Produced upon receipt of order

Air Servo Cylinder

ø125, ø160, ø200, ø250, ø320

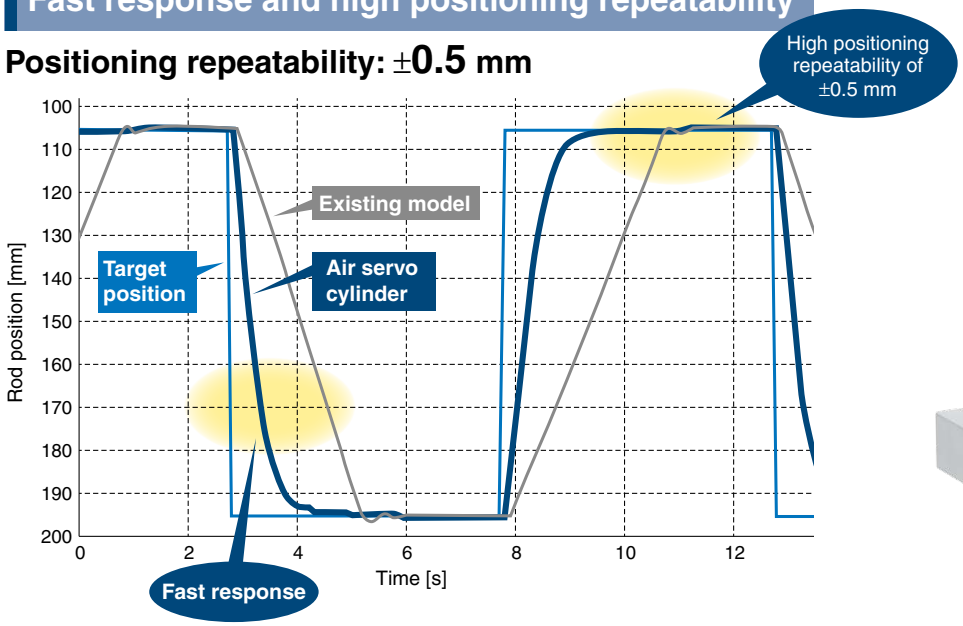
IP67

HART COMMUNICATION PROTOCOL

Capable of air cylinder multipoint positioning and control

Fast response and high positioning repeatability

Positioning repeatability: ±0.5 mm



Measuring conditions Bore size: ø200 mm, Cylinder stroke: 200 mm, Load mass: 70 kg

Easier maintenance due to unitization

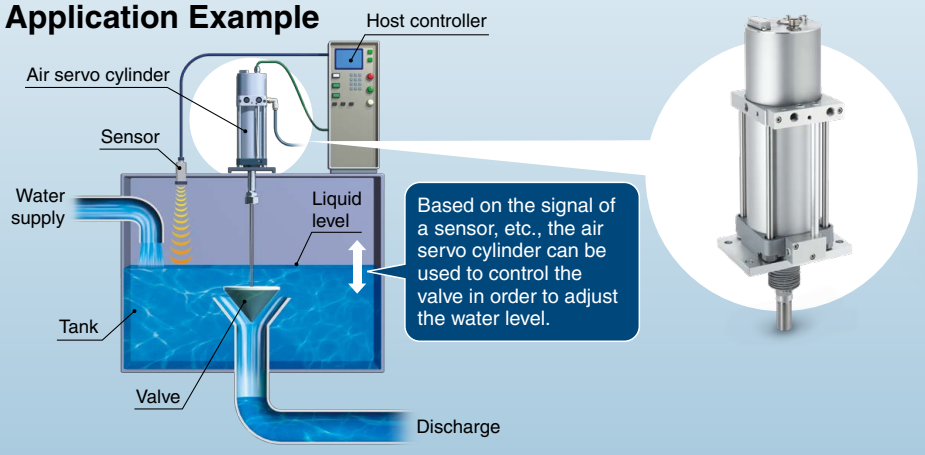
The valve unit, pilot valve, controller assembly, seal kit, etc., are replaceable.

Easy initial setting

Built-in self-diagnosis function (LED lamp and signal output)

Emergency stop of the piston when the air or power supply is cut

Application Example

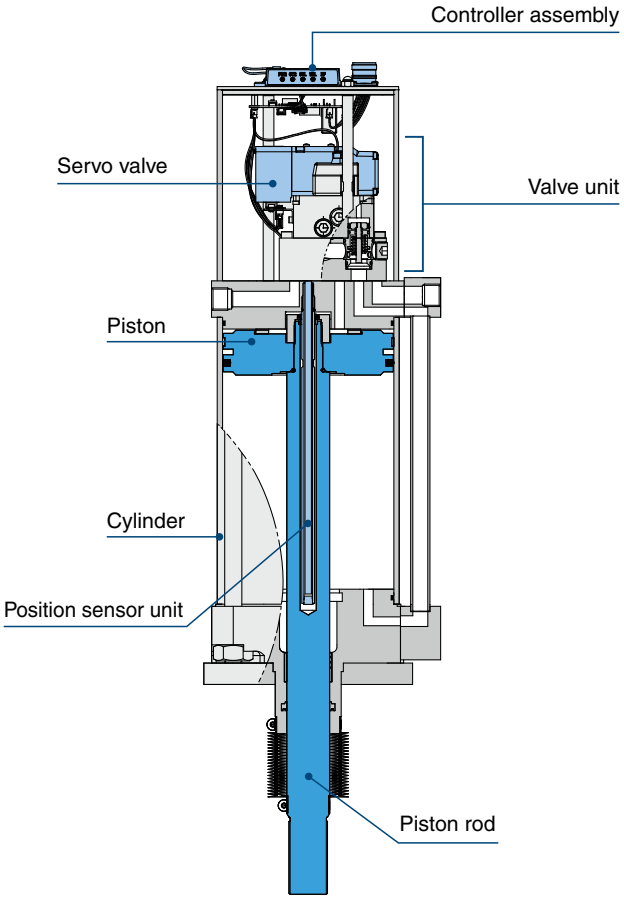


SMC

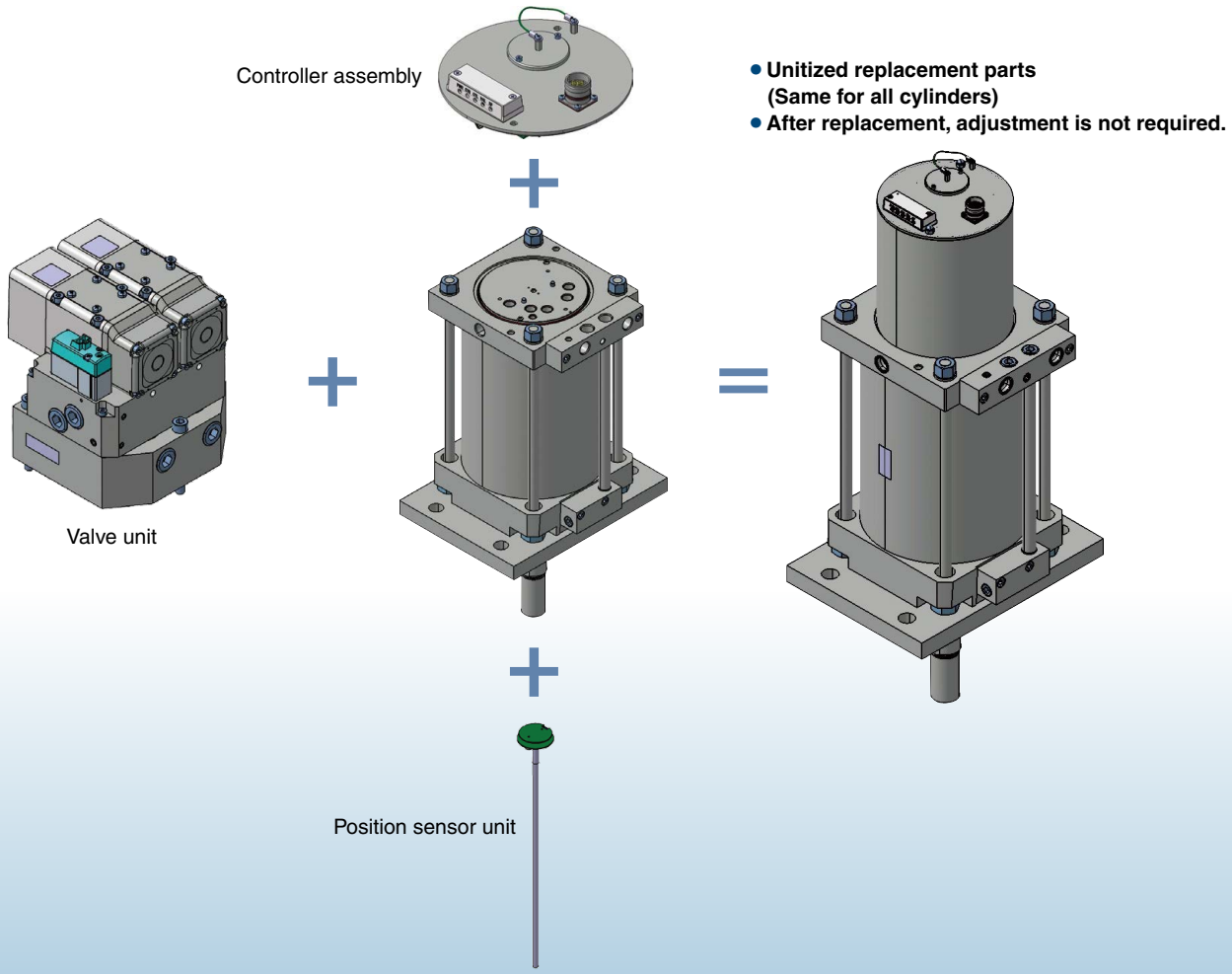
Capable of air cylinder multipoint positioning and control

With a built-in position sensor, the servo valve can be used to control the flow rate on both the head side and the rod side of the cylinder, and it can also be used to position the cylinder.

Cylinder with an integrated servo valve and controller



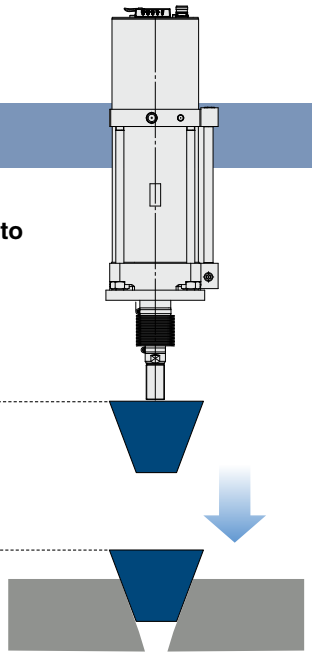
Easier maintenance due to unitization p. 9



- **Unitized replacement parts (Same for all cylinders)**
- **After replacement, adjustment is not required.**

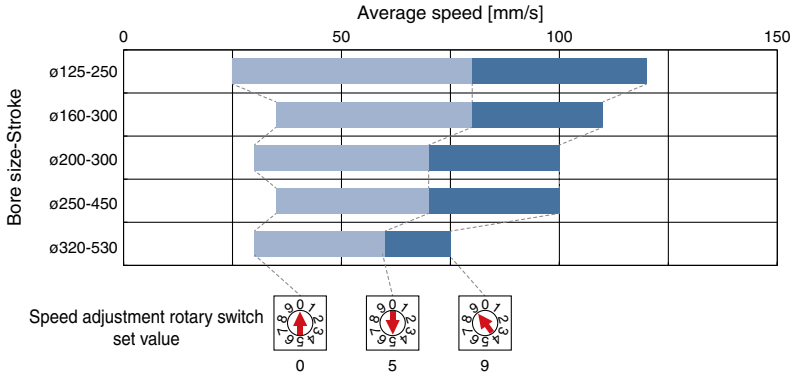
Easy initial setting

Input an I/O signal to move the rod forward, and set the rod stop position to 20 mA (or 4 mA).



Speed adjustment function

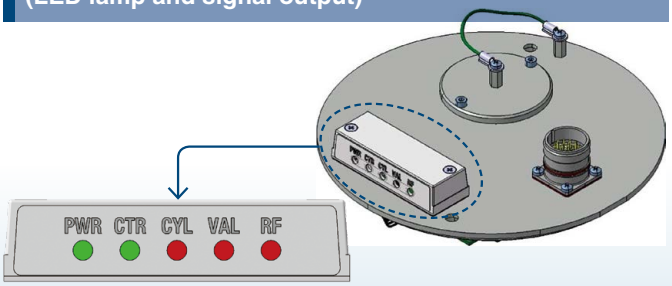
Capable of 10-level speed setting



Measuring conditions	Supply pressure: 0.55 Mpa, Mounting: Vertical downward, Load: no-load, Operating direction: Upward

* The average speed value is the stroke divided by the “full stroke time.”
  The “full stroke time” refers to the time from when the target position operation signal is input until the piston stops.
* The average speed adjustment range of each cylinder size varies according to the operating conditions.
* The data above provide a guide for selection but is not guaranteed.

Built-in self-diagnosis function
(LED lamp and signal output)

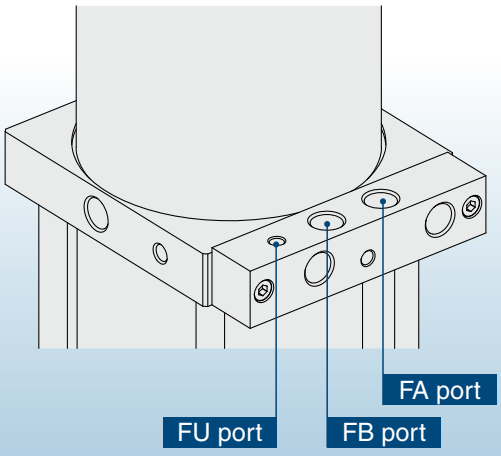


- LED display
- It is possible to output digital signals.

LED display	
PWR	Power supply status
CTR	Controller status
CYL	Cylinder position sensor error
VAL	Valve error
RF	Rod friction error

Fail-safe ports

If the air servo cylinder air or power supply is cut, air from the emergency tank can be supplied via the FA/FB port in order to allow for the manual operation of the air cylinder rod.



Air Servo Cylinder

IN-777

ø125, ø160, ø200, ø250, ø320

Produced upon receipt of order

How to Order

IN – 777 – 160 TF – 300 F J – H L

Bore size

125	125 mm
160	160 mm
200	200 mm
250	250 mm
320	320 mm

Port thread type

TF	G

Stroke [mm]

125	250
160	200, 300
200	200, 300
250	350, 450
320	200, 350, 530*1

*1 The models specified above are classified as Class-2 Pressure Vessels, as stipulated in the order for enforcement of the Industrial Safety and Health Act, and they are therefore not for use within Japan.

Mounting

F	With rod flange

Rod boot

Symbol	Material	Ambient temperature
J	Silicone rubber	–20°C to 60°C (No freezing)
A	Nylon tarpaulin	–10°C to 60°C (No freezing)
Nil	None	–20°C to 60°C (No freezing)

Communication protocol

H	4-20 mA/HART communication

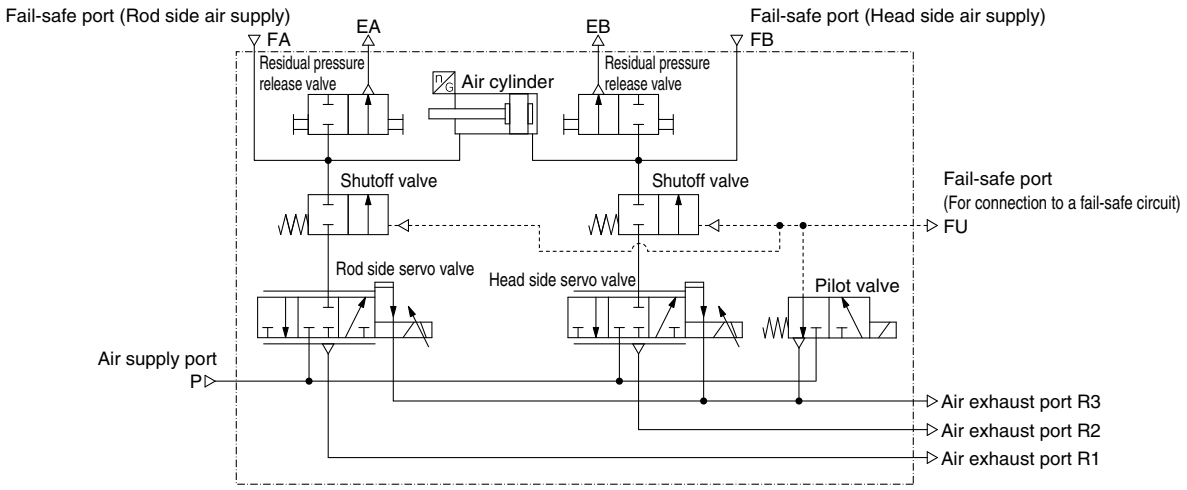
LED alarm display

L	With LED alarm display

Auto-start function

Nil	None
S	With

Pneumatic Circuit



Specifications

Electrical Specifications

Power supply	Supply voltage: 24 VDC ±10%
Control system	Closed loop
Position sensor	Absolute
Analog input signal	4 to 20 mA DC
Analog input impedance	Approx. 250 Ω
Analog output signal	4 to 20 mA DC
Analog output impedance	500 Ω
Voltage between terminals	12 VDC (Equivalent to 600 Ω input resistance at 20 mA DC)
Switch input signal	4 inputs, Connect to +24 VDC ±10%
	Current consumption: 10 mA or less
Switch output signal	5 outputs, n-type MOSFET open source output
	Max. load current: 100 mA
Communication protocol	HART communication

Functional Specifications

- JOG operation
- No signal operation
- Self-diagnosis function (Allows for controller, valve, and position sensor error output when an abnormality is present)
- Fail-safe operation
- Calibration (Automatic/Manual)
- Emergency stop
- Residual pressure release valve mounted
- Target position operation
- Speed adjustment (10-level)

Specifications

Mechanical Specifications

Action	Double acting, Single rod
Fluid	Air
Compressed air filtration	0.3 μm or less
Proof pressure	1.2 MPa
Operating pressure range	0.55 to 0.8 MPa
Positioning repeatability	±0.5 mm or less
Average speed	Refer to **Table 1**.
Ambient temperature	Silicone rubber material with or without rod boot: −20°C to 60°C (No freezing) Nylon tarpaulin with rod boot: −10°C to 60°C (No freezing)
Fluid temperature	−20°C to 60°C (No freezing)
Operating humidity	35 to 85% (No condensation)
Enclosure	IP67
Standards	CE, UKCA, RoHS
Weight	Refer to **Table 2**.
Lubrication	Non-lube
Mounting orientation	Vertical downward/Vertical upward
Vibration resistance	Total amplitude or acceleration: 1.5 mm or 3 G
	Vibration frequency: 5 to 100 Hz
	Vibration applying direction: 3 directions (X, Y, and Z)
	Sweep time/cycle: 12 min/10 cycles
Impact resistance	Acceleration: 15 G
	Pulse applying time/waveform: 11 ms/Sine wave
	Pulse applying direction: 3 times in each direction (X, Y, and Z axes)
Allowable lateral load	Refer to **Table 3**.
Theoretical output/Work load	Refer to **Table 4**.
Power supply connector (body)	M23 19-pin connector (Male): Refer to **Table 5**.

Table 1 Average speed [mm/s]

Bore size [mm]	Stroke [mm]	Speed adjustment rotary switch set value 0	5	9
125	250	25	80	120
160	200	35	70	95
	300	35	80	110
200	200	30	60	85
	300	30	70	100
250	350	35	70	95
	450	35	70	100
320	200	30	55	70
	350	30	60	75
	530	30	60	75

* The average speed value is the stroke divided by the "full stroke time." The "full stroke time" refers to the time from when the target position operation signal is input until the piston stops.
* The average speed adjustment range of each cylinder size varies according to the operating conditions.
* The data above shows values for the following measurement conditions. (Supply pressure: 0.55 MPa, Mounting: Vertical downward, Load: No load, and Operating direction: Upward)

Table 2 Weight

Bore size [mm]	Stroke [mm]	Weight [kg]
125	250	24
160	200	37
	300	43
200	200	53
	300	61
250	350	86
	450	97
320	200	100
	350	129
	530	163

Table 3 Allowable Lateral Load

Bore size [mm]	Allowable lateral load [N]
125	70
160	90
200	140
250	160
320	230

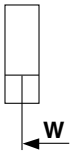
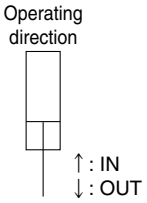


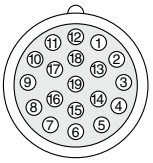
Table 4 Theoretical Output/Max. Work Load

Bore size [mm]	Operating direction	Theoretical output [N] Operating pressure [MPa] 0.55	0.8	Max. work load [kg]*1
125	IN	6,400	9,200	160
	OUT	6,800	9,900	
160	IN	10,400	15,100	240
	OUT	11,100	16,100	
200	IN	16,600	24,200	240
	OUT	17,300	25,200	
250	IN	26,000	37,700	300
	OUT	27,000	39,300	
320	IN	42,700	62,100	300
	OUT	44,300	64,400	



*1 Based on SMC's specific testing conditions

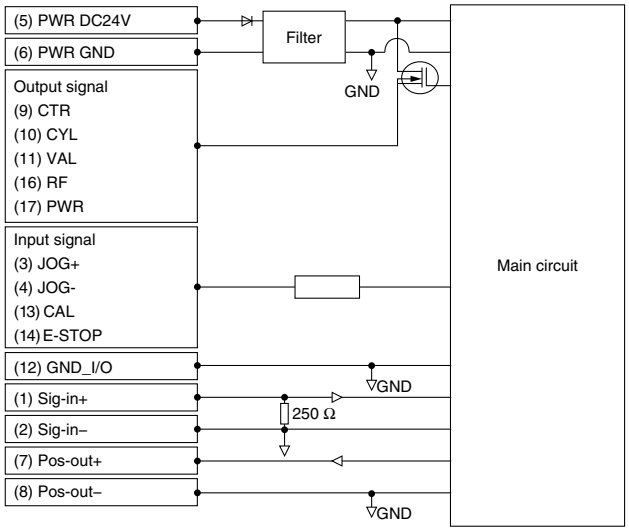
Table 5 Connector Pin Numbers (Body Side)



Pin no.	Signal name	IN/OUT	Description
1	Sig-in+	IN	Analog signal (4-20 mA(+)), HART communication signal input
2	Sig-in−	IN	Analog signal (4-20 mA(−)), HART communication signal input
3	JOG+	IN	JOG operation signal input (Moves to the rod side)
4	JOG−	IN	JOG operation signal input (Moves to the head side)
5	PWR DC24V		Power supply +24 VDC
6	PWR GND		Power supply GND
7	Pos-out+	OUT	Analog position signal (+) output
8	Pos-out−	OUT	Analog position signal (−) output
9	CTR	OUT	Controller signal output
10	CYL	OUT	Position sensor error signal output
11	VAL	OUT	Valve error signal output
12	GND_I/O		Signal GND
13	CAL	IN	Calibration signal input
14	E-STOP	IN	Emergency stop signal input*1
15	—		—
16	RF	OUT	Rod friction error signal output
17	PWR	OUT	Power supply error signal output
18	—		—
19	—		—

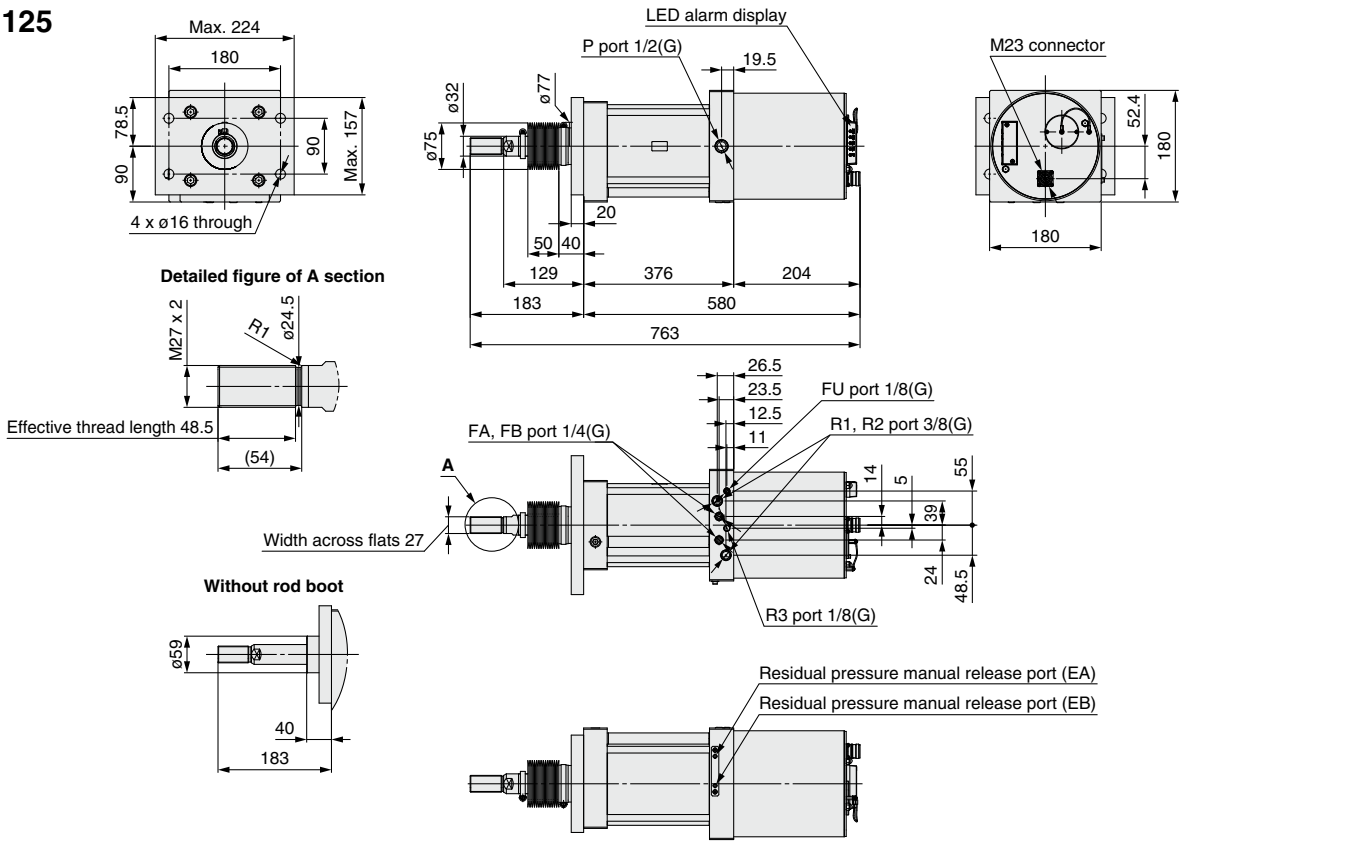
*1 When the signal is OFF, an emergency stop occurs. —: Cannot be connected

Wiring Diagram

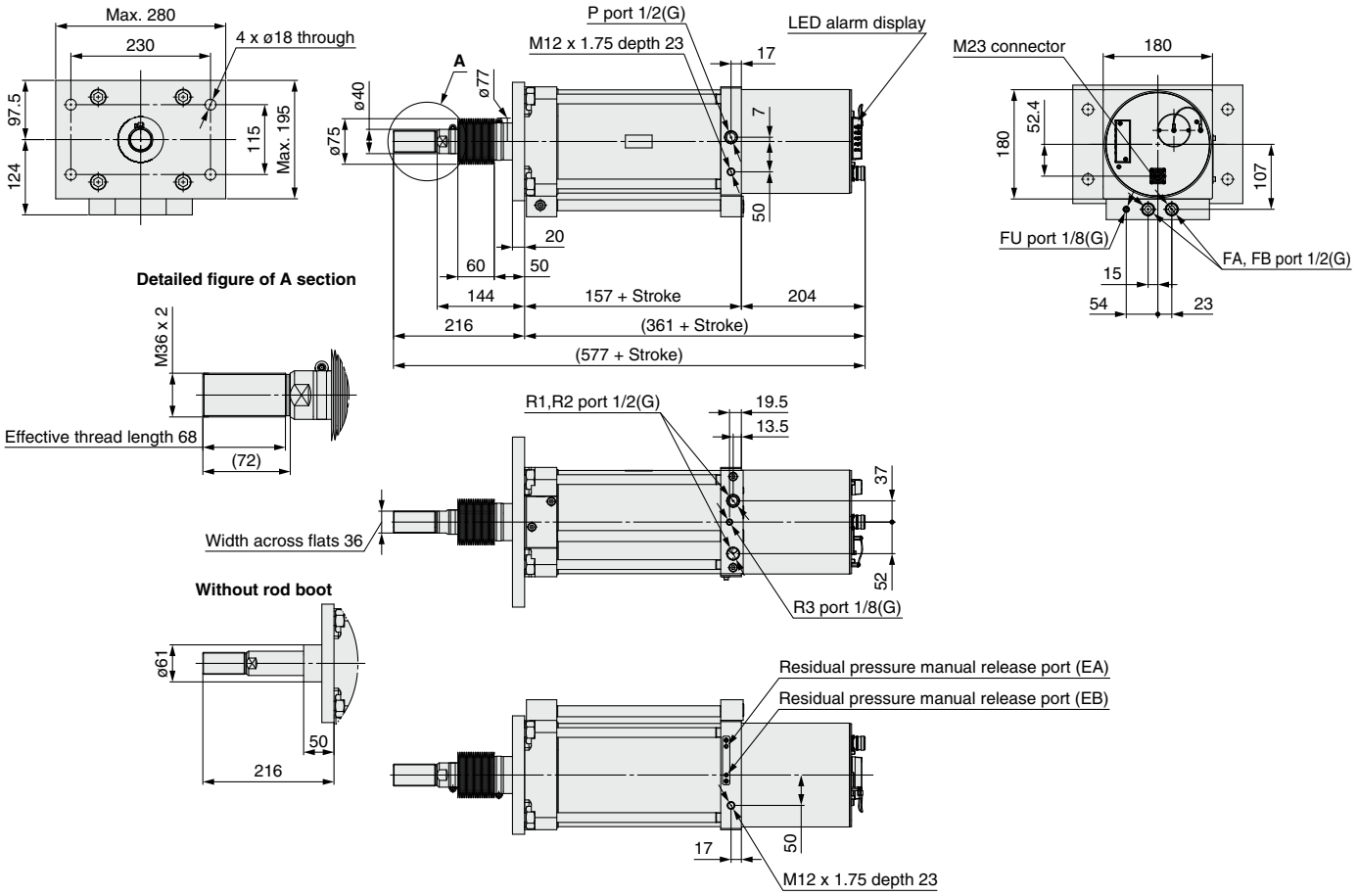


Dimensions

ø125

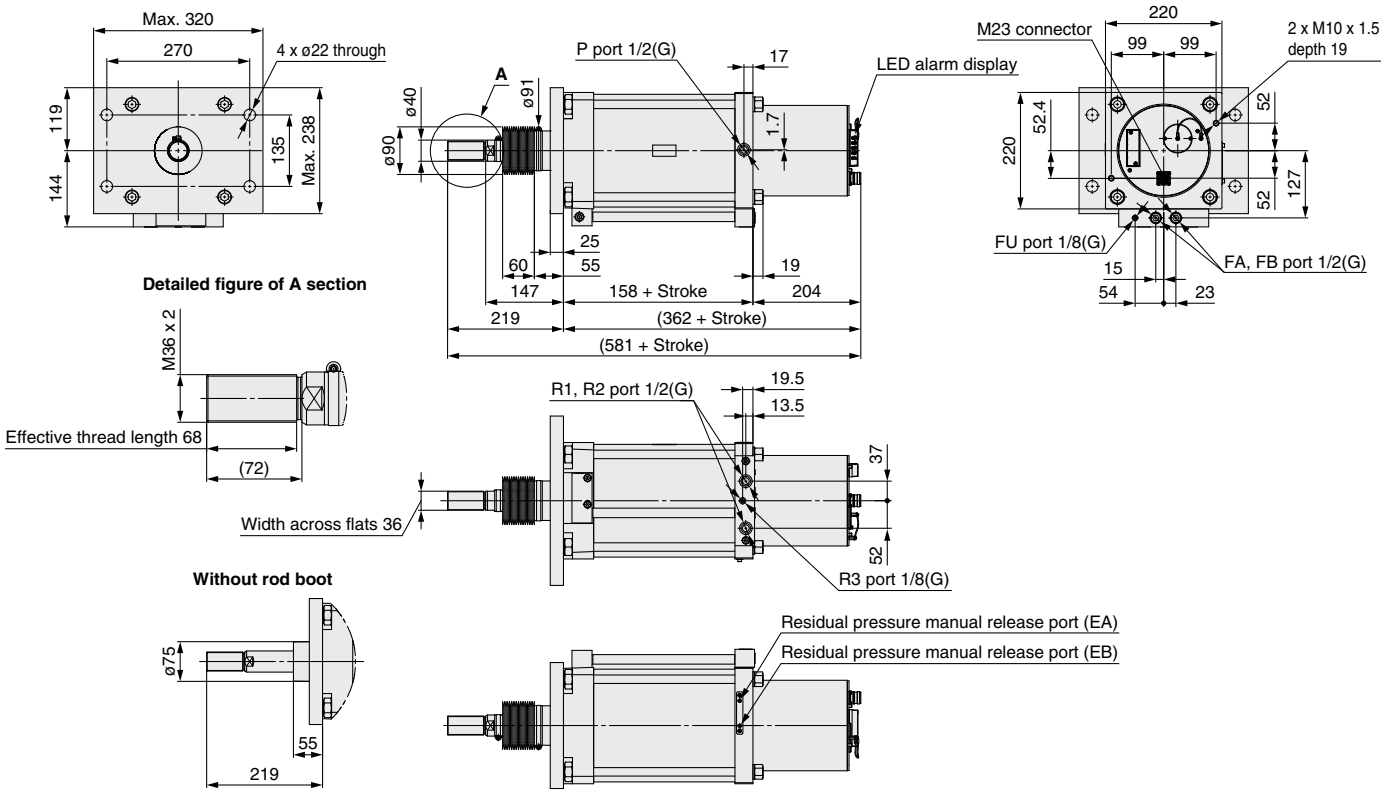


ø160

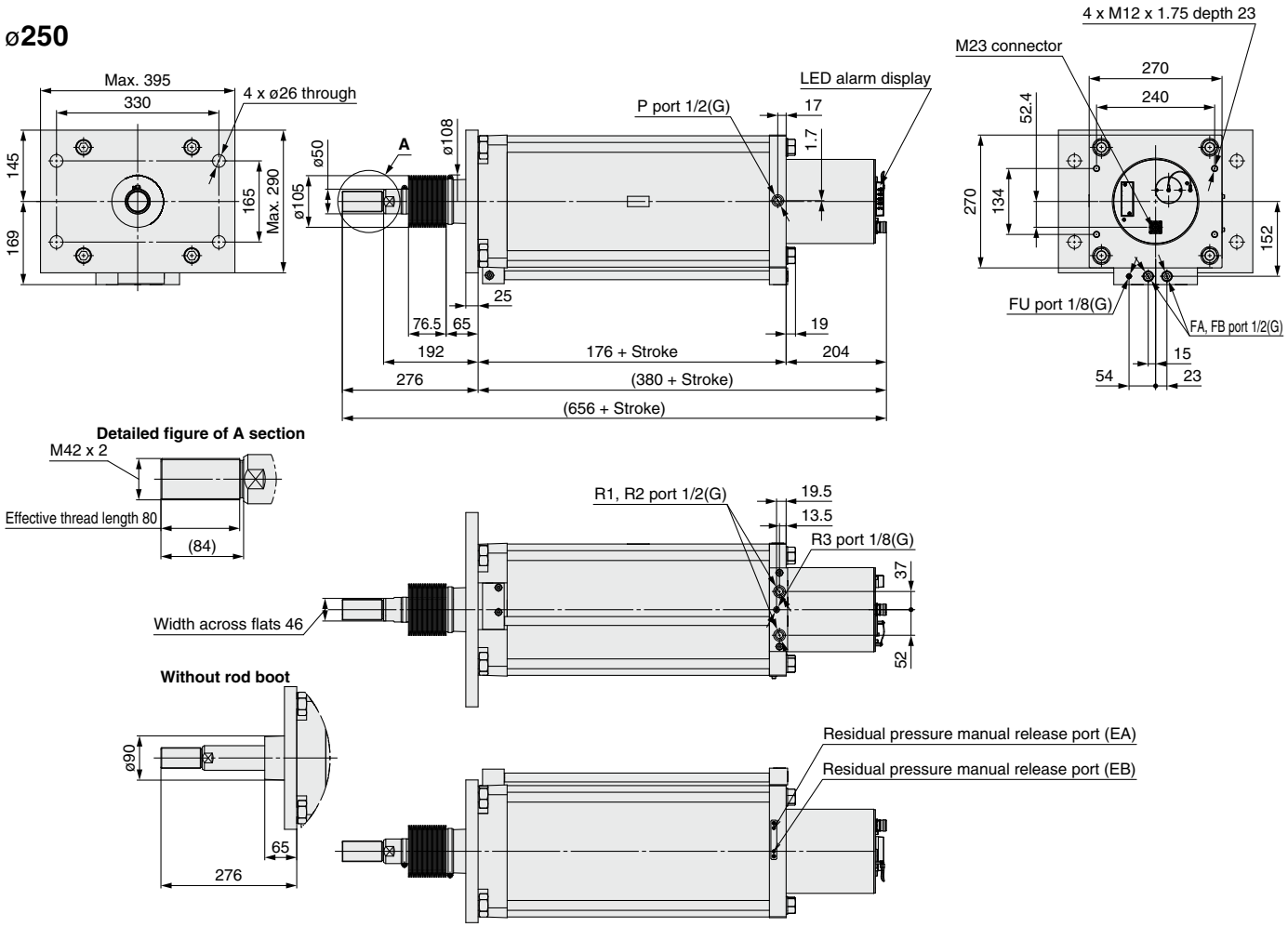


Dimensions

ø200

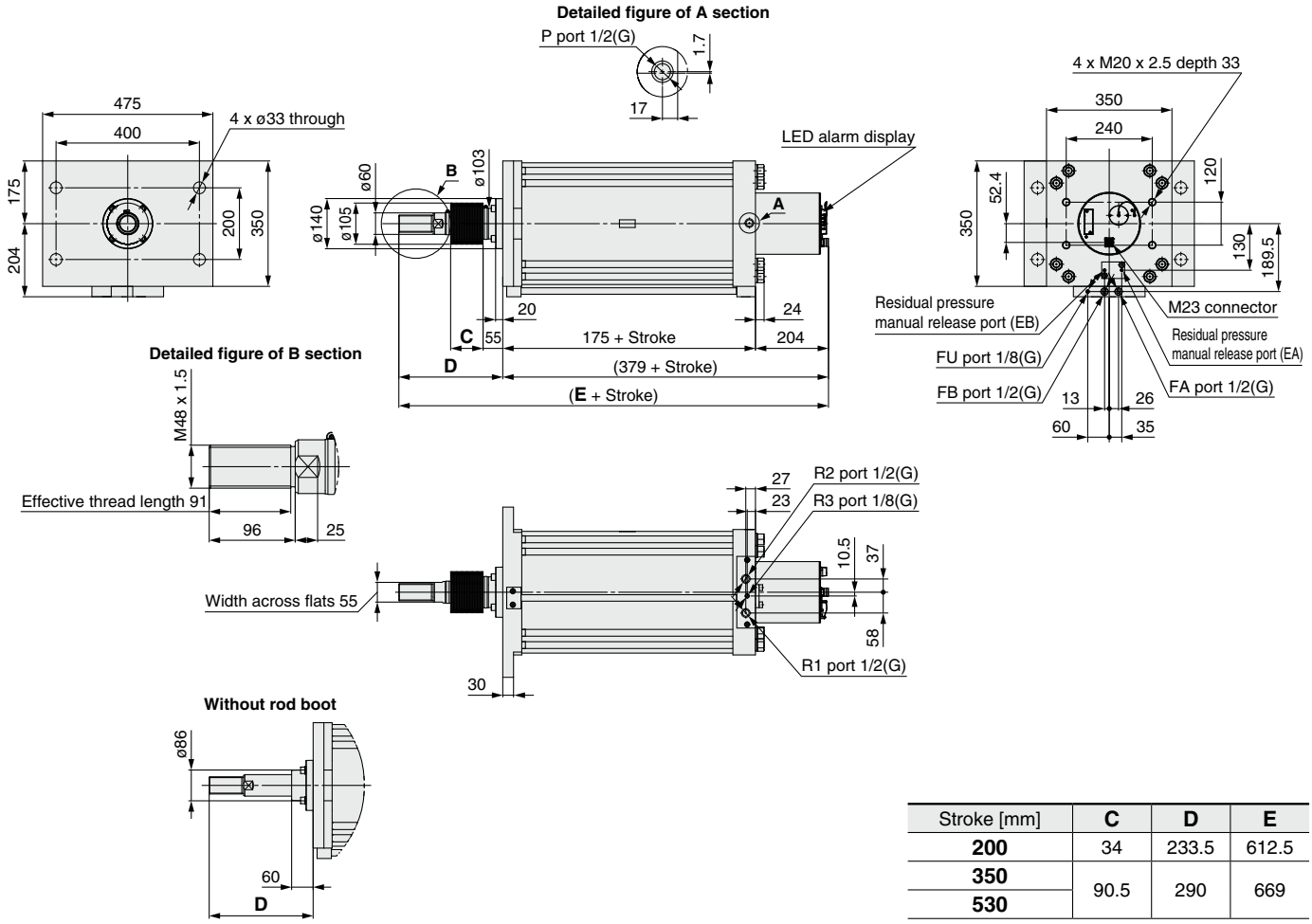


ø250



Dimensions

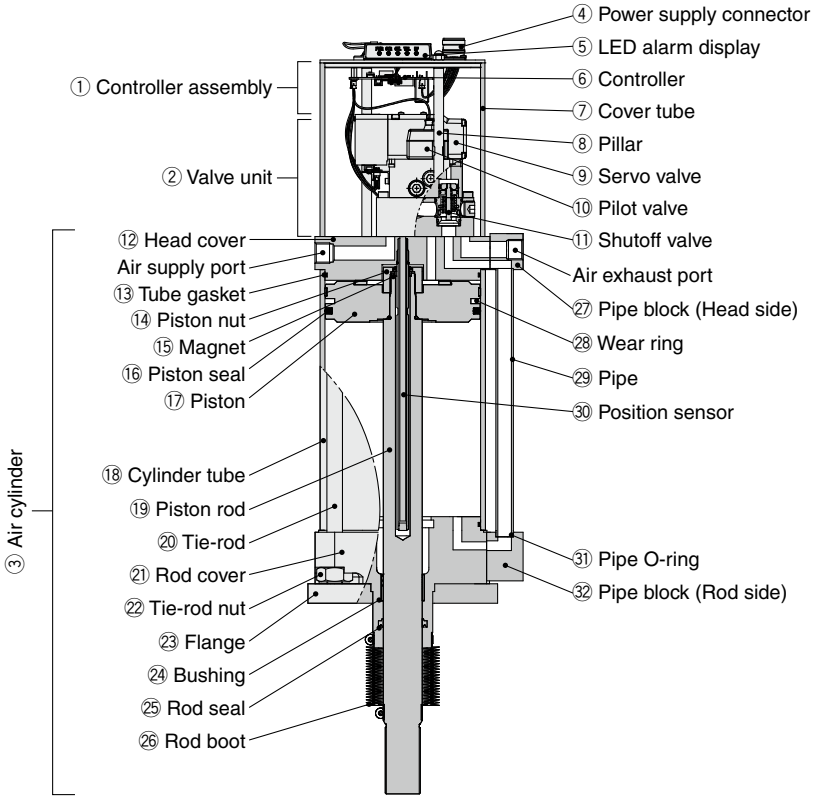
ø320



Stroke [mm]	C	D	E
200	34	233.5	612.5
350	90.5	290	669
530			

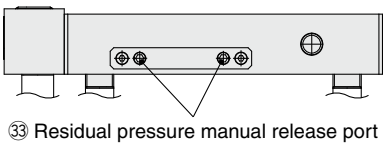
Working Principle/Construction

The ㉚ position sensor built in to the ③ air cylinder outputs the current position of the ⑲ piston rod to the ⑥ controller.
Next, the ⑥ controller outputs a command signal to the 2 ⑨ servo valves according to the target position signal sent from the host controller.
Then, according to the command signal sent from the ⑥ controller, the ⑨ servo valves control the ③ air cylinder air supply or exhaust to move the piston rod forwards or backwards, or to stop it at the target position.
The opening and closing of the ⑪ shutoff valve is controlled by the ⑩ pilot valve connected to the ⑥ controller.
Two air-operated ⑪ shutoff valves (head side and rod side) are mounted along the air passage between the ⑨ servo valves and the ③ air cylinder. During an emergency stop (air or power supply cutoff, emergency stop signal input, etc.), the 2 ⑪ shutoff valves will close and ③ air cylinder operation will be stopped.



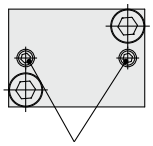
A 160 bore size, 200 mm stroke air cylinder is used in the drawings.

Back portion of ø125 to ø250 head covers



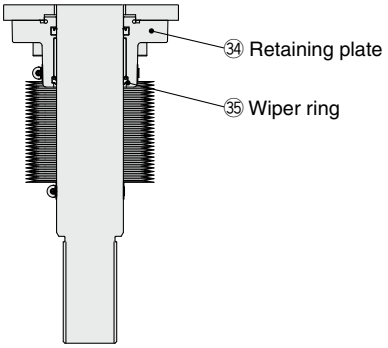
㉝ Residual pressure manual release port

Top portion of ø320 head covers



㉝ Residual pressure manual release port

Cross-section portion of ø320 rod ends



Component Parts

No.	Description	Material/Surface treatment
1	**Controller assembly**∗1	Aluminum alloy/Anodized (Main parts)
2	**Valve unit**∗1	—
3	**Air cylinder**	—
4	**Power supply connector**	—
5	**LED alarm display**	Aluminum alloy/Painted (Main parts)
6	**Controller**	—
7	**Cover tube**	Aluminum alloy/Anodized
8	**Pillar**	Aluminum alloy
9	**Servo valve**∗1	—
10	**Pilot valve**∗1	—
11	**Shutoff valve**	—
12	**Head cover**	Aluminum alloy/Anodized
13	**Tube gasket**∗1	Low-temperature NBR
14	**Piston nut**	Stainless steel
15	**Magnet**	—
16	**Piston seal**∗1	Low-temperature NBR
17	**Piston**	Aluminum alloy/Chromated
18	**Cylinder tube**	ø125 to ø250: Aluminum alloy/Anodized ø320: Carbon steel tube/Painted
19	**Piston rod**	Stainless steel/Hard chrome plating
20	**Tie-rod**	Stainless steel

No.	Description	Material/Surface treatment
21	**Rod cover**	ø160 to ø250: Aluminum die-cast/Chromated ø125 and ø320: Aluminum alloy/Anodized
22	**Tie-rod nut**	Stainless steel
23	**Flange**∗2	Steel/Zinc plating
24	**Bushing**	Bearing alloy
25	**Rod seal**∗1	Low-temperature NBR
26	**Rod boot (Option)**∗1	Silicone rubber material Nylon tarpaulin (selectable)
27	**Pipe block (Head side)**∗3	Aluminum alloy/Anodized
28	**Wear ring**∗1	Resin
29	**Pipe**	Aluminum alloy/Anodized
30	**Position sensor**∗1	—
31	**Pipe O-ring**∗1	Low-temperature NBR
32	**Pipe block (Rod side)**∗4	Aluminum alloy/Anodized
33	**Residual pressure manual release port**	—
34	**Retaining plate**	Stainless steel
35	**Wiper ring**∗1	Low-temperature NBR

∗1 Refer to page 9 for maintenance parts and seal kit accessories.
∗2 The rod cover is integrated for size ø320.
∗3 The head cover is integrated for size ø125.
∗4 The rod cover is integrated for size ø125.

Maintenance Parts

① Controller assembly

IN – 777P – H L □ – 410AS

Communication protocol

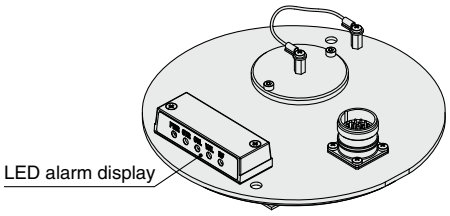
H	4-20 mA/HART communication

Auto-start function

Nil	None
S	With

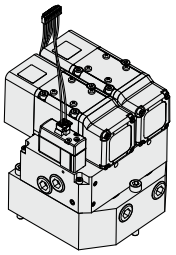
LED alarm display

L	With LED alarm display



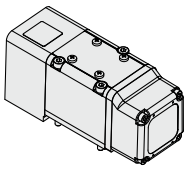
② Valve unit

IN – 777P – 010AS



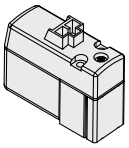
⑨ Servo valve

XT581 – V – C – X001

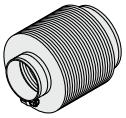


⑩ Pilot valve

V211KT – 5LOZ – X48



㉖ Rod boot



Bore size [mm]	Stroke [mm]	Part number	
		Silicone rubber material	Nylon tarpaulin
125	250	C96A2G-1461V-R	C96A2G-0294Y-R
160	200	C95A6G-471AQ-R	CS1-J16-300
	300		
200	200	C95B0G-472AQ-R	C95B0G-0304Y-R
	300		
250	350	C95B5G-533AQ-R	C95B5G-574EQ-R
	450		
320	200	C1SC2G-1468V-R	CS1-J25-200
	350	C1SC2G-1470V-R	CS1-J25-530
	530		

Ambient temperature specifications
Silicone rubber material: –20°C to 60°C (No freezing)
Nylon tarpaulin: –10°C to 60°C (No freezing)

㉚ Position sensor unit

IN – 777P – 200 – 830AS

Cylinder stroke

200	200 mm
250	250 mm
300	300 mm
350	350 mm
450	450 mm
530	530 mm

∗ For the position sensor unit, the cylinder stroke is the same for all tube sizes.

Seal kit

IN – 777P – 125 – 910AS

Bore size

125 160 200 250	This set includes the following: ⑬Tube gasket (2 pcs.) ⑯Piston seal (1 pc.) ㉕Rod seal (1 pc.) ㉘Wear ring (1 pc.) ㉛Pipe O-ring (2 pcs.)
320	This set includes the following: ⑬Tube gasket (2 pcs.) ⑯Piston seal (1 pc.) ㉕Rod seal (1 pc.) ㉘Wear ring (1 pc.) ㉛Pipe O-ring (2 pcs.) ㉟Wiper ring (1 pc.)

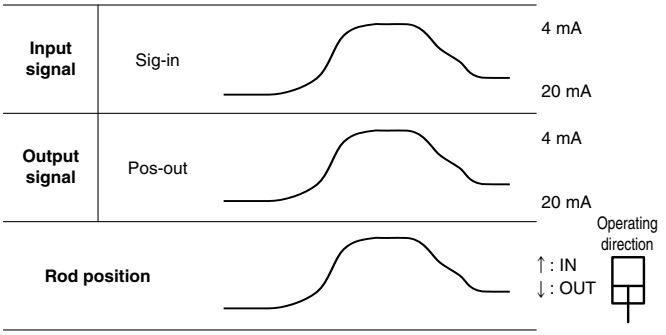
∗ The seal kit includes a grease pack.
∗ The circled numbers correspond to the component numbers in the cross-section construction drawing on page 8.

Operation Modes

■ Target position operation

The rod position is decided according to the Sig-in signal input by the external controller.
The rod position is then output as a Pos-out signal.

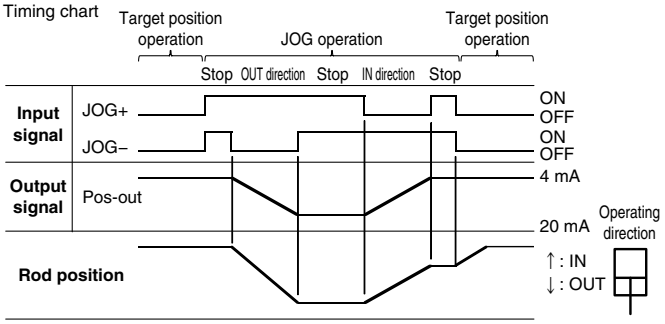
∗ Be sure to calibrate the product before use. If the set point has not yet been set, the rod will not move even during a target position operation. Refer to page 10 for calibration instructions.



∗ The operating direction can be changed.

■ JOG operation

The rod moves according to the JOG signal input by the external controller.



		JOG+	
		OFF	ON
JOG-	OFF	Target position operation	JOG operation (Moves in the OUT direction)
	ON	JOG operation (Moves in the IN direction)	JOG operation (Stops)

∗ The device will move to the target position input as the Sig-in and stop when changing from JOG operation to target position operation.

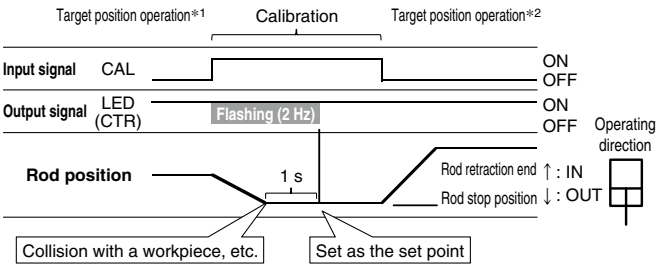
Operation Modes

■ Calibration

Set the rod position (set point) by inputting a CAL signal into the external controller and setting the Sig-in signal to 20 mA (default).
When changing the operation direction, the 4 mA rod position becomes the set point.
It is possible to change the operation mode from automatic to manual.

Automatic (Default)

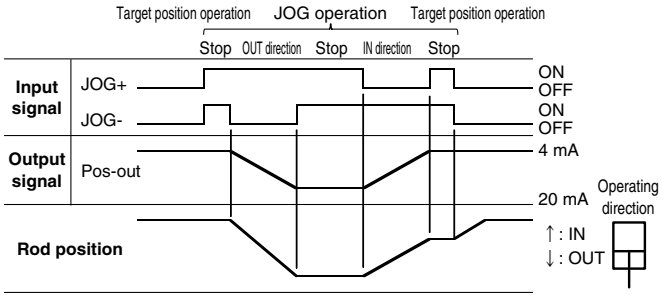
When the CAL signal is turned ON, the rod will move in the OUT direction, and the position where the rod stops for 1 s will become the set point.
When the CAL signal is turned OFF, the rod will move in the IN direction, and the rod will stop at the retraction end.



*1 If the set point has not yet been set, the rod will not move even during a target position operation.
*2 The target position may vary slightly before and after the set point has been set, even if the Sig-in signal is the same.

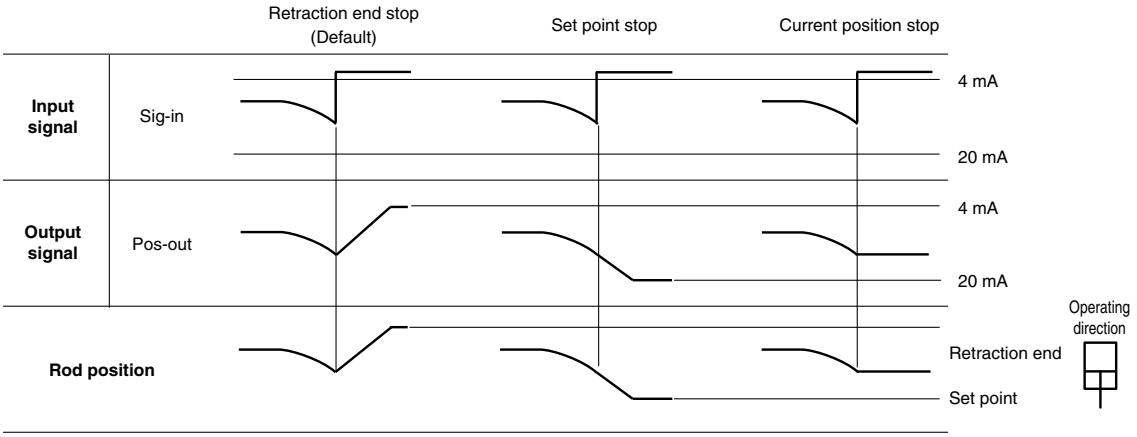
Manual

The rod will be moved by the JOG signal, and the position of the rod when the CAL signal is input will become the set point.



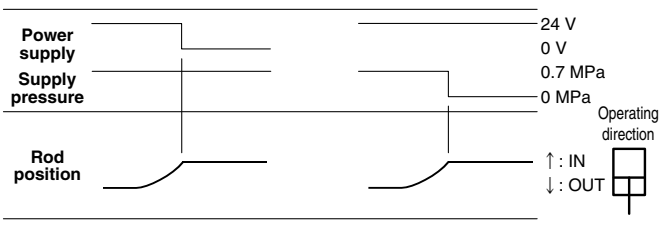
■ No signal operation

This is the operation mode used when the Sig-in signal input into the external controller is 4 mA or less.
The rod will move to the predetermined position and then stop.



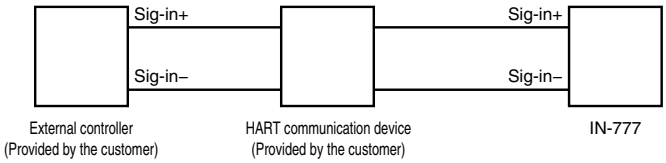
■ Emergency stop

When the air servo cylinder air or power supply is cut during use, the built-in shutoff valves will close, stopping the rod.
Air from the emergency tank can be supplied via the fail-safe port (FA/FB) in order to allow for the operation of the air cylinder rod.



■ HART (Highway Addressable Remote Transducer) communication

With this communication type, a digital signal is superimposed on the 4-20 mA Sig-in signal and then transmitted. Connect a HART communication device (provided by the customer) between the Sig-in + and the Sig-in -.

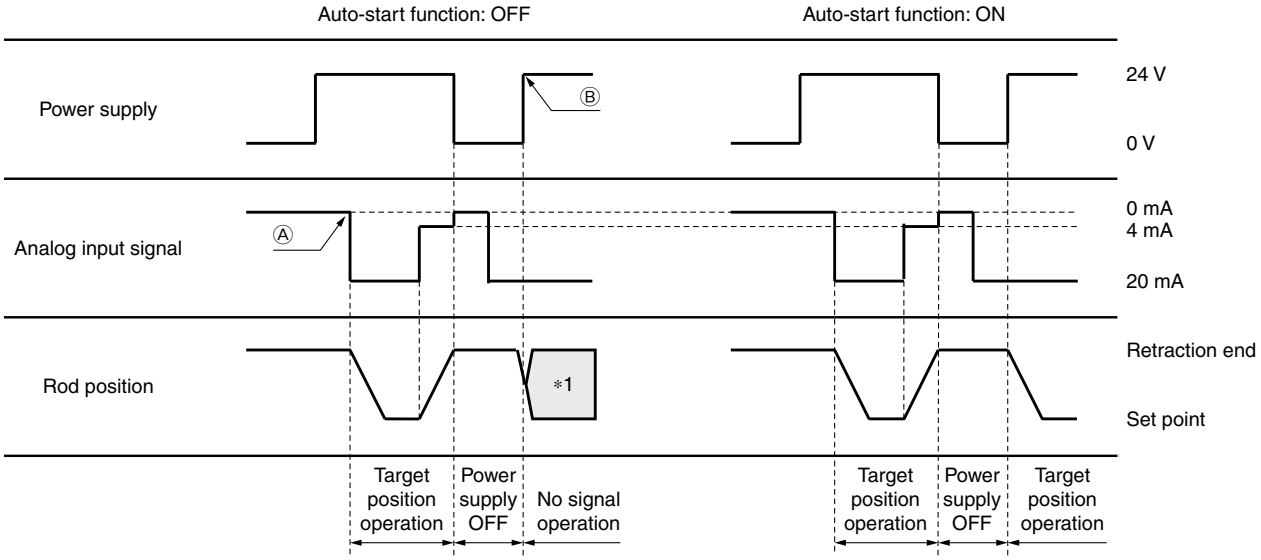


Main transmission contents
1. IN-777 information – confirmation and revision
2. HART communication settings – confirmation and revision
3. Cylinder operating conditions - setting and confirmation
4. Calibration - execution
5. Operating mode - setting and revision
6. JOG operation - execution
7. Operation status/Alarm confirmation

Operation Modes

■ Auto-start function

For the auto-start function OFF specification, to start the target position operation, input the analog input signal (Ⓐ) only after turning the power supply ON. Inputting the analog input signal before the power supply has been turned ON (Ⓑ) will result in a switch to no-signal operation.
For the auto-start function ON specification, the order in which the analog input signal is inputted and the power supply is turned ON does not matter; the target position operation will start once both requirements have been satisfied.



∗1 For no-signal operation, stopping at the retraction end, stopping at the set point, or stopping at the current position can be selected when determining the settings.

IN-777
Air Servo Cylinder
Specific Product Precautions

Be sure to read this before handling the products.

Mounting

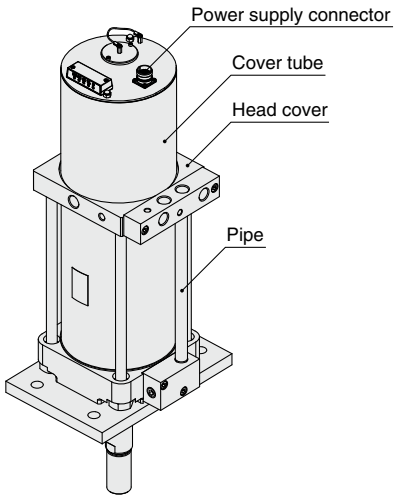
⚠ Caution

1. Vibration may occur due to positioning control depending on the operating environment, load, conditions, etc.
Be sure to inspect the actual machine for sufficient strength retention in regard to the amount of cylinder vibration that occurs.

2. Mount so that a lateral load which exceeds the allowable lateral load is not applied to the piston rod.
If a lateral load which exceeds the allowable lateral load is applied, the positioning repeatability during the target position operation will decline, which may lead to piston rod malfunction.
In addition, if the seals, cylinder tubing, etc., come into direct contact with the metal parts of the piston, air leakage due to uneven wear or reduced service life due to accelerated wear of the bearing may result. Refer to **Table 2** on page 4 for the allowable lateral load.

3. When a workpiece is mounted on the piston rod end, connect them by aligning the axial center of the piston rod and that of the workpiece.
If they are off-center, a lateral load will be generated and the phenomena mentioned in item 2 may occur.

4. When mounting the body, be sure to avoid force being applied to the piping between the air cylinder head cover and the rod cover, cover tube, power supply connector, etc.
Applying excessive external force to the piping may result in damage to the piping or a malfunction.
As screw holes for installing eye bolts are provided on the head covers of sizes ø160 and larger, insert the eye bolts into the screw holes and hang the product to mount it.



Operating Precautions

⚠ Caution

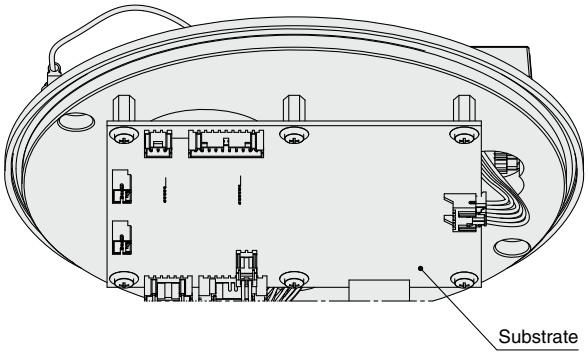
1. When powering-up the product, restarting after an emergency stop, or switching the operating mode, be careful as the piston rod may suddenly extend or retract according to the settings.

2. Avoid use in environments where condensation is generated.
When moving the product to a location at room temperature after operating it in low-temperature conditions, the temperature will rise suddenly and condensation will be generated. If water droplets from the generated condensation adhere to the internal substrate, an electric short-circuit may occur, resulting in a malfunction.

Maintenance

⚠ Caution

1. When disassembling the product for controller assembly replacement, etc., be sure not to touch the substrate with your bare hands.



⚠ Safety Instructions	Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.