

TESTING DOUBLE TRIODES AND OTHER MULTIPLE TUBES

In order to quickly test double triodes and other dual tubes, the Mutual Conductance of the two halves of the tube in parallel is measured. In Figure (1), we see that if the same signal voltage ΔE_g is applied to the grid of V_1

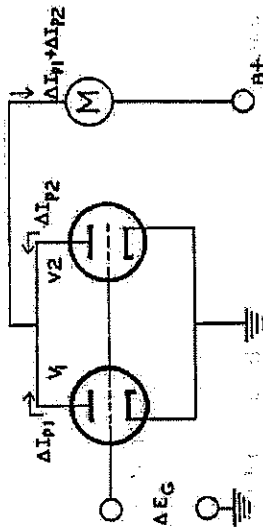


Figure (1) Measuring G_m of Dual Triodes

and V_2 in parallel, the resultant plate current change measured by the meter will be the sum of the ΔI_p of each tube.

$$G_m (V_1 + V_2) = \frac{\Delta I_{p1}}{\Delta E_{g1}} + \frac{\Delta I_{p2}}{\Delta E_{g2}}$$

Since $\Delta E_{g1} = \Delta E_{g2}$

$$\text{Therefore: } G_m (V_1 + V_2) = \frac{\Delta I_{p1} + \Delta I_{p2}}{\Delta E_g}$$

then the G_m reading for the tubes in parallel is the sum of the G_m for each tube. If either tube is down in G_m then the sum will be low, and the tube should be rejected. This way multiple tubes are automatically set up and tested in the DYNA-QUIK with one fast and accurate check.

LIFE TEST

Many manufacturers have found that testing tubes under reduced heater voltage conditions will give a strong indication of its probable useful life. A tube may show adequate G_m under normal test conditions; however, a reduction of 10% to 15% of heater voltage may be marked by a sharp slump in G_m reading. This slump or decay indicates that the space charge of the tube has been depleted to the point where the tube will have a short remaining useful life. While the amount of life remaining cannot be too closely estimated, you can be reasonably sure that a tube showing a sharp slump is not a good risk for continued trouble-free service.

TESTING TUBES FOR GRID EMISSION OR GAS

The Grid Emission or Gas Test is an invaluable aid in TV servicing because it quickly picks out those tubes which can cause trouble in a.g.c. sync, I.F. amplifier, and R.F. tuner circuits.

In order to understand how a tube can have "grid emission" and "gas current" we must look into the theory of electron tubes.

There is normally some little evaporation of the cathode coating material on the grid of a tube. Some of this vapor tends to deposit on the grid and gives rise to what is known as "grid emission", where the grid itself emits electrons and draws current commonly known as "negative grid current". The flow of this "negative grid current" can be followed in Figure (2).

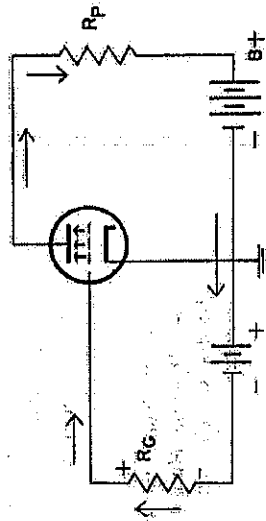


Figure (2) Negative Grid Current

The electrons flow from the grid to the plate then back through the power supply to the grid leak resistor R_g and up to the grid again. Notice that the voltage drop across the grid leak resistor R_g is such that it causes the grid to go more positive than it normally would with no grid emission.

If a slight amount of "gas" is present in a tube some of the electrons from the cathode will collide with molecules of the gas and may knock off one or more electrons, leaving positive ions (ionization). Some of these positive ions may then strike the grid, taking an electron from the grid to form a gas molecule again. The electron flow of this "gas current" is exactly the same as it is for the "grid emission current" and can be traced on Figure (2). Notice again that the grid is made more positive by this "gas current".

Now let us see what happens if an I.F. amplifier tube in a TV set has grid emission current or gas current (negative grid current). In Figure (2) we noted that the grid would tend to go more positive if negative grid current flowed.

In Figure (3), a typical I.F. stage, we see that if there is any negative grid bias voltage in that stage and other associated stages will go more positive because of the flow of current through R_1 . Making the grid more positive will drive the tubes to saturation, causing clipping or overloading.

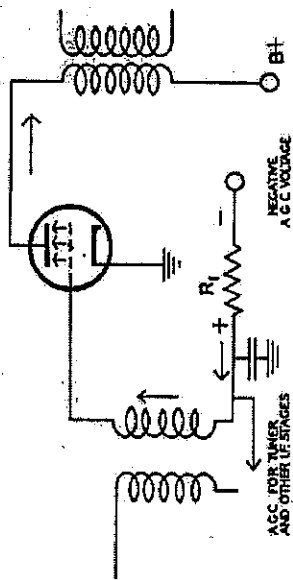


Figure (3) Typical I.F. Stage

After detection, a video signal normally appears as shown in Figure (4). If the signal is clipped in an I.F. stage it will look like Figure (5). Now the horizontal oscillator will try to synchronize both on the blanking signal (A) and on the very black portions of the video (B). This results in pulling or shaking of the picture.



Figure (4) Normal Video and Sync Signal



Figure (5) Overloaded or Clipped Video and Sync Signal

To achieve this sensitive grid emission or gas test, the circuit shown in Figure (6) was employed.

The tube under test has its normal plate voltage applied, but the grid is biased beyond cut-off so that no plate current flows. This bias is applied through the 10 megohm resistor. The same 10 megohm resistor is also in the grid circuit of a 6AT6 d.c. amplifier and the conditions in this tube are such that it, too, is biased just beyond cut-off. Under these conditions, no plate current flows in the 6AT6 and no reading is obtained on the meter in its plate circuit.

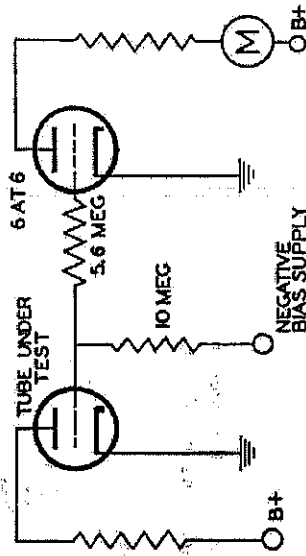


Figure (6) Grid Emission Test Circuit

However, if the tube under test is gaseous, or its grid is contaminated with some of the cathode coating, then current will flow from grid to plate and through the 10 meg resistor back to the grid again. This will produce a positive voltage drop across the 10 meg resistor, lifting the cut-off bias on the 6AT6 and producing a meter deflection. Upon seeing this deflection, the technician immediately knows that the test tube is defective and a replacement is indicated.

AUTOMATIC LINE VOLTAGE COMPENSATION

Every effort has been made to make the operation of this instrument as fast and simple as possible. Toward this end, automatic line voltage compensation has been incorporated into the tester. A voltage sensitive bridge monitors the line voltage at all times and automatically adjusts the sensitivity of the Gm bridge to compensate for these line voltage variations. This eliminates the necessity of readjusting the line voltage for different types of tubes and at different line voltages.

HOW TO OPERATE THE DYNA-QUIK TUBE TESTER

1. Set **HEATER** switch to correct heater voltage.
2. Insert tube in correct socket.
3. Set **SENSITIVITY** control.
4. Test in sequence: **SHORTS**, **Gm**, **LIFE** and **GRID EMISSION**.

Test Procedure

The DYNA-QUIK Tester is designed for use on 105-125 volts 60 cycles AC only. Do not use on any other type of current. Plug the unit into an AC outlet and turn the power on by means of the "ON-OFF" switch in the lower left-hand corner of the front panel. The pilot light just above this switch will indicate when the unit is on.

On the socket panel itself, are listed only the most popular number of the tube type which is available in more than one filament voltage. For example: the 6AL5 is printed on the socket panel; however, the 3AL5 and 12AL5 tubes can also be tested in that same socket. The asterisk printed to the left of the tube type on the panel indicates that tubes of that type with other filament voltages are tested in that socket. The only difference in testing these tubes is that the Heater control is set to the correct filament voltage.

The setting of the Heater switch position determines the filament voltage applied to the tube under test. For example: the switch is set to 3 for 3 volt filament tubes, and the switch is set to 6 for 6 volt filament tubes, etc. This setting is determined by the first number of the tube designation. Thus, for a 3AL5, the heater control would be turned to 3; for a 6AL5, it would be turned to 6; and for a 12AL5, the control would be set to 12.

CAUTION: THE HEATER CONTROL MUST BE SET TO THE CORRECT FILAMENT VOLTAGE BEFORE INSERTING THE TUBE IN THE SOCKET. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BURNING OUT A FILAMENT.

With the instrument in operation, locate the proper socket for the tube to be tested. This socket will have the tube number listed alongside of it. The 100 most popular tube types have been listed right on the socket panel. There are approximately 300 tube types which can be tested, however, and all of these tubes are listed on the chart on the inside of the top cover. The chart indicates in which socket the tube is tested and the filament voltage. Notice that the 7 pin sockets are labeled 7A, 7B, 7C, etc., and the 8 pin sockets are labeled 8A, 8B, 8C, etc., to make it faster and easier for the technician to find

the correct socket. There are some tubes which have the plate connection coming out of the top of the tube. These tubes are tested by inserting the plate cap lead into the tip jack associated with that socket, and located just to the right and slightly below the sockets, 8C, 8D, 8I, and 9D.

Set sensitivity control and you are now ready to start the tube check. The setting of this control is determined by the number which follows the tube designated on the socket panel or chart.

Short Test

The TEST switch has four positions and the starting point is in the lowest position marked SHORT. In this test, any short or leakage between heater and cathode, grid and cathode, grid and plate, or screen grid and plate will cause the neon bulb marked SHORTS to light up. Shorts or leakage up to 1 megohm in value will be uncovered by this test and this detection will occur before the Gm check is made. Any tube which causes the neon bulb to light up is defective and should be discarded. It is generally desirable to tap the tube being tested during the SHORT test in order to bring to light any intermittent shorts. Do not give further tests to tubes which are shorted.

Gm Test (Mutual Conductance)

If the tube successfully passes the SHORT test, the TEST switch is moved to the second position, labelled Gm. Here, a conventional Dynamic Mutual Conductance check is made and the condition of the tube will be indicated on the large $4\frac{1}{2}$ inch meter. For this test, using the SENSITIVITY control settings given on the socket panel, the meter reads in the REPLACE, ?, GOOD portion of the dial. Any tube not indicating GOOD should be replaced.

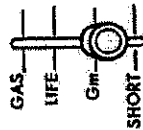
The setting of this control, labeled SENSITIVITY is determined by the number which follows the tube designation on the socket panel. For example, the tube 6AU6 is followed by the number 80, viz.,

6AU6-80

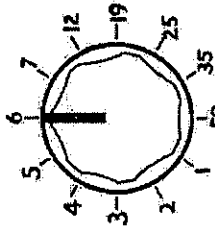
and the latter figure represents the setting for the SENSITIVITY control.



SHORTS



TEST



HEATER

With the instrument in operation, locate the proper socket for the tube to be tested. This socket will have the tube number listed alongside of it. The 100 most popular tube types have been listed right on the socket panel. There are approximately 300 tube types which can be tested, however, and all of these tubes are listed on the chart on the inside of the top cover. The chart indicates in which socket the tube is tested and the filament voltage. Notice that the 7 pin sockets are labeled 7A, 7B, 7C, etc., and the 8 pin sockets are labeled 8A, 8B, 8C, etc., to make it faster and easier for the technician to find

CAUTION: THE HEATER CONTROL MUST BE SET TO THE CORRECT FILAMENT VOLTAGE BEFORE INSERTING THE TUBE IN THE SOCKET. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BURNING OUT A FILAMENT.

With the instrument in operation, locate the proper socket for the tube to be tested. This socket will have the tube number listed alongside of it. The 100 most popular tube types have been listed right on the socket panel. There are approximately 300 tube types which can be tested, however, and all of these tubes are listed on the chart on the inside of the top cover. The chart indicates in which socket the tube is tested and the filament voltage. Notice that the 7 pin sockets are labeled 7A, 7B, 7C, etc., and the 8 pin sockets are labeled 8A, 8B, 8C, etc., to make it faster and easier for the technician to find

The SENSITIVITY dial has 100 divisions and the small white-line marker on the knob should be set to the indicated value as closely as possible.

NOTE: With these SENSITIVITY settings, the condition of the tube will be given on the portion of the meter scale marked, **REPLACE, 2, GOOD.** This is in accordance with conventional practice on Gm tube testers.

On testing diodes the tube is good if the meter reads over the line marked "diodes o.k."

Since the customers for whom you are testing the tubes can easily read the condition of the tube on a GOOD-BAD scale, this is the test you will normally make.

If the exact Gm value of a tube is desired, however, then the setting for the SENSITIVITY control must be obtained from the chart mounted inside of the top cover. Simply locate the tube you are checking and use the SENSITIVITY setting listed next to it in the column marked "TRUE Gm". There are two numerical scales on the meter for reading True Gm; 0-6,000 micromhos and 0-18,000 micromhos. The 0-6,000 micromhos scale is printed on the meter in black, and the 0-18,000 is printed in red. If the True Gm reading is to be in the 0-6,000 micromhos scale, the sensitivity setting in the "TRUE Gm" column will appear in BLACK. However, if the sensitivity setting in the "TRUE Gm" column is in RED, then the meter reading will be on the red scale; 0-18,000 micromhos.

The printed table also indicates the Standard Gm for a new tube. This is an average Gm value to be expected for that type of tube. This can be tested with the True Gm setting of the Sensitivity control.

The True Gm value of a tube is not needed to judge its condition. The relative **REPLACE, 2, GOOD** indication will serve satisfactorily. However, the facility for exact Gm determination is available and may be employed, if desired. It is useful for selecting tubes used in push-pull output stages, for example.

Life Test

The third position of the TEST switch is labeled LIFE and it will help the serviceman judge how much more probable useful life still remains in the tube being tested. This test will enable you to detect those tubes which show up as O.K. on the Gm-test but which are in the process of gradually losing their Gm.

What the test does, in essence, is reduce the filament voltage by a predetermined amount. If the tube has sufficient capacity to continue operating normally, the decrease in meter reading will be nominal. (Of course, if the meter reading does not drop, the condition of the tube is excellent). But if the tube has a depleted space charge, a large drop will occur in the meter reading and the serviceman will thus be placed on notice that this tube should be replaced. A drop to 75% of its normal reading indicates the tube is reaching the end of its useful life.

Grid Emission and Gas Test

In the final position of the TEST switch, the tube is checked for gas, grid emission, and grid contamination. Grid current, which each of these three conditions will produce, can be detected when it is as low as 2 microamperes, which makes this an exceedingly sensitive test.

If the tube under test is gaseous, or its grid is contaminated with some of the heater coating, a meter deflection will result.

If the meter shows any reading other than zero, the technician immediately knows that the tube has this defect and a replacement is indicated, even if the tube seems to be functioning properly in the TV set. If the meter reads zero (after the pointer settles down), there is no gas or grid emission.

NOTICE: As soon as the switch is put in the Gas Test position, the meter will deflect upwards instantaneously even when testing a good tube which has no grid emission. This momentary deflection should be ignored.

The same test will also uncover high-resistance leakages between control grid and cathode that are not discovered by the SHORT test. The latter check revealed short circuits up to a maximum value of 1 megohm. Frequently, however, a grid-to-cathode leakage resistance in excess of this value will appear and lead to such troublesome defects as poor picture contrast, twisting, bending or pulling of the picture, vertical jitter or bounce, sync. buzz, etc. In the present circuit, Fig. 6, this grid-to-cathode leakage will be discovered because enough current will pass through the 10 megohm resistor to cause the 6AT6 to conduct and produce a meter deflection.

The importance of this test cannot be overstressed. Case histories of hundreds of tube failures, particularly those in the R.F., I.F., and video amplifier stages, revealed that a substantial number of failures were due to gas, grid contamination, or grid-to-cathode leakage. Every amplifier tube should be carefully checked in the grid emission position of the TEST switch and any observable meter indication should preferably be followed by tube replacement.

NOTICE:

The a.c. line fuse is a 2 ampere 3AG located beneath the socket panel.

If either of the No. 44 pilot bulbs beneath the socket panel goes bad, both bulbs must be replaced at the same time with the exact type.

If a tube shows shorted in the short test do not test the tube in the Gm, Life or Grid Emission positions as you may damage the instrument.

Some low Gm tubes (i.e. 6J5 and 12AX7) can not be tested on the *Replace, 2, Good* scale. They are tested only on the True Gm scale.

DYNA-QUIK MODEL 500 PARTS LIST

DESCRIPTION	PART No.	
R-1	130 ohms 2 Watt 5% Resistor.....	500-103
R-2	130 ohms 2 Watt 5% Resistor.....	500-103
R-3	1000 ohms 4 Watt Control.....	500-18
R-4	16 ohms 1 Watt Resistor 5%.....	500-89
R-5	16 ohms 1 Watt Resistor 5%.....	500-89
R-6	100K 1 Watt 20% Resistor.....	500-83
R-7	12K 1/2 Watt Resistor.....	500-84
R-8	12K 2 Watt 5% Resistor.....	500-76
R-9	1000 ohms Control.....	500-23
R-10	10 Meg. 1/2 Watt Resistor.....	500-80
R-11	510 ohms 1/2 Watt 5% Resistor.....	500-70
R-12	510 ohms 1/2 Watt 5% Resistor.....	500-70
R-13	220 ohms 1/2 Watt 5% Resistor.....	500-71
R-14	100 ohms Control.....	500-81
R-15	5.6 Meg. 1/2 Watt Resistor.....	500-85
R-16	470K 1/2 Watt Resistor.....	500-87
R-17	56K 1/2 Watt Resistor.....	500-86
R-18	180K 1/2 Watt 20% Resistor.....	500-88
R-19	40 ohms Control.....	500-90
R-20	12K 2 Watt 20% Resistor.....	500-82
R-21	12K 2 Watt 20% Resistor.....	500-82
R-22	12K 2 Watt 20% Resistor.....	500-82
C1	20 mfd. 250 Volts Capacitor.....	500-21
C2	20 mfd. 250 Volts Capacitor.....	500-21
C3	20 mfd. 250 Volts Capacitor.....	500-21
C4	.005 mfd. 600 Volts Capacitor.....	500-34
C5	250 mfd. 5 Volts Capacitor.....	500-95
SW1	Heater Switch.....	500-02
SW2	On-Off Switch.....	500-17
SW3	Test Switch.....	500-03
T1	Transformer.....	500-16
NE-1	NE-51 Neon Lamp.....	500-10
V-1	83.....	500-04
V-2	6AT6.....	500-85
M1	Meter.....	500-07
PL1	Miniature Lamp—Use only No. 44.....	500-64
PL2	Miniature Lamp—Use only No. 44.....	500-64
PL3	Miniature Lamp—Use only No. 44.....	500-64
SR-1	50 MA. Rectifier.....	500-06
SR-2	50 MA. Rectifier.....	500-08

