UNIVERSITY

Model 'TST' Supertester

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INSTRUCTIONS FOR USING THE .....

UNIVERSITY SUPERTESTER (TST)

This instrument has been especially designed to provide a means of simply, speedily and efficiently testing all of the components which go to make up a radio receiver or amplifier. It is also extremely useful in the testing of electrical circuits and equipment. It combines the functions of a milliammeter, DC voltmeter, AC voltmeter, output meter, ohmmeter, valve tester, paper and mica capacitor tester, electrolytic capacitor leakage and impedance tester.

The following instructions describe the method of using the various sections of the instrument in an orthodox manner, but there are many wider applications which will manifest themselves as the operator becomes more familiar with the instrument.

D.C. CURRENTS

The milliamp ranges covered are 0-1 MA, 0-5 MA, 0-25 MA, 0-100 MA and 0-250 MA. To take current measurements the main selector switch should be turned to the MA position and the range selector turned to the desired position. If the approximate current value is unknown, the highest range should be used first working down to the correct one when the approximate value is found. To measure milliamperes of current the circuit in which the current is flowing should be opened and the meter, per medium of the test leads, should be inserted in series with the circuit when the current flow may be read directly from the scale.
The scale on which the current will be read is that one marked "DC and high AC". This scale is used for all voltage and current ranges except 5 and 10 volt AC, in which case, the lower set of graduations is used.
The scale is divided into fifty equal parts, every tenth division being marked by a heavy line and having a voltage figure printed beneath it. Each division will represent a current or voltage equal to $1/50^{th}$ of that indicated by the range to which the range selector knob is pointing.
As an example of this, should the range selector knob be pointing to the 1 MA position and the needle be pointing to the first small division on the scale, the current reading would be $1/50^{th}$ of 5 MA or 0.1 MA. **The same position on amperes:** With the range selector on 5 MA, the reading would be $1/50^{th}$ of 5 MA or 0.1 MA. The same position on 25 MA, 100 MA, and 250 MA would be equal to $1/50^{th}$ of each of these or 0.5 MA, 2 MA and 5 MA respectively.
The lowest scale marking, that is, the 0-10, serves a dual purpose in that it refers to both the top and lower scales so that each figure under the heavy lines refers to this line when the top scale is used, even though they are staggered. That is, the first heavy line, is marked 50, 10, 2, the second 100, 20 and 4, and so on to the maximum scale position, which is marked 250, 50 and 10. The figures 1, 3, 5, 7, 9 on this bottom scale refer to points half way between the heavy lines of the top scale. These points in their turn are distinguished by a line slightly longer than the lines separating each division. The ranges which the instrument possesses, but which are not directly calibrated on the scale, will be found to be direct multiples or divisions of those scales which are calibrated.
The 1 MA scale, as an example, may be read on the 0-10 scale and the results divided by 10. For the 100 MA range the 10 scale can be used and the results multiplied by 10 in each case. This means that 10 would be regarded as 100, 9 as 90, 8 as 80 and so on. Each small graduation would be $1/50^{th}$ of 100 or 2 MA.
To give an example of how this carried out, if with the range selector on the 100 MA position, the needle comes to rest at two divisions past the centre of the scale the correct reading is then 5 x 10 or 50 plus two fiftieths of 100 or 4. This makes 54 MA as the reading. A little practice will soon make the reading of the scale a very simple matter.

WARNING

The milliampere section of any instrument is the one most easily damaged and care should be exercised when using it. Always be sure to turn the main selector off the MA position when the necessary readings have been taken. The instrument is not intended to measure alternating milliamps.

D.C. VOLTS

The ranges of DC Volts 0-5, 0-10, 0-50, 0-250, and 0-1000 are covered by the 0-10, 0-50 and 0-250 ranges calibrated on the meter face. The 0-1000 range may be obtained by multiplying the 10 range by 100 so that the ten is regarded as 1000, the 9 as 900, the 8 as 800 and each small graduation as 20 in a similar manner to that explained in relation to milliamp readings. In the case of the 5 volt range, the 50 is regarded as 5, 40 as 4, 30 as 3 and so on. Each small graduation being $1/50^{th}$ of 5 or 0.1 Volt.
To measure DC Volts, the main selector should be turned to the DCV position and the desired range selected by the range selector. Again, as when measuring current, if the approximate voltage is unknown the highest range should be tried first and lower ranges selected if possible for more accuracy.

A.C. VOLTS

The operation for measuring AC volts is the same as for DC when the higher ranges (0-50, 0-250 and 0-1000) are required except that the main selector is first turned to ACV position. When the 5 and 10 volt ranges are being used the readings must be taken at the lower scale.
This scale is read directly for the 10 volt range and the readings are divided by 2 when the 5 volt range is being used. Each small graduation represents 0.2 volt on the 10 volt range and 0.1 volt on the 5 volt range.

O.P. VOLTS

The output voltage, delivered by a receiver or amplifier may be measured by using the same scales as those used for ordinary AC voltage measurements. The circuit of the instrument is arranged so that the test leads carrying the alligator clips may be connected directly to the plate of the output valve and chassis or between two plates in the case of push pull amplifiers. Alternately the leads can be connected across the primary or secondary windings of the speaker transformer, whichever is more convenient.
To use, the main selector switch should be turned to the OPV position and the range selector turned to 1000 V. The leads may then be plugged into the instrument. One lead may be connected directly to the plate of the output valve whilst the other connects directly to the chassis, or to the plate of the second tube in the case of a push pull output stage.
When the desired signal has been tuned in on the receiver, the range selector may be turned to a lower range, provided the voltage reading does not take the needle past the end of the scale. The 5 V position makes a very sensitive output meter and the signal must be almost inaudible to prevent damage to the meter. Before tuning in the signal or when changing dial settings, always make sure the meter is switched to a high range.

OHMS

The instrument provides five ranges of ohms, 0-1000, 0-10,000, 0-100,000, 0-1 Meg and 0-10 Megs. Three of these are supplied by an internal battery while the remaining two necessitate connection to the AC mains or to a six volt accumulator as the case may be.
To measure resistance on those ranges which operate from the internal battery, that is the R1, R10 and R100, the main selector should be turned to ohms while the range selector is used to select the required range. The test leads are then touched together and the ohms compensating potentiometer is adjusted so that the needle comes across to zero ohms, that is in other words the right hand end of the scale. The two test leads are then placed on each end of the resistance or circuit to be measured. The scale is calibrated in direct relation to the R range so that the range selector set to the R position a direct reading is obtained on the graduations marked "Ohms". When other ranges are used the scale reading is multiplied by the number to which the range selector points. To give an example, with the meter needle pointing to 25 position on the ohms scale, and with the range selector on R, the reading will be 25 ohms. With the range selector on R10 and R100 this same position would represent 250 and 2,500 respectively. The values of the small graduations on the ohms scale can be determined by counting the number between the main divisions on either side of the position where the needle falls.

When changing from one range to another always repeat the process of adjusting the needle to the zero ohms position by connecting the test leads together and varying the ohms compensation potentiometer.
To use the high ohms range requires the same procedure except that the instrument has to be connected to AC power mains or 6 Volt accumulator. The length of flex terminating in battery clips is used to connect to the 6 Volt battery, while the second length of flex is used to connect to the AC mains. The zero ohms adjustment is carried out in the same manner as before. The scale reading is now multiplied by 1,000 or 10,000. In the foregoing example, the resistance which gives a reading of 25 on the scale would be equal to 25,000 ohms or 250,000 ohms.
After the instrument has been in use for some months, it will be found that even with the ohms compensator turned fully to the right it is impossible to make the needle reach the right hand end of the scale on the three lower ranges.
This indicates that the internal battery has become exhausted and requires replacing.
It is merely clipped in and can be removed easily and conveniently. Replacement battery required will be one type 950.

VALVE TESTING

The instrument allows three separate tests to be applied to a valve, namely heater or filament continuity, shorts between elements and finally cathode emission.

READING THE CHART

The roller chart is divided into three sections, each section giving figures for different tubes or in the case of multi-section tubes, the necessary figure for each section. As an example of this, a duo diode pentode such as the 1K7G occupies all three sections. The pentode section is listed in the first section while the diodes take up the other two.
Each section of the chart is divided into six columns. The first column denotes the tube type, while the 2nd, 3rd, 4th and 6th refer to the position of the switches, A,B,C and E respectively. The 5th or D column lists the degrees that the range control (D) should be set.
The column designated B carries two and in cases three figures. One figure is in black, the other or others in red. The red figure is the position on which the second filament or heater connection is found, and is used in conjunction with the filament continuity test as explained later. In the case of the 12A5 and 35Z5GT where two positions are shown in red, these positions indicate the 2nd filament connection and the tap.
The general procedure in testing is as follows. Firstly switch E should be set at the position marked "line". The switch marked A, which controls the voltage applied to the filament should be set to its correct position according to the roller chart. Switch B should be turned to the position indicated by the black figure in the second column. The tube should then be plugged into its correct socket and the top cap connected. After the tube has been plugged in, the tester should be connected to the AC main or the 6 Volt battery. To adjust the instrument correctly for the available mains or battery voltage, switch E should be set at the position marked "line" and the "line compensator" turned until the needle reads full scale deflection. When using a fully charged battery it is desirable to turn the switch back to the left hand side, before plugging in the tube.
When the line compensator has been adjusted correctly, switch E should be turned to the "shorts" position. All that is then necessary to test the filament or heater for continuity is to turn switch C to that position indicated by the red figure in column B. The neon lamp will glow if the circuit is continuous, so that no glow indicates an open heater or filament. In the case of the two tubes having two red figures marked, the switch C is turned first to one and then the other to give an indication of both sections of the filament.

SHORTS TEST

In testing for shorts between elements the switches A, B and E are left in the same position as for filament continuity. In fact the test for continuity and shorts may be carried out simultaneously. Switch C should be rotated through the various positions from 1-9. The tube should be tapped lightly with the switch on each position to make sure no shorts occur when the tube is vibrated. Any short will give a definite glow on the neon lamp. The number on which a glow is obtained indicates the elements between which the short exists according to the standard American numbering system. A glow on the position indicated by the red number on the chart does not indicate a short but indicates filament continuity as explained previously. A steady glow on any of the other positions indicates a definite fault and no attempt should be made to test the valve for emission. If the only steady glow in the neon occurs on the setting of switch C corresponding to the red figure in the B column of the roller chart, it is safe to proceed with the emission test.

EMISSION TEST

Before setting the various switches to the correct position for the emission test, the range control (D) should be turned to zero to avoid overload of the meter. When this has been done, switches C and E should be set to positions indicated on the valve chart. (Switches A and B have already been set in the shorts test).
With all switches set, the range control D should be brought up to the setting indicated by the figures indicated in the D column of the chart. The condition of the valve will then be read directly from the top scale of the meter. A valve giving a reading in the bad section should be replaced, while the questionable section indicates weak valves which may fail at any time, and it is desirable to replace these also.
It will be noticed that no percentage markings or other graduations are provided on the dial scale because even new and perfectly good valves vary in emission by up to 25%. Consequently, any valve which makes the needle register on the good section of the scale can be confidently regarded as having satisfactory emission.

WARNING

When the test has been completed, turn the switch A back to position 1, and control D back to zero.
For the convenience of operator in testing any tube not listed or new releases, the filament voltage obtained from switch A are: 1 = 1.4 volt, 2 = 2.0 volt, 3 = 2.5 volt, 4 = 3.3 volt, 5 = 4.0 volt, 6 = 5.0 volt, 7 = 6.3 volt, 8 = 7.5 volt. 9 = 12.5 volt, 10 = 25 volt, 11 = 30 volt, 12 = 35 volt.
The settings for switches B and C can be determined for any future tube types by reference to ordinary valve data sheets showing the modern standard system of numberings. Switch B should be set to one of the numbers corresponding to the heater or filament connections of the tube. In most octal based tubes this will be number 2. The filament or heater continuity can then be tested by turning switch C to the number corresponding to the other filament or heater connection.
The emission can be tested by turning switch C to the number corresponding to the element closest to the tubes filament or cathode. In all ordinary types of tubes this will be the control grid. In frequency changers it will be the oscillator grid and in diodes and rectifiers it will be the diode plates. Switch E should be set to position 1 for diode tests, to position 2 for all battery tubes and for all ordinary AC operated amplifying tube and to position 3 for AC operated power output tubes and rectifiers.
Brief steps in valve testing.

1. Set E switch to "line"
2. Set A switch
3. Set B switch to black figure shown on chart
4. Plug in tube
5. Connect to AC power or 6 volt battery
6. Adjust the instrument for the line or battery voltage
7. Test for continuity and shorts by varying switch C
8. Set C and E to position indicated on the chart
9. Set range D to correct position

PAPER CONDENSER TEST

In testing mica and paper condensers for both shorts and leakage, the same neon lamp is used as for shorts testing in valves.
The main selector should be turned to the "Conds" position, the "Line Compensator" fully on and the test leads connected one to each end of the two terminals of the condenser.
A flash at the moment of connection indicates that the condenser has taken its charge, but after this first flash a considerable time should elapse before the next one. If the flashes are more rapid than every 30 seconds the condenser should be discarded. No flash indicates a condenser which is open or one in which the capacity is too small to obtain a reading. The condenser test is very sensitive and it is essential that the fingers are kept well away from the test leads or condenser ends to avoid false indications. The leads themselves carry a moderate voltage and a slight shock may be experienced if they are touched, but there is definitely no danger.
Apart from testing condensers, this section may also be used for testing leakage in transformers, cables, electrical equipment etc. It will give definite glow on resistances as high as 40 megohms.

ELECTROLYTIC CONDENSER LEAKAGE

The electrolytic condenser leakage test uses both the main selector and range selector switches. The main selector switch should be turned to "E-leak" position and the range selector turned to the voltage position equivalent to the working voltage of the condenser. In other words, a condenser that has a working voltage of 6 would be turned to the "CV-6" position and one which has a working voltage of 25 would be turned to the "CV-25" position, etc. The correct switch setting for all commonly used electrolytic condensers is listed on the roller chart.
The electrolytic range control which governs the readings obtained on the meter should be set at zero position. This is very important, as with high voltages the meter may be overloaded considerably if the electrolytic happens to be shorting when the test leads are connected to it. The test leads may now be connected to the condenser under test, making sure that the positive lead of the instrument connects to the positive end of the electrolytic and the negative of the instrument to the negative end of the electrolytic. After the condenser has been connected the electrolytic range potentiometer should be advanced slowly to its correct position, as shown on the roller chart.
With new electrolytics or ones that are not formed properly the needle will take some considerable time to come down to the good position, even when the condensers are perfectly satisfactory, and it is consequently necessary to leave the test on for about two minutes on condensers which have not already returned to the "good" position. If however the needle returns almost immediately to the "good" position there is no point in leaving the condenser on test any longer. If the needle has not returned to the "good" portion of the scale within about two minutes disconnect the condenser, as prolonged testing of a short circuited condenser might damage the instrument.
The scale used is the "good-bad" scale at the bottom of the instrument. Electrolytics which read on the "bad" are ones which show an excessive leakage, and although this alone does not condemn the electrolytic, it is quite possible that it will fail quickly under ordinary working conditions. The questionable section means that an electrolytic should be regarded suspiciously, although not necessarily changed immediately.
The correct setting for the range selector and electrolytic range control are shown in the roller chart.
When the test of an electrolytic is completed, the electrolytic range control should be turned to its zero position and only advanced up to its correct setting after a condenser has been connected. Power from AC mains or 6 volt battery is required for this test.

ELECTROLYTIC CONDENSER IMPEDANCE

This test measures the actual resistance and reactance combined of the condenser and therefore forms a very valuable indication of its actual condition. In this test, the main selector switch is the only one used, and this should be turned to the "El-Imp" position. As this test is carried out with AC there is no polarity and the leads may be connected to either side of the condenser with exactly the same results.
The position at which the electrolytic range control is set is shown on the roller chart and this may be brought around to its correct position before the electrolytic is connected, as there is no danger of overload to the meter.

The test for impedance utilises the same scale as the electrolytic leakage test and the condition of the condenser can be read directly from this scale. A reading on the "bad" section definitely indicates a condenser which has reached the end of its useful life. On the other hand, if a condenser registers "good" on both the leakage and impedance test it can be confidently regarded as being in good order. When this test is being carried out with AC power mains the needle will take up a position approximately three quarters of the way across the scale before the condenser is connected. When the condenser is connected to the terminals, the meter needle will drop back to a position depending on the condensers impedance. When power is derived from a 6 volt battery by means of the built in vibrator, the line compensator switch must be turned fully in an anti-clockwise direction so that the meter needle does not exceed the right hand end of the scale. The needle should take up a position somewhere near the right hand end of the scale before the condenser is connected.

GENERAL

The meter needle should normally rest at zero when the meter is not in use. Should it not do so it can be adjusted to zero by means of the bakelite screw on the face of the meter, just below the glass.