User's Manual

2406E Series Insulation Tester

Thank you for purchasing the YOKOGAWA 2406E Insulation Tester.
To ensure correct use, please read this manual thoroughly before beginning operation.
Contact information of Yokogawa offices worldwide is provided on the following sheet.
PIM 113-01Z2 Inquiries List of worldwide contacts

- Model -

240631 240632 240633 240634 240635
240641 240642 240643 240644 240645

Store this manual in an easily accessible place for quick reference.

B3
Printed in China

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM 2406E-E
9th Edition: Oct. 2017 (YMI)

1. Regarding Safe Use of This Product

This product is designed to be used by a person with specialized knowledge.
When operating the instrument, be sure to observe the cautionary notes given below to ensure correct and safe use of the instrument. If you use the instrument in any way other than as instructed in this manual, the instrument's protective measures may be impaired.
This manual is an essential part of the product; keep it a safe place for future reference.
YOKOGAWA is by no means liable for any damage resulting from use of the instrument in contradiction to these cautionary notes.

The following safety symbols are used on the instrument and in this manual.

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

⚠ **WARNING** Indicates a hazard that may result in the loss of life or serious injury of the user unless the described instruction is abided by.

⚠ **CAUTION** Indicates a hazard that may result in an injury to the user and/or physical damage to the product or other equipment unless the described instruction is abided by.

High-voltage Terminal
This symbol indicates a dangerous level of voltage (terminals fed from the interior by voltages exceeding 1000 volts must be so marked). Never touch the terminal.

AC Voltage
This symbol indicates that an AC voltage is present.

■ **Failure to comply with the precautions below could lead to injury or death or damage to the instrument.**

⚠ **WARNING**

Use the instrument Only for Its Intended purpose
- This instrument is a insulation resistance tester that can measure insulation resistance (AC voltage). Do not use this instrument for other purpose.

Check the physical Appearance
- Do not use the instrument if there is a problem with its physical appearance.

During Measurement of Insulation Resistance
- A high voltage is present at the probes. Do not touch the device under test (DUT) or the EARTH, LINE or GUARD terminal.

During Measurement of AC Voltage
- Do not press the MEAS key while measuring AC voltage.
- An AC voltage is present at the GUARD terminal. Do not touch the terminal.

Immediately After Measurement of Insulation Resistance
- The probes or DUT may remain highly charged. Do not touch them immediately after the completion of measurement.

Probes
- Use the probes supplied with this instrument by YOKOGAWA.
- Do not use probes that have deteriorated or broken.
- Remove the probes from the DUT before attaching/detaching the probes to/from the instrument.

Insulation of Casing
- Punctures in the protective insulation may occur if there are any cracks or other damage in the casing as a result of the instrument having been dropped or hit against other objects. Do not use the instrument before any remedial measures are taken; ask the manufacturer for repair.

DUTs
- Turn off electrical power to the DUT before you begin measuring insulation resistance.
- Avoid touching any electrified part while using the instrument around electrically live locations. For safety, it is recommended that you wear rubber-insulates gloves or other safety protectors.

Battery Replacement
- Remove the probes from the DUT and then turn off the ranges selector switch before you open the casing to replace the batteries.
- Do not touch the MEAS key during replacement. Otherwise, a high voltage may be produced.

Operating Environment
- Do not operate the instrument in an atmosphere where any flammable or explosive gas is present.
- Do not use the instrument if there is condensation on it.

Do Not Remove the Case or Disassemble
- Do not open the case except when replacing batteries. Only Yokogawa service personnel are authorized to remove the casing or disassemble or modify the instrument. Do not attempt to repair the instrument yourself, as doing so is extremely dangerous.

⚠ **CAUTION**

Measurement of AC Voltage
- Do not apply any voltage between terminals that exceeds the specified limit.

GUARD Terminal
- The GUARD terminal is an auxiliary measurement terminal to eliminate a leakage current. Do not apply any testing voltage to the terminal.

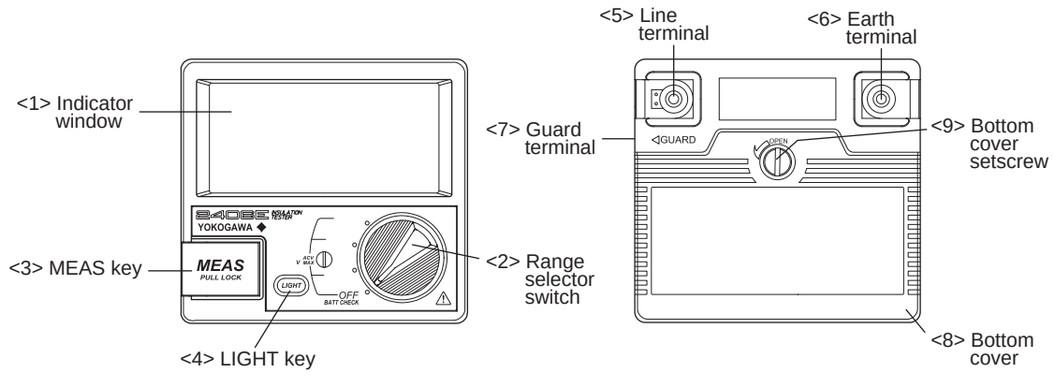
Ranges
- Do not switch between the rated voltages until two to three seconds have elapsed after the completion of each measurement. Switching between voltages immediately after the completion of measurement may result in possible damage to the instrument or DUT due to the electrical charge at the probes or DUT. Note that the tester is provided with a discharge feature.

Power to DUTs
- Electrical charges may be present at metals or wiring cables attached to electrical equipment being tested. Verify that the equipment is free from electrical charges before connecting the testing terminals. The same rule applies to the grounding wire.

Range Selector Switch
- Do not operate the range selector switch during testing.
- Do not apply any voltage to the testing terminals when measuring insulation resistance.

Batteries
- Do not mix batteries of different types or new batteries with used ones. If the instrument will not be in service for a prolonged period, always remove the batteries before you store the instrument. If you store the instrument with the batteries left installed, they are more likely to suffer fluid leakage, resulting in a malfunctioning of the instrument.

2. Components and Their Functions



<1> Indicator window

<2> Range selector switch
Used to switch between the ranges for measuring insulation resistance and to select the OFF position (battery check).

<3> MEAS key
Used to insulation resistance measurements and battery checks.

<4> LIGHT key
Used to turn the lamp for the indicator window on or off.

<5> Line terminal

<6> Earth terminal

<7> Guard terminal

<8> Bottom cover

<9> Bottom cover setscrew
Used to replace batteries.

3. Measuring the Insulation Resistance

3.1 Connecting the Probes

⚠ **WARNING**

- Use the probes supplied with this instrument by YOKOGAWA.
- Do not use probes that have deteriorated or broken.
- Remove the probes from the DUT before attaching/detaching the probes to/from the instrument.

Securely plug the line probe into the LINE terminal and the earth probe into the EARTH terminal.

3.2 Disconnecting the Probes

⚠ **WARNING**

- Remove the probes from the DUT before attaching/detaching the probes to/from the tester.

1. Make sure the range selector switch is off.
2. Unplug the respective probes.

3.3 Measuring the Insulation Resistance

⚠ **WARNING**

- A high voltage is present at the probes during measurement of insulation resistance. Do not touch the DUT or the EARTH, LINE or GUARD terminal.
- The probes or DUT may remain highly charged. Do not touch them immediately after the completion of measurement.
- Turn off electrical power to the DUT before you begin measuring insulation resistance.
- Avoid touching any electrified part while using the instrument around electrically live locations. For safety, it is recommended that you wear rubber-insulates gloves or other safety protectors.

⚠ **CAUTION**

- Do not switch between the rated voltages until two to three seconds have elapsed after the completion of each measurement. Switching between voltages immediately after the completion of measurement may result in possible damage to the instrument or DUT due to the electrical charge at the probes or DUT. Note that the tester is provided with a discharge feature.
- Electrical charges may be present at metals or wiring cables attached to electrical equipment being tested. Verify that the equipment is free from electrical charges before connecting the testing terminals. The same rule applies to the grounding wire.
- Do not operate the range selector switch during testing.
- Do not apply any voltage to the testing terminals when measuring insulation resistance.

1. Adjust the range selector switch to the voltage (rated voltage) to be applied to the DUT.
2. If the DUT is grounded, connect the earth probe clip to the DUT's ground line. If the DUT is not grounded, the earth probe clip may or may not be connected to the DUT's ground line.
3. Bring the line probe into contact with the DUT, and then press the MEAS key. The pointer then indicates the insulation resistance of the DUT. During measurement, exercise care to prevent the leadwire of the line probe from coming into contact with the ground, floor or other object. Not observing this precaution may result in a failure to measure the correct insulation resistance. Upon completion of measurement, always turn the range selector switch off.
4. Immediately after measurement, electrical charges resulting from the applied testing voltage may be present at the probes or DUT. The instrument, therefore, is designed to automatically begin discharging electricity upon completion of measurement.

Current Consumption When Used at 1000 V Rating
Because the battery current consumption increases drastically (insufficient battery power) when resistance around 1 MΩ is measured at 1000 V rating, the reading may change.
This phenomenon is likely to occur when the battery is running low.
If this occurs, replace with new batteries.
Moreover, when measuring resistance around 1 MΩ at 1000 V rating, make sure there is more than enough battery level (capacity).
(Model: 240634, 240644, 240635, 240645; rating: 1000 V/2000 MΩ)

3.4 Discharge Feature

Any capacitive component in the DUT will be charged during measurement and thus the DUT remains electrified even after the completion of measurement, resulting in a hazardous condition.
The instrument is designed to begin discharging when the MEAS key is turned off.
The pointer then swings to the position on the scale proportional to the voltage that has developed across the terminals.
After measurement is completed, leave the probes connected until the pointer swings back to the infinity sign (∞) to allow the electricity in the DUT to fully discharge.

3.5 Locking the MEAS Key

⚠ **WARNING**

- A high voltage is present at the probes during measurement of insulation resistance. Do not touch the DUT or the EARTH, LINE or GUARD terminal.

The MEAS key, when pulled up to the right, can be locked with the key left turned on.
Use this mechanism when making continuous measurement over a prolonged period.
Note, however, that leaving the key turned on for an unreasonably long time will accelerate the discharge of the batteries.

3.6 Measuring Only the volumetric Resistance

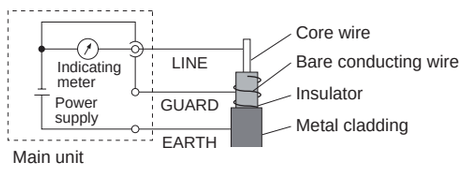
⚠ WARNING

- A high voltage is present at the probes during measurement of insulation resistance.
  Do not touch the DUT or the EARTH, LINE or GUARD terminal.

⚠ CAUTION

- The GUARD terminal is an auxiliary measurement terminal to eliminate a leakage current.
  Do not apply any testing voltage to the terminal.
- Electrical charges may be present at metals or wiring cables attached to electrical equipment being tested.
  Verify that the equipment is free from electrical charges before connecting the testing terminals.
  The same rule applies to the grounding wire.

For example, assume that you are doing an insulation test on a cable, as shown in the figure on the right.
If you bring a lead (optional) connected to the GUARD terminal into contact with an insulator overlapped by bare conducting wire, you can measure the volumetric resistance only.
This is because the leakage current that flows along the surfaces of the insulator does not flow into the indicator. A dedicated lead (part number: 321803) is necessary when using the GUARD terminal.



4. Measuring AC Voltage

⚠ WARNING

- Do not press the MEAS key while measuring AC voltage.
- An AC voltage is present at the GUARD terminal. Do not touch the terminal.
- Turn off electrical power to the DUT before you begin measuring insulation resistance.
- Avoid touching any electrified part while using the instrument around electrically live locations.
  For safety, it is recommended that you wear rubber-insulates gloves or other safety protectors.

⚠ CAUTION

- Do not apply any voltage between terminals that exceeds the specified limit.
- Do not operate the range selector switch during testing.
- Do not apply any voltage to the testing terminals when measuring insulation resistance.

The instrument can also measure commercial-frequency AC voltages. When measuring insulation resistance, also use the instrument to verify that there is no voltage present at the DUT.

1. Plug the probes in the same way as when measuring insulation resistance.
2. Bring the line probe into contact with the location at which the AC voltage is being measured.
   Read the value on the voltage measurement scale (AC V).
   While you are measuring AC voltages, do not press the MEAS key.

5. Other Function

5.1 Lighting Up the Indicator Window

(Models 240641, 240642, 240643, 240644 and 240645 only)
Press the LIGHT key to turn on the scale plate lamp. Press the key once again to turn the lamp off.
The lamp automatically turns off approximately 40 seconds after it has turned on.

6. Battery Check

1. Turn the range selector switch off and then press the MEAS key.
2. The batteries are still operable if the pointer is indicating anywhere within the range for a battery check (B mark).
3. The batteries are low if the pointer fails to stay within the range.
   Replace the batteries by following the instructions given in "Section 7 Battery Replacement" below.

7. Battery Replacement

⚠ WARNING

- Remove the probes from the DUT and then turn off the ranges selector switch before you open the casing to replace the batteries.
- Do not touch the MEAS key during replacement. Otherwise, a high voltage may be produced.

⚠ CAUTION

- Do not mix batteries of different types or new batteries with used ones. If the instrument will not be in service for a prolonged period, always remove the batteries before you store the instrument.
  If you store the instrument with the batteries left installed, they are more likely to suffer fluid leakage, resulting in a malfunctioning of the instrument.

1. Make sure that the range selector switch is off.
2. Loosen the bottom cover setscrew with a coin or the like, and then slide the cover off of the main unit.
3. Remove all six batteries at one time and insert new ones with their polarities set exactly as shown on the battery holder.
4. After changing the batteries, replace the bottom cover and tighten the setscrew.

8. Maintenance

8.1 Storage Conditions

Temperature and humidity: -10 to 60°C, 70%RH or less
Avoid storing the instrument in a location where there is:

- Outdoors,
- Where the instrument is exposed to water or other liquids,
- moisture,
- exposure to direct sunlight,
- a high-temperature heat source nearby,
- exposure to severe mechanical vibrations,
- a large amount of dust and/or salt, or
- a corrosive gas.

8.2 Cleaning

Do not use volatile solvents (such as paint thinners or benzine) as they are likely to cause discoloration.
Wipe off dirt with a cloth dampened water or alcohol.

8.3 Calibration Cycle

It is recommended that the instrument be calibrated once every year for correct operation; ask YOKOGAWA to do the periodic calibration for you.

9. Specifications

Insulation Resistance
(Standard Test Conditions: Ambient temperature 23±5°C, Relative humidity 45 to 75%RH)

Model	Rating	Central scale mark	First effective measuring range	Second effective measuring range	Low limit measuring resistance**	Rated current	AC-Voltage measuring range
240631	25 V/5 MΩ	0.1 MΩ	0.005 - 2 MΩ	2 MΩ (exclusive) - 5 MΩ	0.025 MΩ	1 mA	0 - 300 V
240641*	50 V/10 MΩ	0.2 MΩ	0.01 - 5 MΩ	5 MΩ (exclusive) - 10 MΩ	0.05 MΩ	1 mA	
	125 V/20 MΩ	0.5 MΩ	0.02 - 10 MΩ	10 MΩ (exclusive) - 20 MΩ	0.125 MΩ	1 mA	
240632	125 V/20 MΩ	0.5 MΩ	0.02 - 10 MΩ	10 MΩ (exclusive) - 20 MΩ	0.125 MΩ	1 mA	0 - 300 V
240642*	250 V/50 MΩ	1 MΩ	0.05 - 20 MΩ	20 MΩ (exclusive) - 50 MΩ	0.25 MΩ	1 mA	
240633	125 V/20 MΩ	0.5 MΩ	0.02 - 10 MΩ	10 MΩ (exclusive) - 20 MΩ	0.125 MΩ	1 mA	0 - 600 V
240643*	250 V/50 MΩ	1 MΩ	0.05 - 20 MΩ	20 MΩ (exclusive) - 50 MΩ	0.25 MΩ	1 mA	
	500 V/100 MΩ	2 MΩ	0.1 - 50 MΩ	50 MΩ (exclusive) - 100 MΩ	0.5 MΩ	1 mA	
240634	250 V/50 MΩ	1 MΩ	0.05 - 20 MΩ	20 MΩ (exclusive) - 50 MΩ	0.25 MΩ	1 mA	0 - 600 V
240644*	500 V/100 MΩ	2 MΩ	0.1 - 50 MΩ	50 MΩ (exclusive) - 100 MΩ	0.5 MΩ	1 mA	
	1000 V/2000 MΩ	50 MΩ	2 - 1000 MΩ	1000 MΩ (exclusive) - 2000 MΩ	1 MΩ	1 mA***	
240635	250 V/500 MΩ	10 MΩ	0.5 - 200 MΩ	200 MΩ (exclusive) - 500 MΩ	0.25 MΩ	1 mA***	0 - 600 V
240645*	500 V/1000 MΩ	20 MΩ	1 - 500 MΩ	500 MΩ (exclusive) - 1000 MΩ	0.5 MΩ	1 mA***	
	1000 V/2000 MΩ	50 MΩ	2 - 1000 MΩ	1000 MΩ (exclusive) - 2000 MΩ	1 MΩ	1 mA***	

* : denotes models with a scale plate lamp
** : denotes a value that allows the rated voltage to be maintained during testing
*** : indicates that the value becomes 0.55 mA at the lower limit of the first effective measuring range.

Standard test conditions

Ambient temperature and humidity:	23 ±5°C, 45 to 75% RH
Attitude:	Horizontal (within 5 degrees from horizontal)
Influence of earth magnetism:	Earth magnetic field
Battery Voltage:	Within effective range for the battery (When the battery is checked, the pointer must be within the B mark)

Tolerances under the above conditions

Resistance measurement:	±5% of reading within the first effective measuring range ±10% of reading within the second effective measuring range
Infinity and zero indications:	Up to 0.7% of scale length
AC voltage:	±10% of the maximum value
No load voltage:	Within 130% of the rated voltage
Rated measuring current:	1 mA for the first effective measuring range (-0 to +20%)
Short-circuit current:	12 mA or less

Scale length: Approx. 86 mm

Response time: 3 sec or less until the pointer is within tolerance from the instant the resistors whose values correspond to the midpoint and zero indications are connected abruptly.

Friction: No friction is recognized.

Effects of tilting: Deviation from the infinity indication when the instrument is tilted or rotated by 30 degrees from the horizontal must be 2% or less of the scale length.

Effect of temperature: Deviation from the midpoint indication at 20°C must be 5% or less when ambient temperature is varied from 20°C by ±20°C.
0.7% or less of scale length for infinity and zero indications.

Effect of humidity: Within tolerance when the instrument is left for one hour with the humidity at 90% RH.

Effect of external magnetic field: The change of indication must be 3% or less of the indicated value when an external field of DC 400A/m is applied in the most affected direction.

Effect of AC component of voltage at measurement terminals:
A change when a capacitor of 5μF ±10% is connected in parallel with a resistor corresponding to the midpoint indication connected, must be 10% or less of indication.

Insulation resistance: 50MΩ or more between electric circuits and outer case, when tested at 500V if the rated measuring voltage is 500 V or less and at a voltage identical to the rated voltage if the rated voltage exceeds 500 V.

Dielectric strength: 3700 V AC for one minute between the electric circuits and the outer case.

Vibration proof: When a vibration frequency of 16.7 Hz and peak-to-peak amplitude of 4 mm are applied to the direction of the axis of the moving part, the specifications for tolerances, friction, and the effect of tilting must be met.

Shock proof: When shock of 1000 m/s^2 is applied twice in the direction of axis of the moving part and the direction perpendicular to the axis, specifications for tolerance, friction, and effect of tilting must be met.

Durability: When a resistor corresponding to the midpoint indication is connected across the measuring terminals and the power switch is repeatedly turned on and off 10,000 times at the rate of about 300 times/hour, the specifications for tolerance and friction must be met.

Input mistake protection: When an AC voltage of 50 or 60Hz at 1.2 times the rated measuring voltage is applied to the measuring terminals for 10 seconds, no abnormality must occur.

Operation temperature and humidity: 0 to 40°C, 90%RH or less (no condensing)

Storage temperature and humidity: -10 to 60°C, 70%RH or less (no condensing; remove the battery)

Battery: R6, AA-size 1.5 V (6 batteries)

External dimensions: Approx. 120 × 110 × 60 mm

Weight: Approx. 500 g (including batteries)

EMC Standard: EN 61326-1 Class A, EN 61326-2-2, EN 55011 Class A Group1
The accuracy is within the ranges of specification though under immunity environments.
EMC Regulatory Arrangement in Australia and New Zealand
EN 55011 Class A Group1
Korea Electromagnetic Conformity Standard
(한국 전자파적합성기준)

⚠ CAUTION

This instrument is Class A for use in an industrial environment and may cause radio interference if used for domestic use.
Therefore, appropriate measures must be taken when using it for domestic use.

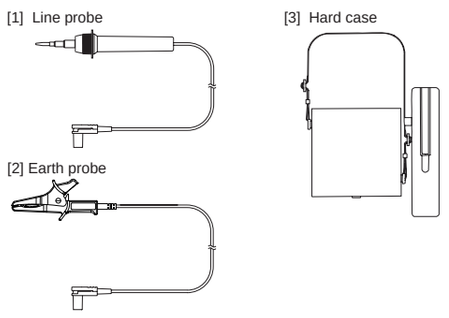
Note:
The application of the following accessory could affect the safety and EMC performance of the product and such item should be used with this consideration.

- **Lead for guard terminal : 321803**

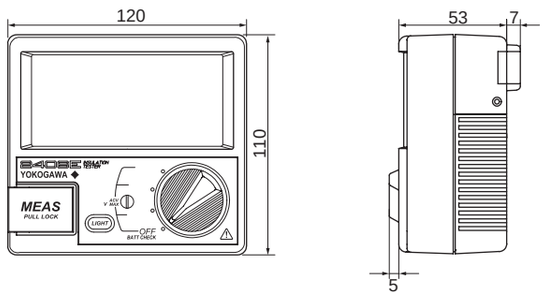
Interconnection with other apparatus is not recommended.

Supplied Accessories
(The items labled [1] to [3] are spare parts)

Description	Model/Part No.	Qt'y	Remarks
Batteries		6	AA-size (R6)
Earth and Line probe	98007		
[1] Line probe	B9204XD		
[2] Earth probe	B9204XJ		
[3] Hard case	B9075UF (including a probe case)		
User's manual	IM 2406E-E	1	This manual



External Dimensions



Notice Regarding The Manual

- The information contained in this manual is subject to change without notice.
- Every effort has been made to ensure that the information contained herein is accurate. However, should any concerns, errors, or omissions come to your attention, or if you have any comments, please contact us.
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