GENERAL

TOOLSMART™

CONNECTED PRECISION

DIGITAL MULTIMETER

USER'S MANUAL

TS04

Please read this manual carefully and thoroughly before using this product.

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INTRODUCTION

Thank you for purchasing General Tools & Instruments' (General's) TS04 ToolSmart™ Digital Multimeter (DMM). Please read this user's manual carefully and thoroughly before using the instrument.

The DMM can be used as a standalone multimeter, or with General's free ToolSmart™ app running on your mobile phone. When used in concert with an iPhone® or Android™ smartphone, the DMM can stream—via Bluetooth®— to the phone all measurements it makes. The phone initiates the data transfer using the ToolSmart™ app, which can be downloaded from the iTunes® App Store or Google Play Store. The measurements can then be used to tag photos taken by the phone's camera. For example, the app can apply current readings to icons of different AC outlets in a rendering of a room as a way to compare their efficiency.

KEY FEATURES

- 10 functions, 26 ranges
- Measures AC/DC voltage, AC/DC current, resistance and surface temperature
- Also checks continuity, diode integrity and battery voltage
- Non-contact voltage (NCV) detector
- ETL certified safe for CAT III 600V use
- True RMS measurements
- 2 in. (51mm) diagonal, 3-3/4 digit (4000 count) LCD with 3/4 in. (19mm) high digits
- Powered by "9V" battery (included)
- Low battery indication

WHAT'S IN THE PACKAGE

The meter is supplied in a display box along with a pair of double-insulated test lleads, a bead thermocouple probe and plug adapter, and a "9V" battery.

PRODUCT OVERVIEW

Fig. 1 shows the labels and positions of the controls, LCD and physical structures of the meter. Fig. 2 shows all possible indications on the LCD. Familiarize yourself with the functions and meanings of all controls, indications and connectors before moving on to the safety, setup and operating instructions.

1. **LCD**
2. **Activates Bluetooth** transmission
3. **Range selector**. Selects Autoranging or Manual Ranging mode and specific manual range, if manual ranging is selected (see page 8)
4. Four-function **FUNC** button. 1) Toggles between AC and DC measurement with the rotary dial in the $\tilde{V}$, $\tilde{\mu}A$, $\tilde{m}A$ or $\tilde{A}$ position. 2) Selects resistance measurement, continuity checking or diode checking with the rotary dial in the Ω position. 3) Toggles between ºC and ºF units with the rotary switch in the **TEMP** position. 4) Disables the meter's Auto Power Off function when pressed and held while moving the rotary function switch out of the **OFF** position.

Fig. 1. The DMM's controls, indicators and physical features

5. **Data hold** button. "Freezes" the display when pressed. Cancels the hold function when pressed again.
6. **Rotary switch**. Selects the meter's primary function.
7. **A** input jack
8. **COM** input jack
9. TEMP mAμAVΩ main input jack (for all functions except measuring current >400mA)
10. **NCV sensor and visual indicator** (red LED)
11. **Battery compartment cover**/flip-up stand (on back)

1. Indicates DC voltage or current measurement
2. Indicates AC voltage or current measurement
3. Negative polarity indicator
4. Bluetooth enabled indicator
5. Indicates Auto power off function is enabled
6. Low battery indicator
7. Indicates detection of non-contact voltage
8. Autoranging mode indicator
9. Indicates LCD is showing maximum session value
10. Indicates LCD is showing minimum session value
11. Indicates data is being held
12. Diode check mode indicator
13. Continuity check mode indicator
14. Measurement units
15. Measured value

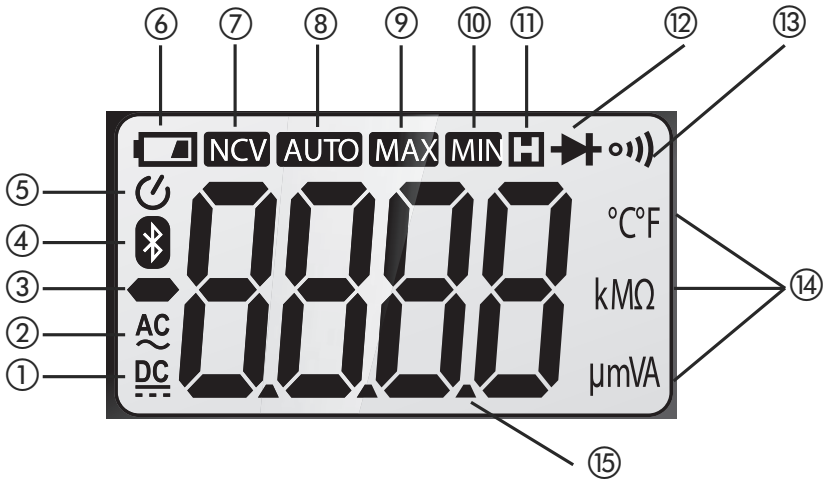


Fig. 2. All possible display indications

SAFETY INSTRUCTIONS

⚠⚠ Warning ⚠⚠

To avoid possible electric shock or personal injury, and to avoid damaging the meter or the equipment under test:

- Before using the meter, inspect the case. Do not use the meter if it is damaged. Look for cracks or missing plastic. Pay particular attention to the insulation around the connectors.
- ⚠**WARNING** Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before using the meter.
- Verify the meter's operation by measuring a known voltage. Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.

- ⚠**WARNING** Do not apply more than the rated voltage, as marked on the meter, between the TEMP mAμAVΩ and **COM** jacks or between any jack and ground. Also do not input more than the rated current, as marked on the meter, through the **A** jack.
- ⚠**WARNING** Do not measure voltages above 600V in Category III installations.
- ⚠**WARNING** Do not attempt to measure voltage with the rotary function switch in any position other than $\tilde{\overline{V}}$. Never attempt to measure current with the rotary function switch in any position other than $\tilde{\overline{\mu A}}$, $\tilde{\overline{mA}}$ or $\tilde{\overline{A}}$.
- Use caution when working with voltages above 42VAC$_{RMS}$, or 60VDC. These voltages pose a shock hazard.
- ⚠**WARNING** Do not operate the meter around explosive gas, vapor, or dust.
- ⚠**WARNING** When using the probes, keep your fingers behind the finger guards. Do not touch the metal probes of the test leads when making a measurement.
- When making connections, connect the black (–) test lead before connecting the red (+) test lead; when disconnecting, disconnect the red (+) test lead before disconnecting the black (–) test lead.
- Disconnect circuit power and discharge all high-voltage capacitors before measuring/testing resistance, continuity or diodes.
- For all DC functions in both auto and manual ranging mode, to avoid the risk of shock due to possible improper reading verify the presence of any AC voltages by first using the AC function. Then select a DC voltage range as wide or wider than the AC range.
- Before measuring current, turn off power to the circuit before connecting the meter.
- Do not operate the meter with the case (or part of the case) removed.
- Replace the battery as soon as the low battery indicator appears. Operated with a weak battery, the meter might produce false readings that could lead to electric shock and personal injury.
- Remove the test leads from the meter before opening the meter case or battery compartment.

Electrical Symbols Used On the Meter and In This Manual

Symbol	Description	Symbol	Description
	AC (Alternating Current)		Fuse
	DC (Direct Current)		Double-insulated
	Caution, risk of electric shock. Hazardous voltage.		Risk of danger. Important information. Refer to the manual.
	Low battery indication		Earth ground
	Diode		Continuity beeper
	AC or DC	Ω	Resistance
CAT III	For measurements made on building equipment such as distribution panels, feeders and short branch circuits, and on lighting systems in large buildings.		

SETUP INSTRUCTIONS

INSTALL BATTERY

Turn the meter over to gain access to the battery compartment.

To open the compartment:

1) Use a small Phillips-head screwdriver to remove the single screw in the middle of the one-piece battery compartment cover/flip-up stand.
2) Remove the cover/stand and set it aside.
3) Plug the "9V" battery included in the package into the wired socket inside the compartment. The terminals of the battery and the socket mate in only one way, with the smaller male terminal plugging into the larger female terminal.
4) Secure the battery compartment by replacing the cover/stand and reinstalling and tightening the Phillips-head screw.

OPERATING INSTRUCTIONS

GENERAL INSTRUCTIONS

All parameters are measured through the included test leads. Unless you are measuring currents larger than 400 mA, plug the red test lead into the TEMP mAμAVΩ jack and the black test lead into the **COM** jack. To measure currents larger than 400 mA, plug the red lead into the **A** jack (Fig. 1, Callout 7) and the black lead into the **COM** jack.

HOLDING READINGS

Pressing the **HOLD** button "freezes" any measurement on the LCD and causes the symbol H to appear on the top line. Pressing the button again releases the hold, removes the symbol and resumes real-time measurements.

CHOOSING A MEASUREMENT RANGE

By default, the DMM automatically enters Auto Ranging mode when powered on. In this mode, it chooses the measurement range that maximizes the resolution of its current, voltage and resistance measurements. The term **AUTO** on the top line of the LCD indicates operation in Auto Ranging mode.

To switch to Manual Ranging mode for any parameter, briefly press the **RAN** button. This will make the **AUTO** term disappear and cause the meter to enter the widest full-scale range available for that parameter (see the Specifications section beginning on p. 14 for a list of the measurement ranges available for voltage, current and resistance).

Once the meter is in manual ranging mode, each subsequent brief press of the **RAN** button typically narrows the full-scale range by an order of magnitude (a factor of 10). For example, briefly pressing the **RAN** button with the meter operating in the 0 to 40V full-scale manual range reduces the full-scale range to 0 to 4V (and improves measurement resolution). The next press of the button reduces the range to 0 to 400mV. When the narrowest full-scale range has been reached, the next press of the **RAN** button switches the meter back to the largest full-scale manual range for the selected parameter.

To exit Manual Ranging mode and return to Auto Ranging mode, press and hold the **RAN** button.

DISABLING AUTO POWER OFF

By default, the DMM will automatically power itself off following any period of 15 minutes of front-panel inactivity. The ↻ icon at the upper left of the LCD indicates that the Auto Power Off function is enabled. **To disable the APO function**, press and hold the **FUNC** button while powering on the meter by moving the rotary function switch to any position other than **OFF**. This will cause the ↻ icon to disappear.

MEASURING AC OR DC VOLTAGE

⚠⚠ Warning ⚠⚠

Do not measure any AC or DC voltage higher than 600V. Doing so may damage the meter's internal circuitry.

(1) Turn the rotary switch to the V̄ position. By default, doing so will prepare the DMM to measure DC rather than AC voltage, indicated by the presence of the DC icon at the lower left of the LCD. If you are certain that the voltage you want to measure is DC voltage, proceed to Step (2).

If you know that the voltage you want to measure is AC voltage, press the **FUNC** button once; this will cause the AC icon to replace the DC icon on the left side of the LCD. If you are unsure whether the voltage to be tested is AC or DC, configure the DMM to measure AC voltage for safety reasons.

(2) Plug the black test lead into the front-panel **COM** jack and the red test lead into the TEMP mAμAVΩ jack.

(3) Touch the black test lead to the lower-potential point of the circuit under test, and the red test lead to the higher-potential point.

(4) Read the measured voltage on the display. If you are working in Manual Ranging mode and the readout is **.OL**, the voltage level is beyond the currently selected range. If that is the case, use the **FUNC** button to select the next-widest position. When measuring DC voltage, if the test leads are reversed a minus sign will appear at the left of the readout.

MEASURING AC or DC CURRENT

⚠⚠ Warning ⚠⚠

Do not attempt to measure: 1) currents larger than 400mA through the TEMP mAμAVΩ jack; 2) currents larger than 10A through the **A** jack; or 3) currents larger than 2A through the **A** jack for more than 2 minutes continuously; pause 10 minutes after each measurement of such a large current.

(1) Remove power from the circuit to be tested and discharge all high-voltage capacitors.

(2) Turn the rotary switch to the Ã, m̃A or µ̃A position,, depending on the amplitude of the current you expect to encounter. If you are unsure of the amplitude, select the **10A** position first and then switch to the m̃A or µ̃A position if all of your measurements are less than 400mA.

(3) By default, the DMM is initially configured to measure DC rather than AC current, indicated by the presence of the DC icon at the lower left of the LCD. If you are certain that the current you want to measure is DC current, proceed to Step (4).

If you know that the current you want to measure is AC current, press the **FUNC** button once; this will cause the AC icon to replace the DC icon on the left side of the LCD. If you are unsure whether the voltage to be tested is AC or DC, configure the DMM to measure AC voltage for safety reasons.

(4) Plug the black test lead into the black **COM** jack at the bottom left of the front panel.

(5) Plug the red test lead into the **A** or TEMP mAµAVΩ jack. Choose the **A** jack if you have set the rotary switch to the Ã position, and the TEMP mAµAVΩ jack if you have set it to the m̃A or µ̃A position.

(6) Break the circuit and touch the red lead to the higher-voltage side of the break and the black lead to the lower-voltage side.

(7) Re-apply power to the circuit and observe the display. If you are working in Manual Ranging mode and the display shows **O.L**, the current amplitude is beyond the selected current range. If that is the case, use the **FUNC** button to select the next-widest position. If the readout is a negative value, the leads are reversed but the absolute value represents a valid measurement of current amplitude.

(8) Remove power from the circuit and discharge all high-voltage capacitors.

(9) Remove the test leads and restore the circuit to its original condition by eliminating the break you made in Step 6.

MEASURING RESISTANCE

⚠⚠ Warning ⚠⚠

To avoid electrical shock or damage to the meter when measuring resistance, turn off all power to the circuit and discharge all high-voltage capacitors.

(1) Turn the rotary switch to the position and press the **FUNC** button until **Ω**, **kΩ** or **MΩ** appears on the right side of the LCD.

(2) Plug the black test lead into the front-panel **COM** jack and the red test lead into the TEMP mAμAVΩ jack.

(3) Measure the resistance by touching the test leads to the desired test points of the circuit or to the terminals of a component, as shown below.

(4) Read the measured resistance on the display. If you are working in Manual Ranging mode and the readout is **.OL**, the resistance value is beyond the currently selected range. If that is the case, use the **FUNC** button to select the next-widest position.

MEASURING TEMPERATURE

The DMM includes a "K" type bead thermocouple probe for measuring surface temperatures. To use it,

(1) Insert the **+V** plug of the plug adapter to which the thermocouple is attached into the TEMP mAμAVΩ jack.

(2) Insert the **COM** plug of the plug adapter into the **COM** jack of the DMM.

(3) Turn the rotary switch to the **TEMP** position.

(4) Press the **FUNC** button until your preferred temperature measurement unit—**ºF** or **ºC**—appears on the right side of the LCD.

(5) Attach the bead probe to the surface whose temperature you wish to measure. The reading will be shown on the LCD.

CHECKING FOR CONTINUITY

⚠⚠ Warning ⚠⚠

To avoid possible damage to the meter or other equipment, turn off the power source and discharge all high-voltage capacitors.

(1) Turn the rotary switch to the position and press the **FUNC** button until the icon appears in the upper right corner of the LCD.

(2) Plug the black test lead into the **COM** jack and the red test lead into the TEMP mAμAVΩ jack.

(3) Touch the test leads to any two points of the circuit. The resistance between those two points will be displayed. If the resistance is <50Ω, the beeper will sound continuously. If there is no continuity (an open circuit or a resistance >50Ω) between the two points, **OL.** will appear on the readout.

CHECKING THE INTEGRITY OF A DIODE

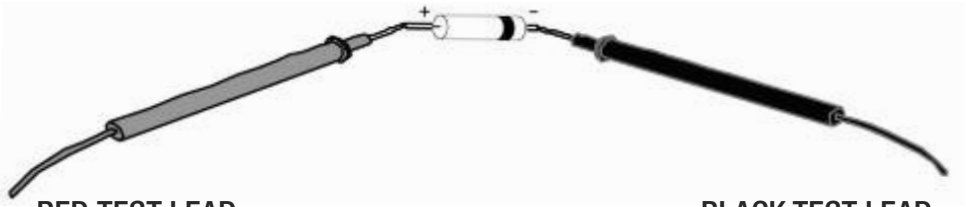
⚠⚠ Warning ⚠⚠

To avoid possible damage to the meter or other equipment, turn off the power source and discharge all high-voltage capacitors.

(1) Turn the function switch to the position and press the **FUNC** button until the icon appears in the upper right corner of the LCD.

(2) Plug the black test lead into the front-panel **COM** jack and the red test lead into the TEMP mAμAVΩ jack.

(3) Touch the red test lead to the anode (positive terminal) of the diode to be tested and the black test lead to its cathode (negative terminal), as shown below.



RED TEST LEAD BLACK TEST LEAD

(4) Read the diode's forward bias voltage drop on the display. A silicon diode typically has a forward voltage drop of 0.7V. A germanium diode typically has a forward voltage drop of 0.3V. A **0V** reading in both directions indicates a shorted diode. A readout of **.0L** means either of two things: the leads are reversed, or the diode is defective. Reverse the leads. If this still produces a readout of **.0L**, the diode is defective and should be replaced.

CHECKING BATTERY VOLTAGE

⚠⚠ Warning ⚠⚠

To avoid possible electrical shock or damage to the meter, do not apply a voltage greater than 600V between the meter's TEMP mAμAVΩ and **COM** jacks.

(1) Turn the rotary switch to the **9V** or **1.5V** position, corresponding to the nominal voltage of the battery to be tested.

(2) Plug the black test lead into the **COM** jack and the red test lead into the TEMP mAμAVΩ jack.

(3) Touch the red test lead to the battery's anode (+ terminal) and the black test lead to its cathode (– terminal). The battery's voltage will appear on the display.

USING THE NCV DETECTOR

To check whether a line, cable or AC outlet is "hot" (energized), touch it with the top of the meter or bring the top within 1/4 inch of it after moving the rotary function switch to the **NCV** position. If the beeper sounds repeatedly and the red LED at the top of the meter (Fig. 1, Callout 10) flashes rapidly, the line or outlet is carrying at least 110VAC_{RMS}.

USING THE DMM WTH THE ToolSmart™ APP AND AN APPLE iOS OR ANDROID SMARTPHONE

To stream measurements and calculations made by the DMM to an Apple iOS or Android smartphone, begin by downloading the ToolSmart™ app from the iTunes Store or Google Play Store to your mobile device.

Once you have downloaded the app, install it. Then, pair the DMM and your phone by activating Bluetooth on your phone and pressing the ᛒ button on the DMM.

A tutorial on the app explains how to save DMM measurements to your phone and overlay them on photos of your project taken by the phone's camera.

SPECIFICATIONS

Parameter or Feature/Function	Attribute	Specification
AC voltage	Measurement ranges	0 to 4V/40V/400V/600V
	Measurement accuracy	±(1% of reading + 10 digits)
	Maximum resolution	1mV
DC voltage	Measurement ranges	0 to 400mV/4V/40V/400V/600V
	Measurement accuracy	±(0.8% of reading + 5 digits) in 600V range; ±(0.5% of reading + 2 digits) in other ranges
	Maximum resolution	0.1mV
AC or DC current	Measurement ranges	0 to 400uA/4mA/40mA/400mA/10A
	Measurement accuracy	±(2% of reading + 3 digits) in 10A range; ±(1.2% of reading + 6 digits) or better in other ranges
	Maximum resolution	0.1μA
Resistance	Measurement ranges	0 to 400Ω/4kΩ/40kΩ/ 400Ω/4MΩ/40MΩ
	Measurement accuracy	±(0.8% of reading + 3 digits), typical)
	Maximum resolution	0.1Ω
Temperature	DMM measurement range	-4º to 1832ºF (-20º to 1000ºC)
	DMM measurement accuracy	±(2.0% of reading + 2 digits)
	Measurement range of included thermocouple	-4° to 500°F (-20° to 260°C)
	Measurement accuracy of Included thermocouple	±(2% + 2 digits)
Continuity	Open circuit voltage	1V
	Threshold	<50Ω
Diode integrity	Range	0 to 2.7V
	Resolution	1mV

Parameter or Feature/Function	Attribute	Specification
Battery voltage	Measurement ranges	0 to 9V, 0 to 1.5V
	Measurement accuracy	±(0.8% of reading + 7 digits) in **9V** position; ±(3% of reading + 5 digits) in **1.5V** position
	Max resolution	1mV
Safety rating		CAT III 600V
NCV detection voltage & distance		>110VAC$_{RMS}$ @ <1/4 in. (6mm)
Bluetooth range		33 ft. (10m)
Maximum input voltage		600VDC/AC$_{RMS}$
Fuse protection		400mV/600V fuse for TEMP mAμAVΩ jack; 10A/600V fuse for **A** jack
Sampling time		3X/sec
Display	No. of digits	3-3/4
	Maximum count	4000
Low battery indication threshold		<6.7VDC
Operating temperature		32° to 104°F (0° to 40°C) @<80%RH
Power source		(1) “9V” battery (included)
Dimensions		5.8 x 2.9 x 2.0 in. (148 x 74 x 50mm)
Weight (including battery)		8.2 oz. (232g)

Note: Accuracy values are stated for an operating temperature between 64° and 82°F (18° and 28°C) with RH<80%. Accuracies are lower outside this range, in proportion to the actual operating temperature's distance from the “sweet spot.”

OPERATING & MAINTENANCE TIPS

When the icon appears in the upper left corner of the LCD, immediately replace the meter's "9V" battery by following the instructions on page 7.

To replace a blown fuse:

1. Power off the meter.
2. Unplug the test leads.
3. Turn the meter over and loosen the small Phillips-head screw in the middle of the back that secures the meter's battery compartment cover. Remove the cover, taking care not to lose the screw.
4. Remove the meter's gray rubber holster by carefully pulling its front lip over the housing, starting at the top and working your way around the perimeter to the bottom.
5. Remove the four larger Phillips-head screws that secure the two halves of the housing and pull the two halves apart.
6. Locate the blown fuse on the circuit board (see photo at right). The DMM uses two different white cylindrical fuses. The TEMP mAμAVΩ jack is protected by an F400mA/600V fuse. The **A** jack is protected by an F10A/600V fuse. Each fuse is located directly behind the jack it protects.
7. Using another multimeter or a continuity checker, verify that the suspected blown fuse produces a resistance reading consistent with an open circuit.
8. Replace the blown fuse by a fuse with the same current and voltage ratings.
9. Rejoin both halves of the housing by replacing and tightening its four screws.

Where to find the DMM's cylindrical white ceramic fuses

10. Replace the battery compartment cover and tighten its screw.
11. Replace the gray rubber holster.

After subjecting the meter to a large change in ambient temperature, wait at least 30 minutes before making measurements to guarantee the accuracy of readings.

Remove the battery when storing the meter or when you do not expect to use it for an extended period of time (months rather than weeks).

Do not disassemble the meter or immerse it in water.

WARRANTY INFORMATION

General warrants its instruments and accessories, and digital tools products against defects in material or workmanship for one year from the date of purchase unless otherwise stated on the packaging, manual, and/or marketing materials. General also warrants its non-digital tools products against defects in material or workmanship on a limited lifetime term.

General will replace or repair the defective unit, at its option, subject to verification of the defect.

This warranty does not apply to defects resulting from abuse, neglect, accident, unauthorized repair, alteration, or unreasonable use of the product. It also does not cover products purchased from unauthorized distributors. A proof of purchase must accompany each warranty claim.

Any implied warranties arising from the sale of a General product, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited to the above. General shall not be liable for loss of use of the product or other incidental or consequential damages, expenses, or economic loss, or for any claim of such damage, expenses, or economic loss.

State laws vary. The above limitations or exclusions may not apply to you.

FCC STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to a different circuit than the one the receiver is connected to.
- Consult your supplier or an experienced radio/TV technician for help.

Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTES