



# Installation and Maintenance Manual CEP1 Precision Monosashi-kun (Scale Reading Cylinder)

For future reference, please keep this manual in a safe place

This manual should be read in conjunction with the leaflet Safety Instructions

## 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 label of "Caution", "Warning" or "Danger". To ensure safety, follow the below instructions as well as ISO4414 <sup>Note 1)</sup>, JIS B8370 <sup>Note 2)</sup>, and other safety instructions.

**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.

<sup>Note 1)</sup> ISO 4414. Pneumatic fluid power - recommendations for the application of equipment to transmission and control systems.

<sup>Note 2)</sup> JIS B8370. General rules for pneumatic systems

## WARNING

- 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. Ensuring the initial performance and safety are the responsibility of the person who decides the compatibility of pneumatic systems. Pneumatic systems should be constructed after full review on the details of the products other than specifications and possibilities of failures by checking the latest product information.
- Only trained personnel should operate pneumatically operated machinery and equipment. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.
- Do not service machinery/equipment or attempt to remove a component until safety is confirmed. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions. When equipment is to be removed, confirm the safety process as mentioned above. Isolate the supply pressure for this equipment and exhaust all residual compressed air in the system. Before machinery/equipment is re-started, take measures to prevent sudden movements of cylinder piston rod.
- Contact SMC and take necessary safety measures if the products are to be used in any of the following conditions: Conditions and environments beyond the given specifications, or if products are used outdoors. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

## Operating and storage environments

## WARNING

- Environments to avoid**  
Avoid using or storing the products in the following environments which may cause failures. If the products need to be used or stored in those environments, take necessary measures.
  - Where ambient temperature exceeds the range of 0°C to 60°C.
  - Where ambient humidity exceeds the range of 25% to 85% RH.
  - Where condensation occurs due to temperature change.
  - Where atmosphere contains corrosive gas, flammable gas or organic solvent.
  - Where atmosphere contains conductive powder such as dust and iron chips, oil mist, salt, or organic solvent, or splashing cutting chips, dust and cutting oil (water, liquid) over the products.
  - Where the products are exposed to direct sunlight or radiated heat.
  - Where strong electromagnetic noise is generated (or strong electric field, strong magnetic field or surge is generated).
  - Where static electricity is discharged or condition that the products have electrostatic discharge.

- Where strong high frequency is generated.
- Where damage due to weather is expected.
- Where vibration or impact is directly imparted to the products.

- Conditions that deform by force or weight application.

## 2. Do not install close to any products that can be affected by magnets.

Since magnets are built into the cylinder, do not install close to magnetic disks, magnetic cards or magnetic tapes. The data may be destroyed.

## Precautions on design

### WARNING

- There is a possibility of dangerous sudden action by cylinders if sliding parts of machinery are twisted due to external forces, etc. In such cases, injury may occur: e.g., by catching hands or feet in the machinery, or damage to the machinery itself may occur.
- Provide a cover to minimise the risk of injury. When a driven object or moving parts of a cylinder may cause the risk of injury, design a structure to avoid contact with operators.
- Securely tighten all stationary parts and connected parts of cylinders. Tighten cylinders securely especially when they are used in high frequency or in locations where direct vibration or impact shock, etc. will be applied to the body of the cylinder.
- Deceleration circuits or shock absorbers may be required in some cases. If a driven load travels at a high speed or is heavy, impact will not be sufficiently absorbed using the cylinder cushion. In such cases, use a circuit to decelerate the cylinder speed before the cushion becomes effective or use external shock absorbers to reduce impact. Ensure rigidity of machinery is taken into account.
- Consider possible pressure drop in a circuit due to power failure. For cylinders used in clamping mechanism, work may unclamp, due to loss of clamping force, due to a pressure drop in the circuit. Install safety devices to prevent injury and machinery damage. Measures should be taken to prevent drop of hanging or lifting equipment.
- Consider possible loss of power sources. Measures should be taken to protect against operator injury and machinery damage in the event that there is a loss of air pressure, electricity or hydraulic power.
- Design the circuit to prevent sudden movements of a driven object. A driven object is quickly shot out when pressure is supplied to one side of the piston after air in the cylinder is exhausted, especially if the cylinder is actuated by an exhaust centre type of directional control valve restarted after residual air is exhausted from the circuit. 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 and constructed to prevent sudden uncontrolled movements.
- Consider emergency stops. Design the machinery so that operator 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 failure or a manual emergency stop.
- Consider actions when operation is restarted after an emergency stop or abnormal stop. Design the machinery so that operator injury or equipment damage will not occur upon restarting the operation. When the cylinder is required to return to the initial position, provide the equipment with a safe override.

## Selection

### WARNING

- Confirm the specifications. The product in this manual is designed to be used only in industrial compressed air systems. The product should not be used with pressures or temperatures outside the range of the specifications, as this may cause damage or malfunction.
- Intermediate stop  
When cylinder piston is stopped intermediately by 3-position closed centre type of directional control valve, intermediate stop positions may not be as precise and exact as hydraulic operation due to compressibility of air. Valves and cylinders are not guaranteed for zero air leakage, and the stop position may not be held for a long period of time. Consult SMC for long term holding of stop positions.

### CAUTION

- Mount speed controller and adjust cylinder operating speed gradually from low speed to desired speed.

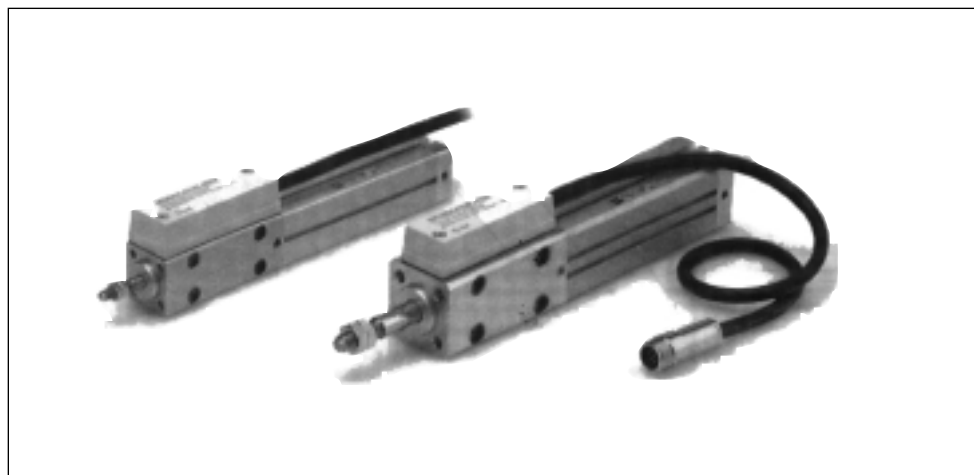


Fig 1

## Air supply

### WARNING

- Do not use the product out of the specified ranges for pressure and temperature to prevent equipment damage and malfunction.

- Operating pressure:  
ø12: 0.15 to 1.0 MPa  
ø20: 0.1 to 1.0 MPa
- Fluid and ambient temperature: 0 to 60°C

## 2. Use clean air

Do not use the product with compressed air includes chemicals, synthetic materials (including organic solvents), salinity, corrosive gases, etc., as this may cause damage or malfunction.

### CAUTION

#### 1. Install an air filter

Install an air filter before and in vicinity of the valve. The filter should be able to collect particles of 5 microns or smaller. A large quantity of drain may cause malfunction of pneumatic components.

#### 2. Install after cooler, air dryer, auto drain, etc.

## Installation

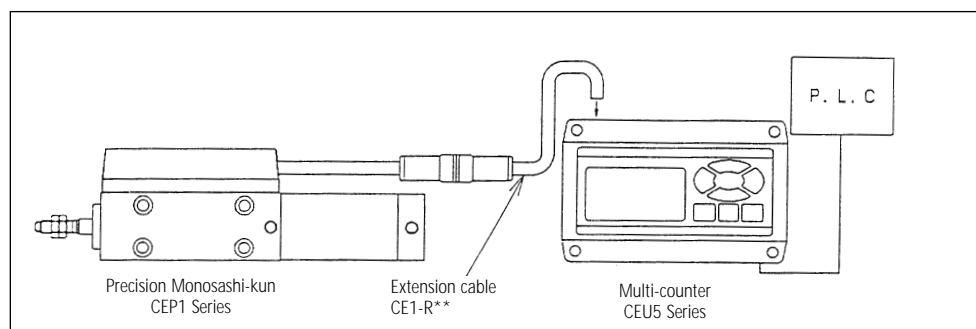


Fig 2

## System configuration (Fig 2)

The Monosashi-kun is a cylinder with a built-in linear encoder.

The scale, on the magnetic piston rod, and the magnetic sensor detect any change in the piston position, and a pulse is outputted via A/B quadrature pulse (90° nominal phase relationship). Position detection, in 0.01mm resolution is possible by inputting this signal into the multi-counter CEU5.

### WARNING

- Ensure all air and power supplies are ISOLATED before commencing installation.
- DO NOT install this product in an explosive atmosphere.
- Protect from oil/water splashes.
- Use the Monosashi-kun CEP1 with the multi-counter CEU5.

### CAUTION

- CEP1 was checked, together with the CEU5, using the SMC extension cable CE1-R\*\* using the maximum wire length of 23m. Exercise CAUTION if using other type counters and cables.
- When using the CEP1 with a connector it will be necessary to use extension cable CE1-R\*\*.
- CEP1 without the connector can be directly connected to the terminal block of the counter.
- If an extension cable is connected to the CEP1 without a connector, it will be necessary to mount a male connector on the cylinder side. Use a CE1-R\*C (see Fig 3).

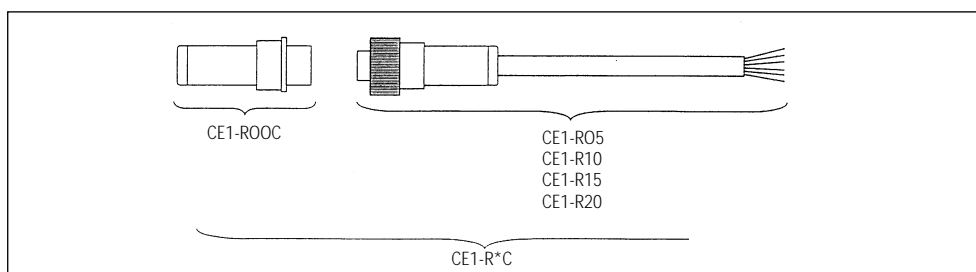


Fig 3

## Actuator specifications

Model	CEP1B12	CEP1B20
Action	Double acting, single rod (non-rotating piston rod)	
Fluid	Air	
Proof pressure	1.5MPa (15.3 kgf/cm <sup>2</sup> )	
Max. operating pressure	1.0MPa (10.2 kgf/cm <sup>2</sup> )	
Min. operating pressure	0.15MPa (1.5 kgf/cm <sup>2</sup> )	0.1MPa (1.0 kgf/cm <sup>2</sup> )
Operating piston speed	50~300mm/s	
Ambient and fluid temperature	0~60° (No freezing)	
Humidity	25~85% RH (No dew condensation)	
Lubrication	Non-lube	
Stroke tolerance range	0~+1.0	
Cushion	None	
Rod non-rotating accuracy	±2°	±3°
Mounting	Rod side tapping, rod cover through-hole	
Thread tolerance	JIS Class 2	

## Sensor specification

Cable	ø7, 6-core twisted pair shielding wire (Heat resistance, oil resistance, flameproof) (Connector...Tajimi Musen Denki)
Maximum wire length	23m <sup>Note 1)</sup>
Position detection method	Incremental encoder (rod with magnetic scale, magnetic sensor)
Magnetic field resistance	145 gauss
Power supply	12 VDC~24VDC (±10%) [Power ripple: 1% or less]
Current consumption	50mA
Resolution	0.01mm (at four times multiplier)
Accuracy (20°C)	±0.02mm <sup>Note 2)</sup>
Output type	NPN open collector (Max. 24VDC, 40 mA or less)
Output signal	A/B quadrature pulse (90° nominal phase relationship)
Insulation resistance	500VDC, 50MΩ or more (Case: Between 12E)
Vibration proof	33.3 Hz, 6.8G, two hours each in X and Y directions, four hours in Z direction, conforming to JIS D1601
Impact resistance	30G, three times each in X, Y and Z directions
Enclosure	IP-67 (IEC standard) <sup>Note 3)</sup>

Note 1: When SMC cable and SMC CEU5 counter are used.

Note 2: Including error due to digital indication at counter CEU5.

The overall measurement accuracy after being mounted to the equipment may vary depending on the mounting state and environment. When accuracy of the equipment as a whole is required, calibration should be performed by the end users.

Note 3: Waterproof for that with cylinder except connector part.

### CAUTION

The position sensor of the Monosashi-kun (scale reading cylinder) utilises a magnetic operating medium. Avoid installing the cylinder within strong magnetic fields.

When attaching a rod end and/or tightening the piston rod locknuts (use double lock nuts), ensure that a spanner is used to support the rod in the retracted position so as not to impart torque to the rod, as shown in Figs 4.

Ensure that loads are ALWAYS applied in the axial direction of the piston rod.

If a load is to be applied in any other direction, other than axial, a guiding system should be employed.

Avoid applications where continuous torque, or impact, is applied to the piston rod.

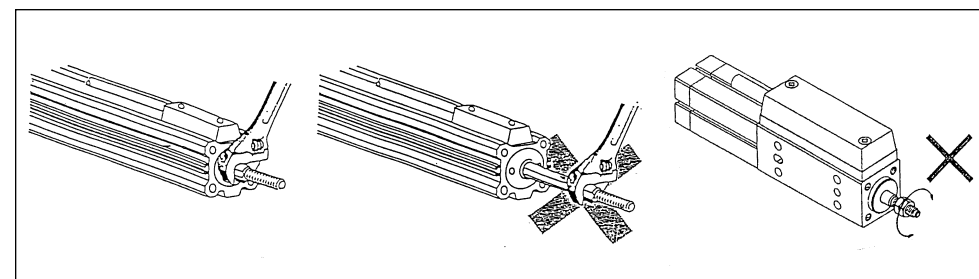


Fig 4

## Cable (Fig 5)

The cable shielding wire must be FG frame ground (earthed).

The maximum transmission distance of the Monosashi-kun is 23m.

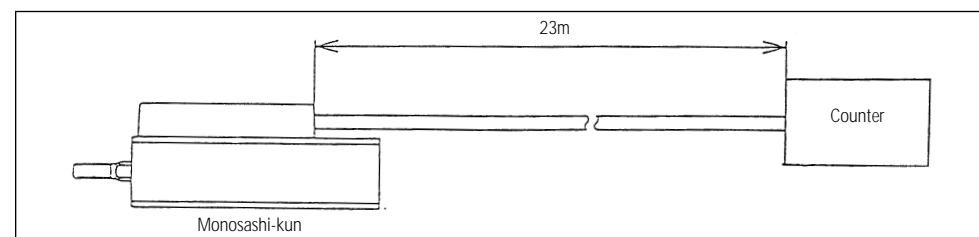


Fig 5

### CAUTION

#### Prevention of noise generation

- As the output signal is a pulsed signal, and to prevent noise generation, ensure that the signal cables are NOT installed in the same trunking as the power supply cables.
- Ensure that cables are fixed close to the terminals to avoid imparting excessive force to the connector.
- Use SMC Cable CE1-R\*\* for wiring of the Monosashi-kun and CEU5.
- Mount a ferrite core onto signal cables to counteract possible radiated noise effects of the cable.
- Install a noise filter to counteract noise effects of power cables.

### Electrical noise prevention (Fig 6)

Follow the instructions below to prevent any malfunction due to noise:

1. Use the SMC extension cable CE1-R\*\* when wiring the Monosashi-kun and CEU5.
2. Use a shielded cable of 5 metres or less when wiring the control input signals, output signals and serial transmissions.
3. Separate signal wires from power supply cables.
4. Use an independent power source for the CEU5 when using AC motors and solenoid valves.
5. Install a noise filter on the power input cable.
6. If using relays ensure they are kept at least 10cm away from the CEU5.

### WARNING

Please note that CE marking applies only to the following format:- CEP1\*\* + CEU5\*\*D i.e. both units coupled together.

Ferrite core: SFC-10 (Kitagawa Kogyo Co. Ltd.)

Impedance (Ω) 1 turn	
25MHZ	100MHZ
149	266

Note: Indicate by the mean value of the measured impedance.

All mounting positions of ferrite cores should be within 10cm from devices.

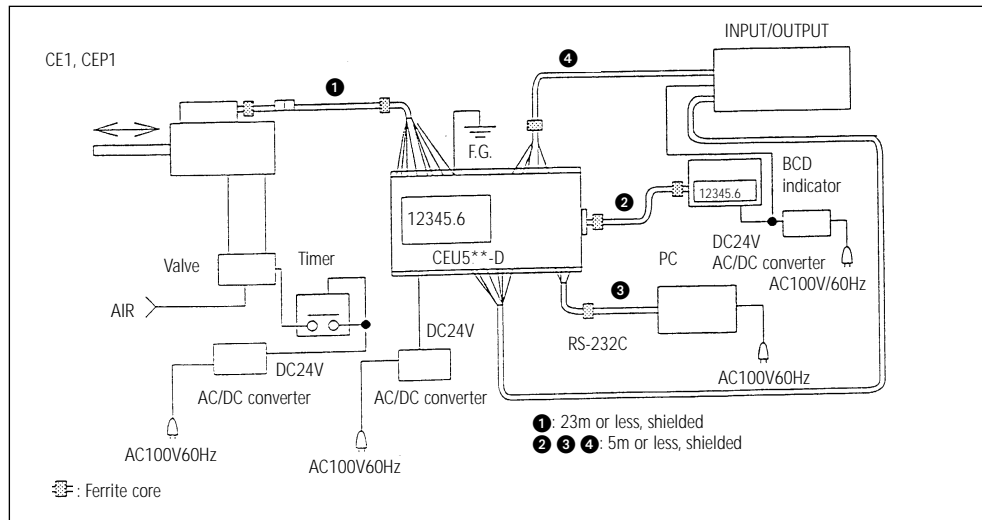


Fig 6

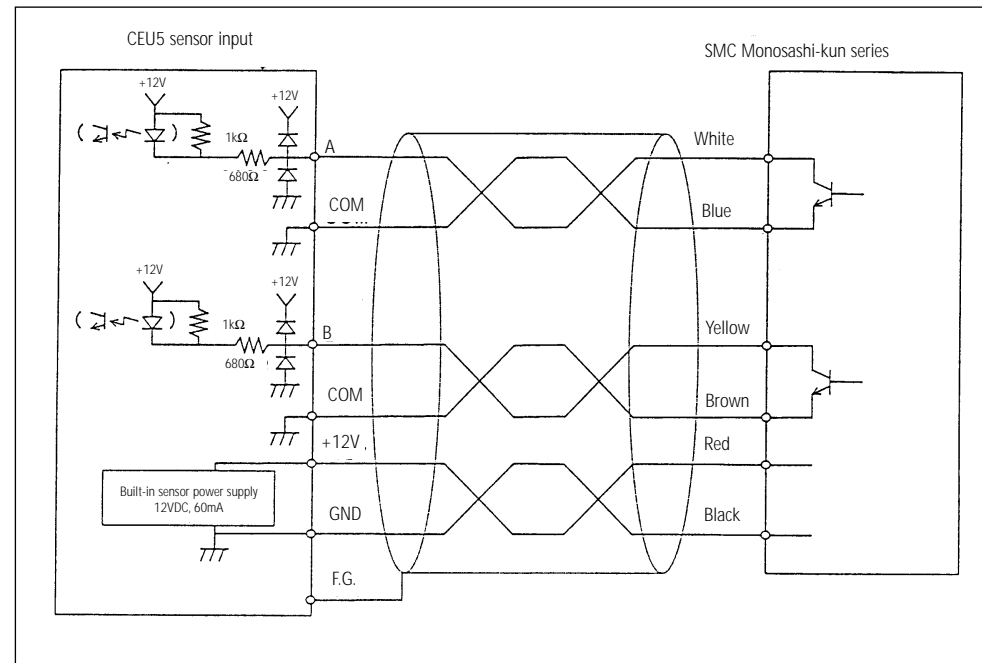
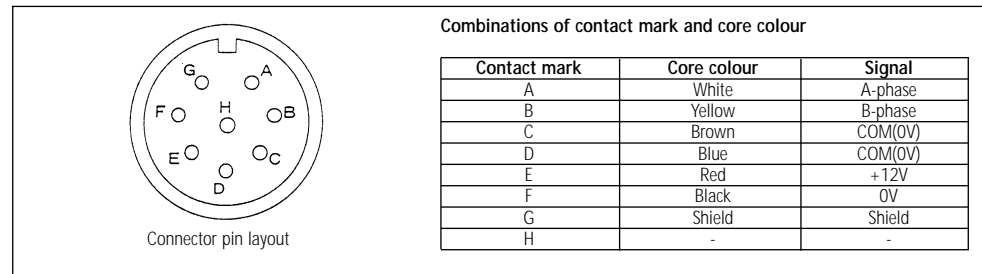


Fig 7

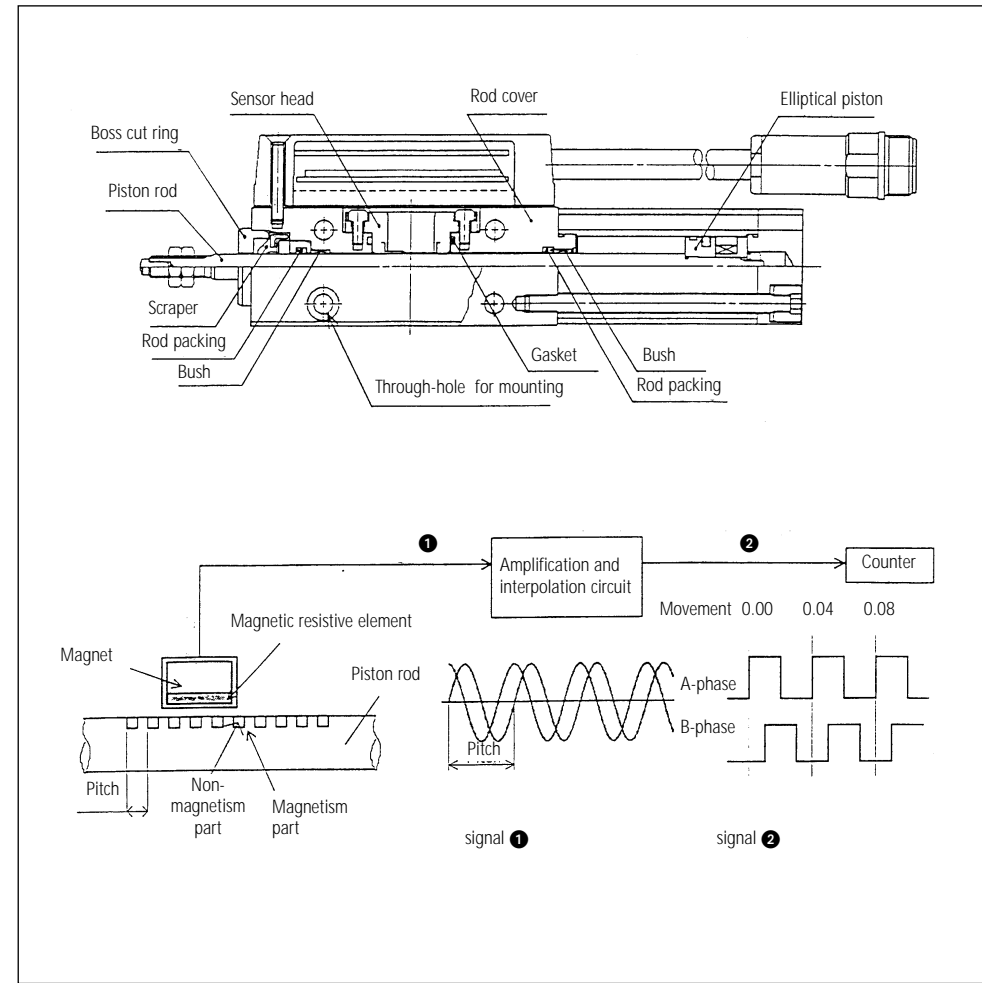


Fig 8

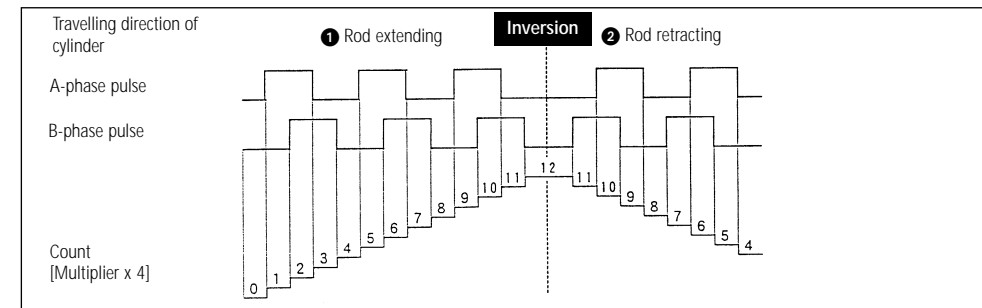


Fig 9

### Connector wiring table (Fig 6)

The table in Fig 6 shows the combinations of contact mark and wire colour. The connector pin layout shows the layout of the CEP1 with connector.

### Wiring for CEU5 (Fig 7)

### Input/Output

The input/output signals are wired using a 7 twisted pair of cables with shield and waterproof connector out of the sensor section.

### Measuring principle (Fig 8)

The precision Monosashi-kun is an air cylinder that has a function to output the piston stroke as a pulse signal in 0.01mm resolution (at 4 times multiplier).

- (1) The piston rod has a scale consisting of a magnetised layer and a non-magnetised layer at 0.8mm pitch.
- (2) The magnetic resistive element receives a 2 phase signal (Signal 1) of sin. and cos. via the piston rod movement. For this waveform, 1 pitch (0.8mm) is equal to one cycle.
- (3) This is amplified and divided into 1/20. As a result, a 90° phase difference pulse signal (Signal 2) is outputted, which is 0.04mm per pulse.
- (4) By counting this pulse, using a counter with a four-quadrant multiplier capability, the piston position can be detected in 0.01mm resolutions.

### Relationship between pulse and count (Fig 9)

### CEP1 output is an A/B quadrature pulse.

In the rod extending direction, A-phase turns on first, then B-phase turns on with the delay of approximately 90° phase difference. In the rod retracting direction, B-phase turns on first, the A-phase turns on with the delay of approximately 90° phase difference. The counter performs an addition in and a subtraction in. Note: When an addition is required in the rod retracting direction, switch the wiring of A-phase with B-phase.

### WARNING

1. Ensure that the Monosashi-kun is wired correctly as incorrect wiring may cause malfunction and damage.
2. Ensure that cables are fixed close to the terminals to avoid imparting excessive force to the connector.
3. Be sure to ground (earth) the terminal block (FG), ensuring that it is NOT grounded with devices that generate strong magnetic fields.
4. Ensure that the power and voltage levels conform to the specifications.
5. After wiring mount a protective cover over the terminal block.

### Maintenance

### WARNING

Ensure all air and power supplies are ISOLATED before commencing any maintenance work.

### CAUTION

Allow sufficient space around the installation to allow access. Carry out regular checks of the system to ensure that malfunctions are corrected as soon as possible.

### Sensor unit

DO NOT attempt to remove the sensor unit as the position and sensitivity of the sensor are pre-set at the factory and any removal or replacement will cause malfunction.

DO NOT attempt any modification to the sensor unit. DO NOT mount any switch or relay to the power supply line (12VDC to 24VDC). Before removing the Monosashi-kun ensure residual air is exhausted from the unit. Ensure safety measures are in place to prevent work pieces from "dropping" and any sudden cylinder movements are prevented.

### Lubrication

1. The cylinder is pre-lubricated and requires no additional lubrication.
2. If it is proposed to lubricate, use an equivalent of the following turbine oil type 1 ISO VG32.
3. Once lubrication is commenced it must be continued.

### Trouble shooting

### 1. Measuring function

Failure	Cause	Countermeasure
Does not count	Is the wiring disconnected, is it correct?	Check the wiring and connector for tightness
	Is 12VDC or 24VDC supplied to the sensor?	Supply the rated power (12VDC-24VDC) to the sensor. Power other than the rated may cause failure
	(When CEU5 is used). Is CEU5 in count mode?	Count values are indicated only in the count mode. Press the MODE key to change to the count mode
	(When other counter is used). Counter setting is wrong	If input mode switching is available with the counter, check the setting. Set the counter input to adding/subtraction mode, 2-phase input (90° phase difference input)
	Short-circuit of the sensor due to entering of liquid or moisture	Replacement of sensor unit is necessary if the circuit is corroded. In addition, take some countermeasures to prevent liquid or moisture from entering
Measured value does not have reproducibility	Sensor output circuit will short-circuit if it is improperly wired and a current larger than the rated is supplied	If it failed, repair will be necessary. Consult SMC or the shop
	Counting speed of the counter is slow or it does not meet the requirements of the input waveform. (Depending on counter, counting speed may slow down due to pulse rise speed and duty conditions)	CEU5 is recommended. When a counter from another company is used, check the requirements on specifications
	Wiring distance is too long and signal is attenuated. (When counter and cable from other supplier are used, wiring distance of 23m is not guaranteed)	If the wiring is longer than 23m, provide transducer of differential input-output
Measured value does not have reproducibility	Check for noise source such as large motor, AC type solenoid valve, relay, inverter power and others in the vicinity	Take appropriate measures by referring to "Countermeasures for Noise"
	Is cylinder speed out of the specified range? When cylinder speed is too fast, counting error may occur. Knocking or bouncing may also cause temporal high speed	Cylinder speed should be in the range of 50 mm/s to 300 mm/s. In addition, prevent knocking and bouncing
Measured value does not have reproducibility	Is torque applied to the piston rod? If the relative position of the sensor head and the scale is displaced, detection failure may be the result	Do not apply torque to the piston rod

### 2. Cylinder operation

Failure	Cause	Countermeasure
Cylinder does not operate	Is air piping correct?	Check the piping
	Is the orifice closed completely?	If the orifice is closed completely, open it gradually until it is adjusted properly
	Is torque applied to the piston rod? It causes malfunction due to torsion of elliptical piston and the sliding face	Do not apply torque to the piston rod. When operation returns to normal, repair will be required
Knocking occurs	Is cylinder speed within the specified range?	Cylinder speed should be in the range of 50 mm/s to 300 mm/s
	When connected to the guide and other equipment, are they centred completely?	Perform centring completely for the connection of other equipment and jigs
	Is torque applied to the piston rod? It causes malfunction due to torsion of elliptical piston and the sliding face	Do not apply torque to the piston rod
	Was lubrication once applied and stopped afterwards?	Use the product without lubrication. Once lubrication is performed, it should be continued since the initial grease flows out
Knocking occurs	Is the cylinder splashed with solvents and chemicals? Solvents and chemicals may make grease flow out and affect packing	Do not use in an environment where the product is splashed with solvents and chemical

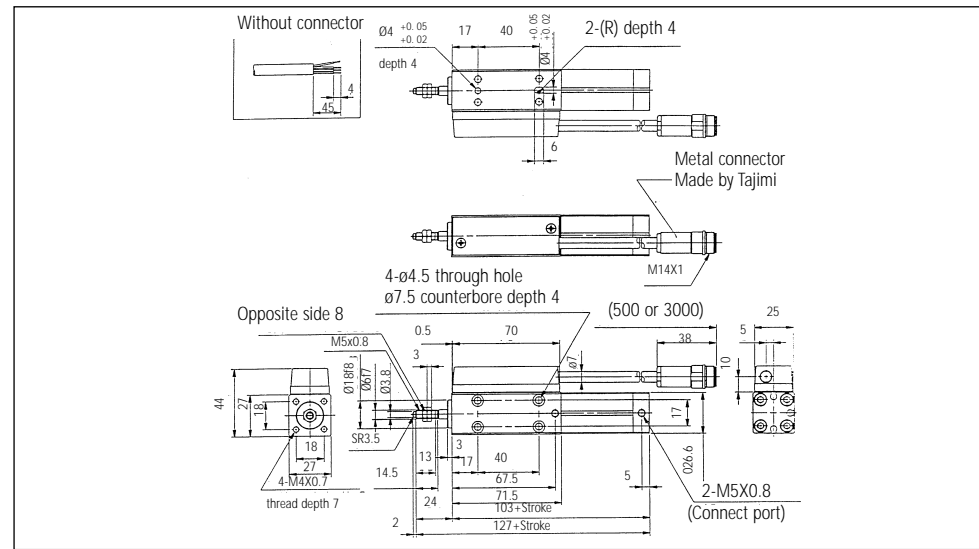


Fig 10

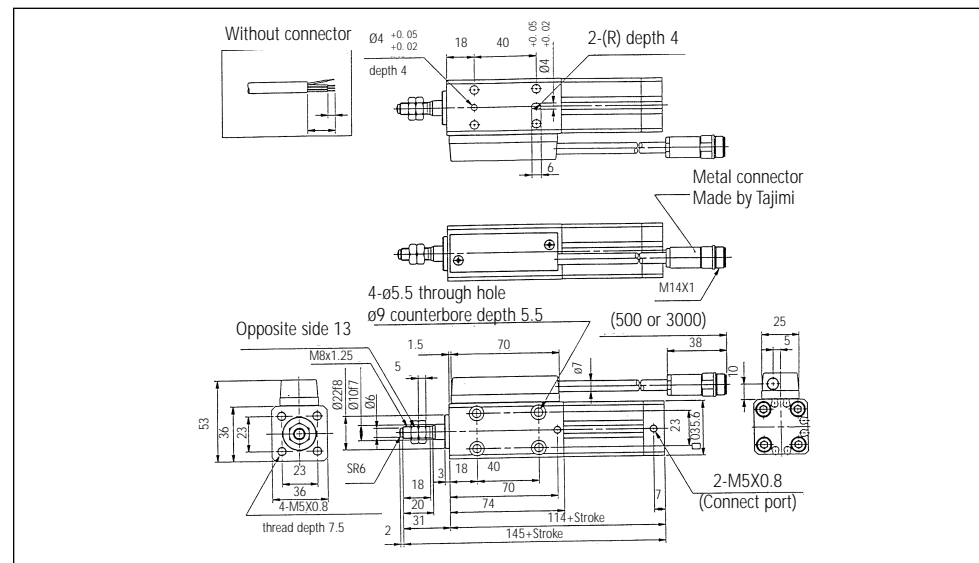


Fig 11

For additional information please contact your local SMC office, see details below:-

When you enquire about the product, please contact the following

<b>SMC Corporation:</b>	
<b>ENGLAND</b> Phone 01908-563888	<b>TURKEY</b> Phone 212-2211512
<b>ITALY</b> Phone 02-92711	<b>GERMANY</b> Phone 6103-402-0
<b>HOLLAND</b> Phone 020-5318888	<b>FRANCE</b> Phone 01-64-76-10-00
<b>SWITZERLAND</b> Phone 052-396 31 31	<b>SWEDEN</b> Phone 08-603 07 00
<b>SPAIN</b> Phone 945-184100	<b>AUSTRIA</b> Phone 02262-62-280
Phone 902-255255	<b>IRELAND</b> Phone 01-4501822
<b>GREECE</b> Phone 01-3426076	<b>DENMARK</b> Phone 70 25 29 00
<b>FINLAND</b> Phone 09-68 10 21	<b>NORWAY</b> Phone 67-12 90 20
<b>BELGIUM</b> Phone 03-3551464	<b>POLAND</b> Phone 48-22-6131847
	<b>PORTUGAL</b> Phone 02-610 8922