



Technical Manual

PCL 6000 Series STUDIO TRANSMITTER LINKS

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GLOSSARY

AFC	Automatic frequency control
AGC	Automatic gain control
BPF	Band pass filter
FET	Field effect transistor
IC	Integrated circuit
IF	Intermediate frequency
IMD	Intermodulation distortion
IPA	Intermediate power amplifier
LED	Light-emitting diode
LO	Local oscillator
MAI	Moseley Associates Inc.
MUX	Multiplex
NC	Normally closed
NO	Normally open
PC	Printed circuit
RCVR	Receiver
SCA	Subsidiary communications authority
SRD	Step Recovery Diode
SNR	Signal-to-noise ratio
STL	Studio-to-transmitter link
THD	Total harmonic distortion
TTL	Transistor-transistor logic
XMTR	Transmitter

INTRODUCTION

The PCL 6000 System, manufactured by Moseley Associates, Inc., is a Studio-to-Transmitter Link (STL) and is designed to convey FM program material from a studio site to a transmitter site. In keeping with its predecessors, the PCL 6000 is easy to operate and maintain. This manual is a comprehensive guide with information on installation, operation, theory of operation, alignment procedures for customer troubleshooting and repairs, module descriptions, schematic and assembly drawings, and parts lists.

If you are not familiar with the basic use of the instrument and want more detailed information, please read Sections 1 through 3 before installing the PCL 6000.

Section 1, System Characteristics, is a brief overview on the PCL 6000. It includes specifications on transmitter and receiver, system features and system description.

Section 2, Installation, covers unpacking, installation and checkout procedures. It also describes antenna interconnections and remote control procedures.

Section 3, Operation, discusses the Controls and adjustments for the PCL 6000 system that the user will encounter in normal operation and initial setup.

Section 4, Module Characteristics, is a detailed analysis on the theory of operation for each module component in the Transmitter and Receiver.

Section 5, Alignment Procedures, covers system performance checks and customer adjustments that are used to service and maintain the PCL 6000. This section also covers recommended test equipment for each alignment procedure and a troubleshooting guide.

Section 6 describes general procedures for customer assistance by telephone consultation, field repair or return of equipment.

Section 7 contains assembly drawings and schematics for the transmitter and receivers.

Section 8 is comprised of parts lists for the STL system.

The Appendix contains 950 MHz Microwave Path Evaluation Instructions, System Calculation sheet and True Earth Radius Graph.

The Final Test Data Sheet, in the pocket of the back cover of the Instruction Manual, may be placed in the Appendix section for easy reference. This Test Data sheet contains results compiled by a Test Technician from tests performed on your particular system.

SECTION 1

SYSTEM CHARACTERISTICS

1.1 INTRODUCTION

The Model PCL 6000 Studio-to-Transmitter Link (STL) is designed to convey FM program material from a studio site to a transmitter site. The PCL 6000 also simultaneously conveys control and secondary programming subcarriers. This equipment may also be used to provide high-quality program transmission in intercity relay service.

The PCL 6000 series of equipment is a family of equipment that can operate in several bands from 150 MHz through 960 MHz.

1.2 SYSTEM SPECIFICATIONS

1.2.1 Composite System - 950 MHz Band

Frequency Range	940-960 MHz
Channel Spacing (6020/6030)	100-500 kHz 500 kHz spacing standard.
Frequency Response - 6020	Composite: ± 0.2 dB or better 30 Hz to 53 kHz, ± 0.3 dB or better 30 kHz to 75 kHz
Frequency Response - 6030	Composite: ± 0.2 dB or better 30 Hz to 53 kHz, ± 0.3 dB or better 30 kHz to 75 kHz
THD and IMD - 6020	Stereo demodulated: 0.2% or less 30 Hz to 7.5 kHz, typically better than .15% at 1 kHz Convolved Stereo demodulation products: greater than 50 dB below the 400 Hz, 100% modulation ref. level from 7.5kHz to 15 kHz

THD and IMD - 6030	Stereo demodulated: 0.1% or or less 30 Hz to 7.5 kHz, typically better than 0.1% at 1 kHz
	Convolved Stereo demodulation products: greater than 50 dB below the 400 Hz, 100% modulation ref. level from 7.5kHz to 15 kHz
Stereo Separation - 6020	50 dB or better 50 Hz to 15 kHz, typically 55 dB or better
Stereo Separation - 6030	51 dB or better, 50 Hz to 15 kHz, typically 55 dB or better
Nonlinear Crosstalk, (6020) Subchannel to Main Channel:	50 dB or better
Nonlinear Crosstalk, (6030) Main Channel to Subchannel:	51 dB or better
Signal-to-Noise Ratio - 6020	72 dB or better, typically 75 dB below 100% modulation, demodulated, de-emphasized left or right
Signal-to-Noise Ratio - 6030	75 dB or better, typically 77 dB below 100% modulation, demodulated, de-emphasized left or right
Dimensions Transmitter & Receiver	3.5" (8.9 cm) high 19" (48.3 cm) wide 16.5" (41.9 cm) deep
Emission	500F9
1.2.2 Monaural System - 950 MHz Band 6020 and 6030	
Frequency Range	940-960 MHz
Program Frequency Response	0.3 dB or better, 30 Hz to 15 kHz
Distortion: THD and IMD	0.2% or less, 30 Hz to 15 kHz, typically better than 0.15% at 1 kHz.

Signal-to-Noise Ratio 6020	72 dB or better, typically 75 dB below 100% modulation
Signal-to-Noise Ratio 6030	75 dB or better
Operating Temperature	-20 degrees C to +70 degrees C
Emission	110F3 (no subcarrier) 110F9 (26 kHz control subcarrier) 230F9 (67 kHz program subcarrier)

1.2.3 6010 Transmitter Specifications

Type	Solid state, direct FM, frequency synthesized, crystal referenced
RF Power 890-960	5 watts minimum, 7 watts maximum
RF Power 300-470	10 watts minimum, 15 watts maximum
RF Output Connector	Type N Female, 50 ohm
Deviation for 100% Modulation	+50 kHz (Composite) +40 kHz (Monaural) Other deviation optional
Frequency Stability	Better than 0.00025% from 0 degrees C to 50 degrees C
Spurious and Harmonic Emission	More than 60 dB below carrier level
Modulation Capability	One program and two sub- carrier channels.
Modulation Inputs	Composite: 3.5V peak-to- peak 6K ohms unbalanced, type BNC female connector. Monaural: +10 dBm 600 ohms balanced, floating. Barrier strip screw input.

Multiplex: 1.5V peak-to-peak 4K ohms unbalanced, type BNC female connectors (2), frequency range 110-185 kHz

Power Source 120/220/240 VAC, \pm 10%, 50/60 Hz, 70 Watts
12/24 Vdc optional

Shipping Weight 12.7 kg (28 lb) domestic

1.2.4 Receiver Specifications

RF Input Connector Type N female, 50 ohm

Sensitivity - 6020 Composite: 120 uV or less required for 60 dB SNR, left or right channel de-emphasized, demodulated
Monaural: 20 uV or less required for 60 dB SNR

Sensitivity - 6030 Composite: 100 uV or less required for 60 dB SNR, left or right channel de-emphasized, demodulated
Monaural: 20 uV or less required for 60 dB SNR

Selectivity - 6020 Composite: 3 dB IF bandwidth \pm 125 kHz; 80 dB IF bandwidth \pm 1.2 MHz
Monaural: 3 dB IF bandwidth \pm 90 kHz; 80 dB IF bandwidth \pm 1.2 MHz

Selectivity - 6030 3 dB IF bandwidth \pm 100 kHz; 80 dB IF bandwidth \pm 1.0 kHz
Monaural: 3 dB IF bandwidth \pm 90 kHz; 80 dB IF bandwidth \pm 1.2 MHz

Modulation Outputs Composite: 3.5V peak-to-peak 200 ohm unbalanced, type BNC female connector

Monaural: +10 dBm, 600 ohms
balanced, barrier strip
screw input

Multiplex: 1.5V peak-to-
peak 100 ohm unbalanced,
type BNC female connectors
(2)

Power Source	120/220/240 VAC, $\pm 10\%$, 50/60 Hz, 30 Watts 12/24 Vdc optional
Adjacent Channel Level to Degrade SNR by 3 dB	+10 dBc - 6020 +20 dBc 6030
Composite outputs (2) Standard	0.1 Hz-80 kHz 3.5 V p-p, unbalanced BNC connector
Multiplex outputs (2) Standard	85-200 kHz 1.5 V p-p, unbalanced BNC connector
Shipping Weight	12.7 kg (28 lb) domestic

1.3 SYSTEM FEATURES

In addition to establishing a new industry standard for performance, the PCL 6000 incorporates many new and innovative features to aid in the installation, operation, and maintenance of a system. Some of the features are:

- Ceramic, adjustment-free, very low distortion IF filters offering unprecedented selectivity.
- A built-in peak reading meter for all major functions.
- A two-decade logarithmic true signal strength meter.
- Important status functions implemented with two-color LED indicators.
- Designed to have a minimum of adjustments for trouble-free operation.
- Modular construction that provides excellent shielding and at the same time allows easy access to components.

It is recommended that the manual be studied at least through Section 5 before attempting to install the system.

1.4 SYSTEM DESCRIPTION

1.4.1 Transmitter - 6010

Block and Level: Figure 1-1
Schematic: Figure 7-2
Assembly: Figure 7-1

The PCL 6010 Transmitter is a high-fidelity broadband FM transmitter with a power output of 5 to 8 watts. It is capable of transmitting the program signal and two multiplex subcarriers with little degradation of signal quality over one link. The linearity and FM noise characteristics of the direct FM oscillator are exceptional. The transmitter is modular in construction and operation, and the system description given below follows the signal flow through the various modules.

Audio Processor (A6)

Three signal inputs are provided to the Audio Processor module: one audio (composite or mono) signal and two multiplex signals. Level adjustments are provided for all signals, which are fed to summing amplifiers. They are combined into a single signal and passed to the FMO Synthesizer module.

FMO Synthesizer (A2)

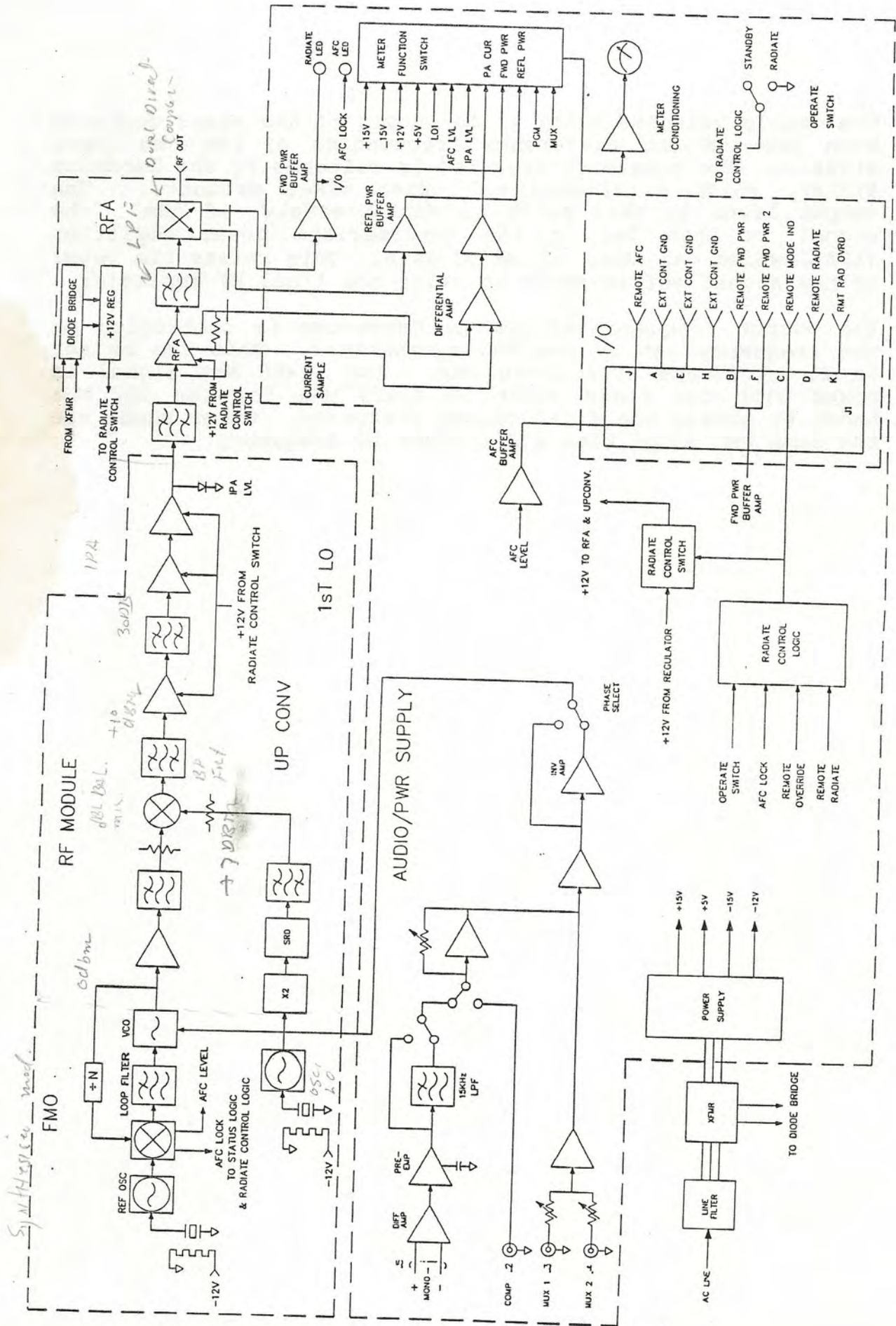
The baseband signal (Audio MUX) is used to modulate the frequency modulated oscillator (FMO) in the FMO Synthesizer module. The FMO is a 60-80 MHz ultralinear, very low noise oscillator. This oscillator is phase locked to a crystal-controlled reference oscillator. The phase lock loop contains the frequency programming switches which allow the synthesizer to be changed in frequency by 25 kHz increments. The RF output of the 60-80 MHz FMO then goes through a low-pass filter to attenuate any harmonics. With 100% composite (mono) stereo modulation, the RF signal will deviate +/-50 (40) kHz from the chosen center frequency. The output power at this point is approximately 1 milliwatt.

Up Converter (A3, A4, A5)

To preserve the low noise and low distortion characteristics of the FMO, the traditional method of multiplying up was avoided. Instead, a scheme was chosen consisting of a single up-conversion utilizing a local oscillator operating at the output frequency plus or minus the FMO frequency. This process takes place in the Up Converter module. The signal from the FMO enters one port of the double balanced mixer; the signal from the first LO enters the LO port of

the double balanced mixer. The output of the mixer contains both the sum and difference frequencies of the two input signals. The frequency required is selected by the bandpass filter, which eliminates all other mixer products. The output level at this point is approximately +10 dBm. The signal is then fed to the intermediate power amplifier (IPA), which has about 30 dB of gain. This raises the level of the signal sufficiently to drive the final RF amplifier.

The output frequency of the Up Converter is controlled by the frequency set by the FMO synthesizer. This can be set in 25 kHz steps from 60-80 MHz. The 60-80 MHz signal is mixed with the fixed first LO (1020 MHz for the 950 MHz band) to obtain the final output frequency. Other bands use the same FMO range with a different LO frequency.



Transmitter Block and Level (6010)
Figure 1-1

First Local Oscillator (A1)

The First Local Oscillator and Multiplier module contains a crystal oscillator (102 MHz for the 950 band) which is then buffered. The crystal itself is controlled in a 65 degree C oven to maintain the frequency of this module within 2 parts per million over the operating temperature range. The output of the buffer amplifier is fed to the multiplier chain, which consists of a frequency doubler and a step-recovery diode multiplier to get to the final LO frequency. The output of the step-recovery diode multiplier is filtered through a bandpass filter to select the desired frequency. The output power of this module is approximately +7 dBm, which is fed to the Up Converter module.

RF Amplifier (A8)

The RF Amplifier module internally consists of a three-stage hybrid amplifier, which takes the nominal 16dBm input signal and raises it to the nominal 6-watt transmitter output. The output of the RF amplifier is passed through a low-pass filter to attenuate all higher order harmonics to a level of at least -60 dBc. The output circuit contains a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier.

Transmitter Control (A6)

The Transmitter Control section of the audio/power supply PCB has several functions. One of these is to sense the output of the FMO Synthesizer module. If this module goes out of lock, then the radiate control logic circuit in the Transmitter Control board provides a signal to the power supply to turn off the 12.5V power to the IPA and RF amplifier, causing the transmitter to stop radiating. This board contains a differential amplifier stage, which senses the voltage drop across a current sampling resistor in the RF amplifier to give a front-panel meter indication of final amplifier current. This board also contains the buffer amplifiers for sending the forward power and AFC signals to the rear-panel remote sampling connector.

Metering and Status (A6)

The Metering and Status section conditions the metering samples for accurate meter indications, and drives the status LEDs on the front panel.

Power Supply (A6, A7)

The Transmitter Power Supply section of the audio/power supply PCB converts any of four ac input voltages (100, 120, 220, or 240 Vac) into the one unregulated and four regulated dc voltages required for the operation of the transmitter. The +12.5 V, 2.5 A output has a digital enable which allows the Transmitter Control section, in conjunction with the FMO Synthesizer, to shut down the Transmitter during the periods of loss of AFC lock on the FM oscillator. The other outputs are +15 V and -15 V at 250 mA and +5 V at 250 mA. This module also provides an unregulated 9V supply, which is used to heat the crystal oven in the first local oscillator.

1.4.2 Receiver

Block and Level: Figure 1-2 (6020)
Figure 1-3 (6030)

Chassis Schematic: Figure 7-12 (6020)
Figure 7-14 (6030)

The PCL 6000 System has two receivers which are designed for different RF environments. The 6030 provides the maximum out-of-band and adjacent channel rejection and the 6020 provides maximum performance in all but the most demanding environments. The two receivers share identical RF and audio subsystems but each has its own unique IF strip and demodulator. Both systems are adjustable to support mono or composite operation.

The preselector, preamplifier, postselector, first LO, mixer and second LO described below are all on one PC board in a shielded module.

Preselector Filter (A6)

The antenna input signal is first passed through the Preselector Filter module, which is a two-pole helical bandpass filter with very low insertion loss. This filter attenuates energy that would be fed to the preamplifier and first mixer at the image frequency and also ensures that any high-level, out-of-band signals will not block the subsequent amplifier stages.

Preamplifier (A4)

The output of the preselector filter is fed to the preamplifier module providing 14 dB of gain with a noise figure of 4 dB.

Postselector

The signal is passed through a three-pole postselector filter to provide a total of five poles of filtering.

Mixer (A3)

The carrier frequency is mixed with the first local oscillator (LO) signal to provide down conversion to the first intermediate frequency (IF) of 60-80 MHz. The mixer module also provides post amplification and filtering before the signal passes to the IF demodulator.

First Local Oscillator (A1)

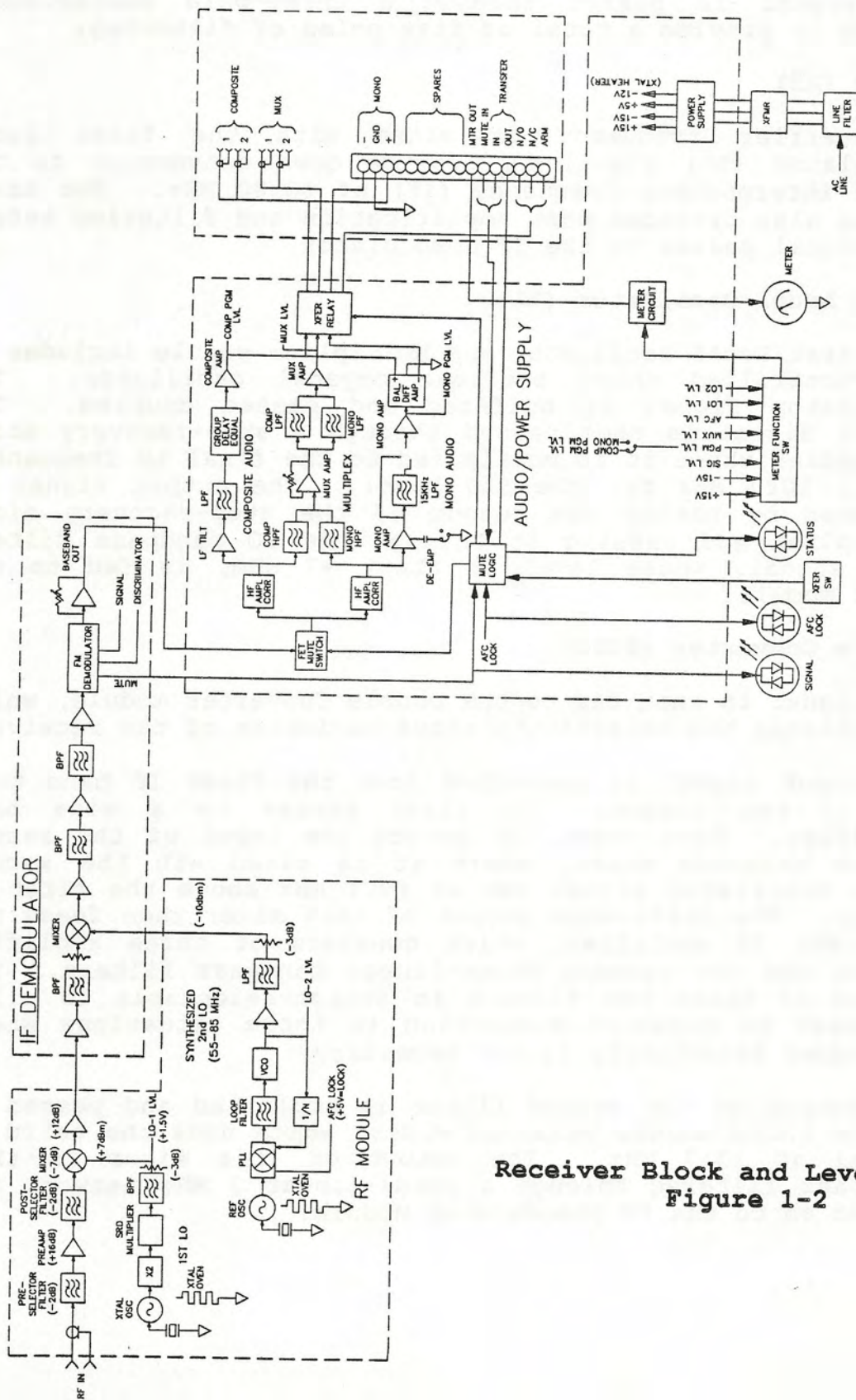
The First Local Oscillator and Multiplier module includes an oven-controlled third overtone crystal oscillator. The oscillator signal is buffered and passed doubled. The output signal is then passed through a step-recovery diode multiplier where it is multiplied to the final LO frequency. (i.e., 1020 MHz for the 950 band). The output signal is selected by taking the output of the step-recovery diode multiplier and passing it through the LO bandpass filter. This signal, whose level is about +7 dBm, is fed to the Mixer module.

Double Converter (6030)

The signal is then fed to the Double Converter module, which establishes the selectivity characteristics of the receiver.

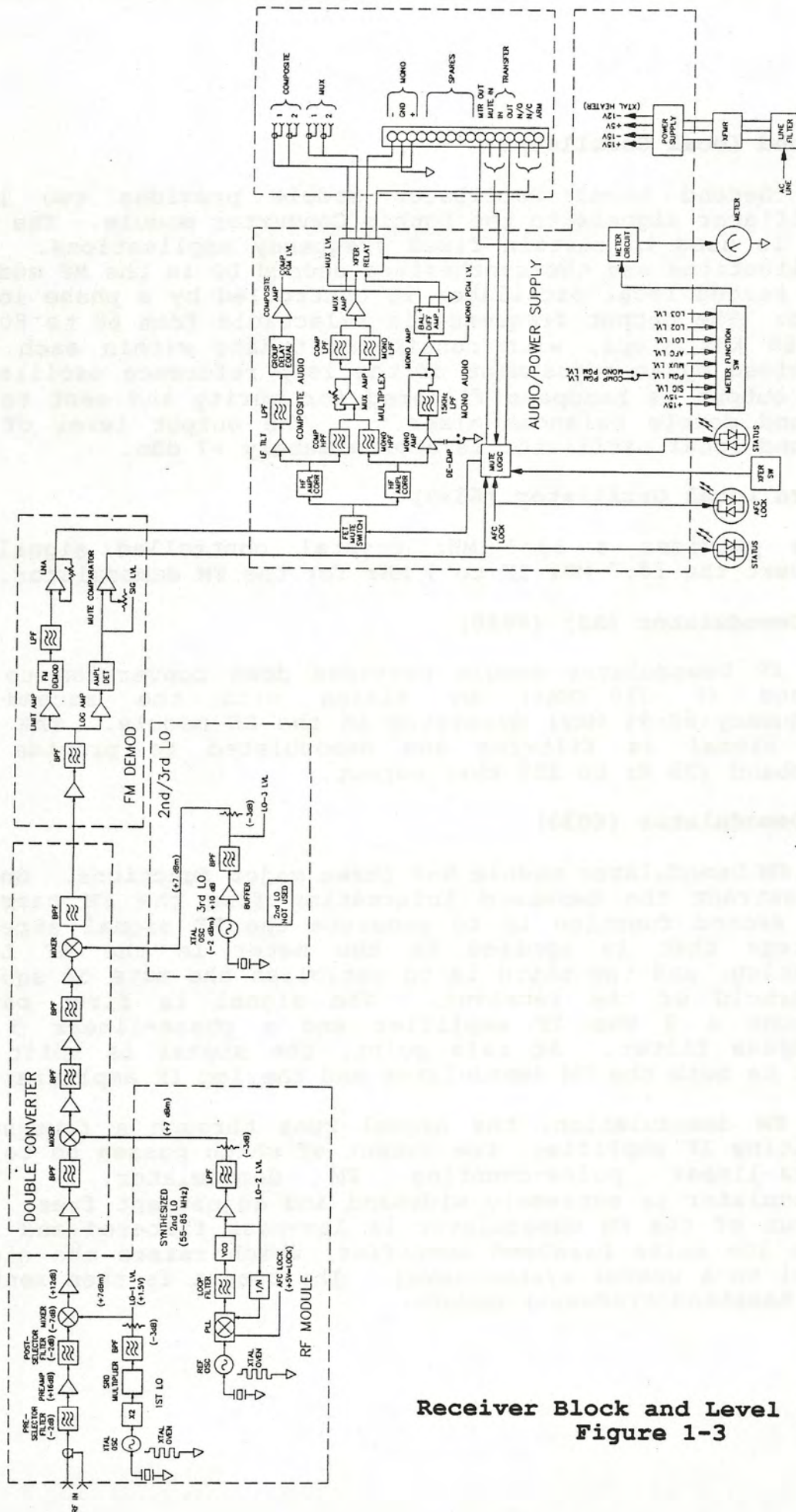
The input signal is converted from the first IF band to 3 MHz in two stages. It first passes to a wide band amplifier. From there, it enters the input of the second double balanced mixer, where it is mixed with the second local oscillator signal set at 10.7 MHz above the first IF signal. The difference output of this mixer then feeds the 10.7 MHz IF amplifier, which consists of three amplifier stages and two ceramic phase-linear bandpass filters. The second of these two filters is switch-selectable to allow the user to minimize distortion in those situations where the added selectivity is not necessary.

The output of the second filter is amplified and passed on to the third double balanced mixer, which uses the third LO signal at 13.7 MHz. The output of this mixer is then bandpass filtered through a phase-linear 3 MHz network and passed on to the FM Demodulator Module.



6020

Receiver Block and Level (6020)
Figure 1-2



6030

Receiver Block and Level (6030)
Figure 1-3

Second Local Oscillator

The Second Local Oscillator module provides two local oscillator signals to the Double Converter module. The 80.7 MHz is used in certain fixed frequency applications. Most applications use the synthesized second LO in the RF module. The second local oscillator is controlled by a phase locked loop. The output frequency is selectable from 60 to 80 MHz in 25 kHz steps, with continuous tuning within each step provided by an adjustment of the loop reference oscillator. The output is bandpass filtered for purity and sent to the second double balanced mixer. The output level of the second local oscillator is approximately +7 dBm.

Third Local Oscillator (6030)

This provides a 13.7 MHz crystal controlled signal to convert the 10.7 MHz IF to 3 MHz for the FM demodulator.

IF Demodulator (A2) (6020)

The IF Demodulator module provides down conversion to the second IF (10.7MHz) by mixing with the second LO frequency (64-96 MHz) generated in the RF module. The 10.7 MHz signal is filtered and demodulated to provide the baseband (30 Hz to 200 kHz) output.

FM Demodulator (6030)

The FM Demodulator module has three major functions. One is to extract the baseband information from the FM carrier. The second function is to generate the RF signal strength voltage that is applied to the meter in the RF LEVEL position, and the third is to establish the mute or squelch threshold of the receiver. The signal is first passed through a 3 MHz IF amplifier and a phase-linear 3 MHz bandpass filter. At this point, the signal is split and sent to both the FM demodulator and the log IF amplifier.

For FM demodulation, the signal runs through a four-stage limiting IF amplifier, the output of which passes on to the ultra-linear pulse-counting FM demodulator. This demodulator is extremely wideband and adjustment free. The output of the FM demodulator is low-pass filtered and sent to a low noise baseband amplifier, which raises the signal level to a useful system level. The output is then sent to the Baseband Processor module.

Baseband Processor

The main functions of the Baseband Processor module are to split the baseband signal into two frequency bands: 30 Hz to 80 Hz for composite, and 85 kHz to 200 kHz for MUX. NOTE: In the extended baseband version of the PCL 6000, the composite band spans 30 Hz to 110 kHz, and the MUX passband extends from 120 kHz to 200 kHz. For mono, the split is 30 Hz to 15 kHz for audio and 28-85 kHz for MUX. This module also contains the FET mute switch, which is controlled by the mute comparator output of the Mute and Transfer module. The signal is then passed through a high-frequency amplitude corrector, which compensates for the baseband high-frequency roll-off caused by the 10.7 IF bandpass filters, to restore proper amplitude response to the baseband signal.

The signal is then fed to an audio amplifier and an 80 kHz (composite) or 15 kHz (mono) low-pass filter. The output of this filter passes through an active group delay equalizer, which compensates for the group delay variations of the low-pass filter. This signal is then buffered by an output amplifier that provides 3.5V peak-to-peak output for 100% modulation. The output of the high-frequency amplitude corrector is also passed to a MUX high-pass filter (80 kHz composite, 22 kHz mono) and then goes to the MUX amplifier. The output of this amplifier drives a MUX low-pass filter (200 kHz composite, 85 kHz mono) which is then buffered to yield the MUX nominal output of 1.5V peak-to-peak.

Metering and Status

The Metering and Status section conditions the metering samples and drives the status LED on the front panel and the front-panel meter.

A dual-color status LED indicates the operational status of the Receiver. The OPERATE LED is green when there is sufficient RF signal to exceed a user-established threshold of RF signal that correlates to the minimum SNR that is acceptable to the user. When the SIGNAL LED is red, there is insufficient signal to meet the minimum SNR requirements and the Receiver is placed in a non-operating muted condition, which is indicated by a red OPERATE LED. When the receiver is operating properly, the OPERATE LED is green.

A second dual-color LED is used for the AFC lock indication. If the second LO PLL is not locked, the LED is red. Under normal conditions, it is green.

Mute and Transfer

The Mute and Transfer section mutes the audio signal during periods of insufficient RF signal strength or for transferring to another receiver.

Power Supply

The Receiver Power Supply section converts one of four possible ac input voltages (100, 120, 220, or 240 Vac) to the three regulated dc voltages and one unregulated dc voltage required to operate the receiver. The regulated voltages are +15V and -15V at about 500 mA, +5V at 500 mA and +9V unregulated, which is used to power the crystal oven in the first local oscillator.

The circuit is shown in Figure 1-1. The input is connected to the primary of a transformer. The output of this transformer is connected to a bridge rectifier. The output of the bridge rectifier is connected to a filter capacitor. The filter capacitor is connected to a series combination of a resistor and a diode. The diode is connected to ground. The resistor is connected to the filter capacitor. The output of the resistor-diode combination is connected to the positive terminal of the +5V regulator. The output of the +5V regulator is connected to the positive terminal of the +15V regulator. The output of the +15V regulator is connected to the positive terminal of the -15V regulator. The output of the -15V regulator is connected to the negative terminal of the +9V unregulated supply. The output of the +9V unregulated supply is connected to the positive terminal of the +9V unregulated supply.

The regulator and filter capacitor are connected to the positive terminal of the +5V regulator. The output of the +5V regulator is connected to the positive terminal of the +15V regulator. The output of the +15V regulator is connected to the positive terminal of the -15V regulator. The output of the -15V regulator is connected to the negative terminal of the +9V unregulated supply. The output of the +9V unregulated supply is connected to the positive terminal of the +9V unregulated supply.

A second filter capacitor is connected to the positive terminal of the +5V regulator. The output of the +5V regulator is connected to the positive terminal of the +15V regulator. The output of the +15V regulator is connected to the positive terminal of the -15V regulator. The output of the -15V regulator is connected to the negative terminal of the +9V unregulated supply. The output of the +9V unregulated supply is connected to the positive terminal of the +9V unregulated supply.

A second filter capacitor is connected to the positive terminal of the +5V regulator. The output of the +5V regulator is connected to the positive terminal of the +15V regulator. The output of the +15V regulator is connected to the positive terminal of the -15V regulator. The output of the -15V regulator is connected to the negative terminal of the +9V unregulated supply. The output of the +9V unregulated supply is connected to the positive terminal of the +9V unregulated supply.

SECTION 2

INSTALLATION

2.1 Unpacking

The PCL 6000 Transmitter and Receiver should be carefully unpacked and inspected for shipping damage. Should inspection reveal any shipping damage, visible or hidden, immediately file a claim with the carrier. Keep all packing materials until the performance of the system is confirmed.

We recommend that the top covers of both the Transmitter and Receiver be removed for a superficial inspection of the internal components. This should ascertain that all modules, assemblies, and cables are mechanically secure. After visually inspecting the internal components, replace the top covers.

CAUTION

Do not attempt any adjustments of any kind until the nature of each adjustment is understood.

Do not apply power to the Receiver until the procedure in Section 2.2 is completed.

Do not apply power to the Transmitter until the procedure in Section 2.2 is completed and a proper load is connected to the RF output.

Do not remove the covers on the transmitter RF Amplifier module.

2.2 Line Voltage Selection

The Transmitter and Receiver each have the capability of operating at one or four nominal ac power source voltages: 100, 120, 220, or 240 Vac, 50-60 Hz. The units are shipped for 120 Vac operation, unless otherwise specified.

Select the operating voltage by rewiring the transformer primary windings as shown in the appropriate schematic and assembly drawings in Section 4.

If the operating voltage is changed, change the fuse in accordance with the following:

<u>Line Voltage</u>	<u>Transmitter Fuse (A)</u>	<u>Receiver Fuse (A)</u>
100	2	1
120	2	1
220	1	0.5
240	1	0.5

2.3 Preinstallation Checkout

While the user has both the Transmitter and Receiver at the same location, we suggest that a preinstallation checkout of the system be performed before mounting the equipment in racks separated by many miles. Figure 2-1 shows one of the several possible bench test setups.

The minimum equipment to perform a bench test setup are:

1. An RF wattmeter with a measurement range of 5 to 12 watts (Bird 43 or equivalent).
2. A 50 Ohm, 10 watt dummy load for 950 MHz with 30 dB attenuation output capability (Sierra 661A-30 or equivalent).
3. A low-distortion audio signal generator (Tektronix SG505 or equivalent).
4. An audio distortion analyzer (Tektronix AA501 or equivalent).
5. Variable attenuator, 0 to 100 dB at 950 MHz (Kay Model 432D or equivalent).

More extensive testing can be accomplished using a stereo generator and demodulator combination and/or a subcarrier generator and demodulator combination.

Observe these precautions when performing any bench test:

CAUTION

Always operate the transmitter terminated into a proper 50-ohm load.

Always attenuate the signal into the receiver to less than 3000 microvolts (Approximately 75 dB attenuation between the Transmitter and Receiver).

Failure to observe these precautions can cause the transmitter final transistor to be destroyed, or the receiver preamplifier transistors may be damaged.

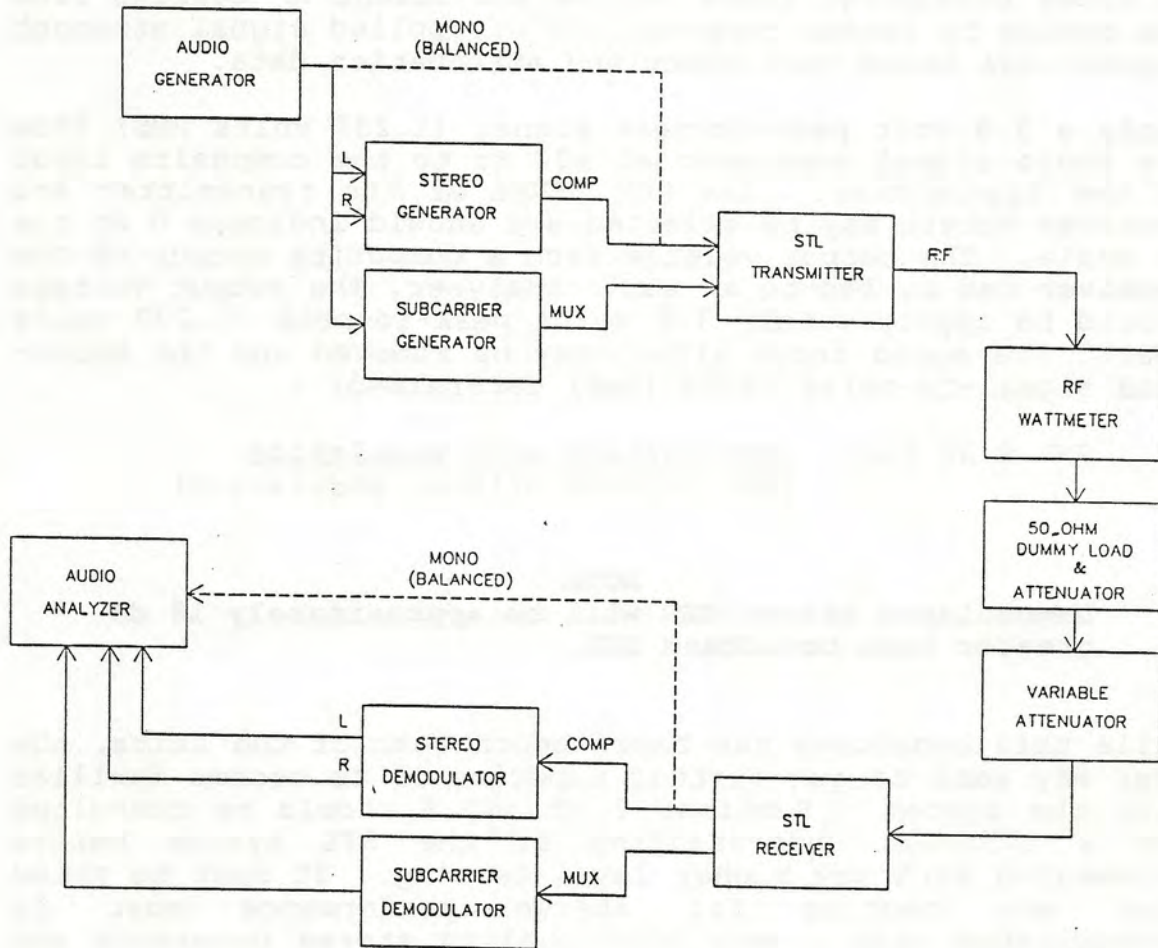


Figure 2-1
Typical Bench Test Setup

With the wattmeter and dummy load connected to the transmitter, apply ac power to the Receiver. The OPERATE LED will be red, indicating that there is no RF.

Apply ac power to the Transmitter and place the OPERATE/STANDBY switch in the OPERATE position. The AFC LOCK and REFL PWR LEDs will be red for several seconds and then turn green. Observe that the wattmeter will indicate between 5 to 8 watts and that the transmitter meter will provide

readings of FWD POWER. A brief period after the REFL PWR becomes green, the OPERATE LED on the Receiver will change from red to green. The RF LEVEL meter position on the Receiver may be selected to determine the strength of the RF signal applied to the receiver. Adjust the variable attenuator until an input signal strength of approximately 1000 microvolts is indicated. It should be mentioned that in any bench testing where the Transmitter and Receiver are in close proximity, there can be sufficient RF leakage from the cables to render computations of applied signal strength impractical based upon power and attenuation data.

Apply a 3.5 volt peak-to-peak signal (1.237 volts RMS) from the audio signal generator at 400 Hz to the composite input of the Transmitter. The PGM LEVEL at the transmitter and receiver meters may be selected and should indicate 0 on the dB scale. The output voltage from a composite output of the Receiver can be fed to an audio analyzer. The output voltage should be approximately 3.5 volts peak-to-peak (1.237 volts RMS). The audio input signal may be removed and the broadband signal-to-noise ratio (SNR) determined:

$$\text{SNR} = 20 \log \frac{(\text{RMS voltage with modulation})}{(\text{RMS voltage without modulation})}$$

NOTE

Demodulated stereo SNR will be approximately 12 dB greater than broadband SNR.

While this concludes the basic bench test of the units, the user may want to run further experiments to become familiar with the system. Sections 2, 5 and 6 should be consulted for a thorough understanding of the STL system before proceeding with any higher level testing. It must be noted that any testing for stereo performance must be accomplished with a very high quality stereo generator and stereo demodulator combination. The stereo generator and demodulator combination should be tested back to back to determine their performance independently of the STL link.

2.3.1 Receiver Selectivity Selection (6030)

Unless otherwise instructed, when the receiver is shipped from the factory, it is normally set in the wide IF mode. If you desire to operate the unit in the narrow IF mode, the alignment procedures in Section 5 should be consulted.

2.4 Rack Installation

The PCL 6000 units are designed for mounting in standard rack cabinets, preferably between waist and shoulder height. The Transmitter and Receiver have mounting holes for Chassis Trak C-300-5-1-14 chassis rack slides. If the rack will accept chassis rack slides, their use is recommended. If chassis rack slides are used, be sure to leave at least a 15-inch service loop in all cables to the equipment.

When mounting the Transmitter or Receiver in a rack, the unit must have an unobstructed free flow of air for cooling purposes across the rear panel. Continued operation in a confined environment can cause the ambient temperature to exceed specification, resulting in reduced life or catastrophic failure.

When a PCL 6000 Receiver is used with a PCL 600, PCL-505 or PCL-303 Receiver, a transfer panel (such as a TPR-2) must be used to accomplish automatic switchover, and should be mounted between the two receivers. Receiver automatic switchover interconnections are detailed in Section 2.10.2.

When two Transmitters are in a system at a site, an automatic transfer panel such as the TPT-2 should be mounted between them. The TPT-2 will allow interconnection of a PCL 6000 with another PCL 6000, PCL-600, PCL-606, PCL-505, or PCL-303 Transmitter and can provide automatic switchover in the event of a detectable failure in the Transmitter, as shown in Section 2.9.1.

2.5 Antenna Installation

The installation of the antennas and associated feed lines determines to a large extent the long-term reliable operation of the STL. Experience has indicated that a reasonably clear path having an 0.6 Fresnel zone clearance along with good feed-line installation results in a highly predictable signal level at the receiver. The appendix contains a series of instructions, calculation sheets, typical gain and loss characteristics, and nomographs to enable the received signal level to be predicted. Since the PCL-6000 has a signal strength meter, it is possible to determine the quality of the antenna installation and path compared to the calculations.

Experience at 960 MHz has indicated that for reliable year-round operation with a predominately overland path and 0.6 Fresnel zone clearance, a 20 dB fade margin should be used. At least a 25 dB fade margin should be allowed if the path is over water or flat terrain with little vegetation.

2.6 Transmission Cables

The transmission cable between antenna and Transmitter or Receiver should be coaxial cable whose loss characteristics are known. Typical quality low-loss foam dielectric lines such as Andrew LDF4-50, a 0.5 inch diameter cable, has a 2.4 dB loss per 100 feet at 950 MHz. This cable will generally be adequate where the total cable run (at both Transmitter and Receiver) is less than 300 feet and there is a good transmission path of less than 10 miles.

When the total transmission cable length exceeds 300 feet, an obstructed or grazing path occurs or the path length exceeds 10 miles, a lower loss cable such as Andrew LDF5-50, a 7/8 inch diameter cable with a loss of 1.4 dB per 100 feet, is recommended.

To reduce system losses, it is important to select type N connectors that are designed for the type of transmission cable used in the system. The connectors must then be installed in accordance with the manufacturer's recommendations. It sometimes will take only one improperly installed connector to reduce the received signal strength sufficiently to provide only marginal system performance.

Reasonable care should be exercised during the installation of the transmission cable. Never put a sharper bend radius in the cable than recommended by the manufacturer. Too sharp a bend can cause internal cable damage that is not observable on the outside of the cable. This damage can result in excessive loss in the cable. Since the higher quality transmission cables are relatively inflexible, Moseley Associates has several short "pigtail" assemblies available. These "pigtailed" are designed to attach to the ends of the transmission cable and allow movement of the equipment or antenna with less chance of damaging the transmission cable or the connectors on the equipment. These "pigtailed" and appropriate connectors are available in installation kits for the more popular types of transmission cable.

Figure 2-2 shows typical transmitter RF connections for the transmission cable to the antenna, and Figure 2-3 shows typical receiver RF connections.

Should it be desired to mount the antenna on a series-fed standard broadcast tower, the required isolation can be obtained with the installation of a Moseley Associates' Isocoupler at the base of the series-fed antenna. Isolation at standard broadcast frequencies is high, and the isocoupler introduces only approximately 1.5 dB loss at the STL frequency.

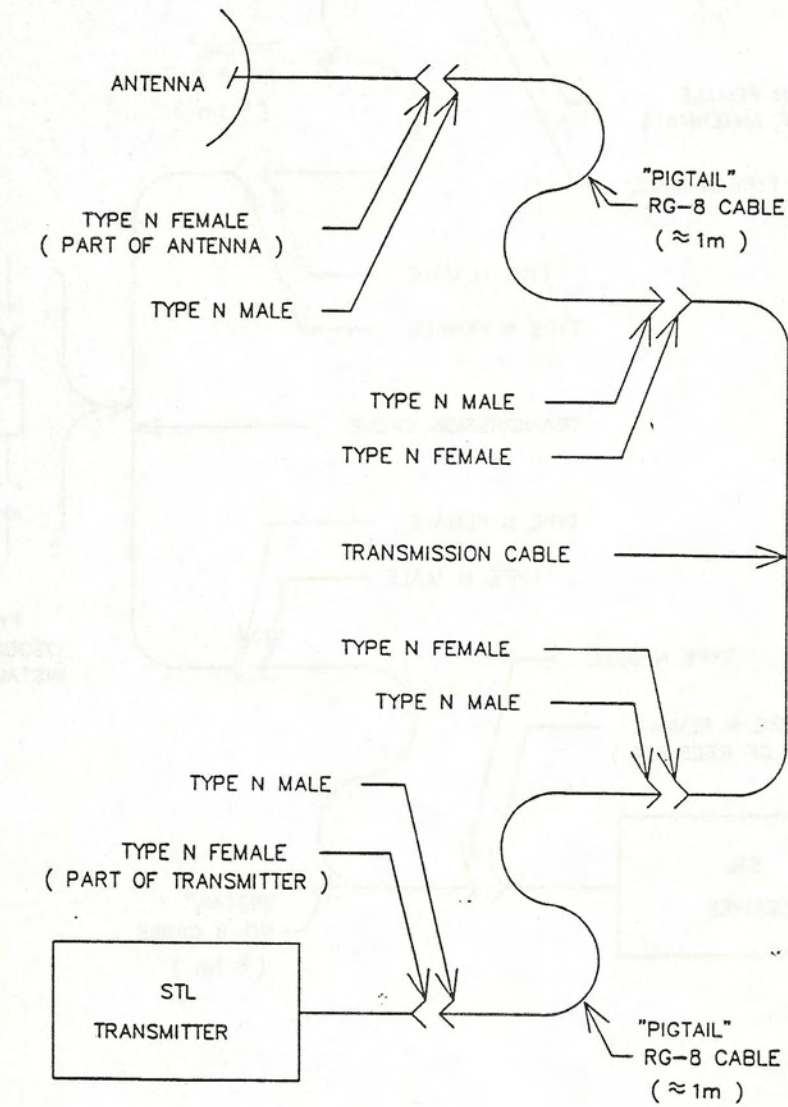


Figure 2-2
Typical PCL-6010 Transmitter RF Connects

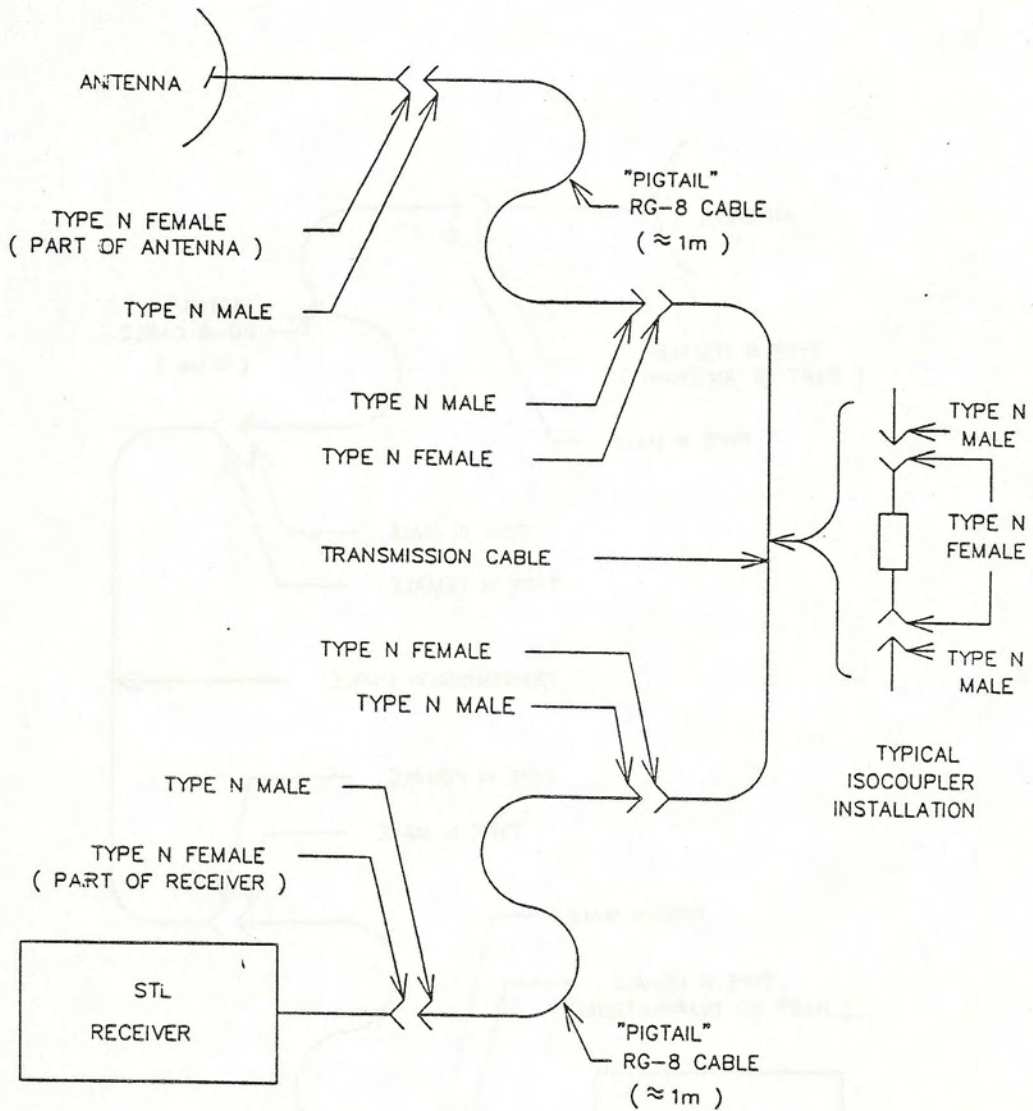
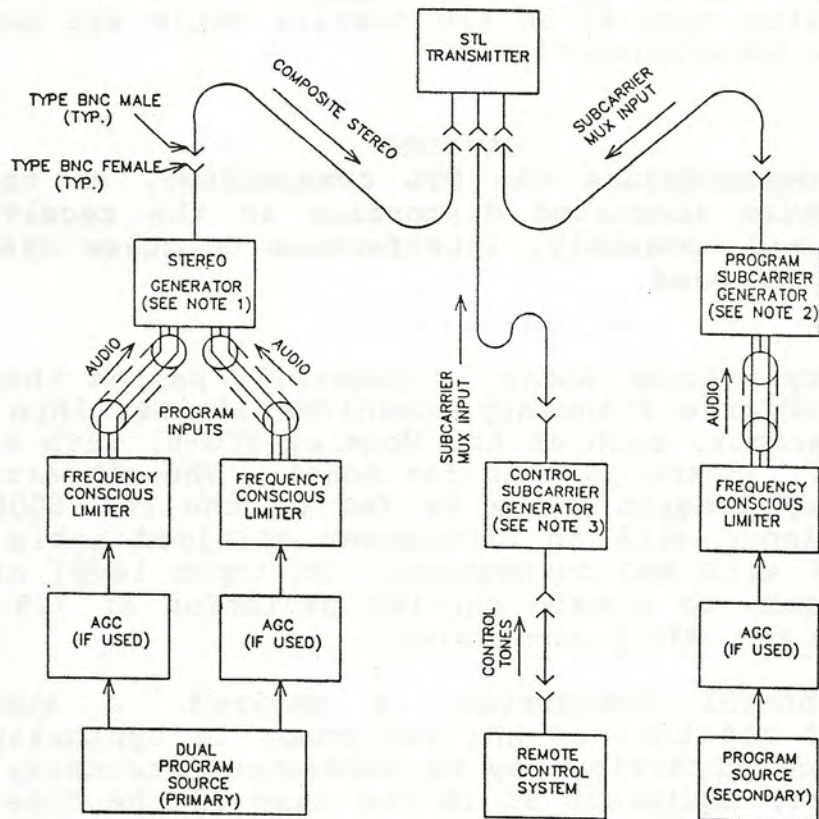


Figure 2-3
Typical PCL-6000 Receiver RF Connects

2.7 Program and Multiplex Installation - Transmitter

Figure 2-4 depicts the typical interconnection of a PCL 6000 as would normally be found at the studio. The Left and Right program material is first passed through an automatic gain control (AGC) such as the Moseley TGR-340 to first establish the nominal system levels. This is followed by a frequency-conscious audio limiter, such as the Moseley TFL-280, to prevent overmodulation of the system as the result of the normal pre-emphasis curve used in FM broadcasts.



NOTES:

1. STEREO GENERATOR MAY BE MODEL SCG-9 OR EQUIVALENT.
2. PROGRAM SUBCARRIER GENERATOR MAY BE MODEL SCG-8 OR EQUIVALENT.
3. CONTROL SUBCARRIER GENERATOR MAY BE PART OF REMOTE CONTROL SYSTEM.
4. COAXIAL CABLE IS RG-58 A/U OR EQUIVALENT.

Figure 2-4
Transmitter PGM and MUX Interconnect - Composite

It is highly desirable that the gain control or limiting units for each channel be interconnected so that any processing that occurs on one channel is performed in the same manner on the other channel. Both TGR-340 and TFL-280 units, installed in pairs, can be interconnected to process both channels in the same manner. The channel requiring the most processing controls both units.

The limiter outputs are then fed to a stereo generator such as the Moseley SCG-9A for conversion of the left and right channels into the standard FM composite baseband signal. The composite signal is then fed into the composite input of the PCL-6000. The standard composite signal is unbalanced, 3.5 volts peak-to-peak, for 100 percent modulation. BNC connectors with type RG-58 A/U coaxial cable are generally used for the interconnection.

CAUTION

Never overmodulate the STL transmitter, as this will cause increased distortion in the received signal and, possibly, interference to other users in the STL band.

The secondary program audio is generally passed through an AGC stage and/or a frequency conscious limiter into a sub-carrier generator, such as the Moseley SCG-8, with a center frequency of 185 kHz (67 kHz for mono). The subcarrier for the secondary program audio is fed to the PCL 6000 MUX-2 subcarrier input with an unbalanced shielded cable (RG-58 A/U typical) with BNC connectors. An input level of 1.5 V p-p corresponds to a main carrier deviation of 7.5 kHz (6 kHz mono) by the MUX-2 subcarrier.

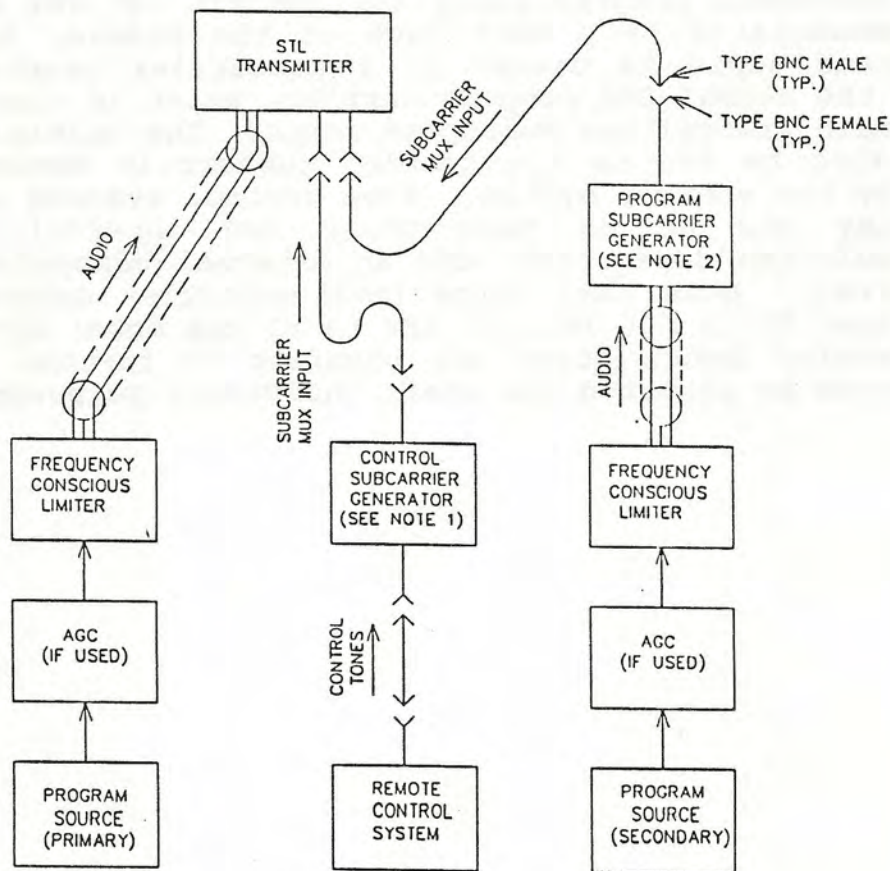
Where a control subcarrier is desired, a subcarrier frequency of 110 kHz (26 kHz for mono) is typically used. The modulated subcarrier may be generated internally in the remote control equipment as in the case of the Moseley MRC series. In any case, the control subcarrier is applied to the MUX-1 input on the PCL 6010 Transmitter with a peak-to-peak signal of 1.5 volts using BNC connectors on coaxial cable (RG-58 A/U typical). This signal will produce a main carrier deviation of 5 kHz (4 kHz mono) by the MUX-1 subcarrier.

The composite and multiplex inputs into the PCL 6010 Transmitter are wideband inputs. It is assumed that the equipment supplying signals to be fed into the Transmitter contain the band limiting filters necessary to limit the signals to the spectrum for the intended use, i.e., 53 kHz for stereo composite, 110 kHz for control subcarrier (26

kHz +/-3 mono), and 185 kHz (67 kHz +/-1.10 mono) for secondary program audio.

If the external equipment generates any spurious signals, these signals will be accepted by the Transmitter and passed to the Receiver. Any spurious signals may cause intermodulation among the composite and subcarrier information, and may increase the occupied bandwidth to the extent that interference will be experienced by neighboring users in the STL Band.

Figure 2-5 shows the connections for a mono setup. The same cautions and considerations apply as for composite. The mono input has a selectable low-pass filter for bandwidth limiting.



NOTES:

1. CONTROL SUBCARRIER GENERATOR MAY BE PART OF REMOTE CONTROL SYSTEM.
2. PROGRAM SUBCARRIER GENERATOR MAY BE MODEL SCG-8 OR EQUIVALENT.
3. COAXIAL CABLE IS RG-58 A/U OR EQUIVALENT.

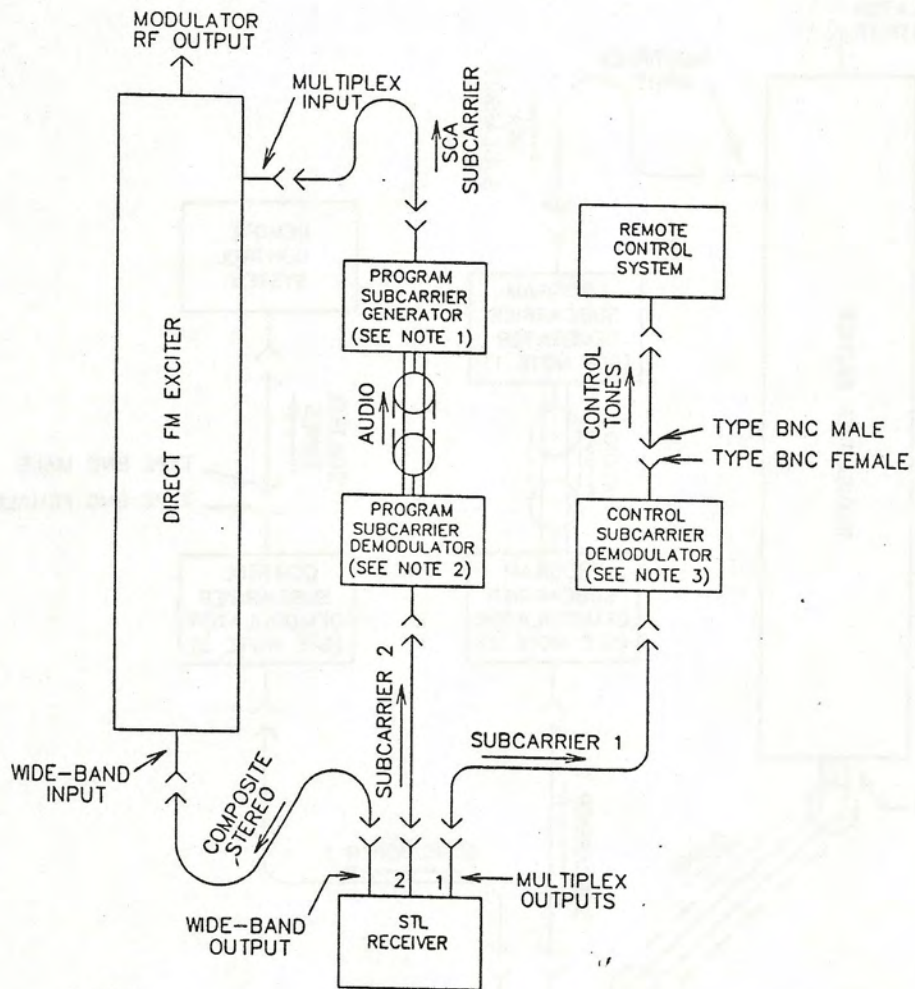
Figure 2-5
Transmitter PGM and MUX Interconnect - Mono

2.8 Program and Multiplex Interconnect - Receiver

At the outputs of the PCL 6000 Receivers, the audio-band output of the IF demodulator is split and filtered into two bands. The audio outputs are from 30 Hz to approximately 85 kHz (15 kHz mono). The multiplex outputs are bandpass filtered to pass the frequency range of 100 kHz to 200 kHz (22 kHz to 85 kHz mono).

Figures 2-6 and 2-7 depict a typical interconnection of a PCL 6000 Receiver at the remote transmitter site. The unbalanced output (3.5 volts peak-to-peak composite, +10 dBm mono) is interconnected to the wideband input of the Transmitter with coaxial cable (RG-58 A/U typical) with BNC connectors, or twisted shielded pair for mono.

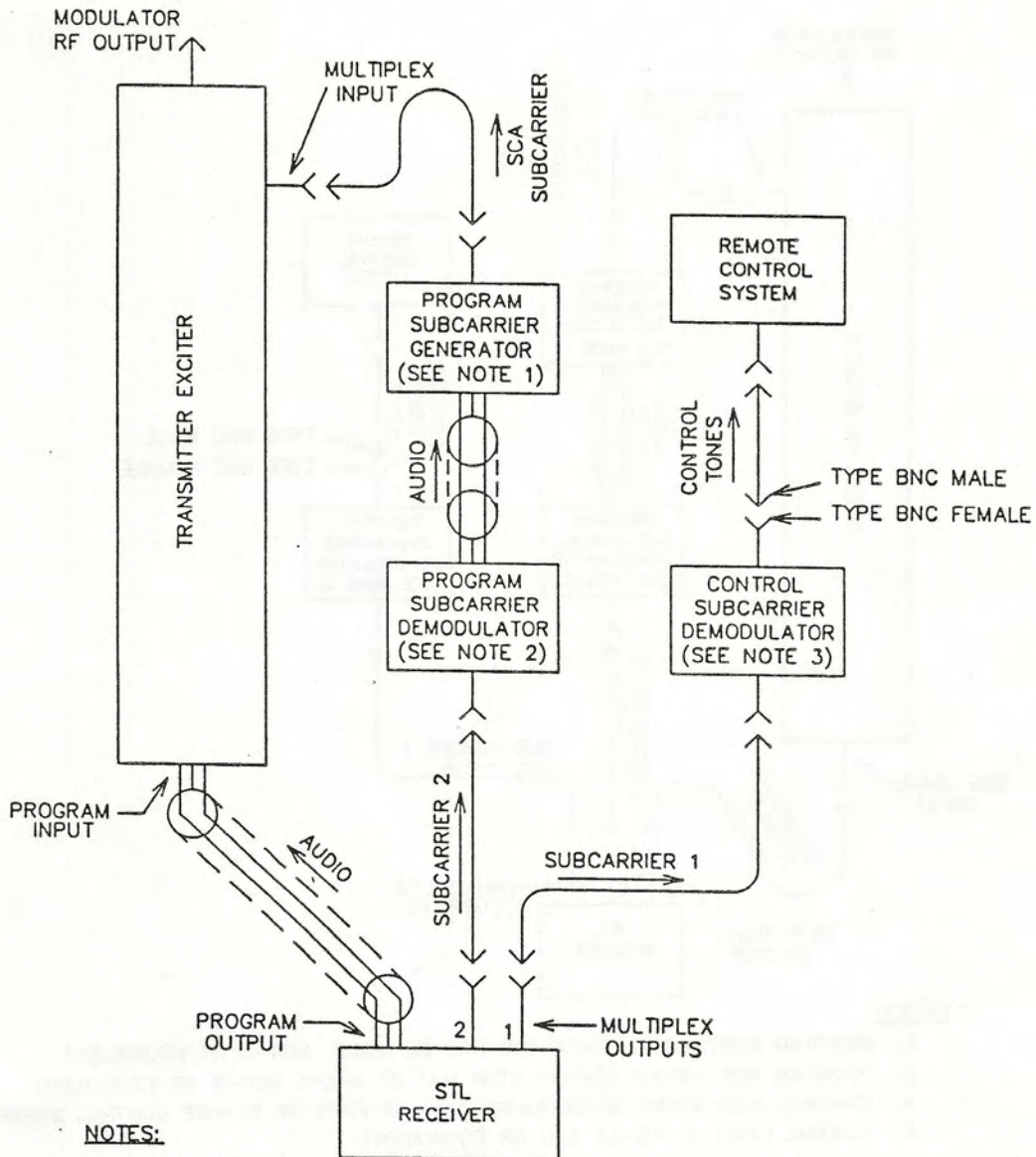
The secondary program audio (on the STL 185 kHz subcarrier) is demodulated by a unit such as the Moseley SCD-8. The baseband audio is passed to a subcarrier generator at 67 kHz, the normal SCA program carrier, which in turn is fed to the main transmitter multiplex input. The multiplex outputs may also be fed to the control subcarrier demodulator for use by the control system. Some control systems such as the Moseley MRC series have their own internal subcarrier demodulation capability, and an external demodulator is not required. Note that since both multiplex outputs contain the same 85 to 200 kHz (20 kHz to 85 kHz mono) spectrum, the subcarrier demodulators are required to further filter the spectrum as required for their individual purposes.



NOTES:

1. PROGRAM SUBCARRIER GENERATOR MAY BE MODEL SCG-8 OR EQUIVALENT.
2. PROGRAM SUBCARRIER DEMODULATOR MAY BE MODEL SCD-8 OR EQUIVALENT.
3. CONTROL SUBCARRIER DEMODULATOR MAY BE PART OF REMOTE CONTROL SYSTEM.
4. COAXIAL CABLE IS RG-58 A/U OR EQUIVALENT.

Figure 2-6
Receiver PGM and MUX Interconnect - Composite



NOTES:

1. PROGRAM SUBCARRIER GENERATOR MAY BE MODEL SCG-8 OR EQUIVALENT.
2. PROGRAM SUBCARRIER DEMODULATOR MAY BE MODEL SCD-8 OR EQUIVALENT.
3. CONTROL SUBCARRIER DEMODULATOR MAY BE PART OF REMOTE CONTROL SYSTEM.
4. COAXIAL CABLE IS RG-58 A/U OR EQUIVALENT.

Figure 2-7
Receiver PGM and MUX Interconnect - Mono

2.9 Main/Standby Interconnect

The PCL 6000 Transmitter and Receiver can be interfaced with other PCL 6000, PCL-606, PCL-505 or PCL-303 systems to form a redundant backup system that provides for automatic changeover between equipment in the event a detectable failure occurs. The Moseley model TPT-2 (Transfer Panel Transmitter) is used to accomplish automatic switchover for transmitters in all combinations. The model TPR-2 (Transfer Panel Receiver) is required on certain receiver combinations.

2.9.1 Transmitter Interconnect

When two transmitters are interconnected with a TPT-2 to form a main/standby pair, the composite and subcarrier generator output is routed to each transmitter in parallel. The RF output of each transmitter is routed to the respective RF input on the TPT-2. The transmission cable to the antenna is connected to the antenna type N connector of the TPT-2. Figures 2-8 and 2-9 detail the interconnection of these signals.

NOTE

For proper operation with a TPT-2, both transmitter RADIATE/ STANDBY switches should be in the STANDBY position. In addition, the remote connector between the transmitters and the TPT-2 should be wired as shown in Figures 2-8 and 2-9.

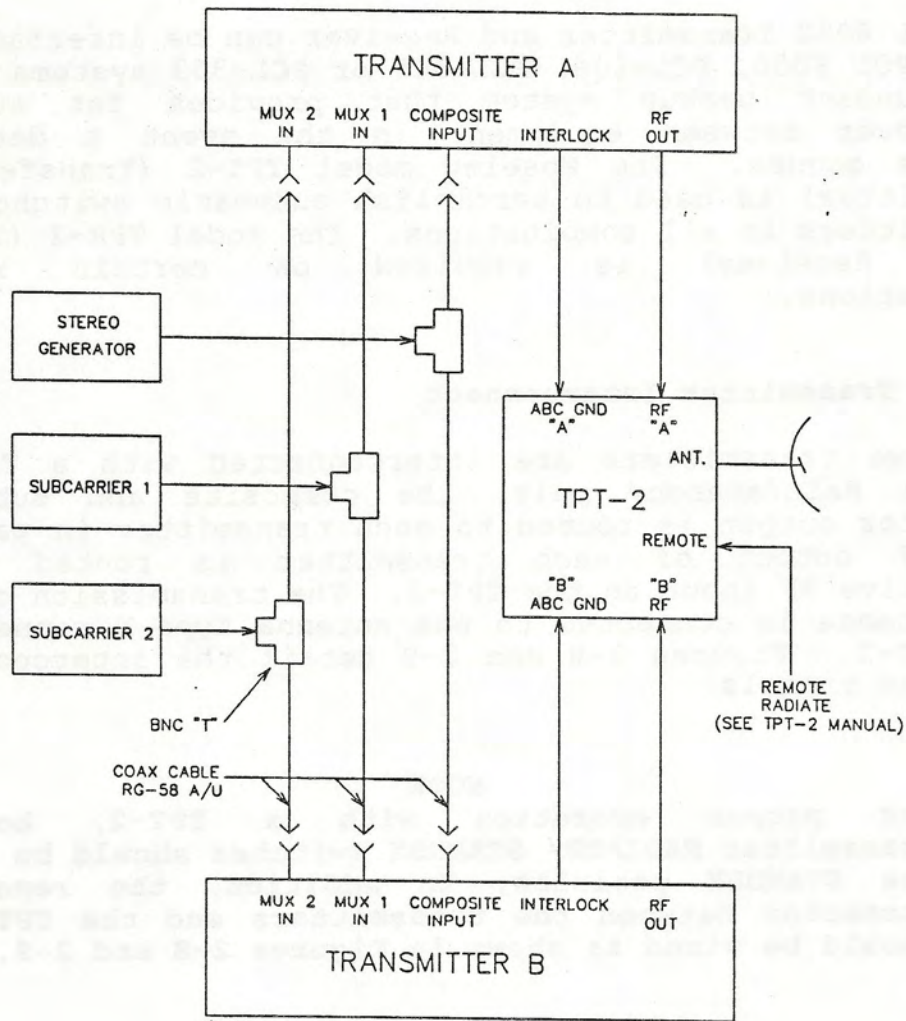


Figure 2-8
Main/Standby Transmitter Interconnect - Composite

Remote Connector Wiring Guide

<u>TPT-2 Terminal</u>	<u>PCL 6000</u>	<u>PCL-606</u>	<u>PCL-505</u>	<u>PCL-303</u>
A	J1-B	A10-J1-B	J1-B	J403-F
B	J1-D	A10-J1-D	J1-D	J403-C
C	J1-C	A10-J1-C	J1-C	J403-D
GND	J1-A	A10-J1-A	J1-A	J403-A

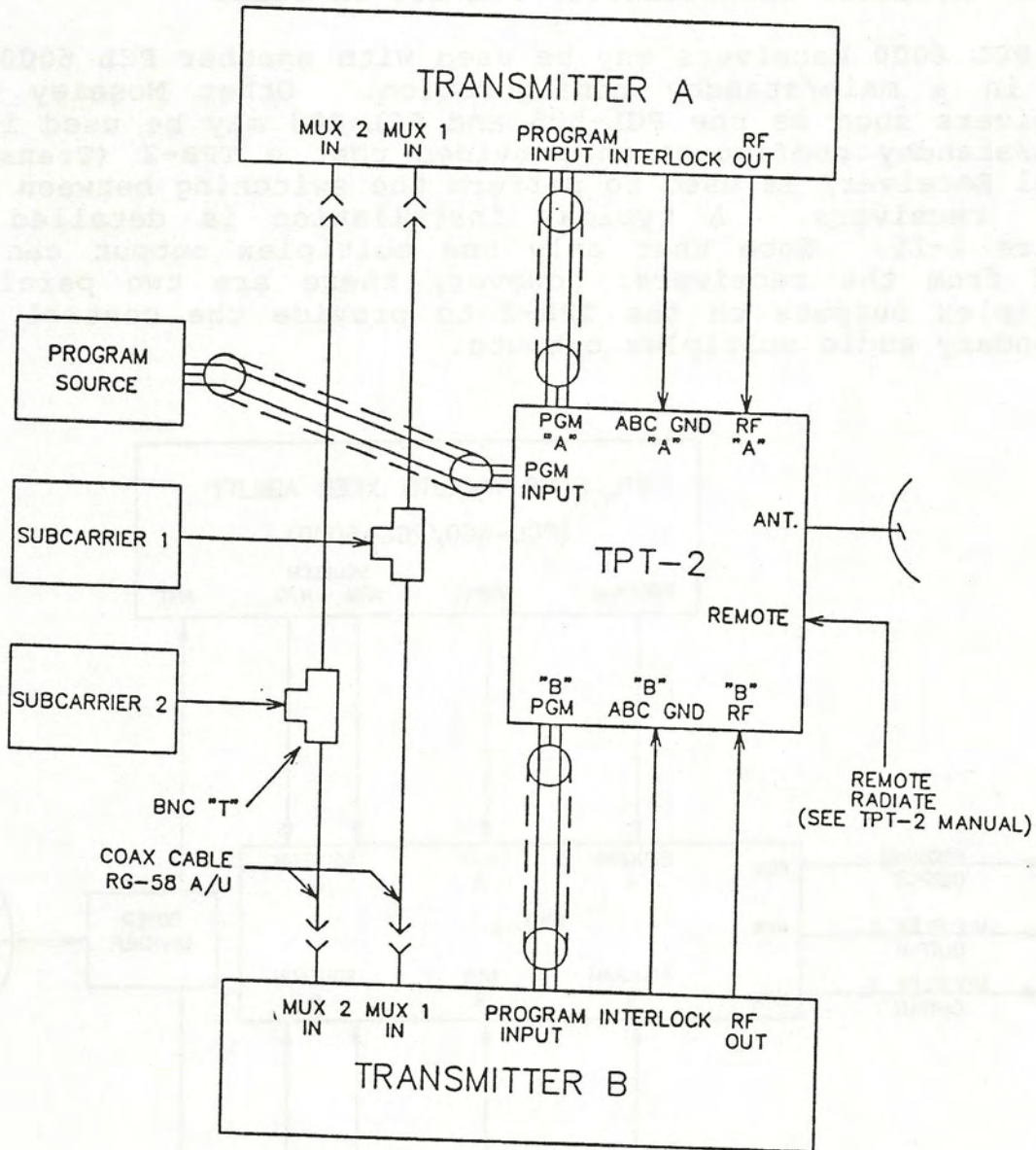


Figure 2-9
Main/Standby Transmitter Interconnect - Mono

2.9.2 Receiver Interconnect, PCL-600 or Other

The PCL 6000 Receivers may be used with another PCL 6000 or 606 in a main/standby configuration. Other Moseley STL receivers such as the PCL-505 and PCL-303 may be used in a main/standby configuration provided that a TPR-2 (Transfer Panel Receiver) is used to perform the switching between the two receivers. A typical installation is detailed in Figure 2-10. Note that only one multiplex output can be used from the receivers; however, there are two parallel multiplex outputs on the TPR-2 to provide the control and secondary audio multiplex outputs.

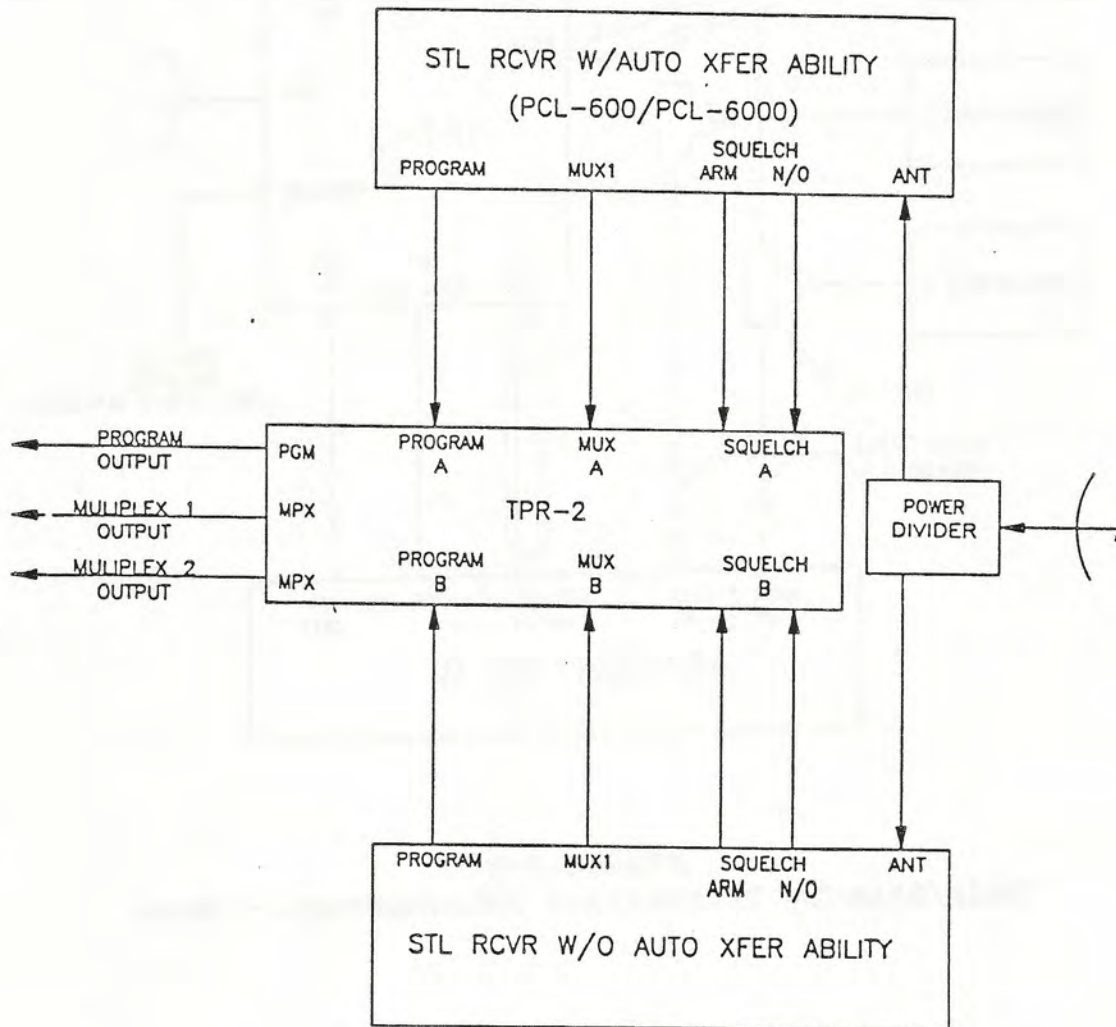


Figure 2-10
Main/Standby Receiver Interconnect PCL 6000

2.10 Remote Control of the STL Transmitter

The PCL 6010 transmitter has been designed to be operated by remote control. Radiate/standby control capability, as well as metering outputs for power and AFC, are built in. Figure 2-11 shows the interconnections required for remote control of the transmitter. All connections to the transmitter are made via A10-J1 on the rear of the unit. The interconnecting cable should have not more than a few hundred ohms resistance per conductor. The panel itself is shown schematically; this entire assembly is available from Moseley Associates as the Model ECP-5 Extension Control Panel.

The OPERATE/STANDBY switch will place the transmitter in a radiating condition when closed. It is electrically interconnected with the control switch on the transmitter itself, which should be placed in STANDBY for remote control operation. The AFC and Output meters give relative indications of these two parameters. The two calibration potentiometers are set to give a suitable meter deflection, as for example, half-scale.

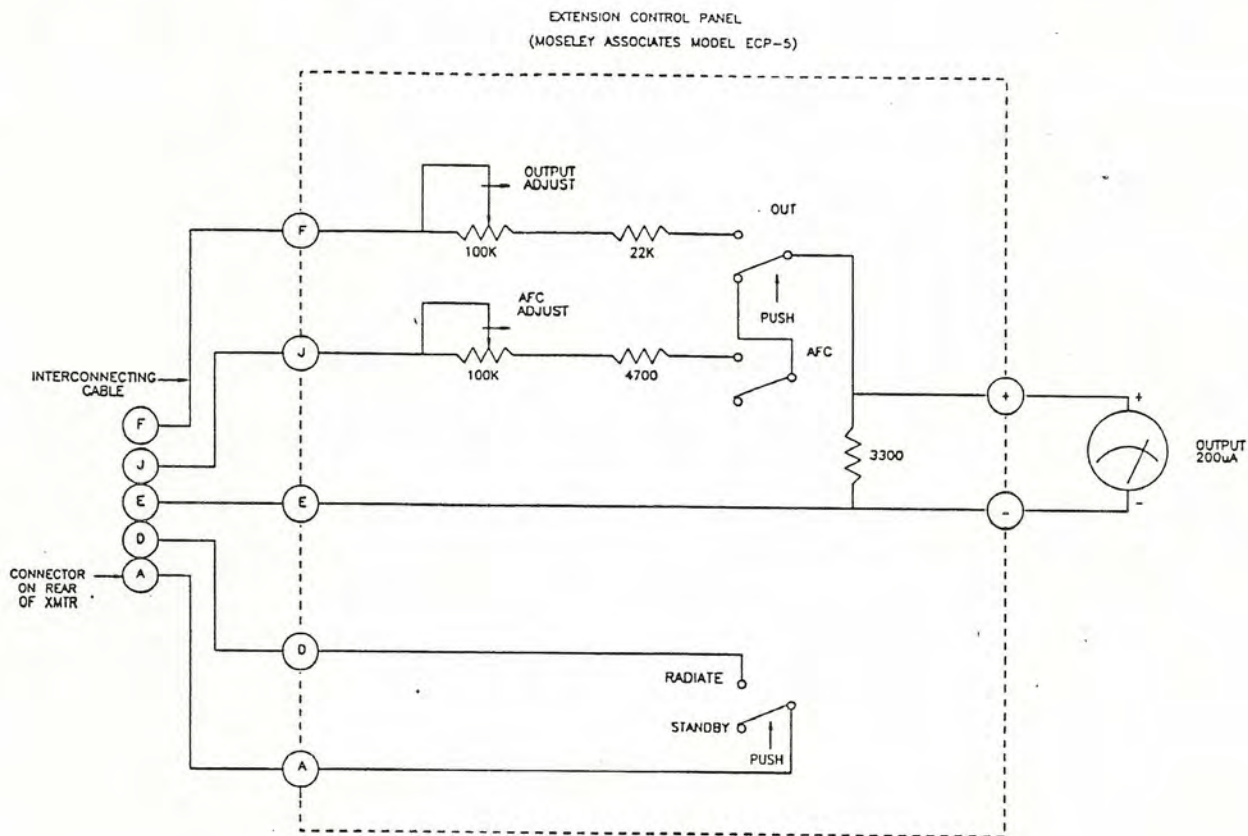


Figure 2-11
External Control Panel Connector

SECTION 3

OPERATION

3.1 Introduction

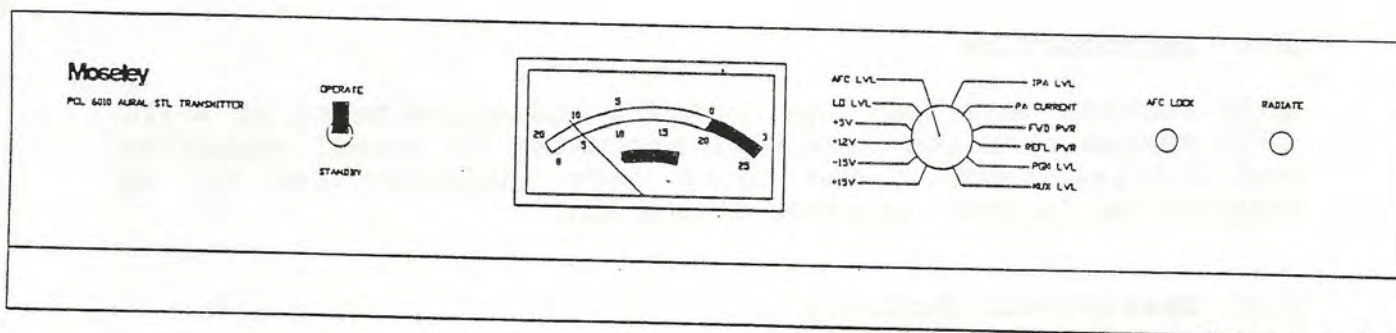
This section describes the controls and adjustments of a PCL 6000 system that the user will encounter in normal operation and initial setup. The units once installed and set up require no further operator attention.

3.2 Operational Controls

3.2.1 Transmitter Front Panel

The transmitter front panel is depicted in Figure 3-1. The meter functions and scales used are:

<u>Function</u>	<u>Scale</u>	<u>Units</u>	<u>Notes</u>
FWD POWER	dB	dB	Power in dB relative to full output. 0 dB = full output.
PGM LEVEL	dB	dB	0 dB = 3.5 V p-p input, 100% modulation.
MUX LEVEL	Linear	kHz	Deviation of main carrier by the subcarriers.
REFL POWER	dB	dB	Power in dB relative to full reflected (VSWR=00). 0 dB = 100% reflected power.
AFC LEVEL	Center	Rel	AFC voltage
LO LEVEL	Center	Rel	Local Oscillator level
IPA LEVEL	Center	Rel	INT power amplifier level
PA CURRENT	Linear	x.1 Amps	RF power amp current
+5	Linear	Volts	
+12	Linear	Volts	STBY=1.5 volt (approx.)
+15	Linear	Volts	
-15	Linear	Volts	



**Figure 3-1
Transmitter Front Panel**

The meter is an absolute value peak-reading type with fast ballistics, since the purpose of the meter is to observe the peak values of modulation which affect the deviation of the Transmitter.

The two transmitter status LEDs are red-green type two-color LEDs. The AFC LOCK LED is green when the FMO Synthesizer has achieved a lock condition. When AFC LOCK is red, it indicates that an unlock condition exists. This inhibits any radiation of RF power, resulting in the RADIATE LED being red. When power is initially applied to the Transmitter, it is normal for the AFC LOCK LED to be red for several seconds.

The RADIATE LED will be green when the Transmitter is supplying RF power and red when not supplying RF power. This LED is controlled by the internal interlock controls, the RADIATE/STANDBY switch, and any external logic associated with main/standby operation.

The RADIATE/STANDBY switch functions as an on/off switch for the RF power output. In the RADIATE position, the RF power will be on provided all of the internal interlocks are enabled. In the STANDBY position, RF radiation is controlled by external switching control and the internal interlocks.

3.2.2 Receiver Front Panel

The operation of the receiver front panel controls is very similar to the transmitter controls. Figure 3-2 shows the receiver front panel. Top scale is calibrated in dB (absolute value peak indicating) followed by a four-decade logarithmic scale, followed by a 0 to 25 linear scale, and on the bottom is a center arc for relative indications. The scale used for each function is:

Function	Scale	Units	Notes
RF LEVEL	Log	micro-volts	RF signal level at input of receiver.
LO1 LEVEL	Center	Rel	1st local oscillator level
LO2 LEVEL	Center	Rel	2nd local oscillator level
LO3 Level	Center	Rel	3rd local oscillator level (6030)
PGM LEVEL	dB	dB	0 dB is 3.5 V p-p (mono)
MUX LEVEL	Linear	KHz	Deviation of main carrier by the subcarriers.
AFC LEVEL	Center	Rel	AFC voltage
+5	Linear	Volts	
+15	Linear	Volts	
-15	Linear	Volts	

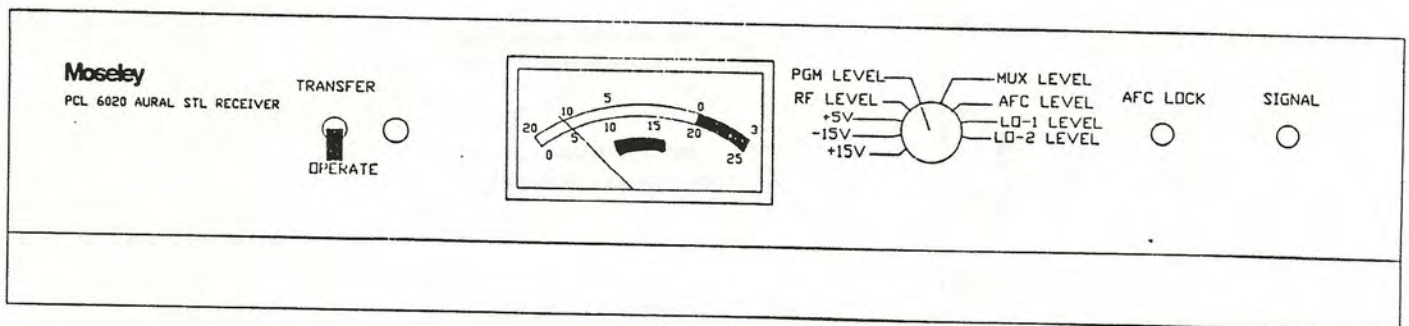


Figure 3-2
6020 Receiver Front Panel

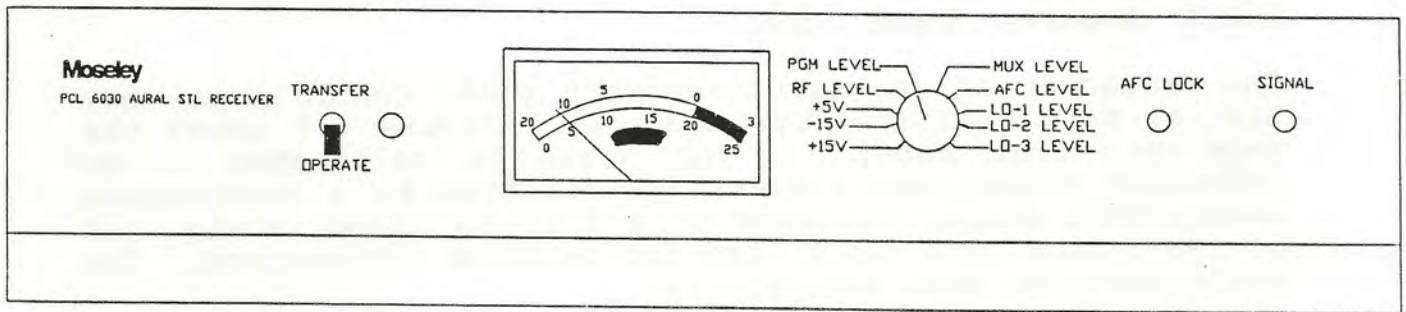


Figure 3-2
6020 Receiver Front Panel

A dual-color status LED indicates the operational status of the Receiver. The OPERATE LED is green when there is sufficient RF signal to exceed a user-established threshold of RF signal that correlates to the minimum SNR that is acceptable to the user. When the SIGNAL LED is red, there is insufficient signal to meet the minimum SNR requirements and the Receiver is placed in a non-operating muted condition, which is indicated by a red OPERATE LED. When the receiver is operating properly, the OPERATE LED is green.

The AFC Lock LED indicates the condition of the synthesized second LO. It is green when the PLL is locked.

Figure 3-3 depicts the basic shape of the SNR curve with and without high-level signals in the band. It should be emphasized that it is not necessarily only high-level adjacent channels that can cause interference. There are many combinations of signals that can give rise to intermodulation distortion, which will cause the resultant product to fall within the desired passband.

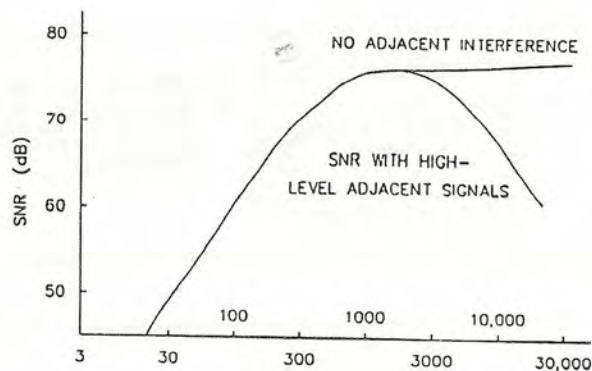


Figure 3-3
Typical SNR Curves

SECTION 4
MODULE CHARACTERISTICS

4.1 Introduction

This section provides theory of operation for the PCL 6000 modules.

The modules are discussed in the following order:

4.2 Transmitter Theory of Operation

- 4.2.1 Audio/Power Supply and Control
- 4.2.2 RF Module
 - FMO Synthesizer
 - 1st Local Oscillator
 - Up Converter Mixer
 - Up Converter Amplifier
- 4.2.3 RF Amplifier

4.3 Receiver Theory of Operation

- 4.3.1 Audio/Power Supply and Control
- 4.3.2 RF Module
 - Preselector Filter
 - Preamplifier
 - Mixer
 - First Local Oscillator
 - Second Local Oscillator
- 4.3.3 IF Demodulator (6020)
- 4.3.4 Double Converter (6030)
- 4.3.5 Second and Third L.O. (6030)
- 4.3.6 FM Demodulator (6030)

4.2 TRANSMITTER

4.2.1 Audio/Power Supply and Control

Schematic: Figures 7-4, 7-5, 7-6

Assembly: Figure 7-3

The Transmitter Power Supply consists of an ac power connector, transformer, rectifiers, capacitive filters, and series pass regulators. The power supply has four output voltages: +15, -15, +5, and +12.5 V. Each is regulated by a series IC regulator. All except the +12.5 V regulator are fixed. The 12.5 V output is adjustable and is factory set to 12.5 V. The 12.5 V output may be reduced to 1.5 V or less by reducing the voltage at pin 12 from its normal level of +5 V to zero. This will occur if the AFC loses lock or if the RADIATE/STANDBY switch is turned to STANDBY.

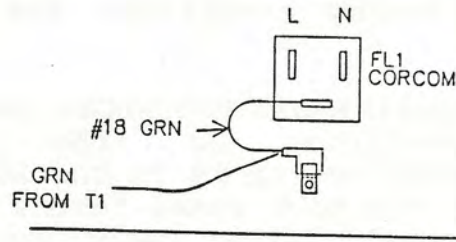
CAUTION

Failure to ground the third lead of the input power cord may result in hazardous shocks to personnel.

The ac power connector includes an RF filter. The transformer primary windings can be wired to select one of the four input voltage ranges listed below:

<u>Nominal Voltage (rms)</u>	<u>Minimum Voltage (rms)</u>	<u>Maximum Voltage (rms)</u>	<u>Line Fuse</u>
100	90	110	1 A
120	108	132	1 A
220	198	242	.5 A
240	216	264	.5 A

The transformer has two primary windings which are placed in parallel for 120 Vac operation and in series for 240 Vac operation. One winding is tapped for 100 Vac or 220 Vac operation. Refer to Figure (4-1) for specific wiring changes.



FROM PRIMARY OF TRANSFORMER	PRIMARY VOLTAGE			
	100VAC	120VAC	220VAC	240VAC
BLK/RED	WHT/RED	FL1-L	N/C	FL1-L
WHT/RED	BLK/RED	FL1-L	BLK	BLK
WHT	FL1-N	FL1-N	FL1-N	FL1-N
BLK	FL1-N	FL1-N	WHT/RED	WHT/RED
BLK/WHT	FL1-L	N/C	FL1-L	N/C

(N/C = NO CONNECTION. TERMINATE & INSULATE THESE WIRES.)

**Figure 4-1
Transformer Wiring Detail**

The Power Supply includes the rectifiers and regulators for the +15V, -15V, and +5 V supplies. The rectifier and regulator for the 12.5 V supply are mounted on the RF Amplifier heat sink. Note: R6 adjusts the output level of the +12.5 V supply; when the transmitter is radiating, this voltage should be between +12.3 and +12.7 volts for proper operation. The regulated -12 V is used to power the crystal oven for the first LO crystal.

Transmitter Control

The Transmitter Control circuitry is divided into three main functional sections:

1. Radiate control logic
2. Final power amplifier (PA) current signal conditioner
3. Metering buffer amplifiers

Radiate Control Logic

The transmitter radiate control logic consists of Q1, Q2, Q3, and U1. This circuit will allow the transmitter to radiate when the following conditions are simultaneously met:

1. The front panel RADIATE/STANDBY switch is in the RADIATE position Or the front panel RADIATE/STANDBY switch is in the STANDBY position and pin D of the back panel remote connector is at ground potential. Either condition will appear as a ground potential on U1 PIN 8 on the Audio/Power Supply Board.
2. The AFC lock signal from the FMO Synthesizer module is greater than +2 V. This will appear as +2 V or more on P5 PIN 11 on the Audio/Power Supply Board.
3. Pin K of the back panel remote connector is floating (not connected to ground). This will appear as +2V or more on P4 PIN 18 on the Audio/Power Supply Board.

When all of the above input conditions occur, the base of Q3 will go from +3V to 0V, enabling the +12.5V power supply. The +12.5V is then supplied to the intermediate power amplifier (IPA) and RF amplifier (RFA), thus allowing the transmitter to radiate.

PA Current Signal Conditioner

Differential amplifier U10 and associated circuitry condition and amplify the PA current sample. The voltage drop appearing across PA current sampling resistor R705 (in the RF Amplifier module) is presented to the Transmitter Control section of the Audio/Power Supply Board on P3 PINS 9 and 10. The voltage between TP2 and TP3, as measured with a floating voltmeter, will be 0.1 V for each Ampere of current drawn by the final PA transistor. This voltage contains a +12.5 V common mode component which is removed by the differential amplifier.

Metering Buffer Amplifiers

The forward power sample from the RF Amplifier enters the Audio/Power Supply Board on P3 PIN 1 and is amplified by U13. The output of U13 PIN 7 is fed to the meter circuit for front-panel meter display. This output also appears on P4 PINS 11 and 12 for remote metering and hot standby purposes. The output of U13 PIN 7 is also fed to

differential amplifier U14, where it is used to control the front panel radiate status indicator.

A section of U10 is used to buffer the FMO Synthesizer AFC signal for a remote meter. The input to this amplifier is from P5 PIN 12, and the amplifier output is sent to P4 PIN 17.

The reflected power sample from the RF Amplifier enters the board on P3 PIN 2 and is amplified by the second section of U13.

Metering and Status

The transmitter Metering and Status circuitry includes three main sections:

1. Twelve metering functions
2. Operating status indicators
3. RADIATE/STANDBY switch

Metering Functions

The signals to be monitored are fed through divider networks to switch S2 which selects a signal to go to the meter circuit.

The signals go to an absolute value amplifier U11 and U12 with a peak detector for the ac signals. The output of the absolute amplifier is connected to U12, the meter ballistics amplifier. R131 is used to electrically zero the meter. R286 is used to adjust the meter ballistics response. The output of this circuit is connected to the meter.

Operating Status Indicators

Comparator U14 is used to detect forward power and drive the RADIATE LED (CR1) on the front panel, the LED is red when in STANDBY, and green when the transmitter is radiating. Another section of U14 is used for the AFC status indication, the output is used to drive the AFC LOCK LED (CR2) on the front panel, the LED is red when the AFC is out of lock, and green when locked.

RADIATE/STANDBY Switch

RADIATE/STANDBY switch S1 on the front panel is a double-pole, double-throw switch used to activate logic circuits within the Transmitter and is connected through the harness to rear panel connector A10-J1-C for remote indication of the RADIATE/ STANDBY mode.

Audio Sections

The audio section supports either mono or composite operation. Mono signals are converted to single-ended through U9 and U8. The second half of U8 does the pre-emphasis (enabled by jumper E5). The signal next goes through the three-stage filter sections made up of U7, J6, U5 and U4. Adjustments FA, FB, and FC are used to tune the roll-off of the filter while R47 sets the low-frequency tilt and R45 sets the filter gain. The filter output goes to jumper E4 which selects either filter or no filter for the mono path. Jumper E3 selects either the mono or composite signal to feed to U3 and U2. The second section of U2 is an inverter to match the phase of the audio signal when used in a dual mono configuration with certain older receivers. U3b is used to mix and buffer the two mux inputs. The individual levels are set through R29 and R40.

4.2.2 RF Module

Although all RF functions through the IPA are included on one circuit board, the sections are discussed separately below.

Schematic: Figures 7-8, 7-9
Assembly: Figure 7-7

FMO Synthesizer

The FMO Synthesizer consists of three main subgroups: the RF group, the digital group, and the loop filter. The RF group includes the oscillator (FMO), buffer, reference oscillator, and low-pass filter. The digital group includes a level translator, a pre-settable divide-by-N counter, and a phase/frequency comparator.

These three groups provide a functional module that has good short-term stability, low noise, and is tunable over a wide frequency range. Selecting the appropriate divide ratio synthesizes the crystal-controlled reference oscillator and ensures long-term stability.

The FMO (frequency modulated oscillator) consists of low-noise field effect transistor Q3 in an RF grounded base configuration. The drain of Q3 is connected to the resonant circuit inductor and capacitors. The capacitance for this circuit is provided by C30, C29 and C31. The inductance consists of a stripline inductor on the PC board. Feedback to cause oscillation is from the drain to the source consisting of C29 and C31. The normal frequency range of the oscillator is 60 to 80 MHz.

The modulation signal enters the FMO module at J1. Potentiometer R33 is used to calibrate the FMO modulation sensitivity for the two preset conditions. The modulation signal is then applied to CR6, which is a variable capacitance diode. CR6 is coupled to the resonant circuit by C28. R37 adjusts the bias on CR6 and is set for minimum modulation distortion, usually approximately -5 volts. R33 adjusts the amount of modulation on the bias voltage applied to CR6. A 3.5 V peak-to-peak input at J1 will produce 100% modulation (50 kHz deviation).

The signal is first buffered by Q4 and Q5. Integrated circuit AR1 is a buffer amplifier which drives the low-pass filter L5, L6 and L7, which attenuate the harmonics of the FMO. The frequency stability of the FMO is maintained by CR5, which is attached to the stripline inductor through C27. A voltage generated by the AFC circuitry changes the capacitance of CR5, which is also part of the tuning of the FMO resonant circuit. This AFC voltage is derived by phase comparing the divided output of the FMO with the divided output of a crystal reference oscillator.

R53 is used as a pickoff to the high speed divider U2. This is a dual modular divider whose output is fed to U1, the PLL chip. The output frequency is set by SW1, SW2, and SW3. They control internal dividers in the PLL.

Crystal Y1, Q1 and Q2 comprise a reference oscillator and buffer. Frequency Trim control C11 is used to set the output frequency of this oscillator to 3.2 MHz.

Loop filter U3 is an integrating low-pass filter that removes most of the reference frequency component of the phase comparator output. It also provides dc gain to decrease the very low frequency noise of the FMO. Further filtering of the AFC voltage is then delivered to CR5 through R38, closing the AFC loop. AFC level adjust C30 is used to place the phase-locked loop in the center of its operating control range. This is indicated by a nominal +4 V level.

The average voltage at U9 pin 1 is +5 V when the loop is locked. If the loop becomes unlocked, the average voltage drops to 2.5 V. This causes the output of U3 pin 7 to change from plus to minus, which lights the red LOSS OF LOCK LED on the module. When lock is lost, the voltage at FL2 drops from +5 V to 0 V, causing the 12.5 V power supply voltage to drop to 1.5 V, which removes the 8 watt RF output.

The output frequency of the PLL is set by the values of switches SW0-SW3. The output frequency is 64 MHz times the value of SW0* (0 or 1) plus 4 MHz times the value of SW1 (0 to 15) plus 250 kHz times the value of SW2 (0 to 15) plus 25 kHz times the value of SW3 (0 to 9).

Transmitter frequency example:

Desired frequency =	950 MHz		
First LO =	1020 MHz		
FMO frequency		<u>70</u>	MHz
Switch settings	SW0	1	64 MHz
	SW1	1	4
	SW2	8	2
	SW3	0	0
			<u>70.0</u> MHz

* Certain early units had SW0 hard-wired to 1.

First Local Oscillator

The output LO signal is derived from a crystal-controlled oscillator which uses an oven-mounted crystal for frequency stability. The signal is buffered and then doubled by an active push-push doubler. The signal is fed to a step-recovery diode multiplier, and the output is filtered to select the desired harmonic. The signal is then attenuated to control the output impedance which reduces the power to the level required by the mixer.

On-board power supply regulation eliminates frequency drifts due to line voltage variations.

The output local oscillator signal is derived from crystal-controlled oscillator Q6. The third overtone crystal is temperature stabilized by a 65 degree C proportionally controlled oven. The output frequency is adjustable by tuning FREQ ADJ C60; this adjustment causes only small output amplitude variations. Oscillator buffers Q7, Q8 and

AR2 isolate the oscillator, preventing frequency pulling when adjusting the multipliers.

The output of the buffer is doubled in an active push-push doubler. The single-ended input from the buffer is split into two out-of-phase voltages in T1 and fed to the bases of two transistors Q9 and Q10. The output of these two transistors is summed at their collectors. The output of the doubler is tuned by C64 and impedance matched to the step-recovery diode multiplier by C63 and L9. The diode self-bias current is determined by R56.

Diode CR9, the step-recovery diode multiplier, converts the input sinusoidal signal to a stream of impulses. These impulses are fed to an unloaded microstrip quarter-wave resonator (Z3), which is tuned to the desired output frequency.

C56 provides a DC block coupling and impedance matching to the 50 ohm input of output filter FL10. The output of the filter is loaded with a 3 dB attenuator, reducing the output power to that required by the first mixer and providing some control over the impedance seen by the filter. The undesired harmonic multiples of 200 MHz removed from the desired frequency are suppressed at least 40 dB. The output power is between +5 and +12 dBm.

Up Converter Mixer

The output of the 60-80 MHz frequency modulated oscillator (FMO) (0 +/-2 dBm) is fed into the double-balanced mixer along with the fixed local oscillator signal (1020 for the 950 MHz band) (+8 +/-2 dBm). The resulting signal level is typically -10 dBm.

Up Converter Amplifier and Filter

The last assembly in the Up converter chain is the Up Converter Amplifier, which is a three-stage broadband RF amplifier with two stages of filtering. FL12 is a two-pole input filter and FL11 is a three-pole filter after the first amplifier stage. The output stage operates in compression to minimize any changes in gain over a wide temperature range.

An output power detector (CR10, R71, C82) is provided for the Up Converter Amplifier. Relative power is detected and relayed to the Audio/Power Supply Board. This voltage should be 2 to 3 volts for +16 dBm output.

4.2.3 RF Amplifier (950 MHz)

Schematic: Figure 7-11

Assembly: Figure 7-10

The RF Amplifier module is a three-stage power amplifier designed to produce 6 watts nominal output power over the 890-960 MHz band when driven with a +16 dBm nominal input signal. The heart of the module is a high gain UHF power amplifier hybrid device (AR1) that exhibits excellent stability and ruggedness. AR1 provides 22 dB of adjustable gain that is factory-set in the transmitter for 6 watts by adjustment of R1. Field adjustment of R1 is not recommended since other design considerations will be compromised (i.e., DC power consumption, temperature stability, efficiency, etc.).

CAUTION

Input Power must be limited to +19 dBm (80mW) or permanent damage to the module may result.

The final stage current monitor sample is derived across R2 plus any additional line losses to provide 0.2 volt/amp sensitivity. This sample is fed to the Audio/Power Supply Board and a test point is provided for monitoring.

The seven-section low-pass filter following AR1 is realized in a semi-lumped configuration utilizing microstripline inductors, open-circuited stubs and lumped capacitors C8 and C9. The filter attenuates the second and third harmonic emissions to better than -60 dBc per FCC requirements.

The dual-directional coupler is fabricated using stripline technology to provide high-directivity, therefore assuring accurate forward and reflected power sampling. Detectors CR1 and CR2 provide DC meter samples for reflected and forward power, respectively. These sample voltages are fed to the Audio/Power Supply Board. The forward power sample is conditioned and fed to the meter for monitoring. The reflected power sample is used to toggle the radiate lamp status to red if the VSWR is excessive at the antenna port (approx. 6 dB return loss). Forward power indication is 0 dB for nominal 6 watts output.

4.3 RECEIVER

4.3.1 Audio/Power Supply and Control

Schematic: Figures 7-17, 7-18, 7-19, 7-20

Assembly: Figure 7-16

The Receiver Power Supply module consists of three sections: the ac power connector, step-down transformer T1, and the regulator portion of the Audio/Power Supply board.

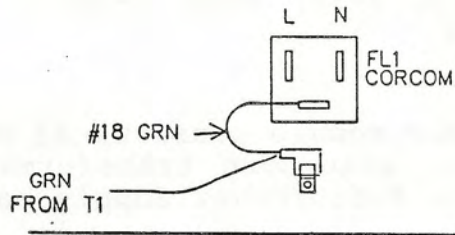
CAUTION

Failure to ground the third lead of the input power cord may result in hazardous shocks to personnel.

The ac power connector includes an RF filter. The transformer primary windings can be wired to select one of the four input voltage ranges listed below:

<u>Nominal Voltage (rms)</u>	<u>Minimum Voltage (rms)</u>	<u>Maximum Voltage (rms)</u>	<u>Line Fuse</u>
100	90	100	1 A (factory set)
120	108	132	1 A
220	198	242	0.5 A
240	216	264	0.5 A

The transformer has two primary windings which are replaced in parallel for 120 Vac operation and in series for 240 Vac operation. One winding is tapped for 100 Vac or 220 Vac operation. Refer to Figure 4-2 for specific wiring changes.



FROM PRIMARY OF TRANSFORMER	PRIMARY VOLTAGE			
	100VAC	120VAC	220VAC	240VAC
BLK/RED	WHT/RED	FL1-L	N/C	FL1-L
WHT/RED	BLK/RED	FL1-L	BLK	BLK
WHT	FL1-N	FL1-N	FL1-N	FL1-N
BLK	FL1-N	FL1-N	WHT/RED	WHT/RED
BLK/WHT	FL1-L	N/C	FL1-L	N/C

(N/C = NO CONNECTION. TERMINATE & INSULATE THESE WIRES.)

**Figure 4-2
Transformer Wiring Detail**

The Receiver Power Supply provides four regulated voltages (+15 V, -12 V, -15 V, and +5 V). The voltage ranges and current limits of the power supplies are listed below:

<u>Supply</u>	<u>Voltage Range</u>	<u>Current</u>
+15 V (J9)	14.25 to 15.75	0.50 A
-15 V (J7)	-14.25 to -15.75	0.50 A
+5 V (J10)	4.75 to 5.25	0.50 A
-12 V (J4)	-11.25 to -12.75	0.4 A

These voltages are produced by fixed IC regulators and are not adjustable.

Mute and Transfer

The Mute and Transfer circuitry contains the necessary logic to squelch the Receiver during periods of insufficient RF signal strength.

The Mute and Transfer circuitry will go into the mute mode whenever PINS 6 or 7 of U15 are in a TTL logic low state (0.0 V to +0.4 V). This will occur whenever one or more of the following conditions are present:

1. The signal mute line from the IF Demodulator module goes to a logic low level, forcing J104 PIN 7 low.
2. The rear panel manual mute input (J18-8) is grounded, forcing P2 PIN 13 to a logic low level.
3. The rear panel auto transfer input (J18-7) is above +2.0 V. This signal will appear on P2 PIN 12, forcing the collector of Q1 to a logic low level.

When one of the above conditions is present, PIN 5 of U15 will go to a TTL logic high state (+2.5 V to +5.0 V). This signal activates the FET mute switch, U1. This signal is inverted by Q2 to control the front panel operate status LED.

Q2 also controls the relay driver (second half U15). When the receiver is muted, PIN 3 of U15 will go high and no current will flow through the coil of squelch relay K1. This condition is also true if power to the receiver is lost. In the mute mode, K1 disconnects the composite signal at J12 and the MUX signal at J2. Also the arm contacts of K1 are connected to the rear panel to activate alarms.

Metering and Status

The receiver Metering and Status circuitry includes two main sections:

1. Nine Metering Functions
2. Operating Status Indicators

Metering Functions

The potentiometers leading to S2 are used to calibrate the meter selections chosen by S2.

The meter circuit contains an absolute value amplifier. The output of the absolute amplifier is connected to U20, the meter ballistics amplifier. R186 is used to electrically zero the meter. R196 is used to adjust the meter ballistics response. The output of this circuit is connected to the meter.

Audio Circuits

The mute gate output goes to U2 which has R7, the high-frequency compensation adjust in the feedback loop. The output of U2 is split into low-frequency audio and higher-frequency mux signals. The high-pass filtered mux signal is buffered by U2 and U4. Jumper E1 is used to send the audio to either the composite or mono processing circuitry.

The composite signal goes to U5 where R61 is used to set the low-frequency compensation, through a low-pass filter, and on to U6 and U7. R111 is used for delay equalization to correct for IF response. The second half of U6 and both sections of U7 form a low-pass filter for the audio before it is fed to the back panel.

The mono signal goes to U8 which buffers and de-emphasizes the signal. Jumper E2 enables or disables de-emphasis. U9, U10, U11 and U12 form an audio filter similar to that in the transmitter. Jumper E3 selects either filtered or unfiltered mono audio to feed to the output amplifier which consists of U12, U13, and U14.

Status Indicator

Amplifier U17 is used to toggle the signal LED (CR1) on the front panel. The LED is red when a signal is not present or muted, and green when a signal is present and the receiver is operating.

The other half of U17 toggles the AFC Lock LED on the front panel. Green indicates the PLL second LO is properly locked.

4.3.2 RF Module

Schematic: Figures 7-22, 7-23
Assembly: Figure 7-21

The RF module contains the first local oscillator, the synthesized second local oscillator, the preselector, the preamp, the first mixer and the first IF amplifier.

The first local oscillator is crystal controlled. Its frequency is set at a multiple of Y2, (102 MHz for the 950 MHz band), the crystal in the oscillator formed around Q6. The output is buffered by Q7, Q8 and AR2. Q10 and Q11 form a balanced frequency doubler which is coupled into the step recovery diode multiplier through a matching network consisting of C64 and C77. P4 is a jumper block which allows three possible signal paths. The LO signal can pass to the filter FL10, or to TP9 for monitoring. The third position allows an external LO signal to be injected through TP9. After FL10, CR9 and R55 are used to give a signal level monitor point. Jumper block P3 performs a similar function to P4. Note that the filter FL10 can be aligned by injecting a signal into TP9 (through P4) and monitoring at TP8 (through TP8) or at the LO level test point. The LO signal is then attenuated and passed to the first mixer HY2.

The RF input passes through FL12, a two-pole helical filter, is amplified by AR5, and then passes through FL11, a three-pole helical filter, and on to the first mixer.

The output of the mixer is buffered by AR6 and fed to the IF demodulator (6020) or the double converter (6030).

Second Local Oscillator

The second local oscillator is nearly identical to the FMO in the transmitter except that it has no modulation input. The oscillator is formed around Q3. The coarse frequency is adjusted by C30, the AFC level adjust while the fine tuning is done by CR5 through the VCO control voltage from the synthesizer loop filter. The oscillator output is buffered by Q4, Q5, AR1 and AR7. There is a three-stage low-pass filter after the buffer to reduce the harmonic content of the LO signal. The LO2 test point voltage is generated by CR7.

A sample of the LO signal is coupled to U2, a high-speed, dual-modulus divider and then into the PLL U1. The reference frequency for the PLL is a 3.2 MHz signal from oscillator Q1 and buffer Q2. C11 is used as the frequency adjust.

The output frequency of the PLL is set by the values of switches SW0-SW3. The output frequency is 64 MHz times the value of SW0 (0 or 1) plus 4 MHz times the value of SW1 (0 to 15) plus 250 kHz times the value of SW2 (0 to 15) plus 25 kHz times the value of SW3 (0 to 9). **Note: In certain early units, SW0 is set permanently to 1.**

IF frequency example:

Desired frequency = 950 MHz
 First LO = 1020 MHz

IF frequency $\overline{70}$ MHz
 Second LO 10.7 MHz

Second LO frequency $\overline{80.7}$ MHz

Switch settings	SW0	1	64 MHz
	SW1	4	16
	SW2	2	0.5
	SW3	8	0.2

$\overline{80.7}$ MHz

4.3.3 IF Demodulator (6020)

Schematic: Figure 7-25

Assembly: Figure 7-24

The IF Demodulator module incorporates several functions including the second local oscillator, first IF bandpass filter, second mixer, second IF filters, and FM demodulator.

The input signal at the first IF (60-80 MHz) enters at J2 and is amplified by Q3 to overcome the succeeding filter losses. The nominal 70 MHz BPF is a 3-pole lumped element, synchronously-tuned, capacitively coupled design whose primary purpose is to reduce undesired signals to levels that will not cause intermodulation in the second mixer and IF amplifier. The 10 dB bandwidth is 4 MHz. Jumper E1 can be used to access this filter for testing.

In certain fixed frequency applications, the second LO frequency (80.7 MHz) is generated by the crystal oscillator composed of Q4, Y1 and associated circuitry. The operating frequency may be adjusted slightly by L15. Q5 and Q6 provide an impedance buffer with gain to prevent "load pulling" of the crystal oscillator. A diode detector (CR1) provides a DC level for metering at TP3 and is available on the audio/power supply board. A three-element low pass filter (C72, L20, C69) reduces the harmonic levels that may cause excessive mixing products in U1. Jumper E2 is provided at this point for testing.

For most applications, the 60-80 MHz second local oscillator is provided by the frequency synthesizer on the receiver RF module.

The second mixer performs down conversion of the carrier to 10.7 MHz. The output is diplexed (L1-L3, C1-C3, R4) to provide a constant impedance filter function and is amplified by Q1, Q2, and associated circuitry.

The FM demodulator is comprised mainly of U2, a high performance integrated circuit designed for wideband FM demodulation at 10.7 MHz and provides a low noise, low distortion output in addition to providing a variety of internal functions. The input (PIN 1) is preceded by the 1st IF Filter (FL7) which is a linear phase, monolithic ceramic resonator. The signal is buffered and the output (PIN 2) is applied to the 2nd IF Filter (FL8). These filters set the selectivity of the receiver and are adjusted by C13 and C18. The signal is then fed to the IF limited amplifier input (PIN 5) and the quadrature detector circuit (PINS 10 and 11). The quadrature tank circuit (C26, C68, R16, L8 and L9) is singly tuned and U2 provides a distortion compensation circuit internally to achieve this simpler approach to quadrature detection. The demodulated baseband output (PIN 15) is applied to amplifier U4 and the output is adjusted by R19. Baseband level (TP2) may be used for monitoring. The IF limiter also provides a logarithmic meter output (PIN 8) which is proportional to signal strength. This output is fed to buffer amp U3 and is available on the audio/power supply board for metering. R18 (mute threshold adjust) provides feedback to the mute circuit (PIN 13) and sets the signal mute level. The mute output (PIN 16) is sent to the mute logic circuit located on the audio/power supply board. The current in R17 is zero when the quad tank is tuned to center frequency, therefore a demod balance voltage is available (TP1) that should be 0 +/- 0.5 volt when tuned properly. The test point is available on the audio/power supply board for metering.

4.3.4 Double Converter (6030)

Schematic: Figure 7-27

Assembly: Figure 7-26

Much of the selectivity of the Receiver is provided by the 70MHz to 3 MHz Double Converter module. The input signal at 70MHz (actually 60-80MHz) is amplified and bandpass filtered and then converted to the second IF frequency at 10.7 MHz. The bandwidth of the second IF circuit is user selectable by switching out the second filter in the IF. This does not change the gain of the IF. The 10.7 MHz signal is converted

to the third IF frequency at 3 MHz, bandpass filtered, and passed to the output.

After preamplification in the Preamplifier and First Mixer module; the input signal is amplified by Q1 to overcome the insertion loss of the 70 MHz bandpass filter. This amplifier also acts as an impedance transformer from the 50 ohm input impedance to the 3000 ohm impedance of the filter.

The primary purpose of the 70 MHz bandpass filter is to reduce undesired signals to levels that will not cause intermodulation in the second mixer and second IF amplifiers. The 10 dB bandwidth of this filter is 4 MHz. The output of the filter is impedance transformed down to 50 ohms to match the mixer.

The signal input to second mixer U1 is mixed with the second LO signal to produce the second IF signal at 10.7 MHz. The 13.2 MHz oscillator signal is provided by the Second and Third Local Oscillator module. The 60-80 MHz second local oscillator is provided by the synthesizer on the RF module.

The second mixer is double balanced, and its IF port (10.7 MHz) is diplexed. The low-pass leg (L8, C21, L10 with a 14 MHz cutoff) connects the signals centered on 10.7 MHz to the first 10.7 MHz amplifier (Q2). The high-pass leg (C20, L9, C19) terminates higher frequency signals in R4.

The output of the first 10.7 MHz amplifier (Q2) is buffered by emitter follower Q3. The source impedance required by filter FL1 is set by R10.

The 10.7 MHz IF filters FL1 and FL2 are linear phase monolithic ceramic resonators. L13 and C31, and L14 and C37 allow slight adjustment of the center frequency of the filters to align both filters on the IF frequency. Amplifiers U2 and U3 maintain the signal level through the filters. Inductor L15 and capacitor C43 form a harmonic and noise filter for the third mixer.

The input to third mixer U4 is mixed with the 13.7 MHz third LO signal to produce the third IF signal at 3 MHz. The third mixer is also double balanced and diplexed. The output signal is sent to the FM Demodulator module.

There are two IF configurations for the 6030. One has separate Double Converter and Second/Third Local Oscillators. The other has them combined on one module.

On the combined module, the second LO (used only in certain fixed frequency applications) is an 80.7 MHz single stage buffered crystal oscillator (shown as the second fixed LO on

the 6020 IF Demodulator schematic). The 13.7 MHz oscillator is identical to that in the separate Second/Third Local Oscillator module.

4.3.5 Second and Third Local Oscillator (6030)

Schematic: Figure 7-29

Assembly: Figure 7-28

The Second and Third Local Oscillator module provides two local oscillator signals (80.7 MHz and 13.7 MHz) to the Double Converter module.

On most versions of the 6030, the frequency synthesizer is used for the second local oscillator (see RF module description). For certain fixed frequency applications, a fixed second LO is needed. The 80.7 MHz oscillator is included on the module for compatibility with those applications.

The Second Local Oscillator consists of crystal-controlled oscillator Q1 and crystal Y1, operating at 20.175 MHz. LO2 Frequency Adjust C10 or C60, selected by jumper E1, can pull the crystal frequency by approximately +/-5 kHz. The LO signal is buffered by Q2 and sent to first push-push frequency doubler U1 and associated circuitry. TP1 (buffer level) monitors the drive level to the first doubler and should indicate between +2V and +5V on a high impedance voltmeter. First doubler Adjust L5 tunes the output of the first doubler, and the voltage at TP2 (First Doubler Level) should indicate between +2.3V and +3.0V.

The output of the First Doubler drives second push-push Frequency Doubler U2 and associated circuitry. Both frequency doublers use well-balanced input transformers and tightly matched monolithic transistors, yielding excellent rejection of fundamental and odd order harmonics at their outputs.

LO2 Output Adjust L6 is used to tune the second doubler for maximum output at TP3 (LO2 Output Level). This voltage should be between +0.8V and +1.2V. The output of the second local oscillator is applied to J2 at a level of +5 dBm to +10 dBm at a frequency of 80.7 MHz adjustable by +/-20 kHz.

The third local oscillator consists of crystal-controlled oscillator Q3 and 13.7 MHz crystal Y2, followed by buffer amplifier Q4 and a 13.7 MHz low-pass filter. The LO3 output level at TP4 should be between +0.8V and +1.2V. The output signal appears at J3 at a level of +5 dBm to 10 dBm. Extremely low noise floors are achieved in both the second

and third local oscillators by using the crystals as series resonant bandpass filters between the oscillators and their buffer amplifiers.

4.3.6 FM Demodulator (6030)

Schematic: Figure 7-31

Assembly: Figure 7-30

The FM Demodulator module performs three major functions:

1. Extraction of baseband information from the frequency modulated input signal;
2. Generation of dc metering signal proportional to the logarithm of the input RF carrier over a three-decade range.
3. Generation of a mute signal to squelch the receiver when the RF input signal is too low for reliable operation.

FM Demodulator

The 3 MHz RF signal at J3 is fed to a low-noise amplifier, U4, and its associated circuitry, where it receives approximately 30 dB of voltage amplification. This signal passes through a 3 MHz phase linear bandpass filter (L8 through L10 with C83 and C84). The output of this filter drives a high-gain (60 dB) non-saturating symmetrical limiting amplifier U6. The amplitude-limited signal is then fed to a precision charge count FM detector to extract the baseband information.

The FM detector operates as follows: Q15, Q16 and Q18 form a differential amplifier with Q13 and Q14 serving as constant-current collector loads. This amplifier has a gain in excess of 30 dB. Q10 and Q17 in conjunction with diodes CR15 through CR17 form low-noise voltage clamps to ensure non-saturating action of the differential amplifier transistors. The current outputs of the differential amplifier alternately charge C62 and C63 through diodes CR12 and CR13. These capacitors are then alternately discharged through Q11 and Q12, the total current being proportional to the signal frequency. Q11 and Q12 serve as current-to-voltage converters whose outputs are combined and integrated in a 500 kHz low-pass filter (L4 and L5 and associated circuitry). The output from this filter contains the baseband information.

A two-stage low-noise amplifier (U5 and U1) then amplifies the baseband signal to a useful system level. Jumper E1 sets the baseband gain to compensate for the differences in wideband and narrowband transmitter deviation. Baseband Level Adjust R10 is set to deliver a 3.5V p-p signal at J2 for an FM signal with 50 kHz (35 kHz in narrowband mode) deviation. This FM detector is inherently wideband, linear, and adjustment free.

RF Signal Strength Detector (Log Amplifier)

The RF signal from U4 is also sent to a four-state successive limiting differential amplifier (Q2 through Q9) through a simple bandpass filter (L3 and C42). Each stage of this amplifier drives an amplitude detector (CR7 through CR10), which in conjunction with the summing amplifier U3, produces a dc metering signal at J1-9 that is proportional to the logarithm of the RF input level over three decades of amplitude. This voltage is used to indicate RF signal strength over the range of 3 microvolts to 3000 microvolts on the front-panel meter. LOG GAIN control R67 is used to establish the linearity of the signal sent to the Metering and Status module.

Mute Logic

The RF signal strength voltage from the log amplifier is also sent to comparator U2, which compares this level to a preset reference voltage established by MUTE Threshold Adjust R22. Decreasing this reference voltage decreases the signal strength required to initiate the mute condition. Whenever the logic circuitry is in the mute condition, MUTE Threshold indicator CR6 will glow red. A 2 dB hysteresis is built into the mute logic to eliminate "chattering" near the mute threshold. Also network CR3, CR4, R16, R17, and C10 provide a fast-attack, slow-release (1 ms and 1.5 seconds, respectively) to and from the mute mode to eliminate "thumps". The mute signal is brought out on J1-10 and J1-11.

SECTION 5

ALIGNMENT PROCEDURES

5.1 Introduction

This section presents the alignment procedures for the PCL 6000 and a list of recommended test equipment. Also included are descriptions of all module adjustments, general troubleshooting information, and test fixture diagrams. Relevant troubleshooting information is included at the end of each alignment procedure.

5.2 Test Equipment

Table 5-1 lists the test equipment recommended for use in the alignment procedures. Equivalent items of test equipment may also be used.

5.3 Alignment Procedures

The PCL 6000 alignment procedures include the following:

1. STL Frequency Alignment (page 5-5)
2. Receiver Sensitivity (page 5-7)
3. Receiver Selectivity (page 5-10)
4. Transmitter Deviation and Receiver Output Level Calibration (page 5-13)
5. Ultimate Signal-to-Noise Ratio (page 5-19)
6. Distortion Alignment (page 5-22)
7. Stereo Separation and Signal-to-Noise Ratio (page 5-26)
8. Stereo Crosstalk (page 5-31)
9. STL frequency Change (page 5-36)

**Table 5-1
Recommended Test Equipment
(Page 1 of 3)**

<u>Instrument Type</u>	<u>Suggested Model</u>	<u>Critical Specifications</u>
Counter	Tektronix DC-508A 1.3 GHz Counter. Note: For dual links on the same frequency, include Option 01.	Single Link +/-5 ppm Dual Link +/-0.2 ppm
Directional Coupler	Microlab/FXR CB-49B	30 dB 1.0 - 2.0 GHz
Attenuator 50 Ohm load	Philco 662A-30 or Sierra 661A-30	50 Ohm, 30 dB
Attenuator, adjustable	Kay Elemetrics Model 432D	50 Ohm, 1,2,3,5,10 & 20 dB steps
RF Signal Generator	Hewlett-Packard Model 8640B with Option 01 & 02	Freq. Range: 0.5 MHz - 1024 MHz Residual FM: Less than 30 Hz, 20 Hz - 15 kHz; Less than 10 Hz, 300 Hz - 3 kHz Output Level Accuracy: +/-3.5 dB -7 to -47dBm; +/-4.0 dB -74 to -137 dBm Output Impedance: 50 Ohm FM Deviation Bandwidth: dc to 250 kHz
Distortion Measurement	Hewlett-Packard Model 339A or Tektronix AA501 with SG5050 and TM503 Main Frame	Distortion Measurement Residual Noise: -92 dB (80 kHz) Input Impedance: 100kOhm shunted by less than 100 pF

Table 5-1
Recommended Test Equipment
 (Page 2 of 3)

<u>Instrument Type</u>	<u>Suggested Model</u>	<u>Critical Specifications</u>
Audio Oscillator	Hewlett-Packard 204C	Accuracy: 20 Hz to 20 kHz +/-2% 10 Hz to 110 kHz +/-4% Oscillator Frequency Range: 10 Hz - 110 kHz Output Level: 3V rms into 600 Ohm Distortion: 10 Hz - 20 kHz -95 dB (0.00187%) THD 600 Ohm output frequency range 100 kHz to 200 kHz
RF Spectrum Analyzer 3 GHz	Hewlett-Packard Model 8559A with 18IT Display	Frequency Band: 0.01-3 greater than 70 dB Dynamic Range: 0.01 to greater than 70 dB Display Range: Log 10 dB/div and 1 dB/div Display Accuracy: Log less than 2 dB over full range Input Impedance: 50 Ohm SWR: 1.3 dB 10 dB input attenuation
Audio Spectrum Analyzer	Tektronix 7L5 with Option 25 & L3 Plug in 7603 Main Frame	Input Impedance: 1M Ohm/28 pF Input Frequency: 10 Hz to less than 500 kHz Display Range: 80 dB, log 10 dB/div

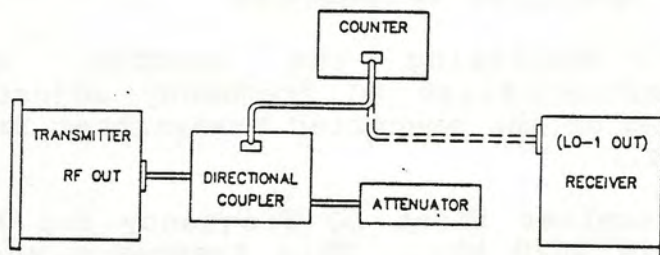
Table 5-1
 Recommended Test Equipment
 (Page 3 of 3)

<u>Instrument Type</u>	<u>Suggested Model</u>	<u>Critical Specifications</u>
Power Meter and Sensor	Hewlett-Packard 435A with 8481A Power Head	Accuracy: +/-1% of full scale Power Range: -25 dBm (3 Microw) to +20 dBm (100 mW) full scale
Stereo Generator	Moseley SCG-9A or equivalent	Stereo SNR: 75dB Separation: 55 dB THD: 0.1% or less
Stereo Demodulator	Belar Stereo Modulation Monitor or equivalent	Stereo SNR: 75 dB Separation: 55 dB THD: 0.5% or less
Oscilloscope	Tektronix T932A	Bandwidth: 35 MHz
Multimeter	Data Precision Floating Input Model 935	
50 Hz Filter		

5.3.1 STL Frequency Alignment

Description

The STL frequency is aligned by using a counter to measure the transmitter output frequency and the receiver first local oscillator frequency. A high-precision counter (± 0.2 ppm) is recommended to align STL links that are used in a redundant installation. If such a counter is not available, we recommend that both STL systems be aligned at the same time using the same counter. A difference greater than 2 kHz between the STL transmitter center frequency and receiver center frequency will result in degradation of the distortion, separation, and crosstalk performance.



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

Figure 5-1
Test Setup for Frequency Alignment

Test Equipment

<u>Name</u>	<u>Manufacturer</u>	<u>Model</u>
Counter	Tektronix	DC-508A w/ option 01
Directional Coupler	Microlab/FXR	CB-49N
Attenuator, Load	Philco	662A-30

Procedure

1. Connect the equipment as shown in Figure 5-1.
2. Position the transmitter RADIATE/STANDBY switch to the RADIATE position. Verify that the RADIATE, and AFC LOCK status LEDs are green.

Using the METER FUNCTION switch, select the FWD POWER position. Verify that the front panel meter reads between -3 and +2 dB on the top scale.
3. Check the serial number label on the back of the STL transmitter for its operating center frequency. The counter should indicate the frequency within 8 kHz of the specified center frequency. If it does not, proceed to the troubleshooting portion of this procedure and verify that the First LO and FMO are operating at their specified frequencies.
4. While monitoring the counter, adjust the Transmitter First LO frequency adjustment for a reading of the specified transmitter frequency +/- 200 Hz.
5. The receiver first LO frequency for the 950 MHz band is 1020 MHz. This frequency should be set +/-200 Hz of this frequency.
6. Calculate the receiver second LO frequency by adding 10.7 to the first LO frequency and subtracting the operating frequency (i.e., for a transmitter at 950 MHz, the second LO is $1020 + 10.7 - 950 = 80.7$ MHz).
7. Connect a frequency counter to the output of the receiver first LO. The counter should indicate a frequency within +/-8 kHz of the frequency calculated in Step 5. If it does not, proceed to the troubleshooting portion of this procedure.
8. Using the counter, adjust the receiver Second LO frequency adjustment for a reading within +/-200 Hz of the frequency calculated in Step 6.

NOTE

If two STL systems are installed for redundant operation, both should be aligned for frequency at the same time.

Troubleshooting

1. The crystal in the transmitter First Local Oscillator should be 102.000 MHz for the 950 MHz band.
2. The crystal frequency of the Receiver First LO should be the same as the PCL 6010 Transmitter.
3. If the First LO fails to meet the +/-8 kHz specified in this procedure, the crystal oven should be checked to ensure that it is operating at 65 degrees C +/-5 degrees C.
4. If the transmitter frequency fails to meet the +/-8 kHz specified in this procedure and the First LO appears to be operating to specification, the FMO should be checked to ensure that it is operating at its designed frequency. The FMO frequency may be calculated as follows:

For the 950 MHz band:

FMO frequency = 1020 MHz minus the transmitter
center frequency

The FMO frequency should be within +/-1 kHz of the value calculated.

5. A red AFC lock status will cause the RADIATE status indicator to remain red.

5.3.2 Receiver Sensitivity

Description

The sensitivity of the PCL 6000 STL Receiver is verified using a signal generator and either a de-emphasis network or a de-emphasized stereo demodulator.

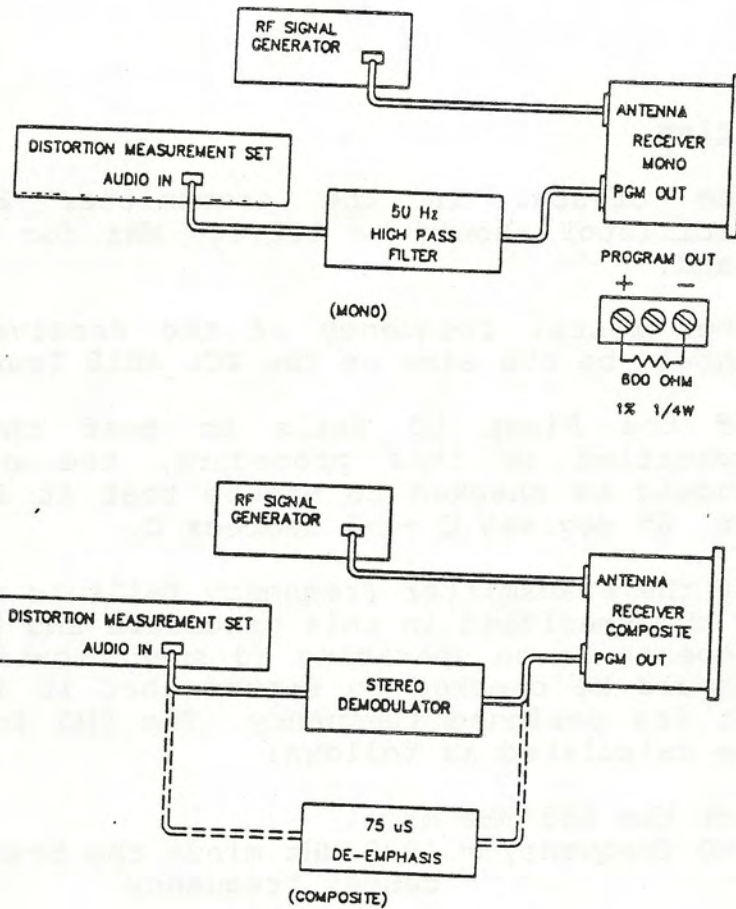


Figure 5-2
Sensitivity Test Setup

Test Equipment

<u>Name</u>	<u>Manufacturer</u>	<u>Model</u>
RF Signal Generator	Hewlett-Packard	HP-8640B
50 Hz Filter	(see Figure 5-15)	
600 Ohm Resistor	RN55D6000F.	600 Ohm, 1%, 1/4 W
Distortion Measurement Set	Hewlett-Packard	HP-339A

Procedure

1. Connect the equipment as shown in Figure 5-2 and set the controls on the signal generator as follows:

Meter Level	Volts
AM Modulation	Off
FM Deviation	Off
Frequency Tuned	Tuned to center frequency (indicated on serial number label on back of STL receiver).
Output Level	-40 dBm
RF	On

Adjust output level on the signal generator for a reading of 3 mV on the signal generator meter.

2. Using the METER FUNCTION switch on the PCL 6000 Receiver, select the RF LEVEL meter position. Verify that the meter reads within the 3K range of the middle scale.
3. While monitoring the center scale of the receiver meter, switch the OUTPUT LEVEL ADJ on the signal generator from -40 to -110 and verify that the signal strength reads within the meter range for each setting. If it does not, proceed to Section 5.4.12 (6030), IF Demodulator, Log Gain Adjust, prior to continuing the test, and perform the calibration adjustments given there.
4. Using the METER FUNCTION switch on the receiver, select the PGM LEVEL position.

Set FM Deviation on the RF Signal generator to ON.

Set the modulation frequency on the signal generator to 400 Hz.

Adjust the deviation control on the signal generator so that the meter on the STL receiver reads 0 dB on the top scale. Verify that the deviation on the signal generator reads 50 \pm 8 kHz.

5. Set the controls on the distortion measurement equipment for a 0 dB reference.

Set the FM Deviation on the RF signal generator to OFF.

Position the controls on the distortion measurement equipment for a reading of 60 dB SNR.

Reduce the RF LEVEL adjustment on the RF signal generator until the distortion measurement equipment reads 60 dB.

Observe the RF level output of the signal generator; it should indicate less than 20 Micro-V.

6. Set the controls on the distortion measurement equipment for a signal-to-noise ratio of 40 dB.

Reduce the RF level on the signal generator until the mute threshold LED on the IF Demodulator module indicates red. Observe the RF level output of the signal generator; it should indicate between 18 and 22 Micro-V. If not, the MUTE THRESHOLD ADJ on the FM Demodulator module should be rotated fully counterclockwise. Then set the RF level output of the signal generator to 20 Micro-V and adjust the MUTE THRESHOLD ADJ until the mute threshold LED changes from off to red.

Troubleshooting

The cable between the RF signal generator and the STL receiver should be kept at a minimum to reduce insertion loss. As an example, a 3-foot cable (RG-58) will cause a 1 dB or 10% loss in signal.

5.3.3 Receiver Selectivity

Specification (6020)

<u>Bandwidth</u>	<u>1st 10.7 MHz IF</u>	<u>2nd 10.7 MHz IF</u>
+/- 90 KHz	1.5 dB	3 dB
+/- 400 KHz	30 dB	60 dB
+/- 1 MHz	70 dB	80 dB

Description

The receiver selectivity is verified using an RF signal generator.

Specification (6030)

<u>Bandwidth</u>	<u>Wideband</u>	<u>Narrowband</u>
3 dB	+/-100 kHz	+/-75 kHz
60 dB	+/-450 kHz	+/-350 kHz
80 dB	+/-1 MHz	+/-1 MHz

The STL link selectivity is determined by positioning the 2nd 10.7 MHz bandwidth select jumpers E2 and E3 located on the receiver Double Converter module.

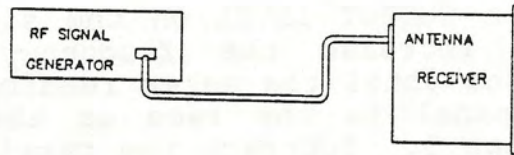


Figure 5-3
Selectivity Test Setup

Test Equipment

RF Signal Generator

Hewlett-Packard 8640B

Procedure

1. Connect the equipment as shown in Figure 5-3. Set the controls on the signal generator as follows:

Meter Level Volts

AM Modulation Off

FM Deviation Off

Frequency Tuned	Tuned to the center frequency (indicated on the serial number label on the back of the STL receiver).
Output Level	-40 dBm
RF	On

Adjust the output level on the signal generator for a reading of 3 mV on the signal generator meter.

2. Using the receiver METER FUNCTION switch, select the RF LEVEL meter position. Verify that the meter reads within the 3K range of the middle scale.
3. Position the OUTPUT LEVEL switch on the signal generator to -100. Verify that the receiver meter reads within the 3 Micro-V range on the center scale. Note the position of the meter reading as a reference for the -60 dB point.
4. Position OUTPUT LEVEL on the signal generator to -40. Increase the frequency on the signal generator until the meter reading on the receiver front panel is the same as the value noted in paragraph 3. Subtract the carrier frequency from the value indicated on the signal generator. The value calculated indicates the positive -60 dB point.
5. Decrease the frequency on the signal generator until the meter reads the same as the value noted in paragraph 3. Subtract the frequency indicated on the signal generator from the center frequency. This value indicates the negative -60 dB bandwidth point.
6. The bandwidth calculated in paragraphs 3 and 4 should be no greater than +/-400 kHz.

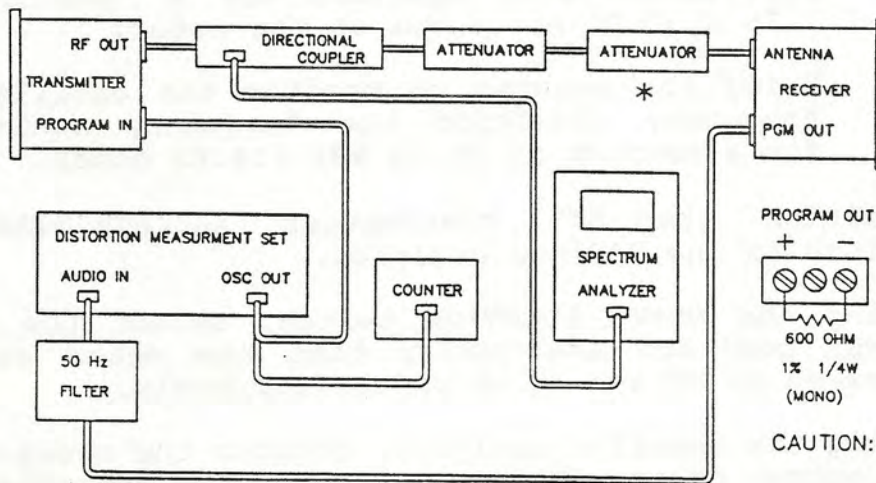
Troubleshooting Notes

The cable between the RF signal generator and the STL receiver should be kept at a minimum to reduce insertion loss. As an example, a 3-foot cable (RG-58) will cause a 1 dB or 10% loss in signal.

5.3.4 Transmitter Deviation, and Receiver Output Level Calibration

Description

The deviation and modulation sensitivity of the composite information is aligned using a Bessel null function as a reference. The MUX channel is aligned using an RF generator as a reference.



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

* CAUTION: To avoid receiver damage, initially set attenuator for maximum attenuation.

Figure 5-4
Test Setup For Deviation Alignment

Test Equipment

Counter	Tektronix DC-508A
Directional Coupler	Microlab FXR CB49N
Attenuator, 50 Ohm Load	Philco 662A-30
Attenuator, Adjustable	Kay Elemetrics 432D
RF Signal Generator	HP-8640B
Distortion Measurement Set	HP-339A
Audio Oscillator	HP-204C
Spectrum Analyzer	HP-8559A
50 Hz Filter	(See Figure 5-15)
Oscilloscope	Tektronix T932A

Procedure

1. Connect the equipment as shown in Figure 5-4.
2. Adjust the audio oscillator of the distortion measurement set for an output voltage of 1.25 V (1.00 mono) rms (3.5 V p-p) at 20.79 kHz (16.62 mono) as follows:
 - a. Position the meter function switch to the oscillator level position and adjust the oscillator level controls for a reading of 1.25 V (1.00 mono) rms on the meter.
 - b. Using the counter to monitor the oscillator frequency, position the frequency controls for a reading of 20.79 kHz (16.62 mono).

3. Position the STL transmitter RADIATE/STANDBY switch to the RADIATE position.

Using the METER FUNCTION switch, select the FWD POWER position and verify that the meter reads between -3 dB and +2 dB on the top scale.

4. Using the spectrum analyzer, monitor the modulated RF output of the STL transmitter. The controls of the spectrum analyzer should be in the following positions:

Frequency Band GHz	.01-3
Time/DIV	Auto
Trigger	Free run
FREQ/SPAN/DIV	50 kHz/DIV with 3 kHz bandwidth
Input ATTEN	30
REF Level	-20
10 dB/DIV	Depress
Tuning	STL transmitter center frequency

5. Disconnect the composite input to the transmitter and adjust display on the spectrum analyzer so that the waveform is at the top graticule (see Figure 5-5A).

Reconnect the composite audio input of the STL transmitter. The display on the spectrum analyzer should be similar to Figure 5-5A.

Adjust PGM Level Adjust R28 on the Audio & Power Supply Board for a Bessel null function of at least -50 dB on the spectrum analyzer.

Using the METER FUNCTION switch on the STL transmitter, select the PGM LEVEL function. Adjust R76 on the STL transmitter Audio & Power Supply Board for a reading of 0 dB on the top scale of the meter.

6. Using the METER FUNCTION switch on the STL receiver, select the RF LEVEL position.

Position the switches on the adjustable attenuator for an RF level reading between 1K and 3K V on the receiver meter.

Set the controls on the distortion measurement set as follows:

Meter Function	Reference level
Frequency	1.0 kHz
Meter Input Range	+10 dB

With the oscillator output connected to the STL transmitter, connect the meter input in parallel with the oscillator output and adjust the Relative Adjust for a 0 dB reference on the distortion measurement set.

Reconnect the distortion input to the composite output of the STL receiver.

On the receiver IF Demodulator module, adjust Baseband Level Adjust R19 for a reading of 0 dB on the distortion measurement set. Using the receiver METER FUNCTION switch, select the PGM LEVEL position and adjust R1 on the Metering and Status board for a reading of 0 dB on the top scale.

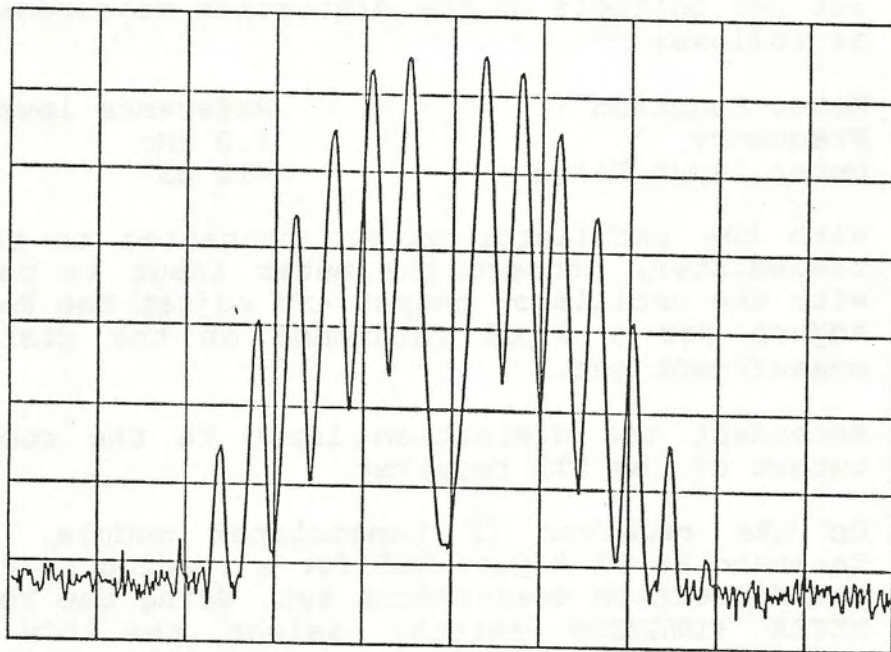
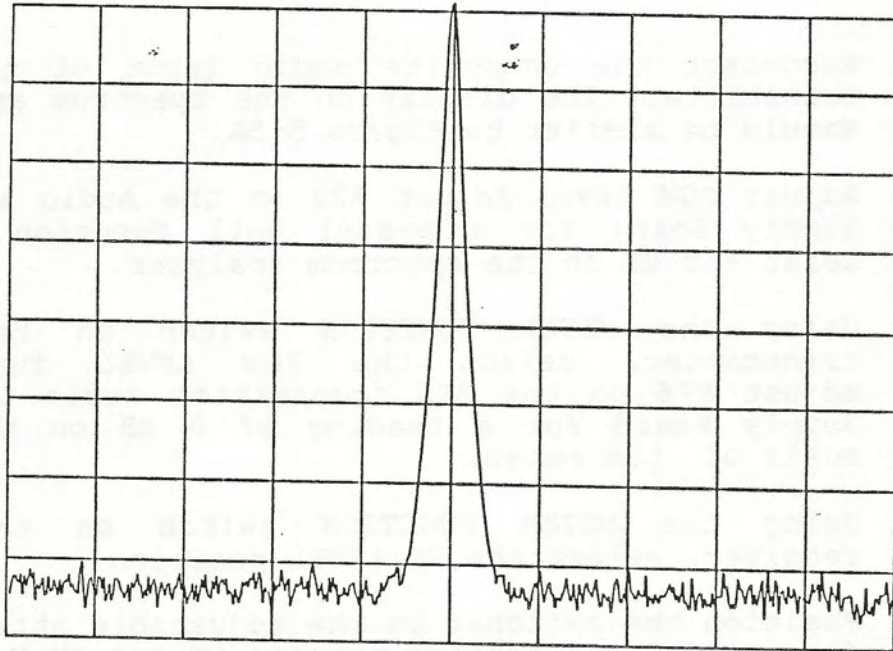
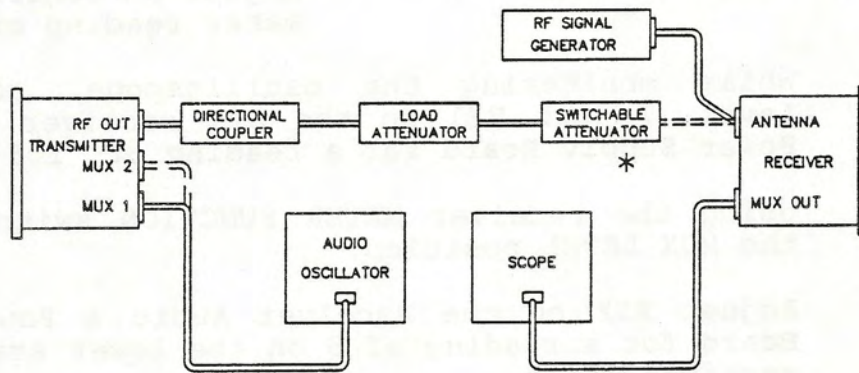


Figure 5-5
Bessel Null Function Waveforms



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

* CAUTION: To avoid receiver damage, initially set attenuator for maximum attenuation.

Figure 5-6
Test Setup for MUX Channel Alignment

7. Position the STL transmitter RADIATE/STANDBY switch to the STANDBY position.

Connect the equipment as shown in Figure 5-6 and adjust the controls on the RF signal generator as follows:

Meter Function	FM
AM	Off
Modulation Frequency	110 kHz
FM	INT
Peak Deviation	10 kHz

Output Level -40

Frequency Tune Tune to the center frequency (specified on serial number label of STL receiver).

Peak Deviation Adjust FM control for a meter reading of 5kHz.

While monitoring the oscilloscope, adjust MUX Level. Adjust R31 on the STL receiver Audio and Power Supply Board for a reading of 1.5 V p-p.

Using the receiver METER FUNCTION switch, select the MUX LEVEL position.

Adjust R12 on the Receiver Audio & Power Supply Board for a reading of 5 on the lower scale of the receiver meter.

8. On the RF signal generator, adjust the modulation frequency to 67 kHz and the FM deviation for 6.0 kHz.

Note the reading on the receiver meter. It should be between 6 and 8 on the lower scale. This reading will be used as a reference to align the transmitter MUX 2 deviation. Connect the output of the adjustable attenuator to the RF input of the STL receiver.

9. Position the STL transmitter RADIATE/STANDBY switch to the RADIATE position.

Using the scope, adjust the output of the audio oscillator for a voltage of 1.5 V p-p and a frequency of 110 kHz (26 kHz mono). Connect the audio oscillator output to the MUX 1 input of the STL transmitter.

Adjust the MUX 1 Level Adjust R28 on the Transmitter Audio & Power Supply Board for a reading of 5 on the lower scale of the receiver meter.

Using the transmitter METER FUNCTION switch, select the MUX LEVEL position.

Adjust R79 on the transmitter Audio & Power Supply Board for a reading of 5 on the meter lower scale.

Connect the audio oscillator to the transmitter MUX 2 input and adjust the oscillator to a frequency of 185 kHz (composite only).

Using the receiver meter as a reference, on the transmitter Audio & Power Supply Board, adjust MUX 2 Level Adjust R40 for the reading noted in paragraph 8. The meter reading on the transmitter front panel should be between 6 and 8 on the lower scale.

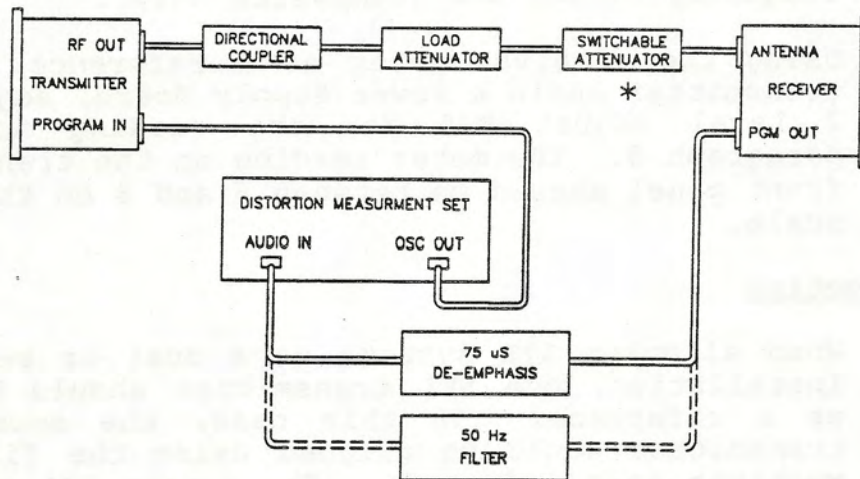
Troubleshooting

1. When aligning STL systems as a dual or redundant installation, one STL transmitter should be used as a reference. In this case, the second STL transmitter would be aligned using the first STL receiver as a reference. The second STL receiver would be aligned using the first STL transmitter as a reference. As a final verification, the second STL transmitter would be checked using the second STL receiver. Using any combination of transmitter and receiver, the composite band should be flat within +/-0.1 dB. The results from the multiplex band measurements should be within 10%.
2. The multiplexed output is lowest when the carrier center frequency of the transmitter and receiver are identical.

5.3.5 Ultimate Signal-to-Noise Ratio

Description

The STL ultimate wideband (50 Hz to 15 kHz), verified using a distortion measurement set. The STL receiver SNR (quieting) is verified during the receiver sensitivity test (see Section 5.3.2).



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

* CAUTION: To avoid receiver damage, initially set attenuator for maximum attenuation.

Figure 5-7
Test Setup For Signal-To-Noise
Ratio Measurement

Test Equipment

Directional Coupler	Microlab/FXR CB-49N
Attenuator, 50 Ohm Load	Philco, 662A-30
Attenuator, Adjustable	Kay Elemetrics Corp., 432D
Distortion Measurement Set	Hewlett-Packard, HP-339A
50 Hz High Pass Filter	(See Figure 5-11)
600 Ohm Resistor, 1% 1/4W	RN55D6000F

Procedure

1. Connect the equipment as shown in Figure 5-7 and set the controls on the distortion measurement set as follows:

Meter Function	REF Level
Meter Input	+10 dBm
Frequency	400 Hz

2. Set the controls on the STL transmitter as follows:

RADIATE/STANDBY	RADIATE (Radiate LED green)
METER FUNCTION	PGM LEVEL

3. Using the METER FUNCTION switch on the STL receiver, select the PGM LEVEL position.
4. Adjust the oscillator output level on the distortion measurement set for a reading of 0 dB on the top scale of the transmitter meter.

Rotate the REFERENCE ADJUST on the distortion measurement set for a 10 dB reference on its front-panel meter. Disconnect the composite input at the STL transmitter rear panel.

Using the INPUT RANGE switch on the distortion measurement set, measure the ultimate wideband SNR. (Note: The reference is +10 dB; hence, a meter input range indicating -60 and a meter reading of -6 would indicate an SNR of -76 dB.)

5. Position the INPUT RANGE switch to +10 dB and reconnect the audio input to the STL transmitter composite BNC connector.

Troubleshooting

1. If the STL link fails to meet the ultimate SNR specification, the sensitivity test (paragraph 5.3.2) should be performed on the receiver prior to troubleshooting the transmitter.

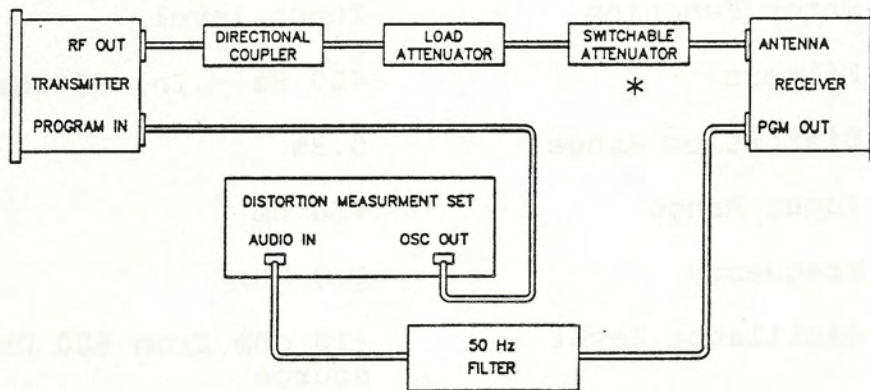
2. If the STL link fails to meet the SNR specification, and the transmitter is suspected, the following method may be used to help isolate the problem:
 - a. Using the 80 kHz filter on the distortion measurement set, measure the baseband output of the Transmitter Audio & Power Supply Board for a reading at least 5 dB greater than specified for the ultimate SNR.
 - b. Substitute the first LO signal (1020 MHz for the 950 MHz band) using an RF signal generator such as the HP-8640B at an output level of +10 dBm.
 - c. Substitute the FMO signal using the RF signal generator at an RF level of +5 dBm.

NOTE
FMO frequency = First LO frequency minus STL
center frequency.

5.3.6 Distortion Alignment

Description

A distortion measurement set is used to align the STL receiver 10.7 MHz IF filter for minimum distortion. This method assumes the FMO will contribute a negligible amount of distortion to the overall reading. The FMO distortion can be verified independently of the receiver by referring to Section 5.5.2, FMO Synthesizer.



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

* CAUTION: To avoid receiver damage, initially set attenuator for maximum attenuation.

**Figure 5-8
STL Distortion Alignment**

Test Equipment

Directional Coupler	Microlab/FXR CB-49B
Attenuator, 50 Load	Philco, 662A-30
Attenuator, Adjustable	Kay Elemetrics Corp., 432A
600 Ohm Resistor, 1 $\frac{1}{4}$ W	RN55D6000F
50 Hz Filter	Figure 5-14

Procedure

1. Connect the equipment as shown in Figure 5-8 and adjust controls on the distortion measurement set as follows:

Meter Function	Input level
Filters	400 Hz - In; 80 kHz - In
Distortion Range	0.3%
Input Range	+10 dB
Frequency	1.0 kHz
Oscillator Level	+10 dBm from 600 Ohm source

2. Position the RADIATE/STANDBY switch on the STL transmitter to the RADIATE position. The RADIATE status LED should be green. Using the METER FUNCTION switch on the transmitter, select the FWD POWER position and verify that the meter reads between -3 and +2 dB on the top scale.

Using the METER FUNCTION switch on the transmitter, select the PGM LEVEL function and verify that the meter reads between -1 and +1 dB on the top scale.

3. Using the METER FUNCTION switch on the STL receiver, select the RF LEVEL function.

Position the switches on the adjustable attenuator for a reading between 1k and 3k Micro-V on the middle scale of the receiver meter.

Using the METER FUNCTION switch on the receiver, select the PGM LEVEL function. The meter should read between -1 and +1 dB on the top scale.

Set the frequency to 15 kHz and verify that the meter of the distortion measurement set reads between .9 and 1.1 V rms.

Adjust the METER FUNCTION switch on the distortion measurement set to the DISTORTION position.

4. Using the distortion measurement set, adjust the following controls on the IF Demodulator module (6020) or Double Converter (6030) for minimum distortion:
 - a. 1ST 10.7 MHz IF ADJ
 - b. 2nd 10.7 MHz IF ADJ
 - c. LO 2 FREQ ADJ

5. The distortion reading should now be less than 0.2%. Switch the frequency on the distortion measurement set to 1.0 kHz. Verify that the distortion reading meets specifications.

Troubleshooting

1. The following procedure may be used to determine if the 10.7 MHz filters are a source of high distortion.
 - a. Remove FL-1 and FL-2 from the receiver IF Demodulator module and replace it with a 1.0 K Ohm resistor. The resistor leads should first be cut between 0.3 and 0.4 inch from the body. The ends of the resistor leads should then be flattened using a pair of needle-nose pliers so they can be inserted in the FL-1 and FL-2 sockets. The cover should then be replaced and the screws tightened.
 - b. Using the distortion measurement set, the distortion reading should now be less than 0.05% at 15 kHz. If it is not, additional troubleshooting will be required prior to determining the performance of the 10.7 MHz IF filters.

2. An RF input to the STL receiver exceeding 6 mV may cause an indication of high distortion.

3. The distortion of the audio and power supply board in the receiver can be tested independently by applying the output of the distortion measurement set's audio oscillator to the baseband input of the Audio/Power Supply module.

5.3.7 Stereo Separation and Stereo Signal-to-Noise Ratio

Description

The stereo separation alignment is accomplished using a stereo generator and demodulator of known quality and an audio spectrum analyzer with tracking generator.

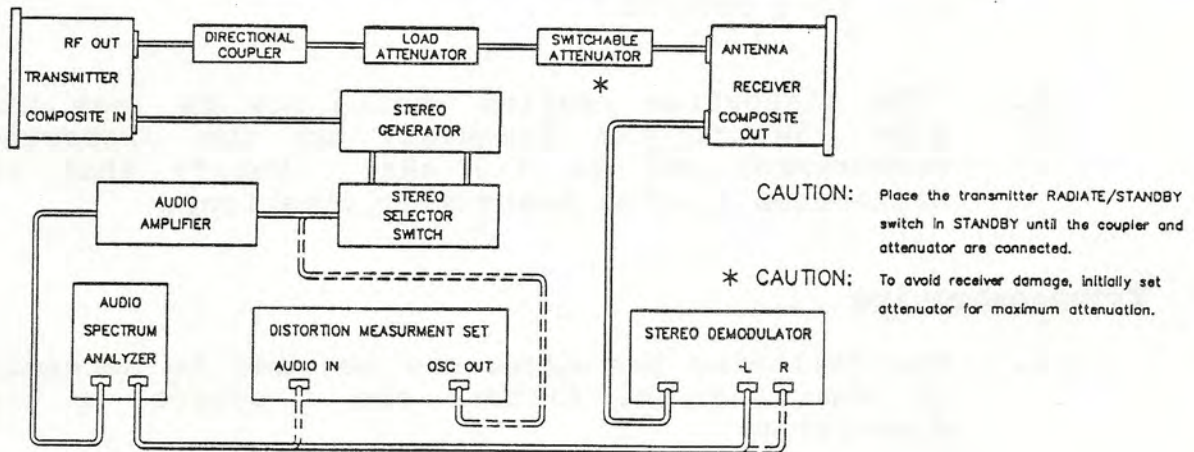


Figure 5-9
Stereo Separation Test Setup

Test Equipment

Directional Coupler	Microlab/FXR CB-49N
Attenuator, 50 Ohm Load	Philco, 662A-30
Attenuator, Adjustable	Kay Elemetrics Corp., 432D
Distortion Measurement Set	Hewlett-Packard HP-330A
Spectrum Analyzer	Tektronics 7L5 w/ Option 01 & Main Frame
Audio Amplifier	
Stereo Generator	Moseley SCG-9A or equivalent
Stereo Demodulator	Belar Stereo Modulation Monitor or equivalent
Stereo Source Selector	

Procedure

1. Connect the equipment as shown in Figure 5-9. This test should be run flat; i.e., the stereo generator pre-emphasis and the stereo demodulator de-emphasis should be switched out. If this cannot be accomplished, the system modulation reference level should be reduced to -20 dB at 400 Hz. Adjust the controls on the audio spectrum analyzer as follows:

Frequency	Far left graticule
Dot Frequency	Zero Hz
LOG	10 dB/DIV
Source	FREE RUN
Mode	NORM
Terminate	1 M Ohm
REF	dBV
Resolution	Coupled
SPAN/DRV	2 kHz
Time/DIV	Auto
Tracking GEN	ON

2. Set the RADIATE/STANDBY switch on the STL transmitter to the RADIATE position. Verify that the RADIATE LED is green.

Using the METER FUNCTION switch on the transmitter, select the FWD POWER position. Verify that the meter reads between -3 and +2 dB on the top scale.

Using the METER FUNCTION switch on the transmitter, select the PGM LEVEL position.

Adjust the dot frequency on the audio spectrum analyzer to 1.0 kHz and the SPAN/DIV to zero.

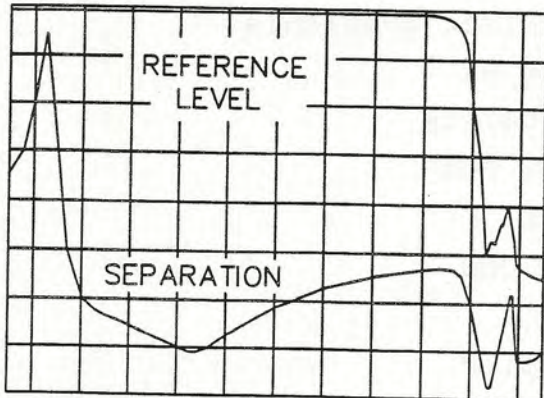
Adjust the level control on the audio spectrum analyzer for a reading of zero dB on the top scale of the transmitter meter.

Set the dot frequency on the audio spectrum analyzer to zero and the SPAN/DIV to 2 kHz.

Using the METER FUNCTION switch on the receiver, select the RF LEVEL position.

Position the switches on the adjustable attenuator for a reading between 1K and 3K on the receiver meter middle scale.

Using the METER FUNCTION switch on the STL receiver, select the PGM LEVEL position. Verify that the meter reads within +/-1 dB of the STL transmitter meter.



Stereo separation: Measurement of the worst-case ratio in dB of residual signal in the stereo demodulated right channel referred to the demodulated left channel with a left-only driving signal for frequencies between 30 Hz and 15 kHz; the procedure is repeated for right to left channel separation.

Vert = 10 dB/div Hor = 2 kHz/div.

Figure 5-10
Swept Separation Waveform

3. Select the LEFT ONLY position on the stereo source selector.

Adjust the step and VAR attenuators on the audio spectrum analyzer so that the waveform is at the top graticule. (See Figure 5-10.)

Select the RIGHT ONLY position on the stereo source selector.

Adjust HF TILT ADJ R7 on the receiver audio/power supply board for maximum separation between 1 and 5 kHz.

Adjust EQ ADJ R111 on the audio/power supply board for maximum separation between 10 and 15 kHz. (See Figure 5-10.)

Using the SAVE A function on the audio analyzer, store this waveform.

Verify that the separation meets specification between 1 kHz and 15 kHz.

4. Connect the spectrum analyzer to the right output of the stereo demodulator.

Select the RIGHT ONLY position on the stereo source selector. Adjust the step and variable attenuators on the audio spectrum analyzer so that the waveform is at the top graticule. (See Figure 5-10.)

Select the LEFT ONLY position on the stereo source selector. Verify that the separation meets specification between 1 kHz and 15 kHz.

Note: The HF TILT ADJ and Delay EQ ADJ module affect both the left and right channel separation. Paragraphs 3 and 4 may be repeated to assure optimum performance on both channels.

5. Connect the audio output of the distortion measurement set to the stereo source selector. Connect the left output of the stereo demodulator to the input of the distortion measurement set.

Set the frequency on the distortion measurement set to 1 kHz. Select the LEFT + RIGHT position on the stereo source selector.

Adjust the output level on the distortion measurement set for a reading of zero dB on the top scale of the STL transmitter. Using the METER FUNCTION switch on the STL receiver, select the PGM LEVEL position and verify that the meter reads within +/-1 dB of the transmitter program level.

Adjust the input controls on the distortion measurement set for a zero dB reference.

Set the frequency on the distortion measurement set to 30 Hz.

Verify that the reference on the distortion measurement set is +/-0.5 dB.

Select the RIGHT ONLY position on the stereo source selector. Using the input attenuator on the distortion measurement set, measure the separation.

Adjust LF TILT ADJ R61 on the Composite Baseband Processor module for maximum separation.

Verify the separation at 50, 100 and 500 Hz.

6. Connect the input of the distortion measurement set to the right channel of the stereo demodulator.

Position the input range and relative ADJ controls on the distortion measurement set for a zero dB reference.

Select the RIGHT ONLY position on the stereo source selector and, if required, adjust the zero dB reference on the distortion measurement set.

Select the LEFT ONLY position on the stereo source selector.

Using the input range controls on the distortion measurement set, measure the right channel separation.

NOTE

The low-frequency tilt adjust affects both channels. Paragraphs 5 and 6 may be repeated several times to optimize this setting.

7. Stereo signal-to-noise ratio. This test should be run using the normal 75 Micro-s de-emphasis characteristics of the stereo demodulator.

Connect the audio output of the distortion measurement set to the stereo source selector.

Set the stereo source selector to the LEFT + RIGHT position.

Using the 50 Hz high-pass filter, connect the left channel of the stereo demodulator to the distortion measurement set input.

Using the METER FUNCTION switch on the STL transmitter, select the PGM LEVEL position.

Adjust the output of the audio oscillator on the distortion measurement set for a frequency of 400 Hz.

Adjust the output level on the distortion measurement set so that the transmitter meter reads zero dB on the top scale.

Using the METER FUNCTION switch on the receiver, select the PGM LEVEL position, and verify that the meter reads within +/-1 dB of the transmitter meter.

Adjust the input range and relative ADJ controls on the distortion measurement set for a zero dB reference on its meter.

Position the stereo source selector to the OFF position.

Measure the stereo demodulated signal-to-noise ratio for the left channel using the input range control on the distortion measurement set.

Using the 50 Hz high-pass filter, connect the input of the distortion measurement set to the right channel and repeat the test.

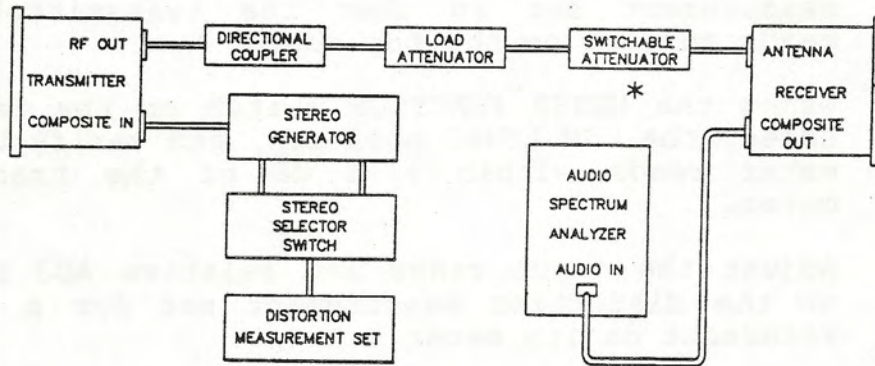
Troubleshooting

The performance of the stereo generator and stereo demodulator can be verified by connecting the output of the stereo generator directly to the input of the stereo demodulator.

5.3.8 Stereo Crosstalk

Description

The crosstalk measurements are made using a stereo generator of known quality, a low-distortion audio oscillator, and an audio spectrum analyzer.



CAUTION: Place the transmitter RADIATE/STANDBY switch in STANDBY until the coupler and attenuator are connected.

* CAUTION: To avoid receiver damage, initially set attenuator for maximum attenuation.

Figure 5-11
Stereo Crosstalk Setup

Test Equipment

Directional Coupler	Microlab/FXR CB-49N
Attenuator, 50 Ohm Load	Philco 662A-30
Attenuator, Adjustable	Kay Elemetrics Corp., 432D
Distortion Measurement Set	Hewlett-Packard HP-339A
Audio Spectrum Analyzer	Tektronix 7L5
Stereo Source Selector	
Stereo Generator	Moseley SCG-9A or equivalent

Procedure

1. Connect the equipment as shown in Figure 5-11. This test should be run with the stereo generator pre-emphasis switched out.

2. Set the RADIATE/STANDBY switch on the STL transmitter to the RADIATE position. The RADIATE status LED should be green.

Using the METER FUNCTION switch, select the FWD POWER position, and verify that the meter of the STL transmitter reads between -3 and +2 dB on the top scale.

Using the METER FUNCTION switch on the transmitter, select the PGM LEVEL position.

Adjust frequency controls on the distortion measurement set for a value of 15 kHz.

Adjust the oscillator output level on the distortion measurement set so that the transmitter meter reads zero dB on the top scale.

3. Using the METER FUNCTION switch on the STL receiver, select the RF LEVEL position.

Position the switches of the adjustable attenuator so that the receiver meter reads between 1K and 3K on the middle scale.

Using the METER FUNCTION switch on the receiver, select the PGM LEVEL position. Verify that the receiver meter reads between -1 and +1 dB on the top scale.

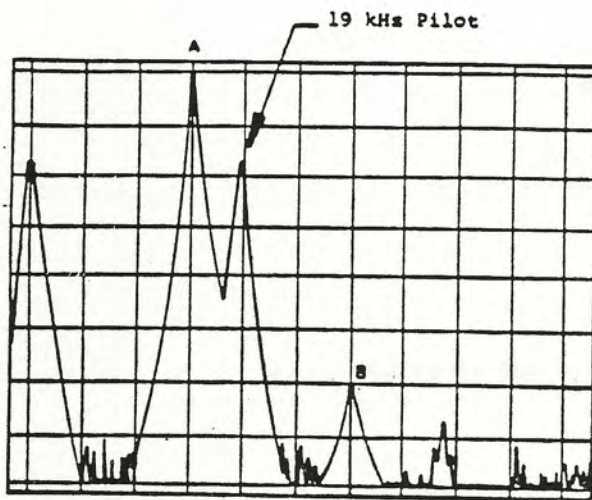
4. Position the controls on the audio spectrum analyzer as follows:

DOT MAR	Dot on far left graticule
DOT FREQUENCY	Zero Hz
LOG	10 dB/DIV
SOURCE	Free run
MODE	NORM
RESOLUTION	Coupled
SPAN/DIV	5 kHz
TIME/DIV	AUTO
TERMIN Z	1 M Ohm
REF	dBV

5. Measure the stereo crosstalk as follows:
 - a. Using the attenuator on the audio spectrum analyzer, adjust the 15 kHz waveform to the top graticule. (See Figure 5-12A.)
 - b. Calculate the main channel to subchannel crosstalk by measuring the indicated waveforms and using the formula shown in Figure 5-12A.
 - c. Adjust the frequency of the distortion measurement set to 7.5 kHz.
 - d. Position the stereo source selector to the left minus right position.
 - e. Calculate the subchannel to main channel crosstalk by measuring the indicated waveforms and using the formula shown in Figure 5-12.

Troubleshooting

1. The stereo generator's performance can be verified by connecting output to the input of the audio spectrum analyzer and performing the tests specified in step 5 above.
2. If the STL link is identified as the source of excessive stereo crosstalk, the following steps should be taken:
 - a. Verify that the cover is on the RF amplifier and install the covers on the STL transmitter and receiver using at least two screws.
 - b. Ensure that the STL transmitter and receiver are more than 2 feet apart.
 - c. Verify that distortion meets specification, using the procedure shown in paragraph 5.3.6.

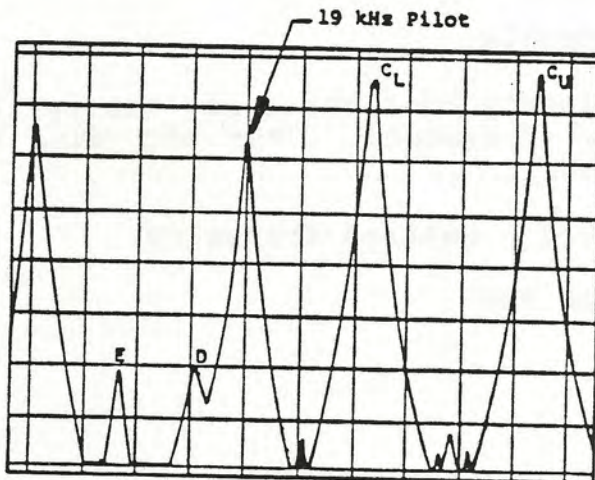


A = 15 kHz L+R Ref. level.
 B = 2nd harmonic distortion level at 30 kHz.

Nonlinear crosstalk main to sub = the difference in dB between level A and level B (60 dB in this example).

Vert = 10 dB/div Hor = 5 kHz/div

(A) Nonlinear crosstalk, main to sub.



C_L and C_U = lower and upper L-R sidaband level at 30.5 kHz and 45.5 kHz.

D = intermodulation product at 15 kHz.

E = linear (vector) crosstalk at 7.5 kHz. This signal is a product of the stereo generator.

Nonlinear crosstalk sub to main = the difference in dB between level C_L or C_U and level D + 6 dB (60 dB in this example).

Vert = 10 dB/div Hor = 5 kHz/div

(B) Nonlinear crosstalk, sub to main.

Figure 5-12
 Nonlinear Crosstalk

Nonlinear crosstalk: Measurement of the ratio in dB of harmonic products in the subchannel referred to 15 kHz L+R at 100% modulation in the main channel (M&S); measurement of the ratio in dB of intermodulation products in the main channel referred to 7.5 kHz L-R at 100% modulation in the subchannel (S&M).

5.3.9 STL Frequency Change

Test Equipment

RF Attenuator

Frequency Counter

Audio Generator (less than 0.5% distortion)

Distortion Analyzer

Dummyload

Procedure

1. Remove RF Module from TX.
2. Pry cover off RF Module.
3. Calculate FMO frequency by subtracting the carrier from the first LO frequency. For 950 MHz, the first LO is 1020 MHz..

$$\text{FMO frequency} = 1020 - \text{desired frequency.}$$

4. Switch settings for FMO
=SW0* X 64 MHz
+SW1 X 4 MHz
+SW2 X .25 MHz
+SW3 X .025 MHz

(* SW0 is not on certain early modules. Its value is set to one.) (Ground pin-19 of U1 for SW0=0.)

5. Reinstall FMO.
6. Put meter switch in AFC Level position and adjust "AFC Level" for senterscale (+7 Vdc AFC LVL on RF Module).
7. Count FMO frequency and adjust frequency trim for proper frequency.

8.
 - a. Reconnect FMO.
 - b. Peak FL-12 and FL-11. Maximum IPA meter reading.
 - c. Remove eExternal filter from the module. This filter (used on certain early modules) is a three-pole helical filter with a passband of about 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of RF band should be used. If the oscillator is not available, peak filter adjustments for maximum forward power meter reading.
9. Connect TX to dummy load and count frequency (use frequency adjust on 1st LO module to set output frequency). Allow 15 minutes for oven to stabilize.
10. Attenuate carrier to 1500 microvolts and feed to RX antenna input.
11. Remove RF Module from RX.
12. Remove cover from component side of module.
13. Calculate new second LO frequency (for 950 MHz band, use first LO = 1020 MHz).
 = First LO - Desired Frequency +10.7 MHz
14. Set switches
 = SW0* X 64 MHz + SW1 X 4 MHz
 + SW2 X .25 MHz + SW3 X .025 MHz
 (*SW0 is not on certain early modules. Its value is 1.)
15. Reinstall RF Module.
16. Adjust AFC level for center scale indication on front-panel meter (+4 Vdc LVL on RF Module).

17. a. Adjust frequency trim for exact frequency calculated in step 13.
 - b. Preselector Filter: Filters FL-12 and FL-11 are two- and three-pole helical filters with a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five adjustments should be set for a flat passband greater than 5 MHz wide.
 - c. Adjust 70 MHz bandpass filter capacitors C41, C44 and C47 for peak on RF signal LVL meter position.
18. Using modulation adjust on FMO, set deviation to ± 50 KHz (± 40 KHz mono).
 19. Using a 15 KHz tone, verify distortion to be within specification. (If adjustment is needed, use 10.7 MHz IF adjustments.)

5.4 Module Adjustments Information

This section is intended to provide additional technical information, assist during alignment troubleshooting and module replacement.

Included are adjustment instructions to be used during troubleshooting, module repair, or module replacement for the following modules:

TRANSMITTER

- 5.4.1 Audio Power Supply and Control
- 5.4.2 RF Module
 - FMO Synthesizer
 - Up Converter Assembly
 - First Local Oscillator
- 5.4.3 RF Amplifier

RECEIVER

- 5.4.4 Audio Power Supply and Control
- 5.4.5 RF Module
 - Preamplifier
 - Mixer
 - First Local Oscillator
 - Synthesized Second LO
- 5.4.6 IF Demodulator 6020
- 5.4.7 Double Converter 6030
- 5.4.8 Demodulator 6030

TRANSMITTER

5.4.1 Audio/Power Supply and Control Composite

Audio Processor

- PGM LVL ADJ R28 Program Level Adjustment. Sets the transmitter deviation of the composite signal. Normal input is 3.5 V p-p. The normal deviation of the transmitter is +/-50 kHz.
- MUX 1 LVL ADJ R29 Multiplex 1 Level Adjustment. Sets the transmitter Multiplex 1 deviation. The normal input is 1.5 V p-p at 110 kHz. Main carrier deviation normally is +/-5 kHz.
- MUX 2 LVL ADJ R40 Multiplex 2 Level Adjustment. Sets the transmitter deviation for the Multiplex 2 input. The normal input is 1.5 V p-p at 185 kHz. Main carrier deviation normally is +/-7.5 kHz.
- PHASE JUMPER E2 Jumper used to select the phase of the modulation. When used with a PCL-600 receiver, the "2-3" position is used for in-phase modulation, and the "1-2" position will result in modulation 180 degrees out of phase with the input.

Metering

- R162 Used to adjust the FWD POWER meter function. 0 dB - 100% power (5 to 7 watts).
- R160 Used to adjust the PGM LEVEL meter function. 0 dB equals 50 kHz deviation.
- R163 RF Power Amp current. Scale is AMPS X 10.
- R164 RF Driver Amplifier output

R165 AFC level in volts; 4.0 is nominal.

R166 LO1 level. High-frequency crystal-controlled LO level.

R159 Used to adjust the MUX LEVEL meter function. 5 on the lower scale equals 5 kHz deviation of the main carrier by the subcarrier.

R286 Adjust the meter ballistics. The meter is normally adjusted for a 0.25 dB overshoot by switching between the REFL POWER meter function and the PGM LEVEL meter function with a 0 dB input (program input = 3.5 V p-p or 1.25 V rms).

R131 Used to electrically zero the meter.

R161 "REFL POWER" meter adjustment 0 dB = 100% reflected power.

Power Supply

R6 Used to adjust the +12.5 V power supply output voltage when the transmitter is in the RADIATE position.

5.4.2 RF Module

FMO Synthesizer

FREQ TRIM Frequency Trim Adjustment. Used to tune the reference oscillator. The frequency switching described below adjusts the frequency in 25 kHz increments. This adjustment is used as a vernier between those increments.

LOSS OF LOCK This LED gives a red indication when the AFC loses lock.

AFC LVL TP1 AFC Level Test Point. Monitors the dc level of the AFC loop. It is normally set to +4 V.

A=VARICAP BIAS ADJ Varicap Bias Adjustment. Used to adjust the FMO for minimum distortion.

TP2=VARICAP BIAS LVL Varicap Bias Level Test Point. A dc test point used to monitor the bias on the Varicap.

MODULATION ADJ Modulation Adjustment. Used to set the FMO deviation. It is normally set to +/-40 kHz with 2.8 V p-p input.

AFC LVL ADJ AFC Level Adjustment. Sets the free run oscillator frequency. Rotating it clockwise causes the frequency to decrease. The final adjustment is made by monitoring TP1 (above) to a value of +4 V.

FMO LVL TP3 FMO Level Test Point. A dc test point used to monitor the output of the FMO oscillator.

Frequency Selector Switches (Internal)

SW0*	64 MHz steps
SW1	4 MHz steps
SW2	250 kHz steps
SW3	25 kHz steps

*SW0 is not on certain early modules.

FMO Adjustment - Test Equipment

RF Signal Generator	HP-8640B
Mixer	Mini-Circuit 2AD-1
Adjustable Attenuator	Kay Elemetrics Corp., 432B
RF Spectrum Analyzer	HP-8559A
Distortion Measurement Set	HP-339A
50 Hz Filter	Figure 6-11
Counter	Tektronix DC-508A
Multimeter	Data Precision 935
Power Meter	HP-435A w/ 8481A Power Sensor

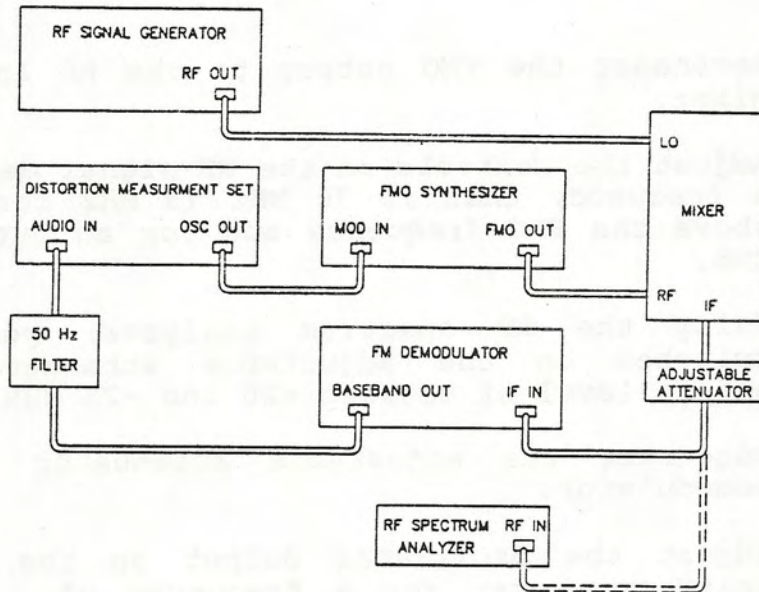


Figure 5-13
Test Setup for FMO Adjustment

Procedure

1. Connect the equipment as shown in Figure 5-13.

Using the counter, measure the output frequency of the FMO.

FMO frequency equals first LO frequency (1020 MHz for the 950 MHz band) minus transmitter frequency.

NOTE

If the frequency is greater than 10 kHz away from the desired frequency, remove the top cover and position frequency selector switches S1 through S4 for the desired frequency.

Adjust the frequency trim on the FMO so that the counter reads the desired frequency.

NOTE

If the FMO LOSS OF LOCK is red, it will be necessary to first adjust the AFC level to accomplish this step. See Step 4 below.

Reconnect the FMO output to the RF input of the mixer.

2. Adjust the controls on the RF signal generator for a frequency that is 70 MHz (3 MHz for the 6030) above the FMO frequency and for an output of +10 dBm.

Using the RF spectrum analyzer, position the switches on the adjustable attenuator for an output level of between -20 and -25 dBm at 70 MHz.

Reconnect the adjustable attenuator to the IF Demodulator.

3. Adjust the oscillator output on the distortion measurement set for a frequency of 1 kHz and a level of 1.25 V rms (3.5 V p-p).
4. Distortion and AFC Level Alignment.

Using the multimeter, monitor TP1 (AFC Level) and adjust the AFC LVL ADJ so that the voltmeter reads 4 volts.

Using the distortion measurement set, verify that the output of the IF demodulator is between 1.0 and 1.5 V rms.

Measure the distortion of the output of the IF Demodulator, and adjust the Varicap Bias adjustment on the FMO (adjustment A) for a minimum distortion reading.

NOTE

Normally there are two setting of the Varicap Bias adjustment that will produce minimum distortion. Varicap bias should be adjusted to the setting that produces the lowest distortion.

Readjust the AFC LVL ADJ so that the voltmeter reads 4 volts.

Repeat this procedure until the varicap bias is set for minimum distortion and the AFC level adjustment is between 3.9 and 4.1 V.

Set the frequency on the distortion measurement set for 15 kHz and verify that the distortion meets specifications.

5. Modulation Level.

The deviation select jumper E1 should be in the wideband (WB) position.

Using the counter, set the output frequency of the distortion measurement set oscillator to 20.78 kHz (16.62 mono). Verify that the oscillator output voltage is 1.25 V rms (1.00 rms mono).

Adjust FMO deviation for +/-50 kHz (40 kHz mono) as follows, using the Bessel null function waveforms in Figure 5-5:

- a. Connect the output of the adjustable attenuator to the RF spectrum analyzer and disconnect the audio input from the FMO. Establish the reference level shown in Figure 5-5A on the RF spectrum analyzer.
- b. Reconnect the audio from the distortion measurement set to the FMO and adjust the MODULATION ADJ on the FMO from minimum to the first Bessel null function (Figure 5-5B).

6. Reconnect the adjustable attenuator to the IF Demodulator.

Verify the AFC level at TP1 is between 3.9 and 4.1 V.

Verify the distortion at 15 kHz meets specifications..

Repeat Steps 3 through 5 of this procedure as required to achieve the above results.

7. Using the Power Meter, verify that the output of the FMO is between 0 dB and +5 dB.

5.4.3 Up Converter Chain

This includes the mixer, output filter, and IPA.

Mixer

The mixer requires no adjustment.

Output Frequency Filter

The output filter is designed to pass the desired carrier frequency and attenuate the local oscillator (offset by the FMO frequency). All adjustments are internal and considered to be factory adjustments.

IPA (Intermediate Power Amplifier)

The only adjustments to the IPA are the filters. These can be adjusted by injecting a sweep signal at TP7 with P2 in the test position. If a quick alignment is needed, put the meter switch in IPA position and peak the reading by adjusting the filter screws. P2 should be in the operate position for this.

5.4.4 First Local Oscillator

FREQ ADJ	Frequency Adjust. Sets the first LO output frequency.
1ST DBLR TUNE	First Doubler Tune Adjustment. Used to tune for maximum DC potential at TP2 (1st Doubler Level).
SRD INPUT MATCH 1	Diode Drive Tune Adjustment. Used to tune for maximum power output.
SRD INPUT MATCH 2	
DIO MATCH	Diode Match Adjustment. Used to tune for maximum power output at TP9 or into FL10.

NOTE

When installed in the PCL 6010 STL transmitter, set for the 950 MHz band, the frequency output of this module should be 1020 MHz with a power output between +5 and +10 dBm. This measurement should be made on a low-power wattmeter.

5.4.5 RF Amplifier

RF Amplifier Alignment

1. Set the HP-8640B signal generator (or equivalent) to center frequency at a power level of -10 dBm.
2. Connect the output of the signal generator to the input of the Intermediate Power Amplifier (IPA).
3. Connect the output of the RF Amplifier to an appropriate power meter.
4. Set the deviation of the signal generator to 5 MHz.

NOTE

When adjusting the RF Amplifier, the final output current should be monitored from the meter PA CURRENT position for a maximum of 1.7 A.

RECEIVER

5.4.6 Audio/Power Supply and Control Composite

Audio Processor

HF TILT ADJ R7	HF Tilt Adjustment. Adjusts the stereo separation between 1 and 5 kHz.
LF TILT ADJ R62	LF Tilt Adjustment. Adjusts the stereo separation between 30 and 100 Hz.
LF TILT ADJ R88	Frequency response for mono
DLY EQ ADJ R11	Delay Equalizer Adjustment. Adjusts the stereo separation between 10 and 15 kHz.
MUX LEVEL ADJ R12	Multiplex Level adjustment. Adjusts the multiplex level output of the Composite Baseband Processor module. Normally adjusted so that +/-5 kHz (4 mono) deviation equals 1.5 V p-p at 110 kHz.

NOTE

The HF TILT, LF TILT, and DELAY EQ adjustments are used primarily to optimize stereo separation performance. In other applications, such as communications, HF TILT and LF TILT would be used to adjust the audio frequency response within +/-1 dB from 30 Hz to 53 kHz. The DELAY EQ adjustment would have no effect on the frequency response performance.

Metering and Status

R171	Adjusts the PGM LEVEL meter function on the receiver Metering and Status board. Zero dB on the top scale of the meter equals +/-50 kHz deviation of the composite signal.
R166	AFC level for frequency synthesizer
R169	LO1 level

R168	L02 (synthesizer) level
R167	L03 level (6030)
R170	Adjusts the MUX LEVEL function of the meter. A reading of 5 on the lower scale equals 5 kHz of the main carrier by the subcarrier.
R172	Used to adjust the RF LEVEL function. A reading of 3K on the center scale of the meter equals 3000 Micro-V of input signal.
R196	Adjusts the meter ballistics.
R186	Adjust meter zero

Mute and Transfer

The Mute and Transfer section requires no adjustment. If a failure is suspected in the Mute and Transfer circuitry, the following information may be useful in isolating the problem:

1. A mute signal from the IF Demodulator (Mute Threshold Adjust LED red) will de-energize the mute relay and disconnect the composite and multiplex audio outputs.
2. This module may be externally muted, either by a remote mute input or a transfer input from a receiver transfer panel (TPR).

Power Supply

Input Voltage: 100, 110, 220, or 240 VAC.

Output Voltages: The output voltages are predetermined by an internal reference in the IC regulator chips. Overvoltage generally indicates a failure of the appropriate chip. Zero output voltage generally indicates a short circuit in one of the STL receiver modules. This can be verified by removing J102 through J104 and checking the output voltage.

Poor regulation generally results from either a high load (greater than 0.75 A) or poor mechanical connection with the heat sink.

5.4.7 Preselector Filter

Filters FL12 and FL11 are two- and three-pole helical filters with a passband of about 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five adjustments should be set for a flat passband greater than 5 MHz wide.

5.4.8 Preamplifier

The preamplifier requires no adjustment.

5.4.9 Mixer

The mixer requires no adjustment.

5.4.10 First Local Oscillator

The adjustments for the receiver First Local Oscillator and Multiplier module are identical to those specified in Section 5.5.4 for the transmitter First Local Oscillator and Multiplier module.

5.4.11 IF Demodulator (6020)

1ST 10.7 MHz IF ADJ	IF Adjustment.	Adjust for minimum distortion.
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2ND 10.7 MHz IF ADJ	IF Adjustment.	Adjust for minimum distortion.
------------------------	----------------	-----------------------------------

NOTE

The L02 FREQ ADJ and the first 10.7 MHz IF ADJ and second 10.7 MHz IF ADJ interact. See paragraph 5.3.6, Distortion Alignment, for additional information.

70 MHz BPF ADJ
(1 to 3)

Bandpass Filter Adjustments. The alignment of the 70 MHz bandpass filter can be checked indirectly by verifying the receiver noise performance to within 20 Micro-V of the value specified on the final test data sheet included in this manual. (See paragraph 5.3.2, STL Receiver Sensitivity).

2ND LO FREQ ADJ	2ND LO Frequency Adjust. Adjusts the 2ND LO frequency between 80.670 kHz and 80.730 kHz. Exact frequency for the purpose of alignment is determined by the 10.7 MHz IF.
2ND LO LVL ADJ	2ND LO Output Adjustment. Adjust for maximum DC LEVEL at TP3 (2ND LO LVL).
2ND LO LVL TP3	2ND LO Output Level Test Point. A dc test point used to indicate that the second doubler is functioning.
MUTE ADJ	Mute Threshold Adjust. Adjusts the mute logic threshold; threshold = 20 Micro-V input signal.
BB LVL ADJ	Baseband Level Adjust. Adjust the output of the baseband including the composite and multiplex levels. +/-50 kHz deviation = 3.5 V p-p.
BB LVL TP2	Baseband Level Test Point. An ac test point used to monitor the output level of the baseband processor. +/-50 kHz deviation = 3.5 V p-p.

5.4.12 FM Demodulator (6030)

LOG GAIN ADJ	Log Gain Adjustment. Calibrates the RF LEVEL meter function. To accomplish this, the RF GAIN ADJ on the Preamplifier and First Mixer module should be at 0 attenuation (-14 V to -16 V). With 10 mV of signal applied to the RF input, R3 on the Metering and Status board should be adjusted for a reading of 3K on the middle scale. The input should then be reduced to 100 mV, and the LOG GAIN ADJ on the FM Demodulator should be adjusted for 100 on the middle scale. The 3, 10, 30, 100, 300, 1K, and 3K levels should be checked to ensure that the meter reads between the upper and lower line on the meter for each range. As a general rule, R3 on the Metering and Status board is used to adjust the full scale or 3K reading, and the LOG GAIN ADJ on the FM Demodulator module is used to adjust the linearity in the 100 to 300 mV range.
--------------	--

LOG LVL TP3	Log Level Test Point. A dc test point used to monitor the first stage of the meter log amplifier.
DEMODO LVL TP2	Demodulator Level Test Point. A dc test point with a voltage proportional to the frequency of the 3 MHz IF. Normally, this voltage is between +4 and +6 Vdc.
MUTE THR ADJ	Mute Threshold Adjust (LED). Indicates status of mute logic (red = mute).
MUTE THR ADJ	Mute Threshold Adjust. Adjusts the mute logic threshold; threshold = 20 mV input signal with RF gain at 15 on receiver meter (TP1 on Preamplifier and First Mixer module at -14 V to -16 V).
BB LVL ADJ	Baseband Level Adjust. Adjust the output of the baseband including the composite and multiplex levels. +/-50 kHz deviation wideband or +/-35 kHz deviation narrowband = 3.5 V p-p.
BB LVL TP1	Baseband Level Test Point. An ac test point used to monitor the output level of the baseband processor. +/-50 kHz deviation wideband or +/-35 kHz deviation narrowband = 3.5 V p-p.

5.5 General Troubleshooting Information

Description

The information below will assist in troubleshooting an STL transmitter or receiver to the module level.

Test Equipment

Attenuator 50-Ohm Load	Philco	662A-30
Counter	Tektronix	DC-508A
Directional Coupler	Microlab/FXR	Model CB-49B
Distortion Measurement Set	Hewlett-Packard	Model 339A
Power Meter and Sensor	Hewlett-Packard	435A w/8481A Power Sensor

RF Signal Generator	Hewlett-Packard	Model 8640B
RF Spectrum Analyzer	Hewlett-Packard	Model 8559A
Stereo Demodulator	Belar	Stereo Modulation Monitor, or equivalent
Multimeter	Data Precision	Model 935
600 Ohm Resistor 1%, 1/4W	RN55D6000F	

5.5.1 Transmitter Troubleshooting Procedure

1. Connect the equipment, as shown in Figure 5-1, and position the RADIATE/STANDBY switch to the RADIATE position.
2. Check the +5 V, +15 V, -15 V and +12.5 V test points on the Audio/Power Supply Board.
3. Verify that the RADIATE, and AFC LOCK status indicators are green. The AFC LOCK indicator is controlled by the FMO. The RADIATE status indicator is controlled by the Transmitter Control circuitry.
4. The following test points on the Audio/Power Supply Board should be checked:
 - a. AFC LVL - The AFC Level should be between 3.5 V and 4.5 V dc. If not, the FMO AFC Level should be aligned before proceeding.
 - b. IPA - The IPA Level should be greater than 1 V dc. If not, the following steps should be taken:

Verify that the +12 V is between 12.25 and +12.75 V.

Using the power meter, verify that the input to the IPA amplifier is at least -10 dBm. If it is, the problem is located in the IPA amplifier.

Measure the output of the First Local Oscillator and module for a value of between +5 and +10 dBm.

Using the power meter, measure the output of the FMO for a value between 0 and +5 dBm.

5.6 Test Fixture Diagrams

The test fixtures shown in Figures 5-14 and 5-15 have been designed to interface with the equipment specified in Table 5-1.

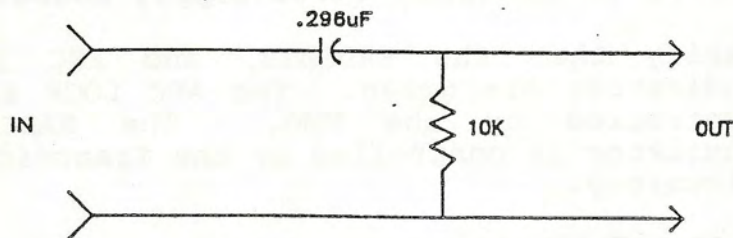


Figure 5-14
50 Hz High-Pass Filter

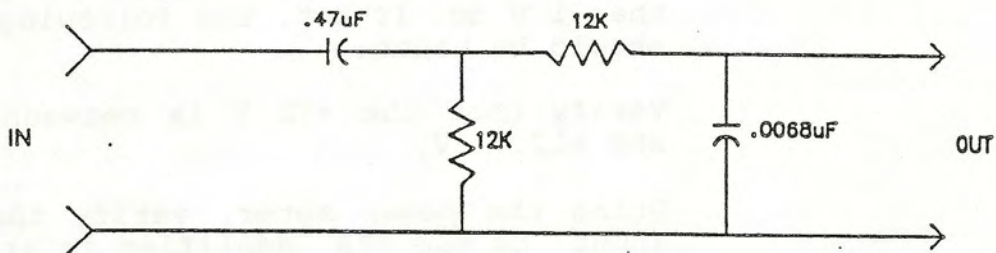


Figure 5-15
75 Micro Second De-Emphasis with
30 Hz High-Pass Filter

SECTION 6

CUSTOMER SERVICE INFORMATION

Moseley Associates, Inc. has a Technical Services Department to assist Moseley product users who experience difficulties. Our service is available at two levels: telephone consultation, and factory service. Different circumstances apply depending on whether product(s) are under Warranty/Service Agreement or outside Warranty/Service Agreement status.

Please read the manual; a large portion of telephone calls to Moseley request information which is needed due to non-familiarity with the equipment. The majority of those questions are already answered by the Installation/Operation sections of each manual. If these do not help your problem, the first step in any factory service transaction should always be telephone consultation.

Telephone Consultation

If telephone assistance is necessary, please have the following information available prior to calling the factory:

- A. Model Number and Serial Number of unit;
- B. Shipment date or date of purchase of an Extended Service Agreement;
- C. Suspected module identification markings;
- D. Be prepared to accurately describe the problems with the unit: Constant or intermittent? Precise symptoms? Meter readings? Operational frequency of unit?
- E. Factory test data, if applicable.

Once you are prepared with the above-requested information, contact our Technical Services Department for assistance. A Technical Services Representative who knows your product(s) is available during normal work hours (8:00 a.m. to 5:00 p.m., Pacific time, Monday through Friday). Please have patience if the particular representative you should talk to is busy. Leave your name, call letters, equipment type, and telephone number(s) where you can be reached in the next few hours. Someone will get back to you as soon as possible.

Please be prepared to keep telephone consultations as short as possible in order to free up the Technical Service Representative to help someone else in trouble. Usually, the Technical Service Representative will make suggestions and recommendations for your next step. After trying these, you may call back if you continue to experience problems.

For telephone assistance, call (805) 968-9621

After Hours Emergency Only Telephone Consultation

Emergency service is provided from 5:00 p.m. to 10:00 p.m., Pacific time, Monday to Friday, and from 8:00 a.m. to 10:00 p.m., Pacific time, on weekends and holidays. For telephone assistance, call (805) 968-9621.

This after-hours service is for **emergencies only**. Please do not expect our representative to know the status of your order, to take parts orders or to be equipped to help with installation problems.

Factory Service

Arrangements for factory service can be made after consultation with the factory Technical Service Representative and his assignment to you of a Return Authorization (R.A.) number. This number expedites your equipment's routing from the Receiving Department to Technical Services.

The following suggestions are offered to assist you when returning your equipment to Moseley Associates, Inc. If you are returning a module, ensure that the module is carefully packed to withstand the rigors of the journey. Make sure the shipping carton is packed evenly and fully, with packing material filling all voids so that the module cannot shift inside the shipping carton. The package also should be marked in red with the words "Electronic Equipment" or "Fragile". Remember, the condition of the module is totally dependent on the care taken in the packing. Reference the return order number, previously obtained from the factory, on the outside of the carton or on the shipping label. Make sure that the name of your company is listed on the shipping label, and insure your module appropriately.

If you are shipping a complete chassis, all modules should be tied down as they were originally received. On some Moseley Associates equipment, shipping screws are required on the underside or topside of the chassis. In this case, printing on the chassis will indicate where such screws should be installed and secured.

Include any and all descriptions of the difficulties encountered with your equipment in the field. This will greatly assist us in processing your equipment and returning it as expeditiously as possible.

Use the original shipping carton in which your equipment was supplied, if possible. Ensure that the carton is packed evenly and fully, with packing material filling any voids so that the chassis cannot shift inside the carton. Make sure the carton is sealed properly with either nylon-reinforced tape or shipping sealing tape. Mark the outside of the carton "Electronic Equipment - Fragile" in big, red letters. This will assist in the survival of the equipment during the shipping process. Again, bear in mind that the survival of the unit depends almost solely on the preparation taken in shipping it.

When returning your equipment to our factory, please address it as follows:

MOSELEY ASSOCIATES, INC.
Attn: Technical Services Department
111 Castilian Drive
Santa Barbara, CA 93117

Display your return order number clearly on the shipping label, and insure the equipment for the appropriate amount.

All equipment must be shipped prepaid; Moseley Associates, Inc. will return the equipment prepaid under Warranty and Service Agreement conditions, and either freight collect or billed for equipment not covered by Warranty or a Service Agreement.

GENERAL

Replacement Modules

Moseley Associates encourages the purchase of spare parts kits to allow the customer to be totally self sufficient with regard to parts. We recognize that there are extenuating circumstances when troubleshooting to the component level is neither practical nor possible. If this is the case, replacement module exchange may be the most expedient way of correcting the problem.

Replacement modules are normally available for immediate shipment. If you require a replacement module from Moseley Associates, please give your shipping address to our Technical Services Engineer. If the module or equipment to be supplied to your company is to be held at the airport

with a telephone number to call, provide at least two telephone numbers. This will often expedite the delivery or pickup of the replacement module or equipment.

Field Repair

Always try to isolate the problem to a specific area or module, if possible. By comparing actual wave shapes and levels with those referenced on the block and level diagrams or schematics, the problem often can be localized to the component level.

If an integrated circuit is suspect, carefully remove the original and install the new one in the same direction. These devices are installed one way only. Installing a new device backward may damage the newly-installed component or the surrounding circuitry. ICs occasionally exhibit temperature-sensitive characteristics. If a suspicious device operates intermittently, or appears to drift, Freeze Mist may aid in diagnosing the problem.

If a soldered component has to be removed from a printed circuit board, do the following:

- o Use a 40W soldering iron with a 1/8-inch tip. Do not use a soldering gun. Excessive heat may cause damage.
- o Remove all solder contacting the lead or leads from the component and from the associated printed circuit pad. To assist in the removal of the solder, solder-sipping braid, such as solder wick, is very useful. Once the solder has been removed, remove the component from the board.

When installing the new component, pre-bend the leads of the replacement component so they will easily fit into the appropriate PC board holes. Solder each lead of the component to the bottom side of the board with a 40W soldering iron with a 1/8-inch tip. Always use a good brand of rosin-core solder. The solder joint should be smooth and shiny. Also, be sure that excessive heat is not used in this soldering operation. Excessive heat will damage the printed circuit pad that comes in contact with the new component. Finally, cut each lead of the replacement component close to the solder on the pad side of the printed circuit board with a pair of diagonal cutters. Then, remove all residual flux with either flux cleaner or a cotton swab moistened with flux cleaner.

SECTION 7

MODULE SCHEMATIC AND ASSEMBLY DRAWINGS

This section contains schematic and assembly drawings referred to in Section 4. For information on individual drawings, refer to Section 4 under the appropriate module description.

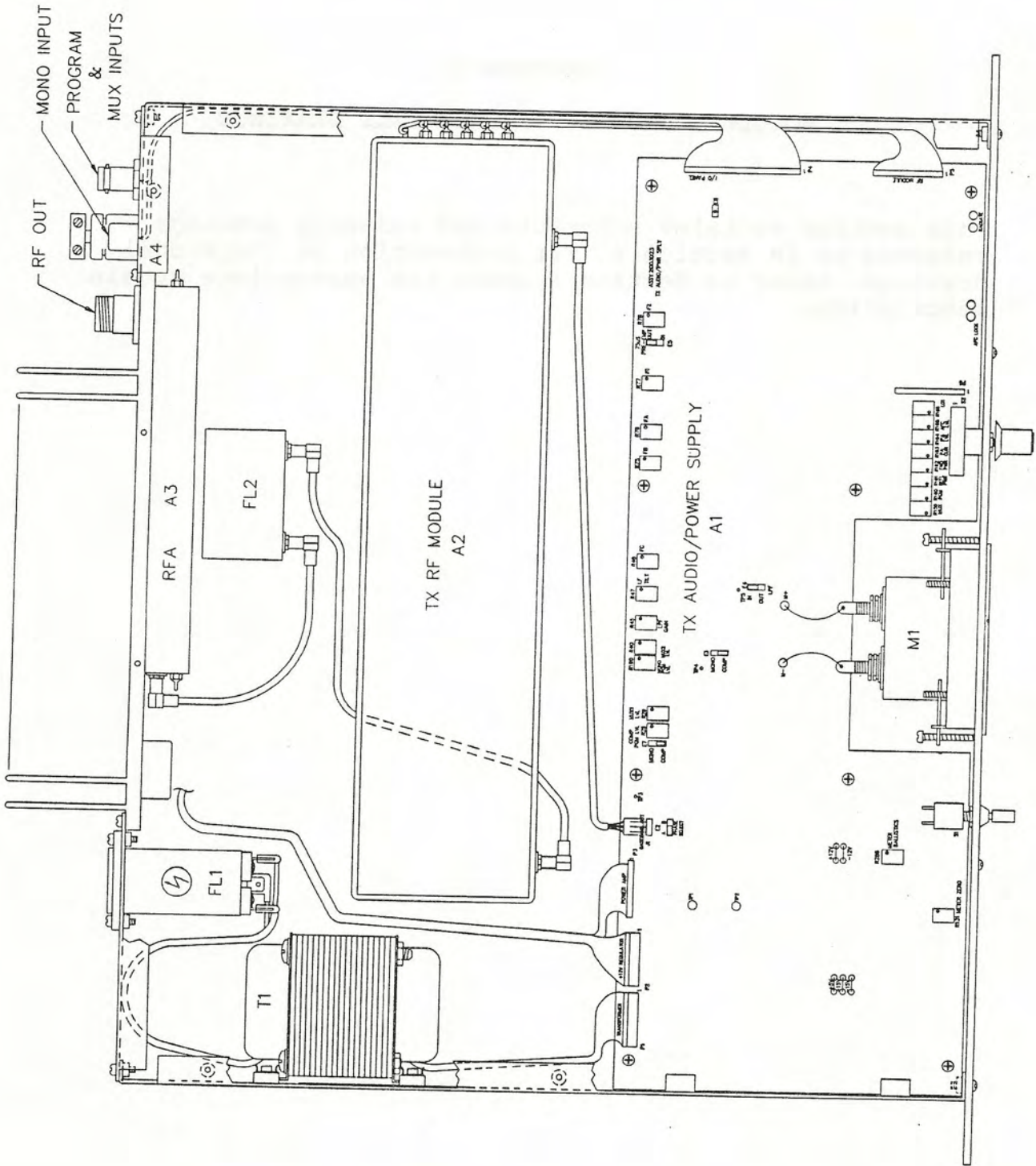


Figure 7-1
 Transmitter Chassis Assembly
 21D2890 Rev 2

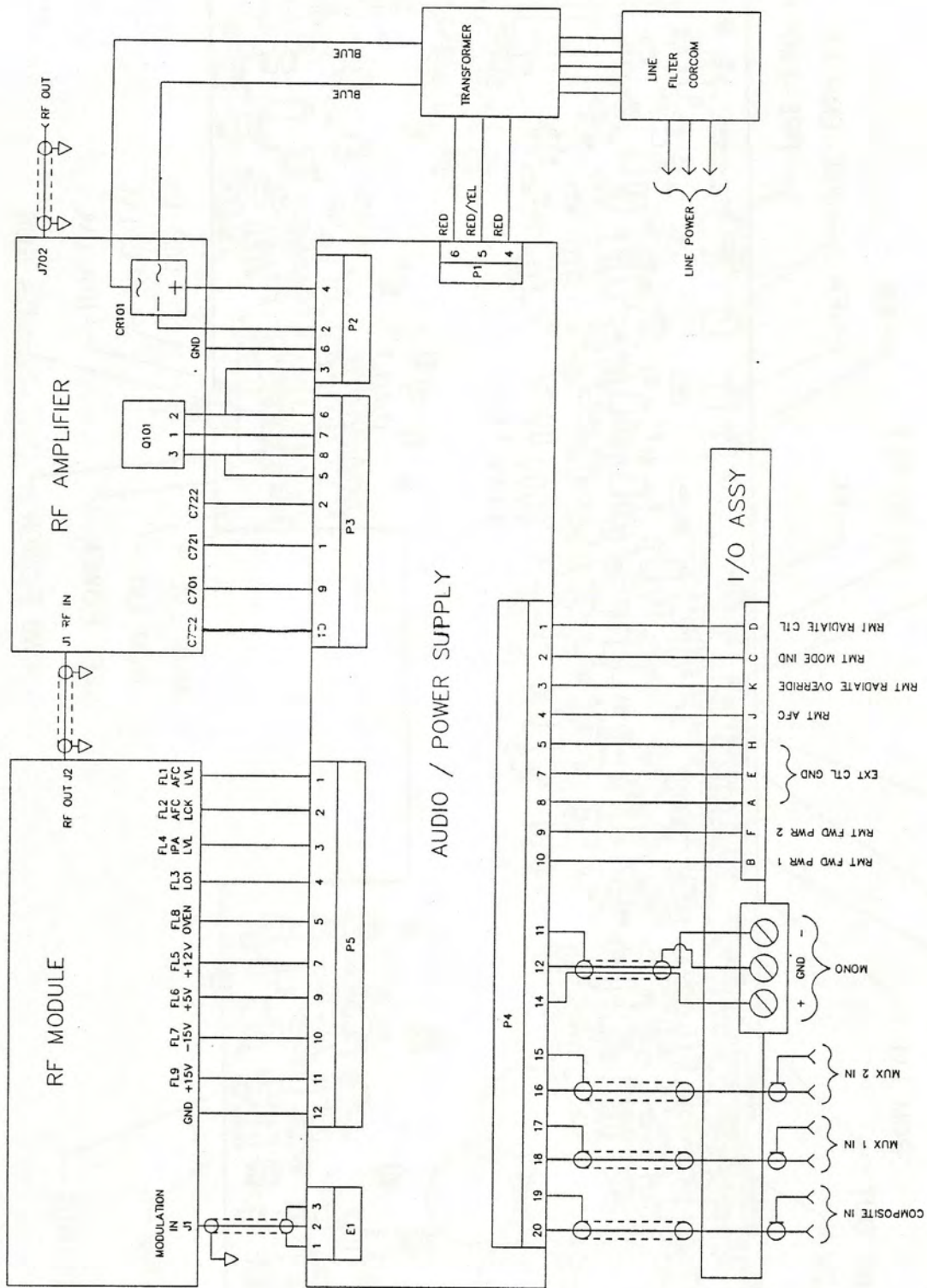


Figure 7-2
Transmitter System Schematic
91D7448 Rev 2

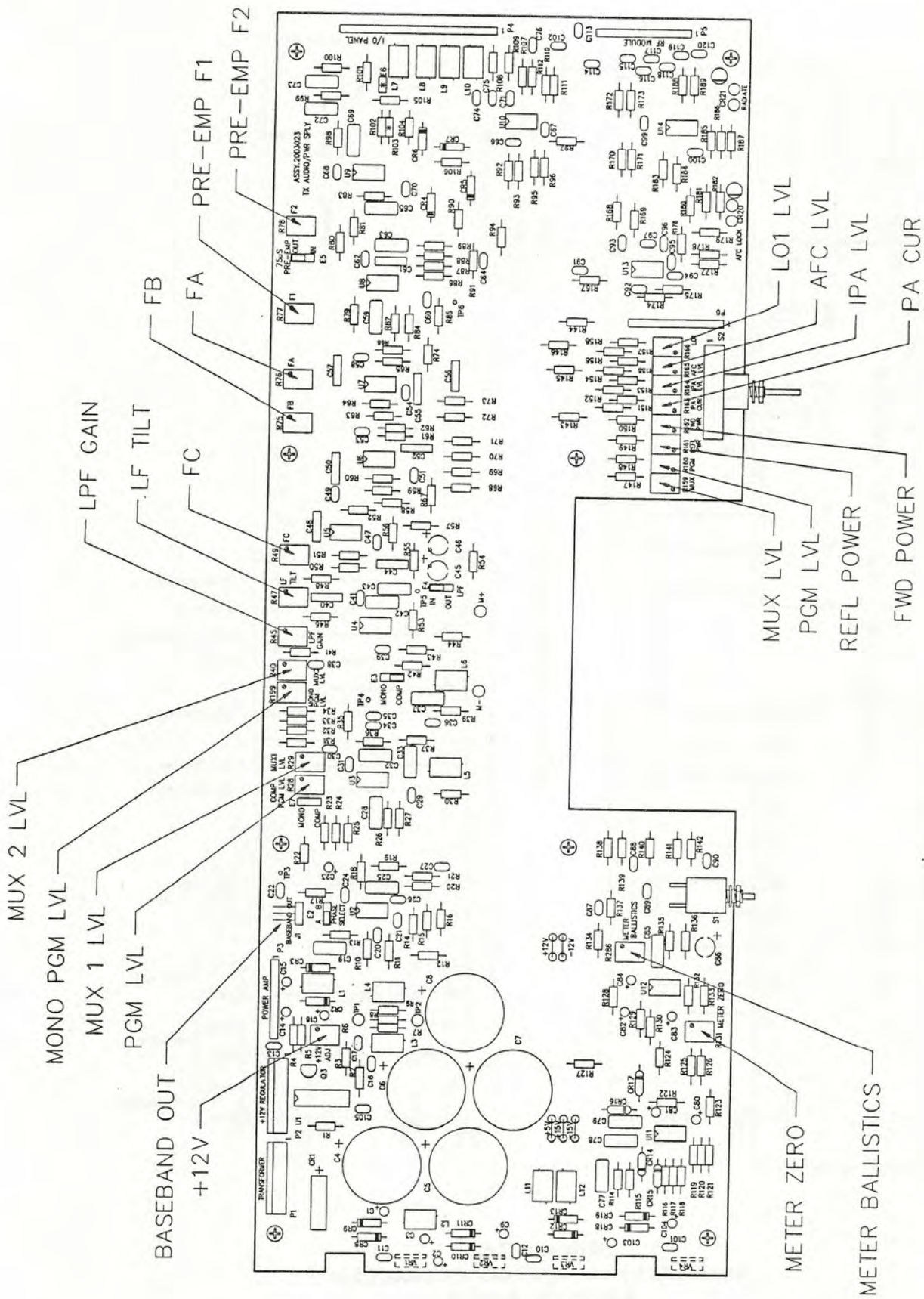


Figure 7-3
 Transmitter Audio/Power Supply Assembly
 20D3023 Rev 2

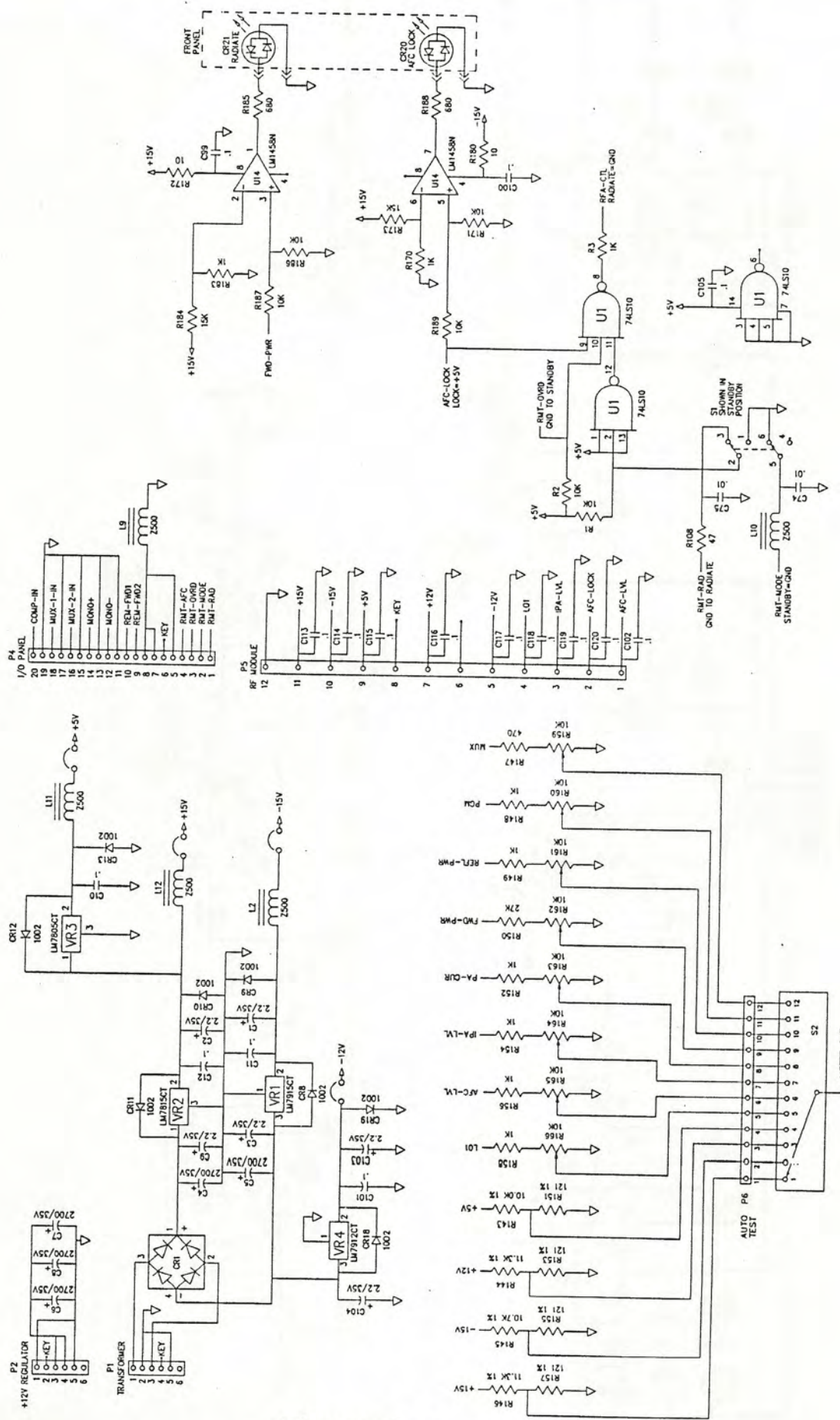


Figure 7-4
 Transmitter Audio/PS Schematic I
 91D7444 Rev 2

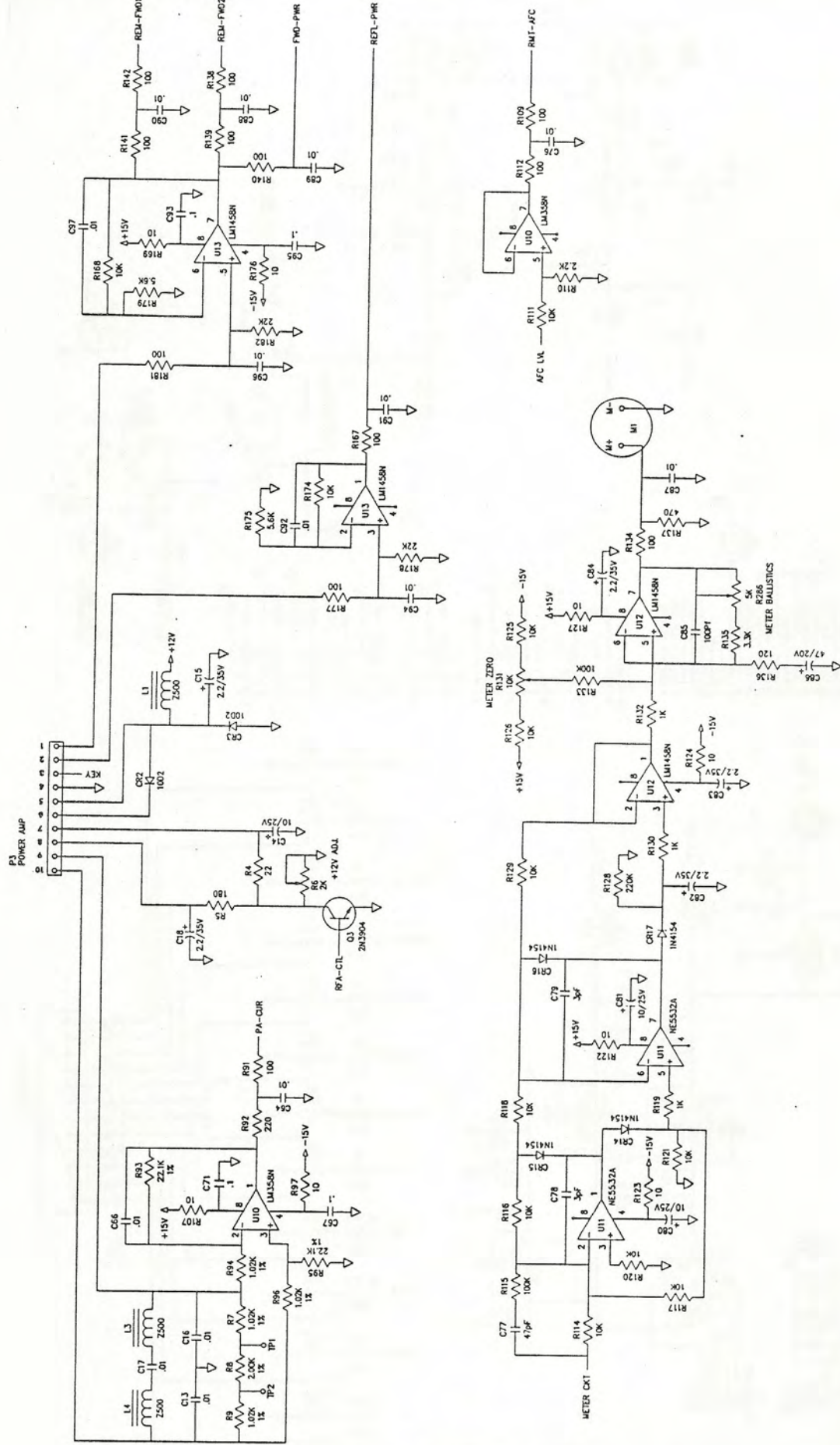


Figure 7-5
 Transmitter Audio/PS Schematic II
 91D7444 Rev 2

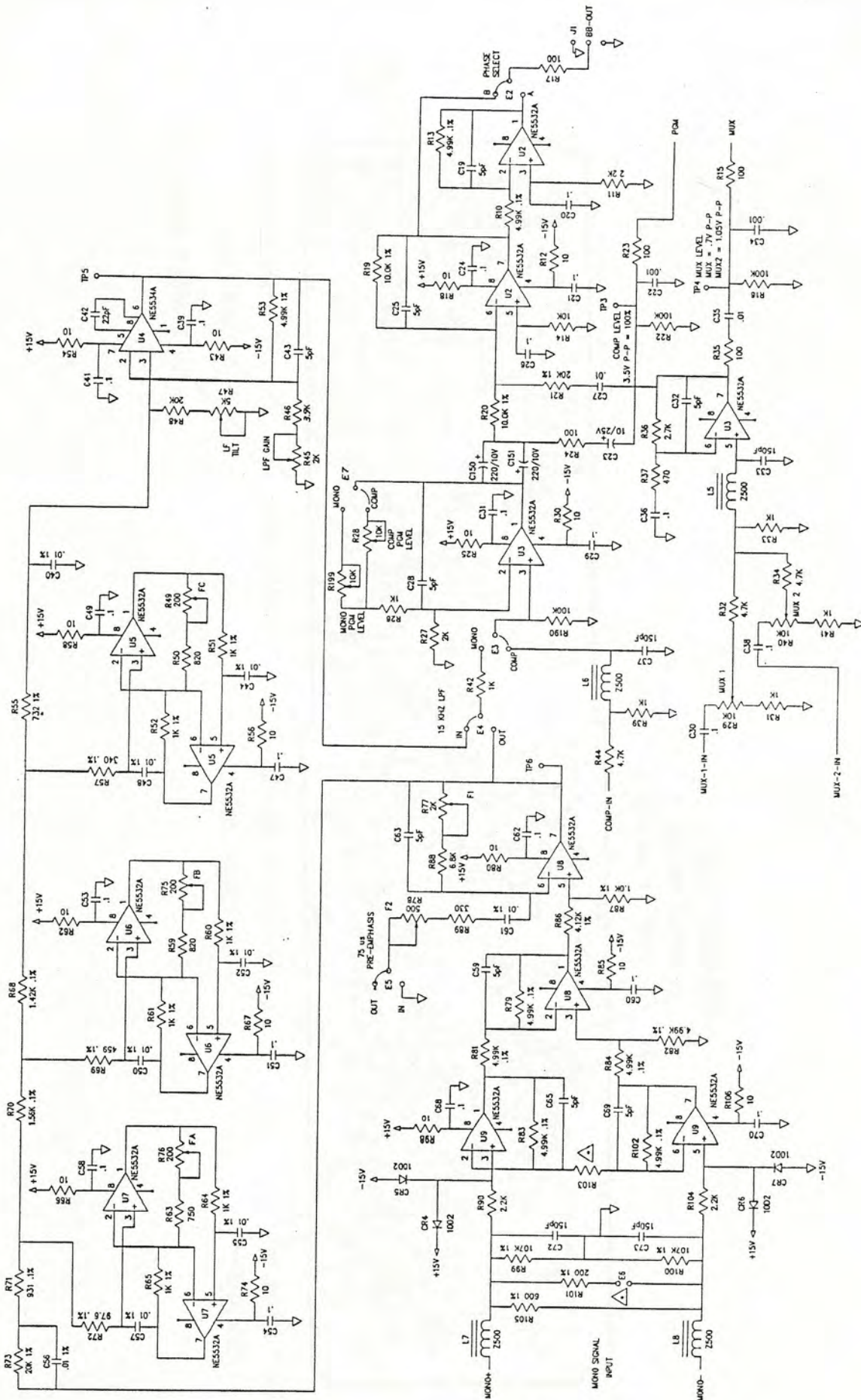


Figure 7-6
 Transmitter Audio/PS Schematic III
 91D7444 Rev 2

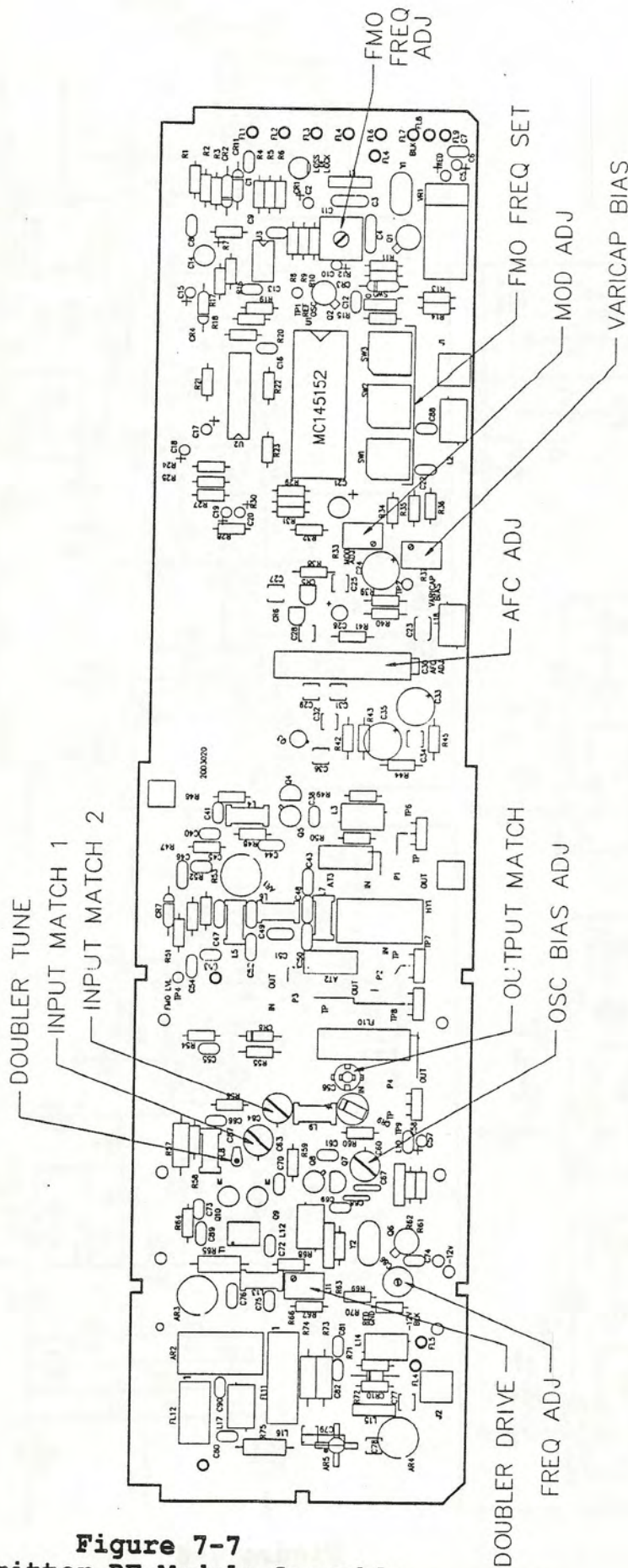


Figure 7-7
Transmitter RF Module Assembly
20D3020 Rev 2

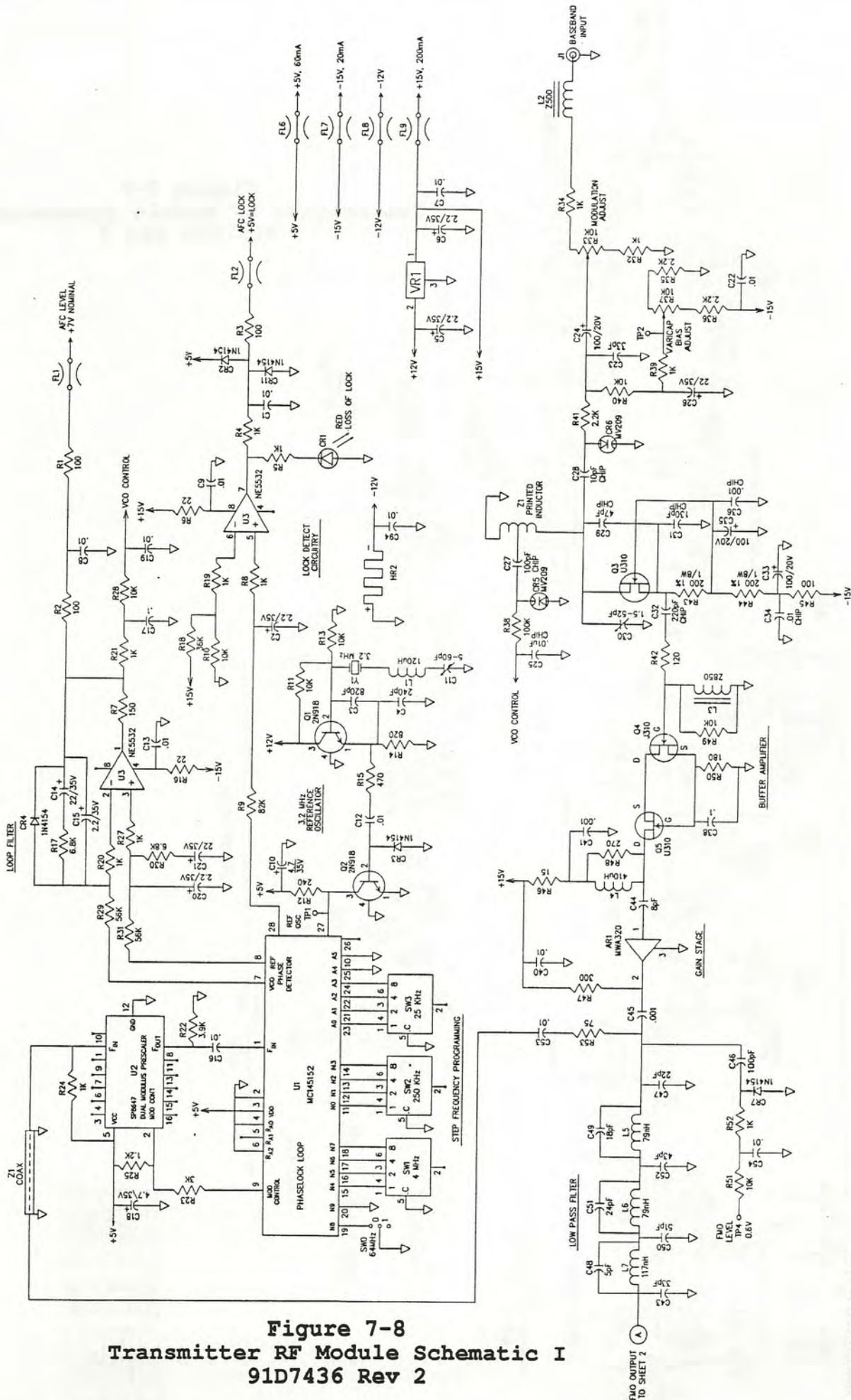
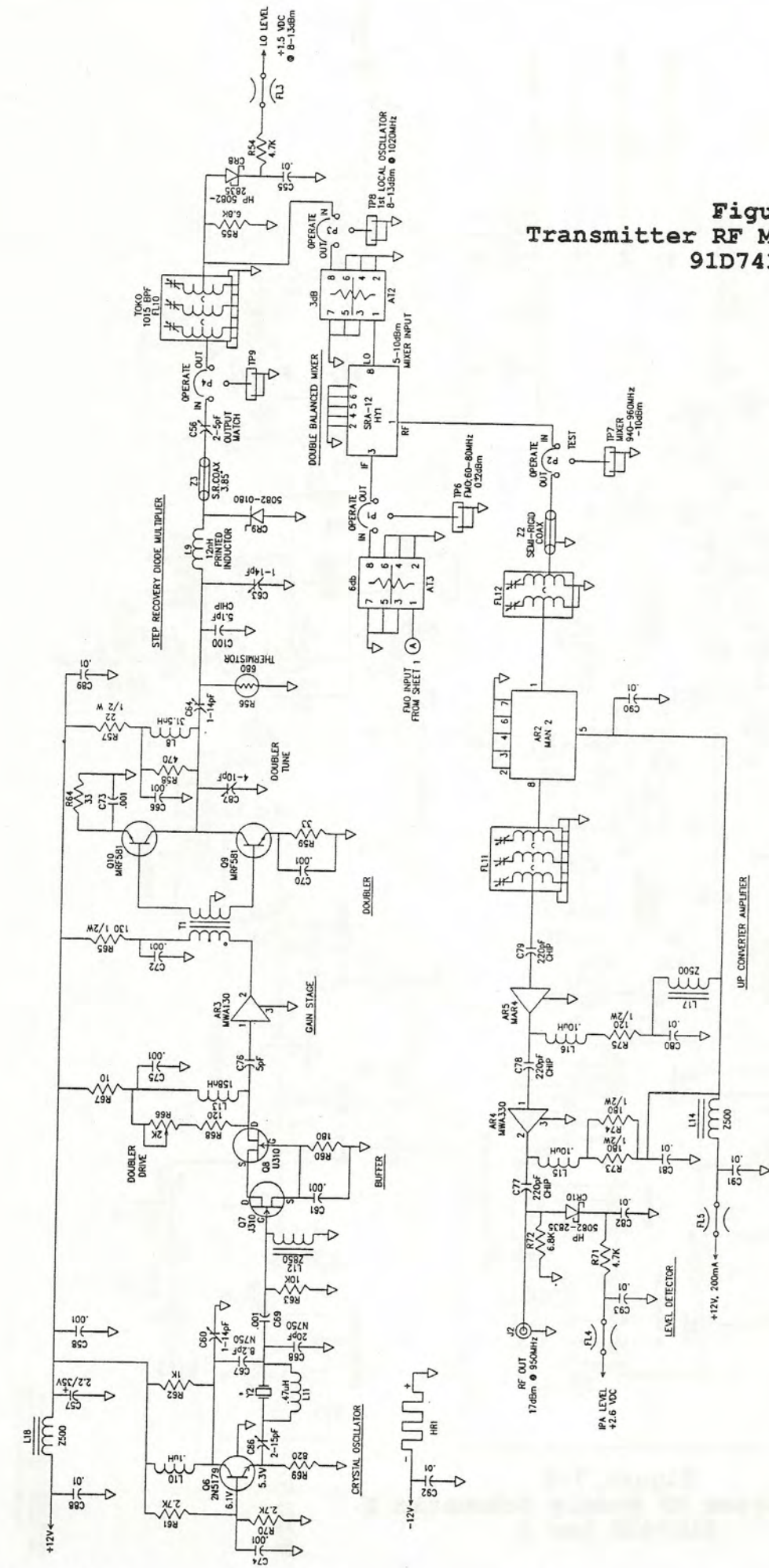


Figure 7-8
Transmitter RF Module Schematic I
91D7436 Rev 2

ALL RESISTOR VALUES ARE 1/4WATT
 ALL CAPACITORS ARE IN MICROFARADS
 UNLESS OTHERWISE SPECIFIED

Figure 7-9
Transmitter RF Module Schematic II
91D7436 Rev 2



Y2 MHz	CARRIER MHz	ITEM NO
102.000	940-960	3341062
100.000	920-940	3341088
98.000	900-920	3341096
97.000	880-900	3341104

If You Didn't Get This From My Site,
 Then It Was Stolen From...
www.SteamPoweredRadio.Com

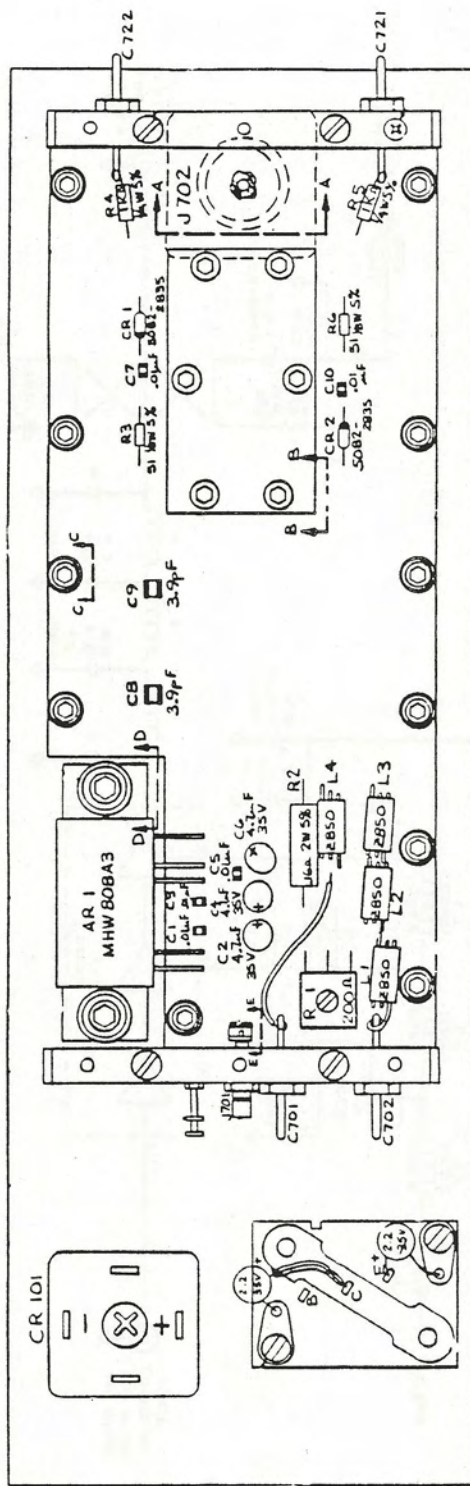


Figure 7-10
 RF Amplifier Assembly
 20D2937 Rev A

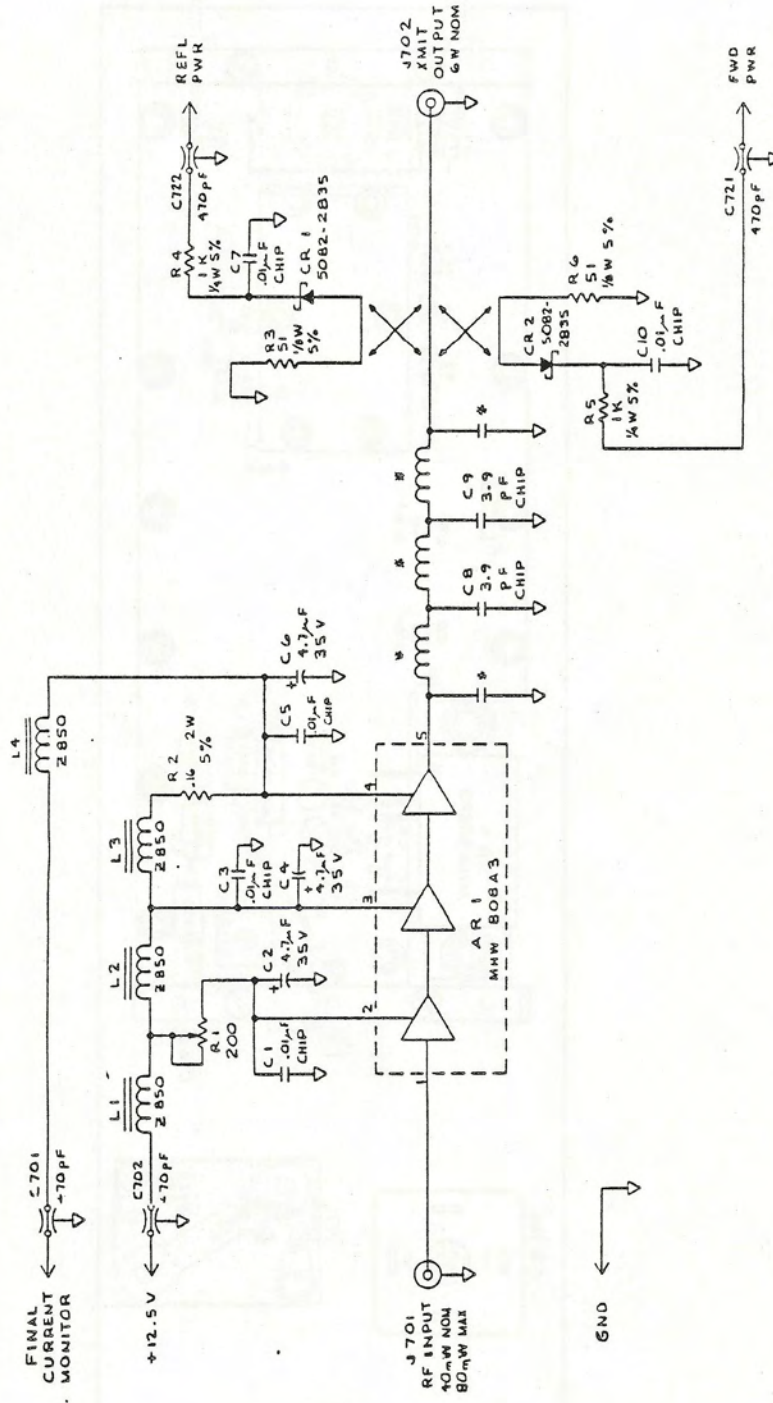


Figure 7-11
 RF Amplifier Schematic
 91C7379 Rev D

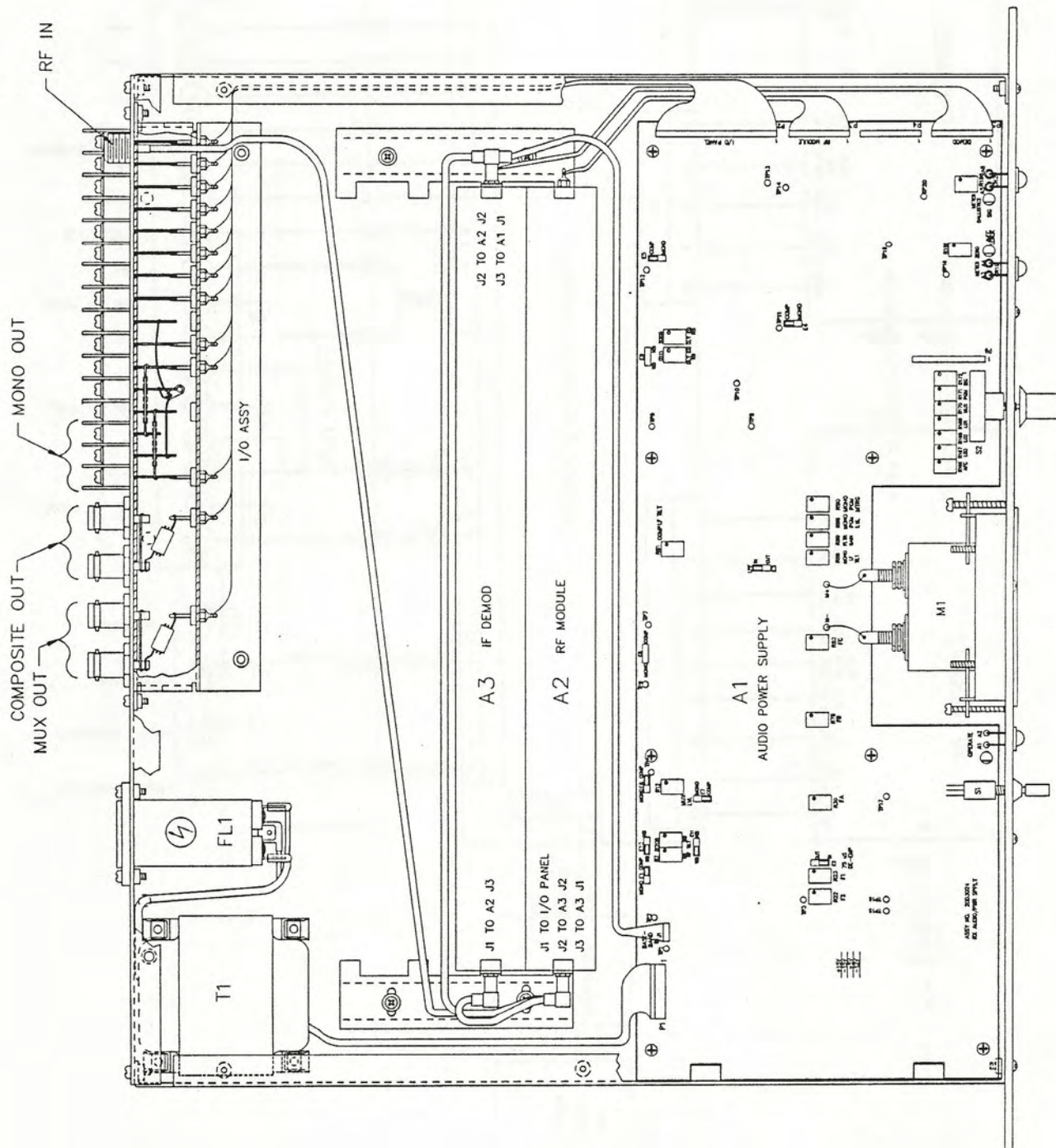


Figure 7-12
 6020 Receiver Final Assembly
 21D2891 Rev 2

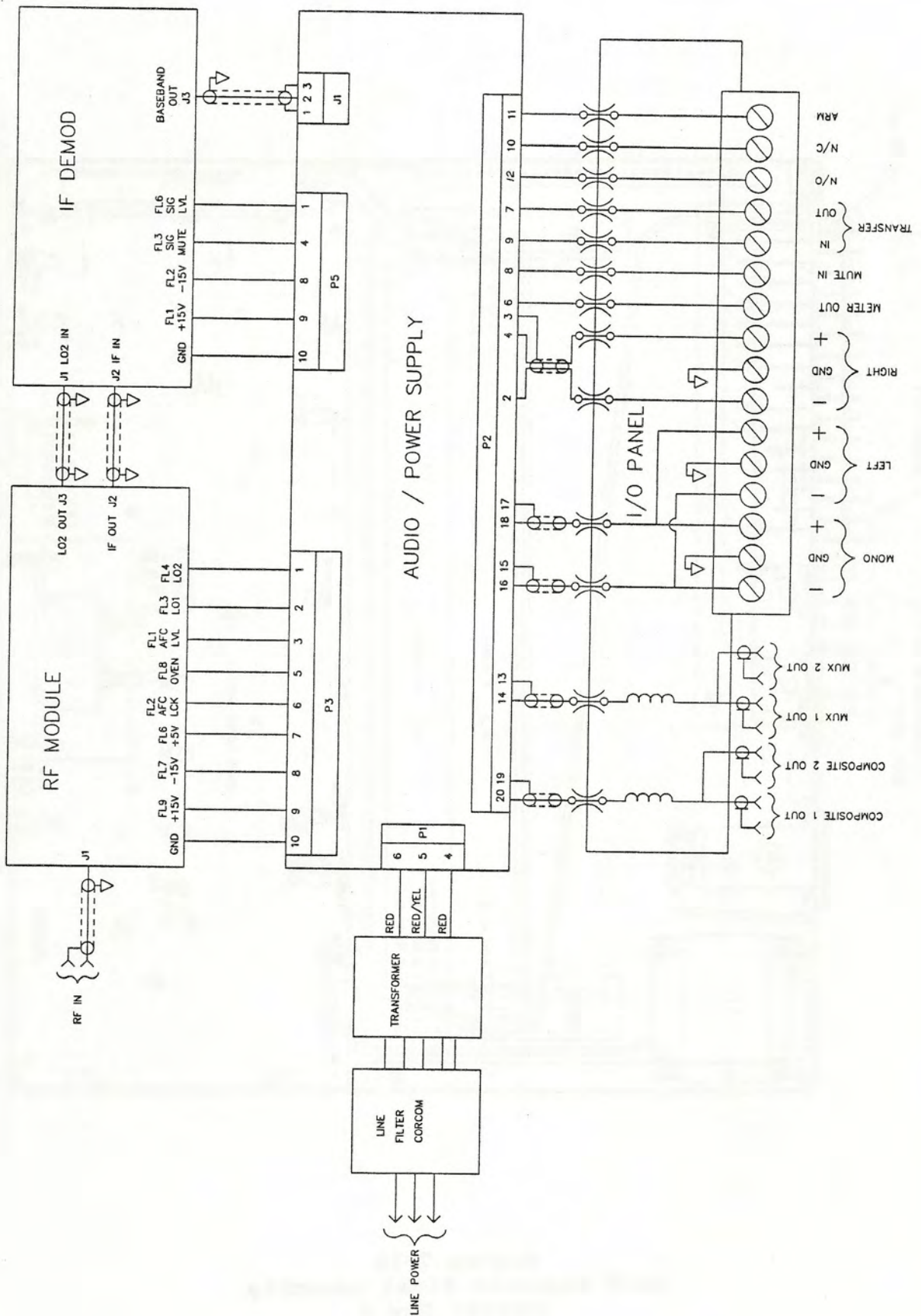


Figure 7-13
6020 Receiver System Schematic
91D7449 Rev 2

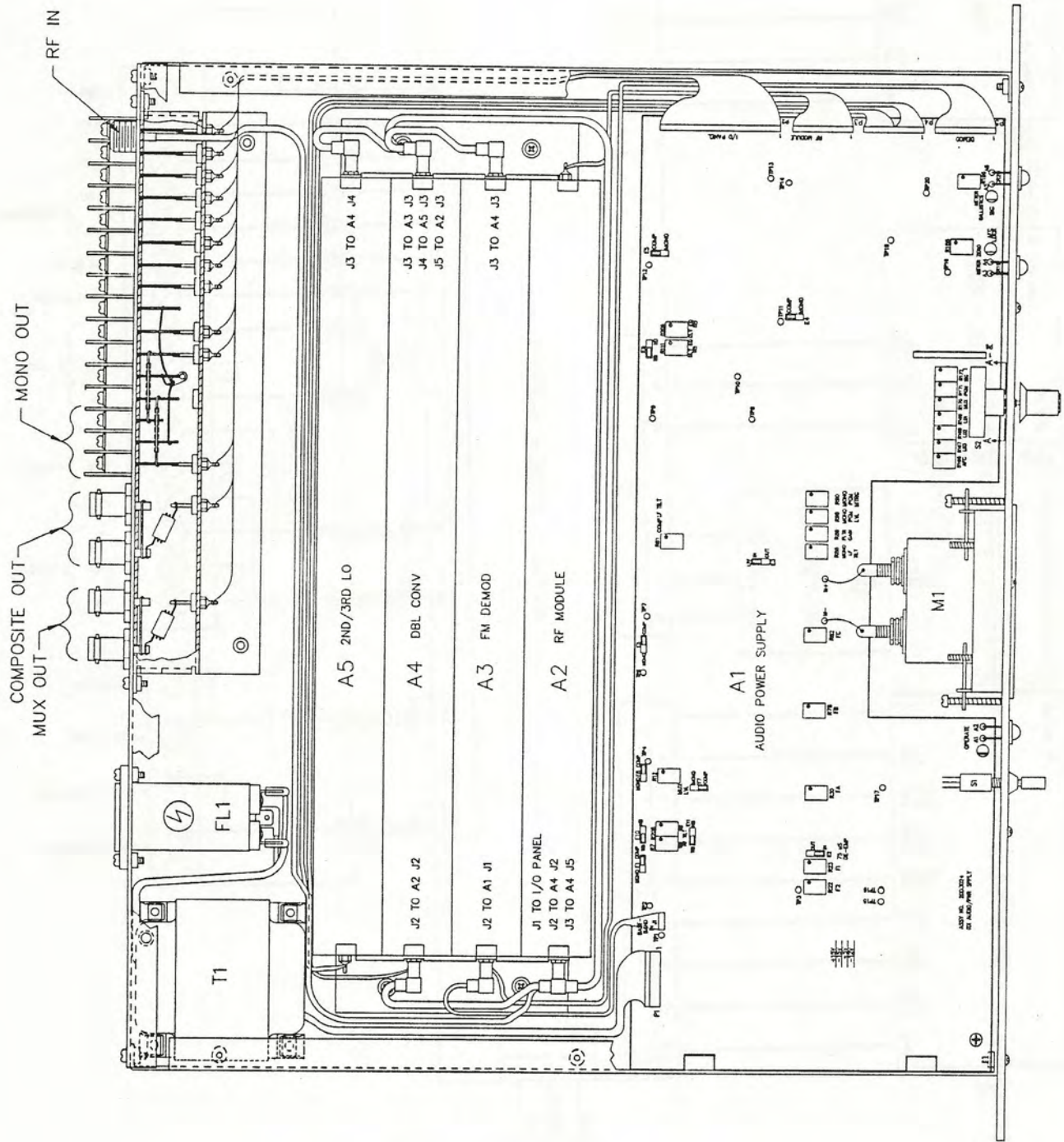


Figure 7-14
 6030 Receiver Final Assembly
 21D2891 Rev 2

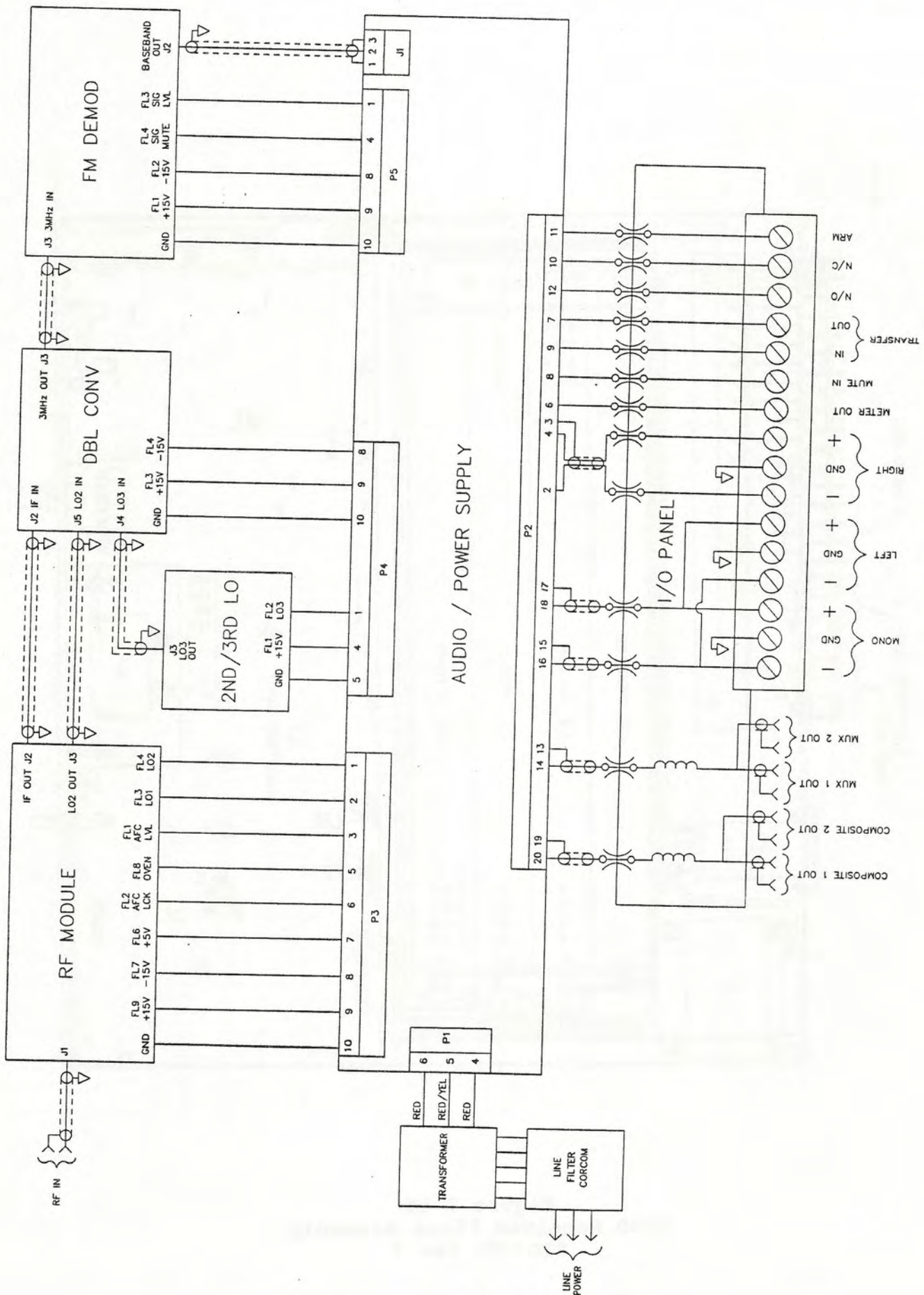


Figure 7-15
6030 Receiver System Schematic
91D7450 Rev 2

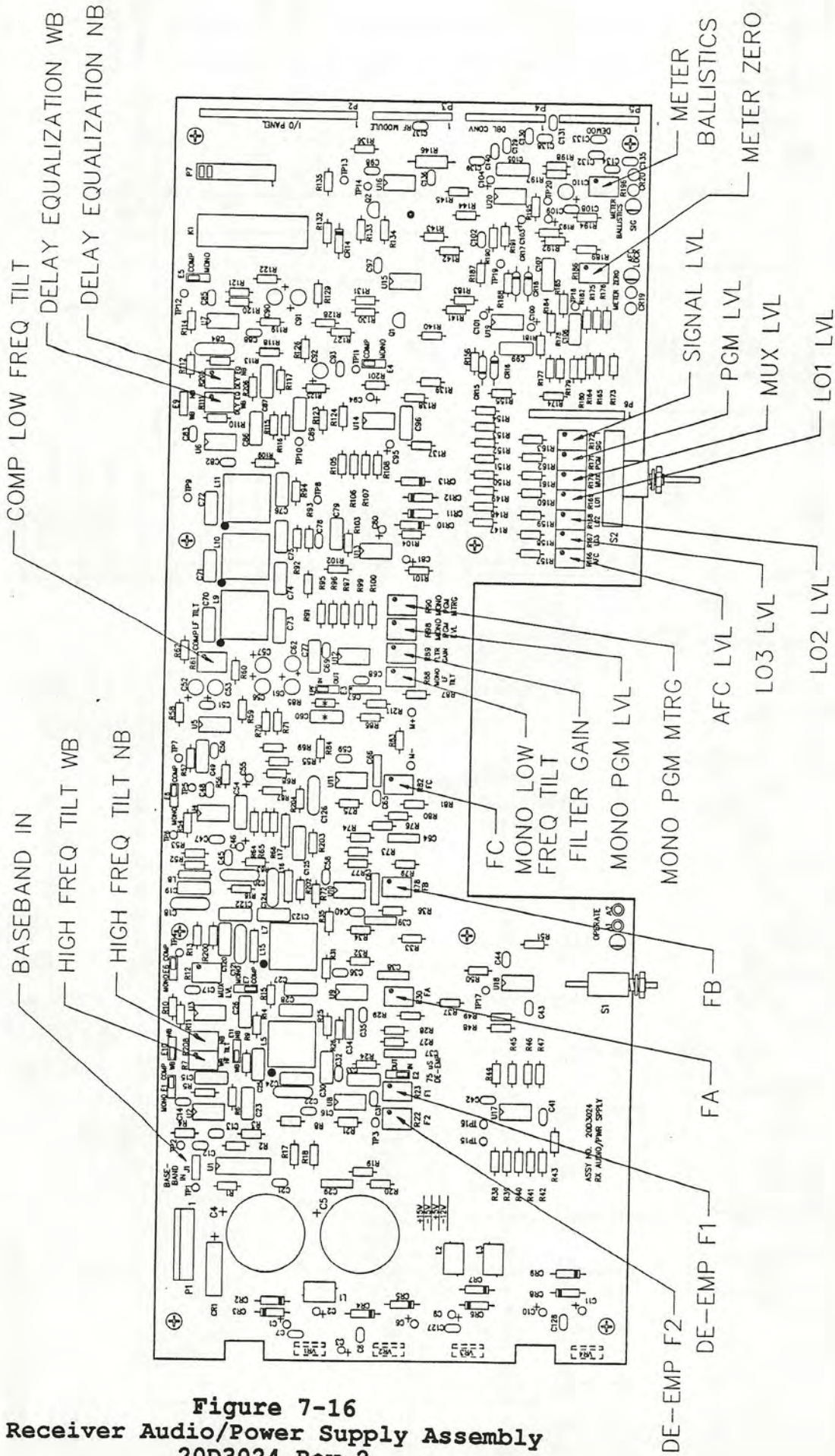


Figure 7-16
Receiver Audio/Power Supply Assembly
20D3024 Rev 2

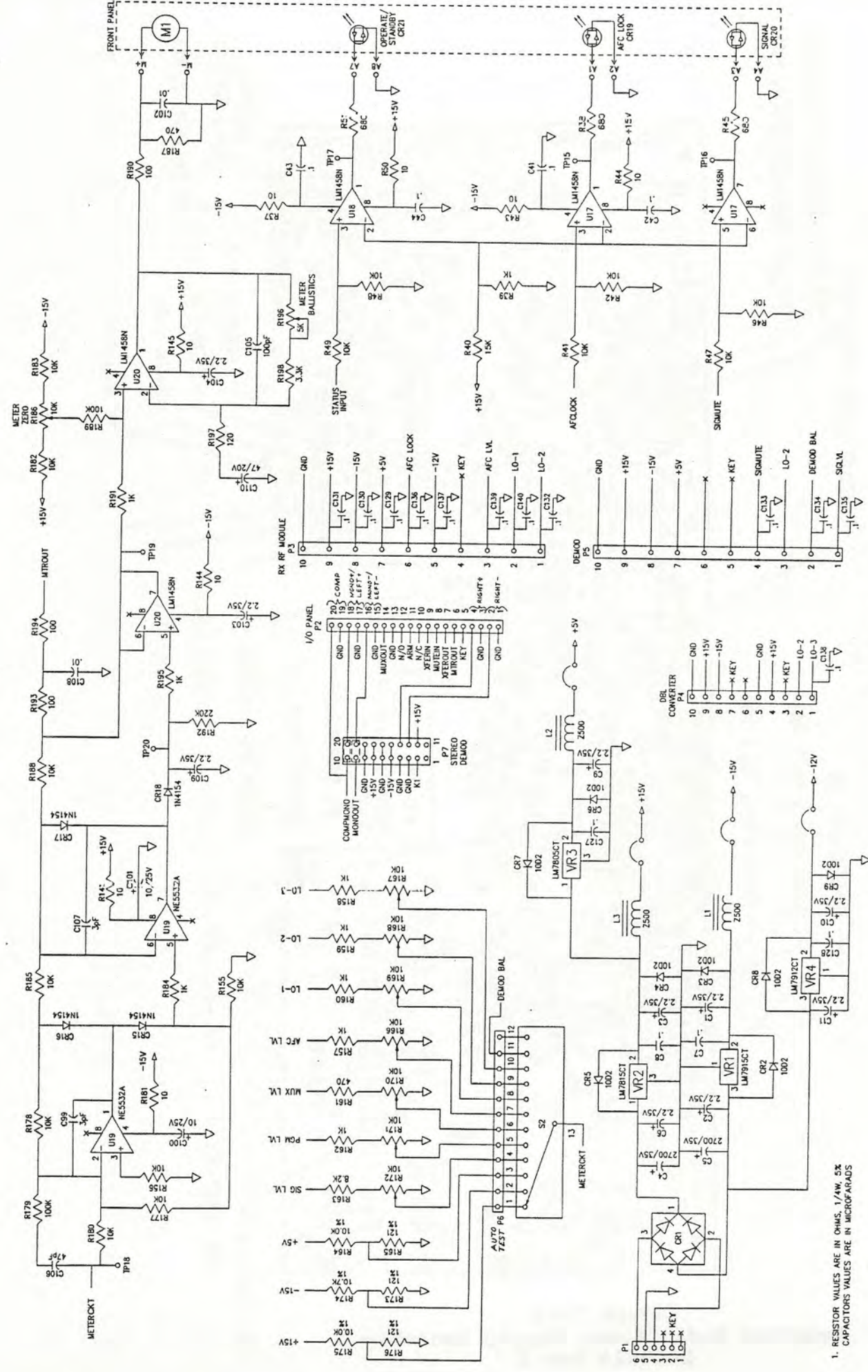


Figure 7-17
Receiver Audio/PS Schematic I
ID7443 Rev 2

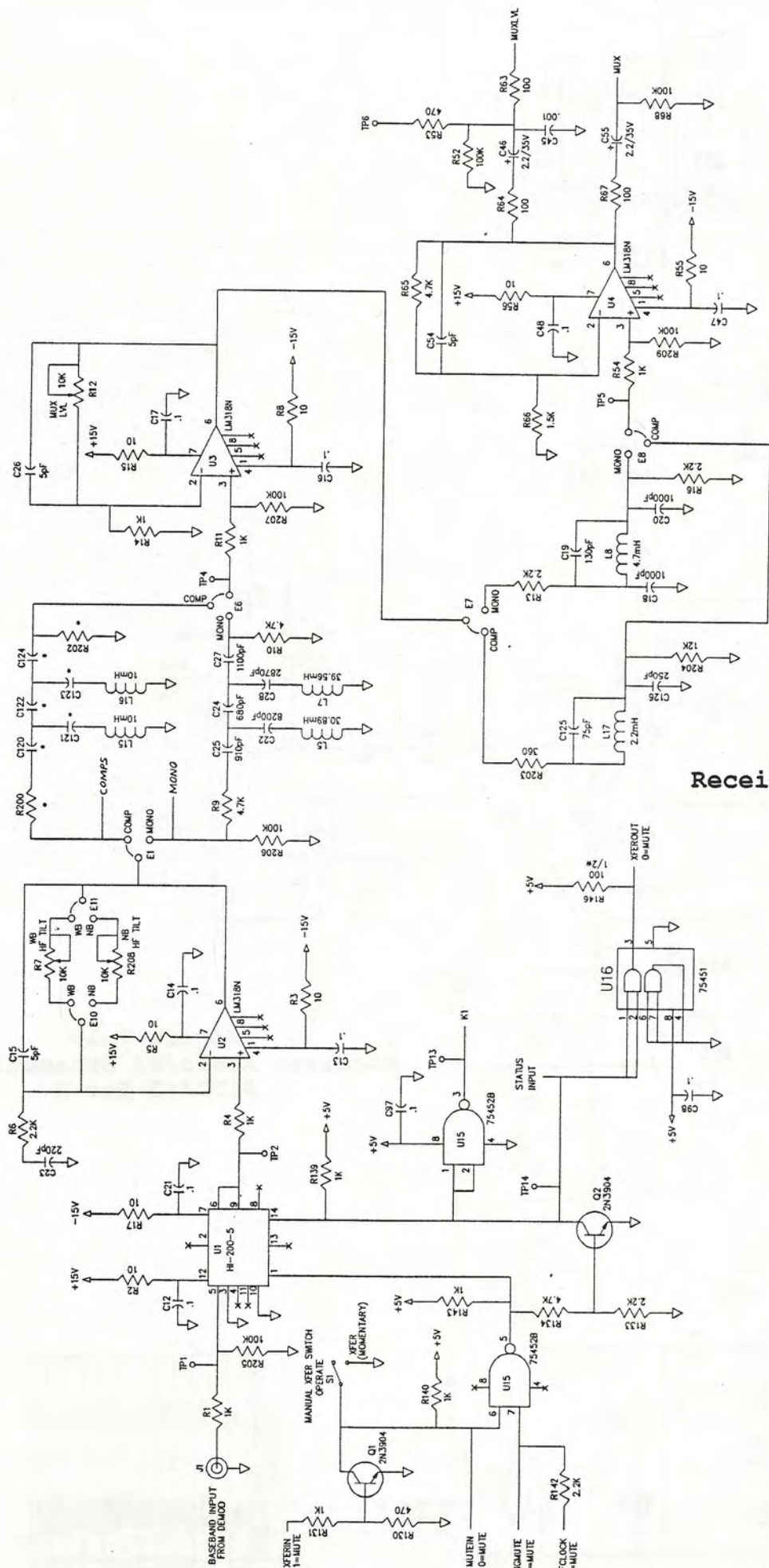


Figure 7-18
Receiver Audio/PS Schematic II
91D7443 Rev 2

REF	DES	COMPOSITE
C120	DASH -1(80KHz)	150pf
C121	DASH -2(115KHz)	1200pf
C122		110pf
C123		510pf
C124		180pf
R200		6.2K
R202		6.2K

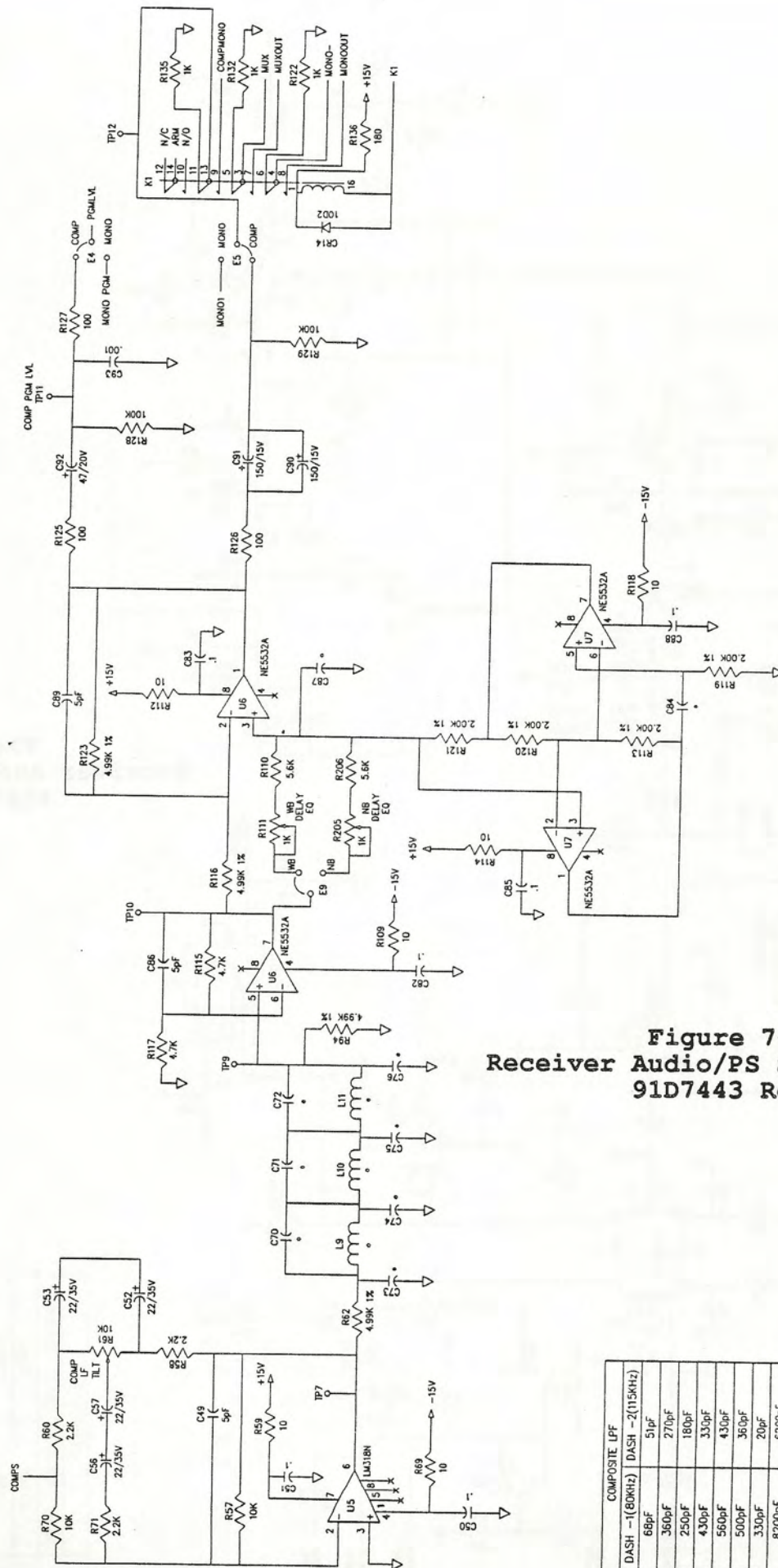


Figure 7-19
Receiver Audio/PS Schematic III
91D7443 Rev 2

REF	DES	COMPOSITE LPF
		DASH -1(80KHz) DASH -2(115KHz)
C70		68pF
C71		360pF
C72		270pF
C73		250pF
C74		430pF
C75		560pF
C76		330pF
C77		500pF
C78		330pF
C79		8200pF
C80		330pF
C81		240pF
C82		10.7mH
C83		7.9mH
C84		6.9mH
C85		5mH
C86		7.6mH
C87		5.5mH

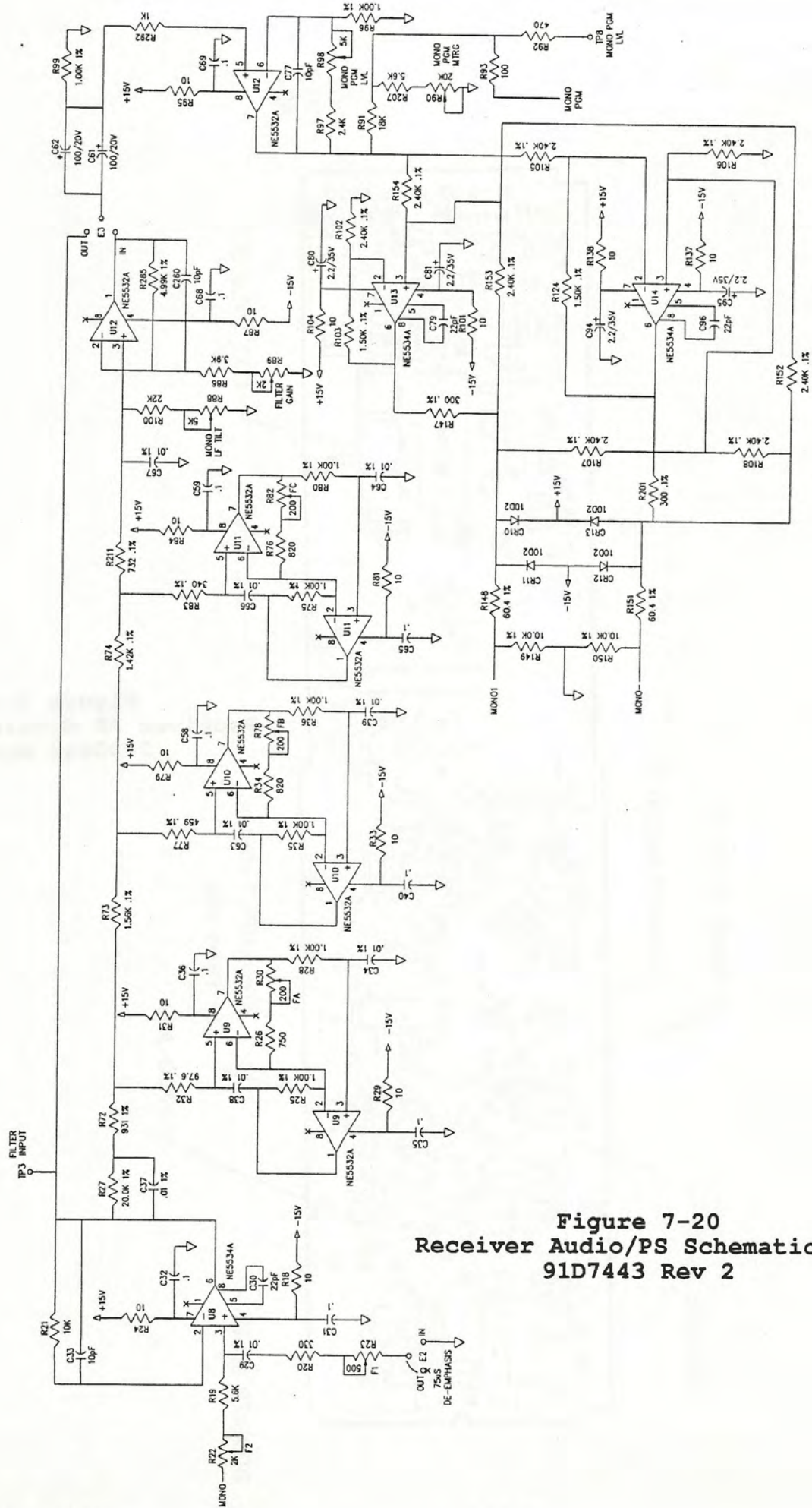


Figure 7-20
Receiver Audio/PS Schematic IV
91D7443 Rev 2

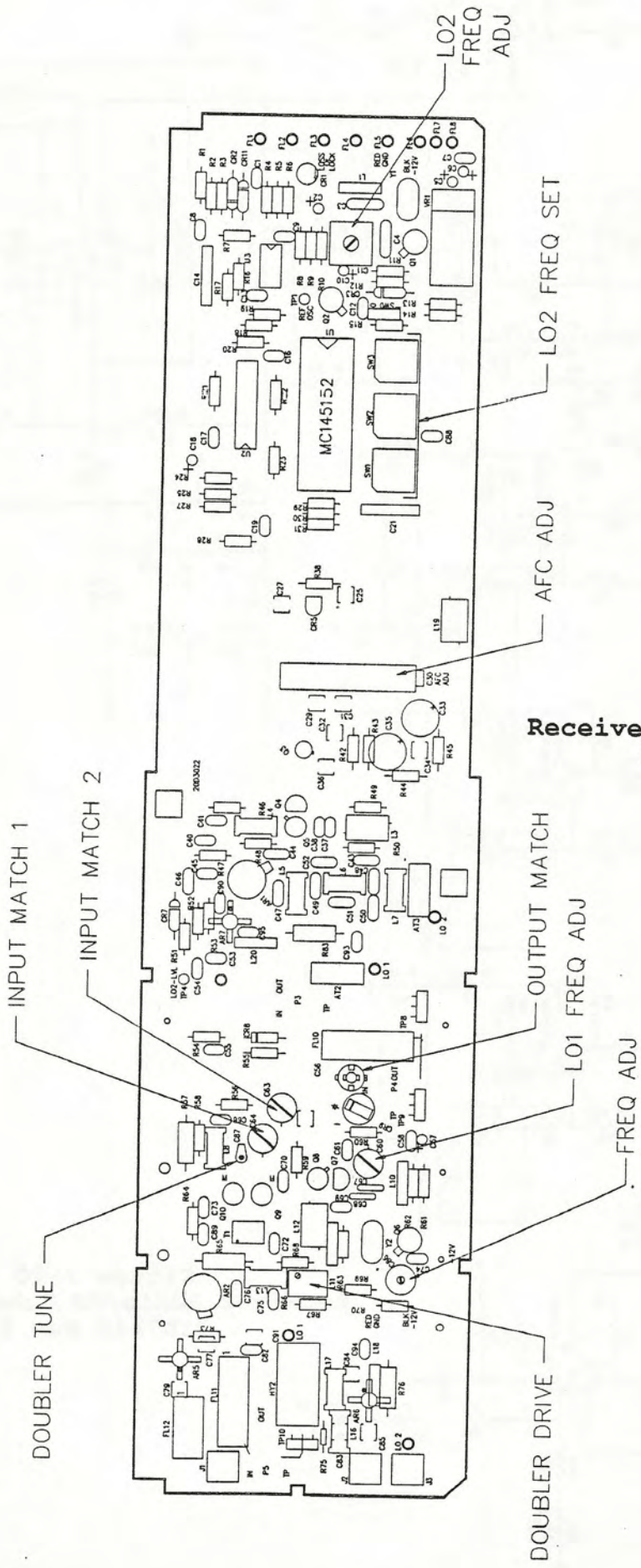


Figure 7-21
Receiver RF Module Assembly
20D3022 Rev 2

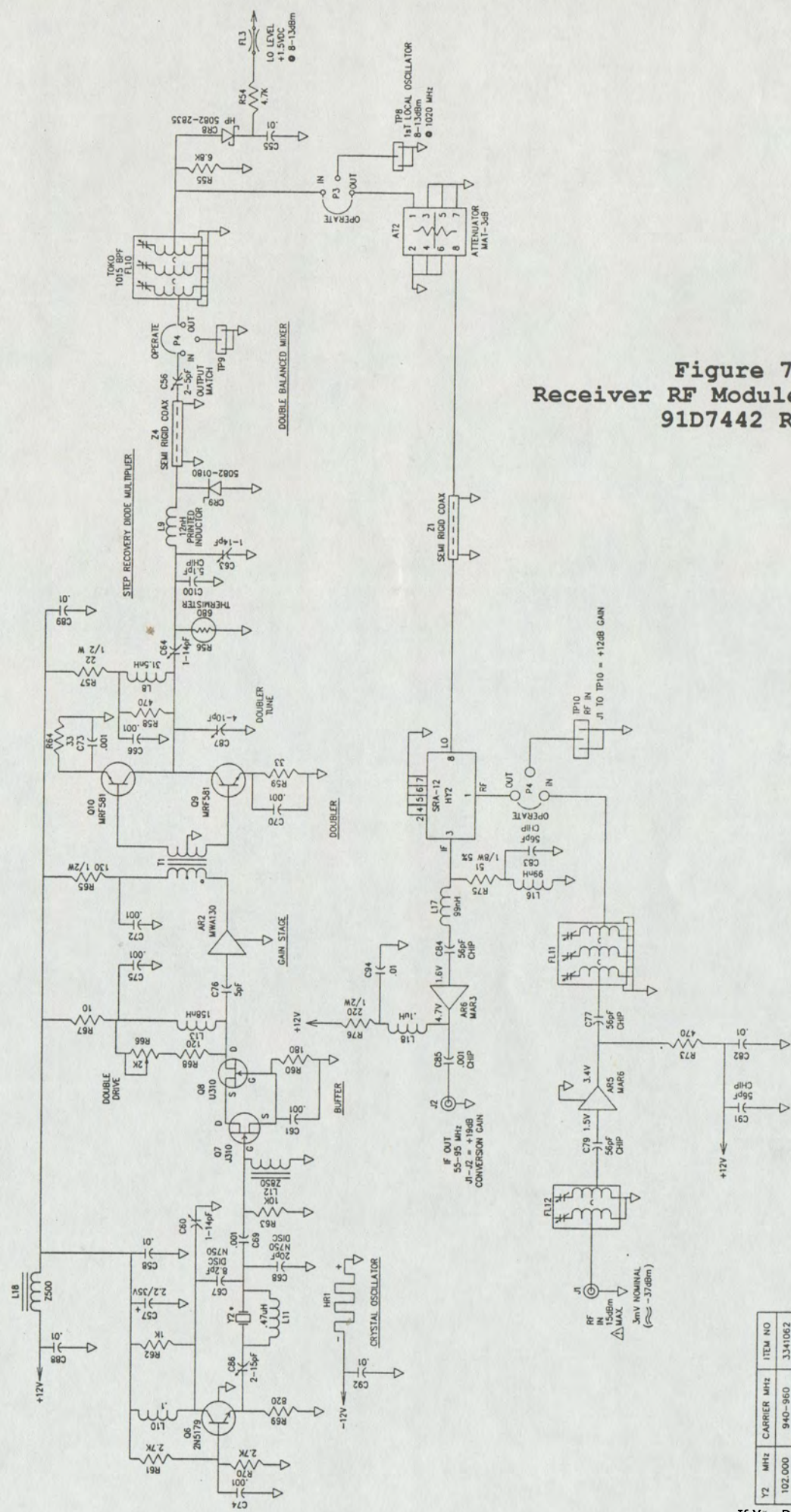


Figure 7-22
Receiver RF Module Schematic I
91D7442 Rev 2

Y2	MHZ	CARRIER MHZ	ITEM NO
	102.000	940-960	3341062
	100.000	920-940	3341088
	98.000	900-920	3341096
	97.000	880-900	3341104

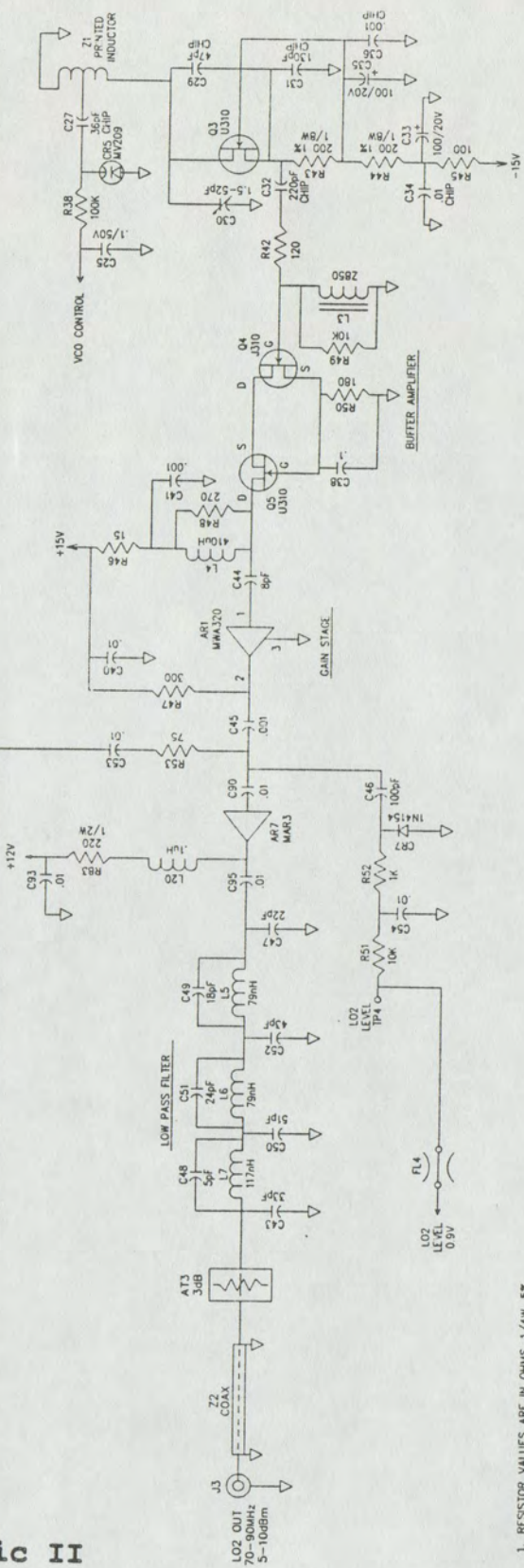
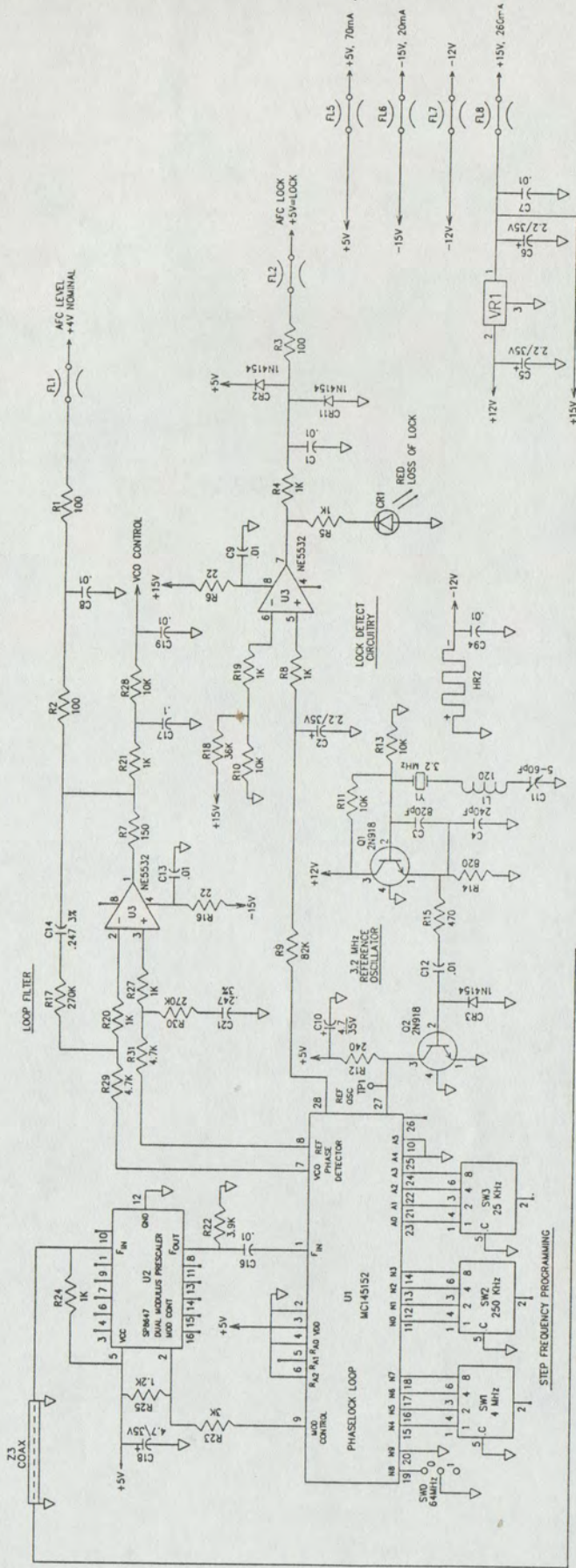
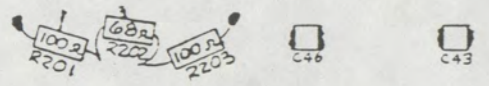
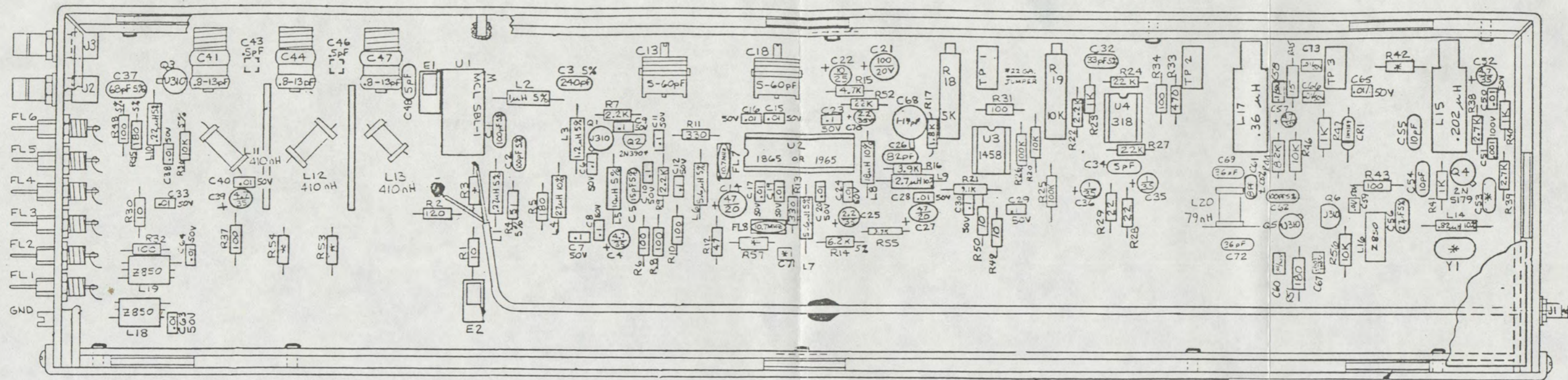


Figure 7-23
Receiver RF Module Schematic II
91D7442 Rev 2

1. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
 CAPACITOR VALUES ARE IN MICROFARADS



DASH LEVEL	ITEM #	DESCRIPTION	J1	Y1	R3	R42	R54	R53	R57	C71	C53
-1	9302563	IF DEMOD PCL-6001-1	OMIT	80.7MHZ	10Ω	10Ω	120K	5TK	OMIT	OMIT	OMIT
-2	9302704	IF DEMOD PCL-6020-2	INSTALL	OMIT	OMIT	OMIT	12K	5.6K	OMIT	OMIT	OMIT

Figure 7-24
6020 IF Demod Assembly
20D2941 Rev 7

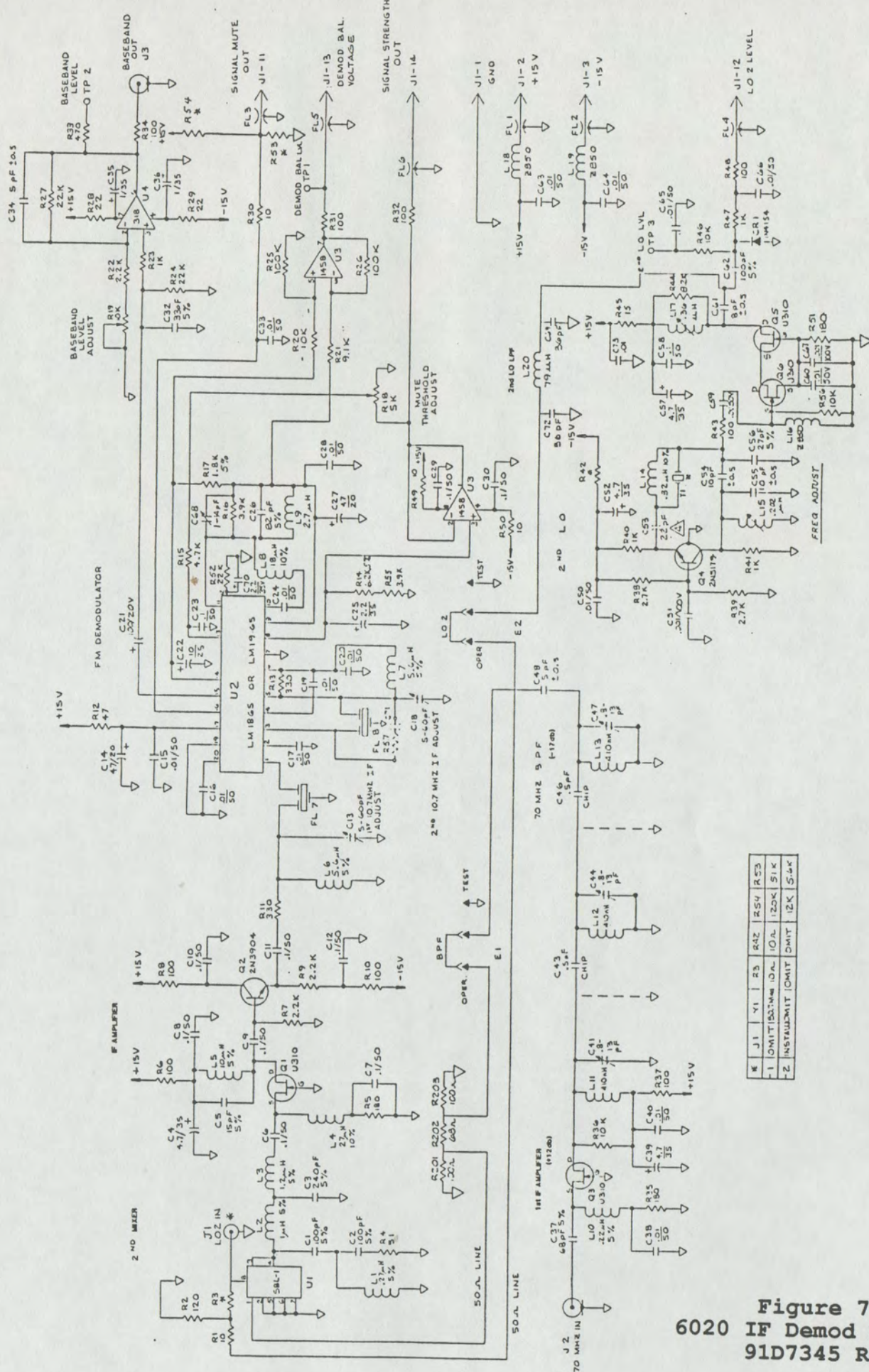
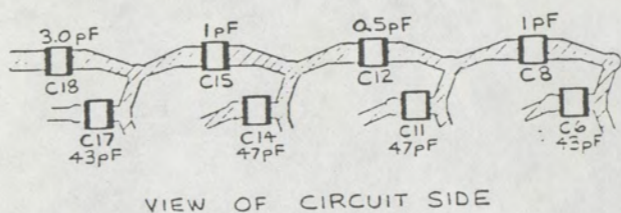
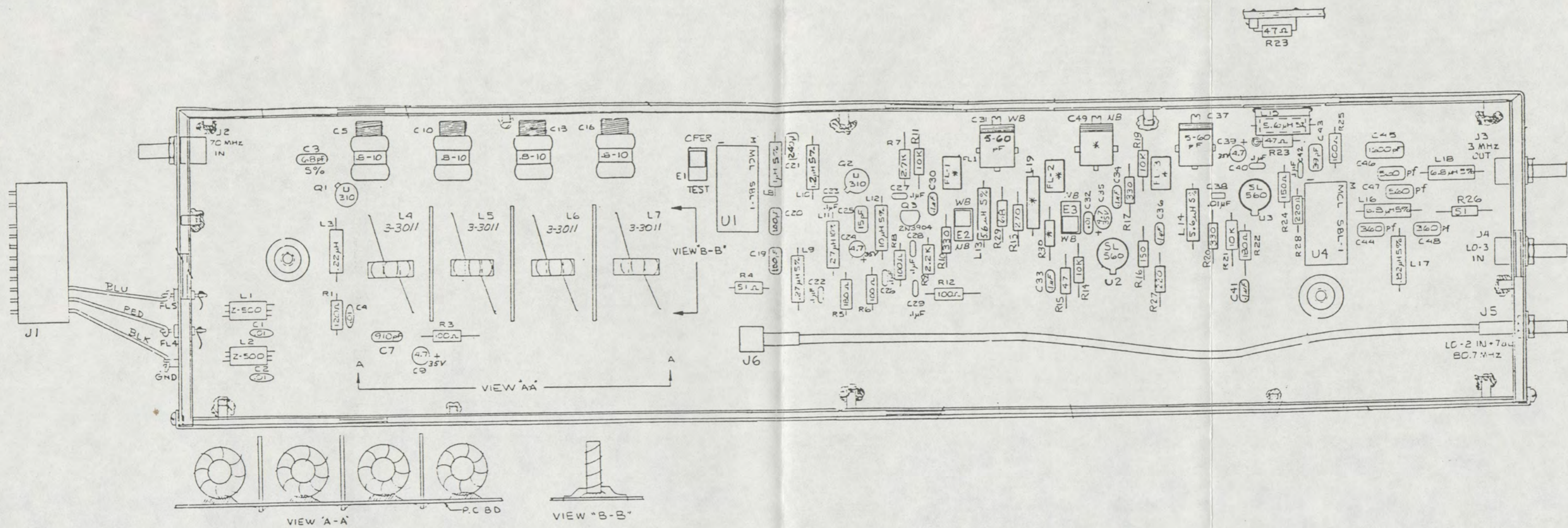
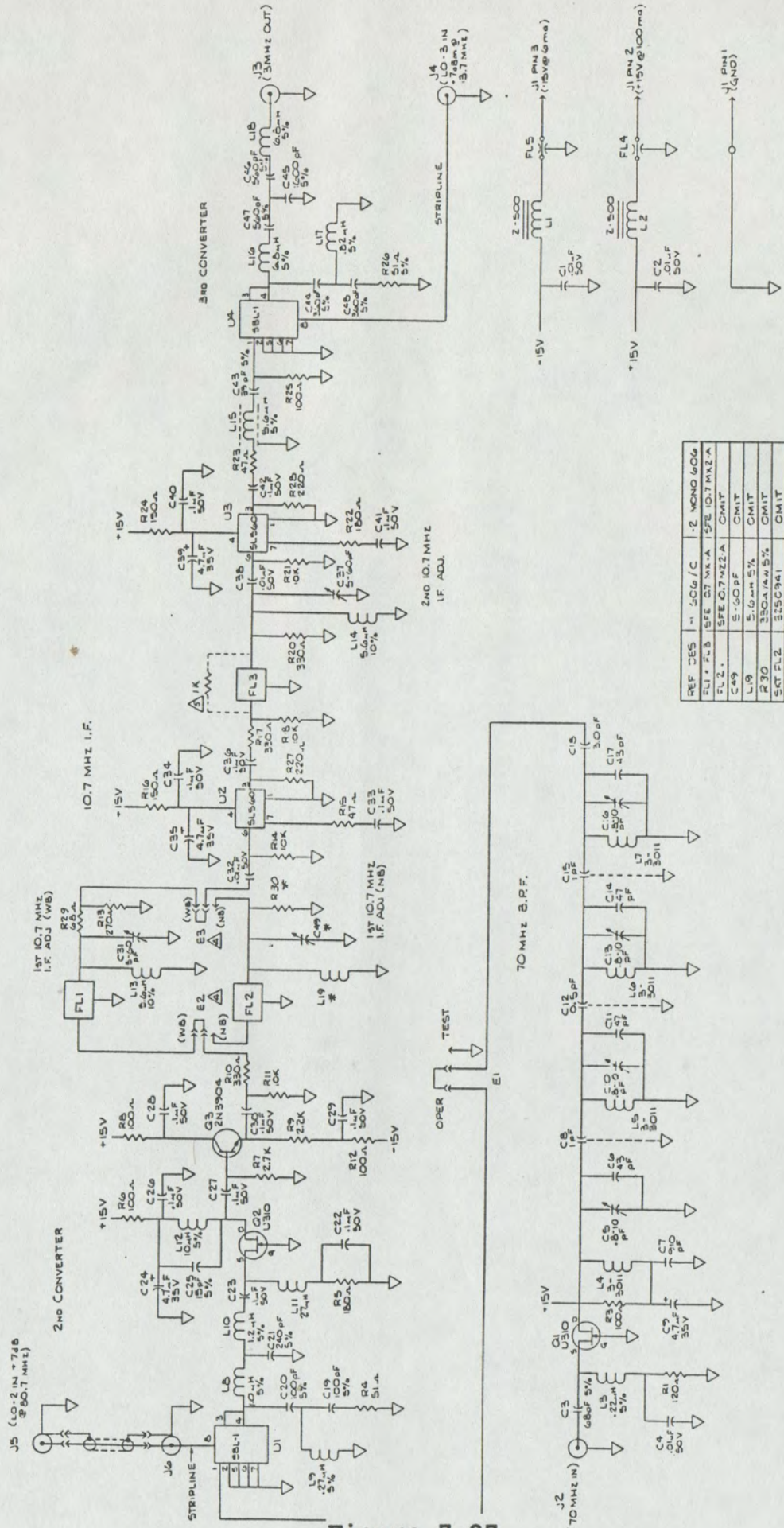


Figure 7-25
6020 IF Demod Schematic
91D7345 Rev 4



REF. DES.	-1 606/C	-2 MONO 606
FL1, FL3	SFE 10.7 MX-A	SFE 10.7 MX2-A
FL-2	SFE 10.7 MZ2-A	OMIT
C49	5-60PF	"
L19	5.6μH 5%	"
R30	330Ω 1/4W 5%	"
SKT FL-2	3250941	"

Figure 7-26
70-3 MHz Double Converter Assembly
20D2824 Rev A



REF	DES	VAL	UNIT	TYPE	MONO	609
FL1	FL3	SFE	07MHZ	A	SFE	10.7MHZ
FL2		SFE	07MHZ	A	CMIT	
C49		S	60PF		CMIT	
L19		S	60MH	5%	CMIT	
R20		S	300A	4W	5%	CMIT
SAT	FL2	S25C9M1			CMIT	

Figure 7-27
 70-3 MHz Double Converter Schematic
 91D7382 Rev 2

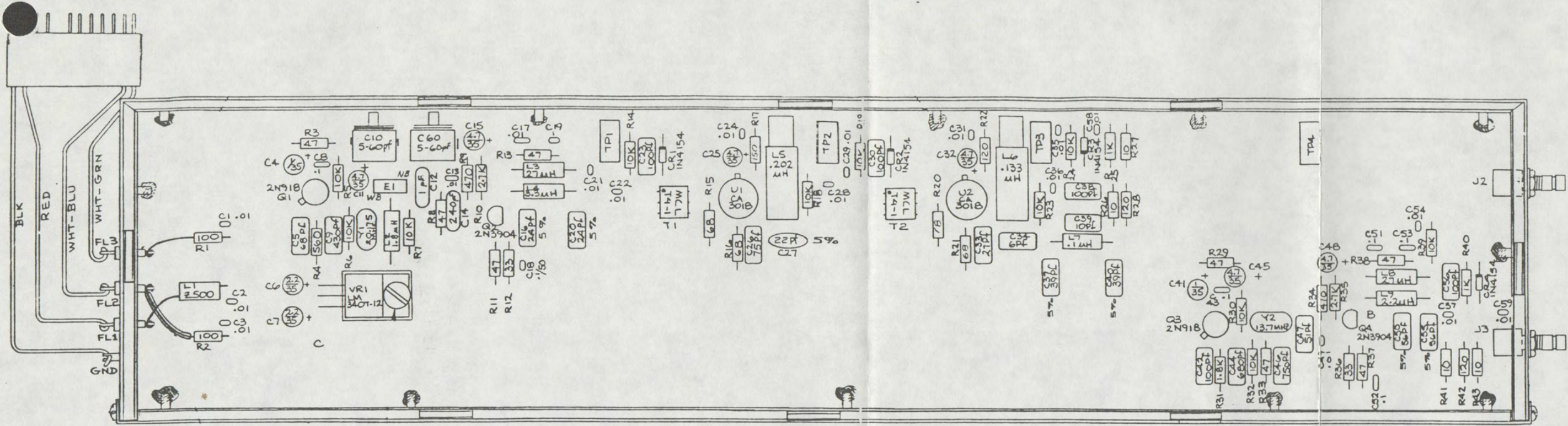


Figure 7-28
 80.7/13.7 2ND/3RD LO Assembly
 20D2948 Rev A

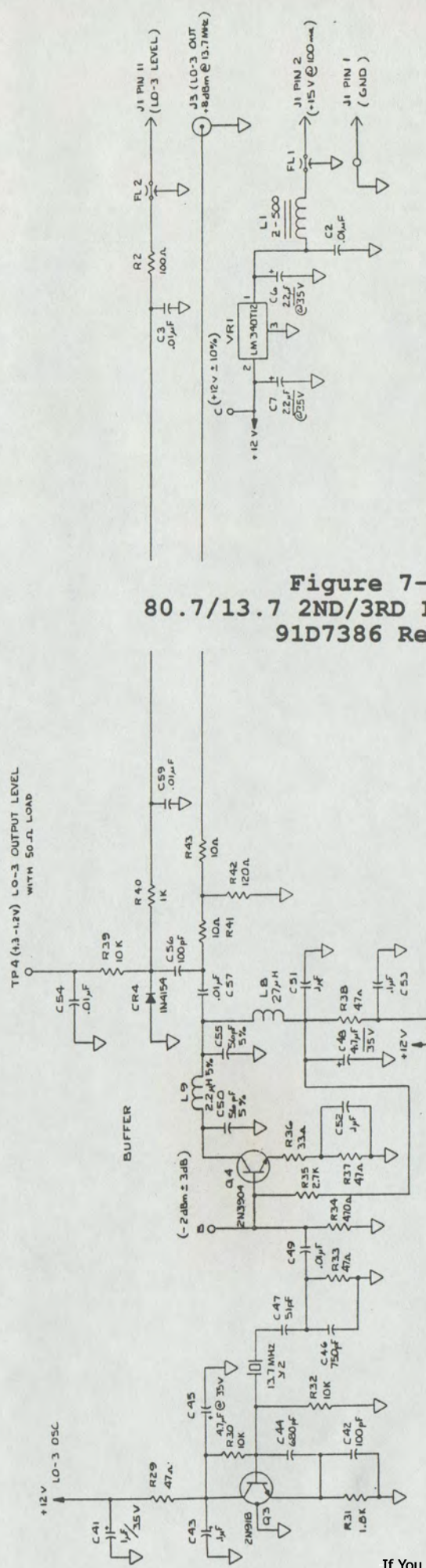
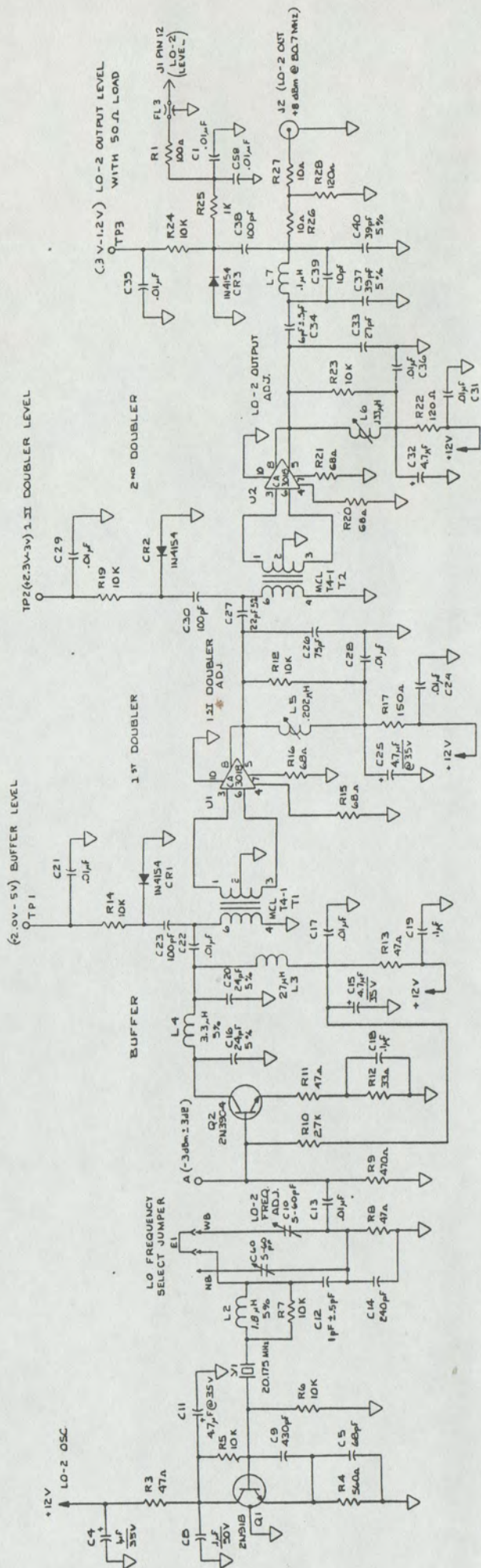


Figure 7-29
 80.7/13.7 2ND/3RD LO Schematic
 91D7386 Rev A

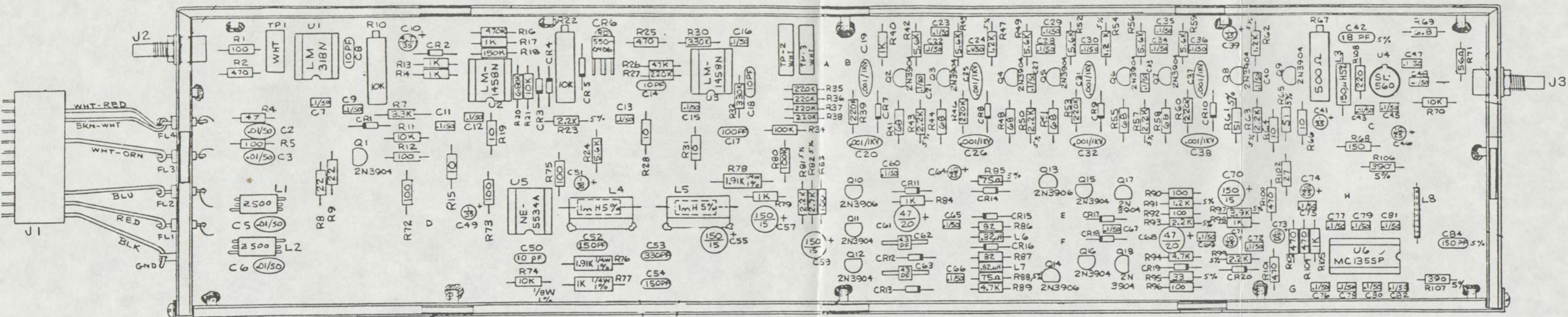


Figure 7-30
 FM Demod Assembly
 20D2811 Rev P

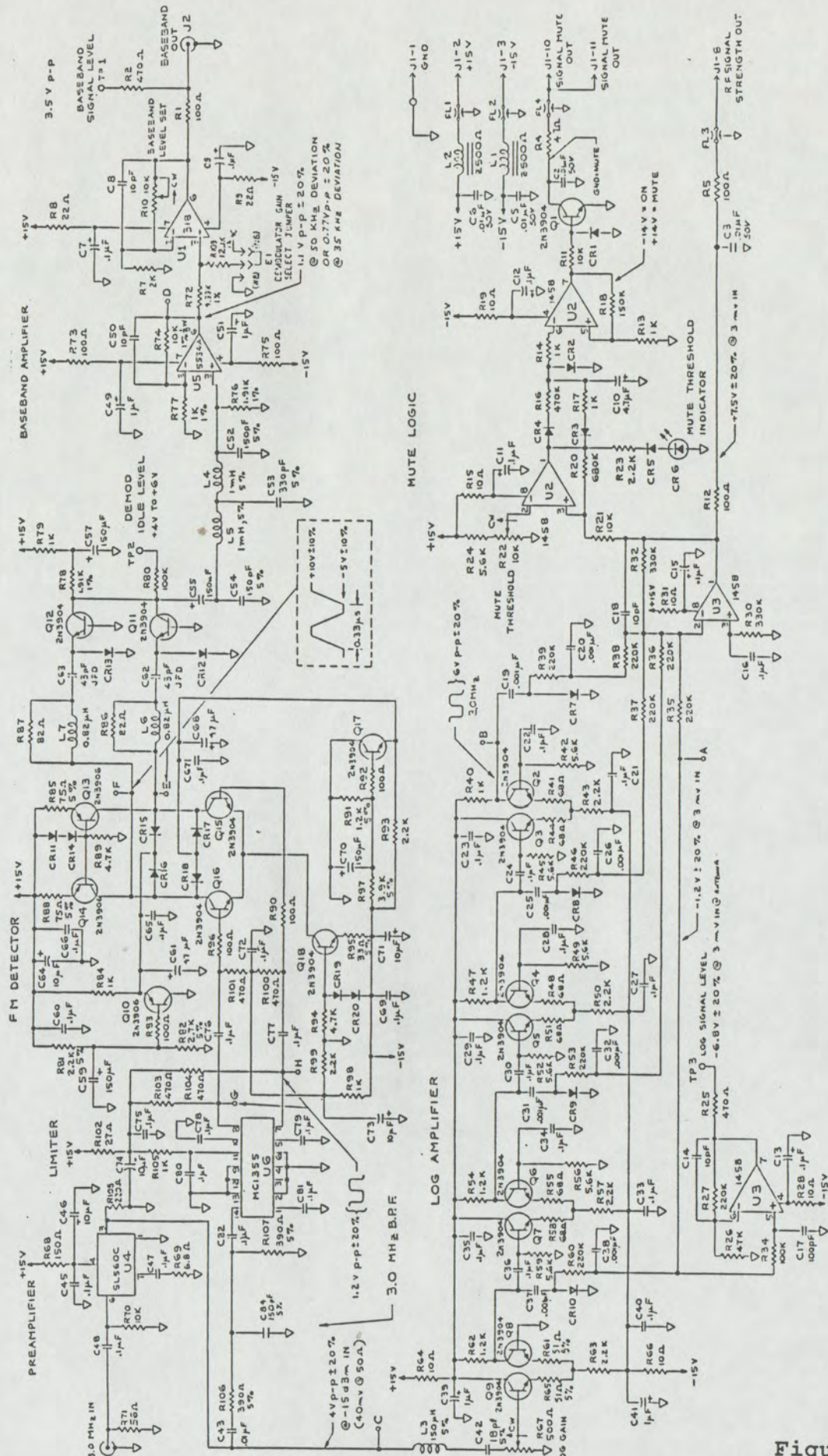


Figure 7-31
 FM Demod Schematic
 91D7387 Rev A

SECTION 8
PARTS LISTS

This section contains parts lists for components outlined in Section 4.

PARENT ITEM: 9205782

DESCRIPTION: ASSY TX AUDIO/PS PCL-6010
 ENG. DRAWING NO.: 2003023 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	3090529	CONN 3 PIN SNGL ROW RTANG HDR J1	87232-3	1
	3091139	CONN 6PIN HDR BRKAWAY LKG .156 P1,P2	MLSS156-6	2
	3091147	CONN 20PIN BREAK-AWAY STR HDR P3,P4,P5,P6,E2,E3,E4,E5, E7	MFSS100-20-XXXB	3
	3150166	SW RTRY DP12T PC MT ADJ STOP S2	0102XC30B12UPJA	1
	3160223	SW TGL DPDT ON-NONE-ON S1	7201-L41-H3-AV2	1
	3250016	SKT DUAL IN LINE 8 PIN U2,U3,U4,U5,U6,U7,U8,U9, U10,U11,U12,U13,U14	640463-1	13
	3250024	SKT DUAL IN LINE 14 PIN U1	640357-1	1
	3250917	JUMPER MINI FOR 2 PINS=.025/.1 E2,E3,E4,E5,E7	65474-001	5
	3600145	DIO 1N4154 25V 4NS SI D035 CR14,CR15,CR16,CR17	1N4154	4
	3610003	DIO 1002 200V 1A SI D039 CR2,CR3,CR4,CR5,CR6,CR7, CR8,CR9,CR10,CR11,CR12, CR13,CR18,CR19	1002	14
	3610076	DIO BRIDGE 100V 2A CR1	MDA-201	1
	3630456	XT 2N3904 Q3	2N3904	1
	3650173	RGLTR UA7805UC 05V 1.0A T0220 VR3	UA7805UC	1
	3650207	RGLTR UA7815UC 15V 1.5A T0220 VR2	7815UC	1
	3650215	RGLTR UA7912UC 12V 1.5A T0 220 VR4	7912UC	1
	3650223	RGLTR UA7915UC 15V 1.5A T0220 VR1	7915UC	1
	3660701	IC SN74LS10 TR 3IN NAND U1	SN74LS10N	1
	3730215	IC LM1458N OPAMP DUAL U12,U13,U14	LM-1458N	3
	3730728	IC NE5534AN OPAMP LO NOISE U4	NE-5534AN	1
	3730967	IC DUAL OP AMP U2,U3,U5,U6,U7,U8,U9,U11	NE5532AN	8
	3730983	IC LM358N U10	LM358N	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4020467	FERROX CUBE 500 OHM L1,L2,L3,L4,L5,L6,L7,L8, L9,L10,L11,L12	VK200 10/38	12
	4210035	CAP MICA DIP 3PF +/- 0.5 C78,C79	DM-15-0300	2
	4210043	CAP MICA DIP 5PF +/- 0.5 C19,C25,C28,C32,C43,C59, C63,C65,C69	DM-15-0500	9
	4210100	CAP MICA DIP 22PF 5% C42	DM-15-220J	1
	4210183	CAP MICA DIP 47PF 5% C77	DM-15-470J	1
	4210266	CAP MICA DIP 100PF 5% C85	DM-15-101J	1
	4210308	CAP MICA DIP 150PF 5% C33,C37,C72,C73	DM-15-151J	4
	4250718	CAP POLYCARB .01/100 1% C40,C44,C48,C50,C52,C55, C56,C57,C61	25U8103F	9
	4260287	CAP LYTIC 2700/35V C4,C5,C6,C7,C8	LP2725035CIP3	5
	4260046	CAP TANT EPOX-DIP 2.2/35V 20% C1,C2,C3,C9,C15,C18,C82, C83,C84,C103,C104	199D225X0035JA1	11
	4280079	CAP TANT EPOX-DIP 10/25V 20% C14,C23,C80,C81	199D106X0025KA1	4
	4260137	CAP TANT EPOX-DIP 47/20V C86	199D476X0020PE4	1
	4260186	CAP TANT EPOX-DIP 220/10V 10% C150,C151	K220E10	2
	4310264	CAP .1 50V 25U 20% C10,C11,C12,C20,C21,C24,C26, C29,C30,C31,C36,C38,C39,C41, C47,C49,C51,C53,C54,C58,C60, C62,C67,C68,C70,C71,C93,C95, C99,C100,C101,C102,C105,C113, C114,C115,C116,C117,C118,C119, C120	5020ES50RD104M	41
	4310272	CAP .01 50V X7R 10% C13,C16,C17,C27,C35,C64,C66, C74,C75,C76,C87,C88,C89,C90, C91,C92,C94,C96,C97	5018EM50RD103K	19
	4310280	CAP .001 100V C22,C34	C315C102MIR5CA	2
	4460010	RES 10 OHM 1/4W 5% R12,R18,R25,R30,R43,R54,R56, R58,R62,R66,R67,R74,R80,R85, R97,R98,R106,R107,R122,R123, R124,R127,R169,R172,R176, R180	RC07GF100J	26
	4460051	RES 100 OHM 1/4W 5% R15,R17,R23,R24,R35,R91, R109,R112,R134,R138,R139, R140,R141,R142,R167,R177, R181	RC07GF101J	17

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4460077	RES 220 OHM 1/4W 5% R92	RC07GF221J	1
	4460119	RES 470 OHM 1/4W 5% R37,R137,R147	RCR07G471J	3
	4460135	RES 680 OHM 1/4W 5% R185,R188	RC07GF681J	2
	4460143	RES 1K OHM 1/4W 5% R3,R26,R31,R33,R39,R41,R42, R119,R130,R132,R148,R149, R152,R154,R156,R158,R170, R183	RC07GF102J	18
	4460192	RES 2.2K OHM 1/4W 5% R11,R90,R104,R110	RC07GF222J	4
	4460200	RES 2.7K OHM 1/4W 5% R36	RC07GF272J	1
	4460226	RES 3.3K OHM 1/4W 5% R135	RC07GF332J	1
	4460242	RES 4.7K OHM 1/4W 5% R32,R34,R44,R46	RC07GF472J	4
	4460259	RES 5.6K OHM 1/4W 5% R175,R179	RC07GF562J	2
	4460275	RES 6.8K OHM 1/4W 5% R88	RC07GF682J	1
	4460317	RES 10K OHM 1/4W 5% R1,R2,R14,R111,R114,R116, R117,R118,R120,R121,R125, R126,R129,R168,R171,R174, R186,R187,R189	RC07GF103J	19
	4460341	RES 15K OHM 1/4W 5% R173,R184	RC07GF153J	2
	4460374	RES 22K OHM 1/4W 5% R48,R178,R182	RC07GF223J	3
	4460382	RES 27K OHM 1/4W 5% R150	RC07GF273J	1
	4460481	RES 100K OHM 1/4W 5% R16,R22,R115,R133	RC07GF104J	4
	4460523	RES 220K OHM 1/4W 5% R128	RC07GF224J	1
	4460655	RES 120 OHM 1/4W 5% R136	RC07GF121J	1
	4460663	RES 750 OHM 1/4W 5% R63	RC07GF751J	1
	4460754	RES 22 OHM 1/4W 5% R4	RC07GF220J	1
	4460788	RES 47 OHM 1/4W 5% R108	RC07GF470J	1
	4460820	RES 180 OHM 1/4W 5% R5	RC07GF181J	1
	4460838	RES 330 OHM 1/4W 5% R89	RC07GF331J	1
	4460853	RES 820 OHM 1/4W 5% R50,R59	RC07GF821J	2

REF COMPONENT NBR ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
4461042	RES 2K OHM 1/4W 5% R27	RC07GF202J	1
4500005	RES 97.6 OHM 1/8W .1% R72	RN55E97R6B	1
4500013	RES 931 OHM 1/8W .1% R71	RN55E9310B	1
4500021	RES 459 OHM 1/8W .1% R69	RN55E4590B	1
4500039	RES 340 OHM 1/8W .1% R57	RN55E3400B	1
4500047	RES 732 OHM 1/8W .1% R55	RN55E7320B	1
4500054	RES 1.42K 1/8W .1% R68	RN55E1421B	1
4500062	RES 1.56K 1/8W .1% R70	RN55E1561B	1
4500112	RES 4.99K OHM 1/8W .1% R10,R13,R79,R81,R82,R83, R84,R102	RN55E4991B	8
4510004	RES 200 OHM 1/8 W 1% R101	RN55E2000F	1
4510061	RES 1.02K 1/8W 1% R7,R9,R94,R96	RN55C1021F	4
4510087	RES 4.12K OHM 1/8W 1% R36	RN55E4121F	1
4510103	RES 4.99K OHM 1/8W 1% R53	RN55E4991F	1
4510145	RES 10.0K OHM 1/8W 1% R19,R20,R143	RN55C1002F	3
4510160	RES 20.0K OHM 1/8W 1% R21,R73	RN55E2002F	2
4510269	RES 107K OHM 1/8W 1% R99,R100	RN55C1073F	2
4510293	RES 2.00K OHM 1/8W 1% R8	RN55C2001F	1
4510301	RES 1.00K OHM 1/8W 1% R51,R52,R60,R61,R64,R65, R87	RN55D1001F	7
4510640	RES 600 OHM 1/8W 1% R105	RN55E6000F	1
4510657	RES 22.1K OHM 1/8W 1% R93,R95	RN55E2212F	2
4510707	RES 10.7K OHM 1/8W 1% R145	RN55E1072F	1
4510715	RES 11.3K OHM 1/8W 1% R144,R146	RN55E1132F	2
4511184	RES 121 OHM 1/8W 1% R151,R153,R155,R157	RN55C1210F	4
4630160	POT CER PC PIN 5K OHM .5W 25T R47,R286	3299W-1-502	2
4630273	POT CER PC PIN 10K OHM .5W 25T R28,R29,R40,R131,R159,R160, R161,R162,R163,R164,R165, R166,R199	3299W-1-103	13

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4630745	POT CER PC PIN 2K OHM .5W 25T R6,R45,R77	64W202	3
	4630901	POT CER PC PIN 200 OHM .5W 25T R49,R75,R76	3299W-1-201	3
	4631008	POT CER PC PIN 500 OHM .5W R78	3299W-1-501	1
1	3474442	PCB TX AUDIO/PWR SPLY 6010	51D6106 PLT 3	1
2	2064525	BRKT RGLTR HEATSINK PCL-6000	05B3323 PLT 2	1
3	1231547	STDF 1/4 HEX 4-40 X 1-5/8 BRSS	8230-8-0440-28	6
4	1050129	SCR PNH PHPS 4-40 X 1/4 SST		12
7	1050665	WSHR SHLDR #4 NYL	B51547F019	4
8	1290188	SIL PAD	7403-09-FR-51	4
9	1641927	W BUSS 22GA	298	
10	1560234	TBG TEFLON 22AWG NAT	TFT200-22	

PARENT ITEM: 9302670

DESCRIPTION: ASSY RF MODULE TX PCL-6010
 ENG. DRAWING NO.: 2003020 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	3090230	CONN SMB PC RT ANG MALE BLKHD J1,J2	2110-1511-000	2
	3090529	CONN 3 PIN SNGL ROW RTANG HDR TP6,TP7,TP8,TP9	87232-3	4
	3111119	CONN SHORTING PLUG RED P1,P2,P3,P4	461-2871-020312	4
	3150117	SW 16P BCD ROT OUTPUT "YELLOW" S1,S2,S3	2300576	3
	3250016	SKT DUAL IN LINE 8 PIN U3	640463-1	1
	3250032	SKT DUAL IN LINE 16 PIN U2	640358-1	1
	3250081	SKT DUAL IN LINE 28 PIN U1	640362-1	1
	3250495	SKT PIN .08500X.200L GOLD FIN Y1,Y2,P1,P2,P3,P4	450-3286-01-03	16
	3290046	TEST PT RED VERT TP1,TP2,TP4	105-0852-001	3
	3291069	FILTER FD-THRU TYPE20 NO/HDWR FL1,FL2,FL3,FL4,FL5, FL6,FL7,FL8,FL9	859619-1	9
	3340841	XTAL RX 3.200MHZ SYNTH/2ND LO Y1	30A0083 A	1
	3341062	XTAL TX PCL-606 102.00 MHZ Y2	30A0093-1 B	1
	3350147	OVEN XTAL HR1,HR2	PCL-1-16-12-65	2
	3350188	MIXER SRA-12 HY1	SRA-12	1
	3350394	ATTENUATOR 3DB PC MT DC-1.5GHZ AT2	MAT-3	1
	3350402	FILTER HELICAL 1015 MHZ 3 POLE FL10	302HN-071B	1
	3350410	FILTER HELICAL 910MHZ 2 POLE FL12	2524A-1568F	1
	3350428	FILTER HELICAL 904MHZ 3 POLE FL11	P302HA-018B	1
	3350436	ATTENUATOR 6DB PC MT DC-1.5GHZ AT3	MAT-6	1
	3390127	LED RED 2.0x20 WIDE DIFFUSED CR1	FLV160	1
	3600145	DIO 1N4154 25V 4NS SI D035 CR2,CR3,CR4,CR7	1N4154	4
	3610045	DIO 5082-2835 FAST CR8,CR10	5082-2835	2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	3610243	D10 5082-0180 CR9	HP 5082-0180	1
	3610250	D10 30V 6/30 PF TU92 MV209 CR5,CR6	MV209	2
	3630001	XT NS2N918 .4W600M030V50M2P Q1,Q2	2N918	2
	3630308	XT NS2N5179 .2W900M020V50M1P Q6	2N5179	1
	3640307	XT U310 Q3,Q5,Q8	U310	3
	3640315	XT FET J310 Q4,Q7	J310	2
	3640422	XT MRF 581 Q9,Q10	MRF 581	2
	3650074	RGLTR LM340T12/7812 VARV1.5A VR1	LM340T-12	1
	3730967	IC DUAL OP AMP U3	NE5532AN	1
	3731056	IC MC145152P FREQ SYNC CONT. U1	MC145152P	1
	3731080	IC SP8647B DUAL MOD 10/11 U2	SP8647B	1
	3731171	IC HYBRID LIN AMP AR1	MWA 320	1
	3731338	IC HYBRID AMP MWA 130 AR3	MWA-130	1
	3731445	IC HYBRID AMP MWA 330 AR4	MWA-330	1
	3731478	IC AMP .5-1000MHZ 180B SHIELD AR2	MAN-2	1
	3731486	IC AMP DC-1GHZ MONOLITHIC YLW AR5	MAR-4	1
	4020368	FERROX-CUBE 850 OHM L3,L12	VK 200 20/48	2
	4020467	FERROX CUBE 500 OHM L2,L14,L17	VK200 10/38	3
	4020640	IDCTR MINI-RED .1 UH 5% L10,L15,L16	MR .10 5%	3
	4020707	IDCTR MINI-RED .47UH 5% L11	MR .47 5%	1
	4020723	IDCTR MINI-RED 120 UH 5% L1	MR 120 5%	1
	4020806	IDCTR 31.5NH 5% 1.5T BROWN L8	132-01	1
	4020871	IDCTR 79NH 5% 6.5T BLUE L5,L6	132-06	2
	4020897	IDCTR 117NH 5% 8.5T GRAY L7	132-08	1
	4020905	IDCTR 410NH 5% 16.5T BLUE L4	132-16	1
	4020913	IDCTR 158NH 5% 10.5T BLACK L13	132-10	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4100038	XFMR MCL T4-1 T1	MCL T4-1	1
	4200002	CAP MICA DIP 5PF +/- 0.5 C48,C76	DM-5-050D	2
	4200028	CAP MICA DIP 8PF +/- 0.5 C44	DM-5-080D	1
	4200069	CAP MICA DIP 100PF 5% C46	DM-5-101J	1
	4200127	CAP MICA DIP 18 PF 5% C49	DM-5-180J	1
	4200135	CAP MICA DIP 43 PF 5% C52	DM-5-430J	1
	4200150	CAP MICA DIP 24 PF 5% C51	DM-5-240J	1
	4200184	CAP MICA DIP DM05 33PF C23,C43	DM-5-330J	2
	4200192	CAP MICA DIP 22PF 5% C47	DM-05-220J	1
	4200226	CAP MICA DIP 51PF 5% C50	DM-5-510J	1
	4210373	CAP MICA DIP 240PF 5% C4	DM-15-241J	1
	4210530	CAP MICA DIP 820PF 5% C3	DM-15-821J	1
	4280038	CAP TANT EPOX-DIP 1/35V 20% C19	199D105X0035HA1	1
	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C2,C5,C6,C15,C20,C57	199D225X0035JA1	6
	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C10,C18	199D475X0035JA1	2
	4280079	CAP TANT EPOX-DIP 10/25V 20% C17	199D106X0025KA1	1
	4280095	CAP TANT EPOX-DIP 22/35V 10% C14,C21,C26	199D226X9035PE4	3
	4280160	CAP TANT EPOX-DIP 100/20V. C24,C33,C35	199D107X0020TE4	3
	4300117	CAP N750 20PF 100V +/-5% TOL. C68	DD104B10N750200	1
	4300307	CAP DISC N750 8.2PF +/-0.5PF C67	DD05B10N7508R2D	1
	4310264	CAP .1 50V Z5U 20% C38	5020ES50RD104M	1
	4310272	CAP .01 50V X7R 10% C1,C7,C8,C9,C12,C13,C16, C22,C40,C53,C54,C55,C80, C81,C82	5018EM50RD103K	15
	4310280	CAP .001 100V C41,C45,C58,C61,C66,C69,C70, C72,C73,C74,C75	C315C102MIR5CA	11
	4350401	CAP CHIP 100PF 5% P90 C27	100B101JP500X	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4350419	CAP CHIP 220PF 5% P90 C32,C77,C78,C79	100B221JP200X	4
	4350427	CAP CHIP 5.1PF +/- .25PF P90 C100	100B5R1CP500X	1
	4350575	CAP CHIP 47 PF 5% P90 C29	100B470JP500X	1
	4350591	CAP CHIP 10PF 5% P90 C28	100B100JP500X	1
	4350666	CAP CHIP .001 UF 5% P90 C36	100B102JP50X	1
	4350623	CAP CHIP .01UF 20% C25,C34	200B103MP50X	2
	4350831	CAP CHIP 130 PF 5% P90 C31	100B131JCA300X	1
	4370219	CAP 1-14PF C60,C63,C64	8053	3
	4370268	CAP VAR PC MT 5-60PF C11	2810000560QND2F	1
	4370300	CAP 4-10PF C87	278-0410-005	1
	4370359	CAP VAR 1.0-60PF GLASS EMBBAND C30	TP60C	1
	4370425	CAP VAR SURFACE MT 1-4PF C56	GKZ4R000	1
	4420154	RES 120 OHM 1/2W 10% R75	RC20GF121K	1
	4420170	RES 180 OHM 1/2W 10% R73,R74	RC20GF181K	2
	4460010	RES 10 OHM 1/4W 5% R67	RC07GF100J	1
	4460051	RES 100 OHM 1/4W 5% R1,R2,R3,R45	RC07GF101J	4
	4460085	RES 240 OHM 1/4W 5% R12	RC07GF241J	1
	4460093	RES 300 OHM 1/4W 5% R47	RC07GF301J	1
	4460119	RES 470 OHM 1/4W 5% R15,R58	RCR07G471J	2
	4460143	RES 1K OHM 1/4W 5% R4,R5,R8,R19,R20,R21,R24,R27, R32,R34,R39,R52,R62	RC07GF102J	13
	4460192	RES 2.2K OHM 1/4W 5% R35,R36,R41	RC07GF222J	3
	4460200	RES 2.7K OHM 1/4W 5% R61,R70	RC07GF272J	2
	4460218	RES 3K OHM 1/4W 5% R23	RC07GF302J	1
	4460242	RES 4.7K OHM 1/4W 5% R54,R71	RC07GF472J	2
	4460275	RES 6.8K OHM 1/4W 5% R17,R30,R55,R72	RC07GF682J	4

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4460317	RES 10K OHM 1/4W 5% R10,R11,R13,R28,R40,R49,R51, R63	RC07GF103J	8
	4460408	RES 30K OHM 1/4W 5% R18	RC07GF363J	1
	4460457	RES 50K OHM 1/4W 5% R29,R31	RC07GF563J	2
	4460481	RES 100K OHM 1/4W 5% R38	RC07GF104J	1
	4460614	RES 33 OHM 1/4W 5% R59,R64	RC07GF330J	2
	4460630	RES 1.2K 1/4W 5% R25	RC07GF122J	1
	4460648	RES 75 OHM 1/4W 5% R53	RC07GF750J	1
	4460655	RES 120 OHM 1/4W 5% R42,R68	RC07GF121J	2
	4460671	RES 270 OHM 1/4 5% R48	RC07GF271J	1
	4460697	RES 3.9K OHM 1/4W 5% R22	RC07GF392J	1
	4460747	RES 15 OHM 1/4W 5% R46	RC07GF150J	1
	4460754	RES 22 OHM 1/4W 5% R6,R16	RC07GF220J	2
	4460812	RES 150 OHM 1/4W 5% R7	RC07GF151J	1
	4460820	RES 180 OHM 1/4W 5% R50,R60	RC07GF181J	2
	4460853	RES 820 OHM 1/4W 5% R14,R69	RC07GF821J	2
	4460861	RES 82K OHM 1/4W 5% R9	RC07GF823J	1
	4470357	RES 130 OHM 1/2 W 5% R65	RC20GF131J	1
	4470365	RES 22 OHM 1/2W 5% R57	RC20GF220J	1
	4510004	RES 200 OHM 1/8 W 1% R43,R44	RN55E2000F	2
	4590311	THERMISTOR 680 OHM 10% R56	1K681K	1
	4630273	POT CER PC PIN 10K OHM .5W 25T R33,R37	3299W-1-103	2
	4630745	POT CER PC PIN 2K OHM .5W 25T R66	64W202	1
1	3474418	PCB TX RF MODULE 6010	51D6103	PLT 4 1
2	2092476	FRAME RF MODULE TX 6010	05D3316	PLT 2 1
3	2092534	FRAME BASE PCL-6010/6020/6030	05C3334	PLT 2 1
4	2092559	ASSY MODULE COVER RF MOD 6000	05C3342	PRE 1
5	2092492	COVER TOP RF MODULE 6000	05C3320	PLT 2 1
6	2064574	SHIELD RF COMP SIDE PCL-6000	05B3328	PLT 2 1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
7	1050434	SCR FLH SKT CAP 4-40 X 5/16 SS		2
8	1050129	SCR PNH PHPS 4-40 X 1/4 SST		3
9	1050590	NUT HEX 4-40 1/4 FLATS SST		1
10	1050632	WSHR LK #4 SR CD PL		1
11	1050665	WSHR SHLDR #4 NYL	851547F019	1
12	1290188	SIL PAD	7403-09-FR-51	1
13	1310093	CLIP MODULE PCL-606/6000	05C2882 B	16
14	1670066	CA COAX RG-174/U 50 OHM Z1	RG-174/U	
15	1670165	CA COAX EL-BEND .086 DIA Z2,Z3	HC70000-1	1
16	3091147	CONN 20PIN BREAK-AWAY STR HDR SWO	MFSS100-20-XXXB	
17	3250917	JUMPER MINI FOR 2 PINS=.025/.1 SWO	65474-001	2
18	1230663	FSTNR CHAS	81591B-11	2

PARENT ITEM: 9302621

DESCRIPTION: ASSY RFA 960 MHZ PCL-600
 ENG. DRAWING NO.: 2002937-1 D

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.		QUANTITY PER
1	3473824	PCB RFA 960 MHZ	51C6042	C	1
2	2091957	COVER ENCL RFA	0583118	B	1
3	2110385	HEATSINK RFA 960 MHZ	0503120	C	1
4	2091965	PLATE INPUT ENCL RFA	0583119	B	1
5	2091981	PLATE OUTPUT ENCL RFA	0583149	B	1
7	2091973	PLATE COVER DIR COUPLER	0583121	B	1
8	3473832	PCB DIRECTIONAL COUPLER	5186049	A	1
9	4350070	CAP FD THRU 470PF 20% C701,C702,C721,C722	54-804-002-471M		4
10	3030178	CONN TYPE N RCPT 1/8 DIA HOLES J702	UG-58	A/U	1
11	3030400	CONN SMB BLKHD STR ML SLDR POT J701	2019-1511-000		1
12	3650363	RGLTR VARV 5.0A T03 VR1	LM338-K-STEEL		1
13	1290162	SIL PAD VR1	7403-09-FR-05		1
14	1250190	COVER INSULATING T0-3 VR1	A22-2003		1
15	3610284	DIO BRIDGE 100V/25A CR101	MDA2501		1
16	3731189	IC HI GAIN RF PWR AMP AR1	MMW808A3		1
17	3610045	DIO 5082-2835 FAST CR1,CR2	5082-2835		2
18	4020368	FERROX-CUBE 850 OHM L1,L2,L3,L4	VK 200 20/48		4
19	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C15,C16	1990225X0035JA1		2
20	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C2,C4,C6	1990475X0035JA1		3
21	4350898	CAP CHIP 3.9PF +/- .25PF P90 C8,C9	100B3R9CP500X		2
22	4350161	CAP .01UF CHIP C1,C3,C5,C7,C10	W100BF103MP		5
23	4630018	POT CER PC PIN 200 OHM .5W R1	3386R-1-201		1
24	4590022	RES .16 OHM 2W 5% R2	BWH .16 2W 5%		1
25	4460143	RES 1K OHM 1/4W 5% R4,R5	RC07GF102J		2
26	4450037	RES 51 OHM 1/8W 5% R3,R6	RC05GF510J		2
27	3250214	SKT XSTR/LAM	LST2202-2		1
28	1090633	BSHG MS-10 NYL #6	B51547F002		4

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
29	1090471	SCR PNH PHPS #6 X 1/2 TYP B		2
30	1050103	SCR PNH PHPS 4-40 X 3/16 SS		2
31	1050798	LUG LKG #4 PREFORMED	T-233	2
32	3290582	TERM	1300T-4.5	1
33	1050574	SCR SCH 4-40 X 3/8 SST		11
34	1090539	SCR SCH 6-32 X 3/8 SST		2
35	1050889	WASHER, BELLEVILLE, CONICAL #4	5808-73-20	11
36	1090851	WSHR BELLEVILLE CONICAL #6	5808-87-25	2
37	1090604	WSHR FL #6 CD PL	AN960-6 CAD 1	2
38	1050640	WSHR FL #4 CD PL	MW-401	11
39	1050871	SCR SCH CAP 4-40 X 7/16		6
40	1050632	WSHR LK #4 SR CD PL		10
41	1050129	SCR PNH PHPS 4-40 X 1/4 SST		14
42	1640416	W STRD 22GA YELLOW	8U-730-22#4	
43	1050525	SCR FLH SLTD 4-40 X 1 SST		4
44	2063675	BRACKET MTG	610	1
45	1130129	SCR PNH PHPS 8-32 X 3/4 SST		1
46	1560234	TBG TEFLON 22AWG NAT	TFT200-22	

PARENT ITEM: 9205774

DESCRIPTION: ASSY RX AUDIO/PS NEUTER 6000
 ENG.DRAWING NO.: 20D3024-0 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
	3090693	CONN 20 PIN DBL ROW STR HDR P7	1-87227-0	1
	3091139	CONN 6PIN HDR BRKAWAY LKG .156 P1	MLSS156-6	1
	3091147	CONN 20PIN BREAK-AWAY STR HDR P2,P3,P4,P5,P6,E1,E2,E3,E4, E5,E6,E7,E8,E9,E10,E11,J1	MFSS100-20-XXXB	4
	3150166	SW RTRY DP12T PC MT ADJ STOP S2	0102XC30B12UPJA	1
	3160231	SW TGL SPST ON-NONE-MOM PC MT S1	7108-L41H3AV2QE	1
	3250016	SKT DUAL IN LINE 8 PIN U2,U3,U4,U5,U6,U7,U8,U9,U10, U11,U12,U13,U14,U15,U16,U17, U18,U19,U20	640463-1	19
	3250024	SKT DUAL IN LINE 14 PIN U1	640357-1	1
	3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1,E2,E3,E4,E5,E6,E7,E8,E9, E10,E11,P7-1,P7-2	65474-001	13
	3270394	RELAY 4PDT 12V K1	DS4E-S-DC12V	1
	3600145	DIO 1N4154 25V 4NS SI D035 CR15,CR16,CR17,CR18	1N4154	4
	3610003	DIO 10D2 200V 1A SI D039 CR2,CR3,CR4,CR5,CR6,CR7, CR8,CR9,CR10,CR11,CR12, CR13,CR14	10D2	13
	3610078	DIO BRIDGE 100V 2A CR1	MDA-201	1
	3630456	XT 2N3904 Q1,Q2	2N3904	2
	3650173	RGLTR UA7805UC 05V 1.0A T0220 VR3	UA7805UC	1
	3650207	RGLTR UA7815UC 15V 1.5A T0220 VR2	7815UC	1
	3650215	RGLTR UA7912UC 12V 1.5A T0 220 VR4	7912UC	1
	3650223	RGLTR UA7915UC 15V 1.5A T0220 VR1	7915UC	1
	3660917	IC SN75451P DU AND HIGHV OC U16	SN754518P	1
	3660925	IC SN754528P DU NAND HIGHV OC U15	SN754528P	1
	3730173	IC LM318N OPAMP HISPEED U2,U3,U4,U5	LM-318N	4

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	3730215	IC LM1458N OPAMP DUAL U17,U18,U20	LM-1458N	3
	3730728	IC NE5534AN OPAMP LO NOISE U8,U13,U14	NE-5534AN	3
	3730934	IC HI-200-5 DUAL SPST CMOS SW U1	HI3-0200-5	1
	3730967	IC DUAL OP AMP U6,U7,U9,U10,U11,U12,U19	NE5532AN	7
	4020038	IDCTR MINI-RED 2.2 MH 5% L17	MR 2200 5%	1
	4020053	IDCTR MINI-RED 4.7 MH L8	MR 4700	1
	4020061	IDCTR MINI-RED 10 MH 5% L15,L16	MR 10,000 5%	2
	4020467	FERROX CUBE 500 OHM L1,L2,L3	VK200 10/38	3
	4041059	ASSY 30.89MH CUP CORE COIL L5	02C1400-124 E	1
	4041067	ASSY 39.56MH CUP CORE COIL L7	02C1400-125 E	1
	4210035	CAP MICA DIP 3PF +/- 0.5 C99,C107	DM-15-030D	2
	4210043	CAP MICA DIP 5PF +/- 0.5 C15,C26,C49,C54,C86,C89	DM-15-050D	6
	4210100	CAP MICA DIP 22PF 5% C30,C79,C96	DM-15-220J	3
	4210183	CAP MICA DIP 47PF 5% C106	DM-15-470J	1
	4210233	CAP MICA DIP 75PF 5% C125	DM-15-750J	1
	4210266	CAP MICA DIP 100PF 5% C105	DM-15-101J	1
	4210290	CAP MICA DIP 130PF 5% C19	DM-15-131J	1
	4210357	CAP MICA DIP 220PF 5% C23	DM-15-221J	1
	4210381	CAP MICA DIP 250PF 5% C126	DM-15-251J	1
	4210506	CAP MICA DIP 680PF 5% C24	DM-15-681J	1
	4210548	CAP MICA DIP 910PF 5% C25	DM-15-911J	1
	4210555	CAP MICA DIP 10PF 5% C33,C77,(C260-NOT ON SILKSCREEN)	DM15-100J	3
	4220018	CAP MICA DIP 1000PF 5% C18,C20	DM-19-102J	2
	4220026	CAP MICA DIP 1100PF 5% C27	DM-19-112J	1
	4220174	CAP MICA DIP 2870PF 2% C28	DM-19-F2871G	1
	4220232	CAP MICA DIP 8200PF 5% C22	DM-19-822J	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4250718	CAP POLYCARB .01/100 1% C29,C34,C37,C38,C39,C63, C64,C66,C67	25UB103F	9
	4260287	CAP LYTIC 2700/35V C4,C5	LP2725035CIP3	2
	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C1,C2,C3,C6,C9,C10,C11,C46, C55,C80,C81,C94,C95,C103, C104,C109	199D225X0035JA1	16
	4280079	CAP TANT EPOX-DIP 10/25V 20% C100,C101	199D106X0025KA1	2
	4280095	CAP TANT EPOX-DIP 22/35V 10% C52,C53,C56,C57	199D226X9035PE4	4
	4260137	CAP TANT EPOX-DIP 47/20V C92,C110	199D476X0020PE4	2
	4260160	CAP TANT EPOX-DIP 100/20V C61,C62	199D107X0020TE4	2
	4280178	CAP TANT EPOX-DIP 150/15V 20% C90,C91	199D157X0015TE4	2
	4310264	CAP .1 50V 25U 20% C7,C8,C12,C13,C14,C16,C17, C21,C31,C32,C35,C36,C40, C41,C42,C43,C44,C47,C48, C50,C51,C58,C59,C65,C68, C69,C82,C83,C85,C88,C97, C98,C127,C128,C129,C130, C131,C132,C133,C134,C135, C136,C137,C138,C139,C140	5020ES50RD104M	46
	4310272	CAP .01 50V X7R 10% C102,C108	5018EM50RD103K	2
	4310280	CAP .001 100V C45,C78,C93	C315C102MIR5CA	3
	4420147	RES 100 OHM 1/2W 10% R146	RC20GF101K	1
	4460010	RES 10 OHM 1/4W 5% R2,R3,R5,R8,R15,R17,R18,R24, R29,R31,R33,R37,R43,R44,R50, R55,R56,R59,R69,R79,R81,R84, R87,R95,R101,R104,R109,R112, R114,R118,R137,R138,R141, R144,R145,R181	RC07GF100J	36
	4460051	RES 100 OHM 1/4W 5% R63,R64,R67,R91,R93,R125, R126,R127,R190,R193,R194	RC07GF101J	11
	4460119	RES 470 OHM 1/4W 5% R53,R92,R130,R161,R187	RCR07G471J	5
	4460135	RES 680 OHM 1/4W 5% R38,R45,R51	RC07GF681J	3
	4460143	RES 1K OHM 1/4W 5% R1,R4,R11,R14,R39,R54,R122, R131,R132,R135,R139,R140, R143,R157,R158,R159,R160, R162,R184,R191,R195	RC07GF102J	21

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4460168	RES 1.5K OHM 1/4W 5% R66	RC07GF152J	1
	4460192	RES 2.2K OHM 1/4W 5% R6,R13,R16,R58,R60,R71,R133, R142	RC07GF222J	8
	4460226	RES 3.3K OHM 1/4W 5% R198,R206	RC07GF332J	2
	4460242	RES 4.7K OHM 1/4W 5% R9,R10,R65,R85,R115, R117,R134	RC07GF472J	7
	4460259	RES 5.6K OHM 1/4W 5% R19,R110	RC07GF562J	2
	4460291	RES 8.2K OHM 1/4W 5% R163	RC07GF822J	1
	4460317	RES 10K OHM 1/4W 5% R21,R41,R42,R46,R47,R48, R49,R57,R70,R155,R156,R177, R178,R180,R182,R183,R185, R188	RC07GF103J	18
	4460325	RES 12K OHM 1/4W 5% R204	RC07GF123J	1
	4460341	RES 15K OHM 1/4W 5% R40	RC07GF153J	1
	4460374	RES 22K OHM 1/4W 5% R100	RC07GF223J	1
	4460473	RES 91K OHM 1/4W 5% R207	RCR07G913J	1
	4460481	RES 100K OHM 1/4W 5% R52,R68,R128,R129,R179,R189	RC07GF104J	6
	4460523	RES 220K OHM 1/4W 5% R192	RC07GF224J	1
	4460580	RES 360 OHM 1/4W 5% R203	RC07GF361J	1
	4460655	RES 120 OHM 1/4W 5% R197	RC07GF121J	1
	4460663	RES 750 OHM 1/4W 5% R26	RC07GF751J	1
	4460820	RES 180 OHM 1/4W 5% R136	RC07GF181J	1
	4460838	RES 330 OHM 1/4W 5% R20	RC07GF331J	1
	4460853	RES 820 OHM 1/4W 5% R34,R76	RC07GF821J	2
	4500005	RES 97.0 OHM 1/8W .1% R32	RN55E97R0B	1
	4500021	RES 459 OHM 1/8W .1% R77	RN55E4590B	1
	4500039	RES 340 OHM 1/8W .1% R83	RN55E3400B	1
	4500047	RES 732 OHM 1/8W .1% R211	RN55E7320B	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4500054	RES 1.42K 1/8W .1% R74	RN55E1421B	1
	4500062	RES 1.56K 1/8W .1% R73	RN55E1561B	1
	4500088	RES 2.4K OHM 1/8W .1% R102,R105,R106,R107,R108, R152,R153,R154	RN55E2401B	8
	4500096	RES 1.5K OHM 1/8W .1% R103,R124	RN55E1501B	2
	4500104	RES 300 OHM 1/8W .1% R147,R201	RN55E3000B	2
	4510103	RES 4.99K OHM 1/8W 1% R62,R94,R97,R116,R123,(R285-NOT ON SILKSCREEN)	RN55E4991F	6
	4510145	RES 10.0K OHM 1/8W 1% R149,R150,R164	RN55C1002F	3
	4510160	RES 20.0K OHM 1/8W 1% R27	RN55E2002F	1
	4510293	RES 2.00K OHM 1/8W 1% R113,R119,R120,R121	RN55C2001F	4
	4510301	RES 1.00K OHM 1/8W 1% R25,R28,R35,R36,R75,R80, R96,R99	RN55D1001F	8
	4510624	RES 60.4 OHM 1/8W 1% R148,R151	RN55E60R4F	2
	4510707	RES 10.7K OHM 1/8W 1% R174	RN55E1072F	1
	4510715	RES 11.3K OHM 1/8W 1% R175	RN55E1132F	1
	4510814	RES 931 OHM 1/8W 1% R72	RN55E9310F	1
	4511184	RES 121 OHM 1/8W 1% R165,R173,R176	RN55C1210F	3
	4630166	POT CER PC PIN 5K OHM .5W 25T R88,R196	3299W-1-502	2
	4630273	POT CER PC PIN 10K OHM .5W 25T R7,R12,R61,R166,R167,R168, R169,R170,R171,R172,R186, R208	3299W-1-103	12
	4630331	POT CER PC PIN 20K OHM .5W 25T R90	3299W-1-203	1
	4630745	POT CER PC PIN 2K OHM .5W 25T R22,R89,R98	64W202	3
	4630785	POT CER PC PIN 1K OHM .5W 25T R111,R205	3299W-1-102	2
	4630901	POT CER PC PIN 200 OHM .5W 25T R30,R78,R82	3299W-1-201	3
	4631008	POT CER PC PIN 500 OHM .5W R23	3299W-1-501	1
1	3474459	PCB RX AUDIO/PWR SPLY 6000	5106107 PLT 4	1
2	2064525	BRKT RGLTR HEATSINK PCL-6000	05B3323 PLT 2	1
3	1231547	STDF 1/4 HEX 4-40 X 1-5/8 BRSS	8230-B-0440-28	6

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
4	1050129	SCR PNH PHPS 4-40 X 1/4 SST		12
7	1050665	WSHR SHLDR #4 NYL	851547F019	4
8	1290188	SIL PAD	7403-09-FR-51	4
9	1641927	W BUSS 22GA	298	

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PARENT ITEM: 9205816

DESCRIPTION: ASSY RX AUDIO/PS 80KHZ 6000
 ENG.DRAWING NO.: 20D3024-1 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
	4041109	ASSY 10.71MH CUP CORE COIL L9	02C1400-129 E	1
	4041422	ASSY 7.510MH CUP CORE COIL L11	02C1400-165 E	1
	4041984	ASSY 6.9MH CUP CORE COIL L10	02C1400-097 E	1
	4210225	CAP MICA DIP 68PF 5% C70	DM-15-680J	1
	4210340	CAP MICA DIP 200PF 5% C122	DM-15-201J	1
	4210381	CAP MICA DIP 250PF 5% C72	DM-15-251J	1
	4210399	CAP MICA DIP 270PF 5% C120	DM-15-271J	1
	4210415	CAP MICA DIP 330PF 5% C76,C87,C124	DM-15-331J	3
	4210423	CAP MICA DIP 360PF 5% C71	DM-15-361J	1
	4210449	CAP MICA DIP 430PF 5% C73	DM-15-431J	1
	4210464	CAP MICA DIP 500PF 5% C75	DM-15-501J	1
	4210480	CAP MICA DIP 560PF 5% C74	DM-15-561J	1
	4210548	CAP MICA DIP 910PF 5% C123	DM-15-911J	1
	4220133	CAP MICA DIP 2200PF 1% C121	DM-19-222F	1
	4220232	CAP MICA DIP 8200PF 5% C84	DM-19-822J	1
	4460242	RES 4.7K OHM 1/4W 5% R200,R202	RC07GF472J	2
1	9205774	ASSY RX AUDIO/PS NEUTER 6000	20D3024-0 PLT 2	1

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PARENT ITEM: 9150418

DESCRIPTION: SW OPTKIT PCL-6000 RX 115KHZ
ENG.DRAWING NO.: 2003024-2

REF COMPONENT NBR ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
9205808	ASSY RX AUDIO/PS 115KHZ 6000	2003024-2 PLT 3	1

PARENT ITEM: 9205808

DESCRIPTION: ASSY RX AUDIO/PS 115KHZ 6000
 ENG.DRAWING NO.: 20D3024-2 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
	4042115	ASSY 7.90MH CUP CORE COIL L9	02C1400-170 E	1
	4042123	ASSY 5.50MH CUP CORE COIL L11	02C1400-171 E	1
	4042131	ASSY 5.00MH CUP CORE COIL L10	02C1400-172 E	1
	4210092	CAP MICA DIP 20PF 5% C76	DM-15-200J	1
	4210191	CAP MICA DIP 51PF 5% C70	DM-15-510J	1
	4210274	CAP MICA DIP 110PF 5% C122	DM-15-111J	1
	4210308	CAP MICA DIP 150PF 5% C120	DM-15-151J	1
	4210324	CAP MICA DIP 180PF 5% C72,C124	DM-15-181J	2
	4210373	CAP MICA DIP 240PF 5% C87	DM-15-241J	1
	4210399	CAP MICA DIP 270PF 5% C71	DM-15-271J	1
	4210415	CAP MICA DIP 330PF 5% C73	DM-15-331J	1
	4210423	CAP MICA DIP 360PF 5% C75	DM-15-361J	1
	4210449	CAP MICA DIP 430PF 5% C74	DM-15-431J	1
	4210472	CAP MICA DIP 510PF 5% C123	DM-15-511J	1
	4220042	CAP MICA DIP 1200PF 5% C121	DM-19-122J	1
	4220257	CAP MICA DIP 6200PF 5% C84	DM-19-622J	1
	4460267	RES 6.2K OHM 1/4W 5% R200,R202	RC07GF622J	2
1	9205774	ASSY RX AUDIO/PS NEUTER 6000	20D3024-0 PLT 2	1

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PARENT ITEM: 9302688

DESCRIPTION: ASSY RF MODULE RX 940-960MHZ
 ENG.DRAWING NO.: 20D3022 PLT 2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
	1641927	W BUSS 22GA R73	298	.200
	3090230	CONN SMB PC RT ANG MALE BLKHD J1,J2,J3	2110-1511-000	3
	3090529	CONN 3 PIN SNGL ROW RTANG HDR TP8,TP9	87232-3	2
	3111119	CONN SHORTING PLUG RED P3,P4	461-2871-020312	2
	3150117	SW 16P BCD ROT OUTPUT "YELLOW" S1,S2,S3	2300576	3
	3250016	SKT DUAL IN LINE 8 PIN U3	640463-1	1
	3250032	SKT DUAL IN LINE 16 PIN U2	640358-1	1
	3250081	SKT DUAL IN LINE 28 PIN U1	640362-1	1
	3250495	SKT PIN .08500X.200L GOLD FIN Y1,Y2,P3,P4	450-3286-01-03	10
	3290046	TEST PT RED VERT TP1,TP4	105-0852-001	2
	3291069	FILTER FD-THRU TYPE20 NO/HWR FL1,FL2,FL3,FL4,FL5,FL6,FL7, FL8	859619-1	8
	3340841	XTAL RX 3.200MHZ SYNTH/2ND LD Y1	30A0083	A 1
	3341062	XTAL TX PCL-606 102.00 MHZ Y2	30A0093-1	B 1
	3350147	OVEN XTAL HR1,HR2	PCL-1-16-12-65	2
	3350188	MIXER SRA-12 HY2	SRA-12	1
	3350394	ATTENUATOR 3DB PC MT DC-1.5GHC AT2,AT3	MAT-3	2
	3350402	FILTER HELICAL 1015 MHZ 3 POLE FL10	302HN-0718	1
	3350410	FILTER HELICAL 910MHZ 2 POLE FL12	252HA-1568F	1
	3350428	FILTER HELICAL 904MHZ 3 POLE FL11	P302HA-018B	1
	3390127	LED RED 2.0@20 WIDE DIFFUSED CR1	FLV160	1
	3600145	DIO 1N4154 25V 4NS SI D035 CR2,CR3,CR7	1N4154	3
	3610045	DIO 5082-2835 FAST CR8	5082-2835	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	3610243	DIO 5082-0180 CR9	HP 5082-0180	1
	3610250	DIO 30V 6/30 PF T092 MV209 CR5	MV209	1
	3630001	XT NS2N918 .4W600M030V50M2P Q1,Q2	2N918	2
	3630308	XT NS2N5179 .2W900M020V50M1P Q6	2N5179	1
	3640307	XT U310 Q3,Q5,Q8	U310	3
	3640315	XT FET J310 Q4,Q7	J310	2
	3640422	XT MRF 581 Q9,Q10	MRF 581	2
	3650074	RGLTR LM340T12/7812 VARV1.5A VR1	LM340T-12	1
	3730967	IC DUAL OP AMP U3	NE5532AN	1
	3731056	IC MC145152P FREQ SYNC CONT. U1	MC145152P	1
	3731080	IC SP8647B DUAL MOD 10/11 U2	SP8647B	1
	3731171	IC HYBRID LIN AMP AR1	MWA 320	1
	3731338	IC HYBRID AMP MWA 130 AR2	MWA-130	1
	3731429	IC AMP DC-2GHZ MONOLITHIC DRN AR6,AR7	MAR-3	2
	3731494	IC AMP DC-2GHZ MONOLITHIC WHT AR5	MAR-6	1
	4020368	FERROX-CUBE 850 OHM L3,L12	VK 200 20/48	2
	4020640	IDCTR MINI-RED .1 UH 5% L10,L18,L20	MR .10 5%	3
	4020707	IDCTR MINI-RED .47UH 5% L11	MR .47 5%	1
	4020723	IDCTR MINI-RED 120 UH 5% L1	MR 120 5%	1
	4020806	IDCTR 31.5NH 5% 1.5T BROWN L8	132-01	1
	4020814	IDCTR 99 NH 5% 7.5T VIOLET L16,L17	132-07	2
	4020871	IDCTR 79NH 5% 6.5T BLUE L5,L6	132-06	2
	4020897	IDCTR 117NH 5% 8.5T GRAY L7	132-08	1
	4020905	IDCTR 410NH 5% 16.5T BLUE L4	132-16	1
	4020913	IDCTR 158NH 5% 10.5T BLACK L13	132-10	1
	4100038	XFMR MCL T4-1 T1	MCL T4-1	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4200002	CAP MICA DIP 5PF +/- 0.5 C48,C76	DM-5-050D	2
	4200028	CAP MICA DIP 8PF +/- 0.5 C44	DM-5-080D	1
	4200069	CAP MICA DIP 100PF 5% C46	DM-5-101J	1
	4200127	CAP MICA DIP 18 PF 5% C49	DM-5-180J	1
	4200135	CAP MICA DIP 43 PF 5% C52	DM-5-430J	1
	4200150	CAP MICA DIP 24 PF 5% C51	DM-5-240J	1
	4200184	CAP MICA DIP DM05 33PF C43	DM-5-330J	1
	4200192	CAP MICA DIP 22PF 5% C47	DM-05-220J	1
	4200226	CAP MICA DIP 51PF 5% C50	DM-5-510J	1
	4210373	CAP MICA DIP 240PF 5% C4	DM-15-241J	1
	4210530	CAP MICA DIP 820PF 5% C3	DM-15-821J	1
	4250585	CAP POLYCARB .247/100V 3% C14,C21	22UB2473H	2
	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C2,C5,C6,C57	199D225X0035JA1	4
	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C10,C18	199D475X0035JA1	2
	4280160	CAP TANT EPOX-DIP 100/20V C33,C35	199D107X0020TE4	2
	4300117	CAP N750 20PF 100V +/-5% TOL. C68	DD104810N750200	1
	4300307	CAP DISC N750 8.2PF +/-0.5PF C67	DD05810N7508R2D	1
	4310264	CAP .1 50V 25U 20% C17,C25,C38	5020ES50RD104M	3
	4310272	CAP .01 50V X7R 10% C1,C7,C8,C9,C12,C13,C16, C19,C40,C53,C54,C55,C58, C90,C93,C95,(C182,C194-NOT ON SILKSCREEN)	5018EM50RD103K	18
	4310280	CAP .001 100V C41,C45,C61,C66,C69,C70, C72,C73,C74,C75	C315C102MIR5CA	10
	4350419	CAP CHIP 220PF 5% P90 C32	100B221JP200X	1
	4350427	CAP CHIP 5.1PF +/- .25PF P90 C100	100B5RICP500X	1
	4350575	CAP CHIP 47 PF 5% P90 C29	100B470JP500X	1
	4350625	CAP CHIP 56PF 5% P90 C77,C79,C83,C84,(C183-NOT ON SILKSCREEN)	100B560JP500X	5

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4350666	CAP CHIP .001 UF 5% P90 C36,C85	100B102JP50X	2
	4350815	CAP CHIP 36PF 5% P90 C27	100B360JP500X	1
	4350823	CAP CHIP .01UF 20% C34	200B103MP50X	1
	4350831	CAP CHIP 130 PF 5% P90 C31	100B131JCA300X	1
	4370219	CAP 1-14PF C60,C63,C64	8053	3
	4370268	CAP VAR PC MT 5-60PF C11	2810000560QN02F	1
	4370300	CAP 4-10PF C87	278-0410-005	1
	4370359	CAP VAR 1.0-60PF GLASS EMBAND C30	TP60C	1
	4370417	CAP VAR PC MT 2-15 PF C86	2807C00215MJ02F	1
	4370425	CAP VAR SURFACE MT 1-4PF C56	GKZ4R000	1
	4420188	RES 220 OHM 1/2W 10% R76,R83	RC20GF221K	2
	4450037	RES 51 OHM 1/8W 5% R75	RC05GF510J	1
	4460010	RES 10 OHM 1/4W 5% R67	RC07GF100J	1
	4460051	RES 100 OHM 1/4W 5% R1,R2,R3,R45	RC07GF101J	4
	4460085	RES 240 OHM 1/4W 5% R12	RC07GF241J	1
	4460093	RES 300 OHM 1/4W 5% R47	RC07GF301J	1
	4460119	RES 470 OHM 1/4W 5% R15,R58,L15	RCR07G471J	3
	4460143	RES 1K OHM 1/4W 5% R4,R5,R8,R19,R20,R21,R24, R27,R52,R62	RC07GF102J	10
	4460200	RES 2.7K OHM 1/4W 5% R61,R70	RC07GF272J	2
	4460218	RES 3K OHM 1/4W 5% R23	RC07GF302J	1
	4460242	RES 4.7K OHM 1/4W 5% R29,R31,R54	RC07GF472J	3
	4460275	RES 6.8K OHM 1/4W 5% R55	RC07GF682J	1
	4460317	RES 10K OHM 1/4W 5% R10,R11,R13,R28,R49,R51, R63	RC07GF103J	7
	4460408	RES 36K OHM 1/4W 5% R18	RC07GF363J	1
	4460481	RES 100K OHM 1/4W 5% R38	RC07GF104J	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4460614	RES 33 OHM 1/4W 5% R59,R64	RC07GF330J	2
	4460630	RES 1.2K 1/4W 5% R25	RC07GF122J	1
	4460648	RES 75 OHM 1/4W 5% R53	RC07GF750J	1
	4460655	RES 120 OHM 1/4W 5% R42,R68	RC07GF121J	2
	4460671	RES 270 OHM 1/4 5% R48	RC07GF271J	1
	4460697	RES 3.9K OHM 1/4W 5% R22	RC07GF392J	1
	4460747	RES 15 OHM 1/4W 5% R46	RC07GF150J	1
	4460754	RES 22 OHM 1/4W 5% R6,R16	RC07GF220J	2
	4460812	RES 150 OHM 1/4W 5% R7	RC07GF151J	1
	4460820	RES 180 OHM 1/4W 5% R50,R60	RC07GF181J	2
	4460853	RES 820 OHM 1/4W 5% R14,R69	RC07GF821J	2
	4460861	RES 82K OHM 1/4W 5% R9	RC07GF823J	1
	4460879	RES 270K OHM 1/4W 5% R17,R30	RC07GF274J	2
	4470357	RES 130 OHM 1/2 W 5% R65	RC20GF131J	1
	4470365	RES 22 OHM 1/2W 5% R57	RC20GF220J	1
	4510004	RES 200 OHM 1/8 W 1% R43,R44	RN55E2000F	2
	4590311	THERMISTOR 680 OHM 10% R56	1K681K	1
	4630745	POT CER PC PIN 2K OHM .5W 25T R66	64W202	1
1	3474434	PCB RX RF MODULE 6000	5106105	PLT 4 1
2	2092518	FRAME RF MODULE RX PCL-6000	0503330	PLT 4 1
3	2092534	FRAME BASE PCL-6010/6020/6030	05C3334	PLT 2 1
4	2092492	COVER TOP RF MODULE 6000	05C3320	PLT 2 1
5	2064574	SHIELD RF COMP SIDE PCL-6000	05B3328	PLT 2 1
6	2092559	ASSY MODULE COVER RF MOD 6000	05C3342	PRE 1
7	1310093	CLIP MODULE PCL-6006/6000	05C2882	B 16
8	1050129	SCR PNH PHPS 4-40 X 1/4 SST		3
9	1050590	NUT HEX 4-40 1/4 FLATS SST		1
10	1050632	WSHR LK #4 SR CD PL		1
11	1050665	WSHR SHLDR #4 NYL	B51547F019	1
12	1290188	SIL PAD	7403-09-FR-51	1
13	1670165	CA COAX EZ-BEND .086 DIA Z1,Z4	HC70000-1	1
14	1670066	CA COAX RG-174/U 50 OHM Z2,Z3	RG-174/U	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
15	1230663	FSTNR CHAS	B15918-11	2
16	3091147	CONN 20PIN BREAK-AWAY STR HDR SWO	MFSS100-20-XXXB	
17	3250917	JUMPER MINI FOR 2 PINS=.025/.1 SWO	05474-001	1
18	1050434	SCR FLH SKT CAP 4-40 X 5/16 SS		2

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PARENT ITEM: 9302704

DESCRIPTION: ASSY IF DEMOD RX PCL-6020
 ENG. DRAWING NO.: 2002941-2 PLT 7

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
	4400044	RES 68 OHM 1/4W 5% R202	RC07GF680J	1
1	3473865	PCB IF DEMOD RX 600/6020	5106045 PLT 4	1
2	2090967	FRAME BASE MODULE PCL-606	05C2867 E	1
3	2091858	FRAME IF DEMOD	05D3146 PLT 2	1
8	3600145	DIO 1N4154 25V 4NS SI D035 CRI	1N4154	1
10	2062529	SHIELD PARTITION	05B2810 C	2
11	3090230	CONN SMB PC RT ANG MALE BLKHD J2,J3	2110-1511-000	2
12	3291069	FILTER FD-THRU TYPE20 NO/HDWR FL1,FL2,FL3,FL4,FL5,FL6	859619-1	6
13	2090975	COVER MODULE PCL-606	05C2868 D	2
17	3731346	IC FM DEMOD U2	LM1865/LM1965	1
18	3300196	MIXER BAL U1	SBL-1	1
20	3730215	IC LM1458N OPAMP DUAL U3	LM-1458N	1
21	3730173	IC LM318N OPAMP HISPEED U4	LM-318N	1
24	3640315	XT FET J310 Q6	J310	1
25	3640307	XT U310 Q1,Q3,Q5	U310	3
26	3630456	XT 2N3904 Q2	2N3904	1
27	3630308	XT NS2N5179 .2W900M020V50M1P Q4	2N5179	1
30	4210266	CAP MICA DIP 100PF 5% C1,C2,C62	DM-15-101J	3
31	4210373	CAP MICA DIP 240PF 5% C3	DM-15-241J	1
32	4210076	CAP MICA DIP 15PF 5% C5	DM-15-150J	1
33	4210225	CAP MICA DIP 68PF 5% C37	DM-15-680J	1
34	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C4,C39,C52,C57	199D475X0035JA1	4
35	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C25,C70	199D225X0035JA1	2
36	4350500	CAP ADJ 5-60PF C13,C18	GXD60000	2
37	4370201	CAP MIN VAR PC .8-10PC C41,C44,C47	MVM010W	3

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
38	4370219	CAP 1-14PF C58	8053	1
40	4280160	CAP TANT EPOX-DIP 100/20V C21	199D107X0020TE4	1
41	4280038	CAP TANT EPOX-DIP 1/35V 20% C35,C36	199D105X0035HA1	2
42	4350716	CAP CHIP .5PF +/- .1PF P90 C43,C46	100BOR58P500X	2
44	4210241	CAP MICA DIP 82PF 5% C26	DM-15-820J	1
45	4210126	CAP MICA DIP 27PF 5% C56	DM-15-270J	1
46	4210142	CAP MICA DIP 33PF 5% C32	DM-15-330J	1
47	4280079	CAP TANT EPOX-DIP 10/25V 20% C22	199D106X0025KA1	1
52	4310264	CAP .1 50V 25U 20% C6,C7,C8,C9,C10,C11,C12, C23,C29,C30,C58	5020ES50RD104M	11
53	4310272	CAP .01 50V X7R 10% C15,C16,C17,C19,C20,C24, C28,C33,C38,C40,C50,C59, C60,C63,C64,C65,C66,C73	5018EM50RD103K	18
54	4310280	CAP .001 100V C51,C67	C315C102MIR5CA	2
55	4210050	CAP MICA DIP 10PF +/- 0.5 C54,C55	DM-15-100D	2
57	4210043	CAP MICA DIP 5PF +/- 0.5 C34,C48	DM-15-050D	2
58	4200028	CAP MICA DIP 8PF +/- 0.5 C61	DM-5-080D	1
59	4200044	CAP MICA DIP 36PF 5% C69,C72	DM-5-360J	2
60	4630695	POT CER PC PIN 10K OHM .75W20T R19	43P103	1
61	4630729	POT CER PC PIN 5K OHM .75W 20T R18	43P502T000	1
65	4020368	FERROX-CUBE 850 OHM L16,L18,L19	VK 200 20/48	3
66	3350261	FLTR CERAMIC 10.7 MHZ FL7,FL8	SFE 10.7 MX-A	2
67	3250941	SKT 3 PIN FL7,FL8	1-583773-1	2
68	4042321	IDCTR 0.36UH TYPE E, WHT L17	117 9.5T 1/2" C	1
70	4020624	IDCTR 1.0 UH 5% MR 1.0 L2	MR 1.0 5%	1
71	4020525	IDCTR MINI-RED 1.2UH 5% L3	MR 1.2 5%	1
72	4020517	IDCTR MINI-RED .27 UH 5% L1	MR .27 5%	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
73	4020673	IDCTR MINI-RED 27UH 10% L4	MR 27 10%	1
74	4020459	LNK/FU MINI-RED 10UH 5% L5	MR 10 / 5%	1
75	4020566	IDCTR MINI-RED 5.6 UH 5% L6,L7	MR 5.6 5%	2
76	4020822	IDCTR MINI RED 18UH 10% L8	MR 18 10%	1
77	4020848	IDCTR MINI RED 2.7 UH 10% L9	MR 2.7 10%	1
78	4020541	IDCTR MINI-RED .22 UH 5% L10	MR .22 5%	1
79	4020871	IDCTR 79NH 5% 6.5T BLUE L20	132-06	1
80	4020582	IDCTR MINI-RED .82 UH 5% L14	MR .82 5%	1
84	4042008	COIL VAR .202UH GREEN L15	SERIES 117 5/2T	1
95	1641927	W BUSS 22GA	298	
96	1050129	SCR PNH PHPS 4-40 X 1/4 SST		2
100	4460010	RES 10 OHM 1/4W 5% R1,R30,R49,R50	RC07GF100J	4
101	4460655	RES 120 OHM 1/4W 5% R2	RC07GF121J	1
102	4460036	RES 51 OHM 1/4W 5% R4	RC07GF510J	1
103	4460820	RES 180 OHM 1/4W 5% R5,R35,R51	RC07GF181J	3
104	4460051	RES 100 OHM 1/4W 5% R6,R8,R10,R31,R32,R34,R37, R43,R48,R201,R203	RC07GF101J	11
105	4460192	RES 2.2K OHM 1/4W 5% R7,R9,R22	RC07GF222J	3
106	4460838	RES 330 OHM 1/4W 5% R11,R13	RC07GF331J	2
107	4460440	RES 51K OHM 1/4W 5% R53	RC07GF513J	1
108	4460317	RES 10K OHM 1/4W 5% R20,R36,R46,R56	RC07GF103J	4
109	4460499	RES 120K OHM 1/4W 5% R54	RC07GF124J	1
110	4460242	RES 4.7K OHM 1/4W 5% R15	RC07GF472J	1
111	4460184	RES 1.8K OHM 1/4W 5% R17	RC07GF182J	1
112	4460697	RES 3.9K OHM 1/4W 5% R16	RC07GF392J	1
114	4460754	RES 22 OHM 1/4W 5% R28,R29	RC07GF220J	2
115	4460119	RES 470 OHM 1/4W 5% R33	RCR07G471J	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
116	4460309	RES 9.1K OHM 1/4W 5% R21	RC07GF912J	1
118	4460143	RES 1K OHM 1/4W 5% R23,R40,R41,R47	RC07GF102J	4
119	4460374	RES 22K OHM 1/4W 5% R24,R27,R52	RC07GF223J	3
120	4460267	RES 6.2K OHM 1/4W 5% R14	RC07GF622J	1
121	4460200	RES 2.7K OHM 1/4W 5% R38,R39	RC07GF272J	2
122	4460788	RES 47 OHM 1/4W 5% R12	RC07GF470J	1
123	4460747	RES 15 OHM 1/4W 5% R45	RC07GF150J	1
124	4460291	RES 8.2K OHM 1/4W 5% R44	RC07GF822J	1
128	4460481	RES 100K OHM 1/4W 5% R25,R26	RC07GF104J	2
129	4590360	TEMP SITOR 3.9K 3K-392-K R55	3K-392-K	1
130	1310093	CLIP MODULE PCL-606/6000	05C2882	B 16
131	3090370	CONN 3 PIN SNGL ROW STR HDR E1,E2	87224-3	2
133	3250016	SKT DUAL IN LINE 8 PIN U3,U4	640463-1	2
134	3250057	SKT DUAL IN LINE 20 PIN U2	640464-1	1
135	3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1,E2	65474-001	2
136	3290152	JACK TEST WHITE R ANGLE TP1,TP2,TP3	430-101	3
137	4260137	CAP TANT EPOX-DIP 47/20V C14,C27	1990476X0020PE4	2
138	3250495	SKT PIN .0850DX.200L GOLD FIN Y1	450-3286-01-03	2
139	2202711	ASSY COAX SMB/S-PIGTAIL 10.75	2481164-1	1
140	4020905	IDCTR 410NH 5% 16.5T BLUE L11,L12,L13	132-16	3

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DATE: 6/02/83

PARENT ITEM: 9302498 DESCRIPTION: ASSY DBL CONV 70-3MHZ PCL600, C
 ENG.DRAWING NO.: 2002945-1 PLT

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG.DRAWING NO.	QUANTITY PER
12	2091163	ASSY MODULE COVER CKT DBL CONV	05C2901 C	1
13	2091155	ASSY MODULE COVER COMP DBL CON	05C2900 C	1
77	3350261	FLTR CERAMIC 10.7 MHZ FL1,FL3	SFE 10.7 MX-A	2
78	3350352	FILTER CERAMIC 10.7MZ2 FL2	SFE 10.7 MZ2-A	1
79	4350500	CAP ADJ 5-60PF C49	GXD60000	1
80	4020566	IDCTR MINI-RED 5.6 UH 5% L19	MR 5.6 5%	1
81	4460838	RES 330 OHM 1/4w 5% R30	RC07GF331J	1
82	3250941	SKT 3 PIN FL2	1-583773-1	1
100	9302076	ASSY DBL CONV 70-3MHZ NEUT 606	2002945-0 PLT 3	1

PARENT ITEM: 9302118

DESCRIPTION: ASSY 2ND/3RD LO 80.7/13.7 SEC
 ENG. DRAWING NO.: 2002948 A

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
1	3473931	PCB 80.7/13.7 2ND/3RD LO SEC	5106054 A	1
2	2092070	FRAME 2ND/3RD LO PCL-606 SEC	0503159 A	1
3	2090967	FRAME BASE MODULE PCL-606	0502867 E	1
4	2090975	COVER MODULE PCL-606	0502868 D	2
5	3250495	SKT PIN .0850DX.200L GOLD FIN	450-3286-01-03	4
6	1310093	CLIP MODULE PCL-606/6000	0502882 B	16
7	4310264	CAP .1 50V 25U 20% C8,C18,C19,C43,C51,C52,C53	5020ES50RD104M	7
8	4310272	CAP .01 50V X7R 10% C1,C2,C3,C13,C17,C21,C22,C24,C28,C29,C31,C35, C36,C49,C54,C57,C58,C59	5018EM50RD103K	18
9	4210050	CAP MICA DIP 10PF +/- 0.5 C39	DM-15-100D	1
10	4210100	CAP MICA DIP 22PF 5% C27	DM-15-220J	1
11	4210233	CAP MICA DIP 75PF 5% C26	DM-15-750J	1
12	4210266	CAP MICA DIP 100PF 5% C23,C30,C38,C42,C56	DM-15-101J	5
13	4210373	CAP MICA DIP 240PF 5% C14	DM-15-241J	1
14	4210449	CAP MICA DIP 430PF 5% C9	DM-15-431J	1
15	4210506	CAP MICA DIP 680PF 5% C44	DM-15-681J	1
16	4210514	CAP MICA DIP 750PF 5% C46	DM-15-751J	1
17	4210191	CAP MICA DIP 51PF 5% C47	DM-15-510J	1
18	4210209	CAP MICA DIP 56PF 5% C50,C55	DM-15-560J	2
19	4210225	CAP MICA DIP 68PF 5% C5	DM-15-680J	1
20	4210118	CAP MICA DIP 24PF 5% C16,C20	DM-15-240J	2
21	4210126	CAP MICA DIP 27PF 5% C33	DM-15-270J	1
22	4210167	CAP MICA DIP 39PF 5% C37,C40	DM-15-390J	2
23	4280046	CAP TANT EPOX-DIP 2.2/35V 20% C6,C7	1990225X0035JA1	2
24	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C11,C15,C25,C32,C45,C48	1990475X0035JA1	6
25	4350500	CAP ADJ 5-60PF C10,C60	GXD60000	2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
26	4370367	CAP MICA DIP 6PF C34	CM05FD060D03	1
27	4210001	CAP MICA DIP 1PF +/- 0.5 C12	DM-15-0100	1
28	4280038	CAP TANT EPOX-DIP 1/35V 20% C4,C41	199D105X0035HA1	2
29	3600145	DIO 1N4154 25V 4NS SI D035 CR1,CR2,CR3,CR4	1N4154	4
30	4460143	RES 1K OHM 1/4W 5% R25,R40	RC07GF102J	2
31	4460184	RES 1.8K OHM 1/4W 5% R31	RC07GF182J	1
32	4460317	RES 10K OHM 1/4W 5% R5,R6,R7,R14,R18,R19,R23,R24,R30,R32,R39	RC07GF103J	11
33	4460010	RES 10 OHM 1/4W 5% R26,R27,R41,R43	RC07GF100J	4
34	4460200	RES 2.7K OHM 1/4W 5% R10,R35	RC07GF272J	2
35	4460614	RES 33 OHM 1/4W 5% R12,R36	RC07GF330J	2
36	4460785	RES 47 OHM 1/4W 5% R3,R8,R11,R13,R29,R33,R37,R38	RC07GF470J	8
37	4460051	RES 100 OHM 1/4W 5% R1,R2	RC07GF101J	2
38	4460655	RES 120 OHM 1/4W 5% R22,R28,R42	RC07GF121J	3
39	4460119	RES 470 OHM 1/4W 5% R9,R34	RCR07G471J	2
40	4460705	RES 560 OHM 1/4W 5% R4	RC07GF561J	1
41	4460044	RES 68 OHM 1/4W 5% R15,R16,R20,R21	RC07GF680J	4
42	4460812	RES 150 OHM 1/4W 5% R17	RC07GF151J	1
43	2300838	ASSY CABLE 2ND & 3RD LO PCL606 J1	24B1087	A 1
44	3340759	XTAL 20.175MHZ PCL-606 2ND LO Y1	30A0080	A0 1
45	3340767	XTAL 13.7MHZ PCL-606 3RD LO Y2	30A0081	A0 1
46	1560226	TBG TEFLON 20AWG NAT R2	TFT200-20	
47	3630001	XT NS2N918 .4W600M030V50M2P Q1,Q3	2N918	2
48	3630456	XT 2N3904 Q2,Q4	2N3904	2
49	3650074	RGLTR LM340T12/7812 VARV1.5A VR1	LM340T-12	1
50	3730041	IC CA3018 XSTR ARRAY U1,U2	CA-3018	2
51	4100038	XFMR MCL T4-1 T1,T2	MCL T4-1	2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
52	4020681	IDCTR 1.8 UH 5% L2	MR 1.8 5%	1
53	4020657	IDCTR 3.3 UH 5% L4	MR 3.3 5%	1
54	4020665	IDCTR 2.2 UH 5% L9	MR 2.2 5%	1
55	4042008	COIL VAR .202UH GREEN L5	SERIES 117 5/2T	1
56	4042073	IDCTR 3.5T ORG .133 UH TYPE E L6	T7-117 3.5T.133	1
57	4020640	IDCTR MINI-RED .1 UH 5% L7	MR .10 5%	1
58	4020673	IDCTR MINI-RED 27UH 10% L3,L8	MR 27 10%	2
59	4020467	FERROX CUBE 500 OHM L1	VK200 10/3B	1
60	1290188	SIL PAD VRI	7403-09-FR-51	1
61	1090182	SCR PNH PHPS 6-32 X 1/4 SST		1
62	1090554	NUT HEX 6-32 SM PATT		1
63	1090588	WSHR LK #6 SR SST		1
64	3291069	FILTER FD-THRU TYPE20 NO/HOWR FL1,FL2,FL3	859619-1	3
65	3090230	CONN SMB PC RT ANG MALE BLKHD J2,J3	2110-1511-000	2
66	3290152	JACK TEST WHITE R ANGLE TP1,TP2,TP3,TP4	430-101	4
67	1050129	SCR PNH PHPS 4-40 X 1/4 SST		2
69	3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1	65474-001	1
70	3090370	CONN 3 PIN SNGL ROW STR HDR E1	87224-3	1

PARENT ITEM: 9302100

DESCRIPTION: ASSY FM DEMOD SEC
 ENG. DRAWING NO.: 20D2949 A

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
1	3473923	PCB FM DEMOD SEC	51D6055 A	1
2	3730173	IC LM318N OPAMP HISPEED U1	LM-318N	1
3	3730215	IC LM1458N OPAMP DUAL U2,U3	LM-1458N	2
4	3730769	IC SL560C U4	SL560C	1
5	3730728	IC NE5534AN OPAMP LO NOISE U5	NE-5534AN	1
6	3730348	IC MC1355P AMP FM/IF U6	MC1355P	1
7	3600145	DIO 1N4154 25V 4NS SI D035 CR1,CR2,CR3,CR4,CR5,CR7,CR8,CR9,CR10,CR11,CR12, CR13,CR14,CR15,CR16,CR17,CR18,CR19,CR20	1N4154	19
8	3390549	LED RED 2.0x20 WIDE RT/HOLDER CR6	550-0406	1
9	3630456	XT 2N3904 Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q11,Q12,Q15,Q16,Q17, Q18	2N3904	15
10	3630464	XT 2N3906 Q10,Q13,Q14	2N3906	3
11	4020467	FERROX CUBE 500 OHM L1,L2	VK200 10/3B	2
12	4020483	LNK/FU MINI-RED 150UH 5% L3	MR 150 5%	1
13	4020475	IDCTR MINI-RED 1.0 MH 5% L4,L5	MR 1000 5%	2
14	4020178	IDCTR RF .82 UH L6,L7	9230-18	2
18	4630299	POT CER PC PIN 10K OHM .75W R10,R22	3006P-1-103	2
19	4630679	POT CER PC PIN 500 OHM .75W R67	3006P-1-501	1
20	4210050	CAP MICA DIP 10PF +/- 0.5 C8,C14,C18,C50	DM-15-100D	4
21	4210084	CAP MICA DIP 18PF 5% C42	DM-15-180J	1
22	4210266	CAP MICA DIP 100PF 5% C17	DM-15-101J	1
23	4210308	CAP MICA DIP 150PF 5% C52,C54,C84	DM-15-151J	3
24	4210415	CAP MICA DIP 330PF 5% C53	DM-15-331J	1
26	4240149	CAP GL 43PF 5% C62,C63	UY01430J	2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
27	4310108	CAP DISC CER .001/1KV C19,C20,C25,C26,C31,C32,C37,C38	DD-102G	8
28	4310132	CAP DISC .01/50V C2,C3,C5,C6	UK-50-103	4
29	4310264	CAP .1 50V 250 20% C7,C9,C11,C12,C13,C15,C16,C21,C22,C23,C24,C27, C28,C29,C30,C33,C34,C35,C36,C40,C45,C47,C48,C60, C65,C66,C67,C69,C72,C75,C76,C77,C78,C79,C80,C81, C82	5020ES50RD104M	37
30	4280038	CAP TANT EPOX-DIP 1/35V 20% C39,C41,C49,C51	199D105X0035HA1	4
31	4280053	CAP TANT EPOX-DIP 4.7/35V 10% C10	199D475X0035JA1	1
32	4280079	CAP TANT EPOX-DIP 10/25V 20% C46,C64,C71,C73,C74	199D106X0025KA1	5
33	4280178	CAP TANT EPOX-DIP 150/15V 20% C55,C57,C59,C70	199D157X0015TE4	4
34	2062412	SHIELD MAGNETIC CYLINDER L4,L5	0562746 A0	2
35	2300846	ASSY CABLE FM DEMOD PCL-606 J1	24B1088 B	1
36	2110237	HEATSINK TO-5 PUSH-ON U4	#11158	1
37	3290152	JACK TEST WHITE R ANGLE TP1,TP2,TP3	430-101	3
39	3250016	SKT DUAL IN LINE 8 PIN U1,U2,U3,U5	640463-1	4
40	3250024	SKT DUAL IN LINE 14 PIN U6	640357-1	1
41	3090230	CONN SMB PC RT ANG MALE BLKHD J2,J3	2110-1511-000	2
42	4460010	RES 10 OHM 1/4W 5% R15,R19,R28,R31,R64,R66	RC07GF100J	6
43	4460051	RES 100 OHM 1/4W 5% R1,R5,R12,R73,R75,R83,R90,R92,R96	RC07GF101J	9
44	4460812	RES 150 OHM 1/4W 5% R68	RC07GF151J	1
45	4460143	RES 1K OHM 1/4W 5% R13,R14,R17,R40,R79,R84,R98,R105	RC07GF102J	8
46	4460630	RES 1.2K 1/4W 5% R47,R54,R62,R91	RC07GF122J	4
47	4460317	RES 10K OHM 1/4W 5% R11,R21,R70	RC07GF103J	3
48	4460481	RES 100K OHM 1/4W 5% R34,R80	RC07GF104J	2
49	4460507	RES 150K OHM 1/4W 5% R18	RC07GF154J	1
50	4461075	RES 6.8 OHM 1/4W 5% R69	RC07GF6R8J	1
51	4460754	RES 22 OHM 1/4W 5% R8,R9	RC07GF220J	2

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
52	4460762	RES 27 OHM 1/4W 5% R102	RC07GF270J	1
53	4460192	RES 2.2K OHM 1/4W 5% R23,R43,R50,R57,R63,R81,R93,R99	RC07GF222J	8
54	4460200	RES 2.7K OHM 1/4W 5% R82	RC07GF272J	1
55	4460523	RES 220K OHM 1/4W 5% R27,R35,R36,R37,R38,R39,R46,R53,R50	RC07GF224J	9
56	4460614	RES 33 OHM 1/4W 5% R95	RC07GF330J	1
57	4460697	RES 3.9K OHM 1/4W 5% R97	RC07GF392J	1
58	4460531	RES 330K OHM 1/4W 5% R30,R32	RC07GF334J	2
59	4460101	RES 390 OHM 1/4W 5% R106,R107	RC07GF391J	2
60	4520052	RES 4.99K OHM 1/4W 1% R72	RN60D4991F	1
61	4460119	RES 470 OHM 1/4W 5% R2,R25,R100,R101,R103,R104	RCR07G471J	6
62	4460242	RES 4.7K OHM 1/4W 5% R89,R94	RC07GF472J	2
63	4460432	RES 47K OHM 1/4W 5% R26	RC07GF473J	1
64	4460549	RES 470K OHM 1/4W 5% R16	RC07GF474J	1
65	4460259	RES 5.6K OHM 1/4W 5% R24,R42,R45,R49,R52,R56,R59	RC07GF562J	7
66	4460044	RES 68 OHM 1/4W 5% R41,R44,R48,R51,R55,R58	RC07GF680J	6
67	4460903	RES 680K OHM 1/4W 5% R20	RC07GF684J	1
68	4460648	RES 75 OHM 1/4W 5% R85,R88	RC07GF750J	2
69	4520250	RES 1.91K OHM 1/4W 1% R76,R78	RN60D1911F	2
70	4520037	RES 1K OHM 1/4W 1% R77	RN60D1001F	1
71	4510145	RES 10.0K OHM 1/8W 1% R74	RN55C1002F	1
72	2090967	FRAME BASE MODULE PCL-606	05C2867	E 1
73	2092062	FRAME FM DEMOD PCL-606 SEC	05D3160	A 1
74	4050129	SCR PNH PHPS 4-40 X 1/4 SST		2
75	4460804	RES 82 OHM 1/4W 5% R86,R87	RC07GF820J	2
76	2090975	COVER MODULE PCL-606	05C2868	D 2
77	1310093	CLIP MODULE PCL-606/6000	05C2882	B 16
78	4460788	RES 47 OHM 1/4W 5% R4	RC07GF470J	1
79	4460796	RES 56 OHM 1/4W 5% R71	RC07GF560J	1

REF NBR	COMPONENT ITEM NBR	COMPONENT DESCRIPTION & COMMENTS	ENG. DRAWING NO.	QUANTITY PER
80	3291069	FILTER FD-THRU TYPE20 NO/HQWR FL1,FL2,FL3,FL4	859619-1	4
82	4460036	RES 51 OHM 1/4W 5% R61,R65	RC07GF510J	2
83	1560226	TBG TEFLON 20AWG NAT L8	TFT200-20	
84	4460077	RES 220 OHM 1/4W 5% R108	RC07GF221J	1
85	4260137	CAP TANT EPOX-DIP 47/20V C61,C68	199D476X0020PE4	2
86	4310272	CAP .01 50V X7R 10% C43	5018EM50RD103K	1
87	1641927	W BUSS 22GA L8	298	
88	3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1	65474-001	1
89	3090370	CONN 3 PIN SNGL ROW STR HDR E1	87224-3	1
90	4461042	RES 2K OHM 1/4W 5% R7	RC07GF202J	1
91	4511499	RES 12.1K OHM 1/8W 1% R109	RN5501212F	1



APP

950 MHZ MICROWAVE PATH EVALUATION INSTRUCTIONS

The enclosed System Calculation sheet, nomograms, table and Fresnel zone clearance formula can be used to prepare a preliminary evaluation of a 950 MHz microwave link. The following instructions will aid you in completing the Microwave System Calculation sheet.

- A. Line 1: Enter the power output of the transmitter in dBm.

Examples: 5W = +37.0 dBm, 6.5W = +38.0 dBm, 7W = +38.5 dBm, 8W = +39.0 dBm. (dBm = 30 + 10 Log Pout [in watts])

- B. Lines 2 and 3: Enter on these lines the Transmitter and Receiver antenna gains over an isotropic source. Refer to the nomogram in Figure 4 which gives the power gain of a parabolic reflector at 950 MHz. Note: If the manufacturer quotes a gain in dBd (referred to a dipole), dBi is approx. dBd +1.1 dB.

- C. Line 4: Total lines 1, 2 and 3 and enter here. This is the total gain in the proposed system.

- D. Line 5: The proposed path should be plotted on a seven-and-one-half minute topographical map which can be obtained from the United States Geological Survey. Mail orders for maps west of the Mississippi River should be addressed to The Geological Survey, Distribution Section, Federal Center, Denver, CO 80225. For maps east of the Mississippi River, mail orders should be addressed to The Geological Survey, Distribution Section, Washington, DC 20242. Maps of Alaska also may be ordered from The Geological Survey, 520 Illinois Street, Fairbanks, Alaska 99701. State indexes and a folder describing topographic maps are furnished free of charge upon request.

Using ground elevation information obtained from the topographical map, a path profile should be prepared using either true earth or 4/3 earth radius graph paper. To obtain the necessary path clearance for a clear path, all obstacles in the path of the rays must be cleared by a distance of 0.6 of the first Fresnel zone. Be sure to include recently erected structures, such as buildings, towers, water tanks, etc., that may not appear on the map. The following formula may be used to determine 0.6 first Fresnel zone clearance.

$$H = \frac{1316 \times A \times B}{P \times F}$$

H = Height in feet*
 A = Distance from terminal to obstruction in miles
 P = Path length in miles
 B = P - A in miles
 F = Frequency in MHz

* This dimension is actually a radius and can be used to consider the clearance needed when the proposed path passes near a building, tower, storage tank, etc.

Draw a straight line on the path profile clearing any obstacle in the path by the distance determined above. This line will then indicate the required antenna and/or tower height necessary at each end. If it is impossible to provide the necessary clearance for a clear path, a minimum clearance of 30 feet should be provided. Any path with less than 0.6 first Fresnel zone clearance, but more than 30 feet generally can be considered a grazing path.

On line 5, enter the amount of path loss as determined by Figure 1, "Nomogram for Clear Path Attenuation", or Figure 2, "Nomogram for Grazing Path Attenuation".

- E. Line 6: Enter the total transmission line loss. Typical losses are shown in Table 1.
- F. Line 7: Enter the total connector losses. A nominal figure of -0.5 dB is reasonable (based on 0.125 dB/mated pair).
- G. Line 8: Enter all other miscellaneous losses here. Such losses might include power dividers, duplexers, diplexers, isolators, isocouplers, and the like.
- H. Line 9: Total lines 5, 6, 7 and 8 and enter here. This is the total loss in the proposed system.
- I. Line 10: Enter the total loss from line 9.
- J. Line 11: Enter the total gain from line 4.
- K. Line 12: Subtract line 11 from line 10. This is the unfaded signal level to be expected at the receiver.

- L. Line 13: Using the information found in Table 2, enter here the minimum signal required for 60 dB signal-to-noise ratio.
- M. Line 14: Subtract line 13 from line 12 and enter here. This is the amount of fade margin in the system. Typical fade margins that should be allowed are 20-25 dB for very short paths (up to 5 miles), 15 dB for median paths (5-15 miles) and increasing fade margins for longer distances (greater than 15 miles) up to a maximum of 35 dB.

TABLE 1

Typical Transmission Line Loss at 950 MHz

<u>Type</u>	<u>Loss (dB/100') (dB/100m)</u>	
1/2" Foam Dielectric (low loss)*	2.6	8.3
7/8" Foam Dielectric (low loss)+	1.5	4.6
1-5/8" Foam Dielectric (low loss)#	0.9	3.0

*Such as Andrew LDF4-50A

+Such as Andrew LDF5-50A

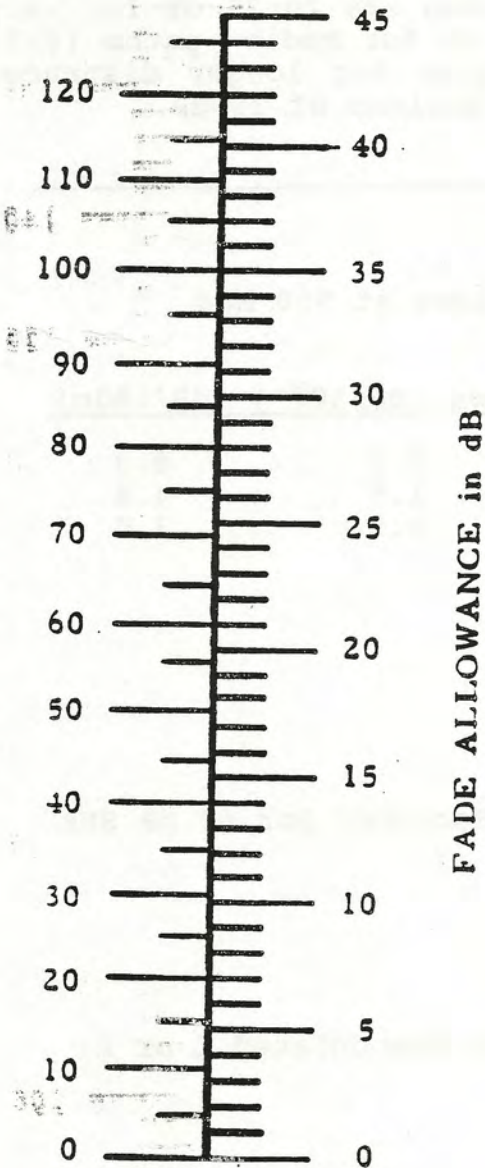
#Such as Andrew LDF7-50A

TABLE 2

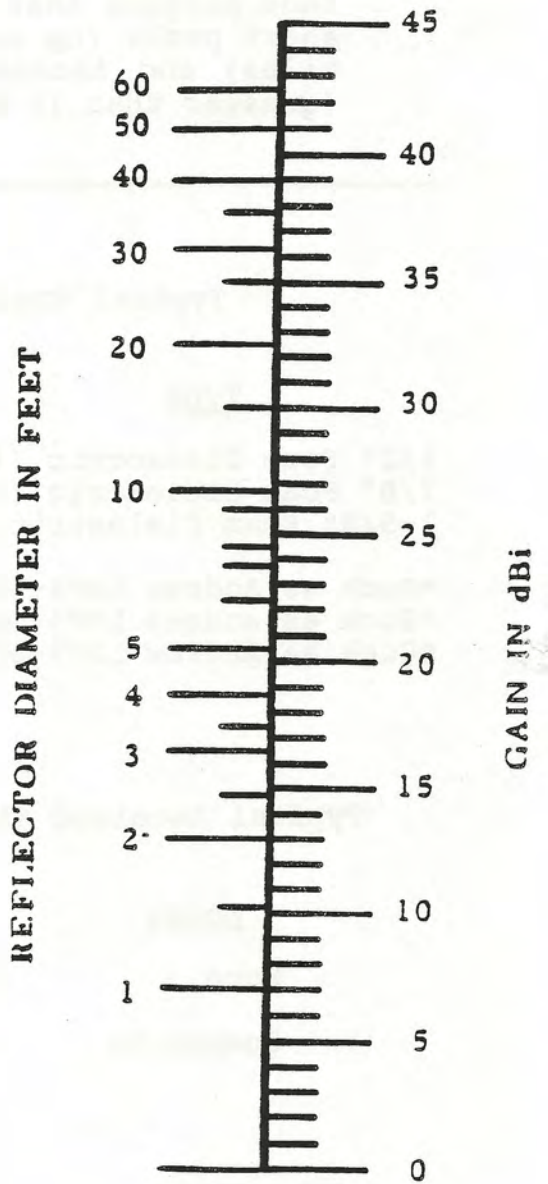
Typical Received Signal Strength Required for 60 dB SNR

<u>Model</u>	<u>dBm</u>	<u>uV</u>
Mono	-84.0	14
Composite	-66.0	112 (for demodulated L or R)

DISTANCE IN MILES



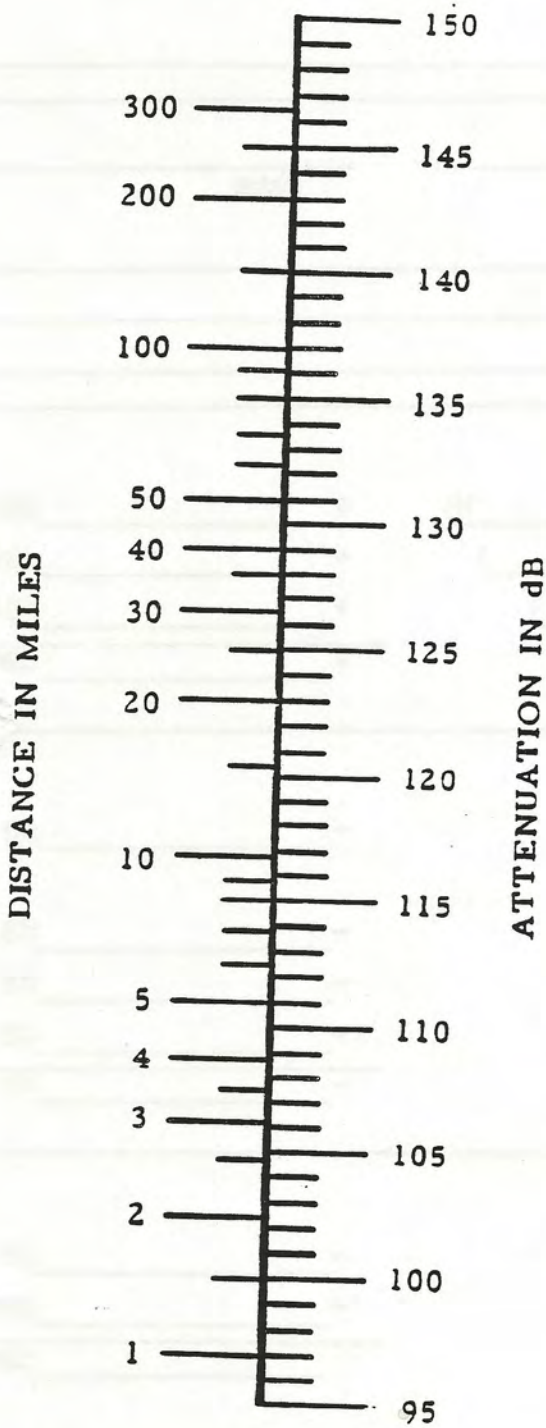
Based on 55% Aperture Efficiency



$$dBi = 10 \log \left[0.55 \frac{\pi^2 D^2}{\lambda^2} \right]$$

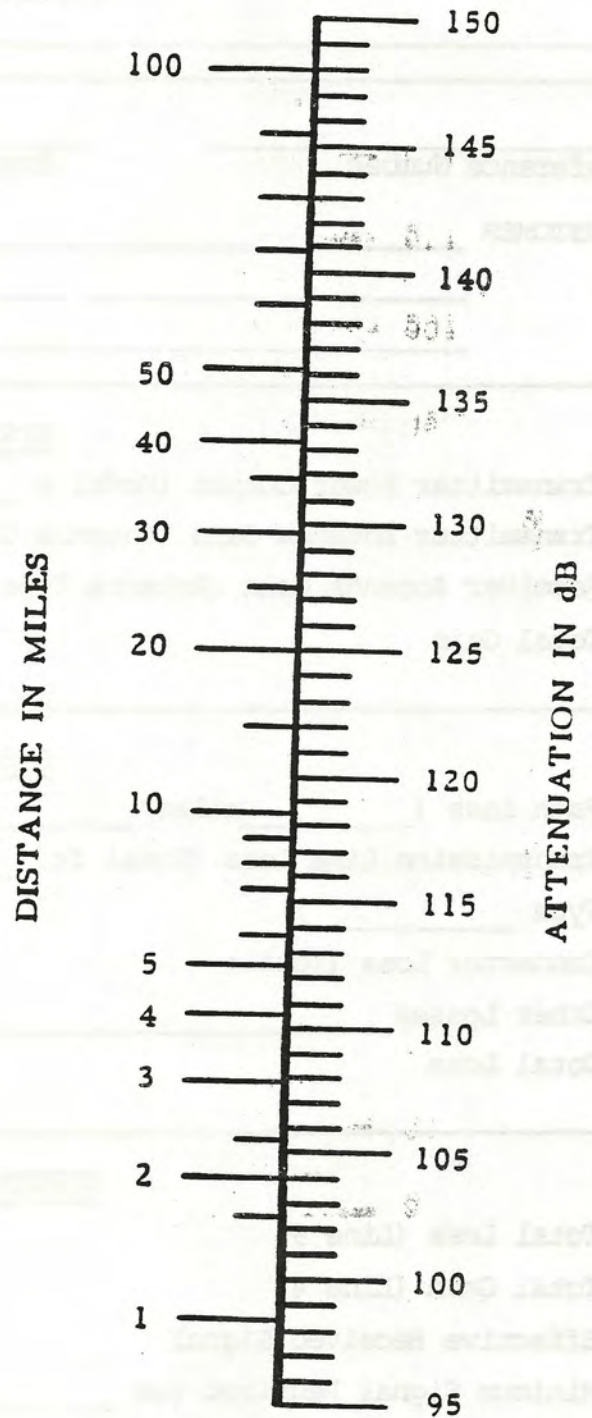
Figure 3. Fading Allowance at 950 MHz

Figure 4. Nomogram for Determination of Apparent Power Gain of a Parabolic Reflector at 950 MHz



ter K. Bullington

Figure 1. Nomogram for Free Space Attenuation Clear Path



After K. Bullington

Figure 2. Nomogram for Space Attenuation Grazing Path

(Use this chart with great care -- consult Moseley Associates, Inc. in the case of any

SYSTEM CALCULATIONS

Reference Number _____

Prepared By _____

Date _____

CUSTOMER _____

SYSTEM GAINS

- | | | | |
|--|---|-------|-----|
| 1. Transmitter Power Output (Model # _____) (_____ W) | + | _____ | dBm |
| 2. Transmitter Antenna Gain (Antenna Type _____) | + | _____ | dBi |
| 3. Receiver Antenna Gain (Antenna Type _____) | + | _____ | dBi |
| 4. Total Gain | + | _____ | dBm |

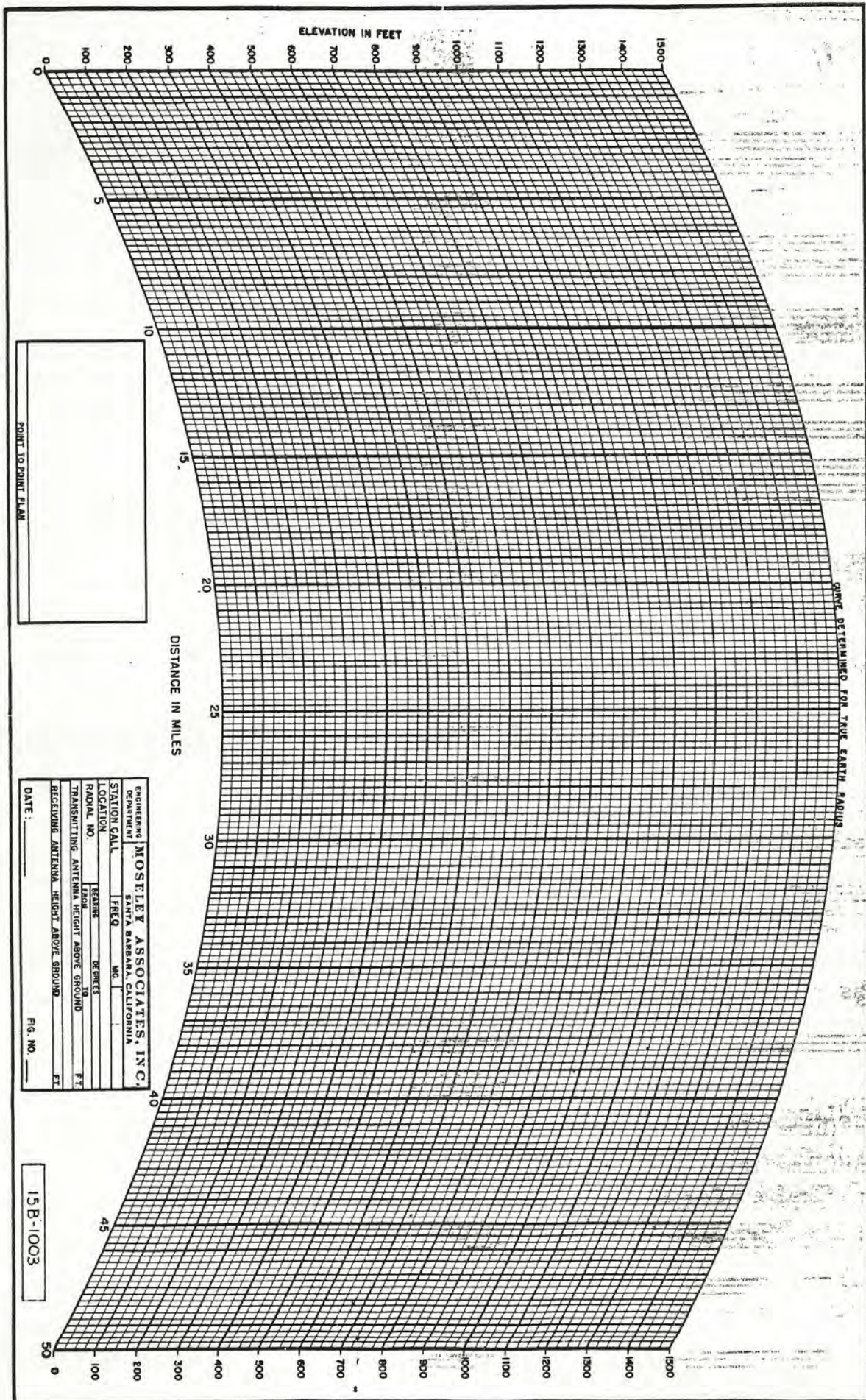
SYSTEM LOSSES

- | | | | |
|--|---|-------|----|
| 5. Path Loss (_____ miles/ _____ km) | - | _____ | dB |
| 6. Transmission Line Loss (Total ft. _____ / _____ m)
Type _____) | - | _____ | dB |
| 7. Connector Loss (Total) | - | _____ | dB |
| 8. Other Losses _____ | - | _____ | dB |
| 9. Total Loss | - | _____ | dB |

SYSTEM CALCULATIONS

- | | | | |
|---|---|-------|-----|
| 10. Total Loss (Line 9) | - | _____ | dB |
| 11. Total Gain (Line 4) | + | _____ | dBm |
| 12. Effective Received Signal | | _____ | dBm |
| 13. Minimum Signal Required for _____ dB SNR
(Model _____) | | _____ | dBm |
| 14. Fade Margin | | _____ | dB |

NOTES:



POINT TO POINT PLAN

ENGINEERING **MOSELEY ASSOCIATES, INC.**
 DEPARTMENT SANTA BARBARA, CALIFORNIA

STATION CALL _____ FREQ _____ MC _____

LOCATION _____ BEARING _____ DEGREES _____

RADIAL NO. _____ FROM _____ TO _____ FT

TRANSMITTING ANTENNA HEIGHT ABOVE GROUND _____ FT

RECEIVING ANTENNA HEIGHT ABOVE GROUND _____ FT

DATE: _____

FIG. NO.

15 B - 1003

