Radio Mechanics
Fourth Year

Module 3
Use me Up Before You Go Go
(Electronic Handtools and Test Instruments)

What this module is about

Do you know that practically all equipment need to be tested and measured? Common troubles of equipment cannot be identified without the use of tools and test instruments. This module was written to help determine problems and troubles that may arise from time to time as we continue studying electronics.

What you are expected to learn

When you have completed this module, you should be able to do the following:

1. Identify commonly used tools and electronic test instrument.
2. Explain the use of tools and test instruments.

How to learn from this module

Here are tips on how to use this module. These will guide you in studying the different lessons. I'm sure you will find these very helpful as you read through.

1. Read the objectives so you will know what you expect to learn from this module.
2. Be sure to work out each activity because each part prepares you for the next.
3. Answer the pretest before you go through the module to determine what you already know about the content. Use the key to correction at the back to check your answers but do this only after completing the module. Always answer the self-check after each activity to determine whether you understood what you read.
4. Read the lesson again if you were not able to answer the question correctly.

Before going through this module, try to answer the pretest. This will acquiant you with electronic handtools and test equipment. Good luck!

PRETEST

Directions: Read each statement carefully and choose the letter of the best answer. Write it on the blank before each number.

_____1. Use to cut soft wires and component parts.
a. long nose pliers
b. diagonal cutters
c. mechanical pliers
d. electrical pliers

_____2. It removes the insulator from the hook up wire.
a. soldering aid
b. soldering iron
c. wire stripper
d. desoldering tool

_____3. A tool used to solder and unsolder the components on a printed circuit board.
a. soldering gun
b. soldering iron
c. heat sink
d. low wattage soldering pencil

_____4. An instrument used to measure voltage.
a. ammeter
b. voltmeter
c. ohmmeter
d. watt meter

_____5. A handtool used in soldering high wattage equipment.
a. soldering lead
b. soldering iron
c. soldering pencil
d. soldering gun

_____6. An instrument used in measuring current.
a. ammeter
b. ohmmeter
c. voltmeter
d. wattmeter

_____7. What does V.O.M. mean?
a. volt ohmmeter
b. volt ohm milliameter
c. voltage ohmmeter
d. ammeter

_____8. An instrument used in measuring resistance.
a. voltmeter
b. wattmeter
c. ohmmeter
d. ammeter

_____9. A handtool used in desoldering components.
a. long nose pliers
b. diagonal cutter
c. electrical pliers
d. soldering pump

_____10. It must be observed when measuring DC voltage and DC current.
a. negative
b. positive
c. polarity
d. meter

Are you familiar with the different electronic handtools and test instruments? If not, you still have the chance to know it because as we go along, you are going to use all those tools and instruments.

Lesson 1

Commonly Used Tools and Electronic Test Instruments

Special tools and various test instruments were developed as a result of the problems encountered in locating, repairing, and replacing worn-out electronic parts. However, tools alone do not enable the technician to service or repair electronic equipment that has broken down completely or is performing inefficiently. Additional test instruments like different kinds of meters are necessary.

Radio and television service is primarily based on the proper use of tools and test instruments. It is therefore needed, that the technician knows the different sets of tools and test instruments and know how to use them. This lesson provides a comprehensive study of various testing instruments such as the ohmmeter, DC voltmeter, AC voltmeter, DC milliammeter and DC ammeter as well as the use of the different electronic tools such as the soldering iron, desoldering tool, pincers, standard screwdriver, flat file, adjustable wrench, socket wrench, pliers, long nose pliers, side cutter and phillip's screwdriver.

Electronic Tools and their Uses

Long nose pliers

Side cutter

Pliers

Standard Screwdriver

Adjustable wrench

Socket wrench

Soldering iron

Desoldering tool

1. *Soldering iron* - solders different component leads on printed circuit board (PCB).
2. *Desoldering tool*- desolders soldering leads from components
3. *Pincers* - gets components mostly in a deeper location of electronic equipment.
4. *Standard screwdriver* - tightens and loosens standard screws.
5. *Phillip's screwdriver* - tightens philip screw.
6. *Flat file* - smoothens the rough edges of PCB and cleans the soldering tip.
7. *Adjustable wrench* - loosens and tightens square and octagon nuts.
8. *Socket wrench* - tightens or loosens the octagon screw.
9. *Long nose pliers* - holds wire and component leads while soldering.
10. *Diagonal cutter* - cuts excess leads of components and wires.
11. *Ohmmeter* - measures resistance unit in ohms.
12. *DC voltmeter* - measures DC voltages in volts.
13. *AC voltmeter* - measures AC voltages in volts.

Activity 1

Cite at least two electronic activities you know and enumerate the tools and test instruments used.

Self-check:

1. How does a soldering iron differ from a desoldering tool?
2. List down at least three handtools which an electronic technician seldom uses.
3. Diagonal cutters and component are used to cut _____.
4. What is the difference between a Phillip's screwdriver and a standard screwdriver?
5. Where is the long nose pliers used?

Lesson 2

Testing Different Electronic Components

Measuring Resistance Using V.O.M. Procedures

1. Set the range selector to R x 1.
2. Connect the end of the negative and positive test probes.
3. Adjust the zero ohm adjuster to zero for accurate measurements.

4. Start measuring resistance.
5. **Note**: When change in range selector occurs, adjust the zero ohm adjuster to zero reading for accurate measurements.

Ohmmeter Reading

1. When the V.O.M. is set to its R x 1 position, read the scale directly.
2. If the instrument is operated on its R x 10 range, multiply the scale reading by 10.
3. Multiply the scale reading by 1,000 if the R x 1K range is used.
4. If the V.O.M. is operated on its R x 10K range, multiply the scale reading by 10,000.

VOM - Volt Ohm Milliammeter

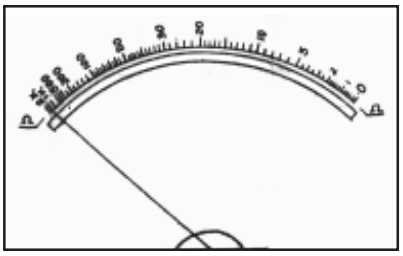
Range Selector
1. R x 1
2. K x 10
3. R x 100
4. R x 1K
5. R x 10K

Example: Read the pointer indicated by numbers in meter scale and multiply the reading by the setting of range selector.

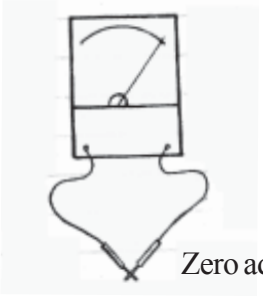
Example: 1. R x 1 = 160 x 1 = 160 Ω
2. R x 10 = 34 x 2 = 68 Ω

Ohmmeter

The ohmmeter is used to measure resistance. The topmost scale of a multimeter is for ohmmeter readings. It is shown in the figure below. Other scales are not shown to focus your attention only on the scale for reading resistance. Zero is located on the right side of the meter. Infinity is on the left side.

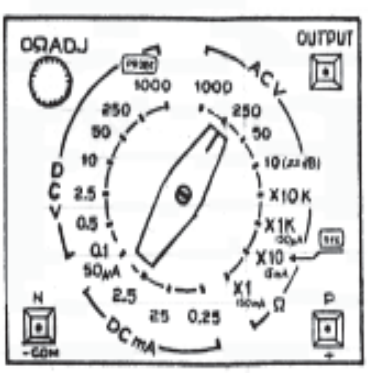


Two steps should be taken before making any resistance measurement. The first step is to select a proper range or multiplier in the function selector. The second step is to adjust the needle or pointer to zero reading. This is done by sorting together test prods and turning slowly the Ohms adjustment knob until the needle points to zero reading. Zero adjustment should be done on any multiplier range. This procedure ensures accuracy of measurement.



Zero adjustment

Sanwa YX-360 TR tester in our examples has been chosen on the basis of its popularity among technicians. There are four multiplier ranges in this Sanwa model: x1, x10, 1K and x 10K. The figure below shows these ranges.



The lowest range is x1. This range is used for measuring low resistances not exceeding 500 ohms. For resistance measurements of less than 1000 ohms x10 range is more accurate. If a higher multiplier range of x1K or x10K is used for this kind of resistance measurements it would appear as zero resistance. The opposite is true when very high resistances are being measured at low multiplier ranges of x1 and x10: it would seem to be open although it may not be the case. For resistance values not exceeding 100,000 ohms multipliers x 1K and x10K can be used either way.

In actual practice, the resistance of a good resistor measured by tester may not coincide with its resistance value indicated by the color on its body. This difference is due to what is called **tolerance**. A resistor is considered defective if the value of the resistor differs by more than 20% from its original color coded value.

Reading Exercises

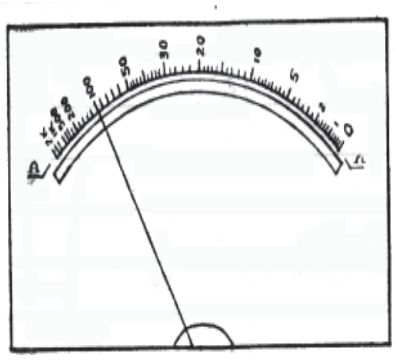


Figure A

Suppose we have a 100 ohms resistor which we would like to check. For this particular resistance range x1 or x10 can be used. Figure A and B show meter readings in both ranges.

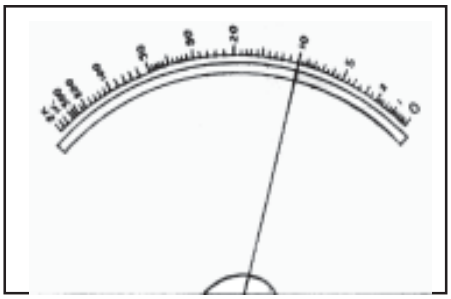
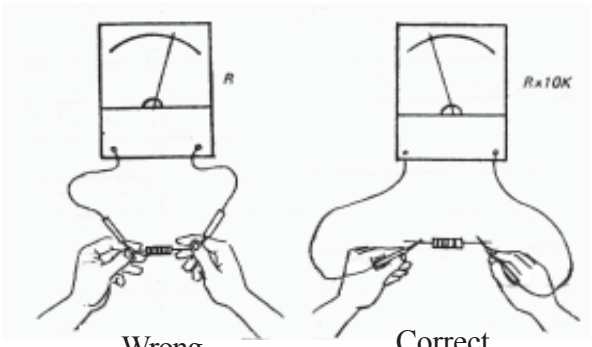


Figure B

In Figure A, the needle points to 100 ohms. This is direct reading because 100 multiplied by 1 equals 100. Figure B shows the needle pointed at number 10 which when multiplied by 10 also equals 100 ohms.

After these two examples you will be able to take measurements of higher resistances yourself. All you have to do is to multiply the reading on the scale by a multiplier to which the selector is set. Should you come across unknown values of resistors try different multiplier settings to determine actual resistance. More practice educates the user to decide quickly on the proper multiplier needed for a given value of a resistor.



Wrong Correct

A meter is highly sensitive when used to measure very high resistances. Care should be taken not to hold the metallic part of the test prods of the tester. Holding these parts of test prods with your fingers or both hands will render the test inaccurate and misleading because your body resistance will be parallel to the resistor or any other component you are testing. Figure C demonstrates human body resistance.

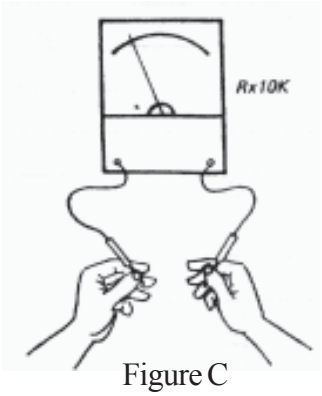


Figure C

When there is a need, a component under test may be held with one hand but make sure that the other hand does not touch the metallic part of the test prods. It would be best to lay the component on the table so that you could avoid holding it during the test. For low resistance test with 1x and x10 multipliers holding components with both hands is permitted because it will not affect measurements.

The ohmmeter can be used only for resistance or continuity tests. Its accidental use for measuring components under high voltage or electrical current will damage the meter. Before taking any resistance test on a radio under service make sure the power is off or unplug it. Another important thing to remember is to set the function selector to DC or AC when the ohmmeter is not used. This prolongs the life of the ohmmeter battery. In DC or AC functions, the battery is switched off. Prolonged shortening of tests prods when the meter is set to ohmmeter function will discharge the battery because it is in series with test prods. It is recommended that test prods are removed from the meter when it is not in use or is stored for safe keeping.

Measuring DC Voltage, AC Voltage and Current in DC

Procedure:

1. Set the range selector to the highest range if you are measuring "unknown" voltage. (1000V).
2. If you are measuring DC voltages, set your range selector to DCV ranges.
3. If you are measuring AC voltages, set your range selector to ACV ranges.

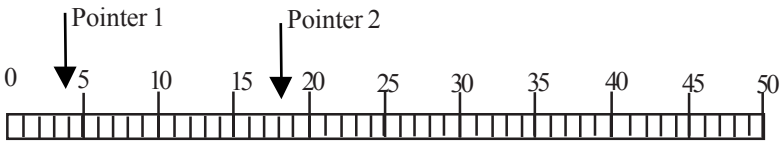
4. If you are measuring current, set your range selector to DCMA ranges.

When your range selector is set at the following selector ranges, the multipliers are as follows:

Range Selectors

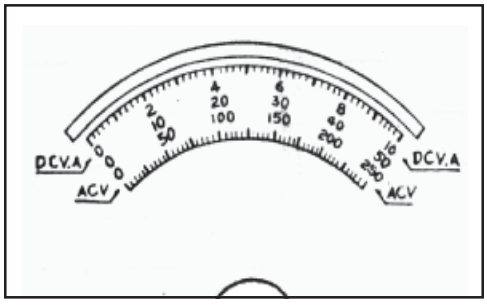
1000 V -multiply by 20 per line
500 V -multiply by 10 per line
250 V -multiply by 5 per line
50 V -multiply by 1 per line
25 V -multiply by .5 per line
10 V -multiply by .2 per line
5 V -multiply by .1 per line
2.5 V -multiply by .05 per line
1 V -multiply by .02 per line
.5 V -multiply by .01 per line
.1 V -multiply by .002 per line

Example:

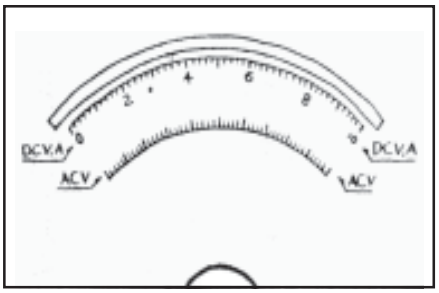


1. If your range selector is set to 500 V and your pointer deflects to 3rd line, 3 x 10 = 30 V.
2. If your range selector is set to 250 V and your pointer deflects to 18th line, 18 x 5 = 90 V.

The figure below shows three sets of scales used for AC and DC measurements. AC and DC voltages will be discussed later in the text. In the meantime do not bother with the type of voltage you are going to test.

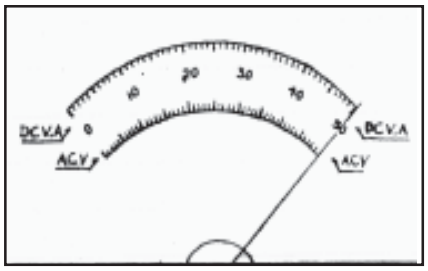


For voltage readings, zero is located on the left side of the voltmeter scale. The pointer of the meter rests on the left and moves towards the right. The voltage range selector indicates the maximum capacity of the voltmeter to measure such voltages. For example, in measuring voltages which are expected to be less than 10 volts the voltage selector can be set to range 10 V. The scale reading will be taken from 0-10 V scale.

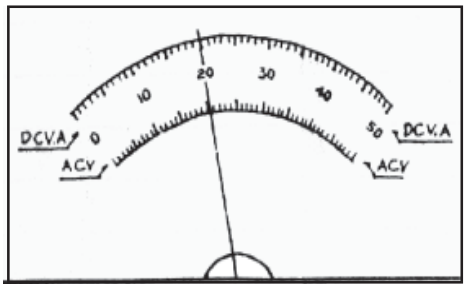


Similarly, if the expected voltage is less than 1000 volts the voltage selector should be set to 1000 V. The scale reading will be taken from 0-10 V scale.

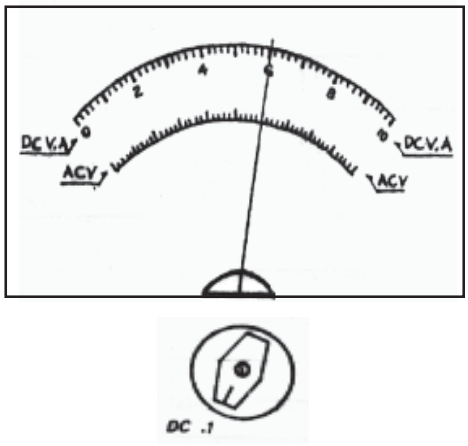
The next scale is 0-50. It is used for voltage reading of two different settings of the voltage selector on DC function. When the expected voltage is about 50 volts, the selector is set to 50 V range. The voltage reading in this case will be direct because the scale is equal to the voltage range setting. The figure below demonstrates the reading and the setting of the range selector.



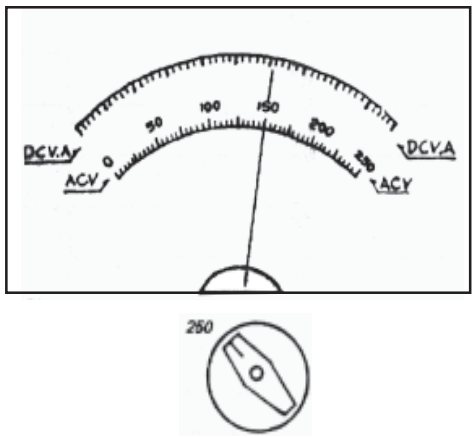
Another voltage range available on DC function is .5 volt. Reading is take from 0-50 V scale. The needle points at number 20 at scale. Thus the voltage reading is .2 volt.



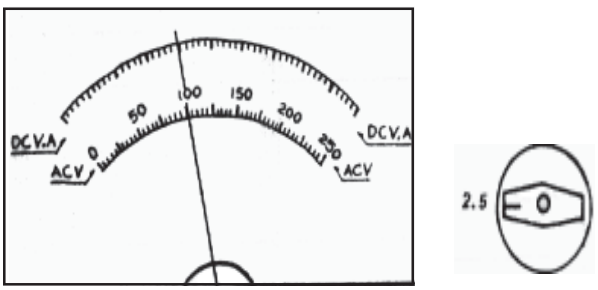
The lowest voltage range of the meter is .1 volt. The reading is taken from 0-10 V scale. The needle points at number 6 which means a reading of .06 volt.



The last scale we are going to deal with is 0-250V. There are two voltage selector settings that can be used for reading from this scale. If the expected voltage is less than 250 volts, the selector is set to 250 V and the reading can be directly taken from the scale. The reading is 150 volts.



The lower voltage setting is 2.5 volts. The same 0-250 V scale is used for voltage readings of this setting. The figure below shows an example of this voltage reading. The pointer is at 100 while the setting is 2.5 volts. The reading is 1 volt.



As to the AC function of the voltmeter, the lowest voltage selector setting is 10 V. Similar reading procedures are applied to AC voltages as for DC function. An important point to remember is that the type of voltage to be measured must correspond to the meter function. The meter will not work properly if the wrong function is set by mistake.

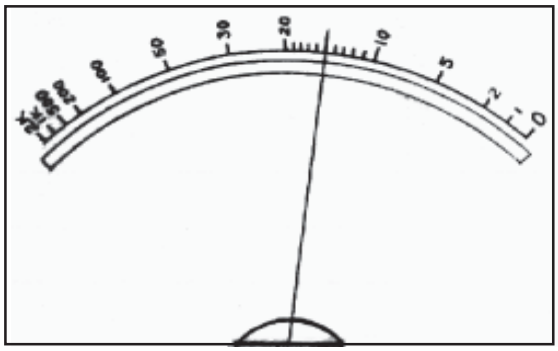
While measuring unknown voltages, it is best to set the voltmeter to the highest voltage setting. Very high voltage damages the meter if the applied voltage exceeds the voltage capacity set by the selector. If the meter does not respond to a higher setting lower, set the voltage of the selector gradually.

DCmA Meter

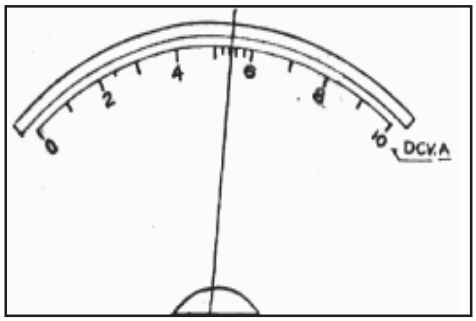
The direct current milliammeter (DC mA) is equally important in troubleshooting. It is used to measure small current flowing in a given circuit component. 0-250 scale is used to measure current. There are four selector settings to choose from. They range from 50 uA to 0.25 A. The procedure of reading the scale for current flow resembles the one for voltages. While interpreting current readings, bear in mind that 0.25 A (Ampere) is equal to 250 mA (milliampere) and 50 uA equals 0.05 mA.

Unnumbered Scale Divisions

Reading unnumbered divisions should be as easy as numbered scales. Looking closer at the ohmmeter scale, you can notice bigger divisions in bold lines and smaller divisions between them. The figure below shows the needle pointing between the bold marks of 10 and 20. If the pointer rests in any of the smaller grades without numbers, each division should be counted. In the example, the reading is 15. Since there are only 5 smaller grades between 10 and 15 each grade is counted as 1.



In the next example, there is a reading of a voltmeter scale. The needle is pointed at the second division after 5. Since there are only 5 grades between numbers 5 and 6, each small grade is counted by 0.2 volt. Thus the reading is 5.4 volts.



Activity 2

AC and DC Voltage Measurements

Materials Needed:

1 transformer
1 cord with plug
4 batteries 1.5 V each
1 V.O.M.
1 connecting wires

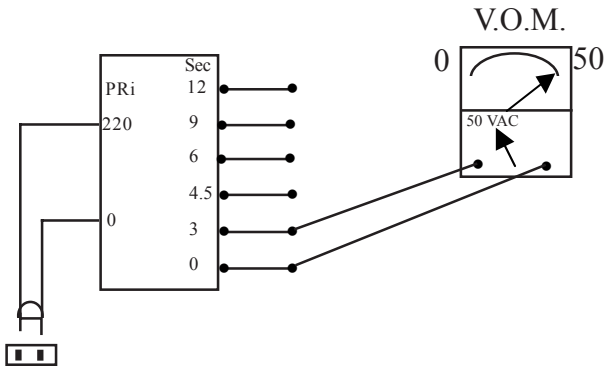
Procedure:

1. Prepare (1) transformer 750 mA, 3 to 12 volts, 220 VAC (PR1).
2. Connect the AC cord to the primary transformer, as shown below.
3. Measure the different secondary AC voltages and record the result in Table 1. Set the range selector to the 50 V AC range. Follow this combination in measuring AC voltages.

AC Voltage Measurements:

Table 1

Combinations	AC Secondary Voltages
0-3V	
0-4.5	
0-6.0	
0-9.0	
0-12.0	

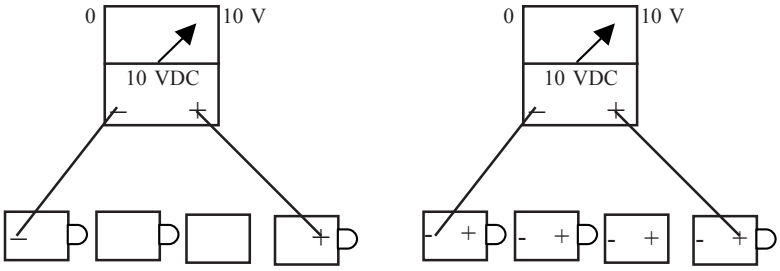


Transformer with AC cord connected to 220 VAC

DC Voltage Measurement

Table 2

Combinations	Measured Value DC Voltages
Series aiding Series opposing Parallel connection Series parallel Combination	

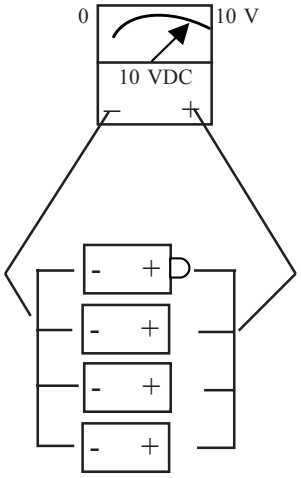


Series Aiding Series Opposing

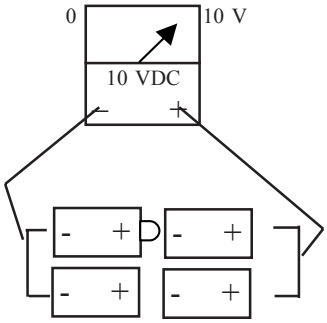
Procedure:

1. Set the range selector to 10 VDC.
2. Connect the batteries in series aiding, series opposing, parallel connection, and series parallel combination.

3. Measure the DC voltage as indicated. Observe correct polarity. Record the measured value in Table 2.
4. Do the same procedure in other combinations as shown below.



Parallel Connection



Series Parallel Combination

Self-check:

1. What is the difference between series aiding and series opposing when it comes to measured value?
2. Which is the normal connection of battery that we commonly use in our radio receiver?
3. What is the difference between primary and secondary AC voltages?
4. What is the purpose of using a transformer?

LET'S SUMMARIZE

Radio and television service work is based primarily on the proper use of meters. It is therefore essential that the technician knows the test instruments and how to use them. This module provides a comprehensive study of various types of testing and measuring instruments such as the ohmmeter DC voltmeter, AC voltmeter, DC micro-ammeter, DC milliammeter and DC ammeter.

Knowledge of the basic tools and instruments and their use gained from this module is essential to achieve success in your chosen career, whatever field of interest you choose. Radio and TV servicing, communication, industrial or computer electronics.

POSTTEST

Directions: Read each statement carefully and choose the letter of the best answer. Write it on the blank before each number.

_____1. Use to cut soft wires and component parts.
a. long nose pliers
b. diagonal cutters
c. mechanical pliers
d. electrical pliers

_____2. It removes the insulators from the hook up wire.
a. soldering aid
b. soldering iron
c. wire stripper
d. desoldering tool

_____3. Tool used to solder and unsolder the components on a printed circuit board.
a. soldering gun
b. soldering iron
c. wire stripper
d. desoldering tool

_____4. An instrument used to measure voltage.
a. ammeter
b. voltmeter
c. ohmmeter
d. wattmeter

_____5. A handtool used in soldering high wattage equipment.
a. soldering lead
b. soldering iron
c. soldering pencil
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_____7. What does V.O.M. mean?

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b. volt ohm milliameter
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_____8. An instrument used in measuring resistance.

a. voltmeter
b. wattmeter
c. ohmmeter
d. ammeter

_____9. A handtool used in desoldering components.

a. long nose pliers
b. diagonal cutter
c. electrical pliers
d. soldering pump

_____10. It must be observed when measuring DC voltage and DC current.

a. negative
b. positive
c. polarity
d. meter

KEY TO CORRECTION

Pretest / Posttest

1. b
2. c
3. d
4. b
5. d
6. a
7. b
8. c
9. d
10. c