

# INSTRUCTION MANUAL

**B&K** MODEL 747

## DYNA-JET SOLID STATE DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER



Product of DYNASCAN CORPORATION  
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

# **INSTRUCTION MANUAL**

**FOR**

**Model 747**

# **DYNA-JET**

**SOLID STATE  
DYNAMIC MUTUAL CONDUCTANCE  
TUBE TESTER**

**B & K DIVISION OF DYNASCAN CORPORATION**

**1801 West Belle Plaine Avenue**

**Chicago, Illinois 60613**

## FEATURES

**VERSATILITY**—The Dyna-Jet Model 747 tube tester checks over 99% of all vacuum tubes in general use in television receivers, radios, and audio equipment. Over 2500 tube types are listed in the tube chart.

**FAST “JET-CHECK” TESTING**—Most of the popular television and radio tubes can be checked on the “Jet-Check” section, which requires setting only the HEATER and SENSITIVITY controls before testing can begin.

**PROGRAMMED TESTING**—All tube types which cannot be tested in the “Jet-Check” section can be given the same type tests in a separate programmed section. A program switch for each pin of the tube sets up the test circuit. Such programmed testing means the instrument is obsolescence proof; all new tube types that are introduced can be tested.

**DYNAMIC TESTING**—Amplifying tubes in either the “Jet-Check” or programmed section are given a true dynamic mutual conductance (Gm) test. Diodes and rectifiers are tested for emission. Test results are reliable, even for high voltage regulators. A large, easy-to-read BAD—?—GOOD meter displays the test results.

**HIGH VOLTAGE REGULATORS**—A special dynamic test has been designed into the Model 747 to properly test high voltage regulator tubes with proper plate current. Some competitive testers destroy tubes with a high current emission test, while others test with insufficient current which results in all tubes testing good. This special dynamic test injects a signal voltage to the grid and another much higher voltage applied to the plate. After extensive set testing and circuit design we now have a test that separates the good tubes from the bad.

**SHORTS TEST**—A single pushbutton shorts test checks shorts or leakage between elements. Leakage paths up to 1 megohm will light the SHORTS lamp, and leakage as low as  $\frac{1}{2}$  microampere can be detected on the meter.

**GRID EMISSION TEST**—A single pushbutton test checks gas, grid emission, or grid-to-cathode leakage by a sensitive grid current check. Grid leakage paths of 100 megohms can be easily detected on the meter.

**LIFE TEST**—A single slide switch checks life expectancy by dropping heater and operating voltages 10% to determine the tube's reserve capacity.

**DUAL SECTION TUBE TESTING**—Each section of a dual section tube is tested separately. Therefore, tubes with identical sections can be checked and selected for balance between sections. This is convenient for selecting dual section tubes to be used in push-pull circuits.

**TUBE CHART**—The tube chart is an integral part of the tester. It lists all set-up instructions for testing each tube type. Pages are indexed for ease and speed in locating tube types. Over 2500 listings cover nearly all tube types available. Additions are published regularly to add the newest tube types.

**VOLTAGE REGULATED**—Compensation for line voltage variations gives highly reliable test readings at all times.

**PORTABILITY**—The rugged, easy to carry case, which is made of molded plastic, allows the tester to be carried into the home on service calls, or used on the bench.

**PIN STRAIGHTENERS**—Five built-in pin straighteners accommodate all tube types with flexible pins.



## OPERATOR'S CONTROLS

(Refer to Figure 1)

- 1 Power cord storage compartment.
- 2 BAD-?-GOOD meter—indicates tube condition and grid emission.
- 3 SHORTS lamp—lights when SHORTS button 8 is pressed if tube is shorted.
- 4 Power on lamp—lights when tester is on.
- 5 TEST 2 pushbutton—activates dynamic test of second section of multi-section tubes.
- 6 TEST 1 pushbutton—activates dynamic test of tube (section one of multi-section tubes).
- 7 GRID EMISSION pushbutton—activates grid emission test.
- 8 SHORTS pushbutton—activates shorts test.
- 9 Power cord.
- 10 LIFE TEST switch—gives life expectancy test in ON position. Returns to OFF position when released.
- 11 POWER switch—turns tester ON and OFF.
- 12 HEATER switch—sets heater voltage.
- 13 Pin straighteners.
- 14 SENSITIVITY control—sets meter sensitivity for each tube type.
- 15 K jack—cathode cap connection.
- 16 G jack—grid cap connection.
- 17 RESET lever—resets program switches No. 1 thru 12 to off position simultaneously.
- 18 Program switches—switches No. 1 thru 14, used to set up test connections for programmed sockets 20.
- 19 P jack—plate cap connection for certain tubes.
- 20 Programmed sockets—Sockets No. 22 thru 30, allow testing of all tubes not tested in the “Jet-Check” sockets.
- 21 “Jet-Check” sockets—Sockets No. 1 thru 21, used for quick “Jet-Check” testing. All the most popular television and radio tubes can be tested in this section.
- 22 Z jack—plate cap connection for certain tubes.
- 23 Y jack—plate cap connection for certain tubes.
- 24 Tube chart—lists socket and settings for testing each tube type.
- 25 Plate cap, grid cap or cathode cap cable.

# OPERATING INSTRUCTIONS

## INTRODUCTION

The tube tester can be used for testing all types of tubes. The more popular television and radio tubes are tested in the "Jet-Check" sockets (sockets No. 1 thru 21), while the more uncommon tube types are tested in the programmed sockets (sockets No. 22 thru 30). Set-up information such as the correct HEATER and SENSITIVITY settings, the proper tube socket, and how to set up any other switches necessary for testing is found in the tube chart. All tube types are listed in alpha-numeric sequence in the tube chart.

The "Jet-Check" section provides very fast testing for the most commonly tested tubes, since no set-up is required other than setting the HEATER and SENSITIVITY controls. The most popular tube types are listed beside the proper test socket, along with the proper SENSITIVITY setting (example: 6EW6-77). This simplifies testing even further, allowing you to skip the use of the tube chart for test set-up. Tube types that are identical except for heater ratings (example: 6AU7, 7AU7, 12AU7) may be tested in the same socket by selecting appropriate HEATER voltage, although only one type is listed beside the socket. The first number of the tube type usually corresponds to the heater voltage.

3AL5 (set HEATER switch to 3)

6AL5 (set HEATER switch to 6)

12AL5 (set HEATER switch to 12)

When the tube type listing beside the socket has two SENSITIVITY settings (example: 12AU7-75-75), the tube contains two sections, each of which is to be tested separately. The first SENSITIVITY value is to be used with the TEST 1 pushbutton for testing the first section, and the second SENSITIVITY value is to be used with the TEST 2 pushbutton for testing the second section.

For testing tubes in the programmed section, refer to the tube chart and set the program switches as indicated. The program switches select the type of signal or voltage for each pin of the tube. For multiple-section tubes, there are multiple entries for that tube type in the chart. The tube is not completely checked until all sections have been tested. Some tubes have as many as four sections, thus four entries in the chart.

## CONDENSED TESTING PROCEDURE

1. Set the **HEATER** switch **12** for the proper heater voltage. Also set up the program switches **18** if the tube is to be tested in the programmed section.
2. Plug the tube into the correct socket. Never plug in more than one tube at a time.
3. Set the **SENSITIVITY** control, **14**.
4. Test in sequence:

<b>SHORTS</b>	Defective tube if <b>SHORTS</b> lamp <b>3</b> lights or
<b>GRID EMISSION</b>	meter <b>2</b> reads in <b>GRID EMISSION-REJECT</b> portion of scale.
<b>TEST 1</b>	Defective tube if meter reads <b>BAD</b> on <b>BAD-?-GOOD</b> scale. Some low Gm tubes use <b>TEST 2</b> .
<b>TEST 2</b>	Defective tube if meter reads <b>BAD</b> on <b>BAD-?-GOOD</b> scale. Used only on some dual-section tubes and special tube types.
<b>LIFE TEST</b>	Short tube life if meter reading drops <b>25%</b> from <b>TEST 1</b> or <b>TEST 2</b> reading.

## COMPREHENSIVE TESTING PROCEDURE

### A. PREPARATION FOR TESTING

1. Open the case.
2. Connect the power cord **9** to an ac outlet.
3. Turn the **POWER** switch **11** ON. The pilot lamp **4** should light.
4. Find the listing in the tube chart **24** for the tube type to be tested. Refer to the following examples for additional information on how to use the tube chart.
5. Set the **HEATER** switch **12** for the correct heater voltage before inserting the tube into the test socket. Failure to observe this precaution could result in a burned out filament.



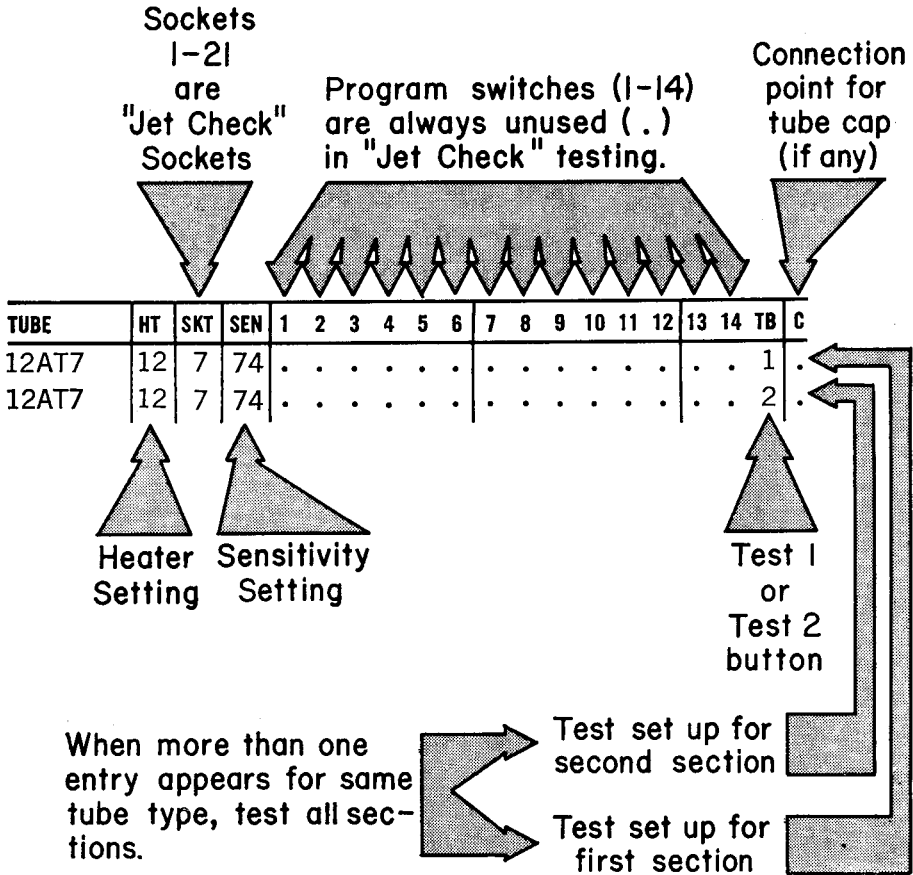
## B. "JET-CHECK" SET UP

1. If the SOCKET column of the tube chart specifies sockets No. 1 thru 21, the tube will be tested in the "Jet-Check" section. Plug the tube into the specified socket. Never plug in more than one tube at a time.
2. For tubes with caps, connect the cap (supplied with tester) to the receptacle specified in the chart (X or Y) **22, 23**.

### WARNING

Do not push the TEST 1 or TEST 2 buttons while handling an exposed plate cap lead. Up to 200 volts ac or dc is present at that time.

3. Set the SENSITIVITY control **14** as indicated in the chart. The tube is now ready for testing.



Typical Example—"Jet Check" Setup

### C. PROGRAMMED SET-UP

1. If the **SOCKET** column of the tube chart specifies sockets No. 22 thru 30, the tube will be tested in the programmed section. Do not plug the tube into the socket until the program switches **18** are properly set.
2. Pull the **RESET** level **17** fully forward to reset program switches 1 thru 12 to the off (●) position.
3. Set the program switches **18** as specified in the chart. For multi-section tubes, each section is tested separately. When this occurs, initially, program the first listing in the chart.
4. Plug the tube into the specified socket. Never plug in more than one tube at a time.
5. For tubes with caps, connect the cap (supplied with tester) to the receptacle specified in the chart (**G, K, P, Y or Z**) **15, 16, 19, 22** or **23**.

#### WARNING

Do not push the **TEST 1** or **TEST 2** buttons while handling an exposed plate cap lead. Up to 200 volts ac or dc is present at that time.

6. Set the **SENSITIVITY** control **14** as specified in the tube chart. The tube is now ready for testing.

### D. SHORTS TEST

Always perform the **SHORTS** test first. A shorted tube could damage the tester.

1. Press and hold down the **SHORTS** pushbutton **8**.
2. The tube is defective if the **SHORTS** lamp **3** lights or the meter deflects into the **GRID EMISSION REJECT** portion of the scale.
3. Tap the tube gently to check for intermittent shorts. Release the **SHORTS** button.

### E. GRID EMISSION AND GAS TEST

1. Press and hold down the **GRID EMISSION** pushbutton **7**.
2. The tube is defective if the **SHORTS** lamp lights or the meter deflects into the **GRID EMISSION-REJECT** portion of the scale. Release the **GRID EMISSION** pushbutton.

### F. TUBE QUALITY TEST

(Mutual Conductance Test for Amplifiers, Emission Test for Diodes and Rectifiers)

1. Press the TEST 1 **6** or TEST 2 **5** button, as specified in the tube chart.
2. Read the tube condition on the BAD-?-GOOD scale of the meter. Tubes that read BAD are defective. The decision whether or not to replace tubes that read in the (?) portion of the scale depends upon their application. For amplifiers that have low input signal levels (such as rf amplifiers), and tubes that operate at near maximum capacity, questionable tubes should be discarded. However, if fairly high input signals are used and the tube has reserve gain in normal operating conditions (for example, an audio preamplifier—seldom are they driven to full capacity), a questionable tube could serve satisfactorily.

### COMMENTS

- Certain low power tubes cannot drive the meter to the GOOD portion of the scale, even if normal. The minimum value is specified in the tube chart immediately below the tube listing in such cases.
- The mutual conductance test may be used to select a balanced pair of amplifiers (for push-pull applications, for example) by using the numerical reference scale on the meter and selecting two tubes (or a tube with two identical sections) that give equal readings.
- The second section of many dual-section tubes is checked by resetting the program switches and again using the TEST 1 button. Follow the tube chart data.
- When testing additional sections of multisection tubes, reset program switches to the off (●) position by use of the reset lever after each section is tested.
- **WHEN TUBES ARE REPROGRAMMED TO TEST ADDITIONAL SECTIONS REPEAT THE SHORTS TEST AND GRID EMISSION & GAS TEST FOR EACH SECTION.**

### G. LIFE TEST

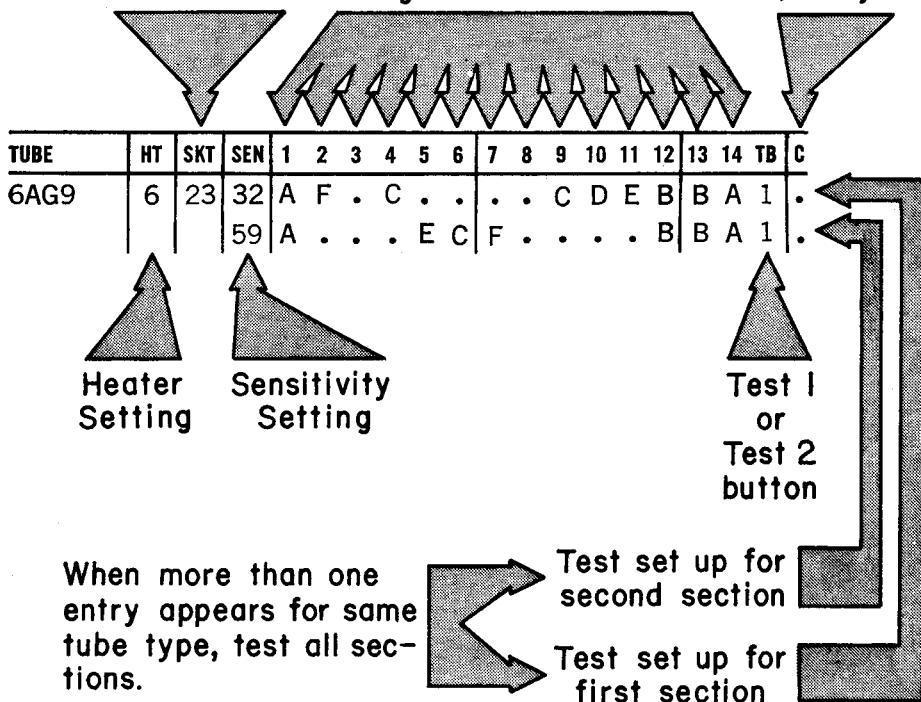
1. Press and hold down the TEST 1 or TEST 2 button as specified on tube chart (repeat the tube quality test) until the reading remains constant after warmup.
2. Note the reading on the numerical scale of the meter.
3. Continue to hold the TEST button and push the LIFE TEST switch **10** to the ON position.
4. After 10 seconds, again note the meter reading and compare it with the original reading (the 10-second period allows the heater to stabilize at the lower value). If the tube has good life expectancy, both

readings should be approximately equal. A significant drop (25%) means that the tube is near the end of its useful life.

Set each of the program switches (1-14) to the position indicated in the tube chart. Switch #1 selects the connection for pin 1 of the tube, switch #2 selects the connection for pin 2 of the tube etc. Switch #13 selects bias and switch #14 selects plate voltage to match the tube being tested.

Sockets 22-30 are programmed Sockets

Connection point for tube cap (if any)



When more than one entry appears for same tube type, test all sections.

Test set up for second section

Test set up for first section

Any special instructions are listed immediately below the test set up. (Example: Good over 40)

Typical Example—Programmed Testing

# PRINCIPLES OF TUBE TESTING

## DYNAMIC MUTUAL CONDUCTANCE TESTING

### A. Introduction

In radio and television circuits practically all tubes (except rectifiers and diodes) are used as some type of amplifier. Even oscillator circuits (i.e. —R.F. or horizontal oscillators) are basically amplifiers with regenerative feedback. Therefore, the most important characteristic to be checked to determine how effectively any radio or TV tube will function in its circuit, is its ability to amplify. This, in turn, is governed by its mutual conductance.

The mutual conductance is the ratio of change in the plate current that results from a small change in grid voltage.

$$G_m = \frac{\Delta I_p}{\Delta E_g} \quad \text{where:}$$

$\Delta I_p$  = a change in plate signal current

$\Delta E_g$  = a small change in grid signal voltage.

The amplification of a circuit =  $G_m R_l$ . Where  $R_l$  is the equivalent load resistance of the stage.

Since  $R_l$  is constant in any circuit, we see that the amplification depends directly on the  $G_m$  of the tube.

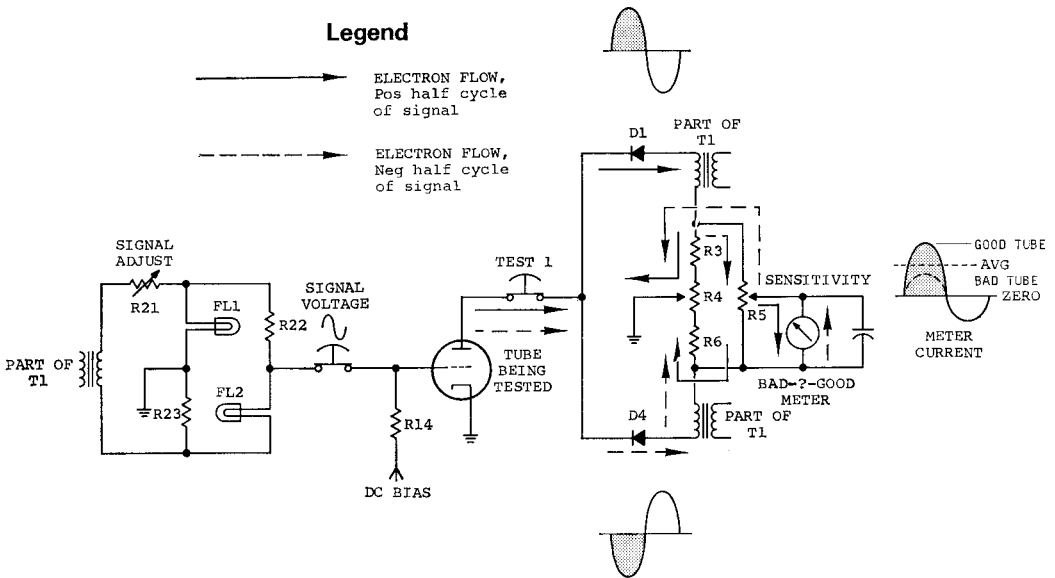


Figure 1. Dynamic Mutual Conductance Testing

## B. Circuit Analysis

Refer to Figure 1. Transformer T1 provides the ac grid signal voltage for the  $G_m$  test. The signal from the secondary of T1 is developed across the bridge network consisting of R22, R23, FL 1 and FL 2. The bridge network gives automatic line voltage compensation as follows:

- An increased transformer voltage causes the lamps to burn brighter and hotter.
- Resistance of the bulbs increase as they become hotter.
- As the resistance of the bulbs increases, proportionally more voltage is dropped across the bulbs and less across the resistors.
- The signal level at the output of the bridge decreases.

The opposite conditions apply when the primary voltage decreases. Thus, the network compensates under high line voltage conditions to provide less signal and under low line voltage conditions to provide more signal. This variation in signal drive compensates for plate voltage variations so that meter readings become strictly a matter of tube condition, and are not affected by line voltage variations.

Adjustable resistor R21 is a calibration adjustment which sets the signal level. A negative dc power supply circuit furnishes bias voltage for the tube being tested. Both signal and bias are applied to the grid of the tube under test.

During the  $G_m$  test, plate voltage for the tube is alternately provided by rectifier circuits D1 and T1, then D4 and T1. The plate current path is completed through a bridge network R3, R4, R5 and R6. The relative  $G_m$  meter (BAD-?-GOOD meter) is connected across one leg of the bridge network to sample plate current.

When a resistive load is placed in the tube socket, which represents a tube with zero  $G_m$ , plate current through the bridge is balanced and the meter reads zero. Plate currents of equal amplitudes but opposite directions give an average current of zero  $\mu\text{A}$ .

The  $G_m$  for a given tube can be measured accurately by applying the correct amount of a.c. signal voltage to the grid and measuring the resulting a.c. plate current. This is done by means of a sensitive bridge circuit.

Measuring the mutual conductance of a tube provides the most accurate and all inclusive single test that can be made on any tube.

When an amplifying tube is placed in the circuit, the signal voltage is in-phase with one plate transformer winding and out-of-phase with the other plate transformer winding. The positive going portion of the signal

causes the plate current through D1 and T1 to increase, while the negative going portion of the signal causes plate current through D4 and T1 to decrease. The meter reads the difference between the two currents, which is proportional to the  $G_m$  of the tube.

### C. Dual Section Tubes

Refer to Figure 2. Each section of a dual section tube is tested separately. The TEST 1 button checks the section with the most elements. For example, in a pentode-triode, TEST 1 checks the pentode section and TEST 2 checks the triode section. For tubes with two identical sections such as twin triodes, the two readings are valuable for selecting tubes with balanced sections for push-pull circuits.

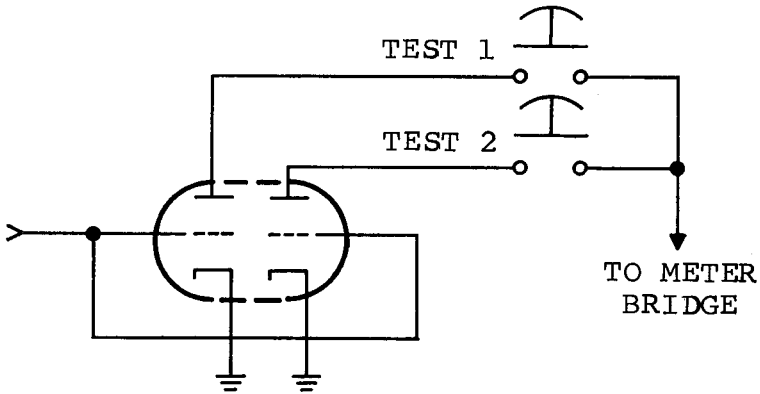


Figure 2. Testing of Individual Sections of Dual Section Tubes.

### DIODE AND RECTIFIER EMISSION TESTING

Refer to Figure 3. Diodes have no  $G_m$ , therefore cannot be given a dynamic mutual conductance test. Diodes are tested by applying an ac

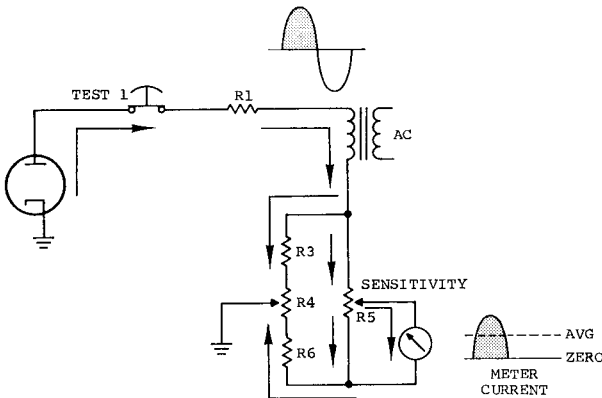


Figure 3. Diode and Rectifier Emission Test

voltage to the plate. The rectifying action of the tube allows current to flow only in one direction through the meter and an indication of the tube's emission is measured. Low voltage diodes such as signal detectors use a current limiting resistor to represent actual circuit conditions and to limit current to a safe level. Rectifiers are tested without current limiting to test their current capabilities under actual circuit conditions. High voltage rectifiers are tested from a separate high voltage ac source to complete the full range of dynamic test conditions.

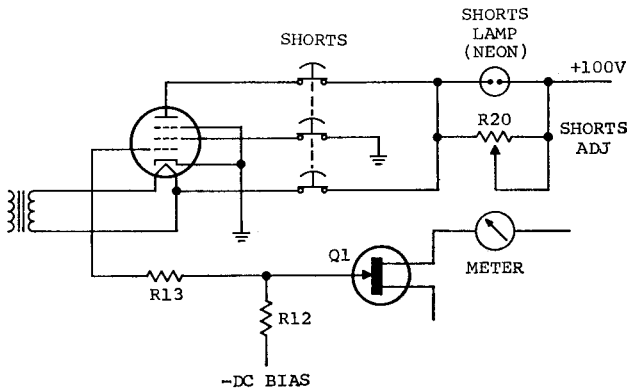


Figure 4. Shorts Test

## SHORTS TEST

Refer to Figure 4. The shorts test applies normal bias voltage to the tube being tested, but grounds the screen while applying a positive dc voltage to the plate and the filament. If any element is shorted to the plate or filament, the resulting current will develop a high potential across resistor R20 and fire the neon SHORTS lamp also, any leakage resistance of 1 megohm or less will cause the lamp to light. If any element is shorted to the grid, grid current will flow and develop a voltage across R12. Such grid current biases field effect transistor Q1 into conduction and produces a meter reading in the GRID EMISSION REJECT portion of the scale.

## GRID EMISSION TEST

### A. Introduction

The Grid Emission 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 mate-



rial 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”.

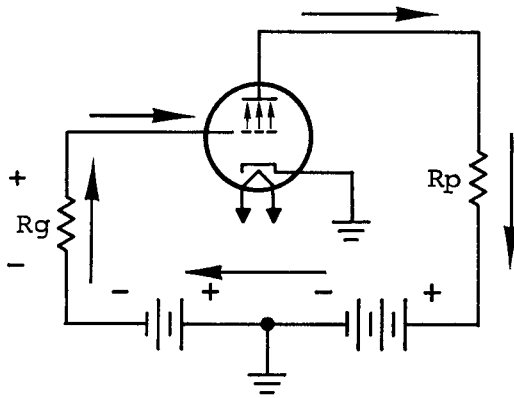


Figure 5. Grid Emission Current

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. (See Fig 5.) 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”. 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 5 we noted that the grid would tend to go more positive if negative grid current flowed.

In Figure 6, a typical I.F. stage, we see that if there is any negative grid current, the bias voltage in that stage and other associated stages will go more positive because of the flow of current through  $R_1$ . Because of the high resistance values normally encountered in tube type AGC circuits, very little negative grid current is necessary to cancel the effects of the negative AGC voltage. Making the grid more positive will drive the tubes to saturation, causing clipping or overloading.

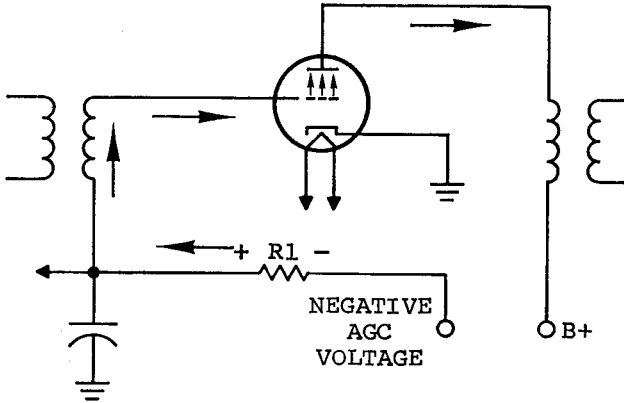


Figure 6. Typical I.F. Stage

After detection, a video signal normally appears as shown in Figure 7. If the signal is clipped in an I.F. stage, it will look like Figure 8. 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 snaking of the picture.



Figure 7. Normal Video and Sync Signal

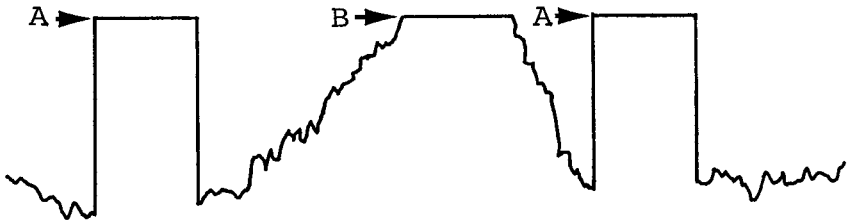


Figure 8. Overloaded or Clipped Video and Sync Signal

## B. Circuit Analysis

Refer to Figure 9. A highly sensitive, solid state grid emission test circuit measures leakage as low as  $\frac{1}{2}$  microampere (100 megohms leakage resistance). During the grid emission test, normal plate and screen voltages are applied to the tube under test, but a high negative dc voltage is applied to the grid. The tube is biased well beyond cut-off so that no plate current flows in a good tube. The meter is driven by a field effect transistor (FET)

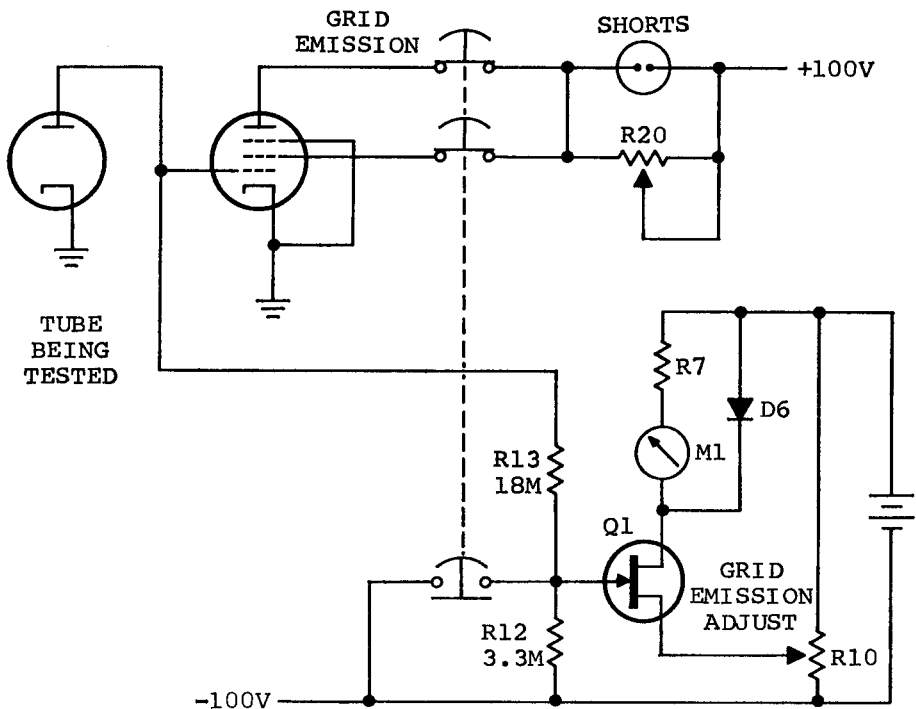


Figure 9. Grid Emission Test

Q1. This FET is also biased to cut-off, resulting in a zero meter reading.

However, if the tube is gassy or its grid is contaminated with some of the cathode coating, the negative grid emission flows through resistor R12 and R13 which are also common to the FET gate. This current causes the gate voltage of the FET to rise in the positive direction, biasing it into conduction and producing a meter reading. The greater the grid emission current, the greater the meter reading. If the leakage current is excessive the SHORTS lamp will also light.

Diodes are checked for shorts or gas by this test. The negative dc voltage is applied to the plate of the diode, while its cathode is grounded. Any reverse current will develop a forward bias to the FET and cause the meter to deflect.

A solid state diode across the meter shunts excessive current to protect the meter. More than full scale readings are easily obtained due to the extreme sensitivity of the circuit; therefore, meter protection is required.

Calibration adjustment R10 in the source circuit of the FET sets the sensitivity of this test circuit so that leakage paths of 100 megohms or less will cause the meter to deflect into the GRID EMISSION-REJECT portion of the meter.

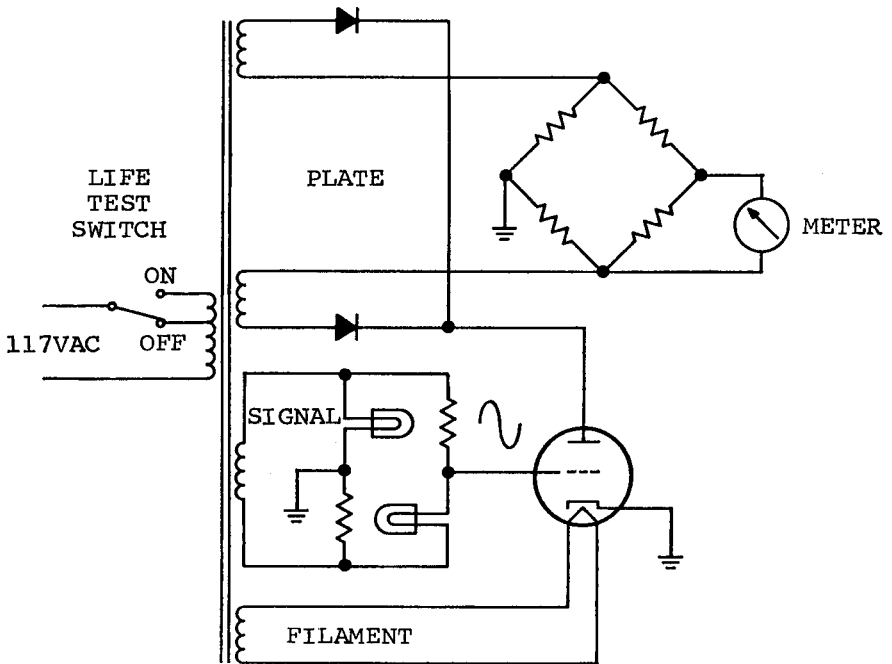


Figure 10. Life Test

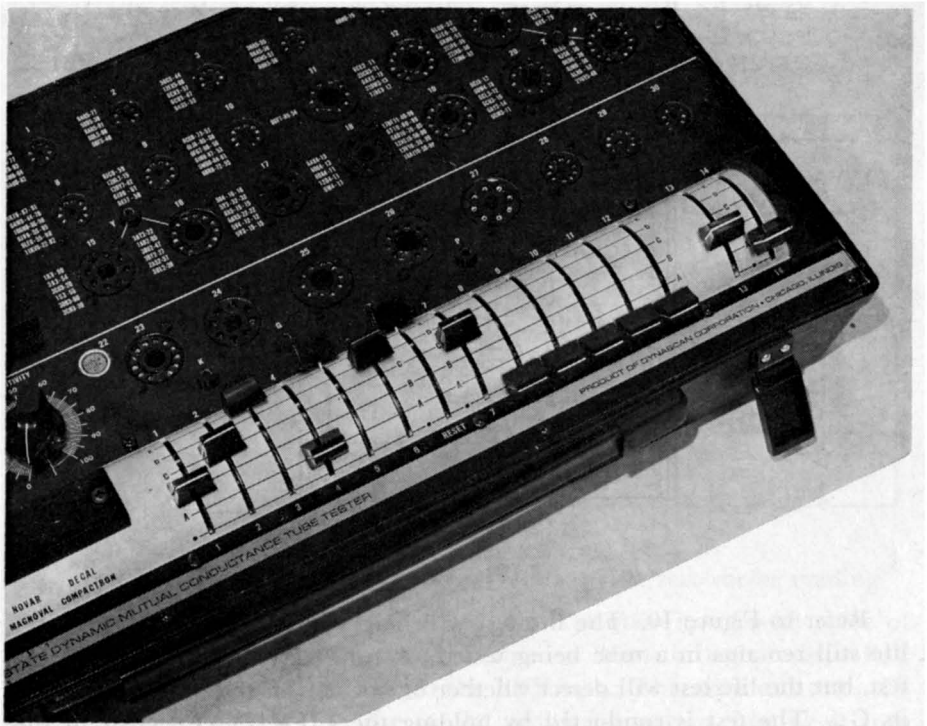
## LIFE TEST

Refer to Figure 10. The life test will help you judge how much useful life still remains in a tube being tested. A tube may test okay on the  $G_m$  test, but the life test will detect whether or not it is in the process of losing its  $G_m$ . The test is conducted by holding the LIFE TEST switch in the ON position and repeating the  $G_m$  test.

When the LIFE TEST switch is placed in the ON position, additional windings are connected into the primary which reduces the voltage induced into the secondary windings by 10%. Filament and plate voltages drop. However, the compensating bridge network increases the amount of signal applied to the tube. The meter reading will drop very little if the tube has sufficient reserve to continue to operate normally at reduced heater voltage. In fact, some meter readings will actually increase slightly due to the small increase in signal level. If the meter reading does not drop, the tube is in excellent condition. But if the tube under test has a depleted space charge, a large drop will occur in the meter reading. A drop of 25% of the normal meter reading indicates that the tube is reaching the end of its useful life and should be replaced.

The LIFE TEST switch must be held in the ON position during the test. It is spring loaded and returns to the OFF position when released.

The switch should be held ON for a few seconds to allow the tube filaments to cool to the reduced value and stabilize before the meter reading is taken. Ten seconds should be adequate for virtually all tube types.



**Figure 11. Programmed Testing**

## **PROGRAMMED TESTING**

Switches No. 1 thru 14 set up the test connections for testing tubes in the programmed section of the tube tester. These program switches are set as listed in the tube chart. Each of these switches has seven positions labelled ●, A, B, C, D, E and F. Switches No. 1 thru 12 set up the function for each pin of the tube; switch No. 1 selects the function of pin 1 of the tube, switch No. 2 selects the function of pin 2, etc. The first position of each switch, marked with a dot (●) is the off (open-circuited) position. It is used when no connection is to be made to that pin. For example, when testing a 7-pin tube, switches No. 8 thru 12 are placed in the ● position. The open-circuited position is also used if the pin has no internal connection in the tube or the pin is intentionally excluded from a test (such as in multi-section tubes where each section is programmed and

tested separately). Positions A thru F of these switches are explained in the accompanying table.

The RESET mechanism is mechanically linked to switches No. 1 thru 12. Pulling the lever to the RESET position returns all 12 switches to the ● position in one easy motion. This feature is very handy since it is usually easier and faster to set up each test from a standard position than from their previous random settings. It is also safer, because there is less chance of inadvertently leaving a switch in the wrong position which could damage the tube or the tester. There's a definite detent at each switch position. By always starting at the ● position; it is easy to "feel" the proper setting of each switch, without undue reading of the panel markings. For example, if the chart says that switch No. 1 should be set to position C, the switch should be pushed to the third notch which is easily felt as the switch lever is moved. Meanwhile, the user may continue reading the chart for the next switch position.

Switch No. 13 sets the bias for the tube being tested. Correlation of switch positions A thru F to the actual bias voltages is given in an accompanying table.

Switch No. 14 selects the type of test to be performed. This selection determines the type and values of plate voltage to match the tube being tested.

### Switches No. 1 thru 12

POSITION	FUNCTION	REMARKS
●	open-circuited	off
A	heater	
B	heater	
C	cathode, suppressor grid	ground
D	screen	100 V
E	grid	bias set by switch No. 13
F	plate	set by switch No. 14

### Switch No. 13

POSITION	FUNCTION	REMARKS
●	open-circuited	off
A	low bias (0.5 V)	1.5 VAC signal
B	- 2.5 V	1.5 VAC signal
C	- 7.5 V	1.5 VAC signal
D	high bias (- 19.5 V)	1.5 VAC signal
E	high signal	35 VAC signal
F	high VAC 110 VAC	

### Switch No. 14

POSITION	FUNCTION	REMARKS
●	open-circuited	off
A	$G_m$	190 VDC
B	diode	35 VAC, current limited
C	rectifier	35 VAC, current not limited
D	high voltage rectifier	190 VAC
E	$G_m$ (current limited)	190 VDC
F	low $G_m$	90 VDC

## TUBE CHART SUBSCRIPTION SERVICE

The Tube chart lists over 2500 tube types. Included in the list are hybrid auto radio tubes, a wide assortment of tubes used in audio high fidelity equipment, and foreign tubes in addition to all the common tube types used in television and radio sets.

To keep your chart up to date, it is recommended that you subscribe to the B & K chart mailing service. If you do not wish to use this subscription service, the latest available chart may be purchased at any time from the factory. Please include the Model and Serial number of your instrument.

*Address requests to:*

Service Department  
B&K Division of Dynascan Corporation  
1801 W. Belle Plaine Ave.  
Chicago, Illinois 60613

## CV TUBE TYPE CONVERSION

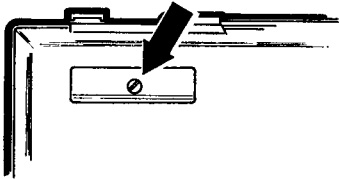
All CV (Commonwealth Valve) tube types of British origin are now discontinued or converted to the European common market numbering system. Test data in the tube chart is for the latter numbering system. For all CV tube types, use the following conversion chart and test as instructed for the equivalent type.

CV Type	Equivalent	CV Type	Equivalent	CV Type	Equivalent
CV131	= 6CQ6	CV573	= 6X5	CV706	= 6U7
CV133	= 6C4	CV574	= 6X5	CV717	= 5R4
CV136	= 6AM5	CV575	= 5U4	CV723	= 1619
CV138	= 6AM6	CV578	= 6A8	CV726	= 35Z3
CV140	= 6AL5	CV579	= 6A8	CV728	= 1P5
CV216	= 0D3	CV580	= 6A8	CV729	= 5V4
CV283	= 6AL5	CV581	= 6C5	CV731	= 6F6
CV450	= 6CN6	CV582	= 6C5	CV732	= 6W4
CV452	= 6AT6	CV583	= 6C5	CV747	= 6AC7
CV453	= 6BE6	CV586	= 6L6	CV753	= 1A3
CV454	= 6BA6	CV587	= 6Q7	CV755	= 1A5
CV455	= 12AT7	CV588	= 6Q7	CV756	= 1A5
CV491	= 12AU7	CV589	= 6Q7	CV760	= 1B7
CV492	= 12AX7	CV590	= 6SJ7	CV764	= 1D5
CV493	= 6X4	CV591	= 6SJ7	CV768	= 1F5
CV511	= 6V6	CV592	= 6SJ7	CV770	= 1F7
CV538	= 12SA7	CV593	= 5Y3	CV772	= 1G6
CV544	= 12SK7	CV594	= 6SH7	CV773	= 1G6
CV547	= 12SQ7	CV595	= 6SH7	CV775	= 1LA6
CV551	= 25C6	CV657	= 6J7	CV776	= 1LB4
CV552	= 25L6	CV660	= 6AC7	CV777	= 1LC5
CV553	= 25L6	CV661	= 6AB7	CV778	= 1LC6
CV554	= 6H6	CV664	= 9002	CV779	= 1LD5
CV559	= 25Z6	CV665	= 9003	CV780	= 1LH4
CV561	= 35L6	CV686	= 0C3	CV781	= 1LN5
CV562	= 35L6	CV692	= 0Z4	CV782	= 1R5
CV565	= 35Z3	CV694	= 12SG7	CV783	= 1S4
CV567	= 35Z5	CV697	= 12SJ7	CV784	= 1S5
CV568	= 35Z5	CV698	= 13SJ7	CV785	= 1T4
CV571	= 50L6	CV700	= 12SR7	CV786	= 1T5
CV572	= 6X5	CV703	= 6K8	CV797	= 2D21

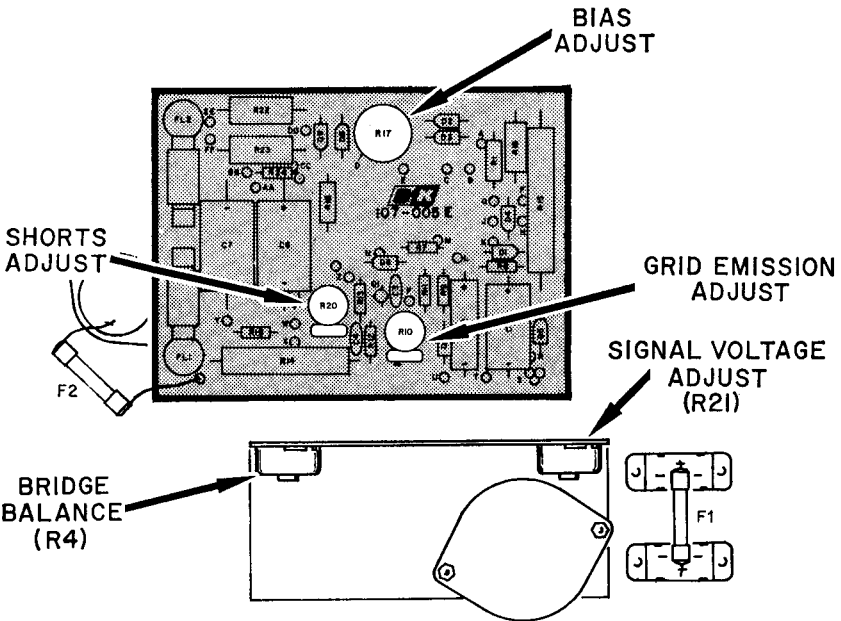
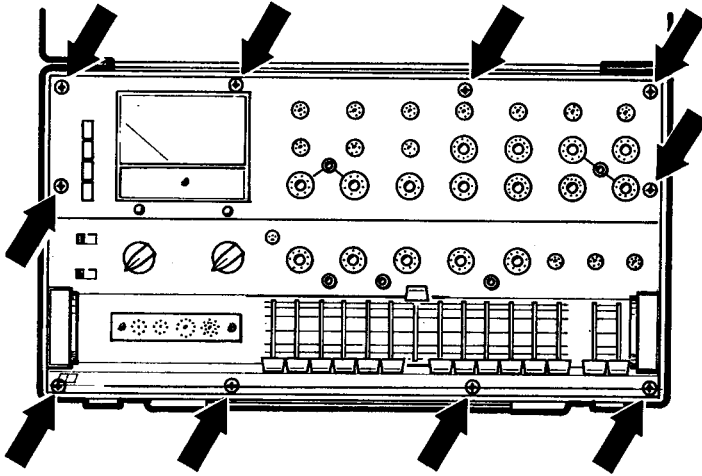


CV Type	Equivalent	CV Type	Equivalent	CV Type	Equivalent
CV805	= 50Y6	CV896	= 7K7	CV1790	= 7Z4
CV807	= 3A4	CV897	= 7J7	CV1800	= 1A7
CV808	= 3A5	CV898	= 7N7	CV1802	= 1A7
CV815	= 3D6	CV899	= 7Q7	CV1803	= 1C5
CV818	= 3Q4	CV900	= 7R7	CV1805	= 1C5
CV819	= 3Q5	CV901	= 7Y4	CV1811	= 1D8
CV820	= 3S4	CV910	= 12A8	CV1818	= 1H5
CV841	= 5U4	CV916	= 12H6	CV1819	= 6P5
CV842	= 5W4	CV917	= 12J7	CV1820	= 1H5
CV844	= 6AC5	CV918	= 12K7	CV1821	= 1N5
CV845	= 6AC5	CV919	= 12SF5	CV1823	= 1N5
CV846	= 6AC7	CV920	= 12SF5	CV1824	= 1Q5
CV848	= 6AG5	CV921	= 12SF7	CV1826	= 1Q5
CV849	= 6AC7	CV922	= 12SH7	CV1829	= 1T5
CV850	= 6AK5	CV924	= 12SL7	CV1832	= 0A2
CV851	= 6B4	CV925	= 12SN7	CV1833	= 0B2
CV852	= 6C4	CV930	= 14F7	CV1846	= 5T4
CV858	= 6J6	CV939	= 25B6	CV1849	= 5W4
CV862	= 6L5	CV945	= 28D7	CV1851	= 5X4
CV865	= 6SD7	CV946	= 28D7	CV1852	= 5X4
CV866	= 6SJ7	CV995	= 6AJ5	CV1854	= 5Y3
CV867	= 6SR7	CV1067	= 6J5	CV1856	= 5Y3
CV873	= 6ZY5	CV1071	= 5U4	CV1857	= 5Y4
CV876	= 7A6	CV1074	= 6J7	CV1862	= 6AQ5
CV877	= 7A7	CV1268	= 5Y3	CV1863	= 5Z4
CV878	= 7A8	CV1280	= 6L7	CV1864	= 5Z4
CV879	= 7B4	CV1285	= 6N7	CV1873	= 6AB7
CV880	= 7B5	CV1301	= 6H6	CV1876	= 6AC7
CV881	= 7B5	CV1375	= 6BY7	CV1878	= 6AD7
CV882	= 7B6	CV1377	= 5AR4	CV1882	= 6AG7
CV883	= 7B8	CV1633	= 12AT7	CV1893	= 6B8
CV885	= 7C5	CV1649	= 6C5	CV1894	= 6B8
CV886	= 7C5	CV1741	= 6CA7	CV1895	= 0A3
CV887	= 7C6	CV1753	= 35A5	CV1902	= 6D8
CV890	= 7E5	CV1757	= 9001	CV1908	= 6F5
CV891	= 7E6	CV1758	= 1L4	CV1909	= 6F5
CV892	= 7E7	CV1762	= 6AK6	CV1910	= 6F5
CV893	= 7F7	CV1763	= 6J4	CV1911	= 6F6
CV894	= 7G7	CV1777	= 7C7	CV1912	= 6F6
CV895	= 7H7	CV1784	= 6AK7	CV1926	= 6G6

CV Type	Equivalent	CV Type	Equivalent	CV Type	Equivalent
CV1928	= 12BA6	CV1961	= 12AU6	CV2390	= 3A4
CV1929	= 6H6	CV1962	= 6R7	CV2500	= 35Z4
CV1930	= 6H6	CV1963	= 6R7	CV2507	= 1U4
CV1931	= 6H6	CV1964	= 6R7	CV2522	= 6AS6
CV1932	= 6J5	CV1966	= 6SA7	CV2524	= 6AU6
CV1933	= 6J5	CV1967	= 6SA7	CV2526	= 6AV6
CV1934	= 6J5	CV1969	= 6SC7	CV2534	= 50L6
CV1935	= 6J7	CV1970	= 6SC7	CV2704	= 7E5
CV1936	= 6J7	CV1972	= 6SF5	CV2706	= 7C4
CV1937	= 6J7	CV1973	= 6SF5	CV2714	= 1614
CV1938	= 6K6	CV1974	= 6S7	CV2716	= 6SC7
CV1940	= 6K6	CV1975	= 6S7	CV2721	= 6CJ6
CV1941	= 6K7	CV1976	= 6SA7	CV2748	= 5Z4
CV1942	= 6K7	CV1978	= 6SG7	CV2769	= 9006
CV1943	= 6K7	CV1981	= 6SK7	CV2901	= 6267
CV1944	= 6K8	CV1982	= 6SK7	CV2938	= 6CA7
CV1945	= 6K8	CV1985	= 6SL7	CV2975	= 6BQ5
CV1946	= 6K8	CV1988	= 6SN7	CV2983	= 3V4
CV1947	= 6L6	CV1990	= 6SQ7	CV2984	= 6080
CV1948	= 6L6	CV1991	= 6SQ7	CV3512	= 5696
CV1949	= 6D4	CV1993	= 6SS7	CV3523	= 6146
CV1950	= 6L7	CV1995	= 6ST7	CV3798	= 0A3
CV1951	= 6L7	CV1996	= 6ST7	CV3799	= 0B3
CV1956	= 6N7	CV2128	= 6AJ8	CV4007	= 5726
CV1957	= 6N7	CV2129	= 5763	CV4010	= 5654
CV1958	= 6N7	CV2370	= 3S4	CV4018	= 2D21
CV1959	= 50C5			CV4024	= 6201



**NOTE —**  
 REMOVE SCREW FROM  
 BOTTOM OF CASE BE-  
 FORE REMOVING FRONT  
 PANEL SCREWS.



**Figure 12. Parts and Adjustment Locations**

# SERVICING AND MAINTENANCE

## SERVICING

The simplicity of design, use of solid state circuits, ruggedness and dependability of this instrument gives long, maintenance-free operation. Servicing consists of occasionally wiping it free of dust and replacement of any broken or malfunctioning part upon failure to operate normally. Certain parts such as bulbs and fuses are more subject to eventual failure. The locations of these components are shown in the accompanying figure.

All necessary voltage readings are given on the schematic. If either of the No. 55 Pilot Lamps under the Socket Panel fails, both lamps must be replaced at the same time with a No. 55 type only.

## CALIBRATION

Calibration should be checked occasionally to assure continued accuracy in testing. Accuracy of calibration is quick and simple to check. Recalibration, when necessary, may be performed with simple test equipment found in any service shop. A good quality volt-ohmmeter or vtvm is the only instrument required. The calibration adjustments are shown and identified in Figure 12.

### A. SIGNAL LEVEL

1. Connect a voltmeter between pin 1 of socket No. 1 and chassis ground (pin 7). If a volt-ohmmeter is used, connect a capacitor in series with the meter lead to block the dc bias voltage that is also present on the pin. (Capacitor should be 1.0 microfarad or more @ 200V DC or more. Do not use an electrolytic or polarized capacitor.
2. Set the meter to a low ac voltage scale. A 3-volt or 5-volt scale is ideal.
3. Press test I button.
4. Adjust the signal level calibration potentiometer **R21** for 1.5 volts ac rms.

### B. BIAS VOLTAGE

1. Connect the voltmeter to measure the dc voltage at pin 1 of socket No. 1 with respect to chassis ground (front panel or pin 7 of socket No. 1).
2. **PRESS TEST I BUTTON.**
3. Adjust the bias potentiometer **R17** for 2.5 volts dc.

### C. METER BRIDGE BALANCE

1. Connect a 10K ohm 5 watt resistor between pins 2 and 5 of socket No. 1.
2. Adjust sensitivity control to 100.
3. Press the TEST 1 button.
4. Adjust the meter bridge balance potentiometer **R4** for an exact zero reading on the BAD-?-GOOD meter.

### D. SHORTS SENSITIVITY

1. Connect a 1 megohm resistor between pins 2 and 5 of socket No. 1.
2. Press the SHORTS button.
3. Adjust the shorts sensitivity potentiometer **R20** so the SHORTS light just comes on.

### E. GRID EMISSION SENSITIVITY

1. Connect 100 megohms resistance between pins 1 and 7 of socket No. 1.
2. Press the GRID EMISSION button.
3. Adjust the grid emission sensitivity potentiometer **R10** so the meter reads at the upper edge of the green segment of the GRID EMISSION-REJECT scale. (100 megohms may be obtained by simply connecting five 20-megohm resistors in series or ten 10-megohm resistors in series, etc.)

# WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Check common electronics parts. Always check instruction manual for applicable adjustments after such replacement.
3. Defective parts removed from units which are within the warranty period should be sent to the factory, prepaid, with model and serial number of product from which removed, and date of product purchase.
4. If the above mentioned procedures do not correct the difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to:

*Service Department*

B & K DIVISION OF DYNASCAN CORPORATION  
1801 West Belle Plaine Avenue  
Chicago, Illinois 60613



## WARRANTY

"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether expressed or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.'*"



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