Cat. No. 22-216

# OWNER'S MANUAL

Please read before using this equipment.

## Auto Range Analog Meter

Radio Shack®

# FEATURES

Your Radio Shack Auto-Range Analog Meter is a high-sensitivity analog multitester, ideally suited for field, lab, shop, and home applications. The features listed here make the multitester easy to use and ensure accurate and reliable operation.

**Auto Range Control** — automatically selects the measurement range, freeing you to concentrate on placing the test probes and taking a reading.

**Manual Range Control** — lets you manually select the range when you know the approximate measurement.

**4 1/8-Inch, Mirrored, Three-Color Scale** — simplifies accurate readings.

**Built-In Diodes and Fuse** — protect meter movement and other internal parts in case of improper function selection.

**Audible Continuity Function** — sounds a built-in buzzer when there is continuity.

**Carrying Handle** — can be flipped to the back to support the meter at an easy-to-read angle.

**Note**: You need four 1.5-volt AA batteries (not included) to operate this multitester.

**WARNING:** USE EXTREME CAUTION IN THE USE OF THIS DEVICE. IMPROPER USE OF THIS DEVICE CAN RESULT IN INJURY OR DEATH. FOLLOW ALL SAFEGUARDS SUGGESTED IN THIS OWNER'S MANUAL IN ADDITION TO NORMAL SAFETY PRECAUTIONS IN DEALING WITH ELECTRICAL CIRCUITS. DO NOT USE THIS DEVICE IF YOU ARE UNFAMILIAR WITH ELECTRICAL CIRCUITS AND TESTING PROCEDURES.

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# A WORD ABOUT SAFETY

We have taken every precaution in designing and manufacturing this meter to ensure that it is as safe as we can make it, but safe operation depends on you, the operator. We recommend that you follow these simple safety rules:

- Never apply voltages to the meter that exceed the limits given in the specifications. Never apply more than 1000V DC or 1000V RMS AC between the input jack and the –COM jack.
- Use extreme caution when working with voltages above 30 Volts AC or 60 Volts DC. Always disconnect power from the circuit you are measuring before you connect the test probes to high-voltage points.
- Never connect the test probes to a source of voltage when you select the resistance, continuity, or current mesurement functions.
- Always turn off the meter's power and disconnect the test probes before you replace the batteries or fuse.
- Never operate the meter unless the back cover is in place and fully closed.
- Because some AC/DC sets have a hot chassis, be sure that the top of your work bench and the floor underneath it are made of non-conductive materials.

The meter is fully calibrated and tested. Under normal use, no further adjustment should be necessary. If the meter should require repair, do not try to adjust it yourself; take it to your local Radio Shack store. Service by unauthorized personnel voids the warranty.

# SPECIFICATIONS

## RANGES

Voltage ..... 300 mV — 3V — 12V — 60V — 300V — 1000V AC or DC

Current ..... 300 mA — 3A AC or DC

Resistance 20 kOhm(x1) — 200 kOhm(x10) — 2 MOhm(x 0.1k) — 20 MOhm(x 1.0k) — 200 MOhm(x 10.0k) (Center Scale 200)

Decibel ..... -40 dB to +63 dB in 6 Ranges

## ACCURACY (Percent of Full-Scale Value)

DC Voltage ..... ±3%

AC Voltage ..... ±4%

DC Current ..... ±3%

AC Current ..... ±4%

Resistance (Percent of Full-Scale Length) ..... ±3%

## GENERAL

Input Impedance ..... 10 MOhms for DCV and ACV (Except mV Ranges)

Meter Movement ..... $4\frac{1}{8}$ -Inch, 3-Color, Mirrored Scale, 200 μA Full Scale

Buzzer Continuity ..... Less Than 300 Ω (Approximate)

Batteries ..... Four 1.5V AA Batteries (Cat. No. 23-582 or 23-552)

Minimum Battery Voltage ..... 2.2V

Test Leads ..... Banana Plug Style

Dimensions ..... $6\frac{11}{16} \times 4\frac{11}{16} \times 1\frac{9}{16}$ inches (170 × 120 × 40 mm)

Weight ..... 12.5 Ounces (360 g)

# CONTROLS AND FUNCTIONS

**Scales** — three-colored scale with mirror; green scale for resistance readings, black scale for volts and current readings, and red for decibel readings. The **RANGE** indicators located below the scale shows the currently selected range.

**ON/OFF Switch** — use to turn the tester on and off.

**Zero-Adjust Screw** — use to set the pointer exactly over the 0 at the left side of the V, A scale for voltage (AC, DC), current (AC, DC) and dB measurements.

**AUTO Switch** — use to switch between automatic ranging and manual ranging.

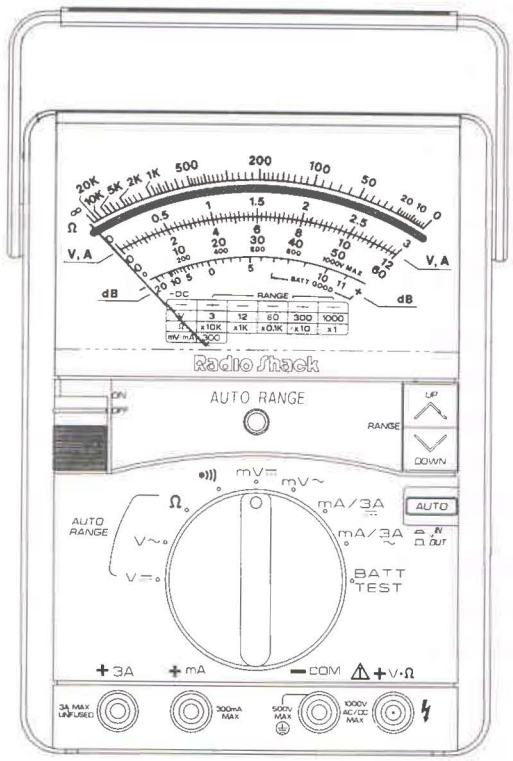
**RANGE UP and DOWN Buttons** — use to manually select the measurement range.

**–COM Jack** — plug in the black test lead here for all measurements. Do not connect this jack to any source of more than 500 volts with respect to earth ground.

**+V-Ω Jack** — plug in the red test lead here for AC and DC voltage measurements and resistance measurements. The maximum DC voltage measured here is 1000V DC. The maximum AC voltage measured here is 1000V AC.

**+mA Jack** — plug in the red test lead here for AC and DC current measurements up to 300 mA.

**+3A Jack** — plug in the red test lead here for AC and DC current measurements from 300 mA to 3A.



# SPECIAL PANEL MARKINGS

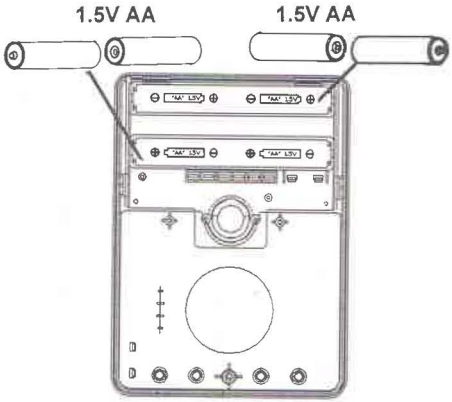
These special markings on the multitester's panel remind you of important measurement limitations and safety precautions.

| | |
|---|---|
| 500V MAX ⏚ | To avoid electrical shock and/or instrument damage, do not connect the common input terminal ( –**COM** jack) to any source of more than 500 volts with respect to earth ground. |
|  | Refer to the complete operating instructions. |
| 1000V AC/DC MAX | The maximum voltage between the **+V-Ω** jack and the –**COM** jack is 1000 VAC and 1000 VDC. |
|  | Be extra careful when making measurements for high voltage; do not touch terminals or test lead tips. |
| 300mA MAX | The maximum current measured between this terminal and the –**COM** jack is 300 mA. |
| 3A MAX UNFUSED | The maximum current measured between this terminal and the –**COM** jack is 3A. The terminal is not fuse-protected — overcurrent can damage the tester. |

**Note**: On the meter's function switch, ⎓ is for DC, ∼ is for AC, Ω is for ohms, and ))) is for continuity.

## INSTALLING/REPLACING THE BATTERIES

You need to install four AA batteries (Cat. No. 23-582 or 23-552) for measurements. Follow these steps to install fresh batteries.




1. Disconnect the test leads from the circuit you are measuring.
2. Set ON/OFF to OFF.
3. Open the cabinet by removing the screw from the back and remove the old batteries, if necessary.
4. Install the batteries as indicated by the polarity symbols (+ and –) in the battery compartment diagram.
5. Close the cabinet and replace the screw.

Replace the batteries if the meter's needle does not go to the BATT GOOD range when you turn on the meter and set the function selector to BATT TEST.

**Cautions:**

- Never leave weak or dead batteries in your tester. Even leak-proof batteries can leak damaging chemicals.
- Remove the batteries if you do not plan to use the tester for a week or more.

# REPLACING THE FUSE

The tester uses an internal fuse to prevent an accidental voltage/current overload. The fuse blows if voltage is applied when the tester is in the ohms, continuity, or current range (except the 3A range), or when excessive current is applied in the 300 mA range. When the fuse blows, the meter stops working.

**Warning:** To avoid electrical shock, disconnect the test leads from the circuit under test before removing the fuse.

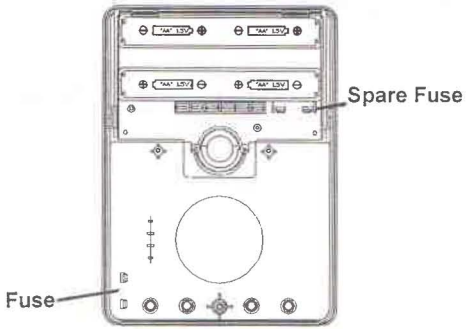
**Caution:** For continued protection, replace a blown fuse with a fuse of the same type and rating. We recommend a 0.5A/250V fast-blow type fuse, such as Cat. No. 270-1047.

To replace the fuse:

1. Disconnect the test leads from the circuit under test.
2. Set **ON/OFF** to **OFF**.
3. Open the tester cabinet by removing the screw from the back.

   There are two fuses in the tester. The circuit fuse is in the metal fuse holder on a board with a red ribbon ring around it. Check this fuse when the tester stops working.

   The spare fuse is inside the plastic enclosure in the battery compartment.
4. Remove the blown fuse by pulling the red ribbon ring.
5. Insert the replacement fuse with a red ribbon ring into the metal fuse holder.
6. Close the tester cabinet and replace the screw.



## METER READING

- Keep the tester on a flat, non-metallic surface for the most accurate readings.
- When using the manual range selection, select a setting that gives a reading in the upper ⅓ or ½ of the meter scale.
- When you read the scale, look at it from the point where the pointer and its reflection in the mirror come together.
- Read the scale that is appropriate to the function you select — green for resistance, black for voltage and current and red for decibels.

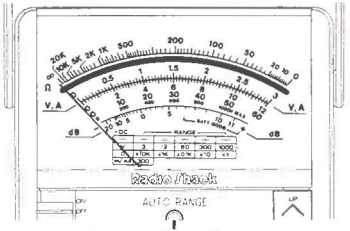
To read the scale, use the appropriate markings based on the selected range (as indicated by the lighted **RANGE** indicators).

| Use This Scale | For These Ranges: |
|---|---|
| 3 | 300 mV, 3V, 300V |
| 12 | 12V |
| 60 | 60V |
| 1000 | 1000V |
| | |

| For This Range: | Multiply Reading By: |
|---|---|
| x 10K | 10,000 |
| x 1K | 1,000 |
| x 0.1K | 100 |
| x 10 | 10 |
| x 1 | 1 |

## ZERO ADJUSTMENT

If the pointer does not normally rest exactly over the zero at the left side of the V, A scale, adjust the plastic zero adjust screw in the center of the tester face to bring the pointer to zero.




**Zero Adjust Screw**

## USING THE TEST LEADS

Use only the same type of test leads as those supplied with your tester. These test leads are rated for 1200 volts. Replacement test leads (Cat. No. 278-704) are available at your local Radio Shack store.

**Caution:** Although these test leads are rated for 1200 volts, the maximum rating of the tester is 1000V AC/DC. Do not attempt to measure any voltage greater than 1000V AC/DC.

Connect the black test lead to the –COM jack.

Connect the red lead to:

- The +V-Ω jack for making all AC and DC voltage and all resistance measurements, including continuity
- The +mA jack for current measurements up to 300 mA
- The +3A jack for current measurements from 300 mA to 3A

If you connect to a circuit using the wrong polarity, the negative indicator turns on and you still get a valid measurement.

**Warning:** Never allow your fingers to touch the bare metal portion of the test leads (or circuit points) during measurements.

**Caution:** Always disconnect the test leads when you have finished using the tester.

# RANGE SELECTION

You can select either manual or automatic range selection with your tester. In the automatic range mode, the tester automatically selects the range appropriate to the measurement you are making.

## Automatic Range Selection

Press AUTO so the button is *in* to select automatic ranging.

**When you select automatic ranging for DCV or ACV measurements,** the meter first sets the range to 3V. The meter automatically shifts to a higher range if required by the input voltage.

**When you select automatic ranging for resistance measurements,** the meter first sets the range to x10k (200 MOhm). The meter automatically shifts to a lower range if required by the input resistance.

The indicators below the meter scale show the selected range.

## Manual Range Selection

Press AUTO so the button is *out* to select manual ranging. Then press the RANGE UP and DOWN buttons to light the indicator for the range you want.

If you do not know the range to be measured, always start with the highest range.

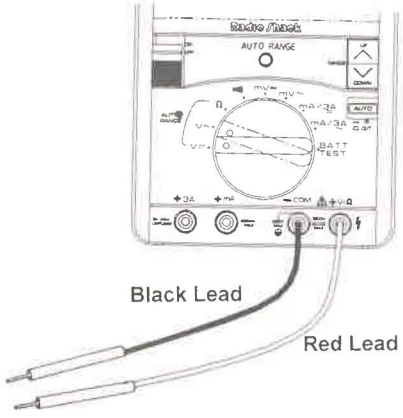
# VOLTAGE MEASUREMENTS

**Warning:** Use extreme care when making high-voltage measurements. Do not touch the terminal or test lead tips.

1. Plug the black test lead into the –**COM** jack.
2. Plug the red test lead into the **+V-Ω** jack.
3. Set **ON/OFF** to **ON**.
4. Set the function switch to **V~** or **V⎓** for voltages higher than 300 mV. Set the function switch to **mV~** or **mV⎓** for AC or DC voltages below 300 mV.

   **Note:** If you do not know the level of the voltage to be measured, start with the **V⎓** or **V~** position.
5. Select automatic or manual ranging (see "Range Selection").
6. Connect the test lead tips to the circuit to be tested, with the red lead to the positive supply and the black lead to the negative supply for DC measurements.

   **Note**: If you connect the leads in reverse polarity for a DC measurement, the –**DC** indicator turns on and you get a valid measurement.
7. Read the voltage on the appropriate scale.



**Hint:** When you use the tester to probe for a voltage in a high-voltage circuit, we recommend that you do not try to position both of the test leads at once. Instead, clamp one lead to the neutral or ground lead of the circuit, using Radio Shack insulated slip-on alligator clips (Cat. No. 270-354). Then probe for voltages with the other probe. This helps prevent you from accidentally touching a hot wire, since you need only concentrate on one test lead.

**Warning:** Never clamp to a hot wire. If you do and then touch the other probe connected to the tester, you could receive an electrical shock.

## AC Voltage Riding On a DC Source Bias Measurements

When measuring an AC voltage superimposed on a DC voltage source bias, set the function switch to AC~ .

## Measuring 3-Phase AC Voltages

We designed your meter to measure household AC voltage. It is not intended for commercial or industrial use. Please note the following about 3-phase line-to-line voltages.

**Warnings:**

- Because of the dangers inherent in measuring 3-phase circuits, do not use this meter for such applications. The actual voltage can be greater than the circuit's rated line-to-ground voltage.
- To determine the line-to-line voltage, multiply the rated line-to-ground voltage by 1.732 (the square root of 3).

  For example, if the rated line-to-ground voltage is 640 volts, the line-to-line voltage is:

  $640 \times 1.732 = 1108$ Volts

  This voltage exceeds the meter's rating and you should not connect the meter to this circuit.

## RESISTANCE MEASUREMENTS

**Warning:** Do not apply voltage to the test leads when the function selector is in the Ω (Ohms) position. Doing so causes the fuse to blow, and the tester stops working.

Before taking any resistance measurements, disconnect power to the unit under test and discharge any capacitors. Remove any batteries from the unit under test and unplug any line cords.

To make resistance measurements:

1. Plug the black test lead into the –COM jack and the red test lead into the +V-Ω jack.
2. Set **ON/OFF** to **ON**.
3. Set the function selector to the Ω (Ohms) position.
4. Select automatic or manual ranging (see "Range Selection").
5. Connect the test lead tips across the circuit or part under test.

   **Note:** When measuring resistance, disconnect one side of the component under test so the remainder of the circuit does not interfere with the readings.
6. Read the resistance on the appropriate scale.

When trying to identify the cathode and anode ends of a diode or the type of transistor (PNP or NPN), the actual polarity of the tester's voltage is the opposite of the test lead colors. The red test lead is the negative source and the black test lead is positive.

## CONTINUITY CHECK

Follow these steps to check for continuity in a wire or circuit.

1. Plug the black test lead into the **–COM** jack and the red test lead into the **+V-Ω** jack.
2. Set **ON/OFF** to **ON**.
3. Set the function selector to .
4. Touch the test lead tips together to check the built-in buzzer. If the buzzer does not sound, check the fuse and the batteries.
5. Connect the test leads to the unit under test. The meter shows the measured resistance.

   If resistance is between 0 and 300Ω, the built-in buzzer sounds.

   **Note:** The buzzer's sound level decreases as the resistance increases.

# CURRENT MEASUREMENTS

To measure current, you must break the circuit and connect the test leads in series with the circuit.

**Warning:** Do not apply voltages to the test leads when the function selector is set to the mA/3A (DC or AC) position. Doing so blows the fuse, and the tester stops working.

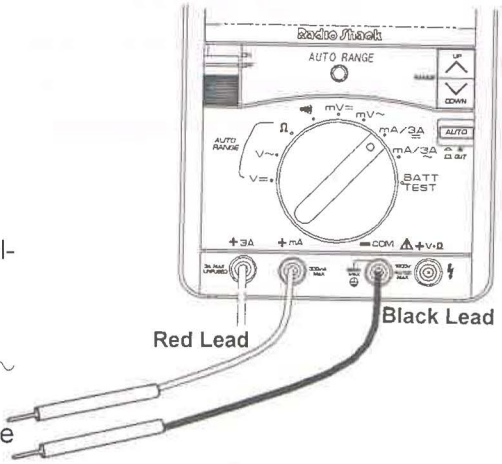
**Note:** The 3A range is not fuse-protected.

To make current measurements:

1. Set **ON/OFF** to **ON**.
2. Connect the red test lead to:
   - **+3A** for current over 300 mA and under 3A.
   - **+mA** for current of 300 mA or less.

   **Note**: If you do not know the level of the current to be measured, always start with the **+3A** jack.
3. Connect the black test lead to the **–COM** jack.
4. Set the function selector to **mA/3A**⎓ for DC current, or **mA/3A**∿ for AC current.
5. Remove power from the circuit under test and break the circuit at the appropriate point.
6. Connect the test leads in series with the circuit (black lead to negative and red lead to positive for DC measurement).

   **Note**: If you connect the test leads in reverse polarity for a DC measurement, the **–DC** indicator turns on and you get a valid measurement.
7. Apply power to the circuit under test.
8. Read the current on the appropriate scale.



## DECIBEL MEASUREMENTS

Follow these steps to measure decibels.

1. Set **ON/OFF** to **ON**.
2. Plug the black test lead into the **–COM** jack and the red test lead into the **+V-Ω** jack.
3. Set the function selector to **V~** .
4. Select either automatic or manual ranging (see "Range Selection").
5. Connect the test lead tips to the circuit under test.
6. Read the red dB scale, adding the appropriate number of decibels to the **dB** scale as noted below:

| Range | Add Number of dB |
|---|---|
| 300 mV | –20 |
| 3V | 0 |
| 12V | +12 |
| 60V | +26 |
| 300V | +40 |
| 1000V | +52 |

**Note:** For the most accurate decibel readings, the circuit impedance must be 600Ω.

0 dB = 1 milliwatt dissipated in a 600 Ohm impedance (equivalent to 0.775 volts across 600 Ohms).

# CARE AND MAINTENANCE

Your Radio Shack Auto-Range Analog Meter is an example of superior design and craftsmanship. The following suggestions will help you care for the meter so you can enjoy it for years.

Keep the meter dry. If it gets wet, immediately wipe it dry. Liquids can contain minerals that can corrode the electronic circuits.

Use and store the meter only in normal temperature environments. Temperature extremes can shorten the life of electronic devices, damage batteries, and distort or melt plastic parts.

Handle the meter gently and carefully. Dropping it can damage the circuit boards and cause the meter to work improperly.

Wipe the meter with a damp cloth occasionally to keep it looking new. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the meter.

Use only fresh batteries of the recommended size and type. Always remove old or weak batteries. They can leak chemicals that destroy electronic circuits.

Keep the meter away from dust and dirt, which can cause parts to wear prematurely.

Modifying or tampering with your meter's internal components can cause a malfunction and might invalidate the meter's warranty. If your meter is not performing as it should, take it to your local Radio Shack store for assistance.

## RADIO SHACK LIMITED WARRANTY

This product is warranted against defects for 90 days from date of purchase from Radio Shack company-owned stores and authorized Radio Shack franchisees and dealers. Within this period, we will repair it without charge for parts and labor. Simply **bring your Radio Shack sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover a product subjected to misuse or accidental damage.

EXCEPT AS PROVIDED HEREIN, RADIO SHACK MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

*We Service What We Sell*

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