TECHNICAL MANUAL

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

MICROWAVE OSCILLATOR SYNCHRONIZER, SAGE MODEL 243C

This copy is a reprint which includes current pages from Change 1

HEADQUARTERS DEPARTMENT OF THE ARMY

FEBRUARY 1974

This manual is an authentication to the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications, the format has not been structured to consider level of maintenance nor to include a formal section on depot overhaul standards.

CHANGE

No. 2

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Change 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 11 April 1986

OPERATORS ORGANIZATIONAL, DIRECT SUPPORT AND

GENERAL SUPPORT MAINTENANCE MANUAL,

INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST:

MICROWAVE OSCILLATOR SYNCHRONIZER,

SAGE MODEL 243A-C (NSN 4931-00763-0762)

Current as of 11 April 1986

TM 9-4931-458-14-1, 4 February 1974, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
i and ii	i and ii
9-1 through 9-18	

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

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DEPARTMENT OF THE ARMY
WASHINGTON, DC *4 February 1974*

Operator's Organizational, Direct Support, and General SUPPORT MAINTENANCE MANUAL, INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST: MICROWAVE OSCILLATOR SYNCHRONIZER, SAGE MODEL 243A-C (NSN 4931-00-763-0762)

LIST OF ILLUSTRATIONS

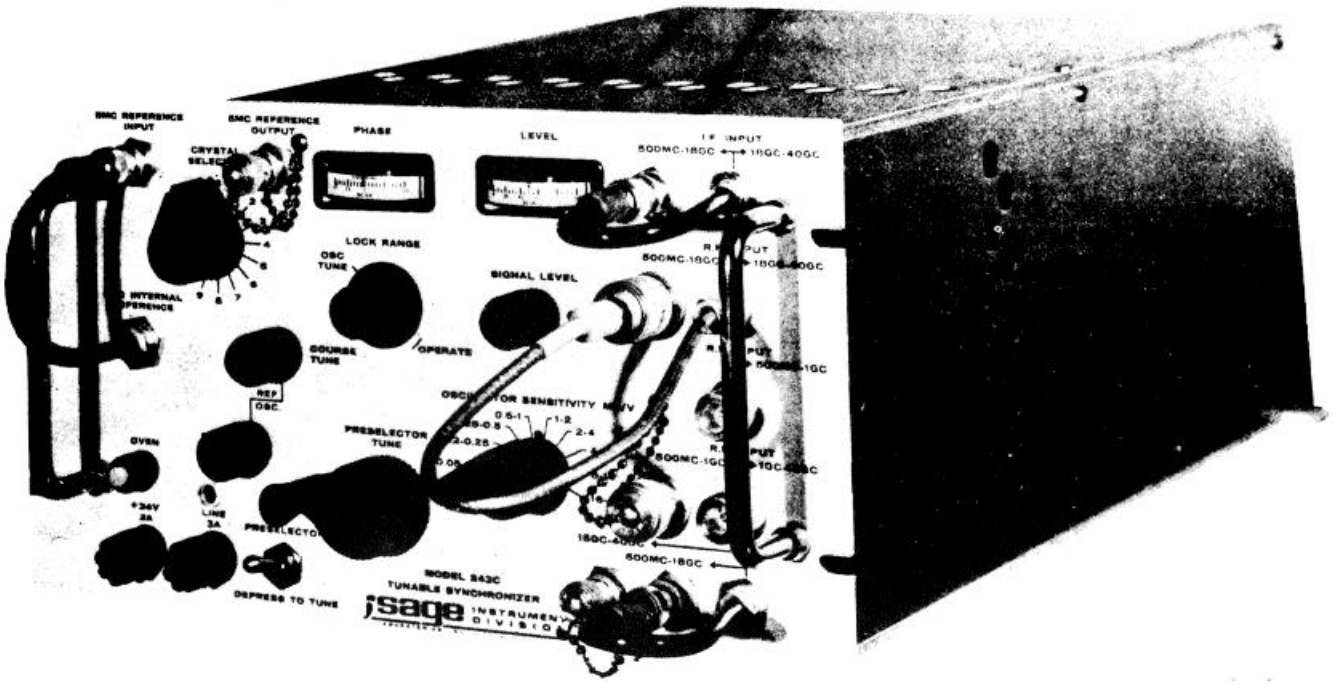


Figure 1-1. Microwave Oscillator Synchronizer Model 243C

Figure 1-1. Microwave Oscillator Synchronizer Model 243C.

SECTION 0

INTRODUCTION

0.1 Scope

The manual includes installation and operation instructions and covers organizational, direct support (DS), and general support (GS) maintenance. It describes Microwave Oscillator Synchronizer, Sage Model 243C. The basic issue items list appears in appendix B.

0.2 Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine if there are any new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are Modification Work Orders (MWO) pertaining to the equipment.

0.3 Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

b. Report of Packaging and Handling Deficiencies (DP Form 6). Fill out and forward DD Form 6 as prescribed in AR 700-58 (Army), NAVSUP Pub 378 (Navy), AFR 71-41 (Air Force), and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report. Fill out and forward Discrepancy in Shipment Report (SF 361) as prescribed in AR 55-38 (Army), NAV SUPINST 4610.33 (Navy), AFM 75-18 (Air Force), and MCO P4610.19A (Marine Corps).

d. Reporting of Equipment Publication Improvements. The reporting of errors, omissions, and recommenda-tions for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to: Commander, US Army Missile Command, ATTN: AMSMI-MFM, Redstone Arsenal, AL 35809.

SECTION 1

GENERAL INFORMATION

SYSTEM CONSIDERATIONS

The Model 243C Microwave Oscillator Synchronizer provides an economical and versatile method for phase locking a voltage-tunable microwave source to a frequency which is related to harmonics of a tunable-crystal reference. Klystrons, backward-wave oscillators, (BWO), voltage-tunable magnetrons(VTM's and other voltage-tunable microwave sources may thus be provided with stability associated with crystals.

The ability to handle the higher helix current and a positive means for selecting each desired lock point is a requisite for phase locking BWO tubes in addition to Klystrons. The Model 243C has a 25 ma. current-carrying capability and a variable lock range control. By being able to vary the lock range, the operator may either disable the phase lock loop or open up the lock range enough to phase lock to the correct harmonic.

Klystrons and BWO tubes also differ in modulation sensitivity. The BWO tube has a much higher MHz per volt rating. For example, a 4 MHz/volt tube and a 40 volt lock range results in a 160 MHz frequency range. With lock points at every 50 MHz there is a probability that the wrong line may be captured unless a narrower lock range is used. However, a wide lock range is desirable in order to compensate for drift due to wide temperature variations. With the Model 243C, the operator may narrow the lock range, center about the desired lock point, capture the line, and then expand the lock range without unlocking. This gives the maximum correction capability without sacrificing frequency resolution.

With the crystal and oven provided in the Model 243C Synchronizer, long term stability is held to 1 part in 10^7 per 1/2 hour. The phase sensitive discriminator, high gain amplifier and optimized band-width gives a high degree of FM noise reduction about the carrier.

A nine position phase lag network allows for optimum noise reduction by optimizing loop stability. An external reference (1 or 5 MHz) may be substituted for the crystal reference, in which case locking will be achieved at discrete fixed frequencies.

This manual provides a description and instructions for installation, operation and maintenance of the Model 243C.

The Microwave Oscillator Synchronizer Model 243C is illustrated in Figure 1-1.

SECTION 2

DESCRIPTION

2.1. ELECTRICAL DESCRIPTION

The Model 243C Microwave Oscillator Synchronizer is a straight-forward device for positive stabilization of voltage-tunable oscillators (typically reflex klystrons, BWO's, VTM's) at discrete frequencies in the range 0.5 to 40 GHz. Ultra stability is achieved in terms of incidental FM and short and long term drift characteristics, by using phase locking circuitry which imparts to the stabilized voltage-tunable oscillator the inherent stability of a crystal reference oscillator. The stabilities obtainable when the Model 243C is used in a phase locked system are as follows

Short-Term Stability	1 in 10^8/sec.
Long-Term Stability	1 part in 107 per thirty minutes

The Model 243C achieves positive stabilization of a voltage-tunable oscillator by sampling the oscillator output, mixing the sample with an appropriate harmonic from a crystal reference to obtain a 25 MHz intermediate beat frequency, and phase-comparing this 25 MHz IF signal with a 25 MHz reference signal derived from the crystal reference. When there is a phase difference, the comparator generates an error voltage which is applied in series to the stabilized oscillator to correct the difference. Thus, when the oscillator tries to drift, a phase error is immediately detected, and an offsetting or correcting voltage is applied to the oscillator, thereby preventing the attempted drift.

2.2. BLOCK DIAGRAM

In the simplified block diagram of Figure 2-1 the RF reference frequency is generated by a temperature-stabilized crystal oscillator at 5 MHz. This reference frequency is carefully multiplied to obtain an IF reference gate (25 MHz), and an RF reference frequency (100 and 200 MHz) used to obtain a 'comb' of harmonic lines, 100 MHz apart which is applied to the mixer together with a sample of the output of the oscillator to be stabilized. A third signal is also derived from this multiplier (20 MHz SIDEBAND SIGNAL) and is utilized in the mixing harmonic process to create sideband signals in addition to harmonic lines as mentioned above giving, therefore, harmonic lines 20 MHz apart. This extra sideband feature permits phase locking signals with continuous coverage tunability at frequencies below 5 GHz.

After conversion the output of the mixer is applied to a 25 MHz amplifier, which has a 3.5 MHz band-width. This amplifier will show an output on the front panel LEVEL meter whenever the sample is approximately 25 MHz on either side of a harmonic line. This arrangement provides two 'lock' points for each line with 100 MHz reference lines present. Lock points will be spaced 50 MHz apart. When the 20 MHz sidebands are added, (see above) the lock points will be 10 MHz apart.

The IF amplifiers provide over 100 db gain at 25 MHz. The amplifier consists of several stages of stagger-tuned amplification plus a stage that acts as a limiter. Limiting eliminates amplitude variations which, if present, would act as variations in loop gain and possibly cause an unstable condition. A separately shielded preamplifier provides 20 db of gain.

The phase comparator provides an output voltage change of approximately + or -40 volts, thereby providing a large tolerance for attempts by the oscillator to drift while phase locked. In addition, it aids in preventing transients from unlocking the system, a function also performed by the hard-limiting characteristics of the phase-comparing circuitry.

This output voltage or LOCK RANGE is manually adjustable. This variable lock range control will permit discrimination of individual lock frequencies, spaced 50 MHz or 10 MHz from one another when the modulation sensitivity of the voltage-tunable oscillator is high.

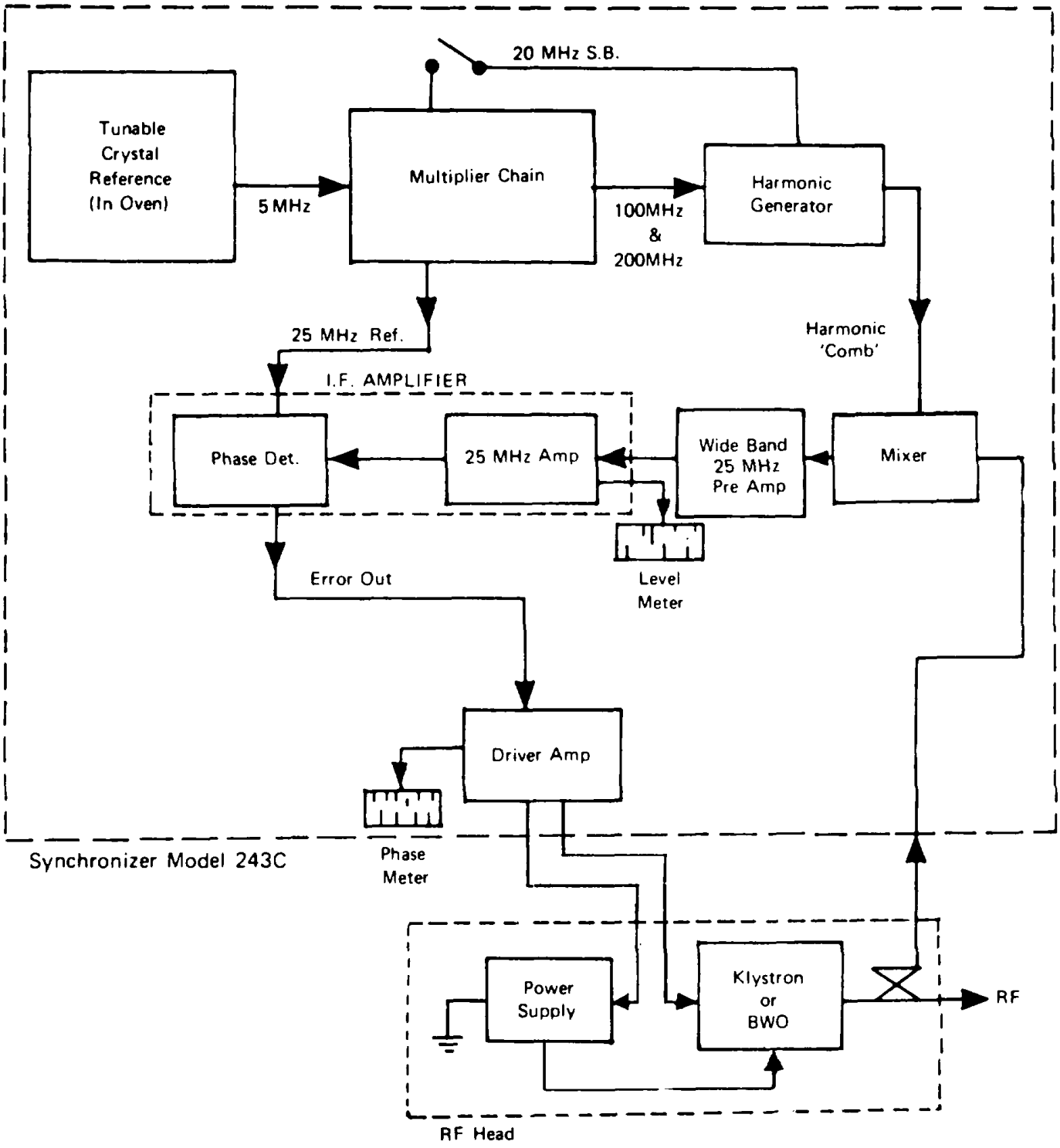


Figure 2-1. Simplified block diagram.

2.3 PERFORMANCE SPECIFICATIONS, MODEL 243C

The following lists the performance specifications of the Microwave Oscillator Synchronizer:

1. Frequency range	500 MHz to 40 GHz continuous
2. Frequency stability Drift	1 part in 107 per thirty minutes
3. Resetability	Mechanical and Electrical resetability of 1 part in 107 at 5 MHz
4. R.F. power required	500 MHz to 1 GHz: 2 milliwatt minimum 1 GHz to 12.4 GHz: 0.2 milliwatt minimum 12.4 GHz to 18.0 GHz: 2 milliwatt minimum 26.5 GHz to 40.0 GHz 0.5 milliwatts minimum
5. Tubes synchronized	Commercial BWO VTM, Triode (via varactor tuning) and klystron tubes.
6. Modulation sensitivity	0.05 MHz/volt to 38 MHz/volt
7. Variable locking range	Variable to ±40 volts maximum
8. Control voltage isolation	Zero to plus 2500 volts maximum
9. Control current	25 ma maximum
10. Lag networks	RC networks necessary to stabilize the phase lock loop for modulation sensitivity between 0.05 MHz/volt and 38 MHz/volt are provided. An adequate number of switch positions are supplied to insure locking of all commercial BWOs varactor tuned oscillators and klystrons.
Lag networks (cont.)	

11 (a) Required open loop Oscillator performance specification.

Maximum Oscillator spurious content	40 db below carrier exclusive of 2nd harmonic
Maximum Oscillator FM (Exclusive of power supply)	20 KHz peak deviation integrated over 1 KHz to 200 KHz from carrier
Maximum fine gain Oscillator power variation	Power/frequency = 0.03 db/MHz with 1.5:1 load VSWR

(b) Required power supply performance specifications

Maximum ripple referred to Oscillator	500 MHz to 1 GHz: 500 KHz at 60 Hz or 120 Hz
Maximum FM Output	1 GHz to 40 GHz: 5 MHZ at 60 Hz or 120 Hz
Maximum transients and noise levels at BWO helix and anode supplies (see Fig. 2-2)	1 KHz to 10 KHz 1 volt to 100 mv 10 KHz to 100 KHz: 100 mv to 20 mv 100 KHz to 1 MHz: 20 mv to 10 mv 1 MHz or greater: 10 mv
Maximum power supply voltage drift	±0.1% per 30 minutes
12. Lock range	0.5% or frequency
13. Search indicator	Not required
14. Search oscillator	Approximately 1 KHz
15. A.C. power	117 ± 10% volts at 50-60 Hz

16. Environment:

a. Temperature	Non-operating: -85°F to +135°F Operating: +40°F to 100°F with ambient change of less than 5°C per thirty minutes
b. Relative Humidity	Zero to 90%
c. Vibration	5 Hz to 52 Hz at 0.036 maximum displacement
d. Shock	15 g for duration of 11 milliseconds
e. Altitude	Non operating: to 90,000 feet Operating: to 10, 000 feet

NOTE: (1) Voltage changes in the upper bound are proportional to frequency change in the above ranges. All voltages are peak-to-peak measurements.

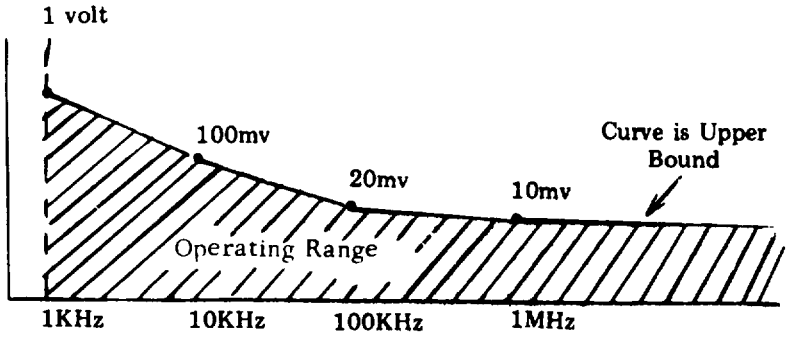


Figure 2-2. Transient and noise levels of helix and anode supply

SECTION 3

INSTALLATION

3.1. UNPACKING INSTRUCTIONS

Carefully unpack the equipment from its shipping container, check each item against the packing list, and inspect for missing or damaged items. If any parts are missing or appear to be damaged, see page 0-1.

TABLE 3-1 EQUIPMENT SUPPLIED

Quantity Supplied	Name of Unit	Overall Dimensions (Inches)	Approx. Weight (Pounds)
1	Tunable Synchronizer Model 243C 4931-763-0762	a. To front panel 6-31/32 in. H x 12-3/8 in. W x 18-3/8 in. L b. To include front panel handles 6-31/32 in. H x 12-3/8 in. W x 19-7/8 in. L c. To include front panel jumper cables in position 6-31/32 in. H x 12-3/8 in. W x 21-7/8 in. L	37 lbs.
1	P Band Jumper Cable B783131-1	5 in. Long	.16 lbs.
1	P Band RF Input Cable B783131-2	10 in. Long	.18 lbs.
1	Harmonic Mixer (18-26.5 GHz) C782730-1	7/8 in. H x 1-5/8 in. W x 3-1/2 in. L (Including mating cable connector)	.17 lbs.
1	Harmonic Mixer (26.5-40GHz) C782730-2	3/4 in. H x 1-9/16 in W x 3-1/4 in. L (Including mating cable connector)	.12 lbs.
1	Mixer RF Cable B782910	12-1/2 in. Long	.16 lbs.
1	Mixer, IF Cable B782909	12-1/2 in. Long	.11 lbs.
2	Instruction Manual Model 243C	8-1/2 x 11 x 1/2	1/2 lb.

3.2. SYSTEM INSTALLATION

The Microwave Oscillator Synchronizer may be placed in any convenient location near the microwave source.

Connections must be made via the rear panel connector, J20, in accordance with the following instructions:

a. Input Power - Connect a source of switched line power (117 volts t 10%, 60 Hz) to pin A and D of J20. The common ground wire is connected to pin B of J20. Connect an oven standby AC source (117V ± 10%, 60 Hz) to pins C and F of J20.

b. Phase Error Signal Leads - Connect the helix power supply voltage (0 to +2500 volts) to pin J of J20. Connect the phase error (helix) signal lead to pin E of J20. These leads should be shielded with the shield wire connected to pins B and M of J20.

CAUTION: The high voltage rating of the power supply shielded wire must acceed 2500 volts.

c. Function Programming Wires

1. Connect a wire to pin P (varactor biasline) and then connect it to ground via the plug-in RF head on the 18-26.5 GHz and 26.5 - 40 GHz heads only.

2. Connect a wire to pin R (10 MHz side-bands) via the plug-in RF head and return to ground through the following resistances:

0.5 -1 GHz	0 + 1 ohm
1 - 2 GHz	0 + 1 ohm
2 - 4 GHz	5.6K ± 5% ohms
4 - 8 GHz	5.6K ± 5% ohms

3.3. RF LEAKAGE GROUND LOOP TEST

On high frequency BWO's, a 25 MHz ground loop will reduce the lock range and may prevent locking entirely. The following test will insure that the leakage signal is adequately low to provide for proper operation.

Connect in turn the 26.5 - 40 and 18 - 26.5 GHz BWO's and set up completely for phase lock opera- tion per operating instructions. Disconnect the lead marked 18 - 40 GHz/500 MHz 18 GHz entirely from either jack. Connect a detector to TP1 of the IF amplifier and view the dc amplitude on a scope as the BWO is tuned from the low end of the range to the high end. Maximum allowable DC shift shall be no greater than 0.1 volts over the band.

SECTION 4

OPERATION

4.1. FRONT PANEL CONTROLS AND INDICATORS

Table 4-1 provides information about the front panel controls and indicators. The relative positions of the controls and indicators are shown on Figure 1-1.

TABLE 4-1. FRONT PANEL CONTROLS AND INDICATORS

Name	Reference Symbol	Function
LINE, power (lamp)	DS1	Indicates when line power (117 VAC) is applied to unit
OVEN, power (lamp)	DS2	Indicates when 117 VAC power is applied to oven control circuitry
LEVEL (meter)	M1	Indicates 25 MHz Amplifier signal level
PHASE (meter)	M2	Indicates the approximate point of operation on the phase detector curve
SIGNAL LEVEL (control)	R13	Potentiometer that adjusts the 25 MHz Amplifier signal level
LOCK RANGE (control)	R26	OSCILLATOR TUNE position is selected for preliminary control adjustment to allow for phase locking with a small lock range OPERATE position is selected for phase lock operation to allow for a large lock range.
FINE TUNE (control)	R27	Used to make relatively minor adjustments to the reference oscillator frequency
COARSE TUNE (control)	R30	Used to make normal adjustments to the reference oscillator frequency
OSCILLATOR SENSITIVITY (Switch) (9 positions plus OFF)	S1	Used to select the correct modulation sensitivity to correspond to the oscillator being synchronized. OFF position used in calibration - breaking the helix loop
PRESELECTOR DEPRESS TO TUNE (Switch)	S2	Enables an FM'd 5MHz oscillator in the Xtal VCO box to provide continuous spectrum overlap when making initial tuning adjustments at P band frequencies
PRESELECTOR TUNE (Control)		Tunes the P band resonant cavity for a peak reading on the SIGNAL LEVEL meter during initial P band phase lock adjustment
CRYSTAL SELECTOR (Control)		Selects any of the 16 crystals in the Xtal VCO box during phase lock turning adjustments

4.2. CONNECTORS

Table 4-2 provides information about the connectors on the Model 243C.

TABLE 4-2. CONNECTORS

Name	Symbol	Function
LINE FUSE (3A)	F1	Maximum current protective device for primary power (117VAC) to unit.
OVEN FUSE (2A)	F2	Maximum current protective device for Crystal VCO Box oven secondary power (36VAC).
5MC REFERENCE INPUT	J4	Reference input to multiplier chain normally connected to 5MC INTERNAL REFERENCE captive cable (P/J14).
5MC REFERENCE OUTPUT	J6	5MC reference monitoring point from the front end of the multiplier chain.
500MC-18GC (lower row center connector)	J7	200 MHz/100 MHz input to varactor harmonic generator (CR5) and mixer Z1 harmonic 'comb' input. Connected to captive cable J15, 200 MHz output, during 500 MHz - 18 GHz operation.
18GC-40GC	J8	200 MHz:100 MHz input to net work box (C23 and C24) and varactor harmonic generator CR7. Connected to captive cable J15, 200MC output, during 18 GHz-40 GHz operation.
500MC-18GC (IF input section)	J10	Mixer Z1 25 MHz output, connected to captive cable (J17) IF INPUT (Pre Amp) during normal 500 MHz - 18 GHz operation.
500MC-18GC (RF input section)	J11	A dummy connector used to hold captive cable (J16) RF INPUT, 18 GC-40 GC during normal 500MC-18GC operation.
RF INPUT, 500MC-1GC	J12	Connection for the external RF Oscillator input to the synchronizer during normal 500 MHz - 1 GHz operation.
500MC-lGC (RF input section 500MC-18GC)	J13	This is the preselector (P Band Cavity) output and is connected to J18 (RF INPUT, 500MC-18GC) during normal 500 MHz-lGHz operation.
5MC INTERNAL REFERENCE	*J14	Crystal Oscillator output signal, this is a captive cable output which is normally connected to J4 (5MC REFERENCE INPUT).
18GC-40GC 500MC-18GC	*J15	200 MHz/100 Hz output from multiplier chain, this captive cable is connected to either J7, for 500 MHz-18 GHz operation, or to J8, for 18 GHz-40 GHz.
18GC-40GC (RF Input section)	*J16	This is the Output of the varactor harmonic generator (CR7), this captive cable is normally connected to J11 (for 500 MHz-18 GHz operation) or to an external mixer reference oscillator input port (for 18 GHz-40 GHz).
IF INPUT	*J17	This captive cable is the 25 MHz IF (Pre Amplifier) input. It is normally connected to J10 (for 500 MHz-18 GHz) or to 18 GHz-40 GHz external mixer IF output port.
RF INPUT, 500MC-18GC	J18	RF input to mixer Z1, connector is normally connected to J13 for 500 MHz-1 GHz operation or directly to the external RF oscillator for 1 GHz-18 GHz operation.
SYSTEM POWER CONTROL	J20	To supply primary power, oven power, and all input/output system control functions.
	*	Captive cable to front panel

4.3. OPERATION WITH 500 MHz to 1 GHz RF HEAD

4.3.1. Preliminary connections and control adjustments are given in the following sequential steps:

a. Jumper J13 to J18, P/J14 to J4.

b. Connect an RF cable between 500 MHz - 1 GHz RF input jack J12 and the RF connector on the RF head.

c. Connect the lower cable marked 500 MHz - 18 GHz/18 GHz - 40 GHz jack J15/p2 to the 500 MHz - 18 GHz connector jack J7.

d. Set the LOCK RANGE control to OSCILLATOR TUNE.

e. Set the SIGNAL LEVEL control to maximum c.w.

f. Adjust the Frequency of the RF oscillator (RF Head) to that desired.

g. Set OSCILLATOR SENSITIVITY switch to 4 - 8 MHz/v position.

4.3.2. Phase lock procedure for operation with 500 MHz to 1 GHz RF head is given in the following sequential steps:

a. Depress the PRESELECTOR DEPRESS TO TUNE control and while depressed, adjust the PRESELECTOR TUNE control either cw or ccw until an upscale indication is achieved on the LEVEL Meter. A cw rotation will lower frequency, a ccw will raise the preselector frequency. Peak the reading with PRESELECTOR TUNE control using the SIGNAL LEVEL control if necessary, if LEVEL indication goes offscale.

b. Release PRESELECTOR DEPRESS TO TUNE.

c. Adjust the CRYSTAL SELECTOR switch to a position which gives the highest reading on the signal level meter. Then adjust the COARSE and FINE TUNE controls for a peak indication on the SIGNAL LEVEL meter.

d. Set LOCK RANGE control to OPERATE. The PHASE (50 ua) meter should not move more than 5 ua during the lock-on procedure.

e. To adjust the BWO frequency to 1 part in 10^7 of a given frequency, rotate the COARSE TUNE and FINE TUNE controls clockwise or counter clockwise until the desired frequency is reached on an external indicator. If it becomes necessary to change the CRYSTAL SELECTOR control to another position to reach the desired frequency, first adjust the RF oscillator (RF Head) more closely to the desired frequency using an external indicator, and relock as before.

f. Repeak the PRESELECTOR TUNE for maximum SIGNAL LEVEL indication. (Only a slight readjustment is required.)

4.4. OPERATION WITH THE 1GHz to 18 GHz RF HEADS

4.4.1. Preliminary connections and control adjustments are given in the following sequential steps:

a. Jumper J14 to J4, J17 to J20.

b. Connect an RF cable between RF input jack J18, 1 GHz - 18 GHz, and the RF connector on the RF head, removing the jumper cable between 1 GHz - 18 GHz/500 MHz - 1 GHz. (J13)

c. Connect the lower cable marked 500 MHz - 18 GHz/18 GHz - 40 GHz jack J15/p to the 500 MHz - 18 GHz connector jack J7.

d. Set the LOCK RANGE control to OSCILLATOR TUNE.

e. Set the SIGNAL LEVEL control to maximum c.w.

f. Adjust the Frequency of the RF oscillator (RF Head) to that desired.

g. Set the OSCILLATOR SENSITIVITY switch in accordance with the nominal positions given depending upon the operating frequency band:

Frequency Range	OSCILLATOR SENSITIVITY Switch Setting Nominal *
1-2 GHz	1-2 MHz/v
2-4 GHz	1-2 MHz/v
4-5 GHz	16-38 MHz/v
5-8 GHz	8-16 MHz/v
8-10.5 GHz	8-16 MHz/v
10.5-12.4 GHz	4-8 MHz/v
12.4-15 GHz	16-38 MHz/v
15-18 GHz	8-16 MHz/v

* For certain BWO's contiguous positions to the nominal are permitted for stable operation.

4.4.2. Phase lock procedure for operation with the 1 GHz to 18 GHz RF heads is given in the following sequential steps:

a. Adjust the CRYSTAL SELECTOR switch until a peak reading is indicated on the SIGNAL LEVEL meter. Adjust the REFERENCE OSCILLATOR COARSE TUNE and the FINE

TUNE until a peak indication on the SIGNAL LEVEL meter is achieved.

b. Set LOCK RANGE control to OPERATE. The PHASE meter should move no more than 5 ua.

c. To adjust the BWO frequency to 1 part in 10^7 of a given frequency, rotate the COARSE and FINE TUNE controls clockwise or counter clockwise until the desired frequency is reached on an external indicator.

4.5. OPERATION WITH 18 GHz to 40 GHz RF HEADS

4.5.1. Preliminary connection and control adjustments are given in the following sequential steps:

a. Connect the captive RF cable between 18 - 40 GHz RF connector jack J16 and the RF connector on the RF head.

b. Connect the IF captive cable between 18 - 40 GHz IF connector jack J17 and the IF connector on the RF head.

c. Connect the lower captive cable marked 500 MHz-18 GHz/18 GHz - 40 GHz jack J15 to the 18 GHz - 40 GHz connector jack J8.

d. Set the LOCK RANGE control to OSCILLATOR TUNE.

e. Set the SIGNAL LEVEL control to maximum c.w.

f. Adjust the frequency of the RF oscillator (RF head) to that desired.

g. Set the OSCILLATOR SENSITIVITY switch in accordance with the positions given depending upon the operating frequency band.

OSCILLATOR SENSITIVITY

Frequency Range	Switch Setting Nominal *
18-21 GHz	16-38 MHz/v
21-26.5 GHz	8-16 MHz/v
26.5-36 GHz	16-38 MHz/v
36-40 GHz	8-16 MHz/v

*For certain BWO's contiguous positions to the nominal are permitted for stable operation.

4.5.2. Phase lock procedure for operation with the 18 GHz to 40 GHz RF heads is given in the following sequential steps:

a. Adjust the CRYSTAL SELECTOR switch until a peak reading is indicated on the SIGNAL LEVEL meter. Adjust the REFERENCE OSCILLATOR COARSE TUNE and FINE TUNE until a peak indication on the SIGNAL LEVEL meter is achieved.

b. Set LOCK RANGE control to OPERATE. The PHASE meter should not move more than 5 ua.

c. To adjust the BWO frequency to 1 part in 107 of a given frequency, rotate the COARSE TUNE and FINE TUNE controls clockwise or counter clockwise until the desired frequency is reached on an external indicator.

4.6. OPERATOR'S MAINTENANCE

Certain periodic adjustments will maintain the Phase Lock Synchronizer in peak operation conditions. These adjustments are normally made during the normal calibration interval, or when it is desired to determine if the unit is operating correctly.

4.6.1. PHASE METER ZERO ADJUSTMENT

a. Do not insert any signal into the Synchronizer. Helix High Voltage should be switched off.

b. Allow the unit to warm up for 10 minutes minimum.

c. Set the SIGNAL LEVEL control to maximum ccw.

d. Set the LOCK RANGE control to maximum c.w.

e. The phase meter should indicate 0 ± 10 ua. If the phase meter reads outside this range, readjust the phase meter to zero by means of the recessed potentiometer on the back of the IF chassis (R-29).

4.6.2 IF SENSITIVITY CHECK OR TEST

a. Connect a Model 80 signal generator via a 20 db pad and 50 ohm cable to the IF input marked IF input 18-40GC (cable right hand top corner. See Fig. 1-1). Adjust signal generator to 25 MHz and output for 200 u volts. At these settings IF level meter should read at least 30 u amps.

CAUTION

Proper phase lock performance at Ka Band depends upon having sufficient IF Bandwidth. If phase locking is erratic alignment procedures in Section 6 should be followed to determine if the IF Bandwidth is correct. A quick method to check if IF Bandwidth is correct is as follows:

Connect and adjust Model 80 as in paragraph 4.6.2 above. Attenuate level of signal generator until level meter reads 20 u amp. Swing frequency of generator either side of 25 MHz until level meter just goes to zero. The difference between these readings should give you bandwidth and will be approximately 4 MHz.

4.6.3 LUBRICATION INSTRUCTIONS

The crystal switch requires periodic lubrication to keep the crystal selection mechanism free and smooth. Lubrication should be accomplished every six months as follows:

a. Remove the top cover of the VCO box.
b. Remove the fiberglass packing from around the top of the oven unit exposing the top cover of the oven unit.
c. Remove the five top cover screws and one on the side just over the switch shaft to remove the oven cover.
d. Spray TUN-O-LUBE (manufactured by Chem-tronics, Inc., Brooklyn, New York (or equivalent into the switch detent mechanism, rotating the tuning mechanism until the switch runs free.
e. Reassemble the VCO box by reversing the disassembly procedure.

4.6.4 F.M. OSCILLATOR TEST

Poor performance at 500 MHz - 1 GHz may be due to misalignment of the "DEPRESS TO TUNE" Oscillator*

* See paragraph 6.4 for proper alignment.

4.6.5 LEAKAGE TEST

NOTE: For all tests set the LOCK RANGE control to maximum c.w.

a. IF Leakage

Disconnect the IF cable and rotate the SIGNAL LEVEL control from minimum to maximum, noting the PHASE meter swing. This phase meter swing should not exceed a total of 20 ua. If leakage exceeds this value, check all shields for mechanical grounds (in the IF chassis) and check all screws on the IF chassis for tightness.

b. RF LEAKAGE

With the Synchronizer connected to the KA band RF Head and level pot turned full c.c.w., rotate lock range full c.w. and note the phase meter swing. It should not exceed a total of 50 ua. If leakage exceeds this value check to see if all screws on the Multiplier Chassis are tight. Recheck all alignments of the Multiplier to be sure that all test points are peaked with 5.0 MHz into the multiplier chain.

c. P Band Leakage

If P Band leakage shows an on scale level reading with the power supply high voltage turned off, readjust the 20 MHz traps per paragraph 6.1.2b for a minimum indication.

SECTION 5

THEORY OF OPERATION

5.1. FUNCTIONAL OPERATION

(Refer to main block diagram - Figure 2-1.)

The Model 243C is fundamentally a very stable microwave superhetrodyne receiver terminated in an I.F. phase comparator. This receiver may be used to phase lock a microwave oscillator at any frequency between 0.5 GHz and 40 GHz (continuously tunable). Microwave energy from a microwave oscillator fed to the receiver mixer heterodynes with a microwave signal from the receiver local oscillator. The local oscillator generates a frequency spectrum of signals spaced 100 MHz or 20 MHz apart from 1 GHz to beyond 18 GHz. Added harmonic generators and preselector permit extended coverage of this basic unit from 0.5 GHz to 40 GHz, using plug-in RF heads. When the input microwave frequency is 25 MHz above or below one of the local-oscillator frequencies, the resultant difference signal is amplified in a high-gain 25 MHz amplifier. This signal is compared in a phase detector to a stable coherent 25 MHz reference signal, whereupon phase lock takes place. The resultant DC error signal is fed to the voltage tunable element of the microwave oscillator, maintaining phase lock. The oscillator frequency is given by the following formula.

F Microwave Oscillator = $nF_{rf} + F_{if}$
where
F_{rf} = RF Reference Frequency
F_{if} = IF Reference
n = some integral multiplication factor from 10 to 150.

Conditions necessary for satisfying the phase lock condition are as follows:

The IF frequency (RF frequency heterodyned to IF) must be within the capture range of the system. Once phase locked the system will stay locked, providing the system does not drift outside the lock range. The lock range is determined by the maximum output of the phase detector and the oscillator voltage tuning sensitivity. After phase coherence has been established, the phase detector can have a maximum swing of ± 90° about a 90° center operating point. This maximum swing is all that is available to correct oscillator drift and thus the maximum lock range is given by $2K_1K_2$ where K_1 is the phase detector maximum swing for a 90° change and K_2 is the oscillator sensitivity. For a phase detector swing of ± 25V and an oscillator sensitivity of 1 MHz/v the lock range is 50 MHz.

The capture range is always equal to or smaller than the lock range, and is determined by the bandwidth of the IF amplifier and the phase-lag networks. Typically, the capture range is less than 1 MHz. To make the capture range correspond approximately to the lock range, a sweep signal is superimposed upon the reflector lead, (in the case of a klystron) causing the frequency of the klystron to sweep plus and minus about its nominal operating frequency. This has the effect of an apparent increase in capture range, for now the system can capture as soon as it is within the frequency range being swept. This makes the acquisition of phase lock less critical and, once phase locked, if the system unlocks for some reason, the sweep will automatically re-establish phase lock.

5.2. DETAILED DESCRIPTIONS

5.2.1. MASTER OSCILLATOR

The local oscillator of the phase lock receiver originates from variable frequency stable crystal oscillator, using 16 crystals, and electrically arranged such that coverage at 5 MHz nominal is 1% total (50 KHz total). Through the use of oven temperature control and transistorized circuitry a very low order of FM residual and drift is obtained.

5.2.2. MULTIPLIER CHAIN

Figure 5-1 shows the sequence of frequency multiplication and is self-explanatory. The three basis reference signals out of the multiplier chain are:

a. 200 MHz signal with a superimposed 100 MHz signal.
b. A coherent 25 MHz IF reference gate.
c. An optional 20 MHz sideband signal.

Double tuned networks are used throughout to maintain a high level of spurious signal rejection. A trap in the 100 MHz stage to reject 50 MHz leakage signals is included to provide added rejection of undesired signals.

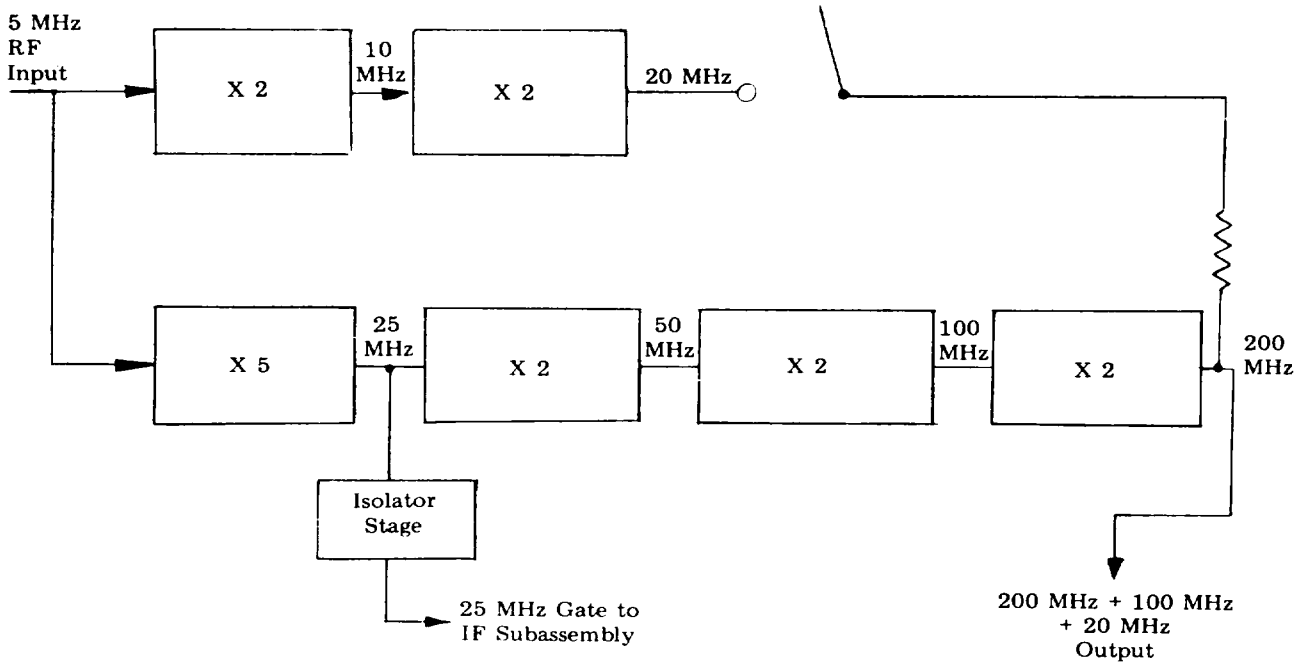


Figure 5-1. Block Diagram, Frequency Multiplier

5.2.3. HARMONIC MIXER Z1

The harmonic mixer consists of a broadband single-ended mixer and a varactor harmonic generator (CR5). The 200 MHz energy is multiplied by the varactor to produce sidebands, 200 MHz apart, from 1GHz to 18Grlz. At the same time, the 100 MHz energy is coupled to the varactor at such a level that a mixing action takes place, with the final result being a spectrum of sidebands 100 MHz apart from 1 GHz to above 18.0 GHz. In this manner, extremely efficient multiplication is achieved, with resulting high system sensitivity. Through the use of a tripolar mixer diode (1N358A) in the mixer, phase lock can be achieved at frequencies above 18 GHz.

5.2.4. IF AMPLIFIER

Tile IF Amplifier is a 5 stage amplifier with a limiter output and a transistorized pre-amplifier front end. The gain is approximately 100 db, bandwidth 3.5 MHz. The limiter functions to remove amplitude - modulation components which could result in residual frequency modulation. The IF amplifier has a cathode bias control to achieve an approximate 60 db gain control. Three traps tuned at 20 MHz are included to reject 20 MHz leakage due to the 20 MHz multiplier sideband signal.

5.2.5. PHASE COMPARATOR

The phase comparator, located at the output of the IF amplifier, is a 6BN6-type gated beam tube acting as a limiter and phase comparator. This configuration gives an extra-wide lock range (± 40V) and hard limiting, both of which are designed to assure that the system remains locked under transient variations.

The 6BN6 operates as a phase detector in the following manner. Applied to the grids are 25 MHz sine waves each of which turns the tube on and off during each cycle of the sine wave. If the sine waves are in phase, both grids are gated on and off at the same time, resulting in a maximum current flow through the tube. If

the sine waves are out of phase, first one signal gates the tube off and then the other, resulting in a minimum current flow. At a 90° phase difference, only a portion of the current is gated off, and this results in a median operating point. In this manner, the phase detector acts as a cosine detector, with the DC output voltage proportional to phase angle.

The supply voltages for the phase detector plate are as high as 2.5 Kv and supply the B+ voltage for the phase detector tube. The phase meter monitors a DC output voltage of the phase detector about the nominal operating voltage of 150V, referred to the cathode of the 6BN6 phase detector. A front panel potentiometer, the LOCK RANGE, is connected between the plate of the phase detector and the reference voltage, changing the gain of the phase detector. This control allows the output control range to be smoothly varied from zero to ± 40 volts.

5.2.6. CURRENT DRIVER

The output of the phase detector is applied to a cathode follower. The combination of the cathode follower and the floating power supply can pass up to 25 ma to the oscillator load without the output error voltage changing more than ± 2-1/2 volts.

5.2.7. SEARCH OSCILLATOR

The 'SEARCH OSCILLATOR' will sweep the KLYSTRON to within the 'capture' range, whereupon phase locking will take place. Once phase lock is obtained, the search oscillator will automatically turn off.

By a proper choice of circuit time constants in the last two IF stages, namely the limiter and the phase detector, it is possible to obtain at 1 KHz a gain of approximately 26 db. Through the use of a Wien-bridge feedback configuration, sustained oscillations are generated (at about 1 KHz). This bridge oscillator is an amplifier having a differential input, with the output fed back to the input through a bridge circuit. The function of the bridge circuit is to allow generation at only one frequency, all other frequencies being degenerated. If the gain of the amplifier is in excess of that required to sustain oscillations, the circuit will produce relaxation oscillations. This type of signal will appear at the plate of the phase detector as a sawtooth because of the integrating action of the RC stabilizing phase lag network present at this point. This sawtooth (approximately 1 KHz) will vary in amplitude, depending on the sensitivity switch position selected for the particular klystron, anywhere from 20 volts peak-to-peak to over 100 volts peak-to-peak. This means that, when this signal is used to sweep a klystron, the sweeping frequency range obtained will be substantially independent of the klystron sensitivity.

This signal, when applied to the reflector of the klystron, will sweep the klystron through a frequency range until within the capture range of the synchronizer. At that time an IF signal will reach grid No. 1 of the IF limiter tube. This tube will then be biased to cutoff (low audio gain). Not having enough low-frequency gain, the search oscillator will stop functioning.

5.2.8. PHASE LOCK AT 1 GHz - 18 GHz AND 18 GHz - 40 GHz

The basic theory of phase locking operation from 18GHz - 40GHz remains the same as from 1GHz to 18GHz. The primary difference lies in the method of obtaining sufficient harmonic signal power to obtain an adequate signal to noise ratio at such high frequencies.

Referring to Figure 2-1, the block diagram remains the same except that the MIXER Z1 is replaced by an external K-Band HARMONIC MIXER. (This mixer is physically mounted by waveguide in the RF Head.) The 200MHz/100MHz signals are connected, via captive cable, to (J8) the network box and varactor harmonic generator CR7. Then these harmonics of the 100 and 200 MHz signals, ranging as high as 18GHz are coupled to the external K Band Harmonic Mixer whereupon additional harmonic generation takes place in the mixer diode. In this manner harmonics are generated in 100MHz increments from 18 to 26.5 GHz and 26.5 to 40 GHz depending upon the RF Head being used.

The sampled K-Band RF input is compared with the K Band harmonic in the same mixer diode resulting in an IF signal at approximately 25 MHz. This IF signal is coupled back to the synchronizer via an IF cable, thus completing the block diagram as shown in Figure 2-1. The rest of the operation at K Band remains exactly the same as that at lower frequencies.

5.2.9. PHASE LOCK BELOW 1 GHz (500 MHz - 1 GHz)

In order to achieve continuous tunability at frequencies below 1 GHz the lower frequency sampled

signal is multiplied up to the 1 to 2 GHz range before being applied to the mixer input. In order to prevent excessive spurious signals this multiplied signal is filtered or 'selected' by a resonant circuit (a microwave cavity) to restore a near sinusoidal signal. This signal, now somewhere between 1 and 2 GHz, is mixed with 20 MHz crystal harmonic spectrum as in the normal operation, producing a 25 MHz IF signal. The phase error is returned to the lower frequency oscillator as before, causing the oscillator to lock to the crystal harmonic.

Unfortunately, the need for the tunable filter to restore the sinusoidal signal requires that three frequency settings be made together in order to lock the oscillator. In order to make the tuning procedure simpler another circuit is added to the Synchronizer.

In the PRESELECTOR TUNE position, the crystal oscillator is mixed with a frequency modulated 5 MHz oscillator, adjusted to FM sufficiently wide so as to provide continuous spectrum overlap. In this mode of operation any frequency applied to the mixer input will produce an IF signal at some time. Threfore the resonant frequency of the PRESELECTOR may be adjusted to 'peak' the harmonic output in the 1 - 2 GHz frequency band. Releasing the PRESELECTOR DEPRESS TO TUNE switch returns the oscillator to the crystal position. Operation thereafter is the same as for all other frequency ranges.

SECTION 6

ALIGNMENT PROCEDURES

6.1 IF Amplifier Alignment

6.1.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT)

a. Signal Generator, H-P Model 608

b. Oscilloscope, Tektronix Type 561 with 3A6 and 3B4 plug-ins

c. Sweep Generator, Wavetek Model 2001

d. Frequency Counter, Systron Donner Model 1037M

e. Detector (Fig. 6-1) (fabricate locally)

6.1.2 TEST PROCEDURE

NOTE
Verify all signal generator frequencies with the frequency counter.

a. Gain.

(1) Connect the signal generator to T1 (Fig. 6-2) on the IF amplifier.

(2) Turn the signal level control maximum clockwise.

(3) Adjust the signal generator frequency to 23.08 MHz and the level to produce a reading of 80 microamperes on the signal level meter. Adjust L3 (Fig. 6-2) for the maximum peak on the signal level meter.

(4) Adjust the signal generator frequency to 26.9 MHz and the level to produce a reading of 80 microamperes on the signal level meter. Adjust L2 (Fig. 6-2) for the maximum peak on the signal level meter.

(5) Adjust the signal generator to 23.84 MHz and the level to produce a reading of 80 microamperes on the signal level meter. Adjust L1 (Fig. 6-2) for a maximum peak on the level meter.

(6) Adjust T1 (Fig. 6-2) to approximately 1/16 inch out. This is 25 MHz peak.

(7) Set signal generator to 25 MHz. Adjust level of signal generator to 200 microvolts. The signal level meter should read greater than 50 microamperes.

b. 20 MHz Trap's Alignment.

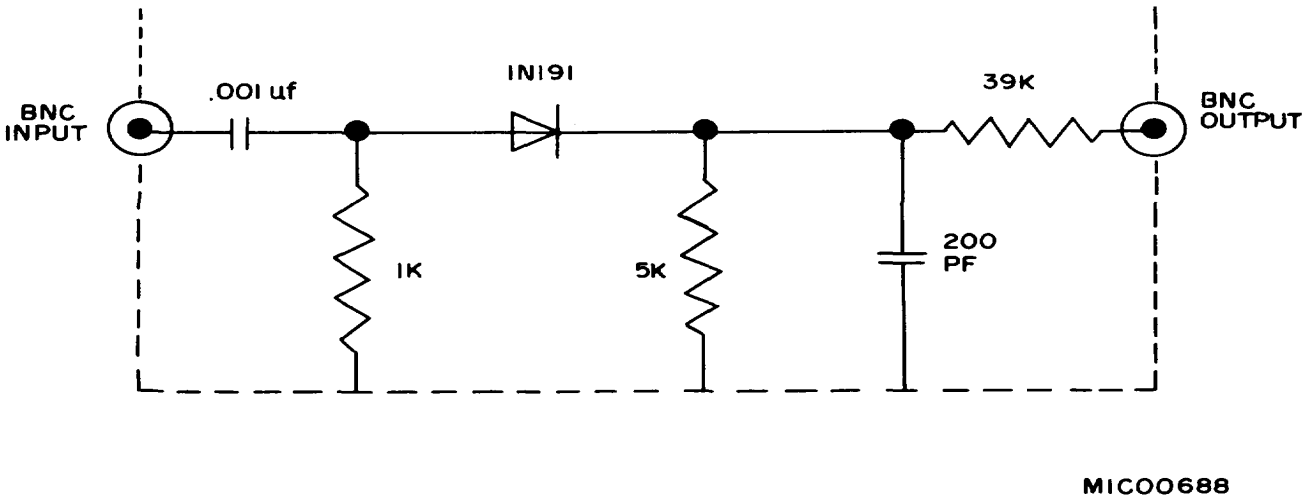


Figure 6-1. Detector box schematic.

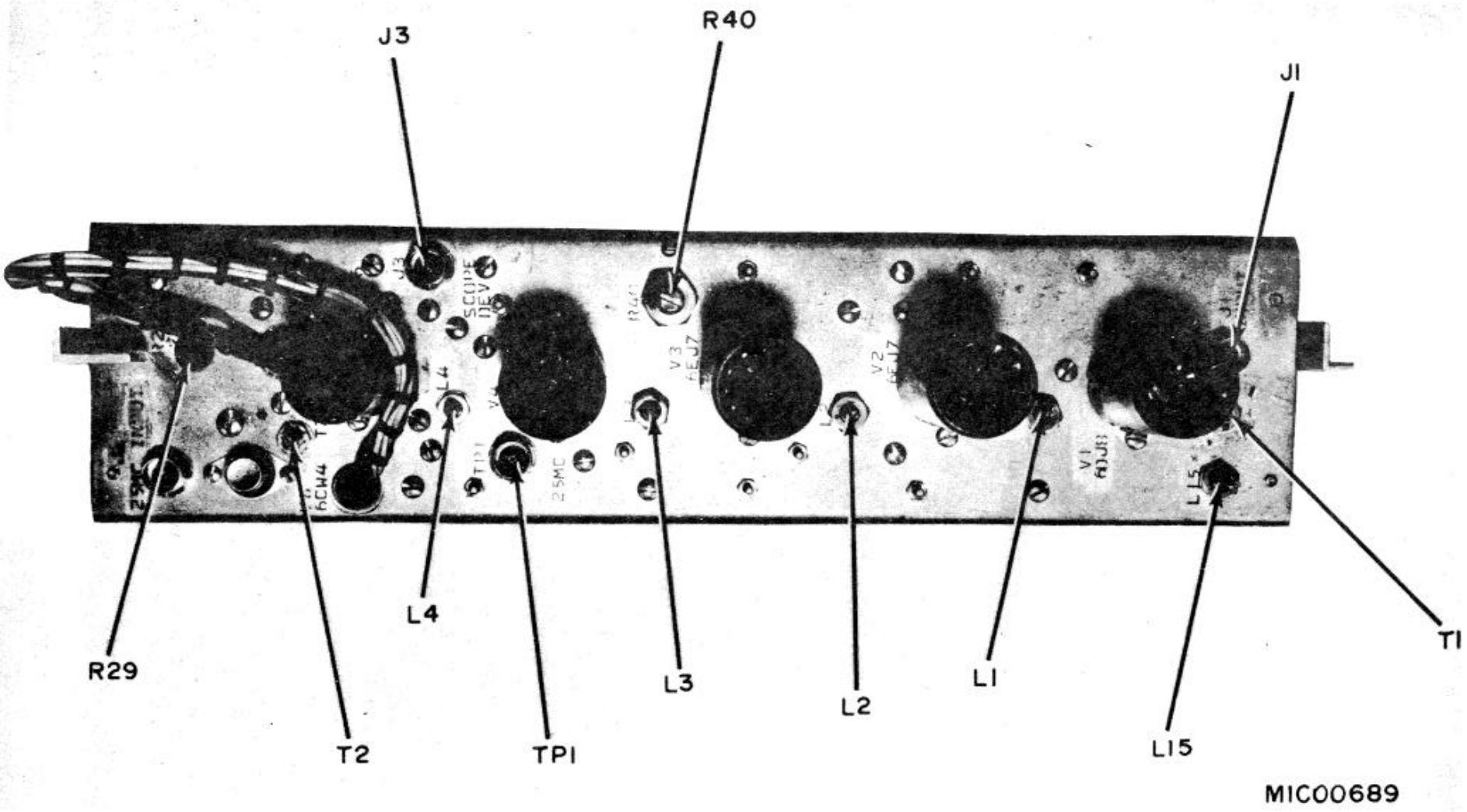


Figure 6-2. IF amplifier - top view.

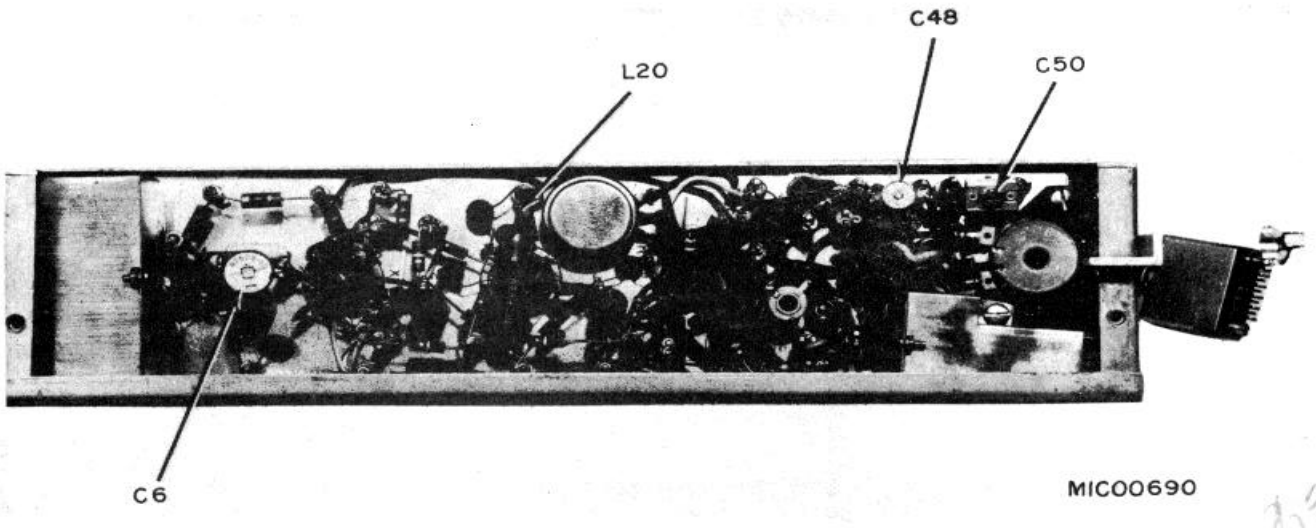


Figure 6-3. IF Amplifier - bottom view.

(1) Connect the signal generator to J1 on the IF amplifier.

(2) Set frequency on signal generator to 20 MHz with an output of 10 millivolts.

(3) Turn signal level on UUT fully clockwise.

(4) Signal level meter should indicate zero or less; if not, remove protective cover and adjust L15, (Fig. 6-2) on the top of chassis and L20 and C6 (Fig. 6-3) on the bottom, in that order.

c. Bandwidth.

(1) Set up equipment as shown in figure 6-4.

(2) Adjust sweep generator to 25 MHz center frequency with a sweep width of 10 MHz.

(3) Set attenuator on sweep generator to -70 db and turn the variable control to the level required to obtain 6 centimeters of vertical deflection with the oscilloscope set to .01 volt per centimeter vertical gain. Display should be approximately that of figure 6-5.

(4) Using the 25-MHz internal marker of the sweep generator and marker produced by the signal generator, determine the 3-db band pass points (Fig. 6-5). They should be approximately 23.5 and 26.5 MHz with a minimum and maximum bandpass of 2.8 to 3.5 MHz.

(5) If the values refered to in c above cannot be obtained, adjust L1, L2, L3, and T1 for optimum display, using 6.1.2a(3), (4), (5), and (6) above as a reference, determine which adjustment will affect the portion of the portion of the response curve that requires changing. Adjust L4 (Fig. 6-2) to center the 25-MHz marker.

(6) Repeat (5) above until conditions and values of (3) and (4) above are obtained.

d. IF Reference Alignment.

(1) Connect equipment as shown in figure 6-4, except connect the detector to J3 (Fig. 6-2) on the IF amplifier and turn lock range fully clockwise.

(2) Adjust T2 (Fig. 6-2) for maximum indication on oscilloscope.

(3) Adjust C48 and C50 to midrange (Fig. 6-3). This is maximum attenuation for 25-MHz leakage.

(4) Turn signal level control fully counter-clockwise and lock range control fully clockwise.

(5) Adjust R29 (Fig. 6-2) until phase meter indicates zero.

e. Search Oscillator.

(1) Connect equipment as shown in figure 6-6.

(2) Turn lock range control maximum clockwise and signal level control maximum counterclockwise. The amplitude of the measured voltage will be within the values listed in table 6-1 below; if not, adjust R40, figure 6-2, for best compromise.

WARNING

Be sure that High Voltage on' the BWO power supply is off.

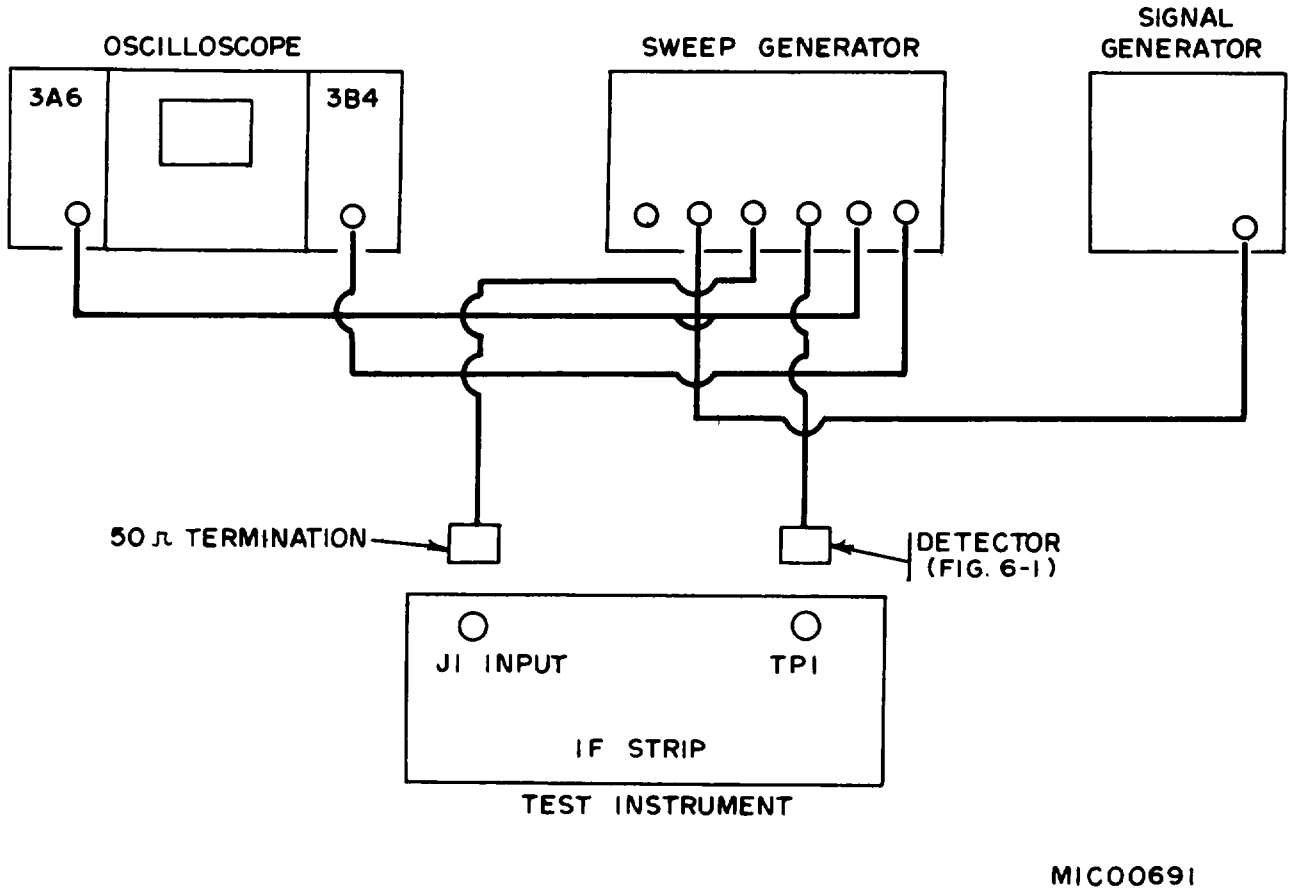


Figure 6-4. Bandwidth setup.

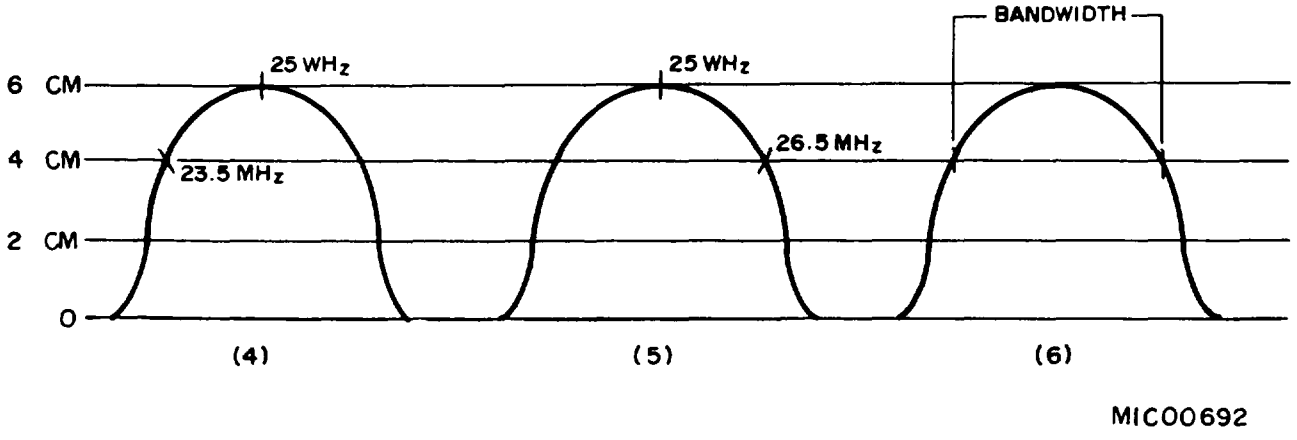


Figure 6-5. IF bandwidth display.

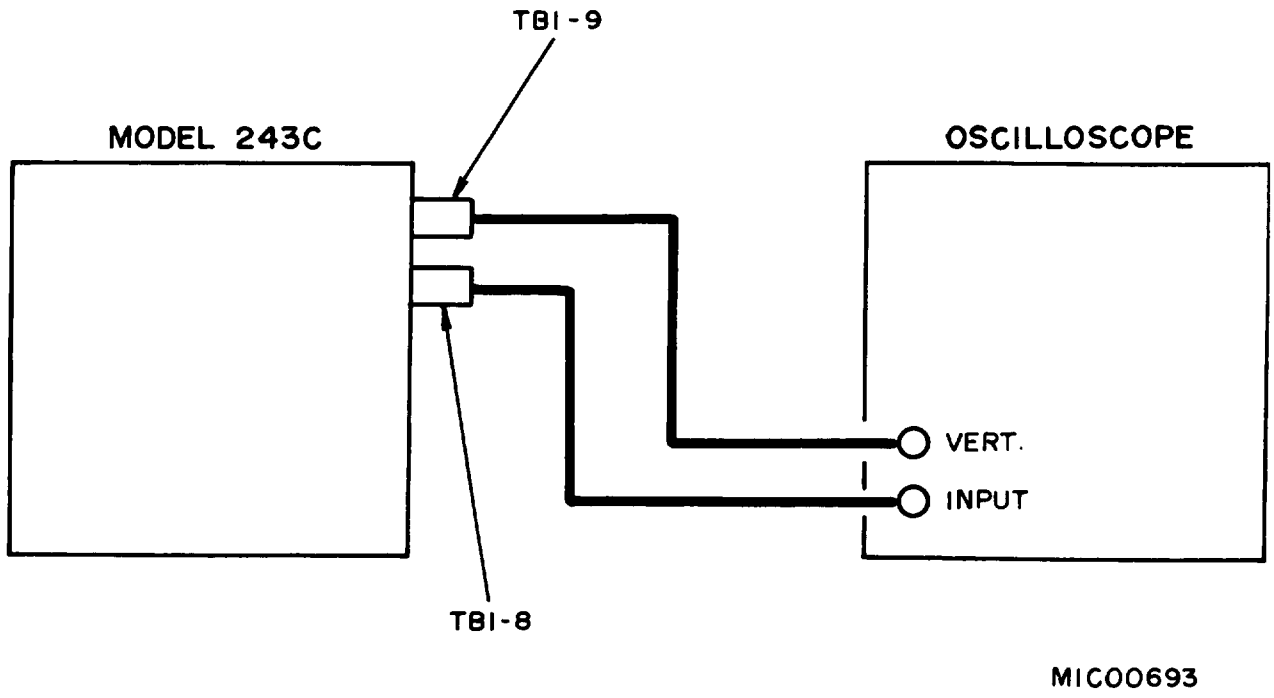


Figure 6-6. Search oscillator test setup.

Table 6-1. Search Oscillator Test Voltages

Switch Setting	Amplitude (v p-p)
0.05-0.12	125 + 30
0.12-0.25	130 ± 30
0.25-0.5	130 ± 20
0.5 -1	120 ± 20
1-2	65 ± 25
2-4	75
4-8	20

6.2 Preamplifier Gain

6.2.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT)

a. Signal generator, H-P Model 608

b. Frequency Counter, Systron Donner Model 1037M

6.2.2. TEST PROCEDURE

a. Connect the signal generator to J1 (Fig. 6-2) on the IF Amplifier.

b. Adjust frequency of signal generator to 25 MHz and output amplitude until signal level meter indicates 50 microamperes with signal level control fully clockwise. Record output attenuator setting (dbm) of signal generator.

c. Adjust output attenuator of signal generator to -100 dbm.

d. Move connection of signal generator from J1 connector to the IF INPUT cable (front panel).

e. Reconnect cable P2 to J1 INPUT connector on IF amplifier.

f. Adjust output attenuator of signal generator to 20 db lower than the value recorded in step c above.

g. Adjust R7 (Fig. 6-7) on preamplifier until signal level meter indicates 50 microamperes.

6.3 Multiplier Chain Adjustment

6.3.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT

a. VOM, Simpson Model 260

b. Frequency Counter, Systron Donner Model 1037M

c. Spectrum Analyzer, Tektronix Type 491

d. VTVM, H-P Model 410C

6.3.2 TEST PROCEDURE

a. Set VCO box for 5 MHz as indicated by the counter connected to reference out jack.

b. Connect VOM between TP2 (Fig. 6-8) and ground and adjust L2 and L3 (Fig. 6-8) for a peak reading of -1.2 volts de F.5 volt.

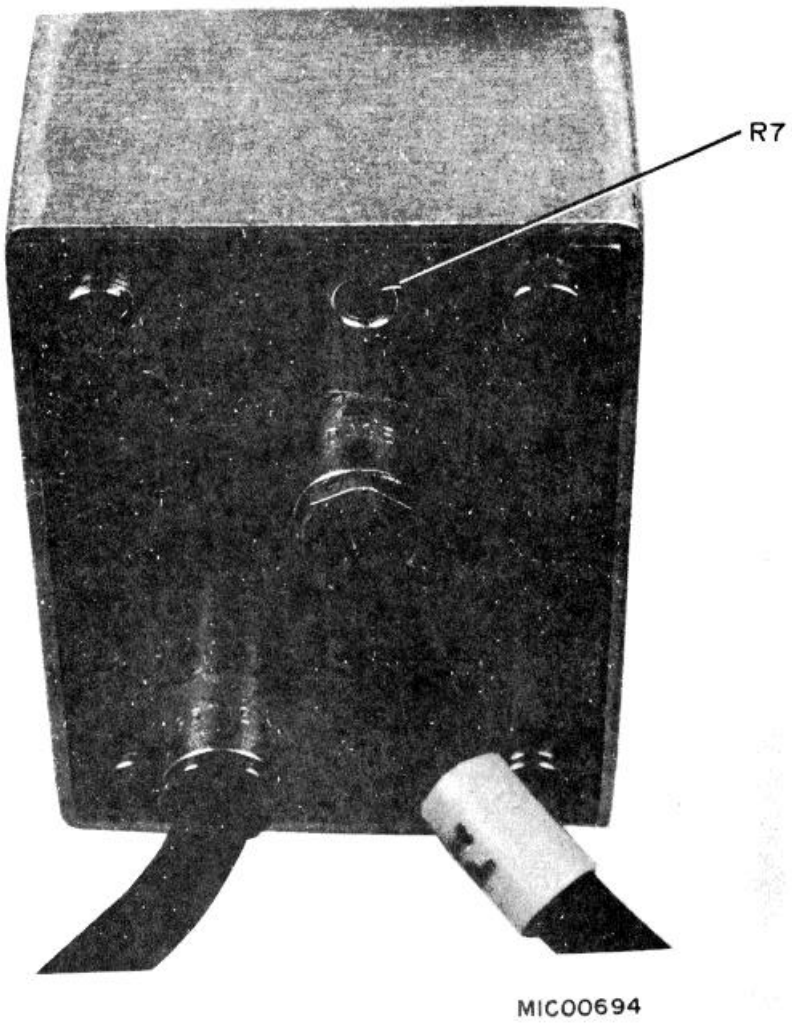


Figure 6-7. Preamplifier.

c. Disconnect P1 from J7 (Fig. 6-8) and ground J7. Connect the VOM between TP3 (Fig. 6-8) and ground. Adjust L4 and L5 (Fig. 6-8) for a peak reading of -volts dc ±1 volt. Remove ground and reconnect P1.

d. Connect 10:1 probe through a 40-db pad to spectrum analyzer. Connect probe tip and VTVM to the junction of C80, C53, and C54 (Fig. 6-9). Adjust top and bottom of T1 (Fig. 6-8) and C53 for a maximum 20-MHz display with a minimum of 2.8 volts ac, as indicated on the VTVM.

e. Connect the VOM between TP4 (Fig. 6-8) and ground. Adjust top and bottom of T2 (Fig. 6-8) until a peak is obtained of -4 volts dc ±1 volt.

f. Connect the spectrum analyzer with the 10:1 probe through the 40-db pad and the VTVM to J6 (Fig. 6-8). Adjust T4 (Fig. 6-8) for a maximum 25-MHz indication with an amplitude of 2.4 volts ac minimum as indicated on the VTVM.

g. Connect VOM between TP5 (Fig. 6-8) and ground. Adjust C37 and T3 (Fig. 6-9) for a peak indication of -7.5 volts dc +1 volt. Repeat as required due to interaction.

h. Set up synchronizer for locked L band operation (TM 9-4931-294-15-1) and connect the VOM to TP6 (Fig. 6-8). Adjust L6 and L7 (Fig. 6-8) for a peak reading of -18 to 20 volts dc on the VOM.

NOTE

To obtain this voltage, it may be necessary to loosen or tighten the coupling between L6 and L7. This is accomplished by moving the link (Fig. 6-9) on or off of L7 only (Fig. 6-9). If the link is moved, it must be reglued.

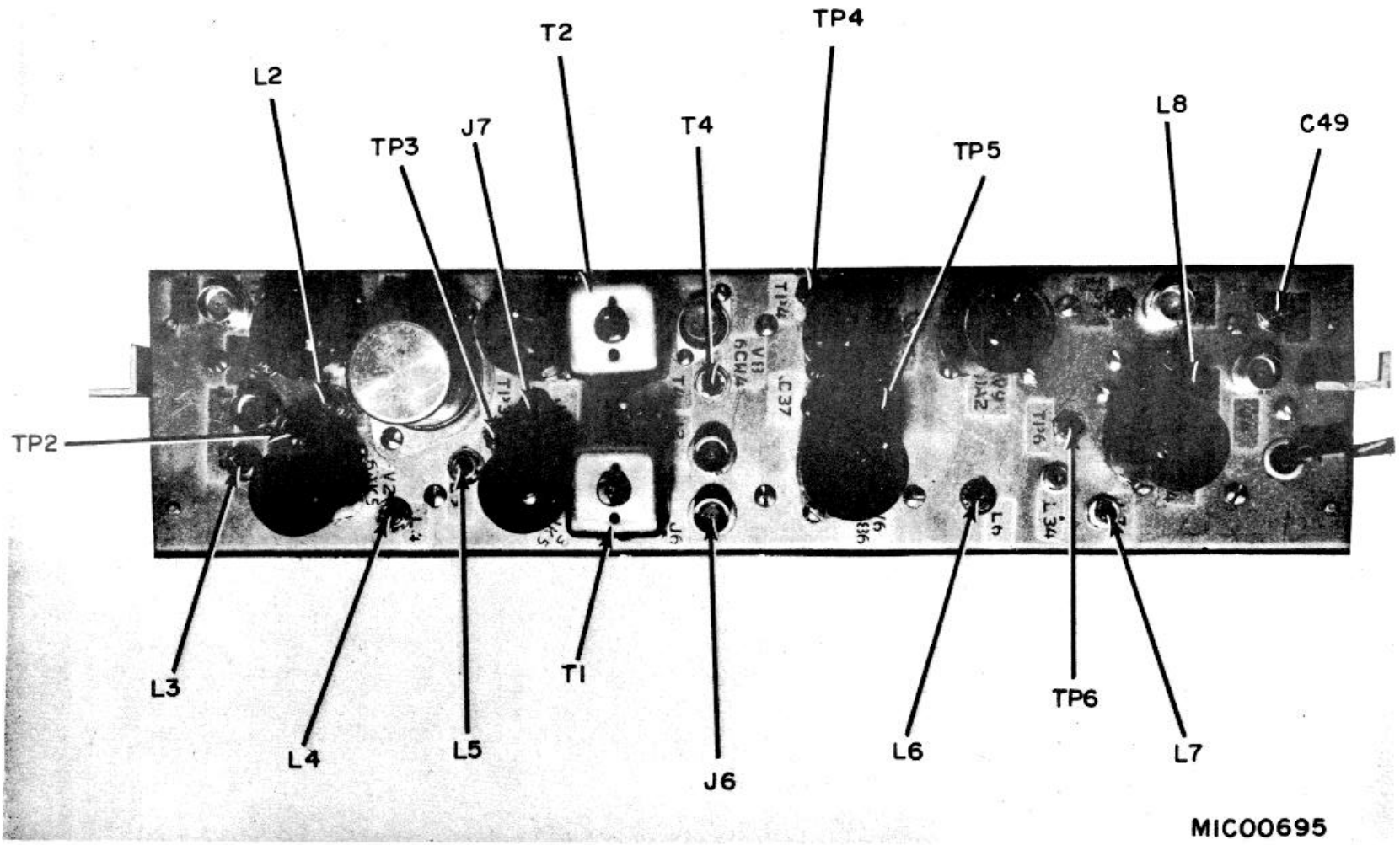


Figure 6-8. Multiplier - top view.

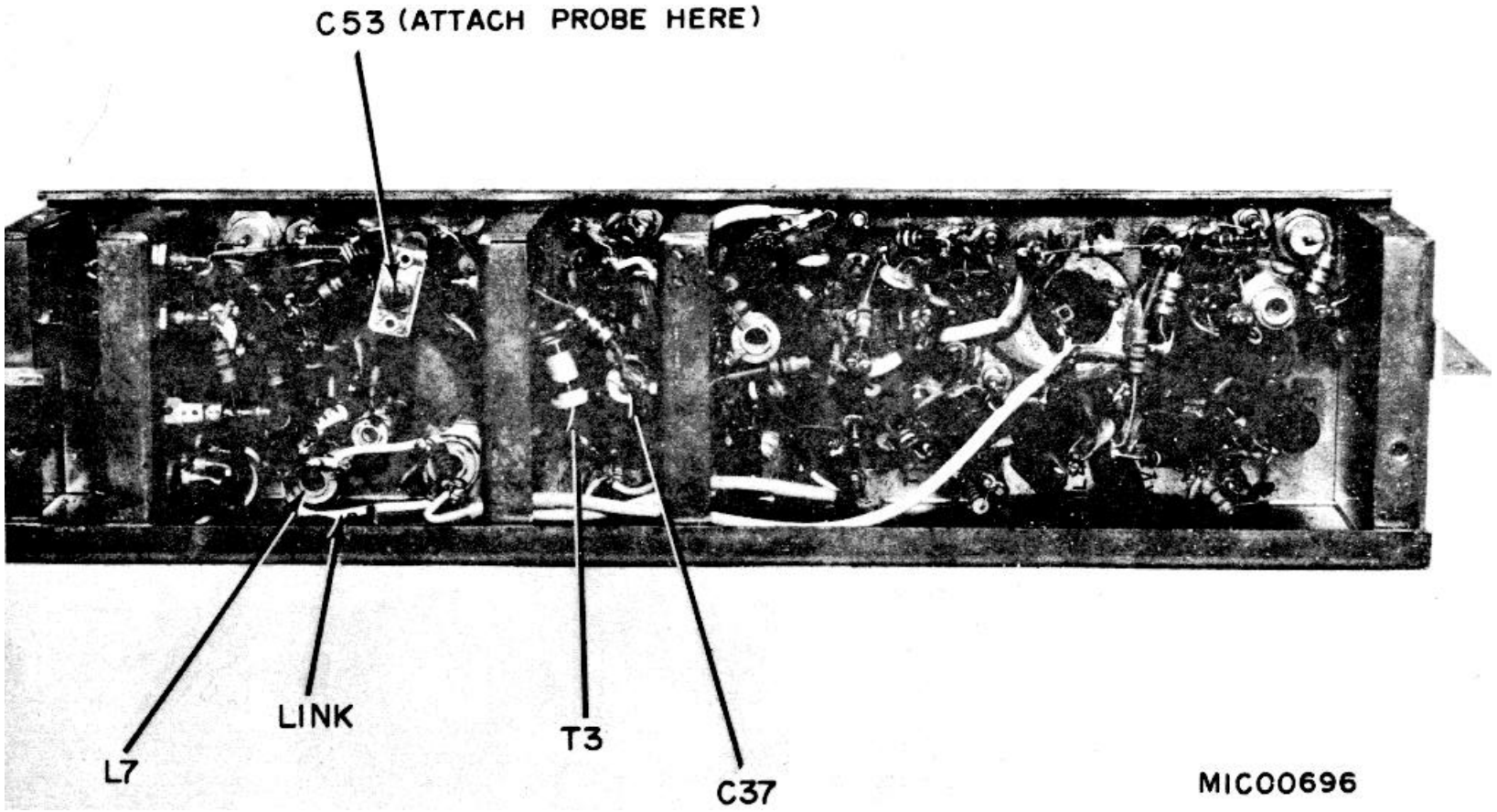


Figure 6-9. Multiplier - bottom view.

i. Set balance; balance means going to highest and lowest crystal of VCO box and maintaining same level at TP6 by adjusting L6 only.

j. Set up synchronizer for locked A band operation (TM 9-4931-294-15-1) and adjust C23 (Fig. 6-10), C49, and L8 (Fig. 6-8) for peak indication on signal level meter.

NOTE

If A and K band heads are not available, use the next highest band RF head. Proceed with j above except omit adjustment of C23.

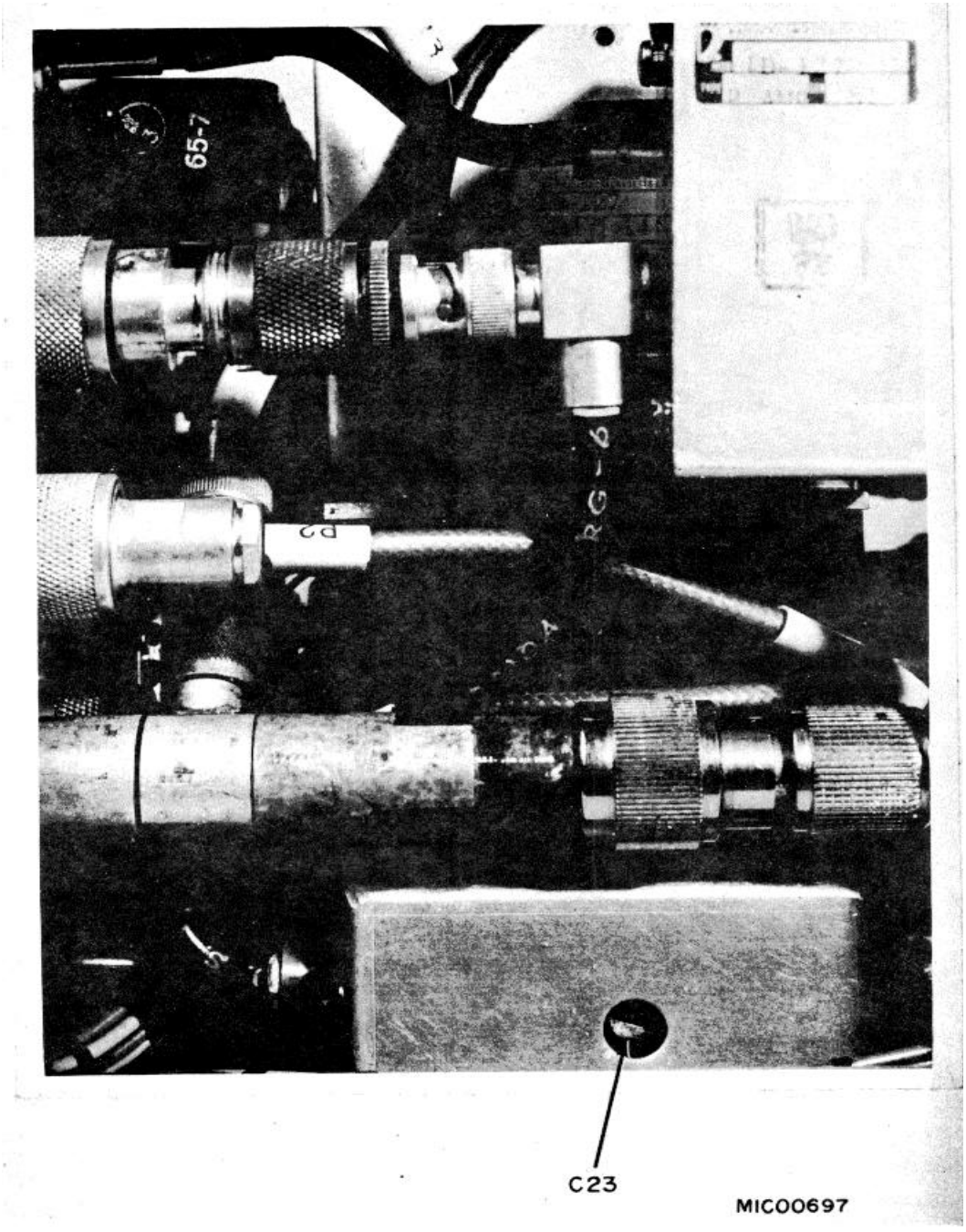


Figure 6-10. Main frame right side.

6.4 FM Alignment

6.4.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT)

a. VOM, Simpson Mode 260

b. Frequency Counter, Systron Donner Model 1037M

6.4.2 TEST PROCEDURE

a. Connect a Simpson 260 set on the 50-volt range to TP6 (Fig. 6-8) and counter to 5 MC reference output. Remove cover of VCO box and adjust R19 (Fig. 6-11) maximum counterclockwise (10 turns).

b. Tune VCO box to a point between crystals, no oscillation, zero volts at TP6.

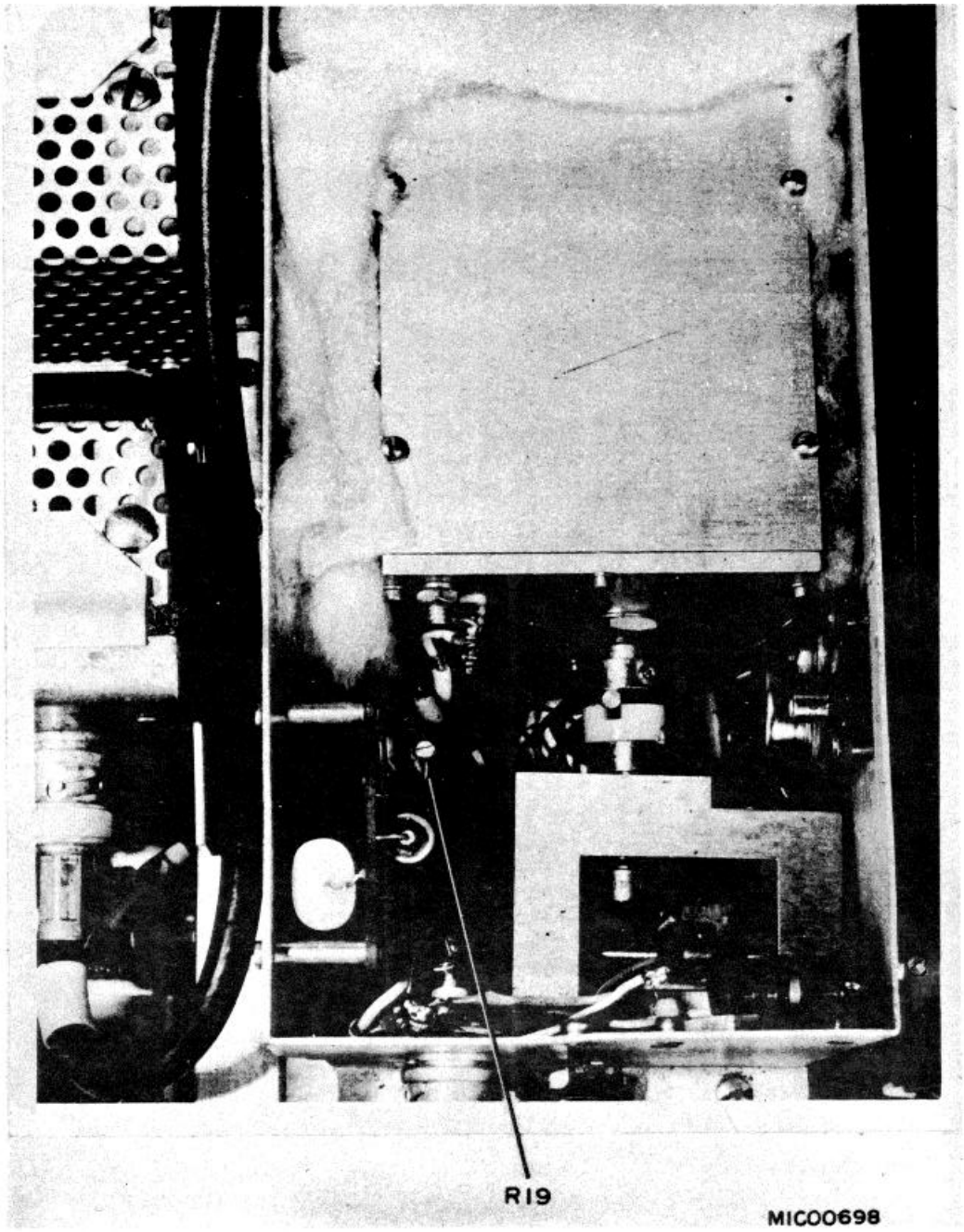


Figure 6-11. VCO box-top view.

c. Depress preselector tune switch. Adjust L9 (Fig. 6-12) for a peak indication on the VOM and with a frequency of 5 MHz. Record the voltage. Release preselector tune switch and tune VCO box to 5 MHz, using coarse and fine tune controls. Depress preselector tune switch.

NOTE

If peak obtained in c above is not within 25 kHz of 5 MHz, recheck multiplier chain alignment, paragraph 6.3 above.

d. Adjust R19 clockwise to reduce the voltage to

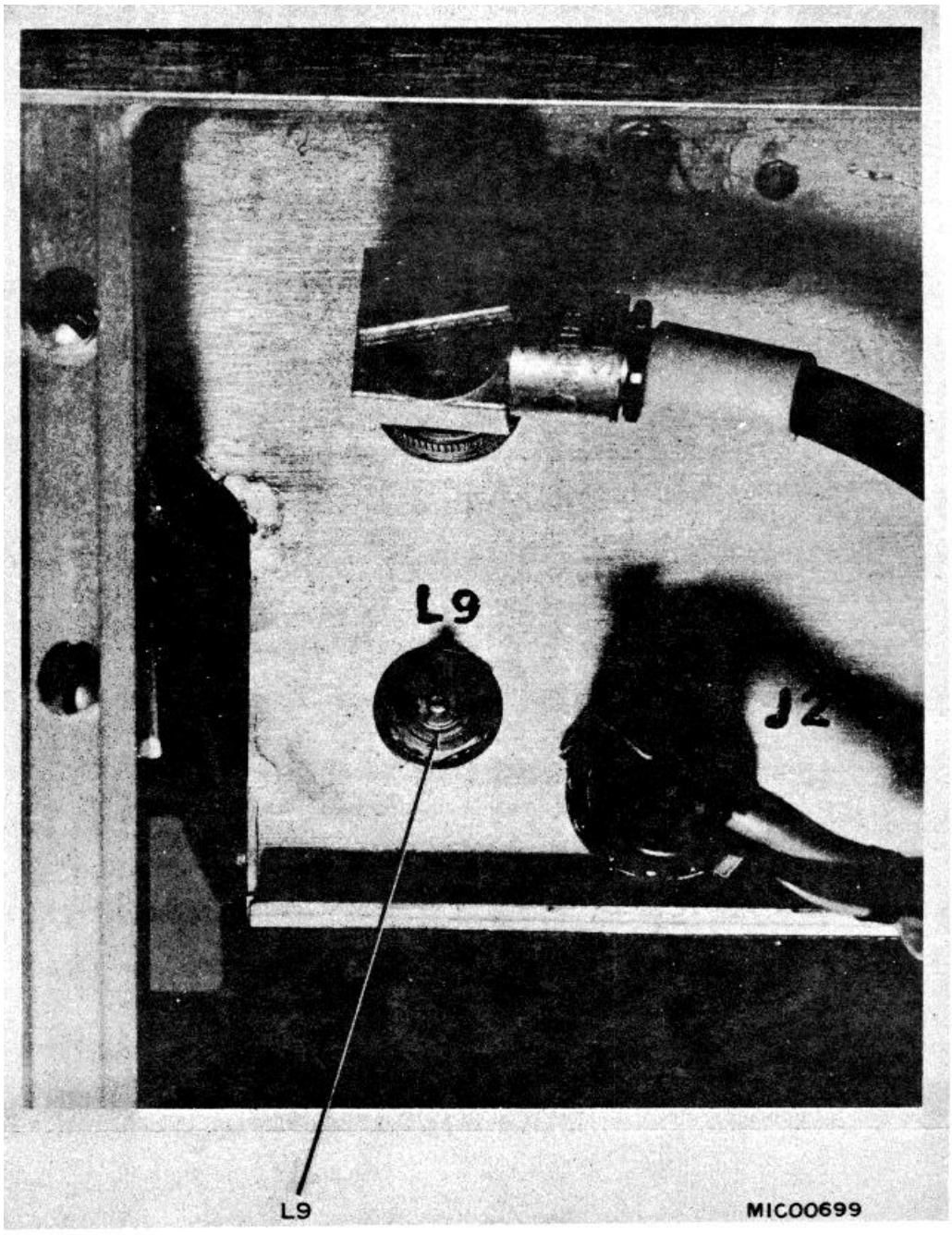


Figure 6-12. VCO box-side view.

TP6 to approximately 75 percent of the value recorded in step c above; i.e., step c = 20 volts reduced to 15 volts.

6.5 Continuous Frequency Coverage Test

6.5.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT)

Frequency Counter, Systron Donner Model 1037M.

6.5.2 TEST PROCEDURE

a. Connect frequency counter to 5 MC reference out jack.

b. Adjust the reference oscillator coarse and fine tune controls and the crystal selector switch to obtain the lowest possible frequency as recorded on the frequency counter.

c. Record lowest frequency (LF_1). Record 7 digits.

d. Tune the reference oscillator tune controls to the other end of their range. Record the frequency (HF_1).

e. Switch the crystal selector control to the next higher position. Rotate the reference oscillator tune controls fully counterclockwise. Record frequency (LF_2).

f. Compute overlap; LF_2 shall be less than HF_1.

g. Continue steps b through d above for all 16 crystals. Record highest frequency reached (F_2).

h. F_2-LF_1, shall be greater than 50.0 kHz.

6.6 Final System Test Alignment

6.6.1 TEST EQUIPMENT REQUIRED (OR EQUIVALENT)

a. Signal Generator, H-P Model 608

b. Oscilloscope, Tektronix Type 561 with 3A6 and 3B4 plug-ins.

c. Detector Box (Fig. 6-1)

6.6.2 TEST PROCEDURE

a. Set signal generator output attenuator fully counterclockwise and connect to the IF input cable.

b. Turn signal level control fully clockwise and set signal generator for a 25-MHz output with a level that will provide a 20-microampere indication on the signal level meter.

c. Connect the oscilloscope to TP1 (Fig. 6-2) 25 MHz on the IF amplifier through the detector box.

d. Measure and record the de voltage in millivolts.

e. Set up synchronizer for A. band 26.5-40 GC swept leveled operation (TM 9-4931-294-15-1).

NOTE

If A and K band heads are not available, use the next highest band RF head. Proceed with remainder of the procedure with the exception of the adjustment of C23 (Fig. 6-10).

f. Set oscilloscope to external horizontal sweep and connect external sweep to sweep out from BWO power supply.

g. Turn signal level control fully clockwise. Tune C23 in network box for optimum spectrum display (Fig. 6-13) (retrofit only).

h. Rotate VCO box through 16 positions, using coarse tune control to fill any holes in spectrum. Smallest harmonic of amplitude of spectrum display shall be greater than 25 percent of scope deflection recorded in d above.

i. If spectrum does not meet the requirements of h above, tune VCO box to 5 MHz and perform 6.3.2h.

j. Set up synchronizer for phase lock operation at 33.25 GHz.

k. Peak level meter, using C49 and L8 (Fig. 6-8).

l. Verify that the synchronizer will remain phase locked by varying the BWO frequency control and observe that a plus 20- and minus 20-microampere swing on the phase meter can be obtained.

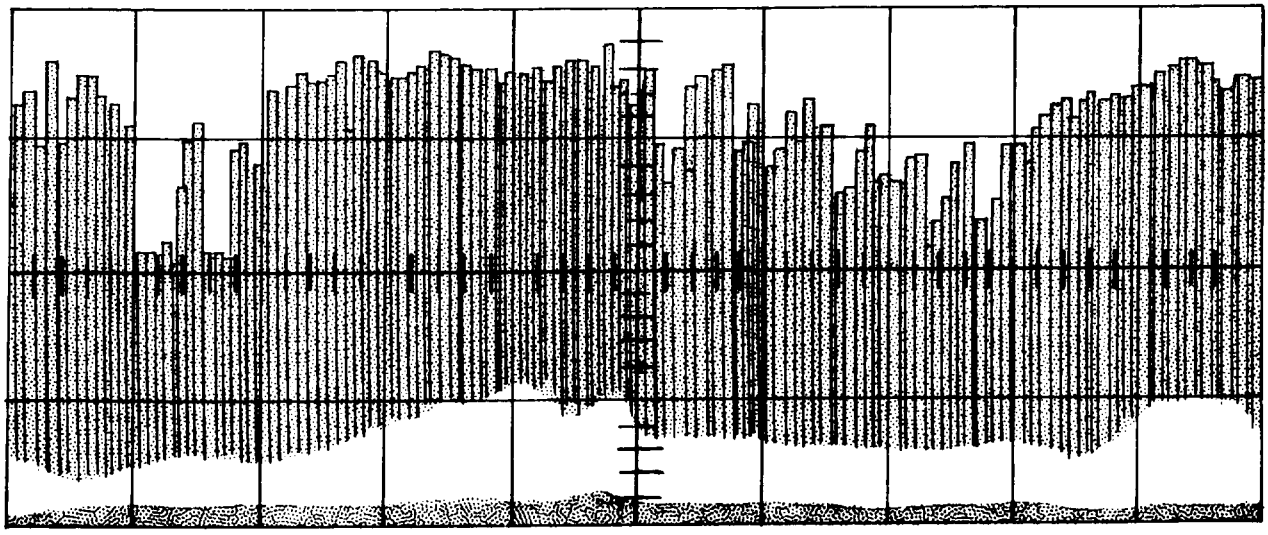
NOTE

Once the multiplier is tuned for the highest band available, do not readjust for any other band.

m. Set up for phase locked operation of the synchronizer, using U band head (TM 9-4931-294-15-1).

n. Verify that the synchronizer will remain phase locked by varying the BWO frequency control and observe that a plus 20- and a minus 20-microampere swing on the phase meter can be obtained.

o. Repeat m and n above for the remaining RF heads.



MICOO700

Figure 6-13. Ka band spectrum.

6.7 Troubleshooting Checks

Check	Possible cause	Procedure to repair	Normal reading	Faulty circuit
1. Preamp and IF gain front panel low sensitivity (less than 30 ua)	Low gain tubes	Disconnect cable to J1-IF input. Check gain of IF amp only. Replace tubes V1, V2, V3, V4 in that order	50 ua	V1, V2, V3, (IF) V4
2. Preamp gain low less than 18 db	Defective Transistors	Replace Q1, Q2	18 db minimum 20 db maximum	Q1, Q2
3. Phase meter will not zero. R-29	Defective tubes	Replace V5 (IF) (V3 Main Frame)	50-0-50 ua	V5-(V3 Main Frame)
4. Unit keeps breaking lock when phase meter is swung to the right under all conditions	25 MHz reference-low re-peak defective tubes	Replace V5 V6 (IF) (V4 V8 Main Frame) Repeak 25 MHz reference. Par. 6.1.2d	11V-1V	V8, V4 Main Frame. V5 V6 IF chassis
5. Phase meter erratic when lock range pot turned fully cw.	High voltage breakdown in sensitivity switch or IF strip	Replace sensitivity switch. Remove shorts in IF by moving components away from elevated power supply	Smoothe response of phase meter and lock range control is turned clockwise	Components associated with V5 in IF strip. Carbon deposit on switch
6. No output at TP6 multiplier	Defective tubes (will not oscillate)	Check filament supply to multiplier. Replace tubes V1 to V8 using substitution method. Check VCO box output to multiplier. Check test point outputs		Defective tubes V1 to V8. Defective VCO box
7. No side bands for low frequency heads 500 MHz to 12.4 GHz	J7 in multiplier jack not being shorted to ground. V3 defective	Check cable P1 from J20 main frame for open. Replace V3 and retune par. 6.3.2d		V3 and associated circuitry
8. VCO Box will not oscillate on any crystal	No B+ to Box (+150V)	Check to see if (V9) OA2 in multiplier is firing. Check to see if any voltage exists C67 multiplier (approx. +180V). Check TP1 main frame		CR1 (FW600) Bridge defective V9 defective B3 shorted to ground through associated circuitry V1 through V6. Finally check VCO box for defective components
9. Synchronizer phase lock can be broken by lightly tapping multiplier	Broken test point. Feed through bad solder joint	Tap multiplier lightly. Try to isolate problem to a certain area. When area of problem is located check all components in that section. Tighten all hardware		
10. Synchronizer phase lock can be broken by lightly tapping IF chassis	Broken component hardware not tight	Tap IF strip lightly to try to isolate problem to a certain area. When area of problem is located check all components in the section. Tighten all hardware		
11. Output varies at TP6 multiplier when unit is lightly tapped	Defective 5686 (V6) 6AK5 (V6) multiplier	Replace V6 and V5		Components associated with V5 and V6 multiplier

12. Signal level indication low. High bands 18 to 40 GHz	Defective varactor mount or varactor CR7. Defective cap C23 or C24 in network box	Replace varactor CR7. Replace C23 or C24 in network box	Cables defective or orientation of cables incorrect
13. Signal level indication low. Low bands 500 MHz to 18 GHz	Defective varactor mount or varactor CR5. Broken pad in low frequency mixer through impact	Replace varactor CR5 and either 6DB pad in rear of mixer or 3DB pad front of mixer	Cables defective or orientation of cables incorrect
14. No level on certain bands	Defective RF source and/ or power supplies	Replace head with one known to be good. Check power supplies	

SECTION 7

SCHEMATICS AND PARTS LISTS

Parts Provisioning Information

Replacement Parts

To obtain replacement parts, find the manufacturer's part number and description in this manual and then refer to the appropriate Repair Parts and Special Tools List (RPSTL) TM. In the RPSTL, find the assembly or subassembly first and then the description which corresponds with that in this manual. Under the description in the RPSTL find the manufacturer's part number, and then order the part by the listed Federal stock number. If the part is not listed in the RPSTL, it should be requisitioned from the NICP in accordance with AR 725-50.

PARTS LIST

TABLE 7-1

MAIN UNIT, PART NO. D783828 Refer to: D783838 SCHEMATIC REV. C

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
AT2	Attenuator, 3DB				1	1	AA03N	Microlab
B1	Fan., 115V, 60 Cycles, 3-1/8 Sq.				1	1	SP2A2	Rotron
C1, 4	Cap., Fixed, Elect., (Dual Unit)	80 uf - 60 uf		400V	2	1	TVL-2677	Sprague
C2	Cap., Fixed, C. D.	.001 uf	3 KV		1	1	DD30-102	Centralab
C3, 18	Cap., Fixed, C. D.	.01 uf	±20%	1 KV	2	1	DD-1032	Centralab
C5, 17	Cap., Fixed, Elect.,	1000 uf		50V	2	1	TVL-1338	Sprague
C6	Cap., Fixed, Glass Diel	.1 uf		3 KV	1	1	OF30-104	Plastic Capacitor Co.
C7	Cap., Fixed, C. D.	390 uf	10%	500V	1	1	DD-391	Centralab
C8	Cap., Fixed, C. D.	750 uuf	10%	500V	1	1	DD-751	Centralab
C9	Cap., Fixed, C. D.	1500 uuf	GMV	500V	1	1	DD-152G	Centralab
C10	Cap., Fixed, C. D.	3000 uuf	GMV	500V	1	1	DD-302	Centralab
C11	Cap., Fixed, C. D.	.0068 uf	GMV +80%	500V	1	1	DD-682	Centralab
C12	Cap., Fixed,	.015 uf	-20% +80%	500V	1	1	DD-153	Centralab
C13, 22	Cap., Fixed, C. D.	.03 uf	-20%	500V	2	1	DD-303	Centralab
C14, 15, 26	Cap., Fixed, Paper	.1 uf		200V	3	1	Type 8292ZN	Aerovox
C16	Cap., Fixed, Paper	1 uf		200V	1	1	Type P8292ZN	Aerovox
C19	Cap., Fixed, C. D.	.01 uf		50V	1		1	CK103 Centralab
C20, 21	Cap., Trimmer,	5.5-18 uuf			2	1	538-000-92R	Erie
C23	Cap., Adj., Trimmer	4.5-25 uuf			1	1	825AZ	Centralab
C24	Cap., Fixed, C. D.	10 uuf	± 5%	1 KV	1	1	CN0410	Mallory
C25	Cap., Fixed, Paper	.5 uf		3 KV	1	1	EP30-504	Plastic Capacitor Co.
CR 1, 2, 8	Rectifier Bridge Silicon, (PIV = 600V)				3	1	FW-600	Mallory
CR 3	Rectifier Bridge Silicon, (PIV = 200V)				1	1	FW-200	Mallory
CR 4	Diode, Zener, 13V				1	1	1N3023B	
CR 5, 7	Diode Varactor, (Co less than .8 uuf)				2	1	MA460DR	Microwave Associates
CR 6	Diode, Schottky, Barrier Type				1	1	MA4851	Microwave Associates
CR 9	Diode, Detector,				1	1	1N358A	
DS 1	Lamp, Pilot, 115V, Clear Lens				1	1	2110A2	Ind. Devices
DS 3	Lamp, Cartridge, 28V				1	1	39-28-1475	Dialco
F 1	Fuse, Slow Blo, 3AMP, 3AG				1	1	A708438-26	SAGE I. D.

TABLE 7-1
MAIN UNIT, PART NO. D783828 Refer to: D783838 SCHEMATIC REV. C

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
AT2	Attenuator, 3DB	1	1	AA03N	Microlab
F2	Fuse, Slow Blo, 2 AMP, 3AG	1	1	A708438-16	SAGE I. D.
J1	Conn., Receptacle, 6 Contact	1	1	78-PCG6	Amphenol
J2	Conn., Plug, 14 Pin	1	1	MRE-14S-N	Winchester
J3	Conn., Socket, 7 Pin	1	1	126-198	Amphenol
J5	Conn., Rec. Female	1	1	MH-5FLRN.	U.S. Comp.
J9	Jack, Red	1	1	SKT-22	Sealectro
J11, 12, 13	Adapter Type N	3	1	UG-30/U	
J20	Conn., Rect., Miniature, 14 Pin Male	1	1	MRE-14P-J6	Winchester
L1	Coil, R.F., 2.2 uh, 1/4W	1	1	1537-20	Delevan
L2, 3	Coil, R.F., 2.2 uh	2	1	A708895-2	SAGE I. D.
M1	Meter, 0-100 uA	1	1	1120HBL100DCUA	Inter Inst.
M2	Modification, Phase Meter	1	1	B782737-1	SAGE I. D.
P1	Plug, Phono	1	1	3502	Switch Craft
P5	Conn., Rec., Female	1	1	MH-7FLRN	U.S. Comp.
Q1	Transistor, Power, Germanium, PNP	1	1	2N174	
R1, 28, 34	Res., Fixed, W.W., 500 ohms, ± 5%, 25W	3	1	Style 3225M	SAGE
R2	Res., Fixed, W.W., 1K ± 5%, 8W	1	1	Style 1650S	SAGE
R3	Res., Fixed, W.W., 375 ohms, ± 5%, 5W	1	1	Style 1550S	SAGE
R4	Res., Fixed, Comp., 470 ohms, ± 5%, 1W	1	1	A708263-41	SAGE I. D.
R5	Res., Fixed, Comp., 5 ohms, ± 5%, 5W	1	1	243E	Sprague
R6	Res., Fixed, Comp., 330 ohms, ± 5%, 2W	1	1	A708262-37	SAGE I. D.
R7	Res., Fixed, Comp., 200 ohms, ± 5%, 2W	1	1	A708262-32	SAGE I. D.
R8	Res., Fixed, Comp., 240 ohms, ± 5%, 1/2W	1	1	A708261-34	SAGE I. D.
R9	Res., Fixed, Comp., 180 ohms, ± 5%, 1/2W	1	1	A708261-31	SAGE I. D.
R10	Res., Fixed, Comp., 91 ohms ± 5%, 1/2W	1	1	A708261-24	SAGE I. D.
RII	Res., Fixed, Comp., 22 ohms, ± 5%, 1/2W	1	1	A708261-9	SAGE I. D.
R12	Res., Fixed, W.W., 900 ohms, ± 5%, 25W	1	1	Style 3225M	SAGE
R13	Res., Adj., Comp., 1K ± 5%, 2W	1	1	CMU1021	Ohmite
R14	Res., Fixed, Comp., 470 ohms, ± 5%, 1/2W	1	1	A701261-41	SAGE I. D.
R15	Res., Fixed, Comp., 430 ohms, ± 5%, 1/2W	1	1	A708261-40	SAGE I. D.
R16	Res., Fixed, Comp., 470 ohms, ± 5%, 2W	1	1	A708262-41	SAGE I. D.
R17	Res., Fixed, W.W., 5K, ± 5%, 5W	1	1	Type 1550S	SAGE
R18	Res., Fixed, Comp., 47K, ±5%, 1/2W	1	1	A708261-89	SAGE I. D.

PARTS LIST continued

TABLE 7-1

MAIN UNIT, PART NO. D783828 Refer to: D783838 SCHEMATIC REV. C

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
R19, 20	Res., Fixed, Comp., 10 ohms, ± 5%, 1/2W	2	1	A708261-1	SAGE I. D.
R21, 22	Res., Fixed, Comp., 47 ohms, ± 5%, 1/2W	2	1	A708261-17	SAGE I. D.
R23	Res., Fixed, Comp., 100K, ± 5%, 1/2W	1	1	A708261-97	SAGE I. D.
R24, 25	Res., Fixed, Comp., 470K, ± 5%, 1/2W	1	1	A708261-113	SAGE I. D.
R26	Res., Adj., Comp., 250K, 2W	1	1	RV4NAYSD254A	
R27	Res., Adj., W.W., 100K, 2W 10 Turns	1	1	3500S-1-104	Bourne
R29	Res., Fixed, Film, 61.9K, ± 1%, 1/2W	1	1	RN70C6192	
R30	Res., Adj., Comp., CW Log Taper, 100K, ± 20% 2W	1	1	Type J	Allen Bradley
R31	Res., Fixed, Film, 1.58K + 1%, 1/2W	1	1	RN70C1581	
R32	Res., Fixed, Film, 17.8K + 1%, 1/2W	1	1	RN70C1782	
R33	Res., Fixed, Comp., 240 ohms, + 5%, 1W	1	1	A708263-34	SAGE I. D.
R35, 36	Res., Fixed, Comp., 4.7K + 5%, 2W	2	1	A708262-65	SAGE I. D.
S1	Switch, Rotary, 3 Deck, 3P, 14 Pos. (Modified)	1	1	C783132-1	SAGE I. D.
S2	Switch, Dpst, Momentary	1	1	ST22M	J.B.T. Instruments, Inc.
T1	Transformer, Power	1	1	C782788-1	SAGE I. D.
T2	Transformer, Heater Stand-By	1	1	FT-12	U.T.C. 5950-723-2573
TP1	Conn., Pin jack, Red	1	1	A709957-1	SAGE I. D.
TP2	Conn., Pin jack, Black	1	1	A709957-2	SAGE I. D.
V1, 4	Tube, Elec., 7 Pin, Min.	2	1	OA2	
V2	Tube, Elec., 7 Pin, Min.	1	1	OB2	
V3	Tube, Elec., 9 Pin, Min.	1	1	5687	
XDS3	Holder, Lamp	1	1	7538	Dialco
XF1, 2	Fuse Holder, 15 AMP	2	1	342004	Little Fuse
XV1, 2, 4	Socket, Elec. Tube, 7 Pin Min.	3	1	A707251-1	SAGE I. D.
XV3	Socket, Elec. Tube, 9 Pin Min.	1	1	A713015-1	SAGE I. D.

PARTS LIST Continued

TABLE 7-2
CABLE ASSEMBLIES, MAIN UNIT

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
J4, P2	Cable Ass'y.	1	1	D781482-9	SAGE I. D.
J6, P3	Cable Ass'y.	1	1	D781482-10	SAGE I. D.
J7, P8	Cable Ass'y.	1	1	D781482-11	SAGE I. D.
J8, P7	Cable Ass'y.	1	1	D781482-12	SAGE I. D.
J10, P6	Cable Ass'y.	1	1	D781482-13	SAGE I. D.
J14	Cable Ass'y., "BNC"	1	1	D781482-18	SAGE I. D.
J15, 17	Cable Ass'y., "BNC"	1	1	D781482-19	SAGE I. D.
J16	Cable Ass'y., "N"	1	1	B783142-1	SAGE I. D.
J17	Cable Ass'y., "BNC"	1	1	D781482-20	SAGE I. D.
P1	Cable Ass'y., 10 MHz Side Band	1	1	B783143-1	SAGE I. D.
P4	Cable Ass'y., Varactor Bias	1	1	B783144-1	SAGE I. D.
P9, J19	(Part of) Network Box Ass'y.	1	1	C783296-1	SAGE I. D.
W1, P1, P2	Cable Ass'y.	1	1	D781481-7	SAGE I. D.
W2, P1, 2	Cable Ass'y.	1	1	D781481-13	SAGE I. D.
W3, P1, 2	Cable Ass'y.	1	1	D781481-12	SAGE I. D.
W4, P1, 2	Cable Ass'y., "N"	1	1	D782187-13	SAGE I. D.
W5, P1, 2	Cable Ass'y., "N"	1	1	D782187-18	SAGE I. D.

PARTS LIST Continued

TABLE 7-3
25 MHZ I.F. UNIT, PART NO. R782824 Refer to: D782817 SCHEMATIC REV. G

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
C1-5, 7-12, 15-17, 19, 22, 26, 27, 33, 35, 37, 39, 51, 56, 57, 59	Cap., Fixed, C. D.,	.001 uf,	± 10%,	1KV	26	8	GPDX5F102K	Aerovox
C6	Cap., Trimmer,	Ceramic	8-50 uuf		1	1	Style 557	Erie
C13, 20, 23, 32, 34, 36, 38, 41, 42	Cap., Fixed,	Ceramic	1000 uf		9	2	Style 319	Erie
C14	Cap., Fixed,	Mica	100 uuf	500V	1	1	DM-10-101	Elmenco
C18	Cap., Fixed,	Mica	47 uuf	500V	1	1	DM-10-470	Elmenco
C21	Cap., Fixed,	C. D.	.01 uf	500V	1	1	SM-110	Mallory
C24	Cap., Fixed,	Mica	10 uuf ±10%	300V	1	1	A707143-122	SAGE I. D.
C25	Cap., Fixed,	C. D.	.006 uf	3 KV	1	1	30GA-D60	Sprague
C28, 30, 31, 47	Cap., Fixed,	C. D.	.001 uf	3 KV	4	1	30GA-D10	Sprague
C29	Cap., Fixed,	C. D.	33 uuf	3 KV	1	1	30GA-Q33	Sprague
C40	Cap., Fixed,	C. D.	.0047 uf	1 KV	1	1	10TS-D47	Sprague
C43, 45	Cap., Fixed,	C. D.	.1 uf	500V	2	1	5HK-P10	Sprague
C44, 46	Cap., Fixed,	C. D.	.02 uf	500V	2	1	5GA-S20	Sprague
C48	Cap., Trimmer	Mica	5.5-18 uuf		1	1	538-000-92R	Erie
C49, 60	Cap., Fixed,	Mica	3.3 uuf + 5%	1 KV	2	1	CNO-533	Mallory
C50	Cap., Trimmer	Mica	3-35 uuf	175V	1	1	403	Elmenco
C53	Cap., Fixed,		22 uuf + 5%	1 KV	1	1	CNO-422	Mallory
C54	Cap., Fixed,		18 uuf ± 5%	1 KV	1	1	CNO-418	Mallory
C55	Cap., Fixed,	C. D.	10 uuf ± 5%	1 KV	1	1	CNO-410	Mallory
C58	Cap., Fixed,	C. D.	4.7 uuf ± 5%	1 KV	1	1	CNO-547	Mallory
J1-3, TP1	Conn., Rect., Type BNC				4	1	UG-625/U	
L1 thru' 3	Coil, R.F., 1.3 - 2.5 uH				1	1	4000-12	Delevan
L4	Coil, R.F., 14 Turn				1	1	C780692-3	SAGE I. D.
L5, 11, 12, 16	Coil, R.F.,	2.2 uH	1/4W,	400MA	4	1	1537-20	Delevan
L6-10, 19	Coil, R.F.,	2.2 uH	1/4W,	505MA	6	2	1840-14	Delevan
L13, 14, 18	Coil, R.F.,	47 uH	1/4W,		3	1	1537-60	
L15, 20	Coil, Adj.,	9.3-18 uH			2	1	4000-22	Delevan

TABLE 7-3

25 MHZ I.F.: UNIT, PART NO. R782824 Refer to: D782817 SCHEMATIC REV. G

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
L17	Coil, R.F., 2.2 uH, 3/8 W, 1600 MA				1	1	2890-04	Delevan
P1	Conn., Plug, 14 Pin (With Hood)				1	1	MRE-14P-N-H	Winchester
P2	Conn., Plug, 7 Pin (With Hood & Clamp)				1	1	126-195	Amphenol
R1	Res., Fixed, Comp.,	200 ohms	± 5%	1/2W	1	1	A70F261-32	SAGE I. D.
R2, 42	Res., Fixed, Comp.,	1.5K	± 5%	1/4W	2	1	Little Devil	Ohmite
R3	Res., Fixed, Comp.,	470K	± 5%	1/2W	1	1	A708261-67	SAGE I. D.
R4	Res., Fixed, W.W.,	8.2K	+ 5%	5W	1	1	Axial Lead	Ohmite
R5, 11, 19	Res., Fixed, Comp.,	100 ohms	± 5%	1/2W	3	1	A708261-25	SAGE I. D.
R6	Res., Fixed, Comp.,	27K	± 5%	1/4W	1	1	Little Devil	Ohmite
R7, 16	Res., Fixed, Comp.,	750 ohms	± 5%	1/2W	2	1	A708261-46	SAGE I. D.
R8, 13, 18, 21, 38	Res., Fixed, Comp.,	100K	± 5%	1/2W	5	2	A708261-97	SAGE I. D.
R9, 17, 32	Res., Fixed, Comp.,	120 ohms	± 5%	1/2W	3	1	A708261-27	SAGE I. D.
R10, 14	Res., Fixed, Comp.,	15K	± 5%	2W	2	1	A708262-77	SAGE I. D.
R12, 20	Res., Fixed, Comp.,	39 ohms	± 5%	1/2W	2	1	A708261-15	SAGE I. D.
R15	Res., Fixed, Comp.,	1.6K	± 5%	1/2W	1	1	A708261-54	SAGE I. D.
R22	Res., Fixed, Comp.,	4.7K	± 5%	1/2W	1	1	A708261-65	SAGE I. D.
R23	Res., Fixed, Comp.,	15K	± 5%	1/2W	1	1	A708261-77	SAGE I. D.
R24	Res., Fixed, Comp.,	1.3K	± 5%	1/2W	1	1	A708261-52	SAGE I. D.
R25	Res., Fixed, Comp.,	68K	± 5%	1/2W	1	1	A708261-93	SAGE I. D.
R26	Res., Fixed, Comp.,	15K	± 5%	1/4W	1	1	Little Devil	Ohmite
R27, 44	Res., Fixed, Comp.,	22K	± 5%	2W	2	1	A708262-81	SAGE I. D.
R28	Res., Fixed, Comp.,	180K	± 5%	1/2W	1	1	A708261-103	SAGE I. D.
R29	Res., Adj., Comp.,	200 ohms		1/2W	1	1	TT-2	Centralab
R30	Res., Fixed, Comp.,	150 ohms	± 5%	1/2W	1	1	A708261-29	SAGE I. D.
R31	Res., Fixed, Comp.,	20K	± 5%	1/2W	1	1	A708261-80	SAGE I. D.
R33	Res., Fixed, Comp.,	20 Meg	± 5%	1/2W	1	1	A708261-156	SAGE I. D.
R34	Res., Fixed, Comp.,	1 Meg	± 5%	1/2W	1	1	A708261-121	SAGE I. D.
R35	Res., Fixed, Comp.,	220K	± 5%	1/2W	1	1	A708261-105	SAGE I. D.
R36	Res., Fixed, Comp.,	560K	± 5%	1/2W	1	1	A708261-11.5	SAGE I. D.
R37	Res., Fixed, Comp.,	510K	± 5%	1/2W	1	1	A708261-114	SAGE I. D.
R39, 41	Res., Fixed, Comp.,	8.2K	± 5%	1/4W	2	1	Little Devil	Ohmite
R40	Res., Adj., Comp.,	2 Meg. 2W			1	1	RV4LAYSA205B	

PARTS LIST Continued

TABLE 7-3

25 MHZ I.F.: UNIT, PART NO. R782824 Refer to: D782817 SCHEMATIC REV. G

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
R43	Res., Fixed, Comp.,	47K	± 5%	1/4W	1	1	Little Devil	Ohmite
R45	Res., Fixed, Comp.,	270 ohms	± 5%	1/4W	1	1	Little Devil	Ohmite
R46	Res., Fixed, Comp.,	18K	± 5%	1/2W	1	1	A708261-79	SAGE I. D.
T1	Transformer I.F. 25 MHz				1	1	B780697-5	SAGE I. D.
T2	Transformer				1	1	B783122-1	SAGE I. D.
V1	Tube, Elec., 9 Pin Min.				1	1	6DJ8	
V2, 3	Tube, Elec., 9 Pin Min.				2	1	6EJ7	
V4	Tube, Elec., 9 Pin Min.				1	1	6CM8	
V5	Tube, Elec., 7 Pin Min.				1	1	6BN6	
V6	Tube, Elec., Nuvistor Triode				1	1	6CW4	
XV1 - 4	Socket, Elec., Tube, 9 Pin Min.				4	1	A713015-1	SAGE I. D.
XV5	Socket, Elec., Tube, 7 Pin Min.				1	1	A707251-1	SAGE I. D.
XV6	Socket, Nuvistor				1	1	5NS-1	Cinch-Jones
Z1, 2, 3	Coil, 30 MHz Trap				3	1	A708895-2	SAGE I. D.

PARTS LIST Continued

TABLE 7-4
MULTIPLIER CHAIN, PART NO. R782826 Refer to: D782818 SCHEMATIC REV. F

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
C1	Cap., Fixed, Mica,	110 uuf,	± 5%	300V	1	1	A707143-104	SAGE I. D.
C2, 3, 4, 10, 11 14, 20, 21, 22, 24, 27, 30, 33, 34, 35, 38, 40, 41, 44, 46, 47, 52, 55, 56, 57, 58, 59, 60, 61, 62, 63, 78, 79	Cap., Fixed, C. D.	.001 uf,		500V	33	10	SM-210	Mallory
C5, 12, 19, 23	Cap., Fixed, C. D.,	.005 uf,		500V	4	1	SM-250	Mallory
C6, 69	Cap., Fixed, C. D.,	.01 uf,		500V	1	1	SM-110	Mallory
C7, 9	Cap., Fixed, Mica,	56 uuf,	± 5%	300V	2	1	A707143-97	SAGE I. D.
C8	Cap., Fixed, Mica,	3000 uuf,	± 5%	500V	1	1	CD20-5D33	Corn. Dub
C13	Cap., Fixed, Elect., Metal Mtg. Plate	50 uf,		350V	1	1	TVL1622	Sprague
C15, 45	Cap., Fixed, Ceramic	10 uuf,	± 5%	1 KV	2	1	CNO-410	Mallory
C16	Cap., Fixed, Mica,	390 uuf,	± 5%	300V	1	1	A707143-117	SAGE I. D.
C17	Cap., Fixed, Mica,	15 uuf,	± 10%	300V	1	1	A707143-124	SAGE I. D.
C18	Cap., Fixed, Ceramic,	4.7 uuf,	± 5%	1 KV	1	1	CNO-547	Mallory
C25	Cap., Fixed, Mica,	470 uuf,	± 5%	300V	1	1	A707143-119	SAGE I. D.
C26	Cap., Fixed, Ceramic,	22 uuf,	± 5%	1 KV	1	1	CNO-422	Mallory
C28, 32	Cap., Fixed, Ceramic,	18 uuf,	± 5%	1 KV	2	1	CNO-418	Mallory
C29	Cap., Fixed, Mica,	68 uuf,	± 10%	500V	1	1	DM-1.5-680	Elmenco
C31, 48, 83	Cap., Fixed, Mica,	240 uuf,	± 5%	300V	3	1	A707143-112	SAGE I. D.
C36, 42	Cap., Fixed, Ceramic,	6.8 uuf,	± 5%	1 KV	2	1	CNO-568	Mallory
C37	Cap., Trimmer,	2-8 uuf,			1	1	538-000-89R	Erie
C39	Cap., Fixed, Ceramic	27 uuf,	± 5%	1 KV	1	1	CNO-427	Mallory
C49	Cap., Adj., Trimmer, .8-18 uuf,				1	1	VC4G	J.F.D.
C50	Cap., Fixed, Ceramic,	1000uut,	± 20%		1	1	319-X5U-102M	Erie
C53	Cap., Adj., Ceramic, 24-200				1	1	425	Arco
C54	Cap., Fixed, Mica,	62 uuf,	± 10%	500V	1	1	DM-15-620	Elmenco
C64, 65, 66, 67, 68, 71, 72, 73, 74, 75, 76, 77	Cap., Fixed, Ceramic, Feed Thru, 1000 uuf				12	3	FT-1000	Sprague
C80	Cap., Fixed, Mica,	820 uuf	± 10%	500V	1	1	DM-15-821	Elmenco

PARTS LIST Continued

TABLE 7-4
MULTIPLIER CHAIN, PART NO. R782826

Refer to: D782818 SCHEMATIC REV. F

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
C81	Cap., Fixed, Ceramic, 3.3 uuf, ± 5% 1 KV	1	1	CNO-533	Mallory
C82	Cap., Fixed, Ceramic, .5 uuf, 600V	1	1	301-COK-508C	Erie
C84	Cap., Fixed, Mica, 1.50 uuf, ± 10% 500V	2	1	DM-15-151	Elmenco
C85	Cap., Fixed, Mica, 1000 uuf, ± 10% 500V	1	1	DM-20-102	Elmenco
J1, 2, 3, 4, 5, 6	Conn., Rect., Type BNC	6	1	UG-625/U	
J7	Jack, Phono	1	1	3501FP	Switch Craft
L1	Coil, R.F., Adj., 120-243 uH	1	1	2060-8C	Cambridge Thermionic
L2, 3, 4, 5	Coil, R.F., Adj., 9-18 uH	4	2	4000-22	Delevan
L6	Coil, R.F., 4-3/4 Turn	1	1	C780692-10	SAGE I. D.
L7	Coil, R.F., 8 Turns	1	1	C780692-9	SAGE I. D.
L8	Coil, R.F., 3 Turns	1	1	C780692-8	SAGE I. D.
L9	Coil, R.F., 3 Turns, No. 20 Ins. Wire, 1/4 I. D. Air Wound	1	1		
L10, 12, 13, 14 19, 20, 21, 22, 23, 24, 25, 26, 27, 29 31, 32, 33	Coil, R.F., 2.2 uH, 400 MA	17	4	1537-20	Delevan
L15, 16, 17 18, 30	Coil, R.F., 47 uH	5	1	1537-60	Delevan
L28	Coil, R.F., 2.2 uH, 505 MA	1	1	1840-14	Delevan
L34	Coil, R.F., 17 Turns		1	B783180	SAGE I. D.
L35	Coil, R.F., 5 Turns No. 22 Ins. Wire 1/4 ID Air Wound	1	1		
L36	Coil, R.F., 2 MH	1	1	A708406-1	SAGE I. D.
P1	Conn., Plug, 6 Pin	1	1	91-MP-M6L	Amphenol
R1	Res., Fixed, Comp., 1 Meg ±5% 1/4W	1	1	Little Devil	Ohmite
R2	Res., Fixed, Comp., 47K ±5% 1/4W	I	1	Little Devil	Ohmite
R3, 6, 9, 10	Res., Fixed, Comp., 39K ±5% 1/2W	4	1	A708261-87	SAGE I. D.
R4, 7, 11, 13, 16, 19	Res., Fixed, Comp., 100K ±5% 1/4W	6	2	Little Devil	Ohmite
R5, 8, 14, 17	Res., Fixed, Comp., 27K ± 5% 1/4W	4	1	Little Devil	Ohmite
R12	Res., Fixed, Comp., 12K ± 5% 1/2W	1	1	A708261-75	SAGE I. D.
R15	Res., Fixed, Comp., 33K ± 5% 1/2W	1	1	A708261-85	SAGE I. D.
R18, 29	Res., Fixed, Comp., 27K ± 5% 1/2W	2	1	A708261-83	SAGE I. D.
R20	Res., Fixed, Comp., 33K ± 5% 1/4W	1	1	Little Devil	Ohmite

PARTS LIST Continued

TABLE 7-4
MULTIPLIER CHAIN, PART NO. R782826

Refer to: D782818 SCHEMATIC REV. F

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
R21	Res., Fixed, Comp.,	390 ohm	± 5%	1/2W	1	1	A708261-39	SAGE I. D.
R22	Res., Fixed, Comp.,	2K,	± 5%	2W	1	1	A708262-56	SAGE I. D.
R23, 25	Res., Fixed, Comp.,	750 ohm	± 5%	1/4W	2	1	Little Devil	Ohmite
R24	Res., Fixed, Comp.,	1K	± 5%	1/2W	1	1	A708261-49	SAGE I. D.
R28	Res., Fixed, Comp.,	18K	± 5%	1/4W	1	1	Little Devil	Ohmite
T1	Transformer, IF				1	1	B782798-1	SAGE I. D.
T2	Transformer, IF				1	1	B782798-2	SAGE I. D.
T3	Transformer,	50 MHz			1	1	B782619-1	SAGE I. D.
T4	Transformer,	25 MHz			1	1	C780692-14	SAGE I. D.
V1, 2, 3, 4, 5	Tube, Electron,	7 Pin Min.			5	1	6AK5	
V6	Tube, Electron,	9 Pin Min.			1	1	5686	
V7	Tube, Electron,	7 Pin Min.			1	1	6C4	
V8	Tube, Electron, Nuvistor Triode				1	1	6CW4	
V9	Tube, Electron,	7 Pin Min.			1	1	OA2	
XV1, 2, 3, 4, 5, 7, 9	Socket, Elec., Tube,	7 Pin Min.			7	2	A707251-1	SAGE I. D.
XV6	Socket, Elec., Tube,	9 Pin Min.			1	1	A713015-1	SAGE I. D.
XV8	Socket, Nuvistor				1	1	5NS-1	Cinch-Jones

PARTS LIST Continued

TABLE 7-5

CRYSTAL-VCO UNIT PART NO. D783818 Refer to: D782819 SCHEMATIC REV. J

Reference Symbol	Description				Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
C1	Cap., Fixed, C. D.	.001 uf,	500V,	± 10%	1	1	DD-102	Centralab
C2, 7	Cap., Fixed, Mica	510 uuf,	500V		2	1	DM15-511	Elmenco
C3, 6, 8, 9, 10	Cap., Fixed C. D.	.01 uf	50V		5	2	CK103	Centralab
(C4	Cap., Fixed, Mica	150 uuf,	500V		1	1	DM10-151	Elmenco
C5	Cap., Fixed, Elect.,	.1 uf,	20V		1	1	UK20-104	Centralab
C11	Cap., Fixed, C. D.	.1 uf,	75V		1	1	DDA-104	Centralab
C12	Cap., Fixed, Mylar,	1 uf,	200V		1	1	Type X663F	Good-All
C13	Cap., Fixed, C. D.	.01 uf,	GMV,	600V	1	1	DD6-103	Centralab
C14	Cap., Fixed, Elect.	50 uf,	25V		1	1	TE-1209	Sprague
C15	Cap., Fixed, Mica,	200 uuf	300V		1	1	A707143-110	SAGE I. D.
C16	Cap., Fixed, Mica,	270 uuf,	300V		1	1	A707143-113	SAGE I. D.
C17, 19	Cap., Fixed, Mica,	100 uuf,	300V		2	1	A707143-103	SAGE I. D.
C18	Cap., Fixed, Mica,	51 uu	300V		1	1	A707143-96	SAGE I. D.
CR1, 2	Diode, Varactor, 50V, 47 pf Nom @ 4V				2	1	V947E	Pacific Semi-Conductor (TRW)
CR3	Diode, Zener,	39V			1	1	1N3034A	
CR4	Diode, Zener,	12V			1	1	1N3022A	
CR5	Diode				1	1	1N4762A	
HR1	Heater - Oven - Right Side				1	1	B783002-1	SAGE I. D.
HR2	Heater - Oven - Left Side				1	1	B783003-1	SAGE I. D.
J1	Conn., Jack				1	1	UG625A/U	
J2	Conn., Plug, 7 Pin Male				1	1	MH-7MLS	U. S. Comp.
L1	Coil, Var. R.F.	22 uh			1	1	VIV-22.0	Essex Elec.
L2, 10	Coil,	22 uh			2	1	1025-52	Delevan
L3, 5	Coil,	2.2 Mh			2	1	2500-44	Delevan
L4, 6, 11, 12	Coil,	1 Mh	1/2W		4	1	2500-28	Delevan
L7	Coil,	47 uh,	1/4W		1	1	1025-60	Delevan
L8	Coil,	47 uh,	1/3W		1	1	1537-60	Delevan
L9	Coil, R.F., Adj., 12-20 uh				1	1	900G	North Hill
P1	Conn., Plug 5 Pin Male				1	1	MH-5MLS	U. S. Comp.
Q1, 2, 3	Transistor, Silicon, Epitaxal planar, PNP				3	1	2N3250	
Q4	Transistor, Germanium, PNP				1	1	2N1637	
Q5	Transistor, Silicon, NPN				1	1	2N718A	
Q6	Transistor, Power Silicon, NPN				1	1	2N3055	

PARTS LIST Continued

TABLE 7-5

CRYSTAL-VCO UNIT PART NO. D783818 Refer to: D782819 SCHEMATIC REV. J

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
R1, 8	Res., Fixed, Comp., 10K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R2	Res., Fixed, Comp., 2.7K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R3, 13	Res., Fixed, Comp., 2K ± 5%, 1/4W	2	1	Little Devil	Ohmite
R4	Res., Fixed, Comp., 33K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R5	Res., Fixed, Comp., 1.8K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R6	Res., Fixed, Comp., 1.8K + 5%, 1/4W	1	1	Little Devil	Ohmite
R7	Res., Fixed, Comp., 1.6K ± 5%, 1W	1	1	708263-54	SAGE I. D.
R9, 23	Res., Fixed, Comp., 1 K ± 5%, 1/4W	2	1	Little Devil	Ohmite
R10	Res., Fixed, Comp., 100K ± 5%, 1/4W	1	1	Little Devil	Ohmite
Rll	Res., Fixed, Comp., 13K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R12	Res., Fixed, Comp., 15K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R14	Res., Fixed, Comp., 2.2K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R15	Res., Fixed, Comp., 4.7K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R16	Res., Fixed, Comp., 1.2K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R17	Res., Fixed, Comp., 510 ohms ± 5%, 1/4W	1	1	Little Devil	Ohmite
R18	Res., Fixed, Comp., 1.5K ± 5%, 1/4W	1	1	Little Devil	Ohmite
R19	Res., Adj., Comp., 1K	1	1	Type 3067 P	Bourns
R20	Res., Fixed, Comp., 2.2K ± 5%, 2W	1	1	A708262-57	SAGE I. D.
R24	Res., Fixed, Comp., 10K ± 5%, 1/2W	1	1	A708261-73	SAGE I. D.
R25	Res., Fixed, Comp., 1K ± 5%, 2W	1	1	A708262-49	SAGE I. D.
R26	Res., Fixed, Comp., 1K ± 5%, 1/2W	1	1	A708261-49	SAGE I. D.
S1	Switch, 16 Position 4 Decks	1	1	C783095-1	SAGE I. D.
S2	Heat Limiter Assy., Set 175° F	1	1	B783376	SAGE I. D.
S3	Mercury T'Stat, 60° C, ± 0.5° C. Diff. 0.10° C Temp. Range Upper Limit 90° C	1	1	T-147	Precision Thermometer
Y1	Crystal 4978.125 KHz	1	1	C782969-9	SAGE I. D.
Y2	Crystal 4981.250 KHz	1	1	C782969-1	SAGE I. D.
Y3	Crystal 4984-375 KHz	1	1	C782969-10	SAGE I. D.
Y4	Crystal 4987.500 KHz	1	1	C782969-2	SAGE I. D.
Y5	Crystal 4990.625 KHz	1	1	C782969-11	SAGE I. D.
Y6	Crystal 4993.750 KHz	1	1	C782969-3	SAGE I. D.
Y7	Crystal 4996.875 KHz	1	1	C782696-12	SAGE I. D.
Y8	Crystal 5000.000 KHz	1	1	C7829694	SAGE I. D.
Y9	Crystal 5003.125 KHz	1	1	C782969-13	SAGE I. D.
Y10	Crystal 5006.250 KHz	1	1	C782969-5	SAGE I. D.
Y11	Crystal 5009.375 KHz	1	1	C782969-14	SAGE I. D.

PARTS LIST Continued

TABLE 7-5

CRYSTAL-VCO UNIT PART NO. D783818 Refer to: D782819 SCHEMATIC REV. J

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
Y12	Crystal 5012.500 KHz	1	1	C782969-6	SAGE I. D.
Y13	Crystal 5015.625 KHz	1	1	C782969-15	SAGE I. D.
Y14	Crystal 5018.750 KHz	1	1	C782969-7	SAGE I. D.
Y15	Crystal 5021.875 KHz	1	1	C782696-16	SAGE I. D.
Y16	Crystal 5025.000 KHz	1	1	C782696-8	SAGE I. D.

PARTS LIST Continued

TABLE 7-6

PREAMPLIFIER, PART NO. D783792 Refer to: C783798 SCHEMATIC REV. A

Reference Symbol	Description	Total Quantity	1 Year Spares	Part Number	Manufacturer or Supplier
C1	Capacitor, Ceramic Disc., .001 uf, ± 107%, 1000V	1	1	GPDX5F10O2K	Aerovox
C2, 3	Capacitor, Fixed Mica, 47 pf, + 5 pf, 100V	2	1	DM10D4703-0100WV4CR	El-Menco
C4, 5, 6	Capacitor, Ceramic Disc, .01 uf, + 80-20% 50VDC	3	1	CK-103	Centralab
L1	Choke, Molded, 10 uh, ± 10%/, 180 ma max.	1	1	1025-44	Delevan
P1, 2	Connector, Plug, Type BNC, UG-260/U	2	1	UG-260/U	
P3	Plug, Terminal, Male	1	1	FT-SM-16	Selectro
Q1, 2	Transistor, Silicon, NPN, Type 2N918	2	1	2N918	
R1	Resistor, Fixed, Comp., 1K ± 5% 1/4W, Miltype RC07GF102J	1	1		
R2	Resistor, Fixed, Comp., 5.6K ± 5%, 1/4W, Miltype RC07GF562J	1	1		
R3, 4	Resistor, Fixed, Comp., 2K, ± 5%, 1/4W, Miltype RC07GF202J	2	1		
R5	Resistor, Fixed, Comp., 2.4K, ± 5%, 1/4W, Miltype RC07GF242J	1	1		
R6	Resistor, Fixed, Comp., 430 ± 5%, 1/4W, Miltype RC07GF4315				
R7	Resistor, Variable, WW, Subminature, 2K, ± 5%, 1W	1	1	3250W-1-202	Bourns
R8	Resistor, Fixed, Comp., 680 ± 5%, 1/4W, Miltype RC07GF681J	1	1		
R9	Resistor, Fixed, Comp., 33 ± 5%, 1/4W, Miltype RC07GF330J				
R10	Resistor, Fixed Comp., 270 ± 5%, 1/4W, Miltype RC07GF271J	1	1		
T1	Transformer	1	1	A783806	SAGE I. D.
	P. C. Board Assembly, PreAmplifier	Ref	Ref	C783803	SAGE I. D.

**Recommended 1 Year Isolated Use Spares

SECTION 8

PREVENTIVE MAINTENANCE INSTRUCTIONS

8.1 Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of this equipment are listed below with a reference to the paragraphs covering the specific maintenance functions. The preventive maintenance procedures require no special tools or test equipment.

a. Daily preventive maintenance checks and services (para 8.5).

b. Weekly preventive maintenance checks and services (para 8.6).

c. Monthly preventive maintenance checks and services (para 8.7).

d. Quarterly preventive maintenance checks and services (para 8.9).

e. Cleaning (para 8.11).

f. Touchup painting instructions (para 8.12)

8.2 Materials Required For Maintenance

a. Trichloroethane (Federal stock No. 6810-292-9625).

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

b. Cleaning cloth.

c. Fine sandpaper.

d. Touchup paint.

8.3 Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of the equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedure given in paragraphs 8.5 through 8.12 covers routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The maintenance checks and services charts outline functions to be performed at specific intervals. These checks and services are to maintain equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal conditions. The reference column lists the paragraphs that contain additional information. If the defect cannot be found by performing the corrective action indicated, higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

8.4 Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of this equipment are required daily, weekly, monthly, and quarterly. Daily maintenance checks and services are specified in paragraph 8.5. Paragraph 8.6 specifies checks and services that must be performed weekly. If the equipment is maintained in a standby condition, the daily and weekly checks should be accomplished at the same time. The maintenance checks and services that are accomplished monthly are specified in paragraph 8.7. Quarterly maintenance checks and services are specified in paragraph 8.9.

8.5 Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Items to be inspected	Procedure	Reference
1	Completeness	See that the equipment is complete.	App B
2	Cleanliness	Exterior of equipment must be clean and dry, free of fungus, dirt, dust, or grease.	Para 8.11
3	Operational check	Check the operational efficiency.	
4	Controls	See that controls operate smoothly and are fastened in place securely.	

8.6 Weekly Preventive Maintenance and Services Chart

Sequence No.	Items to be inspected	Procedure	Reference
1	Cables	Inspect cards and cables for chafed, cracked, or frayed insulation. Replace connectors that are broken, stripped, or worn.	
2	Metal surfaces	Inspect exposed metal surface for rust and corrosion. Clean and touch up with paint as required.	Para 8.11 and 8.12

8.7 Monthly Maintenance

Perform the maintenance functions indicated in the monthly preventive maintenance checks and services chart (para 8.8) once each month. Periodic daily (para 8.5) and weekly (para 8.6) services constitute a part of the monthly checks.

8.8 Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Items to be inspected	Procedure
1	Terminations	Inspect for loose connections and cracked or broken insulation.
2	Control panel	Clean panel thoroughly and check all surfaces for chips, cracks, or abnormal wear.
3	Hardware	Inspect all hardware for possible damage.

8.9 Quarterly Maintenance

Quarterly preventive maintenance checks and services are required for this equipment. Periodic daily, weekly, and monthly services constitute a part of the quarterly preventive maintenance checks and services and must be performed concurrently. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750. Perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (para 8.10) in the sequence listed. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions.

8.10 Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Items to be inspected	Procedure	Reference
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 3104
2	Modifications	Check DA Pam 310-7 to determine whether new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.1	TM 38-750 and DA Pam 310-7

8.11 Cleaning

Inspect the exterior surfaces. The surfaces must be free of dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a clean, soft cloth.

b. Remove grease, fungus, and ground-in dirt. Use a damp cloth (not wet) with trichloroethane to clean terminations. If dirt on the body of the unit is difficult to remove, use mild soap and water.

c. Remove dust or dirt from the jacks and plugs with a brush.

8.12 Touchup Painting Instructions

Remove dust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB 746-10.

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APPENDIX A

REFERENCES

Following is a list of publications available to tunable synchronizer operator and maintenance personnel.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
TM 9-4931-294-15-1	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Microwave Calibration Test Set AN/USM-234 (Description, Inspection, Operation, Operator's Maintenance and Preventive Maintenance).
TM 38-750	The Army Maintenance Management System (TAMMS).
SB 38-100	Preservation, Packaging, Packing, and Marking Materials, Supplies, and Equipment used by the Army.
TB 746-10	Field Instruction for Painting and Preserving Electronic Equipment.
TB 750-236	Calibration Requirements for the Maintenance of Army Materiel.

APPENDIX B

BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(Not Applicable)

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Microwave Oscillator Synchronizer, Sage Model 243C. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perfrom each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. INSPECT. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. TEST. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. SERVICE. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

d. ADJUST. To rectify to the extent necessary to bring into proper operating range.

e. ALIGN. To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly snychronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. CALIBRATE. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison 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 with the certified standard.

g. INSTALL. To set up for use in an operational environment such as an encampment, site, or vehicle.

h. REPLACE. To replace unserviceable items with serviceable like items.

i. REPAIR. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. OVERHAUL. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. REBUILD. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. SYMBOLS. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

C-3. Explanations of Format of Section II, Maintenance Allocation Chart

a. Column 1, Group Number. Not applicable.

b. Column 2, Functional Group. Column 2 lists the noun names of components, assemblies, subassemblies, and modules on which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories: The codes used represent the various maintenance categories as follows:

Code	*Maintenance Category*
C	Operator/crew
0	Organizational maintenance
F	Transfer maintenance
H	Reference maintenance
D	Depot maintenance

d. Column 4, Tools and Equipment. Column 4 specifies, by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in section III.

e. Column 5, Remarks. Self-explanatory.

C-4. Explanation of Format of Section III, Tool and Test Equipment Requirements

The columns in Section III, Tool and Test Equipment Requirements, are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

SECTION II. MAINTENANCE ALLOCATION CHART

Group No.	Functional Group	Maintenance functions											l Tools and equipment	m Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
1	Synchronizer Microwave Oscillator	F	F	F	-	-	-	F	-	H	D	-	1	A
2	Main Unit	-	-	-	H	H	-	-	-	H	D	-	2	B
3	25 MHz IF Amplifier	-	-	-	H	H	-	H	H	H	D	-	3	C
4	Multiplier Chain	-	-	-	H	H	-	H	H	H	D	-	3	C
5	Crystal - VCO Unit	-	-	-	H	H	-	H	H	H	D	-	3	C
6	Preamplifier	-	-	-	H	H	-	H	H	H	D	-	3	C

Section III. TOOL AND TEST EQUIPMENT REQUIRED

TOOL CODE	CATEGORY	NOMENCLATURE	TOOL NUMBER
1-b	H	AWNUSM 234 Microwave Test Set	4931-949-5381
1-c, 1-g,	H	Tool Kit, Calibration Technical	4935-670-7123
& 1-i			
2-d, 2-e,	H	Generator, Signal 60SC	4931-916-5926
& 2-i		Generator, Sweep	Wavetek 2001
		Analyzer, Spectrum Tektronix RM491	6625-228-7839
		AN/USM 234 Microwave Test Set	4931-949-5381
		Tool Kit, Calibration Technical	4935-670-7123
~~2-e~~	~~H~~	~~Generator, Signal 608C~~	~~4931-916-5926~~
	H	Generator, Sweep	Wavetek 2001
~~2-i~~	~~H~~	~~Analyzer, Spectrun Tektronix R91~~	~~6625-228-7839~~
		AN/USM 234 Microwave Test Set	4931-949-5381
		Tool Kit, Calibration Technical	4935-670-7123
~~3-d & 3-e~~	~~H~~	~~See as 2-i above~~	
~~3-g, 3-h,~~	~~H~~	~~Tool Kit, Calibration Technical~~	~~4935-670-7123~~
~~& 3-i~~			

Section IV. REMARKS

REMARKS CODE	REMARKS
A-b	Test in accordance with section 4 of TM 9-4931-458-14-1.
A-c	Service in accordance with section 8 of TM 9-4931-458-14-1.
A-g	Install in accordance with section 3 of TM 9-4931-458-14-1.
A-i	Repair in accordance with sections 6 and 7 of TM 9-4931-458-14-1. Solder all connections in accordance with MIL-S-45743.
B-d	Adjust in accordance with sections 6 and 7 of TM 9-4931-458-14-1.
B-e	Align in accordance with sections6 and 7 of TM 9-4931-458-14-1.
B-i	Repair in accordance with sectiorW6 and 7 of TM 9-4931-458-14-1.
C-d	Adjust in accordance with sectior6 and 7 of TM 9-4931-458-14-1.
C-e	Align in accordance with section 6 and 7 of TM 9-4931-458-14-1.
C-g	Install in accordance with section 4 of TM 9-4931-458-14-1.
C-h	Replace in accordance with section 4 of TM 9-4931-458-14-1.
C-i	Repair in accordance with section6 and 7 of TM 9-4931-458-14-1. Solder all connections in accordance with MIL-S-45743.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:

VERNE L.. BOWERS
Major General, United States Army
The Adjutant General

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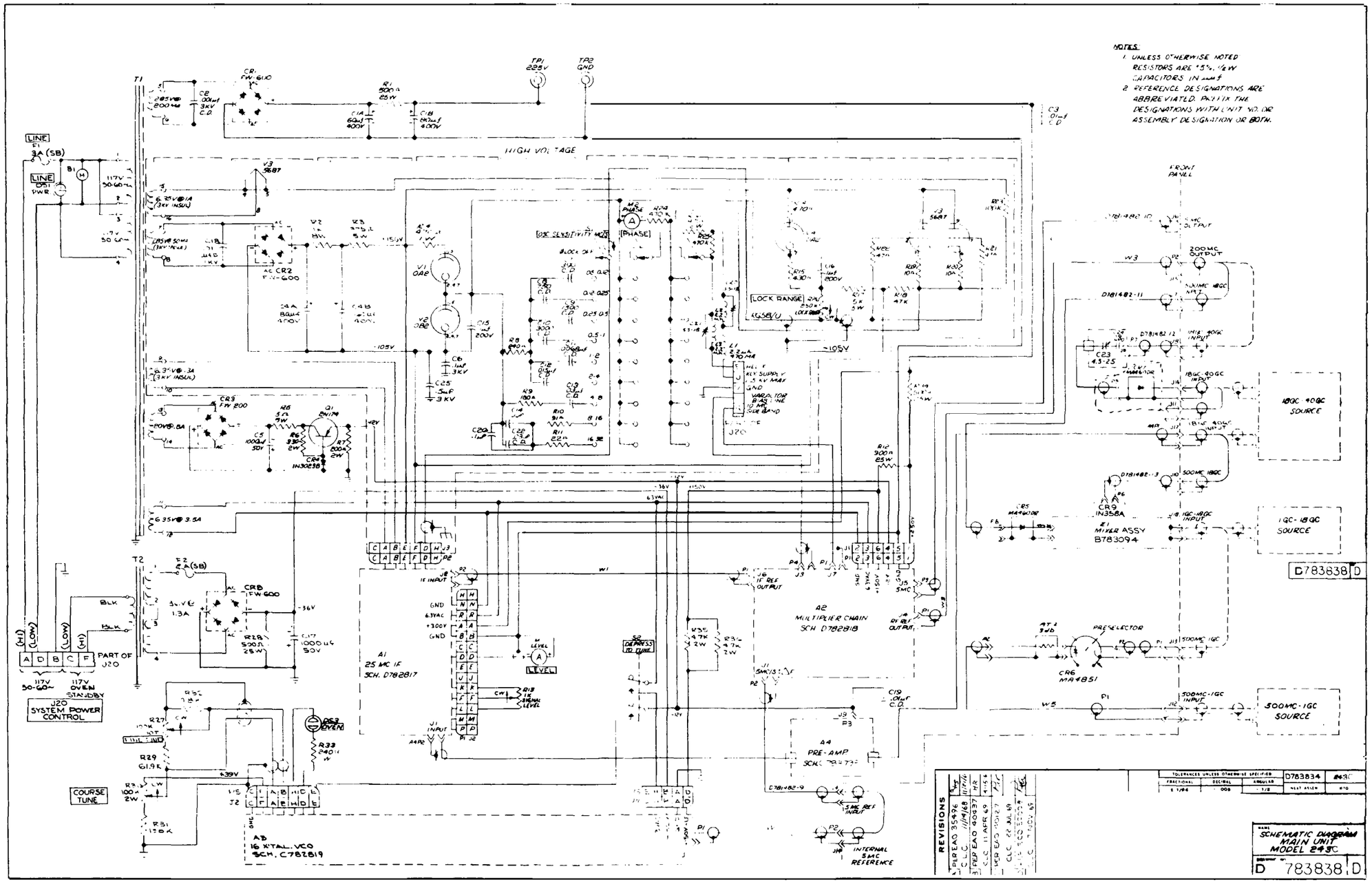
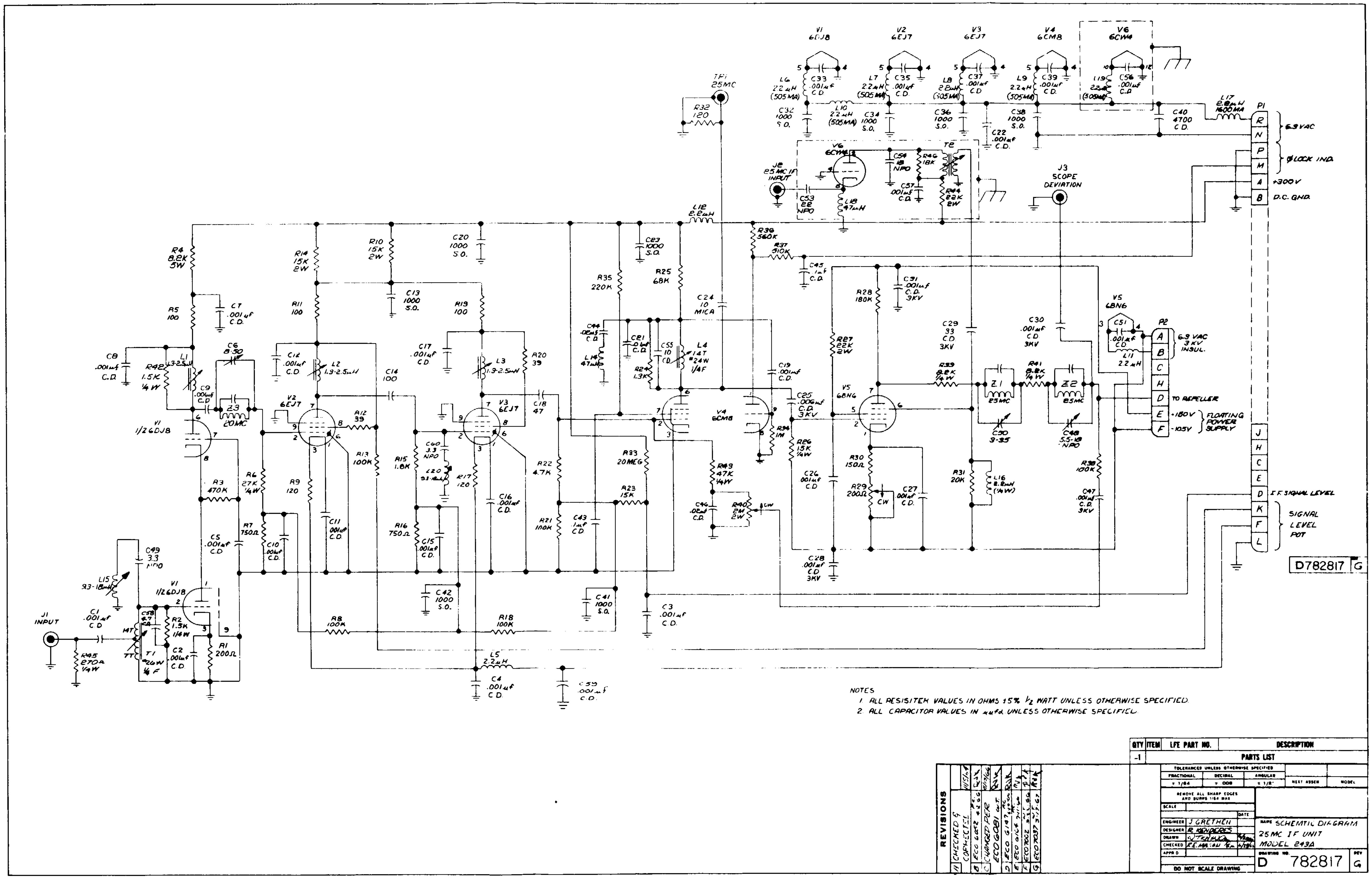
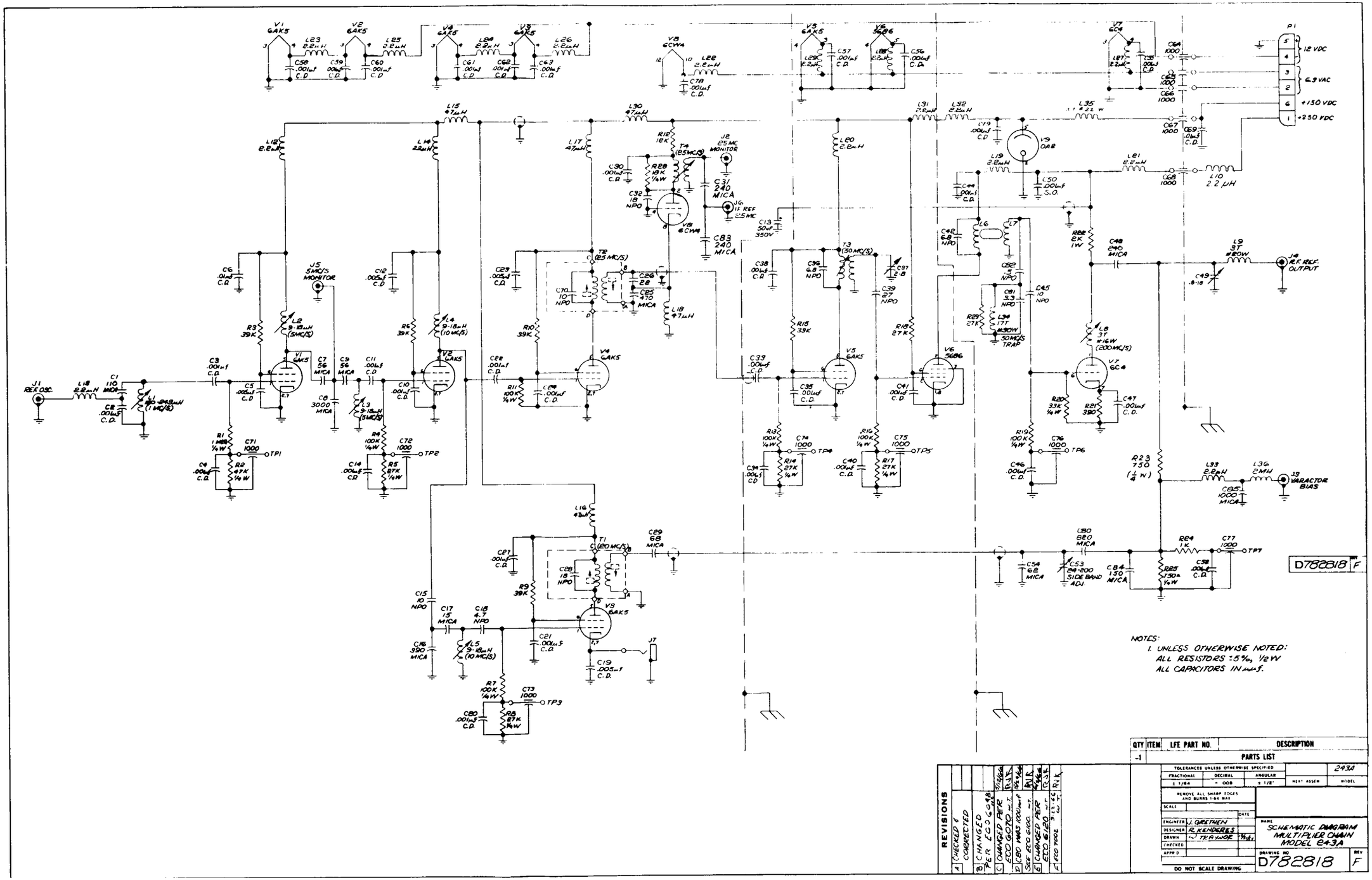
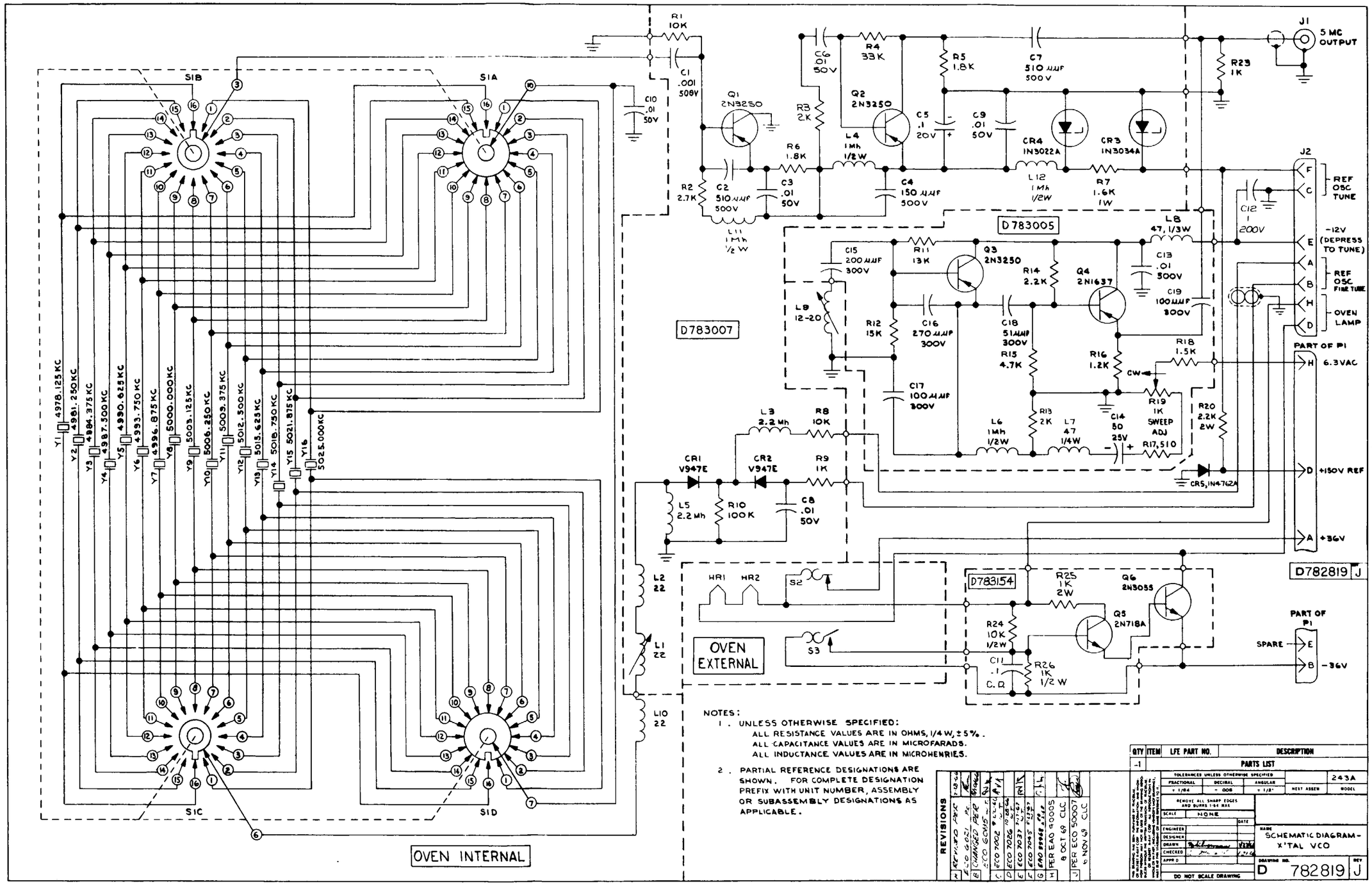

NOTES
1. UNLESS OTHERWISE NOTED RESISTORS ARE ±5%, ½W CAPACITORS IN μμf
2. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH UNIT NO. OR ASSEMBLY DESIGNATION OR BOTH.
HIGH VOLTAGE
LOW VOLTAGE
A1 25 MC IF SCH. D782817
A2 MULTIPLIER CHAIN SCH. D782818
A3 16 X'TAL. VCO SCH. C782819
A4 PRE-AMP SCH. D782732
J20 SYSTEM POWER CONTROL
MIXER ASSY B783094
PRESELECTOR
FRONT PANEL
200MC OUTPUT
500MC IGC SOURCE
1GC-18GC SOURCE
18GC-40GC SOURCE
D783838 D
SCHEMATIC DIAGRAM MAIN UNIT MODEL 243C
D 783838 D


TP1
25MC
R32
120
J2
25MC IF
INPUT
J3
SCOPE
DEVIATION
J1
INPUT
V1
6DJ8
V2
6EJ7
V3
6EJ7
V4
6CM8
V6
6CW4
V5
6BN6
P1
6.3VAC
ØLOCK IND.
+300V
D.C. GND.
P2
6.3 VAC
3KV
INSUL.
TO REPELLER
-180V
-105V
FLOATING
POWER
SUPPLY
I.F. SIGNAL LEVEL
SIGNAL
LEVEL
POT
D782817 G
NOTES
1. ALL RESISITER VALUES IN OHMS ±5% 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES IN μμfd UNLESS OTHERWISE SPECIFIED.
QTY
ITEM
LFE PART NO.
DESCRIPTION
PARTS LIST
REVISIONS
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONAL
DECIMAL
ANGULAR
± 1/64
± .008
± 1/2°
NEXT ASSEM
MODEL
REMOVE ALL SHARP EDGES AND BURRS 1/64 MAX
SCALE
DATE
ENGINEER J GRETHEN
DESIGNER R KENDERES
DRAWN
CHECKED R.E. MASON
APPR'D
NAME SCHEMTIC DIAGRAM
25MC IF UNIT
MODEL 243A
DRAWING NO.
D 782817
REV
G
DO NOT SCALE DRAWING


P1
12 VDC
6.9 VAC
+150 VDC
+250 VDC
J1 REF. OSC.
J2 25MC MONITOR
J3 VARACTOR BIAS
J4 RF REF. OUTPUT
J5 5MC/S MONITOR
J6 1ST REF 2.5MC
J7
TP1
TP2
TP3
TP4
TP5
TP6
TP7
NOTES:
1. UNLESS OTHERWISE NOTED:
ALL RESISTORS ±5%, 1/2W
ALL CAPACITORS IN mmf.
D782818 F
QTY ITEM LFE PART NO. DESCRIPTION
-1 PARTS LIST
REVISIONS
A CHECKED & CORRECTED
B CHANGED PER ECO 6018
C CHANGED PER ECO 6070
D CBO WAS 100mmf
E CHANGED PER ECO 6120
F ECO 7002
DO NOT SCALE DRAWING
SCHEMATIC DIAGRAM MULTIPLIER CHAIN MODEL 243A
DRAWING NO D782818 REV F
MODEL 243A



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W, ±5%.
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER, ASSEMBLY OR SUBASSEMBLY DESIGNATIONS AS APPLICABLE.

QTY	ITEM	LFE PART NO.	DESCRIPTION
-1			PARTS LIST

REVISIONS

A	REVISED PER ECO 6501	1-8-64	
B	CHANGED PER ECO 6545	3-4-64	
C	ECO 7026	10-26-64	
D	ECO 7037	11-23-64	
E	ECO 7045	12-3-64	
F	ECO 7042	12-8-64	
G	ENG RELEASE	1-11-65	
H	PER EAD 90005	8 OCT 69	CLC
J	PER ECO 90007	6 NOV 69	CLC

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONAL	DECIMAL	ANGULAR	NEXT ASSEM	MODEL
± 1/64	± .008	± 1/2°		243A

REMOVE ALL SHARP EDGES AND BURRS 1-64 MAX

SCALE NONE

ENGINEER
DESIGNER
DRAWN
CHECKED
APPR'D

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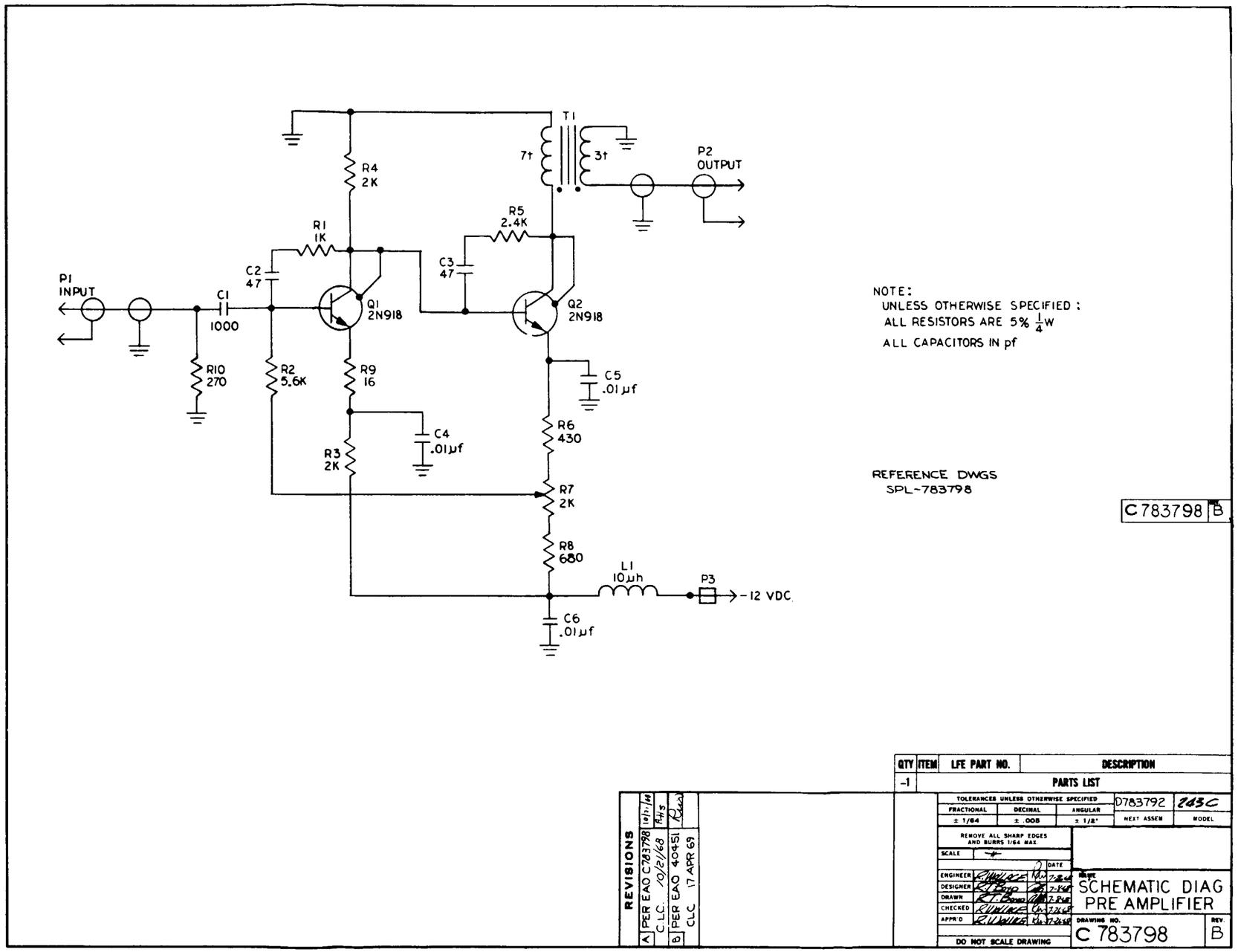
NAME SCHEMATIC DIAGRAM - X'TAL VCO

DRAWING NO. D 782819 REV J



NOTE:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE 5% $\frac{1}{4}$W
ALL CAPACITORS IN pf

REFERENCE DWGS
SPL-783798

C783798 B

QTY	ITEM	LFE PART NO.	DESCRIPTION
-1			PARTS LIST

REVISIONS			
A	PER EAO C783798 C LLC	10/21/68	[illegible]
B	PER EAO 40451 CLC	17 APR 69	[illegible]

TOLERANCES UNLESS OTHERWISE SPECIFIED			D783792	283C
FRACTIONAL	DECIMAL	ANGULAR	NEXT ASSEM	MODEL
± 1/64	± .005	± 1/2°		

REMOVE ALL SHARP EDGES AND BURRS 1/64 MAX.

		DATE
SCALE		
ENGINEER	[illegible]	7-8-68
DESIGNER	[illegible]	7-8-68
DRAWN	[illegible]	7-8-68
CHECKED	[illegible]	7-22-68
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TITLE
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