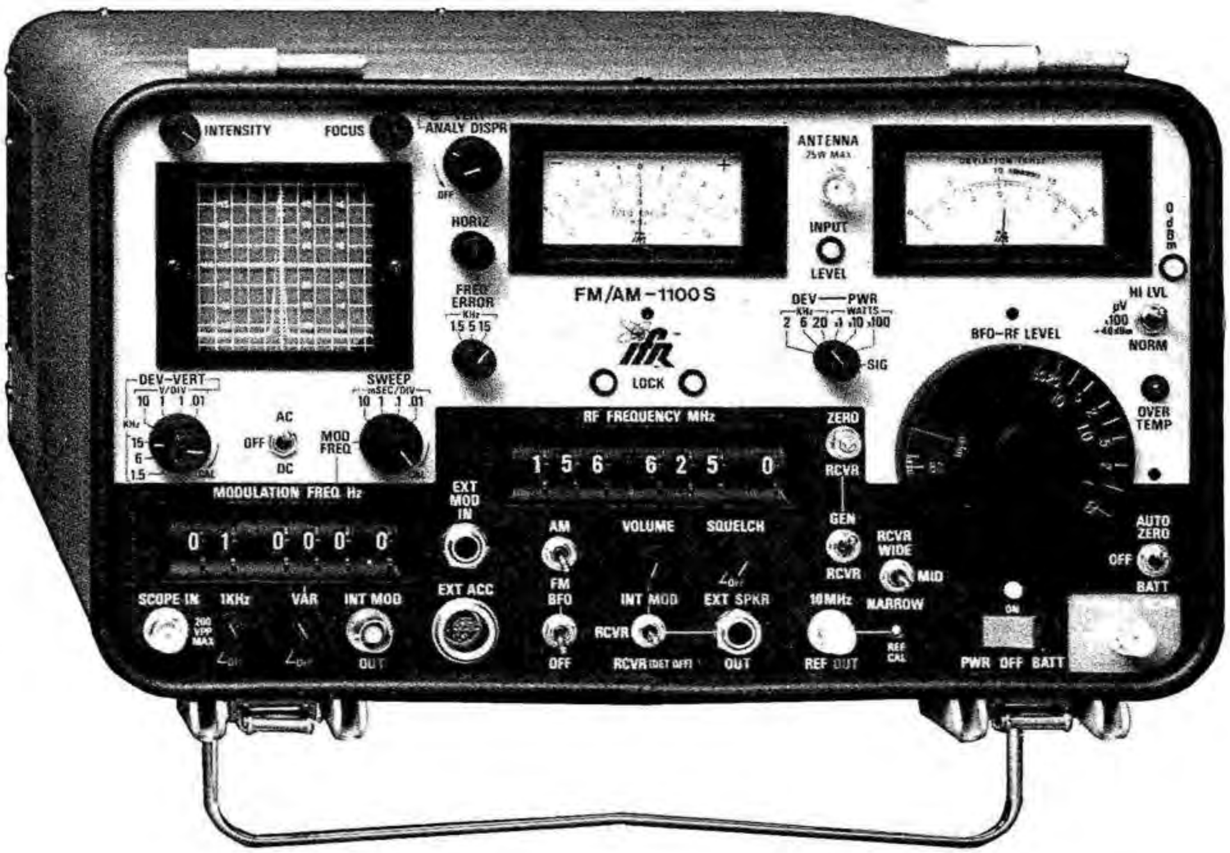
MAINTENANCE MANUAL

FM/AM-1100 S
FM/AM-1100 A

COMMUNICATIONS SERVICE MONITORS



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1100S/A 1002-2398-700

PUBLISHED BY
IFR SYSTEMS, INC.
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WARNING:

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

RESCUE OF SHOCK VICTIMS

1. DO NOT ATTEMPT TO PULL OR GRAB THE VICTIM
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.
3. IF YOU CANNOT TURN OFF ELECTRICAL POWER, PUSH, PULL OR LIFT THE VICTIM TO SAFETY USING A WOODEN POLE, A ROPE OR SOME OTHER DRY INSULATING MATERIAL.

FIRST AID

1. AS SOON AS VICTIM IS FREE OF CONTACT WITH SOURCE OF ELECTRICAL SHOCK, MOVE VICTIM A SHORT DISTANCE AWAY FROM SHOCK HAZARD.
2. SEND FOR DOCTOR AND/OR AMBULANCE.
3. KEEP VICTIM WARM, QUIET AND FLAT ON HIS/HER BACK.
4. IF BREATHING HAS STOPPED , ADMINISTER ARTIFICIAL RESUSCITATION. STOP ALL SERIOUS BLEEDING.

CAUTION

INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FET'S, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS, AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

1. BEFORE USE IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.

2. WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.

3. TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.

4. DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.

5. PC BOARD, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG.

NOTE

Remove any built-in power source, such as a battery, before laying PC Boards on conductive mat or storing in conductive bag.

6. PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING BOX.

THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE TO COMMUNICATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICE OUT TO A DISTANCE OF SEVERAL MILES.

USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND SHOULD TAKE NECESSARY PRECAUTIONS TO AVOID POTENTIAL COMMUNICATION INTERFERENCE PROBLEMS.

LIST OF EFFECTIVE PAGES

The manual pages listed below which are affected by a current change or revision, are so identified by a revision number and an asterisk.

Date of issue for original and changed pages are:

Original .... 0 .... January 1, 1984
Revision .... 1 .... August 1, 1987

TOTAL NUMBER OF PAGES IN THIS MANUAL IS 706 **CONSISTING OF FOLLOWING:**

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Caution	0
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*D Blank	1
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*iii thru xxxi	1
*xxxii Blank	1
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PREFACE

SCOPE

This manual contains maintenance instruction for the FM/AM-1100S and FM/AM-1100A Communication Service Monitors. The information in this manual will enable the technician to:

1. Service, test, repair or replace any major assembly or module within the test set.
2. Maintain the operating condition of the set to expected performance standards.
3. Understand the principles of operation as they relate to the overall operation of the set, as well as to individual circuits.

APPLICABILITY

All information contained in this manual applies to both the FM/AM-1100S and FM/AM-1100A models, except where noted otherwise. For reasons of brevity, whenever text information is applicable to both models, the units are referenced as "FM/AM-1100S/A" (instead of FM/AM-1100S and FM/AM-1100A separately).

ORGANIZATION

The contents of this manual are divided into the following eleven major sections:

SECTION 1 INTRODUCTION

Provides a brief description of the electrical and mechanical configuration of the FM/AM-1100S/A, intended to familiarize the technician with the overall structure of the set.

SECTION 2 THEORY OF OPERATION

Describes the FM/AM-1100S/A circuit theory on both a simplified and detailed level, based on accompanying block diagrams.

SECTION 3 PERFORMANCE EVALUATION

Contains "covers on" functional checkout procedures for evaluating the performance of the FM/AM-1100S/A in either a mobile or bench environment.

SECTION 4 CALIBRATION

Contains step by step calibration and alignment procedures for use during normal calibration intervals or when replacement parts are installed in the FM/AM-1100S/A.

SECTION 5 TROUBLESHOOTING

Contains step by step troubleshooting recommendations, in the form of logical flowcharts, for use in isolating fault conditions within the major electrical circuits.

SECTION 6 DISASSEMBLY

Provides detailed instructions for removing and/or disassembling the various modules within the FM/AM-1100S/A, for purposes of repair or replacement.

SECTION 7 MODULE TESTING

Contains detailed troubleshooting and testing recommendations for all modules within the FM/AM-1100S/A deemed to be field repairable.

SECTION 8 MECHANICAL ASSEMBLIES

Contains mechanical assembly drawings of all modules within the FM/AM-1100S/A.

SECTION 9 PC BOARD ASSEMBLIES

Contains component layout drawings for all PC Board assemblies within the FM/AM-1100S/A.

SECTION 10 SCHEMATICS

Contains FM/AM-1100S/A interconnect diagrams and circuit schematics.

APPENDICES

Contain useful supplementary maintenance and operational data.

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SECTION 1-INTRODUCTION

1-1 GENERAL

This section provides a brief description of the internal electrical and mechanical configuration of the FM/AM-1100S/A, which is intended to familiarize the technician with the overall structure of the set. An "exploded" composite drawing of the FM/AM-1100S/A is provided in Figure 1-1 to aid the technician in identifying and locating the various major assemblies and modules which comprise the set.

1-1-1 ELECTRICAL DESCRIPTION

The FM/AM-1100S/A is a digitally synthesized AM/FM/SSB receiver and signal generator. All components within the unit are solid state, with the exception of the CRT and several switches. The receiver is a quadruple conversion receiver, capable of receiving communication signals from 300 kHz to 999.9999 MHz. The signal generator is capable of generating modulated or unmodulated signals from 1 kHz to 999.9999 MHz. Functionally, the FM/AM-1100S/A is made up of the major electrical systems or circuits listed in the table below. The individual modules which make up each circuit are listed below the respective headings.

FREQUENCY SYNTHESIZING CIRCUITS

High Frequency Phase Lock System (or 1st Local Oscillator System)	Frequency Reference System	Low Frequency Phase Lock System (or 2nd Local Oscillator System)
	TCXO	
1200-2200 MHz VCO	TCXO Output Distribution Amplifier	79-80 MHz Phase Lock Loop PC Bd
VCO Tuner PC Bd	Clock Divider	100 MHz Amplifier/108 MHz Mixer
AGC System PC Bd	100 MHz Amplifier/108 MHz Mixer	108 MHz Bandpass Filter
High Frequency Phase Lock PC Bd	100 MHz Filter	1080 MHz Multiplier
Heterodyne Amplifier/÷2 Prescaler		Frequency Select Switch *
High Frequency Multiplier/Mixer		
Frequency Select Switch *		

RECEIVE/GENERATE CIRCUITS

Signal Input/Output Circuits	120 MHz/250 kHz IF Circuits	1200 MHz IF Circuits
Static Discharge Protect	120 MHz Receiver	1st Mixer Relay
1st Mixer Assembly	250 kHz IF/MON/AUDIO PC Bd	2nd Mixer Assy
High Level Amplifier	2nd Mixer Assy	1200 MHz Filter/Diode Switch
Power Termination Assembly	Dual Tone Generator	1200 MHz Amplifier
	120 MHz Generator Assy	
	Variable Attenuator	
	Front Panel Monitoring Devices	

POWER SUPPLY	SPECTRUM ANALYZER/OSCILLOSCOPE
Power Supply Assy	Spectrum Analyzer Module #1 Assy **
Battery	Spectrum Analyzer Module #2 Assy **
Regulator/Timer PC Board	Spectrum Analyzer Inverter PC Assy
	Spectrum Analyzer Main Bd Assy

* Also referred to as RF FREQUENCY MHz Thumbwheels
** FM/AM-1100S Only

Table 1-1 FM/AM-1100S/A Major Electrical Systems

The information contained in the preceding table is based on the functional block diagrams contained in the beginning of Section 2 in this manual.

1-1-2 MECHANICAL DESCRIPTION

Structurally, the FM/AM-1100S/A is made up of the following major assemblies (or groups) and associated modules (see Figure 1-1):

CASE ASSY

UPPER FLOOR ASSY

TCXO
Clock Divider
Heterodyne Amplifier/÷2 Prescaler
AGC System PC Bd
1200-2200 MHz VCO
TCXO Output Distribution Amplifier

REAR PANEL ASSY *

Power Supply Assy
Battery
Power Termination Assy

RIGHT HAND FRAME MODULES *

1st Mixer Assy
2nd Mixer Assy
100 MHz Filter
1200 MHz Amplifier
108 MHz Bandpass Filter
1200 MHz Filter/Diode Switch
High Frequency Multiplier/Mixer

MOTHER BD *

Regulator/Timer PC Bd
VCO Tuner PC Bd
High Frequency Phase Lock PC Bd
79-80 MHz Phase Lock Loop PC Bd
250 kHz IF/MON/AUDIO PC Bd
1080 MHz Multiplier
High Level Amplifier
Static Discharge Protect

FRONT PANEL ASSY *

Dual Tone Generator
Frequency Select Switch **
FREQ ERROR Meter
Variable Attenuator
DEVIATION/WATTS Meter

LOWER FLOOR ASSY

120 MHz Generator
120 MHz Receiver
100 MHz Amplifier/108 MHz Amplifier

SPECTRUM ANALYZER/OSCILLOSCOPE

Spectrum Analyzer Module #1 ***
Spectrum Analyzer Module #2 ***
Spectrum Analyzer Inverter Bd
Spectrum Analyzer Main Bd

* The modules listed under this heading have been grouped together because of their relative proximity and for ease of reference only. These modules do not constitute a replaceable assembly.
** Also referred to as RF FREQUENCY MHz Thumbwheels
*** FM/AM-1100S Only

Table 1-2 FM/AM-1100S/A Mechanical Structure

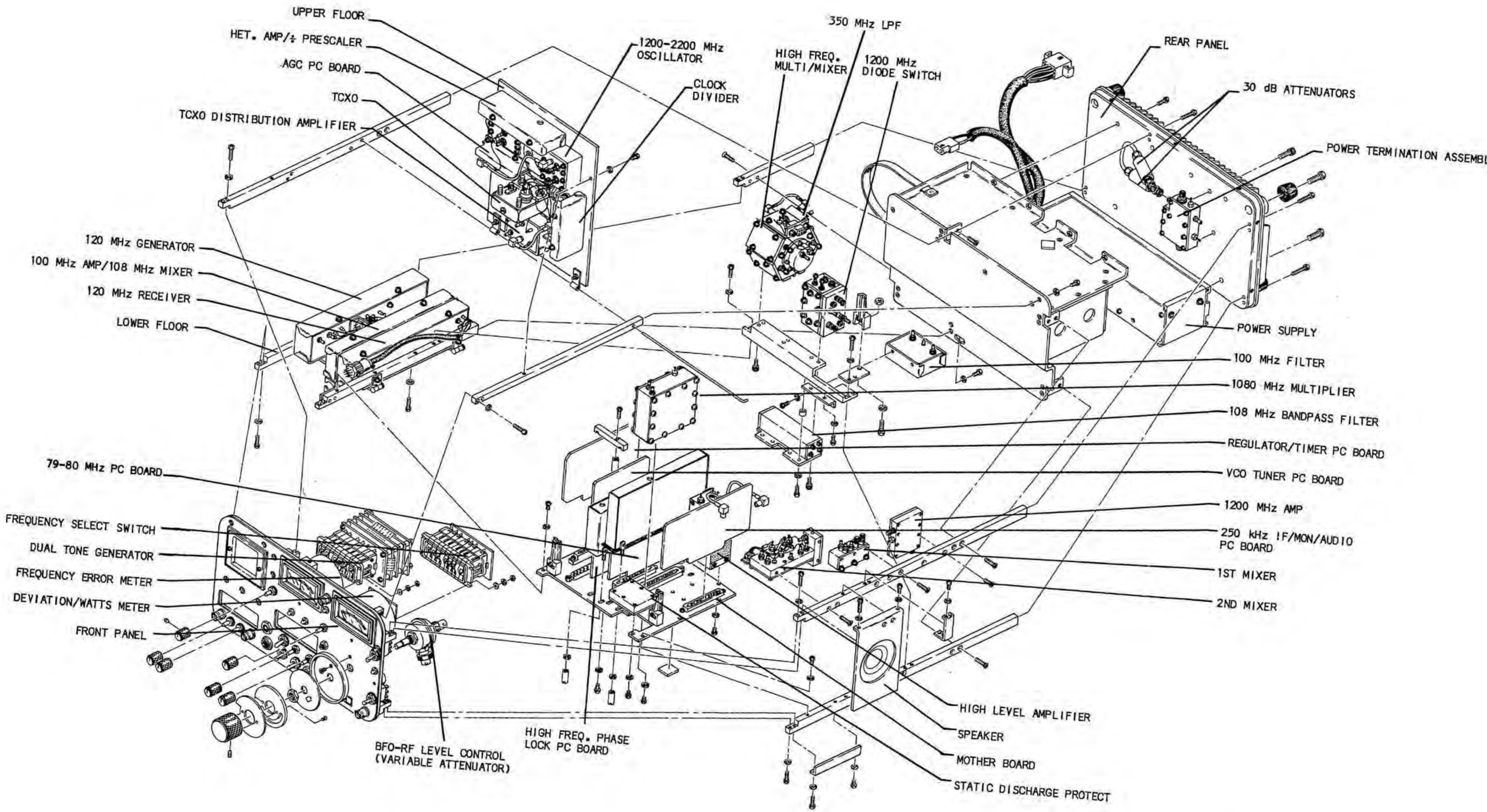


Figure 1-1 FM/AM-1100S/A Composite

SECTION 2-THEORY OF OPERATION

2-1 INTRODUCTION

This section contains a description of the circuitry used in the FM/AM-1100S/A. Circuit theory is presented on two levels of detail and is organized as follows:

1. SIMPLIFIED THEORY OF OPERATION

   Subsection 2-2 provides a simplified description of signal flow through the FM/AM-1100S/A, for both signal generator and receiver operation. This description is based on the FM/AM-1100S/A Simplified Block Diagram shown in Figure 2-1.

2. MODULE LEVEL THEORY OF OPERATION

   Subsection 2-3 contains a more detailed description of the circuit theory developed in Subsection 2-2. This section describes the signal flow between individual modules and/or stages which make up the major circuits within the FM/AM-1100S/A. All circuit descriptions within this subsection are based on FM/AM-1100S/A Detailed Block Diagram shown in Figure 2-2.

2-2 SIMPLIFIED THEORY OF OPERATION

2-2-1 GENERAL

The FM/AM-1100S/A is a digitally synthesized AM/FM/SSB receiver and signal generator. All components within the unit are solid state, with the exception of several switches and the CRT. The receiver is a quadruple conversion superheterodyne receiver, capable of receiving communication signals from 300 kHz to 999.9999 MHz. The signal generator is capable of generating modulated or unmodulated signals from 1 kHz to 999.9999 MHz.

2-2-2 RECEIVER OPERATION

The frequency of the signal to be received is determined by the setting of the RF FREQUENCY MHz Thumbwheels on the FM/AM-1100S/A front panel. The input signal can be received at the FM/AM-1100S/A ANTENNA Connector or applied via direct cable connection to the TRANS/RCVR Connector, both of which comprise the Signal Input/Output Block. If applied at the ANTENNA Connector, the received signal is channelled through a static protect circuit and a series of relays to the 1st Mixer. If applied at the TRANS/RCVR Connector, the received signal is channelled through several relays and attenuators before arriving at the 1st Mixer.

In the 1st Mixer, the received signal is mixed with a signal from the 1st Local Oscillator to produce a 1st IF (Intermediate Frequency) of approximately 1200 MHz. The output of the 1st Local Oscillator is variable in 1 MHz increments within a range of 1200 to 2199 MHz, as the left three RF FREQUENCY MHz Thumbwheels are incremented from 000 to 999. The 1200 MHz 1st IF is filtered and amplified in the IF Filter Amplifier before being passed to the 2nd Mixer, where a second conversion takes place.

In the 2nd Mixer, the 1200 MHz 1st IF is mixed with a signal from the 2nd Local Oscillator to produce a 2nd IF of approximately 120 MHz. The output of the 2nd Local Oscillator is variable from 1079.0001 to 1080 MHz, as the right four RF FREQUENCY MHz Thumbwheels are decremented from .9999 to .0000. The 120 MHz 2nd IF is then applied to 120 MHz Receiver module (and to the Spectrum Analyzer, in the case of FM/AM-1100S models).

In the 120 MHz Receiver, the 120 MHz 2nd IF is fed into a two stage heterodyning circuit, to produce a 3rd and 4th IF. The 4th IF (or final output of the 120 MHz Receiver) is a 250 kHz signal which is fed to the Audio Processing Section, where all signals are demodulated and channelled to various monitoring points on the FM/AM-1100S/A front panel (meters, speaker etc).

2-2-3 SIGNAL GENERATOR OPERATION

In the signal generator mode of operation, the frequency to be generated is determined by the setting of the RF FREQUENCY MHz Thumbwheels. The signal generation process begins with the 120 MHz Generator, which converts the Frequency Reference input of 10 kHz to an output of 120 MHz. This 120 MHz signal can be AM or FM modulated by audio signals originating in the Dual Tone Generator, as selected on the MODULATION FREQ Hz Thumbwheels. From the 120 MHz Generator, the modulated or unmodulated 120 MHz signal is fed to the 2nd Mixer through the Variable Attenuator (front panel BFO-RF LEVEL Control). Within the 2nd Mixer, the 120 MHz signal mixes with the 2nd Local Oscillator signal, to produce an IF output of approximately 1200 MHz. This 1200 MHz IF passes through the IF Filter Amplifier into the 1st Mixer, where it is mixed with the 1st Local Oscillator frequency to produce the desired output frequency (within a range of 100 Hz to 999.9999 MHz). The signal is then channelled by several relays through a 20 dB Attenuator to the TRANS/RCVR Connector in the Signal Input/Output Block. The signal output level at this connection is 0 dBm to -130 dBm (into a 50Ω load).

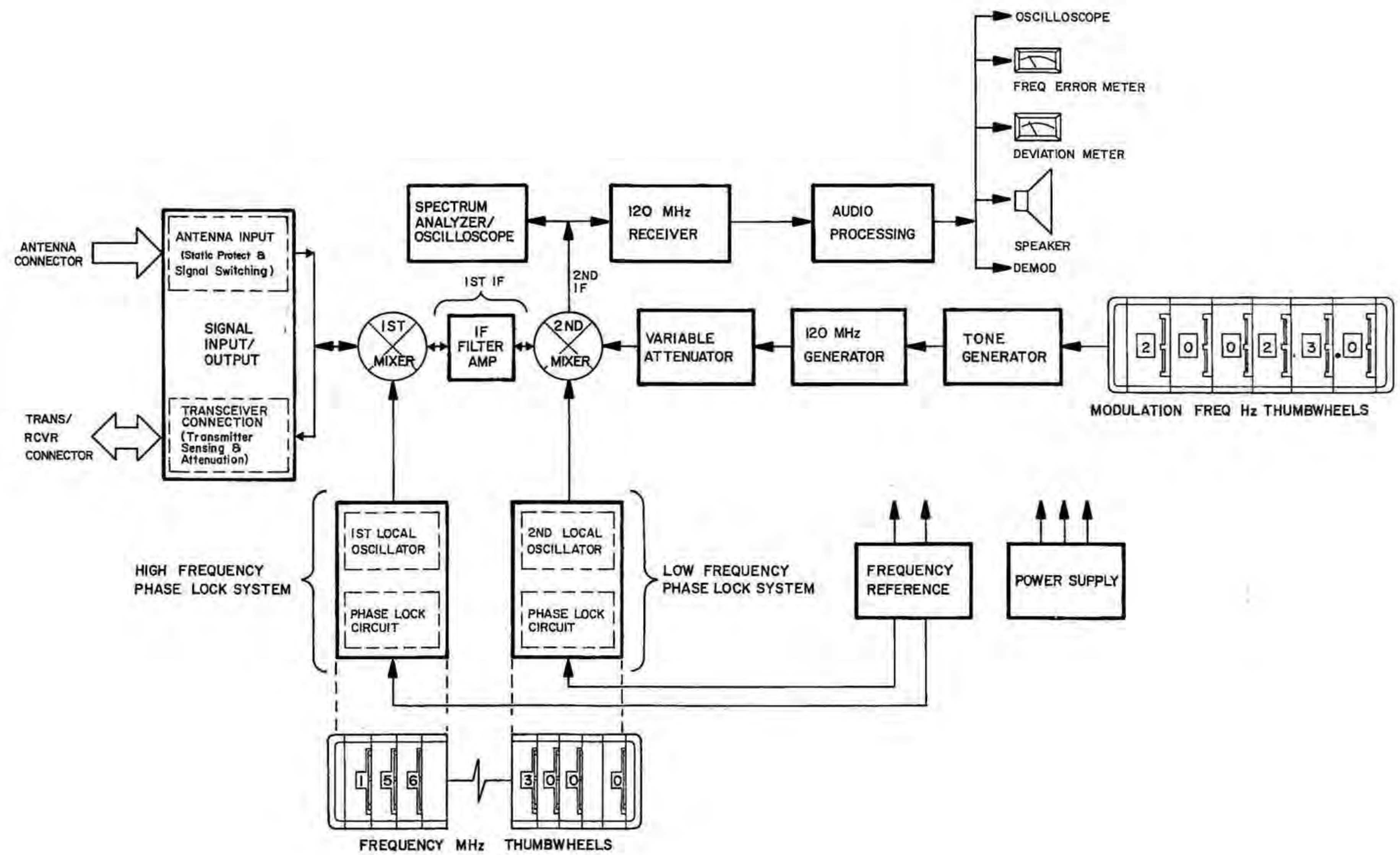


Figure 2-1 FM/AM-1100S/A Simplified Block Diagram

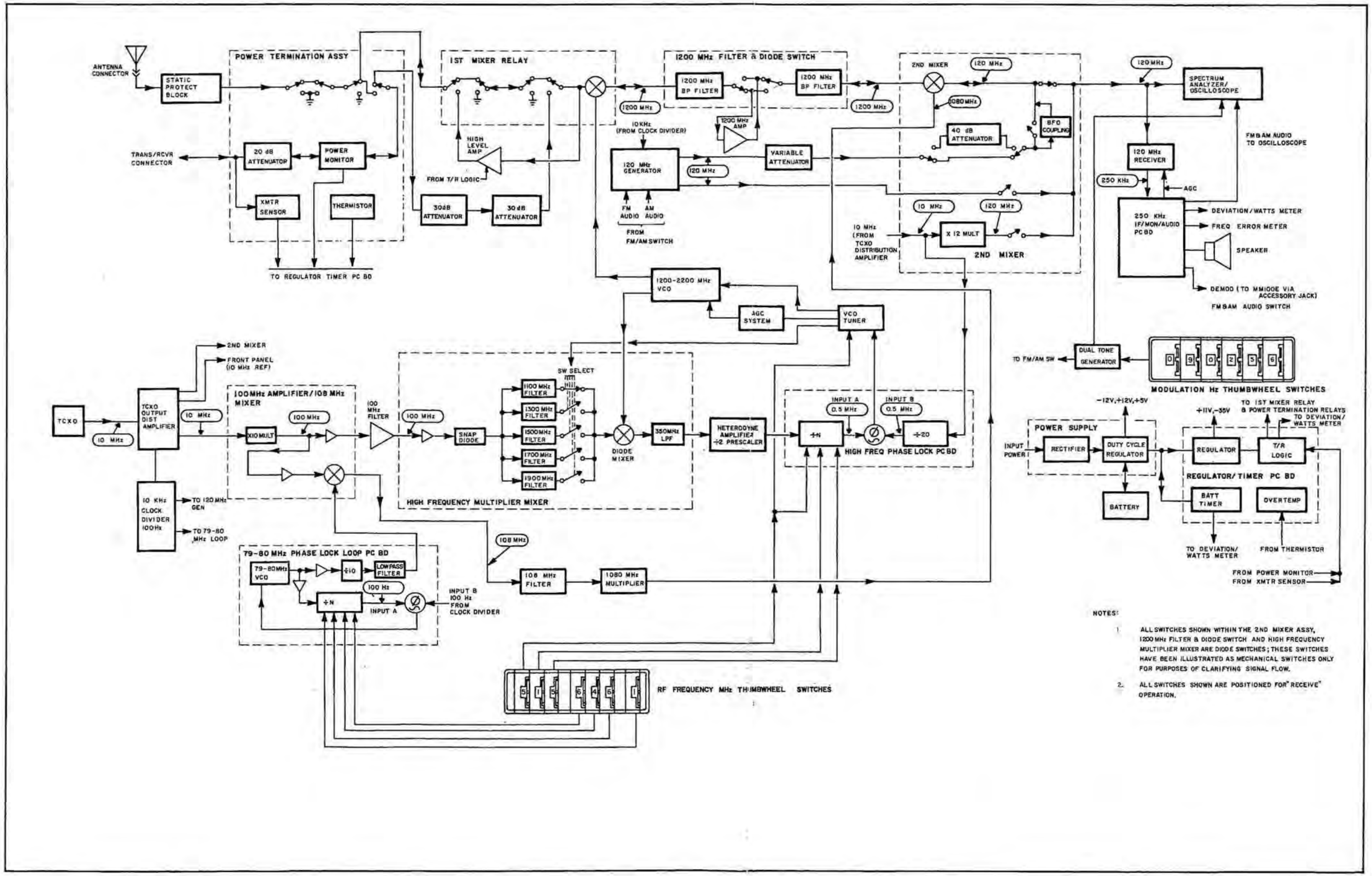


Figure 2-2 FM/AM-1100S/A Detailed Block Diagram

2-3 MODULE LEVEL THEORY OF OPERATION

2-3-1 FREQUENCY REFERENCE SYSTEM

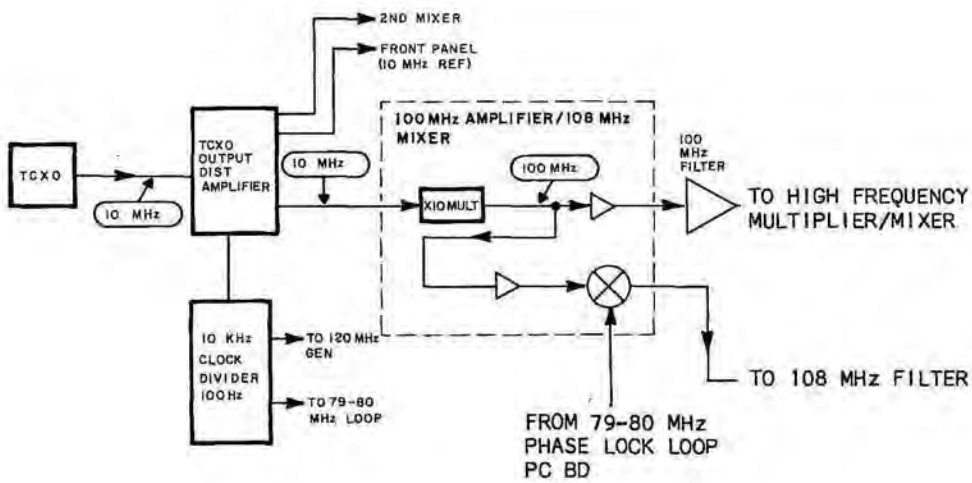


Figure 2-3 Frequency Reference System

The Frequency Reference System provides a stable frequency source for phase locking the frequency synthesizing processes which take place within the High Frequency Phase Lock System, Low Frequency Phase Lock System and 120 MHz Generator. As long as the frequency reference source provides a stable output, all other derived frequencies used elsewhere within the FM/AM-1100S/A circuitry will be within proper tolerance.

The Frequency Reference System is made up of the following modules:

TCXO (Temperature Compensated Crystal Oscillator)
TCXO Output Distribution Amplifier
Clock Divider
100 MHz Amplifier/108 MHz Mixer
100 MHz Filter

The heart of the Frequency Reference System is the TCXO, which provides a reference output of 10 MHz (±0.0005%). This 10 MHz reference signal is applied to the TCXO Output Distribution Amplifier, which amplifies the signal and distributes it to the following points:

1. Clock Divider

   The Clock Divider divides the 10 MHz reference signal down to 10 kHz and 100 Hz. The 100 Hz signal is fed into the Low Frequency Phase Lock System, while the 10 kHz signal is applied to the 120 MHz Generator.

2. <u>2nd Mixer</u>

The 10 MHz signal is also applied to the x 12 Multiplier section of the 2nd Mixer Assy, which supplies a 120 MHz reference signal to the Auto Zeroing Circuit (see 2nd Mixer Circuit Theory for description of Auto Zeroing Circuit).

3. <u>Front Panel 10 MHz OUT Connector</u>

The 10 MHz signal is applied to the Front panel 10 MHz REF OUT Connector for use as an external reference signal.

4. <u>x 10 Multiplier Section of 100 MHz Amplifier/108 MHz Mixer</u>

The 10 MHz signal is applied to the x 10 Multiplier to produce an output signal of 100 MHz, which is further amplified in the 100 MHz Filter before being passed to High Frequency Multiplier/ Mixer. The 100 MHz output signal from the x 10 Multiplier is also fed to the 108 MHz Mixer Section for further conversion within the Low Frequency Phase Lock (or 2nd Local Oscillator) System.

2-3-2 HIGH FREQUENCY PHASE LOCK SYSTEM

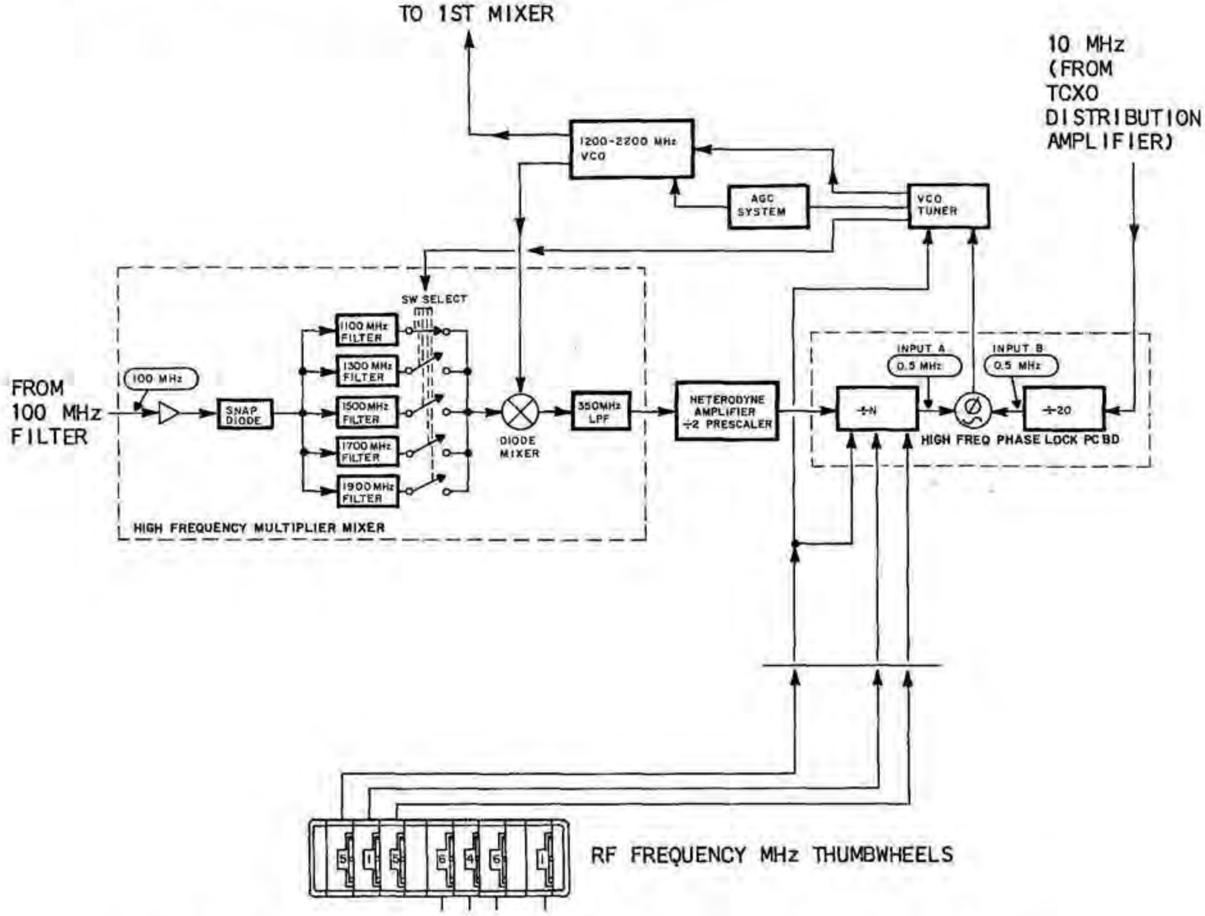


Figure 2-4 High Frequency Phase Lock System

The function of the High Frequency Phase Lock System is to phase lock the output of the 1200-2200 MHz VCO (1st Local Oscillator) with the 10 MHz TCXO reference signal, to ensure that the VCO output to the 1st Mixer is a stable and accurate derivative of that reference signal. The High Frequency Phase Lock System is made up of the following modules:

- 1200-2200 MHz VCO
- VCO Tuner PC Bd Assy
- AGC System
- High Frequency Phase Lock PC Bd Assy
- Heterodyne Amplifier/÷2 Prescaler
- High Frequency Multiplier/Mixer
- 100 MHz, 10 MHz & 1 MHz Digits of RF FREQUENCY MHz Thumbwheels

Control for the High Frequency Phase Lock System begins in the Frequency Reference Section (refer to para. 2-3-1) which provides a 100 MHz input signal to the High Frequency Multiplier/Mixer.

The 100 MHz signal is fed through an amplifier which drives a snap diode. Harmonics of the snap diode are picked off by five tuned filters at frequencies of 1100 MHz, 1300 MHz, 1500 MHz, 1700 MHz and 1900 MHz. One of five diode switches in turn, selects which filter output is applied to the single diode mixer. The diode switches are controlled by the VCO Tuner PC Bd, which through a process of binary decoding, selects the tuned filter corresponding to the value of the 100 MHz (leftmost) digit of the RF FREQUENCY MHz Thumbwheels. The relationship between the selected tuned filter, the frequency of the 1200-2200 MHz VCO and the value dialed into the 100 MHz digit of the RF FREQUENCY MHz Thumbwheels, is shown in the following table:

IF THE VALUE DIALED INTO THE 100 MHz DIGIT OF FREQUENCY MHz THUMBWHEEL IS:	THEN THE OUTPUT FREQUENCY OF THE 1200-2200 MHz VCO IS:	AND THE TUNED FILTER SELECTED IS:
0 or 1	1200 - 1399 MHz	1100 MHz
2 or 3	1400 - 1599 MHz	1300 MHz
4 or 5	1600 - 1799 MHz	1500 MHz
6 or 7	1800 - 1999 MHz	1700 MHz
8 or 9	2000 - 2199 MHz	1900 MHz

Table 2-1 1200-2200 MHz VCO Frequency Data

The output of the diode mixer in the High Frequency Multiplier/Mixer is equal to the difference between the 1200-2200 MHz VCO frequency and the selected tuned filter frequency. The difference frequency stays within a 100 to 299 MHz range. The 100 to 299 MHz output is then passed through a 350 MHz Low Pass Filter before it is divided by two in the Heterodyne Amplifier/÷2 Prescaler, which produces an output from 50 to 149.5 MHz and applied to the High Frequency Phase Lock Board. The 50 to 149.5 MHz signal is fed into the programmable frequency divider and is divided by "N", a 1-2-4-8 BCD frequency code corresponding to the frequency dialed into the 100 MHz, 10 MHz and 1 MHz digits of the RF FREQUENCY MHz Thumbwheels.

The frequency/phase detector on the High Frequency Phase Lock Board receives two simultaneous inputs, Input A and Input B in Figure 2-4. Input A is the 1200-2200 MHz VCO feedback which passes through the diode mixer, Heterodyne Amplifier/÷2 Prescaler and ÷N programmable frequency divider. Input B is a constant reference signal of 0.5 MHz, derived from the TCXO Distribution Amplifier output after being fed through the ÷20 frequency divider. If a frequency/phase difference is detected between Inputs A and B, the resultant signal (a dc level) is applied to the VCO Tuner PC Board, which slews the 1200-2200 MHz VCO frequency as necessary until Input A settles at 0.5 MHz. An indication of phase lock loop stability is also provided by the front panel High Frequency Phase Lock Lamp, which stays "ON" as long as the system remains phase locked. The AGC System maintains maximum gain in the High Frequency Phase Lock Loop to reduce phase noise in the 1200-2200 MHz VCO. The frequency of the 1200-2200 MHz VCO will always be 1200 MHz above the setting of the three leftmost digits of the RF FREQUENCY MHz Thumbwheels. In a state of equilibrium, the 1200-2200 MHz VCO always tracks the reference signal, providing a stable output to the 1st Mixer.

2-3-3 LOW FREQUENCY PHASE LOCK SYSTEM

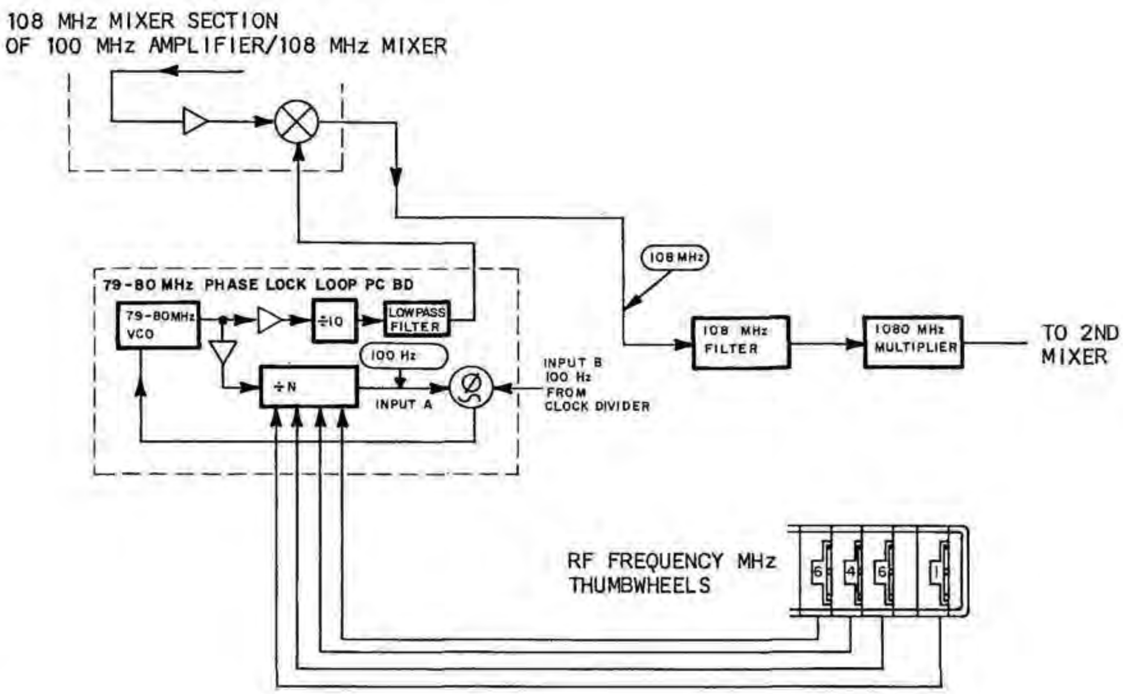


Figure 2-5 Low Frequency Phase Lock System

The function of the Low Frequency Phase Lock System is to phase lock the output of the 79-80 MHz VCO (2nd Local Oscillator) with the 100 Hz reference signal supplied by the Clock Divider, to ensure that the VCO output to the 2nd Mixer is a stable and accurate derivative of the TCXO 10 MHz output. The Low Frequency Phase Lock System is made up of the following modules:

- 79-80 MHz Low Loop PC Bd Assy (Contains 79-80 MHz VCO)
- 108 MHz Mixer section of 100 MHz Amplifier/108 MHz Mixer
- 108 MHz Bandpass Filter
- 1080 MHz Multiplier/Amplifier
- 100 kHz, 10 kHz, 1 kHz & 100 Hz digits of RF FREQUENCY MHz Thumbwheels

The 79-80 MHz VCO output is fed into a phase lock loop consisting of an amplifier, a ÷N programmable divider and a frequency/phase detector. In the programmable divider, the VCO output is divided by "N", a 1-2-4-8 BCD frequency code corresponding to the values dialed into the 100 kHz, 10 kHz, 1 kHz and 100 Hz digits of the RF FREQUENCY MHz Thumbwheels.

The output of the programmable divider is fed into the frequency/phase detector as Input A. Input B to the frequency/phase detector consists of a constant 100 Hz reference signal supplied by the Clock Divider. If a frequency/phase difference is detected between Inputs A and B, the resultant difference signal (a DC level) causes the 79 to 80 MHz VCO output to slew up or down until Input A settles at 100 Hz and is equal to Input B. In this stable state, the VCO will continue to track the reference signal, until the setting of the four rightmost RF FREQUENCY MHz Thumbwheels are altered. As long as the Low Frequency Phase Lock System is phase locked, the front panel Low Frequency Phase Lock Lamp will remain "ON".

The phase locked VCO output is then buffered, fed through a ÷10 frequency divider and filtered to produce an output range of 7.9 to 8.0 MHz, which is applied to the mixer section of the 100 MHz Multiplier/108 MHz Mixer. The 7.9 to 8.0 MHz signal is mixed with a 100 MHz signal supplied by the multiplier section of the 100 MHz Multiplier/108 MHz Mixer, to produce an output of 107.9 to 108 MHz. This output is filtered in the 108 MHz Filter and multiplied by 10 in the 1080 MHz Multiplier, to produce a 1079 to 1080 MHz signal which is fed into the 2nd Mixer.

2-3-4 SIGNAL INPUT/OUTPUT BLOCK

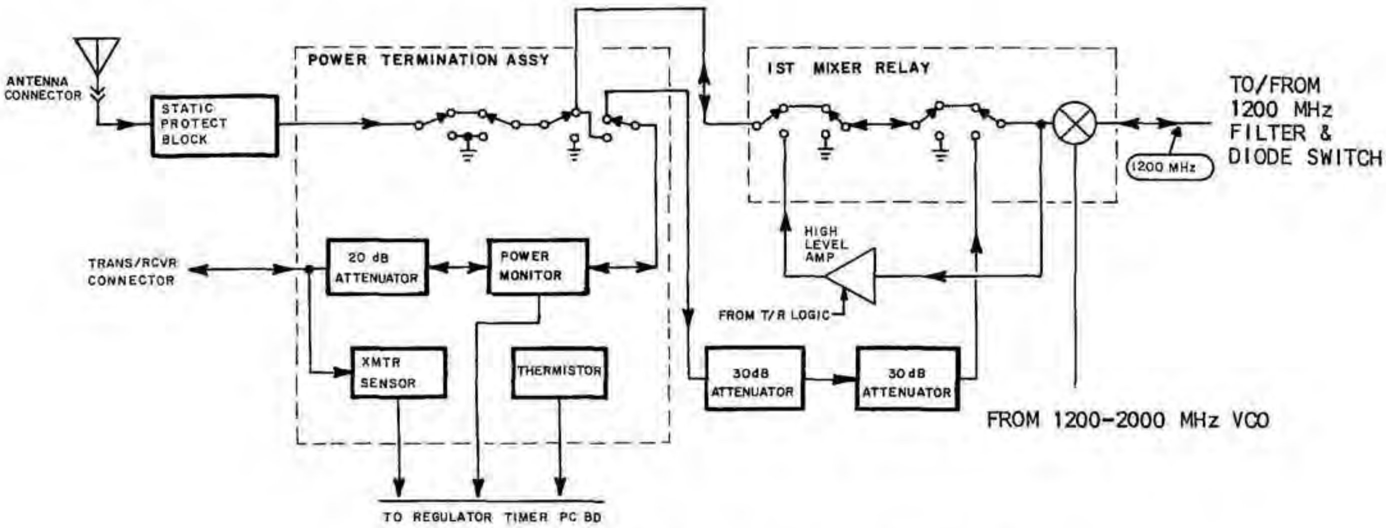


Figure 2-6 Signal Input/Output Block

The Signal Input/Output Block consists of several channelling relays, sensors, attenuators and an amplifier which direct signal flow through the front end of the FM/AM-1100S/A during receiver or generator operation. In the receive mode, external signals may be applied to the FM/AM-1100S/A at the ANTENNA Connector when receiving "off-the-air" signals or at the TRANS/RCVR Connector when receiving signals via direct cable connection. In the generate mode, all signals are transmitted out through the TRANS/RCVR Connector.

The components which make up the Signal Input/Output Block are listed in Table 2-2 below. Each component listed is also identified according to function, indicating whether the component is active during receiver or generator operation (or both).

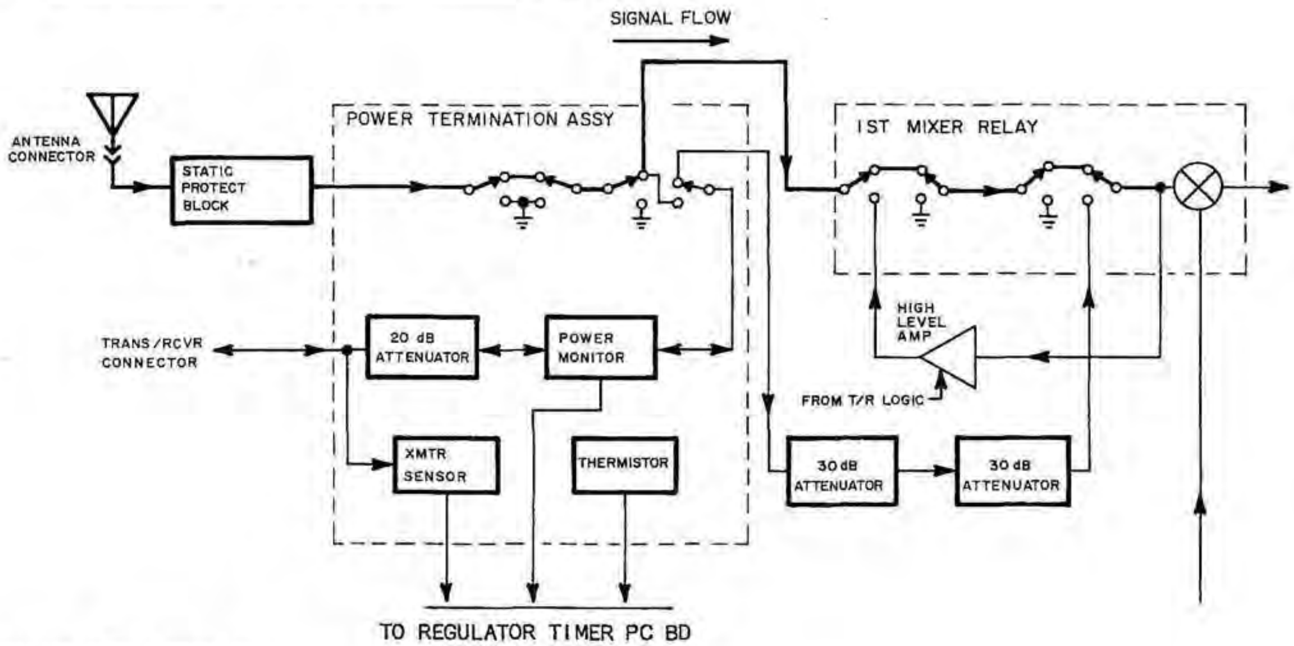
COMPONENT	RECEIVE	GENERATE
Antenna	X	
Static Protect Block	X	
1st Mixer Relay	X	X
High Level Amplifier		X
Power Termination Assembly	X	X

Table 2-2 Signal Input/Output Block Components

For purposes of clarity, signal flow through the Signal Input/Output Block is described separately for the following modes of operation:

1. Receiving "Off-the-Air" Signals
2. Receiving Signals Via Direct Cable Connection
3. Generating Signals Less than -40 dBm.
4. Generating Signals Greater than -40 dBm.

1. Receiving "Off-the-Air" Signals



OPERATION MODE: RECEIVE
INITIAL CONDITIONS:
POWER TERMINATION RELAY: DE-ENERGIZED
1ST MIXER RELAY: DE-ERERGIZED

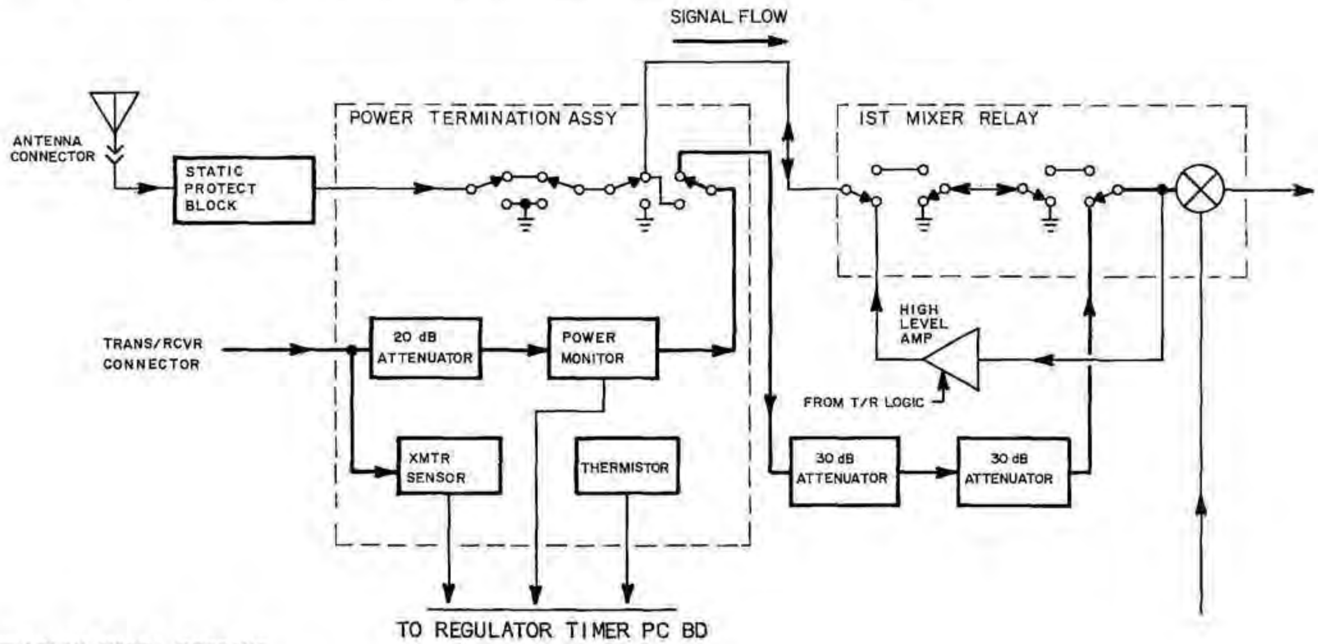
Figure 2-7 Signal Input/Output Block (Receive Signal Flow)

The transmitted signal is received by the FM/AM-1100S/A external antenna and is fed through the Static Protect Block. This circuit functions as a static discharge, protecting the 1st Mixer in case of excessive static electricity at the ANTENNA Connector. As the signal passes through the Static Protect Block, the frequency remains the same, but the amplitude may be slightly attenuated. The signal is then fed through the de-energized Power Termination Assembly and 1st Mixer Relays to the 1st Mixer.

CAUTION

THE INPUT POWER LIMIT FOR THE 1ST MIXER IS .25 WATTS. DO NOT, UNDER ANY CIRCUMSTANCES, APPLY A SIGNAL IN EXCESS OF .25 WATTS TO THE ANTENNA CONNECTOR OR DAMAGE TO THE 1ST MIXER MAY RESULT.

2. Receiving Signals Via Direct Cable Connection



OPERATION MODE: RECEIVE
INITIAL CONDITIONS:
POWER TERMINATION RELAY: DE-ENERGIZED
1ST MIXER RELAY: DE-ENERGIZED (Before signal is applied)

Figure 2-8 Signal Input/Output block (Receive Signal Flow)

The received signal is applied at the TRANS/RCVR Connector and into the Transmitter Sensor, which places the set into the receive mode, (if not already in that mode). This signal is also fed through a 20 dB Attenuator which decreases the signal strength to an acceptable input level for the Power Monitor. As the signal is fed through the Power Monitor, it is detected and a DC voltage proportional to the input power is sent to the Regulator/Timer PC Board. This DC level operates the front panel DEVIATION/WATTS Meter, with the DEV/POWER Control in the "x 1", "x 10" or "x 100" positions. The Regulator/Timer PC Board also processes this voltage to energize the 1st Mixer Relay. After passing through the Power Termination Relay, the signal is further attenuated by the 60 dB of attenuation to decrease the signal strength to an acceptable input level for the 1st Mixer.

3. Generating Signals Less than -40 dBm.

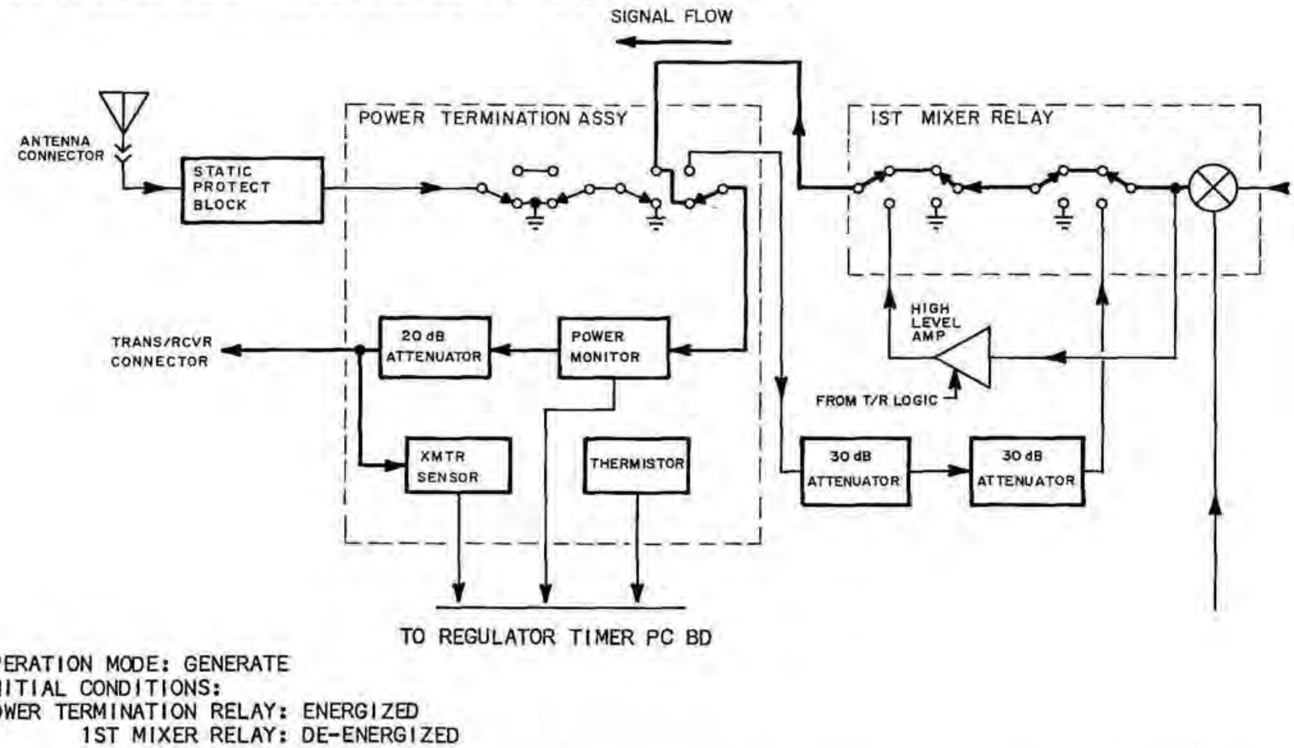


Figure 2-9 Signal Input/Output Block (Generate Signal Flow)

In the generate mode, the output of the 1st Mixer (a difference signal equal to the desired "generate" frequency) is passed through the 1st Mixer Relay, which is in the de-energized state. The signal is then fed through the energized Power Termination Relay, through the Power Monitor, and through the 20 dB Attenuator, where the signal strength is decreased by 20 dB. The signal then passes to the output point at the TRANS/RCVR Connector and to the Transmitter Sensor.

If the FM/AM-1100S/A is in the generate mode and an external signal to be received is applied at the TRANS/RCVR Connector, the set will automatically switch to the receive mode (see subparagraph "2. Receiving Signals Via Direct Cable Connection"). As soon as the input signal is removed from the TRANS/RCVR Connector, the Power Termination and 1st Mixer Relays will automatically return to their original states for generator operation.

4. Generating Signals Greater than -40 dBm.

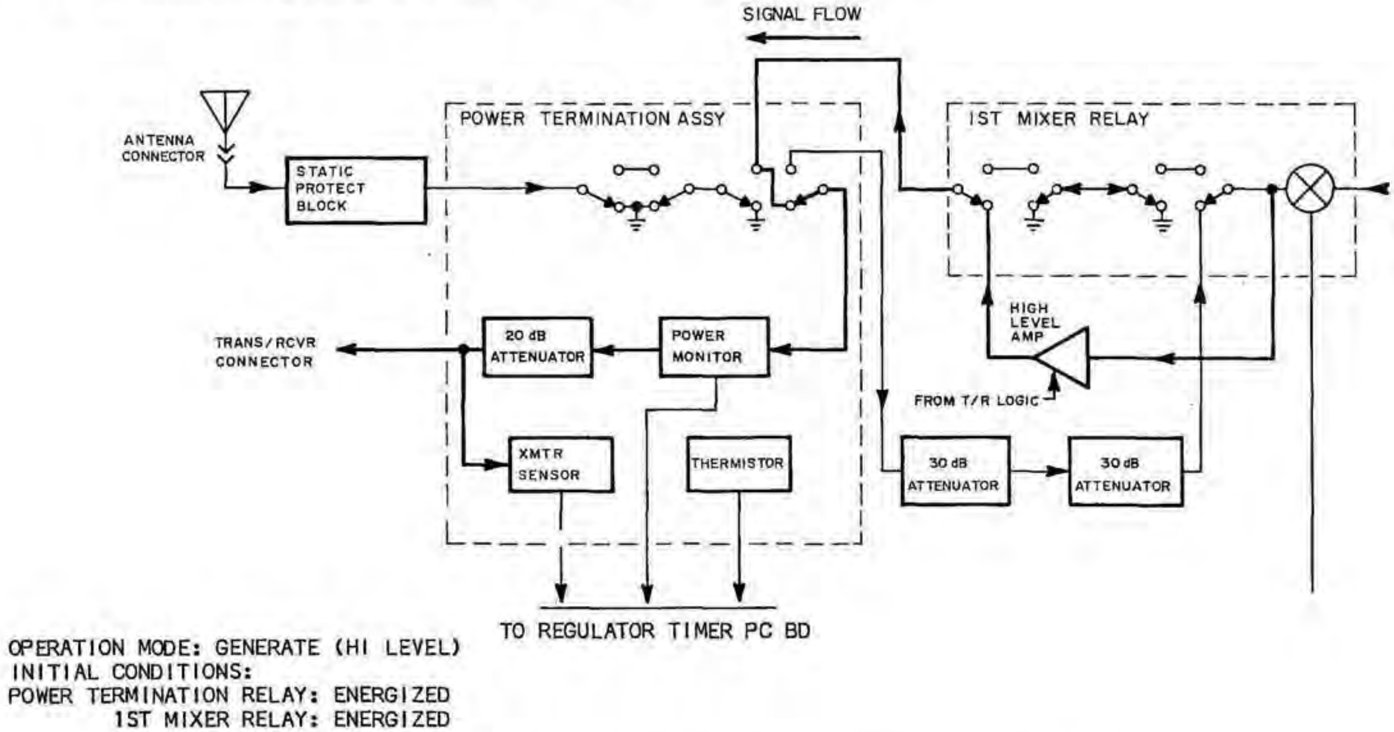


Figure 2-10 Signal Input/Output Block (Generate Signal Flow - HI LVL Mode)

The 1st Mixer output (or difference signal equal to the desired "generate" frequency) is fed through the High Level Amplifier, where the signal strength is amplified to some point above +20 dBm. Whenever +20 dBm is detected at the output of the High Level Amplifier, the 0 dBm Indicator Lamp on the FM/AM-1100S/A front panel will be "ON". The signal is then fed into the energized Power Termination Relay and passed through the 20 dB Attenuator, where the signal strength is decreased to 0 dBm. From there, the signal is passed to the Transmitter Sensor and to the output point at the TRANS/RCVR Connector.

If the FM/AM-1100S/A is in the "HI LVL" generate mode and an external signal to be received is applied at the TRANS/RCVR Connector, the set will automatically switch to the receive mode (see subparagraph "2. Receiving Signals Via Direct Cable Connection").

2-3-5 1ST MIXER

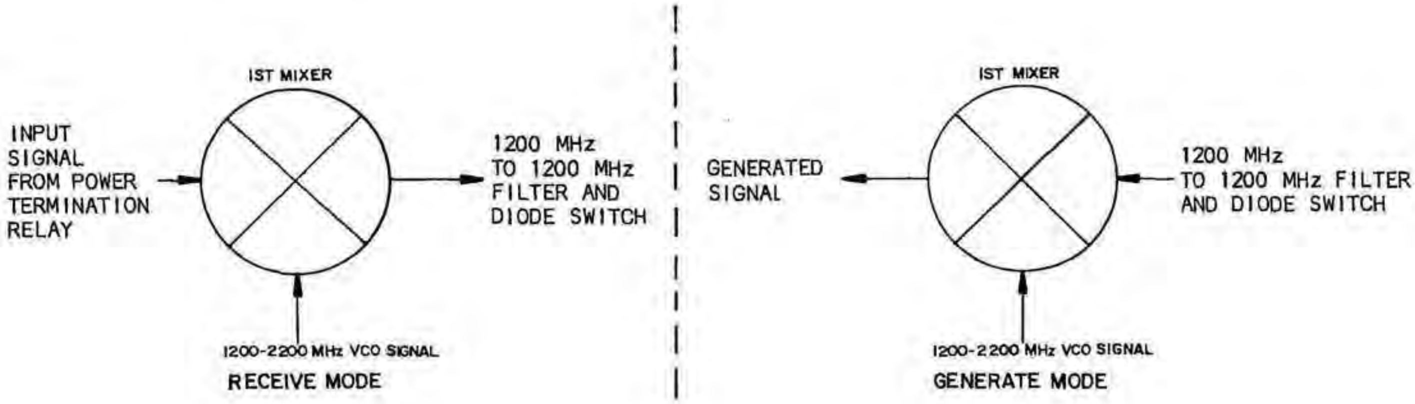


Figure 2-11 1st Mixer (Receive/Generate Signal Flow)

During receiver operation, the 1st Mixer receives the input signal from the Power Termination Relay. In the 1st Mixer, the input signal is mixed with the output of the 1200-2200 MHz VCO (1st Local Oscillator) to produce four separate outputs consisting of the sum, difference and original fundamental frequencies.

NOTE

> The sum and difference signals are predominant, while the two fundamentals are significantly attenuated.

The signal of interest during receiver operation is the difference signal, which is equal to approximately 1200 MHz in all cases. This 1200 MHz signal is referred to as the 1st IF up to the point where it enters the 2nd Mixer stage.

During generator operation, signal flow through the 1st Mixer is in a direction opposite to that in the receive mode. The 1200 MHz IF output produced by the 2nd Mixer is fed into the 1st Mixer and is mixed with the output of the 1200-2200 MHz VCO. The resultant output of the 1st Mixer includes the difference signal, (which represents the desired "generate" frequency), the sum of the two input signals and the fundamentals.

2-3-6 IF FILTER AMPLIFIER

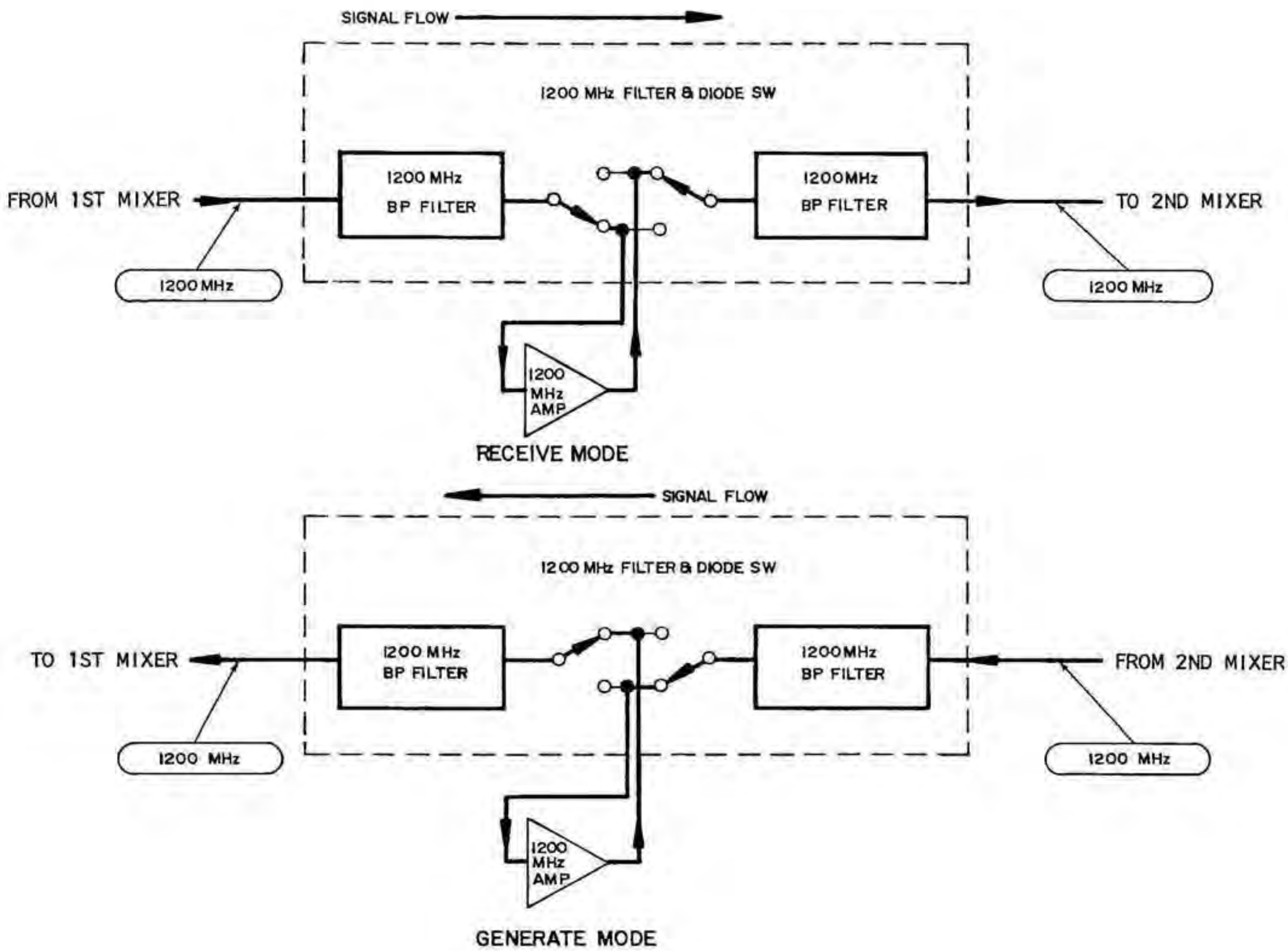


Figure 2-12 IF Filter Amplifier (Receive/Generate Signal Flow)

The IF Filter Amplifier is made up of the 1200 MHz Filter & Diode Switch and 1200 MHz Amplifier Assembly. The 1200 MHz Filter & Diode Switch is a bidirectional filter for the 1200 MHz IF produced by the 1st Mixer in the receive mode and the 2nd Mixer in the generate mode.

During receiver operation, the four 1st Mixer products (described under 1st Mixer theory) are applied to the 1200 MHz Filter & Diode Switch. The 1200 MHz bandpass filter rejects all signals except the 1200 MHz difference signal (or 1st IF), which is passed through the 1200 MHz Amplifier. The amplified 1200 MHz signal is then fed through a second 1200 MHz bandpass filter and out to the 2nd Mixer. Signal flow through the 1200 MHz Filter & Diode Switch and 1200 MHz Amplifier is controlled by two switches which remain positioned as shown in Figure 2-12, as long as the FM/AM-1100S/A is in the receive mode.

NOTE

> The switches used in the 1200 MHz Filter & Diode Switch are solid state diode switches and as such, do not physically change position. These switches are shown as mechanical switches in the above figure, only for purposes of clarifying signal flow.

In the generate mode, signal flow is in a direction opposite to that in the receive mode and the switches in the 1200 MHz Filter & Diode Switch are reversed accordingly. As with the 1st Mixer, the 2nd Mixer also produces four separate outputs which are applied to the 1200 MHz Filter & Diode Switch. The sum signal of approximately 1200 MHz is passed through the two bandpass filters and amplifier to the 1st Mixer, while the remaining three outputs are rejected.

2-3-7 2ND MIXER ASSY.

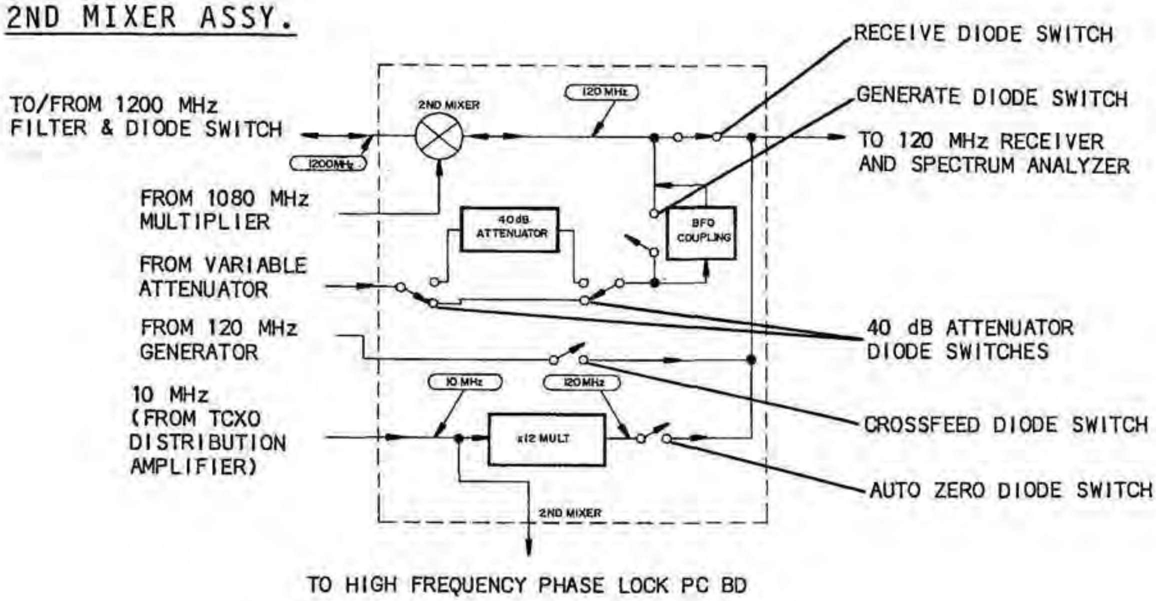


Figure 2-13 2nd Mixer Assy

The 2nd Mixer Assy contains the 2nd Mixer, a 40 dB attenuator, a BFO coupling resistor, a x 12 frequency multiplier and six diode switches. In addition to its primary function of frequency conversion, the 2nd Mixer Assy also contains the control and switching circuitry associated with the operation of the BFO (Beat Frequency Oscillator) and the generation of auto zero reference signals. Each of the major functions of the 2nd Mixer Assy are described below.

NOTE

> The switches used in the 2nd Mixer Assy are solid state diode switches. These switches are shown as mechanical switches in all applicable figures, only for purposes of clarifying signal flow.

1. Signal Flow for Receive/Generate Modes (See Figures 2-14 & 2-15)

   In the receive mode, the 1200 MHz IF signal from the 1200 MHz Filter & Diode Switch is fed into the 2nd Mixer and is mixed with the 1079 to 1080 MHz signal produced by the Low Frequency Phase Lock System. The significant signal of the resultant four mixer outputs (sum, difference and fundamentals) is the 120 MHz difference signal, which is passed on to the 120 MHz Receiver Assy (and Spectrum Analyzer on FM/AM-1100S models), by way of the receive diode switch.

   In the generate mode, 120 MHz signal produced by the 120 MHz Generator Assy is fed through the Variable Attenuator Assy and into the 2nd Mixer Assy. The signal is then applied to the 2nd Mixer by way of the 40 dB attenuator diode switches and the generate diode switch.

NOTE

If the front panel HI LVL/µV x 100/NORM Switch is in "NORM" position, the 40 dB attenuator is selected; if switch is in the "HI LVL" or "µV x 100" position, the attenuator is bypassed.

In the 2nd Mixer, the 120 MHz signal is mixed with the 1079-1080 MHz output of the Low Frequency Phaselock System to produce the 1200 MHz IF (sum signal) which is fed to the 1200 MHz Filter & Diode Switch.

During the generate signal flow just described, a second 120 MHz signal or "crossfeed" signal is simultaneously produced by the 120 MHz Generator and is passed through the crossfeed diode switch to the 120 MHz Receiver Assy (and Spectrum Analyzer on FM/AM-1100S models). This signal enables the operator to view a representation of the 120 MHz generated signal on the FM/AM-1100S Spectrum Analyzer and use the FM/AM-1100S/A monitoring features to monitor modulation.

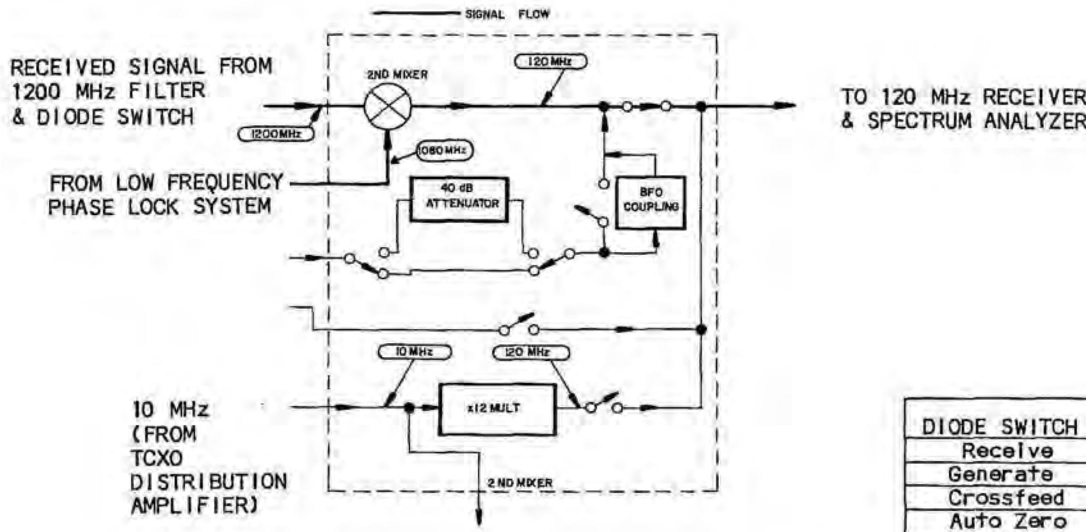
2. Signal Flow for Receive Mode Using BFO Function (See Figure 2-16)

When monitoring CW or SSB signals using the BFO function, the 120 MHz BFO signal produced by the 120 MHz Generator Assy is fed into the 2nd Mixer Assy to beat with the incoming CW or SSB signal. The BFO signal, which at the operator's option can be fed through the selectable 40 dB Attenuator, is coupled to the 2nd Mixer output by the BFO coupling resistor.

3. Auto Zero Reference Signal Flow (See Figure 2-17)

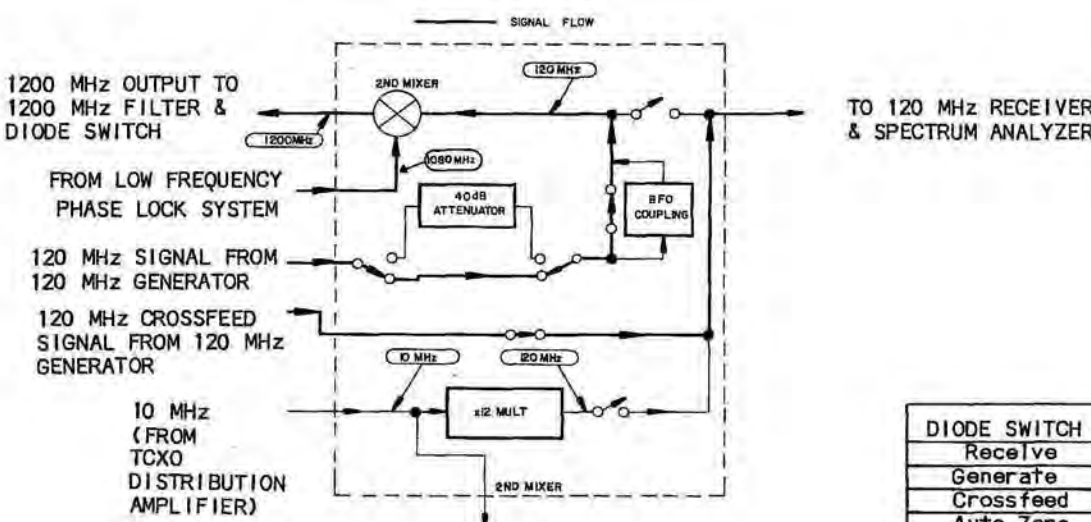
The function of the auto zero circuit is to supply a reference signal to the 250 kHz IF/MON/AUDIO PC Board Assy in order to compensate for any local oscillator offset in the 120 MHz Receiver or any offset in the frequency error meter driver circuit on the 250 kHz IF/MON/AUDIO PC Board. The reference signal (which occurs every 1.5 seconds for a 3 ms duration) is used by the 250 kHz IF/MON/AUDIO PC Board to produce a correction voltage, which will zero the output of the Frequency Error Meter Driver.

The source for the auto zero reference signal is a 10 MHz signal from the TCXO Output Distribution Amplifier which is applied to the diode x 12 multiplier in the 2nd Mixer Assy. The multiplier passes the 12th harmonic to provide an output of 120 MHz. This 120 MHz signal (which occurs every 1.5 seconds for a 3 ms duration) is then fed through the auto zero diode switch to the 120 MHz Receiver. During the 3 ms period, the receive diode switch is open, thereby interrupting the 2nd Mixer output to the 120 MHz Receiver (and Spectrum Analyzer on FM/AM-1100S models). Similarly, when in the generate mode, the crossfeed diode switch is open during the 3 ms period, interrupting the 120 MHz crossfeed signal to the 120 MHz Receiver (and Spectrum Analyzer on FM/AM-1100S models). From the 120 MHz Receiver, the auto zero reference signal is converted to 250 kHz and fed into the 250 kHz IF/MON/AUDIO PC Board.



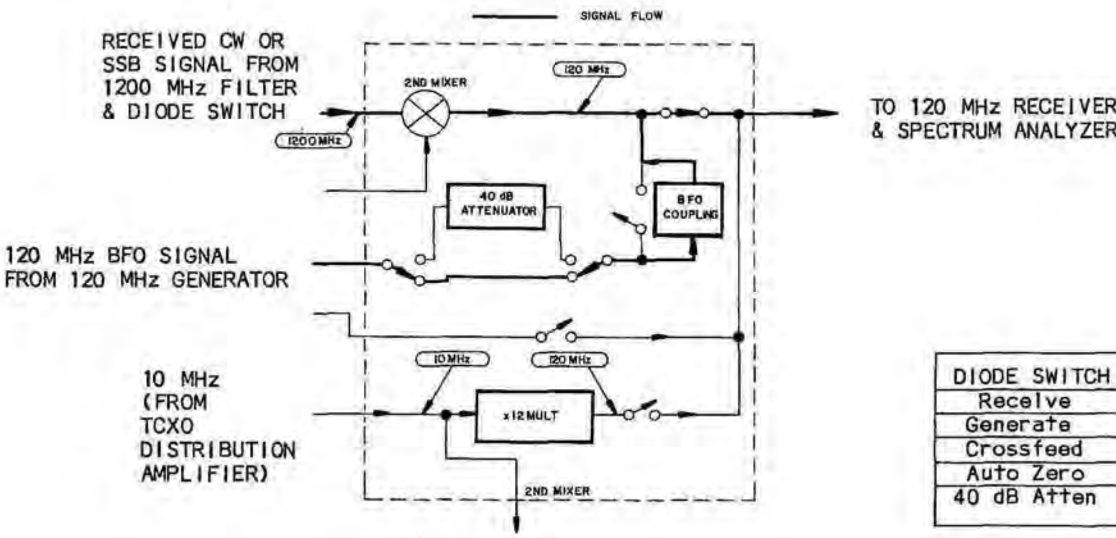
DIODE SWITCH	POSITION
Receive	Closed
Generate	Open
Crossfeed	Open
Auto Zero	Open

Figure 2-14 2nd Mixer Assy (Receive Signal Flow)



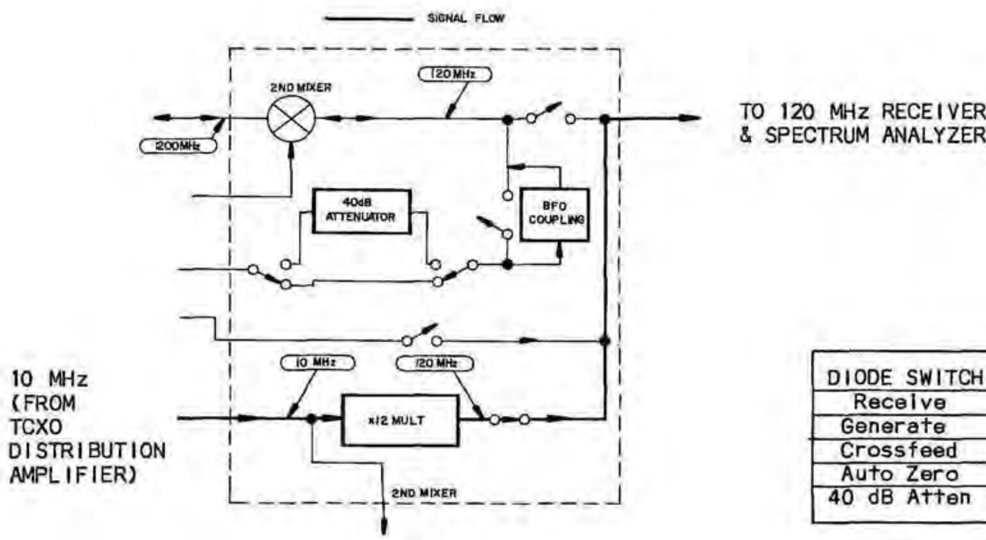
DIODE SWITCH	POSITION
Receive	Open
Generate	Closed
Crossfeed	Closed
Auto Zero	Open
40 dB Atten	Open or Closed

Figure 2-15 2nd Mixer Assy (Generate Signal Flow)



DIODE SWITCH	POSITION
Receive	Closed
Generate	Open
Crossfeed	Open
Auto Zero	Open
40 dB Atten	Open or Closed

Figure 2-16 2nd Mixer Assy (Receive Signal Flow Using BFO Function)



DIODE SWITCH	POSITION
Receive	Open
Generate	Open or Closed
Crossfeed	Open
Auto Zero	Closed
40 dB Atten	Open or Closed

Figure 2-17 2nd Mixer Assy (Auto Zero Reference Signal Flow)

2-3-8 120 MHz RECEIVER

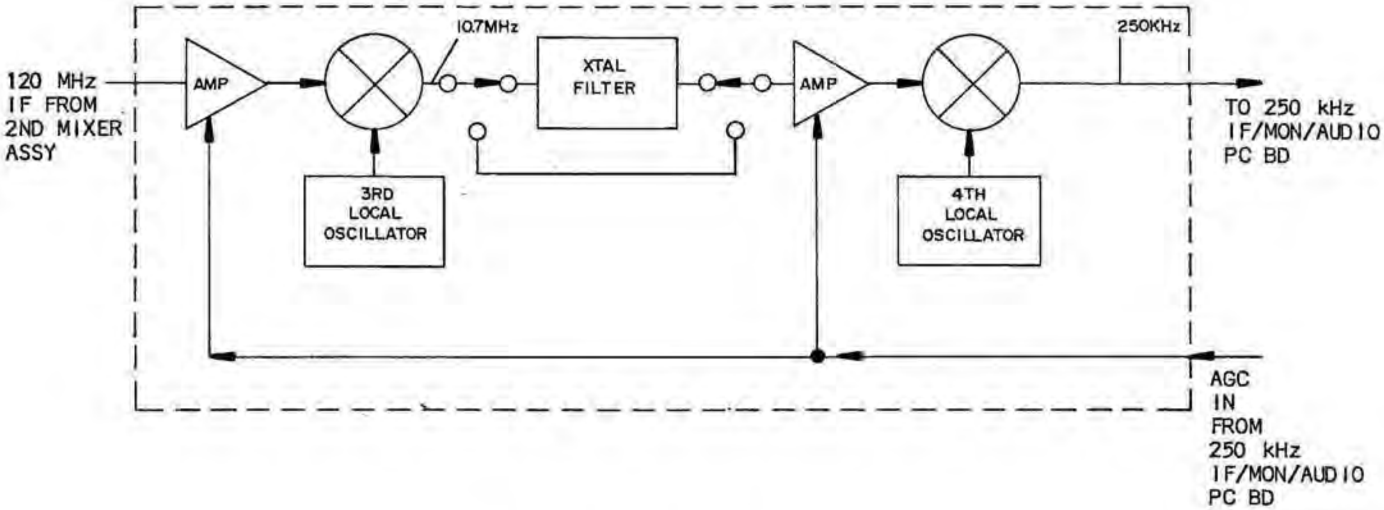


Figure 2-18 120 MHz Receiver (Receive Signal Flow)

The 120 MHz Receiver Assy is tuned to receive the 120 MHz 2nd IF signal produced by the 2nd Mixer Assy. In the receiver, the 120 MHz IF signal is mixed with the outputs of the 3rd and 4th local oscillators, to produce a 3rd IF of 10.7 MHz and 4th IF of 250 kHz. The 250 kHz output is then fed to the 250 kHz IF/MON/AUDIO PC Bd.

The 120 MHz Receiver also receives control inputs for RF bandwidth switching and AGC. Narrow RF bandwidth selection is enabled through the front panel bandwidth control (RCVR WIDE/MID/NARROW Switch) which switches in a 10.7 MHz crystal filter with a ±8 kHz bandpass, to reduce the bandwidth of the 3rd IF. For wide or midrange bandwidths, the crystal filter is bypassed and the 3rd IF is passed on to the 4th Mixer.

The AGC input from the 250 kHz IF/MON/AUDIO PC Bd assures that the 250 kHz output of the 120 MHz Receiver is at a proper level as it is applied to the audio processing circuits of the 250 kHz IF/MON/AUDIO PC Bd.

2-3-9 AUDIO PROCESSING SYSTEM

The 250 kHz IF/MON/AUDIO PC Bd performs numerous audio processing functions which enable the operator to monitor selected characteristics of the demodulated audio signal being received or generated.

The 250 kHz IF signal from the 120 MHz Receiver is applied to the 250 kHz IF/MON/AUDIO PC Bd, where the signal is amplified and fed to the AM Detector and FM Discriminator circuits for simultaneous demodulation. At the input of the AM Detector, the 250 kHz IF signal is also applied to the oscilloscope to provide a display of the AM modulated envelope. The AM Detector output provides:

1. AGC feedback to the 120 MHz Receiver to control the receiver output level.

2. A signal level to the squelch circuit for audio muting purposes.

3. A signal level to the DEVIATION/WATTS Meter circuit for a representation of signal strength.

4. A demodulated AM audio signal which is applied to the front panel AM/FM Switch.

In the FM Discriminator, the 250 kHz IF signal is filtered by either an 8 kHz or 80 kHz lowpass filter for audio bandwidth shaping. The filter is controlled by the front panel RCVR WIDE/MID/NARROW Switch, which selects the 8 kHz filter in the MID and NARROW positions and the 80 kHz filter in the WIDE position. At the output of the FM Discriminator, signal voltages are applied to the frequency error and deviation meter circuits, to provide indications of received signal frequency offset and peak FM deviation. A demodulated FM audio signal is also applied to the front panel AM/FM Switch and Oscilloscope.

The 250 kHz IF/MON/AUDIO PC Bd also generates control pulses for the auto zeroing circuit, which drives the diode switches in the 2nd Mixer Assy and switches in a DC feedback signal to zero the front panel FREQ ERROR Meter. During the 3 ms intervals that the auto zeroing circuit is active, the AGC output to the 120 MHz Receiver is disabled and the flow of modulation information to the monitoring circuits is interrupted.

As previously described, the demodulated AM and FM audio outputs from the AM Detector and FM Discriminator are applied to the front panel AM/FM Switch. This switch selects the desired signal and applies it to the front panel EXT ACC Connector and INT MOD/RCVR/RCVR (DET OFF) Switch. The EXT ACC Connector allows the selected demod signal to be channelled to the optional MM-100E Multi-Meter for AM% modulation measurements and other monitoring functions. The INT MOD/RCVR/RCVR (DET OFF) Switch in turn, selects either the demod signal (RVCR) or Dual Tone Generator output (VAR/OFF) and applies it through the VOLUME Control to the audio power amplifier in order to drive the FM/AM-1100S/A Speaker.

2-3-10 OSCILLOSCOPE

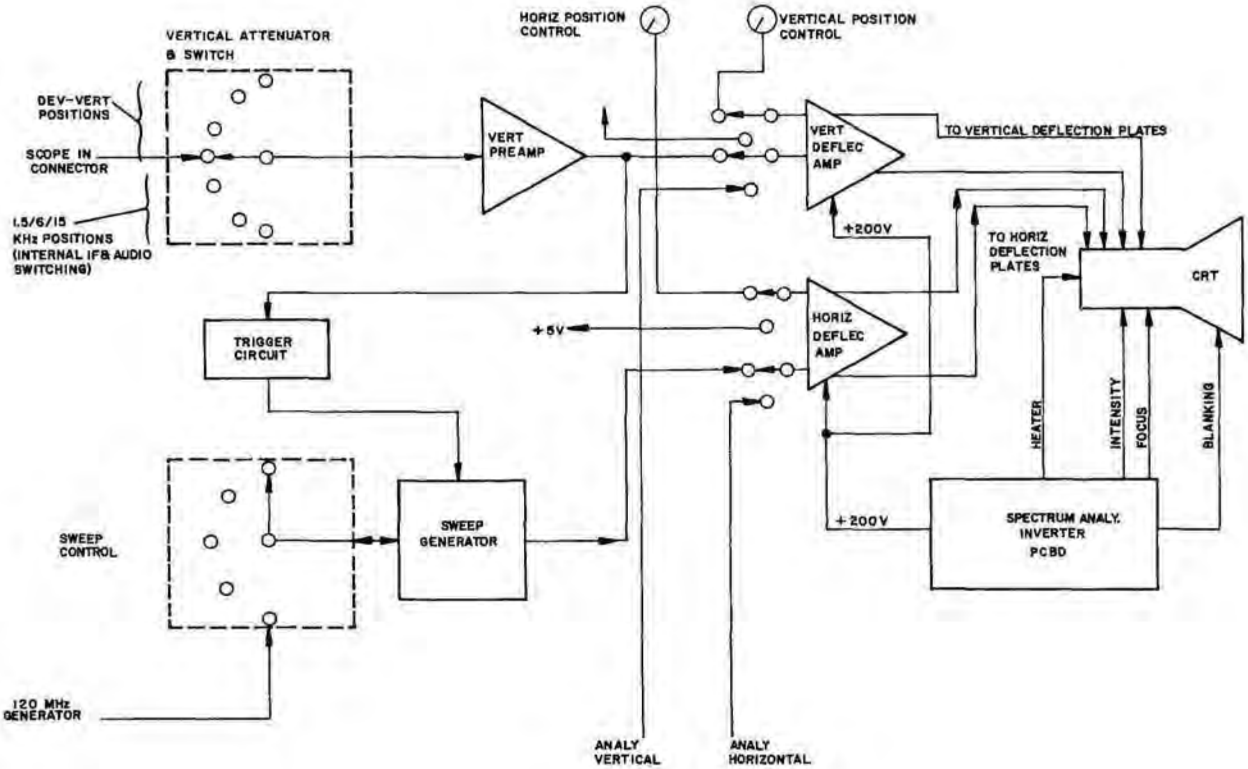


Figure 2-19 Oscilloscope Block Diagram

The FM/AM-1100S/A Oscilloscope consists of the Spectrum Analyzer Inverter PC Bd, the Spectrum Analyzer Main PC Bd, the CRT, the front panel DEV-VERT Control (vertical attenuator & switch assy) and SWEEP Control (sweep generator).

Power to the Oscilloscope is provided by the front panel AC/OFF/DC Switch, which applies +12 volts DC from the Power Supply Assembly to the Spectrum Analyzer Inverter PC Bd, when in the "AC" or "DC" position. The Spectrum Analyzer Inverter PC Bd, in turn, develops +200 volts DC for the vertical/horizontal deflection circuits on the Oscilloscope Main PC Bd, -2000 volts DC for the CRT cathode, as well as several biasing voltages for the CRT heater, focus, intensity and retrace blanking functions.

An external signal to be viewed on the oscilloscope is applied through the front panel SCOPE IN Connector to the vertical attenuator & switch Assy, where the signal is attenuated in selected increments relative to the CRT graticule. From the vertical attenuator & switch, the incoming signal is fed through a vertical pre-amplifier to one input of the vertical deflection amplifier, which also receives a simultaneous and separate input from the vertical positioning control (front panel VERT Control). The amplifier amplifies the difference between the two inputs, producing two outputs 180 degrees out of phase, which are applied to the vertical deflection plates of the CRT. The CRT can also display a demodulated FM audio signal (in FM mode) or 250 kHz IF signal (in AM mode), when the front panel DEV-VERT Control is in the 1.5, 6 or 15 kHz position. These signals are internally generated and when selected, disable any external inputs to the oscilloscope. The output of the vertical preamplifier is also applied to a triggering circuit which senses the zero crossing of the input signal and triggers the retrace, keeping the sweep in sync with the input signal. The sweep generator frequency is determined by the position of the front panel SWEEP Control, which selects the desired sweep frequency or switches in the Dual Tone Generator output. The sweep signal or Dual Tone Generator output is then applied to one input of the horizontal deflection amplifier. A second input to the horizontal deflection amplifier is also provided by the horizontal positioning control (front panel HORIZ Control). The output of the horizontal deflection amplifier consists of two signals 180 degrees out of phase which are applied to the horizontal deflection plates of the CRT.

NOTE

The internal switches at the input vertical and horizontal deflection amplifiers are used to apply either the oscilloscope or spectrum analyzer inputs to the CRT. The Oscilloscope Block Diagram in Figure 2-19 shows the switches positioned for oscilloscope operation.

2-3-11 SPECTRUM ANALYZER (Applies to FM/AM-1100S models only)

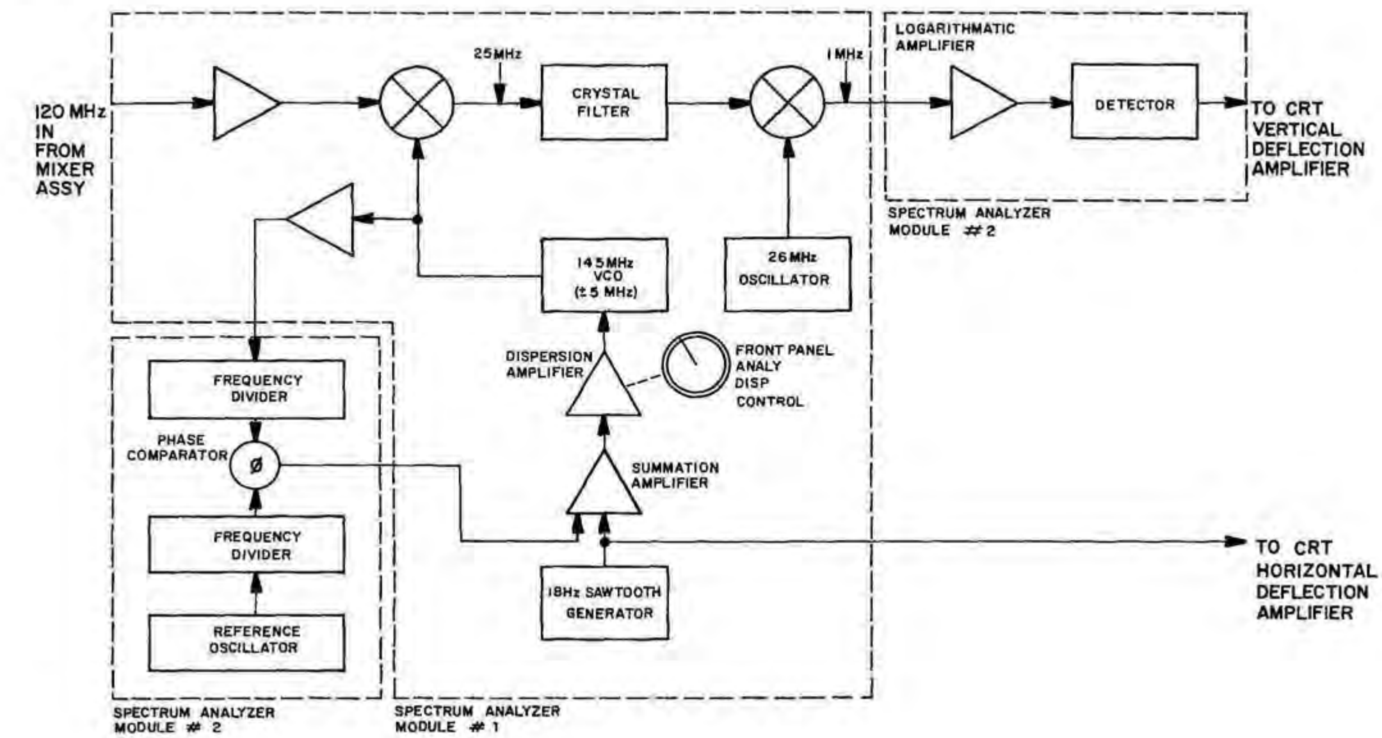


Figure 2-20 Spectrum Analyzer Block Diagram

The FM/AM-1100S Spectrum Analyzer function uses the CRT, the horizontal and vertical deflection circuits of the Spectrum Analyzer Main PC Bd, the Spectrum Analyzer Inverter PC Bd and Spectrum Analyzer Modules #1 and #2. The amplitude and frequency characteristics of a signal are processed in Spectrum Analyzer Modules #1 and #2 and are applied to the vertical/horizontal amplifiers on the Spectrum Analyzer Main PC Bd, for display on the CRT. Power to the Spectrum Analyzer is enabled by the front panel AC/OFF/DC Switch, which applies 12 volts DC from the Power Supply to the Spectrum Analyzer Inverter PC Bd, when in the "AC" or "DC" position. The front panel ANALY DISP Control applies +12 volts to an 11 volt regulator, which in turn, powers Spectrum Analyzer Modules #1 and #2. This control also energizes the internal switches at the inputs of the horizontal and vertical deflection amplifiers on the Spectrum Analyzer Main PC Bd.

The Spectrum Analyzer provides a representation of signal strength between -30 and -100 dBm for the frequency range being scanned. This representation of signal strength or amplitude begins with a 120 MHz 2nd Mixer output which is applied to Spectrum Analyzer Module #1. There the signal is amplified, filtered and mixed with the swept frequency of a 145 MHz VCO, producing an output of 25 MHz. The 25 MHz signal is then fed through a 25 MHz crystal filter (with a 30 kHz bandwidth resolution), into a mixer where the signal is mixed with the output of a 26 MHz fixed oscillator. The resulting 1 MHz output of the mixer is applied to a logarithmic amplifier (in Spectrum Analyzer Module #2) whose output is a linear response signal calibrated from -30 to -100 dBm. This signal is passed through a detector to the Spectrum Analyzer input of the vertical deflection amplifier on the Oscilloscope Main PC Bd and on to the vertical deflection plates of the CRT.

The Spectrum Analyzer also provides a display of signals above and below a center frequency selected on the front panel RF FREQUENCY MHz Thumbwheels. A sawtooth generator produces an 18 Hz signal which is fed into a summation amplifier which also receives a correction voltage input from a phase lock circuit in Spectrum Analyzer Module #2. The output of the summation amplifier is applied to a dispersion amplifier controlled by the front panel ANALY DISP Control. The output of the dispersion amplifier keeps the swept output of the 145 MHz VCO synchronized with the 18 Hz sweep signal. During maximum dispersion (ANALY DISP Control fully cw), the 145 MHz VCO sweeps a 140 to 150 MHz range (±5 MHz from center). During minimum dispersion (ANALY DISP Control fully ccw, short of detent), the VCO sweeps a 144.5 to 145.5 MHz range (±500 kHz from center). The phase lock circuit in Spectrum Analyzer Module #2 uses a reference oscillator, two frequency dividers and a phase comparator to maintain the center frequency of the VCO at 145 MHz. The 18 Hz sawtooth signal is also switched to the input of the horizontal deflection amplifier on the Spectrum Analyzer Main PC Board.

2-3-12 DUAL TONE GENERATOR

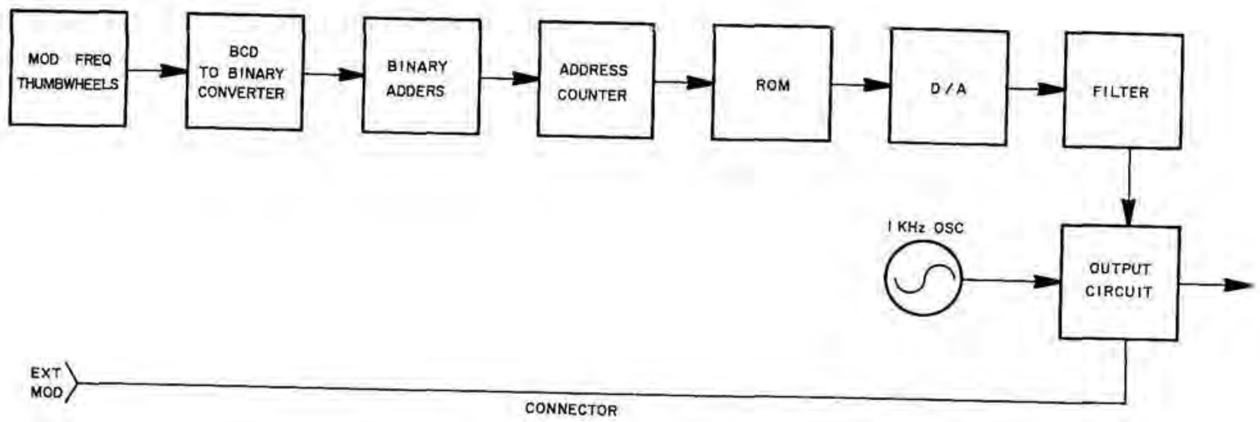


Figure 2-21 Dual Tone Generator Block Diagram

The FM/AM-1100S/A Dual Tone Generator is capable of digitally synthesizing audio frequencies between 10 Hz and 20,000 Hz in 0.1 Hz steps, as well as producing a fixed tone of approximately 1 kHz.

Variable tone frequencies are enabled by the front panel VAR/OFF Control and MODULATION FREQ Hz Thumbwheels. The VAR/OFF Control, when turned cw out of the detent position, applies +5 volts DC to all digital circuits in the Dual Tone Generator. The audio tone to be generated is determined by the setting of the MODULATION FREQ Hz Thumbwheels, which provide an input to the bit rate multiplier circuit. The bit rate multipliers feed an address counter which sequentially accesses a read only memory (ROM), and feeds a digital-to-analog converter (DAC) with digital information representing the amplitude and frequency components of the sine wave being generated. The cycling rate of the address generator increases or decreases as the MODULATION FREQ Hz Thumbwheels are increased or decreased. The output of the DAC consists of a digitized sine wave which is fed into a filter circuit to remove any quantization, thereby producing a smooth sine wave. This signal is then fed to the output circuit of the Dual Tone Generator, through the VAR/OFF Control potentiometer. The variable tone generator can also be keyed externally through the front panel EXT MOD Connector or EXT ACC Connector.

The 1 KHz fixed tone is produced by a 1 kHz oscillator which is coupled to the output circuit of the Dual Tone Generator by the 1 kHz/OFF Control. The output circuit can also receive the variable tone input from the digital circuits described in the preceding paragraph, as well as an external modulation input from the front panel EXT MOD Connector. This permits any one of three signals or any combination thereof to be applied to the output circuit of the Dual Tone Generator. The output of the Dual Tone Generator in turn, is applied to the INT MOD OUT Connector, the AM/FM Switch, the INT MOD/RCVR Switch and the SWEEP Control of the Oscilloscope.

2-3-13 120 MHz GENERATOR ASSEMBLY

The 120 MHz Generator uses a PLL (Phase Locked Loop) technique to produce a modulated 120 MHz signal. The generation process starts with a 10.7 MHz VCO output which is mixed with the output of a 109.3 MHz crystal oscillator, to produce a 120 MHz sum signal. The 120 MHz signal is filtered by the 120 MHz Band Pass Filter, which removes the unwanted frequencies that are produced in mixing (i.e., 10.7 MHz, 109.3 MHz, and 98.6 MHz). The 120 MHz signal is then amplified by the 1st 120 MHz Amp and applied to the Pin Diode Modulator and the Feedback Amp.

The 120 MHz output of the Feedback Amp is fed through a ÷12,000 frequency divider to produce an output of 10 kHz. The 10 kHz signal is then compared with a 10 kHz reference signal supplied by the Clock Divider. The resulting output of the phase comparator (a DC level) is filtered by the Low Pass Filter and used to slew the output frequency of the 10.7 MHz VCO in order to maintain 120 MHz at the output of the mixer. A second input (FM Audio) to the 10.7 MHz VCO provides FM modulation for the 120 MHz generated signal.

AM Audio is applied to the Modulating Amp which produces a control voltage for AM modulation and level information by electrically adjusting the Pin Diode Modulator's attenuation. The 120 MHz signal is then amplified in the 2nd 120 MHz Amp and applied to a Detector output circuit. The Detector will sense the level of the 120 MHz signal and apply this information on the Modulating Amp. The Modulating Amp will compare the RF Level and the AM Audio input with an internal reference. The Modulating Amp's output will drive the Pin Diode Modulator to obtain the correct RF level from the Detector.

The Output Circuit attenuates and splits the 120 MHz signal, which is then applied to the Variable Attenuator and the 2nd Mixer.

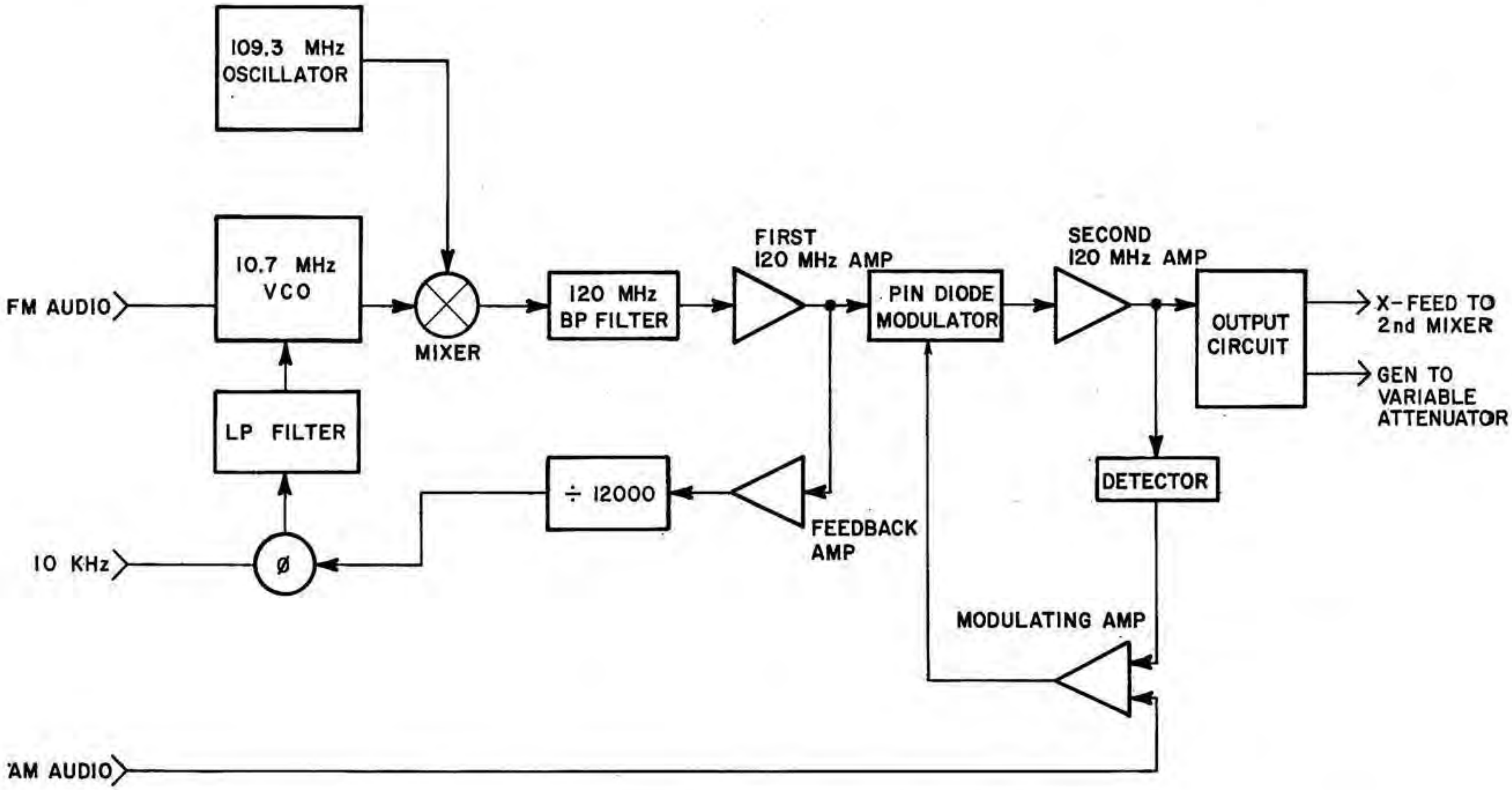


Figure 2-22 120 MHz Generator Block Diagram

2-3-14 VARIABLE ATTENUATOR ASSY

The 120 MHz signal generated by the 120 MHz Generator is fed through the Variable Attenuator Assy, where it is attenuated to a desired output level in either µV or dBm (as indicated on front panel BFO-RF LEVEL Control). The signal at the front panel TRANS/RCVR Connector is calibrated for the selected attenuator setting.

The scaling factor for the BFO-RF LEVEL Control can be altered by the front panel HI LVL/µV x 100/NORM Switch as follows:

"NORM" position - Signal output level at TRANS/RCVR Connector is as indicated on BFO-RF LEVEL Control.

"µV x 100" position - Signal output level at TRANS/RCVR Connector is 100 times the "µV" setting and +40 dB greater than the "-dBm" setting.

"HI LVL" position - BFO-RF LEVEL Control setting represents 0 dBm at point when front panel 0 dBm Indicator Lamp comes on. The dial is now calibrated in -dBm from the 0 dBm setting.

2-3-15 POWER SUPPLY

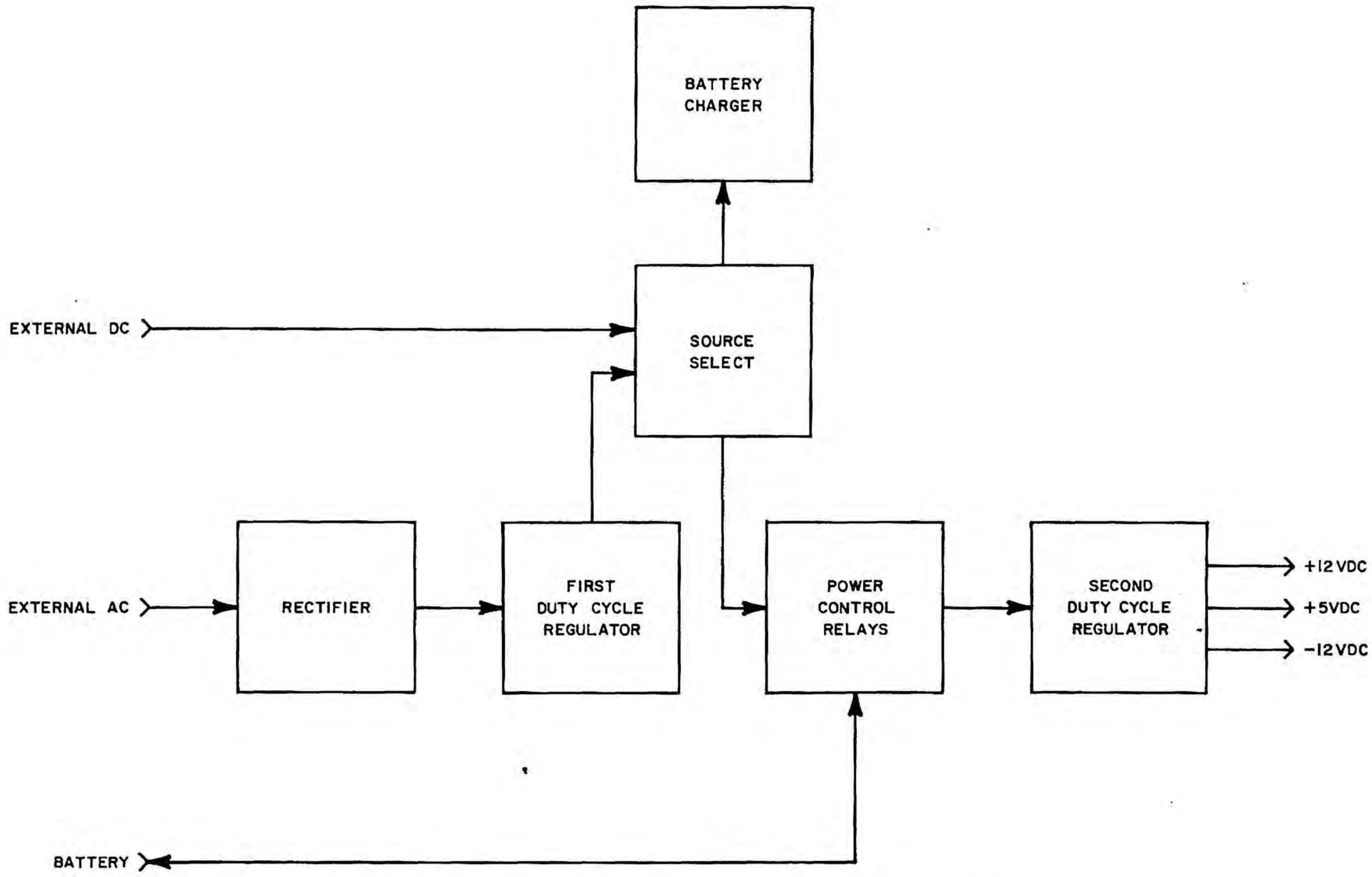


Figure 2-23 Power Supply Block Diagram

The FM/AM-1100S/A Power Supply may operate on external 115-230 VAC at 50-400 Hz, on external +11 to +30 VDC, or on DC voltage from its internal battery.

When operating from its internal battery, 12 VDC is applied directly to the Power Control Relays. The power control relays apply this 12 VDC to the 2nd Duty Cycle Regulator (D.C.R.). The 2nd D.C.R. is a DC-DC converter which produces regulated voltages of +12, -12, and +5 VDC.

When operating from external DC, a potential of +11 to +30 VDC is applied to the Battery Charger and the Power Control Relays. The output of the Battery Charger is applied to the battery. The battery will not charge if its DC input is below approximately 13 V. The Power Control Relays route the +11 to +30 VDC to the 2nd D.C.R. which produces the regulated DC outputs of +12, +5, and -12 V.

When operating off AC, the AC is rectified, producing several hundred volts DC. This high voltage is applied to the 1st D.C.R. which is a DC-DC converter, and changed to 16 VDC. This 16 VDC is applied to the Battery Charger to charge the internal battery and to the Power Control Relays which route the 16 VDC to the 2nd D.C.R. where regulated output of +12, -12, and +5 VDC are produced.

2-3-16 REGULATOR/TIMER PC BOARD

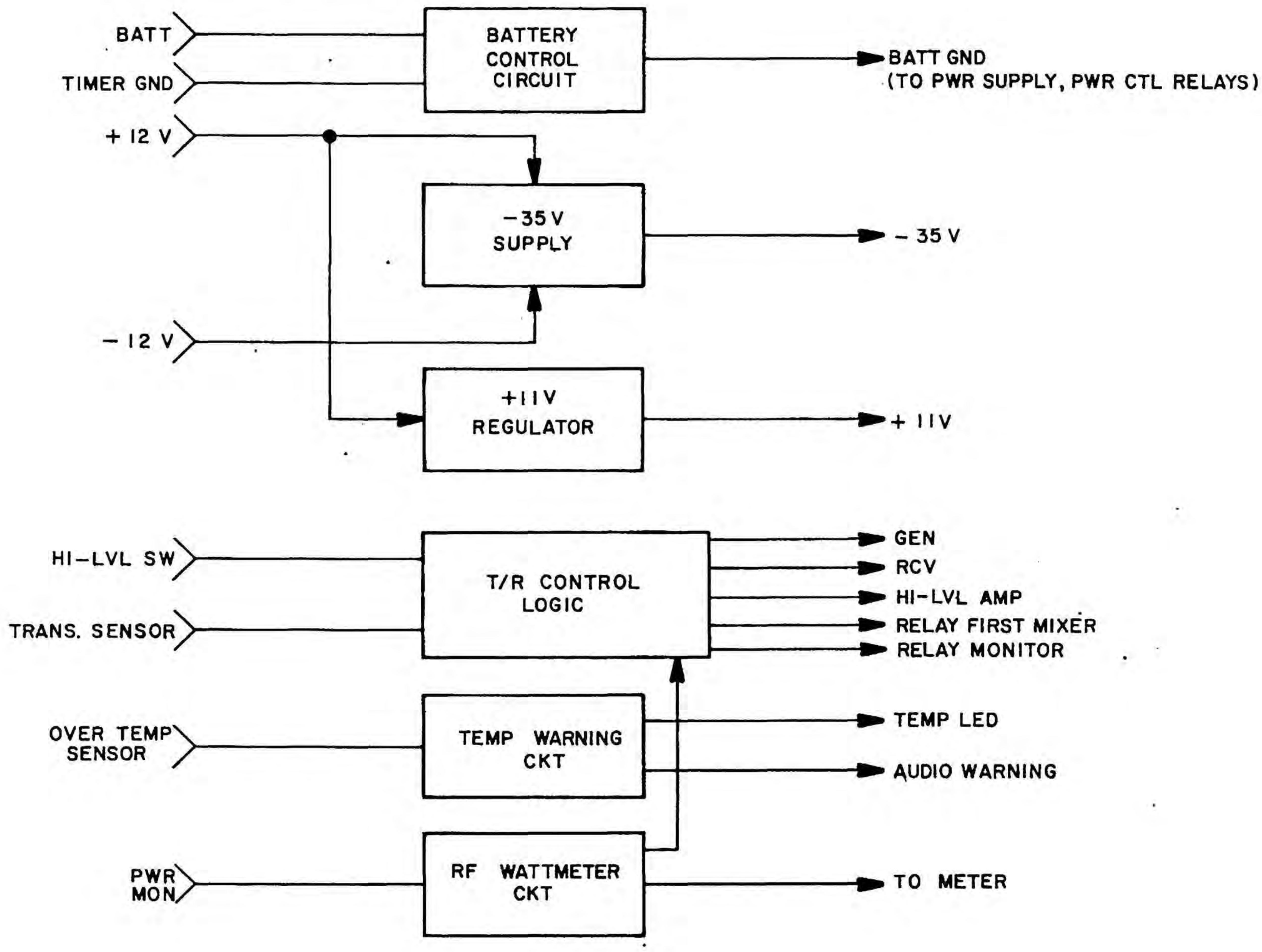


Figure 2-24 Regulator/Timer PC Board Block Diagram

1. Battery Control Circuit

The battery control circuit contains the battery timer, +11 V cutoff circuit, and the battery control flip-flop. The battery control flip-flop, when set, applies a ground to the battery relay in the Power Supply. The flip-flop is toggled by the BATT position of the PWR/OFF/BATT Switch. Once the flip-flop is set, it may be reset by one of the three methods: First, depressing the PWR/OFF/BATT Switch to BATT toggles the battery control flip-flop back to the off state. Second, when the battery timer times out (the battery timer is started when the battery control flip-flop is set) approximately 10 minutes after it is started, the battery control flip-flop is reset. Third, the +11 V cutoff circuit resets the battery control flip-flop if battery voltage drops below +11 V. This third method prevents the 2nd Duty Cycle Regulator in the Power Supply from drawing excessive current when the battery wears down.

2. -35 V Supply

The -35 V Supply is a DC-DC converter which produces -35 V from the +12 V and -12 V supply lines.

3. +11 V Regulator

The +11 V Regulator produces a sub-regulated +11 V from the +12 V line.

4. T/R Logic

The T/R (Transmit/Receive) logic controls the states of the Monitor Relay in the Power Termination Assembly, the 1st Mixer Relay, the High Level Amp, the 1200 MHz Diode Switch, and the 2nd Mixer Switch. T/R logic control is based on information provided by the HI LVL/μV X 100/NORM Switch, the GEN/REC Switch, and the transmitter Sensor and Power Monitor in the Power Termination Assembly.

5. RF Wattmeter

The RF Wattmeter circuit amplifies the low level signal from the Power Monitor in the Power Termination Assembly and applies a calibrated level to the DEVIATION/WATTS Meter.

6. Temp Warning Circuit

The Temp Warning Circuit activates the OVER TEMP Lamp and the OVER TEMP Alarm when the Power Termination Assembly overheats.

2-3-17 POWER TERMINATION ASSEMBLY

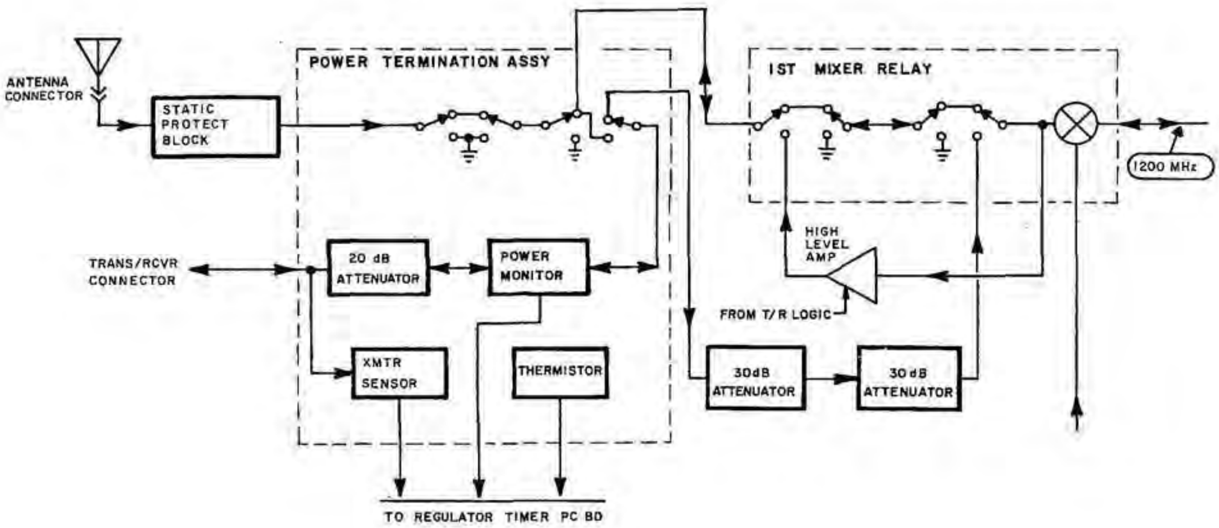


Figure 2-25 Power Termination Block Diagram

The Power Termination Assembly has five functions:

(1) Provide 20 dB power termination for transmitters.

(2) Sense the presence of a transmitted signal.

(3) Measure transmitter power.

(4) Switch signal flow from generate to receive.

(5) Sense temperature of rear heat sink.

RECEIVE OPERATION

When receiving off the air, RF enters the Power Termination Assembly from the Static Protect Block. RF then passes through the cross-over relay and out J8404 to the First Mixer Relay.

When receiving from a transmitter, high power RF enters the Power Termination Assembly from the TRANS/RCVR Connector at J8401. The RF is then applied to a 20 dB Power attenuator and a XMTR (Transmitter) Sensor Circuit. The XMTR Sensor Circuit provides the Regulator/Timer PC Board with a low level DC voltage. When RF is applied to J8401, this low level DC voltage indicates that a transmitter is transmitting into the Power Termination Assembly. The output of the 20 dB Power Attenuator is applied to the Power Monitor Circuit, which sends an analog voltage proportional to the received RF to the Regulator/Timer PC Board. This analog voltage is used to drive the DEVIATION/WATTS meter. The RF which passes through the Power Monitor is applied to the 60 dB of attenuation via the de-energized Crossover Relay.

GENERATE OPERATION

When generating, the Crossover Relay is energized and the generated signal is applied at J8404 from the 2nd Mixer. From J8404 the RF passes through the Crossover Relay, the Power Monitor (which serves no purpose in generate operation), the 20 dB Attenuator, and out J8401 to the TRANS/RCVR Connector.

TEMPERATURE SENSING

A thermistor is provided to detect an over-heat condition on the Power Termination Assembly and Rear Panel Heat Sink.

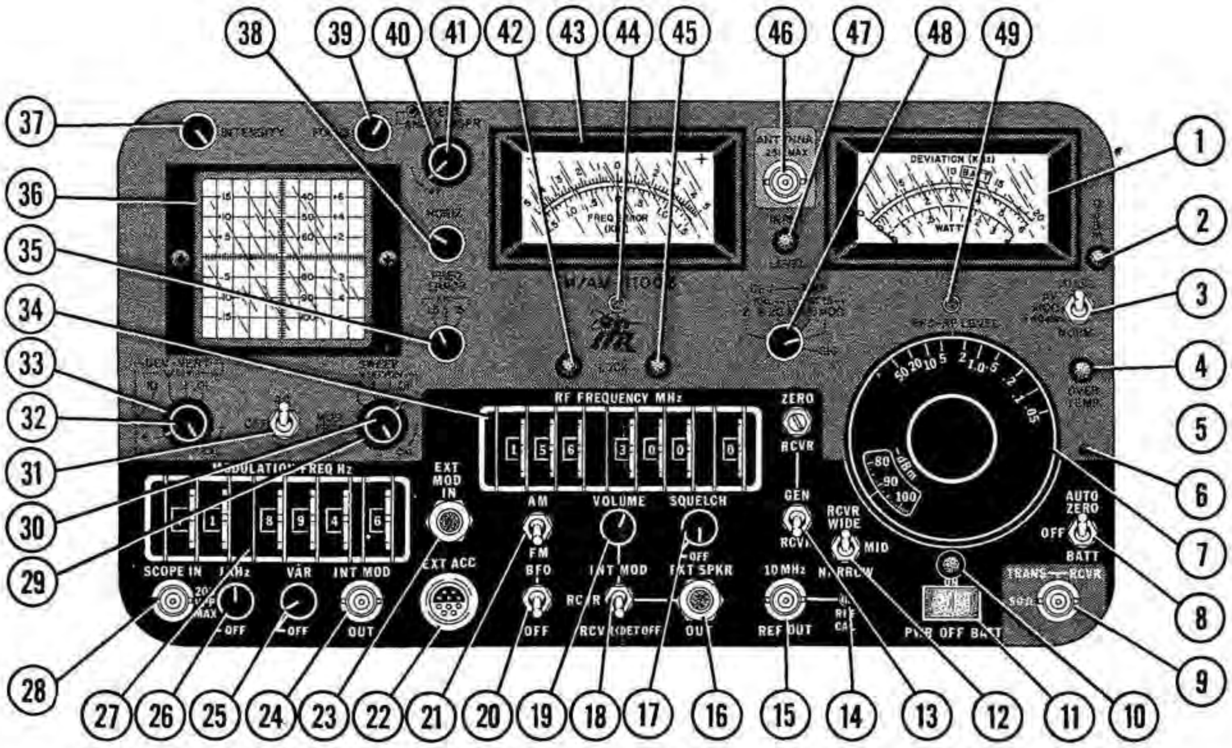


Figure 3-1 FM/AM-1100S Front Panel

(FM/AM-1100A front panel is identical to FM/AM-1100S front panel with exception of CRT Display (36) markings and absence of item (41).)

1 DEVIATION/WATTS Meter
2 0 dBm Lamp
3 HI LVL/µV X 100/NORM Switch
4 OVER TEMP Lamp
5 ZERO RCVR Adjustment
6 OVER TEMP Alarm
7 BFO-RF LEVEL Control
8 AUTO ZERO/OFF/BATT Switch
9 TRANS/RCVR Connector
10 POWER ON Lamp
11 PWR/OFF/BATT Switch
12 RCVR WIDE/MID/NARROW Switch
13 GEN/RCVR Switch
14 CAL Adjustment
15 10 MHz REF OUT Connector
16 EXT SPKR Connector
17 SQUELCH Control
18 INT MOD/RCVR/RCVR (DET OFF) Switch
19 VOLUME Control
20 BFO/OFF Switch
21 AM/FM Switch
22 EXT ACC Connector
23 EXT MOD Connector
24 INT MOD OUT Connector
25 VAR/OFF Control
26 1 kHz/OFF Control
27 MODULATION FREQ Hz Thumbwheels
28 SCOPE IN Connector
29 SWEEP Control
30 SWEEP VERNIER Control
31 AC/OFF/DC Switch
32 DEV-VERT VERNIER Control
33 DEV-VERT Control
34 RF FREQUENCY MHz Thumbwheels
35 FREQ ERROR Control
36 CRT Display
37 INTENSITY Control
38 HORIZ Control
39 FOCUS Control
40 VERT Control
41 ANALY DISPR Control (FM/AM-1100 models only)
42 HIGH Frequency Phase LOCK Lamp
43 FREQ ERROR Meter
44 FREQ ERROR Meter Zero Adjustment
45 LOW Frequency Phase LOCK Lamp
46 ANTENNA Connector
47 INPUT LEVEL Lamp
48 DEV/POWER Control
49 DEVIATION/WATTS Meter Zero Adjustment

SECTION 3-PERFORMANCE EVALUATION

3-1 GENERAL

This section contains step-by-step test procedures for assessing the performance of the FM/AM-1100S/A. These procedures should be relied upon as the first step in the troubleshooting/maintenance process, when the operating condition of the set is in question. All procedures contained in this section are performed using the FM/AM-1100S/A front panel controls and do not require the removal of the exterior case. These procedures are divided into the following two subsections:

1. Mobile Performance Checks
   These procedures are quick qualitative checks designed to assess the performance of the FM/AM-1100S/A in a mobile environment. Any of these checks can be performed within 6 to 10 minutes, while the set is operating on its own battery power. Only a two foot length of 50Ω coaxial cable (w/BNC connectors on each end) is required as accessory equipment to perform these checks.

2. Laboratory (or Bench) Peformance Checks
   These procedures are intended for use in a laboratory or bench environment, where each test can be supported and verified by the use of additional test equipment. These procedures are more detailed than those described for use under mobile conditions and will therefore enable the operator/technician to make a more precise and conclusive evaluation of the set's overall performance.

NOTE

If a determination is made that the FM/AM-1100S/A is not performing properly as a result of performing one or more of the mobile checks, the operator/technician should also perform the corresponding laboratory checks before taking any corrective maintenance action.

Performance check 3-3-6, titled "Power Supply Voltage Checks", needs only to be performed if one or more of the Laboratory checks confirms a failure condition within the FM/AM-1100S/A.

Each test procedure, in both the mobile and laboratory testing subsections, contains several common headings which are defined as follows:

3-2-1 Test procedure number.

TEST PROCEDURE: Name of test procedure to be performed.

SPECIAL ACCESSORY EQUIPMENT REQ'D: List of any special accessory test equipment required to complete the test procedure.

TEST SET-UP DIAGRAM: A diagrammatic aid for making proper connections between FM/AM-1100S/A and any special accessory equipment.

INITIAL FM/AM-1100S CONTROL SETTINGS: Initial FM/AM-1100S/A front panel control settings required to begin the test procedure. (Refer to Figure 3-1 on foldout page for front panel control identification.)

3-1-1 TEST EQUIPMENT REQUIREMENTS

Appendix C at the rear of this manual contains a comprehensive list of test equipment suitable for performing any of the procedures in this manual. Any other equipment meeting the specifications listed in the appendix, may be substituted in place of the recommended models.

NOTE

> For certain procedures in this manual, the equipment listed in Appendix C may exceed the minimum required specifications; for this reason, minimum use specifications appear at the beginning of all individual test procedures where accessory test equipment is required.

3-1-2 CORRECTIVE MAINTENANCE PROCEDURES

The performance checks in this section will aid the operator/technician in determining whether the FM/AM-1100S/A is functioning properly or if a failure condition exists. A failure condition will normally be reflected as either a calibration error or a malfunction. A calibration error is defined as a measurement or reading (relating to the unit being tested) that is not within prescribed tolerance. In this condition, the set may outwardly appear to be functioning properly, despite the presence of a calibration error. A malfunction denotes a defective condition where a signal may be totally absent, grossly out of tolerance or where the unit itself (or any part thereof) is obviously not working properly.

In the event a failure condition is confirmed, the technician should take appropriate corrective maintenance action to return the set to its normal operating condition. The "CORRECTIVE MAINTENANCE FLOWCHART" shown in Figure 3-2 is intended to serve as a guide in directing the technician through the troubleshooting/maintenance process. By observing this general sequence, the technician will be able to use the maintenance/troubleshooting recommendations contained within this and other sections of this manual, to return the FM/AM-1100S/A to normal operation.

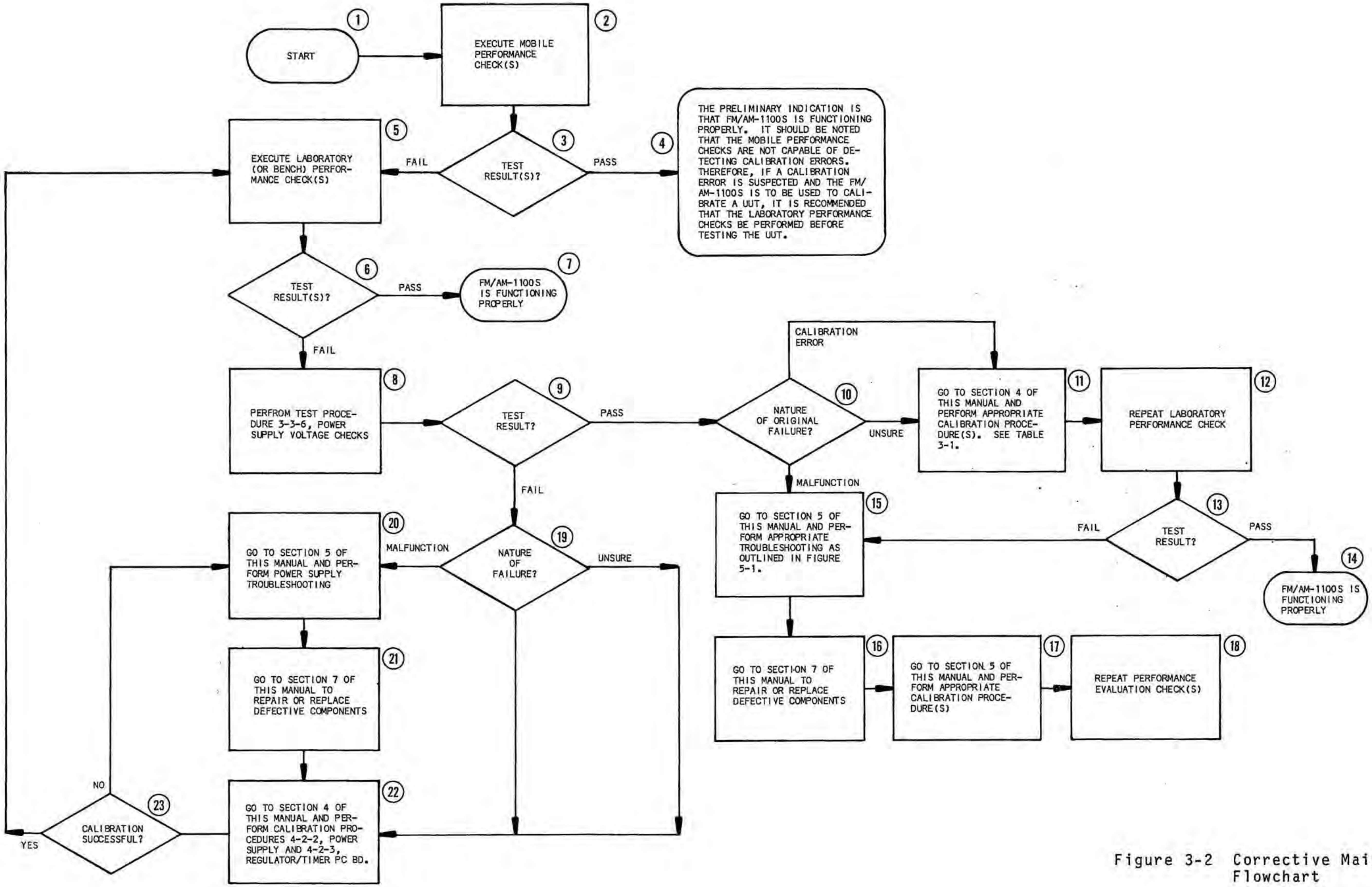


Figure 3-2 Corrective Maintenance Flowchart

PERFORMANCE EVALUATION FAILURE:	CORRECTIVE MAINTENANCE FOR CALIBRATION ERROR(S):	CORRECTIVE MAINTENANCE FOR MALFUNCTION(S):
DUAL TONE GENERATOR	Section 4, Calibration Procedure 4-2-4 titled, "Dual Tone Generator"	Section 7, Module Testing Procedure 7-4, titled "Dual Tone Generator"
OSCILLOSCOPE	Section 4, Calibration Procedure 4-2-8 titled, "Spectrum Analyzer/ Oscilloscope" (Steps 1 Through 21 Only)	Section 5, Receiver Troubleshooting Flow-chart
SPECTRUM ANALYZER (FM/AM-1100S models only)	Section 4, Calibration Procedure 4-2-8 titled, "Spectrum Analyzer/ Oscilloscope" (Steps 22 Through 69 Only)	Section 5, Receiver Troubleshooting Flow-chart
SIGNAL GENERATOR	Section 4, Calibration Procedure 4-2-10 titled, "120 MHz Generator"	Section 5, Generate Troubleshooting Flow-chart
RECEIVER/ DEVIATION METER	Section 4, Calibration Procedure 4-2-9 titled, "250 kHz IF/MON/AUDIO PC Bd"	Section 5, Receive Troubleshooting Flow-chart

Table 3-1 Corrective Maintenance Procedures

3-2 MOBILE PERFORMANCE EVALUATION PROCEDURES

3-2-1

TEST PROCEDURE: DUAL TONE GENERATOR AND OSCILLOSCOPE PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D: 1 2-foot length of 50Ω Coax Cable w/BNC Connectors on each end

TEST SET-UP DIAGRAM:

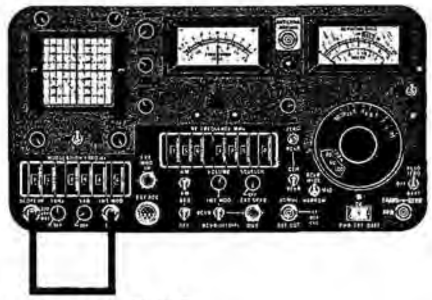


Figure 3-3 Dual Tone Generator/Oscilloscope Test Set-Up Diagram

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"WIDE"
13	GEN/RCVR Switch	"GEN"
21	AM/FM Switch	"AM"
25	VAR/OFF Control	Fully ccw, detent (OFF)
26	1 kHz/OFF Control	Fully ccw, detent (OFF)
27	MODULATION FREQ Hz Thumbwheels	"01000.0"
29	SWEEP Control	"1"
30	SWEEP VERNIER Control	Fully cw, in detent
31	AC/OFF/DC Switch	"DC"
32	DEV-VERT VERNIER Control	Fully cw, in detent
33	DEV-VERT Control	"10 V/DIV"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (1100S Only)	Fully ccw, in detent

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

24 INT MOD OUT Connector
28 SCOPE IN Connector
36 CRT Display

STEP PROCEDURE

1. Set FM/AM-1100S/A controls to initial settings as described above.

2. Connect 2-foot length of 50Ω coax cable between INT MOD OUT Connector (24) and SCOPE IN Connector (28) as shown in Figure 3-3.

3. Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.

4. Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.

5. Adjust HORIZ Control (38) and VERT Control (40) to center trace over major horizontal axis of CRT Display (36) as shown in Figure 3-4.

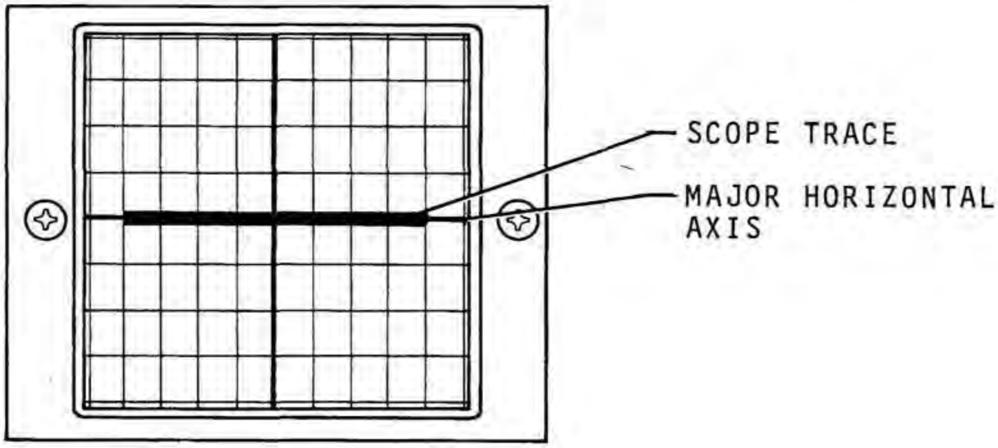


Figure 3-4 Scope Trace Centered Over Major Horizontal Axis

6. Rotate VAR/OFF Control (25) fully cw and verify that the maximum amplitude of displayed sinewave on CRT Display (36) is 12 Vp-p (±4V).

NOTE

To facilitate measurement of sinewave amplitude, adjust VERT Control (40) so negative peaks of waveform rest on major horizontal axis as shown in Figure 3-5.

STEP PROCEDURE

6. (Continued)

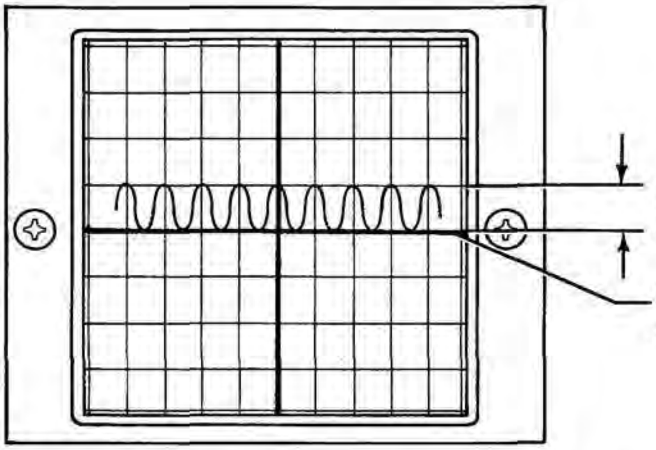


Figure 3-5 Measuring Amplitude Of Sinewave

7. Rotate VAR/OFF Control (25) fully ccw to detent.

8. Rotate 1 kHz/OFF Control (26) fully cw and verify that the maximum amplitude of displayed sinewave on CRT Display (36) is 12 Vp-p (±4 V).

NOTE

To facilitate measurement of sinewave amplitude, adjust VERT Control (40) so negative peaks of waveform rest on major horizontal axis. (See Figure 3-5.)

9. Rotate VAR/OFF Control (25) fully cw:

   a. If amplitude of displayed sinewave is stable, the 1 kHz oscillator is calibrated exactly for 1000 Hz (±2 Hz); proceed directly to Step 11.

   b. If amplitude of displayed sinewave is continuously changing, proceed to Step 10.

10. Increment or decrement MODULATION FREQ Hz Thumbwheels (27) until amplitude of displayed sinewave becomes stable. Verify frequency displayed on MODULATION FREQ Hz Thumbwheels (27) is between 00980.0 Hz and 01020.0 Hz. (Frequency displayed on MODULATION FREQ Hz Thumbwheels (27) represents exact frequency of 1 kHz oscillator.)

11. Rotate 1 kHz/OFF Control (25) fully ccw, to detent.

STEP PROCEDURE

12. Set MODULATION FREQ Hz Thumbwheels (27) to "01000.0 Hz".

13. Adjust VERT Control appropriately until positive peaks of waveform are aligned with major horizontal axis (see Figure 3-6).

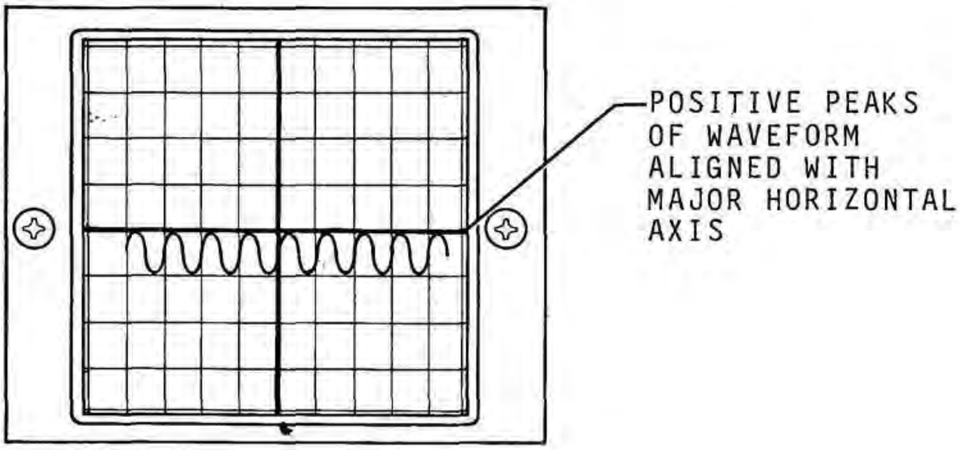


Figure 3-6 Positive Peaks Of Displayed Waveform Aligned With Major Horizontal Axis

14. Adjust HORIZ Control (38) to center one of the positive peaks over major vertical axis and verify that adjacent (right) peak is also centered over vertical axis (within ±2 minor graticule divisions).

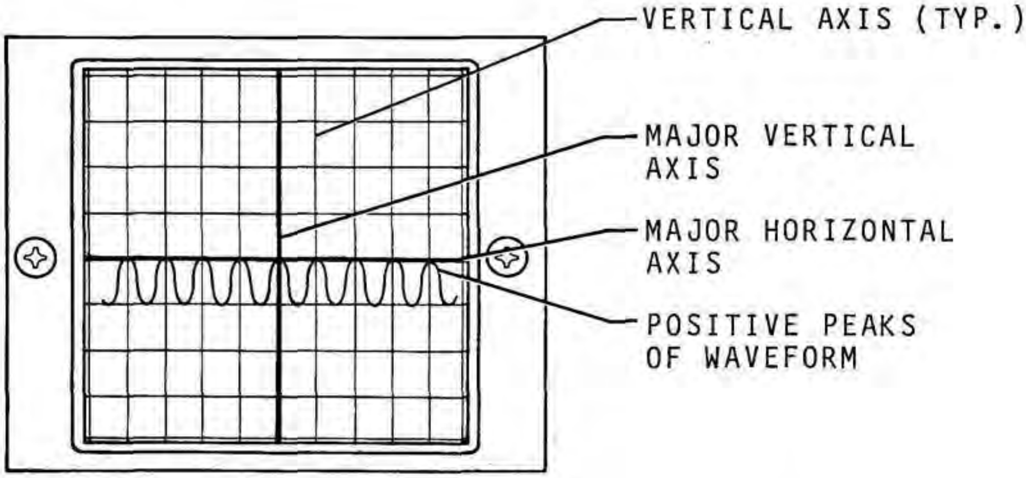


Figure 3-7 Center Positive Peak Of Displayed Waveform Centered Over Major Vertical Axis

STEP	PROCEDURE
15.	Set MODULATION FREQ Hz Thumbwheels (27) to "01000.0" and rotate SWEEP Control (29) to "0.1 mS".
16.	Adjust HORIZ Control (38) to center one of the positive peaks over major vertical axis and verify that adjacent (right) peak is also centered over vertical axis (within ±2 minor graticule divisions). (See Figure 3-7.)
17.	Verify that the amplitude of the waveform peaks are within ±1 minor graticule division of the major horizontal axis.
18.	Set MODULATION FREQ Hz Thumbwheels (27) to "01000.0" and rotate DEV-VERT Control (33) to "15 KHz".
19.	Adjust VERT Control (40) slowly to center displayed waveform over major horizontal axis.
20.	Adjust VAR/OFF Control (25) ccw until waveform on CRT Display (34) exhibits 100% modulation. (See Figure 3-8.)

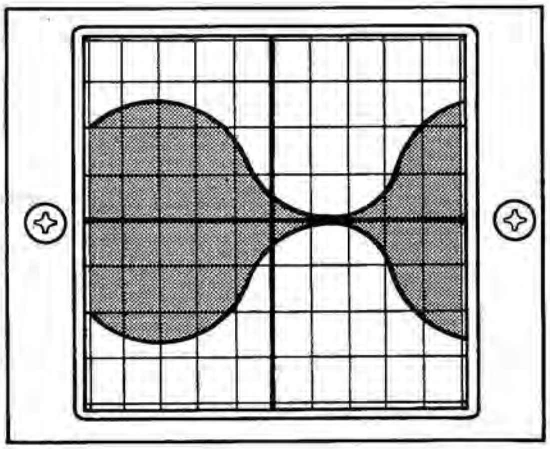


Figure 3-8 Waveform Adjusted For 100% Modulation

21.	Rotate SWEEP Control (29) to "MOD FREQ Hz" and verify that a triangle is present on CRT Display (36). (See Figure 3-9.)

STEP PROCEDURE

21. (Continued)

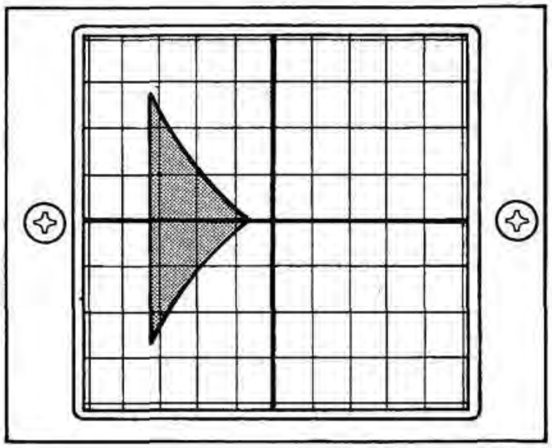


Figure 3-9 Typical Triangular Waveform

22. Set AM/FM Switch (21) to "FM" and verify that a first order Lissajou figure is present on CRT Display (36). (See Figure 3-10.)

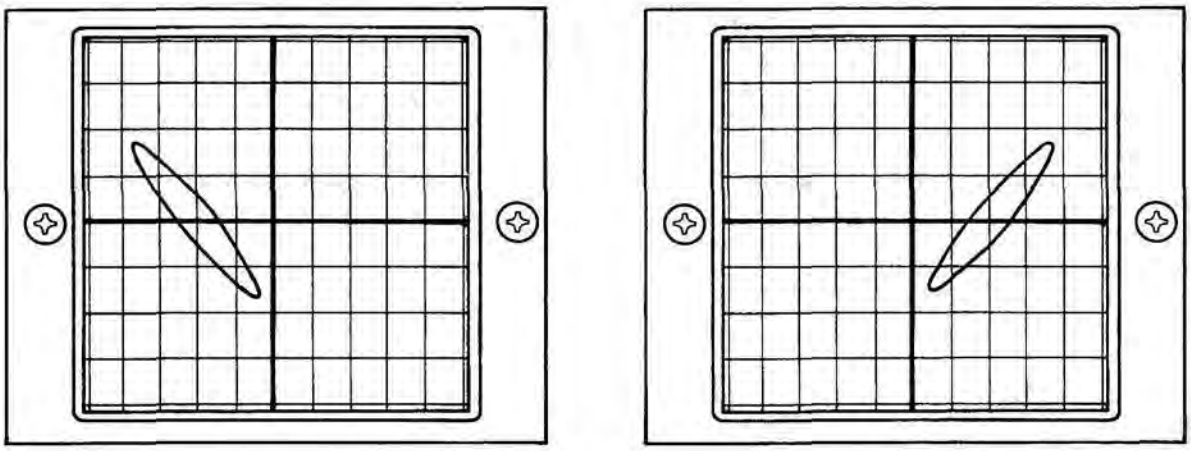


Figure 3-10 First Order Lissajou Figure

3-2-2

TEST PROCEDURE: SPECTRUM ANALYZER PERFORMANCE EVALUATION (APPLICABLE TO FM/AM-1100S MODELS ONLY)

SPECIAL ACCESSORY EQUIPMENT REQ'D: N/A

TEST SET-UP DIAGRAM: N/A

INITIAL FM/AM-1100S CONTROLS SETTINGS:

	CONTROL	INITIAL SETTING
11	PWR/OFF/BATT Switch	"OFF"
13	GEN/RCVR Switch	"GEN"
25	VAR/OFF Control	Fully ccw, detent "OFF"
26	1 kHz/OFF Control	"OFF"
31	AC/OFF/DC Switch	"AC"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
41	ANALY DISPR Control (1100S Only)	Fully ccw, out of detent

Other FM/AM-1100S features related to this performance evaluation but not requiring an initial setting:

36 CRT Display

STEP	PROCEDURE
1.	Set FM/AM-1100S Controls to initial settings as described above.
2.	Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
3.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.
4.	Verify presence of a spectrum display as shown in Figure 3-11. Baseline noise should be less than 2 minor divisions in amplitude.

STEP PROCEDURE

4. (Continued)

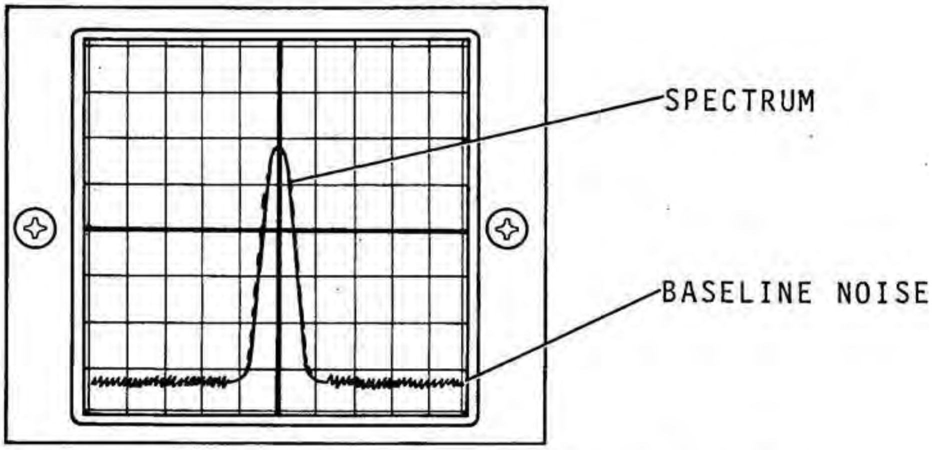


Figure 3-11 Typical Spectrum Analyzer Display

3-2-3

TEST PROCEDURE: FREQUENCY SYNTHESIZER PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D: None

TEST SET-UP DIAGRAM: N/A

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

CONTROL	INITIAL SETTING
11 PWR/OFF/BATT Switch	"OFF"
34 RF FREQUENCY MHz Thumbwheels	"099 000 0"

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

42 HIGH Frequency Phase LOCK Lamp
45 LOW Frequency Phase LOCK Lamp

STEP	PROCEDURE
1.	Set FM/AM-1100S/A Controls to initial settings as described above.
2.	Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT".
3.	Increment the 100 MHz Thumbwheel on RF FREQUENCY MHz Thumbwheels (34) from 1 to 9 and verify that the HIGH Frequency Phase LOCK Lamp (42) illuminates for each setting.

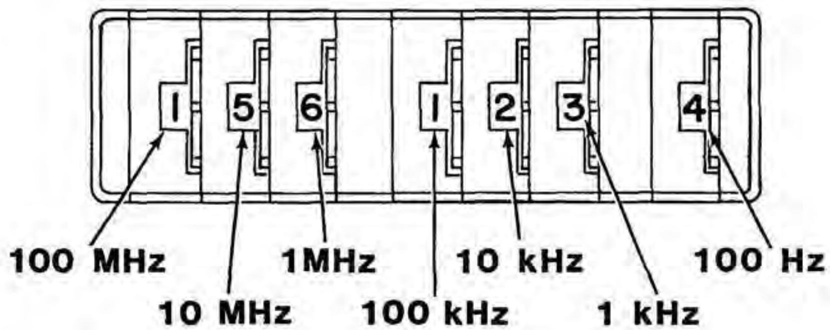


Figure 3-12 RF Frequency MHz Thumbwheels

STEP	PROCEDURE
4.	Rotate all RF FREQUENCY MHz Thumbwheels (34) to "000 000 0". Verify both phase lock lamps provide steady illumination.
5.	Simultaneously rotate all RF FREQUENCY MHz Thumbwheels (34) into each detent 1 through 9. Either or both phase lock lamps may momentarily go out or flash, but should return to steady illumination with each position.

NOTE

If the result of this performance check confirms a failure condition, execute performance check 3-3-6, titled "POWER SUPPLY VOLTAGE CHECKS". Then, if:

1. All power supply voltages are proper, proceed directly to "SECTION 5, TROUBLE-SHOOTING"; if original failure was associated with High Frequency LOCK Lamp, perform "1st LOCAL OSCILLATOR TROUBLE-SHOOTING". If failure was associated with Low Frequency LOCK Lamp, perform "2nd LOCAL OSCILLATOR TROUBLESHOOTING.

2. All or any one of the power supply voltages are not proper, go to CORRECTIVE MAINTENANCE FLOWCHART in Figure 3-2 and proceed with Step 19.

3-2-4

TEST PROCEDURE: SIGNAL GENERATOR PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D: 1 2-foot length of 50Ω Coax Cable w/BNC Connectors on each end

TEST SET-UP DIAGRAM:

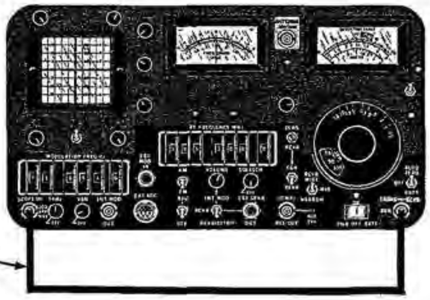


Figure 3-13 Signal Generator Test Set-Up Diagram

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/µV X 100/NORM Switch	"µV X 100"
7	BFO-RF LEVEL Control	"-80 dBm"
8	AUTO ZERO/OFF/BATT Switch	"AUTO ZERO"
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"MID"
13	GEN/RCVR Switch	"GEN"
20	BFO/OFF Switch	"OFF"
21	AM/FM Switch	"FM"
25	VAR/OFF Control	Fully ccw, detent "OFF"
26	1 kHz/OFF Control	Fully ccw, detent "OFF"
27	MODULATION FREQ Hz Thumbwheels	"01000.0"
29	SWEEP Control	".01"
30	SWEEP VERNIER Control	Fully cw, in detent
31	AC/OFF/DC Switch	"AC"
32	DEV-VERT VERNIER Control	Fully cw, in detent
33	DEV-VERT Control	".01 V/DIV"
34	RF FREQUENCY MHz Thumbwheels	"000 100 0"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (1100S Only)	Fully ccw, in detent
48	DEV/POWER Control	"2 kHz"

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

1 DEVIATION/WATTS Meter
2 0 dBm Lamp
9 TRANS/RCVR Connector
28 SCOPE IN Connector
36 CRT Display

STEP	PROCEDURE
1.	Set FM/AM-1100S/A controls to initial settings as described above.
2.	Connect 2-foot length of 50Ω coax cable between TRANS/RCVR Connector (9) and SCOPE IN Connector (28) as shown in Figure 3-13.
3.	Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
4.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.
5.	Using HORIZ Control (38) and VERT Control (40), center displayed sinewave on CRT Display (36) as shown in Figure 3-14.

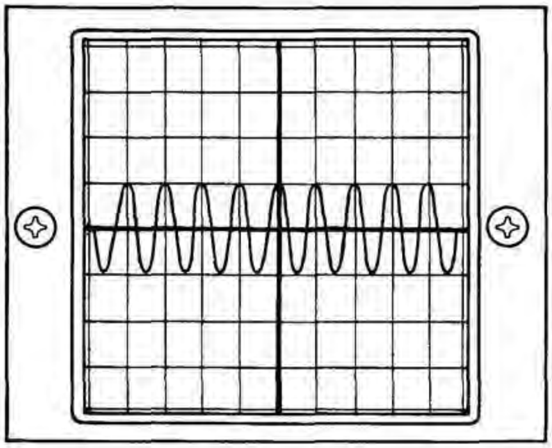


Figure 3-14 Displayed Sinewave Aligned With Major Horizontal Axis

6.	Adjust VAR/OFF Control (25) until DEVIATION/WATTS Meter displays 2 kHz and verify that the rightmost portion of sinewave becomes slightly blurred (see Figure 3-15).

STEP PROCEDURE

6. (Continued)

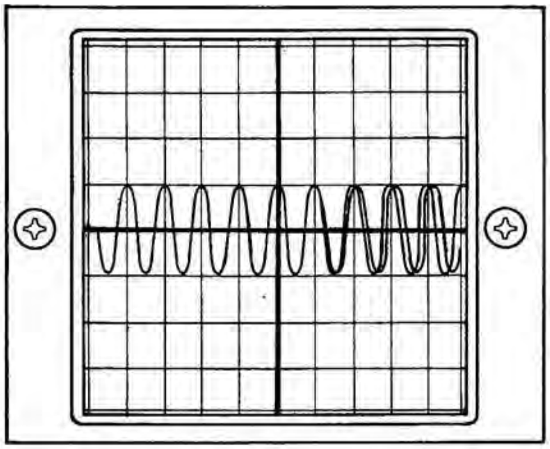


Figure 3-15 Displayed Sinewave With Rightmost Portion Slightly Blurred

7. Rotate SWEEP Control (29) to "MOD FREQ".

8. Set AM/FM Switch (21) to "AM" and verify that a trapezoidal waveform is displayed on CRT Display (36) as shown in Figure 3-16.

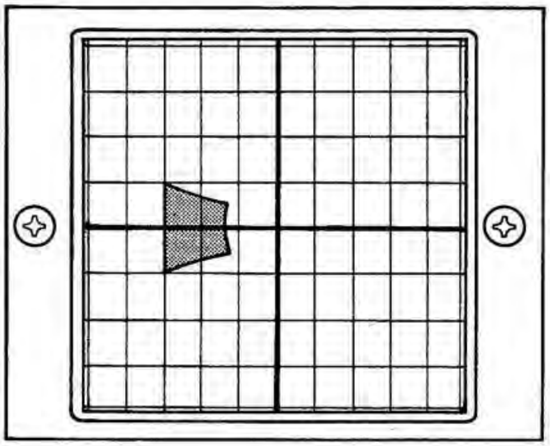


Figure 3-16 Trapezoidal Waveform

9. Set AM/FM Switch (21) to "FM".

10. Adjust BFO-RF LEVEL Control (7) for 1000 μV and verify display on CRT Display (36) is between .45 and .95 graticule divisions in height.

STEP | PROCEDURE

11. Adjust HORIZ Control (38) and VERT Control (40) to center display over major horizontal axis, to facilitate measurement of displayed signal (see Figure 3-17).

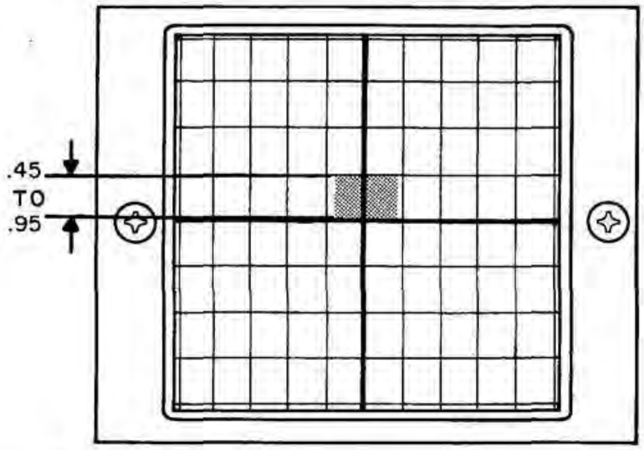


Figure 3-17 Amplitude Of 2 kHz FM Deviated Signal Shown Between .45 And .95 Graticule Divisions In Height

12. Rotate BFO-RF LEVEL Control (7) fully ccw.

13. Rotate DEV-VERT Control (33) to "1 V/DIV", HI LVL/μV X 100/NORM Switch (3) to "HI LVL", and adjust BFO-RF LEVEL Control (7) cw until 0 dBm Lamp (2) illuminates. Verify that the display is between 1.0 and 1.25 graticule divisions in height on CRT Display (36).

14. Adjust HORIZ Control (38) and VERT Control (40) to center display over major horizontal axis, to facilitate measurement of displayed signal (see Figure 3-18).

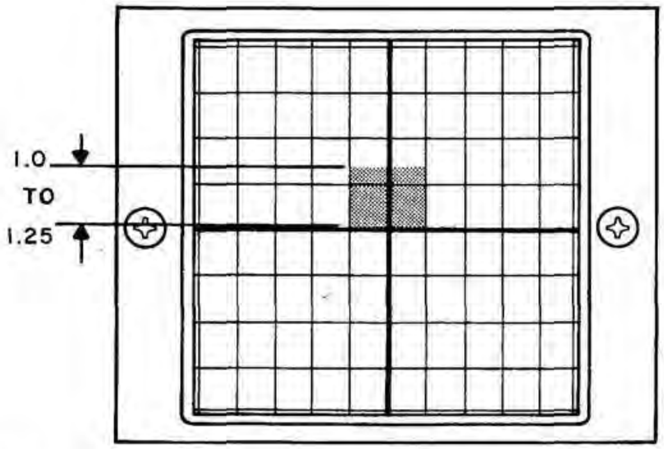


Figure 3-18 Amplitude Of 2 kHz FM Deviated Signal Shown Between 1.0 And 1.25 Graticule Divisions In Height

3-2-5

TEST
PROCEDURE: RECEIVER PERFORMANCE EVALUATION

SPECIAL ACCESSORY
EQUIPMENT REQ'D: Probe with BNC Adaptor

TEST SET-UP
DIAGRAM:

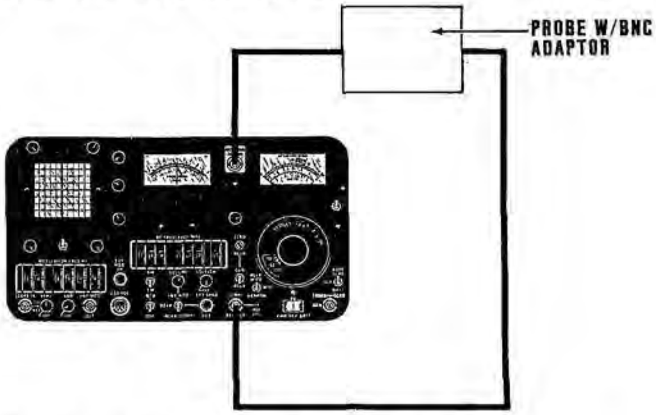


Figure 3-19 Receiver Test Set-Up Diagram

INITIAL FM/AM-1100S/A
CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/µV X 100/NORM Switch	"NORM"
7	BFO-RF LEVEL Control	Fully ccw
8	AUTO ZERO/OFF/BATT Switch	"AUTO ZERO"
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"NARROW"
13	GEN/RCVR Switch	"RCVR"
17	SQUELCH Control	Fully ccw, out of detent
18	INT MOD/RCVR/RCVR (DET OFF) Switch	"RCVR"
19	VOLUME Control	Fully ccw
20	BFO/OFF Switch	"OFF"
21	AM/FM Switch	"AM"
31	AC/OFF/DC Switch	"DC"
34	RF FREQUENCY MHz Thumbwheels	"010 000 0"
35	FREQ ERROR Control	"1.5 kHz"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (1100S Only)	Fully ccw, out of detent
48	DEV/POWER Control	"SIG"

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

9 TRANS/RCVR Connector
15 10 MHz REF OUT Connector
36 CRT Display
43 FREQ ERROR Meter
46 ANTENNA Connector
47 INPUT LEVEL Lamp

STEP	PROCEDURE
1.	Set FM/AM-1100S/A Controls to initial settings as described above.
2.	Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
3.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.
4.	Connect probe BNC connector to 10 MHz REF OUT Connector (15).

CAUTION

MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR (46) MUST NOT EXCEED .25 W. THE 10 MHz REF OUTPUT SUPPLIED TO THE ANTENNA CONNECTOR IN THIS TEST WILL NOT EXCEED THIS POWER LIMIT.

5.	Using probe BNC Adaptor, plug the probe securely into the ANTENNA Connector (46).
6.	Verify that a reading of 0 Hz (±50 Hz) is displayed on FREQ ERROR Meter (43).
7.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100010" and verify FREQ ERROR Meter (43) displays -1.0 kHz (±100 Hz).
8.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099990" and verify FREQ ERROR Meter (43) displays +1.0 kHz (±100 Hz).
9.	Rotate FREQ ERROR Control (35) to "5 kHz".
10.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099960" and verify FREQ ERROR Meter (43) displays 4.7 to 5.3 kHz.
11.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100040" and verify FREQ ERROR Meter (43) displays -4.7 to -5.3 kHz.
12.	Rotate FREQ ERROR Control (35) to "15 kHz".

STEP	PROCEDURE
13.	Set RCVR WIDE/MID/NARROW Switch (12) to "WIDE".
14.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100100" and verify FREQ ERROR Meter (43) displays -10 kHz (±1.0 kHz).
15.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099900" and verify FREQ ERROR Meter (43) displays +10 kHz (±.1 kHz).
16.	Disconnect Probe from ANTENNA Connector (46) and 10 MHz REF OUT Connector (15).
17.	Set RF FREQUENCY MHz Thumbwheels (34) to "1202000".
18.	Set BFO/OFF Switch (20) to "BFO" and adjust BFO-RF LEVEL Control (7) cw until INPUT LEVEL Lamp (47) illuminates. Verify that the BFO-RF LEVEL Control (7) is set between .2 µV and 2 µV.
19.	Rotate SQUELCH Control (17) cw and verify that the INPUT LEVEL Lamp (47) goes out; then return SQUELCH Control (17) to full ccw position, short of detent.
20.	Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".
21.	Rotate BFO-RF LEVEL Control (7) fully ccw.
22.	Adjust BFO-RF LEVEL Control (7) cw until INPUT LEVEL Lamp (47) illuminates and verify that the BFO-RF LEVEL Control (7) is set between .2 µV and 2 µV.
23.	Adjust BFO-RF LEVEL Control (7) to "-80 dBm" position and verify that the displayed signal on CRT Display (34) is -80 dBm (±9 dB) in amplitude (see Figure 3-20).

STEP PROCEDURE

23. (Continued)

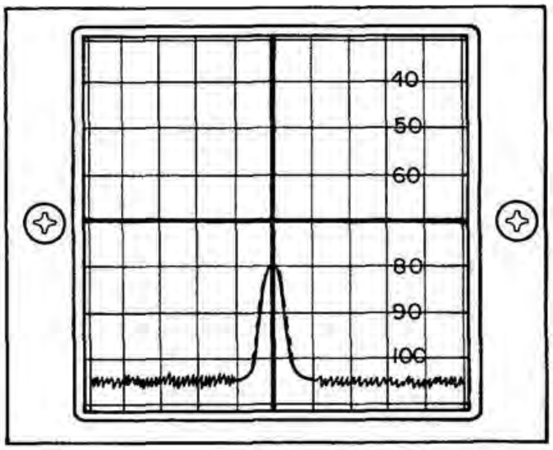


Figure 3-20 -80 dBm BFO Signal Measured Along dB Scale Of CRT Graticule

24. Set HI LVL/µV x 100/NORM Switch (3) to "µV x 100" and verify that the displayed signal on CRT Display (36) is -40 dBm (±9 dB) in amplitude (see Figure 3-21).

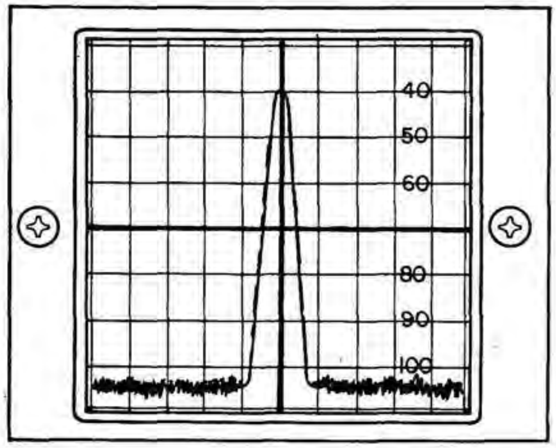


Figure 3-21 -40 dBm BFO Signal Measured Along dB Scale Of CRT

25. Set BFO/OFF Switch (20) to "OFF" and connect an antenna to ANTENNA Connector (46).

STEP	PROCEDURE
25.	(Continued)

CAUTION

IF AN EXTERNAL ANTENNA ATTACHED TO AN UNTERMINATED COAX CABLE IS USED, REMOVE ANY POSSIBLE STATIC CHARGE FROM ANTENNA COAX BEFORE CONNECTING TO FM/AM-1100S/A.

26.	Set INT MOD/RCVR/RCVR (DET OFF) Switch (18) to "RCVR".
27.	Set RF FREQUENCY MHz Thumbwheels (34) to the frequency of a local AM broadcast station, adjust VOLUME Control (19) for a comfortable listening level and verify the presence of audio.
28.	Set RCVR WIDE/MID/NARROW Switch (12) to "WIDE" and AM/FM Switch (21) to "FM".
29.	Set RF FREQUENCY MHz Thumbwheels (34) to a frequency of a local FM broadcast station and verify the presence of audio.

3-2-6

TEST PROCEDURE: DEVIATION METER PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D: N/A

TEST SET-UP DIAGRAM: N/A

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
8	AUTO ZERO/OFF/BATT Switch	"AUTO ZERO"
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"NARROW"
13	GEN/RCVR Switch	"GEN"
18	INT MOD/RCVR/RCVR (DET OFF) Switch	"INT MOD"
19	VOLUME Control	Fully ccw
21	AM/FM Switch	"FM"
25	VAR/OFF Control	Fully ccw, detent "OFF"
26	1 kHz/OFF Control	Fully ccw, detent "OFF"
27	MODULATION FREQ Hz Thumbwheels	"01000.0"
29	SWEEP Control	"1"
30	SWEEP VERNIER Control	Fully cw, in detent
31	AC/OFF/DC Switch	"DC"
32	DEV-VERT Vernier Control	Fully cw, in detent
33	DEV-VERT Control	"1.5 kHz"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (1100S Only)	Fully ccw, in detent
48	DEV/POWER Control	"2 kHz"

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

1 DEVIATION/WATTS Meter
36 CRT Display

STEP	PROCEDURE
1.	Set FM/AM-1100S/A controls to initial settings as described above.
2.	Set PWR/OFF/BATT Switch (11) to either "PWR" or "BATT". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.

STEP	PROCEDURE
3.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.
4.	Using HORIZ Control (38) and VERT Control (40), center displayed trace on CRT Display (36) as shown in Figure 3-22.

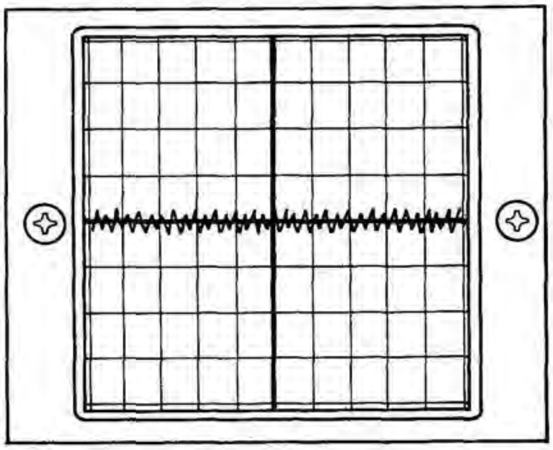


Figure 3-22 Displayed Trace Centered Over Major Horizontal Axis

5.	Adjust VAR/OFF Control (25) cw until DEVIATION/WATTS Meter (1) indicates 1.5 kHz and verify displayed waveform on CRT is 6 graticule divisions peak-to-peak (±.5 graticule divisions) as shown in Figure 3-23.

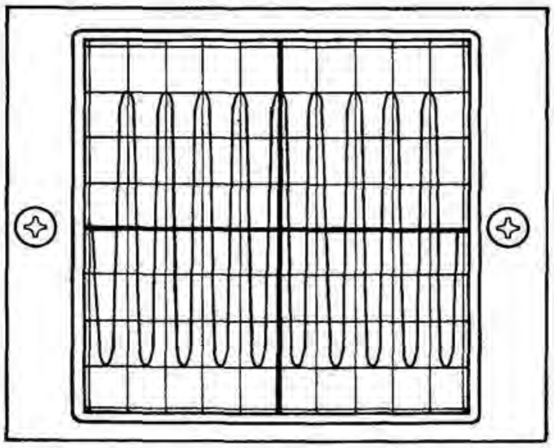


Figure 3-23 Displayed Waveform Measuring 6 Graticule Divisions in Height

STEP	PROCEDURE
6.	Rotate DEV/POWER Control (48) to "6 kHz" and DEV-VERT Control (33) to "6 kHz".
7.	Adjust VAR/OFF Control (25) cw until DEVIATION/WATTS Meter (1) indicates 6 kHz and verify that the displayed waveform on CRT Display (34) is 6 graticule divisions peak-to-peak (±.5 graticule divisions) as shown in Figure 3-23.
8.	Rotate SWEEP Control to "0.1 mS" and check to make sure sinewave is free of any significant distortion.
9.	Set RCVR WIDE/MID/NARROW Switch (12) to "MID".
10.	Rotate DEV/POWER Control (48) to "20 kHz" and DEV-VERT Control (33) to "15 kHz".
11.	Adjust VAR/OFF Control (25) cw until DEVIATION/WATTS Meter (1) indicates 15 kHz and verify that the displayed waveform on CRT is 6 graticule divisions peak-to-peak (±.5 graticule divisions) as shown in Figure 3-23.
12.	Adjust VOLUME Control (19) for a comfortable listening level, and verify the presence of audio.

3-3 LABORATORY PERFORMANCE EVALUATION PROCEDURES

3-3-1

TEST PROCEDURE: DUAL TONE GENERATOR PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D:

1 RMS Voltmeter (Capable of measuring a minimum of 4 volts RMS, 100 KΩ /volt sensitivity.)

1 Frequency Counter (5 Hz to 10 kHz range, .1 Hz resolution)

2 BNC Tee Connectors

2 50Ω Coax Cables with BNC Male Connectors on each end

1 50Ω Coax Cable with BNC Male Connector on one end and two alligator clips on opposite end

1 150Ω Resistor

1 Oscilloscope (DC-1 MHz Bandwidth)

TEST SET-UP DIAGRAM:

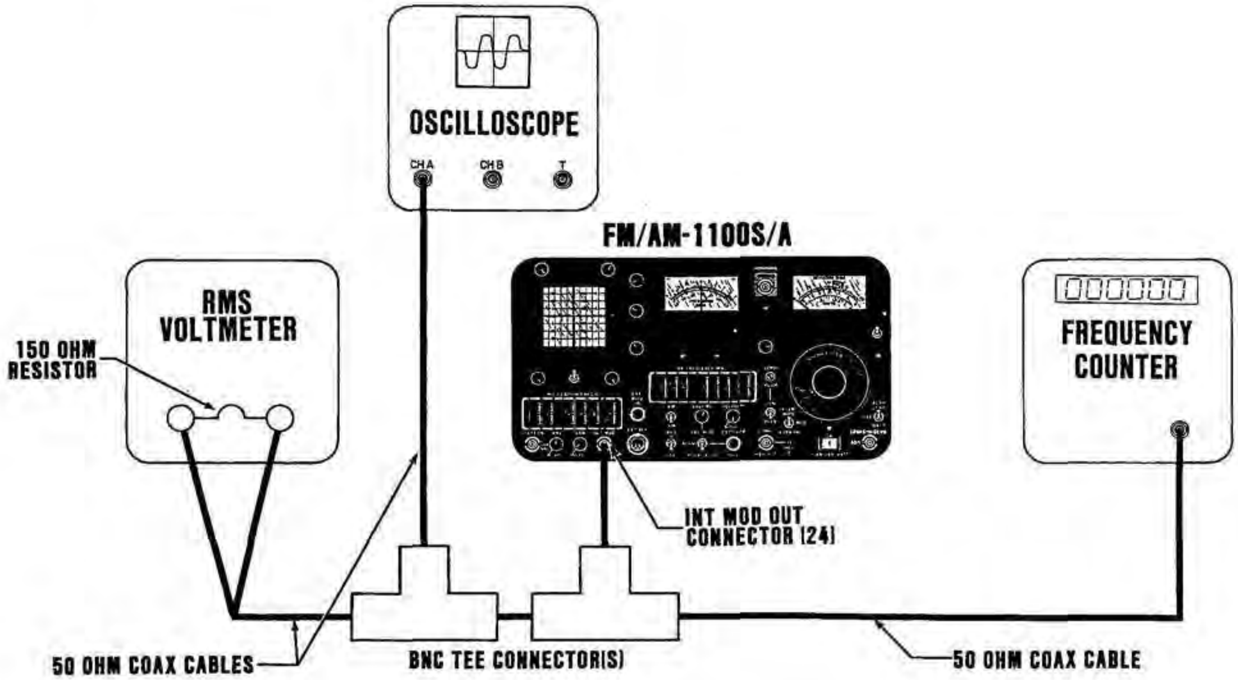


Figure 3-24 Dual Tone Generator Test Set-Up Diagram

INITIAL FM/AM-1100S/A
CONTROL SETTINGS:

CONTROL	INITIAL SETTING
11 PWR/OFF/BATT Switch	"OFF"
18 INT/MOD/RCVR/RCVR (DET OFF) Switch	"INT MOD"
25 VAR/OFF Control	Fully ccw, detent (OFF)
26 1 kHz/OFF Control	Fully ccw, detent (OFF)
27 MODULATION FREQ Hz Thumbwheels	"01000.0 Hz"
31 AC/OFF/DC Switch	"AC"
41 ANALY DISPR Control (FM/AM-1100S models only)	Fully ccw, detent

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

24 INT MOD OUT Connector

STEP	PROCEDURE
1.	Connect FM/AM-1100S/A to required accessory equipment as shown in Figure 3-24.
2.	Set FM/AM-1100S/A controls to initial settings as described above.
3.	Set Frequency Counter range for 0.1 Hz resolution.
4.	Select a range on RMS Voltmeter which will display at least 5 volts RMS.
5.	Set PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
6.	Apply power to RMS Voltmeter, Frequency Counter, and Oscilloscope.
7.	Adjust Intensity Control and Focus Control on external Oscilloscope to obtain a sharp visible trace on CRT Display.
8.	Adjust Horizontal Control and Vertical Control on external Oscilloscope to center trace over major horizontal axis of CRT Display.
9.	Rotate 1 kHz/OFF Control (26) fully cw and verify RMS Voltmeter indicates a minimum of 2.5 VRMS. Also make sure Frequency Counter displays a frequency between 0980.0 Hz and 1020.0 Hz.

STEP PROCEDURE

10. Adjust Vertical Sensitivity Control on external Oscilloscope to display a sinewave 6 graticule divisions peak-to-peak on CRT Display as shown in Figure 3-25. (Inspect waveform for clipping, spikes, or any other irregularities with Sweep Control in "0.1 mS" position.)

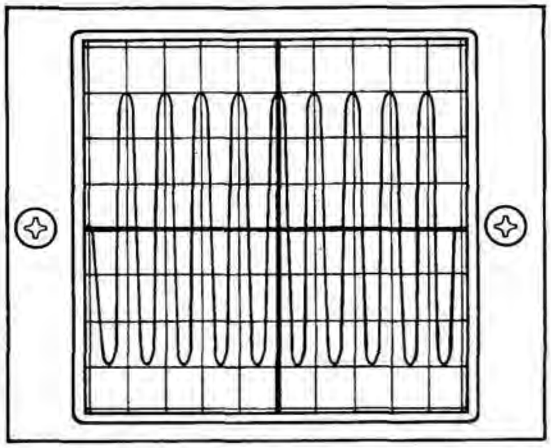


Figure 3-25 Displayed Waveform Measuring 6 Graticule Divisions Peak-to-Peak

11. Adjust VOLUME Control (19) for a comfortable listening level and verify presence of audio.

12. Rotate Sweep Control on external Oscilloscope to "1 mS".

13. Rotate 1 kHz/OFF Control (26) fully ccw to detent (OFF).

14. Rotate VAR/OFF Control (25) fully cw and verify RMS Voltmeter indicates a minimum of 2.5 VRMS. Frequency Counter should display a frequency of 1000.0 Hz (±0.1 Hz).

15. Adjust Vertical Sensitivity Control on external Oscilloscope to display a sinewave 6 graticule divisions peak-to-peak on CRT Display as shown in Figure 3-25. (Inspect waveform for clipping, spikes, or any other irregularities with Sweep Control in "0.1 mS" position.)

16. Set MODULATION FREQ Hz Thumbwheels (27) to "30000.0" and verify RMS Voltmeter indicates a minimum of 2.5 VRMS. Frequency Counter should display a frequency of 30000.0 Hz (±1.0 Hz). Also verify presence of audio.

17. Set MODULATION FREQ Hz Thumbwheels (27) to "00010.0" and verify RMS Voltmeter indicates a minimum of 2.5 VRMS. Frequency Counter should display a frequency of 00010.0 Hz (±0.1 Hz).

STEP PROCEDURE

18. Rotate Sweep Control on external Oscilloscope to "10 mS" and inspect displayed sinewave for clipping, spikes, or any other irregularities.

NOTE

A small amount of staircase stepping in waveform is normal.

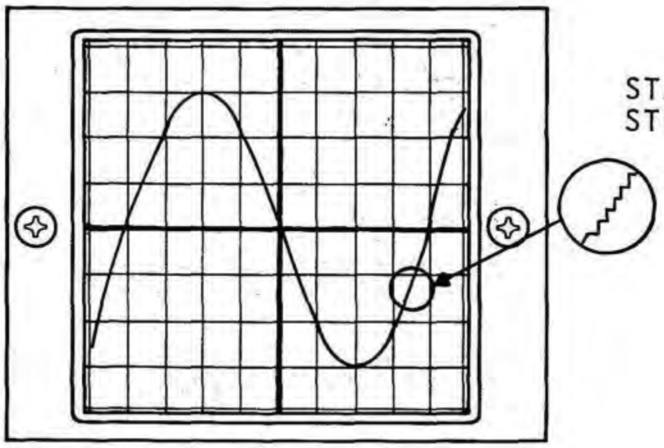


Figure 3-26 Displayed Sinewave Exhibiting Moderate Staircase Stepping

3-3-2

TEST PROCEDURE: OSCILLOSCOPE PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D:

1 Digital Voltmeter (2% accuracy at 1 kHz for levels as low as 20 mVRMS)

2 50Ω coax cables with BNC Male Connectors on both ends.

1 BNC Tee Connector.

1 BNC to DVM Adaptor

TEST SET-UP DIAGRAM:

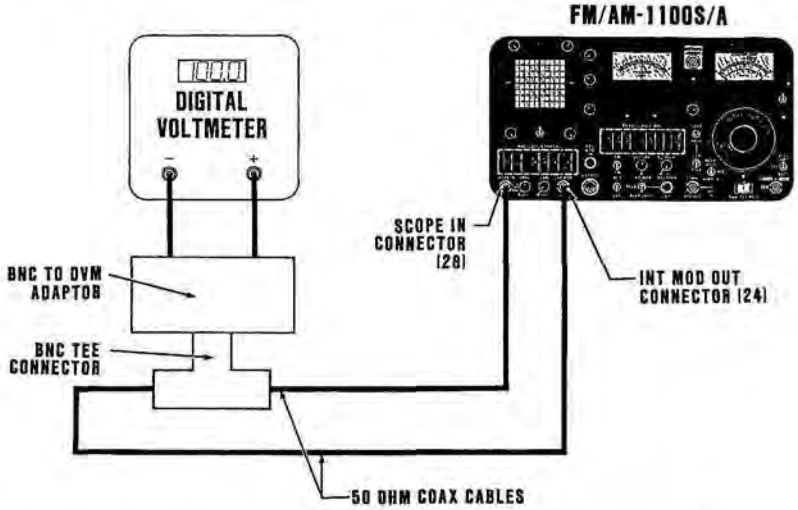


Figure 3-27 Oscilloscope Test Set-Up Diagram

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/µV X 100/NORM Switch	"µV X 100"
7	BFO-RF LEVEL Control	Fully cw
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"MID"
13	GEN/RCVR Switch	"GEN"
21	AM/FM Switch	"AM"
25	VAR/OFF Control	Fully ccw, detent (OFF)
26	1 kHz/OFF Control	Fully ccw, detent (OFF)
27	MODULATION FREQ Hz Thumbwheels	"01000.0"
29	SWEEP Control	"1 mS"
30	SWEEP VERNIER Control	Fully cw, detent (in "CAL")

CONTROL		INITIAL SETTING
31	AC/OFF/DC Switch	"AC"
32	DEV-VERT VERNIER Control	Fully cw, detent (in "CAL")
33	DEV-VERT Control	".01 V/DIV"
34	RF FREQUENCY MHz Thumbwheels	"0001000"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (FM/AM-1100S models only)	Fully ccw, detent
48	DEV/PWR Control	"20 kHz"

Other FM/AM-1100S/A features related to this performance evaluation but not requring an initial setting:

1 DEVIATION/WATTS Meter
9 TRANS/RCVR Connector
24 INT MOD OUT Connector
28 SCOPE IN Connector
36 CRT Display

STEP	PROCEDURE
1.	Connect FM/AM-1100S/A to accessory equipment as shown in Figure 3-27.
2.	Set FM/AM-1100S/A controls to initial settings as described above.
3.	Set Digital Voltmeter controls to display 21.2 mVRMS.
4.	Set PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
5.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace display.
6.	Adjust HORIZ Control (38) and VERT Control (40) to center trace over major horizontal axis of CRT Display (36).
7.	Adjust VAR/OFF Control (25) to display 21.2 mVRMS on Digital Voltmeter. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±3 minor graticule divisions). (See Figure 3-28.)

STEP	PROCEDURE
7.	(Continued)

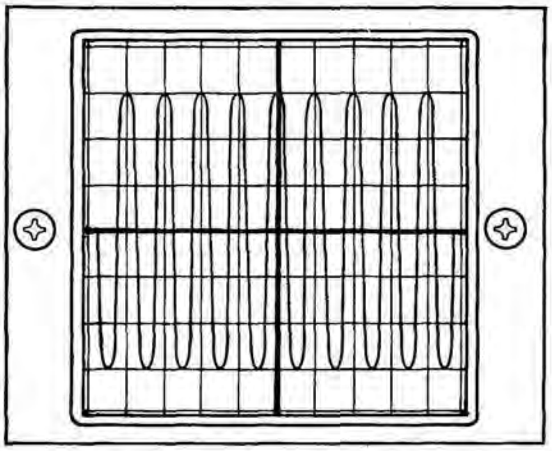


Figure 3-28 Displayed Sinewave Measuring 6 Graticule Divisions Peak-to-Peak

8.	Rotate DEV-VERT Control (33) to ".1 V/DIV". Change range setting on Digital Voltmeter to display 212 mVRMS.
9.	Adjust VAR/OFF Control (25) to display 212 mVRMS on Digital Voltmeter. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±3 minor graticule divisions). (See Figure 3-28.)
10.	Rotate DEV-VERT Control (33) to "1 V/DIV". Change range setting on Digital Voltmeter to display 2.12 VRMS.
11.	Adjust VAR/OFF Control (25) to display 2.12 VRMS on Digital Voltmeter. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±3 minor graticule divisions). (See Figure 3-28.)
12.	Rotate DEV-VERT Control (33) to "10 V/DIV". Verify sinewave displayed on CRT Display (36) is 0.6 graticule divisions peak-to-peak (±5 minor graticule divisions). (See Figure 3-29.)

STEP PROCEDURE

12. (Continued)

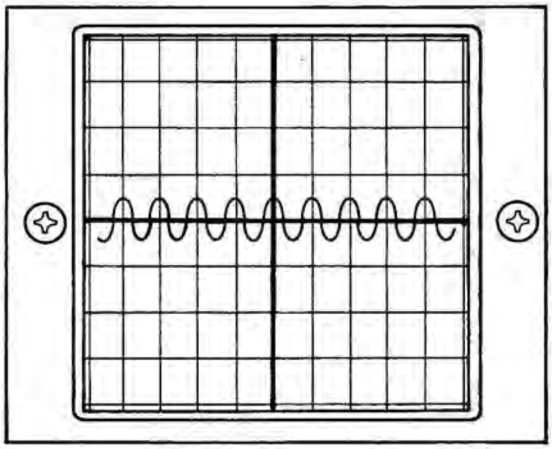


Figure 3-29 Displayed Sinewave Measuring 0.6 Graticule Divisions Peak-to-Peak

13. Rotate DEV-VERT Control (33) to "1 V/DIV".

14. Adjust VERT Control (40) to align positive peaks of displayed sinewave with major horizontal axis (see Figure 3-30).

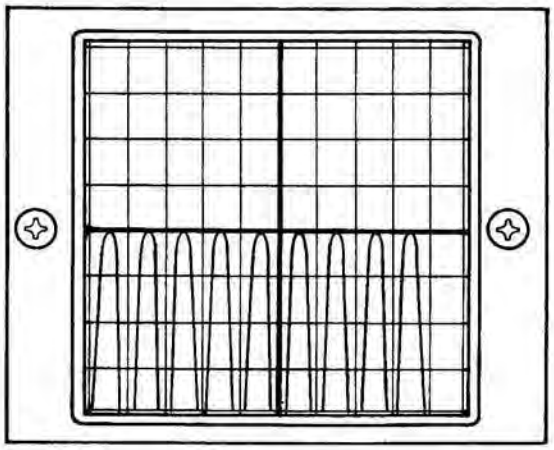


Figure 3-30 Positive Peaks of Displayed Sinewave Aligned With Major Horizontal Axis

STEP PROCEDURE

15. Using HORIZ Control (38), align waveform so centermost positive peak of waveform is centered over major vertical axis. Also verify that peak to right of centermost peak is also centered over vertical axis (within ±1 minor graticule division). (See Figure 3-31.)

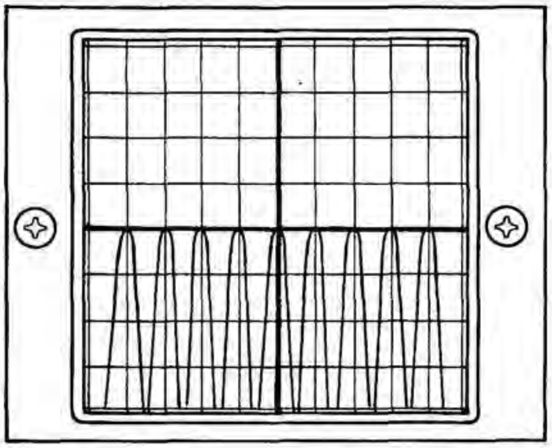


Figure 3-31 Displayed Waveform Peaks Centered Over Vertical Axes

16. Rotate SWEEP Control (29) to "10 mS" and MODULATION FREQ Hz Thumbwheels (27) to "00100.0".

17. Using HORIZ Control (38), position waveform so centermost positive peak of waveform is centered over major vertical axis. Also verify that peak to right of centermost peak is also centered over vertical axis (within ±1 minor graticule division). (See Figure 3-31.)

18. Rotate SWEEP Control (29) to ".1 mS" and MODULATION FREQ Hz Thumbwheels (27) to "09999.9".

19. Using HORIZ Control (38), position waveform so centermost positive peak of waveform is centered over major vertical axis. Also verify that peak to right of centermost peak is also centered over vertical axis (within ±1 minor graticule division). (See Figure 3-31.)

20. Remove BNC Connector from INT MOD OUT Connector (24) and reconnect it to TRANS/RCVR Connector (9).

21. Rotate DEV-VERT Control (33) to ".01 V/DIV", SWEEP Control (29) to "10 μS", and VAR/OFF Control (25) fully ccw, to detent (OFF).

STEP | PROCEDURE

22. Using HORIZ Control (38), position waveform so centermost positive peak of waveform is centered over major vertical axis. Also verify that peak to right of centermost peak is also centered over vertical axis (within ±1 minor graticule division). (See Figure 3-31.)

23. Remove BNC Connector from TRANS/RCVR Connector (9) and connect it to INT MOD OUT Connector (24).

24. Rotate SWEEP Control (29) to "MODULATION FREQ Hz", MODULATION FREQ Hz Thumbwheels (27) to "01000.0", and DEV-VERT Control (33) to "15 kHz".

25. Adjust VAR/OFF Control (25) cw until a triangular waveform is displayed on CRT Display (36) as shown in Figure 3-32.

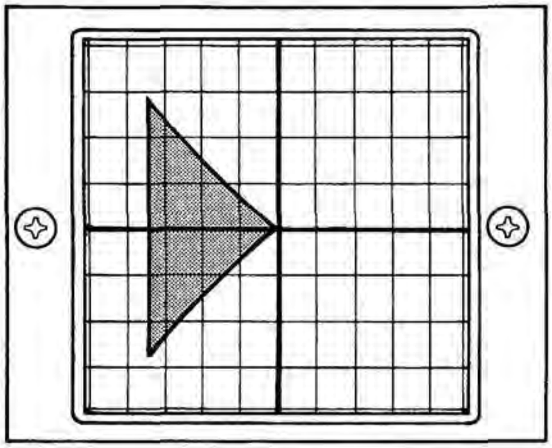


Figure 3-32 Typical Triangular Waveform

26. Set AM/FM Switch (21) to "FM" and verify that a first order Lissajou figure is displayed on CRT Display (36) as shown in Figure 3-33.

STEP · PROCEDURE

26. (Continued)

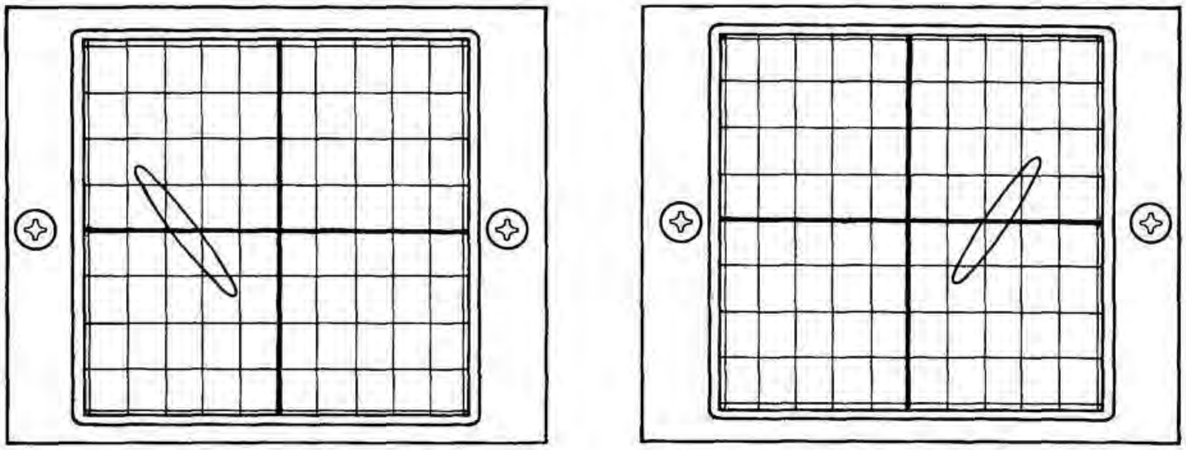


Figure 3-33 First Order Lissajou Figure

27. Rotate SWEEP Control (29) to "1 mS".

28. Adjust VAR/OFF Control (25) until DEVIATION/WATTS Meter (1) indicates 15 kHz deviation. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±1.5 minor divisions). (See Figure 3-28.)

29. Rotate DEV/POWER Control (48) to "6 kHz" and DEV-VERT Control (33) to "6 kHz".

30. Adjust VAR/OFF Control (25) until DEVIATION/WATTS Meter (1) indicates 6 kHz deviation. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±1.5 minor divisions). (See Figure 3-28.)

31. Rotate DEV/POWER Control (48) to "2 kHz", RCVR WIDE/MID/NARROW Switch (12) to "NARROW", and DEV-VERT Control (33) to "1.5 kHz".

32. Adjust VAR/OFF Control (25) until DEVIATION/WATTS Meter (1) indicates 1.5 kHz deviation. Verify sinewave displayed on CRT Display (36) is 6 graticule divisions peak-to-peak (±1.5 minor division). (See Figure 3-28.)

3-3-3

TEST PROCEDURE: SPECTRUM ANALYZER PERFORMANCE EVALUATION (APPLICABLE TO FM/AM-1100S MODELS ONLY)

SPECIAL ACCESSORY EQUIPMENT REQ'D:

1 Signal Generator (Capable of generating 125 MHz between -30 and -100 dBm)

1 50Ω coax cable with BNC Male Connectors on both ends.

TEST SET-UP DIAGRAM:

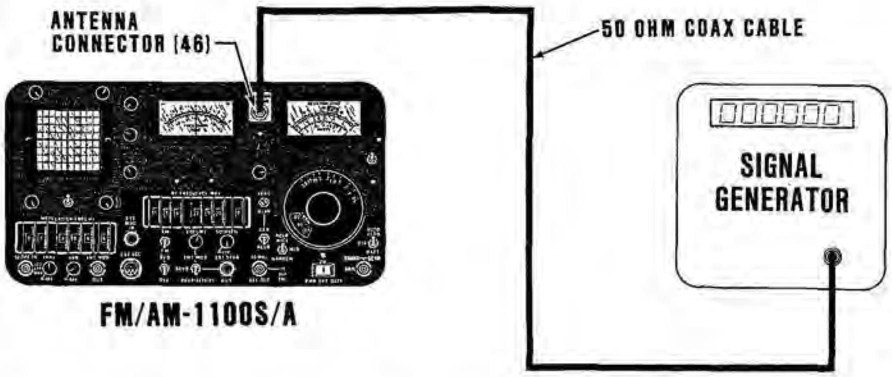


Figure 3-34 Spectrum Analyzer Test Set-Up Diagram

INITIAL FM/AM-1100S CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"NARROW"
13	GEN/RCVR Switch	"RCVR"
17	SQUELCH Control	Fully ccw, detent (OFF)
20	BFO/OFF Switch	"OFF"
31	AC/OFF/DC Switch	"DC"
34	RF FREQUENCY MHz Thumbwheels	"1250000"
37	INTENSITY Control	Midrange
39	FOCUS Control	Midrange
41	ANALY DISPR Control	Fully cw

Other FM/AM-1100S features related to this performance evaluation but not requring an initial setting:

36 CRT Display
46 ANTENNA Connector

STEP	PROCEDURE
1.	Connect FM/AM-1100S to accessory equipment as shown in Figure 3-34.
2.	Set FM/AM-1100S controls to initial settings as described above.
3.	Apply power to signal generator and set output frequency to 125.0000 MHz.
4.	Set PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up. Verify baseline is at 109 dB.
5.	Adjust output level of Signal Generator to -30 dBm and verify displayed signal on CRT Display (36) is -30 dBm (±4 dB).
6.	Adjust output level of Signal Generator to -40 dBm and verify displayed signal on CRT Display (36) is -40 dBm (±4 dB).
7.	Adjust output level of Signal Generator to -50 dBm and verify displayed signal on CRT Display (36) is -50 dBm (±4 dB).
8.	Adjust output level of Signal Generator to -60 dBm and verify displayed signal on CRT Display (36) is -60 dBm (±4 dB).
9.	Adjust output level of Signal Generator to -70 dBm and verify displayed signal on CRT Display (36) is -70 dBm (±4 dB).
10.	Adjust output level of Signal Generator to -80 dBm and verify displayed signal on CRT Display (36) is -80 dBm (±4 dB).
11.	Adjust output level of Signal Generator to -90 dBm and verify displayed signal on CRT Display (36) is -90 dBm (±4 dB).
12.	Adjust output level of Signal Generator to -100 dBm and verify displayed signal on CRT Display (36) is -100 dBm (±4 dB).
13.	Adjust output level of Signal Generator to -60 dBm.
14.	Set RF FREQUENCY MHz Thumbwheels (34) to "1200000" and verify Signal Generator spectrum displayed on CRT Display (36) is 5 graticule divisions to right of the major vertical axis (±4 minor graticule divisions). (See Figure 3-35.)

STEP PROCEDURE

14. (Continued)

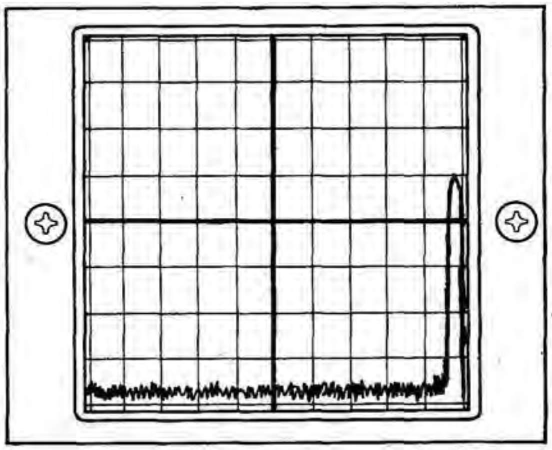


Figure 3-35 Wide Dispersion Spectrum Display 5 Graticule Divisions Right Of Major Vertical Axis

15. Set RF FREQUENCY MHz Thumbwheels (34) to "1300000" and verify Signal Generator spectrum displayed on CRT Display (36) is 5 graticule divisions to left of the major vertical axis (±4 minor graticule divisions). (See Figure 3-36.)

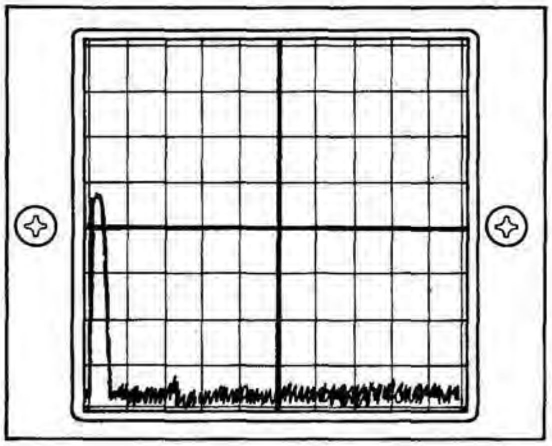


Figure 3-36 Wide Dispersion Spectrum Display 5 Graticule Divisions Left Of Major Vertical Axis

16. Adjust ANALY DISPR Control (41) fully ccw (short of detent).

STEP PROCEDURE

17. Set RF FREQUENCY MHz Thumbwheels (34) to "1250000" and verify Signal Generator spectrum displayed on CRT Display (36) is centered over the major vertical axis (within ±2 minor graticule divisions).

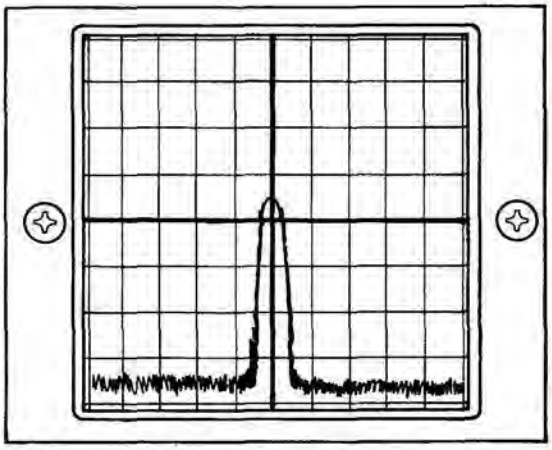


Figure 3-37 Narrow Dispersion Spectrum Display Centered Over Major Vertical Axis

18. Set RF FREQUENCY MHz Thumbwheels (34) to "1255000" and verify Signal Generator spectrum displayed on CRT Display (36) is 5 graticule divisions to left of the major vertical axis (±4 minor graticule divisions). (See Figure 3-38.)

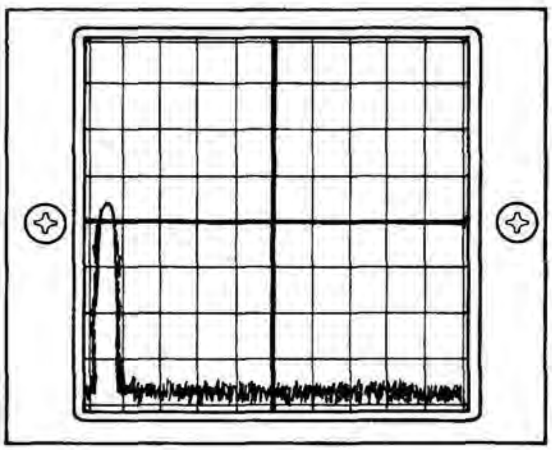


Figure 3-38 Narrow Dispersion Spectrum Display 5 Graticule Divisions Left Of Major Vertical Axis

STEP PROCEDURE

19. Set RF FREQUENCY MHz Thumbwheels (34) to "1245000" and verify Signal Generator spectrum displayed on CRT Display (36) is 5 graticule divisions right of the major vertical axis (±4 minor graticule divisions). (See Figure 3-39.)

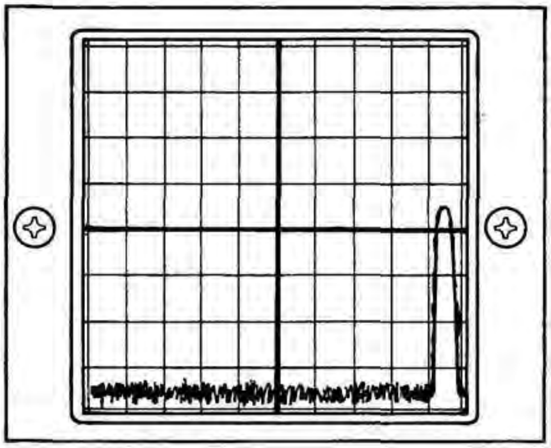


Figure 3-39 Narrow Dispersion Spectrum Display 5 Graticule Divisions Right Of Major Vertical Axis

3-3-4

TEST PROCEDURE: SIGNAL GENERATOR PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D:

1 Frequency Counter (Capable of measuring 200 MHz with 1 Hz resolution.)

1 Spectrum Analyzer (Capable of measuring 125 MHz between 0 and -100 dBm.)

1 Signal Generator (Capable of generating 125 MHz between 0 and -40 dBm, with output level accurate to within 1 dB.)

3 50Ω Coax Cables.

1 Modulation Meter (Capable of measuring AM and FM modulation of 1 kHz tone on 125 MHz carrier.
Range: FM, 0-20 kHz;
AM, 0-100%.)

TEST SET-UP DIAGRAM:

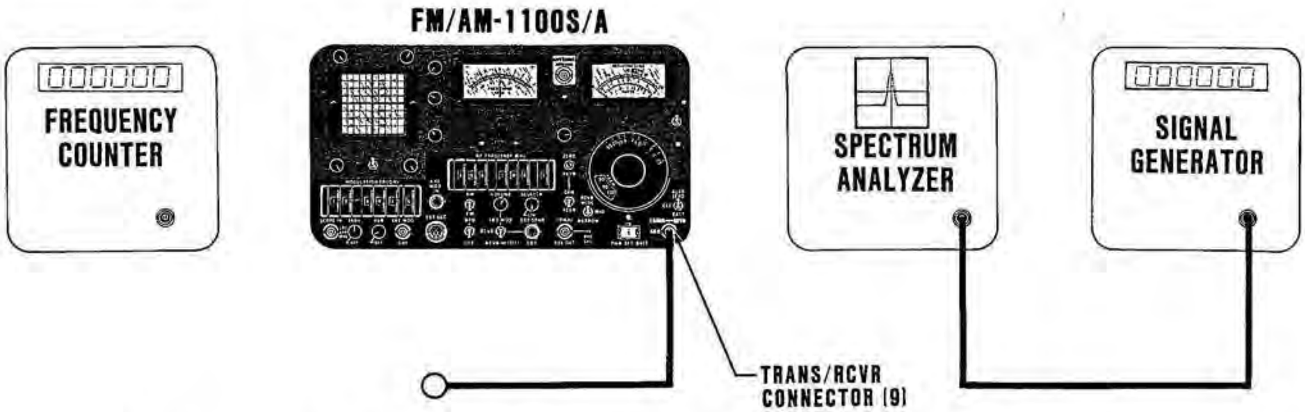


Figure 3-40 Signal Generator Test Set-Up Diagram

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/µV X 100/NORM Switch	"NORM"
7	BFO-RF LEVEL Control	"-100 dBm"
8	AUTO ZERO/OFF/BATT Switch	"AUTO ZERO"
11	PWR/OFF/BATT Switch	"OFF"
13	GEN/RCVR Switch	"GEN"
18	INT MOD/RCVR/RCVR (DET OFF) Switch	"RCVR"

CONTROL		INITIAL SETTING
20	BFO/OFF Switch	"OFF"
25	VAR/OFF Control	Fully ccw, detent (OFF)
26	1 kHz/OFF Control	Fully ccw, detent (OFF)
31	AC/OFF/DC Switch	"DC"
34	RF FREQUENCY MHz Thumbwheels	"1250000"
37	INTENSITY Control	Midrange
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control (FM/AM-1100S models only)	Fully ccw, detent

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

2 0 dBm Lamp
9 TRANS/RCVR Connector
36 CRT Display

STEP	PROCEDURE
1.	Set FM/AM-1100S/A controls to initial settings described above.
2.	Connect coax cable between input of Spectrum Analyzer and output of Signal Generator as shown in Figure 3-40.
3.	Connect a second coax cable to TRANS/RCVR Connector (9) of FM/AM-1100S; leave other end unattached. (See Figure 3-40.)
4.	Apply power to external Spectrum Analyzer and Signal Generator.
5.	Adjust output of Signal Generator to 125.0000 MHz at -40 dBm.
6.	Adjust Spectrum Analyzer to reflect an output level -40 dBm. (Analyzer should be able to display levels from -100 dBm to 0 dBm at 125.0000 MHz.)
7.	Disconnect coax cable connector from Spectrum Analyzer input; in its place, attach free end of coax previously connected to FM/AM-1100S TRANS/RCVR Connector (9).
8.	Set PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up time from a cold start, as trace will not become visible until CRT achieves warm-up.
9.	Adjust INTENSITY Control (37) and FOCUS Control (39) to obtain a sharp visible trace.
10.	Adjust HORIZ Control (38) and VERT Control (40) to center trace over major horizontal axis of CRT Display (36).

STEP	PROCEDURE
11.	Verify an output level reading of -100 dBm (±3 dB) on external Spectrum Analyzer.
12.	Rotate BFO-RF LEVEL Control (7) to "-90 dBm" and verify external Spectrum Analyzer displays -90 dBm (±3 dB).
13.	Rotate BFO-RF LEVEL Control (7) to "-80 dBm" and verify external Spectrum Analyzer displays -80 dBm (±3 dB).
14.	Set HI LVL/µV X 100/NORM Switch (3) to "µV X 100" and rotate BFO/RF LEVEL Control (7) to "-110 dBm" to verify external Spectrum Analyzer displays -70 dBm (±3 dBm).
15.	Rotate BFO-RF LEVEL Control (7) to "100 dBm" and verify external Spectrum Analyzer displays -60 dBm (±3 dB).
16.	Rotate BFO-RF LEVEL Control (7) to "-90 dBm" and verify external Spectrum Analyzer displays -50 dBm (±3 dB).
17.	Rotate BFO-RF LEVEL Control (7) to "-80 dBm" and verify external Spectrum Analyzer displays -40 dBm (±3 dB).
18.	Set HI LVL/µV X 100/NORM Switch (3) to "HI LVL" and slowly rotate BFO-RF LEVEL Control (7) until 0 dBm Lamp (2) illuminates. Verify external Spectrum Analyzer displays 0 dBm (±3 dB).
19.	Subtract 10 dB from current BFO-RF LEVEL Control (7) setting and rotate control to this value. Verify external Spectrum Analyzer displays -10 dBm (±3 dB).
20.	Subtract 10 dB from current BFO-RF LEVEL Control (7) setting and rotate control to this value. Verify external Spectrum Analyzer displays -20 dBm (±3 dB).
21.	Subtract 10 dB from current BFO-RF LEVEL Control (7) setting and rotate control to this value. Verify external Spectrum Analyzer displays -30 dBm (±3 dB).
22.	Set RF FREQUENCY MHz Thumbwheels (34) to 1000000 and verify external Spectrum Analyzer displays a frequency of 100 MHz.
23.	Increment leftmost RF FREQUENCY MHz Thumbwheels (34) (100 MHz digit) from 1 to 9 and verify external Spectrum Analyzer displays the same frequency corresponding to thumbwheel setting.
24.	Adjust BFO-RF LEVEL Control (7) appropriately until 0 dBm Indicator Lamp (2) illuminates.
25.	Disconnect coax cable connector from FM/AM-1100S/A TRANS/RCVR Connector (9).

STEP PROCEDURE

26. Connect a coax cable between input of Frequency Counter and TRANS/RCVR Connector (9).

27. Connect a second coax cable between 10 MHz REF OUT Connector on front panel of FM/AM-1100S/A and external time base input (10 MHz) on Frequency Counter; equipment hook-up should now appear as shown in Figure 3-41.

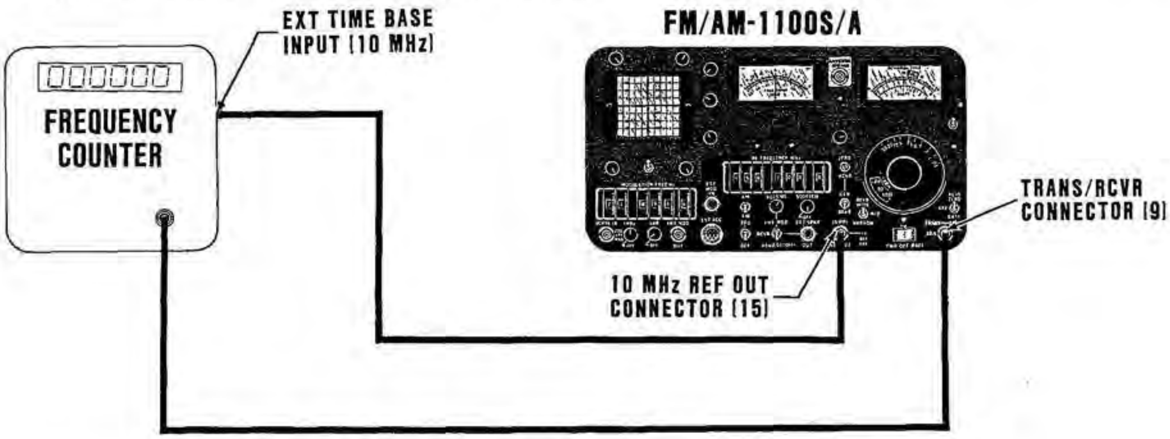


Figure 3-41 FM/AM-1100S/A and Frequency Counter Interconnection

28. Set RF FREQUENCY MHz Thumbwheels (34) to "0111111" and verify Frequency Count r displays 0111111 MHz (±10 Hz).

29. Repeat procedure in Step 28 for frequencies listed below:

Step	FM/AM-1100S/A RF FREQUENCY MHz Thumbwheel Setting	Frequency Counter Display
a	0222222 MHz	0222222 MHz (±10 Hz)
b	0333333 MHz	0333333 MHz (±10 Hz)
c	0444444 MHz	0444444 MHz (±10 Hz)
d	0555555 MHz	0555555 MHz (±10 Hz)
e	0666666 MHz	0666666 MHz (±10 Hz)
f	0777777 MHz	0777777 MHz (±10 Hz)
g	0888888 MHz	0888888 MHz (±10 Hz)
h	0999999 MHz	0999999 MHz (±10 Hz)
i	1000000 MHz	1000000 MHz (±10 Hz)

STEP	PROCEDURE
30.	Set RF FREQUENCY MHz Thumbwheels (34) to 125.0000 MHz. Connect TRANS/RCVR Connector (9) to Modulation Meter.
31.	Slowly rotate VAR/OFF Control (25) cw while observing Modulation Meter. Verify modulation level increases smoothly from 0 thru 100% AM.
32.	Set AM/FM Switch (21) to "FM".
33.	Rotate VAR/OFF Control (25) fully ccw.
34.	Slowly rotate VAR/OFF Control (25) cw while observing Modulation Meter. Verify deviation increases smoothly from 0 thru 20 kHz FM deviation.

3-3-5

TEST PROCEDURE: RECEIVER AND DEVIATION METER PERFORMANCE EVALUATION

SPECIAL ACCESSORY EQUIPMENT REQ'D:

1 RF Power Generator (Capable of generating 125 MHz between +36 dBm and +46 dBm.)

1 Signal Generator (Capable of generating 120 to 130 MHz at -100 and -110 dBm.)

1 Modulation Meter (Capable of measuring from 2 to 15 kHz deviation at 125 MHz, with 2% accuracy.)

1 Thru-Line RF Wattmeter (50Ω, 100 W range and greater than 5% accuracy.)

1 40 dB Attenuator

1 BNC Tee Connector

2 50Ω Coax Cables (w/BNC Connectors on all ends)

TEST SET-UP DIAGRAM:

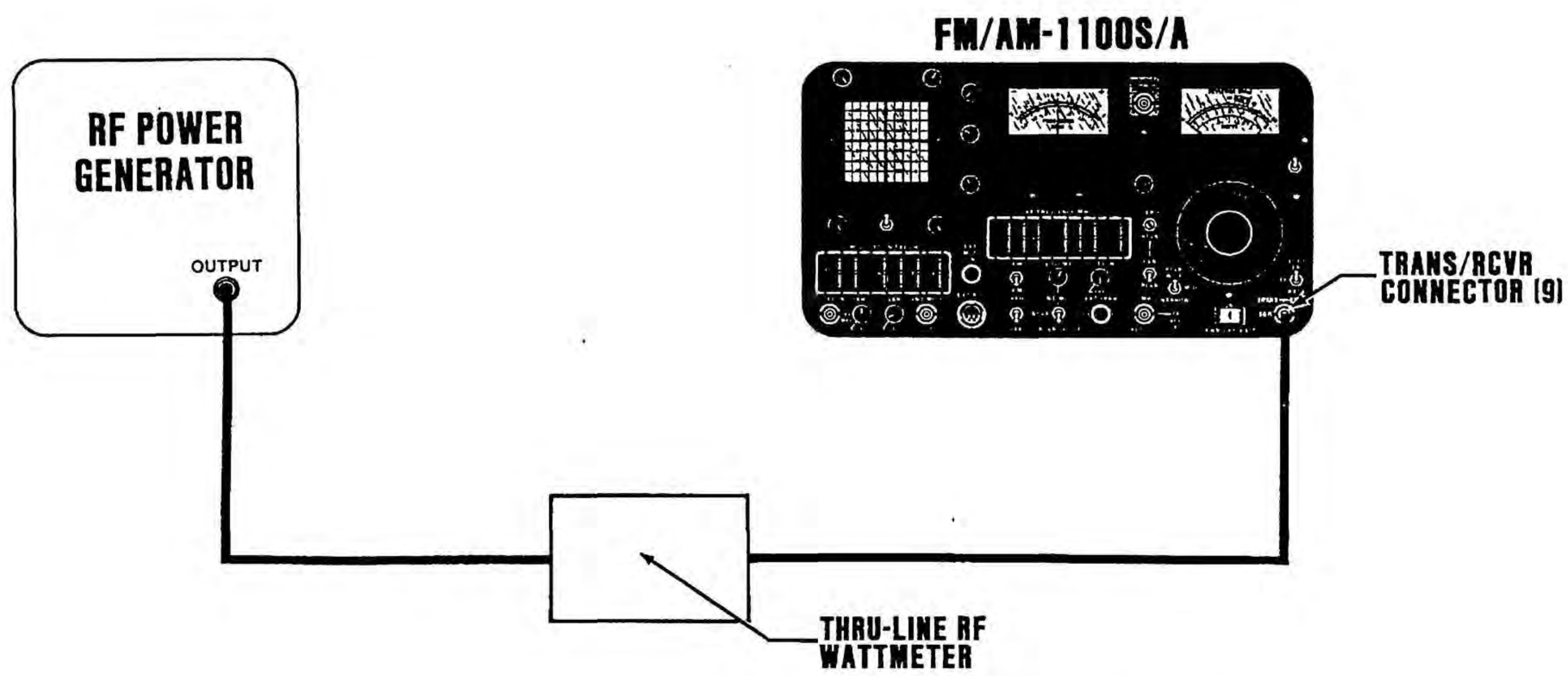


Figure 3-42 Receiver and Deviation Meter Test Set-Up Diagram

INITIAL FM/AM-1100S CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/μV X 100/NORM Switch	"μV X 100"
7	BFO-RF LEVEL Control	Fully ccw
8	AUTO ZERO/OFF/BATT Switch	"AUTO ZERO"
11	PWR/OFF/BATT Switch	"OFF"
12	RCVR WIDE/MID/NARROW Switch	"NARROW"

CONTROL		INITIAL SETTING
13	GEN/RCVR Switch	"RCVR"
17	SQUELCH Control	Fully ccw, detent
18	INT MOD/RCVR/RCVR (DET OFF) Switch	"RCVR"
19	VOLUME Control	Fully ccw
20	BFO/OFF Switch	"OFF"
21	AM/FM Switch	"FM"
25	VAR/OFF Control	Fully ccw, detent (OFF)
26	1 kHz/OFF Control	Fully ccw, detent (OFF)
29	SWEEP Control	".1 mS"
30	SWEEP VERNIER Control	Fully cw, detent (in "CAL")
32	DEV-VERT VERNIER Control	Fully cw, detent (in "CAL")
33	DEV-VERT Control	"15 kHz"
34	RF FREQUENCY MHz Thumbwheels	"1250000"
35	FREQ ERROR Control	"1.5 kHz"
41	ANALY DISPR Control (FM/AM-1100S models only)	Fully ccw, short of detent
48	DEV/POWER Control	"X1"

Other FM/AM-1100S/A features related to this performance evaluation but not requiring an initial setting:

1 DEVIATION/WATTS Meter
9 TRANS/RCVR Connector
15 10 MHz REF OUT Connector
43 FREQ ERROR Meter
46 ANTENNA Connector
47 INPUT LEVEL Lamp

STEP	PROCEDURE
1.	Connect FM/AM-1100S/A to accessory equipment as shown in Figure 3-42.
2.	Set FM/AM-1100S/A controls to initial settings as described above.
3.	Apply power to RF Power Generator.
4.	Set PWR/OFF/BATT Switch (11) to "PWR".
5.	Set output of RF Power Generator to 1250000 MHz at +36 dBm (4 Watts), as displayed on Thru-Line Wattmeter. Verify DEVIATION/WATTS Meter (1) displays 4 Watts (±.4 W).
6.	Rotate DEV/POWER Control (48) to "X10".
7.	Set output of RF Power Generator to +46 dBm (40 Watts), as displayed on Thru-Line Wattmeter. Verify DEVIATION/WATTS Meter (1) displays 40 Watts (±4 W).

STEP PROCEDURE

8. Rotate DEV/POWER Control (48) to "X100". Verify DEVIATION/WATTS Meter (1) displays 40 W (±4 W).

CAUTION

IF SIGNAL IS TO BE MONITORED THROUGH A UUT VIA A DIRECT CABLE CONNECTION TO TRANS/RCVR CONNECTOR (9), DO NOT APPLY MORE THAN 100 WATTS OF CONTINUOUS INPUT TO TRANS/RCVR CONNECTOR (9).

Maximum ON/OFF times for measurement of transmitter output using TRANS/RCVR Connector (9):

325 W; 1 min. ON, 6 min. OFF
200 W: 1 min. ON, 2 min. OFF
150 W; 2 min. ON, 2 min. OFF
100 W; 15 min. ON, 10 min. OFF

Times established using unrestricted convection cooling at 25° C ambient.

100 W continuous if additional forced air cooling is provided across rear panel heat sink.

9. Disconnect RF Power Generator and Thru-Line RF Wattmeter from TRANS/RCVR Connector (9) of FM/AM-1100S/A. Using 50Ω coax cable, connect Signal Generator to ANTENNA Connector (46) of FM/AM-1100S/A, as shown in Figure 3-43.

CAUTION

MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR (46) MUST NOT EXCEED .25 W.

MAXIMUM INPUT TO ANTENNA Connector (46) IS -30 dBm FOR PROPER SPECTRUM ANALYZER OPERATION (signals above -30 dBm may cause spurious signals to be generated and displayed by FM/AM-1100S.)

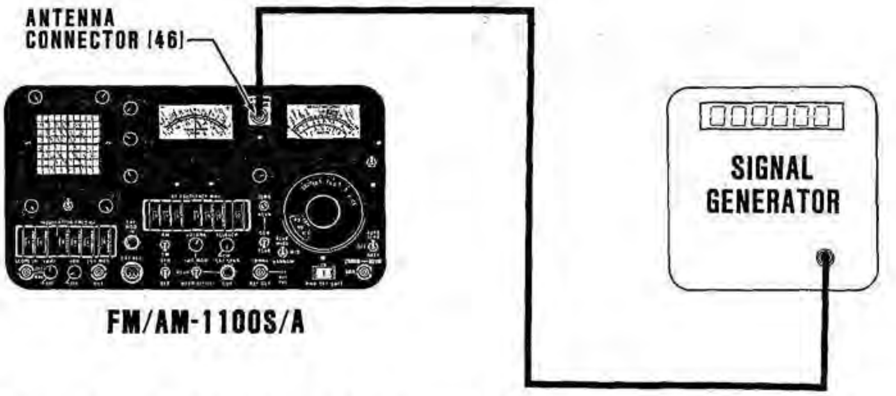


Figure 3-43 Signal Generator to FM/AM-1100S/A Connection.

STEP PROCEDURE

10. Set output of Signal Generator to appropriate setting:

a. 1251000 MHz at -40 dBm for FM/AM-1100S models.

b. 1250010 MHz at -40 dBm for FM/AM-1100A models.

11. Rotate BFO-RF LEVEL Control (7) to "-80 dBm", set BFO/OFF Switch (20) to "BFO" and verify:

a. (On FM/AM-1100S models) spectrum of Signal Generator and FM/AM-1100S BFO are equal in amplitude (within ±4 dB) as viewed on FM/AM-1100S CRT Display (36).

b. (On FM/AM-1100A models) FM/AM-1100A CRT Display (36) displays a 1 kHz modulation envelope at 100%.

12. Set HI LVL/μV X 100/NORM Switch (3) to "NORM", adjust output level of Signal Generator to -80 dBm and verify:

a. (On FM/AM-1100S models) spectrum of Signal Generator and FM/AM-1100S BFO are equal in amplitude (within ±4 dB) as viewed on FM/AM-1100S CRT Display (36).

b. (On FM/AM-1100A models) FM/AM-1100A CRT Display (36) displays a 1 kHz modulation envelope at 100%.

13. Disconnect Signal Generator from FM/AM-1100S/A ANTENNA Connector (46); connect coax cable and 40 dB Attenuator between FM/AM-1100S/A 10 MHz REF OUT Connector (15) and ANTENNA Connector (46) as shown in Figure 3-44.

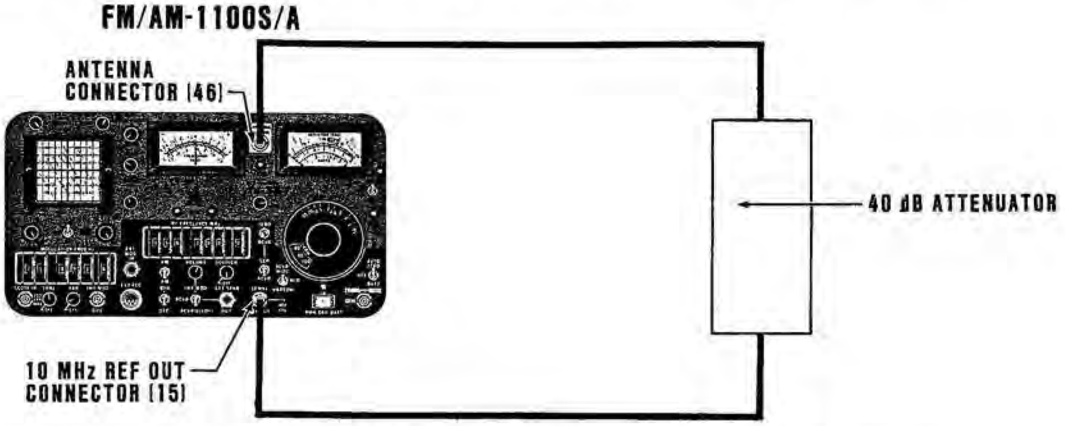


Figure 3-44 40 dB Attenuator Connection Between 10 MHz REF OUT and ANTENNA Connectors

14. Set BFO/OFF Switch (20) to "OFF".

15. Set RF FREQUENCY MHz Thumbwheels (34) to "0100000".

STEP	PROCEDURE
16.	Verify that a reading of 0 Hz (±50 Hz) is displayed on FREQ ERROR Meter (43).
17.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100010" and verify FREQ ERROR Meter (43) displays -1.0 kHz (±100 Hz).
18.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099990" and verify FREQ ERROR Meter (43) displays +1.0 kHz (±100 Hz).
19.	Rotate FREQ ERROR Control (35) to "5 kHz".
20.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099950" and verify FREQ ERROR Meter (43) displays +5.0 kHz (±0.3 kHz).
21.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100050" and verify FREQ ERROR Meter (43) displays -5.0 kHz (±0.3 kHz).
22.	Rotate FREQ/ERROR Control (35) to "15 kHz".
23.	Set RCVR WIDE/MID/NARROW Switch (12) to "WIDE".
24.	Set RF FREQUENCY MHz Thumbwheels (34) to "0100150" and verify FREQ ERROR Meter (43) displays -15 kHz (±3.0 kHz).
25.	Set RF FREQUENCY MHz Thumbwheels (34) to "0099850" and verify FREQ ERROR Meter (43) displays +15 kHz (±3.0 kHz).
26.	Disconnect coax cable and 40 dB Attenuator from 10 MHz REF OUT Connector (15) and ANTENNA Connector (46).
27.	Using BNC Tee Connector and appropriate coax cables, connect Modulation Meter and Signal Generator to FM/AM-1100S/A as shown in Figure 3-45.

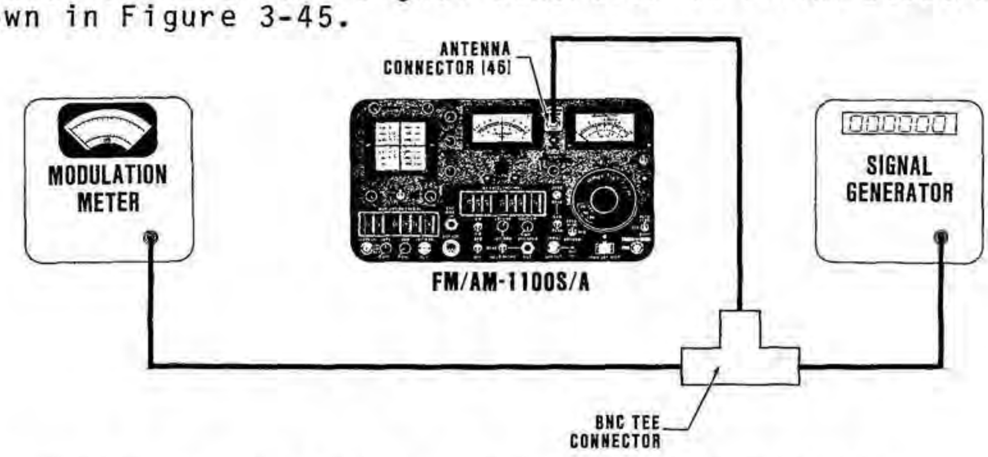


Figure 3-45 Modulation Meter/Signal Generator Connection to FM/AM-1100S/A

STEP	PROCEDURE
28.	Set RF FREQUENCY MHz Thumbwheels (34) to "1250000" and modulate Signal Generator with a 1 kHz tone at 2 kHz peak FM deviation, as seen on Modulation Meter.
29.	Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".
30.	Rotate DEV/POWER Control (48) to "2 kHz" and verify DEVIATION/WATTS Meter (1) displays 2 kHz deviation.
31.	Rotate DEV/POWER Control (48) to "6 kHz", modulate Signal Generator with a 1 kHz tone at 5 kHz peak FM deviation (as seen on Modulation Meter) and verify DEVIATION/WATTS Meter (1) displays 5 kHz deviation.
32.	Set RCVR WIDE/MID/NARROW Switch (11) to "WIDE".
33.	Rotate DEV/POWER Control (48) to "20 kHz", modulate Signal Generator with a 1 kHz tone at 15 kHz peak FM deviation (as seen on Modulation Meter) and verify DEVIATION/WATTS Meter (1) displays 15 kHz deviation.
34.	Rotate VOLUME Control (19) cw to verify presence of 1 kHz tone.
35.	Set AM/FM Switch (21) to "AM", modulate Signal Generator with a 1 kHz tone at 50% AM modulation (as seen on Modulation Meter) and verify presence of 1 kHz tone.
36.	Rotate SQUELCH Control (17) fully cw and verify receiver is muted.
37.	Rotate SQUELCH Control (17) fully ccw in detent.
38.	Adjust Signal Generator to produce a 111.1 MHz signal, modulated with 1 kHz FM at 5 kHz deviation. Set output level to -98 dBm.
39.	Connect Distortion Analyzer to Pin 8 of EXT ACC Connector (22) (See Appendix F). Verify distortion is less than 25%.
40.	Disconnect Signal Generator from ANTENNA Connector (46).
41.	Connect RF Power Generator to TRANS/RCVR Connector (9). Set output of RF Power Generator to 111.1 MHz at 1 W. Verify Spectrum Analyzer displays signal with an amplitude of -44 dBm.

3-3-6

TEST PROCEDURE: POWER SUPPLY VOLTAGE CHECKS

SPECIAL ACCESSORY EQUIPMENT REQ'D: 1 Digital Voltmeter (Capable of measuring 50 V with 100 KΩ/Volt sensitivity)

TEST SET-UP DIAGRAM:

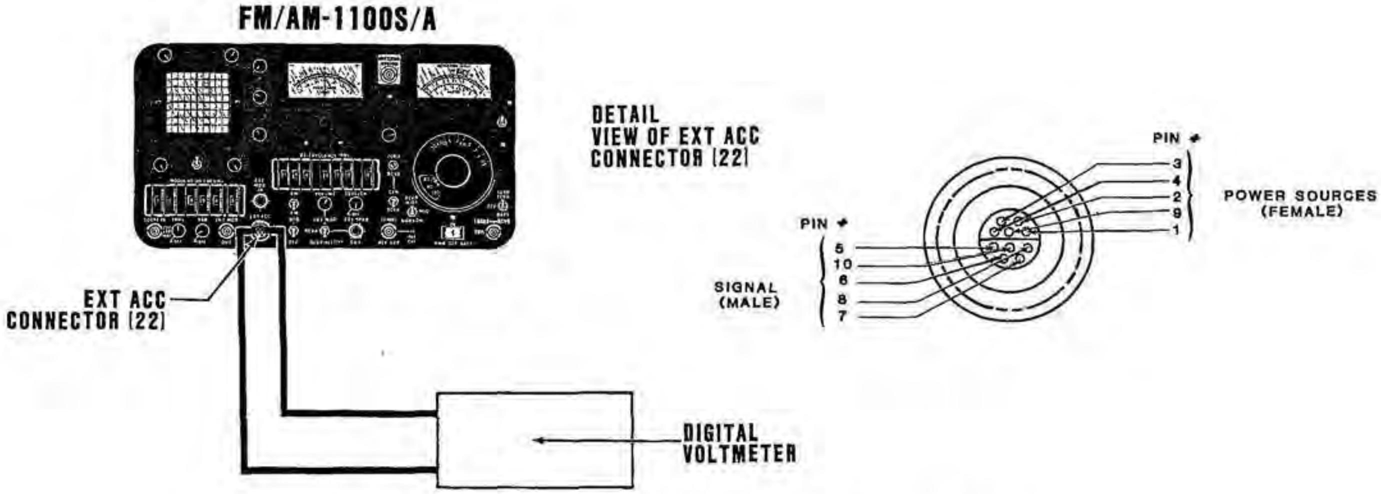


Figure 3-46 Power Supply Voltage Check Test Set-Up Diagram

INITIAL FM/AM-1100S/A CONTROL SETTINGS:

	CONTROL	INITIAL SETTING
3	HI LVL/μV X 100/NORM Switch	"HI LVL"
11	PWR/OFF/BATT Switch	"OFF"
13	GEN/RCVR Switch	"GEN"
25	VAR/OFF Control	Fully ccw, short of detent
26	1 kHz/OFF Control	Fully ccw, short of detent
31	AC/OFF/DC Switch	AC or DC
41	ANALY DISPR Control (FM/AM-1100S models only)	Cw out of detent

STEP	PROCEDURE
1.	Set FM/AM-1100S/A controls to initial settings as described above.
2.	Set PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up time from a cold start, as CRT trace will not become visible until CRT achieves warm-up.

STEP	PROCEDURE
3.	Set Digital Voltmeter for a +DC voltage range.
4.	Connect negative lead of voltmeter to Pin 9 (ground) of front panel EXT ACC Connector (22). (See Figure 3-46.)
5.	Connect positive lead of voltmeter to Pin 1 of EXT ACC Connector (22). Verify voltmeter reading is between +12 V and +12.5 V.
6.	Disconnect positive lead of voltmeter from Pin 1 of EXT ACC Connector (22) and reconnect to Pin 2. Verify voltmeter reading is between +10.85 V and +11.15 V.
7.	Disconnect positive lead of voltmeter from Pin 2 of EXT ACC Connector (22) and reconnect to Pin 3. Verify voltmeter reading is between +4.75 V and +5.2 V.
8.	Disconnect positive and negative voltmeter leads from EXT ACC Connector (22).
9.	To check battery charger circuit without load, disconnect battery connector P8104. Depress and hold AUTO ZERO/OFF/BATT Switch (8) to "BATT"; verify battery voltage is 14 to 15 VDC as displayed on upper scale of DEVIATION/WATTS Meter (1). Reconnect battery connector.
10.	Verify HIGH Frequency Phase LOCK Lamp (42) is illuminated.
11.	If all supply voltages are present and within tolerance as specified in Steps 5 through 9 of this procedure, the FM/AM-1100S/A power supply appears to be functioning properly. If, however, any of these measurements reflect a calibration error or malfunction (i.e., no signal present), a corrective maintenance action must be taken. See Table 3-2 on following page.

STEP PROCEDURE

11. (Continued)

CALIBRATION ERROR	
SUPPLY SIGNAL REFLECTING ERROR:	CORRECTIVE MAINTENANCE ACTION TO BE TAKEN:
+12 V	See Section 4, Calibration Procedure 4-2-2 for POWER SUPPLY
+11 V	See Section 4, Calibration Procedure 4-2-3 for REGULATOR/ TIMER PC BD
+5 V	See Section 4, Calibration Procedure 4-2-2 for POWER SUPPLY
MALFUNCTION	
If any of the supply signals tested in this procedure are absent or grossly out of tolerance, go to Section 5 and perform POWER SUPPLY TROUBLESHOOTING FLOWCHART.	

Table 3-2 Power Supply Corrective Maintenance Recommendations

3-4 PREVENTIVE MAINTENANCE RECOMMENDATIONS

Preventive maintenance on FM/AM-1100S/A test sets consists primarily of cleaning and visual inspection of internal/external components. External cleaning of the test set is recommended as often as necessary, depending on the environmental conditions to which the set is exposed. Internal cleaning should be performed on a more limited basis, preferably when the set is in a disassembled state for routine calibration, troubleshooting and/or repair. Test set disassembly for the sole purpose of internal cleaning is not recommended.

3-4-1 EXTERNAL CLEANING

1. Clean front panel and case with a soft lint-free cloth moistened with rubbing alcohol.

2. To remove tar or oil from outside case, safety solvent may be used.

CAUTION

DO NOT ALLOW SAFETY SOLVENT TO CONTACT FRONT PANEL CONTROL AREA. SOLVENT CAN CAUSE DAMAGE TO FRONT PANEL CONTROLS, MARKINGS ETC.

3-4-2 INTERNAL CLEANING AND INSPECTION

NOTE

The following procedures require external case to be removed from test set.

CAUTION

DELIBERATE MOVING (HOWEVER SLIGHT) OF DISCRETE COMPONENTS ON CIRCUIT BOARDS, ETC. SHOULD BE AVOIDED.

DO NOT OPEN INTERNAL MODULES FOR SOLE PURPOSES OF CLEANING.

1. Remove dust with hand-controlled dry air jet of 15 psi (1.054 kg/cm^2) and wipe internal chassis parts and frame with soft lint-free cloth moistened with alcohol.

1. (Continued)

WARNING

DO NOT USE COMPRESSED AIR IN EXCESS OF 15 PSI. USE EXTREME CARE WHEN USING COMPRESSED AIR IN THE VICINITY OF CRT, IN ORDER TO MINIMIZE POSSIBILITY OF CRT IMPLOSION. OBSERVE FOLLOWING PRECAUTIONS:

a. REMOVE ANY LARGE DIRT/DUST PARTICLES FROM CRT MANUALLY, AS OPPOSED TO USING COMPRESSED AIR.

b. DO NOT USE COMPRESSED AIR IN A DIRTY, CLUTTERED ENVIRONMENT. REMOVE ANY DEBRIS OR SMALL OBJECTS IN THE IMMEDIATE WORK AREA THAT MAY BECOME AIRBORNE DUE TO PRESSURIZED AIRFLOW.

c. IF POSSIBLE, USE AN AIR HOSE NOZZLE EQUIPPED WITH A SPRING LOADED ON/OFF VALVE, AS OPPOSED TO ONE THAT REMAINS OPEN OR CLOSED CONTINUOUSLY.

d. MAKE SURE COMPRESSED AIR HOSE IS FILTERED, TO PREVENT POSSIBLE OIL OR WATER DROPLETS FROM STRIKING CRT AT HIGH SPEEDS.

2. Inspect CHASSIS for:

   a. Tightness of subassemblies and chassis mounted connectors.

   b. Corrosion or damage to metal surfaces.

3. Inspect CAPACITORS for:

   a. Loose mounting, deformities or obvious physical damage.

   b. Leakage or corrosion around leads.

4. Inspect CONNECTORS for:

   a. Loose or broken parts, cracked insulation and bad contacts. DO NOT disassemble connectors needlessly within test set.

5. Inspect POTENTIOMETER CONTROLS for:

   a. Free rotation. If rotation feels rough, check control with an ohmmeter.

6. Inspect readily accessible PRINTED CIRCUIT BOARDS for:

   a. Corrosion or damage to connectors.

6. (Continued)

   b. Damage to all mounted components including crystals and I.C.'s.

   c. Accumulation of dirt, dust or other foreign material.

7. <u>Inspect RESISTORS for</u>:

   a. Cracked, broken, charred or blistered bodies.

   b. Loose or corroded solder connections.

8. <u>Inspect SEMICONDUCTORS for</u>:

   a. Cracked, broken, charred or discolored bodies.

   b. Seals around leads being in place and in good condition.

9. <u>Inspect TOGGLE SWITCHES for</u>:

   a. Loose levers or terminals and switch body contact to frame.

   b. Bent or loose line switch contacts.

10. <u>Inspect TRANSFORMER for</u>:

    a. Signs of excessive heating.

    b. Broken or charred insulation and loose mounting hardware.

11. <u>Inspect WIRING for</u>:

    a. Broken or loose ends and connections.

    b. Proper dress relative to other chassis parts.

NOTE

All laced wiring should be tight with ends securely tied.

SECTION 4-CALIBRATION

4-1 GENERAL

This section contains calibration procedures for the following FM/AM-1100S/A front panel indicators and internal modules:

Calibration Procedure	Module
4-2-1	Front Panel FREQ ERROR & DEVIATION/WATTS Meters
4-2-2	Power Supply
4-2-3	Regulator/Timer PC Bd
4-2-4	Dual Tone Generator
4-2-5	TCXO
4-2-6	VCO Tuner PC Bd
4-2-7	1200-2200 MHz VCO
4-2-8	Spectrum Analyzer/Oscilloscope
4-2-9	250 kHz IF/MON/AUDIO PC Bd
4-2-10	120 MHz Generator
4-2-11	100 MHz Filter

These procedures should be performed as a result of one or more of the following conditions:

1. If, during the course of normal operation, the FM/AM-1100S/A or any major function thereof fails to meet the performance specifications as provided in "SECTION 3 - PERFORMANCE EVALUATION".
2. If a module (other than those listed above) is found to be defective and requires replacement (see Table 4-2, MODULE REPLACEMENT & ALIGNMENT REQUIREMENTS.)
3. If any one or more of the modules listed above requires replacement.
4. If the recommended 12 month calibration interval is due.

4-1-1 SAFETY PRECAUTIONS

As with any piece of electronic equipment, extreme caution should be taken when troubleshooting "live" circuits. Certain circuits and/or components within the FM/AM-1100S/A contain extremely high voltage potentials, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH (see WARNINGS below)! When performing the calibration procedures in this section be sure to observe the following precautions:

WARNING

THE OSCILLOSCOPE INVERTER PC BD AND CRT CATHODE IN THE SPECTRUM ANALYZER/OSCILLOSCOPE MODULE CARRY A VOLTAGE POTENTIAL OF 2000 VDC, WHEN THE FM/AM-1100S/A IS ENERGIZED OR DE-ENERGIZED. DO NOT CONTACT THESE OR ANY ASSOCIATED COMPONENTS DURING TROUBLESHOOTING OR CALIBRATION.

AS LONG AS THE BATTERY IS INSTALLED IN THE FM/AM-1100S/A, A 12 VDC POTENTIAL EXISTS AT VARIOUS POINTS ON REAR PANEL, FRONT PANEL AND MOTHER BOARD REGARDLESS OF THE FRONT PANEL PWR/OFF/BATT SWITCH POSITION.

WHEN WORKING WITH "LIVE" CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK, TO AVOID SERIOUS SHOCK HAZARD.

REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE PERFORMING ANY CALIBRATION PROCEDURES INVOLVING LIVE CIRCUITS.

USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS.

FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDERNEATH ALL POWERED BENCH EQUIPMENT, AS WELL AS A RUBBER FLOOR MAT UNDERNEATH TECHNICIAN CHAIR.

HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.

4-1-2 DISASSEMBLY REQUIREMENTS

To perform any of the calibration procedures contained in this section (with the exception of procedure 4-2-1), the exterior case must be removed from the FM/AM-1100S/A. Refer to "SECTION 6, DISASSEMBLY" for case removal instructions.

4-1-3 RECOMMENDED CALIBRATION SEQUENCE

Although most of the calibration procedures within this section can be performed in a random sequence, certain modules within the FM/AM-1100S/A should be calibrated in a prescribed order. These particular modules are considered interactive, in that the improper calibration of one may adversely affect the calibration of another. The following table defines the recommended sequence of calibration for those interactive modules:

NOTE

The following recommendations are based on the assumption that all other circuits and/or modules within the FM/AM-1100S/A, which are considered interactive, are in proper working order.

WHEN CALIBRATING THE MODULE LISTED BELOW:	FIRST MAKE SURE THE FOLLOWING MODULES ARE IN PROPER CALIBRATION:
REGULATOR/TIMER PC BOARD	1. POWER SUPPLY 2. DEVIATIONS/WATTS METER MECHANICAL ZERO ADJUSTMENT
250 kHz IF/MON/AUDIO PC BD	1. FREQ ERROR METER & DEVIATION/WATTS METER MECHANICAL ZERO ADJUSTMENT 2. OSCILLOSCOPE
CALIBRATION ADJUSTMENTS FOR THE VCO TUNER PC BD AND 1200-2200 MHz VCO ARE INTERACTIVE AND SHOULD THEREFORE BE DONE SIMULTANEOUSLY.	

Table 4-1 Recommended Calibration Sequence

4-1-4 TEST EQUIPMENT REQUIREMENTS

Appendix C at the rear of this manual contains a comprehensive list of test equipment suitable for performing any of the procedures in this manual. Any other equipment meeting the specifications listed in the appendix, may be substituted in place of the recommended models.

NOTE

For certain procedures in this manual, the equipment listed in Appendix C may exceed the minimum required specifications; for this reason, minimum use specifications appear at the beginning of all individual calibration procedures where accessory test equipment is required.

IF THIS MODULE IS REPLACED OR REPAIRED / THEN THE FOLLOWING CALIBRATION STEPS MUST BE PERFORMED	FRONT PANEL METERS	POWER SUPPLY	REGULATOR / TIMER PC BD				DUAL TONE GENERATOR	TCXO	VCO TUNER PC BD	1200-2200 MHz VCO	SPECTRUM ANALYZER/ OSCILLOSCOPE		250 kHz IF/MON/AUDIO PC BD							120 MHz GENERATOR		100 MHz FILTER
			OUTPUT VOLTAGE ADJ.	BATTERY TEST CIRCUIT ADJ.	BATTERY CUTOFF CIRCUIT ADJ.	POWER METER ADJ.					OSCILLOSCOPE	SPECTRUM ANALYZER	RECEIVER GAIN ADJ.	AGC ADJ.	SCOPE DEVIATION ADJ.	SAMPLE & HOLD AMPLIFIER ADJ.	FREQ ERROR METER ADJ.	DEVIATION METER ADJ.	AM DEMOD ADJ.	OUTPUT AMPLITUDE ADJ.	BFO AMPLITUDE ADJ.	
POWER SUPPLY		●																		●		
POWER TERMINATION						●							●	●						●		
1st MIXER													●	●						●		
2nd MIXER													●	●						●	●	
STATIC DISCHARGE PROTECT													●	●								
HIGH LEVEL AMPLIFIER																						
1200 MHz FILTER & DIODE SW													●	●						●		
VARIABLE ATTENUATOR																				●	●	
1200 MHz AMPLIFIER													●	●						●		
120 MHz RECEIVER													●	●								
AGC SYSTEM PC BD									●	●												
HIGH FREQ PHASE LOCK PC BD									●	●												
RF FREQUENCY MHz THUMBWHEELS																						
TCXO DISTRIBUTION OUTPUT AMP																						
CLOCK DIVIDER																						
100 MHz MULT / 108 MHz MIXER																						
79-80 MHz LOW LOOP PC BD																						
HIGH FREQ MULTIPLIER / MIXER									●	●												
108 MHz BANDPASS FILTER																						
1080 MHz MULTIPLIER																						
HETERODYNE AMP / ÷ 2 PRESCALER																						
100 MHz FILTER																						●
REGULATOR / TIMER PC BD	●	●	●	●	●	●																
DUAL TONE GENERATOR							●															
TCXO								●														
VCO TUNER PC BD									●	●												
1200-2200 MHz VCO									●	●												
SPECT ANALY / OSCILLOSCOPE											●	●			●							
250 kHz IF/MON/AUDIO PC BD		●									●		●	●	●	●	●	●	●			
120 MHz GENERATOR																				●	●	
FRONT PANEL FREQ ERROR METER	●																●					
FRONT PANEL DEVIATION / WATTS METER	●			●		●												●				
30 dB ATTENUATOR PADS						●							●	●						●		

Table 4-2 Module Replacement & Alignment Requirements

4-2 CALIBRATION PROCEDURES

4-2-1

CALIBRATION PROCEDURE:	MECHANICAL ZEROING OF FRONT PANEL DEVIATION/WATTS METER & FREQ ERROR METER
SPECIAL ACCESSORY EQUIPMENT REQ'D:	One Small Slotted Screwdriver
TEST SET-UP DIAGRAM:	None

STEP	PROCEDURE
1.	Set FM/AM-1100S/A front panel PWR/OFF/BATT Switch to "OFF".
2.	Using small screwdriver, adjust DEVIATION/WATTS Meter Zero Adjustment (See Figure 4-1) cw or ccw until DEVIATION/WATTS Meter needle is centered over "0".
3.	Using screwdriver, adjust FREQ ERROR Meter Zero Adjustment (See Figure 4-1) cw or ccw until FREQ ERROR Meter needle is centered over "0".

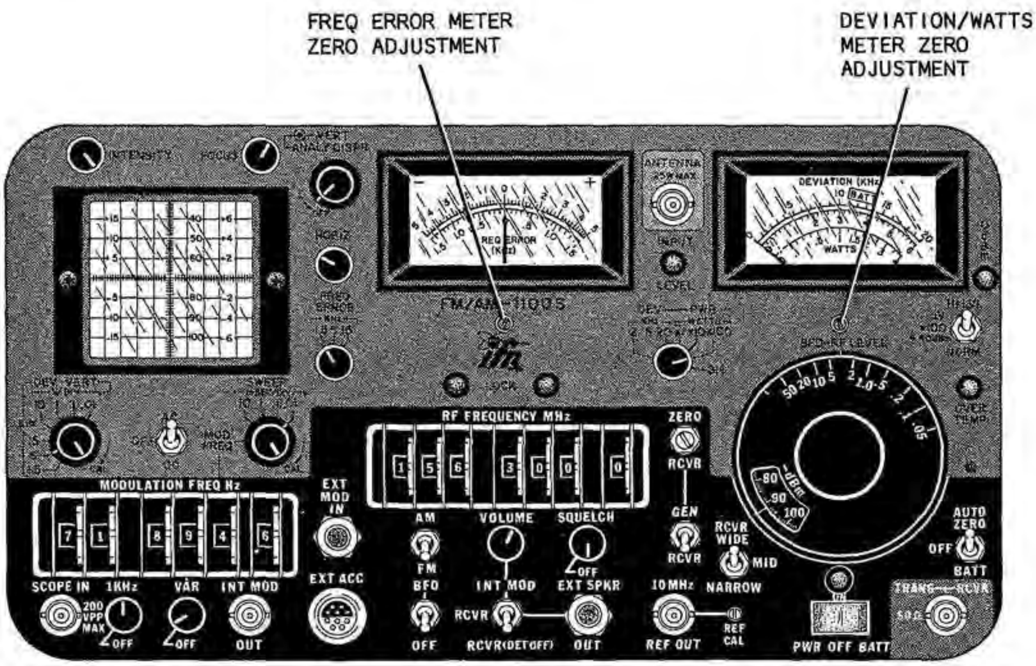


Figure 4-1 FM/AM-1100S/A Front Panel

4-2-2

CALIBRATION PROCEDURE: POWER SUPPLY ASSEMBLY

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One DC Voltmeter (4½ digit, 1% of full scale, 100 KΩ/volt sensitivity)

One Battery Load Simulator (IFR Part No. 1003-9801-600)

FIGURE REFERENCES: Power Supply Mech Assy (Section 8)
Power Supply PC Bd #1 (Section 9)
Power Supply Line Rectifier PC Bd #2 (Section 9)

TEST SET-UP DIAGRAM: None

STEP	PROCEDURE
1.	Connect BATT LOAD Simulator in place of battery.
2.	Rotate load control fully ccw.
3.	Set PWR/OFF/BATT Switch (11) to "PWR".
4.	Connect Multimeter between FL8102 and chassis ground.
5.	Adjust R8241 for a Multimeter voltage reading of +16 (±0.4) VDC.
6.	Connect Multimeter between FL8105 and chassis ground.
7.	Adjust R8255 for a Multimeter voltage reading of +12.05 (±0.10) VDC.
8.	Connect Multimeter between FL8106 and chassis ground. Verify voltage indication is +5.075 (±0.225) VDC. Return to Step 4 if out of tolerance.
9.	Connect Multimeter between FL8107 and chassis ground. Verify voltage indication is -12 (±0.5) VDC. Return to Step 4 if out of tolerance.
10.	Connect Multimeter across + and - terminals on Battery Load Simulator.
11.	Adjust R8206 for a voltage indication of 14.25 V (±0.25 V).

STEP	PROCEDURE
12.	Set PWR/OFF/BATT Switch (11) to "OFF".
13.	Disconnect all test equipment.

4-2-3

CALIBRATION PROCEDURE: REGULATOR/TIMER PC BOARD

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One DC Voltmeter (4½ digit, 1% of full scale, 100 KΩ/volt sensitivity)

One RF Power Source (Capable of generating 150 MHz at 60 W)

One Variable Power Supply (Capable of producing 15 VDC at 7.5 Amps)

One 50Ω Coax Cable w/BNC Connectors on each end

One Wattmeter (Capable of reading 50 W)

FIGURE REFERENCES: Mother Board (Section 8)
Regulator/Timer PC Board (Section 9)

TEST SET-UP DIAGRAM: None

PRELIMINARY SET-UP

STEP PROCEDURE

1. Place following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(3) HI LVL/μV X 100/NORM	"HI LVL"
(11) PWR/OFF/BATT	"PWR"
(13) GEN/RCVR	"GEN"
(25) VAR/OFF	Cw out of detent
(26) 1 kHz/OFF	Cw out of detent
(31) AC/OFF/DC	"DC"

2. Set FM/AM-1100S/A in an upright position on its four standoffs, so front panel is facing upwards. Swing open Upper Floor Assy.

OUTPUT VOLTAGE ADJ

3. Connect negative lead of DC Voltmeter to chassis ground.

STEP	PROCEDURE
4.	Connect positive lead of Voltmeter to +11 V Test Point (Pin 6 of J9101) on bottom side of Mother Board.
5.	Adjust R9157 on Regulator/Timer PC Board to obtain a voltmeter reading of +11 V (±0.02 V).
6.	Disconnect positive lead of Voltmeter from +11 V Test Point on bottom side of Mother Board and reconnect it to chassis ground.
7.	Connect negative lead of Voltmeter to -35 V Test Point (Pin 15 of J9101) on bottom side of Mother Board. Verify voltage reading is 35.5 VDC (±3.5 V).

BATTERY TEST CIRCUIT ADJ

8.	Reset controls to positions shown in Step 1 of this procedure.
9.	Set PWR/OFF/BATT Switch (11) to "OFF".
10.	Disconnect external AC or DC power source from FM/AM-1100S/A.
11.	Disconnect Molex Connectors between Power Supply and Battery.
12.	Connect Variable Power Supply to Molex Battery Connector (red is positive and black is negative).
13.	Set PWR/OFF/BATT Switch (11) to "BATT".
14.	Connect negative lead of Voltmeter to chassis ground.
15.	Connect positive lead of Voltmeter to BATTERY Test Point (Pin 2 of J9101) on bottom side of Mother Board.
16.	Adjust output of Variable Power Supply to obtain a +14 V reading on Voltmeter.
17.	While holding the front panel AUTO ZERO/OFF/BATT Switch (8) in "BATT", adjust R9113 on the Regulator/Timer PC Board until a reading of +14 V is indicated on upper scale (green band area) of front panel DEVIATION/WATTS Meter (1).

BATTERY CUT-OFF CIRCUIT

18.	Reset controls to positions shown in Step 1 of this procedure.

STEP	PROCEDURE
19.	Perform Steps 9 through 17 above.
20.	Slowly decrease output of Variable Power Supply until FM/AM-1100S/A shuts off. Note Voltmeter reading. If Voltmeter reading is between 10.9 and 11.1 VDC, proceed to Step 24.
21.	Increase Variable Power Supply output until Voltmeter again reads +11.1 V.
22.	Set PWR/OFF/BATT Switch (11) to "BATT".
23.	Adjust R9122 on Regulator/Timer PC Board slowly cw until FM/AM-1100S/A shuts off.
24.	Increase Variable Power Supply until Voltmeter reads +14 V.
25.	Set PWR/OFF/BATT Switch (11) to "BATT".
26.	Slowly decrease output of Variable Power Supply until FM/AM-1100S/A shuts off. Note Multimeter reading. If reading is not between 10.9 VDC and 11.1 VDC, return to Step 21.
27.	Increase Variable Power Supply until Multimeter reads +14 VDC.
28.	Set PWR/OFF/BATT Switch (11) to "OFF".
29.	Disconnect all test equipment.
30.	Connect Molex Connector between Power Supply and Battery.

<u>POWER METER ADJ</u>

31.	Reset controls to positions shown in Step 1 of this procedure.
32.	Set PWR/OFF/BATT Switch (11) to "PWR".
33.	Set GEN/RCVR Switch (13) to "RCVR".
34.	Rotate front panel DEV/POWER Control (48) to "WATTS X 1".
35.	Adjust R9165 on Regulator/Timer PC Board appropriately until DEVIATION/WATTS Meter needle is aligned with "0".
36.	Connect 50Ω coax cable from front panel TRANS/RCVR Connector (9) to the output of external Wattmeter.

STEP	PROCEDURE
37.	Connect output of external VHF Transmitter to input of Wattmeter.
38.	Adjust frequency of VHF Transmitter to approximately 70.00 MHz (Band B).
39.	Rotate DEV/POWER Control (48) to "WATTS X100".
40.	Set VHF Transmitter Power Switch to HIGH.
41.	While keying VHF Transmitter (do not apply modulation), adjust R9191 appropriately until DEVIATION/WATTS Meter agrees with external Wattmeter. Note and record external Wattmeter reading.
42.	If power level noted and recorded in Step 41 is >40 W, set VHF Transmitter Power Switch to LOW.
43.	Rotate DEV/POWER Control (48) to "WATTS X10".
44.	While keying VHF Transmitter (do not apply modulation), adjust R9189 appropriately until DEVIATION/WATTS Meter (1) agrees with external Wattmeter. Note and record external Wattmeter reading.
45.	Set VHF Transmitter Power Switch to LOW, if not previously done in Step 42.
46.	If power level noted and recorded in Step 44 is >4 W, place 10 dB Pad between VHF Transmitter and Wattmeter.
47.	Rotate DEV/POWER Control (48) to "WATTS X1".
48.	While keying VHF Transmitter (do not apply modulation), adjust R9187 until DEVIATION/WATTS Meter (1) agrees with external Wattmeter.
49.	End of Alignment. Set PWR/OFF/BATT Switch (11) to "OFF". Disconnect test equipment.

4-2-4

CALIBRATION PROCEDURE:	DUAL TONE GENERATOR
SPECIAL ACCESSORY EQUIPMENT REQ'D:	One Small Slotted Screwdriver
	One 50Ω Coax Cable w/BNC Connectors on each end
	One Frequency Counter (Capable of displaying 1 kHz to 3.4 MHz with .1 Hz resolution)
	One Oscilloscope (DC to 1 MHz Bandwidth)
FIGURE REFERENCES:	Dual Tone Generator Mech Assy (Section 8) Dual Tone Generator PC Board #5 (Section 9)
TEST SET-UP DIAGRAM:	None

FREQUENCY ADJ

STEP PROCEDURE

1. Place following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(11) PWR/OFF/BATT	"PWR"
(25) VAR/OFF	Fully ccw in detent
(26) 1 kHz/OFF	Fully cw
(27) MODULATION FREQ Hz Thumbwheels	01000.0 Hz

2. Set FM/AM-1100S/A in an upright position on its four rear stand-offs, so front panel is facing upwards.

3. Connect coax cable between FM/AM-1100S/A front panel INT MOD OUT Connector (24) and input connector to Frequency Counter.

4. Locate R9015 (1 kHz FREQ) on Dual Tone Generator PC Board No. 5. This adjustment is most easily accessed from bottom side of FM/AM-1100S/A. Adjust R9015 appropriately until Frequency Counter displays 1000 Hz, ±1 Hz.

5. Rotate 1 kHz/OFF Control (26) fully ccw, in detent.

6. Rotate VAR/OFF Control (25) fully cw.

STEP	PROCEDURE
7.	Verify a frequency of 1000 Hz (±.1 Hz). Adjust C9001 as needed.
8.	Set PWR/OFF/BATT Switch (11) to "OFF".
9.	Disconnect all test equipment.

4-2-5(A)

NOTE

The following is the recommended calibration procedure for the TCXO. If, however, WWV is not available, use procedure 4-2-5(B), titled "USING FREQUENCY COUNTER TO CALIBRATE TCXO".

CALIBRATION PROCEDURE: USING TIME STANDARD SIGNAL TO CALIBRATE TCXO

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One Resistor, 1/4 W

FIGURE REFERENCES: FM/AM-1100S/A Front Panel (Section 3)
TCXO Mech Assy (Section 8)

TEST SET-UP DIAGRAM: None

STEP PROCEDURE

1. Place following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(7) BFO-RF LEVEL	Fully ccw
(8) AUTO ZERO/OFF/BATT	"AUTO ZERO"
(11) PWR/OFF/BATT	"PWR"
(12) RCVR WIDE/MID/NARROW	"NARROW"
(13) GEN/RCVR	"RCVR"
(17) SQUELCH	Fully ccw, short of detent
(18) INT MOD/RCVR/RCVR (DET OFF)	"RCVR"
(19) VOLUME	Fully ccw
(20) BFO/OFF	"OFF"
(21) AM/FM	"AM"
(25) VAR/OFF	Fully ccw, detent (OFF)
(26) 1 kHz/OFF	Fully ccw, detent (OFF)
(33) DEV-VERT	"15 kHz"
(34) RF FREQUENCY MHz Thumbwheels	010 0010 if using 10 MHz WWV; 015 0010 if using 15 MHz WWV; 002 5010 if using 2.5 MHz WWV; 005 0010 if using 5 MHz WWV

STEP	PROCEDURE
1.	(Cont'd)

CONTROL	POSITION
(35) FREQ ERROR	"15 kHz"
(37) INTENSITY	Midrange
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S only)	Fully ccw, detent
(48) DEV/POWER	"SIG"

2. Connect an antenna, or a coax connected to an antenna, to ANTENNA Connector (46).

CAUTION

MAXIMUM CONTINUOUS INPUT TO THIS CONNECTOR MUST NOT EXCEED .25 W.

IF AN EXTERNAL ANTENNA ATTACHED TO AN UNTERMINATED COAX CABLE IS USED, REMOVE ANY POSSIBLE STATIC CHARGE FROM ATTENNA CONNECTOR.

3. Insert one lead of resistor into center conductor of 10 MHz REF OUT Connector (15).

4. Adjust VOLUME Control (19) for a comfortable listening level.

5. Adjust position of resistor to obtain a suitable beat note from FM/AM-1100S/A speaker.

6. Using small screwdriver, rotate 10 MHz CAL Adjustment (14) back and forth through zero beat until beat note heard on speaker achieves as low a frequency as possible. Observe oscillation of waveform on oscilloscope while rotating 10 MHz CAL Adjustment (14) and verify oscillation diminishes to a level as close as possible to stationary.

NOTE

Careful calibration can result in a beat frequency less than 0.1 Hz.

7. Set PWR/OFF/BATT Switch (11) to "OFF".

8. Disconnect test equipment from FM/AM-1100S/A.

NOTE

Calibration procedure 4-2-5(A), titled "USING TIME STANDARD SIGNAL TO CALIBRATE TCXO", is the recommended procedure to use. If, however, WWV is not available, the following procedure may be used.

CALIBRATION PROCEDURE: USING FREQUENCY COUNTER TO CALIBRATE TCXO

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One 50Ω Coax Cable w/BNC Connectors on each end

One Frequency Counter (Capable of displaying 15 MHz with .1 Hz resolution)

FIGURE REFERENCES: FM/AM-1100S/A Front Panel (Section 3)
TCXO Mech Assy (Section 8)

TEST SET-UP DIAGRAM: None

OUTPUT FREQUENCY ADJ

STEP	PROCEDURE
1.	Raise Upper Floor Assy to gain access to TCXO.
2.	Remove adjustment access plug from TCXO.
3.	Rotate FM/AM-1100S/A front panel Cal Adjustment (14) fully ccw.
4.	Connect coax cable between FM/AM-1100S/A front panel 10 MHz REF OUT Connector (15) and input to Frequency Counter.
5.	Set FM/AM-1100S/A front panel PWR/OFF/BATT Switch (11) to "PWR". Wait approximately 5 minutes before proceeding with Step 6.
6.	Record reading of Frequency Counter as (F_1).
7.	Rotate front panel 10 MHz CAL Adjustment (14) fully cw.
8.	Record reading of Frequency Counter as (F_2).

STEP	PROCEDURE
9.	Using small screwdriver or tuning tool, rotate adjustment pot located behind TCXO adjustment access plug until Frequency Counter displays value x, where: $$x = \frac{F_2 - F_1}{2} + 10{,}000{,}000 \text{ Hz}$$
10.	Replace TCXO adjustment access plug.
11.	Rotate 10 MHz CAL Adjustment (14) appropriately until Frequency Counter reads 10,000,000, ±1 Hz.
12.	Set PWR/OFF/BATT Switch (11) to "OFF".
13.	Disconnect coax cable and Frequency Counter from FM/AM-1100S/A.
14.	Close Upper Floor.

4-2-6

CALIBRATION PROCEDURE: VCO TUNER PC BOARD

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One SMB "T" Connector

One 50Ω Coax Cable w/BNC Connectors on one end and SMB Connector on opposite end

One Oscilloscope (DC to 1 MHz Bandwidth)

One DC Voltmeter (4½ digit, 1% of full scale, 100 KΩ/volt sensitivity)

FIGURE REFERENCES: VCO Tuner PC Board (Section 9)
1200-2200 MHz Oscillator Mechanical Assembly (Section 8)

TEST SET-UP DIAGRAM:

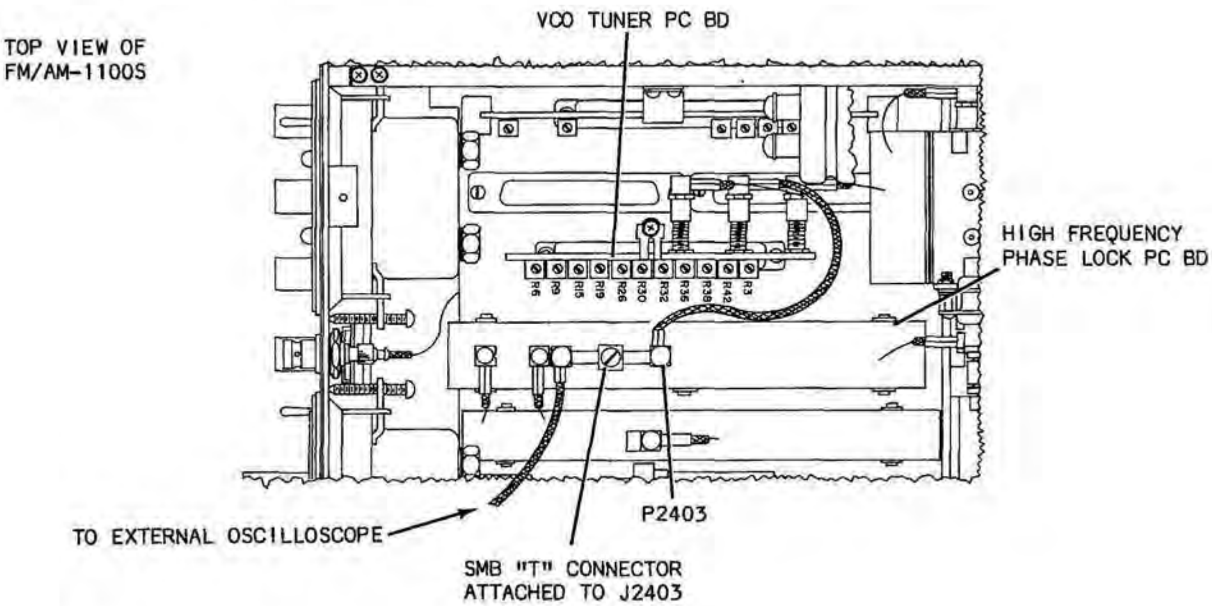


Figure 4-2 Test Set-Up Diagram for Testing VCO Tuner PC Board

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STEP	PROCEDURE
1.	Raise Upper Floor Assembly to gain access to 1200-2200 MHz VCO and VCO Tuner PC Board.

STEP	PROCEDURE
2.	Disconnect P2403 from J2403 on High Frequency Phase Lock PC Board and attach SMB "T" Connector to J2403. Reconnect P2403 to one end of "T" Connector and external Oscilloscope Connector to remaining end of "T" Connector. (See Test Set-Up Diagram.)
3.	Rotate R901 (VCO GAIN) on 1200-2200 MHz VCO fully cw, then ccw 1/8 turn.
4.	Set FM/AM-1100S/A front panel PWR/OFF/BATT Switch (11) to "PWR".
5.	Set FM/AM-1100S/A front panel RF FREQUENCY MHz Thumbwheels to 0000000.
6.	Connect negative lead of Voltmeter to chassis ground.
7.	Connect positive lead of Voltmeter to VCO Tuner Test Point 1 on non-component side of VCO Tuner PC Board.

NOTE

The polarity of the VCO Tuner Test Point 1 will change from one step to another during the course of this procedure. If an Analog Voltmeter is used to make voltage measurements, the test leads must be changed between adjustments, to accommodate the proper polarity. To eliminate the need of changing test leads, the use of a Digital Voltmeter is recommended.

8.	Adjust R2609 (0-199 CENTER) on VCO Tuner PC Board to obtain a +6 V (±1.0 V) voltmeter indication.
9.	Set RF FREQUENCY MHz Thumbwheels (34) to 1990000.
10.	Adjust R2606 (0-199 RANGE) on VCO Tuner PC Board to obtain a -26 V (±1.0 V) voltmeter indication.
11.	Return RF FREQUENCY MHz Thumbwheels (34) to 0000000 to verify +6 V (±1.0 V) is still present at Test Point 1. If voltage is not within tolerance, repeat Steps 8, 9, 10 and 11.
12.	Set RF FREQUENCY MHz Thumbwheels (34) to 2000000.
13.	Adjust R2619 (200-399 CENTER) on VCO Tuner PC Board to obtain a +6 V (±1.0 V) voltmeter indication.
14.	Set RF FREQUENCY MHz Thumbwheels (34) to 3990000.
15.	Adjust R2615 (200-399 RANGE) on VCO Tuner PC Board to obtain a -26 V (±1.0 V) voltmeter indication.

STEP	PROCEDURE
16.	Return RF FREQUENCY MHz Thumbwheels (34) to 2000000 to verify +6 V (±1.0 V) is still present at Test Point 1. If voltage is not within tolerance, repeat Steps 13, 14, 15 and 16.
17.	Set RF FREQUENCY MHz Thumbwheels (34) to 4000000.
18.	Adjust R2630 (400-599 CENTER) on VCO Tuner PC Board to obtain a +6 V (±1.0 V) voltmeter indication.
19.	Set RF FREQUENCY MHz Thumbwheels (34) to 5990000.
20.	Adjust R2626 (400-599 RANGE) on VCO Tuner PC Board to obtain a -26 V (±1.0 V) voltmeter indication.
21.	Return RF FREQUENCY MHz Thumbwheels (34) to 4000000 to verify +6 V (±1.0 V) is still present at Test Point 1. If voltage is not within tolerance, repeat steps 18, 19, 20 and 21.
22.	Set RF FREQUENCY MHz Thumbwheels (34) to 6000000.
23.	Adjust R2636 (600-799 CENTER) on VCO Tuner PC Board to obtain a +6 V (±1.0 V) voltmeter indication.
24.	Set RF FREQUENCY MHz Thumbwheels (34) to 7990000.
25.	Adjust R2632 (600-799 RANGE) on VCO Tuner PC Board to obtain a -26 V (±1.0 V) voltmeter indication.
26.	Return RF FREQUENCY MHz Thumbwheels (34) to 6000000 to verify +6 V (±1.0 V) is still present at Test Point 1. If voltage is not within tolerance, repeat Steps 23, 24, 25 and 26.
27.	Set RF FREQUENCY MHz Thumbwheels (34) to 8000000.
28.	Adjust R2638 (800-999 RANGE) on VCO Tuner PC Board to obtain a +6 V (±1.0 V) voltmeter indication.
29.	Set RF FREQUENCY MHz Thumbwheels (34) to 9990000.
30.	Adjust R2642 (800-999 CENTER) on VCO Tuner PC Board to obtain a -26 V (±1.0 V) voltmeter indication.
31.	Return RF FREQUENCY MHz Thumbwheels (34) to 800000 to verify +6 V (±1.0 V) is still present at Test Point 1. If voltage is not within tolerance, repeat Steps 28, 29, 30 and 31.

STEP	PROCEDURE
32.	While incrementing and decrementing the leftmost (100 MHz digit) RF FREQUENCY MHz Thumbwheel (34) from 0 to 9 and back several times, adjust external Oscilloscope controls to display both maximum and minimum peak, while centering baseline on major horizontal axis.

NOTE

Oscilloscope should be DC coupled.

33.	While incrementing and decrementing the leftmost (100 MHz digit) RF FREQUENCY MHz Thumbwheel (34) from 0 to 9 and back several times, adjust R2603 on VCO Tuner PC Board appropriately until positive and negative peaks are equal in amplitude.
34.	Set PWR/OFF/BATT Switch (11) to "OFF".
35.	Disconnect all test equipment.

4-2-7

CALIBRATION PROCEDURE: 1200-2200 MHz VCO

SPECIAL ACCESSORY EQUIPMENT REQ'D: One Small Slotted Screwdriver

One SMB "T" Connector

One 50Ω Coax Cable w/SMB Connector on one end and BNC Connector on opposite end

One Oscilloscope (DC to 1 MHz Bandwidth)

FIGURE REFERENCES: 1200-2200 MHz Oscillator Mech Assembly (Section 8)

TEST SET-UP DIAGRAM:

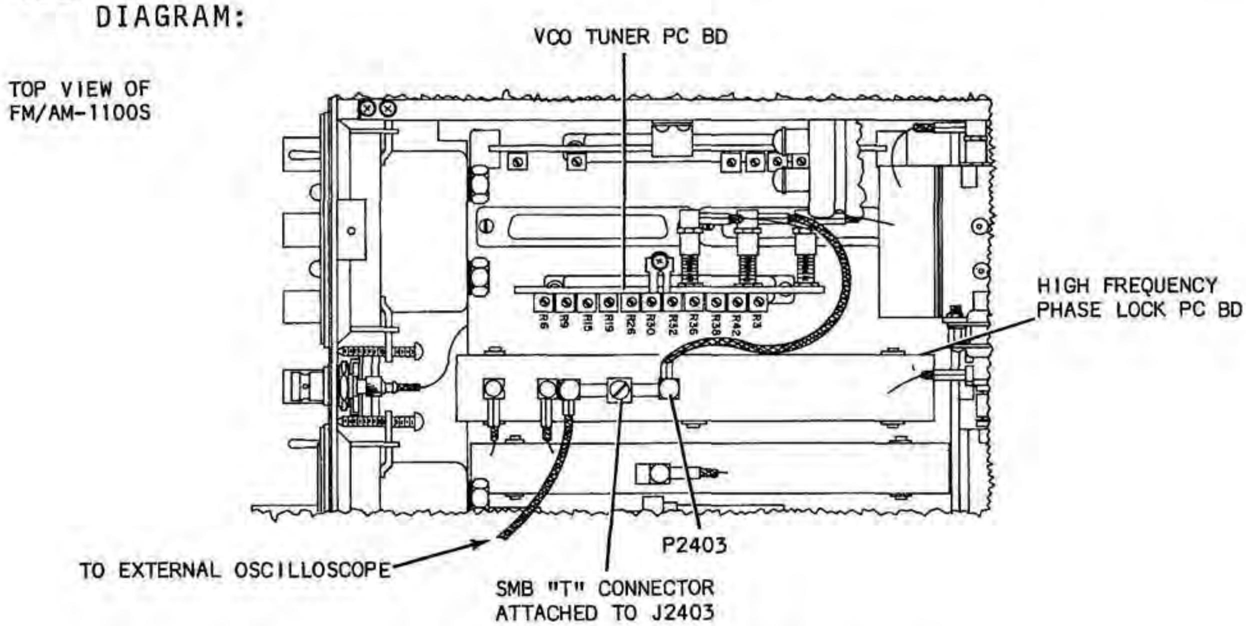


Figure 4-3 Test Set-Up Diagram for Testing 1200-2200 MHz VCO

VCO GAIN ADJ

STEP PROCEDURE

1. Set FM/AM-1100S/A front panel RF FREQUENCY MHz Thumbwheels (34) to 9991000.

2. Raise Upper Floor Assy to gain access to 1200-2200 MHz VCO.

STEP	PROCEDURE
3.	Disconnect P2403 from J2403 on High Frequency Phase Lock PC Board and attach SMB "T" Connector to J2403. Reconnect P2403 to one end of "T" Connector and external Oscilloscope Connector to remaining end of "T" Connector. (See Test Set-Up Diagram.)
4.	Adjust R901 (VCO GAIN) on 1200-2200 MHz VCO fully cw.
5.	Adjust R901 (VCO GAIN) ccw until external Oscilloscope displays a DC Voltage with a minimum of ripple.
6.	Rotate R901 (VCO GAIN) ccw an additional 1/16 turn.
7.	Set RF FREQUENCY MHz Thumbwheels (34) to 0001000.
8.	Increment RF FREQUENCY MHz Thumbwheels (34) in 10 MHz steps up through 9901000 MHz, making sure Oscilloscope display stabilizes at each setting.
9.	Set PWR/OFF/BATT Switch (11) to "OFF".
10.	Disconnect SMB "T" Connector and Oscilloscope coax cable from FM/AM-1100S/A.
11.	Close Upper Floor.

4-2-8

CALIBRATION PROCEDURE:	SPECTRUM ANALYZER/OSCILLOSCOPE CALIBRATION
SPECIAL ACCESSORY EQUIPMENT REQ'D:	One Small Slotted Screwdriver
	One Small Slotted Tuning Tool
	One Oscilloscope (DC to 10 MHz Bandwidth)
	One RF Signal Generator (Capable of generating 120 to 130 MHz at -30 to -90 dBm)
	One DC Voltmeter (4½ digit, 1% of full scale, 100 KΩ/volt sensitivity)
	Two 50Ω Coax Cables w/BNC Connectors on each end
	One BNC "T" Connector
	One 50Ω Coax Cable w/SMB Connector on one end and BNC Connector on opposite end
FIGURE REFERENCES:	Spectrum Analyzer Mech Assembly (Section 8) Spectrum Analyzer/Scope Main PC Board (Section 9) Spectrum Analyzer PC Board #1 (Section 9) Spectrum Analyzer PC Board #2 (Section 9) Spectrum Analyzer Module #1 (Section 8) Spectrum Analyzer Module #2 (Section 8)
TEST SET-UP DIAGRAM:	None

STEP PROCEDURE

1. Place the following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(11) PWR/OFF/BATT	"OFF"
(13) GEN/RCVR	"GEN"
(21) AM/FM	"FM"
(25) VAR/OFF	Fully ccw to detent
(26) 1 kHz/OFF	Fully ccw to detent
(27) MODULATION FREQ Hz Thumbwheels	01000.0 Hz
(29) SWEEP	"1 ms"
(31) AC/OFF/DC	"AC"

STEP PROCEDURE

1. (Cont'd)

CONTROL	POSITION
(32) DEV-VERT VERNIER	Fully ccw.
(33) DEV-VERT	".1 V/DIV"
(37) INTENSITY	3/4 cw
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S models only)	Fully ccw to detent

2. Set FM/AM-1100S/A in an upright position on its four stand-offs, so front panel is facing upwards.

3. Swing open Lower Floor Assembly (refer to "SECTION 6, DISASSEMBLY" for instructions on how to open Lower Floor Assembly).

4. Set front panel PWR/OFF/BATT Switch (11) to "PWR".

5. Connect negative lead of Voltmeter to chassis ground.

6. Connect positive lead of Voltmeter to casing of Q4305 on Spectrum Analyzer Scope Main PC Board.

NOTE

Q4305 is accessible by inserting Voltmeter Probe between magnetic shield of CRT and Spectrum Analyzer Scope Main PC Board.

7. Adjust R43~~05~~26 appropriately on Spectrum Analyzer Scope Main PC Board until voltage at Q4305 reads +11 V (±.02 V).

8. Disconnect Voltmeter leads from Q4305 and chassis ground.

9. Adjust INTENSITY (37) and FOCUS (39) Controls to obtain a sharp visible horizontal trace on CRT.

10. Adjust VERT (40) and HORIZ (38) Controls to center trace over major horizontal axis of CRT.

11. Connect BNC "T" Connector to FM/AM-1100S/A front panel SCOPE IN Connector (28).

12. Connect coax cable from one end of "T" Connector to FM/AM-1100S/A front panel INT MOD OUT Connector (24).

13. Connect second coax cable from remaining end of "T" Connector to vertical input of external Oscilloscope.

STEP POSITION

14. Adjust vertical gain of external Oscilloscope to .1 V/DIV.

15. Rotate VAR/OFF Control (25) cw, until a sine wave of 4 graticule divisions peak-to-peak is displayed on external Oscilloscope.

16. Adjust C4301 (VERT FREQ COMP) on Spectrum Analyzer Scope Main PC Board to obtain a stable sine wave display.

17. Rotate front panel DEV-VERT VERNIER Control (32) cw to "CAL".

18. Adjust R4340 (SWEEP CAL) on Spectrum Analyzer Scope Main PC Board until 9 complete cycles of a sine wave are displayed on the FM/AM-1100S/A Oscilloscope.

19. Adjust R4363 (HORIZ CURRENT) on Spectrum Analyzer Scope Main PC Board to obtain the widest display possible.

20. Simultaneously adjust HORIZ Control (38) and R4357 (HORIZ GAIN) on Spectrum Analyzer Scope Main PC Board to center each positive peak of displayed sine wave over a vertical axis on CRT graticule. (See Figure 4-4.)

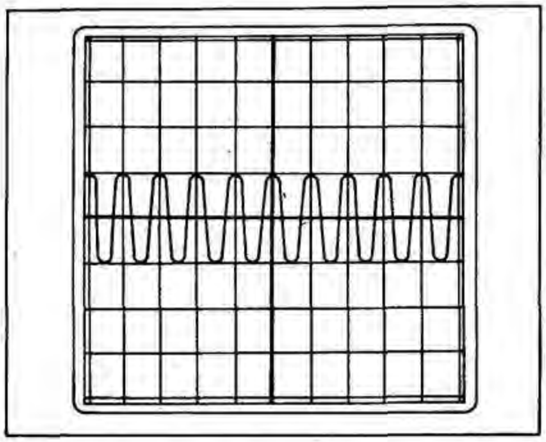


Figure 4-4 Positive Peaks of Sine Wave Centered Over Vertical Axes

21. Adjust R4307 (VERT CAL) on Spectrum Analyzer Scope Main PC Board to set the peak-to-peak amplitude of displayed sine wave to four graticule divisions.

<u>SPECTRUM ANALYZER CALIBRATION</u> (Applies to FM/AM-1100S models only)

1. Place the following FM/AM-1100S front panel controls to the positions indicated:

STEP	PROCEDURE
1.	(Cont'd)

CONTROL	POSITION
(13) GEN/RCVR	"RCVR"
(17) SQUELCH	Fully ccw to detent
(34) RF FREQUENCY MHz Thumbwheels	1255000
(35) FREQ ERROR	"1.5" kHz
(41) ANALY DISPR	Fully cw

2. Connect coax cable from output of external RF Signal Generator to FM/AM-1100S front panel ANTENNA Connector (46).

3. Adjust output of RF Signal Generator to -40 dBm at 125.5000 MHz.

4. Fine tune Signal Generator until FM/AM-1100S front panel FREQ ERROR Meter (43) needle is centered over "0".

5. Connect negative lead of Voltmeter to chassis ground.

6. Connect positive lead of Voltmeter to FL9801 on Spectrum Analyzer PC Board #1.

7. Adjust R4243 (+11 V ADJ) on Spectrum Analyzer PC Board #2 to obtain a voltmeter reading of +11 V (±.05).

8. Make the following adjustments on Spectrum Analyzer PC Board #1 and #2:

COMPONENT	LOCATION	ADJUSTMENT
R4265 (HORIZ GAIN)	S/A Module #2	Fully ccw
R9440 (MAX DISP)	S/A Module #1	Fully ccw
R9434 (MIN DISP)	S/A Module #1	Fully ccw

9. Connect external Oscilloscope Probe to ~~FL9803~~ FL9802 on Spectrum Analyzer Module #1.

10. Adjust R9440 (MAX DISP) on Spectrum Analyzer PC Board #1 to obtain a 4 volt peak-to-peak sawtooth waveform on external Oscilloscope.
WON'T ADJ

11. Adjust L9412 (LOW FREQ) on Spectrum Analyzer PC Board #1 until displayed 125.5 MHz signal on FM/AM-1100S Spectrum Analyzer is phase locked (i.e. stable).

12. Rotate ANALY DISPR Control (41) fully ccw, short of detent.

STEP	PROCEDURE
13.	Adjust R4262 (HORIZ CTR) on Spectrum Analyzer PC Board #2 to center displayed spectrum over major vertical axis of CRT graticule.
14.	Rotate ANALY DISPR Control (41) fully cw.
15.	Set RF FREQUENCY MHz Thumbwheels to 120.5000 MHz.
16.	Adjust R9440 (MAX DISP) on Spectrum Analyzer PC Board #1 until displayed spectrum is centered over vertical axis 5 divisions to right of major vertical axis.
17.	Set RF FREQUENCY MHz Thumbwheels (34) to 130.5000 MHz.
18.	Verify that displayed spectrum is now centered over vertical axis 5 divisions to left of major vertical axis (±1 minor graticule division).
19.	Rotate ANALY DISPR Control (41) fully ccw, short of detent.
20.	Set RF FREQUENCY MHz Thumbwheels (34) to 125.0000 MHz.
21.	Adjust R9434 (MIN DISP) on Spectrum Analyzer PC Board #1 until displayed spectrum is centered over vertical axis 5 divisions to right of major vertical axis.
22.	Set RF FREQUENCY MHz Thumbwheels (34) to 126.000 MHz.
23.	Verify that displayed spectrum is now centered over vertical axis 5 divisions to left of major vertical axis (±1 minor graticule division).
24.	Return RF FREQUENCY MHz Thumbwheels (34) to 125.5000 MHz.
25.	Adjust L9404 (25 MHz FILT) on Spectrum Analyzer PC Board #1 to peak the spectrum display.
26.	Adjust L9406 (FILTER SHAPE) on Spectrum Analyzer PC Board #1 to obtain a minimum of noise on trace.
27.	Rotate ANALY DISPR Control (41) fully cw.
28.	Adjust L9402 (120 MHz TUNE) and L9403 (120 MHz TUNE) on Spectrum Analyzer PC Board #1 so amplitude of displayed spectrum at 126.5000 MHz is equal to displayed amplitude at 124.5000 MHz. Continue incrementing and decrementing RF FREQUENCY MHz Thumbwheels (34) in 1 MHz steps, while adjusting L9402 and L9403, to make sure spectrum amplitudes are equal at: 123.5000 and 127.5000 MHz 122.5000 and 128.5000 MHz 121.5000 and 129.5000 MHz 120.5000 and 130.5000 MHz

STEP	PROCEDURE
29.	Rotate ANALY DISPR Control (41) fully ccw, short of detent.
30.	Set RF Frequency MHz Thumbwheels (34) to 125.5000.
31.	Adjust C4211 (PEAK DETECT) on Spectrum Analyzer PC Board #2 to remove any sharp edges from top of spectrum display.
32.	Adjust C4213 (1 MHz PEAK) on Spectrum Analyzer PC Board #2 to peak spectrum display.
33.	Adjust C4217 (1 MHz PEAK) on Spectrum Analyzer PC Board #2 to peak spectrum display.
34.	Adjust output of RF Signal Generator to -30 dBm.
35.	Connect external Oscilloscope Probe to INPUT TEST POINT (T4201, pin 4) on Spectrum Analyzer PC Board #2.
36.	Adjust R4204 (INPUT LEVEL) on Spectrum Analyzer PC Board #2 to obtain a 0.4 V peak-to-peak spike on external Oscilloscope.
37.	Adjust output of RF Signal Generator to -60 dBm.
38.	Connect external Oscilloscope probe to AMP 1 TEST POINT on Spectrum Analyzer PC Board #2.
39.	Adjust R4213 (AMP 1 GAIN) on Spectrum Analyzer PC Board #2 to obtain a 0.4 V peak-to-peak spike on external Oscilloscope.
40.	Adjust output of RF Signal Generator to -90 dBm.
41.	Connect external Oscilloscope Probe to AMP 2 TEST POINT on Spectrum Analyzer PC Board #2.
42.	Adjust R4222 (AMP 2 GAIN) on Spectrum Analyzer PC Board #2 to obtain a 0.4 V peak-to-peak spike on external Oscilloscope.
43.	Adjust output of RF Signal Generator to -60 dBm.
44.	Adjust R4230 (VERT CENTER) and R4229 (VERT GAIN) on Spectrum Analyzer PC Board #2 to obtain a spectrum display with a baseline of -108 or -109 dBm and a peak of -60 dBm.
45.	Adjust output of RF Signal Generator to -30 dBm.
46.	Adjust R4205 (LOG LIN) on Spectrum Analyzer PC Board #2 to display a -30 dBm (±1 dBm) spectrum. Repeat Steps 34 through 46.

4-2-9

CALIBRATION PROCEDURE:	250 kHz IF/MON/AUDIO PC BOARD
SPECIAL ACCESSORY EQUIPMENT REQ'D:	One Small Slotted Screwdriver
	One 50Ω Coax Cable w/BNC Connectors on each end
	One Signal Generator (Capable of generating 125 MHz at -25 dBm to -110 dBm)
	One DC Voltmeter (4½ digit, 1% of full scale, 100 KΩ/volt sensitivity)
	Modulation Meter
FIGURE REFERENCES:	FM/AM-1100S/A Front Panel (Section 3) 250 kHz IF/MON/AUDIO PC Board (Section 9)
TEST SET-UP DIAGRAM:	None

PRELIMINARY SET-UP

STEP PROCEDURE

1. Place following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(8) AUTO ZERO/OFF/BATT	"AUTO ZERO"
(12) RCVR WIDE/MID/NARROW	"WIDE"
(13) GEN/RCVR	"RCVR"
(17) SQUELCH	Fully ccw short of detent
(20) BFO/OFF	"OFF"
(21) AM/FM	"FM"
(25) VAR/OFF	Fully ccw to detent (OFF)
(26) 1 kHz/OFF	Fully ccw to detent (OFF)
(27) MODULATION FREQ Hz Thumbwheels	1000.0 Hz
(29) SWEEP	"1 mS"
(31) AC/OFF/DC	"DC"
(32) DEV-VERT VERNIER	"CAL"
(33) DEV-VERT	"15 kHz"
(34) RF FREQUENCY MHz Thumbwheels	125 2000
(35) FREQ ERROR	"1.5"
(37) INTENSITY	3/4 cw

STEP	PROCEDURE

1. (Cont'd)

CONTROL	POSITION
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S models only)	Fully ccw to detent
(48) DEV/POWER	"SIG"

2. Connect output of Signal Generator to FM/AM-1100S/A front panel ANTENNA Connector (46) using 50Ω coax cable.

3. Set FM/AM-1100S/A front panel PWR/OFF/BATT Switch (11) to "PWR". Allow a 30 second warm-up for CRT.

4. Adjust FOCUS (39) and INTENSITY (37) Controls for a sharp visible trace display.

5. Adjust VERT (40) and HORIZ (38) Controls to center scope trace over major horizontal axis of CRT graticule.

SQUELCH SETTING

6. Reset controls as shown in Step 1 of this procedure.

7. Adjust Signal Generator controls to produce a continuous wave (CW) output of 125.2000 MHz (1 µV or -107 dBm).

8. Adjust R3107 (WIDE BAND GAIN) until FM/AM-1100S/A front panel INPUT LEVEL Lamp just comes on.

9. Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".

10. Adjust R3108 (NARROW BAND GAIN) until INPUT LEVEL Lamp (47) just turns on.

AGC ADJ

11. Reset controls to positions shown in Step 1 of this procedure.

12. Do Steps 7-10 above.

13. Adjust output of Signal Generator to -25 dBm.

STEP	PROCEDURE
14.	Adjust R3191 (AGC ADJ) until front panel DEVIATION/WATTS Meter (1) indicates a full scale deflection.

NOTE

Perform "SQUELCH SETTING" procedure again (Steps 6-10), to verify potentiometer settings are still correct. Afterwards set Signal Generator to -25 dBm.

SCOPE DEVIATION ADJ

15. Reset controls to position shown in Step 1 of this procedure.

16. Set RF FREQUENCY MHz Thumbwheels (34) to 000 0000.

17. Center oscilloscope trace on major horizontal axis.

18. Set front panel RF FREQUENCY MHz Thumbwheels (34) to 0000100.

19. Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".

20. Adjust R3144 (SCOPE DEV) until FM/AM-1100S/A oscilloscope trace is located two major graticule divisions below major horizontal axis.

SAMPLE & HOLD AMPLIFIER ADJ

21. Reset controls to positions shown in Step 1 of this procedure.

22. Set front panel RF FREQUENCY MHz Thumbwheels (34) to 0000000.

23. Connect negative lead of Voltmeter to chassis ground.

24. Connect positive lead of Voltmeter to SAMPLE & HOLD Test Point. Note Voltmeter reading.

STEP | PROCEDURE

24. (Cont'd)

NOTE

> The polarity of the SAMPLE & HOLD Test Point will change when WIDE/MID/NARROW Switch from "WIDE" to "NARROW". If an Analog Voltmeter is used, the test leads will need to be interchanged each time the switch position is changed. To eliminate need of changing test leads, use of Digital Voltmeter is recommended.

25. Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW". Note Voltmeter reading.

26. Switch RCVR WIDE/MID/NARROW Switch (12) between "WIDE" and "NARROW" several times. Adjust R3127 (SAMPLE & HOLD) until voltage reading obtained in "WIDE" is equal to voltage reading obtained in "NARROW" (±0.5 V).

NOTE

> The polarity of the value obtained in "WIDE" will be negative, as opposed to the value obtained in "NARROW", which will be positive (e.g. WIDE = -2 V and NARROW = +2 V).

<u>FREQ ERROR METER ADJ</u>

27. Reset controls to positions shown in Step 1 of this procedure.

28. Set RF FREQUENCY MHz Thumbwheels (34) to 000 0000.

29. Adjust front panel ZERO RCVR Adjustment (5) to zero FREQ ERROR Meter (43).

30. Set GEN/RCVR Switch (13) to "REC".

31. Set PWR/OFF/BATT Switch (11) to "OFF".

32. Mechanically zero FREQ ERROR Meter (43) using FREQ ERROR Meter Zero Adjustment (44).

33. Set PWR/OFF/BATT Switch (11) to "PWR".

34. Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".

35. Set RF FREQUENCY MHz Thumbwheels (34) to 0000010.

STEP	PROCEDURE
36.	Adjust R3142 (1.5 kHz FREQ ERROR) to obtain a -1 kHz indication on front panel FREQ ERROR Meter.
37.	Rotate FREQ ERROR Control (35) to "5" kHz.
38.	Set RF FREQUENCY MHz Thumbwheels (34) to 0000040.
39.	Adjust R3141 (5 kHz FREQ ERROR) to obtain a -4 kHz indication on FREQ ERROR Meter.
40.	Rotate FREQ ERROR Control (35) to "15" kHz.
41.	Set RF FREQUENCY MHz Thumbwheels (34) to 0000100.
42.	Adjust R3139 (15 kHz FREQ ERROR) to obtain a -10 kHz indication on FREQ ERROR Meter.
43.	Set RF FREQUENCY MHz Thumbwheels (34) to 125 2000.
44.	Set FREQ ERROR Control (35) to "1.5 kHz".
45.	Adjust Signal Generator output to -70 dBm.
46.	Set GEN/RCVR Switch (13) to "RCVR".
47.	Rotate SQUELCH Control (17) fully cw.
48.	Adjust R3147 (ZEROING WHEN SQUELCHED) to obtain an indication of "0" on FREQ ERROR Meter (43).
49.	Set GEN/RCVR Switch (13) to "GEN".
50.	Adjust ZERO/RCVR Adjustment (5) to zero FREQ ERROR Meter (43).

DEVIATION METER ADJ

51.	Reset controls to positions shown in Step 1 of this procedure.
52.	Set PWR/OFF/BATT Switch (11) to "OFF".
53.	Mechanically zero DEVIATION/WATTS Meter (1) using DEVIATION/ WATTS Meter Zero Adjustment (49).
54.	Set PWR/OFF/BATT Switch (11) to "PWR".
55.	Rotate FREQ ERROR Control (35) to "1.5".

STEP	PROCEDURE
56.	Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".
57.	Set GEN/RCVR Switch (13) to "RCVR".
58.	Set RF FREQUENCY MHz Thumbwheels (34) to 0000000.
59.	Set AUTO ZERO/OFF/BATT Switch (8) to "OFF".
60.	Rotate DEV/POWER Control (48) to "2 kHz".
61.	Adjust R3171 (RECEIVER DEV ZERO) to obtain an indication of "0" on DEVIATION/WATTS Meter.
62.	Set GEN/RCVR Switch (13) to "GEN".
63.	Adjust R3181 (GENERATOR DEV ADJ) to obtain an indication of "0" on DEVIATION/WATTS Meter.
64.	Rotate SQUELCH Control (17) fully ccw to detent, not off.
65.	Set GEN/RCVR Switch (13) to "GEN".
66.	Set RF FREQUENCY MHz Thumbwheels (34) to 1255000.
67.	Connect TRANS/RCVR Connector (9) to Modulation Meter.
68.	Rotate BFO-RF LEVEL Control (7) to "-80 dBm".
69.	Set HI LVL/µV X 100/NORM Switch (3) to "µV X 100".
70.	Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".
71.	Rotate VAR/OFF Control (25) cw until external Modulation Meter indicates 2 kHz deviation.
72.	Adjust R3185 (2 kHz DEV ADJ) to obtain an indication of 2.0 kHz on DEVIATION/WATTS Meter.
73.	Rotate DEV/POWER Control (48) to "6 kHz".
74.	Rotate VAR/OFF Control (25) until external Modulation Meter indicates 6 kHz deviation.
75.	Adjust R3183 (6 kHz DEV ADJ) to obtain an indication of 6.0 kHz on DEVIATION/WATTS Meter.
76.	Rotate DEV/POWER Control (48) to "20 kHz".
77.	Set RCVR WIDE/MID/NARROW Switch (12) to "MID".

STEP	PROCEDURE
78.	Rotate VAR/OFF Control (25) until external Modulation Meter indicates 20 kHz.
79.	Adjust R3179 (20 kHz DEV ADJ) to obtain an indication of 20 kHz on DEVIATION/WATTS Meter.

AM DEMOD ADJ

80.	Reset controls to positions shown is Step 1 of this procedure.
81.	Set AM/FM Switch (21) to "AM".
82.	Set GEN/RCVR Switch (13) to "RCVR".
83.	Set RCVR WIDE/MID/NARROW Switch (12) to "NARROW".
84.	Adjust output of Signal Generator to 125.5000 MHz at -60 dBm, with 1 kHz AM modulation at 60%.
85.	Adjust R7415 (AM DEMOD ADJ) to obtain 100 mVRMS on Pin 8 of front panel EXT ACC Connector.

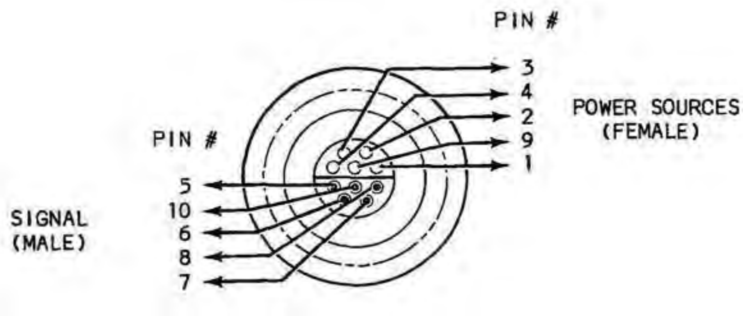


Figure 4-5 Front Panel EXT ACC Connector

86.	End of Calibration. Set PWR/OFF/BATT Switch (11) to "OFF".
87.	Disconnect all test equipment.

4-2-10

CALIBRATION PROCEDURE:	120 MHz GENERATOR
SPECIAL ACCESSORY EQUIPMENT REQ'D:	One Small Slotted Screwdriver
	One 50Ω Coax Cable w/BNC Connectors on each end
	One Spectrum Analyzer (Capable of measuring 125.5 MHz at -60 dBm)
	Signal Generator (Capable of generating 125.5010 MHz)
FIGURE REFERENCES:	120 MHz Generator PC Board (Section 9)
	120 MHz Generator Mech Assembly (Section 8)
TEST SET-UP DIAGRAM:	None

OUTPUT AMPLITUDE ADJ

STEP PROCEDURE

1. Place the following FM/AM-1100S/A front panel controls to positions indicated:

CONTROL	POSITION
(3) HI LVL/µV X 100/NORM	µV X 100
(7) BFO-RF LEVEL	-100 dBm
(13) GEN/RCVR	"GEN"
(20) BFO/OFF	"OFF"
(21) AM/FM	"AM"
(25) VAR/OFF	Fully ccw to detent
(26) 1 kHz/OFF	Fully ccw to detent
(29) SWEEP	"1 ms"
(31) AC/OFF/DC	"AC"
(32) DEV-VERT VERNIER	CAL
(34) RF FREQUENCY MHz Thumbwheels	1255000
(37) INTENSITY	3/4 cw
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S models only)	Fully cw to detent

STEP	PROCEDURE
2.	Connect coax cable between FM/AM-1100S/A front panel TRANS/RCVR connector (9) and input to external Spectrum Analyzer.
3.	Check 0 mark of BFO-RF LEVEL Control (7). Add physical mark to indicate "2" and a second mark to indicate "1". The dial should read 101 dB when 2 mV indication is given on dBm window of indicator (7).
4.	Set FM/AM-1100S/A front panel PWR/OFF/BATT Switch (11) to "PWR". Allow 30 second warm-up for CRT before proceeding to Step 5.
5.	Apply power to external Spectrum Analyzer and tune to 125.5000 MHz.
6.	Adjust R9643 on 120 MHz Generator Assembly to obtain a -60 dBm indication on external Spectrum Analyzer.
7.	Set HI LVL/µV X 100/NORM switch (3) to NORM. DEVIATION/WATTS Meter (1) should drop 40 dB at Generate Out.
8.	Set RF FREQUENCY Thumbwheels (34) to 20 MHz. Adjust BFO-RF LEVEL Control (7) until 0 dBm Lamp (2) illuminates.

BFO AMPLITUDE ADJ

9.	Set GEN/RCVR Switch (13) to "RCVR".
10.	Set BFO/OFF Switch (20) to "BFO".
11.	Adjust output frequency of external Signal Generator to 125.5010 MHz at -60 dBm.
12.	Connect output of Signal Generator to FM/AM-1100S/A front panel ANTENNA Connector (46).
13.	Adjust INTENSITY (37) and FOCUS (39) Controls for a sharp visible trace.
14.	Adjust VERT (40) and HORIZ (38) Controls so trace display on FM/AM-1100S/A Oscilloscope is centered over major vertical and horizontal axes.
15.	Rotate DEV-VERT Control (33) to "15 kHz".
16.	Adjust R9646 on 120 MHz Generator Assembly to obtain 100% modulation display on FM/AM-1100S/A Oscilloscope (Figure 4-6).

STEP PROCEDURE

17. (Cont'd)

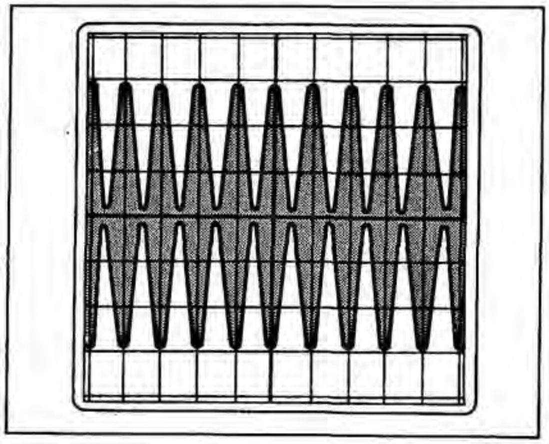


Figure 4-6 100% Modulation Display

18. Set PWR/OFF/BATT Switch (11) to "OFF".

19. Disconnect all test equipment.

SECTION 5-TROUBLESHOOTING

5-1 GENERAL

This section contains logical flowcharts designed to aid the technician in troubleshooting the FM/AM-1100S/A. These flowcharts will enable the technician to isolate a given malfunction down to an individual module or PC Board Assy. Typically, the technician will refer to the flowcharts in this section to isolate a trouble symptom that may have been detected during normal operation and that was subsequently confirmed during performance evaluation and/or calibration.

5-1-1 HOW TO USE FLOWCHARTS

The five major flowcharts in this section are:

1. 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART
2. 2ND LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART
3. GENERATE TROUBLESHOOTING FLOWCHART
4. RECEIVE TROUBLESHOOTING FLOWCHART
5. POWER SUPPLY TROUBLESHOOTING FLOWCHART

Each of the above flowcharts are intended to check a specific system within the FM/AM-1100S/A (e.g. 1st Local Oscillator System, 2nd Local Oscillator System and Power Supply) or a mode of operation (e.g. receive and generate). The number of flowcharts used, as well as their relative sequence of use, will vary depending on the nature of the malfunction being addressed. Generally, the troubleshooting sequence will follow a pattern similar to the one depicted in the following flowchart:

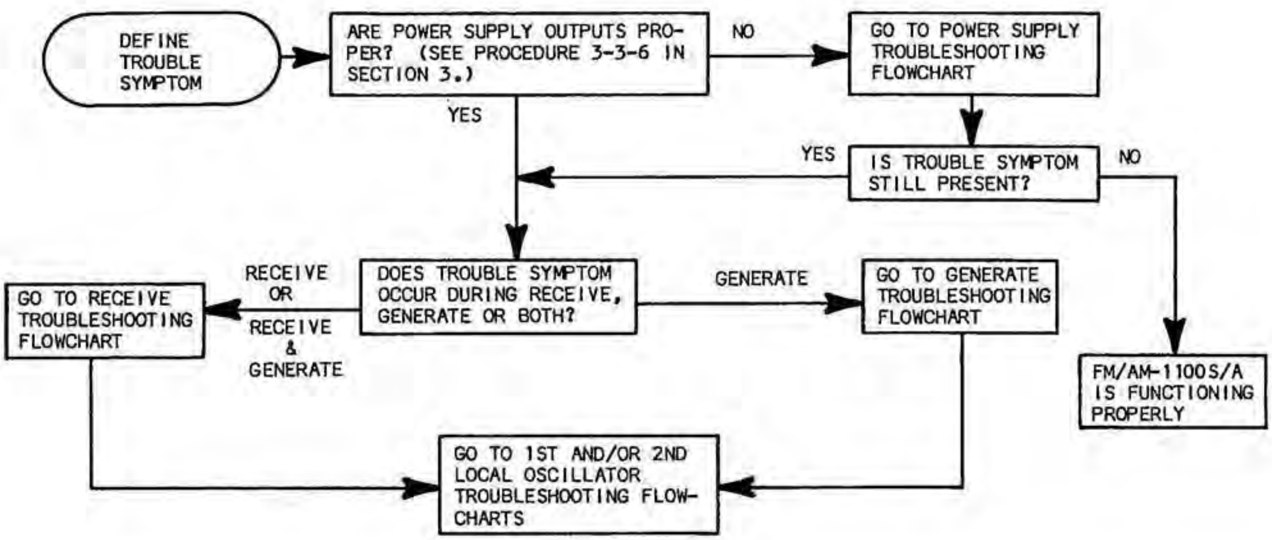


Figure 5-1 Typical Troubleshooting Sequence

The flowcharts are in tabular format. The "INSTRUCTION" column gives the appropriate troubleshooting procedures to perform and/or asks a question about the correctness of a signal or procedure. The "INDICATION" column states the location of a fault or gives an indication of the proper state of the FM/AM-1100S/A. The "YES" and "NO" columns tell where to go for the next step. The "REMARKS" column tells how to correct a fault or where to look for information. In addition to the flowcharts, the following information is required for troubleshooting:

TECHNICAL DATA SUPPLEMENTS
The 1st Local Oscillator and 2nd Local Oscillator Flowcharts are also accompanied by several Technical Data Supplements. These supplements contain important reference information which the technician should read and understand before attempting to troubleshoot the 1st and 2nd Local Oscillator Systems.

MECHANICAL ASSY ILLUSTRATIONS, PC BOARDS & SCHEMATICS
Throughout the troubleshooting flowcharts, references are made to numerous testpoints which may consist of coax cable connectors, connector pins, discrete components, etc. To locate these test points, the technician should refer to the following sections in this manual for the appropriate support illustrations:

SECTION 8	Mechanical Assembly Drawings
SECTION 9	PC Board Layout Drawings
SECTION 10	Circuit Schematics

An index is provided at the beginning of each section for ease of locating the desired drawings. To locate any FM/AM-1100S/A front panel controls, connectors or indicators, refer to page 3-2 in "SECTION 3, PERFORMANCE EVALUATION".

5-1-2 TROUBLESHOOTING HINTS

Before proceeding with extensive troubleshooting, it is advisable that the technician first make a few simple checks, which may be related to the cause of the malfunction. These checks may save the technician many hours of labor, which might needlessly be spent on extensive troubleshooting.

1. CHECK FRONT PANEL CONTROL SETTINGS
   Improper front panel control settings on the FM/AM-1100S/A or any associated test equipment, may produce false trouble symptoms. (Refer to appropriate Operation Manual for information concerning the function of front panel controls.)

2. VISUAL INSPECTION
   After defining the trouble symptom, visually inspect any components within the FM/AM-1100S/A which may have a relationship to the malfunction. In many instances, a malfunction may be caused by broken wires, unsoldered connections, damaged PC Board components, bent connector pins etc. Also, look for signs of excessive heat as evidenced by burned or charred components.

3. CALIBRATION
   Make sure the FM/AM-1100S/A is in proper calibration. One or more maladjusted calibration potentiometers may be the cause of the trouble symptom(s) and the apparent malfunction.

4. PERFORMANCE EVALUATION
   Before attempting any troubleshooting, make sure all appropriate performance evaluation procedures in Section 3 of this manual have been performed. In many cases, these procedures will isolate a trouble symptom to a particular function within the instrument, thereby making any subsequent troubleshooting easier.

5-1-3 SAFETY PRECAUTIONS

As with any piece of electronic equipment, extreme caution should be taken when troubleshooting "live" circuits. Certain circuits and/or components within the FM/AM-1100S/A contain extremely high voltage potentials, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH (see WARNINGS below)! When troubleshooting the FM/AM-1100S/A, be sure to observe the following precautions:

WARNING

THE OSCILLOSCOPE INVERTER PC BD AND CRT CATHODE IN THE SPECTRUM ANALYZER/OSCILLOSCOPE MODULE CARRY A VOLTAGE POTENTIAL OF 2000 VDC, WHEN THE FM/AM-1100S/A IS ENERGIZED OR DE-ENERGIZED. DO NOT CONTACT THESE OR ANY ASSOCIATED COMPONENTS DURING TROUBLESHOOTING OR CALIBRATION.

AS LONG AS THE BATTERY IS INSTALLED IN THE FM/AM-1100S/A, A 12 VDC POTENTIAL EXISTS AT VARIOUS POINTS ON REAR PANEL, REGARDLESS OF THE FRONT PANEL PWR/OFF/BATT SWITCH POSITION.

WHEN WORKING WITH "LIVE" CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK, TO AVOID SERIOUS SHOCK HAZARD.

REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE TROUBLESHOOTING LIVE CIRCUITS.

USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS.

FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDERNEATH ALL POWERED BENCH EQUIPMENT, AS WELL AS A RUBBER FLOOR MAT UNDERNEATH TECHNICIAN'S CHAIR.

HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.

5-1-4 TEST EQUIPMENT REQUIREMENTS

Appendix C at the rear of this manual contains a comprehensive list of test equipment suitable for performing any of the procedures in this manual. Any other equipment meeting the specifications listed in the appendix, may be substituted in place of the recommended models.

5-1-5 DISASSEMBLY REQUIREMENTS

To use the troubleshooting flowcharts contained in this section, the exterior case must be removed from the FM/AM-1100S/A. In some cases, a certain amount of additional disassembly may be required to access test points. Refer to "SECTION 6, DISASSEMBLY" for case removal and module disassembly instructions.

5-1-6 INITIAL CONTROL SETTINGS FOR MODULE TROUBLESHOOTING

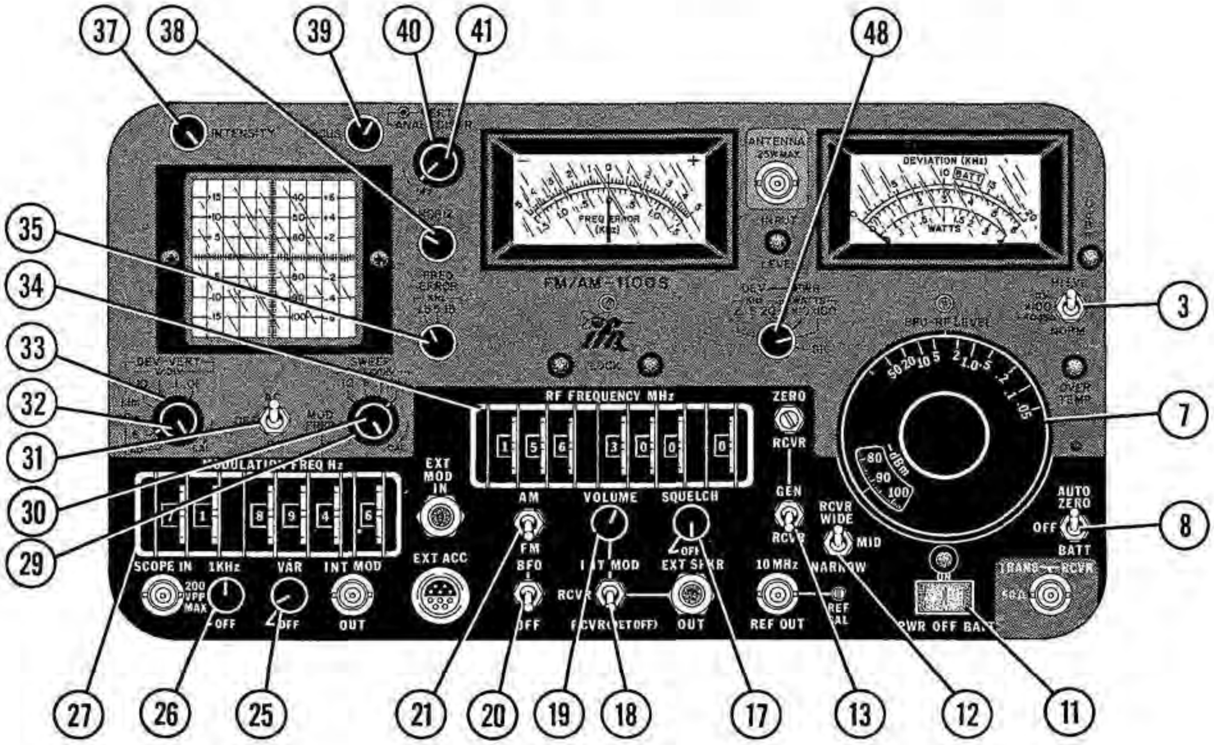
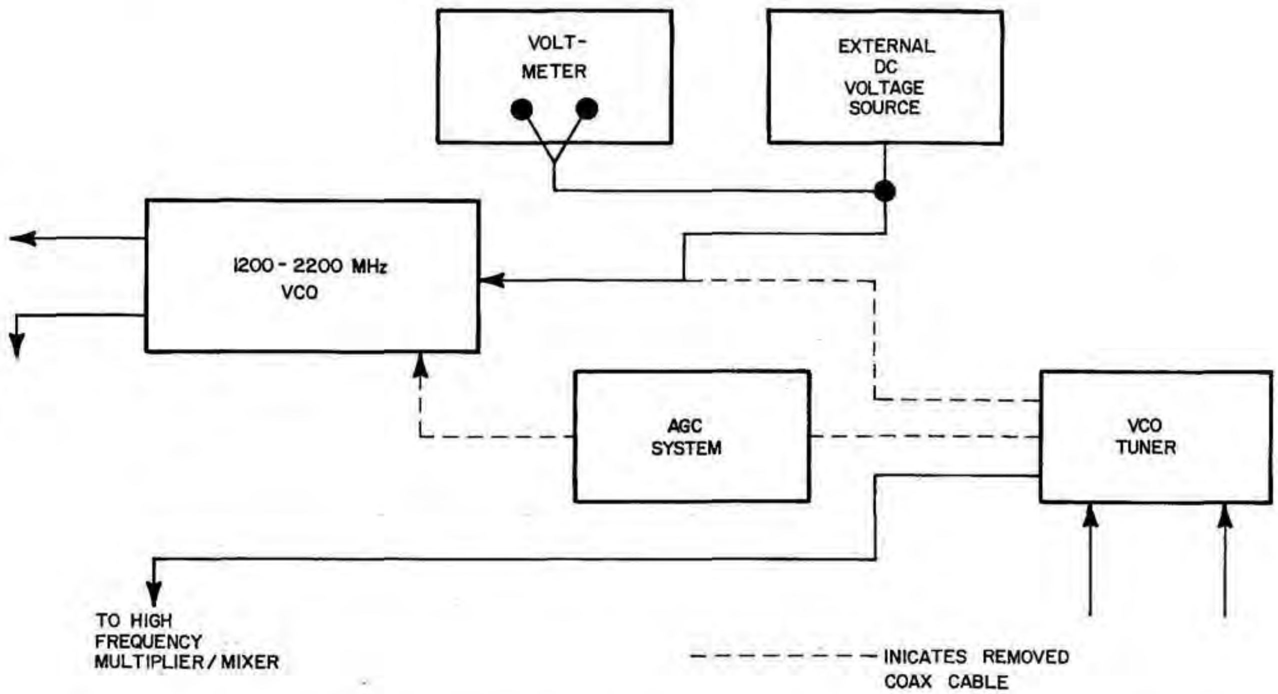


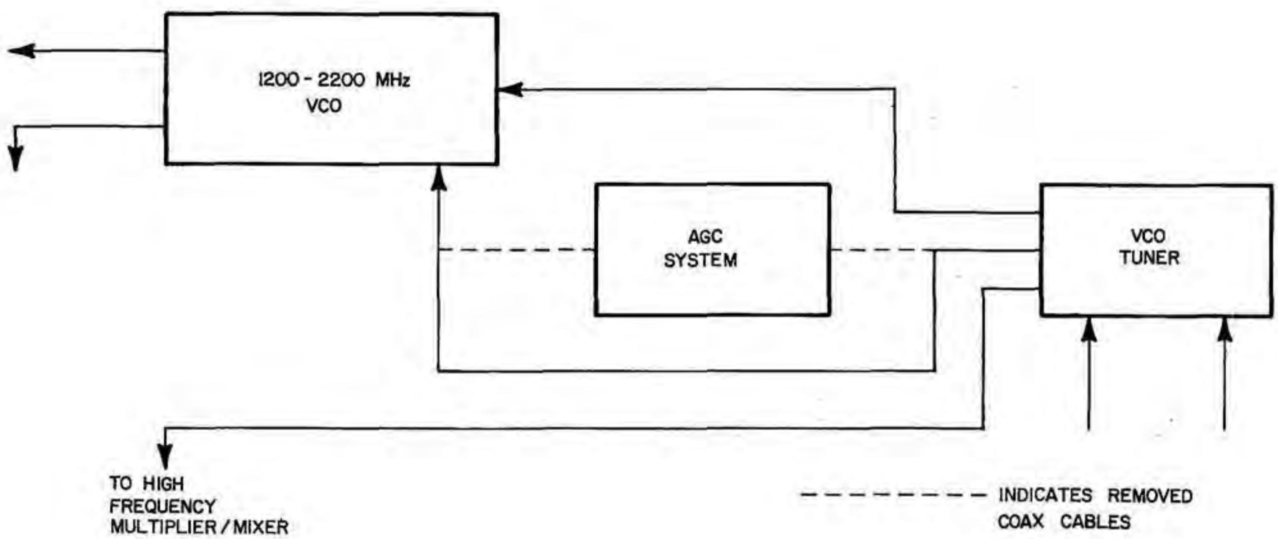
Figure 5-2 Initial FM/AM-1100S/A Control Settings for Module Troubleshooting

	CONTROL	INITIAL SETTING
3	HI LVL/µV X 100/NORM Switch	"NORM"
7	BFO-RF LEVEL Control	"10 µV"
8	AUTO ZERO/OFF/BATT Switch	"AUTO"
11	PWR/OFF/BATT Switch	"PWR"
12	RCVR WIDE/MID/NARROW Switch	"NARROW"
13	GEN/RCVR Switch	"RCVR"
17	SQUELCH Control	Fully ccw, not detent
18	INT MOD/RCVR/RCVR (DET OFF) Switch	"RCVR"
19	VOLUME Control	Fully ccw
20	BFO/OFF Switch	"OFF"
21	AM/FM Switch	"FM"
25	VAR/OFF Control	Fully ccw, detent (OFF)
26	1 kHz/OFF Control	Fully ccw, detent (OFF)
27	MODULATION FREQ Hz Thumbwheels	"0000.0 Hz"
29	SWEEP Control	"1 mS"
30	SWEEP VERNIER Control	Fully cw, detent (in "CAL")
31	AC/OFF/DC Switch	"DC"

	CONTROL	INITIAL SETTING
32	DEV-VERT VERNIER Control	Fully cw, detent (in "CAL")
33	DEV-VERT Control	"15 kHz"
34	RF FREQUENCY MHz Thumbwheels	"111.1000 MHz"
35	FREQ ERROR Control	"15 kHz"
37	INTENSITY Control	Midrange to full cw
38	HORIZ Control	Midrange
39	FOCUS Control	Midrange
40	VERT Control	Midrange
41	ANALY DISPR Control	Fully ccw, detent
48	DEV/POWER Control	"SIG"



Detail A - 1st Local Oscillator Open Loop Troubleshooting



Detail B - 1st Local Oscillator AGC Bypass Troubleshooting

Figure 5-3 1st Local Oscillator Troubleshooting

5-2 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
1.	START: Set front panel controls to initial setting per Figure 5-2.	Left High Freq. Phase Lock Lamp "ON".	2	4	
2.	Is 1311 MHz (+5 dBm to +13 dBm) present at J804 of 1200-2200 MHz VCO?	1st Local Oscillator is functioning properly at this frequency.	4	3	Refer to 1200-2200 MHz Oscillator Mechanical Assembly in Section 8.
3.		Fault indicated in 1200-2200 MHz VCO.			Test/Return to IFR factory for repair/ Calibrate.
4.	Set RF Frequency MHz Thumbwheels to frequency where fault condition occurs. Monitor TP6201 on High Freq. Multiplier Mixer using Spectrum Analyzer. Read Technical Data supplements 1, 2, and 3 before proceeding further.		5	-	Exercise three left-most digits of RF Frequency MHz Thumbwheels while observing Spectrum Analyzer display for all five combinations. Refer to High Frequency Mult./Mixer Mechanical Assembly in Section 8.
5.	Is Spectrum Analyzer display at TP6201 proper?		7	6	
6.	Is F_C frequency and amplitude proper at TP6201 of High Freq. Multiplier/Mixer?		25	10	
7.	Is .6 VDC to 1 VDC present at J10201 (Pin 12) on bottom side of mother board?		8	9	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
8.		Fault indicated in left High Frequency Phase Lock Lamp on front panel.	-	-	Check L.E.D. and wiring. Repair or replace as necessary.
9.		Fault indicated in High Frequency Phase Lock PC Board.	-	-	Test/Repair or Replace/Calibrate.
10.	Is 100 MHz (+2 dBm to +10 dBm) present at J6202 of High Frequency Multiplier/ Mixer?		11	17	Refer to High Freq. Multi./Mixer Mechanical Assembly in Section 8.
11.	Increment or decrement leftmost digit of Frequency MHz Thumbwheels and observe voltage on pins 1 thru 5 of High Frequency Multiplier/ Mixer. (Refer to Technical Data Supplement 6.)		12	-	
12.	Is +11 VDC switching voltage present at appropriate pin of P6204 of High Frequency Multiplier/ Mixer? (Refer to Technical Data Supplement 6.)		15	13	
13.	Increment or decrement leftmost digit of front panel Frequency Select Switch and observe voltage on pins 1 thru 3 of P2601 on VCO Tuner PC Board.	Are Frequency MHz Thumbwheel inputs to VCO tuner proper at P2061? (Refer to Technical Data Supplement 6.)	14	16	

5-2 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
14.		Fault indicated within VCO Tuner PC Board.	-	-	Test/Repair or Replace/Calibrate.
15.		Fault indicated in High Frequency Multiplier/Mixer.	-	-	Test/Repair or Replace/Calibrate.
16.		Fault indicated within front panel Frequency Select Switch.	-	-	Test/Repair or Replace/Calibrate.
17.	Remove screws securing lower floor assembly. Swing open floor assembly to gain access to test points on attached modules.		18	-	
18.	Is 100 MHz (+4 dBm to +8 dBm) present at J5503 of 100 MHz Amplifier/108 MHz Mixer?		19	20	Refer to 100 MHz Amp/108 MHz Mixer Mechanical Assembly in Section 8.
19.		Fault indicated within 100 MHz Filter.	-	-	Test/Repair or Replace/Calibrate.
20.	Is 10 MHz (0 dBm to +10 dBm) present at P5502 of 100 MHz Amplifier/108 MHz Mixer?		21	22	Refer to 100 MHz Amp/108 MHz Mixer Mechanical Assembly in Section 8.
21.		Fault indicated within 100 MHz Amplifier/108 MHz Mixer.	-	-	Test/Repair or Replace/Calibrate.
22.	Is 10 MHz (-5 dBm to +5 dBm) present at J1301 of TCXO Distribution Amplifier?		23	24	Refer to TCXO Distribution Amplifier Mechanical Assembly in Section 8.

5-2 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
23.		Fault indicated in TCXO Distribution Amplifier.	-	-	Test/Repair or Replace/Calibrate.
24.		Fault indicated in TCXO.	-	-	Test/Repair or Replace/Calibrate.
25.	Refer to Technical Data Supplement 4 for instructions on how to break the phase lock loop. Substitute an external DC Voltage source (V_{VCO}) to input of 1200-2200 MHz VCO at J802. Vary the voltage from 0 to -30 VDC. Is F_{VCO} +5 dBm to +13 dBm over the 1200-2200 MHz range at J803 of the 1200-2200 MHz VCO?		27	3	
26.	Repeat Step 25, except measure F_{VCO} at J804 of 1200-2200 MHz VCO. Is F_{VCO} +5 dBm to +13 dBm over the 1200-2200 MHz range?		27	3	
27.	Adjust external DC voltage (V_{VCO}) so (F_{VCO}-F_C) is in 100 MHz to 300 MHz range. Is (F_{VCO}-F_C)/2 from -8 dBm to -12 dBm at P2401 of High Frequency Phase Lock PC Board?		30	28	Refer to High Frequency Phase Lock PC Board in Section 9.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
28.	Is F_{vco}-F_C from -45 to -55 dBm at P601 of Heterodyne Amplifier ÷2 Prescaler? (Use tee connector.)		29	15	Refer to Heterodyne Amp/÷2 Prescaler Mechanical Assembly in Section 8.
29.		Fault indicated within Heterodyne Amplifier ÷2 Prescaler.	-	-	Test/Repair or Replace/Calibrate.
30.	Monitor the DC voltage of J2403 of the High Frequency Phase Lock PC Board with an Oscilloscope. Set front panel Frequency Select Switch to 100 000 0. Use an external DC voltage source to vary F_{vco} above and below 1300 MHz. Is 2.5 VDC to 3.5 VDC present at J2403 of High Frequency Phase Lock PC Board when F_{vco} is below 1300 MHz?		31	32	Refer to High Frequency Phase Lock PC Board in Section 9.
31.	Is 7 VDC to 8 VDC present at J2403 of High Frequency Phase Lock PC Board when F_{vco} is above 1300 MHz?		36	32	Refer to High Frequency Phase Lock PC Board in Section 9.
32.	Is 10 MHz (-5 dBm to +5 dBm) present at P2402 of High Frequency Phase Lock PC Board?		33	34	Refer to High Frequency Phase Lock PC Board in Section 9.

5-2 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
33.	Determine proper operation of RF Frequency MHz Thumbwheels by referring to Technical Data Supplement 8. Are Frequency Select Switch inputs to High Frequency Phase Lock PC Board proper as shown in Technical Data Supplement 8?		9	16	
34.	Is 10 MHz (-5 dBm to +5 dBm) present at J1304 of TCXO Distribution Amplifier?		35	23	Refer to TCXO Distribution Amplifier Mechanical Assembly in Section 8.
35.		Fault indicated within 2nd Mixer Assembly.	-	-	Test/Repair or Replace/Calibrate.
36.	Monitor J2604 on VCO Tuner PC Board with an Oscilloscope. Use an external DC voltage source to vary F_{VCO} above and below 1300 MHz. Does voltage at J2604 of VCO Tuner PC Board increase to 6.5 to 7.5 VDC as F_{VCO} is increased to 1300 MHz?		37	14	Refer to VCO Tuner PC Board in Section 9.
37.	Does voltage at J2604 of VCO Tuner PC Board decrease to 2.5 to 3.5 VDC as F_{VCO} is decreased to 1300 MHz?		38	14	Refer to VCO Tuner PC Board in Section 9.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
38.	Set front panel Frequency Select Switch to 200 000 0. Use external DC voltage source to vary F_{VCO} above and below 1400 MHz. Does voltage at J2604 of VCO Tuner PC Board increase to 3 to 4 VDC as F_{VCO} is increased to 1400 MHz?		39	14	Refer to VCO Tuner PC Board in Section 9.
39.	Does voltage at J2604 of VCO Tuner PC Board decrease to 1 to 2 VDC as F_{VCO} is decreased to 1400 MHz?		40	14	Refer to VCO Tuner PC Board in Section 9.
40.	Monitor J2603 on VCO Tuner PC Board with an Oscilloscope. See Technical Data Supplement 5 for information concerning voltage at this point. Is voltage at J2603 of VCO Tuner PC Board proper?		41	14	Refer to VCO Tuner PC Board in Section 9.
41.	Bypass AGC circuit by connecting P1001 of AGC System PC Board to J801 of 1200-2200 MHz VCO and P802 of 1200-2200 MHz VCO to J802 of 1200-2200 MHz VCO. Is fault condition present?		43	42	Refer to 1200-2200 MHz Mechanical Assembly in Section 8 and AGC System PC Board in Section 9.
42.		Fault indicated in AGC System PC Board.	-	-	Test/Repair or Replace/Calibrate.

5-2 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
43.	Refer to Section 4 and perform calibration of VCO Tuner PC Board.		44	-	
44.	Is VCO Tuner PC Board Calibration procedure successful?		45	3	
45.	Return AGC System PC Board to circuit by connecting P1001 of AGC System PC Board to J1001 and P801 of 1200-2200 MHz VCO to J801. Check 1st Local Oscillator throughout its range.		-	-	Refer to 1200-2200 MHz Mechanical Assembly in Section 8 and AGC System PC Board in Section 9.

FREQUENCY AND VOLTAGE NOTATIONS USED IN 1ST LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHARTS

In the 1st Local Oscillator Troubleshooting Flowchart, references are made to the following frequency and voltage notations:

F_C, F_{VCO}, F VCO, V_{VCO}, V VCO, $F_{VCO} - F_L$ and $\frac{F_{VCO} - F_C}{2}$

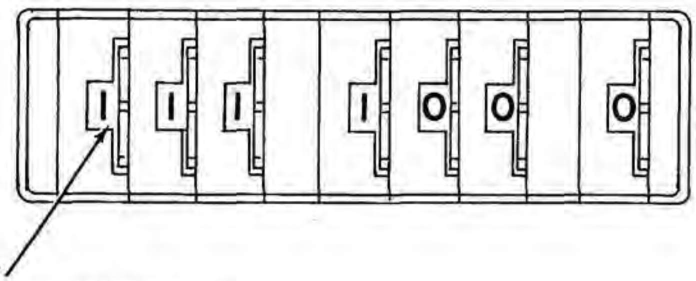
Each of these notations are defined as follows:

1. F_C - This notation represents one of five combination frequencies in the High Frequency Multiplier/Mixer which corresponds to the selected value of the leftmost digit of the front panel RF FREQUENCY MHz Thumbwheels (see Table 5-1 below).

VALUE SELECTED ON LEFTMOST (100 MHz) DIGIT OF RF FREQUENCY MHz THUMBWHEELS	VALUE OF F_C
0 or 1	1100 MHz
2 or 3	1300 MHz
4 or 5	1500 MHz
6 or 7	1700 MHz
8 or 9	1900 MHz

Table 5-1

EXAMPLE 1A: In this example, F_C is equal to 1100 MHz



LEFTMOST DIGIT OF RF FREQUENCY MHz THUMBWHEELS, WHICH DETERMINES VALUE OF F_C

Figure 5-4 RF FREQUENCY MHz Thumbwheels

2. F_{VCO} - This notation represents the frequency being generated by the 1200-2200 MHz VCO (Voltage Controlled Oscillator). During normal operation of the FM/AM-1100S/A, this frequency is determined by the values of the three leftmost digits of the front panel RF FREQUENCY MHz Thumbwheels, based on the following relationship:

F_{VCO} = 1200 + XXX, where XXX is equal to the values of the three leftmost digits of the RF FREQUENCY MHz Thumbwheels.

EXAMPLE 1B: In this example, F_{VCO} is equal to 1200 + 111 or 1311 MHz

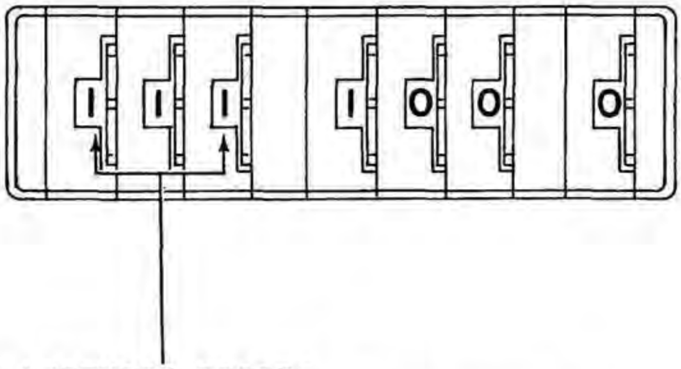


Figure 5-5 RF FREQUENCY MHz Thumbwheels

3. F^1_{VCO} - This notation represents the frequency generated by the 1200-2200 MHz VCO, when controlled by an external voltage source.

4. V_{VCO} - This notation represents the DC voltage presented to the 1200-2200 MHz VCO from the tuning integrator in the VCO Tuner PC Bd. This voltage controls the frequency of the 1200-2200 MHz VCO and therefore the value of F_{VCO}.

5. V^1_{VCO} - This notation represents the DC voltage presented to the 1200-2200 MHz VCO from an external DC voltage source during "open loop" troubleshooting of the 1st Local Oscillator.

6. $F_{VCO} - F_C$ - This notation represents the frequency applied to the Heterodyne Amplifier/÷2 Prescaler from the High Frequency Multiplier/Mixer. During normal operation of the FM/AM-1100S/A, this difference frequency is within the range of 100 MHz to 299 MHz.

7. $\frac{F_{VCO} - F_C}{2}$ - This notation represents the frequency applied to the High Frequency Phase Lock PC Bd from the Heterodyne Amplifier/÷2 Prescaler. During normal operation of the FM/AM-1100S/A, this frequency is within the range of 50 to 149.5 MHz.

TECHNICAL DATA SUPPLEMENT #2

SPECTRUM ANALYZER DISPLAY OF TEST POINT TP6201 ON HIGH FREQUENCY MULTIPLIER/MIXER

The signals present at TP6201 of the High Frequency Multiplier/Mixer are unique for each frequency selected by the three leftmost RF FREQUENCY MHz Thumbwheels on the front panel of the FM/AM-1100S/A.

The five signals which will normally be present at TP6201 are those produced in the resonant cavities of the High Frequency Multiplier/Mixer (1100 MHz, 1300 MHz, 1500 MHz, 1700 MHz and 1900 MHz). For any given setting of the three leftmost RF FREQUENCY MHz Thumbwheels, only one of these frequencies will be present at TP6201. The required power level of the selected frequency is -18 dBm to -25 dBm while the power levels for the unselected frequencies must be at least 25 dB below that of the selected frequency. In the troubleshooting flowcharts, the selected resonant cavity or comb frequency is referenced as F_C.

An additional sixth signal which will be present at TP6201, is the 1200-2200 MHz VCO signal which is attenuated through the High Frequency Multiplier/Mixer detector. This signal, designated as F_{VCO}, is equal in MHz, to 1200 plus the values selected on the three leftmost digits of the RF FREQUENCY MHz Thumbwheels (See Example 1B in TECHNICAL DATA SUPPLEMENT #1.) The power level of F_{VCO} is not specified at TP6201, but is generally 10 dB or so above the level of F_C.

The spectrum analyzer display of F_C and F_{VCO} at TP6201 should reflect the signals as being stable at the proper frequencies and amplitudes.

TYPICAL SPECTRUM ANALYZER DISPLAYS OF TP6201 ON HIGH FREQUENCY MULTIPLIER/MIXER

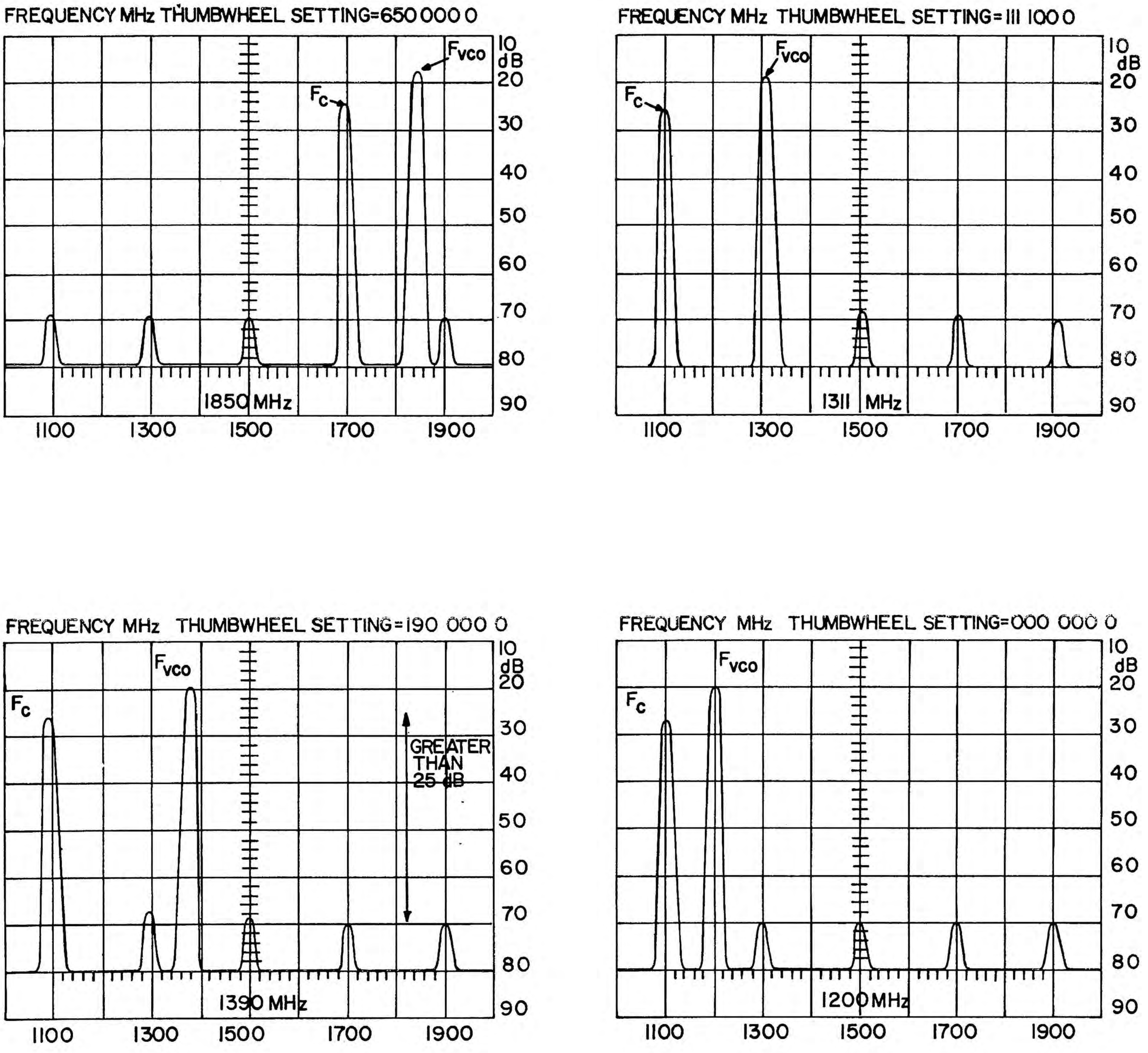


Figure 5-6 Typical Spectrum Displays at TP6201 of High Frequency Multiplier/Mixer

TECHNICAL DATA SUPPLEMENT #4

TROUBLESHOOTING TECHNIQUE FOR BREAKING THE PHASE LOCK LOOP

Troubleshooting certain problems in the High Frequency Phase Lock System requires breaking the phase lock loop.

The 1200-2200 MHz VCO has a tuning characteristic (voltage vs frequency relationship) which requires it to be aligned with the VCO Tuner PC Bd. The DC voltage (V_{VCO}) applied to 1200-2200 MHz VCO controls its output frequency (F_{VCO}).

To troubleshoot the system, remove the coax at J802 of the 1200-2200 MHz VCO and connect in its place an external DC voltage source. By varying the DC voltage (V_{VCO}) from 0 to -30 VDC, the phase lock loop can be exercised through its normal operating range and various components of the loop can be tested.

VOLTAGE VS FREQUENCY CHARACTERISTIC OF 1200-2200 MHz VCO

The output of the VCO Tuner PC Bd at J2603 is a DC voltage which is adjusted to the voltage vs frequency characteristic of the 1200-2200 MHz VCO. A characteristic curve representing such a typical voltage vs frequency relationship is shown below. The VCO Tuner PC Bd operates in one of five separate sections of the characteristic curve, depending on the setting of the leftmost digit of the RF FREQUENCY MHz Thumbwheels.

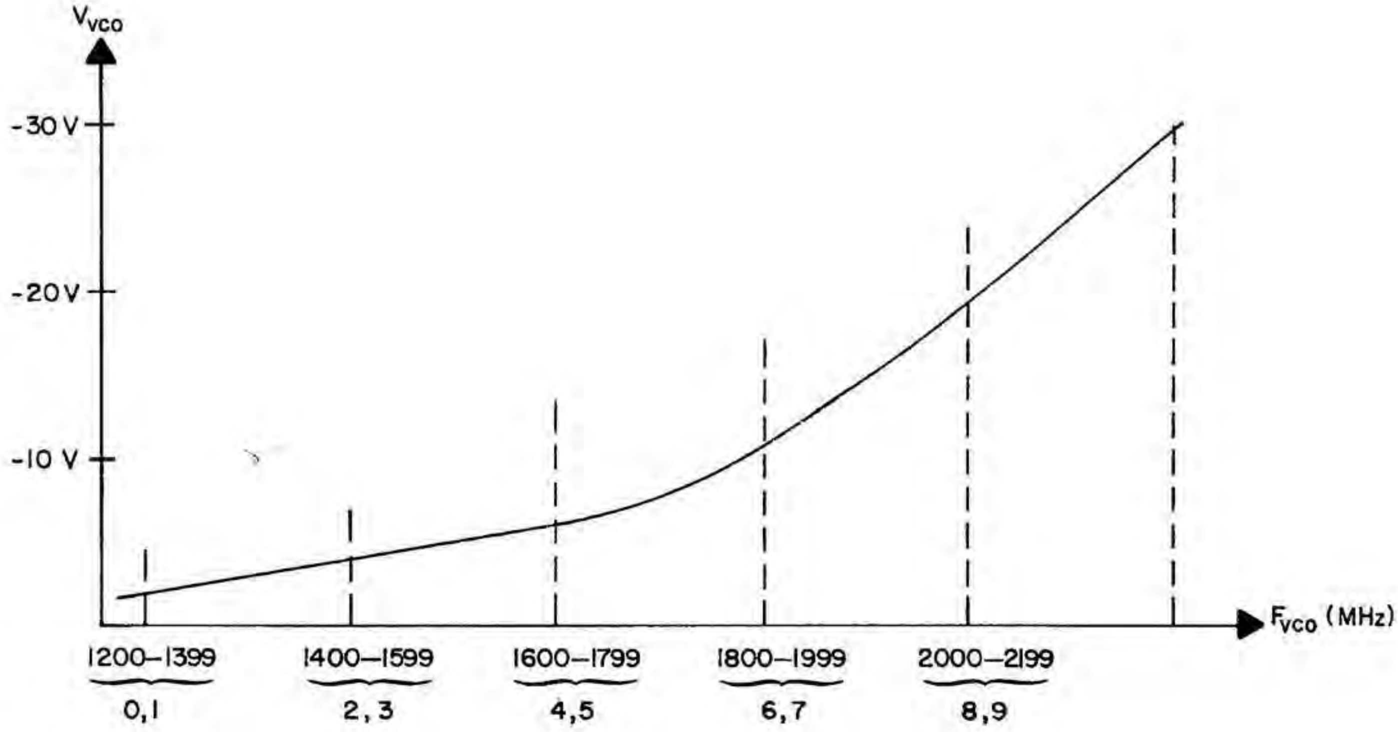


Figure 5-7 1200-2200 MHz VCO Characteristic Curve

The VCO Tuner PC Bd must be aligned with the 1200-2200 MHz VCO for each range shown in the illustration above. Refer to "SECTION 4, CALIBRATION" for the recommended VCO Tuner PC Bd calibration procedure.

When troubleshooting an open phase lock loop, voltage V_{VCO} will be one of two possible values for each range being tested. (See example on following page.) If $F^1{}_{VCO}$ is below the frequency of F_{VCO}, V_{VCO} will adjust to the largest negative value within the range, in an effort to raise the value of F_{VCO}. If $F^1{}_{VCO}$ is above F_{VCO}, V_{VCO} will adjust to the smallest negative value within the range.

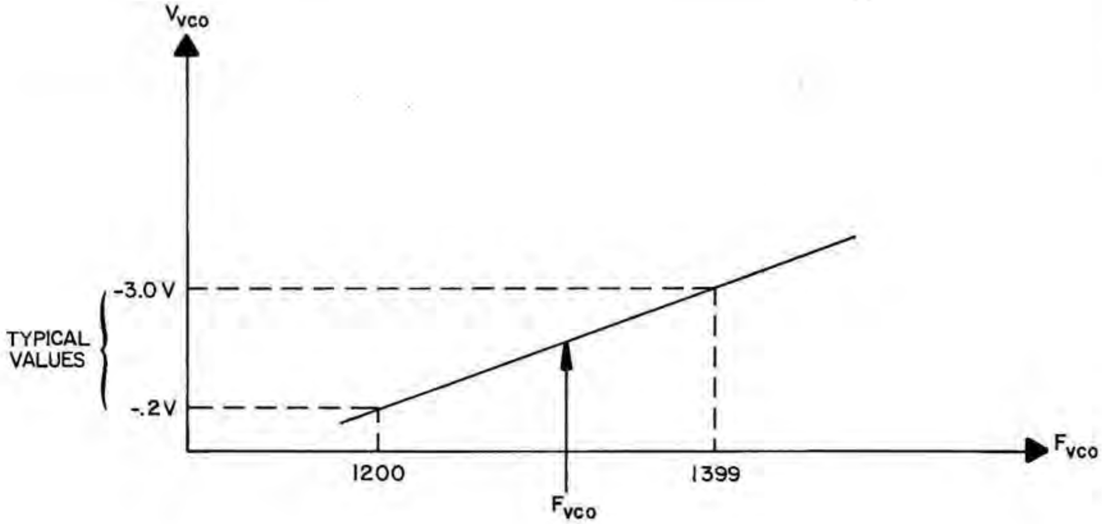


Figure 5-8 Typical 1st Range of VCO Characteristic Curve

EXAMPLE 5A: Setting of RF FREQUENCY MHz Thumbwheels = 1000000

F_{VCO} = 1200 + 100 = 1300 MHz

If external DC Voltage control is adjusted so $F^1{}_{VCO}$ is below 1300 MHz, then V_{VCO} = -3.0 V

If $F^1{}_{VCO}$ is above 1300 MHz, V_{VCO} = -0.2 V

When the High Frequency Phase Lock System is operating in a "closed loop" fashion, as during normal operation, V_{VCO} will adjust to a voltage corresponding to a given frequency based on the characteristic curve of the 1200-2200 MHz VCO. When monitoring V_{VCO} while incrementing through all possible combinations of the RF FREQUENCY MHz Thumbwheel settings, a smooth and continuous increase in negative voltage should be evident.

SWITCHING CONDITIONS FOR VCO TUNER PC BD CONNECTOR P2601 AND HIGH FREQUENCY MULTIPLIER/MIXER CONNECTOR P6204

VALUE OF F_C	P2601 (VCO TUNER PC BD) INPUTS PIN 1	PIN 2	PIN 3	OUTPUT +11 VOLTS AT PIN NO:	P6204 (HI FREQ MUTL/MIX) +11 VOLTS AT PIN NO:
1100 MHz	0 VDC	0 VDC	0 VDC	10	1
1300 MHz	0 VDC	0 VDC	+5 VDC	11	2
1500 MHz	0 VDC	+5 VDC	0 VDC	12	3
1700 MHz	0 VDC	+5 VDC	+5 VDC	13	4
1900 MHz	5 VDC	0 VDC	0 VDC	14	5

Table 5-2

EXAMPLE 6A: If RF FREQUENCY MHz Thumbwheel setting is 1110000, then F_C is equal to 1100 MHz. Therefore voltage at P2601 and P6204 is as follows:

P2601 (Pins 1, 2 and 3) = 0 Volts DC
P2601 (Pin 10) = +11 Volts DC
P6204 (Pin 1) = +11 Volts DC

5-3 2ND LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
1.	START: Set FM/AM-1100S/A front panel controls to initial settings per Figure 5-2. Read Technical Data Supplement 7.	Right low Frequency Phase Lock Lamp "ON".	2	8	
2.	Is $(F_{L}/10)$ +7 dBm to +10 dBm at P1601 of 108 MHz Filter?		4	3	Refer to 108 MHz Filter Mechanical Assy in Section 8.
3.	Is $(F_{L}/10)$ -100 MHz .5 VPP to .7 VPP at J2501 of 79-80 MHz Phase Lock Loop PC Board?		7	-	Refer to 79-80 MHz Phase Lock Loop PC Board in Section 9.
4.	Is $(F_{L}/10)$ 0 dBm to +5 dBm at J1602 of 108 MHz Filter?		5	6	Refer to 108 MHz Filter Mechanical Assy in Section 8.
5.		Fault indicated in 1080 MHz Multiplier.	-	-	Test/Replace or Repair/Calibrate.
6.		Fault indicated in 108 MHz Filter.	-	-	Test/Replace or Repair/Calibrate.
7.		Fault indicated in 108 MHz Amplifier/108 MHz Mixer.	-	-	Test/Replace or Repair/Calibrate.
8.	Is $(F_{L}/10)$-100 MHz .5 VPP to .7 VPP present at J2501 of 79-80 MHz Phase Lock Loop PC Board.		9	12	Refer to 79-80 MHz Phase Lock Loop PC Board in Section 9.
9.	Is 0 VDC to .2 VDC present at P2502 (pin 21) of 79-80 MHz Phase Lock Loop PC Board?		10	11	Refer to 79-80 MHz Phase Lock Loop PC Board in Section 9.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
10.		Fault indicated in Low Frequency Phase Lock Lamp.	-	-	Check L.E.D. and wiring. Repair or replace as necessary.
11.		Fault indicated in 79-80 MHz Phase Lock Loop PC Board.	-	-	Test/Replace or Repair/Calibrate.
12.	Is 100 Hz 3 Vp-p to 5 Vp-p present at P2502 (pin 2) of 79-80 MHz Phase Lock Loop PC Board?		13	16	Refer to 79-80 MHz Phase Lock Loop PC Board in Section 9.
13.	See Technical Data Supplement 8 to determine proper outputs of RF Frequency MHz Thumbwheels.		14	-	
14.	Are RF Frequency MHz Thumbwheel inputs at P2502 (pins 3-18) of 79-80 MHz Phase Lock Loop RC Board proper?		11	15	Refer to 79-80 MHz Phase Lock Loop PC Board in Section 9.
15.		Fault indicated in Frequency Select Switch.	-	-	Test/Replace or Repair/Calibrate.
16.	Is 10 MHz (0 dBm to +10 dBm) present at J1302 of TCXO Distribution Amplifier?		17	18	Refer to TCXO Distribution Amplifier Mechanical Assembly in Section 8.
17.		Fault indicated within Clock Divider.	-	-	Test/Replace or Repair/Calibrate.
18.	Is 10 MHz (-5 dBm to +5 dBm) present at J1301 of TCXO Distribution Amplifier?		19	20	Refer to TCXO Distribution Amplifier Mechanical Assembly in Section 8.

5-3 2ND LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
19.		Fault indicated within TCXO Distribution Amplifier.	-	-	Test/Replace or Repair/Calibrate.
20.		Fault indicated within TCXO.	-	-	Test/Replace or Repair/Calibrate.

FREQUENCY NOTATIONS USED IN 2ND LOCAL OSCILLATOR TROUBLESHOOTING FLOWCHARTS

In the 2nd Local Oscillator Troubleshooting Flowchart, references are made to the following frequency notations:

$$F_L \, , \; \frac{F_L}{10} \text{ and } \frac{F_L}{10} - 100 \text{ MHz}$$

Each of these notations are defined as follows:

1. F_L - This notation represents the frequency of the 2nd Local Oscillator. This frequency is determined by the values selected in the four rightmost RF FREQUENCY MHz Thumbwheels, based on the following relationship:

   F_L = 1080.0000 MHz - .XXXX, where XXXX is equal to the values of the four rightmost RF FREQUENCY MHz Thumbwheels.

   EXAMPLE 7A:

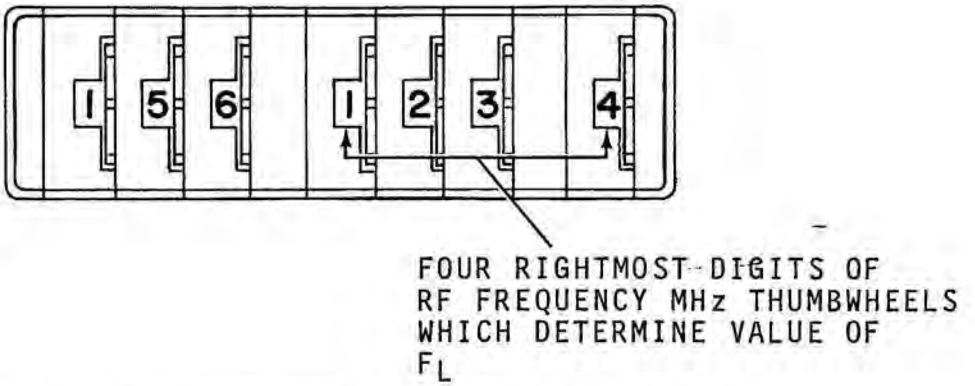


Figure 5-9 RF FREQUENCY MHz Thumbwheels

   In this example:

   F_L = 1080.0000 - .1234
   or
   F_L = 1079.8766

   Based on the above information, F_L will always represent a frequency between 1079.0001 and 1080.0000 MHz.

2. $\frac{F_L}{10}$ - This notation represents the frequency applied to the 1080 MHz Multiplier. This frequency will always be within a range of 107.90001 MHz and 108.0000 MHz. Using the RF FREQUENCY MHz Thumbwheel setting in Example 1A, $\frac{F_L}{10}$ is equal to 107.98766.

3. $\frac{F_L}{10}$ - 100 MHz - This notation represents the frequency produced by the 79-80 MHz Phase Lock Loop PC Bd and applied to the 100 MHz Multiplier/108 MHz Mixer. When the FM/AM-1100S/A is functioning properly, this frequency will always be within a range of 7.90001 MHz and 8.00000 MHz. Using the RF FREQUENCY MHz Thumbwheel setting in Example 1A, $\frac{F_L}{10}$ - 100 MHz is equal to 7.98766 MHz.

BINARY CODED DECIMAL (BCD) CODES FOR RF FREQUENCY MHz THUMBWHEELS

Table 5-3 below provides the BCD (Binary Coded Decimal) Coding for each digit of the front panel RF FREQUENCY MHz Thumbwheels. Table 5-4 provides test points for testing each digit of the RF FREQUENCY MHz Thumbwheels on the bottom side of the Mother Board. (See Mother Board Mechanical Assy drawing in Section 8.)

DECIMAL VALUE	BCD DIGITS			
	A	B	C	D
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

TTL Logic Levels = 0 = 0.0 V to 0.8 V
1 = 2.0 V to 5.25 V

Table 5-3 Decimal to BCD Conversion

BCD DIGITS	100 MHz DIGIT	10 MHz DIGIT	1 MHz DIGIT	100 kHz DIGIT	10 kHz DIGIT	1 kHz DIGIT	100 Hz DIGIT
A	FL10221	FL10225	FL10229	FL10204	FL10208	FL10212	FL10216
B		FL10224	FL10228	FL10205	FL10209	FL10213	FL10217
C		FL10223	FL10227	FL10203	FL10207	FL10211	FL10215
D		FL10222	FL10226	FL10218	FL10206	FL10210	FL10214

Table 5-4 BCD Bit Test Points on Bottom Side of Mother Board

5-4 GENERATE TROUBLESHOOTING FLOWCHART

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
1.	Perform Steps 1-9 of Dual Tone Generator Performance Evaluation. Does Multimeter indicate a minimum of 2.5 VRMS?		10	2	
2.	Using Oscilloscope, verify presence of audio at J8501, pin 3. Is audio >5.6 Vp-p?		3	6	
3.	Using Oscilloscope, verify presence of audio at J8501, pin 10. Is audio >4.0 Vp-p?		4	9	Refer to Dual Tone Generator Mechanical Assembly in Section 8.
4.	Using Oscilloscope, verify presence of audio at J8501 pin 5 and J8501, pin 4. Are pin 5 and pin 4 >8 Vp-p?		5	7	
5.		Fault indicated in contacts 4 and/or 5 of P8501 and/or associated wiring.	-	-	Repair/Replace P8501 and associated wiring.
6.	Measure voltage at following test points. Are voltages within tolerances listed? TEST POINT — VOLTAGE J8501, Pin 13 — +11 V J8501, Pin 12 — -12 V		7	8	

5-4 GENERATE TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
7.		Fault indicated in Dual Tone Generator.	-	-	Test/Repair or Replace/Calibrate.
8.		Fault indicated in front panel wiring.	-	-	Repair/Replace faulty connector or conductor.
9.		Fault indicated in SW7714, R7705 or associated wiring.	-	-	Repair/Replace SW7714, R7750 or associated wiring.
10.	Perform Step 10 of Dual Tone Generator Performance Evaluation. Is displayed frequency correct?		11	7	
11.	Perform Step 11 of Dual Tone Generator Performance Evaluation. Is waveform correct?		12	7	
12.	Perform Step 12 of Dual Tone Generator Performance Evaluation. Is audio present?		21	13	
13.	Using Oscilloscope, verify presence of audio at J3101, pin 12. Is audio between 50 and 300 mVp-p?		14	19	
14.	Using Oscilloscope, verify audio is present on J3101, pin 13. Is audio between .3 and 5.0 Vp-p?		15	74	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
15.	Using Oscilloscope, verify presence of audio at SP10401-E1 Is audio between 0.3 and 5.0 Vp-p?		16	17	Refer to Front Panel Circuit Schematic in Section 10.
16.		Fault indicated in Speaker (SP10401).	-	-	Replace Speaker.
17.	Using Oscilloscope, measure audio at J10201, pin 24. Is audio between 0.3 and 5.0 V?		8	18	
18.		Fault indicated in Mother Board.	-	-	Repair/Replace faulty connector on Mother Board.
19.	Using Oscilloscope, measure audio on J10201, pin 7. Is audio between 50 and 300 mV?		18	20	
20.		Fault indicated in front panel R7708, R7703, SW7709, or associated wiring.	-	-	Repair/Replace faulty item or wiring.
21.	Perform Steps 13-15 of Dual Tone Generator Performance Evaluation. Is indicated voltage correct?		27	22	
22.	Using Oscilloscope, verify audio at J8501, pin 6. Is audio 5.5 Vp-p ±0.5 V?		23	6	Refer to Dual Tone Generator Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
23.	Using Oscilloscope, verify audio at J8501, pin 11. Is audio 5.5 Vp-p ±0.5 V?		25	24	
24.		Fault indicated in front panel R7705 or associated wiring.	-	-	Repair/Replace R7705 or wiring.
25.	Using Multimeter, verify voltage on J8501, pin 14 is +11 V (±0.2 V). Is voltage correct?		4	26	
26.		Fault indicated in front panel SW7712 or associated wiring.	-	-	Repair/Replace SW7712 or wiring.
27.	Perform Step 16 of Dual Tone Generator Performance Evaluation. Is frequency correct?		28	7	
28.	Perform Step 17 of Dual Tone Generator Performance Evaluation. Is waveform correct?		29	7	
29.	Perform Step 18 of Dual Tone Generator Performance Evaluation. Are indications correct?		30	7	
30.	Perform Step 19 of Dual Tone Generator Performance Evaluation. Are indications correct.		31	7	

5-4 GENERATE TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
31.	Perform Step 20 of Tone Generator Performance Evaluation. Is waveform correct?		32	7	
32.	Perform Steps 1-11 of Signal Generator Performance Evaluation. Is output reading correct?		131	33	
33.	Using Spectrum Analyzer, check output of 1200-2200 MHz Oscillator Assembly at J804. Is output +2 dBm (±3 dB) at 1325 MHz?		35	34	Refer to 1200-2200 MHz Oscillator Mechanical Assembly in Section 8.
34.		Fault indicated in 1st Local Oscillator System.	-	-	Go to 1st Local Oscillator Troubleshooting Flowchart, para. 5-2.
35.	Using Spectrum Analyzer, check output of 1080 MHz Multiplier at J3302. Is output +4 ±3 dBm at 1080 MHz?	maybe J1102?	37	36	Refer to 1080 MHz Multiplier Mechanical Assembly in Section 8.
36.		Fault indicated in 2nd Local Oscillator System.	-	-	Go to 2nd Local Oscillator Troubleshooting Flowchart, para. 5-3.
37.	Using Spectrum Analyzer, check output of 120 MHz Generator at J9501. Is output -6 ±3 dBm at 120 MHz? J9501 is 10kHz in.	try J9503 per fig 10-1 page 10-7!!	57	38	Refer to 120 MHz Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
38.	Measure voltage at following pins of J9504. Pin # Voltage H +5 V (±0.25 V) A +11 V (±1.0 V) B 0 V (±1.0 V) Are all voltages correct?		49	39	
39.	Is voltage correct at pin H?		40	18	
40.	Is voltage correct at pin A?		42	41	
41.	Measure voltage at J10202, pin 2. Is voltage +11 V (±1.0 V)?		18	42	
42.	Perform Regulator/Timer Test in Section 7. Does Regulator/Timer pass test?		44	43	
43.		Fault indicated in Regulator/Timer PC Board.	-	-	Repair or Replace/ Calibrate Regulator/ Timer PC Board.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
44.	Place following switches into position shown. Switch / Position GEN/RCVR — GEN HI-LVL/µV x 100/NORM — NORM Check voltage at J9101, pin N. Is voltage -200 mV (±200 mV)?		136	45	
45.	Desolder wire from FL8402. Measure voltage on J9101, pin N. Is voltage -200 mV (±200 mV)?		46	47	Refer to Power Termination Mechanical Assembly in Section 8.
46.		Fault indicated in Power Termination Assembly.	-	-	Test/Replace or Repair/Calibrate Power Termination Assembly.
47.	Check voltage at J10201, pin 27. Is voltage -200 mV (±200 mV)?		18	48	Refer to Mother Board Mechanical Assembly in Section 8.
48.		Fault indicated in front panel.	-	-	Repair/Replace SW7707 and/or associated conductors.
49.	Place GEN/RCVR Switch to RCVR. Is voltage on J9101, pin N +5 V (±0.35 V)?		52	50	
50.	Desolder wire from FL8402. Is voltage at J9101, pin N +5 V (±0.35 V)?		46	51	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
51.	Measure voltage at J10201, pin 27. Is voltage +5 V (±0.35 V)?		18	48	
52.	Measure voltage at J9101, pin J. Is voltage 0 V (±0 V)?		53	76	
53.	Place HI LVL/µV X 100/NORM Switch to HI LVL. Measure voltage at J9101, pin J. Is voltage +12 V (±1 V)?		55	54	
54.	Measure voltage at J10201, pin 36. Is voltage +12 V (±1 V)?		18	48	
55.	Measure voltage at J9101, pin N. Is voltage 0 V (±50 mV)?		57	56	
56.	Measure voltage at FL8402. Is voltage -210 mV ±50 mV?		18	46	
57.	Apply a 125 MHz signal at +30 dBm (10 W) to TRANS/RCVR Connector. Measure voltage at J9101, pin H. Is voltage .95 V ±100 mW?		59	58	
58.	Measure voltage at FL8401. Is voltage <.02 V?		18	46	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
59.	Measure voltage at J9101, pin N. Is voltage .85 V ±100 mV?		61	60	
60.	Measure voltage at FL8402. Is voltage .85 V ±100 mV?		18	46	
61.	Desolder wire from J9101, pin 4 with power off. Measure resistance from free end of wire to ground. Is resistance 1.8 KΩ (±360Ω)?		43	46	
62.	Place FM/AM Switch to "AM". Rotate VAR/OFF fully cw. Set MOD FREQ to 01000.0 Hz. Using Oscilloscope, verify 1 kHz audio at J9504, pin E. Is audio +10 Vp-p ±2 V.		64	63	
63.	Using Oscilloscope, verify audio at P8501, pin 4. Is audio 12 Vp-p ±1 V?		8	7	
64.	Place AM/FM Switch to "FM". Using Oscilloscope, verify 1 kHz audio on J9504, Pin D. Is audio 12 Vp-p ±1 V?		65	63	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
65.	Place BFO-RF LEVEL Control to ON. Place GEN/RCVR Switch to RCVR. Measure voltage on following pins of J9504. Pin # Voltage A 0 V (±1.0 V) B +11 V (±1.0 V) Are voltages correct?		66	67	
66.		Fault indicated in 120 MHz Generator.	-	-	Test/Repair or Replace/Calibrate 120 MHz Generator.
67.	Is voltage at Pin B correct?		42	68	
68.	Measure voltage at J10202, pin 2. Is voltage +11 V (±1.0 V)?		69	42	
69.		Fault indicated in front panel.	-	-	Repair/Replace SW7710 and/or associated conductors.
70.	Test Attenuator in following manner: (1) Connect Spectrum Analyzer input to AT7701-J2. (Remove speaker for access to AT7701.) (2) Set BFO-RF LEVEL Control fully cw.		74	71	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
70.	(Cont'd) (3) Adjust Spectrum Analyzer variable reference level to set peak of display to reference (0 dBm). (4) Rotate BFO-RF LEVEL Control fully ccw. Verify Spectrum Analyzer displays signal level of approximately -60 dB. (5) Set BFO-RF LEVEL Control to -80 dB. (6) Adjust Spectrum Analyzer Variable Control to set peak of display to reference (0 dBm mark). (7) Set BFO-RF LEVEL Control to -130 dBm. Verify Spectrum Analyzer displays signal of -50 dB (±3 dB). Does Attenuator pass test?				
71.	Using Spectrum Analyzer, check AT7701-P1. Is amplitude of 120 MHz signal -6 ±3 dBm?		72	73	
72.		Fault indicated in Variable Attenuator.	-	-	Replace Variable Attenuator (AT7701).
73.		Fault indicated in coax cable.	-	-	Replace coax cable between AT7701-P1 and P10602.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
74.	Rotate BFO-RF LEVEL Control fully cw. Using Spectrum Analyzer, verify 1200 MHz signal at J4904. Note and record level. Is amplitude -64 dBm?		95	75	
75.	Using Multimeter, measure voltage at following pins of J4908: Pin # — Voltage F — +11 V D — -12 V E — +11 V Are voltages correct?		77	76	
76.		Fault indicated in front panel.	-	-	Repair/Replace SW7713 and/or associated wiring.
77.	Set HI LVL/µV X 100/ NORM Switch to µV X 100. Using Multimeter, check voltage on J4908, pin F. Is voltage -12 V (±2 V)?		78	76	
78.	Set AUTO ZERO/OFF/ BATT Switch to "OFF". Measure voltage on J4908, pin H. Is voltage +6 V (±2 V)?		80	79	
79.		Fault indicated in front panel.	-	-	Repair/Replace SW7715 and/or associated wiring.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
80.	Hold AUTO ZERO/OFF/ BATT Switch to "BATT" while measuring voltage at J4908, pin H. Is voltage -7 V (±2 V)?		81	79	
81.	Set AUTO ZERO/OFF/ BATT Switch to "AUTO ZERO". Using oscilloscope, verify presence of 2.7 mS negative-going pulse with voltage swing of <-1 V to >+6 V at J4908, pin H. Is pulse correct?		88	82	
82.	Using Oscilloscope, verify presence of 2.7 mS negative-going pulse at P10201, pin 37. Pulse should swing <-5 V and >+6 V. Is pulse correct?		8	83	
83.	Measure voltage at P10201, pin 33. Is voltage <0.1 V?		84	79	
84.	Measure voltage at J3101, pin K. Is voltage <0.1 V?		85	18	
85.	Using Oscilloscope, verify presence of 2.7 mS pulse at J3101, pin 4. Pulse should swing between <-5 V and >+6 V. Is pulse correct?		86	18	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
86.	Using Multimeter, measure voltages at following pins of J3101: Pin # Voltage 15 +11 V (±.01) 14 +12 V (±.2) 2 -12 V (±.5) Are all voltages correct?		18	87	
87.		Fault indicated in 250 kHz IF/MON/AUDIO PC Board.	-	-	Test/Repair or Replace/Calibrate 250 kHz IF/MON/AUDIO PC Board.
88.	Using Multimeter, voltages at following pins of J4908: Pin # Voltage A +11 V (±1.0 V) B -3 V (±0.5 V) Are voltages correct?		92	89	
89.	Measure voltages at following pins of J10201 and J10202: Pin # Voltage (J1) 1 -3 V (±0.5 V) (J2) 1 +11 V (±1.0 V) Are voltages correct?		90	91	
90.		Fault indicated in front panel.	-	-	Repair/Replace SW7707 and/or associated wiring.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
91.	Perform test of Regulator/Timer PC Board per Section 7. Does board pass test?		44	43	
92.	Set GEN/RCVR Switch to RCVR. Measure voltages on J4908: Pin # Voltage A -4.2 V (±0.5 V) B +11 V (±1.0 V) Are voltages correct?		93	94	
93.		Fault indicated in 2nd Mixer Assembly.	-	-	Test/Repair or Replace/Calibrate 2nd Mixer Assembly.
94.	Measure voltages on following pins of J10201 and J10202: Pin # Voltage (J1) 1 +11 V (±1.0 V) (J2) 1 -4.2 V(±0.5 V) Are voltages correct?		8	91	
95.	Using Spectrum Analyzer, verify level of signal at P10704 is within 2 dB of level noted and recorded in Step 74. Note and record level at P10704. Is level correct?		97	96	
96.		Fault indicated in coax cable.	-	-	Replace coax cable between P4904 and P10704.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
97.	Using Spectrum Analyzer, verify presence of 1200 MHz signal at J10702. Signal level should be 21 dBm (±2 dB) above level recorded in Step 95. Note and record new level. Is level correct?		107	98	
98.	Perform test of 1200 MHz Amplifier Assy. per Section 7. Does Assy. pass test?		100	99	
99.		Fault indicated in 1200 MHz Amplifier Assy.	-	-	Test/Repair or Replace/Calibrate 1200 MHz Amplifier Assembly.
100.	Using Tracking Generator at 1200 MHz, verify cable loss is <1 dB for: J10901 to J10701 and J10902 to J10703. Are both coax cables good?		102	101	
101.		Fault indicated in coax cables.	-	-	Replace coax cable J10901 to J10701 and/or J10902 to J10703.
102.	Measure voltage at FL10701. Is voltage <-6 V?		103	106	
103.	Set GEN/RCVR Switch to "RCVR". Measure voltage at FL10701. Is voltage >+6 V?		104	105	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
104.		Fault indicated in 1200 MHz Filter and Diode Switch Assembly.	-	-	Replace 1200 MHz Filter and Diode Switch Assy.
105.	Measure voltage at J9101, pin L. Is voltage >+6 V?		18	42	
106.	Measure voltage at J9101, pin L. Is voltage <-6 V?		18	42	
107.	Using Spectrum Analyzer, measure signal at P4804. Is 1200 MHz signal within 2 dB of level noted and recorded in Step 97? Note and record new level.		99	98	
108.		Fault indicated in coax cable.	-	-	Replace coax cable between P4804 and J10702.
109.	Using Spectrum Analyzer, measure output of 1st Mixer at J4801. Is level of 125 MHz signal 6 dB (±2 dB) above level noted and recorded in Step 107? Note and record new level.		125	120	
110.	Test 1st Mixer per Section 7. Does 1st Mixer pass test?		112	111	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
111.		Fault indicated in 1st Mixer.			Repair or Replace/Calibrate 1st Mixer.
112.	Set HI LVL/µV X 100/ NORM Switch to HI LVL. Measure voltage at FL4801. Is voltage +11 V (±1.0 V)?		114	113	
113.	Measure voltage at J9101, pin 12. Is voltage +11 V (±1.0 V)?		18	42	
114.	Set HI LVL/µV X 100/ NORM Switch to NORM. Measure voltage at FL4801. Is voltage 0 (±0.1 V)?		116	115	
115.	Measure voltage at J9101, pin 12. Is voltage 0 V (±0.1 V)?		18	42	
116.	Using Tracking Generator, verify following coax cables have insertion losses <2 dB for range listed: Cable — Range P4803/P804 — 1200-2200 MHz P4802/AT10401-J1 — 1-1000 MHz Are coaxes good?		118	117	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
117.		Fault indicated in coax cables.			Repair/Replace faulty coax cable.
118.	Test High Level Amp Assy. per Section 7. Is Assy. good?		120	119	
119.		Fault indicated in High Level Amp Assy.	-	-	Repair or Replace/Calibrate High Level Amp Assy.
120.	Measure voltage at FL6501 and FL6502. Is voltage <100 mV?		121	42	
121.	Set HI LVL/μV X 100/ NORM Switch to HI LVL. Rotate BFO/RF LEVEL Control fully cw. Measure voltage at FL6501 and FL6502. Is voltage +12 V (±1.0 V)?		123	122	
122.	Measure voltage at J9101, pin M. Is voltage +12 V (±1.0 V)?		18	42	
123.	Measure voltage at J10201, pin 11. Is voltage approximately +8 V?		124	18	
124.		Fault indicated in front panel.	-	-	Repair/Replace DS7704 and/or faulty conductor.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
125.	Using Spectrum Analyzer, verify 125 MHz signal at P8403 is within 2 dB of level noted and recorded in Step 109. Note and record new level. Is level correct?		127	126	
126.		Fault indicated in coax cable.			Replace coax cable between P8403 and P4801.
127.	Using Spectrum Analyzer, verify 125 MHz signal at J8402 is 20 dB (±2 dB) below level noted and recorded in Step 125. Is level correct?		129	128	
128.		Fault indicated in coax cable.	-	-	Replace coax cable between P8402 and P7705.
129.	Measure voltage at FL8402. Is voltage +12 V?		46	130	
130.	Measure voltage at J10201, pin 27. Is voltage +11 V (±1 V)?		18	42	
131.	Perform Step 12 of Signal Generator Performance Evaluation. Is display correct?		132	72	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
132.	Perform Step 13 of Signal Generator Performance Evaluation. Is display correct?		133	72	
133.	Perform Step 14 of Signal Generator Performance Evaluation. Is display correct?		134	75	
134.	Perform Step 15 of Signal Generator Performance Evaluation. Is display correct?		135	75	
135.	Perform Step 16 of Signal Generator Performance Evaluation. Is display correct?		136	75	
136.	Perform Step 17 of Signal Generator Performance Evaluation. Is display correct?		137	75	
137.	Perform Step 18 of Signal Generator Performance Evaluation. Is display correct?		138	110	
138.	Perform Step 19 of Signal Generator Performance Evaluation. Is display correct?		139	110	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
139.	Perform Step 20 of Signal Generator Performance Evaluation. Is display correct?		140	110	
140.	Perform Step 21 of Signal Generator Performance Evaluation. Is display correct?		141	110	
141.	Perform Step 22 of Signal Generator Performance Evaluation. Is display correct?		144	142	
142.	Connect Frequency Counter to J9501. Does Freq. Counter display 120 MHz?		143	38	
143.	Using Spectrum Analyzer, check frequency of 1200-2200 MHz Oscillator output. Frequency should be 1200 MHz plus setting of 3 leftmost frequency MHz Thumbwheels. Example: FREQ. MHz Thumbwheels are: 0333333 Frequency should be 120+033=1233 MHz. Is frequency correct?		36	34	

5-4 GENERATE TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
144.	Perform Step 23 of Signal Generator Performance Evaluation. Is display correct?		145	142	
145.	Perform Steps 24-28 of Signal Generator Performance Evaluation. Is display correct?		146	142	
146.	Perform Step 29 of Signal Generator Performance Evaluation. Is display correct?		147	142	
147.	Perform Steps 30-31 of Signal Generator Performance Evaluation. Is display correct?		148	38	
148.	Perform Steps 32-34 of Signal Generator Performance Evaluation. Is display correct?		END	38	

5-5 RECEIVER TROUBLESHOOTING FLOWCHART

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
1.	Perform Steps 1-5 of of Receiver Performance Evaluation (para. 3-3-5). Verify proper indication on DEVIATION/ WATTS Meter. Is reading correct?		2	19	
2.	Perform Steps 6 thru 8 of Receiver Performance Evaluation. Verify proper indication on DEVIATION/ WATTS Meter. Is reading correct?		3	26	
3.	Perform Oscilloscope and Spectrum Analyzer Performance Evaluations. Did both evaluations pass?		4	28	
4.	Perform Receiver Performance Evaluation, Steps 9-11. Verify Spectrum Analyzer display is correct. Is Spectrum Analyzer display correct?		5	34	
5.	Perform Step 12 of Receiver Performance Evaluation. Verify Oscilloscope display is correct. Is display correct?		6	50	
6.	Perform Steps 13-16 of Receiver Performance Evaluation. Verify proper FREQ ERROR Meter display. Is display correct?		7	51	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
7.	Perform Steps 17-25 of Receiver Performance Evaluation. Verify proper FREQ ERROR Meter display. Is FREQ ERROR Meter correct?		8	57	
8.	Perform Steps 26-30 of Receiver Performance Evaluation. Verify proper DEVIATION/WATTS Meter reading. Is reading correct?		9	59	
9.	Perform Step 31 of Receiver Performance Evaluation. Verify proper DEVIATION/WATTS Meter indication. Is indication correct?		10	61	
10.	Perform Steps 32 and 33 of Receiver Performance Evaluation. Verify proper DEVIATION/WATTS Meter indication. Is indication correct?		11	62	
11.	Perform Step 34 of Receiver Performance Evaluation. Verify presence of 1 kHz tone. Is tone audible?		12	63	
12.	Perform Step 35 of Receiver Performance Evaluation. Verify presence of 1 kHz tone. Is tone audible?		13	68	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
13.	Is INPUT LEVEL Lamp illuminated?		14	69	
14.	Perform Step 36 of Receiver Performance Evaluation. Verify receiver is muted and INPUT LEVEL Lamp is not lit. Is receiver muted?		15	71	
15.	Is INPUT LEVEL Lamp <u>not</u> lit?		16	56	
16.	Perform Steps 37-39 of Receiver Performance Evaluation. Verify distortion level is correct. Is distortion correct?		17	73	
17.	Perform Steps 40 and 41 of Receiver Performance Evaluation. Is display correct?		18	75	
18.	End of Receiver Troubleshooting Flowchart.		-	-	
19.	Using Digital Multimeter, measure voltage at FL8401 on Power Termination Assembly. Is voltage +450 mV (±30 mV)?		20	78	Refer to Power Termination Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
20.	Using Digital Multimeter, measure voltage at pin H of J9101 on Regulator/Timer PC Board. Is voltage +450 mV (±30 mV)?		21	79	Refer to Regulator/Timer PC Board in Section 9.
21.	Measure following voltages at J9101 on Regulator/Timer PC Board: Pin # / Voltage / Tol. 14 / -12V / ±0.5V E / +12V / ±0.2V Are voltages correct?		22	80	Refer to Regulator/Timer PC Board in Section 9.
22.	Using Digital Multimeter, measure voltage at pin 35 of J10201 on Mother Board. Is voltage >4.5 V?		23	25	Refer to Mother Board Mechanical Assembly in Section 8.
23.	Measure voltage at pin 8 of J9101 on Regulator/Timer PC Board. Is voltage 180 mV (±20 mV)?		24	81	Refer to Regulator/Timer PC Board in Section 9.
24.	Using Ohmmeter, measure resistance between pin 8 of J9101 on Regulator/Timer PC Board and pin 31 of J10201 on Mother Board. Is resistance <5Ω?		25	79	Refer to Regulator/Timer PC Board in Section 9 and to Mother Board Mechanical Assembly in Section 8.
25.		Fault indicated in Front panel.	-	-	Repair/Replace as necessary.

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
26.	Set DEV/POWER Control to "X1". Using Digital Multimeter, verify voltages on J9101 on Regulator/Timer PC Board are within tolerances listed: Pin # Voltage Tol. 9 1.2V ±1.5V 10 1.2V ±.15V Are voltages correct?		27	81	Refer to Regulator/Timer PC Board in Section 9.
27.	Using Ohmmeter, measure resistances between J9101 on Regulator/Timer PC Board and J10201 on Mother Board as follows: J9101, Pin # J10201, Pin # Res. 9 15 <5Ω 10 17 <5Ω Are resistances correct?		25	79	Refer to Regulator/Timer PC Board in Section 9 and Mother Board Mechanical Assembly in Section 8.
28.	Set RF FREQUENCY MHz Thumbwheels to 1250000. Using Spectrum Analyzer, verify signal at P9804 is approx. 120 MHz, with level of -65 to -70 dBm. Is level correct?		29	34	Refer to Spectrum Analyzer Module #1 Mechanical Assembly in Section 8.

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
29.	Did both Oscilloscope and Spectrum Analyzer functions operate incorrectly during performance evaluation?		30	82	
30.	Test Spectrum Analyzer/Oscilloscope Main PC Board per Section 7. Did test pass?		31	91	
31.	Test Spectrum Analyzer Inverter Board per Section 7. Did test pass?		32	91	
32.	Check SW4701B on Spectrum Analyzer Front Plate for proper operation. Also check all wires associated with SW4701B, J9201, P4301, P4302, J9202, and P4303. Did all above wires and components check out correct?		33	-	Repair/Replace as necessary.
33.		Fault indicated in CRT, V9201.	-	-	Replace CRT, V9201.
34.	Using Spectrum Analyzer, verify level of 1311 MHz signal at J804 on 1200-2200 MHz Oscillator is at +5 dBm (±3 dB). Also verify bandwidth is <100 Hz. Is level correct?		35	92	Refer to 1200-2200 MHz Oscillator Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
35.	Using Spectrum Analyzer, verify 79-80 MHz signal at J4302 is at +5 dBm (±3 dB). Also verify bandwidth is <100 Hz. Is level correct?		36	93	Refer to Spectrum Analyzer/Oscilloscope Main PC Board in Section 9.
36.	Set RF FREQUENCY MHz Thumbwheels to 1250000. Using Frequency Counter, verify frequency of signal at J4302 is 80 MHz (±50 Hz). Is frequency correct?		37	93	Refer to Spectrum Analyzer/Oscilloscope Main PC Board in Section 9.
37.	Using Frequency Counter, verify frequency at J804 on 1200-2200 MHz Oscillator is 1311 MHz (±50 Hz). Is frequency correct?		38	92	Refer to 1200-2200 MHz Mechanical Assy. in Section 8.
38.	Using Spectrum Analyzer, verify amplitude of 125 MHz signal at J1902 on Static Discharge Protect is -61 dBm (±2 dB). Is amplitude correct?		39	94	Refer to Static Discharge Protect Mechanical Assembly in Section 8.
39.	Using Spectrum Analyzer, verify level of 125 MHz signal at J8404 on Power Termination Assembly is -63 dBm (±3 dB). Is level correct?		40	96	Refer to Power Termination Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
40.	Using Spectrum Analyzer, verify 1200.1 MHz signal at J4804 on 1st Mixer is -72 dBm (±3 dB). Is level correct?		41	97	Refer to 1st Mixer Mechanical Assembly in Section 8.
41.	Using Spectrum Analyzer, verify 1200.1 MHz signal at P4904 is -51 dBm (±3 dB). Is level correct?		42	98	Refer to 2nd Mixer Mechanical Assembly in Section 8.
42.	Perform 2nd Mixer Test in Section 7. Did test pass?		43	101	
43.	Using Oscilloscope, verify a negative-going 3 mS pulse occurring every 1.5 Sec, between +6 V and -7 V, at pin H of J4908. Is pulse correct?		44	56	Refer to 2nd Mixer Mechanical Assembly in Section 8.
44.	Using Digital Multimeter, verify following voltages are within tolerances listed: J4908, Pin # / Volt. / Tol. E +11V ±0.5V D -12V ±0.5V Are voltages correct?		45	80	Refer to 2nd Mixer Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
45.	Using Digital Multimeter, verify following voltages are within tolerance listed: J4908, Pin # / Volt. / Tol. B +11V ±0.5V A -4.3V ±0.6V Are voltages correct?		46	81	Refer to 2nd Mixer Mechanical Assembly in Section 8.
46.	Using Digital Multimeter, verify voltage at pin F of J4908 is -12 V (±0.5 V). Is voltage correct?		47	25	Refer to 2nd Mixer Mechanical Assembly in Section 8.
47.	Test 2nd Mixer per Section 7. Did test pass?		48	101	
48.	Set BFO/OFF Switch to "BFO". Using Spectrum Analyzer, verify 120 MHz signal at J9503 on 120 MHz Generator is -15 dBm (±7 dB). Is level correct?		49	102	Refer to 120 MHz Generator Mechanical Assembly in Section 8.
49.		Fault indicated in Variable Attenuator.	-	-	Replace Variable Attenuator.
50.	Using Digital Multimeter, verify voltage at pin F of J4908 is +12 V (±1.5 V). Is voltage correct?		47	25	Refer to 2nd Mixer Mechanical Assembly in Section 8.

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
51.	Using Frequency Counter, verify frequency at J804 is 1311 MHz. Is frequency correct?		52	92	Refer to 1200-2200 MHz Oscillator Mechanical Assembly in Section 8.
52.	Set RF FREQUENCY MHz Thumbwheels to 1250000. Using Frequency Counter, verify frequency at J4302 is 80.0 MHz (±50 Hz). Is frequency correct?		53	93	Refer to Spectrum Analyzer/Oscilloscope Main PC Board in Section 9.
53.	Using Oscilloscope, and holding down AUTO ZERO/OFF/BATT Switch for 60 seconds, verify level of 250 kHz signal at pin 1 of P3101 is approx. 8 Vp-p. Is level correct?		54	105	Refer to 250 kHz IF/MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
54.	Using Digital Multimeter, verify voltages as follows: P3101, Pin # / Volt. / Tol. 2 / -12V / 0.5V 15 / +11V / 0.5V Are voltages correct?		55	80	Refer to 250 kHz IF/MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
55.	Test 2nd Mixer per Section 7. Did test pass?		56	101	
56.		Fault indicated in 250 kHz IF/MON/AUDIO PC Board.	-	-	Test/Replace or Repair/Calibrate.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
57.	Remove 250 kHz IF/ MON/AUDIO PC Board from FM/AM-1100S/A. Using Ohmmeter, Front Panel Schem., and Mother Bd. Schem., verify operation of FREQ ERROR Control and associated wiring. Is operation and continuity correct?		58	25 or 79	
58.	Using Ohmmeter, verify resistance across terminals of FREQ ERROR Meter is 260Ω. Is resistance correct?		56	107	
59.	Remove Meter Limiter PC Board from back of DEVIATION/WATTS Meter. Count wire which was connected to E1 to + terminal of Meter. Connect wire which was connected to E2 to - terminal of Meter. Is meter reading correct?		60	61	Refer to Front Panel Mechanical Assembly in Section 8.
60.		Fault indicated in Meter Limiter PC Bd.	-	-	Repair/Replace Meter Limiter PC Bd.
61.	Remove 250 kHz IF/ MON/AUDIO PC Board. Using Ohmmeter, Front Panel Schem., and Mother Bd. Schem. verify proper operation of DEV/POWER Control and associated wiring. Is operation and continuity correct?		58	25 or 79	

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
62.	Connect Modulation Meter to J5702 on 120 MHz Receiver. Does Modulation Meter indicate 15 kHz (±1 kHz)?		61	108	Refer to 120 MHz Receiver Mechanical Assembly in Section 8.
63.	Using Oscilloscope, verify presence of 1 kHz audio at pin 3 of P3101 on 250 kHz IF/MON/AUDIO PC Bd. Is audio present?		64	56	Refer to 250 kHz IF/ MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
64.	Using Oscilloscope, verify presence of audio at pin 12 of P3101. Is audio present?		65	109	Refer to 250 kHz IF/ MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
65.	Using Oscilloscope, verify presence of audio at pin 13 of P3101. Is audio present?		66	56	Refer to 250 kHz IF/ MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
66.	Using Oscilloscope, verify presence of audio at Speaker terminals. Is audio present?		67	110	
67.		Fault indicated in Speaker (SP10401).	-	-	Replace Speaker.
68.	Using Oscilloscope, verify presence of 1 kHz audio at pin F of P3101 on 250 kHz IF/MON/AUDIO PC Bd. Is audio present?		64	56	Refer to 250 kHz IF/ MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
69.	Using Digital Multimeter, verify voltage at pin 10 of J3101 is <0.3 V. Is voltage correct?		70	56	Refer to 250 kHz IF/MON/AUDIO PC Board in Section 9 and Mother Board Mechanical Assy. in Section 8.
70.	Using Ohmmeter, verify continuity between pin 10 of P3101 and pin 26 of J10701 on 1200 MHz Filter and Diode Switch. Is continuity correct?		25	79	Refer to Mother Bd. Mechanical Assembly in Section 8.
71.	Using Digital Multimeter, verify voltage at pin 23 of J10201 changes smoothly from 0 to -1.5 VDC as the SQUELCH Control is rotated from just out of detent to fully cw. Does voltage change smoothly?		72	25	Refer to Mother Bd. Mechanical Assembly in Section 8.
72.	Using Ohmmeter, verify continuity of conductor from pin 23 of J10201 to pin 9 of J3101. Is continuity correct?		56	79	Refer to Mother Bd. Mechanical Assembly in Section 8.
73.	Perform test of 120 MHz Receiver per Section 7. Did test pass?		74	106	
74.	Verify FM/AM-1100S Spectrum Analyzer displays a level of -98 dBm (±3 dB). Is level correct?		56	34	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
75.	Using Spectrum Analyzer, verify signal level at AT10402-J2 is -50 dBm (±4 dB). Is level correct?		76	111	Refer to Interconnect Diagram in Section 10.
76.	Measure voltage at FL4801 on 1st Mixer. Is voltage >+10.5 V?		77	81	Refer to 1st Mixer Assembly in Section 8.
77.		Fault indicated in 1st Mixer Assembly.	-	-	Test/Repair or Replace/Calibrate.
78.		Fault indicated in Power Termination Assembly.	-	-	Test/Repair or Replace/Calibrate.
79.		Fault indicated in Mother Board Assy.	-	-	Test/Repair or Replace/Calibrate.
80.	Go to Power Supply Troubleshooting (para. 5-6).	Fault indicated in Power Supply.	-	-	Test/Repair or Replace/Calibrate.
81.		Fault indicated in Regulator/Timer PC Board.	-	-	Test/Repair or Replace/Calibrate.
82.	Did Spectrum Analyzer function <u>only</u> operate incorrectly during performance evaluation?		83	86	
83.	Test Spectrum Analyzer Module #1 per Section 7. Did test pass?		84	114	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
84.	Test Spectrum Analyzer Module #2 per Section 7. Did test pass?		85	115	
85.	Check the following for proper operation: 1) Coax between J9802 and J9902. 2) Coax between J9803 and J9903. 3) R4405 4) SW4402 5) Check all wires assocated with P9901 and P9801 for continuity and shorts.	Fault indicated in Spectrum Analyzer wiring harness or Front Panel controls.	-	-	Repair/Replace as necessary.
86.	Did Oscilloscope function only operate incorrectly during performance evaluation?		87	82	
87.	Using Ohmmeter and Spectrum Analyzer Front Panel Schem., check SW4601 and associated components for proper operation and continuity. Is operation correct?		88	116	
88.	Using Ohmmeter and Spectrum Analyzer Front Panel Schem., check SW4501 and associated components for proper operation and continuity. Is operation correct?		89	117	

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
89.	Test Spectrum Analyzer/Oscilloscope Main PC Board per Section 7. Did test pass?		90	91	
90.	Check the following for proper operation: C4701 R4701 C4702 R4702 C4703 R4703 C4704 R4704 C4705 R4401 C4706 R4402 L4701 R4403 R4404 Also check all wires associated with above components and with J9201, P7701, P9801, and P9901.	Fault indicated in Spectrum Analyzer Front Plate Controls or Wiring Harness.	-	-	Repair/Replace as necessary.
91.		Fault indicated in Spectrum Analyzer/Oscilloscope Main PC Board.	-	-	Test/Repair or Replace/Calibrate.
92.	Go to 1st Local Oscillator Troubleshooting Flowchart (5-2).	Fault indicated in 1st Local Oscillator System.	-	-	
93.	Go to 2nd Local Oscillator Troubleshooting Flowchart (5-3).	Fault indicated in 2nd Local Oscillator System.	-	-	
94.	Using Digital Multimeter, measure voltage at FL1901 on Static Discharge Protect. Is voltage +11.0 V (±0.5 V)?		95	80	Refer to Static Discharge Protect Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
95.		Fault indicated in Static Discharge Protect Assembly.	-	-	Test/Repair or Replace/Calibrate.
96.	Unsolder wire from FL8404. Using Digital Multimeter, verify voltage at FL8404 is <1 V. Is voltage <1 V?		78	118	Refer to Power Termination Mechanical Assembly in Section 8.
97.	Using Digital Multimeter, verify voltage at FL4801 is <1 V. Is voltage <1 V?		77	81	Refer to 1st Mixer Mechanical Assembly in Section 8.
98.	Test 1200 MHz Amplifier per Section 7. Did test pass?		99	119	
99.	Test 1200 MHz Filter and Diode Switch per Section 7. Did test pass?		100	120	
100.	Using Digital Multimeter, verify voltage at FL10901 is +11 V ±0.5 V. Is voltage correct?		81	80	Refer to 1200 MHz Amplifier Mechanical Assembly in Section 8.
101.		Fault indicated in 2nd Mixer.	-	-	Test/Repair or Replace/Calibrate.
102.	Using Digital Multimeter, verify voltage at pin B of P9504 is +11 V (±0.5 V). Is voltage correct?		103	25	Refer to 120 MHz Generator Mechanical Assembly in Section 8.

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
103.	Using Digital Multimeter, verify voltage at pin H of P9504 is +5.75 V (±0.2 V). Is voltage correct?		104	80	Refer to 120 MHz Generator Mechanical Assembly in Section 8.
104.		Fault indicated in 120 MHz Generator Assembly.	-	-	Test/Repair or Replace/Calibrate.
105.	Using Digital Multimeter, verify voltage at pin D of J5703 is +11 V (±0.5 V). Is voltage correct?		106	80	Refer to 120 MHz Receiver Mechanical Assembly in Section 8.
106.		Fault indicated in 120 MHz Receiver Assembly.	-	-	Test/Repair or Replace/Calibrate.
107.		Fault indicated in FREQ ERROR Meter.	-	-	Repair or Replace.
108.	Using Digital Multimeter, verify voltage on pin E of J5703 is -12 V (±0.5 V). Is voltage correct?		106	25	Refer to 120 MHz Receiver Mechanical Assembly in Section 8.
109.	Using Ohmmeter, verify continuity from pin 12 of P3101 to pin 7 of J10701. Is continuity good?		25	79	Refer to Mother Board Mechanical Assembly in Section 8.
110.	Using Ohmmeter, verify continuity between pin 13 of P3101 and pin 24 of J10701. Is continuity good?		25	79	Refer to Mother Board Mechanical Assembly in Section 8.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
111.	Using a Tracking Generator, test both 30 dB Attenuators. Verify insertion loss is 30 dB (±2 dB) for each Attenuator. Did both Attenuators test good?		112	121	
112.	Using Digital Multimeter, verify voltage at FL8402 is +80 mV (±20 mV). Is voltage correct?		113	78	Refer to Power Termination Mechanical Assembly in Section 8.
113.	Measure voltage at FL8404. Is voltage >+10.5 V?		78	81	Refer to Power Termination Mechanical Assembly in Section 8.
114.		Fault indicated in Spectrum Analyzer Module #1.	-	-	Test/Repair or Replace/Calibrate.
115.		Fault indicated in Spectrum Analyzer Module #2.	-	-	Test/Repair or Replace/Calibrate.
116.		Fault indicated in SW4601 or associated components on Spectrum Analyzer Front Panel.	-	-	Repair or Replace as necessary.
117.		Fault indicated in SW4501 or associated components on Spectrum Analyzer Front Panel.	-	-	Repair or Replace as necessary.

5-5 RECEIVER TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
118.	Using Digital Multimeter, verify voltage at pin N of J9101 is +5 V (±0.3 V). Is voltage correct?		81	25	Refer to Mother Board Mechanical Assembly in Section 8.
119.		Fault indicated in 1200 MHz Amplifier Assembly.	-	-	Test/Repair or Replace/Calibrate.
120.		Fault indicated in 1200 MHz Filter and Diode Switch Assy.	-	-	Test/Repair or Replace/Calibrate.
121.		Fault indicated in one or both 30 dB Attenuators.	-	-	Replace faulty Attenuator.

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
1.	Perform Power Supply Test per Section 7. Does Power Supply Test pass?		3	2	
2.		Power Supply Assembly is faulty.	-	-	Test/Repair or Replace/Calibrate Power Supply Assembly.
3.	Disconnect AC power cord and variable DC power supply. Reconnect P8104 to J8104 and P8103 to J8103. Install batteries. Connect AC power cord to 115 VAC 50-440 Hz source. Using Digital Multimeter, measure test points below: TEST POINT — VOLTAGE J10202, Pin 3 — +12.05 (±0.1) J10202, Pin 20 — -12 (±0.5) J10202, Pin 8 — +5.075 (±0.225) Are voltages correct?		14	4	
4.	Set PWR/OFF/BATT Switch to "OFF". Disconnect AC line cord. Disconnect P8104 from J8104 and P8103 from J8103. Set PWR/OFF/BATT Switch to "PWR".		8	5	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
4.	(Continued) Verify resistance as listed below: FROM P8103 / TO P8103 / OHMS Pin 5 / Pin 7 / 0-5 FROM P8103 / TO J10202 / OHMS Pin 3 / Pin 8 / 0-2 Pin 4 / Pin 8 / 0-2 Pin 1 / Pin 3 / 0-2 Pin 2 / Pin 3 / 0-2 Pin 6 / Pin 20 / 0-2 Are resistances correct?		8	5	
5.	Using ohmmeter, verify PWR/OFF/BATT Switch operates properly. Does switch operate properly?		6	7	
6.		Fault indicated in wiring and/or connector.	-	-	Reference Mother Board and Front Panel Circuit Schematics.
7.		PWR/OFF/BATT Switch is faulty.	-	-	Replace PWR/OFF/BATT Switch.
8.	Set PWR/OFF/BATT Switch to "OFF". Disconnect P10202 from J10202. Set PWR/OFF/BATT Switch to "PWR".		9	12	

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
8.	(Continued) Measure voltages as listed below: TEST POINT — VOLTAGE J10202, Pin 3 — +12.05 (±0.1) J10202, Pin 20 — -12 J10202, Pin 8 — +5.075 (±0.225) Are all voltages correct?				
9.	Set PWR/OFF/BATT Switch to "OFF". Connect J10202 to P10202. Measure current drawn by the +12 V, -12 V, and +5 V lines of following modules: **CAUTION** REMOVE POWER FROM FM/AM-1100S/A BEFORE CONNECTING OR DISCONNECTING AMMETER. Module — Current (mA): +12V / -12V / +5V Spec. Analy. — <1200 / <5 / — Dual Tone Gen. — — / <50 / <70 120 MHz Gen. — — / — / <50 2nd Mixer — — / <1.2 / — Are all currents correct?		10	11	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
10.		Short indicated in Front Panel.	-	-	Repair/Replace faulty conductor.
11.		Fault indicated in module with faulty current measurement.	-	-	Test faulty module per Section 7.
12.	Set PWR/OFF/BATT Switch to "OFF". Connect J10202 to P10202. Measure current drawn by the +12 V, -12 V, and +5 V lines of following modules: **CAUTION** REMOVE POWER FROM FM/AM-1100S/A BEFORE CONNECTING OR DISCONNECTING AMMETER. Module — Current (mA): +12V / -12V / +5V Rec/Timer PC Bd. — <1000 / <125 / — 250 kHz IF/MON/AUDIO — <10 / <50 / — VCO Tuner — — / — / <10 High Freq. Phase-Lock — — / — / <250 79-80 MHz PC Bd — — / — / <400 Clock Div. — — / — / <50 Het Amp/÷2 — — / — / <40 TCXO Output Amp — — / — / <45 Are all currents correct?		1	11	

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
13.		Short indicated in Mother Board.	-	-	Repair/Replace faulty connector.
14.	Using Digital Multimeter, test voltages below: TEST POINT / VOLTAGE J10202, Pin 26 — +11 (±0.05) J9101, Pin R — -35 (±0.8) J9101, Pin 15 — -40.5 (±3.5) Are voltages correct?		34	15	
15.	Using Digital Multimeter, test voltages below: TEST POINT / VOLTAGE J9101, Pin E — +12 (±0.1) J9101, Pin 14 — -12 (±0.5) Are all voltages correct?		17	16	
16.		Fault indicated in Mother Board.	-	-	Repair/Replace faulty connector. Refer to Mother Board Circuit Schematic.

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
17.	Using Digital Multimeter, verify voltage at J9101, Pin R is -35 V (±0.5). Is voltage correct?		18	29	
18.	Set PWR/OFF/BATT Switch "OFF". Disconnect P10203 from Q10201. Set PWR/OFF/BATT Switch to "PWR". Measure voltage on P10203, pin 3. Is voltage less than +7 V?		20	19	
19.		Regulator/Timer PC Board is faulty.	-	-	Test/Repair or Replace/Calibrate Regulator/Timer PC Board per Section 7.
20.	Set PWR/OFF/BATT Switch to "OFF". Connect P10203 to Q10201. Set PWR/OFF/BATT Switch to "PWR". Measure voltage at P10203, pin 1.		21	19	
21.	Measure base-emitter drop on Q10201. Is voltage drop 0.6 - 0.8 V?		23	22	
22.		Q10201 is faulty.	-	-	Replace Q10201.
23.	Set PWR/OFF/BATT Switch to "OFF". Disconnect P7702 from J7702. Set PWR/OFF/BATT Switch to "PWR". Measure		24	27	

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
23.	(Continued) voltage at J9101, pin 6. Is voltage +11 V (±0.5)?				
24.	Set PWR/OFF/BATT Switch to "OFF". Connect J7702 to P7702. Measure current drawn by the +11 V input of modules below: **CAUTION** REMOVE POWER FROM FM/AM-1100S/A BEFORE CONNECTOR OR DIS-CONNECTING AMMETER. <u>Module</u> <u>Current</u>(mA) Dual Tone Gen. <80 120 MHz Rcvr. <40 2nd Mixer <1.2 Are all currents correct?		25	26	
25.		Fault indicated in Front Panel.	-	-	Repair/Replace faulty connector.
26.		Fault indicated in module(s) with incorrect current reading.	-	-	Test faulty module(s) per Section 7.
27.	Set PWR/OFF/BATT Switch to "OFF". Connect J7702 to P7702. Measure current drawn by		28	26	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
27.	(Continued) the +11 V input of modules below: **CAUTION** REMOVE POWER FROM FM/AM-1100S/A BEFORE CONNECTING OR DIS-CONNECTING AMMETER. Module Current(mA) High Freq. Multi/Mxr <90 1080 MHz Multi Amp <100 Het Amp/÷2 <75 TCXO <20 100 MHz Filter <12 AGC PC Bd <65 Static Discharge Protect <50 1200-2200 MHz Osc. <150 VCO Tuner <50 High Freq. Phase Lock <75 250 kHz IF/MON/ AUDIO <65 79-80 MHz PC Bd <50 Are all currents correct?				
28.		Fault indicated in Mother Board.	-	-	Repair/Replace faulty conductor.
29.	Set PWR/OFF/BATT Switch to "OFF". Remove Regulator/ Timer PC Board.		19	30	

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
29.	(Continued) Using Ohmmeter, measure resistance between J1001, pin R and ground. **NOTE** Connect negative lead of Ohmmeter to ground. Is resistance 3 KΩ (±500Ω)?				
30.	Install Regulator/ Timer PC Board. Remove VCO Tuner PC Board. Set PWR/OFF/ BATT Switch to "PWR". Measure voltage at J9101, pin R. Is voltage approximately -35 V?		31	32	
31.		Fault indicated in VCO Tuner PC Board.	-	-	Test/Repair or Replace/Calibrate VCO Tuner PC Board per Section 7.
32.	Install VCO Tuner PC Board. Set PWR/OFF/ BATT Switch to "OFF". Remove Regulator/ Timer PC Board. Using Ohmmeter, measure resistance from J9101, pin R to ground. Is resistance >1.0 MΩ?		19	33	
33.		Fault indicated between J9101, pin R and J2601, pin 15.	-	-	Repair/Replace shorted conductor.

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
34.	Is POWER ON Lamp illuminated?		38	35	
35.	Measure voltage on anode of DS7705 (POWER ON LED). Is voltage +5 V (±0.25 V)?		36	37	
36.		DS7705 is faulty.	-	-	Replace DS7705.
37.		Fault indicated between P10202 and DS7705.	-	-	Repair/Replace faulty conductor or connector.
38.	Set PWR/OFF/BATT Switch to "BATT". POWER ON Lamp illuminated?		48	39	
39.	Measure voltage at J9101, pin C. Is voltage >1.5 V?		40	41	
40.		Fault indicated between J9101, pin C and P8103, pin 9.	-	-	Repair/Replace faulty conductor or connector.
41.	Connect Digital Multimeter between J9101, pin 2 and ground. Using 22 gauge wire, momentarily ground J9101, pin C while monitoring Digital Multimeter. Is voltage <+11.2 V while pin C is grounded?		42	45	

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
42.	Set PWR/OFF/BATT Switch "OFF". Using Ohmmeter, verify SW7705 (PWR/OFF/BATT Switch) operates properly. Does switch operate properly?		44	43	
43.		SW7705 (PWR/OFF/BATT Switch) is faulty.	-	-	Replace SW7705.
44.	Using Ohmmeter, test resistance from J9101, pin B to SW7705, pin 6 and then from SW7705, pin 5 to ground. Is resistance in both cases <10Ω?		19	6	
45.	Set PWR/OFF/BATT Switch to "OFF". Disconnect P8103 from J8103. Test resistance from P8103, pin 9 to J9101, pin c. Is resistance <10Ω?		46	47	
46.		Batteries are bad or under-charged.	-	-	Replace/Recharge batteries. .
47.		Fault indicated between P8103, pin 9 and J9101, pin C.	-	-	Repair/Replace faulty conductor or connector.
48.	Set PWR/OFF/BATT Switch to "BATT". Does POWER ON Lamp extinguish?		51	49	

5-6 POWER SUPPLY TROUBLESHOOTING FLOWCHART - CONTINUED

STEP	INSTRUCTION	INDICATION	YES	NO	REMARKS
49.	Set PWR/OFF/BATT Switch to "OFF". Disconnect P8103 from J8103. Remove Regulator/Timer PC Bd. Test resistance between P8103, pin 9 and ground. Is resistance >10 MΩ?		19	50	
50.		Fault indicated between P8103, pin 9 and ground.	-	-	Repair/Replace faulty connector or conductor.
51.	Set PWR/OFF/BATT Switch to "BATT" while simultaneously starting stopwatch. Does POWER ON Lamp extinguish after approximately 10 minutes?		52	19	
52.	Go to Receiver Troubleshooting Flowchart (paragraph 5-5).				

SECTION 6-DISASSEMBLY/REASSEMBLY PROCEDURES

6-1 DISASSEMBLY PROCEDURES

6-1-1 GENERAL

To remove any one module, refer to paragraph 6-1-3, "Removal Index and Disassembly Sequence". Case Removal (para. 6-1-4) is a prerequisite for all module removals except the battery and is thus not reflected in 6-1-3 Index.

6-1-2 PRELIMINARY CONSIDERATIONS

Tools Required for Disassembly:

1. Wrenches:
   Allen Hex-head: .050" & 3/32"
   Open End: 5/16" & 1/2"
   Nut-Drivers, Set
2. Screwdrivers:
   Phillips & Spade (slotted)
3. Soldering Iron

WARNING

DISCONNECT POWER CABLES AND FUSES FROM REAR OF FM/AM-1100S/A BEFORE ATTEMPTING ANY DISASSEMBLY OR REASSEMBLY PROCEDURES.

CAUTION

TAG EACH WIRE AND CABLE PRIOR TO REMOVAL.

DO NOT BEND NOR TWIST SEMI-RIGID COAX CABLES.

DO NOT PLACE UNDUE STRAIN ON ANY WIRE OR CABLE.

DO NOT DISCARD LOOSE ITEMS (NUTS, SCREWS, WASHERS, ETC).

USE EXTREME CARE WHEN UNSOLDERING WIRES FROM FEED-THRU. CAREFULLY LIFT WIRES STRAIGHT OUT RATHER THAN PULLING THEM TO SIDE.

NOTE

To replace a module, refer to the Illustrated Parts Catalog. The "I.P.C." will help to determine which items are furnished with a module and which items are attaching parts.

6-1-3 REMOVAL INDEX AND DISASSEMBLY SEQUENCE

MODULE TO BE REMOVED	MODULE REMOVAL STEPS	PREREQUISITES MODULES TO BE REMOVED FIRST	REMOVAL STEPS
UPPER FLOOR		Raise UPPER FLOOR	6-1-5,A
HET AMP ÷2 PRESCALER	6-1-5,B	N/A	
AGC CIRCUIT BOARD	C	N/A	
1200-2200 MHz OSC.	D	AGC CIRCUIT BOARD	6-1-5,C
TCXO MASTER OSC.	E	N/A	
TCXO DIST AMPLIFIER	F	N/A	
CLOCK DIVIDER	G	N/A	
REAR PANEL			
BATTERY	6-1-6,A	N/A	
POWER SUPPLY ASSY	B	N/A	
REAR PANEL	C	N/A	
POWER TERMINATION ASSY	D	REAR PANEL	6-1-6,C
30 dB PADS	E	REAR PANEL	6-1-6,C
RIGHT-HAND SIDE		Raise UPPER FLOOR	6-1-5,A
SPEAKER	6-1-7,A	N/A	
2nd MIXER	B	N/A	
1st MIXER	C	N/A	
100 MHz FILTER	D	N/A	
108 MHz B.P. FILTER	E	N/A	
1200 MHz DIODE SWITCH	F	250 kHz IF MON AUDIO BD	6-1-8,E
		100 MHz FILTER	6-1-7,D
HI-FREQ. MULTI-MIXER	G	N/A	
1200 MHz AMPLIFIER	H	N/A	
MOTHER BOARD		Raise UPPER FLOOR	6-1-5,A
REG/TIMER BOARD	6-1-8,A	N/A	
VCO TUNER BOARD	B	N/A	
HI-FREQ. PHASE LOCK	C	N/A	
79-80 MHz LOOP	D	N/A	
250 kHz IF MON AUDIO BD	E	N/A	
1080 MHz MULTI-AMP	F	SPEAKER	6-1-7,A
		250 kHz IF MON AUDIO BD	6-1-8,E
HI-LEVEL AMPLIFIER	G	SPEAKER	6-1-7,A
		250 kHz IF MON AUDIO BD	6-1-8,E
		2 semi-rigid coax's from 1200 MHz AMP	6-1-7,H
		1st MIXER	6-1-7,G
STATIC DISCHARGE PROTECT	H	N/A	
MOTHER BOARD CONNECTORS		All items in para. 6-1-8	6-1-8,A-H
MOTHER BOARD CONNECTORS	6-1-9,A B-J	May be removed in any sequence.	

6-1-3 REMOVAL INDEX AND DISASSEMBLY SEQUENCE (Cont'd)

MODULE TO BE REMOVED	MODULE REMOVAL STEPS	PREREQUISITES MODULES TO BE REMOVED FIRST	REMOVAL STEPS
LOWER FLOOR	6-1-10,A	Open LOWER FLOOR	
120 MHz GENERATOR	B	N/A	
100 MHz AMP/108 MHz MIXER	C	N/A	
120 MHz RECEIVER	D	N/A	
SPECTRUM ANALYZER			
INTENSITY CONTROL KNOB	6-1-11,A	N/A	
FOCUS CONTROL KNOB	B	N/A	
DEV-VERT KNOB	C	N/A	
VERT/ANALY DISP KNOB	D	N/A	
AC/OFF/DC SWITCH	E	N/A	
HORIZ. CONTROL KNOB	F	N/A	
SWEEP CONTROL KNOB	G	N/A	
FINAL REMOVAL	H	All of above steps.	6-1-11,A-G
INVERTER PC BOARD	I		6-1-11,A-H
MAIN PC BOARD	J	N/A	
MODULE #1	K		6-1-11,A-H
MODULE #2	L		6-1-11,A-H
HORIZ. SWEEP SWITCH	M		6-1-11,A-H
VERT. GAIN SWITCH	N		6-1-11,A-H
AC/OFF/DC SWITCH	O		6-1-11,A-H
VERT/ANALY DISP CONTROL	P		6-1-11,A-H
HORIZONTAL CONTROL	Q		6-1-11,A-H
CRT	R	INVERTER PC BOARD	6-1-11,A-I
FRONT PANEL MODULES		Control Knobs from SPECTRUM ANALYZER	6-1-11,A-G
DUAL TONE GENERATOR	6-1-12,A	N/A	
FREQ. SELECT SWITCH	B	N/A	
FREQ. ERROR METER	C	N/A	
DEV/WATTS METER	D	N/A	
BFO-RF LEVEL CONTROL	E	N/A	
FRONT PANEL SWITCHES AND CONNECTORS	6-1-13, A thru Z	May be removed in any sequence.	

6-1-4 <u>CASE REMOVAL (Fig. 6-2).</u> Remove:

A. Top lid (22) by unlocking latches between lid and case. Raise top lid and slide off hinge pins.

B. Case by removing twelve screws (20 and 21) and ten lock washers (19). Slide case forward and off FM/AM-1100S/A.

6-1-5 <u>UPPER FLOOR MODULE REMOVALS (Fig's 6-1 and 6-3)</u>

NOTE

Sequence of items B through G may be accomplished in any order, but item C is a prerequisite to the removal of item D.

A. <u>RAISE UPPER FLOOR ASSEMBLY (148)</u> after removing two Phillips screws (149) and lock washers (150) which secure floor to two frame support members (138) and (147) (Fig. 6-3).

B. Remove <u>HETERODYNE AMPLIFIER/÷2 PRESCALER (24) (Fig. 6-1)</u> by removing:

1. Two coax cables and wires (unsolder at each feed-thru).

2. Two Phillips screws (19), lock washers (18) and spacers (20).

C. Remove <u>AGC CIRCUIT BOARD (10) (Fig. 6-1)</u> by removing:

1. Wire (unsolder) from feed-thru on 1200-2200 MHz Oscillator (28) which goes to AGC Circuit Board (10).

2. Two coax cables from AGC Circuit Board (10).

3. Two Phillips screws (7) and lock washers (8) which hold AGC circuit board's mounting bracket (9) to 1200-2200 MHz Oscillator (28).

4. Two hex nuts (12) (just loosen) on AGC Board's coax connectors. Slide circuit board (10) free of bracket (9).

D. Remove <u>1200-2200 MHz OSCILLATOR (28) (Fig. 6-1)</u> by removing:

1. Four coax cables and wires from feed-thru.

2. Four Phillips screws (21) and lock washers (22) which hold Oscillator (28) to Upper Floor (23).

E. Remove <u>TCXO MASTER OSCILLATOR (1) (Fig. 6-1)</u> by removing:

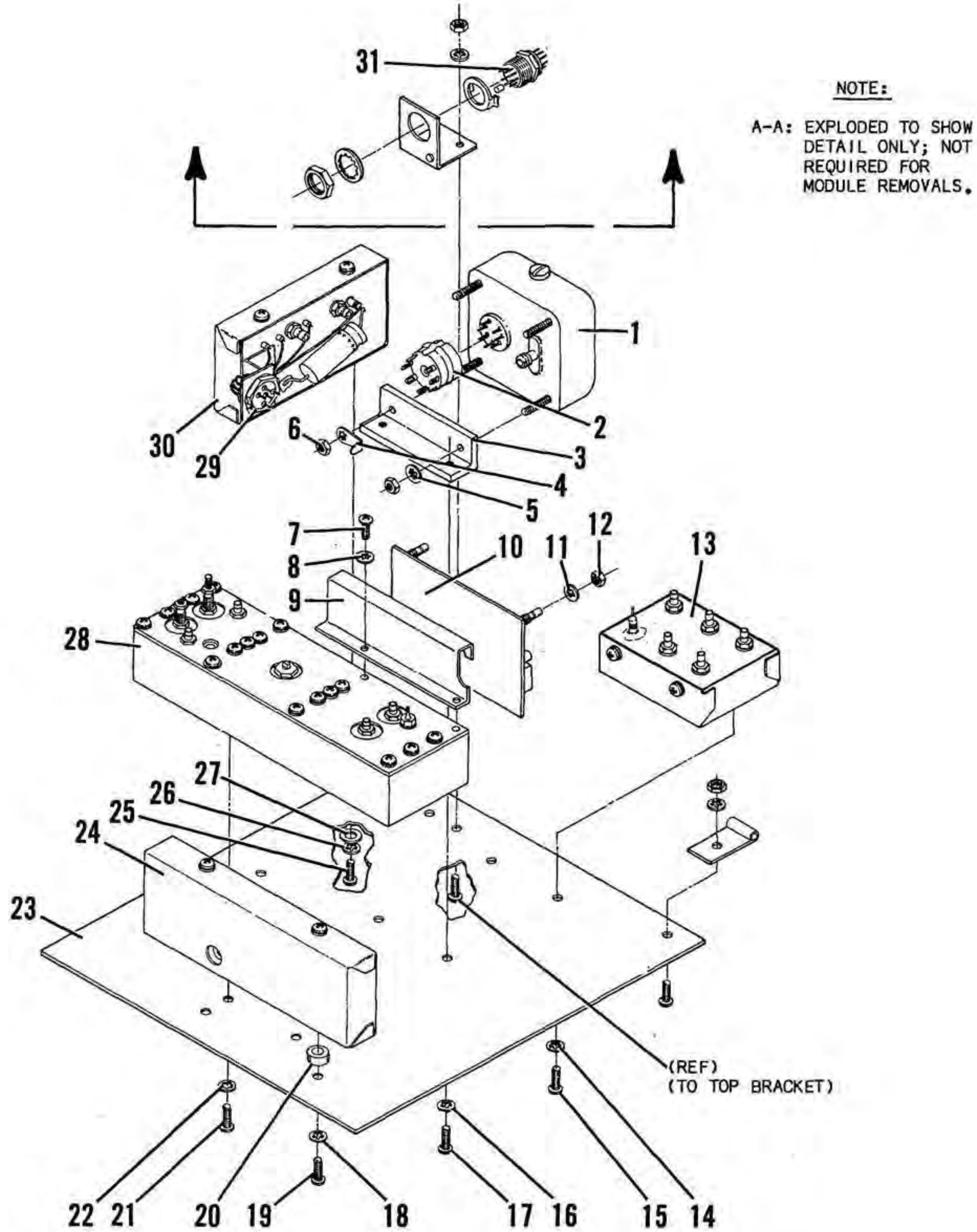


Figure 6-1 Upper Floor Disassembly and Reassembly

1. Two Phillips screws (17) and two lock washers (16) securing mounting bracket (3) to Upper Floor.

2. Coax cable.

3. Tube socket (2) from mating connector.

4. Two hex nuts (6), one lock washer (5) and one terminal lug (4) which secure TCXO Master Oscillator (1) to mounting bracket (3).

F. Remove TCXO DISTRIBUTION AMPLIFIER (13) (Fig. 6-1) by removing:

1. Five coax cables and wire (unsolder from feed-thru).

2. Two Phillips screws (15) and lock washers (14) which secure Amplifier (13) to upper floor (23).

G. Remove CLOCK DIVIDER (30) (Fig. 6-1) by removing:

1. Two coax cables.

2. Circular connector from mating connector (29).

3. Two each Phillips screws (25), lock washers (26) and flat washers (27) which secure Clock Divider (30) to Upper Floor (23).

6-1-6 REAR PANEL MODULE REMOVALS (Fig's. 6-2 & 6-3)

NOTE

Items A, B and C may be removed in any order, but item C is a pre-requisite for items D and E.

A. Remove BATTERY (43) (Fig. 6-2) by:

1. Removing two Phillips screws (46) and two washers (47), and battery cover (45) (Fig. 6-2).

2. Disconnecting Molex connector (5) (Fig. 6-3).

3. Pulling on loop end of removal strap (44) to pull battery (43) out of battery holder (Fig. 6-2).

B. Remove POWER SUPPLY ASSEMBLY (19) (Fig. 6-3) from Rear Panel by removing:

1. Two Molex connectors (5) and (6).

2. Three Phillips screws (17).

Roger
PH # 316-522-4981
Acct# 50950
Antenna P.N. 1201-7616-500

1414-2342-000 This is wrong P.N. this is full size lid
1414-2379-000 Correct #
Hardware 2550-0000-063 064
Lid

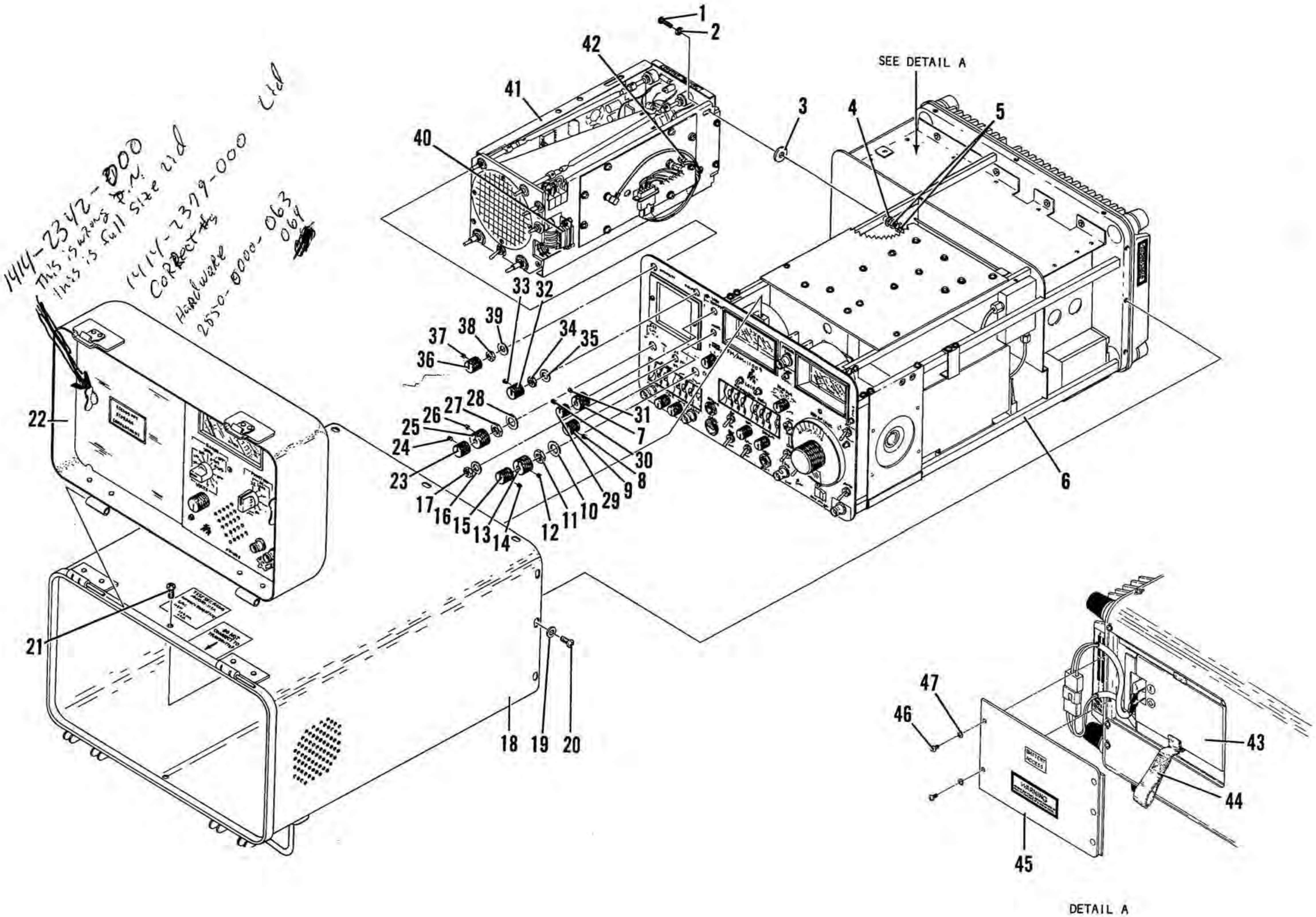


Figure 6-2 FM/AM-1100S/A Disassembly and Reassembly

C. Remove REAR PANEL (7) (Fig. 6-3) by removing:

1. Twelve Phillips screws (8, 9, 16, and 18) securing Rear Panel to frame.

2. Remove three socket head screws (13) securing Power Termination Assembly (12) to Rear Panel.

3. Carefully separate Rear Panel from Power Termination Assembly. (Thermal compound is applied between Rear panel and Power Termination Assembly.)

D. Remove POWER TERMINATION ASSEMBLY (12) (Fig. 6-3) by removing:

1. Three semi-rigid coax cables.

2. One flexible coax cable and four wires (unsolder at each feed-thru and tag).

E. Remove two 30 dB Pads (10) and (11) (Fig. 6-3) by disconnecting rigid coax at both ends of 30 dB pads.

6-1-7 REMOVAL OF MODULES FROM RIGHT-HAND SIDE (Fig. 6-3 & 6-4)

NOTE

Sequence of removing items B through H may be accomplished in any order, after item A is performed, except item D must be removed before item F.

A. Remove SPEAKER ASSEMBLY (59) by removing:

1. 1/4" Phillips screw (57), 1/2" Phillips screw (61), and two lock washers (58 and 62) which secure speaker plate (59) to frame support member (47).

NOTE

Perform Step 2 only if speaker is to be repaired or replaced.

2. Two wires (unsolder) from rear of speaker.

B. Remove SECOND MIXER ASSEMBLY (73) by removing:

1. Seven coax cables from assembly (73).

2. Two Phillips screws (63) from frame support member (47).

3. Circular connector from mating connector (bracket mounted).

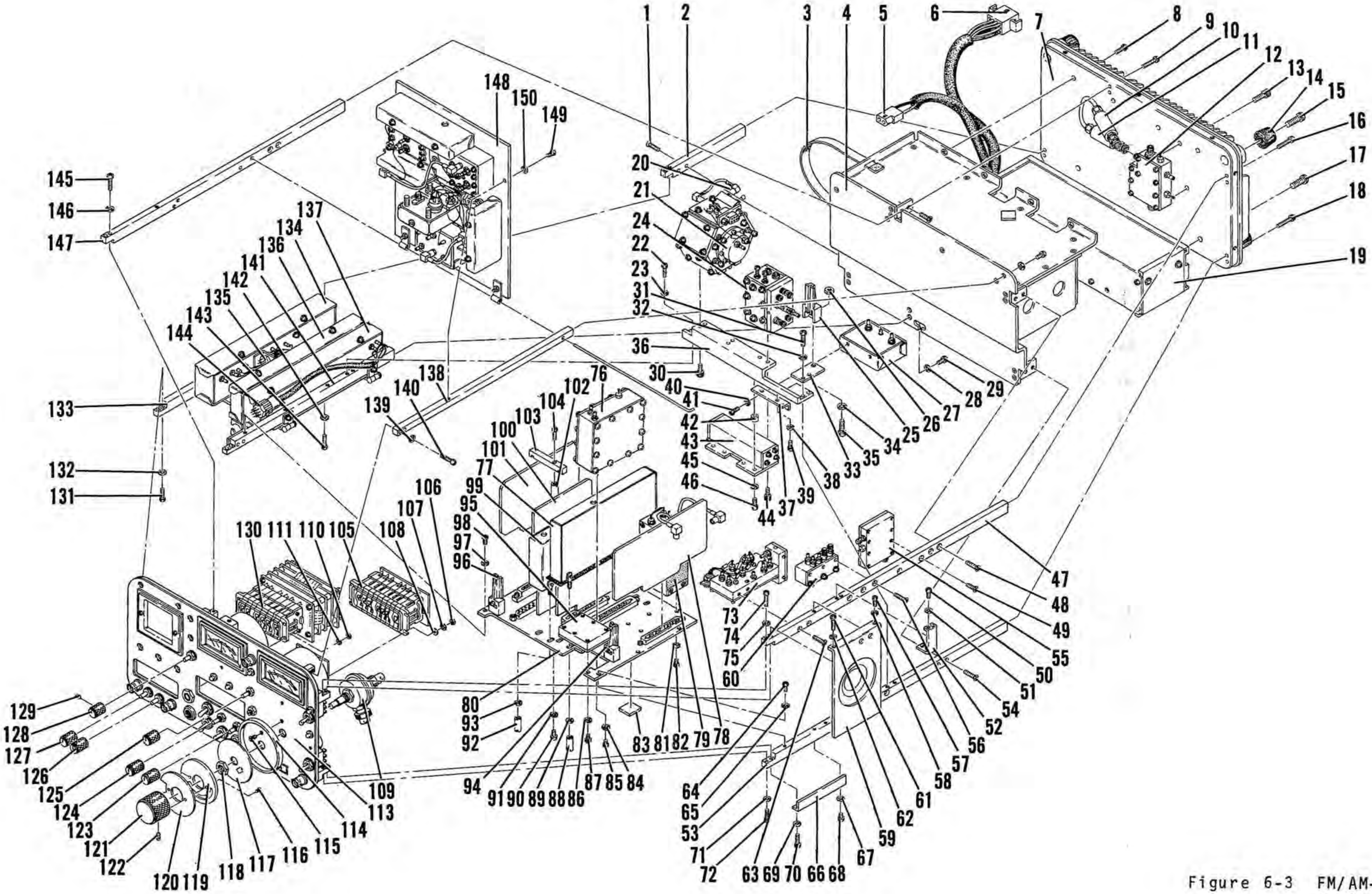


Figure 6-3 FM/AM-1100S/A Composite Disassembly and Reassembly

C. Remove FIRST MIXER ASSEMBLY (60) by removing:

1. Three flexible coax cables and one wire (unsolder from feed-thru).

2. Two semi-rigid coax cables between First Mixer (60) and Power Termination Assembly (12) by disconnecting SMA Connectors on each end.

3. Three Phillips screws (56) which secure First Mixer (60) to frame support member (47).

D. Remove 100 MHz FILTER (27) from bottom by removing:

1. Two vertical Phillips screws (39) and lock washers (38) which secure filter mounting angle (37) to 1200 MHz Diode Switch/High Frequency Multiplier Mixer mounting channel (36).

2. Two coax cables and wire (unsolder from feed-thru).

3. Two Phillips screws (41) and lock washers (40) which secure mounting angle (37) to 100 MHz Filter (27).

E. Remove 108 MHz BANDPASS FILTER (43) from bottom by removing:

1. Two coax cables from bottom of Filter (43).

2. Four each Phillips screws (46), lock washers (45) and spacers (42) which secure Filter to under side of mounting channel (36).

F. Remove 1200 MHz DIODE SWITCH (24) by removing:

1. 250 kHz IF Monitor Audio Circuit Board (78) per para. 6-1-8, item E.

2. Two flexible coax cables and wire (unsolder at feed-thru).

3. Two semi-rigid coax cables.

4. Two socket-head screws (44), using 3/32" Allen wrench which secure 1200 MHz Diode Switch (24) to mounting channel (36).

G. Remove HIGH FREQUENCY MULTIPLIER MIXER (21) by removing:

1. Three coax cables.

2. Four socket-head screws (30) from bottom, using 3/32" Allen wrench, which secure High Frequency Multiplier Mixer (21) to mounting channel (36).

3. Two slotted captive screws which secure P6204 connector to J6204 connector (20). Unplug connector when screws are loosened.

H. Remove 1200 MHz AMPLIFIER (55) by removing:

1. Two semi-rigid coax cables (unscrew hex nuts with 5/16" wrench) and wire (unsolder) from feed-thru.

2. Two Phillips screws (49) which secure 1200 MHz Ampiflier to frame support.

6-1-8 MOTHER BOARD (80) MODULE REMOVALS (Fig. 6-3 & 6-4)

NOTE

Sequence of items A through D may be accomplished in any order; however, items E through H should be performed in exact sequence.

A. Remove REGULATOR/TIMER CIRCUIT BOARD (101) by removing:

1. One Phillips screw (104) (just loosen) and circuit board retainer (103) from standoff (102).

2. Regulator/Timer circuit board (101) from Mother Board (80).

B. Remove VCO TUNER CIRCUIT BOARD (100) by removing:

1. One Phillips screw (104) (just loosen) which secures VCO Tuner Circuit Board retainer (103) to top of stand-off (102). Rotate retainer (103) out of the way.

2. VCO Tuner Circuit Board (100) from Mother Board (80).

3. Three flexible coax cables from VCO Tuner Circuit Board.

C. Remove HIGH FREQUENCY PHASE LOCK CIRCUIT BOARD AND ENCLOSURE (99) by removing:

1. Three coax cables from enclosure (99).

2. Five slotted tube nuts (92) and lock washers (93) from underside of Mother Board (80).

3. Hex nut from three coax connectors which hold Board to Enclosure (99).

4. Circuit Board enclosure (99) from Mother Board (80).

5. High Frequency Phase Lock Circuit Board from Mother Board (80).

D. Remove 79-80 MHz LOOP CIRCUIT BOARD AND ENCLOSURE (77) by removing:

1. Coax cable from enclosure (77).

NOTE

ITEM NUMBERS CORRESPOND WITH ITEMS IN FIGURE 6-3.

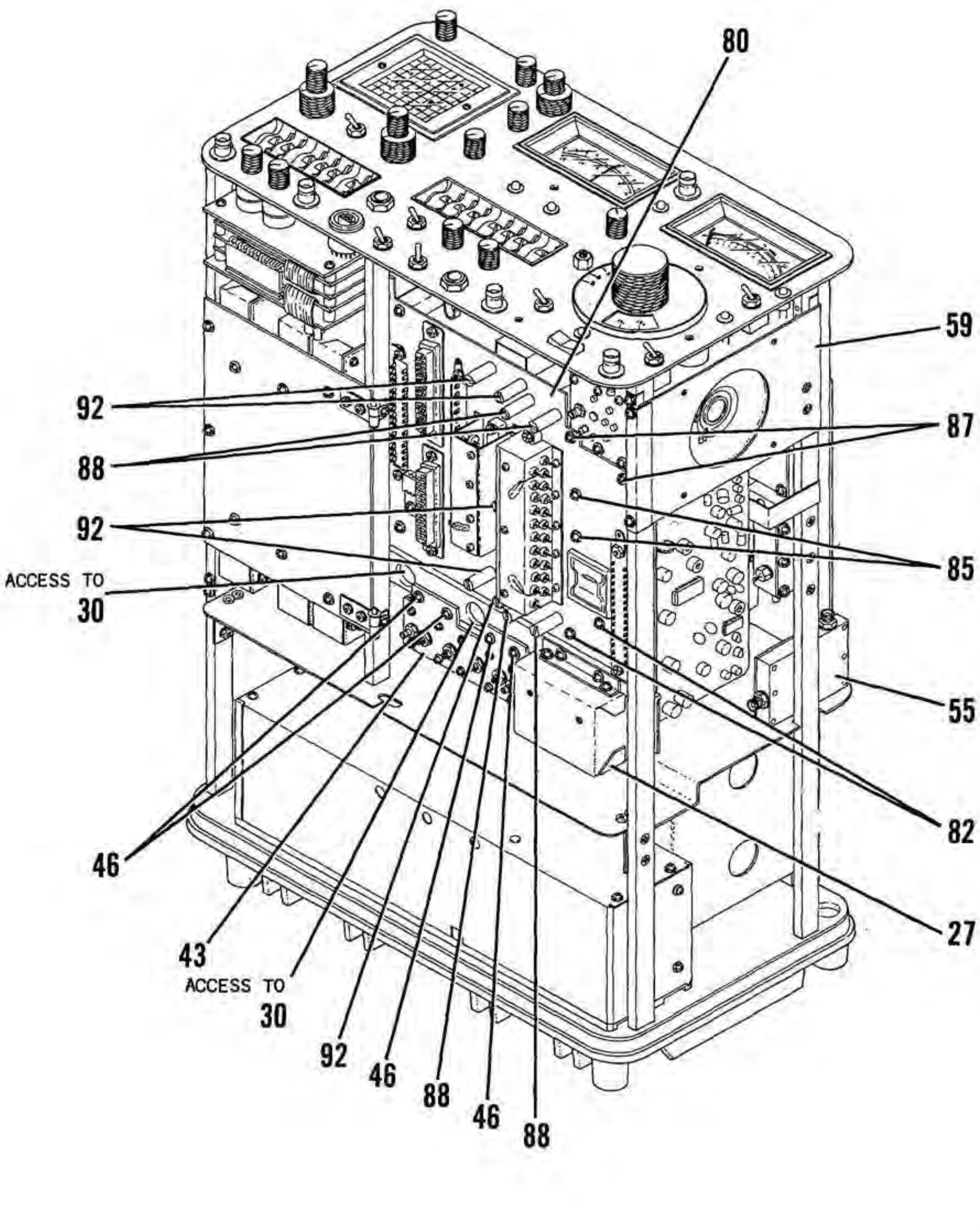


Figure 6-4 Bottom View of FM/AM-1100S/A Composite

2. Four slotted tube nuts (88) and lock washers (89) from underside of Mother Board (80).

3. Hex nut from coax connector which holds Board to Enclosure (77).

4. Circuit board enclosure (77) from Mother Board (80).

5. 79-80 MHz Loop Circuit Board from Mother Board (80).

E. Remove <u>250 kHz I.F. MONITOR AUDIO CIRCUIT BOARD (78)</u> by removing:

1. Two Phillips screws (50) and two lock washers (51) which secure board retainer (52) to frame support member (47).

2. Loosen Phillips screw (35) and lock washer (34) securing plastic circuit board guide (25) to circuit board guide mounting plate (33).

3. 250 kHz I.F. Monitor Audio Circuit Board (78) from Mother Board (80).

F. Remove <u>1080 MHz MULTIPLIER AMPLIFIER (76)</u> by removing:

1. Two coax cables and unsolder wire from feed-thru.

2. Two Phillips screws (85) and two lock washers (84) securing Multiplier Amplifier to Mother Board (80).

G. Remove <u>HIGH LEVEL AMPLIFIER (79)</u> by removing:

1. Two coax cables (slip-ons) from First Mixer.

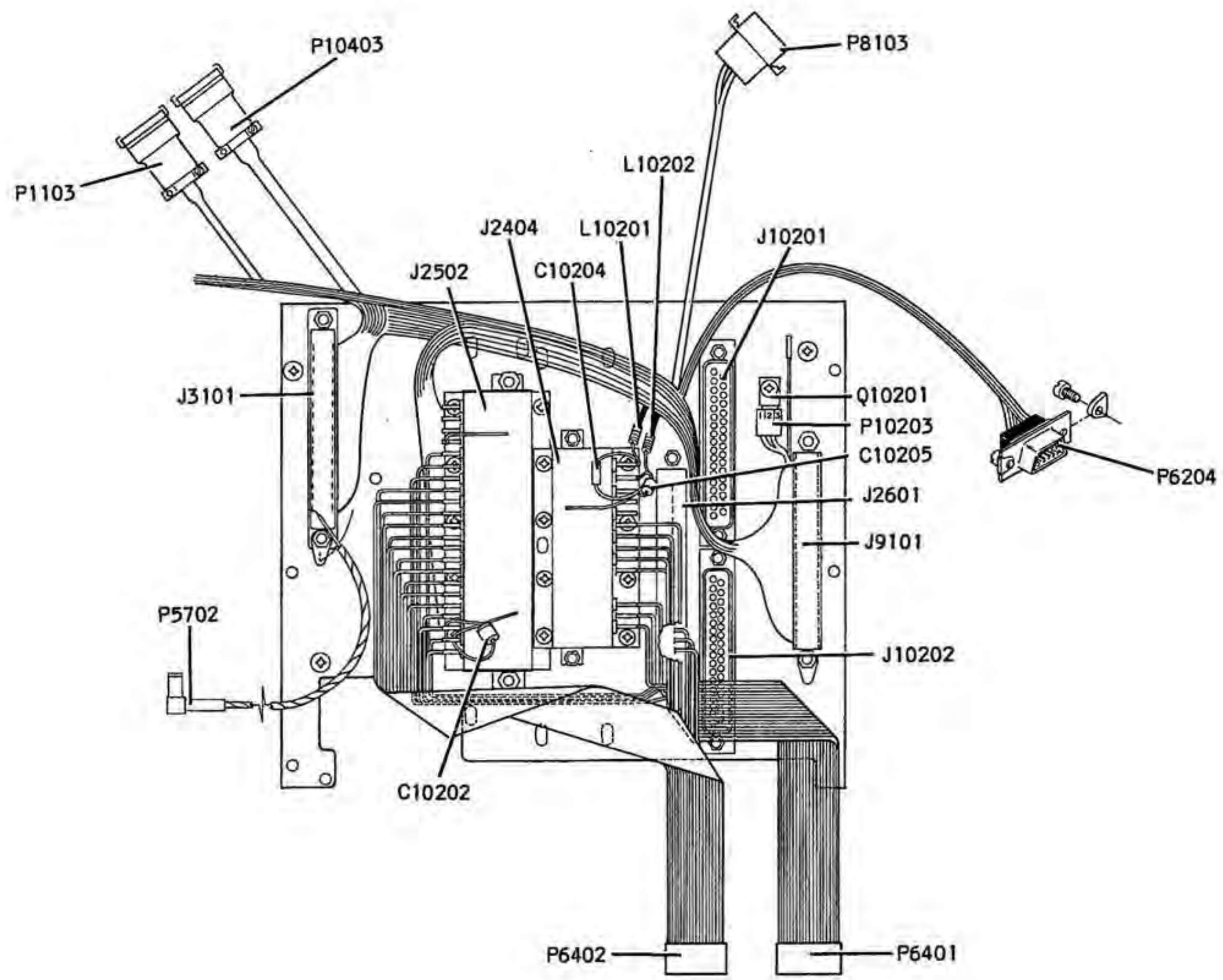
2. Wires (unsolder and tag) from two feed-thru's; leave red wire to third feed-thru in place.

3. Two each Phillips screws (82) and lock washers (81) beneath Mother Board (80).

H. Remove <u>STATIC DISCHARGE PROTECTOR (95)</u> from bottom by removing:

1. Two coax cables and wire (unsolder from feed-thru) beneath Static Discharge Protector (95).

2. Two Phillips screws (87) and lock washers (86) from underside of Mother Board (80).



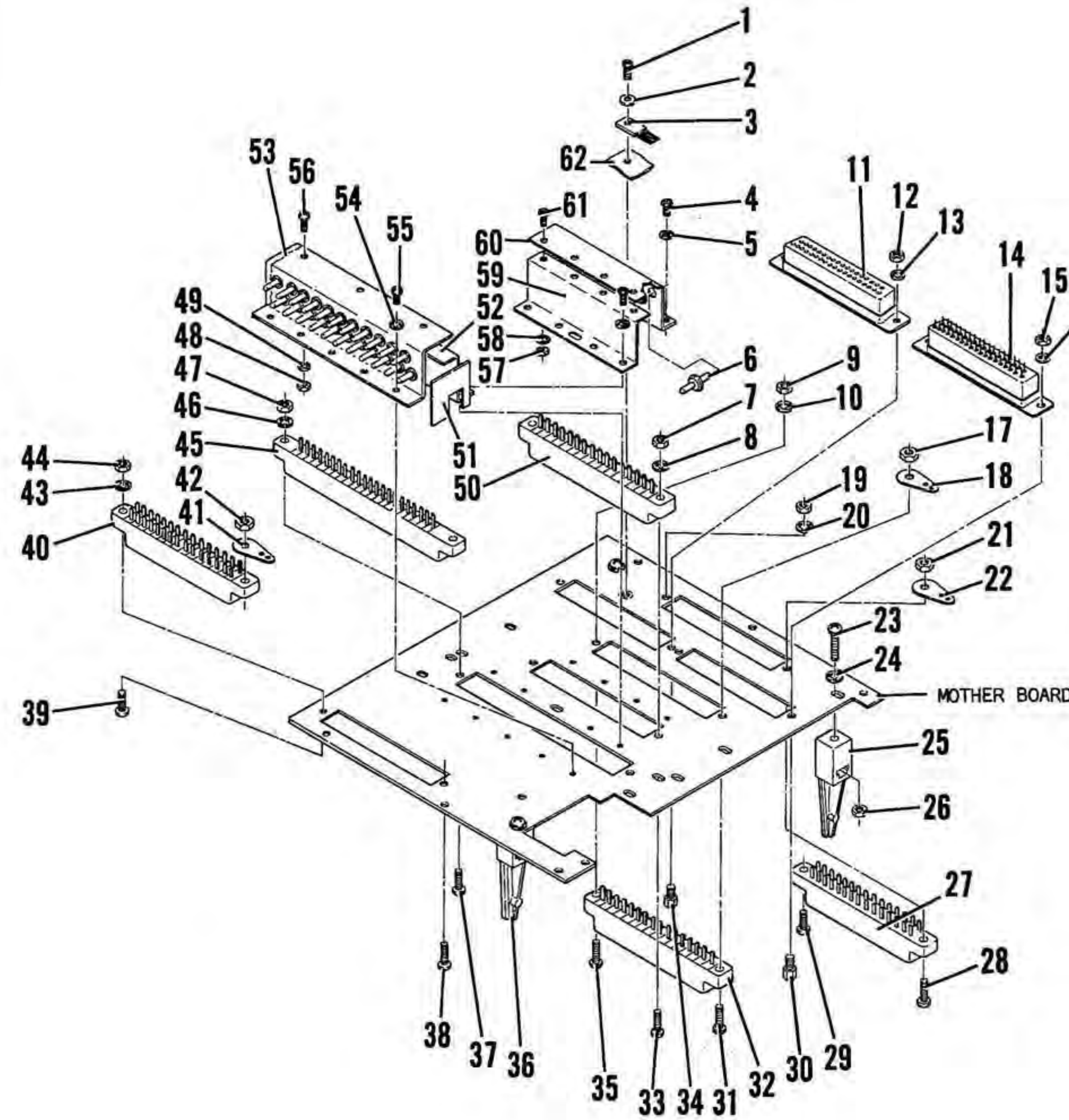


Figure 6-5 Mother Board Connectors Disassembly and Reassembly

2. (Cont'd)

NOTE

If Speaker Assy. (59) was removed per para. 6-1-7, item A, and item E of para. 6-1-8 was removed, then remove Static Protector (95) through the R/H side. If any one of these items weren't removed, then remove Static Protector (95) out the bottom by cocking the Protector at an angle, tilting and rotating as necessary to clear the rear of front panel components.

6-1-9 MOTHER BOARD CONNECTORS (Fig. 6-3 & 6-5)

NOTE

Complete removal of Mother Board requires prior removal of all modules in paragraph 6-1-8.

Tie-downs securing wire bundles in area of Mother Board may be cut as necessary for access.

Coax cables routed in area of Mother Board may be disconnected as necessary for removal of Mother Board.

A. Remove MOTHER BOARD (80) (Fig. 6-3) by removing:

1. Two ribbon cable connectors (P6401 and P6402) to Frequency Select Switch (105) (Fig. 6-3).

2. Molex connector (P8103) to Power Supply (19) (Fig. 6-3).

3. Coax connector (P5702) to 120 MHz Receiver (137) (Fig. 6-3).

4. Connector (P6204) to High Frequency Multiplier/Mixer Block (21) (Fig. 6-3) (unscrew two screws holding connectors together).

5. Circular connector (P10403) from J10403 (31) (Fig. 6-1) on Upper Floor Assembly by rotating connector locking clamp free of latch at mating connector.

6. Circular connector (P1103) from Clock Divider (30) (Fig. 6-1) by rotating connector locking clamp free of latch at mating connector.

7. Connectors P10201 and P10202 from J10201 (11) and J10202 (14) (Fig. 6-5), respectively, by removing two slotted screws securing mating connectors.

8. Six Phillips screws (64 and 98) and six lock washers (65 and 97) securing Mother Board to frame (Fig. 6-3).

9. Mother Board by tilting to clear frame and removing from bottom of FM/AM-1100S/A.

B. Remove TRANSISTOR Q10201 (3) (Fig. 6-5) from Mother Board by removing:

1. Connector P10203 from Transistor (3).

2. Phillips screw (1) and lock washer (2) securing Transistor to Mother Board.

3. Transistor from Mother Board. (Pry gently to remove Transistor, which is secured with thermal compound. Leave insulator pad (62) in place.)

C. Remove CONNECTOR J9101 (27) (Fig. 6-5) by removing:

1. Wires (unsolder and tag) from connector.

2. Two Phillips screws (28), two nuts (19 and 21), lock washer (20), and lug (22) securing connector to Mother Board.

D. Remove CONNECTOR J2601 (32) (Fig. 6-5) by removing:

1. Wires (unsolder and tag) from connector.

2. Two Phillips screws (31 and 35), two nuts (9 and 17), lock washer (10), and lug (18) securing connector to Mother Board.

E. Remove CONNECTOR J3101 (40) (Fig. 6-5) by removing:

1. Wires (unsolder and tag) from connector.

2. Two Phillips screws (38 and 39), two nuts (42 and 44), lock washer (43), and lug (41) securing connector to Mother Board.

F. Remove CONNECTOR J10201 (11) (Fig. 6-5) by removing:

1. Two hex-head screws (34), two nuts (12), and two lock washers (13) securing connector to Mother Board.

2. Wires (remove with insertion tool and tag) from connector.

G. Remove CONNECTOR J10202 (14) (Fig. 6-5) by removing:

1. Wires (unsolder and tag) from connector.

2. Two hex-head screws (30), two nuts (15), and two lock washers (16) securing connector to Mother Board.

NOTE

ITEM NUMBERS 133 TO 144 CORRESPOND WITH ITEMS IN FIGURE 6-3.

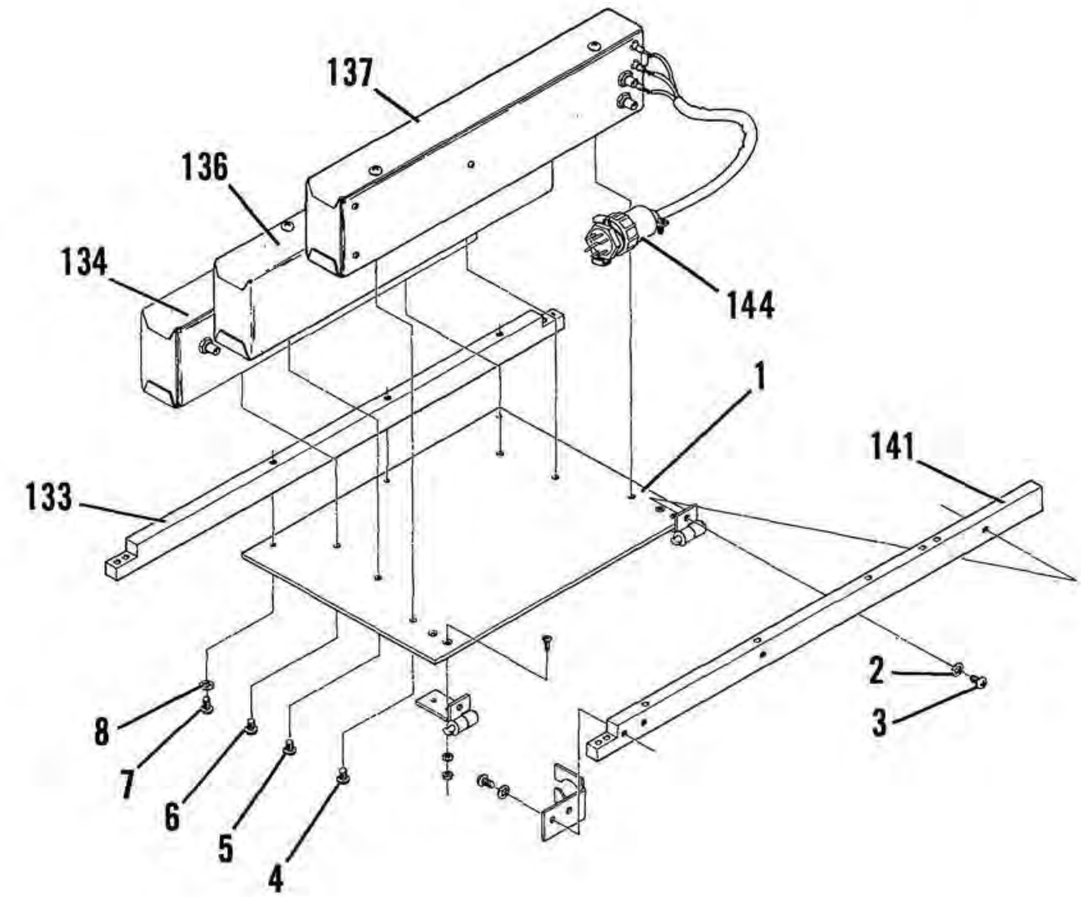


Figure 6-6 Lower Floor Disassembly and Reassembly

H. Remove CONNECTOR J2404 (50) (Fig. 6-5) by removing:

1. Eight Phillips screws (5) and eight lock washers (4) securing shield (59 and 60) to Mother Board.

2. Two Phillips screws (33), two lock washers (8), and two nuts (7) securing connector to Mother Board.

3. Wires (unsolder and tag) from connector.

I. Remove CONNECTOR J2502 (45) (Fig. 6-5) by removing:

1. Eight Phillips screws (55) and eight lock washers (54) securing shield (52 and 53) to Mother Board.

2. Two Phillips screws (37), two lock washers (46), and two nuts (47) securing connector to Mother Board.

3. Wires (unsolder and tag) from connector.

J. Remove FEED-THRU FILTERS (6) (Fig. 6-5) from shield (60) of connector J2404 by removing:

1. Eight Phillips screws (5) and eight lock washers (4) securing securing shield to Mother Board.

2. Four Phillips screws (61), four nuts (57), and four lock washers (58) securing two halves of shield together.

3. Wires (unsolder and tag) from feed-thru filters.

4. Feed-thru filters (unsolder from shield).

K. Remove FEED-THRU FILTERS (Fig. 6-5) from shield (53) of connector J2502 by removing:

1. Eight Phillips screws (55) and eight lock washers (54) securing shield to Mother Board.

2. Shield ends (51) from shield (unsolder).

3. Three Phillips screws (56), three nuts (48), and three lock washers (49) securing two halves of shield together.

4. Wires (unsolder and tag) from feed-thru filters.

5. Feed-thru filters (unsolder from shield).

6-1-10 LOWER FLOOR (98) MODULE REMOVALS (Fig. 6-3 & 6-6)

NOTE

Sequence of this paragraph and items within may be performed in any order after item A is accomplished.

A. OPENING LOWER FLOOR (Fig. 6-3):

Set the FM/AM-1100S/A on its four rear stand-offs (14). To open floor, remove four 1/2" Phillips screws (131) and lock washers (132) which secure lower L/H frame support member (133) to front panel (113) and frame support (2).

B. Remove 120 MHz GENERATOR ASSEMBLY (134) (Fig. 6-6) by removing:

1. Two Phillips screws (6) which hold 120 MHz Generator Assembly (134) to Lower Floor (1).

2. Circular connector (unplug) by rotating connector locking clamp free of latch at mating connector.

3. Three coax cables.

C. Remove 100 MHz AMPLIFIER/108 MHz MIXER (136) (Fig. 6-6) by removing:

1. Two Phillips screws (5) which hold 100 MHz Amplifier/108 MHz Mixer (136) to Lower Floor (1).

2. Four coax cables and wire (unsolder from feed-thru).

D. Remove 120 MHz RECEIVER (137) (Fig. 6-6) by removing:

1. Circular connector (144). Unplug by rotating connector locking clamp free of latch at mating connector.

2. Two coax cables.

3. Two Phillips screws (4) which hold 120 MHz Receiver (137) to Lower Floor (1).

6-1-11 SPECTRUM ANALYZER REMOVALS (109) (Fig's. 6-2, 6-7, & 6-8)

NOTE

Sequence of items A through G may be performed in any order, but all are prerequisite to item H.

Using a .050" Allen wrench, a 5/16" nut driver and a ½" nut driver, remove control retainers as follows:

A. INTENSITY CONTROL KNOB (Fig. 6-2) by removing:

1. Two socket head screws (37) (loosen) and knob (36).

2. Hex nut (38) and washer (39).

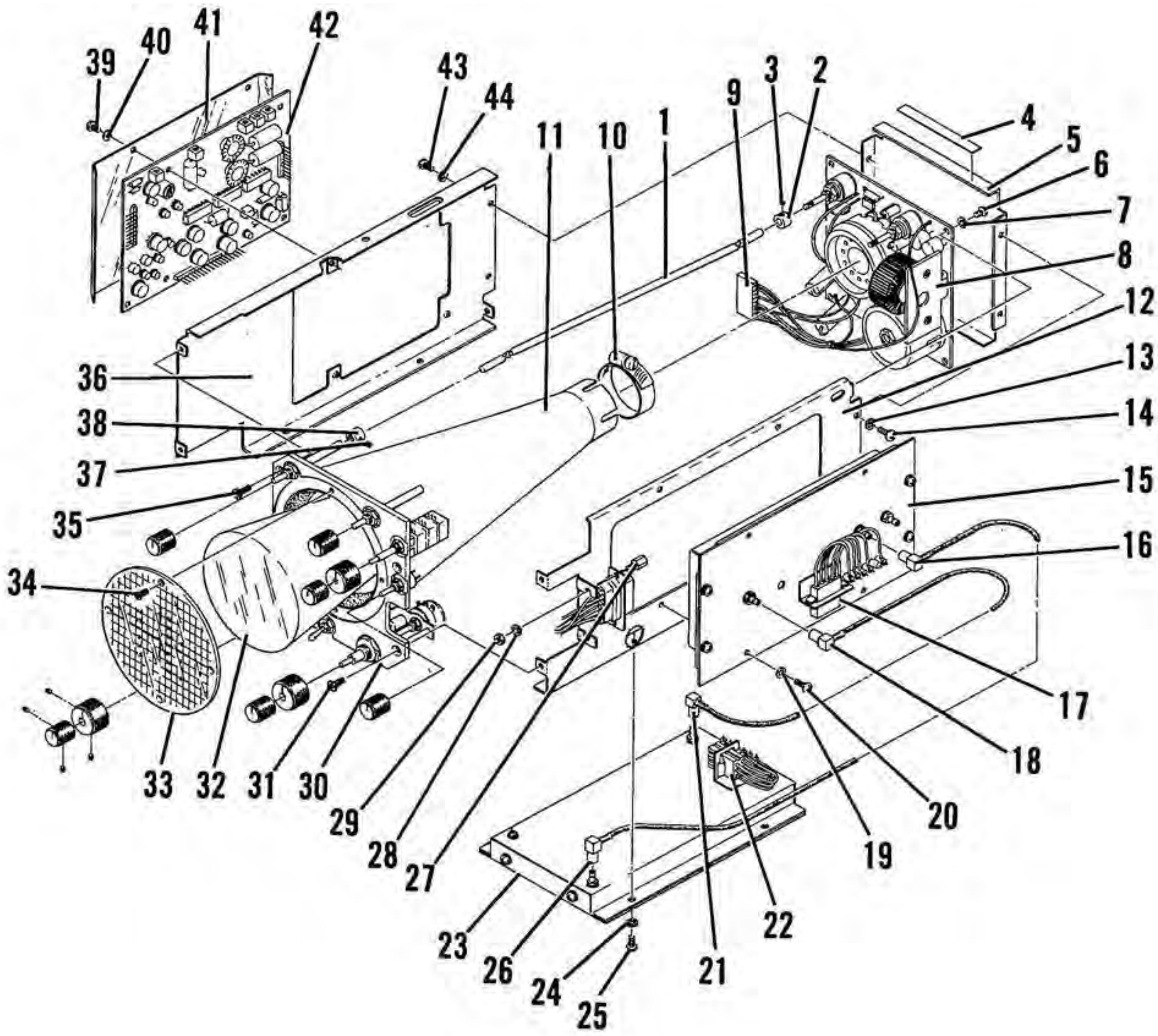


Figure 6-7 Spectrum Analyzer Disassembly and Reassembly

B. <u>FOCUS CONTROL KNOB (Fig. 6-2)</u> by removing:

1. Two socket head screws (33) (loosen) and knob (32).

2. Hex nut (34) and washer (35).

C. <u>DEV-VERT CONTROL KNOB (Fig. 6-2)</u> by removing:

1. Two socket head screws (24) (loosen) and vernier knob (23).

2. Two socket head screws (26) (loosen) and knob ring (25).

3. Hex nut (27) and washer (28).

D. <u>VERT/ANALY DISP CONTROL KNOBS (Fig. 6-2)</u> by removing:

1. Two socket head screws (30) (loosen) and knob (29).

2. Two socket head screws (31) (loosen) and knob ring (7).

E. Loosen <u>AC/OFF/DC SWITCH (Fig. 6-2)</u> by removing hex nut (17) and washer (16).

F. <u>HORIZ. CONTROL KNOB (Fig. 6-2)</u> by removing two socket head screws (8) (loosen) and knob (9).

G. <u>SWEEP CONTROL KNOB (Fig. 6-2)</u> by removing:

1. Two socket head screws (14) (loosen) and vernier knob (15).

2. Two socket head screws (12) (loosen) and knob ring (13).

3. Hex nut (11) and washer (10).

H. <u>REMOVAL OF SPECTRUM ANALYZER ASSEMBLY (41) (Fig. 6-2)</u> by removing:

1. Coax from rear of SCOPE IN Connector.

2. "T" coax connector from mating connector (42).

3. "D"-type connector (40) from mating half on bracket (disconnect two slotted captive screws and unplug connector).

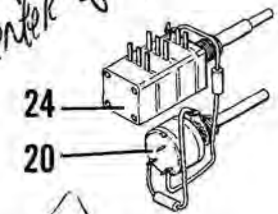
4. Two hex nuts (5) and lock washer (4) from Phillips screw (1) which secures Spectrum Analyzer (41) to frame support member. Nylon spacer (3) and screw (1) are difficult to remove and may stay with the assembly.

5. Spectrum analyzer (41) from FM/AM-1100S/A.

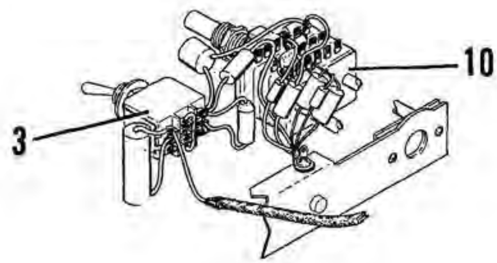
I. <u>REMOVAL OF SPECTRUM ANALYZER MODULE #1 (15) (Fig. 6-7)</u> by removing:

Sandy parts
Rick Frost - Tech
4780-5110-381
vert center & Analyzer ctrl.
$65.28

Ray Reese
Tech



DETAIL A



DETAIL B

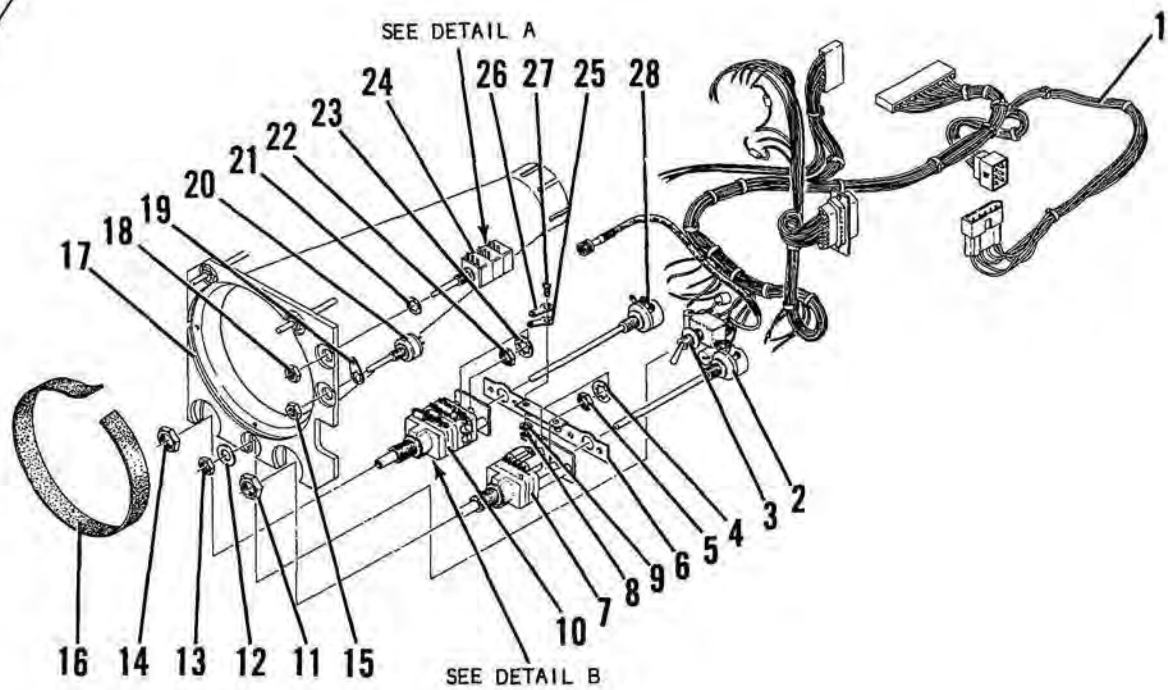


Figure 6-8 Spectrum Analyzer Switches Disassembly and Reassembly

1. Two coax connectors (16) and (18).

2. Molex connector J9801 from P9801 (17).

3. Four Phillips screws (20) and four lock washers (19) which secure Module #1 to Spectrum Analyzer frame (12).

J <u>REMOVAL OF SPECTRUM ANALYZER MODULE #2 (23) (Fig. 6-7)</u> by removing:

1. Four Phillips screws (25) and four lock washers (24) which secure Module #2 to Spectrum Analyzer frame (12).

2. Two coax connectors (21) and (26).

3. Molex connector (22).

K. <u>REMOVAL OF SPECTRUM ANALYZER MAIN PC BOARD (42) (Fig. 6-7)</u> by removing:

1. Four Phillips screws (39), four lock washers (40), and insulating paper (41) which hold Main PC Board to frame (36).

2. Connectors J4301, J4302, and J4303 from PC Board.

L. <u>REMOVAL OF SPECTRUM ANALYZER INVERTER PC BOARD (8) (Fig. 6-7)</u> by removing:

1. Four Phillips screws (14) and four lock washers (13) securing Inverter PC Board cover (5) to frame.

2. Four Phillips screws (6) and four lock washers (7) securing Inverter PC Board to PC board cover (5).

3. Four socket screws (3) and (37) (loosen only) securing control shafts (1) with .050" Allen wrench. Slide control shafts up and off of R4011 and R4014.

4. Inverter PC Board away from frame to gain access to V9201-P1 and P4303 (9).

5. Connectors V9201-P1 and P4303.

M. <u>REMOVAL OF HORIZONTAL SWEEP SWITCH (7)</u> (Fig. 6-8) by removing:

1. Hex nut (11) securing Horizontal Sweep Switch to front panel (17).

2. Hex nut (14) securing Vertical Gain Switch to front panel.

3. Hex nut (13) and lock washer (12) securing AC/OFF/DC Switch to front panel. Rotate entire assembly of switches out away from panel.

4. Wires from outer side of switch (unsolder and tag).

5. Hex nut (5) and lock washer (4) securing Potentiometer (2) to switch assembly.

6. Nut (8), lockwasher (9), and screw (27) securing lugs (25) and (26) to mounting channel (6).

7. Wires from back side of switch (unsolder and tag).

8. Switch off Potentiometer shaft (2).

N. <u>REMOVAL OF VERTICAL GAIN SWITCH (10) (Fig. 6-8)</u> by removing:

1. Hex nut (14) securing Vertical Gain Switch to front panel.

2. Hex nut (11) securing Horizontal Sweep Switch to front panel.

3. Hex nut (13) and lock washer (12) securing AC/OFF/DC Switch (3) to front panel. Rotate entire assembly of switches out away from panel.

4. Wires from outer side of switch (unsolder and tag).

5. Hex nut (22) and lock washer (23) securing Potentiometer (28) to switch assembly.

6. Wires from back side of switch (unsolder and tag).

7. Switch off Potentiometer shaft (28).

O. <u>REMOVAL OF AC/OFF/DC SWITCH (3) (Fig. 6-8)</u> by removing:

1. Hex nut (13) and washer (12) securing Switch to front panel.

2. AC/OFF/DC Switch and washer (3) from front panel (swivel switch out).

3. Wires (unsolder and tag) from switch.

P. <u>REMOVAL OF VERT/ANALY DISPR CONTROL (24) (Fig. 6-8)</u> by removing:

1. Hex nut (18) securing Control to front panel.

2. VERT/ANALY DISP Control and washer (21) from front panel (swivel control out).

3. Wires (unsolder and tag) from control.

Q. <u>REMOVAL OF HORIZONTAL CONTROL (20) (Fig. 6-8)</u> by removing:

1. Hex nut (15) securing Control to front panel.

2. Horizontal Control (20) and lug (19) from front panel (swivel control out).

3. Wires (unsolder and tag) from control.

R. REMOVAL OF CRT (32) (Fig. 6-7) by removing:

CAUTION

CRT WILL IMPLODE IF DROPPED. USE EXTREME CARE WHEN REMOVING CRT.

1. Clamp (10) (loosen only) around base of shield (11).

2. Four flat-head Phillips screws (34) holding graticule lens to frame.

3. CRT from shield (slide out, being careful to hold on to CRT).

6-1-12 FRONT PANEL (113) MODULE REMOVALS (Fig. 6-3 & 6-9)

NOTE

Sequence of items A through E may be performed in any order.

For easier removal of assemblies, remove Phillips screws and lock washers which hold frame support members (47, 53, 133, 138, 141 and 147) to front panel (113). Remove SMA connector on semi-rigid coax behind TRANS/RCVR Connector (lower R/H corner) and tilt Front Panel forward. Also remove coax cables to SCOPE IN Connector, ANTENNA Connector, and 10 MHz REF OUT Connector (Fig. 6-3).

Front Panel can only be tilted forward after removing control knobs on Spectrum Analyzer (see items A through G of paragraph 6-1-11).

A. Remove DUAL TONE GENERATOR (MODULATION FREQ. Hz) (130) (Fig. 6-3) by removing:

1. Connector P8501 from J8501 (bottom of rear circuit board).

CAUTION

P8501/J8501 IS NOT A KEYED CONNECTOR. MARK ITS RELATIONSHIP BEFORE DISCONNECTING TO AVOID INCORRECT ALIGNMENT DURING REASSEMBLY.

2. Four hex nuts (110) and lock washers (111) which hold Dual Tone Generator (130) to front panel (113).

B. Remove <u>FREQUENCY SELECT SWITCH (105) (Fig. 6-3)</u> by removing:

1. Four hex nuts (106), four lock washers (107), and four flat washers (108) which secure Switch Assembly (105) to front panel (113).

2. Two ribbon cable connectors P6401 and P6402 from mating connectors J6401 and J6402 (bottom of circuit board).

C. Remove <u>FREQUENCY ERROR (kHz) METER (78) (Fig. 6-9)</u> by removing:

1. Two hex nuts (77), and two terminal lugs (76) on rear of meter.

2. Two slotted screws (90) (just loosen; clamp (88) with screw (90) and nut (89) will drop out of meter bezel (87)).

3. Bezel (87) and meter (78).

NOTE

The bezel is NOT replaceable as part of the meter; but should be replaced separately.

D. Remove <u>DEVIATION (kHz)/WATTS METER (79) (Fig. 6-4)</u> by removing:

NOTE

PC Board on back of meter is an integral part of Meter Assembly.

1. Wires from PC Board (unsolder and tag).

2. Two slotted screws (same as for FREQ. ERROR METER (78) in Step 3 above. Just loosen; clamp with screw and nut will drop out of meter bezel (80).

3. Bezel (80) and meter (79).

NOTE

The bezel is NOT replaceable as part of the meter; but should be replaced separately.

E. Remove <u>BFO-RF LEVEL CONTROL (109) (Fig. 6-3)</u> by removing:

NOTE

Attenuator minor assembly (109), outer dial (120), and dBm dial (117) are calibrated as a unit. All three items must be replaced as a calibrated unit if any of the three is faulty.

1. Speaker assembly (59) per para. 6-1-7, Item A.

2. Loosen two socket head screws (122) (use a .050" wrench) from knob (121). Remove knob (121), outer dial (120), and stop (119).

3. Two Phillips flat-head screws (116) from dial stop (119), outer dial (120) and knob (121).

4. Hex nut (118) and dBm dial (117) from shaft of BFO-RF LEVEL Control (109).

5. Two coax cables from rear and bottom of attenuator minor assembly (109). Pull control (109) free of front panel (113).

6. Phillips flat-head screw (115) which secures dial index ring (114) to front panel (113).

6-1-13 FRONT PANEL SWITCHES, CONNECTORS AND CONTROLS (Fig. 6-9)

NOTE

Sequence of all assembly removals in this paragraph may be accomplished in any order.

Tag all wires and coax cables before unsoldering or removing.

For clarity, control knobs are not shown in Fig. 6-9. These are already shown in Fig. 6-3.

Remove the following:

A. SCOPE IN Connector (1) by removing:

1. Coax cable (previously removed in para. 6-1-11, Spectrum Analyzer).

2. Hex nut and lock washer from rear of panel (72).

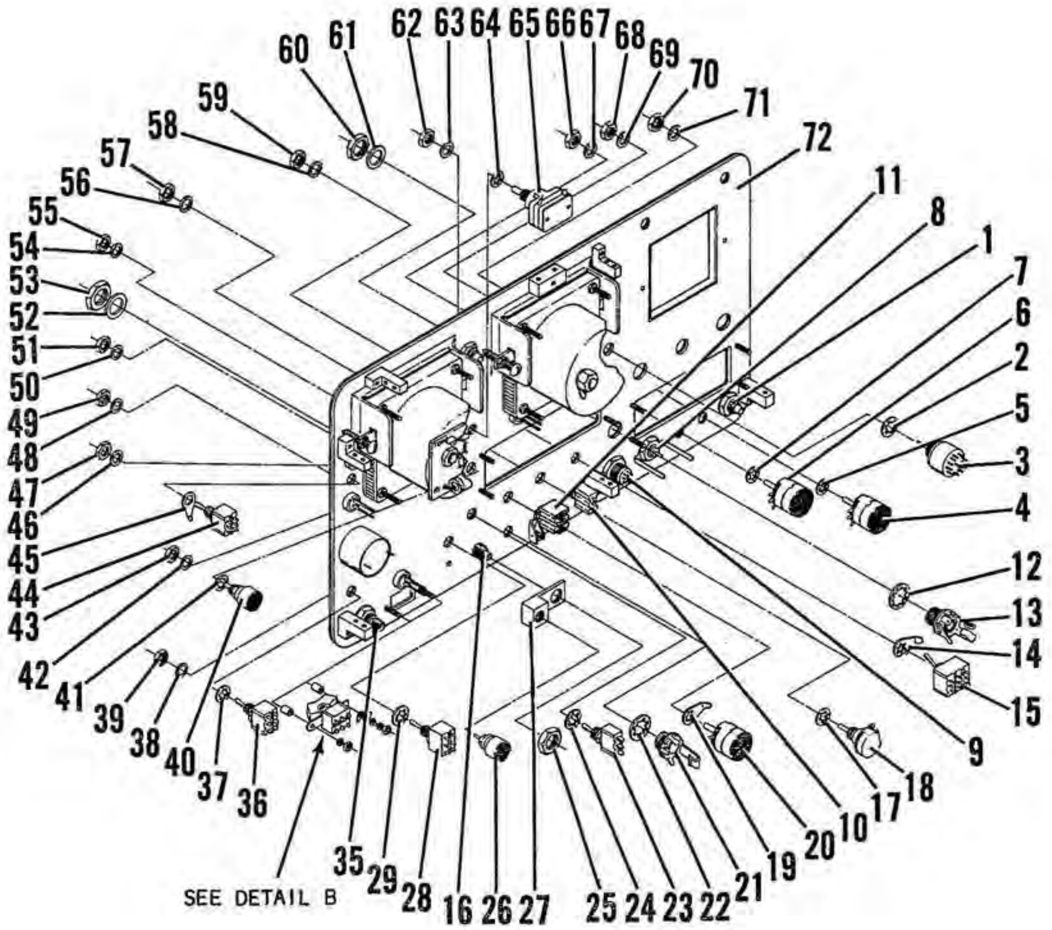
B. FREQ ERROR Control (3) by removing:

1. Control knob (loosen two socket screws with .050" Allen wrench).

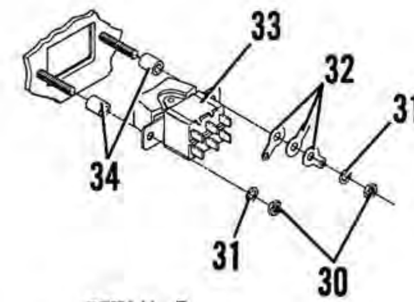
2. Wires (unsolder) from rear of control (3).

3. Hex nut (70) and flat washer (71) which secure control (3) to panel (72).

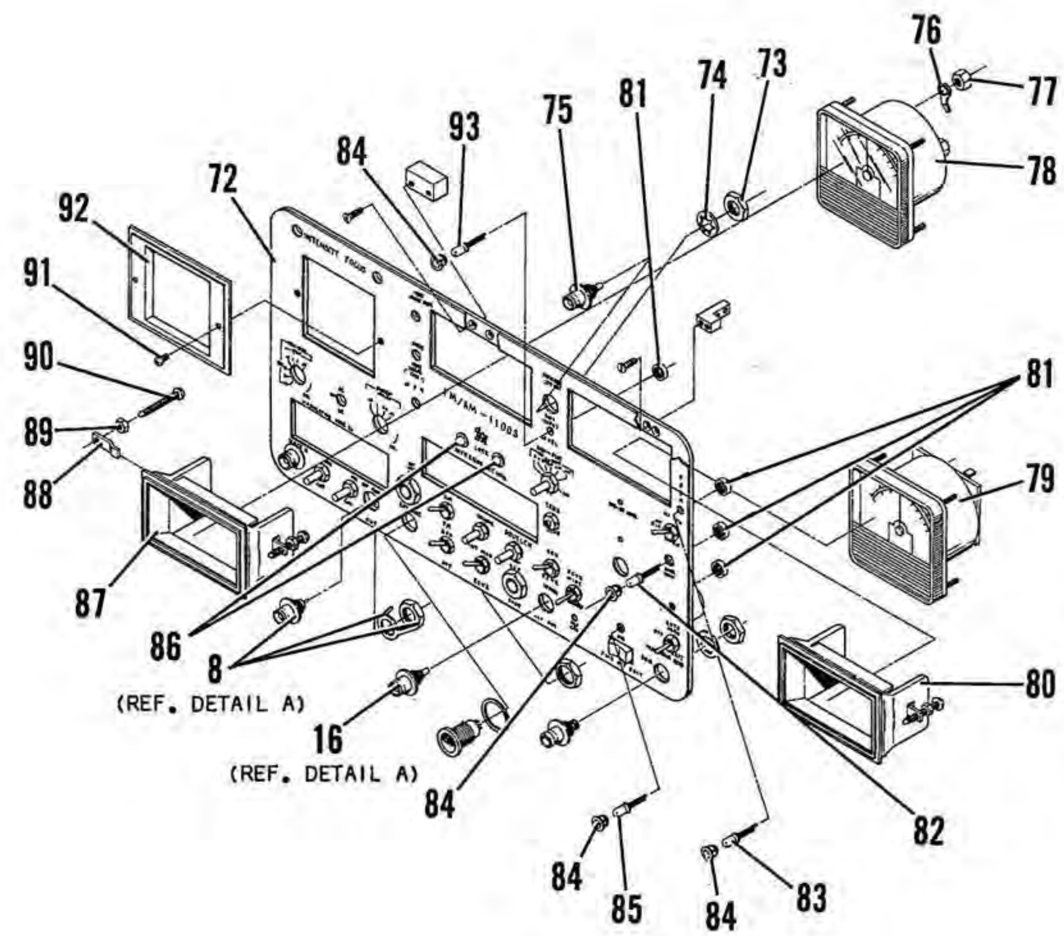
4. Lock washer (2) and control (3) from rear of panel (72).



DETAIL A



DETAIL B



DETAIL C

Figure 6-9 Front Panel Switches, Connectors, Indicators and Controls

C. <u>1 kHz/OFF Control (4)</u> by removing:

1. Control knob (loosen two socket screws with .050" Allen wrench).
2. Wires (unsolder and tag) from side of control (4).
3. Hex nut (68) and flat washer (69) which secure control (4) to panel (72).
4. Control (4) and lock washer (5) from back panel.

D. <u>VAR/OFF Control (6)</u> by removing:

1. Control knob (loosen two socket screws with a .050" Allen wrench).
2. Wires (unsolder and tag) from side of control (6).
3. Hex nut (66) and flat washer (67) which secure control to panel (72).
4. Control (6) and lock washer (7) from back of panel.

E. <u>INT MOD OUT Connector (8)</u> by removing:

1. Wires (unsolder) from connector (8).
2. Hex nut and lock washer from rear of panel (72).

F. <u>EXT ACC Connector (9)</u> by removing:

1. Wires (unsolder) from connector (9).
2. Hex nut and lock washer from rear of panel (72).

G. <u>BFO/OFF Switch (10)</u> by removing:

1. Wires (unsolder) from rear of switch (10).
2. Hex nut and flat washer from front of panel (72); lock washer and switch (10) from rear of panel (72).

H. <u>INT MOD/RCVR/RCVR (DET OFF) Switch (11)</u> by removing:

1. Wires (unsolder) from rear of switch (11).
2. Hex nut and flat washer from front of panel (72); lock washer and switch (11) from rear of panel (72).

I. <u>EXT MOD Connector (13)</u> by removing:

1. Wires (unsolder) from connector (13).

2. Hex nut (60) and flat washer (61) from front of panel (72); lock washer (12) and connector (13) from rear of panel (72).

J. AM/FM Switch (15) by removing:

1. Wires (unsolder) from switch (15).

2. Hex nut (59) and flat washer (58) from front of panel (72); terminal lug (14) and switch from rear of panel (72).

K. 10 MHz REF OUT Connector (16) by removing:

1. Coax cable from rear of connector (16).

2. Hex nut (25) from rear of mounting block (27).

3. Hex nut and lock washer from rear of panel (72).

L. VOLUME Control (18) by removing:

1. Control knob (loosen two socket screws with .050" Allen wrench).

2. Wires (unsolder) from rear of control (18).

3. Hex nut (57) and flat washer (56) from front of panel (72); lock washer (17) and control (18) from rear of panel (72).

M. SQUELCH Control (20) by removing:

1. Control knob (loosen two socket screws with .050" Allen wrench).

2. Wires (unsolder) from control (20).

3. Hex nut (55) and flat washer (54) from front of panel (72); terminal lug (19) and control (20) from rear of panel (72).

N. EXT SPKR Connector (21) by removing:

1. Wires (unsolder) from connector (21).

2. Hex nut (53) and flat washer (52) from front of panel (72); lock washer (22) and connector (21) from rear of panel (72).

O. GEN/RCVR Switch (23) by removing:

1. Wires (unsolder) from switch (23).

2. Hex nut (51) and flat washer (50) from front of panel (72); lock washer (24) and switch (23) from rear of panel (72).

P. CAL Control (26) by removing:

1. Wires (unsolder) from control (26).

2. Control (26) (unscrew) from mounting block (27) on rear of panel (72).

Q. <u>RCVR WIDE/MID/NARROW Switch (28)</u> by removing:

1. Wires (unsolder) from switch (28).

2. Hex nut (49) and flat washer (48) from front of panel (72); lock washer (29) and switch (28) from rear of panel (72).

R. <u>PWR/OFF/BATT Switch (33)</u> by removing:

CAUTION

MAKE SURE TWO-PIN MOLEX BATTERY CONNECTOR (5) (FIG. 6-3) IS DISCONNECTED.

1. Wires (unsolder) from switch (33).

2. Two hex nuts (30), two lock washers (31), three terminal lugs (32), and two spacers (34).

S. <u>TRANS/RCVR Connector (35)</u> by removing:

1. Semi-rigid coax cable from rear of connector (35) (previously removed in para. 6-1-12).

2. Hex nut and lock washer from rear of panel (72).

T. <u>AUTO ZERO/OFF/BATT Switch (36)</u> by removing:

1. Wires (unsolder) from switch (36).

2. Hex nut (39) and flat washer (38) from front of panel (72); lock washer (37) and switch from rear of panel (72).

U. <u>ZERO RCVR Potentiometer (40)</u> by removing:

1. Wires (unsolder) from potentiometer (40).

2. Hex nut (43) and flat washer (42) from front of panel (72); lock washer (41) and potentiometer from rear of panel (72).

V. <u>HI LVL/μV X 100/NORM Switch (44)</u> by removing:

1. Wires (unsolder) from switch (44).

2. Hex nut (47) and flat washer (46) from front of panel (72); terminal lug (45) and switch from rear of panel (72).

W. <u>DEV/POWER Control (65)</u> by removing:

1. Control knob (loosen two socket screws with .050" Allen wrench).

2. Wires (unsolder) from control (65).

3. Hex nut (62) and flat washer (63) from front of panel (72); lock washer (64) and control from rear of panel (72).

X. ANTENNA Connector (75) by removing:

1. Coax cable from rear of connector (75).

2. Hex nut (73) and lock washer (74) from rear of panel (72).

Y. BEZEL, SPECTRUM ANALYZER (92) by removing two Phillips screws (91) which secure bezel (92) to panel (72).

Z. INDICATOR LAMPS, TWO PHASE LOCK (86), 0 dBm (83), POWER ON (85) INPUT LEVEL (93), and OVERTEMP (82) by removing:

1. Wires (tag and unsolder) from rear of lamp socket.

2. Lamp retainer (81). Pry gently off back of lamp socket (84).

3. Lamp from lamp socket (84). Push gently on front of lamp until it snaps out of lamp socket. Remove lamp from rear of panel.

4. Lamp socket (84). Pry gently out of front of panel (72).

6-2 REASSEMBLY PROCEDURES

6-2-1 GENERAL

Normally, the sequence of reassembly should be accomplished in reverse order of disassembly and is based on the premise that every module or assembly has been removed from the unit. Tools required are the same as those in Section 6-1 Disassembly Procedure. Observe the same cautions and warnings.

NOTE

When reassembling FM/AM-1100S/A, carefully remove any soldering flux used to complete a solder joint.

6-2-2 FRONT PANEL SWITCHES AND CONNECTORS (Fig. 6-9)

NOTE

Sequence of items A through Z may be accomplished in any order. Steps within an item should be followed in sequence.

Install the following:

A. SCOPE IN Connector (1) by attaching:

1. Connector (1) at front of panel (72); lock washer and hex nut at rear of panel (72).

2. Coax cable to rear of connector (1).

B. FREQ ERROR Control (3) by attaching:

1. Control (3) and lock washer (2) at rear of panel (72).

2. Flat washer (71) and hex nut (70) to secure control (3) at front of panel (72).

3. Wires (solder as tagged) to rear of control (3).

4. Control knob (tighten two socket screws with .050" Allen wrench).

C. 1 kHz/OFF Control (4) by attaching:

1. Control (4) and lock washer (5) through rear of panel.

2. Flat washer (69) and hex nut (68) to secure control (4) at front of panel.

3. Ensure that control is installed as shown in Figure 6-10 before soldering wires.

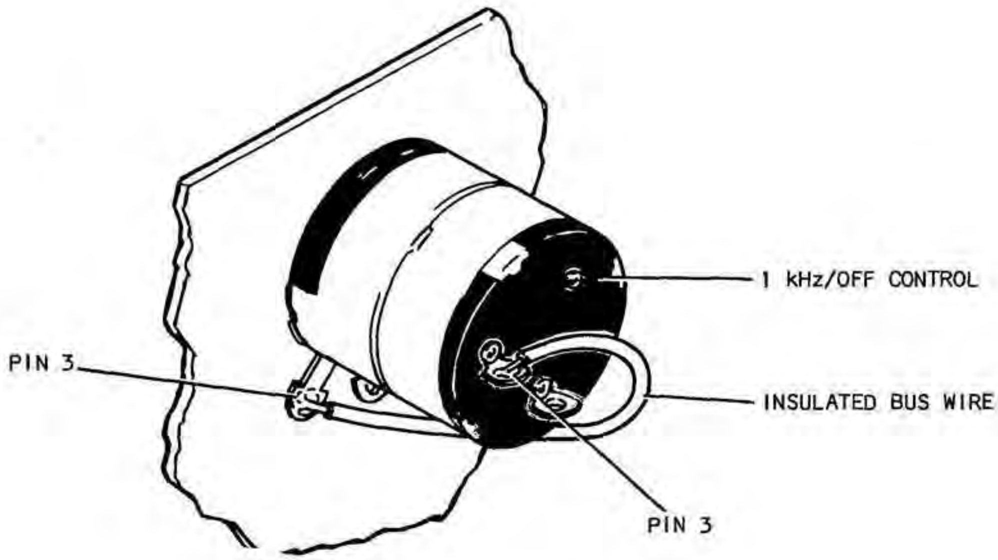


Figure 6-10 1 kHz/OFF Control Installation

4. Wires (solder as tagged) to side of control (4).

5. Control knob (tighten socket screw with .050" Allen wrench).

D. VAR/OFF Control (6) by attaching:

1. Control (6) and lock washer (7) through rear of panel.

2. Flat washer (67) and hex nut (66) to secure control (6) at front of panel.

3. Wires (solder as tagged) to side of control (6).

4. Control knob (tighten socket screw with .050" Allen wrench).

E. INT. MOD. OUT Connector (8) by attaching:

1. Connector (8) at front of panel (72); lock washer and hex nut at rear of panel (72).

2. Ensure that connector is installed as shown in Figure 6-11 before soldering wires.

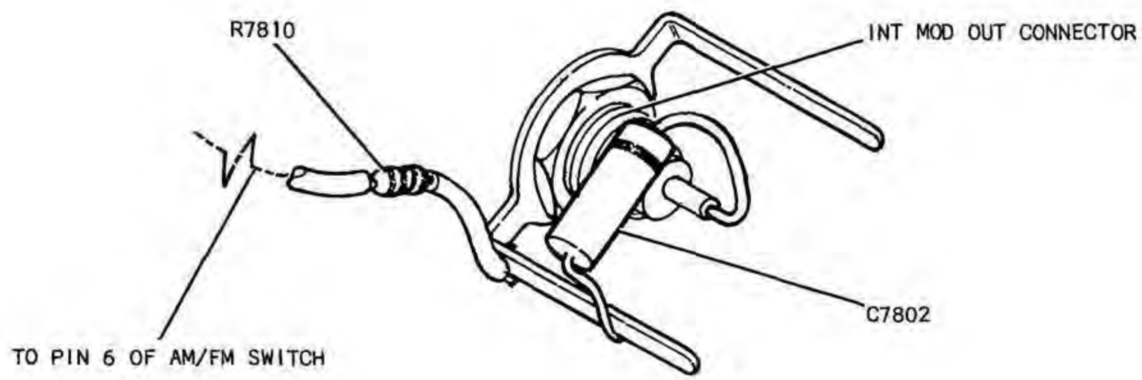


Figure 6-11 INT MOD OUT Connector Installation

3. Wires (solder as tagged) to connector (8).

F. EXT. ACC. Connector (9) by attaching:

1. Connector (9) at front of panel (72); lock washer and hex nut at rear of panel (72).

2. Wires (solder as tagged) to connector (9).

G. BFO/OFF Switch (10) by attaching:

1. Lock washer and switch (10) at rear of panel (72); flat washer and hex nut at front of panel (72).

2. Insure that switch is installed as shown in Figure 6-12 before soldering wires.

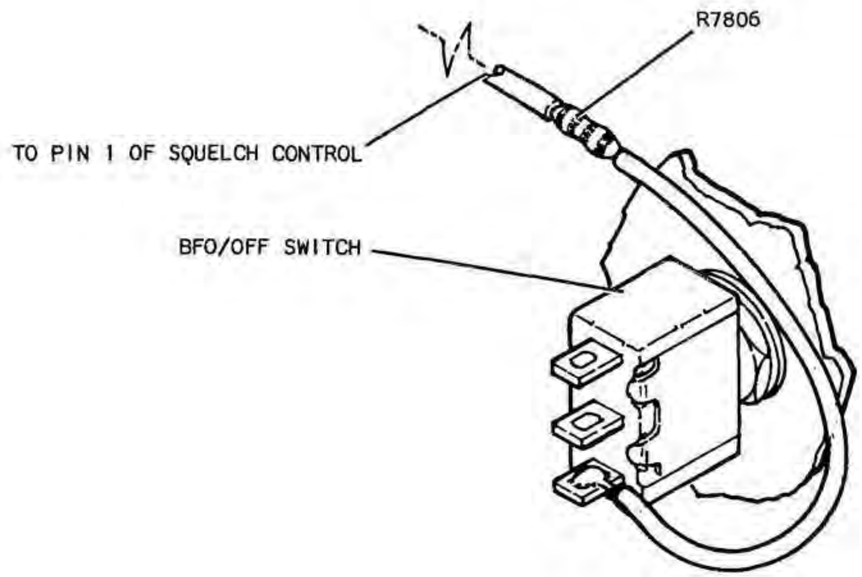


Figure 6-12 BFO/OFF Switch Installation

3. Wires (solder as tagged) to rear of switch.

H. INT MOD/RCVR RCVR (DET OFF) Switch (11) by attaching:

1. Lock washer and switch (11) at rear of panel (72); flat washer and hex nut at front of panel (72).

2. Ensure that switch is installed as shown in Figure 6-13 before soldering wires.

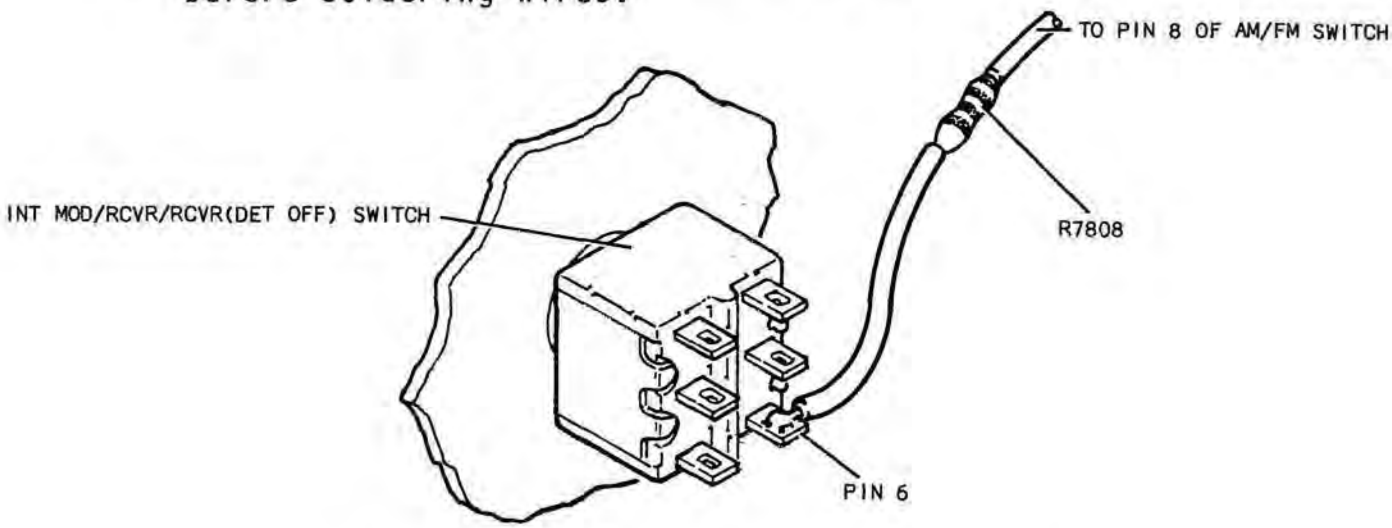


Figure 6-13 INT MOD/RCVR/RCVR (DET OFF) Switch Installation

3. Wires (solder as tagged) to rear of switch (11).

I. EXT MOD Connector (13) by attaching:

1. Lock washer (12) and connector (13) at rear of panel (72); flat washer (61) and hex nut (60) at front of panel (72).

2. Wires (solder as tagged) to rear of connector (13).

J. AM/FM Switch (15) by attaching:

1. Terminal lug (14) and switch (15) at rear of panel (72); flat washer (58) and hex nut (59) at front of panel (72).

2. Ensure that switch is installed as shown in Figure 6-14 before soldering wires.

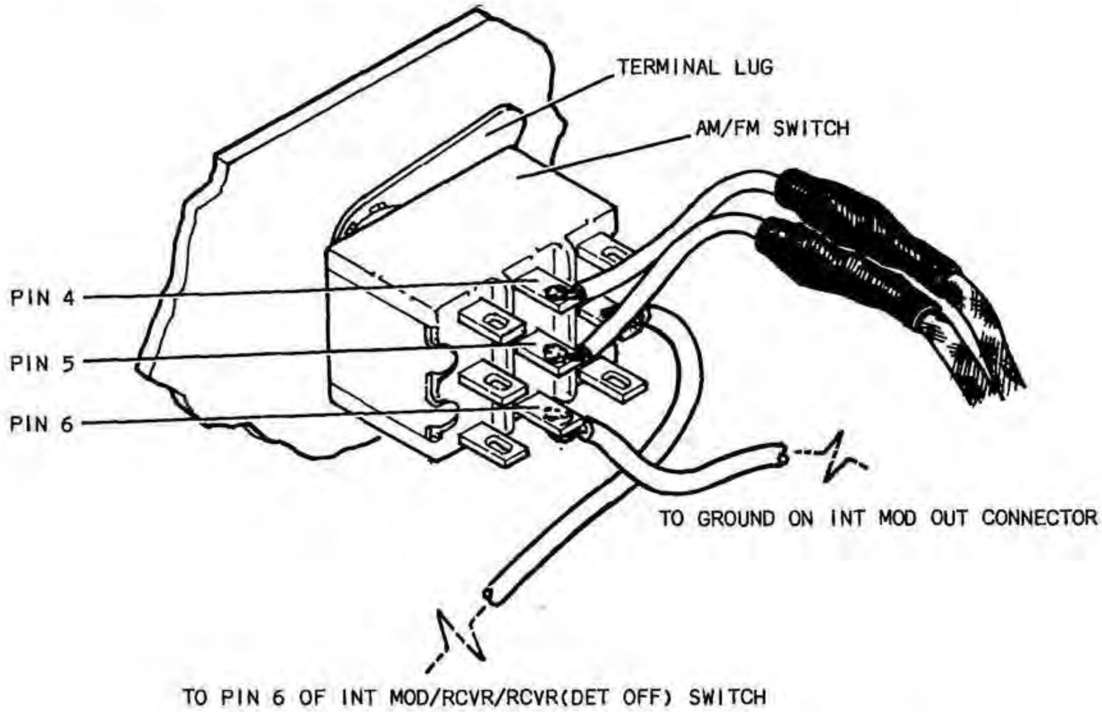


Figure 6-14 AM/FM Switch Installation

3. Wires (solder as tagged) to rear of switch (15).

K. 10 MHz REF OUT Connector (16) by attaching:

1. Connector (16) at front of panel (72); lock washer and hex nut at rear of panel (72).

2. Mounting block (27) and hex nut (25) to rear of connector (16).

3. Coax cable to rear of connector (16).

L. VOLUME Control (18) by attaching:

1. Lock washer (17) and control (18) at rear of panel (72); flat washer (56) and hex nut (57) at front of panel (72).

2. Wires (solder as tagged) to rear of control (18).

3. Control knob (tighten two socket screws with .050" Allen wrench).

M. SQUELCH Control (20) by attaching:

1. Terminal lug (19) and control (20) at rear of panel (72); flat washer (54) and hex nut (55) at front of panel (72).

2. Ensure that control is installed as shown in Figure 6-15 before soldering wires.

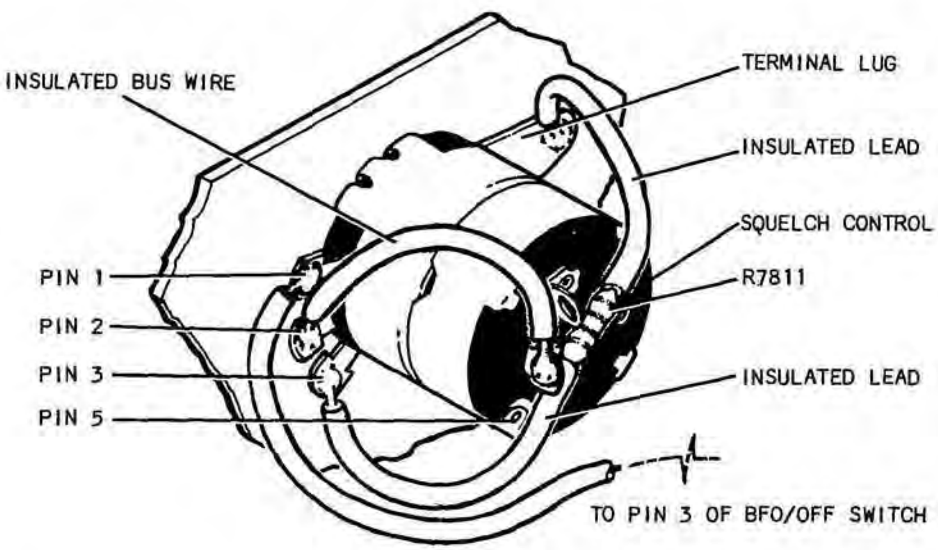


Figure 6-15 SQUELCH Control Installation

3. Wires (solder as tagged) to control (20).

4. Control knob (tighten two socket screws with .050" Allen wrench).

N. EXT SPKR Connector (21) by attaching:

1. Lock washer (22) and connector (21) at rear of panel (72); flat washer (52) and hex nut (53) at front of panel (72).

2. Wires (solder as tagged) to connector (21).

O. GEN/RCVR Switch (23) by attaching:

1. Lock washer (24) and switch (23) at rear of panel (72); flat washer (50) and hex nut (51) at front of panel (72).

2. Ensure that switch is installed as shown in Figure 6-16 before soldering wires.

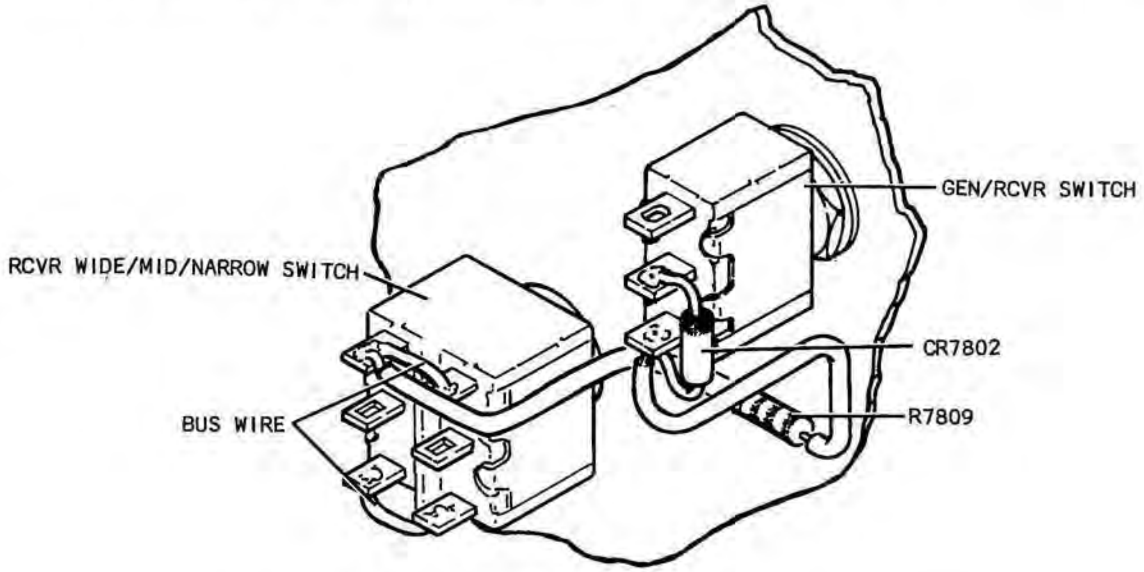


Figure 6-16 GEN/RCVR and RCVR WIDE/MID/NARROW Switch Installation

3. Wires (solder as tagged) to switch (23).

P. CAL Control (26) by attaching:

1. Control (26) (screw) through mounting block (27) on rear of panel (72).

2. Wires (solder as tagged) to control (26).

NOTE

Mounting block (27) is held to rear of front panel (72) by hex nut (25) screwed to rear of REF OUT Jack (16).

Q. RCVR WIDE/MID/NARROW Switch (28) by attaching:

1. Lock washer (29) and switch (28) at rear of panel (72); flat washer (48) and hex nut (49) at front of panel (72).

2. Ensure that switch is installed as shown in Figure 2-16 before soldering wires.

3. Wires (solder as tagged) to switch (28).

R. PWR/OFF/BATT Switch (33) by attaching:

CAUTION

BE SURE TWO-PIN MOLEX BATTERY CONNECTOR (5) (FIG. 6-3) IS DISCONNECTED.

1. Spacers (34), switch (33), three terminal lugs (32), two lock washers (31) and two hex nuts (30) to two threaded studs on rear of panel (72).

2. Ensure that switch is installed as shown in Figure 6-17 before soldering wires.

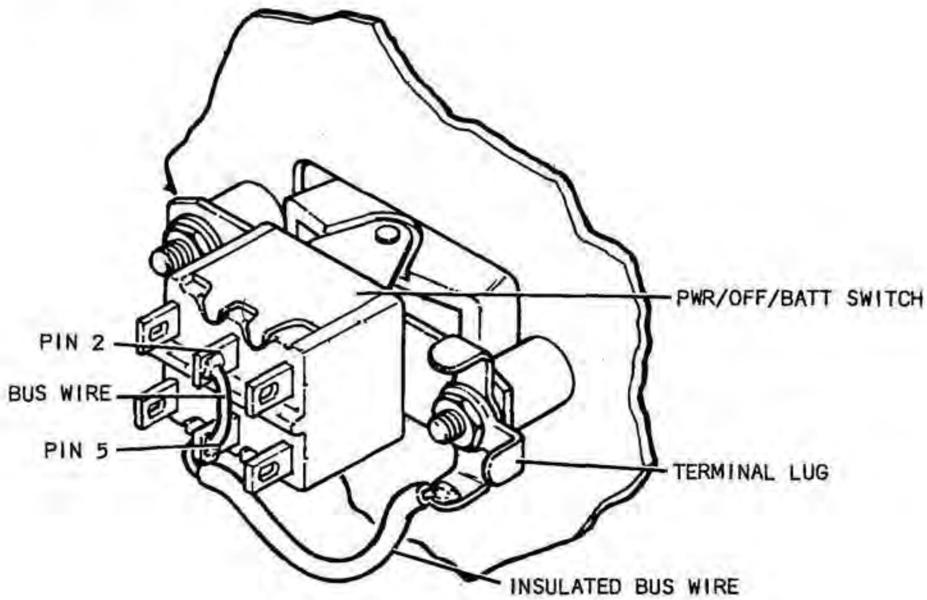


Figure 6-17 PWR/OFF/BATT Switch Installation

3. Wires (solder as tagged) to switch (33).

S. TRANS/RCVR Connector (35) by attaching:

1. Connector (35) at front of panel (72); lock washer and hex nut at rear of panel (72).

2. Semi-rigid coax cable to rear of connector.

T. AUTO ZERO/OFF/BATT Switch (36) by attaching:

1. Lock washer (37) and switch (36) at rear of panel (72); flat washer (38) and hex nut (39) at front of panel (72).

2. Ensure that switch is installed as shown in Figure 6-18 before soldering wires.

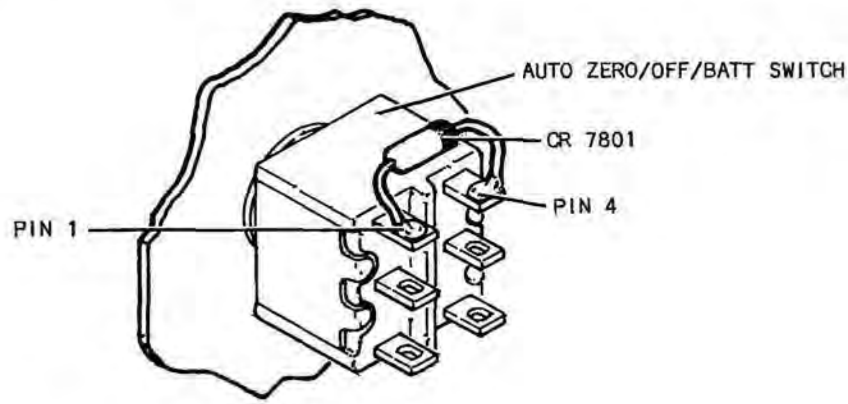


Figure 6-18 AUTO ZERO/OFF/BATT Switch Installation

3. Wires (solder as tagged) to switch (36).

U. ZERC Potentiometer (40) by attaching:

1. Lock washer (41) and potentiometer (40) at rear of panel (72); flat washer (42) and hex nut (43) at front of panel (72).

2. Wires (solder as tagged) to potentiometer (40).

V. HI LVL/μV X 100/NORM Switch (44) by attaching:

1. Terminal lug (45) and switch (44) at rear of panel (72); flat washer (46) and hex nut (47) at front of panel (72).

2. Wires (solder as tagged) to switch (44).

W. DEV/POWER Control (65) by attaching:

1. Lock washer (64) and control (65) at rear of panel (72); flat washer (63) and hex nut (62) at front of panel (72).

2. Wires (solder as tagged) to control (65).

3. Control knob (tighten two socket screws with .050" Allen wrench).

X. <u>ANTENNA Connector (75)</u> by attaching:

1. Connector (75) at front of panel (72); lock washer (74) and hex nut (73) at rear of panel (72).

2. Coax cable to rear of connector (75).

Y. <u>BEZEL, SPECTRUM ANALYZER (92)</u> by attaching Bezel (92) to front panel (72) and secure with two Phillips screws (91).

Z. <u>INDICATOR LAMPS, TWO PHASE LOCK (86), 0 dBm (83), POWER ON (85) INPUT LEVEL (93), and OVERTEMP (82)</u> by installing:

1. Lamp socket (84). Push gently into front of panel (72).

2. Lamp into lamp socket (84). Insert lamp into lamp socket from rear of panel (72). Push gently until lamp snaps into place.

3. Lamp retainer (81). Push gently onto lamp socket (84) from rear of panel (72).

4. Wires (solder as tagged) to terminals of lamp socket.

6-2-3 <u>REASSEMBLY OF MODULES TO FRONT PANEL (113) (Fig's. 6-3 & 6-9)</u>

NOTE

Sequence of items A through E may be performed in any order.

For ease of removal and reassembly, Phillips screws and lock washers were removed which held frame support members (47, 53, 133, 138, 141 and 147) to front panel (43), so front panel could be tilted forward. This also involved removing control knobs from Spectrum Analyzer in Para. 6-1-11, removing semi-rigid coax behind TRANS/RCVR connector, and removing coax cables from SCOPE IN, ANTENNA, and 10 MHz REF OUT Connectors.

Upon completing installation of all the following modules, the above items will need to be restored to original configuration.

A. Install <u>DUAL TONE GENERATOR (MODULATION FREQ. Hz) (130)</u> (Fig. 6-3) by attaching:

1. Four lock washers (111) and four hex nuts (110) to secure Dual Tone Generator (130) to rear of front panel (113).

2. Connector P8501 to J8501 (bottom of rear circuit board).

B. Install FREQUENCY SELECT SWITCH (105) (Fig. 6-3) by attaching:

1. Two ribbon cable connectors P6401 and P6402 to mating connectors J6401 and J6402, respectively (bottom of circuit board).

2. Four hex nuts (106), four lock washers (107) and four flat washers (108) to secure assembly to rear of front panel (113).

C. Install FREQUENCY ERROR (kHz) METER (78) (Fig. 6-9) by attaching:

NOTE

Bezel is not replaced as part of meter, but is instrumental in holding meter in place.

1. Meter (78) from rear and bezel (87) from front of panel.

2. Two slotted screws (90), clamp (88), and nut (89) (tighten to hold meter).

3. Terminal lugs (76) and two hex nuts (77) on rear of meter.

D. Install DEVIATION (kHz)/WATTS METER (79) (Fig. 6-9) by attaching:

NOTE

Bezel is not replaced as part of meter, but is instrumental in holding meter in place.

1. Meter (79) from rear and bezel (80) from front of panel.

2. Two slotted screws, clamp, and nut (tighten to hold meter).

3. Wires to Meter (solder as tagged).

E. Install BFO-RF LEVEL CONTROL (109) (Fig. 6-3) by attaching:

NOTE

Attenuator minor assembly (109), outer dial (120), and dBm dial (117) are a calibrated unit and must be replaced as a unit).

1. Phillips flat-head screw (115) to secure dial index ring (114) to front panel (113).

2. Control (109) through rear of panel.

3. Hex nut (118) and dBm dial (117) to shaft of Control.

4. Two Phillips flat-head screws (116) to secure dial stop (119), outer dial (120), and knob (121). Slide assembly on Control shaft.

5. Two socket head screws (122) to knob (121).

6. Two coax cables to rear and bottom of Control (109) as applicable.

7. Speaker assembly (59) per paragraph 6-2-7, Item C.

6-2-4 SPECTRUM ANALYZER INSTALLATION (Fig's. 6-7 & 6-8); install:

A. CRT (32) (Fig. 6-7) by sliding CRT in shield (11), then attaching:

1. Clamp (10) around base of shield.

2. Four flat-head Phillips screws (34) holding graticule lens (33) to frame.

B. HORIZONTAL Control (20) (Fig. 6-8) by attaching:

1. Wires (solder as tagged) to control.

2. Control and lug (19) in front panel (insert in hole).

3. Hex nut (15) to secure control to front panel.

C. VERT/ANALY DISP Control (24) (Fig. 6-8) by attaching:

1. Wires (solder as tagged) to control.

2. Control (24) and washer (21) in front panel (insert in hole).

3. Hex nut (18) to secure control to front panel.

D. AC/OFF/DC Switch (3) (Fig. 6-8) by attaching:

1. Wires (solder as tagged) to switch.

2. Switch and washer (3) to front panel.

3. Hex nut (13) and washer (12) to front panel.

E. VERTICAL GAIN SWITCH (10) (Fig. 6-8) by attaching:

1. Wires to back of switch (solder as tagged).

2. Potentiometer; slide shaft through switch and secure with hex nut (22) and lock washer (23).

3. Wires to outer side of switch (solder as tagged). Rotate entire assembly of switches up into panel.

4. Hex nut (13) and washer (12) securing AC/OFF/DC Switch to front panel.

5. Hex nut (11) securing Horizontal Sweep Switch to front panel.

6. Hex nut (14) securing Vertical Gain Switch to front panel.

F. <u>HORIZONTAL SWEEP SWITCH (7) (Fig. 6-8)</u> by attaching:

1. Wires to back of switch (solder as tagged).

2. Potentiometer; slide shaft through switch and secure with hex nut (5) and lock washer (4).

3. Nut (8), lock washer (9) and screw (27) securing lugs (25) and (26) to mounting channel (6).

4. Wires to front of switch (solder as tagged).

5. Hex nut (13) and washer (12) securing AC/OFF/DC Switch to front panel.

6. Hex nut (11) securing Horizontal Sweep Switch to front panel.

7. Hex nut (14) securing Vertical Gain Switch to front panel.

G. <u>SPECTRUM ANALYZER INVERTER PC BOARD (8) (Fig. 6-7)</u> by attaching:

1. Connectors V9201-P1 and P4303 (9).

2. Inverter PC Board to frame with four Phillips screws (6) and four lock washers (7).

3. Slide control shafts onto R4011 and R4014 and tighten four socket screws with .050" Allen wrench.

4. Four Phillips screws (14) and four lock washers (13) which secure Inverter PC Board cover (5) to frame.

H. <u>SPECTRUM ANALYZER MAIN PC BOARD (42) (Fig. 6-7)</u> by attaching:

1. Connectors J4301, J4302, and J4303 to PC Board.

2. Four Phillips screws (39), four lock washers (40), and mylar (41) securing PC Board to frame.

NOTE

Make sure mylar is installed between lock washers and Main PC Board.

I. <u>SPECTRUM ANALYZER MODULE #2 (23) (Fig. 6-7)</u> by attaching:

1. Molex connector (22).

2. Two coax connectors (21) and (26).

3. Four Phillips screws (25) and four lock washers (24) which secure Module #2 to Spectrum Analyzer frame (12).

J. <u>SPECTRUM ANALYZER MODULE #1 (15) (Fig. 6-7)</u> by attaching:

1. Four Phillips screws (20) and four lock washers (19) which secure Module #1 to Spectrum Analyzer frame (12).

2. Molex connector J9801 (17).

3. Two coax connectors (16) and (18).

NOTE

Items L thru R may be accomplished in any sequence. Item K is prerequisite to all the rest.

K. <u>SPECTRUM ANALYZER (41) (Fig. 6-2)</u>. Install so control shafts extend through holes in front panel, then attach:

1. Phillips screw (1) with washer (2) and spacer (3) through frame support member, and attach two hex nuts (5) and lock washer (4).

2. "D"-type connector (40) to mating half on bracket, tightening two captive screws.

3. "T" coax connector to mating connector (42).

4. Coax to rear of SCOPE IN Connector.

L. <u>INTENSITY CONTROL Knob (Fig. 6-2)</u> by attaching:

1. Washer (39) and hex nut (38).

2. Knob (36) to control shaft; tighten two socket head screws (37).

M. <u>FOCUS CONTROL KNOB (Fig. 6-2)</u> attaching:

1. Washer (35) and hex nut (34).

2. Knob (32) to control shaft; tighten two socket head screws (33).

N. <u>DEV-VERT CONTROL KNOB (Fig. 6-2)</u> by attaching:

1. Washer (28) and hex nut (27).

2. Knob ring (25); tighten two socket head screws (26).

3. Vernier knob (23); tighten two socket head screws (24).

O. <u>VERT/ANALY DISP CONTROL KNOBS (Fig. 6-2)</u> by attaching:

1. Knob ring (7); tighten two socket head screws (31).

2. Knob (29); tighten two socket head screws (30).

P. <u>AC/OFF/DC SWITCH (Fig. 6-2)</u> by attaching washer (16) and hex nut (17).

Q. <u>HORIZ CONTROL KNOB (Fig. 6-2)</u> by attaching knob (9); tighten two socket head screws (8).

R. <u>SWEEP CONTROL KNOB (Fig. 6-2)</u> by attaching:

1. Washer (10) and hex nut (11).

2. Knob ring (13); tighten two socket head screws (12).

3. Vernier knob (15); tighten two socket head screws (14).

6-2-5 <u>LOWER FLOOR REASSEMBLY (Fig. 6-3 & 6-6)</u>

NOTE

Install the following modules in any sequence.

A. Install <u>120 MHz RECEIVER (137)</u> (Fig. 6-6) by attaching:

1. Two Phillips screws (4) to secure assembly (137) to lower floor (1).

2. Two coax cables to respective connectors.

3. Circular connector (144) to mating connector (rotate connector clamp to lock in place.

B. Install <u>100 MHz AMPLIFIER/108 MHz MIXER (136)</u> (Fig. 6-6) by attaching:

1. Four coax cables to respective connectors and solder wire to feed-thru.

2. Two Phillips screws (5) to secure assembly (136) to lower floor (1).

C. Install <u>120 MHz GENERATOR ASSEMBLY (134)</u> (Fig. 6-6) by attaching:

   1. Two Phillips screws (6) to secure assembly (134) to lower floor (1) (Fig. 6-6).

   2. Circular connector to mating connector (rotate connector clamp to lock in place).

   3. Three coax cables to their respective connectors.

D. <u>CLOSE LOWER FLOOR</u> by attaching four 1/2" Phillips screws (131) and lock washers (132) to secure lower L/H frame support member (133) to front panel (113) and frame support (2) (Fig. 6-3).

6-2-6 <u>REASSEMBLY OF CONNECTORS ON MOTHER BOARD (Fig. 6-5)</u>

A. Install feed-thru filters in shield (53) of connector J2502 by attaching:

   1. Feed-thru filters (solder to shield).

   2. Wires to feed-thru filters (solder as tagged).

   3. Three Phillips screws (56), three nuts (48), and three lock washers (49) securing two halves of shield together.

   4. Shield ends (51) to shield (solder).

   5. Eight Phillips screws (55) and eight lock washers (54) securing shield to Mother Board.

B. Install feed-thru filters in shield (60) of connector J2404 by attaching:

   1. Feed-thru filters to shield (solder).

   2. Wires to feed-thru filters (solder as tagged).

   3. Four Phillips screws (61), four nuts (57), and four lock washers (58) securing two halves of shield together.

   4. Eight Phillips screws (4) and eight lock washers (5) securing shield to Mother Board.

C. Install <u>CONNECTOR J2502 (45)</u> by attaching:

   1. Wires to connector (solder as tagged).

   2. Two Phillips screws (37), two lock washers (46), and two nuts (47) securing connector to Mother Board.

   3. Eight Phillips screws (55) and eight lock washers (54) securing shield (52 and 53) to Mother Board.

D. Install <u>CONNECTOR J2404 (50)</u> by attaching:

1. Wires to connector (solder as tagged).
2. Two Phillips screws (33), two lock washers (8), and two nuts (7) securing connector to Mother Board.
3. Eight Phillips screws (5) and eight lock washers (4) securing shield (59 and 60) to Mother Board.

E. Install <u>CONNECTOR J10202 (14)</u> by attaching:

1. Two hex-head screws (30), two nuts (15), and two lock washers (16) securing connector to Mother Board.
2. Wires to connector (solder as tagged).

F. Install <u>CONNECTOR J10201 (11)</u> by attaching:

1. Wires to connector (insert with insertion tool as tagged).
2. Two hex-head screws (34), two nuts (12), and two lock washers (13) securing connector to Mother Board.

G. Install <u>CONNECTOR J3101 (40)</u> by attaching:

1. Two Phillips screws (38 and 39), two nuts (42 and 44), lock washer (43), and lug (41) securing connector to Mother Board.
2. Wires to connector (solder as tagged).

H. Install <u>CONNECTOR J2601 (32)</u> by attaching:

1. Two Phillips screws (31 and 35), two nuts (9 and 17), lock washer (10), and lug (18) securing connector to Mother Board.
2. Wires to connector (solder as tagged).

I. Install <u>CONNECTOR J9101 (27)</u> by attaching:

1. Two Phillips screws (28 and 29), two nuts (19 and 21), lock washer (20), and lug (22) securing connector to Mother Board.
2. Wires to connector (solder as tagged).

J. Install <u>TRANSISTOR Q10201</u> (3) (Fig. 6-5) by attaching:

1. Transistor to insulator pad. (Coat bottom of Q10201 with heat-sink compound).
2. Phillips screw (1) and lock washer (2) securing Transistor to Mother Board.
3. Connector P10203 to Transistor (3).

K. Install MOTHER BOARD (80) (Fig. 6-3) by attaching:

1. Mother Board in frame by inserting from bottom and tilting to locate in place.

2. Six Phillips screws (64 and 98) and six lock washers (65 and 97) securing Mother Board to frame (Fig. 6-3).

3. Connectors P10201 and P10201 to J10201 (11) and J10202 (14), respectively (Fig. 6-5), and securing mating connectors with two slotted screws.

4. Circular connector P1103 to Clock Divider (30) (Fig. 6-1) by rotating connector to lock in place.

5. Circular connector P10403 to J10403 (31) (Fig. 6-1) on Upper Floor Assembly by rotating connector to lock in place. .

6. Connector P6204 to High Frequency Multiplier/Mixer Block (21) (Fig. 6-3) and securing mating connectors with two slotted screws.

7. Coax connector P5702 to 120 MHz Receiver (137) (Fig. 6-3).

8. Molex connector P8103 to Power Supply (19) (Fig. 6-3).

9. Two ribbon cable connectors (P6401 and P6402) to Frequency Select Switch (105) (Fig. 6-3).

6-2-7 REASSEMBLY OF MODULES ON MOTHER BOARD (71) (Fig. 6-3 & 6-4)

NOTE

Items B and C must precede item D; rest of items may occur in any sequence.

A. Install STATIC DISCHARGE PROTECTOR (95) by attaching:

1. Two lock washers (86) and two Phillips screws (87) to secure assembly (95) to Mother Board (80).

2. Two coax cables to respective connectors and solder wire to feed-thru beneath Protector assembly (95).

B. Install 1080 MHz MULTIPLIER AMPLIFIER (76) by attaching:

1. Two Phillips screws (85) and two lock washers (84) to secure amplifier (76) to Mother Board (80).

2. Two coax cables to respective connectors and solder wire to feed-thru.

C. Install SPEAKER ASSEMBLY (59) (Fig. 6-3) by attaching:

1. Two wires (solder) to speaker (only if wires were unsoldered in disassembly for speaker replacement).

2. One ¼" Phillips screw (57), one ½" Phillips screw (61), and two lock washers (58 and 62) to secure speaker plate (59) to upper R/H frame support member (47).

NOTE

Slide bottom of speaker plate (59) between bracket and lower R/H frame support member (53) before fastening top of plate.

D. Install HIGH LEVEL AMPLIFIER (79) by attaching:

1. Two Phillips screws (82) and two lock washers (81) to secure assembly (79) to bottom of Mother Board (80).

2. Two coax cables to respective connectors and solder wires to two feed-thru's.

E. Install 250 kHz I.F. MONITOR AUDIO CIRCUIT BOARD (78) by attaching:

NOTE

1200 MHz Diode Switch (paragraph 6-2-8, Item B must be installed before 250 kHz IF/MON/AUDIO PC Board.

1. Card edge connector of board (78) into its respective connector on Mother Board (80).

2. Plastic circuit board guide (25) to circuit board guide mounting plate (33) with Phillips screw (35) and lock washer (34).

3. Board retainer (52) to frame support member (47) with two Phillips screws (50) and two lock washers (51).

F. Install 79-80 MHz LOOP CIRCUIT BOARD AND ENCLOSURE (77) by attaching:

1. 79-80 MHz Loop Circuit Board to respective connector on Mother Board (80).

2. Enclosure screws through holes in Mother Board (80).

3. Hex nut to coax connector which holds board to enclosure (77).

4. Four slotted tube nuts (88) and lock washers (89) to secure enclosure (77) to Mother Board (80).

5. Coax cable to connector on enclosure (77).

G. Install HIGH FREQUENCY PHASE LOCK CIRCUIT BOARD AND ENCLOSURE (99) by attaching:

1. High Frequency Phase Lock Circuit Board to connector on Mother Board (80).

2. Enclosure screws through holes in Mother Board (80).

3. Three hex nuts to coax connectors which hold board to enclosure (99).

4. Five slotted tube nuts (92) and lock washers (93) to secure enclosure (99) to Mother Board (80).

5. Three coax cables to respective connnectors on enclosure (99).

H. Install VCO TUNER CIRCUIT BOARD (100) by attaching:

1. Three flexible coax cables to respective connectors.

2. Circuit board (100) to connector on top of Mother Board (80).

3. Circuit board retainer (103) by sliding retainer on top of standoff (102) over top of board (100) and tightening Phillips screw (104).

I. Install REGULATOR/TIMER BOARD (101) by attaching:

1. Circuit board (101) to connector on top of Mother Board (80).

2. Circuit board retainer (103) by sliding retainer on top of standoff (102) over top of board (101) and tightening Phillips screw (104).

6-2-8 REASSEMBLY OF MODULES ON RIGHT-HAND SIDE (Fig. 6-3 and 6-4)

NOTE

Sequence of installing items B through H may be accomplished in any order, except item B must be installed before item D.

A. Install HIGH FREQUENCY MULTIPLIER/MIXER (21) by attaching:

1. P6204 connector to J6204 connector (20). Tighten two captive slotted screws to secure connectors.

2. Four socket head screws (30) from bottom, using 3/32" Allen wrench, to secure Multiplier/Mixer (21) to mounting channel (36).

3. Three coax cables to respective connectors.

NOTE

250 kHz IF/MON/AUDIO PC Board must be removed per paragraph 6-1-8, item E before 1200 MHz Diode Switch can be installed.

B. Install <u>1200 MHz DIODE SWITCH (24)</u> by attaching:

1. Two flexible coax cables to respective connectors and solder wire to feed-thru.

2. Two semi-rigid coax cables to respective connectors.

3. Two socket head screws (44) (use 3/32" Allen wrench) to secure switch (24) to mounting channel (36).

4. 250 kHz I.F. Monitor Audio Circuit Board (78) per para. 6-2-7, item E.

C. Install <u>108 MHz BANDPASS FILTER (43)</u> on bottom by attaching:

1. Four Phillips screws (46), four lock washers (45) and four spacers (42) to secure Filter (43) to bottom of mounting channel (36).

2. Two coax cables to respective connectors on bottom of Filter (43).

D. Install <u>100 MHz FILTER (27)</u> by attaching:

1. Two Phillips screws (41) and two lock washers (40) to secure mounting angle (37) to filter assembly (27).

2. Two Phillips screws (39) and two lock washers (38) to secure filter mounting angle (37) to mounting channel (36).

3. Two coax cables to respective connectors and solder wire to feed-thru.

E. Install <u>FIRST MIXER ASSEMBLY (60)</u> by attaching:

1. Three Phillips screws (56) to secure assembly (60) to frame support member (47).

2. Two semi-rigid coax cables to respective connectors between First Mixer (60) and Power Termination Assembly (12). Tighten 5/16" nuts on each end of each cable.

3. Three flexible coax cables to respective connectors on Mixer (60) and solder wire to feed-thru.

F. Install SECOND MIXER ASSEMBLY (73) by attaching:

1. Circular connector to bracket-mounted mating connector. Rotate clamp on connector to lock in place.

2. Two Phillips screws (63) to secure assembly (73) to frame support member (47).

3. Seven coax cables to respective connectors on assembly (73).

G. Install SPEAKER ASSEMBLY (59) per para. 6-2-7, item C.

. Install 1200 MHz AMPLIFIER (55) by attaching:

1. Two Phillips screws (49) to secure amplifier (55) to frame.

2. Two semi-rigid coax cables to respective connectors (screw hex nuts with 5/16" wrench) and solder wire to feed-thru.

6-2-9 REASSEMBLY OF MODULES ON REAR PANEL (Fig's. 6-2 & 6-3)

A. Install two 30 dB PADS (10 and 11) (Fig. 6-3) by connecting rigid coax at both ends of 30 dB pads.

CAUTION

THERMAL COMPOUND MUST BE APPLIED BETWEEN POWER TERMINATION ASSEMBLY AND REAR PANEL TO PREVENT OVERHEATING OF POWER TERMINATION ASSEMBLY.

B. Install POWER TERMINATION ASSEMBLY (12) (Fig. 6-3) by attaching:

1. One flexible coax cable and four wires (solder at respective feed-thru as tagged.

2. Three semi-rigid coax cables.

C. Install REAR PANEL (7) (Fig. 6-3) by attaching:

1. Thermal compound to area of rear panel which makes contact with Power Termination Assembly. Coat Power Termination Assembly with thermal compound on side that mates with Rear Panel.

2. Three socket head screws (13) securing Power Termination Assembly to Rear Panel.

3. Twelve Phillips screws (8, 9, 16, and 18) securing Rear Panel to frame.

D. Install POWER SUPPLY ASSEMBLY (19) (Fig. 6-3) on Rear Panel by attaching:

1. Two Molex connectors (5) and (6).

2. Three Phillips screws (17) to secure Power Supply to Rear Panel.

E. Install BATTERY (43) (Fig. 6-2) by:

1. Draping removal strap (44) into battery holder (hold onto loop end).

2. Connecting Molex connector (5) (Fig. 6-3).

3. Sliding battery into battery holder, holding onto removal strap.

4. Installing battery cover (45) (Fig. 6-2) and securing with two Phillips screws (46) and two washers (47).

6-2-10 REASSEMBLY OF MODULES ON UPPER FLOOR (Fig's. 6-1 and 6-3)

A. Install CLOCK DIVIDER (30) (Fig. 6-1) by attaching:

1. Two Phillips screws (25), two lock washers (26) and two flat washers (27) to secure Clock Divider (30) to upper floor (23).

2. Circular connector to mating connector (29). Rotate connector clamp to lock in place.

3. Two coax cables to respective connectors.

B. Install TCXO DISTRIBUTION AMPLIFIER (13) (Fig. 6-1) by attaching:

1. Two Phillips screws (15) and two lock washers (14) to secure amplifier (13) to upper floor (23).

2. Five coax cables to their respective connectors and solder wire to feed-thru.

C. Install TCXO MASTER OSCILLATOR (1) (Fig. 6-1) by attaching:

1. Two hex nuts (6), one lock washer (5) and one terminal lug (4) to secure Oscillator (1) to mounting bracket (3).

2. Tube socket (2) to mating connector.

3. Coax cable to its connector (screw on and tighten with ½" open-end wrench).

4. Two Phillips screws (17) and two lock washers (16) securing mounting bracket (3) to Upper Floor.

D. Install 1200-2200 MHz OSCILLATOR (28) (Fig. 6-1) by attaching:

1. Four Phillips screws (21) and four lock washers (22) to secure the Oscillator (28) to Upper Floor (23).

2. Four coax cables to their respective connectors.

3. Solder wire to feed-thru.

NOTE

See Item E, Step 3 for soldering wires from AGC Board to feed-thru.

E. Install AGC CIRCUIT BOARD (10) (Fig. 6-1) as follows:

1. Slide top edge of board (10) (edge with two coax connectors) up into bracket (9) so that two hex nuts (12) and two lock washers (11) are outside the lip of bracket (9). Tighten hex nuts (12).

2. Two Phillips screws (7) and two lock washers (8) to secure AGC circuit board's mounting bracket (9) to Oscillator (28).

3. Solder wire from AGC Board (10) to feed-thru on Oscillator (28).

4. Two coax cables to board connectors.

F. Install HETERODYNE AMPLIFIER/÷2 PRESCALER (24) (Fig. 6-1) by attaching:

1. Two Phillips screws (19), two lock washers (18) and two spacers (20) to secure assembly (24) to Upper Floor (23).

2. Two coax cables to respective connectors and solder wires to respective feed-thru's.

G. SECURE UPPER FLOOR (Fig. 6-3) by attaching two Phillips screws (149) and lock washers (150) to secure floor to two frame support members (138) and (147).

6-2-11 CASE ASSEMBLY (Figure 6-2). Install:

A. Case by sliding case on FM/AM-1100S/A and attaching with fourteen Phillips screws (20 and 21) and ten lock washers (19).

B. Top lid (22) by sliding hinge halves onto case hinge pins and locking latches.

SECTION 7-MODULE TESTING

7-1 GENERAL

This section contains detailed testing procedures for most of the modules and PC Boards which make up the FM/AM-1100S/A. These procedures are intended to aid the technician in determining whether a given module (suspected as being defective) is readily repairable or requires replacement. To properly use the information in this section, the defective module should already have been isolated and identified, using the troubleshooting flowcharts in Section 5 of this manual. Once this has been done, the technician should refer to the appropriate paragraph in this section for further module testing recommendations (see paragraph 7-1-6 for index of module testing procedures).

Each test procedure in this section contains the following information for the module being tested:

1. Functional Block Diagram
2. Theory of Operation
3. Disassembly Procedure
4. Preparation for Testing
5. Step-by Step Test Procedure
6. Reassembly Procedure

During testing, the technician will find it necessary to refer to selected circuit schematics, interconnect diagrams, PC Board layout drawings, mechanical assembly drawings, etc. These drawings are located in the following sections of this manual:

Mechanical Assy Drawings - Section 8
PC Board Layouts Drawings - Section 9
Interconnect Diagrams & Schematics - Section 10

An index is provided at the beginning of each of these sections for ease of locating the desired drawings.

7-1-1 MODULES RECOMMENDED FOR FACTORY REPAIR

The 1200-2200 MHz Oscillator assembly is not field repairable due to specialized test equipment, delicate handling, and critical tolerance requirements. A test procedure is given in Section 7 to determine if the 1200-2200 MHz Oscillator is faulty. A circuit schematic is provided in Section 10 for reference purposes only. The 1200-2200 MHz Oscillator should be returned to IFR Systems for repair.

7-1-2 MOTHER BOARD AND FRONT PANEL TROUBLESHOOTING CONSIDERATIONS

The FM/AM-1100S/A Mother Board and Front Panel Assy consist primarily of interconnecting wires and switches. Troubleshooting a fault within these modules should consist primarily of making continuity checks between specific wires and/or switches, using the circuit schematics provided in Section 10.

NOTE

> Refer to paragraph 7-13 (Regulator/Timer PC Board Testing) for troubleshooting recommendations on power transistor Q10201 which is located on the Mother Board.

7-1-3 SAFETY PRECAUTIONS

As with any piece of electronic equipment, extreme caution should be taken when troubleshooting "live" circuits. Certain circuits and/or components within the FM/AM-1100S/A contain extremely high voltage potentials, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH (see WARNINGS below)! When troubleshooting the FM/AM-1100S/A, be sure to observe the following precautions:

WARNING

> THE OSCILLOSCOPE INVERTER PC BD AND CRT CATHODE IN THE SPECTRUM ANALYZER/OSCILLOSCOPE MODULE CARRY A VOLTAGE POTENTIAL OF 2000 VDC, WHEN THE FM/AM-1100S/A IS ENERGIZED OR DE-ENERGIZED. DO NOT CONTACT THESE OR ANY ASSOCIATED COMPONENTS DURING TROUBLESHOOTING OR CALIBRATION.
>
> AS LONG AS THE BATTERY IS INSTALLED IN THE FM/AM-1100S/A, A 12 VDC POTENTIAL EXISTS AT VARIOUS POINTS ON REAR PANEL, FRONT PANEL, AND MOTHER BOARD, REGARDLESS OF THE FRONT PANEL PWR/OFF/BATT SWITCH POSITION.
>
> WHEN WORKING WITH "LIVE" CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK, TO AVOID SERIOUS SHOCK HAZARD.
>
> REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE TROUBLESHOOTING AND/OR REPAIRING LIVE CIRCUITS.
>
> USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS.
>
> FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDERNEATH ALL POWERED BENCH EQUIPMENT, AS WELL AS A RUBBER FLOOR MAT UNDERNEATH TECHNICIAN'S CHAIR.

WARNING

HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.

7-1-4 TEST EQUIPMENT REQUIREMENTS

Appendix C at the rear of this manual contains a comprehensive list of test equipment suitable for performing any of the procedures in this manual. Any other equipment meeting the specifications listed in the appendix, may be substituted in place of the recommended models.

NOTE

For certain procedures in this manual, the equipment listed in Appendix C may exceed the minimum required specifications; for this reason, minimum use specifications appear within all module test procedures, where accessory test equipment is required.

7-1-5 DISASSEMBLY REQUIREMENTS

Removal of the exterior case from the FM/AM-1100S/A is a primary requirement for performing the test procedures in this section. In addition, most procedures will also require the module under test to be removed from the set to allow access to testpoints, internal components etc. Refer to "SECTION 6, DISASSEMBLY," for instructions on removing individual modules from the set. Instructions for further disassembly of the module are contained within the individual test procedures in this section.

7-1-6 INDEX OF MODULE TESTING PROCEDURES

7-2 AGC SYSTEM PC BOARD

7-2-1 THEORY OF OPERATION (Reference AGC System Circuit Schematic in Section 10)

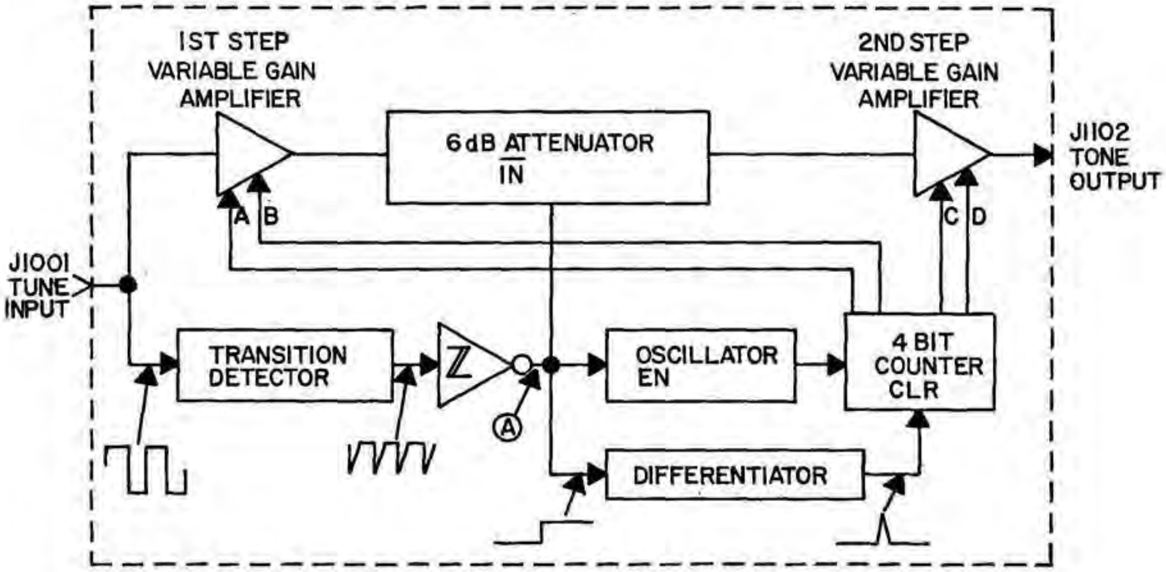


Figure 7-1 AGC System Block Diagram

A. General

The AGC system consists of a variable gain amplifier whose gain is adjustable in 16 steps of 2 dB increments. This circuit also has a 6 dB attenuator associated with the amplifiers. The purpose of the AGC system is to compensate for the non-linear voltage vs frequency curve of the 1200-2200 MHz VCO. This is accomplished by adjusting the gain of the fast tune line for the range within which it must operate for the frequency selected.

B. Transition Detector

The transition detector (Q1001, CR1001) will produce one negative going spike for each input transition. The negative going spikes are produced for both positive going and negative going transitions at the input. These spikes discharge capacitor C1003 and reduce the potential into the Schmitt trigger inverter.

C. Schmitt Trigger Inverter

X1001 is an operational amplifier configured as a Schmitt trigger inverter. The output will go high upon receiving the first negative going spike from the transition detector and will remain high until the negative going spikes cease and C1003 is permitted to charge.

D. Oscillator

X1003 and its associated components form a gated oscillator. The gate is controlled by the output of the Schmitt trigger inverter. When the Schmitt trigger inverter's output is high, the oscillator is permitted to oscillate; when the output is low, the oscillator will stop.

E. Differentiator

The differentiator is composed of R1010 and C1004. When the output of the Schmitt trigger inverter goes high, the differentiator will produce a positive going spike to the counter's preset input, presetting the counter to 0000.

F. Counter

X1002 is a 4 bit counter. It is clocked by the oscillator when the oscillator is enabled. The output of the counter is used to adjust the gain of the two-step variable gain amplifiers.

G. 1st Step Variable Gain Amplifier

The first step variable gain amplifier is comprised of X1004, X1005A and X1005B. With the A and B outputs of the counter at logic 0, X1005A and X1005B will be open. This will allow -2 dB and -4 dB respectively of attenuation in the feedback loop of the operational amplifier. The net result is a gain of +6 dB for the stage. If the A output of the counter goes to a logic 1, X1005A will close, bypassing the 2 dB attenuator. In this condition, the net gain of the stage is +4 dB. Should the B output of the counter also go high, X1005B will be closed, bypassing the -4 dB attenuator. With both attenuators bypassed, the net gain of the stage is unity. Therefore, the 1st step variable gain amplifier may be adjusted from 0 dB to +6 dB of gain, in 2 dB steps.

H. 2nd Step Variable Gain Amplifier

X1006, X1005C and X1005D comprise the 2nd step variable gain amplifier. This amplifier behaves in a manner similar to the 1st step variable gain amplifier, with the following exceptions: X1005C is controlled by the C output of the counter and will bypass an 8 dB attenuator. X1005D is fed by the D output of the counter and will bypass a 16 dB attenuator. The net gain of this stage is adjustable from 0 dB to +24 dB in 8 dB steps.

I. 6 dB Attenuator

R1026 and R1027 form a 6 dB attenuator which may be bypassed by Q1002. When the output of the Schmitt trigger inverter is high, the attenuator is bypassed, yielding unity gain.

J. Interaction of AGC System's Circuits

If the loop gain of the high frequency phase lock system is too low, phase lock will not be achieved. If the loop gain is too high, the phase lock system will be unstable because the phase comparator will overcompensate for phase error. The proper amount of gain needed will change with frequency, due to the non-linear curve of the 1200-2200 MHz VCO. The AGC system adjusts the gain as described below.

When the setting of any of the three leftmost FREQUENCY MHz Thumbwheels is disturbed, the output of the phase comparator (i.e., tune line J1001) will jump to its uppermost or lowermost limits in an effort to slew the 1200-2200 MHz VCO in the appropriate direction. The transition on this tune line (J1001) is detected by the transition detector, discharging C1003 and causing the Schmitt trigger inverter's output to go high. When this line goes high (see A, in Figure 7-1), three events take place:

1. The 6 dB attenuator is bypassed.

2. The counter is reset via the differentiator.

3. The oscillator is enabled.

At this instant, all four lines from the counter are at logic "0", all of the step attenuators in the feedback loops are in the circuit and the 6 dB attenuator is bypassed. As a result, the gain from J1001 to J1002 is approximately +30 dB (+6 dB from the first stage and +24 dB from the second stage) and the AGC system is at maximum gain.

Assume that the loop is unstable or +30 dB is too much gain. With the loop unstable, the tune line will oscillate and a square wave may be seen at J1001. The square wave will cause a series of negative going spikes at the output of the transition detector, keeping the charge on C1003 relatively low. This will cause the initial conditions to persist.

With the oscillator enabled, a clock pulse is produced and the counter will increment. With 0001 in the counter, the 2 dB attenuator in the feedback loop of the first step variable gain amplifier will be bypassed, giving the stage a net gain of only +4 dB. Now the overall gain from J1001 is +28 dB or 2 dB less than our initial condition.

As the counter continues counting, the overall gain from J1001 to J1002 will decrement by 2 dB for each count.

At some point, the gain of the AGC system will come into the proper range for the newly selected 1200-2200 MHz VCO frequency and the loop will stabilize.

When the loop becomes stable, tune line J1001 will exhibit a DC level. The transition detector will allow C1003 to charge, allowing the output of the Schmitt trigger inverter (see A , Figure 7-1) to go low, resulting in the following:

1. The oscillator is stopped and the counter retains its current count value.
2. The 6 dB attenuator is enabled, further reducing the gain of the AGC system by additional -6 dB for the proper operating point.

The AGC system remains in this state until the FREQUENCY MHz Thumbwheels are again disturbed.

Three dip switches are provided on the AGC System PC Board for maintenance purposes. These switches will enable the technician to:

1. Slow the oscillator frequency.
2. Stop the oscillator.
3. Cycle the system.

A crude digital to analog converter for the counter is also provided for test purposes and is available at TP1001.

7-2-2 REMOVAL & DISASSEMBLY

A. Removal

No removal is necessary for testing AGC System PC Board . Open Upper Floor for access to AGC PC Board.

B. Disassembly

No disassembly of AGC System PC Board is required.

7-2-3 PREPARATION FOR TESTING

A. Required Test Equipment

DC Voltmeter .... Any

Oscilloscope .... Dual Trace, with a 1 MHz bandwidth or greater

Oscilloscope Probe .... Any

SMB "T" Connector .... Any

50Ω Coax Cable .... BNC one end, SMB on other end

1' x 1' Rubber Mat .... Any

B. Preparation (Reference AGC System PC Board in Section 9)

1. Disconnect P1001 from J1001.
2. Connect SMB "T" connector to J1001.
3. Connect coax cable connector P1001 to one end of "T" connector.
4. Connect coax cable from CH2 on Oscilloscope to remaining end of "T" connector.
5. Connect Oscilloscope Probe between CH1 of Oscilloscope and pin 1 or 3 of TP1001 on AGC System PC Board.
6. Set RF FREQUENCY MHz Thumbwheels (34) to 9000000.

7-2-4 TESTING

A. Reference AGC System Circuit Schematic in Section 10 and AGC System PC Board in Section 9.

1. Set FM/AM-1100S/A PWR/OFF/BATT Switch (11) to "PWR".
2. Measure voltage at E1001 and verify Voltmeter displays +11 VDC (±.05V).
3. Apply power to external Oscilloscope.
4. Set Dip Switch SW1-3 and SW1-2 to "ON".
5. Set RF FREQUENCY MHz Thumbwheels (34) to 0000000 and verify CH1 on Oscilloscope displays a flat trace at ground potential.
6. Set Dip Switch SW1-1 to "ON".

7. Set Dip Switch SW1-3 to "OFF" and:

   a. Verify CH1 displays 16 levels of DC voltage in roughly even steps from ground to +11 VDC.

   b. Note the level at which CH2 no longer displays a square wave and becomes a DC level (loop becomes stable).

8. Set Dip Switch SW1-1 to "OFF".

9. Disturb loop stability by changing leftmost RF FREQUENCY MHz Thumbwheel (34) to 1, then back to 0 (frequency 000.0000). Verify CH1 on Oscilloscope is steady at the level noted in step 7b.

10. Set Dip Switch SW1-2 to "OFF".

7-2-5 <u>REASSEMBLY</u>

1. Set all power OFF.

2. Disconnect test equipment from AGC System PC Board.

3. Connect P1001 to J1001.

4. Close Upper Floor.

7-3 CLOCK DIVIDER

7-3-1 THEORY OF OPERATION (Reference Clock Divider Circuit Schematic in Section 10)

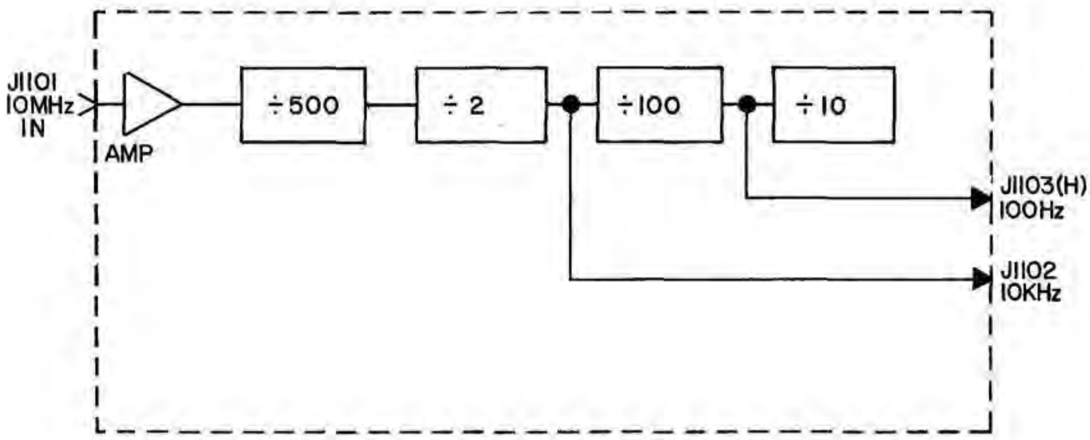


Figure 7-2 Clock Divider Block Diagram

10 MHz enters the Clock Divider through J1101 and is applied to amplifier Q1201. Q1201 will provide a 10 MHz signal at TTL levels. From Q1201, the signal is divided by 500 in X1201A, X1202 and X1203, to produce 20 kHz. From X1203, the 20 kHz signal is directed to X1201B, where it is divided by 2 to produce 10 kHz, which is available at J1102. The 10 kHz signal is also applied to X1204 and X1205, where it is divided by 100 to produce 100 Hz, which is available at J1103, Pin H.

7-3-2 REMOVAL & DISASSEMBLY

A. Removal

Removal of the Clock Divider module from within the FM/AM-1100S/A is necessary only if repair or replacement of the Clock Divider PC Board is required. Otherwise, the Clock Divider can be tested in its assembled state, while attached to the Upper Floor Assy, and the disassembly steps below may be omitted.

B. Disassembly (Refer to Clock Divider Mechanical Assy drawing in Section 8 and Clock Divider PC Board in Section 9)

TOOLS REQUIRED: Soldering Iron
¼" Nut Driver

1. Remove cover halves (3) and (4) by removing four screws (1) and four lock washers (2).

2. Position enclosure (4) so component side of Clock Divider PC Board is visible.

3. Unsolder wire at junction of E1204 and FL1101.

4. Unsolder R1206 from E1202.

5. Unsolder R1205 from J1102.

6. Unsolder R1201 from J1101.

7. Remove PC Board (5) from enclosure (4).

7-3-3 PREPARATION FOR TESTING

A. Required Test Equipment

Frequency Counter	Resolution of .1 Hz capable of counting 10 MHz.
DC Voltmeter	Any
Frequency Counter Probe	Any
1' X 1' Rubber Mat	Any
50Ω Coax Cable	BNC one end, SMB other end

B. Preparation

No special preparation is required, if Clock Divider is to be tested while attached to the Upper Floor Assy, in its assembled state. If, however, the Clock Divider is removed from within the FM/AM-1100S/A and is completely disassembled, the following steps are recommended:

1. Place rubber mat over top of exposed Mother Board modules and PC Boards, for purposes of insulating the module under test from other powered components.

2. Connect coax cable connectors P1101, P1102 and P1103 within FM/AM-1100S/A to their respective mating connectors on Clock Divider PC Board.

3. Position Clock Divider PC Board on top of rubber mat.

7-3-4 TESTING

A. Reference Clock Divider Mechanical Assy drawing in Section 8, Clock Divider PC Board in Section 9 and Clock Divider Circuit Schematic in Section 10.

1. Set FM/AM-1000S/A PWR/OFF/BATT Switch (11) to "PWR".

2. Measure voltage at FL1101 and verify Voltmeter displays 5 VDC (+.25 V, -.20 V).

3. Connect BNC to SMB coax cable between J1102 and input of Frequency Counter. Verify Frequency Counter displays 10 kHz (±1 Hz).

4. Place Frequency Counter Probe to E1202 and verify Frequency Counter displays 100 Hz (±0.1 Hz).

5. Connect BNC to SMB coax cable between J1102 and input of Oscilloscope. Verify voltage swings <0.8 V and >3.5 V (TTL input requirements).

6. Connect Oscilloscope Probe to E1202. Verify voltage swings <0.8 V and >3.5 V (TTL input requirements).

7-3-5 <u>REASSEMBLY</u>

A. With all power "OFF", disconnect test equipment from Clock Divider. If Clock Divider has been totally disassembled, perform reassembly in reverse order of disassembly procedure described in paragraph 7-3-2 and reinstall assembly within FM/AM-1100S/A.

7-4 DUAL TONE GENERATOR

7-4-1 THEORY OF OPERATION (Reference Dual Tone Generator Circuit Schematic in Section 10)

A. PC Board #1

1. BCD Thumbwheel Switches. The BCD Thumbwheel Switches (SW8601 - SW8606) form a 6 digit BCD Thumbwheel Switch with SW8601 being the least significant digit. This BCD information must be converted to binary prior to being applied to the binary adders on PC Board #3.

2. BCD Down Counter. The BCD Down Counter consists of X8601 thru X8607. This 24 bit counter forms the first stage of the BCD to binary converter. The counter is preset to the selected frequency using BCD coding. The counter is then decremented while the binary Up Counter is incremented (the binary Up Counter is located on PC Board #2). Thus, BCD to binary conversion is accomplished by transferring the count in the BCD Down Counter to the binary Up Counter. The BCD Down Counter has a true (TC) and an inverted ($\overline{TC}$) terminal count output. From X8601, the TC output is used to indicate to PC Board #2 that the BCD Down Counter is emptied. The $\overline{TC}$ output is applied to the disable logic on PC Board #5.

3. >1 kHz Decoding Logic. CR8601 thru CR8604 from the >1 kHz decoding logic. These diodes form a 4-input OR gate with inputs tied to the 4 BCD outputs of the 1000 Hz digit of the thumbwheel switches. When any value other than zero is selected, the output of the OR gate goes to the Logic 1. The output of the >1 kHz decoding logic is used to control the 1 kHz/10 kHz LP Filter Select Switch on PC Board #5.

4. >10 kHz Decoding Logic. CR8605 thru CR8608 form the >10 kHz decoding logic. These diodes form a 4-input OR gate with inputs tied to the 4 BCD outputs of the 10,000 Hz digit of the thumbwheel switches. When any value other than zero is selected, the output of the OR gate goes to logic 1. The output of the >10 kHz decoding logic is used to control the LP Filter Bypass Switch on PC Board #5.

B. PC Board #2

1. BCD to Binary Converter. The binary Down Counter, X8704, controls the cycling of the BCD to Binary Converter. At the end of each cycle (when TC goes high), X8704 is preset to $11_{(2)}$. Upon presetting, the clock for both the BCD Down Counter and the binary Up Counter is stopped by inverters #1 and #12, and AND gate #2 (all part of X8701). The binary Down Counter (X8704) starts counting as a

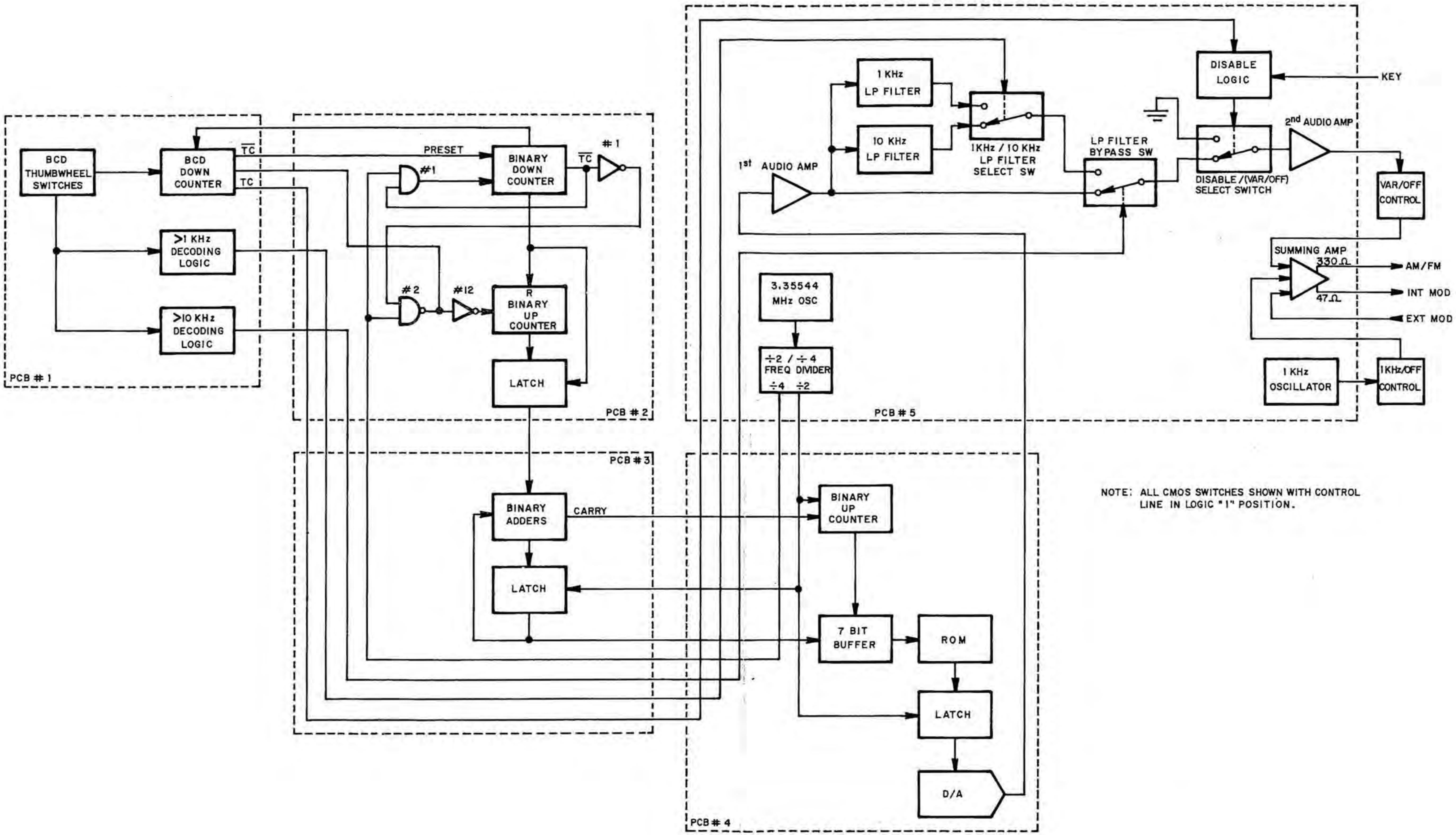


Figure 7-3 Dual Tone Generator Block Diagram

result of the binary Down Counter's $\overline{TC}$ line going high and gating the 838.9 kHz clock thru AND gate #1. The binary Down Counter holds the BCD Down Counter (on PC Board #1) preset line high for 4 counts. When the binary Down Counter reaches count 7, it provides a logic 1 to the Latches and to the binary Up Counter for 4 counts in order to store the final count of the binary Up Counter in the 20 bit Latch and to reset the binary Up Counter to zero. When the binary Down Counter reaches count zero, the $\overline{TC}$ line goes low (at X8704, pin 7), disabling the binary Down Counter's clock and enabling the clock to the BCD Down Counter and the binary Up Counter. Each time the BCD Down Counter (on PC Board #1) is decremented by one, the binary Up Counter (on PC Board #2) is incremented by one. When the BCD Down Counter reaches count zero, the binary Down Counter is preset to $11_{(2)}$ and the cycle repeats itself.

C. PC Board #3

1. Latch. The Latch on PC Board #3 consists of X8802, X8801, and X8803. These three I.C.'s form a 20 bit Latch. The input to the Latch is the sum output of the binary Adders. The output of the Latch is fed back to the A input of the binary Adders.

2. Binary Adders. The binary Adders consist of X8808, X8807, X8806, X8805, and X8804. The output of the BCD to binary Converter is applied to the B input of the Adders. The output (i.e., the sum of A and B) is applied to the Latch. When the Latch is clocked, the input to the Latch is transferred to the A input of the Adders. The clock signal to the Latch occurs every 596 nS. Thus, the value of the setting of the Thumbwheel Switch is added to the sum (i.e. the sum stored in the Latch) every 596 nS. At this rate, the Adders will overflow at the frequency of 128X the setting of the Thumbwheel Switches. The carry output of the Adders is active for 596 nS when the Adders overflow. This carry output is fed to the binary Up Counter on PC Board #4.

D. PC Board #4

1. PC Board #4 converts the pulse train from the binary Adders to a sine wave. The binary Up Counter (X8903) is a 4 bit binary counter, the output of which is applied to the lower 4 bits of the 7 bit Buffer. The upper 3 bits of the 7 bit Buffer come from the 3 most significant bits of the Adders on PC Board #3. The output of the 7 bit Buffer (Q8901 and X8902) is applied to the address lines of the sine wave ROM (X8906). The 8 bit output of the sine wave ROM is applied to a Latch (X8905), which is applied to a D/A Converter (X8901 and X8904). This

constructs a sine wave based upon information supplied by the ROM. The sine wave is quantized. That is, it contains a minor amount of stair-stepping on the waveform. The sine wave is applied to PC Board #5.

F. <u>PC Board #5</u>

PC Board #5 performs the mixing, filtering, and amplification of the audio tones as well as producing the 1 kHz fixed tone.

1. 1 kHz Filter. X9003 forms an active 1 kHz LP Filter. When the Thumbwheel Switches are set to a value less than 1000 Hz, the 1 kHz LP Filter is switched into the circuit by the CMOS Switch which is controlled by the output of the >1 kHz decoding logic on PC Board #1. The filter removes the stair-stepping from the sine wave as well as reducing the noise bandwidth of the Tone Generator.

2. 10 kHz Filter. X9002 forms the active 10 kHz LP Filter. When the Thumbwheel Switches are set to a value between 1000 Hz and 9999.9 Hz, this filter is switched into the circuit by the CMOS switches controlled by the >1 kHz and >10 kHz decoding logic. This filter removes any stair-stepping and reduces the noise bandwidth of the Tone Generator.

3. Disable Logic. CR9002 and CR9004 disable the variable tone if 00000.0 Hz is selected or if the tone key line is active.

4. 1st and 2nd Audio Amps. The variable tone audio from PC Board #4 is applied to the 1st Audio Amp (X9006). The audio output of this two-stage I.C. amplifier is applied to the CMOS switches via the Low Pass Filters. The output of the CMOS switches is applied to Audio Amp #2 (X9004A), a voltage follower op-amp. The output of the 2nd Audio Amp is applied to the VAR/OFF Control and from there to the Summing Amp.

5. 3.35544 MHz Oscillator. The 3.35544 MHz Oscillator consists of oscillator-transistor Q9002, buffer-transistor Q9001, and crystal Y9001. This oscillator supplies the ÷2/÷4 Frequency Divider with 3.35544 MHz.

6. ÷2/÷4 Frequency Divider. The X9005B binary counter is used to deliver 1.67772 MHz to the Adders and 838.86 kHz to the BCD to Binary Converter.

7. 1 kHz Oscillator. X9007 forms the 1 kHz level controlled sine wave oscillator. The output of the oscillator is applied to the 1 kHz/OFF Control and then to the Summing Amp.

8. Summing Amp. The Summing Amp (X9004B) combines the variable tone, 1 kHz tone, and external modulation; and applies the output to the AM/FM Switch, the INT MOD/RCVR/RCVR (DET OFF) Switch, and the INT MOD OUT Connector.

7-4-2 REMOVAL & DISASSEMBLY

A. Removal

The Dual Tone Generator can be tested without removing the assembly from the FM/AM-1100S/A. To gain access to Dual Tone Generator:

1. Carefully place the FM/AM-1100S/A on its right side.

2. Swing open Lower Floor Assy per the instructions provided in Section 6 of this manual.

B. Disassembly (Refer to Dual Tone Generator Mechanical Assy drawing in Section 8 and Dual Tone Generator PC Board #5 in Section 9).

1. Disconnect ribbon cable connector P8501 from J8501.

NOTE

Before disconnecting P8501/J8501, carefully note how this connector is mated. Since this connector is not keyed, it is important to remember its mating position when reconnecting them.

2. Remove four screws (1) and four lock washers (2) which secure Dual Tone Generator PC Board #5.

3. Remove four threaded standoffs (3) which secure Dual Tone Generator PC Board #4.

4. Remove four standoffs (4) which secure Dual Tone Generator PC Board #3.

5. Remove four standoffs (4) which secure Dual Tone Generator PC Board #2.

6. Remove four threaded standoffs (3) and four screws (5) which secure Dual Tone Generator PC Board #1.

7. Unfold and position the five PC Boards so the component side of each board is readily accessible.

CAUTION

TO AVOID SHORT CIRCUIT HAZARD DURING TESTING, DO NOT ALLOW INDIVIDUAL PC BOARDS TO CONTACT ONE ANOTHER OR ANY OTHER COMPONENTS WITHIN FM/AM-1100S/A.

7-4-3 PREPARATION FOR TESTING

A. Required Test Equipment

Digital Voltmeter .... Any

Signal Generator .... Capable of generating 1 kHz at 4.0 Volts peak-to-peak

Oscilloscope .... 10 MHz Bandwidth (minimum)

Frequency Counter .... Capable of counting to approximately 11 MHz

Oscilloscope Probe .... Any

Frequency Counter Probe .... Any

B. Preparation

None required.

7-4-4 TESTING

A. Reference Dual Tone Generator Circuit Schematic in Section 10 and Dual Tone Generator PC Boards in Section 9.

1. Set PWR/OFF/BATT Switch (11) to "PWR".

2. Rotate VAR/OFF Control (25) fully cw. Measure voltages as follows:

J8501, Pin #	Voltage	Tolerance
1	GND	——
2	GND	——
12	-12 V	±1.5 V
13	+11 V	±0.05 V
14	+5 V	+0.25 V, -0.20 V
15	GND	——

3. Place Frequency Counter Probe to collector of Q9001 on PC Board #5. Verify frequency of 3.35544 MHz (±0.002%).

4. Place Frequency Counter Probe to Pin 2 of X8903 PC Board #4.

5. Set MODULATION FREQ Hz Thumbwheels (27) to a value less than 1000.0 Hz but greater than 10 Hz. Verify Frequency Counter displays value below, within ±0.002%.

   Frequency = 16 X (setting of thumbwheels)

6. Set MODULATION FREQ Hz Thumbwheels (27) to a value equal to or greater than 1000.0 Hz. Verify Frequency Counter displays value below, within ±0.002%.

   Frequency = 16 X (setting of thumbwheels)

7. Place Oscilloscope Probe to pin 8 of E8508 on PC Board #5. Verify Oscilloscope displays a sine wave of approximately 5 Vp-p, with some quantization.

8. Move Oscilloscope Probe to pin 6 of J8501. Verify Oscilloscope displays a sine wave of approximately 4.5 Vp-p with no quantization and which is symmetrical about ground. Check for clipping.

9. Move Oscilloscope Probe to pin 11 of J8501. Verify Oscilloscope displays a sine wave approximately 4.5 Vp-p that is symmetrical about ground.

10. While observing Oscilloscope display, slowly rotate VAR/OFF Control (25) ccw. Verify sine wave smoothly diminishes in amplitude, until just a trace remains.

11. Rotate VAR/OFF Control (25) cw while observing Oscilloscope display. Verify sine wave increases smoothly up to approximately 4.5 Vp-p.

NOTE

If Dual Tone Generator does not pass Steps 9, 10, or 11, fault lies in front panel circuitry, <u>not</u> in Dual Tone Generator.

12. Short pin 8 of J8501 to ground. Verify Oscilloscope does not display a sine wave.

13. Remove short between pin 8 of J8501 and ground.

14. Move Oscilloscope Probe to pin 4 of J8501. Verify a sine wave of approximately 12 Vp-p is present.

15. Set MODULATION FREQ Hz Thumbwheels (27) to a value greater than 1000.0 Hz. Verify sine wave is still present.

16. Set MODULATION FREQ Hz Thumbwheels (27) to a value greater than or equal to 10 kHz. Verify sine wave is still present.

17. Rotate VAR/OFF Control (25) fully ccw to "OFF".

18. Rotate 1 kHz/OFF Control (26) fully cw.

19. Move Oscilloscope Probe to pin 3 of J8501. Verify a sine wave of approximately 6 Vp-p is present.

20. Move Oscilloscope Probe to pin 10 of J8501. Verify a sine wave of approximately 6 Vp-p is present.

21. While observing Oscilloscope display, rotate 1 kHz/OFF Control ccw. Verify sine wave decreases smoothly in amplitude until only a trace is left.

22. Rotate 1 kHz/OFF Control (26) cw while observing Oscilloscope display. Verify sine wave increases smoothly in amplitude.

NOTE

If Dual Tone Generator does not pass Steps 20, 21, or 22, fault is in front panel circuitry, <u>not</u> in Dual Tone Generator.

23. Rotate 1 kHz/OFF Control (26) fully cw.

24. Move Oscilloscope Probe to pin 5 of J8501. Verify a sine wave of approximately 12 Vp-p is displayed.

25. Place Frequency Counter Probe on pin 3 of J8501. Verify Frequency Counter displays 1000 Hz, ±20 Hz.

26. Rotate 1 kHz/OFF Control (26) fully ccw to "OFF".

27. Inject a 1 kHz audio tone at 4.0 Vp-p into pin 7 of J8501.

28. Place Oscilloscope Probe to pin 5 of J8501. Verify Oscilloscope displays a sine wave of approximately 2 Vp-p.

7-4-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from Dual Tone Generator. If necessary, reassemble Dual Tone Generator in reverse order of disassembly procedure described under paragraph 7-4-2.

7-5 FIRST MIXER

7-5-1 THEORY OF OPERATION (Reference 1st Mixer Circuit Schematic in Section 10)

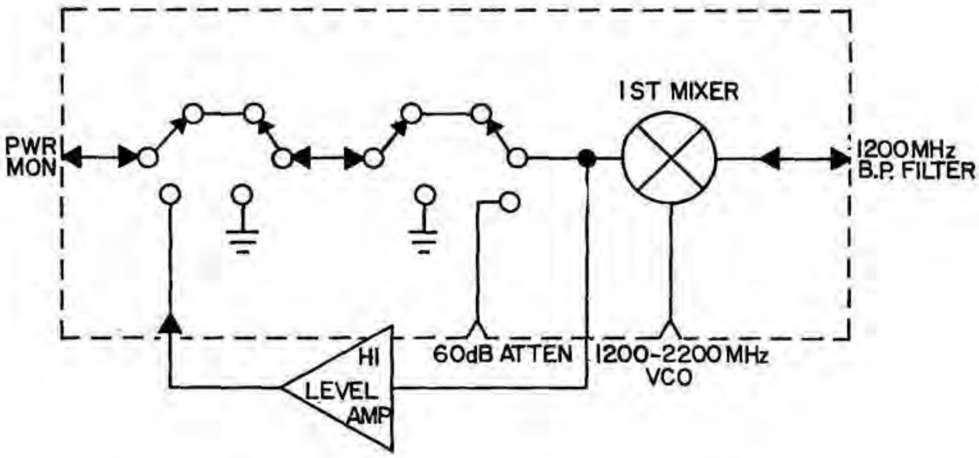


Figure 7-4 1st Mixer Block Diagram

A. Relays

When receiving signals off the air, K4801 and K4802 are de-energized. RF from the Power Termination Assembly enters J4801, passes through both sets of contacts in K4802 and both sets of contacts in K4801 to the 1st Mixer. When receiving through the TRANS/RCVR Connector, both K4801 and K4802 are energized. RF from the 60 dB of attenuation enters the 1st Mixer via J4802 and passes through one set of contacts in K4801 to the 1st Mixer.

In the generate mode, K4801 and K4802 are de-energized and the path of the RF is from the 1st Mixer through both sets of contacts in K4801 and K4802 and out J4801.

When generating with an active High Level Amplifier, K4801 and K4802 are energized. The generated RF travels from the 1st Mixer through R4801 and out J4805.

The RF is then amplified by the High Level Amplifier and is fed back into the 1st Mixer through J4806. The RF passes through one set of contacts in K4802 and out J4801 to the Power Termination Assembly.

B. 1st Mixer

In the receive mode, incoming RF enters the Mixer (MX4801) through the IF port, while the 1st Local Oscillator frequency of 1200 to 2200 MHz is simultaneously applied to the RF port of MX4801. The resultant difference frequency of 1200 MHz leaves MX4801 at the LO (Local Oscillator) port and is passed out through J4804.

In the generate mode, a generated IF of 1200 MHz is injected into the LO port of MX4801 via J4804 and is mixed with the 1st Local Oscillator frequency of 1200 to 2200 MHz. The output present at the IF port of MX4801 is the difference frequency of 0 to 999.9999 MHz.

7-5-2 REMOVAL & DISASSEMBLY

A. Removal

Remove the 1st Mixer from within the FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

NOTE

Further disassembly of the 1st Mixer is not required for testing purposes (paragraph 7-5-4). If, however, repair or replacement of internal components is necessary, continue with disassembly steps below:

B. Disassembly (Reference 1st Mixer Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Soldering Iron
Small Phillips Screwdriver

1. Remove cover (1) by removing three Phillips screws (2) and three lock washers (3) which secure cover to assembly.
2. Unsolder resistor R4801 from lead of mixer (7) and connector J4805.
3. Remove bar (6) holding mixer in place, by removing one Phillips screw (4) and one lock washer (5).
4. Remove mixer (7) from assembly by:
   a. Unsoldering wire from connector J4803.
   b. Unsoldering wire from connector J4804.

7-5-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer .... Capable of measuring 1200 MHz

Signal Generator .... Capable of generating 1200 MHz at -20 dBm

Signal Generator .... Capable of generating 1080 MHz at +12 dBm

A. Required Test Equipment (Continued)

Power Supply	Capable of producing +11 VDC at 100 mA
50Ω Coax Cable	BNC connectors on both ends
50Ω Coax Cable	BNC on one end, SMA on other end
Two 50Ω Coax Cables	BNC on one end, SMB male on other end

NOTE

50Ω Coax Cables should be calibrated for insertion loss at 1000 MHz.

B. Preparation

1. Connect 50Ω coax cable (BNC/BNC) between output of Signal Generator and input of Spectrum Analyzer.

2. Apply power to Spectrum Analyzer.

3. Apply power to Signal Generator. Set Signal Generator output to 1000 MHz at -10 dBm.

4. Adjust Signal Generator to reflect -10 dB on Spectrum Analyzer. Make sure to account for cable loss.

   EXAMPLE: If cable insertion loss is -2 dB, Spectrum Analyzer should reflect -12 dBm to obtain a -10 dB output from Signal Generator.

5. Disconnect 50Ω coax cable between Signal Generator and Spectrum Analyzer.

6. Connect common lead of external Power Supply to 1st Mixer case.

7. Connect +11 VDC lead of external Power Supply to FL4801 of 1st Mixer.

8. Apply power to Power Supply.

7-5-4 TESTING

A. Reference 1st Mixer Circuit Schematic in Section 10 and 1st Mixer Mechanical Assy drawing in Section 8.

   1. Connect 50Ω coax cable (BNC/SMB) between Signal Generator output and J4805 of 1st Mixer.

2. Connect 50Ω coax cable (BNC/SMB) between J4806 and input of Spectrum Analyzer.

   a. Verify isolation is a minimum of 60 dB, using following equation:

      (DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (SIGNAL GENERATOR OUTPUT) = ISOLATION

      EXAMPLE:

      (-13 dB) - (-2 dB) - (-10 dB) =
      -13 dB + 2 dB + 10 dB = -1 dB ISOLATION

3. Disconnect 50Ω coax cable between J4805 and Signal Generator.

4. Connect 50Ω coax cable (BNC/SMA) between Signal Generator and J4802 of 1st Mixer.

5. Disconnect 50Ω coax cable between J4806 and Signal Generator.

6. Connect 50Ω coax cable (BNC/SMB) between J4805 of 1st Mixer and Spectrum Analyzer.

FAIL -27

   a. Verify insertion loss is 12 dB (±4 dB), using following equation:

      (DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (SIGNAL GENERATOR OUTPUT) = INSERTION LOSS

7. Disconnect 50Ω coax cable between J4802 and Signal Generator.

8. Connect 50Ω coax cable (BNC/SMA) between output of Signal Generator and J4801 of 1st Mixer.

9. Disconnect 50Ω coax cable between J4805 and Spectrum Analyzer.

10. Connect 50Ω coax cable (BNC/SMB) between J4806 of 1st Mixer and input of Spectrum Analyzer.

    a. Verify insertion loss is less than 1 dB, using following equation:

       (DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (SIGNAL GENERATOR OUTPUT) = INSERTION LOSS

11. Disconnect +11 VDC Power Supply lead from 1st Mixer.

12. Disconnect 50Ω coax cable between J4801 and Signal Generator.

13. Connect 50Ω coax cable (BNC/SMB) between Signal Generator and J4803 of 1st Mixer. Set Signal Generator output to 1080 MHz at +12 dBm.

14. Connect 50Ω coax cable (BNC/SMB) between J4804 and second Signal Generator. Set Signal Generator output to 1200 MHz at -20 dBm.

15. Disconnect 50Ω coax cable between J4806 and Spectrum Analyzer.

16. Connect 50Ω coax cable (BNC/SMA) between J4801 and Spectrum Analyzer.

    a. Verify Spectrum Analyzer displays a signal of 120 MHz at -25 dBm ($\pm$4 dB).

7-5-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 1st Mixer. If required, reassemble 1st Mixer in reverse order of disassembly procedure described in paragraph 7-5-2 and reinstall 1st Mixer within FM/AM-1100S/A.

7-6 FREQUENCY SELECT SWITCH

7-6-1 <u>THEORY OF OPERATION</u> (Reference Frequency Select Switch Circuit Schematic in Section 10)

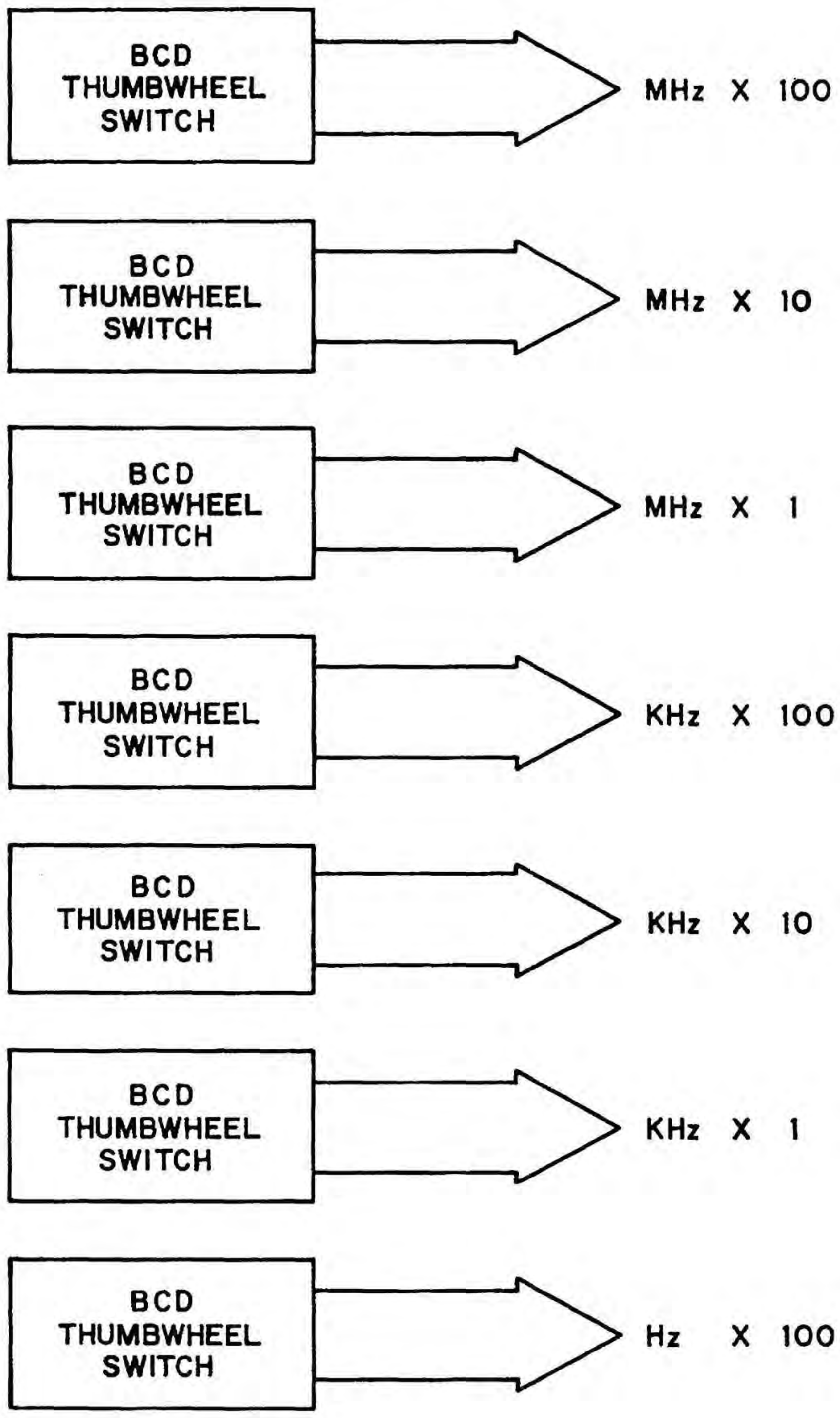


Figure 7-5 Frequency Select Switch Block Diagram

A. The Frequency Select Switch produces seven BCD digits with TTL compatible outputs. Table 7-1 illustrates BCD coding for each of the seven digits. Each thumbwheel digit produces coding for the integers 0-9. These digits carry an implied multiplier of (respectively from left to right) 100,000,000; 10,000,000; 1,000,000; 100,000; 10,000; 1,000; and 100. Thus, the thumbwheel switches may select any frequency from 100 Hz to 999.9999 MHz in 100 Hz increments.

SWITCH POSITION	BIT 2^3	BIT 2^2	BIT 2^1	BIT 2^0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Table 7-1 BCD Outputs for Each Frequency Select Switch Thumbwheel

7-6-2 REMOVAL AND DISASSEMBLY

A. Removal

Remove the Frequency Select Switch from the FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly

None required.

7-6-3 PREPARATION FOR TESTING

A. Required Test Equipment

Power Supply .... Capable of producing +5 V (±0.25 V) at 100 mA

Digital Multimeter .... 3½ digit, 100 KΩ/V

B. Preparation

1. Connect Ground (common) lead of Power Supply to J6402, pin 16.

2. Connect +5 V lead of Power Supply to J6402, pin 2.

Selected Frequency	J6401 Pin #															J6402 Pin #												
	6	7	8	9	2	3	4	5	12	11	10	1	14	16	15	15	9	11	12	8	7	6	5	3	1	13	14	10
000 000 0	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
111 111 1	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø
222 222 2	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø
333 333 3	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø
444 444 4	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø
555 555 5	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø	1	Ø
666 666 6	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø
777 777 7	1	1	1	Ø	1	1	1	Ø	1	1	1	Ø	1	1	1	Ø	1	1	1	Ø	1	1	1	Ø	1	1	1	Ø
888 888 8	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	1
999 999 9	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1	1	Ø	Ø	1
	100 MHz Digit				10 MHz Digit				1 MHz Digit				100 kHz Digit				10 kHz Digit				1 kHz Digit				100 Hz Digit			

Table 7-2 Frequency Select Switch Logic Levels

7-6-4 TESTING

1. Apply power to Power Supply.
2. Set Frequency Select Switch Thumbwheels to first setting in "Selected Freq" column of Table 7-2.
3. Verify logic levels on J6401 and J6402 using Multimeter.

NOTE

Logic Ø = 0.00 V (±0.25 V)

Logic 1 = +5 V (±0.25 V)

4. Repeat Steps 2 and 3 for all settings in "Selected Freq" column.

7-6-5 REASSEMBLY

1. Disconnect Power Supply from Frequency Select Switch.
2. Install Frequency Select Switch per instructions in Section 6 of this manual.

7-7 HETERODYNE AMPLIFIER/÷2 PRESCALER

7-7-1 THEORY OF OPERATION (Reference Heterodyne Amplifier/÷2 Prescaler Circuit Schematic in Section 10)

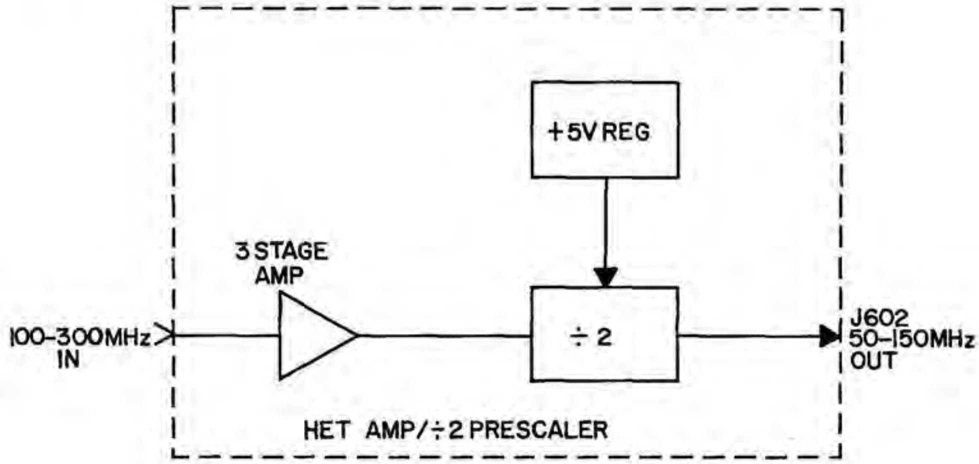


Figure 7-6 Heterodyne Amplifier/÷2 Prescaler Block Diagram

A. Three-Stage Amplifier

Q701, Q702, and Q703 make up the three-stage amplifier. Each of these stages are common emitter amplifiers with a gain of approximately 20 dB each, giving the three-stage amplifier a composite gain of approximately 60 dB. This 60 dB of gain is required to drive the ÷2 prescaler.

B. ÷2 Prescaler

X702 is an ECL (Emitter Coupled Logic) D flip-flop with the $\overline{Q}$ output tied back to the D input. With this configuration, the frequency at the Q output will be 1/2 the frequency presented at the C input. The C input is fed by the three-stage amplifier and the output (J602) is taken off the Q output. R714 will adjust the bias on the C input.

C. +5V Regulator

The +5 V regulator for the ECL circuit is composed of X701 and Q704. X701 will bias Q704 so its emitter (output) will be at the same potential as the junction of R709 and R710 (+5 V nominal).

7-7-2 REMOVAL & DISASSEMBLY

A. Removal

Remove Heterodyne Amplifier/÷2 Prescaler from within the FM/AM-1000S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference Heterodyne Amplifier/÷2 Prescaler Mechanical Assy drawing in Section 8).

TOOLS REQUIRED: Small Phillips Screwdriver
¼" Nut Driver

1. Remove cover halves (3) and (5) by removing four Phillips screws (7) and lock washers (6).

NOTE

Further disassembly of the Heterodyne Amplifier/÷2 Prescaler is not required for testing purposes (paragraph 7-7-4). If, however, repair or replacement of the PC Board is necessary, continue with following disassembly steps.

2. Unsolder wire from FL601 at E701 on Heterodyne Amplifier/÷2 Prescaler PC Board (4).
3. Unsolder wire from FL602 at E702 on Heterodyne Amplifier/÷2 Prescaler PC Board (4).
4. Remove one Phillips screw (1) and lock washer (2) which secure PC Board (4) to cover half (3).
5. Remove two nuts (10) and lock washers (9) from two coax connectors J601 and J602.
6. Remove PC Board (4).
7. Remove two 3/16" spacers (8) from PC Board (4).

7-7-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of generating 100 MHz to 320 MHz at -50 dBm
Spectrum Analyzer	Capable of measuring 50 to 160 MHz
DC Voltmeter	Any

A. Required Test Equipment (Continued)

Two 50Ω Coax Cables .... BNC one end, SMB on other end

Rubber Mat .... Any

B. Preparation

1. Position rubber mat over top of Mother Board modules.
2. Lay Heterodyne Amplifier/÷2 Prescaler (11) on rubber mat.
3. Connect 50Ω coax cable between J601 of Heterodyne Amplifier/÷2 Prescaler and output of Signal Generator.
4. Connect 50Ω coax cable between J602 of Heterodyne Amplifier/÷2 Prescaler and output of Spectrum Analyzer.

7-7-4 TESTING

A. Reference Heterodyne Amplifier/÷2 Prescaler Circuit Schematic in Section 10 and Heterodyne Amplifier/÷2 Prescaler PC Board in Section 9.

1. Set FM/AM-1100S/A PWR/OFF/BATT Switch (11) to "PWR".
2. Measure voltage at FL601. Verify Voltmeter indicates +11 VDC (±.05 V).
3. Measure voltage at FL602. Verify Voltmeter indicates +5 VDC (+.25 V, -.20 V).
4. Measure voltage at emitter of Q704. Verify Voltmeter indicates +5 VDC (+.25 V, -.1 V).
5. Apply power to Signal Generator.
6. Apply power to Spectrum Analyzer.
7. Adjust Signal Generator output to 100 MHz at -50 dBm.
8. Adjust Spectrum Analyzer to display 50-160 MHz at 0 dBm.
9. Rotate R714 fully cw, then back off 1/4 turn.
10. Increase frequency of Signal Generator slowly from 100 MHz to 320 MHz. Verify:
    a. Spectrum of output is in the range of 50 to 160 MHz.
    b. Spectrum maintains narrow uniform width for the range listed in Step 10a above.

c. Spectrum output amplitude does not vary more than 5 dBm through the range listed in Step 10a above.

d. If the requirements in Step 10b above are not met, adjust R714 appropriately to obtain the required results.

7-7-5 REASSEMBLY

With all power "OFF", disconnect test equipment from Heterodyne Amplifier/÷2 Prescaler. Reassemble Heterodyne Amplifier/÷2 Prescaler in reverse order of disassembly procedure described in paragraph 7-7-2 and reinstall assembly within FM/AM-1100S/A.

7-8 HIGH FREQUENCY MULTIPLIER/MIXER

7-8-1 THEORY OF OPERATION (Reference High Frequency Multiplier/Mixer Circuit Schematic in Section 10)

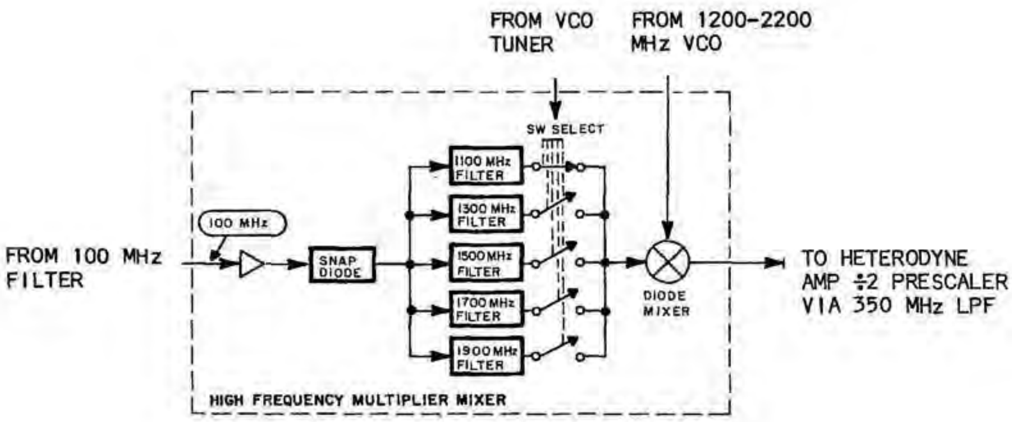


Figure 7-7 High Frequency Multiplier/Mixer Block Diagram

A. 100 MHz Amp

The 100 MHz Amp, Q6301 and Q6302, consists of two common emitter stages. The first stage is Class A, while the second stage is Class C. The half wave output of the final stage is applied to the Snap Diode, CR6201.

B. Snap Diode

When the Snap Diode, CR6201, is "pumped" (turned on and off sharply) its output will be rich in harmonics of the pumping frequency. The 100 MHz half wave cycles from the 100 MHz Amp "pump" the Snap Diode which in turn produces many harmonics of 100 MHz (both odd and even). These harmonics are applied to five Bandpass Filters.

C. Bandpass Filters

TU6201 through TU6210 form five Bandpass Filters. These filters select the 11th (1100 MHz), 13th (1300 MHz), 15th (1500 MHz), 17th (1700 MHz), and 19th (1900 MHz) harmonics of the output of the Snap Diode. The filters are tuned cavity filters. The five outputs of the filters (5 combinations) are applied to the Diode Switches.

D. Diode Switches

There are five Diode Switches in the High Frequency Multiplier/Mixer. Only one switch is closed at any one time. The closed switch allows its associated combination frequency to be applied to the Diode Mixer. Since all five Diode Switches operate identically, only the Diode Switch which selects the 1100 MHz combination frequency will be discussed. This Diode Switch is formed by CR6202, CR6203, and R6206. L6202 is common to all five Diode Switches, providing a DC path for biasing the diodes while also providing isolation from ground for the combination frequencies. With no voltage applied to the top of R6206, both CR6202 and CR6203 are reverse biased and the Diode Switch is off. When +11 V is applied to the top of R6206 (by the VCO Tuner when leftmost RF FREQUENCY MHz Thumbwheel is set to 0 or 1) CR6202 is forward biased (TU6202 provides DC continuity for CR6202) and CR6203 is forward biased (L6202 provides DC continuity for CR6203). The combination frequency is then allowed to pass to the Diode Mixer.

E. Diode Mixer

The single Diode Mixer, CR6212, combines the VCO frequency (which enters at J6201) with the selected combination frequency to produce a difference frequency of 100 to 300 Hz. The output is then passed through a 350 MHz Low Pass Filter and applied to the Heterodyne Amplifier/÷2 Prescaler.

7-8-2 REMOVAL AND DISASSEMBLY

A. Removal

Remove the High Frequency Multiplier/Mixer per the instructions provided in Section 6 of this manual.

NOTE

Further disassembly of the High Frequency Multiplier/Mixer is not required for testing purposes (paragraph 7-8-4). If, however, repair or replacement is necessary, continue with disassembly procedures in paragraph 7-8-2-B.

B. Disassembly (Reference High Frequency Multiplier/Mixer Mechanical Assembly drawing in Section 8)

TOOLS REQUIRED: (Continued)

¼" Open End Wrench

3/16" Nut Driver

.050 Allen Wrench

1. Remove top cover plate (58) by removing four Phillips head screws (1) and four lock washers (2).

2. Desolder feed-thru filter wiring from bottom of cover plate.

3. Desolder L6201 (23) from FL6301 on front of assembly.

4. Remove each of four side cover plates (11) by removing four Phillips head screws (12) and four lock washers (13).

5. Remove four flat head Phillips head screws (38) securing bottom cover plate.

6. Remove rear cover (49) by removing three Phillips head screws (51) and three lock washers (50).

7. Remove front cover (24) by removing two nuts (26 and 28), two lock washers (25 and 27), eight Phillips head screws (29), and eight lock washers (30).

8. Desolder lead of CR6201 (21) where it passes through at E6301. Remove PC board.

9. Desolder junction where CR6201 (21) meets assembly of R6201 thru R6205. Fold resistors up out of the way. (See Figure 7-8.)

10. Remove disc (19) by loosening two set-screws (15 and 40) and pulling disc out from assembly.

11. To remove brass plug (18) and/or L6202 (17), first desolder junction between CR6203, CR6205, CR6207, CR6209, CR6211, CR6212, and L6202. Then the assembly of the brass plug and L6202 may be unscrewed from the block.

CAUTION

JUNCTION MUST BE DESOLDERED BEFORE ANY ATTEMPT AT REMOVAL OF BRASS PLUG IS MADE OR DAMAGE TO L6202 AND DIODE JUNCTION WILL RESULT.

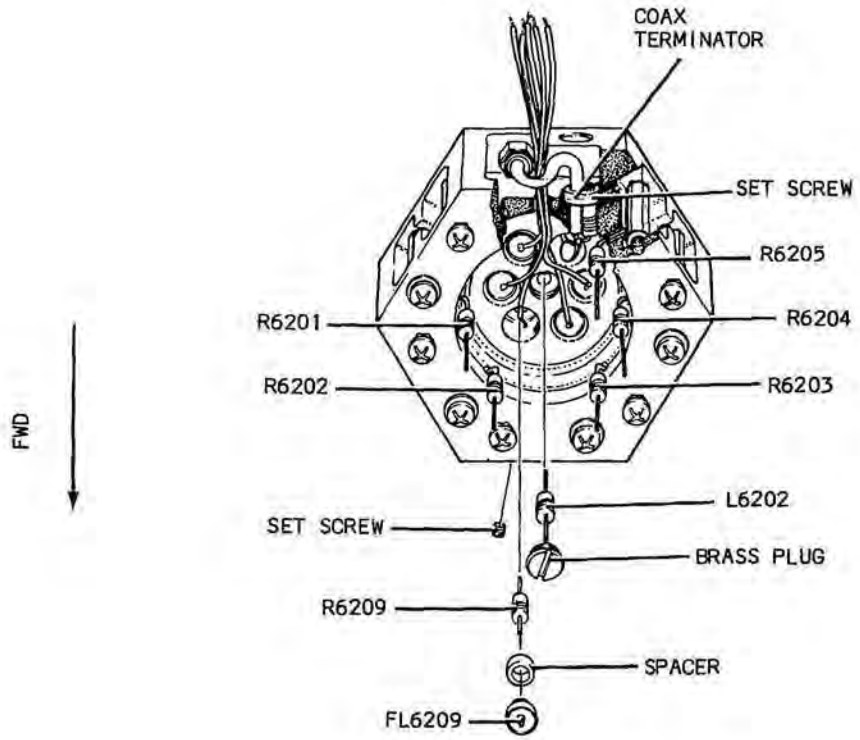


Figure 7-8 Internal View of Front of High Frequency Multiplier/Mixer

12. To remove any of filters FL6206 thru FL6210, first desolder junction with diodes on back of block and then loosen set screw holding filter in place.

    Example: To remove FL6209 (31), desolder junction between CR6208 and CR6209 and then loosen set screw. Assembly of FL6209 (31) and R6209 (33) may then be removed from front of block.

13. To remove R6211 (10), C6201 (56), or coax terminator (9) (See Figure 7-9):

    a. Desolder junction between L6203, C6201 and CR6212.

    b. Loosen set screw holding coax terminator in place.

    c. Remove assembly of coax terminator, C6201, and R6211 out of top of block.

14. To remove L6203 (See Figure 7-9):

   a. Desolder junction of L6203 (55), C6201 (56), and CR6212.

   b. Desolder L6203 from base of J6203.

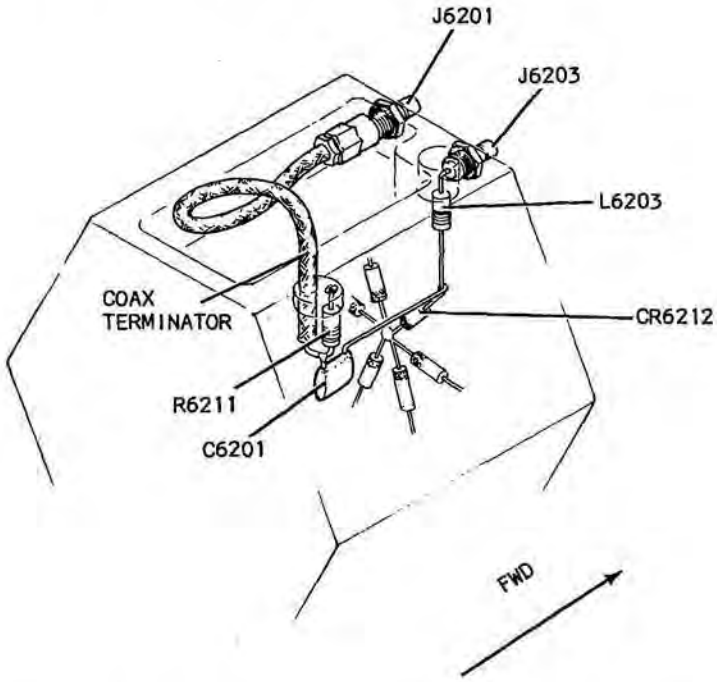


Figure 7-9 Internal View of Top and Rear of High Frequency Multiplier/Mixer

7-8-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of generating 1300 MHz
Sniffer Cable	IFR, 6500-9801-700 or see Appendix B
Spectrum Analyzer	100 MHz to 2.0 GHz Range
Signal Generator	Capable of generating 100 MHz
Power Supply	+11 V @ 200 mA
50Ω Coax Cables (3)	BNC to SMB
Shorting Strap	24 gauge, alligator clips on both ends

B. Preparation

1. Connect +11 V output of Power Supply to pin 7 of J6204.
2. Connect common lead of Power Supply to pin 6 of J6204.
3. Connect output of Signal Generator to J6202.
4. Attach Sniffer Cable to input of Spectrum Analyzer.
5. Locate loop of Sniffer Cable at TP6201.

7-8-4 Testing

A. Reference High Frequency Multiplier/Mixer Mech Assembly in Section 8

1. Apply power to Power Supply.
2. Adjust Signal Generator for 100 MHz at 0 dBm.
3. Adjust C6306 to peak Spectrum Analyzer display at 100 MHz.

NOTE

If amplitude of 100 MHz signal is unstable, or oscillating, detune C6306 until oscillations cease.

4. Connect Shorting Strap between FL6301 and FL6201. Verify 1100 MHz signal increases substantially in amplitude.
5. Adjust TU6201 and TU6202 to peak 1100 MHz signal, then detune TU6201 to lower 1100 MHz signal to -18 dBm (+0, -3 dB).
6. Connect Shorting Strap between FL6301 and FL6202. Verify 1300 MHz signal increases substantially in amplitude.
7. Adjust TU6203 and TU6204 to peak 1300 MHz signal, then detune TU6203 to lower 1300 MHz signal to -18 dBm (+0, -3 dB).
8. Connect Shorting Strap between FL6301 and FL6201. Verify 1500 MHz signal increases substantially in amplitude.
9. Adjust TU6205 and TU6206 to peak 1500 MHz signal, then detune TU6205 to lower 1500 MHz signal to -18 dBm (+0, -3 dB).
10. Connect Shorting Strap between FL6301 and FL6204. Verify 1700 MHz signal increases substantially in amplitude.

11. Adjust TU6207 and TU6208 to peak 1700 MHz signal, then detune TU6207 to lower 1700 MHz signal to -18 dBm (+0, -3 dB).

12. Connect Shorting Strap between FL6301 and FL6205. Verify 1900 MHz signal increases substantially in amplitude.

13. Adjust TU6209 and TU6210 to peak 1900 MHz signal, then detune TU6209 to lower 1900 MHz signal to -18 dBm (+0, -3 dB).

14. Tune Spectrum Analyzer to first frequency indicated in Column 1 of Table 7-3. While sequentially connecting Shorting Strap between FL6301 and each filter indicated by an "X" in Table 7-3, verify frequency level is $\leq$ -43 dBm. Repeat for each indicated frequency in Column I.

Tune Spectrum Analyzer to:	Connect Shorting Strap Between FL6301 and:				
	FL6201	FL6202	FL6203	FL6204	FL6205
1900 MHz	X	X	X	X	
1700 MHz	X	X	X		X
1500 MHz	X	X		X	X
1300 MHz	X		X	X	X
1100 MHz		X	X	X	X

Table 7-3 Signal Levels for High Frequency Multiplier/Mixer

15. Connect Shorting Strap between FL6301 and FL6201.

16. Connect 50Ω coax between output of second Signal Generator and J6201. Set Signal Generator output to 1300 MHz at 0 dBm.

17. Remove Sniffer Cable from input of Spectrum Analyzer.

18. Connect input of Spectrum Analyzer to J6203. Verify Spectrum Analyzer displays a signal at 200 MHz with an approximate amplitude of -55 dBm.

7-8-5 <u>REASSEMBLY</u>

With all power "OFF", disconnect test equipment from High Frequency Multiplier/Mixer. Reassemble High Frequency Multiplier/Mixer in reverse order of diassembly procedure described in paragraph 7-8-2 and reinstall assembly within FM/AM-1100S/A.

7-9 HIGH FREQUENCY PHASE LOCK PC BOARD

7-9-1 THEORY OF OPERATION (Reference High Frequency Phase Lock PC Board Circuit Schematic in Section 10)

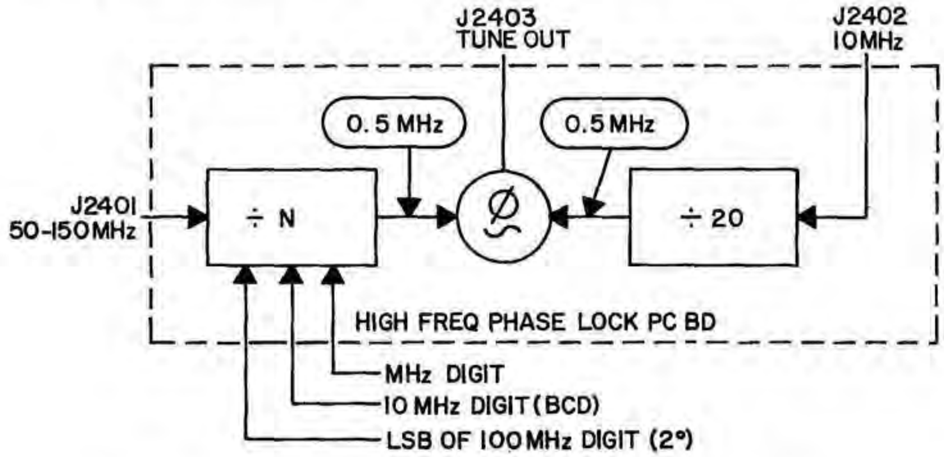


Figure 7-10 High Frequency Phase Lock PC Board Block Diagram

A. ÷20 Frequency Divider

The fixed ÷20 frequency divider consists of X2410, X2404 and X2411. X2410 divides the 10 MHz signal by 2, producing 5 MHz. X2404A and X2404B together are the equivalent of a 2 input AND gate, which inhibit the 5 MHz reference from entering X2411. X2411 divides the 5 MHz by 10. 500 kHz is applied to the phase/frequency detector from Pin 12 of X2411. X2404C stops the counter when the counter reaches count 9, if Pin 5 of X2404C is high. The above feature allows the phase/frequency detector to modify the count length.

B. Programmable Counter (÷N)

Q2401 provides buffering and translation of the 50-100 MHz signal to ECL levels for X2406. X2406 is a ÷10/÷11 prescaler. Assume X2406 is dividing by 11. For each count out of the prescaler, X2401 and X2407 will decrement. When X2401 and X2407 reach zero, the prescaler will divide by 10 and X2409 will decrement. When X2409 is zero and X2407 decrements to 2, then the J input will be high. After one more pulse out of the prescaler, X2408A will be set. After X2408A is set, counters are loaded. X2408A will reset on the next pulse, if the K input is low. At this point, the entire cycle starts over.

C. Phase/Frequency Detector

X2408B is the slip flip-flop. If the output of the programmable divider is too low, X2405B will be set by the output of the fixed divider (X2411, Pin 12). This will cause the fixed divider to wait for the programmable divider to finish its cycle.

If the output of the programmable divider is too high, the output of X2405C will be low, causing the programmable divider to wait for the fixed divider to finish its count cycle. X2412 and Q2416 turn off the phase lock lamp if a slip condition occurs.

Q2405 and Q2406 form the first sampler switch. This switch is gated by Q2415, a single shot stage, with a narrow pulse which is coincident with the falling edge of X2411, Pin 12. The narrow sample pulse uses the rising edge of buffer Q2404 as a steep linear amplifier. The sample capacitor C2408 will be charged or discharged to the point on this ramp that is coincident with the narrow sample pulse. The narrow sample pulse is delayed by Q2414 and Q2413. The charge on C2408 is buffered by Q2407 and Q2408 and is applied to the drain of Q2409. When the narrow sample pulse reaches the gate of Q2409, Q2409 will charge C2412. C2412 is the second hold capacitor. Q2412 and C2411 provide a sample pulse 180° out of phase with the pulse present on the gate of Q2409. The result is to cancel any 500 kHz ripple. Q2410 and Q2411 buffer the charge on C2412.

7-9-2 REMOVAL & DISASSEMBLY

A. Removal

Removal of High Frequency Phase Lock PC Board is not required for first part of test procedure. Further instructions will be given in test procedure when removal is required.

B. Disassembly

No further disassembly of High Frequency Phase Lock PC Board is required.

7-9-3 PREPARATION FOR TESTING

A. Required Test Equipment

Digital Multimeter .... Any

Oscilloscope .... Any

50Ω Coax Cables (2) .... BNC on one end, SMB on other end

"T" Connector .... SMB/SMB/SMB

50Ω Coax Cable .... BNC on both ends

Signal Generator .... Capable of 110 MHz at -24 dB

B. Preparation

1. Disconnect P2402 from J2402.

2. Disconnect P2403 from J2403.

3. Disconnect P2401 from J2401.

4. Connect output of Signal Generator to J2401.

5. Connect SMB Tee to P2402.

6. Connect BNC/SMB coax from Tee Connector to input of Oscilloscope.

7. Connect BNC/BNC Coax from 10 MHz REF OUT Connector to Signal Generator external time base input.

7-9-4 TESTING

A. Reference High Frequency Phase Lock PC Board Circuit Schematic in Section 10 and High Frequency Phase Lock PC Board in Section 9.

1. Set PWR/OFF BATT Switch (11) to "PWR". Verify Oscilloscope displays a 10 MHz wave approximately 4 Vp-p.

NOTE

If Step 1 fails, fault is indicated with TCXO or TCXO Output Distribution Amplifier, not the High Frequency Phase Lock PC Board.

2. Disconnect SMB Tee Connector from P2402.

3. Connect P2402 to J2402.

4. Using Multimeter, measure voltage on following pins at J2404. Verify voltages are within tolerances given.

Pin #	Voltage	Tolerance
1	+11 V	±0.10 V
13	+5.075 V	±0.225 V

NOTE

If Step 4 fails, malfunction is not necessarily caused by High Frequency Phase Lock PC Board. Check Power Supply and Power Supply conductors leading up to J2404.

5. Connect coax from input of Oscilloscope to J2403.

6. Set RF FREQUENCY MHz Thumbwheels (34) to 100 000 0.

7. Set output of Signal Generator to -24 dBm at 100 MHz. Verify HIGH Frequency Phase LOCK Lamp (42) is illuminated.

NOTE

If Step 7 fails, test Frequency Select Switch Assembly to determine whether the Frequency Select Switch or the High Frequency Phase Lock PC Board is at fault.

8. Set Signal Generator frequency to 90 MHz. Verify Oscilloscope displays approximately +4 VDC.

9. Set Signal Generator frequency to 110 MHz. Verify Oscilloscope displays approximately +8 VDC.

10. Make following settings and verify HIGH Frequency Phase LOCK Lamp (42) is illuminated at each setting.

RF FREQUENCY MHz Thumbwheels	Signal Generator Freq.
000 000 0	50.0 MHz
001 000 0	50.5 MHz
002 000 0	51.0 MHz
004 000 0	52.0 MHz
008 000 0	54.0 MHz
010 000 0	55.0 MHz
020 000 0	60.0 MHz
040 000 0	70.0 MHz
080 000 0	90.0 MHz

NOTE

If Step 10 fails, test Frequency Select Switch Assembly to determine whether the Frequency Select Switch or the High Frequency Phase Lock PC Board is at fault.

11. Set all power "OFF" and remove High Frequency Phase Lock PC Board per instructions provided in Section 6 of this manual.

12. Insert High Frequency Phase Lock PC Board into J2404 on Mother Board. Do not reinstall PC Board enclosure.

13. Connect P2401 to J2401, and P2402 to J2402.

14. Connect SMB Tee to J2403.

15. Connect P2403 to one side of Tee Connector.

16. Connect BNC/SMB coax between remaining end of Tee Connector and input of Oscilloscope.

17. Set PWR/OFF/BATT Switch (11) to "PWR".

18. Verify High Frequency Phase LOCK Lamp (42) is illuminated.

NOTE

If High Frequency Phase LOCK Lamp (42) is not lit, troubleshoot 1st Local Oscillator System before proceeding to Step 19.

19. Adjust R2429 on High Frequency Phase Lock PC Board for minimum ripple as seen on external Oscilloscope.

NOTE

Access to R2429 on High Frequency Phase Lock PC Board may be somewhat difficult. Use an insulated flexible adjustment tool to adjust this pot.

7-9-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from High Frequency Phase Lock PC Board. Reinstall High Frequency Phase Lock PC Board and board enclosure within FM/AM-1100S/A.

7-10 HIGH LEVEL AMPLIFIER

7-10-1 THEORY OF OPERATION (Reference High Level Amplifier Circuit Schematic in Section 10)

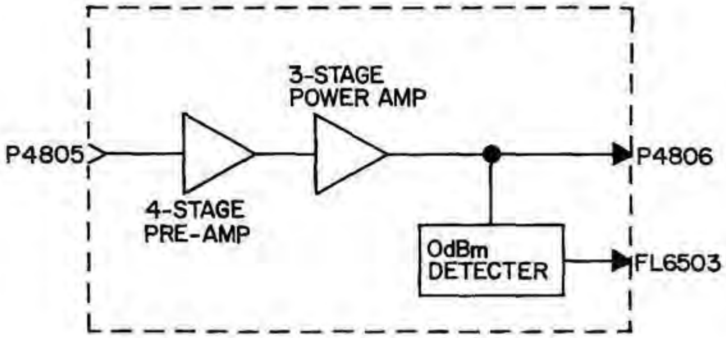


Figure 7-11 High Level Amplifier Block Diagram

A. Four-Stage Pre-Amplifier

The high level pre-amplifier consists of four self-biased, common emitter stages Q6601, Q6602, Q6603 and Q6604. The four stage pre-amplifier is located on High Level Amplifier PC Board #2.

B. Three-Stage Power Amplifier

The three-stage power amplifier consists of one self-biased common emitter stage Q6701 and two current-regulated biased common emitter stages Q6703 and Q6705.

Q6702 is the current regulator for Q6703. Q6704 is the current regulator for Q6705. The three-stage power amplifier is located on High Level Amplifier PC Board #1.

C. 0 dBm Detector

CR6703, CR6704, C6717 and R6719 form a detector whose output is fed to a comparator, X6701. The comparator will detect 0 dBm. The output of the comparator is buffered by Q6706 to drive the 0 dBm Lamp on the front panel. The 0 dBm detector is located on High Level Amplifier PC Board #1.

7-10-2 REMOVAL & DISASSEMBLY

A. Removal

Remove High Level Amplifier from within the FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference High Level Amplifier Mechanical Assy drawing in Section 8).

NOTE

Further disassembly of the High Level Amplifier is not required for testing purposes (paragraph 7-10-4). If, however, repair or replacement of the PC Boards is necessary, continue with following disassembly steps.

1. Remove two covers (2) by removing eight corner screws (1) and four center screws (4).
2. Remove bottom end plate (11) by removing four screws (9).
3. Loosen two 1/4" nuts (18) (one for each coax connector).
4. Unsolder one end of coax (10).
5. Unsolder wire from FL6501.
6. Unsolder wire from FL6502.
7. Unsolder wire from FL6503.
8. Remove 100 turn coil (12) by removing screw (15), two washers (14) and (17) and two core cups (13).
9. Remove High Level Amplifier PC Board #1 (16) by removing four screws (3), four lock washers (5) and two standoffs (6).
10. Remove High Level Amplifier PC Board #2 (7) by removing four screws (3), four lock washers (5) and two standoffs (6).

7-10-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer .... Capable of displaying 0 to 1800 MHz

Signal Generator .... Capable of generating 100 MHz to 1000 MHz at -40 dBm to +5 dBm

Tracking Generator .... Operable within a range of 5 MHz to 1800 MHz

A. Required Test Equipment (Continued)

Power Supply	Capable of producing 12 VDC at 300 mA
20 dB Attenuator	Any
DC Voltmeter	Any
Power Meter	50Ω, capable of displaying up to 30 dBm (1 watt)

B. Preparation (Reference High Level Amplifier Mechanical Assy Drawing in Section 8).

1. Connect output of Tracking Generator to P4805.
2. Connect input of Spectrum Analyzer to P4806.
3. Connect +12 VDC source from Power Supply to FL6501.
4. Connect Power Supply common to case of High Level Amplifier.
5. Connect positive lead of DC Voltmeter to FL6503 on High Level Amplifier.
6. Connect negative lead of DC Voltmeter to case of High Level Amplifier.

7-10-4 TESTING

A. Reference High Level Amplifier Circuit Schematic in Section 10, High Level Amplifier PC Boards #1 & #2 in Section 9 and High Level Amplifier Mechanical Assy drawing in Section 8.

1. Adjust Tracking Generator controls to sweep from 5 MHz to 1800 MHz at -55 dBm.
2. Set Spectrum Analyzer for a +30 dB reference level, with dispersion from 0 to 1800 MHz.
3. Apply power to High Level Amplifier.
4. Apply power to the Spectrum Analyzer.
5. Apply power to Tracking Generator.
6. Adjust C6710 for maximum gain at 1000 MHz.

7. Adjust C6710 for a gain of 55 dB at 1000 MHz.

NOTE

Cable losses and tracking generator tolerances must be taken into account when performing Step 7.

   a. Verify minimum gain from 5 MHz to 1000 MHz is 52 dB.

   b. Verify minimum gain and maximum gain do not differ by more than 13 dB within the range of 5 to 1000 MHz.

8. Increase Tracking Generator's output gradually and verify:

   a. High Level Amplifier saturation level is greater than +22 dB for the range of 5 to 700 MHz.

   b. High Level Amplifier saturation level is greater than +23 dB for the range of 700 to 1000 MHz.

9. Disconnect power to High Level Amplifier.

10. Connect output of High Level Amplifier (P4806) to Power Meter through a 20 dB Attenuator.

11. Connect P4805 to output of Signal Generator. Set Signal Generator output frequency to 100 MHz.

12. Apply power to High Level Amplifier.

13. Adjust output amplitude of Signal Generator until DC Voltmeter displays a value greater than 10 VDC. Verify Power Meter indicates between +2 dBm and -4 dBm.

14. Repeat Step 13 for Signal Generator settings of 200, 300, 400, 500, 600, 700, 800, 900 and 1000 MHz.

15. Disconnect power to High Level Amplifier.

16. Decrease Spectrum Analyzer dispersion to 100 kHz and adjust center frequency to 5 MHz.

17. Connect P4806 to input of Spectrum Analyzer.

18. Set Signal Generator output to 5 MHz.

19. Adjust output of Signal Generator until Spectrum Analyzer displays +22 dBm. Record Signal Generator attenuator setting.

20. Decrease Signal Generator output frequency to 10 kHz.

21. Decrease Spectrum Analyzer center frequency to 10 kHz.

22. Adjust output of Signal Generator until Spectrum Analyzer displays +22 dBm. Verify setting of attenuator on Signal Generator does not differ by more than 12 dB from setting noted in Step 19.

7-10-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from High Level Amplifier. Reassemble High Level Amplifier in reverse order of disassembly procedure described in paragraph 7-10-2 and reinstall assembly within FM/AM-1100S/A.

7-11 POWER SUPPLY

7-11-1 THEORY OF OPERATION (Reference Power Supply Circuit Schematic in Section 10)

The AC Line voltage is filtered and rectified by T8301 and bridge rectifier BR8301. The output of the Rectifier is several hundred volts DC, which is filtered by C8303 and C8304. The negative output is floating ground to the following:

1st Trapezoid Oscillator
1st Comparator
1st Driver
FET Switch
Current Sense Resistors
Fast Current Limiter
Slow Current Limiter

WARNING

THE DIFFERENCE IN POTENTIAL BETWEEN THE FLOATING GROUND AND CIRCUIT GROUNDS CAN EXCEED 300 V PEAK. THIS POTENTIAL CAN CAUSE SERIOUS INJURY OR DEATH. ALWAYS USE AN ISOLATION TRANSFORMER AND TAKE EXTREME CARE WHEN TESTING THE POWER SUPPLY.

The several hundred volts DC from the rectifier is applied to one end of the Step-down Transformer (T8201) and to the +15 V Floating Regulator (Q8203, Q8214 and CR8201). The +15 V floating regulator provides power to:

1st Trapezoid Oscillator
1st Comparator
1st Driver
Opto-Isolator
Slow Current Limiter

The 1st Trapezoid Oscillator (X8201) produces a trapezoidal waveform which is applied to the positive side of the 1st Comparator (X8202). The negative side of the comparator is driven by the Opto-Isolator (U8201). The Opto-Isolator provides a DC level which is controlled by the 1st Regulator (X8208). The output of the 1st Comparator is a rectangular wave with a duty cycle is controlled by the 1st Regulator. This rectangular wave is applied to the 1st Driver (Q8204 and Q8205) which provides the necessary drive current to give FET Switch (Q8207) fast turn-on and turn-off characteristics.

The FET Switch essentially grounds one side of the Step-down Transformer during the time that the rectangular wave from the 1st Driver is high. The output of the Step-Down Transformer is rectified by CR8210. The output of CR8210 is applied to the First Regulator which adjusts the output of the Opto-Isolator and the duty cycle of the rectangular wave to produce +16 VDC at the output of CR8210.

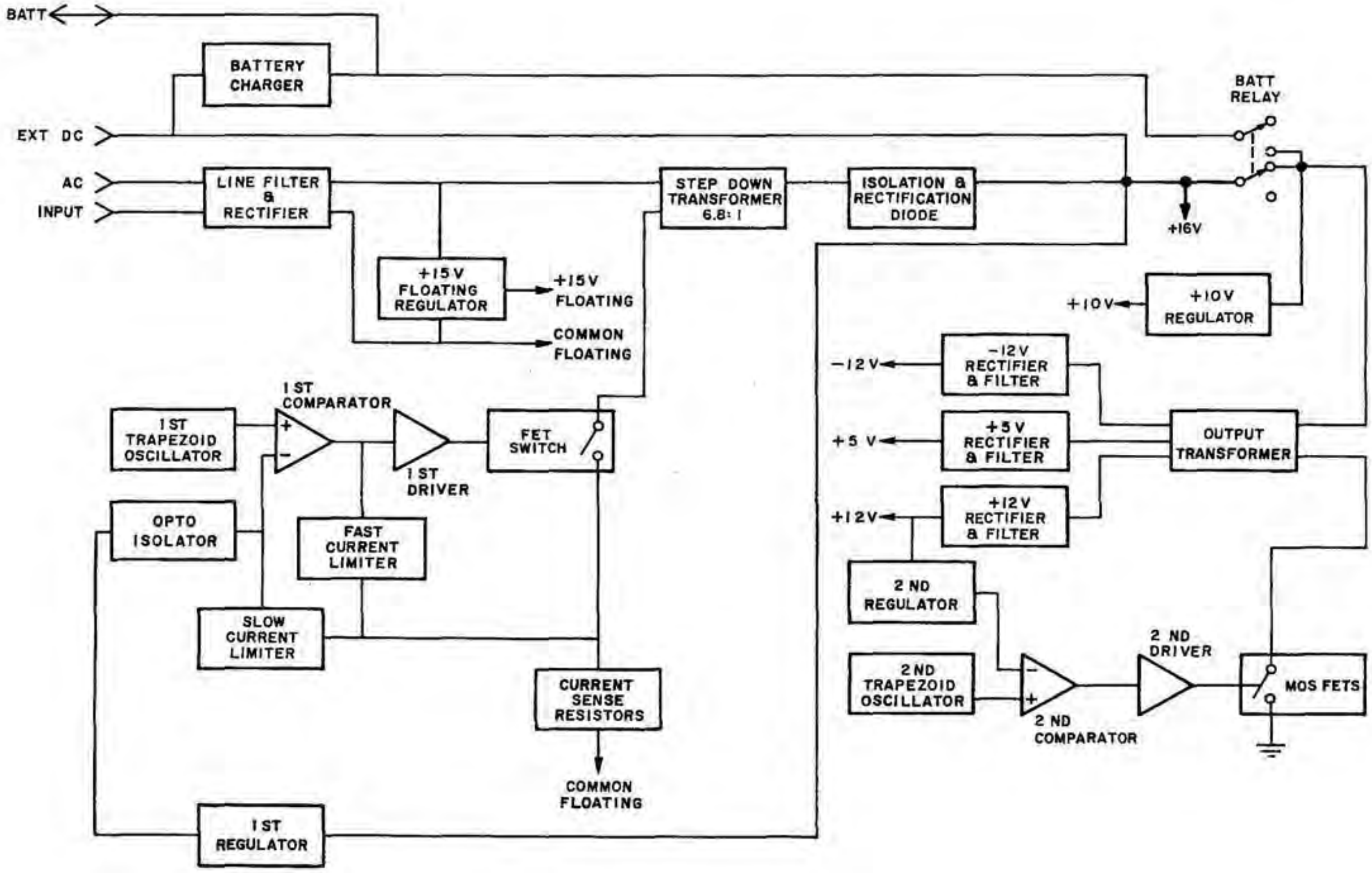


Figure 7-12 Power Supply Detailed Block Diagram

The Current Sense Resistors, R8228 through R8231, produce a voltage proportionate to the current passing thru FET Switch (Q8207). This voltage is applied to the Fast and Slow Current Limiters. The Fast Current Limiter (Q8211) reduces the output of the 1st Driver if the current exceeds 5 A. The Fast Current Limiter limits the peak current. The Slow Current Limiter (X8204) integrates the voltage sample from the current sense resistors and applies its output to the negative side of the 1st Comparator (X8202), which causes the duty cycle to be reduced when the average current through the FET Switch exceeds a predetermined value.

The output of CR8210 is applied to the Battery Charger and Battery Relay. The Battery Charger (X8203, Q8201, Q8202) provides 14.2 VDC to charge the internal 12 V battery. The Battery Charger also limits charging current to 1.6 A. Notice that external DC is also applied to the Battery Charger and Battery Relay. When using external DC, CR8210 prevents the external DC from flowing through the secondary of the Step-Down Transformer. The battery is charged by external DC (if external DC is approximately 13 VC or above).

By pressing PWR/OFF/BATT Switch to BATT, the Battery Relay (K8202) is energized, the battery voltage is applied to the +10 V Regulator and one side of the primary of the output Transformer (T8202).

The +10 V Regulator (Q8206 and CR8214) supplies power to:

2nd Trapezoid Oscillator
2nd Comparator
2nd Driver
2nd Regulator

The 2nd Trapezoid Oscillator (X8205) produces a trapezoidal waveform which is applied to the positive side of the 2nd Comparator (X8206). The negative side of the 2nd Comparator is driven by the 2nd Regulator which controls the DC level at the negative input and therefore the duty cycle of the output of the 2nd Comparator. The output of the 2nd Comparator is applied to the 2nd Driver (Q8212 and Q8213). The 2nd Driver supplies the necessary current to give the MOSFETS (Q8208, Q8209 and Q8210) fast turn-on and turn-off characteristics. The MOSFETS ground the other side of the primary of T8202 when the output of the 2nd Driver is high. T8202 has three secondaries which are rectified to produce +12, -12 and +5 VDC. The output of the +12 V Rectifier is applied to the 2nd Regulator which adjusts the duty cycle of the Comparator to produce +12 V at the output of the +12 V Rectifier.

7-11-2 REMOVAL & DISASSEMBLY

A. Removal

1. Remove AC or DC line cord and then lay FM/AM-1100S/A on right-hand side (speaker side).

2. Disconnect Molex connectors between Power Supply and Mother Board and Battery.

3. Further disassembly is not required for testing. If, however, repair is necessary, continue with 7-11-2-B.

B. Disassembly (Reference Power Supply Mechanical Assembly drawing in Section 8 and Power Supply PC Board in Section 9)

1. Remove Power Supply Assembly from FM/AM-1100S/A by removing three Phillips screws and three lock washers securing it to the rear panel.

2. Remove one Phillips screw (9) and one lock washer (8) securing Line Rectifier PC Board to cover.

3. Remove cover (5) and insulator (4) by removing five Phillips screws (7) and five lock washers (6) securing cover to assembly and sliding cover out of grooves in assembly.

4. Remove Line Rectifier PC Board (3) by:

   a. Removing two Phillips screws (1) and two lockwashers (2) securing PC Board to rear panel of assembly.

   b. Unsoldering wires. Tag wiring.

5. Remove Power Supply PC Board by:

   a. Unsoldering wires to AC and DC fuses, F8101 and F8102.

   b. Unsoldering wires to AC and DC input connectors, J8102 and J8101.

   c. Unsoldering Molex connectors J8103 and J8104 from feed-thru filter. Tag wiring.

NOTE

See Power Supply PC Board drawing in Section 9 for details of PC Board Assembly.

7-11-3 PREPARATION FOR TESTING

A. Required Test Equipment

Battery Load Simulator	IFR, 7003-9801-600 or see Appendix B
Power Supply Load Simulator	IFR, 7099-2399-900 or see Appendix B
Isolation Transformer	115 VAC to 115 VAC, 250 VA
Digital Multimeter	Any

B. Preparation (Reference Power Supply Mechanical Assembly in Section 8 and PC Board in Section 9)

1. Check F8101 and F8102. Replace if blown.

2. Connect test equipment as shown in Figure 7-13.

WARNING

DO NOT COME IN CONTACT WITH THE FLOATING GROUND. THIS GROUND CAN HAVE DIFFERENCE OF POTENTIAL OVER 300 V PEAK RELATIVE TO CHASSIS AND CIRCUIT GROUND.

3. Place Power Switch on Power Supply Load Simulator to line.

4. Rotate Load Control on Battery Load Simulator fully ccw.

5. Connect Multimeter between TP4 and TP5 on Power Supply Load Simulator.

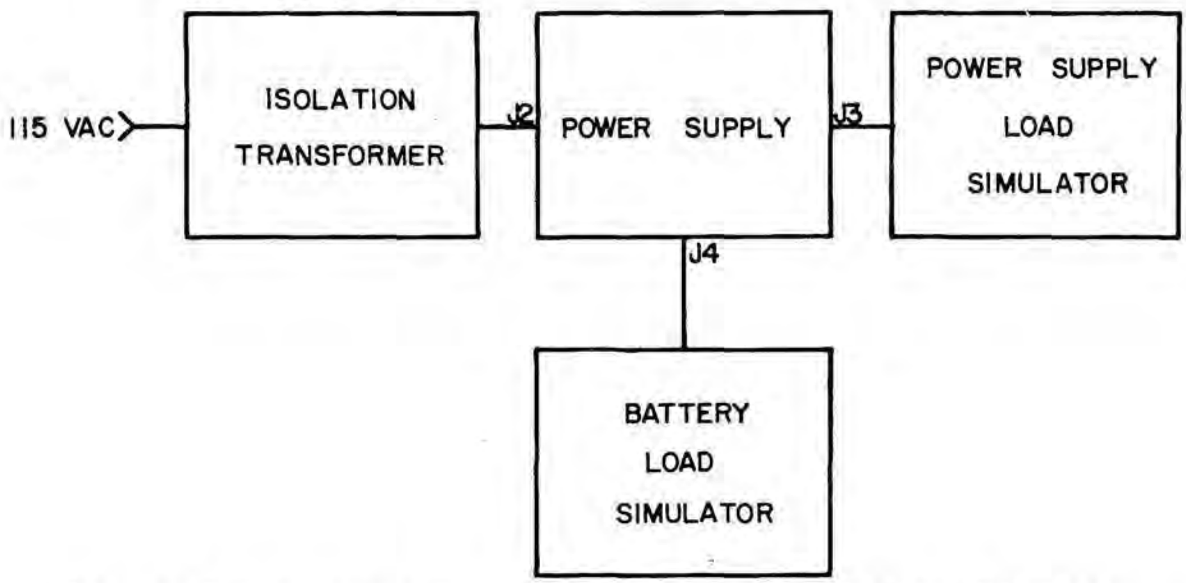


Figure 7-13 Power Supply Assembly Test Set-Up Diagram

7-11-4 TESTING (Reference Power Supply PC Board in Section 9 and Power Supply Mech Assembly in Section 10)

CAUTION

USE INSULATED TUNING TOOL FOR ADJUSTMENTS ON POWER SUPPLY.

1. Adjust R8241 for a Multimeter voltage indication of +16 (±0.4) VDC.

2. Connect Multimeter between red and black terminals on Battery Load Simulator.

3. Adjust R8206 for a Multimeter voltage indication of +14.20 (±0.25) VDC.

4. Rotate Load Control on Battery Load Simulator fully cw. Verify battery current is less than 2 amps.

5. Connect Multimeter between TP1 and TP5 on Power Supply Load Simulator.

6. Adjust R8255 for a Multimeter voltage indication of +12.05 (±0.10) VDC.

7. Connect Multimeter between TP2 and TP5 on Power Supply Load Simulator. Verify Multimeter indicates +5.075 (±0.225) VDC. Return to Step 5 if tolerance is not met.

8. Connect Multimeter between TP3 and TP5 on Power Supply Load Simulator. Verify Multimeter indicates -12 (±0.5) VDC. Return to Step 5 if tolerance is not met.

9. Remove AC power from Isolation Transformer.

10. Set Power Switch on Power Supply Load Simulator to "OFF".

11. Remove Battery Load Simulator and connect FM/AM-1100S/A battery to J8104.

12. Set Power Switch on Power Supply Load Simulator to "BATTERY". Verify Multimeter indicates -12 (±0.5) V.

13. Connect Multimeter between TP1 and TP5 on Power Supply Load Simulator. Verify Multimeter indicates +12.05 (±0.1) V.

14. Connect Multimeter between TP2 and TP5 on Power Supply Load Simulator. Verify Multimeter indicates +5.075 (±0.225) V.

7-11-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from Power Supply. Reassemble Power Supply in reverse order of disassembly procedure described in paragraph 7-11-2 and reinstall assembly within FM/AM-1100S/A.

7-12 POWER TERMINATION

7-12-1 THEORY OF OPERATION (Reference Power Termination Circuit Schematic in Section 10)

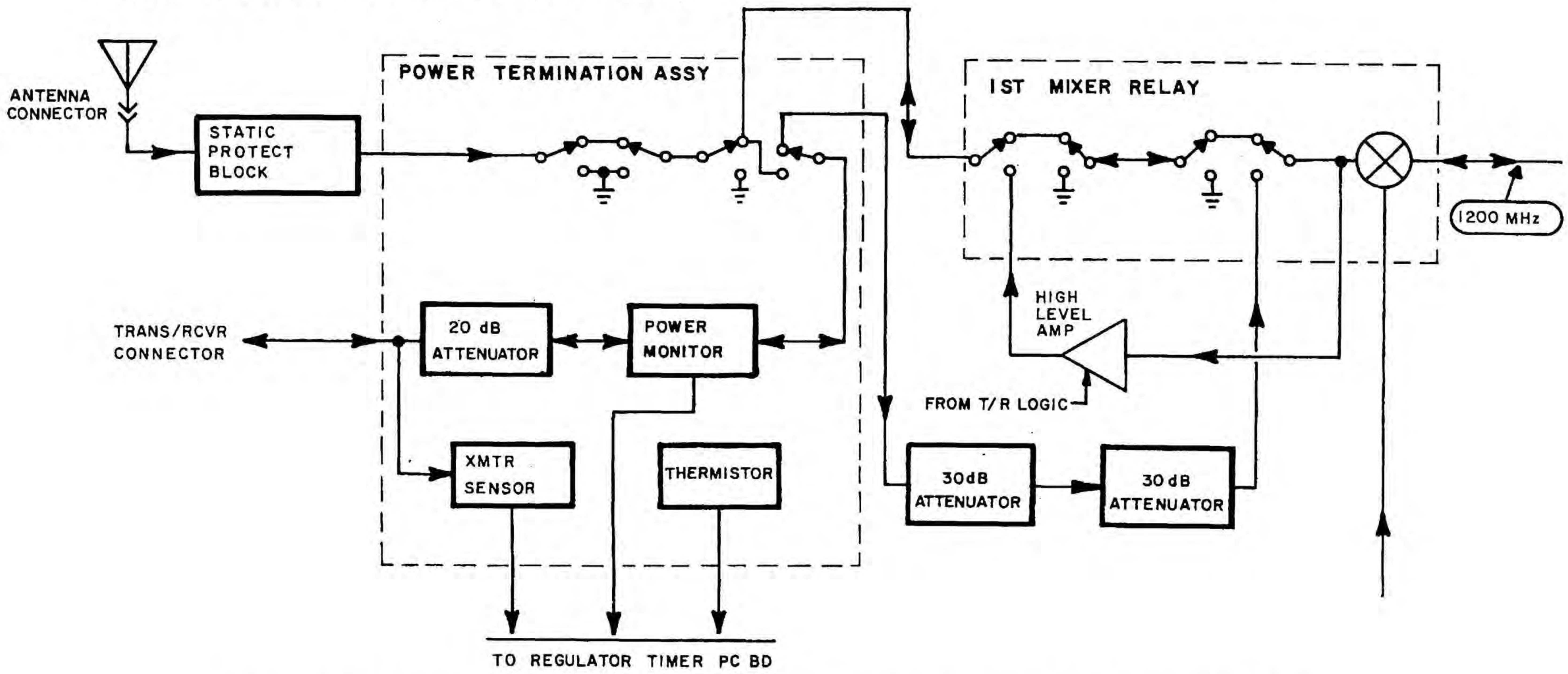


Figure 7-14 Power Termination Block Diagram

The Crossover Relay consists of K8401 and K8402 which are miniature TO-5 relays. The Transmitter Sensor consists of an Attenuator (R8401 and R8402) and a Schottky detector diode (CR8401). The 20 dB Power Attenuator is AT8401, which is a high power termination. AT8401 is heat sunk to the Power Termination Assembly, which in turn is heat sunk to the Rear Panel. A thermistor (RT8401) is provided to detect an Over Temp condition on the Power Termination Assembly and the Rear Panel heat sink. The Power Monitor circuit consists of an Attenuator (R8403, R8404 and R8405) with a Schottky detector diode (CR8402) and Filter (C8401 and L8401).

7-12-2 REMOVAL & DISASSEMBLY

A. Removal

Remove Power Termination Assembly from FM/AM-1100S/A per Section 6. If repair is required, continue with paragraph 7-12-2-B.

B. Disassembly

TOOLS REQUIRED: Small Phillips Head Screwdriver

Soldering Iron

3/32 Allen-Head Wrench

1. Remove ten Phillips head screws (4) securing cover (3) to block.

2. Remove AT8401 assembly by:

   a. Desoldering junction of J8401, R8401, and AT8401.

   b. Desoldering junction of R8403, R8404, and AT8401.

   c. Removing two socket head screws (2) and two washers (1) securing AT8401 to block.

3. Remove Heat Sink Assembly by:

   a. Desoldering junction of R8403, R8404, and AT8401.

   b. Desoldering junction of FL8401 and L8401.

   c. Desoldering junction of R8403 and K8401.

   d. Removing two Phillips head screws (5) securing Heat Sink Assembly to block.

4. Remove K8401 and K8402 by:

   a. Desoldering K8401 and J8403, J8404 and R8403.

   b. Desoldering K8402 and J8402 and FL8404.

   c. Removing two Phillips head screws (6) securing K8401 and K8402 to block.

7-12-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer	Capable of measuring 1 GHz
Tracking Generator	Range of 1 MHz to 1 GHz
Digital Multimeter	Any
Signal Generator	Capable of 500 MHz at +17 dBm
Power Supply	+11 VDC at 100 mA
50Ω Coax Cables (2)	BNC to BNC, calibrated
50Ω Coax Cable	BNC to SMB female, calibrated
50Ω Coax Cable	BNC to SMB female, calibrated
VSWR Bridge	Any

B. Preparation

1. Connect output of Tracking Generator to J8404.

2. Connect input of Tracking Generator to J8402.

3. Adjust output of Power Supply to +11 VDC.

4. Connect negative lead of Power Supply to the casing of the Power Termination Assembly.

7-12-4 <u>TESTING</u> (Reference Power Termination Mech Assembly in Section 8)

1. Using Multimeter, measure resistance from FL8403 to ground. Verify resistance is 1.7 K ±400Ω at 25° C.

2. Using Tracking Generator, verify insertion loss from J8402 to J8404 is ≤1 dB from 1 MHz to 1 GHz and that the response curve is flat (within 6.0 dB) over the range of 1 MHz to 1 GHz.

3. Connect +11 V lead of Power Supply to FL8404. Verify Tracking Generator indicates at least -45 dB of isolation.

4. Disconnect input of Tracking Generator from J8402.

5. Connect input of Tracking Generator to J8401. Verify Tracking Generator displays a flat (within ±2.0 dB) response curve that is approximately -20 dBc.

6. Remove +11 VDC lead from FL8404. Verify Tracking Generator displays at least -40 dB of isolation.

7. Disconnect output of Tracking Generator from J8404.

8. Connect output of Tracking Generator to J8403. Verify Tracking Generator displays a flat (within ±6.0 dB) response curve that is approximately -20 dBc.

9. Connect +11 VDC to FL8404. Verify Tracking Generator displays at least -45 dB of isolation.

10. Disconnect Tracking Generator and +11 VDC Power Supply.

11. Using Signal Generator, apply a 500 MHz cw signal at +17 dBm into J8401.

12. Using Multimeter, verify voltage at FL8402 is 28 mVDC ±10 mV.

13. Using Multimeter, verify voltage at FL8401 is 30 mVDC ±10 mV.

14. Connect the two 30 dB attenuators between input and output of Tracking Generator. Verify Tracking Generator displays a flat (within ±1.5 dB) response curve that is approximately -60 dBc.

15. Connect output of Tracking Generator to generator port of VSWR Bridge using BNC/BNC Coax Cable.

16. Connect input of Tracking Generator to reflected power port of VSWR Bridge using BNC/BNC Coax Cable.

17. Adjust output of Tracking Generator to -10 dBm.

18. Adjust reference level of Tracking Generator to position trace at the reference level.

19. Connect two 30 dB Attenuators to J8403 using BNC/SMA Coax Cable.

20. Connect UUT port of VSWR Bridge to J8401. Note and record highest reflected power over range of 5 MHz to 1000 MHz. This level is return loss.

21. Determine VSWR from graph in Figure 7-15. Verify VSWR is ±1.3.

22. Set all power "OFF".

23. Disconnect all test equipment.

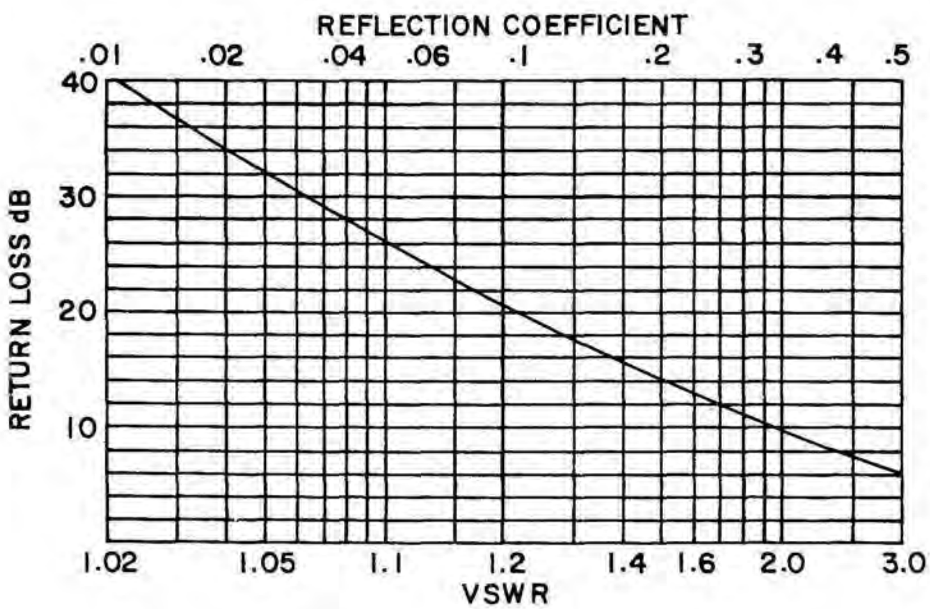


Figure 7-15 VSWR Determination for Power Termination Assembly

7-12-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from Power Termination Assembly. Reassemble Power Termination Assembly in reverse order of disassembly procedure described in paragraph 7-12-2 and reinstall assembly within FM/AM-1100S/A.

7-13 REGULATOR/TIMER PC BOARD

7-13-1 THEORY OF OPERATION (Reference Regulator/Timer PC Board Circuit Schematic in Section 10)

A. Battery ON/OFF Logic

The battery ON/OFF logic consists of X9101, Q9101, Q9102, and Q9103. Q9101 is an inverting driver, with input driven by the "BATT" position of the PWR/OFF/BATT Switch, and with its output driving the battery flip-flop X9101. X9101 is used to store the battery ON/OFF status. The Q output of X9101 drives Q9102, which in turn drives the battery relay. The $\overline{Q}$ output of X9101 is applied to Q9103, which drives the battery timer and 11 V cutoff circuits.

B. Battery Timer

X9102 is an oscillator/counter I.C. It is started when the battery ON/OFF flip-flop is set. After approximately 11 minutes, X9102 applies a signal to the OR gate, resetting the battery ON/OFF flip-flop and turning the FM/AM-1100S/A off.

C. 11 V Cutoff Circuit

The 11 V cutoff circuit, X9106, applies a High to the OR gate if the battery voltage drops below +11 VDC. The OR gate, in turn, resets the battery ON/OFF flip-flop.

D. OR Gate

The OR gate consists of diodes CR9103 and CR9104.

E. Voltage Doubler

X9105, Q9107, Q9110, Q9111, and CR9107 thru CR9110 form a voltage doubler. X9105 is an astable multivibrator which drives Q9107 and Q9111 by means of Q9110. The output of Q9107 and Q9111 is a 24 Vp-p square wave which is applied to the voltage doubler, CR9107 thru CR9110. The output of the voltage doubler is approximately -40 VDC.

F. -35 V Regulator

X9103B, Q9104, and Q9105 form the -35 V Regulator, a series tracking regulator which tracks the +11 V signal. The -35 V Regulator has a current limiter which protects the regulator against overloading.

G. +11 V Regulator

The +11 V Regulator consists of X9107, Q9112, and CR9114. Q9112 is a driver for the PNP pass transistor (Q10201)

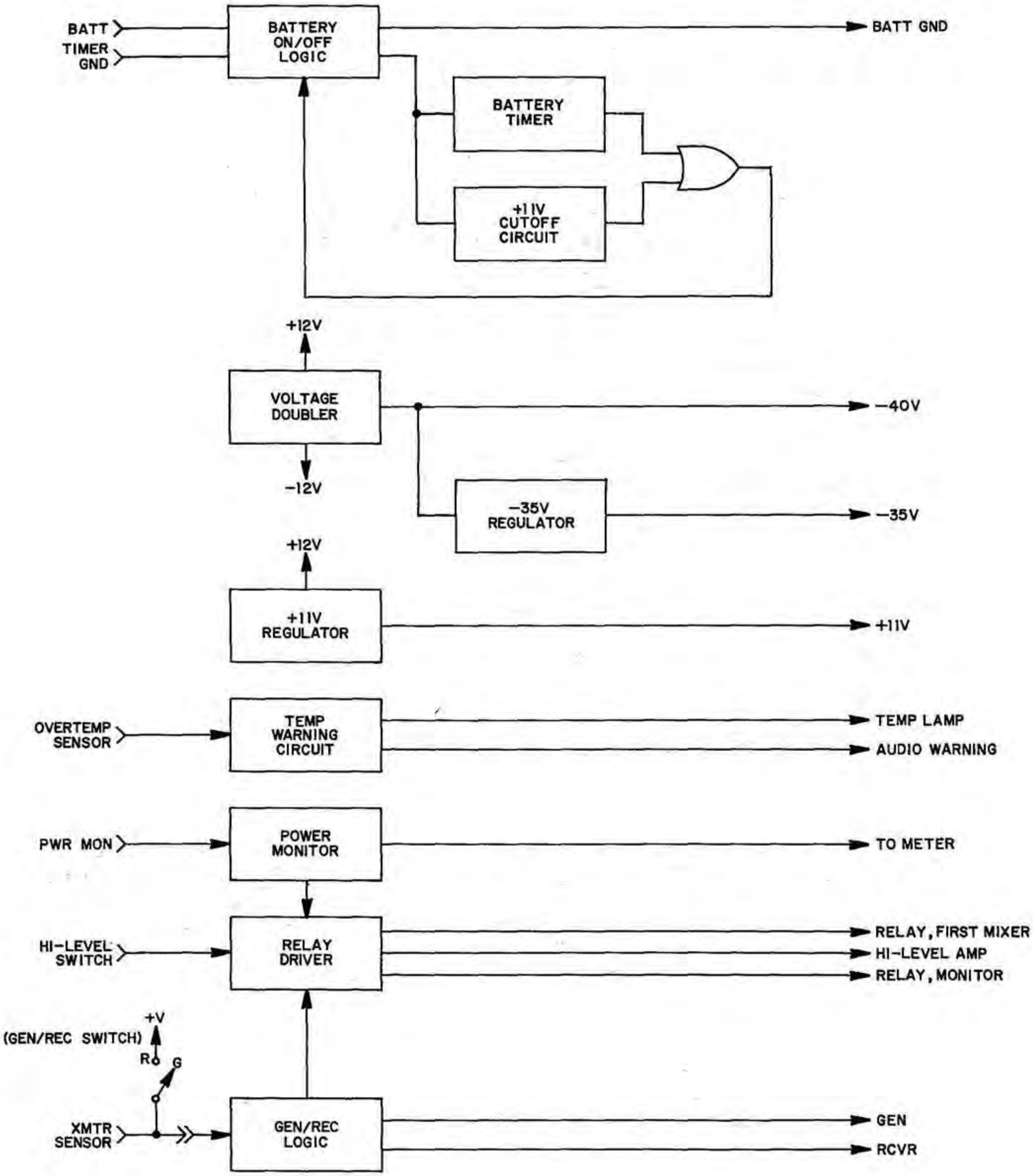


Figure 7-16 Regulator/Timer PC Board Block Diagram

located on the Mother Board. X9107B adjusts the base current of Q9112 until its inputs are balanced. CR9112 sets the reference voltage for this operation. X9107A causes X9107B to shut down the pass transistor (Q10201) when an over-current condition exists.

H. Temp Warning Circuit

X9108, X9109, and Q9118 form the Temp Warning Circuit. U9108 detects an over-temp condition from the Power Termination Assembly. The output of X9108 is applied to X9109, causing X9109 to oscillate. X9109 is a low frequency oscillator which produces a square wave output. The square wave is applied to the driver transistor, Q9118, driving the over-temp L.E.D. and the piezo-electric alarm.

I. GEN/REC Logic

The GEN/REC logic consists of X9103A, Q9106, Q9109, Q9113, and Q9114. X9103A drives Q9106 when a generate condition exists (i.e., when the XMTR sensor line is low) and drives Q9114 by means of Q9113 when a receive condition exists (i.e., when the XMTR sensor line is high). Q9109 provides a positive voltage in receive, and a negative voltage in generate, to the 1200 MHz Filter and Diode Switch.

J. Power Monitor

The Power Monitor is formed by X9104. X9104A is an amplifier which drives the Deviation/Watts Meter by means of range resistors R9187 thru R9192. X9104B generates a signal for the relay driver circuit when the input power exceeds a predetermined level (typically 100 mW).

K. Relay Driver

Q9108 and Q9115 thru Q9117 form the Relay Driver. This circuit contains the necessary logic and drive current for the high level amplifier, first mixer relay, and power monitor relay. Table 7-4 summarizes the logic functions of the Relay Driver.

MODE OF OPERATION	LOGIC STATE OF DEVICE		
	1ST MIXER RLY	PWR TERM RLY	HI LVL AMP
REC thru ANTENNA	0	0	0
REC thru TRANS/RCVR	1	0	0
GEN	0	1	0
GEN (HI LVL)	1	1	1

Logic States: 0 = De-energized
1 = Energized

Table 7-4 Relay Driver Truth Table

7-13-2 REMOVAL & DISASSEMBLY

No removal or disassembly is required for testing purposes.

7-13-3 PREPARATION FOR TESTING

A. Required Test Equipment

Oscilloscope	DC to 1 MHz
Digital Multimeter	100 KΩ/V, 3½ Digit
300 KΩ Resistor	¼ W, 10%
Power Supply	+10 to +15 VDC at 8 Amps
Stopwatch	10 min. capacity, 1 sec. resolution
Shorting Strap	24 gauge, alligator clips both ends

B. Preparation

Testing of the Regulator/Timer PC Board can be accomplished by leaving the circuit board installed in place and monitoring the various test signals on the bottom side of the Mother Board at connector J9101 (all pins on this connector are labeled). The necessary adjustments are also accessible with the PC Board installed. For PC Board troubleshooting, an extender card (IFR Part No. 7010-9801-300) is available.

1. Verify fully charged batteries are installed in FM/AM-1100S/A.

2. Place front panel controls to following settings:

Control	Initial Settings
(3) HI LVL/μV X 100/NORM	"NORM"
(11) PWR/OFF/BATT	"OFF"
(13) GEN/RCVR	"GEN"
(48) DEV/POWER	"SIG"

3. Place unit on rear panel standoffs.

7-13-4 TESTING

A. Reference Regulator/Timer PC Board Circuit Schematic in Section 10, Regulator/Timer PC Board in Section 9, and Mother Board Mechanical Assembly in Section 8.

1. Set PWR/OFF/BATT Switch (11) to "PWR".

2. Using Multimeter, measure voltage on following pins of J9101 on bottom of Mother Board. Verify voltages are within tolerances listed below:

Pin No.	Voltage	Tolerance
E	+12 V	±100 mV
14	-12 V	±500 mV
N	-200 mV	±200 mV
H	0 V	±300 mV
J	0 V	±2.0 V
4	>1.0 V	———
2	+13 V	±2.0 V
B	+13 V	±2.0 V

NOTE

If Step 2 fails, the malfunction is not necessarily associated with the Regulator/Timer PC Board. Check associated modules and wiring for malfunction.

3. Set GEN/RCVR Switch (13) to "RCVR". Verify pin N of J9101 is at +5.075 (±0.225) V.

4. Set HI LVL/µV X 100/NORM Switch (3) to "HI LVL". Verify pin J of J9101 is +12 (±0.4) V.

5. Connect Multimeter to pin 6 of J9101.

6. Adjust R9157 for an indication of +11 V ±.05 on Multimeter.

NOTE

If Step 6 fails, malfunction may be associated with the PNP pass transistor (Q10201) located on the Mother Board and/or its associated wiring. Check this transistor and wiring before deciding that Regulator/Timer PC Board is bad.

7. Measure voltage of pin 15 of J9101. Verify voltage is -40 (±3) V.

8. Measure voltage at pin R of J9101. Verify voltage is -35 (±0.5) V.

9. Measure voltage at pin 1 of J9101. Verify voltage is >+3 V.

10. Connect Shorting Strap between pin 4 of J9101 and ground.

11. Using Oscilloscope, verify pin 3 of J9101 displays a square wave with a frequency of approximately 3 Hz and amplitude of >4 Vp-p.

12. Using Oscilloscope, verify pin 5 of J9101 displays a square wave with a frequency of approximately 3 Hz and amplitude of approximately 12 Vp-p.

13. Remove Shorting Strap from pin 4 of J9101.

14. Using Multimeter, measure voltage at following pins of J9101. Verify voltage is within tolerances listed:

Pin No.	Voltage	Tolerance
L	+725 mV	±100 mV
13	+11 V	±0.4 V
11	<0.3 V	
12	0 V	±0.3 V
M	0 V	±0.3 V
K	0 V	±0.3 V

15. Set GEN/RCVR Switch (13) to "GEN".

16. Measure voltage at following pins of J9101. Verify voltage is within tolerance listed:

Pin No.	Voltage	Tolerance
L	-725 mV	±100 mV
13	<0.3 V	
11	+11 V	±0.3 V
12	+11 V	±0.4 V
M	+12 V	±0.4 V
K	+11 V	±0.4 V

17. Set HI LVL/µV X 100/NORM Switch (3) to "µV X 100".

18. Measure voltage at following pins of J9101. Verify voltage is within tolerances listed below:

Pin No.	Voltage	Tolerance
12	0 V	±0.4 V
M	0 V	±0.3 V
K	+11 V	±0.4 V

19. Connect 300 K Resistor between pin H of J9101 and +5 V which is available at FL31 on J2404 on Mother Board.

20. Measure voltage at following pins of J9101. Verify voltage is within tolerance listed below:

Pin No.	Voltage	Tolerance
12	+11 V	±0.4 V
M	0 V	±0.3 V
K	+11 V	±0.4 V
8	±200 mV	
9	±200 mV	
10	±200 mV	

21. Set PWR/OFF/BATT Switch (11) to "OFF".

22. Remove AC power cord from FM/AM-1100S/A.

23. Remove 300 KΩ resistor from FM/AM-1100S/A.

24. Disconnect Molex connector (J8104) from battery.

25. Connect Variable Power Supply to battery connector J8104.

26. Adjust Variable Power Supply to produce +15 V at 6 Amps.

27. Measure voltage on pin 1 of J9101. Verify voltage is approximately 4 V.

28. Connect Multimeter to pin C of J9101. Verify voltage is +12 V.

29. Apply power to FM/AM-1100S/A by momentarily grounding pin B of J9101 and start stopwatch at same time. Verify voltage on Multimeter drops below 1 V.

30. Monitor Multimeter. When voltage rises above +11 V, stop the stopwatch. Verify stopwatch indicates approximately ten minutes.

31. Rotate R9122 fully cw.

32. Adjust Variable Power Supply to produce +11 (±0.02) V.

33. Momentarily ground pin B of J9101.

34. Slowly adjust R9122 ccw to the point where Multimeter jumps above +10 V.

35. Set output of Variable Power Supply to +15 V.

36. Momentarily ground pin B of J9101.

37. Slowly decrease voltage of Variable Power Supply until Multimeter voltage jumps above +10 V.

38. Measure voltage of Variable Power Supply. Verify voltage is +11 (±0.2) V.

NOTE

If voltage in Step 36 is incorrect, repeat Steps 26 thru 38.

7-13-5 REASSEMBLY

1. Set all power "OFF".

2. Disconnect all test equipment.

3. No reassembly of Regulator/Timer PC Board is necessary. If, however, replacement of Regulator/Timer PC Board is necessary, replace it in FM/AM-1100S/A per Section 6.

7-14 SECOND MIXER

7-14-1 THEORY OF OPERATION (Reference 2nd Mixer Circuit Schematic in Section 10)

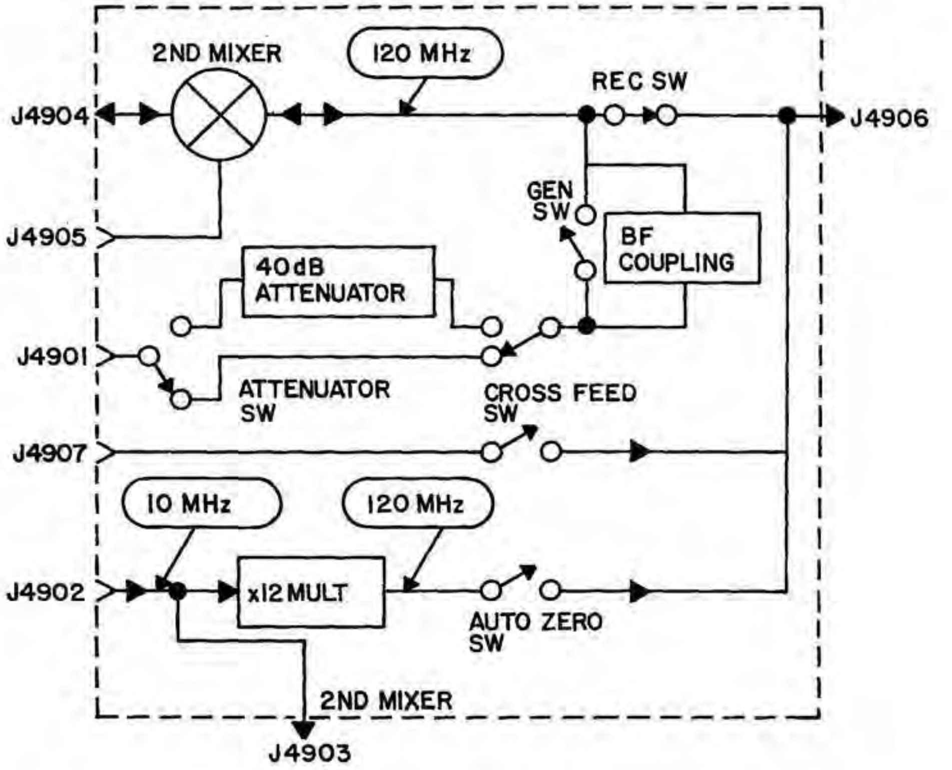


Figure 7-17 2nd Mixer Block Diagram

A. 2nd Mixer

During receiver operation, 1200 MHz fed through J4904 is mixed in the 2nd Mixer (MX4901) with the 1080 MHz 2nd local oscillator signal fed in through J4905. The resulting difference frequency leaves the mixer through J4906 after passing through the receive diode switch which is comprised of CR4901, CR4902, CR4903 and L4903.

During generator operation, 120 MHz enters the 2nd Mixer through J4901. The 120 MHz signal may or may not be attenuated by 40 dB Attenuator before being passed through the generate diode switch, C4903, CR4904 and R4902 into the mixer, MX4901.

1080 MHz from the 2nd Local Oscillator is mixed with 120 MHz signal to produce 1200 MHz, which is fed out the 2nd Mixer through J4904.

B. 40 dB Attenuator

R4904, R4905, R4906, CR4905, CR4906, CR4907 and CR409 comprise the 40 dB Attenuator bypass diode switch. With the HI LVL/μV X 100/NORM Switch in "NORM" position and a positive potential applied to Pin F of J4908, diodes CR4905 and CR4908 will be reverse biased and CR4906 and CR4907 will be forward biased. This condition will allow the 120 MHz signal to be passed through the 40 dB (π) Attenuator consisting of R4907 through R4911.

With the HI LVL/μV X 100/NORM Switch in the "μV X 100" or "HI LVL" position and a negative potential applied to Pin F of J4908, CR4906 and CR4907 will be reverse biased. This condition will allow the 120 MHz signal to bypass the 40 dB (π) Attenuator.

C. BFO Coupling

In the receive mode, R4903 is provided for BFO coupling of the 1200 MHz BFO signal around the generate diode switch. This coupling provides for BFO injection into the receiver.

D. Crossfeed Diode Switch

In the generate mode, 120 MHz will enter J4907 to permit reception of the generated signal for monitoring purposes. The crossfeed diode switch consists of CR4912 through CR4914 and L4905.

E. x12 Multiplier

A 10 MHz reference signal enters the 2nd Mixer through J4902. The 10 MHz signal will drive snap diode CR4915. The diode, when driven in this fashion, will produce many harmonics. The 120 MHz filter, consisting of L4906, C4907 and C4908 will allow the 12th harmonic to be applied to the auto zero diode switch.

F. Auto Zero Diode Switch

The auto zero diode switch is comprised of CR4916 through CR4918 and L4907 through L4909. This switch will be closed during the 3 ms auto zero pulse. At this same time, the receive diode switch and crossfeed diode switch will be opened by CR4909 and CR4910 respectively.

7-14-2 REMOVAL & DISASSEMBLY

A. Removal

2nd Mixer may be tested without removal from FM/AM-1100S/A.

NOTE

Further disassembly of 2nd Mixer is not required for testing purposes (paragraph 7-14-4). If, however, repair or replacement of internal components is necessary, continue with following disassembly steps.

B. Disassembly (Reference 2nd Mixer Mechanical Assy drawing in Section 8)

1. Remove cover (3) by removing ten Phillips screws (5) and ten lock washers (4) which secure cover to assembly.

CAUTION

DO NOT TURN GOLD PLATED SCREWS ON SIDE OPPOSITE COVER (3) DURING DISASSEMBLY, AS DAMAGE TO ASSEMBLY COULD RESULT.

2. Unsolder resistor R4903 from mixer MX4901.

3. Unsolder inductor L4901 from ground pin and swing free of mixer MX4901.

4. Remove mixer MX4901 from assembly by removing:

   a. Two Phillips screws (2) and bar (1) holding mixer in place.

   b. Two leads (unsolder) from connector J4904 and connector J4905.

7-14-3 PREPARATION FOR TESTING

A. Required Test Equipment

Two Signal Generators	Capable of generating 10 to 1200 MHz at -56 to +4 dB
Spectrum Analyzer	Capable of measuring 120 to 1200 MHz
Three 50Ω Coax Cables	BNC on one end/SMB male on other end, calibrated
One 50Ω Coax Cable	BNC male on both ends, calibrated
Digital Multimeter	Any

NOTE

50Ω coax cables listed above must be calibrated for insertion loss at the following frequencies: 10 MHz, 120 MHz, 1080 MHz, 1200 MHz.

B. Preparation

1. Disconnect connectors to J4901, J4903, J4904, J4905, J4906, and J4907.

2. Connect output of first Signal Generator to input of Spectrum Analyzer with 50Ω coax cable (BNC/BNC).

3. Apply power to Spectrum Analyzer.

4. Apply power to Signal Generator. Set output to 120 MHz at -56 dBm.

5. Adjust output of Signal Generator to reflect a power level of (-56 dBm) + (CABLE LOSS) on the Spectrum Analyzer.

   EXAMPLE: (-56 dBm) + (-3 dB) = -59 dBm

6. Remove coax cable between Signal Generator and Spectrum Analyzer.

7. Connect 50Ω coax cable (BNC/SMB) between output of Signal Generator and J4907 on 2nd Mixer.

8. Connect second 50Ω coax cable (BNC/SMB) between J4906 on 2nd Mixer and input of Spectrum Analyzer.

7-14-4 TESTING

A. Reference 2nd Mixer Circuit Schematic in Section 10 and 2nd Mixer Mechanical Assembly in Section 8.

1. Set following front panel controls to positions shown:

Control	Initial Setting
(3) HI LVL/µV X 100/NORM	"µV X 100"
(8) AUTO ZERO/OFF/BATT	"OFF"
(11) PWR/OFF/BATT	"PWR"
(13) GEN/RCVR	"RCVR"

2. Using Multimeter, measure following voltages on J4908. Verify voltages are within tolerances listed.

Pin No.	Voltage	Tolerance
A	-4.3 V	±1.5 V
B	+11.3 V	±1.5 V
F	-12 V	±0.5 V
H	-5.8 V	±0.5 V

3. Using Multimeter, measure voltage at J4908, pin H while holding AUTO ZERO/OFF/BATT Switch (8) to "BATT". Verify voltage is -~~8~~6V ±1.5 V.

4. Set following controls to positions shown:

Control	Initial Settings
(3) HI-LVL/μV X 100/NORM	"NORM"
(13) GEN/RCVR	"GEN"

5. Using Multimeter, measure voltages at following pins of J4908. Verify voltages are within tolerances listed.

Pin No.	Voltage	Tolerance
A	+11.5 V	±1.0 V
B	-3.0 V	±1.0 V
F	+11.1 V	±0.5 V

5A. SET (8) AUTO ZERO/OFF/BATT "AUTO ZERO"

6. Verify insertion loss to be less than 2 dBm.

(DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (-56 dBm) = INSERTION LOSS

EXAMPLE: (-60 dBm) - (-3 dB) - (-56 dBm) = -1 dB LOSS

7. Disconnect coax cables between J4906, J4907, Signal Generator and Spectrum Analyzer.

8. Connect 50Ω coax cable (BNC/SMB) between J4906 on 2nd Mixer and input to Spectrum Analyzer.

9. Set GEN/RCVR Switch (13) to "RCVR".

10. Hold the AUTO ZERO/OFF/BATT Switch (8) to "BATT".

    a. Verify Spectrum Analyzer displays a 120 MHz signal at -36 to -42 dBm. (Make sure to account for cable loss.)

    b. Release the AUTO ZERO/OFF/BATT Switch (8).

11. Disconnect coax cables from J4906 to Spectrum Analyzer and P4902 from J4902.

12. Connect 50Ω coax cable (BNC/BNC) between output of Spectrum Analyzer.

13. Adjust output of Signal Generator to display (+4 dB) + (CABLE LOSS) at 1080 MHz as seen on the Spectrum Analyzer.

14. Remove coax cable between Signal Generator and Spectrum Analyzer.

15. Connect 50Ω coax cable (BNC/SMB) between output of Signal Generator and J4905 on 2nd Mixer.

NOTE

Do not disturb setting of this first Signal Generator for remainder of this procedure.

16. Connect 50Ω coax cable (BNC/BNC) between output of second signal Generator and Spectrum Analyzer.

17. Adjust Signal Generator to display a 1200 MHz signal at (-20 dBm) + (CABLE LOSS).

18. Remove coax cable installed in Step 16.

19. Connect 50Ω coax cable (BNC/SMB) between output of Signal Generator (calibrated in Step 17) and J4904 on 2nd Mixer.

20. Connect 50Ω coax cable (BNC/SMB) between J4906 on 2nd Mixer and input of Spectrum Analyzer.

    a. Verify output to be between -25 and -35 dB at 120 MHz (make sure to account for cable loss).

21. Remove coax cable between J4906 and Spectrum Analyzer.

22. Remove coax cable between J4904 and the 1200 MHz Signal Generator.

23. Connect 50Ω coax cable (BNC/BNC) between output of Signal Generator described in Step 22 and input of Spectrum Analyzer.

24. Adjust Signal Generator to display a 120 MHz signal at (-6 dB) + (CABLE LOSS).

25. Remove coax cable installed in Step 23.

26. Connect 50Ω coax cable (BNC/SMB) between output of Signal Generator calibrated in Step 24 and J4901 on 2nd Mixer.

27. Connect 50Ω coax cable (BNC/SMB) between J4904 on 2nd Mixer and input of Spectrum Analyzer.

a. Verify output to be between -58 and -60 dB at 1200 MHz.

28. Set HI LVL/μV X 100/NORM Switch (3) to "μV X 100".

    a. Verify Spectrum Analyzer display increases by 40 dB (±1 dB).

7-14-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 2nd Mixer. Reassemble 2nd Mixer in reverse order of procedure described in paragraph 7-14-2 and reinstall assembly within FM/AM-1100S/A.

7-15 SPECTPUM ANALYZER INVERTER BOARD

7-15-1 THEORY OF OPERATION (Reference Spectrum Analyzer/Scope Inverter Board Circuit Schematic in Section 10)

A. Start-Up Circuit

The start-up circuit, Q4001 and associated components, provides momentary bias to Q4002 and Q4003 in the inverter in order to excite them into oscillation when power is applied. Before power is applied, C4001 is in a discharged state. Upon application of power, C4001 charges through R4001, R4002, and R4003 as well as the base-emitter junction of Q4001. The charge-up of C4001 causes Q4001 to conduct, applying a bias voltage to Q4002 and Q4003 via a center tapped winding of T4001. When C4001 is fully charged, Q4001 turns off and the start-up circuit remains dormant during operation.

B. Inverter

Q4002, Q4003, and T4001 form a self-oscillating inverter circuit. Oscillations are sustained by feedback from the base winding of T4001. Secondaries of T4001 provide 200 V, 1 KV, and approximately 6 V for filaments.

C. 200 V Rectifier

CR4002 thru CR4005 form a full wave bridge rectifier which produces +200 V. C4003, C4004, and R4004 form a low pass filter which smoothes the rectifier's output.

D. Voltage Divider

The voltage divider, R4017 and R4018, provide +100 VDC for the CRT screen grid.

E. Voltage Doubler

CR4007, CR4008, C4006 thru C4008, R4005, and R4006 form a voltage doubler which produces -2 K VDC, CR4007, CR4008, C4006, and C4007 rectify and double the applied voltage. C4008, R4005, and R4006 form a low pass filter. The -2 K VDC is applied to the CRT grid, the blanking switch, and the focus intensity circuit.

F. Low Voltage Rectifier

The low voltage rectifier, CR4006 and C4005, provides DC power for the opto-isolator.

G. Opto-Isolator

The opto-isolator, U4001, provides electrical isolation between the blanking signal and the blanking switch.

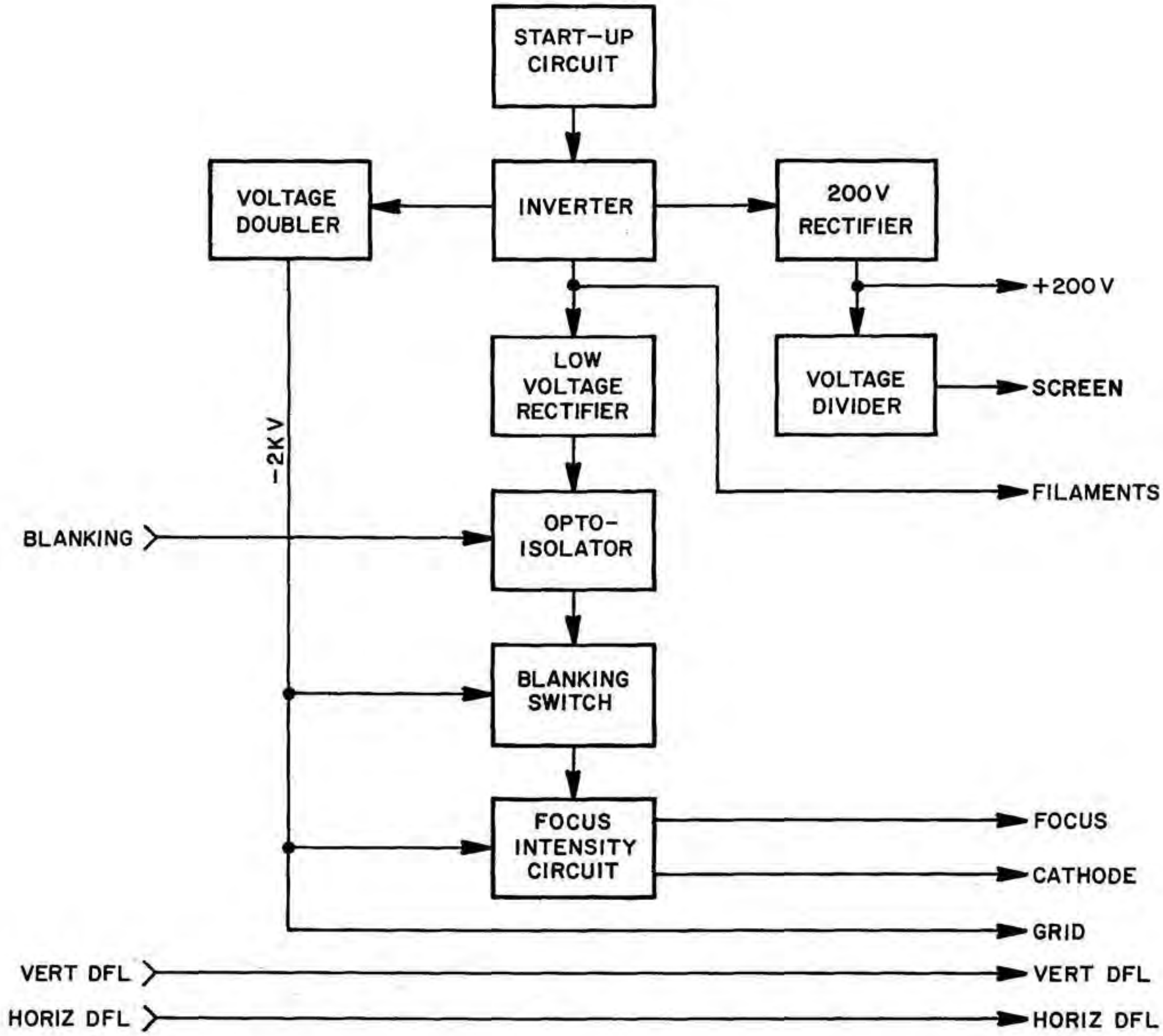


Figure 7-18 Spectrum Analyzer/Oscilloscope Inverter Board Block Diagram

H. Blanking Switch

The blanking switch, Q4004, controls current through the focus and intensity circuit to provide blanking. CR4009 protects Q4001 from stress due to over-voltage.

I. Focus and Intensity Circuit

The focus and intensity circuit, R4009 thru R4016 and C4009, is essentially a voltage divider which provides proper biasing voltages for the cathode and the focus anode in the CRT. R4001 adjusts the focus, while R4014 adjust the intensity.

7-15-2 REMOVAL & DISASSEMBLY

A. Removal

Remove Spectrum Analyzer/Oscilloscope from FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference Spectrum Analyzer/Oscilloscope Mechanical Assembly drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

1. Remove Inverter Board Shield from Spectrum Analyzer/ Oscilloscope.

NOTE

Further disassembly of the Inverter Board is not necessary for testing. If Inverter Board requires repair or replacement, remove per instructions provided in Section 6 of this manual.

7-15-3 PREPARATION FOR TESTING

A. Required Test Equipment

Oscilloscope w/X10 Probe ... Dual trace, 10 MHz bandwidth or greater

Digital Multimeter .... 100 KΩ/V Sensitivity

High Voltage Probe .... -3 KV range

B. Preparation

1. Connect J9201 to P9201.

2. Place front panel controls to following settings:

Control	Initial Setting
(29) SWEEP	"MOD FREQ Hz"
(30) SWEEP VERNIER	Fully cw, detent (in "CAL")
(31) AC/OFF/DC	"AC"
(32) DEV-VERT VERNIER	Fully cw, detent (in "CAL")
(33) DEV-VERT	"10 V/DIV"
(37) INTENSITY	Fully ccw
(38) HORIZ	Midrange
(39) FOCUS	Fully ccw
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S models only)	Fully ccw, detent

WARNING

THE SPECTRUM ANALYZER/OSCILLOSCOPE INVERTER BOARD HAS VOLTAGE POTENTIALS APPROACHING 2.3 KV. CARE MUST BE TAKEN WHEN WORKING WITH INVERTER BOARD.

7-15-4 TESTING

A. Reference Spectrum Analyzer/Oscilloscope Inverter Board Circuit Schematic in Section 10 and Spectrum Analyzer/Oscilloscope Inverter PC Board in Section 9.

1. Set PWR/OFF/BATT Switch (11) to "PWR".

2. Using Digital Multimeter, measure voltage at E4002. Verify voltage of +220 (±30) VDC.

3. Using Digital Multimeter, measure voltage at E4008. Verify voltage is +110 (±20) VDC.

4. Connect High Voltage Probe to Digital Multimeter.

5. Set PWR/OFF/BATT Switch (11) to "OFF".

6. Connect High Voltage Probe to E4009.

7. Set PWR/OFF/BATT Switch (11) to "PWR". Verify measured voltage is approximately -2.3 KV.

8. Set PWR/OFF/BATT Switch (11) to "OFF".

9. Connect High Voltage Probe to E4006.

10. Set PWR/OFF/BATT Switch (11) to "PWR". Verify measured voltage is approximately -1.7 KV.

11. Set PWR/OFF/BATT Switch (11) to "OFF".
12. Connect High Voltage Probe to E4001.
13. Set PWR/OFF/BATT Switch (11) to "PWR". Verify measured voltage is approximately -2.1 KV. Note and record voltage reading.
14. Rotate INTENSITY Control (37) fully cw. Verify measured voltage is at least 40 V more negative than voltage recorded in Step 13.
15. Set PWR/OFF/BATT Switch (11) to "OFF".
16. Rotate FOCUS Control (39) fully cw.
17. Connect High Voltage Probe to E4001.
18. Set PWR/OFF/BATT Switch (11) to "PWR". Verify measured voltage is approximately -1.5 KV.
19. Set PWR/OFF/BATT Switch (11) to "OFF".
20. Remove High Voltage Probe.
21. Connect Oscilloscope to junction of R4001 and R4010, using X10 probe and AC coupling.
22. Set PWR/OFF/BATT Switch (11) to "PWR".
23. Rotate INTENSITY Control (37) to "MIDRANGE".
24. Rotate SWEEP Control (29) to "10 mS/DIV".
25. Verify Oscilloscope displays a 10 to 30 V positive going pulse approximately 750 μS wide.

7-15-5 REASSEMBLY

1. Set all power "OFF".
2. Disconnect test equipment.
3. If removal was required for replacement or repair, install Inverter Board Assembly per Section 6 of this manual.
4. Install shield over Inverter Board.
5. Install Spectrum Analyzer/Oscilloscope Assembly in FM/AM-1100S/A per Section 6 of this manual.

7-16 SPECTRUM ANALYZER /OSCILLOSCOPE MAIN BOARD

7-16-1 THEORY OF OPERATION (Reference Spectrum Analyzer/Scope Main Board Circuit Schematic in Section 10)

A. External Input Amp

The external input amp, X4302 and Q4301, amplifies the input signal to a level sufficient for driving the vertical differential amplifier. X4302 provides voltage gain, while Q4301 provides drive current.

B. Vertical Differential Amplifier

The vertical differential amplifier, Q4302 thru Q4304, supplies the CRT's vertical deflection plates with a 200 V differential representation of the input signal. Q4304 is a current regulator for the differential pair of Q4302 and Q4303. CMOS switches, X4303D and X4303C, form a SPDT switch which selects between a fixed vertical position for Spectrum Analyzer operation and a variable vertical control (VERT Control) for Oscilloscope operation. X4305 performs the switching function.

C. Constant Current Source

Q4306 and associated components form a constant current source which linearly charges the sweep capacitors, located at the sweep switch, to produce a linear ramp voltage. This linear ramp voltage is the basis for the horizontal sweep.

D. Gate & Sync Circuit

The gate and sync circuit consists of X4307, Q4308, and Q4311 thru Q4314. Q4308 turns on when the sweep capacitors charge to a predetermined level. When Q4308 turns on, Q4311 will turn off, causing Q4312 to turn off. The gate flip-flop, Q4311 and Q4312, is now set. The high level at the collector of Q4312 is applied to the reset transistor, Q4314, and to the blanking transistor, Q4313, both of which are on. The output of the blanking transistor is applied to the Inverter Board to blank the CRT display. The reset transistor, Q4314, discharges the sweep capacitor. When the sweep capacitor is completely discharged, Q4311 is turned off through CR4308, turning on Q4312 and turning off Q4313 and Q4314. The sweep capacitors are then allowed to charge again. Synchronization is accomplished by X4307, which produces a square wave. This square wave is differentiated by C4307 and applied to the voltage divider, R4337 and R4336, which determines the level at which the sweep is reset. When a signal is applied to the sync circuit and the sweep is near the reset point, the output of X4307 causes the sweep to reset prematurely, which in effect synchronizes the sweep frequency to a subharmonic of the input signal.

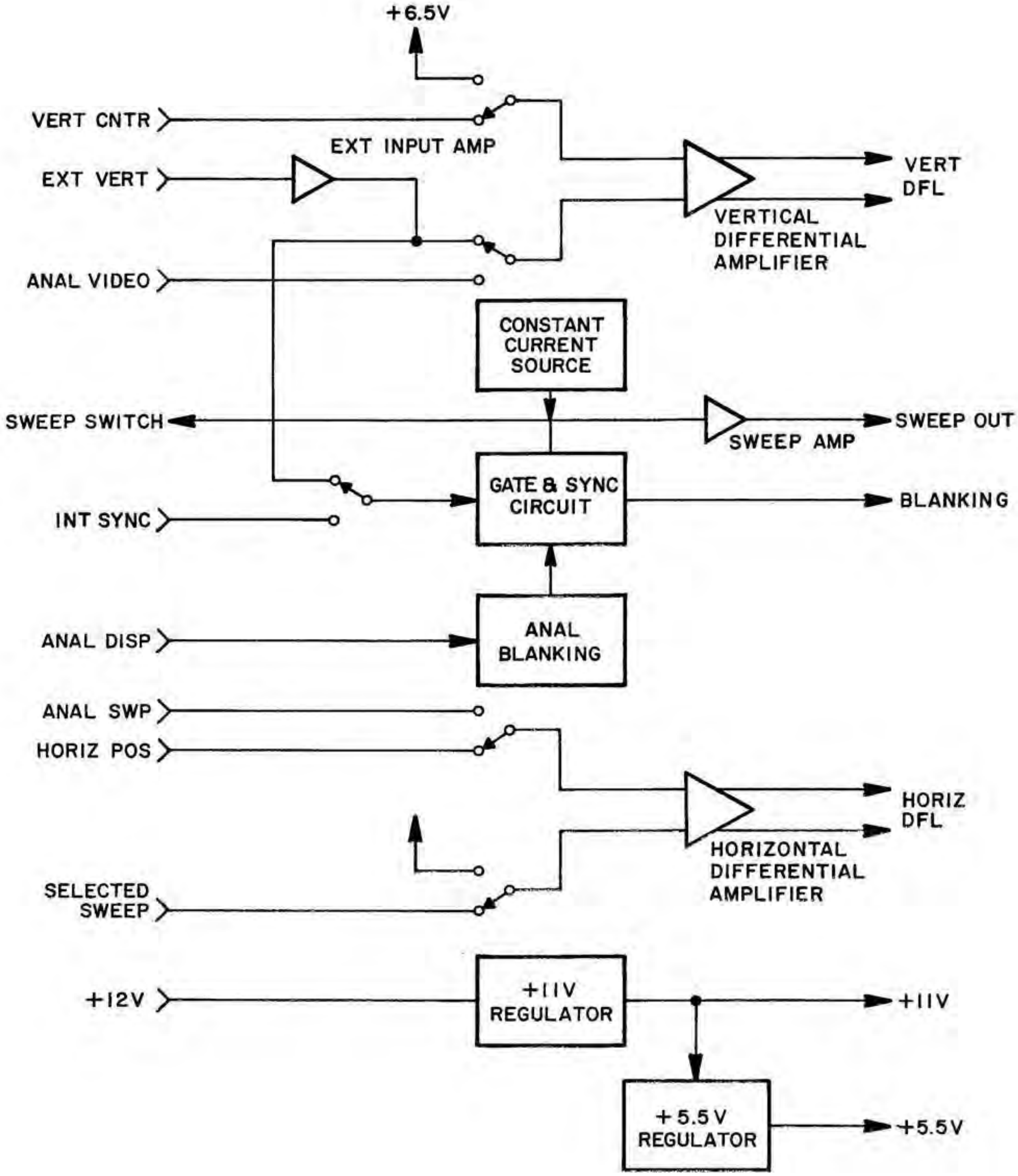


Figure 7-19 Spectrum Analyzer/Oscilloscope
Main Board Block Diagram

E. Sweep Amp

The sweep amp, Q4307 inverts the sweep signal and applies a positive DC offset to the sweep. The output of the sweep amp is applied to the sweep switch.

F. Analyzer Blanking Circuit

The analyzer blanking circuit, X4308, Q4309, and Q4310, produces the blanking signal for the CRT when in analyzer mode.

G. Horizontal Differential Amplifier

Q4315 thru Q4317 form a horizontal differential amplifier which provides a 200 V differential sweep signal to the horizontal deflection plates in the CRT. Q4317 is a current regulator for differential transistors Q4315 and Q4316. CMOS switches X4309A and X4309D select between the analyzer sweep (fixed horizontal position for analyzer operation) and selected sweep (variable horizontal position from Sweep Control) for oscilloscope operation.

H. +11 V Regulator

X4306 and Q4305 form a series regulator. CR4307 sets the reference voltage for this +11 V regulator.

I. +5.5 V Regulator

The +5.5 V regulator is derived from the +11 V line by R4365 and R4366 and then buffered by voltage follower X4304.

7-16-2 REMOVAL & DISASSEMBLY

A. Removal

Spectrum Analyzer Main Board may be tested without complete removal from the set.

B. Disassembly (Reference Spectrum Analyzer/Oscilloscope Mechanical Assembly drawing in Section 8 of this manual)

TOOLS REQUIRED: Small Phillips Screwdriver

1. Remove four Phillips head screws and lock washers securing Main Board to Spectrum Analyzer.
2. Fold Main Board outward to gain access to test points on board.

7-16-3 PREPARATION FOR TESTING

A. Required Test Equipment

Oscilloscope w/X10 Probe ... Dual trace, 10 MHz bandwidth or greater

Digital Multimeter .... Any

50Ω Coax Cable .... BNC to BNC

B. Preparation

1. Make following control settings:

Control	Initial Setting
(11) PWR/OFF/BATT	"OFF"
(13) GEN/RCVR	"GEN"
(25) VAR/OFF	"OFF"
(26) 1 kHz/OFF	"OFF"
(29) SWEEP	"MOD FREQ"
(30) SWEEP VERNIER	Fully cw, detent (in "CAL")
(31) AC/OFF/DC	"AC"
(32) DEV-VERT VERNIER	Fully cw, detent (in "CAL")
(33) DEV-VERT	".01 V/DIV"
(37) INTENSITY	Midrange
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S Models Only)	Fully ccw, detent

7-16-4 TESTING

A. Reference Spectrum Analyzer/Oscilloscope Main Board Assembly in Section 9 and Spectrum Analyzer/Oscilloscope Main Board Circuit Schematic in Section 10.

1. Set PWR/OFF/BATT Switch (11) to "PWR".

2. Connect Multimeter between J4302 pin 13 and ground.

3. Adjust R4326, if necessary, for an indication of +11 V (±0.2) VDC.

4. Adjust INTENSITY (37) and FOCUS (39) Controls to produce a sharp visible dot on the CRT.

5. Adjust VERT (40) and HORIZ (38) Controls to center dot at the intersection of the major horizontal and vertical axes.

6. Set base lines of CH A and CH B to the bottom graticule line on bench Oscilloscope.

7. Connect CH A of bench Oscilloscope to J4303 pin 4 using X10 probe.

8. Connect CH B of bench Oscilloscope to J4303 pin 6 using X10 probe.

9. Set CH A and CH B vertical sensing controls to 5 V/DIV. Use DC coupling.

NOTE

Oscilloscope now displays 50 V/DIV.

10. Verify voltage level on CH A is +120 V (±30 V).

11. Verify voltage level on CH B is +120 V (±30 V).

12. Rotate VERT Control (40) fully ccw. Verify CH A is >+190 VDC. Also verify CH B is <+15 VDC.

13. Rotate VERT Control (40) fully cw. Verify CH B is >+190 VDC. Also verify CH A is <+15 VDC.

14. Adjust HORIZ Control (38) and 1 kHz/OFF Control (26) to produce a trace 8 graticule divisions long, centered about the intersection of the major horizontal and vertical axes.

15. Connect coax cable between INT MOD OUT Connector (24) and SCOPE IN Connector (28).

16. Adjust VERT Control (40) and DEV-VERT VERNIER Control (32) to produce a first order Lissajou pattern six graticule divisions high and eight graticule divisions wide, centered about the intersection of the major horizontal and vertical axes.

17. Verify bench Oscilloscope CH A displays a sine wave which is approximately 100 Vp-p.

18. Verify bench Oscilloscope CH B displays a sine wave which is approximately 100 Vp-p.

19. Connect CH A of Oscilloscope to pin 8 of J4303. Verify CH A displays a sine wave at least 140 Vp-p.

20. Connect CH B of Oscilloscope to pin 10 of J4303. Verify CH B displays a sine wave approximately 140 Vp-p.

21. Rotate HORIZ Control (38) fully ccw. Verify that on CH B the sine wave is limited at >+190 V. Also verify CH A limits below +15 V.

22. Rotate HORIZ Control (38) fully cw. Verify that on CH A the sine wave is limited at >+190 V. Also verify CH B limits below +15 V.

23. Adjust VERT (40) and HORIZ (38) Controls to center Lissajou pattern.

24. (Perform this step on FM/AM-1100S only.) Rotate ANALY DISPR Control (41) fully cw. Verify CH A displays a sawtooth waveform with a period of approximately 55 mS. Verify CH B displays a sawtooth waveform with a period equal to that of CH A. Also verify pin 6 of J4302 is at +11 (±0.2) V.

NOTE

Sawtooth waveform may be limited above +190 V and below +15 V. This is a normal occurrence.

If sawtooth waveform is not present on CH A or CH B, verify that sawtooth waveform is present at pin 10 of J4302. If sawtooth is not present at pin 10, the Spectrum Analyzer Main Board Assembly is faulty. If it is present, at pin 10, either Spectrum Analyzer Module #1 or Module #2 is faulty.

After completion of Step 24, rotate ANALY DISPR Control (41) fully ccw, detent.

25. Rotate SWEEP Control (29) to "10 mS/DIV". Connect Multimeter (mA meter) between pin 5 of J4301 and ground. Verify current is approximately 400 μA.

26. Rotate SWEEP VERNIER Control (30) fully ccw. Verify current on Multimeter is approximately 150 μA.

27. Rotate SWEEP VERNIER Control (30) fully ccw, detent. Rotate SWEEP Control (29) to "1 mS/DIV".

28. Remove Multimeter. Verify Oscilloscope CH A and CH B display sawtooth waveforms with periods of approximately 9 mS. Verify no clipping or limiting occurs on waveforms. Also verify FM/AM-1100S/A Oscilloscope displays a stable sine wave.

29. Connect CH B of bench Oscilloscope to pin 9 of J4303. Verify a 1.3 (±0.5) V pulse occurs during the retrace interval.

29. (Cont'd)

NOTE

Steps 30 thru 33 are only applicable to FM/AM-1100S models.

30. Rotate SWEEP Control (29) to "MOD FREQ".

31. Rotate ANALY DISPR Control (41) fully cw.

32. Verify CH B displays a 1.3 (±0.5) V pulse which occurs during the retrace interval.

33. Verify FM/AM-1100S displays analyzer video.

NOTE

If analyzer video is not present, verify analyzer video is present at pin 9 of J4302. If video is present at pin 9, the Spectrum Analyzer Main Board Assembly is faulty. If video is not present at pin 9, either Spectrum Analyzer Module #1 or Module #2 is faulty.

7-16-5 REASSEMBLY

1. Set all power to "OFF".

2. Remove test equipment from set.

3. Install four Phillips head screws and lock washers which secure Main Board to Spectrum Analyzer Assembly.

7-17 SPECTRUM ANALYZER MODULE #1 (FM/AM-1100S Models Only)

NOTE

Test Spectrum Analyzer Module #2 prior to this test. Module #2 must be in operational order for this test to be conclusive.

7-17-1 THEORY OF OPERATION (Reference Spectrum Analyzer Module #1 Circuit Schematic in Section 10)

A. 18 Hz Sawtooth Generator

The 18 Hz Sawtooth Generator, consisting of Q9409, X9401A, and X9401B, produces the sweep signal for both the VCO and Horizontal Deflection Circuits. Q9409 regulates current into the sweep capacitor, C9436. C9436 charges linearly until discharged by X9401A. X9401B buffers the sawtooth output and applies the resulting sweep signals to the Summation Amp and Horizontal Deflection Circuits.

B. Summation Amp

The Summation Amp consists of X9402 and X9403A. X9402 establishes a DC operating point. X9403A is a summing amplifier which sums the phase lock signal and sweep signal together. The result is a sawtooth sweep signal centered around the 145 MHz operating point of the VCO.

C. Dispersion Amp

The Dispersion Amp (X9403B) provides gain to the composite signal before applying it to the 145 MHz VCO.

D. 145 MHz VCO

Q9406, Q9407, CR9403 and associated components form a 130-140 MHz VCO. Q9406 is an active supply line filter (low pass). Q9407 is the oscillator transistor. CR9403 and L9412 form the resonant oscillator circuit. Output of the VCO is applied to the Divider Amp and the First Spectrum Analyzer Mixer. The output of the VCO is a frequency sweep centered around 145 MHz when phase locked.

E. Divider Amp

Q9408, a common emitter class A amplifier, is provided for buffering between the VCO and the Frequency Divider located in Spectrum Analyzer Module #2.

F. 120 MHz Amp

The 120 MHz Amp is a two stage, class A, temperature compen-

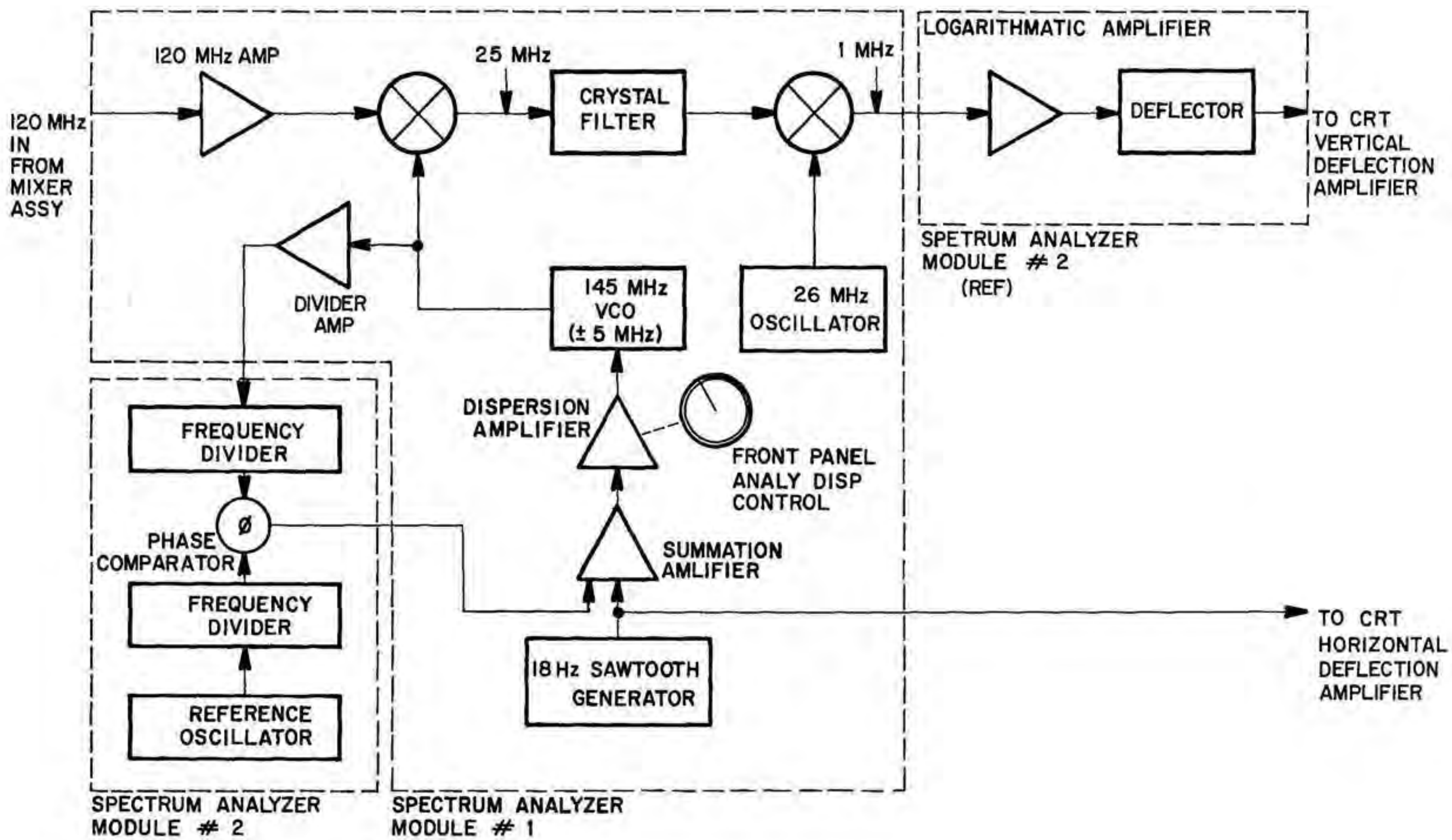


Figure 7-20 Spectrum Analyzer Module #1 Block Diagram

sated amplifier. RT9401 maintains constant gain of the first stage transistor Q9401. The second stage transistor, Q9402, has its output tuned at 120 MHz with a 10 MHz Bandpass. 10 MHz is also the maximum dispersion. The output of the 120 MHz Amp is applied to the 1st Spectrum Analyzer Mixer.

G. 1st Spectrum Analyzer Mixer

The 1st Spectrum Analyzer Mixer, Q9403, mixes the output of the 145 MHz VCO with the 120 MHz IF to produce a 25 MHz output. Since the VCO output sweeps from 140 MHz to 150 MHz, the 25 MHz output will reflect a portion of the 115-125 MHz spectrum present at the output of the 120 MHz Amp. The output of the 1st Spectrum Analyzer Mixer is applied to the 25 MHz Crystal Filter.

H. 25 MHz Crystal Filter

The Crystal Filter, YFL9401, is a 25 MHz bandpass filter with a 30 kHz bandwidth. It sets the resolution of the FM/AM-1100S/A to 30 kHz. The output of the Crystal Filter is applied to the 2nd Spectrum Analyzer Mixer.

I. 26 MHz Oscillator

The 26 MHz Oscillator, Y9401 and Q9404, is a crystal controlled oscillator producing the 26 MHz 2nd Spectrum Analyzer Local Oscillator frequency of 26 MHz. The output of the 26 MHz Oscillator is applied to the 2nd Spectrum Analyzer Mixer.

J. 2nd Spectrum Analyzer Mixer

The 2nd Spectrum Analyzer Mixer, Q9405, combines the 25 MHz from the Crystal Filter and the 26 MHz from the 26 MHz Oscillator to produce the final IF frequency of 1 MHz which is applied to Spectrum Analyzer Module #2.

7-17-2 REMOVAL & DISASSEMBLY

A. Removal

1. Remove Spectrum Analyzer from FM/AM-1100S per Section 6.

2. Remove Spectrum Analyzer Module #1 from Spectrum Analyzer Assembly per Section 6. Further disassembly is not required for testing. If, however, repair is necessary, continue with paragraph 7-17-2-B.

3. Remove Spectrum Analyzer Module #2 from Spectrum Analyzer Assembly per Section 6.

B. Disassembly (Reference Spectrum Analyzer Module #2 Mechanical Assembly in Section 8)

TOOLS REQUIRED: Small Phillips Head Screwdriver

Soldering Iron

3/16" Nut Driver

1. Remove four Phillips screws (5) and four lock washers (6) securing cover (4) to enclosure (1).

2. Remove three nuts (2) and three lock washers (3) securing J9802, J9803, and J9804 to cover.

3. Desolder filter feed-thru wires from inside of cover. Tag wiring.

7-17-3 PREPARATION FOR TESTING

A. Required Test Equipment

Oscilloscope	Dual trace, 100 MHz bandwidth
Spectrum Analyzer	120-160 MHz Range, Variable Sweep Control
Frequency Counter	0.1 Hz Resolution, 15-22 Hz Response
Connector, Tee	SMB/SMB/SMB
50Ω Coax Cables (2)	BNC to SMB
Digital Multimeter	3½ digit, 100 KΩ/V

B. Preparation

1. Connect P9201 to J9201 on Spectrum Analyzer.

2. Connect P9901 to J9901 on Spectrum Analyzer Module #2.

3. Connect P9801 to J9801 on Spectrum Analyzer Module #1.

4. Connect SMB Tee connector to J9903 on Spectrum Analyzer Module #2.

5. Connect P9803 to J9803 on Spectrum Analyzer Module #1.

6. Connect Multimeter between P9901 (pin 6) and Spectrum Analyzer chassis ground.

7. Connect P9903 to one of the free ends of the SMB Tee connector.

8. Connect input of bench Spectrum Analyzer to remaining free end of SMB Tee connector.

9. Connect CH B of Oscilloscope to J9901 pin 2. (Trigger on CH B.)

10. Connect CH A of Oscilloscope to J9802.

11. Connect input of Frequency Counter to J9901 pin 2.

12. Make following control settings on FM/AM-1100S.

Control	Initial Setting
(11) PWR/OFF/BATT	"OFF"
(13) GEN/RCVR	"GEN"
(25) VAR/OFF	Fully ccw, off
(26) 1 kHz/OFF	Fully ccw, off
(31) AC/OFF/DC	"AC"
(34) RF FREQUENCY MHz Thumbwheels	120 MHz (120 000 0)
(41) ANALY DISPR	Fully cw

Make following settings on external Spectrum Analyzer:

Control	Initial Setting
Reference Level	+10 dBm
Scale	2 dB/DIV
Center Frequency	145 MHz
Resolution	300 kHz
Dispersion	2 MHz/DIV
Sweep Rate	1 Sec/DIV

7-17-4 TESTING

1. Set PWR/OFF/BAT Switch (11) to "PWR".

2. Verify Multimeter displays +11 V (±0.2) V.

NOTE

If Step 2 fails, check continuity of +11 V line per Spectrum Analyzer Schematic in Section 10 before deciding Spectrum Analyzer Module #2 is faulty.

3. Verify Frequency Counter displays 15 to 22 Hz.

4. Verify CH B of Oscilloscope displays a sawtooth waveform with amplitude of approximately 5 Vp-p.

5. Verify bench Spectrum Analyzer display is similar to Figure 7-21. Amplitude should be between 0 dBm and +10 dBm for the minimum frequency range of 145 MHz (±6 MHz).

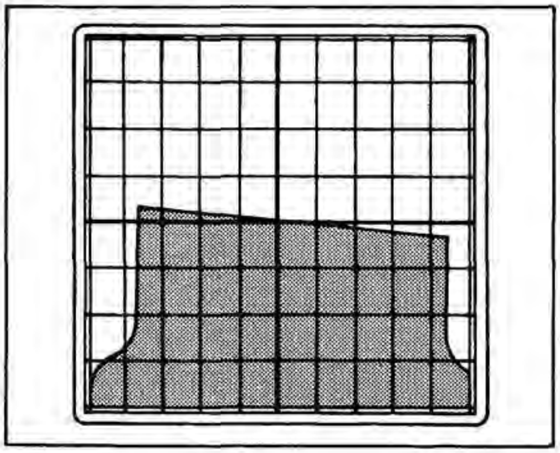


Figure 7-21 145 MHz Frequency Range Display

6. Rotate ANALY DISPR Control (41) fully ccw just short of detent. Verify bench Spectrum Analyzer display is similar to Figure 7-22 below. Amplitude should be between 0 and +10 dBm for the frequency range of approximately 144 to 145 MHz.

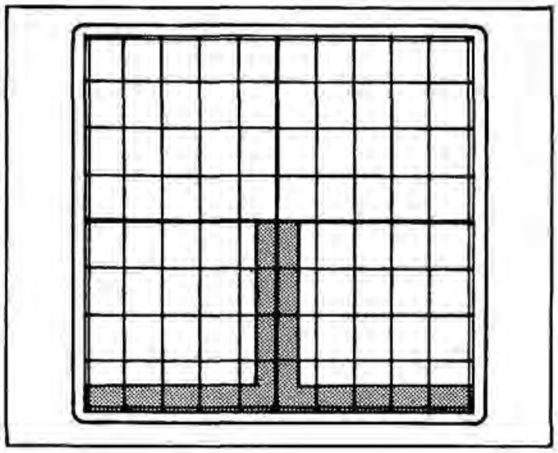


Figure 7-22 144 to 145 MHz Frequency Range Display

7. Verify CH A of Oscilloscope displays 1 MHz IF with Analyzer Video present (see Figure 7-23). Amplitude of Video should be at least 0.2 Vp-p.

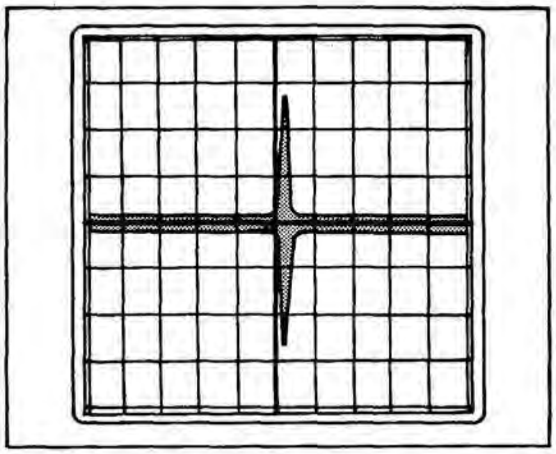


Figure 7-23 1 MHz IF Frequency Display

7-17-5 REASSEMBLY

1. Set all power "OFF".
2. Disconnect all test equipment.
3. Install Spectrum Analyzer Module #2 in Spectrum Analyzer Assembly per Section 6.
4. If Module #1 was disassembled, reassemble in reverse order of paragraph 7-17-2.
5. Install Spectrum Analyzer Module #1 in Spectrum Analyzer per Section 6.
6. Install Spectrum Analyzer Assembly in FM/AM-1100S/A per Section 6.

7-18 SPECTRUM ANALYZER MODULE #2 (FM/AM-1100S Models Only)

7-18-1 THEORY OF OPERATION (Reference Spectrum Analyzer Module #2 Circuit Schematic in Section 10)

A. ÷464,000 Frequency Divider

The ÷464,000 frequency divider provides phase comparator with an average frequency of 312.5 Hz which is derived from the 140-150 MHz VCO. Q4213 buffers the 140-150 MHz signal and applies this signal to X4207, a decade counter. X4207 divides the 140-150 MHz signal by 10 to produce 14-15 MHz which is applied to binary counter X4208. X4208 divides the 14-15 MHz signal by 16 to produce 875-937.5 kHz. The 875-937.5 kHz signal is applied to X4209A, X4209B, X4210, and X4211, all of which make up a ÷2900 counter. This ÷2900 counter divides the 875-937.5 kHz signal by 2900 to produce 301.72-323.27 Hz, yielding an average frequency of 312.5 Hz that is applied to the phase comparator.

B. 5.12 MHz Oscillator

Q4208 and Q4209 form the 5.12 MHz oscillator. Q4208 and Y4201 form a crystal oscillator while Q4209 buffers the crystal oscillator's output.

C. ÷16,384 Frequency Divider

The ÷16,384 frequency divider, X4202, is a 14 bit binary counter which divides the 5.12 MHz by 16,384 to produce the 312.5 Hz reference frequency for the phase comparator.

D. Phase Comparator

The phase comparator consists of Q4210, Q4212, X4204, and X4205. Differentiating capacitor C4240 produces a negative spike on the falling edge of the 312.5 MHz reference signal. This spike momentarily opens CMOS switch X4204C which causes X4204B to discharge capacitor C4230. When X4204B opens, a ramp voltage on the rising edge of the 312.5 MHz signal from the ÷464,000 frequency divider is produced by C4230 and current regulator Q4210. Q4212, an inverter, produces a falling edge which is differentiated by C4229 to produce a narrow spike which opens CMOS switch X4204D. When X4204D opens, sampling switch X4204A is closed. This causes C4231 to be charged to the instantaneous voltage that is present on C4231. X4205, a voltage follower, buffers the charge on C4231 and applies this voltage to a low-pass filter consisting of R4258, R4259, C4234, and C4233. The low-pass filter removes switching transients from the tune voltage. As the falling edge of the 312.5 Hzf reference signal and the rising edge of the output of the ÷464,000 frequency divider change position relative to each other, C4231 charges to a different point on its ramp. This change in tune vol-

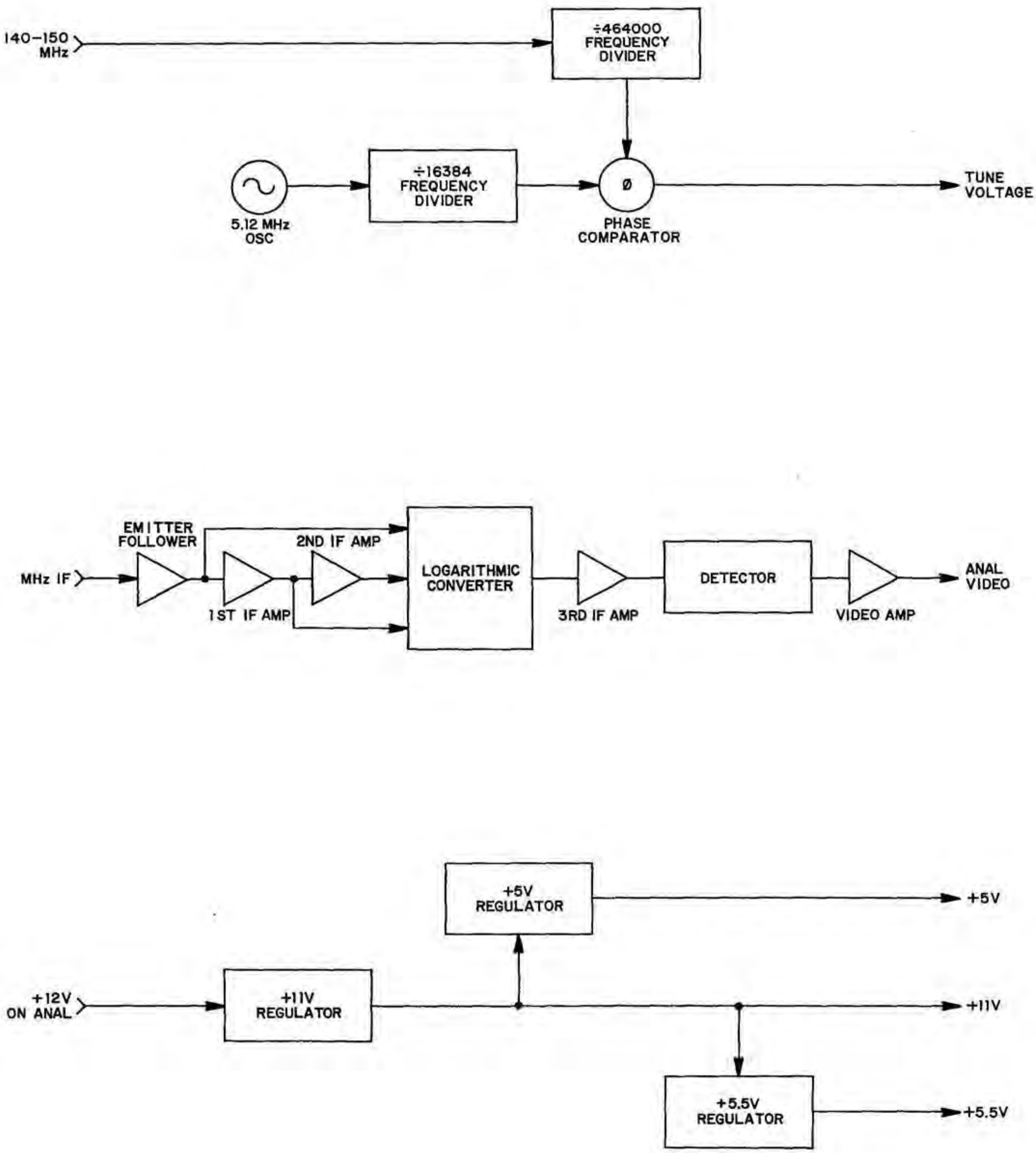


Figure 7-24 Spectrum Analyzer Module #2 Block Diagram

tage steers the falling edge of the 312.5 Hz reference signal and the rising edge of the output of the ÷464,000 frequency divider toward their correct positions relative to each other. This action phase-locks the 140-150 MHz VCO to the 5.12 MHz reference signal.

E. Emitter Follower

Q4201 is an emitter follower which buffers the 1 MHz IF before applying it to the IF amps.

F. 1st and 2nd If Amps

Q4204 and Q4205 form the 1st IF amp, the output of which is applied to the 2nd IF amp and the logarithmic converter. The 2nd IF amp consists of Q4206 and Q4207, the output of which is applied to the logarithmic converter.

G. Logarithmic Converter

The logarithmic converter, X4201, gives the IF strip its logarithmic characteristics, and consequently gives the Spectrum Analyzer its logarithmic scale.

H. 3rd IF Amp

Q4203 is the final IF amp. This inverting amplifier amplifies the output of the logarithmic converter and applies the final IF output to the detector.

I. Detector

The detector consists of CR4205, CR4206, C4220, C4221, and C4222. The detector produces the analyzer video based on the information fed to it.

J. Video

X4203 is a non-inverting video amplifier, the output of which is applied to the Spectrum Analyzer/Oscilloscope Main PC Board for display in analyzer mode.

7-18-2 REMOVAL & DISASSEMBLY

A. Removal

1. Remove Spectrum Analyzer from FM/AM-1100S per instructions in Section 6.

2. Remove Spectrum Analyzer Modules #1 and #2 from Spectrum Analyzer Assembly per instructions in Section 6.

2. (Continued)

NOTE

Further disassembly of Spectrum Analyzer Module #2 is not necessary for testing purposes. If, however, repair or replacement of internal components is necessary, continue with disassembly steps below.

B. Disassembly (Refer to Spectrum Analyzer Module #2 Mechanical Assembly drawing in Section 8 and Spectrum Analyzer Module #2 PC Board in Section 9)

TOOLS REQUIRED: Soldering Iron

Small Phillips Screwdriver

¼" Nut Driver

1. Remove four Phillips screws (4) and four lockwashers (3) securing top cover (1) to bottom cover (2).

2. Unsolder wires betwen PC Board and feed-thru filters.

3. Remove two Phillips screws (7) and two lockwashers (6) securing PC Board to top cover (1).

4. Remove two nuts (9), two lockwashers (8), and two spacers (5) securing J9902 and J9903 to top cover (1).

7-18-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator .... 1 MHz to 146 MHz, -50 to 0 dBm output cw

Oscilloscope .... Dual trace, 100 MHz bandwidth

Digital Multimeter .... 3½ digit, 100 KΩ/V sensitivity

50Ω Coax Cables (2) .... BNC to SMB

B. Preparation

1. Connect J9201 to P9201.

2. Connect J9801 to P9801.

3. Connect P9901 to P9901.

4. Connect output of Signal Generator to J9902.

5. Make following control settings on FM/AM-1100S:

Control	Initial Setting
(31) AC/OFF/DC	"AC"
(41) ANALY DISPR	Fully cw

7-18-4 TESTING (Reference Spectrum Analyzer Module #2 Circuit Schematic in Section 10 and Spectrum Analyzer Module #2 Mechanical Assembly in Section 8)

1. Adjust Signal Generator to produce a 1 MHz cw (Continuous Wave) signal at -50 dBm.

2. Set PWR/OFF/BATT Switch (11) on FM/AM-1100S to "PWR".

3. Adjust INTENSITY (37) and FOCUS (39) Controls for sharp visible trace.

4. Using Multimeter, verify voltage on FL9904 is +12 V (±0.5 V).

NOTE

If voltage in Step 4 is not correct, fault is not in Spectrum Analyzer Module #2. Check ANALY DISPR Control (41) (SW9202) for continuity.

5. Using Multimeter, verify voltage at FL9906 is +11 V (±0.2 V).

6. Connect CH A of Oscilloscope to FL9901.

7. Connect CH B of Oscilloscope to FL9902. Verify waveform on CH B resembles waveform on CH A except for amplitude and DC offset characteristics.

8. Note and record vertical position of trace on FM/AM-1100S CRT.

9. Set output level of Signal Generator to -40 dBm. Verify trace on FM/AM-1100S moves upward 1 (±0.2) graticule divisions from position noted in Step 8. Note and record new position.

10. Set FM/AM-1100S output level of Signal Generator to -30 dBm. Verify trace on FM/AM-1100S moves upward 1 (±0.2) graticule division from position noted in Step 8. Note and record new position.

11. Set output of Signal Generator to -20 dBm. Verify trace on FM/AM-1100S moves upward 1 (±0.2) graticule division from position noted in Step 10. Note and record new position.

12. Set output of Signal Generator to -10 dBm. Verify trace moves upward 1 (±0.2) graticule divisions from position noted in Step 11. Note and record new position.

13. Set output of Signal Generator to 0 dBm. Verify trace moves upward 1 (±0.2) graticule division from position noted in Step 12.

14. Connect Signal Generator to J9902.

15. Set Signal Generator to produce a 144.9 MHz cw (Continuous Wave) signal at 0 dBm.

16. Connect CH A of Oscilloscope to FL9905, using 1 Sec/DIV setting. Verify Oscilloscope displays a low frequency sawtooth wave with amplitude of approximately +9 V. See Figure 7-25.

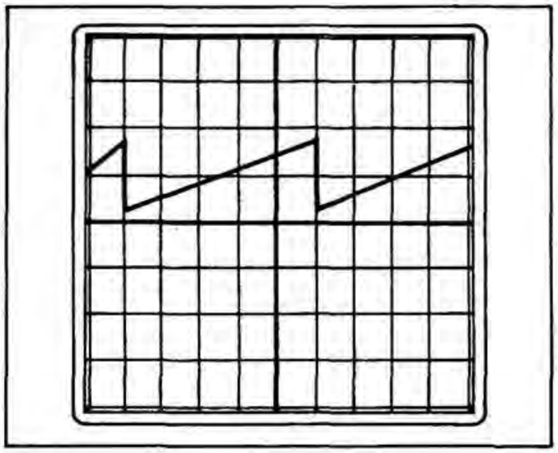


Figure 7-25 Ramp-Up Display of Sawtooth Waveform

17. Set Signal Generator frequency to 145.1 MHz. Verify Oscilloscope displays a low frequency inverted sawtooth waveform with amplitude of approximately +9 V. See Figure 7-26.

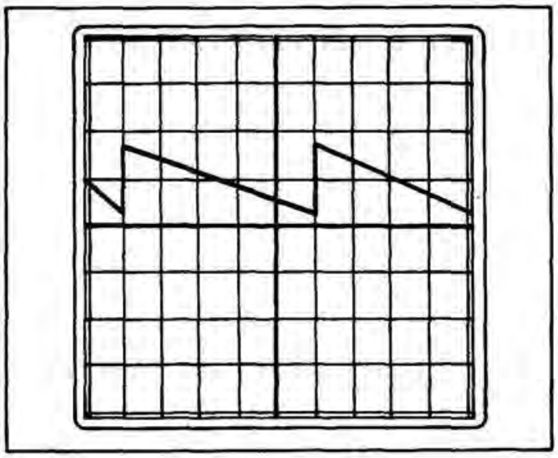


Figure 7-26 Ramp-Down Display of Sawtooth Waveform

7-18-5 REASSEMBLY

1. Set all power "OFF".
2. Disconnect all test equipment.
3. If Spectrum Analyzer Module #2 has been disassembled, reassemble it in reverse order of paragraph 7-18-2.
4. Install Spectrum Analyzer Module #1 and Module #2 in Spectrum Analyzer per instructions in Section 6.
5. Install Spectrum Analyzer in FM/AM-1100S per instructions in Section 6.

7-19 STATIC DISCHARGE PROTECT

7-19-1 THEORY OF OPERATION (Reference Static Discharge Protect Circuit Schematic in Section 10)

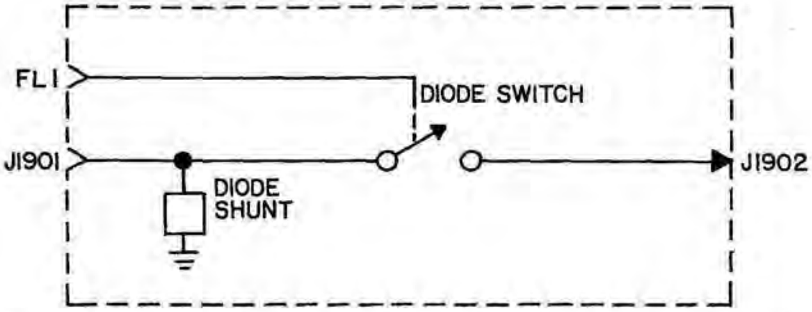


Figure 7-27 Static Discharge Protect Block Diagram

A. Diode Shunt

CR1901 through CR1904 will shunt to ground any potential present at J1901 that is large enough to forward bias CR1901 and CR1902 or CR1903 and CR1904. A static charge will be large enough to forward bias these diodes; low level RF, however, will not.

B. Diode Switch

CR1905 through CR1908 form a diode switch. With +11 VDC applied to FL1901, these four diodes will be forward biased, allowing low level RF to pass through to J1902. When power is removed from FL1901 (i.e. FM/AM-1100S/A is off), these four diodes are not biased and nothing will be allowed to pass J1902.

7-19-2 REMOVAL & DISASSEMBLY

A. Removal

Static Discharge Protect Assembly may be tested while installed. No removal is necessary.

NOTE

No further disassembly of Static Discharge Protect is required for testing purposes (paragraph 7-19-4). If, however, replacement internal components is necessary, continue with following disassembly steps.

B. Disassembly (Reference Static Discharge Protect Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

1. Remove cover assembly (2) by removing six Phillips screws (4) and six lock washers (3) which hold cover to enclosure (1).

7-19-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of generating 120 to 1000 MHz at -20 dBm
Spectrum Analyzer	Capable of measuring 120 to 1000 MHz
Tee Connector	SMB/SMB/SMB
Two 50Ω Coax Cables	BNC on one end, SMB on other end

NOTE

50Ω coax cables above must be calibrated for insertion loss at 120 and 1000 MHz.

B. Preparation

1. Connect output of Signal Generator to input of Spectrum Analyzer with 50Ω coax cable using two BNC/SMB Cables with SMB Tee in between.

2. Apply power to Spectrum Analyzer.

3. Apply power to Signal Generator. Set output to 120 MHz at -20 dBm.

4. Adjust Spectrum Analyzer to reflect (-20 dB) + (cable loss).

5. Disconnect SMB Tee between Signal Generator and Spectrum Analyzer.

6. Connect output of Signal Generator to J1901 of Static Discharge Protect with 50Ω coax cable (BNC/SMB).

7. Connect J1902 of Static Discharge Protect to input of Spectrum Analyzer with 50Ω coax cable (BNC/SMB).

7-19-4 TESTING

A. Reference Static Discharge Protect Circuit Schematic in Section 10.

1. Set PWR/OFF/BATT Switch (11) to "PWR". Verify insertion loss is less than 2 dB, using following equation.

   (DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (SIGNAL GENERATOR OUTPUT) = INSERTION LOSS

   EXAMPLE:

   (-23 dB) - (-2 dB) - (-20 dB)=
   -23 dB + 2 dB + 20 dB = -1 dB INSERTION LOSS

2. Connect output of Signal Generator to input of Spectrum Analyzer with BNC/SMB coax cables with SMB Tee in between.

3. Adjust Signal Generator output to 1000 MHz at -20 dBm.

4. Adjust Spectrum Analyzer to reflect (-20 dB) + (cable loss).

5. Disconnect SMB Tee between Signal Generator and Spectrum Analyzer.

6. Connect output of Signal Generator to J1901 with BNC/SMB Cable.

7. Connect input of Spectrum Analyzer to J1902 with BNC/SMB Cable.

8. Verify insertion loss is less than 4.5 dB, using following equation.

   (DISPLAYED ANALYZER POWER) - (CABLE LOSS) - (SIGNAL GENERATOR OUTPUT) = INSERTION LOSS

7-19-5 <u>REASSEMBLY</u>

A. With all power "OFF", disconnect test equipment from Static Discharge Protect. If required, reassemble Static Discharge Protect in reverse order of disassembly procedure described in paragraph 7-19-2 and reinstall assembly within FM/AM-1100S/A.

7-20 TCXO

7-20-1 THEORY OF OPERATION (Reference TCXO Mechanical Assy drawing in Section 8)

Power is supplied to the TCXO on Pin 3 (ground) and Pin 1 (+11 VDC). A tuned voltage ranging from 0 VDC (ground) to +11 VDC is supplied to Pin 7 of the TCXO.

7-20-2 REMOVAL & DISASSEMBLY

A. Removal

The TCXO can be tested while in its installed position on the FM/AM-1100S/A Upper Floor Assy. No removal is necessary.

B. Disassembly

The TCXO is a factory sealed unit and should not be disassembled.

7-20-3 PREPARATION FOR TESTING

A. Required Test Equipment

Frequency Counter	Capable of counting to 10 MHz with 1 Hz resolution
Oscilloscope	10 MHz Bandwidth (minimum)
Oscilloscope Probe	Any
Frequency Counter Probe	Any
DC Voltmeter	Any
Thermal Chamber (OPTIONAL) .	0° C to 50° C

B. Preparation

None

7-20-4 TESTING

A. Reference TCXO Mechanical Assy drawing in Section 8.

1. Set FM/AM-1100S/A PWR/OFF/BAT Switch (11) to "PWR".
2. Measure voltage at Pin 1 of P503 on TCXO. Verify Voltmeter displays +11 VDC (±.05 VDC).
3. Connect Frequency Counter to J502 of TCXO.

4. Rotate front panel 10 MHz CAL Adjustment (14) fully ccw. Note Frequency Counter reading; rotate 10 MHz CAL Adjustment (14) fully cw.

   a. Verify frequency change is at least 15 Hz.

   b. 10 MHz signal is approximately in the center of two above readings.

   c. If 10 MHz is not in the approximate center of two above readings, perform TCXO calibration in Section 4 of this manual and repeat Steps 1 through 4 of this procedure.

   d. Adjust 10 MHz Cal Adjustment (14) for 10 MHz on Frequency Counter.

5. Connect external Oscilloscope to J502 of TCXO. Verify Oscilloscope displays a sinewave of at least 1.2 Vp-p.

B. Thermal Stability Test (OPTIONAL - To be conducted only if a thermal chamber is available).

1. Perform TCXO calibration procedure in Section 4 of this manual.

2. Place FM/AM-1100S/A into thermal chamber.

3. Connect Frequency Counter to 10 MHz REF OUT Connector (15) on front panel.

4. Decrease temperature to 0° C and note Frequency Counter display.

5. Raise temperature to 50° C while observing Frequency Counter. Verify Frequency Counter display deviates no more than 7 Hz.

7-20-5 <u>REASSEMBLY</u>

1. Set all power "OFF".

2. Disconnect test equipment.

3. Close Upper Floor.

7-21 TCXO OUTPUT DISTRIBUTION AMPLIFIER

7-21-1 THEORY OF OPERATION (Reference TCXO Output Distribution Amplifier Circuit Scehmatic in Section 10)

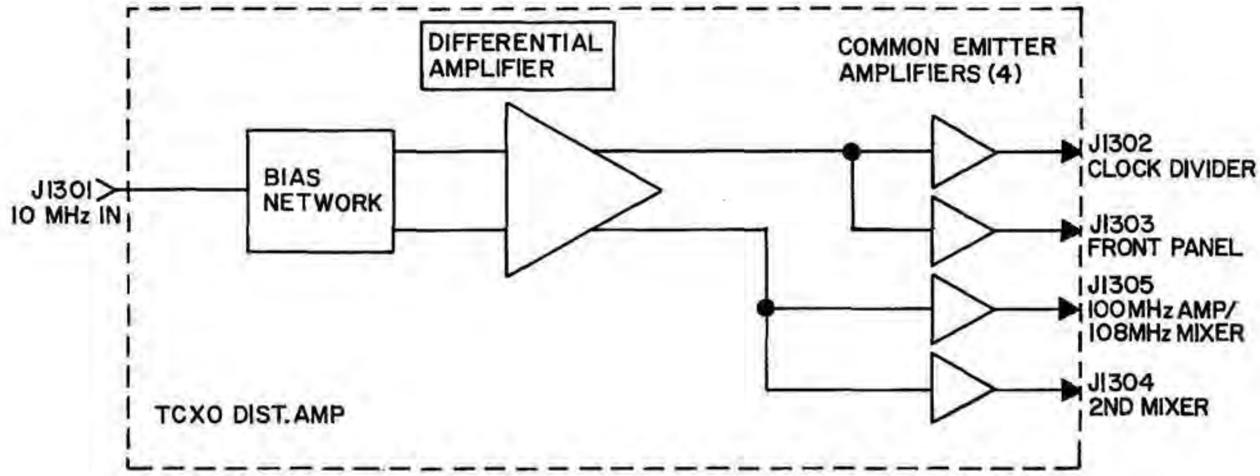


Figure 7-28 TCXO Output Distribution Amplifier Block Diagram

A. Differential Amplifier & Bias Network

A differential amplifier is formed by Q1301, Q1304, R1307, R1312 and R1304. The bias network for this amplifier is composed of C1301, C1304, R1303, R1308 and R1309. R1308 and R1309 form a voltage divider, C1304 removes noise and R1303 keeps the bases of Q1301 and Q1304 at the same potential with no signal in.

10 MHz enters the amplifier at J1301. This signal is coupled through C1301 to the base of Q1301 and causes current to flow through R1303, creating a difference of potential between the bases of Q1301 and Q1304. The difference in potential will cause one of the transistors to conduct harder than the other. The output of this stage is taken from R1307 and R1312.

B. Common Emitter Amplifiers

Q1302, Q1303, Q1305 and Q1306 are common emitter amplifiers. The outputs of Q1302 and Q1303 will be in phase with the incoming signal. Conversely, the outputs of Q1305 and Q1306 are 180° out of phase with the input. Common emitter amplifier Q1306 has a lower output level to drive the 2nd Mixer.

7-21-2 REMOVAL & DISASSEMBLY

A. Removal

Remove TCXO Output Distribution Amplifier from within FM/AM-1100S/A per instructions provided in Section 6 of this manual.

B. Disassembly (Reference TCXO Output Distribution Amplifier Mechanical Assy drawing in Section 8 and TCXO Output Distribution Amplifier PC Board in Section 9)

1. Remove four screws (7) and lock washers (8) from sides of enclosure (6).

2. Unsolder wires from both ends of feed-thru filter FL1301 (9).

NOTE

Leave other end of bus wire soldered to TCXO Output Distribution Amplifier PC Board (E1301).

3. Remove five hex nuts (1) and lock washers (2) from coax connectors.

4. Remove TCXO Output Distribution Amplifier PC Board (5) from enclosure (3).

5. Remove five 3/32" spacers (4) from around the PC Board's connectors.

7-21-3 PREPARATION FOR TESTING

A. Required Test Equipment

Multimeter .... Any

Oscilloscope .... 10 MHz Bandwidth (minimum)

Oscilloscope Probe .... Any

Rubber Mat .... Any

B. Preparation (Reference TCXO Output Distribution Amplifier Mechanical Assy drawing in Section 8 and TCXO Output Distribution Amplifier PC Board in Section 9)

1. Solder +5 VDC line (that was previously connected to top of FL1301 (9)) to unattached end of bus wire connected to E1301 on TCXO Output Distribution Amplifier PC Board.

2. Place rubber mat over Mother Board modules.

3. Lay TCXO Output Distribution Amplifier PC Board on mat.

4. Connect P1301, P1303, P1304 and P1305 to mating connectors on TCXO Output Distribution Amplifier PC Board.

7-21-4 TESTING

A. Reference TCXO Output Distribution Amplifier Circuit Schematic in Section 10 and TCXO Output Distribution Amplifier PC Board in Section 9.

1. Set FM/AM-1100S/A PWR/OFF/BATT Switch (11) to "PWR".

2. Measure voltage at E1301 with a Voltmeter. Verify voltmeter displays 5 VDC (+.25 VDC, -.20 VDC).

3. Measure voltage at junction of R1308 and R1309. Verify Voltmeter displays 2 VDC (±.25 VDC).

4. Connect Oscilloscope to J1302. Verify a 10 MHz waveform of approximately 3.5 to 5.5 V p-p is present.

5. Connect Oscilloscope to J1303. Verify a 10 MHz waveform of approximately 3.5 to 5.5 V p-p is present.

6. Connect Oscilloscope to J1304. Verify a 10 MHz waveform of approximately 3.5 to 5.5 V p-p is present.

7. Connect Oscilloscope to J1305. Verify a 10 MHz waveform of approximately 3.5 to 5.5 V p-p is present.

8. Measure resistance of FL1301 to chassis ground. Verify resistance is greater than 5 KΩ.

7-21-5 REASSEMBLY

With all power "OFF", disconnect test equipment from TCXO Output Distribution Amplifier. Reassemble TCXO Output Distribution Amplifier in reverse order of disassembly procedure described in paragraph 7-21-2 and reinstall assembly within FM/AM-1100S/A.

7-22 VCO TUNER PC BOARD

7-22-1 <u>THEORY OF OPERATION</u> (Reference VCO Tuner Circuit Schematic in Section 10)

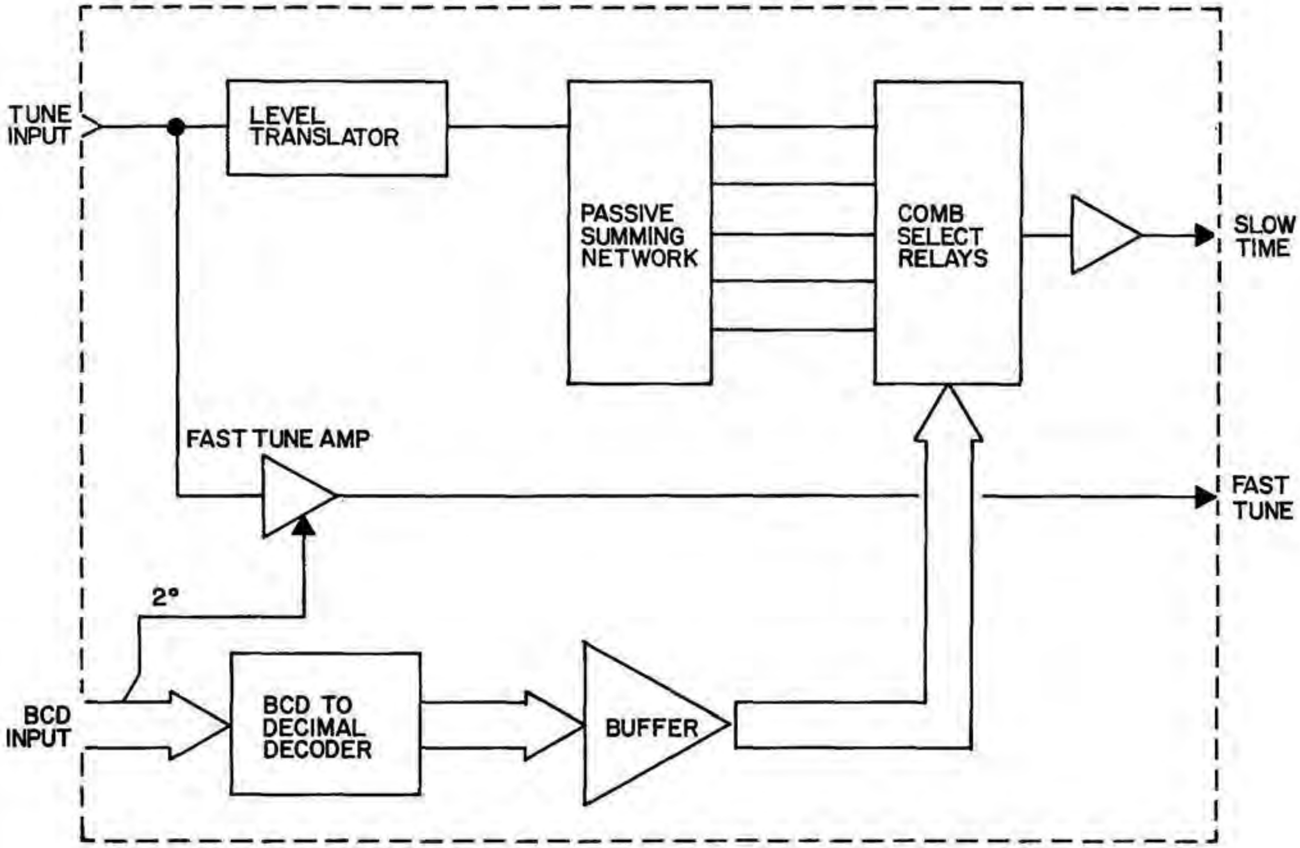


Figure 7-29 VCO Tuner PC Board Block Diagram

A. BCD to Decimal Decoder

The BCD to decimal decoder X2601 converts the three most significant bits of 100 MHz digit of RF FREQUENCY MHz Thumbwheels to a "1 of 5" code.

B. Buffer

Q2607 through Q2611 are five identical buffers. These buffers convert the +5 VDC TTL levels to a +11 VDC swing, to drive relays K2602 through K2606 and the diode switches in the High Frequency Multiplier Mixer.

C. Level Translator

Q2601 and Q2602 convert the positive DC level on the Tune Input line (J2602) to a negative DC level.

D. Passive Summing Network

R2606 through R2642 make up the passive summing network which will add the output of the level translator to five fixed potentials; each potential corresponds to an operating point on the 1200-2200 MHz VCO frequency vs voltage characteristic curve, with one potential for each comb.

E. Comb Select Relays

K2602 through K2606 select which of the fixed potentials from the passive summing network will be used. Only one relay will be energized at a time.

F. Slow Tune Amplifier

Q2603 and Q2604 amplify the DC potential for the comb selected and apply it to the 1200-2200 MHz VCO's slow tune line through J2603.

G. Fast Tune Amplifier

Q2605 is the fast tune amplifier. Q2606 (which drives K2601) is driven by the least significant bit of the 100 MHz digit of the FREQUENCY MHz Thumbwheels. K2601 will be energized for all odd settings of the thumbwheel switches (1, 3, 5, 7, 9) and will be de-energized for the even settings (0, 2, 4, 6, 8). Therefore, the net gain of the fast tune amplifier will be less for the odd settings of the thumbwheels. The output of the fast tune amplifier is fed to the AGC System PC Board through J2604.

7-22-2 REMOVAL & DISASSEMBLY

A. Removal

Removal of the VCO Tuner PC Board from within the FM/AM-1100S/A is necessary only if repair or replacement of the VCO Tuner PC Board is required. Otherwise, the VCO Tuner PC Board can be tested in its installed position. (Refer to Section 6 of this manual for removal instructions.)

B. Disassembly

None required.

7-22-3 PREPARATION FOR TESTING

A. Required Test Equipment

Oscilloscope .... Any

50Ω Coax Cable .... BNC on one end, SMB on other end

B. Preparation

1. Disconnect all three coax cable connectors from top of VCO Tuner PC Board.

2. Connect 50Ω coax cable between Oscilloscope and J2603 of VCO Tuner PC Board.

3. Set RF FREQUENCY MHz Thumbwheels to 000 XXX X (where X = any setting).

7-22-4 <u>TESTING</u>

A. Reference VCO Tuner PC Board Circuit Schematic in Section 10 and VCO Tuner PC Board in Section 9.

1. Apply power to FM/AM-1100S/A.

2. Apply power to Oscilloscope and note displayed DC level.

3. Set RF FREQUENCY MHz Thumbwheels (34) to 200 XXX X and verify that displayed DC level is more negative than that level noted in Step 2. Note level.

4. Set RF FREQUENCY MHz Thumbwheels (34) to 400 XXX X and verify that displayed DC level is more negative than that level noted in Step 3. Note level.

5. Set RF FREQUENCY MHz Thumbwheels (34) to 600 XXX X and verify that displayed DC level is more negative than that level noted in Step 4. Note level.

6. Set RF FREQUENCY MHz Thumbwheels (34) to 800 XXX X and verify that displayed DC level is more negative than that level noted in Step 5.

7. Return RF FREQUENCY MHz Thumbwheels (34) to 000 XXX X.

8. Connect Oscilloscope to J2604 on VCO Tuner PC Board.

9. Connect coax cable connector P2602 to J2602 on VCO Tuner PC Board.

10. Connect coax cable connector P2603 to J2603 on VCO Tuner PC Board. Note peak-to-peak amplitude of square wave displayed on Oscilloscope.

11. Set RF FREQUENCY MHz Thumbwheels (34) to 100 XXX X and verify that peak-to-peak amplitude of displayed square wave has increased from level noted in Step 10. Note peak-to-peak amplitude.

12. Increment the 100 MHz digit of the RF FREQUENCY MHz Thumbwheels (34) from 2 to 9 to confirm:

    a. That the peak-to-peak amplitude for all even thumbwheel settings is equal to the level noted in Step 10.

    b. That the peak-to-peak amplitude for all odd thumbwheel settings is equal to the level noted in Step 11.

7-22-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from VCO Tuner PC Board. If necessary, reinstall VCO Tuner PC Board within FM/AM-1100S/A and return all coax cable connectors to their proper stations.

7-23 100 MHz AMPLIFIER/108 MIXER

7-23-1 THEORY OF OPERATION (Reference 100 MHz Amplifier/108 Mixer Circuit Schematic in Section 10)

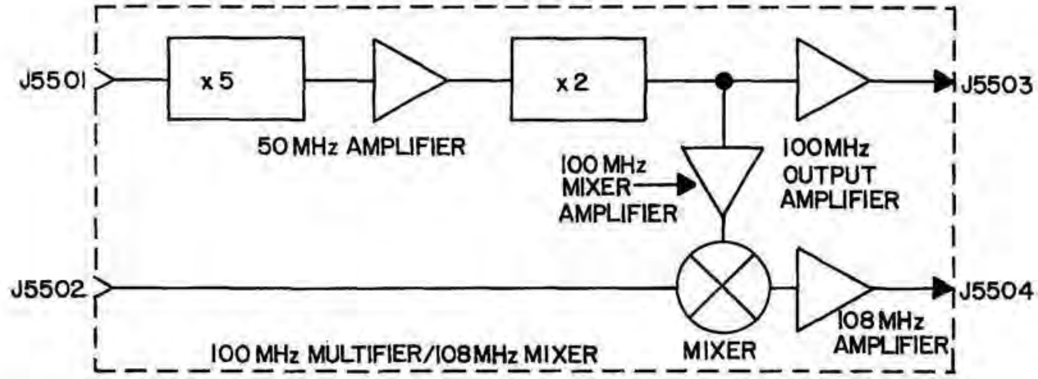


Figure 7-30 100 MHz Amplifier/108 MHz Mixer Block Diagram

A. x5 Multiplier

Q5601 and its associated components form a Class C common source amplifier. The drive frequency is 10 MHz via J5501. L5601, L5602, C5606, C5607 and C5608 select the fifth harmonic, producing 50 MHz.

B. 50 MHz Amplifier

Q5602 and its associated components comprise the 50 MHz amplifier. L5603, L5604, C5611, C5612 and C5613 attenuate harmonics for the tuned stage.

C. x2 Multiplier

Q5603 and its associated components comprise a x2 multiplier. When driven at a frequency of 50 MHz, this common emitter Class C amplifier will produce various harmonics. All undesired harmonics will be attenuated by L5605, L5606, C5615, C5616 and C5617. Only the second harmonic of 100 MHz signal is passed to the next stages.

D. 100 MHz Output Amplifier

Q5604 is a common emitter self-biased, Class A amplifier. This amplifier will amplify the 100 MHz signal produced by the x2 multiplier and will apply it to J5503.

E. 100 MHz Mixer Amplifier

Q5605 and its associated components make up a tuned 100 MHz common source amplifier, which supplies 100 MHz to the 108 MHz mixer.

F. 108 MHz Mixer

An 8 MHz signal from the 79-80 MHz Phase Lock Loop PC Board is fed into the 100 MHz Multiplier/108 MHz Mixer through J5502 and is mixed with 100 MHz in Q5606. L5608, L5609, C5627 and C5628 will select the sum of the two inputs (or 108 MHz), while rejecting the two fundamentals and the difference frequencies (8 MHz, 100 MHz and 92 MHz, respectively).

G. 108 MHz Amplifier

Q5607 and Q5608 form a 108 MHz tuned amplifier. L5611, L5612, C5632, C5633 and C5634 perform filtering and interstage coupling functions. The output of this amplifier is applied to J5504.

7-23-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 100 MHz Amplifier/108 MHz Mixer from within FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference 100 MHz Amplifier/108 MHz Mixer Mechanical Assy drawing in Section 8 and 100 MHz Amplifier/108 MHz Mixer PC Board in Section 9)

TOOLS REQUIRED: Small Phillips Screwdriver

¼" Nut Driver

Soldering Iron

1. Remove cover (7) by removing four Phillips screws (6) and lock washers (5) which secure cover to assembly.

NOTE

Further disassembly of the 100 MHz Amplifier/108 MHz Mixer is not required for testing purposes (paragraph 7-23-4). If, however, repair or replacement of the 100 MHz Amplifier/108 MHz Mixer PC Board is required, continue with following disassembly steps.

2. Remove PC Board (4) from assembly by:

   a. Unsoldering wire from feedthru filter FL5501.

   b. Removing four 1/4" nuts (1) and four lock washers (2) from connectors J5501, J5502, J5503 and J5504, respectively.

7-23-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer	Capable of measuring 10 to 108 MHz
RF Sniffer Cable	See Appendix B
50Ω Coax Cable	BNC one end, SMB on other end
Wooden Block	Any

B. Preparation

1. Place FM/AM-1100S/A on its left (Spectrum Analyzer or Scope) side.
2. Swing open lower floor assembly.
3. Position wooden block under lower floor assembly to maintain it in an open position.
4. Solder +11 VDC line (previously disconnected per Section 6 removal procedure) to FL5501 on 100 MHz Amplifier/108 MHz Mixer.
5. Connect coax cable connector P5501 to J5501 on 100 MHz Amplifier/108 MHz Mixer.
6. Connect coax cable connector P5502 to J5502 on 100 MHz Amplifier/108 MHz Mixer.
7. Attach connector end of RF Sniffer Cable to input of Spectrum Analyzer.
8. Set RF FREQUENCY MHz Thumbwheels (34) on FM/AM-1100S/A front panel to 0014999.

7-23-4 TESTING

A. Reference 100 MHz Amplifier/108 MHz Mixer Circuit Schematic in Section 10, 100 MHz Amplifier/108 MHz Mixer PC Board in Section 9 and 100 MHz Amplifier/108 MHz Mixer Mechanical Assy drawing in Section 8.

1. Apply power to FM/AM-1100S/A.
2. Place coil of RF Sniffer Cable into slot on shield of L5601 and L5602 (insert into slot over L5601).
3. Adjust L5601 to peak analyzer display at 50 MHz.

4. Place RF Sniffer Coil into slot on shield of L5601 and L5602 (insert into slot over L5602).

5. Adjust L5602 to peak analyzer display at 50 MHz.

6. Place RF Sniffer Coil into slot on shield of L5603 and L5604 (insert into slot over L5603).

7. Adjust L5603 to peak analyzer display at 50 MHz.

8. Place RF Sniffer Coil into slot on shield of L5603 and L5604 (insert into slot over L5604).

9. Adjust L5604 to peak analyzer display at 50 MHz.

10. Place RF Sniffer Coil into slot on shield of L5605 and L5606 (insert into slot over L5605).

11. Adjust L5605 to peak analyzer display at 100 MHz.

12. Place RF Sniffer Coil into slot on shield of L5605 and L5606 (insert into slot over L5606).

13. Adjust L5606 to peak analyzer display at 100 MHz.

14. Repeat Steps 2 through 13 to ensure a spurious free output.

15. Disconnect RF Sniffer Cable and connect 50Ω coax cable between J5503 of 100 MHz Amplifier/108 MHz Mixer and input of Spectrum Analyzer.

    a. Verify output is at least +6 dBm.

    b. Verify that all spurs within ±15 kHz to either side of 100 MHz spectrum are no greater than -65 dBm.

16. Remove 50Ω coax cable from J5503 and reconnect it to J5504 on 100 MHz Amplifier/108 MHz Mixer.

17. Adjust L5607 to obtain a maximum indication of 107.95 MHz on Spectrum Analyzer.

NOTE

The 100 MHz spectrum will also increase, but this is of no significance as the signal of interest is 107.95 MHz.

18. Adjust L5608, L5609, L5611 and L5612 to obtain a maximum indication of 108 MHz on Spectrum Analyzer.

19. Repeat Steps 17 and 18 in order to minimize spurious outputs.

    a. Verify output level is at least +6 dBm.

    b. Verify that all spurs within ±15 kHz to either side of 107.95 MHz spectrum are no greater than -65 dBm.

7-23-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 100 MHz Amplifier/108 MHz Mixer. Reassemble 100 MHz Amplifier/108 MHz Mixer in reverse order of procedure described in paragraph 7-23-2 and reinstall assembly within FM/AM-1100S/A.

7-24 100 MHz FILTER

7-24-1 THEORY OF OPERATION (Reference 100 MHz Filter Circuit Schematic in Section 10)

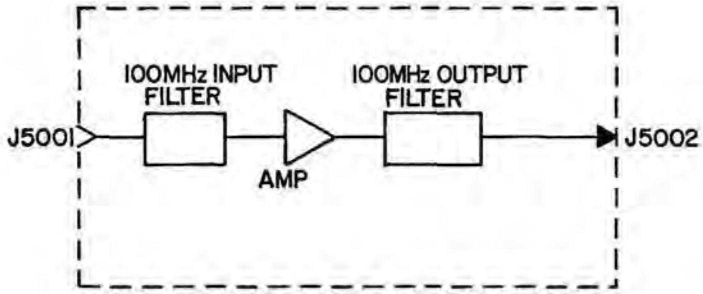


Figure 7-31 100 MHz Filter Block Diagram

A. Input Filter

100 MHz enters the 100 MHz filter through J5001 and is injected into a tank circuit consisting of L5101, C5101 and C5102. Tank circuit L5102, C5103 and C5104 is located in the immediate vicinity of tank circuit L5101, C5101 and C5102. Some of the 100 MHz RF ringing in the first tank circuit is transmitted to the second tank circuit, exciting it into oscillation.

B. Amplifier

Q5101 and its associated components form a common source amplifier. Part of the output filter is in the drain circuit.

C. Output Filter

The output filter is series fed by the drain circuit of Q5101. This filter behaves as the input filter does, with the exception of C5109. C5109 is provided for tighter coupling.

7-24-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 100 MHz Filter from within the FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference 100 MHz Filter Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

¼" Nut Driver

Soldering Iron

1. Remove cover (1) by removing four Phillips screws (6) and four lock washers (7) which hold cover to assembly.

NOTE:

Further disassembly of 100 MHz Filter is not required for testing purposes (paragraph 7-24-4). If, however, repair or replacement of the 100 MHz Filter PC Board is necessary, continue with following disassembly steps.

2. Remove PC Board (2) from assembly by:

   a. Unsoldering wire from feedthru filter FL5001.

   b. Removing one 1/4" nut (5) and one lock washer (4) from connector J5001.

   c. Removing one 1/4" nut (5) and one lock washer (4) from connector J5002.

7-24-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of producing 100 MHz at +9 dBm
Spectrum Analyzer	Capable of measuring 100 MHz
Digital Voltmeter	Any
Power Supply	Capable of producing +11 VDC at 400 mA
Two 50Ω Coax Cables	BNC on one end, SMB on other end

B. Preparation (Reference 100 MHz Filter Mechanical Assy drawing in Section 8)

1. Connect 50Ω coax cable between output of Signal Generator and J5001.

2. Connect 50Ω coax cable between J5002 of 100 MHz Filter and input of Spectrum Analyzer.

3. Connect positive lead of Power Supply (+11 VDC) to FL5001

4. Connect common lead of Power Supply to case of 100 MHz Filter.

7-24-4 TESTING

A. Reference 100 MHz Filter Circuit Schematic in Section 10 and 100 MHz PC Board in Section 9.

1. Apply power to Power Supply.

2. Apply power to Spectrum Analyzer.

3. Apply power to Signal Generator. Set output to 100 MHz at +9 dBm.

4. Measure voltage at junction of L5105 and R5103. Verify voltage is +11 VDC (+.05 VDC, -.1 VDC).

5. Adjust L5101, L5102, L5103 and L5104 for maximum power as displayed on Spectrum Analyzer.

6. De-tune L5104 to obtain an indication of +4 dBm on Spectrum Analyzer.

7-24-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 100 MHz Filter. Reassemble 100 MHz Filter in reverse order of procedure described in paragraph 7-24-2 and reinstall assembly within FM/AM-1100S/A.

7-25 108 MHz BANDPASS FILTER

7-25-1 THEORY OF OPERATION (Reference 108 MHz Bandpass Filter Circuit Schematic in Section 10)

108 MHz enters the filter at J1601 and is coupled to tank circuit L1601 and C1602 by C1601. RF from tank circuit L1601 and C1602 will propagate down the channel to tank circuit L1604 and C1605 and will be coupled to J1602 by C1606. Tank circuits L1602/C1603 and L1603/C1604 will shunt any RF to ground which is not at a frequency of 108 MHz.

7-25-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 108 MHz Bandpass Filter from within FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

NOTE

Further disassembly of the 108 MHz Bandpass Filter is not required for testing purposes (paragraph 7-25-4). If, however, repair or replacement of internal filters (L1601 through L1604) is necessary, continue with the following disassembly steps.

B. Diassembly (Reference 108 MHz Bandpass Filter Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

5/16" Nut Driver

Soldering Iron

1. Remove cover (3) by removing ten Phillips screws (4) and ten lock washers (5) which hold cover to assembly.
2. Remove filter L1601 from assembly by:
   a. Unsoldering wire from capacitor C1601.
   b. Removing one 5/16" nut (1) and one lock washer (2).
3. Remove filter L1602 from assembly by removing one 5/16" nut (1) and one lock washer (2).
4. Remove filter L1603 from assembly by removing one 5/16" nut (1) and one lock washer (2).
5. Remove filter L1604 from assembly by:

a. Unsoldering wire from capacitor C1606.

b. Removing one 5/16" nut (1) and one lock washer (2).

7-25-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of producing 108 MHz at -10 dBm
Spectrum Analyzer	Capable of measuring 108 MHz
50Ω Coax Cable	BNC on one end, SMB on other end (13" long contact to contact; critical length)
Adaptor	SMB both ends
50Ω Coax Cable	BNC on one end, SMB on other end

B. Preparation

1. Connect critical length 50Ω coax cable of 13.0" to output of Signal Generator.

2. Connect adaptor to free end of critical length coax cable.

3. Connect other 50Ω coax cable between free end of adaptor and Spectrum Analyzer.

4. Apply power to Spectrum Analyzer.

5. Apply power to Signal Generator. Set output to 107.5000 MHz at -10 dBm.

6. Note power level displayed on Spectrum Analyzer.

7. Remove adaptor.

8. Connect free end of critical length coax cable to J1601 of 108 MHz Bandpass Filter.

9. Connect free end of remaining coax cable to J1602 of 108 MHz Bandpass Filter.

7-25-4 TESTING

A. Reference 108 MHz Bandpass Filter Circuit Schematic in Section 10 and 108 MHz Bandpass Filter Mechanical Assy drawing in Section 8.

1. Adjust C1602, C1603, C1604 and C1605 to peak power displayed on Spectrum Analyzer. Verify difference between displayed power and power noted in Step 6 of paragraph 7-25-3,B is less than -17 dB after adjustment (less than -14 dB is preferred).

7-25-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 108 MHz Bandpass Filter. If required, reassemble 108 MHz Bandpass Filter in reverse order of procedure described in paragraph 7-25-2 and reinstall assembly within FM/AM-1100S/A.

7-26 1080 MHz MULTIPLIER

7-26-1 THEORY OF OPERATION (Reference 1080 MHz Multiplier Circuit Schematic in Section 10)

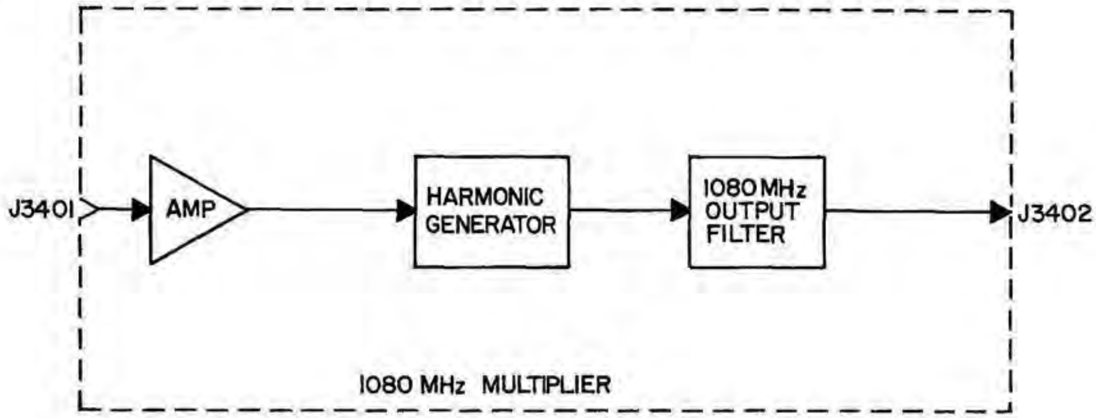


Figure 7-32 1080 MHz Multiplier Block Diagram

A. Amplifier

The 108 MHz Amplifier is a single stage amplifier which amplifies the 108 MHz output of the 100 MHz Multiplier/108 MHz Mixer to a level which is sufficient to drive the harmonic generator. Q11002 is a Class A amplifier which employs negative feedback to stabilize gain.

B. Harmonic Generator

The amplifier 108 MHz signal is applied to a snap diode (CR11002). The output of CR11002 is rich in harmonics which are applied to the 1080 MHz input filter.

C. 1080 MHz Input Filter

The 1080 MHz Input Filter is a pathwork filter designed to pass only the tenth harmonic of the 108 MHz signal. After the filter, the 1080 MHz output is amplified by Q11003 and sent to the 1080 MHz output filter.

D. 1080 MHz Output Filter

The 1080 MHz Output Filter is a pathwork filter. This filter passes the 10th harmonics (i.e., 1080 MHz) while suppressing all other harmonics. The signal is amplified by Q11101 and Q11102 and sent to J11102.

7-26-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 1080 MHz Multiplier from within FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

NOTE

Further disassembly of 1080 MHz Multiplier is not required for testing purposes (paragraph 7-26-4). If, however, repair or replacement of the 1080 MHz Multiplier PC Board is necessary, continue with following disassembly steps.

B. Disassembly (Reference 1080 MHz Multiplier Mechanical Assy drawing in Section 8 and 1080 MHz Multiplier PC Board in Section 9)

1. Remove cover (4) by removing twelve Phillips screws (5) and lifting cover from assembly.

2. To remove PC Board (2) from assembly:

a. Unsolder lead of Feed-Thru Wire.

b. Unsoldering J11102.

c. Remove four Phillips screws (3) from PC Board.

d. Remove one 1/4" nut (7) from connector J11102.

7-26-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer	Capable of measuring 1080 MHz
Variable Attenuator	1 dB to 10 dB
50Ω Coax Cable	BNC on one end, SMB on other end

B. Preparation (Reference 1080 MHz Multiplier Mechanical Assy drawing in Section 8, 1080 MHz Multiplier Circuit Schematic in Section 10, and FM/AM-1100S/A Coax Interconnect in Section 10).

1. Reconnect +11 V supply line to FL11001.

2. Reconnect coax cable connector P11001 to mating connector J11001 on 1080 MHz Multiplier.

3. Connect 50Ω coax cable between J11002 and input of Spectrum Analyzer.

4. Set RF Frequency MHz Thumbwheels (34) on FM/AM-1100S/A to 000 5000.

7-26-4 TESTING

A. Reference 1080 MHz Multiplier Circuit Schematic in Section 10, 1080 MHz Multiplier PC Board in Section 9 and 1080 MHz Multiplier Mechanical Assembly drawing in Section 8.

1. Apply power to Spectrum Analyzer.

2. Apply power to FM/AM-1100S/A.

3. Verify harmonics are substantially attenuated.

4. Verify 1080 MHz output is at least +4 dBm.

7-26-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 1080 MHz Multiplier. If required, reassemble 1080 MHz Multiplier in reverse order of procedure described in paragraph 7-26-2. Reinstall 1080 MHz Multiplier within FM/AM-1100S/A.

7-27 120 MHz GENERATOR

7-27-1 THEORY OF OPERATION (Reference 120 MHz Generator Circuit Schematic in Section 10 and 120 MHz Generator Block Diagram in Section 2)

A. 10.7 MHz VCO

Q9605, CR9602, and CR9603 form the 10.7 MHz VCO. The tune voltage reverse biases CR9602 and CR9603. As the reverse potential is increased, the anode to cathode capacitance decreases, changing the frequency response characteristics of the oscillator's feedback circuit.

B. 109.3 MHz Oscillator

The 109.3 MHz oscillator is made up of Q9603 and Y9601, a common crystal oscillator.

C. Mixer

A dual gated FET (Field Effect Transistor), Q9604, is used to mix the 10.7 MHz and 109.3 MHz signals. This is a common drain mixer with a series fed output filter. The output filter (L9606) is tuned to 120 MHz, attenuating all other mixing frequencies (i.e., 10.7 MHz, 109.3 MHz, and 98.6 MHz).

D. 120 MHz Band-pass Filter

L9607 thru L9610 are parallel resonant filters that form a four stage 120 MHz band-pass filter. These filters will shunt the unwanted mixing frequencies to ground while allowing the 120 MHz frequency to pass. Inter-stage coupling is provided by C9615, C9619, C9621, and C9623.

E. 1st 120 MHz Amp

Q9607 and its associated components form the 1st 120 MHz Amp, a common emitter amplifier.

F. Feedback Amp

Q9606 and its associated components form the feedback amp. This is a common emitter amplifier that is used to drive the ÷12000 counter.

G. ÷12,000 Counter

X9604, X9603A, and X9603B each divide their input frequencies by 10, for a combined division factor of 1,000. X9602 is a ÷12 counter. The total division factor of X9602, X9603, and X9604 is 12,000. With 120 MHz present at the input of X9604 (pin 1) the output of X9602 (pin 8) will be 10 kHz.

H. Phase Comparator

X9601, Q9601, and Q9602 form the phase comparator. Q9601 and Q9602 are common emitter drivers that are used to buffer the 10 kHz from the Clock Divider and the 10 kHz from the ÷12,000 counter respectively. X9601 is a phase locked loop I.C., but only the phase comparator is used. The output (X9601, pin 13) is applied to the low-pass filter.

I. Low-Pass Filter

The low-pass filter consists of R9607, R9611, R9612, R9613, C9605, C9606, C9610, and C9611. The output of this filter is a DC level that is used to drive the 10.7 MHz VCO.

J. PIN Diode Modulator

The PIN diode modulator is formed by CR9605 and CR9606. These PIN diodes adjust the attenuation across the modulator as the DC current through them changes. Attenuation decreases as forward bias current increases. The control current contains a DC level with the modulated audio imposed on the DC offset.

K. 2nd 120 MHz Amp

Q9608, a common emitter, series-feed, tuned amplifier, is the 2nd 120 MHz amplifier. The output is taken from the top of L9613 (for the detector circuit) and from the center tap of L9613 (for the output circuit).

L. Detector

CR9609 and C9639 make up the detector. This positive detector produces a DC version of the modulation envelope.

M. Modulating Amplifier

X9605, an op amp, is the modulating amplifier. The amplifier's reference level is +6.9 V at pin 3. This amplifier is an inverting amplifier with the PIN diode modulator, the 2nd 120 MHz amp, and the detector in its feedback circuit. The output of the amplifier (pin 6) adjusts the PIN diode modulator until the detector output and AM audio cancel at pin 2 of X9605. Pin 2 must be at the same level as pin 3.

N. Output Circuit

The output of the 2nd 120 MHz amp is fed to three different places. 120 MHz is fed through R9641, R9640, and R9638 (which together make up a "T" attenuator) and out J9502 as a cross-feed signal. The 120 MHz signal is also applied to R9643 and R9646. These potentiometers are calibrated for a specific level, with R9643 controlling the generate level and R9646 controlling the BFO (Beat Frequency Oscillator) level. R9643 is selected when CR9610 is forward biased, while R9646 is selected when CR9611 is forward biased. The selected level is applied to J9503 and is passed on to the Variable Attenuator.

7-27-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 120 MHz Generator from within the FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference 120 MHz Generator Mechanical Assembly drawing in Section 8).

TOOLS REQUIRED: Soldering Iron
¼" Nut Driver
Small Phillips Screwdriver

1. Remove cover (1) by removing four Phillips screws (4) and four lock washers (5) which secure cover to assembly.

NOTE

Further disassembly of the 120 MHz Generator is not required for testing purposes (paragraph 7-27-4). If, however, repair or replacement of the PC Board is necessary, continue with the following disassembly steps.

2. Remove 120 MHz Generator PC Board from within mechanical assembly by:

   a. Unsoldering wire from feedthru filter FL9503.

   b. Unsoldering wire from feedthru filter FL9504.

   c. Unsoldering wire from feedthru filter FL9501.

   d. Unsoldering wire from feedhtru filter FL9502.

   e. Unsoldering wire from feedthru filter FL9505.

   f. Removing nuts (3) and lock washers (2) from connectors, J9501, J9502, and J9503 respectively.

7-27-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer .... Capable of measuring 50-120 MHz

A. Required Test Equipment (Continued)

Digital Multimeter .... Any

50Ω Coax Cable .... BNC on one end, SMB on other end

RF Sniffer Cable .... See Appendix B

B. Preparation (Reference 120 MHz Generator Circuit Schematic in Section 10, 120 MHz Generator PC Board in Section 9 and 120 MHz Generator Mechanical Assembly drawing in Section 8)

1. Stand FM/AM-1100S/A on its right (speaker) side.

2. Swing open lower floor assembly.

3. Connect J9504 on 120 MHz Generator to cable connector P9504.

4. Connect coax cable connector P9503 to J9503 on 120 MHz Generator.

5. Connect RF Sniffer Cable to input of external Spectrum Analyzer.

6. Connect coax cable connector P9501 to J9501 on 120 MHz Generator Assembly.

7. Connect Digital Multimeter between the junction of R9612, R9616, and ground on 120 MHz Generator PC Board.

8. Set the following FM/AM-1100S/A front panel controls to the positions indicated:

Control	Initial Setting
(13) GEN/RCVR	"GEN"
(20) BFO/OFF	"OFF"
(21) AM/FM	"AM"
(25) VAR/OFF	"OFF"
(26) 1 kHz/OFF	"OFF"
(29) SWEEP	".1 mS"
(30) SWEEP VERNIER	Cw to detent
(31) AC/OFF/DC	"DC"
(32) DEV-VERT VERNIER	Cw to detent
(33) DEV-VERT	"10 V/DIV"
(37) INTENSITY	3/4 cw
(38) HORIZ	Midrange
(39) FOCUS	Midrange
(40) VERT	Midrange
(41) ANALY DISPR (FM/AM-1100S Models Only)	Fully ccw to detent

7-27-4 TESTING

A. Reference 120 MHz Generator Circuit Schematic in Section 10 and 120 MHz Generator PC Board in Section 9.

1. Apply power to FM/AM-1100S/A.
2. Apply power to external Spectrum Analyzer.
3. Apply power to Digital Multimeter.
4. Adjust Spectrum Analyzer to display at least 120 MHz ±110 MHz full screen (10 MHz to 230 MHz range).

109.3 MHz Oscillator Adjustment

5. Place RF Sniffer Cable in slot on shield of L9606.
6. Adjust C9606 to peak 109.3 MHz signal as seen on Spectrum Analyzer.

10.7 MHz Oscillator Adjustment

7. Adjust L9603 for a Multimeter reading of +3.45 VDC.

NOTE

If Step 7 fails, perform Steps 8 thru 16 and then return to Step 8.

8. Adjust L9606 to peak 120 MHz signal as seen on Spectrum Analyzer.
9. Place RF Sniffer Cable into slot on shield of L9607.
10. Adjust L9607 to peak 120 MHz signal as seen on Spectrum Analyzer.
11. Place RF Sniffer Cable in slot on shield of L9608.
12. Adjust L9608 to peak 120 MHz signal as seen on Spectrum Analyzer.
13. Place RF Sniffer Cable into slot on shield of L9609.
14. Adjust L9609 to peak 120 MHz signal as seen on Spectrum Analyzer.
15. Place RF Sniffer Cable into slot on shield of L9610.
16. Adjust L9610 to peak 120 MHz signal as seen on Spectrum Analyzer.

2nd 120 MHz Amplifier Adjustment

17. Place positive lead of Multimeter on X9605, pin 6.

18. Adjust L9612 and L9613 to obtain the smallest possible voltage reading on the Multimeter.

Output Level Check

19. Disconnect P9503 from J9503. Remove RF Sniffer Cable from Spectrum Analyzer.

20. Connect input of Spectrum Analyzer to J9503.

21. Adjust L9606 for smallest possible voltage indication on Multimeter.

22. Adjust L9607 for smallest possible voltage indication on Multimeter.

23. Adjust L9608 for smallest possible voltage indication on Multimeter.

24. Adjust L9609 for smallest possible voltage indication on Multimeter.

25. Adjust L9610 for smallest possible voltage indication on Multimeter.

26. Observe Spectrum Analyzer and Multimeter for following indications. If necessary, re-adjust L9606 thru L9610 sequentially for following indications:

    a. 10.7 MHz sidebands (sidebands at 109.3 MHz and 130.7 MHz) are <-45 dBc.

    b. Maximum levels of sidebands are within 5 dB of each other.

    c. Multimeter indication for each adjustment is <1.1 V.

27. Rotate R9643 fully ccw. Verify Spectrum Analyzer indicates <-20 dBm for 120 MHz signal.

28. Rotate R9643 fully cw. Verify Spectrum Analyzer indicates >-5 dBm for 120 MHz signal.

29. Set GEN/RCVR Switch (13) to "RCVR". Set BFO/OFF Switch (20) to "BFO".

30. Rotate R9646 fully ccw. Verify Spectrum Analyzer indicates <-20 dBm.

31. Rotate R9646 fully cw. Verify Spectrum Analyzer indicates >-5 dBm.

32. Connect Spectrum Analyzer input to J9502. Set GEN/RCVR Switch (13) to "GEN". Verify Spectrum Analyzer indicates -50 dBm ±10 dB.

7-27-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 120 MHz Generator. Reassemble FM/AM Generator in reverse order of disassembly procedure described in paragraph 7-27-2 and reinstall assembly within FM/AM-1100S/A.

7-28 120 MHz RECEIVER

7-28-1 THEORY OF OPERATION (Reference 120 MHz Receiver Circuit Schematic in Section 10)

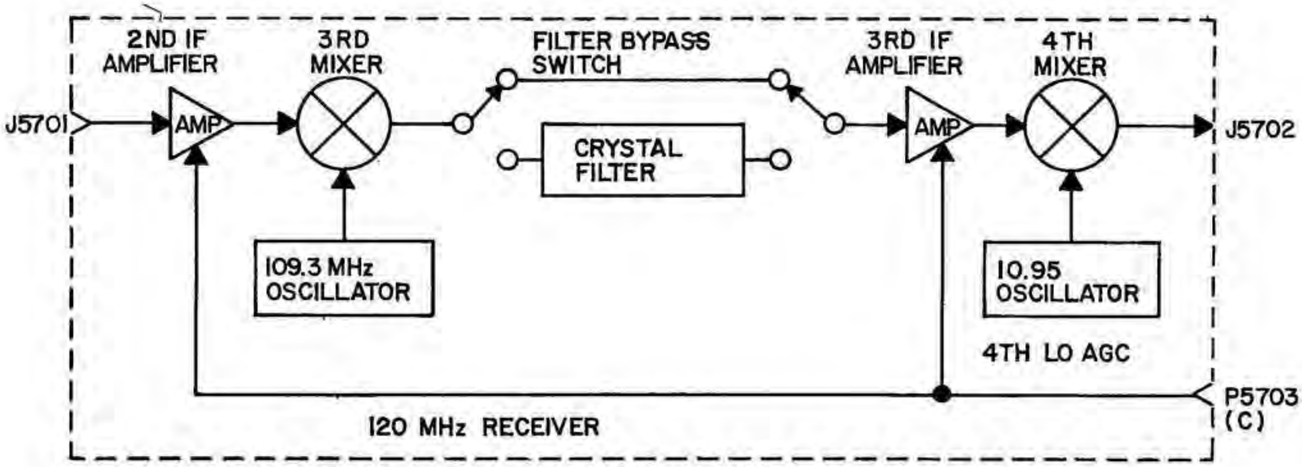


Figure 7-33 120 MHz Receiver Block Diagram

A. General

120 MHz enters the receiver at J5701 and is amplified by the 2nd IF amplifier. The signal is then mixed in the 3rd mixer with a 109.3 MHz signal supplied by the 3rd local oscillator. The resulting 10.7 MHz 3rd IF may or may not be filtered by the crystal filter (depending on position of the front panel RCVR WIDE/MID/NARROW Switch). The 10.7 MHz signal is then amplified by the 3rd IF amplifier and is fed to the 4th Mixer. The 10.7 MHz signal is mixed with the output of the 10.95 MHz 4th local oscillator, producing an output of 250 kHz, which is applied to J5702. An AGC input is provided by the 250 kHz IF/MON/AUDIO PC Board to control the gain of the 2nd and 3rd IF amplifiers.

B. 2nd IF Amp

The 120 MHz 2nd IF Amplifier Q5801 is a common drain amplifier with a series fed output filter (L5802 and C5807). The gain of Q5801 is controlled by Q5807 and Q5806.

C. 3rd Local Oscillator

Q5803 and Y5801 makeup the 3rd local oscillator. This is a common crystal oscillator with an output frequency of 109.3 MHz.

D. 3rd Mixer

Q5802 and its associated components comprise the 3rd mixer. This mixer is a common drain mixer with a shunt fed output filter (L5805 and C5818).

E. Crystal Filter

YFL5801 is the 15 kHz bandpass crystal filter. This filter is switched into the circuit when CR5803 and CR5804 are forward biased and CR5801 and CR5805 are reverse biased (i.e. when Pin E of P5703 is positive). The filter is bypassed when CR5803 and CR5804 are reverse biased or when Pin E of P5703 is negative.

F. 3rd IF Amplifier

The 3rd IF amplifier is a two stage amplifier with AGC controlling both stages. Q5804, which represents the first stage, is a common drain amplifier with a series fed output filter (L5809 and C5825). The gain of Q5804 is controlled by Q5805, Q5806 and Q5807. The second stage, represented by Q5808, is also a common drain amplifier with a series fed output filter. The gain of Q5808 is controlled by Q5807.

G. 4th Local Oscillator

Q5809 and Y5802 comprise the 4th local oscillator. This is a common crystal oscillator with an output frequency of 10.95 MHz.

H. 4th Mixer

Q5810 and its associated components make up the 4th mixer. This mixer is a common drain mixer with a series fed output filter (L5812 and C5837). The 250 kHz IF is coupled to J5702 by series LC circuit L5813 and C5839.

7-28-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 120 MHz Receiver from within FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference 120 MHz Receiver Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

¼" Nut Driver

Soldering Iron

1. Remove cover (3) by removing four Phillips screws (1) and four lock washers (2) which hold cover to assembly.

NOTE

Further disassembly of 120 MHz Receiver is not required for testing purposes (paragraph 7-28-4). If, however, repair or replacement of the 120 MHz Receiver PC Board is necessary, continue with following disassembly steps.

2. Remove PC Board (4) from assembly by:

   a. Unsoldering three wires from feedthru filters, FL5701, FL5702 and FL5703.

   b. Removing two 1/4" nuts (6) and two lock washers (5) from connectors J5701 and J5702.

   c. Removing three Phillips screws (7) and three lock washers (8) from PC Board.

7-28-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer	Capable of measuring 10 MHz to 120 MHz
DC Voltmeter	Any
Oscilloscope	Any
50Ω Coax Cable	BNC on one end, SMB on other end
Wooden Block	Any
RF Sniffer Cable	See Appendix B
Distortion Analyzer	Any

B. Preparation

1. Stand FM/AM-1100S/A on its four rear standoffs (with front panel facing up).

2. Swing open Lower Floor Assy.

3. Prop wooden block under Lower Floor Assy, so Lower Floor remains in an "open" position.

4. Connect coax cable connector P5703 to J5703 on 120 MHz Receiver.

5. Connect coax cable connector P5701 to J5701 on 120 MHz Receiver.

6. Connect RF Sniffer Cable to input of Spectrum Analyzer.

7. Place the following FM/AM-1100S/A front panel controls to positions indicated:

Control	Initial Setting
(3) HI LVL/μV X 100/NORM	"NORM"
(7) BFO-RF LEVEL	Fully cw
(8) AUTO ZERO/OFF/BATT	"OFF"
(12) RCVR WIDE/MID/NARROW	"NARROW"
(13) GEN/RCVR	"RCVR"
(17) SQUELCH	Fully ccw to detent
(19) VOLUME	Fully ccw
(20) BFO/OFF	"BFO"
(21) AM/FM	"FM"
(25) VAR/OFF	Fully ccw to detent
(26) 1 kHz/OFF	Fully ccw to detent
(27) MODULATION FREQ Hz Thumbwheels	1030.0
(48) DEV/POWER	"SIG"

7-28-4 TESTING

A. Reference 120 MHz Receiver Circuit Schematic in Section 10 and 120 MHz Receiver PC Board in Section 9.

1. Apply power to FM/AM-1100S/A.

NOTE

Allow 20 minute warmup time for 120 MHz Receiver.

2. Apply power to Spectrum Analyzer.

3. Place RF Sniffer Coil into slot on shield of L5802 and L5803 (insert into slot over L5802).

4. Adjust L5801 to peak analyzer display at 120 MHz.

5. Adjust L5802 to peak analyzer display at 120 MHz.

6. Place RF Sniffer Coil into slot on the shield of L5802 and L5803 (insert into slot over L5803).

7. Adjust L5803 to peak analyzer display at 120 MHz.

8. Place RF Sniffer Coil into slot on shield of L5818.

9. Adjust L5818 to peak analyzer display at 109.3 MHz.

10. Place RF Sniffer Coil into slot on shield of L5809.

11. Adjust L5805 and L5807 to peak analyzer at 10.7 MHz.

12. Adjust L5809 to peak analyzer display at 10.7 MHz.

13. Place RF Sniffer Coil into slot on shield of L5811.

14. Adjust L5811 to peak analyzer display at 10.7 MHz.

NOTE

When adjusting L5811, a 10.7 MHz peak and a 10.95 MHz peak will be visible on Spectrum Analyzer. Be sure to adjust L5811 to peak the 10.7 MHz display, not the 10.95 MHz.

15. Connect coax cable connector P5702 to J5702 on 120 MHz Receiver.

16. Remove RF Sniffer Coil from L5811.

17. Adjust L5811 for maximum needle deflection on DEVIATION/ WATTS Meter.

18. Adjust L5809 for maximum needle deflection on DEVIATION/ WATTS Meter.

19. Adjust L5807 for maximum needle deflection on DEVIATION/ WATTS Meter.

20. Adjust L5805 for maximum needle deflection on DEVIATION/ WATTTS Meter.

21. Adjust L5803 for maximum needle deflection on DEVIATION/ WATTS Meter.

22. Adjust L5802 for maximum needle deflection on DEVIATION/ WATTS Meter.

23. Adjust L5801 for maximum needle deflection on DEVIATION/ WATTS Meter.

24. Rotate DEV/POWER Control (24) to "6 kHz".

25. Rotate VAR/OFF Control (25) until front panel DEVIATION/ WATTS Meter indicates 5 kHz deviation.

26. Connect Distortion Analyzer to pin 8 of EXT ACC Connector (see Appendix F).

27. Adjust Distortion Analyzer controls to measure distortion of 1.5 kHz signal.

28. Adjust L5807 for minimum distortion as indicated on Distortion Analyzer.

29. Adjust L5805 for minimum distortion as indicated on Distortion Analyzer.

30. Re-adjust L5807 for minimum distortion as indicated on Distortion Analyzer.

31. Disconnect Distortion Analyzer from EXT ACC Connector.

32. Disconnect coax cable connector P5702 from J5702 on 120 MHz Receiver.

33. Connect 50Ω coax cable between J5702 and external Oscilloscope.

34. Verify output is between 6 and 10 Vp-p.

35. Disconnect external Oscilloscope from 120 MHz Receiver.

36. Connect coax cable connector P5702 to J5702 on 120 MHz Receiver.

37. Set BFO-RF LEVEL Control (7) to "-110 dBm".

38. Set HI LVL/μV X 100/NORM Switch (3) to "NORM".

39. Set GEN/RCVR Switch (13) to "RCVR".

40. Measure voltage at collector of Q5807 to verify voltage is approximately 6.3 VDC.

41. Rotate BFO-RF LEVEL Control (7) fully cw.

42. Set HI LEVEL/μV X 100/NORM Switch (3) to "μV X 100". Verify voltage at collector of Q5807 has dropped to <1 V.

7-28-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 120 MHz Receiver. Reassemble 120 MHz Receiver in reverse order of disassembly procedure described in parapraph 7-28-2 and reinstall assembly within FM/AM-1100S/A.

7-29 1200 MHz AMPLIFIER

7-29-1 THEORY OF OPERATION (Reference 1200 MHz Amplifier Circuit Schematic in Section 10)

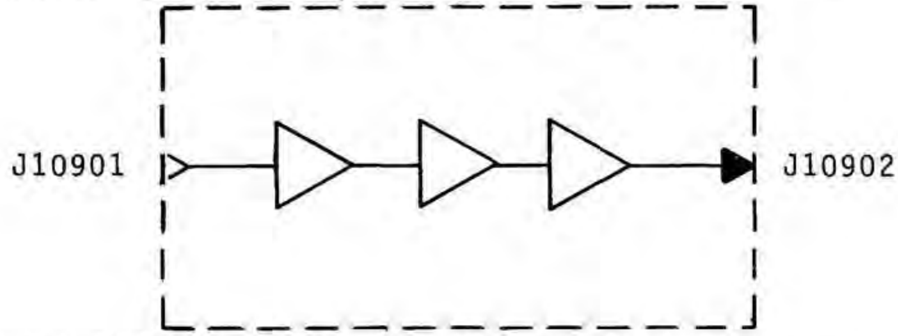


Figure 7-34 1200 MHz Amplifier Block Diagram

The 1200 MHz Amplifier consists of three common emitter stages (two stages on serial numbers 3001-3453) capable of delivering beyond 40 dB of total gain from J10901 to J10902.

7-29-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 1200 MHz Amplifier from within FM/AM-1100S/A per the instructions provided in Section 6 of this manual.

B. Disassembly (Reference 1200 MHz Amplifier Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver

¼" Nut Driver

Allen Wrench

Soldering Iron

1. Remove cover (2) by removing four screws (4) and four lock washers (3).

NOTE

Further disassembly of the 1200 MHz Amplifier is not required for testing purposes (paragraph 7-29-4). If, however, repair or replacement of the 1200 MHz Amplifier PC Board is necessary, continue with following disassembly steps.

2. Unsolder PC Board from J10901.

3. Unsolder PC Board from J10902.

4. Remove connector J10901.

5. Remove connector J10902.

6. Remove three screws (1) which secure PC Board to block (5).

7. Lift PC Board from block.

NOTE

Care should be taken when lifting PC Board from block in order to prevent damage to wire (5) or feedthru filter FL10901.

8. Unsolder wire from FL10901.

9. Remove PC Board from assembly.

7-29-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator	Capable of generating 1200 MHz within a range of -10 dBm to -60 dBm
Spectrum Analyzer	Capable of measuring 1200 MHz within a range of +2 dBm and -12 dBm
Multimeter	Any
Two 50Ω Coax Cables	BNC on one end, SMA on other end

B. Preparation (Reference 1200 MHz Amplifier Mechanical Assy drawing in Section 8)

1. Connect +11 VDC line to FL10901 on 1200 MHz Amplifier.

2. Using 50Ω coax cable, connect J10901 of 1200 MHz Amplifier to Signal Generator.

3. Using 50Ω coax cable, connect J10902 to Spectrum Analyzer.

7-29-4 TESTING

A. Reference 1200 MHz Amplifier Circuit Schematic in Section 10

1. Set Signal Generator output to 1200 MHz at -10 dBm. Verify Spectrum Analyzer displays 1200 MHz at +0 and +4 dBm.

2. Set Signal Generator output to 1200 MHz at -30 dBm. Verify Spectrum Analyzer displays 1200 MHz at -6 dBm and -8 dBm.

3. Set Signal Generator output to 1200 MHz at -60 dBm. Verify Spectrum Analyzer displays 1200 MHz at -25 dBm or less.

NOTE

If the 1200 MHz Amplifier does not perform as outlined above, the faulty stage may be detected by measuring the DC voltage at the collector of Q11001, Q11002, and Q11003 (Q10301 and Q10302 on serial numbers 3001-3453). A fairly high DC potential (relative to the other stages) would be seen at the weakest (lowest gain) transistor.

7-29-5 REASSEMBLY

A. With all power "OFF", disconnect all test equipment from 1200 MHz Amplifier. Reassemble 1200 MHz Amplifier in reverse order of disassembly procedure described in paragraph 7-29-2 and reinstall assembly within FM/AM-1100S/A.

7-30 1200 MHz FILTER & DIODE SWITCH

7-30-1 THEORY OF OPERATION (Reference 1200 MHz Filter & Diode Switch Circuit Schematic in Section 10)

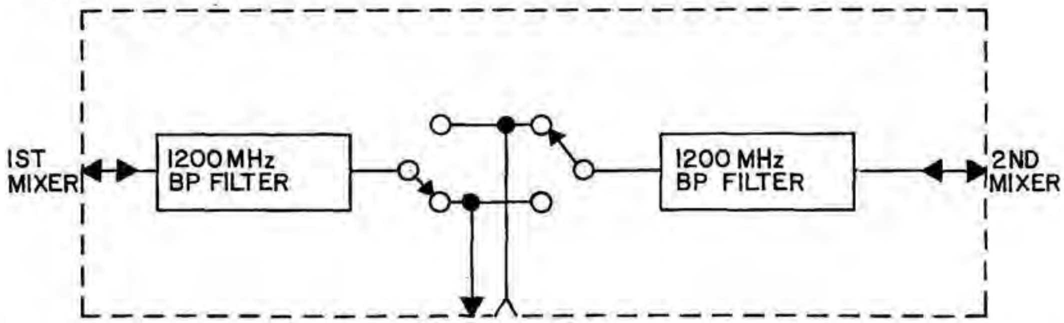


Figure 7-35 1200 MHz Filter & Diode Switch Block Diagram

In the receive mode, FL10701 possesses a positive potential. The following diodes are then forward biased:

CR10702	CR10707
CR10703	CR10709
CR10705	CR10712

The following diodes are reverse biased:

CR10701	CR10708
CR10704	CR10710
CR10706	CR10711

1200 MHz enters at J10701 and is filtered by TU10701 and TU10702. After being filtered, the 1200 MHz signal passes through CR10703 and CR10702 to J10702 and to the input of the 1200 MHz Amplifier. From the output of the amplifier, the 1200 MHz signal enters the 1200 MHz Filter & Diode Switch at J10703, passes through CR10707 and CR10709, through the second 1200 MHz filter (TU10703 and TU10704) and out J10704.

In the generate mode, a negative potential exists at FL10701. All 12 diodes (described above) will change states (i.e. the six that were previously forward biased in receive mode will now be reverse biased and vice versa).

In the generate mode, the 1200 MHz signal from the 2nd Mixer enters the 1200 MHz Filter & Diode Switch at J10704, is filtered by TU10704 and TU10703, passes through CR10710 and CR10711 and out J10702. The generated signal is then amplified by the 1200 MHz Amplifier before it re-enters the 1200 MHz Filter & Diode Switch through J10703. From there, the signal passes through R10706 and CR10704 to the 2nd Filter (TU10702 and TU10701) and out J10701.

L10701 through L10706 provide DC continuity for the control current applied to FL10701 and represent an open to the 1200 MHz RF. These inductors prevent the 1200 MHz RF signal from entering control circuit.

7-30-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 1200 MHz Filter & Diode Switch from within FM/AM-1100S/A per the instructions contained in Section 6 of this manual.

NOTE

Further disassembly of the 1200 MHz Filter & Diode Switch is not necessary for testing purposes (paragraph 7-30-4). If, however, repair or replacement of any internal components is necessary, continue with following disassembly steps.

B. Disassembly (Reference 1200 MHz Filter & Diode Switch Mechanical Assy drawing in Section 8)

TOOLS REQUIRED: Small Phillips Screwdriver
¼" Nut Driver

1. Remove two access plugs (5).
2. Unsolder two junctions, one located beneath each access plug (5).
3. Remove eight hex-screws (4) to remove diode switch (6).
4. Remove six Phillips screws (12), six lock washers (11), two Phillips screws (1) and two lock washers (2) which hold the 1200 MHz Filter block enclosure cover (3) to the 1200 MHz Filter block enclosure.
5. Remove block enclosure cover (3) from block enclosure.
6. Repeat Steps 4 and 5 for enclosure cover on opposite side of 1200 MHz Filter block enclosure.

7-30-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator .... Capable of generating 1200 MHz at 0 dBm

Spectrum Analyzer .... Capable of measuring 1200 MHz

A. Required Test Equipment (Continued)

Digital Multimeter	Any
Ground Strap	20 gauge minimum, approx 1' long
Two 50Ω Coax Cables	BNC on one end, SMB on other end
One 50Ω Coax Cable	BNC on both ends

B. Preparation

1. Connect GEN/REC line to FL10701. (A short extension wire may need to be spliced onto it to facilitate testing of the box.)
2. Connect ground strap between FM/AM-1100S/A chassis ground and 1200 MHz Filter & Diode Switch.
3. Connect output of Signal Generator to input of Spectrum Analyzer with 50Ω coax cable.
4. Set Signal Generator output to 1200 MHz at 0 dBm.
5. Set 0 dBm reference level on Spectrum Analyzer.
6. Connect output of Signal Generator to J10701 of 1200 MHz Filter & Diode Switch.
7. Connect input of Spectrum Analyzer to J10702 of 1200 MHz Filter & Diode Switch.
8. Connect Multimeter between FL10701 and ground.

7-30-4 TESTING

A. Reference 1200 MHz Filter & Diode Switch Circuit Schematic in Section 10 and 1200 MHz Filter & Diode Switch Mechanical Assembly drawing in Section 8.

1. Set GEN/RCVR Switch (13) to "RCVR".
2. Set PWR/OFF/BATT Switch (11) to "PWR".
3. Adjust TU10701 and TU10702 for maximum indication on Spectrum Analyzer. Verify analyzer displays -4 dBm to 0 dBm. Also verify Multimeter indicates +0.70 V ±75 mV.
4. Connect Signal Generator to J10704 of 1200 MHz Filter & Diode Switch and set GEN/RCVR Switch (13) to "GEN". Verify Multimeter indicates -0.70 V ±75 mV.

5. Adjust TU10703 and TU10704 for maximum indication on Spectrum Analyzer. Verify analyzer displays -4 dBm to 0 dBm.

6. Connect Signal Generator to J10703 of 1200 MHz Filter & Diode Switch.

7. Connect Spectrum Analyzer to J10701 of 1200 MHz Filter & Diode Switch. Verify analyzer displays -4 dBm to 0 dBm.

8. Connect Spectrum Analyzer to J10704 of 1200 MHz Filter & Diode Switch and set GEN/RCVR Switch (13) to "RCVR". Verify analyzer displays -4 dBm to 0 dBm.

7-30-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 1200 MHz Filter & Diode Switch. Reassemble 1200 MHz Filter & Diode Switch in reverse order of procedure described in paragraph 7-30-2. Reinstall assembly within FM/AM-1100S/A.

7-31 1200-2200 MHz OSCILLATOR

7-31-1 THEORY OF OPERATION (Reference 1200-2200 MHz Oscillator Circuit Schematic in Section 10)

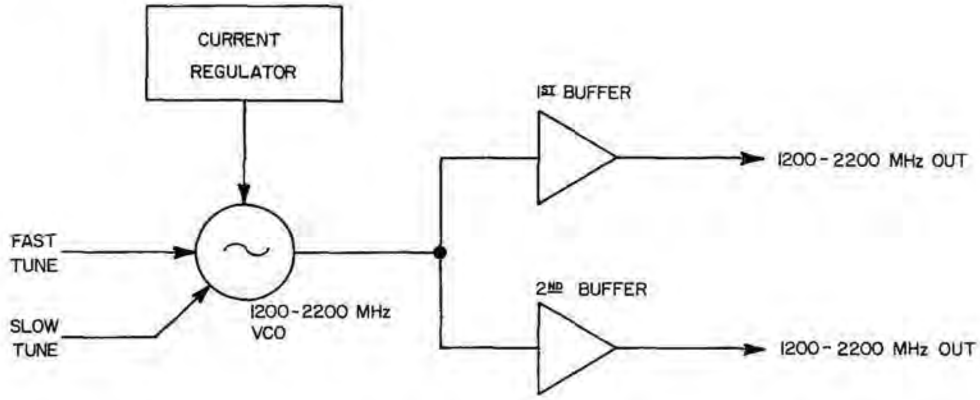


Figure 7-36 1200-2200 MHz Oscillator Block Diagram

A. Current Regulator

Q901 and associated components form a current regulator which provides a stable operating current for the 1200-2200 MHz VCO.

B. 1200-2200 MHz VCO

The 1200-2200 MHz VCO is formed by Q902 and CR901. Q902 is the oscillating transistor, the frequency of which is controlled by CR901, a varactor. The fast and slow tune lines are summed and applied as reverse bias to CR901, changing its bias and thus the oscillating frequency.

C. 1st and 2nd Buffers

The 1st (Q903 and Q904) and 2nd (Q905 and Q906) buffers operate identically. They are two stage, common emitter, self-biased amplifiers which amplify and isolate the 1200-2200 MHz Oscillator outputs.

7-31-2 REMOVAL & DISASSEMBLY

None required.

NOTE

The 1200-2200 MHz Oscillator is a non-repairable module. If the test (paragraph 7-31-4) fails, the 1200-2200 MHz Oscillator must be returned to the I.F.R. factory for repair.

7-31-3 PREPARATION FOR TESTING

A. Required Test Equipment

Modulation Meter .... 2200 MHz Response

Digital Multimeter .... 100 KΩ/V

Spectrum Analyzer .... 1100-2300 MHz Range

Signal Generator .... Capable of generating 500 kHz and 1 MHz

Oscilloscope .... 10 MHz Bandwidth

Power Supply .... Variable from -1 to -40 V

Resistor .... 30 KΩ

B. Preparation

1. Open Upper Floor.
2. Remove mating connectors from J801, J802, J803, and J804.
3. Connect negative lead of Variable Power Supply to center conductor of J802.
4. Connect common lead of Variable Power Supply to chassis of 1200-2200 MHz Oscillator.
5. Connect 30 KΩ Resistor across output of Variable Power Supply.
6. Connect input of Spectrum Analyzer to J803.
7. Connect output of Signal Generator to J801.
8. Connect Multimeter across output of Variable Power Supply.

7-31-4 TESTING

A. Reference 1200-2200 MHz Oscillator Mechanical Assembly in Section 8.

1. Set PWR/OFF/BATT Switch (11) to "PWR".
2. Apply power to Variable Power Supply.
3. Apply power to +11 V Power Supply.

4. Adjust Variable Power Supply to produce a 1200 MHz signal on Spectrum Analyzer. Verify Multimeter displays -1 V (±0.2 V). Verify amplitude of signal on Spectrum Analyzer is >+2 dBm.

5. Adjust Variable Power Supply to produce 2200 MHz on Spectrum Analyzer. Verify Multimeter indicates -25 V (±5 V). Also verify amplitude of signal on Spectrum Analyzer is >+2 dBm.

6. Disconnect Spectrum Analyzer and connect Modulation Meter to J803. Set Modulation Meter to most sensitive scale.

7. Adjust Signal Generator frequency to 500 kHz.

8. Adjust output of Signal Generator until Modulation Meter indicates mid-scale deviation.

9. Adjust L801 for minimum deviation reading on Modulation Meter.

CAUTION

OUTPUT OF SIGNAL GENERATOR MUST NOT EXCEED 0 dBm.

NOTE

If deviation reading drops off scale, increase Signal Generator output level until Modulation Meter reads 1/2 scale. Then continue adjusting L801 for minimum deviation. Repeat adjustment, increasing Signal Generator output as necessary.

10. Set Signal Generator frequency to 1 MHz.

11. Adjust Signal Generator output to indicate 1/2 scale reading on Modulation Meter.

12. Adjust L802 for minimum deviation on Modulation Meter.

CAUTION

OUTPUT OF SIGNAL GENERATOR MUST NOT EXCEED 0 dBm.

NOTE

If deviation reading drops off scale, increase Signal Generator output level until Modulation Meter reads 1/2 scale. Then continue adjusting L802 for minimum deviation. Repeat adjustment, increasing Signal Generator output as necessary.

13. Disconnect Modulation Meter from J803 and connect Spectrum Analyzer to J803.

14. Use Variable Power Supply to slowly tune 1200-2200 MHz Oscillator from 2200 MHz to 1200 MHz as seen on Spectrum Analyzer. Verify signal tunes smoothly with a flatness of 3 dB and amplitude of >+2 dBm. Verify any sideband, spurious signal, or noise is at least -50 dBc.

15. Disconnect Spectrum Analyzer from J803 and connect to J804.

16. Repeat Step 14.

7-31-5 REASSEMBLY

1. Set all power "OFF".

2. Disconnect all test equipment.

3. Connect all mating connectors to 1200-2200 MHz Oscillator.

4. Close Upper Floor.

7-32 250 MHz IF/MON/AUDIO PC BOARD

7-32-1 THEORY OF OPERATION (Reference 250 kHz IF/MON/AUDIO PC Board Circuit Schematic in Section 10)

A. IF Section

250 kHz enters the 250 kHz IF/MON/AUDIO PC Board on pin 1 of J3101 and is applied to one of the gates of Q3101, a dual gated FET. The other gate receives an AGC input to control the gain of the stage. From the drain of Q3101, the 250 kHz signal will pass through the band select filter. Switching of the bands is controlled by CR3101 and CR3102. The 250 kHz is further amplified by Q3102 where it will divide between the AM and FM legs.

B. AM Leg

The 250 kHz IF is amplified by Q3115, then detected and buffered by CR3115 and X3110A. At this point, the IF is removed from the composite 250 kHz IF and the intelligence (for an AM signal) or a DC level (for an FM signal) is all that remains. Any AM audio is passed through X3103A and out to the AM/FM Switch. The audio and/or DC level is amplified by X3111A and is sent to the squelch circuit and out to the 120 MHz Receiver.

C. Squelch

X3111B is an operational amplifier configured as a comparator. A level selected by the squelch control on the front panel is compared against the output of the AGC amplifier. If the output of the AGC amplifier is of sufficient amplitude, X3111B will turn on Q3116 (squelch lamp driver), X3103A (AM squelch switch) and X3103C (FM squelch switch).

D. FM Leg

The 250 kHz signal is passed through a 350 kHz low pass filter into the driver, Q3103 and Q3104 and into discriminator Q3105 through Q3108. The discriminator is a dual pulse counter discriminator. Half of the discriminator has an 80 kHz audio bandwidth and the other has an 8 kHz audio bandwidth. The 80 kHz is selected for "WIDE" and the 8 kHz is selected for "MID" and "NARROW" (positions of the front panel RCVR WIDE/MID/NARROW Switch).

The output of the discriminator will be the audio (for FM signals) or a DC level (for AM signals). The audio and/or DC level is amplified by the FM amplifier, X3102.

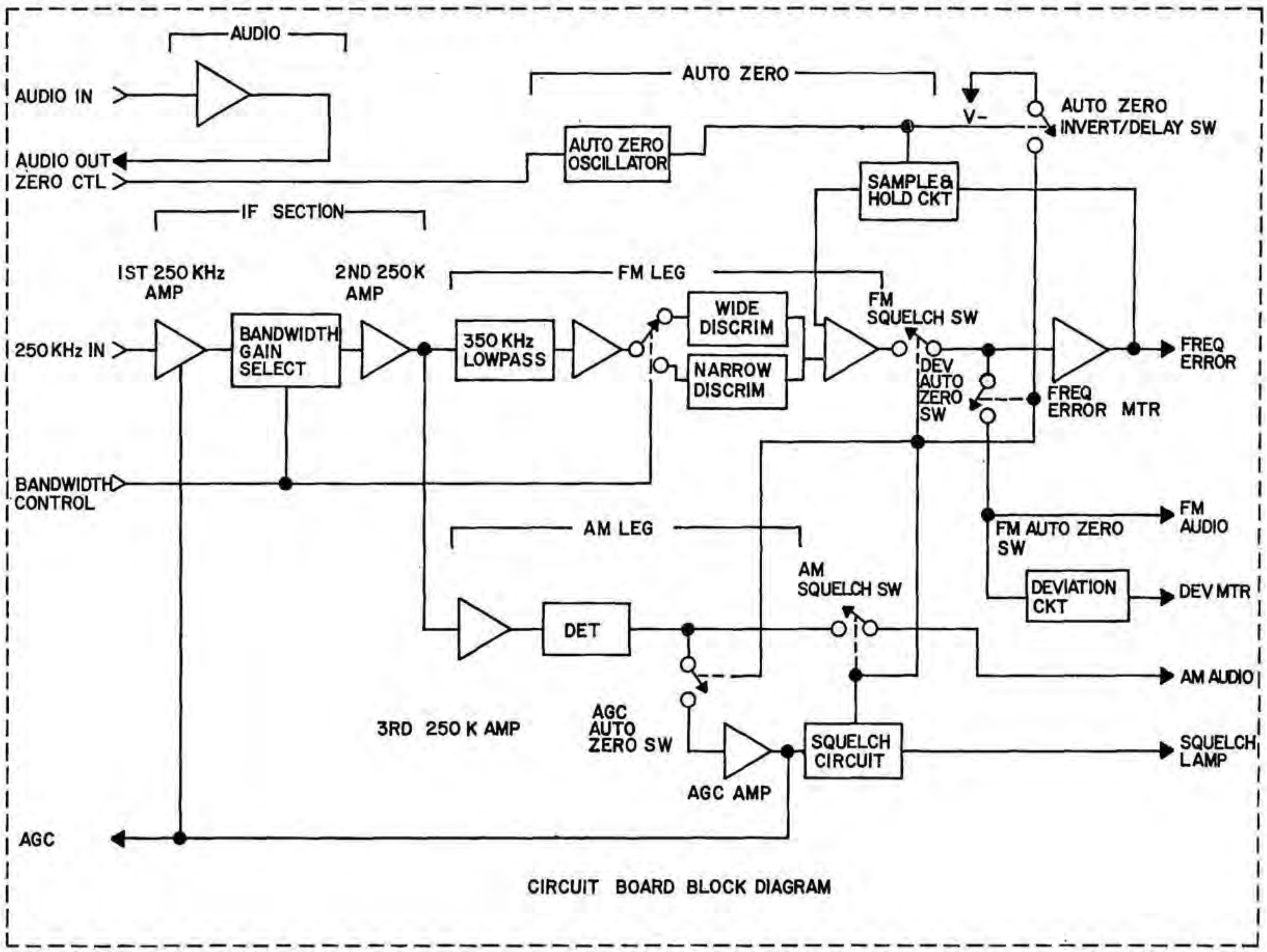


Figure 7-37 250 kHz IF/MON/AUDIO PC Board Block Diagram

The audio from this point is fed to three circuits:

1. Audio and/or a DC level passes through the FM squelch switch, the auto zero switch and out to the front panel AM/FM Switch via C3129. C3129 removes any DC offset.

2. Audio and/or a DC level is fed to the meter driver circuit. The meter driver removes any audio and only a DC level will be present at its output. This DC level will:

   a. Drive the front panel Frequency Error Meter.

   b. Supply an input to the sample and hold circuit.

3. Audio is routed to the deviation circuit.

E. Deviation Circuit

The audio enters the deviation circuit at pin 3 of X3108 and is amplified by X3108. The output of X3108 is fed to a peak detector, X3109 and CR3113. The resulting DC level is buffered by X3105A and is supplied to the front panel DEVIATION/WATTS Meter.

F. Auto Zero

Q3109 through Q3112 select the operating mode of the pulse generator. With Pin K of J3104 at ground potential, the pulse generator will be in the automatic zeroing mode. If Pin K is open, continuous zeroing will result. Automatic zeroing is defeated with Pin K at +12 VDC. X3106 and Q3113 form a pulse generator producing a 3 mS pulse every 1.5 seconds. This pulse will be used throughout the FM/AM-1100S/A for auto zero switching.

During the auto zero pulse, the following events take place:

1. 250 kHz with no modulation will enter the 250 kHz IF/MON/AUDIO PC Board. This reference signal represents the receive center frequency.

2. The sample and hold circuit is placed in the sample mode.

3. The auto zero invert/delay switch (X3104C and X3104D) is closed.

4. The AGC auto zero switch (X3103B) is opened to prevent disturbing the AGC.

5. The deviation switch (X3103D) is opened to prevent disturbing the DEVIATION/WATTS Meter.

The 250 kHz unmodulated reference burst is processed through the IF section and the FM leg. The output of the frequency error meter driver (a DC level representing the frequency offset) is applied to the sample and hold amplifier.

Upon the falling edge of the auto zero pulse, the sample and hold circuit will go into the hold mode.

0.5 mS later, the auto zero invert/delay switch will open. This will allow the deviation auto zero switch and AGC auto zero switch to close, returning the receiver to its normal operating state.

The output of the sample and hold circuit is fed back to the input of the FM amplifier to cancel the offset measured during the previous auto zero pulse.

G. Audio

X3112 is the amplifier for the speaker. Audio will pass through the AM/FM Switch, the INT MOD/RCVR/RCVR (DET OFF) Switch and into the audio amplifier.

H. Summary

Both the AM and FM legs are always active regardless of the mode selected. The AM leg will:

1. Demodulate AM audio.

2. Provide AGC for AM & FM.

3. Control squelch for AM & FM.

The FM leg will:

1. Demodulate FM audio

2. Provide information to the front panel Frequency Error Meter for AM & FM.

3. Provide deviation information for the DEVIATION/WATTS Meter.

Selection of modes is accomplished by switching either the AM audio output or FM audio output to the input of the audio amplifier.

7-32-2 REMOVAL & DISASSEMBLY

None required.

7-32-3 PREPARATION FOR TESTING

A. Required Test Equipment

Signal Generator .... Capable of 1 MHz at -40 dBm

Oscilloscope .... 1 MHz Bandwidth (minimum)

Oscilloscope Probe .... Any

Multimeter .... Any

Modulation Meter .... Any

B. Preparation

1. Testing is accomplished with the 250 kHz IF/MON/AUDIO PC Board in place. No special preparation is necessary.

7-32-4 TESTING

A. Reference 250 kHz IF/MON/AUDIO PC Board Circuit Schematic in Section 10 and 250 kHz IF/MON/AUDIO PC Board in Section 9.

Power Supply Check - This check serves to determine whether power is properly supplied and distributed within the 250 kHz IF/MON/AUDIO PC Board.

1. Using Multimeter, verify input supply voltages at P3101 as follows:

Pin 12	-12 VDC
Pin 15	+11 VDC
Pin 14	+12 VDC

2. Using Multimeter, verify internally regulated voltages as follows:

Test Point 1 (Junction of CR3106 and C3126) +6 VDC (±0.5 V)
Test Point 2 (Junction of CR3107 and C3125) -7 VDC (±1.5 V)

250 kHz IF Input Level Check - This check is to verify that the proper signal is reaching 250 kHz IF/MON/AUDIO PC Board.

3. Place FM/AM-1100S/A into generate mode.

4. Using external Oscilloscope, monitor 250 kHz input at P3101, Pin 1. Verify 250 kHz signal is 0.5 VDC to 2.0 Vp-p.

5. Disable AGC circuit by holding front panel AUTO ZERO/OFF/BATT Switch (8) to "AUTO ZERO".

6. Verify 250 kHz signal at P3101, Pin 1, increases.

Auto Zero Pulse Check - This check is to verify that suspected malfunction is not associated with 120 MHz Receiver.

7. While holding AUTO ZERO/OFF/BATT Switch (8) to "BATT".

   a. Verify Pin 4 of J3101 decreases to about -7 VDC, indicating proper switching to 2nd Mixer.

   b. Verify junction of operational amplifier X3106, Pin 6 and R3161 (Test Point 3) is at approximately +4.5 VDC (±0.5 V).

   c. Verify Pin 8 of X3104C is at approximately -7 VDC (±1.5 V).

8. Set AUTO ZERO/OFF/BATT Switch (8) to "AUTO ZERO". Using external Oscilloscope, monitor R3161 (Test Point 3) and verify signal appears as follows:

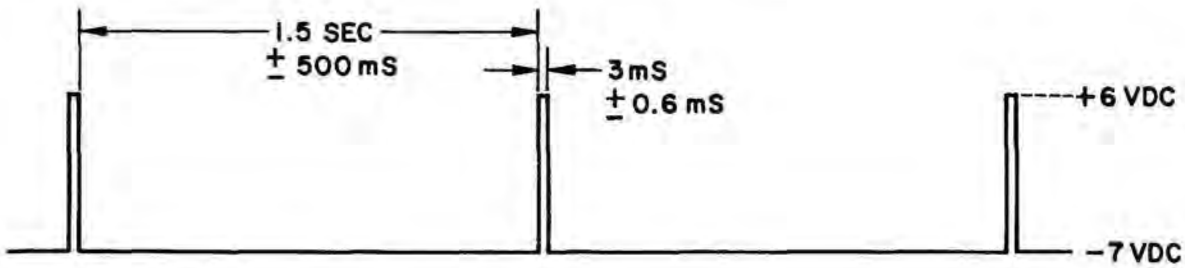


Figure 7-38 Waveform at R3161 (Test Point 3)

AGC Action - This check serves to determine whether the proper AGC control signal is being supplied to the 250 kHz IF/MON/AUDIO PC Board.

9. Set RF FREQUENCY MHz Thumbwheels (34) to 100 000 0.

10. Set front panel GEN/RCVR Switch (13) to "RCVR" and set BFO/OFF Switch (20) to "BFO". Using Oscilloscope Probe, monitor Pin 6 of P3101, while varying the BFO-RF LEVEL Control (7). Verify the DC level at Pin 6 increases (indicating increased AGC gain) for decreasing BFO level. Maximum DC level at Pin 6 of P3101 is approximately 5.8 VDC and minimum is approximately 0 VDC.

11. Connect BNC/BNC Coax Cable between output of Signal Generator and ANTENNA Connector (46).

12. Set output of Signal Generator to 1.0000 MHz at -40 dBm.

13. Set following controls to positions indicated:

Control	Initial Setting
(12) RCVR WIDE/MID/NARROW	"NARROW"
(13) GEN/RCVR	"RCVR"
(17) SQUELCH	Fully ccw, "OFF"
(18) INT MOD/RCVR/RCVR (DET OFF)	"RCVR"
(19) VOLUME	Fully ccw
(20) BFO/OFF	"OFF"
(21) AM/FM	"FM"
(34) RF FREQUENCY MHz Thumbwheels	001 000 0
(35) FREQ ERROR	"1.5 kHz/DIV"

14. Verify FREQ ERROR Meter (43) indicates 0 ±50 Hz.

15. Set RF FREQUENCY MHz Thumbwheels (34) to 001 001 0. Verify FREQ ERROR Meter indicates -1 kHz ±50 Hz.

16. Rotate FREQ ERROR Control (35) to "5 kHz".

17. Set RF FREQUENCY MHz Thumbwheels (34) to 001 004 0. Verify FREQ ERROR Meter indicates -4 kHz ±100 Hz.

18. Rotate FREQ ERROR Control (35) to "15 kHz".

19. Set RF FREQUENCY MHz Thumbwheels (34) to 001 010 0. Verify FREQ ERROR Meter indicates -10 kHz ±500 Hz.

20. Modulate Signal Generator carrier signal with approximately 10 kHz deviation, 1 kHz FM Tone.

21. Set RF FREQUENCY MHz Thumbwheels (34) to 001 000 0.

22. Set RCVR WIDE/MID/NARROW Switch (12) to "WIDE".

23. Adjust VOLUME Control (19) for comfortable listening level. Verify 1 kHz Tone is clearly heard.

24. Decrease output of Signal Generator to -60 dBm.

25. Rotate SQUELCH Control (17) fully cw. Verify 1 kHz Tone is no longer heard.

26. Rotate SQUELCH Control (17) fully ccw.

27. Set Signal Generator to produce 1 MHz, -40 dB AM carrier signal with 50% amplitude modulated 1 kHz Tone.

28. Set AM/FM Switch (21) to "AM".

29. Adjust VOLUME Control (19) for comfortable listening level. Verify 1 kHz Tone is clearly heard.

30. Disconnect BNC/BNC Coax Cable between Signal Generator and ANTENNA Connector (46) and connect it between Modulation Meter and TRANS/RCVR Connector (9).

31. Set following controls to positions indicated:

Control	Initial Setting
(3) HI LVL/μV X 100/NORM	"μV X 100"
(7) BFO-RF LEVEL	"-80 dBm"
(12) RCVR WIDE/MID/NARROW	"NARROW"
(13) GEN/RCVR	"GEN"
(21) AM/FM	"FM"
(25) VAR/OFF	"OFF"
(26) 1 kHz/OFF	"OFF"
(27) MODULATION FREQ Hz Thumbwheels	01000.0
(48) DEV/POWER	"2 kHz"

32. Slowly rotate VAR/OFF Control (25) cw until external Modulation Meter indicates 1 kHz deviation. Verify FM/AM-1100S/A DEVIATION/WATTS Meter (1) indicates 1 kHz ±50 kHz.

33. Rotate DEV/POWER Control (48) to "6 kHz".

34. Slowly rotate VAR/OFF Control (25) cw until external Modulation Meter indicates 5 kHz deviation. Verify FM/AM-1100S/A DEVIATION/WATTS Meter (1) indicates 5 kHz ±50 Hz.

35. Rotate DEV/POWER Control (48) to "20 kHz".

36. Slowly rotate VAR/OFF Control (25) cw until external Modulation Meter indicates 10 kHz deviation.

37. Set RCVR WIDE/MID/NARROW Switch (12) to "WIDE". Verify FM/AM-1100S/A DEVIATION/WATTS Meter (1) indicates 10 kHz ±500 Hz.

7-32-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment from 250 kHz IF/MON/AUDIO PC Board and restore system to normal.

7-33 79-80 MHz PHASE LOCK LOOP PC BOARD

7-33-1 THEORY OF OPERATION (Reference 79-80 MHz Phase Lock Loop Circuit Schematic in Section 10)

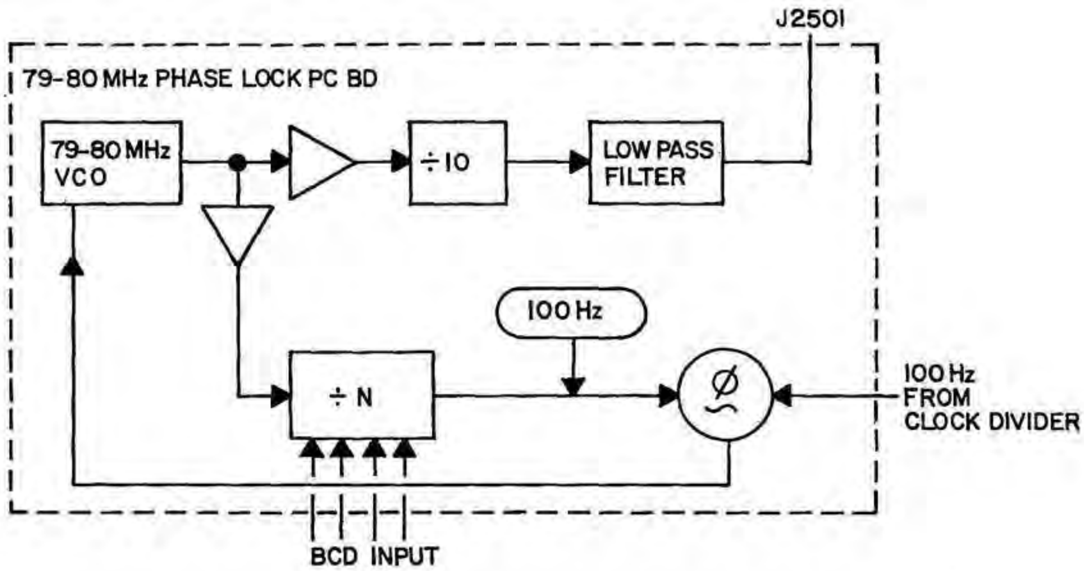


Figure 7-39 79-80 MHz Phase Lock Loop PC Board Block Diagram

A. General

The output of the 79-80 MHz VCO is buffered by an amplifier and fed to a programmable divider. This divider supplies the phase/frequency detector with a 100 Hz signal, while a 100 Hz reference signal is also fed to the other input of the phase/frequency detector. The output of the detector is a DC level which is used to slew the VCO up or down, whichever is required, to maintain the output of the programmable divider at the exact reference frequency of 100 Hz.

A sample of the 79-80 MHz signal is fed through an amplifier, a fixed ÷10 frequency divider, a low pass filter and out of the 79-80 MHz Phase Lock Loop PC Board through J2501. A 7.9 to 8.0 MHz signal may be seen at J2501.

B. 79-80 MHz VCO

Q2502, CR2502 and their associated components make up the 79-80 MHz VCO. CR2502 is operated reverse biased and as the reverse potential increases, so does the diode's depletion region. The effect is similar to increasing the distance between capacitor plates. This action changes the frequency response of the oscillator's feedback circuit.

C. Buffer Amplifiers

Q2503 is a common emitter, self-biased amplifier which acts as a buffer for the VCO. Stages Q2504 and Q2506 are identical to stage Q2503, with the exception of the input coupling. Q2505 and Q2507 are level translators.

D. ÷10 Frequency Divider

X2502 is an ECL ÷10/÷11 prescaler that operates strictly as a ÷10 prescaler.

E. Low Pass Filter

L2506, L2507, L2508, C2520, C2521, and C2522 make up a three section L type low pass filter.

F. Programmable Divider

The programmable divider consists of X2503, X2504A, X2504D, X2505, X2507, X2508, X2509, X2510, X2511, X2512, X2513, and X2514. X2507 through X2510 are preset to a value selected by the four rightmost FREQUENCY MHz Thumbwheels. X2507 is loaded with the 100 Hz digit, X2508 with the 1 kHz digit, X2509 with the 10 kHz digit, X2510 with the 100 kHz digit, X2511 with a zero which corresponds to a 1 MHz digit and X2512 with a 2 which corresponds to a 10 MHz digit. Therefore, the counters will be loaded with the composite value of 20XXXX, where XXXX equals the setting of the four rightmost digits of RF FREQUENCY MHz Thumbwheels.

Assume that all the counters have just been preset to 20,000 (RF FREQUENCY MHz Thumbwheels set to XXX0000). Also assume the following conditions to be true: X2505B is reset (which will enable X2507 and cause X2503 to ÷11) and X2505A is reset.

80 MHz will enter X2503 at Pin 15. Eleven cycles (or counts) later, Pin 7 will have completed one cycle, causing X2507 and X2508 to increment from 0 to 1. X2507 and X2508 will increment 1 for every 11 cycles into the ÷10/÷11 prescaler. When X2507 and X2508 have both reached 9 (after 99 cycles into the ÷10/÷11 prescaler), Pin 12 of X2507 will go high, thereby applying a high to the J input of X2505B. After an additional 11 counts, Pin 7 of X2503 will have completed one more cycle, causing X2505B to be set (Q output high), X2507 and X2508 to roll over to 0 and X2509 to increment to 1. As a result, the ÷10/÷11 prescaler will divide by 10. At this point, 110 cycles have been presented to X2503.

With X2507 disabled and X2503 dividing by 10, X2508 will increment once for every 10 additional cycles presented to X2503. After X2508 rolls over to 0, X2509 will increment to 2. At this point, 210 cycles have been presented to X2503.

When X2509 reaches 9 and rolls over to 0, X2510 will increment to 1. At this point, 1010 cycles have been presented to X2503. This action continues until the following counters contain the noted counts:

X2512 --- 9	X2509 --- 9
X2511 --- 9	X2508 --- 7
X2510 --- 9	

At this point (after 799,980 counts have been applied to X2503; recall that X2512 was preset to 2), all inputs to X2513A will be high and its output will be low. Also Pin 12 of X2509, X2510, X2511 and X2512 will be high, causing the output of X2513B to be low. With both inputs of X2514D low, its output will be high and will be applied to the J input of X2505A. After an additional 10 counts (for a total of 799,990) are applied to X2503, X2505A will be set. With X2505A set, its Q output will be high and the $\overline{Q}$ output will be low, resetting X2505B and presetting the counter.

After an additional 10 counts have been applied to X2503 (for a total of 800,000), X2505 is reset and X2508 through X2512 are allowed to count. One pulse at Pin 12 of X2505A will occur for every 800,000 counts into X2503.

At this point we have returned to the original conditions. With an input frequency of 80 MHz applied to the programmable divider, the output will be 100 Hz (80,000,000 ÷ 800,000 = 100). The division factor will be 800,000 less the setting of the RF FREQUENCY MHz Thumbwheels.

G. Phase/Frequency Detector

Q2508 and Q2509 make up a Schmitt Trigger to prevent jitter from the 100 Hz reference line.

If the output frequency of the programmable divider is greater than 100 Hz, X2506A will be set first, charging C2532 via CR2504. When X2506B is set, both flip-flops are reset by X2504B.

If the output frequency of the programmable divider is lower than 100 Hz, X2506B will be set first, discharging C2532 via CR2505. When X2506A is set, both flip-flops will be reset.

The potential on C2532 will be buffered and smoothed by the integrator which consists of Q2510, Q2511, and Q2512.

X2504C, Q2513, and Q2514 will detect a phase lock condition.

H. +10V Regulator

X2501 and Q2501 make up the series regulator for the 79-80 MHz VCO.

7-33-2 REMOVAL & DISASSEMBLY

A. Removal

Remove 79-80 MHz Phase Lock Loop PC Board from within FM/AM-1100S/A per the instructions contained in Section 6 of this manual.

B. Disassembly

No further disassembly of 79-80 MHz Phase Lock Loop PC Board is required.

7-33-3 PREPARATION FOR TESTING

A. Required Test Equipment

Spectrum Analyzer	Capable of measuring 8 MHz
Digital Voltmeter	Any
50Ω Coax Cable	BNC on one end, SMB on other end
Extender PC Board	Specifications: .062" thick, 22 pins each side with pins .156" on center (IFR Part No. 7010-9801-200)
Frequency Counter	Capable of measuring 8 MHz

B. Preparation

1. Install Extender PC Board into J2502 on Mother Board (where 79-80 MHz Phase Lock Loop PC Board is normally seated).
2. Insert 79-80 MHz Phase Lock Loop PC Board into Extender PC Board.
3. Connect 50Ω coax cable between J2501 of 79-80 MHz Phase Lock Loop PC Board and input of Spectrum Analyzer.
4. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 111 1 (where X = any setting).

7-33-4 TESTING

A. Reference 79-80 MHz Phase Lock Loop PC Board Circuit Schematic in Section 10 and 79-80 MHz Phase Lock Loop PC Board in Section 9.

1. Apply power to FM/AM-1100S/A.

2. Apply power to Spectrum Analyzer.

3. Apply power to Digital Voltmeter.

4. Using Multimeter and Tables 5-3 and 5-4, verify BCD coding is correct for four rightmost RF FREQUENCY MHz Thumbwheel Switches (34).

NOTE

If Step 4 fails, problem is not associated with 79-80 MHz PC Baord.

Be sure to reset thumbwheels per Step 4 of Preparation for Testing.

5. Using Multimeter, verify supply voltages on following filters of J2502 are within tolerances listed.

Filter #	Voltage	Tolerance
FL19	+5.075 V	±0.225 V
FL20	+11.0 V	±0.05 V

NOTE

If Step 5 fails, fault is not associated with 79-80 MHz PC Board.

6. Connect Voltmeter between emitter of Q2501 and ground.

7. Adjust R2505 for an indication of +10 VDC (±.02) on Voltmeter.

8. Connect Voltmeter between ground and collector of Q2512.

9. Adjust L2502 for an 8.25 VDC (±.25) indication on Voltmeter. Make sure Spectrum analyzer displays a power level between -4 dBm and +1 dBm throughout the range of the 79-80 MHz Phase Lock Loop PC Board (check at 100 kHz increments on RF FREQUENCY MHz Thumbwheels (34)).

10. Verify that frequency is stable throughout same range specified in Step 9.

11. Disconnect Spectrum Analyzer from 79-80 MHz Phase Lock Loop PC Board.

12. Connect J2501 of 79-80 MHz Phase Lock Loop PC Board to Frequency Counter and verify that Frequency Counter displays 7.98889 (±.00002).

13. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 222 2 and verify Frequency Counter displays 7.97778 (±.00002).

14. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 333 3 and verify Frequency Counter displays 7.96667 (±.00002).

15. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 444 4 and verify Frequency Counter displays 7.95556 (±.00002).

16. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 555 5 and verify Frequency Counter displays 7.94445 (±.00002).

17. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 666 6 and verify Frequency Counter displays 7.93332 (±.00002).

18. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 777 7 and verify Frequency Counter displays 7.92221 (±.00002).

19. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 888 8 and verify Frequency Counter displays 7.91110 (±.00002).

20. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 999 9 and verify Frequency Counter displays 7.90001 (±.00002).

21. Set RF FREQUENCY MHz Thumbwheels (34) to XXX 000 0 and verify Frequency Counter displays 8.000 MHz (±.00002).

7-33-5 REASSEMBLY

A. With all power "OFF", disconnect test equipment and test fixtures from 79-80 MHz Phase Lock Loop PC Board. Reinstall 79-80 MHz Phase Lock Loop PC Board within FM/AM-1100S/A.

SECTION 8-MECHANICAL ASSEMBLIES

8-1 GENERAL

This section contains mechanical assembly drawings of all of the mechanical modules contained within the FM/AM-1100S/A. These drawings are provided for purposes of:

1. Locating and identifying various connectors, discrete components, test points, adjustment pots etc. which are referenced in other sections of this manual.
2. Aiding in the disassembly of individual modules (per the module disassembly procedures described in Section 7).

All drawings in this section are sequenced in alphanumerical order, by module name (see index in paragraph 8-1-1).

NOTE

Each figure title for each mechanical assembly is followed by a number within parentheses. This number represents the reference designator series number assigned to the mechanical assembly shown in that figure.

The numbered callouts shown in each of the figures in this section are for use in performing the module disassembly procedures described in Section 7 of this manual. These numbers are referenced in the disassembly procedures for purposes of identifying those components which are affected by the disassembly process.

The drawings in this section are not intended for use in ordering spare or replacement parts. For parts ordering information, see FM/AM-1100S/A Illustrated Parts Catalog.

8-1-1 INDEX OF MECHANICAL ASSEMBLIES

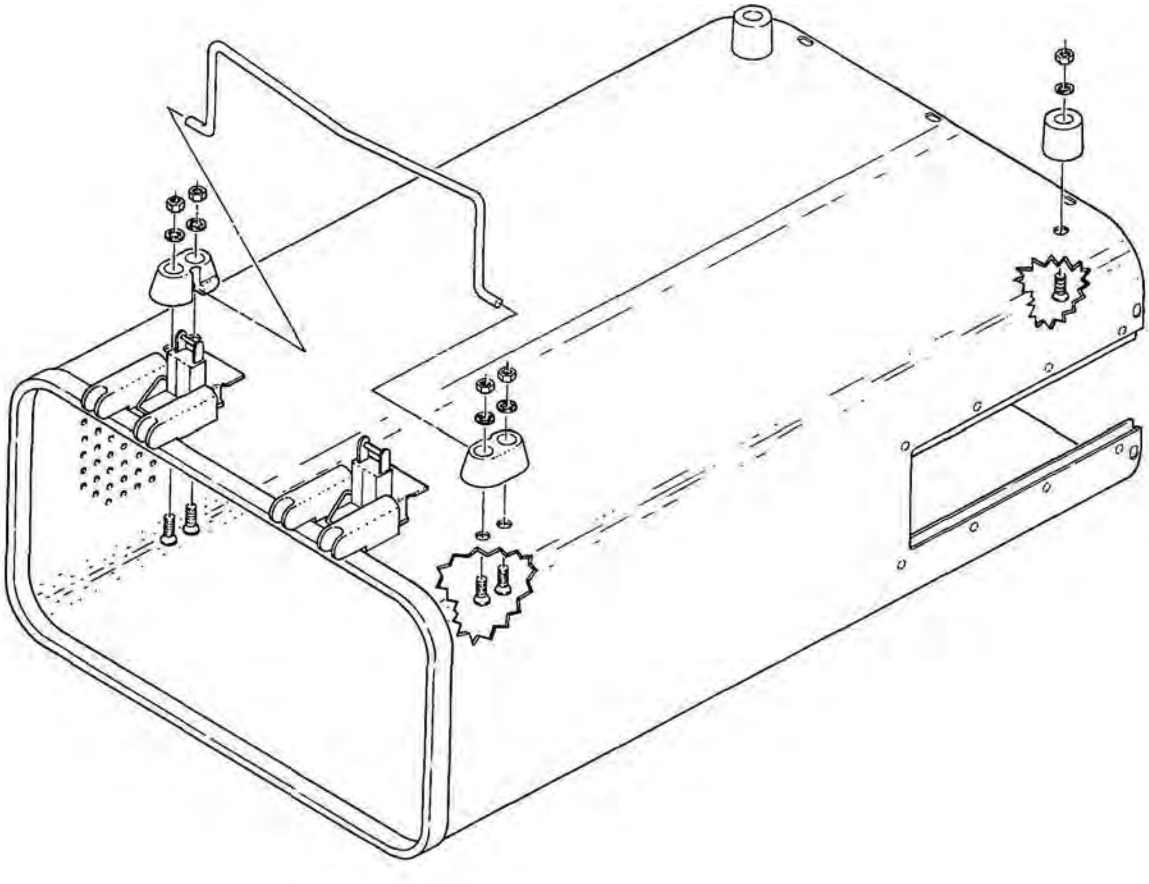
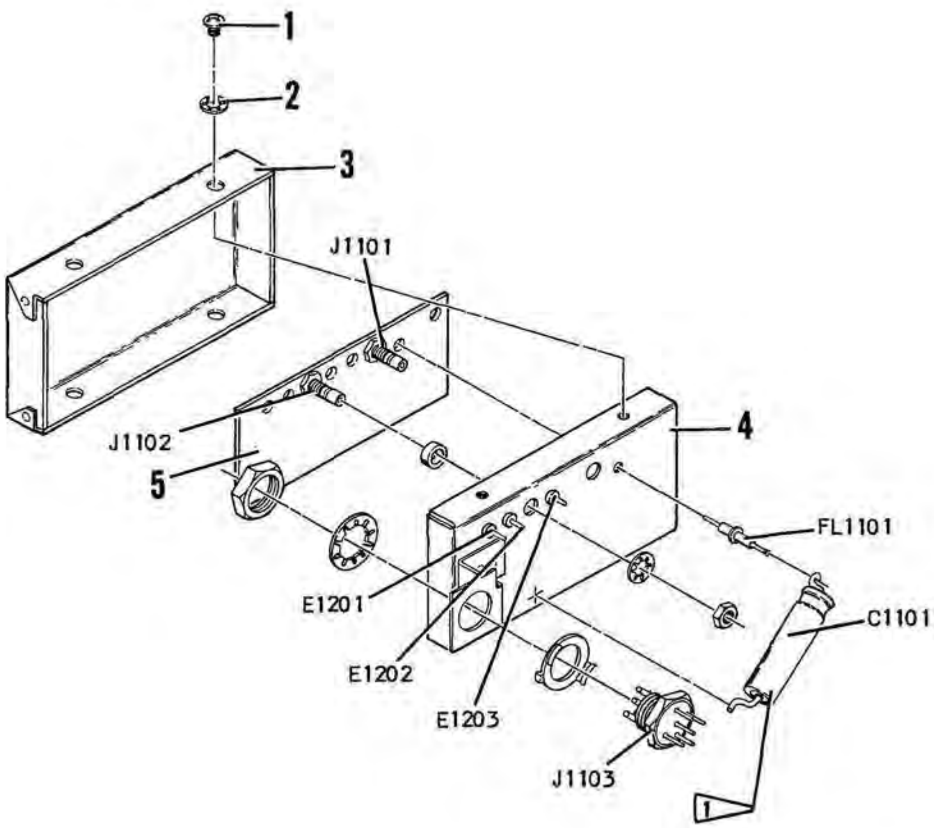


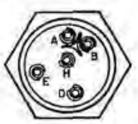
Figure 8-1 Case Assembly (6900)

WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
E1202	J1103-H	WHT/BLUE	26	1.5"
FL1101	J1103-A	ORANGE	26	3.0"

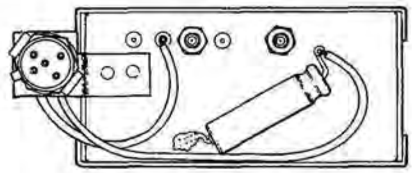
1 Solder positive lead of capacitor C1101 to FL1101 and negative lead to enclosure base as shown.



WIRE END VIEW OF J1103



DETAIL A



DETAIL B

Figure 8-2 Clock Divider (1100)

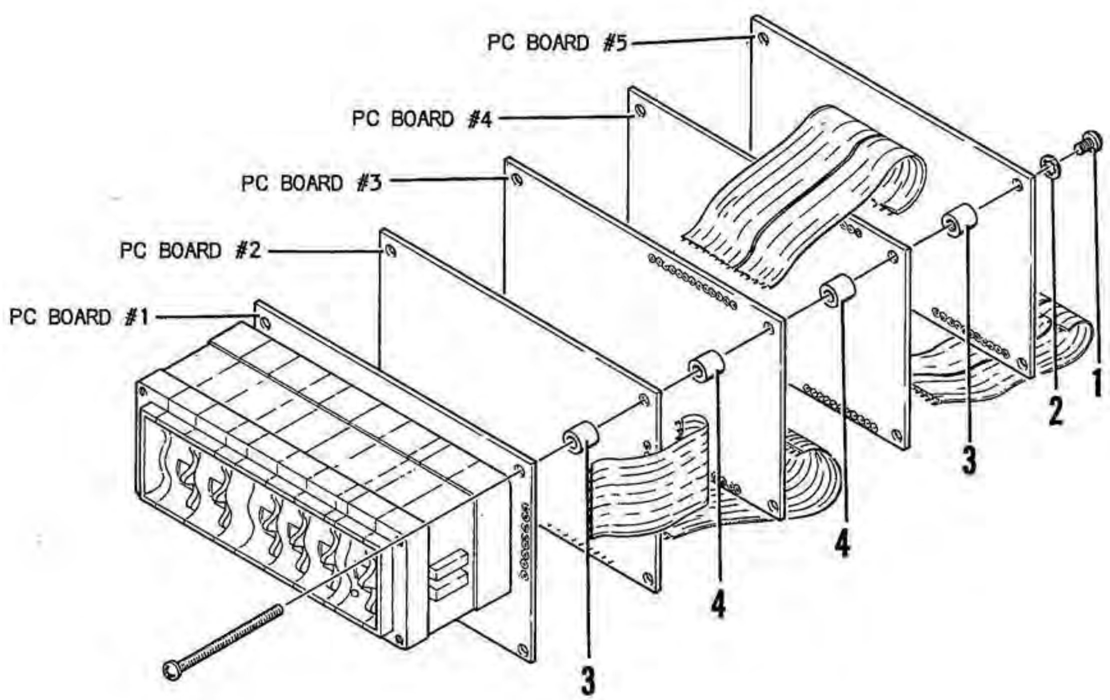


Figure 8-3 Dual Tone Generator (8500)

NOTES:

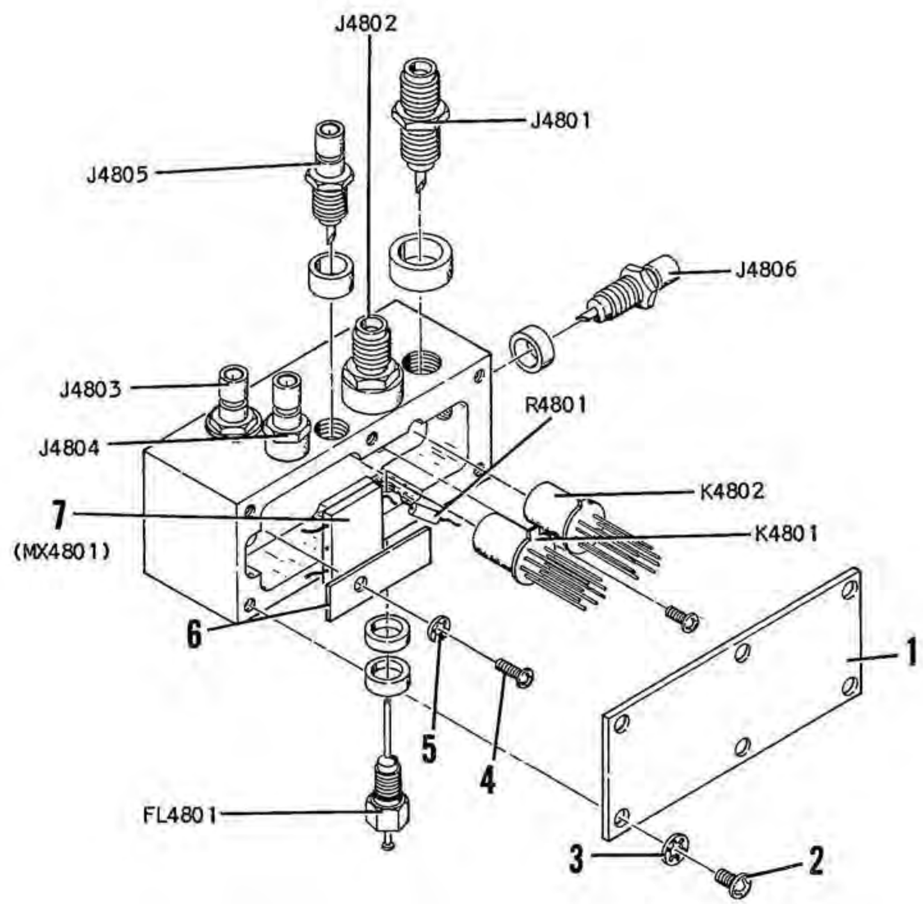
1. SOLDER ONE END OF 5/8" LONG, 26 AWG BUS WIRE TO CONNECTOR J4803. SLIDE 1/2" LENGTH OF 26 AWG TEFLON SLEEVING OVER BUS WIRE AND INSERT CONNECTOR/BUS WIRE ASSEMBLY INTO BLOCK. SOLDER OPPOSITE END OF BUS WIRE TO LEAD "L" ON MIXER MX4801.

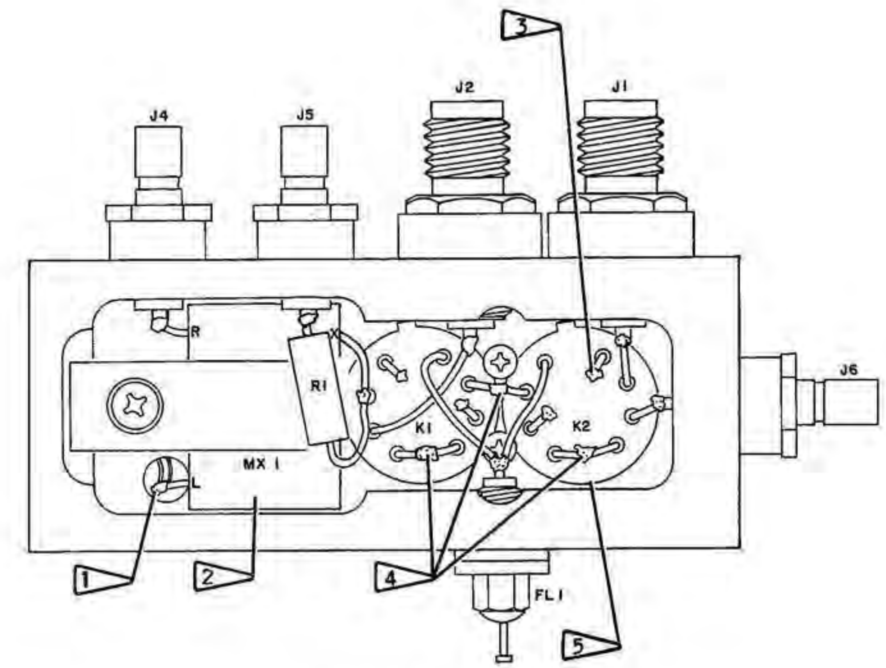
2. LEAVE LEADS R, L, AND X. TRIM ALL OTHER LEADS OFF FLUSH WITH MIXER MX4801.

3. LEADS TO BE SOLDERED TO RELAY CASE INSIDE OF LEAD PATTERN.

4. LEADS ARE SOLDERED TOGETHER BUT SHOULD NOT MAKE CONTACT WITH RELAY CASE.

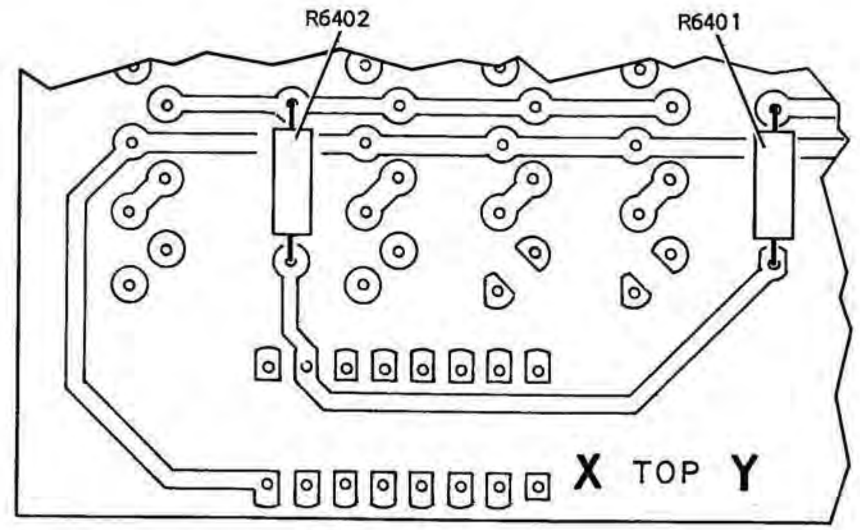
5. BOND RELAYS K4801 AND K4802 TO BLOCK USING ECCOBOND SOLDER -72C (IFR 1051-0100-400).





DETAIL A

Figure 8-4 First Mixer Assembly (4800)



DETAIL A

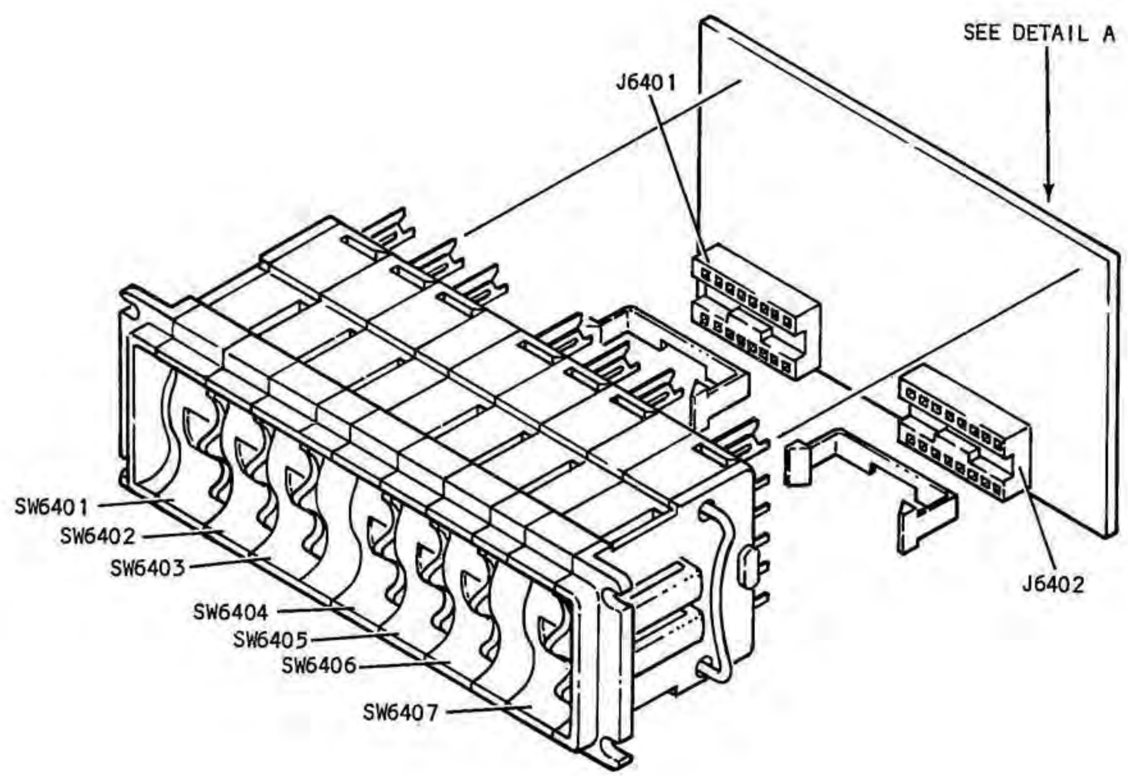
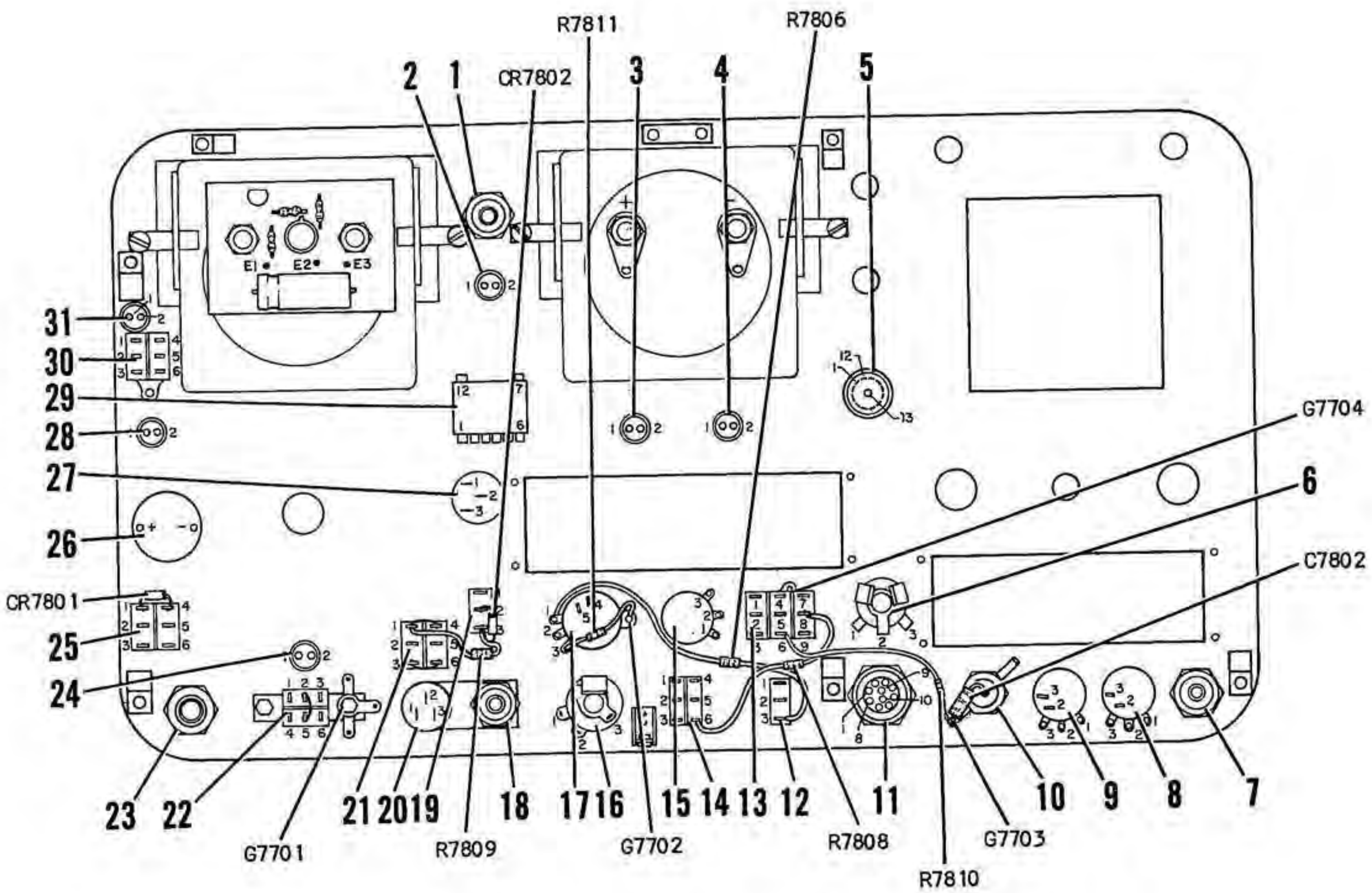


Figure 8-5 Frequency Select Switch (6400)



1. ANTENNA CONNECTOR (J77062F) (J7706R)
2. INPUT LEVEL LAMP (DS7701)
3. LOW FREQUENCY PHASE LOCK LAMP (DS7703)
4. HIGH FREQUENCY PHASE LOCK LAMP (DS7702)
5. FREQ ERROR CONTROL (SW7702)
6. EXT MOD CONNECTOR (J7710)
7. SCOPE IN CONNECTOR (J7701F) (J7705R)
8. 1 kHz/OFF CONTROL (SW7714) (R7707)
9. VAR/OFF CONTROL (SW7712) (R7705)
10. INT MOD OUT CONNECTOR (J7709)
11. EXT ACC CONNECTOR (J7712)
12. BFO/OFF SWITCH (SW7710)
13. AM/FM SWITCH (SW7711)
14. INT MOD/RCVR/RCVR (DET OFF) SWITCH (SW7709)
15. VOLUME CONTROL (R7703)
16. EXT SPKR CONNECTOR (J7711)
17. SQUELCH CONTROL (SW7704F) (R7704R)
18. 10 MHz REF OUT CONNECTOR (J7704F) (J7708R)
19. GEN/RCVR SWITCH (SW7707)
20. CAL ADJUSTMENT (R7702)
21. RCVR WIDE/MID/NARROW SWITCH (SW7706)
22. PWR/OFF/BATT SWITCH (SW7705)
23. TRANS/RCVR CONNECTOR (J7703F) (J7707R)
24. POWER ON LAMP (DS7705)
25. AUTO ZERO/OFF/BATT SWITCH (SW7715)
26. OVER TEMP ALARM (LS7701)
27. ZERO RCVR ADJUSTMENT (R7701)
28. OVER TEMP LAMP (DS7706)
29. DEV/POWER CONTROL (SW7701)
30. HI LVL/µV X 100/NORM SWITCH (SW7713)
31. 0 dBm LAMP (DS7704)

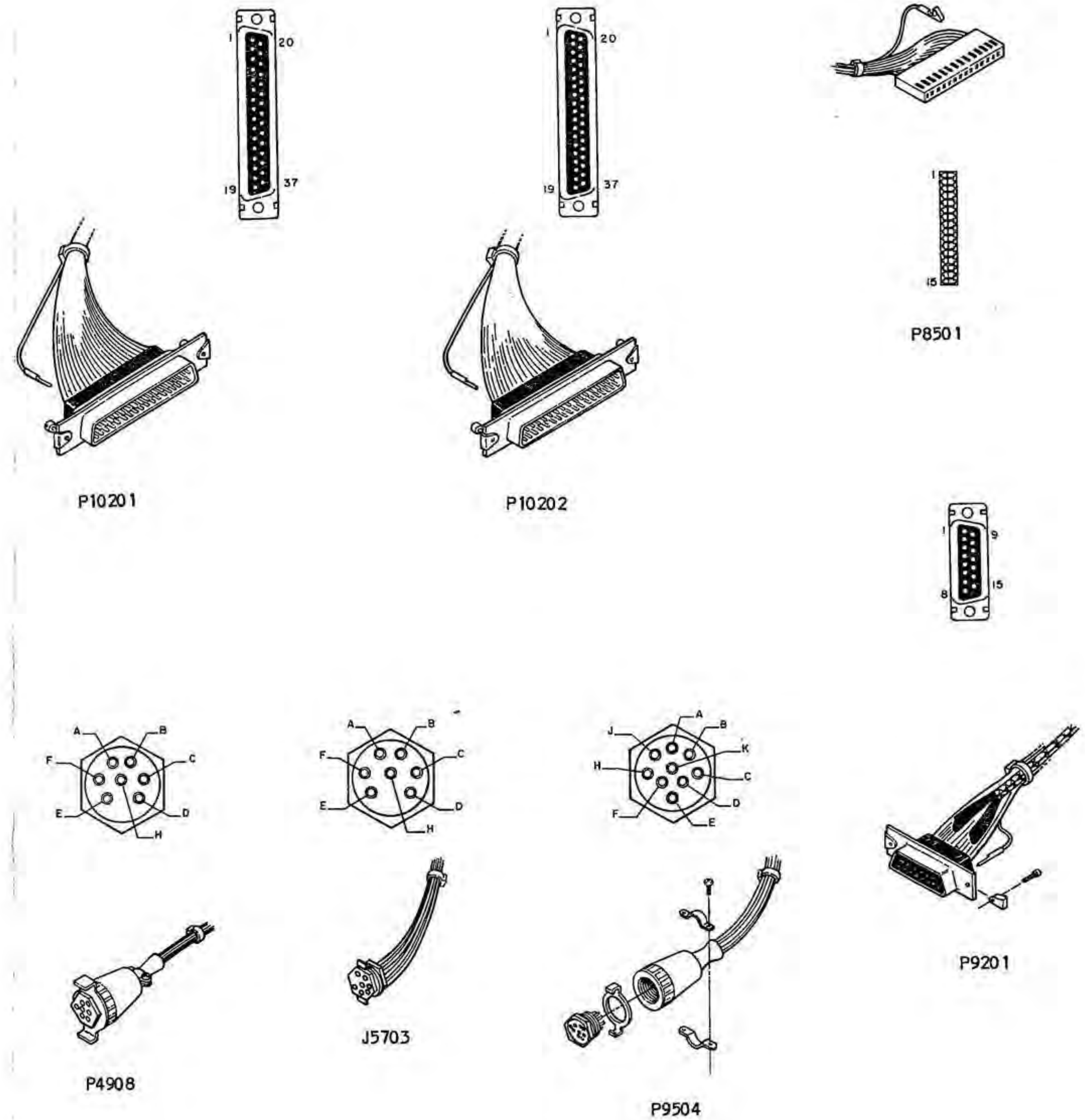


Figure 8-6 Front Panel (7700)/Wire Harness (7800)

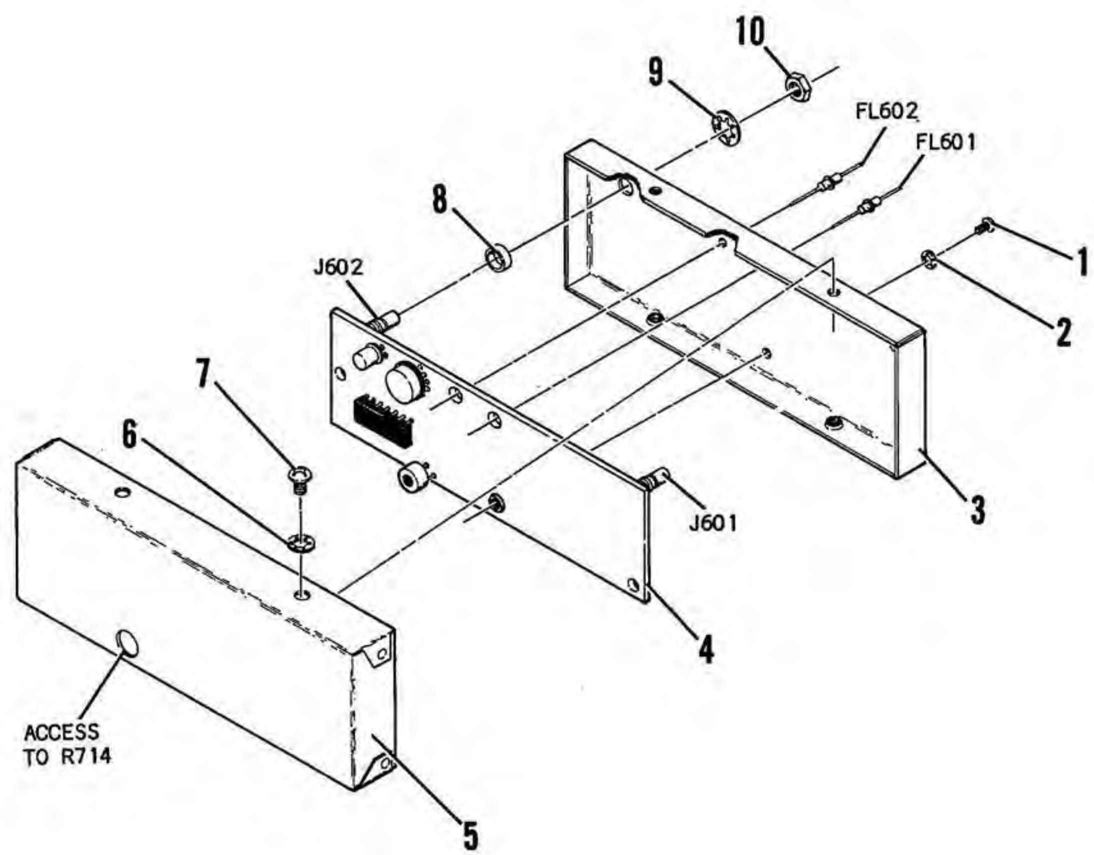


Figure 8-7 Heterodyne Amplifier/
÷2 Prescaler (600)

NOTES: MECHANICAL

1. SEAL WITH ALUMINUM TAPE AFTER ADJUSTMENT OF C6306 ON PC BOARD.

2. AFTER ASSEMBLY, SEAL ALL MATING SURFACES WITH TWO COATS OF SILVER CONDUCTIVE PAINT. APPLY PER MANUFACTURER'S INSTRUCTIONS.

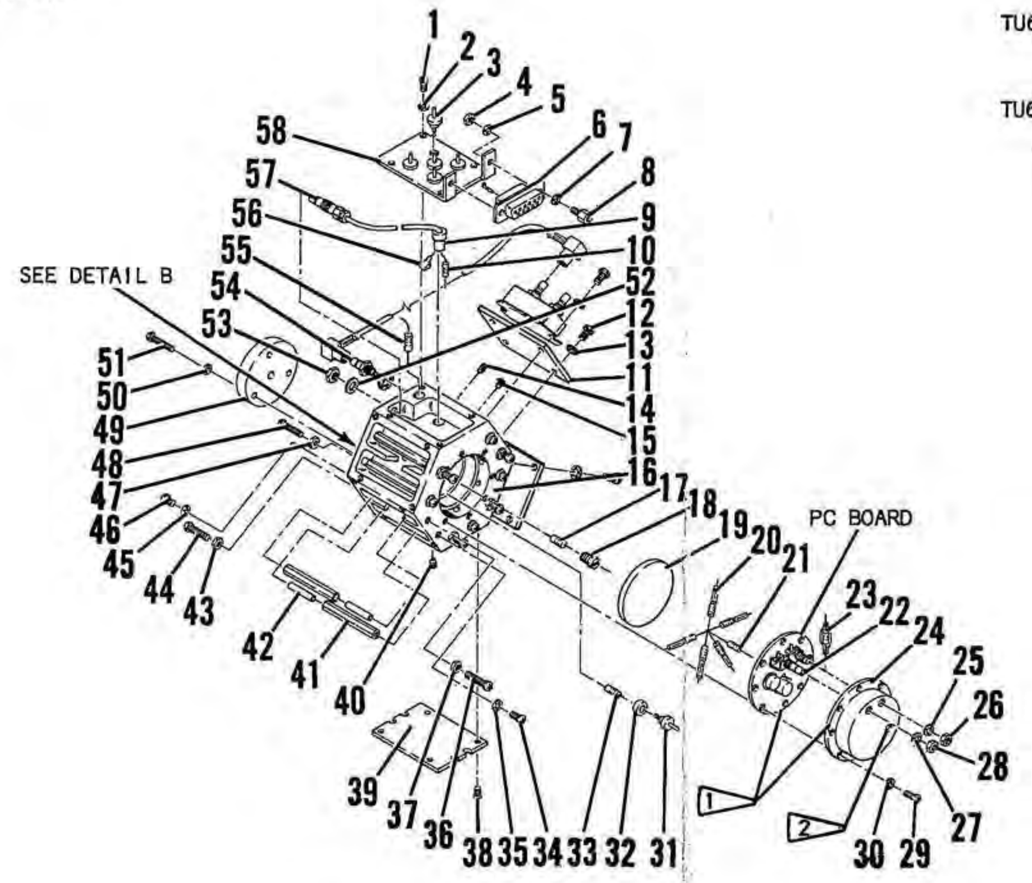
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS DRAWING CARRIES SERIES 6200; THEREFORE J1 IS DESIGNATED J6201).

WIRING LIST (OUTSIDE)

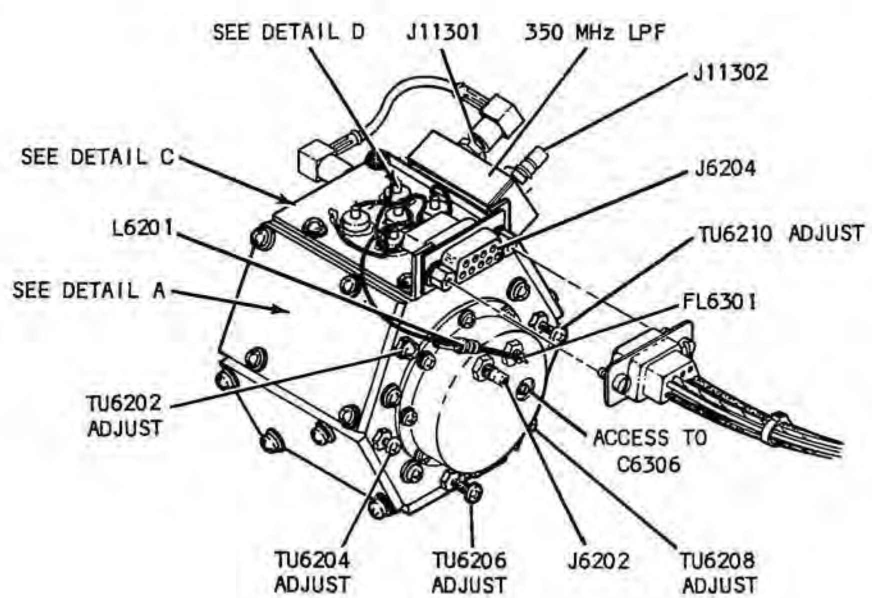
FROM	TO	COLOR	GA	LENGTH
J4-1	FL1	GREEN	26	1"
J4-2	FL2	BROWN	26	1 3/8"
J4-3	FL3	WHT/BLU	26	1 1/4"
J4-4	FL4	WHT/BRN	26	1 1/4"
J4-5	FL5	WHT/VIO	26	1"
J4-6	PLATE	BLACK	22	1 3/8"
J4-7	L1	WHT/RED	22	3"

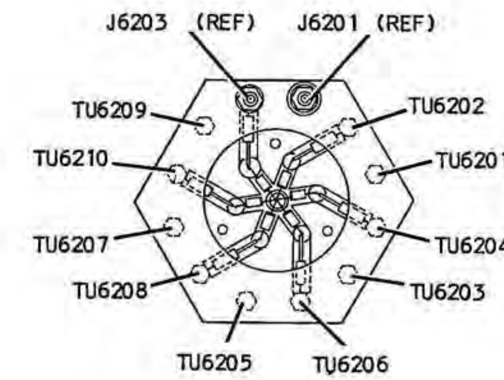
WIRING LIST (INSIDE)

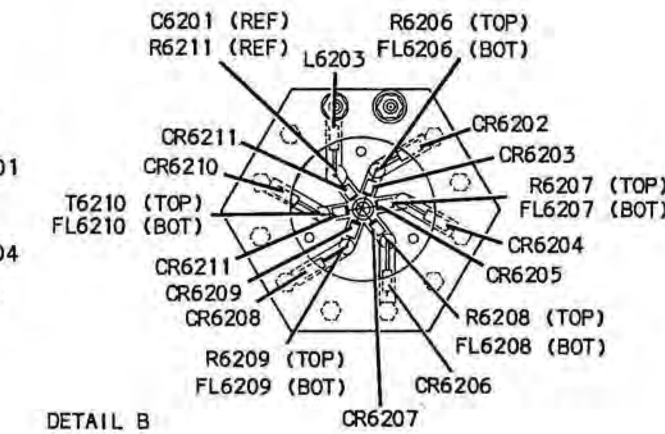
FROM	TO	COLOR	GA	LENGTH
FL1	FL6	GREEN	26	4"
FL2	FL7	BROWN	26	4"
FL3	FL8	WHT/BLU	26	4"
FL4	FL9	WHT/BRN	26	4"
FL5	FL10	WHT/VIO	26	4"



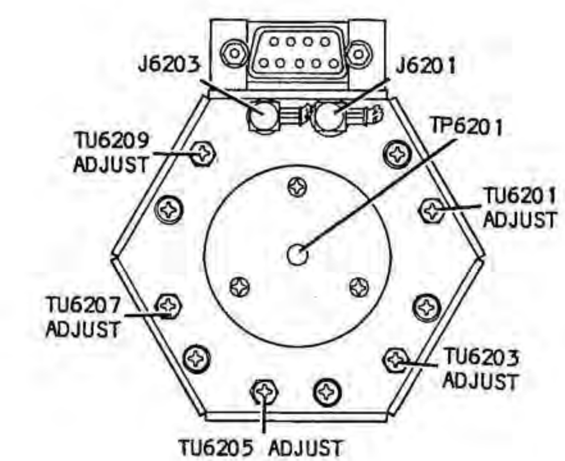
DETAIL A



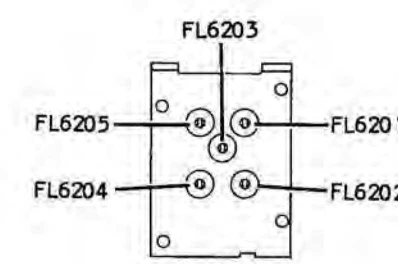




DETAIL B



DETAIL C



DETAIL D

Figure 8-8 High Frequency Multiplier/Mixer Assembly (6200)

NOTES:

1. CONNECTORS P4806 AND P4805 TAKE THEIR REFERENCE DESIGNATORS FROM THE FIRST MIXER (SEE FM/AM-1100S/A INTERCONNECT DIAGRAM).

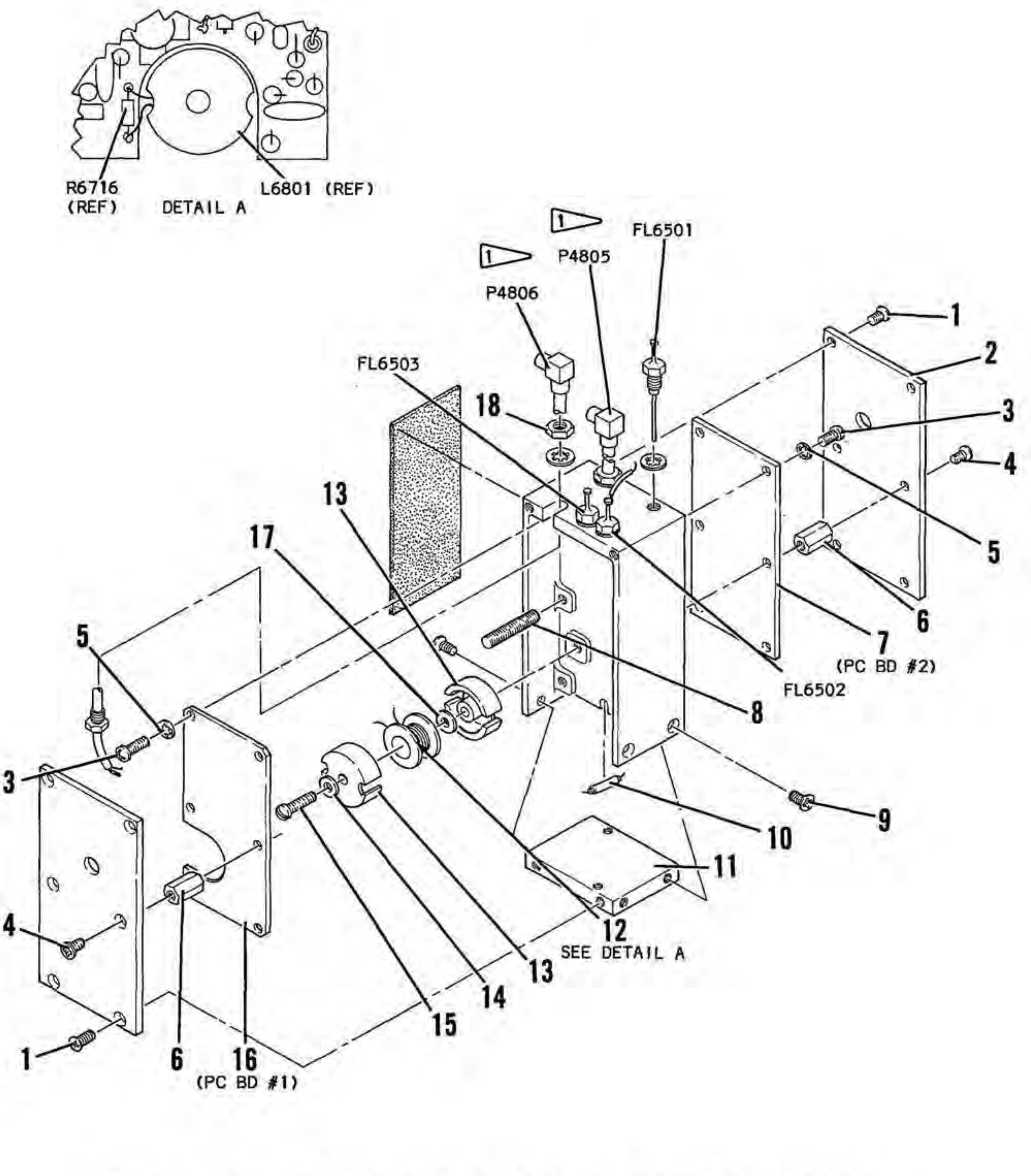


Figure 8-9 High Level Amplifier Assembly (6500)

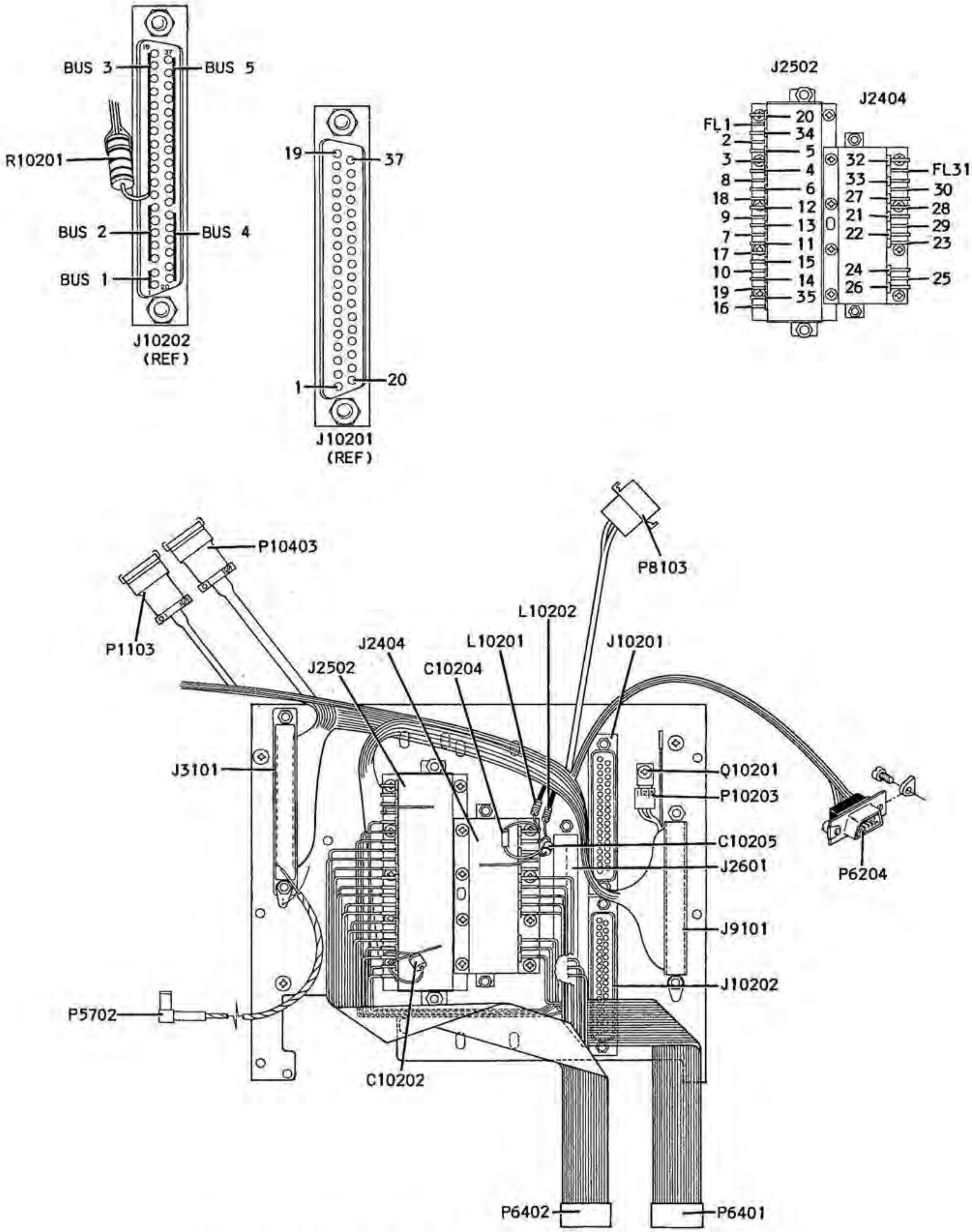
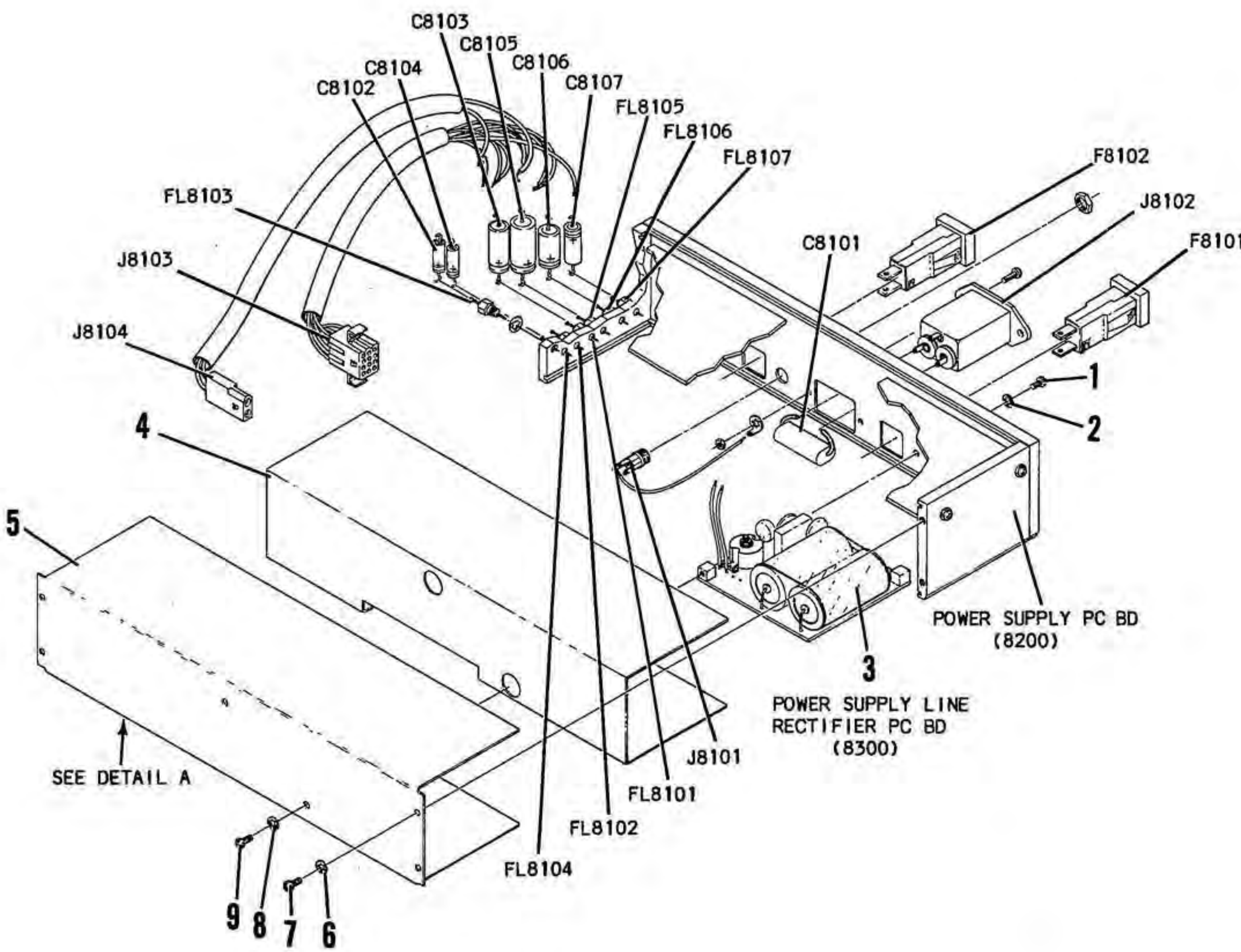
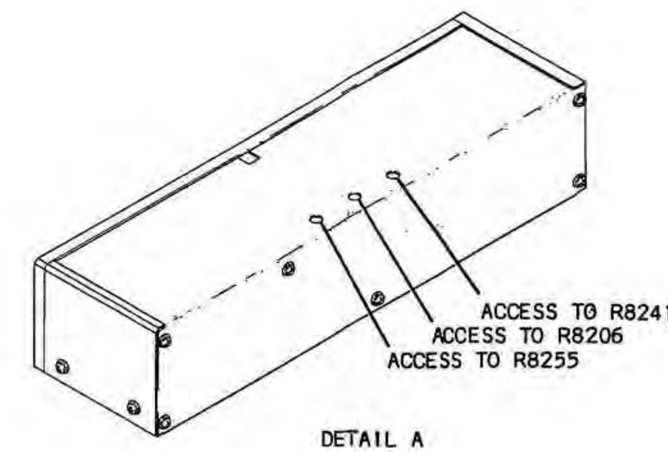


Figure 8-10 Mother Board Assembly (10200)





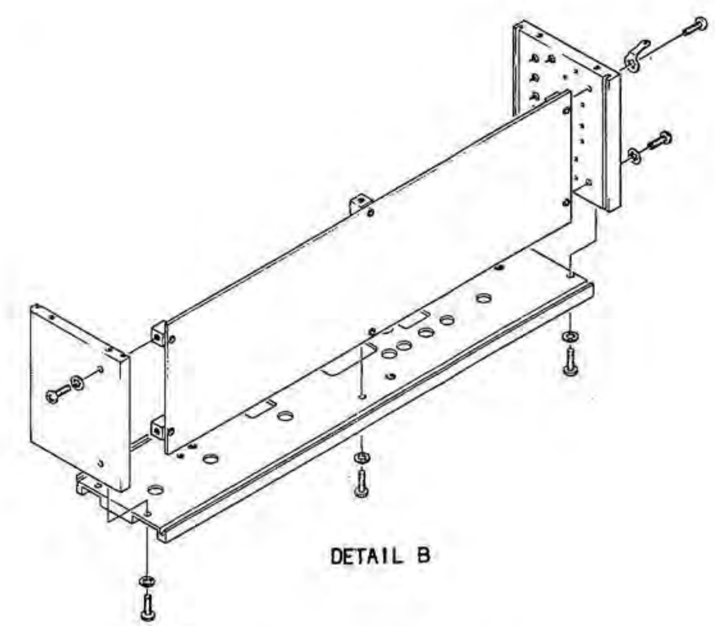
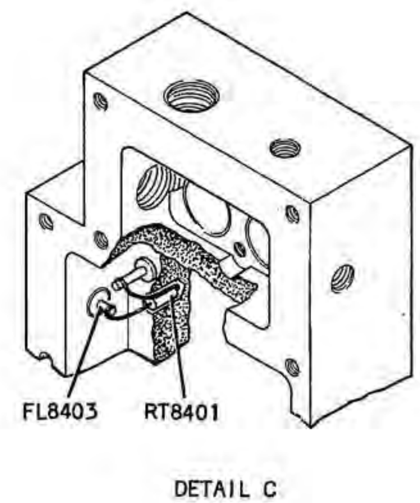
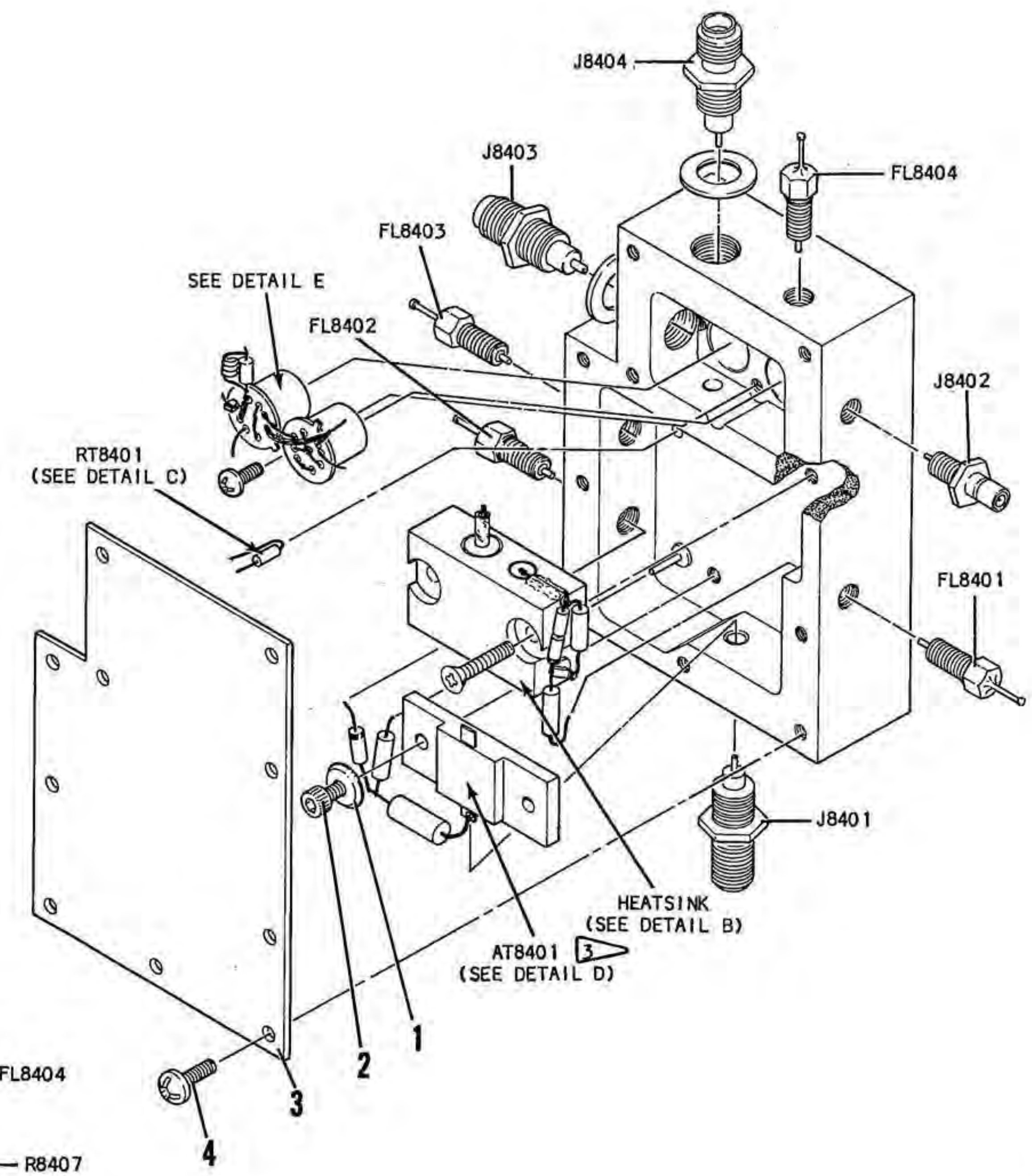


Figure 8-11 Power Supply (8100)

NOTES:

1. SHOULDER ON J8401 MUST SEAT AGAINST THIS SURFACE.
2. C8401 SHOULD SOLDER VERTICAL TO POST.
3. APPLY THERMAL COMPOUND TO UNDERSIDE OF AT8401.
4. APPLY THERMAL COMPOUND AROUND R8403.
5. TRIM LEAD OF R8403 TO 1/4".
6. TRIM LEAD OF R8403 TO 1/8".
7. SLEEVE BODY OF R8404 USING TEFLON TUBING (10 AWG).
8. NOT USED.
9. TORQUE J8401 TO 25 IN.-LBS.
10. R8406 IS SELECT AT TEST. NOMINAL = 56 OHM; RANGE = 10 TO 120 OHM.





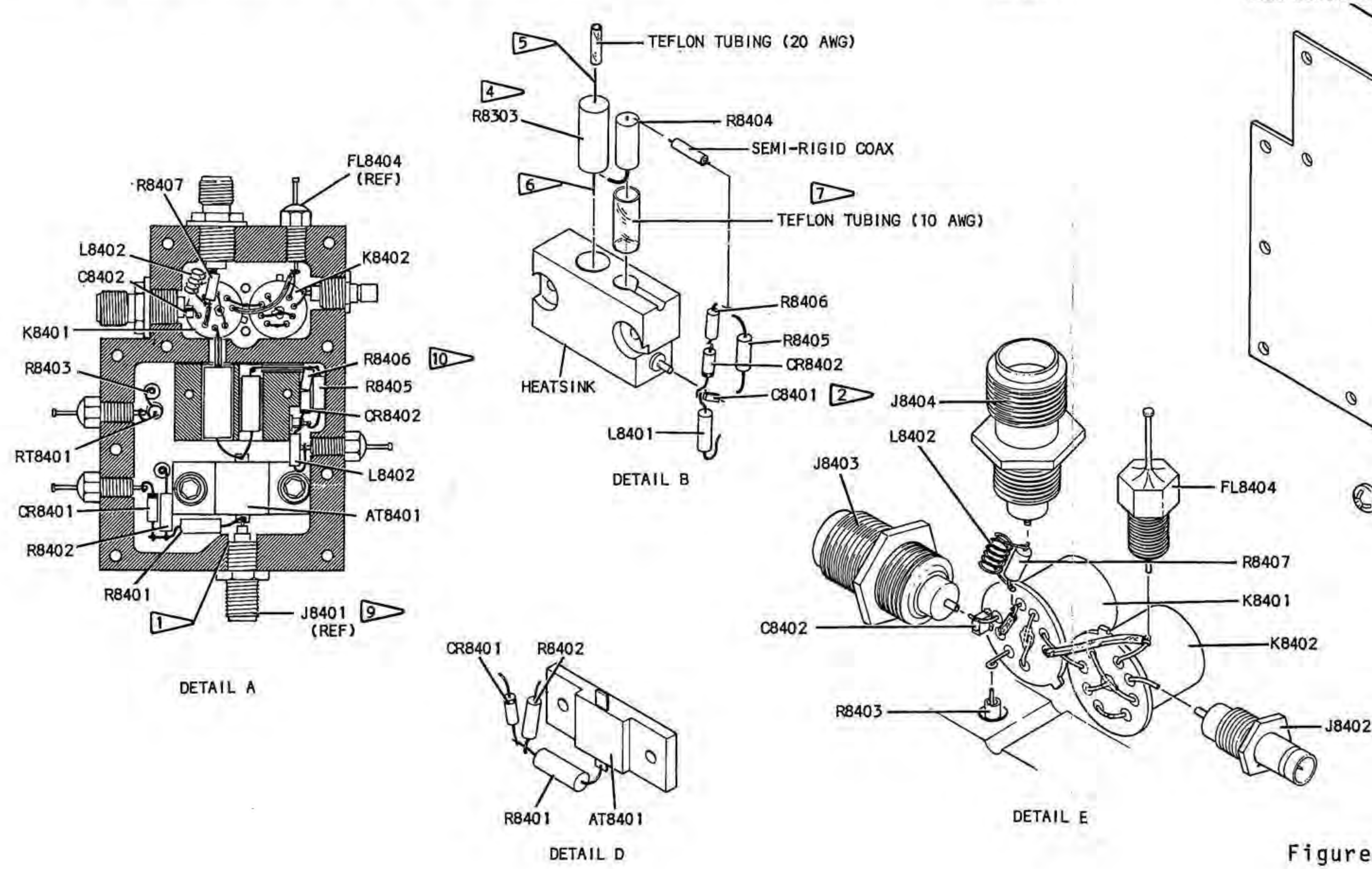
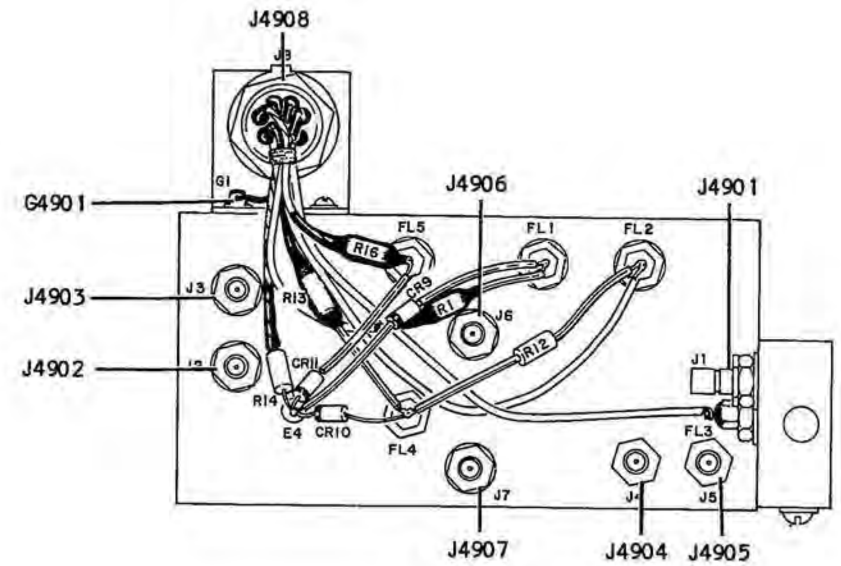
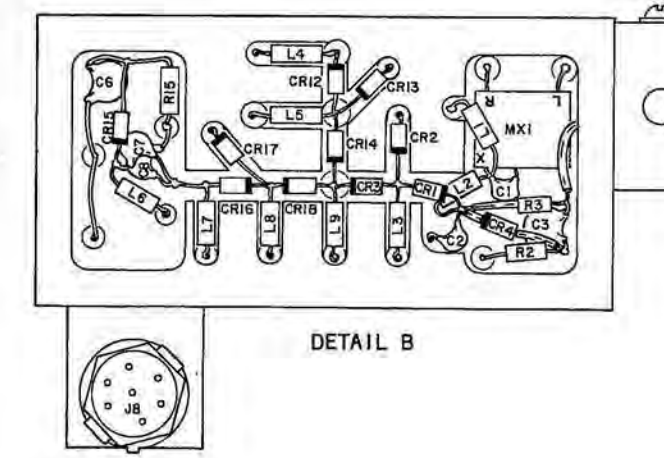


Figure 8-12 Power Termination Assembly (8400)

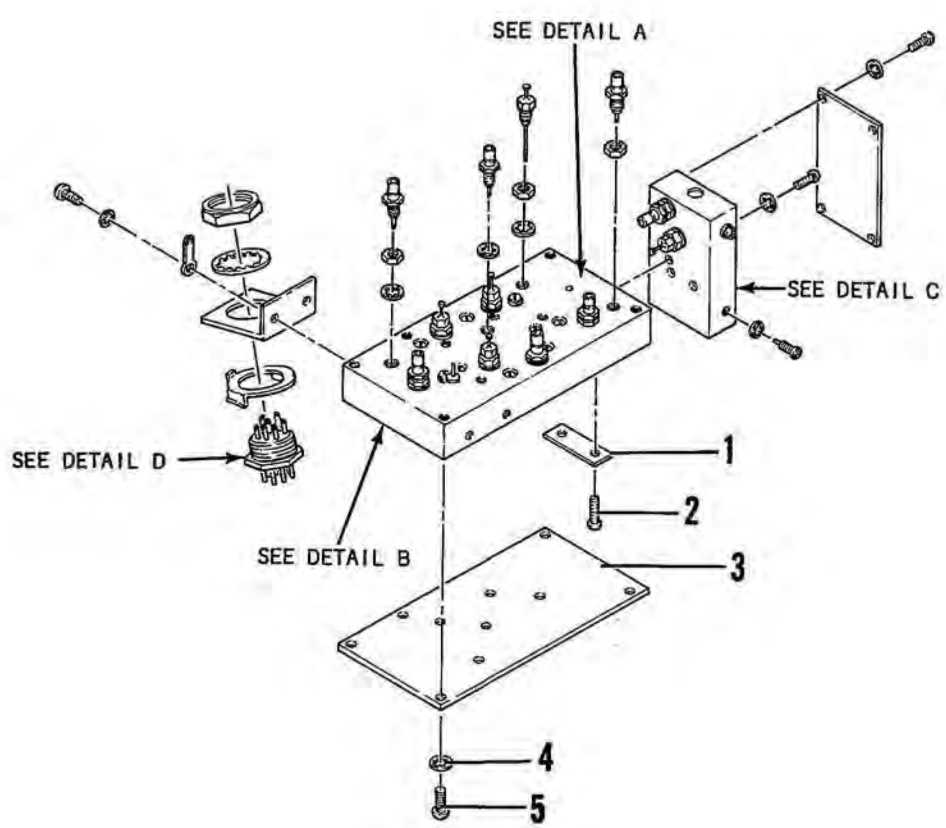
WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
J4908-D	FL4904	(R4913) WHT/RED	26	1.75"
J4908-E	FL4905	(R4916) VIO	26	1.75"
J4908-F	FL4903	WHITE	26	4.25"
J4908-H	E4904	(R4914) WHT/BLU	26	1.87"
J4908-C	G4901	BLACK	26	1.50"
J4908-B	FL4901	(R4901) WHT/ORG	26	2.00"
J4908-A	FL4902	YELLOW	26	3.75"
FL4902	FL4904	R4912	SLEEVED LEADS	—
FL4904	E4904	CR4910	—	—
FL4905	E4904	CR4911	SLEEVED LEADS	—
FL4901	E4904	CR4909	SLEEVED LEADS	—

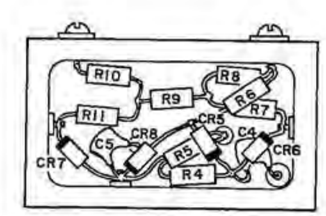


DETAIL A

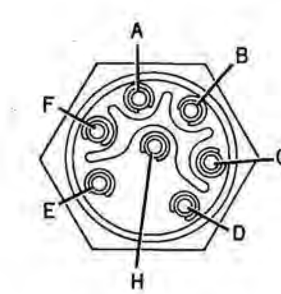


DETAIL B





DETAIL C



DETAIL D

Figure 8-13 Second Mixer Assembly (4900)

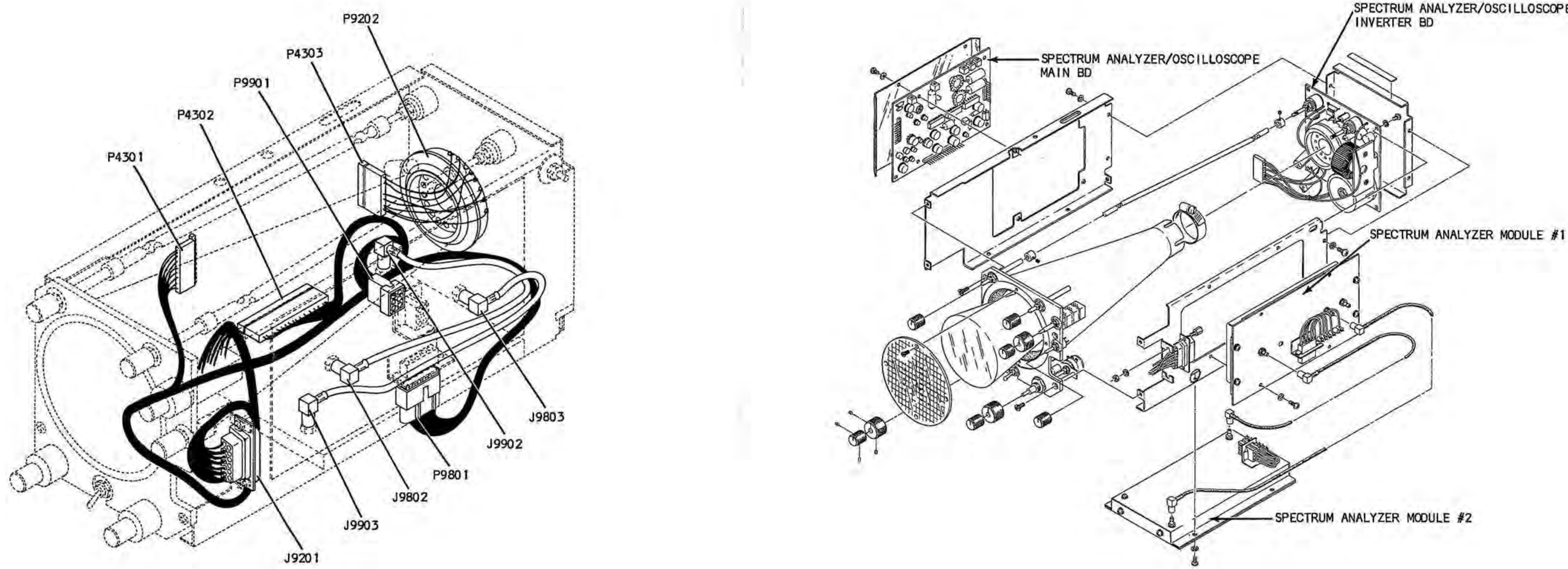


Figure 8-14 Spectrum Analyzer/Oscilloscope (9200)

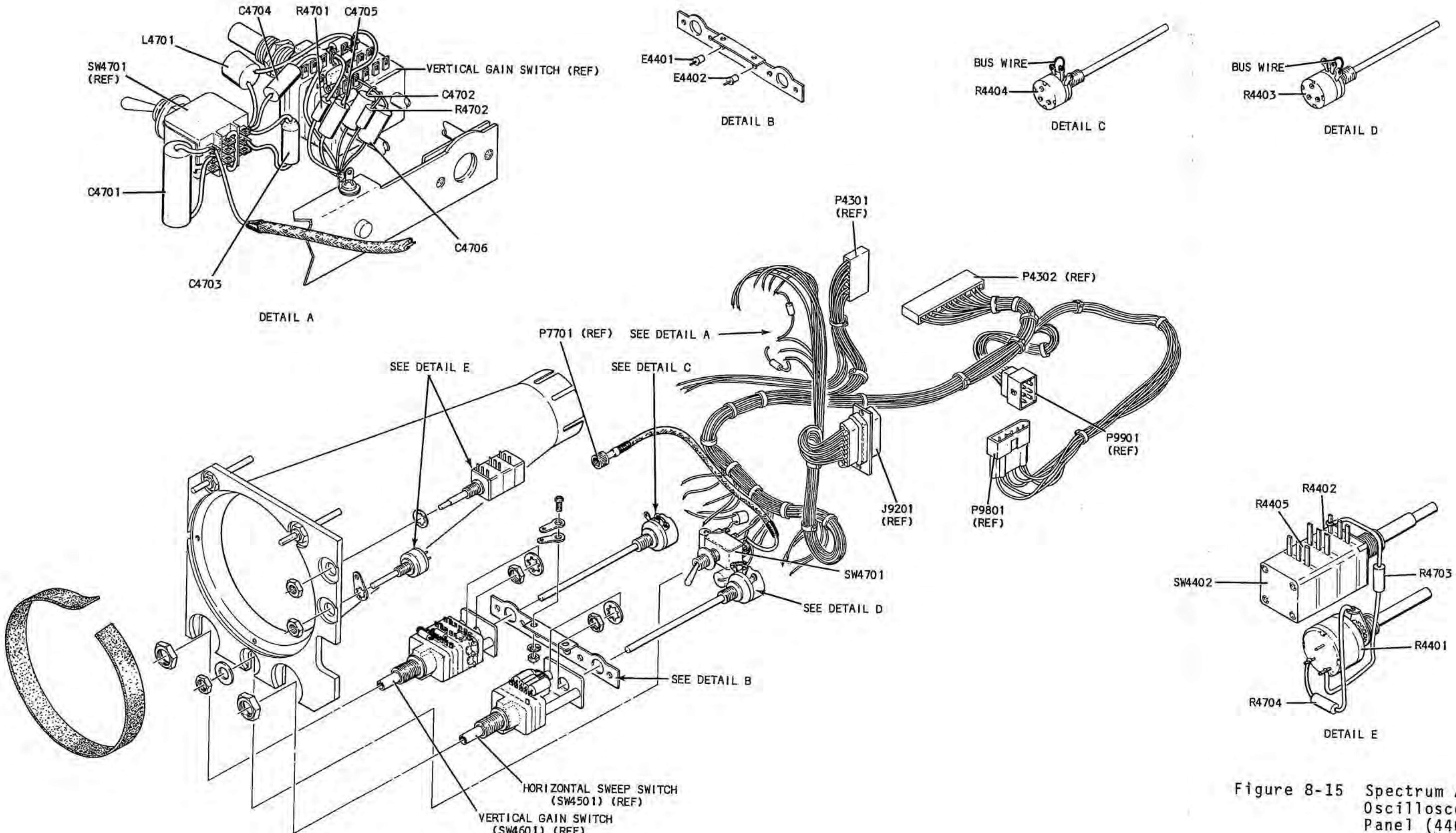
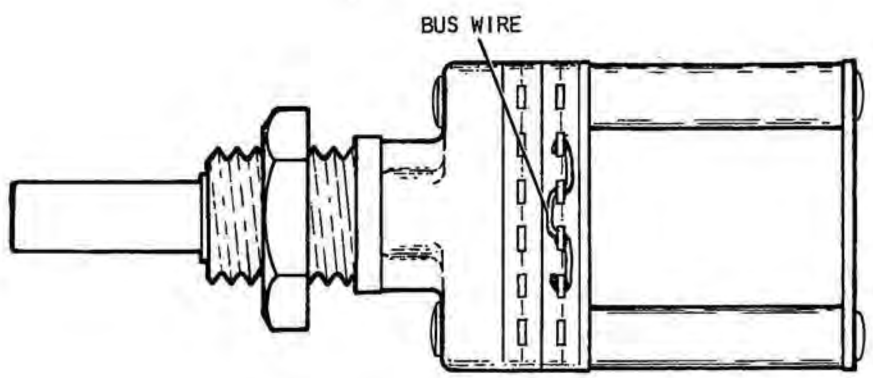


Figure 8-15 Spectrum Analyzer/Oscilloscope Front Panel (4400)/Wire Harness (4700)



DETAIL B

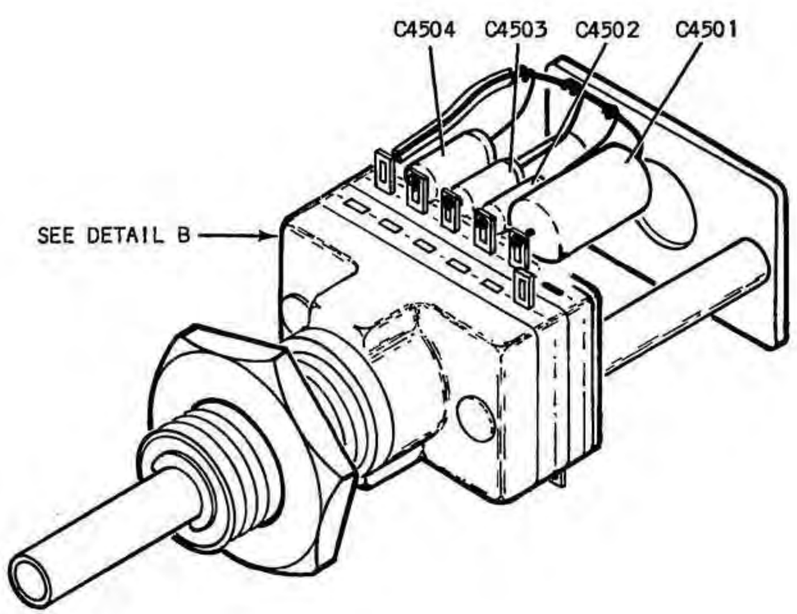


Figure 8-16 Spectrum Analyzer/Oscilloscope Horizontal Sweep Switch (4500)

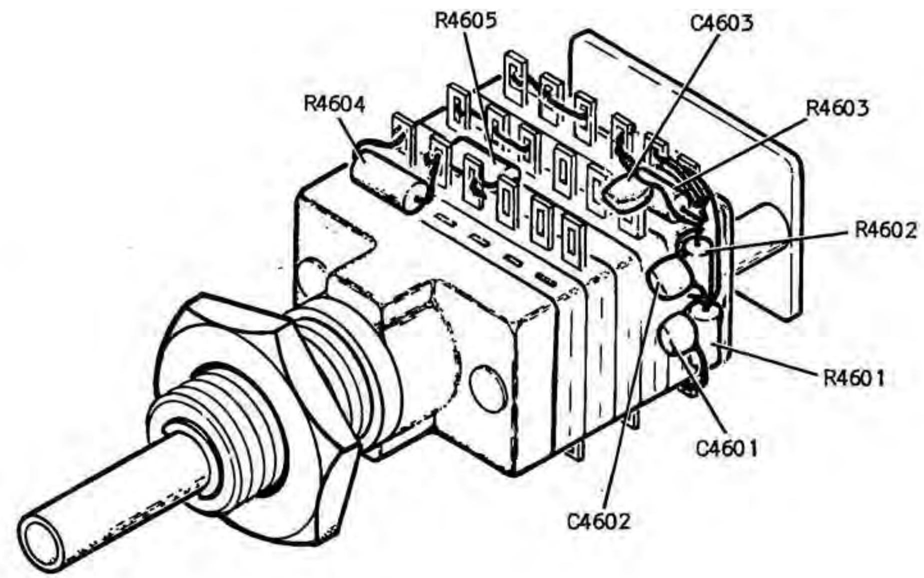


Figure 8-17 Spectrum Analyzer/
Oscilloscope Vertical
Gain Switch (4600)

WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
J9801-1	FL9801	WHT/RED	22	3.2"
J9801-2	FL9802	BLU	26	2.5"
J9801-3	FL9803	BRN	26	3.0"
J9801-4	FL9804	WHT/BLU	26	2.4"
J9801-5	FL9805	GRAY	26	3.0"
E9401	FL9801	WHT/RED	22	3.0"
E9402	FL9802	BLU	26	3.0"
E9403	FL9803	BRN	26	3.5"
E9404	FL9804	WHT/BLU	26	3.0"
E9405	FL9805	GRAY	26	2.0"
E9406	FL9806	WHT	26	3.0"

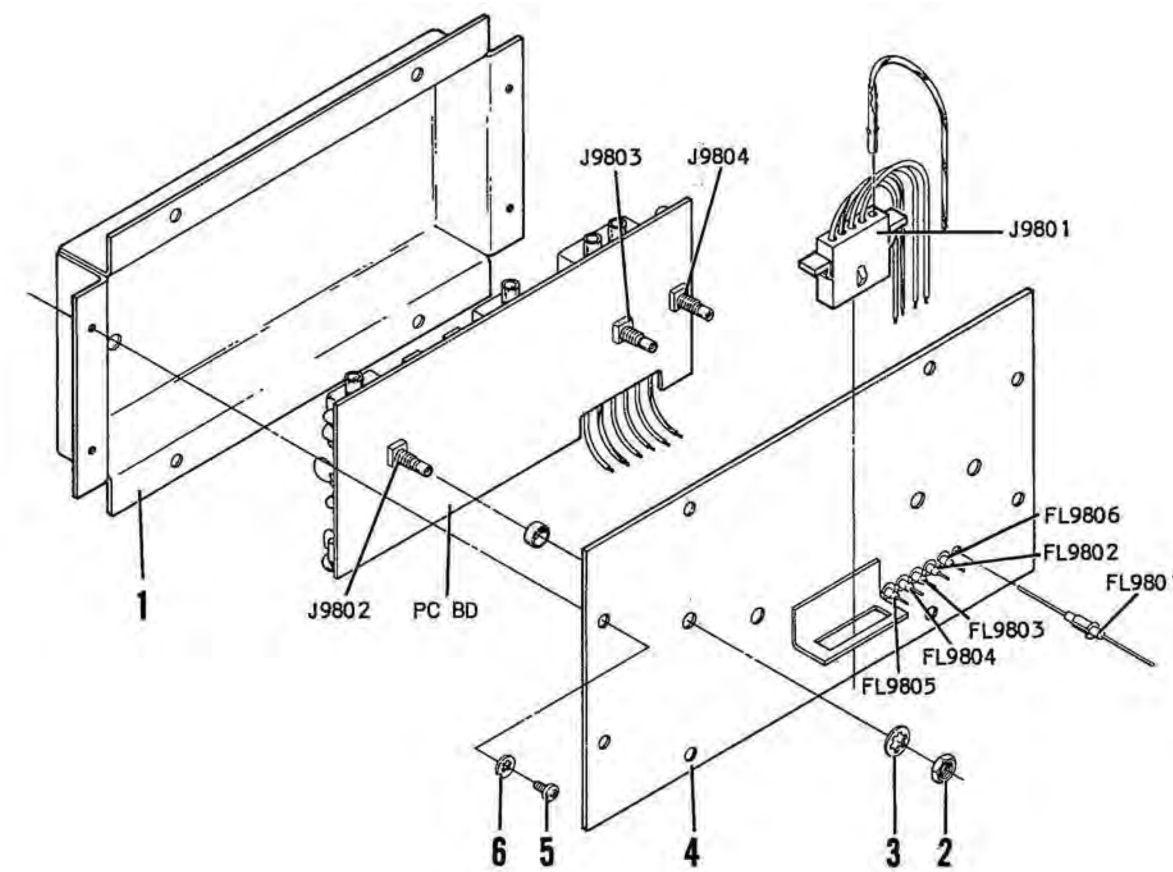
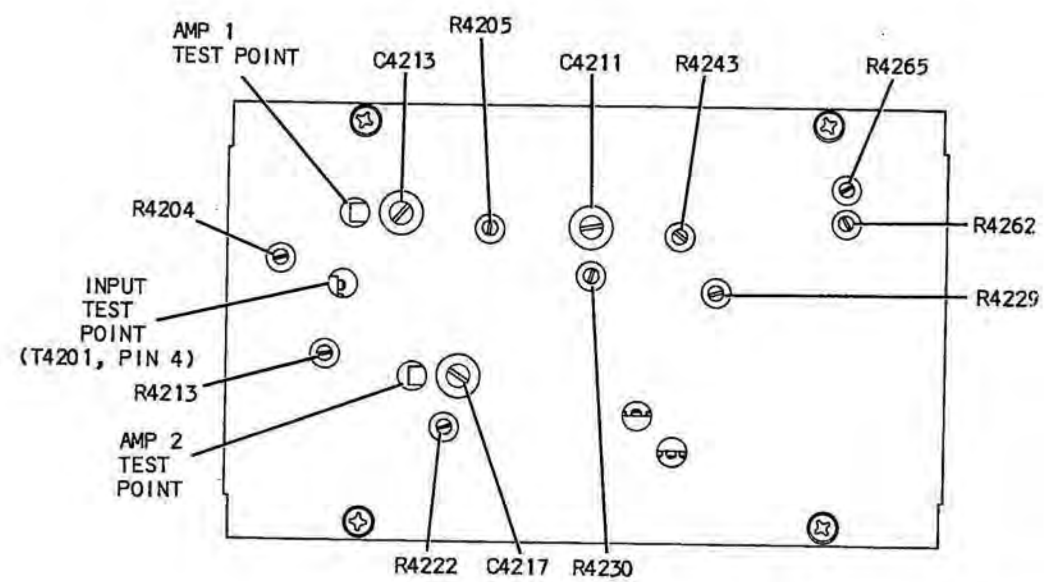


Figure 8-18 Spectrum Analyzer Module #1 (9800)

NOTES:

1. TRIM FILTER LEADS TO .15" FROM BODY AND SOLDER FEED THRU FILTERS (FL9901 THRU FL9906) TO COVER.

WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
J9901-1	FL9901	WHT/BLU	26	4"
J9901-2	FL9902	BLU	26	4"
J9901-3	FL9903	WHITE	26	4"
J9901-4	FL9904	RED	26	4"
J9901-5	FL9905	BROWN	26	4"
J9901-6	FL9906	WHT/RED	26	4"
FL9901	E4201	WHT/BLU	26	3"
FL9902	E4202	BLU	26	6"
FL9903	E4203	WHT	26	4.5"
FL9904	E4204	RED	26	5"
FL9905	E4205	BROWN	26	3"
FL9906	E4206	WHT/RED	26	2"



ACCESS HOLES FOR TEST/ADJUSTMENT POINTS

DETAIL A

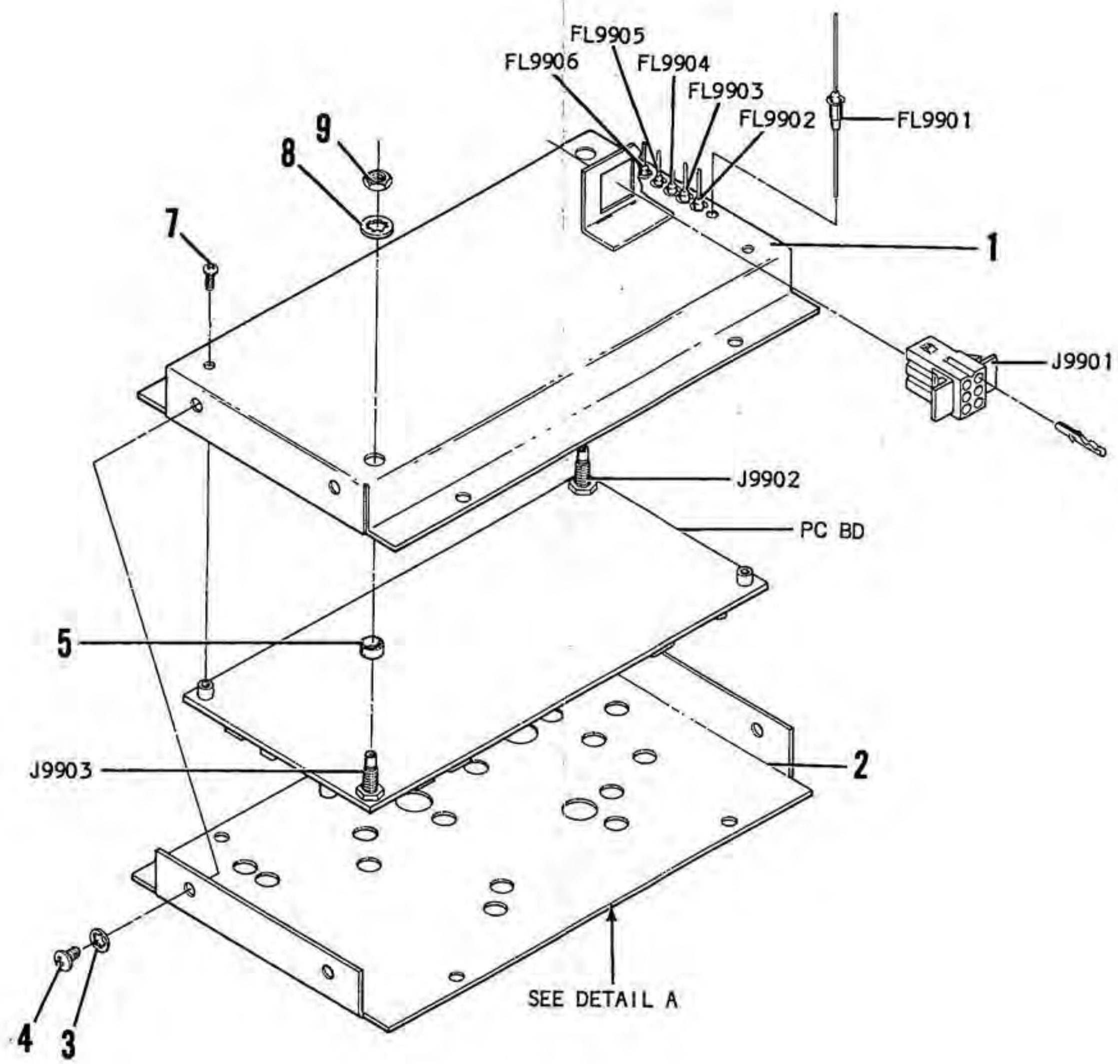
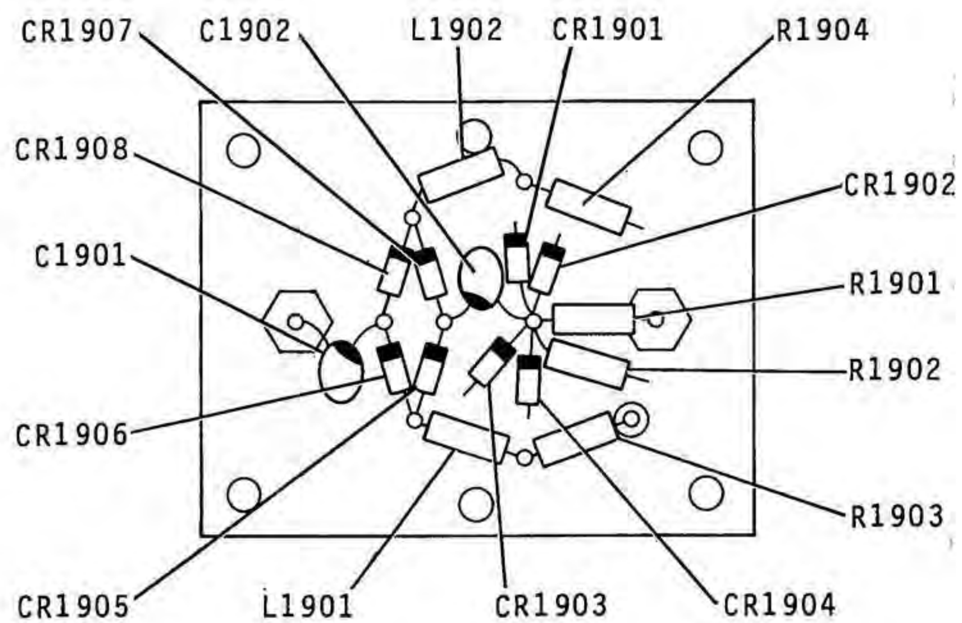
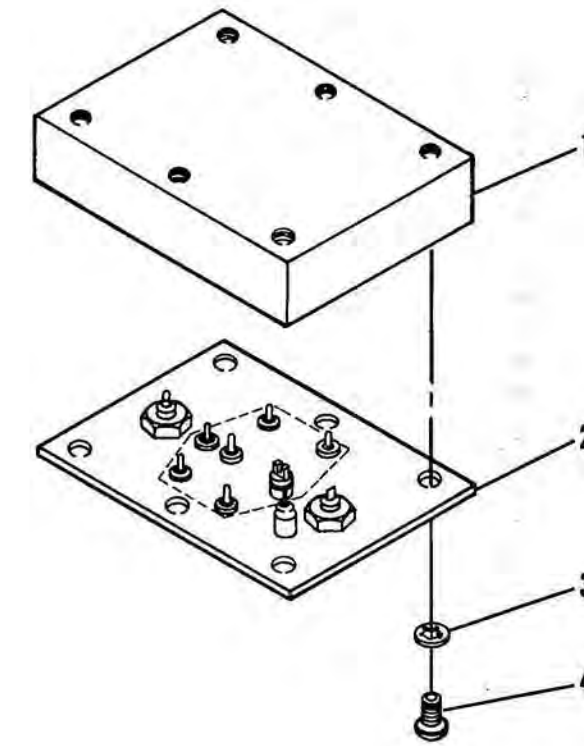


Figure 8-19 Spectrum Analyzer Module #2 (9900)





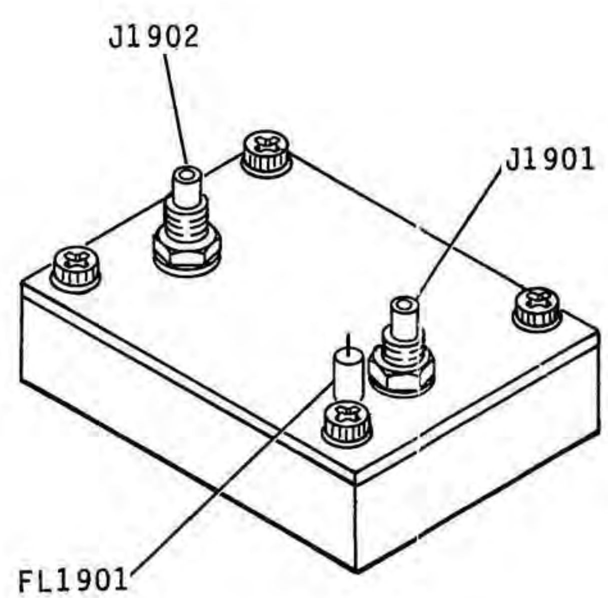


Figure 8-20 Static Discharge Protect Assembly (1900)

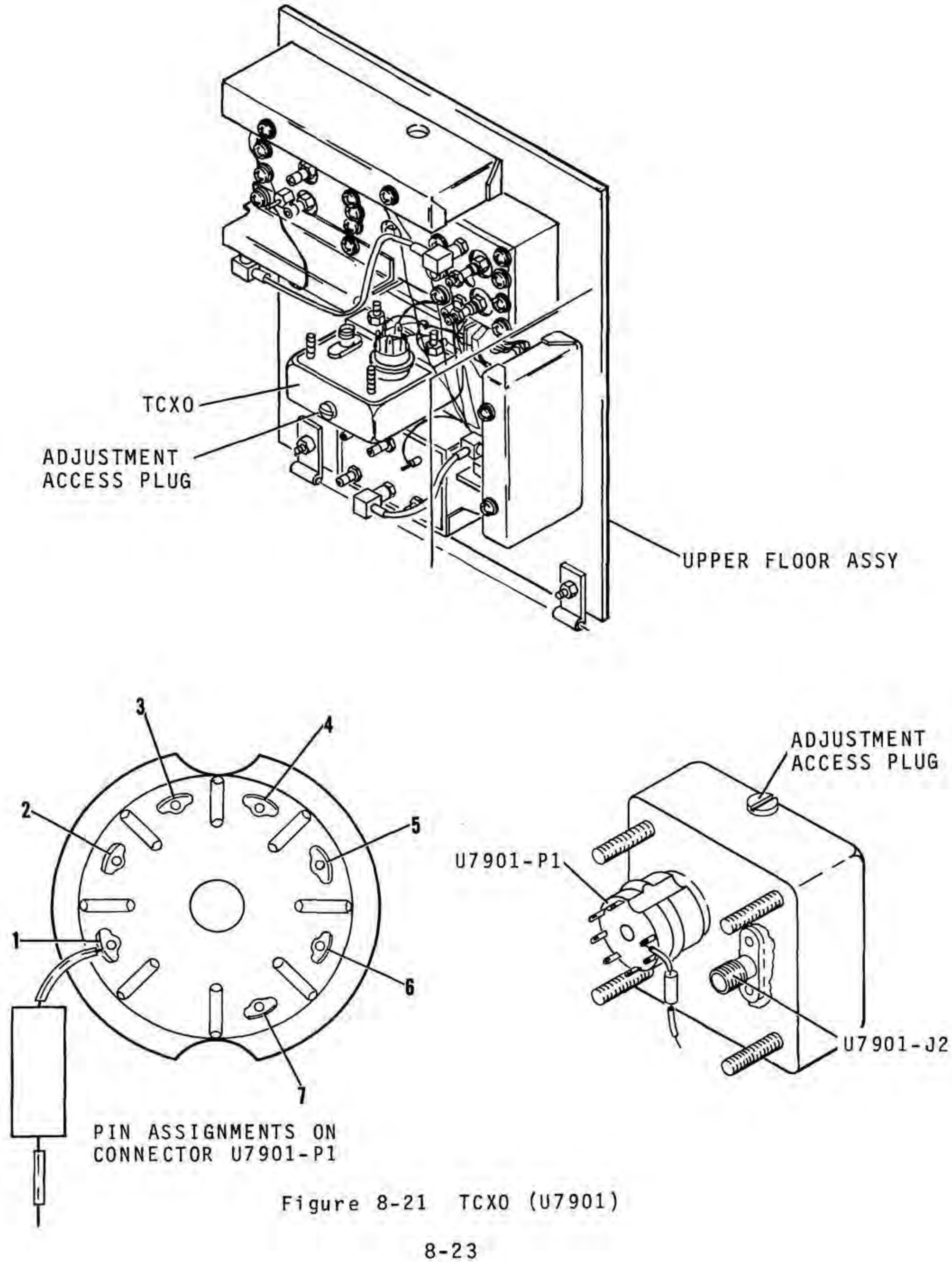


Figure 8-21 TCXO (U7901)

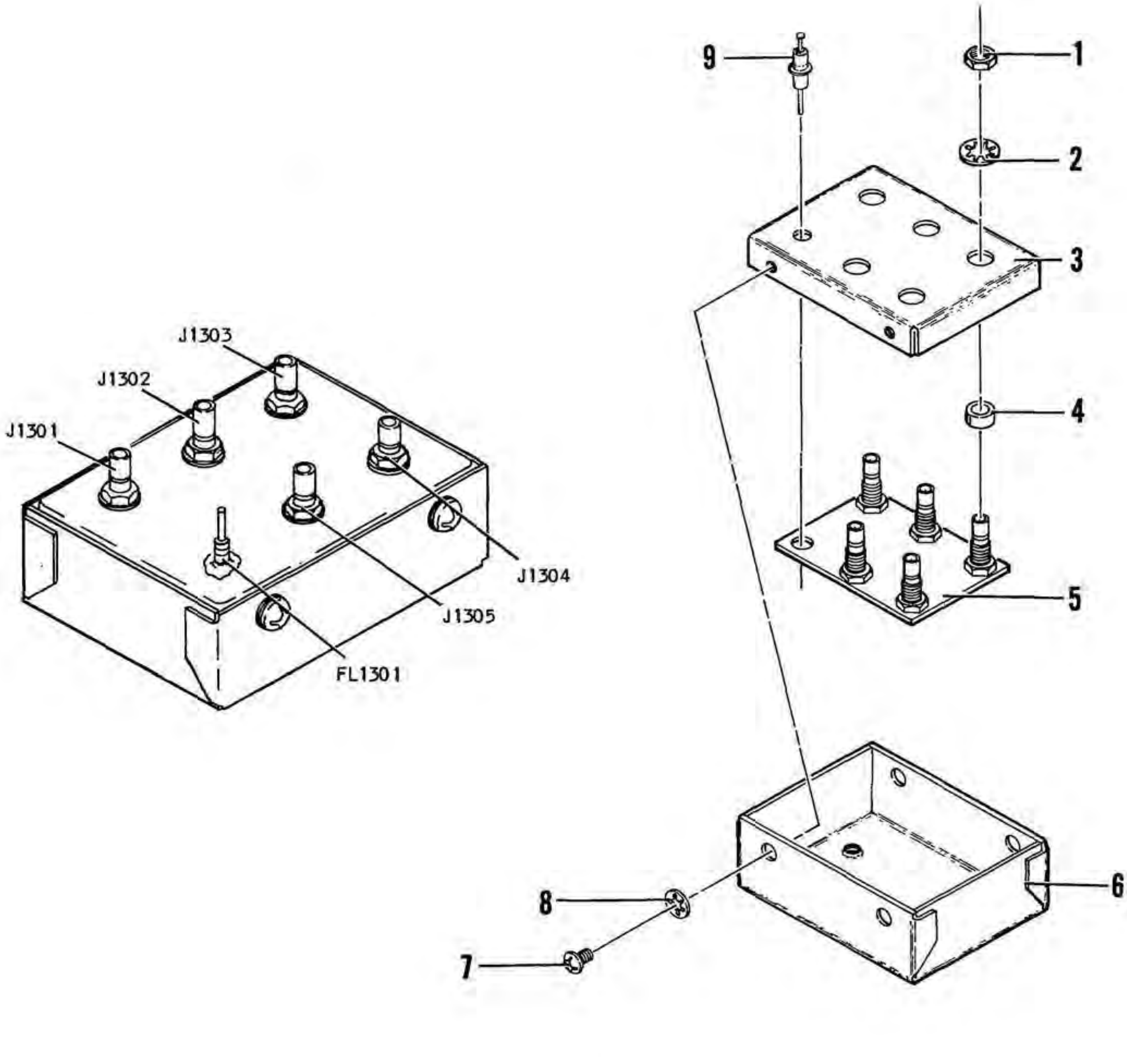


Figure 8-22 TCXO Output Distribution Amplifier Assembly (1300)

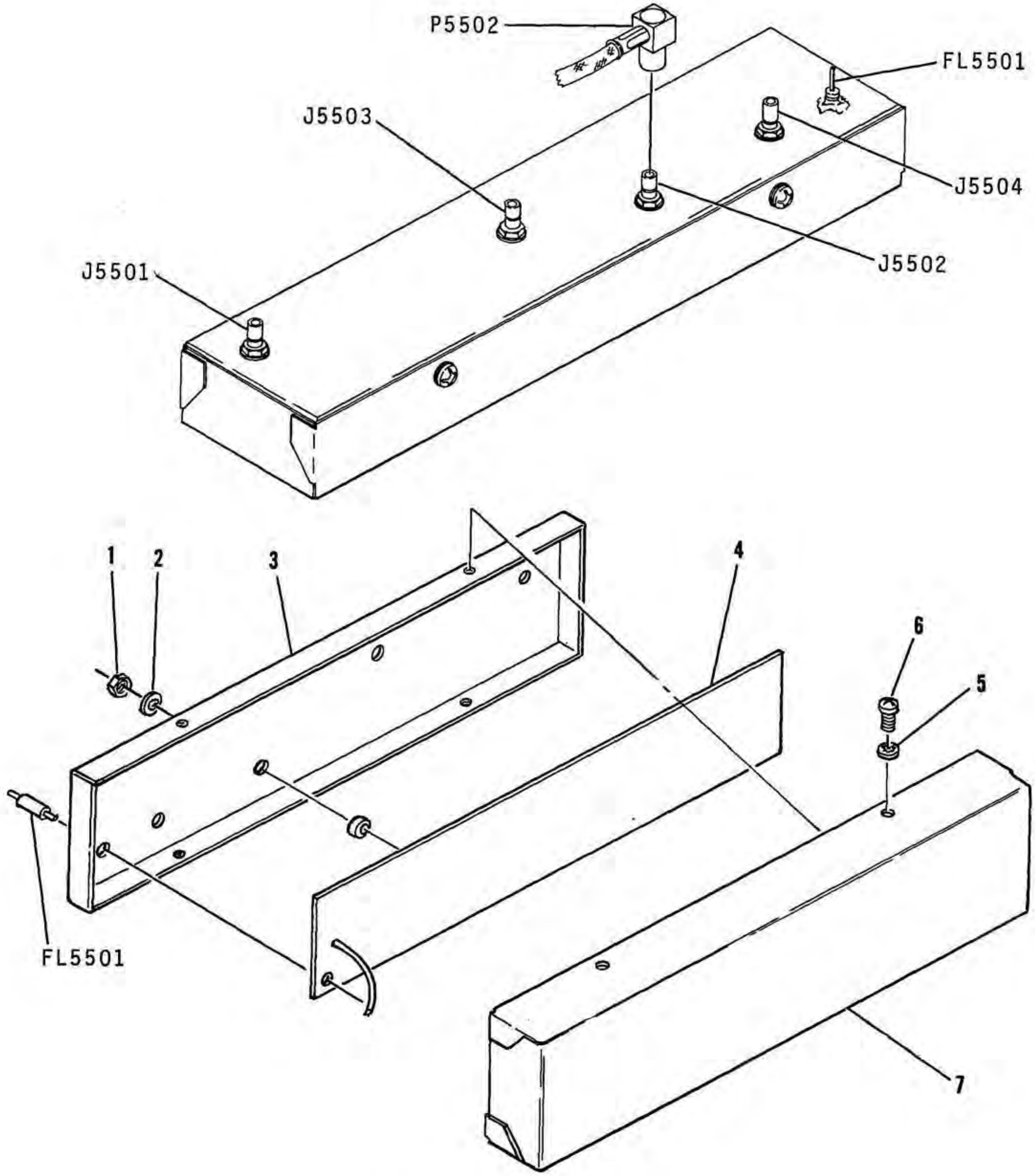


Figure 8-23 100 MHz Amplifier/108 MHz Mixer Assembly (5500)

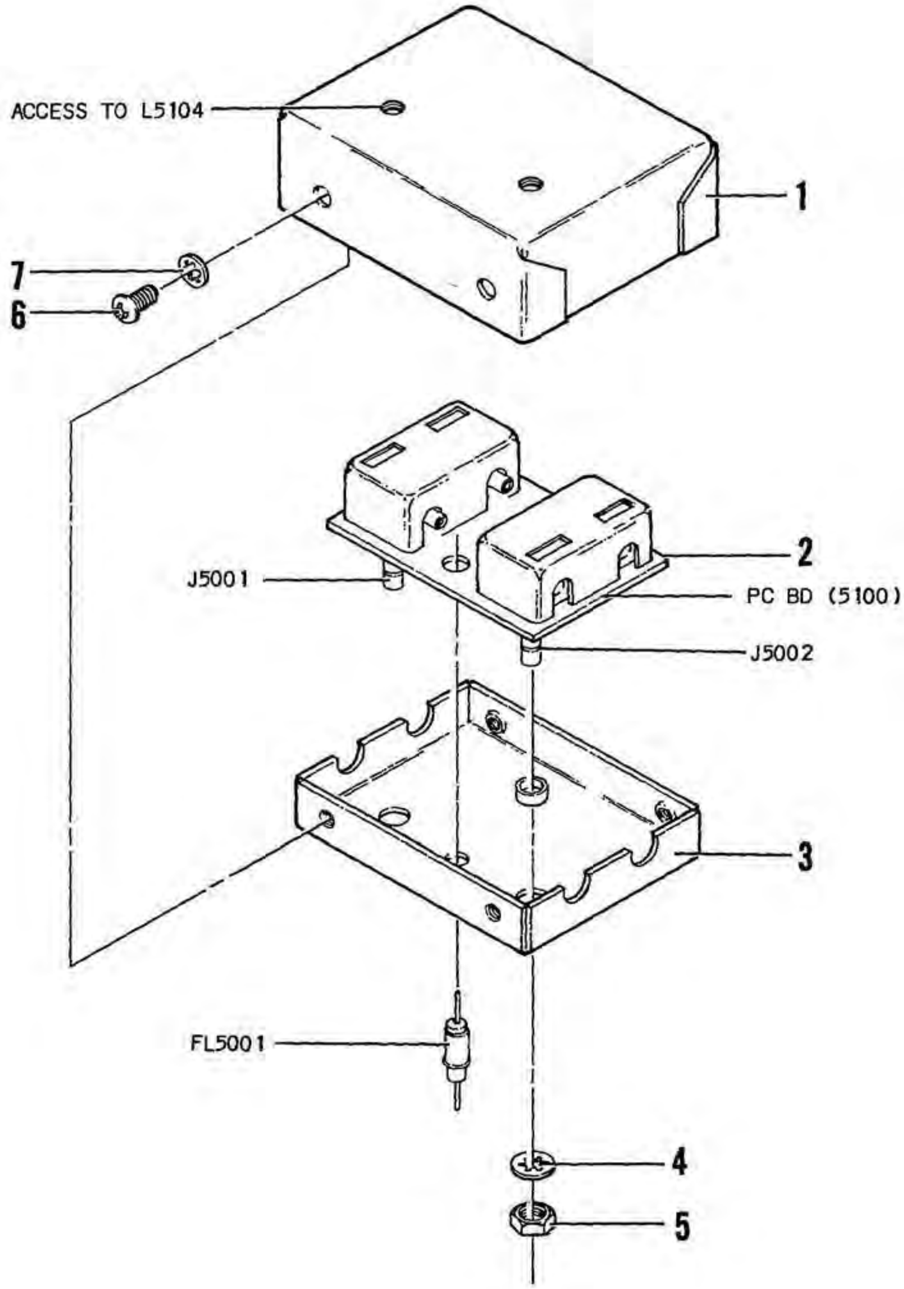


Figure 8-24 100 MHz Filter Assembly (5000)

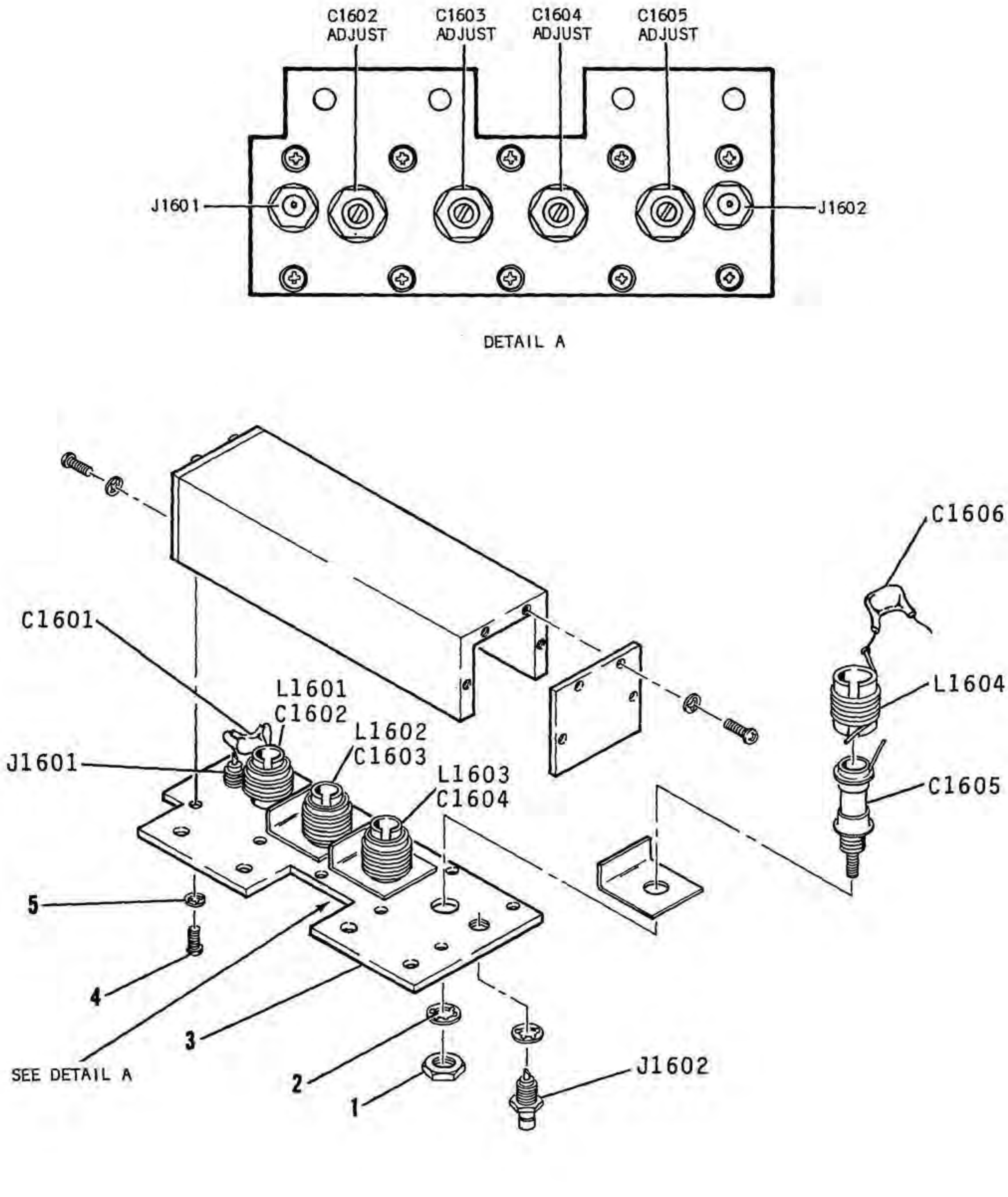


Figure 8-25 108 MHz Bandpass Filter Assembly (1600)

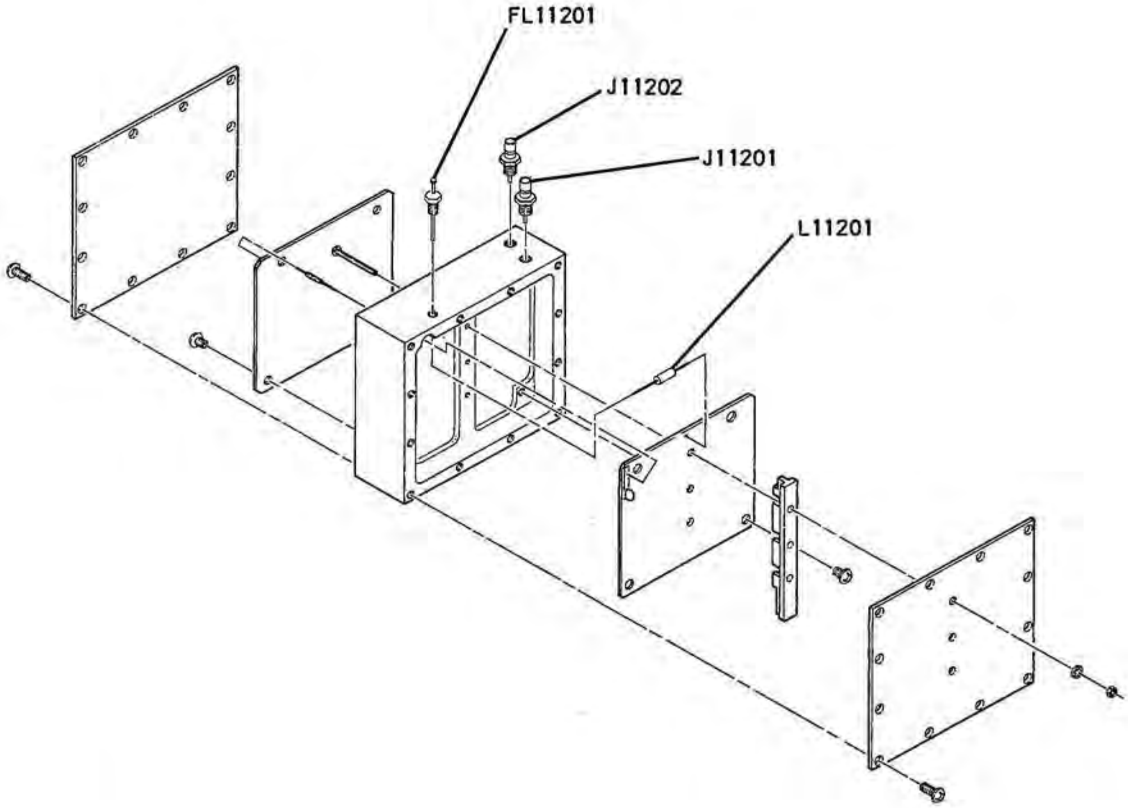


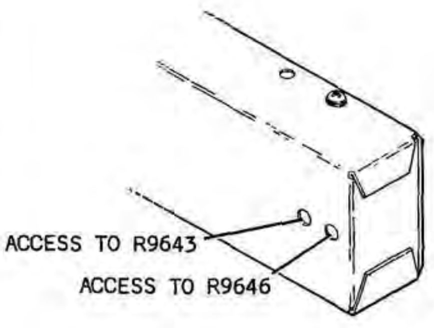
Figure 8-26 1080 MHz Multiplier/Amplifier (11200)

NOTES:

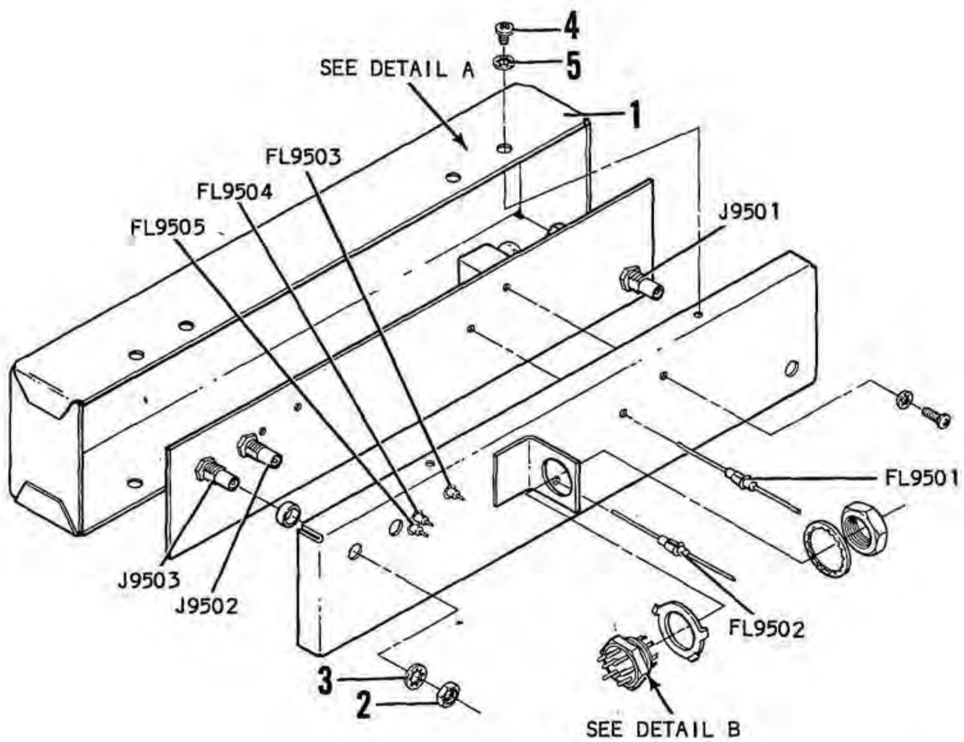
1. SOLDER LEAD OF FEED-THRU CAPACITORS TO LEADS MOUNTED ON PC BOARD.

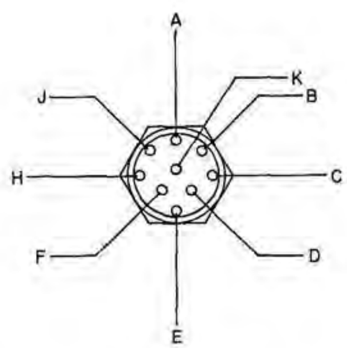
2. SOLDER END OF WIRE TO BASE.

WIRING LIST				
FROM	TO	COLOR	GA	FUNCTION
FL9502	J9504-H	ORN	26	+5 V INPUT
GND	J9504-F	BLK	26	GND
FL9501	J9504-D	VIO	26	FM AUDIO IN
FL9505	J9504-E	GRN	26	AM AUDIO IN
FL9504	J9504-A	BRN/WHT	26	+11 VDC ON BFO
FL9503	J9504-B	BLU/WHT	26	+11 VDC ON GEN



DETAIL A





DETAIL B

Figure 8-27 120 MHz Generator (9500)

WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
FL5702	P5703-C	GRN	22	7.0"
FL5703	P5703-E	BLU	22	7.0"
FL5701	P5703-D	WHT/RED	22	7.0"
GND	P5703-F	BLK	22	7.0"
FL5702	GND	CAP (1 µF, 35 V)	—	—

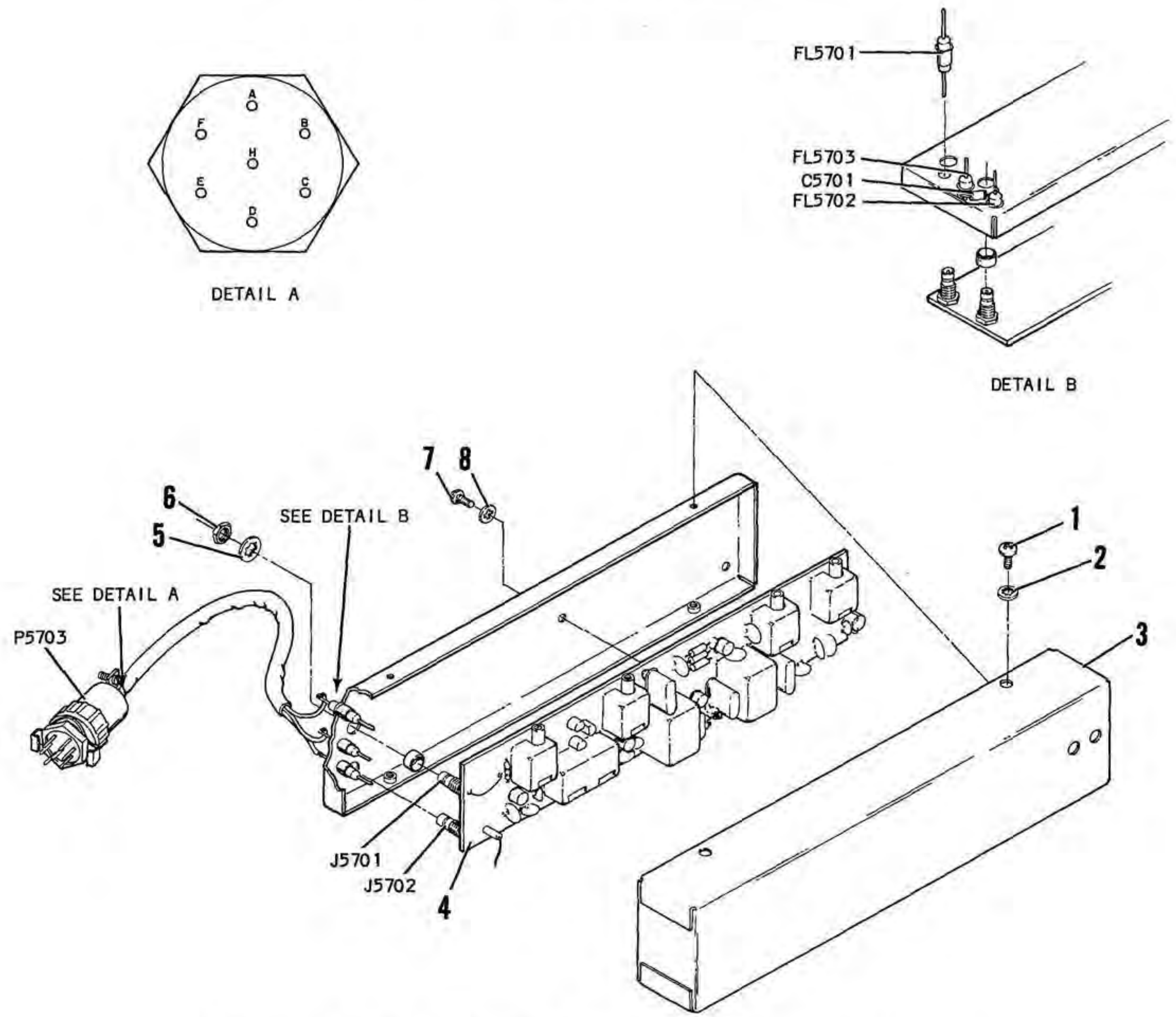
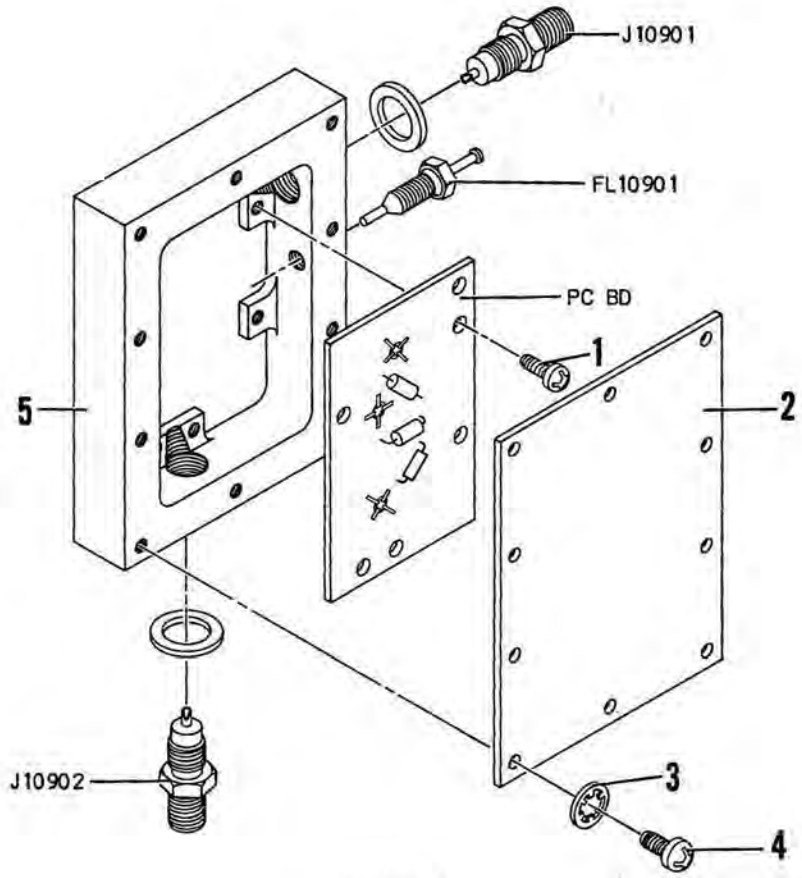
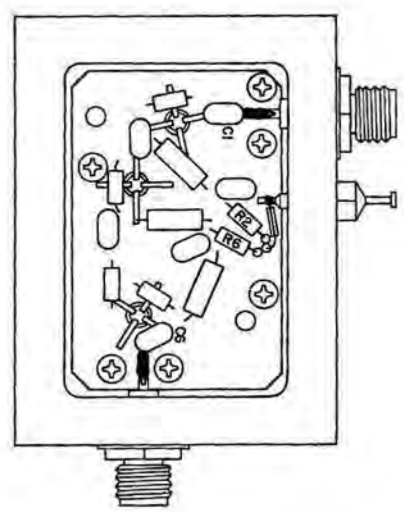


Figure 8-28 120 MHz Receiver Assembly (5700)

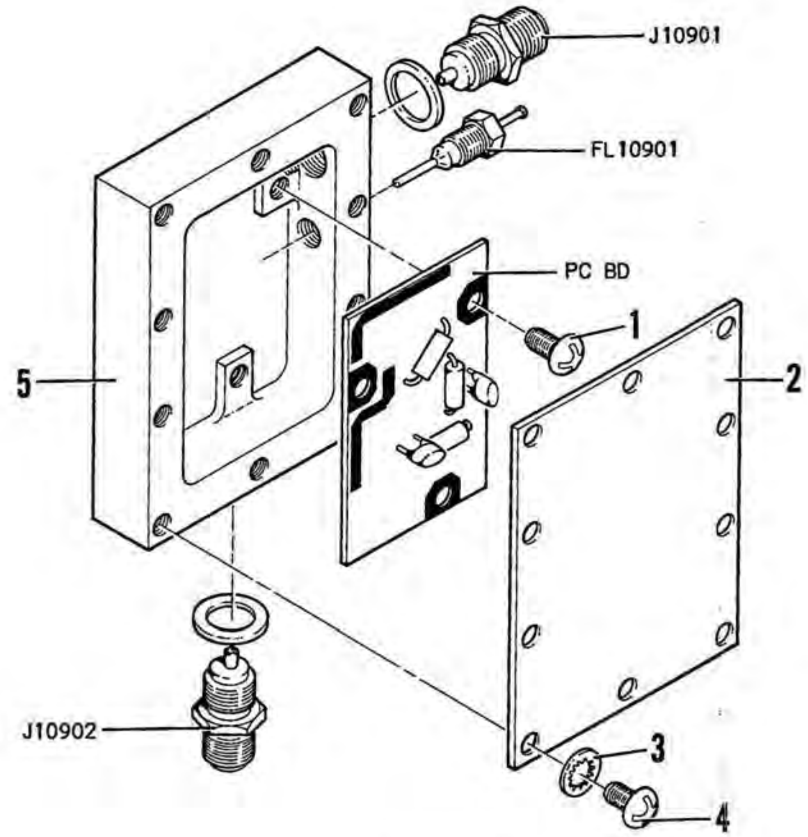
EFFECTIVE SN 3454 & ON

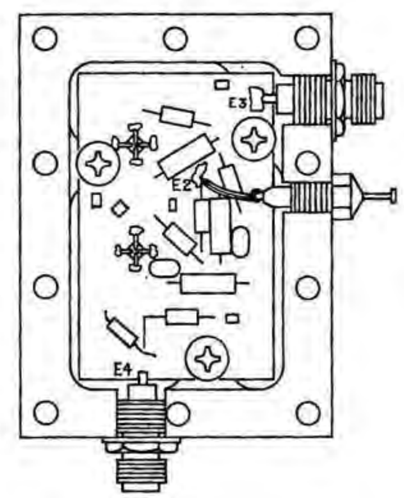




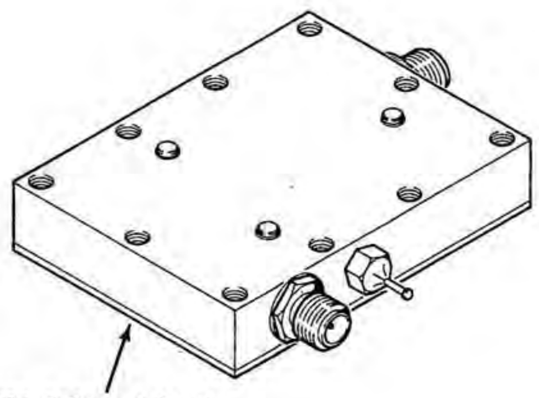
DETAIL A

EFFECTIVE SN 3001 THRU 3453



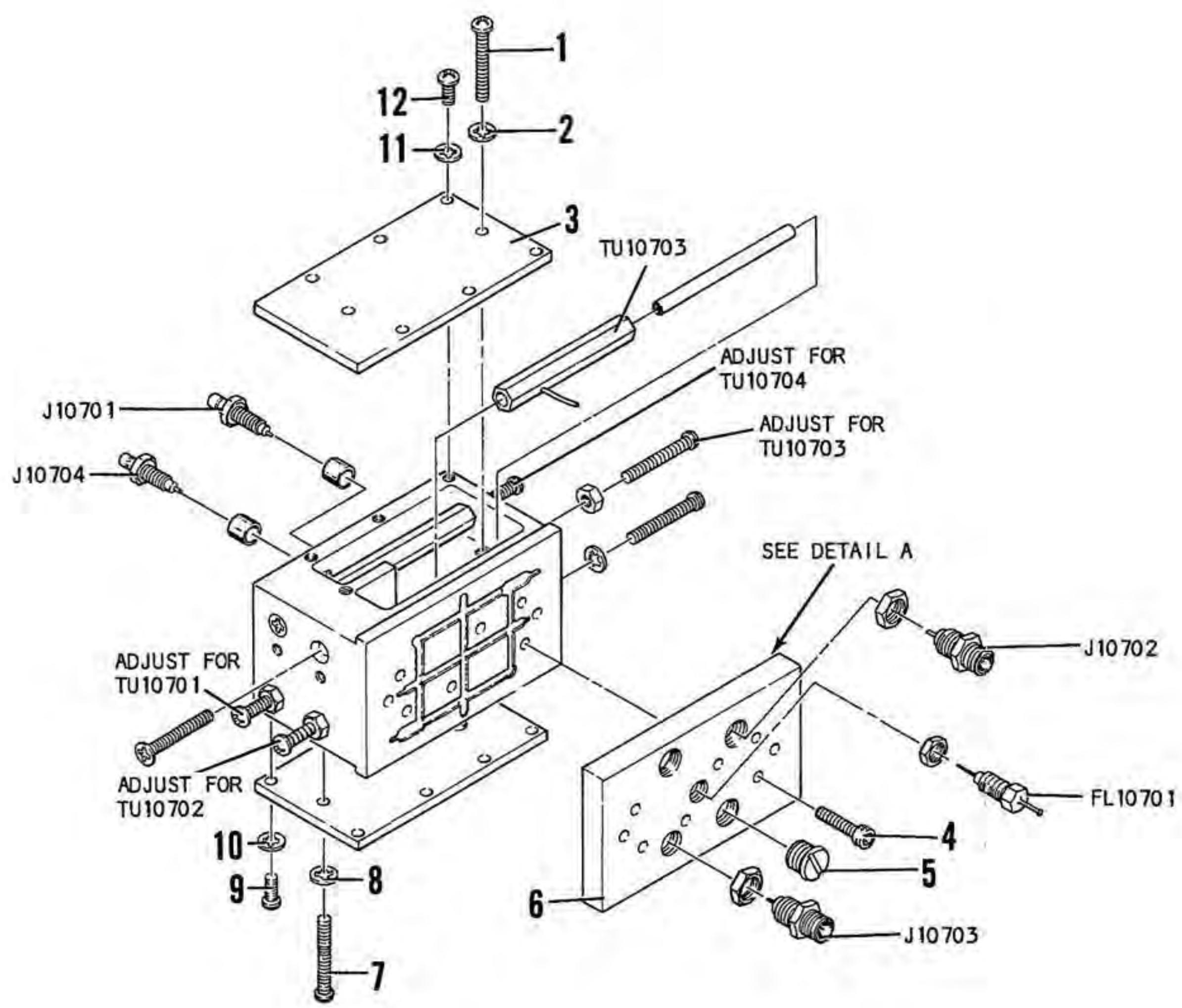


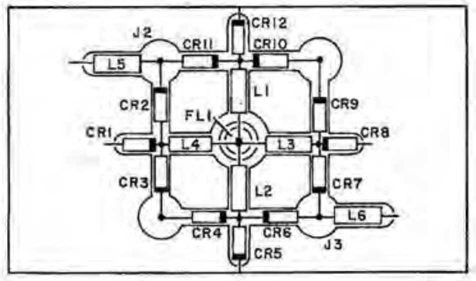
DETAIL B



SEE DETAIL A OR B

Figure 8-29 1200 MHz Amplifier (10900)





DETAIL A

Figure 8-30 1200 MHz Filter & Diode Switch (10700)

NOTE:

THE 1200-2200 MHz OSCILLATOR IS FACTORY REPAIRABLE ONLY.

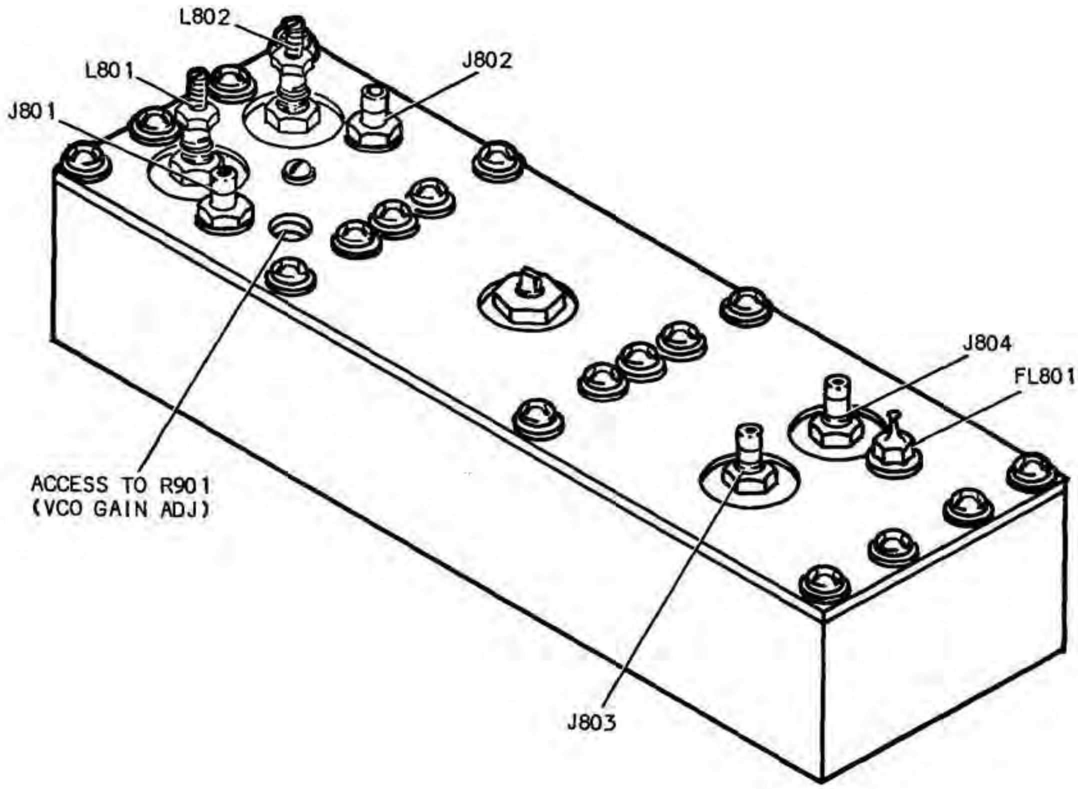
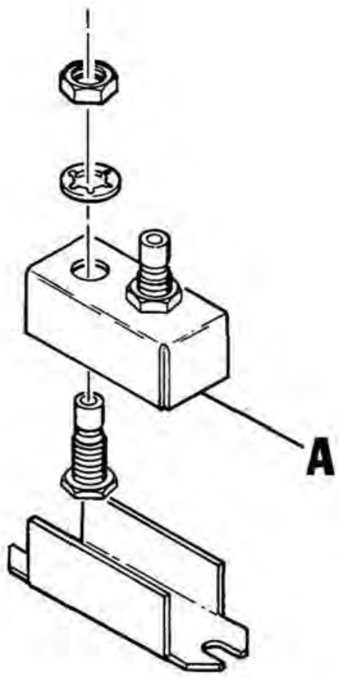
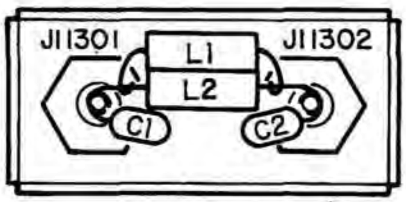


Figure 8-31 1200-2200 MHz Oscillator Assembly (800)





DETAIL A

Figure 8-32 350 MHz Low Pass Filter (11300)

SECTION 9-PC BOARD ASSEMBLIES

9-1 GENERAL

This section contains component layout drawings for all PC Boards contained within the FM/AM-1100S/A. These drawings are provided for purposes of locating and identifying discrete components, connectors, test points etc. which are referenced in other sections of this manual. These drawings are sequenced in alphanumerical order, by the PC Board name (see index in paragraph 9-1-1).

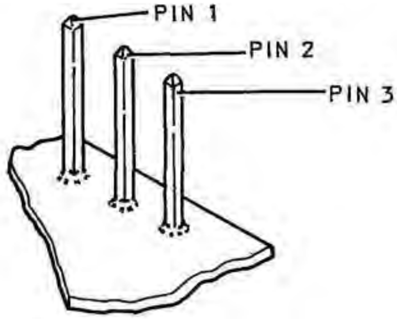
NOTE

Each figure title for each PC Board is followed by a number enclosed within parentheses. This number represents the reference designator series number assigned to the PC Board shown in that figure (e.g. if a PC Board carries a designator series number 1200, then component R1 is R1201, X5 is X1205, CR36 is CR1236 etc.).

If a PC Board has components located on both sides of the board, both a top and bottom view of the PC Board will be provided in the Figure. If, however, a PC Board has components only on one side, then only the component side will be shown.

The drawings in this section are not intended for use in ordering spare or replacement parts. For parts ordering information, see FM/AM-1100S/A Illustrated Parts Catalog.

9-1-1 INDEX OF PC BOARD ASSEMBLIES



TP1001
DETAIL A

TP1001

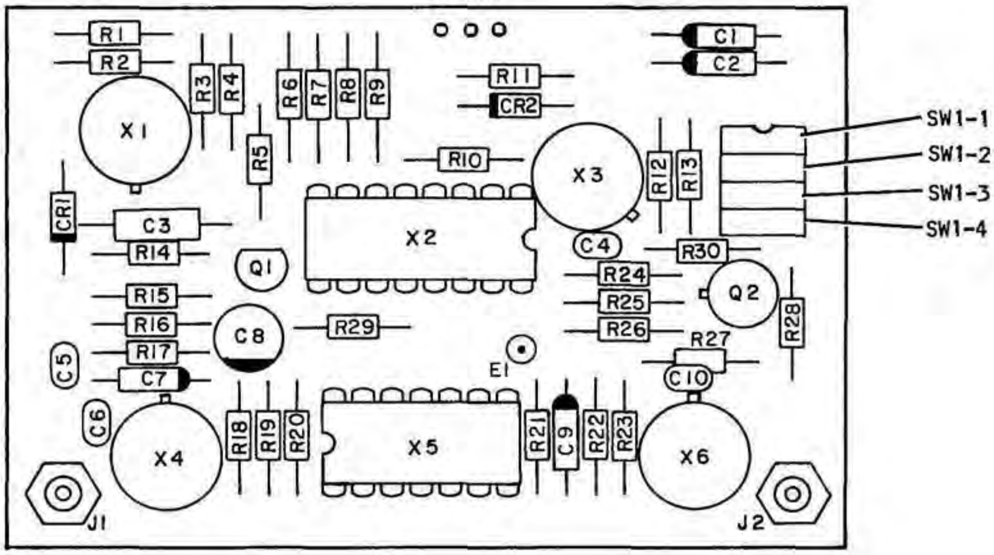


Figure 9-1 AGC System PC Board (1000)

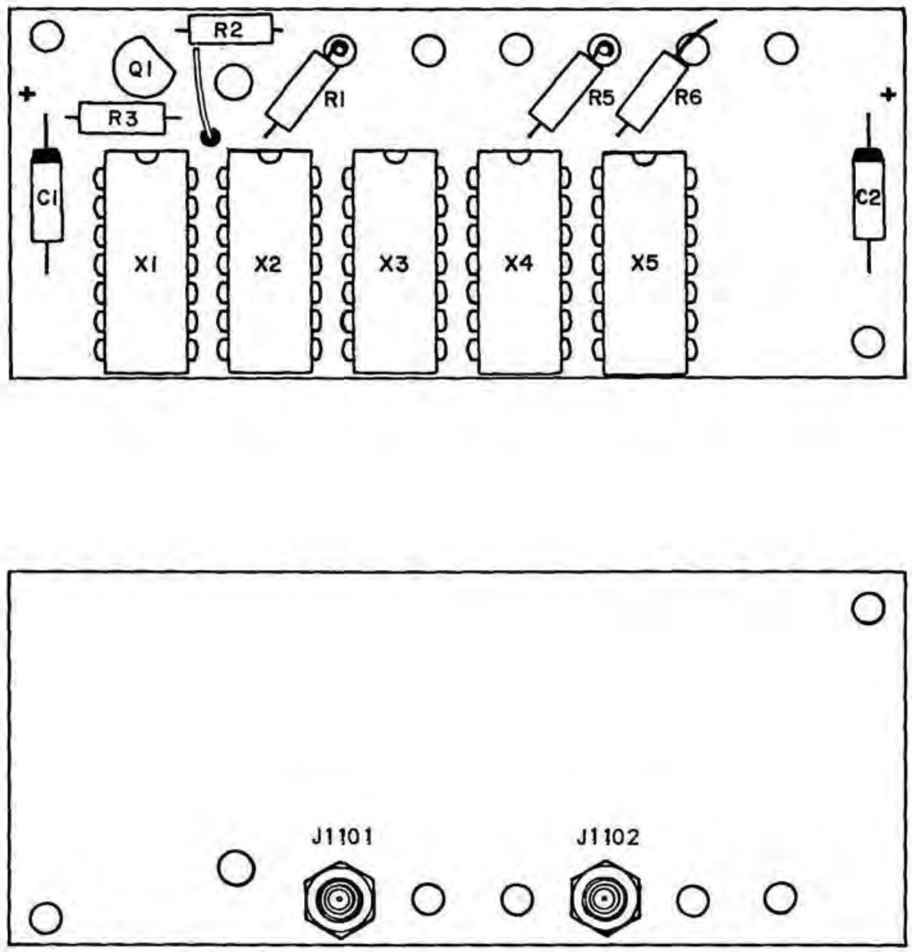


Figure 9-2 Clock Divider PC Board (1200)

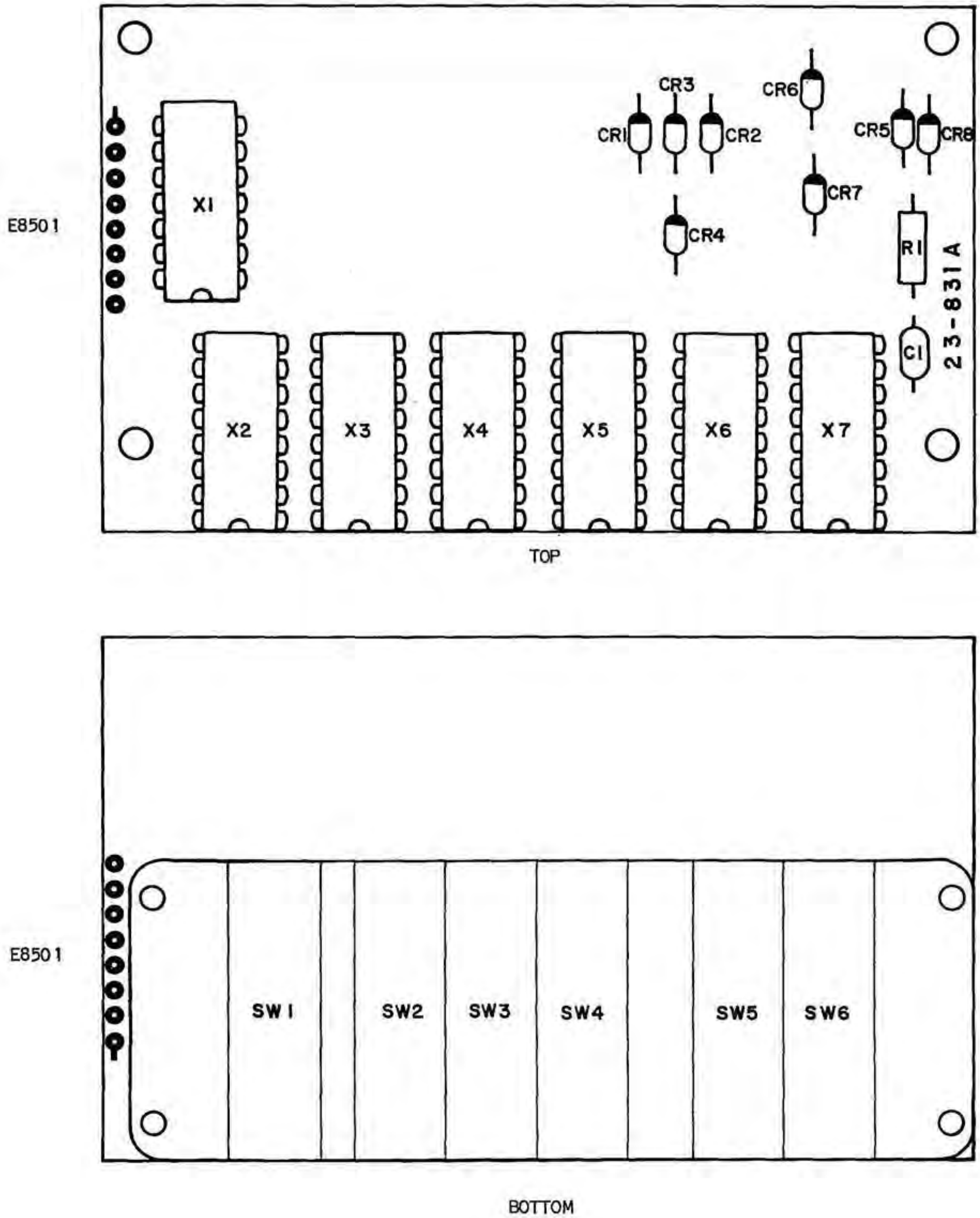


Figure 9-3 Dual Tone Generator PC Board #1 (8600)

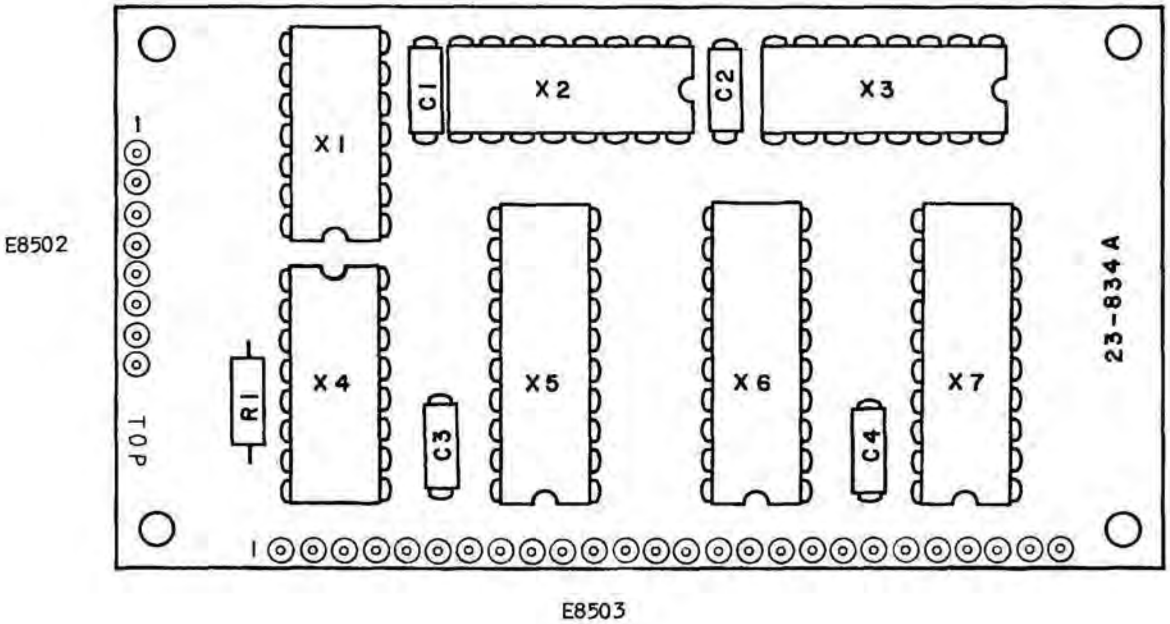


Figure 9-4 Dual Tone Generator PC Board #2 (8700)

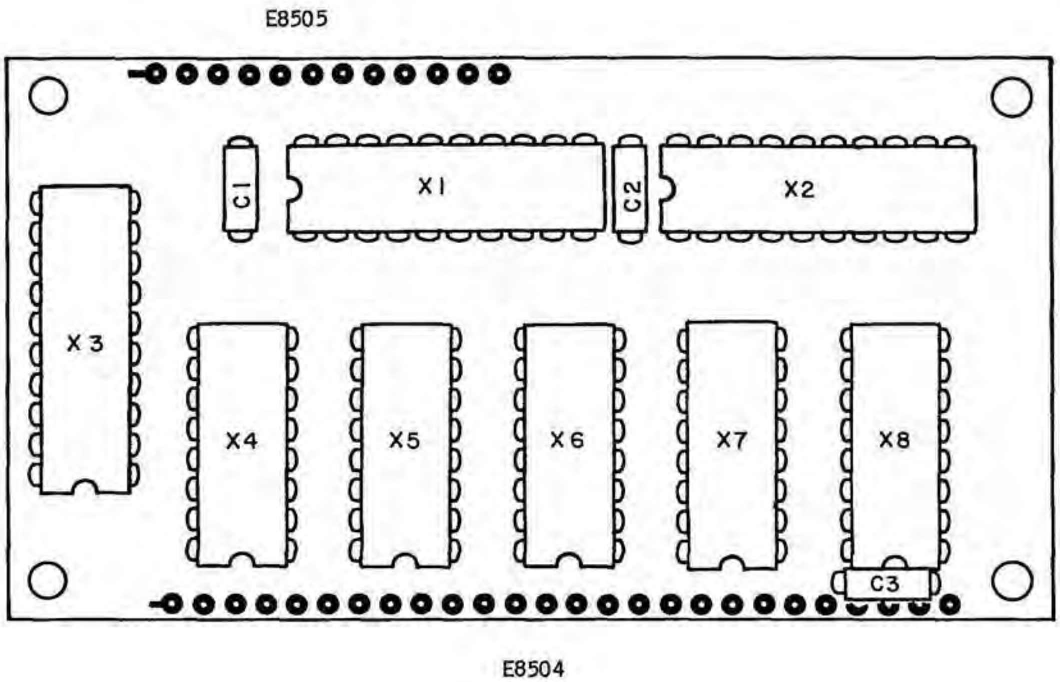


Figure 9-5 Dual Tone Generator PC Board #3 (8800)

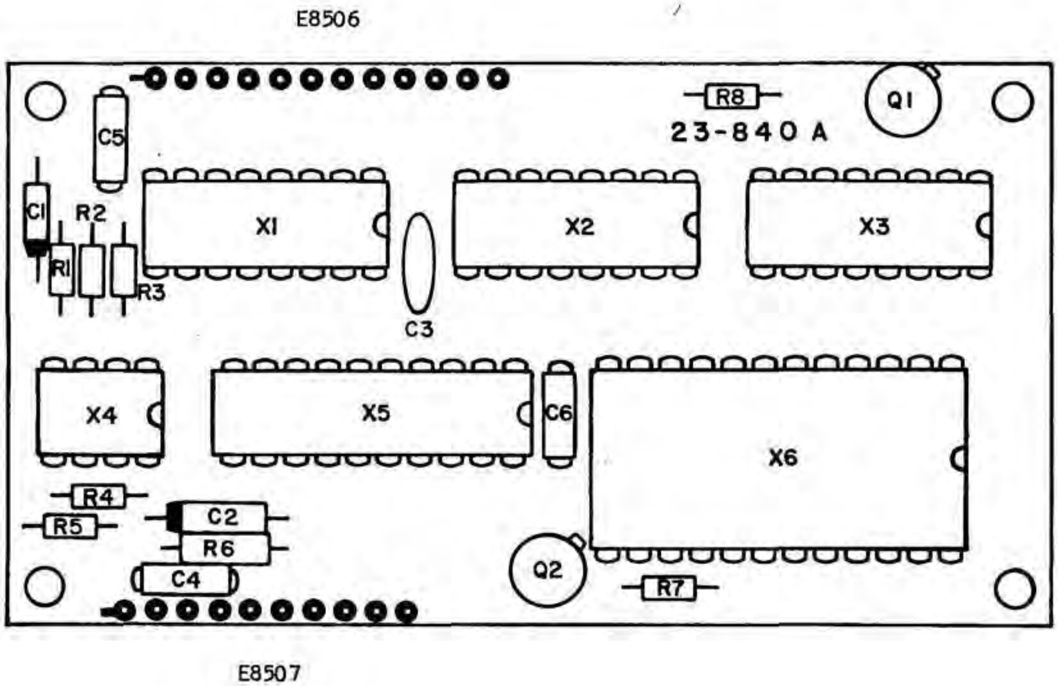
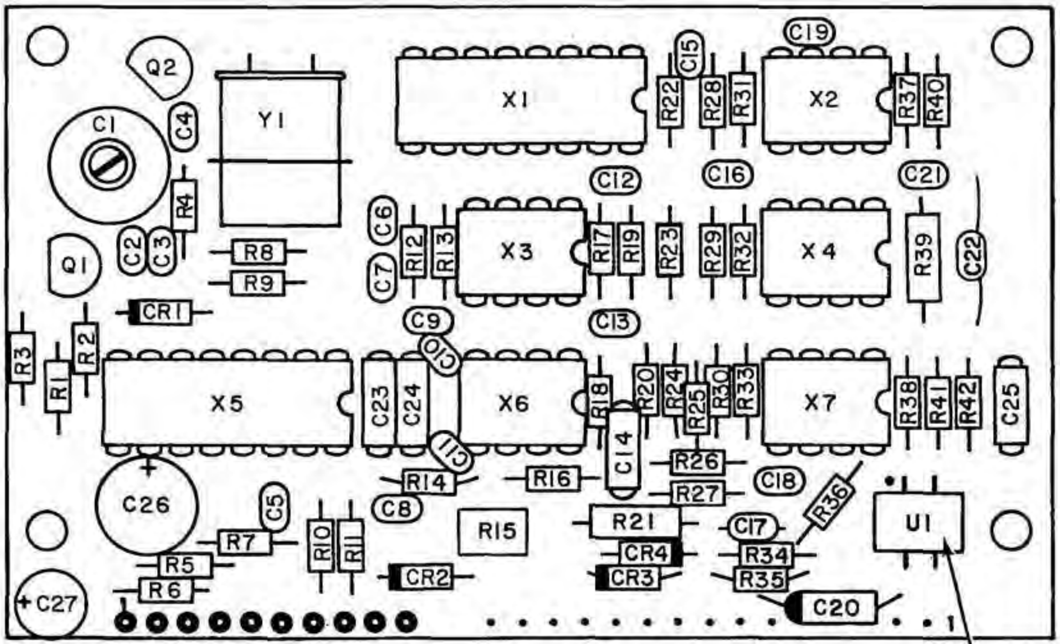
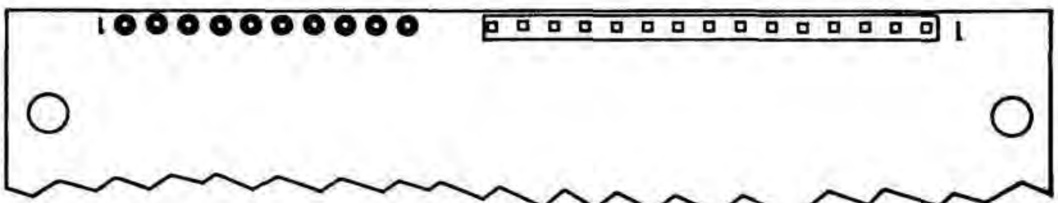


Figure 9-6 Dual Tone Generator PC Board #4 (8900)



E8508 TOP VIEW SEE DETAIL A

E8508 J8501



BOTTOM VIEW

Figure 9-7 Dual Tone Generator PC Board #5 (9000)

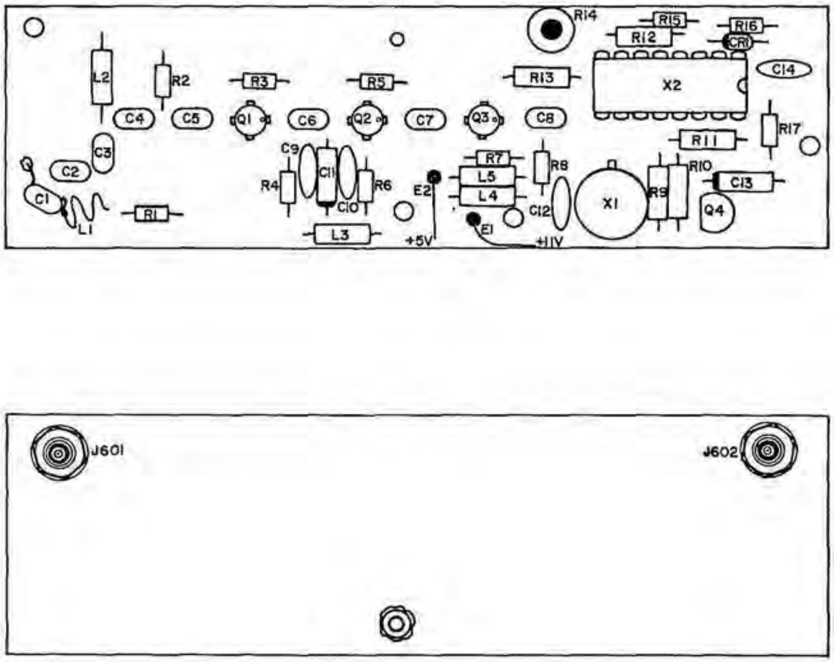


Figure 9-8 Heterodyne Amplifier/÷2 Prescaler PC Board (700)

NOTES:

1. MAXIMUM HEIGHT OF COMPONENTS TO BE .37" FROM TOP SIDE OF BOARD, EXCEPT COMPONENTS SHOWN IN DETAIL A, AND .15" FROM BOTTOM SIDE OF BOARD.

2. TRIM COMPONENT LEADS TO EXTEND .04" TO .06" BEYOND BOTTOM OF BOARD AFTER SOLDERING.

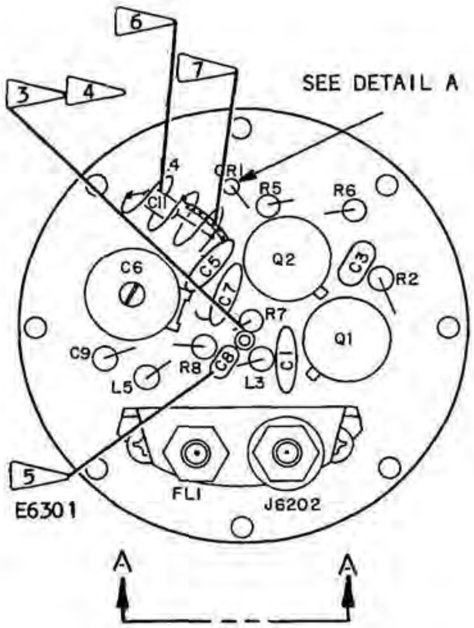
3. MAINTAIN LEADS TO A MINIMUM LENGTH.

4. SOLDER LEAD OF C6307 TO TOP LEAD OF R6307.

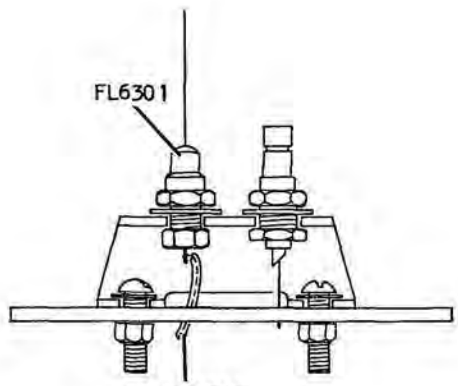
5. TRIM WHEN NECESSARY.

6. SOLDER CAPACITOR LEADS TO INDUCTOR AS INDICATED. MAKE SURE CAPACITOR DOES NOT TOUCH INDUCTOR AND INDUCTOR DOES NOT TOUCH PC BOARD GROUND PLANE.

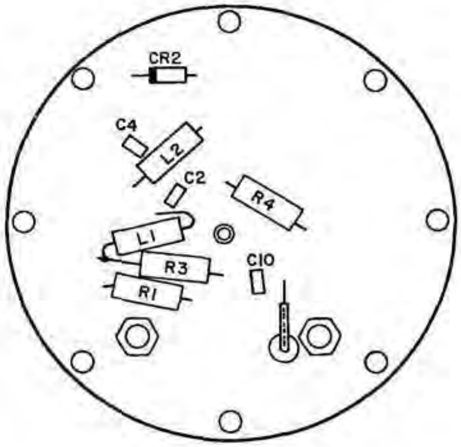
7. SOLDER SLEEVED LEAD TO TOP CENTER OF INDUCTOR AS SHOWN. LEAD LENGTH SHOULD BE MINIMAL.



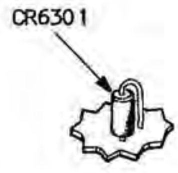
TOP VIEW



VIEW A-A



BOTTOM VIEW



DETAIL A

Figure 9-9 High Frequency Multiplier/Mixer PC Board (6300)

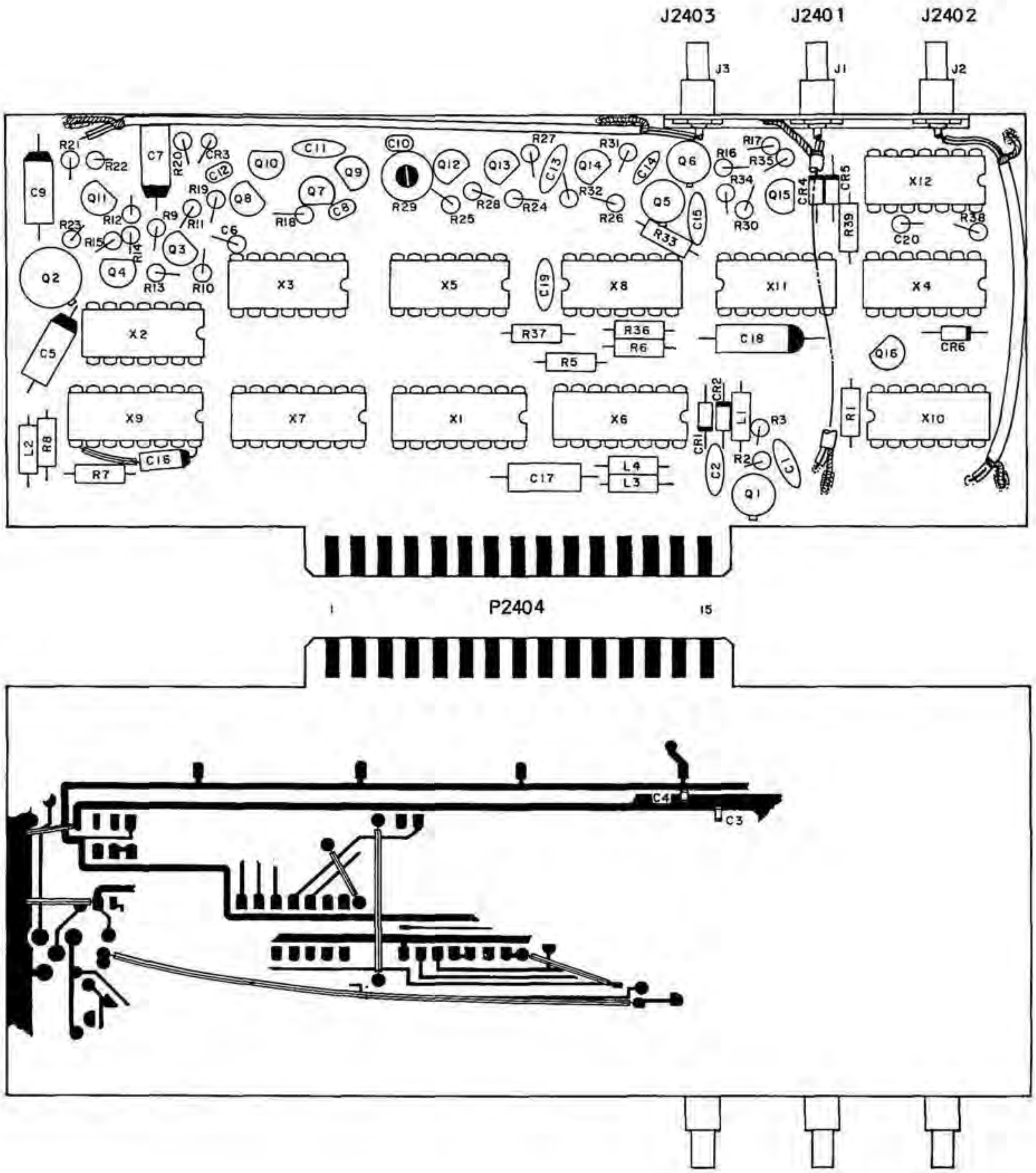


Figure 9-10 High Frequency Phase Lock PC Board (2400)

NOTES:

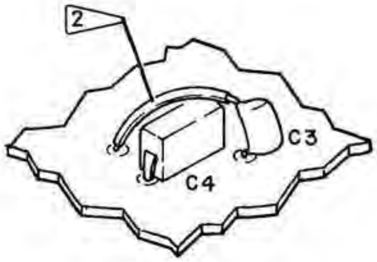
1. ALL TANTALUM CAPACITORS MOUNTED VERTICALLY ARE POSITIVE END UP.

2. USE TEFLON SLEEVE .06" LONG ON C3 LEAD TO ENSURE SAME LEAD LENGTH ON EVERY INSTALLATION.

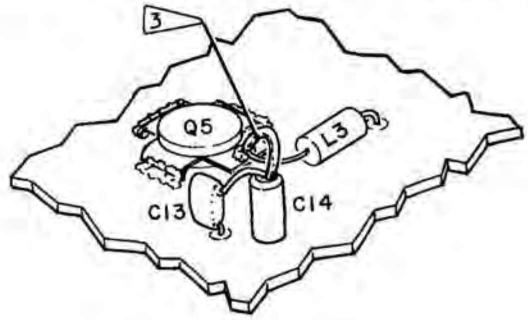
3. USE TEFLON SLEEVE .30" LONG FROM +C14 LEAD TO COLLECTOR OF Q5 TO ENSURE SAME LEAD LENGTH ON EVERY INSTALLATION.

4. USE TEFLON SLEEVE .40" LONG ON C8 LEAD TO ENSURE SAME LEAD LENGTH ON EVERY INSTALLATION.

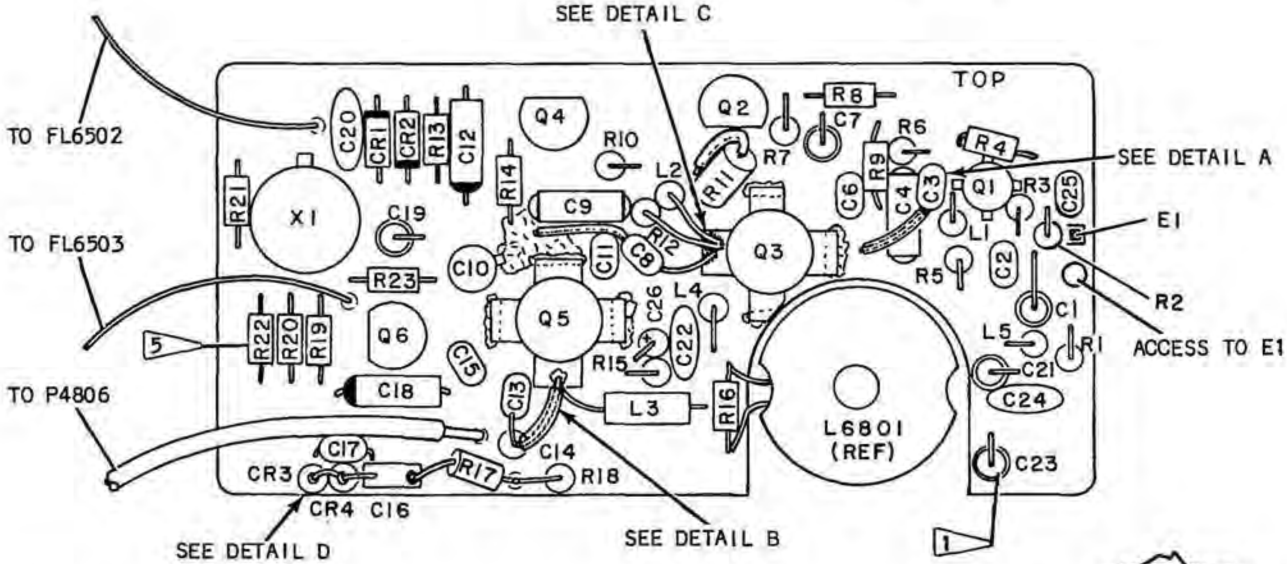
5. R22 IS SET-AT-TEST. NOMINAL = 39 K OHM. RANGE = 39 K OR 33 K.

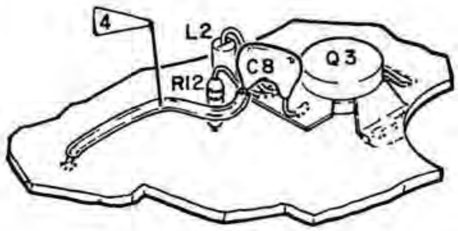


DETAIL A

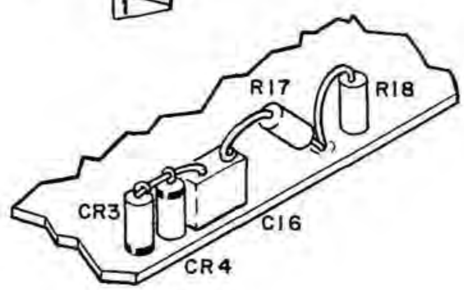


DETAIL B





DETAIL C



DETAIL D

Figure 9-11 High Level Amplifier PC Board #1 (6700)

NOTES:

1. USE 26 AWG TEFLON SLEEVING .60" LONG ON ONE LEAD OF C5, C7 AND C9 TO ENSURE SAME LEAD LENGTH ON EVERY INSTALLATION.

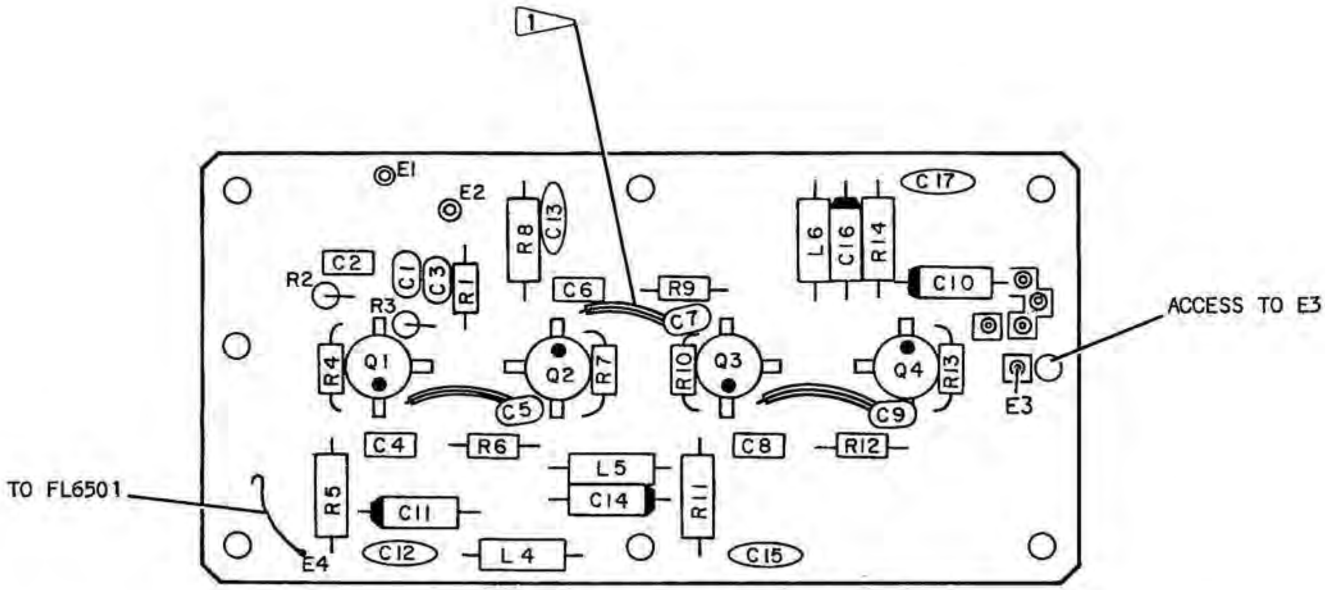
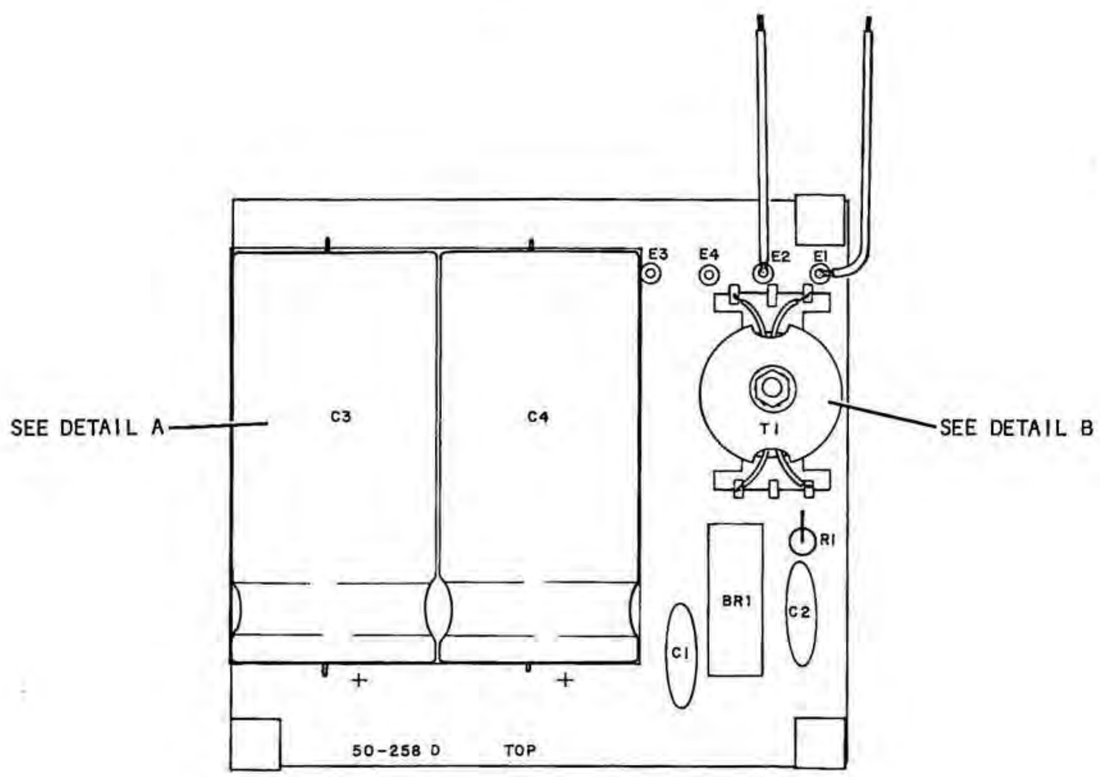
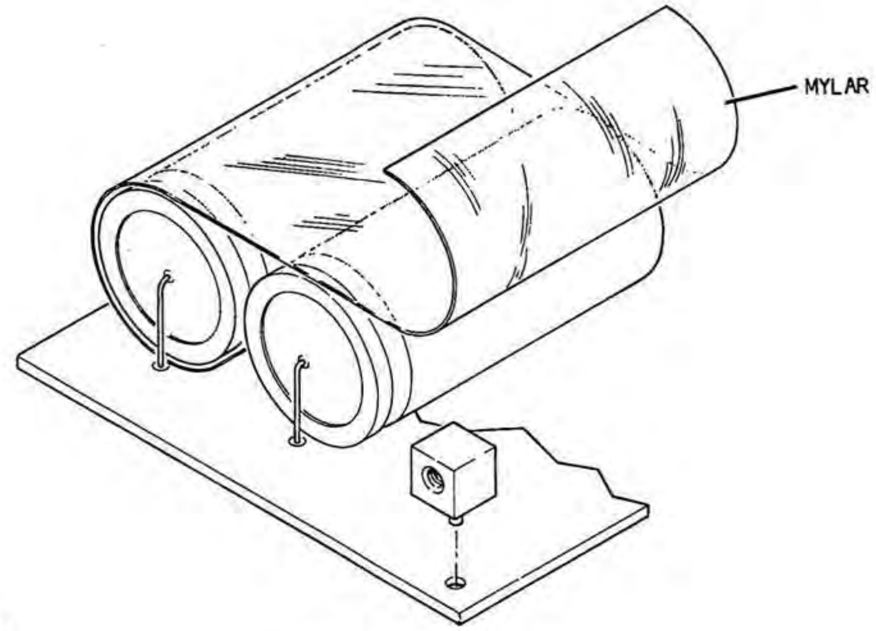
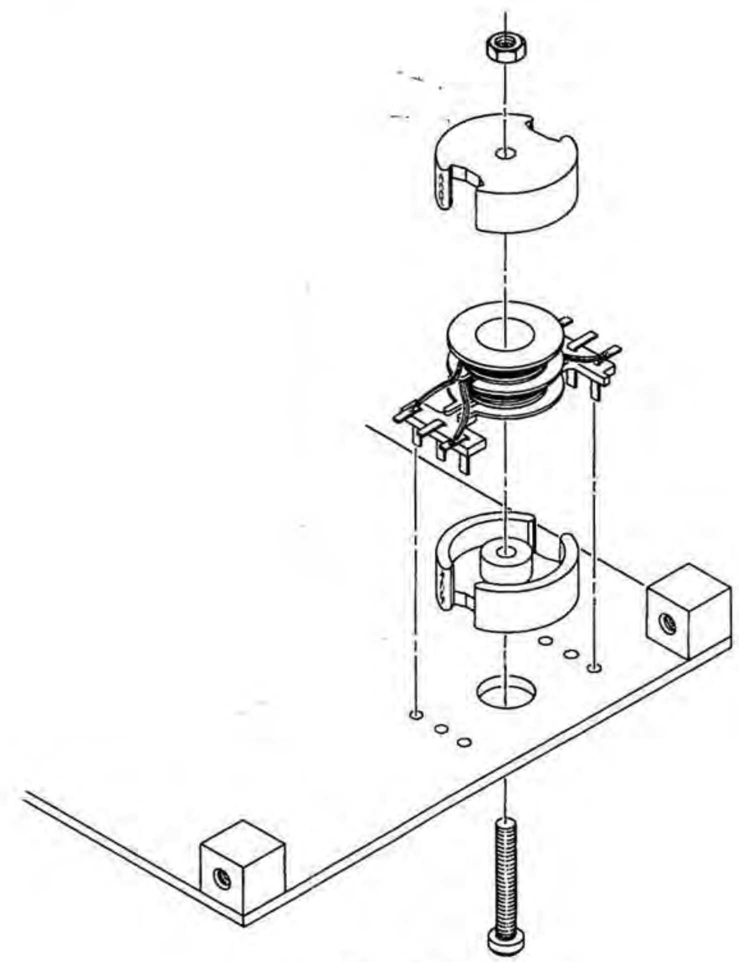


Figure 9-12 High Level Amplifier PC Board #2 (6600)





DETAIL A



DETAIL B

Figure 9-13 Power Supply Line Rectifier PC Board (8300)

NOTES:

1. ASSEMBLY PROCEDURES:

   A. MOUNT ALL SMALL COMPONENTS ONTO BOARD FIRST. DO NOT MOUNT TALL CAPS.

   B. MOUNT LEFT RAIL AND FRONT RAIL WITH ASSOCIATED COMPONENTS.

   C. INSTALL T1, L1 AND T2.

   D. INSTALL TOROID COILS L2, L3, and L4. MOUNT TOROID AT LEAST .1" FROM ENCLOSURE.

   E. INSTALL WIRES TO E POINTS. REFERENCE WIRING LIST.

   F. MOUNT TALL CAPS USING RTV BETWEEN C9, C10 AND C11; BETWEEN C19 AND C20; BETWEEN C25 AND C26. OBSERVE POLARITY.

2. DO NOT USE ANY SILICONE GREASE OR THERMAL COMPOUND.

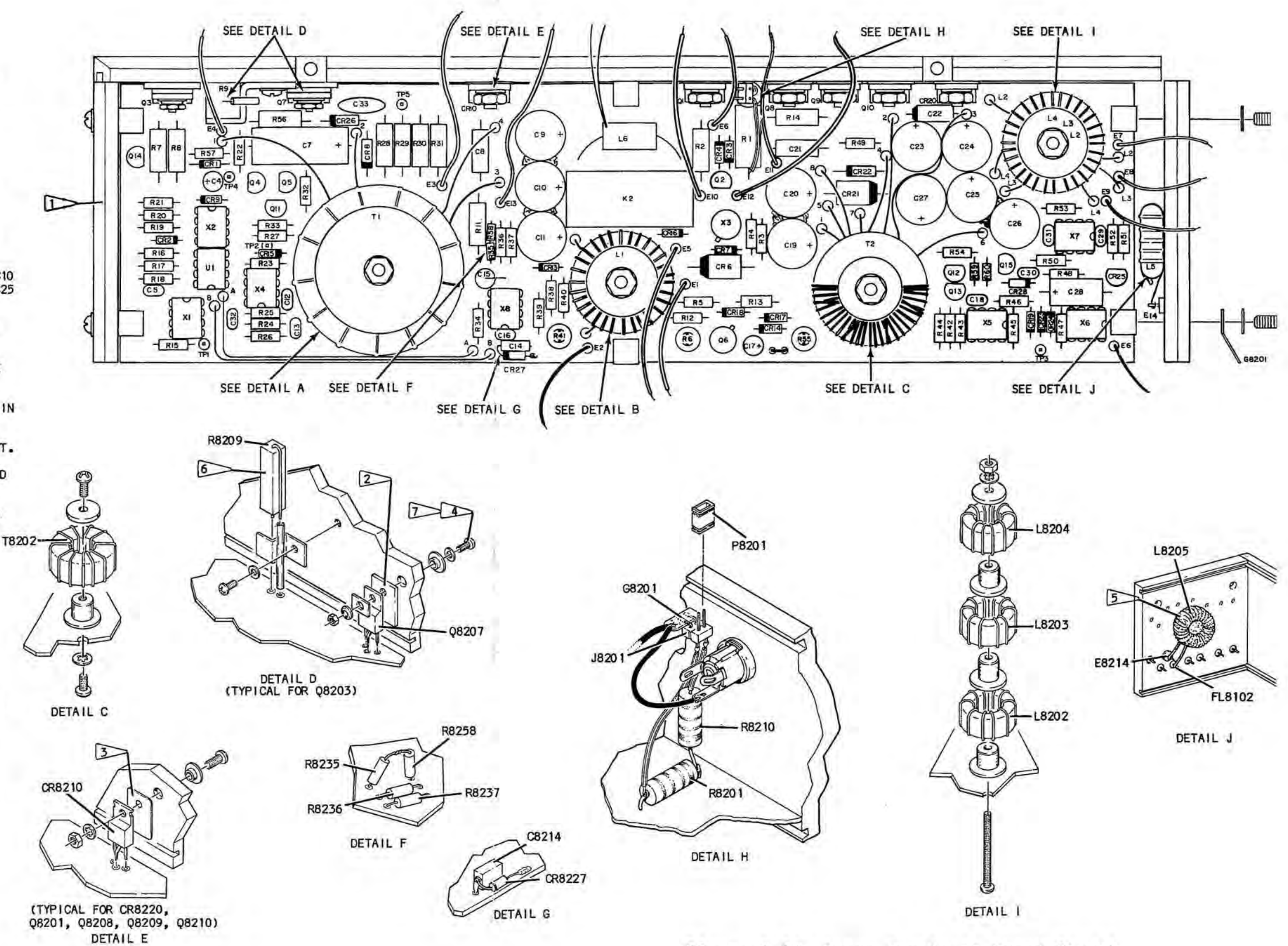
3. ASSEMBLE WITH SILICONE GREASE. DO NOT USE THERMAL COMPOUND.

4. DO NOT RETIGHTEN SCREW UNLESS NUT IS HELD IN PLACE.

5. ATTACH L5 USING TAC-PAC ADHESIVE/EQUIVALENT.

6. APPLY THERMAL COMPOUND BETWEEN RESISTOR AND POWER SUPPLY PLATE.

7. APPLY RTV SEALANT AROUND SCREW HEADS AFTER INSTALLATION.



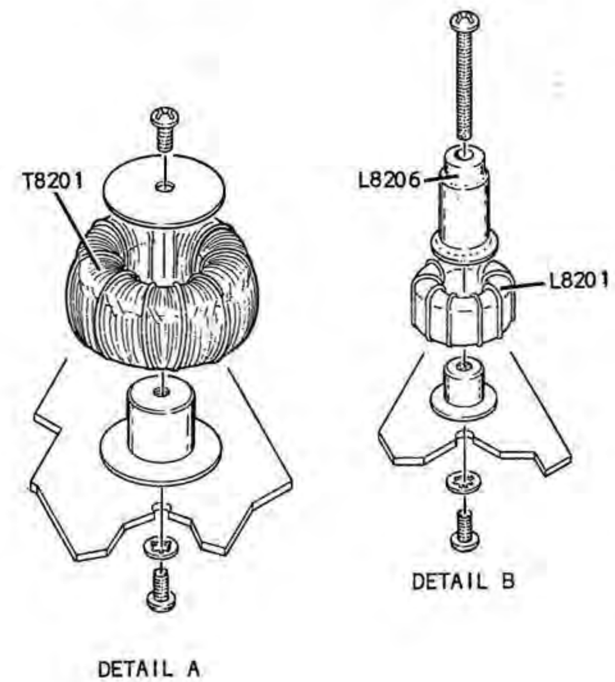


Figure 9-14 Power Supply PC Board (8200)

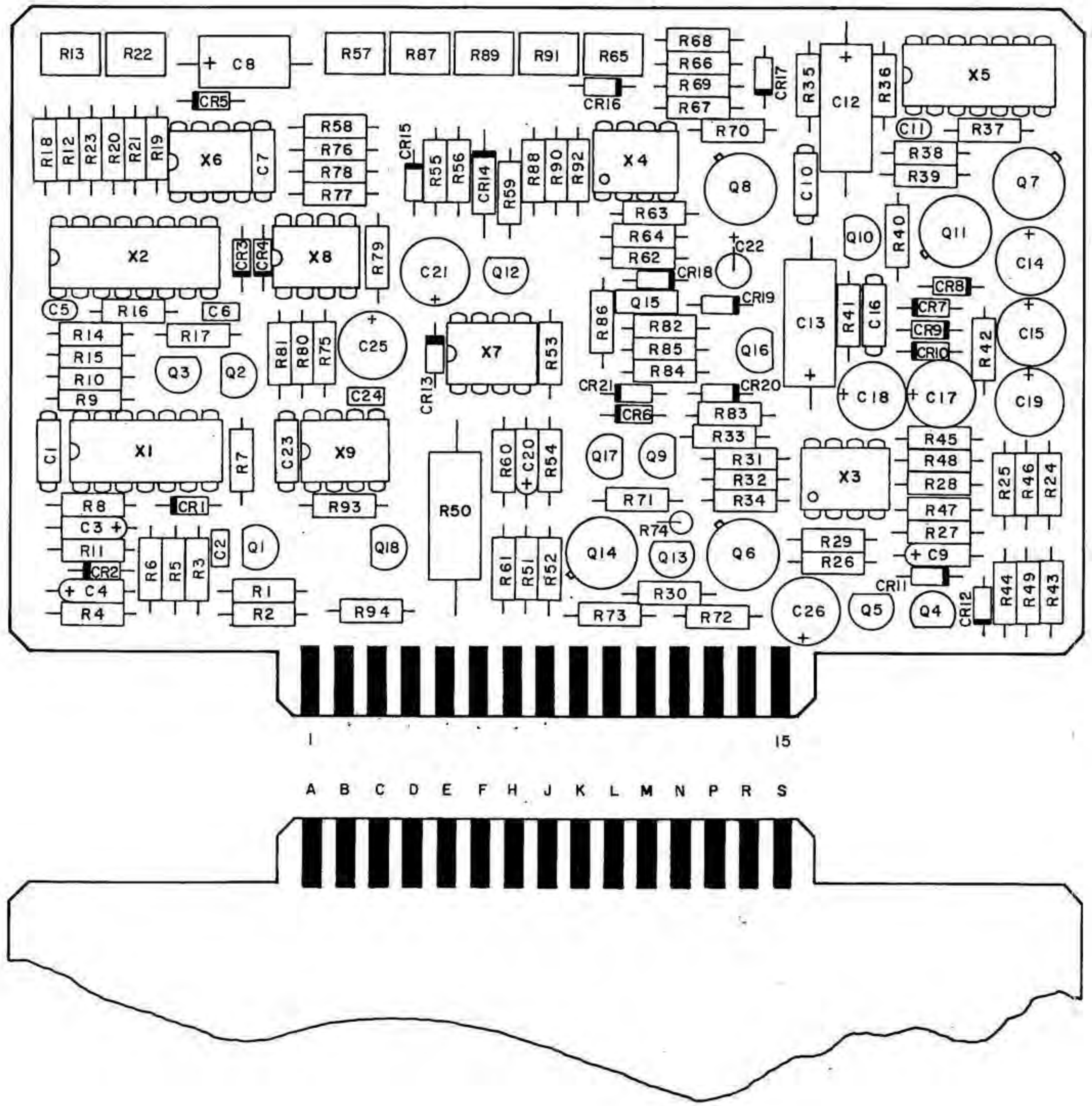


Figure 9-15 Regulator/Timer
PC Board (9100)

NOTES:

1. APPLY A ONE INCH DIAMETER X 1/8" THICK CUSHION OF G.E. RTV/EQUIVALENT ON TOP OF L4001 INDUCTOR.

2. SOLDER A PIECE OF #2 SOLDER WICK TO SIDE OF T4001 AND THEN TO GROUND ON BOTTOM OF PC BOARD.

3. APPLY A 1/2" LONG X 3/8" DIAMETER BEAD OF G.E. RTV/EQUIVALENT TO HOLD WIRES ONTO BOARD AS SHOWN.

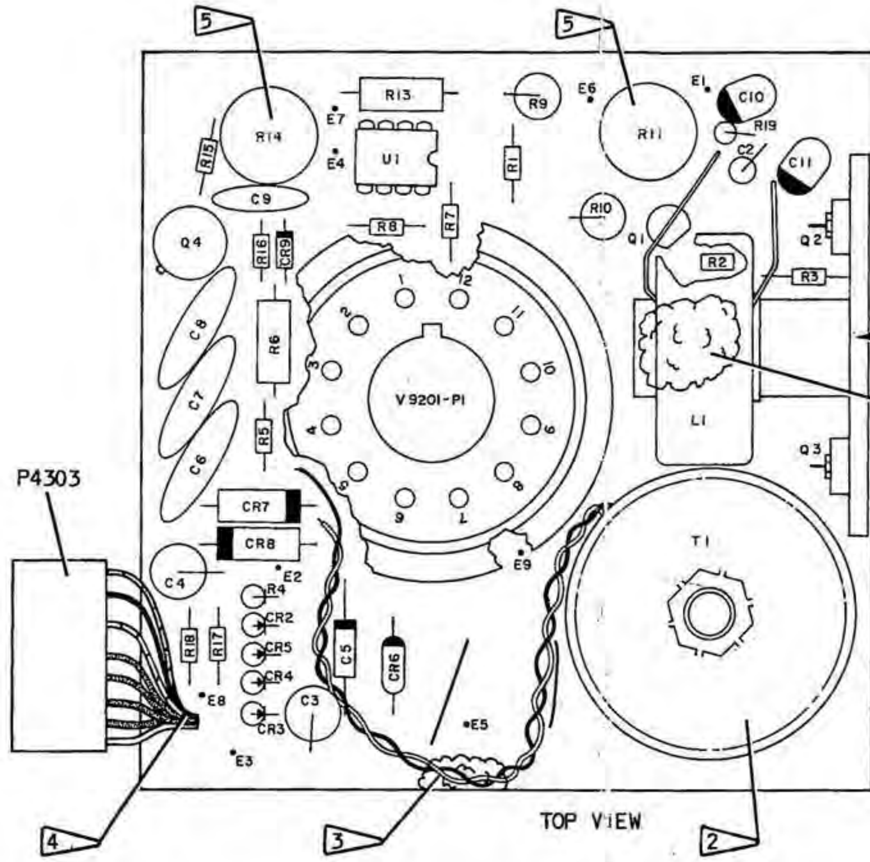
4. BUNDLE WIRES TOGETHER 2" FROM CONNECTOR AND TIE WITH LACING TWINE.

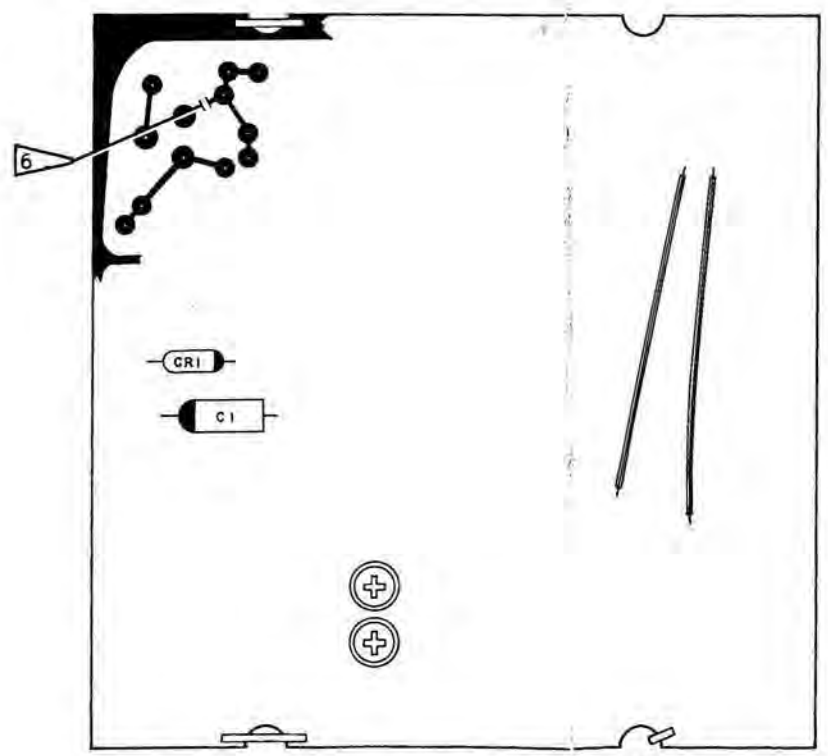
5. CUT OFF HOOK TERMINALS OF R4011 AND R4014 LEAVING .10" (MINIMUM) LONG PINS FOR INSERTION THRU PC BOARD.

6. CUT PATH AS INDICATED.

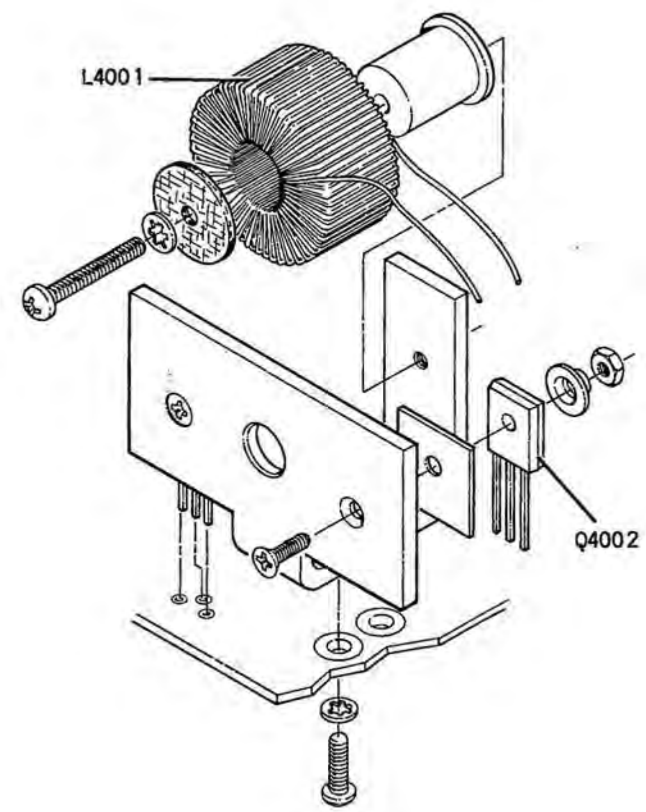
7. PC BOARD ASSEMBLY TO BE SPRAYED WITH ACRYLIC PLASTIC AFTER ASSEMBLY.

WIRING LIST				
FROM	TO	COLOR	AWG	LENGTH
P4303-1	E2	WHT/ORN	22	6"
P4303-2	E3	BLK	22	6"
P4303-4	V9201-P1-6	WHT/VIO	22	5"
P4303-6	V9201-P1-7	VIO	22	5"
P4303-7	E1	RED	22	8"
P4303-8	V9201-P1-9	BLU	22	5"
P4303-9	E4	GRY	22	8"
P4303-10	V9201-P1-10	WHT	22	5"
V9201-P1-1	V9201-P1-2	GRN	22	1"
V9201-P1-1	E9	GRN	22	5"
V9201-P1-3	E7	WHT/GRN	22	5"
V9201-P1-4	E6	YEL	22	5"
V9201-P1-8	E8	ORN	22	5"
V9201-P1-12	E5	BRN	22	5"





BOTTOM VIEW

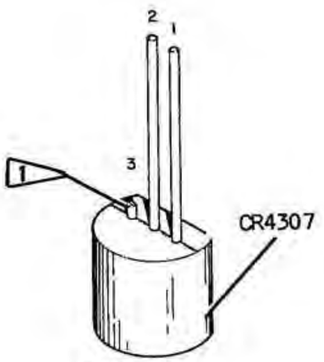


DETAIL A

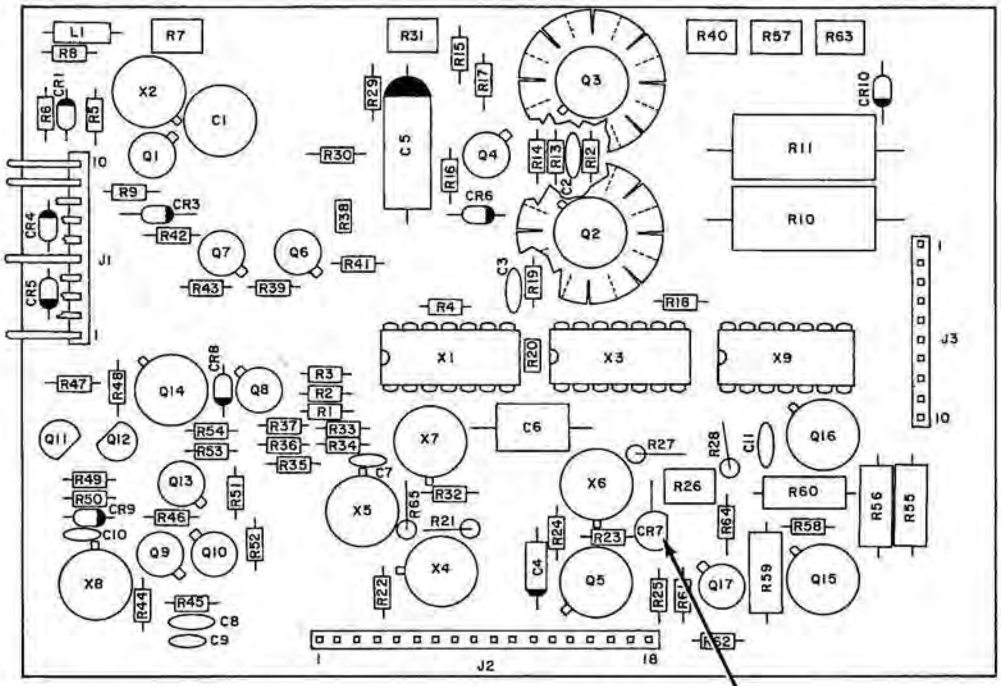
Figure 9-16 Spectrum Analyzer/Oscilloscope Inverter PC Board (4000)

NOTES:

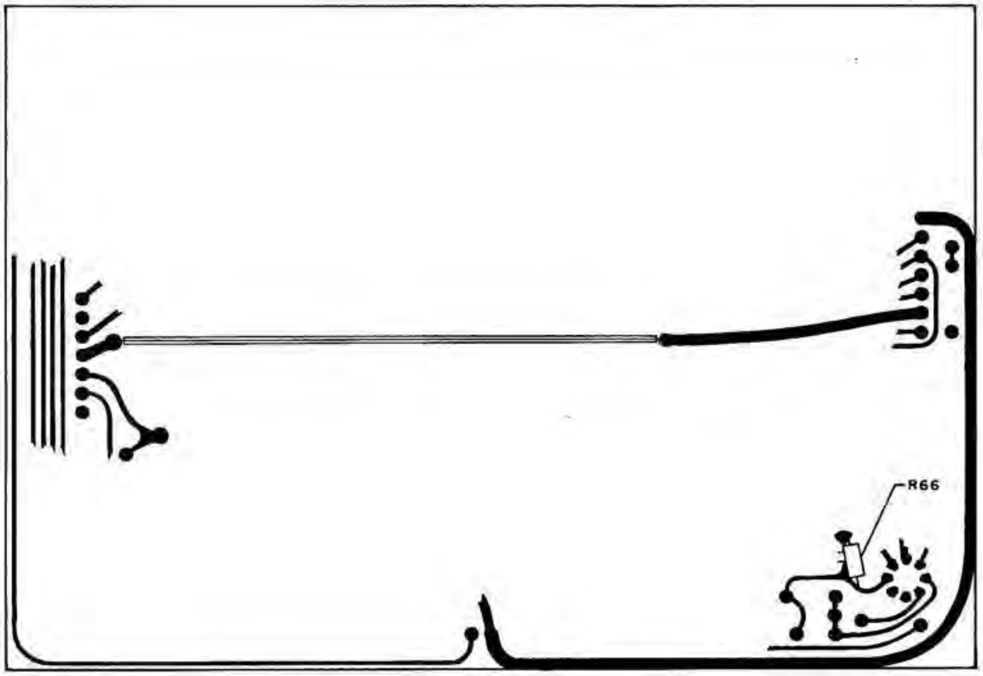
1. CLIP LEAD NO. 3 AT BASE AS SHOWN.



DETAIL A



TOP VIEW SEE DETAIL A



BOTTOM VIEW

Figure 9-17 Spectrum Analyzer/Oscilloscope Main PC Board (4300)

NOTES:

1. SOLDER ALL SIDES OF RF SHIELDS COMPLETELY TO PC BD.

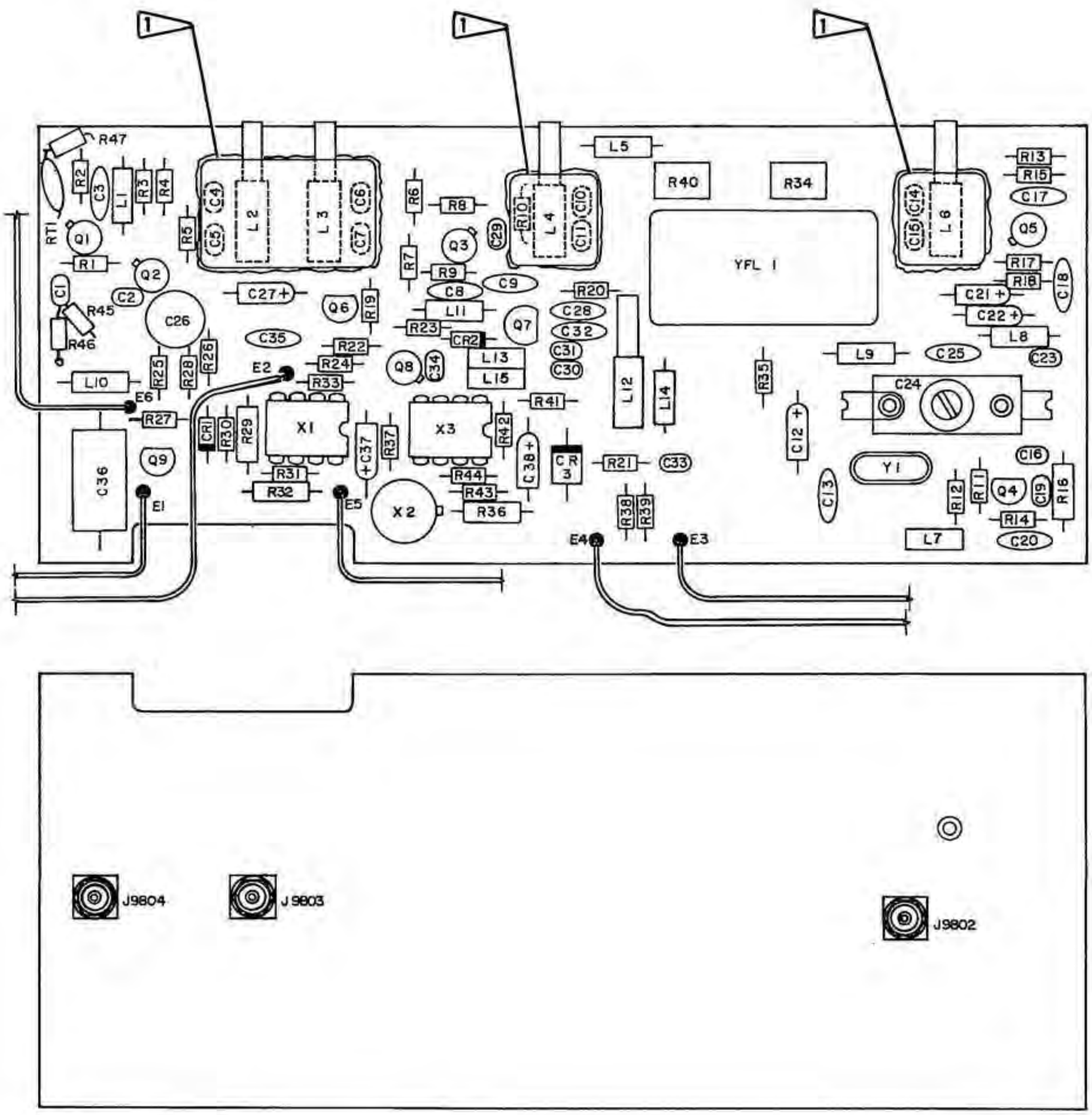
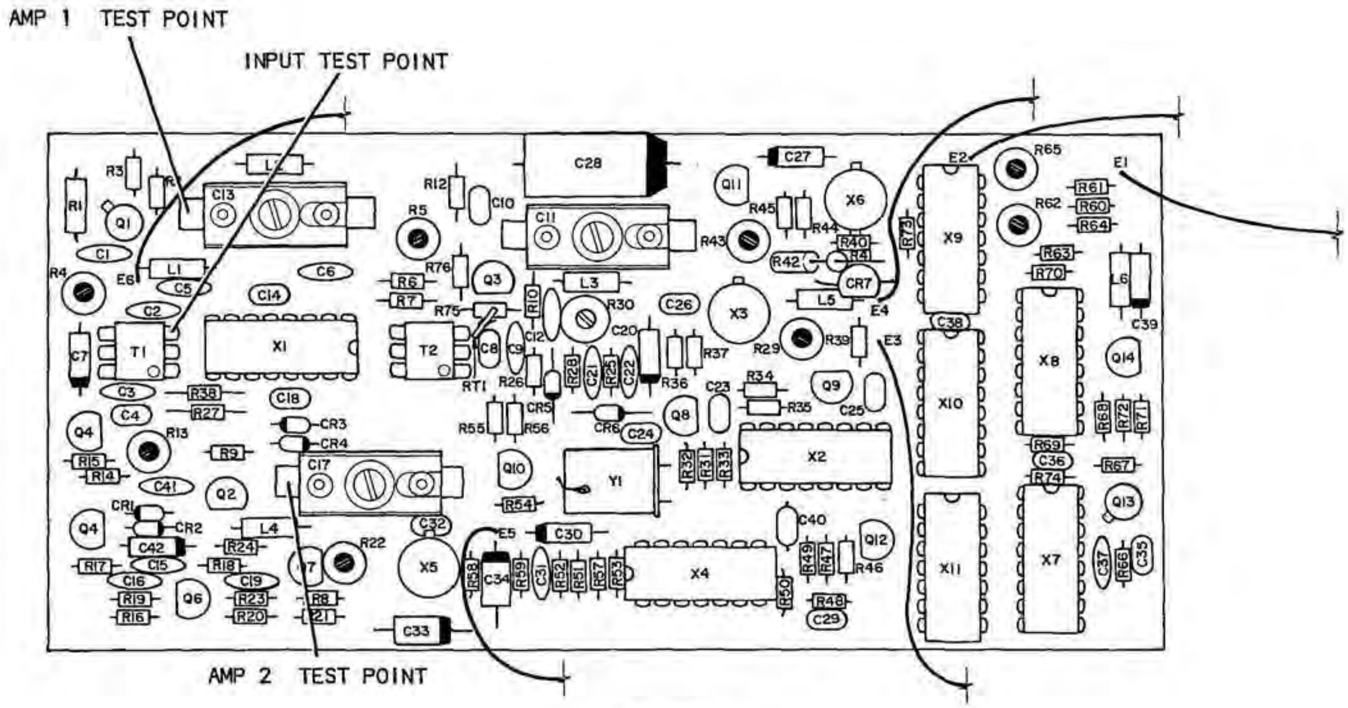
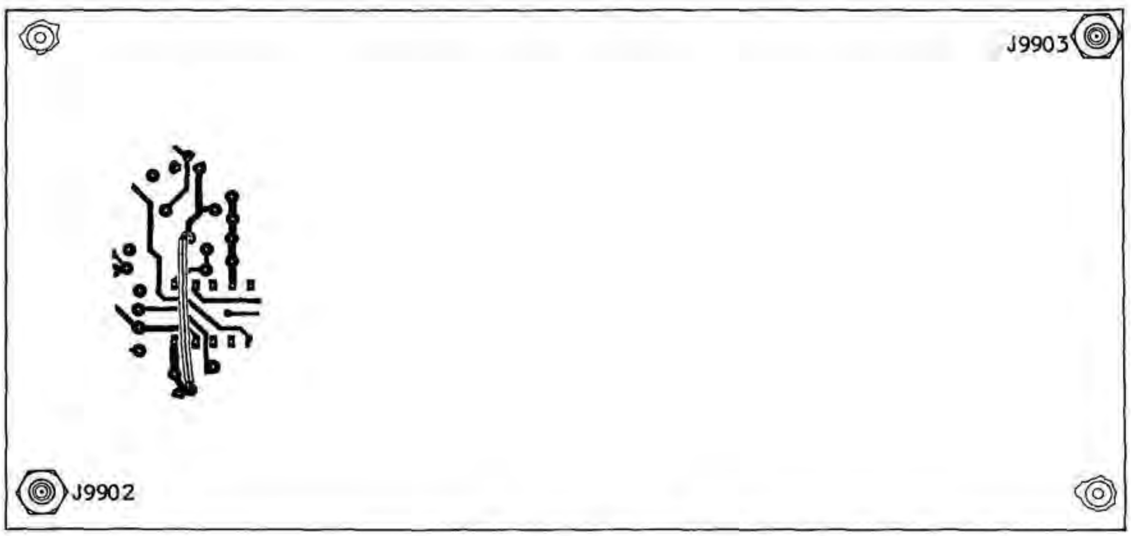


Figure 9-18 Spectrum Analyzer Module #1
PC Board (9400)

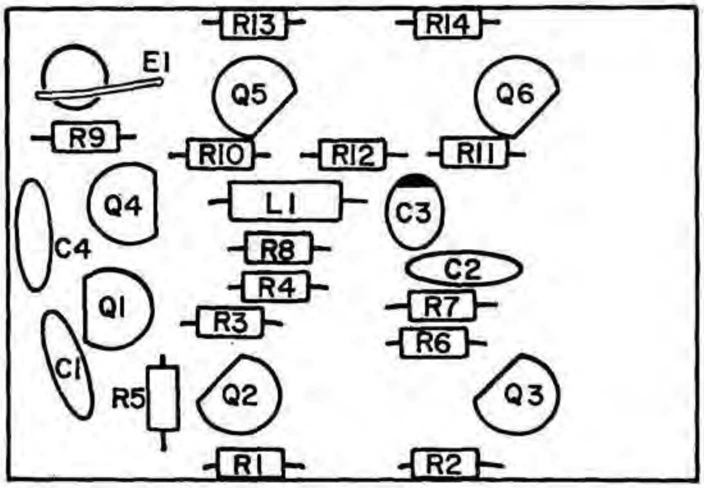


TOP VIEW

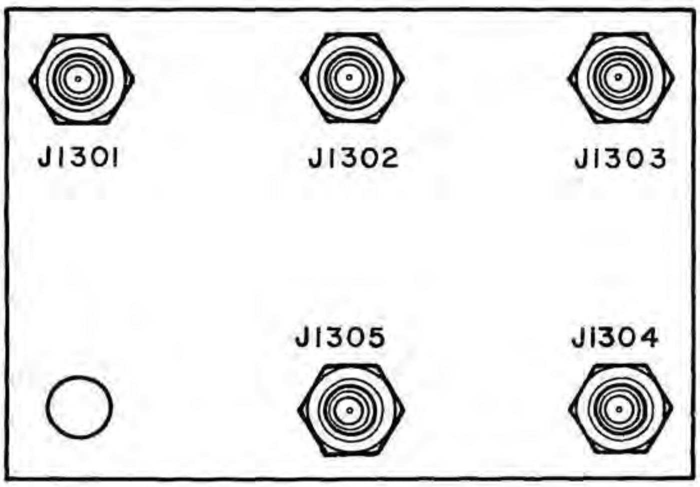


BOTTOM VIEW

Figure 9-19 Spectrum Analyzer Module #2 PC Board (4200)

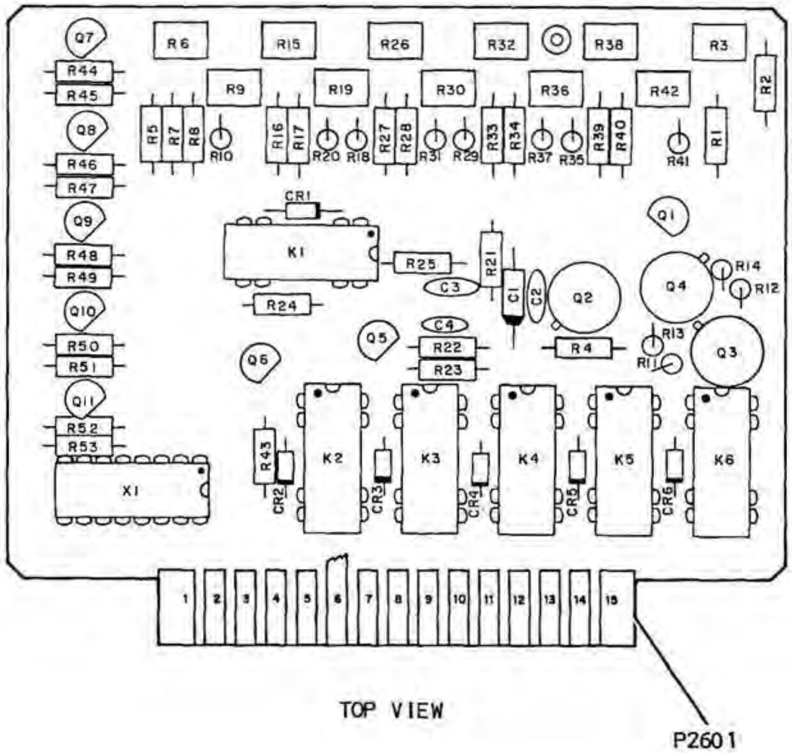


TOP VIEW



BOTTOM VIEW

Figure 9-20 TCXO Output Distribution Amplifier
PC Board (1400)



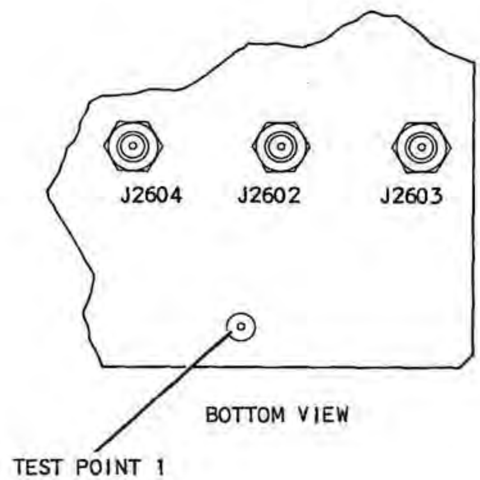


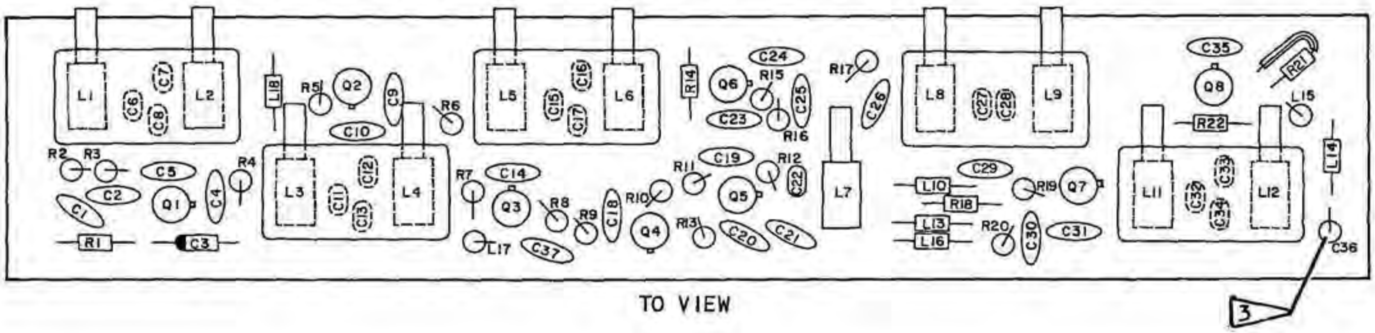
Figure 9-21 VCO Tuner PC Board (2600)

NOTES:

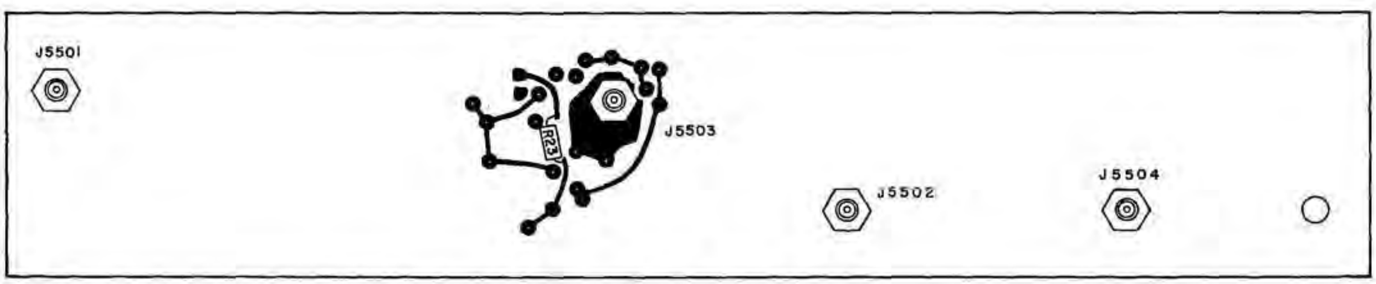
1. COMPONENT LEADS MAY EXTEND .04" TO .06" BEYOND BOTTOM OF BOARD AFTER SOLDERING.

2. MAXIMUM HEIGHT OF COMPONENTS TO BE .65" FROM COMPONENT SIDE OF BOARD AND .11" FROM BOTTOM SIDE OF BOARD.

3. POSITIVE END OF C5606 SHOULD BE UP.



TO VIEW



BOTTOM VIEW

Figure 9-22 100 MHz Amplifier/108 MHz Mixer PC Board (5600)

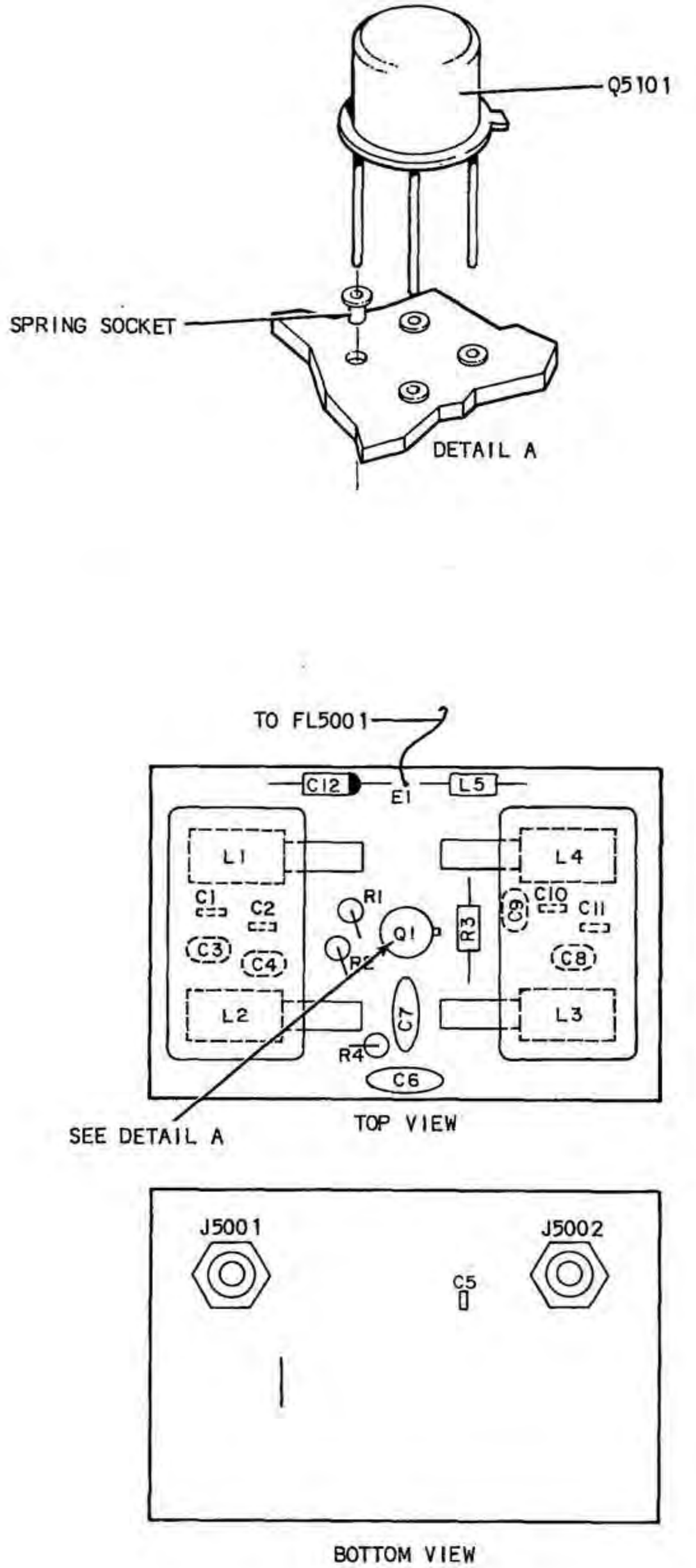
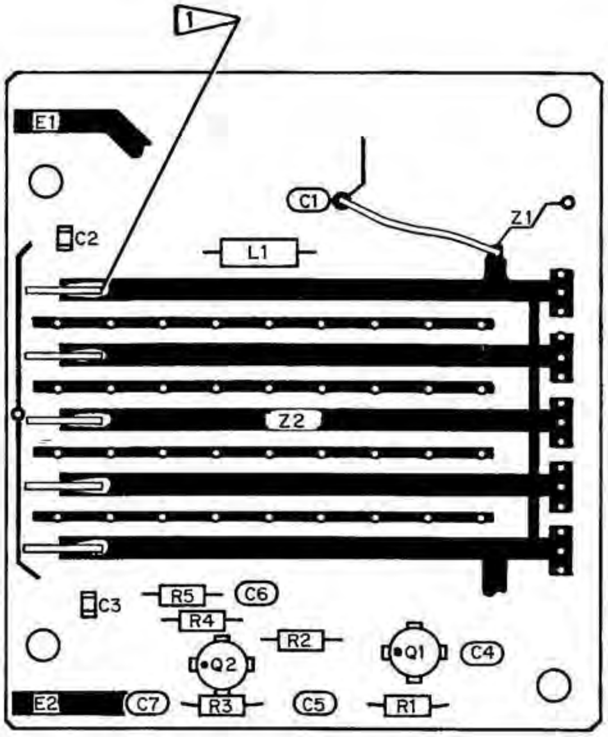
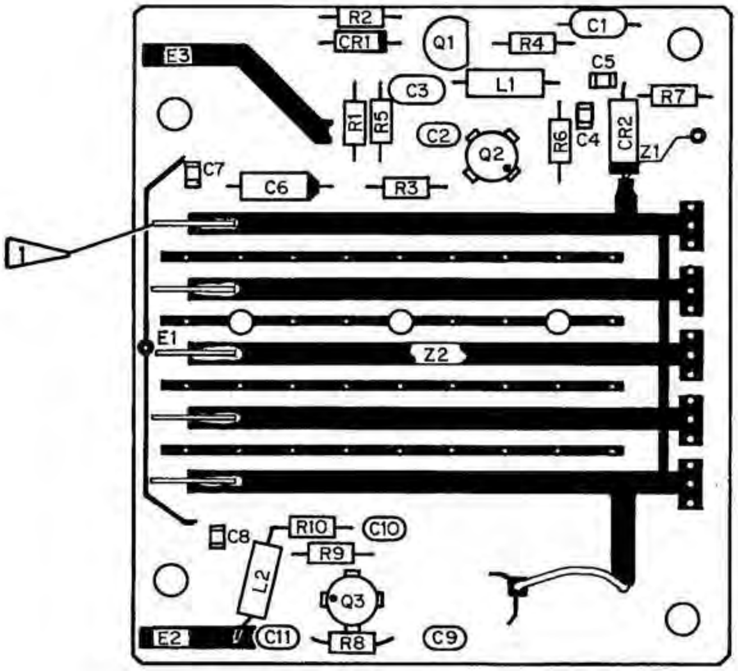


Figure 9-23 100 MHz Filter PC Board (5100)



1080 MHz Multiplier/Amplifier
PC Board (11000)



1080 MHz Multiplier/Amplifier
PC Board (11100)

NOTES:

1. THIS PORTION OF Z2 IS .3" OF 22 GA BUS WIRE EXTENDED .12" FROM END OF PATH.

Figure 9-24 1080 MHz Multiplier/Amplifier PC Boards

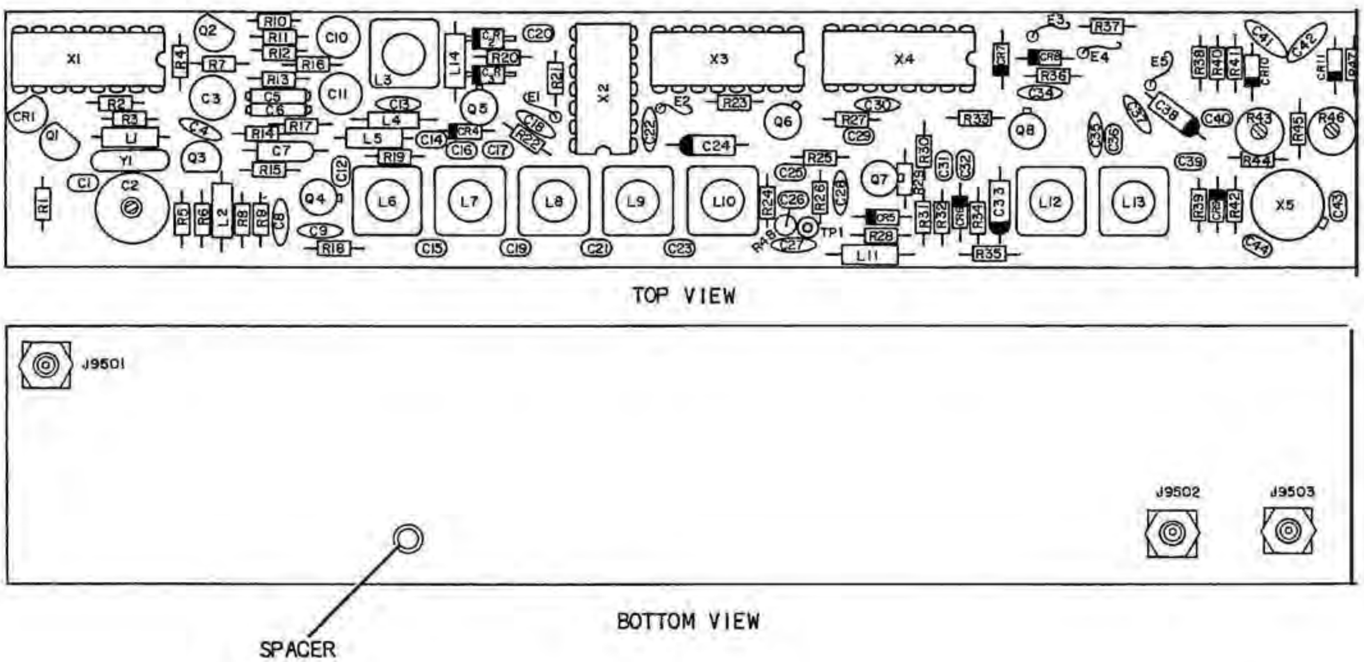


Figure 9-25 120 MHz Generator PC Board (9600)

NOTES:

1. COMPONENT LEADS MAY EXTEND .04" TO .06" BEYOND BOTTOM OF PC BOARD AFTER SOLDERING.

2. MAXIMUM HEIGHT OF COMPONENTS TO BE .65" FROM COMPONENT SIDE OF BOARD AND .11" FROM BOTTOM SIDE OF BOARD.

3. PLACE CHIP CAPACITORS ON BACK SIDE OF BOARD.

4. INSTALL C5808 WITH POSITIVE END UP.

5. R5845 IS SET AT TEST. NOMINAL VALUE = 330 OHM; RANGE = 270 OHM TO 390 OHM.

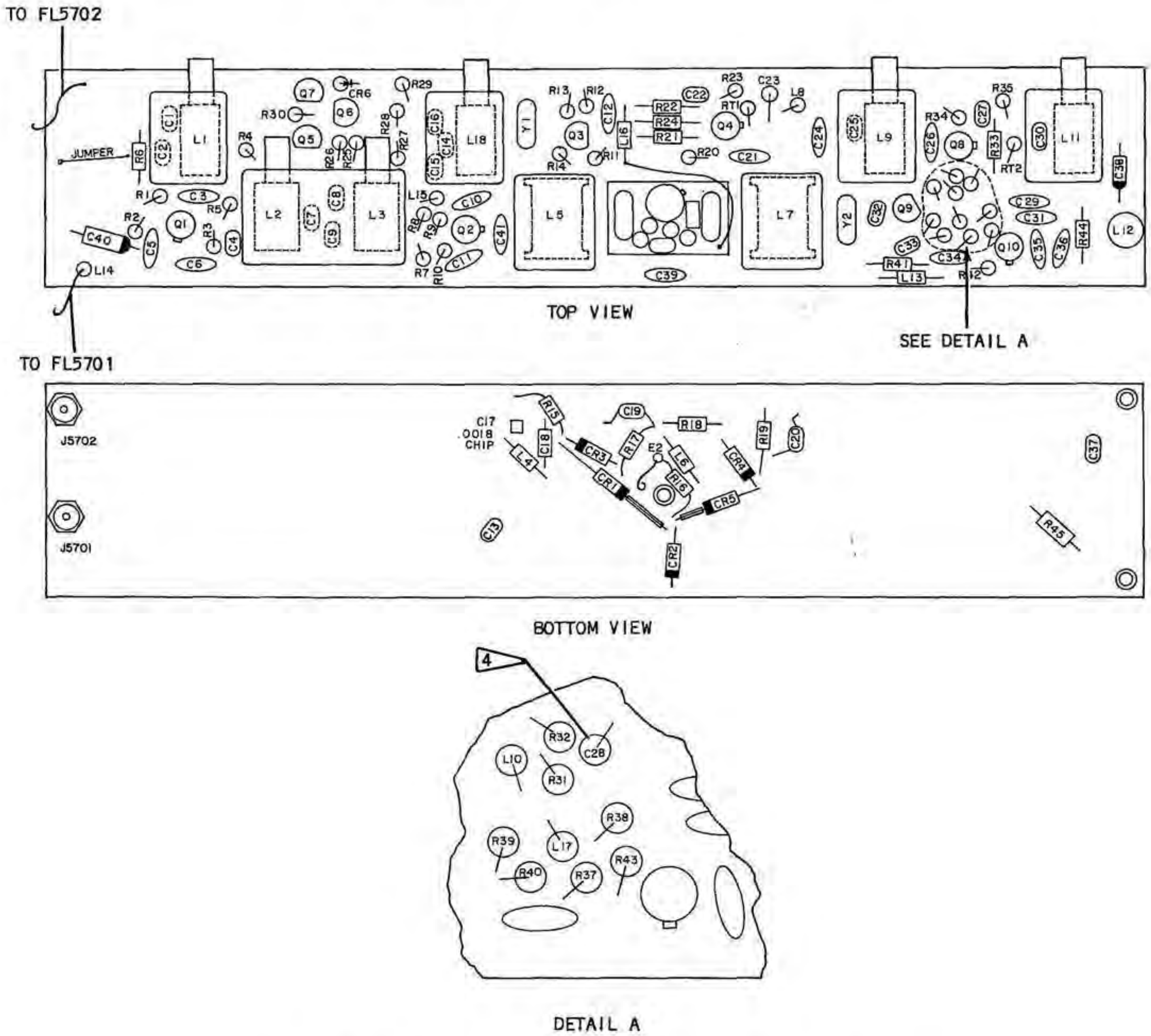


Figure 9-26 120 MHz Receiver PC Board (5800)

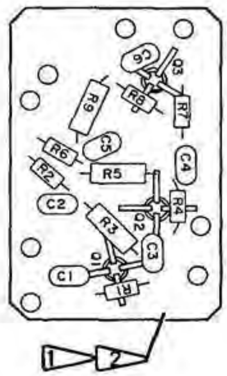
NOTES:

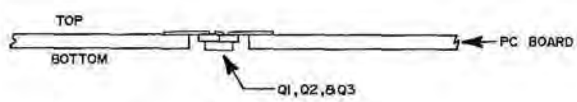
1. EFFECTIVE FM/AM-1100S/A SERIAL NUMBERS 3454 AND ON.

2. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES. THIS PC BOARD CARRIES SERIES 11000 (E.G., R1 IS DESIGNATED R11001).

3. EFFECTIVE FM/AM-1100S/A SERIAL NUMBERS 3001 THRU 3453.

4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES. THIS PC BOARD CARRIES SERIES 10300 (E.G., R1 IS DESIGNATED R10301).





DETAIL A

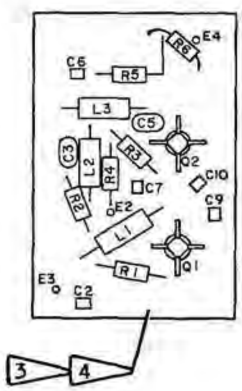
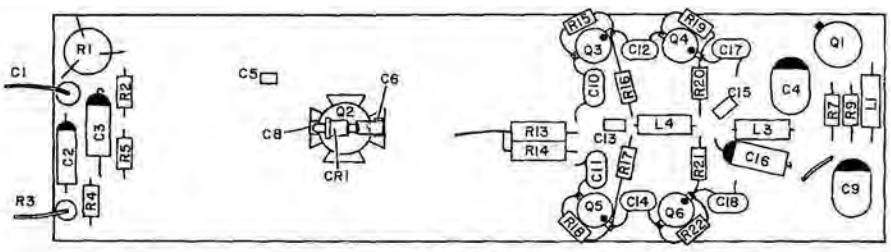
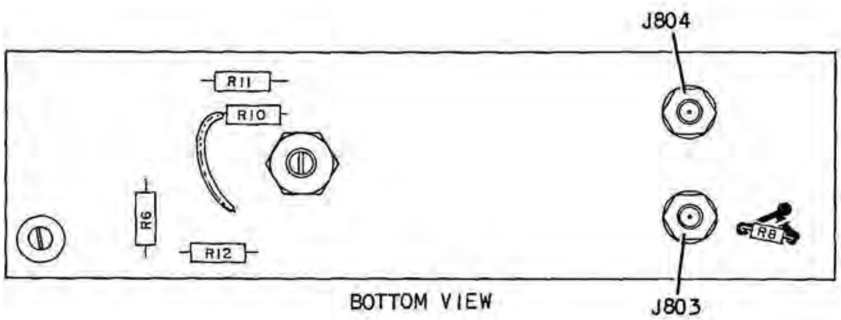


Figure 9-27 1200 MHz Amplifier PC Board



TOP VIEW



BOTTOM VIEW

Figure 9-28 1200-2200 MHz Oscillator PC Board (900)

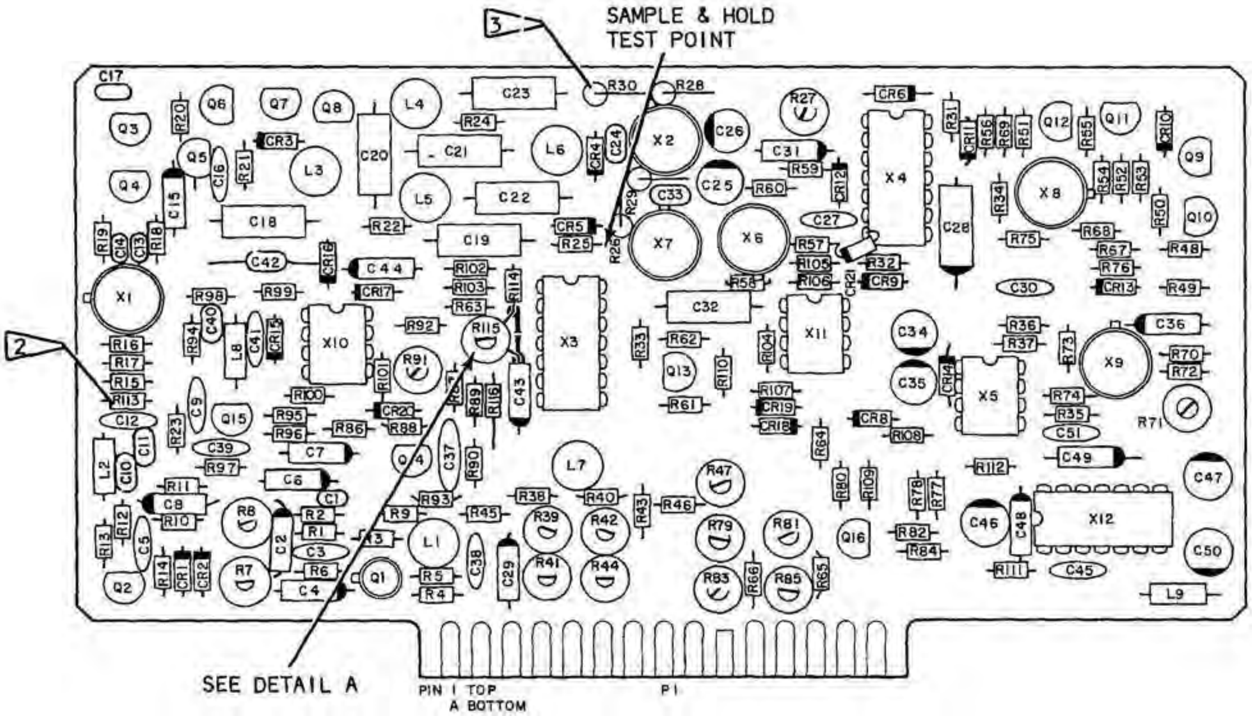
NOTES:

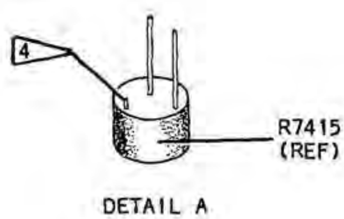
1. COMPONENT LEADS MAY EXTEND .06" BELOW BOTTOM OF BOARD AFTER SOLDERING.

2. R7413 MAY OR MAY NOT BE INSTALLED AS NECESSARY. NOMINAL VALUE = 680 K OHM; RANGE = 680 K OHM TO 10 M OHM.

3. R3130 IS S.A.T. NOMINAL VALUE = 2.32 K OHM; RANGE = 2.10 K OHM to 2.32 K OHM.

4. CUT OFF LEAD OF R7415 AS SHOWN.





DETAIL A

Figure 9-29 250 kHz IF/MON/AUDIO PC Board (3100/7400)

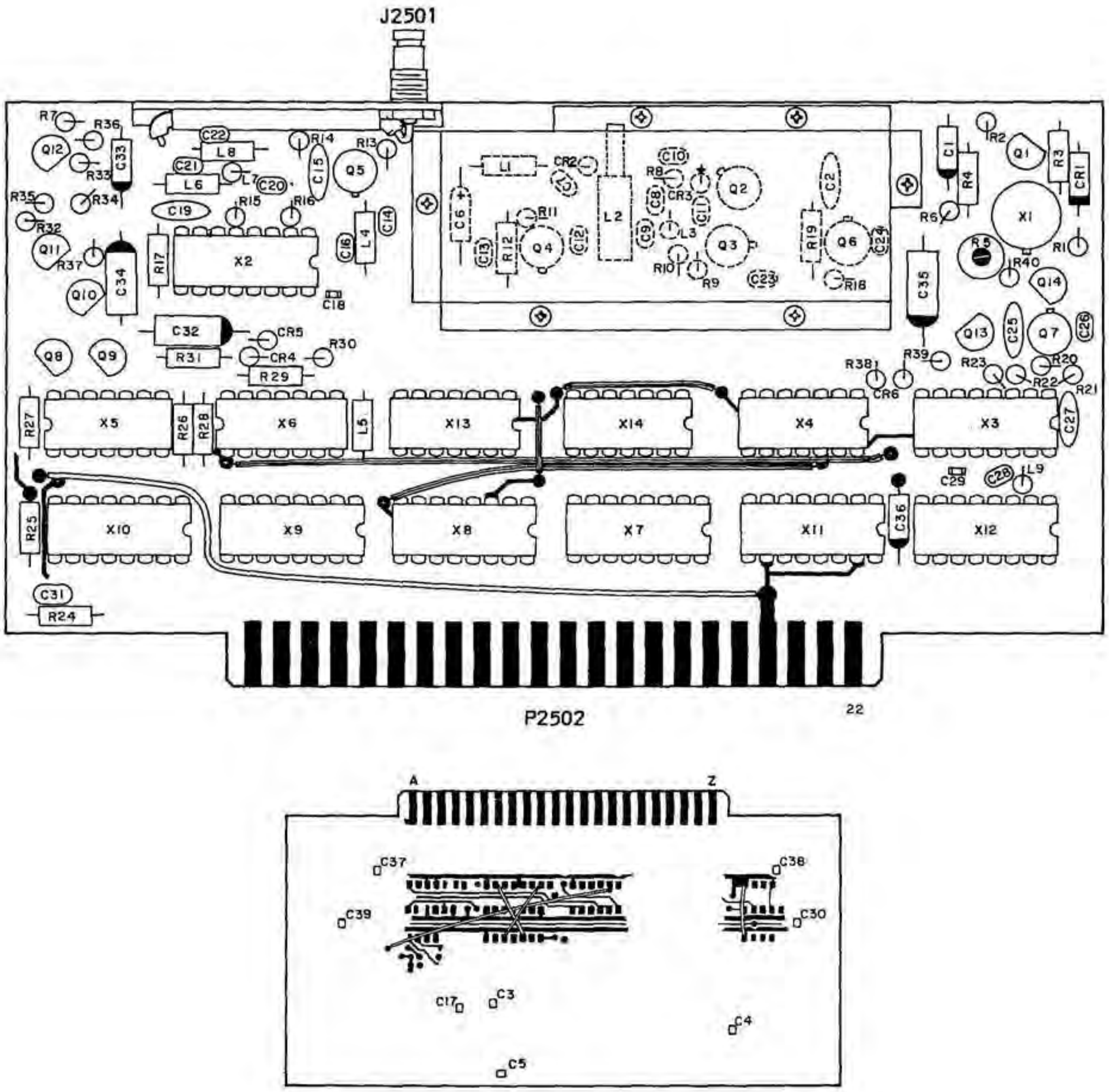


Figure 9-30 79-80 MHz Phase Lock Loop PC Board (2500)

SECTION 10-SCHEMATICS

10-1 GENERAL

This section contains circuit schematics and interconnect diagrams for the FM/AM-1100S/A. These drawings are sequenced in alphanumerical order by the name of the assembly to which the circuit schematic applies (see index in paragraph 10-1-1).

NOTE

Because FM/AM-1100S models are equipped with both the Oscilloscope and Spectrum Analyzer functions (as compared to FM/AM-1100A models, which have the Oscilloscope function only), the following exceptions to schematic/interconnect diagram applicability should be noted:

1. The Spectrum Analyzer Interconnect applies to FM/AM-1100S models exactly as shown. For FM/AM-1100A models this drawing serves as the Oscilloscope Interconnect with the following exception: Spectrum Analyzer Modules #1 and #2 are not present on FM/AM-1100A models.

2. Spectrum Analyzer PC Board #1 Circuit Schematic applies to FM/AM-1100S models only.

3. Spectrum Analyzer PC Board #2 Circuit Schematic applies to FM/AM-1100S models only.

4. DISPERSION Control R4405, SW4402 and associated wiring shown on Spectrum Analyzer Front Plate/Shield Circuit Schematic are not present on FM/AM-1100A models.

10-1-1 INDEX OF CIRCUIT SCHEMATICS AND INTERCONNECT DIAGRAMS

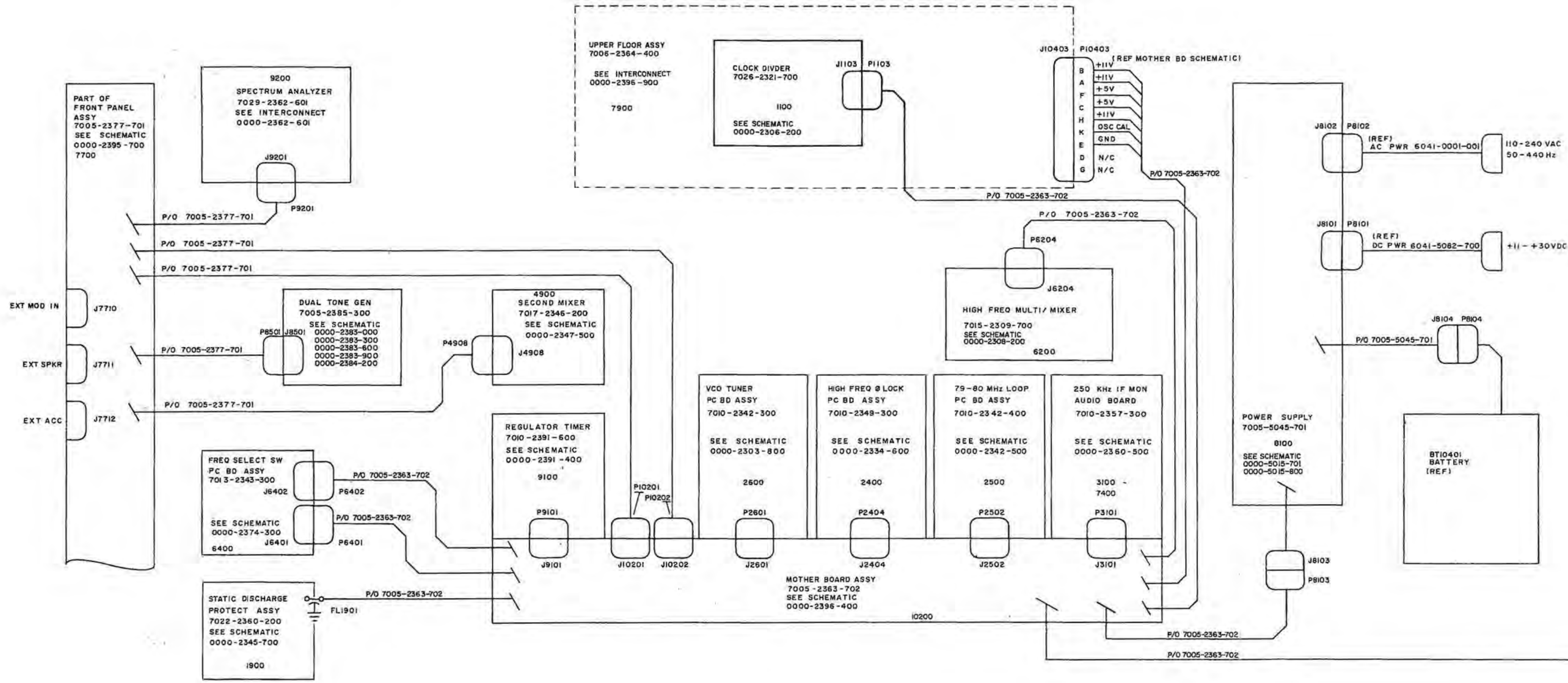


Figure 10-1 FM/AM-1100S/A Interconnect (Sheet 1 of 3)

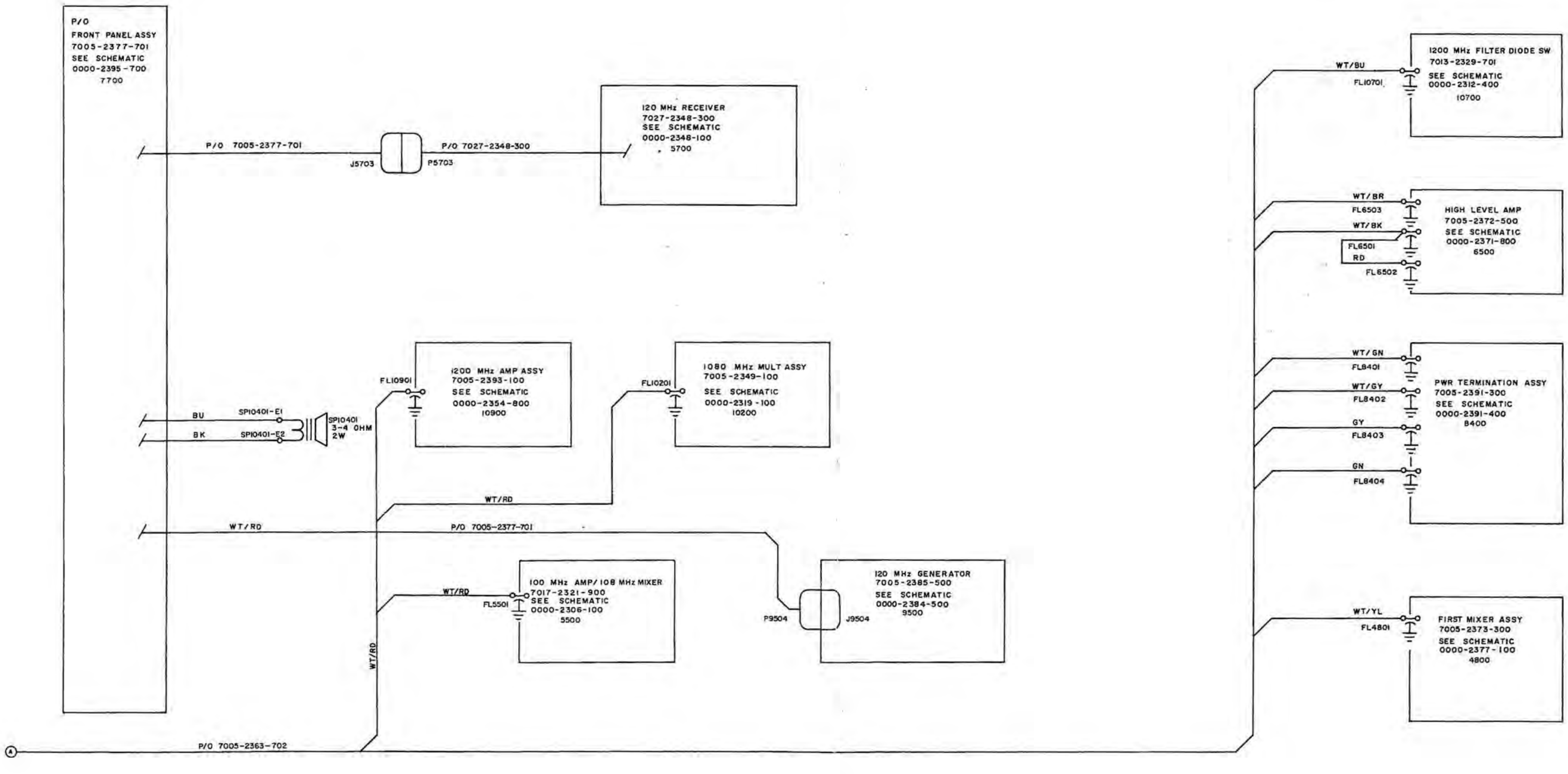


Figure 10-1 FM/AM-1100S/A Interconnect
(Sheet 2 of 3)

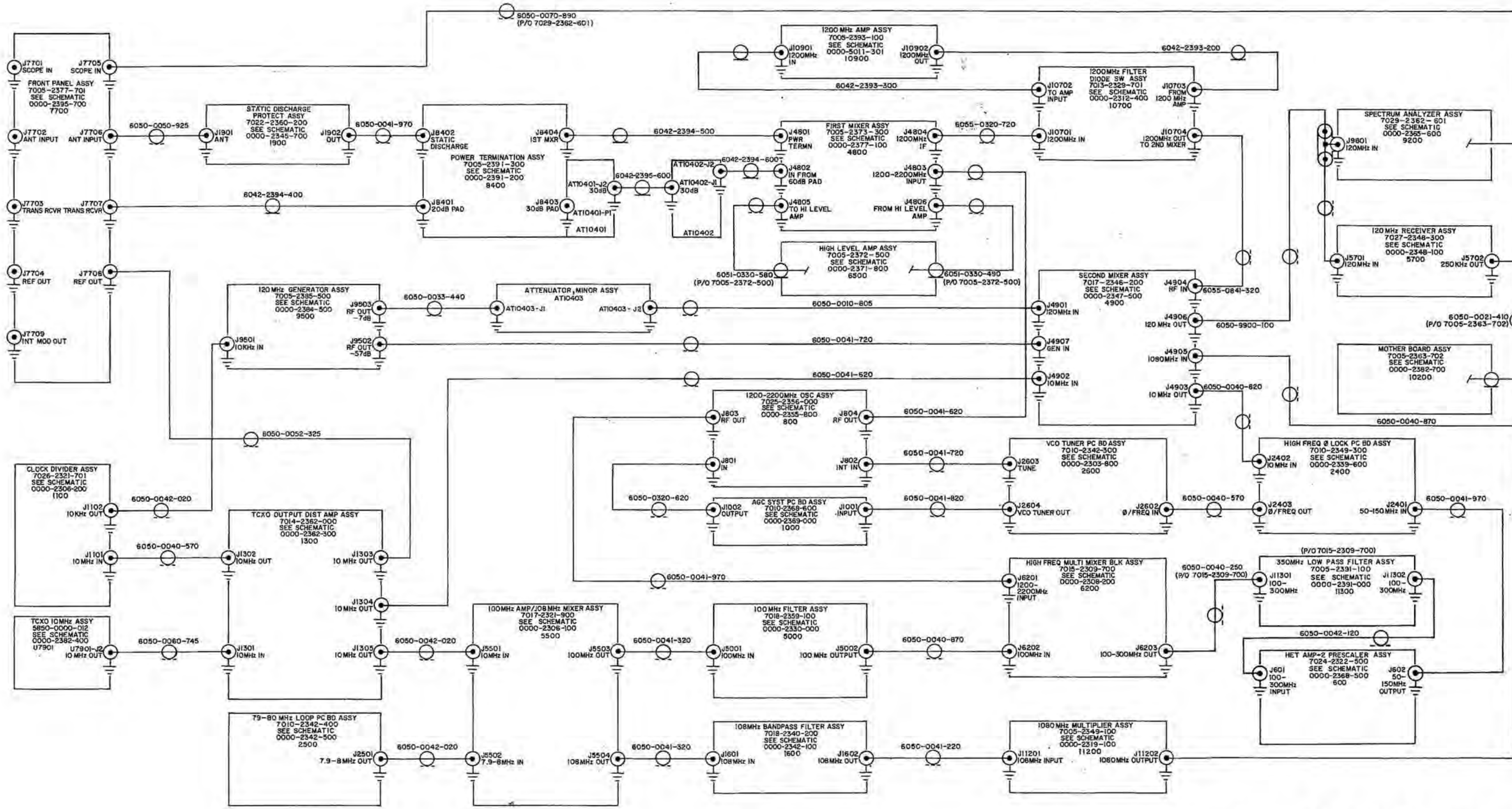


Figure 10-1 FM/AM-1100S/A Interconnect (Sheet 3 of 3)

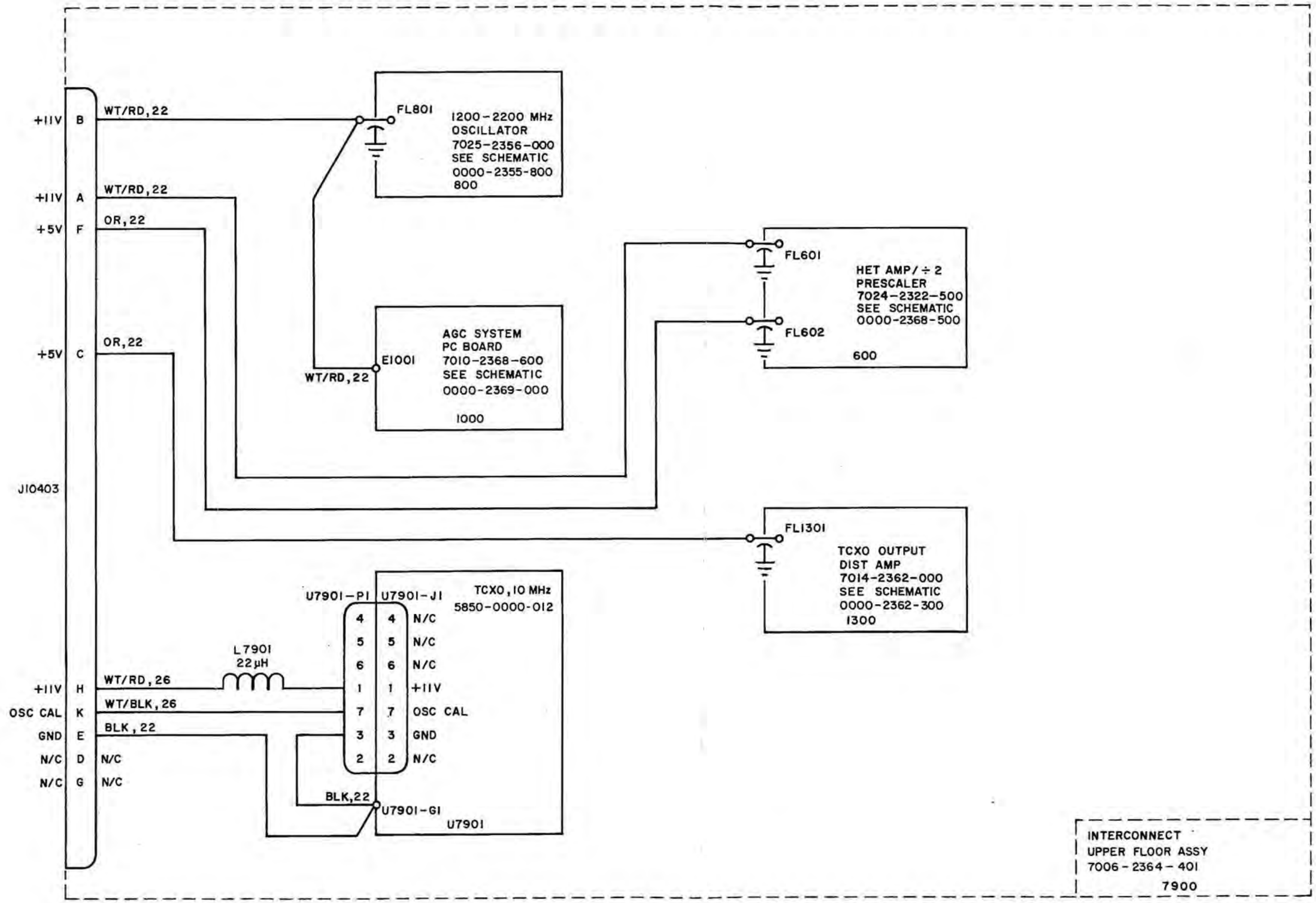
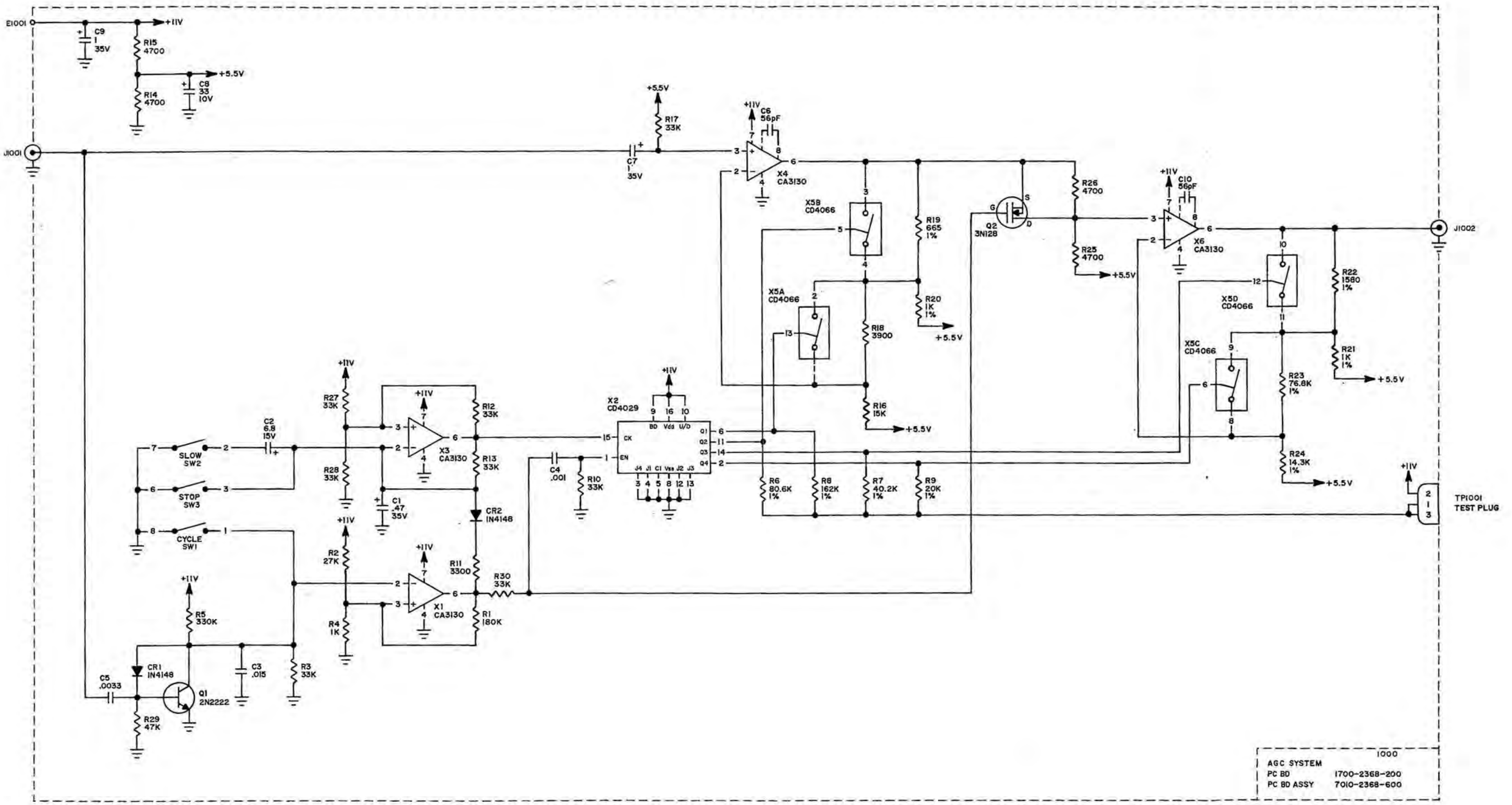


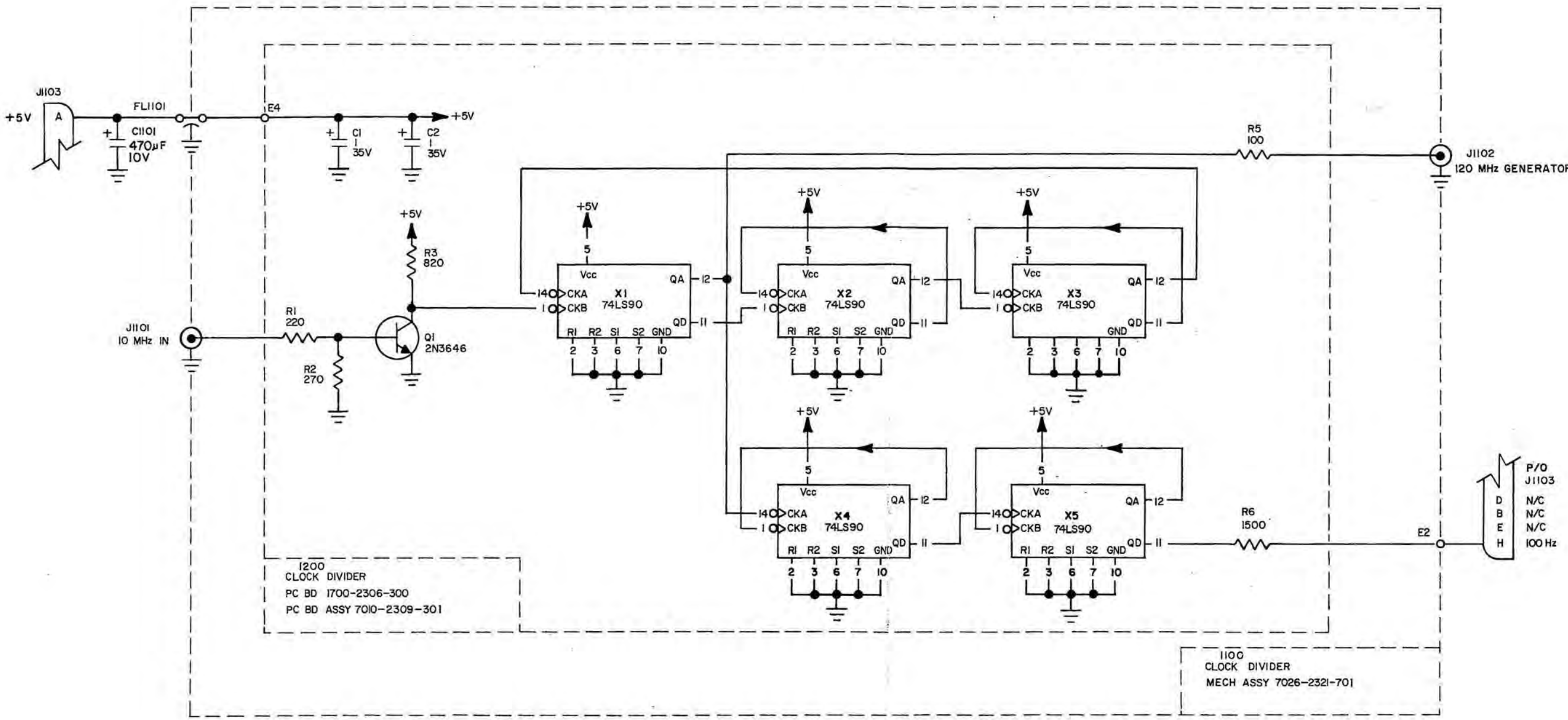
Figure 10-2 Upper Floor Mech Assembly Interconnect



NOTES:

1. NOT USED.
2. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
3. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
4. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
5. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 1000; THEREFORE J1 IS DESIGNATED J1001).

Figure 10-3 AGC System Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 1100 and 1200; THEREFORE J1 IS DESIGNATED J1101 AND R1 IS DESIGNATED R1201).

Figure 10-4 Clock Divider Circuit Schematic

NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES FAMILY DESIGNATOR 8500 WITH EACH PC BOARD CARRYING ITS OWN DESIGNATOR AS FOLLOWS:
   PC BD #1 (SHEET 2 OF 6) CARRIES 8600
   PC BD #2 (SHEET 3 OF 6) CARRIES 8700
   PC BD #3 (SHEET 4 OF 6) CARRIES 8800
   PC BD #4 (SHEET 5 OF 6) CARRIES 8900
   PC BD #5 (SHEET 6 OF 6) CARRIES 9000
   THEREFORE, R1 ON PC BD #4 IS DESIGNATED R8901.
5. R26 IS A SELECT AT TEST (S.A.T.) RESISTOR.
   NOMINAL = 15 K OHM;
   RANGE = 6.8 K OHM - 33 K OHM

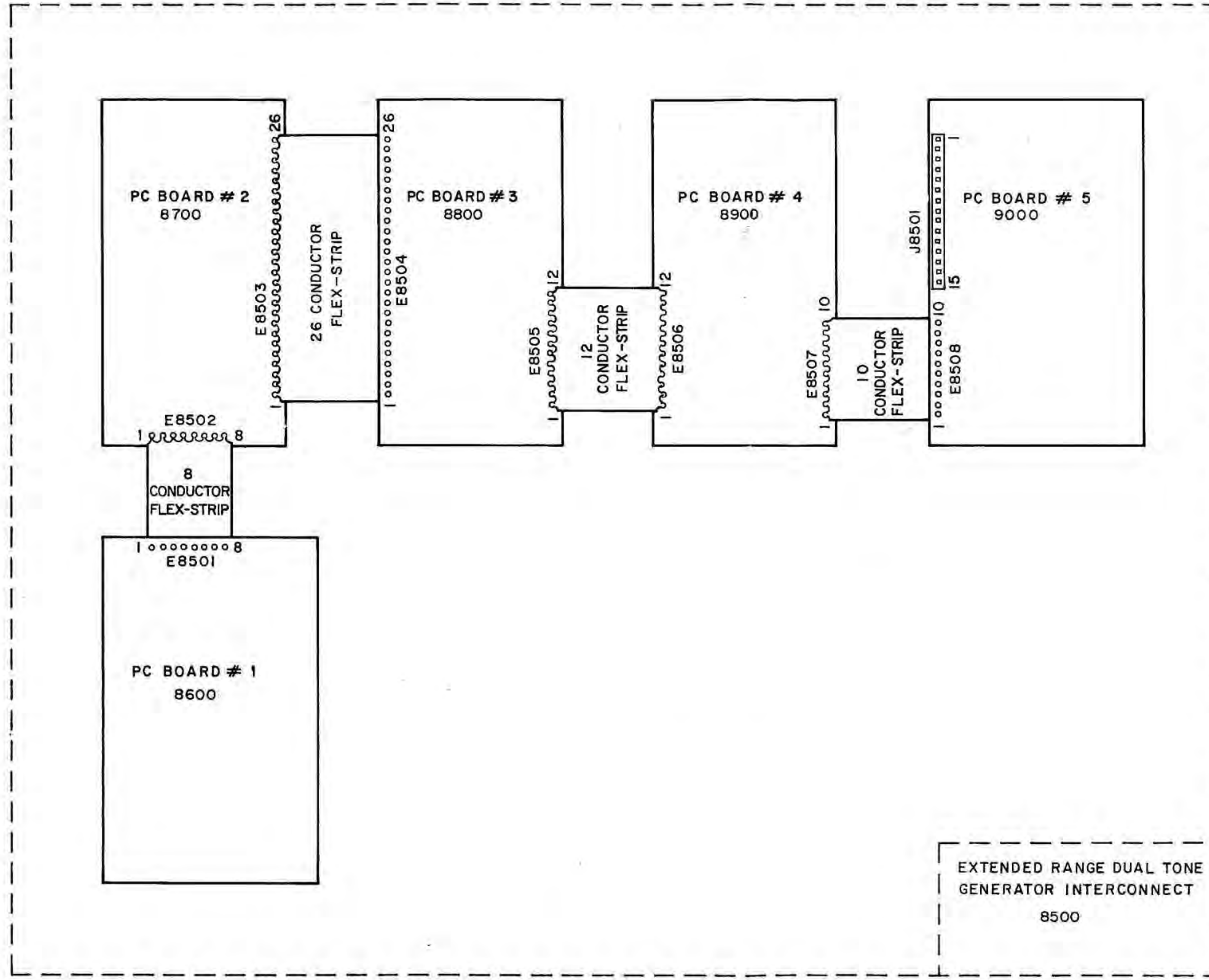
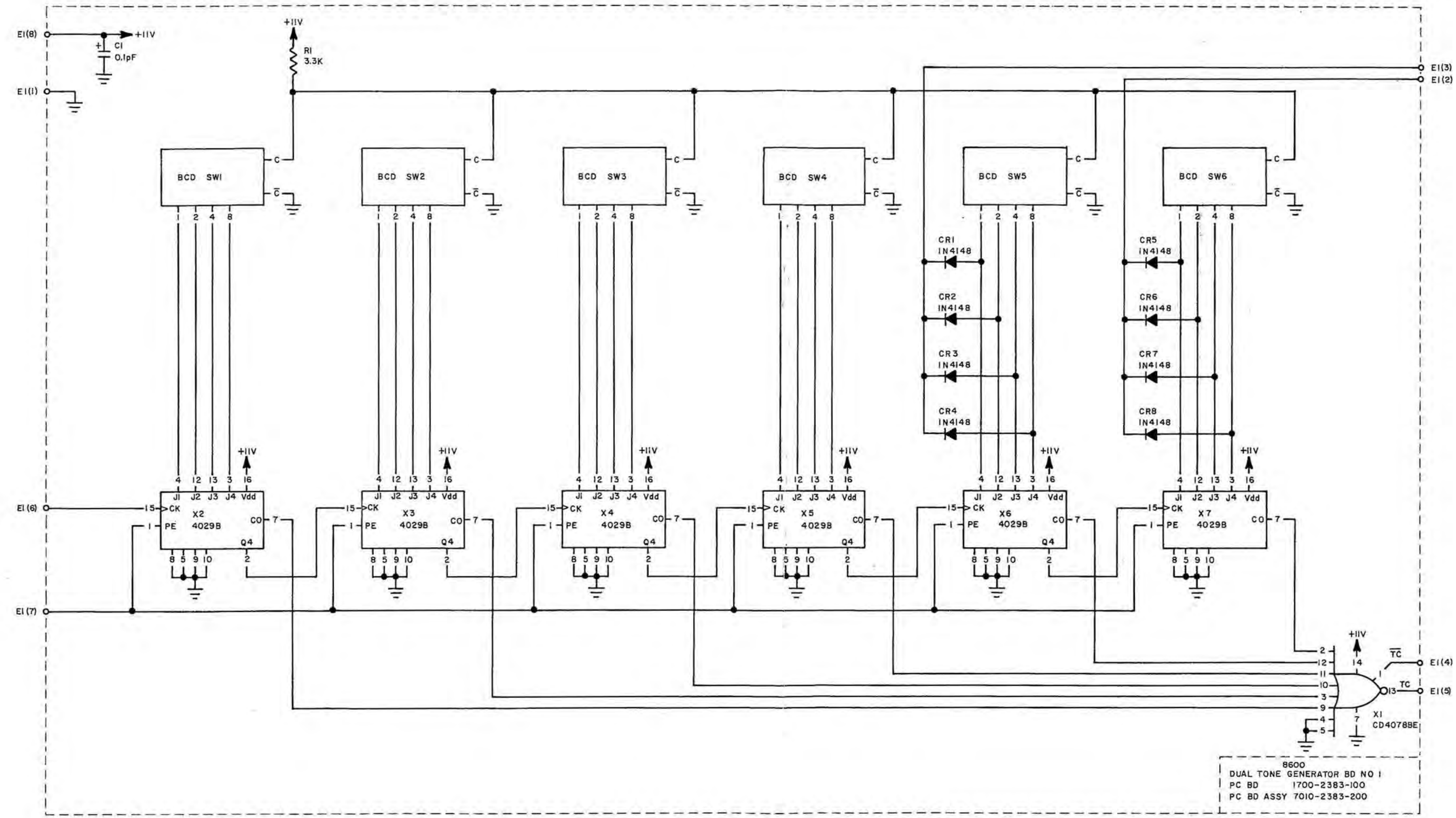


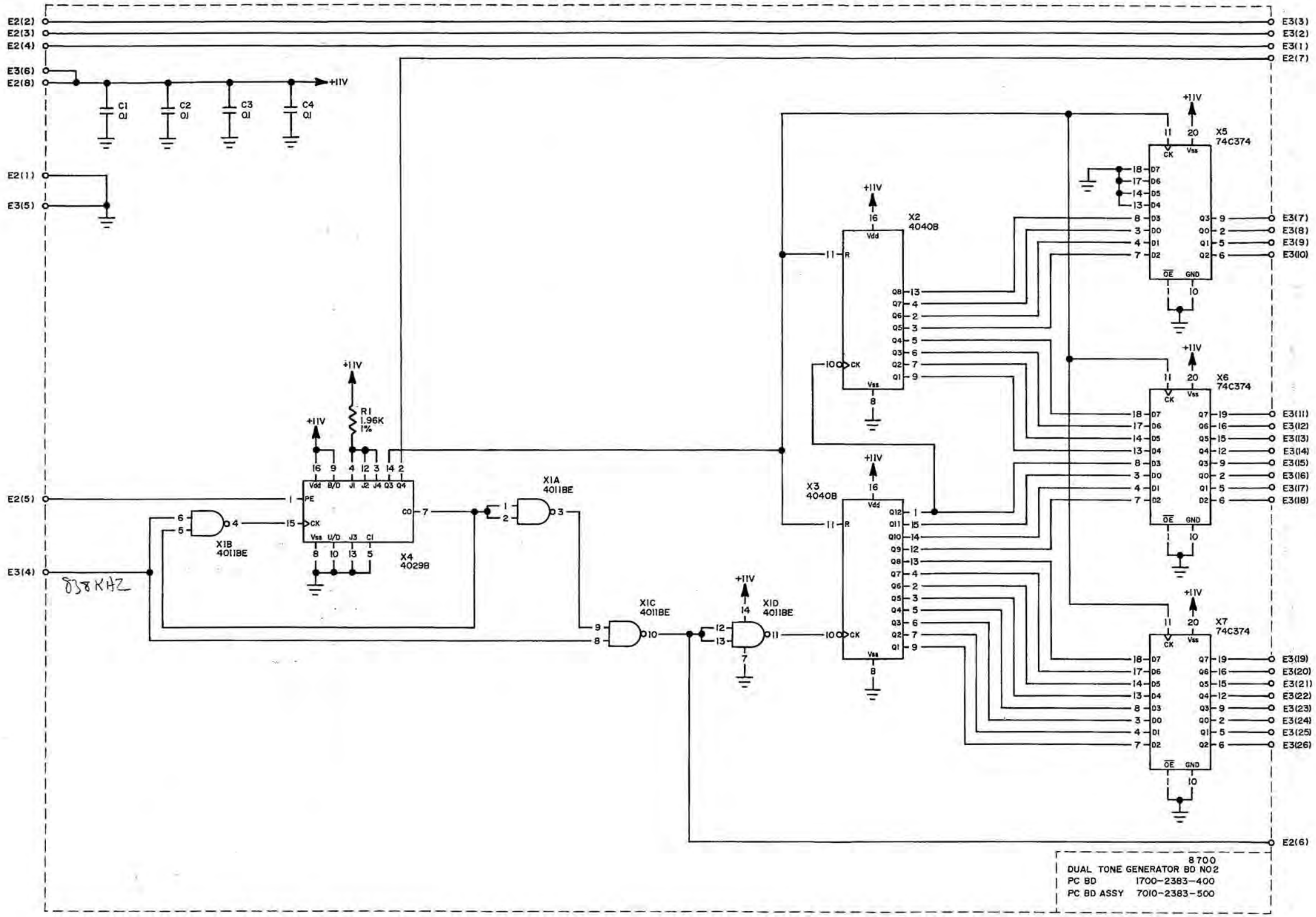
Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 1 of 6)



NOTE:

E1 CARRIES FAMILY DESIGNATOR 8500.

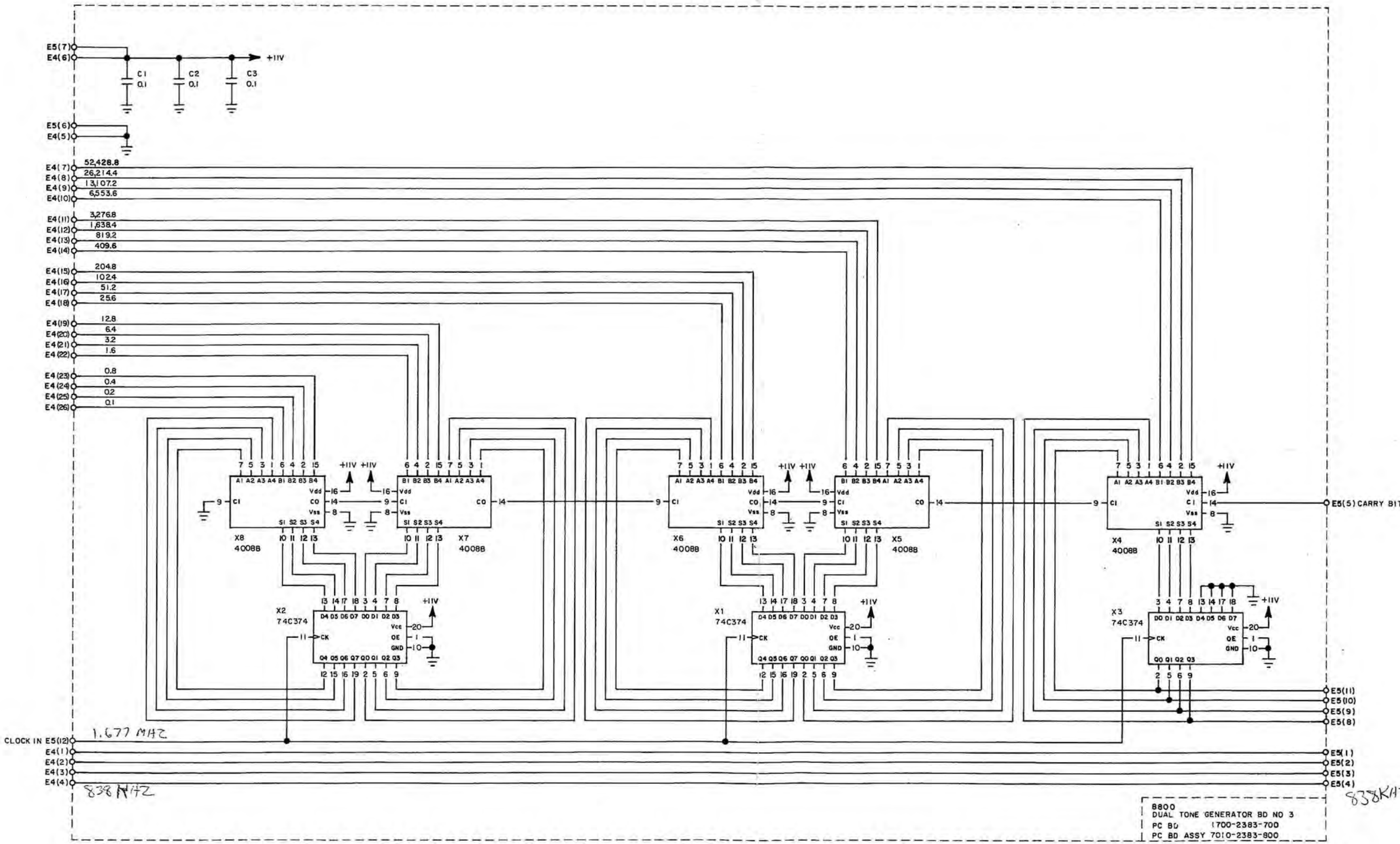
Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 2 of 6)



NOTE:

E2 AND E3 CARRY FAMILY DESIGNATOR 8500.

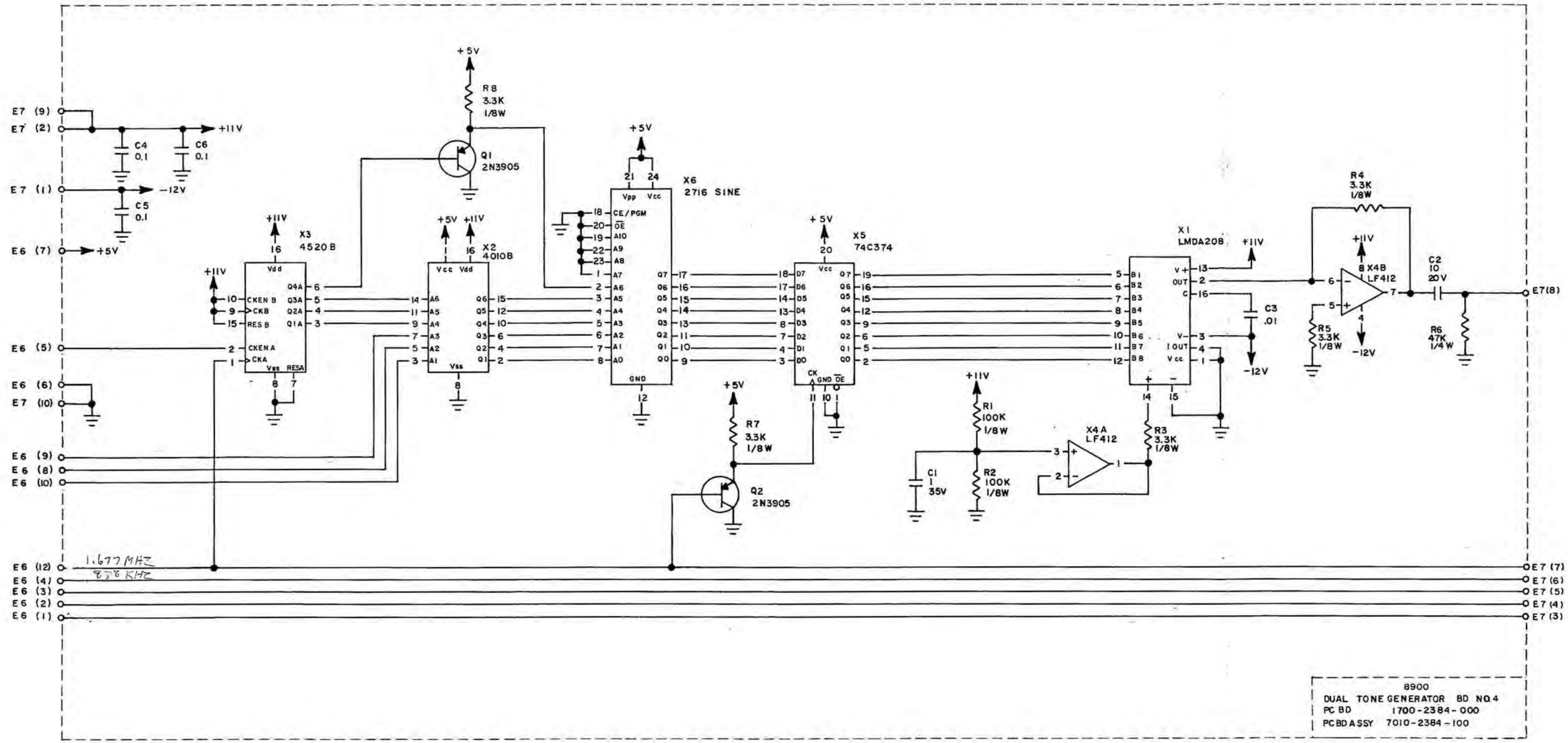
Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 3 of 6)



NOTE:

1. E4 AND E5 CARRY FAMILY DESIGNATOR 8500.

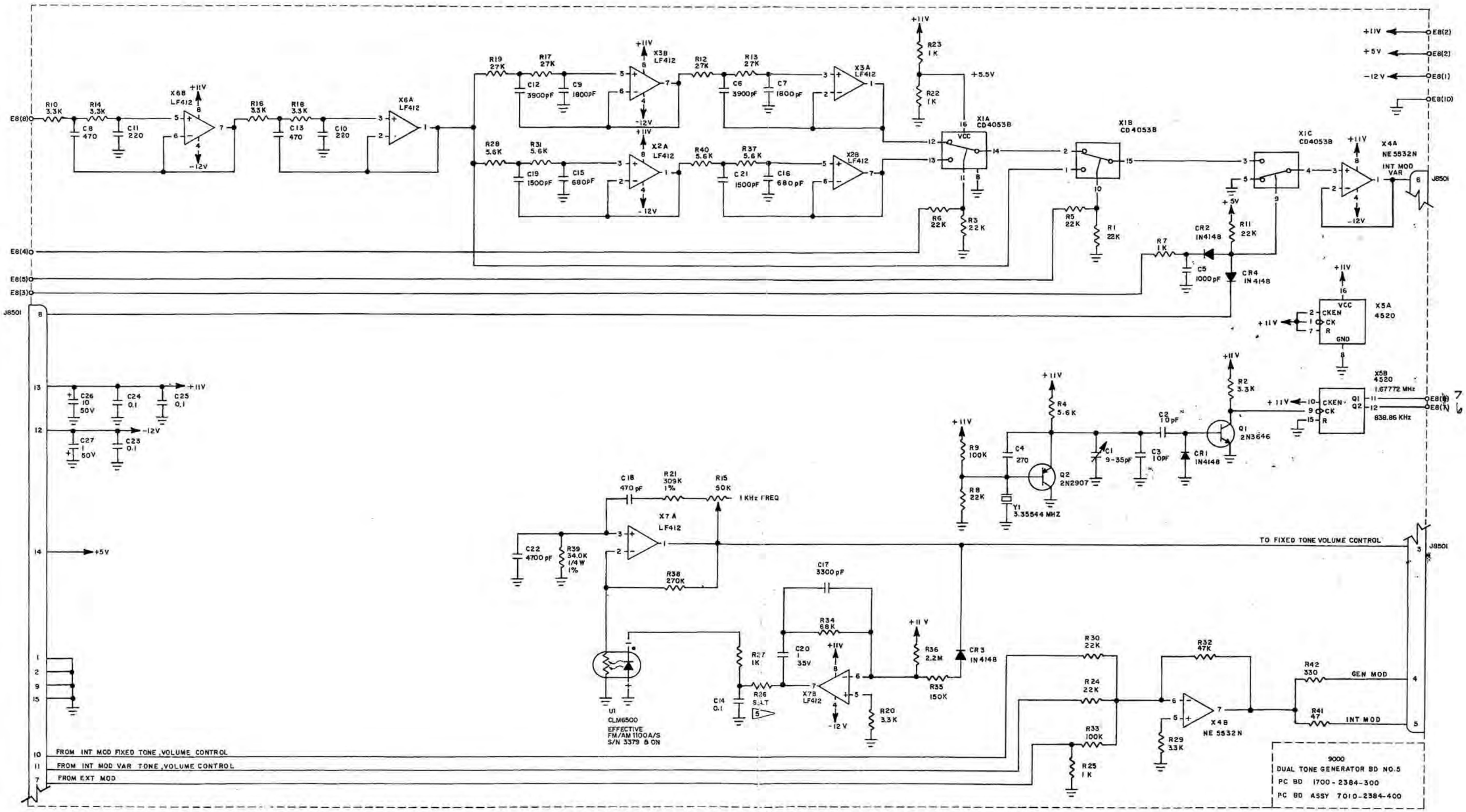
Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 4 of 6)



NOTE:

1. E6 AND E7 CARRY FAMILY DESIGNATOR 8500.

Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 5 of 6)



NOTE:

1. E8 CARRIES FAMILY DESIGNATOR 8500.

Figure 10-5 Dual Tone Generator Circuit Schematic (Sheet 6 of 6)

NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS.
2. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 4800; THEREFORE R1 IS DESIGNATED R4801).

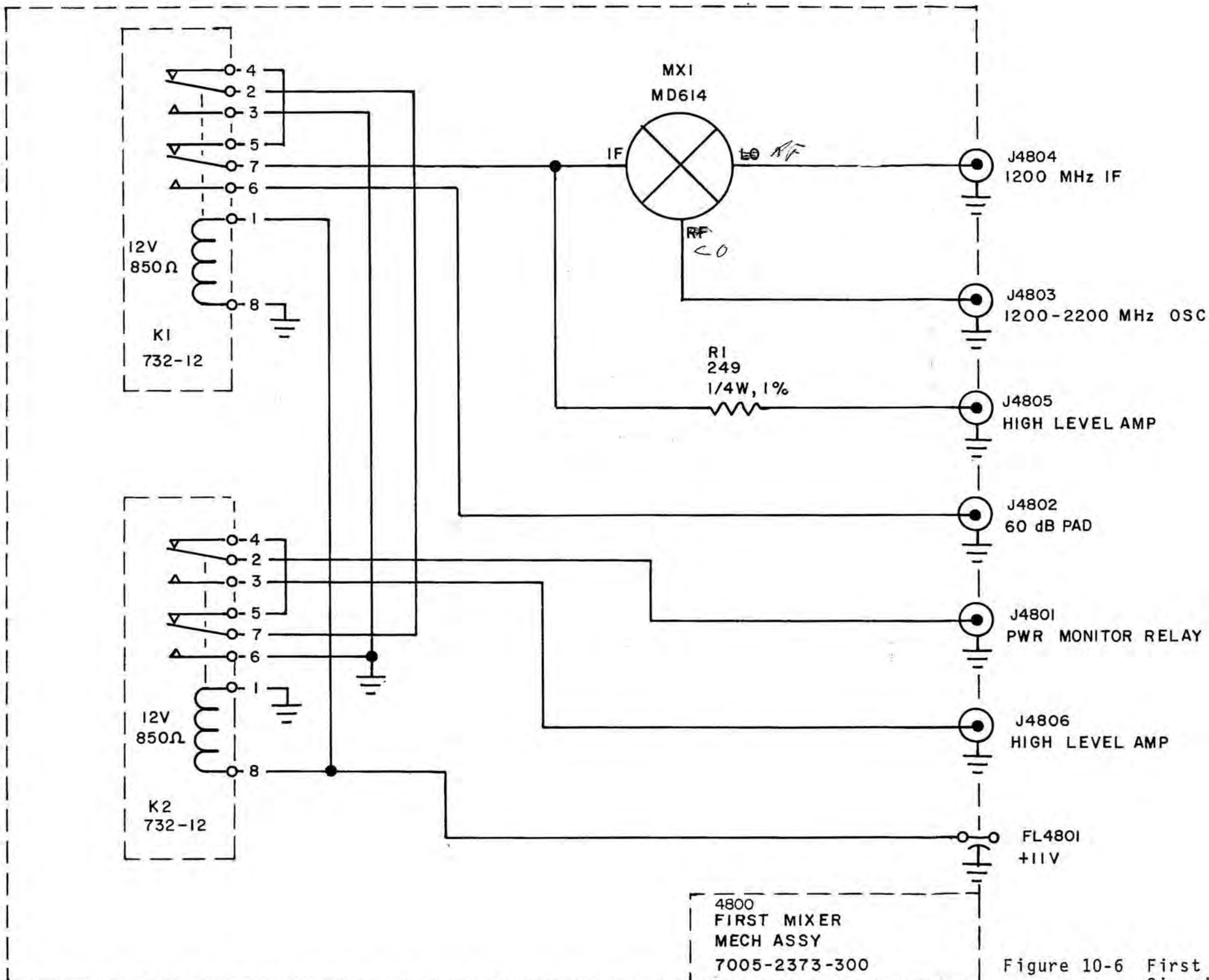
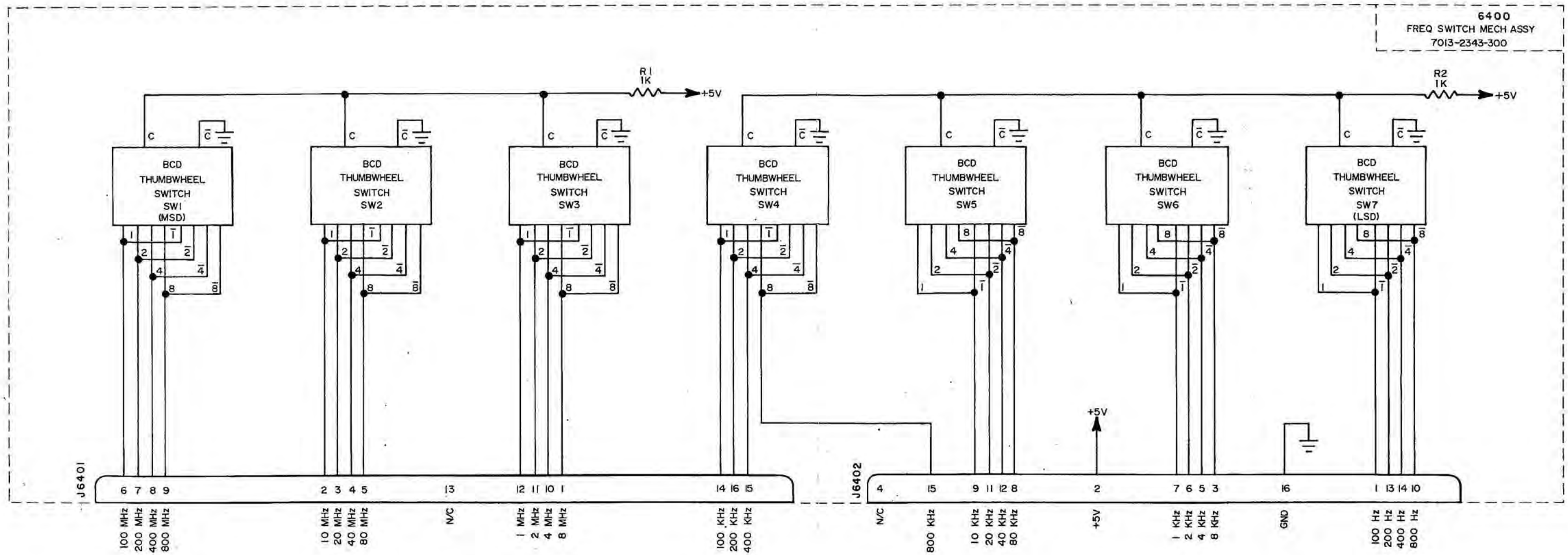


Figure 10-6 First Mixer Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 6400; THEREFORE J1 IS DESIGNATED J6401).

Figure 10-7 Frequency Select Switch Circuit Schematic

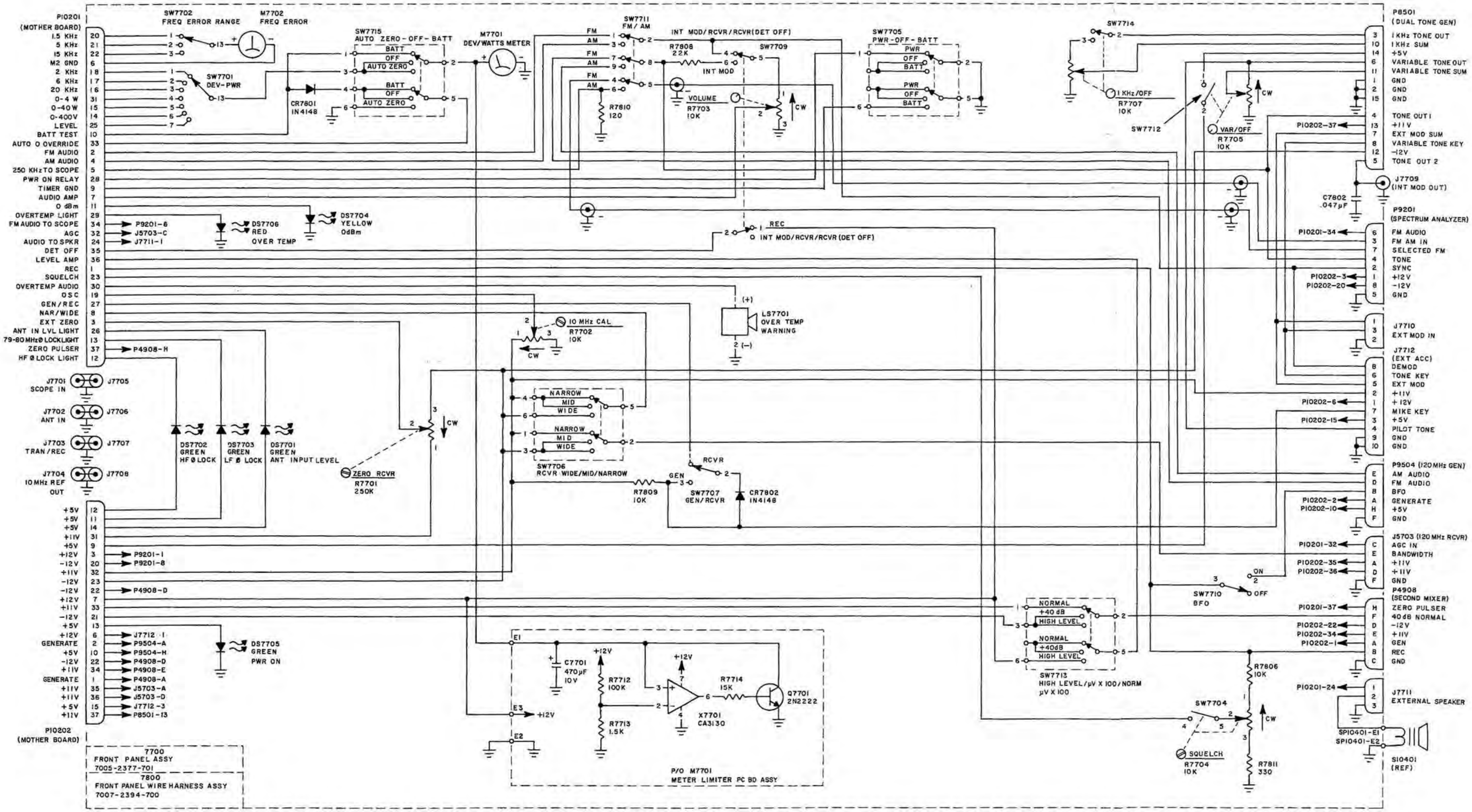
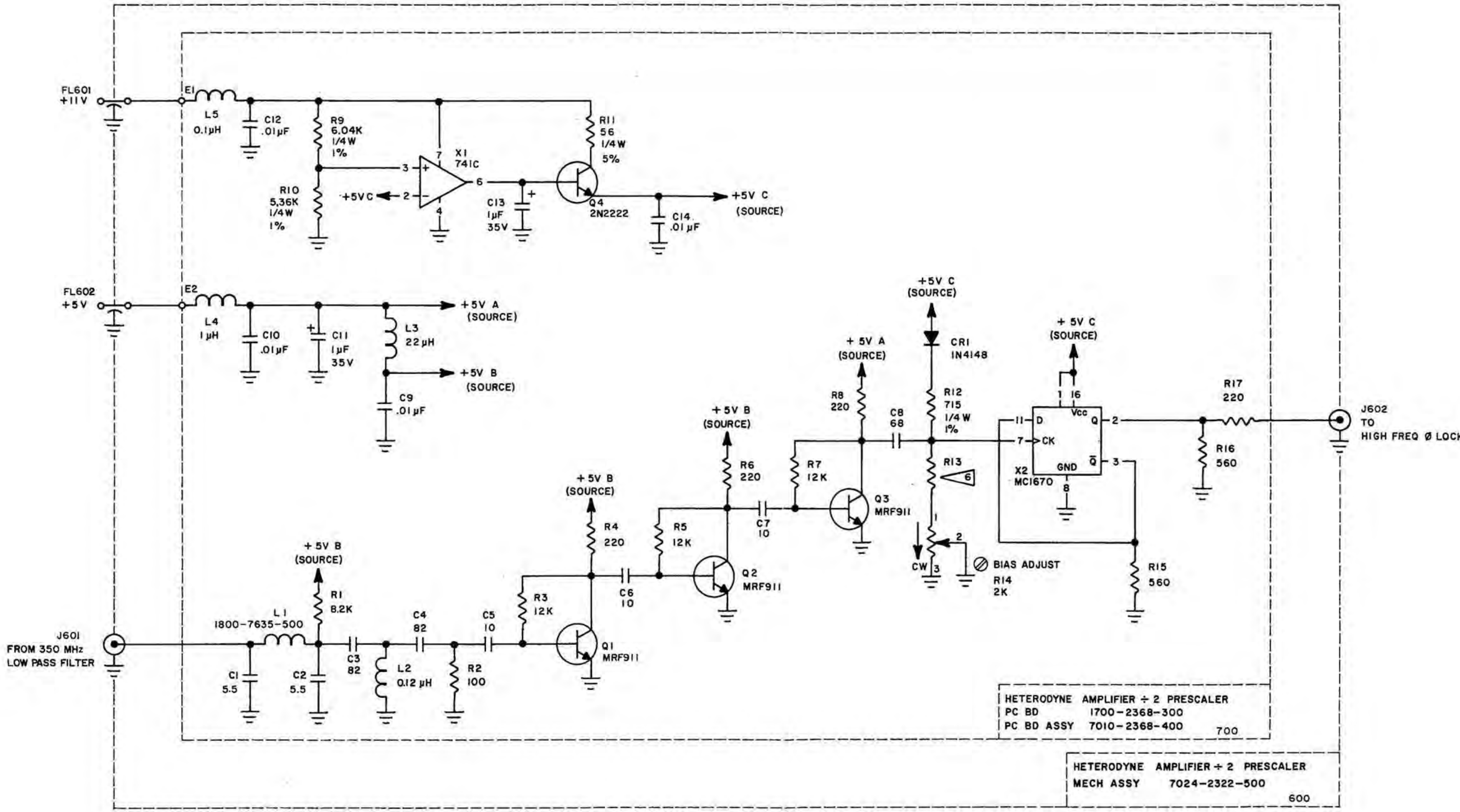


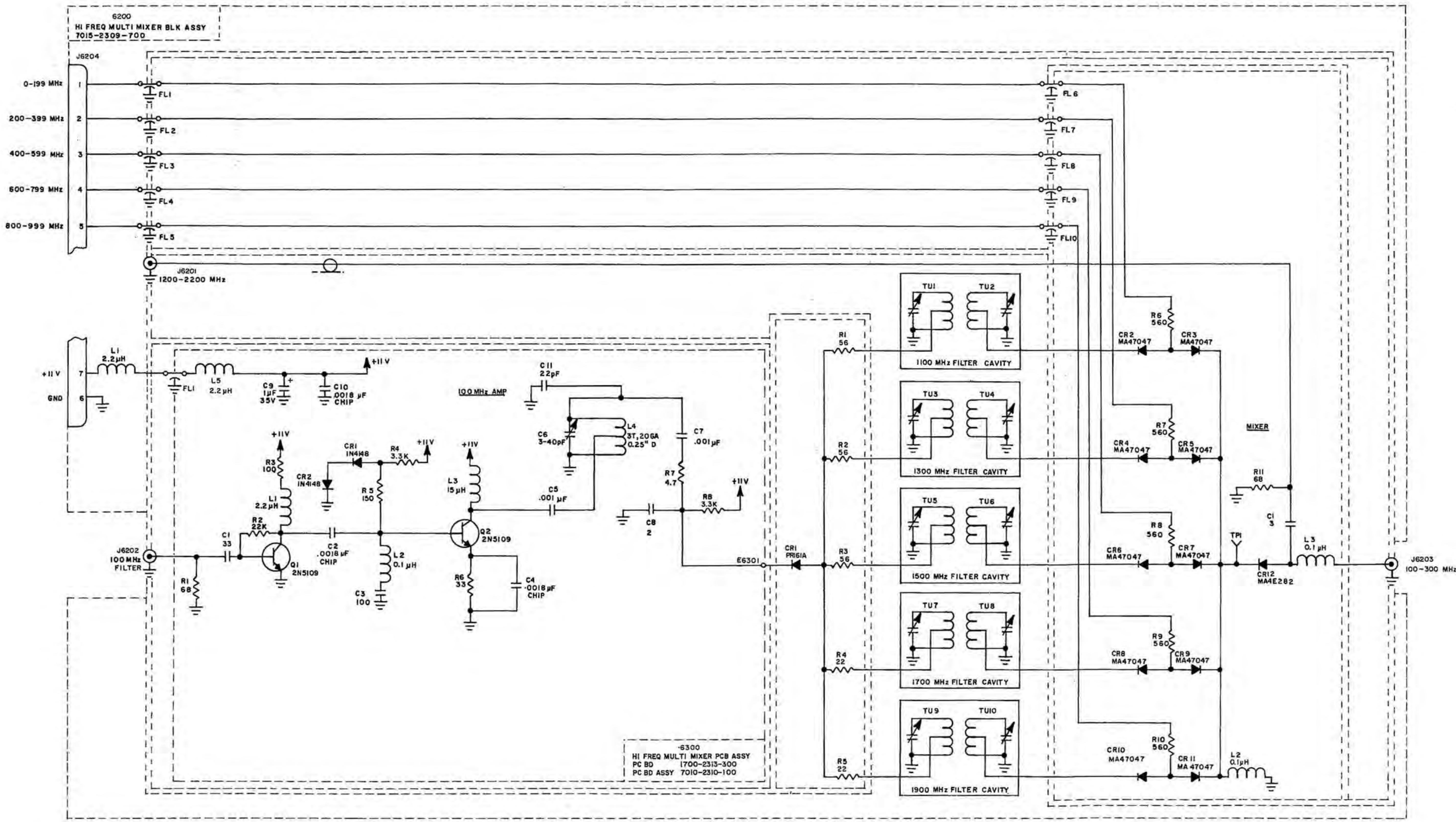
Figure 10-8 Front Panel Circuit Schematic



NOTES:

1. NOT USED.
2. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
3. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
4. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
5. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 600 AND 700; THEREFORE J1 IS DESIGNATED J601 AND R1 IS DESIGNATED R701).
6. R13 IS SET AT TEST (S.A.T.). NOMINAL = 4.64 K OHM; RANGE = 2.6 K OHM TO 6.04 K OHM. 1/4 W, 1%.

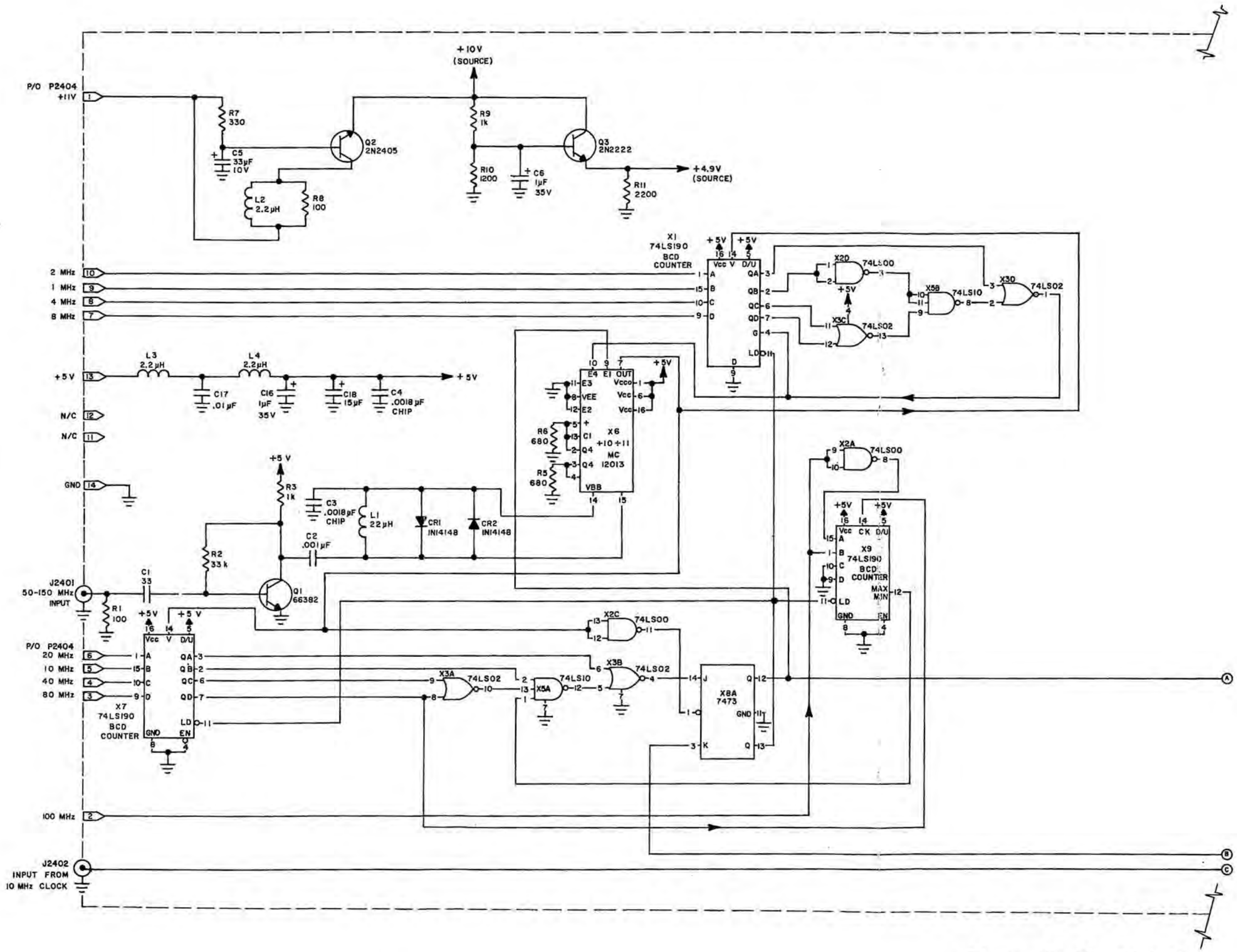
Figure 10-9 Heterodyne Amplifier/÷2 Prescaler Circuit Schematic



NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 6200 AND 6300; THEREFORE R1 IN MECHANICAL ASSEMBLY IS DESIGNATED R6201 AND R1 ON PC BOARD IS DESIGNATED R6301).

Figure 10-10 High Frequency Multiplier/Mixer Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 2400; THEREFORE R1 IS DESIGNATED R2401).
5. ALL INDUCTANCE IS EXPRESSED IN MILLIHENRYS UNLESS OTHERWISE NOTED.

Figure 10-11 High Frequency Phase Lock Circuit Schematic (Sheet 1 of 2)

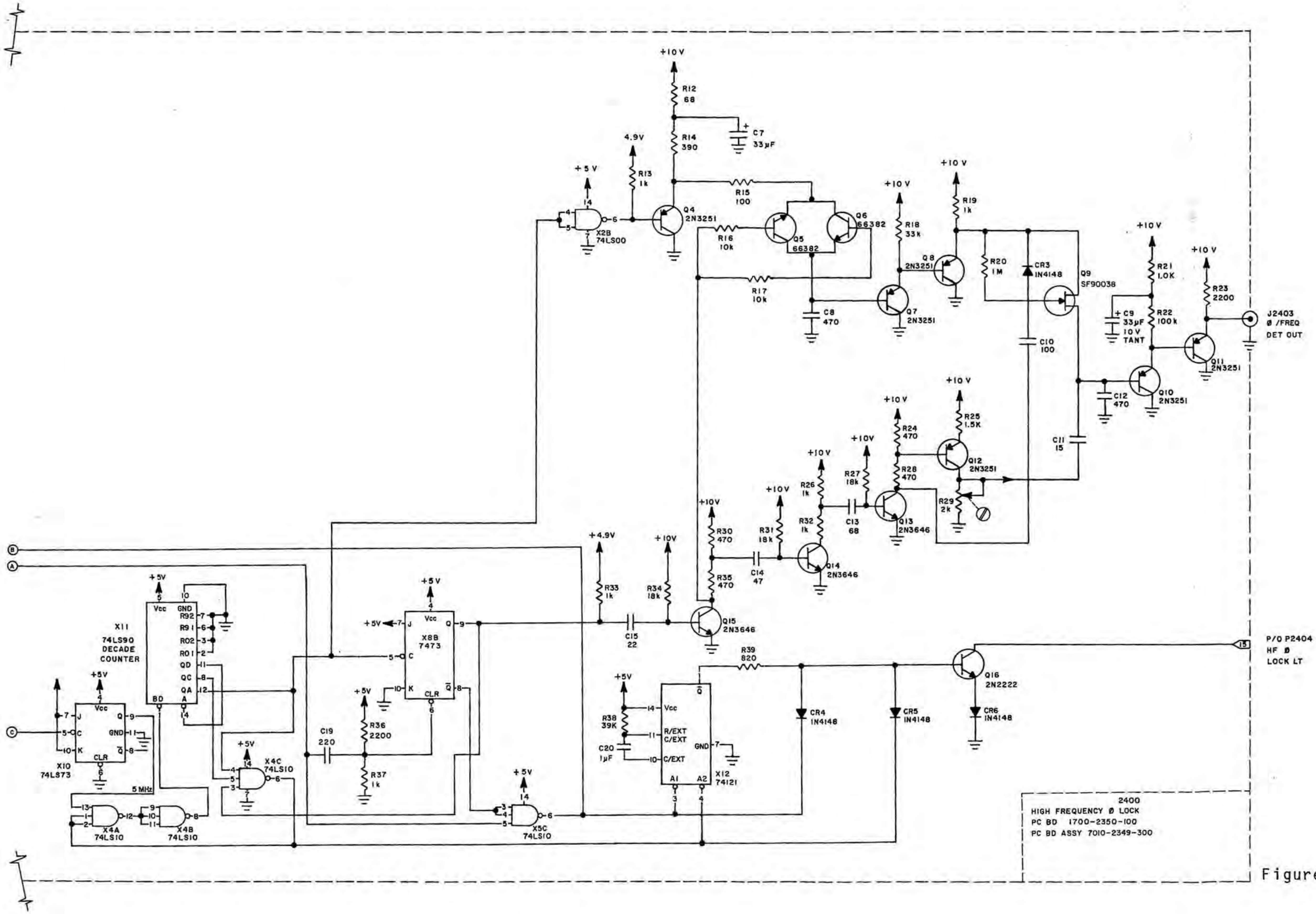
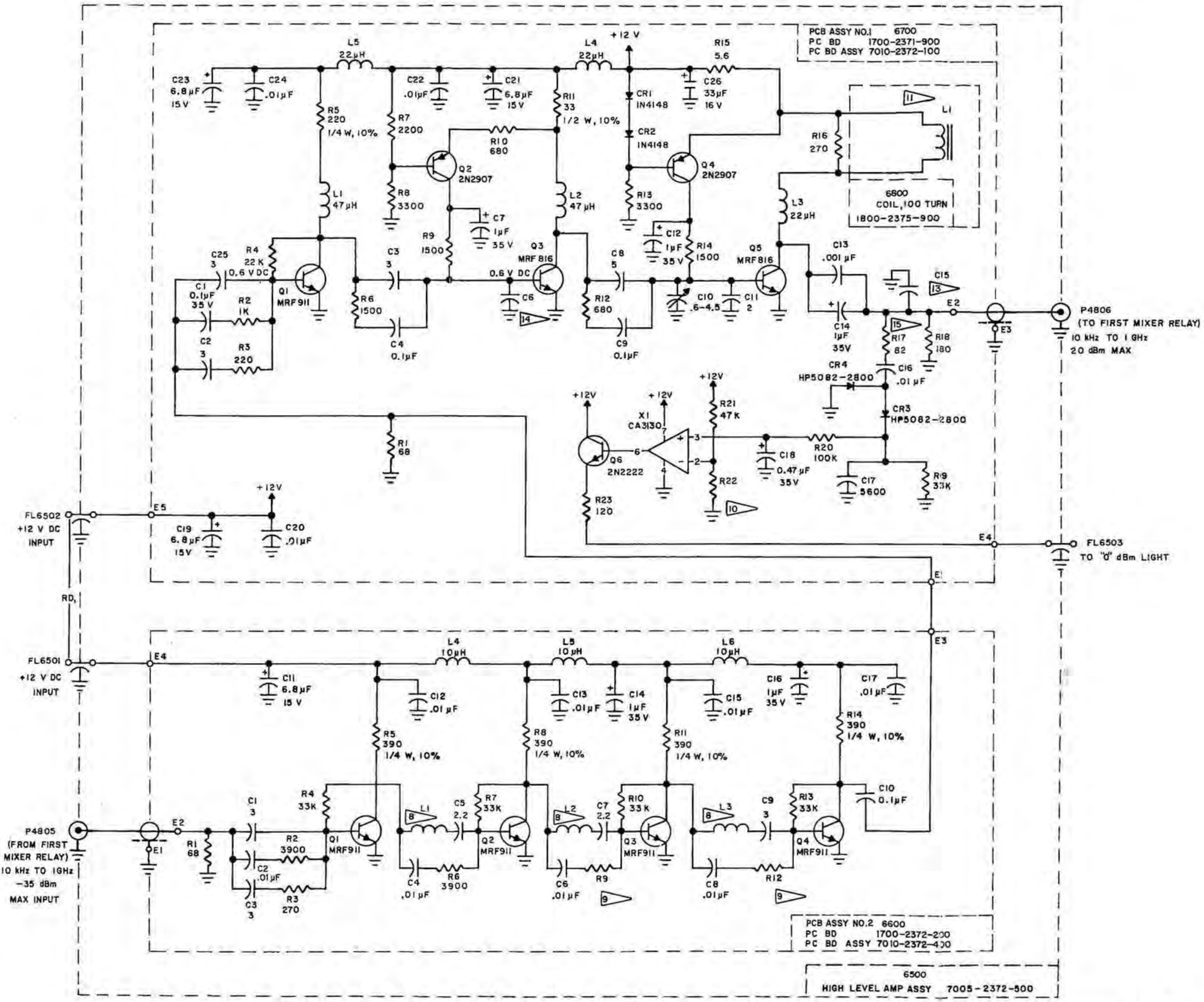


Figure 10-11 High Frequency Phase Lock Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL POLARIZED CAPACITORS ARE TANTALUM.
5. ALL .01 µF CAPACITORS ARE DISC.
6. ALL CAPACITORS LESS THAN .01 µF ARE NPO.
7. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 6500, 6600, 6700 AND 6800; THEREFORE J1 IS DESIGNATED J6501).

8. NOTED INDUCTORS ARE FORMED BY STRAY INDUCTANCE FROM CAPACITOR LEAD 0.6" LONG (TYP 3 PLCS.) C5, C7, C9.

9. R9 AND R12 ON PC BOARD #2 ARE SELECT AT TEST (S.A.T.) RESISTORS.
R9 NOMINAL = 3.9 K OHM;
R12 NOMINAL = 3.3 K OHM;
RANGE = 1.5 K OHM - 3.9 K OHM, 1/8 W, 10%.

10. R22 ON PC BOARD #1 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 39 K OHM; RANGE = 39 K OHM OR 33 K OHM, 1/8 W, 10%. R22 IS SELECTED FOR "0" dBm INDICATOR LIGHT ADJUSTMENT.

11. L6801 INDUCTANCE VALUE EQUALS 3.0 mH ±25% MEASURED AT 1 kHz SERIES CIRCUIT/OR EQUIVALENT.

12. NOT USED.

13. C15 ON PC BOARD #1 IS A SELECT AT TEST CAPACITOR. NOMINAL = 2 pF; RANGE = 1-3 pF.

14. C6 ON PC BOARD #1 IS A SELECT AT TEST CAPACITOR. NOMINAL = 3 pF; RANGE = 2 OR 3 pF.

15. R17 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 82 OHM; RANGE = 68 OHM - 100 OHM

Figure 10-12 High Level Amplifier Circuit Schematic

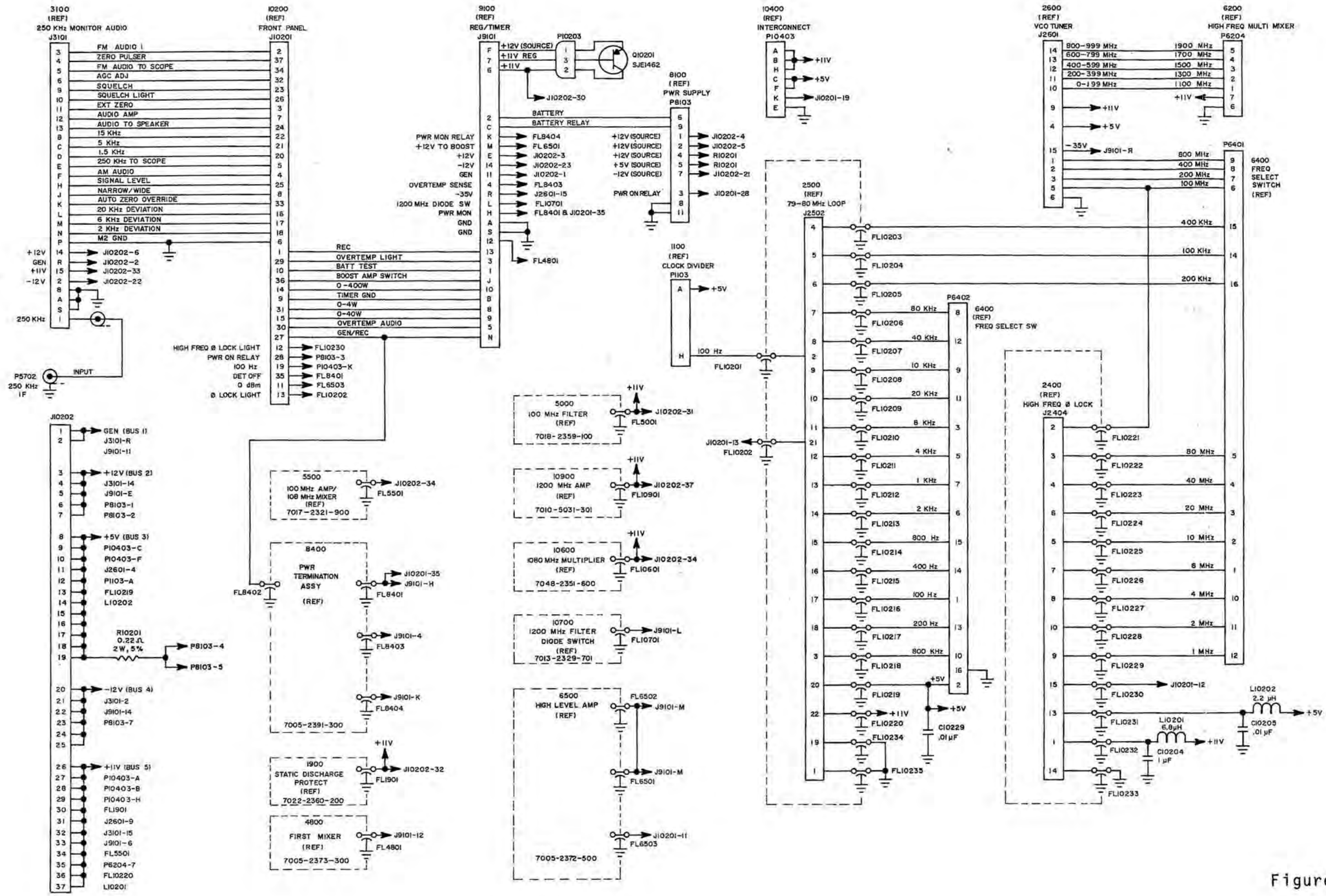
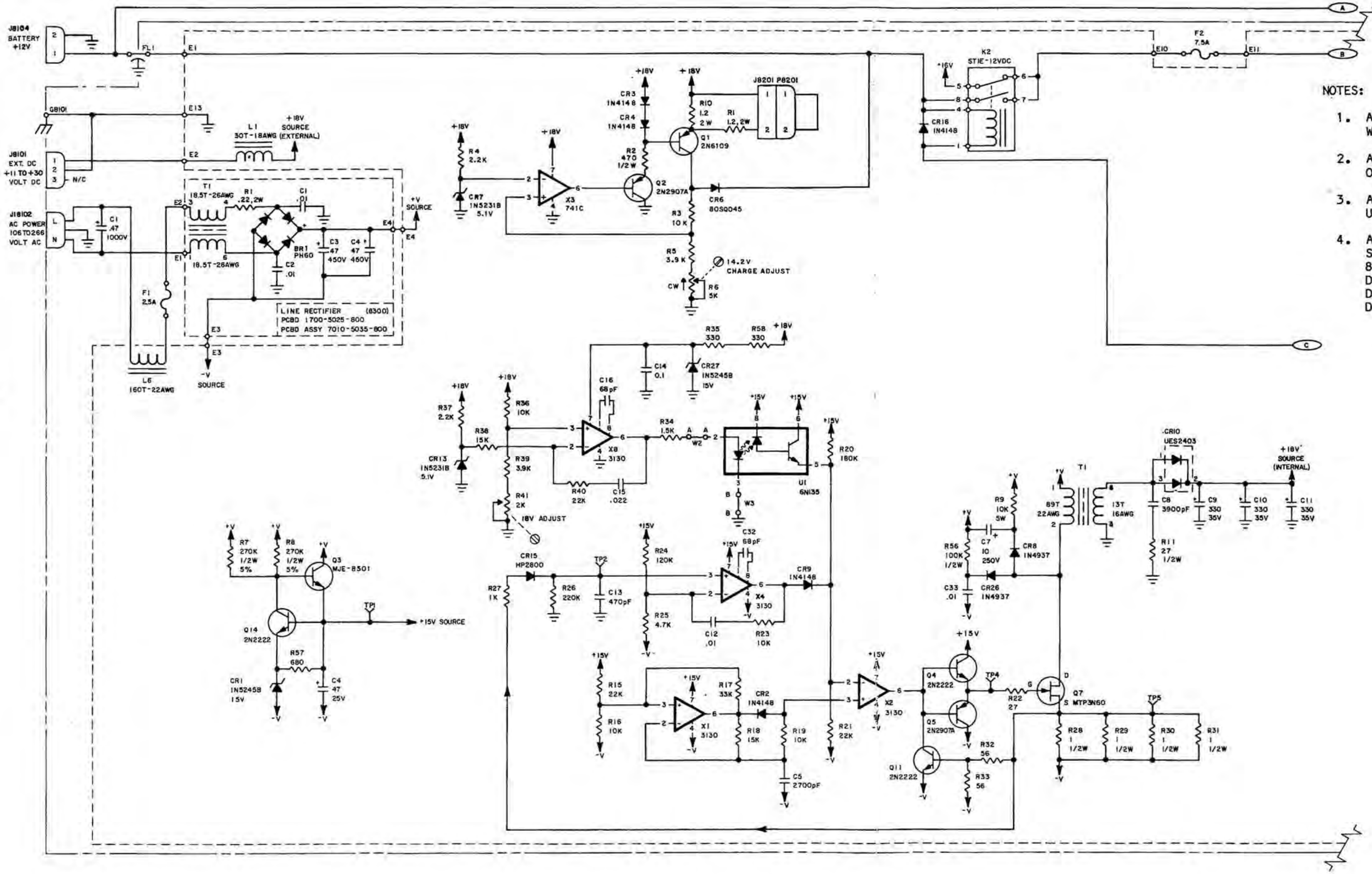


Figure 10-13 Mother Board Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 8100, 8200, AND 8300; THEREFORE J1 IS DESIGNATED J8201, R1 ON PC BOARD #1 IS DESIGNATED R8201, AND C1 ON PC BOARD #2 IS DESIGNATED C8301).

Figure 10-14 Power Supply Circuit Schematic (Sheet 1 of 2)

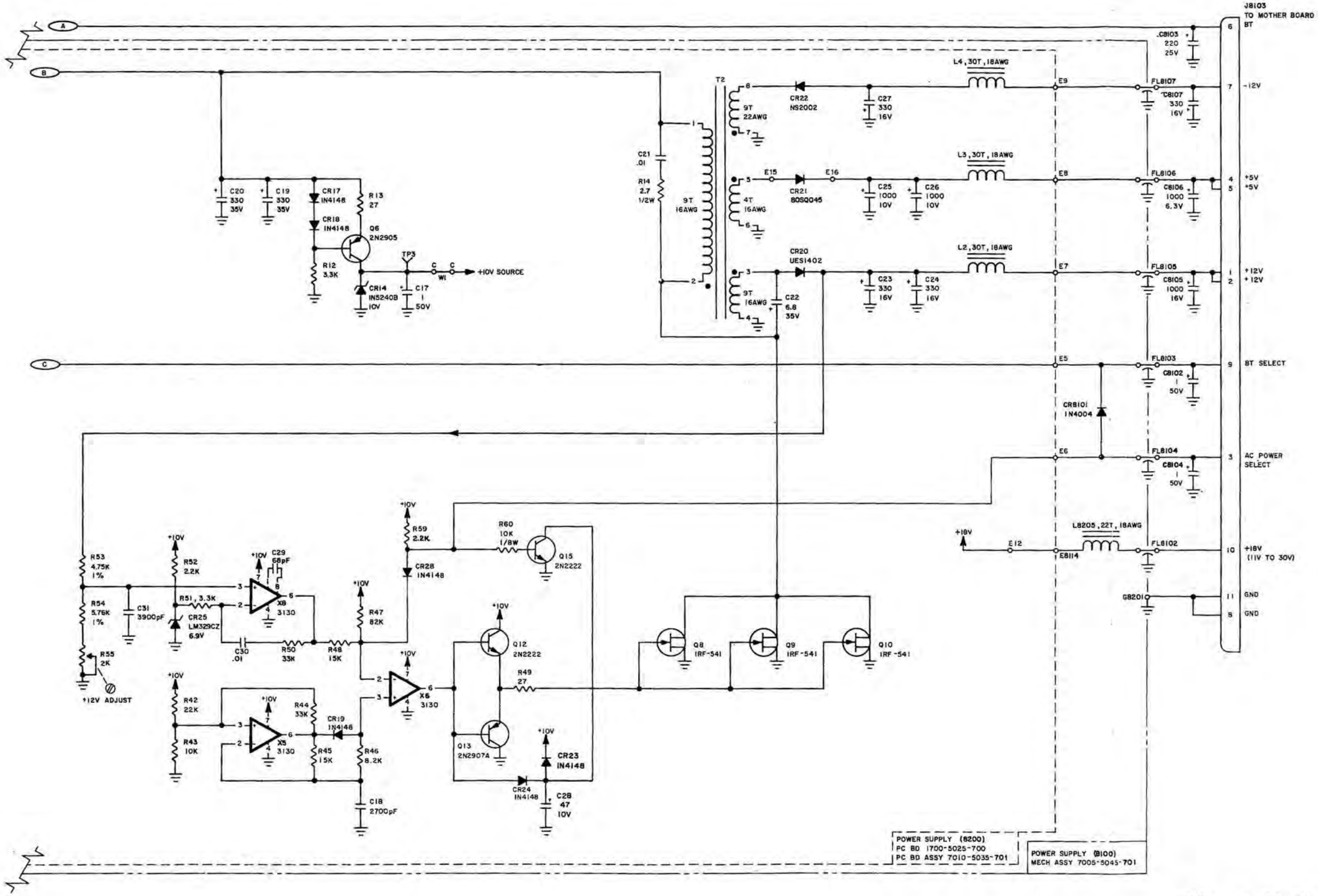
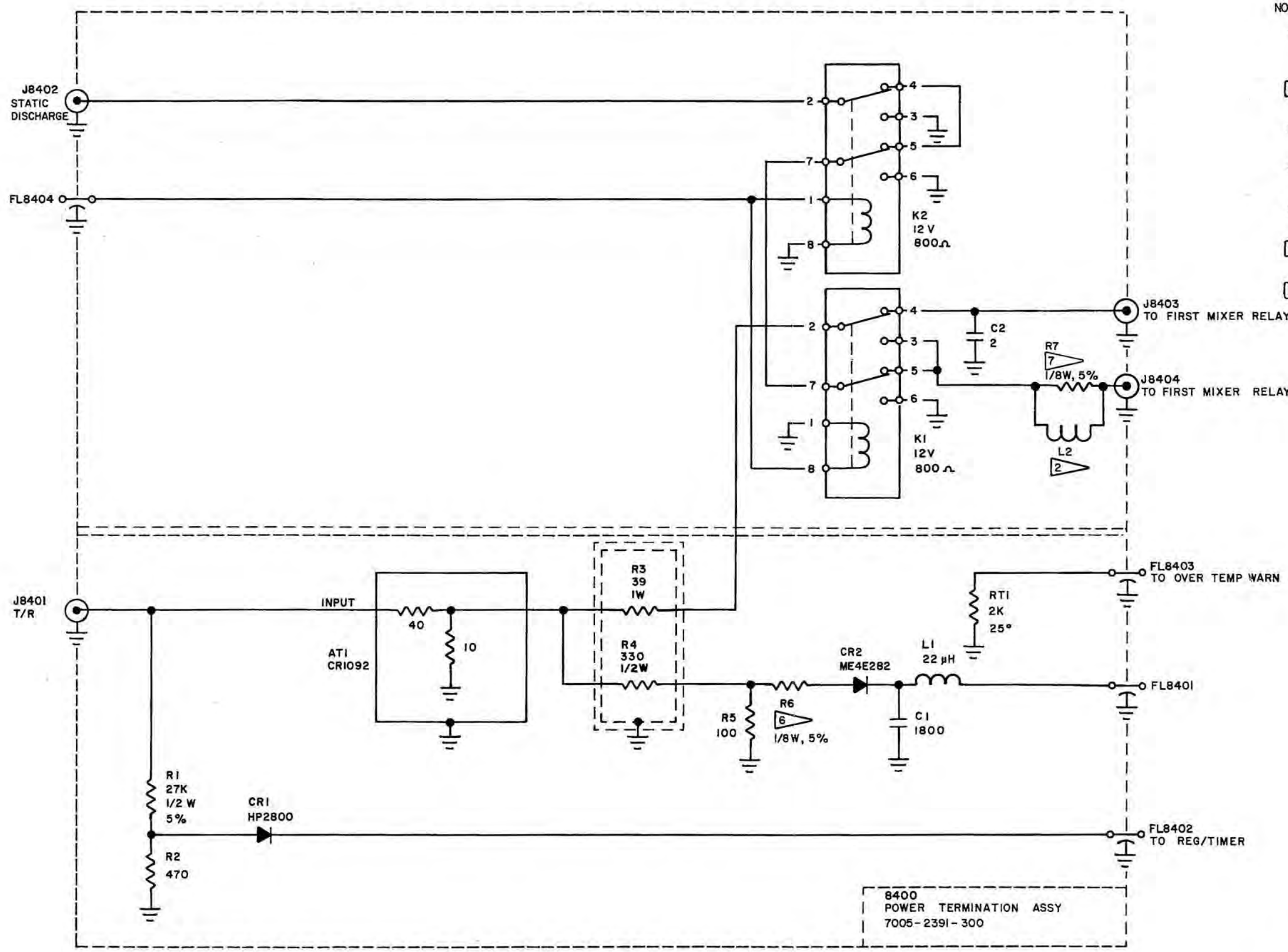


Figure 10-14 Power Supply Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 8400; THEREFORE R1 IS DESIGNATED R8401).

2. L2 IS FORMED BY 5 TURNS OF 26 GAUGE WIRE ON .063 INCH AIR CORE.

3. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

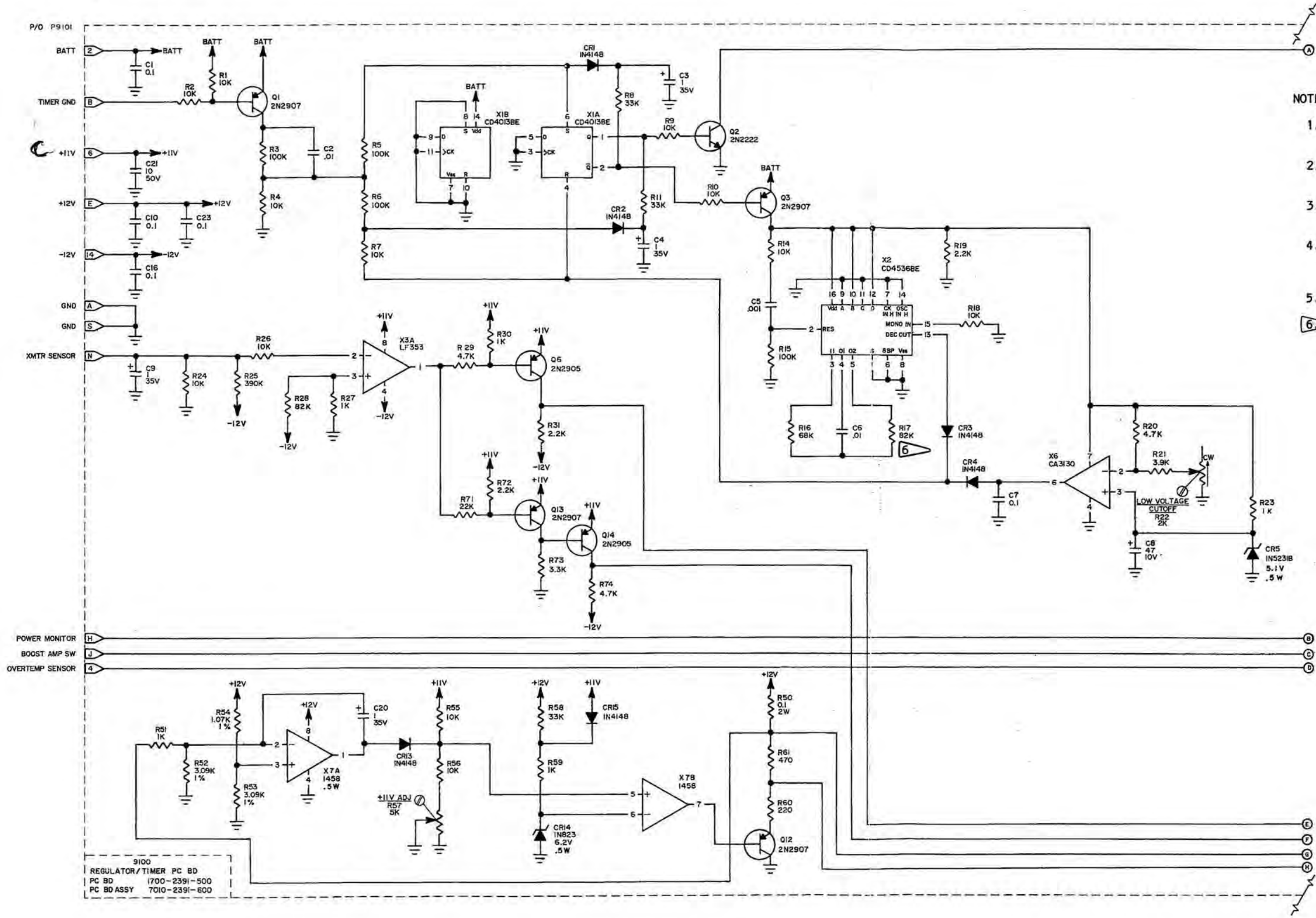
4. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.

5. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.

6. R6 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 18 OHMS; RANGE = 10 OHMS TO 120 OHMS.

7. R7 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 47 OHM;
RANGE = 22 OHM - 120 OHM.

Figure 10-15 Power Termination Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 9100; THEREFORE R1 IS DESIGNATED R9101).
5. NOT USED.
6. R17 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 68 K OHM; RANGE = 47 K OHM - 100 K OHM.

Figure 10-16 Regulator/Timer Circuit Schematic (Sheet 1 of 2)

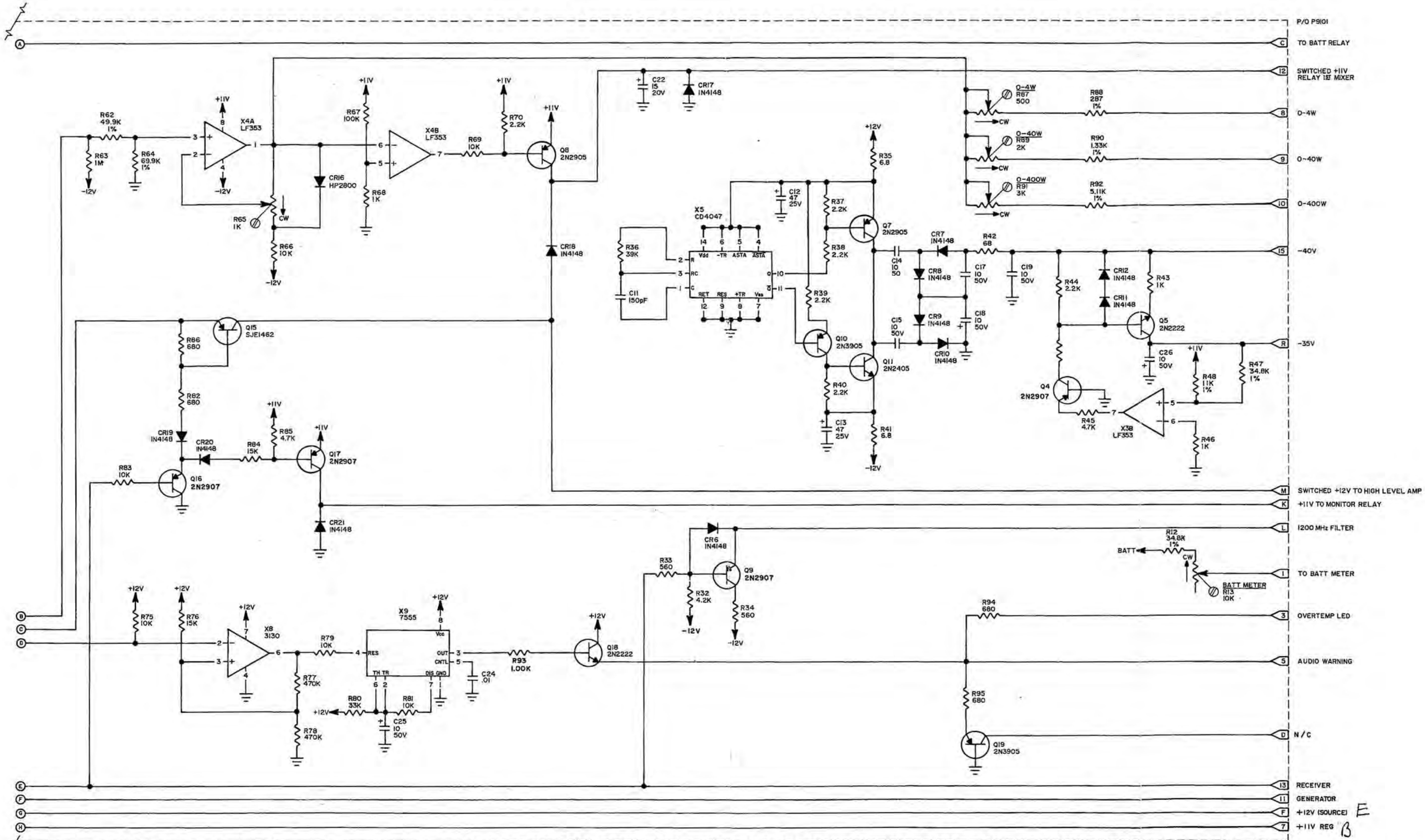
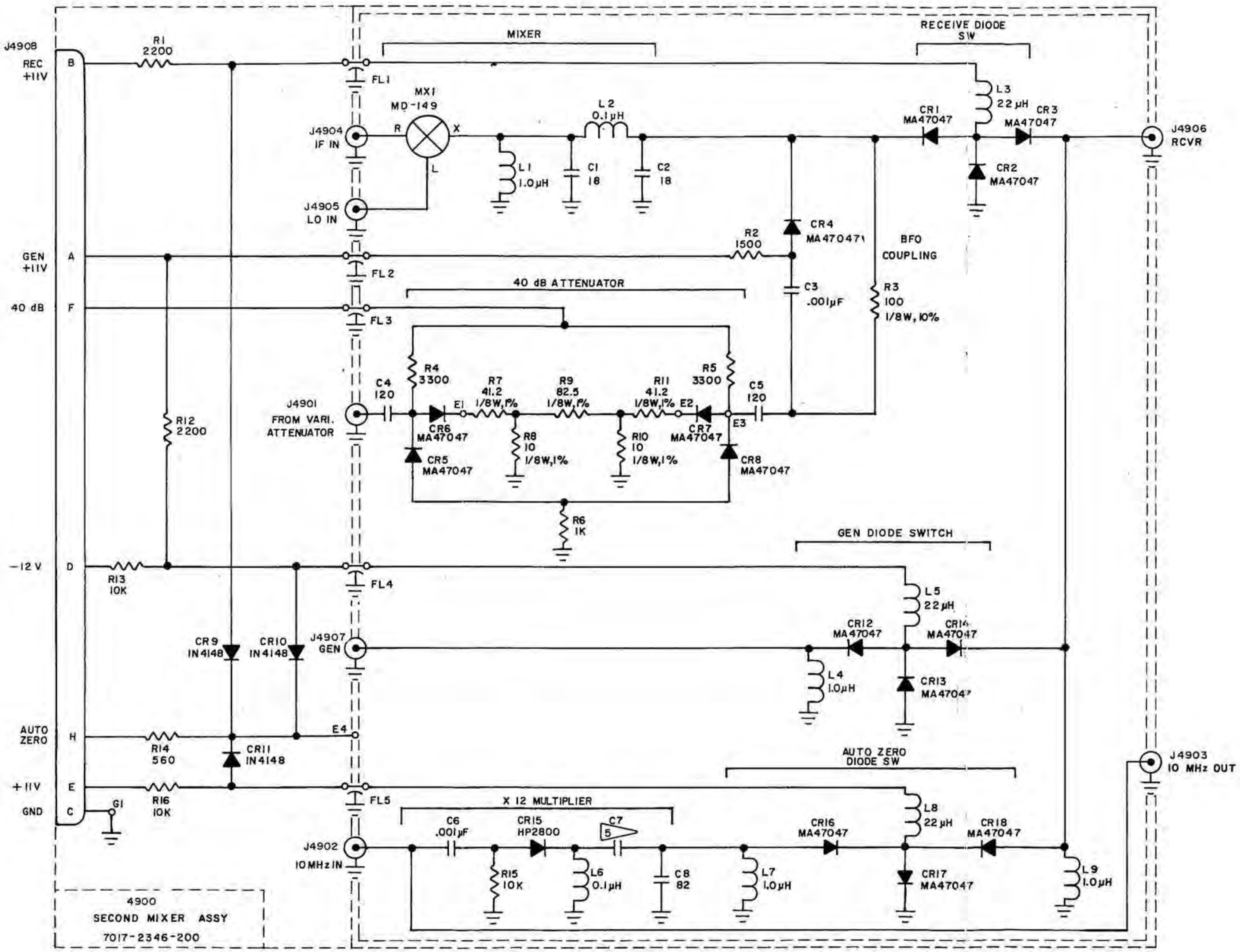


Figure 10-16 Regulator/Timer Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 4900; THEREFORE J1 IS DESIGNATED J4901).
5. C7 IS A SELECT AT TEST (S.A.T.) CAPACITOR. NOMINAL = 22 pF; RANGE = 18 pF TO 39 pF.

Figure 10-17 Second Mixer Circuit Schematic

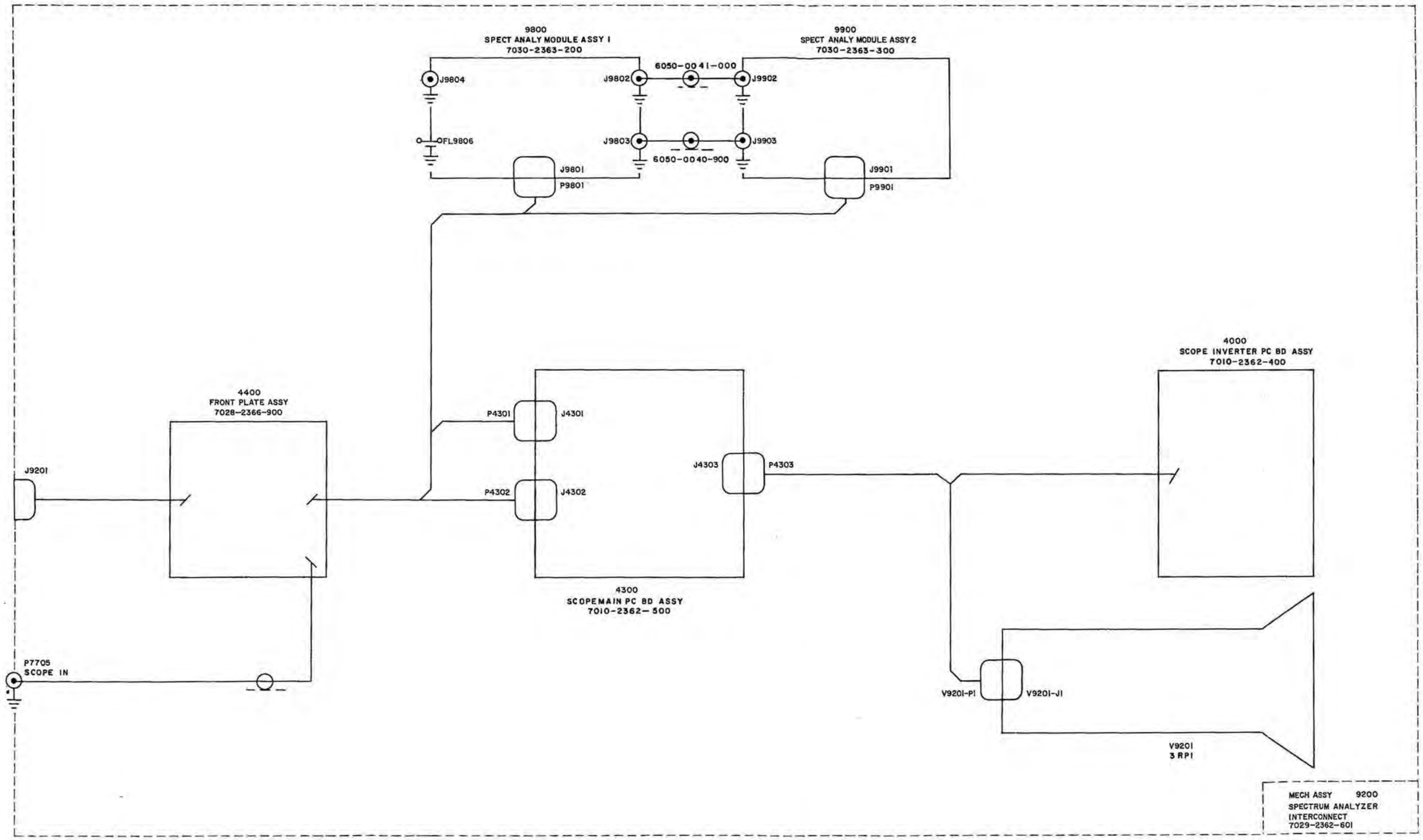
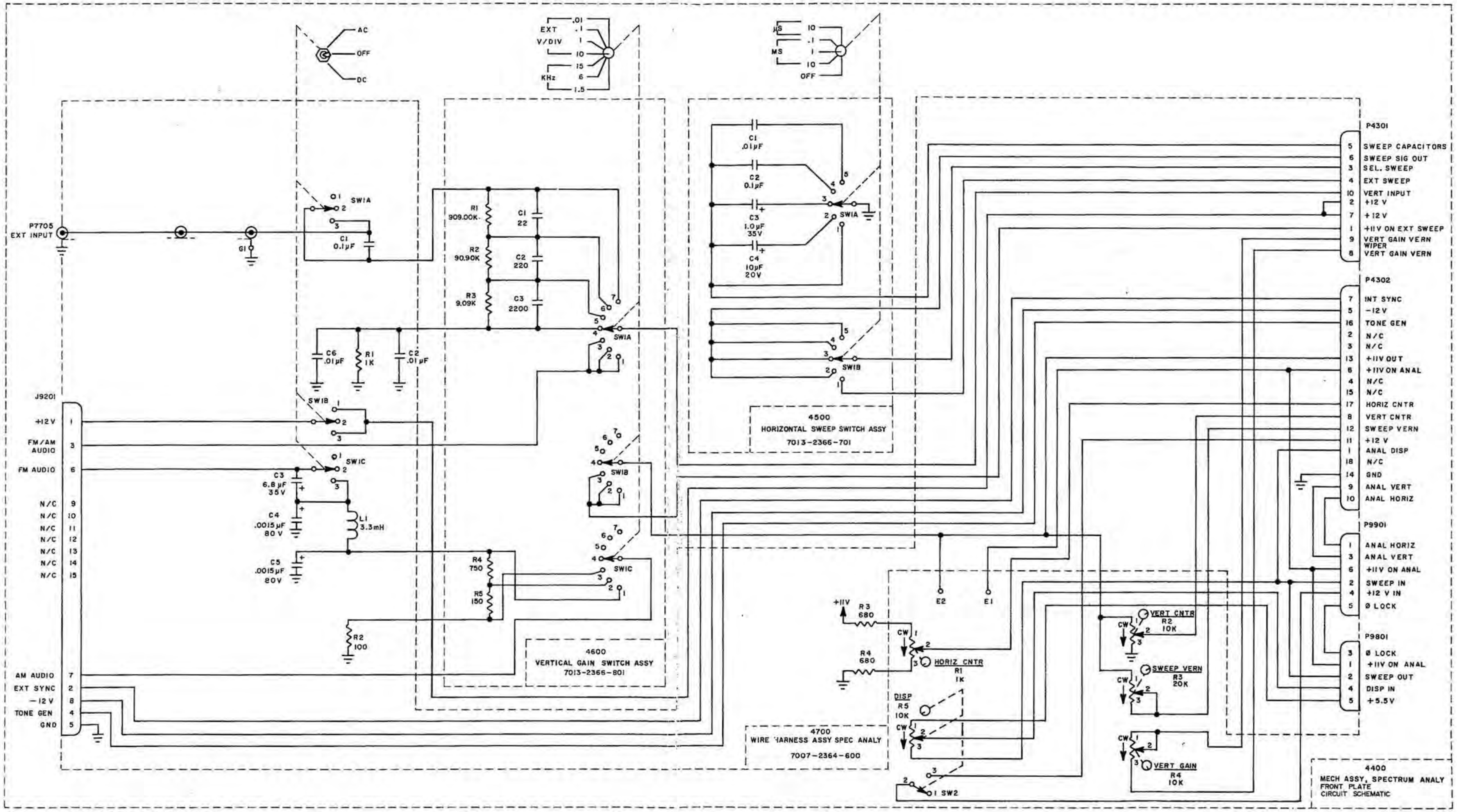


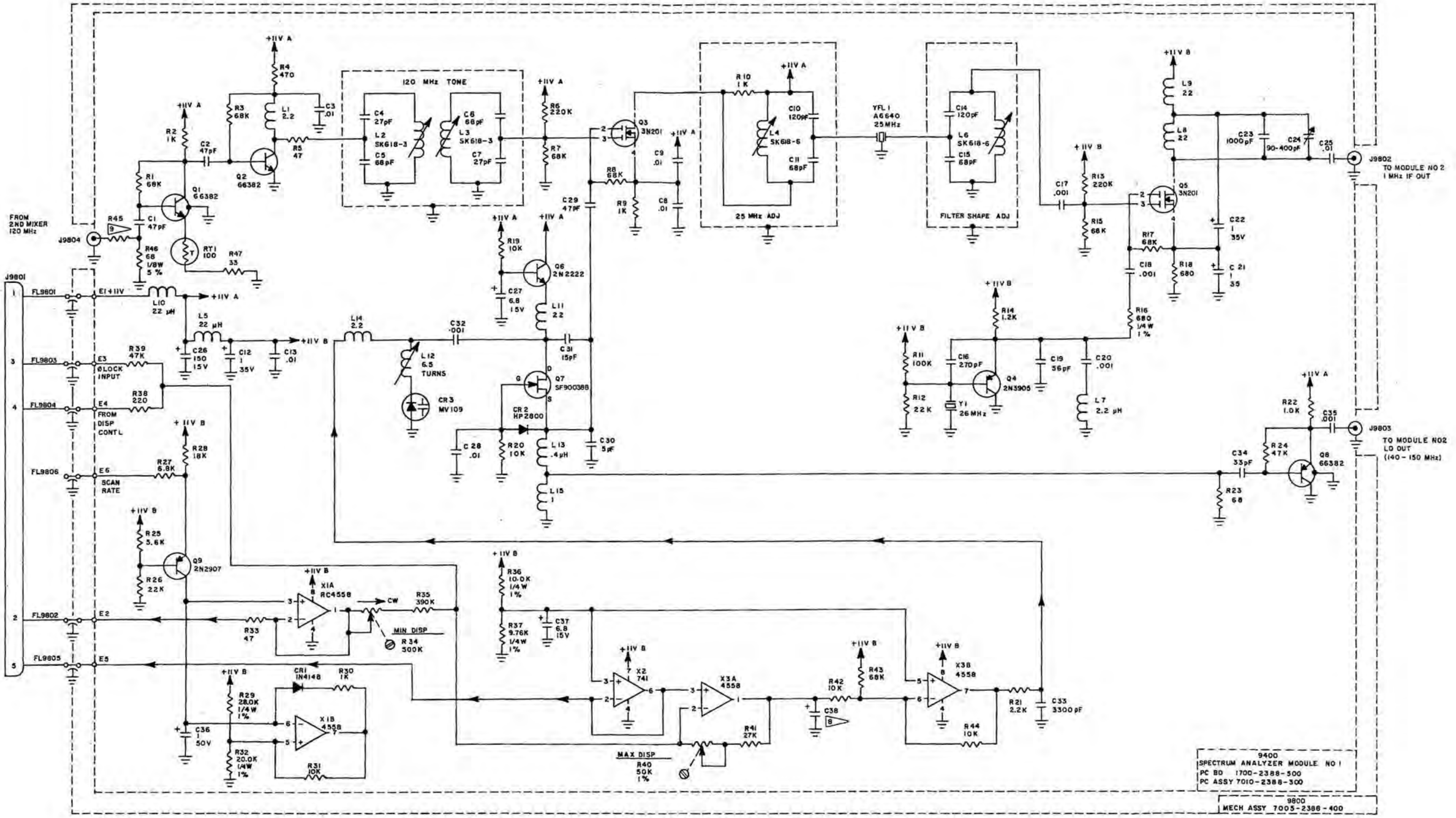
Figure 10-18 Spectrum Analyzer Interconnect



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. G1 IS PART OF SPECTRUM ANALYZER FRONT PLATE ASSEMBLY AND CARRIES A DESIGNATOR SERIES NUMBER OF 4400.
5. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES NUMBER (E.G. THIS SCHEMATIC CARRIES SERIES 4400, 4500, 4600 AND 4700; THEREFORE R1 ON ASSEMBLY 4400 IS DESIGNATED AS R4401).
6. DISPERSION CONTROL R4405, SW4402 AND ASSOCIATED WIRING SHOWN ON THIS SCHEMATIC ARE NOT PRESENT ON FM/AM-1100A MODELS.

Figure 10-19 Spectrum Analyzer Front Plate/Shield Circuit Schematic



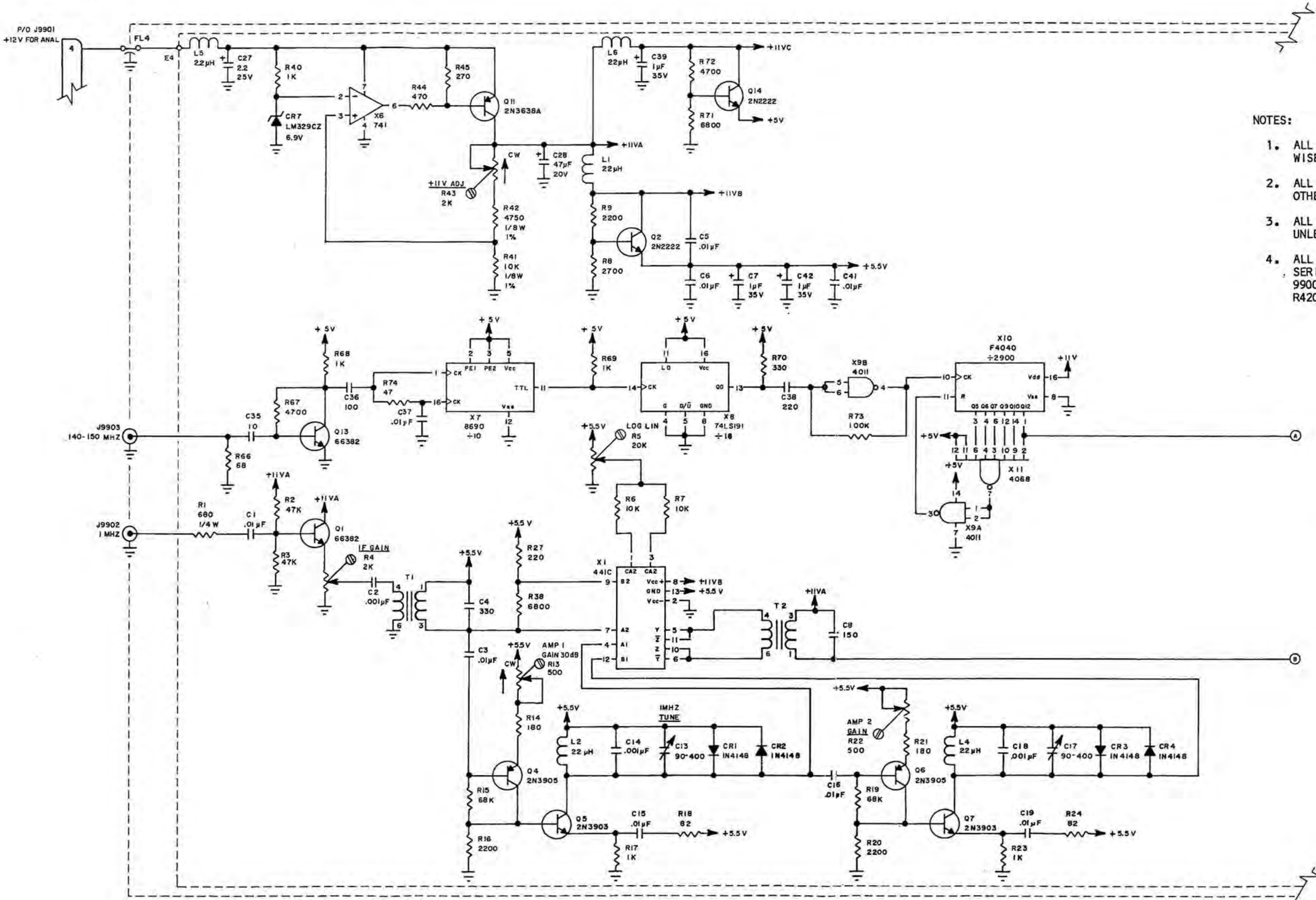
NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 9800 AND 9400; THEREFORE R1 IS DESIGNATED R9401).
4. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
5. NOT USED.
6. NOT USED.
7. NOT USED.

8. C38 IS A SELECT AT TEST (S.A.T.) CAPACITOR. NOMINAL = 3.3 µF, 15 V; RANGE = 13 µF - 6.8 µF.

9. R45 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 100 OHMS; RANGE = 33 - 150 OHMS.

Figure 10-20 Spectrum Analyzer Module #1 Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 9900 AND 4200; THEREFORE R1 IS DESIGNATED R4201).

Figure 10-21 Spectrum Analyzer Module #2 Circuit Schematic (Sheet 1 of 2)

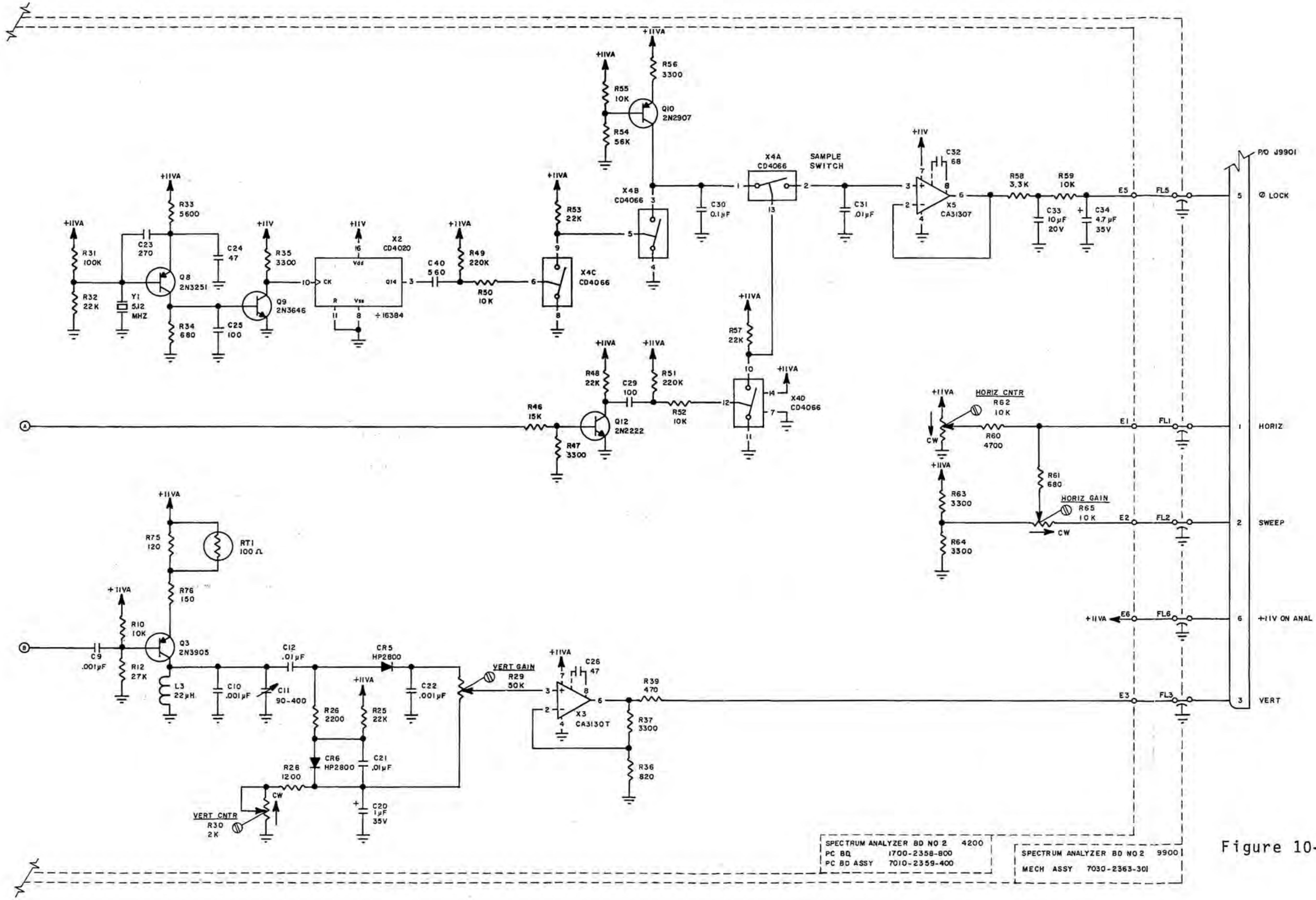
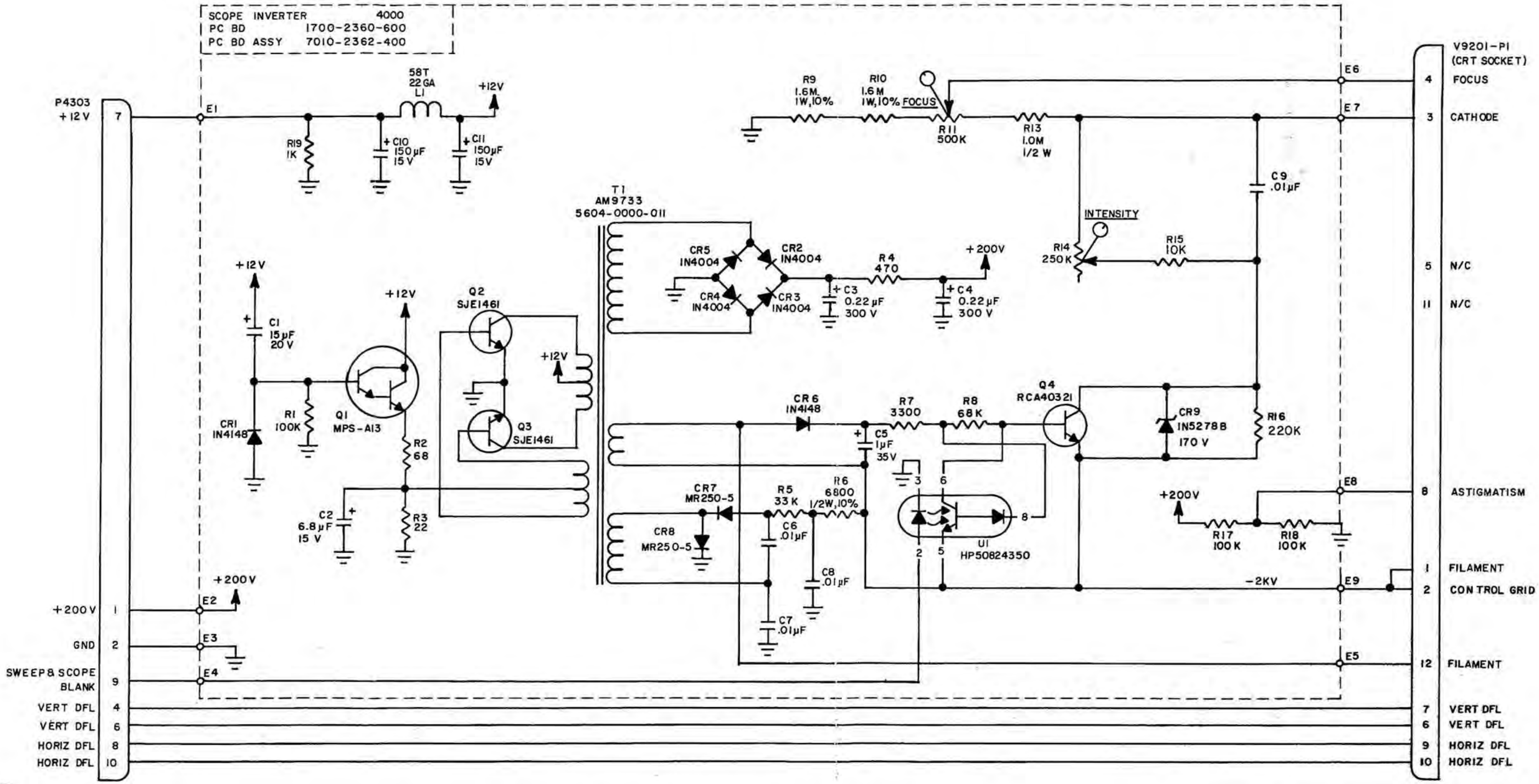


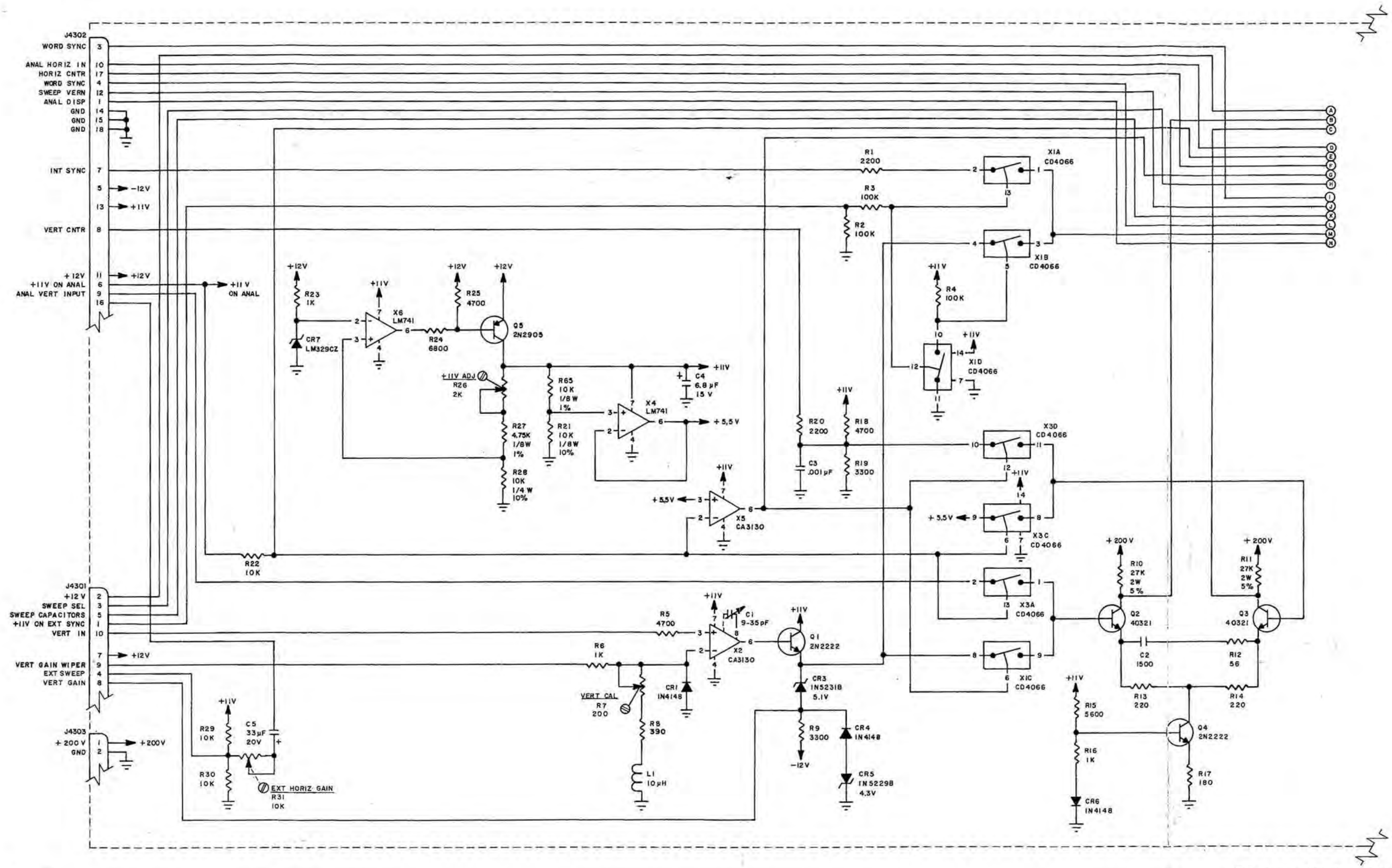
Figure 10-21 Spectrum Analyzer Module #2 Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 4000; THEREFORE R1 IS DESIGNATED R4001).

Figure 10-22 Spectrum Analyzer/Scope Inverter Board Circuit Schematic



NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 4300; THEREFORE R1 IS DESIGNATED R4301).

Figure 10-23 Spectrum Analyzer/Scope Main Board Circuit Schematic (Sheet 1 of 2)

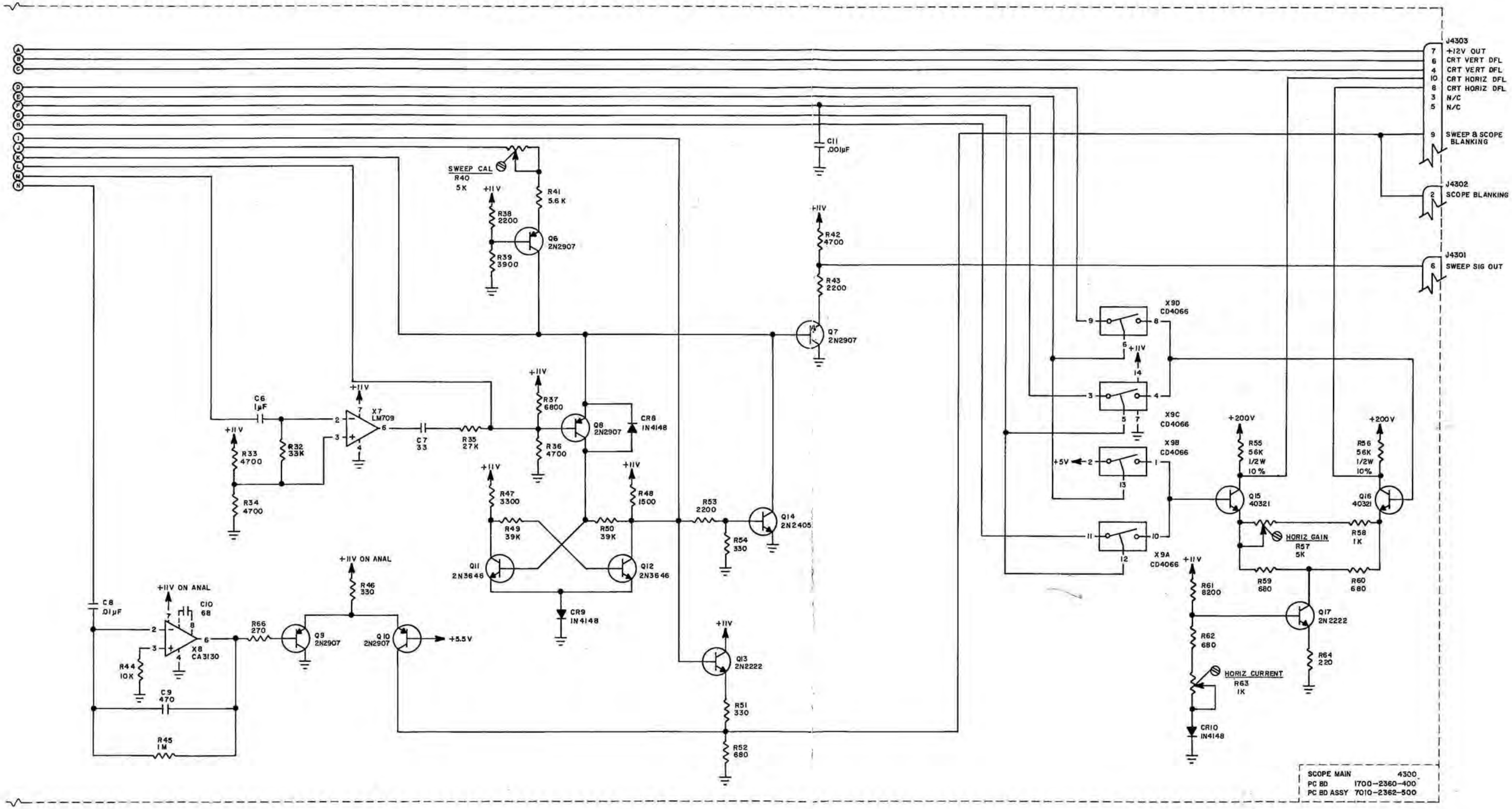
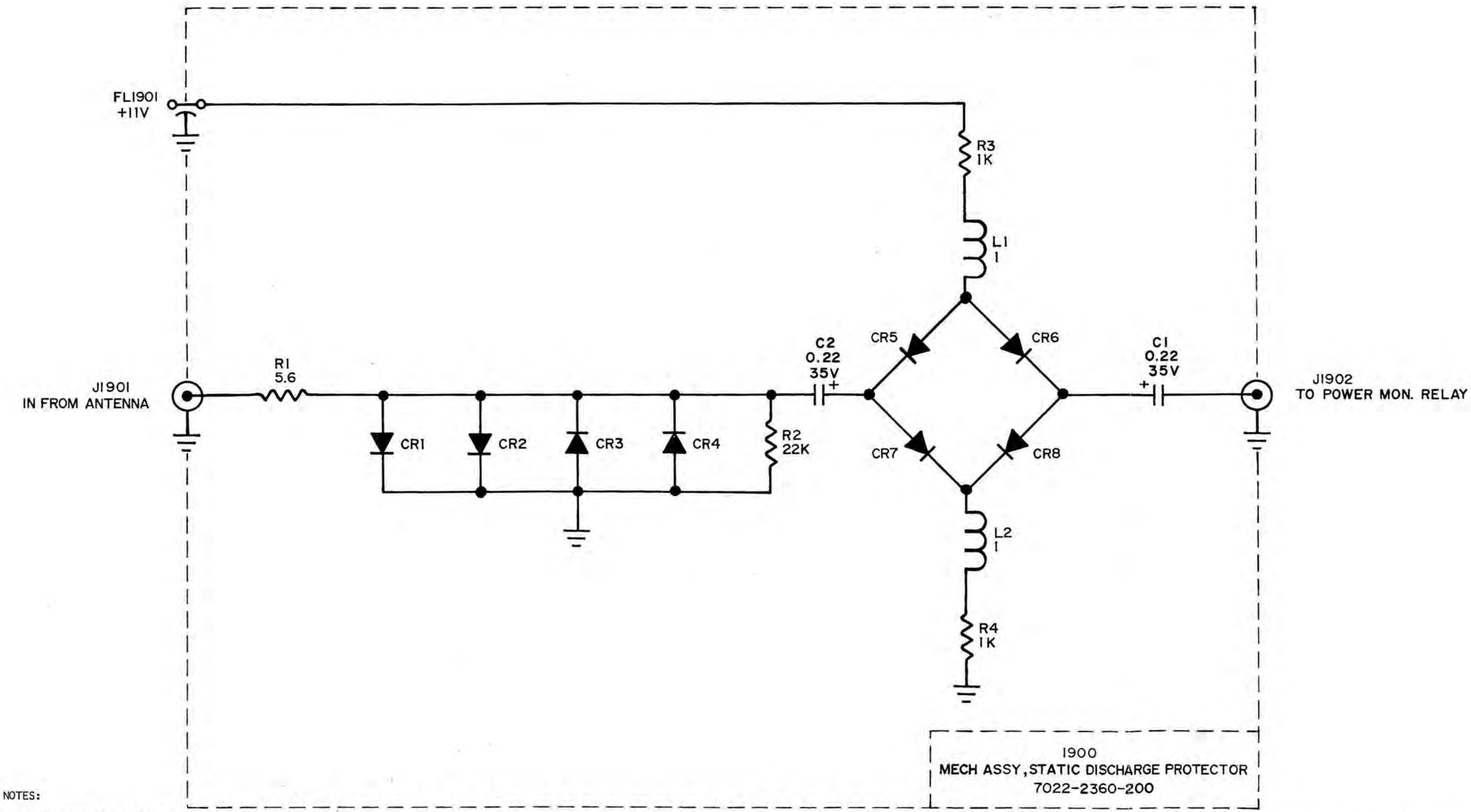


Figure 10-23 Spectrum Analyzer/Scope Main Board Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10%.
2. ALL RESISTANCE IS EXPRESSED IN OHMS.
3. ALL DIODES ARE MA-47047.
4. ALL INDUCTANCE IS EXPRESSED IN MILLIHENRYS.
5. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS.
6. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 1900; THEREFORE R1 IS DESIGNATED R1901).

Figure 10-24 Static Discharge Protect Circuit Schematic

NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 1300 AND 1400; THEREFORE J1 IS DESIGNATED J1301 AND R1 IS DESIGNATED R1401).

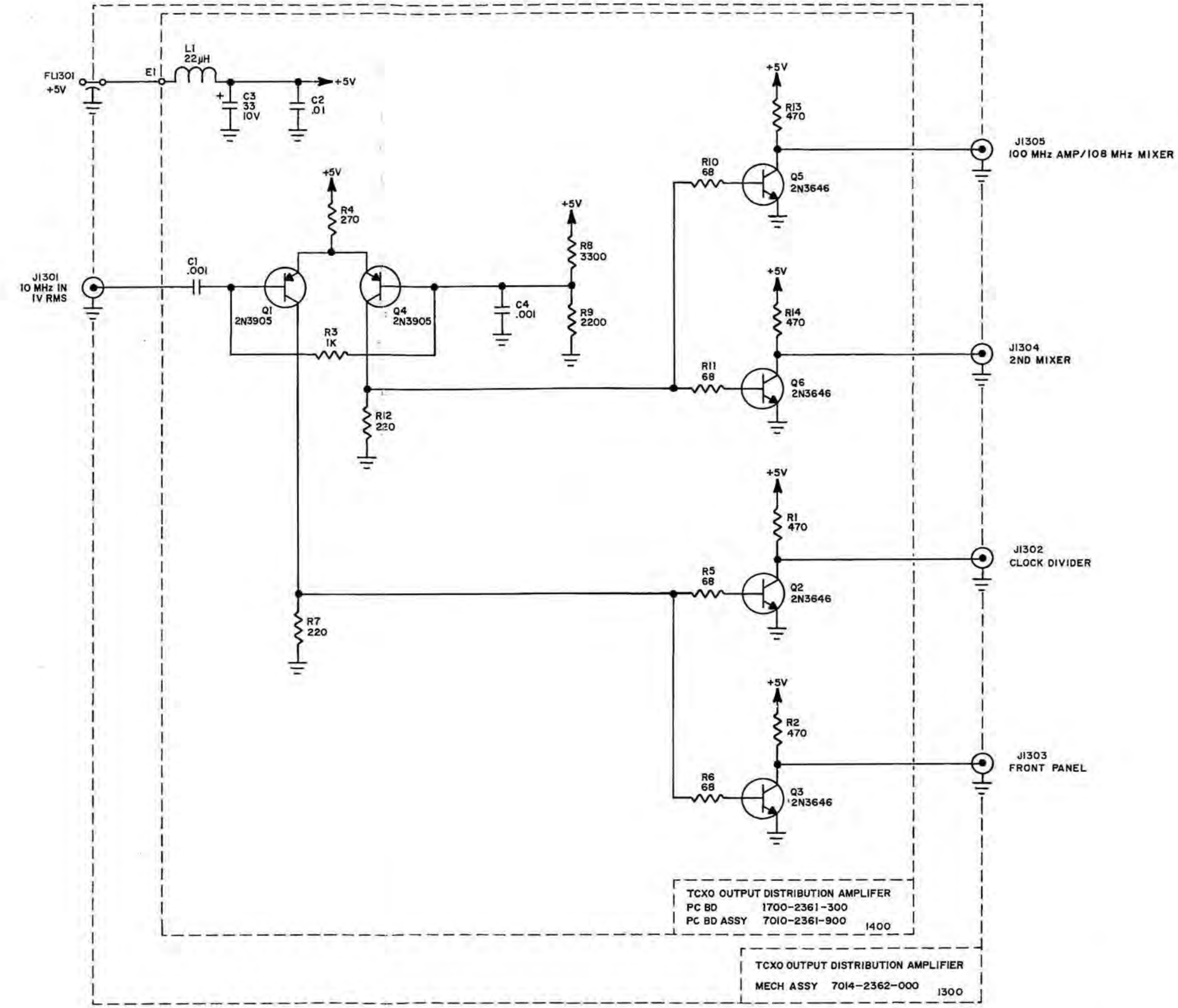
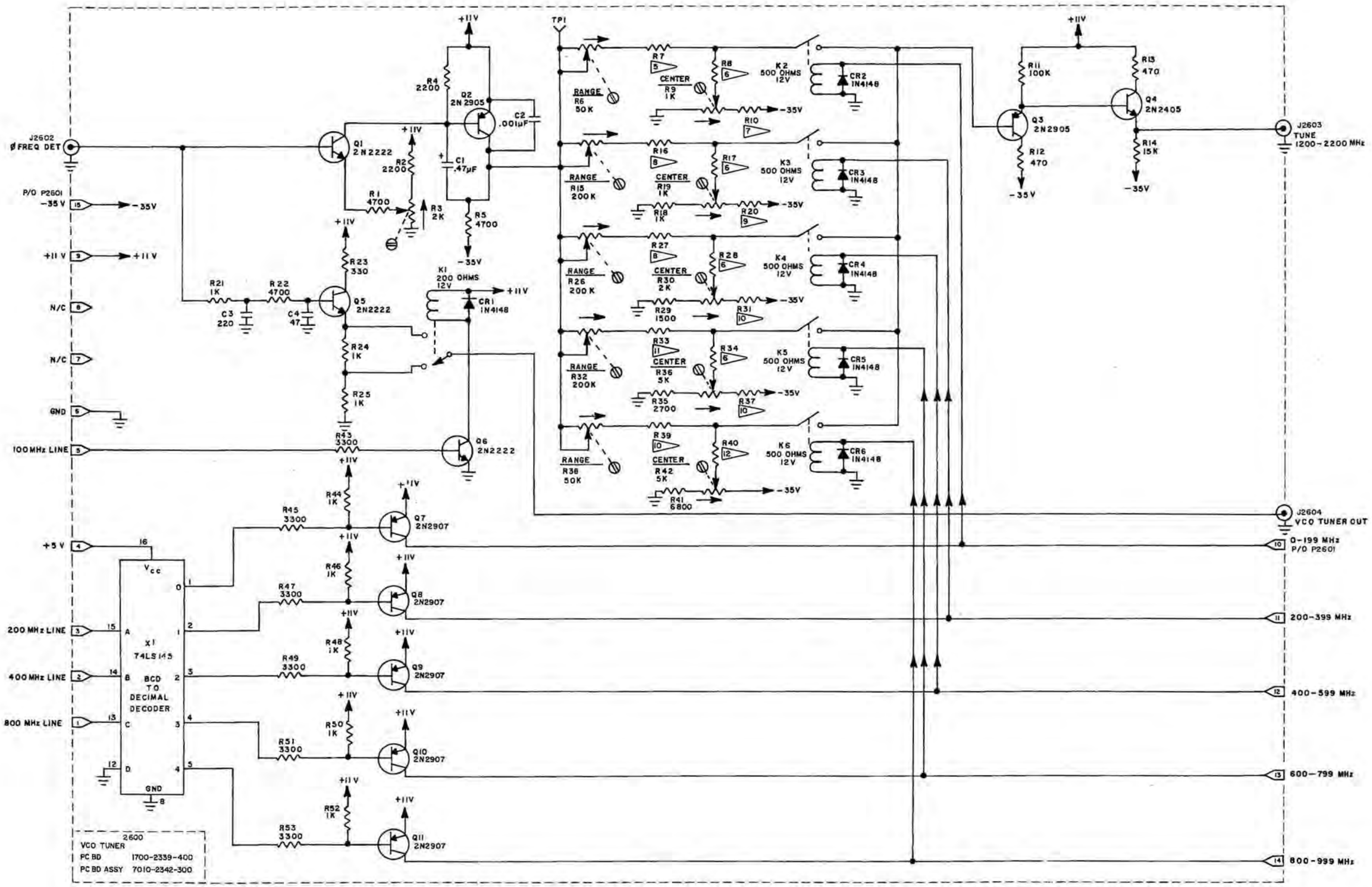


Figure 10-25 TCXO Output Distribution Amplifier Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.

2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

3. ALL CAPACITANCE IS EXPRESSED IN PICO-FARADS UNLESS OTHERWISE NOTED.

4. ALL REF NUMBERS CARRY AN ASSIGNED DESIGNATOR SERIES (E.G., THIS SCHEMATIC CARRIES SERIES 2600; THEREFORE, R1 IS DESIGNATED R2601).

5. R7 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 100K OHM;
RANGE = 68 K OHM - 150 K OHM.

6. R8, R17, R28 AND R34 ARE SELECT (S.A.T.) RESISTORS.
NOMINAL VALUE = 18 K OHM;
RANGE = 10 K OHM - 27 K OHM.

7. R10 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 15 K OHM;
RANGE = 12 K OHM - 33 K OHM.

8. R16 AND R27 ARE SELECT AT TEST (S.A.T.) RESISTORS.
NOMINAL VALUE = 180 K OHM;
RANGE = 150 K OHM - 270 K OHM.

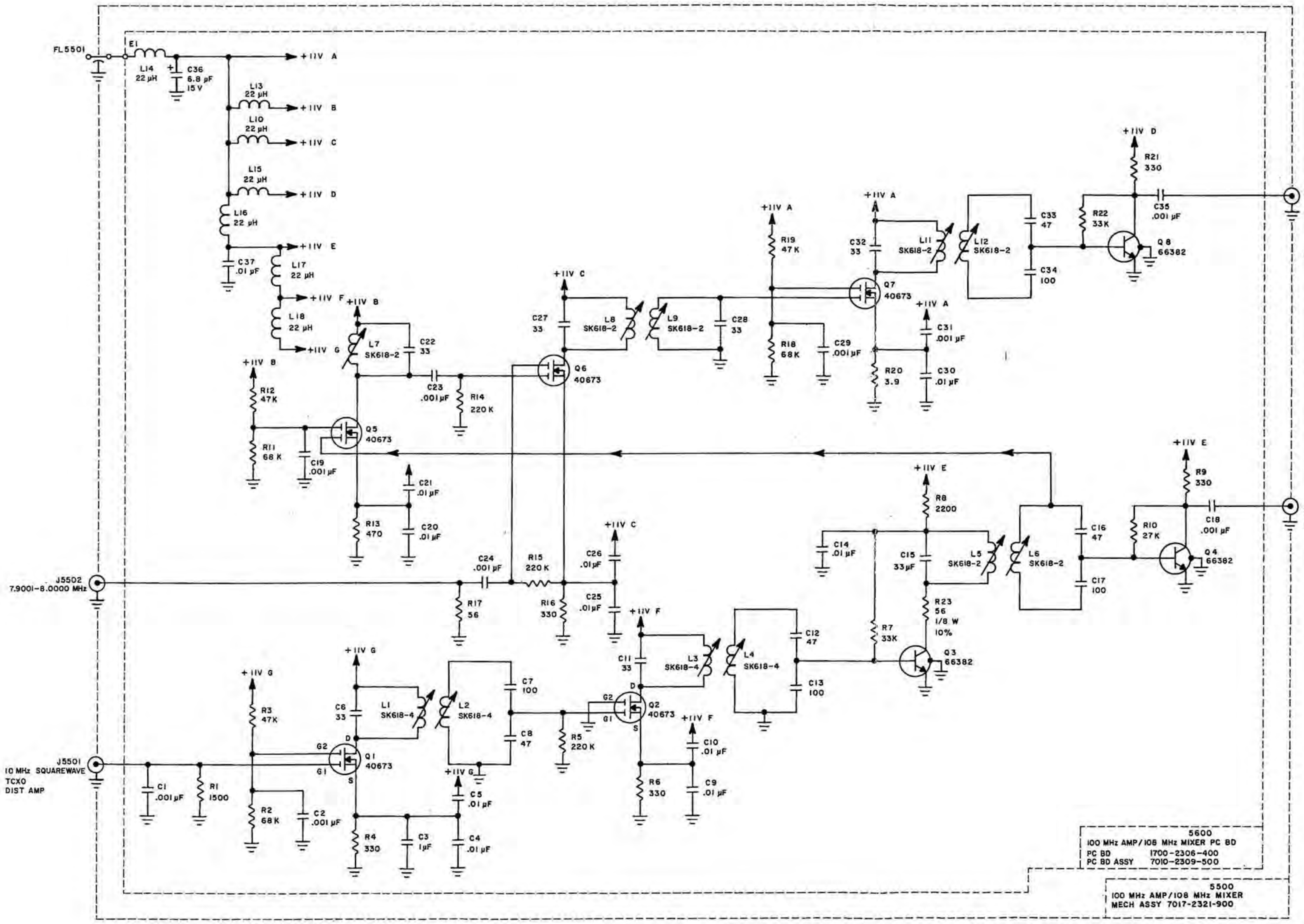
9. R20 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 18 K OHM;
RANGE = 6.8 K OHM - 22 K OHM.

10. R31, R37 AND R39 ARE SELECT AT TEST (S.A.T.) RESISTORS.
NOMINAL VALUE = 10 K OHM;
RANGE = 6.8 K - 22 K OHM.

11. R33 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 82 K OHM.
RANGE = 56 K OHM - 120 K OHM.

12. R40 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 27 K OHM;
RANGE = 18 K OHM - 39 K OHM.

Figure 10-26 VCO Tuner Board Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 5500 AND 5600; THEREFORE J1 IS DESIGNATED J5501 AND R1 IS DESIGNATED R5601.

Figure 10-27 100 MHz Amplifier/108 MHz Mixer Circuit Schematic

NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 5000 AND 5100; THEREFORE J1 IS DESIGNATED J5000 AND R1 IS DESIGNATED R5101).
5. ALL INDUCTORS ARE SK618-2 UNLESS OTHERWISE NOTED.

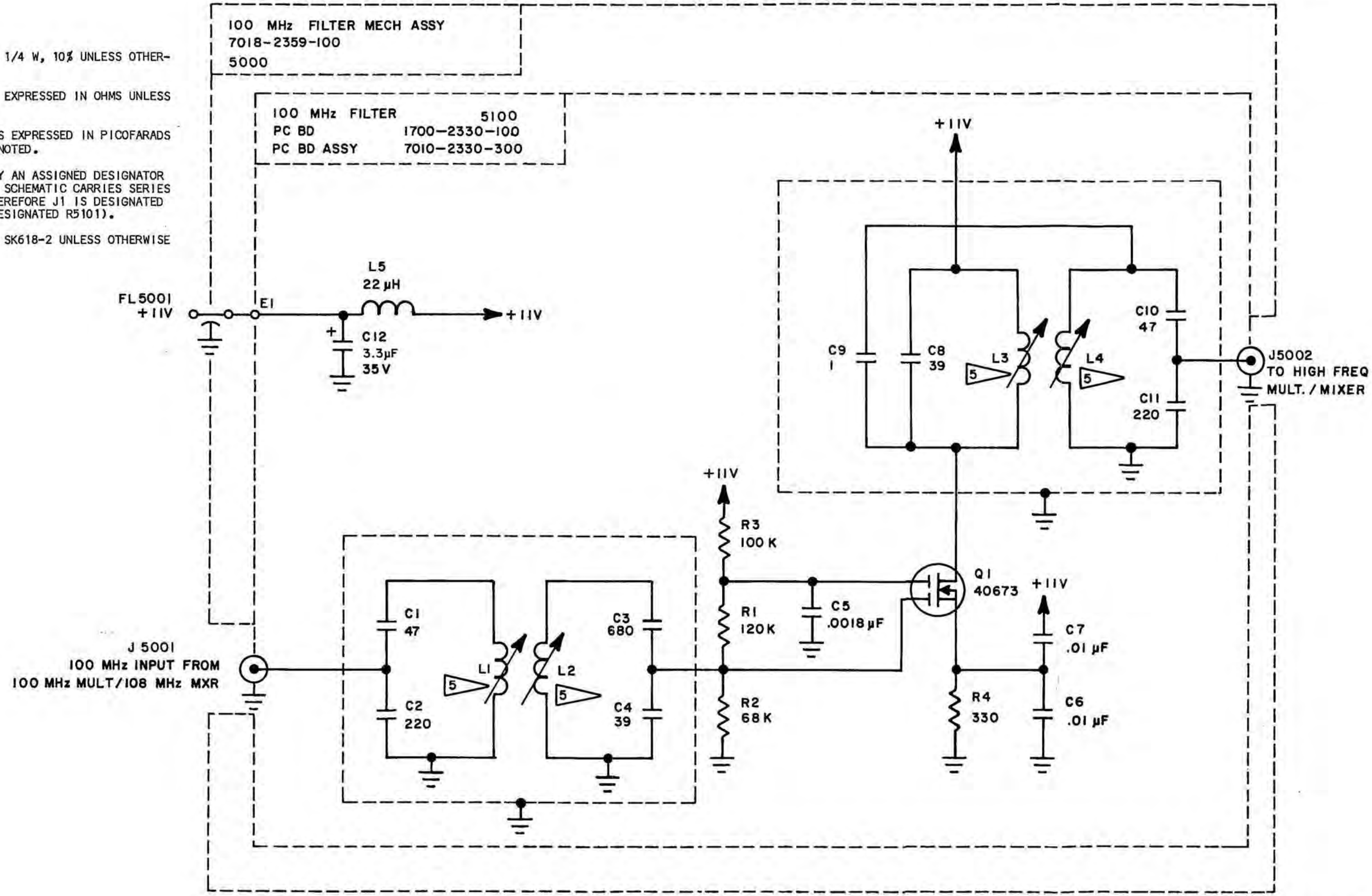


Figure 10-28 100 MHz Filter Circuit Schematic

NOTE:

1. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 1600; THEREFORE J1 IS DESIGNATED J1601).

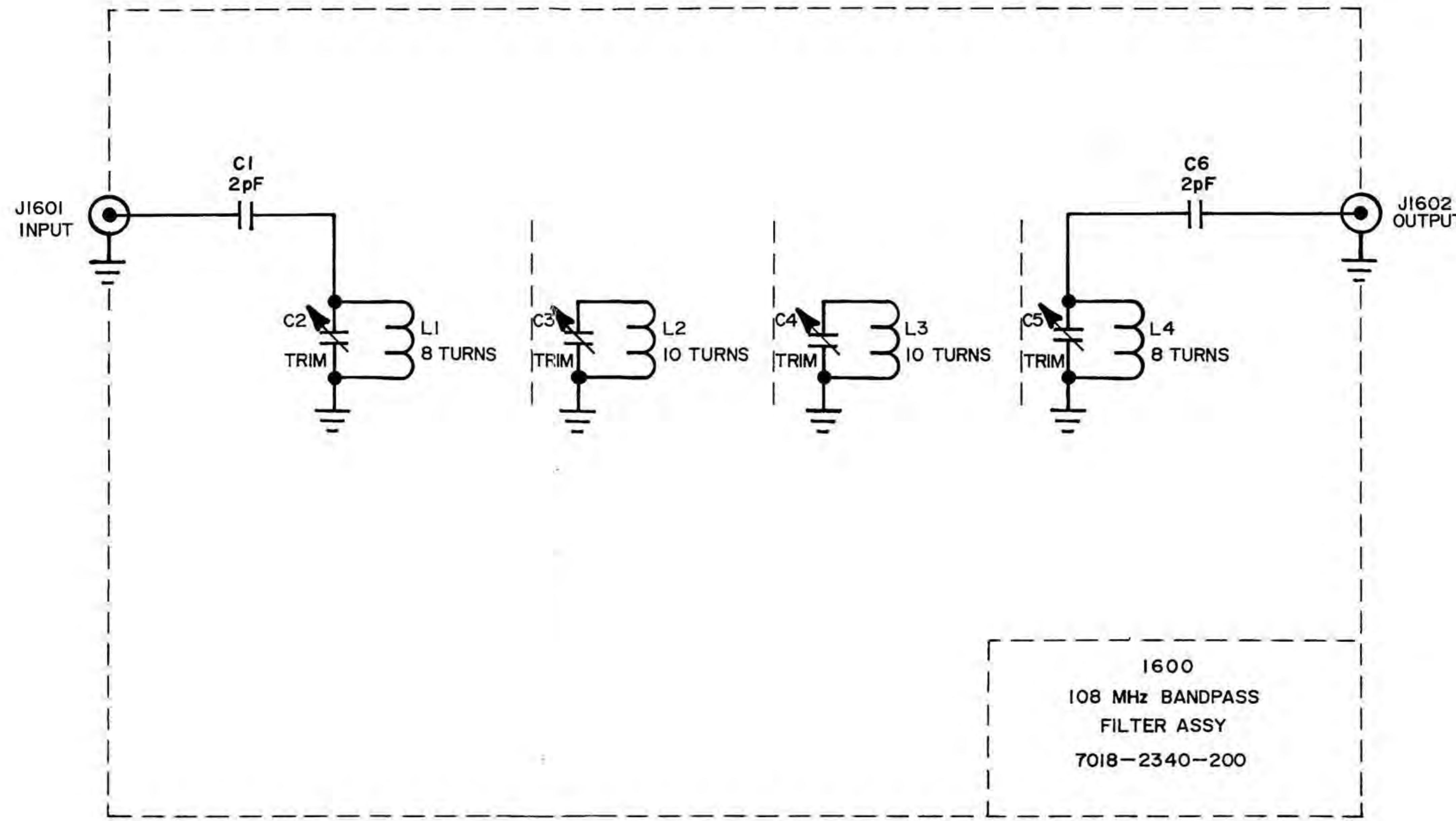
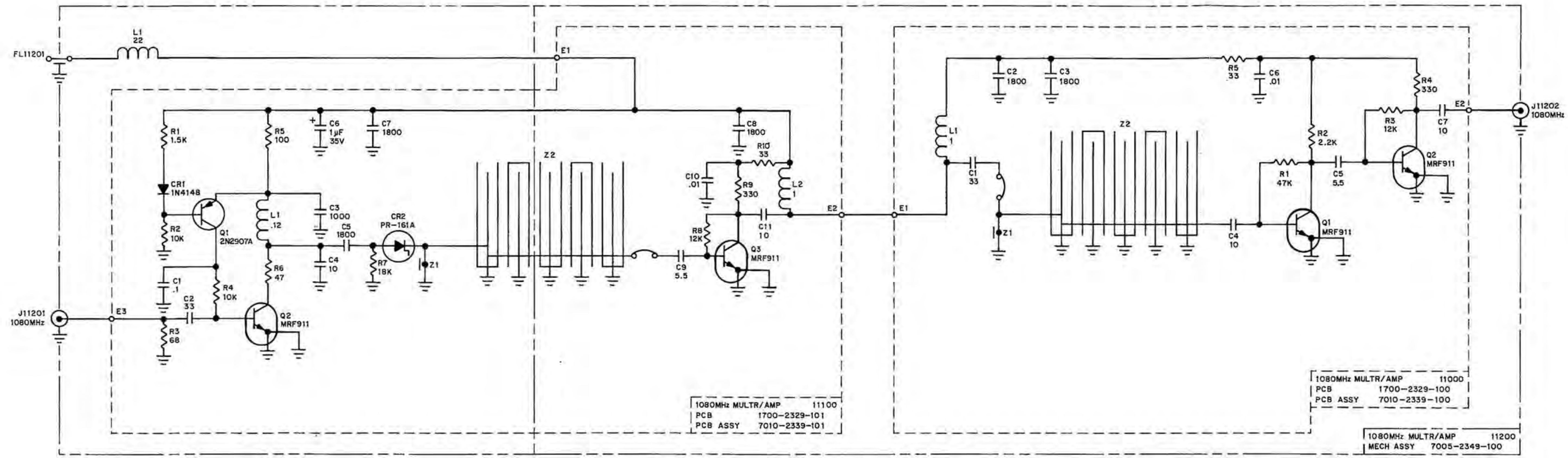


Figure 10-29 100 MHz Bandpass Filter Circuit Schematic



NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

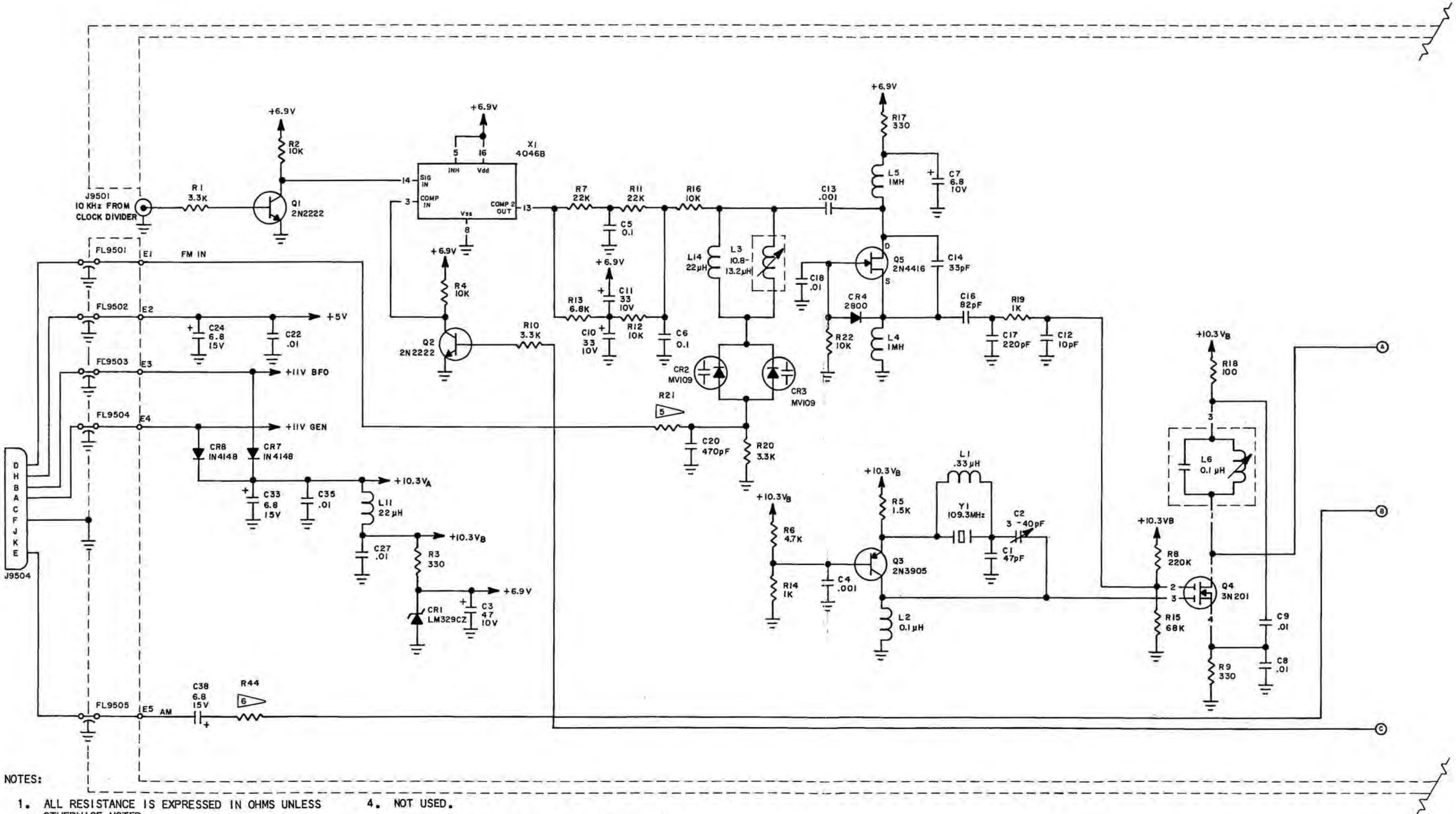
2. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.

3. ALL CAPACITANCE IS EXPRESSED IN PICO-FARADS UNLESS OTHERWISE NOTED.

4. ALL INDUCTANCE IS EXPRESSED IN MICROHENRYS UNLESS OTHERWISE NOTED.

5. ALL REF NUMBERS CARRY AN ASSIGNED DESIGNATOR SERIES (E.G., THIS SCHEMATIC CARRIES SERIES 11000 FOR 7010-2339-100; 11100 FOR 7010-2339-101; 11200 FOR 7005-2349-100; THEREFORE, R1 IS DESIGNATED R11001, ETC.).

Figure 10-30 1080 MHz Multiplier/Amplifier Circuit Schematic



NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

2. ALL CAPACITANCE IS EXPRESSED IN MICROFARADS UNLESS OTHERWISE NOTED.

3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 9500 AND 9600; THEREFORE J1 IS DESIGNATED J9501 AND R1 IS DESIGNATED R9601).

4. NOT USED.

5. R21 IS A S.A.T. RESISTOR. NOMINAL = 39KΩ; RANGE = 27 TO 68 KΩ.

6. R44 IS A S.A.T. RESISTOR. NOMINAL = 18KΩ; RANGE = 15 TO 33 KΩ.

Figure 10-31 120 MHz Generator Circuit Schematic (Sheet 1 of 2)

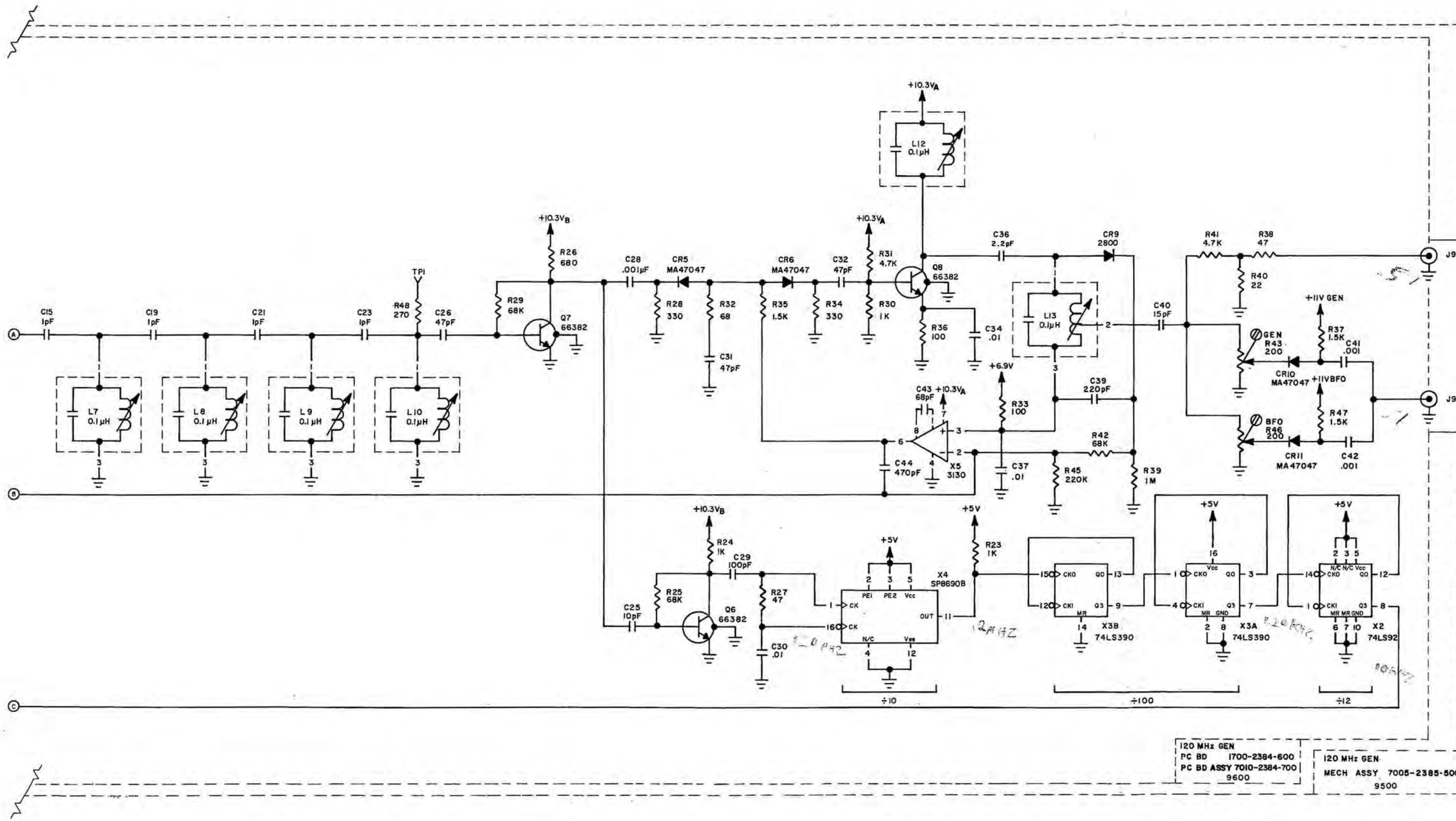
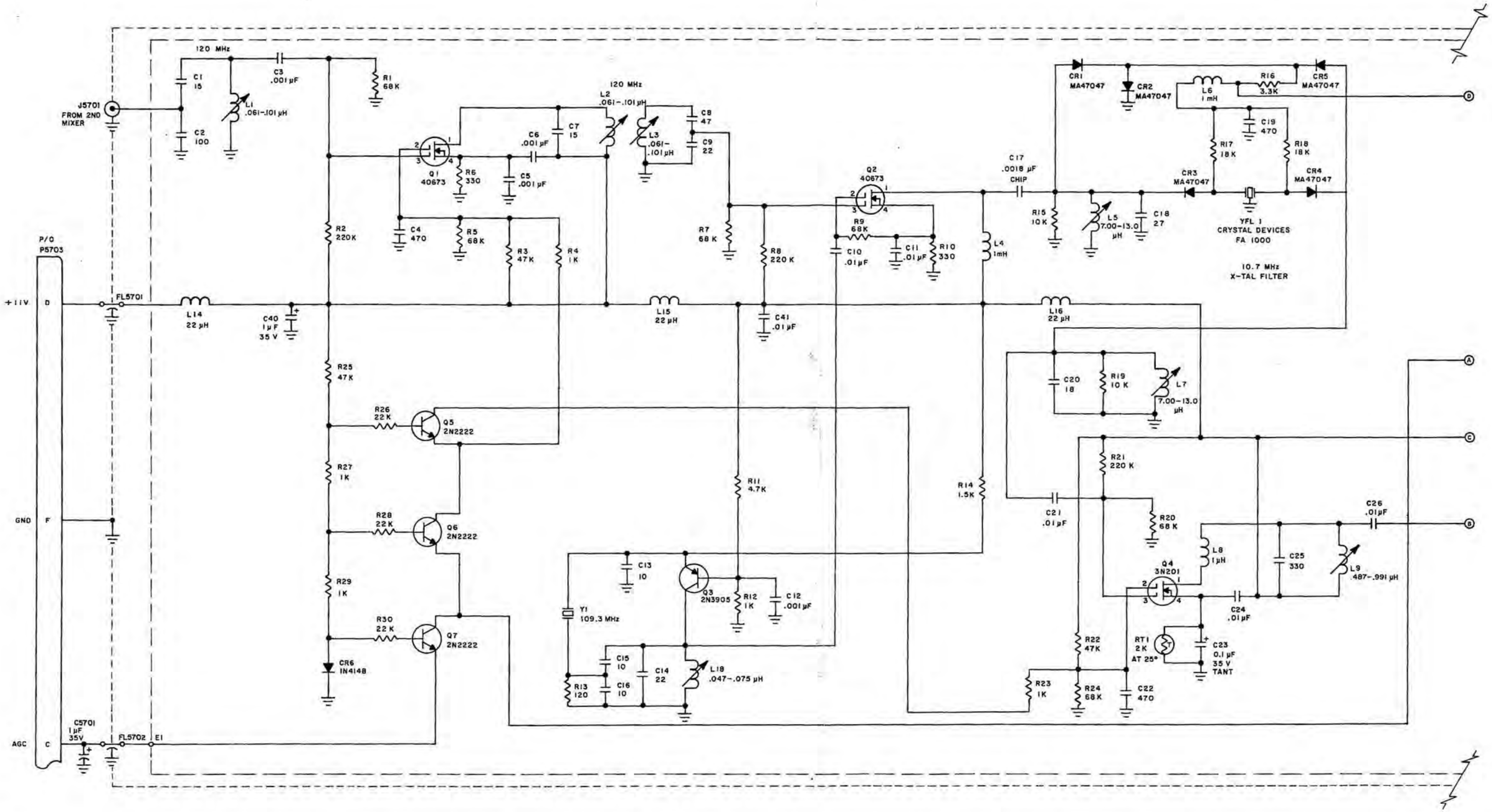


Figure 10-31 120 MHz Generator Circuit Schematic (Sheet 2 of 2)



NOTES:

1. NOT USED.
2. REFERENCE NO. NOT USED - R36.
3. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.
4. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
5. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.
6. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 5700 AND 5800; THEREFORE FL1 IS DESIGNATED FL5701 AND R1 IS DESIGNATED R5801).
7. R45 IS SET AT TEST (S.A.T.) NOMINAL = 300 OHM; RANGE = 270 OHM - 390 OHM.

Figure 10-32 120 MHz Receiver Circuit Schematic (Sheet 1 of 2)

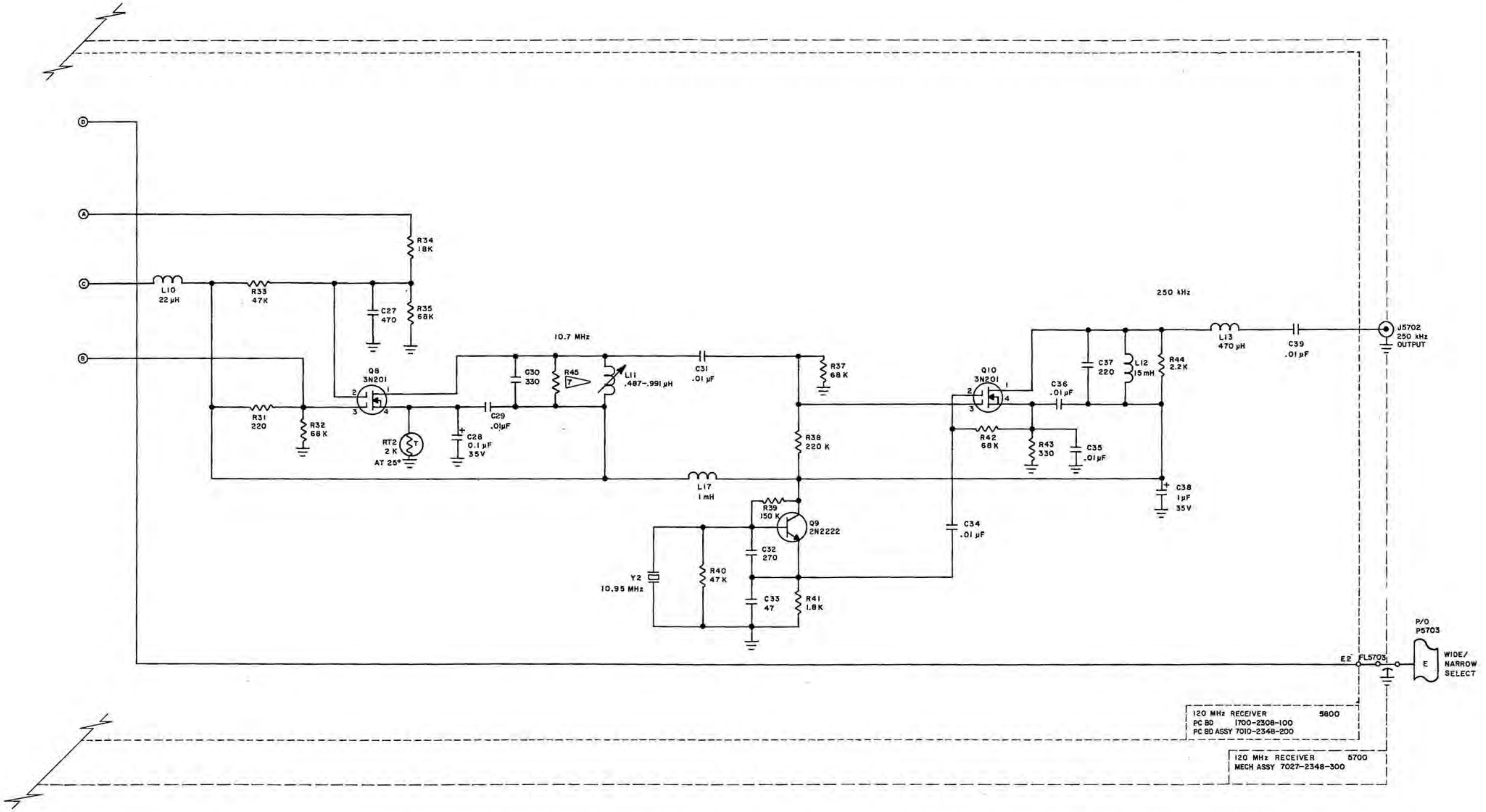
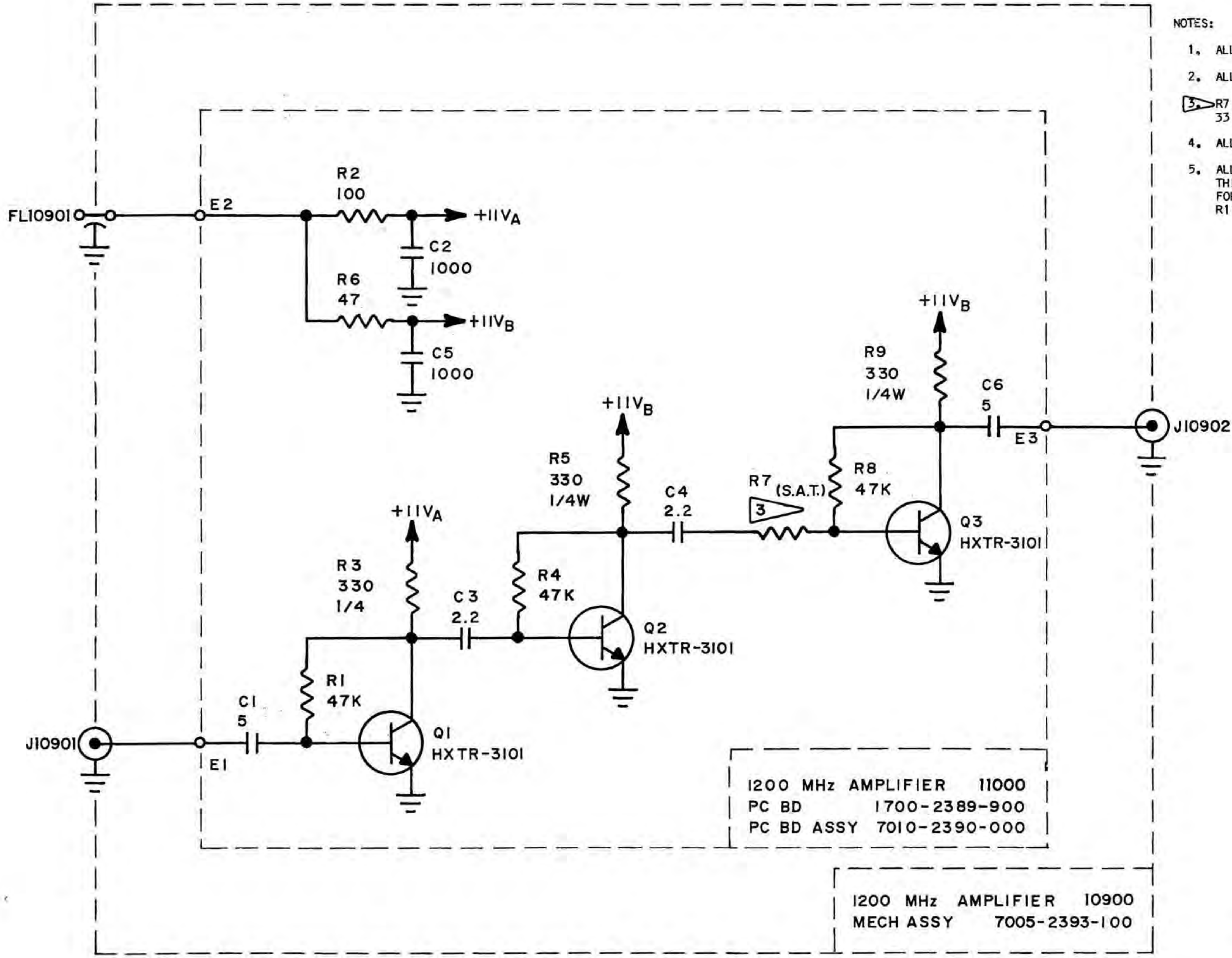


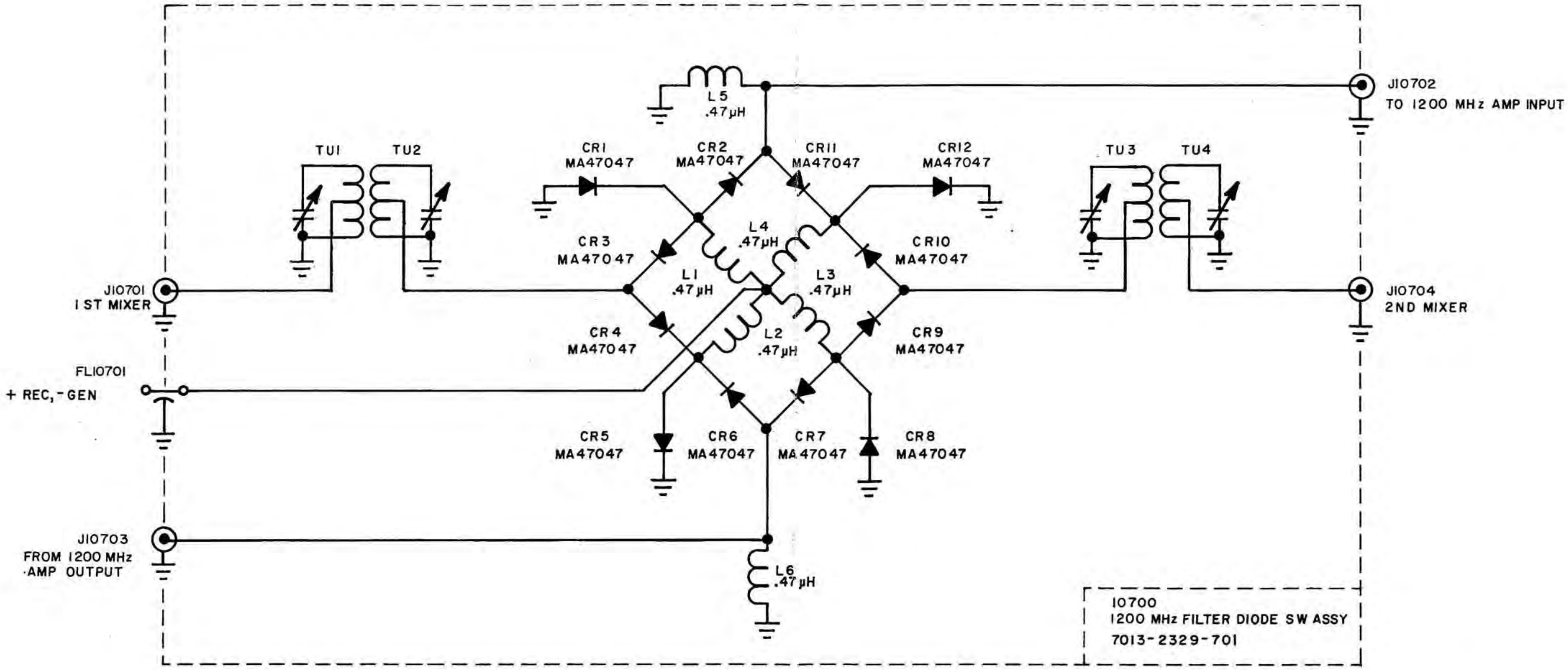
Figure 10-32 120 MHz Receiver Circuit Schematic (Sheet 2 of 2)



NOTES:

1. ALL RESISTORS ARE 10%, 1/8 W.
2. ALL RESISTANCE IS EXPRESSED IN OHMS.
3. R7 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 33 OHMS; RANGE = 10-120 OHMS.
4. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS.
5. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 10900 AND 11000; THEREFORE J1 IS DESIGNATED J10901 AND R1 IS DESIGNATED R11001).

Figure 10-33 1200 MHz Amplifier Circuit Schematic



NOTES:

1. ALL REF. NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 10700; THEREFORE CR1 IS DESIGNATED CR10701.

Figure 10-34 1200 MHz Filter & Diode Switch Circuit Schematic

NOTES:

1. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.
2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.
3. ALL CAPACITANCE IS EXPRESSED IN PICO-FARADS UNLESS OTHERWISE NOTED.
4. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 800 AND 900; THEREFORE J1 IS DESIGNATED J801 AND R1 IS DESIGNATED R901).
5. L3, L4, L5, L6 AND L7 ARE 1800-2359-700.
6. L2 IS FORMED BY ATTACHING 22 GA BUS WIRE TO LEAD OF R13. LEAD EXTENDS (PARALLEL TO BOARD) TO POINT ADJACENT TO BASE OF Q2. THEN LEAD IS BENT IN A VERTICAL LOOP AND SOLDERED TO GROUND PLANE AT POINT ADAJCENT TO COLLECTOR OF Q2.
7. L8 IS FORMED BY METAL LOOP SOLDERED TO CATHODE OF CR1.
8. R19 AND R22 ARE SELECT AT TEST (S.A.T.) RESISTORS.
NOMINAL VALUE = 22 K OHM;
RANGE = 6.8 K OHM - 22 K OHM.
9. R12 IS A SELECT AT TEST (S.A.T.) RESISTOR.
NOMINAL VALUE = 220 OHM;
RANGE = 68 OHM - 330 OHM.

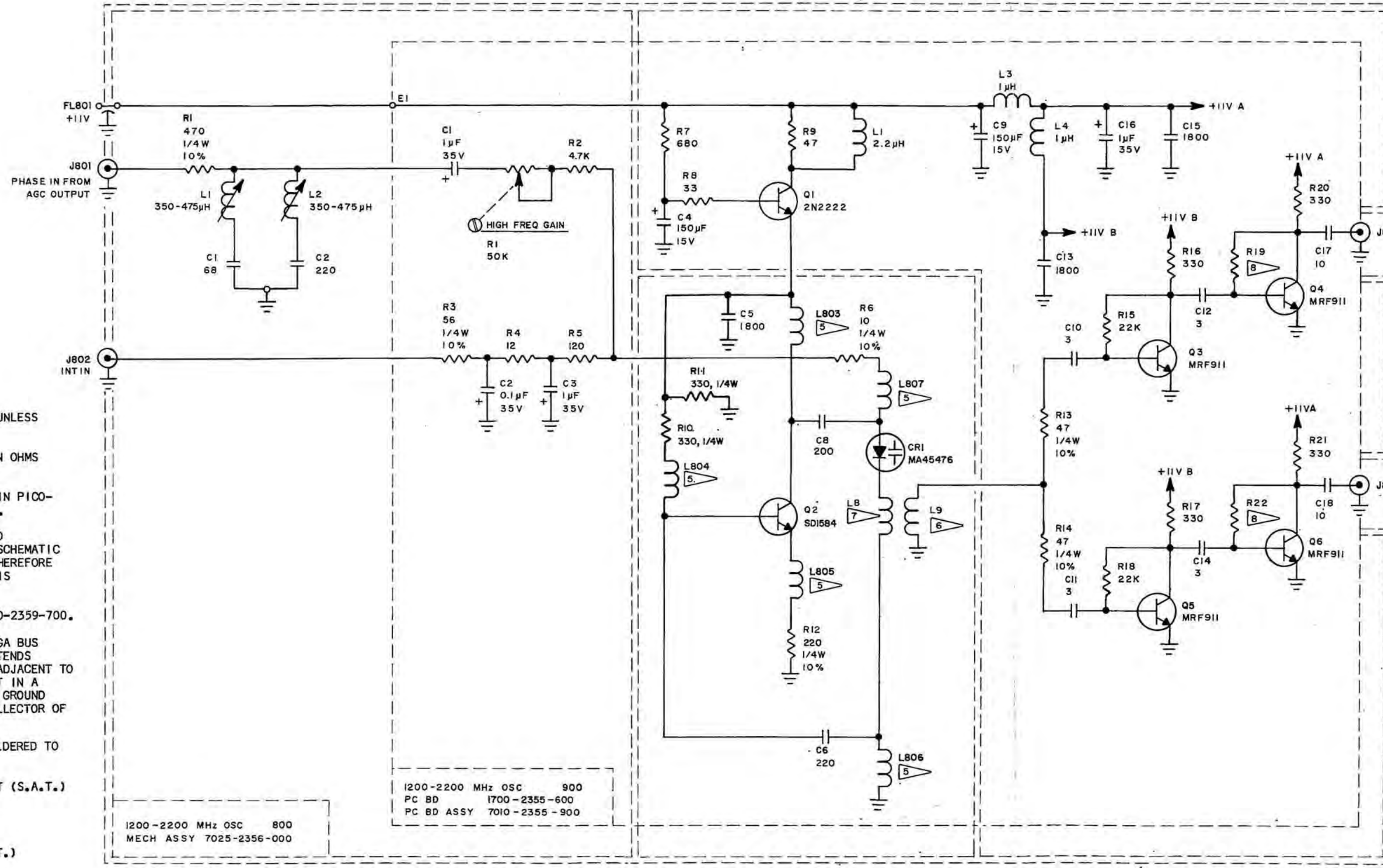
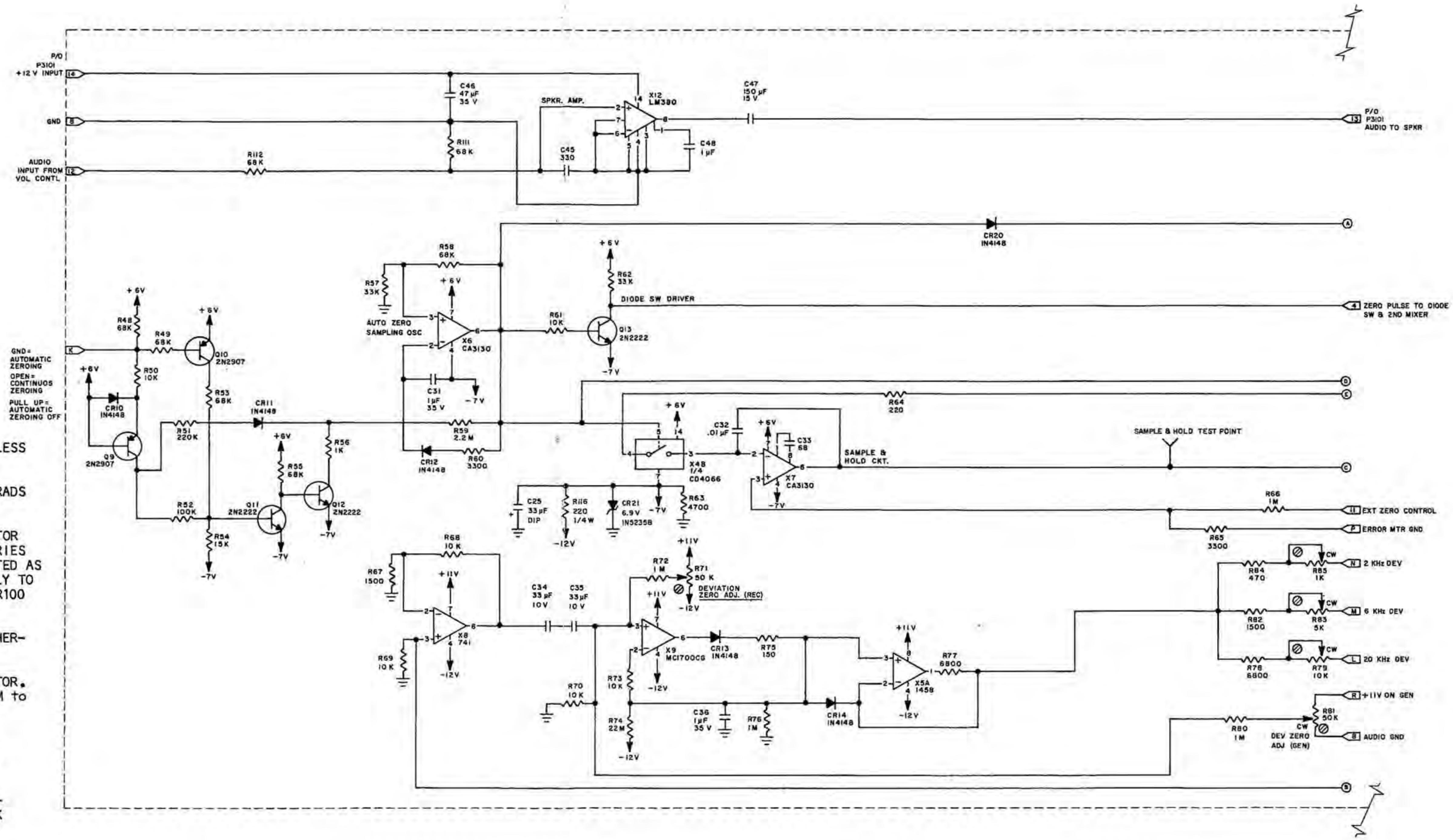


Figure 10-35 1200-2200 MHz Oscillator Circuit Schematic



NOTES:

1. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

2. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.

3. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 3100 AND 7400; THEREFORE R1 IS DESIGNATED AS R3101. THE 7400 DESIGNATOR APPLIES ONLY TO RESISTORS FROM R100 AND ON; THEREFORE R100 IS DESIGNATED AS R7401).

4. ALL RESISTORS ARE 1/8 W, 10% UNLESS OTHERWISE NOTED.

5. R30 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 2.32 K OHM; RANGE = 2.1 K OHM to 2.32 K OHM.

6. R7413 MAY OR MAY NOT BE INSTALLED AS NECESSARY. NOMINAL VALUE = 680 K OHM; RANGE = 680 K OHM TO 10 M OHM.

7. R88 IS A SELECT AT TEST (S.A.T.) RESISTOR. NOMINAL = 120 K OHM; RANGE = 82 K OHM TO 180 K OHM.

Figure 10-36 250 kHz IF/MON/AUDIO Circuit Schematic (Sheet 1 of 3)

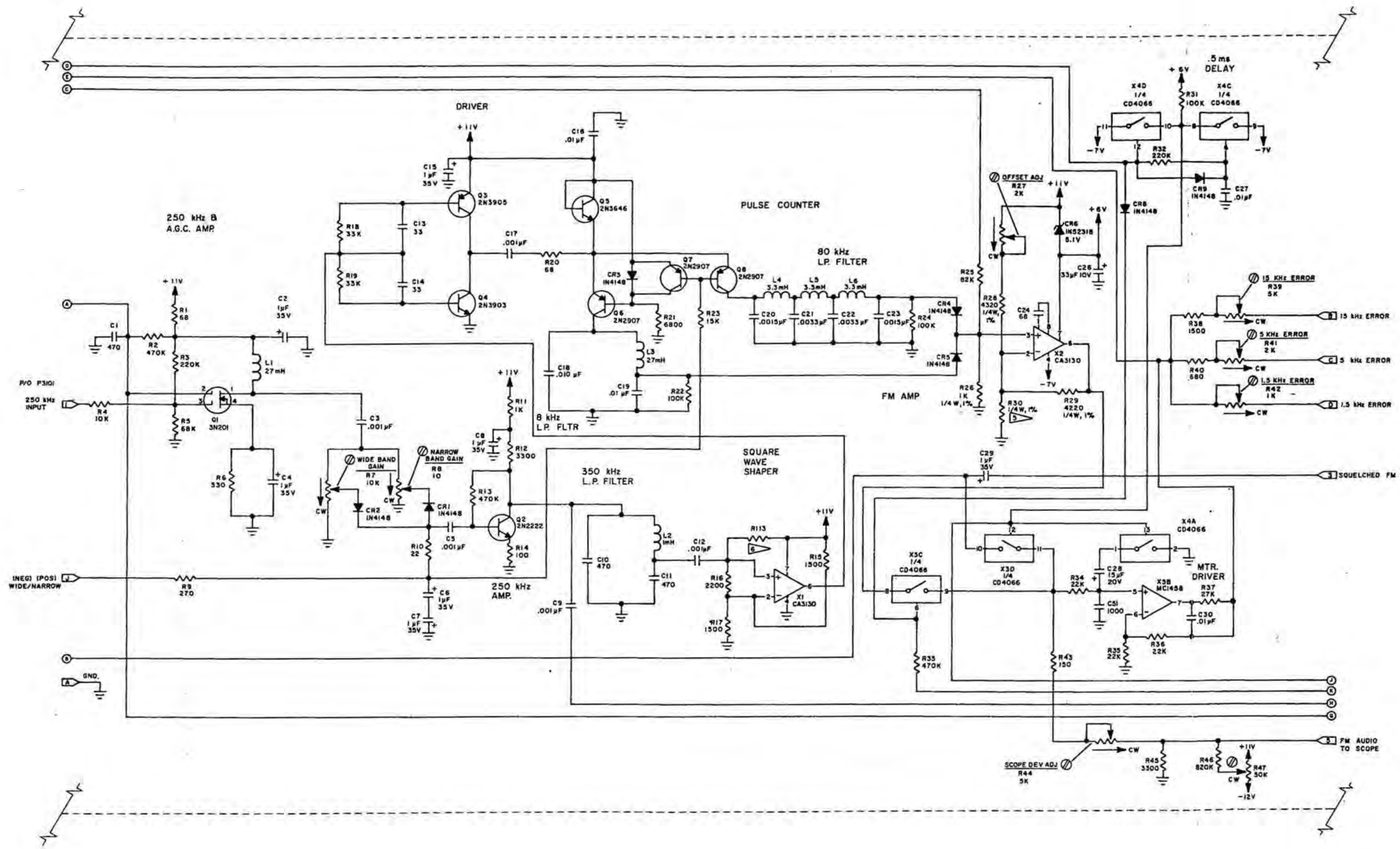


Figure 10-36 250 kHz IF/MON/ AUDIO Circuit Schematic (Sheet 2 of 3)

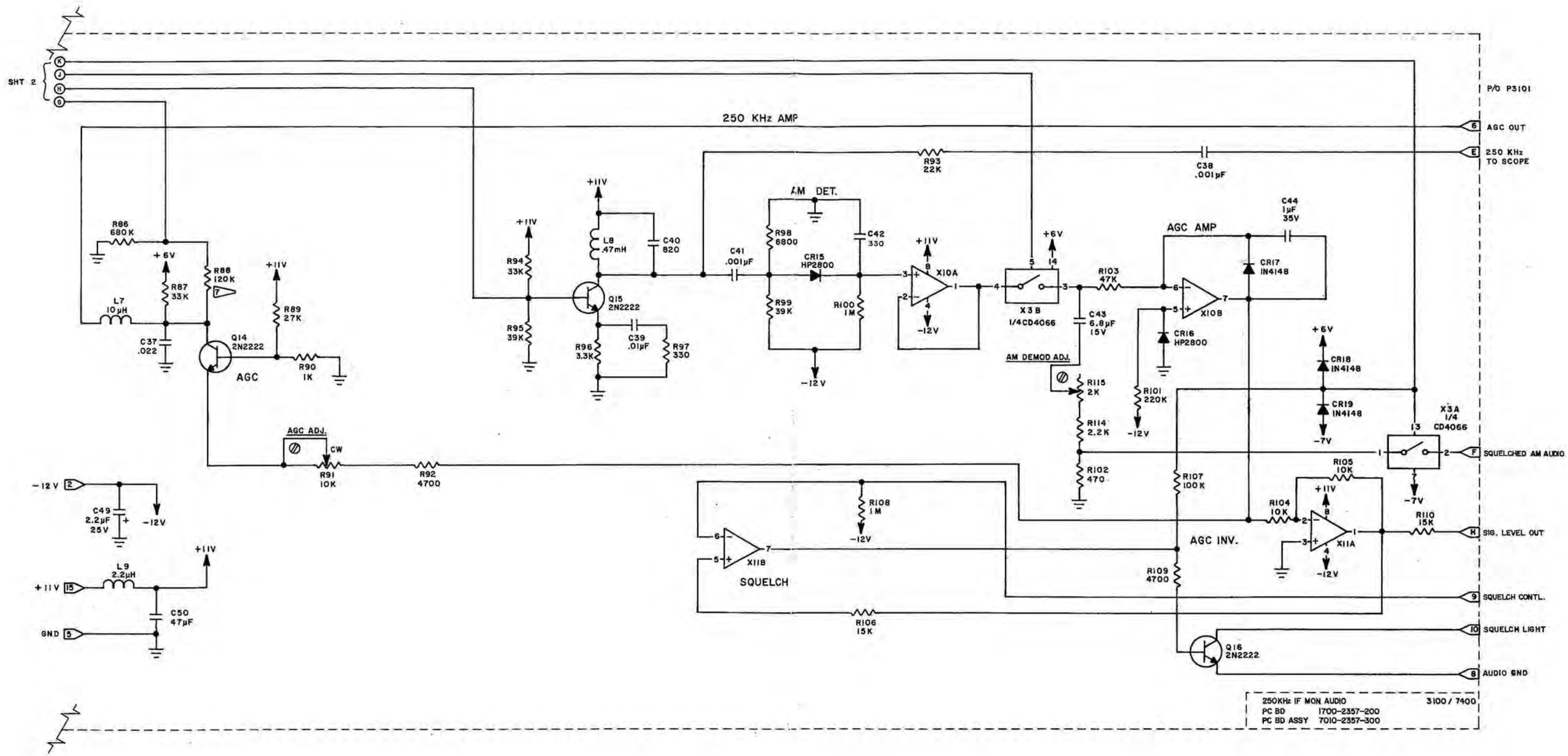
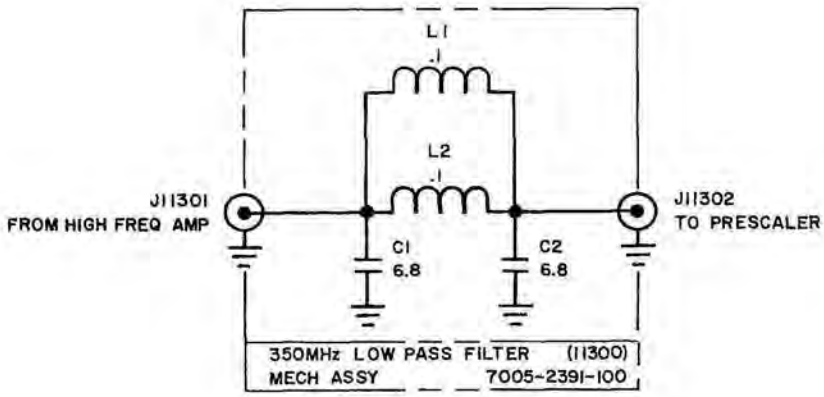


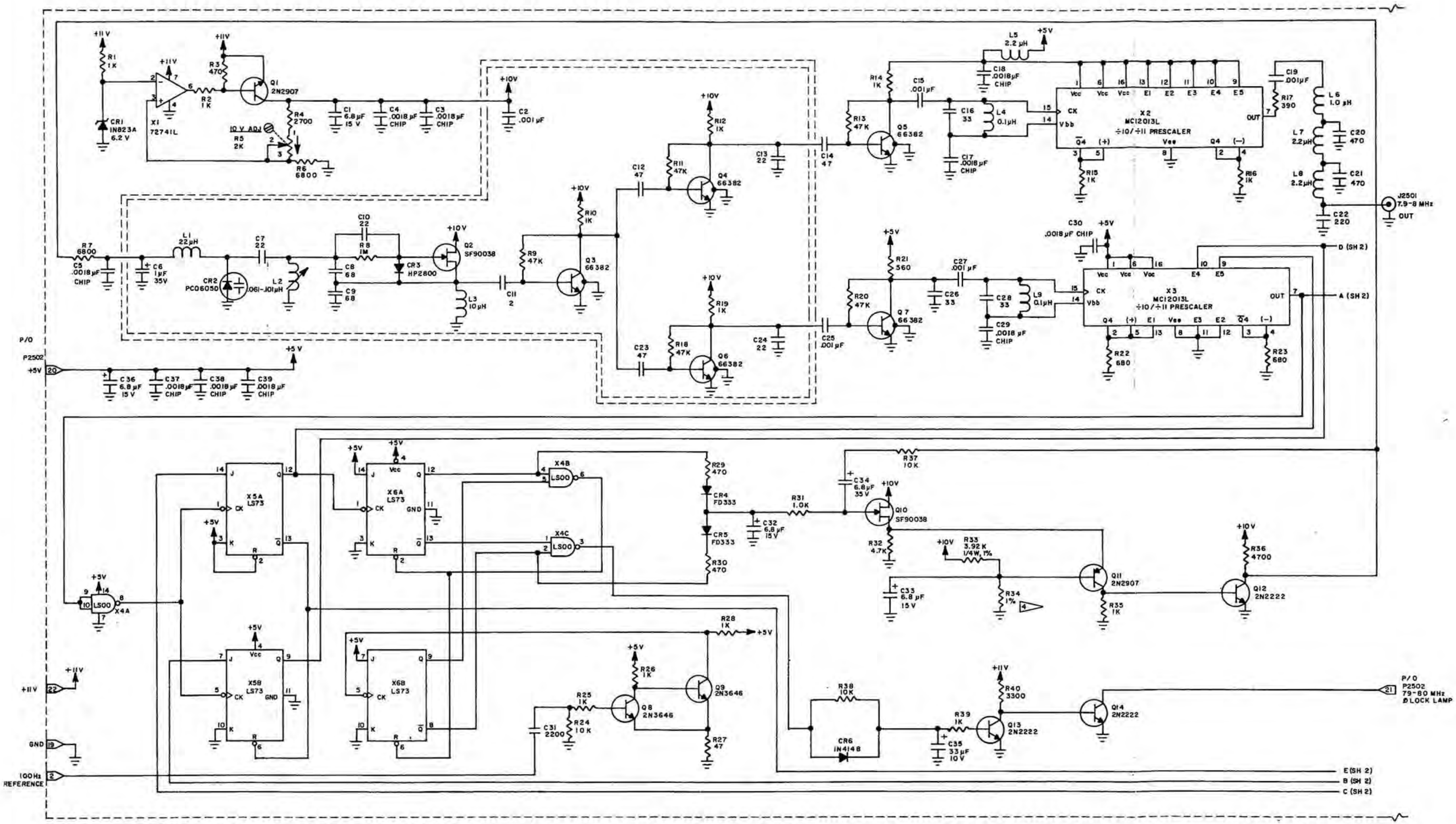
Figure 10-36 250 kHz IF/MON/AUDIO Circuit Schematic (Sheet 3 of 3)



NOTES:

1. ALL CAPACITANCE IS EXPRESSED IN MICRO-FARADS UNLESS OTHERWISE NOTED.
2. ALL INDUCTANCE IS EXPRESSED IN MICRO-HENRYS UNLESS OTHERWISE NOTED.
3. ALL REF NUMBERS CARRY AN ASSIGNED DESIGNATOR SERIES (E.G., THIS SCHEMATIC CARRIES SERIES 11300; THEREFORE, C1 IS DESIGNATED C11301).

Figure 10-37 350 MHz Low Pass Filter Circuit Schematic



NOTES:

1. ALL RESISTORS ARE 1/4 W, 10% UNLESS OTHERWISE NOTED.

2. ALL RESISTANCE IS EXPRESSED IN OHMS UNLESS OTHERWISE NOTED.

3. ALL CAPACITANCE IS EXPRESSED IN PICOFARADS UNLESS OTHERWISE NOTED.

4. R34 IS SET AT TEST (S.A.T.) FROM THE FOLLOWING VALUES (1/4 W, 1%): 1000, 1020, 1050, 1070, 1100, 1130, 1150, 1180, 1210, 1240, 1270 OHM. NOMINAL = 1.07 K OHM.

5. ALL REF NO'S CARRY AN ASSIGNED DESIGNATOR SERIES (E.G. THIS SCHEMATIC CARRIES SERIES 2500; THEREFORE R1 IS DESIGNATED R2501).

6. ALL INDUCTANCE IS EXPRESSED IN MILLIHENRYS UNLESS OTHERWISE NOTED.

Figure 10-38 79-80 MHz Phase Lock Loop Circuit Schematic (Sheet 1 of 2)

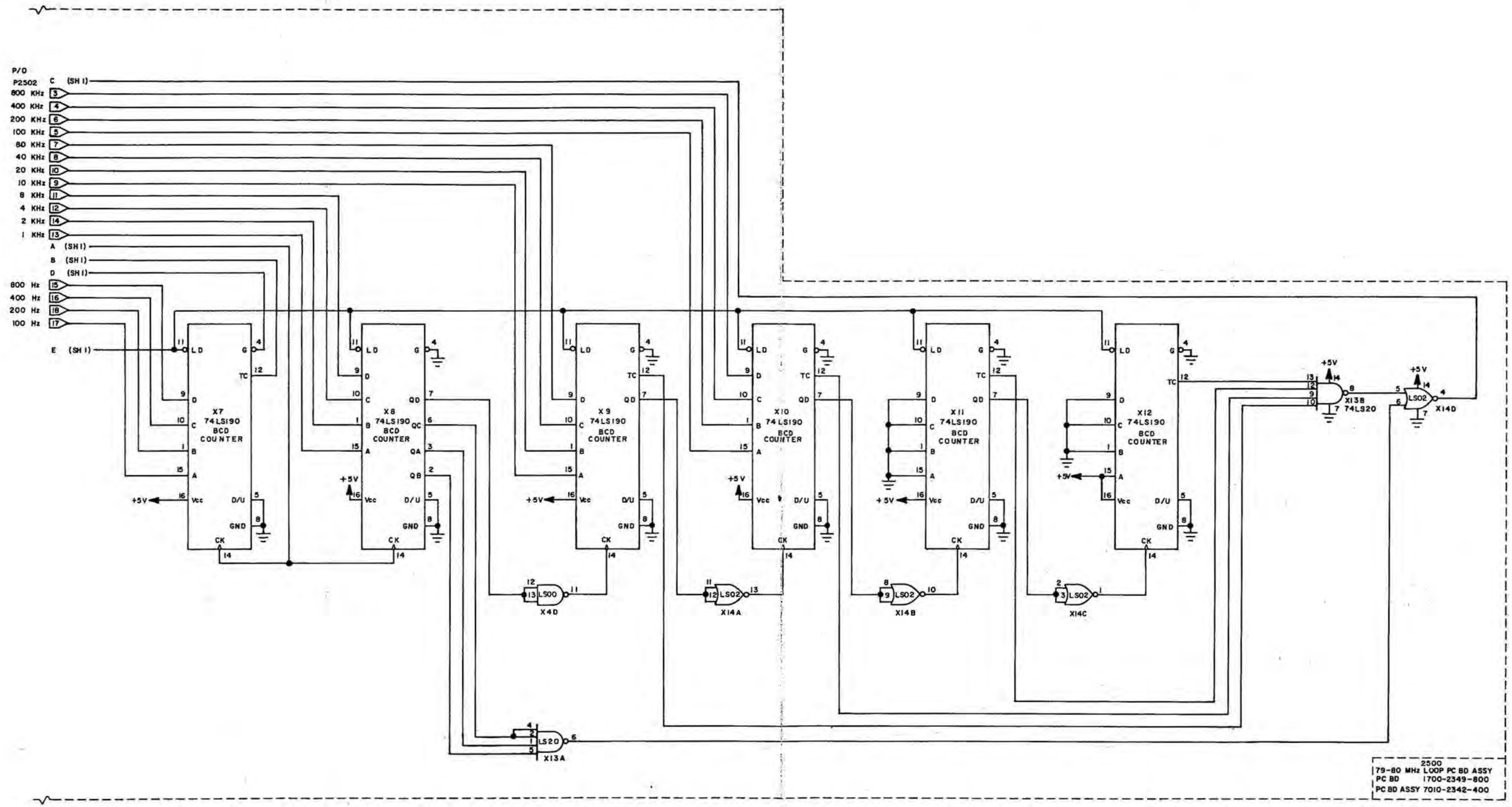


Figure 10-38 79-80 MHz Phase Lock Loop Circuit Schematic (Sheet 2 of 2)

APPENDICES

APPENDIX A: SPECIFICATIONS FM/AM-1100S AND FM/AM-1100A

A-1 RF SIGNAL GENERATOR

FREQUENCY RANGE:	100 kHz to 999.9999 MHz in 100 Hz increments
FREQUENCY ACCURACY:	$5x10^{-7}$ (±0.00005%) $2x10^{-7}$ (typically)
OUTPUT IMPEDANCE:	50Ω
RESIDUAL FM:	<100 Hz (typically <50 Hz)
RF OUTPUT POWER:	-130 dBm to -35 dBm (1 kHz to 1 GHz) -130 dBm to 0 dBm (20 kHz to 1 GHz)
RANGES:	Normal µV x 100 Hi level (0 dBm)
ACCURACY:	-110 to -35 dBm ±2.5 dB up to 400 MHz ±3.0 dB above 400 MHz
HI LEVEL POWER RANGE INDICATOR ACCURACY:	0 dBm ±2.5 dB (20 kHz to 600 MHz) ±4.0 dB (600 MHz to 999.9999 MHz) Dial indicator accuracy (dBm scale) is maintained relative to 0 dBm indication
MODULATION:	Internal: AM: 10 Hz to 5 kHz, 0 to 90% FM: 10 Hz to 20 kHz rate 10 Hz to ±20 kHz deviation External: AM: ≈3.0 Vp-p produces 90% modulation FM: ≈6.0 Vp-p produces 15 kHz deviation (maximum modulating frequency 20 Hz)
FM MODULATOR DISTORTION:	2% maximum at ±15 kHz deviation

A-2 POWER MONITOR

FREQUENCY RANGE:	1 MHz to 1000.00 MHz
POWER RANGES:	0 to 4, 0 to 40, and 0 to 400 watts

A-2 POWER MONITOR (Cont'd)

ACCURACY:	1 to 600 MHz ±7% of reading plus 3% of full scale
	600 to 1000.00 MHz ±20% of reading plus 3% of full scale
INPUT POWER:	100 watts continuous, 325 watts maximum
CHANGEOVER:	Changeover from generate to monitor mode occurs at nominally 100 mW input level to the TRANS/RCVR connector.
PROTECTION:	Visual and audible warning is provided by a pulsed front panel LED and audio indicator which warns the operator that a power termination overtemp condition will result if input power level or duty cycle is not reduced.

A-3 OSCILLOSCOPE

DISPLAY SIZE:	5 x 5 cm
VERTICAL BANDWIDTH:	DC to 1 MHz (at 3 dB bandwidth)
EXTERNAL VERTICAL INPUT RANGES:	10 mV, 100 mV, 1 V, 10 V per division
HORIZONTAL SWEEP RATE:	10 mSec, 1 mSec, 0.1 mSec, 0.01 mSec per division

A-4 SPECTRUM ANALYZER *

DYNAMIC RANGE:	70 dB (-30 dBm to -100 dBm)
DISPERSION:	Continuous from ±0.5 MHz to ±5 MHz from center frequency (1 to 10 MHz span)
FREQUENCY RANGE:	1 MHz to 1 GHz
BANDWIDTH RESOLUTION:	30 kHz

A-5 RECEIVER/MONITOR

FREQUENCY RANGE:	300 kHz to 999.9999 MHz

* Only pertinent to FM/AM-1100S

A-5 RECEIVER/MONITOR (Cont'd)

RESOLUTION:	100 Hz
10 dB SINAD SENSITIVITY:	2 µV (typical)
SELECTIVITY AT 3 dB POINT:	NARROW: Rcvr 15 kHz; detector audio bandwidth is 8 kHz. MID: Rcvr 150 kHz; detector audio bandwidth is 8 kHz. WIDE: Rcvr 150 kHz; detector audio bandwidth is 80 kHz.
DEVIATION RANGE:	0 to 2, 0 to 6, 0 to 20 kHz
ADJACENT CHANNEL REJECTION:	>25 dB at ±25 kHz >40 dB at ±50 kHz
BEAT FREQUENCY OSCILLATOR (BFO):	Variable injection level Accuracy: ±3 dB, from 2 µV to 5000 µV. BFO is phase-locked to master oscillator.
DEMODULATION OUTPUT LEVEL:	AM: 100% = 0.5 V P-P nominal FM: ±10 kHz = 0.65 V P-P nominal
RECEIVER ANTENNA INPUT PROTECTION:	0.25 watts maximum level without damage

A-6 AUDIO GENERATOR

OPERATING MODES:	Internal: Variable frequency generator or 1 kHz tone, or both simultaneously. *External Plus Internal: Any external tone(s) plus either or both internal tones simultaneously.
FREQUENCY RANGE:	Variable Tone: 10.0 Hz to 20 kHz Fixed Tone: 1 kHz

* RF Generator may be modulated simultaneously from internal and external sources and internal variable frequency generator may be externally keyed for sequential tone coding.

A-6 AUDIO GENERATOR (Cont'd)

ACCURACY:	±20 Hz (fixed tone) 0.01% (variable tone)
RESOLUTION:	0.1 Hz
OUTPUT LEVEL:	0 to 2.5 VRMS minimum for either tone into 150Ω
DISTORTION:	Fixed Tone: 2% maximum Variable Audio Generator: 1.5% maximum, 10 Hz to 100 Hz 0.7% maximum, 100 Hz to 20 kHz Some frequencies have a measured distortion of less than 1.5% as measured on a typical null type distortion analyzer.

A-7 TCXO MASTER OSILLATOR

STABILITY:	$5x10^{-7}$ (±0.00005%) $2x10^{-7}$ (typically) Greater accuracy is attainable with front panel adjustment to WWV.
AGING STABILITY:	2 to 3 PPM during first year, 1 PPM per year thereafter

A-8 TONE FREQUENCY MONITORING

MEASUREMENT TECHNIQUES:	Internal tone is selectable with the oscilloscope time base switch to produce a Lissajou oscilloscope pattern from a received signal.

A-9 FREQUENCY ERROR METER MEASUREMENT CAPABILITY

METER SENSITIVITY:	Typically 1.5 µV above 1 MHz (sensitivity is reduced below 1 MHz)
RANGES:	±1.5 kHz, ±5 kHz, ±15 kHz (full scale)
RESOLUTION:	50 Hz (calibration marks at 100 Hz on ±1.5 kHz range)

A-9 FREQUENCY ERROR METER MEASUREMENT CAPABILITY (Cont'd)

ZEROING:	Frequency error meter is automatically zeroed every 1.5 seconds during a 3 mSec time period. Auto zeroing may be disabled with AUTO ZERO/OFF/BATT Switch.

A-10 GENERAL CHARACTERISTICS

DIMENSIONS:	12.5" wide, 8" high, 21.75" deep (31.8 cm W, 20.3 cm H, 55.25 cm D)
WEIGHT:	47 lbs. (21.32 kg) with battery and accessories installed)
TEMPERATURE RANGE:	0° to 50° C
POWER REQUIREMENTS:	105 thru 266 V AC, 50 thru 400 Hz, 57 watts typical, 11 to 30 V DC. Typical DC currents 4.3 A at 12 V and 1.85 A at 28 V.
BATTERY:	12 V DC
BATTERY OPERATION:	Typically, over 1 hour operation

NOTE

Do not apply more than 100 Watts of continuous input to TRANS/RCVR Connector. Maximum "ON" time for measurement of transmitter output using TRANS/RCVR Connector is:

325 W; 1 min. ON, 6 min. OFF
200 W; 1 min. ON, 2 min. OFF
150 W; 2 min. ON, 2 min. OFF
100 W; 15 min. ON, 10 min. OFF

Times established using unrestricted convection cooling at 25°C ambient.

100 W continuous if additional forced air cooling is provided across rear panel heat sink.

APPENDIX B: SPECIAL ACCESSORY TEST EQUIPMENT

B-1 GENERAL

This appendix contains recommendations for constructing an RF "Sniffer" Cable, High Frequency Multiplier/Mixer "Sniffer" Cable, Battery Load Simulator and Power Supply Load Simulator. These items are used as accessory test equipment in several of the maintenance procedures described in this manual. The procedures covering the construction of the Sniffer Cables contain detailed step-by-step assembly instructions. The Battery Load Simulator and Power Supply Load Simulator are supported by recommended circuit schematics, which are intended to serve as a guide in fabricating these units. The exact method of construction and materials to be used are left to the technician's discretion.

B-2 RF "SNIFFER" CABLE (IFR, 6050-0534-800)

Materials Required:

3' (Minimum) length of RG316/U or RG58/U coax cable w/BNC female connector on one end.

Electrical Tape
Knife
Wire Strippers
Scissors
Soldering Iron
Solder

STEP PROCEDURE

1. Prepare length of flexible coax cable as shown in Figure B-1 below:

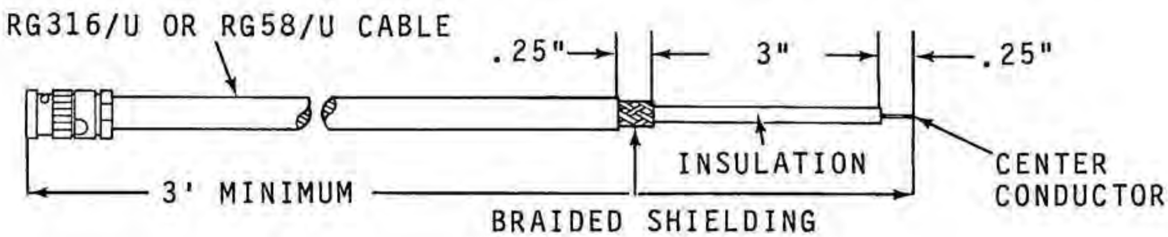


Figure B-1 Flexible Coax Cable Preparation

STEP PROCEDURE

2. Bend coax cable into loop as shown in Figure B-2 below and solder center conductor to braided shielding.

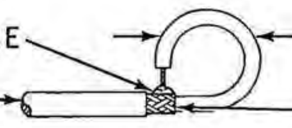


Figure B-2 Soldering Cable Center Conductor to Braided Shielding

3. Wrap soldered joint completely with electrical tape, making sure no portion of braided shielding, solder or center conductor is exposed. RF pickup cable is now ready for use.

B-3 HIGH FREQUENCY MULTIPLIER/MIXER "SNIFFER" CABLE (IFR, 6500-9801-700)

Materials needed:

1. Wire, #22 GA. Bus X .63"
2. Sleeving, #22 GA. X .53"
3. Probe Tip, Sniffer
4. Probe Head, Sniffer
5. Coax, Sniffer
6. Tubing, Heat Shrink 5/16 I.D. X 11"
7. Probe End, Sniffer
8. Connector, M SMB W/Term, STR

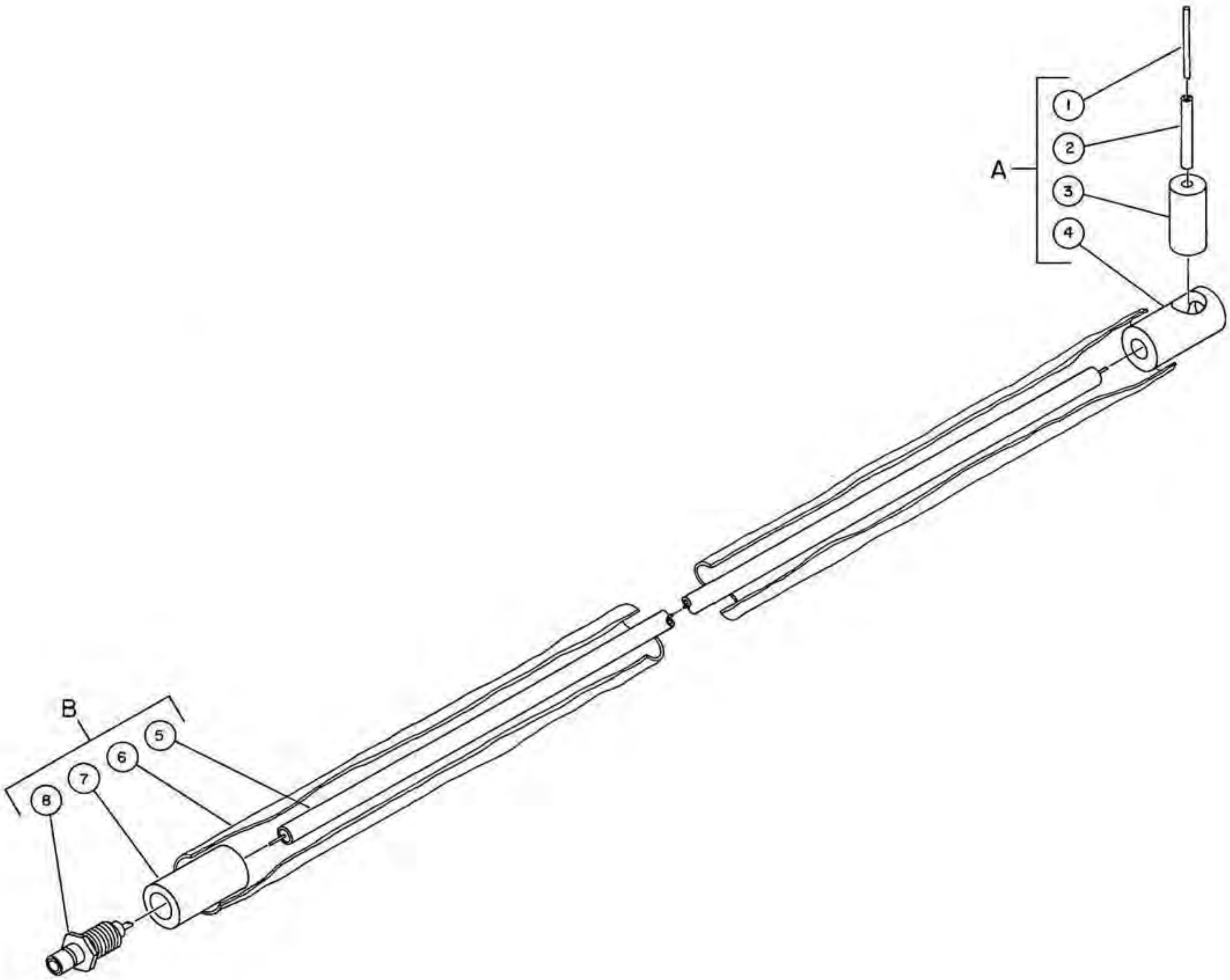


Figure B-3 Sniffer Cable Construction

STEP PROCEDURE

1. Cut and strip a 10.00" piece of .141" diameter semi-rigid coax (5) as shown in Figure B-4.

STEP PROCEDURE

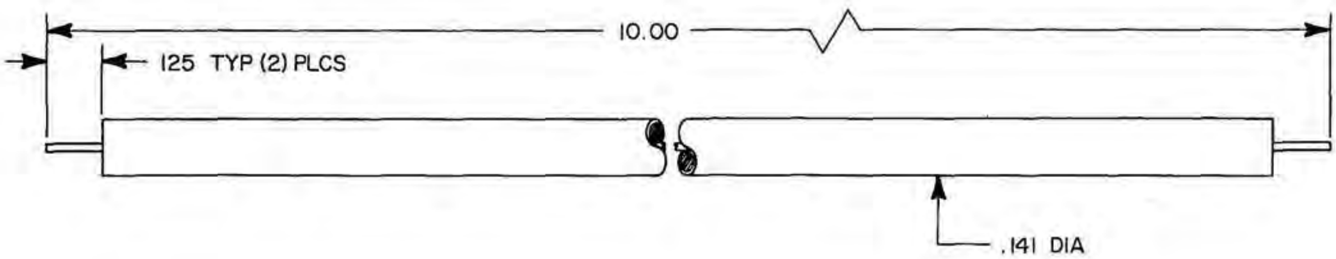


Figure B-4 Coax Cable Preparation

2. Fabricate a probe tip (3) from 3/16" diameter brass rod as shown in Figure B-5.

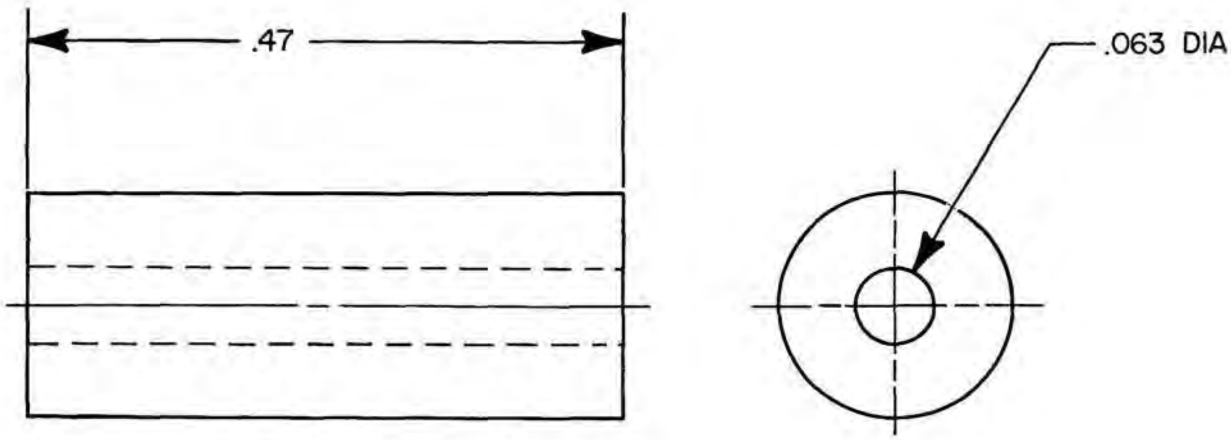


Figure B-5 Probe Tip Preparation

3. Fabricate a probe end (7) from 5/16" diameter brass rod as shown in Figure B-6.

STEP PROCEDURE

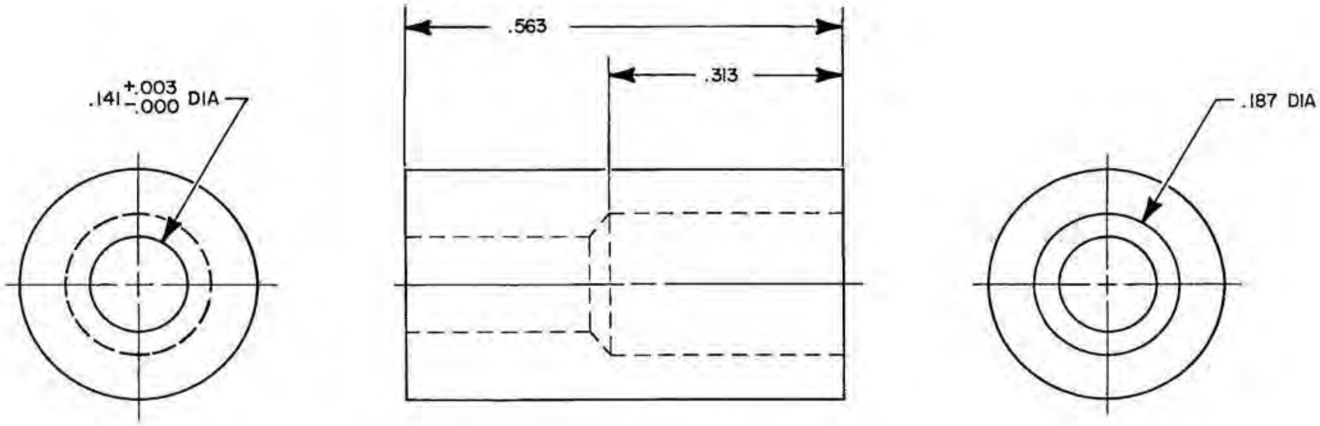


Figure B-6 Probe End Preparation

4. Fabricate a probe head (4) from 5/16" diameter brass rod as shown in Figure B-7.

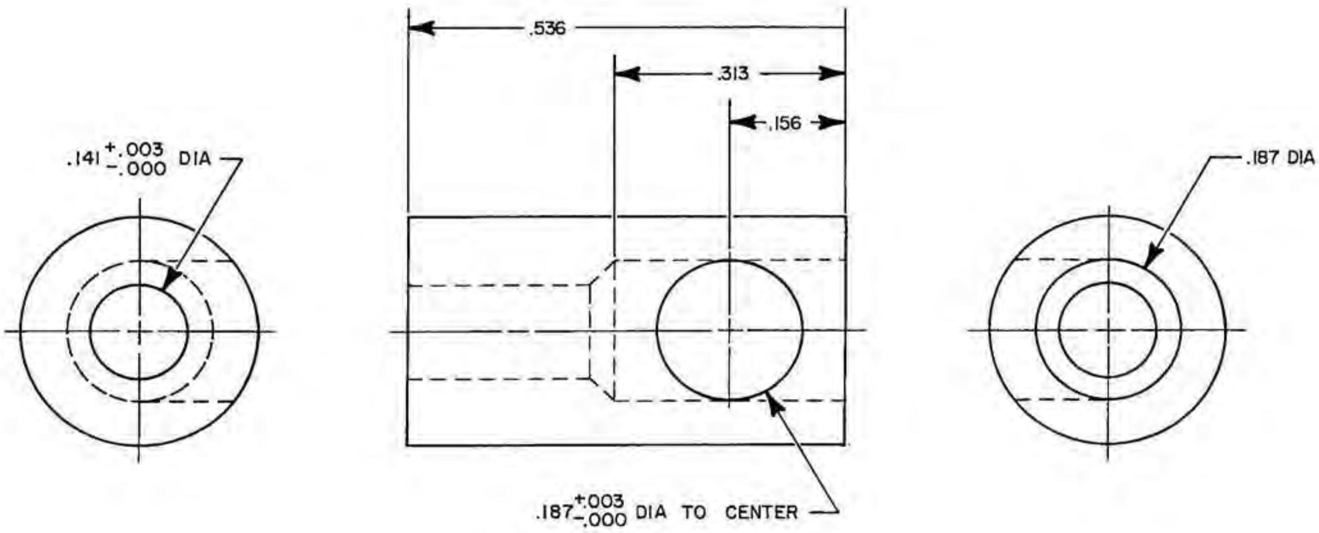
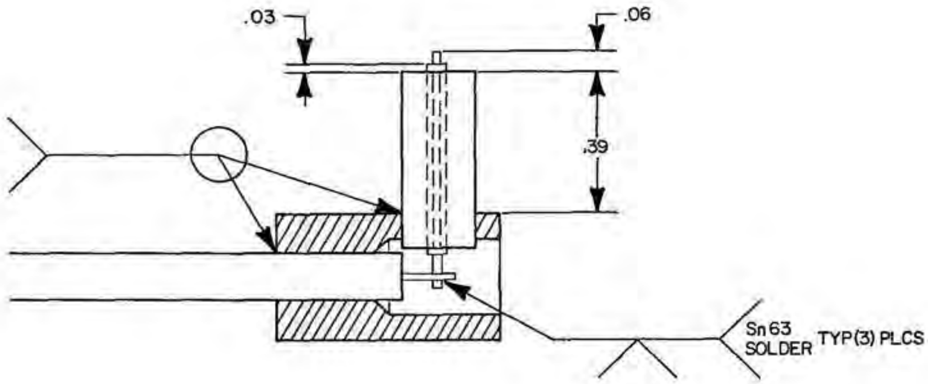


Figure B-7 Probe Head Preparation

STEP PROCEDURE

5. Solder probe tip (3), probe head (4), coax (5), and bus wire (1) together as shown in Figure B-8.

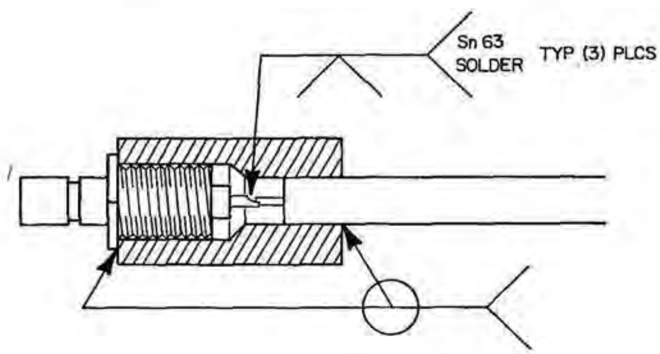


DETAIL A

Figure B-8 Sniffer Cable Construction, Detail A

6. Slide heat shrink tubing (6) and probe end (7) onto free end of coax (5).

7. Solder probe end (7), coax (5), and SMB connector (8) together as shown in Figure B-9.



DETAIL B

Figure B-9 Sniffer Cable Construction, Detail B

8. Shrink-fit heat shrink tubing (6) around probe head (4), probe end (7), and coax (5) as shown in Figure B-3.

B-4 BATTERY LOAD SIMULATOR

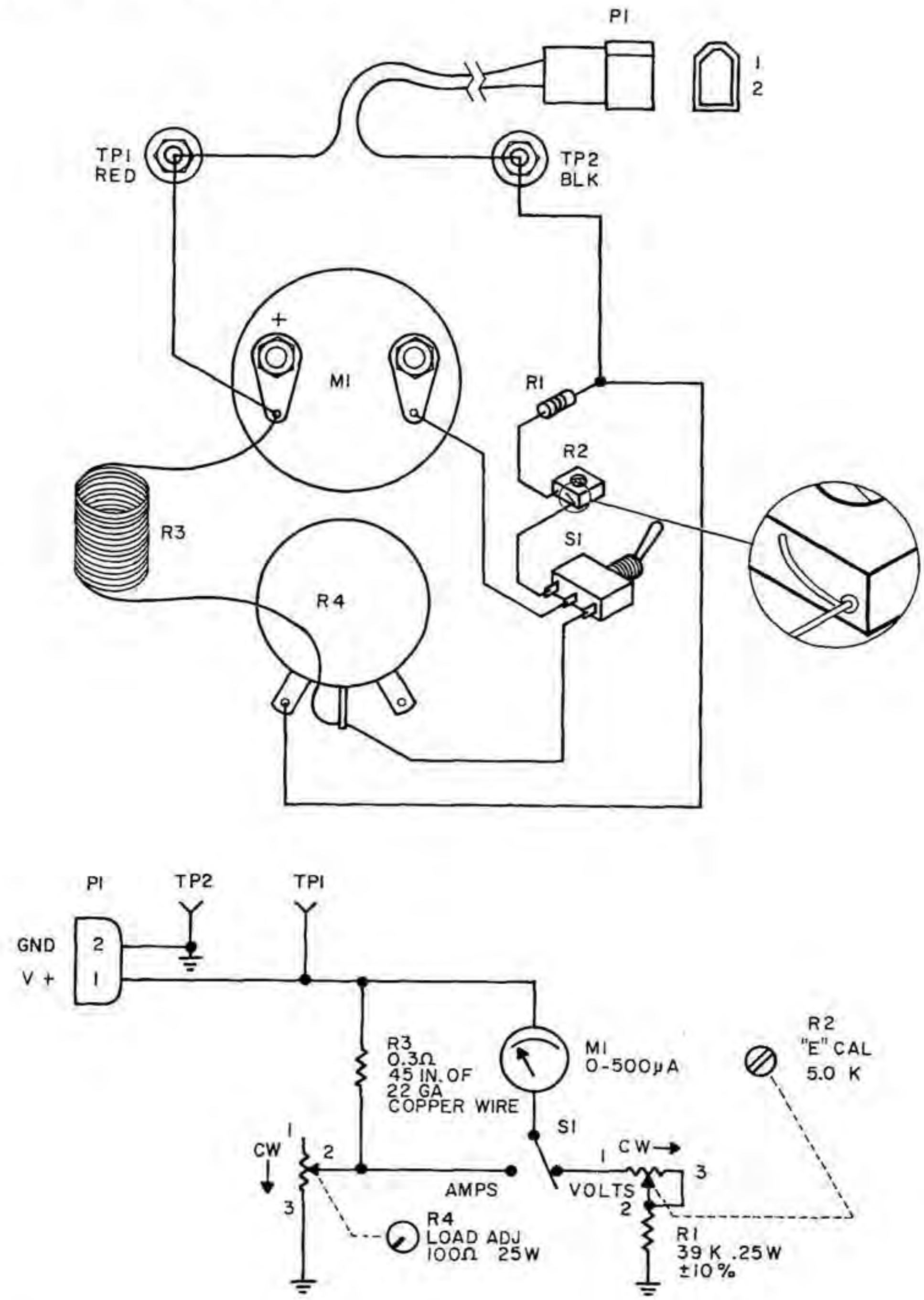


Figure B-10 Circuit Schematic and Diagram of Battery Load Simulator

B-5 POWER SUPPLY

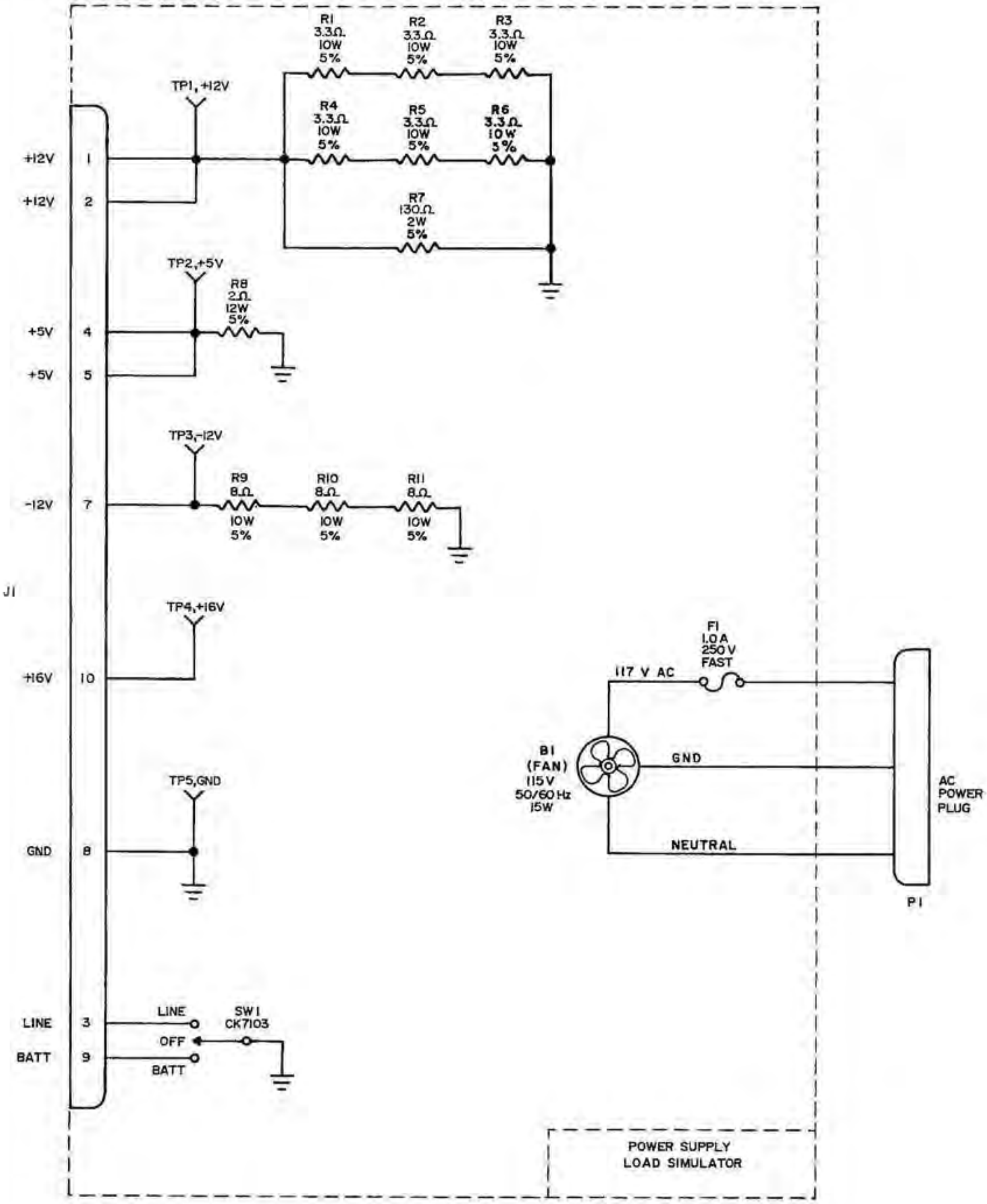


Figure B-11 Power Supply Load Simulator
Circuit Schematic

APPENDIX C: TEST EQUIPMENT REQUIREMENTS

C-1 GENERAL

This appendix contains a list of test equipment suitable for performing all of the maintenance procedures contained in this manual. Any other equipment meeting the specifications listed in this appendix may be substituted in place of the recommended models. It should be noted that the equipment listed in this appendix may exceed the minimum required specifications for some of the procedures contained in this manual.

C-2 RECOMMENDED TEST EQUIPMENT

TYPE	MANUFACTURER & MODEL	SPECIFICATIONS
Oscilloscope	Tektronix 465B	DC to 100 MHz 5 mV/div vertical trace 2 nS/div sweep rate Dual Trace
Spectrum Analyzer	Tektronix 7613 Frame	Variable Persistance Storage Oscilloscope
	Tektronix 7L13/U Spectrum Analyzer	Frequency Range: 1 kHz to 2.5 GHz Resolution Bandwidth: 30 Hz to 3 MHz
Tracking Generator	Tektronix TM503 Frame	Three-wide Mainframe
	Tektronix TR502 Tracking Generator	Frequency Range: 100 kHz to 1.8 GHz Output Level: 0 dBm, ±0.5 dB Power Range: 0 to -59 dBm in 10 and 1 dB steps
Frequency Counter	Fluke Model 1910A	Frequency Range: 5 Hz to 125 MHz
Digital Multimeter	Fluke Model 8010A	3½ digit, ±0.1% basic DC accuracy
Distortion Analyzer	Sound Technology Model 1700B	Frequency Range: 10 Hz to 110 kHz Accuracy: .002% distortion AC Voltage Accuracy: 2%

APPENDIX C (Cont'd)

TYPE	MANUFACTURER & MODEL	SPECIFICATIONS	
Function Generator	Wavetek 182A	Frequency Range: Functions: High Level Output:	.004 Hz to 4 MHz Sine, Triangle & Square 20 Vp-p (10 Vp-p into 50Ω)
Signal Generator	Wavetek 3000	Frequency Range: Resolution: Accuracy: RF Output:	1 to 520 MHz 1 kHz 0.001% +13 to -137 dBm
Sweep Signal Generator	Wavetek 2002A	Frequency Range: Calibrated RF Output:	1 to 2500 MHz +13 to -77 dBm
Wattmeter	Sierra 174A-1	Frequency Range: VSWR: 25-512 MHz: 512-1000 MHz: Accuracy Incident Power: 25-512 MHz: 512-1000 MHz:	25 to 1000 MHz 1.10 max 1.20 max ±5% of full scale ±7% of full scale
FM/AM Modulation Meter	Boonton Model 82AD	Frequency Range: Accuracy: FM: Accuracy: AM: Resolution:	10 MHz to 1.2 GHz ±2% of reading from 30 Hz to 100 kHz ±2% of reading from 10 Hz to 90% AM and 5% of reading below 10% and above 90%; from 30 Hz to 100 kHz 0.1% of full scale for FM and AM

APPENDIX C (Cont'd)

TYPE	MANUFACTURER & MODEL	SPECIFICATIONS	
RF Power Source	MCL 15122 Main Frame		
	6048 Oscillator Module	Frequency Range: Power Range:	50 to 200 MHz 0 to 65 W
RF Power Meter with Power Detector	Boonton RF Microwatt-meter Model 42 BD	Frequency Range: Power Range: Accuracy:	200 kHz to 18 GHz 1.0 nW to 10 mW ±0.25% fs ±0.15 dB >10 nW
	Boonton Power Sensor Model 41-4A	Frequency Range: Power Range: Accuracy:	200 kHz to 7 GHz 1 nW to 10 mW ±0.3 dB >10 nW
VSWR Bridge	Wiltron 60N50 Type N Male	Frequency Range: Accuracy: Directivity:	5 MHz to 2000 MHz 0.01 ±0.09 p^2, where p is the reflection coefficient being measured 40 dB
Triple Output Power Supply	LAMBDA LPT-7202-FM	Regulation: Ripple: Voltage Ranges:	0.01% + 1 mV 500μV 0-7 VDC @ 5.0 A 0-20 VDC @ 1.5 A 0-20 VDC @ 1.5 A
Power Supply	LAMBDA LK-351-FM	Regulation: Ripple: Voltage Range:	.015% or 1 mV 500μV 0-36 VDC @ 25.0 A
Variable Attenuator	Texscan RA-50	Frequency Range: Attenuation: Accuracy: Insertion Loss:	DC to 2000 MHz 0 to 10 dB in 1 dB steps ±0.1 dB at 30 MHz ±0.3 dB at 500 MHz ±0.5 dB at 1500 MHz Less than 0.3 dB at 1000 MHz Less than 0.5 dB at 1500 MHz

APPENDIX D: MECHANICAL ALIGNMENT OF FM/AM-1100S/A BFO-RF LEVEL CONTROL

D-1 GENERAL

In certain maintenance operations it may be necessary to disassemble the front panel BFO-RF LEVEL Control (or Variable Attenuator). Upon reassembly, the inscribed inner and outer attenuator dials must be properly aligned in order to reflect the true output power levels as indicated on the dials. The procedure for this alignment is described in paragraph D-2 below:

NOTE

The Variable Attenuator and its accompanying dials are individually calibrated to one another at factory; do not interchange dial and attenuators from different sets.

D-2 ALIGNMENT PROCEDURE

REQUIRED TOOLS:

.050" Allen Wrench
9/16" Wrench

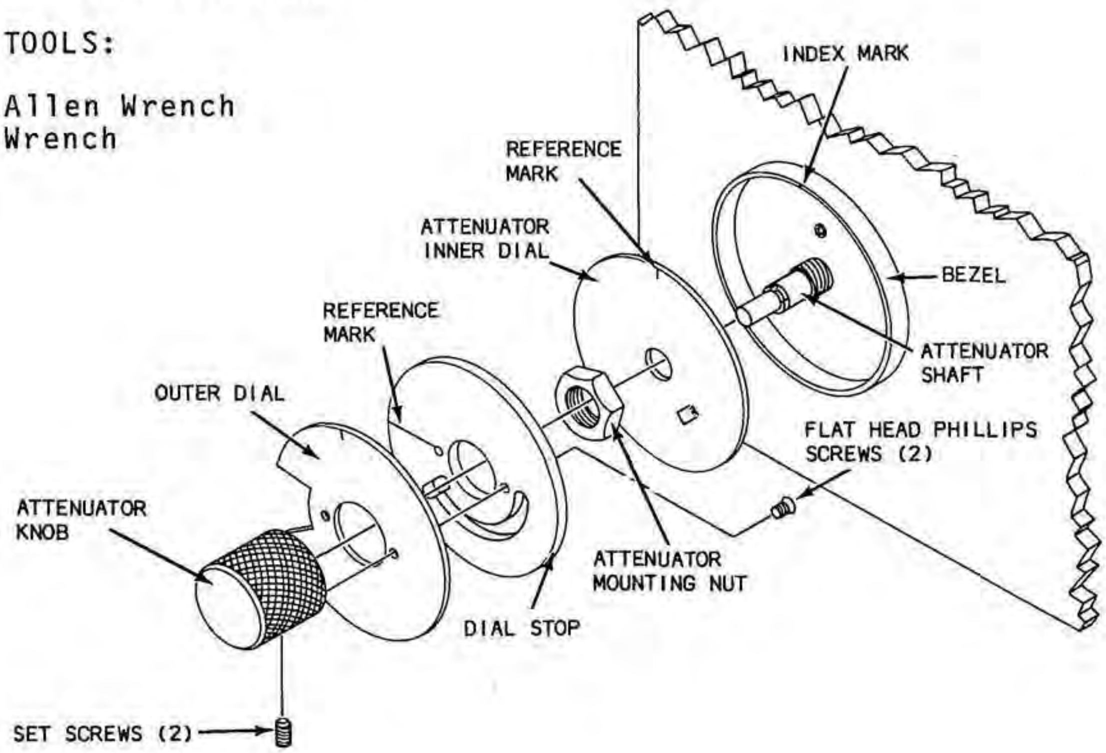


Figure D-1 Identification of Attenuator Components

STEP PROCEDURE

1. Loosen and remove 2 set screws on Attenuator Knob to remove knob, outer dial and dial stop from Attenuator Shaft.

STEP	PROCEDURE
2.	Loosen Attenuator Mounting Nut.
3.	Rotate Attenuator Inner Dial on shaft to align reference mark on inner dial with index mark on Bezel (see Figure D-2).
4.	Tighten Attenuator Mounting Nut.
5.	Rotate Attenuator Shaft fully cw.
6.	Slide assembly of knob, outer dial, and dial stop onto Attenuator Shaft. Rotate assembly to align reference mark on outer dial with index mark on bezel. (See Figure D-3.)
7.	Tighten two set screws on Attenuator Knob.

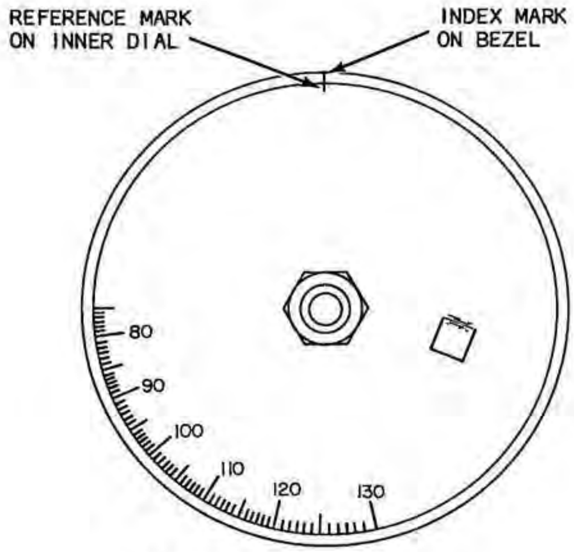


Figure D-2

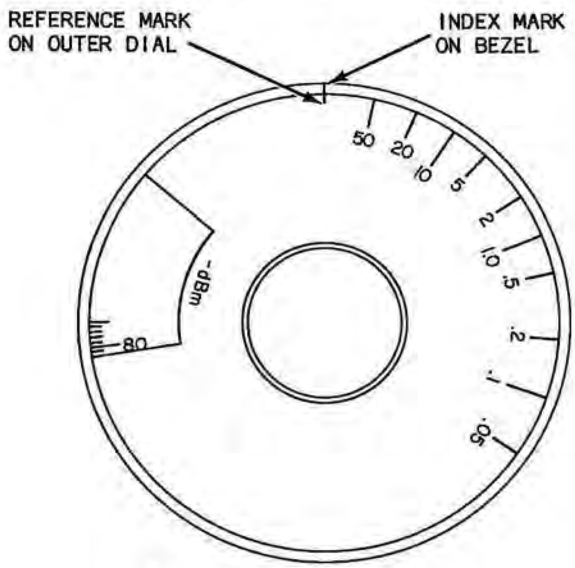


Figure D-3

APPENDIX E: dBm TO MICROVOLT CONVERSION CHART

dBm	µV	dBm	µV	dBm	µV
0	223,607	-47	1,000	-94	4.46
-1	199,290	-48	890	-95	3.98
-2	177,617	-49	793	-96	3.54
-3	158,302	-50	707	-97	3.16
-4	141,086	-51	630	-98	2.82
-5	125,743	-52	562	-99	2.51
-6	112,069	-53	501	-100	2.24
-7	99,882	-54	446	-101	1.99
-8	89,020	-55	398	-102	1.78
-9	79,339	-56	354	-103	1.58
-10	70,711	-57	316	-104	1.41
-11	63,021	-58	282	-105	1.26
-12	56,168	-59	251	-106	1.12
-13	50,059	-60	224	-107	1.00
-14	44,615	-61	199	-108	0.890
-15	39,764	-62	178	-109	0.793
-16	35,439	-63	158	-110	0.707
-17	31,585	-64	141	-111	0.630
-18	28,150	-65	126	-112	0.562
-19	25,089	-66	112	-113	0.501
-20	22,361	-67	100	-114	0.446
-21	19,929	-68	89.0	-115	0.398
-22	17,762	-69	79.3	-116	0.354
-23	15,830	-70	70.7	-117	0.316
-24	14,109	-71	63.0	-118	0.282
-25	12,574	-72	56.2	-119	0.251
-26	11,207	-73	50.1	-120	0.224
-27	9,988	-74	44.6	-121	0.199
-28	8,902	-75	39.8	-122	0.178
-29	7,934	-76	35.4	-123	0.158
-30	7,071	-77	31.6	-124	0.141
-31	6,302	-78	28.2	-125	0.126
-32	5,617	-79	25.1	-126	0.112
-33	5,006	-80	22.4	-127	0.100
-34	4,462	-81	19.9	-128	0.0890
-35	3,976	-82	17.8	-129	0.0794
-36	3,544	-83	15.8	-130	0.0707
-37	3,159	-84	14.1	-131	0.0630
-38	2,815	-85	12.6	-132	0.0562
-39	2,509	-86	11.2	-133	0.0501
-40	2,236	-87	10.0	-134	0.0446
-41	1,993	-88	8.90	-135	0.0398
-42	1,776	-89	7.93	-136	0.0354
-43	1,583	-90	7.07	-137	0.0316
-44	1,411	-91	6.30	-138	0.0282
-45	1,257	-92	5.62	-139	0.0251
-46	1,121	-93	5.01	-140	0.0224

APPENDIX F: PINOUT/CONTACT ASSIGNMENTS FOR EXTERNAL ACCESSORY AND EXTERNAL MODULATION CONNECTORS

F-1 PINOUT TABLE FOR EXTERNAL ACCESSORY CONNECTOR

The table below provides pin assignments for the EXT ACC Connector located on front panel of the FM/AM-1100S/A. This connector provides power and signal sources for external accessory equipment used with the FM/AM-1100S/A.

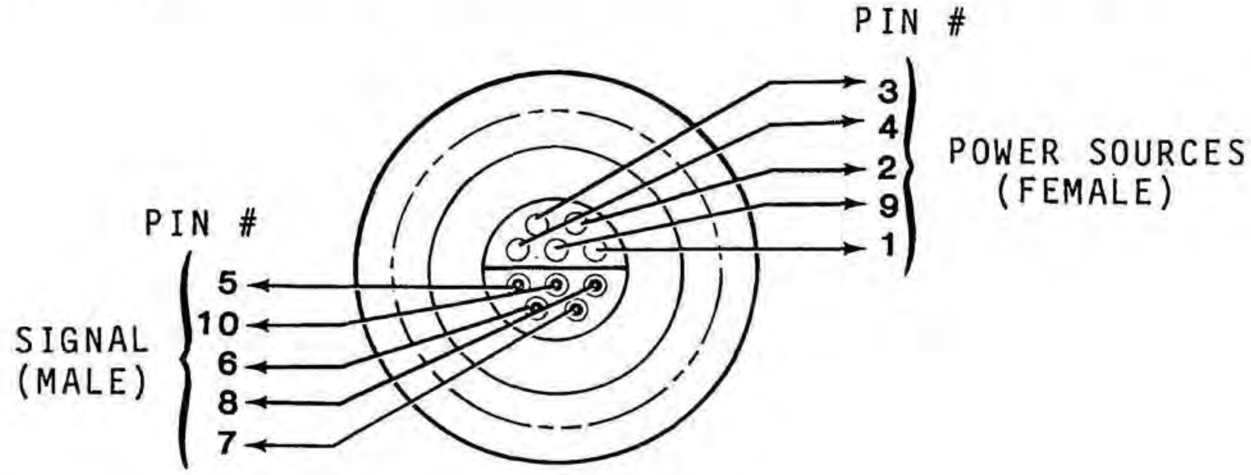


Figure F-1 External Accessory Connector (Front View)

CONNECTOR PIN ASSIGNMENTS			
Pin No.	Power Source	Pin No.	Signal Source
1	+12 V	5	External Modulation
2	+11 V	6	Tone Keying *
3	+5 V	7	Microphone Keying **
4	Pilot Tone	8	Demodulated Signal Out
9	Ground	10	Signal Ground

* Open enables variable tone generator; short to ground disables variable tone generator.

** Short to ground places FM/AM-1100S/A into generate mode.

F-2 CONTACT ASSIGNMENTS FOR EXTERNAL MODULATION CONNECTOR

The illustration below provides contact assignments for the mating EXT MOD Connector (3 conductor ¼" phone plug) used with the EXT MOD Connector (21) on front panel of FM/AM-1100S/A. This connector provides an external modulation input signal and keying for the FM/AM-1100S/A Variable Tone generator. (See External Modulation Specifications in Appendix A.)

NOTE

Keying affects only the variable tone generator (not the 1 kHz fixed tone generator or external modulation input.)

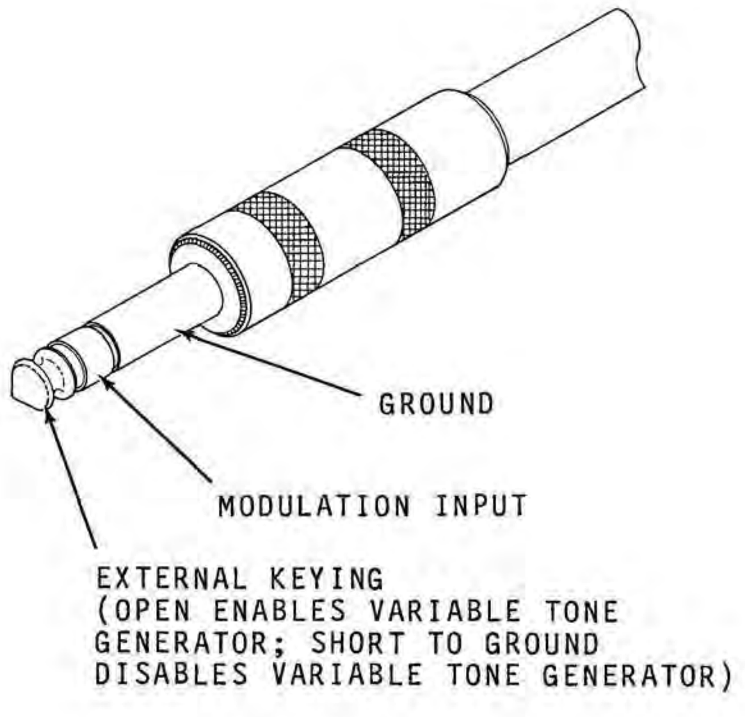


Figure F-2 EXT MOD Connector (¼" Phone Plug) Contact Assignments

APPENDIX G: REPACKING FOR SHIPMENT

G-1 SHIPPING INFORMATION

IFR test sets returned to factory for calibration, service or repair must be repackaged and shipped subject to the following conditions:

Do not return any products to factory without first receiving authorization from IFR Customer Service Department.

CONTACT:

Customer Service Dept.
IFR, Inc.
10200 West York Street
Wichita, Kansas 67215

Telephone: (800)-835-2350
TWX: 910-741-6952

All test sets must be tagged with:

a. Owner's identification and address.
b. Nature of service or repair required.
c. Model No.
d. Serial No.

Sets must be repackaged in original shipping containers using IFR packing models. If original shipping containers and materials are not available, contact IFR Customer Service Dept. for shipping instructions.

All freight costs on <u>non-warranty</u> shipments are assumed by customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

G-2 REPACKING PROCEDURE (Reference-Figure G-1):

1. Make sure bottom packing mold is seated on floor of shipping container.

2. Carefully wrap test set with polyethylene sheeting to protect finish.

3. Place test set into shipping container, making sure set is securely seated in bottom packing mold.

4. Place top packing mold over top of set and press down until mold rests solidly on bottom packing mold.

5. Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.

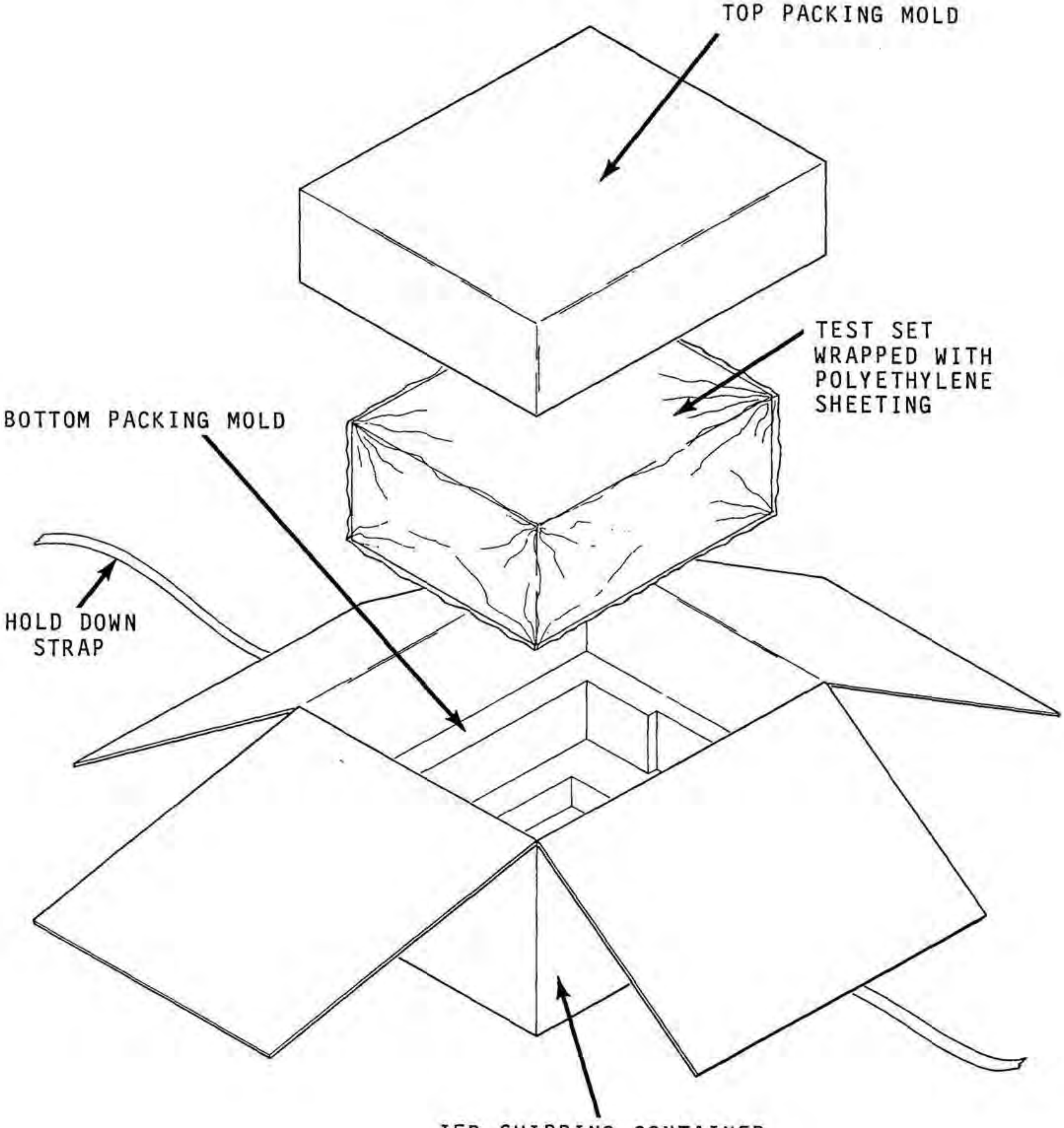


Figure G-1 Repacking for Shipment

APPENDIX H: ABBREVIATIONS & SYMBOLS

H-1 GENERAL

Defined below are various abbreviations and symbols which are commonly used throughout the FM/AM-1100S/A Maintenance Manual text.

H-2 GENERAL ABBREVIATIONS

A	-	Ampere
AC or ac	-	Alternating Current
Adj	-	Adjustment
AGC	-	Automatic Gain Control
AM	-	Amplitude Modulation
Amp	-	Ampere
ANALY DISP.	-	Analyzer Dispersion
Assy	-	Assembly
BATT	-	Battery
BCD	-	Binary Coded Decimal
BFO	-	Beat Frequency Oscillator
°C	-	Degrees Celsius
CAL	-	Calibration
ccw	-	Counterclockwise
CRT	-	Cathode Ray Tube
cw	-	Clockwise
CW	-	Carrier Wave
DAC	-	Digital to Analog Converter
dB	-	decibels
dBm	-	decibels above (or below) 1 milliwatt
DC or dc	-	Direct Current
DCR	-	Duty Cycle Regulator
DEFLEC AMP	-	Deflection Amplifier
DEMOD	-	Demodulation, demodulate or demodulated
DEV	-	Deviation
DMM	-	Digital Multimeter
DVM	-	Digital Voltmeter
ECL	-	Emitter Coupled Logic
EXT ACC	-	External Accessory
EXT MOD	-	External Modulation
EXT DC	-	External Direct Current
°F	-	Degrees Fahrenheit
FET	-	Field Effect Transistor
FILT	-	Filter
FM	-	Frequency Modulation
FREQ	-	Frequency
GEN	-	Generate
GHz	-	Gigahertz
GND	-	Ground
HI LVL	-	High Level
HORIZ	-	Horizontal

Hz	- Hertz
IC	- Intergated Circuit
IF	- Intermediate Frequency
INT MOD	- Internal Modulation
IPC	- Illustrated Parts Catalog
Kg/cm^3	- Kilogram per cubic centimeter
kHz	- kilohertz
L/H	- Left-hand
LOG LIN	- Logarithmic Linearity
LO	- Local Oscillator
mA	- Milliamperes
MAX DISP	- Maximum Dispersion
Mech	- Mechanical
MHz	- Megahertz
MON	- Monitor
µs	- microsecond
µV	- microvolt
ms or mSec	- millisecond
mV	- millivolt
mW	- milliwatt
MULT	- Multiplier
N/A	- Not Applicable
NORM	- Normal
OSC	- Oscillator
para	- paragraph
PC Bd	- Printed Circuit Board
PLL	- Phase Lock Loop
Preamp	- Preamplifier
psi	- pounds per square inch
PWR	- Power
PWR MON	- Power Monitor
RCVR	- Receiver
REF	- Reference
RF	- Radio Frequency
R/H	- Right-hand
RMS	- Root Mean Square
ROM	- Read Only Memory
sec	- Seconds
Scope Dev	- Oscilloscope Deviation
SIG	- Signal
SSB	- Single Sideband
SW	- Switch
TCXO	- Temperature Compensated Crystal Oscillator
TRANS	- Transmitter or Transceiver
TTL	- Transistor Transistor Logic
V	- Volts
Vp	- Volts Peak
Vp-p	- Volts Peak-to-Peak
VAC	- Volts Alternating Current
VCO	- Voltage Controlled Oscillator

VDC	- Volts Direct Current
VHF	- Very High Frequency
VOL	- Volume
VRMS	- Volts Root Mean Square
VSWR	- Voltage Standing Wave Ratio
W	- Watts
XMTR	- Transmitter
XTAL	- Crystal

H-3 ABBREVIATIONS FOR REFERENCE DESIGNATORS

BR	- Bridge Rectifier
C	- Capacitor
CR	- Diode
DS	- Display Lamps
E	- Terminal
F	- Fuse
FL	- Feed-thru Filter
G	- Ground
J	- Connector (Fixed)
K	- Relay
L	- Inductor
M	- Meter
MX	- Mixer
P	- Connector (Movable)
Q	- Transistor
R	- Resistor
SW	- Switch
T	- Transformer
TU	- Tuning Pole
U	- Inseparable Circuit, (e.g. Optoisolator)
VR	- Voltage Regulator
X	- Integrated Circuit
Y	- Crystal
YFL	- Crystal Filter

APPENDIX J: REFERENCE DESIGNATOR SERIES FOR FM/AM-1100S/A ASSEMBLIES

Assembly	Reference Designator
AGC PC Board	1000
Case	6900
Clock Divider	1100
PC Board	1200
Composite Assembly	10400
Dual Tone Generator	8500
PC Board #1	8600
PC Board #2	8700
PC Board #3	8800
PC Board #4	8900
PC Board #5	9000
First Mixer	4800
Frequency Select Switch	6400
Front Panel	7700
Front Panel Wire Harness	7800
Heterodyne Amplifier/÷2 Prescaler	600
PC Board	700
High Frequency Phase Lock	2400
High Frequency Multiplier/Mixer	6200
PC Board	6300
High Level Amplifier	6500
PC Board #1	6700
PC Board #2	6600
Coil	6800
Lower Floor Assembly	10100
Mother Board Assembly	10200
Power Supply	8100
Power Supply PC Board	8200
Line Rectifier PC Board	8300
Power Termination	8400
Regulator/Timer Board	9100
RF Coaxial Cable Assembly	5200
Second Mixer	4900
Spectrum Analyzer	9200
Front Plate	4400
Horizontal Sweep Switch	4500
Inverter Board	4000
Main Board	4300
Module #1	9800
PC Board	9400
Module #2	9900
PC Board	4200
Vertical Gain Switch	4600
Wire Harness	4700
Static Discharge Protect	1900
TCXO	U7901

APPENDIX J (Cont'd)

Assembly	Reference Designator
TCXO Output Distribution Amplifier	1300
PC Board	1400
Upper Floor Assembly	7900
VCO Tuner Board	2600
100 MHz Filter	5000
PC Board	5100
100 MHz Amp/108 MHz Mixer	5500
PC Board	5600
108 MHz Bandpass Filter	1600
1080 MHz Multiplier	11200
PC Board	11000/11100
120 MHz Generator	9500
PC Board	9600
120 MHz Receiver	5700
PC Board	5800
1200 MHz Amplifier	10900
PC Board	11000
1200 MHz Filter & Diode Switch	10700
1200-2200 MHz Oscillator	800
PC Board	900
250 kHz IF/MON/AUDIO Board	3100/7400
350 MHz Low Pass Filter	11300
79-80 MHz Phase Lock	2500