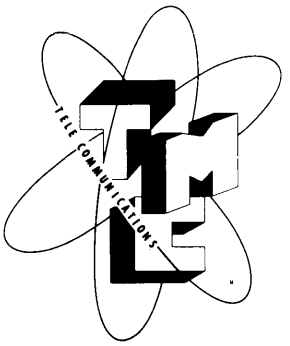
INSTRUCTION BOOK

for

DIVERSITY VISUAL MONITOR MODEL DVM



THE TECHNICAL MATERIEL CORPORATION
Mamaroneck, New York

TABLE OF CONTENTS

SECTION I—GENERAL DESCRIPTION

Paragraph — Page

1. Purpose and Basic Principles 1-1
2. Description of Unit 1-1

SECTION II—THEORY OF OPERATON

1. General Description of Circuits 2-0
   a. Visual Operation 2-0
   b. Audio Operation 2-4
   c. BFO Operation 2-4
   d. Calibration Operation 2-4

SECTION III—INSTALLATION

1. Installation Procedure 3-1

SECTION IV—OPERATION

1. Initial Adjustments CW/MCW-Phone Operations 4-1
2. Initial Adjustments Frequency Shift Operations 4-2

SECTION V—OPERATOR'S MAINTENANCE

1. Emergency Maintenance 5-1

SECTION VI—PREVENTATIVE MAINTENANCE

1. Routine Maintenance 6-1

SECTION VII—CORRECTIVE MAINTENANCE

1. DVM Oscilloscope (V-13) Adjustment and Test 7-0
2. DVM Circuit Alignment 7-0
3. Schematic Diagram 7-3, 7-4
4. Electrical Parts List 7-5

LIST OF ILLUSTRATIONS

SECTION I—GENERAL DESCRIPTION

Figure — Page

1-1. DIVERSITY VISUAL MONITOR, MODEL DVM FRONT VIEW 1-0

1-2. DIVERSITY VISUAL MONITOR, MODEL DVM REAR VIEW 1-00

SECTION II—THEORY OF OPERATON

2-1. BLOCK DIAGRAM 2-1

2-2. REFERENCE MARKER, CORRECTLY TUNED SIGNAL PULSE 2-2

2-3. SIGNAL MONITORING, INCORRECTLY TUNED CW OR PHONE 2-3

SECTION VII—CORRECTIVE MAINTENANCE

7-0. DIVERSITY VISUAL MONITOR, MODEL DVM TOP VIEW 7-00

7-00. DIVERSITY VISUAL MONITOR, MODEL DVM BOTTOM VIEW 7-000

7-1. SCHEMATIC DIAGRAM 7-3, 7-4

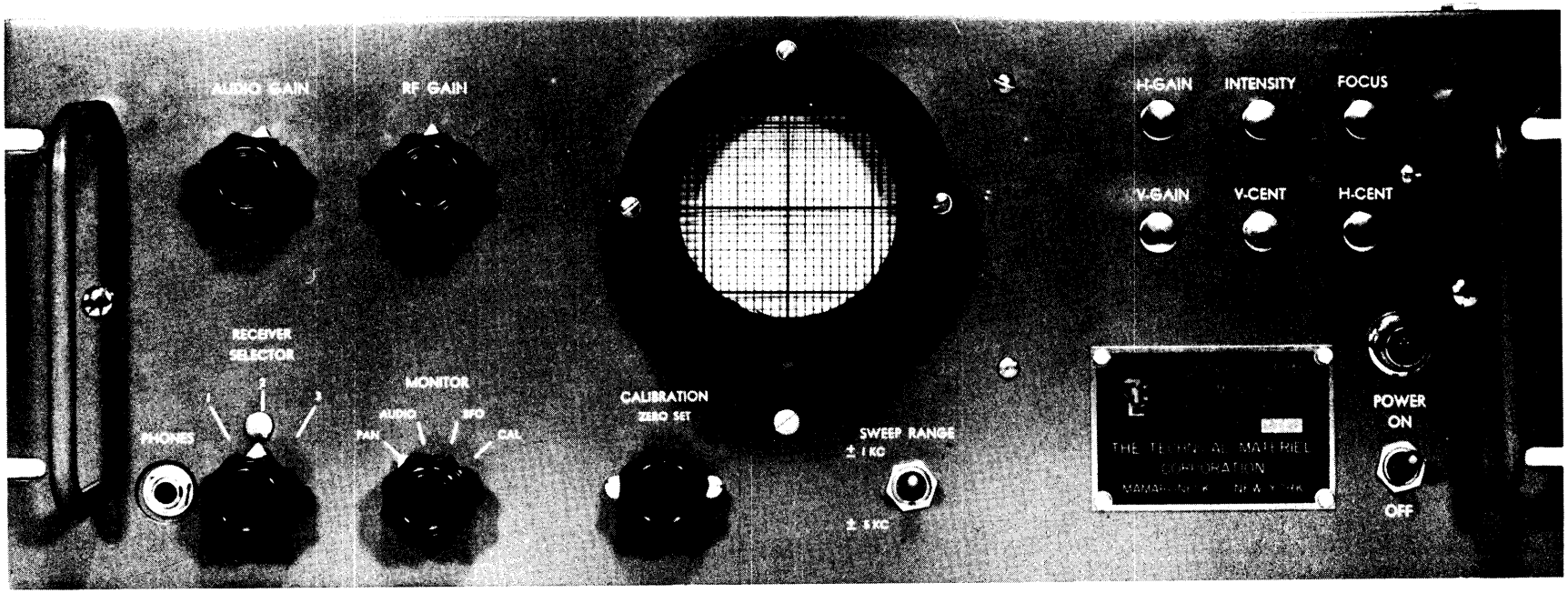


Figure 1-0. Diversity Visual Monitor, Model DVM-* Front View

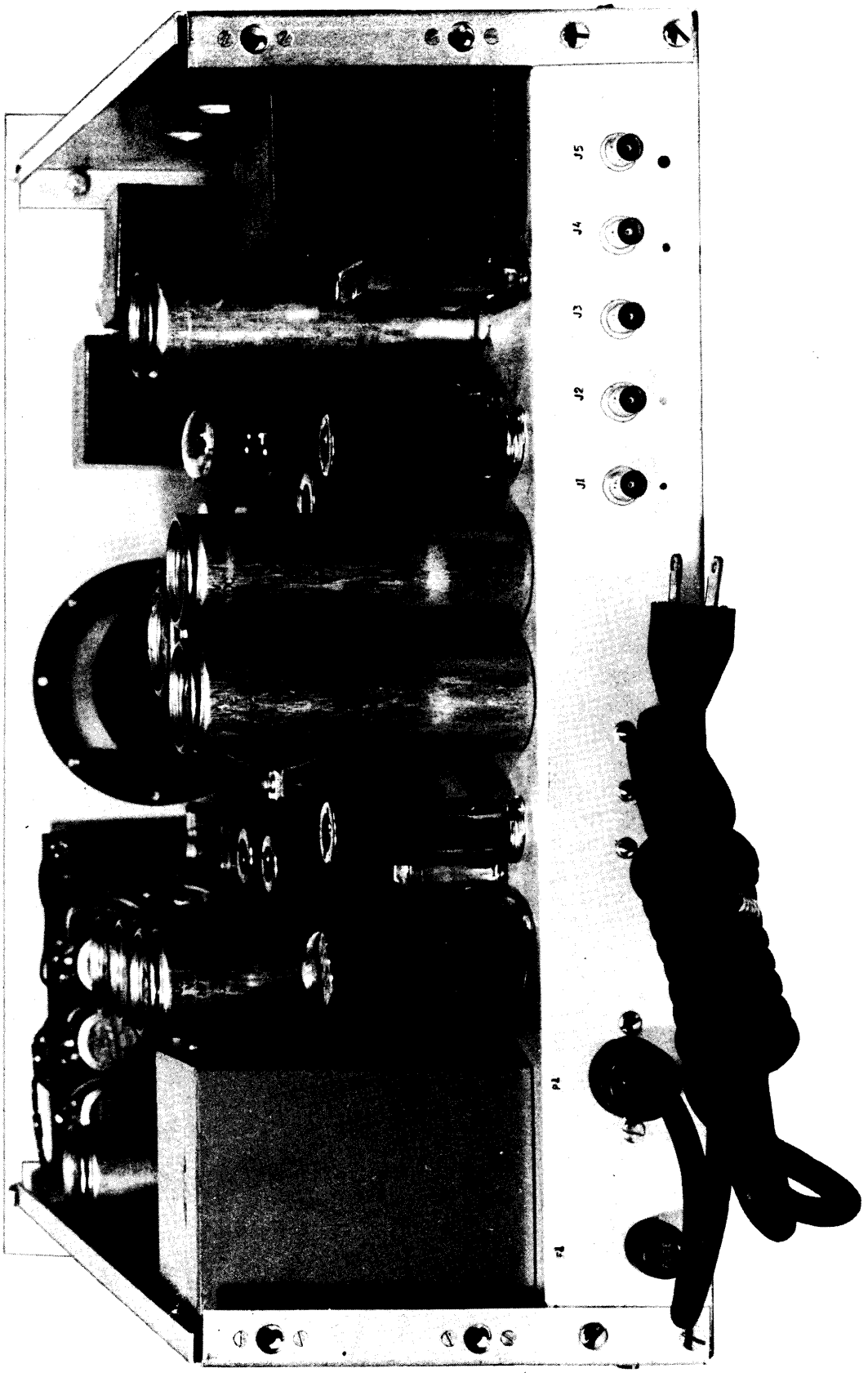


Figure 1-00. Diversity Visual Monitor, Model DVM-* Rear View

SECTION I
GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES

The Diversity Visual Monitor Unit, Model DVM, designed for application with the Model DDR-2 system, can also be utilized as an independent Diversity Visual Monitor Unit, for FREQUENCY SHIFT, CW/MCW and PHONE operations.

The DVM provides extremely accurate visual tuning of the center frequency of an incoming signal carrier. This accuracy is accomplished by means of a calibrated oscilloscope, upon which incorrect tuning is indicated as a displacement of a pulse pattern above or below the mean IF center frequency of the diversity receivers.

A stable 455 kc crystal oscillator is used as a standard reference source for accurately calibrating the oscilloscope screen. For correct tuning, the received signal, presented on the oscilloscope, would be made to be coincident with the calibrating or reference standard.

Any incorrectly tuned signal can be quickly recognized and immediately corrected to proper frequency. The DVM acts to sweep the IF frequency spectrum continuously. Sweep ranges of ±1kc and ±5kc may be selected by a front panel switch.

2. DESCRIPTION OF UNIT

a. The front panel is 19" wide by 7" high by 3/16" thick, finished in TMC GREY enamel. The DVM chassis extends 12 7/8" behind panel. Weight of the unit is 30 lbs.

b. INPUT:

1. 455 kcs IF from diversity receivers. (minimum signal input not less than 0.2 volts).

c. OUTPUT:

1. 455 kcs signal, application as follows:

a. Oscilloscope internal sweep pattern ±1 kc. or ±5 kc. as a receiver visual tuning aid. Accuracy is 10% of the indicated sweep.

b. Feeding any IF Converter Unit.

c. In conjunction with the TMC DDR-2 system to feed the DCU input.

d. INDICATOR:

The basic visual and aural functions of the DVM are obtained in the following four monitor operations.

1. In the PAN position, the DVM projects the completed tuned signal of the input receivers and the DVM is functioning as in operation position. The PAN position is also utilized as the scanning position in the operational function of the DVM, preparatory to setting up equipment on specific frequencies, i.e. schedules, standby monitoring etc.

2. In the BFO position, the DVM provides an aural check of the input signal by beating the internal BFO CRYSTAL 455 kc signal against the incoming signal.

In the BFO position, the DVM also provides a visual check of the input signal by projecting on the oscilliscope screen a pattern of both the internal BFO CRYSTAL 455 kc. and the incoming receiver 455 kc signal as a comparative tuning operation.

3. In the CAL position, the DVM projects a reference pattern of the internal CRYSTAL BFO 455 kc signal on the calibrated scope screen.

4. In the Audio position, the DVM permits an aural monitoring of the input signals.

e. CONTROLS:

FRONT PANEL -

1. Primary power switch.
2. SWEEP RANGE ±1 kc., ±5 kc.
3. Receiver input selector.
4. MONITOR selector.
5. Calibration zero set.
6. RF Gain.
7. Audio Gain.
8. H - Gain
9. V - Gain
10. Phone jack.
11. Intensity (Screwdriver Adjust).
12. Focus (Screwdriver Adjust).
13. V-Cent (Screwdriver Adjust).
14. H-Cent (Screwdriver Adjust).

TOP CHASSIS - (Screwdriver)

1. Sweep Oscillator linearity.

2. ±1 kc. sweep range adjustment.
3. ±5 kc. sweep range adjustment.
4. Crystal phasing.
5. Crystal peaking.
6. 455 kc IF peaking.
7. Sawtooth generator fine frequency.
8. Sweep Oscillator central frequency.
9. 100 kc input IF.
10. 100 kc output IF.

f. TUBE COMPLEMENT:

V-1	6AG5	455 KC Crystal Oscillator.
V-2	6AG5	455 KC IF Amplifier.
V-3	6AT6	Detector - Audio Amplifier.
V-4	6BE6	Pentagrid Mixer.
V-5	6AG5	100 KC IF Amplifier.
V-6	6AL5	Rectifier - Clamper.
V-7	12AU7	Amplifier - Cathode Follower.
V-8	6J6	Sweep Oscillator.
V-9	12AU7	Reactance Tube.
V-10	884	Sawtooth Generator.
V-11	12AX7	Horizontal Deflection Amplifier.
V-12	12AX7	Vertical Deflection Amplifier.
V-13	3BP1-A	Visual Monitor.
V-14	5Y3GT	Positive Supply Rectifier.
V-15	6X4	Negative Supply Rectifier.
V-16	OB2	Voltage Regulator.
V-17	OB2	Voltage Regulator.
V-18	6X4	Voltage Doubler Rectifier.
V-19	6X4	Voltage Doubler Rectifier.

g. POWER REQUIREMENTS:

1. Input Voltage 110/220 volts.
2. Frequency 50/60 cycles.
3. Power Consumption 90 watts.
4. Fuse protection 2 amp.

h. COMPONENTS AND CONSTRUCTION:

All equipment is manufactured in accordance with JAN specifications, wherever practicable.

We reserve the right to make changes in the design of our equipment, consistent with good engineering practice, in order to make improvements in design and to effect economies in manufacture.

SECTION II
THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS

To simplify the theory of operation, the following data will detail the specific function of the DVM in its four operating positions, as indicated by the front panel monitor switch.

A. Panoramic
B. Audio
C. BFO
D. Calibration.

Figure 2-1 illustrates a functional block diagram of the DVM unit.

a. VISUAL OPERATION:

The input signal, 455 kc is applied to V-4 (6BE6) and is made to mix with the sweep oscillator frequency of 355 kc of V-8 (6J6). This produces a frequency modulated voltage difference of 100 kc in the plate circuit of V-4. This 100 kc voltage difference is then applied to a crystal filter, whose high-Q characteristic permits passage of a small band of frequencies (100 kc region), attenuating all other frequencies. V-5 (6AG5) then amplifies the filtered frequency to the rectifier circuit, V-6($\frac{1}{2}$6AL5) where the resultant rectified positive portion of applied voltage or positive pulse is fed to the pulse amplifier V-7 ($\frac{1}{2}$12AU7).

The output pulse of the one half amplifier section of V-7, (negative due to polarity reversal of an amplifier) is coupled to the differentiating circuit for pulse sharpening. These sharp pulses are then applied to the clamping circuit of V-6 ($\frac{1}{2}$6AL5) which removes the negative sharp pulse and the resultant positive pulse is now fed to the push-pull vertical deflecting amplifier, V-12 (12AX7).

The output pulse of V-12 is coupled to plates #7 and #8, (vertical deflecting plates of V-13 (3BP1-A) monitor scope). Thus, a vertical signal pulse appears on the monitor scope screen, when a 100 kc signal difference is obtained at the output of the DVM mixer circuit.

To synchronize the vertical signal pulse,

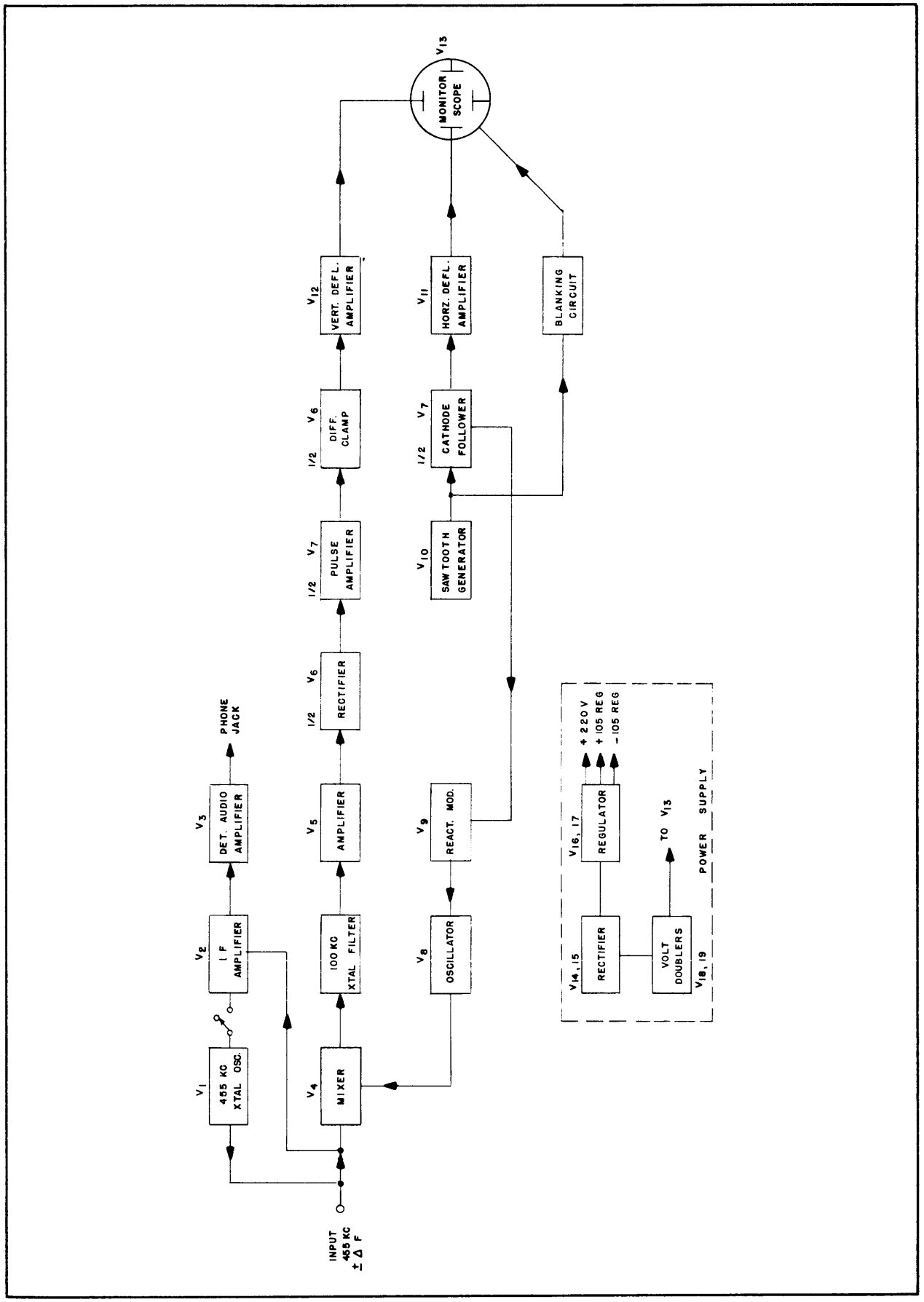


Figure 2-1. Block Diagram

with the horizontal sweep voltage, a sawtooth generator V-10 (884) is fed to a cathode follower V-7 ($\frac{1}{2}$12AU7) which provides DC isolation for the reactance modulator V-9 (12AU7). The cathode follower V-7 also provides a sawtooth voltage to the horizontal deflecting amplifier V-11 (12AX7). The push-pull output of V-11 is then fed to plates #10 and #11 (horizontal deflecting plates of V-13 monitor scope).

NOTE

To give the operator or technician a better understanding of the DVM circuits relative the Sawtooth Generator V-10, the following details describe and illustrate the circuit function.

The Sawtooth Generator is a self-running oscillator at approximately 20 cycles per second. The frequency is determined by the time constants, R-43, R-44 and C-43. At the start, V-10 is in a non-conducting state (deionized). C-43 starts to charge linearily with time, through R-43 and R-44, until the voltage across C-43 is sufficiently high to cause V-10 to conduct (ionize). C-43 quickly discharges through the low resistance of V-10. When the voltage across C-43 drops to a sufficiently low value, V-10 deionizes and the cycle is ready to repeat again.

The voltage change across C-43 between charging and discharging time, resembles, a sawtooth and is a linear function of time with a repetition rate of 20 cycles per second.

V-9 (12AU7) reactance modulator has its plate circuit directly connected across the sweep oscillator tank of V-8 (6J6). The sawtooth voltage which is developed in V-10 is applied to V-9, whose plate circuit reactance changes with Sawtooth voltage. The operating point of V-9 is so chosen that when the sawtooth voltage is one half maximum amplitude the reactance reflected across the oscillator tank (due to V-9), causes the oscillator tube to maintain center frequency of 355 kc. As the amplitude of the sawtooth increases above the operating center, the oscillator frequency increases proportionately. Likewise, the oscillator frequency will increase to center frequency for value of Sawtooth from zero to one-half amplitude.

The pulse visable on the linear horizontal sweep will be in exact center position (hereafter called ZERO reference point), whenever the input signal is 455 kc. However, an input signal of 457 kc mixing with 357 kc will cause a 2 kc displacement of the pulse to the right of zero reference point. This displacement to the right is due to the fact that the 357 kc sweep oscillator frequency is generated at a later time than 355 kc. Note

REFERENCE MARKER OR CORRECTLY TUNED SIGNAL PULSE

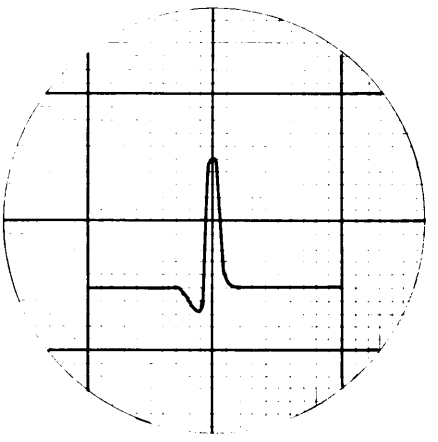


FIG.-2-D

SWEEP RANGE ±5KC

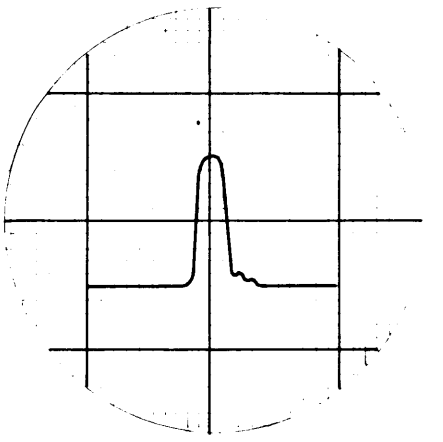


FIG.-2-E

SWEEP RANGE ±1 KC

MONITOR SWITCH SET TO CAL.
PULSE HEIGHT ADJUSTED BY RF GAIN CONTROL

SIGNAL MONITORING
INCORRECTLY TUNED CW OR PHONE

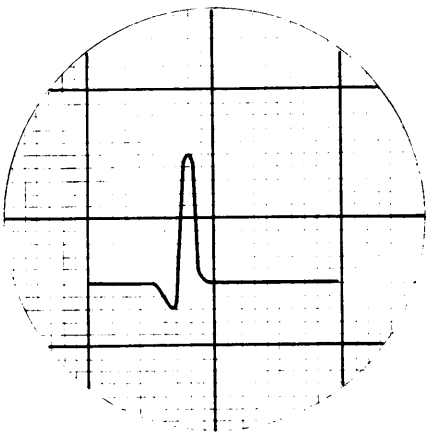


FIG.-2-F

SIGNAL DETUNED TO -2KC
OR BELOW CENTER OF
DESIRED FREQUENCY
(RANGE ± 5 KC)

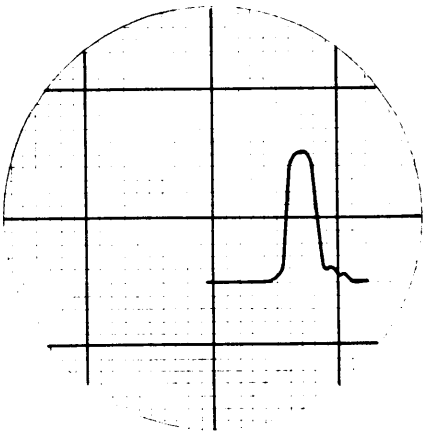


FIG.-2-G

SIGNAL DETUNED TO + 700 CPS
OR ABOVE CENTER OF
DESIRED FREQUENCY
(RANGE ± 1 KC)

FREQUENCY SHIFT MONITORING
CORRECTLY TUNED
(850 ~ SHIFT)

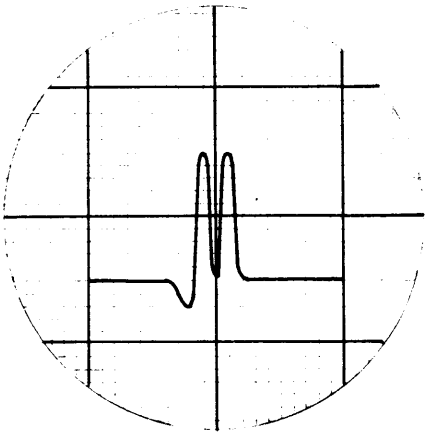


FIG.-2-H

F.S. SIGNAL PULSE
(RANGE ± 5 KC)

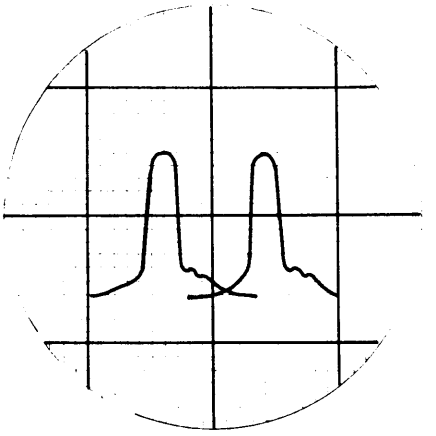


FIG.-2-I

F.S. SIGNAL PULSE
(RANGE ± 1 KC)

here that the sweep oscillator frequency shift and the horizontal sweep are both a function of Sawtooth voltage and as a consequence, the vertical pulse developed is always in correct time position along the horizontal sweep. Similiarily, the vertical pulse position will be somewhere to the left of zero point for an input signal less than 455 kc.

Placed on the face of the Monitor Tube V-13 is a lucite screen, with cross hatched lines, for the purpose of calibrating the signal horizontal sweep. The accentuated vertical center line is Zero Reference. A heavy vertical line on the screen one inch to the right of the center or zero reference line represents the plus 1 kc or the plus 5 kc sweep calibration width dependent upon position of the sweep range panel switch. Correspondingly, the opposite heavy vertical line, one inch to left of center reference line represents the minus 1 kc or minus 5 kc calibration width. By observing the distance from center reference line to either side, right or left, (consisting of 10 divisions or 9 fine lines) it is apparent that the monitor scope sweep is divided into 10 parts. Thus, each division right or left of center will represent 100 cycles on the ±1 kc range and 500 cycles on the ±5 kc range.

With a receiver in exact tune condition, an IF of 455 kc will result and will be indicated on the DVM scope by a pulse pattern peaking on the zero reference point, center vertical accentuated line. Any slight detuning will result in an IF response higher or lower than 455 kc. This amount of detuning will instantly show on the calibrated monitor scope screen of V-13.

When observing a signal on the monitor scope, the incoming signal pulse peak should coincide with the vertical center or zero reference line. See Figs. 2-D and 2-E. Tuning a signal higher in frequency will cause the signal pulse on monitor scope to move to the right of center or zero reference, indicating plus frequency calibration. Thus, an opposite signal pulse to the left of center or in the minus calibration portion of the monitor scope screen, will indicate lower frequency tuning of the signal. See Figs. 2-F and 2-G.

A Frequency Shift radio printer or F.S. CW signal pulse consists of two carriers, a mark or plus frequency and a space or minus frequency. In normal operations the F.S. bandwidth will vary from 850 cycles to narrower cycle widths, depending upon the type of equipment used.

The DVM, primarily designed as a fast tuning aid, may also be used in the ±1 kc Sweep Range to measure approximate cycle widths of a Frequency Shift signal. See Figs. 2-H and 2-I.

b. AUDIO OPERATION:

Aural monitoring of the incoming signal is obtained by feeding the incoming 455 kc signal voltage to an IF amplifier V-2 (6AG5). The amplified 455 kc signal voltage is then coupled to the DET-AUDIO Amplifier circuit V-3 (6AT6) and the resultant audio output is connected to the panel earphone jack J6.

c. BFO OPERATIONS:

For signal check monitoring, when receiving CW signals, the DVM functioning circuit is only slightly changed from the Audio operation position. In BFO operation, a 455 kc internal Crystal Oscillator V-1 (6AG5) is turned on. The high pitch tone heard in the earphones is a result of a Beat between the incoming received signal and the BFO Oscillator. (No sound should be audible when correctly tuned to exact zero beat). This is also a check condition or indication of detuning. In this BFO operation position, there is also present on the monitor scope screen a marker pulse or reference standard with which the incoming signal pulse can be synchronized.

When using the BFO as a marker pulse or reference standard, it is advisable to use the ±5 kc sweep range. In the beating process, the two beating signals produce side bands, which would tend to obscure the panoramic presentation for the ±1 kc sweep.

d. CALIBRATION OPERATION:

For CAL operation, the incoming signals are removed from the monitor scope screen and only the internal 455 kc Crystal Oscillator signal V-1 is projected. Zero Reference on scope screen can now be established by adjusting the front panel control, CAL ZERO SET. This control adjusts the sweep oscillator V-8 center frequency to 355 kc.

SECTION III
INSTALLATION

1. INSTALLATION PROCEDURE

The Diversity Visual Monitor, Model DVM has been carefully engineered as a daily tuning aid for the correct reception of all types of signal pulses. When the DVM is being installed as part of the TMC DDR-2 equipment, an interconnecting cable harness is furnished. Refer to Figure 3-6 and 3-7 of the DDR-2 instruction manual for illustrations of terminal connections.

The DVM is mounted in the upper portion of the DDR-2 rack, directly above Receiver #1. The top chassis, side panel and front panel screwdriver nonoperating controls have been pre-set at the factory and will require no further adjustments for initial setting up or operating conditions. The input power requirements of the unit are 110 volts 150/60 cycles. For 220 volt operation, transformers T-2 and T-3 primary taps must be rewired.

SECTION IV
OPERATION

1. INITIAL ADJUSTMENTS

CW/MCW - PHONE OPERATIONS.

NOTE

The Schematic Diagram details all controls and switches in their individual circuit function for operational simplicity.

a. Throw Power Switch S-4 to the ON position.

b. Set Monitor Switch S-2 to CAL position.

c. Set Sweep Range Switch S-3 to ±5 kc position.

WARNING

Whenever the Sweep Range Switch is thrown from the 5kc to 1kc position or vice versa, THE CALIBRATION ZERO SET CONTROL MUST BE READJUSTED FOR THE CORRECT CENTERING OF THE DVM CALIBRATED REFERENCE POINT OR TUNING STANDARD PATTERN.

d. Adjust RF Gain Control to decrease or increase amplitude of pulse pattern on monitor scope scope screen. A good operational height of pattern on scope screen should be approximately 3/4 to 1 inch.

e. Adjust Calibration ZERO set control for the centering of the pulse peak to the accentuated vertical center line or reference point of the monitor scope screen.

f. Set Receiver Selector Switch SW-1 to Receiver #1.

g. Change Monitor Switch S-2 to the AUDIO Position, and with headphones plugged into DVM phone jack, proceed to tune receiver to desired signal input.

h. Throw Monitor Switch S-2 to the PAN position, check signal pulse pattern on DVM scope screen.

i. Readjust RF Gain Control, decrease or increase amplitude of the pulse pattern to approximately 3/4'' to 1'' in height.

j. Proceed with Receiver #1 tuning until the desired signal pattern or pulse peak is centered on the accentuated vertical center line which is now the ZERO REFERENCE point of the DVM scope screen.

k. Change Receiver Selector Switch SW-1 to the #2 Receiver and proceed with tuning adjustment as in the above -j- for Receiver #1.

CONTINUOUS MONITOR OPERATIONS. CW-PHONE

1. Throw Monitor Switch S-2 to the BFO position, observe simultaneous scope pattern of both marker or reference pulse and incoming signal pulse.

NOTE

In the BFO position, the DVM will permit an audible comparison beat note in the earphones of both the incoming receiver signal and the internal DVM crystal 455 kc beat oscillator. At the same time, the DVM will project a Marker pattern on the Zero Reference center of the scope screen.

This function, thus permits a visual and a audible observation of any signal detuning effect from the center of the incoming signal carrier.

2. INITIAL ADJUSTMENTS

FREQUENCY SHIFT Operations.

NOTE

A FS signal usually consists of two carriers, a Mark Frequency and a Space Frequency. Normally, the Mark Frequency is the higher frequency. When tuning in a FS signal on Standby transmitting position, the FS will usually be on the Mark Frequency or the Mark pulse peak indication will appear to the right of the center Zero Reference point on the scope screen. With start of pulse transmission, the Mark and Space pulse peaks of the receiver signals should be tuned in so as to appear spread an equal distance each side of the center Zero Reference point, or center accentuated marker line of scope screen grid.

a. Throw Power Switch S-4 to the ON position.

b. Set Monitor Switch S-2 to CAL position.

c. Set Sweep Range Switch S-3 to ±5 kc position.

WARNING

Whenever the Sweep Range Switch is thrown from ±5 kc to ±1 kc position or vice versa, THE CALIBRATION ZERO CONTROL MUST BE READJUSTED FOR THE CORRECT CENTERING OF THE DVM CALIBRATED REFERENCE POINT OR TUNING STANDARD PATTERN.

d. Adjust RF Gain control to decrease or increase amplitude of pulse pattern on scope screen.

e. Adjust CALIBRATION ZERO SET control for centering of the reference pulse peak to the accentuated vertical center line, or Reference Point of the monitor scope screen.

f. Set Receiver Selector Switch SW-1 to Receiver #1.

g. Change Monitor Switch SW-2 to the AUDIO position and with headphones plugged into the DVM phone jack, proceed to tune receiver to approximate desired signal input.

h. Throw Monitor Switch SW-2 to the PAN position, adjust RF Gain control for proper pulse amplitude and check signal pulse pattern on the DVM scope screen. (If the incoming signal is being keyed, proceed to tune receiver until correct centering of carrier is obtained by an indication of equal spread of pulsating peaks each side of the scope screen center or reference point marker vertical line. If incoming signal is static, on Standby or Mark Frequency, tune receiver so that single signal pulse peak is approximately ONE Division to the right of the center line or reference mark).

i. Throw Sweep Range Switch to the +1 kc position.

j. Readjust RF Gain Control for proper pulse amplitude.

k. Readjust the CALibration ZERO SET control for correct centering of the reference pulse peak.

l. Change Monitor Switch SW-2 to the PAN position.

m. Proceed to tune receiver #1 until the incoming signal pulse on Standby or Mark Frequency is approximately 4 to 5 divisions to the right of the center line or zero reference mark.

On a keyed FS Signal with scope screen showing both Mark and Space Frequency pulses, tune receiver #1 until the signal pulse peaks are an equal distance, each side of the centerline or zero reference mark on scope screen.

n. With DVM correctly set for reference point and signal pattern on Receiver #1 proceed to throw Receiver Selector Switch SW-1 to Receiver #2 and follow the same receiver tuning procedure above as performed on Receiver #1.

CONTINUOUS MONITOR OPERATIONS (FS)

o. DVM on the 1 kc. Sweep Range Switch position.

p. Monitor Sweep Switch on the PAN position.

SECTION V
OPERATOR'S MAINTENANCE

The Model DVM Diversity Visual Monitor has been designed to provide long term, trouble free, continuous 24 hour a day operation. It is recommended that any maintenance to the equipment be done by a competent maintenance technician.

1. EMERGENCY MAINTENANCE

a. NOTICE TO OPERATORS.- Operators should not perform any of the following emergency maintenance procedures without proper authorization.

b. REPLACEMENT OF TUBES AND FUSES.

(1) Replacement of Fuses -

- - - - WARNING - - - -

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

(a) Fuse failure in the DVM would normally be indicated by failure of the pilot lamp to be on when the power switch is turned on. The pilot lamp in the equipment is operated at 1/2 voltage and therefore would not ordinarily be the cause of no indication. In addition to the pilot lamp not lighting, the Vacuum tubes in the DVM would not be lighted. In this case, the 2 ampere fuse on the rear panel should be checked and replaced if defective.

(2) Replacement of Tubes - The tubes may be checked visually to see if they are lighted, or for warmth. When necessary the tubes should be carefully removed and tested and when replaced care should be taken to install tube shields.

SECTION VI
PREVENTIVE MAINTENANCE

In order to prevent actual failure of the equipment due to corrosion, tube failures, dust and other destructive ambient conditions, it is suggested that the following preventative maintenance the performed.

1. ROUTINE MAINTENANCE

a. Remove equipment from the rack, and thoroughly inspect the insides of chassis for signs of dirt, dampness, moulding, charring and corrosion. Correct any defect found. A recommended cleaning agent is clean carbon tetrachloride applied with a soft brush. Recommended SEMI-ANNUALLY.

b. Test all DC and AC voltages as indicated on the respective tube voltage data sheets and investigate any serious descrepancies. Recommended SEMI-ANNUALLY.

c. Test each tube one at a time in a reliable tube tester, replacing tube in socket from which it was removed, if its measured characteristics are within the manufacturers tolerances. (usually plus or minus 20% from tube manual values). Replace those tubes only which are found to be below par. Recommended QUARTERLY.

d. When replacing the DVM in the rack, be certain that all terminal strip screw connections at the rear of the equipment are tight.

SECTION VII
CORRECTIVE MAINTENANCE

1. DVM OSCILLOSCOPE (V-13) ADJUSTMENT AND TEST

There are six oscilliscope controls which periodically may require some attention during normal operations of the DVM. These controls are located at the upper right hand corner of the front panel. Four of these controls requiring the least adjusting are (covered screwdriver adjustments) the tubes H-centering, V-centering, Intensity and Focus. Two other controls, the Horizontal Gain and the Vertical Gain, are more frequently adjusted and utilize small knobs.

a. Horizontal (H) and Vertical (V) Centering Procedure.

Turn the Monitor Switch to the CAL position, thus projecting a Marker Pulse on the scope-screen and adjust its height or amplitude with the RF Gain control to some convenient pattern size. Next collapse the Horizontal trace or signal by reducing the H-gain until only a Vertical trace is obtained. If this Vertical trace is not coincident with the center reference line, adjust the H-centering control until the Vertical trace is exactly centered. Increase the Horizontal gain control until the sweep trace extends slightly beyond the ± limits (the outer accentuated lines, right and left of center). The Vertical position of the Horizontal trace may be adjusted with the V-centering control, to a measuring position with the trace appearing mid-way between the center and lower accentuated horizontal lines, of the scope screen.

b. Intensity and Focus Adjustments.

The brightness of the picture trace can be varied with the intensity control. However, there is a dual adjustment involved at this point due to the internal interlocking of the tube functions of intensity and focus. Thus, whenever the intensity is changed, the trace must be refocused for sharpness and clarity using the focus control. The Intensity control is adjusted at the factory so that the return trace is hardly visible (usually a matter of judgement which effects the horizontal sweep width).

As a result of discharge of C-43 through the Sawtooth Generator (V-10), there is an abrupt voltage change in a small interval of time. This voltage appears as a return trace on the monitor tube. Another effect of this voltage is to quickly sweep the oscillator (V-8), resulting in a pulse on the left hand side of the H-sweep. A blanketing circuit is utilized to eliminate this return trace. However, the effect of blanketing is not as pronounced, when the intensity is increased to a point above where the return trace becomes visible.

2. DVM CIRCUIT ALIGNMENT

NOTE

Circuit Alignment as well as Sweep Range Calibration should not be attempted unless it is positively determined that these circuits require adjustments and should be performed by a qualified technician.

a. IF Alignment.

Remove tubes V-8 and V-9. Connect a signal generator such as, General Radio type 1001-A or Measurements type 65-B, to pin #7 of V-4. Set Monitor Switch to the PAN position, and RF Gain control to maximum.

Next, connect an oscilloscope such as the DuMont type 304-H with an AC probe type 316 to the junction point of Y-2 (100 kc crystal socket) and the green lead from the IF transformer Z-1. With the signal generator delivering 2 volts at 100 kc and NO MODULATION, feed enough signal input to get a good indication on the oscilliscope. Adjust alignment of L-1 and L-2 (Z-1) for the greatest amplitude.

Remove the oscilliscope connection from pin #7 of V-4 and connect it to pin #7 of V-6. Adjust alignment of L-4 and L-5 (Z-2) for maximum amplitude.

Remove oscilliscope and signal generator and replace V-8 and V-9.

After the IF coils L-1, L-2, L-3 and L-4 have been aligned, loosely couple an insulated lead near L-4 or placed near C-34 (CAL ZERO SET) and connect the end of this lead to a frequency meter such as the BC-221 or the LM-18. Plug a pair of earphones into the frequency meter and set its frequency to 355 kc. With C-34 at mid-capacity (50%), align L-6 for maximum buzz. Remove the frequency meter and connecting lead.

b. Pulse Shape Form Adjustment.

Next, turn monitor switch to CAL position,

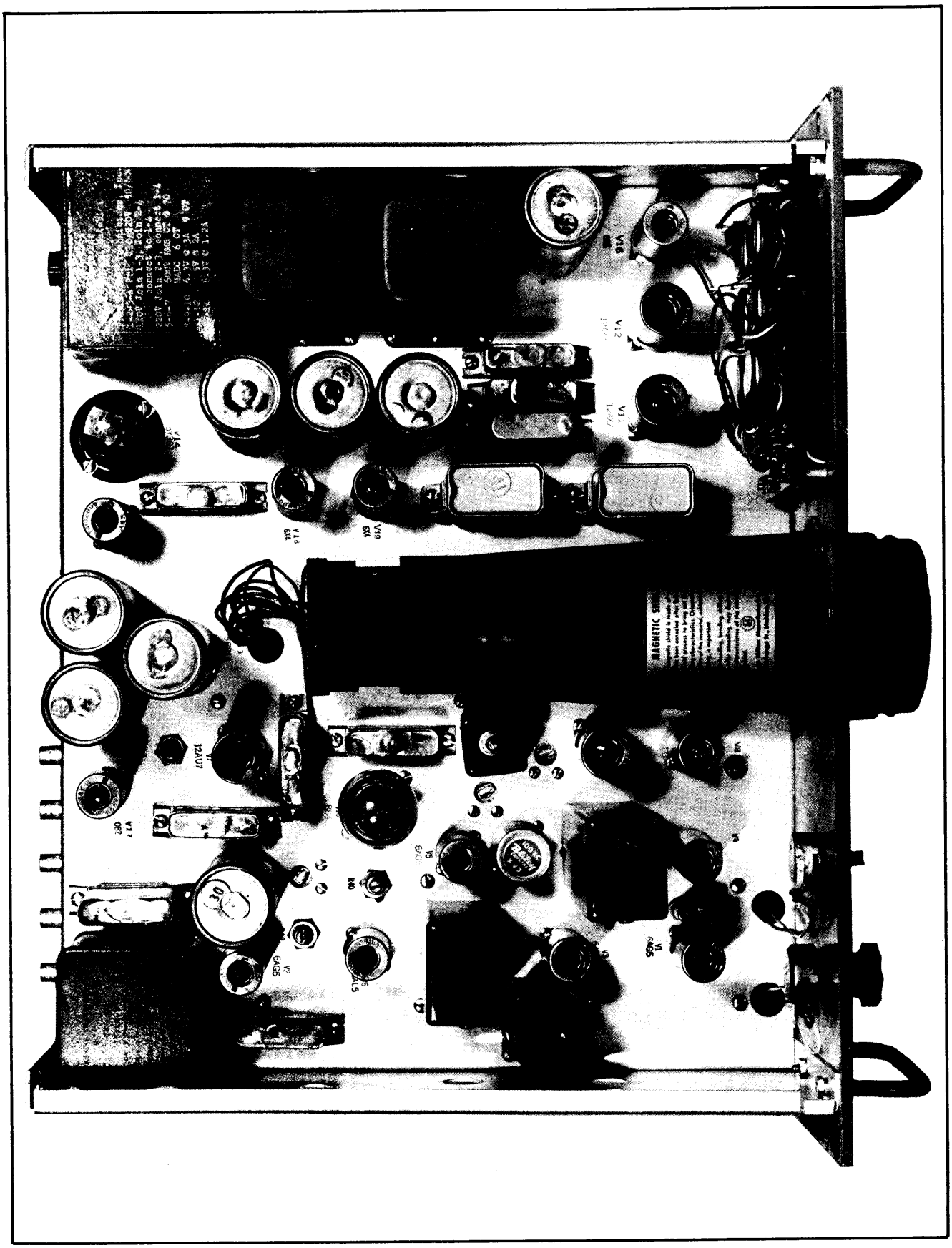


Figure 7-0. Diversity Visual Monitor, Model DVM-*. Top View.

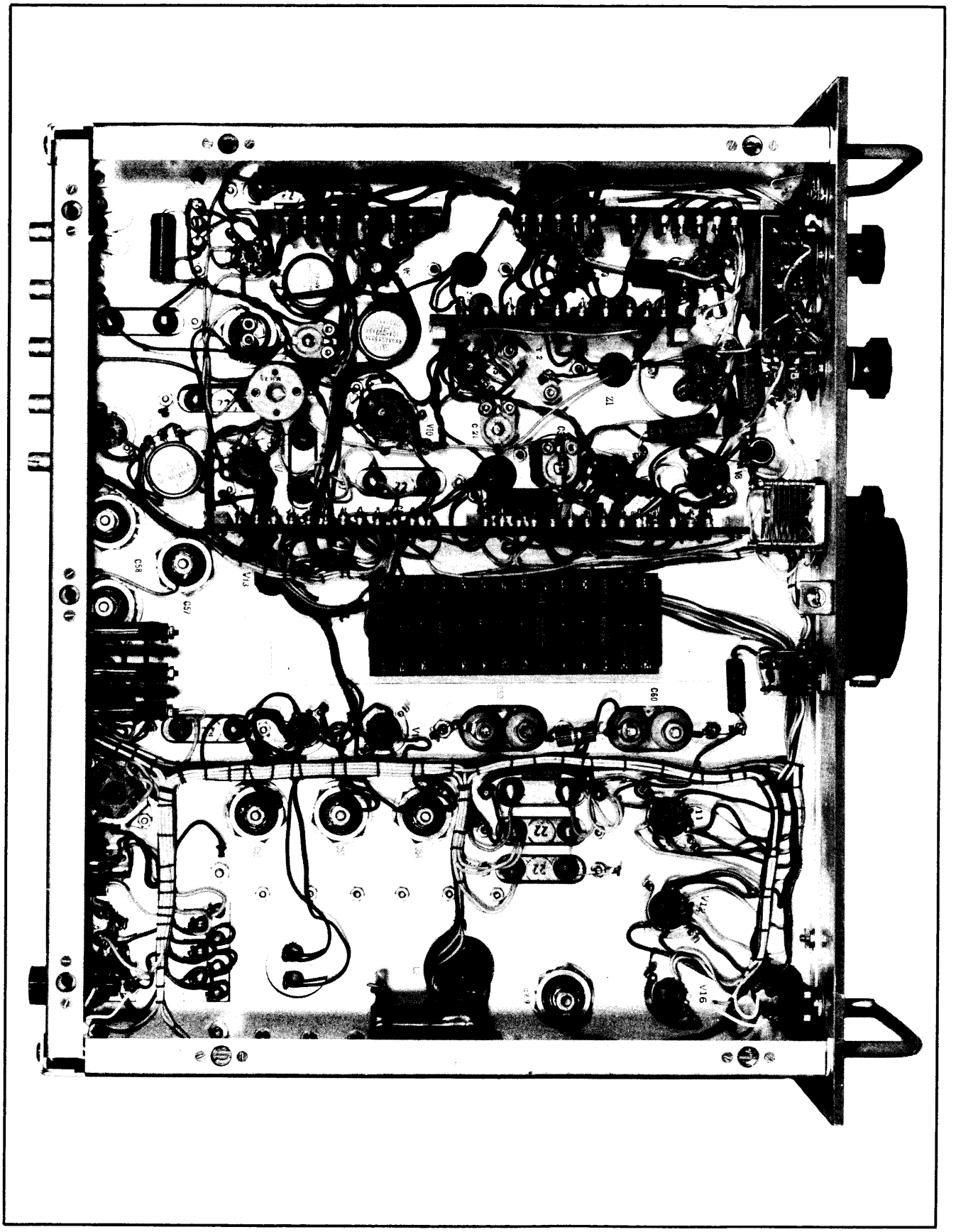


Figure 7-00. Diversity Visual Monitor, Model DVM-*. Bottom View.

and a pulse should appear on the monitor tube screen. (Adjust its amplitude by means of the RF gain control). This pattern should have a reasonable good pulse shape form such as those shown in Fig. 2-D. The pulse shape can be adjusted by means of the crystal phasing trimmer C-21 and coil L-3 (transformer Z-3). The approximate setting of C-21 is about 1/3 capacity and L-3 is adjusted so that the pulse shape height remains approximately the same in either the 1 kc or 5 kc sweep range position. After these adjustments repeak coils L-4 and L-5 for maximum pulse shape height.

c. Sweep Range Adjustment.

Connect the frequency meter output to pin #7 of V-4 and set the frequency meter calibration for 455 kc. Throw the DVM sweep range switch to the ±1 kc position. Adjust the Horizontal gain control so that the trace meets the heavv left and right vertical lines of the scope screen, (one inch either side of the center vertical line). Adjust the CAL ZERO SET control to center the incoming 455 kc pulse. Next, swing the frequency meter from 454 kc to 456 kc, a total of 2 kc, and note the pulse displacement on the DVM scope screen. If this pulse displacement is less than or greater than the overall two inch spread between the heavy right and left vertical lines, the 1 kc range adjustment setting of pot R-40 should be changed so that a total 2 kc range can be obtained across face of the scope screen.

Similarly the ±5 kc range can be checked and calibrated in the same way. Change the DVM sweep range switch to the 5 kc position. Retune the frequency meter to the 455 kc setting, and center the 455 kc pulse with the CAL ZERO SET adjustment.

Vary the frequency meter tuning from 450 kc to 460 kc and if the sweep range pattern is greater or less than 10 kc, adjust the 5 kc sweep setting of pot. R-42. During the process of sweep range calibration, if observation indicates that the frequency swing on scope screen is not symmetrical around either side of center, (pulse displacement is greater to one side of center than opposite side) then slightly adjust C-38 until equal displacement on either side of center line is obtained.

NOTE

Whenever C-38 is adjusted or returned, always recheck the sweep range calibration. Accuracy of the sweep pattern in both 1 kc and 5 kc position should come within 10% of the sweep range.

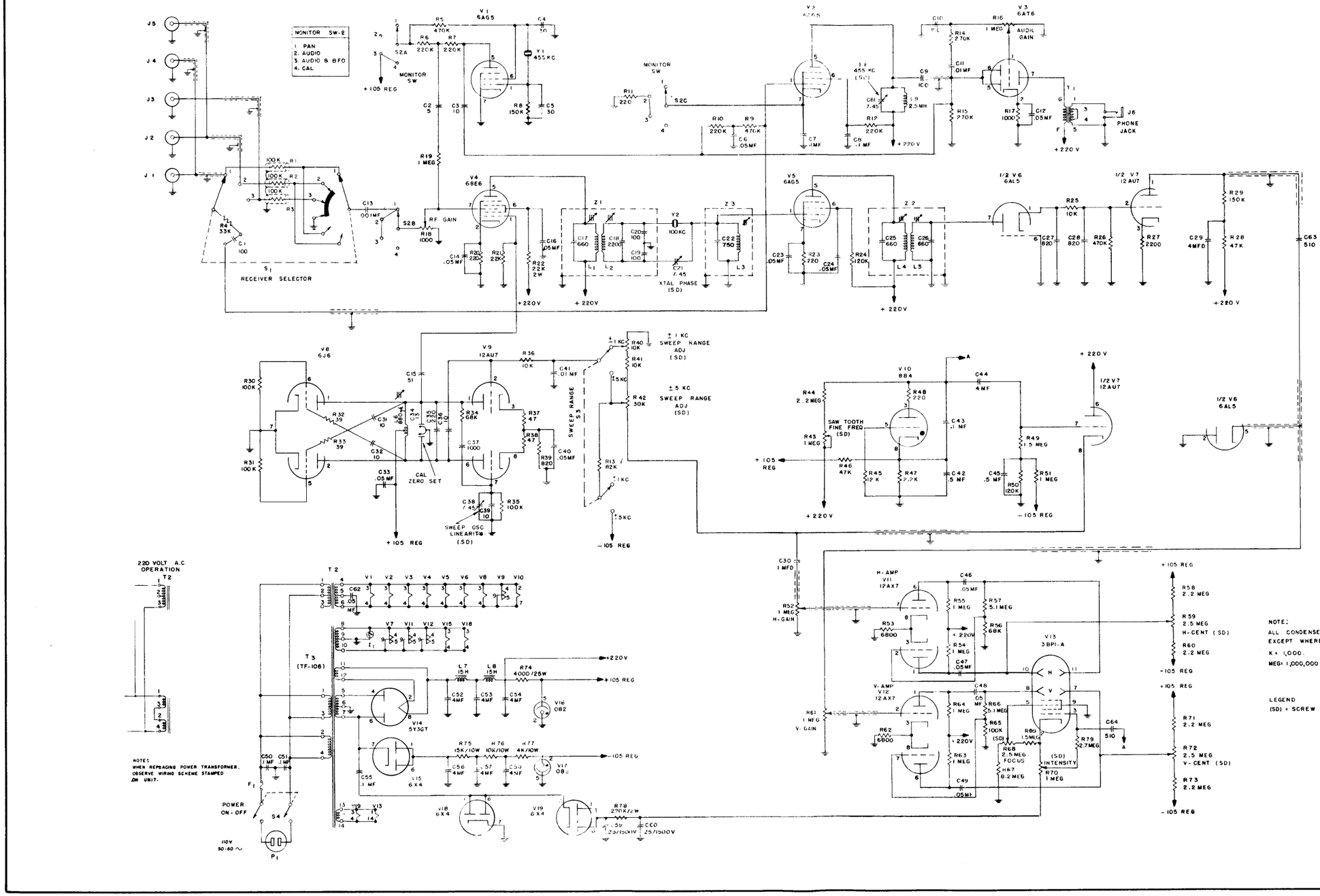


Figure 7-1. DVM-1 Schematic Diagram

ELECTRICAL PARTS LIST

FOR

DIVERSITY VISUAL MONITOR, MODEL DVM

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C1	CAPACITOR, fixed: mica; 100 mfd, ±10%; 500 wvdc.	Blocking Cond.	CM20B101K
C2	CAPACITOR, fixed: mica; 5 mmfd, ±20%; 500 wvdc.	Marker Osc. Coupling	CM20B050M
C3	CAPACITOR, fixed: mica; silvered mica; 10 mmfd, ±5%; 500 wvdc.	BFO Osc. Coupling	CM20C100J
C4	CAPACITOR, fixed: mica silvered; 30 mmfd, ±5%; 500 wvdc.	Xtal Osc. Screen	CM20D300J
C5	CAPACITOR, fixed: mica silvered; 30 mmfd, ±5%; 500 wvdc.	Xtal Osc. Grid to Cathode Coupling	CM20D300J
C6	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	RF Bypass	CN-100-3
C7	CAPACITOR, fixed: paper dielectric; .1 mfd, ±10%; 600 wvdc; oil-filled and impregnated; hermetically sealed metal case.	Cathode Bypass	CP69B1EF104K
C8	CAPACITOR, fixed: paper dielectric; .1 mfd, ±10%; 600 wvdc; oil-filled and impregnated; hermetically sealed metal case.	Screen Bypass	CP69B1EF104K
C9	CAPACITOR, fixed: mica; 100 mfd, ±10%; 500 wvdc.	Coupling Cond.	CM20B101K
C10	CAPACITOR, fixed: mica; 100 mmfd, ±10%; 500 wvdc.	RF Bypass	CM20B101K
C11	CAPACITOR, fixed: paper; .01 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Audio Coupling	CN-100-1
C12	CAPACITOR, fixed; paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Cathode Bypass	CN-100-3
C13	CAPACITOR, fixed: mica; .001 mfd, ±10%; 500 wvdc.	RF Coupling	CM20A102K
C14	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Cathode Bypass	CN-100-3

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C15	CAPACITOR, fixed: mica; 51 mmfd, ±10%; 500 wvdc.	Sweep Osc. Coup.	CM20B510K
C16	CAPACITOR, fixed: paper; .05 mfd. +40, -20%; 400 wvdc; tubular molded plastic case.	Screen Bypass	CN-100-3
C17	CAPACITOR, fixed: silvered mica; 660 mmfd, ±5%; 500 wvdc.	Part of IF Tank	CM20D661J
C18	CAPACITOR, fixed: silvered mica; 2200 mmfd. ±5%; 500 wvdc.	Part of IF Tank	CM30C222J
C19	CAPACITOR, fixed: silvered mica; 100 mmfd, ±5%; 500 wvdc.	Voltage Divider	CM20C101J
C20	CAPACITOR, fixed: silvered mica; 100 mmfd, ±5%; 500 wvdc.	Voltage Divider	CM20C101J
C21	CAPACITOR, variable: ceramic; rotary type, single sect; 7-45 mmfd; 500 wvdc.	Crystal Phasing	CV11C450
C22	CAPACITOR, fixed: mica; 750 mmfd, ±5%; 500 wvdc; (Part of Z3)	Part of IF Tank	CM20D751J
C23	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Cathode Bypass	CN-100-3
C24	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Screen Bypass	CN-100-3
C25	CAPACITOR, fixed: silvered mica; 660 mmfd, ±5%; 500 wvdc; (Part of Z2)	Part of IF Tank	CM20D661J
C26	CAPACITOR, fixed: silvered mica; 660 mmfd, ±5%; 500 wvdc; (Part of Z2)	Part of IF Tank	CM20D661J
C27	CAPACITOR, fixed: mica; 820 mmfd, ±10%; 500 wvdc.	RF Filter	CM20A821K
C28	CAPACITOR, fixed: mica; 820 mmfd, ±10%; 500 wvdc,	RF Filter	CM20A821K
C29	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20%,-10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C30	CAPACITOR, fixed: paper dielectric; 1.0 mfd, ±10%; 600 wvdc; hermetically sealed metal case.	Coupling	CP69B1EF105K
C31	CAPACITOR, fixed: silvered mica; 10 mmfd, ±5%; 500 wvdc.	Sweep Osc. Feedback	CM20C100J

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C32	CAPACITOR, fixed: silvered mica; 10 mmfd, ±5%; 500 wvdc.	Sweep Osc. Feedback	CM20C100J
C33	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	RF Bypass	CN-100-3
C34	CAPACITOR, variable: air dielectric; 4.3 to 26 mmfd; .030 inch spacing.	Sweep Osc. Center Freq. Adj.	CB-104-2
C35	CAPACITOR, fixed: silvered mica; 220 mmfd, ±5% ; 500 wvdc.	Part of Sweep Osc. Tank	CM20C221J
C36	CAPACITOR, fixed: mica; 10 mmfd, ±5%; 500 wvdc.	Part of React. Tube Phase-shift	CM20C100J
C37	CAPACITOR, fixed: mica; 1000 mmfd, ±10%; 500 wvdc.	Blocking	CM20A102K
C38	CAPACITOR, variable: ceramic; rotary type, single sect; 7-45 mmfd; 500 wvdc.	React. Tube Linearity Cont.	CV11C450
C39	CAPACITOR, fixed: silvered mica; 10 mmfd, ±5%; 500 wvdc.	Part of React. Tube Phase-shift Network	CM20C100J
C40	CAPACITOR, fixed: paper .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Cathode Bypass	CN-100-3
C41	CAPACITOR, fixed: paper; .01 mfd, +40, -10%; 400 wvdc; tubular molded plastic case.	RF Bypass	CN-100-1
C42	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .5 mdf, ±10%; 600 wvdc; herm. sealed metal case.	Cathode Bypass	CP69B1EF504K
C43	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .1 mfd, ±10%; 600 wvdc; hermetically sealed metal case.	Part of Freq. Deter. Network	CP69B1EF104K
C44	CAPACITOR, fixed: paper dielectric; oil-filled; 4.0 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Coupling	CP41B1FF405V
C45	CAPACITOR, fixed: paper dielectric; .5 mfd, ±10%; 600 wvdc; hermetically sealed metal case; oil-filled and impregnated.	Grid Circuit Bypass	CP69B1EF504K
C46	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Scope H-plate Coupling	CN-100-3

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C47	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Scope H-plate Coupling	CN-100-3
C48	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Scope V-plate Coupling	CN-100-3
C49	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic case.	Scope V-plate Coupling	CN-100-3
C50	CAPACITOR, fixed: paper dielectric; oil filled and impregnated; .1 mfd, ±10%; 600 wvdc; hermetically sealed metal case.	Line Bypass	CP69B1EF104K
C51	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .1 mfd, ±10%; 600 wvdc; hermetically sealed metal case.	Line Bypass	CP69B1EF104K
C52	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C53	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C54	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C55	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .1 mfd, ±10%; 600 wvdc; hermetically sealed metal case.	Coupling	CP69B1EF104K
C56	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C57	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20, -10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C58	CAPACITOR, fixed: paper dielectric; oil-filled; 4 mfd, +20,-10%; 600 wvdc; hermetically sealed metal case.	Filter	CP40C2DF405V
C59	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .25 mfd, ±10%; 1500 wvdc.	High Voltage Filter	CP70B1EH254K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C60	CAPACITOR, fixed: paper dielectric; oil-filled and impregnated; .25 mfd, ±10%; 1500 wvdc.	High Voltage	CP70B1EH254K
C61	CAPACITOR, variable: ceramic; rotary type, single section; 7-45 mmfd, 500 wvdc.	IF Peaking	CV11C450
C62	CAPACITOR, fixed: paper; .05 mfd, +40, -20%; 400 wvdc; tubular molded plastic.	Filament Bypass	CN-100-3
C63	CAPACITOR, fixed: mica dielectric; 510 mmfd, ±10%; 500 wvdc.	Part of Differ-entiating Circuit	CM20A511K
C64	CAPACITOR, fixed: mica dielectric; 500 mmfd, ±10%; 500 wvdc.	Part of Blanking Circuit	CM20A501K
F1	FUSE, cartridge: 2 amps; oper. in one hour at 135% load and in 25 sec. at 200% load; 250 v.; glass body.	Line Protection	FU-100-2
I1	LAMP, incandescent: 6-8 volts; 0.250 amp; min. bayonet base; bulb T-3-1/4, clear.	Power Indicator	BI-101-44
J1	CONNECTOR, coaxial: female chassis receptacle; single contact; BNC type.	Input Jack Receiver #1	UG-625/U
J2	CONNECTOR, coaxial: female chassis receptacle; single contact; BNC type.	Input Jack Receiver #2	UG-625/U
J3	CONNECTOR, coaxial: female chassis receptacle; single contact; BNC type.	Input Jack Receiver #3	UG-625/U
J4	CONNECTOR, coaxial: female chassis receptacle; single contact; BNC type.	IF Output Jack Receiver #1	UG-625/U
J5	CONNECTOR, coaxial: female chassis receptacle; single contact; BNC type.	IF Output Jack Receiver #2	UG-625/U
J6	JACK, telephone: closed circuit; insulated.	Phone Monitor	JJ-034
L1	COIL, R.F. slug tuned: pri. of IF; (part of Z1)	Pri. IF Coil	A-360
L2	COIL, R.F. slug tuned: sec. of IF; (Part of Z1)	Sec. IF Coil	A-361
L3	COIL, R.F. slug tuned: pri. of IF; (Part of Z3)	IF Tank	A-360
L4	COIL, R.F. slug tuned: pri. of IF; (Part of Z2)	Pri. IF Coil	A-360
L5	COIL, R.F. slug tuned: pri. of IF; (Part of Z2)	Sec. IF Coil	A-360

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
L6	COIL, R.F. part of sweep osc. tank; slug tuned.	Osc. Tank Coil	A-362
L7	REACTOR, filter choke: 15 h.; 85 ma DC; 270 ohms DC resistance; 2500 v. RMS test; enclosed metal case.	Power Supply Filter	TF-5000
L8	REACTOR, filter choke: 15 h.; 85 ma DC; 270 ohms DC resistance; 2500 v. RMS test; enclosed metal case.	Power Supply Filter	TF-5000
L9	CHOKE, RF: 2.5 mh; 125 ma; ceramic. form.	Part of IF Tank	CL-109-1
P1	CONNECTOR, assembly: male contact; flush motor plug type; two parallel non-polarized "twist-lock" contacts; 10 amps; 250 v.	Power Receptacle	JJ-100
R1	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Part of RF Voltage Div.	RC20GF104K
R2	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Part of RF Voltage Div.	RC20GF104K
R3	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Part of RF Voltage Div.	RC20GF104K
R4	RESISTOR, fixed: composition; 33,000 ohms, ±10%; 1/2 watt.	Grid Voltage Dropping Res.	RC20GF333K
R5	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Osc. Screen Res.	RC20GF474K
R6	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt.	Part of Osc. Plate Dropping	RC20GF224K
R7	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt.	Part of Osc. Plate Dropping	RC20GF224K
R8	RESISTOR, fixed: composition; 150,000 ohms, ±10%; 1/2 watt.	Osc. Grid Bias	RC20GF154K
R9	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Grid Resistor	RC20GF474K
R10	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt.	Part of RF Filter	RC20GF224K
R11	RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF221K
R12	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt.	Screen Dropping	RC20GF224K
R13	RESISTOR, fixed: composition; 82,000 ohms, ±10%; 1/2 watt.	Part of 5kc Range	RC20GF823K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R14	RESISTOR, fixed: composition; 270,000 ohms, ±10%; 1/2 watt.	Part of RF Filter	RC20GF274K
R15	RESISTOR, fixed: composition; 270,000 ohms, ±10%; 1/2 watt.	Diode Load	RC20GF274K
R16	RESISTOR, variable: composition potentiometer; 1 megohm, ±20%; 2 watts; 1/4'' flatted shaft; 7/8'' fr. mtg. sfc.	Audio Gain	RV4ATFD102K
R17	RESISTOR, fixed: composition; 1000 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF102K
R18	RESISTOR, variable: composition potentiometer; 1000 ohms, ±10%; 2 watts; 1/4'' flatted shaft; 7/8'' fr. mtg. sfc.	RF Gain Control	RV4ATFD102K
R19	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	RF Volt Drop	RC20GF105K
R20	RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF221K
R21	RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1/2 watt.	Mixer Gird. Bias	RC20GF223K
R22	RESISTOR, fixed: composition; 22,000 ohms, ±10%; 2 watt.	Screen Dropping	RC42GF223K
R23	RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF221K
R24	RESISTOR, fixed: composition; 120,000 ohms, ±10%; 1/2 watt.	Screen Dropping	RC20GF124K
R25	RESISTOR, fixed: composition; 10,000 ohms, ±10%; 1/2 watt.	RF Filter	RC20GF103K
R26	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Diode Load	RC20GF474K
R27	RESISTOR, fixed: composition; 2,200 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF222K
R28	RESISTOR, fixed: composition; 47,000 ohms, ±10%; 1/2 watt.	Plate Filter	RC20GF473K
R29	RESISTOR, fixed: 150,000 ohms, ±10%; 1/2 watt.	Plate Load	RC20GF154K
R30	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Osc. Grid Leak	RC20GF104K
R31	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Osc/ Grid Leak	RC20GF104K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R32	RESISTOR, fixed: composition; 39 ohms, ±10%; 1/2 watt.	Parasitic suppressor	RC20GF390K
R33	RESISTOR, fixed: composition; 39 ohms, ±10%; 1/2 watt.	Parasitic Suppressor	RC20GF390K
R34	RESISTOR, fixed: composition; 68,000 ohms, ±5%; 1/2 watt.	Part of React. Tube Phase-shift Network	RC20GF683J
R35	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	React. Tube Grid Resistor	RC20GF104K
R36	RESISTOR, fixed: composition; 10,000 ohms, ±5%; 1/2 watt.	Grid Resistor	RC20GF103J
R37	RESISTOR, fixed: composition; 47 ohms, ±10%; 1/2 watt.	Inverse Feedback	RC20GF470K
R38	RESISTOR, fixed: composition; 47 ohms, ±10%; 1/2 watt.	Inverse Feedback	RC20GF470K
R39	RESISTOR, fixed: composition; 820 ohms, ±10%; 1/2 watt.	Cathode Bias	RC20GF821K
R40	RESISTOR, variable: composition potentiometer; 10,000 ohms, ±10%; 2 watts; 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	+1 kc Sweep Range Adj.	RV4ATSA103A
R41	RESISTOR, fixed: composition; 10,000 ohms, ±10%; 1/2 watt.	Sawtooth Voltage Div.	RC20GF103K
R42	RESISTOR, variable: composition potentiometer; 30,000 ohms, ±10%; 2 watts; 1/4'' slotted shaft, 5/8'' fr. mtg. sfc.	+5 kc Sweep Range Adj.	RV4ATSA303A
R43	RESISTOR, variable: composition; 1 megohm, ±20%; 2 watts; 1/4'' slotted shaft, 5/8'' fr. mtg. sfc.	Sawtooth Freq. Adj.	RV4ATSA105B
R44	RESISTOR, fixed: composition; 2.2 megohms, ±10%; 1/2 watt.	Sawtooth Freq. Deter.	RC20GF225K
R45	RESISTOR, fixed: composition; 12,000 ohms, ±10%; 1/2 watt.	Grid Resistor	RC20GF123K
R46	RESISTOR, fixed: composition; 47,000 ohms, ±5%; 1/2 watt.	Fixed Cath. Bias	RC20GF473J
R47	RESISTOR, fixed: composition; 2,200 ohms, ±5%; 1/2 watt.	Cathode Bias	RC20GF222J
R48	RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt.	Plate Current Limiter	RC20GF221K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R49	RESISTOR, fixed: composition; 1.5 megohms, ±10%; 1/2 watt.	Grid Resistor	RC20GF155K
R50	RESISTOR, fixed: composition; 120,000 ohms, ±10%; 1/2 watt.	Bias Volt Div.	RC20GF124K
R51	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	Bias Volt Div.	RC20GF105K
R52	RESISTOR, variable: composition; 1 megohm, ±20%; 2 watts; 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	H-Gain	RV4ATSA105B
R53	RESISTOR, fixed: composition; 6800 ohms, ±10%; 1/2 watt.	Cath. Bias	RC20GF682K
R54	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	H-amp Plate Load	RC20GF105K
R55	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	H-amp Plate Load	RC20GF105K
R56	RESISTOR, fixed: composition; 68,000 ohms, ±5%; 1/2 watt.	Phase Inverter Grid Resistor	RC20GF683J
R57	RESISTOR, fixed: composition; 5.1 megohms, ±5%; 1/2 watt.	H-deflection Plate Return	RC20GF515J
R58	RESISTOR, fixed: composition; 2.2 megohms, ±10%; 1/2 watt.	Part of Voltage Div.	RC20GF225K
R59	RESISTOR, variable: composition; 2.5 megohms, ±20%; 2 watts; 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	H-cent. Control	RV4ATSA255B
R60	RESISTOR, fixed: composition; 2.2 megohms, ±10%; 1/2 watt.	Part of Voltage Div.	RC20GF225K
R61	RESISTOR, variable: composition; 1 megohm, ±20%; 2 watts, 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	Vert Gain	RV4ATSA105B
R62	RESISTOR, fixed: composition; 6800 ohms, ±10%; 1/2 watt.	Cath. Bias	RC20GF682K
R63	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	V-amp Plate	RC20GF105K
R64	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	V-amp Plate Load	RC20GF105K
R65	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Phase Inverter Grid Res.	RC20GF104K
R66	RESISTOR, fixed: composition; 5.1 megohms, ±5%; 1/2 watt.	V-deflection Plate Return	RC20GF515J

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R67	RESISTOR, fixed: composition; 8.2 megohms, ±10%; 1 watt.	H-volt Blder.	RC30GF825K
R68	RESISTOR, variable: composition; 2.5 megohms, ±20%; 2 watts; 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	Focus Control	RV4ATSA255B
R69	RESISTOR, fixed: composition; 1.5 megohms, ±10%; 1/2 watt.	Part of H-volt Bleeder	RC20GF155K
R70	RESISTOR, variable: composition; 1 megohm, ±10%; 2 watts; 1/4'' slotted shaft; 5/8'' fr. mtg. sfc.	Intensity Cont.	RV4ATSA105B
R71	RESISTOR, fixed: composition; 2.2 megohms, ±10%; 1/2 watt.	Part of Volt Div.	RC20GF225K
R72	RESISTOR, variable: composition; 2.5 megohms, ±20%; 2 watts; 1/4'' slotted shaft, 5/8'' fr. mtg. sfc.	V-centering Cont.	RV4ATSA255B
R73	RESISTOR, fixed: composition; 2.2 megohms, ±10%; 1/2 watt.	Part of Volt Div.	RC20GF225K
R74	RESISTOR, fixed: wire-wound; 4,000 ohms, ±10%; 25 watts.	Volt Div.	RW-111-28
R75	RESISTOR, fixed: wire-wound; 15,000 ohms,±10%; 10 watts.	Filter	RW-109-36
R76	RESISTOR, fixed: wire-wound; 10,000 ohms, ±10%; 10 watts.	Filter	RW-109-34
R77	RESISTOR, fixed: wire-wound; 4,000 ohms; ±10%; 10 watts.	Filter	RW-109-31
R78	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 2 watts.	Filter	RC42GF224K
R79	RESISTOR, fixed: composition; 2.7 megohms, ±10%; 1/2 watt.	Part of Scope Blanking Circuit	RC20GF275K
S1	SWITCH, rotary: 3 pole; 3 position; two sect.; shorting type contacts.	Receiver Selector Sw.	SW-122
S2	SWITCH, rotary: two sect; 4 pole; 4 position ea. sect.	Monitor Switch	SW-115
S3	SWITCH, toggle: DPDT; 3 amp; 250 v.; phenolic body.	Freq. Dispertion Range	ST-22N
S4	SWITCH, toggle: DPST; 3 amp; 250 v.; phenolic body.	Power On/Off	ST-22K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
T1	TRANSFORMER: audio, line to grid; pri 50,200,500 ohms taps; secdy. 80,000 ohms resp flat within 3 db 40 to 10,000 cps; input level plus 10 dbm max.; shielded against 60 cps; potted in round metal can.	Audio Transformer	TF-112
T2	TRANSFORMER, filament; pri 110/220 volts, 50/60 cps input; secdy. 6.3 volts, 4.125 amp output; CT; hermetically sealed in rectangular metal can.	Filament Transformer	TF-104
T3	TRANSFORMER, filament and power: pri 110/220 volts, 50/60 cps, single phase, four output windings; sec. #1-300 v. CT; .070 amps; sec. #2-3.15 volts, CT, 3 amps; Sec. #3-5 volts 2 amps; sec. #4-6.3 volts, 1.2 amps; hermetically sealed metal rectangular can.	Power Transformer	TF-123
V1	TUBE, electron: 6AG5; min. 7 pin.	Marker Osc. & BFO	6AG5
V2	TUBE, electron: 6AG5; min. 7 pin.	IF Amp.	6AG5
V3	TUBE, electron: 6AT6; min. 7 pin.	Detector Amp.	6AT6
V4	TUBE, electron: 6BE6; min. 7 pin type pentagrid converter.	Mixer	6BE6
V5	TUBE, electron: 6AG5; min. 7 pin.	IF Amp.	6AG5
V6	TUBE, electron: 6AL5; min. 7 pin twin type diode.	Rectifier	6AL5
V7	TUBE, electron: 12AU7; dual triode, 9 pin min.	Cath. Foll. Amp.	12AU7
V8	TUBE, electron: 6J6; min. 7 pin type UHF twin triode.	Sweep Osc.	6J6
V9	TUBE, electron: 12AU7; dual triode; 9 pin min.	React. Modul.	12AU7
V10	TUBE, electron: thyratron, gas filled triode; Octal 884.	Sawtooth Gen.	884
V11	TUBE, electron: 12AX7; dual triode; min. 9 pin type.	H-amp	12AX7
V12	TUBE, electron: 12AX7; dual triode; min. 9 pin type.	V-amp.	12AX7
V13	TUBE, electron: 3BPI-A cathode ray oscilloscope; 14 pin type.	Visual Monitor	3BPI-A
V14	TUBE, electron: duodiode rectifier; octal; 5Y3GT.	Rectifier	5Y3GT

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
V15	TUBE, electron: 6X4; dual diode; min. 7 pin.	Rectifier	6X4
V16	TUBE, electron: OB2; min. 7 pin type voltage regulator.	Regulator	OB2
V17	TUBE, electron: OB2; min. 7 pin type voltage regulator.	Regulator	OB2
V18	TUBE, electron: 6X4; dual diode; min 7 pin.	Rectifier	6X4
V19	TUBE, electron: 6X4; dual diode; min 7 pin.	Rectifier	6X4
XF1	HOLDER, fuse: extractor post type; for single AGC cartridge fuse; phenolic shell and body; 15 amp; 250 volts max.	Fuseholder	FH-100-2
XI1	LIGHT, indicator: w/lens; for miniature bayonet base; 1/2 '' diam.; red smooth lens; T-3-1/4 bulb; enclosed shell; chrome plated brass shell; bakelite socket shell.	Lamp Socket	TS-106-1
XV1	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V1	TS102P01
XV2	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V2	TS102P01
XV3	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V3	TS102P01
XV4	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V4	TS102P01
XV5	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V5	TS102P01
XV6	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam holes on 7/8'' mtg. center.	Socket for V6	TS102P01
XV7	SOCKET, tube: 9 pin min. one piece saddle mtg.; two 1/8'' diam holes on 1.125'' mtg. center; round mica filled phenolic body.	Socket for V7	TS103P01
XV8	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8'' diam. holes on 7/8'' mtg. center.	Socket for V8	TS102P01

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
XV9	SOCKET, tube: 9 pin min. one piece saddle mtg.; two 1/8" diam holes on 1.125" mtg. center; round mica filled phenolic body.	Socket for V9	TS103P01
XV10	SOCKET, tube: octal; one piece saddle mtg. w/4 tinned ground lugs; two 0.156" diam mtg. holes on 1-1/2" mtg. centers; rd. mica filled phenolic body.	Socket for V10	TS101P01
XV11	SOCKET, tube: 9 pin min. one piece saddle mtg.; two 1/8" diam holes on 1.125" mtg. center; round mica filled phenolic body.	Socket for V11	TS103P01
XV12	SOCKET, tube: 9 pin min. one piece saddle mtg.; two 1/8" diam. holes on 1.125" mtg. center; round mica filled phenolic body.	Socket for V12	TS103P01
XV13	SOCKET, tube: diheptal.	Socket for V13	TS-113
XV14	SOCKET, tube: octal; one piece saddle mtg. w/4 tinned ground lugs; two 0.156" mtg. holes on 1-1/2" mtg. centers; round mica filled phenolic body.	Socket for V14	TS101P01
XV15	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8" diam holes on 7/8" mtg. center.	Socket for V15	TS102P01
XV16	SOCKET, tube: 7 pin min. one piece saddle mtg; two 1/8" diam holes on 7/8" mtg. center.	Socket for V16	TS102P01
XV17	SOCKET, tube: 7 pin min. one piece saddle mtg.; two 1/8" diam holes on 7/8" mtg. center.	Socket for V17	TS102P01
XV18	Socket, tube: 7 pin min.; one piece saddle mtg.; two 1/8" diam holes on 7/8" mtg. center.	Socket for V18	TS102P01
XV19	SOCKET, tube: 7 pin min.; one piece saddle mtg; two 1/8" diam holes on 7/8" mtg. center.	Socket for V19	TS102P01
XY1	SOCKET, crystal: for JAN CR-7 crystals; 050" diam holes spaced .487" center to center.	Socket for Y1	TS-104-1
XY2	SOCKET, crystal: for JAN FT243 crystal; .095" diam holes spaced .487" center to center.	Socket for Y2	TS-105-1

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
Y1	CRYSTAL, unit: 455 kcs; ±.01%.	455 kcs Oscillator	CR-25/U
Y2	CRYSTAL, unit: 100 kcs; ±.01%.	100 kcs Oscillator	CR-100
Z1	TRANSFORMER, assembly IF: 100 kc; includes C17, 18, 19, 20, L1, L2.	Input IF Trans.	A-363
Z2	TRANSFORMER, assembly IF: 100 kc; includes C25, 26, L4, L5.	Output IF Trans.	A-364
Z3	TRANSFORMER, assembly:IF: 100 kc; includes C22, L3.	Crystal peaking	A-365