INSTRUCTION MANUAL

FOR

MAGNETOSTRICTIVE LEVEL MEASUREMENT

SENSOR MODEL: MS 350
               MS 360
               MS 370
               MS 380

MONITOR UNIT MODEL: MS 2000

Revision 2014-04-15
Read and understand this manual for safe usage.

- This manual describes the product of standard specification. Read the other manual for the product of explosion-proof specification.
- This manual describes the handling, inspection and adjustment of the product whose model is mentioned on the cover page. Read and understand this manual before handling.
- Follow the additional document and/or direction, submitted by NOHKEN INC. and our distributor or agent, even if the terms are mentioned in this manual.
- Save this manual in a proper place being available to refer to immediately.
- The specification of product mentioned in this manual may not be satisfied by the condition of environment and usage. Check and consider carefully before using.
- Contact to sales office at NOHKEN INC. for any question or comment about this manual and product.

The following are the description of the terms in this manual.

<table>
<thead>
<tr>
<th>![WARNING]</th>
<th>Indicates a potentially hazardous situation which, if not paid attention to, could result in death, serious injury or serious disaster.</th>
</tr>
</thead>
<tbody>
<tr>
<td>![CAUTION]</td>
<td>Indicates a hazardous situation which, if not paid attention to, may result in minor or moderate injury or damage to the device.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>![Prohibited]</th>
<th>Indicates a prohibited matter. The explanation with this mark shall be followed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Instructed]</td>
<td>Indicates an instructed matter. The explanation with this mark shall be followed.</td>
</tr>
</tbody>
</table>
### WARNING

This product is not explosion-proof construction. Do not install this product to the place where the flammable gas or vapor occurs. If installed, the flammable gas or vapor may be ignited, and serious disaster may occur. Use the product of explosion-proof construction in this case.

Do not modify or disassemble the product. Otherwise, the product and connected device may be malfunctioned, damaged, fired, or minor injury and electric shock may occur. (Follow the additional document and/or direction, submitted by NOHKEN INC. and our distributor or agent.)

Turn off the power, before wiring and inspection. Otherwise, electric leakage, fire caused by short circuit, and electric shock may occur.

Ensure the wire is properly connected. The product and connected device may be malfunctioned, damaged, fired, or minor injury and electric shock may occur by improper wiring.

Turn off the power immediately, if the smoke, strange smell and sound occur. Do not use it until the problem is solved.

### CAUTION

Avoid strong shock and rough handling to this product. The product may be damaged by strong shock such as dropping, falling, throwing, knocking, lugging, etc.

Follow the specification of operating temperature, operating pressure, switch rating, etc. Otherwise, the product and connected device may be malfunctioned, damaged, fired, or minor injury and electric shock may occur. Check the manual or specification sheet.

Operation test shall be done before practical usage. If the serious accident is expected to occur by malfunction of the product, the other operating principle of product shall be installed in parallel.
<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check and deeply consider the chemical compatibility for the material of product in advance. The part especially float, which is very thin, may be malfunctioned by minor corrosion.</td>
</tr>
<tr>
<td>Hold the stem very close to the mounting point, when carrying, installing, and removing. If held by the terminal box, it may be taken off from the flange or plug, and the product may be damaged by dropping.</td>
</tr>
</tbody>
</table>
| The product is 50cm or longer
The product shall be kept horizontally. The product and other goods could be damaged, and minor injury may occur by falling. |
| In case of connecting inductive or lamp load to the product.
Provide protective circuit to the load to avoid over voltage and over current. If not provided, the contact may be damaged. |
| Provide arrester or surge absorber to avoid electrical impact such as lightning and static electricity. If not provided, the product and connected device may be malfunctioned, damaged, and fired, or minor injury and electric shock may occur. |
INTRODUCTION
A) This manual specifies the specification of a general product.
   If you order a special product, some details of specification may be different with the manual.
B) We are glad to suggest and advise for Model selection and chemical resistance of material, but final decision has to be made by the customer.
C) This manual has been prepared with close attention. Ask sales office at NOHKEN INC. for any question or comment about the contents of this manual.
D) For replacement parts
   The quality of product has frequently improved, so same spare parts may not be supplied. In this case, replacement parts or products may be supplied. Ask sales office at NOHKEN INC. for details.
E) The contents of this manual are subject to change any time without notice due to the improvement of the product.

WARRANTY & DISCLAIMER
A) NOHKEN INC. warrants this product against defect in design, material and workmanship for a period of 1(one) year from the date of original factory shipment.
B) The warranty only covers the damage of products. The secondary and third kind disasters are not covered by NOHKEN INC.
C) NOHKEN INC. shall not be liable for the following.
   C-a) Do not follow the description and direction in this manual.
   C-b) Damage due to improper installation, wiring, usage, maintenance, inspection, storing, etc.
   C-c) Repair and modification are done by the person who is not an employee of NOHKEN INC. and our distributor or agent.
   C-d) Improper parts are used and replaced.
   C-e) The damage is occurred by the device or machine except our products.
   C-f) Improper usage. (See "Purpose of use" in chapter 1 in this manual)
   C-g) Force Majeure including, but not limited to, fire, earthquake, tsunami, lightning, riots, revolution, war, radioactive pollution, acts of God, acts of government or governmental authorities, compliance with law, regulation, and order.

THE TERMS OF WARRANTY AND DISCLAIMER SHALL IN NO WAY LIMIT YOUR LEGAL RIGHTS.
# TABLE OF CONTENTS

1. PURPOSE OF USE

2. DESCRIPTION
   2.1 Description
   2.2 Principle of operation
   2.3 Block diagram
   2.4 Features of the monitor unit

3. SPECIFICATIONS
   3.1 Model numbering
      3.1.1 Model name of the sensor
      3.1.2 Model name of the monitor unit
   3.2 Specifications
      3.2.1 Specifications of the sensor
      3.2.2 Specifications of the monitor unit

4. HANDLING NOTES
   4.1 Sensor handling notes
   4.2 Monitor unit handling notes

5. INSTALLATION
   5.1 Sensor unpacking
   5.2 Sensor installation
      5.2.1 Location
      5.2.2 Mounting
   5.3 Monitor unit unpacking
   5.4 Monitor unit installation
      5.4.1 Check of attachment place
      5.4.2 Installation

6. WIRING
   6.1 Preparation of the sensor
   6.2 Preparation of the monitor unit
   6.3 Wiring for input signal
   6.4 Operational check

7. PART NAMES AND FUNCTION
   7.1 Sensor part names
   7.2 Part names and function of the monitor unit
8. OPERATION

8.1 Operation

8.2 Setting of the monitor unit

8.2.1 Zero and Span point adjustment

8.2.2 Alarm output setting

8.3 Contents of parameter

8.3.1 Input and output

8.3.2 Alarm output operation

8.3.3 Volume conversion

8.3.4 Linear profile

8.3.5 Check test of operation

8.3.6 Initialization

8.4 Error message

9. MAINTENANCE AND INSPECTION

9.1 Maintenance and inspection of the sensor

9.1.1 Removing

9.1.2 Maintenance and inspection

9.1.3 Re-installation

9.1.4 Wiring

9.1.5 Replacement parts and cycle

9.1.6 Replacement parts

9.1.7 Calibration

9.2 Maintenance and inspection of the monitor unit

10. STORING

10.1 Storing of the sensor

10.2 Storing of the monitor unit

11. TROUBLESHOOTING

12. GLOSSARY
1. PURPOSE OF USE

The MS series is designed for level detection of liquids such as water, oil, chemicals, solvents, and so on. It is used for continuous process control and precise inventory control.

2. DESCRIPTION

2.1 Description

The MS continuous level measuring system is constructed from the sensor, Model MS350, MS360, MS370, MS380, and the remote Monitor unit, Model MS2000 to measure the liquid level in the tank.

The sensor is mounted onto the tank by the mounting flange(*) or mounting plug.

As the float(*) rises or falls on the stem(*), continuous electrical signal, 4-20mA DC, is transmitted in proportional to the liquid level.

Monitor unit is a microprocessor-based (MPU) and compact. It provides easy calibration, volume conversion, linearization, and analog output (4-20mA DC) and relay outputs.

2.2 Principle of operation

The MS consists of a magnetostrictive wire(*) in the stem and a permanent magnet(*) inside the float. Once a pulse current is induced from the end of the magnetostrictive wire, a tubular magnetic field emanates. As the float travels, torsional vibration is launched by the interaction between the float magnetic field and the magnetostrictive wire. This is so-called Wiedeman effect.

The float position is measured by measuring the lapse of time from the launching of the torsional vibration to the arrival to the pick-up.

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* Refer to 12. GLOSSARY
2.4 Features of the monitor unit

1. Available wide power supply, 100 to 240 V AC.
2. Programmable relay outputs for alarm orientation (High and Low), hysteresis and fail-safe function.
3. EEPROM stores all parameter values permanently.
4. Volume conversion for volumetric indications.
5. Easy-to-read graphic indication and 4-digit LED.
6. Built-in test circuit for signal (4-20mA DC).
7. Power supply, inputs and outputs are isolated.

3. SPECIFICATIONS

3.1 Model numbering

3.1.1 Model name of the sensor

<table>
<thead>
<tr>
<th>Model</th>
<th>Wetted parts material</th>
<th>Float travel stop (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>304 stainless steel</td>
<td>316L stainless steel</td>
</tr>
<tr>
<td>V</td>
<td>316 stainless steel</td>
<td>27.2</td>
</tr>
<tr>
<td>F4T</td>
<td>PVC (only standard type)</td>
<td>13.8</td>
</tr>
<tr>
<td>F6T</td>
<td>TFE's PTFE tubing (only stem 27.2)</td>
<td>16</td>
</tr>
<tr>
<td>PFT</td>
<td>TFE's PFA tubing (only stem 31)</td>
<td>31</td>
</tr>
</tbody>
</table>

3.1.2 Model name of the monitor unit

<table>
<thead>
<tr>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Standard type</td>
</tr>
<tr>
<td>V</td>
<td>Standard type</td>
</tr>
<tr>
<td>F4T</td>
<td>Heatproof type</td>
</tr>
<tr>
<td>F6T</td>
<td>Heatproof type</td>
</tr>
<tr>
<td>PFT</td>
<td>Heatproof type</td>
</tr>
</tbody>
</table>

5. CAUTIONS

Model F4T, F6T, PFT:
Output value at lowest level can be smaller than 4.00mA when the tubing pipe is extended due to high working temperature and more the float travel stop.

Refer to 12. GLOSSARY
### 3.2 Specifications

#### 3.2.1 Specifications of the sensor

<table>
<thead>
<tr>
<th>Material</th>
<th>Specific Gravity</th>
<th>Stainless Steel</th>
<th>PVC</th>
<th>PTFE</th>
<th>FEP</th>
<th>PFA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MS350</td>
<td>MS360</td>
<td>MS370</td>
<td>MS380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>0.55 or more</td>
<td>0.55 or more</td>
<td>0.7 or more</td>
<td>0.7 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC</td>
<td>0.65 or more</td>
<td>-</td>
<td>0.8 or more</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFA</td>
<td>-</td>
<td>-</td>
<td>0.95 or more</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

#### Power supply

<table>
<thead>
<tr>
<th>Material</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>-10 to +80 °C</td>
</tr>
<tr>
<td>PVC</td>
<td>-5 to +50 °C</td>
</tr>
<tr>
<td>PTFE</td>
<td>-10 to +50 °C</td>
</tr>
<tr>
<td>FEP</td>
<td>-10 to +50 °C</td>
</tr>
<tr>
<td>PFA</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Mechanical characteristics

<table>
<thead>
<tr>
<th>Material</th>
<th>Mechanical characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>-10 to +80 °C</td>
</tr>
<tr>
<td>PVC</td>
<td>-5 to +50 °C</td>
</tr>
<tr>
<td>PTFE</td>
<td>-10 to +50 °C</td>
</tr>
<tr>
<td>FEP</td>
<td>-10 to +50 °C</td>
</tr>
<tr>
<td>PFA</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Environment

<table>
<thead>
<tr>
<th>Material</th>
<th>Wetted parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>JIS 5K 50A</td>
</tr>
<tr>
<td>PVC</td>
<td>JIS 5K 80A</td>
</tr>
<tr>
<td>PTFE</td>
<td>-</td>
</tr>
<tr>
<td>FEP</td>
<td>-</td>
</tr>
<tr>
<td>PFA</td>
<td>-</td>
</tr>
</tbody>
</table>

### Electrical characteristics

<table>
<thead>
<tr>
<th>Material</th>
<th>Electrical characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>2 MPa</td>
</tr>
<tr>
<td>PVC</td>
<td>200 kPa</td>
</tr>
<tr>
<td>PTFE</td>
<td>200 kPa</td>
</tr>
<tr>
<td>FEP</td>
<td>200 kPa</td>
</tr>
<tr>
<td>PFA</td>
<td>-</td>
</tr>
</tbody>
</table>

### Model

<table>
<thead>
<tr>
<th>Separation distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3C-2V coaxial cable</td>
</tr>
<tr>
<td>500 m Max.</td>
</tr>
</tbody>
</table>

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### IP65

Refer to the sensor model (Section 3.1.1)

### Aluminum die casting (ADC12)

### Withstanding pressure of float

For MS2000 and MS3500

### Working temperature

<table>
<thead>
<tr>
<th>Working withstanding pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
</tr>
<tr>
<td>PVC, PTFE, FEP, PFA</td>
</tr>
</tbody>
</table>

---

### Electrical specifications

<table>
<thead>
<tr>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
</tr>
<tr>
<td>PVC, PTFE, FEP, PFA</td>
</tr>
</tbody>
</table>

---

### Withstanding pressure of float

For MS2000 and MS3500
3.2.2 Specifications of the monitor unit

**Model MS2000**

- **Operation Accuracy Sensor measurement**: ±1000 ppm measurement ±1000 ppm characteristics
- **Input/Output**:
  - MS350S: 1 channel, ±0.1% F.S.
  - MS360S: 1 channel, ±0.1% F.S.
  - MS370S: 1 channel, ±0.1% F.S.
  - MS380S: 2 channels, ±0.1% F.S.

- **Display**:
  - MS350F4T: 1 digit, ±0.2% F.S.
  - MS350F6T: 1 digit, ±0.2% F.S.
  - MS370PFT: 1 digit, ±0.2% F.S.

- **Digits**: -9999 to 99999
- **Sampling cycle**: Approximately 0.12 seconds

**Electrical Power supply**

- 100 to 240 V AC ±10% 50/60 Hz
- **Power consumption**: Max. 20 VA
- **Power supply for sensor**: 15 V DC

**Input signal for MS350, MS360, MS370, MS380**

- **Output signal**: 4 to 20 mA DC
- **Allowable resistive load**: 600 Ω Max.

**Alarm**

- Number: 4 alarm points (2 points ~ 2 circuits) transfer of contact (common use between HH and H, LL and L)
- **Contact rating**:
  - 240 V AC (resistive load) 3 A
  - 240 V AC (resistive load) 3 A

**Withstand voltage**

- 1500 V AC, 1 minute (between power supply terminal and earth terminal)
- 500 V AC, 1 minute (between output terminal and input terminal)

**Insulation resistance**

- 100 MΩ or more (between power supply terminal to earth terminal)
- 50 MΩ or more (between output terminal and input terminal)

**Environment**

- **Working temperature**: -5 to +50°C (no dew condensation)
- **Working humidity**: 85% RH Max.

**Others**

- **Material body**: ABS
- **Front panel**: Polyester
- **Mounting screws**: Stainless steel

**Dimension (H~W~D)**: 96 mm~96 mm~132 mm (except fittings, panel cut-out: 92~92 mm)

**Mass**: 560 g (except fittings)
### Handling Notes

#### 4.1 Sensor Handling Notes

When handling the sensor, the following should be observed to prevent malfunction or accidents. Lay the sensor horizontally in your inventory, placing a wood piece or adequate materials under it to prevent rolling, bending, or scoring. If the stem length is longer than 2000mm, it is recommended to place them 1000mm apart.

Do not paint on the nameplate to keep the indication of the serial number for future reference when ordering parts. Do not use or store the sensor in a corrosive atmosphere (such as NH₃, SO₂, etc.). Internal circuitry may be corroded, leading to conduction failure. Do not use or store the sensor in a vibration-prone area. If vibration cannot be avoided, provide appropriate means to prevent it. Locate the sensor away from noise generators like motors, pumps, inverters, and high-frequency electric fields. Do not use the sensor in a liquid containing metallic substances, as this may cause it to malfunction.

<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Correct Diagram" /></td>
<td><img src="image" alt="Incorrect Diagram" /></td>
</tr>
</tbody>
</table>

**Diagram Notes:**
- **Correct:** Proper handling with a specified distance between sensors to prevent rolling, bending, or scoring.
- **Incorrect:** Improper handling leading to rolling, scoring, or falling.

**Diagram Details:**
- **Correct:** Physical shock and distance markers.
- **Incorrect:** Bending, rolling, scoring, and falling.

**Environment Diagrams:**
- **Corrosive atmosphere**
- **Vibration**
- **High frequency electric field**
- **Metallic substances**

---

**Diagram Sources:**
- **Correct Diagram:** [Image Source]
- **Incorrect Diagram:** [Image Source]

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**Handling Tips:**
1. Store the sensor horizontally to prevent damage.
2. Keep a distance of 1000mm between sensors with a stem longer than 2000mm.
3. Avoid painting the nameplate to maintain serial number visibility.
4. Do not store in corrosive environments to prevent internal circuitry corrosion.
5. Prevent vibration and locate the sensor away from noise generators.
6. Do not use in liquids containing metallic substances.
4.2 Monitor unit handling notes

Following shall be observed when handling the monitor unit. Otherwise, malfunction or accident may occur.

Avoid physical shock. Dropping, throwing or bumping will damage the monitor unit.

Do not put the monitor unit where it will be exposed to direct sunlight. Locate away from condensation, dust and foreign matters.

Do not put the monitor unit in puddles to avoid insulation failure.

Do not use in a corrosive atmosphere such as NH₃, SO₂, Cl₂, etc. Internal circuit board will be corroded through radiation slots.

Keep the Monitor Unit in sealed plastic bags with desiccant or other moisture proof packing. Put it indoor when storing.

Operational test should be performed to avoid malfunction when it is not used over one year.

To avoid personal injury, JIS Class D earthing (less than 100Ω) should be done.

Key switches on the front panel are cushion switches. Push them surely.

Do not push the front panel with sharp objects.

Wipe the front panel clean of dirt with a clean dry cloth. Do not use solvents.
5. INSTALLATION

5.1 Sensor unpacking

**CAUTION**
- The MS350, MS360, MS370, MS380 is not an explosion-proof construction, do not use where flammable gas, explosive gas or the vapor exists.

**CAUTION**
- Turn the mounting plug only when installing. Do not turn the housing. Otherwise, the housing connection to the mounting plug will be broken.

When unpacking, grab the flange or the stem base near by the flange to keep the balance of mass. Otherwise, you will drop the sensor or bend the stem. Avoid physical shock for the stem tip or the enclosure. We recommend to handle at least two persons for the long stem, more than 1500mm.
Avoid physical shock.
Dropping, throwing or bumping shall damage the sensor.

Remove all sealed plastic bags or tapes from the sensor.
After removing and tilting the stem, avoid physical shock to the float due to slip on the stem.
Otherwise, magnetic strength of the float will vary or the float will collapsed.

Do not put on the sensor.
It shall damage and deform the sensor.

Make sure that it is the right product you required.
Model numbering of the sensor is indicated on the nameplate.
If incorrect, ask Nohken or our distributor.

After unpacking, inspect the sensor for shipping damage.
If there is evidence of damage, notify the carrier immediately and ask Nohken.
5.2 Sensor installation

5.2.1 Location

Before installing the sensor, provide ample space for installation, maintenance and inspection. Especially keep enough overhead space for top mounting.

This sensor shall be installed in an area which meets the following conditions.

1. Do not locate near liquid inlets or outlets. Optimally provide a guard pipe (*).
   - Inner diameter of the guard pipe should be larger than 20mm of the float outside diameter.
   - Drill vent holes in the tube and use the spacer (*) to keep the float travelling.

2. Locate away from the obstruction (pipe, plumbing, pump, and so on) to the float travelling.

5.2.2 Mounting

Provide the compatible mating flange on the tank top. Install the sensor to the tank using appropriate tools and suitable bolt and nuts.

If there is pressure in the tank, the appropriate seal gasket shall be provided.

Bolt, nuts, and gasket shall be ordered separately if necessary.

* Refer to 12. Glossary
5.3 Monitor unit unpacking

**CAUTION**

Since this monitor unit is not an explosion-proof construction, do not use where flammable gas, explosive gas or the vapor exists.

1. Avoid physical shock. Dropping, throwing or bumping will damage the monitor unit.
2. Do not put things on the monitor unit. It will deform and damage the product.
3. Inspect the model numbering on the name plate to meet your order. If incorrect, ask to our sales department or our distributor.
4. After unpacking, inspect the monitor unit for shipping damage. If there is evidence of damage, notify the carrier and us immediately.

5.4 Monitor unit installation

**CAUTION**

The products are shipped with a protective film on the front panel. Remove the film before use. Left on for a long period, glue on the film will not be removed completely to reduce the screen clarity.

5.4.1 Check of attachment place

Provide ample space for maintenance and inspection. Make sure the following to avoid malfunction.

1. Ambient temperature range is from -5°C to +50°C, and humidity is under 85%RH.
2. The weight of the monitor unit is 560g. Provide appropriate reinforce for thin panels if necessary.
3. Locate away from rain and jetting water. The monitor unit is not waterproof.
5.4.2 Installation

1. Drill the mounting panel to mount the monitor unit. See the following figure for dimensions and mounting pitches.
2. Insert the monitor unit from the front panel.
3. Install mounting brackets into the body of the transmitter from the back side of the mounting panel. See the following figure for mounting procedures.
4. Tighten mounting brackets with the Phillips screwdriver surely.
6. WIRING

6.1 Preparation of the sensor

Turn off the power supply.

⚠️ WARNING ⚠️

Turn off the power before wiring, maintenance or inspection. Otherwise, the electric leakage, electric shock and ignited by short circuit may be occurred.

⚠️ CAUTION ⚠️

Remove the cover from the housing. Do not mix when removing more than two sensors on the same location. Model number, serial number, total length and measuring range are indicated on the back of the cover.

The size of the cable inlet is G 3/4".
There are two ways for connecting the sensor cable. One is fixing the cable with a cable gland. The other is connecting a conduit to the housing. In either case, an adequate sealing should be provided to prevent water or dust ingress into the housing through the sensor cable. Secure the cable using sealing material for the conduit connection, or a proper tool when the gland is used, to protect the housing inside from dust or water. When water or moisture comes into the housing from the conduit, use putty to fill the inside of the conduit.

Correct

![Correct Wiring Diagram](image)

Incorrect

As for wiring of the sensor and the transmitter, please use the 3C-2V coaxial cable or 5C-2V coaxial cable. Do not lay it in parallel with power cable or control cable for the magnetic switch.

Connect either external or internal terminal to the ground. (Grounding resistance: 100Ω Max.) Otherwise, measuring signal will be unstable or fluctuated due to noise problem.

Reinstall the cover.
Ensure that there is no metallic dust in the housing.
6.2 Preparation of the monitor unit

Turn off the power supply during wiring.

**WARNING**

Turn off the power before wiring, maintenance or inspection. Otherwise, the electric leakage, electric shock and ignited by short circuit may be occurred.

**CAUTION**

To prevent electrical shock, the earth terminal should be connected to the JIS class D earthing (less than 100Ω).

Lay the analog output cable away from the power line to prevent noise. Should be done.

The shield of the input signal cable should be connected to the earth at the sensor side.

The earth connection of output and input signal cable shield should be one point.

Make sure that the supply voltage is sufficient, within 100 to 240V AC range. Otherwise, the Monitor Unit may cause malfunction or damage.

The load resistance of current output is 600Ω Max. Excessive load cause malfunction.

Contact rating for relay output is 240V 3A AC or 30V 3A DC. Provide external relays when exceeding.

When electrical surges are produced, provide appropriate surge absorber or protective circuit.

Reinstall the protective cover which is placed over the terminal plate to avoid electric shock.
6.3 Wiring for input signal

Fail-safe mode is programmable for alarm outputs. Relay operations are completely changed when you choose the fail-safe mode. The default is without fail-safe mode. See the below table for operating differences.

<table>
<thead>
<tr>
<th>Power</th>
<th>Liquid level</th>
<th>Fail-safe mode</th>
<th>Without fail-safe mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Set point or higher</td>
<td>Up ON</td>
<td>Down ON</td>
</tr>
<tr>
<td>ON</td>
<td>Set point or lower</td>
<td>Up ON</td>
<td>Down ON</td>
</tr>
<tr>
<td>OFF</td>
<td>-</td>
<td>Up ON</td>
<td>Down ON</td>
</tr>
</tbody>
</table>

6.4 Operational check
Ensure the monitor unit operation in the test stage. If the operation is unsuccessful, check wiring, read this manual again, or contact our sales department.
7. PART NAMES AND FUNCTION
7.1 Sensor part names

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover</td>
<td>6</td>
<td>Float travel stop</td>
</tr>
<tr>
<td>2</td>
<td>External earth terminal</td>
<td>7</td>
<td>Float</td>
</tr>
<tr>
<td>3</td>
<td>Cable inlet (G 3/4)</td>
<td>8</td>
<td>Stem</td>
</tr>
<tr>
<td>4</td>
<td>Housing</td>
<td>9</td>
<td>Radiation fin</td>
</tr>
<tr>
<td>5</td>
<td>Flange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MS350S  MS350V  MS370S  MS370V  MS360S  MS380S

MS350F4T  MS350F6T  MS370PFT

- 15 -
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>‡@</td>
<td>Mode key</td>
<td>Used to change the items to be set.</td>
</tr>
<tr>
<td>‡A</td>
<td>Enter key</td>
<td>Enters the data value.</td>
</tr>
<tr>
<td>‡B</td>
<td>Up key</td>
<td>Used to change the data value.</td>
</tr>
<tr>
<td>‡C</td>
<td>Down key</td>
<td>Used to change the data value.</td>
</tr>
<tr>
<td>‡D</td>
<td>Alarm HH</td>
<td>Lights while HH set.</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>Lights while H set.</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>Lights while L set.</td>
</tr>
<tr>
<td></td>
<td>LL</td>
<td>Lights while LL set.</td>
</tr>
<tr>
<td>‡E</td>
<td>Mode OP.</td>
<td>Lights while measurement mode.</td>
</tr>
<tr>
<td></td>
<td>ADJ.</td>
<td>Lights while adjustment mode.</td>
</tr>
<tr>
<td></td>
<td>(Without zero point mode and span point adjustment mode.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALARM</td>
<td>Lights while alarm setting mode.</td>
</tr>
<tr>
<td></td>
<td>TEST</td>
<td>Lights while test mode.</td>
</tr>
<tr>
<td></td>
<td>ZERO</td>
<td>Lights while zero point adjustment mode.</td>
</tr>
<tr>
<td></td>
<td>SPAN</td>
<td>Lights while span point adjustment mode.</td>
</tr>
<tr>
<td>‡F</td>
<td>Unit</td>
<td>Display indication unit. (Choose a use unit from the unit seal and set it.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‡G</td>
<td>Variable data</td>
<td>Display process value, characters identifying the data being set and error messages.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‡H</td>
<td>Parameter data</td>
<td>Display parameter data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‡I</td>
<td>Liquid level/contents</td>
<td>Display liquid level / contents.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alarm identification</td>
<td>Display alarm identification.</td>
</tr>
</tbody>
</table>

**CAUTION**

The products are shipped with a protective film on the front panel. Remove the film before use. Left on for a long period, glue on the film will not be removed completely to reduce the screen clarity.
8. OPERATION
Monitor unit’s operation, setting and calibration are done by depressing the keypad on the front panel as MODE key, ENTER key, UP key, and DOWN key. Once you entered your desired value to the parameter, it will be saved until change or initialization when the MS is powered up, it automatically starts up the setting mode. Parameter’s value are programmable after changing to the setting mode. Incidentally, when ordering a sensor and monitor unit by the set, it sets to the electric current output by 4 to 20mA and 0 to 100 displays in the early stages to zero - the span point.

8.1 Operation
The mode composition of monitor unit is divided into the measurement mode and the setting mode. Measurement mode is the mode which processes the display according to the signal of a sensor, an alarm output, a current signal, etc., and is the mode which operates in the case of use. Setting mode is the mode which performs a display setup in measurement mode, an alarm output setup, an output test, etc. When dividing a setting mode mainly, it is divided into the following four.

- Measurement mode
  - Various setting mode(ADJ.)
    - The setting of measurement display (Parameter No. P-10-P-17, but, P-12 is an empty number)
  - The setting of alarm output operation (Parameter No. P-19-P-39)
  - The setting of volume conversion (Parameter No. P-50-P-79)
  - The setting of lock parameters (Parameter No. P-00)

- Setting mode(ALARM)
  - The setting of alarm output operation (Parameter No. P-20-P-39)

- Test mode(TEST)
  - Manual test (Parameter No. P-90)
  - Auto-test (Parameter No. P-91)
  - Display test (Parameter No. P-92)

- Zero and Span point adjustment mode
  - The input signal setting by zero and the span point (Parameter No. P-01, P-02)
  - The output signal setting by zero and the span point (Parameter No. P-03, P-04)
  - The setting of resolution (Parameter No. P-05)
  - The setting of display offset (Parameter No. P-06)
  - The setting of elevation function (Parameter No. P-07)
  - The setting of cut of the display and the output (Parameter No. P-08)
  - Default all data to the factory setting value (Parameter No. P-99)

Parameter No. P-20-P-39 can be changed in either of various setting mode (ADJ.), alarm setting mode (ALARM).
The flow of the display contents and the changing operation

- **Measurement mode**
  - Various setting mode (ADJ.)
  - ADJ. blinking

- **Setting mode**
  - Alarm setting mode (ALARM)
  - ALARM blinking

- **Test mode**
  - Zero and Span point adjustment mode
  - TEST blinking

- **Push for 3 sec.**
  - OP. blinking
  - (It cancels setting and returns.)
  - OP. lighting
8.2 Setting of the monitor unit

Incidentally, when ordering a sensor and monitor unit by the set, it sets to the electric current output by 4 to 20mA and 0 to 100 displays in the early stages to zero - span point. Therefore, it is possible to use in basically setting the alarm output to hope for. A way of zero and span point adjustment and the alarm output setting is shown below.

### 8.2.1 Zero and Span point adjustment

When ordering a sensor and monitor unit by the set, zero and span point adjustment has completed in for warding. Therefore, there is not readjustment’s necessity.

<table>
<thead>
<tr>
<th>Setting example</th>
</tr>
</thead>
<tbody>
<tr>
<td>‡@Remove the sensor from the tanks or vessels. (It is not necessary to remove the sensor, if the float can be moved to ZERO and SPAN points at the inside of the tanks or vessels.)</td>
</tr>
<tr>
<td>‡AMove the float to the lowest position, and set ZERO calibration.</td>
</tr>
<tr>
<td>‡BMove the float to the highest position, and set SPAN calibration.</td>
</tr>
<tr>
<td>‡CReinstall the sensor to the measuring condition.</td>
</tr>
</tbody>
</table>

**Setting change procedure**

(1) It begins at the measurement mode.
(2) It pushes for 3 seconds. ‘ADJ.' blinks. ‘OP.' pushes for 3 sec.
(3) It pushes . ‘OP.' blinks. ‘ADJ.' pushes.
(4) It pushes for 3 seconds. ‘P-01' blinks.

### Measurement mode

- **measurement mode**
  - ‘ADJ.' blinks.
  - ‘OP.' lights.

### Setting mode

- **setting mode**
  - ‘OP.' blinks.

### Zero and Span point adjustment mode

- **zero and span point adjustment**
  - ‘P-01' blinks.
(5) It pushes . The value of the zero point set up now is displayed. (If there is not a process which zero adjusted before in zero position, 0.000 will blink.)

(6) Move the float to the lowest position. Float is the lowest position.

(7) In the case except 0.000, push and change or into 0.000. {If being 0.000 in (5), this work is unnecessary.}

(8) It pushes while the float sets Float is the lowest position. Then, zero point signal was memorized at the memory and that P-01 will be in a blink state. (Zero point adjustment's completion)

(9) It pushes . P-02 blinks. (Span point adjustment) It pushes . The value of the span point set up now is displayed. (If there is not a process which span adjusted before in span position, 100.0 will blink.)

(10) Move the float to the highest position. Float is the highest position.

(11) In the case except 100.0, push and change or into 100.0. {If being 100.0 in (10), this work is unnecessary.}

The value of the span point set up now is displayed.
It pushes while the float sets at Float is the highest position. Then, span point signal was memorized at the memory and that will be in a blink state.

Span point adjustment's completion

It pushes or. "push or"

"push"

"push"

When pushing, it returns to the measurement mode.

Zero and span point adjustment's completion

8.2.2 Alarm output setting

As follows, in the early stage setting, because an alarm value is set, when changing into the setting value except this, do this setting.

Setting example

It changes L alarm into ON at less than 30 from ON at less than 40.

Setting contents

‡@It changes P-26 (the caution value of the L alarm) into 30.00 from 40.00.

Setting change procedure

(1) It begins at the measurement mode.

(2) It pushes for 3 seconds. "push for 3sec."

"ADJ."

It pushes.

"Alarm."

(3) It pushes. "push"

"P-20"

Span point signal was memorized at the memory. "P-02"

"OP."

Measurement mode "OP." lights.

(Adjustment's completion) Measurement mode "OP." lights.

Setting mode "ALARM" blinks.

Alarm setting mode "P-20" blinks.

(LL alarm relay operation)
(L alarm relay setting value) (8) It pushes.

It pushes or several times and it makes display "P-26" blink. (9) It pushes or . "OP." blinks. It pushes or . "ALARM" blinks. (10) When pushing , it returns to the measurement mode.

When changing the other caution value continuously, return to (4) after (7) ends and operate a parameter in the change by the similar procedure.
8.3 Contents of parameter

All the parameters of monitor unit are shown below. Contents about the various setting such as the change operation confirmation test of the change of the way of displaying and the alarm output operation are shown.

8.3.1 Input and output (P-00 to P-17)

P-00. Lock

Default 1965

Parameter No.00 are called and setting values other than 1965 are inputted. A parameter will be in a lock state and it will become impossible to perform a setup and reference of a parameter. When canceling a keylock, is pushed for 3 seconds at the time of measurement mode, and it shifts to the setting mode of a parameter P-00, and a keylock will be canceled if 1965 is inputted into a setting value.

Programmable range 0000 to 9999

P-01. Zero point adjustment

Default 0.000

It changes into the state where the signal of a connection sensor is inputted, and it is made to recognize by carrying out an input setup that the signal of the connection sensor is an input signal value in the setting position (comparatively at the time of setting the full scale of a sensor signal to 100). (Keep in mind that the error of Err1 will occur if it sets up by the same input signal as the span point input value of P-02.) Refer to the 8.4 clause for the release method.

Fundamentally, the input signal of a connection sensor is in the state which inputted the signal in the zero point position of a sensor, and please set up the setting value 0.000.

Programmable range 0.000 to 200.0

P-02. Span point adjustment

Default 100.0

It changes into the state where the signal of a connection sensor is inputted, and it is made to recognize by carrying out an input setup that the signal of the connection sensor is an input signal value in the setting position (comparatively at the time of setting the full scale of a sensor signal to 100). (Keep in mind that the error of Err1 will occur if it sets up by the same input signal as the zero point input value of P-01.) Refer to the 8.4 clause for the release method.

Fundamentally, the input signal of a connection sensor is in the state which inputted the signal in the span point position of a sensor, and please set up the setting value 100.0.

Programmable range 0.000 to 200.0
P-03. Output for Zero point: The output current value in a zero point position default 0.00 is set up.

- Programmable range: 0.00 to 22.00
- Unit: mA DC

P-04. Output for Span point: The output current value in a span point position default 20.00 is set up.

- Programmable range: 0.00 to 22.00
- Unit: mA DC

P-05. Resolution: Change display at desired resolution. It is made the output change for every resolution which set up the measurement value and the current output value.

- Programmable range: 0000 to 2000

P-06. Display value offset: It is used when indicating the display value by default 0.000 offset on the whole. The display which made the center standard zero as main uses is attained.

Setting example

<table>
<thead>
<tr>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero point display</td>
<td>0.000</td>
</tr>
<tr>
<td>Output</td>
<td>4.00mA</td>
</tr>
<tr>
<td>Span point display</td>
<td>100.0</td>
</tr>
<tr>
<td>Output</td>
<td>20.00mA</td>
</tr>
</tbody>
</table>

- Span suppression(P-15): 0.000, Measuring range(P-14): 100.0, Zero elevation(P-13): 0.000

Please input an input value to become Display value offset (P-06) < Span suppression(P-15) + measuring range(P-14) + Zero elevation(P-13).

When not satisfied, Err2 is displayed and it becomes impossible to shift to measurement mode. Refer to the 8.4 clause for the release method.

- Since it is dependent on the numerical value set up by measurement range (P-14), an input value should surely input this parameter after a setup of P-14.
- Since it depends for an alarm setup on a display value, please be sure to reconfirm the parameter setting value about alarm output operation of P-19 to P-39 after a setup.
- This parameter cannot indicate the display value by offset to the measurement mode {P-10=1 (deposition volume) or 3 (space volume)} of volume conversion.
P-07. Elevation function

It is used when making a display value and a current output value slide on the whole.

Setting example

<table>
<thead>
<tr>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero point display</td>
<td>0.000</td>
</tr>
<tr>
<td>output</td>
<td>P-07 as -1.000.</td>
</tr>
<tr>
<td>output</td>
<td>3.84mA</td>
</tr>
<tr>
<td>Span point display</td>
<td>100.0</td>
</tr>
<tr>
<td>output</td>
<td>20.00mA</td>
</tr>
<tr>
<td>output</td>
<td>19.84mA</td>
</tr>
</tbody>
</table>

- Since it is dependent on the numerical value set up by measurement range (P-14), an input value should surely input this parameter after a setup of P-14.
- Since it depends for an alarm setup on a display value, please be sure to reconfirm the parameter setting value about alarm output operation of P-19 to P-39 after a setup.
- When this parameter is changed, the measurement mode of volume conversion is also influenced. When a volume conversion setup is carried out, please re-set up the value of P-50 to P-59.

Programmable range: -9999 to 9999

Unit: The unit on a surface panel (arbitrary display units)

P-08. Cut function

The display and current output below a zero point and beyond a span point are cut.

Standard
1: It cuts below a zero point.
2: It cuts beyond a span point.
3: It cuts below a zero point and beyond a span point.

Example
Span suppression (P-15) = 0.000, Measuring range (P-14) = 100.0, Zero elevation (P-13) = 0.000. In this setup, if P-08 = 3 are inputted, in below a zero point, as for a display, 0.000 and a current output will be 4.00mA, and, in beyond a span point, as for a display, 100.0 and a current output will be 20.00mA.

- When this parameter is changed, the measurement mode of volume conversion is also influenced. When a volume conversion setup is carried out, please re-set up the value of P-50 to P-59.

Programmable range: 0 to 3
P-10. Measuring mode

It chooses a measurement object.

It calculates in the set-up measurement mode and a display, a current output, and an alarm output are performed to an operation result. A current output full scale serves as the range of measurement range (P-14) in a level display (0 or 2) at the time of selection, and, in selection of a volume display (1 or 3), even a top position serves as a range from a bottom position.

0: Material level
1: Material volume
2: Space level
3: Space volume

Programmable range: 0 to 3

P-11. Decimal points

Selectable display decimal points.

0: no digits after the decimal point
1: 1 digit after the decimal point
2: 2 digits after the decimal point
3: 3 digits after the decimal point
4: floating point

Programmable range: 0 to 4

Unit on a surface panel (arbitrary display units)

P-13. Zero elevation

The display level from 0% position to the bottom point of a sensor input signal is inputted. It is used when performing the case where carry out the uniform increase of the material level display value, and it is displayed, and a material volume conversion display. Please input an input unit on a surface panel.

Programmable range: 0.000 to 9999

Unit on a surface panel (arbitrary display units)

P-14. Measuring range

The display level of 0 to 100% position of full-scale one of a sensor input signal is inputted. The amount of change of a display level is inputted. Please input an input unit on a surface panel.

Programmable range: 0.000 to 9999

Unit on a surface panel (arbitrary display units)
**P-15. Span suppression**

The amount of display levels from 100% position to the default top point of a sensor input signal is inputted. It is used when performing the case where carry out the uniform increase of the space level display value, and it is displayed, and a space volume conversion display. Please input an input unit on a surface panel.

- **Programmable range:** 0.000 to 9999
- **Unit:** The unit on a surface panel (arbitrary display units)

**P-16. Damping rate**

It is useful to delete an excessive change over pre-setting default value to avoid accidental outputs.

- **Programmable range:** 0.001 to 100.0
- **Unit:** (Rate to the full scale of an input signal)
P-17. Input filter

Input signal equalization.

- **Default**: 0
- **Options**:
  - Equalize 10 signals
    - The value which averaged the last measurement value for 10 times is updated and outputted every approximately 0.12 seconds.
  - Equalize 100 signals
    - Tracking speed becomes slow
    - The last measurement value for 10 times is summarized to one block, and the value which averaged the value of the last block for ten pieces is updated and outputted every approximately 1.2 seconds.
  - Equalize 30 signals
    - Tracking speed becomes slow
    - The last measurement value for 10 times is summarized to one block, and the value which averaged the value of the last block for three pieces is updated and outputted every approximately 1.2 seconds.
  - Equalize 50 signals
    - Tracking speed becomes slow
    - The last measurement value for 10 times is summarized to one block, and the value which averaged the value of the last block for five pieces is updated and outputted every approximately 1.2 seconds.
  - Equalize 70 signals
    - Tracking speed becomes slow
    - The last measurement value for 10 times is summarized to one block, and the value which averaged the value of the last block for seven pieces is updated and outputted every approximately 1.2 seconds.

**Programmable range**: 0, 1, 3, 5, 7

8.3.2 Alarm output operation (P-19 to P-39)

- (1) Programmable alarm relays with reference to material level of the measuring mode (0 or 1, P-10).
- (2) If you choose space level, note to the different display and setting value for alarm points.

P-19. Fail-safe

- **Default**: 0
- **Options**:
  - Fail-safe off
  - Fail-safe on

**Programmable range**: 0, 1

P-20. LL alarm relay operation

- **Default**: 2
- **Options**:
  - OFF (empty)
  - Close ON rising (normally open)
  - Close ON falling (normally closed)

**Programmable range**: 0 to 2
P-21. LL alarm relay setting value
Key-in desired setting value for the LL alarm relay. (A bottom position is inputted as a standard position.)

Programmable range: -999 to 9999
Unit: The unit on a surface panel (arbitrary display units)

P-22. LL alarm relay hysteresis
Key-in desired hysteresis for the LL alarm relay.

Programmable range: 0.000 to 9999
Unit: The unit on a surface panel (arbitrary display units)

P-23. LL alarm relay ON delay timer
Key-in desired ON state delay time for the LL alarm relay.

Programmable range: 0 to 30
Unit: seconds

P-24. LL alarm relay OFF delay timer
Key-in desired OFF state delay time for the LL alarm relay.

Programmable range: 0 to 30
Unit: seconds

P-25. L alarm relay operation
Programmable operation for the L alarm relay.

Default: 2
0: OFF (empty)
1: Close ON rising (normally open)
2: Close ON falling (normally closed)

Programmable range: 0 to 2

P-26. L alarm relay setting value
Key-in desired setting value for the L alarm relay. (A bottom position is inputted as a standard position.)

Programmable range: -999 to 9999
Unit: The unit on a surface panel (arbitrary display units)

P-27. L alarm relay hysteresis
Key-in desired hysteresis for the L alarm relay.

Programmable range: 0.000 to 9999
Unit: The unit on a surface panel (arbitrary display units)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Default</th>
<th>Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-28</td>
<td>L alarm relay ON delay timer</td>
<td>0 seconds</td>
<td>0 to 30 seconds</td>
<td>seconds</td>
</tr>
<tr>
<td>P-29</td>
<td>L alarm relay OFF delay timer</td>
<td>0 seconds</td>
<td>0 to 30 seconds</td>
<td>seconds</td>
</tr>
<tr>
<td>P-30</td>
<td>H alarm relay operation</td>
<td>1 (Close ON rising (normally open))</td>
<td>0 to 2</td>
<td></td>
</tr>
<tr>
<td>P-31</td>
<td>H alarm relay setting value</td>
<td>60.00</td>
<td>-999 to 9999</td>
<td>arbitrary display units</td>
</tr>
<tr>
<td>P-32</td>
<td>H alarm relay hysteresis</td>
<td>0.000</td>
<td>0.000 to 9999</td>
<td>arbitrary display units</td>
</tr>
<tr>
<td>P-33</td>
<td>H alarm relay ON delay timer</td>
<td>0 seconds</td>
<td>0 to 30 seconds</td>
<td>seconds</td>
</tr>
<tr>
<td>P-34</td>
<td>H alarm relay OFF delay timer</td>
<td>0 seconds</td>
<td>0 to 30 seconds</td>
<td>seconds</td>
</tr>
</tbody>
</table>
P-35. HH alarm relay operation

Programmable operation for the HH alarm relay.

**Default:** 1

0: OFF (empty)
1: Close ON rising (normally open)
2: Close ON falling (normally closed)

*Programmable range:* 0 to 2

P-36. HH alarm relay setting value

Key-in desired setting value for the HH alarm relay. (A bottom position is inputted as a standard position.)

**Default:** 80.00

*Programmable range:* -999 to 9999

*Unit:* The unit on a surface panel (arbitrary display units)

P-37. HH alarm relay hysteresis

Key-in desired hysteresis for the HH alarm relay.

**Default:** 0.000

*Programmable range:* 0.000 to 9999

*Unit:* The unit on a surface panel (arbitrary display units)

P-38. HH alarm relay ON delay timer

Key-in desired ON state delay time for the HH alarm relay.

**Default:** 0

*Programmable range:* 0 to 30

*Unit:* seconds

P-39. HH alarm relay OFF delay timer

Key-in desired OFF state delay time for the HH alarm relay.

**Default:** 0

*Programmable range:* 0 to 30

*Unit:* seconds
3.3 Volume conversion (P-50 to P-59)

A display is provided which is proportional to the level of the tank for those seven common tank shapes. You just input parameters related to your desired tank shape. We recommend to keep default volume for P-58 (conversion factor $C$) and P-59 (conversion multiplier $P$) if unnecessary.

Total of P-13, P-14, and P-15 should be equal to the total length of the tank.

Choose your suitable tank shape below.

- **0**: Spherical bottom
- **1**: Conic bottom
- **2**: Pyramidal bottom
- **3**: Sloped bottom
- **4**: Parabolic ends
- **5**: Flat end
- **6**: Sphere

For the tank number 3, enter carefully to $D_1$ and $D_2$. Check the correct orientation with the drawing.
Following are automatically converted when you enter the half paraborized end of tank number 4. Since it becomes a factor with error when conditions differ, please examine using a linear display etc.

Diameter of the cylinder: \( DD = (\text{Zero elevation}) + (\text{Measuring range}) + (\text{Span suppression}) \)

Radius of the half paraborized end: \( RR \)

Rounded corner of the half paraborized end: \( rr \) (Note: \( RR : rr = 2 : 1 \))

Height of the half paraborized end: \( hh \) (Note: \( hh = 1/4DD \))

If capacity conversion are performed, the full scale of a current output will be changed into a top position from a bottom position. Keep in mind that it differs from the case of level conversion.

P-50. Selectable tank shape—Choose your desired tank from those seven common default tanks.

When performing a volume conversion setup, it is necessary to change a setup of P-10 (measurement mode) into 1 (or 3) simultaneously.

0: Spherical bottom
1: Conic bottom
2: Pyramidal bottom
3: Sloped bottom
4: Parabolic ends
5: Flat end
6: Sphere
9: Linear

Programmable range 0 to 9

P-51. Tank dimension D—Enter the diameter of the tank if P-50 = 0 or 1.

Default 1.000 Programmable range 0.000 to 9999 Unit the unit inputted by P-14 (measurement range)

P-52. Tank dimension R—Enter the radius of the parabolic bottom if P-50 = 0.

Default 1.000 Programmable range 0.000 to 9999 Unit the unit inputted by P-14 (measurement range)
P-53. Tank dimension r
Enter the radius of rounded ends of the tank if P-50 = 0.

Default: 0.100
Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

P-54. Tank dimension h
Enter the height of bottom section of the tank if P-50 = 1, 2, 3.

Default: 0.500
Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

P-55. Tank dimension D1
Enter the depth of tank if P-50 = 2, 3.

Default: 1.000
Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

P-56. Tank dimension D2
Enter the depth of tank if P-50 = 2, 3.

Default: 1.000
Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

P-57. Tank dimension L
Enter the horizontal length of tank if P-50 = 4, 5.

Default: 1.000
Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

P-58. Conversion factor C
Enter the factor the conversion value to be multiplied.

Default: 1.000
Programmable range: 0.000 to 9999

P-59. Conversion multiplier P
Enter the multiplier the conversion value must be multiplied to 1\times10^p.

Default: 0.000
Programmable range: 0.000 to 9999
8.3.4 Linear profile (P-60 to P-79)

(1) If your tank design does not match one of the seven common tank shapes, it can be programmed as eleven separate breakpoint settings, including zero point and span point. Parameter number from P-60 to P-79 is those breakpoint settings.

(2) The tank profile is achieved by entering the level (linearization $X$) and corresponding volume (linearization $Y$) for each breakpoint.

(3) If capacity conversion are performed, the full scale of a current output will be changed into a top position from a bottom position. Keep in mind that it differs from the case of level conversion.

Relation between the linearization $X$ and the linearization $Y$
P-60. Level breakpoint X1
Enter the level data X1
[Default: 10.00]

P-61. Level breakpoint X2
Enter the level data X2
[Default: 20.00]

P-62. Level breakpoint X3
Enter the level data X3
[Default: 30.00]

P-63. Level breakpoint X4
Enter the level data X4
[Default: 40.00]

P-64. Level breakpoint X5
Enter the level data X5
[Default: 50.00]

P-65. Level breakpoint X6
Enter the level data X6
[Default: 60.00]

P-66. Level breakpoint X7
Enter the level data X7
[Default: 70.00]

P-67. Level breakpoint X8
Enter the level data X8
[Default: 80.00]

P-68. Level breakpoint X9
Enter the level data X9
[Default: 90.00]

The range which can be inputted and unit to P-60 to P-68 are as follows.

Programmable range: 0.000 to 9999
Unit: The unit inputted by P-14 (measurement range)

In addition, data inputs a value including Zero elevation (P-13) and Span suppression (P-15).
P-69. Breakpoint volume Y0
Enter the volume data for Zero point.
[default: 0.000]

P-70. Breakpoint volume Y1
Enter the volume data for breakpoint X1.
[default: 1.000]

P-71. Breakpoint volume Y2
Enter the volume data for breakpoint X2.
[default: 2.000]

P-72. Breakpoint volume Y3
Enter the volume data for breakpoint X3.
[default: 3.000]

P-73. Breakpoint volume Y4
Enter the volume data for breakpoint X4.
[default: 4.000]

P-74. Breakpoint volume Y5
Enter the volume data for breakpoint X5.
[default: 5.000]

P-75. Breakpoint volume Y6
Enter the volume data for breakpoint X6.
[default: 6.000]

P-76. Breakpoint volume Y7
Enter the volume data for breakpoint X7.
[default: 7.000]

P-77. Breakpoint volume Y8
Enter the volume data for breakpoint X8.
[default: 8.000]

P-78. Breakpoint volume Y9
Enter the volume data for breakpoint X9.
[default: 9.000]

P-79. Breakpoint volume Y10
Enter the volume data for Span point.
[default: 10.000]

The range which can be inputted and unit to P-69 to P-79 are as follows.
programmable range 0.000 to 9999
unit The unit inputted by P-14 (measurement range)

In addition, data inputs a value including Zero elevation (P-13) and the Span suppression (P-15).
8.3.5 Check test of operation (P-90 to P-92)

P-90: Manual test mode Check for output current status and relay output status by entering your desired value in manual. Output should be in proportional to your input value. Enter desired numeric value within the range of from Zero to Span. Do not enter below Zero or over Span.

P-91: Auto-test mode Output current and relay repeatedly from zero and span.

P-92: Display test The display test of LED is performed. Indication and all display on LED are alternately flashed. You can check each one segment by depressing . You can check all display at the same time by depressing .

8.3.6 Initialization (P-99)

P-99: Initialization A parameter is returned to a setup of factory shipments. Default 1999 Initialize all parameters to default (factory setting) by entering 1965. It returns to the setting value specified when the contents of a parameter of a Monitor Unit were specified in advance. When there is no specification especially, it returns to the initial value of standard of our company. Programmable range 0000 to 9999

8.4 Error message

If an error arises, an error massage appears as follows.

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E051</td>
<td>Cable of input line is broken</td>
<td>Check for the rating of input signal.</td>
</tr>
<tr>
<td>E052</td>
<td>Unusual torsional vibration</td>
<td>Make sure the float is in the normal condition.</td>
</tr>
<tr>
<td>E053</td>
<td>Improper calibration</td>
<td>Re-calibrate. Do not key-in same value for both Zero and Span.</td>
</tr>
<tr>
<td>E054</td>
<td>Measuring computation error</td>
<td>Check for all input value to correct.</td>
</tr>
<tr>
<td>E055</td>
<td>Internal MPU malfunction</td>
<td>Ask to our Service department.</td>
</tr>
</tbody>
</table>

To reset system error:

Depress + at the same time, and re-calibrate Zero and Span.

Depress over 3 seconds, and check for all parameter value.

Depress + at the same time to delete error message. If unsuccessful, ask to our Service department.
MAINTENANCE AND INSPECTION

9.1 Maintenance and inspection of the sensor

Remove the sensor from the tank before maintenance. See section 4, Handling notes. Keep the ample space for maintenance.

9.1.1 Removing

(1) Turn off the power supply to the monitor unit.

**WARNING**

To avoid personal injury, leakage current or short circuit, the power supply shall be always turned off while wiring.

(2) Remove the housing cover. Disconnect all wires and the flexible conduit.

**CAUTION**

Turn the mounting plug only when installing. Do not turn the housing. Otherwise, the housing connection to the mounting plug will be broken.

(3) Unscrew the fixing bolts and nuts or loosen the plug and remove the sensor carefully from the tank.

(4) Put the sensor on the flat and ample space.

9.1.2 Maintenance and inspection

Inspect the sensor semi-annually or annually. Since inspection intervals vary with applications and process conditions such as pressure, temperature etc., we recommend periodical inspection.

(1) Check for and replace damaged and collapsed parts.

(2) Clean contaminant or sticky.

(3) Clean dirt, dust and moisture from the housing.

(4) Tighten float travel stops using appropriate tool.
9.1.3 Re-installation
See section 5.2 Sensor installation (page 9).

9.1.4 Wiring
See section 6 Wiring (page 12 to 14).

9.1.5 Replacement parts and cycle
Replace parts if the following symptoms occur. Use a genuine name brand parts carefully.

9.1.6 Replacement parts
Float: When it is damaged, collapsed or corroded.

9.1.7 Calibration
See section 8 Operation (page 17 to 38).

9.2 Maintenance and inspection of the monitor unit
Please perform maintenance check once in one year from half a year. However, this frequency is a standard to the last. If there is a difference in operating frequency, temperature, an operating condition, etc., it is necessary to carry out more frequently than this.

(1) Please use a tool and check that the transmitter is being firmly fixed by the attachment implement. When you are loosening, please refasten by the tool.

(2) Please check that the actual measurement of a surface and the display value of a transmitter are in agreement in the state of measurement. When a value shifts, please perform zero span point adjustment, and check that directions are in agreement.

(3) Please call the test parameter of P-90 (or P-91), and check the display value by variable. Since this display value is interlocked with and an output current value and an alarm output operate, please also check the state of the load to connect of operation and check that there is no incorrect operation.

(4) Please call the display test of P-92 and check whether there are any abnormalities in the display of LED.
10.1 Storing of the sensor

(1) The sensor shall be stored under the following conditions when it is not used for a long time.

Environmental conditions are as follows:
- Temperature: -5 to +50 °C
- Humidity: 85 %RH Max. (no dew condensation)
- No excessive vibration.
- No corrosive atmosphere such as NH₃, SO₂, Cl₂ etc.

(2) Locate away from rain, condensation, dust and foreign matters.

(3) Tighten the housing cover and the cable gland.
Do not remove the blind plate from the cable gland to protect from dust or moisture.
We recommend to put the cable gland pointing down.

(4) Do not use in the liquid which has metallic substances.
Otherwise the MS will cause malfunction.

(5) When keeping in stock the sensor in your inventory, lay the sensor horizontally.
Put the wood piece or adequate materials under the sensor to avoid rolling, bending, scoring the sensor.
If the stem length is longer than 2000mm, we highly recommend you to put them 1000mm each.

Note:
Wrap the sensor with polyethylene sheet and seal it to protect from moisture and dust. If the sensor is stored where temperature change is enormous, enclose desiccant such as silica gel in the polyethylene sheet.

10.2 Storing of the monitor unit

(1) The monitor unit shall be stored under the following conditions when it is not used for a long time.

Environmental conditions are as follows:
- Temperature: -5 to +50 °C
- Humidity: 85 %RH Max. (no dew condensation)
- No excessive vibration.
- No corrosive atmosphere such as NH₃, SO₂, Cl₂ etc.

(2) Locate away from rain and jetting water.
The transmitter is not a drip-proof construction.

(3) Do not put things on the level controller.
It will deform and damage the product.

Note:
Wrap the monitor unit with polyethylene sheet and seal it to protect from moisture and dust. If the monitor unit is stored where temperature change is enormous, enclose desiccant such as silica gel in the polyethylene sheet.
# Troubleshooting

## CAUTION

In the event of trouble, perform the following and nothing else. If you have any question, please contact our sales office.

<table>
<thead>
<tr>
<th>Troubleshooting Case</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>No display</td>
<td>Loose terminals of the wire incorrectly wired or miswiring.</td>
<td>Wire correctly.</td>
<td>P12 to P14</td>
</tr>
<tr>
<td>No or insufficient power supply</td>
<td>Supply or repair the power.</td>
<td>P12 to P14</td>
<td></td>
</tr>
<tr>
<td>Reading does not change, but output level does.</td>
<td>Loose terminals of the wire incorrectly wired or miswiring.</td>
<td>Wire correctly.</td>
<td>P12 to P14</td>
</tr>
<tr>
<td>Wrong parameter values entered.</td>
<td>Enter correctly.</td>
<td>P17 to P38</td>
<td></td>
</tr>
<tr>
<td>No output alarm alarms</td>
<td>Loose terminals of relay or miswiring.</td>
<td>Wire correctly.</td>
<td>P12 to P14</td>
</tr>
<tr>
<td>Wrong parameter values entered.</td>
<td>Enter correctly.</td>
<td>P17 to P38</td>
<td></td>
</tr>
<tr>
<td>No output signal output</td>
<td>Loose terminals of the wire incorrectly wired or miswiring.</td>
<td>Wire correctly.</td>
<td>P12 to P14</td>
</tr>
<tr>
<td>Output signal does not change, but level does.</td>
<td>Enter correctly.</td>
<td>P17 to P38</td>
<td></td>
</tr>
<tr>
<td><strong>Terms</strong></td>
<td><strong>Definitions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flange</td>
<td>The flat edge parts to install the sensor in the tank by using bolts and nuts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Float</td>
<td>Light objects that floats on the surface of a liquid. It moves as liquid level changes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem</td>
<td>A protective outer pipe for the magnetostrictive wire, and supports the float movement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnet</td>
<td>Metallic piece in the float with a magnetic field to distort the magnetostrictive wire.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetostrictive Wire</td>
<td>Nickel wire twisted by the intersection of magnetic field wire from float magnets. This twist is detected as return pulse to determine the level measurement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Float Travel Stop</td>
<td>Upper and lower limit to control travel of the float.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guard Pipe</td>
<td>A depression in a tank enough to reduce turbulence or flow of the liquid.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacer</td>
<td>The flat plate to keep the float from contact with the guard pipe.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>