INSTRUCTION MANUAL

MINI-TOP ELECTRONIC ACTUATOR (linear type; CC-Link)	MODEL	MSP4C/MSP5C /MSP6C

CONTENTS

1. BEFORE USE ....

Thank you for choosing M-System. Before use, please check contents of the package you received as outlined below.
If you have any problems or questions with the product, please contact M-System's Sales Office or representatives.

■ PACKAGE INCLUDES:

Mini-Top ....(1)
The Mini-Top is not provided with a yoke or other components required for mounting it to a valve. They are to be provided by the user.

■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

2. POINTS OF CAUTION

■ POWER INPUT RATING & OPERATIONAL RANGE

- Locate the power input rating marked on the product and confirm its operational range as indicated below:
    24V DC: 24V rating ±10%, approx. 0.5A

■ GENERAL PRECAUTIONS

- Remove the power supply to the actuator before wiring to it.

■ INSTALLATION

- Indoor, or outdoor where the MSPxC is NOT exposed to direct sunlight
- Ambient temperature: -5 to +55°C (23 to 131°F)
- Operating humidity: 30 to 85% RH (non-condensing)
- Vibration: 0.5 G (4.9 m/s^2) max.
- Install the MSPxC where you can reach for maintenance. Observe at the minimum of 15 centimeters (6 inches) above the cover.

■ ELECTRICAL CONNECTION

- Separate the cables (power supply and communications) from other cables to prevent surge or inductive interference.
- Do not bind these cables together with mains supply cables or high-voltage cables. Do not install them in the same duct.

■ OUTDOOR USE

- When installing the MSPxC outdoor or where it is exposed to rain or water drops, be sure to fasten the cable connector tightly and leave a slack of the cable.
- Do not mount the MSPxC in such direction that the output stem is at the top of the Mini-Top unit.

■ O-RING, GASKET

- When replacing the actuator cover after adjustments, check that the O-ring is securely placed in the groove.
- When replacing the communication box cover, check that the gasket is in place.

■ YOKE DESIGN

- When a foreign object is caught in the valve, a torque four times greater than the maximum rating could be generated. Leave enough strength for mechanical components such like the yoke and stem.
- If the MSPxC is used on a steam line in temperature control, it is possible that the MSPxC temperature rises higher than the ambient temperature due to transmission or radiation via the steam piping, even when the ambient temperature is within allowable range.
  Use a longer yoke to increase heat dissipation and apply insulating material.
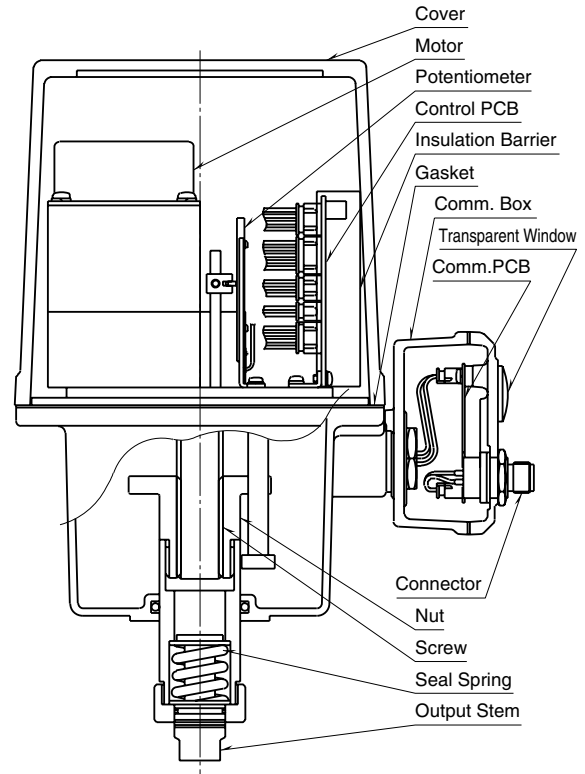
■ AND ....

- DO NOT loosen the screw fixing the potentiometer stem. Loosening it could cause a malfunction.
- DO NOT step onto the actuator. DO NOT rest a heavy object on or against it.

3. COMPONENT IDENTIFICATION
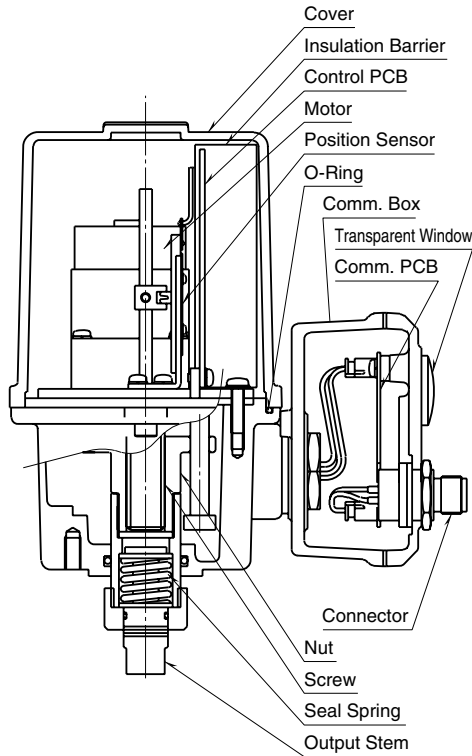
Figure 1. Component identification, MSP4C, MSP5C

Figure 2. Component identification, MSP6C

Note: Construction of the MSP4C is partly different from the above figure.

■ CC-Link CONNECTOR:

5-core micro-style connector, male

PIN ASSIGNMENT	
1	SL-D
2	DB
3	DG
4	DA
5	Not used

■ POWER INPUT CONNECTOR:

XS2M-D424-2 (OMRON)

PIN ASSIGNMENT	
1	24 V
2	Not used
3	GND
4	Not used

■ COMMUNICATION MONITOR INDICATOR LED

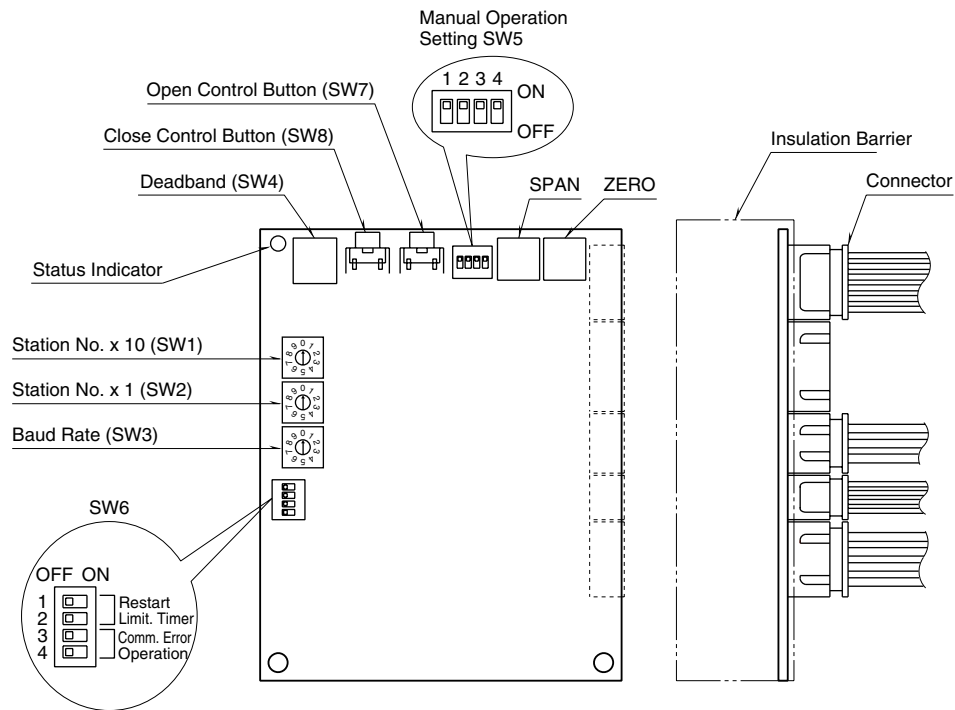| ID	STATUS	MEANING
L RUN	ON	Communicating
	Blink	----
	OFF	Not entering the network yet Timeout
L ERR	ON	CRC error Switch configuration error detected when the power was turned on.
	Blink	Switch configuration has been altered after the power was turned on.
	OFF	Normal

■ STATUS INDICATOR LED

Normal status: Blinks with 0.5 Hz frequency (1 second ON; 1 second OFF)
Motor deadlock: Blinks with 2 Hz frequency
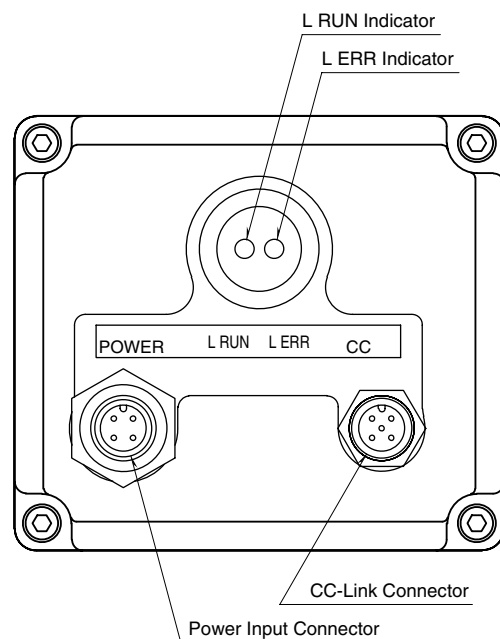
Figure 3. Component identification, Communication Box

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Figure 4. Component identification, Control PCB

Note 1: Applying excessive torque on potentiometers and switches may destroy the stoppers of these adjustments. Turn them gently and stop immediately where the controls hit the stopper.

4. OUTPUT SPAN ADJUSTABILITY

The servo-control circuit compares and amplifies "Input as Target" (position setpoint) signal and the feedback signal from the potentiometer, and drives the motor to such direction to minimize difference of the two signals.
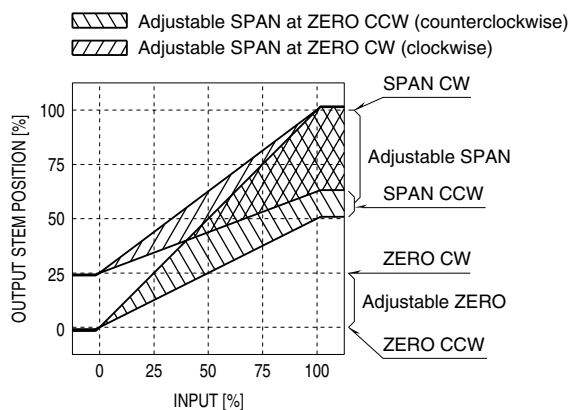
The Span, with the Zero turned fully counterclockwise, is adjustable from 50% to 100%. With the Zero turned gradually clockwise, the Span's adjustable range become narrower, down to 62.5 – 100%. The Span is adjustable to 50 – 100% of the remaining total stroke after the Zero adjustment.

Figure 5. I/O characteristics (adjustable range)
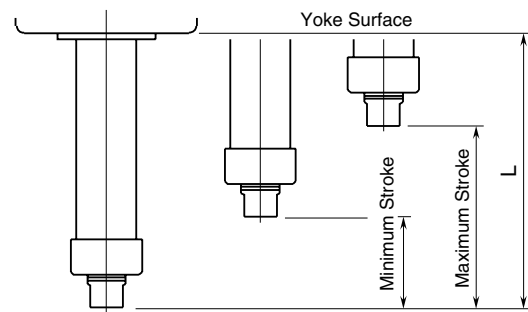
Figure 6. Definition of the minimum and maximum strokes

Table 1. Available Stroke Range for Each Model

MODEL	L	MIN. STROKE	MAX. STROKE
MSP4C-1	29*	5	10
MSP4C-2	34*	8	15
MSP5C-1	40	5	10
MSP5C-3	50	10	20
MSP6C-3	58	10	20
MSP6C-4	78	20	40

*Add 3.5 mm for stem button type.

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5. INSTALLATION

The following is a general procedure for mounting the MSPxC to a valve with a yoke and coupling.

Be sure NOT TO CHANGE factory adjusted setting of the MSPxC.

Remove power supply during the procedure unless otherwise specified.

1) Supply power to the actuator and manually control the actuator stem to the longest position.

2) Push in the valve stem at the lowest position.

3) Set the yoke to the actuator.

4) Push the valve stem into the actuator stem until there is no gap between them.

   If you need to seal the valve, leave a spring contraction shown in Table 3 (for example, 0.5 mm for MSP4C-x3).

5) Fix the actuator stem and valve stem with a lock nut.

6) Supply power to the actuator again and raise (retract) the actuator stem by several millimeters. Check that the opening between the yoke and valve bonnet is closed. Fix the yoke and valve.

7) Attach the position indicator if required.
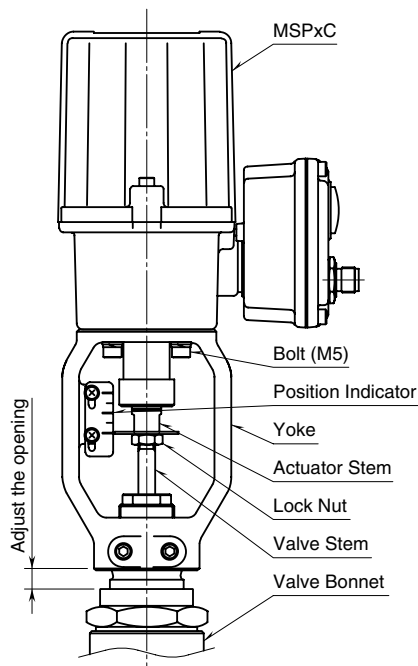
Figure 7. MSP×C mounted onto a valve (example)

■ **STEM BUTTON**
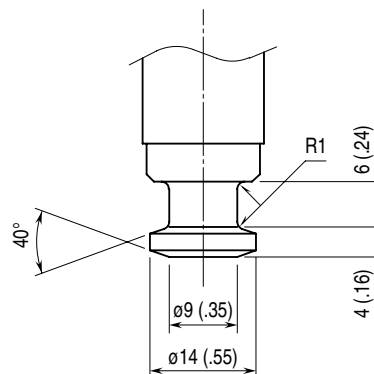
Figure 8. Stem Details
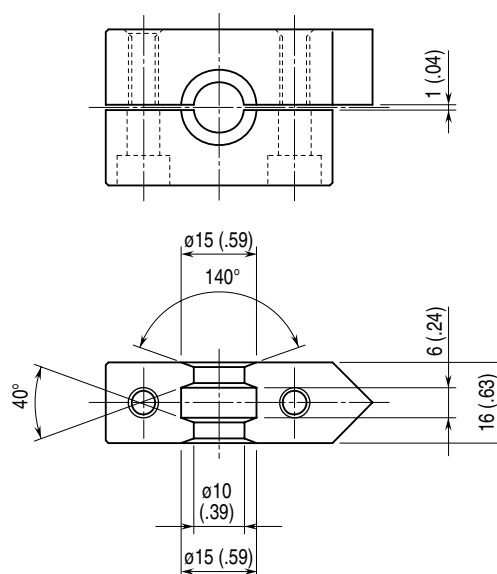
Figure 9. Indicator Details

6. WIRING CONNECTION

■ **CC-Link CONNECTOR**

Use a 5-core micro-style connector, female (e.g. Woodhead CC-Link Micro-Change), and cable approved for CC-Link.

■ **POWER INPUT CONNECTOR**

Use a 4-core micro-style connector, female (e.g. OMRON XS2F or XS2WD42).

Recommended T-shape adaptor, if necessary, is OMRON XR2R-D427-5.

■ **TERMINATING RESISTOR**

Recommended terminating resistor (connector) is Woodhead CC150.

7. ADJUSTMENT PROCEDURE

7.1. MANUAL OPERATION

The MSPxC can be manually controlled regardless of the communications status. Turn the SW5-1 ON to enable the manual operation mode. The SW8 and SW7 are used for control.

Table 2. SW5 setting, manual operation

SW5	OFF	ON
1	Control via communications	Manual operation
2	Invalid	0% manual control command
3	Invalid	100% manual control command
4	Unused	

Turning both SW5-2 and -3 is invalid. The actuator operation stops.

SW8: The stem moved toward 0% position while pressing this switch.

SW7: The stem moved toward 100% position while pressing this switch.

7.1.1. GENERAL PROCEDURE

After installing the valve and actuator, go to adjustments in order of Zero, Span, and the seal-spring.

7.1.2. ZERO & SPAN

1) Zero Adjustment: Turn the power supply on and set the SW5-1 and -2 ON (OFF for the others on the SW5). This turns the actuator into the manual operation mode and automatically controls the stem toward the 0% position.

Once the stem reaches the position, adjust either the actuator with the Zero potentiometer or the mechanical position of the valve stem connection so that the actuator's extended position (valve's retracted position) is adequate.

If extra sealing pressure by the seal-spring is required, push in the actuator stem referring to Table 3.

2) Span Adjustment: Turn the power supply on and set the SW5-1 and -3 ON (OFF for the others on the SW5). This turns the actuator into the manual operation mode and automatically controls the stem toward the 100% position.

Once the stem reaches the position, adjust either the actuator with the Span potentiometer or the mechanical position of the valve stem connection so that the actuator's retracted position (valve's extended position) is adequate.

For three-way valves, the sealing pressure can be adjusted to be applied in the direction where the output stem is fully retracted (not available for the MSP4C). Adjustment procedure is the same for Zero.

3) With 0% input again, check that the Mini-Top is at the fully extended position. If the position is shifted, go through the above procedure again.

Note 1: There is only minimal effect of span adjustment to zero point, thus the stem position shifts very little at the extended side when the span potentiometer is turned.

Note 2: With the stroke narrower, hunting (the motor repeats changing direction) can happen more often. Adjust Deadband in such cases.
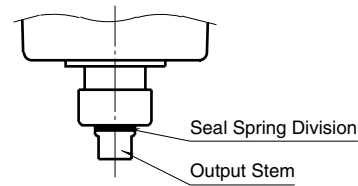
Figure 10. Seal-spring

Table 3. Seal-spring pressure

MODEL	SPRING CONTRACTION (mm)	CONTACT* PRESSURE (N / lbs)	SEALING PRESSURE (N / lbs)
MSP4C-x3	0.5	147/33	98/22
MSP4C-x4	1.0	300/67	250/56
MSP4C-x7	1.0	686/154	294/66
MSP5C-x3	0.5	150/34	110/25
MSP5C-x4	1.0	294/66	216/49
MSP5C-x7	1.0	686/154	294/66
MSP6C-x3	1.0	588/132	441/99
MSP6C-x4	1.0	1170/263	882/198
MSP6C-x6	1.5	2350/529	1170/263

* The minimum pressure required to contract the spring.

Note: Graduations by 1 millimeter increments are marked on the stem. For example, with MSP4C-x7, the sealing pressure reaches approx. 490 N at 0.5 mm, 686 N at 1 mm.

7.1.3. DEADBAND

'Deadband' is provided in 0.2% increments from 0.1%, 0.3%, 0.5%, ... with the fractions dropped.

SW4	DEADBAND (%)
0	0.1
1	0.3
2	0.5
3	0.7
4	0.9
5	1.1
6	1.3
7	1.5
8	1.7
9	1.9

Figure 11. Deadband

7.1.4. RESTART LIMITING TIME

Set the restart limiting time as follows:

SW6-1	SW6-2	RESTART LIMITING TIME (sec.)
OFF	OFF	0
ON	OFF	1.5
OFF	ON	5
ON	ON	10

7.1.5. COMMUNICATION ERROR OPERATION

The actuator operation in case of a communication error once normal communication is established after the power is turned on is defined as follows:

SW6-3	SW6-4	COMM. ERROR OPERATION
OFF	OFF	Stop
ON	OFF	0% position
OFF	ON	100% position
ON	ON	Stop

7.2. CC-Link
7.2.1. STATION NO.

Set the upper digit (x10) with SW1 and the lower digit (x1) with SW2.
This device occupies one station.

7.2.2. BAUD RATE

The baud rate is selected with the SW3.

SW3	BAUD RATE
0	156 kbps
1	625 kbps
2	2.5 Mbps
3	5 Mbps
4	10 Mbps

All other settings are invalid.

7.2.3. COMMUNICATIONS
■ MASTER to SLAVE

DATA TYPE	ADDRESS	FUNCTION	DETAIL
Bit	RY0	Forced Closed Position Input *1	0 : Disable 1 : Position = 0%
	RY1	Forced Open Position Input *1	0 : Disable 1 : Position = 100%
	RY2		
	RY3		
	RY4		
	RY5		
	RY6		
	RY7		
	RY8	Enable Target Position Input	0 : Disable 1 : Enable
	RY9		
	RYA	Reset Motor Deadlock Alarm	Motor deadlock alarm is canceled when '1' is set.
	RYB	Clear Motor Starting Counter	Motor starting counter is reset to 0 when '1' is set.
	RYC	Clear Motor Reversing Counter	Motor reversing counter is reset to 0 when '1' is set.
	RYD	Clear Accumulated Running Distance	Accumulated running distance is reset to 0 when '1' is set.
	RYE		
	RYF		
Word	RWw0	Target Position Input	Signed, 0.01% increments (e.g. 100 = 1.00%) Valid only when Enable Target Position Input is enabled.
	RWw1		
	RWw2		
	RWw3		

*1. Valid regardless of the RY8 (Enable Target Position Input) status. Stopped when '1' is set both at RY0 and RY1.

■**SLAVE to MASTER**

| DATA TYPE	ADDRESS	FUNCTION	DETAIL
Bit	RX0		
	RX1		
	RX2		
	RX3		
	RX4		
	RX5		
	RX6		
	RX7		
	RX8	Motor Deadlock Alarm	0 : Normal 1 : Overload or other deadlock alarm
	RX9	Target Position Input Error	0 : Normal 1 : Out of range from -0.5 to +100.5%
	RXA	System Error	0 : Normal 1 : Memory or other system error
	RXB	Control Status	0 : Remote (CC-Link) 1 : Manual
	RXC		
	RXD		
	RXE		
	RXF		
Word	RWr0	Position Output	Signed, 0.01% increments (e.g. 100 = 1.00%)
	RWr1	Motor Starting Counter *2	1 count per every 100 starting actions
	RWr2	Motor Reversing Counter *2	1 count per every 100 reversing actions
	RWr3	Accumulated Running Distance (%) *2	1 count per running 100% distance every time

*2. When the count reaches 65535, the value is held until it is reset.

7.2.4. BASIC OPERATING PROCEDURE

(1) Normal Operation

Once the communication is established, the actuator can be operated only by setting 'Enable Target Position Input' (RY8) to '1' and providing 'Target Position Input' value (RWw0).

Target Position Input data is described by signed 16-bit data, representing 0.01% by 1 LSB.

```
Set 'Enable Target Position Input' to '1.'
    └─ Set 'Target Position Input.'
```
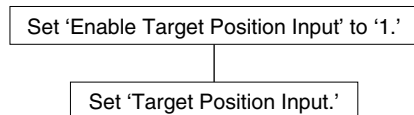
For example, set '5000' in binary for 50% setpoint. Set '-50' for -0.5%. Binary must be 2's complement.

'Position Output' (RWr0) data is in the same format.

(2) Motor Deadlock Alarm

When the motor is overloaded or stuck with a foreign object, the actuator sets '1' to 'Motor Deadlock Alarm' (RX8) and stops.

When '1' is set to 'Reset Motor Deadlock Alarm' (RYA), the actuator restarts.

Be sure to confirm that the Motor Deadlock Alarm is reset to '0' before returning Reset Motor Deadlock Alarm to '0.'

(3) Operation Report

The following data can be read out for maintenance purposes: Motor Starting Counter, Motor Reversing Counter and Accumulated Running Distance.

These data are stored in the nonvolatile memory every 10 minutes and are not deleted even when the power is removed.

In order to reset these data to 0, set '1' to the respective reset commands (RYB to RYD).

Return the reset signals to '0' after the data resetting has been confirmed.

8. MAINTENANCE

For effective use and longer life of the Mini-Top, regular checking appropriate for its operating conditions are recommended. Refer to the following table.

ITEM	CHECKING POINT	HOW TO PROCEED
Functioning	Apply input 0%, 50%, 100%, then back to 50%, 0%. Check the actuator operations and positions at each input value.	Repair or calibration
Abnormal sound	No abnormal sound is heard during operation.	Repair or calibration
Connector Leadwire	The connector is firmly connected. No breakdown of leadwires. The insulation covers are not torn, not bruised.	Repair or calibration
Inside humidity, rust	No condensation. No rust. If there is water inside, check the packing.	Remove water, dry the case and inside parts. Replace rusted parts. If the packing is damaged, replace it.
Screws	Check that screws and bolts are securely fastened.	Re-tighten them.
Nut	Check that the nut at the valve stem is not loose.	Re-tighten it and calibrate.

For repair or parts replacement, contact M-System or representatives.

■LUBRICATION

There is no need of oiling the Mini-Top in normal operating conditions.

■REGULAR TEST RUNNING

If the valve is not frequently operated, run a test operation regularly (once a week, for example) to check proper functions.

9. TROUBLESHOOTING

TROUBLE	L RUN	L ERR	POSSIBLE CAUSE	HOW TO PROCEED
No Function	ON	OFF	Normal communication?	Confirm that the manual operation is possible.
	ON	Blink	Baud rate has been changed after the power supply has been turned on.	Turn the power supply off and on.
	OFF	OFF	Power source is turned off or cable broken.	Check the power source and the cables.
	—	ON	Station No. and/or Baud rate error detected when the power supply has been turned on. Communication error	Correct the Station No. and/or Baud rate setting. Check noise possibilities. Check the terminating resistor.
Unstable functioning			Power voltage is low or fluctuating.	Check the power supply.
			Position sensor damaged.	Replace the position sensor.
Stopped in the middle of stroke Slows down in the middle of stroke			Actuator mechanism is damaged.	Repair.
			Overload cause by a foreign object caught in stroke the valve.	Check the valve.

10. LIGHTNING SURGE PROTECTION

M-System offers a series of lightning surge protectors for protection against induced lightning surges. Please contact M-System to choose appropriate models.