Type BW-4A and BWU-4A Television Demodulators

Instructions

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.

IB-36160

ERRATA IN IB-36160

INSTRUCTION BOOK FOR BW-4A AND BWU-4A TELEVISION DEMODULATORS

DISPOSITION: To be inserted in and become part of IB-36160.

1. Replace the tabulation on page 21 with the table on the last page of this errata.

2. On page 33, in the group of parts listed for the VHF CONVERTER, MI-34003, make the necessary changes to bring the PARTS LIST into agreement with the following tabulation:

Symbol No.	Description	Drawing No.	Stock No.
R2	Resistor, 27 ohms, ±10%, 1/2 watt.	82283-43	502027
R4	Same	Same	522010
R12	Same	Same	502322
R15	Resistor, 100k ohms, ±10%, 1/2 watt.	82283-86	502410
R21	Same	Same	512333

3. On page 34, in the group of parts listed for the UHF CONVERTER, MI-34004, make the necessary changes to bring the PARTS LIST into agreement with the following tabulation:

Symbol No.	Description	Drawing No.	Stock No.
CR1	Same	Same	95696
R19	Same	Same	502322
R21	Same	Same	512312

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden, New Jersey, U.S.A.

Printed in U.S.A.

IB-36160-a

4. On page 34, the parts-list heading below the center of the page should read, "IF, VIDEO, AND POWER SUPPLY, MI-34002".

5. In the group of parts listed for the IF, VIDEO AND POWER SUPPLY, MI-34002, make the necessary changes to bring the PARTS LIST into agreement with the following tabulation:

Symbol No.	Description	Drawing No.	Stock No.
CR1	Same	Same	76675
CR2	Same	942423-2	95696
J4	Same	751500-3	204563
L13	Same	149484-503	99169
L14	Same	8825473-517	99185
L15	Same	149484-501	Same
L16	Same	149484-502	Same
R22	Resistor, 100k ohms, ±10%, 1/2 watt.	88283-86	502410
R28	Resistor, 100k ohms, ±10%, 1/2 watt. Same as R22.	Same	Same
R31	Same	Same	502347
R37	Same	Same	502068
R38	Same	Same	502075
R45	Same	Same	502147
R49	Same	Same	512333
R51	Same	Same	512327
R52	Same	Same	522318
R54	Resistor, 100k ohms, ±10%, 1 watt.	Same	Same
R57, R58	Same	Same	512068
R63	Resistor, 100k ohms, ±10%, 1/2 watt. Same as R22.	Same	Same

6. Add the items listed in the following tabulation to the PARTS LIST for the IF, VIDEO, AND POWER SUPPLY, MI-34002.

Symbol No.	Description	Drawing No.	Stock No.
	Connector, coaxial termination plug.	149475-1	54256
	Connector, coaxial.	427992-501	56153
	Connector, video output.	252868-1	66344
	Connector, 4 contact.	727969-27	99213
	Cord, power, 8 feet long.	399708-1	52556

7. Make the following changes in the schematic diagram on page 38:

(a) Change the value of R2 to 27 ohms.

(b) On the tube-socket diagram for channels 2 to 6, change the value of C23B to 18 mmf.

(c) On the tube-socket diagram for channels 2 to 6, delete C23A. There should be no connection between socket terminals 1 and 2.

8. In the instruction books for equipments bearing serial numbers 1023 and above, make the following changes in the schematic diagram on page 37:

(a) Remove the end of R19 which connects to the junction point between R20 and R21. Reconnect this end of R19 to the side of R21 which connects to terminal 14 of J4.

(b) Delete R20. Resistor, R21, should now be connected directly to C19.

(c) Delete C20.

(d) Change the value of R19 to 39k ohms.

(e) Change the value of R21 to 5600 ohms.

(f) Change the value of C26 to 510 mmf.

9. On page 34 of the instruction books for equipments bearing serial numbers 1023 and above, in the group of parts listed for the UHF CONVERTER, MI-34004, make the necessary changes to bring the PARTS LIST into agreement with the following tabulation:

Symbol No.	Description	Drawing No.	Stock No.
C20	Not Used	--	--
C26	Capacitor, 510 mmf, ±10%, mica.	748252-248	90009
R19	Resistor, 39k ohms, ±10%, 1/2 watt.	82283-81	502339
R20	Not Used	--	--
R21	Resistor, 5600 ohms, ±10%, 1 watt.	90496-71	512256

TABLE III

TYPICAL OPERATING VOLTAGES

Symbol	Function	RCA Tube Type	Pin Numbers 1	2	3	4	5	6	7	8
	IF, VIDEO, AND POWER SUPPLY CHASSIS									
V1	First Buffer	6C4	-	-	0	6.3ac	215	-	5	-
V2	Second Buffer	6C4	-	-	0	6.3ac	215	-	5	-
V3	First IF	6CB6	0	2	0	6.3ac	200	145	2	-
V4	Second IF	6CB6	0	2	0	6.3ac	200	145	2	-
V5	Third IF	6CB6	0	2	0	6.3ac	200	145	2	-
V6	Fourth IF	6AK6	0	10	0	6.3ac	185	180	10	-
V7	Video Output	6AG7	0	6.3ac	0	0	3	140	-	195
V8	Envelope Detector Amp	6AK6	0	170	0	6.3ac	170	170	4	-
V9	Series Regulator	6AS7	175	420	250	175	420	250	-	-
V10	D-C Amplifier	6CB6	106	105	-	-	175	150	105	-
V11	Voltage Reference	0C3	-	-	-	-	105	-	-	-
V12	Rectifier	5V4	-	-	-	400ac	-	400ac	-	450
	VHF CONVERTER UNIT									
V1	Oscillator, First Mult.	6J6	120	180	0	6.3ac	-27	-10	0	-
V2	Second Multiplier	6CB6	-8	2	0	6.3ac	190	200	2	-
V3	Mixer	6AS6	RF	2	0	6.3ac	190	100	-5	-
	UHF CONVERTER UNIT									
V1	Oscillator, First Mult.	6J6	120	180	0	6.3ac	-27	-10	0	-
V2	Second Mult. and Third Mult.	6BQ7-A	190	-12	0	0	6.3ac	190	-13	0
V3	Buffer	6CB6	0	2	0	6.3ac	200	145	2	-

All voltages measured with respect to ground with VoltOhmyst (RCA Type WV-97A)

ADDENDA TO IB-36160

INSTRUCTION BOOK FOR BW-4A AND BWU-4A TELEVISION DEMODULATORS

DISPOSITION: To be inserted in and become part of IB-36160.

The following changes should be made in the instruction books for only those BW-4A and BWU-4A equipments bearing serial numbers 1086 and above.

1. On the IF, Video, and Power Supply Schematic Diagram on page 39, make the following changes:

(a) Change the symbol number C40A to C67.

(b) Change the value of C67 from 80 to 5 microfarads.

(c) Change the value of R37 from 68 to 39 ohms.

(d) Change the value of R39 from 15 K ohms, 1 W to 10 K ohms, 2 W.

(e) Change the value of R41 from 1200 to 3000 ohms.

(f) Change the value of R42 from 820 to 1800 ohms.

(g) Add a resistor in parallel with R42. The symbol number for this resistor should be R65. This resistor has a value of 1800 ohms, 2 watts.

2. In the IF, Video, and Power Supply Parts List on pages 35 and 36, make the necessary changes to bring the list into agreement with the following tabulation:

Symbol No.	Description	Drawing No.	Stock No.
C67	Capacitor: dry electrolytic, 5 mf +100% -10%, 350 v	442901-66	28417
R37	Resistor: fixed, composition, 39 ohm ±5%, 1/2 w	82283-45	502039
R39	Resistor: fixed, composition, 10,000 ohm ±5%, 2 w	99126-74	522310
R41	Resistor: fixed, wire wound, 3000 ohm ±5%, 10 w	458574-58	97379
R42	Resistor: fixed, composition, 1800 ohm ±5%, 2 w	99126-65	522218
R65	Resistor: fixed, composition, 1800 ohm ±5%, 2 w. Same as R42	99126-65	522218

3. On page 21, in TABLE III, the voltages listed should be changed to agree with the following list:

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden, New Jersey, U.S.A.

Printed in U.S.A.

Symbol	Function	RCA Tube Type	Pin Numbers							
			1	2	3	4	5	6	7	8
V3	First IF	6CB6	0	2	0	5.4ac	200	145	2	-
V4	Second IF	6CB6	0	2	0	5.4ac	200	145	2	-
V5	Third IF	6CB6	0	2	0	5.4ac	200	145	2	-
V6	Fourth IF	6AK6	0	10	0	6.0ac	185	180	10	-
V7	Video Output	6AG7	0	6.3ac	0	0	1.9	148	0	108

4. On page 15, following Step 8, and on page 16, following Step 11, add the following paragraphs:

As a result of the introduction of higher power TV transmitters, it has become apparent that the directional coupler furnishes excessive voltages to the r-f input of the demodulator even in the minimum penetration position.

In cases where the voltage required for a video presentation without sync compression cannot be obtained even at minimum penetration, it will be necessary to insert a 50-ohm attenuator pad at the r-f input jack of the demodulator. The value of the pad must at present be obtained by a cut and try method. The best procedure is to have several pads available, such as 10-db, 6-db, and 3-db, and to adjust the r-f input to get the proper video output presentation.

TYPE BW-4A AND BWU-4A
TELEVISION DEMODULATORS

INSTRUCTIONS

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden, New Jersey U. S. A.

Printed in U. S. A.

IB-36160

FIRST AID

WARNING!

Operation of electronic equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

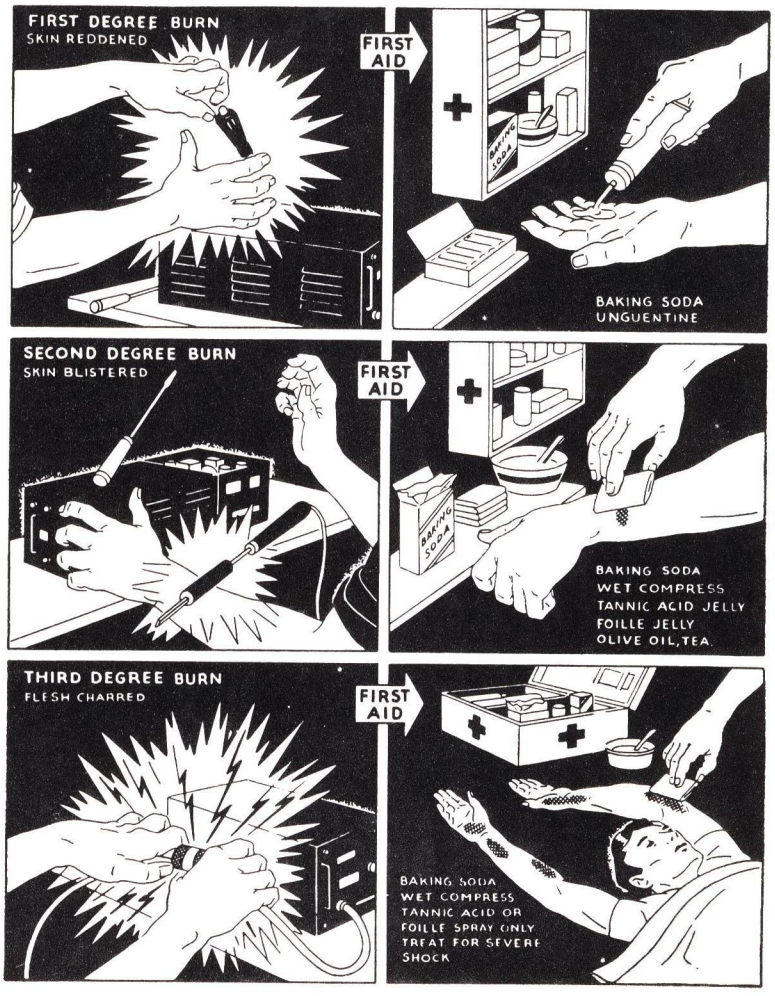
ABOUT FIRST AID

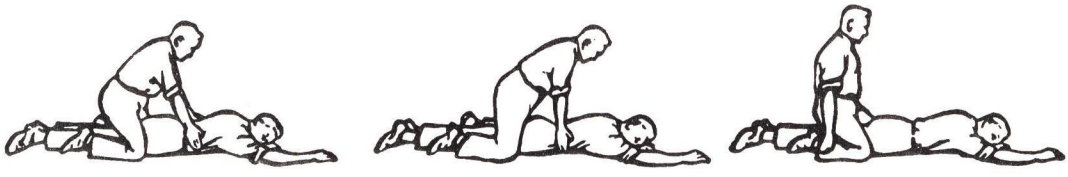
Personnel engaged in the installation, operation and maintenance of this equipment or similar equipment are urged to become familiar with the following rules both **in theory and in the practical application thereof.** It is the duty of every radioman to be prepared to give adequate First Aid and thereby prevent avoidable loss of life.

PRONE-PRESSURE METHOD OF RESUSCITATION

1. PROTECT YOURSELF with dry insulating material.
2. BREAK THE CIRCUIT by opening the power switch or by pulling the victim free of the live conductor.

DON'T TOUCH VICTIM WITH YOUR BARE HANDS UNTIL THE CIRCUIT IS BROKEN.





(A) (B) (C)

3. LAY PATIENT ON STOMACH, one arm extended, the other arm bent at elbow. Turn face outward resting on hand or forearm.
4. REMOVE FALSE TEETH, TOBACCO OR GUM from patient's mouth.
5. KNEEL STRADDLING PATIENTS THIGHS. See (A).
6. PLACE PALMS OF YOUR HANDS ON PATIENT'S BACK with little fingers just touching the lowest ribs.
7. WITH ARMS STRAIGHT, SWING FORWARD gradually bringing the weight of your body to bear upon the patient. See (B).
8. SWING BACKWARD IMMEDIATELY to relieve the pressure. See (C).
9. AFTER TWO SECONDS, SWING FORWARD AGAIN. Repeat twelve to fifteen times per minute.
10. WHILE ARTIFICIAL RESPIRATION IS CONTINUED, HAVE SOMEONE ELSE:
    (a) Loosen patient's clothing.
    (b) Send for doctor.
    (c) Keep patient warm.
11. IF PATIENT STOPS BREATHING, CONTINUE ARTIFICIAL RESPIRATION. Four hours or more may be required.
12. DO NOT GIVE LIQUIDS UNTIL PATIENT IS CONSCIOUS.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ELECTRICAL SPECIFICATIONS

R-F CONVERTER UNIT

Frequency Range	Channels 2 to 13 (BW-4A). Channels 14 to 83 (BWU-4A).
Input Required	Approximately 1 to 2 volts r-f
Output	Video carrier i-f frequency, 25 mc. Sound carrier i-f frequency, 20.5 mc.
Stability	Crystal frequency deviation less than ±0.002 percent.

IF AND VIDEO UNIT

IF Bandwidth	1.5 db down at 4 mc from video carrier with sound notch. 1.5 db down at 5 mc from video carrier without sound notch. Video carrier frequency 25 mc at 6 db point. Curve corresponds to standard RTMA TV receiver characteristics.
Low Frequency Response	Less than 2 percent tilt to 60-cycle square wave.
Transient Characteristics (100 kc square wave)	
Anticipatory undershoot	18 percent
Rise time	
(with sound notch)	0.13 microseconds.
(without sound notch)	0.09 microseconds.
Ringing frequency	
(with sound notch)	approx. 4.5 mc.
(without sound notch)	greater than 5.5 mc.
Amplitude of first positive overshoot	10 percent.
Amplitude of first negative overshoot	6 percent.
Axis of cutoff transient	Does not deviate more than -10% or + 3% of axis separation.

Second and following overshoots less than amplitude of first.

Sound Rejection	More than 50 db aural signal rejection at ±25 kc deviation from carrier frequency

Sensitivity	Approximately 0.05 volts input for 1.5 volts peak sync output across 75 ohms.
Output Voltage	Maximum 1.5 volts peak of sync across 75 ohms output impedance. Sync negative.

ENVELOPE DETECTOR

Input	Maximum available (up to five volts). Input connector internally terminated for VHF. External pad used for UHF. Transmitter to be modulated with video sweep signal.
Output	Varies with input (may be observed on any standard oscilloscope).

POWER SUPPLY

Power Source	105 to 125 vac, 50/60 cycles, 250 watts (3 amp slo-blo fuse).
D-C Output Voltages	250 volts (regulated). -10 volts (unregulated). -3 volts (unregulated).

MECHANICAL SPECIFICATIONS

IF, Video, and Power Supply Chassis

Height	14 inches.
Width	Standard 19 inch Rack Mounting.
Depth	9 inches.
Weight	30 pounds.

UHF or VHF R-F Converters (mounts on IF, Video, and Power Supply Chassis)

Length	9-1/2 inches.
Width	4-1/2 inches.
Depth	4-1/2 inches.
Weight	2 pounds.

Directional Coupler

Dimensions	3 inches x 2 inches x 2 inches.
Weight	2-3/8 pounds.

Coupler Housing

TYPE	LENGTH	DESIGNED TO FIT
UHF (MI-19396-2)	6 in., flanged each end	3-1/8 in. 50 ohm UHF line
VHF (MI-19396-3)	9 in., unflanged	3-1/8 in. 51.5 ohm VHF line

OPERATING CONDITIONS

Ambient Temperature	15°C to 45°C
Relative Humidity	0 to 95%

TUBE AND GERMANIUM DIODE COMPLEMENT

IF, Video, and Power Supply Unit

Symbol	RCA Tube Type	Function
V1	6C4	Sound Notch
V2	6C4	Sound Notch
V3	6CB6	First IF Amplifier
V4	6CB6	Second IF Amplifier
V5	6CB6	Third IF Amplifier
V6	6AK6	Fourth IF Amplifier
V7	6AG7	Video Output
V8	6AK6	Envelope Detector Amplifier
V9	6AS7	Series Regulator
V10	6CB6	D-C Amplifier
V11	OC3	Voltage Reference Tube
V12	5V4	Rectifier
CR1	1N64	Video Detector
CR2	1N72 (G7C)	Envelope Detector

VHF Converter Unit

V1	6J6	Oscillator - First Multiplier
V2	6CB6 (Chan. 7-13)	Second Multiplier
V3	6AS6	Mixer

UHF Converter Unit

V1	6J6	Oscillator - First Multiplier
V2	6BQ7-A	Second Multiplier - Third Multiplier
V3	6CB6	Buffer
CR1	1N72 (G7A)	Mixer - Multiplier

EQUIPMENT LIST

The following items are included with the BW-4A and BWU-4A TV Demodulators.

TYPE BW-4A DEMODULATOR (ES-34006)

Qty.	Description	RCA Reference
1	IF, Video, and Power Supply Chassis	MI-34002
1	VHF RF Oscillator Converter	MI-34003
1	Directional Coupler	MI-19396-1
1	VHF Housing	MI-19396-3
1	Channel Frequency Crystal	MI-34008-A(*)
1	Cable Kit	MI-34013
**	Set of Spare Tubes	MI-34014
1	Instruction Book	IB-36160

TYPE BWU-4A TV DEMODULATOR (ES-34007)

Qty.	Description	RCA Reference
1	IF, Video, and Power Supply Chassis	MI-34002
1	UHF RF Oscillator Converter	MI-34004
1	Directional Coupler	MI-19396-1
1	UHF Housing	MI-19396-2
1	Channel Frequency Crystal	MI-34008-A(*)
1	Cable Kit	MI-34013
**	Set of Spare Tubes	MI-34015
1	Instruction Book	IB-36160

* Supplied for specific operating channel.
**Supplied if specified on sales order.

RECOMMENDED TEST EQUIPMENT

The following, or equivalent, types of test equipment are recommended for tuning adjustments and, when required, realignment of the TV Demodulator.

RF CONVERTER TUNING ADJUSTMENTS

VoltOhmyst (RCA Type WV-97A)
§Plate Current Meter (RCA MI-21200-C1)

IF ALIGNMENT (In addition to preceding equipment)

Signal Generator (Measurements Model 80)
Sweep Generator (RCA Type WR-59C)
Television Calibrator (RCA Type WR-39C)
Wideband Oscilloscope (Tektronix Type 524-D)

SOUND NOTCH ALIGNMENT (In addition to preceding equipment)

Audio Voltmeter, 0.01 Volts Full Scale (RCA Type WV-73A)

§ Required for UHF converter only.

INTRODUCTION

The vestigial sideband television broadcasting system which is standard in the United States, provides maximum utilization of the six-megacycle channel width. However, due to the attenuation of the lower sideband and the sharp cut-off of the higher sideband, distortion is introduced into the transmitted picture. This distortion is evidenced in the picture by leading whites, trailing smears, ringing, and loss of picture detail. While not usually discernable during normal program telecasting, these effects become clearly evident when a test pattern is used.

NOTE

This distortion is characteristic of the vestigial sideband method of transmission and is not a fault of the equipment.

The radiated vestigial sideband TV signal is such that approximately 0.75 mc of the lower sideband is transmitted with little attenuation. Upon demodulation, corresponding lower and upper sideband components are complementary and a demodulator input characteristic, similar to that shown by the linearly sloping dotted lines in Figure 6, is required to obtain uniform video amplitude response. This is the RTMA recommended receiver response curve for vestigial sideband reception.

With vestigial sideband transmission, cancelling of sideband components does not occur and phase distortion is present. Since a sharp white-to-black transition is equivalent to modulating the transmitter with a square wave, this phase distortion at low video frequencies alters the square wave response in the receiver so that a dip precedes the transition from white-to-black as shown in Figure 7. This dip may be observed as a leading white (whiter-than-white) immediately prior to a white-to-black picture change. See Figure 8. A dip precedes a transition from black-to-white also, but in this case the signal is driven into the blacker-than-black region and is not visible on the kinescope. The gradual slope of the transition line is the commonly observed trailing smear produced by sharply defined bordering half-tones.

Although these leading whites and trailing smears are introduced because of the suppression of the lower sideband, ringing and the associated lack of detail will be found in any practical television system as a result of the high frequency video cut-off characteristic and the associated high frequency time-delay. Ringing is evident in the square wave response as a ripple along the top of the square wave. In a high quality home receiver this appears as a multiple repeat adjacent to well defined picture elements. The rapid high frequency cut-off introduced by the receiver circuits results in the curtailment of certain high frequency components, and a relative time-delay error. Both influence the degree of ringing.

Picture detail (for well defined adjoining half-tone picture elements) is essentially determined by the rapidity of transitions of the kinescope. The square wave characteristic related to picture detail is the rise time or slope for the edge of the wave as shown in Figure 7. Since this slope is a function of the high frequency components, the higher the cut-off frequency in the system, the steeper the slope of the square wave response and the finer the resulting picture detail.

The Type BW-4A and BWU-4A Television Demodulators may be used to check radiated picture signal characteristics for compliance with applicable RTMA and FCC standards. Vertical wave form patterns will show low frequency spurious responses while the horizontal waveforms include depth of modulation, percent synchronizing signal, transient content, and white compression. Analyses of resolution may also be made by utilizing an adequate resolution chart.

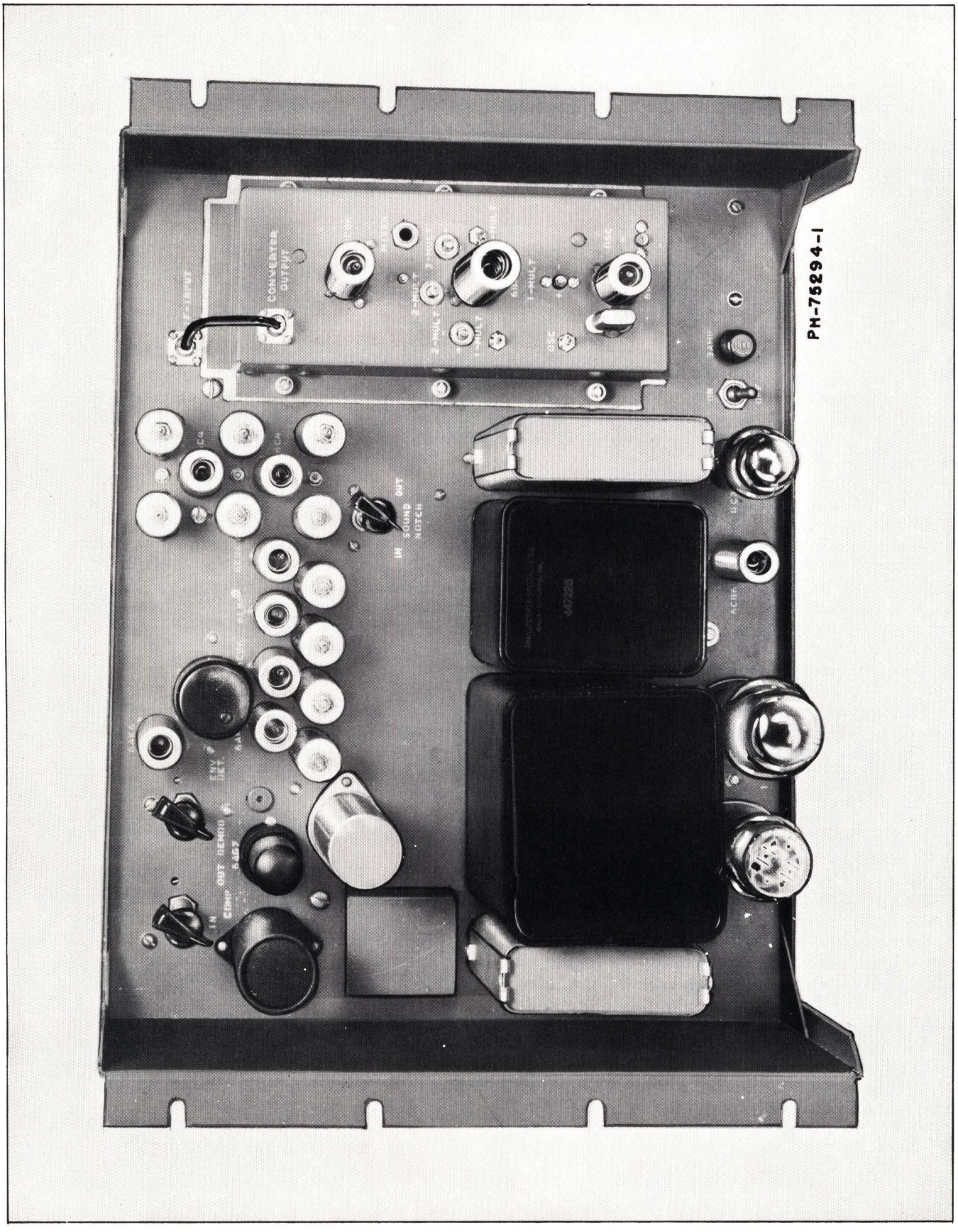


Figure 1 - BWU-4A Television Demodulator

DESCRIPTION

GENERAL

The RCA Types BW-4A and BWU-4A Television Demodulators are designed to produce a video signal that, when applied to a master monitor, will permit visual observation of the signal delivered to the TV transmitting antenna. The picture information is equivalent to that obtainable from a high quality television receiver.

The type BW-4A equipment is used to cover the VHF television channels, 2 to 13, and the BWU-4A is used for UHF channels 14 to 83. These units are nearly identical except for circuit design in the r-f converter sections. See Figure 1.

CIRCUITS

The TV demodulator is basically a superheterodyne receiver designed for vestigial sideband reception and includes a crystal-controlled r-f to i-f frequency converter, a sound rejection circuit, four stages of i-f amplification, a video detector, and a video output stage. Refer to Figure 2. The frequency conversion circuits are assembled on a small, separate chassis, which is mounted on the main i-f and power supply chassis. See Figures 1, 12, and 14.

A directional coupler, MI-19396-1, designed to mount in a 3-1/8 inch transmission line, is included as part of the demodulator equipment. This coupler samples the transmitter output and supplies the resultant signal to the converter unit. Complete details of the directional coupler are included in the instruction book, IB-36169, supplied with it.

VHF Converter (Channels 2 to 13)

The BW-4A Converter (See Figure 19) contains a crystal controlled oscillator using one-half of a type 6J6 tube, V1. The second half of V1 is used as a frequency multiplier.

On channels 7 to 13, a second multiplier stage, V2, is required. When the converter is operated on channels 2 to 6, this second multiplier tube is removed from its socket and replaced by a plug-in capacitor. The r-f output frequency from the oscillator and multiplier section is then applied to the suppressor grid of the mixer tube, V3.

The TV transmitter signal is obtained from the directional coupler which may be inserted into the transmission line at any of several points between the vestigial sideband filter and the antenna. By installing the directional coupler in one of the feed lines between the diplexer and the antenna, mismatches in the line being monitored will be readily evident. With this installation, however, mismatches may not be detected in the second antenna feed line unless provision is made for sampling the signal in this line also.

Alternatively, the directional coupler may be inserted into the transmission line between the sideband filter and the diplexer. This location will not be as sensitive to antenna mismatch as the antenna feed line installation.

If a filterplexer is used, the directional coupler must be installed between the filterplexer and the antenna.

The transmitter signal is applied to the control grid of the mixer tube, V3, and may be varied in level by changing the penetration setting of the directional coupler. The i-f output circuit of the mixer is untuned and has no effect on the i-f frequency response.

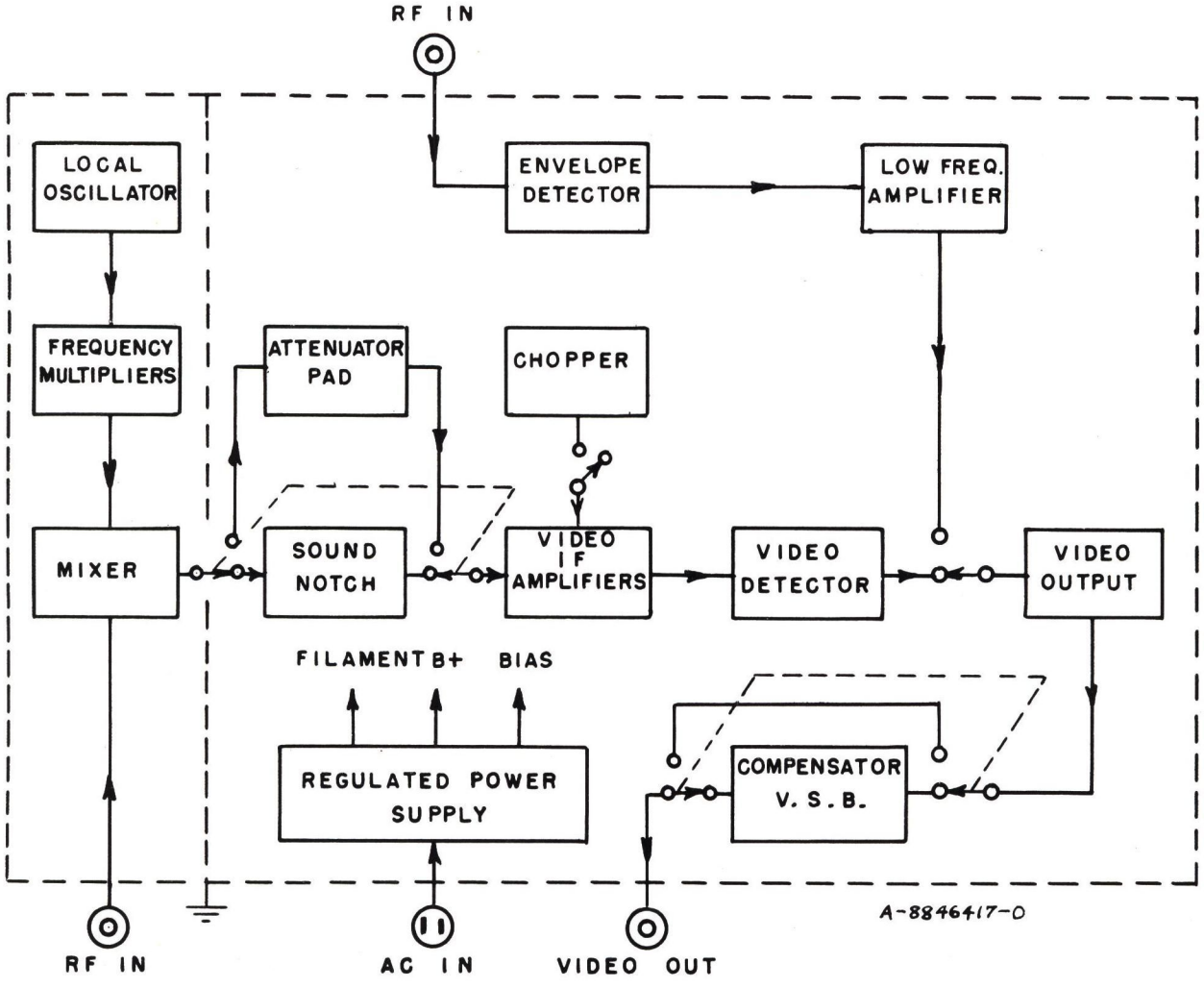


Figure 2 - **BW-4A/BWU-4A** Block Diagram

UHF Converter (Channels 14 to 83)

The BWU-4A converter includes a crystal oscillator and first multiplier stage using a type 6J6 tube, V1, as shown in Figure 18. The signal then passes through two additional multiplier stages using a type 6BQ7-A tube, V2, and is finally coupled to the crystal mixer, CR1.

The frequency of the injected local oscillator signal is one-half the frequency required for the operating channel since, in this case, the crystal acts as a frequency doubling device.

The TV signal is obtained from the directional coupler which should be located between the filterplexer and the antenna. This signal is injected into the mixer, CR1, at the same point as the local oscillator signal. The resultant i-f signal is applied to a type 6CB6 buffer stage which has a untuned output circuit.

I-F Amplifier and Power Supply

The schematic diagram of this unit is shown in Figure 20. The i-f amplifier, which includes tubes V3, V4, V5, and V6, uses a video carrier frequency of 25 megacycles and is stagger tuned for optimum brand width. A sound frequency rejection circuit peaked at 20.5 megacycles may be switched into the i-f input circuit when desired. This circuit includes tubes V1 and V2, and three bridged T networks. When the rejection network is switched out of the i-f circuit, a 10 db pad is automatically inserted to maintain a constant output level.

Output from the i-f section is applied to a type 1N64 crystal diode video detector, which then feeds the video signal to the output stage, V7.

Vestigial sideband transmission of television signals introduces a characteristic phase distortion into the detected video signal. Although not usually discernable during regular program telecasting, this distortion will be clearly evidenced by leading whites and trailing smears when a test pattern is used. See Figures 8 and 9. To correct this distortion, a phase compensating network is provided which may be switched into the video output circuit of tube V7 with the typical results shown in Figures 10 and 11.

A mechanical 50/60-cycle chopper, which may be controlled from a remote location, is included as part of the i-f section. When this chopper is energized, it will apply a negative cut-off bias to i-f amplifier tubes V4, V5, and V6 at a 50/60-cycle rate, and thereby provide a zero level base line on the monitor oscilloscope screen.

The output signal from the TV demodulator includes synchronizing pulses and video from the transmitted signal, and is intended to be coupled to the master monitor through a 75-ohm coaxial line.

The directional coupler may be connected through jack J3 to a long time-constant envelope detector, CR2, which feeds a low-frequency amplifier, V8. Switch S3 switches the output of V8 to the video output stage, V7. This detector circuit is used to enable observation of the television transmitter response envelope when the transmitter is modulated by a video sweep generator. See Figure 5.

Operating voltages for the entire unit are furnished by a regulated power supply mounted on the i-f chassis.

INSTALLATION

GENERAL

Carefully unpack the units comprising the TV demodulator and inspect them for possible damage incurred during shipment. The individual items are tabulated on the Equipment List at the front of this book and on the Master Item (MI) lists packed with the equipment.

Mount the converter unit (MI-34003 or MI-34004) on the main i-f and power supply chassis MI-34002 as shown in Figure 1. Make certain that the two-contact Jones power plug on the converter is inserted correctly into the corresponding socket, J4, on the i-f chassis.

Connect the IF INPUT jack, J1, on the i-f chassis to the corresponding CONVERTER OUTPUT jack using the i-f cable assembly supplied (MI-34002 item 2).

MOUNTING

The BW-4A and BWU-4A TV Demodulators have identical mounting dimensions and should be mounted in a standard relay rack in the transmitter room. The location should be such that not more than 75 feet of RG-9A/U coaxial cable (MI-34013 item 1) will be required to interconnect the demodulator and the directional coupler. Two cable connectors (MI-34013 item 2) are supplied.

Measure the a-c line voltage and connect the primary tap of transformer T1 accordingly. Select the tap that is either equivalent to, or the next tap higher than the line voltage. For example: use the 125 volt tap if the line voltage is 117 volts.

DIRECTIONAL COUPLER

Install the directional coupler housing in the preferred transmission line location, then mount and connect the directional coupler as described in the instruction book, IB-36169, supplied with it. See Figure 21.

TUNING ADJUSTMENTS

After the TV Demodulator has been properly installed, the r-f circuits must be adjusted for correct functioning at the operating frequency. During the following adjustment procedure, the directional coupler should be connected to the RF-INPUT jack of the converter.

Note that the slotted shafts of the tuning capacitors have one segment painted red. Additionally, + and - signs are marked on the chassis adjacent to each capacitor shaft. When the shaft is rotated so the red segment is nearest to the + mark, the capacity is maximum (plates meshed). With the red segment at the - mark, the capacity is minimum.

VHF CONVERTER (BW-4A)

1. Plug the channel frequency crystal, MI-34008-A(*), into the socket on the converter chassis. The transmitter should not be operating at this time.

2. If the BW-4A TV Demodulator is to be used on channels 2 to 6, plug the capacitor unit (MI-34003 item 2) into socket X2 on the converter chassis.

   For operation on channels 7 to 13, plug a type 6CB6 tube into socket X2.

*Number determined by operating channel.

3. Adjust the angle and penetration settings of the directional coupler probe in accordance with the instructions and charts in IB-36169.

4. Close switch S4 on the main chassis and allow the equipment to warm-up for at least thirty minutes.

5. Connect a VoltOhmyst (-30 volt d-c scale) from the OSC test point to ground.

Rotate capacitor C1, through its range while observing the meter indication. As the tuning capacity is increased, the voltage will gradually rise and then drop sharply. Set C1 slightly on the low capacity side of the point where the sharp drop occurs. If two peaks are obtained at different capacitor settings, use the setting nearest to the maximum capacity value.

6. On channels 2 to 6, connect the VoltOhmyst from the MIX. DR. test point to ground. Connect the master monitor to the VIDEO OUTPUT jack, J1, on the main chassis. Turn on the visual transmitter and apply a modulated r-f signal, at the channel frequency, to the converter input. Adjust the 1-MULT tuning capacitor, C7, until a picture is seen on the master monitor, then peak C7 for maximum meter indication.

On channels 7 to 13, connect the VoltOhmyst from the 1-MULT test point to ground. Tune the 1-MULT capacitor, C7, for peak indication on the meter. A peak may be obtained at two different capacitor settings, in this case, use the setting nearest the minimum capacity position.

In the remaining steps of this procedure, if the amplitude of the sync pulses exceeds one volt as shown on the master monitor oscilloscope, readjust the penetration setting of the directional coupler to reduce the input to the correct value.

7. On channels 2 to 6, set the 2-MULT capacitor, C13, at its minimum capacity position.

On channels 7 to 13, connect the VoltOhmyst from the MIX. DR. test point to ground. Tune the 2-MULT capacitor, C13 for peak meter indication which should be approximately -5 volts.

8. Readjust the penetration setting of the directional coupler to give an output voltage of one volt, peak of sync, at the master monitor. Adjust the angle setting to correspond with the value shown on the appropriate calibration chart, in IB-36169, for the operating frequency and penetration setting.

UHF CONVERTER (BWU-4A)

1. Refer to Table I and install the appropriate coils in the converter multiplier stages for the operating frequency. These coils must be mounted by inserting the ends into the capacitor terminals and soldering them in position.

It is important that resistors R12 and R16 (See Figures 15 and 18) be connected as near as possible to the exact electrical centers of coils L5 and L4 respectively. At this time, however, tentatively connect the resistors to the mechanical center of the coils. Final adjustment will be made later with the equipment operating.

TABLE I
BWU-4A CONVERTER COILS

COIL	CHANNELS	NO. OF TURNS
L4	14 to 28	4
	29 to 44	3
	45 to 64	2
	65 to 83	1
L5, L6	14 to 43	5
	44 to 83	3

2. Plug the channel frequency crystal into the socket provided on the converter chassis. The transmitter should not be operating at this time.

3. Adjust the angle and penetration settings of the directional coupler probe in accordance with the instructions in IB-36169.

4. Close switch S4 on the main chassis to apply power to the equipment and allow it to warm-up for at least thirty minutes.

5. Connect a VoltOhmyst (-30 volts d-c scale) from the OSC test point to ground. Adjust capacitor C1 as described in step 5 for the "VHF Converter Adjustment".

6. Connect the VoltOhmyst form the 1-MULT test point to ground. Adjust capacitor C7 for a peak meter reading. In some cases, two peaks will be obtained at different capacity settings. On channels 14 to 46 use the peak nearest the maximum capacity setting; on channels 47 to 83 use the peak nearest minimum capacity.

7. Connect the VoltOhmyst from the 2-MULT test point to ground. Adjust the 2-MULT capacitors, C9 and C16, for peak voltage indication.

8. Plug a Plate Current Meter (RCA MI-21200-C1) into the MIXER jack on the converter chassis to indicate crystal mixer current. Adjust the 3-MULT capacitor, C12, for peak meter indication (approximately 100).

9. Disconnect the Plate Current Meter then turn on the transmitter. If the amplitude of the sync pulses exceeds one volt as shown on the master monitor oscilloscope, readjust the penetration setting of the directional coupler to reduce the input to the correct value.

10. While observing the waveform on the master monitor oscilloscope, retune C12 slightly to obtain peak amplitude of sync pulses.

11. Readjust the penetration setting of the directional coupler to give an output voltage of one volt, peak of sync, at the master monitor, then readjust the angle setting to correspond with the value shown on the calibration chart in the instruction book for the operating frequency and penetration setting.

12. USING EXTREME CAUTION BECAUSE OF THE 250 VOLTS ON THE COILS, touch a small insulated screwdriver or similar loading device to the junction points between resistor R12 and coil L5, and between resistor R16, and coil L4. If the output waveform displayed on the master monitor oscilloscope is affected, move the resistor connection to the point where the least moticeable effect is obtained. Recheck adjustments made in steps 7 to 11.

In some cases, evidence of r-f from the sound carrier may be observed as a wide or "fuzzy" trace of the sync pulses on the monitor oscilloscope. The sound notch should then be adjusted for optimum rejection by slightly readjusting coils L1, L4, and L7 (see Figure 16) until the oscilloscope trace has maximum sharpness.

It is assumed that the BW-4A or BWU-4A Television Demodulator has been installed and adjusted in accordance with the instructions in the preceding sections of this book.

PROGRAM MONITORING

Set the demodulator unit control switches to the following positions:

S1	SOUND NOTCH	IN
S2	PHASE COMPENSATOR	OUT
S3	ENV. DET.-DEMOD.	DEMOD
S4	AC POWER	ON

Turn on the power to the master monitor which is connected to the output of the TV demodulator. Allow the equipment to warm-up for several minutes then adjust the master monitor controls for the best picture. The picture on the monitor will be equivalent to that shown on the screen of a high-quality home television receiver, and will enable observation of picture transmission faults. The amplitude and waveform of the synchronizing signal will be displayed on the monitor oscilloscope. By closing the chopper control switch, the chopper relay, K1, will be energized and provide a zero level base line on the oscilloscope for calibration reference.

During regular TV program transmission, the demodulator controls will be usually set as described previously to obtain a true replica of the transmitted picture. However, when it is desired to observe the overall quality of the entire system, the PHASE COMPENSATOR should be switched IN. Distortion caused by the single sideband method of transmission will then be reduced as summarized under "Description", and the system characteristics will be more evident.

When tests are to be made of the video transmitter outside of regular program periods, the aural transmitter may be shut down and the SOUND NOTCH on the TV demodulator switched OUT of the circuit.

ENVELOPE DETECTOR

The envelope detector is used to enable observation of the overall response envelope of the television transmitter when the transmitter is being modulated by a video sweep generator. For this application, disconnect the lead from the directional coupler to the converter unit at the converter r-f input jack. Reconnect this lead to the diode input jack, J3, on the i-f and power supply chassis. Connect the vertical input terminals of an oscilloscope to the 75 ohm termination resistor, MI-34002 item 3, which should be plugged into the video output jack, J2. Select a suitable horizontal sweep frequency for the oscilloscope. Place switch S3 in the ENV. DET. position, and the compensator switch S2 in the OUT position. The pattern on the oscilloscope should be similar to that shown in Figure 5.

MAINTENANCE

GENERAL

Maintenance of the BW-4A and BWU-4A Television Demodulators will be mainly concerned with keeping the unit clean and free from dust. Check the cable connections at intervals and retighten when necessary. Periodically test the tubes in the converter and main chassis and replace any that test below standard.

Typical operating voltages for the equipment are listed in Table III as an aid in trouble shooting.

VOLTAGE ADJUSTMENTS

1. Measure the a-c line voltage and connect the primary tap accordingly. Select the tap that is equivalent to, or the next tap higher than the line voltage.

2. Connect the power jack, J7, to the a-c line. Close the power switch, S4, and allow the unit to warm-up for approximately thirty minutes.

3. Connect a VoltOhmyst to pin 3 of tube V9 and adjust the voltage control, R50, for 250 volts.

4. Adjust the sliders on resistor R60 (see Figure 17) to obtain a voltage of -3 volts on the slider nearest the ground end of the resistor, and -10 volts on the remaining slider.

5. The voltage adjustments made in the preceding steps 3 and 4 tend to interact. Recheck them and readjust if necessary.

RF CONVERTER ALIGNMENT

Adjustment of the r-f converter circuits is described under the "Tuning Adjustments" section of this book.

If replacement of an oscillator crystal is required, the crystal frequency may be determined from the following formula:

$$\text{crystal freq. (mc)} = \frac{25 \text{ mc} + \text{visual carrier freq. (mc)}}{\text{multiplier factor (Table II)}}$$

TABLE II
MULTIPLYING FACTORS

Channels	2 to 6 (VHF)	7 to 13 (VHF)	14 to 46 (UHF)	47 to 83 (UHF)
Multiplier Factor	3	6	16	24

I-F ALIGNMENT

The i-f circuits have been properly aligned at the factory and will not ordinarily require readjustment unless tampered with. If realignment should be necessary, use the following procedure:

NOTE

Unless otherwise stated, all references are to components on the i-f, video, and power supply chassis. Check the tuning adjustments with all shields and covers in place.

1. Remove the short, i-f coupling cable between the CONVERTER OUTPUT jack on the r-f converter chassis and the IF-INPUT jack, J1, on the i-f, video, and power supply chassis. Connect the 75 ohm termination resistor (MI-34002 item 3) to the VIDEO OUTPUT jack, J2.

2. Temporarily solder a 50 ohm ±5 percent, 1/2 watt non-inductive resistor from the IF-INPUT jack, J1, to ground.

3. Solder a 330 ohm damping resistor across the terminals of coils L10, L11, and L12.

4. Connect a suitable signal generator (covering a frequency range of 20 to 30 mc with 0.1 volt or greater output) to the IF-INPUT jack, J1.

5. Connect the d-c voltage leads of a VoltOhmyst across the detector load resistor, R34.

6. Set the control switches on the i-f chassis as follows:

S1	SOUND NOTCH	OUT
S2	COMPENSATOR	OUT
S3	ENV. DET. - DEMOD.	DEMOD.

7. Close the power switch, S4, and allow the equipment to warm-up for at least thirty minutes.

8. Set the signal generator to 22.9 mc, and adjust the slug of the first i-f coil, L9, for peak indication on the VoltOhmyst.

9. Disconnect the 330 ohm resistor from inductance L10 and resolder it across L9.

10. Set the signal generator to 19.6 mc, and adjust the second i-f coil, L10, for peak meter indication.

11. Disconnect the 330 ohm resistor from L11 and resolder it across L10.

12. Set the signal generator to 24.35 mc, and adjust the third i-f coil, L11, for peak meter indication.

13. Disconnect the 330 ohm resistor from L12 and resolder it across L11.

14. Set the signal generator to 20.85 mc, and adjust the fourth i-f coil, L12, for peak meter indication.

15. Disconnect and remove all the 330 ohm resistors which were previously connected across the i-f coils.

16. Connect an i-f sweep generator, with a sweep range of approximately 10 mc and covering the frequency band of 20 to 30 mc, to the IF-INPUT jack, J1. Connect a television calibration oscillator to the same jack to serve as a marker signal source.

Connect an oscilloscope across the 75 ohm termination resistor, R38, at the VIDEO OUTPUT jack, J2.

17. With the sweep generator operating, observe the amplitude response curve on the oscilloscope. Referring to Figure 3, superimpose marker signals on the sweep signal at the indicated frequencies and, if necessary, make slight readjustments of L9, L10, L11, and L12 to obtain the desired response.

Use a low signal level for this adjustment to avoid overloading the i-f and video stages. If any of these stages are overloaded, grid current will flow through the corresponding grid resistor. The presence of this current can be determined by measuring the voltage drop with a VoltOhmyst. A test jack is provided on the main chassis (see Figure 16) which will enable an approximate measurement of overload conditions.

18. Disconnect the sweep generator and calibration marker oscillator.

SOUND NOTCH ALIGNMENT

1. Connect an i-f sweep generator and calibration marker oscillator to the IF-INPUT jack, J1, and switch S1 to the SOUND NOTCH IN position. Connect an oscilloscope across the 75 ohm termination resistor (R38) at the VIDEO OUTPUT jack, J2.

2. Tune the three "bridged T" network coils, L1, L4, and L7 to approximately the lowest possible frequency observable on the oscilloscope sweep pattern.

3. Set the marker oscillator to 20.5 mc and tune L1 for a notch in the sweep pattern at 20.5 mc.

4. Adjust the associated peaking coil, L2, for approximately flat response to about 21 mc as shown in the typical response curve, Figure 4.

5. Retune L1 from its previous setting (step 3) to the lowest possible frequency.

6. Adjust L4 for a notch in the sweep pattern at 20.5 mc. Adjust the associated peaking coil, L5, for flat response as was done for L2 in step 4.

7. Retune L4 to its lowest possible frequency.

8. Tune L7 for a notch in the sweep pattern at 20.5 mc and adjust coil L8 as was done for L2 in step 4.

9. Retune L1 and L4 until their notches coincide with the notch produced by L7 at 20.5 mc.

10. Retune L2, L5, and L8 to obtain as nearly as possible the typical i-f response with sound notch as shown in Figure 4.

11. Disconnect the sweep generator and marker oscillator. Connect an audio-modulated signal generator to the IF-INPUT jack. Connect an audio voltmeter to the VIDEO OUTPUT jack.

12. Set the signal generator to 23 megacycles and adjust its output voltage to a value just below the point at which overloading occurs in the i-f stages.

13. Use a heterodyne calibrator, set the signal generator accurately to 20.5 megacycles.

14. Retune L1, L4, and L7 for minimum indication on the audio voltmeter using the most sensitive scale. Recheck peaking coil adjustments with all shields and covers in place by use of the sweep generator and oscilloscope.

TABLE III
TYPICAL OPERATING VOLTAGES

Symbol	Function	RCA Tube Type	Pin Numbers							
			1	2	3	4	5	6	7	8
IF, VIDEO, AND POWER SUPPLY CHASSIS										
V1	Rectifier	5V4				400ac		400ac		450
V2	Series Regulator	6AS7	175	420	250	175	420	250		
V3	D-C Amplifier	6CB6	106	105			175	150	105	
V4	Voltage Reference	OC3					105			
V5	First Buffer	6C4			0	6.3ac	215		5	
V6	Second Buffer	6C4			0	6.3ac	215		5	
V7	First IF	6CB6	0	2	0	6.3ac	202	147	-2	
V8	Second IF	6CB6	0	2	0	6.3ac	202	147	-2	
V9	Third IF	6CB6	0	2	0	6.3ac	202	147	-2	
V10	Fourth IF	6AK6	0	-10	0	6.3ac	185	180	10	
V11	Video Output	6AG7	6	6.3	0	0	3	138	0	193
V12	Envelope Detector Amp.	6AK6	0	169	0	6.3ac	169	169	4	
VHF CONVERTER UNIT										
V1	Oscillator, First Mult.	6J6	180	120	0	6.3ac	-4	-13	0	
V2	Second Multiplier	6CB6	-0.8	2.1	0	6.3ac	192	202	-2	
V3	Mixer	6AS6	0	2	0	6.3ac	192	102	-5	
UHF CONVERTER UNIT										
V1	Oscillator, First Mult.	6J6	135	200	0	6.3ac	-27	-10	0	
V2	Second Mult. and Third Mult.	6BQ7	190	-12	0	0	6.3ac	190	-13	0
V3	Buffer	6CB6	0	5	0	6.3ac	202	147	-5	

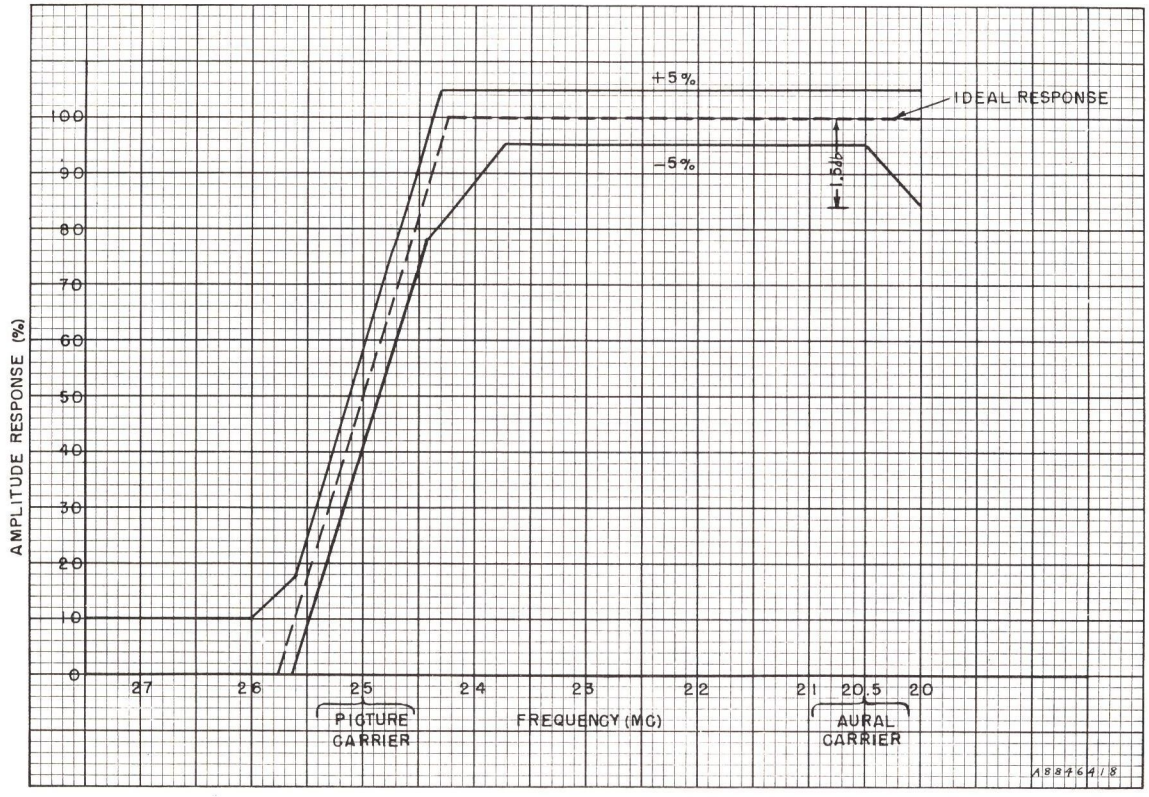


Figure 3 - IF Amplifier Response, Sound Notch Out

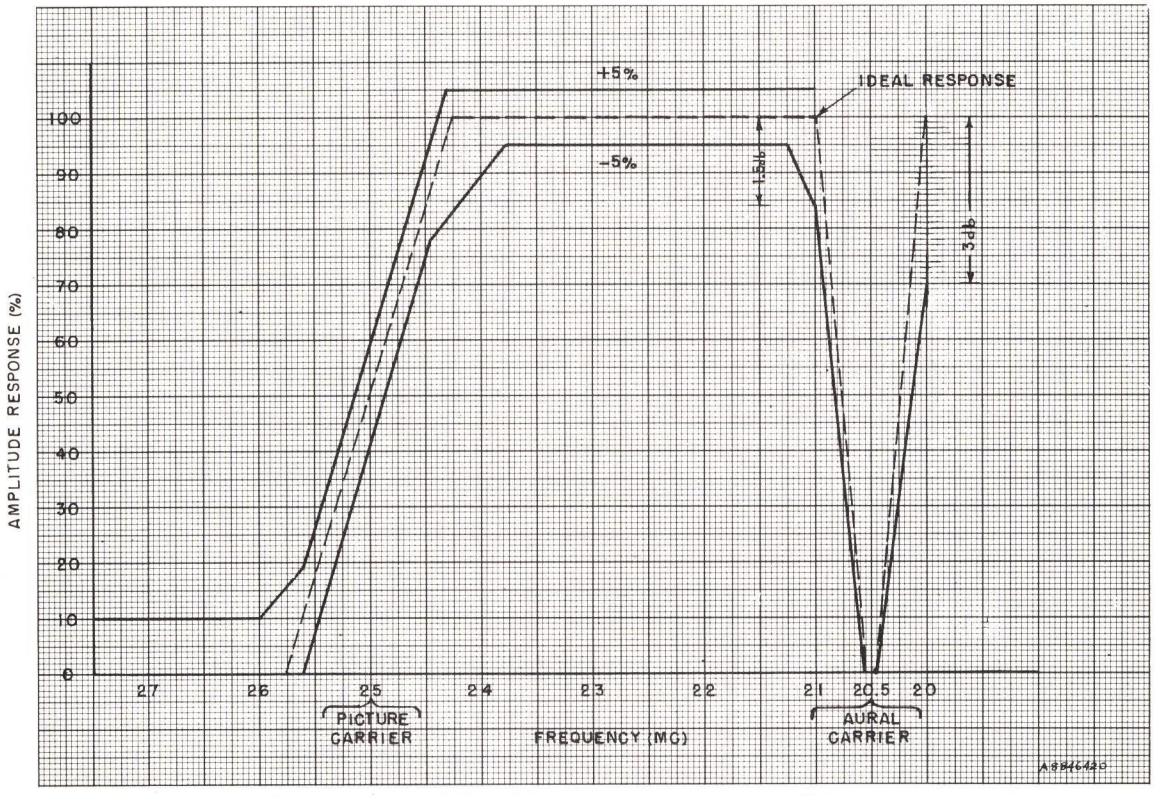


Figure 4 - IF Amplifier Response, Sound Notch In

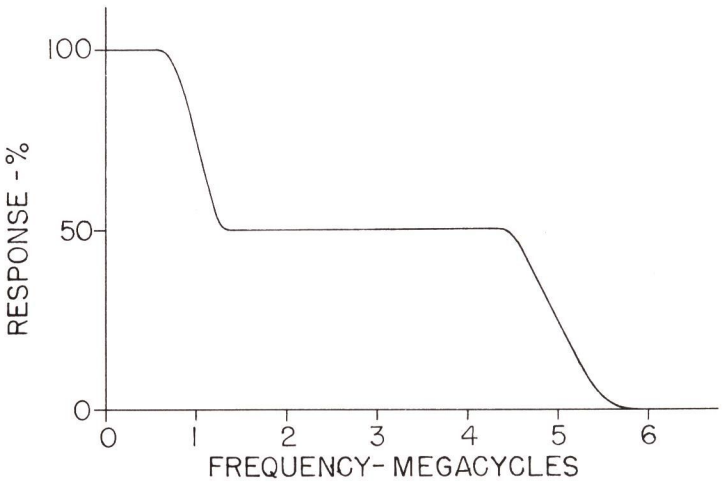


Figure 5 - Demodulated Output of Envelope Detector

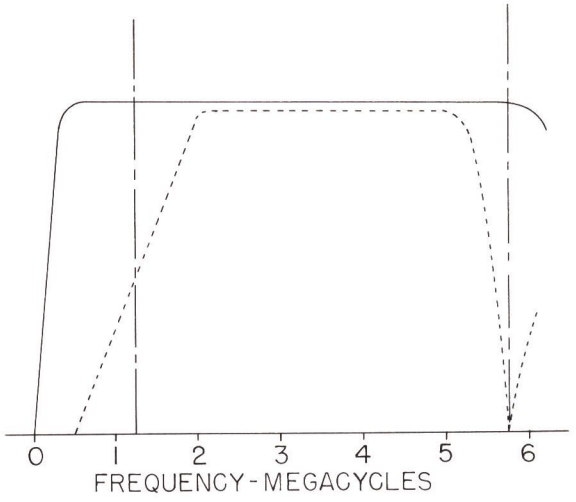


Figure 6 - Response With Notch (After Sideband Filter)

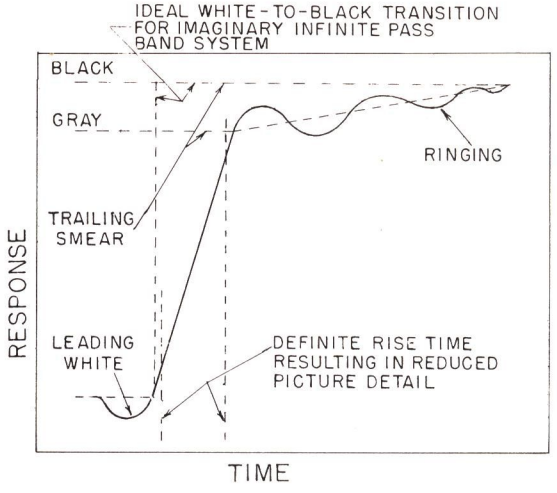


Figure 7 - Typical Square Wave Response (See Text)

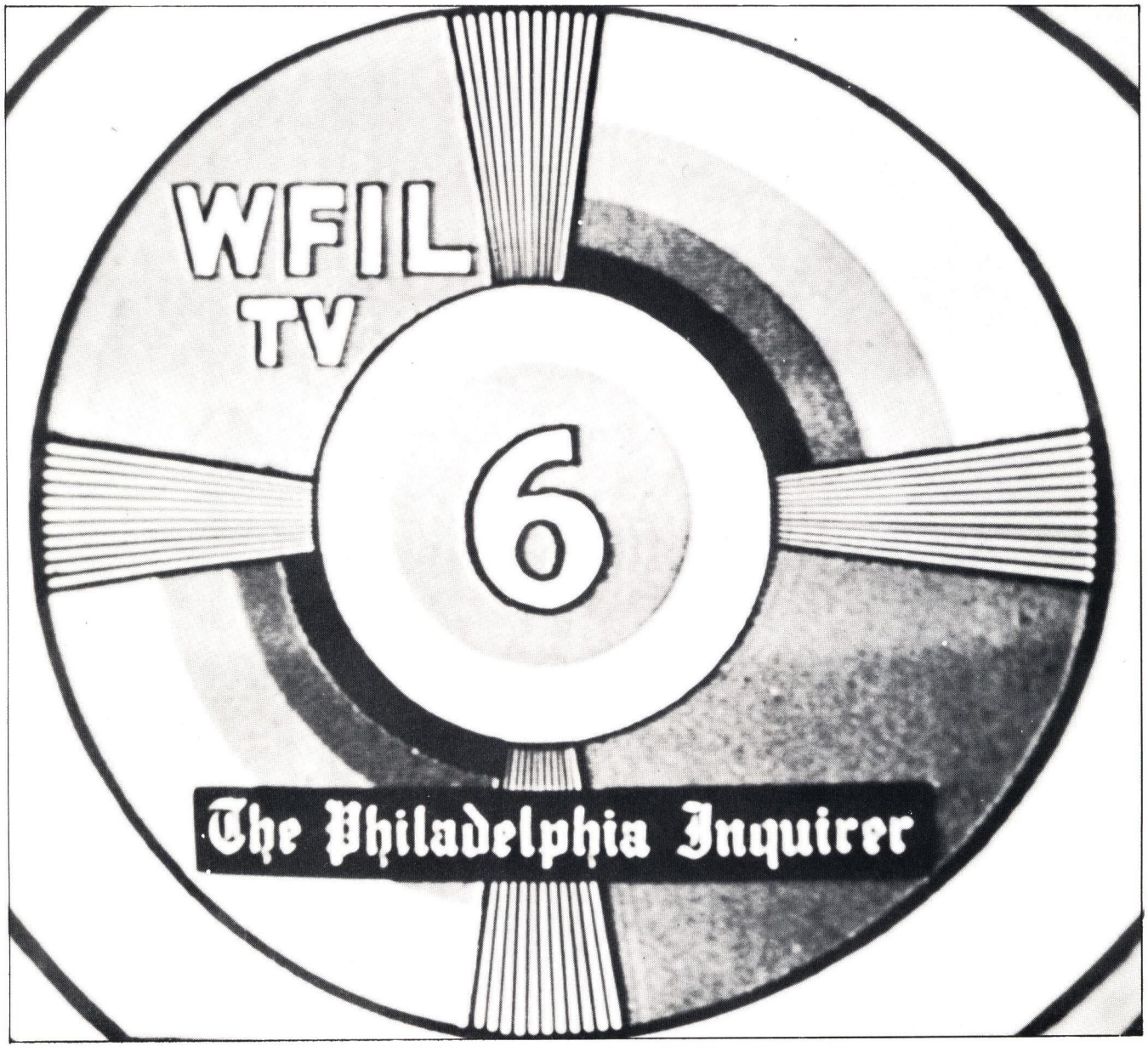


Figure 8 - Picture Test Pattern, Phase Compensator Out

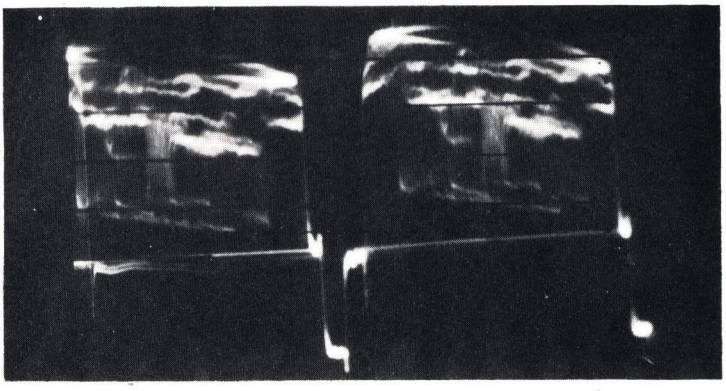


Figure 9 - Waveform With Phase Compensator Out

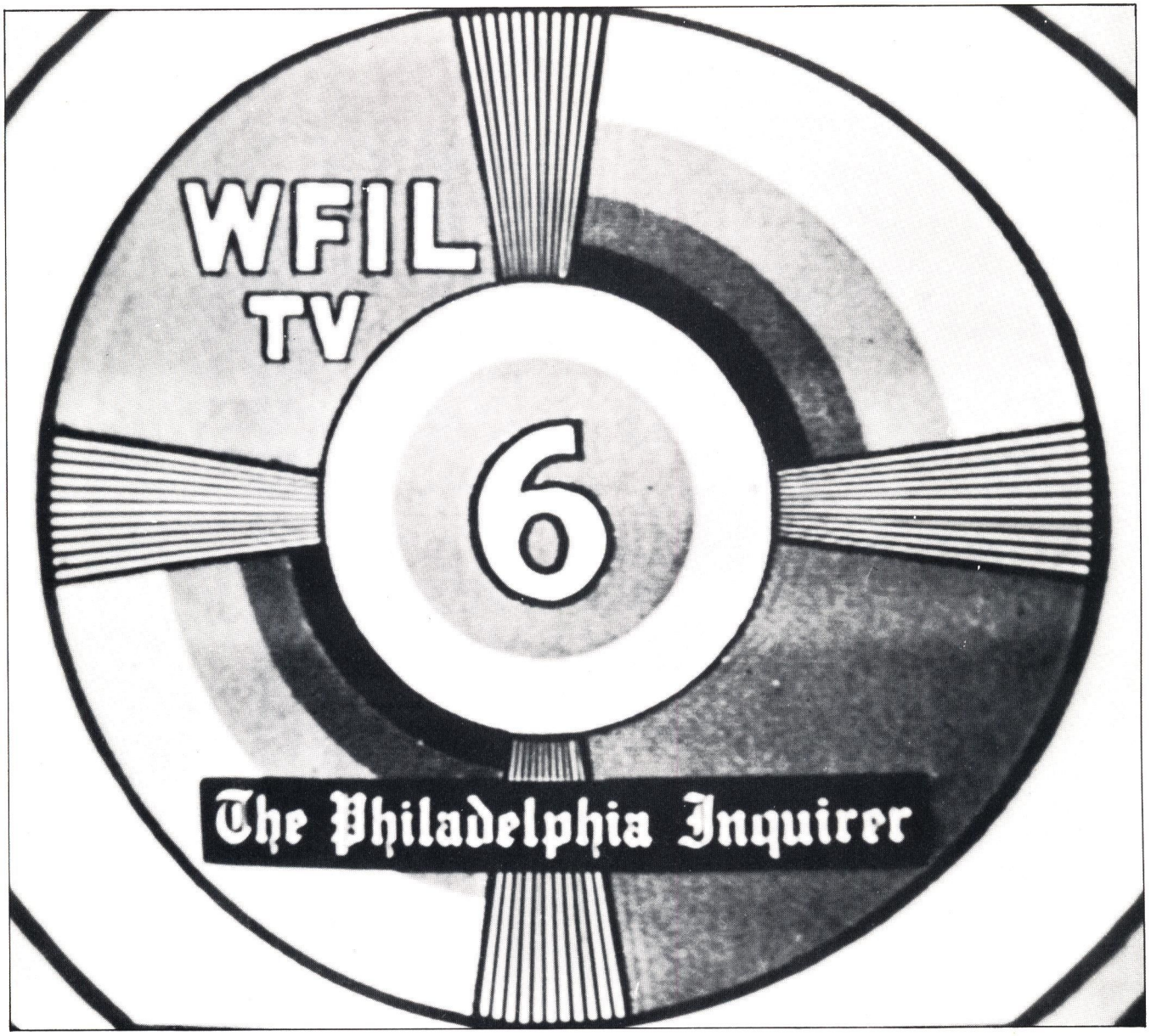


Figure 10 - Picture Test Pattern, Phase Compensator In

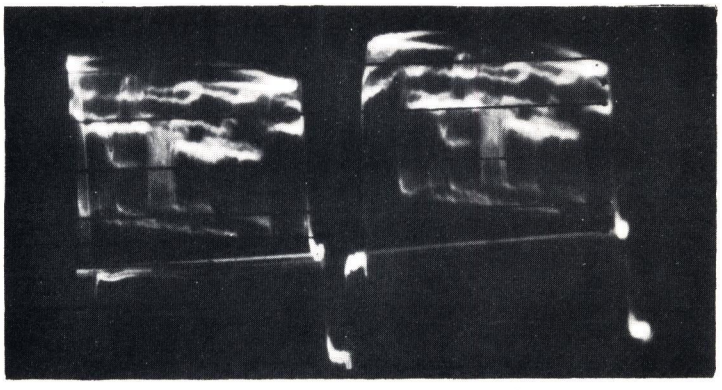


Figure 11 - Waveform With Phase Compensator In

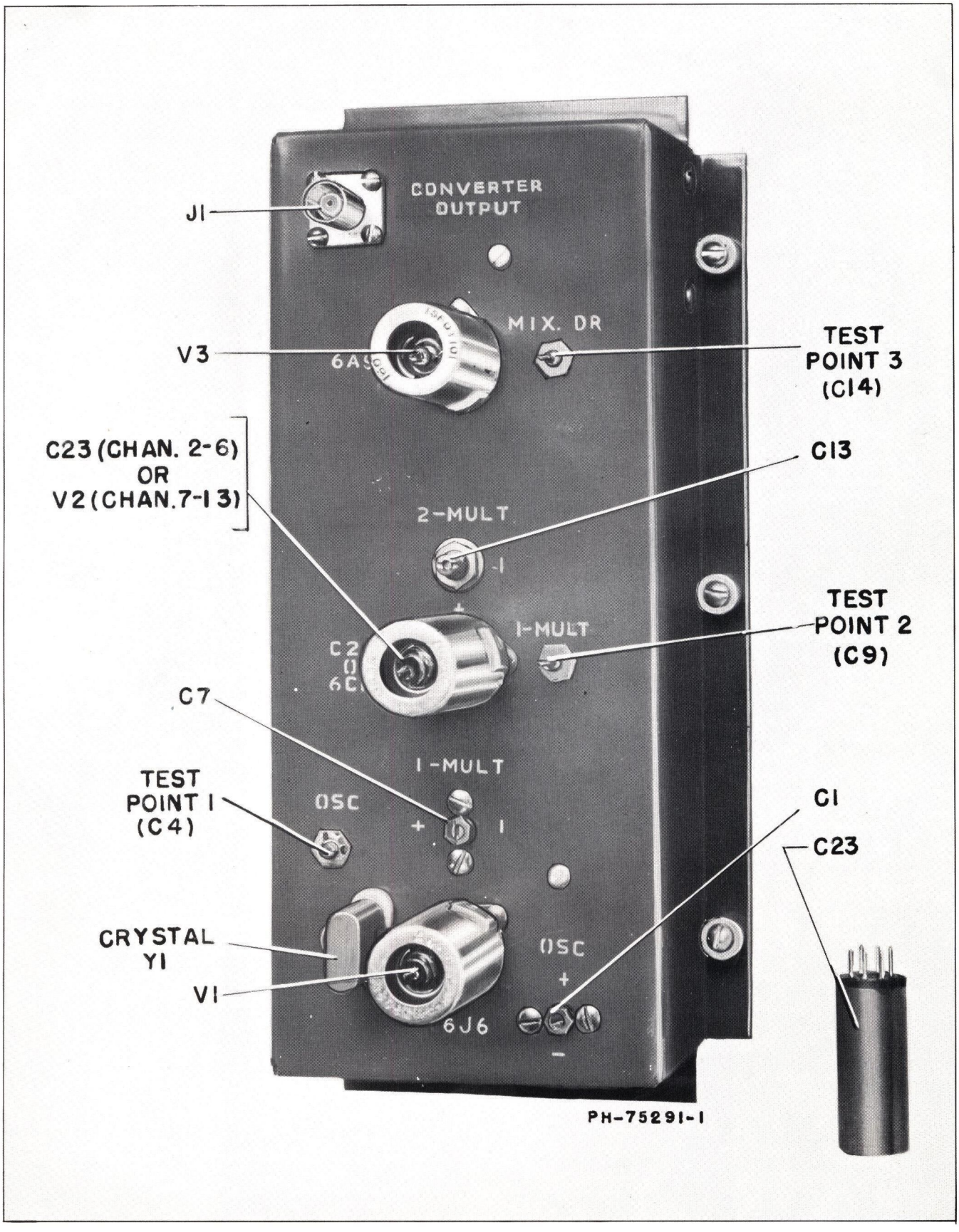


Figure 12 - VHF Converter Unit, Top View

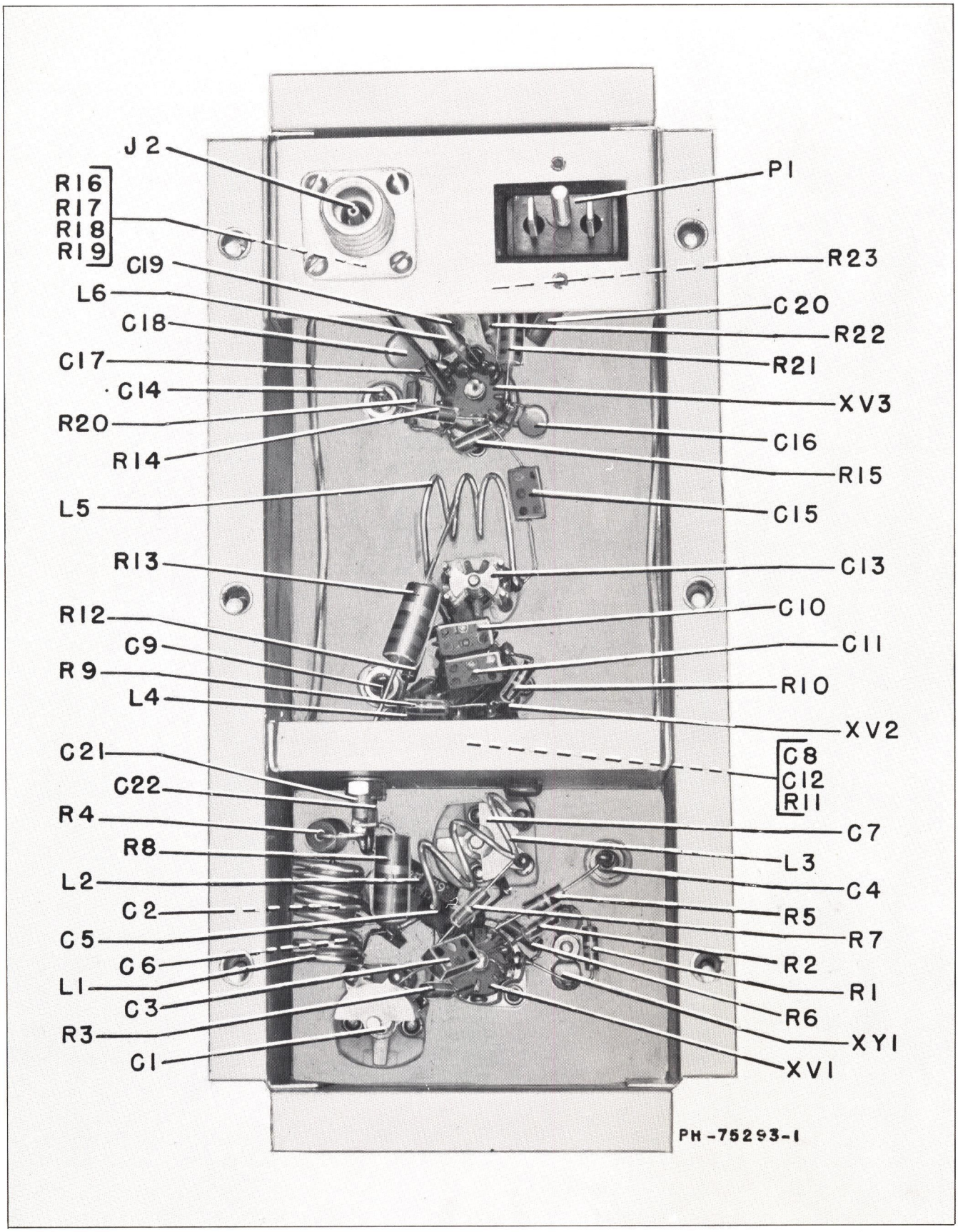


Figure 13 - VHF Converter Unit, Bottom View

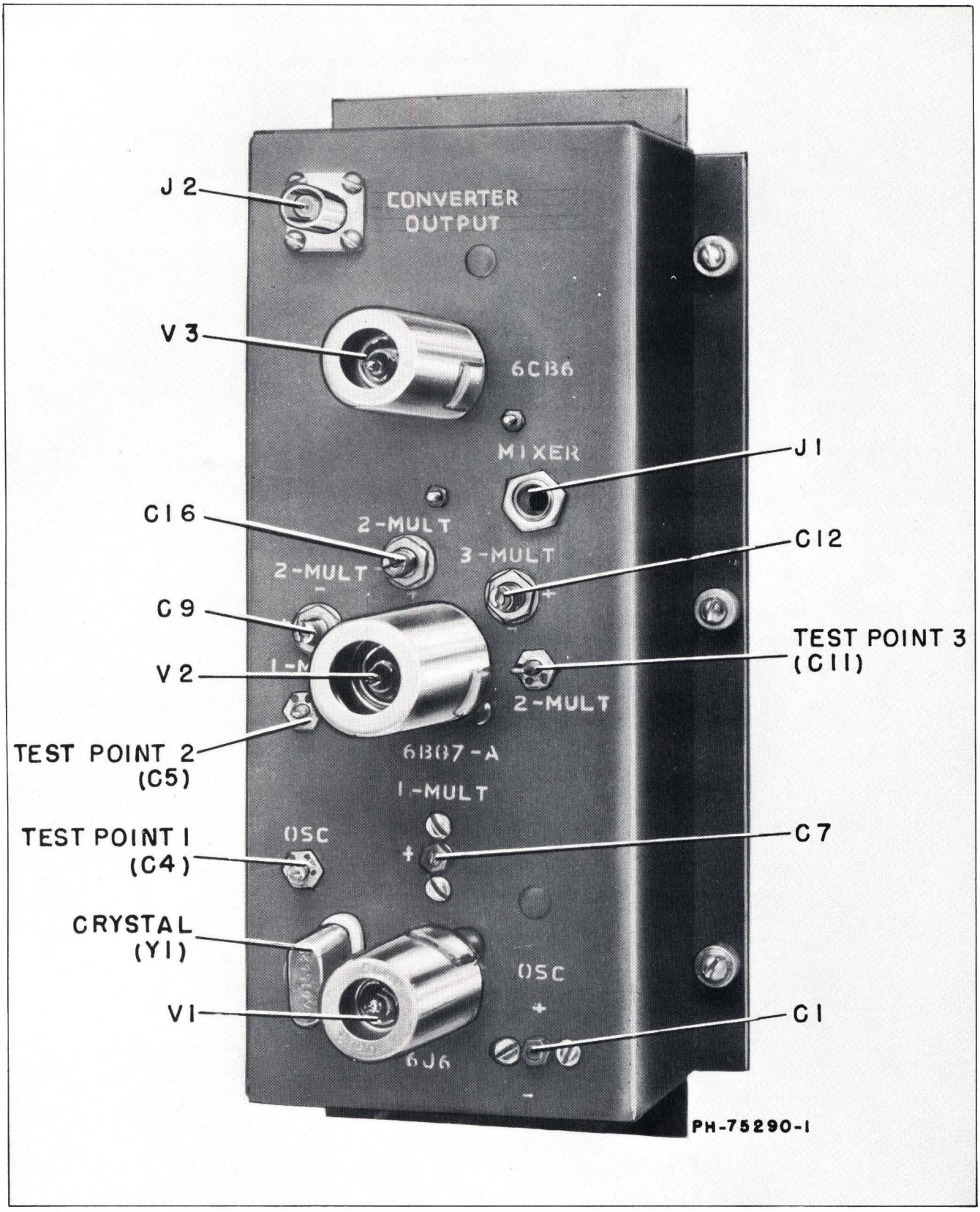


Figure 14 - UHF Converter Unit, Top View

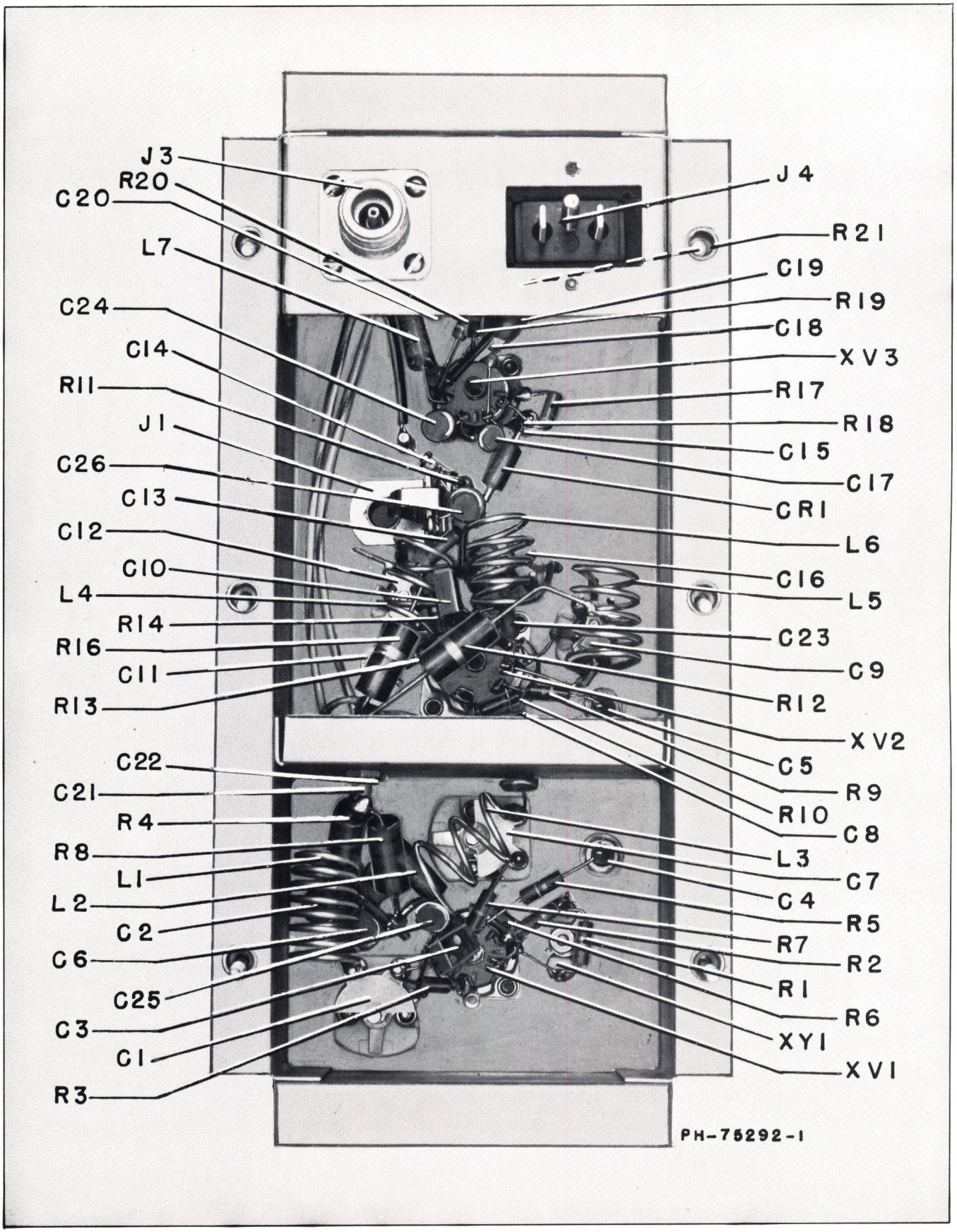


Figure 15 - UHF Converter Unit, Bottom View

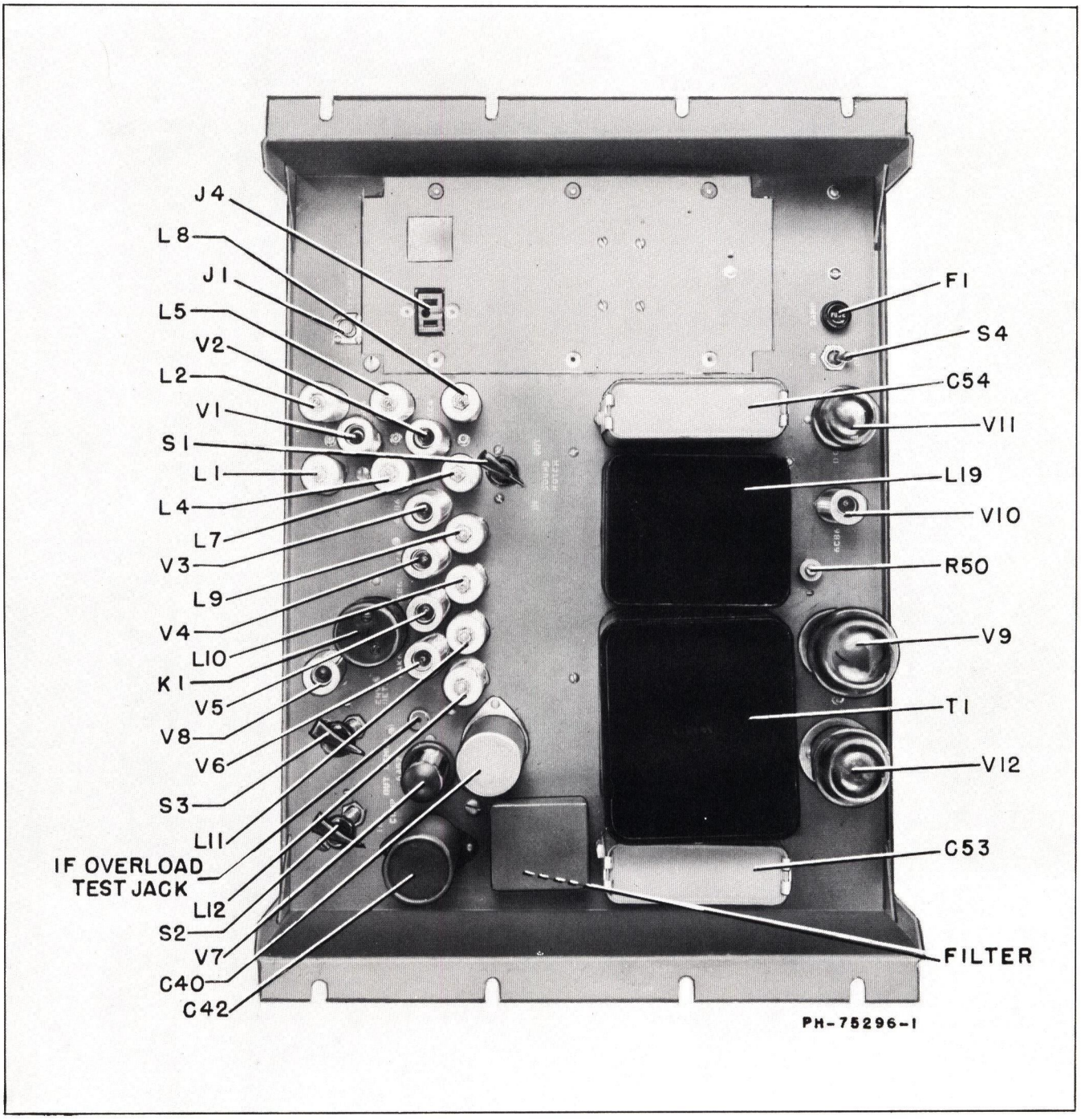


Figure 16 - IF, Video, and Power Supply Unit, Top View

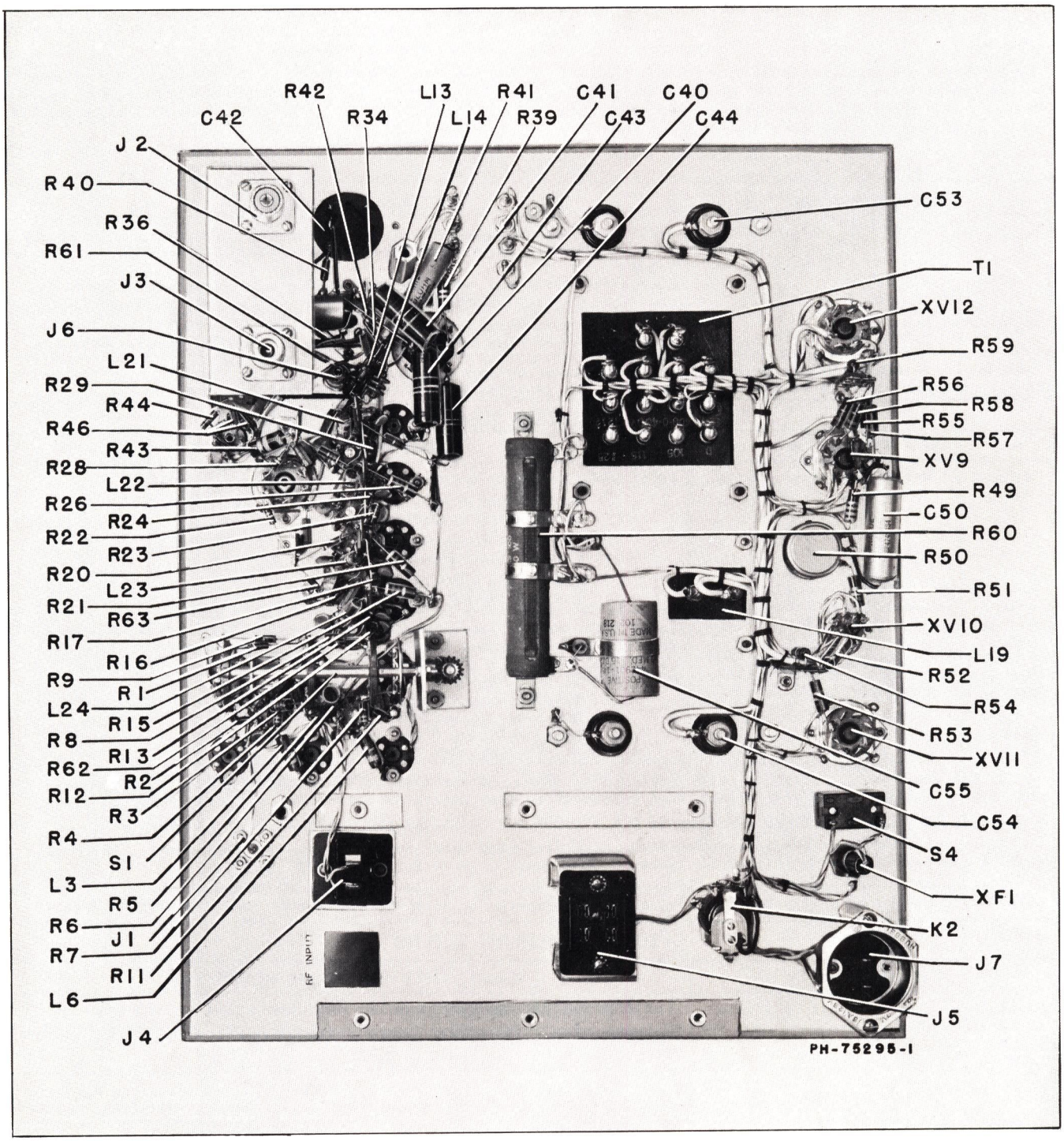


Figure 17 - IF, Video, and Power Supply Unit, Bottom View

REPLACEMENT PARTS AND ENGINEERING SERVICE

When ordering replacement parts, please give symbol, description, and stock number of each item ordered.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However, it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

The following tabulations list service parts, electron tube, and field engineering service ordering instructions according to the geographical location of the station.

SERVICE PARTS

STATION LOCATION	OBTAIN SERVICE PARTS FROM
Continental United States or Alaska	Local Broadcast Equipment Sales Representative, his office, or directly from the Service Parts Order Service, Bldg.60, 19th and Federal Streets, Camden 5, N. J. Emergency orders may be telephoned, telegraphed, or teletyped to RCA Emergency Service, Bldg.60, Camden, N.J. (Telephone: Woodlawn 3-8000).
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Local Broadcast Equipment Sales Representative, or Service Parts Order Service, RCA International Division, Gloucester, New Jersey. U.S.A.

ELECTRON TUBES

STATION LOCATION	OBTAIN ELECTRON TUBES FROM
Continental United States or Alaska	Local Distributor or nearest of the following warehouses: 34 Exchange Place Jersey City 2, New Jersey 589 E. Illinois Street Chicago 11, Illinois 420 S. San Pedro Street Los Angeles 13, California
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Local Distributor or from: Tube Department RCA International Division 30 Rockefeller Plaza New York 20, New York. U.S.A.

If for any reason, it is desired to return tubes, please return them to the place of purchase. If this is not convenient, please notify your RCA serving warehouse so that Return Authorization may be forwarded to you.

PLEASE DO NOT RETURN TUBES DIRECTLY TO RCA WITHOUT AUTHORIZATION AND SHIPPING INSTRUCTIONS.

It is important that complete information regarding each tube (including type, serial number, hours of service and reason for its return) be given.

When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

FIELD ENGINEERING SERVICE*

STATION LOCATION	REQUEST FIELD ENGINEERING SERVICE FROM
Continental United States or Alaska	Local Broadcast Equipment Sales Representative or the RCA Service Company, Inc., Broadcast Communications Service Division, Camden, N.J. Telephone: Woodlawn 3-8000.
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Chief Engineer RCA International Division 30 Rockefeller Plaza New York 20, New York, U.S.A.

**Charges for field engineering service will be made at current rates.*

For Ordering Information See Page 32

Symbol No.	Description	Drawing No.	Stock No.
	VHF CONVERTER, MI-34003		
C1	Capacitor, variable, 3.9 to 75 mmf	149476-5	99186
C2	Capacitor, 0.001 mf, button ceramic	449696-57	77252
C3	Capacitor, 47 mmf, ±10%, mica	737817-223	59985
C4	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru	8825449-1	99177
C5, C6	Capacitor 0.001 mf, button ceramic. Same as C2	449696-57	72252
C7	Capacitor, variable, 2.9 to 36 mmf	149476-3	99187
C8	Capacitor, 18 mmf, ±10%, mica	748252-213	97790
C9	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru. Same as C4	8825449-1	99177
C10, C11, C12	Capacitor, 220 mmf, ±10%, mica	737817-239	96518
C13	Capacitor, variable, butterfly, 3.2 to 11 mmf	455882-2	99191
C14	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru. Same as C4	8825449-1	99177
C15	Capacitor, 18 mmf, ±10%, mica. Same as C8	748252-213	97790
C16, C17, C18, C19	Capacitor, 0.001 mf, button ceramic. Same as C2	449696-57	77252
C20	Capacitor, 220 mmf, ±10%, mica. Same as C10	737817-239	96578
C21, C22	Capacitor, 0.001 mf, ceramic feedthru. Same as C4	8825449-1	99177
C23	Capacitor, assembly		
C23B	Capacitor, 18 mmf, ±10%, mica. Same as C8	748252-213	97790
J1	Receptacle	445813-2	54890
J2	Receptacle	433647-1	92180
L1	Not stocked by RCA		
L2	Choke, filament	941689-3	99188
L3	Not stocked by RCA		
L4	Choke, filament. Same as L2	941689-3	99188
L5	Not stocked by RCA		
L6	Choke, filament. Same as L2	941689-3	99188
P1	Plug, Jones, 2 contact, male	458545-3	99189
R1	Resistor, 27K ohms, ±10%, 1/2 watt	82283-79	502327
R2	Resistor, 82 ohms, ±10%, 1/2 watt	82283-49	502082
R3	Resistor, 10 ohms, ±10%, 1/2 watt	82283-38	502010
R4	Resistor, 18K ohms, ±10%, 2 watt	99126-77	39158
R5	Resistor, 100K ohms, ±10%, 1/2 watt	82283-86	502410
R6	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R5	82283-86	502410
R7	Resistor, 10 ohms, ±10%, 1/2 watt. Same as R3	82283-38	502010
R8	Resistor, 8200 ohms, ±10%, 2 watt	99126-73	522282
R9, R10	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R5	82283-86	502410
R11	Resistor, 220 ohms, ±10%, 1/2 watt	82283-54	502122
R12	Resistor, 22K ohms, ±10%, 1/2 watt	82283-78	30492
R13	Resistor, 6800 ohms, ±10%, 2 watt	99126-72	522268
R14	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R5	82283-86	502410
R15	Resistor, 15K ohms, ±10%, 1/2 watt	82283-76	36714
R16, R17 R18, R19, R20	Resistor, 220 ohms, ±10%, 1/2 watt. Same as R11	82283-54	502122
R21	Resistor, 33K ohms, ±10%, 1 watt	90496-80	38895
R22	Resistor, 390 ohms, ±10%, 1/2 watt	82283-57	30498
R23	Resistor, 18K ohms, ±10%, 2 watt. Same as R4	99126-77	39158
XY1	Socket, crystal	8885952-1	57025
XV1, XV2, XV3	Socket, 7 pin miniature	737867-13	94925
	Clip, crystal holding	8837459-1	98083
	Shield, tube for V3	99369-1	54428
	Shield, tube for V1 and V2	99369-2	54521
	UHF CONVERTER, MI-34004		
C1	Capacitor, variable, 3.9 to 75 mmf	149476-5	99186
C2	Capacitor, 0.001 mf, button ceramic	449696-57	77252
C3	Capacitor, 47 mmf, ±10%, mica	737817-223	59985
C4, C5	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru	8825449-1	99177
C6	Capacitor, 0.001 mf, button ceramic. Same as C2	449696-57	77252
C7	Capacitor, variable, 2.9 to 36 mmf	149476-3	99187
C8	Capacitor, 18 mmf, ±10%, mica	748252-213	97790
C9	Capacitor, variable, butterfly, 3.2 to 11 mmf	455882-2	99191
C10	Capacitor, 18 mmf, ±10%, mica. Same as C8	748252-213	97790
C11	Capacitor, 0.001 mf, ±20%, 500 volts, ceramic feedthru. Same as C4	8825449-1	99177
C12	Capacitor, variable, butterfly, 1.8 to 2.8 mmf	455882-9	99348
C13, C14	Capacitor, 0.5 mmf, ±0.25 mmf, tubular ceramic	722401-51	99194
C15	Capacitor, 5 mmf, ±0.5 mmf, 500 volt, ceramic stand-off	8811295-1	99193

For Ordering Information See Page 32

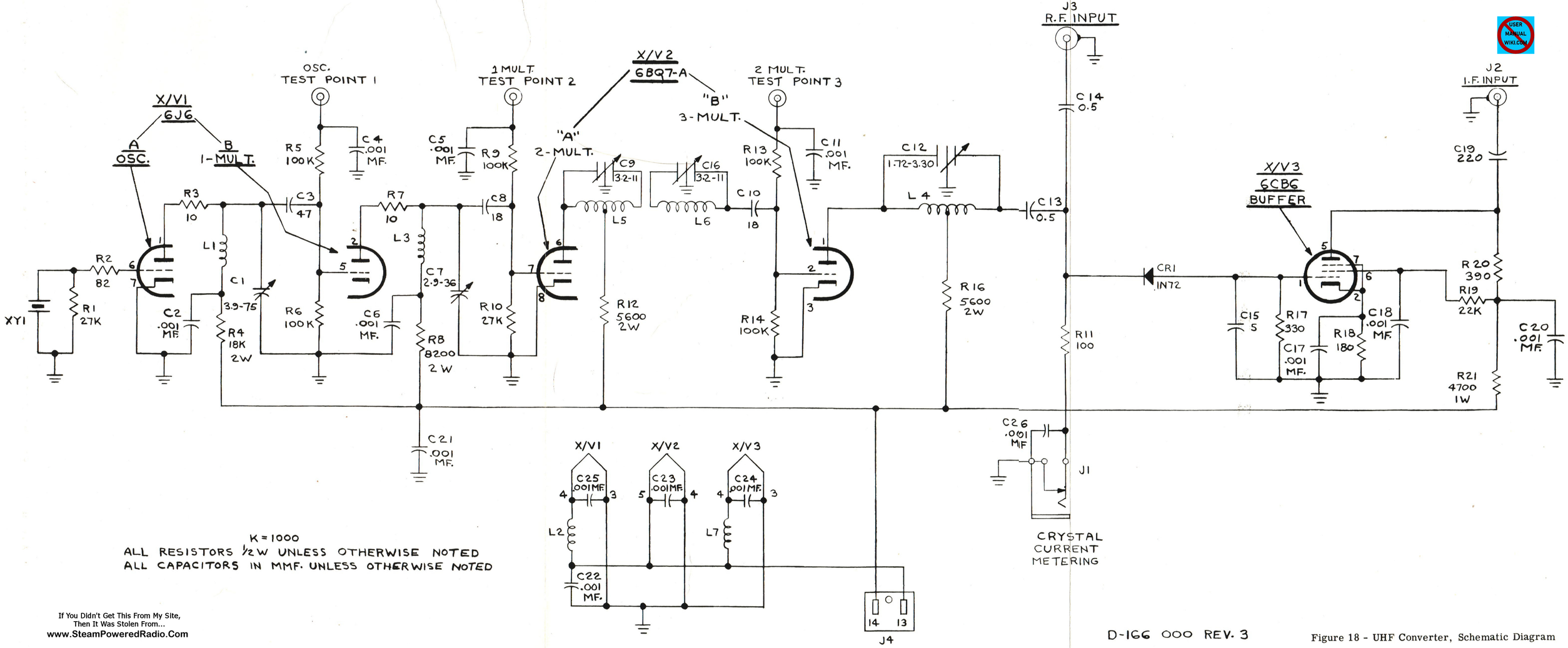
Symbol No.	Description	Drawing No.	Stock No.
C16	Capacitor, variable, butterfly, 3.2 to 11 mmf	455882-2	99191
C17, C18	Capacitor, 0.001 mf, button ceramic. Same as C2	449696-57	77252
C19	Capacitor, 220 mf, ±10%, mica	748252-239	72789
C20	Capacitor, 0.001 mf, button ceramic. Same as C2	449696-57	77252
C21, C22	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru. Same as C4	8825449-1	99177
C23, C24, C25, C26	Capacitor, 0.001 mf, button ceramic. Same as C2	449696-57	77252
CR1	Diode, germanium	1N72	
J1	Jack, phone	185009-1	7903
J2	Receptacle, single contact, female	445813-2	54890
J3	Receptacle, single contact, male	433647-1	92180
J4	Plug, Jones, 2 contact, male	458545-3	99189
L1	Not stocked by RCA		
L2	Choke, rf, insulated	941689-3	99188
L3 to L6	Not stocked by RCA		
L7	Choke, insulated	941689-11	99182
R1	Resistor, 27K ohms, ±10%, 1/2 watt	82283-79	502327
R2	Resistor, 82 ohms, ±10%, 1/2 watt	82283-49	502082
R3	Resistor, 10 ohms, ±10%, 1/2 watt	82283-38	502010
R4	Resistor, 18K ohms, ±10%, 2 watt	99126-77	39158
R5, R6	Resistor, 100K ohms, ±10%, 1/2 watt	82283-86	502410
R7	Resistor, 10 ohms, ±10%, 1/2 watt. Same as R3	82283-38	502010
R8	Resistor, 8200 ohms, ±10%, 2 watt	99126-73	522282
R9	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R5	82283-86	502410
R10	Resistor, 27K ohms, ±10%, 1/2 watt. Same as R1	82283-79	502327
R11	Resistor, 100 ohms, ±10%, 1/2 watt	82283-50	502110
R12	Resistor, 5600 ohms, ±10%, 2 watt	99126-71	522256
R13, R14	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R5	82283-86	502410
R15	Not Used		
R16	Resistor, 5600 ohms, ±10%, 2 watt. Same as R12	99126-71	522256
R17	Resistor, 330 ohms, ±10%, 1/2 watt	82283-56	502133
R18	Resistor, 180 ohms, ±10%, 1/2 watt	82283-53	502118
R19	Resistor, 22K ohms, ±10%, 1/2 watt	82283-78	30492
R20	Resistor, 390 ohms, ±10%, 1/2 watt	82283-57	30498
R21	Resistor, 12K ohms, ±10%, 1 watt	90496-75	522312
XV1	Socket, 7 pin miniature	737867-13	94925
XV2	Socket, 9 pin miniature	737870-27	99190
XV3	Socket, 7 pin miniature. Same as XV1	737867-13	94925
XY1	Socket, crystal	8885952-1	57025
	Attenuator, UHF, fixed, 10db	8879706-2	99192
	Clip, crystal holding	8837459-1	98083
	Shield, tube for XV2	8858642-3	57533
	Shield, tube for XV1 and XV3	99369-2	54521
	IF, VIDEO, AND BLOWER SUPPLY, MI-34002		
C1, C2	Capacitor, 120 mmf, ±5%, mica	737817-333	99160
C3, C4	Capacitor, 0.001 mf, button ceramic	449696-57	77252
C5	Capacitor, 220 mmf, ±10%, mica	737817-239	96518
C6, C7	Capacitor, 120 mmf, ±5%, mica. Same as C1	737817-333	99160
C8, C9	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C10	Capacitor, 220 mmf, ±10%, mica. Same as C5	737817-239	96518
C11, C12	Capacitor, 120 mmf, ±5%, mica. Same as C1	737817-333	99160
C13, C14, C15	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C16	Capacitor, 220 mmf, ±10%, mica. Same as C5	737817-239	96518
C17	Capacitor, 12 mmf, ±5%, mica	748252-311	59906
C18, C19, C20	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C21	Capacitor, 220 mmf, ±10%, mica. Same as C5	737817-239	96518
C22	Capacitor, 12 mmf, ±5%, mica. Same as C17	748252-311	59906
C23	Capacitor, 160 mmf, ±5%, mica	737817-336	99159
C24, C25	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C26	Capacitor, 220 mmf, ±10%, mica. Same as C5	737817-239	96518
C27	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C28	Capacitor, 12 mmf, ±5%, mica. Same as C17	748252-311	59906
C29	Capacitor, 160 mmf, ±5%, mica. Same as C23	737817-336	99159
C30, C31, C32	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C33	Capacitor, 220 mmf, ±10%, mica. Same as C5	737817-239	96518
C34	Capacitor, 12 mmf, ±5%, mica. Same as C17	748252-311	59906

For Ordering Information See Page 32

Symbol No.	Description	Drawing No.	Stock No.
C35	Capacitor, 5 mmf, ±5%, mica	748252-305	99161
C36	Capacitor, 20 mmf, ±5%, mica	748252-314	99162
C37	Capacitor, 0.47 mf, 400 volt, paper tubular	737818-96	59512
C38, C39	Capacitor, 750 mmf, ±5%, mica	722022-506	99176
C40, C40A C40B, C40C	Capacitor, 80 mf/60 mf/60 mf, 350 volt, electrolytic	442900-84	99184
C41	Capacitor, 0.1 mf, ±10%, 400 volt, paper	735715-175	73551
C42	Capacitor, 125 mf, 350 volt, electrolytic	442900-32	93406
C43, C44	Capacitor, 0.1 mf, ±10%, 400 volt, paper. Same as C41	735715-175	73551
C45, C46	Capacitor, 47 mmf, ±10%, mica	737817-223	59985
C47	Capacitor, 6800 mmf, ±10%, mica	722028-559	99175
C48, C49	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru	8825449-1	99177
C50	Capacitor, 0.47 mf, 400 volt, paper, tubular. Same as C37	737818-96	59512
C51, C52	Capacitor, 0.001 mf, ±20%, 500 volt, ceramic feedthru. Same as C48	8825449-1	99177
C53, C54	Capacitor, 10 mf, 600 volt	984629-8	18501
C55	Capacitor, 500 mf, 15 volt, electrolytic	442901-145	58477
C56, C57 C58, C59	Capacitor, 0.001 mf, ceramic feedthru. Same as C48	8825449-1	99177
C60 to C65	Capacitor, 0.001 mf, button ceramic. Same as C3	449696-57	77252
C66	Capacitor, 160 mmf, ±5%, mica. Same as C23	737817-336	99159
CR1	Diode, germanium	1N64	
CR2	Diode, germanium	1N72	
F1	Fuse, slo-blow, 3 amp. 3AG	896698-8	99164
J1	Receptacle	445813-2	54890
J2	Receptacle	727215-3	51800
J3	Receptacle	433647-1	92180
J4	Socket, 2 contact, female	458545-4	99183
J5	Socket, 4 contact, female	727969-26	99165
J6	Connector	742565-1	93678
J7	Receptacle, ac	8875725-1	8032
K1	Relay	149475-1	99181
K2	Relay	8874711-2	99180
L1	Coil, if	8815047-501	99170
L2	Coil, peaking	8815053-501	99173
L3	Choke, rf, insulated	941689-11	99182
L4	Coil, if. Same as L1	8815047-501	99170
L5	Coil, peaking. Same as L2	8815053-501	99173
L6	Choke, rf, insulated. Same as L3	941689-11	99182
L7	Coil, if. Same as L1	8815047-501	99170
L8	Coil, peaking	8815053-502	99174
L9	Coil, if	8815047-502	99171
L10	Coil, if	8815047-503	99172
L11	Coil, if. Same as L9	8815047-502	99171
L12	Coil, if. Same as L10	8815047-503	99172
L13	Choke, rf	8825473-517	99185
L14	Choke, rf	149484-8	99169
L15	Choke, rf	149484-6	99167
L16	Choke, rf	149484-7	99168
L17, L18	Choke, rf, insulated. Same as L3	941689-11	99182
L19	Reactor	447226-1	56407
L20, L21, L22, L23, L24	Choke, rf, insulated. Same as L3	941689-11	99182
R1	Resistor, 390 ohms, ±10%, 1/2 watt	82283-57	30498
R2	Resistor, 2700 ohms, ±5%, 1/2 watt	82283-169	502227
R3	Resistor, 2700 ohms, ±10%, 1 watt	90496-67	512227
R4	Resistor, 330 ohms, ±10%, 1/2 watt	82283-56	502133
R5	Resistor, 2700 ohms, ±5%, 1/2 watt. Same as R2	82283-169	502227
R6	Resistor, 2700 ohms, ±10%, 1 watt. Same as R3	90496-67	512227
R7	Resistor, 330 ohms, ±10%, 1/2 watt. Same as R4	82283-56	502133
R8, R9	Resistor, 200 ohms, ±5%, 1/2 watt	82283-142	3581
R10	Resistor, 270 ohms, ±5%, 1/2 watt	82283-145	30929
R11	Resistor, 2700 ohms, ±5%, 1/2 watt. Same as R5	82283-169	502227
R12	Resistor, 180 ohms, ±10%, 1/2 watt	82283-53	502118
R13	Resistor, 10 ohms, ±10%, 1/2 watt	82283-38	502010
R14	Resistor, 22K ohms, ±10%, 1/2 watt	82283-78	502322
R15	Resistor, 4700 ohms, ±10%, 1 watt	90496-70	512247

For Ordering Information See Page 32

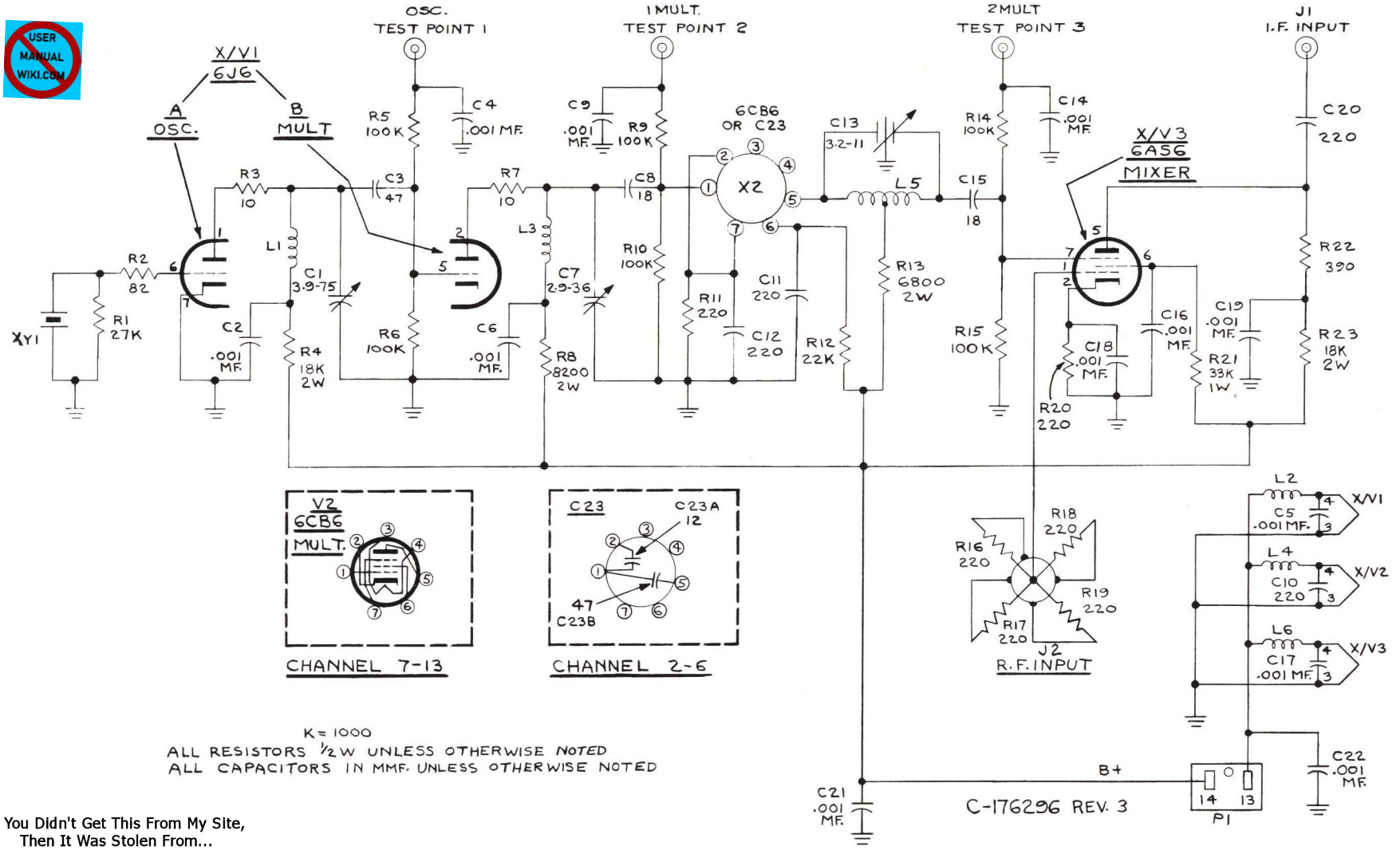
Symbol No.	Description	Drawing No.	Stock No.
R16	Resistor, 1200 ohms, ±5%, 1/2 watt	82283-161	502212
R17	Resistor, 180 ohms, ±10%, 1/2 watt. Same as R12	82283-53	502118
R18	Resistor, 10 ohms, ±10%, 1/2 watt. Same as R13	82283-38	502010
R19	Resistor, 22K ohms, ±10%, 1/2 watt. Same as R14	82283-78	502322
R20	Resistor, 3900 ohms, ±5%, 1/2 watt	82283-173	502239
R21	Resistor, 4700 ohms, ±10%, 1 watt. Same as R15	90496-70	512247
R22	Resistor, 100K ohms, ±10%, 1 watt	90496-86	512410
R23	Resistor, 180 ohms, ±10%, 1/2 watt. Same as R12	82283-53	502118
R24	Resistor, 10 ohms, ±10%, 1/2 watt. Same as R13	82283-38	502010
R25	Resistor, 22K ohms, ±10%, 1/2 watt. Same as R14	82283-78	502322
R26	Resistor, 4700 ohms, ±10%, 1 watt. Same as R15	90496-70	512247
R27	Resistor, 4700 ohms, ±5%, 1/2 watt	82283-175	502247
R28	Resistor, 100K ohms, ±10%, 1/2 watt	82283-86	502410
R29	Resistor, 820 ohms, ±10%, 1/2 watt	82283-61	502182
R30	Resistor, 10 ohms, ±10%, 1/2 watt. Same as R13	82283-38	502010
R31	Resistor, 47K ohms, ±10%, 1/2 watt	82283-82	30787
R32	Resistor, 56000 ohms, ±5%, 1 watt	90496-177	512256
R33	Resistor, 100 ohms, ±10%, 1/2 watt	82283-50	502110
R34	Resistor, 2200 ohms, ±5%, 1/2 watt	82283-167	502222
R35	Resistor, 1 megohm, ±10%, 1/2 watt	82283-98	502510
R36	Resistor, 120 ohms, ±10%, 1/2 watt	82283-51	502112
R37	Resistor, 68 ohms, ±10%, 1/2 watt	82283-48	34763
R38	Resistor, 75 ohms, ±5%, 1/2 watt	82283-132	34764
R39	Resistor, 15K ohms, ±10%, 1 watt	90496-76	512315
R40	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R28	82283-86	502410
R41	Resistor, 1200 ohms, ±5%, 10 watt	443853-78	94772
R42	Resistor, 820 ohms, ±10%, 2 watt	99126-61	36746
R43	Resistor, 10K ohms, ±10%, 2 watt	99126-74	522310
R44	Resistor, 100 ohms, ±10%, 1/2 watt. Same as R33	82283-50	502110
R45	Resistor, 470 ohms, ±10%, 1/2 watt	82283-58	30499
R46	Resistor, 10K ohms, ±10%, 1/2 watt	82283-74	502310
R47	Resistor, 2200 ohms, ±10%, 1/2 watt	82283-66	502222
R48	Resistor, 100 ohms, ±10%, 1/2 watt. Same as R33	82283-50	502110
R49	Resistor, 33K ohms, ±5%, 1 watt	90496-195	38895
R50	Resistor, 5K ohms, variable, 2 watt	433196-18	52009
R51	Resistor, 27K ohms, ±5%, 1 watt	90496-193	71990
R52	Resistor, 18K ohms, ±10%, 2 watt	99126-77	39158
R53	Resistor, 56K ohms, ±10%, 1 watt	90496-83	512356
R54	Resistor, 100K ohms, ±10%, 1 watt. Same as R22	90496-86	512410
R55, R56	Resistor, 560 ohms, ±10%, 1 watt	90496-59	38884
R57, R58	Resistor, 68 ohms, ±10%, 1 watt	90496-48	36976
R59	Resistor, 270K ohms, ±10%, 1 watt	90496-91	19232
R60	Resistor, 100 ohms, adjustable, ±10%, 50 watt	8815079-1	99166
R61	Resistor, 1 meg. ±5%, 1/2 watt	82283-231	502510
R62	Resistor, 390 ohms, ±5%, 1/2 watt	82283-149	30498
R63	Resistor, 100K ohms, ±10%, 1/2 watt. Same as R28	82283-86	502410
R64	Resistor, 51 ohms, ±5%, 2 watt	99126-128	522051
S1, S1A, S1B	Switch assembly, mycalex wafer, 3 section, 1 pos.	468233-1	99163
S2, S2A, S2B	Switch assembly, mycalex wafer, 1 section, 2 pos.	468228-1	99179
S3	Switch assembly, mycalex wafer, 1 section, 2 pos.	468229-1	99178
S4	Switch, toggle, ac	426780-7	48791
T1	Transformer, power	447213-1	56406
XF1	Receptacle, fuse	99088-2	48894
XK1	Socket, octal	99390-2	54414
XV1, XV2, XV3 XV4, XV5, XV6	Socket, 7 pin miniature,	737867-13	94925
XV7	Socket. Same as XK1	99390-2	54414
XV8	Socket, 7 pin miniature. Same as XV1	737867-13	94925
XV9	Socket, octal. Same as XK1	99390-2	54414
XV10	Socket, 7 pin miniature. Same as XV1	737867-13	94925
XV11, XV12	Socket, octal. Same as XK1	99390-2	54414
	Knob	818739-1	7960
	Thumbscrew	8854872-4	99663
	CABLE KIT, MI-34013		
	Connector, type "N"	146978-502	96579



K = 1000
ALL RESISTORS ½W UNLESS OTHERWISE NOTED
ALL CAPACITORS IN MMF. UNLESS OTHERWISE NOTED

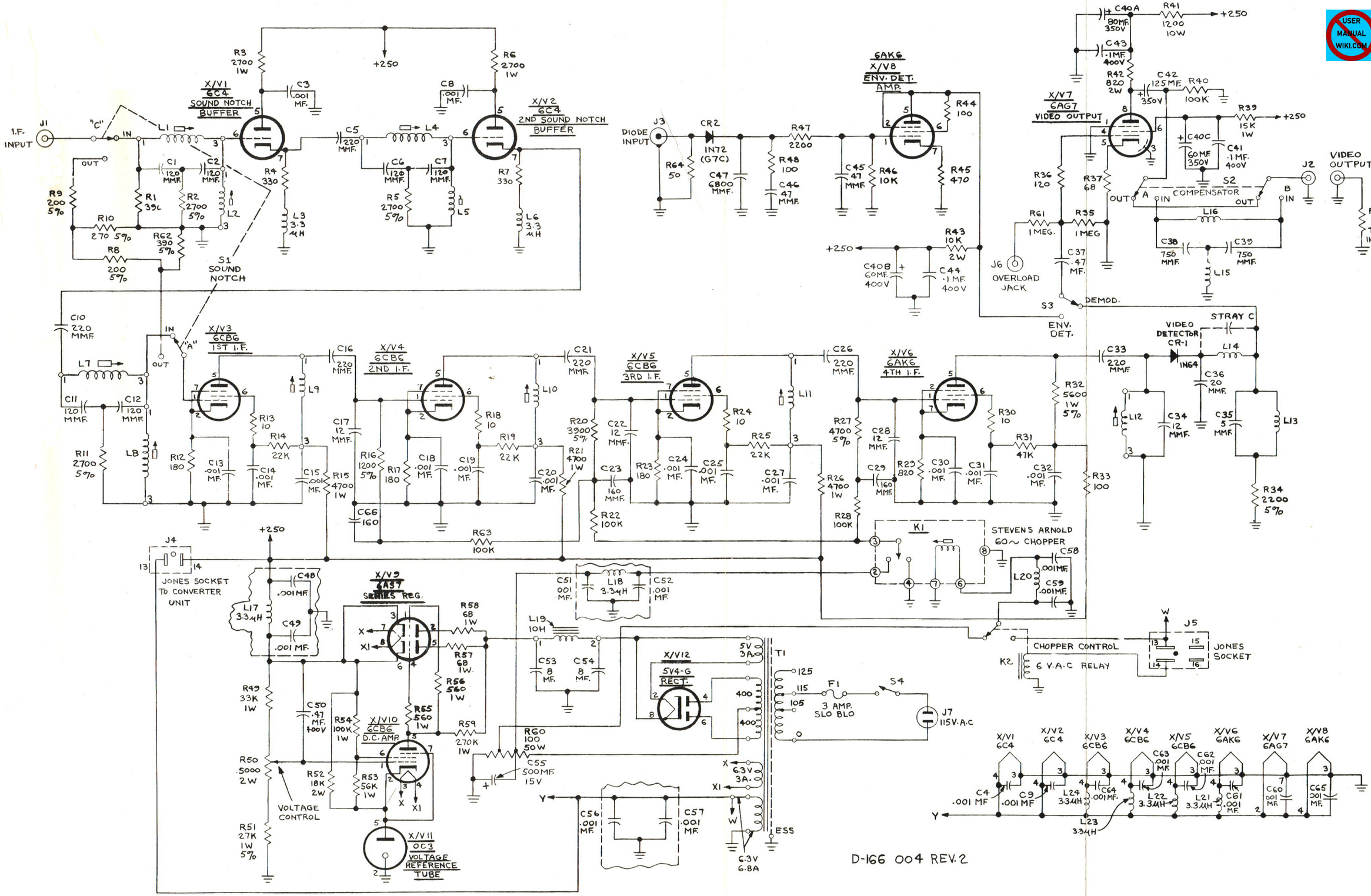
D-166 000 REV. 3

Figure 18 - UHF Converter, Schematic Diagram



K = 1000
ALL RESISTORS ½W UNLESS OTHERWISE NOTED
ALL CAPACITORS IN MMF. UNLESS OTHERWISE NOTED

Figure 19 - VHF Converter, Schematic Diagram



D-166 004 REV. 2

Figure 20 - IF, Video, and Power Supply, Schematic Diagram

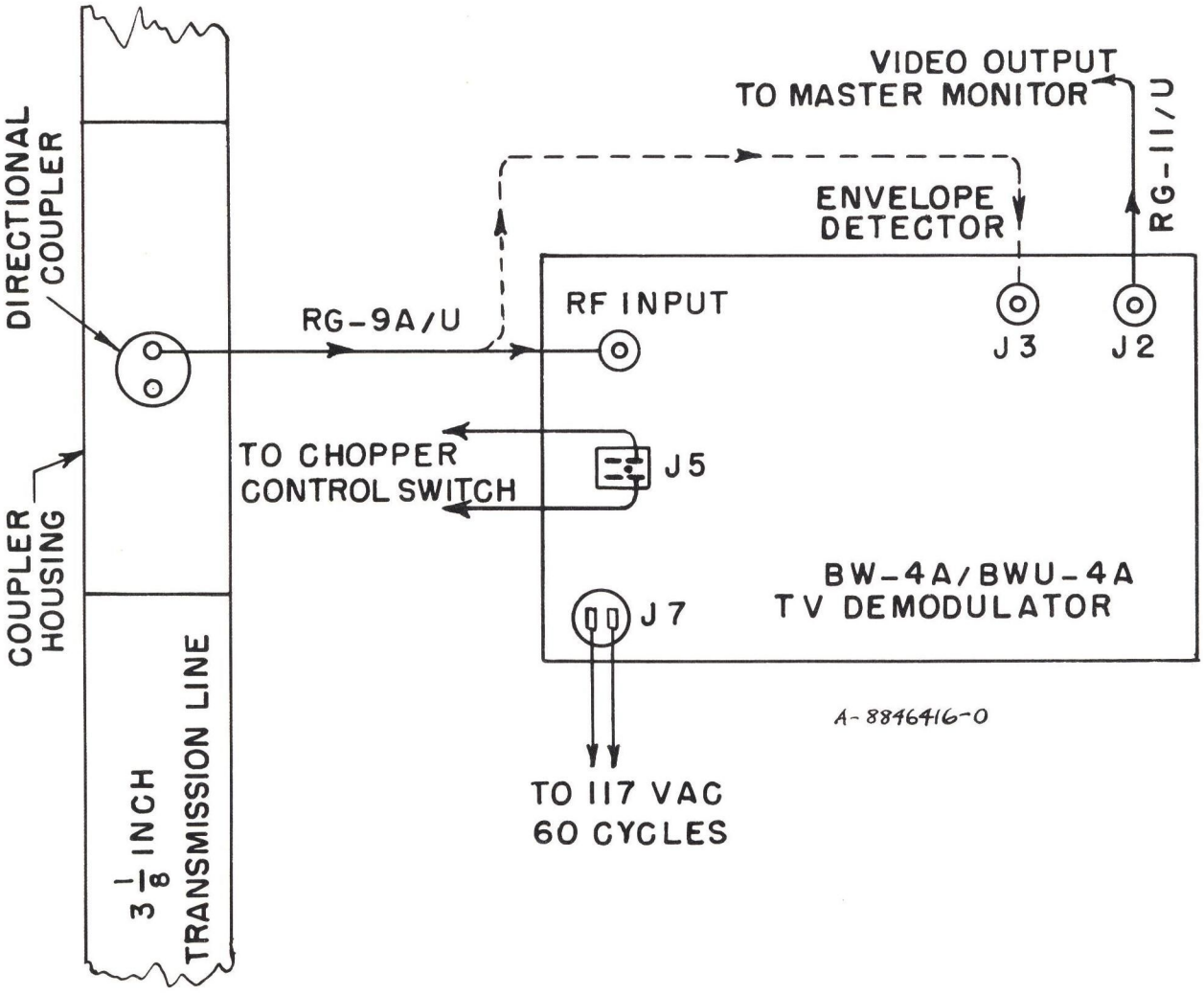


Figure 21 - BW-4A/BWU-4A Interconnections

RADIO CORPORATION OF AMERICA

ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.