

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 R E

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Revision△   Feb. 20, 2004

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**NOHKEN INC.**



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# 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:

 <b>WARNING</b>	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates an potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
 <b>NOTE</b>	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.



• Co-axial cable (RG62A/U) core is hollow. For this reason, measuring medium and corrosive gas may invade into an amplifier from generating, a housing cover, etc. with the faulty seal of electrode. When there is such the possibility, please fill up the hollow pipe opening end at the tip of a sensor side cable with silicone etc.



• 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.





## CAUTIONS

- 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"> <li>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.</li> </ul>	
<ul style="list-style-type: none"> <li>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.</li> </ul>	
<ul style="list-style-type: none"> <li>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.</li> </ul>	
<ul style="list-style-type: none"> <li>To prevent overvoltage and overcurrent, provide a protective circuit to the load. Otherwise, the contact may be damaged.</li> </ul>	
<ul style="list-style-type: none"> <li>When removing the screw-mounted liquid 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.</li> </ul>	
<ul style="list-style-type: none"> <li>When carrying, installing and removing the liquid level switch, hold the flange or the plug part. Otherwise, the flange or the plug may drop off from the housing and be damaged.</li> </ul>	
<ul style="list-style-type: none"> <li>Check the chemical compatibility with the material you want to use. A minor corrosion to the float and the thin thickness part may be chemically effected.</li> </ul>	
<ul style="list-style-type: none"> <li>Check the chemical compatibility with the material you want to use.</li> </ul>	
<ul style="list-style-type: none"> <li><u>The sensor which is 50 cm 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.</li> </ul>	

# 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 2, 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

It is essential for the user to read this manual carefully before installing the KRE capacitive level sensors to ensure proper operation.

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# 1. HANDLING OF INTRINSICALLY-SAFE

The KRE series Capacitive level sensors are listed as complete assembly by Technical Institute of Industrial Safety (TIIS), Japanese Ministry of Labor, for use in i3aG5.

Since there are certain restrictions as to the handling and environmental conditions of individual units, cautions given in this manual shall be strictly observed.

## 1. 1 EXPLOSIONPROOF SPECIFICATIONS

The KRE series are of intrinsically safe construction, and has the following specifications:

Model name	Approval type number	Explosion construction and applicable gas
KRE65-□□□ & KRE6000	No. 48945	i3aG5
KRE65-□□□ & KRE6200	No. 48944	i3aG5

Since the KRE series are approved by combination of sensor and amplifier, match these manufacturing number when using.

## 1. 2 INDICATION OF EXPLOSIONPROOF SPECIFICATIONS

The KRE carries the intrinsically safe type name, model name, type approval number and explosionproof construction applicable gas.

## 1. 3 LIMITATIONS ON INSTALLATION SITE

The KRE can be installed in hazardous locations containing the gas atmospheres which the unit is certified to be explosionproof in.

## 1. 4 ENVIRONMENT CONDITIONS AT INSTALLATION SITE

The allowable humidity range and temperature range at the installation site are as follows:

Humidity ; 85% RH Max.

Temperature; 0 to 40°C (Electronics)

The temperature range of each electrode is specified in Chapter 3, STANDARD SPECIFICATIONS.

## 1. 5 EXTERNAL WIRING

The inductance and capacitance of the wiring to the intrinsically safe section must not exceed the specified limits. Also, take appropriate measures to protect the cables from damage and to prevent the intrinsically safe and non intrinsically safe circuits from contacting each other. See Chapter 6, WIRING, for details.

## 1. 6 REPAIR AND REPLACEMENT

As a rule, all repair and replacement of intrinsically safe sections shall be conducted only to recover the original state's factory. To alter specifications, make any modification or disassembly on site is strictly prohibited. That's why in case of repair and replacement, return the KRE to NOHKEN.

# 2. PURPOSE OF USE

The KRE series are made specifically for point level detection of liquids, solids or interface of two immiscible liquids in containers. The remote amplifier may be mounted up to 200 m away from sensor, and connected by coaxial cable.

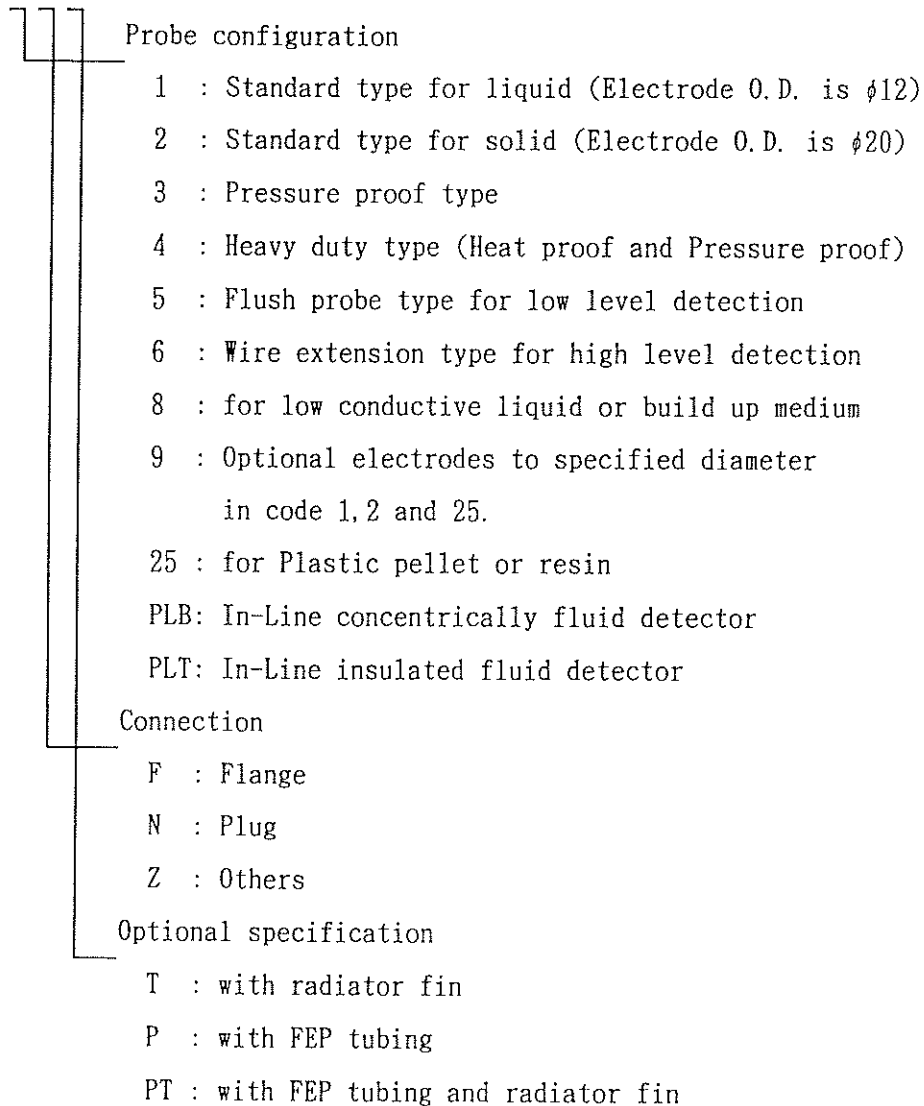
The KRE is not affected by static electricity as it has a resistance leakage to the earth. The stable sensitivity minimizes errors due to measuring medium build up.

### 3. STANDARD SPECIFICATIONS

#### 3. 1 MODEL NAME

##### 3. 1. 1 SENSOR

KRE65-□□□



#### 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.

##### 3. 1. 2 AMPLIFIER

KRE6000 : Outdoor use(IP54), Aluminum casting

KRE6200 : Indoor use(IP10), Acrylic

### 3. 2 SPECIFICATIONS

- 3.2.1 Construction and applicable gas : i3aG5
- 3.2.2 Power supply : 100 V, 200 V AC  $\pm$  10 % 50/60 Hz
- 3.2.3 Power consumption : Approx. 2.5 W
- 3.2.4 Contact rating : 250 V 2 A AC (resistive load)  
30 V 2 A DC (resistive load)
- 3.2.5 Insulation resistance : 100 M $\Omega$  or more (500 V DC)
- 3.2.6 Withstand voltage : 1500 V AC for a minute
- 3.2.7 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 2FP, 2FPT and 8
- 3.2.8 Vibration proof : 10 to 55 Hz (Amplitude 1.5 mm)
- 3.2.9 Working temperatures : Sensor -10 $^{\circ}$ C to +40 $^{\circ}$ C  
Amplifier -10 $^{\circ}$ C to +40 $^{\circ}$ C
- 3.2.10 Working humidity : 85 % RH Max.
- 3.2.11 Heatproof temperature: Electrode +60 $^{\circ}$ C (+180 $^{\circ}$ C for Heat-proof type※)

#### NOTE※1

Recognized by TIIS and specified on the application form.

## 4. PRINCIPLE OF OPERATION

Once the sensor is installed on the container, a condenser is made between the earth electrode or the container and the detection electrode. The detection circuit is connected to the detection electrode. When the detection electrode is in the air, the oscillation circuit synchronizes the detection circuit. When medium contacts with the detection electrode, by taking in capacitance of medium, the synchronized voltage changes and the relay energizes.

## 5. INSTALLATION

### 5. 1 UNPACKING

When unpacking, exercise caution not to subject the KRE to mechanical shock. After unpacking, visually check the KRE exterior for damage.

### 5. 2 ENVIRONMENT

The KRE should be installed in an area which meets the following conditions:

(1)The ambient temperature is 0 to 40°C.

**NOTE:** Install a sun shield over the housing if exposed to direct sunlight.

Do not install in the place where ambient temperature rapidly drop

(for example, 40°C to 0°C). It may cause dew and damage the sensor.

(2)Locate away from splashing water or rain.

(3)No corrosive gases(such as NH<sub>3</sub>, SO<sub>2</sub>, Cl<sub>2</sub>, etc.).

(4)Humidity and vibration are low.

(5)Ample space is provided for maintenance/inspection.

### 5. 3 LOCATION

#### 5. 3. 1 SENSOR

Install the sensor at the position where the medium level variations will actually make contact with it. The sensor may be installed in any position or orientation. However, we recommend the cable entry to point down to the ground to prevent rain or splashing water from intruding. In case of negative or positive pressure within the container, use suitable pipe compound or thread tape.

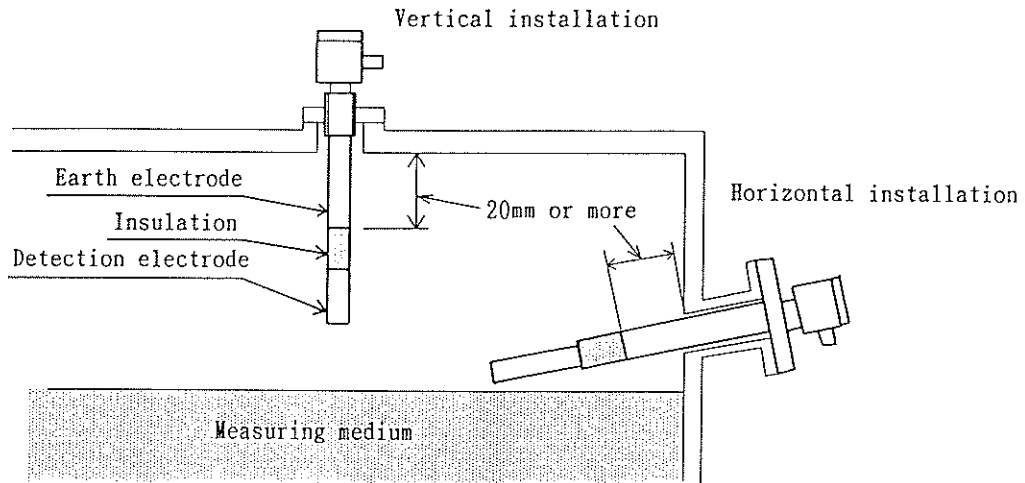


Fig.1

**NOTE** the following points:

- Make sure the electrode or the wire is not touching the stand off pipe.
- Make sure the sensor must be located away from the container wall 30cm or more.
- When installing more than 2 sensors in one container, separate the sensors more than 30cm.
- When horizontal installation, the earth electrode shall extend into the tank at least 20mm to prevent it from medium dead stock.
- Keep the electrode out of the direct flow of medium. If necessary, install a protective shield at least 10cm above it.
- Do not install near liquid inlets/outlets. If there is surface wave motion, use the time delay relay to dampen the relay actions.

### 5. 3. 2 AMPLIFIER

Dimensions and mounting pitch are as follows:

① KRE6000

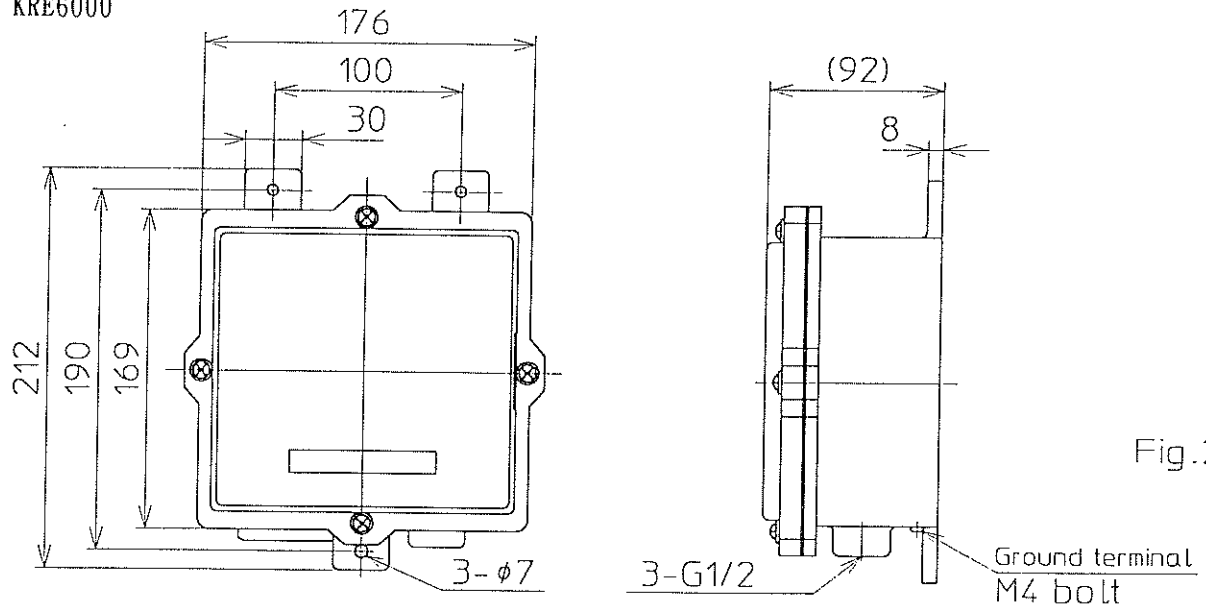


Fig.2

The cable inlet and the cover must be properly fitted to ensure airtightness and to protect from rain, splashing water, and so on.

Maximum separation distance between the sensor and the amplifier is 200 m.

② KRE6200

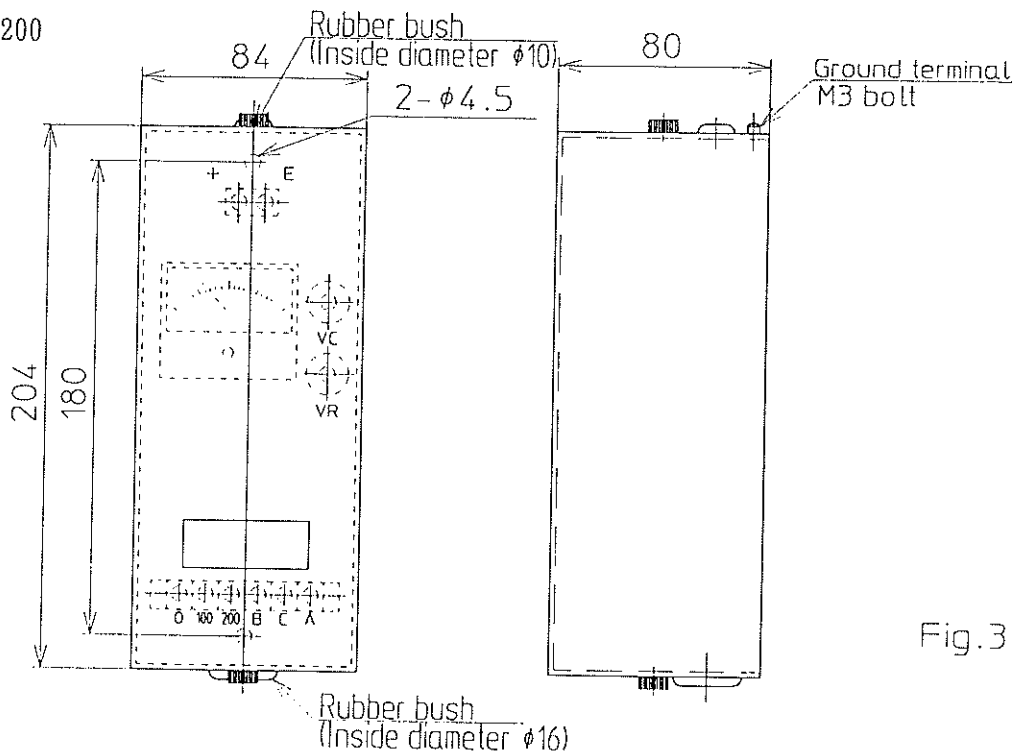


Fig.3

Since the housing protection is IP10(indoor use), install the KRE in the dustproof and/or dripproof enclosure if necessary.

Maximum separation distance between the sensor and the amplifier is 200 m.

## 6. WIRING

### ⚠ CAUTION

- (1) All wiring shall be in accordance with the Plant Electrical equipment Intrinsically safe guide book that is published by Technical Institute of Industrial Safety, Japanese Ministry of Labor.
- (2) The cable inlet shall be properly fitted by the explosionproof fitting to ensure airtightness and to protect the sensor and the amplifier from rain, splashing water, etc.
- (3) In hazardous area, do not power the KRE until the conduit is sealed and the housing cover is surely secured.
- (4) The wiring inductance shall be 1.0mH maximum and the capacitance 0.1 $\mu$ F maximum.
- (5) The grounded terminal shall be grounded.
- (6) Supplying voltage must match terminals indicated on board. Incorrect voltage or miswiring will damage the KRE.

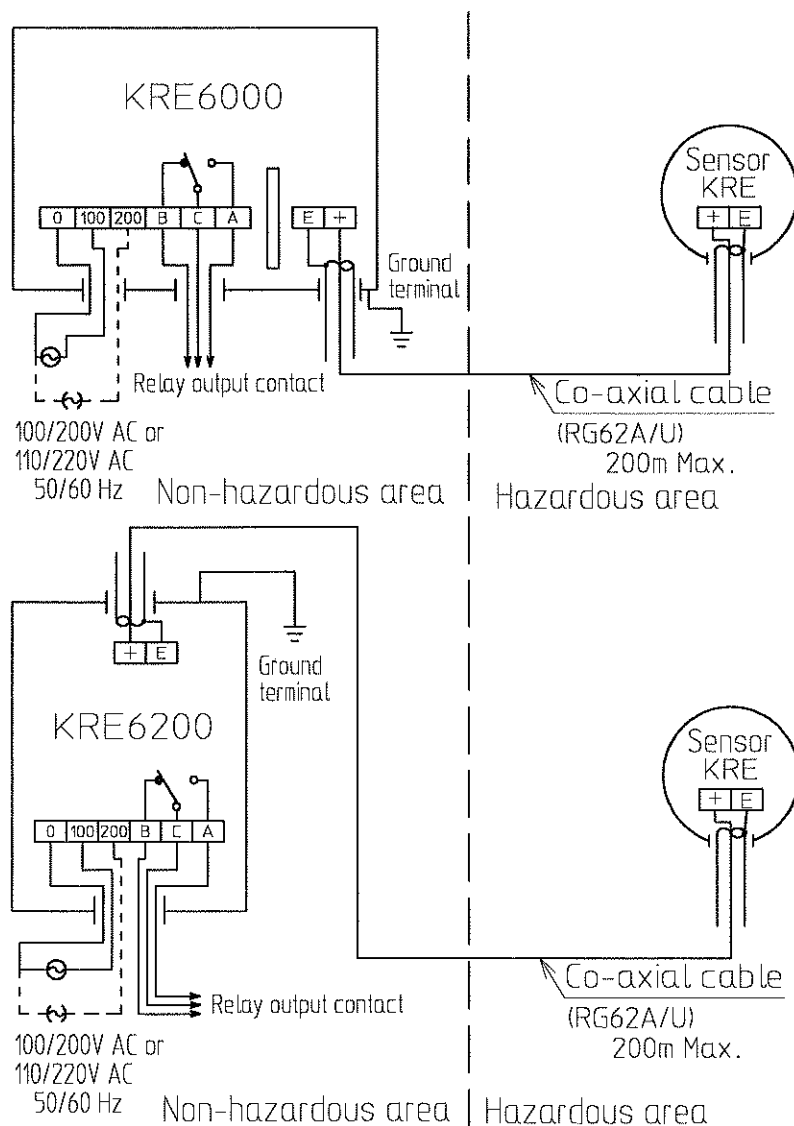


Fig. 4

① Applicable cable

Co-axial cable RG62A/U (O. D.  $\phi 6.1$ ) or equivalent shall be used between the sensor and the amplifier. This cable must be run in conduit and be grounded.

For relay output and power supply, control cable 1.25 mm<sup>2</sup> is recommended (finished outside diameter 8 to 10 mm). Terminal screw is M3.0.

⚠ NOTE

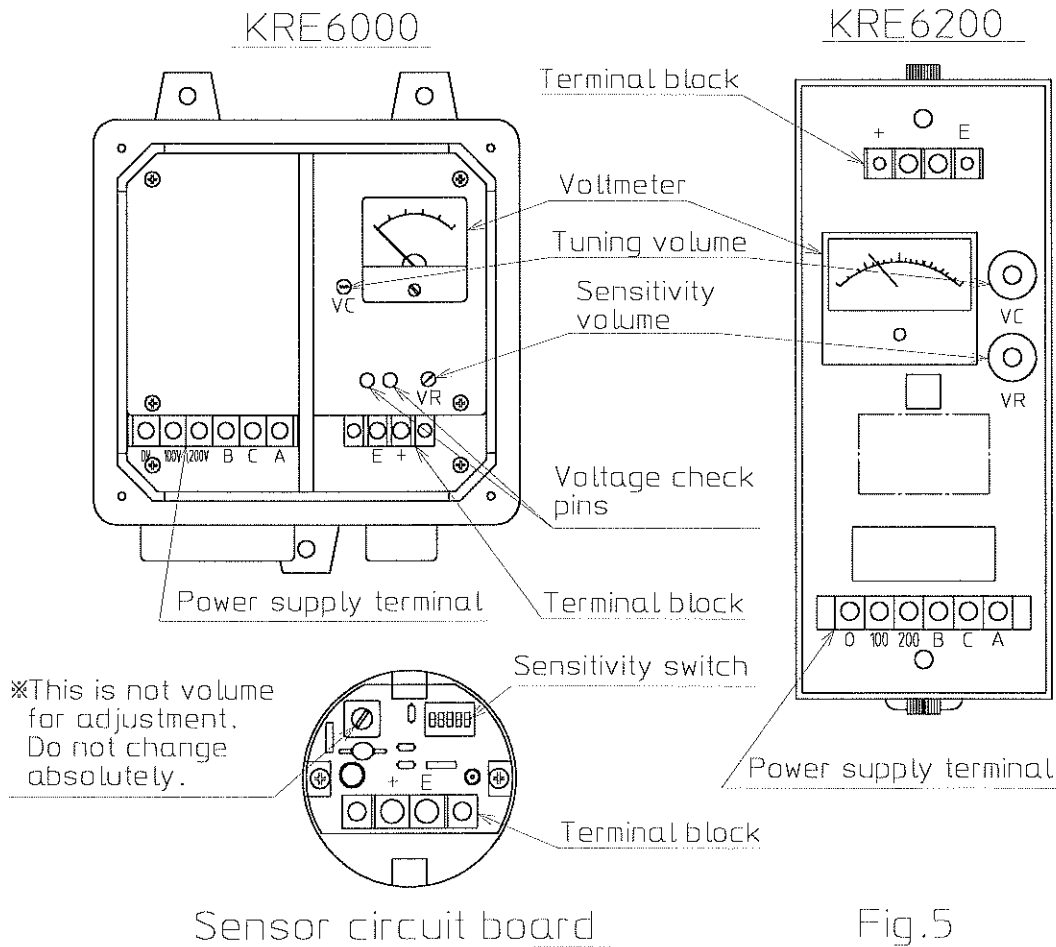
(1) Do not perform cutting of Co-axial cable RG62A/U, and extension.

(2) Co-axial cable (RG62A/U) core is hollow. For this reason, when the poor seal of electrode is generated, and when a housing cover is not fully bound tight, a measurement thing and corrosive gas may pass along the hollow pipe of a cable core part, and may invade into an amplifier part. When there is such the possibility, please fill up the hollow pipe opening end at the tip of a sensor side cable with silicone etc.

(3) The maximum separation distance between the sensor and the amplifier is 200 m.

## 7. ADJUSTMENT

### 7. 1 NOMENCLATURE



⚠ CAUTION

Do not change the switch (volume) except being explained by this manual absolutely. When you have changed, ask Nohken.

## 7.2 SENSITIVITY ADJUSTMENT

Initial tuning in the air is calibrated at the factory. Generally, only the sensitivity needs to be adjusted.

### ⚠ CAUTION

For hazardous areas, extra precaution must be taken during adjustment. Before the housing cover is removed, power must be turned off.

- When measuring medium can be put in.
  - ① Put medium into the container until electrode is buried.
  - ② Turn on the power and connect the voltmeter to voltage check pins.
  - ③ Make sure that the voltmeter reads 8V DC or more. If 8V DC or more is not read, turn the sensitivity volume (VR).

**NOTE:** DO NOT set the sensitivity extremely high or low to ensure the reliable operation.

- ④ Put medium out of the container until electrode is in the air and make sure the voltmeter reads 1V DC or less.

If 1V DC or less is not read, see 7.3, "SELECTING SENSITIVITY RANGE", and change the sensitivity.

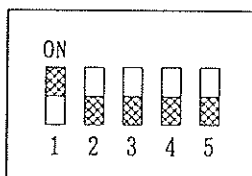
- When measuring medium can not be put in.

Turn sensitivity volume until the voltmeter reads 1V DC.

If measuring medium is put into the container at some future date, adjust sensitivity in accordance with above mentioned "When measuring medium can be put in".

## 7.3 SELECTING SENSITIVITY RANGE

The sensitivity range of the KRE is divided into classes. For fine adjustment, select one sensitivity to meet your application before shipment.



DETECTING SENSITIVITIES		
Switch No.	Sensitivity	Operation capacity
1	A	0.5 pF or more
2	B1	2 pF or more
3	B2	5 pF or more
4	C	200 pF or more
5	D	4000 pF or more

Highest



Lowest

**NOTES** the following points:

- More than one switch shall not be switched on.
- The sensitivity needs to be adjusted when measuring medium is changed or the operation is unstable. See 7.2, "SENSITIVITY ADJUSTMENT", and 7.4, "INITIAL ADJUSTMENT".

## 7.4 INITIAL ADJUSTMENT

Readjust initial tuning as follows when:

- sensitivity setting can not adjust.
- the sensitivity range is changed.
- the probe length is changed.
- the measuring medium is changed.

### ⚠ CAUTION

For hazardous areas, extra precaution must be taken during adjustment. Before the housing cover is removed, power must be turned off.

- ① Check for no miswiring.
- ② Make sure the KRE is not contacting medium or the container.
- ③ Turn on the power and connect the voltmeter to voltage check pins.

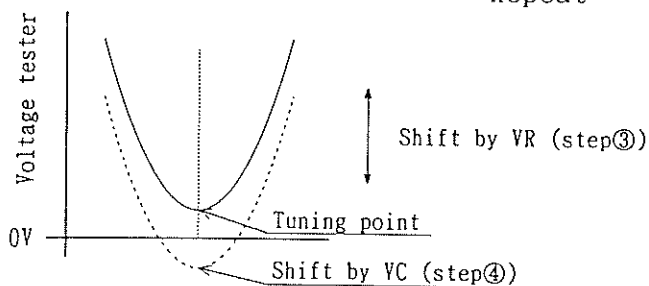
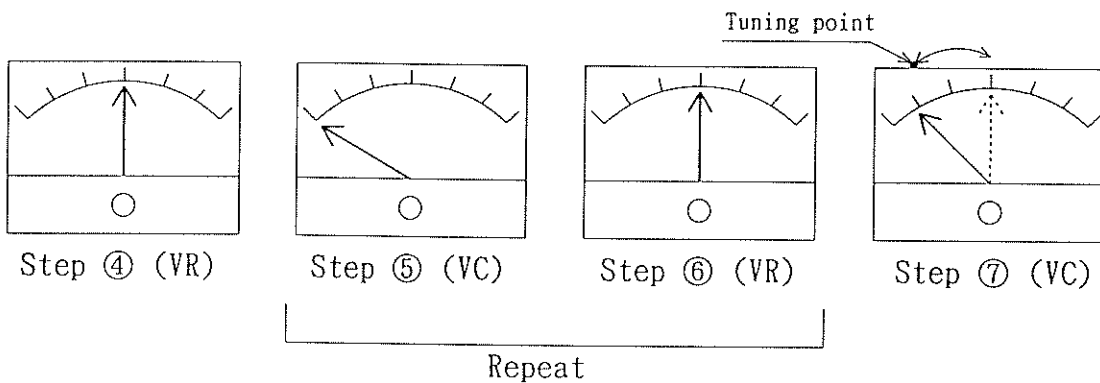


Fig. 6

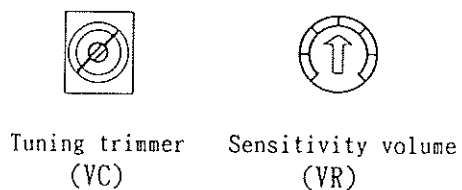


Fig. 7

④ Turn the sensitivity volume (VR) until the 3~5V DC can be read.

**NOTE :** If VR can not set to 3~5V DC, turn the tuning volume (VC) to decrease voltages . Then turn the VR as above mentioned.

⑤ Turn the VC slowly until 0V DC or near.

⑥ Repeat steps ③ and ④ several times. After all, when turning the VC, it will not fall to 0V DC, but rises to 7~10V DC.

⑦ Turn the VC again until the lowest voltage value can be just read.

**NOTE :** Repeat step ⑥ several times and set to the lowest voltage. Only one adjustment might not be set to the lowest voltage.

⑧ The initial tuning is now adjusted. Set the sensitivity.

## 8. MAINTENANCE

① If medium is adhesive, clean an electrode periodically.

② If atmosphere or medium changed, readjust an amplifier.

In the event that the KRE is put in storage for long time, care should be taken as follows:

① Never store the KRE in the direct sunlight or near the heater. Store at the following temperature:

Sensor ; 0 to +60℃

Amplifier; 0 to +55℃

② To prevent condensation and/or liquid penetration, store the KRE in sealed plastic bags with desciccant or other moisture proof packing.

## 9. TROUBLESHOOTING

### ▲ CAUTION

Use the following chart to troubleshoot the malfunctioning sensor.  
If your remedies are unsuccessful, ask Nohken for repair and replacement.

#### ◆ TUNING CAN NOT ADJUST

Possible causes	Remedies
Miswiring.	Wire correctly.
Wire probe too close to the wall.	Locate the probe 100mm or more from the wall.
More than two sensors are installed too close.	Separate them 300mm or more.
Heavy build up on an electrode.	Clean an electrode.
Water/oil penetrated inside the probe. Then it became resistive probe.	Check the resistance between the probe and housing inside. Replace the probe if you can NOT read $\infty$ .

#### ◆ NO SIGNAL WITH LEVEL CHANGE

Possible causes	Remedies
Miswiring.	Wire correctly.
Material has bridge or angle of repose.	Install the probe in good location.
Sensitivity too low.	Adjust the sensitivity.
Incorrect selection of the sensitivity range.	Select the correct sensitivity range.
More than two sensors are installed too close.	Separate them 300mm or more.
Insufficient power supplied.	Repair and replace the power.
Dielectric constant of the medium changed.	Reselect the sensitivity range.

◆ RELAY WILL NOT RESET/PROBE UNCOVERED

Possible causes	Remedies
Miswiring.	Wire correctly.
Material has bridge or angle of repose.	Install the probe in good location.
Heavy build up on an electrode.	Clean an electrode.
Sensitivity too high.	Adjust the sensitivity.
Incorrect tuning.	Readjust the tuning.
Incorrect selection of the sensitivity range.	Select the correct sensitivity range.
More than two sensors are installed too close.	Separate them 300mm or more.
Dielectric constant of the medium changed.	Reselect the sensitivity range.
Water/oil penetrated inside the probe. Then it became resistive probe.	Check the resistance between the probe and housing inside. Replace the probe if you can NOT read $\infty$ .

◆ RELAY CHATTERED

Possible causes	Remedies
Electrode is in contact with the tank wall.	Locate an electrode 100mm or more from the wall.
Insufficient power supplied.	Repair and replace the power.
Incorrect tuning.	Readjust the tuning.
Maladjustment of tuning.	Readjust the sensitivity.

If above remedies are unsuccessful, ask NOHKEN service department. Check and inform the nameplate model number and serial number.

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