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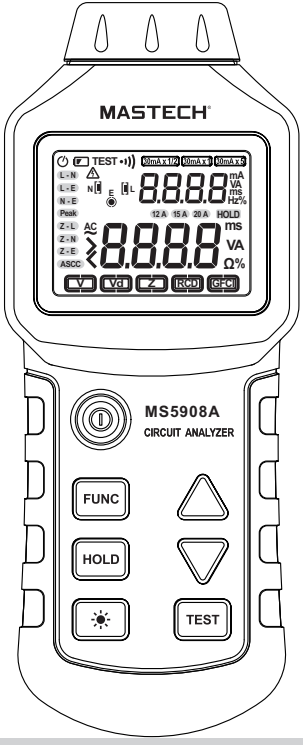
MS5908A

Circuit Analyzer

Operation'S Manual



General Instructions

This circuit analyzer is a special test device designed for AC low-voltage distribution line quick fault location. With simple operation, accurate measurement and other features, it can detect multiple problems on a line, such as causing to electric shock, electrical fire, abnormal operation of equipment, etc.

Functions:

- TRMS measuring AC voltage
- Artificial load 12A, 15A, 20A measuring line drop
- Measuring phase voltage, neutral line (zero line) voltage to earth, peak voltage, frequency
- Measuring phase (live line), neutral line (zero line), earth line conductor impedance
- Identifying 3-wire socket connection mode (zero for left and live for right, having earth line or not)
- Test the reliability of residual current device (RCD) and response action time
- Test the reliability of GFCI action and response action time
- Backlight function and data hold function

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⚠ Warning

Do not use this instrument without reading, understanding and following the instructions in this manual. Read and follow them carefully, as well as all warnings and instructions marked on the instrument!

To prevent damages to the instrument, it should not be used for measuring the output of UPS equipment, nor for measuring adjustable light and square wave generator!

For measurement accurency during repeated usage, allow at least 30 seconds between two consecutive measurements to facilitate equipment cooling when measuring voltage drop and cable impedance.

To ensure accurate measurement data, please check whether there is important load or heavy load in the line before testing. Turn off the heavy load, if necessary, then retest.

FRONT PANEL

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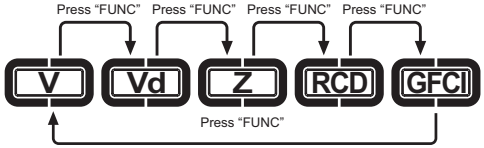
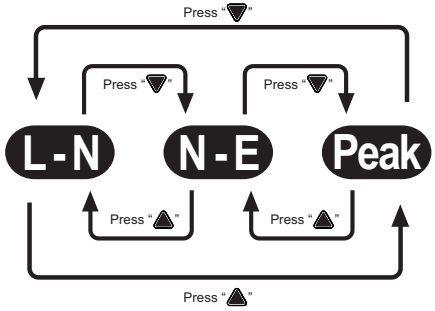
1. Input for testing
2. Display
3. Power switch key “⏻”
4. Main test item selection key “FUNC”
5. Data hold key “HOLD”
6. Backlight function key “☼”
7. Sub test item up selection key “▲”
8. Sub test item down selection key “▼”
9. Test key “TEST”

Menu Operation

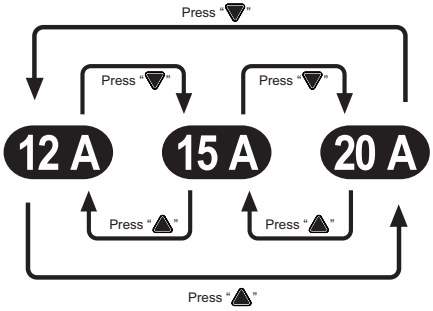
The main test items of the analyser are located on the bottom of display, including five test items, namely: voltage (V), voltage drop (Vd), impedance (Z), RCD and GFCI. Press the main test item selection key "FUNC" to select relevant test item.



Voltage (V): real time display of TRMS of phase voltage, wiring status and frequency. This test item includes 3 submenus, namely phase voltage (L_N) TRMS, voltage to earth of neutral line (zero line) (N_E) TRMS, peak voltage (Peak). Press Up "▲" or Down"▼" selection key on the sub test item to enter the relevant test item.



Voltage drop (V_d): real time display of cable connection status and display the voltage drop of current load and measurement results of phase voltage drop TRMS. This test item includes 3 submenus, namely load with 12A, 15A and 20A. Press Up "▲"or Down"▼" selection key on the sub test item to enter the relevant test item.
One analog load can be added to live line (phase line) and zero line (neutral line) for the analyser to measure the voltage drop, and then calculate the voltage drop of 12A, 15A and 20A load separately. Under the appropriate test function, press the test key "TEST" to test.



Impedance (Z): real time display of line connection status and frequency, and display of the impedance test results. This test item includes 4 submenus, namely phase line (live line), conductor impedance (Z_L), neutral line (zero line) conductor impedance (Z_N), erath line conductor impedance (Z_E), available short-circuit current (ASCC). Press Up "▲"or Down "▼" selection key on the sub test item to enter the relevant test item.
The Available Short-Circuit Current (ASCC) feature can measure the current passing through breaker when the lines are completely short-circuited. Under the appropriate test function, press the test key "TEST" to test.

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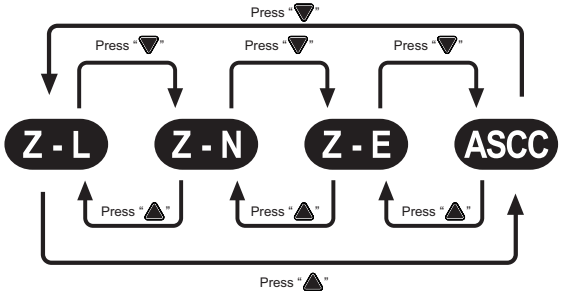

RCD: real time display of line connection status, and display current RCD trigger current and trip time. The analyser simulates current greater than 30mA between live line and earth line to test the performance of residual current device. Press the test key "TEST"to test.

GFCI: real time display of line connection status, and display current GFCI trigger current and trip time. "GFCI" (Ground Fault Circuit Interrupter) is a fault leakage protector to earth. The tester simulates current greater than 5mA between live line and earth line to test the performance of GFCI. Press the test key "TEST" to test.

Other Operations:

Backlight operation: in powered status, press "☼" key to light up the backlight. If there is no other key operation for 30 seconds, the backlight will automatically turn off. You can also turn off the backlight by pressing the "☼" key.

Auto power off: press the " ⏻ "key to power on the analyser, the " ⏻ " symbol will show on the display, which means that the auto power off is enabled. If the "FUNC" key is held while pressing " ⏻ " key to power on the analyser, the " ⏻ " symbol will not show on the display, which means that the auto power off is automatically cancelled. When auto power off function is enabled, if there is no other key operation for 30 minutes, the analyser will automatically turn off.

Data hold function: press the "HOLD" key to enable data hold function, "HOLD" symbol will show on the display; when the data hold function is enabled, press the "HOLD" key to disable the data hold function. This function is available only for voltage (V) measurement item, not available for other measurement items.

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⚠ Warning

Testing earth line conductor impedance, RCD and GFCI will trigger leakage protection device (RCD or GFCI) over the circuit!
Suggestion: check whether there is important load over the circuit, then turn off the load, if necessary, and retest to avoid testing error.

Wiring test

The wiring test result will be shown immediately after the analyzer is plugged to the socket under test. The analyzer can identify the following wiring conditions and display the test result on the screen.

Wiring condition	Screen display L E N	Caption
Normal	◉ ◉ ◉	○ Off ◉ On ☼ Flashing
No ground wire is found	◉ ○ ◉	
The live/zero line is connected inversely.	☼ ◉ ☼	
Other conditions	○ ○ ○	

Where any wiring abnormality is found, the analyzer can only complete partial measurement. Where there is no earth line, the analyzer can only measure the phase voltage and voltage drop.

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Notes: The analyzer can't detect

1. Circuit voltage, i.e. the voltage between two live lines;
2. Combined fault;
3. Reverse connection of earth line and neutral line.

Voltage measurement

The normal measured value of phase voltage is 120V±10%, 60Hz. The peak voltage of sine-wave alternating current is 1.414 times to the effective value of phase voltage. The voltage to earth of neutral line shall be less than 2V. In the single-phase circuit, if the “voltage to earth of zero line” is high, it indicates that the leakage current in zero line or earth line is high. In the three-phase circuit with neutral line, a high “voltage to earth of zero line” indicates that the three-phase load is imbalanced or the neutral line is affected by harmonic interference. Excessive voltage (voltage to earth of zero line) will result in running deviation or interruption.

⚠ Warning The maximum measurement voltage shall not exceed 265V!

Fault localization and trouble shooting for voltage problems

Measurement Item	Normal measurement result	Fault measurement result	Possible cause	Trouble shooting
Phase voltage	108-132V (120V)	The voltage is too high or too low.	The circuit is overloaded.	Redistribute the circuit load.
			High impedance points are found in switchboard or circuit.	Locate the high impedance and repair or replace relevant parts.
			The supply voltage is too high or too low.	Consult the power supply department
Voltage to earth of zero line	<2V	>2V	Leakage current	Find the current source: Is there any multipoint ground? Does the equipment or device leak current?
			Three-phase imbalance	Check and redistribute the load

Voltage to earth of zero line	<2V	>2V	Harmonic interference	Increase neutral line conductor, install electrical filter or use other methods to reduce the harmonic interference
Peak voltage	153-185V (120V)	The voltage is too high or too low.	The supply voltage is too high or too low	Consult the power supply department
			The electron device in the circuit results in the electric wave distortion	Revaluate and relocate (if necessary) the electronic device in the circuit
Frequency	60Hz	The frequency is too high or too low.	The supply frequency is too high or too low.	Consult the electricity department

Voltage drop (V_d) measurement

Dummy load shall be used in the circuit to measure the load phase voltage and then calculate the voltage drop. The voltage drop and load phase voltage will be displayed when the load reaches 12A, 15A and 20A.

In terms of qualified circuit, when measurement is made in the most remote socket from the switchboard, the voltage drop shall be less than 5%. During the measurement of the remaining sockets of the same area, the farthest socket from the switchboard shall be measured first and then other measurements shall be made from the distant to the near. The reading of the voltage drop shall be shown on the downward trend.

If the voltage drop exceeds 5% and no obvious drop of reading is found during the measurement made near the switchboard, it indicates that the first connection point goes wrong. In this case, perform a visual inspection of the wire connection among the first connection point, equipment and switchboard and the connection of breaker (air-break switch). Usually, a high impedance point generates heat. To locate this problem, infrared radiation thermometer can be used. In addition, we can directly measure the voltage on both sides of the breaker (air-break switch) to locate the point of failure.

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If the voltage drop exceeds 5%, and during the measurement made near the switchboard, the reading drops constantly and no obvious change is found between the two sockets, it indicates that the lead wire diameter is too small compared with the transmission distance, the transmission distance is too long or the circuit is overloaded. Under such circumstances, check the cable to see if the lead wire diameter complies with the required standard, and measure the lead wire current to see if it is overloaded.

If the voltage drop exceeds 5% and there is an obvious change of voltage drop reading between the two sockets, it indicates that a high impedance point exists between the two sockets. Usually, problems are found at the contact, such as poor connection, loose connector, or socket problem.

Fault localization and trouble shooting for voltage drop

Measurement Item	Normal measurement result	Fault measurement result	Possible cause	Trouble shooting
Voltage drop	<5%	The voltage drop is too high.	The circuit is overloaded.	Redistribute the circuit load
			Compared with power transmission length, the wire is small.	Rearrange the wire in compliance with the relevant standard.
			High impedance point exists between the circuit and switchboard.	Repair or replace the parts generating high impedance

Cable impedance (Z) measurement

If the voltage drop exceeds 5%, analysis on the impedance of live line and zero line shall be made. If one datum is obviously larger than the other, it indicates that the high impedance conductor goes wrong. Under these circumstances, check all the conductor connection behind the switchboard. If impedances are all high, this indicates that the lead wire diameter is too small for the power transmission length or the quality of equipment, parts or connector is poor.

Usually, the earth line impedance is less than 1Ω to provide a free discharge route for failure current.

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According to IEEE, the earth line impedance shall be less than 0.25Ω to ensure the earthing conductor to discharge the failure current which threatens all the equipment. The surge suppression system shall be grounded reliably to protect the equipment when this system suffers transient overvoltage.

ASCC is the data calculated based on this formula: phase voltage/line impedance (Live line + zero line):

ASCC= Phase voltage/
(Live line impedance + Zero line impedance)

Notes:

1. As the test of earth line impedance will trigger the residual current device due to test principle, similar device shall be removed from the circuit before testing.
2. Check the circuit to see if there is heavy load over the circuit before testing and, if necessary, turn off the load to avoid wrong test result.
3. Earth connection is required when the cable impedance is tested in the 2-wire system (without earth line).

Fault localization and trouble shooting

Measurement Item	Normal measurement result	Fault measurement result	Possible cause	Trouble shooting
Conductor impedance for live line and zero line	No. 14 line (2.0mm²) <0.15Ω/m	The impedance is too high	The circuit is overloaded.	Redistribute the circuit load.
	No. 12 line (3.3mm²) <0.1Ω/m		The wire diameter is too small for the power transmission length.	Check the wire diameter and rearrange the wire accordingly.
	No. 10 line (5.2mm²) <0.03Ω/m		High impedance point exists in the circuit or switchboard.	Locate the high impedance and repair or replace the parts
Conductor impedance for earth line	For personnel safety <1Ω	The impedance is too high	The wire diameter is too small for the power transmission length.	Check the wire diameter and rearrange the wire accordingly.
	For equipment safety <0.25Ω		High impedance point exists in the circuit or switchboard.	Locate the high impedance and repair or replace the parts

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Residual current device (RCD) test

During the RCD test, the analyzer will generate a low current between live line and earth line by means of a fixed resistance, which will affect the current balance between live line and zero line. According to UL, this current trigger shall be less than 30mA. The RCD shall response to the current imbalance by cutting off the power. The analyzer will display the value of the current triggered (mA) and response time (ms).

The word “TEST” will be displayed when the button “TEST” is pressed, which means the test is in the process. RCD shall be triggered within the specified index to cut off the power of the circuit under test. If the RCD fails to be triggered, the analyzer will stop testing automatically after 6.5 seconds. Analysis on RCD shall be made according to the test result to see if it goes wrong, is installed properly or protects the circuit effectively.

Notes:

1. Check the circuit to see if there is heavy load over the circuit before testing and, if necessary, turn off the load to avoid wrong test result.
2. Earth connection is required when the RCD is tested in the 2-wire system (without earth line). .

Fault localization and trouble shooting

Measurement Item	Normal measurement result	Fault measurement result	Possible cause	Trouble shooting
RCD test	RCD is triggered within the specified time	Fail to be triggered within the specified time	The RCD is installed improperly	Check the circuit and install the RCD according to the manufacture requirement and relevant standard
		Fail to be triggered (Invalid test)	RCD goes wrong	Repair or replace RCD

Triggering time formula specified by UL: $T = (20/I)^{1.43}$

T: Triggering time (Unit: second)

I: Triggering current (Unit: mA)

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GFCI test

During the GFCI test, the analyzer will generate a low current between live line and earth line by means of a fixed resistance, which will affect the current balance between live line and zero line. The GFCI shall response to the current imbalance by cutting off the power. The analyzer will display the value of the current triggered (mA) and response time (ms).

The word “TEST” will be displayed when the “TEST” key is pressed, which means the test is in the process. GFCI shall be triggered within the specified index to cut off the power of the circuit under test. If the GFCI fails to be triggered, the analyzer will stop testing automatically after 6.5 seconds. Analysis on GFCI shall be made according to the test result to see if it goes wrong, is installed properly or protects the circuit effectively.

Notes:

1. Check the circuit to see if there is heavy load over the circuit before testing, if necessary, turn off the load to avoid wrong test result.
2. Earth connection is required when the GFCI is tested in the 2-wire system (without earth line).

Fault localization and trouble shooting

Measurement Item	Normal measurement result	Fault measurement result	Possible cause	Trouble shooting
GFCI test	GFCI is triggered within the specified time	Fail to be triggered within the specified time	The GFCI is installed improperly	Check the circuit and Install the GFCI according to the manufacture requirement and r elevant standard
		Fail to be triggered (Invalid test)	GFCI goes wrong	Repair or replace GFCI

General technical index

Display: LCD
Overload: “OL” or “>”
Low battery voltage: “ ”
Time for auto power-off: Power off when the keys aren't pressed for 30 minutes.
Humidity: <80% Relative humidity (0°C~50°C)
Storage temperature: 0°C~50°C <80%
Relative humidity
Physical dimension: 193mm (L)×78mm(W)×38mm(D)
Power source: Six AAA batteries
Weight: 295g (including batteries)

Accuracy index

Accuracy: ±(% reading + words), one-year guarantee.
Reference conditions:
Ambient temperature: 18°C-28°C
Relative humidity: no more than 80%

AC conversion is measured with true RMS

Measurement item	Range	Resolution	Accuracy
Phase voltage	85.0-265.0V	0.1V	±(1.0%+ 0.2V)
Peak voltage	121.0-374.0V	0.1V	±(1.0%+ 0.2V)
Frequency	45.0~65.0Hz	0.1Hz	±(1.0%+ 0.2Hz)
Voltage drop	0.1%~99.9%	0.1%	±(2.5%+ 0.2%)
Load voltage	10.0~265.0V	0.1V	±(2.5%+ 0.2V)
Voltage to earth of zero line	0.0~10.0V	0.1V	±(2.5%+ 0.2V)
Impedance for live line, zero line and earth line	0.00~3.00Ω	0.01Ω	±(2.5%+ 0.02Ω)
	>3.00Ω		No ensure the accuracy
RCD triggering time	1ms~6.500s	1ms	±(1.0%+ 2ms)
RCD triggering current	30mA~37mA	0.1mA	±(1.0%+ 0.2mA)
GFCI triggering time	1ms~6.500s	1ms	±(1.0%+ 2ms)
GFCI triggering current	6mA~9mA	0.1mA	±(1.0%+ 0.2mA)

Maintenance

Battery installation and replacement:

1) The analyzer is powered by six AAA batteries.
2) Cut off the power and pull out the test line.
3) Unscrew the battery compartment and open the cover.
4) Replace the batteries.
5) Ensure the batteries are installed properly
   (Do not mismatch polarity)
6) Put back the cover and tighten the screws.

Cleaning:

Use soft cloth and neutral cleanser to clean the housing.
Use of abrasive or organic solvent is not allowed.