TMK

INSTRUCTION MANUAL

for

MODEL 700B

MULTITESTER

CONTENTS

INSTRUCTION MANUAL
FOR
MULTITESTER

This Multitester is a precision instrument for the measurements of direct and alternating voltages and currents, and resistances over a wide range. A sensitive and rugged 20 DC microammeter is used in conjunction with large easy-to-read scales. The meter movement has full automatic overload protection. The DC and AC voltage sensitivities are 50,000Ω/V and 4,000Ω/V, fespectively. The provision for measuring alternating currents of low range is a feature not usually found in instruments of this kind; currents in audio circuits can be determined easily. A self-contained buzzer is convenient for making rapid checks on shorts, point-to-point wiring, etc. At the NORM position, the meter is shorted for protection against damage during transit. The whole instrument is enclosed in a strong impact resistant molded case.

This Multitester is designed for the following functions;

- ○ To measure DC voltages from 0.002V to 1,000V.
- ○ To measure AC voltages from 0.05V to 1,000V.
- ○ To measure direct currents from 0.5 microampere to 10A.
- ○ To measure alternating currents from 0.01mA to 10A.
- ○ To measure audio power levels from −10 to +42 dB.
- ○ To measure resistances from 1Ω to 100MΩ.
- ○ To check low resistance circuits by audible means.

SPECIFICATIONS

DC Voltage	8 ranges; 50,000Ω/V 0-0.1-0.5-2.5-10-50-100-250-1,000V
AC Voltage	7 ranges; 4,000Ω/V 0-2.5-10-50-100-250-1,000V.
Direct Current 6 ranges;	0-20μA, 0-0.5-5-50-500mA, 0-10A.
Altern, Current 5 ranges;	0-0.5-5-50-500mA, 0-10A.
Resistance 5 ranges;	×1-×10-×100-×1K-×10K. (70, 700, 7000, 70K, 700K at center)
Decibels	−10 t0 +42 dBm (OdBm = 1mW in 600Ω)
Continuity Test	Buzzer for audible checks
Batteries	1 UM2, or Burgess 1, or equiv. (1.5V) 1 Burgess Y10, or equiv. (15V)

Test Leads	1 pair
Dimensions	195 × 142 × 95mm (7" × 5" × 3" approx.)
Weight	1.8kg (4 Lb.)

General

For the most commonly used ranges in this Multitester, the tow pin jacks marked **COM.** and **POS.** are utilized. The highest current and voltage ranges make use of the four jacks at the left and right.

The automatic overload protection featured in this instrument is effective in preventing meter movement burnouts for currents up to 500 times full scale. However, it will not serve to protect resistors employed as multipliers or shunts.

There are three controls on the panel, namely. range selector at center "Ω" ADJuster, and "**AC-Ω-DC**" function selector.

During transit or storage, the range selector is set to NORM and function selector to **AC** or **DC** for meter protection by damping.

Before using this Multitester, the operator should follow the directions in this manual to achieve the most satisfactory results and maximum benefits.

1. DC VOLTAGE MEASUREMENTS

The voltage sensitivity is 50,000Ω/V which minimizes the loading of the circuit under test. The maximum current consumption is 20 microamperes at full scale.

1.1 Scale Reading.

The full scale readings for the various range are given in the following table.

Range	Scale DC-AC mA	Multiplier	Volts per Division
1000	0-10	100	20
250	0-250	1	5
100	0-10	10	2
50	0-50	1	1
10	0-10	1	0.2
2.5	0-250	0.01	0.05
0.5	0-50	0.01	0.01
0.1	0-10	0.01	0.002 (2mV)

1.2 0.5V to 250V ranges.

☆ Insert **BLACK** test lead in **COM.** jack, and **RED** test lead in **POS.** jack.

☆ Set function selector to **DC.**

☆ Set range selector to the desired range on one of the five positions along the left side marked Ω-**V**.
If the voltage is of unknown magnitude, start from 250V and work down until a reading is obtained reasonably high up on the scale.

☆ Connect test leads across the source or load under test, **RED** to positive terminal and **BLACK** to negative terminal.

☆ Read the voltage along the black scale marked **DC-AC mA,** second from the top, and the black figures for the range in use.

1.3 0.1V range.

☆ For this range, the selector is set to the **DC 0.1V-20μA** position. It corresponds to a full scale of 0.1V or 100 millivolts.
It is used in the circuit analysis of low voltage portions of sets, especially in transistor radios. The voltmeter resistance is 5,000Ω, which must be taken into account when measuring high resistance circuits.

2. AC VOLTAGE MEASUREMENTS

The range of **AC** voltages covered is from 0.05V to 1,000V.
The voltage sensitivity is 4,000Ω /V.

2.1 Scale Reading.

The full scale readings for the various ranges are given in the following table.

Range	Scale AC V (red)	Multiplier	Volts per Division
1000	0-10	100	20
250	0-250	1	5
100	0-10	10	2
50	0-50	1	1
10	0-10	1	0.2
2.5	0-2.5	1	0.05

2.2 2.5 to 250V ranges.

☆ Insert **RED** and **BLACK** test leads in **POS.** and **COM.** jacks, respectively,

☆ Set function selector to **AC.**

☆ Set range selector to the desired range on one of the 5 positions along the left side marked Ω-**V**.
If the voltage is of unknown magnitude, start from 250V and work down until a reading is obtained reasonably high on the scale.

☆ The test leads are connected across the source or load under test. The polarities are not important but it is a good habit to use

the **BLACK** test lead for the lower potential or grounded side of the circuit.

☆ There are two **AC** volts scale printed in red. The upper scale. **AC-V,** is used for 10V and higher, using the black printed scale markings. The lower scale is used for the 2.5V range only.

3. DIRECT CURRENT MEASUREMENTS

3.1 Scale Reading.

The full scale reading for the various current ranges are given in the following table.

Range	Scale DC-AC mA	Multiplier	Current per Division
500mA	0-50	10	10mA
50mA	0-50	1	1mA
5mA	0-50	0.1	0.1mA
5mA	0-50	0.01	0.01mA
20μA	0-20	1	0.5μA

3.2 0.5mA to 500mA ranges.

☆ Insert **RED** and **BLACK** test leads in the **POS.** and **COM.** jacks, respectively.

☆ Set function selector to the desired on one of the 4 positions along the right side marked mA.
If the current is of unknown magnitude, start from 500 mA and work down to obtain a reading reasonably high up on the scale.

☆ Turn off the power on the equipment under test. This is important for safety to the operator.
Open the circuit under test and connect the test leads in series, observing the proper polarities, **RED** test lead to the plus (+) and **BLACK** test lead to minus (−) sides, respectively.

☆ Turn on the power. If the pointer does not swing in the expected direction, turn the power off, and reverse the lead connections.
The current readings are taken on the **DC-AC mA** scale, using the 0-50 markings.

☆ Always turn the power off when removing the test leads. The power should be turned on only when the circuit connections have been restored.

☆ The meter movement protection does not prevent damage to the shunts which may burn out through overloading.

3.3 20μA range

☆ Set the selector to **DC-0.1V-20μA** position with the function selector at DC.

☆ The measuring procedure is the same as for the ranges described in

3.2 above. Care must be taken in that the microampere currents are to be measured. Check up on the schematic to be sure.

4. . ALTERNATING CURRENT MEASUREMENT

4.1 Scale Reading.

The full scale readings for the various current are given in the following table.

Range	Scale DC-AC mA	Multiplier	Current per Division
500mA	0-50	10	10mA
50mA	0-50	1	1mA
5mA	0-50	0.1	0.1mA
0.5mA	0-50	0.01	0.01mA

It is a feature of this instrument that the linear scale. same as for direct currents, is used. The lower readings are not crowded at the left end as in the conventional alternating current meters.

4.2 0.5mA to 500mA ranges.

☆ Insert **RED** and **BLACK** test leads in the **POS.** and **COM.** jacks. respectively.

☆ Set function selector to **AC.**

☆ Set range selector to the desired range on one of the 4 positions along the right side marked **mA.**
If the current is of unknown magnitude, start from 500mA and work down to obtain a reading reasonable high up on the scale.

☆ Turn off the power on the equipment under test. This is important for the safety of the operator. Open the circuit under test, and connect the test leads in series; the polarities are not important. It is recommended, however, to make a habit of using the **BLACK** test lead on the low potential side.
In any current measurements in the audio frequency range, the meter connections should be made at the low potential portion of the circuit, or near the ground side. This will prevent undesirable capacitance shunting effects.

☆ Turn on the power.
The current readings are taken on the **DC-AC-mA** scale, using the 0-50 markings.

☆ Always turn the power off when removing the test leads. The power should be turned on only when the circuit connections have been restored.

5. 1,000 Volt AND HIGH CURRENT MEASUREMENTS

The 1,000 volt and 10 ampere ranges require the use of auxiliary jacks.

5.1.1 DC volts.

☆ Set function selector to **DC**.
☆ Insert **BLACK** test lead in **COM** jack.
☆ Insert **RED** test lead in **1,000 V DC** jack at panel right.
☆ Set range selector to **1,000** at the **×10K-250** position of the Ω-V range.
Test leads are connected across the source or load under test.
The proper polarities must be observed.
☆ Be very careful during the measurements, high voltages are dangerous.
☆ The voltage readings use the 0-10 scale marking. The scale multiplier is 100, or 20 volts-per-division.

5.1.2 AC volts.

☆ Set function selector to AC.
☆ Insert **BLACK** test lead in **COM.** jack.
☆ Insert **RED** test lead in **1000V AC** jack at panel right.
☆ Set range selector to **1,000** or ×10K-250 position of Ω-V range.
Test leads are connected across the source or load under test.
Their polarities are not important, but it is recommended that the **BLACK** test lead be used on the low potential side.
☆ Be very careful during the measurements, high voltages are dangerous.
☆ The voltage readings use the 0-10 scale making on the **AC-V** scale(red).
The scale multiplier is 100, or 20 volts-per-division.

5.2 10 ampere ranges.

5.2.1 Direct Current, 10A range.

☆ Set function selector to **DC**.
☆ Set range selector to **1-A-DC** at the **500-mA** position.
☆ Insert **BLACK** test lead in **COM.** jack.
☆ Insert **RED** test lead in **10 AMP DC** jack at panel left.
☆ Turn off power of the equipment under test.
This is important for the safety of the operator.
☆ Open the circuit under test, and connect the test leads in series, **RED** test lead to the plus (+) and **BLACK** test lead to minus (−) sides, respectively. If the meter does not swing in the expected direction, turn the power off, and reverse connections.
Turn on the power. Read the **DC-AC mA** scale, using the 0-10 scale markings.
For current readings, the multiplier is 1, or 0.2 amperes-per-division
☆ Turn the power off when removing the test leads. Power should be turned on only when the circuit connections have been restored.

5.2.2 Alternating Current, 10A range.

- ☆ Set function selector to **AC.**
- ☆ Set range selector to **10A-AC** at the **DC-0.1V-20**μA position.
- ☆ Insert **BLACK** test lead in **COM.** jack.
- ☆ Insert **RED** test lead in **10 AMP** AC jack at panel left.
- ☆ Turn off the power to the equipment under test. This is important for safety to the operator.
- ☆ Open the circuit under test, and connect the test lead in series. Their polarities are not important, but it is good practice to use the **BLACK** test lead on the low potential side.
- ☆ Turn on the power. Read the **DC-AC mA** scale, using the 0-10 scale markings.
  For this range, the multiplier is 1, 0.2 amperes-per division.
- ☆ Turn the power off when removing the test leads. Power should be turned on only when the circuit connections have been restored.

6. RESISTANCE MEASUREMENTS (Ohmmeter circuit)

6.1 OHMS scale.

The uppermost scale on the dial is used for all range with the proper multipliers. It is marked from O to 10K, and infinity from the right to left.

6.2 "OHMS ADJust" control (Ω ADJ).

When making a resistance measurement. this control is adjusted for the 0 (zero) setting on the dial at the extreme right.

Each time the ohmmeter circuit is used, it is necessary to check the zero setting on the different ranges.

- ☆ Insert **BLACK** test lead in **COM.** Jack, and **RED** test lead in **POS.** jack.
- ☆ Set function selector to Ω position.
- ☆ Set range selector to one of the ranges along the Ω-V side.
- ☆ Connect the tips of the test leads together. The meter will swing to the O mark at the right end of the **OHMS** scale.
- ☆ Rotate Ω **ADJ** control if the pointer does not at this O mark.
  The accuracy of measurements will depend on the setting of the pointer to O.
- ☆ Open the test lead connections.
  The ohmmeter circuit is ready for use on this range. It will be noted that when an adjustment is made at a low range, there will be very little shifting, provoded that the batteries are in good condition.

6.3 Measurements.

6.3.1After the Ω ADJustment has been completed, connect the test leads

across the resistor, or device upper measurement.

The resistance value is the scale reading in OHMS multiplied by the range selector marking, **×1, ×10, ... ×10K.**

6.3.2 In order to make the most effective use of the **OHMS** ranges, the following selector settings are suggested:

Range	Resistances
×1	O up to 500 ohms
×10	up to 5,000 ohms
×100	up to 50,000 ohms (5K)
×1K	ut to 500K (500,000 ohms)
×10K	over 500K to 50 Megohms

In this manner, the readings are kept at relatively spread out portion on the scale.

6.3.3 Always have the power turned off when measuring a componet wired in on a radio, amplifier, etc. It is important to make certain that one or both ends of the device is "open" or free. It is best to make a check on the schematic of the set to be certain. If there is any doubt, disconnect one end from the circuit.

6.4 Battery Replacements.

When the Ω **ADJ** fails to bring the pointer to the O mark on the **OHMS** scale, the batteries must be replaced. The molded case is opened by removing the four rubber feet at the bottom with the thumb and forefinger. The fastening screws are unscrewed by inserting a screw driver in the holes. The case is separated from the panel with care.

There are two molded battery holders whose covers can be taken off by turning them in a counterclockwise direction. Take out the worn batteries and replace with new ones. The center caps, or plus terminal, should be at the top. The covers are screwed on carefully. The onter case fitted on the panel, fastened with screws, and the rubber feet attached.

The 1.5 volt cell may require more frequent replacements than the 15 volt battery, especially when a large number of measurements are made at the ×1 and ×10 ranges, and when the buzzer is used often, because of the greater current consumption.

7. DECIBEL MEASUREMENTS-OF POWERLEVELS

The lowest scale on the dial is calibrated from −10 to +10 dB, where O dB=1 mW in a 600 ohm line or load, for the **AC 2.5V range.**

Three other rahges make it possible to increase the readings to +42 dB.

The measuring procedure is identical to that of the AC voltage measurements described in Section 2.2.

The ranges are as follows (function selector at AC);

Range Selector	ADD dB	Power Level dB	Power in mW-W
2.5V	0	−10 to +10	0.1-10 mW
10 V	12	+2 to +22	1.6-160 mW
50 V	26	+16 to +36	40-4000 mW
100 V	32	+22 to +42	1.6-16 mW

The power level in DB is the sum of the scale reading and the ADD DB value according to the table printed at the lower right on the dial.

8. AUDIO POWER MEASUREMENTS

This instrument can be used to determine the power outputs of audio amplifiers, either by the voltage or current measurements, with the function selector at AC.

8.1 Voltage Method.

The voltages across lines, moving coils of loudspeakers, resistance loads, etc., can be conveniently measured because of the high internal impedance of the meter.

Where there is a DC voltage existing across the load, it is necessary to use an external blocking capacitor of 0.1 μF or more, with a voltage rating of at least 600 WVDC. This capacitor is connected between the "hot" terminal and the RED test lead.

The measuring procedure is identical to that of AC Voltages desscribed in Section 2.2.

The power is calculated from the formula

$$\frac{(\text{Volts})^2}{\text{Load Resistance, ohms}} = \text{Power in watts}$$

8.2 Current Method.

The Multitester is set up for the alternating current measurement procedure as descrided in Section 4.

There should be no DC voltages existing in any part of the measuring circuit.

The test leads are connected in series with the load, with must be non-inductive.

Connect the meter at the low potential side of the circuit, or with one terminal to the ground if conditions permit.

The power output is calculated from the following formula

(Current)^2 × Load (ohms) = Power in Watts

The load resistor must be capable of dissipating the full power.

9. USE OF BUZZER

The built-in buzzer is operated by the internal 1.5 volt battery. It will be found most convenient in checking wiring for point-to-point continuity where the circuit resistance are less than about 1 ohm. The indication is by audible means, there is no need to observe the meter each time a test is being made, as when using the ohmmeter.

☆ Insert the test leads in the **COM.** and **POS.** jack.

☆ Set range selector to **BUZZ-NORM** position, function to Ω.

☆ Make certain that the power to the equipment under test is turned off.

☆ Connect the test leads across the terminals under check.
A buzzing sound will be heard if there is a low resistance connection. No sound indicates no connection, or that the resistance is over about 1 ohm. (For actual resistance measurements, the procedure in Section 6 must be followed.)

☆ If the buzzer position is used often. the 1.5 volt battery should be checked frequently since the same source is used in the ohmmeter circuit.

10. NORMAL SELECTOR POSITION

At this range selector position. the meter movement is short-circuited to provide damping for protection during transportation, or when not in use.

After the tests with the Multitester have been completed, the range selector should always be set to this position, and with the function selector at **AC** or **DC**. If the the function selector is at Ω, there is possibility of putting the buzzer in operation when the test leads are shorted, and using up battery power.

11. GENERAL INFORMATION

This Multitester is a precision type instrument and should be handled as such. Rough treatment and overloading must be avoided, and you will be repaid in long and useful life from this instrument.

11.1 Mechanical zero.

The Multitester is carefully inspected and tested prior to shipment. However, it is possible that the mechanical zero adjustment might require a slight readjustment before use. The pointer should be at the O line at the left end on the scales. If not, turn the zero adjusting screw at the lower center of the meter front using a small screw driver, and align to the O line.

11.2 Accuracy.

11.2.1 Voltage and current.

The meter movement is adjusted to an accuracy of ±2% of full scale or better. All multipliers and shunts are 1% tolerance or better. The overall accuracies are maintained as follows;

Ranges	Voltage and Current percent of full scale.
Direct voltages and currents	± 3 %
Altern voltages and currents	± 5 %
10 Amp.: DC and AC 1000V : DC and AC	± 5 %

11.2.2 Resistance (Ohmmeter)

The resistance is indicated within 3° of arc of the actual values. This rating is used because of the non-linearity of the OHMS scale, and the tolerance is related to its linear length.

11.3 Overload protection.

The sensitive meter movement is protected by non-linear elements against overloads. However, the voltage multipliers, current shunt, ohmmeter resistors, and the current transformer are not protected in the same manner.

The operator is cautioned against excessive overloading of the Multitester ranges.

Always start the measurements of voltage and current from a high range and work down when the quantity under measurement is not known.

11.4 Waveforms.

In the alternating voltage and current measuring circuits of the instrument, a full wave germanium bridge rectifier is used. The rectified current is indicated on an average reading meter, which is calibrated in the rms (effective) values of a since wave. Therefore, if the waveform of the source is not sinusoidal, errors will be present in the readings. Usually, power lines and audio generators have reasonably good waveforms, and the reading are reliable.

11.5 Precautions.

11.5.1 High voltages.

In measuring voltages and currents, especially in unknown circuits. the utmost caution must be exercised not to get in contact with the test lead tips, terminals, and chassis, of the circuit under test, Obtain and follow the schematic and maintenance date for study before measurements.

The values of the currents being measured might be low, but they may be in the high voltage circuits. Do not forget to turn off the poiver before connecting the test leads when measuring current.

11.5.2 "Ampere-Hours Capacity" of batteries.

Batteries should never be tested for their ampere-hour or current rating with the current ranges in this Multitester. Such measurements require special equipment and techniques.

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