TM 11-6625-2909-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

SIGNAL GENERATOR AN/USM-48

(NSN-6625-00-555-2264)

HEADQUARTERS, DEPARTMENT OF THE ARMY

SEPTEMBER 1978

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Voltages as high as —1300 volts exist inside the cabinet. Be careful when signal generator is removed from cabinet.

DON'T TAKE CHANCES!

CHANGE No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *19 October 1979*

Operator's, Organizational,
Direct Support, and General Support
Maintenance Manual
for
SIGNAL GENERATOR AN/USM-48
(NSN 6625-00-955-2264)

TM 11-6625-2909-14, 11 September 1978, is changed as follows:

1. New or changed material is indicated by a vertical bar in the margin of the page.

2. Remove and insert pages as indicated in the page list below:

Remove	*Insert*
i and ii	i and ii
iii and 1-0	iii/(iv blank)
0-1	0-1 and 0-2
	1-0
A-1	A-1
B-1 and B-2	B-1 and B-2

3. File this change sheet in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

DISTRIBUTION:
Active Army:

TSG (1)
USAARENBD (1)
USAINSCOM (2)
TRADOC (2)
DARCOM (1)
TECOM (2)
OS Maj Cmd (2)
USACC (2)
HISA (Ft Monmouth) (21)
Armies (1)
USASIGS (10)
Svc Colleges (1)
USASATC&S (2)
Ft Richardson (CERCOM Ofc) (1)
Ft Carson (5)
Ft Gillem (10)
WSMR (1)
USAERDAA (1)
USAERDAW (1)
Army Dep (1) except
LBAD (10)
SAAD (30)
TOAD (14)
SHAD (3)
USA Dep (1)
Sig Sec USA Dep (1)
Units org under fol TOE:
29-134 (1)
29-136 (1)
29-207 (2)
29-610 (2)
32-52 (1)
32-57 (1)

NG: None
USAR: None
For explanation of abbreviations used see, AR 310-50.

TM11-6625-2909-14

TECHNICAL MANUAL
No. 11-6625-2909-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *11 September 1978*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

SIGNAL GENERATOR AN/USM-48

(NSN 6625-00-555-2264)

REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 2028-2 in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703.

In either case a reply will be furnished direct to you.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 0

INTRODUCTION

0-1. *SCOPE,*

This manual describes Signal Generator AN/USM-48 (Hewlett-Packard Model 628A) and provides instructions for operation and maintenance. The manual includes a components of end item list (COEIL) (appx B) and a maintenance allocation chart (MAC) (appx D). Repair parts and special tools lists (RPSTL) are included in TM 11-6625-2909-24P$_d$ Calibration procedures are contained in TB 11-6625-2710-50. The manual applies directly to, HP Model 628A signal generators having serial number prefix 652- above 01669. For serial umber 652-01668 and below, see appendix F; for serial prefixes above 652, see appendix O.

0-2. INDEXES OF PUBLICATIONS.

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertain-in& to the equipment.

b. DA Pam 310-7. Refer to DA Pam 319-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

0-3. FORMS AND RECORDS.

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records$_9$ and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM-38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AH 700=58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A and DLAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and for - ward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/APR 75-18/MCO P4610.19C and DLAR 4500.15.

O-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your Signal Generator AN/USM-48 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let as know why you don't like the design. Tell us why a procedure is hard to perform. Rut it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703. We'll send you a reply.

O-5. ADMINISTRATIVB STORAGE,

Administrative storage of equipment issued to and used by Army activities Shall be in accordance with TM 740-90-1.

O-6. DESTRUCTION OF ARMY ELECTRONICS MATERIEL.

Destruction of Army electronics material to prevent enemy use shall be in accordance with TM 750-244-2.

O-7. HAND RECEIPTS,

Rand receipts for Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization list (AAL) items are published in a hand receipt *manual, TM ll-6625-29090-14-HR. This manual is published to aid in property accountability and is available through: Commander, US Army Adjutant General Publications Center, ATTN: AGDL-OD, 1655 Woodson Road, St. Louis, MO 63114.

Table 1-1. Specifications

FREQUENCY RANGE:
115 to 2l GHz

FREQUENCY CALIBRATION:
Dial read directly in GHz; accuracy better than ±1%

OUTPUT RANGE:
10 mW to 1 pW (+10 dBm to -90 dBm); attenuator dial directly calibrated in output dBm; SWR less than 2.5 at +10 dBm; 1.2 at 0 dBm and lower

OUTPUT MONITOR ACCURACY:
Better than +1 dB

OUTPUT ATTENUATOR ACCURACY:
Better than +2% of attenuation in dB introduced by output attenuator

OUTPUT CONNECTOR:
0.590 in. by 0.335 in. *waveguide,* WR-51, Flat Cover Flange

LEAKAGE:
Less "than minimum calibrated signal generator

MODULATION:
Internal or external pulsed, FM or square wave

INTERNAL PULSE MODULATION:
Repetition rate variable from 40 to 4000 pps; pulse width **vasriable** 0.5 to 10 microseconds

SYNC OUT SIGNAL:
20 to 50 volts amplitude into 1000-ohm load. Better than one microsecond rise time

(1) Simultaneous with RF pulse-positive

(2) In advance of RF pulse-positive, variable *3* to *300 micrseconds*

EXTERNAL SYNCHRONIZATION:
(1) Sine wave, 40 to 4000 Hz, amplitude 5 to 50 volts rms

(2) Pulse signals 0 to 4000 pps, 5 to 50 volts amplitude, positive or negative; pulse width *0.5* to *5* microseconds; rise time 0.1 to 1 microsecond

INTERNAL ▌ ARE WAVE MODULATION:
Variable 40 to 4000 Hz controlled by "pulse rate" **control**

INTERNAL FREQUENCY MODULATION
Power line frequency, deviation up to l 5 MHz

EXTERNAL PULSE MODULATION
Pulse Reguirements: Amplitude 15 to 70 volts peak positive or negative; width 1.9 to 2500 microseconds

EXTERNAL FREQUENCY MODULATION:
Provides capacitive coupling to repeller of klystron; maximum deviation approximately +5 MHZ

POWER SOURCE:
115 or 230 volts +10% 50 *to* 60 Hz, approximately 200 watts

ACCESSORIFS FURNISHED:
HP NP292A, N to P Band waveguide adapter, WR-51 to WR-62 guide

HP NK292A, N to K Band waveguide adapter, WR-51 *to WRt-42* guide

DIMENSI0NS:
Cabinet Mount: 17 in. wide, 14 in. high, 15 in. deep

Rack Mount:

E MODULATION:
variable from 40 to 4000 pps; able 0.5 to 10 microseconds

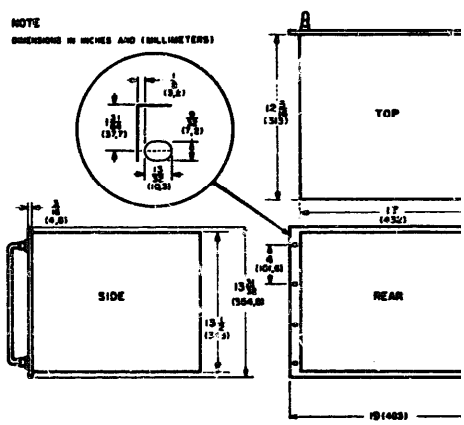
L:
amplitude into 1000-ohm load. microsecond rise time

with RF pulse-positive

of RF pulse-positive, variable roseconds

HRONIZATION:
0 to 4000 Hz, amplitude 5 to

s 0 to 4000 pps, 5 to 50 volts ositive or negative; pulse width croseconds; rise time 0.1 to nd



WEIGHT':
Net 63 lb

ACCESSORIES AVAILBLE:
P362A I.aw Pass Filter
K362A Low Pass Filter

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION

1-2. **The HP Model 628A SHF Signal Generator (Figure 1-1) is a general purpose broadband signal generator which produces RF output voltages from 15 to 21 GHz. The output frequency is set with a single control and is directly read on a dial calibrated to an accuracy of 1% or better. The output power level is continuously adjustable from -90 dBm to +10 dBm (1 pW to above 10 milliwatts) over the full frequency range. The attenuator calibration is accurate within ±2% of the attenuation in dB introduced by the attenuator.**

1-3. The Model 628A is provided with versatile modulation characteristics. The output can be frequency modulated, square-wave modulated, or pulse modulated by internally or externally generated signals. The Model 628A also provides synchronizing pulses for external equipment being used.

1-4. In addition to producing **am accurate and controllable** radio-frequency test signal, the **Model** 628A is useful for the following:

a. Testing pulse systems.

b. Measuring sensitivity and selectivity of amplifiers, receivers, and other tuned systems.

c. Measuring signal-to-noise ratio of RF' signals.

d. Making slotted line measurements.

e. Investigation of microwave impedances and other transmission line characteristics.

f. Measuring frequency response of microwave systems.

Determining resonant frequency and **Q** of waveguide cavities.

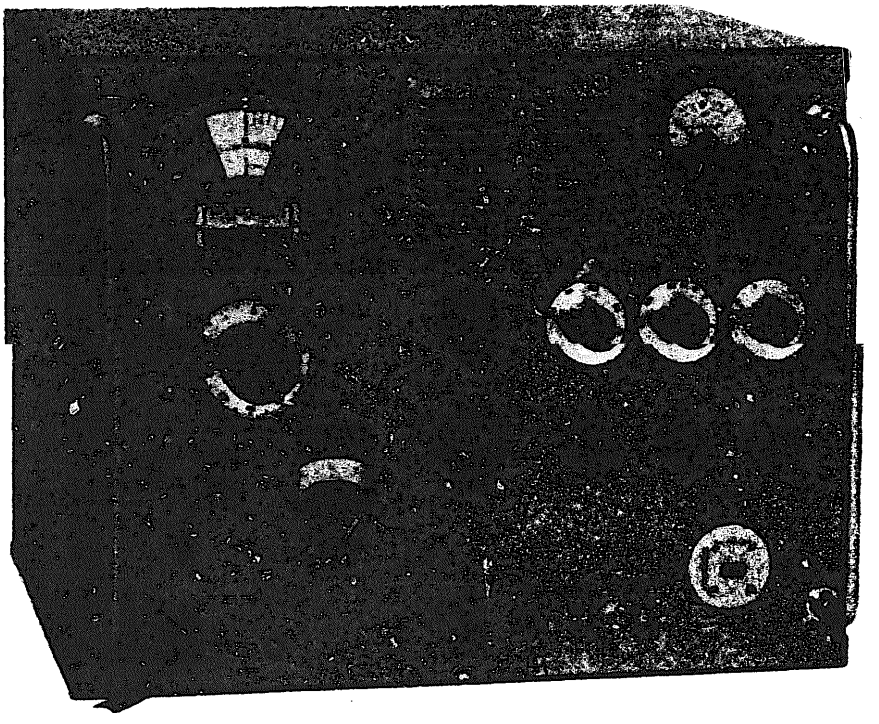


Figure l-l. HP Model 628A SHF Signal Generator

1-5. The Model 628A has a self-contained modulator and power supply located on a deck at the rear of the instrument. The entire chassis and cabinet are fabricated from aluminum alloy. Guard rails are provided on the front panel to facilitate handling, and to protect the operating controls. Front panel connectors are of the BNC type except for the output connector which is rectangular waveguide. Etched circuit construction is used extensively, and circuit accessibility is very good.

1-6. ACCESSORIES FURNISHED.

1-7. The Model **628A** is supplied with two different waveguide adapters for connecting the RF output waveguide to either P- or K-band waveguide. The adapters are as follows: Model NP292A used to connect to P-band waveguide; and Model NK292A used to connect to K-band waveguide.

1-8. ACCESSORIES AVAILABLE

1-9. To suppress second and third harmonics an additional 40 dB, an HP Mode?, P362A or K262A Low Pass Filter is recommended,

1-10. INSTRUMENT IDENTIFICATION.

1-11. Refer to paragraph 0-1 for coverage on instrument identification and differences. Also, refer to the ERRATA section of appendix G for changes coverage applicable to all instruments.

1-12. KLYSTRON TUBE WARRANTY

1-13. The Klystron Tube Warranty is illustrated in Figure 1-2, A sheet for your use is included in the rear of this manual.

WARRANTY CLAIM AND ADJUSTMENT PROCEDURE

for microwave tubes supplied by the
HEWLETT-PACKARD COMPANY
for use in Hewlett-Packard instruments

The procedure described below is for use within the United States. For warranty claims arising outside the U.S.A., before returning the tube, fill out the form on the reverse side and send it with a request for shipping instructions to your nearest Hewlett-Packard Sales and Service Office or to:

(in Western Europe)	(Rest of World)
Hewlett-Packard S.A. 1217 Meyrin Geneva, Switzerland Telephone: (022) 41 54 00 Telex: 2.24.86 Cable: HEWPACKSA	Hewlett-Packard Co. International Marketing Dept. 1501 Page Mill Road Palo Alto, California, 94304, U.S.A. Telephone: (415) 326-7000 Telex: 033811 Cable: HEWPACK

Microwave tubes supplied by the Hewlett-Packard Company, either as original or replacement, for use in Hewlett-Packard instruments are actually warranted by the tube manufacturer and not by Hewlett-Packard. However, all warranty claims on tubes obtained from us either as original or replacement will be processed by Hewlett-Packard.

In the event of failure you should purchase a new tube and return your old tube immediately to Hewlett-Packard. Credit allowances will be passed on to you upon receipt of the defective tube.

For your convenience, warranty claims for all microwave tubes supplied by the Hewlett-Packard Company may be made on this single form, merely fill out the information on the reverse side and return this form, along with the defective tube, to your Hewlett-Packard Sales and Service Office or to Hewlett-Packard. Please be sure each space on the form is filled in--lack of complete information may delay processing of your claim

MICROWAVE TUBE WARRANTY CLAIM
INFORMATION FORM

IMPORTANT: Please answer all questions fully -- insufficient information may delay processing of your claim.

DATE: _____

FROM: (Tube Owner)

Company _____

Address _____

_____

_____

Tube type _____

Tube serial No. _____

Tube mfr. _____

Use in HP Model _____

Instrument serial No. _____

SHIPPING INSTRUCTIONS

The following instructions are included to aid you in preventing damage in transit. Package your tube carefully--no allowance can be made on broken tubes.

1. Carefully wrap tube in 1 4-inch thick cellulosic cushioning, cotton batting, or other soft padding material. Cable assemblies and other accessories not rigidly mounted to the tube should be padded and wrapped separately to prevent damage to the tube during shipment.
2. Wrap the above in heavy kraft paper.
3. Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 2 inches of shock absorbing material. Be certain that the packing is tight all around the tube.
5. Tubes returned from outside the continental United States should be packed in a wooden box.
6. Mark container FRAGILE and ship prepaid via Air freight or Railway Express. Do not ship via Parcel Post or Air Parcel Post since experience has shown that fragile items are more apt to be damaged when shipped by these means.

Note

Tubes with permanent magnets can interfere with magnetic compasses.
For air shipment plainly mark container: "MAGNETIZED MATERIAL"

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, or to:

Hewlett-Packard Company
Customer Service Center
333 Logue Avenue
Mountain View, California 94040
USA

Rev 12/16/69

Tube is Original ( ) or Replacement ( )

Date tube received _____

Date of failure _____

Total hours filament operation _____

SYMPTOMS: (Please describe conditions prior to and at time of failu tube's defect, if known) _____

_____

_____

_____

IMPORTANT:
Replacement (new) tube serial No. _____

Signature _____

Title _____

For HP use only
Repair order # _____

Figure 1-2. Klystron Tube Warranty

SECTION II

INSTALLATION

2-1. INSPECTION

2-2. Unpack the instrument upon receipt and inspect it for signs of physical damage such as scratched panel surfaces, broken knobs, etc. If there is any apparent damage, file a claim with the carrier and refer to the warranty page in this manual.

2-3. An electrical inspection should be performed as soon as possible after receipt. See Section V, paragraph 5-60 for performance checks. These procedures make a good test as part of incoming quality-control inspection.

2-4. AIR FILTER

2-5. This instrument is equipped with a renewable type air filter. When first placing the instrument into service, the filter must be coated with **a** dirt-gathering adhesive. We recommend **a** water-soluble adhesive such as Super Filter Coat from Research Products Corporation. This adhesive comes in a convenient spray can and is available from most heating supply stores or from your authorized Hewlett-Packard sales representative (HP Part No. 3150-0002). For preventive maintenance on the air filter, refer to paragraph 5-3.

2-6. POWER REQUIREMENTS

2-7. The Model 628A requires a power source of 115 or 230 volts ±10%, 50 to 60 Hz, which can deliver approximately 200 watts.

2-8. POWER CABLE

2-9. This instrument is equipped with a three-prong conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The off set pin on the power cable three-prong connector is the ground pin.

2-10. To preservethe protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the pigtail on the **adapter** to ground.

2-11. 230-VOLT OPERATION.

2-12. To operate the Model 628A from **a** 230-volt ±10% source, change the primary windings of T1 and T2 from **a** parallel to **a** series arrangement. Refer to Figure 5-16 and proceed as follows:

a. Remove the two bare wire jumpers from the terminals on T1 and T2. These jumpers connect terminal Al to A4 and A2 to A5 on the primary winding.

b. Connect a new jumper between termiual A4 and *A5.*

c. Change the line fuse to a 1.25 amp slow-blow.

2-13. REPACKAGING FOR SHIPMENT.

2-14. The following list is a general guide for repackaging an instrument for shipment. If you have any questions, contact your authorized Hewlett-Packard sales representative.

a. If possible, use the original container designed for the instrument.

b. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

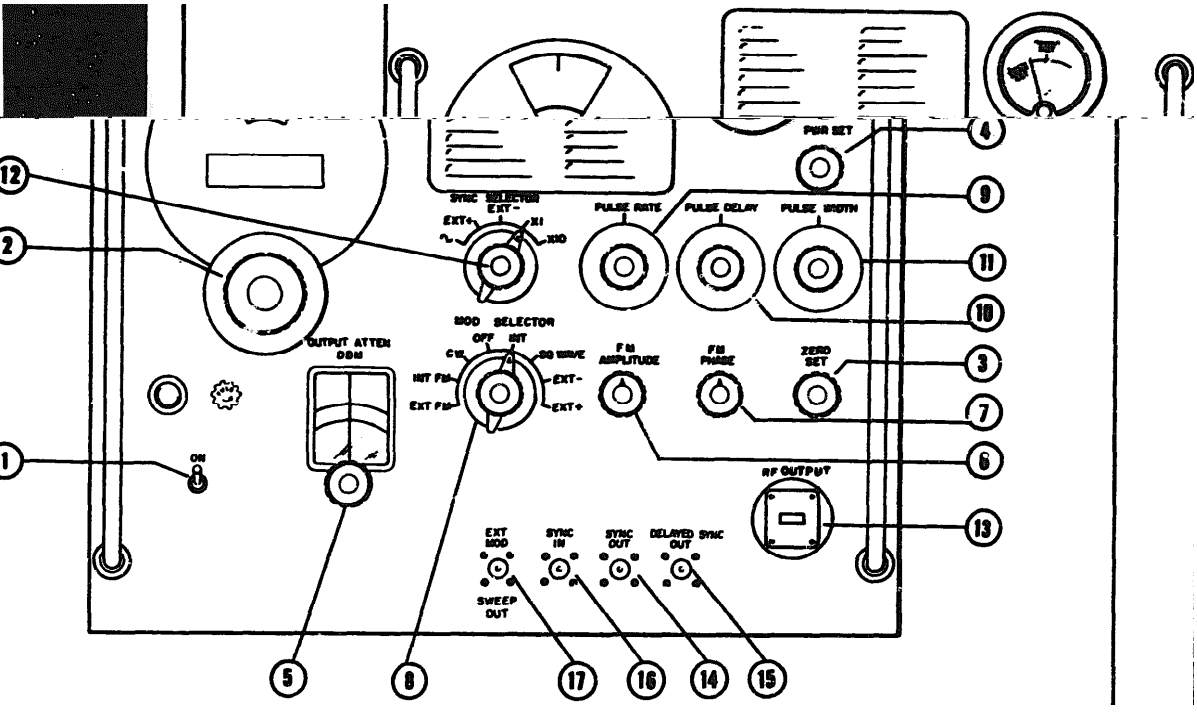
c. Use plenty of packing-material around all sides of the instrument and protect the panel with cardboard strips.

d. Use a heavy cardboard carton or wooden box to house the instrument and use heavy tape or metal bands to seal the container.

e. Mark the packing box with “Fragile,” “Delicate Instrument, ” etc.

NOTE

If the instrument is to be shipped to Hewlett-Packard Company for service or repair, attach to the instrument a tag identifying the owner and indicating the service or repair to be accomplished. In any correspondence be sure to identify the instrument by model number, serial prefix, and serial number.



1. Turns on line power to the instrument.
2. Frequency control (not labeled) is used to set to desired RF output frequency. Frequency dial is read directly in KILOMEGACYCLES (GHz).
3. ZERO SET contro1 is used to zero-set the power-monitor meter.
4. PWR SET control is used to establish the correct power level fed to the output attenuators.
5. OUTPUT ATTEN control adjusts the RF output levelfrom +10 dBm to -90 dBm (10 mW to 1 pW).
6. FM AMPLITUDE control adjusts the frequency deviation of the output signal when internal or external frequency modulation is employed.
7. FM PHASE control adjusts the phase of frequency modulation from approximately +90 degrees to -90 degrees with respect to the SWEEP OUT signal only when internal frequency modulation is employed.
8. MOD SELECTOR switch is used to select the desired type of modulation to be applied to the RF output signal.
9. PULSE RATE control adjusts the repetition rate of the RF output pulse *or* square wave when the MOD SELECTOR is set to INT or SQ WAVE. The Xl or X10 positions of the SYNC SELECTOR determines the multiplying factor to be applied to the reading of the calibrated PULSE RATE dial.
10. PULSE DELAY control adjusts the time delay between the leading edge of the SYNC CUT pulse and the RF output pulse from 3 to 300 microseconds when the MOD SELECTOR is set to INT.
11. PULSE WIDTH control adjusts the width of the RF output pulse from 0.5 to PO microseconds when the MOD SELECTOR is set to INT.
12. SYNC SELECTOR switch is used to select the type of synchronization to be employed by the signal generator during internal pulse modulation of the RF output signal.
13. RF OUTPUT: N-band type WR-51 waveguide, cover type flange.
14. SYNC OUT connector is the output for sync pulses in either square-wave or pulse operation.
15. DELAYED SYNC OUT connector is the output for delayed sync pulses in either square-wave or pulse operation. These pulsesare controlled by PULSE DELAY.
16. SYNC IN connector is the input for sync pulses. These pulsesare used only when MOD SELECTOR is set to INT and SYNC SELECTOR to EXT -, EXT+, or ~.
17. EXT MOD/SWEEP CUT: Thisconnector is used as an input forexternal modulation signals when to EXT. FM., EXT. - or. is also used as an output which occurs only when set to INT .FM.

Figure 3-1. Front Panel Controls and Connectors

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. **This** section contains operating instructions for the various modes of operation; each is covered in Figures 3-2 through 3-7. Front panel controls and connectors and their uses are shown in Figure 3-1. In paragraph 3-9 is a list of the various uses of the signal generator.

3-3. HARMONICS.

3-4. At. output levels between -50 and +10 dBm, harmonics in the RF output are at least 20 dB below the fundamental frequency. Normally harmonics will not degrade measurements such as determining sensitivity of tuned receivers or tuned systems. However, when measuring standing wave ratios, accuracy can be increased by using a low-pass filter which suppresses second and third harmonics. A low-pass filter with a broad stop band, such as the HP Model P362A and K362A is recommended.

3-5, The signal generator attenuator will affect only the fundamental frequency, and therefore harmonics can be identified.

3-6. OPERATING PROCEDURE

3-7. The operation of the Model 628A consists of adjustingthe two **major** sections: the **RF section,** and the modulator section. Adjust the **RF section first,** since this adjustment establishes the output **power** reference level, for the output attenuators.

3-8. After turning the instrument on, allow it at least 5 minutes to reach a stable operating temperature. If the ambient temperature is below 10°C (50°F) a longer warmup period is necessary.

Note

The klystron tube used in **this instrument is** expensive and has a shorter life than that of the conventional vacuum tube. When the MOD SELECTOR switch is set to OFF, filament and plate voltages are still present on the klystron tube, and therefore power should be removed from the instrument when it is not in use in order to increase the useful life of the tube. Average tube life approximates 1000 hours and the warranty period approximated 500 hours.

3-9. Various uses for the Model 628A are as follows:

a. Testing pulse systems.

b. Measuring sensitivity and selectivity of amplifiers, receivers, and other tuned systems,

c. **Measuring** signal to noise ratio of RF signals.

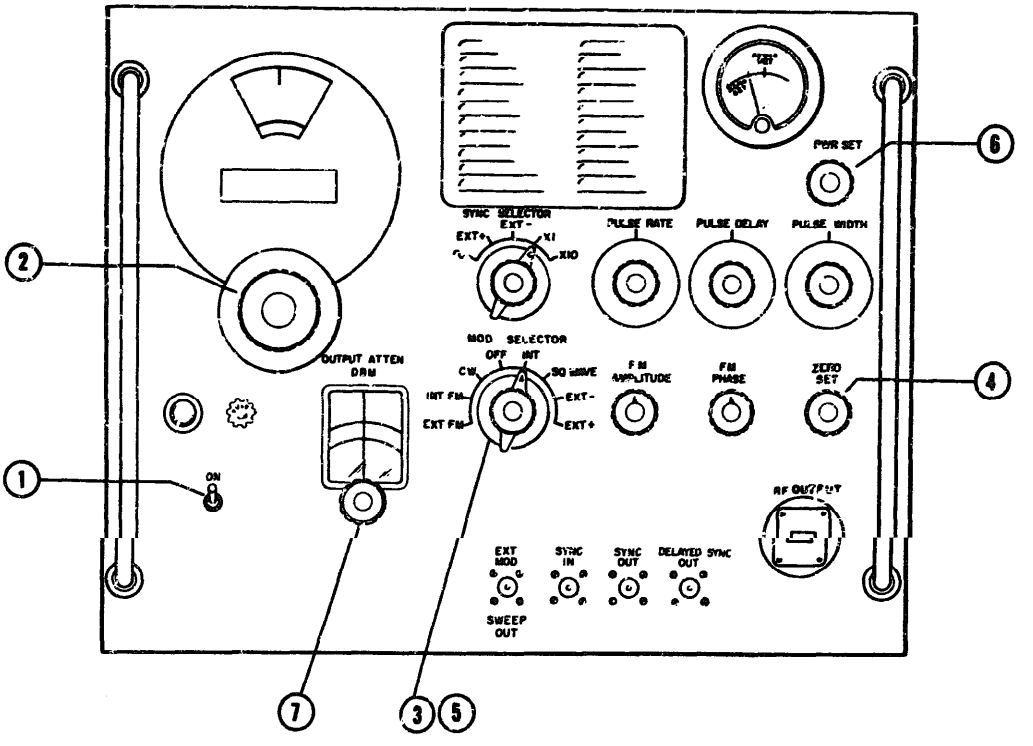
d. Making slotted line measurements.

e. Investigation of microwave impedance and transmission line characteristics.

f. Measuring frequency response of microwave systems.

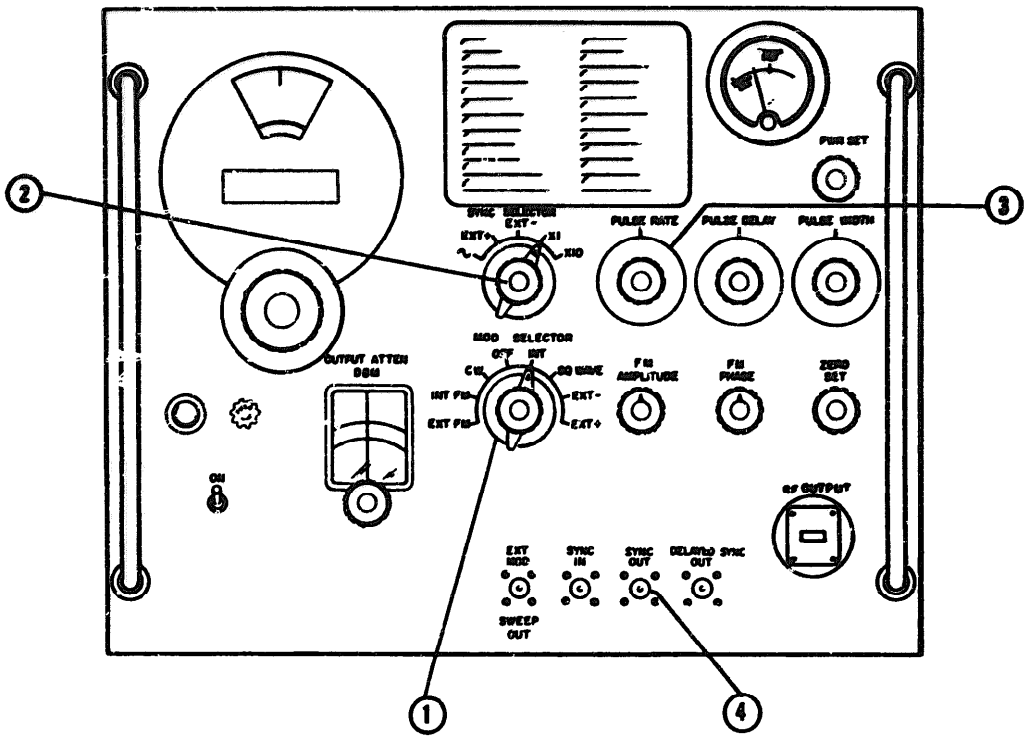
g. Determining resonant frequency and Q of waveguide cavities.

3-10. Figures 3-2 through 3-7 give step-by-step operating instructions. Each step is numbered and the control or connector to which the step refers is keyed by the same number.



1. Switch to ON and allow at last a 5-minute warmup.
2. Set frequency dial for desired frequency.
3. Set MOD SELECTOR to OFF.
4. Adjust ZERO SET to obtain a power-monitor meter indication exactly on ZERO SET index.
5. Set MOD SELECTOR to CW.
6. Adjust PWR SET to obtain a meter indication exactly on POWER SET index (red line at center of scale).
7. Set OUTPUT ATTEN for desired CW output level.

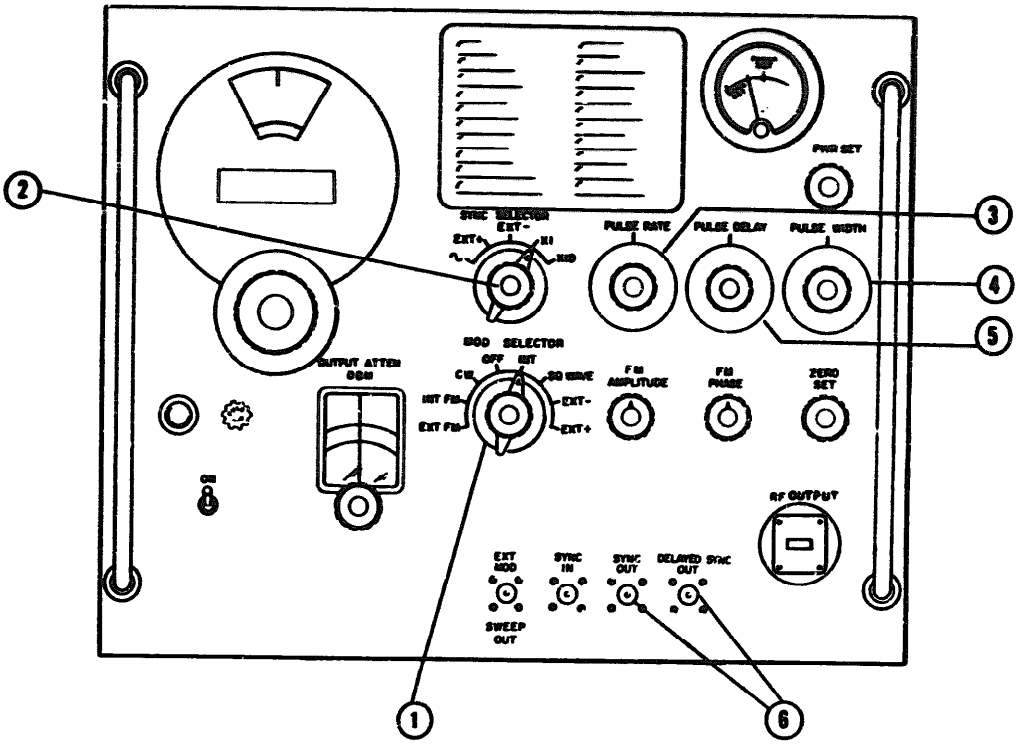
Figure 3-2. Turn-On Procedure and CW Operation



Perform turn-on procedure and set for desired CW output level as described in Figure 3-2. After obtaining desired level, proceed as follows:

1. Set MOD SELECTOR to SQ -WAVE.
2. Set SYNC SELECTOR to X1 or X10. (Xl and Xl0 are multiplying factors. The factor times the reading of the PULSE RATE dial is the frequency of the square-wave signal.)
3. Adjust PULSE RATE to obtain desired square-wave frequency.
4. Obtain from SYNC OUT a pulse coincident with the rise of each square-wave cycle.

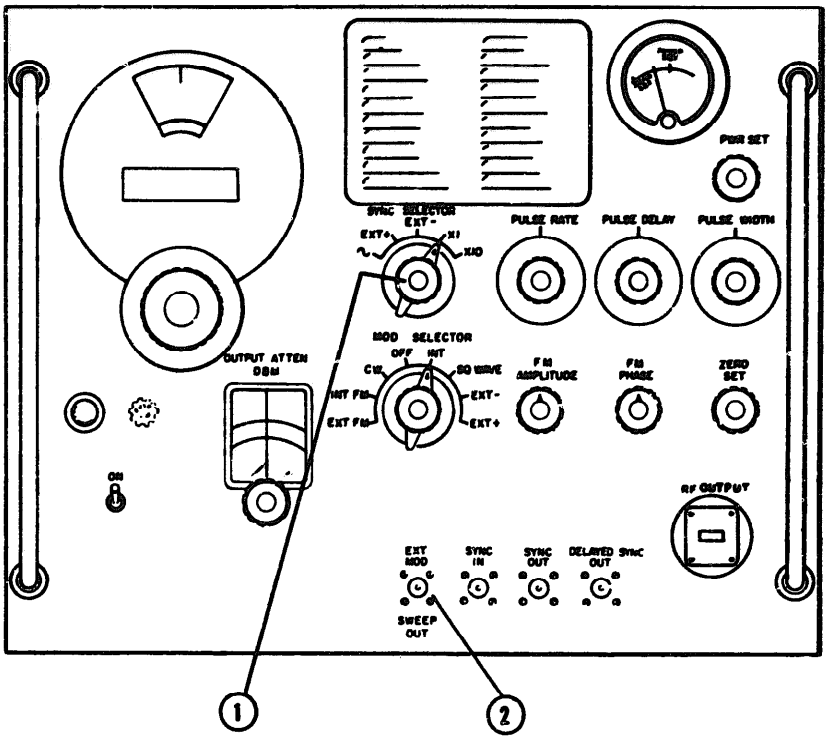
Figure 3-3. Square-Wave Operation



Perform turn-on procedure and set for desired CW output level as described in Figure 3-2. After obtaining desired level, proceed as follows:

1. Set MOD SELECTOR to INT.
2. a) Internal Pulsin'.
   Set SYNC SELECTOR to X1 or X10. (Xl and X10 are multiplying factors. Thefactor times the reading of the PULSE RATE dial is the repetition rate of the pulse signal.)
   b) External Synchronization.
   If generator is to be externally synchronized, set SYNC SELECTOR to ', EXT +, or EXT- and apply specified signal to SYNC IN.
3. Adjust PULSE RATE to obtain desired pulse repetition rate if internal pulsing is used.
4. Adjust PULSE WIDTH to obtain desired width of RF pulse.
5. Adjust PULSE DELAY to obtain desired delay between synchronizing pulse obtained at SYNC OUT' and leading edge of RF pulse.
6. Synchronize external equipment w it h SYNC OUT and/or DELAYED SYNC OUT pulses.

Figure 3-4. Internal Pulse Operation

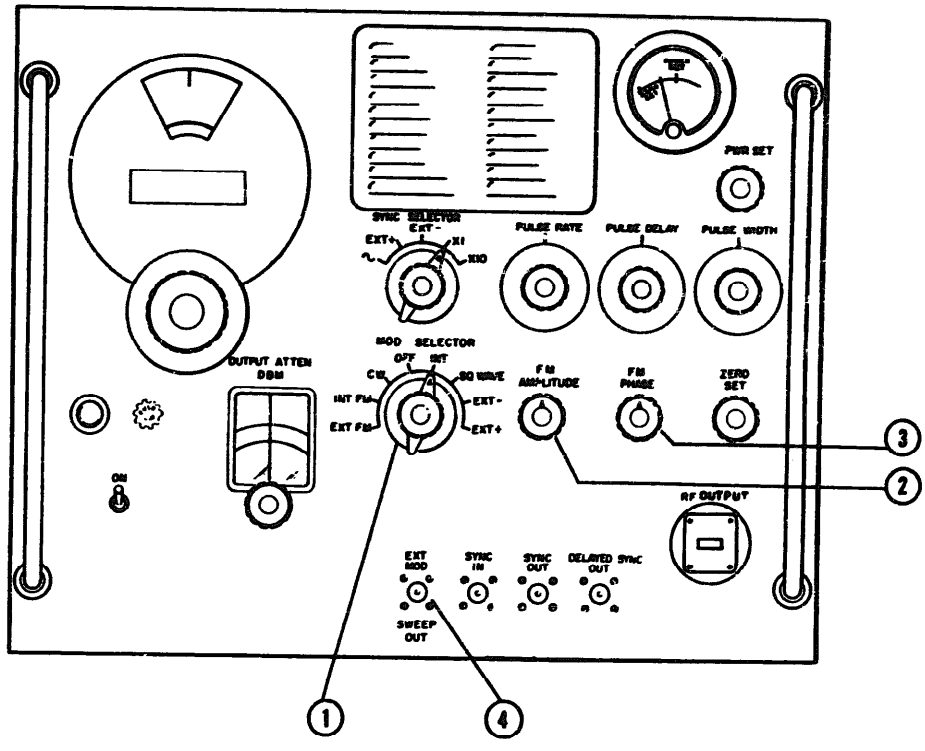


Perform turn-on procedure and set for desired CW output level as described in Figure 3-2. After obtaining desired level, proceed as follows:

1. Set MOD SELECTOR to EXT - or EXT +. Position of MOD SELECTOR is determined by polarity of external modulating pulse.

2. Apply external modulating pulse to EXT MOD. Modulating pulse must have an amplitude of at least 15 volts peak and width of 1 to 2500 microseconds.

Figure 3-5. External Pulse Operation



Perform turn-on procedure and set for desired CW output level as described in Figure 3-2. After obtaining desired level, proceed as follows :

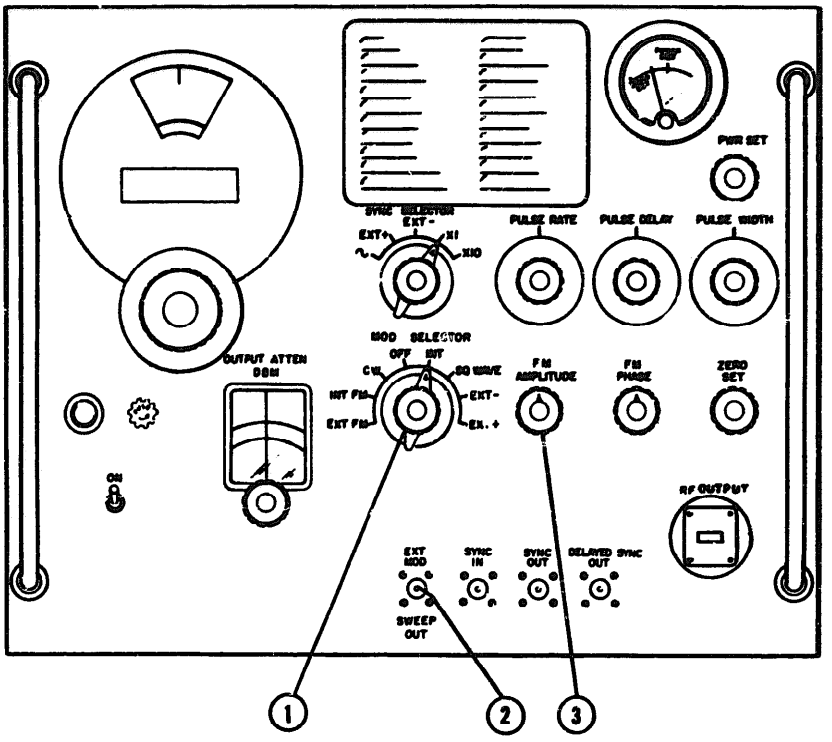
1. Set MOD SELECTOR to INT FM.

2. Set FM AMPLITUDE to full counterclockwise position, then advance control clockwise to establish desired degree of frequency deviation about the center frequency.

3. Adjust FM PHASE to obtain desired phase deviation between frequency modulation signal and SWEEP OUT signal.

4. To observe the mode pattern on an oscilloscope, obtain sweep signal at SWEEP OUT.

Figure 3-6. Internal FM Operation



Perform turn-on procedure and set for desired CW output level as described in Figure 3-2. After obtaining desired level, proceed as follows :

1. Set MOD SELECTOR to EXT FM.

2. Apply external frequency modulation signal to EXT MOD. Modulating signal must have an amplitude of 20 to 30 volts rms.

3. Set FM AMPLITUDE to full counterclockwise position, then advance control clockwise to establish desired degree of frequency deviation about the center frequency.

Figure 3-7. External FM Operation

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. The Model 628A contains five main circuit sections and a regulated power supply. The five main circuit sections, and all front panel controls and connectors are shown in block diagram, Figure 4-2. These circuits provide FM, CW, square wave, and pulse modulated signals in the 15- to 21-GHz range.

4-3. PULSE SECTION.

4-4. This section generates all pulses for internal modulation and synchronizing equipment The circuits of the pulse section are shown in Figure 4-3, and explained in the following paragraphs. The time relationship between pulses is shown in Figure 4-1.

4-5. INPUT AMPLIFIER AND PULSE RATE MULTIVBRATOR

4-6. The functions of input amplifier and pulse rate multivibrator V9 are dependent upon the position of the SYNC SELECTOR switch. Refer to Figure 4-4.

a. With SYNC SELECTOR switch S2 at position (-) or 2 (EXR+). V9 is an input amplifier for sine waves **V9 is an input inverter amplifier for negative pulses.**

(1) In position 1 or 2, the input signal is applied to the grid of V9A and the grid of V9B is grounded through capacitor C22. The output signal, in phase with the input signal, is taken from the plate of V9B and couples to V10 which is arranged as a Schmitt Trigger.

(2) In position 3, the input signal is applied to the grid of V9B and the grid of V9A is grounded through capacitor C22. The output signal, 180° out of phase with the input signal, is taken from the plate of V9B and coupled to V10.

b. With S2 in positions 4 (X1) and 5 (X10), V9 becomes a free running multivibrator. The frequency of oscillation is determined by time constants of the RC networks and a variable positive voltage towards which the grids are returned.

(1) In position 4 (Xl) frequency of oscillation is from 40 to 400 and the RC network consists of C16-R35 and C20-R42.

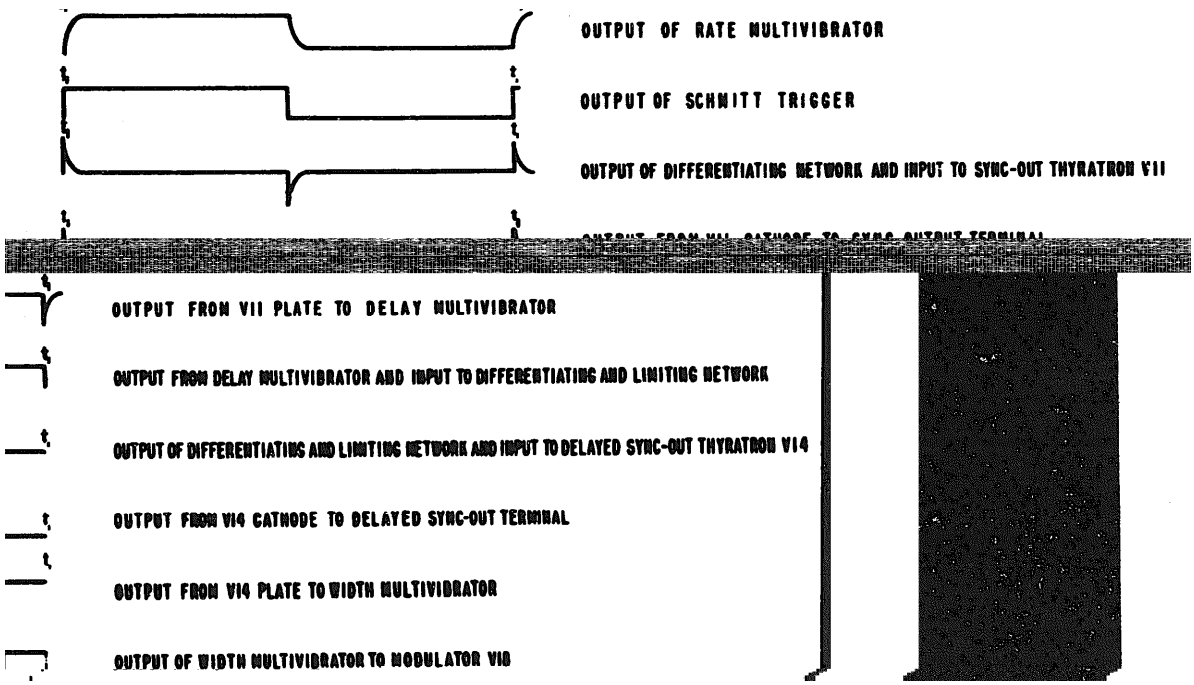


Figure 4-1. Timing Sequence in Pulse Section

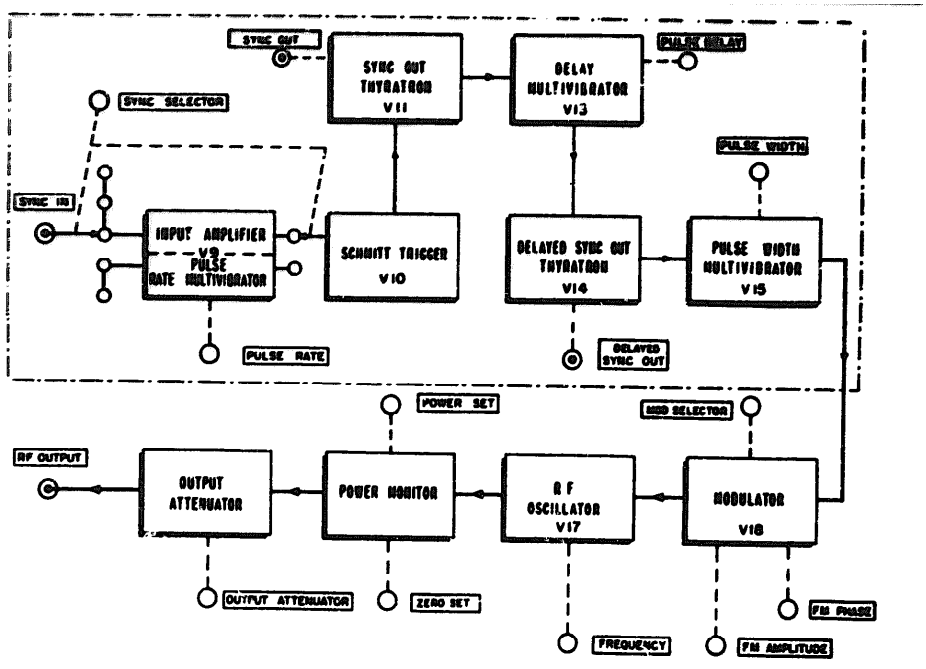


Figure 4-2. Block Diagram

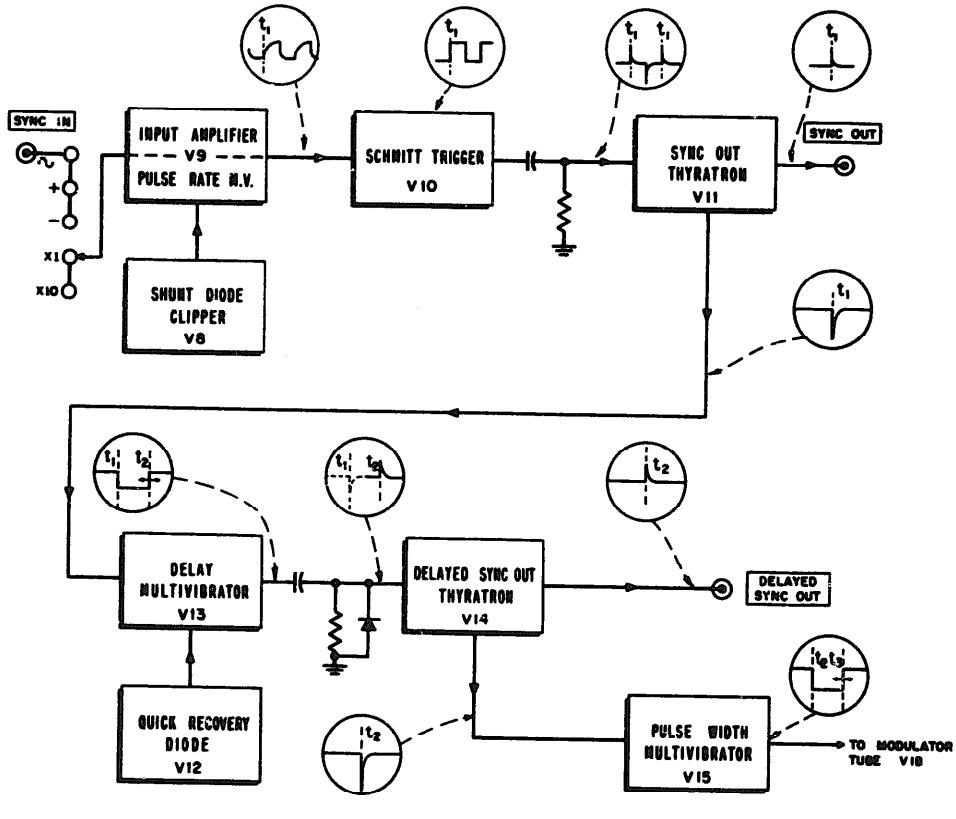


Figure 4-3. Block Diagram of Pulse Section Showing Waveforms

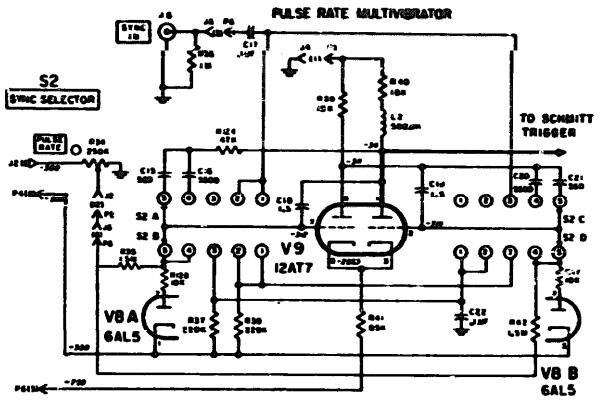


Figure 4-4. **Input** Amplifier and Pulse Rate Multivibrator

(2) In position 5 (X10) frequency of oscillation is from 400 to 4006 pps and the RC network consists of C15-R35 and C21-R42. Note that C15 and C21 are one-tenth the capacity of C16 and C20, and thus the RC time in the X10 position is one-tenth of that in the X1 position, giving a frequency multiplication of ten.

4-7. PULSE RATE control, R34, varies the voltage towards which the timing capacitors tend to discharge, hence the time it takes the instantaneous grid voltage to reach cut off value in the discharge period of the RC networks.

4-8. The two sections of V8 act as clamping diodes which prevent V9 grids from drawing grid current on their positive swing. Both diodes are clamped to -300 volts and they conduct whenever the instantaneous grid voltages go positive with respect to -300V. This action prevents any transients f **from** appearing in the plate circuits, thereby improving the output waveform.

4-9. The output signal taken from the plate of V9B is coupled by capacitor C23 to the grid of V10A.

4-10. SCHMITT TRIGGER.

4-11. A pulse of fast rise and decay time is required for triggering thyratron V11. Therefore the output from V9 is passed through a schmitt trigger circuit before being applied to sync out thyratron V11. The Schmitt trigger circuit is shown in Figure 4-5.

4-12. Transition from one state to the other in a schmitt trigger circuit (a direct coupled multivibrator) is very **fast,** which results in a square wave output of sharp waveform. V10 reverses conduction when the rise of the input signal reaches an upper trigger level, and again when the decay of the input signal goes **through a lower trigger level. These trigger l are established by the change in potential in the mon cathode circuit which results from the differ in conduction through two sections of V10. The** trigger level is established when V10B is conducting and is approximately -233 volts. The hysteresis of the circuit is 10-11 volts which places the decaying trigger level at approximately -233 volts when V10A is conducting.

4-13. **a voltage divider composed of R43, R44, R45, and R46 establishes the no-signal level on the V10A grid below the lower trigger level or at approximately -234 volts.**

4-14 **imum sensitivity of the schmitt trigger is obtained when the average dc level of the input signal is so set that the signal is symmetrical with respect to the two trigger levels. The average dc level at the input to V10 is raised or lowered by adjustment of Trigger Level Adj. (R44), which in turn adjusts the duty cycle of the square-wave output.**

4-15. The signal which will be used for square-**wave** modulation is provided by the schmitt trigger. **To** avoid loading the output of V10B, the square-**wave** modulating voltage is taken from the plate of **V10A,** and is coupled to modulator V18 when MODSELECTOR switch S3 is in SQ WAVE.

4-16. The output signal is taken from the plate of V10B for triggering thyratron V11.

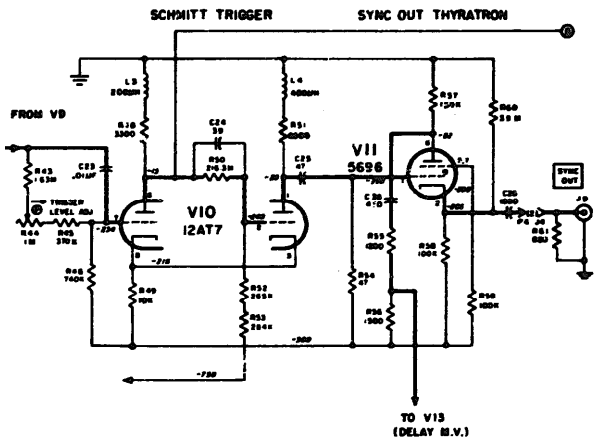


Figure 4-5. Schmitt Triggerand Sync Out Thyratron

4-17. SYNC OUT THYRATRON.

4-18. The output of V10B is differentiated by C25 and R54. The sharp positive spike fires sync out thyratron V11 (Figure 4-5) by driving its grid positive. A large negative pulse (-130 volts peak) is developed in the plate circuit of V11 and is fed through C38 and R55 to delay multivibrator V13. A positive pulse (30 volts peak) appears at the **t the cathode of V11 and is fed t** SYNC OUT connector **ector through C26. This sync s** is simultaneous in ti**in time with the front of the ori** pulse established by **l by the pulse rate multivibrato** by an external source of sync signals. The time relationships are indicated in Figure 4-1.

4-19. **DELAY MULTIVIBRATOR:**

4-20. Delay multivibrator V13 (Figure 4-6) produces an output pulse whose width is variable from 3 to 300 **3(**s with respect to its leading edge t1 (see Figure 4-1). Its trailing edge establishes time reference t2. The width of the output pulse is controlled by setting PULSE DELAY control, R80.

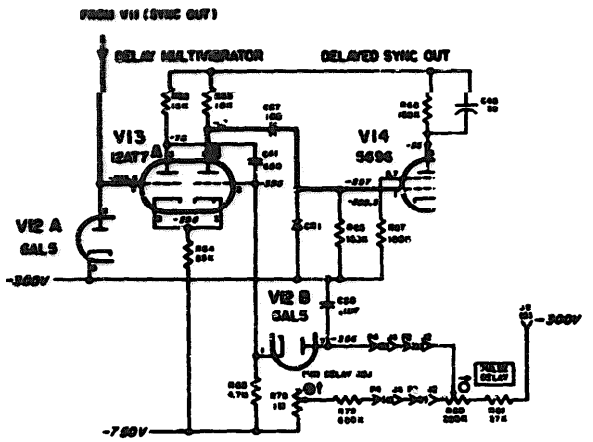


Figure 4-6, Delay Multivibrator

4-21. Delay multivibrator V13, is **arrangedas** a one- multivibrator, with diode clamp in each of its **clamp** circuits. Diode V12A clamps V13A grid to pre- **ive the** t from going more positive than -300 volts. Diode **event it from** sV13B grid toprevent it from going more **ined by the s** n a level determined by the setting of the **evel which** DELAY control, a level which is somewhere **ignal conditions** Under no-signal conditions V13A is conducting, V13B is cut off, and V12B is conducting. **no-sig** the circuit is in the no-signal condition, the **ibiished in** on V13B grid is established through V12B and is essentially the same as the potential on V12B plate.

4-22. **from** the large negative pulse from V11 is ap- **nau** ied to the grid of V13A, conduction in V13A ceases, **opea** the positive signal developed in the plate of V13A **through timing capacitor** C41. **V13B** conducts, V12B **ls -750 volts, pulling the until cutoff is reached. , and the negative signal 3A is coupled to the grid rid negative from cutoff te swing of V13A. Diode lischarges through V12B, d to the no-signal condi- veforms shown in Figure a recovery time obtained**

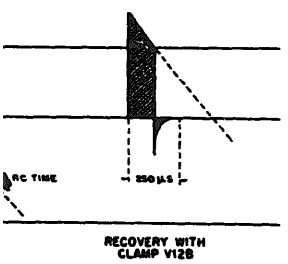


Figure 4-7. Waveform Comparison

4-23. **Rapid return of V13B grid to the no-signal level is required so that the delay multivibrator will be prepared to receive the next pulse incoming from V11. Since at high pulse repetition rates the period between pulses is short (250 µs at 4000 pps), interaction would occur if grid recovery time is short.**

4-24. The relation **between changes in grid level and** pulse width is indicated **cated in the waveform diagram figure** 4-8. The width of the Output pulse is dependent upon two things: the RC time constant of C41-R65 and the level of potential on the V13B grid when the delay multivibrator is in the no-signal condition. While the **RC time can not be varied, the level of potential on the V13B grid can be raised or lowered by changing PULSE DELAY control. For example, when PULSE DELAY** is set so that the no-signal level on V13B grid is approximately -390 volts, the positive pulse from V13A will drive V13B grid very little above cutoff, **conduc**tion time of V13B will be brief, and therefore the width of the output pulse will be greatly shortened.

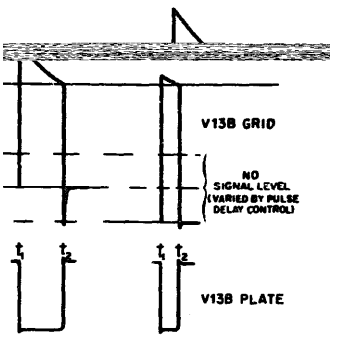


Figure 4-8. Delay Multivibrator Grid and Plate Waveforms

4-25. With PULSE DEL sistor R78 adjusts the m leading (t_1) and trailing thus effecting minimum with respect to t_1.

4-25. With PULSE DELAY at minimum, variable resistor R78 adjusts the minimum interval between the leading (tl) and trailing (t2) edges of the output pulse, thus effecting minimum delay of the RF output pulse with respect to tl.

4-26. The output of V13 R66, and the negative s eliminated through diod representing time refer sync out thyratron V14.

4-26. The output of V13B is differentiated by C27 and R66, and the negative spike, corresponding to t1, is eliminated through diode CR1. The positive spike, representing time reference t2, is passed to delayed sync out thyratron V14.

4-27. DELAYED SYNC

4-27. DELAYED SYNC OUT THYRATRON.

4-28. The action of de (Figure 4-9) is similar t thyratron V11 (paragrap entiated spike from V13 tive pulse (30-volt peak) circuit is fed to the DEL and the large negative pu circuit is coupled to widt

4-28. The action of delayed sync out thyratron V14 (Figure 4-28) is similar to that described for sync out thyratron V11 (paragraph 4-17). The positive differentiated spike from V13 fires the thyratron. The positive pulse (30-volt peak) developed in the V14 cathode circuit is fed to the DELAYED SYNC OUT connector, and the large negative pulse developed in the V14 place circuit is coupled to width multivibrator V15.

4-29. PULSE WIDTH MULTIVIBRATOR.

4-30. The action of pulse width multivibrator V15 (Figure 4-29) is similar to that of delay multivibrator

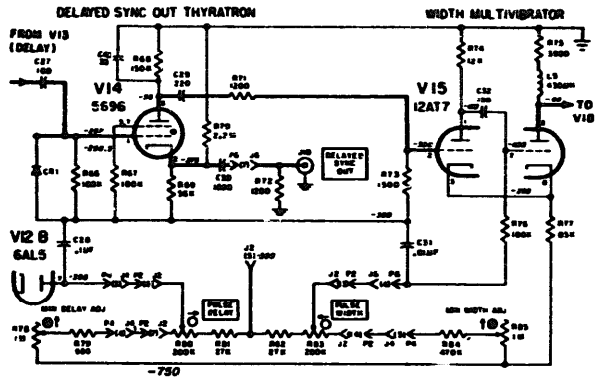


Figure 4-9. Delayed Sync Out Thyratron and Pulse Width Multivibrator

V13 (paragraph 4-19) except that there is no diode in the V15B grid circuit to shorten recovery time. Normal recoverytime is adequate to return the circuit to the no-signal condition before the next pulse is received from V14.

4-31. Bias for the Vl5B grid is applied through a voltage divider, R82-R85, which includes variable resistor R83, brought out to the front panel as the PULSE WIDTH control. The relation between the level of grid potential and width of output pulse was discussed in paragraph 4-24. The pulse width multivibrator provides an output pulsewhose width is variable from 0.5 to 10 μs. The trailing edge of the V15B output pulse establishes time reference t3, see Figure 4-1. With pulse width at minimum, variable resistor R85 adjusts the minimum interval between the leading (t2 and trailing (t3) edges of the output pulse, thus effecting m in i mu m width of the RF output pulse with respect to t2.

4-32. The V15B output **pulse is coupled to the grid of** V18B in the modulator **section when the MOD SELEC-**TOR switch is set to INT.

4-33. MODULATOR SECTION.

4-34. The modulator section (Figure 4-10) includes modulator tube V18 and MOD SELECTOR switch S3. This section receives all pulse and square-wave modulation signals to be applied to the RF oscillator section. The modulator tube functions only in posi tions 4, 5, 6, and 7 of S3. In positions 1 and 2 **FM** signals are applied to the klystron reflector. In position 3 no modulation signal is applied to the klystron thus the RF output signal is a continuous wave. Circuit conditions at each position of S3 are as follows:

a. Position 1 (EXT FM) -- An externally-supplied FM signal, supplied at the EXT MOD/SWEEP OUT connector, is placed across variable resistor R115 (FM AMPLITUDE control), and then coupled by capacitor C35 to the klystron reflector.

b. Position 2 (INT FM) -- An internally-supplied FM signal of the same frequency as the line voltage is placed across R115 (FM AMPLITUDE control), and then coupled to the klystron reflector. This signal taken from secondary winding B of power-supply trans former T2 by leads P7 (8) and P7 (7), is applied to the modulator section through a phase-determinig network which includes the FM PHASE control. The fm signal voltage is also supplied to the EXT MOD/ SWEEP OUT connector.

c. Position 3 (CW) -- In this position modulation is not appliedto the klystron reflector and the RF output signal generaged by the RF oscillator is a continuous wave.

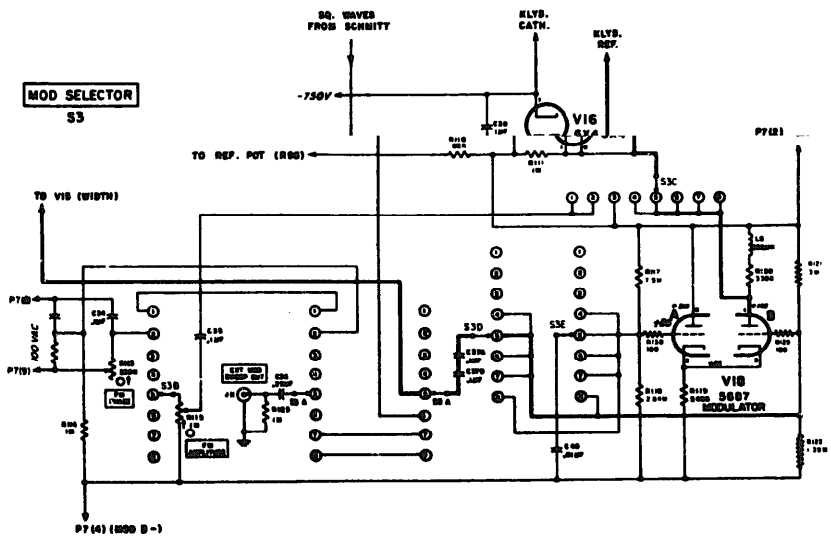


Figure 4-10. Modulaator V18 and MOD SELECTOR Switch S3

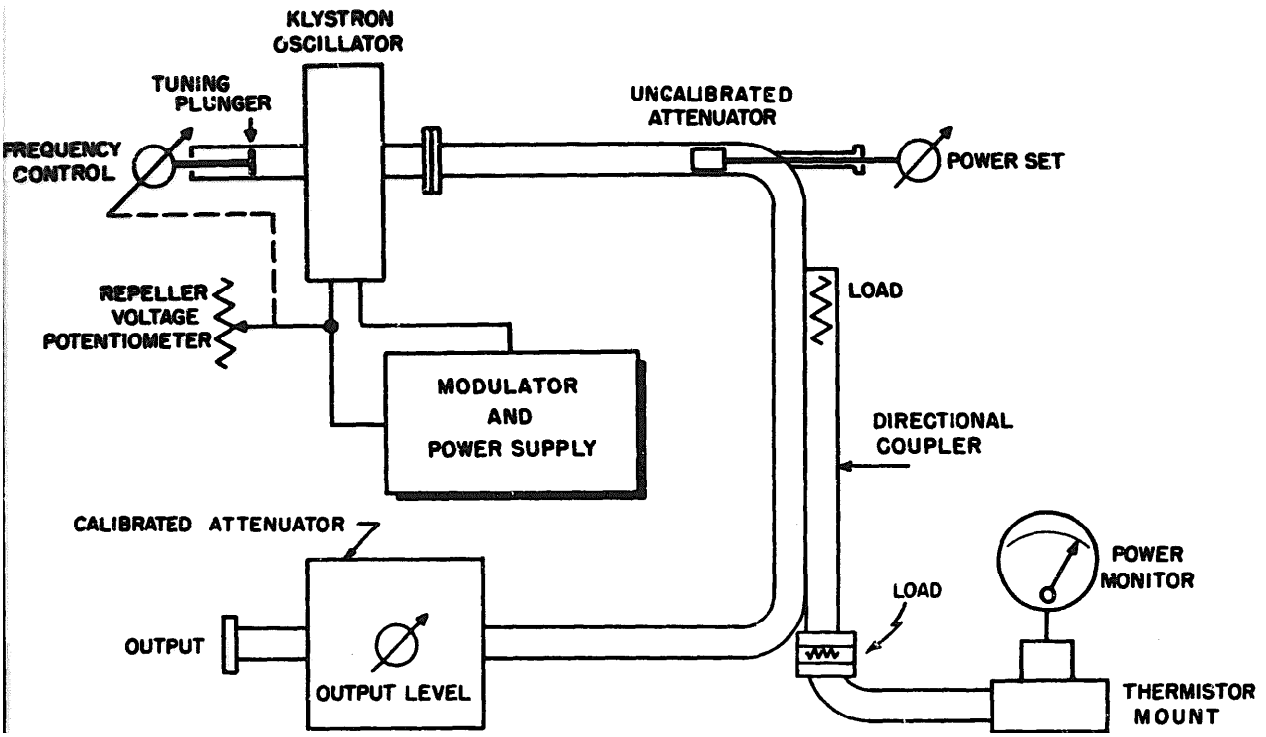


Figure 4-11. RF Oscillator and Waveguide System

d. Position 4 (OFF) -- In this position the klystron reflector is tied to the plate of V18B. With the modulator section in the no-signal condition, V18A is cut off and V18B is conducting. The drop across the V18B plate load resistor (approximately 60 volts) drives the reflector outside the operating mode, and there is no oscillation.

e. Position **5 (INT)** -- In this position, modulating voltage is supplied from width multivibrator V15. In the no-signal condition the circuit is as described for position 4. When a negative pulse from V15 is placed on its grid, V18B cuts off. Potentialon the V18B plate rises, returning the klystron reflector to the operating level, and the klystron oscillates. Oscillation continues for the duration of the pulse, and then the V18 circuit returns to the no-signal condition, againdriving the klystron reflector outside the operating mode.

f. Position 6 (SQ WAVE) --The square-wave signal from the V10A section of the Schmitt trigger is placed In the V18B grid. As described for position 5, the resulting action alternately changes the klystron reflector voltage 80 that the klystron moves in and out of oscillation*

g. Position 7 (EXT.) -- The action in this position is identical to that described for position **5** except that **the negative pulse**s that are applied to the modulator **section are suppli**ed from an external source at the **EXT MOD/SWEEP** OUT connector.

h. Position 8 (EXT+) -- The action in this position is similar to that described for position 7 except that externally-supplied pulses are applied to V18A grid. **V18A** conducts, **V18B** cuts off and allows the klystron to oscillate. In the EXT+ position V18 acts as a pulse inverter.

4-35. The action of diode V16 protects the klystron from drawing reflector current. V16 is connected across **the** cathode and the reflector, and conducts in the event. the klystron reflector goes positive with respect to the klystron cathode.

4-36. RF OSCILLATOR SECTION

4-37. The RF oscillator section (Figure 4-11) of the Model 628A is essentially an all waveguide system, employing a reflex klystron **tube** mountedin a plunger tuned cavity for generation of the RF energy. The energy from the cavity is coupled to a power set attenuator (uncalibrated) which adjusts the power level applied to the calibrated attenuator. The level at the input of the calibrated attenuator is monitored by a compensated thermistor bridge which operates a front panel meter. Monitoring is accomplished **by** sampling the RF energy through a waveguide directional coupler which feeds the sampled RF energy to a thermistor located in one leg of the bridge. The calibrated attenuator is a rotary type, operating in circular waveguide with a transition to rectangular waveguide at its output.

4-38. REFLEX KLYSTRON OPERATION.

4-39. The resonant circuit of the RF oscillator includes klystron resonator-grid capacitance, beam admittance, and the primarily inductive impedance of

the external cavity. The cavity is fitted with a movable plunger w h i c h changes cavity dimensions, thereby varying the impedance of the oscillator resonant circuit. With a change in impedance, the frequency of oscillation is changed.

4-40. In the following discussion of how oscillations are sustained in a reflex klystron oscillator, the presence of a low amplitude RF **voltage** across the resonator grids is assumed. As in any oscillator, this initial voltage is supplied by the thermal agitation noise.

4-41. Electrons emitted from the cathode toward the resonator grids are velocity modulated, i.e., the electrons are accelerated or decelerated according to the phase of the RF voltage existing across the resonator grids. After leavingthe resonator grids, the electrons encounter **a** retarding electric field set up by the negative reflector voltage and are repelled back toward the grids. Since the electrons have been velocity modulated they tend to form in bunches when they arrive at the grids.

4-42. This bunching of electrons is illustrated in Figure 4-12, which shows the transit time relationship of electrons while in the drift space between the resonator grids and the reflector. Consider an electron (a) leaving the grids at time tl. The voltage of the RF signal on the grids is such that the electron receives energy and is accelerated into the drift space. It arrives back at the grids at time tn. An electron (b) leaving at time t2 receives no acceleration because the RF signal is now at zero volts. Thus electron (b) does not travel as far into the drift space and arrives back at the grids at the same time as electron (a). Electron (c) leaving at time t3 is decelerated since the **RF** signal has reversedvoltage polarity since time t1. Electron (c) **travels** a shorter distance into the drift space and arrives back at the grids at the same time as electrons (a) and (b).

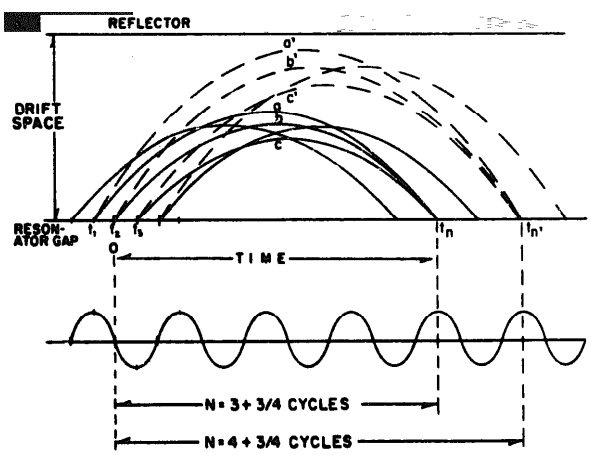


Figure 4-12. Bunching of Electrons in **a** Reflex Klystron

4-43. Whenbunched electrons arrive back at **the grids** at a time when the RF signal tends to retard **their return**, they deliver energy to the grids and sustain oscillations in the resonant cavity.

4-44. The time that the electrons spend in the drift space is adjusted by changing the reflector voltage. As reflector voltage is increased in the negative direction, electrons a, b, and c spend less time in the drift space. As reflector voltage is decreased electrons al, b', and c1 (Figure 4-12) travel farther into the drift space and take a longer time (tn1) to return to the grids. At the low end of the frequency band (15 to 18 GHz), the reflector voltage is adjusted so that the number of oscillations (N) that occur at the grid while the electrons are in the drift space is equal to **3-314** cyc,es. At the high end of the frequency band (18 to 21 GHz), the reflector voltage is adjusted so that the number of oscillations equals 4-3/4 cycles. When the oscillator is operating with 3-3/4 cycles drift time it is known as operating in the 3-3/4 reflector mode. A plot of reflector modes with respect to frequency and reflector voltage is given in Figure 4-13.

4-45. RF OSCILLATOR TUBE.

4-46. The RF oscillator tube is a Varian type V40B reflex klystron operating in a tunable cavity resonator. The klystron and cavity assembly are shown in Figures 5-3a and 5-3b. The klystron is constructed with two irises located opposite each other and near the resonator grids. One iris looks into the external cavity and the other into the output system.

4-47. The klystron cavity system in the Model 628A operates on the 3/4 cavity mode, and oscillation **of** both the 3-3/4 and a-3/4 reflector modes are employed to cover the frequency band from 15 to 21 GHz. The 3-3/4 mode is used from 15 GHz to approximately 18 GHz. At this frequency **the** tuning **mechanism** actuates mode switch S4 to decrease the voltage applied to the reflector by approximately 200 volts. This action places the system on the 4-3/4 mode for the remainder of the band from approximately 18 to 21 GHz.

4-48. As shown in the plot of modes, Figure 4-13, the 5/4 **cavity** mode interferes with the 3-3/4 reflector mode at the lower end of the band. This mode is suppressed by means of a tapered load adjoining the cavity. Since klystrons possess a natural tendency to oscillate **on** the 1/4 cavity mode, and since this mode is undesirable, it is suppressed by a small adjustable, slug inserted into the cavity. Both mode suppressors are shown in Figure 5-4.

4-49. Voltage is applied to the klystron reflector from variable resistor R96. The movable arm of R96 is ganged to the frequency drive in such a manner that voltage on the reflector is automatically tracked with frequency in the desired reflector mode.

4-50. POWER - MONITOR SECTION.

4-51. The power-monitor section monitors the RF power level at the input to the calibrated attenuator (OUTPUT ATTEN DBM). The power-monitor section includes an uncalibrated attenuator (PWR SET) which

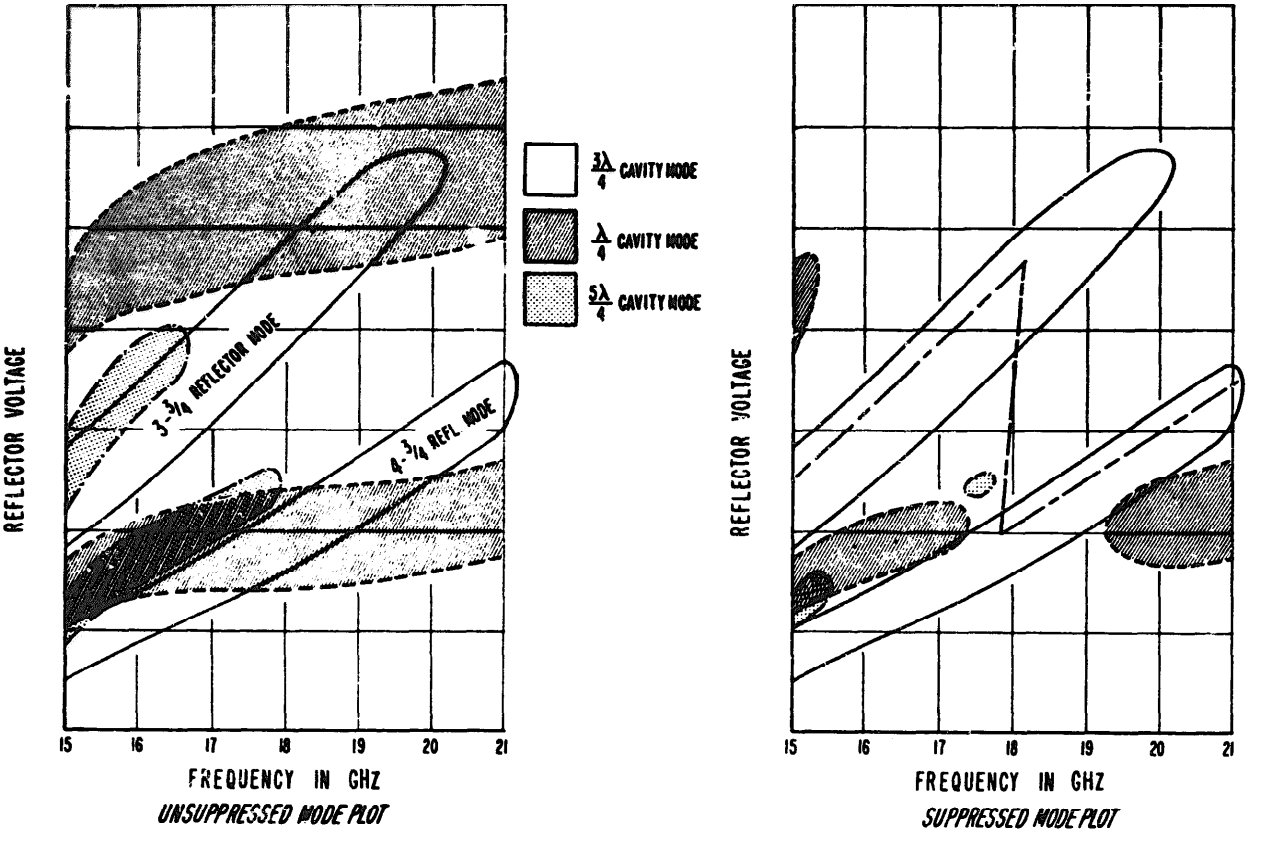


Figure 4-13. Graph Showing Klystron Oscillation Modes

adjusts the level of power applied to the calibrated attenuator, and a thermistor bridge which monitors the power applied to the calibrated attenuator. Refer to Figure 4-14.

4-52. RF power from the klystron is coupled to the uncalibrated attenuator which is **brought out to the front** panel as the PWR SET control. Power from the uncalibrated attenuator is coupled directly to the calibrated attenuator. Power delivered to the calibrated attenuator is sampled by a specially-designed directional coupler andapplied to one leg of the temperature-compensated thermistor b ridge (RT123). Power-monitor meter Ml is connected across the bridge and when the bridge is balanced the meter reads ZERO **SET. To** bring the bridge into balance adjust the ZERO SET control. If the bridge is balanced before the power

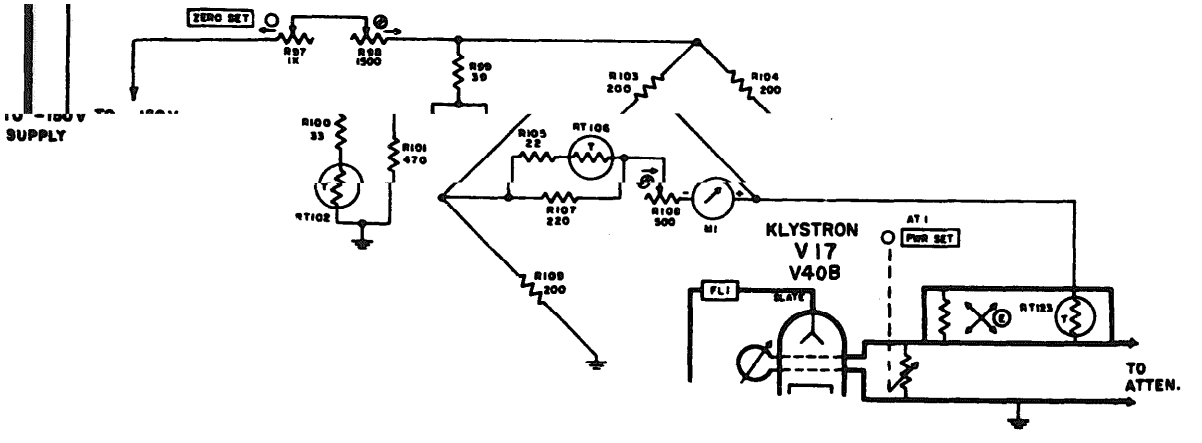


Figure 4-14. Power-Monitor Section

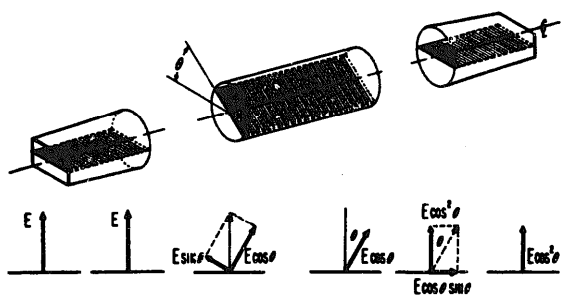
is sampled and when the sampled power causes the meter to read 0 dBm, the power level at the input to the calibrated attenuator is +l0 dBm (10 mW).

4-53. Thermistor RT106 connected in series with the meter acts as a sensitivity-regulating device, necessary because of the characteristic of thermistor bridges to increase in sensitivity as the ambient temperature increases. Thermistor RT102 in the network shunted across the bridge is a temerature-compensating device. Since RT123 is temperature sensitive, the bridge could drift appreciably from its zero setting with changes in ambient temperature. RT102 compensates for this tencency. With changes in the voltage across the bridge, current through thermistor RT102 also changes, and its resistance varies in such manner as to regulate the current through RT123. The regulation of current through RT123 tends to keep the bridge in balance by counteracting any change in current through RT123 due to ambient temperature changes. Thus the bridge can be zero-set and will remain in balance to a relatively high degree.

4-54. OUTPUT ATTENUATOR SECTION.

4-55. The output attenuator section consists essentially of two broadband, precision waveguide attenuators operating in series and ganged to the OUTPUT ATTEN DBM control. The OUTPUT ATTEN is calibrated to read the output in dBm.

4-56. Each attenuator consists of three sections of waveguide in tandem. In each section a resistive film is placed across the guide as shown in Figure 4-15. The middle section is a short length of round guide which is free to rotate axially with respect to the two fixed end sections. The end sections are rectangular-to-round waveguide transitions in which the resistive films are normal to the E field of the applied wave. The construction is symmetrical.



ATTENUATION - 20 lDC cds's - 40 LOG COS S

Figure 4-15. Phantom View Showing Output Attenuator

4-57, When all films are aligned, the E **field of the** applied wave is normal to all films and **no attenuation** occurs. When the center section is **rotated through** an angle 0, the E field may be consider**ed as resolved** into two components: E sin O in the plane of the film and E cos 0 normal to the plane. The E sin 0 component will be absorbed by the film while the E cos 0 component, now oriented at an angle 0 with respect to the applied wave, will be passed Unattended to the third section. When ii encounters the third film, the E SOS 0 component will be split into two components: the E cos 0 sin0 component which will be absorbed by the film, and the E $\cos^2$ 0 component which will emerge with orientation identical to the original wave.

4-58. The attenuation is thus a function only of the angle to which the center section is rotated and is almost completely independent of frequency. In terms of dB the attenuation is equal to 40 log cos 0. Attenuation through both attenuator sections in series is twice the attenuation through one of them, i. e. [2(40 log cos 0)] , and attenuation up to 100 dB may be introduced.

4-59. POWER SUPPLY.

4-60. The power supply section consists of three interdependent electronically-regulated voltage supplies, furnishing -300, -750, and -1300 volts as measured from chassis ground and an unregulated supply furnishing -210 volts. The -300 volt supply also furnishes a regulated -150 volts for the power-monitor bridge.

4-61. The separate supplies and their relationships are shown in block diagram, Figure 4-16. The regulated supplies are stacked, and voltage regulator V7 in the -550 volt supply furnishes the reference voltage for the whole supply.

a. The -300 **volt** regulated supply furnishes voltage for operation of the pulse generator.

b. The -450 volt regulated supply, stacked with the -300 volt supply, furnishes -750 volts to the klystron cathode and the pulse circuits.

c. The -550 volt regulated supply, stacked with the -300 and -450 volt supplies, furnishes -1300 volts to the klystron reflector.

4-62. After **the** instrument is turned on, there is **a** 30-second $elay before the -300 and -450 volt supplies are energized. The delay is due to thermal relay K1 holding the transformer T1 primary circuit open. This delay permits tube filaments to heat before klystron beam voltage and tube potentials are applied.

4-63. Notice that V6. the control tube for the -750 **volt supply (Figure 5-16 j , has a divided** plate load consisting of R21 and R25-R26. R21 acts as the plate load before the thermal relay is actuated while R25-R26 act as the plate load after the relay trips.

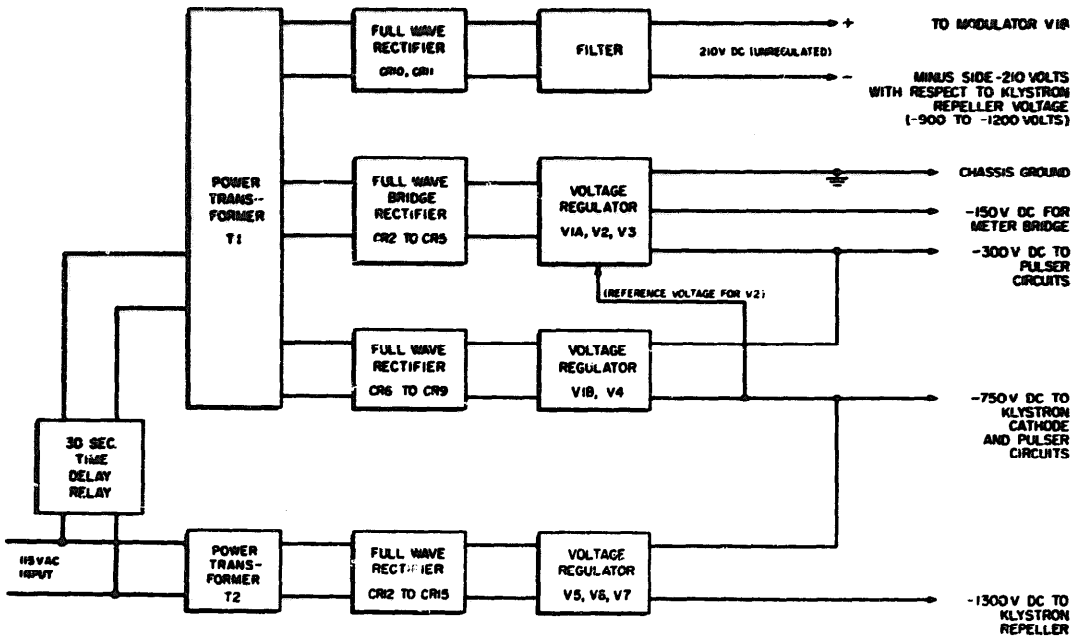


Figure 4-16. Block Diagram of **Power** Supply

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides maintenance and service information for the Model 628A SFF Signal Generator. The section includes recommended test equipment, replacement procedures for tubes, repair and adjustment procedures, and troubleshooting charts. Also included are performance checks which verify proper instrument operation.

5-3. CLEANING THE AIR FILTER

5-4. the air filter for the Model 628A is located behind the louver on the front panel. Inspect the air filter regularly, and clean it before it becomes dirty enough to restrict air flow. To remove and clean the air filter, proceed as follows:

a. Remove filter from instrument front panel by removing the four machine screws at the corners.

b. Wash filter in warm water and detergent.

c. Dry filter thoroughly and coat it with filter adhesive. We recommend Super Filter Coat from Research Products Corporation. This adhesive comes in a convenient spray can and is available from most heating supply stores or from your authorized Hewlett-Packardsales representative (HP Part No. 3150-0002).

5-5. TEST EQUIPMENT.

5-6. Test equipment required for use in maintaining and checking performance of the Model 628A is listed in Table 5-1. Equipment having similar characteristics can be substituted for the equipment listed.

5-7. TROUBLESHOOTING.

5-8. LOCATING TROUBLE.

5-9. Always start locating trouble with a thorough vlsual inspection for burned-out or loose components, loose connections, or any condition which suggests a source of trouble. Check tubes for open filaments by touchingtubes and replace all that are cold. Replacing a cold tube, in most cases, will restore the generator to normal operation. Check the fuse to see that it's not open.

5-10. If trouble cannot be isolated to a bad component by a visual inspection or **a** cold tube, the trouble should then be isolated to **a** circuit section. Isolation to **a** circuit section can best be accomplished by using block diagram, Figure 4-2.

5-11. TROUBLESHOOTING CHARTS.

5-12 Troubleshooting charts, T ables 5-2, 5-3, and **5-4, list checks and symptoms, possible causes, and remedies of various troubles. The power supply should be checked first; refer to paragraph 5-14.**

5-13. For simplification, only tubes are referenced in the troubleshooting charts, but it should be remembered that components associated with referenced tubes are also failure possibilities. When testing the signal generator it is recommended that line voltage be applied through a variable transformer, and that the transformer be adjusted to deliver a voltage at the low end of the rated 103- to 127 volt range, An instrument in good condition should operate satisfactorily from any line voltage within the rated range, but where there is marginal operation (from weak tubes, etc.) weaknesses become easier to trace at low line voltages.

5-14. POWER SUPPLY.

5-15. Correct operation of the power supply is vital to proper operation of the signal generator. Noise or variation in the regulated voltages causes other circuits to operate in a random or erratic manner. It is advisable to make a voltage check of the power supply whenever the instrument is suspected of marginal operation. This eliminates factors such as low voltages or poor regulation which cause unsatisfactory performance in other sections of the instrument.

5-16. When measuring voltages in the power supply, the procedure given in **Table** 5-2 should be followed. This permits the voltmeter common to be attached to **-750** volt bus at all times, while the dc probe is moved from point to point. Use of polarity switch on the voltmeter will be required only when measuring +750 and **+450** volts to chassis ground.

WARNING

When measuring voltages from points on the regulator card which have dc potential to ground, use a plastic encased multimeter. When using metal case vtvm's exercise great care since metal cabinets will be at high negative potentials.

5-17. Adjust line voltage from 103 to 127 volts while measuring output voltages from the regulated supply. The regulated voltages may vary + 1% with this line voltage change.

5-18. REPAIR

5-19. CABINET REMOVAL.

5-20. To remove Model 628A from its cabinet proceed as follows:

a. Position instrument so that it is resting on front panel guard rail handles.

b. Remove four screws on the back of the cabinet, and lift the cabinet from instrument chassis.

Table 5-1. Required Test Equipment

Instrument Type	Required Characteristics	Use	Recommended Model
Oscilloscope	Internal Sweep: 0.5 μsec/cm to 100 μsec/cm	Signal tracing, calibration and performance checks	HP Model 160B
Audio Oscillator	Frequency Output: 1000 Hz	Calibration	HP Model 200AB
Pulse Generator	Pulse Duration: 5 μsec Output Voltage: 5 volts peak Repetition Rate: 4000 pps	Adjustments	HP Model 212A
Vacuum Tube Voltmeter	AC Voltage Range: 1 mV to 10V DC Voltage Range: to 750V positive and negative	General purpose and adjustments	HP Models 400D/H and 410B
Microwave Power Meter	Power Range: to 10 mW Scale to read in dBm and milliwatts	Adjustments and performance checks	HP Model 432A
Crystal Detector	Sensitivity: 0.05 V/mW Frequency Response: ±2 dB Frequency Range: 15 to 21 GHz	Signal tracing, calibration and performance checks	HP Models P421A and K422A
Thermistor Mount	Power Range: to 10 mW Frequency Range: 15 to 21 GHz	Adjustments, calibration and performance checks	HP Models P487B and K487C
Frequency Meter	Dial Calibration Accuracy: 0.08% Frequency Range: 15 to 21 GHz	Calibration and performance checks	HP Models P532A and K532A

Table 5-2. Power Supply Troubleshooting

Symptom	Possible Cause	Remedy
-550 VOLT SUPPLY		
With voltmeter common lead connected to -750 volt terminal, connect positive lead to -1300 volt terminal to read -550 volts.		
Small deviation	Out of adjustment	Adjust R28 (Fig. 5-1) to -550V
Low voltage	Defective series regulator V5 Defective rectifier diode	Replace V5; adjust R28 above Replace CR12, 13, 14, or 15; adjust R28 above
High voltage	Defective control tube V6	Replace V6; adjust R28 above
Erratic voltage	Defective reference tube V7	Replace V7; adjust R28 above
-450 VOLT SUPPLY		
With voltmeter common lead connected to -750 volt terminal, connect positive lead to -300 volt terminal to read +450 volts.		
Low voltage	Defective series regulator V1 Defective rectifier diode	Replace V1 Replace CR6, 7, 8, or 9
High voltage	Defective control tube V4	Replace V4
-300 VOLT SUPPLY		
With voltmeter common lead connected to -750 volt terminal, connect positive lead to chassis ground to read +750 volts.		
Low voltage	Defective series regulator V1 Defective rectifier diode	Replace V1 Replace CR2, 3, 4, or 5
High voltage	Defective control tube V2	Replace V2
-150 VOLT BRIDGE SUPPLY		
Connect voltmeter terminals between chassis and pin 2 of V3 to read -150 volts.		
Voltage unstable	Defective V3 Defective -300 volt regulation	Replace V3 Adjust -300 volt supply

Table 5-3. RF Generator Troubleshooting

Symptom	Possible Cause	Remedy
With MOD SELECTOR set to OFF		
Power-monitor meter not indicating	No supply voltage	Measure bridge supply voltage across end tap (orange lead) R98 (Figure 5-6) and ground; should be approximately 2 to 3 volts. Check -150 volt supply
	Defective VR tube V3	Replace V3; readjust ZERO SET (para 5-36)
	Open meter	Disconnect meter; check continuity Caution: 200 μA movement
Power-monitor meter pins upscale or downscale	Shorted or open component on one side of bridge causing unbalance	Disconnect one side of meter. Measure bridge supply voltage at R98 (see remedy step above) for 2 to 3 volts. Measure voltage between each side of bridge and ground to determine side at fault. The voltage at both midpoints on each side of the bridge should be 1/2 voltage applied to bridge from R98.
Power-monitor meter pins to left below zero	Open thermistor RT123	Replace thermistor mount. Recalibrate power-monitor meter (para 5-57)
Power-monitor meter pins to right upscale	High bridge voltage; defective VR tube V3	Replace V3
	Shorted thermistor mounting-post insulator. (One post is insulated from mounting by mica washer which also acts as bypass capacitance)	It is recommended that entire mount be replaced because of difficulties in adjusting mount frequency response after reinsulating post (para 5-57)
With MOD SELECTOR set to CW		
Power-monitor meter indicates weak output	Incorrect tracking adjustments	Check reflector tracking adjustments (para 5-45). Observe mode patterns.
	Defective klystron	Replace klystron, cavity, and frequency drive mechanism (para 5-25)
	Extraneous material in cavity (braid, filings, polyiron chips, etc)	Remove foreign matter

Table 5-4. Pulse Section Troubleshooting

Symptom	Possible Cause	Remedy
No RF output with MOD SELECTOR set to INT or SQ WAVE. INT FM and CW positions satisfactory	Defective V8, V9, or V10	Replace; see Table 5-5
	Schmitt trigger sensitivity out of adjustment	Adjust R44; see para 5-38
No RF output with MOD SELECTOR set to INT and no SYNC OUT or DELAY SYNC OUT pulses. SQ WAVE position satisfactory	Defective V11	Replace; see Table 5-5
No RF output with MOD SELECTOR set to INT and no DELAY SYNC OUT pulse. SYNC OUT pulse and SQ WAVE positions satisfactory	Defective V12, V13, V14	Replace; see Table 5-5
	Min. delay adj. misadjusted	Adjust R78; see para 5-55
No RF output with MOD SELECTOR set to INT SYNC OUT pulse, DELAY SYNC OUT pulse and SQ WAVE positions satisfactory	Defective V15	Replace; see Table 5-5
	Min. width adj. misadjusted	Adjust R85; see para 5-56
No RF output with MOD SELECTOR set to INT or SQ WAVE. SYNC OUT pulse, DELAY SYNC OUT pulse and INT FM and CW positions satisfactory	Defective V18	Replace; see Table 5-5

5-21. **TUBE REPLACEMENT CHART.**

5-22. **Tubes used in Model** 628A arc listed in **Table 5-5. Any tube may be** replaced with a tube [illegible] standard character- **i. When tube replacement requires that an ad- ient be performed, Table 5-5 references para- h or table where pertinent adjustment informa- s given. It is recommended that tubes be ted by substituting n**ituting new tubes of the same type: **improvement in perf** in performance is noted, return **nal tube to the socket.**

5-23 **NG ETCHED CIRCUIT BOARDS.**

5-24 **ce etched circuit boards the following is are recommended:**

D a. Do not apply excessive heat.

R b. Remove a damaged component by clipping leads **compon** component.

Apply h Apply heat to component lead and remove lead **a straig** a straight upward pull.

d, Use a toothpick or wooden splinter to clean holes.

e. Solder replacement components from the conductor side.

5-25. KLYSTRON TUBE REPLACE**MENT.**

5-26. If it is necessary to replace the klystron tube, the klystron cavity and frequency drive mechanism must he replaced as a unit. Replacement unit (HP Part No. Part No. 00628-6065) consists of a new klystron installed in a cavity which is attached to the associated frequency drive mechanism. A new calibrated frequency dial is also included with the unit. Units are completely pretested and adjusted at the factory. Field installation of the replacement unit is simple and requires no extensive readjustment procedure. Units can be obtained from the factory on an exchange basis by contacting the nearest Hewlett-Packard field representative or factory service department.

CAUTION

THE STOPS FOR THE **FREQUENCY** DRIVE MECHANISM ARE INOPERATIVE WHEN FREQUENCY DIAL IS NOT PLACE. ROTATING THE SHAFT FOR THE FREQUENCY DIAL **AND** FREQUENCY DRIVE CAM TO ONE EXTREME OR THE OTHER WITHOUT THESE STOPS MAY RESULT IN SERIOUS AND PERMANENT DAMAGE TO PLUNGER ON INNER END OF FREQUENCY DRIVE ROD. HANDLE WITH **CARE.**

Table 5-5. Tube Complement

		Function
6080	Series Regulator (-300 volt supply and -450 volt supply)	Table 5-2
6AU6	Control Tube (-300 volt supply)	Table 5-2
OA2	Voltage Reference Tube (-150 volts) PWR SET bridge supply	Paragraph 5-57
6AU6	Control Tube (-450 volt supply)	Table 5-2
6AQ5	Series Regulator (-550 volt supply)	Table 5-2
6AU6	Control Tube (-550 volt supply)	Table 5-2
5651	Reference Tube (-550 volt supply)	Table 5-2
6AL5	Clamping Diode	No adjustment required
12AT7	Pulse Rate Multivibrator and Input Squaring Amplifier	Paragraph 5-53
12AT7	Schmitt Trigger	Paragraph 5-38
5696	Sync Out Thyratron	No adjustment required; selection may be neces- [illegible]
	Clamping Diode	No adjustment required.
	Pulse Delay Multivibrator	Paragraph 5-55
	Delayed Sync Out Thyratron	No adjustment required.
	Pulse Width Multivibrator	Paragraph 5-56
	Limiting Diode	No adjustment required
	[illegible]	[illegible] 5-25
	Modulator	No adjustment required

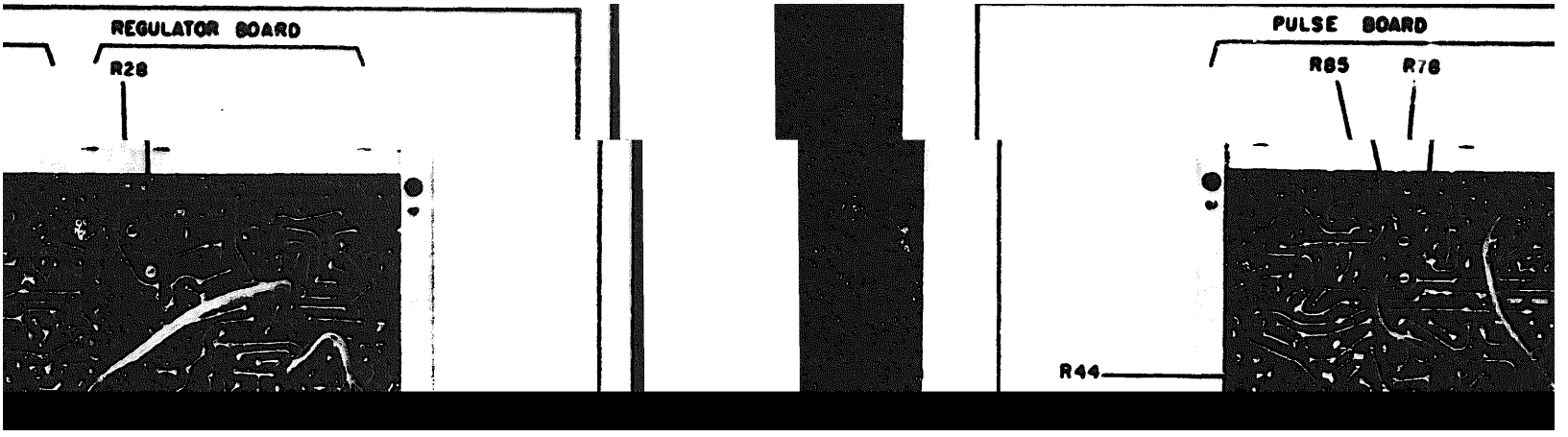


Figure 5-1. Rear View of Instrument Showing Power Supply and Pulse Sections

5-27. REMOVAL. Refer to Figure 5-2 and proceed as follows:

a. Obtain a scratch awl or similar sharp-pointed tool.

b. Rotate frequency control full counterclockwise to stop. Normally **a** small dot just to the left of 15 GHz dial point will be under the hair line.

c. Remove and save frequency control knob and cover over frequency dial. This cover is held in place by four screws.

d. With awl, mark a valley on the frequency drive shaft gear and the tooth of frequency dial which meshes in this valley.

e. The dial is held on frequency dial shaft by a retaining ring with four screws. Remove all four screws without permitting frequency dial to rotate with respect to shaft and hub on which it is mounted Place a short scratch mark across shaft end, dial hub, and a short way onto dial so that all three can be replaced later in the same position. This scratch mark will be found on shaft, dial hub, and dial supplied in the replacement assembly (HP Part No. 00628-6005).

f. Remove dial hub and spring washer over frequency dial shaft. Save spring washer for use in step f under paragraph 5-28, Installation.

g. Note connections to reflector potentiometer by drawing a sketch before disconnecting leads. Disconnect leads.

h. Remove and save three front panel screws that hold frequency drive mechanism onto rear of panel, Tip instrument forward onto guard rail handles at each end of the panel.

i. Remove and save V16 and V18. Note connections of the four wires from klystron cavity by drawing a sketch and disconnect at terminals adjacent to V16 tube socket.

j. Remove and save four screws holding waveguide section to klystron cavity. Support cavity as last screw is removed to prevent damage to waveguide.

k. Slide klystron cavity and frequency drive assembly to left and lift cavity upward. The entire assembly will now swing to one side to expose the connections to reflector mode switch.

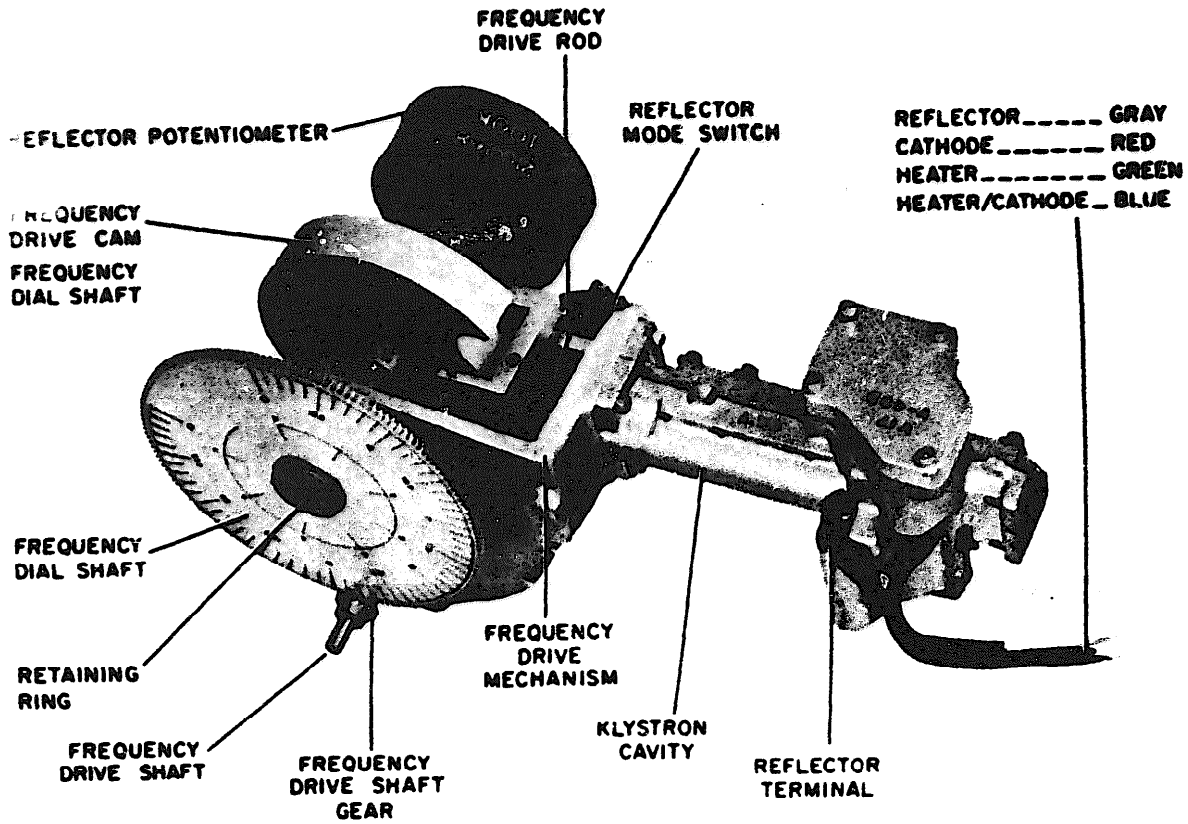


Figure 5-2. View of Klystron Cavity and Frequency Drive Mechanism

m. Note connections to reflector mode switch by drawing a sketch before disconnecting leads. Disconnect leads.

n. Lift entire assembly from instrument. Observe the CAUTION following paragraph 5-26.

5-28. INSTALLATION. Ref e r to Figure 5-2, and proceed as follows:

a. Reconnect leads to reflector mode switch. Refer to the sketch made in step m under paragraph 5-27, Removal.

b. Swing klystron cavity and frequency drive mechanism in place on instrument and replace the four screws (removed in step j under Removal) that fasten klystron cavity to waveguide section. Tighten all screws firmly.

c. Reconnect klystron leads. Refer to notes made in step i under Removal. Check connections carefully as an error may result in a burned out klystron. Replace tubes V16 and V18.

d. Hold frequency drive mechanism against back of front panel and turn instrument upright. Insert and tighten one of three screws (saved in step h under Removal) that hold frequency drive mechanism. Insert and tighten remaining two screws.

e. Reconnect leads to reflectorpotentiometer. Refer to the sketch made in step g under Removal.

f. Replace spring washer (saved in step f under Removal) over end of frequency dial shaft.

g. Install frequency dial hub supplied with new assembly. Align scratch marks on end of shaft and dial hub, push hub back until end of shaft and surface of hub are approximately flush. Tighten setscrews in hub. The shaft must not protrude beyond the front surface of hub.

h. Turn frequency drive shaft gear full counterclockwise. Replace frequency dial and align the mark on gear with the marked tooth on dial. Align scratch mark across dial hub and dial before replacing retaining ring and tightening the four screws.

i. Replace frequency dial cover.

j. Replace frequency control knob on frequency drive shaft.

k. Rotate frequency drive shaft full counterclockwise and hold against stop. Check that the dot on frequency dial is under the hair line.

5-29. ADJUSTMENTS. After replacing the klystron cavity the following adjustments are necessary. Refer to Figure 5-2 and proceed as follows:

a. Connect an ac voltmeter such as an HP Model 400D/H between the heater-cathode terminal and heater terminal.

WARNING

Use an insulated voltmeter. This is necessary due to high voltages applied to the klystron tube. If the voltmeter has a ground lead be sure it is isolated by using a three-prong to two-prong adapter and leave the pigtail floating, Extreme care must be taken to insulate the metal instrument case as it will be at the same potential as the ground clip lead.

b. Connect power cord to proper source and turn Model 628A on.

c. The heater voltage should be 6.3 Vac. If heater voltage is not 6.3 Vac refer to paragraph 5-84.

d. Set Model 628A MOD SELECTOR' switch to INT FM.

e. Connect an HP Model 410B VTVM positive lead to the reflector terminal and negative or common lead to the cathode terminal. Voltmeter SE L E C T OR switch should be set to -.

f. Set potentiometers R89 and R95:(Figure 5-9) to approximate center of range ove[illegible]ange over which the[illegible] rotated. These two controls are[illegible]rols are located on [illegible] lated bracket mounted on the botto[illegible]he bottom edge of m[illegible] assembly.

g. Set frequency dial to 15 GHz and adjust control R92 for a voltmeter reading of * volts. Slowly increase frequency setting u n t i the point is reached where reflector mode switch just operates as can be determined by an audible click. At t[illegible]K. At this poin[illegible] R87 for a voltmeter reading of * [illegible] of * volts. [illegible] R92 or R87 have insufficient range-[illegible]nge, adjust cont[illegible] beyond point where desired reading is o[illegible]ding is obta[illegible] then readjust the particular control that ori[illegible]that origina[illegible] insufficient range.

h. Decrease frequency dial setting slightly as required to cause reflector mode switch to operate. At this point, adjust control R88 for a voltmeter reading of * volts. Set frequency dial to 21 GHz and adjust control R93 for a voltmeter reading of 'volts. If either R88 or R93 have insufficient range, adjust control R99 beyond point where the desired reading is obtained and then readjust the particular control that originally had insufficient range.

i. Repeat steps g and h several times asnecessary. These controls all interact but if steps g and h are repeated enough times a point will be reached where additional adjustment will not be necessary.

j. If reflector voltages are carefully set, no additional adjustments will normally be required. To check instrument performance refer to paragraph 5-61.

*These voltages vary from one kly[illegible]one klystro[illegible]other. Correct voltages will be specified [illegible]ecified in th[illegible]ctions sent with each replacement unit.

5-30. To better understand the relationship of parts in the klystron cavity and drive mechanism, refer to Figures 5-3 and 5-4.

5-31. REFLECTOR POTENTIOMETER REPLACEMENT.

5-32. To replace reflector potentiometer R96, refer to Figure 5-5 and proceed as follows:

a. Remove power to instrument.

b. Draw a sketch of reflector potentiometer, R96, noting color and location of leads.

c. Remove leads from potentiometer.

d. Remove retaining ring and back of potentiometer. Remove screw holding potentiometer to supporting bracket.

e. Loosen setscrews on mode-switch cam located between cam and potentiometer. DO NOT LOOSEN setscrews between mode-switch cam and frequency drive casting (see Figure 5-5).

f. Remove reflector potentiometer.

g. Remove back from replacement potentiometer and connect it to supporting bracket with the screw removed in step d.

h, Do not tighten mode-switch cam setscrews at this time.

i. Refer to sketch made in step b and reconnect leads to potentiometer.

j. Connect an ohmmeter set on the X1000 range between the center tap and wiper arm of potentiometer.

k. Position frequency dial to point of mode-switch actuation. Move frequency dial back and forththrough the mode-switch lag distance to determine mid-point. Place frequency dial at this midpoint.

m. Hold frequency dial in place and adjust position of wiper arm inside potentiometer until ohmmeter reads minimum resistance.

n. Tighten mode-switch cam setscrews and replace back of potentiometer.

p. If necessary, perform reflector tracking adjustment as described in paragraph 5-46, step i.

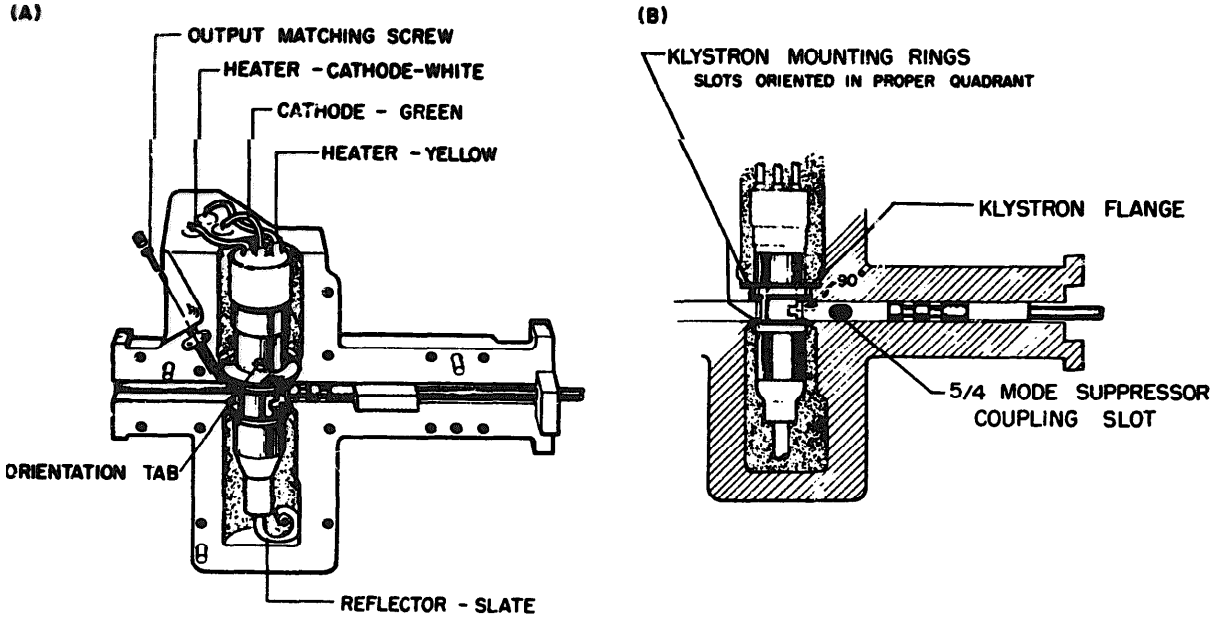


Figure 5-3. Cutaway Views of Klystron

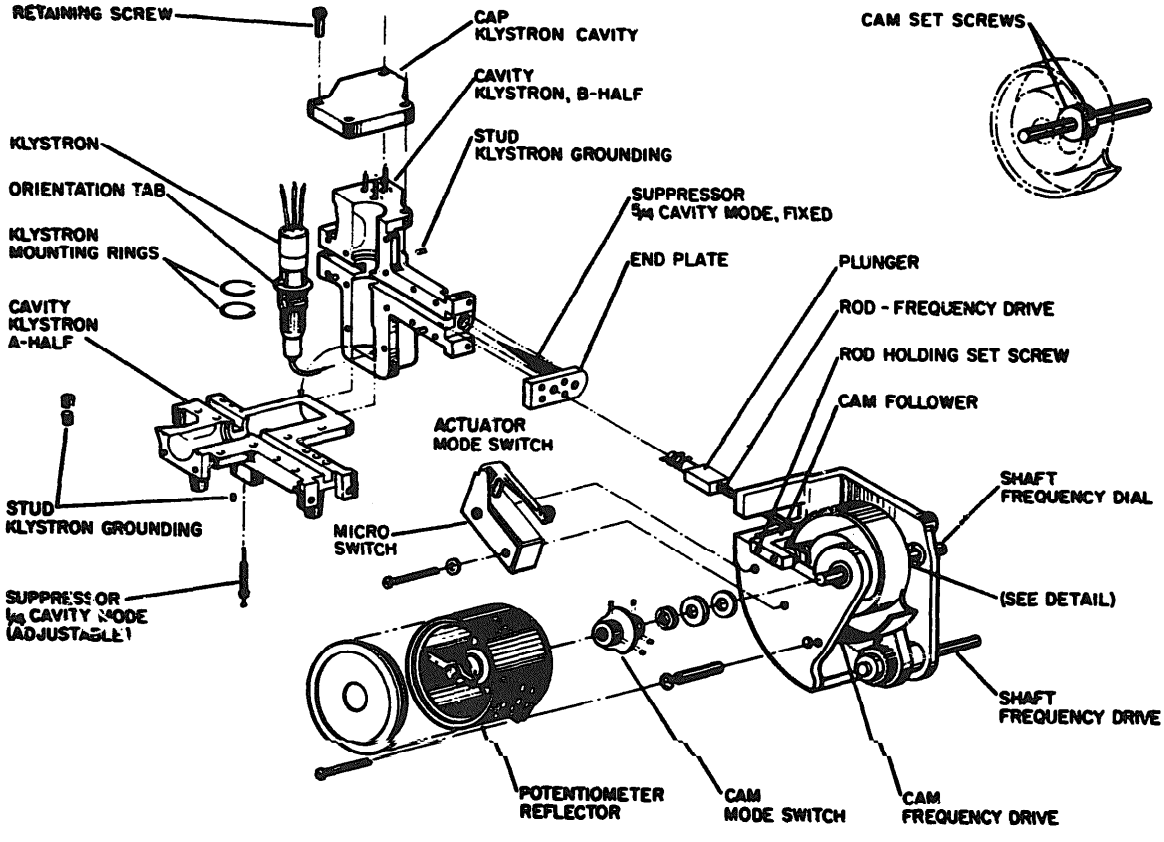


Figure 5-4. Exploded View of Klystron Cavity and Plunger Drive Mechanism

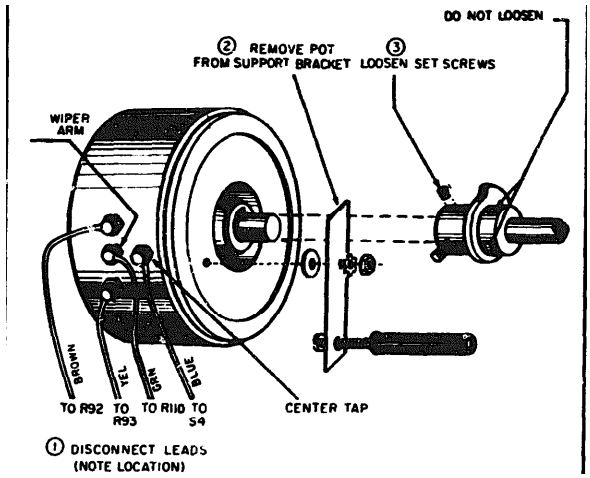


Figure 5-5. Detail Showing Reflector Potentiometer Removal

5-33. **REPLACING RT1.**

5-34. **After replacing RT1 the klystron heater voltage should be checked and adjusted if necessary. Refer to Figures 5-1 and 5-2 and proceed as follows:**

a. Connect voltmeter such as an **HP Model 400D/H** between the heater-cathode terminal **and heater terminal.**

b. Voltmeter reading should be 6.3 Vac.

c. If voltmeter reads high, decrease shunt resistane (R131). Increase this resistance if reading is low. Continue to change this resistance until the heater voltage reads 6.3 Vac.

d, Wait 10 minutes and repeat steps a and b. If voltmeter reading is not 6.3 Vac, repeat step c.

5-36. ZERO SET CONTROL ADJUSTMENT.

5-37. When front panel ZERO SET control will not zero-set the power-monitor meter, the range of this control needs to be extended. To extend its range, refer to Figure 5-6 and proceed as follows:

a. Set MOD SELECTOR to OFF and position ZERO SET control to its mechanical center.

b. Adjust R98 until power-monitor meter indicates **Zero** Set.

5-38. SCHMITT TRIGGER LEVEL ADJUSTMENT.

5-39. To adjust Schmitt trigger level, refer to Figures 5-1 and 5-9 and proceed as follows:

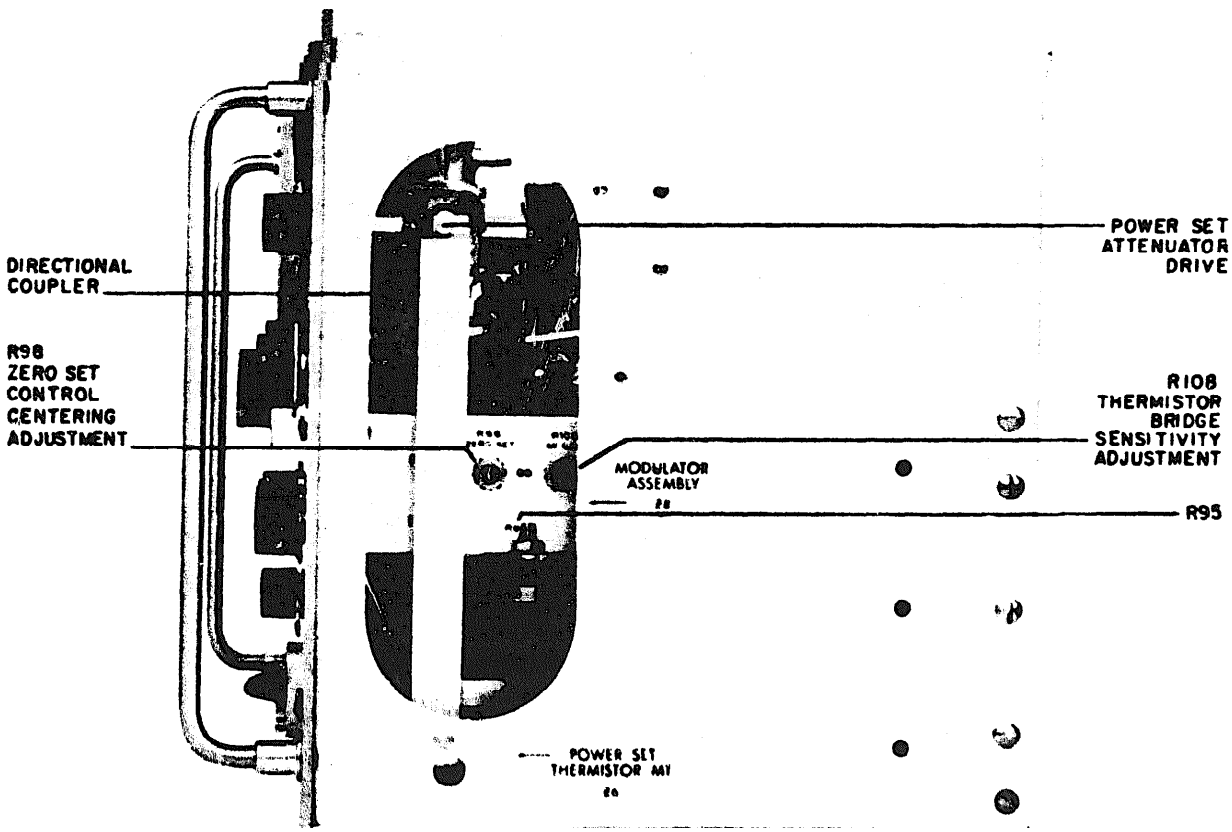


Figure 5-6. Right Side View Showing Power Monitoring Bridge Adjustments

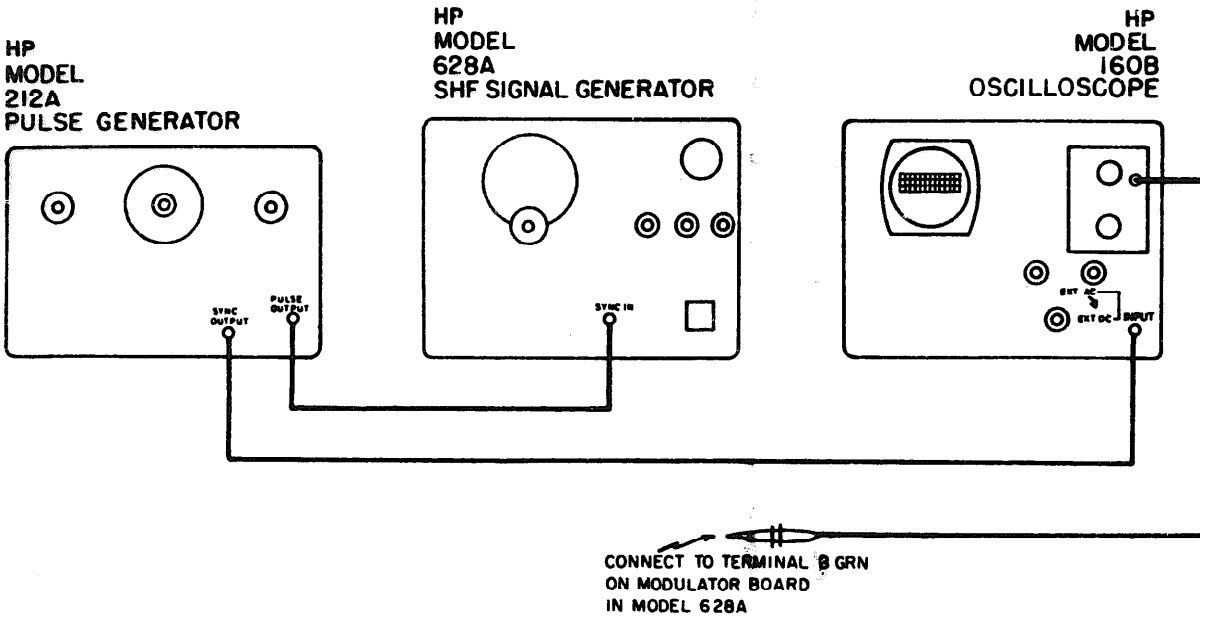


Figure 5-7. Test Setup for Schmitt Trigger Level Adjustment

a. Connect test setup as shown in Figure 5-7. Oscilloscope **Vertical input** is to be connected to **terminal** B GRN on modulator board.

b. Adjust calibrated pulse generator output for 4000 pps. Pulses should be 5 u sec duration and 5 voltspeak. For maximum accuracy, calibrate pulse generator with oscilloscope.

c. Set Model 628A MOD SELECTOR to OFF and SYNC SELECTOR to polarity of external sync pulses **Used.**

d. Adjust oscilloscope so that It is calibrated to 1 u sec/cm.

e. Adjust R44 until pulse duration is 5 u sec.

5-40. ADJUSTMENTS FOLLOWING KLYSTRON

5-41. Following replacement of a new klystron (tube only) certain adjustments must be made before the ipstrument will operate in a satisfactory manner. The general steps in the overall procedure are as follows:

a. Establish initial reflector tracking voltages.

b. Partial reset of frequency dial.

c. Suppress undesired modes of oscillation, fine-adjust frequency dial and fine-adjust reflector tracking.

d. Output power response adjustment.

5-42. INITIAL REFLECTOR-VOLTAGE ADJUSTMENTS.

a. Check all power supply voltages as indicated in Table 5-2.

b. Reflector voltages can now be set, as described in paragraph 5-43, to values given on the data sheet supplied with the replacement klystron. Voltages are most easily measured at klystron terminal strip located on the modulator deck. There are four terminals marked K, II, II, R Cathode-to-reflector voltage is measured between terminals *K* and R. The frequency at which each reflector tracking potentiometer is adjusted is shown in Figure 5-8.

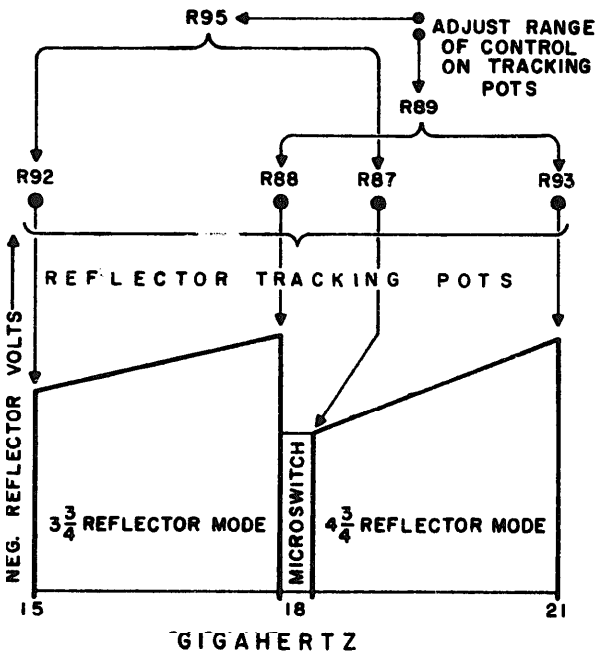


Figure 5-8. Graph Showing Reflector Tracking Voltage vs Frequency

Note

A data sheet supplied with the replacement klystron tabulates reflector (reflector-to-cathode) voltage vs frequency. The klystron manufacturer tests the tube under slightly different operating conditions from those in the instrument, but voltages are close enough to be useful when making tracking adjustments. It should be mentioned that while voltages given at 15 GHz and 21 GHz are directly applicable, the klystron manufacturer switches from 3-3/4 reflector mode to 4-3/4 reflector mode at a frequency (generally 18.5 GHz) which varies slightly from that at which the instrument switches (generally 18 GRz). Voltages specified in the data sheet should be used, however, and (R87 or R88) adjusted above and below the instrument mode switching point. (This is proper practice since adjustment pots are designed to adjust voltages at the high and low frequency sides of specific modes rather than at specific frequencies.) The setting obtainedthis way will be close enough for initial tracking.

5-43. INITIAL TRACKING PROCEDURE. Refer to **Figure** 5-9 and proceed as follows:

WARNING

When measuring reflector-to-cathode voltage the reflector should be negative with respect to the cathode by the voltage shown in the data sheet. Use extreme care when measuring this voltage since it is 1300 volts negative with respect to instrument chassis.

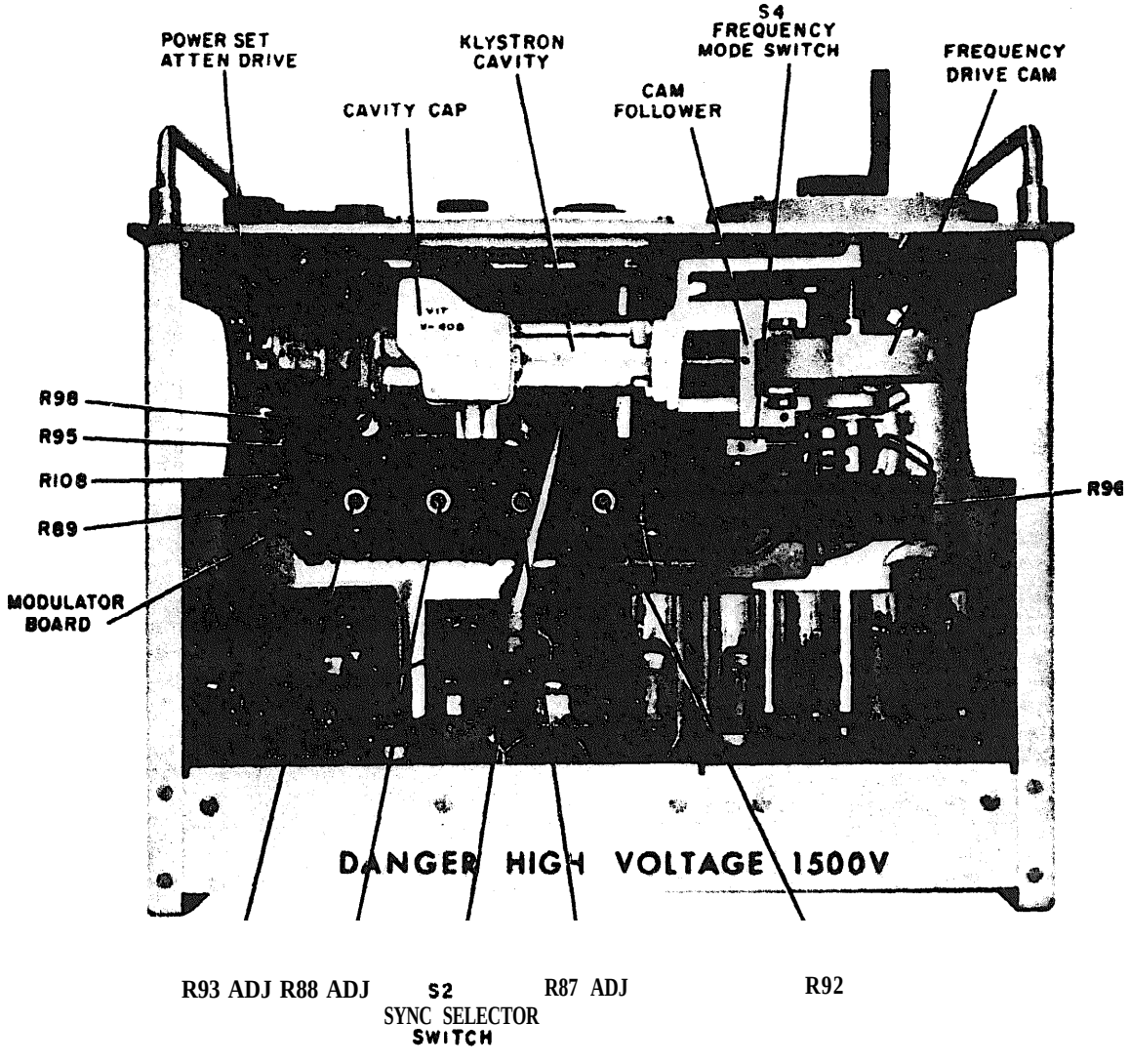


Figure 5-9. Top View Showing LOCation of Reflector Tracking Pots

a. Set R95 and R89 to mechanical center of rotation,

b. Connect voltmeter common to klystron terminal **K, and** connect positive lead to klystron terminal R **Set frequency** dial to 15 GHz and adjust R92 (and R95 if necessary) to read tabulated voltage for 15 GHz point.

c. Set frequency dial to point near 18 GHz just before **microswitch actuates.** Adjust R88 (and R89 if **necessary) to read tabulated** voltage for 3-3/4 reflector mode high frequency point.

d. Set frequency dial to point near 18 GHz just after microswitch actuates. Adjust R87 to read tabulated voltage for low frequency point of 4-3/4 reflector mode.

e. Set frequency dial to 21 GHz and adjust R93 to read tabulated voltage for 21 GHz point.

f. When voltages are correct, remove power from instrument and connect klystron heater and cathode leads as shown in Figure 5-3a.

5-44. INITIAL FREQUENCY SETTING.

a. Turn Model 628A on and check klystron heater voltage (paragraph 5-34).

b. Set Model 628A controls as follows:

MOD SELECTOR. . . . . INT FM
OUTPUT ATTEN. . . . . .+10 DBM
FM AMPLITUDE . . . . . full clockwise
Frequency dial. . . . . 21 GHz

c. Connect test setup as shown in Figure 5-10 and check for output.

Note

The test setup shown in Figure 5-10 with control settings on the signal generator described in step b permits the Model 628A to internally FM the klystron with a 60-Hz sine wave of sufficient amplitude to drive the klystron in and out of oscillation. When an oscilloscope is connected, its horizontal sweep circuit is driven by 60 Hz synchronized with the 60-Hz sine wave frequency modulating the reflector. Vertical trace is driven by detected output from klystron. As klystronpasses in and out of oscillation, a humped waveform will appear on the oscilloscope. The hump is an indication of klystron output amplitude vs reflector voltage and may be construed as the reflector mode for frequency of oscillation.

d. Adjust oscilloscope to center horizontal trace for equal deflection on each side of vertical scale center.

e. Adjust FM PHASE for optimum presentation of mode pattern at 21 GHz. It may be necessary to bring **crest of the mode pattern closer to the oscilloscope vertical center line with R93 in order to produce satisfactory output, but such a tracking adjustment is not critical at this stage of alignment as long as significant output is available at extremes of the band. If voltages have been set according to klystron manufacturer's data** sheet, adequate output should be available, barring such considerations as a weak klystron or improper seating in cavity.

WARNING

When loosening setscrews holdingplunger rod to cam follower, extreme care should be used **as** microswitch (located near cam follower) has high negative voltages on it.

f. Set frequency dial to 21 GHz and set wavemeter to 21 GHz. Loosen setscrews holding plunger rod to cam follower (refer to Figure 5-4) and pull plunger rod out of cavity until it touches frequency drive cam.

g. With a thin-pointed tool, pushplunger rod slightly into the cavity until wavemeter notch appears on mode pattern, Tighten one setscrew lightly which holds plunger rod to cam follower.

Note

The purpose of adjustments in step g (adjusting plunger rod) and in step **i** (adjusting cam) is to adjust the length of plunger travel against length of dial travel from the low end of the band to high end of the band. These adjustments interact, but by repeated adjustments of the cam at 15 GHz and plunger rod at 21 GHz , the ends of the dial may be brought into calibration. DO NOT loosen frequency dial hubscrews or otherwise attempt to calibrate the dial by slipping it at the hub.

h. Set frequency d i a 1 to 15 GHz (changing wavemeter and detector mount) and set wavemeter to 15 GHz. If savemeter notch is present on mode pattern, proceed w it h paragraph 5-45. If notch is not present, proceed with step i.

i. Loosen setscrews on frequency drive cam. Hold frequency dial in position and adjust the cam (thus moving cam follower, plunger rod, and plunger) until wavemeter notch appears on mode pattern. Tighten setscrews on frequency drive cam.

j. Repeat steps f through i to obtain approximate dial calibrationat end of band. Final calibration is made between mode suppression and fine trackingadjustments.

5-45. MODE SUPPRESSION AND REFLECTOR TRACKING. Mode suppression in Model 628A consists of reducing effects of the 1/4 wave cavity mode and, in case of vigorous tubes, the 5/4 wave cavity mode. These unwanted modes create problems only around the 18 GHz mode switch point and it is here that suppression is conducted.

5-46. Unwanted modes are suppressed before fine reflector tracking adjustments are made, and in rare cases the fine tracking adjustments may interact with the 1/4 wave **cavity** mode suppression. When this happens the 1/4 wave mode suppressor can be adjusted slightly to restore adequate **suppression.** Trouble with the 5/4 **wave cavity** mode is remote; however, when it occurs, it appears as a narrow, low amplitude mode pattern near the desired male at approximately 18 GHz on the high frequency side of the mode switch (i.e. , on the 4-3/4 reflector mode side of the

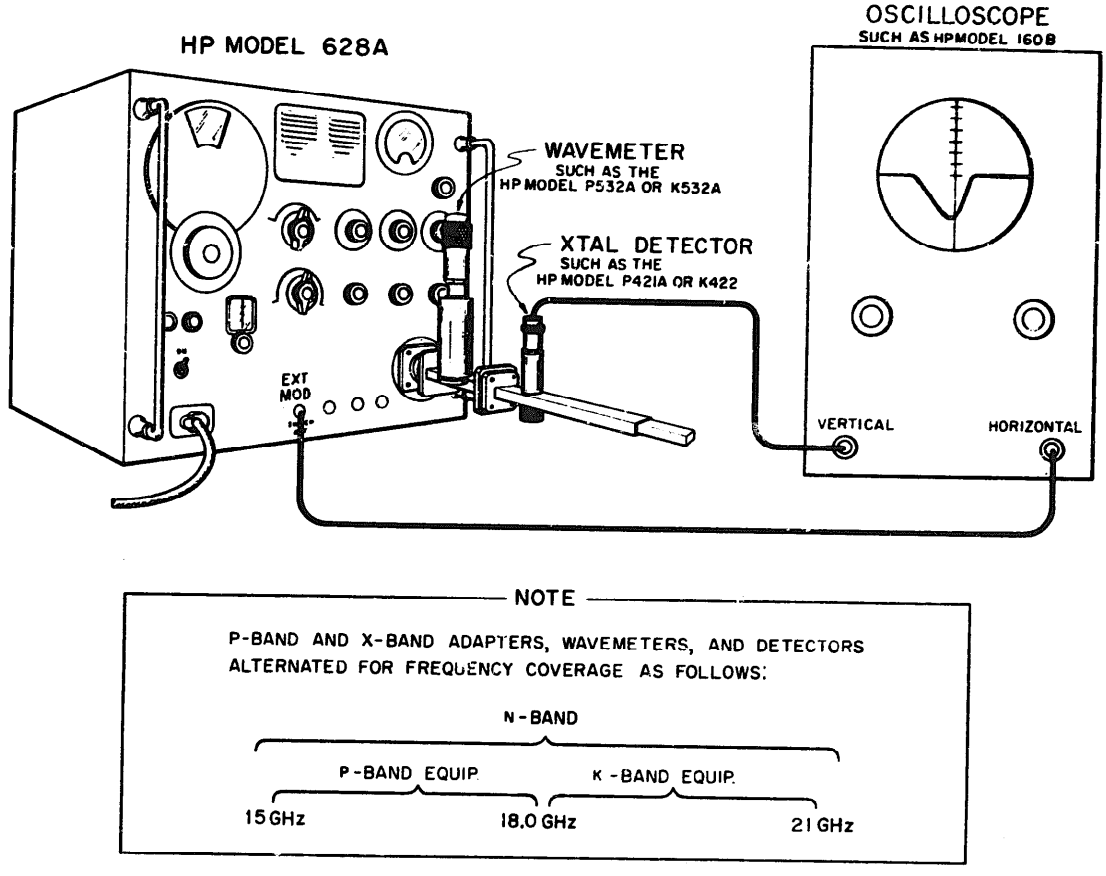


Figure 5-10. Test Setup for Observing Reflector Modes

microswitch). Two techniques are available for either suppressing or neutralizing the 5/4 mode, and they are discussed in paragraph 5-47. The procedure for 1/4 cavity mode suppression is as follows:

a. Connect test setup as shown in Figure 5-10.

Note

Desired and undesired modes are most easily identified by using the wavemeter e. The mode plot, Figure 4-13, will be of assistance also. The wavemeter frequency of the 1/4 wave cavity mode will be below 15 GHz, while that of the desired mode will correspond closely to the frequency dial (approximately 18 GHz). The frequency of the 5/4 wave cavity mode will probably be above 21 GHz.

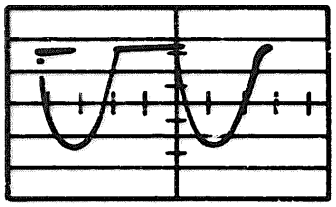
b. Tune generator from 15 GHz to the point near *18 GHz just before* microswitch actuates. Examine the oscilloscope trace for evidence *of* 1/4 **wave** mode interference. Under the worst conditions two similar modes may be present. The modes should be identifled with the wavemeter, and then the 1/4 wave mode suppress& with the adjustable suppressor shown in Figure **5-4.**

Note

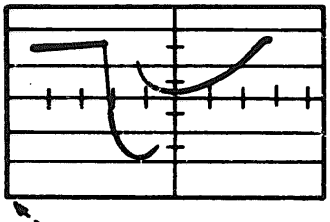
The suppression adjustment is critical. And as little as 1/4 turn on the adjustment may be all t hat is required to completely suppress the unwanted mode at this point.

c. Tune the frequency dial slightly toward the high frequency end of the band to the point near 18 GHz just after the microswitch actuate. . 1/4 wave mode interference is likely to be worse at this point. In some cases the 1/4 wave mode cantotally mask the desired mode, but in the majority of cases it will appear as shown in Figure 5-11 (particularly if the suppressor was not moved during klystron change). Careful adjustment of the adjustable suppressor, Figure 5-4, (after the desired mode has been identified) will normally reduce the 1/4 wave mode. In some cases the 1/4 wave cavity mode can be completely suppressed at this point.

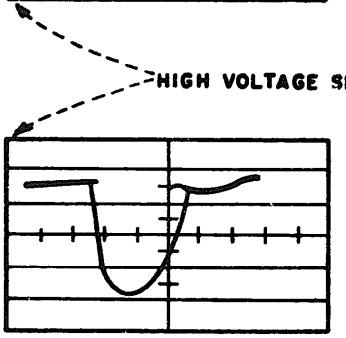
d. As the frequency dial is tuned to 21 GHz, the 1/4 wave cavity mode may reappear, but it should be separated from the desired mode to a degree which makes further suppression unnecessary.



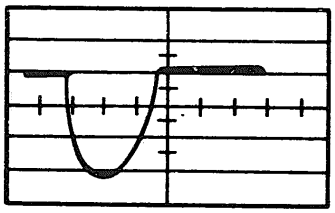
(a) Mode pattern at low frequency side of mode switch (just below 18 GHz). At right, desired mode. At left, 1/4 wave cavity mode unsuppressed (on high voltage side of desired mode).



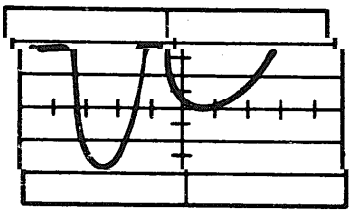
(b) Mode pattern at high frequency side of mode switch (just above 18 GHz.) Undesired mode (1/4 wave cavity) at right (on low voltage side of desired mode) inadequately suppressed.



(cl Same as step b except that 1/4 wave cavity mode is adequately suppressed.



(d) Same as step b except that 1/4 cavity mode completely suppressed, but mode not properly centered.



(e) 4-3/4 reflector mode with same suppressor s et t in g as in steps c and d, except frequency dial moved to 19 GHz (well above crossover point). Note 1/4 wave cavity mode (at right) reappears. Separation, however, p r e v e n t s interference despite high 1/4 wave mode amplitude.

Figure 5-11. Typical 1/4 Wave Mode Interference Patterns

e. Recheck for presence of the 1/4 wave cavity mode **above and just below the** microswitch point. *A* comp**romise should be sought.**

f. Perform paragraph 5-44, steps e through i, except dial should be set to within 150 MHz of 15 GHz and within 210 MHz of 21 GHz. Check points between 15 and 21 GHz. If these points are out of specifications (1%) a compromise of the extremes will correct the dial.

g. After final dial calibrationtighten all setscrews.

h. Onceundesired modes have been suppressed and final dial calibration performed, the reflector tracking must be fine adjusted. Center the oscilloscope horizontal trace.

i. Set frequency dial to 15 GHz and adjust R92 so that the vertical centerline of oscilloscope graticule divides the mode pattern about 1/3 of the way from the high frequency side into the mode. Verify high frequency side, if necessary, with wavemeter.

Note

When MOD SELECTOR is placed in OFF position, voltage applied to reflector should bias the klystron off. If mode pattern is centered on oscilloscope the reflector voltage may not be adequate to bias the klystron off. Pulse and square-wave operation may be deteriorated by failure of klystron to cut off during "off" portion of modulation. If mode pattern is positioned so that the high frequency side is too close to oscilloscope vertical centerline, a weak output is obtained.

j. Set frequency dial to point just before microswitch actuation and adjust mode pattern with R88 as described in step i.

k. Set frequency dial to point just past microswitch actuation and adjust mode pattern with R87 as described in step i.

m. Set frequency dial to 21 GHz and adjust mode pattern with R93 as described in step i.

n. Since adjustments are somewhat interacting, tune through frequency range of Model 628A, observing tracking behavior. Read just pots as necessary to produce satisfactory tracking.

5-47. 5/4 WAVE CAVITY MODE SUPPRESSION.

5-48. As described in paragraph, 5-46, the 5/4 cavity mode will only occur just after the switch points (when approaching from 15 GHz) near the 18 GHz on the 4-3/4 reflector mode. It is shown in Figure 4-13 as a small "island" near 18 GHz on the suppressed mode plot. When revealed, after suppression of the 1/4 wave cavity mode at this point, it will he a narrow, low amplitude mode. Two methods are available for removing its effects. The first method is preferred in all cases while the second, extending the coupling slot to the fixed suppressor) should only be performed after consulting the Hewlett-Packard Company.

5-49. **The first method consists of adjusting the mode switching point slightly higher in frequency. In Figure 4-13 this would be the same as moving the dotted switching line to the right on the suppressed plot, away from the 5/4 wave mode island. Proceed as follows:**

a. With Model 628A turned off, place it in the normal position, facing you.

b. Tune frequency dial to stop near 15 GHx.

c. Refer to Figure 5-4. Locate cam mode switch. Note that cam is secured on each side by setscrew pairs. Note compression washers (unmarked in figure) between mode switch cam and frequency drive cam housing.

d. Loosen pair of setscrews between mode switch cam and frequency drive cam only. DO NOT loosen setscrew pair between mode switch cam and reflector potentiometer.

e. Press reflector pot toward front panel to preserve compression in washers.

f. Making sure that frequency drive mechanism is against the low frequency stop, rotate mode switch cam about 5O clockwise as seen from front panel. (This direction corresponds to the direction of force holding the frequency drive mechanism against stop.)

g. Pressing reflector pot toward front panel, tighten setscrews on mode switch cam.

h. Remove back cover of reflector tracking potentiometer.

i. Tune frequency dial to 21 GHz stop. The wiper arm inside the reflector potentiometer should still be on the windings near the lower shorting plate. If this is the case proceed with step j. Wipers, however, should not be touching the shorting plate.

Note

As long as wiper is on windings, upper-frequency limiting reflector tracking is preserved. If wiper is on shorting plate, cam adjustment limits either have been exceeded or were never available. The following remaining procedure assumes the former, and attempts to realize the maximum available adjustment of the cam.

j. If wiper is on shorting plate, leave frequency dial at 21 GHz stop. Loosen same mode switch cam setscrew as in step d and rotate mode switch **cam** following general procedure above, except that **cam** is rotated counterclockwise so that wiper just leaves shorting plate. Tighten setscrew on mode switch cam.

k. Turn Model 628A ON and check to see whether or not 5/4 wave mode behavior at switching point (on oscilloscope) has improved.

Note

Reflector tracking adjustments may require **slight** refinement after the above cam adjustment.

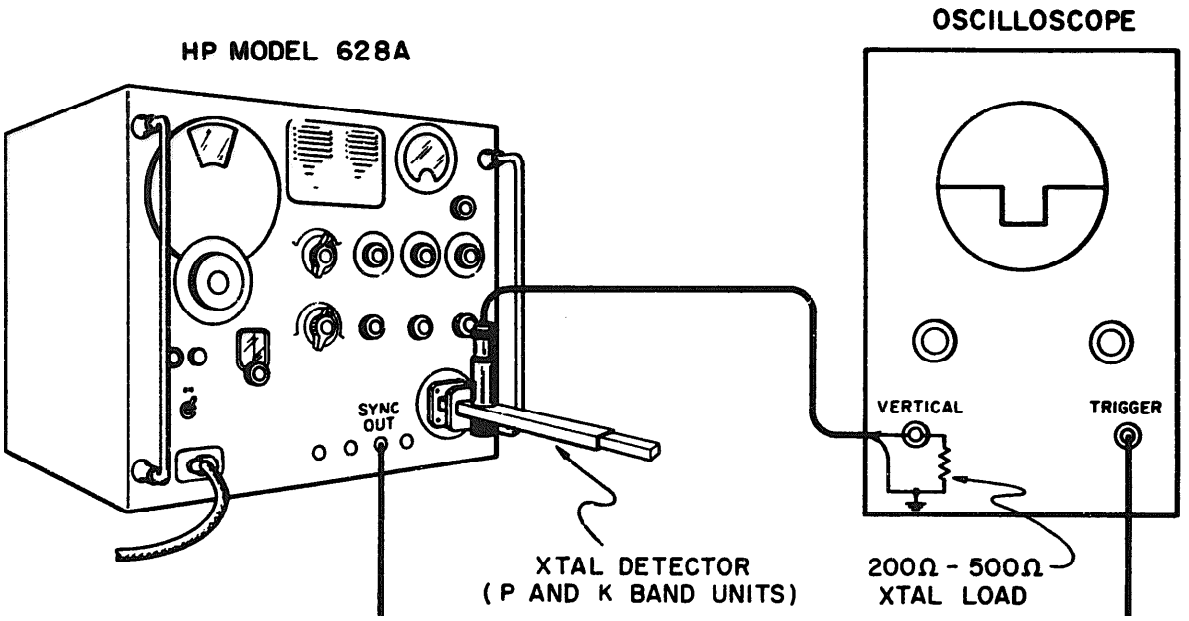


Figure 5-12. Calibration Test Setup

m. In most cases the above cam adjustment is sufficient to avoid trouble with the 5/4 cavity mode. If its presence cannot be avoided by the mode switch delay however, you are urged to consult the Hewlett-Packard Company.

5-50. TRACKING CHECK, PULSE AND SQUARE WAVE.

a. Connect test setup as shown in Figure 5-12.

b. Set Model 628A controls as follows:

SYNC SELECTOR	X10
MOD SELECTOR	INT
PULSE RATE	100
PULSE DELAY	.3 usec
PULSE WIDTH	1 usec

c. Adjust oscilloscope for a 1 usec/ cm sweep.

d. Tune frequency dial on signal generator slowly from 15 to 21 GHz while observing pulse shape and pulse base line appearance on oscilloscope. Various pulse waveforms are shown in Figure 5-13. If pulses have sharp overshoot, the reflector tracking potentiometer for that frequency has been adjusted beyondthe crest of the mode pattern. A ragged base line indicates that oscillation is taking place when klystron should be cut off. If either of these troubles are present, readjust tracking potentiometer applicable to reflector mode and frequency under examination.

e. Set MOD SELECTOR to OFF and PWR SET to full clockwise position. Tune across the band while observing power-monitor meter for any indication of RF power. Where power is present the reflector tracking voltage for the particular frequency is not properly adjusted and do e s not bias klystron out of oscillation mode. Adjust appropriate tracking potentiometer to eliminate indication.

5-51. OUTPUT POWER RESPONSE ADJUSTMENT. After satisfactory tracking has been obtained and undesired modes suppressed, the output matching screw must be adjusted as shown in Figure 5-3a.

a. Connect test setup as shown in Figure 5-14.

b. Set signal generator frequency dial to 15 GHz and PWR SET for maximum output power asindicated on Model 432A. Record reading obtained.

c. Set signal generator frequency dial to 21 GHz and record reading obtained.

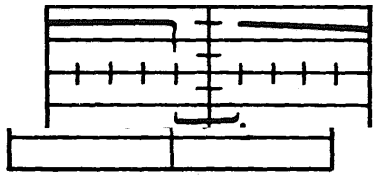
d. Adjust output matching screw for a reading approximately midway between readings obtained in steps b and c. This adjustment is interacting so repeat it at 15 and 21 GHz until maximum output power is approximately equal at both ends of frequency band,

e. Check across frequency band to see that power-monitor meter can be POWER SET.

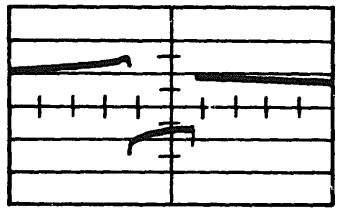
5-52. CALIBRATION

5-53. CALIBRATING PULSE RATE DIAL,

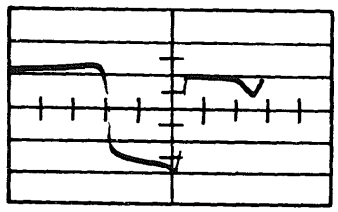
5-54. Replacing V9 may change calibration of the pulse rate dial but will not otherwise affect the signal generatorperformance. If the replacement tube triode



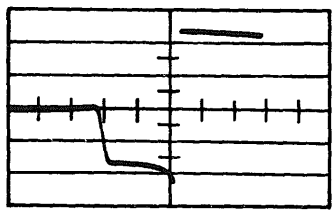
(a) Correct tracking adjustment. Ideal RF pulse. Note absence of square-wave overshoot, good rise and decay, flat crest and base line.



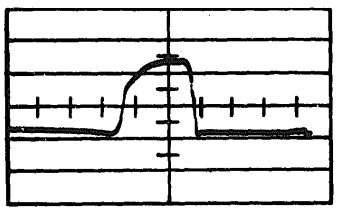
(b) Tracking voltage adjusted incorrectly, so that reflector voltage pulses beyond mode crest. Pulse crest should be from -1 -100% of initial rise amplitude. Square-wave overshoot should be no more than 10% of initial rise.



(c) Tracking voltage nearly correct, but small pulse to right indicates oscillation taking place during pulse "off' time,



(d) Low base line at left indicates that tracking adjustment prevents klystron from biasing "off'* during pulse off-time.



(e) Reflector tracking voltage incorrect. Instrument pulsing "oft" when actually "on" and vice versa.

Figure 5-13. Typical Pulse and Square-Wave Oscillograms

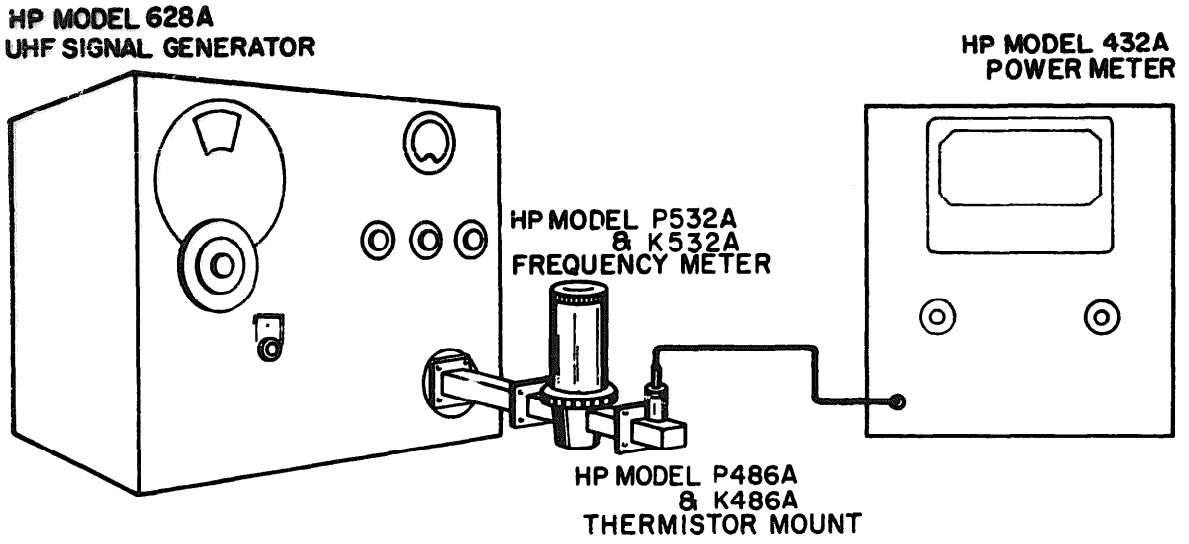


Figure 5-14. Test Setup for Adjusting Output Power

sections are too far out of balance, try another tube. Recalibration procedure is as follows:

a. Connect test setup as shown in Figure 5-12. DELAYED SYNC GUT signal may be used instead of the RF pulse.

b. In series with the output of a calibrated audio oscillator, connect a 10K resistor and then connect the oscillator to the vertical input of oscilloscope.

c. Zero-set and power-set the power monitor meter. Refer to Figure 3-2.

d. Set Model 628A controls as follows:

MOD SELECTOR . . . . . INT
SYNC SELECTOR X10
PULSE RATE. 100

e. Set audio oscillator frequency to 1000 Hz.

f. Adjust PULSE RATE until sync pulses zero-beat with signal from audio oscillator.

g. Without changing PULSE RATE control position, slip dial so that 100 is located under index on front panel.

h. Check PULSE RATE dial calibration at 40 and 400. If dial is in error, slip dial to average error across range.

5-55. CALIBRATING PULSE DELAY DIAL.

a. Connect test setup as shown in Figure 5-12.

b. Zero-set and power-set the power-monitor meter. Refer to Figure 3-2.

Model 628A conde1 628A controls as follows:

'TOR . . .CTOR . . . . . INT
CTOR . . . .CTOR.. . . . . X1 or X10
PULSE DELAY. . . . . minimum

d. Adjust R78 (Figure 5-1) so that delay between SYNC OUT (start of horizontal trace) and 1 e ad in g edge of RF pulse is <3 microseconds on calibrated oscilloscope.

e. Set PULSE DELAY so that 50 microseconds delay exists between SYNC OUT and leading edge of RF pulse.

f. Without changing PULSE RATE control position, slip dial so that 50 is located under index on front panel.

g. Check PULSE DELAY dial calibration at 5 and 200. If necessary repeat steps c through f.

5-56. CALIBRATING PULSE WIDTH DIAL.

a. Connect test setup as shown in Figure 5-12 except that DELAYED SYNC OUT signal is to be used for triggering oscilloscope.

b. Zero-set and power-set the power-monitor meter. Refer to Figure 3-2.

c. Set Model 628A MOD SELECTOR to INT and PULSE WIDTH to minimum.

d. Adjust R85 (Figure 5-1) for a pulse width of just less than 0.5 microseconds as observed on a calibrated oscilloscope.

e. Locate within frequency band of generator the point of maximum pulse width.

f. At frequency of maximum pulse width, readjust R85 for a pulse width of just less than 0.5 microseconds.

g. Set PULSE WIDTH for a 10-microsecond pulse as observed on calibrated oscilloscope.

h. Without changing PULSE WIDTH control position, slip dial so that 10 is located under index on front panel.

5-57. POWER-MONITOR METER CALIBRATION.

5-58. Replacement of power-set monitoring thermistor (RT123) requires considerable skill and equipment. If facilities are not available consult your Hewlett-Packard field sales engineer or write Customer Service Department at the factory concerning repair.

5-59. If facilities are available, and the replacement is to be made in the field, the entire thermistor mount may be procured as a unit under HP Part No, 628A-28. Recalibration procedure for the power-monitor meter is as follows:

a. Connecttest setup as shown in Figure 5-14.

b. Set Model 628A MODSELECTOR to CW and frequency dial to center of band (18 GHz).

c. Set OUTPUT ATTEN to -2 DBM and adjust PWR SET for a -2 dBm reading on Model 432A.

d. Adjust R108 (Figure 5-6) so that power-monitor meter indicates 0 DBM (red line at center of scale).

Note

To increase accuracy of power output calibration at a particular frequency follow the above procedure at that frequency.

5-60. PERFORMANCE

5-61. Performance checks are included to verify proper operation of the Model 628A. They may be used by incoming quality control for the electrical inspection.

5-62. *FREQUENCY* CALIBRATION CHECK.

a. Connect test setup as shown in Figure 5-14 using P-band equipment.

b. Set signal generator frequency dial to 15 GHz.

c. Zero-set and power-set the power-monitor meter. Refer to Figure 3-2.

d. Set MOD SELECTOR to CW and OUTPUT ATTEN to 0 DBM.

e. Adjust power meter to read 0 dBm (1 mW).

f. Adjust frequency meter to locate a dip in power around the frequency&put of signal generator. Frequency meter should read 15 GHz + 150 MHz.

g. Set signal generator frequency dial to 18 GHz, and repeat steps c through f. Frequency meter should read 18 GHz + 180 MHz.

h. Remove P-band equipment from test setup, and replace with K-band equipment using the Model NK292A Adapter. Adapter is to be connected between frequency meter and RF OUTPUT of signal generator.

i. Set signal generator frequency dial to 21 GHz, and repeat steps c through f. Frequency meter should read 21 GHz + 210 MHz.

5-63. OUTPUT POWER CHECK.

a, Connect test setup as shown in Figure 5-14 using K-band equipment and the Model NK292A Adapter.

b. Using a calibrated frequency meter, set signal generator output for 21 GHz.

c. Zero-set andpower-set the power-monitor meter. Refer to Figure 3-2.

d. Set MOD SELECTOR to OFF and OUTPUT ATTEN to -1 DBM.

e. Zero-set a power meter such as a Model 432A as per its instruction manual, and set RANGE switch to 0 DBM.

f. Set signal generator MOD SELECTOR to CW.

g. With Model 432A properly zero-set, the meter should read -1 dBm + 1 dB.

h. Repeat steps b through g except set signal generator output for 18 GHz.

i. Remove K-band equipment and adapter from test setup and replace with P-band equipment.

5. Repeat steps b through g except signal generator output for 15 GHz.

NOTES; ALL VOLTAGES MEASURED FROM INDICATED POINT TO CHASSIS UNLESS OTHERWISE NOTED.
O VOLTAGES MEASURED FROM NDICATED POINT TO -300V BUS.

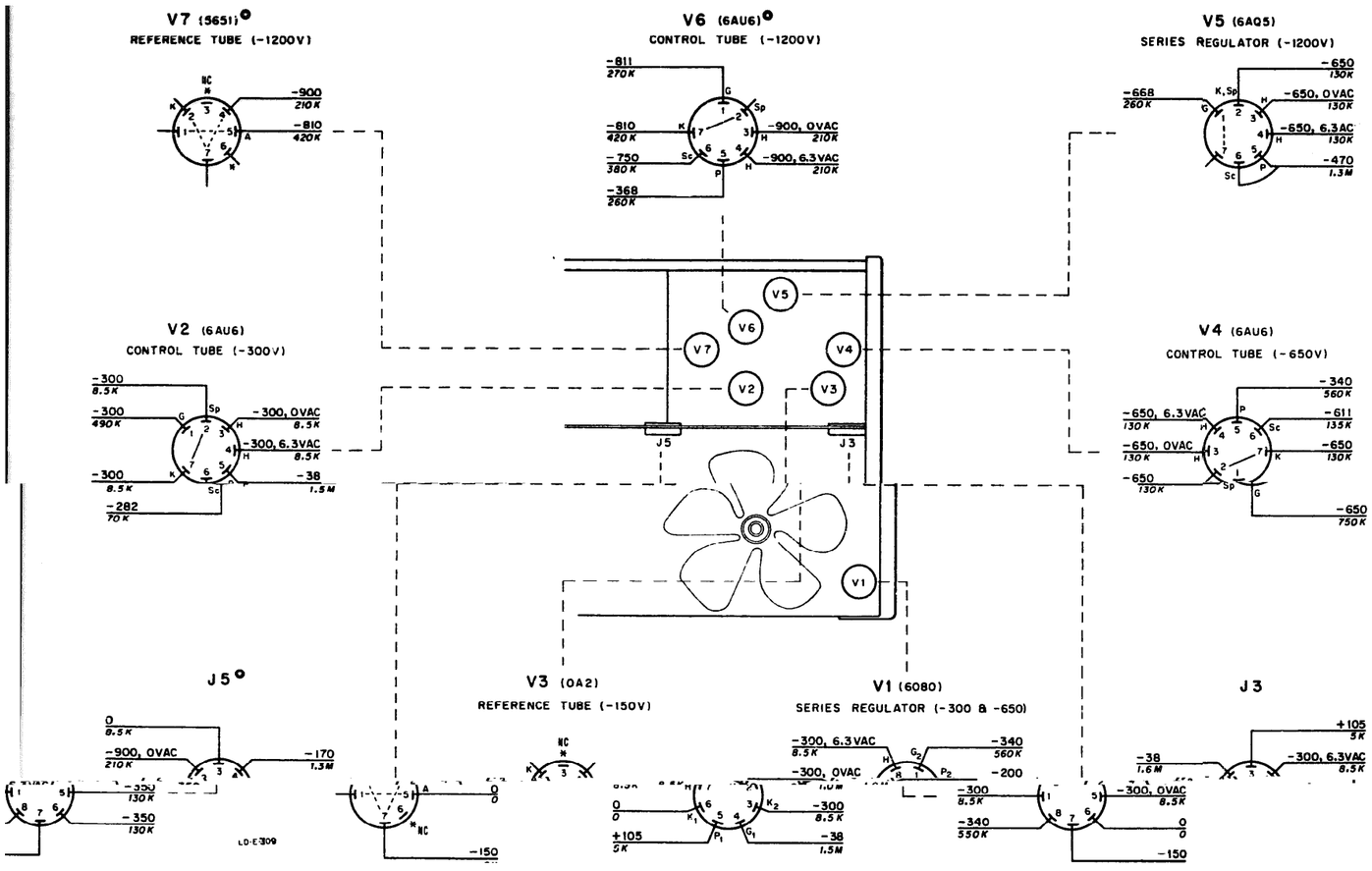


Figure 5-15. Power Supply, Voltage and Resistance Diagram

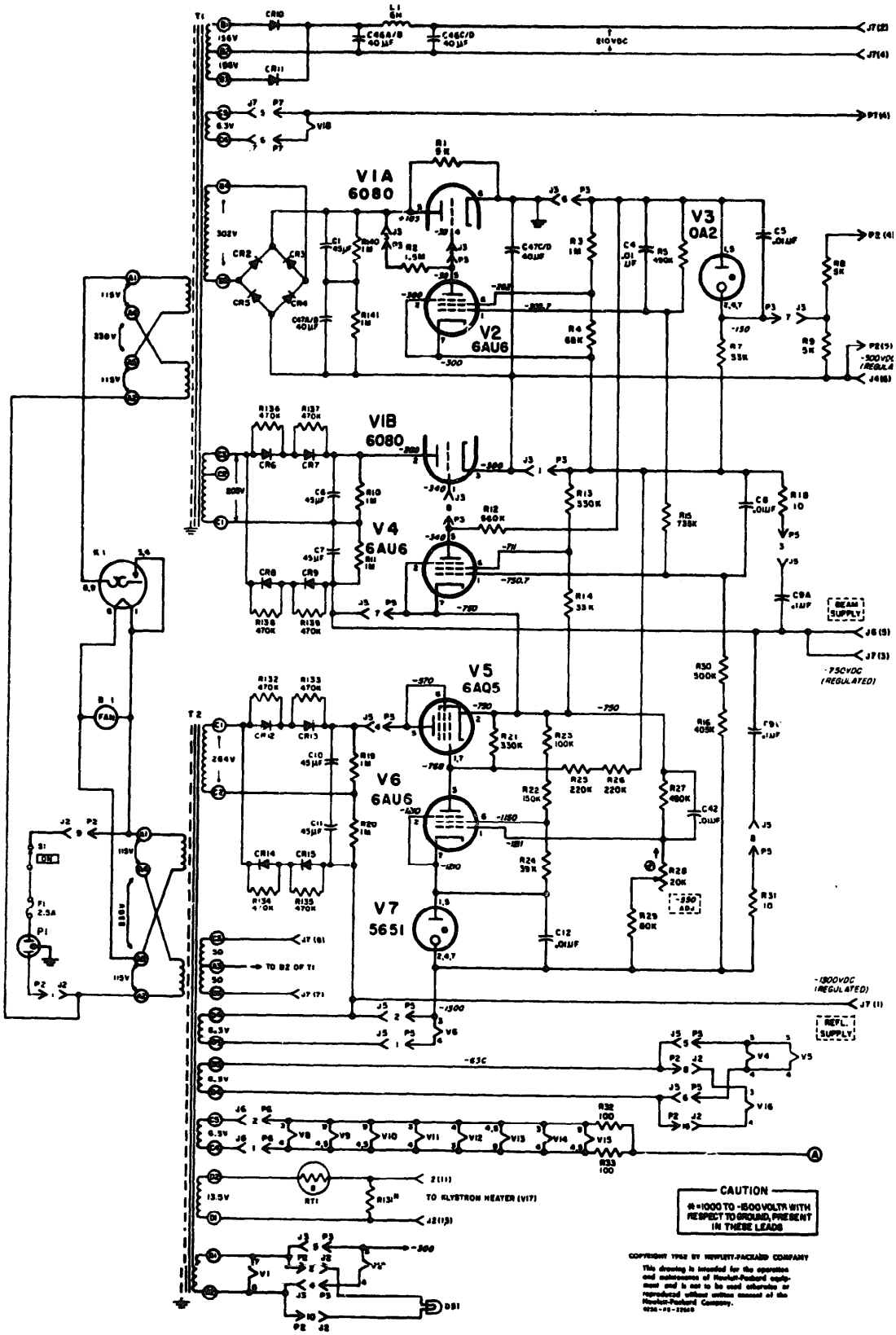


Figure 5-16. Power Supply

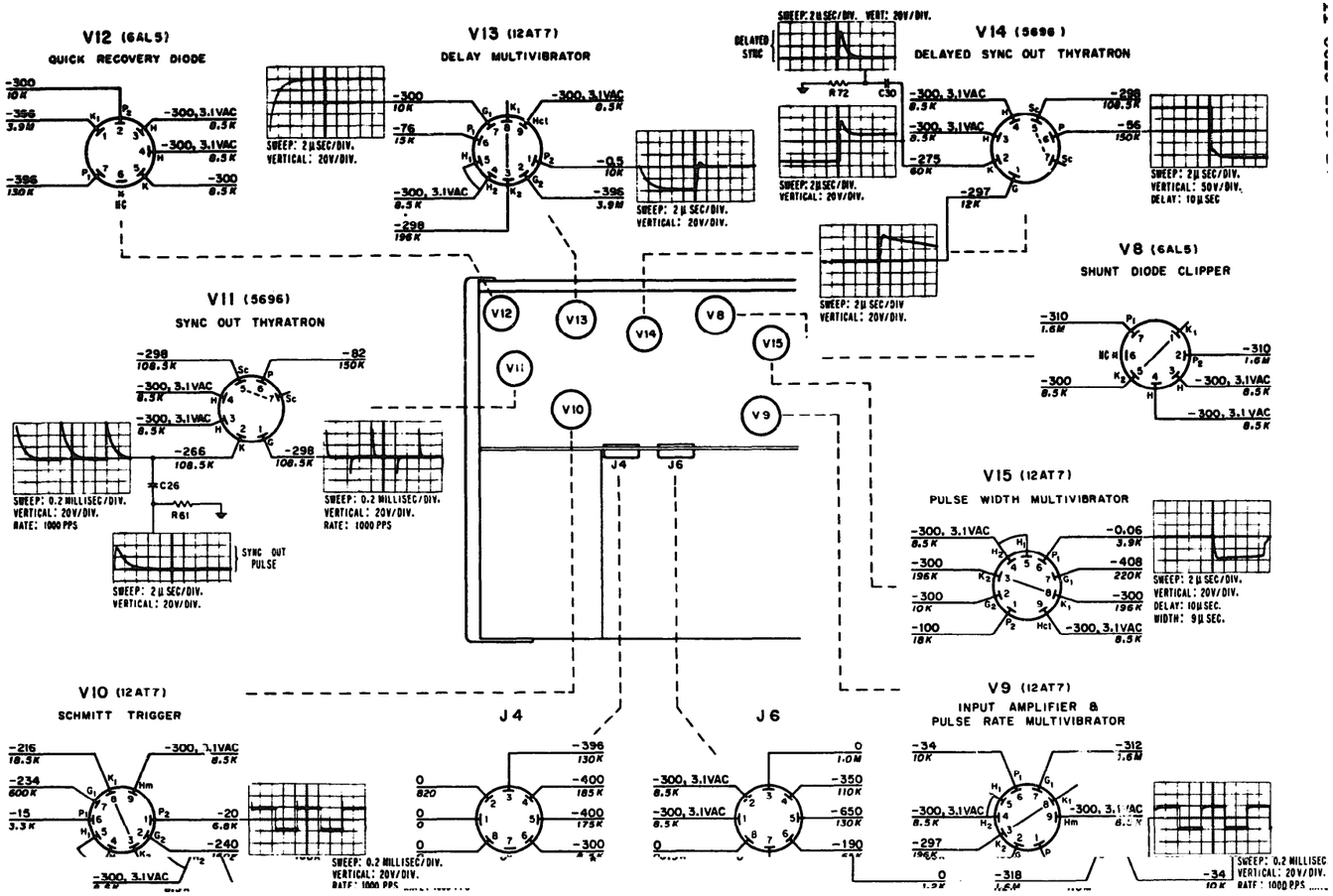


Figure 5-17. Pulse Section, Voltage and Resistance Diagram

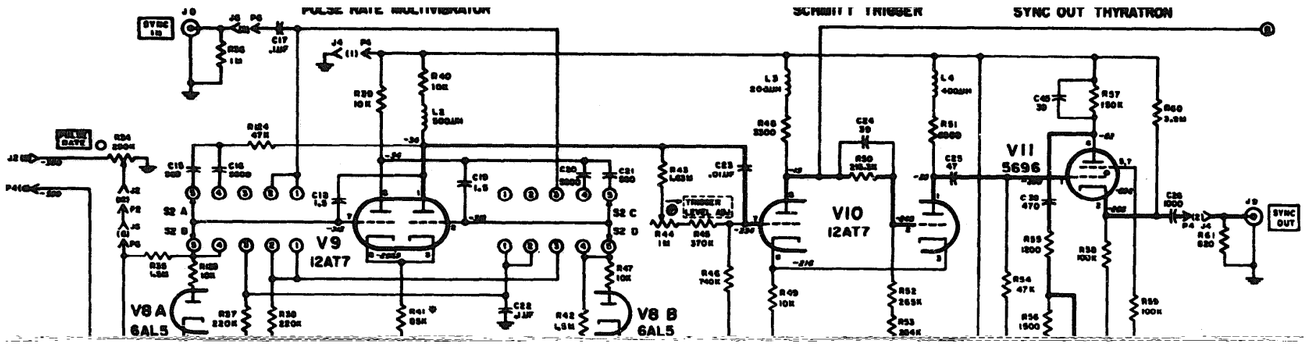


Figure 5-18. Pulse Generator

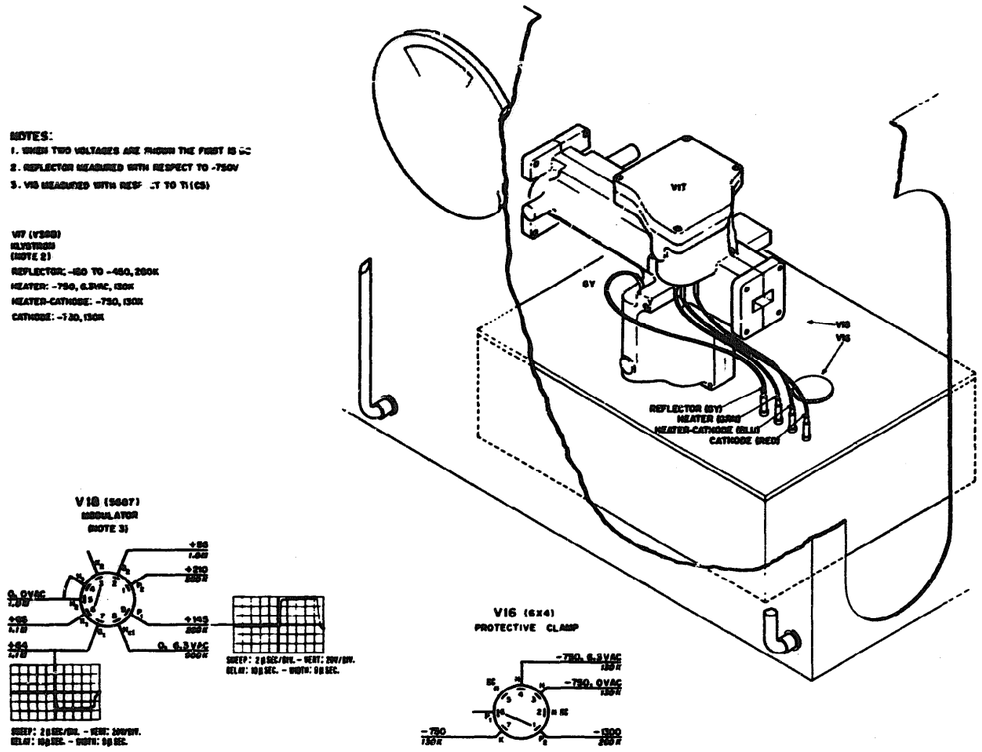


Figure 5-19. **Modulator** and RF Generator Sections, Voltage and Resistance Diagram

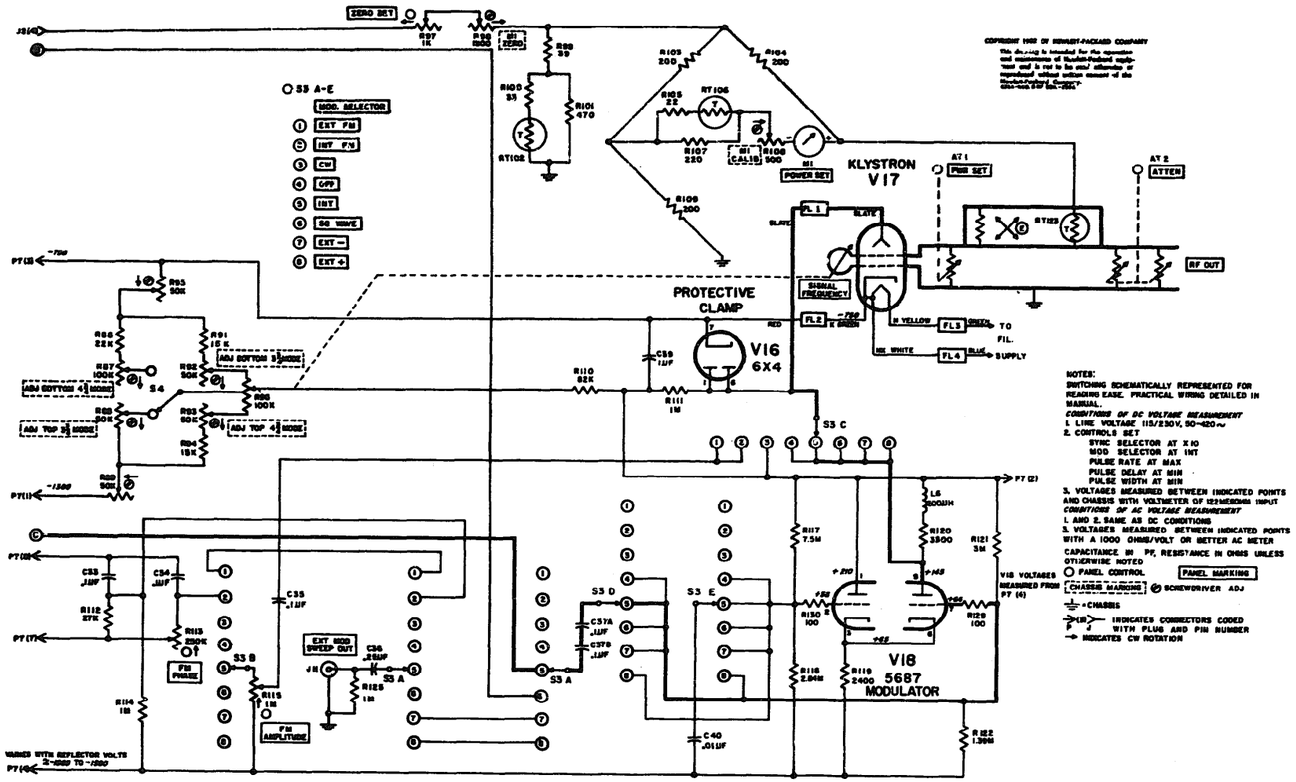


Figure 5-20. Modulator and RF Generator, Schematic Diagram

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in **alpha**-numerical order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their HP Part **Number** and provides the following information on each part.

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts; address order or inquiry to your local Hewlett-Packard Field Office,

Identify parts by their Hewlett-Packard stock numbers:

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	F = fuse	MP = mechanical part	U = integrated circuit
B = motor	FL = filter	P = plug	V = vacuum, tube, neon bulb, photocell, etc.
BT = battery	IC = integrated circuit	Q = transistor	
C = capacitor	J = jack	R = resistor	VR = voltage regulator
CP = coupler	K = relay	RT = thermistor	W = cable
CR = diode	L = inductor	S = switch	X = socket
DL = delay line	LS = loud speaker	T = transformer	Y = crystal
DS = device signaling (lamp)	M = meter	TB = terminal board	Z = tuned cavity, network
E = misc electronic part	MK = microphone	TP = test point	

ABBREVIATIONS

A = amperes	H = henries	N/O = normally open	RMO = rack mount only
AFC = automatic frequency control	HDW = hardware	NOM = nominal	RMS = root-mean square
AMPL = amplifier	HEX = hexagonal	NPO = negative positive zero (zero temperature coefficient)	RWV = reverse working voltage
	HG = mercury		
BFO = beat frequency oscillator	HR = hour(s)		S-B = slow-blow
BE CU = beryllium copper	HZ = hertz	NPN = negative-positive-negative	SCR = screw
BH = binder head			SE = selenium
BP = bandpass	IF = intermediate freq	NRFR = not recommended for field replacement	SECT = section(s)
BRS = brass	IMPG = impregnated		SEMICON = semiconductor
BWO = backward wave oscillator	INCD = incandescent	NSR = not separately replaceable	SI = silicon
	INCL = include(s)		SIL = silver
CCW = counter-clockwise	INS = insulation(ed)		SL = slide
CER = ceramic	INT = internal	OBD = order by description	SPG = spring
CMO = cabinet mount only		OH = oval head	SPL = special
COEF = coefficient	K = kilo = 1000	OX = oxide	SST = stainless steel
COM = common			SR = split ring
COMP = composition	LH = left hand	P = peak	STL = steel
COMPL = complete	LIN = linear taper	PC = printed circuit	
CONN = connector	LK WASH = lock washer	PF = picofarads = 10^{-12} farads	TA = tantalum
CP = cadmium plate	LOG = logarithmic taper		TD = time delay
CRT = cathode-ray tube	LPF = low pass filter	PH BRZ = phosphor bronze	TGL = toggle
CW = clockwise		PHL = Phillips	THD = thread
	M = milli = 10^{-3}	PIV = peak inverse voltage	TI = titanium
DEPC = deposited carbon	MEG = meg = 10^{6}	PNP = positive-negative-positive	TOL = tolerance
DR = drive	MET FLM = metal film		TRIM = trimmer
	MET OX = metallic oxide	P/O = part of	TWT = traveling wave tube
ELECT = electrolytic	MFR = manufacturer	POLY = polystyrene	
ENCAP = encapsulated	MHZ = mega hertz	PORC = porcelain	U = micro = 10^{-6}
EXT = external	MINAT = miniature	POS = position(s)	
	MOM = momentary	POT = potentiometer	VAR = variable
F = farads	MOS = metal ozide substrate	PP = peak-to-peak	VDCW = dc working volts
FH = flat head	MTG = mounting	PT = point	
FIL H = fillister head	MY = "mylar"	PWV = peak working voltage	W/ = with
FXD = fixed			W = watts
	N = nano (10^{-9})	RECT = rectifier	WIV = working inverse voltage
G = giga (10^{9})	N/C = normally closed	RF = radio frequency	
GE = germanium	NE = neon	RH = round head or right hand	WW = wirewound
GL = glass	NI PL = nickel plate		W/O = without
GRD = ground(ed)			

01194-14

Table 6-1. Reference Designation Index

Reference Designation	Part No.	Description #	Note
AT1		POWER SET ATTENUATOR ASSEMBLY	
AT1		NOT RECOMMENDED FOR FIELD REPLACEMENT	
AT2		RF ATTENUATOR ASSEMBLY	
AT2		NOT RECOMMENDED FOR FIELD REPLACEMENT	
B1	3140-0052	MOTOR:SHADED POLE	
B2	3160-0012	BLADE:FAN 5 BLADES 5-1/2	
C1	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C2		NOT ASSIGNED	
C3		NOT ASSIGNED	
C4	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C5	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C6	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C7	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C8	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C9	0160-0089	C:FXD PAPER 2(0.1UF)-10%+20%1C00VDCW	
C10	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C11	0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	
C12	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C13		NOT ASSIGNED	
C14		NOT ASSIGNED	
C15	0140-0028	C:FXD MICA 560 PF 10% 500VDCW	
C16	0140-0071	C:FXD MICA 5600PF 1% 500WVDC	
C17	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C18	0150-0011	C:FXD TI 1.5 PF 20% 500VDCW	
C19	050-0011	C:FXD TI 1.5 PF 20% 500VDCW	
C20	0140-0071	C:FXD MICA 5600PF 1% 500WVDC	
C21	0140-0028	C:FXD MICA 560 PF 10% 500VDCW	
C22	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C23	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C24	0140-0035	C:FXD MICA 39 PF 5%	
C25	0140-0032	C:FXD MICA 47 PF 10% 500VDCW	
C26	0140-0003	C:FXD MICA 1000 PF 10%	
C27	0140-0041	C:FXD MICA 100PF 5% 500VDCW	
C28	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C29	0140-0031	C:FXD MICA 220 PF 10% 500VDCW	
C30	0140-0003	C:FXD MICA 1000 PF 10%	
C31	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C32	0140-0041	C:FXD MICA 100PF 5% 500VDCW	
C33	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C34	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C35	0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	
C36	0160-0088	C:FXD PAPER 0.25UF 10% 1500VDCW	
C37	0160-0089	C:FXD PAPER 2(0.1UF)-10%+20%1000VDCW	
C38	0140-0027	C:FXD MICA 470 PF 10%	
C39	0160-0079	C:FXD PAPER 1.0 UF 10% 600VDCW	
C40	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C41	0140-0007	C:FXD MICA 680 PF 10%	
C42	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	
C43		NOT ASSIGNED	
C44		NOT ASSIGNED	

Sec introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
C45	0140-0021	C:FXD MICA 39 PF 10% 500VDCW	
C46	0180-0025	C:FXD ELECT 4 SECT 20UF 450VDCW	
C47	0180-0025	C:FXD ELECT 4 SECT 20UF 450VDCW	
C48	0140-0021	C:FXD MICA 39 PF 10% 500VDCW	
CR1	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
CR2	1901-0029	DIODE:SILICON 600 PIV	
CR3	1901-0029	DIODE:SILICON 600 PIV	
CR4	1901-0029	DIODE:SILICON 600 PIV	
CR5	1901-0029	DIODE:SILICON 600 PIV	
CR6	1901-0029	DIODE:SILICON 600 PIV	
CR7	1901-0029	DIODE:SILICON 600 PIV	
CR8	1901-0029	DIODE:SILICON 600 PIV	
CR9	1901-0029	DIODE:SILICON 600 PIV	
CR10	1901-0029	DIODE:SILICON 600 PIV	
CR11	1901-0029	DIODE:SILICON 600 PIV	
CR12	1901-0029	DIODE:SILICON 600 PIV	
CR13	1901-0029	DIODE:SILICON 600 PIV	
CR14	1901-0029	DIODE:SILICON 600 PIV	
CR15	1901-0029	DIODE:SILICON 600 PIV	
DS1	2140-0009	LAMP:INCANDESCENT 6.8V TYPE 47	
F1	2110-0015	FUSE:CARTRIDGE 2.5 AMP 125 V MAX SLOW BLOW	
F1		FOR 115V OPERATION	
F1	2110-0021	FUSE:CARTRIDGE 1.25 AMP SLOW BLOW	
F1		FOR 230V OPERATION	
J1		NOT ASSIGNED	
J2	1251-0007	CONNECTOR:FEMALE 16-PIN	
J3	1200-0005	SOCKET:TUBE,OCTAL	
J4	1200-0005	SOCKET:TUBE,OCTAL	
J5	1200-0005	SOCKET:TUBE,OCTAL	
J6	1200-0005	SOCKET:TUBE,OCTAL	
J7	1200-0035	SOCKET:TUBE 11 PIN	
J8	1250-0075	CONNECTOR:BNC	
J9	1250-0075	CONNECTOR:BNC	
J10	1250-0075	CONNECTOR:BNC	
J11	1250-0074	CONNECTOR:BNC PANEL RECEPTACLE	
K1	0490-0009	RELAY:TIME DELAY SPST 115V 2A AC	
L1	9110-0011	REACTOR:CHOKE/FILTER	
L2	9140-0022	COIL:FXD RF 500 UH	
L3	9140-0019	COIL:FXD RF 200 UH 10%	
L4	9140-0020	COIL:FXD RF 400 UH	
L5	9140-0021	COIL:FXD RF 430 UH	
L6	9140-0019	COIL:FXD RF 200 UH 10%	
M1	1120-0037	METER:360 OHM 200 MA	
P1	8120-0015	CABLE ASSY:POWER	
P2	1251-0006	CONNECTOR:R & P 16 CONTACT	
P3	1251-0026	CONNECTOR:ELECT 8 PIN MALE PLUG	
P4	1251-0026	CONNECTOR:ELECT 8 PIN MALE PLUG	
P5	1251-0026	CONNECTOR:ELECT 8 PIN MALE PLUG	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
P6	1251-0026	CONNECTOR:ELECT 8 PIN MALE PLUG	
P7	1251-0052	CONNECTOR:ELECT 11 PIN MALE PLUG	
R1	0816-0006	R:FXD WW 5000 OHM 10% 10W	
R2	0687-1551	R:FXD COMP 1.5 MEGOHM 10% 1/2W	
R3	0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	
R4	0687-6831	R:FXD COMP 68K OHM 10% 1/2W	
R5	0730-0092	R:FXD DEPC 490K OHM 1% 1W	
R6		NOT ASSIGNED	
R7	0693-3331	R:FXD COMP 33K OHM 10% 2W	
R8	0816-0006	R:FXD WW 5000 OHM 10% 10W	
R9	0816-0006	R:FXD WW 5000 OHM 10% 10W	
R10	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R11	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R12	0690-5641	R:FXD COMP 560K OHM +10% 1W	
R13	0693-3341	R:FXD COMP 330K OHM 10% 2W	
R14	0687-3331	R:FXD COMP 33K OHM 10% 1/2W	
R15	0730-0097	R:FXD DEPC 735K OHM 1% 1W	
R16	0730-0088	R:FXD DEPC 405K OHM 1% 1W	
R17		NOT ASSIGNED	
R18	0690-1001	R:FXD COMP 10 OHM 10% 1W	
R19	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R20	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R21	0690-3341	R:FXD COMP 330K OHM 10% 1W	
R22	0693-1541	R:FXD COMP 150K OHM 10% 2W	
R23	0693-1041	R:FXD COMP 100K OHM 10% 2W	
R24	0687-3931	R:FXD COMP 39K OHM 10% 1/2W	
R25	0690-2241	R:FXD COMP 220K OHM 10% 1W	
R26	0690-2241	R:FXD COMP 220K OHM 10% 1W	
R27	0730-0092	R:FXD DEPC 490K OHM 1% 1W	
R28	2100-0098	R:VAR COMP 20K OHM 20% LIN 1/3W	
R29	0730-0062	R:FXD DEPC 80K OHM 1% 1W	
R30	0727-0244	R:FXD DEPC 500K OHM 1% 1/2W	
R31	0690-1001	R:FXD COMP 10 OHM 10% 1W	
R32	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
R33	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
R34	2100-0034	R:VAR COMP 250K OHM 20% LIN 1/2W	
R35	0686-1555	R:FXD COMP 1.5 MEGOHM 5% 1/2W	
R36	0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	
R37	0687-2241	R:FXD COMP 220K OHM 10% 1/2W	
R38	0687-2241	R:FXD COMP 220K OHM 10% 1/2W	
R39	0690-1031	R:FXD COMP 10K OHM 10% 1W	
R40	0690-1031	R:FXD COMP 10K OHM 10% 1W	
R41	0773-0010	R:FXD MET FLM 85K OHM 5% 5W FACTORY SELECTED PART	
R42	0686-1555	R:FXD COMP 1.5 MEGOHM 5% 1/2W	
R43	0730-0110	R:FXD DEPC 1.63 MEGOHM 1% 1W	
R44	2100-0096	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	
R45	0730-0087	R:FXD DEPC 370K OHM 1% 1W	
R46	0727-0252	R:FXD DEPC 740K OHM 1% 1/2W	
R47	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
R48	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
R49	0770-0004	R:FXD MET FLM 10K OHM 5% 4W	
R50	0727-0223	R:FXD DEPC 216.3K OHM 1% 1/2W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
R51	0693-6821	R:FXD COMP 6800 OHM 10% 2W	
R52	0730-0082	R:FXD DEPC 265K OHM 1% 1W	
R53	0730-0083	R:FXD DEPC 284K OHM 1% 1W	
R54	0687-4731	R:FXD COMP 47K OHM 10% 1/2W	
R55	0690-1221	R:FXD COMP 1200 OHM 10% 1W	
R56	0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	
R57	0687-1541	R:FXD COMP 150K OHM 10% 1/2W	
R58	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R59	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R60	0687-3951	R:FXD COMP 3.9 MEGOHM 10% 1/2W	
R61	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	
R62	0693-1531	R:FXD COMP 15K OHM 10% 2W	
R63	0690-1031	R:FXD COMP 10K OHM 10% 1W	
R64	0773-0010	R:FXD MET FLM 85K OHM 5% 5W	
R65	0690-4751	R:FXD COMP 4.7 MEGOHM 10% 1W	
R66	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R67	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R68	0687-1541	R:FXD COMP 150K OHM 10% 1/2W	
R69	0687-5631	R:FXD COMP 56K OHM 10% 1/2W	
R70	0687-2251	R:FXD COMP 2.2 MEGOHM 10% 1/2W	
R71	0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	
R72	0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	
R73	0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	
R74	0693-1231	R:FXD COMP 12K OHM 10% 2W	
R75	0687-3921	R:FXD COMP 3900 OHM 10% 1/2W	
R76	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R77	0773-0010	R:FXD MET FLM 85K OHM 5% 5W	
R78	2100-0096	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	
R79	0687-6841	R:FXD COMP 680K OHM 10% 1/2W	
R80	2100-0014	R:VAR COMP 200K OHM 20% LIN 1/2W	
R81	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
R82	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
R83	2100-0014	R:VAR COMP 200K OHM 20% LIN 1/2W	
R84	0687-4741	R:FXD COMP 470K OHM 10% 1/2W	
R85	2100-0096	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	
R86	0690-2231	R:FXD COMP 22K OHM 10% 1W	
R87	2100-0045	R:VAR COMP 100K OHM 10% CWLOG 2W	
R88	2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	
R89	2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	
R90		NOT ASSIGNED	
R91	0690-1531	R:FXD COMP 15K OHM 10% 1W	
R92	2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	
R93	2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	
R94	0690-1531	R:FXD COMP 15K OHM 10% 1W	
R95	2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	
R96	2100-0120	R:VAR WW 100K OHM 5% 8W	
R97	2100-0036	R:VAR COMP 1000 OHM LIN	
R98	2100-0025	R:VAR COMP 1500 OHM 10% LIN 2W	
R99	0687-3901	R:FXD COMP 39 OHM 10% 1/2W	
R100	0687-3301	R:FXD COMP 33 OHM 10% 1/2W	
R101	0687-4711	R:FXD COMP 470 OHM 10% 1/2W	
R102		NOT ASSIGNED	
R103	628A-67A	R:FXD WW 200 OHM	
R104	628A-67A	R:FXD WW 200 OHM	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
R105	0687-2201	R:FXD COMP 22 OHM 10% 1/2W	
R106		NOT ASSIGNED	
R107	0687-2211	R:FXD COMP 220 OHM 10% 1/2W	
R108	2100-0068	R:VAR COMP 500 OHM 2W LIN	
R109	628A-67A	R:FXD WW 200 OHM	
R110	0687-8231	R:FXD COMP 82K OHM 10% 1/2W	
R111	0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	
R112	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
R113	2100-0034	R:VAR COMP 250K OHM 20% LIN 1/2W	
R114	0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	
R115	2100-0159	R:VAR COMP 1 MEGOHM 20% 1/8W	
R116		NOT ASSIGNED	
R117	0730-0131	R:FXD DEPC 7.5 MEGOHM 1% 1W	
R118	0727-0291	R:FXD DEPC 2.84 MEGOHM 1% 1/2W	
R119	0770-0002	R:FXD MET OX 2400 OHM 5% 4W	
R120	0770-0003	R:FXD MET FLM 3300 OHM 5% 4W	
R121	0727-0292	R:FXD CARBON 3 MEGOHM 1% 1/2W	
R122	0727-0281	R:FXD DEPC 1.39 MEGOHM 1% 1/2W	
R123		NOT ASSIGNED	
R124	0687-4731	R:FXD COMP 47K OHM 10% 1/2W	
R125	0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	
R126		NOT ASSIGNED	
R127		NOT ASSIGNED	
R128	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
R129	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
R130	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
R131	0693-1801	R:FXD COMP 18 OHM 10% 2W	
R131		FACTORY SELECTED PART	
R132	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R133	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R134	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R135	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R136	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R137	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R138	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R139	0690-4741	R:FXD COMP 470K OHM 10% 1W	
R140	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
R141	0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	
RT1	0852-0007	TUBE:BALLAST 12-14V SUPPLY	
RT2-RT101		NOT ASSIGNED	
RT102	0839-0003	THERMISTOR:DISK TYPE 0.4" DIA	
RT103-RT105		NOT ASSIGNED	
RT106	0839-0003	THERMISTOR:DISK TYPE 0.4" DIA	
RT107-RT122		NOT ASSIGNED	
RT123	0839-0022	THERMISTOR:BEAD TYPE	
S1	3101-0030	SWITCH:TOGGLE SPST 15 AMP 125VAC	
S2	3100-0121	SWITCH-ROTARY: 2 SECT 5 POS	
S3	3100-0111	SWITCH-ROTARY: 3 SECT 8 POS	
S4	3102-0001	SWITCH: SENSITIVE SPDT	

See introduction this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
T1	9100-0114	TRANSFORMER:POWER	
T2	9100-0115	TRANSFORMER:POWER	
V1	1932-0010	ELECTRON TUBE: 6080 DUAL TRIODE	
V2	1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	
V3	1940-0004	ELECTRON TUBE: 0A2 VOLTAGE REGULATOR	
V4	1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	
V5	1923-0018	ELECTRON TUBE: 6AQ5 BEAM PENTODE	
V6	1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	
V7	1940-0001	ELECTRON TUBE:5651	
V8	1930-0013	ELECTRON TUBE: 6AL5 TWIN DIODE	
V9	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
V10	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
V11	1941-0003	ELECTRON TUBE:EIA TYPE	
V12	1930-0013	ELECTRON TUBE: 6AL5 TWIN DIODE	
V13	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
V14	1941-0003	ELECTRON TUBE:EIA TYPE	
V15	1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	
V16	1930-0016	ELECTRON TUBE:RECTIFIER FULL WAVE	
V17		N.S.R. PART OF KLYSTRON CAVITY ASSY	
V18	1932-0002	ELECTRON TUBE: 5687 DOUBLE TRIODE	
		MISCELLANEOUS	
	628A-28	ASSY:THERMISTOR MOUNT	
	5040-0252	CAP:WAVEGUIDE PLASTIC MOLDING	
	5040-0212	COUPLER:BAKELITE	
	00628-6005	KLYSTRON CAVITY ASSY:COMPLETE W/ V17	
	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
	0370-0028	KNOB:ROUND BLACK 1" DIA	
	0370-0029	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT	
	0370-0035	KNOB:SKIRTED BAR 1" DIA	
	628A-40A	KNOB:SIGNAL FREQ W/VERNIER DIAL	
	628A-65A	PRINTED CIRCUIT BOARD:PULSE SECT	
	628A-65B	PRINTED CIRCUIT BOARD:POWER SECT	
	00628-6007	PRINTED CIRCUIT BOARD:MODULATOR SECT	
	628A-65D	PULSER ASSY	
	1450-0004	PILOT LIGHT:RED	

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Part No.	Description #	Mfr.	Mfr. Part No.
0140-0003	C:FXD MICA 1000 PF 10%	04062	RCM20E120K
0140-0007	C:FXD MICA 680 PF 10%	04062	RCM20E681K
0140-0021	C:FXD MICA 39 PF 10% 500VDCW	00853	RCM15E390K
0140-0027	C:FXD MICA 470 PF 10%	00853	RCM20E471K
0140-0028	C:FXD MICA 560 PF 10% 500VDCW	04062	CM30B561K
0140-0031	C:FXD MICA 220 PF 10% 500VDCW	04062	RCM20E221K
0140-0032	C:FXD MICA 47 PF 10% 500VDCW	04062	RCM15E470K
0140-0035	C:FXD MICA 39 PF 5%	04062	RCM15E390J
0140-0041	C:FXD MICA 100PF 5% 500VDCW	28480	0140-0041
0140-0071	C:FXD MICA 5600PF 1% 500WVDC	28480	0140-0071
0150-0011	C:FXD TI 1.5 PF 20% 500VDCW	78488	TYPE GA
0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
0160-0050	C:FXD MY 0.1 UF 10% 400VDCW	01281	HEW-102
0160-0079	C:FXD PAPER 1.0 UF 10% 600VDCW	82047	23F467
0160-0088	C:FXD PAPER 0.25UF 10% 1500VDCW	24446	47F14G4
0160-0089	C:FXD PAPER 2(0.1UF)-10%+20%1000VDCW	CC853	CP54B4EG104V
0180-0019	C:FXD ELECT 45UF -10/+50% 450VDCW	14655	CE41F450R
0180-0025	C:FXD ELECT 4 SECT 20UF 450VDCW	56289	D32452
0370-0028	KNOB:ROUND BLACK 1" DIA	28480	0370-0028
0370-0029	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT	28480	0370-0029
0370-0035	KNOB:SKIRTED BAR 1" DIA	28480	0370-0035
0490-0009	RELAY:TIME DELAY SPST 115V 2A AC	28480	0490-0009
0686-1555	R:FXD COMP 1.5 MEGOHM 5% 1/2W	01121	EB 1555
0687-1011	R:FXD COMP 100 OHM 10% 1/2W	01121	EB 1011
0687-1031	R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
0687-1041	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
0687-1051	R:FXD COMP 1 MEGOHM 10% 1/2W	01121	EB 1051
0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	01121	EB 1221
0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	01121	EB 1521
0687-1541	R:FXD COMP 150K OHM 10% 1/2W	01121	EB 1541
0687-1551	R:FXD COMP 1.5 MEGOHM 10% 1/2W	01121	EB 1551
0687-2201	R:FXD COMP 22 OHM 10% 1/2W	01121	EB 2201
0687-2211	R:FXD COMP 220 OHM 10% 1/2W	01121	EB 2211
0687-2241	R:FXD COMP 220K OHM 10% 1/2W	01121	EB 2241
0687-2251	R:FXD COMP 2.2 MEGOHM 10% 1/2W	01121	EB 2251
0687-2731	R:FXD COMP 27K OHM 10% 1/2W	01121	EB 2731
0687-3301	R:FXD COMP 33 OHM 10% 1/2W	01121	EB 3301
0687-33212	R:FXD COMP 3300 OHM 10% 1/2W	01121	EB 3321
0687-3331	R:FXD COMP 33K OHM 10% 1/2W	01121	EB 3331
0687-3901	R:FXD COMP 39 OHM 10% 1/2W	01121	EB 3901
0687-3921	R:FXD COMP 3900 OHM 10% 1/2W	01121	EB 3921
0687-3931	R:FXD COMP 39K OHM 10% 1/2W	01121	EB 3931
0687-3951	R:FXD COMP 3.9 MEGOHM 10% 1/2W	01121	EB 3951
0687-4711	R:FXD COMP 470 OHM 10% 1/2W	01121	EB 4711
0687-4731	R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
0687-4741	R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
0687-5631	R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
0687-6831	R:FXD COMP 68K OHM 10% 1/2W	01121	EB 6831
0687-6841	R:FXD COMP 680K OHM 10% 1/2W	01121	EB 6841
0687-8211	R:FXD COMP 820 OHM 10% 1/2W	01121	EB 8211
0687-8231	R:FXD COMP 82K OHM 10% 1/2W	01121	EB 8231
0690-1001	R:FXD COMP 10 OHM 10% 1W	01121	GB 1001
0690-1031	R:FXD COMP 10K OHM 10% 1W	01121	GB 1031
0690-1051	R:FXD COMP 1 MEGOHM 10% 1W	01121	GB 1051

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0690-1221	R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221	1
0690-1531	R:FXD COMP 15K OHM 10% 1W	01121	CB 1531	2
0690-2231	R:FXD COMP 22K OHM 10% 1W	01121	GB 2231	1
0690-2241	R:FXD COMP 220K OHM 10% 1W	01121	GB 2241	2
0690-3341	R:FXD COMP 330K OHM 10% 1W	01121	GB 3341	1
0690-4741	R:FXD COMP 470K OHM 10% 1W	01121	GB 4741	8
0690-4751	R:FXD COMP 4.7 MEGOHM 10% 1W	01121	GB 4751	1
0690-5641	R:FXD COMP 560K OHM +10% 1W	01121	GB 5641	1
0693-1041	R:FXD COMP 100K OHM 10% 2W	01121	HB 1041	1
0693-1231	R:FXD COMP 12K OHM 10% 2W	01121	HB 1231	1
0693-1531	R:FXD COMP 15K OHM 10% 2W	01121	HB 1531	1
0693-1541	R:FXD COMP 150K OHM 10% 2W	01121	HB 1541	1
0693-1801	R:FXD COMP 18 OHM 10% 2W	01121	HB 1801	1
0693-3331	R:FXD COMP 33K OHM 10% 2W	01121	HB 3331	1
0693-3341	R:FXD COMP 330K OHM 10% 2W	01121	HB 3341	1
0693-6821	R:FXD COMP 6800 OHM 10% 2W	01121	HB 6821	1
0727-0223	R:FXD DEPC 216.3K OHM 1% 1/2W	28480	0727-0223	1
0727-0244	R:FXD DEPC 500K OHM 1% 1/2W	28480	0727-0244	1
0727-0252	R:FXD DEPC 740K OHM 1% 1/2W	28480	0727-0252	1
0727-0281	R:FXD DEPC 1.39 MEGOHM 1% 1/2W	28480	0727-0281	1
0727-0291	R:FXD DEPC 2.84 MEGOHM 1% 1/2W	28480	0727-0291	1
0727-0292	R:FXD CARBON 3 MEGOHM 1% 1/2W	28480	0727-0292	1
0730-0062	R:FXD DEPC 80K OHM 1% 1W	28480	0730-0062	1
0730-0082	R:FXD DEPC 265K OHM 1% 1W	28480	0730-0082	1
0730-0083	R:FXD DEPC 284K OHM 1% 1W	28480	0730-0083	1
0730-0087	R:FXD DEPC 370K OHM 1% 1W	28480	0730-0087	1
0730-0088	R:FXD DEPC 405K OHM 1% 1W	28480	0730-0088	1
0730-0092	R:FXD DEPC 490K OHM 1% 1W	28480	0730-0092	2
0730-0097	R:FXD DEPC 735K OHM 1% 1W	28480	0730-0097	1
0730-0110	R:FXD DEPC 1.63 MEGOHM 1% 1W	28480	0730-0110	1
0730-0131	R:FXD DEPC 7.5 MEGOHM 1% 1W	28480	0730-0131	1
0770-0002	R:FXD MET OX 2400 OHM 5% 4W	28480	0770-0002	1
0770-0003	R:FXD MET FLM 3300 OHM 5% 4W	28480	0770-0003	1
0770-0004	R:FXD MET FLM 10K OHM 5% 4W	28480	0770-0004	1
0773-0010	R:FXD MET FLM 85K OHM 5% 5W	28480	0773-0010	3
0816-0006	R:FXD WW 5000 OHM 10% 10W	28480	0816-0006	3
0839-0003	THERMISTOR:DISK TYPE 0.4" DIA	83186	27D1	2
0839-0022	THERMISTOR:BEAD TYPE	83186	32A504	1
0852-0007	TUBE:BALLAST 12-14V SUPPLY	70563	13-4	1
1120-0037	METER:360 OHM 200 MA	65092	MODEL 206	1
1200-0005	SOCKET:TUBE,OCTAL	71785	101-24-11-314	4
1200-0035	SOCKET:TUBE 11 PIN	02660	77 MIP-11T	1
1250-0074	CONNECTOR:BNC PANEL RECEPTACLE	28480	1250-0074	1
1250-0075	CONNECTOR:BNC	28480	1250-0075	3
1251-0006	CONNECTOR:R & P 16 CONTACT	02660	26-4100-16P	1
1251-0007	CONNECTOR:FEMALE 16-PIN	28480	1251-0007	1
1251-0026	CONNECTOR:ELECT 8 PIN MALE PLUG	C2660	86CP8T-041-2	4
1251-0052	CONNECTOR:ELECT 11 PIN MALE PLUG	C2660	86CP11T-041-2	1
1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	79515	342014	1
1450-0004	PILOT LIGHT:RED	72619	812210-111B	1
1901-0029	DIODE:SILICON 600 PIV	28480	1901-0029	14
1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361	1
1923-0018	ELECTRON TUBE: 6AQ5 BEAM PENTODE	93332	6AQ5	1

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
1923-0021	ELECTRON TUBE: 6AU6 MIN PENTODE	33173	6AU6	3
1930-0013	ELECTRON TUBE: 6AL5 TWIN DIODE	33173	6AL5	2
1930-0016	ELECTRON TUBE:RECTIFIER FULL WAVE	28480	1930-0016	1
1932-0002	ELECTRON TUBE: 5687 DOUBLE TRIODE	94154	5687	1
1932-0010	ELECTRON TUBE: 6080 DUAL TRIODE	86684	6080	1
1932-0027	ELECTRON TUBE:12AT7 DUAL TRIODE	33173	12AT7	4
1940-0001	ELECTRON TUBE:5651	86684	5651A	1
1940-0004	ELECTRON TUBE: 0A2 VOLTAGE REGULATOR	86684	0A2	1
1941-0003	ELECTRON TUBE:EIA TYPE	86684	5696	2
2100-0014	R:VAR COMP 200K OHM 20% LIN 1/2W	28480	2100-0014	2
2100-0025	R:VAR COMP 1500 OHM 10% LIN 2W	28480	2100-0025	1
2100-0028	R:VAR COMP 50K OHM 10% LIN 2W	28480	2100-0028	5
2100-0034	R:VAR COMP 250K OHM 20% LIN 1/2W	28480	2100-0034	2
2100-0036	R:VAR COMP 1000 OHM LIN	28480	2100-0036	1
2100-0045	R:VAR COMP 100K OHM 10% CWLOG 2W	28480	2100-0045	1
2100-0068	R:VAR COMP 500 OHM 2W LIN	28480	2100-0068	1
2100-0096	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	28480	2100-0096	3
2100-0098	R:VAR COMP 20K OHM 20% LIN 1/3W	28480	2100-0098	1
2100-0120	R:VAR WW 100K OHM 5% 8W	28480	2100-0120	1
2100-0159	R:VAR COMP 1 MEGOHM 20% 1/8W	28480	2100-0159	1
2110-0015	FUSE:CARTRIDGE 2.5 AMP 125V SLOW BLOW	75915	31302.5	1
2110-0021	FUSE:CARTRIDGE 1.25 AMP SLOW BLOW	71400	MDL 1.25	1
2140-0009	LAMP:INCANDESCENT 6.8V TYPE 47	24455	TYPE 47	1
3100-0111	SWITCH-ROTARY: 3 SECT 8 POS	28480	3100-0111	1
3100-0121	SWITCH-ROTARY: 2 SECT 5 POS	28480	3100-0121	1
3101-0030	SWITCH:TOGGLE SPST 15 AMP 125 VAC	04009	82601	1
3102-0001	SWITCH: SENSITIVE SPDT	91929	BZ 2RS	1
3140-0052	MOTOR:SHADED POLE	28480	3140-0052	1
3160-0012	BLADE:FAN 5 BLADES 5-1/2	06812	0 5527 5/CW	1
5040-0212	COUPLER:BAKELITE	28480	5040-0212	1
5040-0252	CAP:WAVEGUIDE PLASTIC MOLDING	28480	5040-0252	1
8120-0015	CABLE ASSY:POWER	70903	KH 3981/PH70	1
9100-0114	TRANSFORMER:POWER	28480	9100-0114	1
9100-0115	TRANSFORMER:POWER	28480	9100-0115	1
9110-0011	REACTOR:CHOKE/FILTER	28480	9110-0011	1
9140-0019	COIL:FXD RF 200 UH 10%	28480	9140-0019	2
9140-0020	COIL:FXD RF 400 UH	28480	9140-0020	1
9140-0021	COIL:FXD RF 430 UH	28480	9140-0021	1
9140-0022	COIL:FXD RF 500 UH	28480	9140-0022	1
00628-6005	KLYSTRON CAVITY ASSY:COMPLETE W/ V17	28480	00628-6005	1
00628-6007	PRINTED CIRCUIT BOARD:MODULATOR SECT	28480	00628-6007	1
68A-28	ASSY:THERMISTOR MOUNT	28480	628A-28	1
628A-40A	KNOB:SIGNAL FREQ W/VERNIER DIAL	28480	628A-40A	1
628A-65A	PRINTED CIRCUIT BOARD:PULSE SECT	28480	628A-65A	1
628A-65B	PRINTED CIRCUIT BOARD:POWER SECT	28480	628A-65B	1
628A-65D	PULSER ASSY	28480	628A-65D	1
628A-67A	R:FXD WW 200 OHM	28480	628A-67A	3

See introduction to this section to this section for ordering information

TABLE 6-3.

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00267	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Croven Ltd.	Whitby, Ontario Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01538	Small Parts Inc	Los Angeles, Calif.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Ametock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02875	Hudson Tool & Die Co.	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Calif.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Trentleni Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Mtc. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Britcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atoha Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13103	Thermalloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Ametco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computer Diode Corp.	Lodi, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Me.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17856	Siliconix Inc.	Sunnyvale, Calif.

00015-48
Revised October, 1969

From: FSC. Handbook Supplements

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Parelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialities Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shafercross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56289	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56501	Sprague Electric Co.	North Adams, Mass.
56845	Telex Corp.	Tulsa, Okla.
57668	Thomas & Betts Co.	Elizabeth, N.J.
58474	Triplett Electrical Inst. Co.	Bluffton, Ohio
58849	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
59730	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Birtley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78424	Specialty Leather Prod. Co.	Newark, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Weeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Cooper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Simon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96508	Xcelite Inc.	Orchard Park, N.Y.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomson Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99926	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000UU	California Fastener Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

00015-48
Revised October, 1969

From: FSC. Handbook Supplements

APPENDIX A

REFERENCES

DA Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310–7	Index of Modification Work Orders.
TB 11–6625–2710–50	Calibration Procedure for Generator, SHF Signal AN/USM–48 and Hewlett-Packard Model 628A.
TM 11–6625–2909–24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Repair Parts and Special Tools) for Signal Generator AN/USM–48.
TM 38–750	The Army Maintenance Management System (TAMMS).
TM 740–90–1	Administrative Storage of Equipment.
TM 750–244–2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B

COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

B - 1

This appendix lists integral components of and basic issue items for the AN/USM-48 to help you inventory items required for safe and efficient operation.

B - 2 .

This Components of End Item List is divided into the following sections :

a. Section II. Integral Components of the End Item. Not applicable. These items, when assembled, comprise the AN/USM-48 and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the AN/USM-48 in operation, to operate it, and to perform emergency repairs. Although shipped separately packed they must accompany the AN/USM-48 during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on TOE/MTOE authorization of the end item

B - 3 . Explanation of Columns

a. Illustration. This column is divided as follows :

(1) Figure number. Indicates the figure number of the illustration on which the item is shown.

(2) *Item* number. The number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. *Description.* Indicates the Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. *Usable* art Code. Not applicable.

f. Quantity *Required (Qty Reqd). This column* lists the quantity of each item required for a complete major item.

g. Quantity. This column is left blank for use during an inventory. Under the Rcvd column, list the quantity you actually receive on your major item. The Date columns are for your use when you inventory the major item.

(Next printed page is B-2.)

SECTION II INTEGRAL COMPONENTS OF END ITEM

ILLUSTRATION (A) FIG NO.	ILLUSTRATION (B) ITEM NO.	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION PART NUMBER (FSCM)	(4) LOCATION	(5) USABLE ON CODE	(6) QTY REQD	(7) QUANTITY RCVD	(7) QUANTITY DATE
1-1		6625-00-555-2264	SIGNAL GENERATOR AN/USM-48 (HP 628A) (28480)			1		

DRSEL-MA Form 6010, (Edition of 1 Jun 76 is obsolete) DSEA-FM 545-77

SECTION III BASIC ISSUE ITEMS

(1) ILLUSTRATION (A) FIG NO.	(1) ILLUSTRATION (B) ITEM NO.	(2) NATIONAL STOCK NUMBER		(3) DESCRIPTION		(4) LOCATION	(5) USABLE ON CODE	(6) QTY REQD	(7) QUANTITY RCVD	(7) QUANTITY DATE
	3-1	5920-00-280-3178	1178	FUSE, CARTRIDGE (FOR 115V) 2.5 AMPS 31302.5	(75915)				1	
		5920-00-131-9817	9817	FUSE, CARTRIDGE (FOR 230V) 1.25 AMPS MDL 1.25	(71400)				1	

DRSEL-MA Form 6010, (1 Mar 77) (Edition of 1 Jun 76 is obsolete)

APPENDIX D

MAINTENANCE ALLOCATION

SECTION I. INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for the AN/USM-48. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2.

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating conditions, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. InstalL The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part., subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., AWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

D - 3 .

a. ***Column*** 1, ***Group Number.*** **Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.**

b. Column 2, Component/Assembly. **Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.**

c. Column 3, Maintenance Functions. **Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.**

d. Column 4, Maintenance Category. **Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:**

C - Operator/Crew
O - Organizational
F - Direct Support
H - General Support
D - Depot

e. Column 5, Tools and Equipment. **Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.**

f. ***Column 6, Remarks.*** **Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.**

D-4. Tool and Test Equipment Requirement (sect III).

a. Tool or Test Equipment Reference Code. **The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.**

b. Maintenance **Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.**

c. Nomenclature. **This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.**

d. National/NATO Stock Number. **This column lists the National/NATO stock number of the specified tool or test equipment.**

e. Tool Number. **This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.**

D-5. Remarks (sect IV)

a. Reference Code. **This code refers to the appropriate item in section II, column 6.**

b. Remarks. **This column provides the required explanatory information necessary to clarify items appearing in section II.**

(Next printed page is D–3.)

SECTOIN II MAINTENANCE ALLOCATION CHART
FOR

SIGNAL GENERATOR AN/USM-48

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	SIGNAL GENERATOR AN/USM-48 (HP 628A)	Inspect		0.3					
		Test				0.5		1 thru 14	
		Service				0.5		1	
		Adjust				1.0		1 thru 14	
		Install		0.3				1	
		Replace		0.3				1	
		Repair				0.3		1	
		Overhaul					24.0	1 thru 14	
01	CIRCUIT CARD ASSEMBLY, PULSE SECTION, A1	Inspect			0.3				
		Replace				0.5		1	
		Repair				0.5		1	
02	CIRCUIT CARD ASSEMBLY, POWER REGULATOR, A2	Inspect			0.3				
		Replace				0.5		1	
		Repair				0.5		1	
03	CIRCUIT CARD ASSEMBLY, MODULATOR, A3	Inspect			0.3				
		Replace				0.5		1	
		Repair				1.5		1	
04	KLYSTRON ASSEMBLY, A4	Inspect				0.3			
		Test				0.5		1 thru 14	
		Replace				0.5		1	
		Repair							A

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR

SIGNAL GENERATOR AN/USM-48

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	TOOL KIT, ELECTRONIC TK-105/G	5180-00-610-8177	
2	H,D	MULTIMETER AN/USM-223A	6625-00-999-7465	
3	H,D	OSCILLOSCOPE, HEWLETT-PACKARD 1608	b625-00-291-1029	
4	H,D	AUDIO OSCILLATOR, HEWLETT-PACKARD 200AB	6625-00-519-2384	
5	H,D	PULSE GENERATOR, HEWLETT-PACKARD 212A	6625-00-519-5593	
6	H,D	VACUUM TUBE VOLTMETER, HEWLETT-PACKARD 400D/H	6625-00-643-1670	
7	H,D	VACUUM TUBE VOLTMETER, HEWLETT-PACKARD 410B	6625-00-360-2493	
8	H,D	MICROWAVE POWER METER, HEWLETT-PACKARD 432A	4931-00-436-4883	
9	H,D	CRYSTAL DETECTOR, HEWLETT-PACKARD P421A	5961-00-867-6990	
10	H,D	CRYSTAL DETECTOR, HEWLETT-PACKARD K422A	6625-00-874-7733	
11	H,D	THERMISTOR MOUNT, HEWLETT-PACKARD P487B	6625-00-618-9192	
12	H,D	THERMISTOR MOUNT, HEWLETT-PACKARD K487C	6625-00-838-1343	
13	H,D	FREQUENCY METER, HEWLETT-PACKARD P532A	6625-00-691-6598	
14	H,D	FREQUENCY METER, HEWLETT-PACKARD K532A	6625-00.444-6085	

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	RETURN TO MANUFACTURER FOR REPAIR

APPENDIX F

BACKDATING

MANUAL CHANGES

Model 628A
SHF SIGNAL GENERATOR

Make all backdating corrections in this manual according to changes below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
134 thru 253	A, B, C, D, E, F	652-01617 and below	E, F
254 thru 008-00328	B, C, D, E, F	652-01668 and below	F
016-00329 thru 301	C, D, E, F		
652-	D, E, F		

CHANGE A: Parts Lists:
Change R117 to 750K ohms HP Part No. 0727-0253.
Change R118 to 284K ohms HP Part No. 0730-0083.
Change R121 to 900K ohms HP Part No. 0730-0103.
Change R122 to 405K ohms HP Part No. 0727-0240.

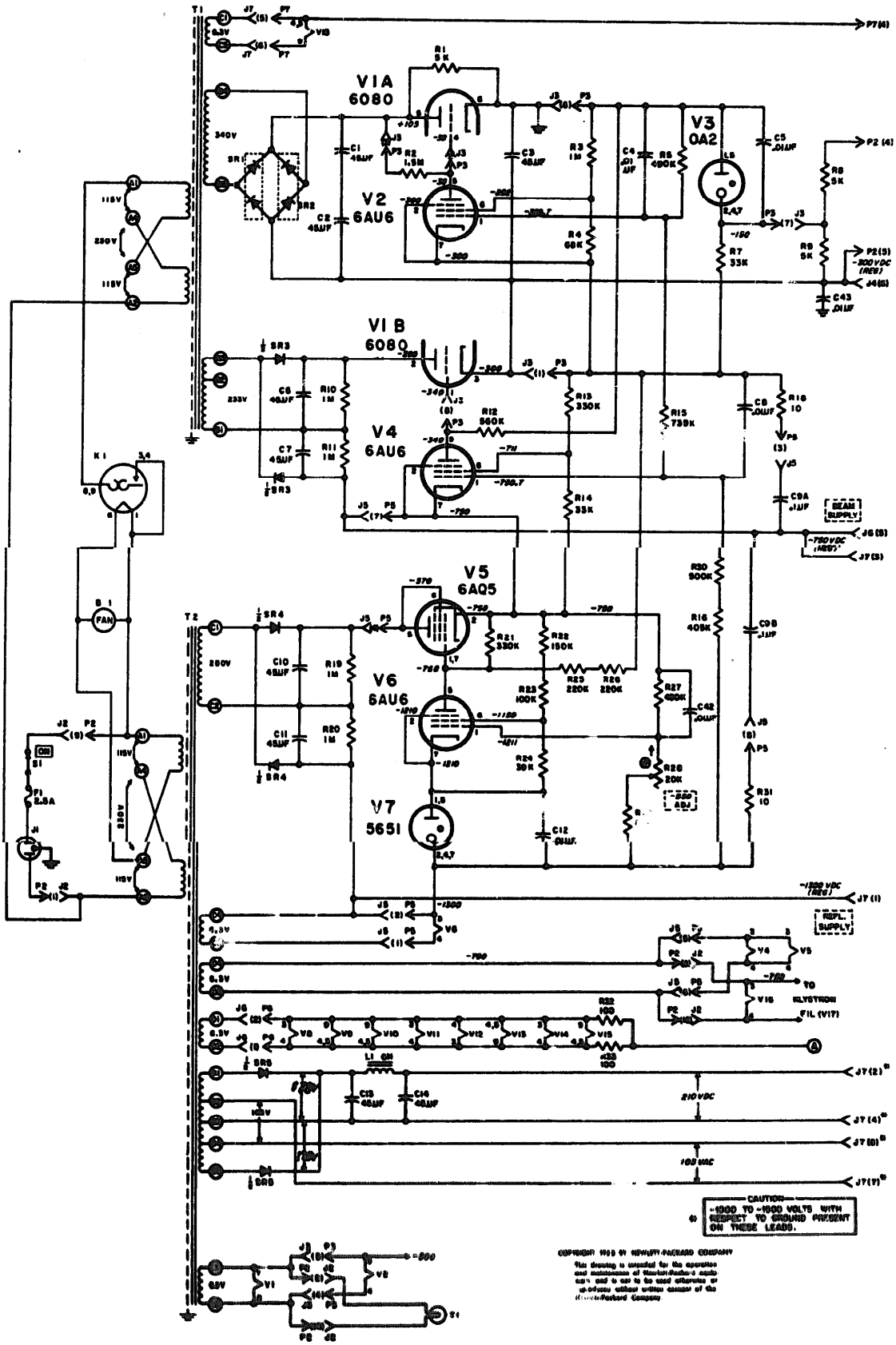
CHANGE B: Refer to power supply schematic on following page and to Parts Lists:
Delete C46, C47, CR2 through CR15, R139 through R142, R134, and RT1.
Add C2, C3, C13, and C14: C:fxd, elect, 45 uF, 450 VDCW.
Add SR1 and SR2: Rectifier Metallic HP Part No. 1883-0002.
Add SR3: Rectifier Metallic HP Part No. 1883-0004.
Add SR4: Rectifier Metallic HP Part No. 1883-0003.
Add SR5: Rectifier Metallic HP Part No. 1883-0002.
Change T1 to HP Part No. 9100-0072.
Change T2 to HP Part No. 9100-0071.

CHANGE C: Parts Lists:
Change C40 to HP Part No. 0150-0012 C:fxd, cer, 0.01 uF, 20%, 1000 VDCW.

CHANGE D: Parts Lists:
Delete the asterisk (*) from R41.

CHANGE E: Parts Lists:
Change B1 from HP Part No. 3140-0052 to HP Part No. 3140-0010.

CHANGE F: Figure 5-16 and Parts Lists:
Change R131* "FACTORY SELECTED PART" from 18 ohm, HP Part No. 0693-1801, 2 per, to 47 ohm, HP Part No. 0693-4701, 2 per.



Model 628A Power Supply Schematic Diagram - Serials 13 % through 008-00326

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 628A
Date Printed: January, 1970
Part Number: 00628-90004

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
▶977-	1
1101A	1, 2
1126A	1, 2, 3
1149A01849 to 01968	1 thru 4
▶1149A01969 to 02016	1 thru 5
1311A02019 to 02068	1 thru 6

Serial Prefix or Number	Make Manual Changes
1311A02069 to 02328	1 thru 7
1542A	1 thru 8
▶1604A	1 thru 9

▶NEW ITEM

ERRATA

▶**Page 5-23, Figure 5-18 and Parts List:**

Change C26 and C30 to 0140-0044 C: FXD MICA 560 PF 10%.
Delete R59 and R67; connect pins 5 and 7 to pin 2 on V11 and V14.
Change V11 and V14 to 1941-0005 ELECTRON TUBE: 2D21.

Parts List:

Delete 1400-0084 FUSEHOLDER, and add the following items in its place.

1400-0090	WASHER, NEOPRENE
2110-0465	CAP, FUSEHOLDER
2110-0467	NUT, HEX
2110-0470	FUSEHOLDER

NOTE

If any part of the old fuseholder (1400-0084) needs replacing, all four parts of the new fuseholder must be ordered. The old fuseholder can be identified by a straight solder lug to which the white-black-gray wire attaches. On the new fuseholder the solder lug is at a right angle to the body.

Add Label, Warning, HP Part No. 7120-4162 (Qty 3) "HAZARDOUS VOLTAGE" (Large).
Add Label, Warning, HP Part No. 7120-4163 (Qty 2) "HAZARDOUS VOLTAGE" (Small).
Add Label, Warning, HP Part No. 7120-4295 "HAZARDOUS VOLTAGE ALWAYS PRESENT. . . ."
Add Label, Warning, HP Part No 7120-5087 "TO PREVENT ELECTRICAL SHOCK. . . ."

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

10 February 1976
5 Pages

HEWLETT hp PACKARD

Printed in U.S.A.

CHANGE 1

Page 2-1, paragraph 2-11:
Delete paragraph 2-12 and replace with the **following:**

2-12. To operate the Model 628A from a 230-volt + 10% source, p**roceed as follows:**

a. Turn unit off.
b. Place 115/230 switch on rear to the 230-volt position.
c. Change line fuse to 2 ampere.

Page 5-21, Figure 5-16:
Replace existing Figure 5-16 with the new attached copy.

Parts List:
Change DS1 to Lamp: Flow, HP Part No. 2140-0244.
Change Fl(115V) to 4 amp standard, HP Part No. 2110-0055.
Change F1 (230V) to 2 amp standard, HP Part No. 2110-0002.
Add Jl, Connector: AC Receptacle 3 pin male, HP Part No. 1**251-2357**
Change Pl to HP Part No. 8120-1348. The power cord is now **detachab**le.
Add R142, R:FXD, MET FLM, 34.8K OHM, 1% 1/2W, HP Part No. 0757-0123.
Change Sl to Switch: Pushbutton, HP Part No. 3101-1248.
Add S5, Switch: 4PDT Slide, HP Part No. 3101-1272.

CHANGE 2

Table l-l, Sync Out Signal:
Change (2) to read, "...variable 5 to 300 microseconds change all other references in the**manual, pertaining to Sync** out **Pulse, from "3 to 300 microseconds to "5 to 300 microseconds."**

CHANGE 3

Table 1-1, Page 1-0:
Under Output Range change last line to mad, "than 2.5 at +10 dBm; 1.35 at 0 dBm and lower,"

CHANGE 4

Table 6-1, Page 6-7,
Add:
628A-3 Panel Assy (Light Gray).
00628-60028 Panel Assy (Light Gray).
00628-60022 Cabinet Assy (Blue Gray).
00628-60031 Cabinet Assy (Live Gray).
00628-60024 Panel Assy Rack Mount (Light Gray).
00628-60029 Panel Assy Rack Mount (Mint Gray).

Table 6-1, Page 6-2.
Change HP Part No. of C35.
Delete 0160-0050.
Add 0160-3192.

CHANGE 5

Page 5-23, Figure 5-18:
Change R43 to 1.23M.

Page 6-2, Table 6-1:
Change C35 to 0160-3192 C: FXD PAPER 0.1 UF ± 10% 1200 WVDC.

Page 6-4, Table 6-1:
Change R43 to 0730-0108, R:FXD DEP C 1.23M 1% 1W.

Page 6-9, Table 6-2:
Add 0730-0108, R:FXD, DEP C, 1.23M 1% 1W, 28480, 0730-0108.

CHANGE 6

Page 6-2, Table 6-1:
Change:
C36 to 0160-0595, C:FXD PAPER 0.25 UF ± 10% 1500 VDCW
C39 to 0160-0593, C:FXD PAPER 1 UF ± 10% 600 VDCW.

Page 6-8, Table 6-2:
Add:
0160-0593, C:FXD PAPER 1 UF ± 10% 600 VDCW, 56289, P34315
0160-0595, C:FXD PAPER 0.25 UF ± 10% 1500 VDCW, 56289, P52789.
Delete: 0160-0079 and 0160-0088.

NOTES

1. *When 0160-0593 first replaces 0160-0088, a new mounting bracket, HP Part Number 1400-0512, must also be ordered.*
2. *When 0160-0595 first replaces 0160-0079 a new mounting bracket, HP Part Number 1400-0526, must also be ordered.*

CHANGE 7

Page 5-23, Figure 5-18:
Change R69 to 75K.

Page 6-5, Table 6-1:
Change R69 to 0686-7535, R:FXD COMP 75K OHM 5% 1/2W.

Page 6-8, Table 6-2:
Add 0686-7535, R:FXD COMP 75K OHM 5% 1/2W, 01121, EB 7525, 1.
Delete 0687-5631.

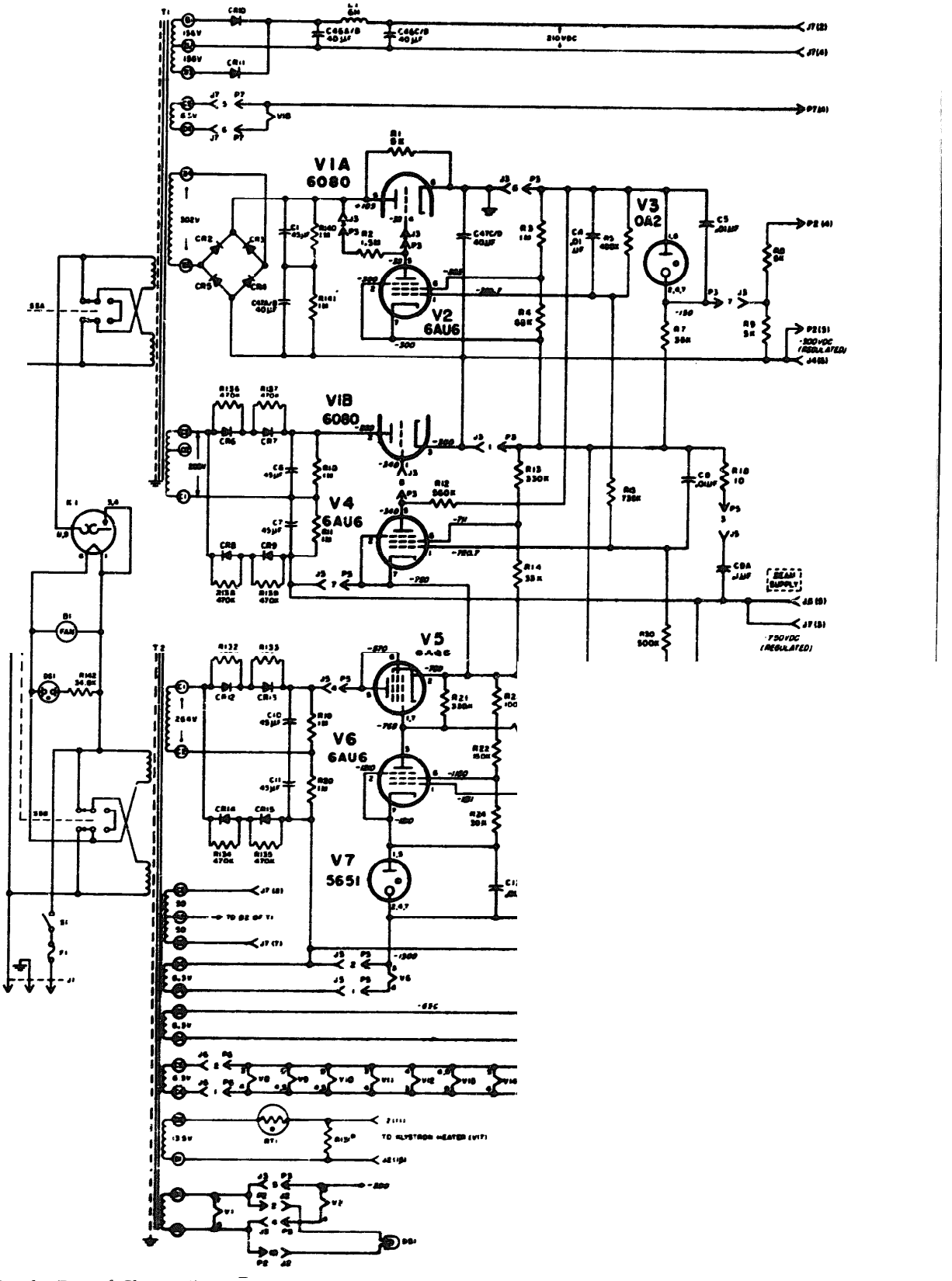
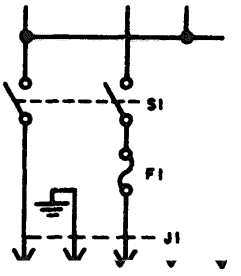


Figure 5-16. Power Supply (Part of Change 1)

CHANGE 8

Page 21, Figure 5-16:
Change line switch as shown in the following illustration.



Page 6-6. Table 6-1:
1 to 3101-1395 SWITCH-PB DPDT-DB ALTNG 105A 250 VAC,

Table 6-2:
3101-1248 (see Change 1) to 3101-1395 SWITCH-PB DPDT-DP ALTNG 10.5A 250 VAC.

CHANGE 9

Page 5-23, Figure 5-18:
Change C25 to 100 pF.
Change R58 to 47 kΩ.

Page 6-2, Table 6-1:
Change C25 to 0140-0041 C: FXD MICA 100 PF 5% 500 WVDC.

Page 6-5, Table 6-1:
Change R54 to 0687-1041 R: FXD COMP 100K OHM 10% 1/2W.
Change R58 to 0687-4731 R: FXD COMP 47K OHM 10% 1/2W.

WARRANTY CLAIM AND ADJUSTMENT PROCEDURE

for microwave tubes supplied by the
HEWLETT-PACKARD COMPANY
for use in Hewlett-Packard instruments

The procedure described **below is** for use within the United States. For warranty claims arising outside the U.S.A., before returning the tube, fill out form on the reverse side and send it with a request for shipping instructions to your nearest Hewlett-Packard Sales and Service Office or to:

(in Western Europe)

Hewlett-Packard S.A.
1217 Meyrin
Geneva, Switzerland
Telephone: (022) 41 54 00
Telex: 2.24.86
Cable: HEWPACKSA

(Rest of World)

Hewlett -Packard Co.
International Marketing Dept.
1501 Page Mill Road
Palo Alto, California, 94304, U.S. A.
Telephone: (415) 326-7000
Telex: 033811
Cable: HEWPACK

Microwave tubes supplied by the Hewlett-Packard Company, either as original or replacement, for use in Hewlett-Packard instruments are actually warranted by the tube manufacturer and not by Hewlett-Packard, However, all warranty claims on tubes obtained from us either as original or replacement will be processed by Hewlett-Packard.

In the event *of* failure you should purchase a new tube and return your old tube immediately to Hewlett-Packard. Credit allowances will be passed on to you upon receipt of the defective tube.

For your convenience, warranty claims for all microwave tubes supplied by the Hewlett-Packard Company may be made on this single form; merely fill out the information on the reverse side and return this form, along with the defective tube, to your Hewlett-Packard Sales and service Office or to Hewlett-Packard. Please be sure each space on the form is filled in--lack of complete information may delay processing of your claim.

Each tube manufacturer has his own warranty policy. Copies of individual Conditions of Warranty are available from your Hewlett-Packard Sales and Service Office or from the Hewlett-Packard Company.

SHIPPING INSTRUCTIONS

The following instructions are included to aid you in preventing damage in transit. Package your tube carefully-.. no allowance can be made on broken tubes.

1. Carefully wrap tube in 1/4 inch thick cellulosic cushioning, cotton batting, or other soft padding material. Cable assemblies and other accessories not rigidly mounted to the tube should be padded and wrapped separately to prevent damage to the tube during shipment.
2. Wrap the above in heavy kraft paper.
3. Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 2 inches of shock absorbing material, Be certain that the packing is tight all around the tube.
5 Tubes returned from outside the continental United States should be packed in a wooden box.
6. Mark container FRAGILE and ship prepaid via Airfreight or Railway Express, Do not ship via Parcel Post or Air Parcel Post since experience has shown that fragile items are more apt to be damaged when shipped by these means.

Note

Tubes with permanent magnets can interfere with magnetic compasses.
For air shipment plainly mark container: “MAGNETIZED MATERIAL”

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, ***or to:***

Hewlett-Packard Company
Customer Service Center
333 Logue Avenue
Mountain View, California 94040
USA

Rev 12/16/69

MICROWAVE TUBE WARRANTY CLAIM
INFORMATION FORM

IMPORTANT: Please answer all questions fully -- insufficient information may delay processing of your claim.

DATE: _____

PROM: (Tube Owner)

Company _____

Address _____

_____

_____

Tube type _____

Tube serial No. _____

Tube mfr. _____

Use in HP Model _____

Instrument serial No. _____

Tube is Original ( ) or Replacement ( )

Date tube received _____

Date of failure _____

Total hours filament operation _____

SYMPTOMS: (Please describe conditions prior to and at time of failure, along with description of tube's defect, if known) _____

_____

_____

_____

IMPORTANT:
Replacement (new) tube serial No. _____

Signature _____

Title _____ Title _____

12/16/69

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)
Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE 10 July 1975

PUBLICATION NUMBER	DATE	TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/PSC-76

TEAR ALONG DOTTED LINE

BE EXACT. . .PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		F03		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER: SSG I. M. DeSpiritof 999-1776

SIGN HERE: SSG I. M. DeSpiritof

DA FORM 1 AUG 74 2028-2

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FIND," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

HISA 1686-75

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2909-14	11 Sep 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TEAR ALONG DOTTED LINE

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 1 AUG 74 2028-2

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FIND," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and
Electronics Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

FOLD BACK

TEAR ALONG DOTTED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN, JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2909-14	11 SEP 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 1 AUG 74 2028-2

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FIND," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG DOTTED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and Electronics
Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

FOLD BACK

TEAR ALONG DOTTED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2909-14	11 Sep 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2

P.S. IF YOUR OFFICE WANTS TO KEEP UP WITH THE MANUAL, MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG DOTTED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and Electronics
Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

FOLD BACK

TEAR ALONG PERFORATION

By order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:
Active Army:
TSG (1)
USAARENBD (1)
USAINSCOM (2)
TRADOC (2)
DARCOM (1)
CS Maj Comd (2)
USACC (1)
HISA (Ft Monmouth) (26)
Armies (1)
USASIGS (10)
Svc Colleges (1)
Ft Carson (5)
Ft Gillem (10)
Ft Huachuca (5)
Ft Richardson (CERCOM Ofc) (1)
WSMR (1)

ARNG: None
USAR: None

USAERDAA (1)
USAERDAW (1)
Army Dep (1) except
LBAD (10)
SAAD (30)
SHAD (3)
TOAD (14)
USA Dep (1)
Sig Sec USA Dep (1)
USASATC&S (2)
Units Org Under Fol TOE:
29-134
29-136
32-52
32-57 (1 ea)
29-207
29-610 (2 ea)

For explanation of abbreviations used, see AR 310-50.

DEPARTMENT OF THE ARMY
US ARMY AG PUBLICATIONS CENTER
1655 WOODSON ROAD
ST. LOUIS, MISSOURI 63114

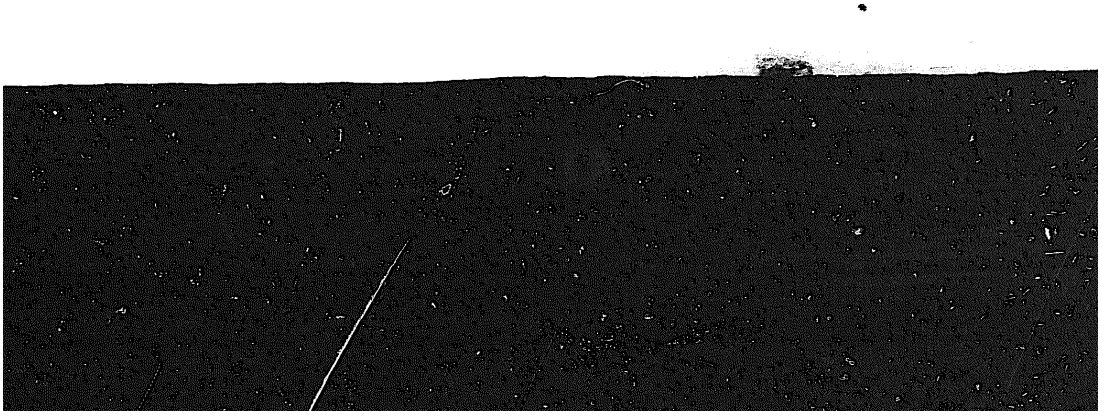
OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314

END

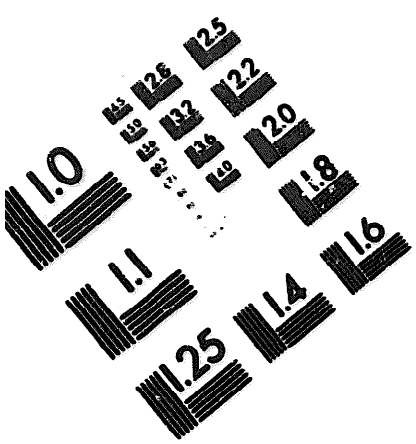
9-18-83

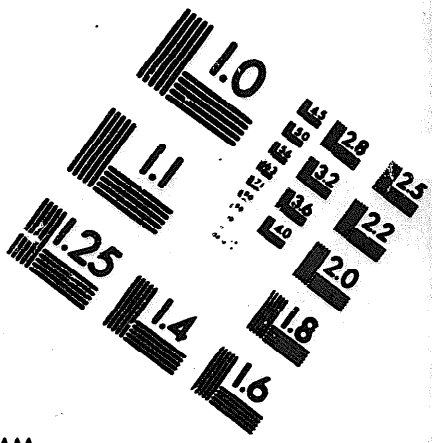
DATE



DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

1.5 mm (e= 1.09 mm)

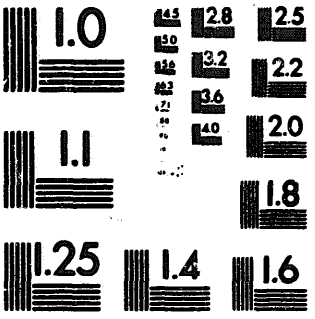
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

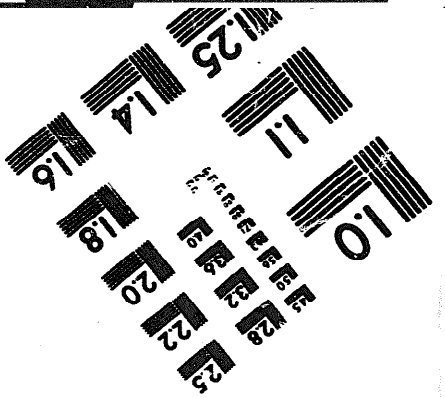
2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM



250 MM