

I N S T R U C T I O N M A N U A L
F O R
I N T R I N S I C A L L Y S A F E C O N S T R U C T I O N
C A P A C I T I V E L E V E L S E N S O R

M O D E L : K S I
M O D E L : K S D




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NOHKEN INC.

MUST BE READ BEFORE USING

- This manual is for explosion-proof specifications. Read the other manuals for standard specifications.
- This manual describes the handling, inspection and adjustment of the sensor. Read and understand this manual before installation.
- Any documents and/or directions from Nohken and the agents aside from this manual shall be preceded.
- Save this manual to refer when you need.
- If you have any questions or comments about this manual and/or the sensor, ask Nohken's sales office.

Signal words in this manual means as follows:

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates an potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
 NOTE	Indicates exceptional cases and attention for handling of sensors.

	Indicates prohibition. The explanation with this manual should always be followed.
	Indicates directions. The explanation with this manual should always be followed.



WARNING

Do not modify or disassemble the equipment. Otherwise, the ignition to an explosive gas may occur.



Before opening the cover, make sure that the terminal box is cooled down.

Otherwise, the ignition to an explosive gas may occur.



CAUTIONS

- Adjustment, inspection and maintenance shall be done by the skilled engineer.



- The electrical instrumentation for maintenance shall also be an explosion-proof construction.



- Turn off the power immediately if there is bad smell and/or the strange sound.
Do not use until the remedy is administrated.



- Make sure that the wiring is correct.
Otherwise, the sensors may be damaged, ignited or cause an electric shock.












- For grounding, we recommend to use the earth terminal in the housing to prevent from deterioration by atmospheric condition.



- Use the specified color for grounding to identify easily.
For example, we recommend to use green.



▲ NOTES

<ul style="list-style-type: none"> Do not give strong shocks to the sensor. Dropping, throwing, striking and dragging the sensor, for example, are to cause strong shocks and damage the sensor. 	
<ul style="list-style-type: none"> The specifications such as ambient temperature, maximum voltage and the power rating shall meet the conditions. Otherwise, the sensor may cause malfunction, damage, ignition, electric shock and injury. Read and check the clause of specification in the manual or specification sheets. 	
<ul style="list-style-type: none"> Operating test shall be conducted before practical use. If malfunction occurs and the accident is predicted, the remedy shall be administrated by using another sensor with different operating principle in parallel. 	
<ul style="list-style-type: none"> To prevent overvoltage and overcurrent, provide a protective circuit to the load. Otherwise, the contact may be damaged. 	
<ul style="list-style-type: none"> When removing the screw-mounted level switch from the container, the appropriate wrench is applied only to the mounting plug. Do not turn the housing. Otherwise, the internal wiring may be broken. 	
<ul style="list-style-type: none"> When carrying, installing and removing the level switch, hold the flange or the plug part. Otherwise, the flange or the plug may drop off from the housing and be damaged. 	
<ul style="list-style-type: none"> Check the chemical compatibility with the material you want to use. 	
<ul style="list-style-type: none"> Check the chemical compatibility with the material you want to use. 	
<ul style="list-style-type: none"> <u>The sensor which is 50cm or longer</u> Do not leave the sensor upright, but lay it down on the floor. Otherwise, the sensor and/or the surrounding things may be damaged or get injured if the sensor falls. 	

INTRODUCTION

- A. This manual specifies standard specifications of this product. Some specifications may be different from your product if you order the custom-made product.
- B. A variety of specifications are available to meet your process conditions, such as installation conditions, chemical compatibility, and so on. We are glad to offer suggestions to assist your decision.
- C. If you have any questions or comments for the contents of this manual, ask Nohken's sales office written on the front cover.
- D. Nohken Inc. pursues a policy of continuing improvement in design and performance of this product. We will supply the alternative parts or complete new products required to repair or replacement.
- E. Specifications are subject to change without any obligation on the part of the manufacturer.

WARRANTY & DISCLAIMER

- A. Nohken Inc. warrants this product against defects in design, material and workmanship for a period of 1 (one) year from the date of original factory shipment.
- B. If defects occurs during the above-mentioned warranty period, Nohken will, at its option, replace or recondition the product without charge. This shall constitute the exclusive remedy for breach of warranty.
- C. Nohken Inc. makes no warranty with respect to:
 - C-a Failure not to comply with instructions of this manual.
 - C-b Failure or damage due to improper installation, wiring, operation, maintenance, inspection and storing.
 - C-c Product which has been in any way repaired, altered or tampered with by others.
 - C-d Product repaired or modified by using undesignated parts, subassemblies and materials.
 - C-e Direct incidental or consequential damages or losses or expenses resulting from any defective product or the use of any product.
 - C-f Objective of the sensor is clearly specified in chapter 1, PURPOSE OF USE.
 - C-g Inevitable accident such as acts of God, force majeure, radioactive contamination and so on.

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IMPORTANT USER NOTE

Thank you for adopting the KSI (KSD) type static capacity type level sensor. This pamphlet provides a comprehensive description of proper operation method, adjustment and check method to ensure long use. Please read this before use without fail.

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1. PURPOSE OF USE

This equipment is a level sensor which uses a high frequency and is capable of detecting and controlling the level of various kinds of liquid, powder, or granular substances. This unit can be adjusted simply and does not need any adjusting devices such as testers.

The instrument consists of a Model KSD sensor and a Model KSI power unit.

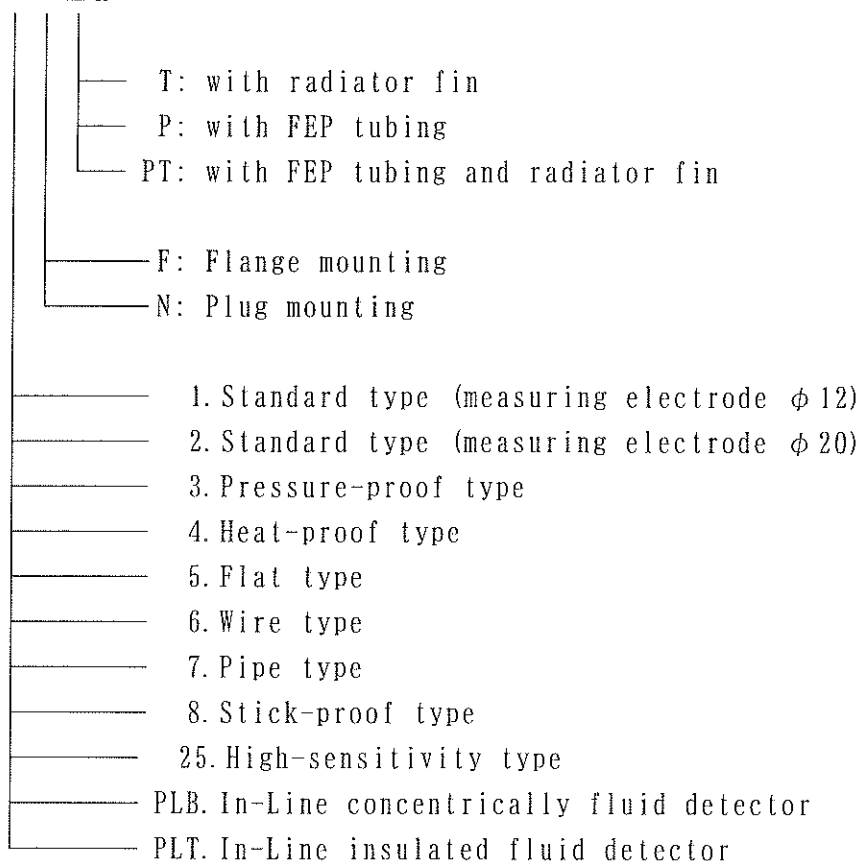
The sensor can be provided with general type and low-sensitivity type.

The electric circuit automatically corrects sensitivity through changes in the impedance of the adhered deposit. Furthermore, since the detecting section to be inserted in the tank does not incorporate any movable parts, we are confident of its reliability and durability over a long period of time.

2. STANDARD SPECIFICATIONS

2.1 Model and Suffix Code

KSD-□□□H



NOTES

- Code - T : Not applied to code 3 and 4.
- Code - P and - PT : For Flange mounting type only.
- Code - PLB and -PLT : Not appeared mounting codes.

2.2 Standard Specifications

- 2.2.1 Power supply : 100/200 V AC \pm 10 % 50/60 Hz or
110/220 V AC \pm 10 % 50/60 Hz or
120/240 V AC \pm 10 % 50/60 Hz
- 2.2.2 Power consumption : Approx. 4 VA
- 2.2.3 Contact rating : 250 V 2 A AC (resistive load)
30 V 2 A DC (resistive load)
- 2.2.4 Insulation resistance: 100 M Ω or more (500 V DC)
- 2.2.5 Withstand voltage : 1500 V AC for a minute
- 2.2.6 Withstand Pressure : 1 MPa Max. for code 1, 2, 5, and 25
3 MPa Max. for code 3 and 4
500 kPa Max. for code 6
100 kPa Max. for code 7, 8, P and PT
- 2.2.7 Vibration proof : 10 to 55 Hz (Amplitude 1.5 mm)
- 2.2.8 Working temperatures : Power unit : -10 to +40 $^{\circ}$ C
Sensor : -10 to +40 $^{\circ}$ C
- 2.2.9 Heatproof temperature: Electrode : +60 $^{\circ}$ C
(+180 $^{\circ}$ C heat-proof type)
- 2.2.10 Working humidity : 85 % RH Max.
- 2.2.11 Construction : Power unit : IP 10
Sensor housing : IP 65

3. PRINCIPLE OF OPERATION

When this level sensor is set on a tank, a condenser is formed between the detector electrode and the tank inside wall. The capacitance of this condenser varies proportional to the specific inductivity of the material put in the tank. This change in capacitance is detected, whereby liquid or powder level is detected.

※ Specific inductivity

Capacitance when nothing is in a tank : C_0

Capacitance when material is put in a tank and its level reaches the detection electrode : C_1

$$\epsilon s = \frac{C_1}{C_0}$$

The " ϵs " is called a specific inductivity, a constant determined by the kind of material to detect.

Therefore, the detection sensitivity of this level sensor is determined by the specific inductivity " ϵs " of material to detect.

4. INSTALLATION

The level sensor is installable horizontally or vertically.

4.1 Horizontal installation

The electrode is parallel to the level fluctuating surface of the detecting material in this installation. Even a slight change in the material level can be exactly detected, since an electrode area ratio is taken large for this change and a large capacity change is obtained. However, this is unsuitable for viscous materials. Such material easily adheres to the electrode, spoiling stability.

4.2 Vertical installation

The problem of adhering to the electrode is less and the operation is stable. However, as the electrode area ratio is small for a change in material level, the detection accuracy is lowered and the electrode size needs to be long for detection of the lower limit of a tank.

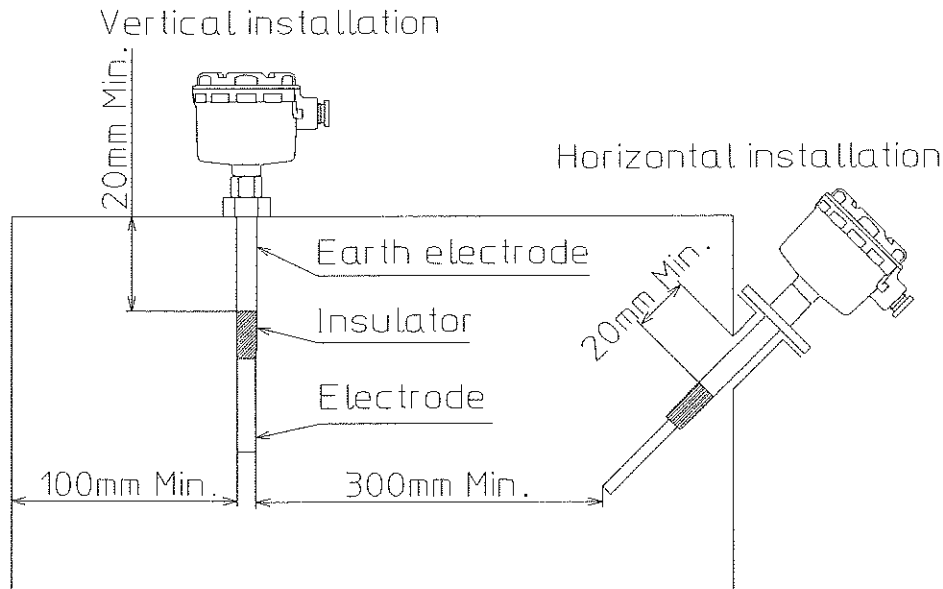


Fig. 1

- ※ In the horizontal installation, we recommend to set the level sensor obliquely so that the electrode is directed as downward as possible. This minimizes material stacking on or adhering to the electrode.
- ※ When a nozzle neck is used, set it so that the earth electrode is inserted into a tank 20mm or more. This prevents the electrode from being affected by the material adhered to the tank inside wall or adhesions.

5. WIRING

- 5.1 Use a cable with a cross sectional area (conductor) of 0.75mm^2 or more, an inductance of 1mH or less, and an electrostatic capacity of $0.05\ \mu\text{F}$ or less irrespective of the distance between the sensor and power unit. If the wire may be subjected to power noise or induction, use a shielding wire. (Current in the wire is approximately 13V , 10mA DC)
- 5.2 For other wiring work, follow the intrinsically safe circuit of the explosion prevention guide of the plant electrical facility.
- 5.3 If the wiring work is completed, perform wiring in accordance with Fig.2.

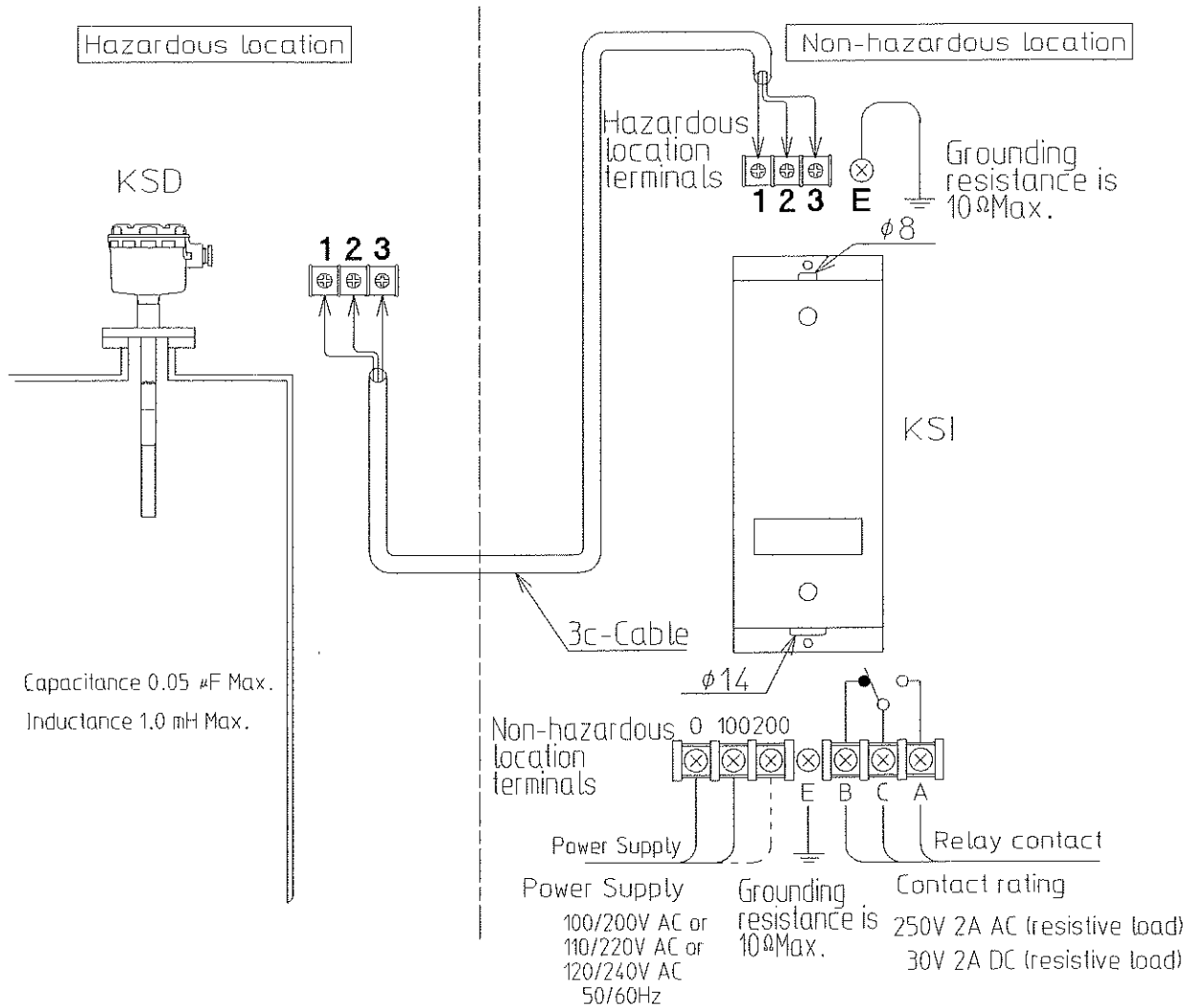


Fig. 2

6. ADJUSTMENT PROCEDURES

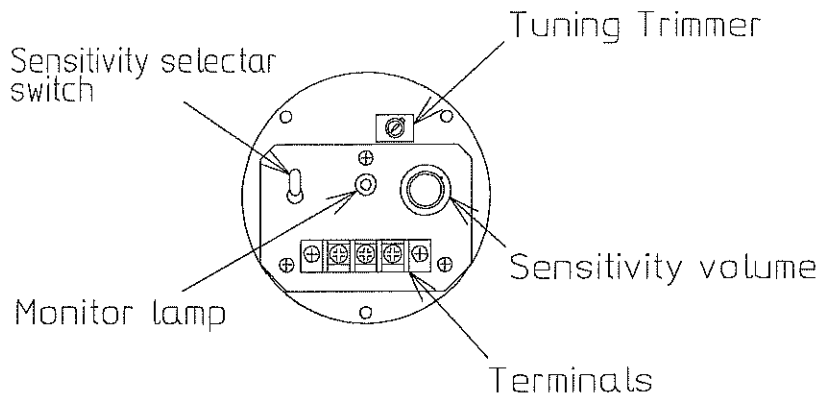


Fig. 3

6.1 Sensitivity adjustment

6.1.1 Marking sure there is nothing inside, set the sensor on the tank reserved for measuring.

6.1.2 Ascertain that the power supply is turned on.

6.1.3 Turning the sensitivity selector switch to the H side actuates high sensitivity; turning the switch to L actuates low sensitivity. Turning the sensitivity volume in the direction of 0 on the scale heightens sensitivity of detection; turning the volume in the direction of 10 lessens the sensitivity.

Turn the sensitivity selector switch to the H side and turn the sensitivity volume in the direction of 0 on the scale till the monitor lamp turns on. Next, turn the volume in the direction of 10 till the monitor lamp turns off. If the monitor lamp acts abnormally, correct the electrode capacitance according to chapter 6.2 correction of electrode capacitance.

When the measuring material is available:

6.1.4 With the sensitivity selector switch turning to the L side and the sensitivity volume turned to 10 on the scale, feed the measuring material into the tank till the electrode is hidden under the material.

6.1.5 Sensitivity is properly adjusted if the monitor lamp turns on under this condition. Otherwise, perform the next step 6.1.6

6.1.6 With the sensitivity selector switch turned to the L side, slowly turn the sensitivity volume to 0 on the scale untill the monitor lamp turns on. Note the setting (X). Increase the sensitivity volume by one division from (X) to (X+1).

If the monitor lamp does not turn on at this stage, turn the sensitivity selector switch to the H side and then, slowly turn the sensitivity volume from 10 to 0 untill the monitor lamp turns on. Note the setting (X). Increase the sensitivity volume by one division from (X) to (X+1).

- 6.1.7 Empty the tank and ascertain that the monitor lamp is turned off. This ends adjustments over sensitivity. If the monitor lamp remains lit, correct the electrode capacitance according to chapter 6.2 correction of electrode capacitance and repeat steps under chapter 6.1 sensitivity adjustment.

Simplified method of adjustment when the measuring material is not available:

- 6.1.8 With the sensitivity selector switch turned to H, turn the sensitivity volume to 0.
- 6.1.9 Slowly turn the sensitivity volume to 10 on the scale until the monitor lamp turns off. Note the setting (X). Reduce the sensitivity volume by one division from (X) to (X-1). This ends adjustment over sensitivity. Follow the above procedure for all subsequent measurements.

6.2 Correction of electrode capacitance

The electrode capacitance has been corrected at time of delivery but one or the other of the factors which are outlined in the following paragraphs might affect adversely the adjustment described under chapter 6.1 sensitivity adjustment

- 6.2.1 Shape, structure, and/or material of tank.
- 6.2.2 Floating capacity of electrode mounting on nozzle neck.
- 6.2.3 Deposits adhering to electrode unit or to inner walls of tank.
- 6.2.4 Vibration and/or large change in temperature.
- In either of the foregoing cases, perform the following steps to correct electrode capacitance
- 6.2.5 Without letting the electrode come in contact with the measuring material, turn the sensitivity selector switch to H side and turn sensitivity volume to 0 on the scale.
- 6.2.6 Turn the tuning trimmer and stop it at the position that the monitor lamp changes from OFF to ON .
- 6.2.7 Turn the sensitivity volume to 1 on the scale and ascertain that the monitor lamp turns ON and OFF by turning the volume back and forth at this position.
- 6.2.8 Perform the adjustment described under chapter 6.1 sensitivity adjustment.

7. PRECAUTION

The sensor and the amplifier in each of our level sensor as well as the sensitivity of detection have been preset to match the capacitance (specific inductivity) and/or the resistance of the measuring object.

Please consult us if you need to replace any materials.

8. MAINTENANCE

8.1 All the electrodes in our level sensor have been designed to automatically compensate for any adhering deposits but these deposits tend to accumulate in the course of time. In order to prevent malfunctioning, the sensor should be pulled out at regular intervals to free the electrode contaminants and keep it clean.

8.2 In case environmental conditions (ambient temperature and humidity, amongst others) should change to a considerable extent, readjust the amplifier unit before actual operation in order to avoid malfunctioning of the level sensor.

9. TROUBLESHOOTING



CAUTION

Use the following chart to troubleshoot the malfunctioning sensor.

If your remedies are unsuccessful, ask Nohken for repair and replacement.

9.1 Relay de-energized when electrode is covered by materials

- Sensitivity set too low Perform adjusts according to chapter 6. ADJUSTMENT PROCEDURES.
- Material has bridge or angle Change mounting position with angle of repose considered.
- Improper output connections Recheck with reference to Fig.2 connection diagram under chapter 5. WIRING.

9.2 Relay energized when electrode is not covered by materials

- Tuning is wrong Perform adjusts according to chapter 6. ADJUSTMENT PROCEDURES.
- Sensitivity set too high Perform adjustments according to chapter 6. ADJUSTMENT PROCEDURES.
- Material has dead stock Instal level sensor to better position where generation of dead stock not possible.
- Improper output connections Recheck wiring with reference to Fig.2 connection diagram under chapter 5. WIRING.
- Faulty electrode insulation Trace and remove defect and repeat adjustments according to chapter 6. ADJUSTMENT PROCEDURES.

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