User's Manual

734 01/02

Digital Multimeter

Store this manual in a safe place for future reference.

YOKOGAWA
Yokogawa M&C Corporation

IM 73401
4th Edition
July. 2001

Thank you for purchasing our Model 734 Digital Multimeter.
This user's manual describes the specifications and handling precaution for this Digital Multimeter.
Before using this Digital Multimeter, thoroughly read this manual to get a clear understanding on proper use.

Always observe the following instructions.
Failure to do so may result in electric shock or other dangers that may lead to serious injury or the loss of life.
Yokogawa M&C Corporation is in no way liable for any damage resulting from the user's mishandling of the product.
For safe use of this product, the following safety symbols are used on the product:

■ About This Manual

- Every effort has been made to ensure accuracy in the preparation of this manual.
  However, should any errors or omissions come to the attention of the user, please contact Yokogawa M&C Corporation.

- The contents of this manual are subject to change without prior notice because of improvement in performance or function.

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Regarding Safe Use of This Product

For safe use of this product, the following safety symbols are used on the product:

WARNING This indicates that the operator must refer to an explanation in the instruction manual in order to avoid the risk of serious injury or the loss of life.

CAUTION This indicates that the operator must refer to an explanation in the instruction manual in order to avoid the risk of injury or damage to the product.

Note This indicates information that is essential for handling the instrument or should be noted in order to familiarize yourself with the instrument's operating procedures and/or functions.

Danger! Handle with Care
This symbol indicates that the operator must refer to an explanation in the instruction manual in order to avoid risk of injury or death of personnel or damage to the instrument.

Double Insulation
This symbol indicates double insulation.

Direct Current
This symbol indicates DC voltage/current.

Alternating Current
This symbol indicates AC voltage/current.

DC/AC
This symbol indicates AC and DC.

Fuse
This symbol indicates a fuse.

Ground
This symbol indicates ground (earth).

⚠ WARNING

■ **Always observe the following instructions. Failure to do so may result in electric shock or other dangers that may lead to serious injury or the loss of life.**

Testing leads
- Use the probes supplied by Yokogawa M&C with this instrument.
- Do not use testing leads that have deteriorated or are defective.
- Disconnect testing leads from the circuit under test before opening the casing to replace the batteries or for any other reason.
- Disconnect testing leads from the circuit under test before attaching/detaching the testing leads to/from the instrument.
- Disconnect testing leads from the instrument before opening the casing to replace the batteries or for any other reason.

Casing
- Do not use the instrument if there is any damage to the casing or when the casing is removed.

Fuses
- Use fuses of the specified rating when the fuse is replaced.

Operating Environment
- Do not operate the instrument in an atmosphere where any flammable or explosive gas is present.
- Avoid using the instrument if it has been exposed to rain or moisture or if your hands are wet.

Disassembly
- No person, except personnel from Yokogawa M&C, is authorized to disassemble this instrument.

⚠ WARNING

■ **To avoid damage to instrument and/or electric shock**

The restrictions on the maximum voltage level for which the 734 01 and 734 02 can be used, depend on the over-voltage categories specified by the safety standards. These category specifications are set to protect operators against transient impulse voltages and surge voltages in power line.

Do not apply any input level higher than maximum allowable input.

AC/DC 600V CAT.III
AC/DC 1000V CAT.II

● **Over-voltage Category (Safety standards EN61010-1)**

CAT.III: Covers the path from an indoor distribution switchboard to a mains outlet.

CAT. II: Covers a primary-stage circuit of equipment connected to a mains outlet.

CAT. I : Covers a secondary-stage circuit of power transformer of equipment.

Note

Radiation immunity affects the accuracy of the 734 01 and 734 02 under the conditions specified in EN5008-1 and EN61326-1.

Use of this instrument is limited to domestic, commercial, and light industry applications. If equipment generating strong electromagnetic interference is located nearly, the instrument may malfunction.

Contents

1. Overview

● **Fast and more accurate measurement**

The 734 01 and 734 02 digital multimeters use ΔΣ modulation for A/D conversion, which enable fast and more accurate measurement.

● **Display**

5-digit (LCD)
Maximum Reading: 50000
Bar graph indicator

● **Supports a variety of measurement function**

DC Voltage, AC Voltage, DC Current, AC Current, Resistance, Frequency, Temperature, Capacitor,
Duty cycle ratio, Decibel (dB), Averaging when the measured value may greatly fluctuate,
Relative values from the reference measurement values (REL Δ),
Minimum value (MIN), Maximum value (MAX), Average value (AVG), Range Hold (R•H), Data Hold (D•H), Auto Hold (A•H), Peak Hold* (P•H), Continuity Check, Zero Adjustment (Capacitor, Resistance), Diode Test, Save to Memory, LCD backlight*,

*: For model 734 02 only

● **Communication: Optional communication unit is required**

- Enables downloading of measurement data to a personal computer using optional communication package.
  Uploading of data, making trend graph and downloading to EXCEL are possible according to applications.
- Output of measurement data to the optional printer is possible.

● Safety design

Complied standards: CE standards
Uses a current-input terminal shutter for preventing wrong input.
Uses high-performance UL-standard fuses.

2. Specifications

2-1 General Specifications

Function:	DC Voltage, AC Voltage, DC Current, AC Current, Resistance, Frequency, Temperature, Capacitor, Duty cycle ratio, Decibel (dB), Averaging functuon, Relative values from the reference measurement values (REL Δ), Minimum value (MIN), Maximum value (MAX), Average value (AVG), Range Hold (R•H), Data Hold (D•H), Auto Hold (A•H), Peak Hold* (P•H), Continuity Check, Zero Adjustment (Capacitor, Resistance), Diode Test, Save to Memory, LCD backlight*,
	*: For model 734 02 only
Measuring method:	$\Delta\Sigma$ modulation
Display:	5-digit (LCD) Maximum Reading: 50000 Polarity Indicator: "–" Appears automatically when the polarity is negative Overrange Indicator: " OL " Low-battery Indicator: "  " Appears when the batteries become low
Measurement cycle:	Digital display 3 times per second When frequency measurement: one times per second When capacitor measurement (50mF): max. 0.03 time per second Bar graph display 10 times per second

Operating temperature and humidity ranges:
-10 to 50ºC, 80%RH or less (no condensation)
70%RH or less at 40 to 50ºC.

Storage temperature and humidity ranges:
-25 to 60ºC, 70%RH or less (no condensation)

Temperature coefficient: (Accuracy at 23±5ºC× 0.05)/ºC or less
(Temperature ranges: -10 to 18ºC and 28 to 50ºC)

Operating altitude: 2000m max. above sea level

Power supply: AA-size (R6) 1.5V batteries: 2

Battery life: Approximately 120 hours
(Operating hours of alkaline batteries when in DC voltage-mode.)
Note: The battery life varies depending on the operating conditions.

Withstand voltage: 5.5kVrms AC for one minute
(across input terminals and casing)

External dimensions: Approximately 85(W)×191(H)×40(D)mm

Weight: Approximately 450g

Complied standards: Safety standards
EN61010-1; 1995, EN61010-2-031; 1995
Overvoltage category III (Max. input voltage: AC/DC600V)
Overvoltage category II (Max. input voltage: AC/DC1000V)
Pollution degree 2
EMC standards
EMI (Electro Magnetic Interference)
EN55011; 1998
EN61326-1; 1997+A1;1998
(Class B, Group 1)

EMS (Immunity)

EN50082-1; 1997

EN61326-1; 1997+A1;1998

Effect of radiation immunity:

Accuracy range of reading:

[Rated accuracy +12% of maximum reading] for the strength of a radio-frequency electromagnetic field of 3V/m

Standard accessories:

Instruction manual: 1

Testing leads: 1set

Batteries (included): 2

Fuse (included)

500mA/600V, 15A/600V

Optional accessories:

Communication package with communication cable	
Engligh version	920 01-E
Package with RS-232C Cable	920 01-E/P
Temperature probes	7511 02 to 05
Carrying case	
For the 734 main unit with testing leads	B9646HH
For the 734 main unit with testing leads and communication cable	930 14
Fuse	
500mA/600V	A1518EF
15A/600V	A1519EF
Testing leads (1set)	RD031
Printer	97010
AC adapter (for printer, Europe)	940 06
AC adapter (for printer, USA)	940 07
Thermal paper for printer (10 rolls)	970 80
RS-232C Cable (for printer)	910 15

2-2 Measurement Ranges

Test conditions:
Temperature and humidity: 23±5ºC at 80%RH or less
Accuracy: ±(percentage of reading + number of digits)

Note: Each response time is a value to rated accuracy within selected range.

DC Voltage Measurement ⎓ V

Range	Resolution	Accuracy		Input Resistance	Maximum Input Voltage
		73401	73402		
50mV	0.001mV	0.1+10	0.05+10	Approx. 100MΩ	1000V DC
500mV*	0.01mV	0.04+2	0.02+2		
2400mV	0.1mV				
5V	0.0001V	0.07+2	0.025+5	10MΩ	1000V rms AC
50V	0.001V		0.03+2		
500V	0.01V				
1000V	0.1V				

*: Maximum Reading of 2400mV Range: 24000
NMRR: 80dB or more 50/60Hz –0.1%
CMRR: 120dB or more 50/60Hz (Rs=1kΩ)
Response time: 1 sec max.

AC Voltage Measurement ∼ V

734 01

AC Coupling, Rms-value detection, Crest factor: <3

Range	Resolution	Accuracy				Input Impedance	Maximum Input Voltage
		10 to 20Hz	20Hz to 1kHz	1k to 10kHz	10k to 20kHz		
500mV	0.01mV	1.5+30 *1	0.7+30 *1		2+50 *2	11MΩ <50pF	1000V rms AC
5V	0.0001V						
50V	0.001V					10MΩ <50pF	
500V	0.01V						
1000V	0.1V	*2	*2	3+30 *2	—		1000V DC

AC Voltage Measurement ~ V

734 02

AC Coupling, Rms-value detection, Crest factor: <3

Range	Reso-lution	Accuracy						Input Impe-dance	Maxi-mum Input Voltage
		10 to 20Hz	20Hz to 1kHz	1k to 10kHz	10k to 20kHz	20k to 50kHz	50k to 100kHz		
500mV	0.01mV	1+30 *1	0.4+30 *1		1+40 *1	2+70 *2	5+200 *2	11MΩ <50pF	1000V rms AC
5V	0.0001V								
50V	0.001V							10MΩ <50pF	
500V	0.01V								
1000V	0.1V	*2	*2	3+30 *2	—				1000V DC

Accuracy

*1: At 5 to 100% of range

*2: At 10 to 100% of range

CMRR: 80dB or more DC to 60Hz (Rs=1kΩ)

Response time: 2 sec max.

DCV+ACV ⎓ + ~

734 01

Maximum Reading 5000, Crest factor: <3

Range	Resolution	Accuracy				Input Impe-dance	Maximum Input Voltage
		DC, 10 to 20Hz	DC, 20Hz to 1kHz	DC, 1k to 10kHz	DC, 10k to 20kHz		
5V	0.001V	1.5+10 *1	1+10 *1		2+10 *2	11MΩ <50pF	1000V rms AC
50V	0.01V						
500V	0.1V					10MΩ <50pF	
1000V	1V	*2	*2	—			1000V DC

DCV+ACV ⎓ + ∿

734 02

Maximum Reading 5000, Crest factor: <3

Range	Resolution	Accuracy						Input Impedance	Maximum Input Voltage
		DC, 10 to 20Hz	DC, 20Hz to 1kHz	DC, 1k to 10kHz	DC, 10k to 20kHz	DC, 20k to 50kHz	DC, 50k to 100kHz		
5V	0.001V	1.5+10 *1	0.5+10 *1		1+10 *1	2+10 *2	5+20 *2	11MΩ <50pF	1000V rms AC 1000V DC
50V	0.01V							10MΩ <50pF	
500V	0.1V								
1000V	1V	*2	*2	—					

Accuracy

*1: At 5 to 100% of range

*2: At 10 to 100% of range

CMRR: 80dB or more DC to 60Hz (Rs=1kΩ)

Response time: Approx. 5 sec

DC Current Measurement ⎓ A

Range	Resolution	Accuracy 73401/02	Voltage Drop	Maximum Input Current
500µA	0.01µA	0.2+2	<0.11mV/µA	500mA Protected by a 500mA/600V fuse.
5000µA	0.1µA			
50mA	0.001mA		<4mV/mA	
500mA	0.01mA			
5A	0.0001A	0.6+2	<0.1V/A	15A Protected by a 15A/600V fuse.
10A	0.001A			

Response time: 1 sec max.

AC Current Measurement ~ A

734 01

Crest factor: <3

Range	Resolution	Accuracy		Voltage Drop	Maximum Input Current
		10 to 20Hz	20Hz to 1kHz		
500µA	0.01µA	1.5+20	1+20	<0.11 mV/µA	500mA Protected by a 500mA/600V fuse.
5000µA	0.1µA				
50mA	0.001mA			<4mV/mA	
500mA	0.01mA				
5A	0.0001A			<0.1V/A	15A Protected by a 15A/600V fuse.
10A	0.001A				

AC Current Measurement ~ A

734 02

Crest factor: <3

Range	Resolution	Accuracy			Voltage Drop	Maximum Input Current
		10 to 20Hz	20Hz to 1kHz	1k to 5kHz		
500µA	0.01µA	1+20	0.75 +20	1+30	<0.11 mV/µA	500mA Protected by a 500mA/600V fuse.
5000µA	0.1µA					
50mA	0.001mA				<4 mV/mA	
500mA	0.01mA					
5A	0.0001A	1.5+20	1+20	2+30	<0.1 V/A	15A Protected by a 15A/600V fuse.
10A	0.001A					

Model 734 01/02

Accuracy

At 5 to 100% of range

Note: At 10 to 100% of range for 10A Range

Response time: 2 sec max.

DCA+ACA ⎓ + ∿
734 01

Maximum Reading 5000, Crest factor: <3

Range	Resolution	Accuracy		Voltage Drop	Maximum Input Current
		DC, 10 to 20Hz	DC, 20Hz to 1kHz		
500µA	0.1µA	2+10	1.5+10	<0.11 mV/µA	500mA Protected by a 500mA/600V fuse.
5000µA	1µA				
50mA	0.01mA			<4mV/mA	
500mA	0.1mA				
5A	0.001A			<0.1V/A	15A Protected by a 15A/600V fuse.
10A	0.01A				

DCA+ACA ⎓ + ∿
734 02

Crest factor: <3

Range	Resolution	Accuracy			Voltage Drop	Maximum Input Current
		DC, 10 to 20Hz	DC, 20Hz to 1kHz	DC, 1k to 5kHz		
500µA	0.1µA	1.5+10	1+10	1.5+10	<0.11 mV/µA	500mA Protected by a 500mA/600V fuse.
5000µA	1µA					
50mA	0.01mA				<4 mV/mA	
500mA	0.1mA					
5A	0.001A	2+10	1.5+10	3+10	<0.1 V/A	15A Protected by a 15A/600V fuse.
10A	0.01A					

Model 734 01/02
Accuracy
At 5 to 100% of range
Note: At 10 to 100% of range for 10A Range
Response time: Approx. 5 sec

Resistance Measurement Ω

Range	Resolution	Accuracy		Measuring Current	Open-loop Voltage	Input Protective Voltage
		73401	73402			
500Ω	0.01Ω	0.1+2	0.05+2	<1mA	<2.5V	600V rms
5kΩ	0.0001kΩ			<0.25mA		
50kΩ	0.001kΩ			<25μA		
500kΩ	0.01kΩ			<2.5μA		
5MΩ	0.0001MΩ	0.5+2		<1.5μA		
50MΩ	0.001MΩ	1+2		<0.13μA		

Accuracy is specified after zero adjustment (resistance).

Response time: 3 sec max. at 500Ω to 500kΩ
10 sec max. at 5MΩ to 50MΩ

Continuity Check ·))

Maximum Reading 5000

Range	Resolution	Range of Operation	Measuring Current	Open-loop Voltage	Input Protective Voltage
500Ω	0.1Ω	The buzzer turns on for resistances lower than 100±50Ω.	Approx. 0.5mA	<5V	600V rms

Diode Test →|←

Range	Resolution	Accuracy	Measuring Current (Vf=0.6V)	Open-loop Voltage	Input Protective Voltage
2.4V	0.0001V	1+2	Approx. 0.5mA	<5V	600V rms

Temperature Measurement TEMP

Range	Resolution	Accuracy	Input Protective Voltage
-50 to 800˚C	0.1˚C	1+1.5˚C	600V rms
-58 to 1472˚F	0.1˚F	1+3.0˚F	

Use optional Temperature Orobe: Thermocouple Type K

Capacitor Measurement ⊣⊢

Range	Resolution	Accuracy	Input Protective Voltage
5nF	0.001nF	1+5	600V rms
50nF	0.01nF		
500nF	0.1nF		
5µF	0.001µF		
50µF	0.01µF		
500µF	0.1µF	2+5	
5mF	0.001mF	3+5	
50mF	0.01mF		

Accuracy is specified after zero adjustment (capacitor).

Frequency Measurement Hz

AC Coupling, Maximum Reading 9999

Range (AUTO)	Resolution	Accuracy
2.000 to 9.999Hz	0.001Hz	0.02+1 *1
9.00 to 99.99Hz	0.01Hz	
90.0 to 999.9Hz	0.1Hz	
900 to 9999Hz	1Hz	
9.00 to 99.99kHz	0.01kHz	*2

Accuracy

*1: At 10 to 100% of input voltage or current range

*2: At 40 to 100% of input voltage or current range

Duty cycle ratio Hz

Range	Resolution	Accuracy
10 to 90%	1%	±1%*

Accuracy

*: At 10.00Hz to 500.0Hz, square wave

At 40 to 100% of input voltage or current range

Peak Hold P•H

Maximum Reading 5000

Range	Accuracy	Response Time Maximum
DCV, DCA	±100 digit	>1msec

3. Operation

3-1 Precautions Before Measurement

■ Examining Items Contained in the Package

After opening the package, be sure to examine the product as instructed below before use. Should the delivered product be the wrong model, lack any item, or show any flaw in its appearance, contact the vendor from which you purchased the product.

■ Precautions of Operation and Storage

⚠ CAUTION

- The instrument is shipped with batteries included ready for use after unpacking.
  (The batteries, therefor, may not last their full specified life.)
- Do not use the instrument near noise-emitting equipment or where there may be a sudden change of temperature. Otherwise, the instrument may give an unstable reading or errors.

Removal of Dirt

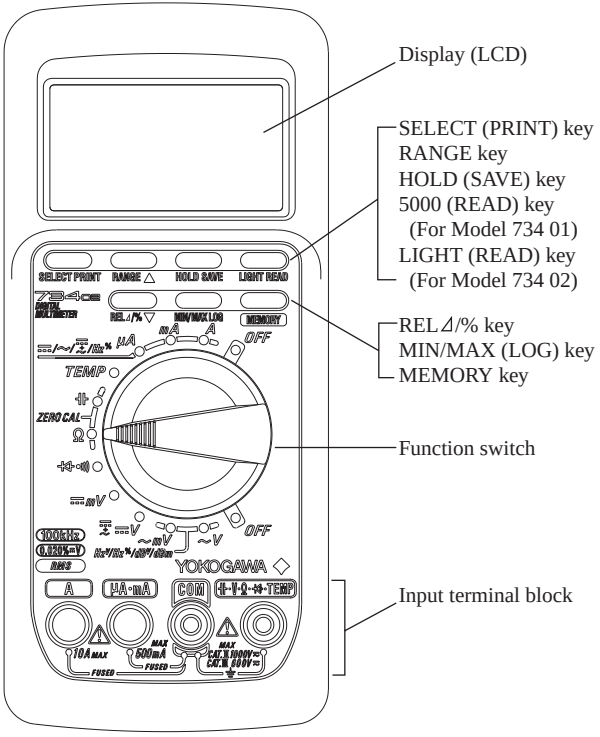
Do not wipe the instrument using any volatile such as benzine or paint thinner, as this may damage or discolor the front panel.
Use a dry cloth to clean the instrument.

Storage Conditions

- Do not leave the instrument exposed to direct sunlight or in a hot and humid location such as the inside of a vehicle, for any prolonged length of time.
- If the instrument will not be used for a prolonged period, remove the batteries.

3-2 Components

■ Panel Description



1) Function switch

Turns off the power or select the measurement mode (function).

OFF	Turns off the power.	Ω	Resistance measurement
~ V	AC voltage (V) measurement	⊣⊢	Capacitor measurement
~ mV	AC voltage (mV) measurement	TEMP	Temperature measurement
⎓ V	DC voltage (V) measurement	μA mA A	DC/AC current measurement
⎓ mV	DC voltage (mV) measurement		
⊣◁⊢ ·))	Continuity check, Diode Test		

2) SELECT key

Pressing this key in each measurement modes (function) described above selects other measurement modes (function).

~ V, ~ mV	1 Hz^{V}	: Frequency measurement (Voltage value is displayed.)
	2 $Hz^{\%}$	: Frequency measurement (Duty cycle ratio)
	3 dB^{V}	: dB measurement (Voltage vaë e is displayed.)
	4 dBm	: dBm measurement
⎓ V	⎓ + ~ (DC+AC) measurement	
Ω	ZERO CAL: Zero Adjustment of Resistance measurement	
·))	⊣◁⊢ Diode Test	
⊣⊢	ZERO CAL: Zero Adjustment of Capacitor measurement	
μA/mA/A	1 ~	: AC voltage measurement
	2 ⎓ + ~	: (DC+AC) measurement
	3 $Hz^{\%}$	: Frequency measurement (Duty cycle ratio)

3) RANGE key

Allows the operator to select the measuring range.

Fixed ranges : The display shows the " R•H " symbol.
The range increases every time this key is pressed.

AUTO range : The display shows the " AUTO " symbol.
To return to the auto-ranging mode, hold down this key for more than one second.

4) HOLD key

Selects between the DATA HOLD, AUTO HOLD and PEAK HOLD functions. To cancel functions, press this key once again.

DATA HOLD: Holds the display readings.
The display shows the " D•H " symbol.

AUTO HOLD: Holds the measured value when the testing leads are handled.
The display shows the " A•H " symbol.

PEAK HOLD: Holds the peak value.
The display shows the " P•H " symbol. (For Model 734 02)

5) 5000 key (For Model 734 01), LIGHT key (For Model 734 02)

5000 key: Used to select 3.5-digit display.
Press this key once again to display 5-digit.

LIGHT key: Use to turn on the LCD backlight.
Press this key once to turn on the LCD backlight for approximately one minute.
The LCD backlight is lit for approximately one minute.
(To postpone turned on time, press this key once again.)
To cancel the function, hold down this key for more than one second.

Enables switching 3.5-digit display and 5-digit display.
To execute the above, please use Additional functions simply set when POWER ON.

6) REL Δ / % key

The instrument can calculate relative values or differences, and percentage values from the reference measurement values.

1 : Relative Calculation

The display shows the " REL " symbol.
The sub-display shows the reference voltage value.

2 : Percentage Calculation

The display shows the " % " symbol.
The sub-display shows the reference voltage value.

7) MIN/MAX key

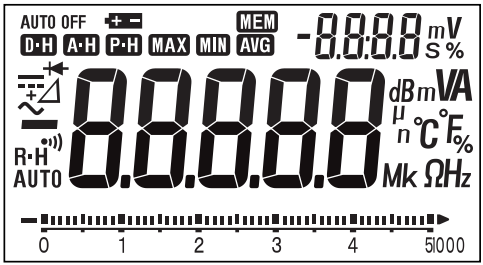
Displays the minimum value (MIN), maximum value (MAX) and average value (AVG) during measurement.

Pressing this key starts recording and at the same time the display shows MIN/MAX/AVG to release AUTO POWER OFF.

8) MEMORY key

Data can be stored in internal memory using this key.
Used when outputting to printer with the optional communication package.

■ Display (LCD) Description



Symbol and Unit	Description
⎓	Appears when in DC-mode measurement
∼	Appears when in AC-mode measurement
⎓ + ∼	Appears when in DC+AC-mode measurement
–	Appears when the polarity is negative
⊣▷⊢	Appears when in diode test
·))	Appears when in continuity check
△	Relative calculation indicator
R•H	Fixed ranges indicator
AUTO	AUTO range indicator
D•H	DATA HOLD indicator
A•H	AUTO HOLD indicator
P•H	PEAK HOLD indicator
MAX	Lit when in MIN/MAX/AVG-mode
MIN	Lit when in MIN/MAX/AVG-mode
AVG	Lit when in MIN/MAX/AVG-mode
AUTO OFF	Auto power off indicator
nF, µF, mF	Unit for capacitance measurement
mV, V	Unit for voltage measurement
µA, mA, A	Unit for current measurement
MΩ, kΩ, Ω	Unit for resistance measurement
˚C (˚F)	Unit for temperature measurement
kHz, Hz	Unit for frequency measurement
dB, dBm	Decibel calculation indicator
% (Main-display)	Unit for percentage calculation
% (Sub- display)	Unit for duty cycle ratio calculation
mV, V (Sub- display)	Unit for voltage measurement (dB^V, Hz^V)
s (Sub- display)	Unit for recording time when in MIN/MAX/AVG-mode
-8.8.8.8 (Sub- display)	Recording time indicator when in MIN/MAX/AVG-mode Number of saved data indicator Reference value indicator when relative calculation Duty cycle ratio indicator Voltage value (dB^V, Hz^V) indicator Reference resistance value (dBm) indicator
▭	Appears when the batteries become low
0 1 2 3 4 9000	Bar graph indicator, Range indicator

3-3 Measuring Instructions

WARNING

To avoid damage to instrument or equipment

- Before starting measurement, make sure that the position of function switch and the input terminals for connecting the testing leads are appropriate for the desired mode of measurement.
- Temporarily remove the testing leads from the device under test before operating the function switch.

● AC Voltage Measurement (~ V, ~ mV)

1) Turn the function switch to the " ~V " or " ~mV " position.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

● DC Voltage Measurement (⎓ V, ⎓ mV)

1) Turn the function switch to the " ⎓ V "or " ⎓ mV" position.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

Note

If " mV "range is selected and the testing leads are left open-circuited, the instrument may give a certain reading. This dose not affect your measurement.

● **DC+AC Voltage Measurement (⎓ + ∼)**

1) Turn the function switch to the " ⎓ V " position.
2) Press the SELECT key to select DC+AC voltage measurement.
   (The display shows the " ⎓ + ∼ " symbol.)
3) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
4) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

● **Resistance Measurement (Ω)**

CAUTION

To avoid damage to instrument

Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.

1) Turn the function switch to the "Ω " position.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

Note

Zero adjustment

Zero adjustment is recommended for correct measurement. After executing 1), 2) above, short the two testing leads. Press the SELECT key for adjust. (The display shows the "0.0Ω" value.) The value stores till turn off.

● Continuity Check (·)))

CAUTION

To avoid damage to instrument

Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.

1) Turn the function switch to the " ·)) " position.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Connect the testing leads to the circuit under test. If the circuit is continuous (no more than approximately 100Ω), the buzzer sounds.

● Diode Test (⊣◁⊢)

CAUTION

To avoid damage to instrument

Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.

1) Turn the function switch to the " ⊣◁⊢ • ·))" position.
   Press the SELECT key to select Diode test.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Connect the testing leads to the diode and then read the value when it stabilizes.

<Forward-bias Diode Test>

Connect the black testing lead to the cathode and the red testing lead to the anode.

Silicon diodes should give a reading of approximately 0.5V and light-emitting diodes a reading between approximately 1.5V and 2.0V.

<Reverse-bias Diode Test>

Connect the black testing lead to the anode and the red testing lead to the cathode.

Normally, the display shows the " OL " symbol, indicating that the diode under test is normal. The diode is defective if the display gives a certain voltage level.

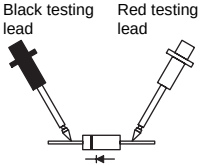


Figure 1 Forward-bias Diode Test

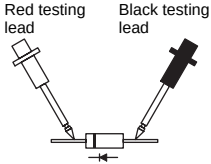


Figure 2 Reverse-bias Diode Test

● Temperature Measurement (TEMP)

CAUTION

To avoid damage to instrument

Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.

Note

Optional Temperature probe is required for temperature measurement.
Temperature Probe: Thermocouple Type K
Model: 7511 02 to 05

1) Turn the function switch to the " TEMP " position.
2) Plug the black terminal of measuring probe into the " COM " input terminal and the red terminal of measuring probe into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Contact the measuring probe to the under test and then read the value when it stabilizes.

To switch temperature units

Displaying " ºC " only is configured at factory before shipment. Carry out the following setting procedure to display " ºF ". While pressing the SELECT, RANGE and HOLD key simultaneously, turn the function switch to the " TEMP " position. Next time pressing the SELECT key, the temperature unit switches from ºC to ºF.

● Current Measurement (μA/mA/A)

⚠ WARNING

To avoid damage to instrument or equipment

Before starting measurement, make sure that the position of function switch and the input terminals for connecting the testing leads are appropriate for the desired mode of measurement.

1) Turn the function switch to the "μA " , "mA " or "A "position.
(If the magnitude of the current being measured is not known, select the "A "position. Make sure the current being measured is no more than 0.5A before the "μA " or "mA " position is selected.)

2) Please select between DC and AC. When selecting AC, press the SELECT key.
3) Plug the black testing lead into the " COM " input terminal and the red testing lead into the "A "input terminal.
   If the current is in the order of mA or less, plug the red testing lead into the "μA • mA" input terminal.
4) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

● **DC+AC Current Measurement (⎓ + ∿)**

WARNING

To avoid damage to instrument or equipment

Before starting measurement, make sure that the position of function switch and the input terminals for connecting the testing leads are appropriate for the desired mode of measurement.

1) Turn the function switch to the "μA" , "mA" or "A" position.
   (If the magnitude of the current being measured is not known, select the "A" position. Make sure the current being measured is no more than 0.5A before the "μA" or "mA" position is selected.)
2) Press the SELECT key to select the DC +AC measurement.
   (The display shows the ⎓ + ∿ symbol.)
   Plug the black testing lead into the " COM " input terminal and the red testing lead into the "A" input terminal.
   If the current is in the order of mA or less, plug the red testing lead into the "μA • mA" input terminal.
3) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

● **Capacitor Measurement (⊣⊢)**

CAUTION

To avoid damage to instrument

- Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.
- Before starting measurement, be sure to discharge the capacitor under check.

1) Turn the function switch to the " ⊣⊢ "position.
2) Plug the black testing lead into the " COM " input terminal and the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal.
3) Open the testing lead and press the SELECT key in 5nF range to adjust the capacitance to zero. (The display shows " 0.000 ".)
4) Connect the testing leads to the circuit under test and then read the value when it stabilizes.

Note

When the capacitor check is below the capacity at zero calibration, "0.00" is displayed until the power off.

● **Frequency Measurement (Hz), Duty cycle ratio (Hz)**

CAUTION

To avoid damage to instrument

Turn off the power to the circuit under test before starting measurement in order to prevent any excessive voltage from being applied to the instrument.

1) Turn the function switch to the voltage(⏦ V, ⏦ mV) or the current(μ A, mA, A)position.
2) Press the SELECT key to select the range of frequency. (The display shows the unit of frequency.)
3) Plug the black testing lead into the " COM " input terminal.
   Plug the red testing lead into the " ⊣⊢ • V • Ω • ⊣◁⊢ • TEMP " input terminal when voltage measurement.
   Plug the red testing lead into the suitable input terminal (" A" or "μA•mA") for current value when current measurement.
4) Contact the measuring probe to the under test and then read the value when it stabilizes. The display shows frequency value in main-display and duty cycle ratio value in sub-display.

● AUTO HOLD Function

The instrument can automatically retain the measured value when the testing leads are handled as described below.

1) Press the HOLD key to select u ûêAuto hold function.
   (The display shows the" A•H " symbol.)
2) Connect the testing leads to the circuit under test.
3) When the reading stabilized, the buzzer sounds.
4) Remove the testing leads from the circuit under test.
5) The display shows the measured value that is retained.
   You can repeat steps 2) to 4)as many times as you like as long as the display shows the " A•H " symbol.

Note

- In DC/AC voltage measurement, the Auto hold function is only available for ranges greater than the 5V range.
- This function is not available for Temperature, Capacitor and Frequency measurement.
- The Auto hold function can not be applied to unstable signals.

● PEAK HOLD Function

This instrument can always detect, update and display the peak value (instantaneous) in DCV and DCA measurement. The peak value of the wave can be seen.

1) Turn the function switch to DCV or DCA position.
2) Connect the testing leads to the circuit under test.
3)Press the HOLD key to select Peak Hold. (The display shows the " P•H " symbol.)
4) The display shows the peak value.
5) When resetting the peak value in HOLD, press the MIN/MAX key. Then new peak value can be in HOLD.

Note

Even though the input signals (DCV, DCA) have negative polarity, the peak value can be measured when the peak is in the positive direction.

1) Press the REL⊿/% key to relative calculation in PEAK HOLD mode. The display shows the "⊿" symbol and the relative peak value.
2) Press the REL⊿/% key to percentage calculation. The display shows the " % " symbol and the percentage peak value.

SEE ALSO
Next section " Relative and percentage calculation"

When resetting the peak value, press the MIN/MAX key. Then new peak value can be in HOLD.

To cancel the percentage calculation, Press the REL⊿/% key again. " % " symbol disappears, then retrieves the PEAK HOLD mode.

● Relative and percentage calculation

The instrument can calculate relative values or difference, and percentage values from the reference measurement values. (The range will be fixed.)

<Relative (REL) calculation>

Subtracts the reference value from the measured value to display the relative value or difference.

1) Enter the reference value.
2) Press the REL Δ/% key.
   (The display shows the" Δ " symbol and the sub-display shows the reference value.)
3) Enter the measured value.
   The display shows the relative value or difference.

<Percentage (%) calculation>

Calculates and display the percentage value according to the following equation: % value =(measured value – reference value)/reference value

1) Enter the reference value.
2) Press the REL Δ/% key.
   (The display shows the" Δ" symbol and the sub-display shows the reference value.)
3) Enter the measured value.
   Press the REL Δ/% key again. (The display shows the" % " symbol.)

● Decibel calculation (dBm, dB^{V})

The instrument can perform logarithmic calculations on a AC voltage.

$$\text{dBm} \quad : 20\log \frac{\text{Measured voltage value}}{\sqrt{\text{Reference resistance value} \times 10^{3}}}$$

(1mW/Reference resistance (Ω)=0dBm)

dB^V : $20\log \frac{\text{Measured voltage value}}{1(V)}$

1) Turn the function switch to the ~ V or ~ mV position.
2) Press the SELECT key to select dBm dB^V .
   (The display shows the " dBm ", " dB " symbol.)
3) Connect the testing leads to the circuit under test and then read the value when it stabilizes.
4) When calculating relative value, press the REL Δ/% key.

Note

The instrument can switch (select) reference resistance value when measuring dBm.

The reference resistance value is switched as follows every time the RANGE key is pressed. (Shown in sub-display.)

Reference resistance value:

4,8,16,32,50,75,93,110,125,135,150
200,250,300,500,600,800,900,1000,1200
Default value: 600Ω

● MIN/MAX/AVG Function

The minimum value (MIN), maximum value (MAX) and average value (AVG) during measurement are shown. The average value is shown by dividing the integrated record data by the number of recording times.

Pressing this key starts recording and at the same time the display shows "MIN", "MAX" and "AVG" to release AUTO POWER OFF.

<Recording time>

The timer is activated to show the elapsed time from the start and simultaneously the renewed time for MIN/MAX is also recorded.

The elapsed time is displayed as follows:

0 sec. to 99 min. and 59 sec.: steps of 1 sec.

100 min. or more: steps of 1 min.

Press the HOLD key to stop recording. (The display shows the " D•H " symbol.)

<To confirm the recording time>

For confirming the recording time, press the MIN/MAX key. Subsequent pressing of this key repeats to display the present minimum value (MIN), maximum value (MAX) and average value (AVG). Press the HOLD key once again to restart recording.

Note

- No influence is exerted on the recorded data even if the test leads are disconnected while the recording is stopped.
- If overload is recorded, the MIN or MAX display changes to " OL " display, resulting in incorrect average data.
- For widely varying signal measurement, set the appropriate range in which the MAX or MIN does not change to " OL " display.

● Memory Function

<To save a Data in internal memory>

The instrument can save a data using with the following two types of modes.

SAVE-mode:	Saves a data for one measurement by manual operation.
LOGGING-mode:	Automatically saves a data from the start of logging.

Memory capacity

SAVE-mode:	50 data
LOGGING-mode:	one time (600 data)

Number of saved data

Number of saved data is 3-digit numbers. When LOGGING-mode, " L " is attached to the top of 3-digit numbers. The instrument allocates the smallest number, between 000 to 999, that has not yet been used. Use the △ (RANGE) key or ▽ (REL Δ/%) key switches the number of saved data.

To save a Data (SAVE-mode)

1) Press the MEMORY key. (The display shows the " MEM "symbol.)
2) Press the SAVE (HOLD) key.
   (The display shows the number of saved data.)
3) Press the SAVE (HOLD) key to save the data.
   Another press of the SAVE (HOLD) key saves a data for the second time measurement or later.
4) To cancel the function, hold down the MEMORY key for one second.
   (" MEM " symbol disappears.)

To save a Data (LOGGING-mode)

1) Press the MEMORY key. (The display shows the " MEM "symbol.)
2) Press the LOG (MIN/MAX) key.
   (The display shows the logging interval (period).)
   Set the value with the △ (RANGE) key or ▽ (REL Δ/%) key.
   The default setting is one second.
   The display shows " FULL " when the logging data is already saved.
   When saving the new data, perform delete of data.
3) Press the LOG (MIN/MAX) key to start logging. (The " MEM "symbol is flashing.)
4) To cancel the function, hold down the MEMORY key for one second. When memory capacity becomes full, the function is automatically canceled.
   (" MEM " symbol disappears.)

Note

LOGGING-mode operation during HOLD-mode disables HOLD-mode.

To load a Data (SAVE-mode)

1) Press the MEMORY key. (The display shows the " MEM "symbol.)
2) Press the READ (5000/ LIGHT*) key.
3) Press the SAVE (HOLD) key to select the number of saved data.
   Select the number with the △ (RANGE) key or ▽ (REL⊿/%) key.
4) To cancel the function, hold down the MEMORY key for one second.
   (" MEM " symbol disappears.)

To load a Data (LOGGING-mode)

1) Press the MEMORY key. (The display shows the " MEM "symbol.)
2) Press the READ (5000/ LIGHT*) key.
3) Press the LOG (MIN/MAX) key to select the number of saved data.
   Select the number with the △ (RANGE) key or ▽ (REL⊿/%) key.
4) To cancel the function, hold down the MEMORY key for one second.
   (" MEM " symbol disappears.)

<To delete of saving data>

Delete method (SAVE-mode)

• To delete all data

1) Press the MEMORY key.
   (The display shows the " MEM "symbol.)
2) Hold down the SAVE (HOLD) key for one second.
   (The display shows the " CLr "symbol.)
3) Press the SAVE (HOLD) key.
   All data is deleted.

• To overwrite (delete) selected data
1) Press the MEMORY key.
(The display shows the " MEM "symbol.)
2) Press the SAVE (HOLD) key.
(The sub-display shows the number of saved data.)
3) Use the △ (RANGE) key or ▽ (REL Δ/%) key to select the number of saved data.
4) Press the SAVE (HOLD) key to save the data.
5) To cancel the function, hold down the MEMORY key for one second.
("MEM" symbol disappears.)

Delete method (LOGGING-mode)

• To delete all data
1) Press the MEMORY key.
(The display shows the " MEM "symbol.)
2) Hold down the LOG (MIN/MAX) key for one second.
(The display shows the " CLr "symbol.)
3) Press the LOG (MIN/MAX) key.
All data is deleted.

● AUTO POWER OFF Function

<To use the AUTO POWER OFF function>

The display shows the " AUTO OFF "indication.

- The instrument automatically turns off if no key is pressed for a period of 20 minutes.
  The instrument will beep for approximately 30 seconds to alert the operator before the AUTO POWER OFF function takes effect.
- Pressing any key or switch while the instrument is beeping postpones the power-off time.
- Turning the function switch once after the power to the instrument is automatically turned off switches the instrument on again.

<To cancel the AUTO POWER OFF function>

1) Turn the function switch to the OFF.
2) With pressing the HOLD key, turn the function switch to the desired position of any measurement mode (function).
   The " AUTO OFF " indication turns off when the function is canceled.

Note

Additional functions simply set when POWER ON can be used.

<To enable the AUTO POWER OFF function once again>

1) Turn the function switch to the OFF.
2) Turn the function switch to the desired position of any measurement mode (function).
   The AUTO POWER OFF function is enabled again.
   The display shows the " AUTO OFF " indication.

CAUTION

To avoid damage to instrument

When the measurement function is completed, turn the function switch back to the OFF position to turn off.

● **Additional functions simply set when POWER ON**

With pressing the following keys, turn the function switch to the desired position of any measurement mode (POWER ON-state).
This enables the following functions corresponding to the press keys.

Keys	Functions to be set
MIN/MAX	Averaging Function (calculates the average of 8 times)
RANGE	5000 (3.5-digit display) For 734 02 only
SELECT	LCD check (Lit only while pressing the SELECT key)
HOLD	Cancels the Auto power off function
HOLD + REL ⊿/%	Reset all calibration values to those before shipment.
SELECT + RANGE	Calibration function

● Averaging Function

The measured value may greatly fluctuate, the instrument can calculate the average (8 times / approx. 2.4 seconds).
This function is available for Voltage, Current and Resistance-mode measurement.

Note

Additional functions simply set when POWER ON can be used.

● 5000 display mode (734 01)

This function switches 3.5-digit display (5000) and 5-digit display (50000). The function is not available for Capacitor, Temperature, DC+AC, Continuity and Frequency-mode measurement.

Note

Additional functions simply set when POWER ON can be used.

● LCD Check

The instrument can lit all segments and mark for LCD check.
Additional functions simply set when POWER ON can used.
(Lit only while pressing the SELECT key.)

● User Calibration Function

It is recommended that the instrument be calibrated periodically.
The instrument can be calibrated.

CAUTION

To avoid electrical shock

- Only authorized engineers are allowed to calibrate the instrument using dedicated facilities.
- Connect the calibrator to the instrument with the calibrator's testing leads.
- Before carrying out calibration, read the instruction manual of the calibrator.
- Temporarily remove the testing leads from the instrument before switching measurement mode (function).

<Conditions of calibration>

Calibrator: With accuracy higher than of this instrument

Ambient Environment:

Temperature: 23±3ºC
Humidity: 55%RH or less
Leave the instrument for 30 minutes under above conditions before carrying out calibration.

After reference valve of Calibrator stabilizes, Press the key to confirm for calibration valve.

<Table 1>

Carry out calibration of ranges in accordance with Table 1.

Calibration for 2 points (Input 1 and Input 2) is required other than DC range.

After Input 1, carry out calibration of Input 2 repeating steps 6) and 7).

For AC voltage and AC current ranges (marked with ◯), calibration is carried out at 50Hz frequency.

1) Turn the function switch from the OFF position to the ⎓ mV position while pressing the SELECT and RANGE keys at the same time.
   The display shows the " CAL " symbol then the " PASS " symbol.
2) Press the SELECT key. (The display shows the " - " symbol.)
3) Press the HOLD key twice. (The display shows the " - - - " symbol.)
4) Press the RANGE key. (The display shows the " mV " symbol.)
5) Connect the instrument to the calibrator with the testing leads.
6) Set the calibrator to Input 1 value as an input to the instrument.
7) Press the HOLD key.
8) Be sure to confirm that the function switch and input terminal are set to the desired range.
   Carry out calibration of other ranges by repeating steps 6) and 7).
9) To quit calibration, turn the function switch back to the OFF position.

Table 1. Input Signal for Calibration

Range	Input 1	Input 2	Unit
DC 50mV	50.000	—	mV
DC 500mV	500.00	—	mV
DC 2400mV	2000.0	—	mV
DC 5V	5.0000	—	V
DC 50V	50.000	—	V
DC 500V	500.00	—	V
DC 1000V	1000.0	—	V
○AC 500mV (50Hz)	50.00	500.00	mV
○AC 5V (50Hz)	0.5000	5.0000	V
○AC 50V (50Hz)	5.000	50.000	V
○AC 500V (50Hz)	50.00	500.00	V
○AC 1000V (50Hz)	100.0	1000.0	V
500‰	0.00	500.00	‰
5k‰	0.0000	5.0000	k‰
50k‰	0.000	50.000	k‰
500k‰	0.00	500.00	k‰
5M‰	0.0000	5.0000	M‰
50M‰	0.000	30.000	M‰
Continuity Check (·))	0.0	500.0	‰
DC 500 A	500.00	—	A
DC 5000 A	5000.0	—	A
DC 50mA	50.000	—	mA
DC 500mA	500.00	—	mA
DC 5A	5.0000	—	A
DC 10A	10.000	—	A
○AC 500 A (50Hz)	50.00	500.00	A
○AC 5000 A (50Hz)	500.0	5000.0	A
○AC 50mA (50Hz)	5.000	50.000	mA
○AC 500mA (50Hz)	50.00	500.00	mA
○AC 5A (50Hz)	0.5000	5.0000	A
○AC 10A (50Hz)	1.000	10.000	A

<Table 2>

After completing the calibration for ranges in Table 1, carry out calibration for " Frequency Characteristic".

The calibration for is frequency characteristic required for AC voltage and AC current ranges (marked with ○).

Calibration is carried out at the designated frequency in table 2.

1) Set the calibrator to Input value as an input to the instrument.
2) Press the MEMORY key.
3) After 20 seconds, buzzer sounds and the instrument confirm calibration.
   (Do not next key operation till buzzer sounds.)

Table 2. Input Signal for Calibration

Range		Input	Unit
○AC 500mV	5kHz	500.00	mV
○AC 5V		5.0000	V
○AC 50V		50.000	V
○AC 500V		500.00	V
○AC 1000V 1kHz(400Hz)		1000.0	V
○AC 500μA	1kHz	500.00	μA
○AC 5000μA		5000.0	μA
○AC 50mA		50.000	mA
○AC 500mA		500.00	mA
○AC 5A		5.0000	A
○AC 10A		10.000	A

● Calibration of Capacitor Range

Before start calibration of the Capacitor range,

turn the function switch back to the OFF position.

1) Turn the function switch from the OFF position to the ⊣⊢ (Capacitor) position while pressing the SELECT and RANGE keys at the same time. The display shows the “ CAL ” symbol then the “ PASS ” symbol.
2) Press the SELECT key. (The display shows the “ - ” symbol.)
3) Press the HOLD key twice. (The display shows the “ - - - ” symbol.)
4) Press the RANGE key. (The display shows the “ nF ” symbol.)
5) Connect the instrument to the calibrator with the testing leads.
6) Set the calibrator to Input 1 value as an input to the instrument.
7) Press the HOLD key to confirm.
8) Set the calibrator to Input 2 value as an input to the instrument.
9) Press the HOLD key to confirm.
10) Carry out calibration of other ranges by repeating steps 6) to 9).
11) To quit calibration, turn the function switch back to the OFF position.

Range	Input 1	Input 2	Unit
5nF	0.500	5.000	nF
50nF	5.00	50.00	nF
500nF	50.0	500.0	nF
5µF	0.500	5.000	µF
50µF	5.00	50.00	µF
500µF	50.0	500.0	µF
5mF	0.500	5.000	mF
50mF	5.00	40.00	mF

4. Battery and Fuse Replacement

4-1 Battery Replacement

If the batteries fall below the normal operating voltage, the "  "symbol turns on.

Follow the steps below to replace the batteries with new ones.

(AA-size (R6) 1.5V batteries)

WARNING

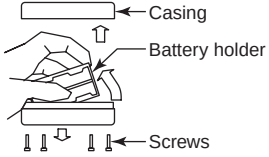
Be sure to disconnect the instrument from the circuit under test and testing leads before replacing the batteries.

CAUTION

- Do not mix batteries of different types or new batteries with used ones.
- Make sure the polarities of the new batteries are exactly as shown on the battery holder.

To replace the batteries:

1) Remove the four screws on the back of the casing.
2) Open the casing.
3) Take the battery holder out of the casing.
4) Replace the batteries with new ones and install the battery holder back into the casing.
5) Close the casing and fasten it with the four screws.



4-2 Fuse Replacement

If a current greater than the rated value flows when the instrument is in the current-measurement range, a protection fuse may blow.
If this happens, replace that fuse. The instrument contains the following types of fuses.

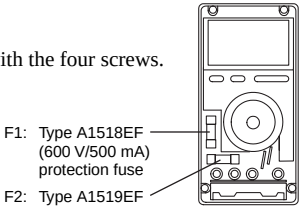
⚠ WARNING

- Be sure to disconnect the instrument from the circuit under test and testing leads before replacing the batteries.
- Do not operate the instrument with the casing left open.
- In order to avoid damage to the instrument or any possible accident, use fuses of the specified rating.

Fuse rating:	F1	A1518EF (500mA/600V)
	F2	A1519EF (15A/600V)

To replace the fuse:

1) Remove the four screws on the back of the casing.
2) Open the casing.
3) Take the battery holder out of the casing.
4) Remove the blown fuse from the fuse holder.
   Install a new fuse in the holder.
   (Make sure the fuse rating.)
5) Close the casing and fasten it with the four screws.



View with the Casing Open

5. Calibration and Maintenance

Calibration Cycle

It is recommended that the instrument be calibrated once every year. (SEE ALSO: User Calibration Function)

Contacts of Services

Please contact one of the Yokogawa M&C sales offices listed on the back cover of this manual or the sales representative from which you purchased the instrument.

Phillips screw.