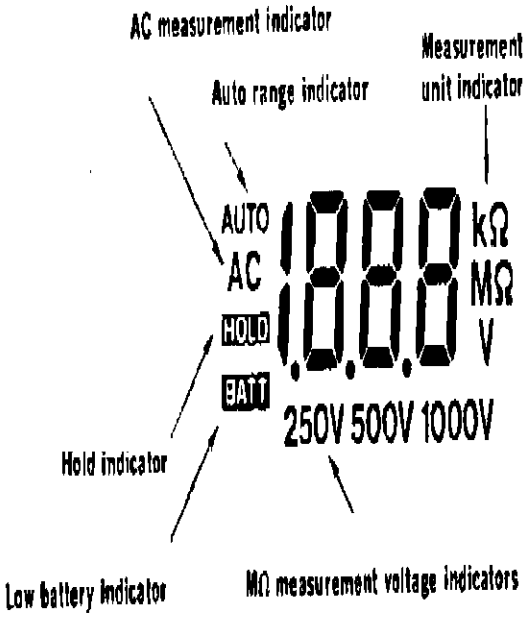
HIOKI

3116
DIGITAL
MΩ HI TESTER

INSTRUCTION MANUAL

WARNING

This instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurement. Failure to follow directions can result in a serious or fatal accident.



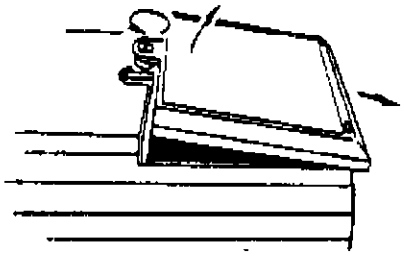


図 2　Fig.2

⚠ **Operating Precautions**

(1) Before making measurements, always verify that the function and other switches have been set properly.

(2) If the "BATT" appears, it is an indication that the batteries have worn down and should be replaced with new ones. For MΩ measurements in particular, the resistance under measurement has a great effect on current consumption. Verify that the "BATT" does not appear with the MEASURE switch set to ON and the input shorted.

(3) If the fuse blows or is removed, resistance measurement is not possible. Replace the fuse, referring to Section 3. 2.

(4) When storing the 3116, avoid locations subject to high temperature or humidity and condensation.

(5) After using the 3116, always remember to set the power switch to OFF.

1. OPERATION

① Display

The 3116 uses a large, custom-designed liquid crystal display with a 12mm character height. In addition to the measured value, this display indicates units, AC, and such conditions as hold in addition to the measurement voltage mode. If an input overload occurs, the most significant digit will flash "1".

② Voltage Detection Indicator Lamp

In the MΩ and ACV functions, this lamp lights to indicates that the measurement lines are alive (i. e., at 50VAC or greater). In the MΩ function, this lamp lights when the MEASURE switch is set to ON to indicate that high voltage is being generated.

③Voltage Mode Switch

This switch is used to select MΩ measurement voltage as 250V, 500V, or 1000V.

④Function Switch

This switch is used to select various measurement functions, as follows.

OFF	Power off
MΩ	Insulation resistance measurement
ACV	AC voltage measurement
Ω, kΩ	Resistance measurement

⑤MEASURE Switch

When measuring insulation resistance in the MΩ function, this switch is set to ON. When it is at this setting, a voltage indicated by the mode switch③is generated and insulation resistance can be measured. After setting the switch to OFF, the measured value at the time the switch was set to OFF is held in the display.

Notes:

1) Operation is not possible unless the LINE probe is inserted into the main unit.
2) The data hold condition is maintained and measurement is not possible except if the switch to ON.
3) In the data hold condition, "HOLD" appears at the top of the LCD.

⑥ LIGHT Switch

Pressing this switch turns on the LCD back illumination lamp for approximately eight seconds.

Notes:

1) If this switch is pressed continuously, the time is from the first pressing.
2) In addition to automatically turning off, the lamp can not can be turned off except by switching the power to OFF.

⑦ MΩ, ACV Measurement Terminal

This is the input terminal to measure insulation resistance and AC voltage.

Note:

1) In the MΩ function, the internally generated high voltage positive side is connected to these terminals.

⑧ Ω, kΩ Measurement Terminal

This is the input terminal used to measure resistance.

⑨ LINE Terminals

These are common input terminals used for all measurements. They include guard and switch terminals.

⑩ GUARD Terminal

When measuring insulation resistance, this terminal is used to measure only bulk resistance without the effect of surface leakage resistance on the device under measurement.

⑪ Battery Compartment

Removing a screw on the rear of the case reveals the batteries and fuse.

2. Measurement Method

(1) Insulation Resistance Measurement

⚠ CAUTION

Do not apply a voltage to the input which exceeds the overload protection voltage.
MΩ measurement 600VDC or DC+AC peak (with the MEASURE switch at OFF)
500V DCorDC+AC peak (with the MEASURE switch at ON)

① Insert the red test probe into the LINE terminal and the black test probe into the EARTH terminal.
② Set the function switch to MΩ.
③ Select the measurement voltage to be applied by using the voltage mode switch (setting this to 250, 500 or 1000V).
④ Make contact with the device under measurement using the probes and press the MEASURE switch, releasing the switch when the display value has stabilized to hold the measured value on the display for easy reading.
⑤ When making long-term measurements, lock the MEASURE switch in the upper position. (see Fig.1)
⑥ When reading the display in dark locations, press the LIGHT switch. This will turn on the LCD back illumination for approximately eight seconds.

Note:
1) Never make measurement on a live circuit. Before making measurements, always check for the existence of voltage at the measurement points.
2) Voltage will not be generated unless the LINE probe is inserted into the main unit and therefore measurement will not be possible.
3) Do not change the position of the voltage mode switch with the MEASURE switch in the ON condition.
4) If one side of the measured circuit is grounded, connect this to the EARTH terminal. This usually results in a lowered measured value and should provide better operational safety. When doing this, take care that the LINE probe does not make contact with ground or other objects.
5) For a circuit or device not grounded, the LINE and EARTH terminals can be connected in either direction.
6) When measuring the insulation resistance of a circuit having a capacitive component, the displayed value may vary. Also, since the capacitants will be charged up to the measured voltage, the LED lamp will not go out even when the MEASURE switch is set to OFF, until the measurement probe is grounded.

(2) AC Voltage Measurement

⚠ CAUTION

Do not apply a voltage to the input which exceeds the overload protection voltage.
AC voltage measurement.: 850VDC or DC+AC peak

① Insert the red test probe into the LINE terminal and the black test probe into the EARTH terminal.
② Set the function switch to ACV.
③ Make contact the circuit under measurement using the probes and read the measured value from the display.
④ When reading the display in dark locations, press the LIGHT switch. This will turn on the LCD back illumination for approximately eight seconds.

(3) **Resistance Measurement**

⚠ CAUTION

Do not apply a voltage to the input which exceeds the overload protection voltage.
Resistance measurement 250VDC or ACrms (fuse protected)

① Insert the red test probe into the LINE terminal and the black test probe into the Ω, kΩ terminal.
② Set the function switch to the Ω, kΩ. The AUTO 1.000kΩ display will appear and the most significant digit will flash as "1".
③ Make contact with the circuit under measurement using the measurement probes and read the measured value from the display.
④ When reading the display in dark locations, press the LIGHT switch. This will turn on the LCD back illumination for approximately eight seconds.

Note:
1) In making resistance measurements, the display may indicate several counts even with the test probes shorted. This is an indication of the resistance of the test probes themselves.
2) When measuring the resistance inside a circuit, remove the power from the circuit to be measured and discharge capacitors within this circuit before measurement.
3) If the fuse has blown or is removed, an OVER indication will appear even with the measurement probes shorted together.

(4) **Line Voltage Detection**

⚠ CAUTION

Do not apply a voltage to the input which exceeds the overload protection voltage.

MΩ measurement	600VDC or DC+AC peak (with MEASURE switch at OFF)
	500VDC or DC+AC peak (with MEASURE switch at ON)
AC voltage measurement	850VDC or DC+AC peak

① Insert the red test probe into the LINE terminal and the black test probe into the EARTH terminal.
② Set the function to MΩ or ACV.
③ Make contact with the circuit under measurement using the probes and verify the LED lamp (this will light at 50VAC or greater).

Note:
1) In making insulation resistance measurements, measured is not possible with voltage applied. Always check, therefore, for the presence of voltage before measurement.

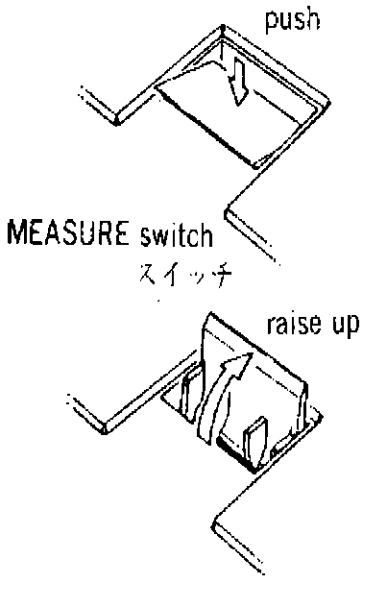


図1 Fig. 1

3. FUSE AND BATTERY REPLACEMENT

(1) **Batteries**

① Remove the battery cover by loosening the screw on this cover with a coin or similar implement. (see Fig.2)
② The batterry compartment holds eight type AA batteries. Replace these all at the same time, observing correct battery polarity.

Note:
1) When storing the 3116 for long periods of time, remove the batteries.
2) When making MΩ measurements, alkaline manganese batteries are recommended because of the large current consumption.

(2) **Fuse**

① In the Ω function, a fuse with an arc-suppressant is used to protect the 3116 circuitry from excessive input.
② To replace the fuse, remove the battery cover in the same manner as described in Section 3. (1). The battery component also contains a spare fuse.
When replacing the fuse, use a 0.5A/250V (6.4mm diameter×30mm long) tubular fuse with an arc-suppressant.

Note:
1) Resistance measurements are not possible if the fuse has blown or has been removed.

4. USING THE 9139 SWITCHED PROBE

① Connect the probe to the LINE terminal and lock the MEASURE switch in the upper position (see Fig.1).
② MΩ measurement will be performed only when the probe switch is pressed.
③ With the switch set to OFF, the measured value is held in the display.

- **General Specifications**

Operating method	Dual integration type
Display	Liquid crystal display (maximum indication 1999) (except for the AC 600V range), including units and symbols
Range switching	Fully auto-ranging
Input/over indicator	Most signifisant digit flashed "1" (except for the AC 600V range)
Battery low indicator	"BATT" mark appears at 8.7V ±0.3V
Sampling rate	2 times/second
Temperature characteristics (0 to 40°C)	Zero drift: 0.3dgt/°C Gain drift: Measurement accuracy ±2% of rdg (±5% of rdg at 2000M /250V)
Guaranteed accuracy temperature/humidity range	18 to 28°C, 80% RH max. (with no condensation)
Operating temperature/ humidity	0 to 40°C, 80% RH max. (with no condensation)
Storage temperature/ humidity	−20 to +60°C, 70% RH max. (with no condensation)
Power supply	Eight type AA batteries
Power consumption	MΩ: 500mW (typical) in the ready condition and 2.8W (typical) for 1MΩ/1000V measurement. ACV, Ω: 300mW (typical) With lamp lighted: 700mW (typical)
Continuous operating time and number of measurements	MΩ ready condition: Approx. 44hr (manganese batteries) MΩ ON/OFF: Approx. 1500 times (with manganese batteries) (1MΩ/1000V ON: 5s, OFF: 25s)
Dielectric strength	2.2kVAC for one minute (between input terminals and outer case)
Dimensions	Approx. 170(H)×114(W)×67(D)mm
Weight	685g (including batteries)
Accessories	9353 carrying case, 9130 test lead with probe 9122 test lead with clip, spare fuse (0.5A/250V, 6.4dia.×30mm long tubular fuse with arc suppressant), eight type AA batteries.
Optional accessory	9139 Measurement probe with switch

- **Additional Functions**

Display hold	MΩ function only
Voltage detection indicator	In the MΩ and ACV functions, the LED lights for an input of 50VAC or greater. In the MΩ function, the LED lights when high voltage is being generated.
Display lamp	Approx. 8s when a switch is pressed (LCD back illumination)

● **Measurement Ranges** (At 23°C ±5°C, 80% RH max., accuracy guaranteed for six months)

絶縁抵抗計 Insulation resistance measurement

定格電圧 Reted voltage	250V	500V	1000V
測定レンジ Measurement range	2M, 20M, 200M, 2000MΩフルオート (Fully auto-ranging)		
応答時間 Response time	(端子開放から100MΩを測定した場合) 3 sec max (measuring 100MΩ starting at open terminals)		
確度 Accuracy	(19.99MΩ max.) ±2%rdg±8dgt	(500MΩ max.) ±2%rdg±8dgt	(1000MΩ max.) ±2%rdg±8dgt
	(20.0MΩ min.) ±5%rdg±8dgt	(501MΩ min.) ±5%rdg±8dgt	(1001MΩ min.) ±3%rdg±8dgt
測定端子電圧 Measurement terminal voltage	(0.25MΩ～∞) 250V～275V	(0.5MΩ～∞) 500V～550V	(1MΩ～∞) 1000V～1100V
測定電流 Measurement current	(0MΩ) 1.5mA max (0.25MΩ) 1mA	← (0.5MΩ) 1mA	← (1MΩ) 1mA
過負荷保護 Overload Protection	600V DCorDC+AC peak/1minute (測定端子間、メジャースイッチOFF) (between measurement terminals and measure switch OFF) 500V DC or DC+AC peak/1minute (測定端子間、メジャースイッチON) (between measurement terminals and measure switch ON) 100V DC or DC+AC peak/1minute (ガードと測定端子間) (between guard and measurement terminals)		

交流電圧計 **AC Voltage Measurement**

測定レンジ Measurement range	600V
確度 Accuracy	±1%rdg±6dgt
周波数範囲 Frequency response	40～100Hz
入力抵抗 Input resistance	約10MΩ Approx. 10MΩ
数字残り Residual digits	2dgt max.
過負荷保護 Overload protection	850V DCorDC+AC (peak) / 1 minute

抵抗計 **Resistance Measurement**

測定レンジ Measurement range	200Ω 2kΩ フルオート (Fully auto-ranging)
確度 Accuracy	±0.8%rdg±4dgt
開放端子電圧 Open-circuit terminal voltage	0.5V max.
過負荷保護 Overload protection	250V DCorACrms (ヒューズ保護) (Fuse protected)