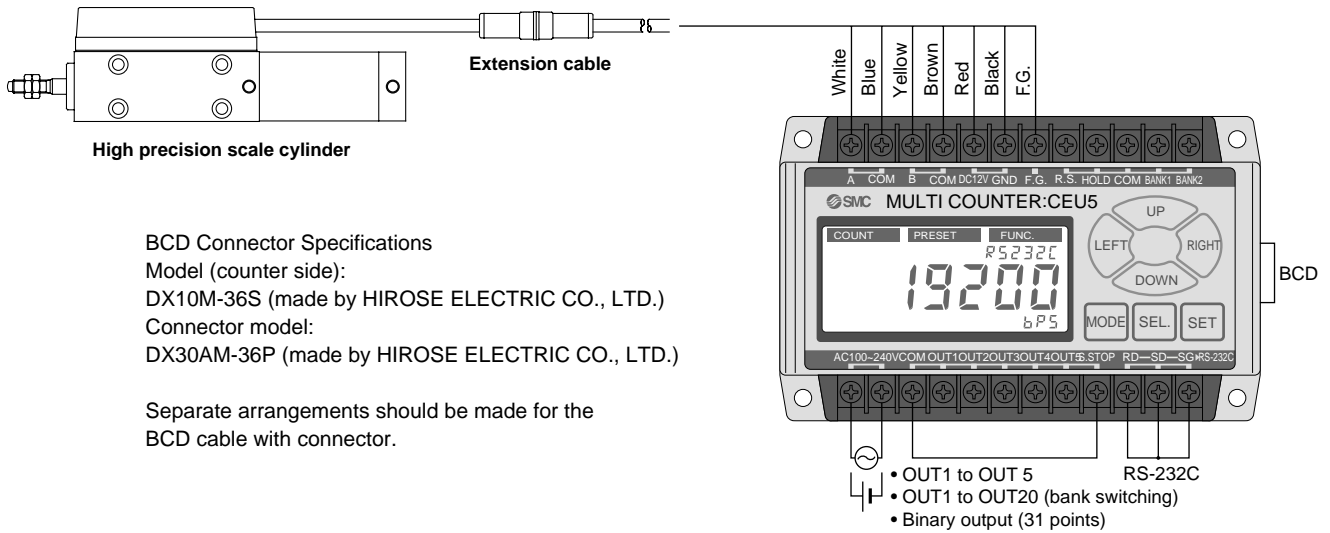
Series CEU Series CE Counter / Extension Cable

Multi Counter

How to Order



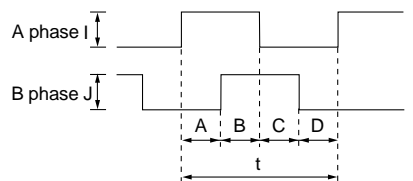
Connection Method



Multi Counter/Specifications

Model	CEU5	CEU5-D	CEU5P	CEU5P-D	CEU5B	CEU5B-D	CEU5PB	CEU5PB-D
Type	Multi counter							
Mounting	Surface mounting (DIN rail or screw stop)							
Operating system	Adding - subtracting type							
Operation modes	Operating mode, Data setting mode, Function setting mode							
Reset system	External reset terminal							
Display system	LCD (with back light)							
Number of digits	6 digits							
Memory holding (storage medium)	Setting value (always held), Count value (hold/non-hold switching), (E ² ROM (warning display after writing approx. 800,000 times: E2FUL))							
Input signal type	Count input, Control signal input (reset, hold, bank selection)							
Count input	No-voltage pulse input							
Pulse signal system	90° phase difference input ^{Note 1)} / UP:DOWN separate input ^{Note 2)}							
Counting speed	100kHz ^{Note 1)}							
Control signal input	Voltage input (12VDC or 24VDC)							
Sensor power supply	12VDC ±10%, 60mA							
Output signal type	Preset output, Cylinder stop output				Preset output, Cylinder stop output, BCD output			
Preset output configuration	Compare/Hold/One-shot (100ms point to point)							
Output system	Separate 5 point output/Binary code output							
Output delay time	5ms or less (for normal output)							
Communication system	RS-232C							
Output transistor mode	NPN open collector MAX. 30VDC, 50mA		PNP open collector MAX. 30VDC, 50mA		NPN open collector MAX. 30VDC, 50mA ^{Note 3)}		PNP open collector MAX. 30VDC, 50mA ^{Note 2)}	
Power supply voltage	100 to 240VAC (±10%)	24VDC (±10%)	100 to 240VAC (±10%)	24VDC (±10%)	100 to 240VAC (±10%)	24VDC (±10%)	100 to 240VAC (±10%)	24VDC (±10%)
Power consumption	20VA or less	10W or less	20VA or less	10W or less	20VA or less	10W or less	20VA or less	10W or less
Withstand voltage	Between case and AC line: 1500VAC for 1 min. Between case and signal ground: 500VAC for 1 min.							
Insulation resistance	Between case and AC line: 500VDC, 50MΩ or more							
Ambient temperature	0 to 50°C (without freezing)							
Ambient humidity	35 to 85%RH (without condensation)							
Noise resistance	Square wave noise from a noise simulator (pulse duration 1μs) between power supply terminals ±2000V, I/O line ±600V							
Vibration resistance	Endurance 10 to 55Hz; amplitude 0.75mm; X, Y, Z for 2 hours each							
Impact resistance	Endurance 10G; X, Y, Z directions, 3 times each							
Weight	350g or less							

Note 1) 90° phase difference input

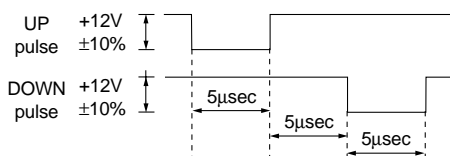


A: Counting input pulse duration
 B: } 2.5μsec or more required
 C: }
 D: }
 t : 10μsec or more required

$$\text{Counting speed } f = \frac{1}{t} = \frac{1}{10 \times 10^{-6}} = 100000\text{Hz}$$

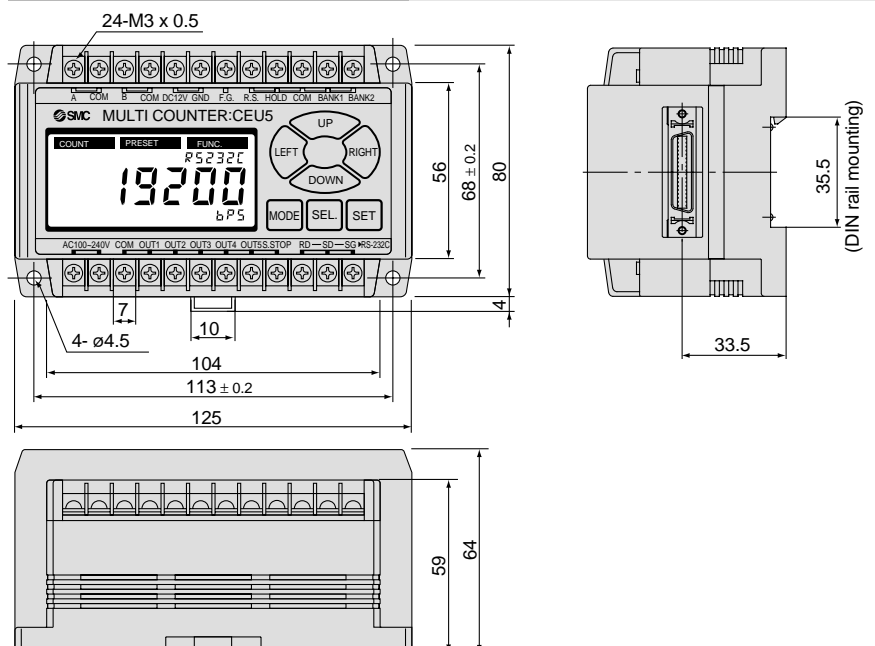
(Approx: 100kHz)

Note 2) UP / DOWN input Input wave form conditions: At a maximum of 100kHz, the UP/DOWN wave form should be as shown below.



Note 3) 15mA when BCD is output.

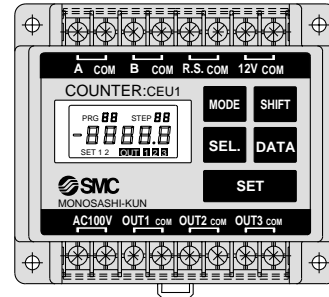
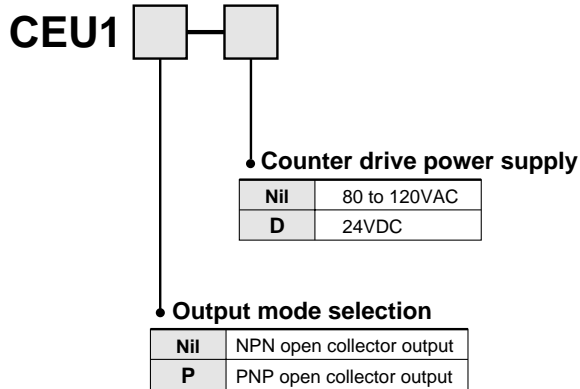
Multi Counter/Dimensions



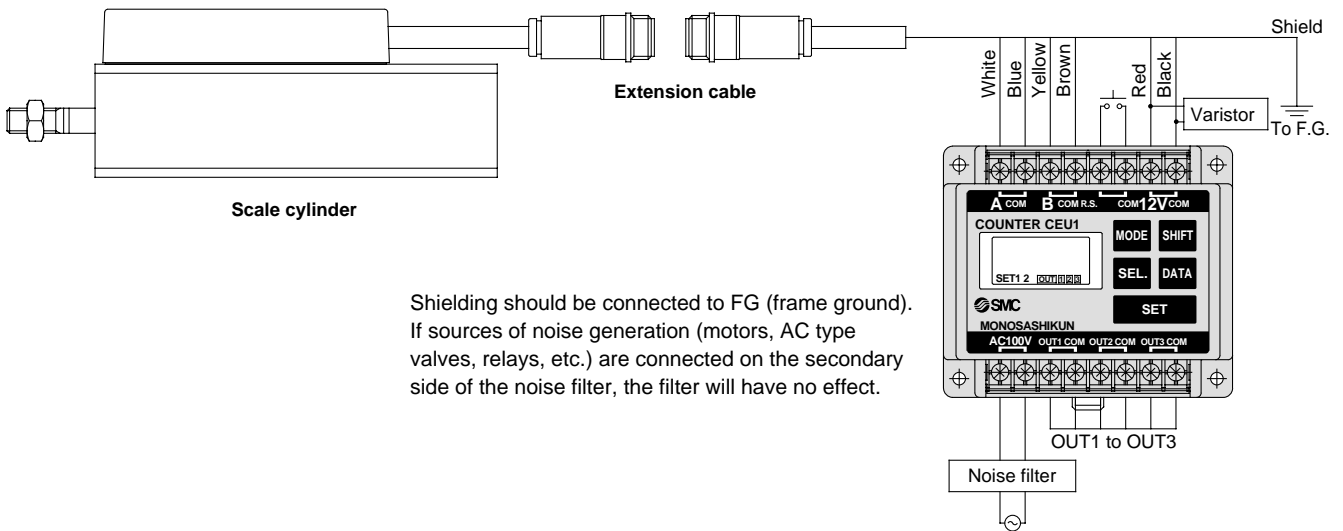
Series CEU1

■ 3 Point Preset Counter

How to Order



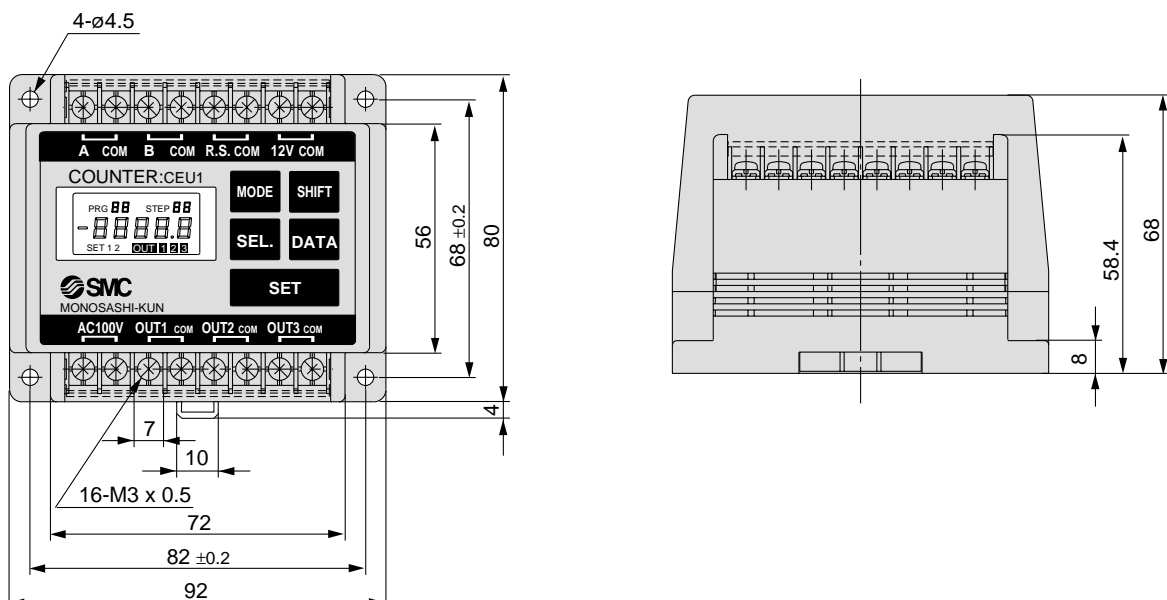
Connection Method



3 Point Preset Counter/Specifications

Model	CEU1	CEU1P	CEU1-D	CEU1P-D
Type	3 point preset counter			
Mounting	Surface mounting (DIN rail or screw stop)			
Operating system	Adding - subtracting type			
Operation modes	Operating mode, Data setting mode			
Reset system	External reset terminal			
Display system	LCD (with back light)			
Number of digits	5 digit display (-9999.9 to 9999.9)			
Memory holding (storage medium)	Preset data (always held) {E ² ROM (warning display after writing approx. 65,000 times: F_L)}			
Input signal type	Count input, Reset input			
Count input	No-voltage pulse input			
Pulse signal system	90° phase difference input			
Counting speed	20kHz			
Reset input	R.S. and COM terminals are shorted for 10ms or more (pulse input)			
Sensor power supply	12VDC \pm 10%, 60mA			
Output signal type	Preset output			
Preset output configuration	Compare/Hold/One-shot (100ms Fixed pulse)			
Output delay time	5ms or less			
Output transistor mode	NPN open collector MAX 30VDC, 50mA	PNP open collector MAX 30VDC, 50mA	NPN open collector MAX 30VDC, 50mA	PNP open collector MAX 30VDC, 50mA
Power supply voltage	100VAC (\pm 10%)		24VDC (\pm 10%)	
Power consumption	10VA or less		5W or less	
Withstand voltage	Between case and AC line: 1500VAC for 1 min. Between case and signal ground: 500VAC for 1 min.			
Insulation resistance	Between case and AC line: 500VDC, 50M Ω or more			
Ambient temperature	0 to 50°C (without freezing)			
Ambient humidity	35 to 85%RH (without condensation)			
Noise resistance	Square wave noise from a noise simulator (pulse duration 1 μ s) between power supply terminals \pm 1500V, I/O line \pm 600V			
Vibration resistance	Endurance 10 to 55Hz; amplitude 0.75mm; X, Y, Z for 2 hours each			
Impact resistance	Endurance 10G; X, Y, Z directions, 3 times each			
Weight	250g or less			

3 Point Preset Counter/Dimensions



Series CEU

■ Extension Cable

How to Order

CE1-R

Cable length

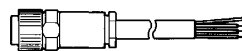
05	5m
10	10m
15	15m
20	20m

Cable suffix

Nil	Extension cable
C	Extension cable & connector

Extension cable

CE1-R□



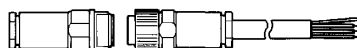
Scale cylinder side connector (unit)

CE1-R00C



R04-J8M7.3
(Made by TAJIMI ELECTRONICS CO., LTD.)

CE1-R□C



Operating Condition of each Output Mode

One-shot output

Without an allowed value	With an allowed value
<p>When the counter value passes the preset value, output is turned ON for 100ms.</p>	<p>When the counter value passes the sum of the preset value + the allowed value, output is turned ON for 100ms.</p>

Hold output

Without an allowed value	With an allowed value
<p>When the counter value passes the preset value, output is turned ON and that state is maintained. Output is cancelled when the power is turned off, the reset signal is input or when the setting value is changed.</p>	<p>When the counter value passes the sum of the preset value + the allowed value, output is turned ON. Output is cancelled when the power is turned off, the reset signal is input or when the setting value is changed.</p>

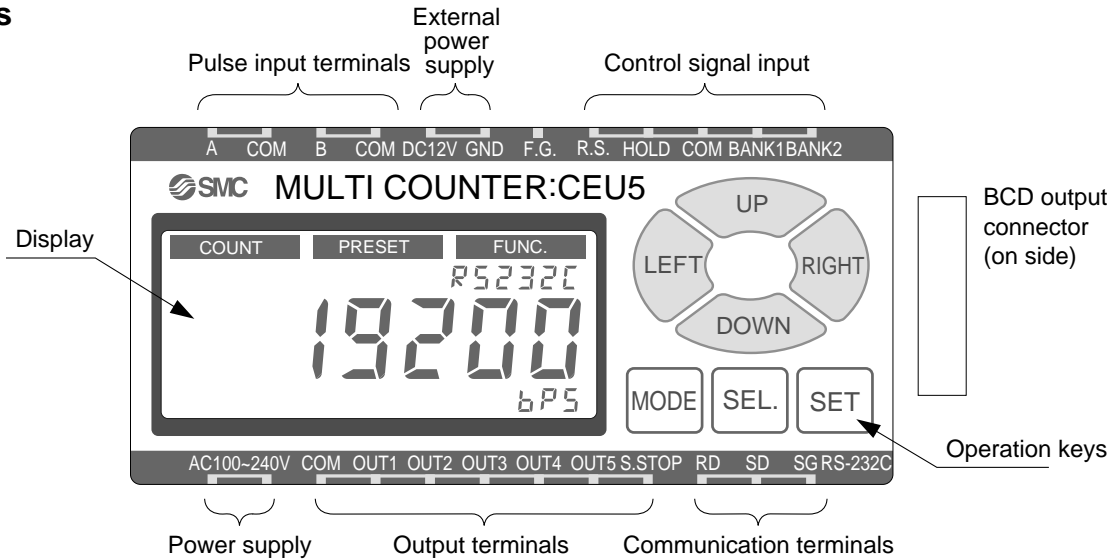
Compare output

Without an allowed value	With an allowed value
<p>Output is turned ON only when the counter value coincides with the preset value.</p>	<p>When the counter value passes the sum of the preset value + the allowed value, output is turned ON.</p>

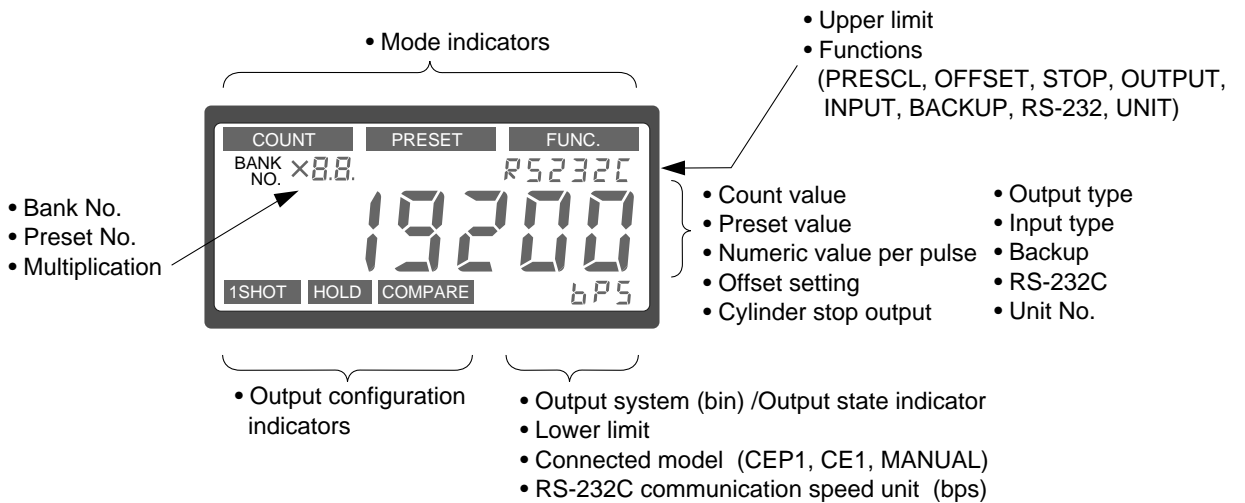
Series CEU

CEU5 Operation

Part names



Display detail

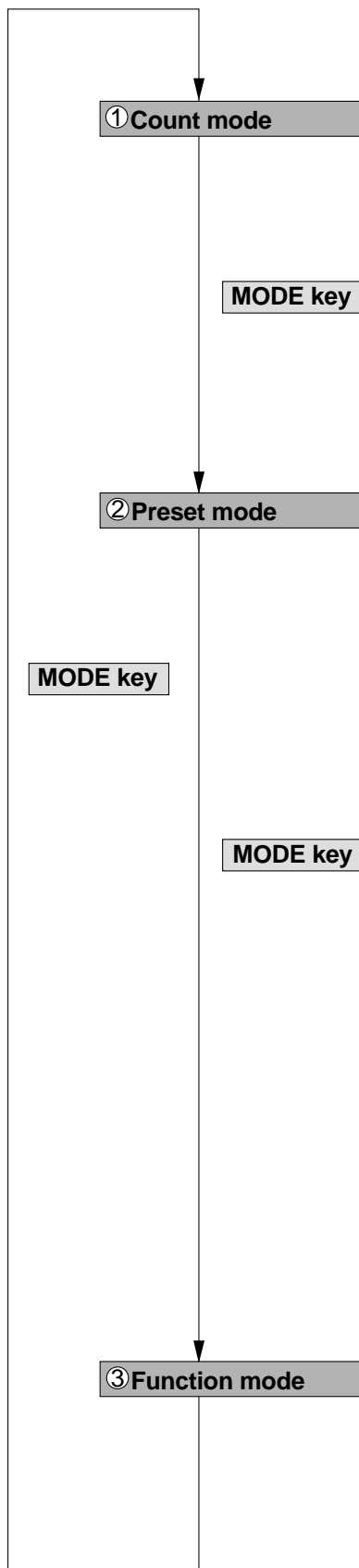


Keys and functions

Key	Function
MODE	Changes the mode. In any given condition, it shifts to the next mode. Does not write data.
SEL.	Shifts the cursor to the next item. Does not write data.
SET	Writes displayed data into the memory when setting.
RIGHT	Shifts the cursor to the right when setting numerical values.
LEFT	Shifts the cursor to the left when setting numerical values.
UP	Changes the contents of a setting. Increases the value when setting numerical values.
DOWN	Changes the contents of a setting. Decreases the value when setting numerical values.

In the explanations of the operating method, references to "direction keys" indicate the 4 keys RIGHT, LEFT, UP and DOWN.

Mode cycle using mode key



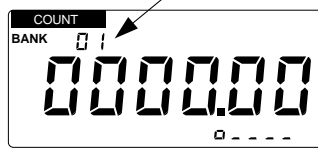
Basic Operation

- **SET key** : In any of the conditions (1) through (5), this writes the display data into the memory and shifts to (1).
- **SEL. key** : Shifts to the next item, but does not write data.
- **MODE key** : In any given condition, this shifts to the next mode, but does not write data.
- **Direction keys**: LEFT/RIGHT keys shift the digits, and UP/DOWN keys increase or decrease numerical values.

1. Explanation of display in count mode

Normal output display

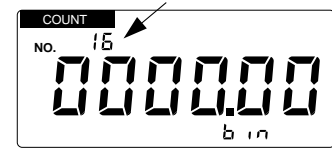
Displays current output bank



Displays output state of each OUT terminal

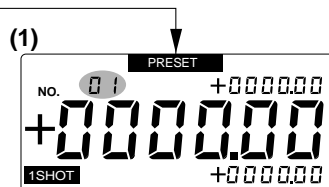
Binary output display

Displays only when matched with preset



Display of binary output selection

2. Setting of preset mode



Selection of preset No.

- Select a preset number from 1 to 31 with the UP/DOWN keys.
- Shift to the next item with the SEL. key.

SEL. key



Setting the preset value

- Shift the digits with the LEFT/RIGHT keys, and increase or decrease numerical values with the UP/DOWN keys.
- Shift to the next item with the SEL. key.

SEL. key



Setting the upper limit tolerance

- Set numerical values in the same way with the direction keys.
- When ± is selected, the lower limit display is cleared and ± setting is possible.
- Shift to the next item with the SEL. key.

SEL. key



Setting the lower limit tolerance

- Set numerical values in the same way with the direction keys.
- When ± is selected in the upper limit setting, this item is not displayed.
- Shift to the next item with the SEL. key.

SEL. key



Setting the output configuration

- Switch to 1SHOT, HOLD or COMPARE with the UP/DOWN keys.
- Store the setting with the SET key.
- The SEL. key only shifts to another item without storing the setting.

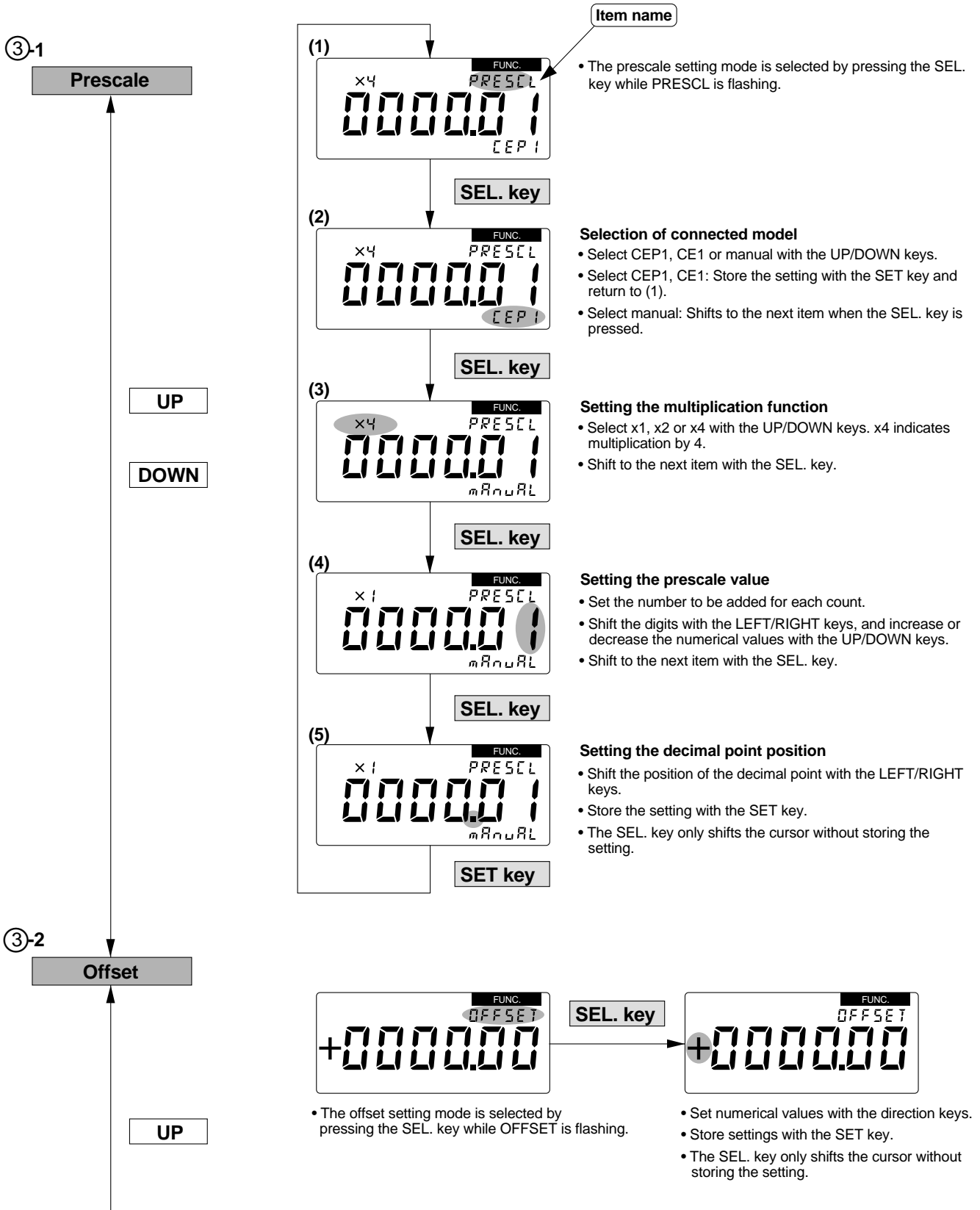
SET key

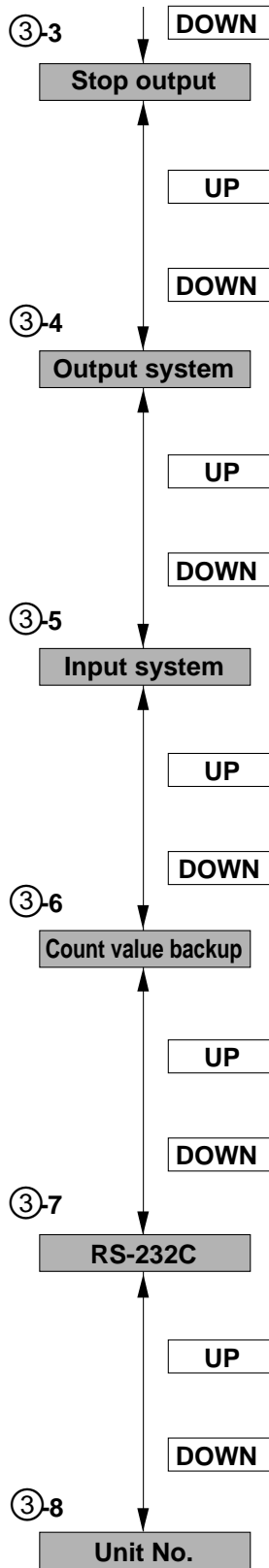
Series CEU

CEU5 Operation

③ Explanation of settings in the function mode

If the UP/DOWN keys are pressed when an item name is flashing, it shifts to another setting item. When the SEL. key is pressed, the cursor shifts and it is possible to change the content of the setting for the item which is being displayed.





SEL. key

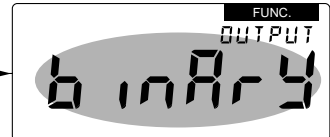


- When the SEL. key is pressed while STOP is flashing, the setting mode is selected for the stop output waiting time.

- Set numerical values with the direction keys.
- The unit is 0.1sec.
- Store the setting with the SET key.
- The SEL. key only shifts the cursor without storing the setting.



SEL. key

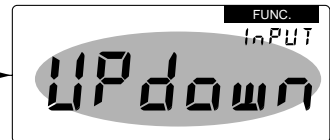


- The output system setting mode is selected by pressing the SEL. key while OUTPUT is flashing.

- Select normal output or binary output with the UP/DOWN keys.
- Store the setting with the SET key.
- The SEL. key only shifts the cursor without storing the setting.



SEL. key

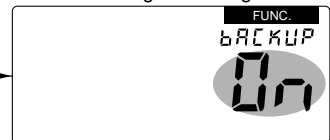


- The input system setting mode is selected by pressing the SEL. key while INPUT is flashing.

- Select phase difference input (2PHASE) or separate input (UP-DOWN) with the UP/DOWN keys.
- Store the setting with the SET key.
- The SEL. key only shifts the cursor without storing the setting.

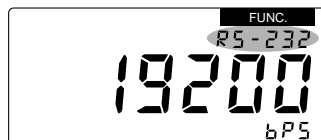


SEL. key

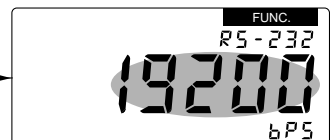


- The count value backup setting mode is selected by pressing the SEL. key while BACKUP is flashing.

- Select ON or OFF with the UP/DOWN keys.
- Store the setting with the SET key.
- The SEL. key only shifts the cursor without storing the setting.



SEL. key



- The RS-232C communication speed setting mode is selected by pressing the SEL. key while RS-232 is flashing.

- Select the communication speed from 1200, 2400, 4800, 9600 or 19200 with the UP/DOWN keys.
- Store the setting with the SET key.
- The SEL. key only shifts the cursor without storing the setting.



SEL. key

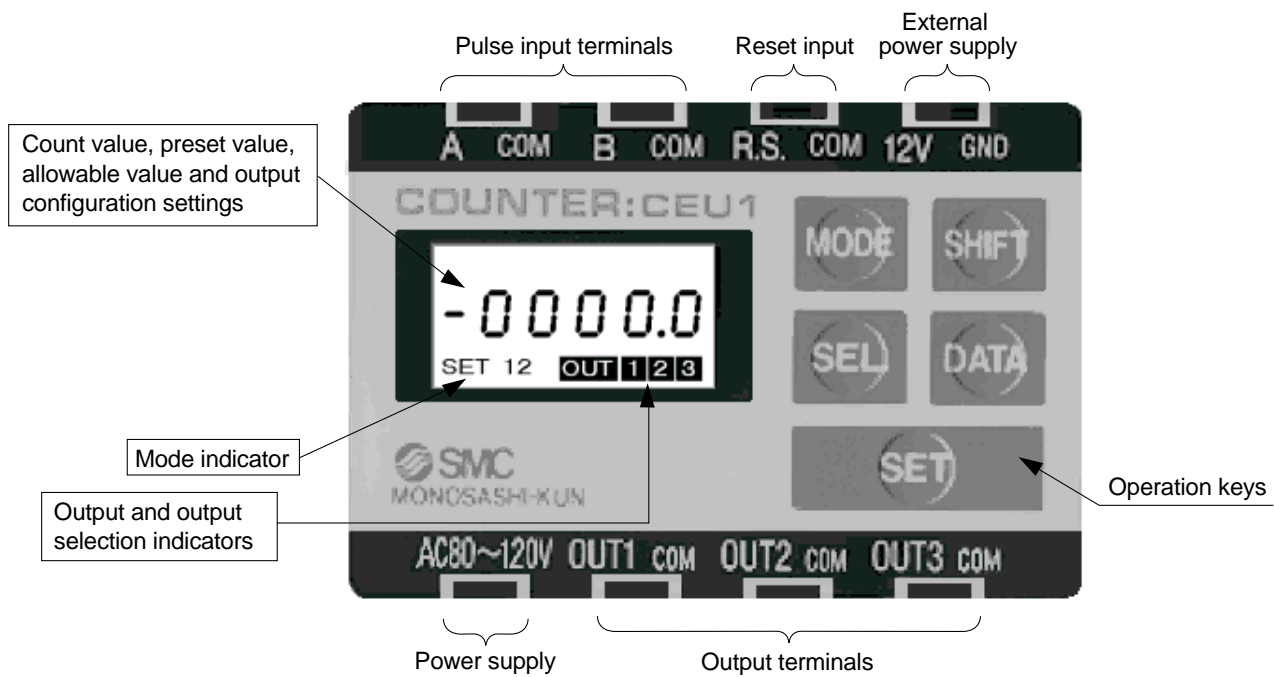


- The unit number registration mode is selected by pressing the SEL. key while UNIT is flashing.

- Set numerical values with the direction keys.
- Settings can be made from 00 to 99.
- Store the setting with the SET key.

Series CEU

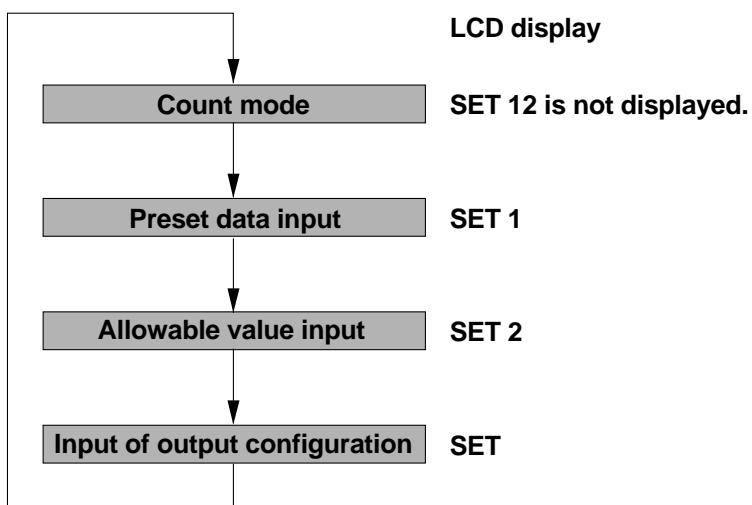
CEU1 Operation

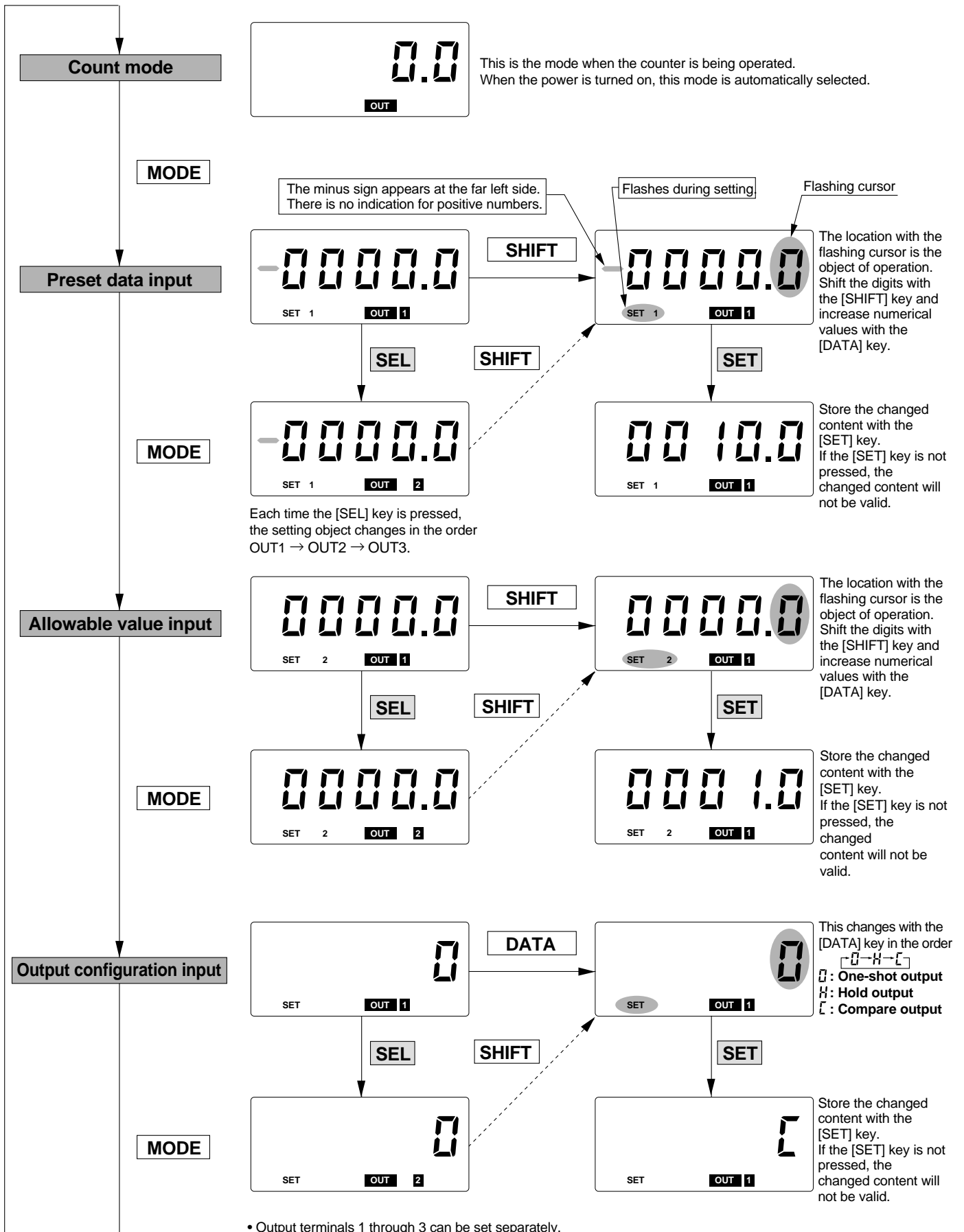


Keys and functions

Key	Function
MODE	Switches between the count mode and the setting mode.
SHIFT	Switches digits for preset data input and allowable value input. Shifts the flashing cursor to the left each time it is pressed.
SEL	In the setting mode, this switches the output terminal number which is to be set. Switches in the order OUT1 → OUT2 → OUT3 each time it is pressed.
DATA	In the setting mode, this changes numerical values, or codes and symbols. Numerical values increase by 1 each time it is pressed. For positive and negative codes, a minus sign turns on or off.
SET	Registers the setting contents in the setting mode. Press this key to perform registration after making setting changes. The setting will not be registered if the screen is changed by pressing the [MODE] or [SEL] keys without pressing the [SET] key.

The counter mode changes in the order shown below each time the [MODE] key is pressed.





- Output terminals 1 through 3 can be set separately.
- In the model CEU1, the allowable value is a ± value. (Only the model CEU5 is equipped with a function to set different values for the upper and lower limits.)

Series CE Glossary (CEU5 Functions)

BCD Output

This is a system which expresses one digit of a decimal number with a 4 digit binary number.

The count value is expressed by the ON/OFF state of each BCD output terminal. In the case of 6 digits, 24 terminals are required.

The relation between decimal numbers and BCD codes is shown in the table below.

Decimal No.	0	1	2	3	4	5	6	7	8	9
BCD	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001

Ex.) 1294.53 is expressed as follows.
0001 0010 1001 0100 0101 0011

RS-232C

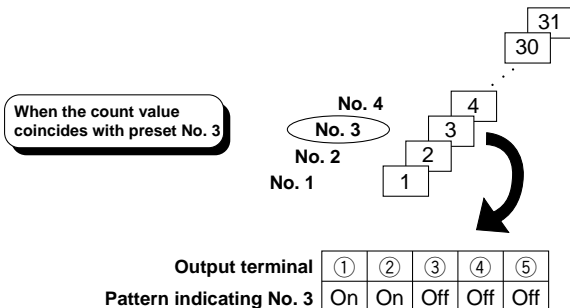
This is the interface standard for the serial transmission method, which is standard equipment on a personal computer.

Prescale Function

This function allows free setting of how many millimeters will indicate one pulse.

Binary Output

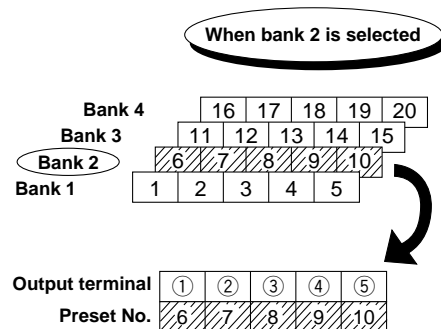
31 point preset output is possible without bank switching, by means of binary system output from a 5 point output terminal. Cylinder stop output is used as the readout release signal.



The coincident preset number is expressed as a 5 digit binary number.

Bank Function

5 points of preset output are possible simultaneously, however, a maximum of 20 types of work discrimination, etc. can be performed by using the 5 points of preset values as one of a maximum of four quadrants, and switching its use during operation.



For example, when bank 2 is selected, presets 6 through 10 are valid and when the count value coincides with the setting value of 6 through 10, the respective output terminals ① through ⑤ are turned ON.

Bank switching correspondence table

Input terminal / Bank No.	BANK 2	BANK 1
1	OFF	OFF
2	OFF	ON
3	ON	OFF
4	ON	ON

Glossary (CEU5 Functions)

Display Offset Function

Normally the count value returns to "0" after resetting, but with this function, the initial value can be set to any desired value.

Hold Function

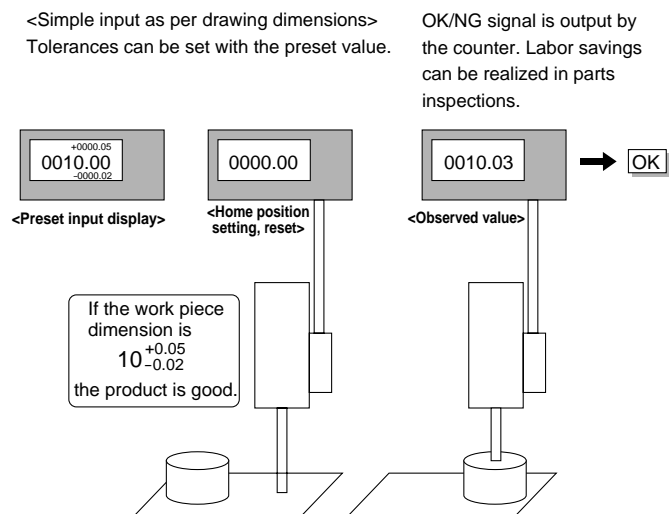
When "hold" is input, the counter holds the current count value in memory. Next, when the count value is read into a PLC which uses serial or BCD output, etc., the count value that was held can be read in, even if there is a time lag.

Setting of Preset Value Tolerances

In the current model CEU1, the preset value tolerances could only be set as \pm , but now it has become possible to set an upper and lower limit of $+ \Delta$ mm and $- \Delta$ mm.

By including preset tolerance setting, superior performance is exhibited in parts inspections, etc. In a work piece to be measured, there are tolerances which assure a good product. For example, in the case of $10^{+0.05}_{-0.02}$, the CEU5 allows these tolerances to be input as they stand. If the work piece is within tolerances the OK signal is sent.

On the other hand, in ordinary counters, No.1 is set to 9.98 and No.2 is set to 10.06, and if No.1 is ON and No.2 is OFF, an acceptance decision is made. 2 points of output are used in order to check whether or not the product is within dimension tolerances. In this example, one preset of the CEU5 performs the same function as two presets of an ordinary counter.



Count Value Protection

In the past, the count value returned to "0" when the power supply was cut off, but this function holds the previous value even after a power failure. This function can be switched between active and inactive settings.

Cylinder Stop Output

When work piece discrimination is performed using a preset counter, it has been common to estimate the amount of time from the cylinder's start of operation until it touches the work piece and stops, using a timer to read the output after a fixed amount of time.

Since cylinder stop output is now output when there is no cylinder movement for a fixed amount of time, timing of preset output and external output, etc. is simplified.

Series CE Auto Switch Common Specifications



⚠ Specific Product Precautions

Be sure to read before handling.
Refer to pages 39 through 41 for auto switch precautions.

Auto Switch Common Specifications

Type	Reed switch	Solid state switch
Leakage current	None	3 wire: 10μA or less 2 wire: 1mA or less
Operating time	1.2ms	1ms or less ^{Note 3)}
Impact resistance	300m/s ² {30.6G}	1000m/s ² {102G}
Insulation resistance	50MΩ or more with a 500VDC megohmmeter (between lead wire & case)	
Withstand voltage	1500VAC for 1 min. ^{Note 1)} (between lead wire & case)	1000VAC for 1 min. (between lead wire & case)
Ambient temperature	-10 to 60°C	
Enclosure	IEC529 standard IP67, JISC0920 watertight construction ^{Note 2)}	

Note 1) Electrical entry: Connector type (A73C, A80C, C73C, C80C) and D-9, 9□A, A9, A9□V are 1000VAC for 1 min. (between lead wire and case)

Note 2) Terminal conduit type (D-A3, A3□A, A3□C, G39, G39A, G39C, K39A, K39C) and DIN terminal type (D-A44, A44A, A44C) are IEC529 standard IP63, JISC0920 raintight construction.

Note 3) Excluding solid state switches with timer (D-M5□TL, G5NTL, F7NTL, F5NTL) and ferromagnetic resistant 2 color indicator type solid state switch (D-P5DWL). D-J51 is 5ms or less.

Lead Wire Length

Lead wire length designation (example)

D-A73 **L**

• Lead wire length

Nil	0.5m
L	3m
Z	5m
N ^{Note)}	None

Note) Applies only to D- □□ C type connector switches.

Note 1) Lead wire length Z: Auto switches applicable for 5m
Reed switch: D-B53/B54, D-C73(C)/C80C, D-A73(C)(H)/A80C
D-A53/A54, D-Z73, D-90/97/90A/93A

Solid state switch: All models are produced upon receipt of order (standard procedure). However, this does not include D-F9, F9□V and F7□WV.

Note 2) A lead wire length of 3m is standard for solid state switches with timer and water resistant 2 color indicator type solid state switches. (0.5m is not available.)

Note 3) Lead wire lengths of 3m and 5m are standard for ferromagnetic resistant 2 color indicator type solid state switches. (0.5m is not available.)

Part Nos. of lead wires with connectors
(applicable only for connector type)

Type	Lead wire length
D-LC05	0.5m
D-LC30	3m
D-LC50	5m

Series CE Auto Switch

Contact Protection Box

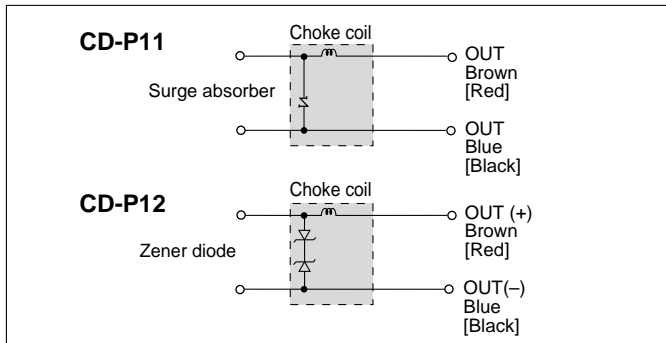
D-A7 and D-A8 type switches do not have built-in contact protection circuits. A contact protection box should be used in cases such as when there is an induction load, when lead wires are 5m or longer, and with 100V or 200VAC.

Part No.	Operating voltage	Lead wire length
CD-P11	100V, 200VAC	Switch connection side: 0.5m Load connection side: 0.5m
CD-P12	24VDC	

* Since D-A8 switches have no particular voltage designation below 100VAC, type selection should be based upon the operating voltage.

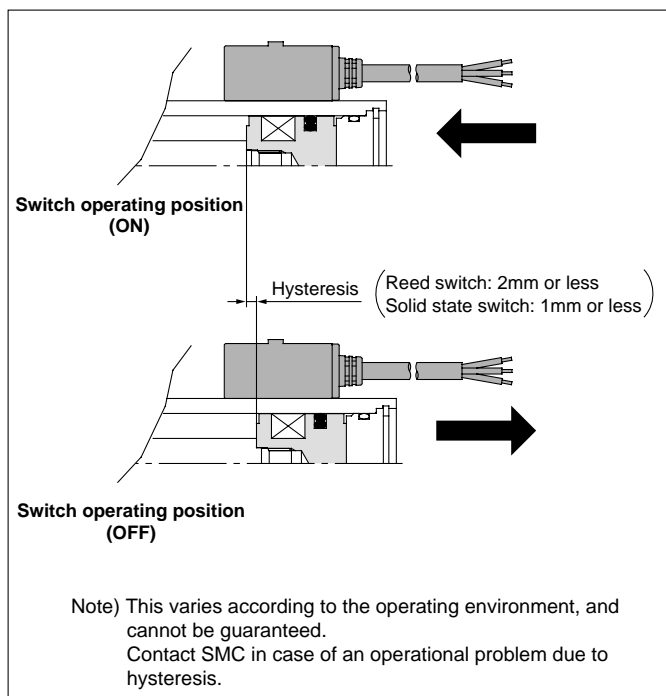


Contact protection box internal circuits

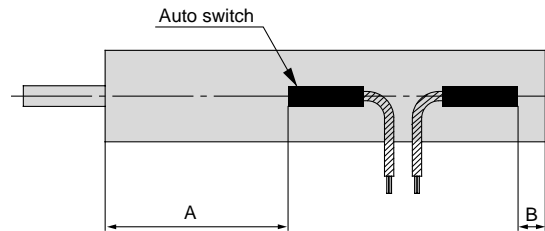


Lead wire colors inside [] are those prior to conformity with IEC standards.

Switch Hysteresis



Proper Auto Switch Mounting Positions (Stroke End)



Proper auto switch mounting positions (Series CE1)

Auto switch model	Symbol	Bore size (mm)					
		12	20	32	40	50	63
D-A7, A8	A	40.5	47	55	79	82	85.5
	B	4	13	17	39	44	41.5
D-A7□H, A80H, A73C, A80C, D-F7□, J79, F7□V, J79C	A	41	47.5	55.5	79.5	82.5	86
	B	4.5	13.5	17.5	39.5	44.5	42
D-A79W	A	38	44.5	52.5	76.5	79.5	83
	B	2	10.5	14.5	36.5	41.5	39
D-F7BA, F7□W, F7□F, J79W	A	45	51.5	59.5	83.5	86.5	90
	B	8.5	17.5	21.5	43.5	48.5	46
D-F7□WV	A	41.5	48	56	80	83	86.5
	B	5	14	18	40	45	42.5
D-A9□□	A	39.5	46	54	78	81	40.5
	B	3	12	16	38	43	81.5
D-F7NT	A	46	52.5	60.5	84.5	87.5	91
	B	9.5	18.5	22.5	44.5	49.5	47
D-F9□□	A	43.5	50	58	82	85	88.5
	B	7	16	20	42	47	44.5
D-F9□W□	A	42.5	49	57	81	84	87.5
	B	6	15	19	41	46	43.5

Proper auto switch mounting positions (Series CEP1)

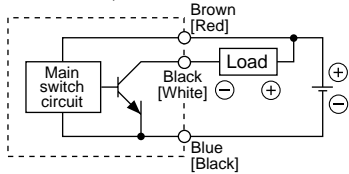
Auto switch model	Symbol	Bore size (mm)	
		12	20
D-A90, A93, A96	A	75.2	82
	B	7.9	12
D-A90V, A93V, A96V	A	75.2	82
	B	7.9	12
D-F9N, F9P, F9B	A	79.2	86
	B	11.9	16
D-F9NV, F9PV, F9BV	A	78.2	85
	B	10.9	15
D-F9NW, F9PW, F9BW	A	79.2	86
	B	11.9	16
D-F9NWV, F9PWV, F9BWV	A	78.2	85
	B	10.9	15
D-F9BA□	A	79.2	86
	B	11.9	16

Series CE Auto Switch Connections and Examples

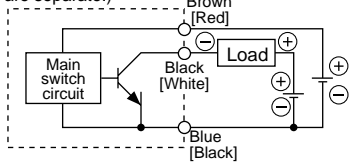
Basic Wiring

Solid state 3 wire, NPN

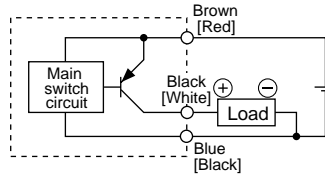
(Power supply for switch and load are the same.)



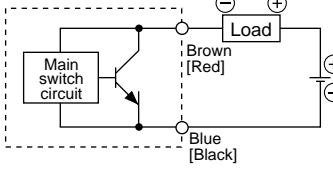
(Power supply for switch and load are separate.)



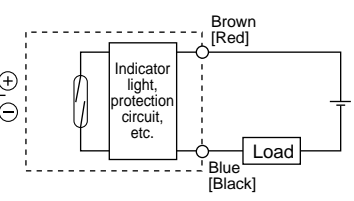
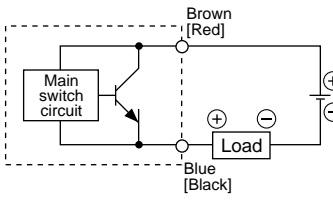
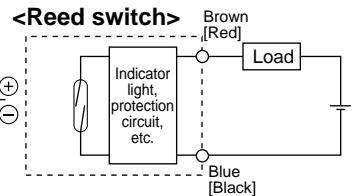
Solid state 3 wire, PNP



2 wire <Solid state>



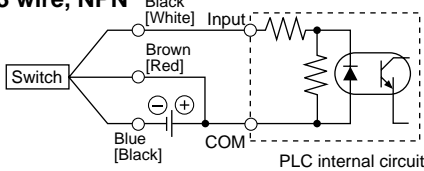
2 wire <Reed switch>



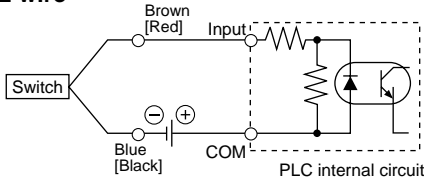
Examples of Connection to PLC (Sequence Controller)

Specification for sink input

3 wire, NPN

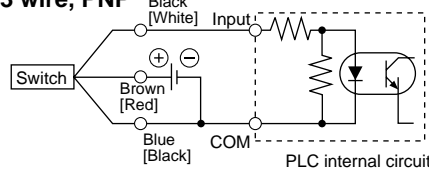


2 wire

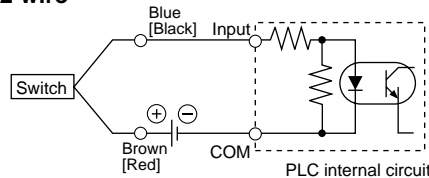


Specification for source input

3 wire, PNP



2 wire

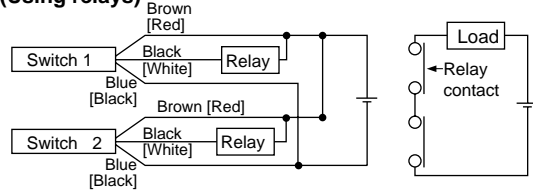


Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

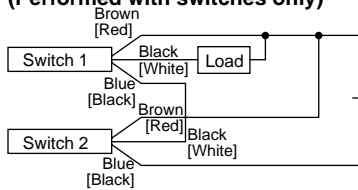
Connection Examples for AND (Series) and OR (Parallel)

3 wire

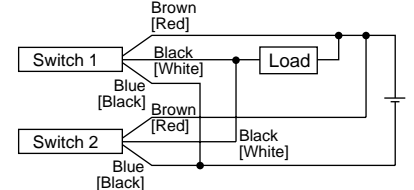
AND connection for NPN output (Using relays)



AND connection for NPN output (Performed with switches only)

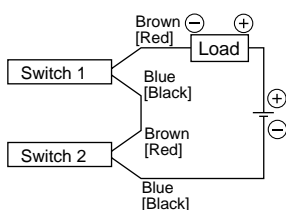


OR connection for NPN output



The indicator lights will light up when both switches are turned ON.

2 wire with 2 switch AND connection

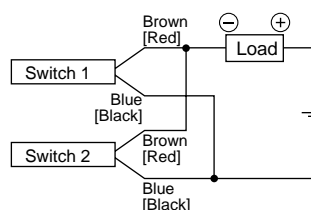


When two switches are connected in series, a load may malfunction because the load voltage will decline when in the ON state. The indicator lights will light up if both of the switches are in the ON state.

$$\begin{aligned} \text{Load voltage at ON} &= \text{Power supply voltage} - \text{Residual voltage} \times 2 \text{ pcs.} \\ &= 24\text{V} - 4\text{V} \times 2 \text{ pcs.} \\ &= 16\text{V} \end{aligned}$$

Example: Power supply is 24VDC
Voltage decline in switch is 4V

2 wire with 2 switch OR connection



<Solid state>
When two switches are connected in parallel, malfunction may occur because the load voltage will increase when in the OFF state.

<Reed switch>
Because there is no current leakage, the load voltage will not increase when turned OFF, but due to the number of switches in the ON state, the indicator lights will sometimes get dark or not light up, because of dispersion and reduction of the current flowing to the switches.

$$\begin{aligned} \text{Load voltage at OFF} &= \text{leakage current} \times 2 \text{ pcs.} \times \text{load impedance} \\ &= 1\text{mA} \times 2 \text{ pcs.} \times 3\text{k}\Omega \\ &= 6\text{V} \end{aligned}$$

Example: Load impedance is 3kΩ
Leakage current from switch is 1mA

Series CE Related Products

Scale Cylinder with Brake/CE2 Controller/CEU2

ø40, ø50, ø63, ø80, ø100

A cylinder capable of highly reproducible positioning (stopping accuracy of $\pm 0.5\text{mm}$) has been created by adding a brake mechanism to a scale cylinder which can measure stroke length.

Brake mechanism

Excellent safety

Secure locking is possible even when power is OFF and compressed air is stopped.

Long life

A special friction material is used in the brake shoe, eliminating piston rod damage and extending life.

Simple maintenance

Disassembly for maintenance is simple, and manual unlocking can also be easily performed.

Employs a combination spring & air pressure locking system

When there is a drop in air pressure, the work piece is held by a spring lock.

Can lock in both directions

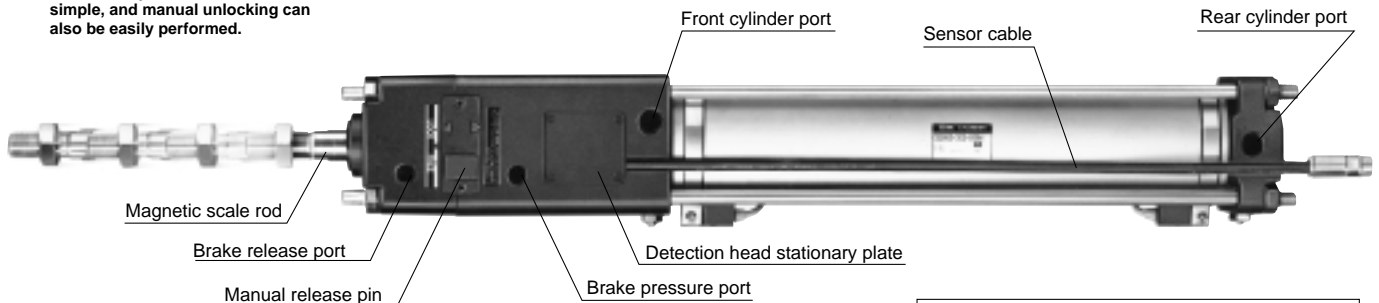
Locking is possible on either of the cylinder's reciprocating strokes.

System configuration

For safety measures

Scale cylinder with brake + Counter (prevents dropping from raised positions during intermediate stops)

- Ideal for simple positioning systems
- Ideal for systems requiring safety when performing measurements

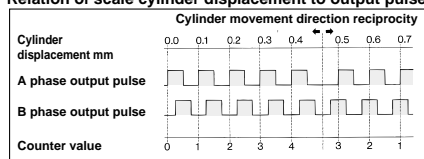


Measurement function

Minimum unit of measure: 0.1mm

Measurement is performed by a scale rod and a built-in detection head.

Relation of scale cylinder displacement to output pulse

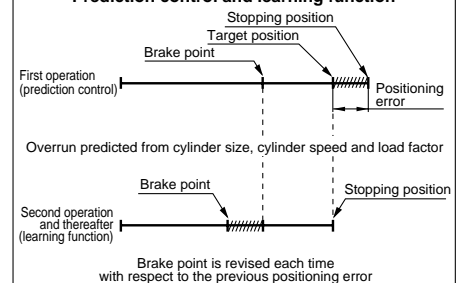


For precision positioning (stopping accuracy $\pm 0.5\text{mm}$)

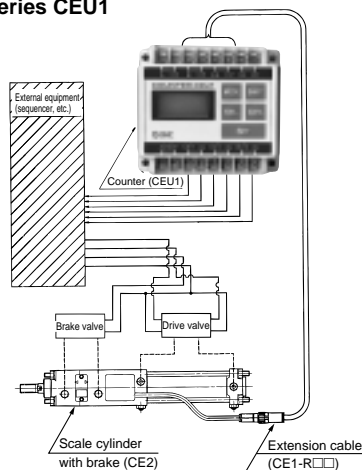
Scale cylinder with brake + Controller

- Highly reproducible positioning is realized through prediction control and a learning function.
- The stopping position is revised automatically by means of a "retry" function.

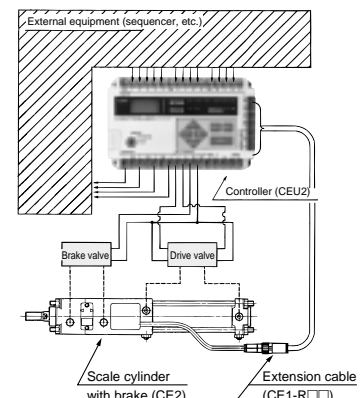
Prediction control and learning function



3 point preset counter Series CEU1



Controller Series CEU2



Series CE Related Products

Rodless Scale Cylinder with Brake/ML2B

A cylinder capable of highly reproducible positioning (stopping accuracy of $\pm 0.5\text{mm}$) has been achieved by adding a brake mechanism and stroke sensor to a mechanically jointed rodless cylinder.

Brake mechanism

Employs a combination spring and air pressure locking system

When there is a drop in air pressure or air compression is stopped, the slider is held by a spring lock.

The brake mechanism keeps a load from being applied to the cylinder section

The slider can be stopped without harming cylinder performance, because a load is not applied to the cylinder section. This is achieved by a structure in which the spring force acts directly on the brake shoe, pressing the brake plate on the right and left.

Can lock in both directions

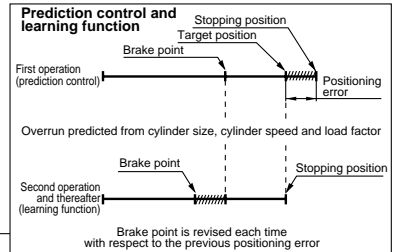
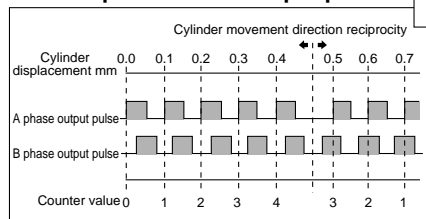
Locking is possible on either of the cylinder's reciprocating strokes.

Measurement function

Resolution: 0.1 (accuracy $\pm 0.2\text{mm}$)

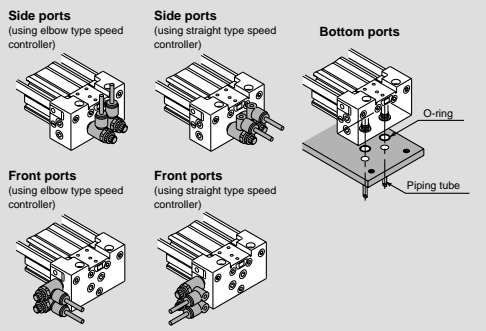
Measurement is performed by a scale plate and a built-in detection head.

Relation of scale cylinder displacement to output pulse



Rodless cylinder

Highly flexible port variations Concentrated port type (air drive)



Maintenance

The brake mechanism can be disassembled and replaced as a unit. In addition, manual release is possible.

A mechanism to prevent the entrance of dust

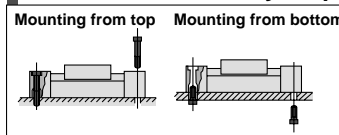
A special lip shaped side scraper is installed on the bottom of the moving element to prevent the entrance of dust.

Stroke adjustment unit combines a shock absorber and stopper bolt

The stroke is adjustable. The shock absorber is a non-adjustable energy absorbing part.

Auto switches have a space saving design which allows them to be contained inside the main body

Excellent mountability & space savings





Series CE Safety Instructions

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by a label of "**Caution**", "**Warning**" or "**Danger**". To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

⚠ Caution : Operator error could result in injury or equipment damage.

⚠ Warning : Operator error could result in serious injury or loss of life.

⚠ Danger : In extreme conditions, there is a possible result of serious injury or loss of life.

Note 1) ISO 4414: Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems.

Note 2) JIS B 8370: Pneumatic system axiom.

⚠ Warning

1 The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.

Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

2 Only trained personnel should operate pneumatically operated machinery and equipment.

Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

3 Do not service machinery/equipment or attempt to remove components until safety is confirmed.

1. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for this equipment and exhaust all residual compressed air in the system.
3. Before machinery/equipment is restarted, take measures to prevent shooting-out of cylinder piston rod, etc. (Bleed air into the system gradually to create back-pressure.)

4 Contact SMC if the product is to be used in any of the following conditions:

1. Conditions and environments beyond the given specifications, or if product is used outdoors.
2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverages, recreation equipment, emergency stop circuits, press applications, or safety equipment.
3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.



Series CE Actuator Precautions 1

Be sure to read before handling.

Precautions on design

Warning

1. **There is a possibility of dangerous sudden action by air cylinders if sliding parts of machinery are twisted due to external forces, etc.**

In such cases, human injury may occur; e.g., by catching hands or feet in the machinery, or damage to the machinery itself may occur. Therefore, the machine should be designed to avoid such dangers.

2. **A protective cover is recommended to minimize the risk of personal injury.**

If a stationary object and moving parts of a cylinder are in close proximity, personal injury may occur. Design the structure to avoid contact with the human body.

3. **Securely tighten all stationary parts and connected parts so that they will not become loose.**

When a cylinder operates with high frequency or a cylinder is installed where there is a lot of vibration, ensure that all parts remain secure.

4. **A deceleration circuit or shock absorber, etc., may be required.**

When a driven object is operated at high speed or the load is heavy, a cylinder's cushion will not be sufficient to absorb the impact. Install a deceleration circuit to reduce the speed before cushioning, or install an external shock absorber to relieve the impact. In this case, the rigidity of the machinery should also be examined.

5. **Consider a possible drop in operating pressure due to a power outage, etc.**

When a cylinder is used in a clamping mechanism, there is a danger of work dropping if there is a decrease in clamping force due to a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and human injury. Suspension mechanisms and lifting devices also require consideration for drop prevention.

6. **Consider a possible loss of power source.**

Measures should be taken to protect against human injury and equipment damage in the event that there is a loss of power to equipment controlled by air pressure, electricity or hydraulics, etc.

7. **Design circuitry to prevent sudden lurching of driven objects.**

When a cylinder is driven by an exhaust center type directional control valve or when starting up after residual pressure is exhausted from the circuit, etc., the piston and its driven object will lurch at high speed if pressure is applied to one side of the cylinder because of the absence of air pressure inside the cylinder. Therefore, equipment should be selected and circuits designed to prevent sudden lurching, because there is a danger of human injury and/or damage to equipment when this occurs.

8. **Consider emergency stops.**

Design so that human injury and/or damage to machinery and equipment will not be caused when machinery is stopped by a safety device under abnormal conditions, a power outage or a manual emergency stop.

9. **Consider the action when operation is restarted after an emergency stop or abnormal stop.**

Design the machinery so that human injury or equipment damage will not occur upon restart of operation. When the cylinder has to be reset at the starting position, install manual safety equipment.

Selection

Warning

1. **Check the specifications.**

The products advertised in this catalog are designed according to use in industrial compressed air systems. If the products are used in conditions where pressure, temperature, etc., are out of specification, damage and/or malfunction may be caused. Do not use in these conditions.

Consult SMC if you use a fluid other than compressed air.

2. **Intermediate stops.**

When intermediate stopping of a cylinder piston is performed with a 3 position closed center type directional control valve, it is difficult to achieve stopping positions as accurate and minute as with hydraulic pressure, due to the compressibility of air.

Furthermore, since valves and cylinders, etc. are not guaranteed for zero air leakage, it may not be possible to hold a stopped position for an extended period of time. Contact SMC in case it is necessary to hold a stopped position for an extended period.

Caution

1. **Use a speed controller to adjust the cylinder drive speed, gradually increasing from a low speed to the desired speed setting.**

Mounting

Caution

1. **Do not apply strong impact or large moment, etc. when mounting a work piece.**

An external force greater than the allowable moment can cause rattling in the guide unit and increased sliding resistance, etc.

2. **Do not use in applications subject to the effect of a large external force or impact force, etc.**

This can cause failure.

3. **Do not use until you verify that the equipment can operate properly.**

After mounting, repair or modification, etc., connect the air supply and electric power, and then confirm proper mounting by means of appropriate function and leak inspections.

4. **Instruction manual.**

The product should be mounted and operated after thoroughly reading the manual and understanding its contents.

Keep the instruction manual where it can be referred to as needed.

Piping

Caution

1. **Preparation before piping.**

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove cutting chips, cutting oil and other debris from inside the pipe.



Series CE Actuator Precautions 2

Be sure to read before handling.

Lubrication

⚠ Caution

1. Lubrication of non-lube type cylinder.

The cylinder is lubricated at the factory and can be used without any further lubrication.

However, in the event that it will be lubricated, use turbine oil class 1 (with no additives) ISO VG32.

Stopping lubrication later may lead to malfunction due to the loss of the original lubricant. Therefore, lubrication must be continued once it has been started.

Air Supply

⚠ Warning

1. Use clean air.

If compressed air includes chemicals, synthetic oils containing organic solvents, salt or corrosive gases, etc., it can cause damage or malfunction.

⚠ Caution

1. Install air filters.

Install air filters at the upstream side of valves. The filtration degree should be 5µm or less.

2. Install an air dryer, after cooler, etc.

Air that includes much condensate causes malfunction of valves and other pneumatic equipment. To prevent this, install an air dryer, after cooler, etc.

3. Use the product within the specified range of fluid and ambient temperature.

Take measures to prevent freezing, since moisture in circuits will be frozen under -5°C, and this may cause damage to seals and lead to malfunction.

Refer to the "Air Cleaning Equipment" catalog for details on compressed air quality.

Operating Environment

⚠ Warning

1. Do not use in environments where there is a danger of corrosion.

Refer to the construction drawings regarding cylinder materials.

2. In dirty areas, such as dusty locations or where water, oil, etc. splash on the equipment, take suitable measures to protect the entire actuator.

3. When using auto switches, do not operate in an environment with strong magnetic fields.

⚠ Caution

1. Do not use in an environment where fluids such as cutting oil will come into direct contact with the actuator.

Operation in environments where fluids such as cutting oil, coolant or oil mist come into contact with the actuator body can cause rattling, increased sliding resistance and air leaks, etc.

Operating Environment

⚠ Caution

2. Do not operate in an environment where particulate matter, dust, cutting chips or spatter, etc. come into direct contact with the actuator.

This can cause rattling, increased sliding resistance and air leaks, etc.

Contact SMC regarding applications in this kind of environment.

3. Provide shading in locations which receive direct sunlight.

4. Block off any nearby heat sources.

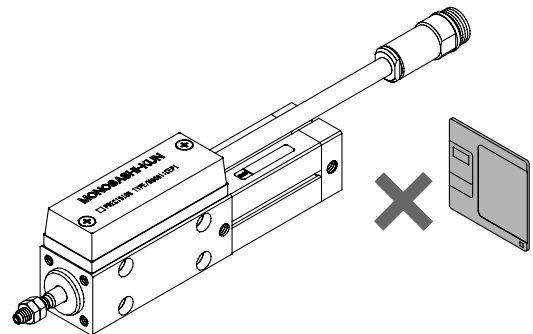
When heat sources are present in the vicinity, it is possible for radiated heat to raise the product's temperature beyond its operating temperature range. In this case, a cover, etc. should be provided to block the heat.

5. Do not operate in locations where vibration or impact occur.

Since this can cause damage or malfunction, etc., contact SMC regarding applications in this kind of environment.

6. Do not allow items influenced by magnetism near the actuator.

Since magnets are built into the cylinder, items such as magnetic disks, magnetic cards or magnetic tapes should not be allowed nearby, as data may be destroyed.



Maintenance

⚠ Warning

1. Maintenance should be done according to the procedure indicated in the operating manual.

If handled improperly, malfunction and damage of machinery or equipment may occur.

2. Machine maintenance, and supply and exhaust of compressed air.

When machinery is serviced, first check measures to prevent dropping of driven objects and run-away of equipment, etc. Then cut off the supply pressure and electric power, and exhaust all compressed air from the system.

When machinery is restarted, check that operation is normal with actuators in the proper positions.

⚠ Caution

1. Drain flushing.

Remove condensate from air filters regularly.
(Refer to specifications.)



Series CE Auto Switch Precautions 1

Be sure to read before handling.

Design & Selection

Warning

1. Confirm the specifications.

Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications for current load, voltage, temperature or impact.

2. Take precautions when multiple cylinders are used close together.

When multiple auto switch cylinders are used in close proximity, magnetic field interference may cause the switches to malfunction. Maintain a minimum cylinder separation of 40mm.

3. Pay attention to the length of time that a switch is ON at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too great the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$V(\text{mm/s}) = \frac{\text{Auto switch operating range (mm)}}{\text{Time load applied (ms)}} \times 1000$$

4. Wiring should be kept as short as possible.

<Reed switch>

As the length of the wiring to a load gets longer, the rush current at switching ON becomes greater, and this may shorten the product's life. (The switch will stay ON all the time.)

- 1) For an auto switch without a contact protection circuit, use a contact protection box when the wire length is 5m or longer.
- 2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please contact SMC in this case.

<Solid state switch>

- 3) Although wire length should not affect switch function, use a wire 100m or shorter.

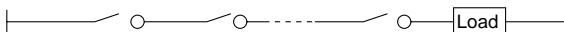
5. Take precautions for the internal voltage drop of the switch.

<Reed switch>

- 1) Switches with an indicator light (Except D-A76H, A96, A96V)
 - If auto switches are connected in series as shown below, take note that there will be a large voltage drop because of internal resistance in the light emitting diode. (Refer to internal voltage drop in the auto switch specifications.)

[The voltage drop will be "n" times larger when "n" auto switches are connected.]

Even though an auto switch operates normally, the load may not operate.



Warning

- In the same way, when operating under a specified voltage, although an auto switch may operate normally, the load may not operate. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\text{Supply voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load}$$

- 2) If the internal resistance of a light emitting diode causes a problem, select a switch without an indicator lamp (Model D-A80, A80H, A90, A90V).

<Solid state switch>

- 3) Generally, the internal voltage drop will be greater with a 2 wire solid state auto switch than with a reed switch. Take the same precautions as in 1).

Also, note that a 12VDC relay is not applicable.

6. Pay attention to leakage current.

<Solid state switch>

With a 2 wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

$$\text{Operating current of load (OFF condition)} > \text{Leakage current}$$

If the criteria given in the above formula are not met, it will not reset correctly (stays ON). Use a 3 wire switch if this specification will not be satisfied.

Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

7. Do not use a load that generates surge voltage.

<Reed switch>

If driving a load such as a relay that generates a surge voltage, use a switch with a built-in contact protection circuit or use a contact protection box.

<Solid state switch>

Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if the surge is applied repeatedly. When a load, such as a relay or solenoid, which generates surge is directly driven, use a type of switch with a built-in surge absorbing element.

8. Cautions for use in an interlock circuit.

When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch. Also perform periodic maintenance and confirm proper operation.

9. Ensure sufficient clearance for maintenance activities.

When designing an application, be sure to allow sufficient clearance for maintenance and inspections.



Series CE Auto Switch Precautions 2

Be sure to read before handling.

Mounting & Adjustment

Warning

1. Do not drop or bump.

Do not drop, bump or apply excessive impacts (300m/s² or more for reed switches and 1000m/s² or more for solid state switches) while handling.

Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

2. Do not carry a cylinder by the auto switch lead wires.

Never carry a cylinder by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

3. Mount switches using the proper fastening torque.

When a switch is tightened beyond the range of fastening torque, the mounting screws, mounting bracket or switch may be damaged. On the other hand, tightening below the range of fastening torque may allow the switch to slip out of position.

4. Mount a switch at the center of the operating range.

Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is ON).

(The mounting position shown in a catalog indicates the optimum position at stroke end.) If mounted at the end of the operating range (around the borderline of ON and OFF), operation will be unstable.

Wiring

Warning

1. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from applying bending stress or stretching force to the lead wires.

2. Be sure to connect the load before power is applied.

<2 wire type>

If the power is turned ON when an auto switch is not connected to a load, the switch will be instantly damaged because of excess current.

3. Confirm proper insulation of wiring.

Be certain that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.). Damage may occur due to excess current flow into a switch.

4. Do not wire with power lines or high voltage lines.

Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits, including auto switches, may malfunction due to noise from these other lines.

5. Do not allow short circuit of loads.

<Reed switch>

If the power is turned ON with a load in a short-circuited condition, the switch will be instantly damaged because of excess current flow into the switch.

Wiring

Warning

<Solid state switch>

Model D-F9□(V), F9□W(V) and all models of PNP output type switches do not have built-in short circuit prevention circuits. If loads are short circuited, the switches will be instantly damaged. Take special care to avoid reverse wiring with the brown (red) power supply line and the black (white) output line on 3 wire type switches.

6. Avoid incorrect wiring.

<Reed switch>

A 24VDC switch with indicator light has polarity. The brown lead wire or terminal No. 1 is (+), and the blue lead wire or terminal No. 2 is (-).

- 1) If connections are reversed, a switch will operate, however, the light emitting diode will not light up.

Also note that a current greater than that specified will damage a light emitting diode and it will no longer operate.

Applicable models: D-A73, A73H, D-A93, A93V

- 2) Note however, that in the case of 2 color indicator type auto switches (D-A79W), if the wiring is reversed, the switch will be in a normally ON condition.

<Solid state switch>

- 1) If connections are reversed on a 2 wire type switch, the switch will not be damaged if protected by a protection circuit, but the switch will always stay in an ON state. However, it is still necessary to avoid reversed connections, since the switch could be damaged by a load short circuit in this condition.
- 2) If connections are reversed (power supply line + and power supply line -) on a 3 wire type switch, the switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue (black) wire and the power supply line (-) is connected to the black (white) wire, the switch will be damaged.

* Lead wire color changes

Lead wire colors of SMC switches and related products have been changed in order to meet NECA (Nippon Electric Control Equipment Industries Association) Standard 0402 for production beginning September, 1996 and thereafter. Please refer to the tables provided.

Special care should be taken regarding wire polarity during the time that the old colors still coexist with the new colors.

2 wire

	Old	New
Output (+)	Red	Brown
Output (-)	Black	Blue

3 wire

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black

Solid state switch with diagnostic output

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black
Diagnostic Output	Yellow	Orange

Solid state switch with latch type diagnostic output

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black
Latch type diagnostic Output	Yellow	Orange



Series CE Auto Switch Precautions 3

Be sure to read before handling.

Operating Environment

⚠ Warning

1. Never use in an atmosphere of explosive gases.

The structure of auto switches is not intended to prevent explosion. Never use in an atmosphere with an explosive gas since this may cause a serious explosion.

2. Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside cylinders will become demagnetized. (Consult SMC regarding the availability of a magnetic field resistant auto switch.)

3. Do not use in an environment where the auto switch will be continually exposed to water.

Although switches, except for a few models, satisfy IEC standard IP67 construction (JIS C 0920: watertight construction), do not use switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside switches may cause malfunction.

4. Do not use in an environment with oil or chemicals.

Consult SMC if auto switches will be used in an environment with coolant, cleaning solvent, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by improper insulation, malfunction due to swelling of the potting resin, or hardening of the lead wires.

5. Do not use in an environment with temperature cycles.

Consult SMC if switches are used where there are temperature cycles other than normal temperature changes, as they may be adversely affected.

6. Do not use in an environment where there is excessive impact.

<Reed switch>

When excessive impact (300m/s² or more) is applied to a reed switch during operation, the contact point will malfunction and generate or cut off a signal momentarily (1ms or less). Consult SMC regarding the need to use a solid state switch depending upon the environment.

7. Do not use in an area where surges are generated.

<Solid state switch>

When there are units (solenoid type lifter, high frequency induction furnace, motor, etc.) which generate a large amount of surge in the area around cylinders with solid state auto switches, this may cause deterioration or damage to the switch. Avoid sources of surge generation and disorganized lines.

8. Avoid accumulation of iron powder or close contact with magnetic substances.

When a large amount of ferrous powder such as machining chips or spatter is accumulated, or a magnetic substance (something attracted by a magnet) is brought into close proximity with an auto switch cylinder, it may cause the auto switch to malfunction due to a loss of the magnetic force inside the cylinder.

Maintenance

⚠ Warning

1. Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.

- 1) Secure and tighten switch mounting screws.

If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.

- 2) Confirm that there is no damage to lead wires.

To prevent faulty insulation, replace switches or repair lead wires, etc., if damage is discovered.

- 3) Confirm the lighting of the green light on the 2 color indicator type switch.

Confirm that the green LED is on when stopped at the established position. If the red LED is on, the mounting position is not appropriate. Readjust the mounting position until the green LED lights up.

Other

⚠ Warning

1. Consult SMC concerning water resistance, elasticity of lead wires, and usage at welding sites, etc.



Series CE / Specific Product Precautions

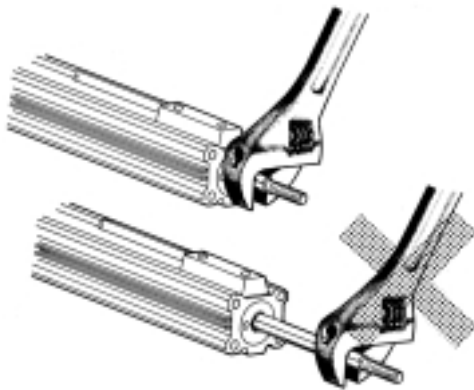
Be sure to read before handling. Refer to pages 36 through 41 for safety precautions, actuator precautions and auto switch precautions.

Mounting

Caution

- When screwing a nut or fitting, etc. onto the threaded section at the end of the piston rod, return the piston rod to its fully retracted position, and grasp the exposed portion of the rod across two parallel sides with a wrench. In the case of the high precision scale cylinder, there are no parallel sides. Secure the work piece with a double nut.

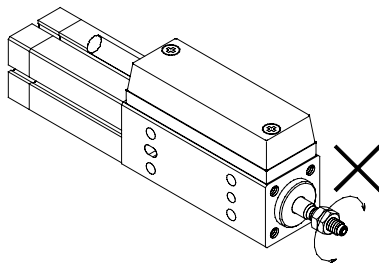
Note) Do not apply rotational torque to the piston rod.



- The load on the piston rod should normally be applied in an axial direction.
 - In case a load is applied that is not in the axial direction of the cylinder, the load itself should be controlled with a guide.
 - When mounting the cylinder, it should be carefully aligned.

- Applications which apply rotational torque to the piston rod should be avoided.

- Be careful to avoid scratches or dents, etc. on the sliding sections of the piston rod.



Sensor Unit

Caution

- The sensor unit is adjusted to the proper position at the time of shipment. Therefore, the sensor unit should not be removed from the body under any circumstances.
- The cylinder should be protected from contact with liquids such as coolants or coolant water. (CE1)
- The sensor cable should not be pulled with a strong force.
- Since the scale cylinder sensor uses a magnetic system, malfunction may occur if there is a strong magnetic field near the sensor.

The cylinder can be used in an external magnetic field of 145 gauss or less.

This is equivalent to a magnetic field from a welding unit using a welding current of about 15,000 amperes, at a radius of approximately 18cm. When operating in a magnetic field greater than this, the sensor unit should be shielded with a magnetic material.

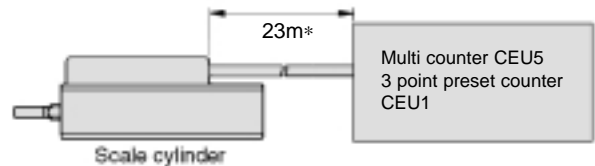
- Switches or relays, etc. should not be installed in the power supply line (12 to 24VDC).

Effects of Noise

Caution

When the scale cylinder is used near a motor, welding machine or other source of noise generation, there is a possibility of miscounting. In this case, noise should be suppressed as much as possible and the following countermeasures should be taken.

- Connect the shield wire to FG (frame ground).
- The maximum transmission distance for the scale cylinder is 23m, but since the output signal is a pulse output, the sensor cable should be wired separately from other power lines.

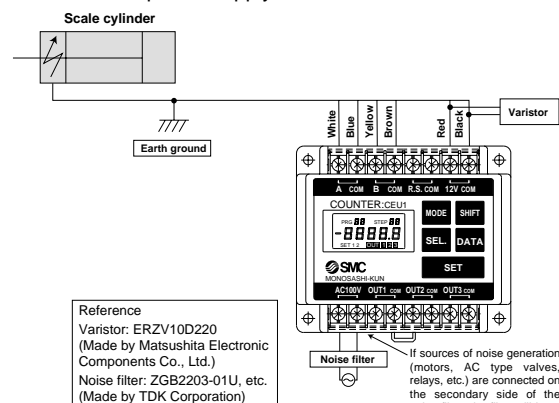


* When using SMC extension cable and counter.

Noise Countermeasures for the Scale Cylinder

Methods of dealing with noise are given below.

- Connect only the shield wire to FG (frame ground).
- Use a power source separate from large motors and AC type valves, etc.
- Run the scale cylinder's cable away from other power lines.
- Install a noise filter in the 100VAC power line, and install a varistor in the DC power supply of the sensor cable.



If sources of noise generation (motors, AC type valves, relays, etc.) are connected on the secondary side of the noise filter, the filter will have no effect.

<Counting speed of counter>

When the speed of the scale cylinder is greater than the counting speed of the counter, the counter will miscount.

For the CE1 (when measuring to 0.1mm), a counter should be used with a counting speed of 10kHz (kcps) or more, and for the CEP1 (when measuring to 0.01mm) using 4 times input, a counter should be used with a counting speed of 50kHz (kcps) or more.

<Malfunction due to lurching and bounding>

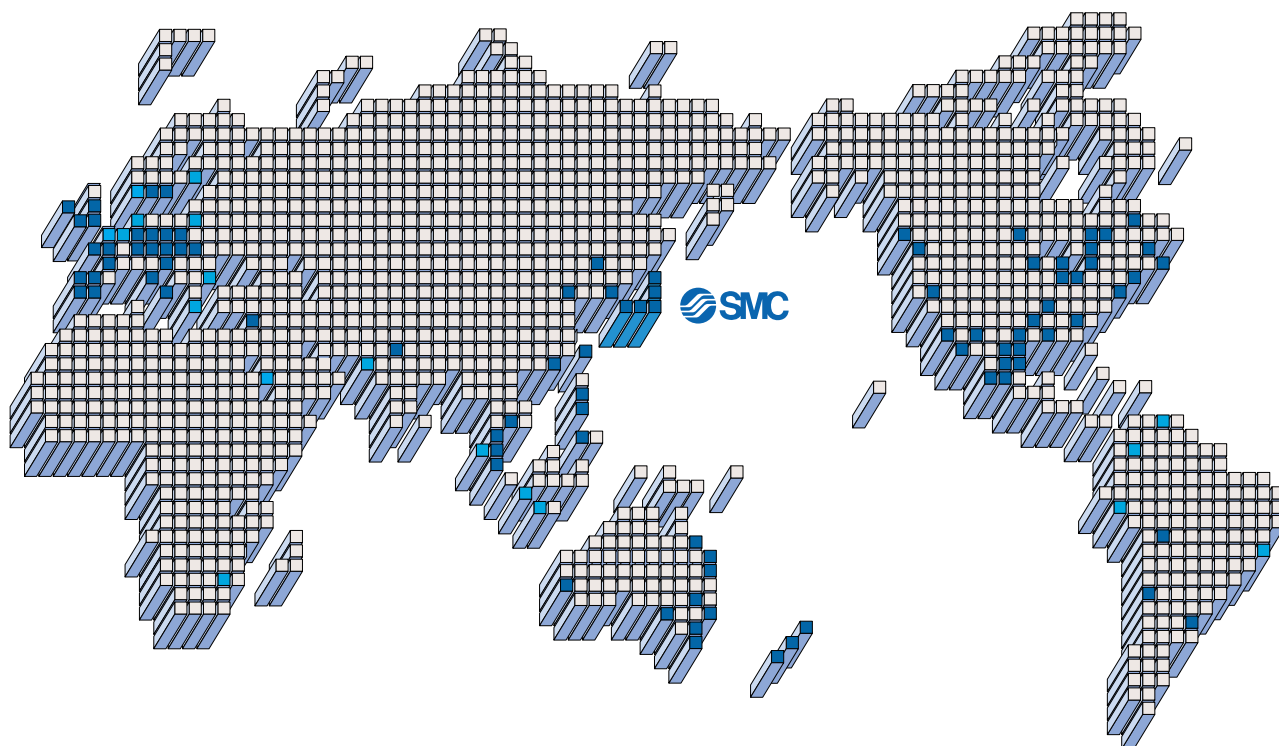
When lurching or bounding occurs at the beginning or end of strokes, or due to other causes, the cylinder speed momentarily increases, and there is a possibility of exceeding the counting speed of the counter or the response speed of the sensor, thereby causing a miscount.

The product should be used under conditions such that lurching and bounding will not occur.

The instruction manuals should be read before using the Series CEP1 high precision scale cylinder, CEU5 multi counter, Series CE1 scale cylinder and CEU1 3 point preset counter.



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