HIOKI

INSTRUCTION MANUAL

3226

mΩ HiTESTER

HIOKI E. E. CORPORATION

Contents

Introduction

Thank you for purchasing this HIOKI "3226 mΩ HiTESTER." To get the maximum performance from the tester, please read this manual first, and keep this at hand.

Inspection

When the unit is delivered, check to make sure that it has not been damaged in transit. In particular, check the accessories, panel switches, and connectors.
If the unit is damaged, or fails to operate according to the specifications, contact your dealer or HIOKI representative.

Accessories

9287 CLIP TYPE LEAD

TC adapter
Four R6P manganese dry batteries
Instruction Manual

Safety

⚠ DANGER

Incorrect measurement procedures could result in injury or death, as well as damage to the equipment. Please read this manual carefully and be sure that you understand its contents before using the equipment. The manufacturer disclaims all responsibility for any accident or injury except that resulting due to defect in its product.

Safety symbols

This Instruction Manual provides information and warnings essential for operating this equipment in a safe manner and for maintaining it in safe operating condition. Before using this equipment, be sure to carefully read the following safety notes.

	This symbol is affixed to locations on the equipment where the operator should consult corresponding topics in this manual (which are also marked with the ⚠ symbol) before using relevant functions of the equipment. In the manual, this mark indicates explanations which it is particularly important that the user read before using the equipment.

The following symbols are used in this Instruction Manual to indicate the relative importance of cautions and warnings.

⚠WARNING	Indicates that incorrect operation presents significant danger of accident resulting in death or serious injury to the user.
⚠CAUTION	Indicates that incorrect operation presents possibility of injury to the user or damage to the equipment.
NOTE	Denotes items of advice related to performance of the equipment or to its correct operation.

Precautions

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.

⚠WARNING **The data output connector and the GND of the comparator output terminal are not isolated from the measurement system. To prevent electric shock, be sure to disconnect all wiring and replace the connector cover when not using the connector and terminals.**

⚠CAUTION

- Never apply an external voltage to the SENSE and SOURCE terminals of the instrument.
- A switch that changes the instrument's power source frequency from 50 to 60 Hz is provided on the rear panel. Prior to use, be sure to select the correct frequency setting. Changing the frequency during use is not possible. When setting the frequency, turn the instrument off and on again after changing the switch position.
- Do not store or use the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
- To avoid damage to the unit, do not subject the equipment to vibrations or shocks during transport or handling. Be especially careful to avoid dropping the equipment.

NOTE

- The battery low mark lights when the batteries are low and need to be replaced.
- Be sure to turn the power switch OFF (○) when not using the instrument.
- Warm up the instrument for at least 15 minutes prior to use, to attain proper measurement accuracy.
- The recommended ambient operating temperature range and humidity for the instrument are 0 to 40℃ and less than 80% RH, respectively.
- A fuse is provided in the current source (SOURCE) to protect the circuit. If the fuse burns out, measurements cannot be made.
  Refer to 5.2 Fuse Replacement procedure on how to check for a burned-out fuse.
- This instrument should not be used with relays or other devices that handle small signals, since it may damage their contact coating.
- Do not measure points which have a voltage across them. The main unit of the 3226 will be damaged by an induced voltage if a measurement is made immediately after a temperature rise test or dielectric test of a motor or transformer.
- Accurate measurement may be difficult to obtain if the instrument is used near equipment that generates noise. Also, the indicator may sometimes fluctuate if the device-under-test picks up noise. Therefore, do not use the instrument in environments with excessive electrical noise.
- The measurement indication may sometimes fluctuate due to noise pick-up if the TC adapter is touched or held with bare fingers.

NOTE

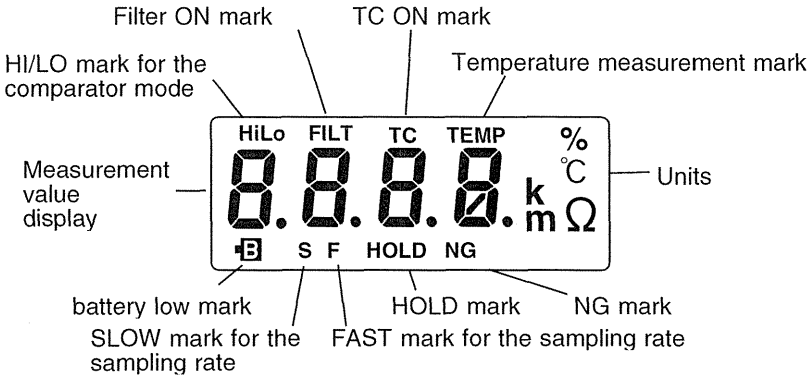
- Temperature correction is not possible when the TC adapter is in contact with the surface of the device to be measured. Note that the TC adapter is only designed to

measure ambient air temperature.

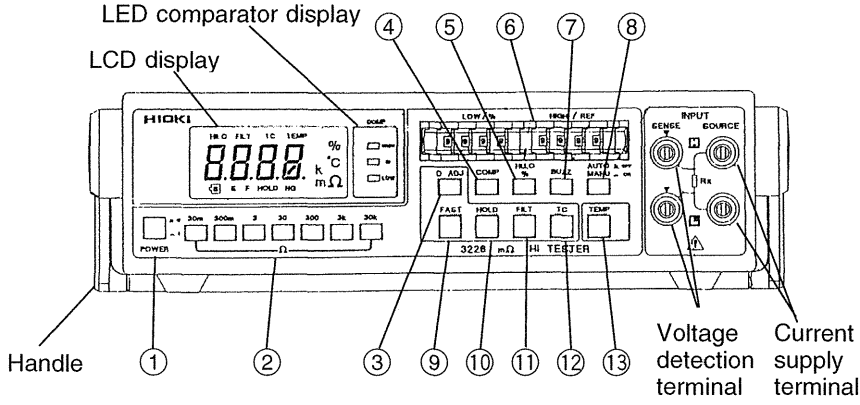
- Significant measurement error will result if the device to be temperature corrected and the TC adapter are not at the same ambient air temperature.
- Connect the AC adapter to the unit with the power OFF.
- The AC adapter may pick up noise which will affect the measurement. In such a case, operate the instrument from battery power.

Chapter 1
Name and Functions

1.1 LCD Display

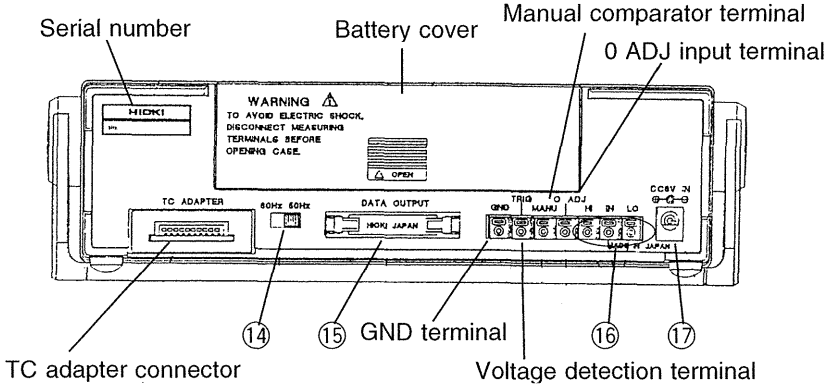


1.2 Front Panel



① POWER switch ② Range switch ③ 0 adjustment switch
④ Comparator switch ⑤ HI.LO/% selection switch
⑥ Comparator setting switch ⑦ BUZZ switch
⑧ Comparator AUTO/MANU switch ⑨ Sampling rate selection switch
⑩ HOLD switch ⑪ Filter switch ⑫ TC switch
⑬ Temperature measurement switch

1.3 Rear Panel



⑭ 50 Hz/60 Hz selection switch ⑮ Data output connector
⑯ Comparator output terminals ⑰ AC adapter socket

1.4 Functions

① Turning the power ON

On power-up, the LCD and LED's light, and the instrument performs an internal check and initialization of internal analog circuits.

An error code is displayed if an internal error is detected during the checks.

(Refer to 5.3.2 Error code table.)

② Range selection

Select the appropriate measurement range with the range switch.

③ Zero adjustment (0 ADJ) function (0 ADJ switch)

To adjust the instrument, short the leads and press the [0 ADJ] switch.

(Zero adjustment is only possible with a reading of 400 counts or less.)If the 0 ADJ and GND terminals on the rear panel are shorted for 10 ms or more, the 0 ADJ function activates.

④ Comparator ON/OFF switch

Switches comparator operation ON and OFF. This switch is disabled in the temperature measurement mode. Pressing the [COMP] switch to ON activates comparator function. Two comparison modes are available : a percent comparison with respect to a reference (REF) value and range (%) setting, and HI-LO comparison with respect to high limit value (HI) and a low limit value (LO). Comparison results can be output to the comparator output terminals on the rear of the unit.

⑤ HILO/% selection switch
Select the reference value(REF) and range(%), or sets the high(HI) and low(LO) limit values.

⑥ Comparator setting switch
Sets the reference value (REF) and range (%), or sets the high (HI) and low (LO) limit values.

⑦ BUZZ switch
Enable the beeper sound for reporting intermediate(in) comparator results.

⑧ AUTO/MANU selection switch
Selects the AUTO mode, for continuous comparator output operation("normal" mode), or the MANU mode for comparator output only when the MANU and GND terminals on the rear panel are shorted.

⑨ Sampling rate selection switch (FAST switch)
Select the sampling rate:
FAST switch ON: 20 samples-per-second;
FAST switch OFF: 2.5 samples-per-second.

⑩ HOLD switch (**HOLD**)
Holds the current measurement value on the display when in ON position. The HOLD state is released when the TRIG and GND terminals on the rear panel are shorted.
Set the HOLD switch to OFF for normal measurement mode.

⑪ Filter switch (**FILT**)
Enable the filter, which removes fluctions in the measurement values. (When the filter is on, the measurement response is slower.)

⑫ TC switch (**TC**)

Converts the resistance value of copper wire to its 20℃-equivalent resistance value and displays it. (The TC adapter must be connected.)

⑬ Temperature measurement switch (**TEMP**)

Selects the temperature measurement mode. (The TC adapter must be connected to the unit.)

⑭ Data output function

Output the numerical values of the measurement in parallel BCD. (Open collector outputs)

⑮ 50 Hz/60 Hz switch

Changes the power supply frequency of the instrument to match that of the power source. The state of the switch is read by the instrument only when the **POWER** switch is turned ON.

⑯ Comparator output terminal

Outputs HI, IN and LO from the comparator on separate lines (open collector).

⑰ AC adapter jack

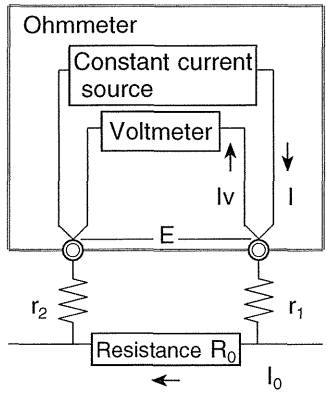
The 3226 can be operated from an AC power source by connecting an AC adapter rated at DC 6 V and 300 mA to the AC adapter socket. The polarity of socket is center-minus.

Chapter 2
Outline

The 3226 m Ω HiTESTER is an four-terminal method tester designed to accurately measure the coil resistance in motors and transformers, the contact resistance of relays, switches and connectors, and the trace resistance on printed circuit boards.
In addition, a temperature correction function, comparator function and data output function are provided, making the 3226 m Ω HiTESTER ideal for use in production and inspection lines and systems.

2.1 Four-terminal method

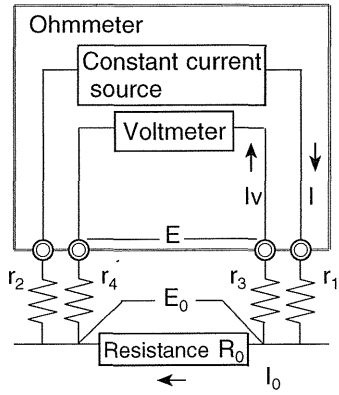
To obtain accurate results when measuring resistance values that are very small, the Four-terminal method must be used. As shown in figure 1, in the Two-terminal method, the resistance of the test leads adds to the resistance of the device being measured, resulting in an erroneous measurement. However, in the Four-terminal method shown in the Figure 2, the input consists of two current terminals to which a constant current is supplied, and two voltage terminals measured the voltage drop. The voltmeter has a high input impedance so that essentially no current flows through the leads connected between the device-under-test and the voltage terminals. As a result, there is almost no voltage drop across the resistances r_3 and r_4. Thus the voltage drop due to the lead resistances and contact resistances is very small, and these can be canceled out.



For $Iv \ll I$, $I_0 = I \therefore Iv = 0$
$E = I_0 \ (r_1 + R_0 + r_2)$
From the equation,
$R = E / I$
$R = I_0 \ (R_0 + r_1 + r_2) / I$
$= R_0 + r_1 + r_2$

r_1 to r_2 is the resistance of the test leads plus the contact resistance at the device connections.

Figure 1



For $Iv \ll I$, $I_0 = I \therefore Iv = 0$
$E = E_0 + Iv \ (r_3 + r_4)$
$= E_0$
From the equation,
$R = E / I = I_0 \times R_0 \ / I = R_0$

r_1 to r_4 is the resistance of the test leads plus the contact resistance at the device connections.

Figure 2

2.2 Temperature Correction Function

The resistance of copper wire depends on the ambient temperature, so it is need to attend to this temperature dependence. Using the TC adapter, the resistance of copper wire can be easily converted and displayed at its 20℃ equivalent. Generally, the resistance of copper wire is expressed in terms of its resistive temperature coefficient with the following equation:

wire:Rt and Rto are the resistance of copper wire at temperatures t℃ and to℃, respectively.

$$Rt = Rto \times \{1 + \alpha to \times (t - to)\} \quad \cdots\cdots (1)$$

α to is referred to as the resistive temperature coefficient and expressed as :

$$\alpha to = 1 / [\{1 / (0.00393 \times \sigma)\} + (to - 20)] \quad \cdots\cdots (2)$$

Here, σ is the conductivity of copper wire. Using equations (1) and (2), and the resistive temperature coefficient for the particular type of copper wire, the resistance of a sample at a particular temperature can be calculated. Table 1 shows the conductivity values of common types of copper wire.

Diameter (mm)	Soft copper	Tin-plated soft copper	Hard copper
0.10~0.26 or less	0.98	0.93	—
0.26~0.50 or less	0.993	0.94	0.96
0.50~2.0 or less	1.00	0.96	0.96
2.0~8.0 or less	1.00	0.97	0.97

Table 1 Conductivity σ

The 3226 performs temperature correction using a temperature sensor consisting of a platinum film resistor with linear temperature dependence. The resistance value of the sample is sensed, converted to a voltage, and then applied to an A/D converter for calculation and display of the 20℃-equivalent resistance value. (See Figure 3.)

The TC adapter circuit assumes a conductivity of 1 when calculating the corrected resistance value. Therefore, the temperature-corrected values for copper wire will not be accurate for conductivities other than 1. The temperature dependence of the conductivity is shown in Table 2. For example, Table 1 shows the conductivity of tin-plated soft copper wire (diameter of 0.10 to 0.26 or less) as σ =0.93, from equation (2), α to is calculated to be 0.00365 (for a conductivity of 1, α to becomes 0.00393). Consequently, the corrected value at 30℃ will be erroneous by +0.0269%.

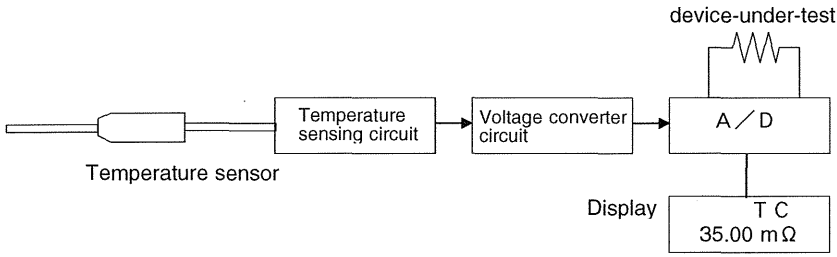


Figure 3 Block diagram of temperature correction circuit

Temperature	10	12	14	16	18	20
Corrected value	1.0409	1.0325	1.0241	1.0160	1.0079	1.0000
Temperature	22	24	26	28	30	
Corrected value	0.9922	0.9845	0.9770	0.9695	0.9622	

Table 2 Corrected conductivity table

Chapter 3
Specifications

3.1 General Specifications

Measurement method	Four-terminal method
Operating method	Dual integrator circuit
Display	LCD display (Reflector type), Max 3500 counts
Annunciators	**HILO**, **FILT**, **TC**, **TEMP**, **B**, **%**, **S**, **F**, **HOLD**, **NG**, **k**, ℃, (LCD), Comparator result (LED)
Overload input	"OF" display
Maximum rated voltage	100 VAC(rms)/DC (Circuit protected by fuse.)
Sampling rate	2.5 samples-per-second or 20 samples-per-second (switchable)
Battery low display	mark lights
Operating temperature/humidity	0 to 40℃, <80% RH (No condensing)
Storage temperature/humidity	-10 to 50℃, <80% RH (No condensing)
Power source	Four R6P manganese Batteries or 6 VDC AC adapter

Continuous operating time	R6P manganese Batteries - approx. 1.5 hours (30 m range) approx. 3 hours (other ranges) LR6 Alkaline Batteries - approx. 5 hours (30 m range) approx. 9 hours (other ranges)
Maximum rated power	Approx. 1.4 W (30 m range) Approx. 0.9 W (other ranges)
Dielectric strength	AC 2 kV (for 1 minute) between the case and the AC power line
Dimensions	Approx. 215(W)×60(H)×220(D) mm (Excluding protrusions)
Mass	Approx. 950 g (Main unit only)
Accessories	9287 CLIP TYPE LEAD, TC adapter, Instruction manual, Four R6P manganese batteries

3.2 Measurement Range

Measurement condition	23℃±5℃, <80% RH (No condensing) After zero adjustment
Correction interval	6 months
Response time	Approx. 150 ms on FAST setting approx. 800 ms on SLOW setting Response time depends on the device being measured.

Resistance measurement (with sampling rate set to SLOW)

Range	30 mΩ	300 mΩ	3 Ω	30 Ω	300 Ω	3 kΩ	30 kΩ
Resolution	10μ Ω	100μ Ω	1 mΩ	10 mΩ	100 mΩ	1 Ω	10 Ω
Measurement current	100 mA	10 mA	1 mA			10μ A	
Max. test voltage	3.5 mV			35 mV	350 mV	35 mV	350 mV
Accuracy	±0.1% rdg.±6 dgt.			±0.1% rdg.±4 dgt.			
Temperature coefficient	±0.02% rdg.±0.5 dgt./℃						
Open-terminal voltage	5 V max						

* If the sampling rate is set to FAST, add±3 dgt. to the digit accuracy error.

Temperature measurement

Measurement range	-10.0℃~99.9℃
Resolution	0.1℃
Accuracy	±0.3% rdg.±0.5℃

3.3 Temperature Correction Function

Correctable temperature range	0 to 40℃
Temperature sensor	Platinum resistance element
Dielectric strength	100 V between the sheath of the TC adapter and the grounding terminal of the unit
Accuracy	Add the following values to the accuracy specifications of the resistance measurement with temperature correction in subsection 3.3.2.

Temperature range	Accuracy
0～15℃	±0.3% rdg.
15～25℃	±0.2% rdg.
25～40℃	±0.3% rdg.

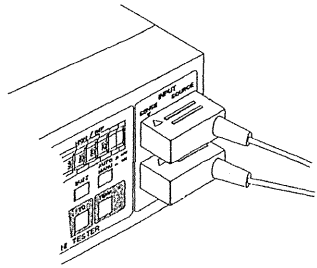
Chapter 4
Operating Procedure

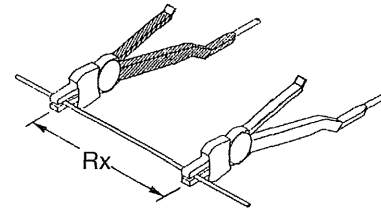
4.1 Preparing measurement

The 3226 works on battery power or with an AC adapter. Refer to the section on battery replacement when installing batteries into the battery compartment while. (Refer to "5.1 Battery Replacement Procedure".)
When connecting the AC adapter, first make sure the POWER switch is OFF, then insert the jack of AC adapter socket, connect the AC adapter body to the AC power source, and finally turn ON the POWER switch.

4.2 Resistance Measurement

① Plug the leads into the input terminals.
Make the connection by mating the red ▽ marks on the leads.
Make the connection by mating the black ▽ marks on the unit and the leads. (See the Figure below.)





② Select the range.
③ Zero adjust (0 ADJ) the instrument referring to subsection 4.2.1.
④ Connect the lead clips to the device to be measured, and read the measurement value.

NOTE

Pressing two range switches simultaneously results in abnormal operation. The range switches are ignored in the temperature measurement mode.

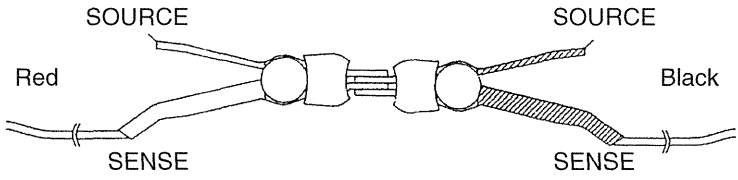
4.2.1 Zero adjust function (0 ADJ)

⚠CAUTION	The GND terminal on the rear panel is not isolated from the measurement system. To prevent electric shock, take proper care when handling the instrument.

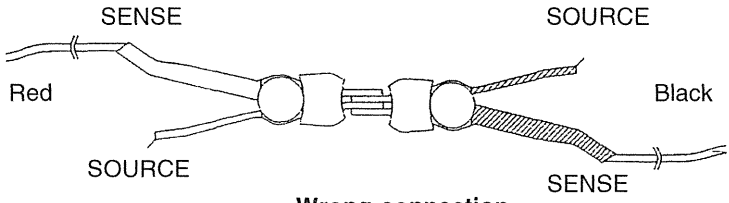
To zero adjust the instrument, short the leads and press the [0 ADJ] switch. (Zero adjustment is only possible for reading of 400 counts or less.)
If the 0 ADJ and GND terminals on the rear panel are shorted for 10 ms or more, the 0 ADJ function activates.

NOTE

- Connect as follows with the specified leads.
- A Wrong connection will cause erroneous readings.

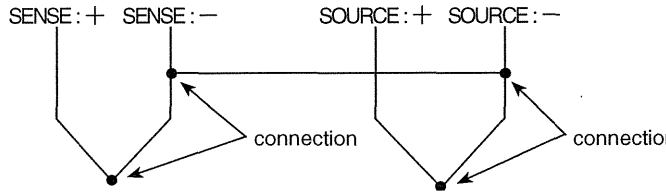


Right connection

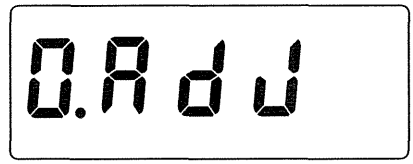


Wrong connection

NOTE If leads other than the specified ones are used, connect as shown in the following figure.

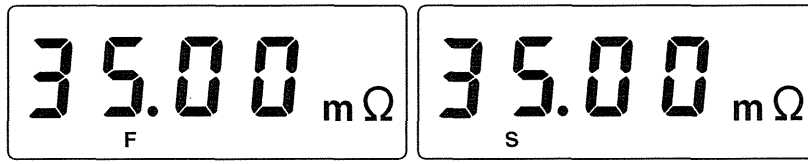


NOTE The following is displayed on the LCD during 0 ADJ.



4.2.2 Sampling rate selection

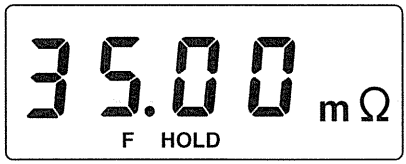
The sampling rate is changed with the FAST switch.
FAST switch ON : 20 samples-per-second
FAST switch OFF : 2.5 samples-per-second
The marks **F** and **S** on the LCD indicate FAST and SLOW, respectively.



FAST setting SLOW setting

4.2.3 Hold function

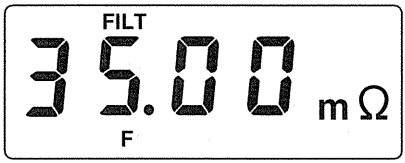
When the HOLD switch is pressed to ON, the current measurement value is held and the **HOLD** mark is displayed on the LCD. The HOLD state is released when the TRIG and GND terminals on the rear panel are shorted.



NOTE The internal analog circuit continues to operate even during HOLD.

4.2.4 Filter function

When the FILT switch is pressed to ON, the filter activates and the "FILT" mark is displayed on the LCD. The filter is useful when the measurement value fluctuates due to noise. (Cut-off frequency: approx. 5 Hz)

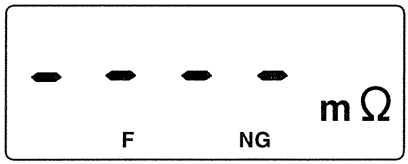


4.2.5 Overload indicator

If the input overloads, the following mark is displayed on the LCD.

4.2.6 NG function

The NG function detects abnormalities in the current source (SOURCE) and displays an **NG** mark on the LCD. In addition, appears on the date outputs of the rear panel. (Refer to "4.6 Data output Function".)



An NG is output when:

① The resistance value of the device to be measured is too large (out of range).
(Ex: A 30 Ω measurement is attempted in the 30 mΩ range.)

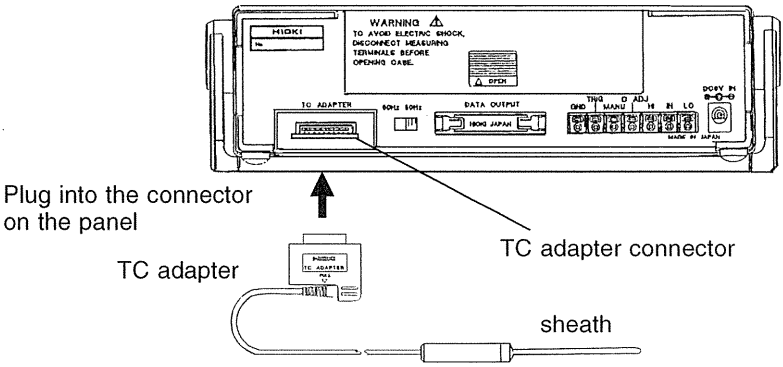
② The lead wire is burned out.

③ The 4 input terminals are not properly connected.

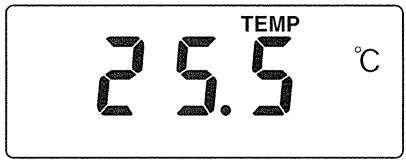
④ The leads are open-circuited.

4.3 Temperature Measurement

Trun the power off. And connect the TC adapter as a following this Figure.



The ambient air temperature is sensed by the TC adapter and displayed on the LCD.



NOTE

- Accurate temperature measurement are not possible if the sheath of the TC adapter is held with bare fingers.
- The FILT function, FAST function, Comparator function, Temperature correction function and NG function are disabled during temperature measurement.

4.4 Temperature Correction Function

With the 3226's built-in temperature coefficient correction circuit, manual temperature correction for copper wire resistance values is no longer necessary. Using the temperature coefficient for copper wore (approx. 0.393%/℃) together with the ambient temperature measured by the temperature sensor, the 20℃-equivalent resistance value is automatically calculated and displayed.
The TC adapter is connected to the unit through the connector on the rear panel. (Refer to "4.3 Temperature Measurement".)
With the TC adapter connected, temperature correction is performed by pressing the TC switch on the front panel, displaying the **TC** mark on the LCD.
If the TC adapter is missing or is not properly connected, the temperature correction function does not work, even if the TC switch is pressed. (In this case, an "Err 5" is displayed on the LCD.)
Before attempting a temperature correction, make sure the **TC** mark is lit.

NOTE

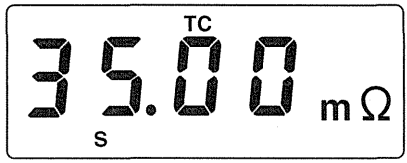
- The temperature sensor is not designed to sense surface temperature. It should only be used to sense ambient air temperature. Note also that unless both the sample and the sensor have completely adjusted to the ambient air temperature, the reading error will be large.
Prior to use, the TC adapter should be connected to the 3226, and both should be allowed to warm up at least 15 minutes.

- During temperature correction measurements, if the display shows OF even when the inputs are shorted, the lead wires of the TC adapter burned out.

- The TC adapter should be connected or disconnected with the power of the unit OFF.

- Note also that the TC adapter is not watertight. Therefore, do not allow the instrument to get wet or be immersed in water or any other fluid.

Display when the temperature correction function is used.



4.5 Comparator Function

Two settings are available for the comparator function: the high limit (HI) / low limit value (LO) setting, and the reference value (REF) / range (%) setting.
In addition to the HIGH, IN and LOW LED indicator results are also signaled by a beep sound and are output via an open-collector output.

4.5.1 Setting the comparison value

HI-LO setting

(1) Turn ON the COMP switch, and turn OFF the HI.LO/% switch.

(2) Set the high limit value (HI) and the low limit value (LO) with the comparator setting switches.
(3) Ignoring the decimal point and range, perform the comparison.
Setting range :
High limit value 0 to 3500 counts
Low limit value 0 to 3500 counts

NOTE

- Setting the low limit value larger than the high limit value causes a setting error (Err 4), which will sound the beeper periodically.
- During an overload condition, the LCD display shows OF and the comparator output is HIGH.
- If the Constant current source is missing, the LCD display shows "----" and **NG**. And conparator output is canceled.

REF-% setting

(1) Turn the COMP switch and the HI.LO/% switch ON.
The display shows a % deviation value.

(2) Set the reference value (REF) and range (%) with the comparator setting switches. (The range can be set in 0.1% increments.)

(3) Ignoring the decimal point and range, perform the comparison.
Setting range :
Reference value (REF) ··· 1 to 3500 counts
Range (%) ····· 0.1 to 99.9%
Comparison value :
High limit value = REF + (| REF | × % ÷ 100)
Low limit value = REF − (| REF | × % ÷ 100)

NOTE

- Setting the range (%) outside 0.1 to 99.9 cause a setting error, which will sound the beeper periodically. (Use the lower three digits on the setting switch.)
- In case of s comparator error :
  Indication : Err 4
  LEDs : All LEDs are dark
  External output : All OFF (HIGH level)
  Beeper : Sounds periodically
- If the measurement value overload the 3500 counts, the LCD display shows OF.

The comparator output is as follows :

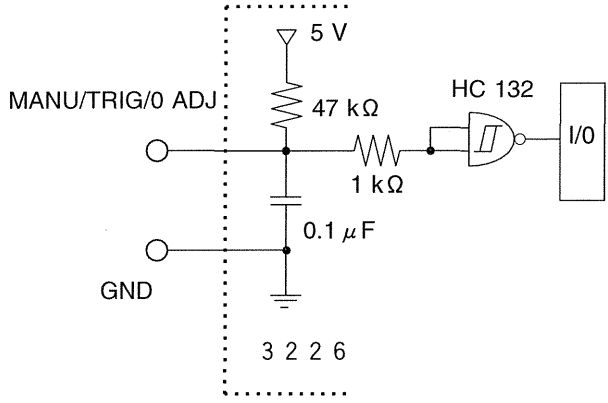
Displayed value > High limit value :Outputs a HIGH.
High limit value ≧ Displayed value ≧ Low limit value:Outputs an IN.
Low limit value > Displayed value :Outputs a LOW.

4.5.2 Switch between AUTO and MANU

The comparator can be used in two modes : AUTO or MANU. Changing the mode is performed using the **AUTO/MANU** switch on the front panel.

① MANU mode

In the MANU mode, the LED, beeper and external output are all disabled. In this mode, comparison results can be output at an arbitrary time by shorting the MANU and GND ternimals on the rear panel. When the ternimals are open-circuited, the output is again disabled.



② AUTO mode

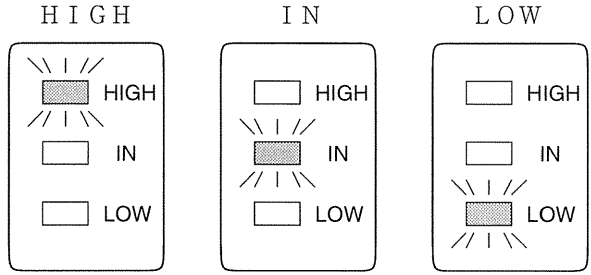
In the AUTO mode, the comparator operates continuously.

4.5.3 Output of comparison results

⚠CAUTION	· The open collector output circuit is not isolated from the measurement system. · Make sure that the output voltage and output current do not exceed the specified range.

① LED indicators

The LED indicators are located on the front panel.



② Beeper

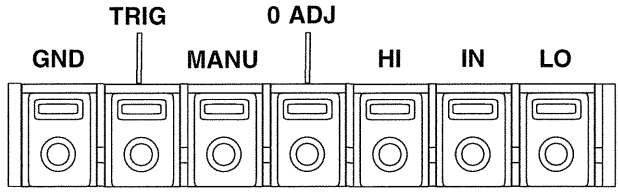
The beeper sounds if the comparison results is IN. The beeper can be turned ON / OFF with the BUZZ switch on the front panel.

③ Open collector output

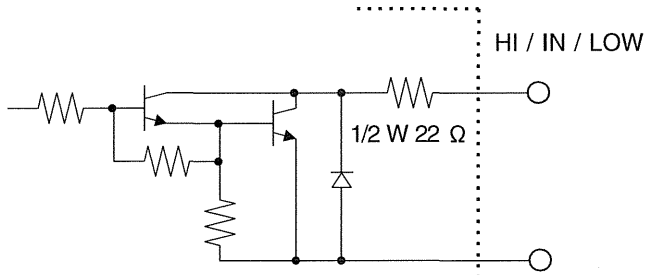
The comparison results are available on the respective comparator output terminal HI, IN or LO, depending on the result.

Output timing during HOLD swith and AUTO/MANU. swith pressed, refre to "4.6 Data output Function".

Rear panel output ternimals



Open collector output circuit

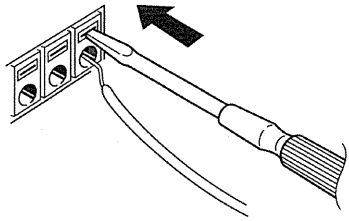


Output dielectric strength : 35 V max

Output current : 50 mA max

4.5.4 Connections to terminals on the rear panel

① Use suitable wires bared at their ends for a length of about 10 mm
② As shown in Figure, depress the knob on the terminal with a screwdriver, and push the end of the wire into the connection hole.
③ Release the screwdriver, and the wires will be locked into place.
④ Use the same procedure to remove the wires



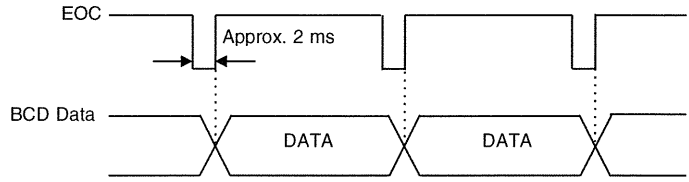
Recommended wire
Single strand: 1.0 mm dia. (AWG #18)
Multi-strand: 0.75 mm^2
Usable limits
Single strand: 0.4 to 1.0 mm dia.
(AWG #26 to #18)
Multi-strand: 0.3 to 0.75 mm^2
(AWG #22 to #20)
Strand diameter: minimum 0.18 mm
Standard insulation stripping length: 10 mm
Button pressing tool: Blade screwdriver
(tip width 2.6 mm)

4.6 Data Output Function

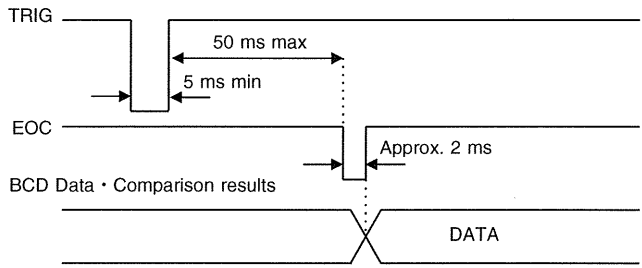
The BCD value of the measurement, and the NG and EOC (End-of-convresion) signals are available via open collector outputs.

4.6.1 Output timing

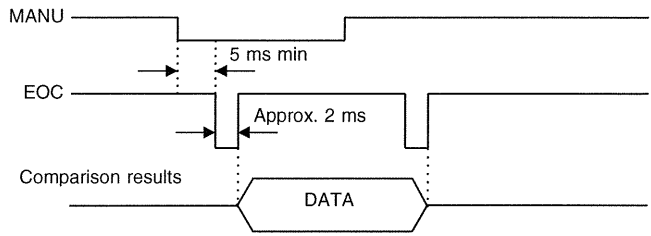
The numeric data are converted on the rising edge of EOC. The NG signal is output irrespective of the EOC timing. (Active Low)



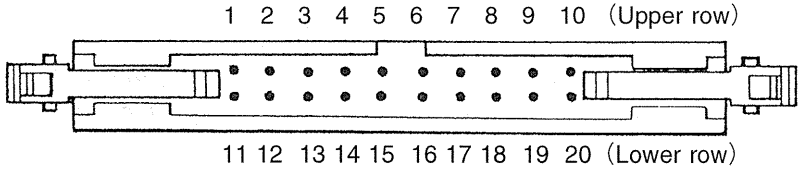
Output timing during HOLD swith ON (sampling FAST)



Output timing during comparator mode is MANU.
The MANU signal level is detected from 5 ms before EOC falling. Only when the MANU signal is low level, the data is changed by EOC rising signal.



4.6.2 Connector diagram



Use the following connectors :
On the main unit : PS-20PE-D4LT2-M1
(from Japan Air Electronics, Inc.)
Cable side : 9161 (HIOKI) or PS-F20CM-50X [50 cm]
(from Japan Air Electronics, Inc.)

4.6.3 Pin-out diagram

Pin number	Signal	Pin number	Signal
1	10^3Digit (BCD)	11	10^1Digit (BCD)
2	10^3Digit (BCD)	12	10^1Digit (BCD)
3	10^3Digit (BCD)	13	10^0Digit (BCD)
4	10^3Digit (BCD)	14	10^0Digit (BCD)
5	10^2Digit (BCD)	15	10^0Digit (BCD)
6	10^2Digit (BCD)	16	10^0Digit (BCD)
7	10^2Digit (BCD)	17	NG
8	10^2Digit (BCD)	18	EOC
9	10^1Digit (BCD)	19	GND
10	10^1Digit (BCD)	20	NC

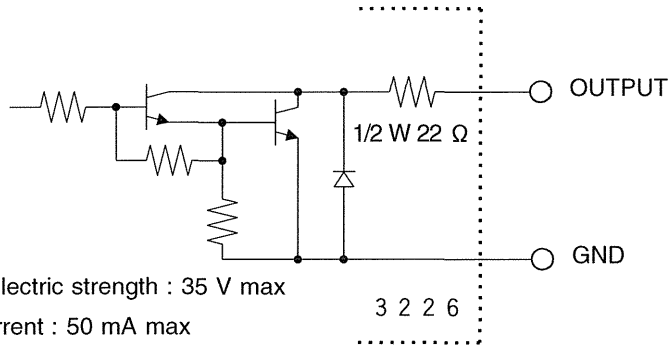
NC : not connected

4.6.4 Output circuit

⚠WARNING

- **The data output connector and the GND of the comparator output terminal are not isolated from the measurement system. To prevent electric shock, be sure to disconnect all wiring and replace the connector cover when not using the connector and terminals.**
- **Make sure the output voltage and output current do not exceed the specified range.**

The output circuit is shown below.



Output dielectric strength : 35 V max
Output current : 50 mA max

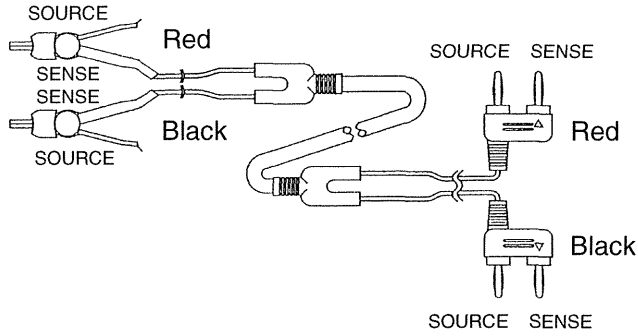
4.6.5 Data format

Only the measurement values have parallel BCD output for each digit.

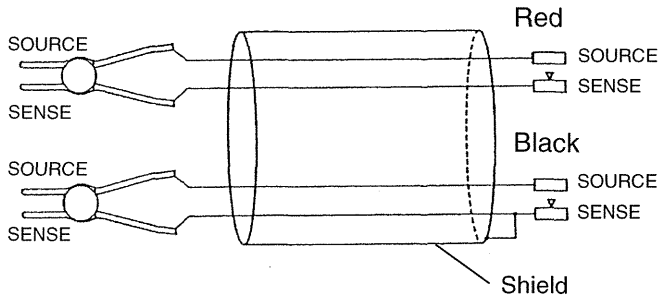
データ	D	C	B	A	
0	1	1	1	1	
1	1	1	1	0	
2	1	1	0	1	
3	1	1	0	0	
4	1	0	1	1	
5	1	0	1	0	
6	1	0	0	1	
7	1	0	0	0	
8	0	1	1	1	
9	0	1	1	0	
OF	0	1	1	0	All digits are "9".
NG	0	0	0	0	All digits are "F".

4.7 Leads

Connect the leads as shown in the following figure :



The cable part of the lead is shielded.



For user-made leads, take the following precautions when the leads :

(1) A shield must be applied. (Refer to the above figure.)

(2) The cable length must be 5 m or less (The resistance of the wire material should be 100 m Ω/m or less.)

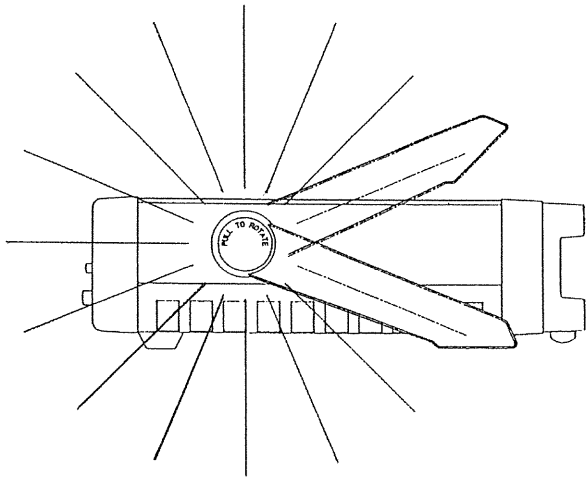
NOTE

- The rubber on the 9287 CLIP TYPE LEAD is available as a service part (rubber for 9099). Please contact your nearest dealer.
- Replacement method :
  Wet the inside of the rubber and insert the clip into the rubber.

4.8 Instrument Handle

⚠CAUTION	Be sure not to bear down too hard on the top of the unit when it is tilted upwards. Doing so may damage the stand.

The handle can be used as a stand. Pull both ends of the handle outward to release it and rotate it to the desired position. Then, push the handle inward to lock it in place. The handle can be locked at interval of 22.5 degrees.



Rotate pitch : 22.5 degrees

Chapter 5
Maintenance and Service

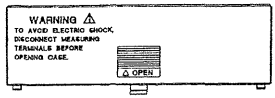
5.1 Battery Replacement Procedure

⚠WARNING

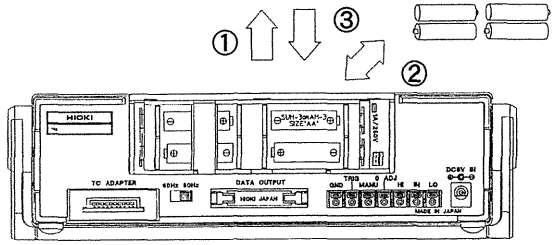
- To avoid electric shock when replacing the batteries first disconnect the AC adapter and leads from the object to be measured. Also, after replacing the batteries always replace the cover before using the unit.
- When replacing the batteries, do not install old batteries with new ones, and do not mix different types of batteries. Check the battery polarity carefully when inserting the batteries.
- Do not short-circuit used batteries, disassemble them, or throw them in a fire. Doing so may cause the batteries to explode.
- Be sure to dispose of used batteries according to their type in the prescribed manner and in the proper location.

① Remove the battery cover
② Replace the batteries with new ones, observing the correct polarity.
③ Replace the battery cover.

Battery cover



R6P manganese Batteries

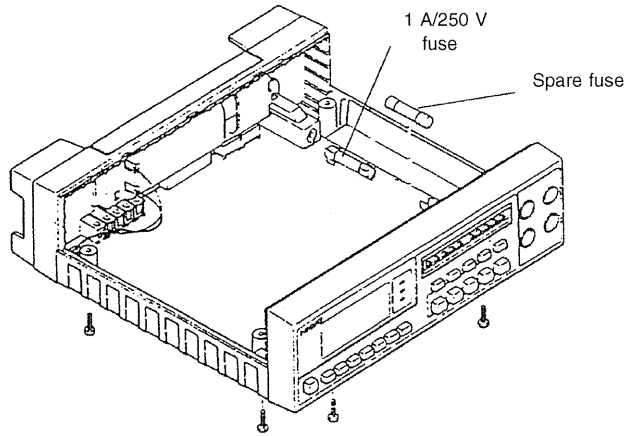


5.2 Fuse Replacement Procedure

⚠WARNING

- **To avoid electric shock when replacing the fuse turn the power switch off and disconnect the AC adapter and leads before beginning.**
- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death.**
  1 A/250 V 30×6.4 mm dia.

To check whether the fuse is burned out set the instrument to the resistance measurement mode. If **NG** is displayed on the LCD when the leads are shorted, the fuse is burned out. The fuse is mounted on the printed circuit board of the main unit. To access the fuse, remove the screws on the bottom of the case and remove the upper part of the case. Then, replace the fuse with the spare fuse in the battery compartment.



5.3 Troubleshooting

5.3.1 Checking items for malfunction

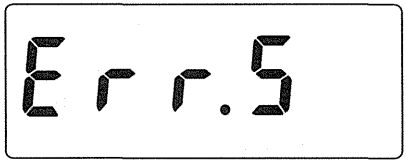
When the instrument does not work normally, check the following items :

LCD does not light even when the power switch is turned ON.	Check whether the batteries are low.
Resistance measurement can not be performed.	Check whether the instrument is in the NG state. Check whether the fuse has burned out.
Temperature measurement can not be performed.	Check whether the TC adapter is properly connected.
Temperature correction can not be performed.	Check whether the TC adapter is properly connected.
Comparator function does not work.	Check whether the AUTO/MANU switch is in the MANU position.

5.3.2 Error code table

An error code is displayed on the LCD when particular errors occur.

Example :



Error code	Description
1	Internal diagnostic check failed on power-up. If this code is displayed for several consecutive power-ups, consult your nearest dealer.
2	The lead on the SOURCE side is not connected during a zero adjustment.
3	An offset of over 400 counts is being measured during a zero adjustment.
4	The comparator setting is incorrect.
5	The TC adapter is not connected while using the TC function.
6	The TC adapter is not connected while performing a temperature measurement.
7	A temperature measurement can not be performed because the TC adapter is non-standard.

5.4 cleaning

Gently wipe dirt from the surface of the unit with a soft cloth moistened with a small amount of water or mild detergent.
Do not try to clean the unit using cleaners containing organic solvents such as benzine, alcohol, acetone, ether, ketones, thinners, or gasoline. They may cause discoloration or damage.

5.5 Service

If the unit is not functioning properly, check leads. If a problem is found, contact your dealer or HIOKI representative. Pack the unit carefully so that it will not be damaged during transport, and write a detailed description of the problem. HIOKI cannot bear any responsibility for damage that occurs during shipment.

5.6 Applications

5.6.1 Resistor Selection

Resistor can be selected by using the REF/% comparison function of the comparator. The resistance value used as the reference is input into REF, and the deviation (%) from the reference is displayed as the measurement value.

5.6.2 Short Location on a Printed Circuit Board

The location of a short on a printed circuit board (Boad with no parts installed.) can be detected by using the REF/% function of comparator.

Assuming that pattern A and B are shorted as shown in the following figure :

(1) Connect SOURCE (+) and SOURCE (-) to each pattern respectively.

(2) Connect SENSE (+) to a point near SOURCE (+), and connect SENSE (-) to the point marked ①.

(3) Set the REF setting switches of the comparator to a measurement value, and set the comparator to the REF/% mode.

(4) Read the measurement value (%) while moving SENSE (-) to points ②, ③ and ④.

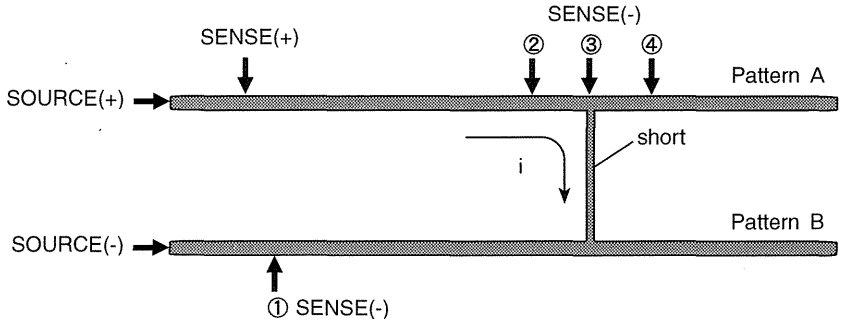
The measurement values read as follows :

For point ② : 30 %

For point ③ : 40 %

For point ④ : 40 %

The short at point ③ can be determined from the above measurement values.


SENSE(+)
SENSE(-)
② ③ ④
SOURCE(+)
Pattern A
short
i
Pattern B
SOURCE(-)
① SENSE(-)

HIOKI 3226 mΩ HiTESTER

Instruction Manual

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