DIGITAL HARMONICS TESTER

MODEL　HWT-301

INSTRUCTION MANUAL

Thank you very much for selecting our digital AC digital harmonics tester.
This model is complex instrument and employ a very reliable mechanical/electronic design.

Before you use your new instrument, read this Instruction Manual completely and familiarize yourself thoroughly with all functions. With proper use and care, your tester will give you years of satisfactory service.

MULTI MEASURING INSTRUMENTS CO.,LTD.
Akihabara Murai Bldg. 7F, 1-26 Kanda Sakuma-cho,
Chiyoda-ku, Tokyo, Japan, 101-0025
TEL：+81-3-3251-7016　FAX：+81-3-3253-4278
Home Page：http://www.mutimic.com/
E-mail：multi@multimic.com

CONTENTS

1. INTRODUCTION

Model HWT-301 harmonics tester is portable and handheld clamp-on type tester which is least affected by external magnetic fields.
It measures not only true rms value for line current and leakage current of the low voltage circuit over a range from 0.1mA to 300A but also the harmonics current and voltage in the line up to the 25th harmonics.
In addition to above basic measurement functions, model HWT-301 provides voltage and resistance measurement with a full scale display of 4000 counts as well as conformity of IEC safety standards.

2. SAFETY SUMMARY

The WARNINGs which appear on the following pages must be followed to ensure operator safety and to retain the operating condition of the tester.

Safety Symbols:

 indicates the operator must refer to an explanation in this manual.

 indicates terminals at which dangerous voltages may exist.

⚠WARNING

- Do not make voltage measurements of power lines carrying more than 250V.
  IN SOME CASES, POWER LINES MAY CARRY VOLTAGE SPIKES OF SEVERAL TIMES OF THE NORMAL SUPPLY VOLTAGE. THIS TESTER SHOULD NOT BE USED TO MEASURE POWER LINES.
  *The term of "POWER LINE" means the electrical circuit providing the power to factories, buildings, and etc.
- To avoid damage to the tester, disconnect test leads before changing functions.
- Always check to make sure that the function switch is set to the proper position.
- When making measurements, use CAUTION as dangerous voltages may be present in normally safe areas.
- To avoid electrical shock, use CAUTION when working above 60V DC or 25V AC rms. Such voltages pose a shock hazard.
- Never make measurements with the case opened.
- Never fail to keep the maximum tolerable input.
- Never operate this tester if it becomes wet, damp or has any liquid condensation build-up on any part of the instrument.
- Do not operate the tester in presence of flammable gasses or fumes.
- Never make measurements for uninsulated conductors or bus bars.

3. SPECIFICATIONS

3-1 General Specification

Measuring method : Dual integration mode with true rms reading.
Measuring function: Load current, leakage current, harmonics current, AC voltage, harmonics voltage, resistance.
Safety standard : Meets the requirements for double insulation to IEC61010-1 and IEC 61010-2-032, Category II 600V or Category III 300V.
E.M.C. standard : Meets EN 61326
Affection of magnetic fields: Less than 3mA (nearby 100A conductor)
Display: 3 3/4 digit LCD, max. reading of 4000 count
Range: Current 0~400mA/4A/40A/300A
Voltage 0~400mV/400V
Resistance 0~4000Ω
Input frequency: 45Hz~65Hz
Sampling : 2 times/s
Over range indication : "OL" mark on LCD
Low battery indication : "B" mark on LCD readout
Data hold indication : "D·H" mark on LCD readout
Jaw opening capability : 40mm ϕ
Limitation of circuit voltage: Less than AC 600V
Withstanding voltage : AC 3700V, 1 minute (between outer case and core of CT)
Auto power off : The meter is set to power off mode approx. 20 minutes after the power switch on.
Operating temperature : 0℃ to 40℃, ＜80%RH (non-condensing)
Strange temperature : - 10℃ to 60℃, ＜70%RH (non-condensing)
Power supply : 1.5V ("AAA" size, R03) x 3
Power consumption and battery life : Approx. 13mA, 50 hours continuous.
Size : 70(W)x223(H)x34(D)mm
Weight : Approx. 440g
Accessories : Carrying case..... 1
Instruction manual..... 1
Batteries.....3
Test leads..... .1 set

3-2 Measuring Range

Note: Electrical characteristic (18℃～28℃, 80%RH max.)

3-2-1 All Pass Mode

AC current (True RMS)

Range	Resolution	Accuracy
400mA	0.1mA	±1.0%rdg±8dgt
4A	1mA	
40A	10mA	
300A	100mA	±1.0%rdg±1% of full scale

AC voltage (True RMS)

Range	Resolution	Accuracy	Input impedance	Max. input voltage
400mV	0.1mV	±1.0%rdg±8dgt	>10MΩ	AC 250V rms
400V	100mV			AC 450V rms

Resistance

Range	Resolution	Accuracy	Max. test current	Open circuit voltage
4000Ω	1Ω	±1.0%rdg±8dgt	70μA	1.5V

* Input Protection: 400V rms

3-2-2 Harmonics Mode

Measuring method: Synchronous filter
Measurable harmonics: Fundamental frequency to 25th harmonics
Minimum fundamental input: More than 5% of full scale in each range

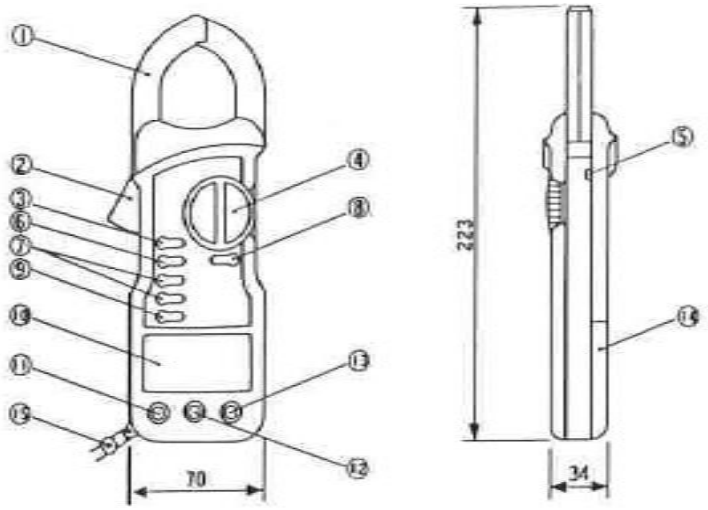
Harmonics	Accuracy (In case of more than 4%, harmonics are included against fundamental input)
1~9th	(±1%rdg±5dgt)±(Basic accuracy of ACA or ACV) - (Error by neighboring harmonics)
10~19th	(±2%rdg±5dgt)±(Basic accuracy of ACA or ACV) - (Error by neighboring harmonics)
20~25th	(±5%rdg±5dgt)±(Basic accuracy of ACA or ACV) - (Error by neighboring harmonics)

Typical error by neighboring harmonics

Harmonics	Error (Compensation %)	Harmonic component ratio of the neighboring frequency
2~6th	1.5%	65%
7~8th	2.5%	41%
9~14th	4%	20%
15~20th	8%	10%
21~25th	15%	10%

* For example:
The neighboring frequency of 5th harmonic means 4th harmonic and 6th harmonic. If the harmonic component ratio of 4th and 6th harmonic is 65%, the estimated error will be 1.5% typically.

4. DIMENSIONS AND PANEL FUNCTION



①Current transducer(Jaw)
②Jaw opening lever
③Power switch: Push switch for power ON or OFF
④Range selector switch: Rotary switch for range selection
⑤Data hold switch: This push switch locks the display. To release, press the switch again to cancel the hold condition.
⑥SELECT switch: Press this switch the harmonics mode. To return to the normal mode (all pass mode), press the switch again.
⑦"UP" and "DOWN" switch: Press this switch to select a harmonic number.
⑧X 10 switch: In harmonics measurements, press this switch to read the measured value at 10 times when the displayed value is less than 100 counts. When this switch is pressed once, "X 10" is displayed on the LCD.
⑨V-RANGE switch: Press this switch to select 400mV or 400V range at 400V/400mV measurements.
⑩LCD display
⑪400V terminal: This terminal is used for 400V range measurement.
⑫COM terminal: This is the common terminal for voltage and resistance measurements.
⑬400mV/Ω terminal: This terminal is used for 400mV and 4000Ω range measurements.
⑭Battery compartment
⑮Wrist strap

5. METHOD OF MEASUREMENT

5-1 Preparation and Caution before Measurement

- Avoid using the tester in places subject to high temperature, humidity or excessive vibration.
- Before measurements, be sure the data hold switch is set to "OFF" (It is impossible to make measurements if the data hold switch is set to "ON").
- Remove the batteries if the tester will not be used for a long period of time.

⚠CAUTION

If the instrument is subjected to an electrical field of 3V/m within the frequency range from 27MHz to 20MHz, the display error for voltage and resistance measurements might increase.

⚠WARNING

- To avoid electrical shock, use CAUTION when working with more than 60V DC or 25V AC rms since the danger of electric shock exists. In addition, check that the test leads are normal condition.
- POSSIBLE ELECTRICAL SHOCK: Do not make measurements if the case is damaged or the rear case is removed.
  Take off all electrical inputs before re removing the rear case.
- POSSIBLE ELECTRICAL SHOCK or FIRE HAZARD: Do not expose this tester to rain or moisture. Do not operate the tester in the presence of flammable gases or fumes.
- To avoid damage to the tester, disconnect test leads before changing functions. Do not exceed the maximum input limits.
- Never make measurements for uninsulated conductors or bus bars.
- Do not make voltage measurements of power lines carrying more than 250V.
  IN SOME CASES, POWER LINES MAY CARRY VOLTAGE SPIKES OF SEVERAL TIMES OF THE NORMAL SUPPLY VOLTAGE. THIS TESTER SHOULD NOT BE USED TO MEASURE POWER LINES.
  * The terms of "Power Line" means the electrical circuit providing the power to factories, buildings, etc.

5-2 Line Current Measurement

① Set the POWER switch to "ON" position.
② Set the range selector switch to a range appropriate to the current to be measured. If the current of circuit is unknown, set the switch to highest range and reduce setting until satisfactory reading is obtained.
③ Clamp the conductor of the circuit under test. Be sure the clamp jaws are securely closed.
④ Read the current value in the display.
⑤ If you make measurements in a dark place or in a place where it is difficult to see the readings, use the data hold switch.

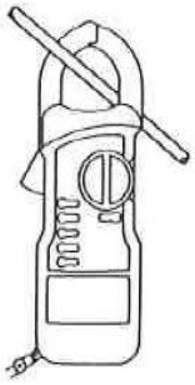


Fig.1

Note : Clamp around only one conductor of the circuit to be measured. (See Fig.1)

5-3 Leakage Current Measurement

5-3-1 Leakage Current Measurement for The Grounded Conductor

① Set the POWER switch to “ON”.
② Set the range selector switch to a range appropriate to the current to be measured.
③ Clamp the conductor of the circuit under test with clamp jaws. Be sure the clamp jaws are securely closed.
④ If you make measurements in a dark place or in a place where it is difficult to see the readings, use the data hold switch.
⑤ Read the displayed value.

5-3-2 Leakage Current Measurement for The Single-phase or Three-phase Electric Circuit

① Set the POWER switch to “ON”.
② Set the range selector switch to a range appropriate to the current to be measured.
③ To measure a leakage current in a single-phase electric circuit, clamp the two conductors together. Or clamp the three conductors together in the case of three-phase electric circuit.
④ If you make measurements in a dark place or in a place where it is difficult to see the readings, use the data hold switch.
⑤ Read the displayed value.

5-4 Harmonics Current Measurement

① Set the POWER switch to "ON".

② Set the range selector switch to a range appropriate to the current to be measured.
If the current of the circuit is not known, set the switch to highest range and reduce setting until satisfactory reading is obtained.
When the range is set incorrectly, "OL" mark will be displayed.

③ Clamp the conductor of the circuit under test.
Be sure the clamp jaws are securely closed.

④ Press the SELECT switch once, "HARMONIC NO. XX" is displayed and the tester is activated to the harmonics mode.
"HARMONIC NO. 1" is the fundamental current.

⑤ Select a harmonic number by pressing UP and DOWN switch.
If you make measurements in a dark place or in a place where it is difficult to see the readings, disconnect clamp and press UP and DOWN switches to select a harmonic number.

⑥ Read the displayed value.

⑦ When the displayed value is less than 100 counts in harmonics mode, use "X10" switch to read the measured value at 10 times.
Please note this value is 10 times of the actual value. In "X10" mode, even if the least significant digit is fluctuated, this is not abnormal.

Note: In harmonics mode, it is impossible to change the range. If necessary, press to release the harmonics mode with the SELECT switch once again and set the range selector switch again to a range appropriate to the current to be measured. To start the harmonics current measurement, press the SELECT switch again. If the input current is relatively small, it will take the reasonable time to get the sable reading.

5-5 Compensation for The Influence by The Harmonic Component of The Neighboring Frequency

The accuracy of this tester is influenced by the harmonic component of the neighboring frequency, as the synchronous filter method is used to measure the harmonic current. For more accurate measurement, the following compensation calculation is recommended.

$$\text{Measured value} - \left[\begin{array}{l}\text{Measured harmonic value}\\ \text{of neighboring frequency}\end{array} \times \begin{array}{l}\text{Compensating}\\ \text{percentage (\%)}\end{array}\right] = \text{Compensated value}$$

For example:
If the 5th harmonics = 2.00A (Measured harmonics value)
6th harmonics = 1.00A (Measured harmonics value)
The compensating calculation should be made as below.
5th harmonics = 2.00A − (1.00A x 0.15) = 1.985A
6th harmonics = 1.00A − (2.00A x 0.15) = 0.97A
Compensation percentage (1.5%)

Note: Refer to item 3-3-3 for the value of compensating percentage.

5-6 Calculation Method of The Harmonic Distortion

① Harmonic distortion ratio for each harmonic number: In/I1 x 100 (%)
I1 = Fundamental current In = Harmonic current for each harmonic number
For example: Fundamental current 3A
5th harmonic current 0.5A
5th harmonic distortion ratio = 0.5/3x100 = 16.7%

② Total harmonics distortion ration (THD) = $\frac{\sqrt{\sum_{n=2}^{5} In^2}}{I1}$ x 100 (%)

For example: Fundamental current 3A
3rd harmonic current 0.5A
5th harmonic current 0.3A
7th harmonic current 0.1A

$$THD = \frac{\sqrt{0.5^2 + 0.3^2 + 0.1^2}}{3} \times 100\ (\%) = 19.7\%$$

Note: For harmonics voltage measurement, above calculation method is also used.

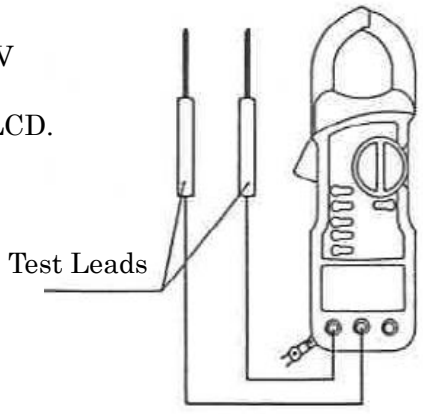
5-7 Voltage Measurement

5-7-1 Voltage Measurement for AC 400V Range

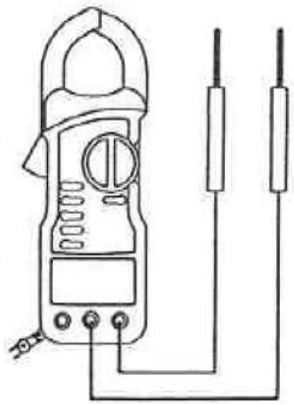
⚠WARNING

- Do not make voltage measurements of power lines carrying more than 250V. IN SOME CASES, POWER LINES MAY CARRY VOLTAGE SPIKES OF SEVERAL TIMES OF THE NORMAL SUPPLY VOLTAGE. THIS TESTER SHOULD NOT BE USED TO MEASURE POWER LINES
  * The term of "Power Line" means the electrical circuit providing the power to factories, buildings, etc.
- To avoid damage to the tester, disconnect test leads before changing functions. Do not exceed the maximum input limits.

① Set the power switch to "ON" position.
② Set the range selector switch to 400V/400mV range. AC 400V range is automatically selected and "V" mark is displayed on the LCD.
③ Connect the plug of black test lead into the "COM" terminal and the plug of red test lead into the "400V" terminal.
④ Contact the circuit under test with the test leads and read the displayed value.



5-7-2 Voltage Measurement for AC 400mV Range



① Set the range selector switch to 400V/400mV range.
② To select AC 400mV, press V-RANGE switch once. The "mV" mark is displayed on the LCD.
③ Connect the plug of the black test lead into the "COM" terminal and the plug of the red test lead into the 400mV/Ω terminal.
④ Contact the circuit under test with the test leads and read the displayed value.

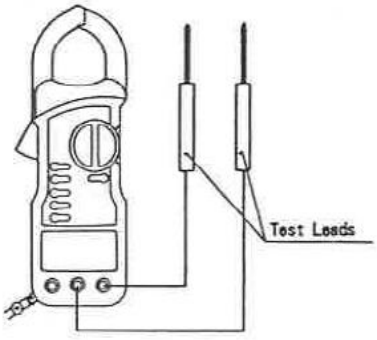
5-8 Harmonics Voltage Measurement

① Set the POWER switch to "ON".
② Set the selector switch to 400V/400mV range.
③ Select 400V or 400mV range appropriate to the voltage to be measured.
④ Connect the plug of the black test lead into the "COM" terminal.
For 400V range, connect the plug of the red test lead into "400V" terminal.
Or for 400mV range, connect the plug of the red test lead into the "400mV/Ω" terminal.
⑤ Contact the circuit under test with the test leads and press the SELECT switch once. "HARMONIC NO. XX" is displayed and the tester is activated to the harmonics mode.
"HARMONIC NO. 1" is the fundamental voltage.
⑥ Select a harmonic number by pressing UP and DOWN switches.
⑦ Read the displayed value.
⑧ When the displayed value is less than 100 counts in harmonics mode, use "X10" switch to read the measured value at 10 times.

Note: In harmonics mode, it is impossible to change the range.
If necessary, press to release the harmonics mode with the SELECT switch once again to a range appropriate to the voltage to be measured.
To start the harmonics voltage measurement, press the SELECT switch again.

5-9 Resistance Measurement

⚠WARNING
Be sure all voltage is turned OFF in the circuit before making resistance measurement.

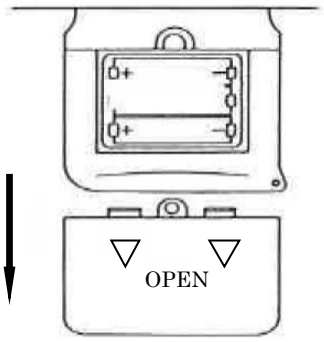


① Set the Power switch to "ON".
② Set the range selector switch to 400Ω range.
③ Connect the plug of the black test lead into the "COM" terminal. Connect the plug of red test lead into the "400mV/Ω" terminal.
④ Contact the circuit under test with test leads and the displayed value.

6. REPLACEMENT OF BATTERIES

> ⚠WARNING
> Prior to opening the case, always disconnect the test leads from the input terminal.

When the battery becomes exhausted or drops below the operating voltage, the battery mark will appear on the display. Set the POWER switch to "OFF" prior to installing batteries.
To install the batteries, remove the battery case located on the unit back.
Loosen the screw on the battery case.
Replace the batteries (AAA size or R03) with new ones, observing polarity.
Use high-quality batteries which are guaranteed against leakage.
If the instrument is to be left unused for long periods of, remove the batteries to prevent damage from leakage.



7. REPAIR SERVICE

When making requests for repair service, please bring the instrument directly to the dealer. If this is impossible, however, send the instrument directly to our sales office.
When mailing this instrument, always pack it in its original or equivalent packing material and pack together with name, address, telephone number and the warranty documentation.

- To ensure speedy and reliable repair, always include information as the type of failure and cause.
- If required, always return accessories with the instrument.
- When contacting us, provide the model number and serial number of your instrument.

8. WARRANTY

This instrument is sent out from our factory after the sufficient internal inspections but if you find any defect due to the fault in our workmanship or the original parts, please contact the dealer where you bought the instrument.

The warranty period is 12 months from the date of purchase and the instrument shall be repaired at free of charge, provided that we judge the cause of defect is obviously resulted from our responsibility.