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To become familiar with

- **MULTIMETERS AND THEIR RANGES**

Measuring Voltage and current with multimeter

Apparatus:

- Digital Multimeter
- Analog Multimeter
- Power supply

Multimeters

Multimeters are used for electrical measurement. They combine the capability of measuring voltage (Volts), resistance (Ohms) and Current (Amps). Some multimeters have additional features such as transistor testing and ranges for measuring capacitance and frequency. There are two types of Multimeters. Analog Multimeter, Digital Multimeters.



Analog Multimeter



Digital Multimeter

Multimeters are very useful test instruments. By operating a multi-position switch on the meter they can be quickly and easily set to be a **voltmeter**, an **ammeter** or an **ohmmeter**. They have several settings (called 'ranges') for each type of meter.

Measuring voltage and current with a multimeter

- For **Voltage** connect the leads of Multimeter in parallel with Load as shown in fig 1
- For **Current** connect the leads of Multimeter in series with Load as shown in fig 2
- **Select a range** with a maximum greater than you expect the reading to be.
- **Connect the meter**, making sure the leads are the correct way round.
Digital meters can be safely connected in reverse, but an analog meter may be damaged.
- **If the reading goes off the scale:** immediately disconnect and select a higher range.

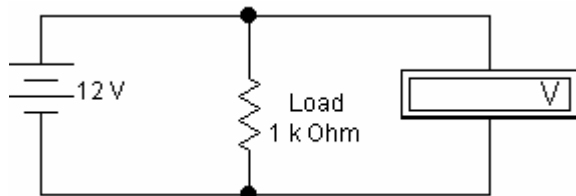


Fig.1 Measurement of Voltage

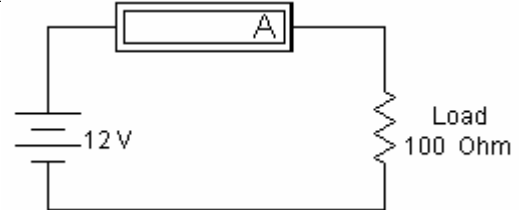


Fig.2 Measurement of current

Precautions

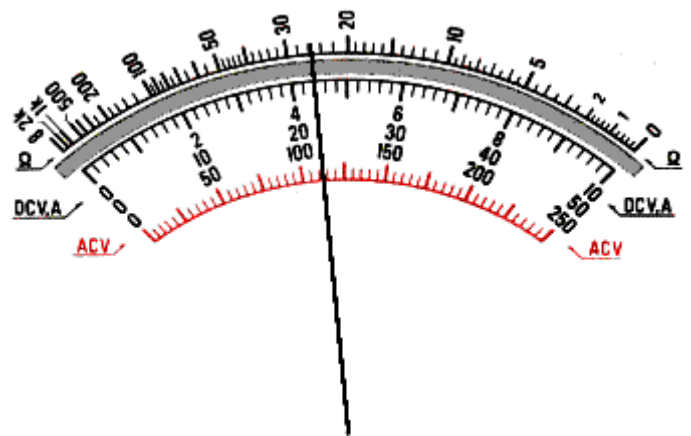
- Always disconnect the multimeter before adjusting the range switch.
- Always check the setting of the range switch **before** you connect to a circuit.
- Never leave a multimeter set to a current range (except when actually taking a reading).
Ammeter is always connected in series with load The greatest risk of damage is on the current ranges when connected in parallel.

Reading analog scales

Check the setting of the range switch and **choose an appropriate scale**. For some ranges you may need to multiply or divide by 10 or 100 as shown in the sample readings below. For AC voltage ranges use the **red** markings because the calibration of the scale is slightly different.

Sample readings on the scales shown:

- DC 10V range: 4.4V (read 0-10 scale directly)
- DC 50V range: 22V (read 0-50 scale directly)
- DC 25mA range: 11mA (read 0-250 and divide by 10)
- AC 10V range: 4.45V (use the red scale, reading 0-10)



Analog Multimeter Scales

Remember that you only need to read **one** scale at a time!
The top scale is used when measuring resistance.

Measuring resistance with a multimeter

To measure the resistance of a component it must not be connected in a circuit. If you try to measure resistance of components in a circuit you will obtain false readings (even if the supply is disconnected) and you may damage the multimeter.

The techniques used for each type of meter are very different so they are treated separately:

Measuring resistance with a DIGITAL multimeter

- Touch the meter probes together and check that the meter reads zero.
If it doesn't read zero, turn the switch to 'Set Zero' if your meter has this and try again.
- Set the meter to a resistance range greater than you expect the resistance to be.
Notice that the meter display shows "off the scale" (usually blank except for a 1 on the left). Don't worry, this is not a fault, it is correct - the resistance of air is very high!
- Put the probes across the component.
Avoid touching more than one contact at a time or your resistance will upset the reading!

Measuring resistance with an ANALOG multimeter

- Hold the meter probes together and adjust the control on the front of the meter which is usually labelled " 0Ω ADJ" until the pointer reads zero (on the RIGHT).
If you can't adjust it to read zero, the battery inside the meter needs replacing.
- The resistance scale on an analogue meter is normally at the top,
- Set the meter to a suitable resistance range.
Choose a range so that the resistance you expect will be near the middle of the scale.
- Put the probes across the component.
Avoid touching more than one contact at a time or **your** resistance will upset the reading.

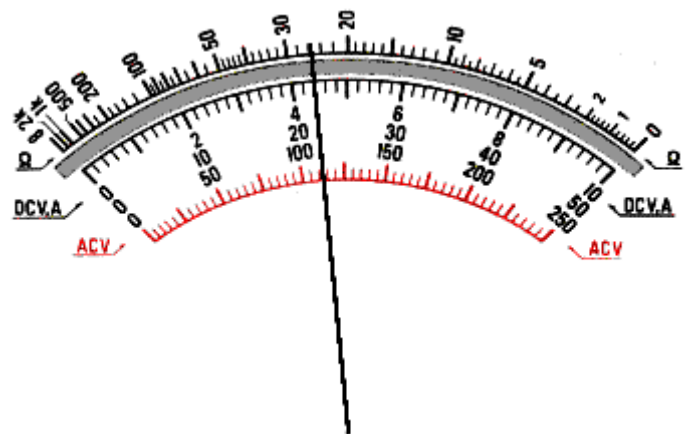
Reading analog resistance scales

- For resistance use the upper scale,
- Check the setting of the range switch so that you know by how much to multiply the reading.

Sample readings on the scales shown:

$\times 10\Omega$ range: 260Ω

$\times 1k\Omega$ range: $26k\Omega$



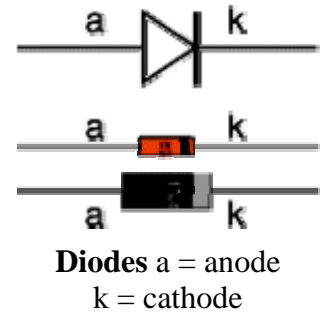
Analog Multimeter Scales

The resistance scale is at the top, note that it reads backwards and is not linear (evenly spaced).

Testing a diode with a multimeter

Testing a diode with a DIGITAL multimeter

- Digital multimeters have a special setting for testing a diode, usually labelled with the diode symbol.
- Connect the **red** (+) lead to the anode and the **black** (-) to the cathode. The diode should conduct and the meter will display a value
- Reverse the connections. The diode should NOT conduct this way so the meter will display "off the scale" (usually blank except for a 1 on the left).



Testing a diode with an ANALOG multimeter

- Set the analogue multimeter to a low value resistance range such as $\times 10$.
- It is essential to note that the polarity of analogue multimeter leads is reversed on the resistance ranges, so the **black** lead is positive (+) and the **red** lead is negative (-)! This is unfortunate, but it is due to the way the meter works.
- Connect the **black** (+) lead to anode and the **red** (-) to the cathode. The diode should conduct and the meter will display a low resistance (the exact value is not relevant).
- Reverse the connections. The diode should NOT conduct this way so the meter will show infinite resistance (on the left of the scale).

Observations:

S.No	Measurement	Scale selected	Reading on scale	Remarks (Measured Voltage) (multiplier/divider)	Digital Reading
1.	AC main supply				
2.	12V AC				
3.	12V DC				
4.	5V DC				

S.No	Voltage	Load Resistance	$I=V/R$	Scale selected	Reading on scale	Remarks Measured Current) (multiplier/divider)	Digital Reading
5.	12V DC						
6.	9V DC						
7.	5V DC						

Assignment. Explain the functions of Analog multimeter in your own word.