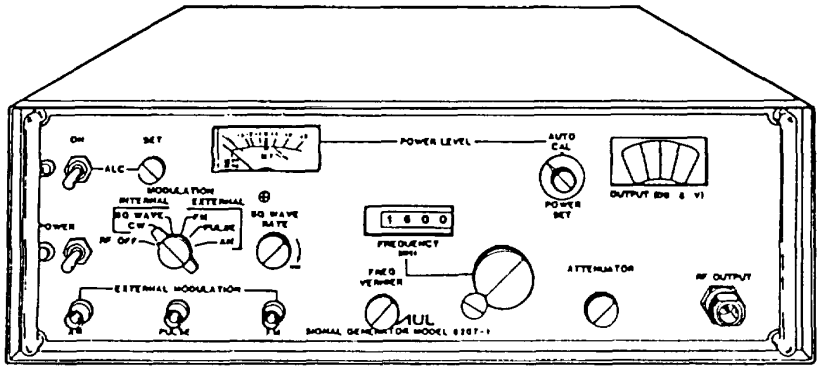
TECHNICAL MANUAL

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



SIGNAL GENERATOR
AN/USM—213B
(NSN 6625—00—872—3215)

HEADQUARTERS, DEPARTMENT OF THE ARMY
WASHINGTON, DC
26 DECEMBER 1985

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1 DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2 IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3 IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL

4 SEND FOR HELP AS SOON AS POSSIBLE

5 AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

WARNING

HIGH VOLTAGE

HIGH VOLTAGE is used in the operation of this equipment. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

Be careful not to contact high voltage connections of the 115 volt AC or 230 volt AC input connections when installing or operating this equipment. The High Voltage supplies produce voltages of 775V which power the Klystron oscillator.

Whenever possible, the power supply to the equipment must be shut off when working inside the unit.

When alining or troubleshooting inside the unit-when power must be on-extreme care should be used at all times to avoid contact with dangerous voltages.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

For artificial respiration, refer to FM 21-11 and the paragraph below.

WARNING

TOXIC SUBSTANCES

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of the vapor should be avoided. The solvent should not be used near heat or open flame. The products of decomposition are toxic and irritating.

Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be AVOIDED. When necessary, use gloves which solvent cannot penetrate. If the solvent is taken internally, SEEK MEDICAL HELP IMMEDIATELY.

TECHNICAL MANUAL
No. 11-6625-3053-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 26 December 1985

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL SIGNAL GENERATOR AN/USM-213B (NSN 6625-00-872-3215)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS You can help improve this manual. If you find any mistakes or if you know a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Headquarters, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5007. A reply will be furnished to you.

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TABLE OF CONTENTS (CONT.)

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LIST OF TABLES

HOW TO USE THIS MANUAL

This manual tells about operating and maintaining the AN/USM-213B Signal Generator at the Operator's, Organizational, Direct Support, & General Support Maintenance level.

Use the front cover locator index and corresponding tab marked pages to find quickly those parts of the manual shown on the cover. Those portions of the manual were chosen because they are used often.

This manual has been divided into chapters, sections, and paragraphs which are numbered sequentially. Tables and figures are also numbered this way.

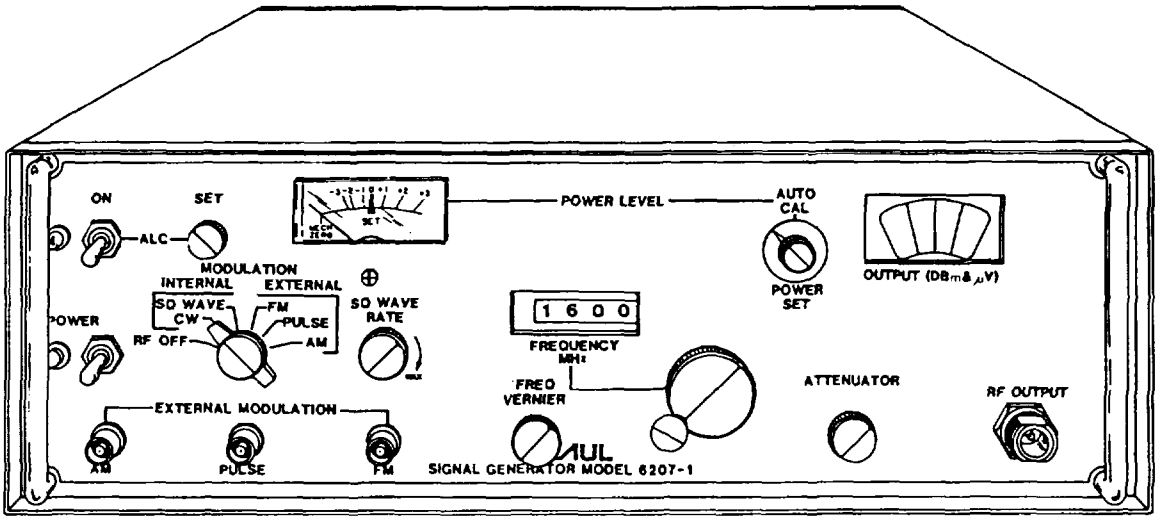


Figure 1-1. Signal Generator AN/USM-213B

CHAPTER 1

INTRODUCTION

SECTION I. GENERAL INFORMATION

1-1. SCOPE.

This manual describes the operation of Signal Generator AN/USM-213B and covers its Organizational and General Support Maintenance. There is no Operator or Direct Support Maintenance since maintenance at these levels is not authorized by the Maintenance Allocation Chart (MAC) Appendix B.

The Signal Generator provides accurate CW or modulated signals, calibrated to frequency and power, in the range of 800 MHz to 2400 MHz. Its output can be used to test microwave systems and components in that range. See Figure 1-1 for external view of the AN/USM-213B.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the Signal Generator.

1-3. MAINTENANCE FORMS, RECORD, AND REPORTS.

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records which are to be used by maintenance personnel at all levels are listed in and prescribed in DA Pam 738-750 as contained in Maintenance Management update.

b. Report Packaging and Handling Deficiencies. Fill out and forward SF364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73A/AFR 400-54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P- 4610.19D/DLAR 4500.15.

1-4. ALINEMENT.

Alinement of this instrument is covered by the procedures in Chapter 6., Section V, Alinement.

1-5. EQUIPMENT IMPROVEMENT RECOMMENDATION.

If your Signal Generator 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 us know why you don't like the design. Put it on an SF-368 (Quality Deficiency Report). Mail it to Commander, US Army Communications- Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703- 5007. We'll send you a reply.

1-6. WARRANTY INFORMATION.

This Signal Generator AN/USM-213B is warranted by Aul Instruments, Inc. against defects in material and workmanship for a period of one year from date of original acceptance and shipment, except for the klystron tube, which is warranted

for 1000 hours of operation or one year, whichever comes first. Report all defects in material and workmanship to your supervisor, who will take appropriate action through your organizational maintenance shop.

1-7. DESTRUCTION OF ARMY MATERIEL.

Destruction of Army Electronics Materiel to prevent enemy use shall be in accordance with TM 750-244-2. If destruction of the Signal Generator is to be by explosives, refer to FM 5-25 Explosives & Demolitions.

1-8. ADMINISTRATIVE STORAGE.

Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness. Disassembly and repacking of equipment for shipment or limited storage are covered in paragraphs 2-3 and 4-8.

1-9. LIST OF ABBREVIATIONS.

A	Amperes
AC	Alternating Current
ADJ	Adjust
approx	approximately
AR	Army Regulations
assy	assembly
atten	attenuator
aux	auxiliary
cal	calibrated
ckt	circuit
CW	continuous wave
DA	Department of the Army
dB	decibel
dBm	decibel referenced to 1 milliwatt
DC	Direct Current
ext	external
fd	farad
gen	generator
gnd	ground
hor	horizontal
mA	milliamperes
max	maximum
min	minimum
mins	minutes
mV	millivolts
mW	milliwatts
neg	negative
osc	oscillator
P/O	part of
P-P	peak to peak
para	paragraph
pos	positive
pot	potentiometer
pps	pulses per second
reg	regulating
rep	repetition

sig	signal
scope	oscilloscope
T/S	troubleshooting
uA	microamperes
ufd	microfarad
uV	microvolt
V	volts
vert	vertical
Xfmr	transformer

AN/USM-213B is referred to as the instrument, signal generator, sig gen, or equipment.

SECTION II. EQUIPMENT DESCRIPTION

1-10. EQUIPMENT CHARACTERISTICS, CAPABILITIES & FEATURES.

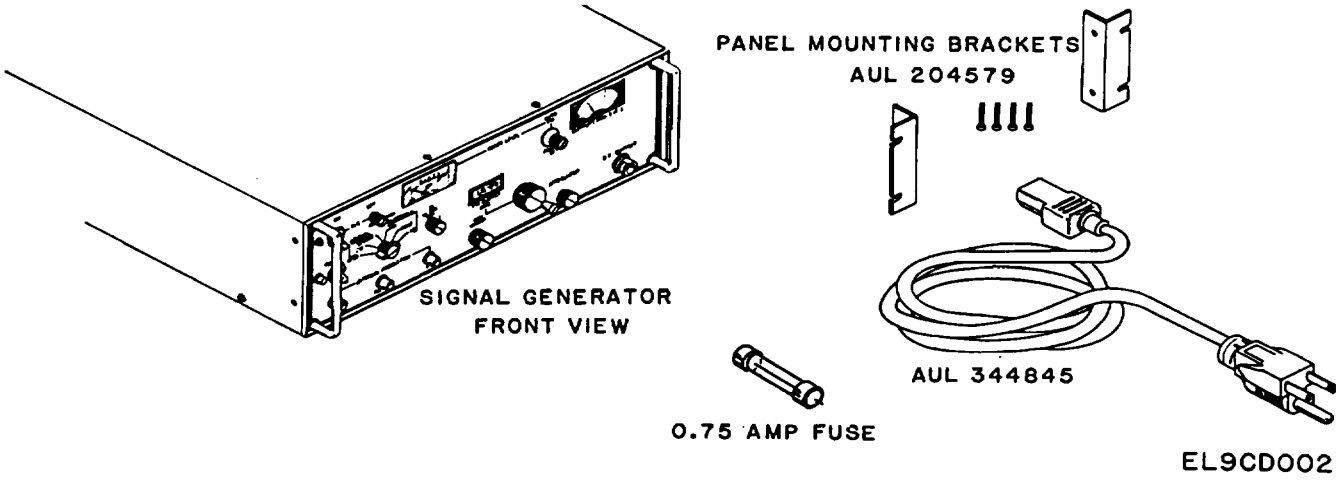
The AN/USM-213B Signal Generator is a self contained, portable or rack mounted high frequency RF generator producing signals of calibrated frequency and power output. It is used for testing a variety of broad and narrow band microwave systems and components.

Capabilities & Features

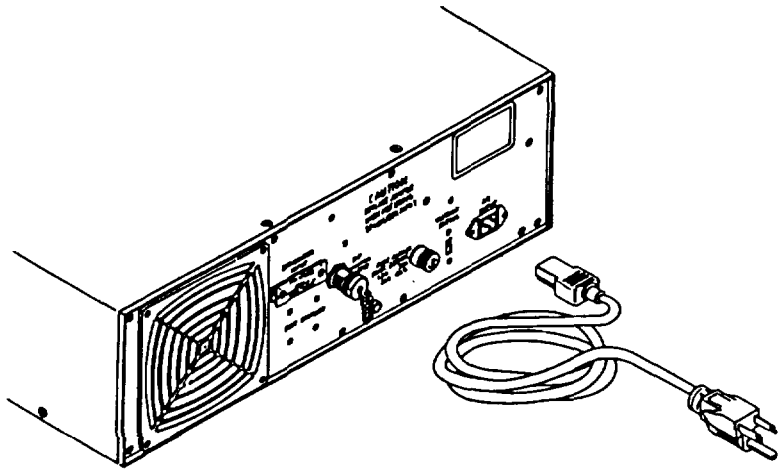
a. High frequency accuracy: 800 MHz to 2400 MHz
b. Output power
   1. Calibrated: 1 mW calibrated down to -127 dBm
   2. Max uncalibrated: 10 mW
c. CW or four different types of modulated signal output
d. Stable operation-low drift
e. High purity signal output
f. Low noise output

1-11. DESCRIPTION OF MAJOR ITEMS.

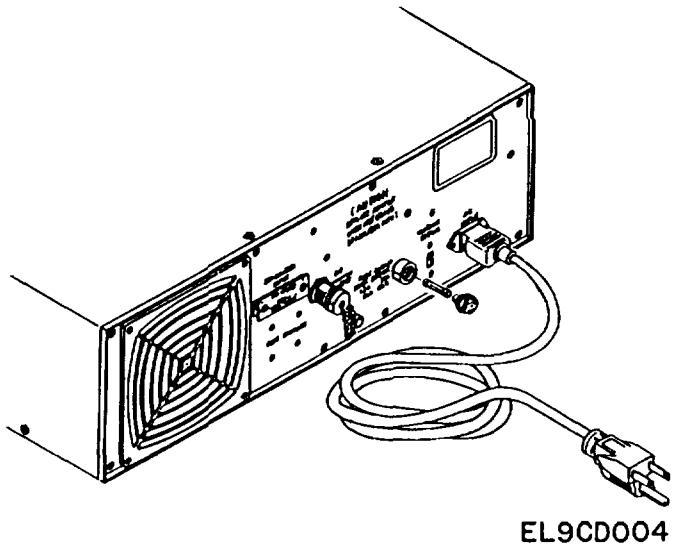
The signal generator includes a line (power) cord, panel mounting bracket set (with hardware) and alternate fuse, as shown below.



The line power cord attaches to the rear panel of the instrument.



The fuse is also mounted on the rear.

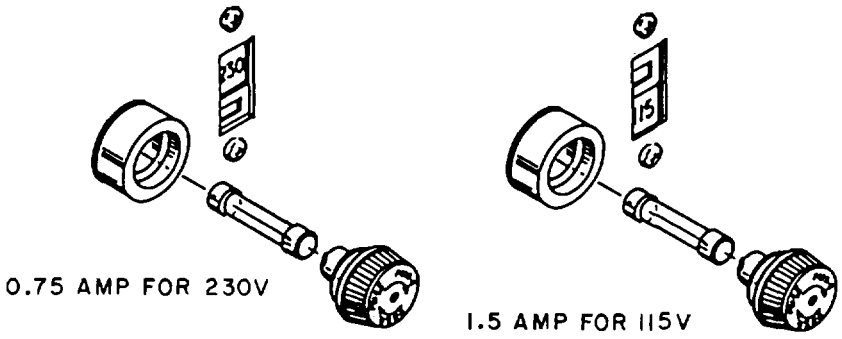


The instrument is shipped with a 1.5 amp fuse mounted in holder for use on 115V, 50-60 Hz power source. The 0.75 amp fuse is used with 230V, 50-60 Hz power source.

CAUTION

Be sure that Voltage Rating Switch is in the proper position (115V or 230V) and the proper fuse is in the unit for the line voltage available.

VOLTAGE RATING SWITCH SETTINGS	VOLTAGE RATING SWITCH SETTINGS



1-12. PHYSICAL DATA.

The dimensions and weights of the Signal Generator are given below.

HEIGHT	5 5/8 in.	BENCH MOUNT
WIDTH	16 1/2 in.	
LENGTH	21 in. (incl. handles)	
WEIGHT	43 lbs.	
HEIGHT	5 1/4 in.	RACK MOUNT
WIDTH	19 in.	
LENGTH	21 in. (incl. handles) 19 1/2 in. (behind panel)	
WEIGHT	40 1/4 lbs.	
LENGTH	90 in.	LINE (POWER) CORD
WEIGHT	1/4 lb.	

See Figure 1-2 for illustration of outline dimensions for bench and rack installation.

Instructions for both installation modes are given in Chapter 4, Section II, Service Upon Receipt. See para 4-6 and 4-7.

1-13. PERFORMANCE DATA.

a. Frequency

1.	Range	800 MHz to 2400 MHz
2.	Dial accuracy	<+/-5 MHz
3.	Stability	<50 ppm/week at constant ambient temperature and constant line voltage after 4 hour warm-up.
4.	Temperature coefficient	<-80 ppm/deg C

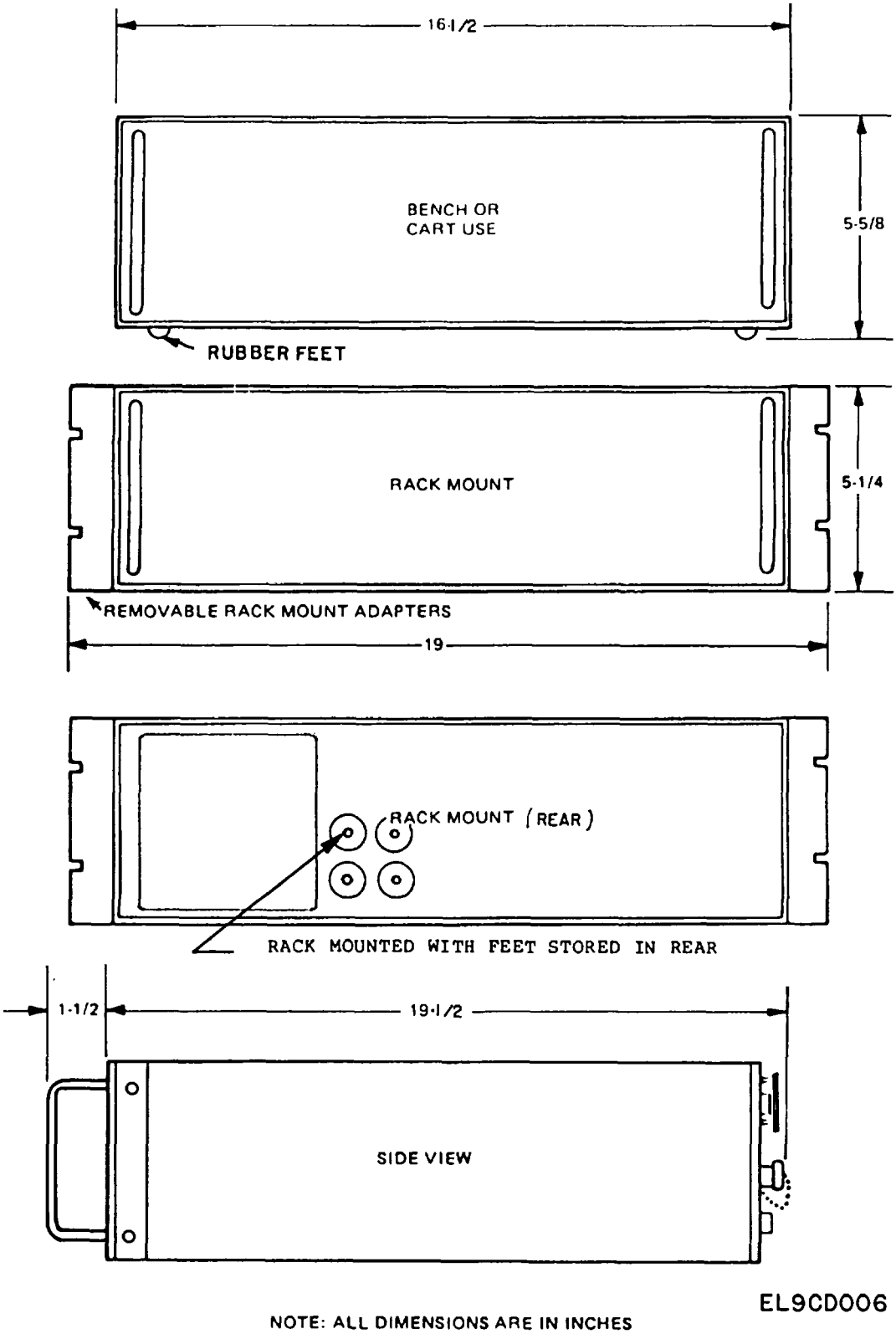


Figure 1-2. Outline Installation Drawing

b. Output

1.	Power	+10 dBm to-127 dBm
2.	Attenuator Accuracy	+/-2 dB (0 to -127 dBm)
3.	Impedance	50 ohms nominal
4.	SWR	<2
5.	Auxiliary	<-6 dBm
6.	Leveled Variation	<+/-0.75 dB(0 to-127 dBm)
7.	RF Power Accuracy	Attenuator Accuracy + Leveled Variation (0 to -127 dBm)

c. Modulation, External

1.	AM		
	a.	Frequency	DC to 1 MHz
	b.	Depth	0 to 90%
2.	FM		
	a.	Frequency	DC to 100 KHz
	b.	Deviation	DC to 1 MHz
3.	Pulse (PM)		
	a.	Pulse/Second (PPS)	50 Hz to 50 KHz
	b.	Rise Time	<2 microseconds from 10% to 90% of Pulse Amplitude
	c.	Fall Time	<3.5 microseconds from 10% to 90% of Pulse
	d.	On/Off Ratio	>20 dB

d. Modulation, Internal Square Wave — 950 to 1050 Hz continuously variable duty cycle-45% to 55% Max

e. Harmonics — <-30 dB below carrier

f. Power Input

1.	Voltage	115/230
2.	Frequency	50/60
3.	Watts	150

g. Rack Mountable

1-14. SAFETY, CARE & HANDLING.

The AN/USM-213B is a precision electronic instrument and must be handled as such.

a. Avoid electrical shock.
- Always follow recommended operating procedures (see para 2-5)
- Always use the correct 3-wire power cord which grounds front panel, chassis, and cover at all times.
- Never operate the equipment without its protective dust cover.
- Always make sure equipment is dry.

b. Maintain properly.
- Pay particular attention to performing equipment Preventive Maintenance Checks and Services (PMCS) (Chapter 2, Section II).
- Keep equipment clean at all times.
- Keep accessories and this manual together in a safe place.
- If equipment is rack mounted, make sure it is securely fastened.

c. Handle carefully.
- When lifting or moving instrument, always have a firm grip on one of the front panel handles, with the other hand around the opposite rear side of the case.
- Never drop instrument abruptly or subject it to unnecessary jarring or physical shock.

SECTION III.

PRINCIPLES OF OPERATION

1-15. PRINCIPLES OF OPERATION.

Consult Figure 1-3 which refers to items noted in explanation.

a. The heart of the AN/USM-213B is the klystron oscillator (Item Ⓐ) which produces signals from 800 MHz to 2400 MHz.

1. Signal produced by klystron tube in cylindrical cavity of variable resonant internal length.
   a) Klystron tube powered by 4 different power supplies (Item Ⓑ).
      - -750V Repeller.
      - -325V Beam.
      - +6V Filament.
      - Grid Supply.

      The repeller and beam supplies are regulated by the AI osc regulating assy (Item Ⓒ).

   b) Frequency control ganged linearly with rotation of three key elements.
      - Frequency cam (Item Ⓓ).
      - Frequency readout on front panel.
      - Repeller pot (Item Ⓔ) determines repeller voltage on klystron tube.

   c) Klystron oscillator has three probes.
      - Power Set Probe (Item Ⓕ). Penetration is variable and controlled by front panel POWER SET control.

        At a given frequency, POWER SET control adjusts penetration of power set probe to register 1 mW or SET or "0" on front panel POWER MONITOR meter. This is called POWER SETTING. See para 2-5 d.1.

        At same time, attenuator hairline (Item Ⓖ) seeks correct position relative to attenuator dial.

      - Attenuator Probe (Item Ⓗ). Penetration is variable and controlled by front panel ATTENUATOR control.

        Output goes to the front panel RF OUTPUT jack.

        At same time, attenuator dial (Item Ⓘ) shows attenuation reading at hairline corresponding to depth of probe in cavity. Attenuator dial is linear and graduated in dBm and microwatts.

      - RF MONITOR Probe (Item Ⓙ) is fixed. Output goes directly to rear panel RF MONITOR jack.

NOTE

When producing a signal at a fixed frequency, the operator POWER SETS the instrument as in 1-c above before setting the attenuator dial at a given power output level.

If signals at a given power output level must be simulated at different frequencies or over a frequency range, the leveling circuits are put into play.

b. Leveling. When the ALC or Automatic Leveling Control switch is turned on, the instrument is capable of maintaining a given power output over its entire frequency range without manually POWER SETTING. Output levels may be varied as required.

In this case, the process is called ALC SETTING and is explained in para 2-5 e.

The ALC ckt is part of the Leveling & Modulation ckt or A3 assembly (Item Ⓚ). It works in conjunction with the Leveling Attenuator Assy A5 (Item Ⓛ) to control the output at a constant level.

c. Modulation. The AN/USM-213B is capable of modulating the RF OUTPUT signal in four different manners. The type of modulation is selected by setting the MODULATION switch to the required position. Three types of modulation are acted upon in the modulation part of A3 assy.

1. Internal Square Wave Modulation. The square wave signal is generated in the modulation ckt of A3 assy.
2. External AM Modulation. A sine wave is introduced at front panel AM jack. This signal passes through a modulation ckt of A3 assy.
3. External Pulse Modulation. A pulse is introduced at front panel PULSE jack. This signal passes through a modulation ckt of A3 assy.

   All of the above modulating signals are injected at the AT-1 part of the leveling attenuator.

   The fourth and last type of modulation is external FM. A sine wave is introduced at front panel FM jack, goes through a ckt in A2 power supply and then is capacitor coupled directly to the klystron repeller.

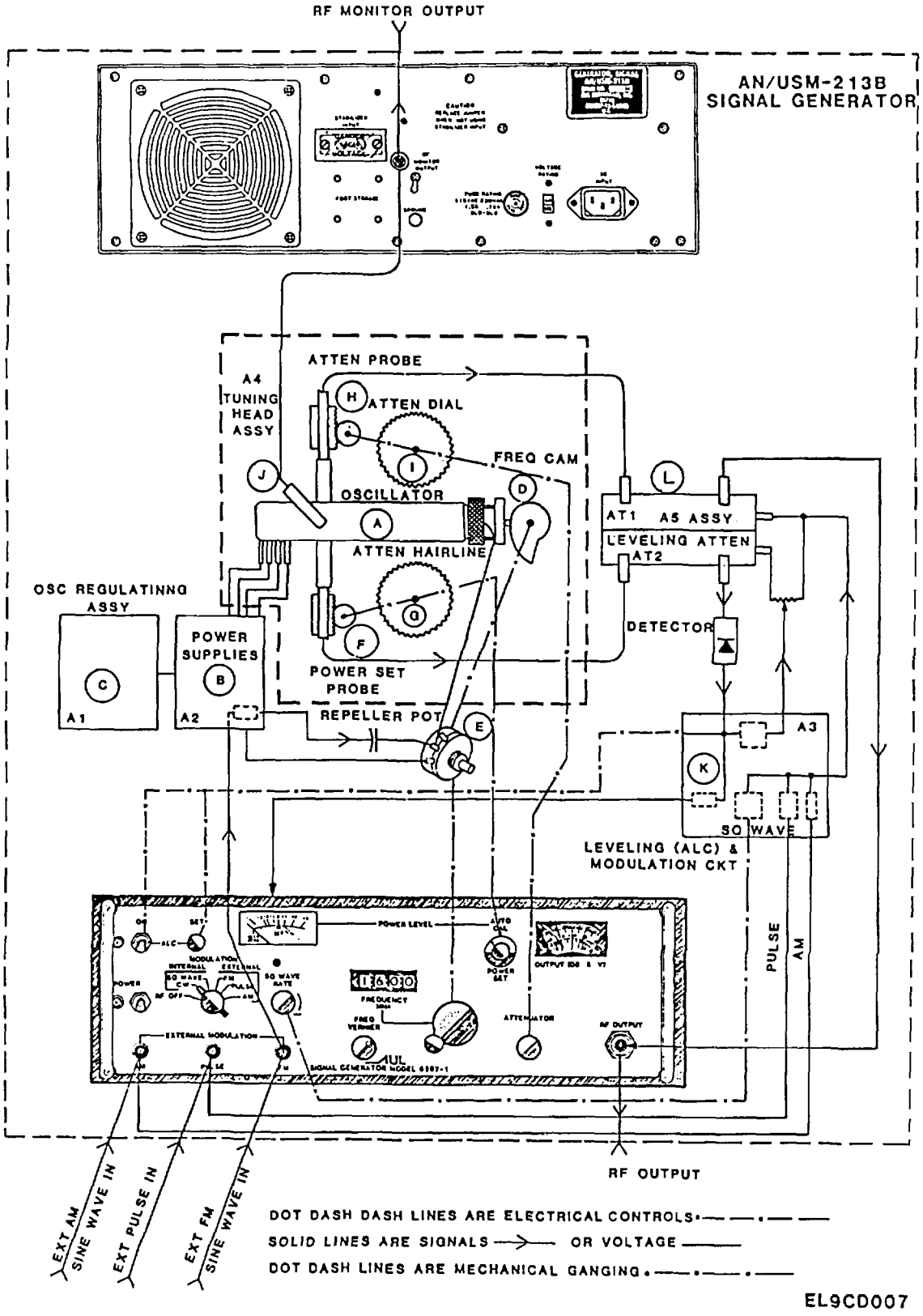


Figure 1-3. Simplified Block Diagram

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I.

DESCRIPTION & USE OF CONTROLS, INDICATORS & CONNECTORS

2-1. The illustration shows the front and rear panel controls, indicators, and connectors, while the associated table explains the function of each item.

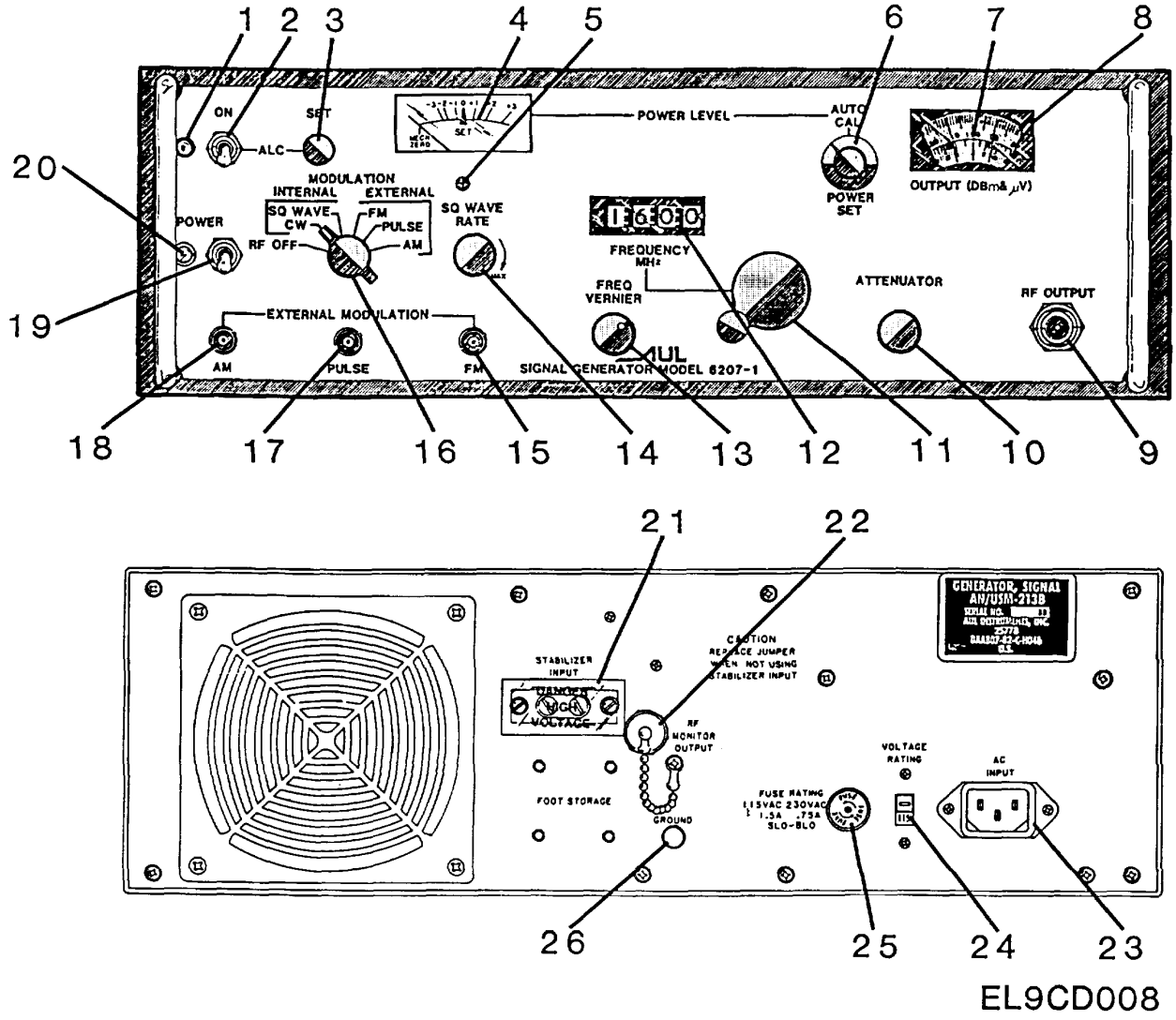


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Table 2-1. Description & Use of Controls, Indicators & Connectors

Key	Control, Indicator or Connector	Function
	The following are located on the front panel:	
1	ALC ON Indicator	Lights red when ALC switch is ON.
2	ALC Switch	Turns ALC circuit ON when set in its upward position.
3	ALC SET Control	Allows you to set power once for entire frequency range.
4	POWER MONITOR Meter	Shows when power set probe is set (POWER SET) or when ALC circuit is properly adjusted (ALC SET).
5	MECHANICAL ZERO ADJUST	Allows you to adjust position of meter needle to zero when signal generator POWER is OFF.
6	POWER SET/AUTO CAL Control	Allows you to SET POWER MONITOR meter when ALC is not ON. Simultaneously sets ATTENUATOR hairline. When ALC is ON, set white arrow to AUTO CAL on front panel, and ALC SET.
7	ATTENUATOR Hairline	Shows you where to read the attenuation level on the ATTENUATOR DIAL.
8	ATTENUATOR DIAL	Allows you to read the ATTENUATION level at the location of the ATTENUATOR hairline.
9	R F OUTPUT Jack	Connects the signal generator output to other equipments in a test set-up.
10	ATTENUATOR Control	Allows you to vary the attenuation level of the RF output.
11	FREQUENCY Control	Allows you to vary the frequency across the frequency range of the signal generator.
12	FREQUENCY MHz	Allows you to read the frequency which you set with the FREQUENCY control.
13	FREQ VERNIER Control	Allows you to vary the frequency output over small limits from the displayed value.
14	SQUARE WAVE RATE Control	Allows you to vary the frequency rate of the internal square wave generator when the MODULATION switch is in INTERNAL SQ. WAVE position.
15	EXTERNAL FM Jack	Allows you to introduce an external sine wave signal to modulate the RF output.

Table 2-1. (Continued)

Key	Control, Indicator or Connector	Function
16	MODULATION Switch	Allows you to select any of six modes of operation of the signal generator- RF OFF, CW, INTERNAL SQ WAVE; EXTERNAL FM, PULSE, OR AM.
17	EXTERNAL PULSE Jack	Allows you to introduce an externally generated pulse used to pulse modulate the RF output.
18	EXTERNAL AM Jack	Allows you to introduce an external sinusoidal signal to AM modulate the RF output.
19	POWER Switch	When set in the upward position, it turns the signal generator power on.
20	POWER INDICATOR	Lights green when the POWER switch is turned ON.
	The following are located on the rear panel:	
21	STABILIZER INPUT	Allows you to introduce a correction voltage to the klystron repeller from an external phase lock frequency stabilizer. **DANGER** STABILIZER INPUT is at 750 volts. Avoid bodily contact. Always keep input covered when not in use.
22	RF MONITOR Jack	Allows the RF output from a fixed oscillator probe to feed an external phase lock frequency stabilizer, or for cases where synchronized dual RF output are required.
23	AC INPUT Receptacle	Accepts power cord which connects line power to the signal generator.
24	VOLTAGE RATING Switch	Allows instrument to adapt to two different line voltages -115 VAC or 230 VAC.
25	FUSE Holder	Holds fuse of proper value to coordinate with available line voltage: 1.5 amps for 115V or 0.75 amps for 230V.
26	GROUND Jack	A point at chassis ground potential for testing, or auxiliary grounding of instrument.

SECTION II.

OPERATOR PREVENTIVE MAINTENANCE CHECKS & SERVICES

(OPERATOR PMCS)

2-2. You must do scheduled preventive maintenance checks and services (PMCS) to make sure that your signal generator is always in operating condition. When you are doing any PMCS or routine checks, keep in mind the WARNINGS & CAUTIONS about electrical shock and bodily harm.

PMCS PROCEDURES

a. Tools, Materials, and Equipment Required for Preventive Maintenance. No special tools or equipment are required for operator preventive maintenance. The following cleaning materials will be useful.

Lint free cloths
Soap or detergent
Trichlorotrifluoroethane

b. Routine Checks and Services, Routine checks and services are not listed in the PMCS table at the end of this section. You should do these whenever you see the need for them to be done. Do the following checks and services as necessary.

1. Clean your equipment.

Remove overall dust with a lint free cloth.

Brush dirt from meter face, attenuator window and frequency readout.

Use clean cloth slightly dampened with soapy water if meter face or attenuator window is foggy.

Check connectors for dirt or corrosion. Clean with soft rag or brush to remove encrusted dirt.

If equipment is particularly encrusted with dirt, wipe with clean cloth moistened with trichlorotrifluorethane. Avoid plastic surfaces.

WARNING

Read precautions inside front cover on use of trichlorotrifluoroethane. Avoid contact. Use only in well ventilated area.

2. Check controls and switches for smooth operation.

3. Check for loose screws or knobs.

4. Check for completeness of equipment.

5. Check for completeness and current changes to publications.

c. Preventive Maintenance Checks and Services. Preventive maintenance checks and services are presented in tabular form. Refer to Table 2-2. An explanation of the columns in this table follows.

1. Item No. This column contains a number for each procedure to be performed. When reporting malfunctions or failures, place this number in the TM Item No. column of DA Form 2404, Equipment Inspection and Maintenance Worksheet.

2. Interval. These columns tell you when to do a procedure. A dot in the column indicates when the interval applies.

B stands for BEFORE you operate the equipment.
D stands for DURING operation of the equipment.
A stands for AFTER operating the equipment.
W stands for WEEKLY.
M stands for MONTHLY.

3. Item to be Inspected/Procedure. This column tells you what item to inspect and how to perform the required checks and services. Follow these instructions carefully and perform them in the order listed.

4. Equipment is Not Ready/Available If. This column tells you under what circumstances you cannot use your equipment. Refer to your supervisor if you get a cannot use indication.

Table 2-2. Operator Preventive Maintenance Checks & Services

NOTE

Within designated intervals, these checks and services are to be performed in the order listed.

B=Before Operation D=During Operation A=After Operation
W=Weekly M=Monthly

Item No.	Interval B	D	A	W	M	Item To Be Inspected Procedure/Repair if Necessary	Equipment Is Not Ready/Available If
1					•	BLOWER FILTER Unscrew rear panel blower filter plate and remove mesh filter. Soak filter in soapy water solution for 5 minutes. Agitate several times. Rinse in clear water and dry. Re-install.	If blower filter is clogged.
2	•					FUSEHOLDER & CAP (REAR PANEL) A. Verify that cap is present. Remove and inspect for presence of fuse. Request proper fuse if missing.	Fuse or cap is missing.
						CAUTION	
						B. Fuse value should be that necessary for supply voltage you are using for this instrument: 1.5A for 115V or 0.75A for 230V. SLO-BLO Check accessory pack for alternate fuse. Install if necessary.	Wrong fuse installed.
						C. Check fuse visually to insure it has not blown. Next higher maintenance level to replace blown or open fuse.	Fuse blown or open.

Table 2-2. (Continued)

B=Before Operation D=During Operation A=After Operation
W=Weekly M=Monthly

Item No.	Interval B	D	A	W	M	Item To Be Inspected Procedure/Repair if Necessary	Equipment Is Not Ready/Available If
3	•					VOLTAGE RATING SWITCH (REAR PANEL) CAUTION Make sure switch shows correct voltage for power source you are using. Flip it to correct position if necessary.	If voltage rating switch set to wrong line voltage.
4	•					POWER MONITOR METER Make sure that meter needle points to MECH ZERO before power turned ON. Adjust screw head below meter.	If meter needle does not point to MECH ZERO.
5				•		FRONT PANEL KNOBS Check for presence.	Any knobs missing.
6		•				INDICATOR LIGHTS Green light lit when power ON. Red light lit when ALC ON. Attenuator window lit.	Indicators not lit, or attenuator lamp not lit.
7		•				BLOWER Listen for blower operation when power ON.	Blower not working.
8		•				POWER SET CONTROL Moves attenuator hairline	If ATTEN Hairline does not move.
9		•				FREQUENCY CONTROL Displayed frequency increases as control turned clockwise.	If displayed frequency does not vary.

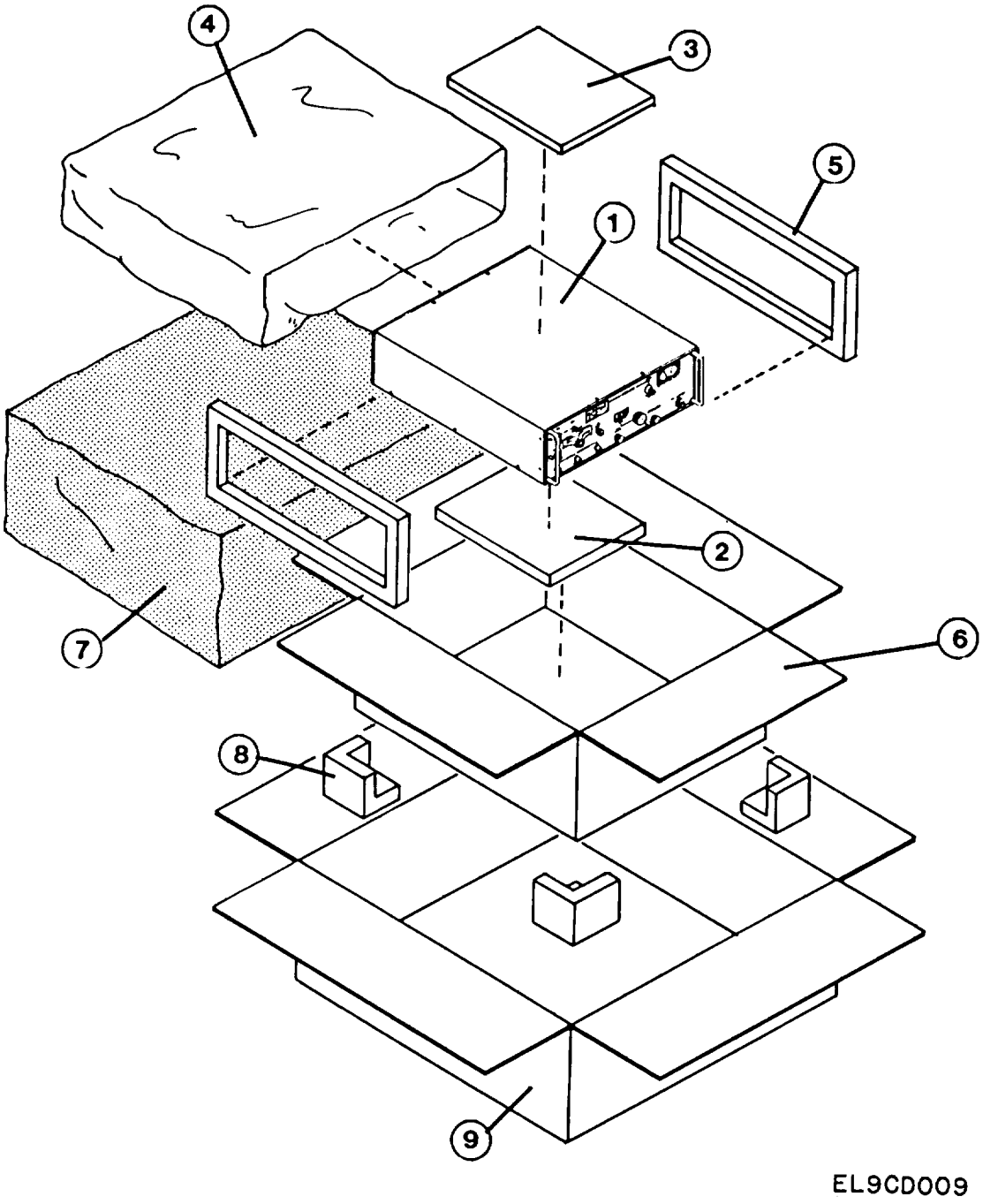
Refer to Appendix B, Maintenance Allocation Chart (MAC), at back of this manual. It tells you which maintenance level is authorized to repair your equipment when it fails any of your PMCS procedures.

SECTION III.

OPERATION UNDER USUAL CONDITIONS

2-3. UNPACKAGING INSTRUCTIONS.

The signal generator comes in a shock protected double carton packaging as shown:



The order of unpackaging is as follows:

Figure No.	Item of Packaging
9	Outer carton
8	8 ea styrofoam corner pieces
7	Vapor bag around inner carton
6	Inner carton
5	2 ea corrugated side inserts
4	Plastic bag
3	Technical Manual
2	Accessories
1	Instrument

After removing the equipment, the technical manual, and the accessories, the packaging should be returned through established supply channels for storage and future use.

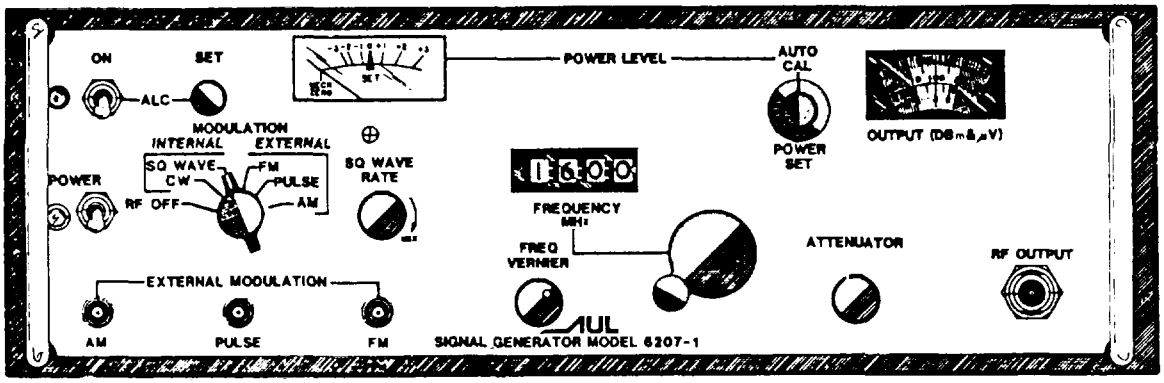
2-4. INITIAL ADJUSTMENTS.

CAUTION

Before connecting to power source, read all sections of this manual pertaining to the operation of the signal generator.

a. Place equipment close to power source on an adequate table or shelf, or rack mount it if preferable.

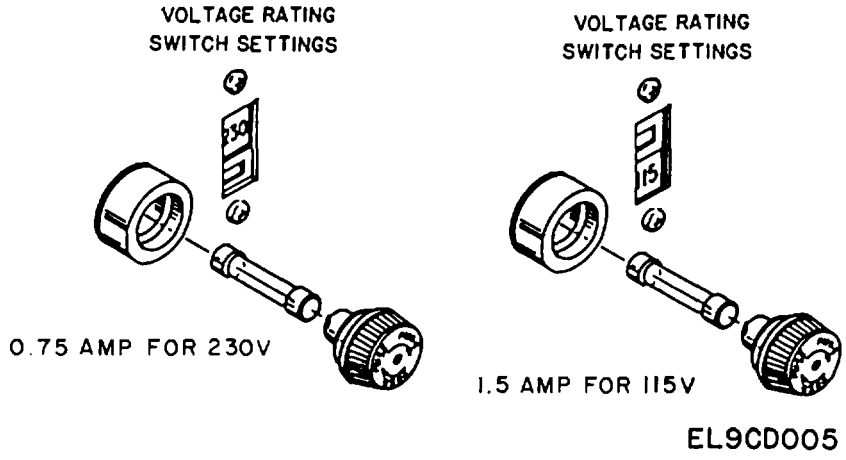
b. Be sure that the POWER switch is in the downward, or OFF position.



EL9CD010

CAUTION

Verify that position of the rear panel VOLTAGE RATING switch corresponds with voltage of power source you will use. (115 VAC 50 or 60 Hz or 230 VAC 50 or 60 Hz).

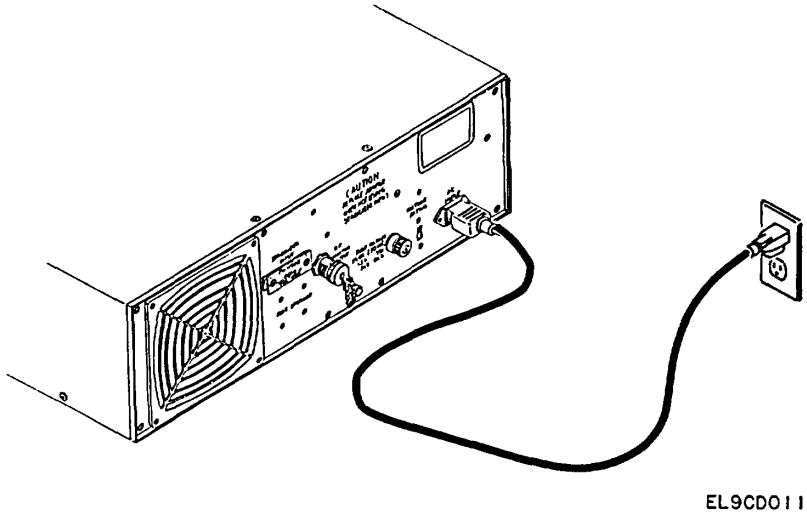


CAUTION

Be sure that the fuse (rear panel) corresponds with value of power source you are using:

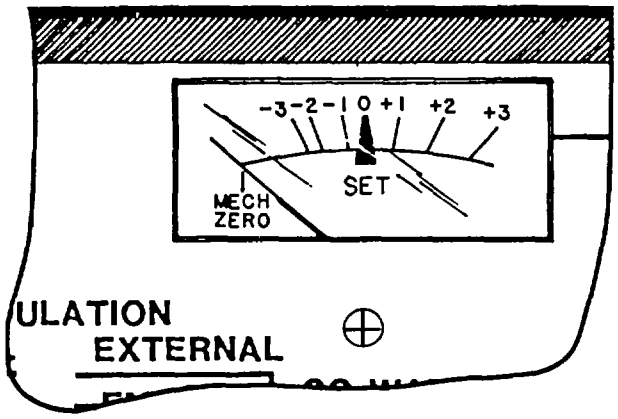
1.5A fuse for 115 V operation
.75A fuse for 230V operation

c. Connect the power (line) cord (from the accessory kit) to the 3 pronged jack on the rear panel. Connect the other side to the power source.



d. Before turning power ON, be sure that

- Modulation control is set to RF OFF.
- ALC switch is in the depressed or OFF position.
- White dot of FREQ VERNIER control is in the vertical position (centered).
- POWER SET control-White arrow in vertical position.
- ATTENUATION control set to 0 dBm.
- POWER LEVEL meter points to MECH ZERO setting at lower left of meter scale. If it does not, adjust by turning screw immediately below meter.

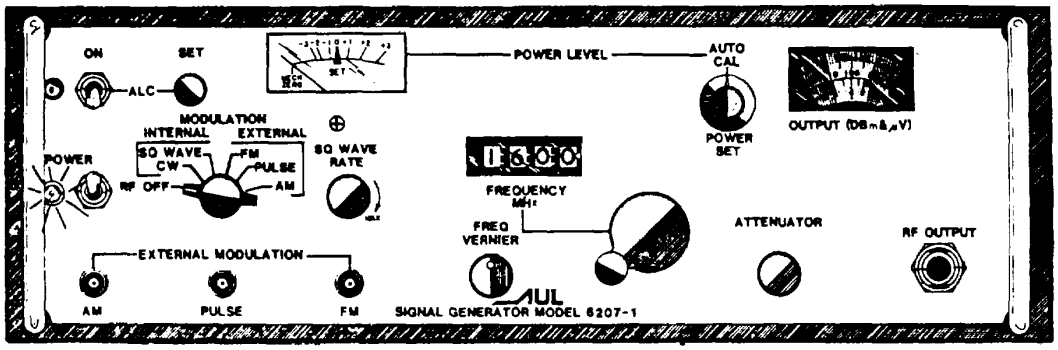


EL9CD012

YOU ARE NOW READY TO ENERGIZE THE SIGNAL GENERATOR.

2-5. NORMAL OPERATION.

a. Application of Power. Make sure you have followed steps a through d in para 2-4 above. Then set POWER switch ON (upward). Indicator to left of POWER switch lights green. You will also be able to hear the blower in the rear of the instrument, and the attenuator window will light up.



EL9CD013

b. Delay Circuit Operation. Wait approximately 2 minutes for grid voltage ckt to energize.

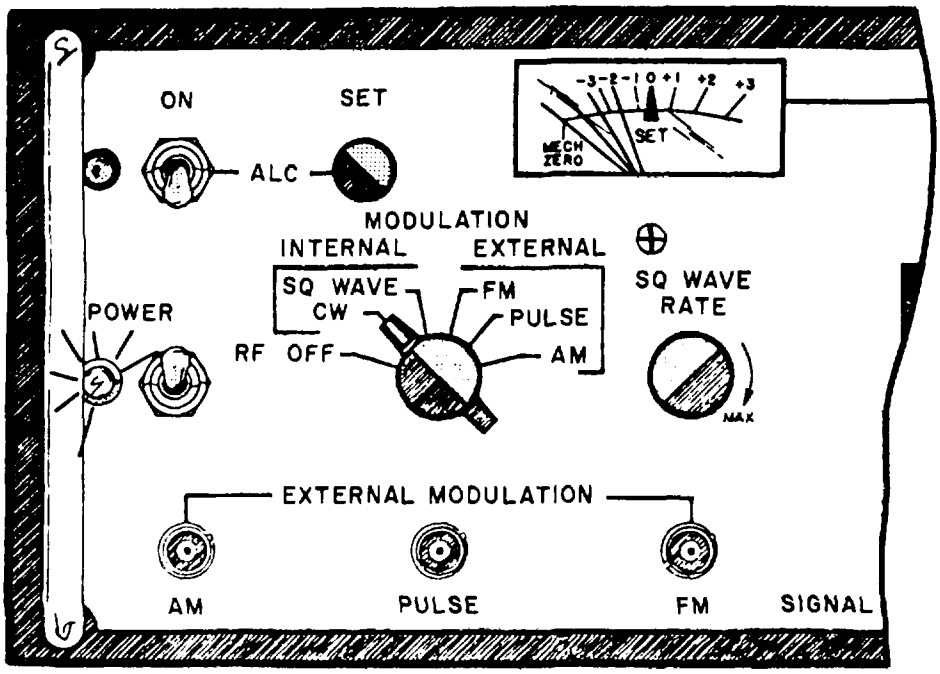
CAUTION

Then, and only then, turn MODULATION control to CW.

CAUTION

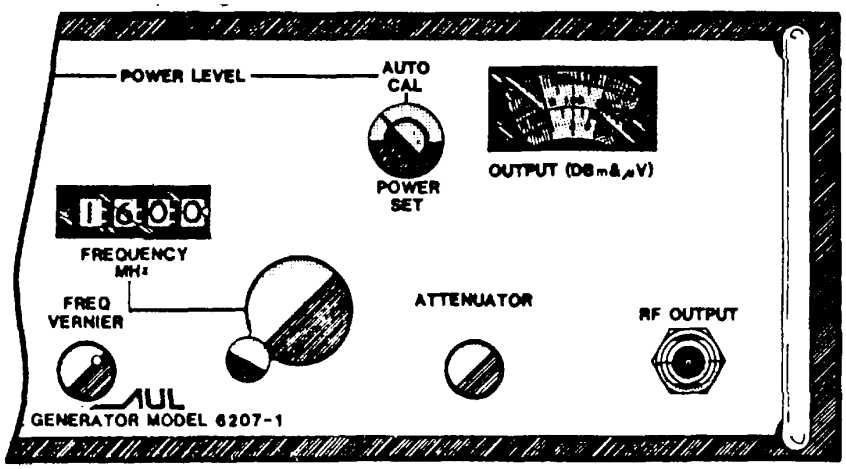
Premature switching to CW position may cause damage to the klystron tube. When modulation is switched to CW, the POWER LEVEL meter needle will register to the right.

When switching to CW, the power level meter needle will register toward the right.



EL9CD014

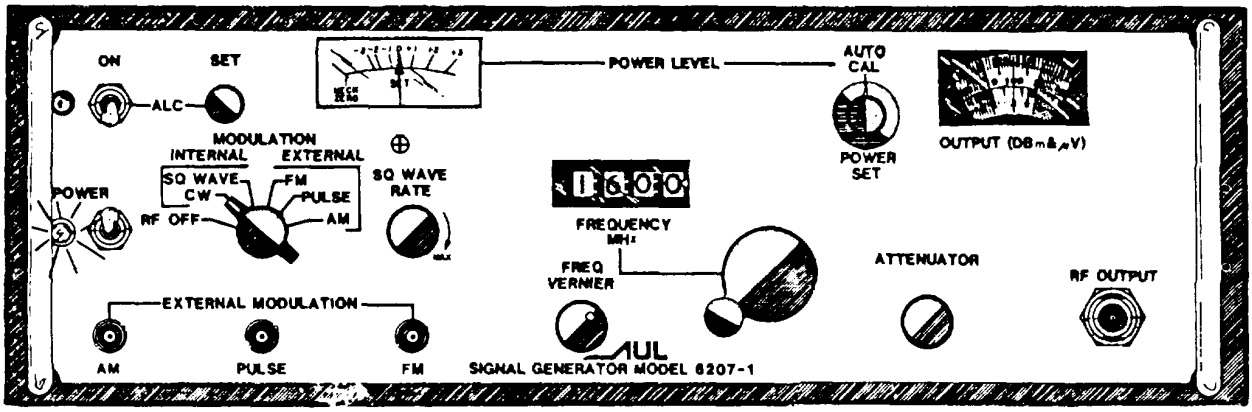
c. Frequency Selection. Turn the FREQUENCY control so that the desired frequency appears on the FREQUENCY MHz readout. Turning the control clockwise increases the frequency, turning it counter- clockwise decreases it. The numbers in the readout show frequency in MHz. Tenths of MHz may be read by reading the horizontal lines on the right side of the right hand number against an arrowhead at the extreme right hand of the readout opening.



EL9CD015

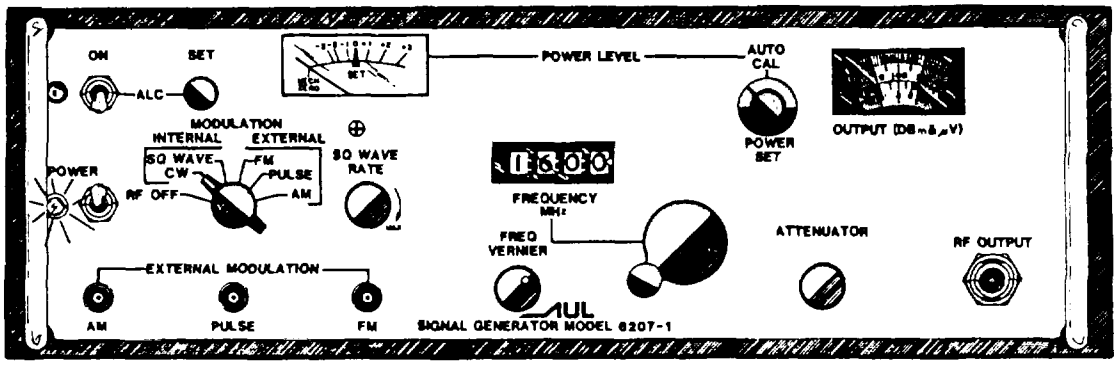
d. Set output level. There are two parts to setting the output level:

1. Turn the POWER SET control until the meter needle centers on the scale to the "0" position. The ATTENUATOR hairline moves simultaneously to a calibrated position relative to the ATTENUATOR dial. This is called POWER SETTING the instrument.



EL9CD016

2. Turn the ATTENUATOR control until the value of attenuation desired falls behind the ATTENUATOR Hairline. You now have a calibrated RF output at a chosen frequency.

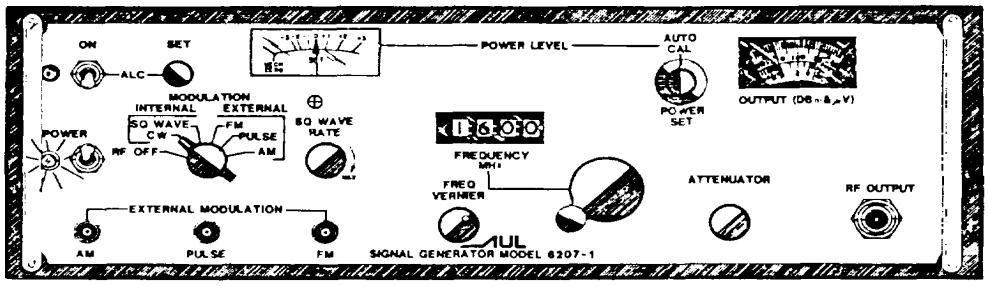


EL9CD017

e. Automatic Level Control. If you will be varying the frequency often, rather than having to set output level after each change of frequency, it is preferable to be able to set the output level once for all frequencies.

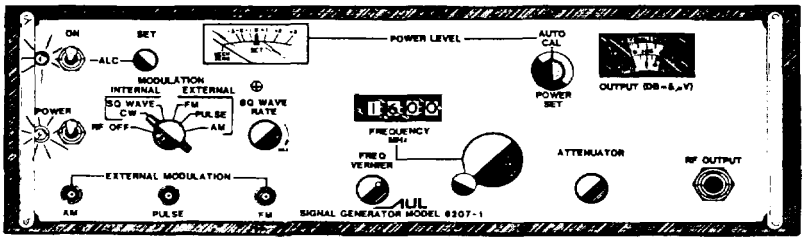
To do this-

- Set POWER SET Control so that white arrow on control is centered (upwards) on the black mark of the front panel labeled AUTO CAL.



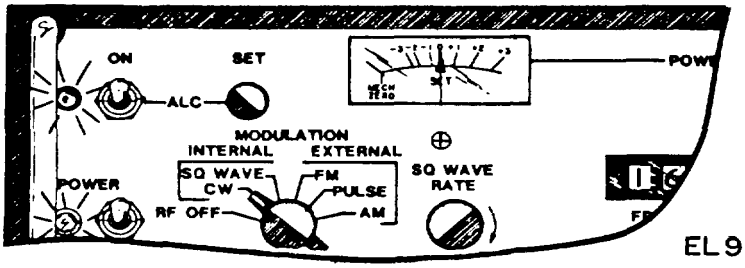
EL9CD018

- Set the ALC switch to ON while observing the red indicator light up.



EL9CD019

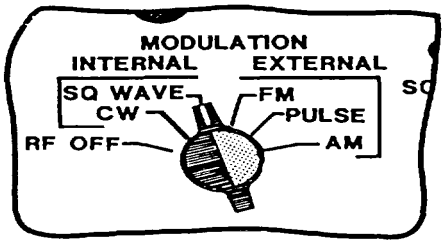
- Turn the ALC set control until the meter needle is centered on the meter scale in the SET position.



EL9CD020

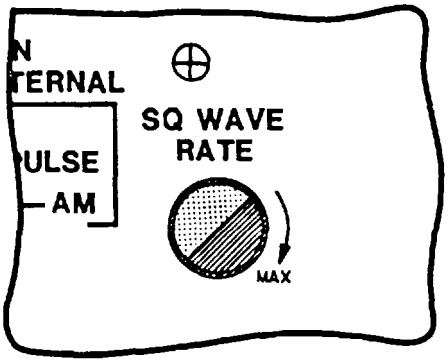
Now, as you change frequency, the ATTENUATOR dial will read accurately at all levels of

f. Internal Square Wave Modulation. Set the signal generator to the initial adjustments of para 2-4. Set MODULATION switch to INTERNAL SQ WAVE position.



EL9CD021

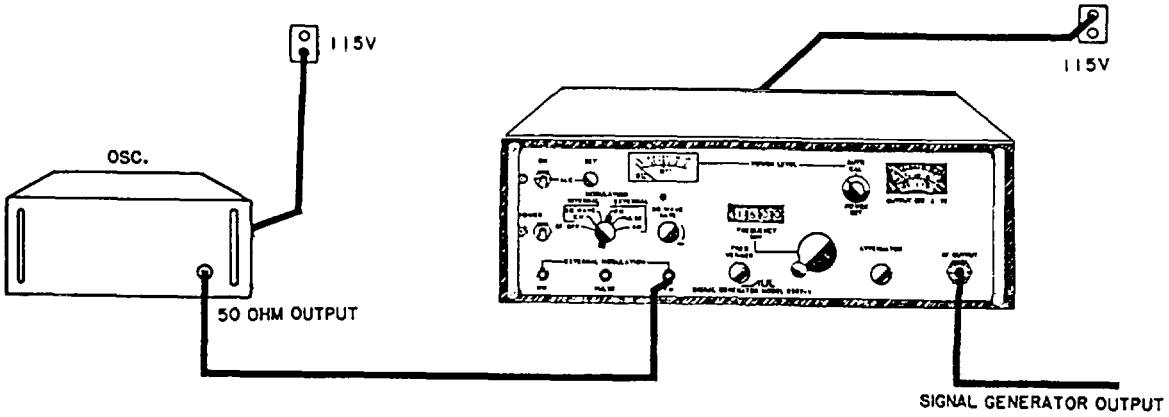
The output is now modulated by a square wave which can be varied in repetition rate from 950 to 1050 per second by turning the SQ WAVE RATE control. Turn the control clockwise to increase the repetition rate.



EL9CD022

g. FM Modulation:

- Auxiliary equipment required: 1 oscillator capable of producing a sine wave signal.
  - Frequency: 0 to 100 KHz.
  - Amplitude: 0 to 20 V peak to peak.
  - HP model 652A or equivalent.
- Make set-up as shown below.
- Set signal generator to initial adjustments of para 2-4.
  - Energize signal generator and wait 2 minutes.
  - Set MODULATION switch to EXTERNAL FM.
  - Set to desired frequency and set output level or ALC operation.
  - Energize oscillator.
- Set oscillator at desired frequency and amplitude.

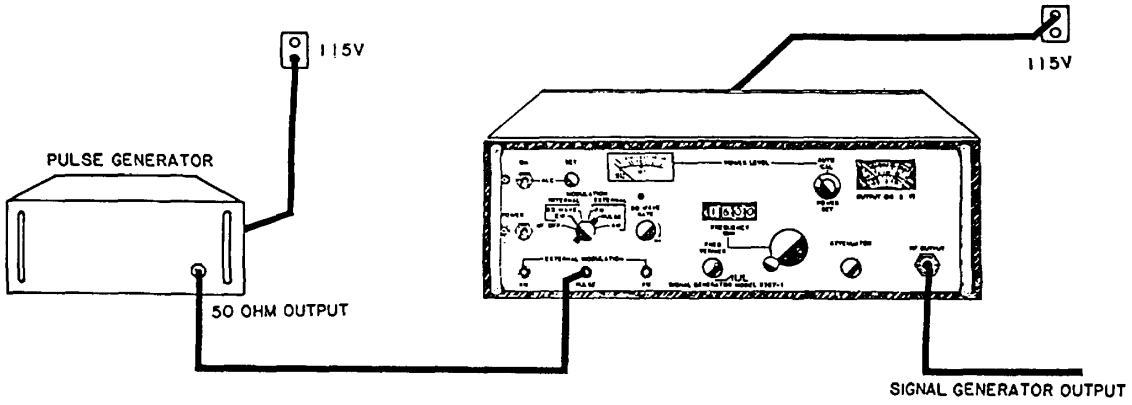


EL9CD023

h. Pulse Modulation:

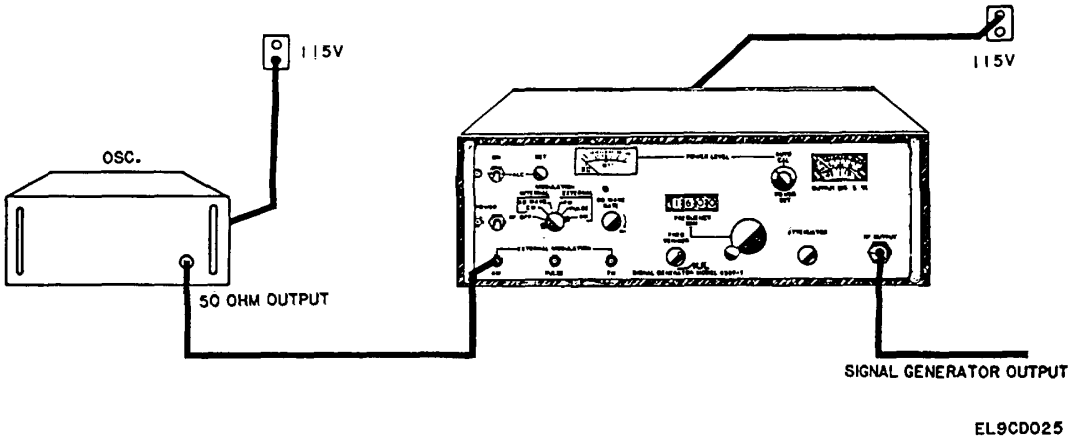
- Auxiliary equipment required: Pulse generator capable of producing a pulse:
  - Variable, between 50 Hz and 50 KHz.
  - Amplitude 20 to 100 volts positive.
  - HP 214A or equivalent.

- Make set-up as shown below.
- Set signal generator to initial adjustments of para 2-4.
    - Energize signal generator and wait 2 minutes.
    - Set MODULATION switch to EXTERNAL PULSE.
    - Set to desired frequency and set output level or ALC operation.
    - Energize pulse generator.
- Set pulse generator to desired frequency and amplitude.



i. External AM Modulation:

- Auxiliary equipment required: 1 oscillator capable of producing a sine wave signal:
    - Frequency: 0 to 1 MHz.
    - Amplitude: 5 to 6V peak to peak.
    - HP Model 652A or equivalent.
- Make set-up as shown below.
- Set signal generator to initial adjustments of para 2-4.
    - Energize signal generator and wait 2 minutes.
    - Set MODULATION switch to EXTERNAL AM.
    - Set to desired frequency and set output level, or ALC.
    - Energize oscillator.
- Set oscillator to desired frequency and amplitude.



SECTION IV.

OPERATION UNDER UNUSUAL CONDITIONS

This precision instrument is intended to be used under moderate temperatures in properly conditioned areas, such as shelters or test vehicles.

Certain precautions should be taken if operating under conditions of:

- Extreme moist heat. Problems could arise in a tropical climate. Always keep the equipment wiped clean of moisture and mildew.

- Extreme cold. Always keep instrument out of direct contact with blizzard conditions (snow or sleet). If exposed while being transported wipe clean and dry immediately to prevent corrosion of connectors, or water seepage into unit.

- Dust or sand storms. Under these conditions perform your PMCS's (Chapter 2, Section II) more frequently than scheduled. Pay particular attention to blower filter and front panel connectors.

CHAPTER 3

OPERATOR MAINTENANCE

3-1. OPERATOR MAINTENANCE.

There is no Operator Maintenance authorized for the AN/USM-213B. Consult Appendix B, Maintenance Allocation Chart (MAC) to determine maintenance responsibilities.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

SECTION I. REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

4-1. COMMON TOOLS & EQUIPMENT.

For authorized common tools and equipment refer to the Modified Table of Organization and Equip- ment (MTOE) applicable to your unit.

4-2. SPECIAL TOOLS, TMDE, & SUPPORT EQUIPMENT.

Refer to Section III of the Maintenance Allocation Chart (MAC) (Appendix B) for this information.

4-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (including Depot RPSTL) TM 11-6625-3053-24P covering maintenance for this equipment.

SECTION II. SERVICE UPON RECEIPT

4-4. UNPACKING.

Refer to para 2-3 for unpacking (unpackaging) instructions.

4-5. CHECKING UNPACKED EQUIPMENT.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6, Packaging Improvement Report.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.

c. Check to see whether the equipment has been modified.

4-6. BENCH INSTALLATION.

The major requirements for bench installation of this equipment are:

a. A stable level surface on which the four feet may stand without wobbling.

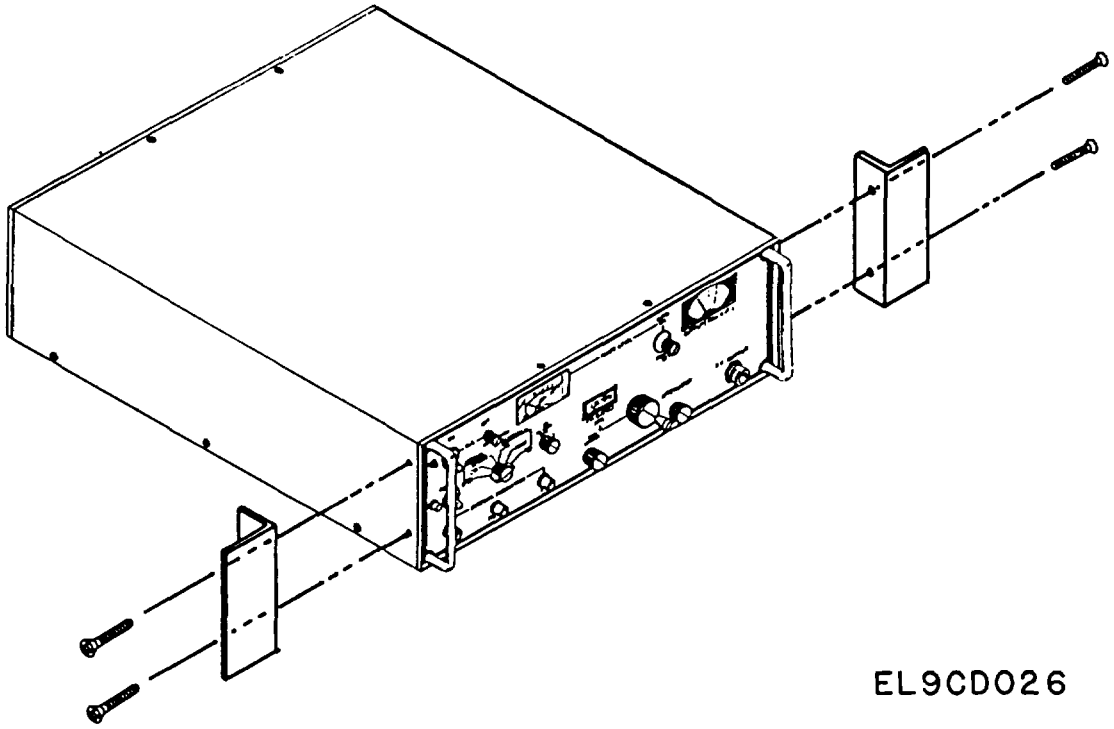
b. Proximity to a proper power source (power cord length 90 in).

4-7. RACK INSTALLATION.

a. Remove the four feet from the bottom of instrument.

b. Attach the four feet, using the same mounting screws, to the location provided on the rear panel near the blower filter. See Figure 1-2 for storage location of feet.

c. Remove rack mounting kit from plastic bag and attach one bracket to each side of dust cover by means of the four screws furnished.



d. Mount the instrument in the open rack space (5-1/4 inches) using standard rack mount screws furnished with the rack.

e. Attach power cord to rear panel receptable of instrument. Do not plug into power source before observing procedure outlined in para 2-4b. through 2-4f.

4-8. PREPARATION FOR STORAGE OR SHIPMENT.

Since the signal generator was shipped in a specially designed set of packaging which should have been returned through supply channels for storage (see para 2-3), this material should be re-used when storing or shipping the equipment.

SECTION III. PREVENTIVE MAINTENANCE CHECKS & SERVICES, TROUBLESHOOTING, AND MAINTENANCE

4-9. PREVENTIVE MAINTENANCE CHECKS & SERVICES.

Organizational Maintenance is authorized to perform all Operator PMCS. See Chapter 2, Section II for this information.

4-10. ORGANIZATIONAL TROUBLESHOOTING PROCEDURES.

Table 4-1 below lists the common malfunctions you may find which prevent the AN/USM-213B from operating. You should perform the checks/inspections in the order listed.

Table 4-1. Organizational troubleshooting

MALFUNCTION	CHECK OR INSPECTION	CORRECTIVE ACTION
AN/USM-213B NOT OPERATING.	1. Check to see if power cable is connected to the power receptacle and to the AN/USM-213B.	Make proper connections (para 2-4c).
	WARNING Disconnect Power Cord before removing or replacing fuse.	
	2. Check to see if fuse (rear panel) is not blown or open.	Replace fuse with one of proper rating: 1.5A for 115V 0.75A for 230V Always SLO-BLO
	3. Check to see if VOLTAGE RATING SWITCH (rear panel) is on the proper setting	Set switch to proper setting.
	4. Check to see if power is available at power receptacle.	Move to working receptacle.
	5. Check to see if voltage available at end of power cord when other end plugged into power receptacle.	Replace power cord.
	6. Check to see that POWER switch (S1) clicks into place when turned ON (upward).	Notify General Support Maintenance.

This troubleshooting information is presented in tabular form. The major malfunction appears in the let hand column entitled MALFUNCTION. The center column tells you what CHECKS or INSPECTIONS to make. The third column, CORRECTIVE ACTION, tells you how to compensate for a faulty result in the center column, using the tools, equipment, and parts at your disposal.

4-11. ORGANIZATIONAL MAINTENANCE.

In addition to being authorized to perform all Operator PMCS, you may replace the following

a. **Fuses**. See previous references in PMCS Chart, Table 2-2, item 2.

b. **Front panel knobs**. See previous references in PMCS Chart, Table 2-2, item 5.

Refer to the Maintenance Allocation Chart (MAC) in Appendix B at the back of this manual. It tells you what you are authorized to replace on this equipment.

CHAPTER 5

DIRECT SUPPORT MAINTENANCE

5-1. DIRECT SUPPORT MAINTENANCE.

There is no Direct Support Maintenance authorized for the AN/USM-213B. Consult Appendix B, Maintenance Allocation Chart (MAC) to determine maintenance responsibilities.

CHAPTER 6
GENERAL SUPPORT MAINTENANCE

SECTION I. REPAIR PARTS, SPECIAL TOOLS, TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

6-1. COMMON TOOLS & EQUIPMENT.

For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

6-2. SPECIAL TOOLS, TMDE & SUPPORT EQUIPMENT.

Refer to Section III of the Maintenance Allocation Chart (MAC) (Appendix B) for this information.

6-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (including Depot RPSTL) TM 11-6625-3053-24P covering maintenance for this equipment.

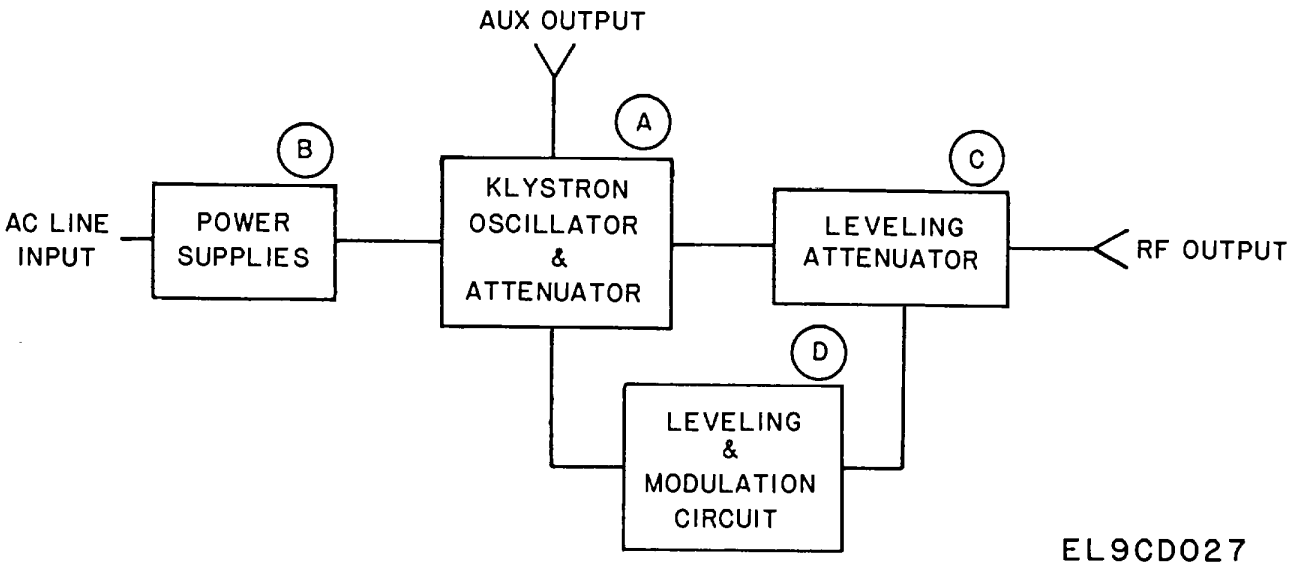
SECTION II. TECHNICAL PRINCIPLES OF OPERATION

6-4. GENERAL.

This section describes the electrical functions of the AN/USM-213B signal generator. The discussion first describes the overall function of the instrument and its major components. A detailed circuit description for each module follows.

6-5. ELECTRICAL FUNCTIONS (Figure 6-1).

The klystron oscillator (Item (A)) and attenuator produces an RF signal between 800 and 2400 MHz. The frequency is varied by the operator using the tuning knob. The output amplitude is also controlled by the operator using front panel knobs. The power supplies (Item (B)) provide the DC voltages which the klystron oscillator needs for its operation. The leveling attenuator (Item (C)) has two functions. When in the automatic leveling (ALC) mode, variations in output level coming from the klystron oscillator are removed when the frequency is changed. This means that the operator does not have to power set the attenuator when changing frequency. When in the non ALC mode, power levels are set manually. The klystron oscillator output passes through the leveling attenuator unaltered. The other function of the leveling attenuator is to modulate the RF output. Both functions of the leveling attenuator are controlled by the leveling and modulation circuit (Item (D)). This circuit originates the square wave signal for INTERNAL SQUARE WAVE modulation, and selectively feeds it or the externally received sine wave ampli- tude modulation (AM) & pulse modulation (PULSE) signals when a modulated output is required.



6-6. AI REGULATOR CARD AND POWER SUPPLY CIRCUITRY (Figure 6-2). Figure 6-1. Simplified Block Drawing

115 or 230 volt AC power is connected to power transformer T1 (Item A through the power switch and fuse circuit (Item B). Low voltage AC from the power transformer T1 is rectified by diode bridge CR1 (Item () and filtered by filter capacitors C1 and C2 (Item C). The unregulated DC voltage (about +40 volts) is connected to pins 10 and 16 of the A1 board connector. Pin 14 is ground (negative). AR6 (Item D on the A1 board is a 15 volt positive regulator to supply power to AR1 and AR3. AR5 (Item A E is a 5 volt positive regulator to supply power to AR2. CR 2 (Item K controls the voltage on pins 7 and 8 of AR4 at 35V DC. AR1 (Item G is a 20 KHz square wave oscillator which supplies the clock signal for the high voltage inverter power supply. AR2 (Item H is a phase splitter which provides complimentary signals to turn the inverter transistors on and off. AR3 (Item (3) is a timer which prevents the regulator AR4 from coming on before an approximate 2 min. delay. The AR4 (Item J) regulator circuit controls series regulator Q1 (Item L and is described in detail in the next paragraph.

6-7. -325 VOLT REGULATOR (Figure 6-3).

Square wave signals (Item A from AR2 continuously switch Q1 and Q2 of the A2 assembly on and off. This produces a high voltage square wave at CR1-4, the high voltage rectifier on the A2A3 board (Item B The magnitude of this voltage depends on the DC voltage applied to the primary center tap of T1 (Item C). This voltage is varied by Q1 through R7 from the +40 volt unregulated supply. Q1 is controlled by the output of regulator AR4 (Item a D AR4 provides constant voltage regulation by comparing the DC output of the A2A3 assembly (Item E) with an internal reference. This voltage is adjustable by R18. AR4 will also shut off the DC to T1 if an overcurrent condition exists. This is achieved by the voltage across R17.

6-8. -750 VOLT REGULATOR (Figure 6-4).

The -750 volt regulator is actually a 450 volt regulated power supply connected in series with the -325 volt supply described in paragraph 6-7. AC for the power supply is derived from T1, the same transformer that supplies the -325 volt power supply (Item A). The AC voltage is rectified by the rectified and filter CR1-4, C1 (Item B). Shunt regulator Q1, Q2 (Item D draws sufficient current to cause the voltage on

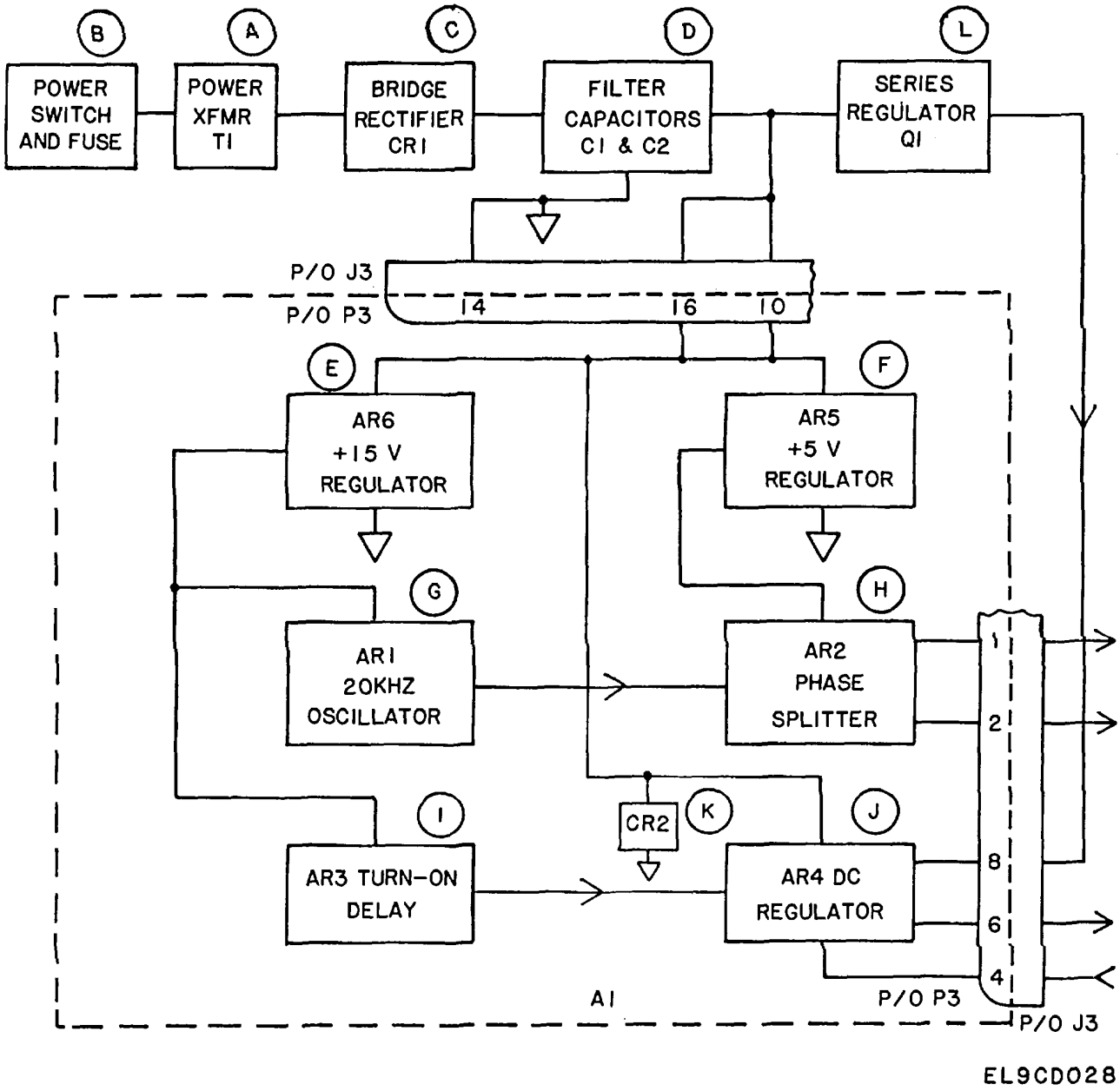


Figure 6-2. Oscillator Card Assembly

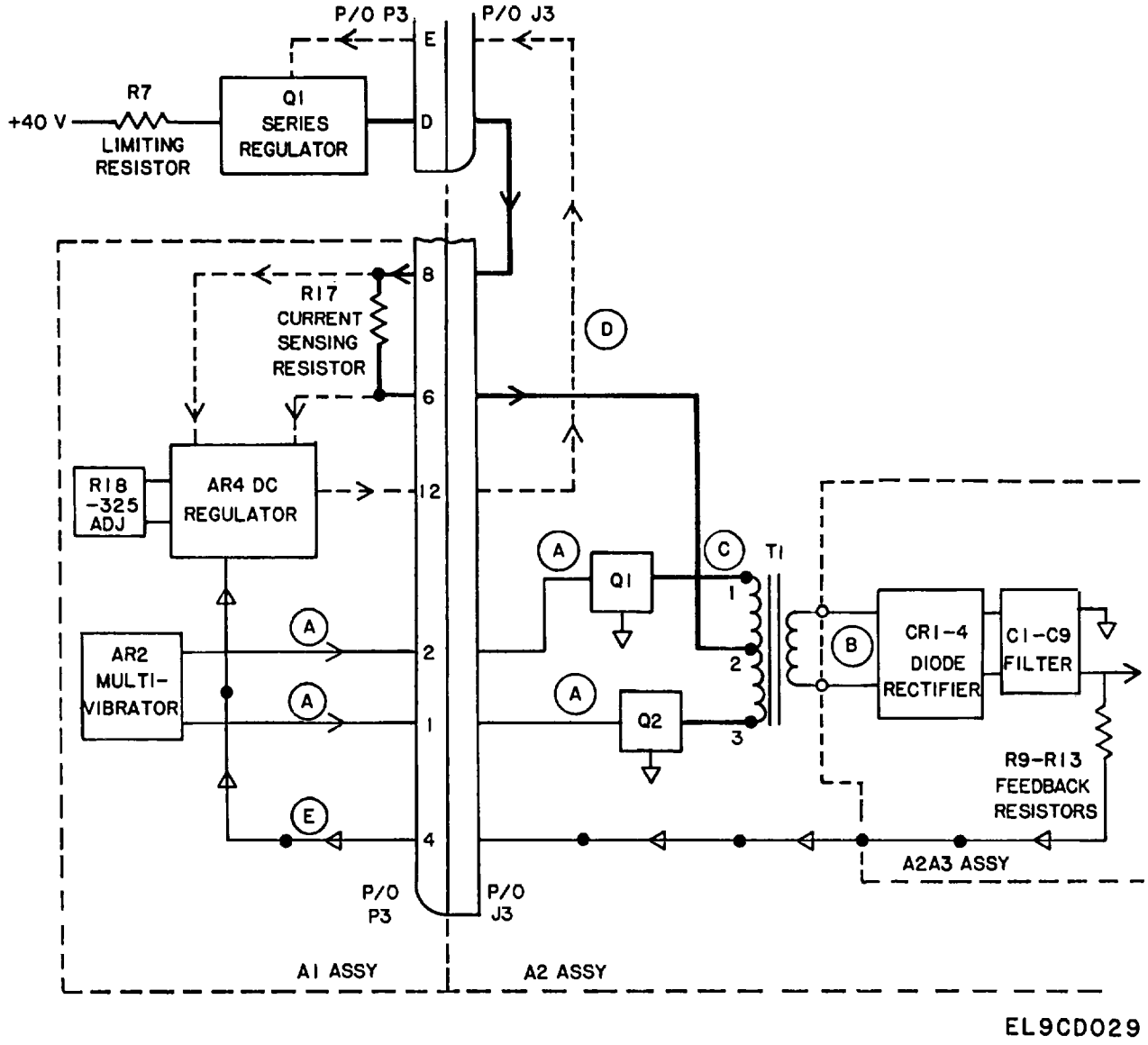


Figure 6-3. 325 regulated Supply

the left of R12 (Item C) to be exactly -450 volts with respect to the -325 volt line (Item E), which is the common point for this circuit. Error amplifier AR1 (Item F) is balanced when the voltage across CR8 (Item if G) is equal to the output of the feedback network (item H).

6-9. GRID AND FILAMENT POWER SUPPLIES (Figure 6-5).

Two additional low voltage DC power supplies are required to operate the klystron oscillator. Both these supplies float at -325 volts. The filament power supply is operated from the main power transformer T1, terminals 5 and 6 (Item A). On the A2A2 assembly, the rectifier and filter assembly CR1-4, C1, C2 converts the AC to DC (Item B). Regulator AR1 regulates this voltage to 6.0 VDC (Item C). The grid voltage supply is turned on and off by the optical coupler U1 (Item D) and shunt transistor Q1 (Item E). This circuit is controlled by the MODULATION switch S1 on the front panel (Item F). When shunt transistor Q1 is off, the grid voltage is positive with respect to the -325 volt circuit common (Item G). It is regulated by AR2 on the A2A1 board (Item H). Adjustment of the grid voltage to cause the correct beam current to flow in the klystron tube is provided by A4A1 R1 in the A4 tuning head assembly (item I). When the shunt transistor Q1 is on (Item E), the grid voltage is negative with respect to the -325 volt circuit common (Item G). This voltage is supplied by rectifier and filter CR12, 13 and C6 (Item J) on the A2A1 assembly. The positive voltage o operate the grid voltage regulator (Item H) is supplied by rectifier and filter CR11, 14 and C5 (Item K).

6-10. KLYSTRON OSCILLATOR AND TRACKING SYSTEM (Figure 6-6).

Klystron oscillator V1, provides the rf power output. The klystron is mounted at one end of the cavity. The outer cylinder makes contact with the first grid, and the inner conductor makes contact with the second resonator grid. The resonant circuit is completed at the other end of the cavity by a movable non- conducting shorting plunger. The position of the shorting plunger (Item A) determines the resonant frequency of the cavity.

The frequency of oscillation of the klystron oscillator is determined by the resonant frequency of the cavity and the magnitude of the negative repeller voltage. For a given setting of the cavity, there is an optimum repeller voltage that will cause the bunched electrons to return to the resonator at the proper time. The repeller voltage, therefore, cannot remain the same over the frequency range of the oscillator. In order to produce the oscillation over the frequency range of the oscillator, a tracking arrangement is used to vary the DC voltage on the repeller. This voltage is maintained at the optimum value for maximum ampli- tude of oscillation at a given plunger setting

At the low end of the frequency range, the repeller voltage is at its lowest negative value and the klystron operates in its 1-3/4 mode. As the frequency increases, the repeller voltage increases in the negative direction until at 1.7 GHz, the repeller voltage becomes excessive and it is more practical to change the repeller voltage. The repeller voltage is lowered so that the klystron operates in its 2-3/4 mode. In this higher mode, the bunched electrons require a greater number of cycles before returning to the resonator grids.

The DC voltage applied to the repeller is controlled by tracking potentiometer A4R1 (Item E). The movement of the arm of A4R1 is mechanically ganged with the movement of the tuning plunger in the klystron cavity. Repeller mode switch A4S1 (Item F) is operated by a cam driven by the tuning drive and changes the voltage applied to A4R1. Adjustment potentiometers are provided in the tracking circuit to compensate for variation in klystron repeller voltage characteristics. The maximum voltage across tracking voltage potentiometer A4R1 is 425 volts since it is connected from the -325 volt beam supply to the -750 volt repeller supply. The FREQ VERNIER control A4R2 (Item G) provides a small variation in the repeller voltage, which produces a vernier frequency variation of at least 1.5 MHz.

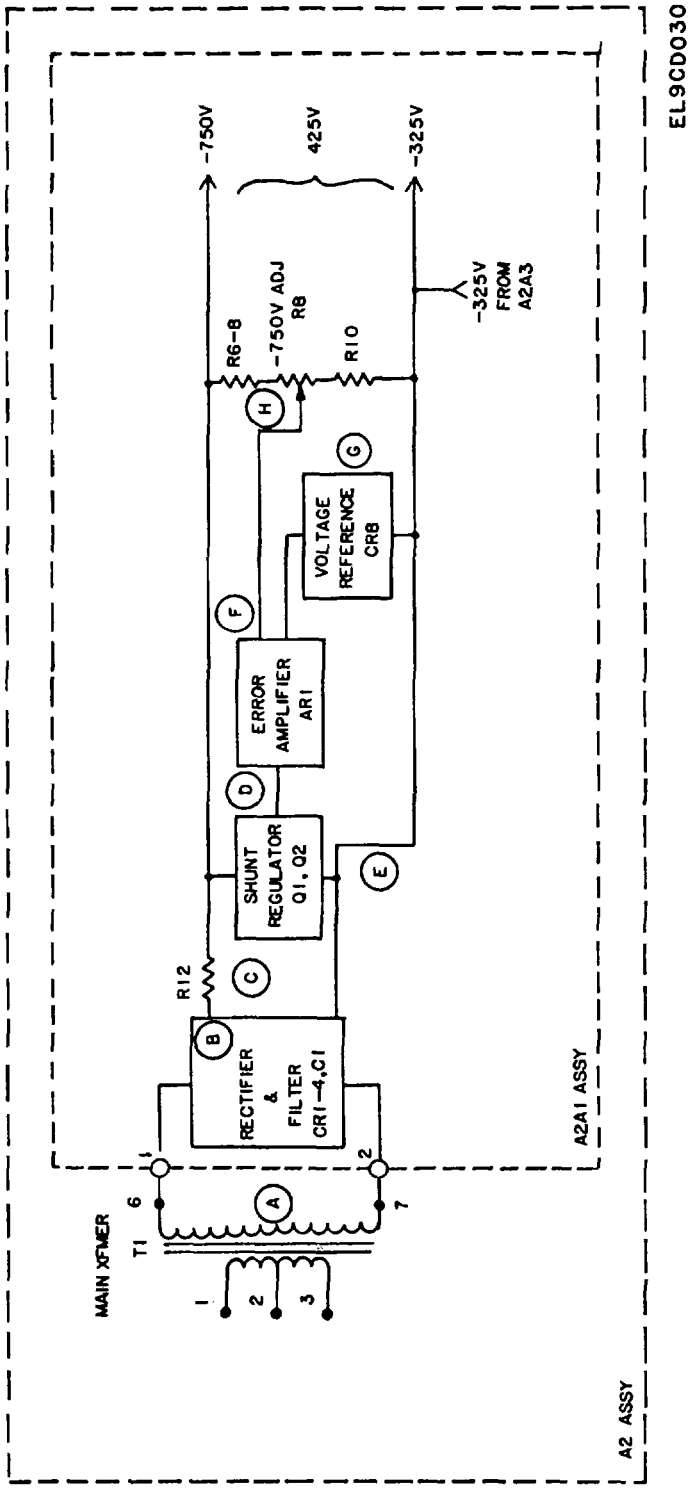


Figure 6-4. -750 V regulated Supply

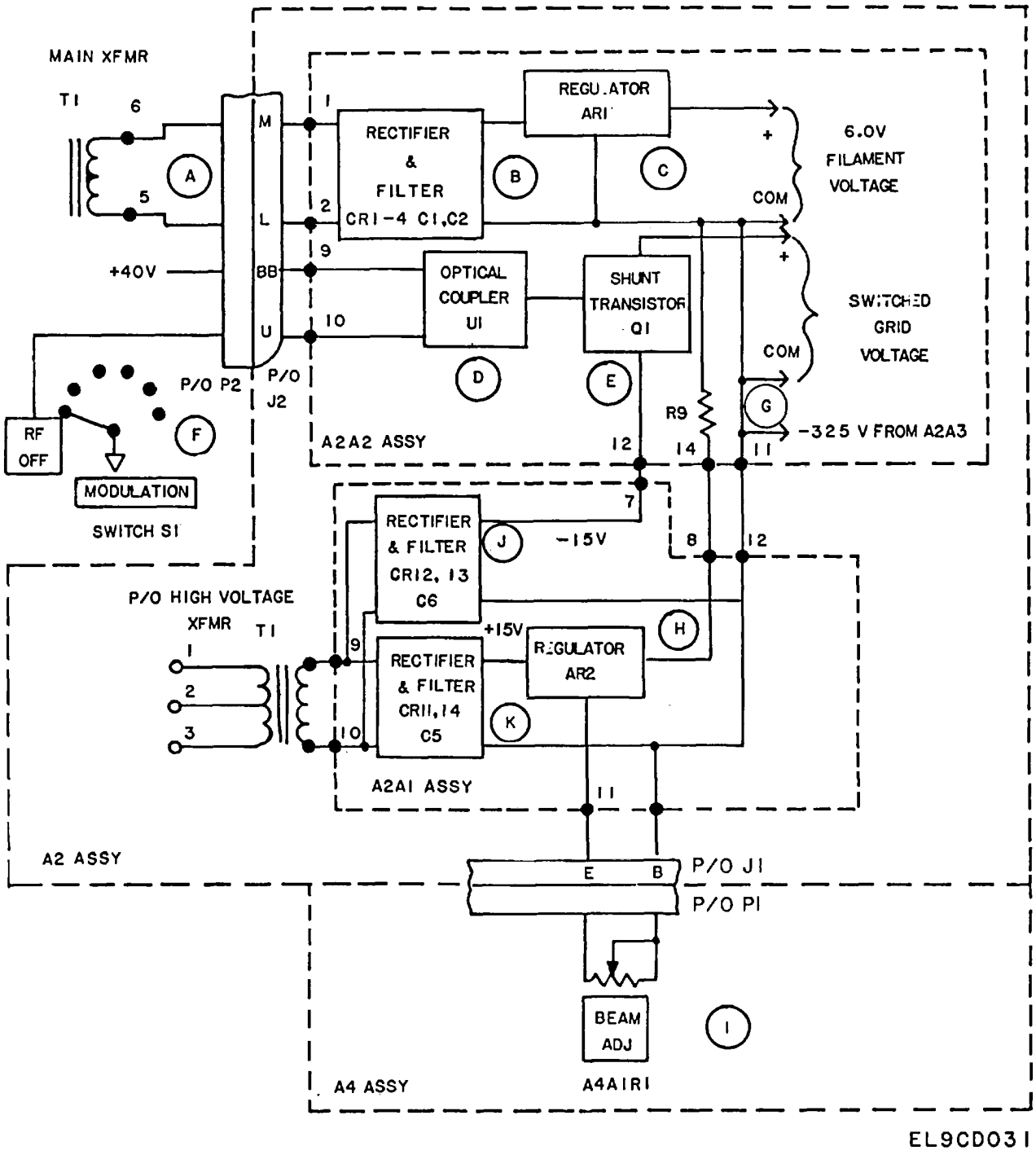


Figure 6-5. Filament and Grid Power Supplies

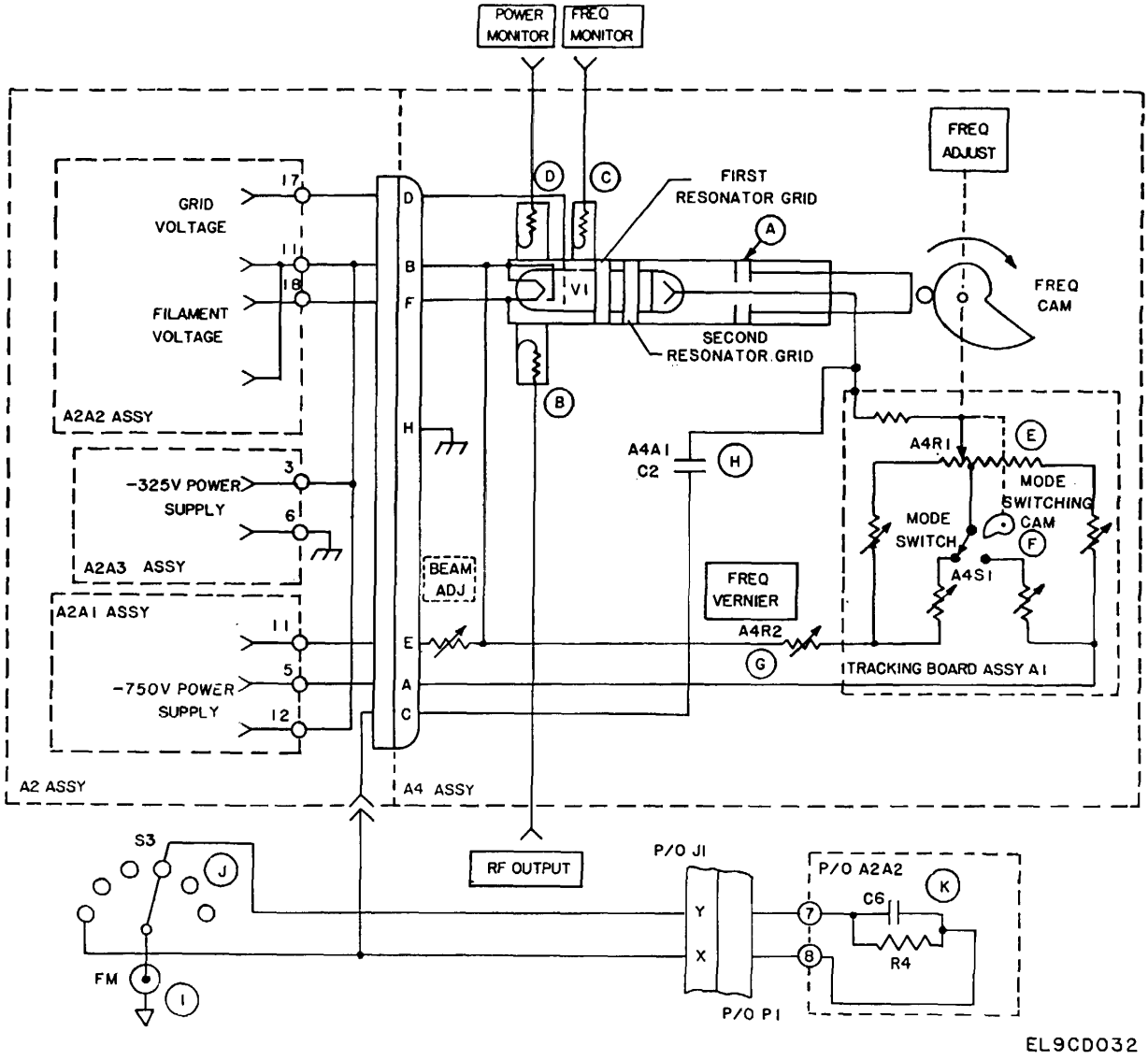


Figure 6-6. Klystron Oscillator and Tracking System

External FM modulation is accomplished by applying the modulating signal to the klystron repeller through coupling capacitor C2 of the A4A1 tracking board (Item H). The external modulating signal enters the FM front panel jack (Item I). The MODULATION switch S3 (Item J) is placed in the EXT FM position. The incoming signal goes through the switch, into a resistor/capacitor circuit (Item K) of the A2A3 card assy and then back to the MODULATION switch from which it goes to the repeller.

The oscillator cavity is coupled through three probes. The attenuator probe (Item B) has a variable amount of insertion that determines the rf power level delivered to the RF OUTPUT connector. The fixed rf monitor probe (Item C) supplies a power sample for automatic frequency stabilization. The power set probe (Item D) has a variable amount of insertion that supplies power to the monitoring circuit for attenuator calibration and leveling.

6-11. OSCILLATOR OUTPUT POWER CALIBRATION (Figure 6-7).

Power from the klystron cavity is coupled through two symmetrical pipes into two matched waveguide- beyond-cutoff attenuators. The POWER SET control (Item A) positions the power set probe (Item B) in its pipe. The power set probe couples rf power from the klystron cavity to the crystal detector and the power monitor meter and also moves the hairline of the attenuator dial. When the POWER SET control is adjusted for a power monitor meter indication of SET (Item C), the power set probe is coupled to ap- proximately 1 milliwatt power level. Should the energy level within the cavity change when the cavity is tuned to a different frequency, the power set probe must be reset to obtain the 1 milliwatt level of power absorption which will bring the power monitor meter back to its reference SET position. At the same time, the attenuator hairline (Item D) is repositioned to a new 0 dBm reference.

Once the POWER SET adjustment is set for SET, by turning the attenuator control (Item E) the attenuator probe (Item F) can be adjusted for 0 dBm output at the same time the attenuator dial (Item G) is being set for 0 dBm behind the hairline. In this way, as frequency is varied, and the power monitor meter is set for SET, by placing the attenuator dial at 0 dBm behind the hairline, the output (Item H) will be 0 dBm within the specification accuracy. In order to obtain other levels of power, the ATTENUATOR control is adjusted so that the desired level is behind the hairline of the attenuator dial. This adjustment varies the position of the attenuator probe in its waveguide-beyond-cutoff pipe. The rate of attenuation within the pipe follows a rigid physical law and is extremely accurate, thus the rate of attenuation is translated onto the dial.

6-12. AUTOMATIC LEVELING & MODULATION (Figure 6-8).

Leveling of the rf output is done through the use of a pin diode attenuator (A-5 Assy). The pin diode attenuator is composed of identical sections, one attenuator AT2 (Item A) is in series with the power set probe (Item B) and the second attenuator AT1 (Item C) is in series with the rf output probe (Item D). The power output of AT2 is detected and fed as a -DC feedback voltage to the inverting input of leveling amplified A3AR4 (Item E). A DC reference voltage is also present at the inverting input of A3AR4. The reference voltage is developed across A3CR2 (Item F) and connected to the front panel ALC SET control (Item G). A portion of this reference voltage is summed by A3AR4 with the detected negative voltage. A proportional DC output is developed at the output of A3AR4 and divided between AT1 and AT2 by balance control A3R24 (Item H). The pin diode attenuator is configured in such a manner that with a positive voltage applied to control input, the pin diodes are turned on therefore shunt- ing to ground some amount of the rf, proportional to the DC applied. The amount of attenuation in both halves of the attenuator is identical when properly adjusted by the balance control A3R24. Therefore, if the power at the power set probe increases with a change in frequency, the power at the rf output probe also increases by exactly the same amount. The increase is detected at the set output and fed to amplifier A3AR4. The amplifier inverts the detected change and produces a proportional change at the output which is fed to both halves of the attenuator, thus returning the output to the predetermined level.

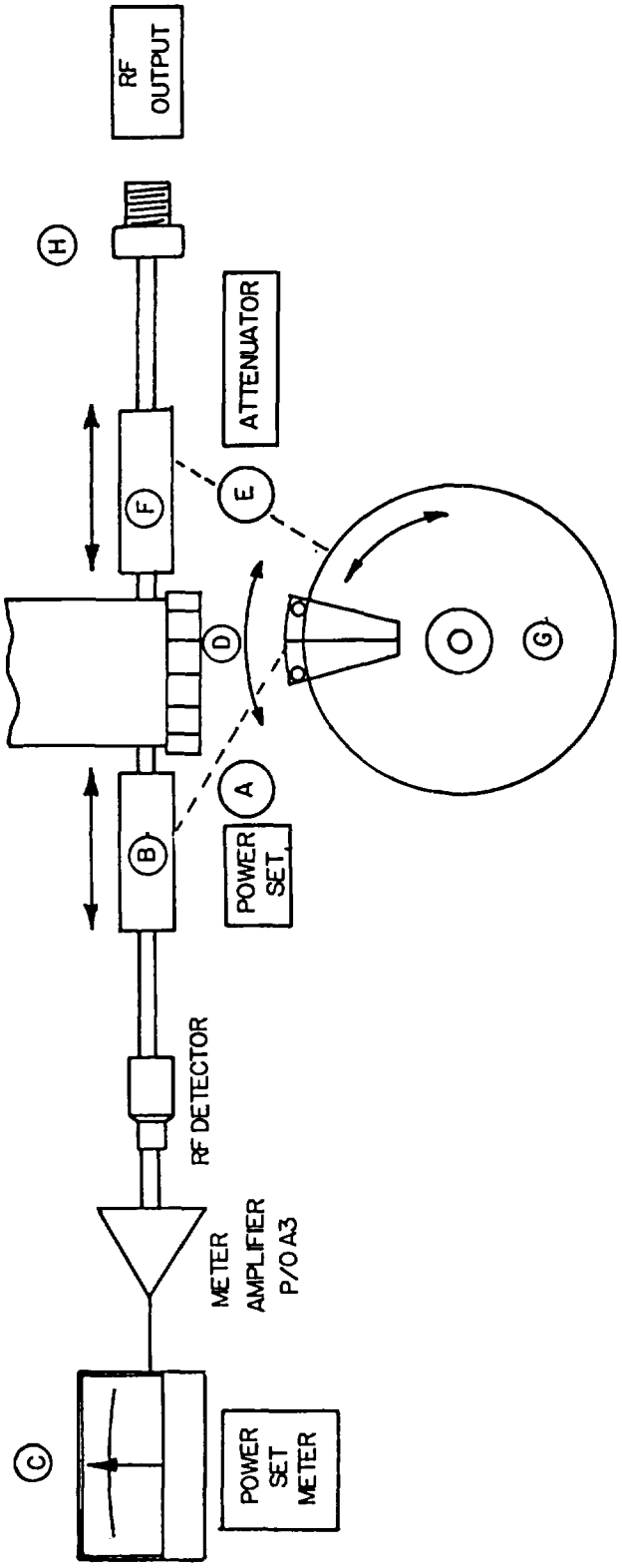


Figure 6-7. Oscillator Output Calibration System

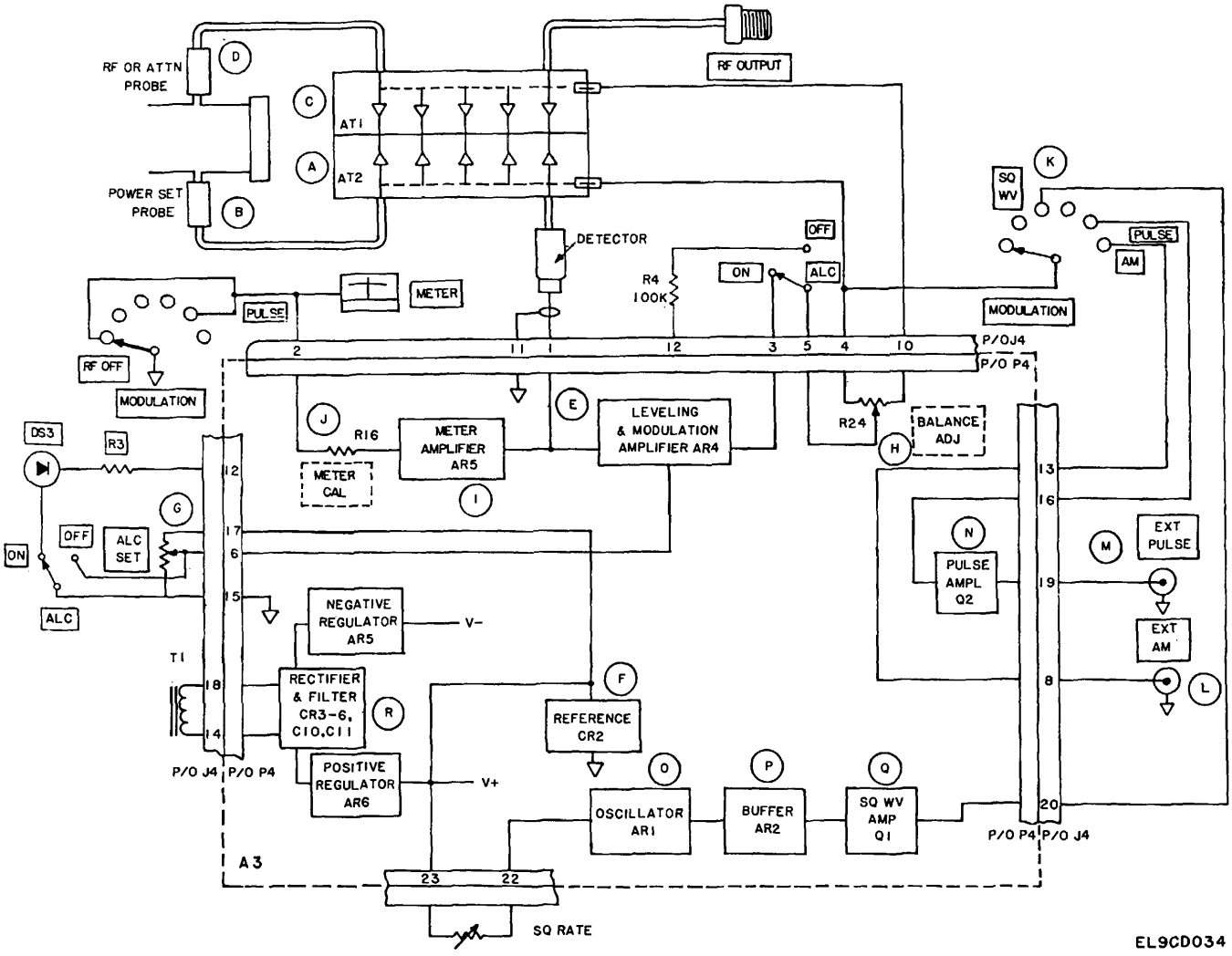


Figure 6-8. Automatic Leveling and Modulation

AR5 is the meter amplifier (Item I). The detected rf signal is fed to the inverting input of AR5 and a positive voltage is produced at the output and fed through METER CAL potentiometer R16 (Item J) to the power monitor meter.

Amplitude Modulation (A.M.) is obtained by adding a modulating signal to the DC level control signal connected to AT1. A section of the MODULATION switch (Item K) selects the source of the modulating signal. In the case of A.M., the signal is obtained from the front panel EXT AM Jack (Item L). When PULSE modulation is selected, the pulse from the EXT PULSE jack (Item N) is inverted by pulse amplifier Q2 (Item M) and connected to the DC level control signal. When square wave modulation is selected, an internal oscillator AR1 (Item O) is used to produce a 950-1050 Hz square wave. This square wave is amplified by AR2 (Item P) and Q1 (Item before being connected to the DC level control line at the modulation switch (Item K). A dual power supply consisting of CR3-CR6, C10, C11, and AR5-AR6 (Item R) provides + and -12V DC power on the A3 card for these circuits.

SECTION III. ELECTRICAL CHECK PROCEDURES

6-13.
This section contains a check procedure which determines if the signal generator is operating correctly.

You should perform a signal generator check:

- completely, every six months.
- on those performance stands which may have been affected as a result of a repair, immediately after the repair.
- on those performance standards which you suspect are not functioning properly, when you suspect them.

The check procedures are in tabular form:

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	The various checks are numbered in the left hand column. OPERATION column shows the steps necessary to perform the electrical check of the AN/USM-213B. NORMAL INDICATION column shows what to look for on the AN/USM-213B, or on the associated test equipment in the set-up. CORRECTIVE ACTION indicates what must be done to correct a problem such as — • if alinement is necessary you will be referred to the appropriate step no. in Section IV, Alinement. • if fault location or troubleshooting is required, you will be referred to the appropriate item no. in Section V, Troubleshooting.

Refer to the Schematic Diagram AN/USM 213(FO-2), all functional schematics, and wiring diagrams. Read Section II circuit descriptions since they will help you in locating the defective component when you troubleshoot the unit.

6-14. ELECTRICAL CHECK PROCEDURES.

INITIAL SETTINGS

Before starting the electrical check procedure, set the AN/USM-213B controls as outlined in paragraph 2-4.

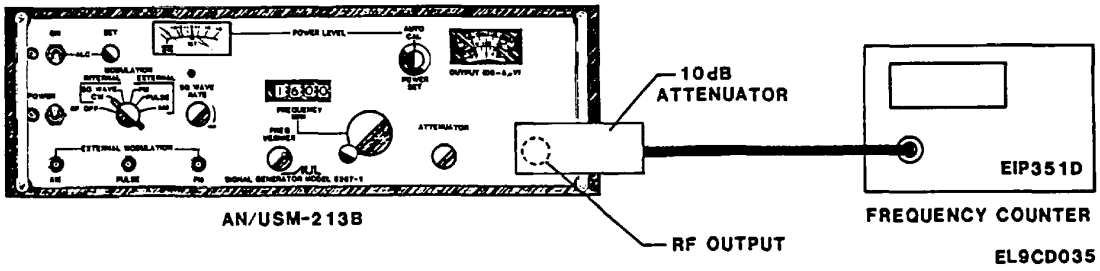
Table 6-1.

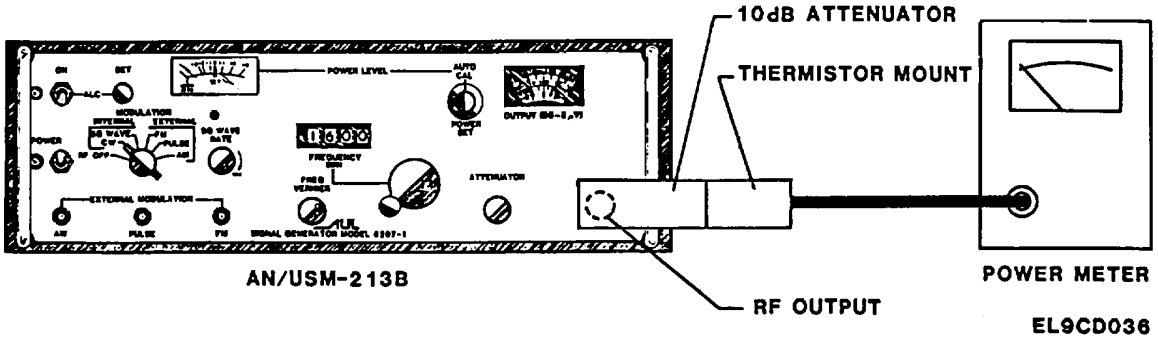
ELECTRICAL CHECKS PROCEDURES INDEX

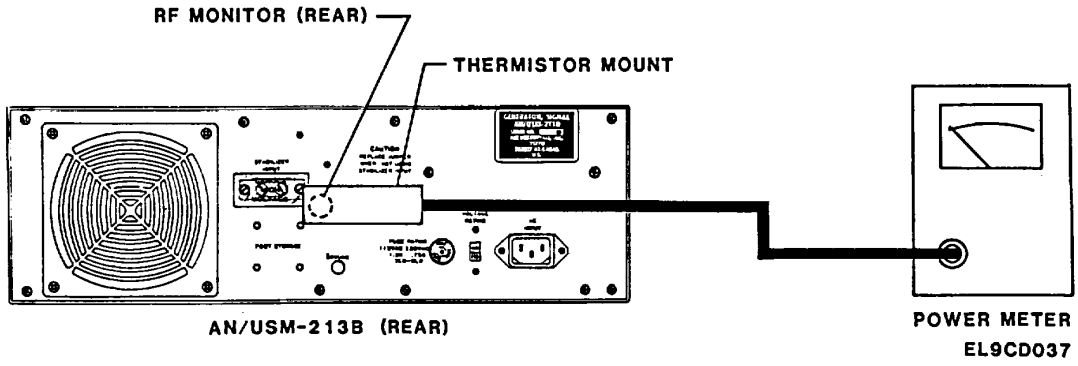
TITLE	STEP NO.
Application of Power	1
Delay Circuit Check	2
Power Set Check	3
Frequency Accuracy Check	4
Maximum Uncalibrated RF Output Check	5
Minimum RF Monitor Uncalibrated Power	6
Attenuator Accuracy Check	7
Internal Square Wave Check	8
External Pulse Check	9
External AM Modulation Check	10
On-Off Ratio Check	11
Leveled Power Output Check	12

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
1	APPLICATION OF POWER Set up AN/USM-213B as called for in paragraph 2-4. Energize sig gen by setting POWER switch S1 to ON. All of the following should happen: Power indicator DS1 lights. Check DS1 per troubleshooting item 1. Blower B1 can be heard running. Check B1 per troubleshooting item 2. Attenuator window lamp DS2 lights. Check DS2 per troubleshooting item 3. If none of the above happens: Check F1, S1 & S2 in that order per troubleshooting item 4. **NOTE** When conducting electrical checks, allow signal generator to warm up for 90 min. before taking measurements or making adjustments. Once this requirement has been satisfied, further electrical checks may be made immediately after the signal generator delay circuit has operated.
2	DELAY CIRCUIT CHECK After setting POWER ON as in step 1, wait approx. 2 min. for delay circuit to operate. No visible indication. **CAUTION** After allowing 2 min. for the delay circuit to operate and only then, set MODULATION switch S3 to CW.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Meter M1 should deflect to the right showing that delay circuit has operated and has energized high voltage supply.
	NOTE After switching to CW, you may have to turn POWER SET/AUTO CAL control clockwise to register a meter reaction. If after doing this you still observe no meter movement:
	Proceed to troubleshooting item 5.
3	POWER SET CHECK
	Continuing from step 2, with MODULATION switch set to CW, set FREQUENCY readout to 800 MHz.
	Adjust POWER SET control for a POWER MONITOR meter center deflection or SET position. This is called POWER SETTING the instrument.
	Repeat every 200 MHz until you reach the upper frequency limit of 2400 MHz.
	Troubleshooting, item 5.
4	FREQUENCY ACCURACY CHECK
	If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with gen POWER off.
	Connect test set up as shown below by attaching the RF OUTPUT jack of the signal generator through a 10 dB pad to the input jack of the frequency counter through an RF cable.



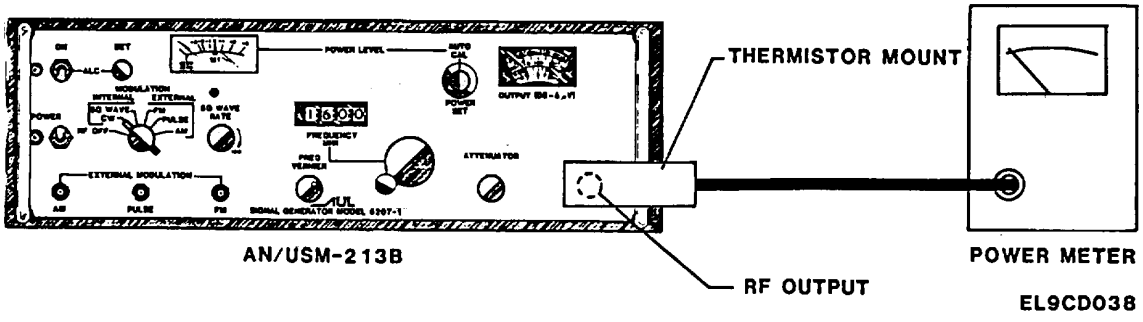
STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Set signal generator to initial settings of para 2-4 and frequency counter range to cover 800 MHz to 2400 MHz. Set frequency counter to ON and energize sig gen if off. Set sig gen MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Set signal generator FREQUENCY at 800 MHz and POWER SET the instrument as in step 3 for all test frequencies. Read frequency displayed by frequency counter. The frequency set on the AN/USM-213B and that displayed on the frequency counter should agree within +/– 5 MHz. Repeat frequency comparison for signal generator settings of 1000, 1200, 1400, 1600, 1800, 2000, 2200, and 2400 MHz. Frequency set on the AN/USM-213B and that displayed on the frequency counter should agree within +/– 5 MHz. Alinement step 5.
5	MAXIMUM UNCALIBRATED RF OUTPUT POWER CHECK If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with signal generator POWER off. Connect the test set up as shown below by attaching a 10 dB fixed attenuator to the signal generator, the thermistor mount to the 10dB attenuator, and the ext power meter through its input cable to the thermistor mount.  Set the signal generator to the initial settings of para 2-4 and the frequency to 800 MHz. Set the ext power meter to its maximum positive range.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Set sig gen POWER SET control to a mid range position. Set ext power meter power to ON and energize sig gen if off. Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Gently turn ATTENUATOR control fully clockwise, also observing ext power meter to make sure that limit position does not short out power. Measure the RF OUTPUT on the ext power meter. The sum of the ext power meter reading plus 10 for the 10 dBm attenuator should equal + 10 dBm or greater. Alinement step 7.
6	MINIMUM RF MONITOR UNCALIBRATED POWER OUT If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off. Connect test set up as shown below by attaching thermistor mount to signal generator rear panel RF MONITOR jack and the ext power meter through its cable to the thermistor mount.  Set the signal generator to the initial settings of para 2-4 and the FREQUENCY to 800 MHz. Set the ext power meter to the 0 dBm range. Energize ext power meter and energize sig gen if off. Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Measure RF MONITOR power on the ext power meter. Ext power meter should read -6 dBm or more.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
7	ATTENUATOR ACCURACY CHECK

If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off.

Connect test set up as shown below by attaching thermistor mount to the RF output of the signal generator and the ext power meter through its cable to the thermistor mount.



Set the signal generator to the initial settings of para 2-4 and the ext power meter to its maximum positive range.

Set power ON ext power meter and energize signal generator if off.

Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized.

Set the signal generator to 800 MHz and POWER SET.

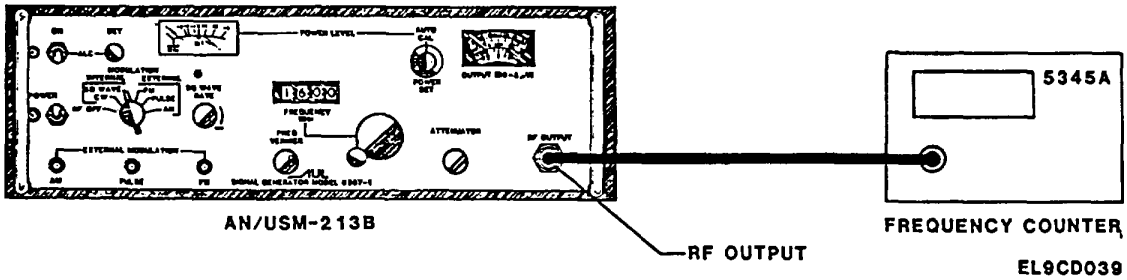
Set ATTENUATOR control successively for an external power meter reading of 0, -10, -20, and -30 dBm.

Attenuator dial readings should be within +/– 2 dBm of external power meter reading.

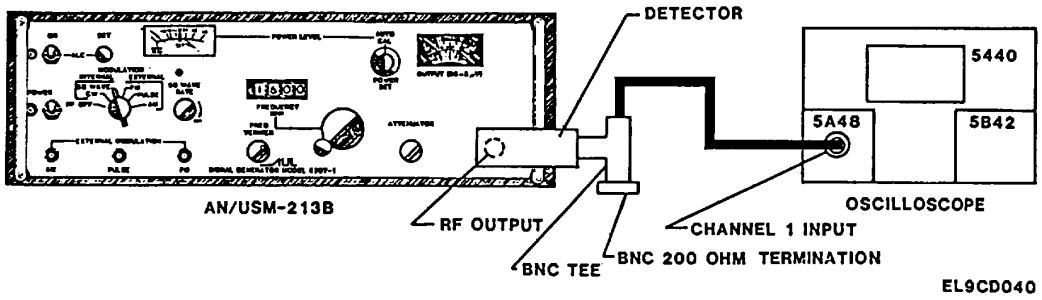
Repeat the procedures at 1600 MHz and then at 2400 MHz.

Attenuator dial readings should be within +/– 2 dBm of external power meter reading.

Alinement step 7.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
8	INTERNAL SQUARE WAVE CHECK A. SQ WAVE RATE CHECK. If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off. Connect test set up as shown below by attaching RF OUTPUT directly through and RF cable to the 5345A frequency counter for this check only.  Set signal generator to initial settings of para 2-4 and the frequency counter in a range to measure up to 2000 Hz. Set frequency counter power ON and energize sig gen if off. Set MODULATION switch to INTERNAL SQ WAVE if sig gen was on, or wait 2 mins before doing so if just energized. Set SQ WAVE RATE control fully counter clockwise. Read the frequency displayed on frequency counter. Frequency counter reading should be 950 Hz or less. Set SQ WAVE RATE fully clockwise and repeat measurement. Frequency counter reading should be 1050 Hz or more. Alinement step 10. B. INTERNAL SQUARE WAVE SYMMETRY CHECK If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off. Connect test set up as shown below by attaching detector to signal generator RF Output, a BNC tee to the detector, a 200 ohm termination to one size of the tee and the scope to the other side through a video cable.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION



Set signal generator to initial settings of para 2-4 and the scope to internal sync.

Set scope for normal operation. Turn POWER ON and energize sig gen if off.

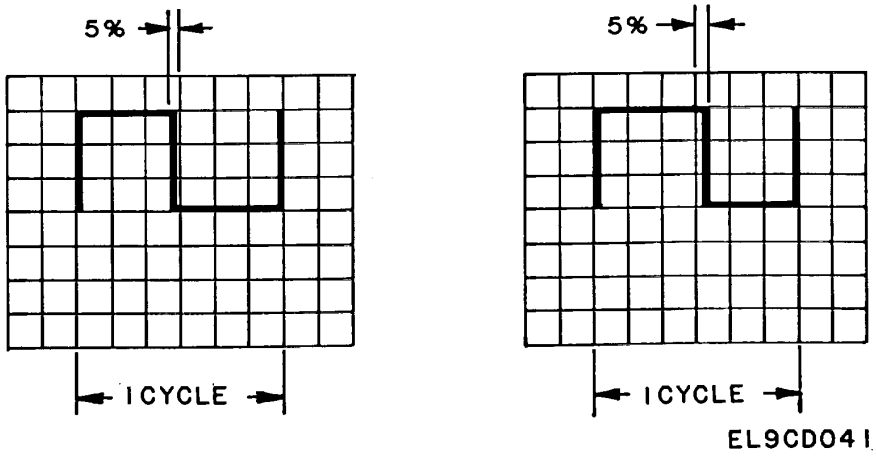
Set MODULATION switch to INTERNAL SQUARE WAVE if sig gen was on, or wait 2 mins before doing so if just energized. Center SQ WAVE RATE control.

Set FREQUENCY to 800 MHz and ALC to ON.

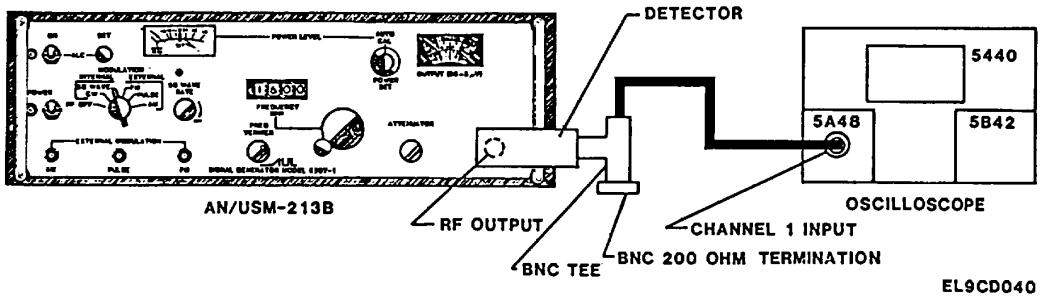
Adjust ALC SET control for zero reading on POWER MONITOR meter.

Adjust oscilloscope to display one full square wave cycle with approx. 3 cm of vertical deflection.

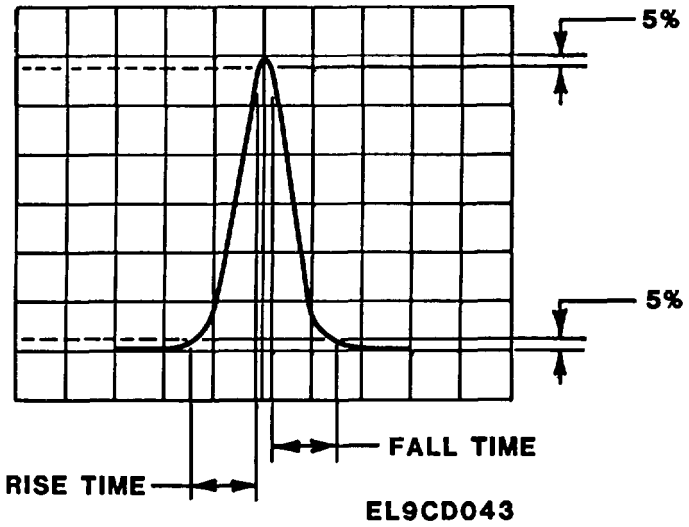
Tune upwards in frequency across the band, observing the displayed square wave. Square wave should be symmetrical within +/- 5% across the band.



Alinement step 10.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
9	EXTERNAL PULSE CHECK If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off. Connect the output of the pulse generator to the vertical input of the oscilloscope through a video cable. Set vert sensitivity on scope to the 5V/cm scale. Set pulse generator rep rate at 50 pps and amplitude to the 20 volt range. Set pulse generator and scope ON. Synchronize hor sweep on scope and adjust pulse generator amplitude to show a vertical display of 4 cm or boxes representing a pulse amplitude of 20V. Adjust pulse width for a hor display of 4 cm or boxes on the 1 usec/cm scale. Leave pulse generator settings and disconnect video cable from scope. De-energize pulse generator and scope. Connect test set up as shown below:  Set signal generator initial settings of para 2-4, and the FREQUENCY to 1600 MHz. Energize scope for normal operation. Energize pulse generator, and sig gen if off. Set MODULATION switch to EXTERNAL PULSE if sig gen was on, or wait 2 mins before doing so if just energized. Set scope vert sensitivity to the .01 volts/cm scale and adj. hor sweep to display one pulse on 1 usec/cm sweep scale. Adjust signal generator ATTENUATOR control to display pulse 5 boxes vertically on scope.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Measure rise time and fall time of the pulse. Ignore the first and last 5% of vertical amplitude.



Rise time is less than 2 usecs.
Fall time is less than 3.5 usecs.

Redo entire test with the pulse generator output now at 50 K pps, all other factors remaining unchanged. Vary the signal generator ATTENUATOR control to obtain a modulated pulse 5 cm high on the scope.

Rise time is less than 2 usecs.

Fall time is less than 3.5 usecs.

Troubleshooting item 16.

10 EXT AM MODULATION CHECK

If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off.

Set POWER on test oscillator and scope.

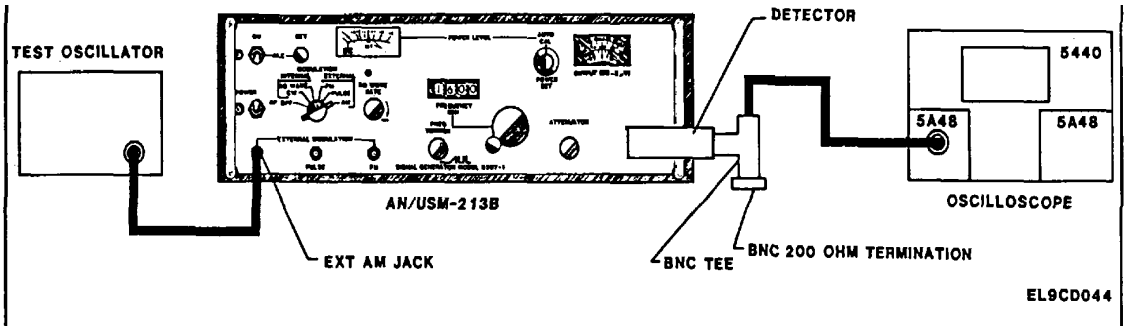
Connect the output of the test oscillator to the vert input of the scope. Set scope to 2V/cm vertical sensitivity, and test oscillator to an output of 1 KHz.

Adjust hor sweep on scope to display 5 or 6 cycles.

Adjust test oscillator amplitude to display 5 cm p-p vertically, or 10 volts. Leave test oscillator settings.

De-energize test oscillator and scope.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Connect test set up as shown below.



Set signal generator initial settings of para 2-4, and FREQUENCY to 800 MHz.

Energize test oscillator, and scope, and sig gen if off.

Set MODULATION switch to EXT AM if sig gen was on, or wait 2 mins before doing so if just energized. Set ALC to ON, and adjust ALC SET for monitor meter reading of -3.

Set scope vert sensitivity to .01V per cm. Adjust sweep to display 5 or 6 full cycles, and ATTENUATOR to display 6 boxes vertically.

Adjust ALC SET control to eliminate peak clipping on scope, and retouch ATTENUATOR control to maintain the six cm vertical display.

Increase the AM signal frequency to 1 MHz.

The vertical display should be 3 cm high or more.

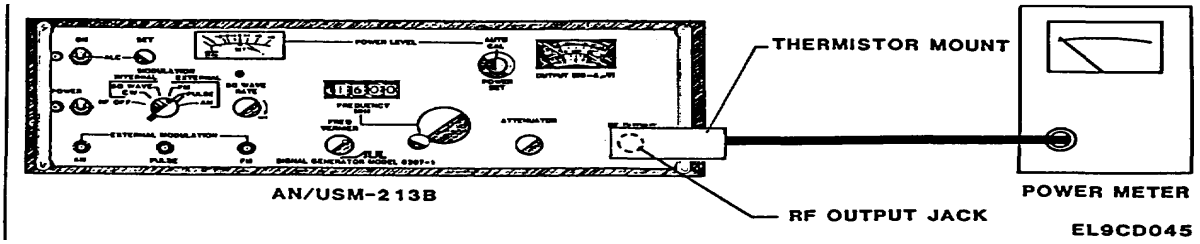
Troubleshooting item 17.

11 ON-OFF RATIO CHECK,

If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off.

Connect test set up as shown below, attaching thermistor mount to signal generator output and ext power meter through its cable to the thermistor mount.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION



Set signal generator initial settings of para 2-4, and ext power meter to the 0 dBm range.

Energize external power meter and sig gen if off.

Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Set ALC ON and SET.

Adjust signal generator ATTENUATOR control for a mid scale reading on ext power meter.

Note the ext power meter reading.

Switch MODULATION control to the EXT pulse position.

The RF OUTPUT power on the ext power meter should now be at least 20 dB lower.

Troubleshooting item 16.

12 LEVELED POWER OUTPUT CHECK.

If you are continuing from previous step, set MODULATION switch to RF OFF. If you are performing this as a separate test, start with sig gen POWER off.

Connect test, set up as in electrical check step 11, if not so connected.

Set signal generator frequency to 800 MHz.

Set ext power meter to the +5 dBm range and set its POWER on. Energize sig gen, if off.

Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Center AUTO CAL/POWER SET control. Adjust ALC SET control for 0 or SET reading on panel monitor meter.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Red ALC indicator lights. Note the power displayed on the ext power meter at 800 MHz. Increase the FREQUENCY slowly noting the reading on the ext power meter every 200 MHz until the top FREQUENCY limit of 2400 MHz is reached. The ext power meter reading should not vary across the signal generator frequency range by more than +/- 0.75 dB.

SECTION IV. ELECTRICAL ALINEMENT PROCEDURE

6-15. GENERAL

This section contains information to enable you to aline the AN/USM-213B so that it will always be emitting an accurate RF signal of selected frequency and output level.

The alinement procedure is presented in tabular form of the same type as in Section III, Electrical Check Procedures. There are 10 steps in a complete alinement.

As in the case of the Electrical Checks, the sig gen should be allowed to warm up for 90 mins before per-forming electrical alinements. If the instrument has been operating immediately before you run the electrical alinement or alinements, that time counts toward the warmup period.

The entire 10 alinement procedures should be performed every 6 months immediately prior to the running of the electrical check procedures of Section III.

Alinement steps 1 through 9 should be performed after the replacement of an oscillator assembly or the replacement of a klystron tube.

Individual alinement steps are to be performed as called for in Section III, Electrical Check Procedures, or after the replacement of certain parts as indicated in Section Vl.

WARNING

When performing the alinement procedures, you will be working inside the signal generator in its energized state. You must exercise extreme care when adjusting electrical elements such as potentiometers, and when positioning mechanical parts such as the frequency cam tabs. Observe all safety rules. Refer to para 1-14a, Safety, Care Handling and Warning pages at the front of this manual.

When adjusting potentiometers inside the instrument, always use insulated adjustment rods of sufficient length to avoid direct bodily contact.

Table 6-2.

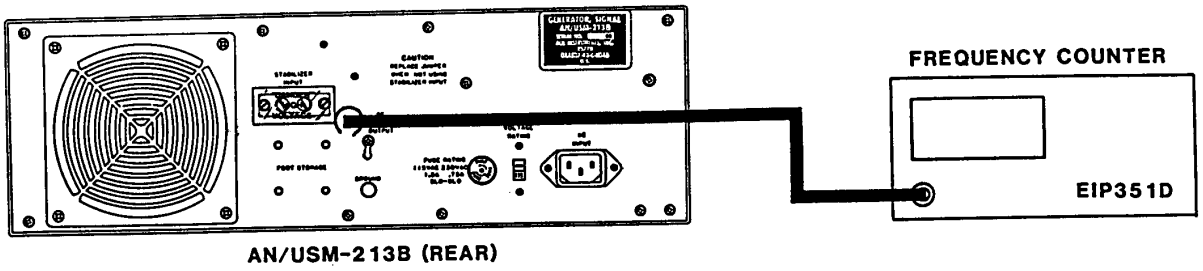
ELECTRICAL ALINEMENT PROCEDURES INDEX

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
1	-325V BEAM SUPPLY VOLTAGE ALINEMENT Deenergize sig gen. Remove sig gen dust cover (para 6-20). Set MODULATION switch to RF OFF. Using multimeter, set to 1000 VDC range and energize. Set probes between instrument ground and -325 volt test point on tracking board. Reenergize sig gen. **CAUTION** Wait 2 mins before setting MODULATION switch to CW. Voltage should read -325 VDC +/- 10 VDC. Adjust AR18 for a beam volt-age of -325 VDC. Troubleshooting item 7. Go to alinement step 2.
2	-750 VOLT SUPPLY ALINEMENT Deenergize sig gen. Remove instrument dust cover if on (para 6-20). Set MODULATION switch to RF OFF. Using multimeter, set to 1000 VDC range and energize. Set neg probe at -325V test point and pos probe at -750V test point on tracking board. Energize sig gen. **CAUTION** Wait 2 mins before setting MODULATION switch to CW. Voltage should read -425 VDC +/- 10 VDC. Adjust R9 on A2A1 circuit card for a reading of -425 VDC.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	T/S item 6.
	If alinement ends here:
	Deenergize sig gen.
	Replace dust cover (para 6-20).
3,	KLYSTRON FILAMENT ALINEMENT
	Deenergize sig gen.
	Remove instrument dust cover if on (para 6-20).
	Set MODULATION switch to RF OFF. Remove A2 High Voltage Assembly cover (para 6-30).
	Attach multimeter neg probe to test pin 11 & pos probe to test pin 18 on the A2A2 card assy to measure dc voltage.
	Measurement must be taken before the delay circuit has operated.
	Energize multimeter and sig gen. Voltage should read +6.0 VDC +/- 0.1 VDC.
	Within 1 min. of turning POW-ER ON, adjust R1 of the A2A2 circuit board for a reading of +6.0 VDC.
	If voltage is not obtained, go to T/S item 10.
	If alinement ends here:
	Deenergize sig gen.
	Replace high voltage cover (para 6-22).
	Replace instrument dust cover (para 6-20).
4	BEAM CURRENT ALINEMENT
	Remove sig gen dust cover if on (para 6-20).
	Set MODULATION switch to RF OFF.
	Energize sig gen if off.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	Set MODULATION switch to CW if sig gen was on, or wait 2 mins before doing so if just energized. Using digital multimeter, set to 10 VDC range and energize. Set probes between ground on the tracking board and TP1 (located near Al osc reg ckt card). Voltmeter should read between 1.8 and 2.1 volts DC. This voltage is across R14 on the A2A3 card assy and is equivalent to a current reading of between 18 and 21 mA. Divide the voltage read by 100 (the value of R14) to obtain between 0.018 and .021 amperes of beam current. This is the same as between 18 and 21 mA. Adjust A4A1R1 (BEAM CURRENT ADJ) on tracking board for a current between 18 mA and 21 mA. T/S item 9. Glyptol pot shaft to shaft lock after adjustment. If alinement ends here: Deenergize sig gen. Replace dust cover (para 6-20).
5	FREQUENCY CAM CALIBRATION & MODE ALINEMENT AFTER REPLACEMENT OF KLYSTRON TUBE OR TRACKING CIRCUIT COMPONENT. Remove instrument dust cover if on (para 6-20). Before frequency alinement, the following alinements must be performed if not already done: -325V BEAM SUPPLY VOLTAGE ALINEMENT -750V REPELLER VOLTAGE ALINEMENT KLYSTRpN FILAMENT ALINEMENT BEAM CURRENT ALINEMENT With the sig gen energized and in the RF OFF position, connect simultaneously the rear and front panel setups as shown in Figure 6-9. Set up scope for X-Y operation with a 5A48 in the left compartment and another 5A48 in the horizontal compartment. Set V/Div. to 1 V and adjust as necessary.

TM 11-6625-3053-14



REAR PANEL SET UP

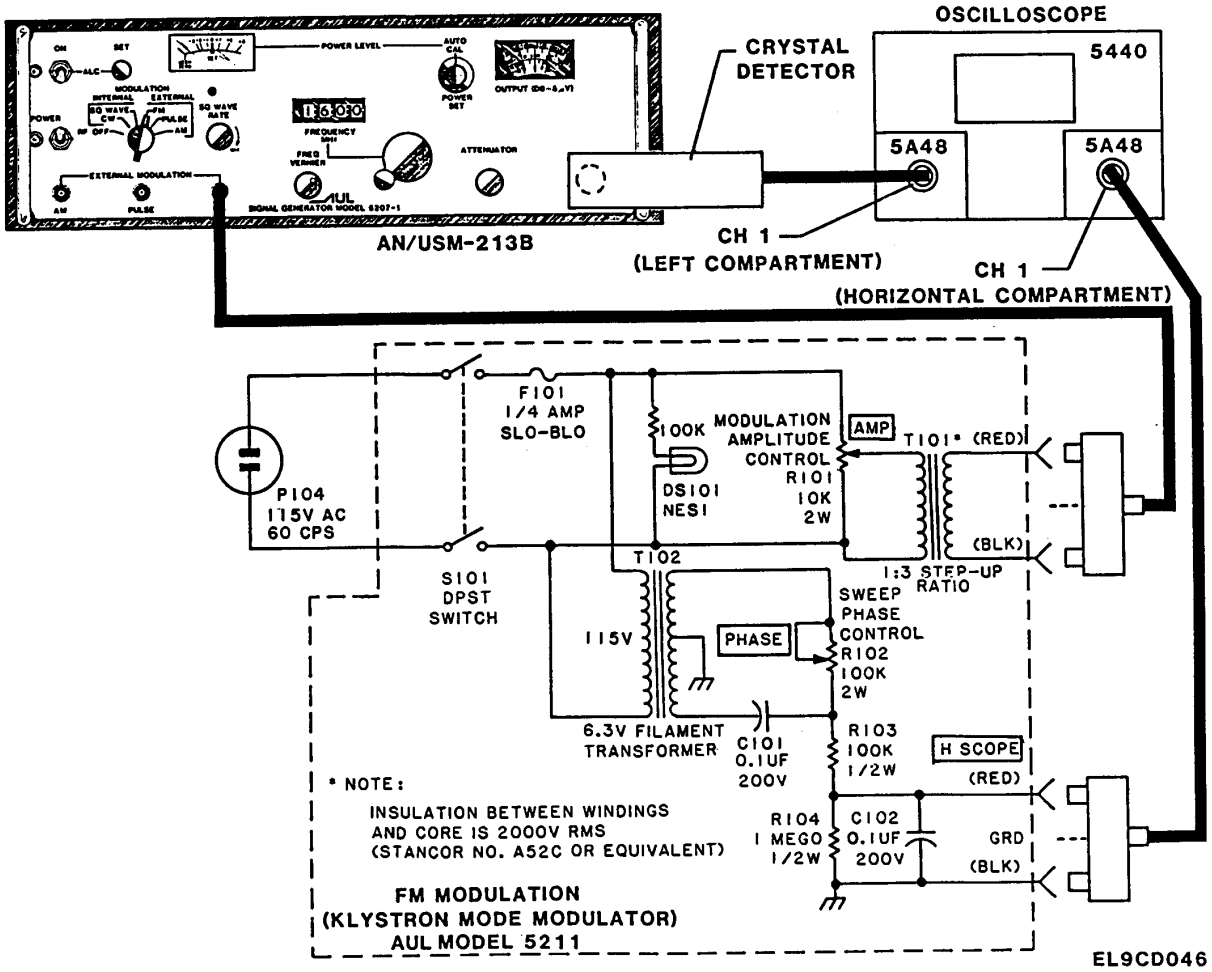
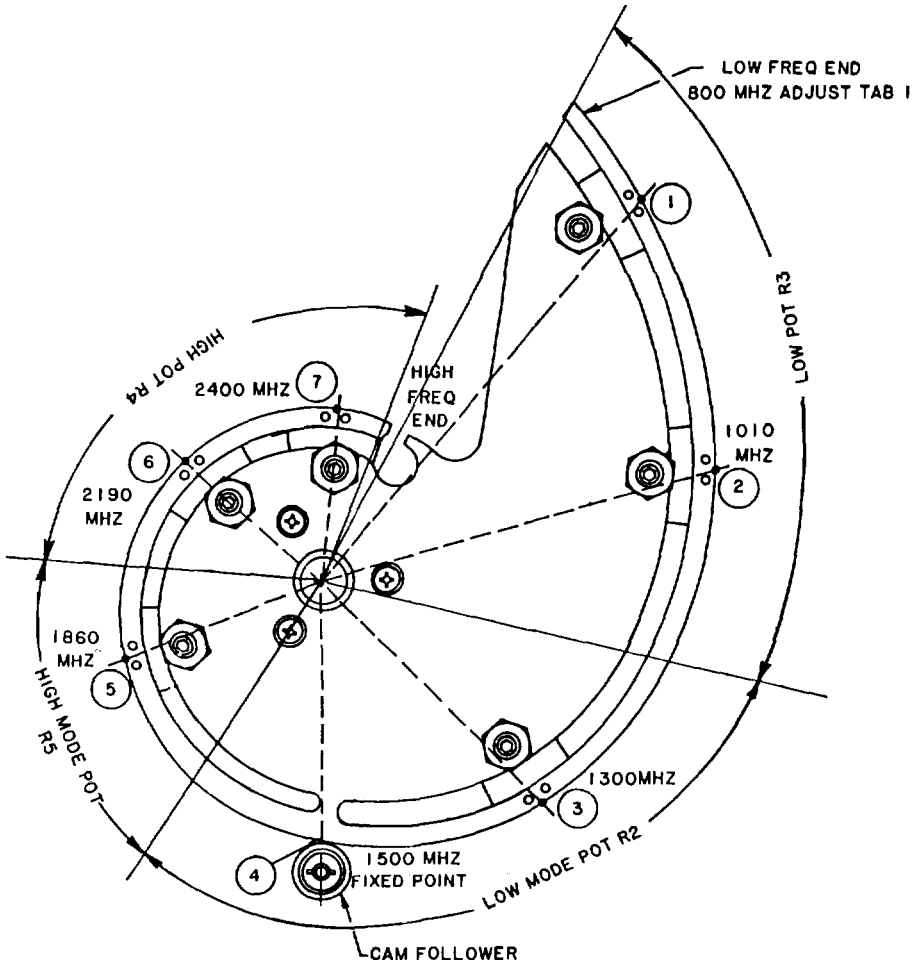
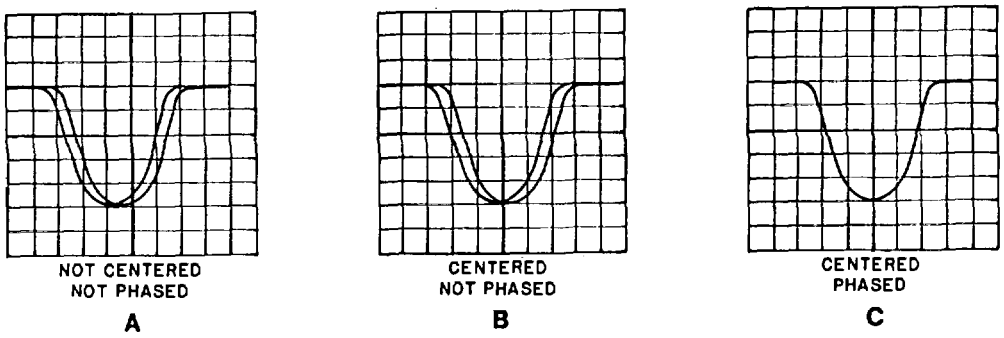


Figure 6-9. Test Setups for Frequency Cam and Mode Alinement



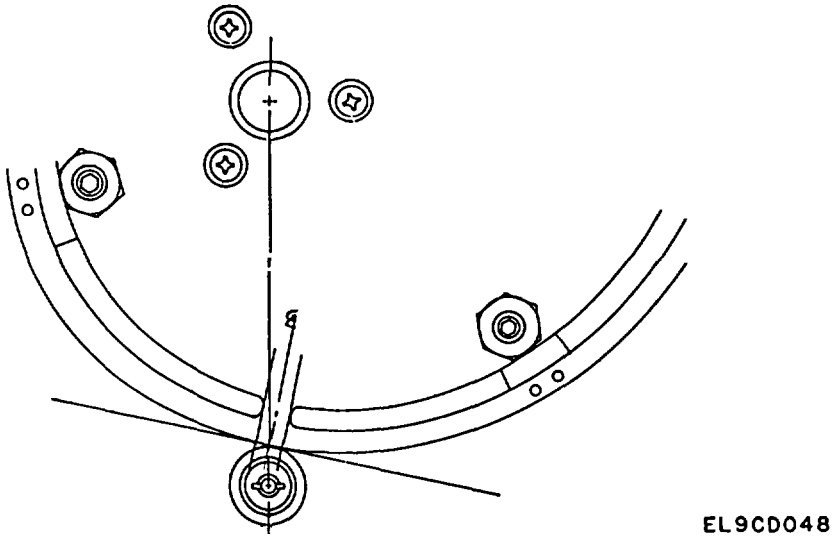
INITIAL FIXED POSITIONING OF FREQUENCY CAM



EL9CD047

TYPICAL MODE CENTERING & PHASING PATTERNS

Figure 6-10. Frequency Cam Tab Locations & Klystron Mode Patterns

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	Set sig gen to initial settings of para 2-4, except turn the klystron mode modulator output knob fully counter clockwise. Set freq counter to measure up to 2500 MHz. Energize the system and set sig gen MODULATOR switch to EXTERNAL FM. **NOTE** If a component of the repeller tracking voltage circuit has been replaced, such as the A4R1 repeller pot or the HIGH mode pot, set all of the adjustable pots to their center positions. If only the klystron has been replaced, leave the pot settings as they were. The following procedure concerns alinement of the tracking pots and the frequency tab points. Refer to Figure 6-10. Set the frequency control of the signal generator to 1520 MHz, the frequency which corresponds to the center of the solid point on the frequency cam. The frequency counter should display 1520 MHz +/- 1 MHz. **NOTE** A line from the center of the cam follower to the center of the cam shaft intersects the cam surface at the center of the solid portion of the cam. See point 4 on the cam, Figure 6-10 for detail below. This delicate setting should not be altered unless you have reason to believe the cam has shifted, or unless you have replaced the cam. If either of these is the case:  EL9CD048 *INITIAL CAM POSITIONING RELATIVE TO SOLID PORTION*

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	Deenergize sig gen. Loosen two 6-32 spline set screws on underside of cam hub holding frequency cam to cam shaft.

WARNING

Be careful when working on energized unit.

Set controls to initial settings as in para 2-4.

Set POWER ON and wait 2 mins.

Set MODULATION switch to CW.

Make sure FREQUENCY read-out reads 1520 MHz.

Carefully move frequency cam until the centers of cam shaft, follower, and solid portion all line up per diagram above.

Tighten spline set screws on cam hub.

Adjust the output of the klystron mode modulator for a vertical deflection on the scope of about 6 cm. Adjust the scope hor gain to display the full mode pattern. Adjust PHASE control of Mode Modulator for single trace.

The mode should be centered as shown in C of Figure 6-10.

Adjust LOW MODE pot R2 to center mode.

Observe the frequency readout of the signal generator and the frequency displayed on the frequency counter.

The two frequencies should agree within +/- 1 MHz.

Adjust the penetration of the oscillator choke as follows:

WARNING

Exercise care not to contact live voltages.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	Loosen the 8-32 alien cap screw holding the push rod disk. Carefully adjust penetration of push rod disk with thumb and forefinger of both hands until the instrument frequency and the frequency counter agree with 1520 GHz within +/-1 MHz.
	NOTE
	Move the push rod yoke disk TOWARD the klystron tube to INCREASE output frequency, and AWAY rom the klystron tube to LOWER it.
	Tighten cap screws when adjustment completed.
	Decrease the sig gen freq to a reading of 1300 MHz and POWER SET instrument.
	Modes should be centered on scope, per figure 6-10C, and frequency of signal generator should agree with frequency counter within +/- 2-1/2 MHz.
	If modes not centered, adjust LOW pot R3 on tracking board. Touch up R2 LOW MODE if necessary.
	If frequencies in agreement, go to 1010 MHz on sig gen. If frequencies were not brought into agreement by this adjustment to within +/- 2-1/2 MHz, cam tabs must be adjusted as follows:
	To loosen cam tab, place 6-32 allen wrench in center of tab adjustment system. Place adjustable wrench on hex nut and, holding alien wrench fixed, turn adjustable wrench counter clockwise.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	To ADJUST cam tab, once loosened, turn allen wrench as required. To lock setting, hold alien wrench fixed at proper adjustment position, and turn hex nut using adjustable wrench, clockwise until hard against cam surface. 1. Loosen the 3 lower freq cam tabs. 2. Adjustment cam tab at point 3 until the instrument frequency agrees with the frequency counter within +/- 2-1/2 MHz and lock in position. Do not tighten cam adjustments at points 2 and 1.
	Decrease sig gen freq to a reading of 1010 MHz and POWER SET instrument.
	Modes should be centered on scope, per figure 6-10C, and frequency of signal generator should agree with freq counter within +/- 2-1/2 MHz.
	If modes are not centered, adjust LOW pot R3 on tracking board. If frequencies in agreement, lock cam tab 2. If frequencies not brought into agreement by this adjustment within +/- 2-1/2 MHz. 1. Loosen cam tab 2 & 1. 2. Adjust cam tab 2 to accomplish same and lock in position. When done leave tab 1 loose.
	Decrease sig gen freq to a reading of 800 MHz and POWER SET instrument.
	Modes should be centered on scope, per figure 6-10C, and frequency of signal generator should agree with freq counter within +/- 2-1/2 MHz.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	If modes not centered, note position of R3 LOW pot shaft. Further adjust LOW pot R3 on tracking board. If adjustment has no effect, return it to previous adjustment position. If frequencies in agreement, lock cam tab 1. If frequency not brought into agreement by this adjustment within +/- 2-1/2 MHz, adjust cam tab 1 and lock into position when accomplished. Increase sig gen freq to 1860 MHz and POWER SET instrument. Modes should be centered on scope, pcr figure 6-10C, and frequency of signal generator should agree with freq counter within +/- 2-1/2 MHz. If modes not centered, adjust HIGH MODE pot R5 on tracking board. If frequencies in agreement, go to 2190 MHz on sig gen. If frequency not brought into agreement by this adjustment within +/- 2-1/2 MHz, loosen the remaining 3 high freq cam tabs at points 5, 6 & 7. Adjust tab 5 until frequency agreement is attained and then tighten. Leave tabs 6 and 7 loose. Increase sig gen freq to 2190 MHz and POWER SET instrument. Modes should be entered on scope, per figure 6-10C, and frequency of signal generator should agree with freq counter within +/- 2-1/2 MHz. If modes not centered, adjust HIGH pot R4 on tracking board. If frequencies in agreement, go to 2400 MHz on sig gen.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
5 (cont'd)	If freq not brought into agreement by this adjustment within +/- 2-1/2 MHz, adjust tab 6 and lock when accomplished. Leave tab 7 loose.
	Increase sig gen freq to 2400 MHz and POWER SET instrument.
	Modes should be centered on scope, per figure 6-10C, and frequency of signal generator should agree with freq counter within +/- 2-1/2 MHz.
	If modes not centered, note position of R4 HIGH shaft. Further adjust HIGH pot R4 on tracking board. If adjusting R4 ineffective, return it to previous adjustment position.
	If freq not brought into agree-ment by this adjustment within +/- 2-1/2 MHz, adjust tab 7 and lock when accomplished.
	Once cam tabs have been frequency alined, tune through the freq range of the sig gen from low to high observing frequencies displayed on sig gen and frequency counter. Observe mode displays on the scope.
	At all points across the frequency range, the sig gen frequency agrees with the frequency counter within +/- 5 MHz.
	The mode patterns should be continuous. When starting at 800 MHz, the mode pattern is centered. As frequency is increased, the pattern shifts to the right of the scope screen until the mode switching point (1700 MHz) when the pattern recenters itself until 2400 MHz is reached. The pattern should exhibit no loss of power except at the mode switching point (about 1700 MHz) where an abrupt change in power level is observed.
	Touch up adjustments of the tracking pots in the areas of their influence on frequency until frequencies agree within +/-5% across band. Mode patterns will improve upon touch up of pot adjustments. After final adjustment, tighten all tracking board pots and place a glyptol dot on each adjusted pot between pot shaft and locking mechanism to pre-vent movement.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	If alinement ends here: Deenergize signal generator. Replace dust cover (para 6-20).
6	POWER MONITOR METER CALIBRATION Deenergize sig gen. Disconnect POWER SET probe from A5 PIN diode attenuator at J2. Attach an SMA female to type N female adapter to POWER SET cable at P2. Connect the thermistor mount and external power meter to the type N female end of the adapter. Set sig gen controls to initial settings of para 2-4 and FREQUENCY to 800 MHz, and ext power meter to 0 dBm scale. Energize sig gen and ext power meter. Wait 2 mins. and set MODULATION switch to CW. Set the hairline to exact center of window. Aline 50 dBm behind the hairline. Adjust POWER SET/AUTO CAL control within the range of -55 dBm & -60 dBm against the stationary ATTENUATOR dial so that: External power meter reads -7 dBm.
	If little or no output obtained, go to T/S item 5, check 5b. If more than or less than -7 dBm is obtained and cannot be adjusted to -7 dBm on ext power meter, deenergize sig gen. Remove Tuning Head Assy (para 6-23). Loosen 2 ea 6-32 spline set screws securing POWER SET probe to its drive cylinder. Reenergize sig gen with MODULATION switch in RF OFF position. Wait 2 mins and set MODU-LATION switch to CW.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION	
		Make sure ATTENUATOR dial still shows 50 dBm in center of window. Set POWER SET/AUTO CAL control so that ATTENUATOR hairline is on 58 dBm on the already set ATTENUATOR dial. Carefully move the POWER SET probe keeping it oriented with ground stub vertical in very small steps until you obtain the -7 dBm on the external power meter. Move the probe toward the cavity for more power, away from the cavity for less power. When the -7 dBm is obtained, tighten set screws on POWER SET PROBE and deenergize the sig gen. Disconnect the ext power meter. Reconnect P2 to J2 on the A5 assembly. If alinement ends here reassemble the tuning head assy onto the main frame (para 6-23).
	Adjust ALC SET control (R1) fully clockwise and Modulation Switch to RF OFF. Reenergize signal generator. Wait 2 mins. and set MODULATION switch to CW. Set attenuator control so that attenuator reading of 50 is in the center of the window. Set hairline at -58. Adjust A3R16 for a -1 dBm deflection on POWER MONITOR METER. The POWER MONITOR METER is now calibrated.	
7	CALIBRATION OF ATTENUATOR OUTPUT With tuning head still to right of main frame: Deenergize sig gen.	

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
7 (cont'd)	Connect the thermistor mount and external power meter to the RF OUTPUT JACK. Set MODULATION switch to RF OFF and energize sig gen. Set FREQUENCY to 800 MHz. Set ext power meter to 10 dBm range and energize. Wait 2 mins. and set MODULATION switch to CW. Power SET the instrument by turning the POWER SET/AUTO CAL control until the POWER MONITOR meter points to "0", or SET position. Turn ATTENUATOR control so that the external power meter registers "0" dBm. The ATTENUATOR dial registers 0 dBm behind the hairline. If output power is low, and ATTENUATION control has reached its stop before attenuator probe can penetrate enough to get 0 dBm power out, do the following. **WARNING** Exercise extreme care in the execution of the following procedure since you will be making mechanical adjustments on an energized unit. Deenergize test set up but do not change settings. Loosen 2 set screws holding ATTENUATOR probe to its drive yoke. Reset sig gen to RF OFF. Add a 10 dBm attenuator pad between RF OUTPUT & THERMISTOR. Reenergize set up. Wait 2 mins and set MODULATION switch to CW. Make sure ATTENUATOR control is fully clockwise during this procedure. Advance attenuator probe to-ward oscillator until the sum of the ext power meter reading and the 10 dB for the attenuator pad exceeds +10 dBm.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
7 (cont'd)	Rotate ATTENUATOR probe from ground stub vertical position to attain this, if necessary. Once +10 dBm attained, tighten set screws holding attenuator probe to drive yoke. If +10 dBm cannot be attained go to T/S item 14. Set MODULATION to RF OFF. Remove 10 dB atten pad from set up. Set MODULATION to CW. Rotate ATTENUATOR control counterclockwise until "0" dBm is measured on ext power meter. Check if ATTENUATOR dial reads "0" behind the hairline. If it does, the ATTENUATOR dial is calibrated. If not, continue. With the sig gen running, loosen the 2 ea 6-32 spline set screws on the hub of the ATTENUATOR dial. Slip the ATTENUATOR dial until the "0" registers against the hairline. Tighten the 2 set screws. Reverify that the POWER MONITOR meter reads "0" or SET, and the ATTENUATOR dial reads "0" at the same time the ext power meter reads 0 dBm. The Attenuator dial is now calibrated.

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
	If the alinement ends here: Deenergize the sig gen. Replace tuning head inside the main frame (para 6-23). Replace dust cover (para 6-20).
8	ALINEMENT OF POWER SET/AUTO CAL KNOB AS ALC REFERENCE Perform this alinement when there is no further need to keep the turning head removed from the main frame. Deenergize the sig gen. Replace tuning head into main frame (para 6-23). Set sig gen to initial settings of para 2-4. Energize sig gen. Set frequency to 800 MHz. Wait 2 mins and set MODULATION switch to CW. Adjust POWER SET/AUTO CAL control for a reading of 0.5 dBm on the POWER MONITOR meter. White arrow on POWER SET/AUTO CAL control points directly to vertical marker on front panel. Loosen set screw holding POWER SET/AUTO CAL knob to its shaft. Rotate knob so that white arrow points directly to vertical line on panel. Tighten knob screw at that position with 0.5 dB still reading on POWER MONITOR meter. POWER SET/AUTO CAL knob is in proper position for ALC operation when the white arrow points directly to the vertical line on the front panel. If alinement ends here: Deenergize sig gen. Replace dust cover (para 6-20).

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
9	MODE BALANCE ALINEMENT, OR BALANCING OUTPUT OF AT1 AND AT2 ON A5 LEVELING ATTENUATOR ASSY. Remove instrument dust cover if on. If dust cover is already off, and sig gen energized, set modulation switch to RF OFF. Connect test set up for output power check as in para 6-14 step 7. Set sig gen to initial settings of para 2-4, and FREQUENCY at about 1680 MHz. Set ext power meter to +5 dBm range. Energize ext power meter and sig gen if off. Set MODULATION switch to CW if sig gen was on or wait 2 mins before doing so if just energized. Set ALC switch to ON and adjust ALC SET to SET on POWER MONITOR METER. Observing ext power meter, tune upward in frequency through the mode switching frequency to about 1720 MHz. The steady state level of power measured before the mode switching should equal the power measured after the mode switching within 0.2 dB. If this is not the case, position and turn circuit card A3 into vertical position. Adjust A3R24 until the condition is met. Replace A3 card to its permanent hor position. **NOTE** Adjustment of A3R24 balances output of both halves of A5 assy by sending the output of AR4 Leveling and Modulating Amplifier in equal parts to AT-1 and AT-2 sections of A5 assy. This compensates for changes in power levels generated as frequency is changed. Being inverted, the output of AR4 opposes the direction of the power level change, and thereby restores the level to its original value. See para 6-12 for a more complete explanation of this process. If alinement ends here: Deenergize sig gen. Replace dust cover (para 6-20).

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
10	ALINEMENT OF A3R1 SQ RATE ADJ Leave dust cover off or remove if on (para 6-20). Swing A2 ckt card up counterclockwise to vertical position until locked in place by stop located on A3 mtg bracket. Connect the R F OUTPUT to ext frequency counter 5345A through an R F cable. Set MODULATION switch to RF OFF and SQ WAVE RATE control to center position. Energize ext frequency counter and sig gen if off. Set MODULATION switch to INT SQ WAVE if sig gen was on, or wait 2 mins before doing so. ADJUST A3R1 for a reading of: 1000 Hz on the frequency counter. T/S item 15. Turn SQ WAVE RATE control fully counter clockwise. Ext frequency counter should register 950 Hz or less. T/S item 15. Turn SQ WAVE RATE control fully clockwise. Ext frequency counter should register 1050 Hz or more. T/S item 15. Return A3 ckt card to original position: Deenergize sig gen.

SECTION V. TROUBLESHOOTING (FAULT LOCATION)

6-16. This section contains a troubleshooting table which will aid you in isolating signal generator malfunctions due to defective components. This table is based upon the signal generator check procedure in Section III and requires power be turned ON inside the unit. You must exercise extreme care when making measurements inside an operating unit. Observe all safety rules. Refer to para 1-14a, Safety, Care & Handling and Warning pages at the front of this manual.

6-17. TROUBLESHOOTING TABLE.

You will observe that the troubleshooting table contains three columns. These are:

- ITEM — The number in this column is keyed to a similar item in the CORRECTIVE ACTION column of the electrical check procedure given in Section III or the alinement procedure given in Section IV. It directs you to the applicable MALFUNCTION in this table.
- MALFUNCTION — This column lists the fault you have observed when performing the electrical check or alinement.
- CHECKS/ — This column provides you with instructions to make additional checks CORRECTIVE ACTION to components which you must replace. If a malfunction or fault cannot be isolated to a single component, those components which may be faulty are listed in order of most probable failure or their ease of replacement.

6-18. PROCEDURE.

Proceed as follows to troubleshoot the signal generator.

- Perform the checks or corrective action given in the CHECKS/CORRECTIVE ACTION column of the troubleshooting table for any fault you observe during checkout.
- Be sure to observe the sequence of checks or corrective actions as given.
- Inspect components for signs of burning or other deterioration as an aid to fault location.
- Before replacing a component, check associated wiring for breaks or shorts. Refer to the schematics (Figure FO-2) and functional schematics contained in Section II, and the wiring diagrams contained at the end of this section. (Figures 6-19, 6-20, and 6-21.)

* If broken wiring or poor connections are repaired, perform the check procedure to see if the repair you have made has corrected the malfunction. You may not have to replace the component if wiring repairs have eliminated the malfunction.

NOTE

If a DC voltage is to be measured, the troubleshooting procedure will first mention the point of lower potential or closest to ground. For example, if the instructions are to measure the voltage between test pin 11 and test pin 18 of A2A2 card assy, the common or neutral probe will first be placed on pin 11, and the active or voltage probe will be placed on pin 18.

Since a digital voltmeter/multimeter is called for in the maintenance of this instrument, you will always obtain a reading of the proper polarity.

NOTE

Because you will be troubleshooting inside the unit with the dust cover removed, you should never set POWER ON unless instructed to do so by the Alinement or Troubleshooting procedure. Observe all safety precautions when working inside an energized unit.

- Refer to Section VI for replacement procedures.
- Refer to Figure FO-1, Top Internal View of AN/USM-213B for location of certain adjustments, parts and assemblies.
- Refer to top views of circuit card assemblies for location of components when troubleshooting the particular section of the instrument to which the card illustration pertains.
- After replacement of a component, perform the check procedure to make sure that the malfunction has been eliminated.

Table 6-3. TROUBLESHOOTING SYMPTOM INDEX

	Troubleshooting Item
DS1 - POWER ON INDICATOR doesn't light	1
B1 - Rear Blower doesn't run	2
DS-2 - Attenuator Lamp doesn't light	3
DS1, B1 DS-2 all not operating - no indication that instrument operating	4
No Power Monitor movement when in CW	5
Cannot Aline -750V Supply	6
Cannot Aline -325V Beam Supply	7
A2 Power Supply not functioning	8
Beam Current faulty	9
Filament Voltage faulty	10
Grid Voltage faulty	11
Output Voltages of Input Xfmr faulty	12
A1 Card Assy Output faulty	13
Low or No Power Output	14
Internal Square Wave Frequency incorrect	15
External Pulse Modulation not functioning properly	16
AM Modulation not working	17

STEP	OPERATION → NORMAL INDICATION → CORRECTIVE ACTION
1	DS1 does not light up (green) when S1 set to ON. Remove equipment dust cover (para 6-20). Remove rear panel through stage 1 (para 6-21). Set modulation switch to RF OFF & POWER switch to ON. Using the multimeter, set it for the 1000 VAC range and measure AC voltage across terminals. 1 & 2 of input Xfmr T1. Voltmeter should read between 105 VAC and 125 VAC. If this reading is obtained, replace DS1. If this reading is not obtained, go to item 4.
2	B1 does not run when S1 set to ON. Remove equipment dust cover (para 6-20). Set MODULATION switch S3 to RF OFF and reset POWER ON. Using the multimeter, set it for the 1000 VAC range and measure the voltage across the two blower terminals. Voltage should read between 105 and 125V. If this reading is obtained, replace B1. If this reading is not obtained, go to item 4.
3	DS2 does not light when S1 set to ON. Remove equipment dust cover (para 6-20). Set modulation Switch S3 to RF OFF and Reset POWER ON. Using a multimeter set for the 100 VAC range, measure the voltage between the center conductor of the socket and the shell of the socket. Voltage should read between 30 and 35 VAC. If this reading is obtained, replace DS1. If this reading is not obtained, go to item 4.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
4	DS1, B1 & DS2 all inoperative when S1 set to ON. 1. Check Fl as follows: Remove fuse from rear panel of sig gen. Inspect fuse for signs of having blown. If blown, replace F1. If no visible signs of having blown, check continuity of fuse with multimeter set for 10 ohm range. Measure resistance across fuse. If resistance measures infinity replace Fl. If resistance measures 0, go to check 2. 2. Check S1 as follows: Remove instrument dust cover (para 6-20). Reenergize sig gen. Using multimeter set for the 1000 VAC range, measure voltage between white lead on input power jack J10 and the white lead on S1. Voltage should read between 105 and 125V. If reading is not obtained, replace S1. If reading is obtained, go to check 3. 3. Check S2 as follows: With instrument dust cover still removed and POWER OFF, remove rear panel (para 6-21). Set S2 to correspond with the voltage of the power source you are using. 11 5V or 230V. Using a multimeter set for the 1000 VAC range, measure voltage between the white lead at J10 and terminal 3 of input power Xfmr T1. Voltage should read between 105 and 125V. If this reading is not obtained, replace S2. Replace dust cover (para 6-20) after correction has been made and performance verified.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
5	No POWER MONITOR METER indication after waiting for delay ckt to operate and then switching to CW. 1. Check the -325V beam supply per Alinement step 1. a) If between -310V and -340V, proceed to check 2 below. b) If between -270V and -315V, aline to -325V per Alinement step 1. If you cannot aline to -325V, go to T/S item 7. c) If no voltage measured, go to T/S item 7. 2. Check the -750V repeller supply per Alinement step 2. a) If between -740V and -760V, proceed to check 3 below. b) If between -650V and -740V, aline to -750V per Alinement step 2. If you cannot aline to -750V, go to T/S item 6. c) If no voltage measured go to T/S item 6. If already done in check, 1 above, eliminate this check. 3. Check repeller voltage: a) Using multimeter set to 1000 VDC range, set the test probes between -325V test point and the REPELLER test point on the tracking board. Refer to Figure 6-11. Repeller Voltage vs Frequency. Vary the frequency control from 800 MHz to 2400 MHz. Observe the variations of voltage on the multimeter, and record the voltages at 800 MHz and at every 2CO MHz thereafter. b) If the voltages are within the shaded area of Figure 6-11, go to step 4 below. c) If the voltage is continuous but lower or higher than those shown in Figure 6-11, aline the tracking board pots per Alinement step 5. d) If the voltage is very irregular, with points of no voltage as you tune the frequency, replace A4R1 (para 6-33).

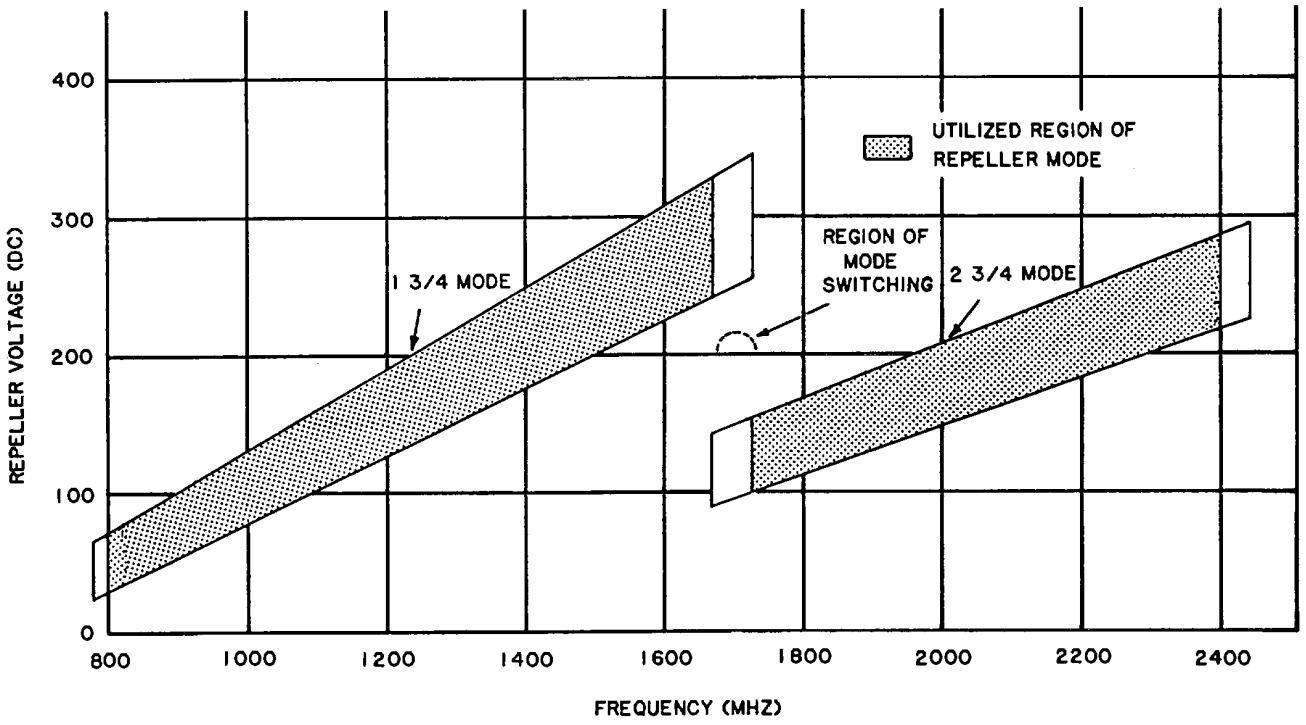


Figure 6-11. Repeller Voltage vs Frequency

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
5 (cont'd)	4. Check beam current per Alinement step 4. a) If the beam current measures between 18 and 21 mA, go to check 5 below. b) If beam current higher or lower, aline beam cur- rent per alinement step 4. If beam current cannot be alined, go to T/S item 10. c) If no beam current, check klystron tube per T/S item 11. 5. Check Power Set Probe output per Alinement step 6. a) If -7 dBm obtained reconnect P2 To J2 and go to check 6 below. b) If you measure little or no power out at P2, or you cannot obtain the -7 dBm output, deenergize sig gen and remove the Power Set Probe assembly (para 6-34). Using a multimeter set to 100 ohm range, measure resistance between center conductor of P2 and the outer shell of P2. Resistance should measure between 45 and 55 ohms. if resistance is not within these limits, replace the POWER SET probe assy. Recheck for the -7 dBm output at P2 per aline- ment step 6. 6. Check the Leveling Attenuator Assembly. a) Deenergize sig gen POWER. Disconnect P1 from J1. b) Attach an adapter SMA male to type N female to J1. Connect a thermistor mount to the type N connector and an ext power meter to the thermistor mount. c) Set sig gen to initial settings of para 2-4 and energize sig gen and ext power meter. Wait 2 mins and set MODULATION switch to CW. d) Measure rf output at J1 with the external power meter. This time, you should read -9 dBm with the POWER SET control in the same position in which you 'obtained the -7 dBm as in check 5 above.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	e) If you get a reading of approx -9 dBm reattach P1 to J1 and go to check 7 below. f) If you get less power than -12 dBm replace A5 assembly. g) Recheck for the approx -9 dBm output at J1. h) Reassemble tuning head into main frame. (para 6-23). 7. Check cable from P2 to Detector. a) Detach cable from J1 going into the detector junction. b) Attach adapter, type N female to type N female. c) As in check 6d above, and under the same conditions, check power on ext power meter at this point. d) Power should still read same as in check 6d above. e) If it does, reattach the detector and go to check 8 below. f) If it doesn't, replace cable connecting J1 to the detector. 8. Check meter circuit. a) Position A3 card to vertical position. b) Using multimeter, set to VDC. Measure voltage to bottom of R8 of the A3 assy (pin 2 of P3). Voltage should be .017 VDC. If voltage is obtained, replace M1. If voltage not obtained, go to check c) below. c) Continuing with multimeter, measure voltage between ground and pin 4 of AR5 on the A3 assy (Fig. 6-16). Voltage should be approx -12 VDC. If voltage obtained, replace AR5. If voltage not obtained, check power input to A3 card assy per T/S item 12, check 1 e) 2).
6	Cannot aline -750V supply-incorrect voltage. 1. Check -325V output of A2A3 card assy. a) Remove instrument dust cover if on.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
6 (cont'd)	b) Remove high voltage cover if on (para 6-22). c) Set multimeter to 1000 VDC range. d) Set sig gen initial settings of para 2-4. e) Energize sig gen and multimeter. f) Wait 2 mins and set MODULATION Switch to CW. g) Using multimeter, check voltage between chassis ground and test pin 12 on A2A1 card assy. Voltage should read -325 VDC. If voltage is not obtained, go to T/S item 7. If voltage is obtained, go to check 2 below. 2. Check -425V output from A2A1 card assy. a) Using multimeter as set, measure voltage between test pin 12 and test pin 5 on the A2A1 card assy. Voltage should be -425VDC. If voltage obtained, check wiring between test pin 5 on A2A1 card and -750V test point on tracking board assy. Repair as required. If voltage not obtained, go to check 3 below. 3. Rectifier output check. a) Using multimeter, set to 1000 VDC range and measure voltage between test pin 12 and junction of C1 and R12 on A2A1 card assy. Voltage should be greater than -495 VDC. If voltage is not obtained, go to check 4 below. If voltage is obtained, check R12 and CR5. Replace faulty component. If this does not correct the -425 output, go to check 5 below. 4. Input check. a) Using multimeter, set to 1000 VAC range. Measure voltage across test pins 1 and 2 on A2A1 card assy. Voltage should be approx 593 VAC. If voltage not obtained, go to troubleshooting item 8. If voltage obtained, check CR1 through CR4 and replace defective component.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	5. Check Q1 and Q2 regulators. a) Using the multimeter, set to 1000 VDC range and measure voltage between test pin 12 and the collector of Q2 on the A2A1 card. Voltage should be approx -238 VDC. If voltage is not obtained, replace Q1 and Q2 as needed. If voltage is obtained, go to check 6 below. 6. Check AR1 input. **NOTE** Modulation is still in CW. a) Using multimeter as set, measure voltage on pin 3 of AR1. Voltage should be approx -6.0 VDC. If voltage obtained, go to step 7. If voltage not obtained, check CR8, CR9, and CR10, capacitor network C2, C3, and C4, and resistance network R6 through R10 in that order. Replace faulty components. 7. Check error amplifier AR1 output. a) Using multimeter, set to 10 VDC range. Measure voltage between test pin 12 and pin 6 of AR1. Voltage should be approx -2.5 VDC. If voltage is not obtained, replace AR1.
7	Cannot aline -325V Beam Supply-Check A2A3 Card Assy. 1. Check -325V output. If already known to be incorrect, go to check 2 below. a) Remove instrument dust cover if on (para 6-20). b) Remove high voltage cover if on (para 6-22). c) Set multimeter to 1000 VDC range. d) Set sig gen to initial settings of para 2-4. e) Energize sig gen and multimeter. f) Wait 2 mins and set MODULATION Switch to CW.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	g) Using multimeter, check voltage between test pin 6 (ground) and test pin 3 on the A2A3 card assy. Voltage should measure -325V +/- 1 VDC. If this voltage is not obtained, go to check 2 below. If this voltage is obtained, check the wiring between pin 3 on A2A3 and the -325TP on the tuning head tracking board. Repair as required. 2. Output filter circuit check. a) Using multimeter, measure voltage between test pin 6 (ground) and the negative side of C1 on the A2A3 card assy. Voltage should be approx -326 VDC. If this voltage is not obtained, go to check 3 below. If this voltage is obtained, check L1, C6 through C9 and R5 through R8. Replace defective components. 3. Input filter check. **NOTE** Next measurement is in volts AC. a) Using multimeter set to 1000 VAC, measure voltage across test pins 1 and 2 on the A2A3 card assy. Voltage should be approx 364 VAC. If this voltage is not obtained, go to T/S item 8. If this voltage is obtained, check CR1 through CR4, C1 through C4, R1 through R4, C5 & R14. Replace defective components.
8	A2 Power Supply Assembly Check. 1. A2 assy output check. a) Using multimeter set to 1000 VAC range, measure voltage across the following pins: Note typical voltages to the right of the points. 1 and 2 of A2A3 card assy 364 VAC 1 and 2 of A2A1 card assy 588 VAC 9 and 10 of A2A1 card assy 20 VAC If these voltages are not obtained, go to check 2 below.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
8 (cont'd)	2. A2T1 input check. a) Continuing with multimeter, set to 100 VAC range. Measure voltage at points listed below. 1) Ground to Collector of Q4 and Q2. Voltage should measure approx 21 VAC. 2) Ground to Collector of Q3 and Q1. Voltage should measure approx 21 VAC. If these voltages are not obtained, go to check 3 below. b) Continuing with multimeter, set to 100 VDC range. Measure voltage between ground and the junction of C1 and C2 of the A2 assy at R5, on the white- orange wire (FO-2 Sheet 2 of 3) Voltage should be approx +26 VDC. If this voltage is not obtained, go to check 4 below. c) If the correct voltages were obtained in checks 2a) and 2b) above, replace A2T1. 3. A2 input check at Al card output. a) Using multimeter set to 10 DC range, measure voltage between chassis ground and point between R6 and pin 2 of P3 on the A1 card assy. Voltage should be approx .7 VDC. Square Wave at same test point when viewed on scope will be 1 V peak at approx 20 kHz. If either of these is not obtained, go to T/S item 13, check 1. b) Repeat voltage measurement between chassis ground and point between R7 and pin 1 of P3 on the A1 card assy. Voltage should be approx .7 VDC. When viewed on scope set as in check 3a above, the waveform will be the same. If either of these is not obtained, go to T/S item 13, check 2. 4. A2T1 Centertap voltage check. a) Using the multimeter set to the 100 VDC range, measure the voltage between chassis ground and pin 1 of AR4 on the A1card assy.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	Voltage should be approx 23 VDC. If voltage is not obtained, go to T/S item 13, check 7. If this voltage is obtained, check C1, C2 and R5 of the A2 assy and replace faulty component. 5. If voltages measured in checks 3.a) and 4 above were correct. Replace Q4. If this does not restore voltage of 21 VAC as called for in check 2.a.1 above, then replace Q2. 6. If voltages measured in checks 3.b) and 4 above were correct. Replace Q3. If this does not restore voltage of 21 VAC as called for in check 2.a.2 above, then replace Q1.
9	Beam Current Faulty. 1. Aline -325V Beam Supply per alinement step 1 if not previously done. If beam current still faulty, to to check 2 below. 2. Aline -750V voltage supply per alinement step 2 if not previously done. If beam current still faulty, go to check 3 below. 3. Aline filament voltage per alinement step 3 if not previously done. If beam current still faulty, go to check 4 below. 4. Grid voltage check. a) Remove high voltage cover (para 6-22). b) Set sig gen to initial settings of para 2-4 and energize. c) Wait 2 mins and set MODULATION Switch to CW. d) Using multimeter set to 1000 VDC range, measure grid voltage between GROUND test point and GRID test point on the A4 tracking board assy. Voltage should read approx -317.5 VDC. If this voltage is not obtained, go to T/S item 11. If this voltage is obtained, go to check 5 below.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	5. RK5837 Klystron tube check. a) Remove instrument dust cover (para 6-20). b) Remove klystron cover and socket by following klystron tube removal procedure step c). Do not remove the tube (para 6-30). c) Allow the tube to cool for 30 minutes in this state. d) Using the digital multimeter set to 10 ohm range, measure the resistance between pins 2 and 4 of the tube. Resistance should be between 1 and 2 ohms in the cold state. If the filament is open, or does not measure between 1 and 2 ohms in cold state, replace klystron RK5837 (para 6-26).
10	Filament voltage faulty, cannot be alined. 1. Check AR1. a) Remove instrument dust cover if on (para 6-20). b) Remove high voltage cover if on (para 6-22). c) Deenergize sig gen. d) Set sig gen controls as in para 2-4. e) Set multimeter to 10 VDC range. f) Energize multimeter and sig gen. g) Measure the voltage between test pin 11 of the card and pin 1 of AR1 on A2A2 card assy. Voltage should be greater than 9 VDC. If correct voltage is obtained, replace A2A2AR1. If incorrect voltage is obtained, go to check 2 below. 2. Check R5. a) Measure voltage between test pin 11 and the positive terminal of C1 or C2 on the A2A2 card assy. Voltage should be between 9 V and 11 VDC. If correct voltage is obtained, replace A2A2R5. If incorrect voltage is obtained, go to check 3 below. 3. Check filament input rectifier and filter. a) Set multimeter to 50 VAC range.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	b) Measure voltage between test pins 1 and 2 of A2A2 card assy. Voltage should measure approx 10.8 VAC. If voltage is obtained, individually check CR1 through CR4 for directional conductivity, and check individually C1 and C2 for non shorted state. Replace faulty components. If voltage is not obtained, check main input transformer T1 per T/S item 12.
11	Grid Voltage Faulty. 1. Grid supply output check. a) Remove instrument dust cover (para 6-20) and high voltage supply cover, (para 6-22) if on. b) Set sig gen to initial settings of para 2-4 and energize. c) Wait 2 mins and set MODULATION Switch to CW. d) Using multimeter, set to 1000 VDC range and measure voltage between ground and test pin 17 on A2A2 card assy. Voltage should measure approx -317.5 VDC. If voltage is obtained but was not obtained when measured on tracking board, check wiring between A2A2 card and the tuning head. If voltage is not obtained, go to check 2 below. 2. Check voltage at pin 12. a) Continuing with multimeter as set. Measure voltage between chassis ground and test pin 12 of A2A2 card assy. Voltage should be -345 VDC. If voltage is obtained, go to check 3 below. If voltage is not obtained, go to check 6 below. 3. Check L1. a) Continuing with multimeter as set, measure voltage at the junction of L1 and R9. Voltage should be approx. -345V. If voltage is obtained, replace L1. If voltage is not obtained, go to check 4 below.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
(cont'd)	11 4. Q1 check. a) Continuing with multimeter, set to 100 VDC range. Measure voltage between pin 4 of U1 and test pin 12 of A2A2 card. Voltage should be approx 0. If reading is obtained, replace Q1. If reading is not obtained, go to step 5. 5. U1 check. a) Continuing with multimeter, set it to 100 VDC range. b) Set MODULATION Switch to RF OFF. c) Measure voltage between test point 10 and 9 of A2A2 card assy. Voltage should be between 40 and 44 VDC. If reading is obtained, replace U1. If reading-is not obtained, go to T/S item 12, check 2. 6. Check input to grid supply. a) Continuing with the multimeter, set to 100 VDC range. b) Measure voltage between test pins 9 and 10 on the A2A1 card assy. Voltage should be approx 20 VAC. If this reading is obtained, go to check 2 below. If this reading is not obtained, go to T/S item 8. 7. Bridge circuit check. a) Continuing with multimeter as set, measure voltage between pin 1 of AR2 and pin 12 on the A2A1 card assy. Voltage should measure approx +21 VDC. If voltage is obtained, go to check 8 below. If voltage is not obtained, check CR11 through CR14, C5, and C6. Replace faulty components. 8. AR2 check. a) Set MODULATION to CW. b) Continuing with multimeter as set.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	c) Measure voltage between test pins 12 and 8 on A2A1 card and between test pins 12 and 11 on same card. In both cases, voltage should measure approx +9 VDC. If voltage is not obtained, replace AR2.
12	Output Voltages of Input Transformer T1 Faulty. 1. Output voltage check. a) Remove instrument dust cover if on (para 6-20). b) Set sig gen initial settings of para 2-4. c) Energize sig gen. d) Wait 2 mins and set MODULATION Switch to CW. e) Using multimeter set to 100 VAC range. Measure voltages at the points indicated. Correct voltages are shown. 1) Between test pins 1 and 2 of A2A2 card assy..... 10.8 VAC 2) Between pins 14 and 18 of P4..... 26.5 VAC If either of these voltages is not obtained, and DS1 and B1 are operating, replace input transformer T1.
13	A1 Card Assy (Osc Reg Assy) Output Faulty. 1. Check Al assy output. a) Remove instrument dust cover if not off (para 6-20). b) Set sig gen to initial settings of para 2-4 and energize. c) Wait 2 mins and set MODULATION Switch to CW. d) Start with the results of measurements per trouble- shooting item 8, checks 3.a, 3.b, and 4. For faulty results on checks 3.a and 3.b, go to check 2 below. For faulty results on check 4, go to check 7 below.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
13 (cont'd)	2. AR2 check. a) Continuing with multimeter, set to 10 VDC range and measure voltage between ground and pin 14 of AR2. Voltage should be approx 5 VDC. If voltage is not obtained, go to check 5 below. If voltage obtained, replace AR2. 3. AR2 check continued. a) Continuing with multimeter as set, measure voltage between ground and pin 3 of AR 1. Voltage should be approx 8.8 VDC. b) Set scope for vertical sensitivity of 0.5 V per CM. Measure waveform between ground and pin 3 of AR1. Waveform should be square wave 2 CM high. c) If voltage of check 3 and waveform of 3b obtained, replace AR2. If voltage and waveform not obtained, go to check 4 below. 4. AR1 check. a) Continuing with multimeter, set to 100 VDC range. Measure voltage between ground and pin 2 of AR6. Voltage should be approx 15 VDC. If voltage is obtained, replace AR1. If voltage not obtained, go to check 5 below. 5. AR6 and AR5 check. a) Continuing with multimeter as set, measure voltage between ground and junction of R21 and C11. Voltage should be approx 25 VDC. If voltage is obtained replace: AR5 if you came here from check 2 above. AR6 if you came here from check 4 above. If voltage not obtained, go to check 6 below. 6. +40 V check. a) Continuing with multimeter as set, measure voltage between ground and pin 16. Voltage should be between 40 and 44 VDC.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
13 (cont'd)	If voltage is obtained, check R21 and C11 and replace faulty component. If voltage is not obtained, check +40 VDC supply per T/S item 12, checks 2 and 3. 7. Check Q1 of Main assembly. a) Continuing with multimeter as set, measure voltage between ground and the junction of R17 and R22. Voltage should measure approx 23 VDC. If voltage is obtained, go to check 8 below. If voltage is not obtained, replace Q1 of the main assy. 8. AR4 check. a) Continuing with multimeter as set, measure voltage between ground and pin 1 of AR4. Voltage should be approx 23 VDC. If voltage is obtained, stop here. If voltage not obtained, go to check 8b) below. b) Continuing with multimeter as set, measure voltage between ground and pin 8 of AR4. Voltage should be approx 35 VDC. If voltage obtained, go to check 8c) below. If voltage is not obtained, check +40 V supply as in check 6 above. c) Continuing with multimeter as set, measure voltage between ground and pin 9 of AR4. Voltage should be approx 25.5 VDC in steady state CW operation, and approx 1.5 VDC in RF OFF before delay activates. If voltages were obtained as required in check 8.b) and 8.c), replace AR4. If voltages were not obtained, go to check 9 below. 9. Check Q1 of Al Assy. a) Continuing with multimeter as set, measure voltage between ground and pin 3 of AR3. Voltage should be approx 0 VDC in steady state CW operation, and approx 13.5 V in RF OFF before delay activates.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
	If voltage is not obtained, go to check 10 below. If voltage is obtained, replace Q1. 10. AR3 check. a) Continuing with multimeter as set, measure voltage between ground and pin 4 or 8 of AR3. Voltage should be approx 15 VDC in steady state CW operation, and .5 VDC in RF OFF before delay activates. If voltage obtained, replace AR3.
14	Low Attenuator Output. 1. Remove instrument dust cover if on. 2. Disconnect J4 from P4. 3. Using multimeter, set to the 100 ohm resistance range. 4. Measure resistance between the outer pin of P4 and ground. Resistance should be between 45 and 55 ohms. If resistance is not within these limits, replace ATTEN- UATOR probe. 5. Repeat Alinement step 7.
15	Internal Square Wave Frequency Incorrect. 1. Square Wave output check on A3 card assy. a) Remove instrument cover (para 6-20). b) Set up sig gen initial settings of para 2-4. c) Swing A3 ckt card up counter clockwise to vertical position until locked in place by stop located on A3 mtg bracket. d) Make set up as in Square Wave Electrical. Check step 8. e) Set Freq Counter power on. Energize sig gen and wait 2 mins. f) Set MODULATION Switch to INT SQ WAVE. g) Center Square Wave rate control. h) Using multimeter, set to 100 VAC range. Measure voltage between ground and pin 20 of P4.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
15 (cont'd)	Voltage should be approx 11.6 VAC. i) Observe frequency displayed on counter. Frequency should be approx 1000 Hz +/- 50 Hz. j) If result of check h or i above is incorrect, go to check 2 below. If results are correct, go to check 5 below. 2. CR7/Q1 check. a) Continuing with multimeter as set, measure voltage on pin 14 of AR2. Voltage should be approx 11.8 VDC. If voltage obtained, replace Q1. If voltage is not obtained, go to check 3 below. 3. AR2 check. a) Continuing with multimeter as set, measure voltage at pin 11 of AR2. Voltage should be approx 11.3 VDC. If voltage obtained, replace AR2. If voltage is not obtained, go to check 4 below. 4. AR1 check. a) Continuing with multimeter as set, measure voltage between ground and pin 4 or 8 of AR1. Voltage should be approx 11.8 VDC. If voltage obtained, replace AR 1. If voltage is not obtained, check power input to A3 card assy per T/S item 12, check 1.e. 5. Repeat Alinement step 10 to set center Sq Wave frequency. If square wave is not present at RF OUTPUT, check wiring between pin 20 of P4 and E2 of the A5 Leveling Attenuator Assy. If wiring is good, then check RF cable between E2 of the A5 assy and RF OUTPUT Jack. If cable is good, replace A5 assy.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
16	Ext Pulse Modulation Not Functioning Properly. 1. Check for Pulse Modulation on A5 Assy. a) Remove instrument dust cover (para 6-20). b) Set up pulse generator as in Ext Pulse Electrical check step 9. c) Connect pulse generator output cable to pulse jack on front panel. d) Set initial settings on sig gen. e) Set up scope separately as in electrical check step 9 for probe use. f) Energize system and wait 2 mins. g) Set MODULATION Switch to EXT PULSE. h) Using scope with probes, measure waveform between ground and E2 on the A5 Leveling Attenuator Assy. Adjust scope sensitivity as required. Pulse should be displayed on scope. If pulse not present, go to check 2 below. If pulse displayed, check RF cable between E2 on A5 assy and RF OUTPUT jack. If cable is good, replace A5 assy. 2. Check PULSE circuit in A3 card assy. a) Continuing with scope, measure waveform on A3 card assy between ground and collector of Q2 on the A3 card. Pulse should be displayed on scope. If pulse not displayed, go to check 3 below. If pulse displayed, check wiring between collector of Q1 and E2 on A5 assy. Repair wiring if defective. 3. Q2 check. a) Using multimeter, set to 100 VDC range. Measure voltage on the collector of 02. Voltage should be approx +11.8 VDC. If voltage obtained, replace Q2. If voltage not obtained, check power input to A3 card assy per T/S item 12 check 1.e.

ITEM	MALFUNCTION → CHECKS/CORRECTIVE ACTION
17	Ext AM Modulation Not Working. 1. Trace AM near RF output. a) Remove instrument dust cover (para 6-20). b) Set up oscillator used for AM check as in Electrical Check step 10, AM MODULATION. c) Connect oscillator output cable to AM MODULA- TION jack of sig gen. d) Set initial settings on sig gen. e) Set up scope separately as in Electrical check step 10 for probe use. f) Energize system and wait 2 mins. g) Set MODULATION Switch to EXT AM. h) Using the scope with probes, measure waveform between ground and E2 on the A5 Leveling Attenuator assy. Adjust scope sensitivity as required. A sine wave of same frequency as that introduced should be present. If sine wave is not present, go to check 2 below. If sine wave is present, check RF cable between E2 on A5 assy and RF OUTPUT. If cable is good, replace A5 assy. 2. Check AM Circuit in A3 card assy. a) Continuing with scope, measure waveform on A3 card assy between ground and pin 13 on P4. Similar sine wave of same frequency as 1h above should be displayed. If sine wave present, check wiring between Pin 2 of P4 and E2 of the A5 assy. Repair Wiring if defective. If sine wave is not present, go to check 3 below. 3. Continuing with scope, measure waveform at pin 8 of P4. Sine wave of similar characteristics should be present. If present, check R12 and C13 of the A3 card assy. Replace faulty component. If not present, check wiring between Pin 8 of A3 card assy and front panel AM jack. Repair wiring if defective.

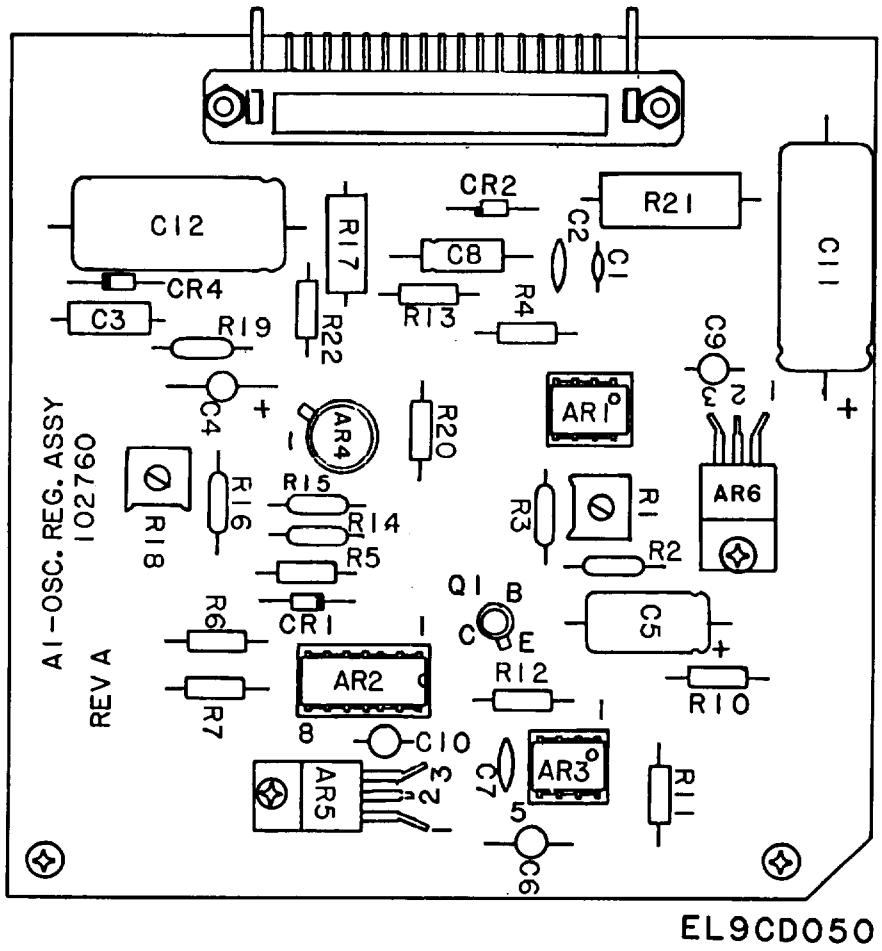


Figure 6-12. A1 Circuit Card Assy

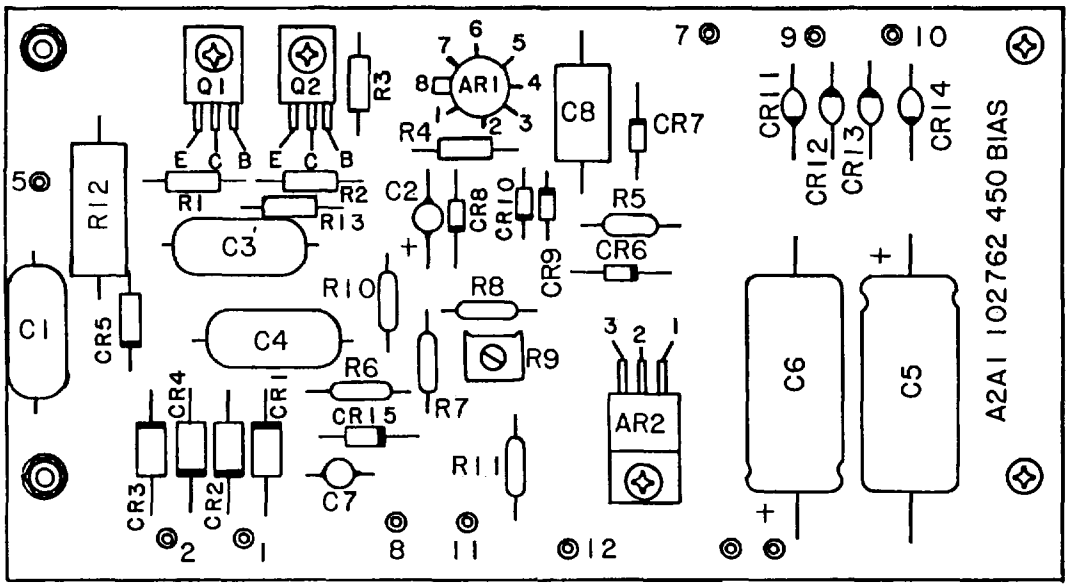


Figure 6-13. A2A1 Circuit Card Assy

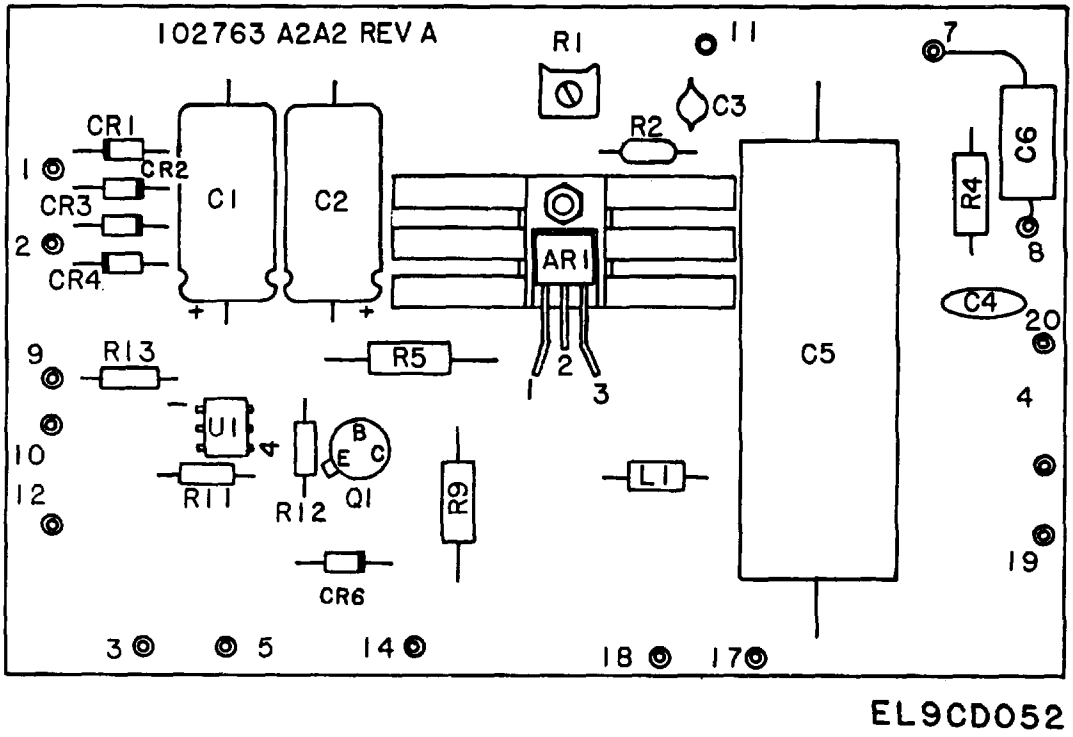


Figure 6-14. A2A2 Circuit Card Assy

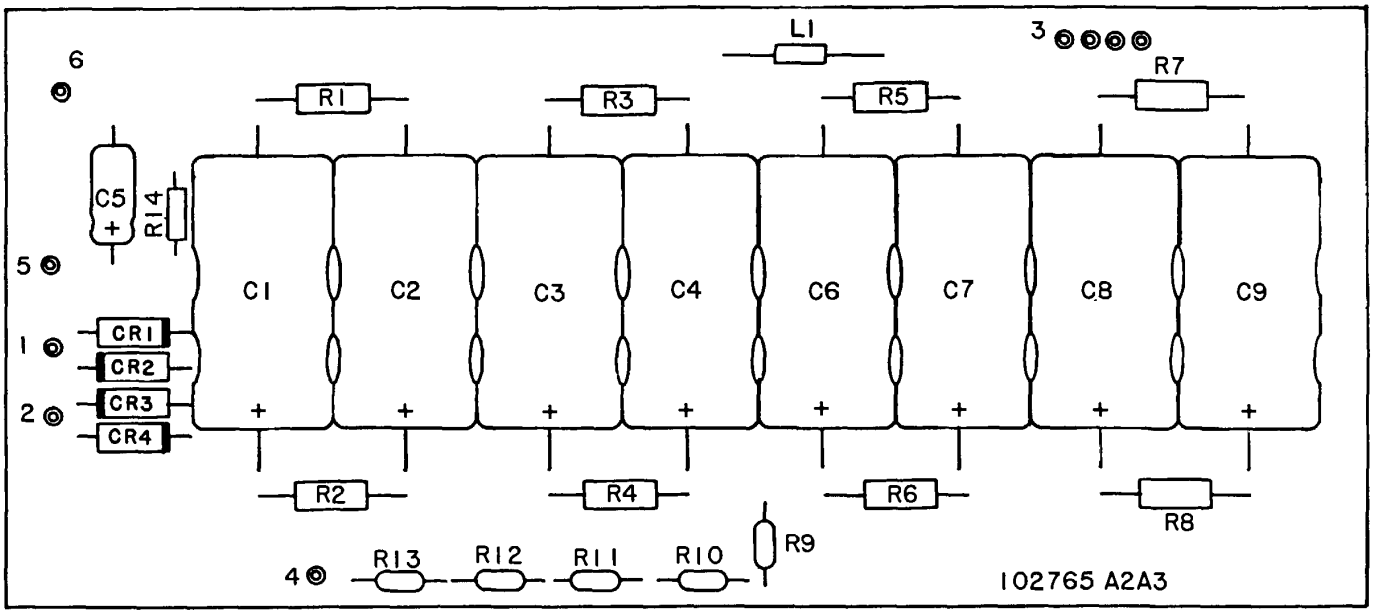


Figure 6-15. A2A3 Circuit Card Assy

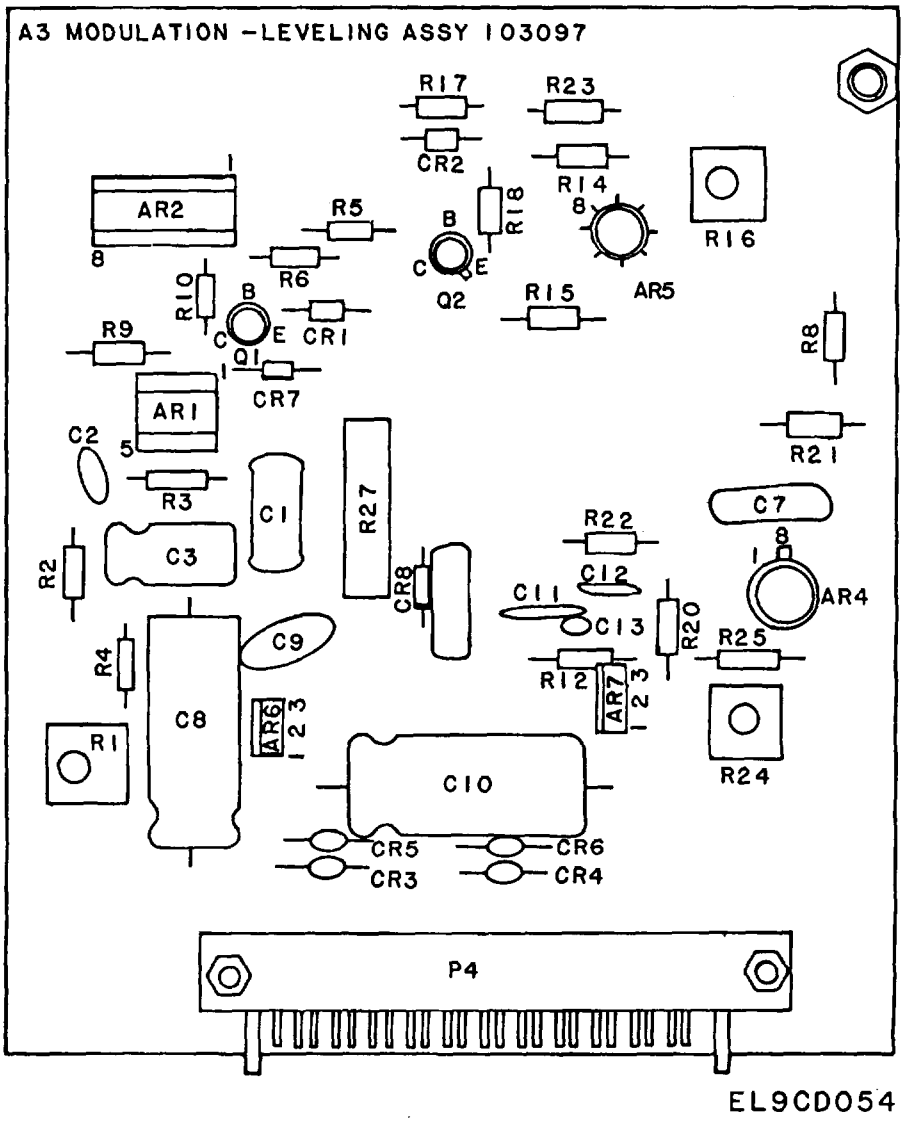


Figure 6-16. A3 Circuit Card Assy

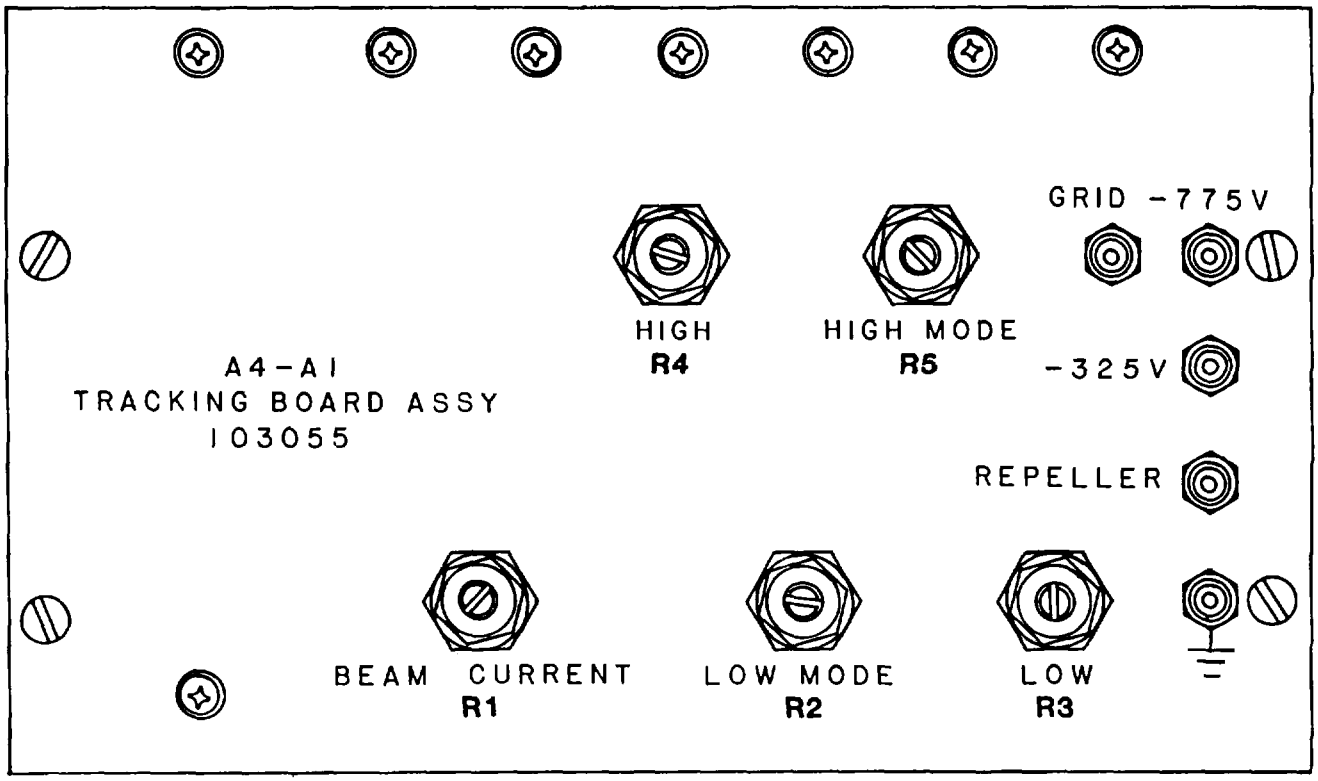


Figure 6-17. A4A1 Board Assy

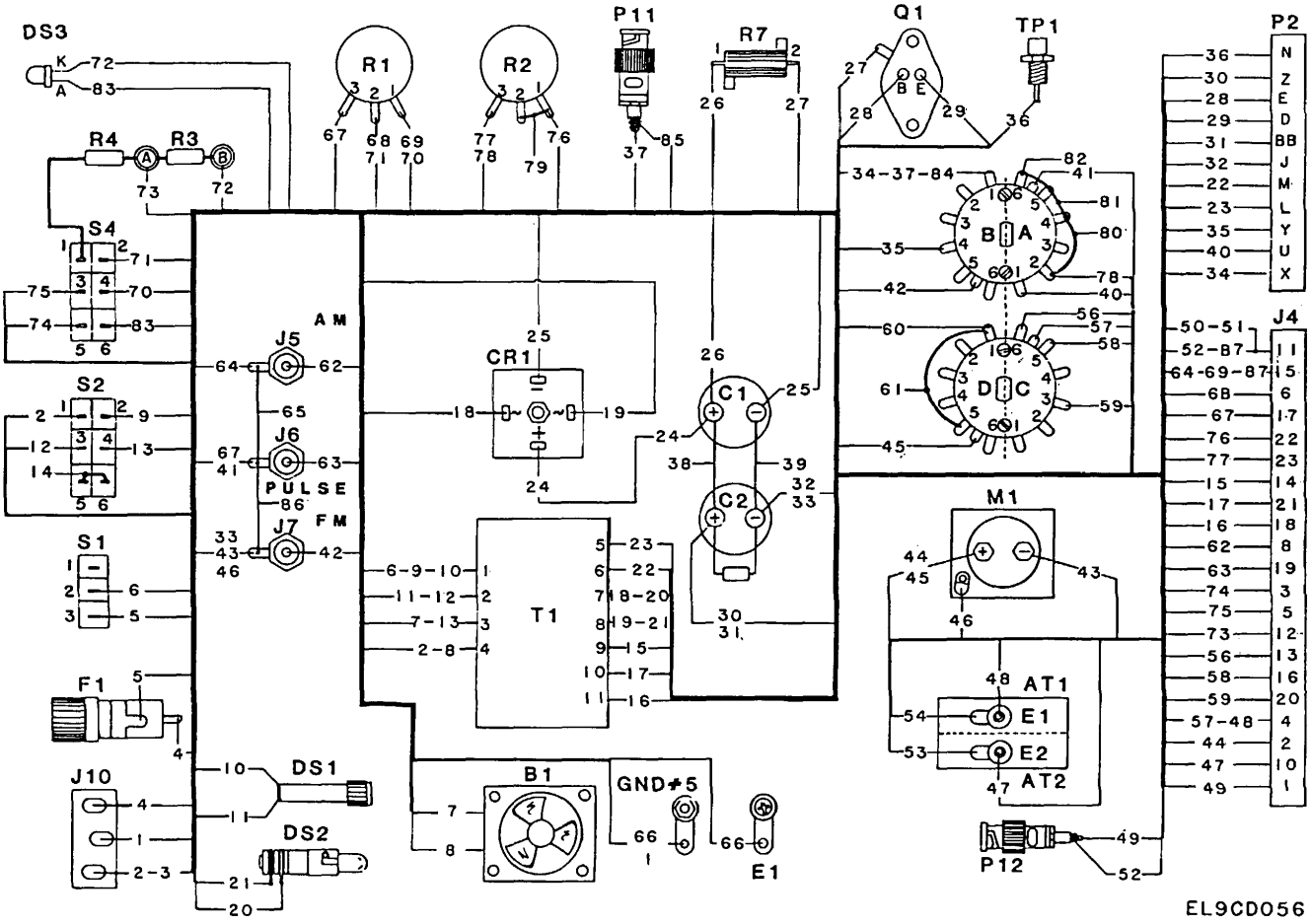


Figure 6-18. Main Frame Harness

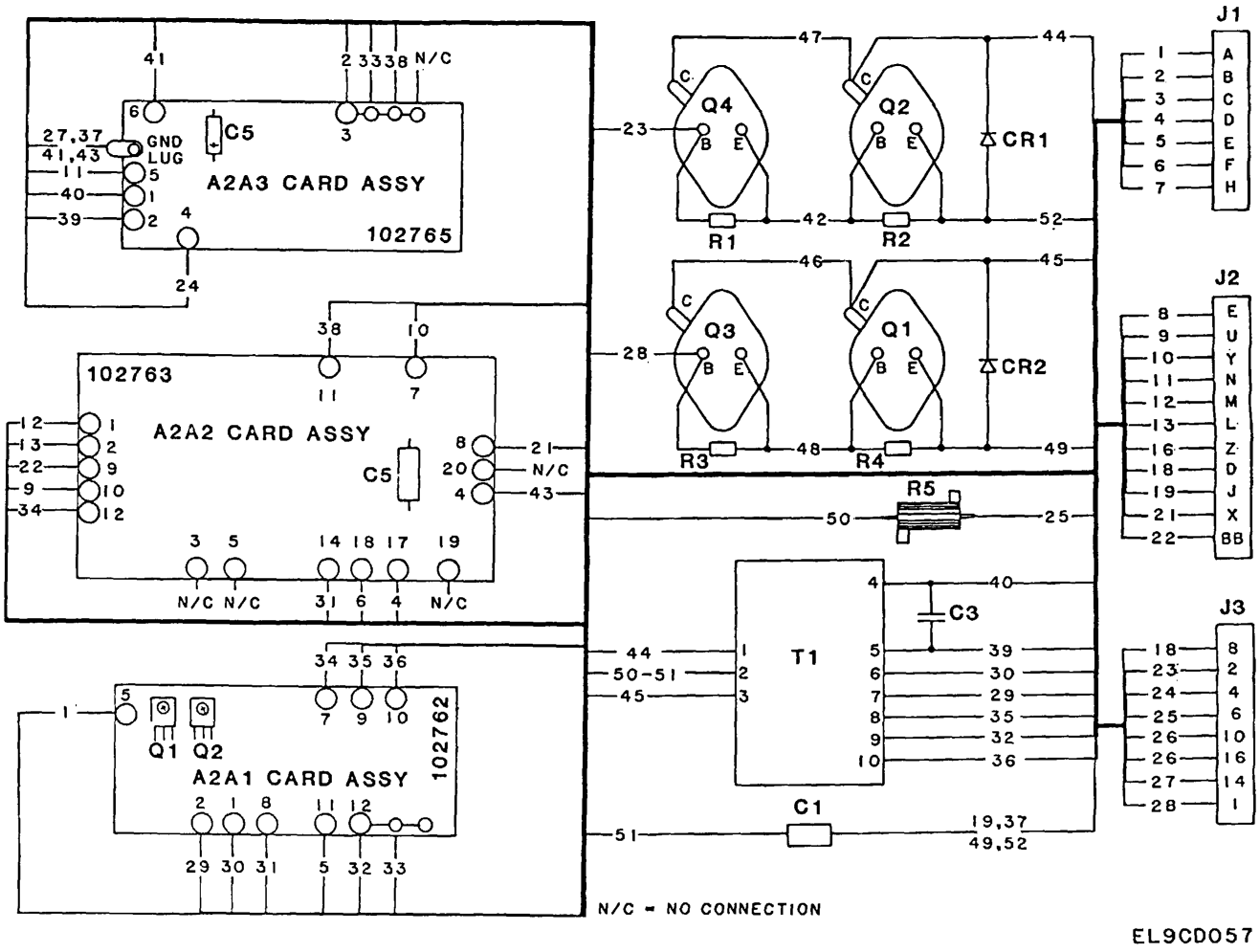


Figure 6-19. High. Voltage Power Supply Harness

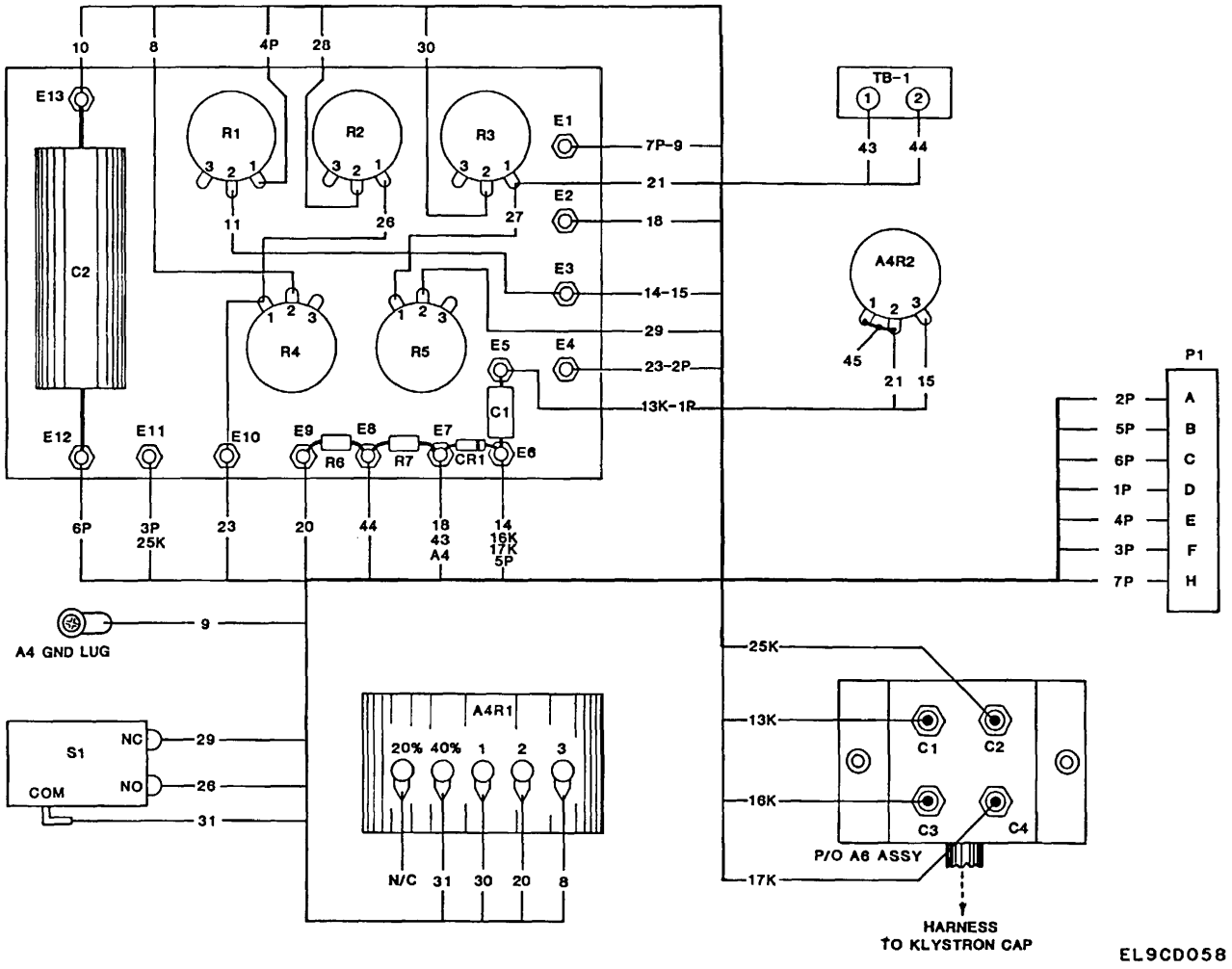


Figure 6-20. A4 Tuning Head Assy Harness

TABLE 6-4

AN/USM-213B WIRE LIST

A. MAIN FRAME HARNESS.

FROM	TO	COLOR CODE	WIRE SIZE
J10-2	GND LUG-5	GRN	22B
J10-1	S2-1	WHT	228
J10-i	T1-4	WHT	22B
J10-3	XF1-CENTER	WHT/BLK	22B
XF1-OUTER	S1-3	GRY	22B
T1-1	S1-2	WHT	22B
T1-3	B1-2	BLK	22B
T1-4	B1-1	WHT	22B
T1-1	S2-2	WHT/GRN	22B
T1-1	DS1	WHT/BLK	228
T1-2	DS1	WHT	22B
T1-2	S2-3	WHT/YEL	22B
T1-3	S2-4	WHT/RED	22B
S2-5	S2-6	BUSS	18
T1-9	J4-14	BLK	22B
T1-11	J4-18	BRN	22B
T1-10	J4-21	GRN	22B
T1-7	CR1-AC1	BRN	22B
T1-8	CR1-AC2	WHT/BRN	22B
T1-7	DS2-1	BRN	22B
T1-8	DS2-2	WHT/BRN	22B
T1-6	P2-M	WHT/BLK	228
T1-5	P2-L	WHT	22B
CR1-(+)	C1-(+)	RED	20B
CR1-(-)	C1-(-)	BLK	20B
C1-(+)	R7-1	RED	20B
R7-2	Q1-(C)	YEL/RED	18B
P2-E	Q1-(B)	VIO	22B
P2-D	Q1-(E)	GRY	22B
P2-Z	C2-(+)	RED	20B
P2-BB	C2-(+)	RED	208
P2-J	C2-(-)	BLK	20B
J7-GND-2	C2-(-)	BLK	228
P2-X	S3B-1	ORN	228
P2-Y	S3B-4	YEL	22B
P2-N	TP-1	WHT/GRY	22B
P-1 1-CENTER	S3B-1	COND.	RG316
C1-(+)	C2-(+)	BUSS	18
C1-(-)	C2-(-)	BUSS	18
P2-U	S3A-1	WHT/GRN	22B

TABLE 6-4 CONT.

AN/USM-213B WIRE LIST

A. MAIN FRAME HARNESS.

FROM	TO	COLOR CODE	WIRE SIZE
S3A-ARM	J6-GND-3	GRN	22B
S3B-ARM	J7-CENTER	YEL	22B
J7-GND-2	M1-(-)	BLK	22B
J4-2	M1-(+)	RED	22B
S3D-ARM	M1-(+)	WHT/RED	22B
BRACKET	J7-GND-2	BLK	20B
J4-10	A4-AT2-E1	COND.	RG316
J4-4	A5-AT1-E2	COND.	RG316
J4-1	"KINGS" BUC. CONN KC-59-89	COND.	RG316
SHLD OF 47 AT J4	J4-11	BLK	22B
SHLD OF 48 AT J4	J4-11	BLK	22B
SHLD OF 49 AT J4	J4-11	BLK	22B
SHLD OF 47 AT AT2	GND LUG	BLK	22B
SHLD OF 48 AT AT1	GND LUG	BLK	22B
J4-13	S3C-6	YEL	22B
J4-4	S3C-ARM	BLU	22B
J4-16	S3C-5	GRY	22B
J4-20	S3C-3	ORN	22B
S3D-1	J6-G N D-3	BLK	22
S3D-1	S3D-5	BUSS	20
J4-8	J5-CENTER	VIO	22B
J4-19	J6-CENTER	RED	22B
J4-15	J5-GND-4	BLK	22B
J6-GND-3	J5-GND-4	BUSS	20
J4-17	R1-3	WHT	22B
J46	R1-2	GRY	22B
J4-15	R1-1	BLK	22B
R1-I	S4-4	BLK	22B
R1-2	S4-2	GRN	22B
R3-B	DS3-K	WHT/BLK	22B
R3-A	J4-12	YEL	22B
J4-3	S4-5	BLU	22B
J4-5	S4-3	ORN	22B
J4-22	R2-1	VIO	22B
J4-23	R2-3	GRN	22B
R2-3	S3-A-2	WHT	22B
R2-1	R2-2	BUSS	20

TABLE 6-4 CONT.

AN/USM-213B WIRE LIST

A. MAIN FRAME HARNESS.

FROM	TO	COLOR CODE	WIRE SIZE
S3-A-2	S3-A-4	BUSS	20
S3-A-4	S3-A-5	BUSS	20
S3-A-5	S3-A-6	BUSS	20
DS3-A	S4-6	WHT/BRN	22B
1 MEG (R8)	SHLD OF WIRE 37	BLK	22B
J4-11	J4-15	BLK	22B
B. HIGH VOLTAGE POWER SUPPLY HARNESS			
J1-A	A2A1-5	YEL	22D
J1-B	A2A3-3	BRN	22D
J1-C	BNC CENTER (FM)	RG316	CABLE
J1-D	A2A2-17	WHT	22D
J1-E	A2A1-11	GRAY	22D
J1-F	A2A2L-18	BLU	22D
J1-H	BNC GND.LUG	SHLD OF NO. 3	22D
J2-E	J3-12	WHT/GRN	22B
J2-U	A2A2-10	GRN	22B
J2-Y	A2A2-7	VIO	22B
J2-N	A2A3-5	BLK/GRY	22B
J2-M	A2A2-1	GRY	22D
J2-L	A2A2-2	BLK	22B
J2-Z	J3-16	RED	20B
J2-D	J3-8	WHT/YEL	22B
J2-J	C1 (-)	BLK	20B
J2-X	A2A2-8	YEL	22B
J2-BB	A2A2-9	GRY	22B
J3-2	Q4-B	VIO	22B
J34	A2A3-4	YEL	22B
J3-6	R5-T	RED	22B
J3-10	J3-16	BUSS	22
J4-14	A2A3 GND	BLK	22B
J3-1	Q3-B	GRY	22B
A2A1-2	T1-7	ORN	22D
A2A1-1	T1-6	WHT	22D
A2A1-8	A2A2-14	RED	22D
A2A1-12	T1-9	BRN	22D
A2A1-12	A2A3-3	BRN	22D
A2A1-7	A2A2-12	YEL	22D
A2A1-9	T1-8	BLK/WHT	22D
A2A1-10	T1-10	GRY/WHT	22D
C1-(-)	A2A3 GND	BLK	22B
A2A3-2	T1-5	GRN	22D
A2A3-1	T1-4	BLU	22D
A2A3-6	A2A3 GND LUG	BLK	22B

TABLE 6-4 CONT.

AN/USM-213B WIRE LIST

B. HIGH VOLTAGE POWER SUPPLY HARNESS

FROM	TO	COLOR CODE	WIRE SIZE
Q4-E	Q2-B	ORN	22B
A2A3 GND	A2A2-4	BLK	22B
Q4-C	T1-1	RED	22B
Q3-C	T1-3	WHT/RED	22B
Q3-C	Q1-C	WHT/RED	22B
Q2-C	Q4-C	RED	22B
Q3-E	Q1 -B	GRY	22B
Q1-E	C1-(-)	BRN	22B
R5-B	T1-2	WHT/ORN	22B
C1-(+)	T1-2	WHT/ORN	22B
C1-(-)	Q2-E	BLK	22B
C. A4 TUNING HEAD ASSY HARNESS			
A4A1 R2-1	A4A1 R4-1	VIO	22D
A4A1 R3-1	A4A1 R3-1	ORN	22D
A4A1-E2	A4A1-E13	RED	22D
A4A1-E3	A4A1 R1-2	BRN	22D
A4A1-E3	A4A1-E6	BRN	22D
A4A1-E7	A4A1-E2	RED	22D
A4R2-2	A4A1 R3-1	ORN	22D
A4A1-E10	A4A1 E4	VIO	22D
A4A1-E10	A4A1 R4-1	VIO	22D
A4A1-R1-I	P1-E	GRY	22D
A4A1 R4-2	A4R1-3	GRY	22D
A4S1-N.O.	A4A1 R2-2	BLU	22D
A4S1-N.C.	A4A1 R5-2	BRN	22D
A4S1 -C	A4 R 1 -40%	ORN	220
A4A1 R3-2	A4R1-1	WHT	22D
A4A1-E9	A4R1-2	GRY/WHT	22D
A4 REPELLER	A4A1-E7	RED	22D
A4A1-El	A4 GND LUG	BLK	22B
A4A1-E3	A4R2-1	ORN	22D
A4A1-E4	P1-A	WHT	22D
A4A1-E5	A6-C1	GRN	22D
A4A1-E5	P1-D	VIO	22D
A4A1-E6	A6-C3	BLU	22D
A4A1-E6	A6-C4	BRN	22D
A4A1-E6	P1-B	RED	22D
A4A1-E11	P1-F	BLK	22D
A4A1-E11	A6-C2	BLK	22D
A4A1-E12	P1-C	YEL	22D
A4A1-E7	TB1-1	RED	22B/COAX
A4A1-E8	TB1-2	GRN	22B/COAX

SECTION VI. DISASSEMBLY AND ASSEMBLY

6-19. GENERAL.

The instructions in this section give you the information to replace parts and assemblies as authorized in the maintenance Allocation Chart in Appendix B of this manual.

Each of the replacement procedures is complete for that part or assembly. However, the steps in one pro- cedure are not repeated in another. Instead, one procedure may make reference to one or more procedures which must be performed prior to the one being described. For example, if the Circuit Card Assy A2A3 must be removed, the procedure for its removal will first reference the procedures for the removal of:

-the equipment dust cover, and
-the high voltage module cover.

The replacement of a part or assembly, in most cases, will best be accomplished by reversing the actions for its removal within a particular procedural step and reversing the order of the steps by starting with the last and ending with the first. In these cases, the REPLACEMENT procedure will state:

REVERSE THE REMOVAL PROCEDURE.

In cases where REPLACEMENT cannot be accomplished by simple reversal of REMOVAL procedure, a detailed step-by-step replacement procedure will be given.

You will find replacement procedures only for those items which require special care or skill for their removal or replacement.

When you must remove parts to gain access to a particular location in the instrument, you will be instructed to remove parts. At the end of the procedure, you will be told to replace the part which you previously removed. The use of the word "replace" in this instance means only that the original part is to be reassembled to the signal generator.

When the instruction to replace a component is given as a result of a troubleshooting procedure, after electrical or physical measurements, the meaning of "replace" in this case is to remove a faulty component and install a good one in its place.

Table 6-5. INDEX OF REPLACEMENT PROCEDURES

PARA	TITLE
6-20	Replacement of Instrument Dust Cover
6-21	Replacement of Rear Panel
6-22	Replacement of High Voltage Cover
6-23	Replacement of RF Tuning Head
6-24	Replacement of DS1
6-25	Replacement of B1
6-26	Replacement of RK837 Klystron Tube A4U1
6-27	Replacement of Rectifier CR1
6-28	Replacement of Input Transformer T1
6-29	Replacement of Components on Circuit Cards
6-30	Replacement of A2 Power Supply Assy
6-31	Replacement of T1 of the A2 Power Supply
6-32	Replacement of A1 Oscillator Card Assy
6-33	Replacement of Tracking Pot A4R1
6-34	Replacement of Power Set Probe
6-35	Replacement of Attenuator Probe
6-36	Replacement of Klystron Oscillator
6-37	Replacement of A5 Leveling Attenuator Assembly

REPLACEMENT PROCEDURES

620. REPLACEMENT OF INSTRUMENT DUST COVER.

WARNING

Access to any part inside the signal generator starts with the removal of this dust cover. Before removing dust cover, be sure that:

- Power switch is in the OFF or downward position.
- Power cord is disconnected from J10 on the rear panel.

WARNING

Power is to remain OFF if further parts or assemblies must be removed, for example, if this procedure is part of a procedure for the removal of another part or as- sembly further inside the unit.

If the removal of the dust cover is called for as part of an alinement or troubleshooting procedure, after the dust cover has been removed, POWER may be restored only if the alinement or troubleshooting procedure calls for it.

WARNING

When working inside the unit with the POWER ON, all precautions must be taken to avoid bodily contact with any energized parts. Be especially careful to avoid those places where high voltages exist. Read the WARNINGS ON HIGH VOLTAGE AND ELECTRICAL SHOCK in the front of this manual before working inside the unit with the POWER ON.

REMOVAL

Be sure to follow warnings at the beginning of this paragraph, then:

a. Remove 4 phillips head screws with plastic washers from top surface of dust cover.
   - 2 screws at front edge of unit.
   - 2 screws at rear edge of unit.

b. Remove 3 phillips head screws with plastic washers from the bottom of each side of the dust cover.

c. Remove 2 phillips head screws from each of two rack-mounting brackets if unit was rack- mounted.

d. Remove dust cover from top of unit and store it in a safe place with side brackets.

REPLACEMENT

Reverse the removal procedure. Restore POWER if electrical checks are in progress.

6-21. REPLACEMENT OF REAR PANEL.

REMOVAL

a. Remove instrument dust cover (para 6-20).
b. Remove 4 phillips head screws, one at each corner of rear panel.
c. Remove 2 phillips head screws from back panel fastened to T1 transformer bracket.
d. Remove 3 phillips head screws at bottom of rear panel.
e. Bend rear panel backward gently so as not to break any wires.

This completes rear panel removal, stage 1.

f. Remove screws holding TB1 to rear panel. Work TB 1 through panel opening toward interior of instrument. Place insulating tape over terminals to avoid shock.
g. Remove J9 frontwards through rear panel, using socket wrench to unscrew retaining nut. This completes rear panel removal, stage 2.
h. Remove the following components from rear panel, leaving them wired: R7, S2, XF1, CR1 & B1.
i. Unwire leads to power jack J10. Remove J10.

This completes rear panel removal, stage 3. The rear panel is now fully detachable from the instrument.

REPLACEMENT

Reverse removal procedure.

622. REPLACEMENT OF HIGH VOLTAGE COVER.

REMOVAL

a. Remove instrument dust cover (para 6-20).
b. Remove 8 screws (4 on each side) on depthwise flanges at main frame floor level.
c. Remove 6 screws (3 on each edge) of the top surface of cover.
d. Peel back tape protecting wires from edge of cover.
e. Work cover out of its position by raising the back and sliding it backwards (toward rear panel) at same time until it clears cabling at main frame floor level.

REPLACEMENT

Reverse the removal procedure.

6-23. REPLACEMENT OF RF TUNING HEAD.

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Remove rear panel through stage 2 (para 6-21).

c. Remove the following controls by loosening their set screws:

FREQUENCY
ATTENUATOR
POWER SET/AUTO CAL
FREQ VERNIER

d. Remove J8 RF OUTPUT through rear of panel by unscrewing retaining nut with a socket wrench to avoid scratching front panel.

e. Remove 2 flat head screws holding box assy 103505 to main frame floor.

f. Remove 4 flat head screws holding the A5 leveling assy to main frame floor.

g. Remove 4 flat head phillips screws holding RF tuning head main casting to main frame floor.

h. Lift tuning head assy up and out of main assembly and set down directly to the right of the sig gen. Dress loose cables and wires so that they are not kinked.

REPLACEMENT

Reverse the removal procedure.

6-24. REPLACEMENT OF DS1.

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Cut flat retaining spring nut from around DS1 behind panel and remove.

c. Pull DS1 out slowly through front panel.

d. Cut open the tubing from the connections to DS1 and remove.

e. Unsolder leads from DS1 and remove DS1.

REPLACEMENT

a. Make sure wires leading to DS1 are properly twisted.

b. Slip a piece of protective tubing 3/16" diameter by 1/2" long on each wire beyond the bare end.

c. Form a 1/4" diameter open loop of end of each wire and on end of each DS1 lead.

d. Slip replacement flat spring nut onto wires with spring nut curvature away from front panel.

e. Interlock one loop of each wire with one loop of each DS1 lead so that a mild mechanical bond has been made.

f. Solder the connections made in step e.

g. Slip the protective tubing over each connection.

h. Gently push the new DS1 back through the front panel. At the same time, force the flat spring nut onto body of new DS1 until it is touching rear of panel as the DS1 seats against front of panel.

i. Replace instrument dust cover (para 6-20).

6-25. REPLACEMENT OF B1.

REMOVAL

a. Remove equipment dust cover (para 6-20).

b. Separate rear panel from instrument by performing removal procedure, stage 1 (para 6-21).

c. Remove the 4 phillips head screws on the outside of the rear panel holding the filter cover and filter, and attaching the blower assembly to the inside of the rear panel. Save the screws.

d. Unsolder the two leads from the blower and remove the blower. Note direction fan points.

e. On the old blower, remove the screws and lock washers holding the hexagonal spacers on each of the four corners.

f. Remount the hexagonal spacers on each corner of the new blower, using the original hardware from step e.

g. Resolder the leads to the terminals of the new blower, the white lead on top.

h. Use original screws from step c above to replace the filter and cover on the outside of the rear panel and the new blower on the inside of the rear panel. Insure that blower is facing properly to provide adequate ventilation.

i. Replace the rear panel (reverse of step b. above).

j. Replace the dust cover (reserve of step a. above).

6-26. REPLACEMENT OF RK837 KLYSTRON TUBE A4V1.

REMOVAL

WARNING

Do not attempt to remove or replace the klystron tube with the instrument energized. Disconnect the power cord from the instrument before beginning.

a. Remove instrument dust cover (para 6-20).

b. Allow instrument to remain in a de-energized condition for at least 15 minutes before removing the klystron tube.

c. Loosen clamp holding klystron cover to oscillator barrel. Gently work cover off knurled nut toward rear panel and remove the klystron socket from the tube.

d. Loose knurled klystron nut with adjustable pliers to a point where you can turn it by hand. Remove klystron nut.

e. Pull klystron tube out gently, screwing it clockwise as you do. Keep old tube in a safe place.

f. Remove the spacer and cylindrical spring.

REPLACEMENT

a. Remove the silver-plated spring from its core and replace with new spring which comes with the klystron tube.

b. Replace spring and core into cavity, followed by the spacer.

c. Insert new klystron tube straight into the klystron cavity barrel. Do not use excessive force. Slowly rotate the tube clockwise as you push forward. You will meet resistance when the resonator ring meets the circular spring teeth of the cavity inner conductor. Continue rotating the tube while pushing the tube forward until it jumps forward and seats.

d. Remount klystron knurled nut and tighten as much as possible by hand. Complete by tightening nut with adjustable wrench while exercising caution as not to break glass envelope of the klystron tube.

e. Reconnect socket to klystron tube pins.

f. Remount klystron cover into cavity end and tighten clamp.

g. Turn Beam Current Adjust pot on tracking board of A4 assy fully counterclockwise.

h. Perform Alinement step 5.

6-27. REPLACEMENT OF RECTIFIER CR1

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Remove rear panel through stage 1 (para 6-21).

c. Then remove exterior screw holding CR1 to rear panel.

d. Unsolder leads from the four terminals and identify.

e. Remove CR1.

REPLACEMENT

a. Slip 5/8 inch length insulated sleeving on each of the loose wires going to CR1.

b. Solder wires to new CR1 according to step d above.

c. Slide insulated sleeving toward CR1 over solder joint.

d. Remount CR1 to rear panel.

e. Remount rear panel to instrument (para 6-21).

f. Replace instrument dust cover (para 6-20).

6-28. REPLACEMENT OF INPUT TRANSFORMER T1

a. Remove instrument dust cover (para 6-20).

b. Remove rear panel through stage 1 (para 6-21).

c. Swing up Al card assembly by removing 2 screws at rear.

d. Remove 4 screws holding plate on which Q1 & TP1 are mounted. Peel back plate.

e. Remove 4 screws holding T1 to main frame floor.

f. Unsolder wires from transformer terminals, preserving their general location and special conditions, such as twisted pairs and identify.

g. Remove transformer.

REPLACEMENT

Reversal of removal procedure.

NOTE

Consult main assy wiring diagram when reconnecting wires to terminals.

6-29. REPLACEMENT OF COMPONENTS ON CIRCUIT CARDS

REMOVAL

a. Remove defective component from circuit card by heating leads on printed conductor side and pulling component off with suitable tools on the component side.

b. Remove solder from mounting holes with suction desoldering aid or wooden toothpick.

REPLACEMENT

a. Cut leads of replacement component to allow 1/4 inch more than finished length. Shape leads to conform with holes in card.

b. Insert component leads into mounting holes. Position component in the same manner as the original.

c. Solder leads to bottom of printed conductor side of card, making sure component maintains proper position.

d. Clip the excess component leads to within 1/32 inch from soldered surface.

NOTE

When replacing axial lead components such as tubular capacitors & resistors, it is not necessary to unsolder the faulty component. You may clip the leads close to the body of the faulty component, remove the component, and straighten the lead end still soldered to the card.

Introduce the new component by placing it properly, then wrap the leads of the replacement once around the original lead stub.

Solder the connection and clip excess lead.

6-30. REPLACEMENT OF A2 POWER SUPPLY ASSEMBLY

REMOVAL

a. Remove instrument cover (para 6-20).

b. Remove high voltage cover (para 6-22).

c. Remove Al oscillator card assy (para 6-32).

d. Detach P1 from J1.

e. Remove 4 flat head screws holding A2 assy to main frame from bottom of main frame.
f. Remove A2 assy.

REPLACEMENT

Reversal of removal procedure.

6-31. REPLACEMENT OF T1 of the A2 POWER SUPPLY

REMOVAL

a. Remove instrument dust cover (para 6-20).
b. Remove high voltage cover (para 6-22).
c. Remove A2 Power Supply Assy (para 6-30).
d. Working on the A2 Power Supply Assy, remove the 2 screws hardware and spacer post securing

The A2A2 card assy.

e. Swivel card assembly upward and out of way to gain access inside the box.
f. Remove 4 screws spacers & hardware securing the A2A1 card assy to the A2 assy.
g. Remove the 4 flat head screws from the bottom of the A2 assy holding the A2T1 transformer.
h. Unsolder wires from A2T1, noting any twisted pairs or similar wire colors and identify.
i. Remove A2T1.

REPLACEMENT

a. Place the replacement T1 in bottom of A2 assy and attach and wrap wires to the correct terminals with the aid of wiring diagram Figure 6-18 and Table 6-4.
b. Solder wires to replacement T1 according to step h above.
c. Secure T1 to the bottom plate of A2 assy with the 4 flat head screws.
d. Remount A2A1 card assy with spacers & hardware previously removed.
e. Swivel A2A2 card assy back down & secure at rear end with original hardware & spacers.
f. Replace A2 Power Supply assy (para 6-30).
g. Replace high voltage cover (para 6-22).
h. Replace instrument dust cover (para 6-20).

6-32. REPLACEMENT OF Al OSCILLATOR CARD ASSY

REMOVAL

a. Remove instrument dust cover if on (para 6-20).
b. Remove 2 screws at rear of card.
c. Swivel Al oscillator card to vertical position.
d. Pull Al card upwards to discharge P3 from J3.

REPLACEMENT

Reversal of removal procedure.

6-33. REPLACEMENT OF TRACKING POT A4R1

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Remove RF tuning head assy (para 6-23).

c. Set frequency to 2400 MHz.

d. Remove 4 screws at top of tracing board and fold back board to expose R 1 below.

e. Loosen 2 6-32 spline screws holding mode cam to R 1 shaft. Remove mode cam.

f. Remove mode switch by removing its 2 holding screws and hardware. Note orientation for remounting.

g. Unsolder the 4 wires going to R1 terminals 1 through 3 plus the 40% tap point. Note position of terminals for remounting replacement.

h. Remove the 3 phillips countersink screws holding R 1 to its upper plate.

i. Remove the R 1 pot and drive gear attached through the bottom of the A4 casting.

j. Remove R1 pot drive gear from bottom of pot.

REPLACEMENT

a. Remount gear on bottom of replacement R1.

b. Reinstall replacement R1 through bottom of A4 casting in same orientation as noted in step g above.

c. Attach R1 to mtg place with its 3 Phillips countersink screws.

d. Adjust backlash if any between cam drive gear and R1 gear by loosening 4 screws securing R1 mounting plate and moving plate closer to cam drive gear if necessary. Gears should mesh smoothly with minimum backlash.

e. Set frequency to low limit.

f. Set multimeter to 1000 ohm range and place probes on terminals 1 and 2 of R1. Loosen R1 hub screws, and rotate R1 shaft to obtain 400 ohm resistance measurement. Retighten gear onto R1 shaft.

g. Set frequency to extreme high. As in step f, measure resistance between terminals 2 and 3 on R 1. Reading should be approximately 400 to 450 ohms.

h. If resistance on both ends is not equal, repeat steps f and g until resistances at ends agree within 100 ohms. Tighten set screws on pot gear hub.

i. Check for smooth 'reading of R1 pot by measuring resistance between wiper terminal 2 and each of the other terminals 1 and 3 respectively.

j. Resolder wires to pot terminals per notations of removal step g and by consulting tuning head wiring diagram (figure 6-20).

k. Remount mode switch in original position, and place mode cam on shaft.

l. Set frequency to 1700 MHz.

m. Using multimeter set to 100 ohm range, set probes between the common terminal and the normally closed terminal of A4S1.

n. Rotate mode cam clockwise as viewed from above until the high portion of the cam just leaves the A4S1 arm. The arm will pop up and the circuit will break. The multimeter will register an open ckt.

At this precise setting, tighten the set screws on the mode cam.

o. Place the A4 tracking board in place and attach mounting hardware.

p. Replace RF tuning head assy (para 6-23).

q. Replace instrument dust cover (para 6-20).

6-34. REPLACEMENT OF POWER SET PROBE

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Remove A4 tuning head assy if in place (para 6-23).

c. Turn power set probe fully clockwise.

d. Loosen 2 4-40 hex set screws at the bottom of the drive yoke on the power set mounting block.

e. Without rotating the probe, pull it out straight.

If only the probe is being removed at this time and not the entire Klystron Oscillator, note the orientation of the ground stub so that the replacement may be reinserted at the same orientation.

f. Detach P2 from J2. Removal is now complete.

REPLACEMENT

a. Turn power set control fully clockwise until it can move no further.

b. Insert replacement power set probe straight into power set drive.

- at same orientation that the removed probe had if only the probe has been replaced, or

- with ground stub in vertical position if the whole Klystron Oscillator has been replaced.

c. Gently seat probe until it butts against inner conductor. Then back off approximately .006 inches or the thickness of a 34 AWG solid wire.

d. Lock the set screws to secure probe to drive cylinder.

e. Set up probe electrically by performing Alinement step 6 to the point where -7 dBm is obtained at P2.

f. Reattach P2 to J2.

g. Replace A4 tuning head (para 6-23).

h. Replace instrument dust cover (para 6-20).

6-35. REPLACEMENT OF ATTENUATOR PROBE

REMOVAL

a. Remove instrument dust cover if on (para 6-20).

b. Remove A4 tuning head assy if in place (para 6-23).

c. Turn attenuator control until the 4-40 hex set screw holding the attenuator probe is centered in hole at top of attenuator probe mounting block.

   Loosen this screw and the other 4-40 hex set screw appearing in the slot at the rear of the mounting block.

d. Pull attenuator probe out of drive yoke.

e. Detach P4 from J4. Removal is now complete.

REPLACEMENT

a. Turn attenuator control fully clockwise to its bottom position.

b. Insert replacement attenuator probe straight into the attenuator drive with the ground stub of probe in the vertical position.

c. Gently seat the probe until it butts against inner conductor. Then back off about .006 inches or the thickness of a 34 AWG solid wire.

d. Lock the set screws to secure probe to drive cylinder.

e. Reattach P4 to J4.

f. Perform Alinement step 7 to calibrate attenuator.

6-36. REPLACEMENT OF KLYSTRON OSCILLATOR

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Remove A4 tuning head assy (para 6-23).

c. Remove Klystron tube VI (para 6-26).

d. Remove attenuator probe (para 6-35).

e. Remove Power Set probe (para 6-34).

f. Turn Power Set drive gear fully clockwise.

g. Loosen attenuator probe drive gear at front of tuning head. Rotate attenuator dial clockwise to retract probe drive until leading edge enters drive mounting block approximately 5/8 inch.

h. Remove central screw in oscillator yoke disc holding push rod yoke to disc.

i. Pull yoke/cam follower fully toward front panel and clamp it out of the way to the front panel.

j. Remove 2 8-32 allen cap screws retaining the 2 oscillator cylinder clamps.

k. Remove klystron oscillator from seating.

l. Unsolder red repeller lead on oscillator from terminal A4A1 E7. Remove A4A1 tracking board to accomplish this. Remove this red lead from harness.

NOTE

In replacing klystron oscillator, resolder red repeller lead to E7 and tie new lead to existing harness.

REPLACEMENT

a. Reverse the removal procedure through step h above except do not tighten screws in step j above. Then continue as instructed below.

b. Turn attenuator control clockwise until it reaches limit of its travel.

c. Reset power set drive system as follows:

(1) Loosen set screws on drive gear which drives attenuator hairline gear.

(2) Rotate drive gear until leading edge of probe drive yoke is flush with mounting block.

(3) Loosen 2 set screws on cursor gear hub to allow cursor to move freely.

(4) Position attenuator dial with any convenient number dead center as a reference.

(5) Rotate hairline gear to a position 24 dB left of the center reference. Tighten cursor gear screws provisionally.

(6) Rotate power set drive shaft clockwise until all stops make contact and shaft stops.

(7) Tighten screws on power set drive gear.

(8) Install power set probe per separate replacement procedure (para 6-34). Move klystron cavity forward or backward slightly, if necessary, to aline probe with probe tube. Tighten oscillator cylinder screws when alined.

d. Reset attenuator drive system as follows:

(1) Rotate attenuator dial counterclockwise until probe drive yoke bottoms out on probe pipe.

(2) Set power set control fully clockwise (hairline fully counterclockwise).

(3) Loosen attenuator dial and adjust so that 0 on the dial falls under the hairline.

(4) Tighten attenuator dial set screws.

(5) Rotate the attenuator drive shaft fully clockwise until it stops.

(6) Tighten attenuator drive gear.

(7) Install attenuator probe per separate replacement procedure (para 6-35).

e. Reinstall Klystron tube VI (para 6-26).

6-37. REPLACEMENT OF A5 LEVELING ATTENUATOR ASSEMBLY.

REMOVAL

a. Remove instrument dust cover (para 6-20).

b. Note connections and dressing of cables and wires attached to J1, J2, J3, J4, El, and E2 and the detector mounted on the A5 assy.

c. Remove 2 nuts on top of saddle holding the detector to A5 assy.

d. Remove top saddle yoke and dress detector and move cabling out of the way.

e. Remove round head phillips screw attaching bracket on which saddle is mounted to top of A5 assy. Remove bracket holding saddle from A5 assy.

f. Remove from underside of main frame 4 flat head screws holding A5 assy to main frame.

g. Extract A5 assy from fixed position to gain access to connections.

h. Remove cables attached to J1, J2, J3 and J4.

i. Unsolder center conductor and black grounding wire from El and E2.

NOTE

Be careful not to harm or lose the ferrite bead on center conductor of each shielded lead. Be sure to position properly when performing replacement procedure.

REPLACEMENT

Reversal of removal procedure.

NOTE

Be sure to dress cables and leads attached to A5 assy in same manner as before removal.

APPENDIX A

REFERENCES

A-1. SCOPE

This appendix lists all field manuals, forms, pamphlets, regulations and technical manuals referenced in this manual.

A-2. FIELD MANUALS

Explosives and Demolitions ..... FM 5-25
First Aid for Soldiers ..... FM 21-11

A-3. FORMS

Recommended Changes to Publications and Blank Forms ..... DA Form 2028
Recommended Changes to Equipment Technical Publications ..... DA Form 2028-2
Equipment Inspection and Maintenance Worksheet ..... DA Form 2404
Packaging Improvement Report ..... DD Form 6
Quality Deficiency Record ..... DD Form 1715
Discrepancy in Shipment Report ..... SF Form 361
Report of Discrepancy ..... SF Form 364
Quality Deficiency Report ..... SF Form 368

A-4. PAMPHLETS

Consolidated Index of Army Publications and Blank Forms ..... DA PAM 310-1
US Army Equipment Index of Modification Work Orders ..... DA PAM 750-10
The Army Maintenance Management System (TAMMS) ..... DA PAM 738-750

A-5. REGULATIONS

Reporting of Transportation Discrepancies in Shipments ..... AFR 75-18
Reporting of Item and Packaging Discrepancies ..... AFR 400-54
Reporting of Transportation Discrepancies in Shipments ..... AR 55-38
Reporting of Item and Packaging Discrepancies ..... AR 735-11-2
Reporting of Item and Packaging Discrepancies ..... DLAR 4140.55
Reporting of Transportation Discrepancies in Shipments ..... DLAR 4500.15
Reporting of Item and Packaging Discrepancies ..... MCO 4430.3F
Reporting of Transportation Discrepancies in Shipments ..... MCO P4610.19D
Reporting of Item and Packaging Discrepancies ..... NAVMATINST 4355.73A
Reporting of Transportation Discrepancies in Shipments ..... NAVSUPINST 4610.33C

A-5. TECHNICAL MANUALS

Repair Parts and Special Tools List (including Depot RPSTL):
Signal Generator AN/USM-213B ..... TM 11-6625-3053-24P
Procedures for Destruction of Electronics Materiel to Prevent Enemy Use
(Electronics Command) ..... TM 750-244-2

APPENDIX B

MAINTENANCE ALLOCATION CHART

SECTION I. INTRODUCTION

B-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. MAINTENANCE FUNCTIONS.

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 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 condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubri- cants, chemical fluids, hydraulic fluids, compressed air supplies or gases.

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

e. Aline. 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, or module (component or assembly) in a manner to allow the proper functioning of an 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 1 or other maintenance actions 2 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 in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Over- haul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equip- ment 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.

B-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II.

a. Column 1, Group Number. Column 1 lists functional group codes 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 names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph B-2).

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category 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 work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, sub- assembly, 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 con- trol time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various categories are as follows:

C ..... Operator or crew.
O ..... Organizational maintenance.
F ..... Direct support maintenance.
H ..... General support maintenance.
D ..... Depot maintenance.

e. Column 5, Tools and Equipment. Column 5 specified, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function. The code in this column is keyed to the tools and test equipment requirements list in Section 11 .

f. Column 6, Remarks. Column 6 contains, when applicable, a code which is keyed to the remarks contained in Section IV.

---

[1] Services-inspect, test, service, adjust, aline, calibrate or replace.
[2] Actions-welding, grinding, riveting, straightening, facing, remachining, or resurfacing.

B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. Column 2, Maintenance Category. The lowest category maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test equipment. d. Column 4, National Stock Number. The National stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

B-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.

a. Column 1, Reference Code. The code listed in Column 6, Section II.

b. Column 2, Remarks. This column lists information pertinent to the maintenance function being performed

SECTION II MAINTENANCE ALLOCATION CHART

FOR

GENERATOR, SIGNAL AN/USM-213B

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	GENERATOR, SIGNAL AN/USM-213B	Inspect		.5					
		Test		.2					A
		Repair		.5				1	B
		Test				2.0		2 thru 16	
		Replace				.5		2 and 3	
		Repair				4.0		2 thru 16	
		Aline				2.0		2 thru 16	
		Test					2.0	2 thru 16	
		Repair					4.0	2 thru 16	
		Aline					2.0	2 thru 16	
01	Al CIRCUIT CARD ASSEMBLY	Test				1.0		2, 3, 4, 6, 7, 8	
		Replace				.5		2 and 3	
		Repair				2.0		2, 3, 4, 6, 7, 8	
		Aline				.5		2, 3, 4, 6, 7, 8	
02	A2 POWER SUPPLY ASSEMBLY	Test				1.5		2, 3, 4, 6, 7, 8	
		Replace				.5		2 and 3	
		Repair				2.0		2, 3, 4, 6, 7, 8	
0201	A2A1 CIRCUIT CARD ASSEMBLY	Test				1.5		2, 3, 4, 6, 7, 8	
		Replace				.5		2 and 3	
		Repair				2.5		2, 3, 4, 6, 7, 8	
		Aline				.5		2, 3, 4, 6, 7, 8	
0202	A2A2 CIRCUIT CARD ASSEMBLY	Test				1.5		2, 3, 4, 6, 7, 8	
		Replace				.5		2 and 3	
		Repair				2.5		2, 3, 4, 6, 7, 8	
		Aline				.5		2, 3, 4, 6, 7, 8	
0203	A2A3 CIRCUIT CARD ASSEMBLY	Test				.5		2, 3, 6, 7, 8	
		Replace				.5		2 and 3	
		Repair				1.0		2, 3, 6, 7, 8	
		Aline				.5		2, 3, 6, 7, 8	
03	A3 CIRCUIT CARD ASSEMBLY	Test				2.0		2, 3, 4, 6, 7, 8 10, 11, 16	
		Replace				.5		2 and 3 10, 11, 16	
		Repair				3.0		2, 3, 4, 6, 7, 8 10, 11, 16	
		Aline				1.0		2, 3, 4, 6, 7, 8	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
GENERATOR, SIGNAL AN/USM-213B (CONT.)

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
04	A4 TUNING HEAD ASSEMBLY	Test				4.0		2 thru 15	
		Replace				1.0		2 and 3	
		Repair				6.0		2 thru 15	
		Aline				2.5		2 thru 15	
0401	A4A1 CIRCUIT CARD ASSEMBLY	Test				.5		2 thru 15	
		Replace				1.0		2 and 3	
		Repair				.5		2 thru 15	
		Aline				.5		2 thru 15	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
GENERATOR, SIGNAL AN/USM-213B

TOOL OR TEST EQUIPMENT SELF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NO.
1	0	TOOL KIT, ELECTRONIC EQUIPMENT TK-101	5180-00-064-5178	
2	H, D	TOOL KIT, ELECTRONIC EQUIPMENT JTK-17	4931-01-073-3845	
3	H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100	5180-00-605-0079	
4	H, D	VOLTMETER, DIGITAL 3490A OPTION 060	6625-00-557-8305	
5	H, D	COUNTER, ELECTRONIC, EIP351D	4931-01-095-5457	
6	H, D	OSCILLOSCOPE, TEK 5440 MIS 28706 TYPE 1	6625-01-046-3712	
7	H, D	AMPLIFIER, DUAL TR MIS 28706/3 (TEK 5A48) (2 EA)	6625-01-008-1480	
8	H, D	TIME BASE, DELAYING MIS 28706/4	6625-01-008-1479	
9	H, D	METER, POWER E12-432A	6625-00-148-8069	
10	H, D	GENERATOR, PULSE (214B) 214A	5895-01-103-9550	
11	H, D	TEST OSCILLATOR, MIS 10224 (HP 652A)	6625-00-113-2943	
12	H, D	DETECTOR, COAXIAL CRYSTAL HP MODEL 423A	5820-00-877-7148	
13	H, D	MODULATOR, KLYSTRON MODE AUL MODEL 5211		
14	H, D	THERMISTOR MOUNT HP MODEL 8478B	6625-00-811-2435	
15	H, D	10 dB ATTENUATOR, FIXED 777C-10dB	4931-01-019-5773	
16	H, D	COUNTER, ELECTRONIC 5345A	6625-00-531-4752	

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	OPERATIONAL TEST.
B	FUSES, KNOBS AND POWER CORD ARE REPLACED AT THE ORGANIZATIONAL LEVEL.

APPENDIX C

EXPENDABLE SUPPLIES AND MATERIALS

C-1. This appendix lists expendable supplies and materials you will need to maintain the AN/USM-213B.

a. Trichlorotrifluoroethane-cleaning solvent. See WARNING in front part of this manual for the safe use of this material.

b. Insulated Sleevings-for covering soldered joints on replaced components. Lengths as necessary in the following outside diameters:

1/8 inch
3/16 inch
1/4 inch
3/8 inch
1/2 inch

c. General purpose laundry soap-to clean the blower filter on the rear panel.

d. Glyptol-for preventing movement of adjusted pot shafts relative to their locking mechanisms.

SUBJECT INDEX

By Order of the Secretary of the Army:

JOHN A. WICKHAM JR.
General, United States Army
Chief of Staff

Official:

MILDRED E. HEDBERG
Brigadier General, United States Army
The Adjutant General

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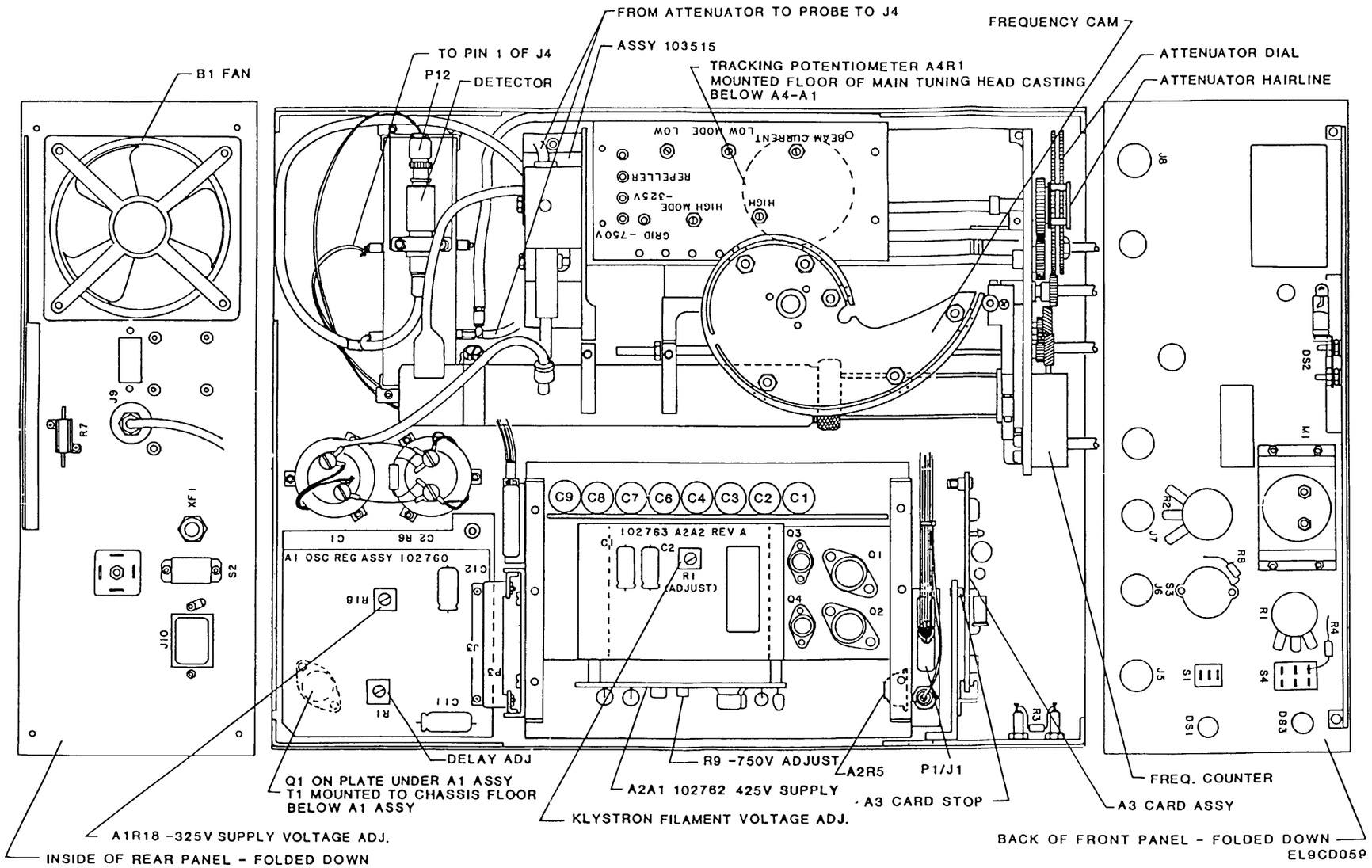
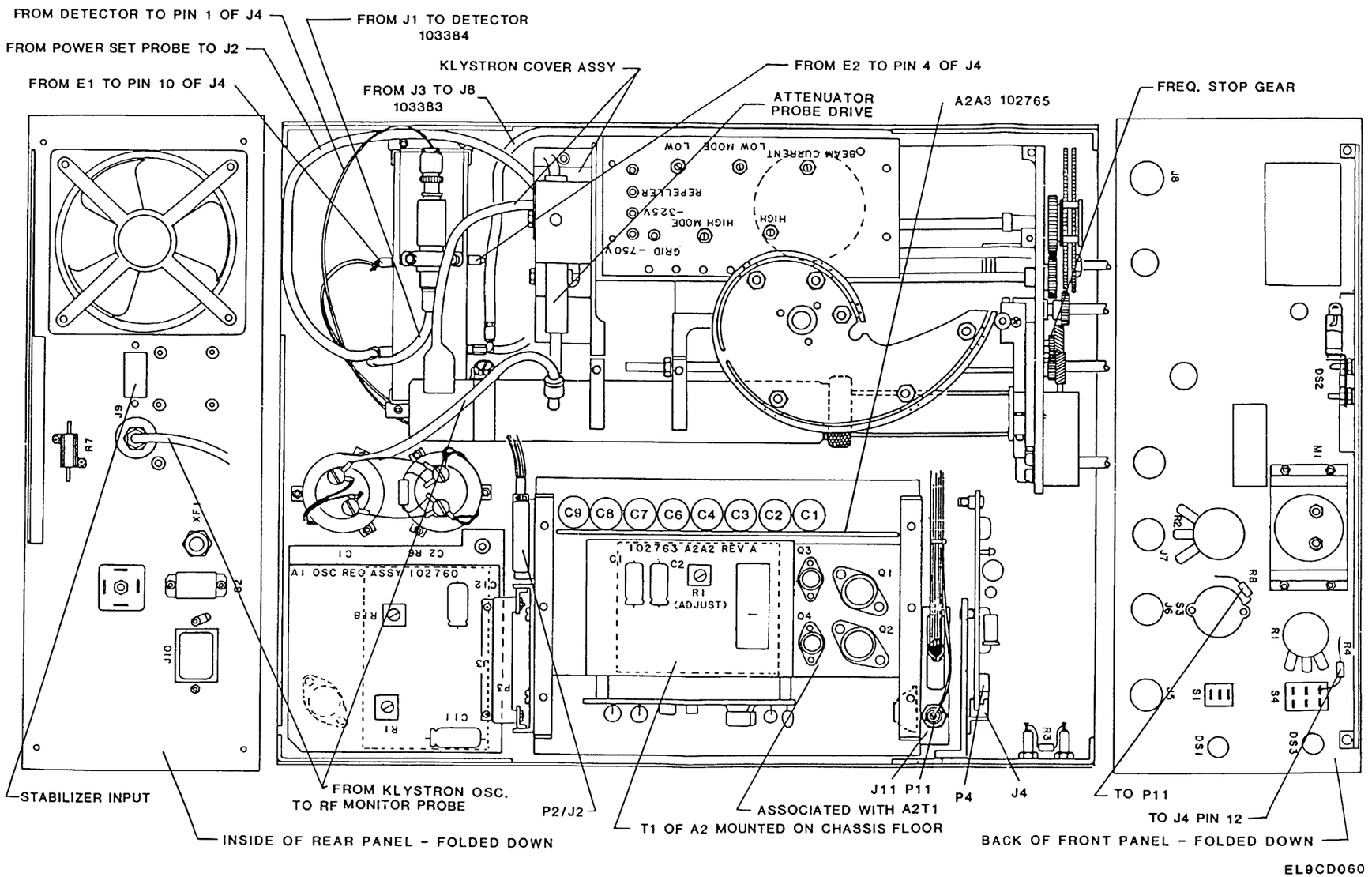


Figure FO-1. Top Internal View of AN/USM-213B (Sheet 1 of 2)



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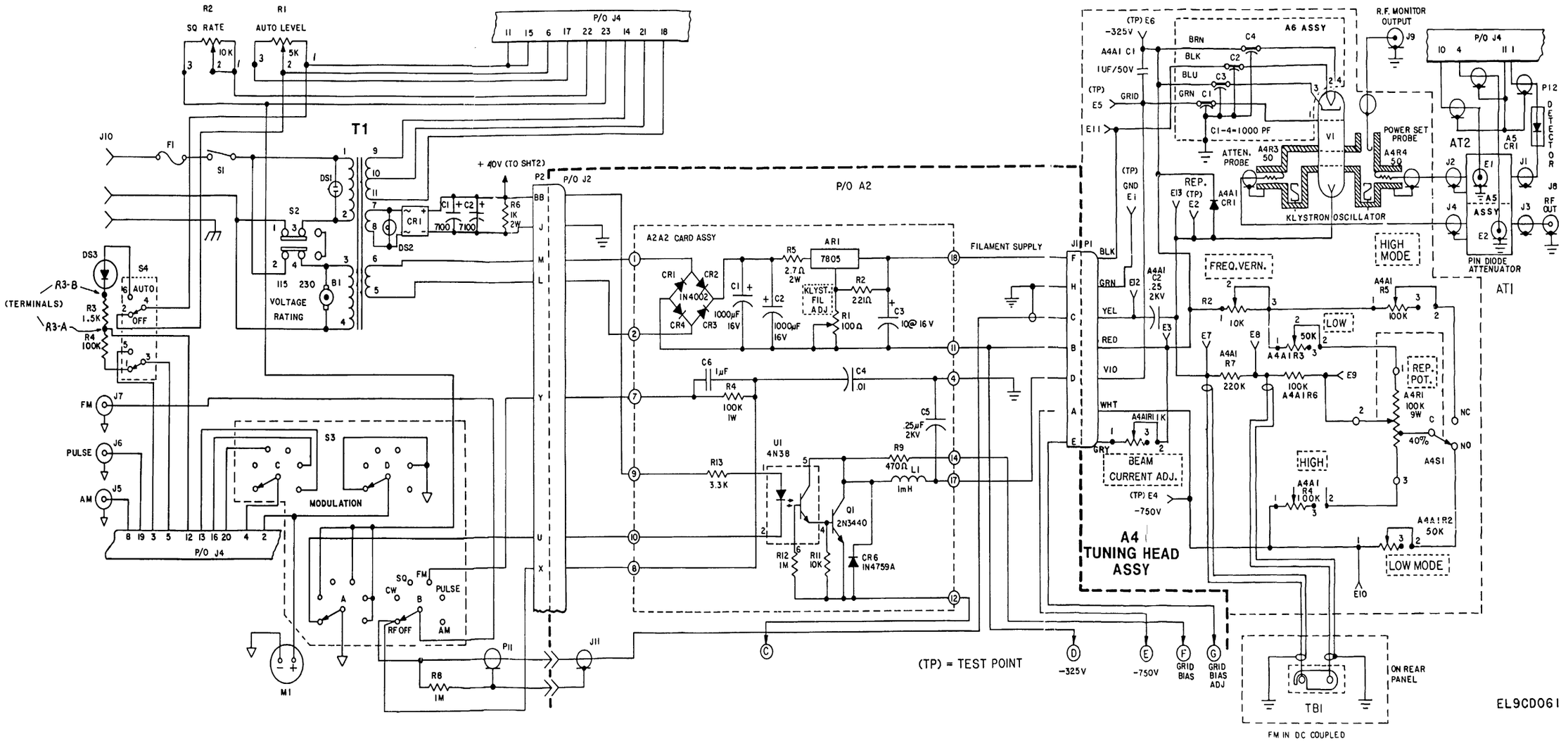

Figure FO-2. Schematic DiagramAN/USM-213B
(Sheet 1 of 3)

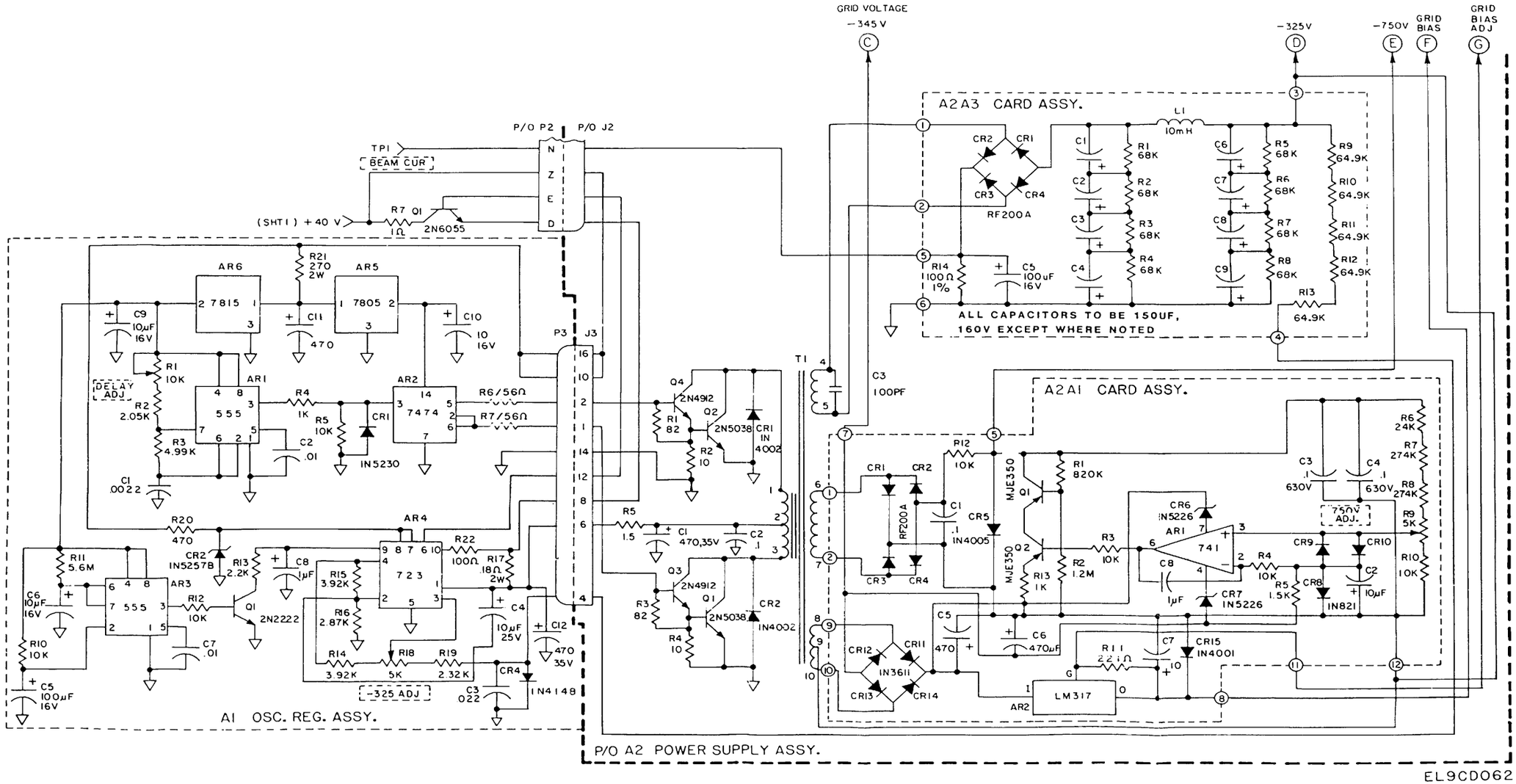

Figure FO-2. Schematic Diagram AN/USM-213B
(Sheet 2 of 3)

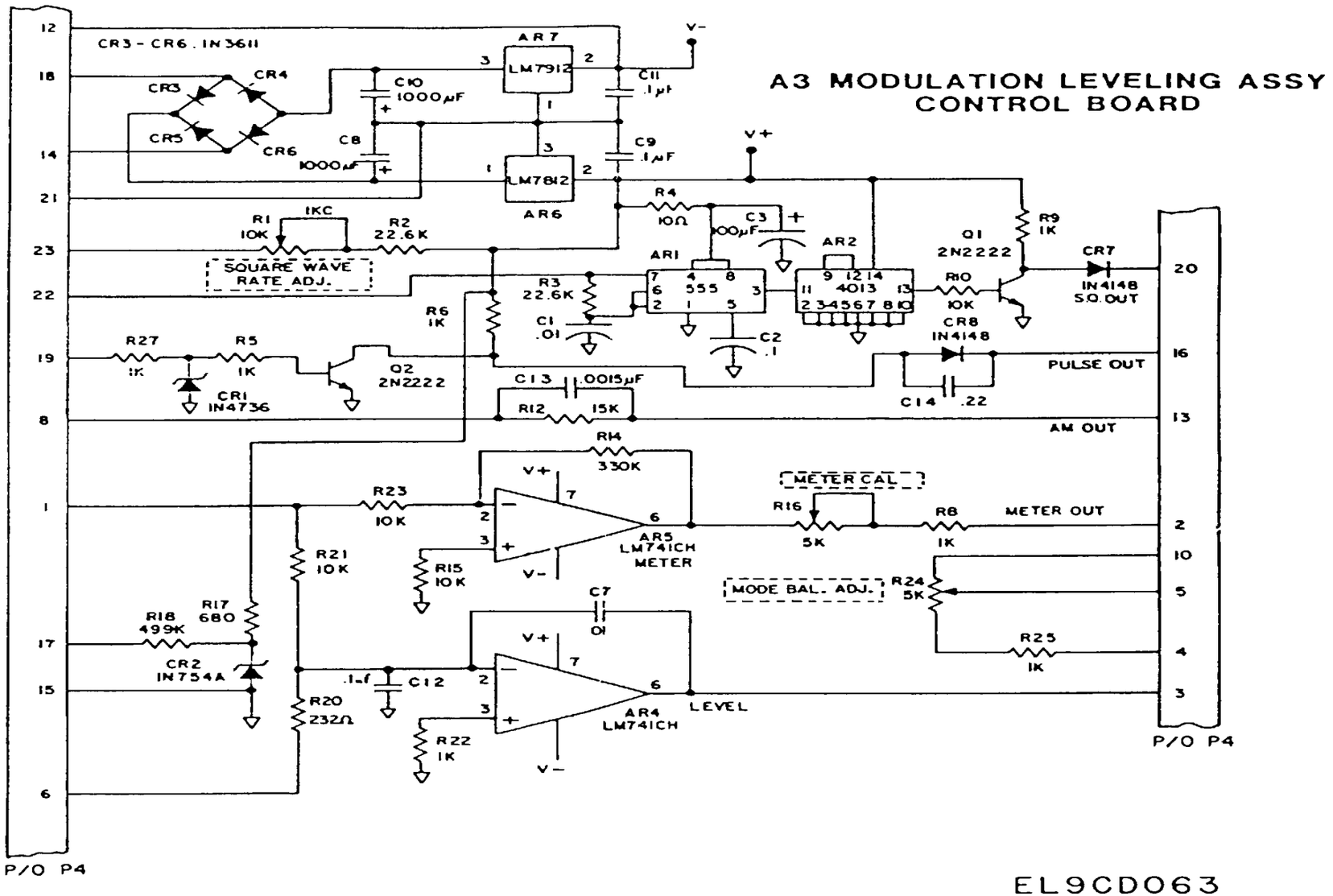

Figure FO-2. Schematic DiagramAN/USM-213B
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