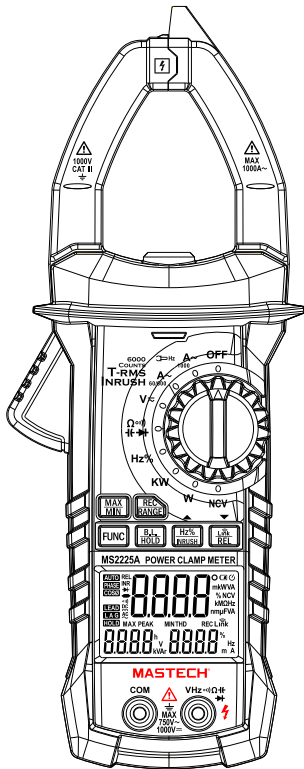




EPROTECA

MS2225A

Digital Clamp Power Meter Operation Manual



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1. Safety information

WARNING

Please pay special attention when using this meter, improper use may result in electric shock or damage to the meter. Please follow the common safety rules, and fully comply with the safety precautions specified in the user manual.
To make full use of the meter, and ensure safe operation, please read carefully and follow the application methods in this specification.

This meter conforms to IEC 61010 Safety Requirements of Electronic Measuring Instrument. It causes secondary pollution, and the over-voltage standard is CAT IV 600 V and CAT III 1000V. Please abide by the safe operation guidance to ensure the safety use of the meter. Appropriate use and protection of the meter will bring you satisfactory service

1.1 Preparation

- 1.1.1 The users must comply with the following safety regulations when using the meter:
 - General electric shock protection
 - Prevent the misuse of the meter
- 1.1.2 After receiving the meter, check whether it is damaged in the transportation.
- 1.1.3 Check and verify whether the meter is damaged after being stored and shipped in poor condition.
- 1.1.4 The probe must be in good condition. Check whether the insulation of the probe is broken and the metal wire of the conductor is exposed before using.









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- 1.1.5 The probe provided with the meter can ensure the safe use, and it must be replaced with the same probe or the probe of the same grade, if necessary.

1.2 Use


- 1.2.1 You must use the meter according to requirements of correct functions and measuring range.
- 1.2.2 Do not exceed the indicated value of protection scope of each measuring range during the measurement.
- 1.2.3 Do not touch the top of the probe when the meter is connected for measuring the circuit.
- 1.2.4 During the measurement, if the measured voltage is higher than 60V DC or 30 V AC (effective value), you should keep your fingers behind the probe protector all the time.
- 1.2.5 Do not measure the voltage when the AC voltage between the measuring terminal and the ground is greater than 750 V.
- 1.2.6 Select the highest range of the manual range if you don't know the measured value in advance.
- 1.2.7 Remove the probe from the measured circuit before rotating the change-over switch to change the measuring function.
- 1.2.8 Do not perform the live line measurement for the resistance, capacitance, diodes and circuit continuity.
- 1.2.9 Do not connect the meter to the voltage source during the current, resistance, capacitance, diodes and circuit continuity test.
- 1.2.10 Do not measure the capacitance before the capacitor is fully discharged.
- 1.2.11 Do not use this meter near the explosive gas, steam or dust.

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- 1.2.12 In case of any abnormality or fault, please stop using the meter.
- 1.2.13 Do not use this meter, unless the bottom case and the battery cover are fully fastened in situ.
- 1.2.14 Do not store or use this meter in direct sunlight, high temperature, or high humidity.

1.3 Mark

	Note-Important safety information, refer to the instruction manual.
	Application around and removal from UNINSULATED HAZARDOUS LIVE conductors is permitted.
	Equipment protected throughout by double insulation or reinforced insulation.
	Alternating current
	Both direct and alternating current
	Conforms to UL STD. 61010-1, 61010-2-032, 61010-2-033; Certified to CSA STD C22.2 NO. 61010-1, 61010-2-032, 61010-2-033
	Complies with European (EU) safety standards
	Earth (ground) TERMINAL
CAT III	It is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
CAT IV	MEASUREMENT CATEGORY IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation.

1.4 Maintenance

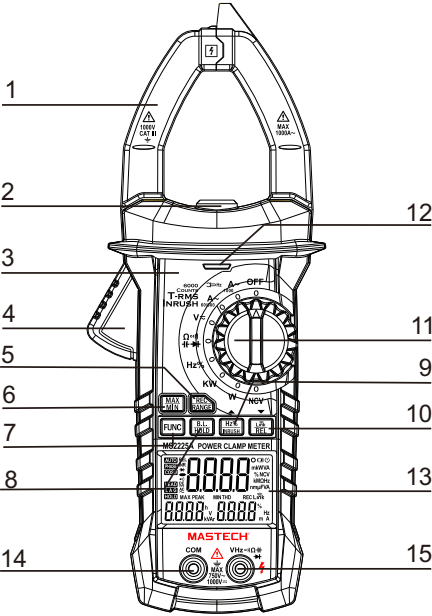
- 1.4.1 Do not try to open the bottom case of the meter for adjustment or repair. These operations can only be performed by the technicians who understand the meter and the shock hazard adequately.
- 1.4.2 Please remove the probe from the measured circuit before opening the bottom case or the battery cover of the meter.
- 1.4.3 In order to avoid the electric shock caused by the incorrect reading, when the meter displays "  " replace the battery immediately.
- 1.4.4 Use wet cloth and mild detergent to clean the meter, and do not use the abrasive or solvent.
- 1.4.5 Turn off the power of meter when you don't use it, rotate the range switch to the OFF gear.
- 1.4.6 Take off the battery to prevent the damage to the meter, if you do not use it for a long time.

2. Description

- MS2225A single-phase clamp-type harmonic power meter is hand-type intelligent power measuring meter, which combines the digital multimeter and power measurement with Bluetooth function. The range switch with one-handed performance is convenient for the measurement, and this meter can perform the functions of overload protection and low battery indicator.
- The meter can be used for the measurement of the alternating current, alternating voltage, direct voltage, frequency, duty ratio, resistance and capacitance and circuit continuity, diode test, non-contact voltage detection, as well as the measurement of the active power, reactive power, apparent power, power factor, harmonics measurement and phase angle measurement.

-
- The meter supports the auto range and manual range.
 - The meter supports reading holding.
 - The meter supports maximum measurement.
 - The meter supports minimum measurement.
 - The meter supports relative measurement.
 - The meter supports Bluetooth.
 - The meter supports data storage.
 - The meter supports back-light and clamp lamp.
 - The meter supports automatic shutdown.
 - The meter supports low voltage indicator.

2.1 Name of parts



(1)	Current clamp: for current measurement.
(2)	Clamp lamp
(3)	Faceplate
(4)	Trigger
(5)	Button for data storage and switch of auto and manual range

(6)	Button for maximum/minimum selection
(7)	Button for function switch
(8)	Button for reading holding/back-light
(9)	Button for frequency and duty ratio measurement, inrush current and up
(10)	Button for Bluetooth function, relative measurement and down
(11)	Change-over switch
(12)	NCV indicator light
(13)	LCD display
(14)	Input jack of resistance, capacitance, voltage, frequency, diode and continuity.
(15)	Jack of common terminal

2.2 Descriptions of switch, button and input jack

FUNC button: for switching the measurement function.
B.L/HOLD button: the readings will be held by the short press, and the back-light will be turned on by long press. The back-light and clamp lamp will be turned on at the same time by pressing the B.L/HOLD button in the current gear and in the power gear on the current interface.
REC/RANGE button: short press for switching between auto and manual range mode, and long press for data storage.
LINK/REL/▼ button
1) Long press for validating Bluetooth in all gears.
2) Short-press in the harmonic measurement interface at KW and W gears to scroll down, and to switch between the 1st

harmonic and 20th harmonic. At the KW and W gears, short-press the function key in the maximum/minimum value measurement interface to scroll down, and switch and display the maximum/minimum value.

3) Short press on alternating current, AC/DC voltage and capacitance for relative value measurement mode.

Hz%/INRUSH/▲ button

1) Short press on alternating current, alternating voltage and HZ% gear for the switch among alternating current or alternating voltage, frequency and duty ratio.

2) Short-press on the harmonic measurement interface at KW and W gears to scroll up, and switch between the 1st harmonic and 20th harmonic. At the KW and W gears, short-press the function key in the maximum/minimum value measurement interface to scroll up, and switch and display the maximum/minimum value.

3) Long press on the alternating current gear for switching to the measurement mode of inrush current.

MAX/MIN button: for the switch between the maximum/minimum measurement.

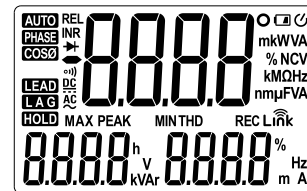
OFF gear: for power off.

INPUT jack: input terminal of voltage, resistance, frequency, duty ratio, capacitance, diode and circuit continuity.


COM jack: common terminal of voltage, resistance, frequency, duty ratio, capacitance, diode and circuit continuity.

Change-over switch: for selection of functions and ranges.

2.3 LCD display




AC, DC	Alternating current/Direct current
▶◀)	Diode and continuity
AUTO	Auto range mode
MAX	Status of maximum measurement
MIN	Status of minimum measurement
REL	Status of relative measurement
⏻	Status of automatic shutdown
🔋	LOW BATTERY
HOLD	Status of reading holding
HZ	Frequency measurement
%	Percentage (duty ratio)
mV,V	Millivolt, volt (voltage)
A	Ampere (electric current)
nF,μF,mF	Nano farad, microfarad and millifarad
Ω,kΩ,MΩ	Ohm, kilo-ohm and megohm (resistance)
Hz,kHz,MHz	Hertz, kilohertz and megahertz (frequency)

NCV	Non-contact voltage detection
W, KW	Watt and kilowatt (active power)
VA, KVA	Unit of apparent power
Var, KVAR	Reactive power
Ø	Phase angle
PEAK	Peak value measurement
THD	Total harmonic distortion
H01F	Total harmonic distortion F (relative to fundamental wave)
H01r	Total harmonic distortion r (relative to actual effective value)
COSØ	Power factor
Phase	Phase
INR	Status of inrush current measurement
REC	Data recorder
Link	Bluetooth function
LEAD	Leading phase angle
LAG	Lagging phase angle
h	Hour (time unit)
	Negative sign

3. Specification

Recalibrate the meter under the conditions of 18°C~28°C and the relative humidity less than 75%, with the calibration cycle of 1 year.

3.1 General

1	Auto range and manual range.
2	Full-scale overload protection.
3	Maximum allowable voltage between measured end and the ground: 1000 V DC or 750 V AC.
4	Working height: less than 2,000 m.
5	Displayer: LCD.
6	Maximum displayed value: 5999 dgt.
7	Polar indication: self-indicating, "-" means negative polarity.
8	Over-range display: 'OL' or '-OL'.
9	Sampling time: around 3 times/s.
10	Unit display: display the functions and the unit of electric quantity.
11	Time of automatic shutdown: 30 minutes.
12	Power supply: DC power supply 9 V.
13	Type of battery: NEDA 1604 or 6F22.
14	Under-voltage indication of battery: LCD display  symbol.
15	Temperature coefficient: less than 0.1×degree of accuracy/°C.

16	Working temperature: 18°C~28°C.
17	Storage temperature: -10°C~50°C.
18	Dimension: 238×92×50 mm.
19	Weight: around 420 g (including battery).

3.2 Technical specifications

Environmental temperature: 23±5°C relative humidity: ≤ 75%

3.2.1 Alternating current

Range	Resolution	Accuracy
60A	0.01A	±(2.0% rdg+ 8 dgt)
600A	0.1A	
1000A	1A	

- Maximum input current: 1000AAC
- Frequency range: 40~400 Hz

3.2.2 Inrush current

Range	Resolution	Accuracy
60A	0.01A	<60 A (for reference only) ±(5% rdg+ 60 dgt)
600A	0.1A	
1000A	1A	

Integral time: 100 ms; measurement range: 20~1000 A; frequency range: 40~400 Hz

3.2.3 DC voltage

Range	Resolution	Accuracy
6V	0.001V	±(0.5% rdg+ 5 dgt)
60V	0.01V	
600V	0.1V	
1000V	1V	±(0.8% rdg+ 4 dgt)

- Input impedance: 10M
- Maximum input voltage: 750 V AC (effective value) or 1000 V DC.

3.2.4 AC voltage

Range	Resolution	Accuracy
6V	0.001V	±(0.6% rdg+ 4 dgt)
60V	0.01V	
600V	0.1V	
750V	1V	±(0.8% rdg+ 4 dgt)

- Input impedance: 10M
- Maximum input voltage: 750 V AC (effective value) or 1000 V DC.
- Frequency range: 40~400 Hz.

Note:

Under the small voltage range, there might be reading on the meter before the probe is connected to the measured circuit.

The above phenomenon is normal because the meter has high sensitivity and it has no influence on the actual measurement result.

3.2.5 Frequency

3.2.5.1 Frequency measurement with clamp (at A gear):

Range	Resolution	Accuracy
99.99Hz	0.01Hz	$\pm(1.5\% \text{ rdg} + 5 \text{ dgt})$
999.9Hz	0.1Hz	

- Measurement range: 10 Hz~1 kHz
- Range of input signal: $\geq 20\text{A AC}$ (the input current is increased with the measured frequency)
- Maximal input current: AC 1000 A (effective value)

3.2.5.2 At V gear:

Range	Resolution	Accuracy
99.99Hz	0.01Hz	$\pm(1.5\% \text{ rdg} + 5 \text{ dgt})$
999.9Hz	0.1Hz	
9.999kHz	0.001kHz	

- Measurement range: 10 Hz~10kHz
- Range of input voltage: $\geq 1\text{ V AC}$ (effective value) (the input voltage is increased with the measured frequency)
- Input impedance: $10\text{M}\Omega$
- Maximum input voltage: 750 V AC (effective value)

3.2.5.3 At HZ/DUTY gear:

Range	Resolution	Accuracy
9.999Hz	0.001Hz	$\pm(0.3\% \text{ rdg} + 5 \text{ dgt})$
99.99Hz	0.01Hz	

999.9Hz	0.1Hz	$\pm(0.3\% \text{ rdg} + 5 \text{ dgt})$
9.999kHz	0.001kHz	
99.99KHZ	0.01kHz	
999.9KHZ	0.1KHZ	
9.999MHZ	0.001MHZ	

- Overload protection: 1000 V DC or 750 V AC (effective value)
- Range of input voltage: $\geq 2\text{ V}$ (the input voltage is increased with the increase of the measured frequency)

3.2.6 Duty ratio

Range	Resolution	Accuracy
0.1 - 99.9%	0.1%	$\pm(3.0\% + 3)$

3.2.6.1 At A gear (from the clamp):

- Frequency response: 10 ~ 1 kHz.
- Range of input current: $\geq 20\text{ A AC}$ (effective value)
- Maximal input current: AC 1000 A

3.2.6.2 At V gear:

- Frequency response: 10 ~ 10kHz.
- Range of input voltage: 1 V AC.
- Input impedance: $10\text{M}\Omega$
- Maximum input voltage: 750 V AC (effective value)

3.2.6.3 At HZ/DUTY gear:

- Frequency response: 10 ~ 10MHz.
- Range of input voltage: $\geq 2\text{V AC}$ (effective value) (the input voltage is increased with the measured frequency)
- Maximum input voltage: 250V AC (effective value)

3.2.7. Resistance

Range	Resolution	Accuracy
600Ω	0.1Ω	±(0.8% rdg+ 3 dgt)
6kΩ	0.001kΩ	
60kΩ	0.01kΩ	
600kΩ	0.1kΩ	
6MΩ	0.001MΩ	
60MΩ	0.1MΩ	±(2% rdg+ 5 dgt)

- Open-circuit voltage: around 0.78 V
- Overload protection: 1000 V DC or AC (effective value)

3.2.8 Circuit continuity test

Range	Resolution	Function
600Ω	0.1Ω	If the resistance of measured circuit is less than 50Ω, the buzzer inside the meter will send a sound.

- Open-circuit voltage: around 1.48V
- Overload protection: 1000 V DC or 750 V AC (effective value)

3.2.9. Capacitance

Range	Resolution	Accuracy
9.999nF	0.001nF	±(3.0% rdg+ 5 dgt)
99.99nF	0.01nF	
999.9nF	0.1nF	

9.999μF	0.001μF	±(3.0% rdg+ 5 dgt)
99.99μF	0.01μF	
999.9μF	0.1μF	
9.999mF	0.001mF	
99.99mF	0.01mF	

- Overload protection: 1000 V DC or 750 V AC (effective value)

3.2.10 Diode test

Range	Resolution	Function
3V	0.001V	Display the approximate value of diode forward voltage

- DC forward current is around 1 mA
- DC reverse voltage is around 3.2 V
- Overload protection: 1000 V DC or 750 V AC (effective value)

3.2.11 Single-phase active power

Range	Resolution	Accuracy
3W	0.01W	±(3.0% rdg+ 5 dgt)
100W	0.1W	
4000W	1W	
10kW	0.01kW	
100kW	0.1kW	
750kW	1kW	

Minimum input current: 1 mA, and minimum input voltage: 1 V.

3.2.12 Single-phase apparent power

Range	Resolution	Accuracy
3VA	0.01VA	$\pm(3.0\% \text{ rdg} + 5 \text{ dgt})$
100VA	0.1VA	
4000VA	1VA	
10kVA	0.01kVA	
100kVA	0.1kVA	
750kVA	1kVA	

Minimum input current: 1 mA, and minimum input voltage: 1 V.

3.2.13 Single-phase reactive power

Range	Resolution	Accuracy
3W	0.01W	$\pm(3.0\% \text{ rdg} + 5 \text{ dgt})$
100W	0.1W	
4000W	1W	
10kW	0.01kW	
100kW	0.1kW	
750kW	1kW	

Minimum input current: 1 mA, and minimum input voltage: 1 V.

3.2.14 Power factor

Range	Resolution	Accuracy
0.3 ~ 1 capacitive	0.001	$\pm(3.0\% \text{ rdg} + 5 \text{ dgt})$
0.3 ~ 1 inductive	0.001	

Minimum input current: 1 mA, and minimum input voltage: 1 V.

3.2.15 Harmonics measurement

Range	Accuracy of harmonic electrical level
1	$\pm(3.0\% \text{ rdg} + 10 \text{ dgt})$
2-6	$\pm(3.5\% \text{ rdg} + 10 \text{ dgt})$
7-8	$\pm(4.5\% \text{ rdg} + 10 \text{ dgt})$
9-10	$\pm(5.0\% \text{ rdg} + 10 \text{ dgt})$
11-15	$\pm(7.0\% \text{ rdg} + 10 \text{ dgt})$
16-20	$\pm(10.0\% \text{ rdg} + 10 \text{ dgt})$

Minimum input current: 1 mA, and minimum input voltage: 1 V.

4. Operation Guide

4.1 Reading holding

- 1) During the measurement, if the reading shall be held, short-press the "HOLD/B.L" key to lock the display value of the display, and short-press the "HOLD/B.L" key to unlock the kept reading.

4.2 Manual range

The RANGE key is used for setting the auto/manual range, and this key can be activated through triggering. Its startup default state is auto range. Press the key once to switch to the manual range. In the manual range mode, move the meter to the next higher gear after pressing the key once, and after moving to the highest gear, press the key continuously to move the meter to the lowest gear. Perform the cyclic operations in sequence. If press the key for more than 2 s, the meter will be switched to the state of auto range.

Note:

During the measurement of diode, continuity test, capacitance, and frequency KW, W and NCV gear, the manual range is unavailable.

4.3 Switchover of frequency and duty ratio

- 1) When the meter is at AC current gear, short-press the "Hz/%/INRUSH/▲" key, the meter can be in Hz measurement state to measure the frequency of measured AC voltage and current signals. Then, short-press the "Hz/%/INRUSH/▲" key again, the meter will be in DUTY measurement state to measure the duty ratio of measured voltage and current signals. If the meter is in HZ/% gear, short-press "Hz/%/INRUSH/▲" key to switch the meter to the HZ and DUTY states circularly.
- 2) If the meter is in AC current and AC/DC voltage gear, short-press the "Hz/%/INRUSH/▲" key, the meter will be in the voltage and current measurement state.

4.4 Selection of maximum/minimum value measurement

- 1) Press the "MAX/MIN" key in the kW and W gear, the interface will simultaneously display the maximum and minimum values obtained after the test for a period of time, and then press the ▲ or ▼ key on this interface to enter the interface displaying the time of record. After that, the specific time period of these maximum and minimum values will be displayed.
- 2) When the meter is at AC current gear, AC/DC voltage gear and resistance gear, press the "MAX/MIN" to enter the MAX mode and measure the maximum value all the time; press "MAX/MIN" key once again to enter the state for measuring the minimum value; and then press the "MAX/MIN" key for the third time to exit the measurement mode of maximum and minimum value.

Note:

- 1) The meter is in manual range mode under the measurement states of max/min value.

4.5 Function switching

- 1) Long-press the FUNC key in the power measurement interface to enter the power, voltage and current measurement interface.
- 2) Short-press the FUNC key in the power measurement interface to enter the active power, apparent power, reactive power, power factor and phase angle measurement interface.
- 3) When the meter is at power gear, short-press the FUNC key in the voltage measurement interface to enter the voltage effective value, harmonic, harmonic distortion rate THD-R and harmonic distortion rate THD-F measurement interface.

-
- 4) When the meter is at power gear, short-press the FUNC key in the current measurement interface to enter the current effective value, harmonic, harmonic distortion rate THD-R and harmonic distortion rate THD-F measurement interface.
 - 5) When the meter is at DC/AC gear, short-press the FUNC key to switch between the DC voltage measurement and AC voltage measurement interface.
 - 6) When the meter is at resistance/diode/buzzer/capacitance gear, short-press the FUNC key to switch among resistance, diode, buzzer and capacitance measurement.

4.6 Measurement of relative value

- 1) Short-press the LINK/REL/▼ key at AC current, AC/DC voltage and capacitance gears to enter the relative value measurement mode and store the current displaying value in memory as the reference value. For the sequent measurement, the displayed value is the difference value between the input value and reference value, i.e. $REL \blacktriangle (\text{current reading}) = \text{input value} - \text{reference value}$.
- 2) This function of relative value measurement only can be available in the manual measurement mode.

4.7 LINK measurement

At any gear (excluding OFF gear), long-press LINK/REL/▼ to turn on the Bluetooth of meter. Then open the corresponding APP (iOS or Android) of the meter through mobile phone or other equipment and search the signal to link them. After the linking, the APP will display the content displayed on meter in real time. Long-press the LINK/REL/▼ key once again, the Bluetooth of meter will

be turned off and the meter will be disconnected from the APP.

4.8 REC function

The meter performs the functions of data recording and Bluetooth data reading.

- 1) Data recording: the meter can save 1000 pieces of data records. Long-press REC/RANG key to enable the meter to record data. The REC indicator on LCD will be on, and the meter will store the current measurement data at the rate of 3 times/s. Long-press REC key again to exit the data recording function. The meter also can exit the data recording function when the 1000 pieces of data are recorded or a key operation or gear switching operation is performed.
- 2) Data reading: the meter cannot support the direct reading of stored data, and it only support the reading of the stored data with the Bluetooth function through a specific APP on the mobile phone.

4.9 ▼ function

Short-press LINK/REL/▼ in the harmonic measurement interface at KW and W gears to scroll down, and to switch between the 1st harmonic and 20th harmonic. At the KW and W gears, short-press the function key in the maximum/minimum value measurement interface to scroll down, and switch and display the maximum/minimum value.

4.10 ▲function

Short-press in the harmonic measurement interface at KW and W gears to scroll up, and to switch between the 1st harmonic and 20th harmonic. At the KW and W gears, short-press the function key in the maximum/minimum value measurement interface to scroll up, and switch and display the maximum/minimum value.


4.11 INRUSH measurement




Long-press "Hz/%/INRUSH/▲" for more than 2 s at AC current gear to enter the inrush measurement state.

4.12 Back-light and clamp lighting

- 1) During measurement, if the ambient light is too dim to read, press the "B.L/HOLD" for more than 2 s to turn on the back-light, and the back-light will be off 20 s later.
- 2) In this period, press the "B.L/HOLD" key for 2 s to turn off the back-light.
- 3) Turn on the back-light of the meter at the current gear, and the clamp lamp will be on at the same time.
The luminous object of the back-light is LED with high working current.
Although this meter is set with timing circuit (with time of 30 s), the service life of battery will be shortened with frequent use of back-light.
Therefore, you shall minimize the use of back-light as far as possible under the unnecessary conditions.

Note:



When the battery voltage ≤ 7.2 V, the display will display the symbol of "  " (under-voltage). However, if the back-light is used, when the battery voltage ≥ 7.2 V,

the battery voltage is reduced due to high working current, the display may display the symbol "  " (when the symbol of "  " is displayed, the measurement accuracy cannot be guaranteed). Under such circumstance, the battery will not be replaced until the symbol "  " is displayed without back-light.

4.13 Automatic shutdown

- 1) After startup, in case of no operation within 30 minutes, the meter will enter the dormant state and shut down automatically for saving electric energy. There will be voice prompt (a prolonged blast) from the buzzer 1 minute before shutdown, and then the meter will shut down automatically.
- 2) After shutdown, press FUNC key and the meter will resume operation.
- 3) If the "B.L/HOLD" key is pressed during startup, the function of automatic shutdown will cancel automatically.

4.14. Measurement preparation

- 1) Turn the change-over switch to power on the meter. If the battery is in under-voltage state (the voltage ≤ 7.2 V), the display will display the symbol "  ", and then the battery shall be replaced.
- 2) "  " means that the input voltage or current shall not be greater than the indicated value in order to prevent the internal circuit from damage.
- 3) Turn the change-over switch to the required measurement function and range.
- 4) For wiring, connect the public testing line at first and then connect the energized testing line. For disconnecting, remove the energized testing line at first.

4.15 AC current measurement




WARNING

Electric shock.

Remove the probe from the meter before measuring with the current clamp.

- 1) Turn the change-over switch to AC current gear. At this time, the meter is in AC current measurement state, and then the suitable range shall be selected.
- 2) Hold the trigger, and open the clamp to clamp one conductor of measured circuits.
- 3) Read the current value from LCD display.

Note:

- 1) If two or more circuits of the measured circuits are clamped, the measurement result will be not correct.
- 2) In order to acquire the accurate reading, the measured conductor shall be in the center of clamp as far as possible.
- 3) "  " means that the maximum AC input current is 1000 A.
- 4) When the reading is greater than 600.1 A at 60 A/600 A, there will be the alarm sound "beep" from the meter. When the reading is greater than 620 A rms, the ACA will display overload.
- 5) When the reading is greater than 1001 A at 1,000 A, there will be the alarm sound "beep" from the meter. When the reading is greater than 1,100 A rms, the ACA will display overload.

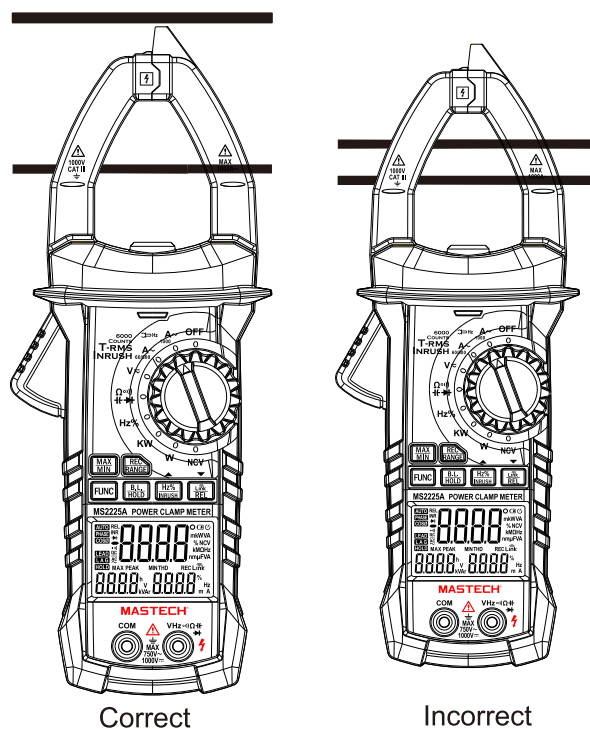


Figure 1 Schematic Diagram for Current Measurement at AC Gear

4.16. Voltage measurement



WARNING

Electric shock.

Pay special attention to high voltage measurement to avoid electric shock.

Do not input the voltage with the effective value greater than AC 750.

- 1) Plug the black probe into COM jack, plug the red probe into INPUT jack, and select the suitable range.
- 2) Turn the change-over switch to AC/DC voltage gear. In this case, the meter is in the DC voltage measurement state. If the AC voltage shall be measured, press the FUNC key and the meter will enter the AC voltage measurement state.
- 3) Connect the probe to both ends of voltage source or load to conduct measurement.
- 4) Read the voltage value from LCD.

Note:

- 1) The auto range will be unavailable under the relative measurement mode.
- 2) "△" means that the maximum input voltage is 750 V AC or 1000 V DC.
- 3) There will be the alarm sound "beep" from the meter, when the measured reading of the meter is greater than 600 V rms ACV. When the reading is greater than 750 V rms ACV, the meter will display overload.
- 4) There will be the alarm sound "beep" from the meter, when the measured reading of the meter is greater than 1000 V rms DCV. When the reading is greater than 1100V rms, the DCV will display overload.

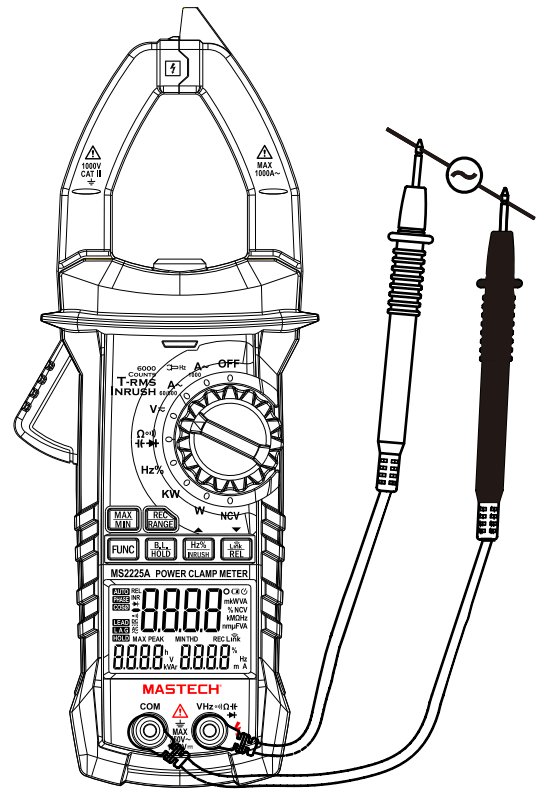


Figure 2: Schematic Diagram for AC Voltage Measurement at AC/DC Voltage Gear

4.17 Measuring frequency and duty ratio

1) Frequency measurement with clamp (at current gear):



WARNING

Electric shock.

Remove the probe from the meter before measuring with the current clamp.

- (1) Turn the change-over switch to AC current gear.
- (2) Hold the trigger, and open the clamp to clamp one conductor of measured circuits.
- (3) Press the "**Hz/%INRUSH/▲**" button shortly to switch into the status of frequency measurement.
- (4) Read the frequency value from LCD display.
- (5) Press "**Hz/%INRUSH/▲**" again to enter the status of duty ratio measurement.

Note:

- (1) If two or more circuits of the measured circuits are clamped, the measurement result will be not correct.
- (2) The measurement range of frequency is 10 Hz ~ 1 kHz. If the measured frequency is less than 10 Hz, the frequency greater than 10 kHz might be measured, but the accuracy of measurement cannot be guaranteed.
- (3) The measurement range of duty ratio is 10 ~ 95%.
- (4) The maximum input current of "**▲**" is 1000AAC (effective value).

2) At voltage gear:



WARNING

Electric shock.

Pay special attention to high voltage measurement to avoid electric shock.

Do not input the voltage with effective value greater than AC 750.

- (1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- (2) Turn the change-over switch to AC/DC voltage gear, press FUNC to enter the status of AC voltage measurement.
- (3) Press the "**Hz/%INRUSH/▲**" button to switch into the frequency measurement state.
- (4) Connect the probe to both ends of signal source or load to conduct measurement.
- (5) Read on the LCD.
- (6) Press "**Hz/%INRUSH/▲**" again to enter the status of duty ratio measurement.

Note:

- (1) The measurement range of frequency is 10 Hz ~ 10kHz. If the measured frequency is less than 10 Hz, the LCD will display "00.0", the frequency less than 10 kHz might be measured, but the accuracy of measurement cannot be guaranteed.
- (2) The measurement range of duty ratio is 10 ~ 95%.
- (3) The maximum input voltage of "**▲**" is 750 V AC (effective value).

3) At HZ/DUTY gear:

WARNING

Electric shock.
Pay special attention to high voltage measurement to avoid electric shock.
Do not input the voltage with effective value greater than AC 750 V.

- (1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- (2) Turn the change-over switch to HZ% gear.
- (3) Connect the probe to both ends of signal source or load to conduct measurement.
- (4) Read on the LCD.
- (5) Press "Hz/%INRUSH/▲" again to enter the status of duty ratio measurement.

Note:

The measurement range of frequency is 10 Hz ~ 9.999 MHz, if the measured frequency less than 10 Hz, the LCD will display "00.0"; the frequency greater than 9.999 MHz might be measured, but the accuracy of measurement cannot be guaranteed.

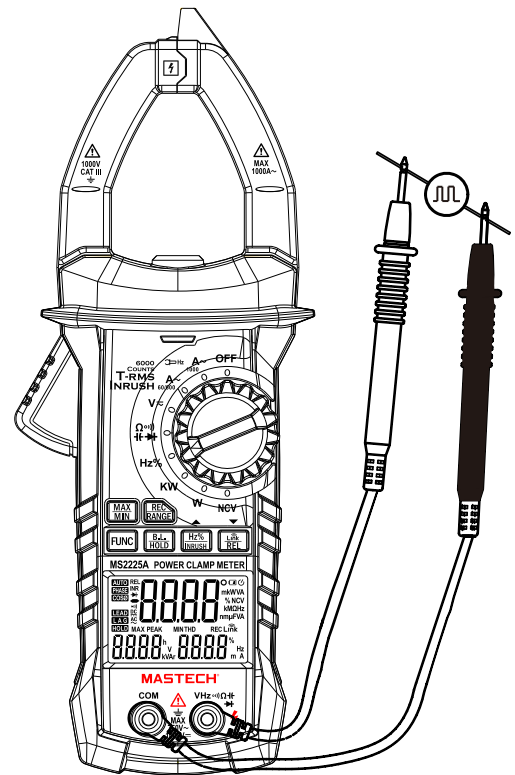


Figure 3: Schematic Diagram for Frequency Measurement at HZ% Gear

4.18 Resistance measurement



WARNING

Electric shock.

When measuring the impedance on the circuit, the circuit power should be disconnected, and the capacitor in the circuit should be completely discharged.

- 1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- 2) Place the change-over switch on the Ω gear, and set the meter in the status of resistance measurement.
- 3) Connect the probes to both ends of the measured resistor or the circuit for measurement.
- 4) Read on the LCD.

Note:

- 1) When the input is open-circuited, the LCD will display "OL" for over range.
- 2) If the resistance of measured resistor is greater than 1 M Ω , the reading of the meter might be stable after a few seconds, and it is common for the high resistance readings.

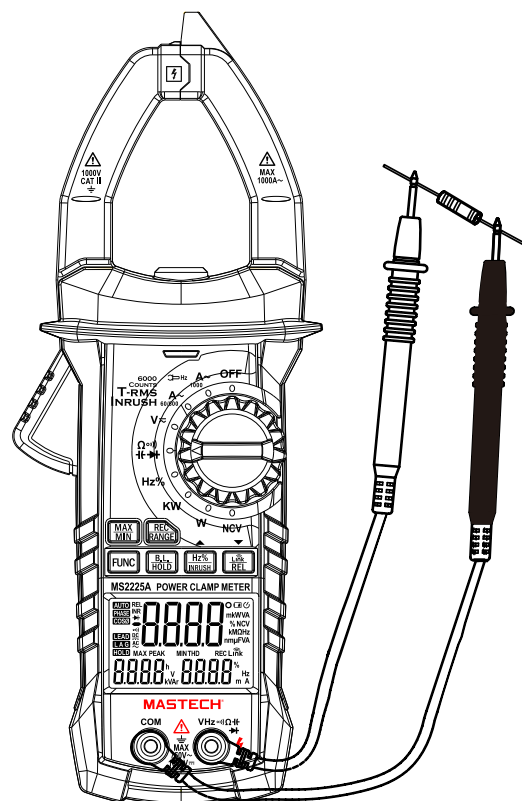


Figure 4 Schematic Diagram for Resistance Measurement at Ω Gear

4.19 Diode test

- 1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- 2) Turn the change-over switch to the $\Omega \rightarrow$ gear.
- 3) Press "FUNC" to switch into the status of \rightarrow measurement.
- 4) Connect the red probe to the positive pole of the diode, and connect the black probe to the negative pole for measurement.
- 5) Read on the LCD.

Note:

- 1) The approximate value of the forward voltage drop of diode will be displayed on the meter.
- 2) If the probe is connected inversely or the probe is open-circuited, the LCD will display "OL".

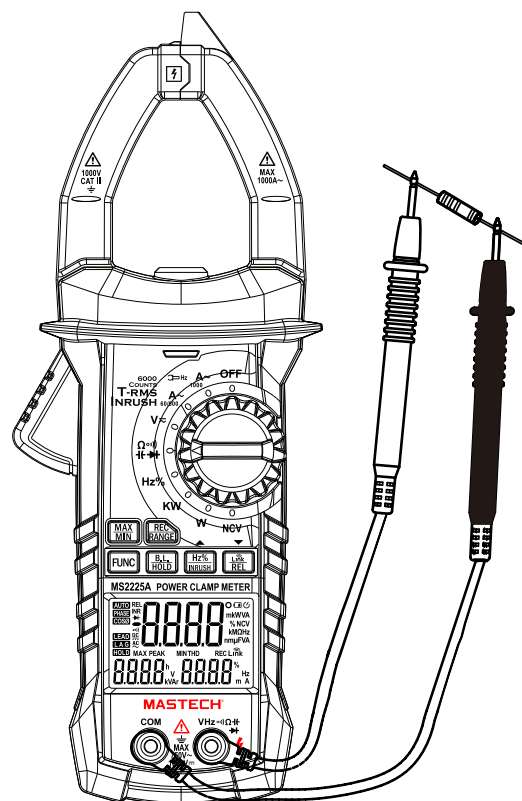


Figure 5 Schematic Diagram for Diode Testing at $\Omega \rightarrow$ Gear

4.20 Circuit continuity test



WARNING

Electric shock.

For the circuit continuity test, the circuit power should be disconnected, and the capacitor in the circuit should be completely discharged.

- 1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- 2) Turn the change-over switch to the Ω gear.
- 3) Press "FUNC" button to switch to the status of Ω circuit continuity testing.
- 4) Connect the probes to both ends of the circuit for measurement.
- 5) If the resistance of measured circuit is less than 50 Ω , the buzzer inside the meter will make a sound.
- 6) Read the resistance value of the circuit from LCD.

Note:

If the probe is open-circuited or the resistance of the measured circuit is greater than 600 Ω , the "0L" will be displayed.

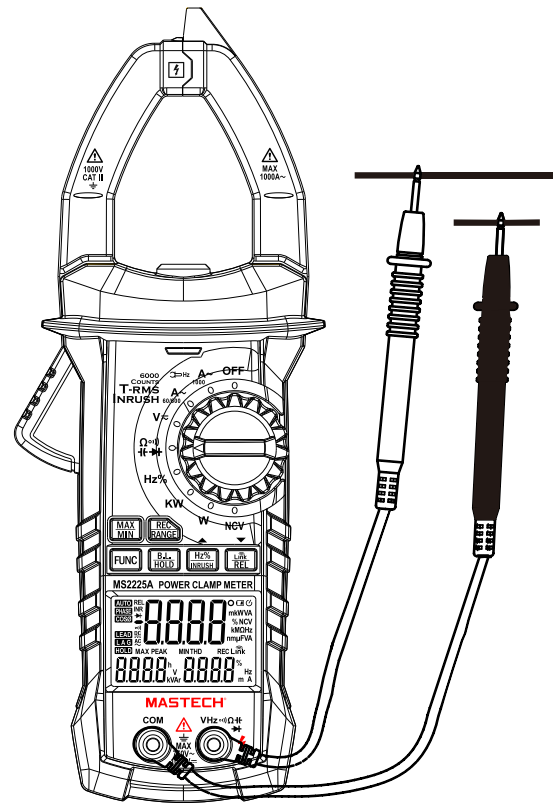


Figure 6 Schematic Diagram for Circuit Continuity Test at Ω Gear

4.21 Capacitance measurement

WARNING

Electric shock.

To avoid electric shock, the capacitor should be completely discharged before the capacitance measurement.

- 1) Insert the black probe into COM jack, and insert the red probe into INPUT jack.
- 2) Turn the change-over switch to the Ω gear.
- 3) Connect the probe to the both ends of the measured capacitor for measurement after the capacitor is completely discharged.
- 4) Read the capacitance value from LCD.

Note:

To improve the accuracy of the measured value less than 10 nF, the distributed capacitance of the meter and conductors should be subtracted.

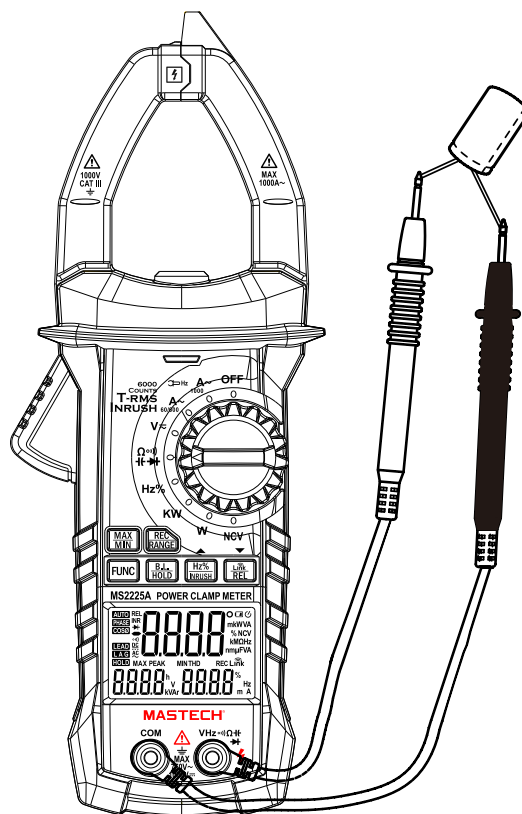


Figure 7 Schematic Diagram for Capacitance Measurement at Ω Gear

4.22 Measurement of inrush current

⚠ WARNING

Electric shock.
Remove the probe from the meter before measuring with the current clamp.

- 4.22.1 Turn the change-over switch to 60/600 A or 1000 A AC current gear.
 - 4.22.2 Hold the trigger, and open the clamp to clamp one conductor of measured circuits.
 - 4.22.3 Long press the "HZ%/INRUSH/▲" button more than 2 seconds to enter the mode of inrush current measurement. Then the LCD will display "INR", and the meter will display and hold the inrush current value until the motor start-up is detected.
 - 4.10.4 Read the inrush current value from LCD display.
- Note:
- 1) If two or more circuits of the measured circuits are clamped, the measurement result will be not correct.
 - 2) In order to acquire the accurate reading, the measured conductor shall be in the center of clamp as far as possible.
 - 3) The LCD only displays "OL" in the manual range mode indicating the over range, and the higher range should be selected.
 - 4) Under the manual range mode, if the measured value is not known in advance, the highest level should be set for the range.
 - 5) "⚠" means that the maximum input current is 1000A AC (effective value).

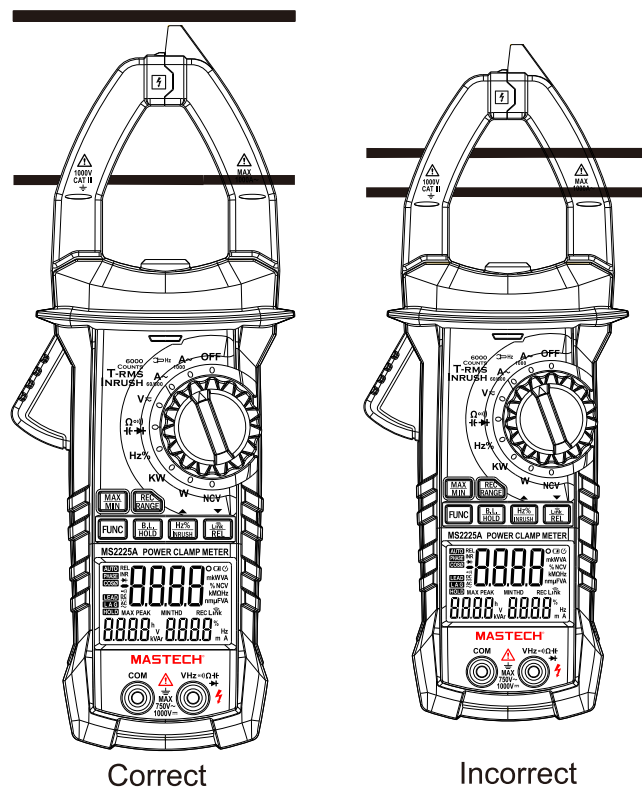


Figure 8 Schematic Diagram for Inrush Current Measurement at AC Current Gear

- 1) Turn the change-over switch of the meter to the NCV gear.
- 2) The top of the meter should be arranged near the conductor. When the detected voltage is great than 110 Vac (RMS), the voltage sensing indicator may be on, and the buzzer may make the alarm sound "beep".

Note:

- 1: The voltage may still exist even without instructions. Do not determine whether there is voltage in the conductor only by using the non-contact voltage detectors. The detecting operation might be affected by the socket design, insulation thickness, type and other factors.
- 2: When there is input voltage to the input terminal of the meter, the voltage sensing indicator may also be on.
- 3: Intrusive sources (such flashlight, motor, etc.) in the external environment may cause a wrong trigger of non-contact voltage detection.

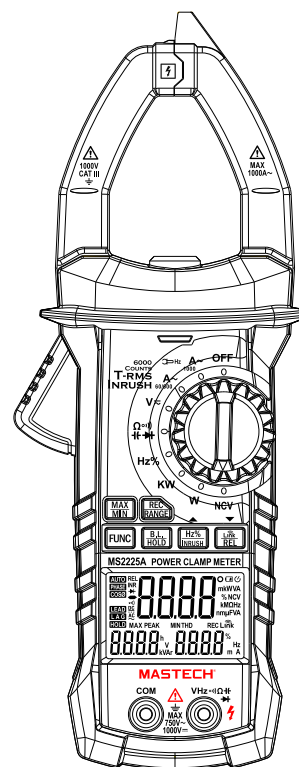


Figure 9 Schematic Diagram for Voltage Detection at NCV Gear

4.24 Active power measurement



WARNING

Electric shock.

Pay special attention to high voltage and high current measurement to avoid electric shock.

Do not input the voltage with the effective value greater than AC 750 and the current with the effective value greater than 1000 A.

- 1) Turn the change-over switch to kW or W gear.
- 2) Clamp the measured conductor of the power supply or load with the clamp. Input the measured voltage from the V end and COM end. After the measuring circuits are connected correctly, the active power shall be read from the LCD and the LCD displays the effective values of measured voltage and current simultaneously.
- 3) Determine whether the switch shall be turned to the KW gear or W gear according to the measured current. At the W gear, the measurement range of current is 1 mA - 4,000 mA and at the KW gear, the measurement range of current is 1 A - 1000 A. The measurement range of voltage at both the KW gear and W gear is 1 V - 750 V.
- 4) Press MAX/MIN key in the active power measurement interface to enter the maximum/minimum value measurement mode, and the LCD will display the measured value of active power and the maximum and minimum values of active power within a certain period simultaneously. Press the Hz/%INRUSH/▲ key or LINK/REL/▼ key again in this interface, the LCD will display the recording time and real-time measurement value of active power.

Note:

- 1) The maximum measurement range of active power is 750 kW, and the LCD will display OL for over range.
- 2) The maximum measured current is 4000 mA at W gear. Please do not operate by mistake.
- 3) The minimum measured voltage is 1 V and the minimum measured current is 1 mA.
- 4) The maximum measured voltage is 750 V and the maximum measured current is 1000 A.

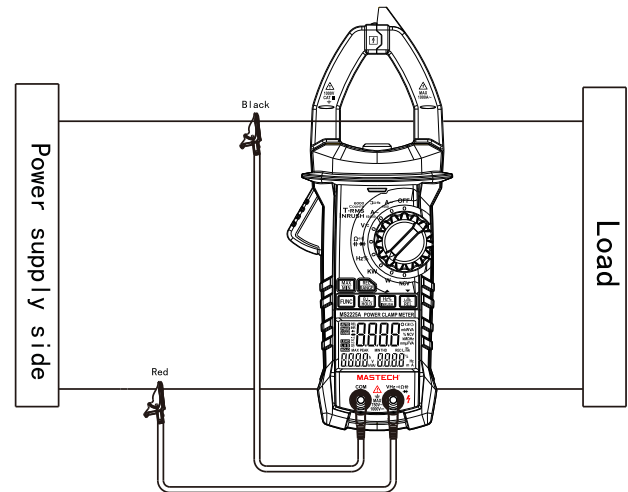


Figure10 Schematic Diagram for Active Power Measurement at KW Gear

4.25 Apparent power measurement



WARNING

Electric shock.

Pay special attention to high voltage and high current measurement to avoid electric shock.

Do not input the voltage with the effective value greater than AC 750 and the current with the effective value greater than 1000 A.

- 1) Turn the change-over switch to the kW or W gear, press FUNC key to enter the apparent power measurement interface.
- 2) Clamp the measured conductor of the power supply or load with the clamp. Input the measured voltage from the V end and COM end. After the measuring circuits are connected correctly, read the apparent power from the LCD and the LCD displays the effective values of measured voltage and current simultaneously.
- 3) Determine whether the switch shall be turned to the KW gear or W gear according to the measured current. At the W gear, the measurement range of current is 1 mA - 4000 mA and at the KW gear, the measurement range of current is 1 A - 1000 A. The measurement range of voltage at both the KW gear and W gear is 1 V - 750 V.
- 4) Press MAX/MIN key in the apparent power measurement interface to enter the maximum/minimum value measurement mode, and the LCD will display the measured value of apparent power and the maximum and minimum values of apparent power within a certain period simultaneously. Press the Hz/%INRUSH/▲ key or LINK/REL/▼ key once again in this interface. The LCD will display the recording time and real-time measurement value of apparent power.

Note:

- 1) The maximum measurement range of apparent power is 750 kW, and the LCD will display OL for over range.
- 2) The maximum measured current is 4000 mA at W gear. Please do not operate by mistake.
- 3) The minimum measured voltage is 1 V and the minimum measured current is 1 mA.
- 4) The maximum measured voltage is 750 V and the maximum measured current is 1000 A.

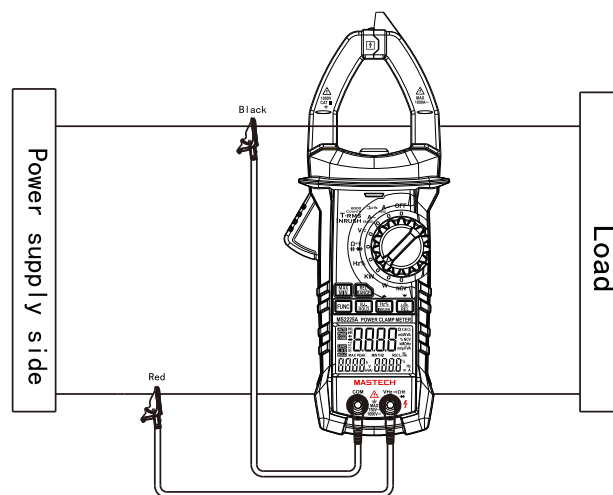


Figure11 Schematic Diagram for Apparent Power Measurement at KW Gear

4.26 Power factor measurement



WARNING

Electric shock.

Pay special attention to high voltage and high current measurement to avoid electric shock.

Do not input the voltage with the effective value greater than AC 750 and the current with the effective value greater than 1000 A.

- 1) Turn the change-over switch to the kW or W gear, press FUNC key to enter the power factor measurement interface.
- 2) Clamp the measured conductor of the power supply or load with the clamp. Input the measured voltage from the V end and COM end. After the measuring circuits are connected correctly, the power factor from the LCD shall be read and the LCD displays the value of reactive power simultaneously.
- 3) Determine whether the switch shall be turned to the KW gear or W gear according to the measured current. At the W gear, the measurement range of current is 1 mA - 4,000 mA and at the KW gear, the measurement range of current is 1 A - 1000 A. The measurement range of voltage at both the KW gear and W gear is 1 V - 750 V.
- 4) There is a phase difference between the voltage value and current value of the inductive load and capacitive load. Generally, the power factor is indicated by the cosine $\cos\phi$ of phase angle ϕ . When the power factor is negative, it means that the measured load is capacitive load.
- 5) The reactive power is a indirectly measured value. The computational formula of kVAR is: $kVAR^2 = kVA^2 - kW^2$, and

the value is calculated out with the measured voltage, current and active power value.

Note:

- 1) The maximum measured current is 4000 mA at W gear. Please do not operate by mistake.
- 2) The minimum measured voltage is 1 V and the minimum measured current is 1 mA.
- 3) The maximum measured voltage is 750 V and the maximum measured current is 1000 A.

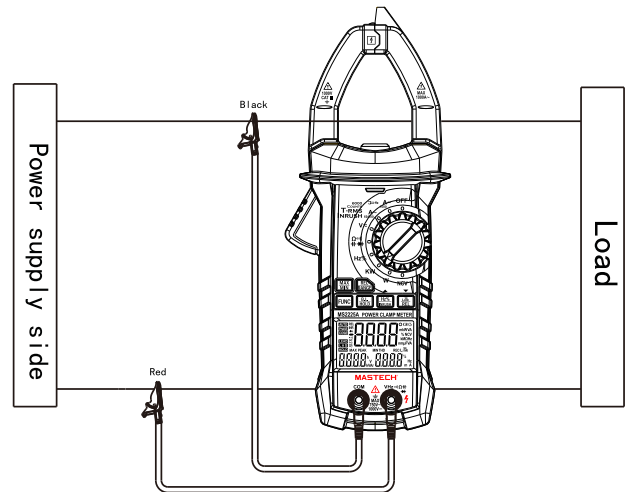


Figure12 Schematic Diagram for Power Factor Measurement at KW Gear

4.27 Phase angle measurement



WARNING

Electric shock!

Pay special attention to high voltage and high current measurement to avoid electric shock.

- 1) Turn the change-over switch to the kW or W gear, press FUNC key to enter the phase angle measurement interface.
- 2) Clamp the measured conductor of the power supply or load with the clamp. Input the measured voltage from the V end and COM end. After the measuring circuits are connected correctly, the phase angle shall be read from the LCD and the LCD displays the effective values of measured voltage and current simultaneously.
- 3) Determine whether the switch shall be turned to the KW gear or W gear according to the measured current. At the W gear, the measurement range of current is 1 mA - 4,000 mA and at the KW gear, the measurement range of current is 1 A - 1000 A. The measurement range of voltage at both the KW gear and W gear is 1 V - 750 V.
- 4) There is a phase difference between the voltage and current value of the inductive load and capacitive load. Generally, the phase difference is indicated by the phase angle ϕ .

Note:

- 1) The maximum measured current is 4000 mA at W gear. Please do not operate by mistake.
- 2) The minimum measured voltage is 1 V and the minimum measured current is 1 mA.
- 3) The maximum measured voltage is 750 V and the maximum measured current is 1000 A.

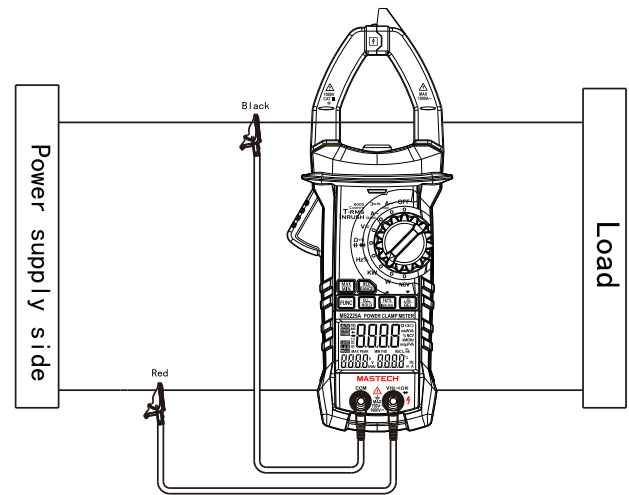


Figure 13 Schematic Diagram for Phase Angle Measurement at KW Gear

4.28 Harmonics measurement (voltage signal)



WARNING

Electric shock.

Pay special attention to high voltage measurement to avoid electric shock.

Do not input the voltage with the effective value greater than AC 750.

- 1) Turn the change-over switch to the kW or W gear, first long-press the FUNC key to enter the voltage measurement interface, and then short-press the FUNC key to enter the harmonics measurement interface, and switch from 1st - 20th harmonic through pressing the **Hz/%INRUSH/▲** key or **LINK/REL/▼** key.
- 2) Input the measured voltage signal from the V end and COM end.
- 3) After the measuring circuits are connected correctly, the effective value of the nth harmonic component shall be read.
- 4) Short-press the FUNC key in the harmonic measurement interface once again to enter into THD-R (relative to the actual effective value) or THD-F (relative to the fundamental wave) measurement mode. The main interface displays the effective value of the nth harmonic component and the minor interface displays the total harmonic distortion.
- 5) Press MAX/MIN key in the voltage measurement interface to enter the maximum/minimum value measurement mode. In this case, the main interface displays the measured effective value of voltage and the minor interface displays the maximum and minimum values within a certain period. Press the **Hz/%INRUSH/▲** key or **LINK/REL/▼** key again in this interface to enter into the time recording interface. In this case, the main interface displays the limited voltage measurements, and the minor interface displays the time of maximum and minimum values.

Note:

- 1) The minimum measured voltage is 1 V and the maximum measured voltage is 750 V. This interface will display OL for over 750 V.

⚠ WARNING

Electric shock.
Pay special attention to high current measurement to avoid electric shock.
Do not input the current with the effective value greater than AC 1000 A.

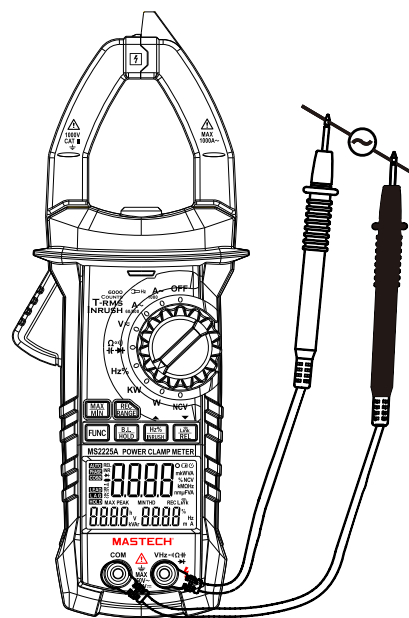


Figure 14 Schematic Diagram for Harmonics Measurement of Voltage Signal at KW Gear

4.29 Harmonics measurement (current signal)

- 1) Turn the change-over switch to the kW or W gear, first long-press the FUNC key to enter the current measurement interface, and then short-press the FUNC key to enter into the harmonics measurement interface, and switch from 1st - 20th harmonic through pressing the Hz/%INRUSH/▲ key or LINK/REL/▼ key.
- 2) Clamp the measured conductor of the power supply or load with the clamp.
- 3) After the measuring circuits are connected correctly, the effective value of the nth harmonic component shall be read.
- 4) Short-press the FUNC key in the harmonic measurement interface once again to enter into THD-R (relative to the actual effective value) or THD-F (relative to the fundamental wave) measurement mode. The main interface displays the effective value of the nth harmonic component and the minor interface displays the total harmonic distortion.
- 5) Press MAX/MIN key in the current measurement interface to enter the maximum/minimum value measurement mode. In this case, the main interface displays the measured effective value of current and the minor interface displays the maximum and minimum values within a certain period. Press the Hz/%INRUSH/▲ key or LINK/REL/▼ key again in this interface to enter into the time recording interface. In this case, the main interface displays the limited voltage measurements, and the minor interface displays the time of maximum and minimum values.

Note:

- 1) The minimum measured current is 1 mA and the maximum measured current is 1000A. This interface will display OL for over 1000A.

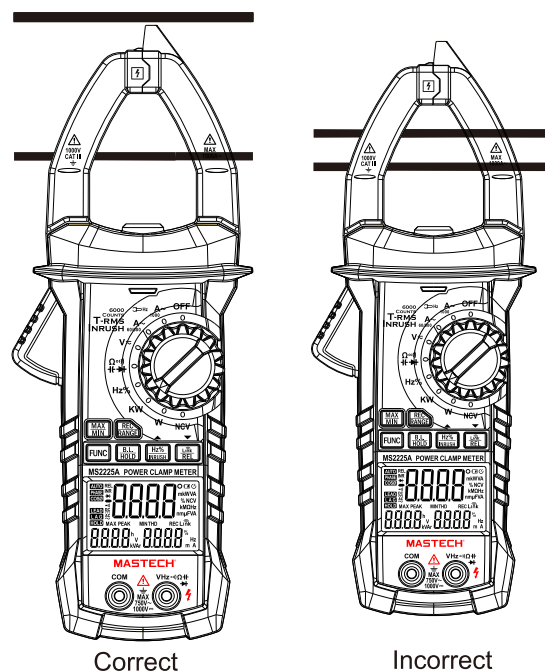


Figure 15 Schematic Diagram for Harmonics Measurement of Current Signal at KW Gear


5 Maintenance

5.1 Battery replacement



WARNING

Before opening the battery cover of meter, take the probe away from the measuring circuits to avoid electric shock.

- 1) If the meter displays the symbol " - 2) Unscrew the fastening screw of the meter battery cover and remove it.
- 3) Replace the old battery.
- 4) Install the battery cover in the original position.

Note:

Do not install the battery in the incorrect direction.

5.2 Replacing Test Leads

Replace test leads if leads become damaged or worn.



WARNING

Use meet EN 61010-031 standard, rated CAT III 1000V, MAX 10A or better test leads.



Warning

To avoid electric shock, make sure the probes are disconnected from the measured circuit before removing the rear cover. Make sure the rear cover is tightly screwed before using the instrument.

6 Attachments

1)	Probe	Grade: 1000V 10A	A pair
2)	Operation instruction		1 copy
3)	Battery	6F22 9VOLTS	

