ITT Mackay Marine

A DIVISION OF ITT TELECOMMUNICATIONS CORPORATION

INSTRUCTION MANUAL
FOR

3031A/EB3039
SYNTHESIZED RECEIVERS

PUBLICATION NO.
600198-823-001

ISSUE 2
NOVEMBER, 1979

ITT Mackay Marine

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NOTICE

ITT MACKAY MARINE reserves the right to make changes to the equipment without notice.

PROPRIETARY STATEMENT

SAFETY NOTICE

The voltages present in this equipment may cause BURNS or INJURY. Use caution when servicing the equipment. When power-off maintenance is performed, disconnect the power cord, if practicable, so that the equipment cannot be accidentally energized.

PREFACE

This manual describes the 3031 family of ITT Mackay Marine synthesized, scan tuned receivers. The first tab section describes the standard 3031A receiver. Each succeeding tab section describes the unique features of each of the other receivers in this series; these tab sections must be used in conjunction with the 3031A tab section.

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GENERAL DESCRIPTION

1.1 SCOPE

This publication is intended primarily as an operator's manual, not a serviceman's manual. It provides the information necessary to install and operate the equipment. Included in this manual are sections on general description, operation, circuit description, maintenance, replaceable and spare parts, and drawings.

1.2 INTRODUCTION

The 3031A is a fully synthesized, dual conversion, superheterodyne, maritime and fixed station communications receiver. It covers a continuous frequency range of 15 kHz to 29.99999 MHz in 10 Hz increments and is scan tuned. Operating modes are AM (amplitude modulated double sideband), CW (continuous wave), and SSB (single sideband); the RTTY (radioteletype) mode is available with additional (optional) equipment. The 3031A provides excellent selectivity and high stability.

The receiver is completely solid state and features the latest development in modular construction. Electronic components are mounted on printed circuit boards, most of which are housed in chassis mounted plug-in modules. Plug-in type boards are utilized in each module housing more than one PC board. With the exception of the power supply circuits, interconnections are accomplished by interconnection PC boards, coaxial cables with snap-on connectors, and flat ribbon cables with plug-in connectors. Routine preventive maintenance generally is not required and corrective maintenance can consist of replacing modules or PC boards.

To permit fully synthesized, high resolution tuning, the receiver has a synthesizer which provides the 10 Hz tuning increments. An incoming signal can be tuned to within 5 Hz of its exact frequency while maintaining the high stability of the internal 10 MHz standard reference oscillator. In addition, the 1 ppm stability ensures that the maximum error in reading the exact frequency of the received signal is 30 Hz at 30 MHz.

A preselector is provided for matching short, vertical antennas to the nominal 50 ohm receiver input impedance. The preselector also can be utilized to attenuate excessively strong interfering signals.

The receiver operates from 90 to 130 or 195 to 260 volts, 47 to 63 Hz, single phase. Power consumption is about two-thirds that of earlier models, thus reducing internal temperatures and improving realiability.

The receiver can be installed in its own (optional) cabinet for table top mounting or can be rack mounted as part of a communications console.

1.3 TECHNICAL SPECIFICATIONS

All performance parameters meet or exceed U.K. Specification MPT 1201.

Frequency range — 15 kHz to 29.99999 MHz in 10 Hz increments.

Operating modes — A1, A2, A2H, A3, A3A, A3H, A3J; F1 with optional filter and external demodulator (SSB modes are USB).

I-f bandwidths

SWITCH POS. (FILTER)	MODE SWITCH	6 dB BANDWIDTH	60 dB BANDWIDTH
8.0 kHz	AM	8.0 kHz minimum	20 kHz maximum
2.0 kHz	AM	2.0 kHz minimum	12 kHz maximum
1.0 kHz	AM	1.0 kHz minimum	6 kHz maximum
0.4 kHz	AM	0.4 kHz maximum	4 kHz maximum
USB	USB	≤ +0.35 & ≥ +2.7 kHz	≥ 0.5 & ≤ +3.8 kHz
RTTY*	RTTY	0.5 kHz maximum	4 kHz maximum

*Optional; when installed, the filter is centered at 1700 Hz, offset from the 5 MHz i-f. If the RTTY is not installed, the USB is automatically switched in when the RTTY mode is selected.

Frequency stability — 1 ppm 0°C to +40°C (5 ppm to +50°C) with ±10% power supply variation; ≤ 1 ppm per year aging.

Sensitivity

FREQUENCY RANGE		SENSITIVITY μV EMF FOR 10 dB SINAD	DUMMY ANTENNA	MODE	BANDWIDTH (kHz)
100-160	kHz	32.0	10Ω/220 pF	CW	1
.16-4	MHz	10.0	10Ω/220 pF	CW	1
.16-4	MHz	32.0	10Ω/220 pF	AM	2
1.6-4	MHz	5.1	10Ω/220 pF	AM	8
1.6-30	MHz	0.8	50Ω	SSB	SSB
4-30	MHz	0.6	50Ω	CW	2

Sensitivity is reduced uniformly by approximately 20 dB between 100 kHz and 15 kHz.

Intermediate frequency rejection — Greater than 80 dB.

Image rejection — Greater than 80 dB.

Spurious response rejection (external) — Greater than 80 dB, referenced to rated sensitivity (includes image and i-f rejection).

Internally generated spurious responses	With the antenna input connector terminated in a 50 ohm load and the preselector set to WIDEBAND, the maximum level of internally generated spurious responses does not exceed 0.13 microvolt (-124 dBm) equilvalent input level in any marine band, or 0.5 microvolt outside marine bands.
Cross modulation (using 2 kHz filter)	With a wanted signal of 1.0 millivolt EMF, an unwanted signal of 32 millivolts EMF (30 percent, 400 Hz modulation and separated by 10 kHz) produces an output at least 30 dB below the output level due to the wanted signal standard output. At separation of 20 kHz, the unwanted output is at least 33 dB below the standard output.
Blocking	With a wanted signal of 1 millivolt EMF (2 kHz bandwidth), an unwanted signal of 100 millivolts EMF (separated by 10 kHz) causes less than 3 dB change in output; for the 0.10 to 0.16 MHz frequency band, the separation is 5 kHz (1 kHz bandwidth).
Intermodulation products	With a desired signal of 31.6 microvolts EMF set to give standard output (50 mW), two equal level undesired signals offset +30 and +60 kHz, respectively, do not produce more than standard output when their levels are as specified in the following table:

FREQUENCY RANGE	BAND-WIDTH	MODE	DUMMY ANTENNA	PRESELECTOR POSITION	MINIMUM LEVEL (EMF) OF EACH UNWANTED SIGNAL
100-525 kHz	8 kHz	AM	10Ω/220 pF	As Tuned	100.0 mV
525-1600 kHz	8 kHz	AM	10Ω/220 pF	As Tuned	31.6 mV
1.6-30 kHz	USB	SSB	50Ω	Wideband	68.0 mV

Automatic gain control	Range: less than 6 dB change in output for input signal variation from 1 microvolt to 100 microvolts (100 dB measured in SSB mode with preselector set to WIDEBAND (50 ohm input). Attack time: 10 milliseconds nominal. Decay time: FAST - 150 milliseconds nominal. SLOW - 1.5 seconds nominal.
Audio output	Speaker: 3.5 watts into 3.2 ohm load with 10% maximum distortion. Line: adjustable to +10 dBm (10 mV) into 600 ohm balanced load.
Spurious emissions	The rms voltage present at the antenna terminal of the receiver is less than 10 microvolts into a 50 ohm dummy antenna.
Overload	There is no damage to the receiver when an input signal of 30 volts EMF is applied for 15 minutes using a standard antenna.
Operating temperature	Full performance range: 0°C to +50°C. Operating temperature range: -15°C to +55°C.
Relative humidity	Up to 95%.
Input power	90-130/195-260 volts, 47-63 Hz, single phase.
Power consumption	62 watts.
Clarifier range	±150 Hz minimum.
BFO range	Adjustable to a beat note ranging from 0 to ≥ 2 kHz, centered at 1 kHz nominal.
Number of PC boards (includes mother boards, interconnect boards, and plug-in boards)	16 (See table 1.1, following page)
Number of replaceable plug-in modules	4 (See table 1.1, following page)

1.4 DIMENSIONS AND WEIGHT

	WITHOUT CABINET		CABINET (OPTIONAL)	
Height	5.25 in	13.1 cm	6.00 in	15.0 cm
Width	19.00 in	47.5 cm	19.75 in	49.4 cm
Depth	17.00 in	42.5 cm	18.00 in	45.0 cm
Weight	30 lb	13.5 kg	18 lb	8.1 kg

TABLE 1.1

MAJOR ELECTRONIC COMPONENTS

Front Panel
- Front Panel Interconnect PC Board
- Display Decoder PC Board**

Rear Panel
- Rear Panel Interconnect PC Board

#Preselector Module
- Preselector PC Board

#Signal Path Module
- Signal Path Mother Board
- Front End PC Board
- 5 MHz i-f PC Board
- Audio Amplifier PC Board
- Information Filter PC Board

#Synthesizer Module
- Synthesizer Mother Board
- Major Loop VCO PC Board*
- Major Loop PC Board
- Minor Loop PC Board
- Loop Translator PC Board
- Low Frequency Reference PC Board
- 87 MHz Oscillator PC Board
- 5 MHz BFO PC Board

Scan Tune Mechanism
- Opto-Coupler PC Board

#Scan Tune Module
- Scan Tune Counter PC Board
- Scan Tune Encoder PC Board

*Mounted on Major Loop PCB

**Mounted on Front Panel Interconnect PCB

#Plug-in Module

1.5 RECEIVER CONFIGURATIONS

Following is a table indicating the various configurations presently available in the 3031A receiver. An "X" indicates that the item listed is used in a unit of a given dash number.

The complete part number is obtained by adding the appropriate dash number to the base part number. Thus, a standard 3031A is P/N 600165-800-001, and has a black front panel and black handles.

Refer to the label on the rear panel of your receiver to determine the part number and correct configuration as shown in Table 1.2.

TABLE 1.2 RECEIVER CONFIGURATIONS

	-001	-002	-003	-004	-005	-006	-007	-008	-009	-010	-011	-012	-013	-014
Standard 3031A	X	X	X	X		X	X	X	X					
3031A For Use in IMM Consoles												X		X
3031A for STK													X	
EB3039					X									
Black Front Panel	X	X	X	X		X	X	X	X	X	X			
Greige Front Panel												X	X	X
Black Handles	X	X	X	X		X	X	X	X	X	X			
Chrome Handles												X	X	X
Preselector with All-Band Preamp					X								X	
RTTY Filter						X	X	X	X		X			X
Fan		X		X			X		X					
Remote Power Connector			X	X				X	X					
3041A*										X	X			
LSB Filter*										X	X			

*For reference only. Not applicable to 3031A.

SECTION 2

INSTALLATION

2.1 GENERAL

Installation of the receiver is quick and simple as the unit is completely wired, calibrated, and tested before shipment from the factory. When purchased as part of an ITT Mackay Marine communications console, the receiver is shipped installed in the console.

The receiver can be installed in its own (optional) cabinet for table-top mounting or can be installed in a communications console; see Figure 2.1 for outline and dimensions. Provision has been made for slide mounting the receiver. A set of right and left slides is available from ITT Mackay Marine.

The front panel is designed to support the receiver when the unit is installed in an equipment rack; however, it is recommended that additional supports be provided under the side edges (the receiver is supported in this fashion when factory installed in an ITT Mackay Marine communications console).

> CAUTION
>
> Do not support the receiver by the chassis bottom in such a way that the air flow will be restricted.

If installation assistance is required, consult the ITT Mackay Marine Service Department.

2.2 REAR PANEL

All external connections are made to the receiver's rear panel; see Figure 2.2. Mounted on the rear panel are the antenna connector, terminal board TB1, 12-volt and 6-volt regulators U1 and U2, respectively, and filter FL1. The locations of potentiometers R4 through R7 (mounted on the rear panel interconnect printed circuit board) are shown on the rear panel.

a. <u>Terminal Board</u>

The pins on terminal board TB1 provide the following.

(1) Pins 1 and 3 - balanced 600 ohm line output.

(2) Pins 2 and 6 - ground.

(3) Pin 4 - 3.2 ohm audio output.

(4) Pin 5 - mute input.

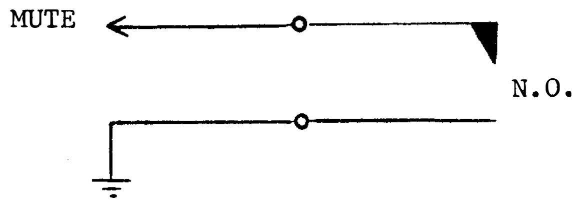
(5) Pins 7 and 8 - spare.

> CAUTION
>
> Turn off the receiver and disconnect the power cord before making connections to TB1.

For connection to a 3 ohm external speaker, connect the speaker leads to pin 4 (3.2 ohm audio output) and pin 2 or pin 6 (ground). The front panel on/off speaker switch does not affect the external speaker.

For continuous muting, connect pin 5 (mute input) to pin 2 or pin 6 (ground).

For break-in muting, connect spare contacts on the external break-in relay to pin 5 (mute input) and pin 2 or pin 6 (ground) in accordance with the following diagram.



> CAUTION
>
> The external receiver muting circuit must provide a grounding contact during key down. During key up, no voltage should be applied to the muting circuit.

b. Filter FL1

Filter FL1 houses the outlet for the ac power cord, the ac fuse, and the ac voltage board. See AC OPERATION in this section.

c. Potentiometers R4 through R7

The locations of potentiometers R4 through R7 (mounted on the rear panel interconnect PC board) are shown on the rear panel. R4 (BFO PRESET ADJUST) adjusts the BFO, while R5 (SPAN), R6 (RANGE), and R7 (AUDIO) adjust the front panel meter. See BFO AND METER CALIBRATION in the MAINTENANCE section; before adjusting.

2.3 AC OPERATION

> CAUTION
>
> Do not energize the receiver until first determining that the correct fuse is inserted in the fuse holder and ensuring that the voltage selector board is set to the proper ac voltage.

The fuse and voltage selector board are housed in filter FL1 located on the rear panel. Proceed as follows.

a. Turn off the receiver and remove the power cord.

b. Slide the clear plastic cover all the way to the left.

c. Move the FUSE PULL lever all the way to the left and the fuse will pop out.

d. With a hook or needlenose pliers, pull the voltage selector board (located below the fuse) all the way out. Do not mar the metal surfaces.

e. Four ac voltages are imprinted on the board: 120 and 240 on one side, 100 and 220 on the other. Insert the board with the desired voltage on the left side facing up.

f. Move the FUSE PULL lever all the way to the right.

g. Insert the 250-volt, 3/4 ampere Slo-Blo fuse for 100 or 120 VAC operation, or the 250-volt, 3/8 ampere Slo-Blo fuse for 220 or 240 VAC operation.

h. Slide the cover all the way to the right and replace the power cord.

2.4 BATTERY CONNECTION

The 6.25 volt Nicad battery located inside the receiver on the side panel powers the circuitry which enables the 3031A to automatically return to the dialed frequency when receiver power has been turned off. This battery must be connected when the 3031A is initially placed into service. (The receiver will operate if the battery is not connected but the battery will not charge and the automatic frequency return circuitry will be disabled.) (*Also see Section 4.7, page 4.16 for futher details.)

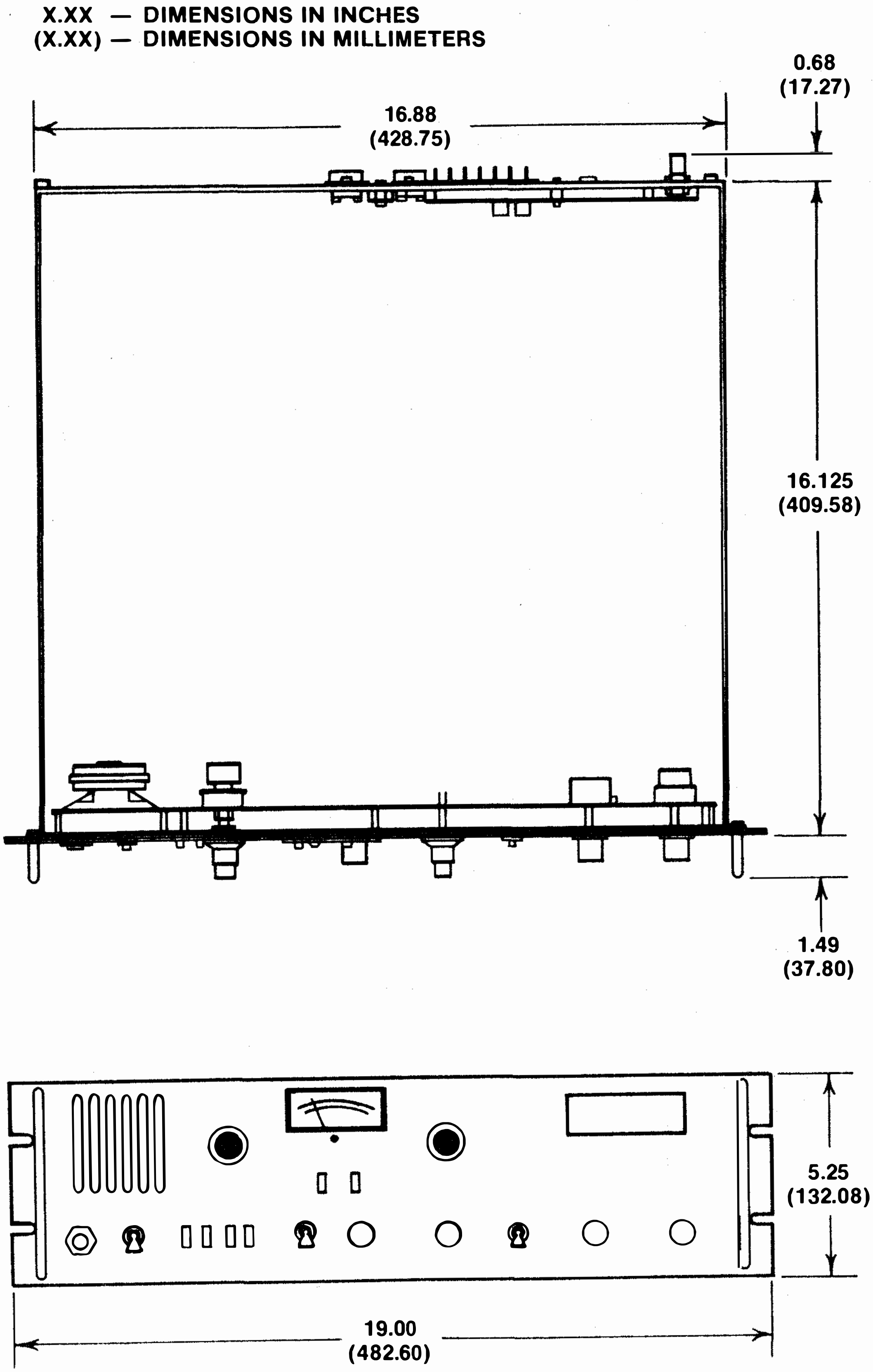
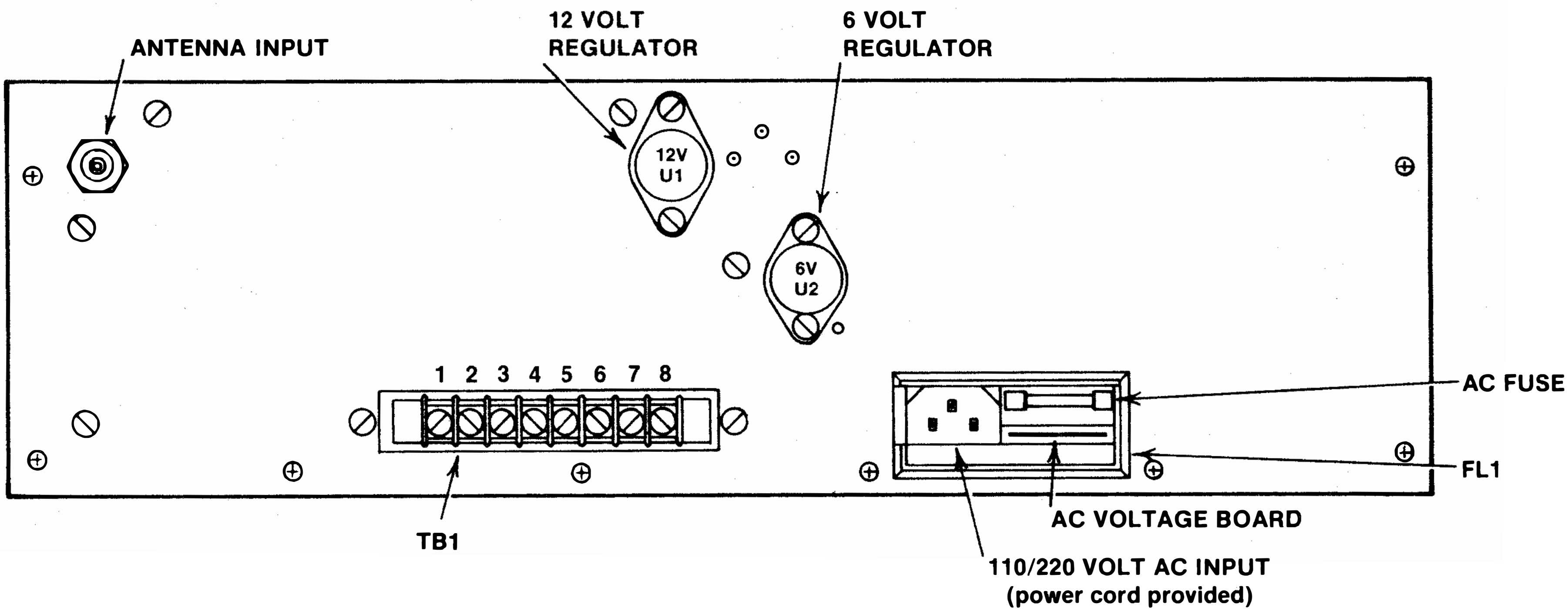


Figure 2.1. Outline and Dimensions



<u>**TB1**</u>

Pins 1/3 — bal. 600 ohm line out
Pin 2 — ground
Pin 4 — 3.2 ohm audio out
Pin 5 — mute in (ground to mute receiver)
Pin 6 — ground
Pins 7/8 — spare

Figure 2.2. Rear Panel

SECTION 3

OPERATION

3.1 GENERAL

Operation of the receiver is simple and straightforward. All controls and indicators are located on the front panel; they are logically grouped with clear, easy to read lettering.

3.2 CONTROLS AND INDICATORS

a. PHONES

The PHONES jack accepts a standard 1/4-inch (0.625 cm) diameter headphones plug. The jack impedance is 3.2 ohms; approximately 20 milliwatts of audio are delivered with 600 ohm headphones. <u>Plugging in the headphones turns off the speaker</u>.

b. SPEAKER ON/OFF

The SPEAKER ON/OFF toggle switch turns the speaker on or off (when the headphones are not plugged in).

c. MODE/VAR BFO

The MODE switch/VAR (variable) BFO control consist of two concentric knobs. The MODE (outer) knob selects the following modes:

(1) AM - amplitude modulated double sideband.
(2) CW FIXED - zero beats a signal for centering in the i-f passband.
(3) CW VAR (variable) - allows adjustment of the CW pitch from 0 to 2 kHz.
(4) CW PRESET - provides a preset CW pitch when the signal is properly centered. (Zero beat the signal in the CW FIXED position, then switch to CW PRESET so that the same tone is always heard.) CW PRESET is adjustable; see BFO AND METER CALIBRATION in the MAINTENANCE section.
(5) USB - selects the product detector and upper sideband filter for single-sideband operation (the i-f bandwidth switches do not function in this mode).
(6) RTTY - radioteletype. Selects the product detector and the RTTY filter (optional) when installed; otherwise the USB filter is selected.

The VAR BFO (inner) knob controls the BFO pitch.

d. IF BANDWIDTH

The IF BANDWIDTH pushbuttons select bandwidths of 0.4 kHz (very narrow), 1.0 kHz (narrow), 2.0 kHz (intermediate), or 8 kHz (wide). These pushbuttons can be used only in the AM and CW modes.

e. RF/AF METER DISPLAY

The RF/AF METER DISPLAY pushbuttons select the rf and af input levels for display on the meter. The rf level shows AGC voltage in dB above 1 microvolt rms while the af level shows the 600 ohm line voltage in dBm (1 milliwatt equals 0 dBm).

f. AGC FAST/SLOW

The AGC FAST/SLOW toggle switch controls the AGC decay time; FAST equals 150 milliseconds and SLOW equals 1.5 seconds. The SLOW position will ordinarily yeild best results on CW and SSB. FAST can be used in AM mode if desired. The AGC is disabled when the RF GAIN control is used.

g. RF GAIN/AGC ON

The RF GAIN/AGC ON control knob turns the AGC on and off, and permits manual adjustment of the receiver gain; the AGC is disabled when the gain is adjusted. (Turn the knob clockwise to increase the gain and counterclockwise to decrease the gain; turn the knob fully counterclockwise to turn on the AGC.)

h. PRESELECTOR BAND MHz

The PRESELECTOR BAND MHz rotary switch selects the proper preselector tuning range. It has 10 bands labeled in MHz as follows (WIDEBAND equals 15 kHz to 29.99999 MHz).

WIDEBAND
0.015 - 0.10
0.10 - 0.16
0.16 - 0.32
0.32 - 0.73
0.73 - 1.80
1.80 - 4.00
4.00 - 8.00
8.00 -16.00
16.00 -30.00

i. TUNING

The TUNING control knob provides tuning in all PRESELECTOR positions except WIDEBAND and .015-.10, and is used in conjunction with the rf meter to peak the receiver's input signal. The TUNING control matches the receiver front end to the antenna and provides increased selectivity.

j. ANT. ATTEN. IN/OUT

When set to IN, the ANT. ATTEN. (antenna attenuator) IN/OUT toggle switch inserts a 20 dB pad ahead of the first mixer to attenuate incoming signals. When set to OUT, the attenuator is disabled. (Set to IN to reduce interference from strong signals.)

k. AUDIO GAIN/POWER OFF

The AUDIO GAIN/POWER OFF control knob turns the power on and off and adjust the audio level to the speaker and headphones. (Turn the knob clockwise to turn on the receiver and increase the gain; turn the knob counterclockwise to decrease the gain and turn off the receiver.)

l. PULL FOR SPEECH CLARIFIER

When pulled, the PULL FOR SPEECH CLARIFIER control knob unlocks the synthesizer and can be used to vary the tuned frequency. Pushing the knob disables the clarifier. (This control normally is not required because of the receiver's 10 Hz tuning increments.)

m. Frequency Selection and Display

Frequency selection is provided by the continuously rotable TUNING control knob. The dialed frequency is displayed on seven 7-segment LEDs. (If there is a power failure, the receiver will automatically return to the dialed frequency when power is restored, so long as the tuning rate selected is the "LOCK" position.)

n. TUNING RATE

The TUNING RATE pushbuttons select the step size in which the synthesizer moves as the TUNING control is rotated:

(1) LOCK - locks the TUNING control.
(2) FAST - 100 kHz increments.
(3) SLOW - 100 Hz increments.
(4) FINE - 10 Hz increments.

The LOCK pushbutton should be kept depressed once the final tuned frequency is reached. This will ensure that the receiver will return to the dialed frequency in case of power loss.

3.3 AUTOMATIC GAIN CONTROL

The receiver normally is used with the AGC enabled for all modes. The AGC has a large operating range over which the output is held constant. The attack and decay time have been chosen to provide optimum performance when receiving AM, CW, SSB, and RTTY signals.

3.4 SSB OPERATION

Set the MODE switch to USB for single sideband operation. In this condition, the displayed frequency is that of the suppressed (or reduced) carrier of the receiver station. The VAR BFO control is inoperative in the USB mode. Set the AGC to the SLOW position.

The frequency of the desired station generally is known and can be dialed. When the frequency is not known, the band can be scanned using either the 10 Hz or 100 Hz Tuning Rates. Sideband is easily tuned for excellent clarity using the 10 Hz tuning rate.

3.5 PRESELECTOR OPERATION

Above 4 MHz, the PRESELECTOR BAND MHz switch normally is left in the WIDE-BAND position as the receiver meets all sensitivity, image, cross modulation, and suprious response specifictaions at this setting. When a short (35 foot whip, for example) antenna is used on frequencies below 4 MHz, a sensitivity improvement can be obtained by using the PRESELECTOR TUNING control as an impedance matching network. The PRESELECTOR also is effective in reducing interference from strong off-frequency signals. In conjunction with the ANTENNA ATTENUATOR, the PRESELECTOR can improve otherwise unreadable signals.

3.6 CW OPERATION

The excellent selectivity characteristics of the receiver can be more fully utilized in CW operation than in voice operation where the information bandwidths are relatively wide (the three CW modes are CW FIXED, CW VAR, and CW PRESET).

With the MODE switch set to CW FIXED, the frequency display indicates the frequency of the received carrier when the audio output is zero beat. It is recommended that the first step in receiving a CW signal is to tune to the incoming frequency by zero beating in the CW FIXED mode.

To copy a CW signal, it is necessary to use the CW VAR or CW PRESET modes. The CW PRESET mode generally is used, then an audible tone (preset to a normal pitch) is heard when the receiver has been set to the incoming carrier frequency. The i-f bandwidth pushbuttons should be set to 0.4 kHz (very narrow) or 1.0 kHz (narrow) for the best reception of weak signals, although the wider i-f bandwidths, 2.0 kHz (intermediate) or 8.0 kHz (wide), may assist in searching for a signal when its exact frequency is not known.

The CW VAR mode may be used if a pitch different than that of the CW PRESET mode is desired. In the CW VAR mode, the VAR BFO control allows the pitch to be varied over a relatively wide range.

The USB mode can be used for CW operation but this is inconvenient and normally is not utilized. In order for the signal to be in the passband of the filter, the dialed frequency must be offset from the exact frequency of the transmitting station.

3.7 AM OPERATION

Set the MODE switch to AM for reception of amplitude modulated double sideband signals. The 8 kHz (wide) i-f bandwidth normally is selected for use with the AM mode, and the frequency is set to the exact frequency of the transmitting station. Reception of weak AM signals usually can be enhanced by selecting the USB mode.

3.8 RTTY OPERATION

When radioteletype is transmitted as an upper sideband signal, the carrier frequency normally is considered to be that of the supressed (or reduced) carrier.

This means that the RTTY signal appears at some frequency which is offset from the carrier. (The RTCM standard offset currently is +1700 Hz; other offsets currently in use are +1900 Hz and +2100 Hz.) The RTTY signal then is deviated ±85 Hz relative to the offset.

It is possible to copy RTTY signals in several ways. The receiver has a narrow filter (optional) which is centered at +1700 Hz, offset from the 5 MHz i-f, so that when the carrier frequency is tuned correctly, a 1700 Hz (±85 Hz) tone is produced at the audio output. This tone then is demodulated by an external RTTY demodulator (optional). RTTY filters for other offsets are available on special order. The RTTY filter should be installed to achieve optimum RTTY reception.

When the RTTY filter is not installed, the USB filter is strapped in so that setting the MODE switch to RTTY automatically selects the USB filter. Since the USB filter is 2.7 kHz wide, any of the standard offset signals will be satisfactorily passed. The only deficiency of this method is that optimum selectivity is not realized.

To overcome this deficiency, a third possibility exists. By selecting the CW mode, the 400 Hz i-f filter can be used to achieve improved selectivity. This method requires that the receiver tuned frequency be offset by the proper amount (for example, +1700, +1900, or +2100 Hz). This places the RTTY signal into the i-f passband center. In this mode it is necessary to offset the product detector injection in order to obtain the +1700, +1900, or +2100 Hz (±85 Hz) tone; set the MODE switch to BFO VAR and adjust the BFO to obtain the tone. This method should provide reception adequate for most purposes. Since the BFO is crystal controlled, drift should not be a problem.

3.9 DUPLEX OPERATION

The receiver is suitable for full duplex operation, depending on factors such as the transmitter's power, transmitting and receiving frequencies, separation of transmitting and receiving antennas, and strength of the received signal.

SECTION 4

CIRCUIT DESCRIPTION

4.1 GENERAL

The 3031A is completely modular in construction with each module housing one or more printed circuit boards. The modules and their functions are as follows.

a. The SIGNAL PATH module provides mixing, filtering, and amplification.

b. The SYNTHESIZER module generates various outputs to provide mixer and product detector signals for the signal path module.

c. The PRESELECTOR module matches certain antennas to the receiver.

d. The SCAN TUNE module provides the facility for frequency selection by scan tuning.

In addition to the above modules, the receiver also has the following chassis-mounted PC boards.

a. The REAR PANEL INTERCONNECT PC board ties all parts of the receiver together.

b. The FRONT PANEL INTERCONNECT PC board mounts and interconnects most of the front panel controls.

c. The OPTO-COUPLER PC board provides pulse information in response to rotation of the scan tuning mechanism, when tuning the receiver frequency.

d. The DISPLAY DECODER PC board provides the facility for converting a BCD code to a display code, corresponding to the receiver tuned frequency.

4.2 SIGNAL PATH MODULE

The signal path module houses the PC boards which process incoming rf signals to output an audio signal. This module handles AM, CW, SSB, and RTTY signals (RTTY must be demodulated by an external demodulator). Four PC boards are interconnected inside the module by a mother board and several coaxial cables; these boards are the front end, 5 MHz i-f, information filter, and audio amplifier PC boards.

The module is designed to receive 15 kHz to 30 MHz. Incoming signals are up-converted to 92.010 MHz, amplified, then down-converted to 5 MHz by the front end PC board. The signal is then applied to the information filter PC board which provides final selectivity. The information filter PC board has crystal filters with various bandwidths and offsets from center frequency to accommodate the desired reception mode.

The output from the information filter PC board is routed to the 5 MHz i-f PC board which amplifies, detects, and processes signals for AGC of the i-f and front end. The reconverted audio signal is applied to the input of the audio amplifier PC board which has a gain control amplifier to set final speaker/headphone volume, and a power amplifier stage to boost the low level audio to the desired level (up to 3.5 watts).

Injection signals for the mixers and product detectors are derived from the synthesizer module. These are the 92 to 122 MHz first local oscillator (L.O.), 87 MHz second L.O. and 5.000 or 5.001 MHz for the product detector. All L.O. signals are connected to the signal path module via coaxial cables which plug onto the module faceplate.

Refer to the signal path block diagram, 690013-028-001, in Section 8. The received signal passes through the preselector module and is routed to the signal path module. The preselector module has a low pass filter which rejects incoming signals above 40 MHz and various local oscillator signals which otherwise would leak to the antenna output connector. At the signal path module, the signal passes through another low pass filter to provide additional rejection. The signal then is applied directly to a high performance, double balanced mixer. The mixer is followed by a low noise, high dynamic range 92 MHz i-f amplifier. This combination provides good immunity to overloading while simultaneously providing a moderately good overall noise figure.

To obtain high level overload performance, the mixer is pumped at +17 dBm (1.5 volts rms) of L.O. injection. The L.O. is run at 92 to 122 MHz so that incoming signals are up-converted to the 92 MHz first i-f frequency.

The 92 MHz i-f amplifier has three gain stages and two sections of crystal bandpass filters to obtain the required selectivity. The final 92 MHz amplifier also is controlled by the AGC circuitry to provide delayed AGC. This amplifier drives the second mixer, which converts the 92 MHz i-f signal to 5 MHz by mixing it with the 87 MHz signal derived from the synthesizer module.

The resultant 5 MHz second i-f is applied to front-panel-selected crystal filters which yield final i-f selectivity appropriate to the desired signal mode. For AM, an 8 kHz filter normally is used. For CW, the operator can select 8 kHz (wide), 2 kHz (intermediate), 1 kHz (narrow), or 0.4 kHz (very narrow) filters to provide high performance reception in crowded communications bands. For USB, a filter is selected which essentially passes signals removed from 5 MHz by 350 to 2700 Hz and rejects all others. For RTTY (optional), a filter centered at 1700 Hz removed from 5 MHz provides a 400 Hz bandpass for optimum reception of narrow shift radioteletype signals.

The output from the information filter PC board is applied to the 5 MHz i-f/detector/AGC PC board. This board has two i-f gain stages which provide approximately 80 dB controllable gain. The amplified signal is applied to appropriate detectors for AM, CW, or SSB signals, in addition to the AGC detector. A diode detector is provided for AM and a high performance product detector is provided for CW and SSB. The output from these detectors is applied to the audio amplifier PC board.

The AGC detector drives a dc amplifier which has selectable decay-time constants. These decay times of approximately 150 milliseconds and 1.5 seconds permit optimum reception of stable or rapidly fading signals in all receiver modes. Attack time for the circuit is about 10 milliseconds. The AGC is applied to two 5 MHz i-f stages and to the 92 MHz i-f stage through a delay circuit.

The audio signal from the i-f is applied to a gain controlled amplifier which is adjusted by a dc level obtained from the front panel audio gain control. The amplified signal then drives a 3.5-watt amplifier which drives the internal speaker and/or an external speaker connected to the rear panel terminal block.

a. Signal Path Mother Board

The signal path mother board provides dc and audio interconnections and power supply sources for all signal path module PC boards. Rf interconnections are made via plug-in coaxial cables in all but two cases.

An hermaphroditic connector pin connects the mother board and PC boards. The PC boards are secured by 6-32 screws which thread into mother board standoffs.

Connections between the mother board and other receiver circuitry are made via two plug-in flat ribbon cable connectors. All front panel controls and power sources are tied into the module through this connector system.

b. Front End PC Board

The front end PC board contains the first and second mixers, 92 MHz i-f, and associated mixer injection amplifiers. The 15 kHz to 30 MHz input is first up-converted by mixer M1, amplified, and down-converted to 5 MHz by Q5. An input low-pass filter prevents L.O.1 from being coupled to the antenna connector where it could radiate and cause interference to other services.

The overall receiver noise figure is determined by this PC board. The effective noise figure at the input to Q1 is about 8 dB, and the 6 dB mixer loss adds to this figure to provide about 14 dB overall.

Since the first mixer is not preceded by an rf gain stage, a suitable compromise is permitted between noise figure and overload capability. The receiver must be capable of simultaneously handling several very strong signals without overloading because: (1) the HF band is very crowded, and (2) the mixer is not preceded by any selectivity in the preselector WIDEBAND position. A measure of this overload capability is given by the third order intermodulation intercept point (IMD3) which occurs at +17 dBm (typical receivers range from -10 dBm to 0 dBm).

The high intercept is accomplished by using a mixer with very high L.O. injection (+17 dBm) and by following it with an i-f stage which itself has a good intercept. The U431 parallel-FET has an intercept about +11 dBm. Since the mixer has 6 dB loss, the overall +17 dBm intercept is obtained. The U431 provides a very broadband, 50 ohm termination to the mixer ($50\angle\pm5°$ over 1 to 100 MHz, typical); this is the key to obtaining good mixer performance. In addition, L.O. injection amplifier Q10 has approximately 50 ohms driving impedance. These criteria maintain the high intercept.

The U431 is followed by a 92.010 MHz two-pole crystal filter which prevents interference to subsequent stages from signals removed by more than 30 kHz. A second parallel-FET stage, consisting of J310s, provides moderately good overload capability and good noise figure. Stage gain is kept low to prevent overloading subsequent stages. A second two-pole 92 MHz filter boosts stop-band performance to a level sufficient to protect the following amplifier/mixer (Q4 and Q5).

The third i-f amplifier, Q4, provides about 16 dB gain and 30 dB delayed AGC. Delayed AGC does not work until input to the receiver reaches about 40 dB above 1 microvolt. The second mixer is a dual-gate MOS FET, with injection at 87 MHz applied to gate 2. The pi-configuration output matching network transforms the following 50 ohm crystal filter impedance up to a suitable value for correct drain matching of the FET.

Both injection amplifiers have a nominal 50 ohm input impedance. This provides proper termination to coaxial cables which otherwise would have reflections and would cause attendant spurious problems. The first mixer injection is 92.010 to 122.00999 MHz and the second is 87.010 MHz.

Since the front end PC board was designed for use in a variety of equipment, the L.O. injection amplifier input circuits are standard 50 ohm attenuator pads or hybrid splitters. The hybrids accept the L.O. input and route it to the onboard amplifiers and to external circuitry. Since this receiver does not use the hybrids, the pads compensate for the normal 6 dB hybrid loss.

c. <u>IF/AGC PC Board</u>

The 5 MHz i-f PC board contains the 5 MHz i-f amplifiers, detectors, and AGC circuitry. Two MC1350 integrated circuit amplifiers provide about 90 dB gain. The second stage, U2, drives the AGC detector (Q3, CR8, and CR9), i-f output buffer Q2, AM detector Q4 and CR3, and product detector Q7.

The AM detector is enabled by applying 12 volts to P6; the product detector similarly is enabled at P5. Product detector injection amplifier Q6 is turned off when the product detector is disabled; this reduces 5 MHz radiation inside the module.

The amplifier i-f signal is available at J1 at a level of about 70 millivolts into 50 ohms for use in driving external equipment such as demodulators.

AGC is derived by amplifying the i-f signal at Q3, detecting it (CR8 and CR9), and amplifying the dc level in U3-A (+26 dB gain). The output of U3-A charges AGC hold capacitor C49, and AGC attack time is controlled by the time constant of R48, R51, and C49. R49, discharging C49, controls the AGC slow release time constant. When P9 is grounded, Q9 saturates and places R50 in parallel with R49 to switch the AGC time constant to fast release. An adjustable AGC output at P13 is derived from the i-f AGC line through potentiometer R46. R46 is adjusted to set the cut-in voltage of the rf AGC on the front end PC board.

The AGC is switched off by applying 12 volts to P11. With the AGC off, manual gain control can be applied through P12 which is routed to the i-f stages through CR6, Q11, and U3-B.

d. Information Filter PC Board

The information filter PC board mounts up to six crystal filters which determine overall receiver selectivity. The filters are selected by series-diode switches which are turned on by applying 12 volts to pins P9 through P15. This forward biases the desired diodes and reverse biases the others.

For applications in which a filter is not used, it is possible to strap the board so that selection of that filter by a front panel switch causes the receiver to mute. (In the present configuration, setting the MODE switch to RTTY with the RTTY filter not installed automatically selects the USB mode.) This permits the receiver to be equipped in different ways without necessarily changing the front panel and also permits the user to change to a different type of information filter PC board without rewiring the receiver. It also is possible to field retrofit the board itself.

e. Audio Amplifier PC Board

The audio amplifier PC board provides a 3.5-watt output into a standard 3.2 ohm load and a +10 dBm output into a 600 ohm balanced line. The board has three integrated circuits. U2 (TBA 810P) provides the 3.5-watt output to drive the internal speaker and has approximately 34 dB gain. U2 is driven by U1 (MC 1350) which has 26 dB maximum gain and is used as a voltage controlled variable gain stage. This permits adjustment of the audio output level from the front panel AUDIO control or from a remote location.

The line amplifier consists of U3 (MC 1458), a dual operational amplifier which is driven directly from the audio input through gain control potentiometer R20. R20 sets the maximum line output level, which is delivered to the rear panel terminal block through a line matching transformer mounted on the rear panel interconnect PC board. The line output level is independent of the receiver audio gain control setting. Line output level is normally set to 0 dBm.

4.3 SYNTHESIZER MODULE

The synthesizer module houses a mother board and six boards. Refer to the synthesizer module block diagram, 690015-028-001. The synthesizer produces three output frequencies for use as mixer injection sources. The main output is 92.010 to 122.00999 MHz, in 10 Hz steps, addressed by a standard TTL logic BCD code. This output is used to tune the receiver over a 0 to 29.99999 MHz range. An i-f of 92.010 MHz is necessary to achieve this tuning range.

The second output, 87.010 MHz, is derived from a crystal-controlled oscillator mounted on the 87 MHz oscillator PC board. It is not phase locked to the main reference oscillator, but is injected simultaneously into the major loop mixer and into the signal path second mixer. The two mixers function so that variations in the 87 MHz frequency are cancelled out at the final 5 MHz i-f. In this way the overall stability of the synthesizer reference, in parts per million, is maintained, while allowing the lower stability 87 MHz source to be used.

The third output, 5 MHz, is derived by X2 division of the 10 MHz reference oscillator frequency, followed by low-pass filtering to remove undesired harmonic content. The 5 MHz also can be derived from the 5 MHz BFO PC board, running at 5.001 MHz (±1.1 kHz). Whichever output is selected, the signal is applied to the receiver product detector for reception of CW or SSB signals.

The 92 to 122 MHz variable output is synthesized by three phase-locked loops, which are locked to the high-stability 10 MHz internal reference oscillator, mounted on the low-frequency-reference PC board. The first loop (the minor loop PC board) generates 1 to 1.1 MHz in 10 Hz, 100 Hz, 1 kHz, and 10 kHz steps.

This output is fed to the loop translator PC board which translates the output of the minor loop PC board up to 88 to 88.1 MHz while retaining the same step size as generated by the minor loop PC board.

The output of the loop translator PC board, in turn, is fed to a mixer on the major loop PC board. This mixer combines the 92 to 122 MHz signal from the major loop PC board with the 88 to 88.1 MHz signal from the loop translator PC board so that the steps generated by the minor loop PC board are added to those generated by the major loop PC board. The minor loop PC board itself generates 100 kHz, 1 MHz, and 10 MHz steps.

The major loop, minor loop, and loop translator PC boards have loss-of-lock detectors which are logic-combined to produce a single loss-of-lock indicator output. This output can be used to inhibit a transmitter or for troubleshooting.

All rf outputs from the synthesizer module are at 50 ohms. Plug-in miniature coaxial connectors are utilized. The frequency address is standard TTL-BCD. Power requirements are +5, +12, and +20 volts dc.

a. Synthesizer Mother Board

The synthesizer mother board provides dc and control line interconnections for all synthesizer module PC boards. Rf interconnections between the PC boards and module are made via plug-in coaxial cables.

An hermaphroditic connector pin connects the mother board and PC boards. The PC boards are secured by 6-32 screws which thread into mother board standoffs.

The mother board is connected to the other receiver circuitry via two plug-in flat ribbon cables. One carries all synthesizer frequency address lines and the other carries dc supplies and control lines. Most lines are bypassed by axial-lead capacitors located near the edge connector fingers of the board.

b. 87 MHz Oscillator PC Board

The 87 MHz oscillator PC board provides injection for the second mixer and mixes the 88 MHz VCO (on the loop translator PC board) down to 1 MHz. The drift of this oscillator cancels by being injected into the translator and the receiver second mixer, and thus does not require phase lock to the internal standard. This permits using a freerunning crystal oscillator without degrading overall receiver stability below that of the internal synthesizer standard.

The oscillator is a Colpitts configuration with the crystal run in series mode and placed in the emitter feedback path. Tuning L2 adjusts the frequency to compensate for circuit variations.

The oscillator is followed by a low pass filter which reduces harmonic output to extremely low levels. The filter is terminated by J-FET amplifiers Q2 and Q3. These stages provide about 10 dB gain. Q2 drives the loop translator and Q3 drives the second mixer. Both stages are tuned and both are followed by additional low pass filtering (L8, L9, and associated capacitors).

c. Low Frequency Reference PC Board

The low frequency reference PC board provides the following:

(1) 1 kHz and 100 kHz reference frequencies for the minor loop and major loop PC boards, respectively.
(2) 5 MHz product detector injection source for the signal path module.
(3) switching between the 5.000 MHz reference and 5.001 MHz BFO.
(4) 10 MHz reference output or external 10 MHz reference input.
(5) ±220 Hz (minimum) clarifier offset for the receiver.
(6) logical AND function to combine LOCK indications from the major loop, minor loop, and loop translator PC boards into one synthesizer lock line.

The 10 MHz frequency standard, Y1 is powered from the REF B+ line and can be switched off when an external reference is used.* The 10 MHz output from Y1 is buffered by Q1 which, in combination with R4, provides a 50 ohm termination to J13. When the internal 10 MHz reference is used, the signal is available at J13. When an external reference is used, power to Y1 is switched off and Q1 and Q4 terminate connector J13.* The 10 MHz signal is fed to diode clippers CR1 and CR2, then to amplifiers Q2 and Q3. Counter U1 divides the signal from Q3 by 2 when lines 2, 3, 6, and 7 of U1 are low (5.000 MHz output at pin 12). The 5.001 MHz BFO (nominal frequency) is fed to J5 and amplified to TTL levels by Q5. The 5.001 MHz signal (±1.1 kHz minimum) is fed from the emitter of Q5 to pin 12 of U2. When high, the 5 MHz REF/BFO (12 volts) causes a TTL LOW at pin 12 of U3. This LOW enables counter U1 and switches U2 so that the path between pins 1 and 8 is connected (5.000 MHz reference). When the 5 MHz REF/BFO line is low, pin 12 of U3 is a TTL high, shutting off counter U1 and connecting the path between pins 12 and 8 of U2. In the AM mode, the 5 MHz REF/BFO line is low, enabling the BFO path to pin 8 of U2; however, the BFO input is off, giving no 5 MHz output from U2.

* Not applicable to 3030A series receivers.

The 5 MHz signal is fed from U2 to emitter follower Q4. The low impedance from Q4's emitter drives the 50 ohm lowpass filter, consisting of L6, L7, and C20 through C24, through R16. The filter's output goes to a 22 dB pad consisting of R17, R18, and R19, then to PC coaxial jack J6. This signal then is fed to the synthesizer module bulkhead and, in turn, to the signal path module.

The 10 MHz output from Q2 is fed to dividers U4 and U11 where the frequency is divided by 100. The 100 kHz signal at pin 11 of U11 is buffered by U5, output as the 100 kHz reference at P10, and sent to the major loop PC board. The 100 kHz signal also is fed to pin 10 of U8 when pins 5 and 10 of U5 are high. When the clarifier is off (pins 2, 4, and 5 of U8 low), the 100 kHz reference is fed from pin 4 to pin 8 of U5 and from pin 10 to pin 11 of U8. The 100 kHz reference then is fed to dividers U9 and U10 where it is divided by 100. The 1 kHz reference output from U10 is fed to connector P8, then to the minor loop PC board.

To enable the clarifier, the 12V RX line must be +12 volts (receive mode) and the CLARIFY SW line must be low, turning on transistor switch Q6. The 12 volts at the collector of Q6 are fed to oscillator FET Q7, then to voltage divider R32 and R33. The TTL HIGH at R33 is fed to pins 2, 4, and 5 of U8. The LOW at pin 6 of U8 disables the 100 kHz reference path between pins 4 and 8 of U5, and also disables the path between pins 10 and 11 of U8. The HIGH at pin 2 of U8 enables the path between pins 1 and 11 of U8.

The clarifier oscillator frequency is controlled by crystal Y2 and reactive elements L12, CR3, CR4, C38, and C39. The oscillator is a Colpitts configuration. The crystal is series resonant at 4.9984 MHz but, by varying the reactance presented to it by changing the varicap bias (0 to 12 volts from the CLARIFIER CONTROL line), the frequency can be pulled from less than 4.9989 MHz to greater than 5.0011 MHz (5.000 MHz ±1.1 kHz minimum).

The variable 5 MHz signal at the source of Q7 is fed to amplifier Q8 which amplifies the signal to TTL levels. The amplified signal is fed to divider U6 where it is divided by 5, then to U7 where it is divided by 10. The resultant 100 kHz signal at pin 11 of U7 varies ±1.1 kHz, causing a variation of the receiver's frequency of ±220 Hz when the clarifier is enabled. The variable 100 kHz signal then is fed to IC switch U8, then to dividers U9 and U10, providing a variable 1 kHz (±0.22 Hz) reference to the minor loop.

The three lock signals from the major loop, loop translator and minor loop PC boards are fed to pins 3, 4, and 5, respectively, of NAND gate U3. If all three signals are high (locked condition), pin 6 of U3 is low, indicating synthesizer lock. If any one of these three lock inputs are low, pin 6 of U3 (and thus P3) is high, indicating a synthesizer out-of-lock condition.

d. <u>5 MHz BFO PC Board</u>

The 5 MHz BFO PC board provides a variable 5.001 MHz (±1.1 kHz minimum) signal to the signal path product detector. The BFO is a voltage controlled crystal oscillator (VCXO) which can be trimmed approximately ±1.1 kHz. This is accomplished by varying the voltage applied to a varicap diode placed in the frequency determing network. Adjustment is via a potentiometer mounted on the receiver front panel.

When a BFO mode is selected, the 5.000 MHz standard is turned off and the 5 MHz BFO PC board is energized. Simultaneously, the BFO is connected to the signal path through a TTL logic switch on the low frequency reference PC board.

The oscillator, a Colpitts configuration, is crystal controlled by the frequency determining network consisting of Y1, L3, CR1, CR2, C2, and C3. The crystal is series-resonant at 4.9995 MHz but, by varying the reactance presented to the crystal by changing the bias on varicaps CR1 and CR2, the frequency can be pulled from less than 4.99990 MHz to greater than 5.00110 MHz. The signal is buffered from the emitter of JFET Q1 by Q2, which also provides a 50 ohm cable termination impedance through a low emitter impedance in combination with R9. The oscillator's output is at PC coaxial connector J4.

e. Minor Loop PC Board

The minor loop PC board provides a 1.00000 to 1.09999 MHz TTL signal, in 10 Hz steps, for use by the loop translator PC board as its reference. The minor loop uses a 1 kHz reference frequency and synthesizes a 100.00 to 109.999 MHz signal in 1 kHz steps. This is divided by 100 to yield the 1.0 to 1.1 MHz output, in 10 Hz steps.

The VCO, a Colpitts oscillator, operates over a 100 to 110 MHz frequency range. The frequency is varied by changing a control voltage (present at TP1) from 5.5 volts to 13 volts. This changes the tank capacitance through a change in the capacitance of varicap CR5. Tank coil L2 with C17 and CR5 form the resonant tank circuit. The 100 to 110 MHz oscillator output, at the source of JFET Q6, is coupled through C-transformer C22 and C23 where its path is split. The output path goes through L4 to common-gate JFET amplifier Q7. The 100 millivolt (minimum) signal at Q7's drain is coupled through C40 to ECL prescaler U3. This counter is connected as a divide-by-10 and has a TTL output at pin 7. This 10 to 11 MHz TTL signal is routed to divide-by-10 counter U5 which generates the required 1.00000 to 1.09999 MHz output (also present at connector P3).

The other path from C23 goes through L15 and to a similar common-gate amplifier, Q8. The 100 to 110 MHz signal then is coupled through C32 to ECL divide-by-10/11 prescaler U4. U4, with counters U7 through U11, counter control logic chip U6, and hex inverter U12 form a 110 MHz programmable down-counter. A 4-digit TTL BCD code enters the board at P6 through P21. The following table relates the input code to VCO and output frequencies.

CODE AT P6-P21	COUNTER DIVISOR	VCO FREQ. (MHz)	OUTPUT FREQ. AT P3 (MHz)
0000	100,000	100.000	1.00000
5000	105,000	105.000	1.05000
9999	109,999	109.999	1.09999

Counter U11 is always loaded with a count of 10 (hardwired). Counters U10, U9, and U8 are loaded with the 10 kHz, 1 kHz, and 100 Hz digits, respectively. Counter U7 is loaded with the desired 10 Hz digit and, in conjunction with U6, determines how many divide-by-11 cycles U4 takes (0 through 9 possible divide-by-11 cycles). Every time U4 goes through a divide-by-10 or divide-by-11 cycle, one count is removed from the count in counter chain U8 through U11 and a count is subtracted from the count in U7. When the counters are first loaded with the desired divisor (at 1 millisecond intervals), U6 switches U4 to a divide-by-11 mode (at pin 7 of U6) and a count is subtracted from U7 (and from U8 through U11) after each divide-by-11 cycle. The modulus of U4 is changed from divide-by-11 to divide-by-10 by U6 when the output of U7 first reaches zero. The modulus stays at divide-by-10 until the count in U8 through U11 reaches zero. When this happens, the signal at TP2 goes high and U6 generates a load pulse at pin 9, loading the counter chain with the desired divisor, and the counting cycle again starts.

Thus the signal at TP2 is 1 kHz when the loop is locked (100.000 MHz divided by 100,000 equals 1 kHz and 109.999 MHz divided by 109,999 equals 1 kHz). This 1 kHz signal from the counters is fed to pin 3 of frequency-phase detector U1 where it is compared to the 1 kHz reference frequency. The 1 kHz reference frequency enters the board at P29 and is fed to pin 1 of U1. Transistors Q2 and Q3, in conjunction with R7, R8, R10, R11, C7, C9, and C10, form a lead-lag integrating filter. The output of the phase detector at pins 5 and 10 of U1 is a high impedance when the loop is locked. If the loop is off frequency, this output goes to a low impedance: 0.8 volt or 2.2 volts. Since the base voltage of Q2 is at 1.5 volts, a voltage of 0.8 volt at pins 5 and 10 of U1 (VCO frequency low) sinks current and causes the collector voltage of Q3 to rise. This rising voltage is filtered by a 2-pole lowpass filter (Q4, Q5, R13, R14, R15, C12, and C65) and by a 1 kHz notch filter (R16 through R18 and C13 through C16) which causes the voltage at TP1 to rise, also increasing the VCO frequency to reestablish lock. If the VCO frequency is high, pins 5 and 10 of U1 go to 2.2 volts, causing the voltage at the collector of Q3 to drop, thus lowering the VCO frequency.

The minor loop PC board also has a lock detector. When the loop is in lock, pins 4, 13, 11, and 2 of U1 are approximately 4 volts. Thus C6 is charged through resistor R2 to approximately 4.5 volts, producing about 3.3 volts at pin 11 of U2 (through emitter-follower Q1 and diode CR1). This logic level is inverted twice producing a logic high level at pins 4 and 12 of U2. LED DS1 is off and there is a logic high at P24, indicating a locked condition. When the loop is out of lock, negative-going pulses are at pins 4 and 13 or pins 2 and 11 of U1. These pulses discharge capacitor C6, producing a logic low at pin 11 of U2. In addition, pins 4 and 12 are low, lighting out-of-lock LED DS1 and causing a logic low, out-of-lock voltage at P24.

f. Loop Translator PC Board

The loop translator PC board provides an 88.010 to 88.10999 MHz signal to the major loop PC board. The -13 dBm output is stepped in 10 Hz increments under control of the minor loop PC board, which feeds a 1.00000 to 1.09999 MHz TTL signal to the loop translator. The loop translator also uses an 87.010 MHz, -3 dBm rf injection from the 87 MHz oscillator as a loop input.

The VCO, consisting of JFET Q1, L1, CR1, C2, C3, and associated circuitry is a Colpitts-type oscillator which can be pulled from 87.5 MHz to approximately 89 MHz by varying the control voltage at TP2. A change in the dc voltage at this point changes the bias on varicap CR1, in turn changing the VCO tank capacitance and thus the VCO frequency. The 88.01 to 88.11 MHz signal is coupled from the source of Q1 through C-transformer C47 and C48, and is split into two paths. The output path goes through common-gate rf amplifiers Q2 and Q3 (which provide high reverse isolation), to resistive pad R10, R11, and R12, then to the output lowpass filter consisting of C44, C45, C46, L10, and L15. The signal then is routed to PC coaxial connector J12.

The other path from the VCO goes to common-gate amplifiers Q4 and Q5, with the output circuit of Q5 tuned to 88 MHz by L9, C20, and C22 to maximize the gain of this stage. The signal is tapped from the tank of this stage, across C22, through resistive pad R17, R18, and R19, then to the L.O. port of mixer M1 as the local oscillator for the mixer. Thus the signal at TP3 is an 88.01 to 88.10999 MHz signal. The 87.010 MHz input at J11 is coupled through a 14 dB pad to the rf input of M1. The pad provides a good 50 ohm termination to the 87 MHz oscillator and also gives 14 dB isolation between M1 and the 87 MHz oscillator.

Since the L.O. port of M1 is driven with 88.010 to 88.10999 MHz and the rf port is 87.010 MHz, the i-f port is a 1.00000 to 1.09999 MHz signal, approximately 16 millivolts rms. This signal is amplified by a 15 dB amplifier (Q11, Q12, and associated circuitry) to provide a 1 to 1.1 MHz, 300-millivolt pp signal at the emitter of Q11. The signal then is coupled through R44 and C40 to lowpass filter C37, C38, C39, L13, and L14 to provide 65 millivolts rms at TP8. The signal is routed from here to high-gain common-emitter amplifiers Q10 and Q9 to generate a 3-volt pp waveform at TP6. This signal is the loop input to the phase detector and is fed to pin 3 of U2. The reference frequency for the loop translator is the 1.00000 to 1.09999 MHz signal from the minor loop and is fed to pin 1 of U2. Thus the loop translator causes the VCO to generate a frequency which, when the 87.010 MHz is subtracted from it by M1, is the same as the minor loop input frequency.

The output of phase detector U2 is at pins 5 and 10 (TP5), and is a high impedance when the loop is locked. This output is connected to a lead-lag type integrating filter consisting of Q6, Q7, R29, R28, R25, C23, C24, and associated biasing components. The filter output, at the collector of Q7, goes through R26 to TP2 where it is fed to the VCO at R2. Zener diode CR7 is biased at 5.6 volts by R27 so that CR3 conducts and limits the minimum voltage to approximately 5 volts when the voltage at TP2 falls below 5.6 - 0.6 = 5 volts. This limits the minimum VCO frequency to 87.5 MHz when L1 is correctly adjusted (the VCO frequency must never go below 87.01 MHz or a false lock condition may occur). If the VCO frequency were low, the output frequency of mixer M1 (pins 3 and 4) also would be low, causing pins 5 and 10 of phase-detector U2 to drop to a low impedance state of 0.7 volt. Since the base voltage of Q6 is a constant 1.5 volts, the collector voltage of Q6 and Q7 starts to rise, raising the VCO frequency to reestablish lock. If the VCO frequency were high, the output frequency of M1 (pins 3 and 4) also would be high, causing the output of U2 (pins 5 and 10) to be a low impedance 2.2-volt source. This causes the collector voltage of Q6 and Q7 to drop, lowering the VCO frequency to reestablish lock. The output of U2 at TP5 again goes to a high impedance when lock is achieved.

The loop translator PC board also has a lock detector. When the loop is locked, pins 2, 11, 4, and 13 of phase detector U2 are at approximately 4 volts. Thus CR5 and CR6 permit C28 to be charged to approximately 4.5 volts by R33. Emitter-follower Q8 buffers the voltage across C28, producing 3.9 volts at its emitter and about 3.3 volts at pin 3 of U1. This logic high level is inverted twice and appears as a logic high at pin 2 of U1 (also at P6), indicating a locked condition; it also appears at pin 6 of U1, causing out-of-lock indicator DS1 to be off. When the loop is out of lock, pins 2 and 11 or pins 4 and 13 of U2 go low, causing CR5 or CR6 to conduct and discharge C28. This produces a logic low at pin 3 of U1 and at P6, the translator lock output. Pin 6 of U1 also is low, lighting LED DS1 to indicate an out-of-lock condition on the board itself.

g. Major Loop/Major Loop VCO PC Boards

The major loop PC board provides a 92.010 to 122.00999 MHz injection source for the first mixer in the signal path. The major loop uses a 100 kHz reference frequency and synthesizes 100 kHz steps. Onboard decoding accepts a positive referenced TTL binary coded decimal for the frequency address, 0.0 to 29.9 MHz. Smaller frequency steps are made possible by stepping the translator rf input to the major loop, from 88.010 to 88.110 MHz. The loop translator PC board takes 10 Hz steps over this range, also providing the 10 Hz steps to the major loop output.

The major loop VCO PC Board is a separate, fully shielded PC board that plugs into, and is mounted on, the major loop PC board. The VCO board has a control line, lowpass filter, range switching for the oscillator tank circuit, a 92 to 122 MHz Colpitts oscillator, and an output rf buffer amplifier.

The control line enters the VCO board at P24 and goes through a Cauer-type lowpass filter consisting of R1, C1, C2, L1, and C3. The filtered tuning voltage is fed to varicaps CR1 and CR10 to vary the tank capacitance. Capacitors C5 and C7 are switched by PIN diodes CR2 and CR3, depending on which VCO range the major loop is addressed to:

VCO RANGE	RECEIVED FREQ (MHz)	VCO RANGE (MHz)	C5	C7
I	0 - 7.9	92.0- 97.9	IN	IN
II	8.0-13.9	98.0-105.9	IN	OUT
III	14.0-21.9	106.0-113.9	OUT	IN
IV	22.0-91.9	114.0-121.9	OUT	OUT

By changing ranges this way, the oscillator FREQUENCY/CONTROL VOLTAGE ratio can be kept small without requiring four separate oscillators. The VCO range information is stored in PROM U8. Half of U1 is used to buffer the range switching lines from U8 to the PIN diode switches.

Inductor L5, the tank coil, has been adjusted to calibrate the oscillator. Capacitors C14 and C15 form a C-transformer, with C14 adjusted to provide the correct rf level at the output of the major loop. Transistor Q2 is a common-base rf amplifier which: (1) buffers the VCO to reduce loading, and (2) provides reverse isolation from the major loop and signal path mixers back to the VCO. The VCO output level, approximately 224 millivolts into 25 ohms appears at J29 and TP1 on the major loop PC board.

The signal from the VCO output is split. One path is fed sequentially to: (1) common-base rf amplifier Q3, (2) low-pass filter L24 and C24, and (3) through a 6 dB pad to coaxial connector J1. The other path from the VCO goes through common-base rf buffer amplifier Q5 and Q6 to amplify the signal to approximately 500 millivolts rms, and to provide a 92 to 122 MHz (actually 92.01 to 122.00999 MHz) local oscillator drive for mixer M1.

The loop translator's 88.01 to 88.010999 MHz signal is fed to the major loop at coaxial connector J2, and through the 5 dB pad (R30, R31, and R32) to the rf input of mixer M1. This provides a 4.0 to 33.9 MHz signal (14 millivolts in level) at the i-f output of mixer M1. For example, to receive 4.35 MHz, the major loop frequency is 92.01 MHz (first i-f) plus 4.35 MHz equals 96.36 MHz. The loop translator frequency is 88.06 MHz, so the major loop mixer i-f frequency is 96.36 MHz minus 88.06 MHz equals 8.30000 MHz. Thus, over a 100 kHz range, the major loop output steps with the translator input, leaving the output frequency from mixer M1 constant and in even multiples of 100 kHz.

Resistor R33 and capacitor C34, together with R34 and 14 dB amplifier Q11 and Q2, provide broadband termination for the mixer i-f port. The signal then is fed to a lowpass filter consisting of C34 through C68, L21, and L22, and then to high-gain saturated amplifier U10. The 4.0 to 33.9 MHz, 1 Vpp square wave then is fed to high-speed switch Q13 to drive the counter section.

Counters U7, U6, and U5 form a high speed, programmable down-counter. The desired 0 to 29.9 MHz receive frequency address enters the board in positive BCD form at P11 through P20. The 100 kHz digit lines go directly to Schottky counter U7 and the 0 to 33 MHz digit lines go to a BCD-to-binary converter to convert the 0 to 33 MHz into a binary PROM address. This address goes to 8-bit code, 32-word PROM U8. The 2-digit BCD word (four bits for units MHz and two bits for tens MHz) and a 2-bit VCO range control code are stored in the PROM. Thus with a BCD-to-binary converter and a PROM, the desired 0.0 to 29.9 MHz receive frequency address has been translated to the desired 4.0 to 33.0 MHz counter address while providing VCO range switching information. Integrated circuits U3 and U4 detect when the down counter reaches zero and when to reload the proper divisor.

When the loop is locked, the output of the counter is a 100 kHz pulse train. This pulse train is fed to pin 3 of frequency-phase detector U2, while the 100 kHz reference frequency enters the board at P7 and is fed to pin 1 of U2. The output of the phase detector at pins 5 and 10 is a high impedance state when the loop is locked on frequency. Transistors Q10 and Q9, together with R48 through R53 and C45 through C47, form a lead-lag integrating type filter to attenuate the reference frequency and noise from the VCO control line. Emitter-follower Q8, together with R76 and R47, limits the minimum voltage applied to the VCO. (The VCO frequency must never drop below 88 MHz or the loop will lock up incorrectly.)

If the loop output frequency is low, the counter frequency is low, causing pins 5 and 10 to drop to a low impedance 0.7-volt source. This pulls current through C45 (the base voltage of Q10 is held constant); consequently, the collector voltage of Q9 rises, causing the VCO frequency to reestablish lock. If the loop output frequency is high, pins 5 and 10 of U2 go high, sourcing current to cause C45 to discharge. This lowers the collector voltage at Q9 and thus the VCO frequency.

When the loop is locked, pins 2 and 11 and pins 4 and 13 are high ($\simeq$ 4 volts), allowing R45 to charge C42 to approximately 5 volts. Emitter-follower Q7 buffers this voltage and provides approximately 3.5 volts to pins 1 and 2 of U1. This logic level gets inverted twice and appears at P3 as a high logic level, indicating a major loop locked condition (LED DS1 is off). If the loop becomes unlocked, negative-going pulses appear at pins 2 and 11 or pins 4 and 13 of phase detector U2, discharging C42 and causing a low level at P3. This indicates an out-of-lock condition which is displayed by LED DS1.

4.4 PRESELECTOR MODULE

The preselector module houses the preselector PC board and a variable capacitor which tunes the selected ranges. The primary function of the preselector is providing selectivity ahead of the first mixer above 100 kHz, and providing matching of short antennas in the 100 kHz to 4 MHz frequency ranges. Below 100 kHz and above 4 MHz, the receiver input impedance is a nominal 50 ohms.

Below 100 kHz, the preselector has a low-pass filter which rejects signals above 100 kHz to prevent interfering with signals in the 15 kHz to 100 kHz range. Above 4 MHz, the preselector is a tunable bandpass filter having the following:

$$Z_{IN} \simeq Z_{OUT} \simeq 50 \text{ ohms}$$

This circuit provides selectivity in the 4 to 8, 8 to 16, and 16 to 30 MHz bands, thus attenuating strong, out-of-band interfering signals.

The preselector can be operated in the wideband position (50 ohms in and out), in which case it looks transparent between 15 kHz and 30 MHz. This position allows the operator to tune continuously over the receiver's range with no need to make additional tuning adjustments. The preselector also can be operated on individual bands, selected to permit matching short antennas below 4 MHz or to provide selectivity in 50 ohm systems above 4 MHz. The preselector has an overload protection circuit which can sustain a 30-volt EMF applied signal for 15 minutes without damage to the receiver.

To reduce interference from adjacent and/or high power transmitters, the preselector has a 20 dB pad which can be switched in to attenuate incoming signals. Under certain conditions, in which the receiver is severly overloaded, the pad permits reception of signals that otherwise would be unintelligible.

The preselector also has a low-pass filter which attenuates signals above 30 MHz. In particular, this filter provides image suppression because the first image of the receiver is 184 MHz above the tuned channel frequency. The filter also reduces first local-oscillator feed-through to the antenna connector, to prevent unwanted signal radiation from the receiver.

4.5 POWER SUPPLY

The power supply consists of regulated outputs of +5, +12, and +20 volts dc. These voltages are derived from a bridge rectifier, followed by single-chip current limited voltage regulators.

The +5-volt supply has a crowbar circuit which shunts the line to ground if the line surges above seven volts (approximately) dc. Since the regulator is current limited, there is no damage to the supply and the sensitive TTL chips are protected from over-voltage blowout.

The power supply accepts 115 or 230-volt ($\pm$10%) ac inputs which are fused and selectable by means of a plug-in printed circuit strapping mechanism mounted on the rear panel. Changeover can be accomplished in less than five minutes. The line cord is detachable to permit rapid removal from rack mounted installations.

4.6 REAR PANEL INTERCONNECT PC BOARD

The rear panel interconnect PC board ties all parts of the receiver together. It routes the front panel controls to the signal path module and routes the power supplies to all modules.

A terminal block mounted on this board protrudes through an aperture in the receiver rear panel to connect various external functions to the receiver, including mute, external audio, and 600 ohm line output. The 20-volt regulator and low current 12-volt regulator also are mounted on this board.

Other active circuitry includes the meter amplifier and mute inverter. The rf span, rf range, and audio meter adjustments and the BFO preset adjustment also are mounted on this board.

The rear panel interconnect PC board has a large number of diodes which perform switch logic functions to turn detectors and filters on and off as the front panel MODE switch is operated. For example, when the USB mode is selected, the USB filter and product detector are activated simultaneously and the product detector injection is switched to internal reference. The 8.0, 2.0, 1.0, or 0.4 kHz filter, together with internal reference or BFO injection, can be used for CW operation, depending on the MODE switch setting.

A multipin connector permits the board to be removed from the receiver without unsoldering connections.

4.7 FRONT PANEL INTERCONNECT PC BOARD

The front panel interconnect PC board mounts and interconnects most of the front panel controls, including power on-off/volume, rf gain, AGC rate, meter range, speaker on/off, i-f bandwidth, mode select/BFO adjust, speech clarifier, and scan tuning rate. The LED frequency displays also are mounted in this board.

The display decoder PC board, which decodes the synthesizer address and drives the LED display digits, is mounted on the front panel interconnect PC board. Connector J1 on the display decoder PC board connects to the scan tune module output. The scan tune module provides the synthesizer address/display decoder address to determine the receiver frequency.

Connectors J8 and J9 are also mounted on the front panel interconnect PC board. J8 provides power and scan-tune-rate switching to the scan tune module. Pulses from the scan tune mechanism also are routed to the scan tune module via terminals E3 through E6. J9 connects the front panel interconnect PC board to the rear panel interconnect PC board which ties all controls and switches to the signal path module, power supply, and other areas.

The front panel meter, speaker, and phones jack are connected into the front panel interconnect PC board. The speaker has a board-mounted on-off toggle switch and panel-mounted phone connector which disables the speaker when headphones are plugged into the phones jack.

All controls and switches, except for speaker on-off, provide dc levels to related receiver circuits. This includes volume control so that low level audio is not routed around outside the signal path module.

A 6.25 volt Nicad battery maintains a supply voltage on the counters on the Counter Logic PC board when the receiver is turned off. This feature holds the last frequency tuned on the receiver locked in when the ac power is turned off or temporarily lost (when the TUNE LOCK switch is in the LOCK position).

When the receiver is to be off in excess of a week, the battery may become discharged. The battery will be automatically re-charged when the receiver is turned on again.

A completely dead battery may cause the tuning mechanism to not work properly when the receiver is first turned on. A few seconds will supply enough charge to the battery for the receiver to again tune normally. Regular use of the receiver will maintain a full charge on the battery.

Ac power is routed to the front panel through a shielded cable pair which connects to the board through a "flying lead" connector wired to the power on-off/volume control.

4.8 SCAN TUNE MODULE

a. General

The Scan Tune Logic Assembly (690014-000) consists of two interlocked printed circuit boards:

1) Scan Tune Counter Board (600926-536-001).
2) Scan Tune Encoder Board (600927-536-001).

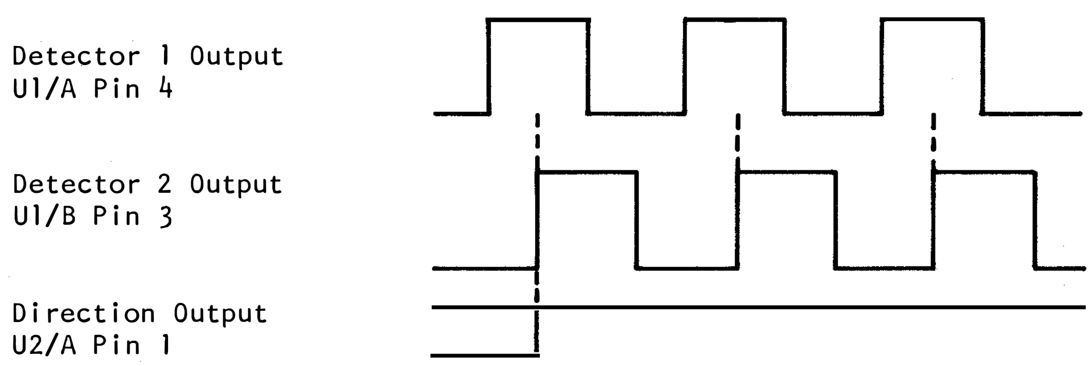
The function of this assembly is to provide BCD information to program a frequency synthesizer and BCD outputs to be decoded and displayed.

b. Circuit Description

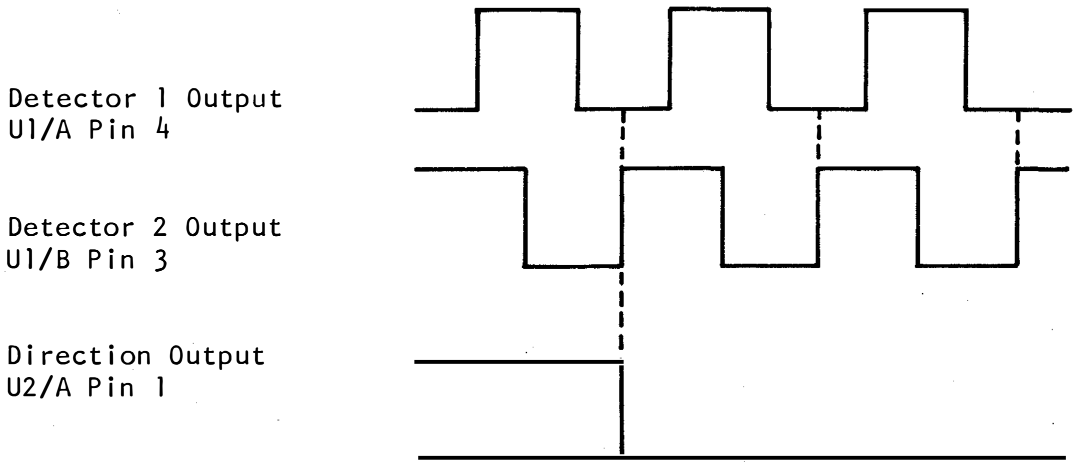
1. Scan Tune Encoder Printed Circuit Board

The Encoder Board is used to generate clock signal, count direction, count speed, and data retention command inputs to the Counter Board. Two clock pulse trains, shifted 90° relative to each other, are generated by an electro-optical system consisting of two emitter/detector modules and a metal disc with teeth, mechanically coupled to and rotated by the front panel tuning knob. The disc is positioned between the emitters and detectors such that tuning knob rotation interrupts the light paths and generates an electrical signal at the detector outputs which pulsates at a rate proportional to the speed of tuning knob rotation. Transistors Q1 and Q2 amplify the detector outputs and Schmitt Triggers U1/A and U1/B shape the signals to CMOS compatible waveforms. Flip-flop U2/A utilizes the direction sensitive 90° phase relationship between the Schmitt Trigger outputs to generate a direction logic level at its Q output as follows:

a) For clockwise rotation (count up)



b) For counterclockwise rotation (count down)



The main clock signal (U1/B Pin 3) is delayed 100µSEC by network R8, C2 to insure that the direction information at U2/A Pin 3 is stable before counterclocking occurs. Buffers U1/C and U1/D feed the delayed main clock to the Counter Board.

Inputs from the Front Panel tuning rate switches, as specified in the following table, are clocked into flip-flops U2/B, U5/A and U5/B, decoded by gates U3/A, U4/A, U4/B, U4/C and U6/D and are used to determine which Scan Tune Counter decade receives the clock signal.

TUNING RATE SWITCH POSITION

		FAST	SLOW	FINE	LOCK
INPUTS	FAST P1-26	+5V	0	0	0
	LOCK P1-25	0	0	0	+5V
	FINE P1-6	0	0	+5V	0
OUTPUTS (AFTER CLOCKING)	U2/B/13	+5V	0	0	0
	U5/B/13	0	0	0	+5V
	U5/A/1	0	0	+5V	0
	U3/A/3	0	+5V	+5V	0
	U6/D/11	+5V	+5V	10Hz $\overline{\text{carry}}$*	+5V
	U4/B/6	0	+5V	+5V	+5V
	U4/C/10	+5V	0	0	0
	U4/A/9	+5V	0	10Hz carry*	+5V

*The 10 Hz carry enters via J43.

CMOS to TTL buffer/converters U7-U11 accept the outputs of the scan tune counters and drive the 7-segment display drivers located on the receiver front panel. The four outputs of the 10 MHz scan tune counter decades are processed by U6/A, U6/B, U6/C and U3/B to generate a "2" jam input and a preset enable command for the 10 MHz counter decade to control the counter modulus. When counting up, at a counter contents of 29.99999 MHz an additional clock pulse will force the 10 MHz decade to 0 via U6/C/10 and when counting down, at a count of 0.00000 MHz an additional clock pulse will force the 10 MHz decade to 2. The other six scan tune counter decades contain internal logical feedback circuitry to effect a 9 to 0 transition on decade underflow.

2. Scan Tune Counter Printed Circuit Board

Up/down decade counters U4 through U10 comprise a counter chain with an ultimate capacity of 10,000,000 counts. Feedback circuitry as described above allows the 10 MHz decade to operate in only three states, 0, 1 and 2 thereby limiting the range of the counter in this application from a count of 0,000,000 to a count of 2,999,999. Since at maximum resolution each count represents 10 Hz of frequency, this counter range represents a 0.00000 MHz to 29.99999 MHz tuning frequency range. The count up or count down command (+5V = count up), generated on the Encoder Board, enters via P33-34 and is applied simultaneously to all counter packages. To facilitate the four tuning rates, FAST, SLOW, FINE and LOCK, the counter is divided into three portions with interconnecting logic to control the distribution of clock and carry/borrow pulses. Operation for each tuning rate is as follows:

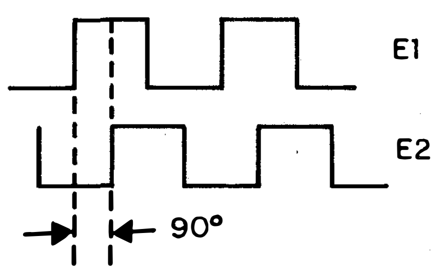
	FAST	SLOW	FINE	LOCK
U11/A/3	0	+5V	+5V	+5V
U3/A/3	0	+5V	+5V	0
U2/D/11	+5V	0	0	0
U1/B/1	CLK ÷ 4	0	0	0
U2/A/3	$\overline{\text{CLK} \div 4}$	+5V	+5V	+5V
U3/B/4	+5V	$\overline{\text{CLK}}$	$\overline{\text{CLK}}$	+5V
U3/D/11	CLK ÷ 4	CLK	CLK	0
U2/B/4	$\overline{\text{CLK} \div 4}$	+5V	+5V	+5V
U3/C/10	+5V	$\overline{\text{10 kHz carry}}$	$\overline{\text{10 kHz carry}}$	+5V
U2/C/10	CLK ÷ 4	10 kHz carry	10 kHz carry	0
U11/B/5	pos. 10 mS pulse*	0	0	0
U11/B/4	$\overline{\text{CLK} \div 4}$ or neg. pulse*	$\overline{\text{10 kHz carry}}$	$\overline{\text{10 kHz carry}}$	+5V
U11/D/11	CLK ÷ 4 or pos. pulse*	10 kHz carry	10 kHz carry	+5V

*A single pulse is generated when leaving the FAST tuning rate to inhibit clocking of U8 for ≈ 10 mS to prevent erroneous counting caused by switching transients.

In FAST, the clock signal entering via P31-32 is divided by four in U1/A, U1/B and applied to the input of U8, the 100 kHz decade. Therefore each four clock pulses increment or decrement the receiver frequency by 100 kHz. All less significant decades remain undisturbed. In SLOW, a low logic level is applied to U5/5, the clock inhibit input, to enable U5 to count the clock pulses applied to U5/15. As detailed above, the 10 kHz decade carry (or borrow) output from U7/7 is input to U8/5 to complete a six decade counter. Each clock pulse increments or decrements the receiver frequency by 100 Hz. The 10 Hz decade is undisturbed. In FINE, carry/borrow outputs from 10 Hz decade U4 are input to the 100 Hz decade U5 and outputs from 10 kHz decade U7 are input to the 100 kHz decade U8 to produce a seven decade counter. In this configuration each clock pulse increments or decrements the frequency by 10 Hz. In LOCK, counting in decades U4-U7 is prevented by a high logic level on U4/5 and U5/5 clock inhibit inputs and in decades U8-U10 by disabling the clock source to Pin 15 of these packages.

4.9 OPTO-COUPLER PC BOARD

The opto-coupler PC board has two LED/photo-transistor devices which detect direction and amount of angular displacement of a chopper disk attached to the front panel frequency tuning control. Pulses are generated at terminals E1 and E2 by allowing the disk to interrupt the light path between the LED and photo-transistor. The devices are mounted such that the chopper sequence occurs 90 degrees apart between the two outputs. Two pulse trains are then generated, phased as shown in the following diagram.



If E1 leads E2, this signifies that the disk is rotating in one direction; if E2 leads E1, this signifies rotation in the opposite direction.

The pulse trains are applied to a pluse counter, part of the scan tune module, which counts up for one direction of rotation and counts down in the opposite direction.

A resistor mounted on the opto-coupler PC board limits LED current to approximately 7 milliamperes.

4.10 DISPLAY DECODER PC BOARD

The display decoder PC board converts a BCD synthesizer address code to a

7-segment LED code. Thus a BCD digit "6" address is converted to a 7-segment display code "6".

Each display is addressed by a 74LS47 display decoder-driver chip. The interface is routed through 470 ohm resistors to limit the segment current to about 6 milliamperes. These resistors are DIP integrated circuits, each of which contains seven resistors.

The decoder also provides blanking of all digits but the 10 Hz and 100 Hz displays. Blanking occurs for all leading zeroes; thus the 10 MHz digit is blanked if it is zero. This is progressed downward sequentially. (Note that the 10 MHz digit can display "1", "2", or "blank" only.)

SECTION 5

MAINTENANCE

5.1 GENERAL

The receiver has been designed to be particularly easy to service. Routine preventative maintenance generally is not required and corrective maintenance usually consists of substituting plug-in printed circuit boards or modules.

Most of the individual PC boards are grouped and housed in plug-in modules. The individual PC boards within such a module have handles for easy extraction, are color coded, and use guide pins to ensure that they are replaced in their proper locations. In addition, each PC board and its location within the respective module are labeled.

Each module has connecting cables of sufficient length so that internal measurements can be made with the receiver operating; no extender cards, card extractors or test cables are needed. With the exception of the power supply circuits, interconnections are accomplished by "mother" boards, coaxial cables with snap-on connectors, and flat ribbon cables with plug-in connectors. Most cable connectors are color coded and the ribbon cable connectors are keyed to prevent improper connections.

Figure 5.1 depicts a top view of the receiver with the locations of the modules and printed circuit boards. Figures 5.2, 5.3, and 5.4 show, respectively, the receiver with a module being removed, the module completely removed, and the module opened with a printed circuit board removed.

5.2 MODULE AND PC BOARD REMOVAL

CAUTION
Turn off the power and disconnect the power cord before removing any components from the receiver.

a. <u>Synthesizer, Signal Path, and Scan Tune Modules</u>

The synthesizer, signal path, and scan tune modules are secured to the chassis by two nipples which protrude through clips located on the left side (looking at the front panel) of the receiver and one hex-head stop-nut secured to the chassis bottom.

Proceed as follows to remove a module.

(1) Loosen (do not remove) the stop nut.

(2) Carefully insert a screwdriver between the module and left side of the receiver.

(3) While gently prying with the screwdriver, slide the module to the right until the nipples are clear of the clips and the stop-nut is centered in the hole in the module flange (clear of the slot).

(4) Lift the module straight up and place where desired.

b. Preselector Module

Proceed as follows to remove the preselector module.

(1) Remove the synthesizer module as described above.

(2) Remove the knobs from the PRESELECTOR BAND MHz and TUNING controls.

(3) Remove the four screws securing the preselector module to the chassis bottom; they are accessible on the under side of the bottom.

(4) Slide the module straight back until the preselector tuning control shafts clear the front panel. Lift the module straight up and place where desired.

c. Printed Circuit Boards

The synthesizer and signal path module covers are secured by screws located at six places. Loosen, but do not remove, the screws to gain access to the printed circuit boards. Each PC board is secured with four corner screws. Loosen the screws and lift the PC board straight up by pulling the plastic handle.

To gain access to the PC boards in the scan tune module, remove the top and bottom covers. Loosen the screws securing the scan tune counter (lower) PC board; remove the board by carefully inserting a screwdriver through the apertures in the sides of the module and prying the board out. Remove the scan tune encoder (upper) PC board by removing the spacers and screws (if necessary).

To remove the preselector module cover, remove the two screws from the module top and the screws from the module front (two screws) and rear (two screws). The five screws located on the right (cable connect) side secure the PC board to the module.

CAUTION

When placing PC boards into their respective modules, ensure that the boards are properly seated. DO NOT BEND the PC board pins.

When reconnecting the cables, ensure that the connectors are properly seated. DO NOT FORCE the connectors together.

Observe all color coding and keying when re-assembling the receiver.

5.3 ROUTINE MAINTENANCE

The receiver is factory aligned and is designed to be highly stable. Periodic routine alignment is not necessary* and should not be attempted. Other routine maintenance should be restricted to removing dust, and a visual inspection to ensure that all internal and external connectors are properly seated.

(*Except for frequency calibration: see next paragraph.)

5.4 FREQUENCY CALIBRATION

The frequency should be calibrated once per year after the receiver is placed into service, when the synthesizer module is replaced, or when the low frequency reference printed circuit board (housed in the synthesizer module) is replaced. The frequency should not be calibrated during installation of the receiver because the equipment has been factory calibrated. This adjustment is critical and is best performed by a factory authorized technician but, if necessary, can be performed by another qualified technician if a proper frequency counter is available.

> The frequency counter <u>must</u> have precise accuracy of 0.1 ppm (1.000000 Hz at 10.000000 MHz) -- otherwise, DO NOT ATTEMPT this adjustment. If the counter is available and in working order, proceed as follows.

a. With the room temperature at 25°C (77°F) and the receiver cold, connect the counter to the external reference jack of the synthesizer module. The jack is located at the lower left corner, on the connector end of the module.

b. Turn on the receiver and allow it to warm up for five minutes (maximum).

c. Adjust the frequency control on the reference oscillator of the low frequency reference PC board (accessible through the top of the synthesizer module where labeled FREQ ADJ) as follows:

   (1) To the frequency stamped on the oscillator tab.*
   (2) To precisely 10.000000 MHz if there is no tab.

d. WWV may be utilized to confirm the oscillator setting.

L2 on the 87 MHz PC board (housed in the synthesizer module) also should be calibrated once per year, when the synthesizer module is replaced, or when the 87 MHz PC board is replaced. Proceed as follows.

a. Connect the above counter with a 50 ohm termination to J7 on the 87 MHz PC board.

b. Adjust L2 until a frequency of 87.010 MHz (-0, +200 Hz) is obtained.

*Some units must be set slightly offset from 10 MHz in order to properly meet temperature compensation specifications.

5.5 BFO AND METER CALIBRATION

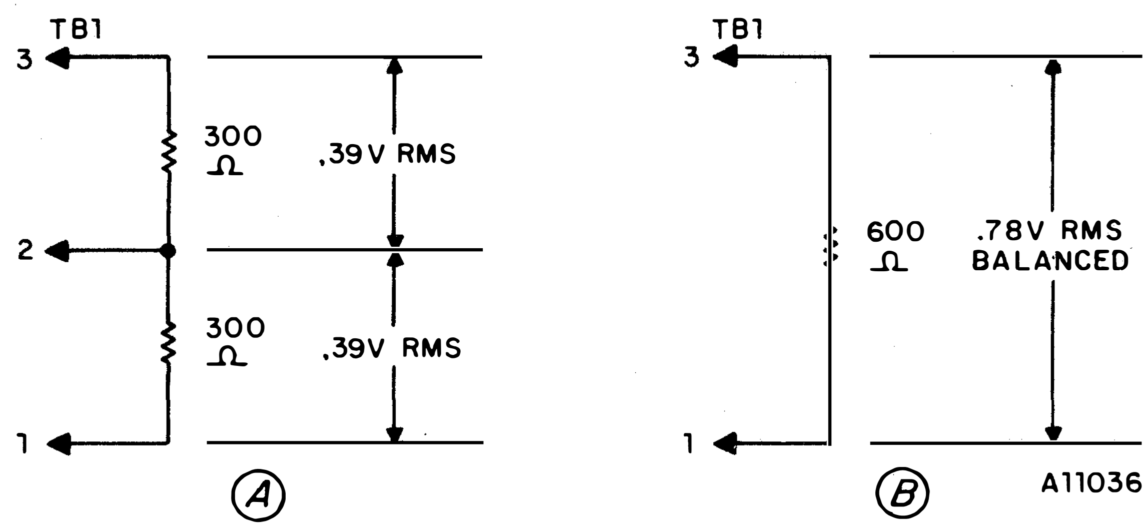
The BFO and front panel meter can be calibrated by adjusting potentiometers R4 (BFO) and R5, R6, and R7 (meter) on the rear panel interconnect PC board. The board and locations of R4 through R7 are shown in Figure 5.5.

To adjust the BFO, set the BFO MODE control to CW PRESET and tune the receiver to 00000.00 kHz. Adjust R4 to obtain a satisfactory tone -- usually 1 kHz but this is a matter of operator preference. If desired, set the frequency precisely by measuring the audio frequency at TB1 audio output terminals.

The meter must be calibrated whenever the signal path module or any of the PC boards housed therein are replaced, or whenever any voltage regulator is replaced. This procedure is not intended for installation or preventive maintenance calibration. An external signal generator is required to calibrate the meter. Proceed as follows.

a. Tune the receiver to 00001.00 kHz, set the MODE switch to CW FIXED, set the IF BANDWIDTH to 8 kHz, and turn the AGC ON (FAST or SLOW).

b. Connect a 600 ohm load across the TB1 output terminals as shown in the following diagram.



Part "A" of the above diagram depicts a method of terminating the output so that an unbalanced meter can be used to measure the voltage levels. If a balanced meter is available, it can be used, as depicted in Part "B" of the above diagram. (CAUTION: Do not connect the grounded side of the meter to pin 1 or to pin 3 of TB1.)

If the meter does not read the voltages depicted in the diagram, adjust R20 on the audio amplifier PC board to obtain the correct level.

c. When the correct level has been obtained at TB1, depress the METER DISPLAY AF pushbutton on the receiver front panel and adjust R7 (audio) to obtain a 0 dBm reading on the front panel meter. The meter will now read correctly for line levels up to +10 dBm.

d. The signal generator must be used to adjust the rf meter (see item e, below). Tune the receiver to 4 MHz, set the PRESELECTOR to WIDEBAND, turn the AGC ON, set the IF BANDWIDTH to 8 kHz, and set the MODE switch to AM. Depress the RF pushbutton. Connect the signal to the rear panel antenna connector of the receiver and apply a 100 mV rms unmodulated signal to the receiver. Adjust R6 (range) to obtain a full scale reading. Reduce the input signal level to 1 uV and adjust R5 (span) for a zero reading. Repeat the two procedures until there is no interaction.

e. If a signal generator is not available, a crude adjustment can be accomplished by tuning the receiver to 00000.00 kHz, adjusting R6, tuning to 29,999.99 kHz, and adjusting R5. Repeat these procedures until there is no interaction. With this method, readjustment of R5 and R6 will be required with a signal generator to obtain proper meter calibration.

5.6 AC FUSE REPLACEMENT

The ac fuse is housed in Filter FL1 located on the rear panel. Proceed as follows to replace the fuse.

a. Remove the power cord from FL1.

b. Slide the clear plastic cover all the way to the left.

c. Move the FUSE PULL lever to the left and the fuse will pop out of the holder.

d. Move the FUSE PULL lever all the way to the right.

e. Replace the fuse.

f. Slide the cover all the way to the right and replace the power cord.

If it becomes necessary to replace the fuse due to a change in ac voltage (for example, from 110 to 220 VAC or from 220 to 110 VAC), it also is necessary to change the position of the voltage board, located below the fuse. See AC OPERATION in the INSTALLATION section.

5.7 RTTY FILTER ADDITION

The RTTY filter can be added to units in the field by either exchanging pc boards or modifying the existing filter board. This should be done by a factory authorized technician. See page 6.7 for a list of parts which must be ordered to modify an existing filter board. Refer to schematic and assembly drawings for wiring details.

5.8 TROUBLESHOOTING GUIDE

CAUTION

Turn off the power and disconnect the power cord before removing any modules, module covers, or PC boards.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
a. <u>Receiver</u>		
Receiver power switch on but meter light off.	1. Power cord not properly connected. 2. Fuse blown. 3. Improper ac voltage selected on FL1 voltage board. 4. Interconnect cables not properly seated. 5. +12 VDC supply out (refer to the schematics for the front and rear panel interconnect PCBs, interconnect diagram, and Figure 5.6).	1. Ensure power cord is plugged in. 2. Replace fuse. 3. Set voltage board to proper ac voltage. 4. Ensure all cable connectors are properly seated. 5. Check E6 on the rear panel interconnect PCB. If 0 VDC, check +12V regulator -U1 on the rear panel or bridge CR1. If low voltage, remove the ribbon cables from J1-J4 on the rear panel interconnect PCB and again check for +12 VDC at E6.
No noise at speaker with: (a) No signal input. (b) Volume fully CW. (c) RF gain off (fully CCW). (d) AM mode. (e) Bandwidth = 8 kHz. (f) Speaker on. (g) No phone plug.	1. Ribbon or RF coaxial cables improperly seated. 2. Front panel settings incorrect. 3. Signal path continuity problem.	1. Ensure all cables are properly seated, including those to rear panel interconnect PCB. 2. Ensure front panel controls are set as described in SYMPTOM column. 3. Remove signal path module and uncover 5 MHz i-f and audio amplifier PCBs. (a) Ensure PCBs and cables are properly seated. (b) P15 of audio amplifier PCB should measure +12 VDC. (c) P7 of audio amplifier PCB should measure less than +8 VDC at full volume. U2 should be warm; replace if it is very hot. (d) Voltages on the pins of U1 and U2 of audio amplifier PCB should correspond to those shown on the PCB schematic. (e) P6 and P15 of 5 MHz i-f PCB should measure +12 VDC.
Receiver does not tune to a signal but noise is present at the speaker.	1. Cables improperly seated. 2. Front panel control settings incorrect.	1. Ensure all ribbon and coaxial cables are seated (remove top cover to check). 2. Ensure frequency select control is properly set; preselector is on wideband or tuned to correct frequency; antenna attenuator is off; mode switch is set to correct position for type of signal desired (i.e., AM, CW, USB, etc.).

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
	3. External signal generator setting incorrect (for example, during frequency calibration).	3. Ensure generator is set to the receiver tuned frequency; the modulation corresponds to that of the receiver; the rf output of the generator is above sensitivity threshold level of receiver (see specifications).
	4. Synthesizer not locked or has low level.	4. Check 92-122 MHz synthesizer rf output for: (a) V_{out} = 0 dBm (224 mV) $\pm$ 2 dB (178-282 mV) (b) $f_{out} = f_{dial}$ + 92.1- MHz (c) Loss-of-lack lamp on rear panel PCB is <u>out</u> if synthesizer is locked.
	5. 87 MHz synthesizer output absent or has low level.	5. Check 87 MHz synthesizer output for: (a) V_{out} = -3 dBm (159 mV) $\pm$ 3 dB (112-224 mV) (b) f_{out} = 87.010 MHz $\pm$ 1.7 kHz
	6. 5 MHz synthesizer rf output absent or has low level.	6. Check 5 MHz synthesizer output for: (a) V_{out} = -14 dBm (45 mV) $\pm$ 2 dB (35-56 mV rms) (b) f_{out} = 5.000 MHz in CW FIXED or USB modes = 4.999-5.002 MHz in CW VAR and CW PRESET
	7. Synthesizer locked to wrong frequency.	7. Check 92-122 MHz synthesizer output for stable output frequency that changes in steps with any selected front panel frequency digit change.

NOTE - when items 4 through 7 apply, refer to troubleshooting guide section b, "Synthesizer".

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
	8. Signal path module problem.	8. Remove signal path module and uncover the PC boards. (a) Check P5 on 5 MHz i-f PCB for +12 VDC. (b) If the rf meter reading does not change with input signal level, check front end PCB, information filter PCB, 5 MHz i-f PCB, and rear panel PCB.
	9. Information filter or 5 MHz i-f PCB problems.	9. Remove signal path module and uncover information filter and 5 MHz i-f PCBs. Set the receiver to CW PRESET mode, 8 kHz bandwidth, and apply a 5 MHz, 50 mV rms signal to J1 of information filter PCB. (a) Check P13 of information filter PCB for +12 VDC. If a tone is present at the speaker, the problem is in the front end interconnect PCB. (b) If there is no tone, check the rf level at P14 of the 5 MHz i-f PCB (about 35 mV) with a high impedance rf voltmeter. If the level is correct, the problem is in the 5 MHz i-f PCB or in the connections to that board from the information filter PCB.
	10. Front end interconnection PCB problem.	10. Check the front end interconnect PCB for the following: (a) P4 should measure +12 VDC. (b) P6 should measure +20 VDC. (c) TP3 should measure greater than 8 VDC (AGC line: less than 8V = front end gain reduced).

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
		(d) Measure TP2 with rf voltmeter for: $V_{TP2} \simeq 1.2V$ rms; $f_{TP2} = 92.01\text{-}122.01$ MHz (e) Measure TP4 with high impedance rf voltmeter for: $V_{TP4} \simeq 1.2V$ rms; $f_{TP4} = 87.010$ MHz (f) Apply a 500 uV signal to J1 at the frequency to which the receiver is tuned. Measure J6 with a 50 ohm rf voltmeter for: $V_{J6} \simeq 10$ mV; $f_{J6} = 5$ MHz
b. <u>Synthesizer</u>		
(1) <u>92-122 MHz Output Defective</u>		
Frequency correct but output level low.	1. Cable from J1 on major loop PCB to module bulkhead loose or broken.	1. Check J1 on major loop PCB with rf voltmeter for $V_{out} = 178\text{-}282$ mV.
	2. Q3 defective on major loop PCB.	2. Check TP1 on major loop PCB with rf voltmeter for $V_{TP1} = 178\text{-}282$ mV.
No output.	1. 12 VDC supply out. 2. 20 VDC supply out. 3. Major loop regulator out. 4. Cable from J1 on major loop PCB to module bulkhead loose or broken.	1. Check P5 on major loop PCB for +12 VDC. 2. Check P6 on major loop PCB for +20 VDC. 3. Check emitter of Q4 on major loop PCB for +18.5 VDC. 4. Check output at J1 on major loop PCB with rf voltmeter (178-282 mV).
Output level correct but frequency wrong.	1. Major loop unlocked.	1. Check the following: (a) LED on major loop (on = unlocked). (b) P4 of major loop PCB for +5 VDC. (c) P7 of major loop PCB for 100 kHz TTL waveform. (d) J2 of major loop PCB with rf voltmeter for: $f_{in} = 88.010\text{-}88.110$ MHz; $V_{in} = 36\text{-}71$ mV
	2. Major loop locked but frequency incorrect.	2. Check for the following: (a) Loose address pins P11-P20 on major loop PCB and P6-P21 on minor loop PCB. (b) Defective frequency address cable between front panel frequency control and synthesizer module.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
	3. Minor loop unlocked.	3. Check for the following: (a) LED on minor loop (on = unlocked). (b) P25 of minor loop for +5 VDC. (c) P26 of minor loop for +12 VDC. (d) P27 of minor loop for +20 VDC. (e) P3 of minor loop for 1.00000 to 1.09999 MHz waveform. (f) P29 of minor loop for 1 kHz TTL waveform.
	4. Loop translator unlocked.	4. Check for the following: (a) LED on loop translator (on = unlocked). (b) P8 of loop translator for +12 VDC. (c) P7 of loop translator for +5 VDC. (d) J2 of loop translator with rf voltmeter for: V_{in} = 112-224 mV f_{in} = 87.010 MHz (e) P3 of loop translator for 1.00000 to 1.09999 MHz TTL waveform.
	5. 87 oscillator frequency wrong.	5. Check for the following: (a) P7 and P8 of 87 MHz oscillator with rf voltmeter for: f_{out} = 87.010 MHz V_{out} = 112-224 mV rms (b) P4 of 87 MHz oscillator for +12 VDC.
	6. No 100 kHz or 1 kHz TTL reference waveforms.	6. Check for the following: (a) P13 of low frequency reference for +20 VDC. (b) P17 of low frequency reference for +5 VDC. (c) U13, pin 11 of low frequency reference for 100 kHz TTL waveform. If absent, check Y1, Q1, Q2, Q4, U11.
	7. 1 kHz TTL waveform present, 100 kHz TTL waveform absent.	7. Check U5 of low frequency reference.
	8. 100 kHz TTL waveform present, 1 kHz TTL waveform absent.	8. Check U5, U8, U9, U10 of low frequency reference.
(2) <u>87 MHz Output Defective</u>		
No output.	1. Cable from J7 of 87 MHz oscillator to module bulkhead loose or broken.	1. Check J7 or 87 MHz oscillator with rf voltmeter for: f_{out} = 87.010 MHz V_{out} = 122-224 mV
	2. Power supply out.	2. Check P4 of 87 MHz oscillator for +12 VDC.
(3) <u>5 MHz Output Defective</u>		
No output in CW or USB modes.	1. Cable from J6 of low frequency reference to module bulkhead loose or broken.	1. Check J6 of low frequency reference with rf voltmeter (CW mode) for: f_{out} = 5.000 MHz V_{out} = 36-56 mV

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
No output in CW PRESET or CW VARIABLE modes.	1. BFO inoperative.	1. Check for the following: (a) J4 on 5 MHz BFO PCB with rf voltmeter for: V_{out} = 180-500 mV rms f_{out} = 4.999-5.002 MHz (b) P5 on BFO for +12 VDC. (c) P6 on BFO for 0-12 VDC (varies with tuning of front panel BFO control in CW VARIABLE mode; varies with setting of R4 on rear panel PCB in CW PRESET mode).
	2. Cable between 5 MHz BFO and low frequency reference loose or broken.	2. Check J5 on low frequency reference with rf voltmeter for the following: V_{in} = 180-500 mV rms f_{in} = 4.999-5.002 MHz
	3. Low frequency reference PCB defective.	3. Check for the following: (a) P2 of low frequency reference for 0 VDC (less than 1.0 VDC).
(4) <u>Clarifier Inoperative</u>		
	1. Loose or broken pins or cables.	1. Check for the following: (a) P15 on low frequency reference for +12 VDC. (b) P20 on low frequency reference for 0 VDC when clarifier enabled. (c) P21 on low frequency reference for 0-12 VDC. (d) P8 on low frequency reference for 1 kHz TTL waveform. If present, check Q7, Q8, U6, U7, U8.
c. <u>Scan Tune Components</u>		
All segments of 7-segment frequency display LEDs do not illuminate when receiver has been turned off continuously for over 14 days.	This is normal due to discharging of the battery.	None. LED displays should function normally after frequency has been dialed. Battery should re-charge after continuous receiver operation for 12-24 hours.
Improper or erratic frequency display; partial or missing digit(s).	Faulty pin connections between scan tune encoder and scan tune counter PCBs; faulty connections between ribbon cable connectors and card edges or pin connectors.	Check alignment of pins, looking for bent, damaged, or missing pins within scan tune module. Check pins on display decoder PCB. Check ribbon cable connections to front panel interconnect PCB.
Entire frequency display turned off or complete scan tune malfunction.	Loss of 12 VDC or 5 VDC in receiver power supply.	1. Check entire power supply. 2. Check for 5 VDC at pin 1 of U7. 3. Check for 12 VDC at anode of CR2 on scan tune encoder PCB.
One of the tuning rates (LOCK, FAST, SLOW, or FINE) does not function.	1. Faulty ribbon cable connection. 2. Defective IC(s) such as U2 or U5 on encoder PCB.	1. Ensure ribbon cable connections are secure. 2. Replace scan tune encoder PCB or scan tune module.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDED ACTION
Scan tune counts up only, or does not count.	1. Connections to opto-coupler PCB faulty.	1. While slowly tuning the frequency, check voltages at E2 and E1 on opto-coupler PCB; pulses of 1-2 VDC to 5 VDC should be present from OC1 and OC2. Check wires to E1 through E4 on opto-coupler PCB.
	2. OC1 or OC2 defective.	2. Replace opto-coupler PCB.
Dial frequency does not remain constant during power shutdown.	1. Defective battery.	1. Replace battery.
	2. Defective charging circuit.	2. Replace scan tune encoder PCB or scan tune module.
	3. LOCK pushbutton not depressed.	3. Depress LOCK pushbutton.
Incorrect frequency address going to the synthesizer module.	1. Defective component(s) in major or minor loop PCBs, affecting scan tune outputs.	1. Disconnect ribbon cable at J2 of synthesizer module. If this causes a change in frequency display, replace scan tune encoder PCB or scan tune module.
	2. Faulty connection to scan tune module or J2 of synthesizer module.	2. (a) Check connections. (b) Replace synthesizer module; replace mother board, major loop PCB, and/or minor loop PCB.
Synthesizer tracking with scan tuning but frequency display is incorrect. Display LED segments missing or digits do not change.	1. Faulty pin connections.	1. (a) Check pin alignment and check for bent, missing, or damaged pins. (b) Ensure that display decoder PCB is securely mounted on front panel interconnect PCB. (c) Ensure that ribbon cable connections to front panel interconnect PCB are secure.
	2. Defective display decoder PCB.	2. Replace display decoder PCB.
Displayed frequency is greater than 29.99999 MHz or display does not clock back to zero at end of frequency range.	1. Faulty pin connections within scan tune module.	1. Check pin alignment between scan tune encoder and scan tune counter PCBs. Check for bent, damaged, or missssing pins.
	2. Faulty scan tune counter PCB.	2. Replace scan tune counter PCB or scan tune module.

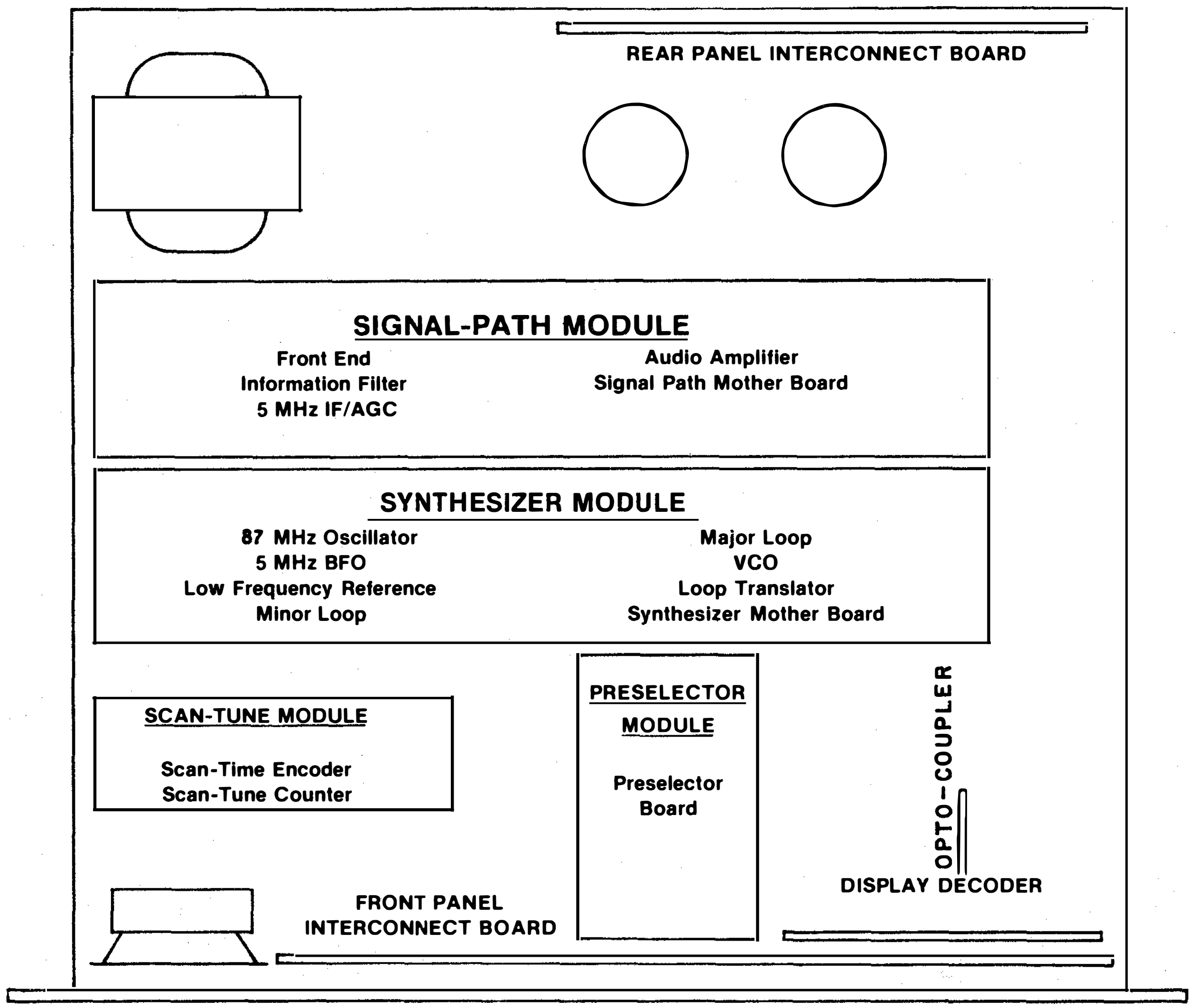


Figure 5.1. Locations of PC boards and modules (top view)

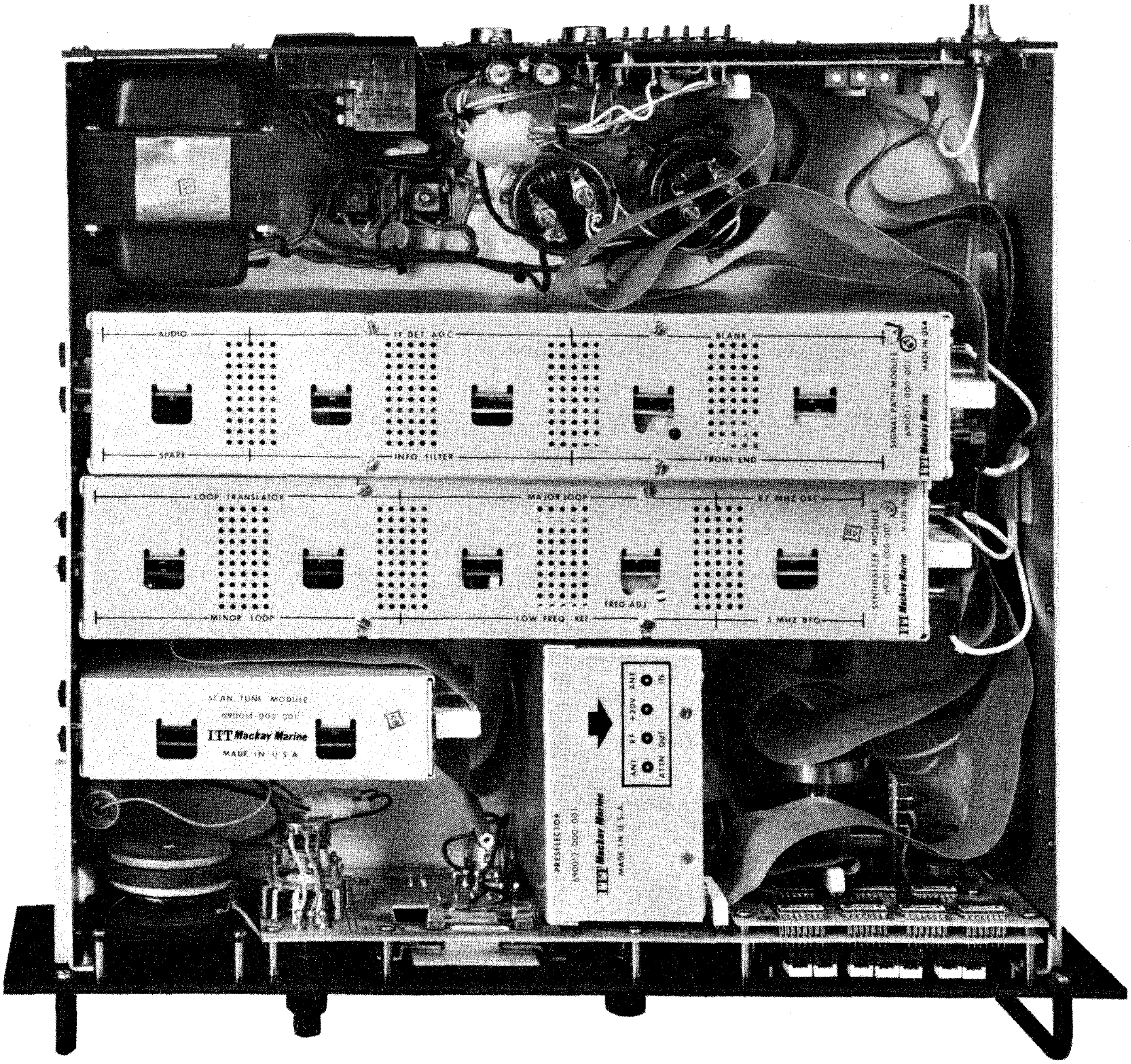


Figure 5.2. Receiver top view, cover removed and signal path module being removed

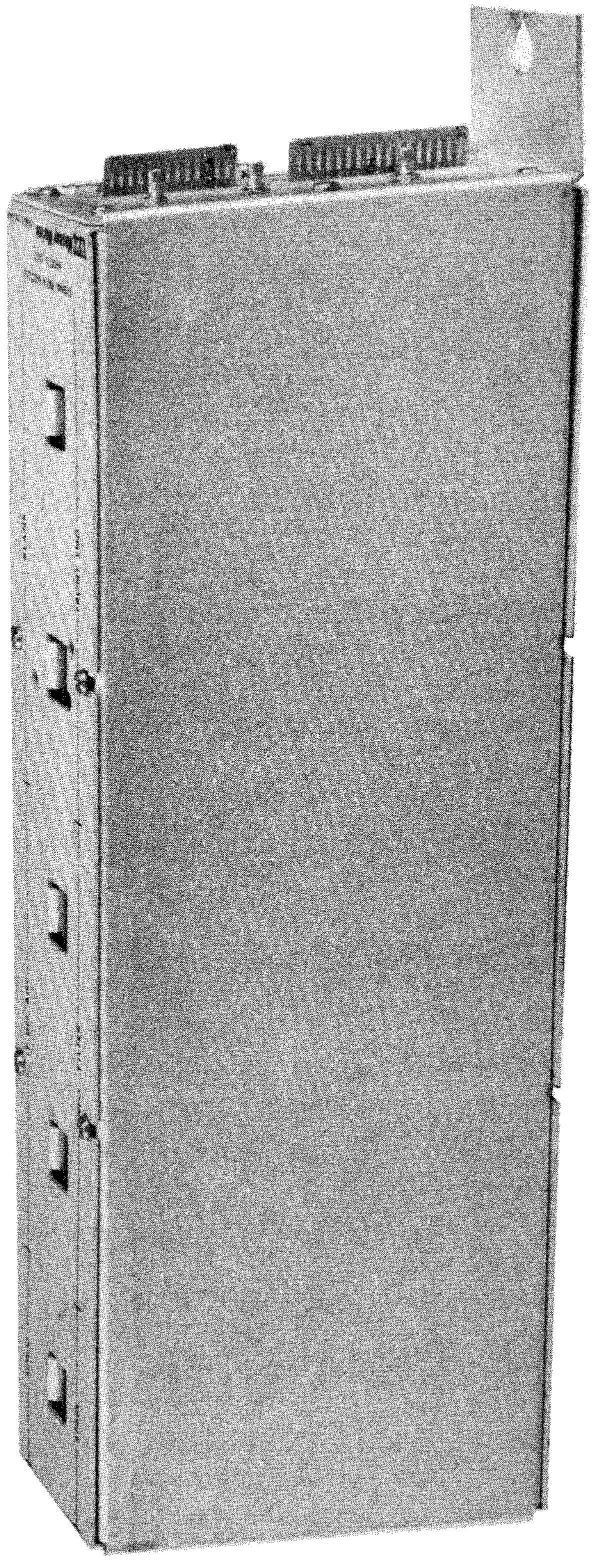


Figure 5.3 Signal path module removed from receiver

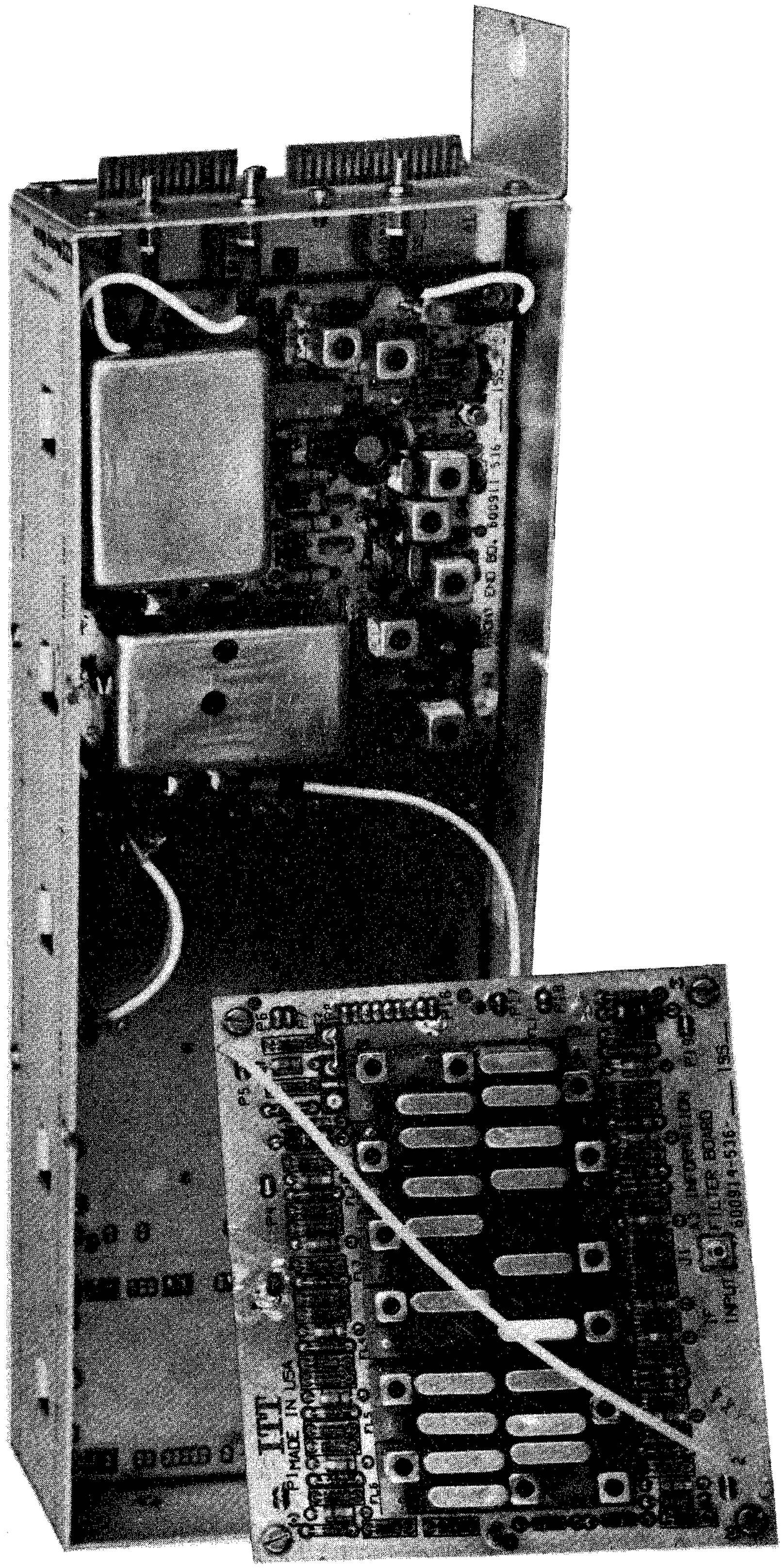


Figure 5.4 Signal path module opened, information filter PCB removed

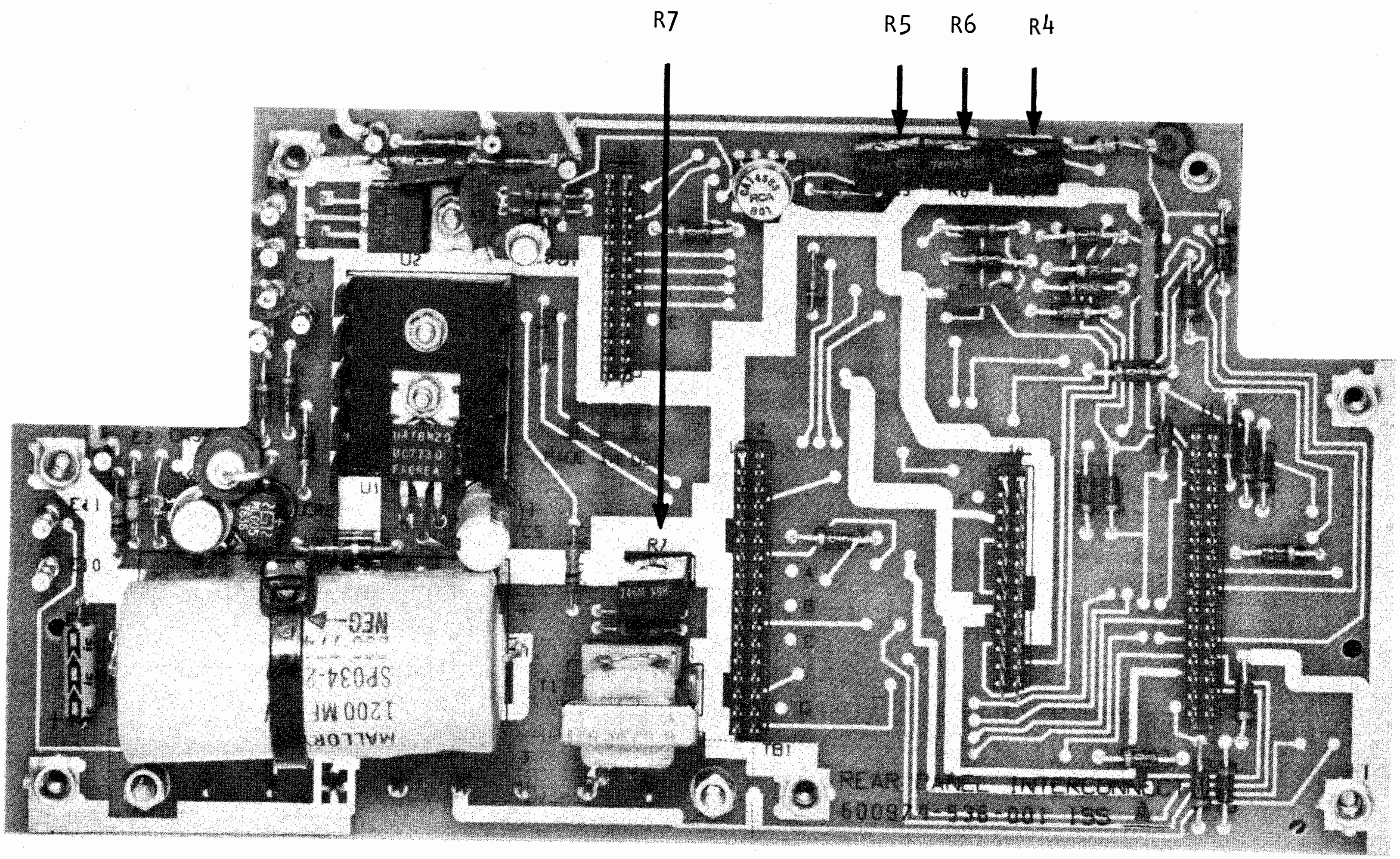


Figure 5.5 Rear panel interconnect PCB with locations of R4-R7

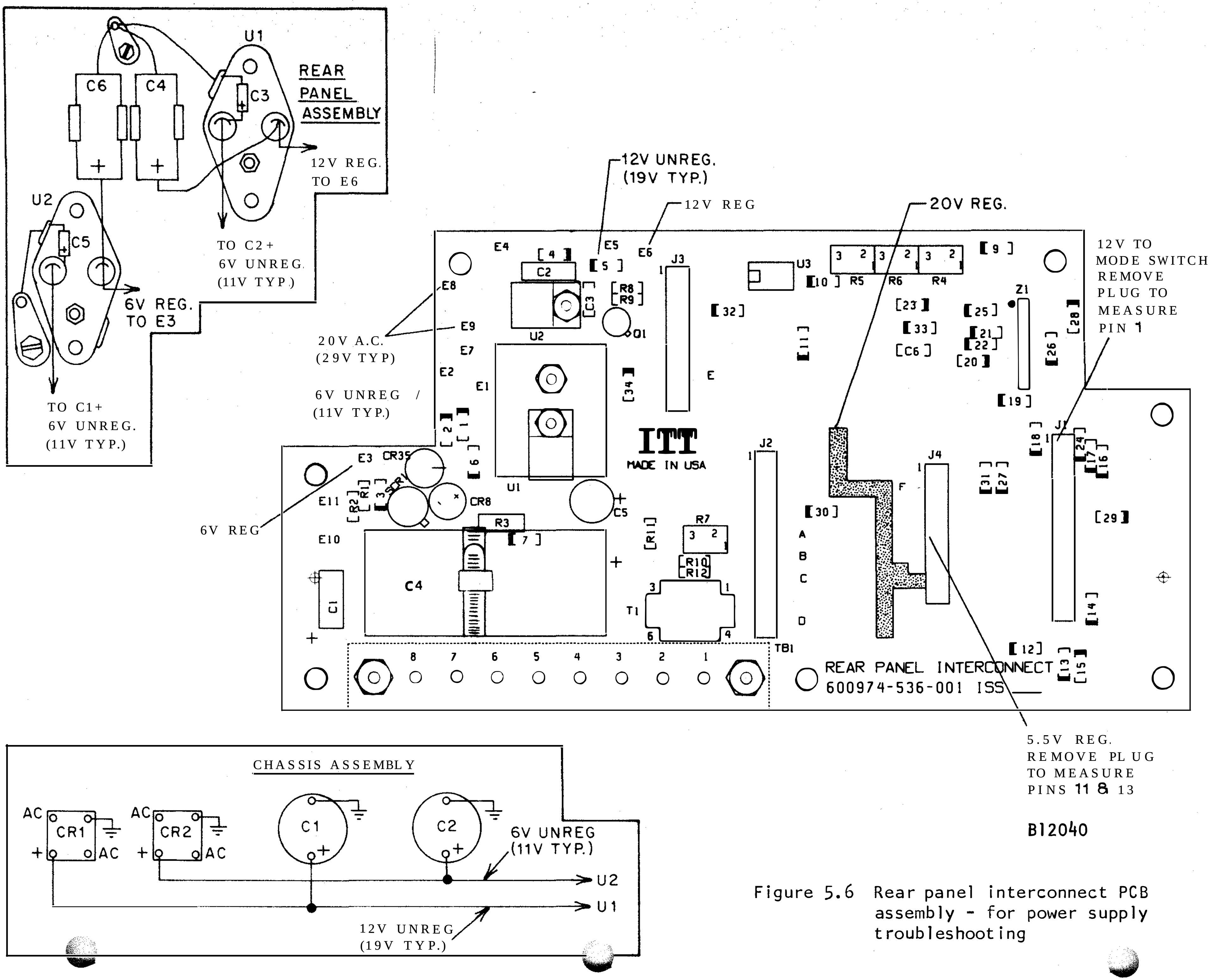


Figure 5.6 Rear panel interconnect PCB assembly - for power supply troubleshooting

SECTION 6

REPLACEABLE PARTS

3031A
(600165-800-001)

SYMBOL	DESCRIPTION	PART NUMBER
A11	Preselector Assembly	690012-000-001
A14	Signal Path Module	690013-000-001
A12	Scan Tune Module	690014-000-001
A13	Synthesizer Module	690015-000-001
A10	Front Panel Assembly	600048-539-001
A15	Rear Panel Assembly	600051-539-001
C1	Capacitor, 9100 uF, 35V	600183-314-025
C2	Capacitor, 12,000 uF, 20V	600183-314-024
-	Line Cord, ac	600078-102-001
CR1, CR2	Rectifier, bridge	600032-416-002
R1	Resistor, 1.3K, 1W, 5%	613014-341-325
R2	Resistor, 510 ohm, 1W, 5%	651004-341-325
T1	Transformer, power supply	600101-512-001
-	Lens, display	600461-609-001
-	6.25-volt Nicad Battery/Cable Assembly	600118-540-001
-	Battery Clip	600132-233-002

FRONT PANEL SUB ASSEMBLY
(600048-539-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1	Front Panel Interconnect PCB (includes Display Decoder PCB 600975-536-001)	600972-536-001
M1	Meter, audio dB	600030-368-001
SP1	Speaker	600008-370-001
A2	Scan Tune Mechanism	600052-539-001

FRONT PANEL INTERCONNECT PCB
(600972-536-001)

SYMBOL	DESCRIPTION	PART NUMBER
-	Display Decoder PCB	600975-536-001
C3	Capacitor, 1 uF, 50V	600259-314-101
C4, C5, C7, C8	Capacitor, 0.1 uF, 16V	600189-314-056
C6	Capacitor, 100 uF, 25V	600259-314-111
DS8	Lamp, +12V	600056-390-001
DS1 thru DS7	LED Display (HP 7610 or MAN 3620 readouts)	600256-415-001
S1, S6	Switch, DPDT, 4-position	600216-616-003
S10	Switch, DPDT, 2-position	600216-616-001
S4, S8, S9	Switch, DPDT, toggle	600219-616-001
S5/R10	Switch, SP 6-position	600221-616-001
S2/R3	Switch/potentiometer, 10K	600092-360-001
S7/R8	Switch/potentiometer, 10K	600092-360-002
S3/R5	Switch/potentiometer, 10K	600091-360-002
R1	Resistor, 470 ohm, 1/4W, 5%	647004-341-075
R2	Resistor, 4.7K, 1/4W, 5%	647014-341-075
R4	Resistor, 30K, 1/4W, 5%	630024-341-075
R6	Resistor, 10 ohm, 1W, 5%	610094-341-325
R7	Resistor, 2.7K, 1/4W, 5%	627014-341-075
R9	Resistor, 8.2K, 1/4W, 5%	682014-341-075
Z1	Resistor pack, 4.7K X 7	600201-537-001

REAR PANEL ASSEMBLY
(600051-539-001)

SYMBOL	DESCRIPTION	PART NUMBER
FL1	Corcom Filter	600070-529-001
A4	Rear Panel Interconnect PCB	600974-536-001
U1	Regulator, LAS 1412, 12V	600301-415-003
U2	Regulator, LAS 1406, 6V	600301-415-002
C4, C6	Capacitor, 500 uF, 25V	600259-314-103
C3, C5	Capacitor, 1 uF, 35V	610045-319-350
-	*Fuse, 3/4A, 250V, Slo-Blo (for 110V operation)	600006-396-017
-	*Fuse, 3/8A, 250V, Slo-Blo (for 220V operation)	600006-396-012

*Either fuse installed in FL1, depending on voltage source.

SYNTHESIZER MODULE
(690015-000-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1	Mother Board	600925-536-001
A2	5 MHz BFO PCB	600924-536-001
A3	Low Freq. Reference PCB	600920-536-001
A4	Minor Loop PCB	600920-536-001
A5	87 MHz Oscillator PCB	600923-536-001
A6	Major Loop PCB	600919-536-001
	Major Loop VCO PCB (mounted on A6)	600918-536-001
U1	Integrated Circuit μA7812C	600296-415-001

PRESELECTOR MODULE
(690012-000-001)

SYMBOL	DESCRIPTION	PART NUMBER
-	Preselector PCB	600959-536-001
-	Preselector PCB*	600959-536-002
C1	Capacitor, variable	600051-317-001
C2, C3	Capacitor, feedthrough	600219-314-001

*600959-536-002 used only in receivers 600165-800-005 and 600165-800-013.

SIGNAL PATH MODULE
(690013-000-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1	Mother Board	600916-536-001
A2	Front End PCB	600911-536-002
A3	Information Filter PCB (with optional RTTY filter 600914-536-001)	600914-536-002
A4	5 MHz i-f PCB	600912-536-002
A6	Audio Amplifier PCB	600913-536-002

PARTS REQUIRED TO ADD AN RTTY FILTER TO AN EXISTING BOARD

TOTAL QTY. REQ'D	REF. DESIGNATION	DESCRIPTION	PART NUMBER
2	L13, L14	Choke, 33 uH	600125-376-007
4	C23, 24, 25, 26	Capacitor, 0.1 mF	600272-314-001
2	CR11, CR12	Diode 1N4148	600109-410-001
1	FL6	Filter, RTTY	600068-529-001

SCAN TUNE MODULE
(690014-000-001)

SYMBOL	DESCRIPTION	PART NUMBER
-	Scan Tune Encoder PCB	600927-536-001
-	Scan Tune Counter PCB	600926-536-001

SCAN TUNE MECHANISM
(600052-539-001)

SYMBOL	DESCRIPTION	PART NUMBER
-	Opto-Coupler PCB	600961-536-001
-	Block, bearing assembly	600029-620-001
-	Spacer	600172-637-001
-	Shaft	600052-615-001
-	Flywheel, front	600007-627-001
-	Flywheel, rear	600008-627-001
-	Disc, chopper	600009-627-001
-	Ring, retainer	600020-239-001
-	Collar	600050-625-001
-	Washer, internal tooth, #4	622004-217-005
-	Nut-lock, 1/4-20 UNC	600050-212-009
-	Screw, PHM, #4-40	690440-203-165
-	Grease, silicon	600006-112-001

SECTION 7

STANDARD SPARE PARTS
(600164-817-001)

QUANTITY	DESCRIPTION	PART NUMBER
5	Fuse, 3/4A, 250V, Slo-Blo (for 110VAC operation)	600006-396-017
5	Fuse, 3/8A, 250V, Slo-Blo (for 220VAC operation)	600006-396-012
5	Lamp, 12V	600056-390-001

Additional spare parts lists which include special (optional) spares are available from the ITT Mackay Marine Service Department.

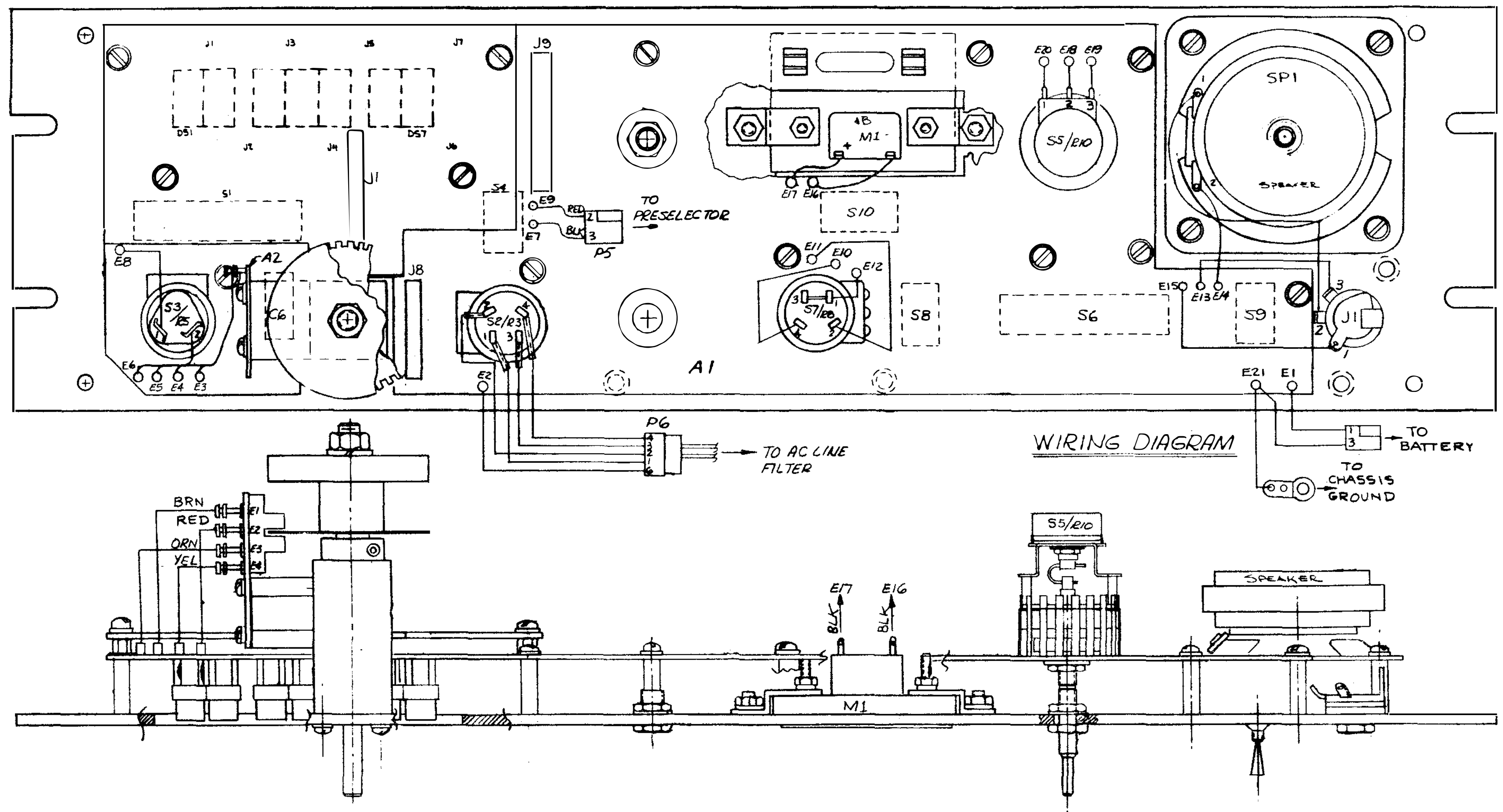
SECTION 8

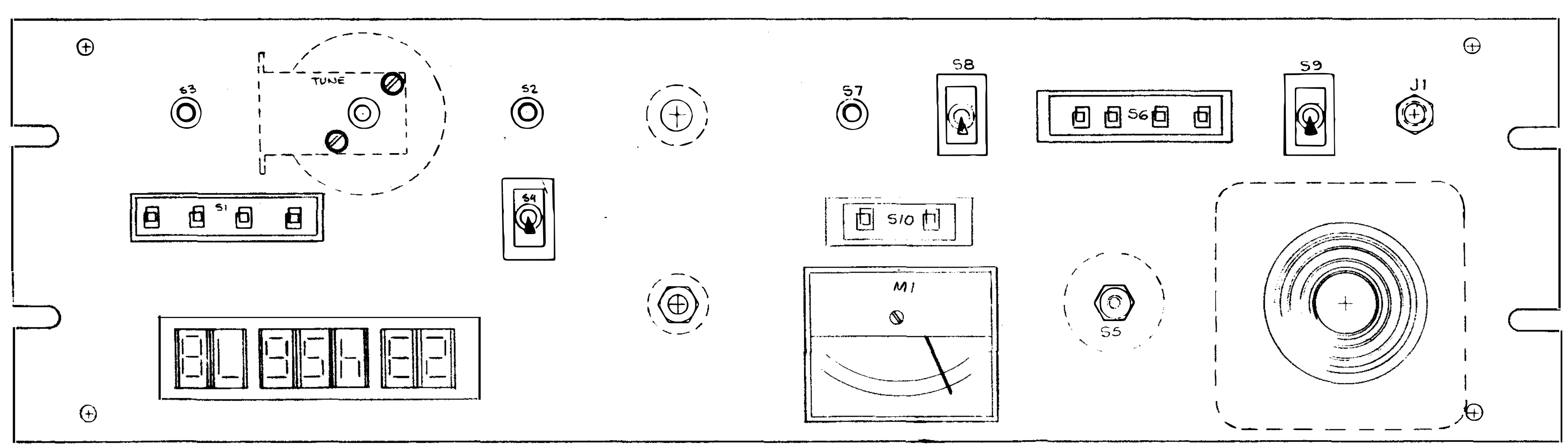
SCHEMATIC AND ASSEMBLY DRAWINGS
INDEX

SCHEMATIC AND ASSEMBLY DRAWINGS
INDEX
(continued)

NOTE

Many of the boards and modules used in this receiver are designed to be used in other SSB products. Consult schematics CAREFULLY, paying particular attention to notes which explain the various configurations.





WIRING DATA								
FROM		TO						
SYM NO.	PIN	WIRE NO.	SYM NO.	PIN	SIZE AWG	COLOR	LG/IN	ITEM
A2	E1	1	A1	E5	20 GA	BRN	4.5	22
	E2	2		E3		RED	4.0	23
	E3	3		E6		ORN	4.0	24
	E4	4		E4		YEL	4.25	25
M1	+	5	A1	E17		BLK	1.75	26
	−	6		E16		BLK	2.0	26
SP1	1	7	J1	2		RED	7.75	23
	2	8	A1	E14		BLK	2.5	26
J1	1	9		E15		BRN	4.5	22
	3	10		E13	20 GA	ORN	3.5	24

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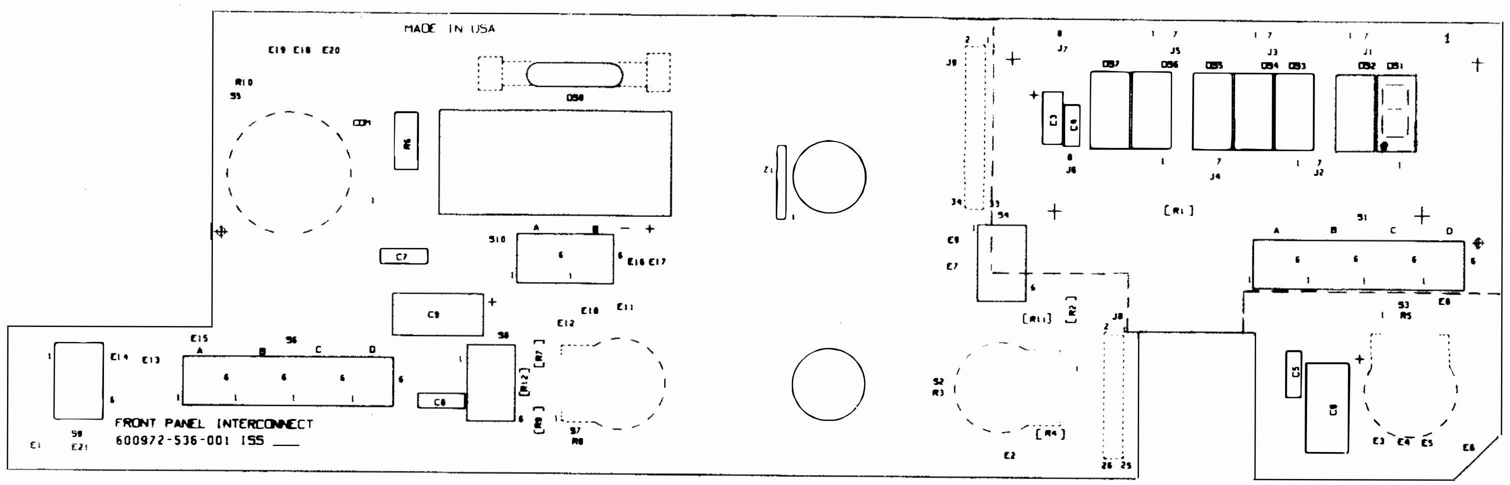
FRONT PANEL SUBASSEMBLY

D | 600048-539 | D



WIRING DATA								
FROM		TO						
SYM. NO.	PIN	WIRE NO.	SYM NO.	PIN	SIZE AWG	COLOR	LG/IN	ITEM
S3	1	1	A1	E8	20 AWG	BLK	2.5	57
	2	2		E6		BLK	2.5	57
S5	1	3	A1	E20		BRN	2.0	53
	2	4		E18		RED	2.0	54
	3	5		E19		ORN	2.0	55
S7	1	6	A1	E12		BLK	1.75	57
	2	7		E11		BLK	2.0	57
	4	8		E10		BLK	2.5	57
	1	9	S7	3		BLK	.75	57
P4	1	10	A1	E1		RED	—	49
	3	11		E2		BLK	—	49
P5	2	12	A1	E9		RED	2.5	54
	3	13		E7		BLK	2.5	57
P6	1	14	S2	1		BRN	3.0	53
	2	15		2		RED	3.0	54
	3	16		3		ORN	3.0	55
	4	17		4		YEL	3.0	56
	6	18	A1	E2	20 AWG	BLK	3.5	57
A1	E21	19	—	—	16 AWG	BLK	3.0	50/58

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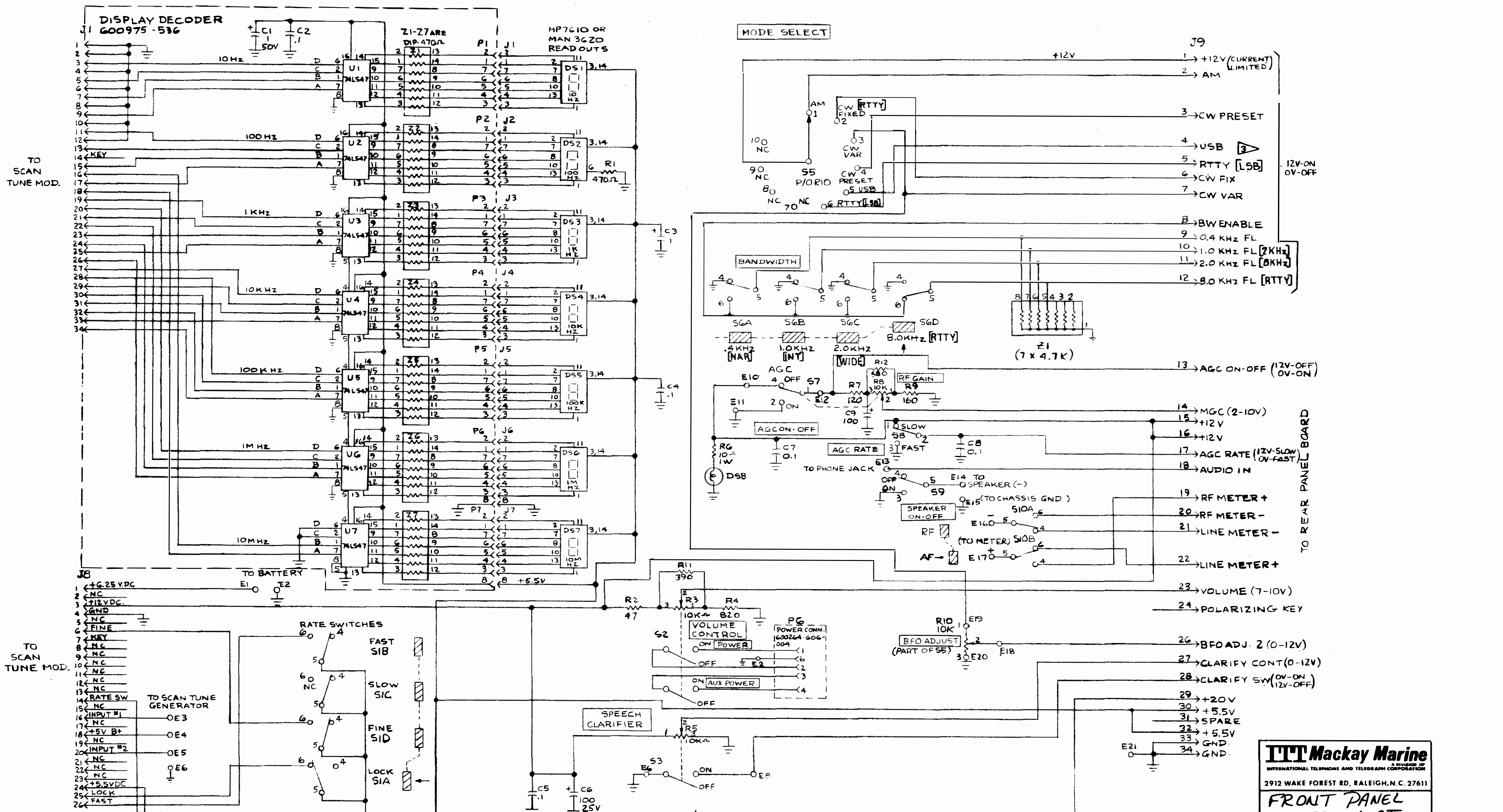
FRONT PANEL INTERCONNECT PCB ASSEMBLY

D	600972-536	E



NOTES:
1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5%, ALL CAPACITORS ARE IN µF, UNLESS OTHERWISE SPECIFIED.
2. LAST USED: C8, DS8, E20, J9, Z1, R10, S10 FOR 600972-536 (C1,2 NOT USED). P7, U7, Z7, C2 FOR 600975-536
3. DESCRIPTION INSIDE BRACKET [ ] IS FOR 3041.

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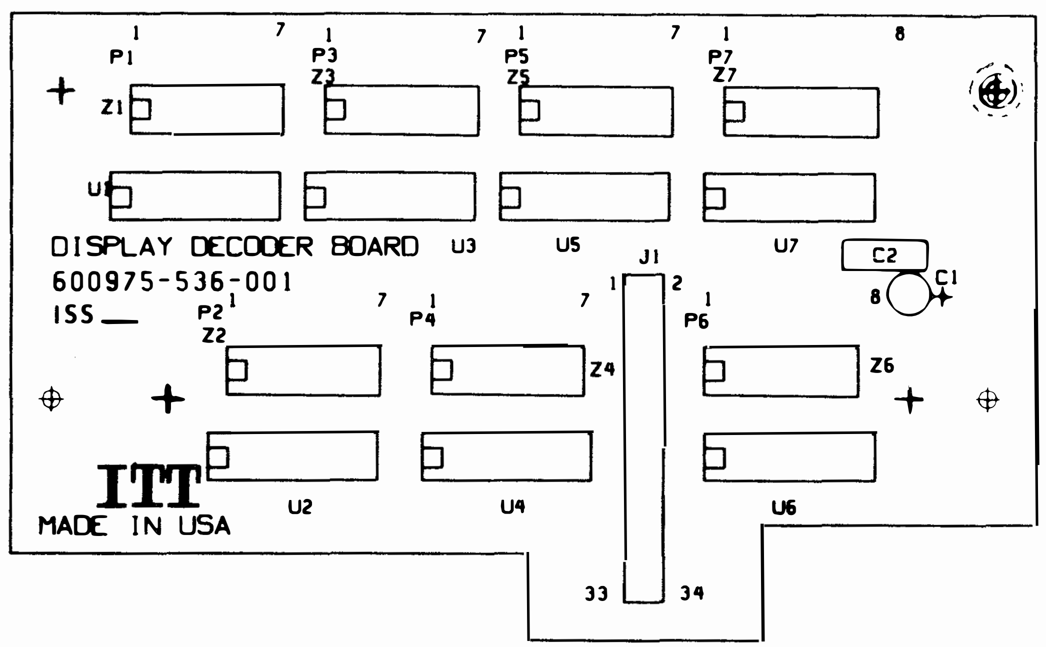
FRONT PANEL INTERCONNECT PCB SCHEMATIC

D | 620972-536 | D



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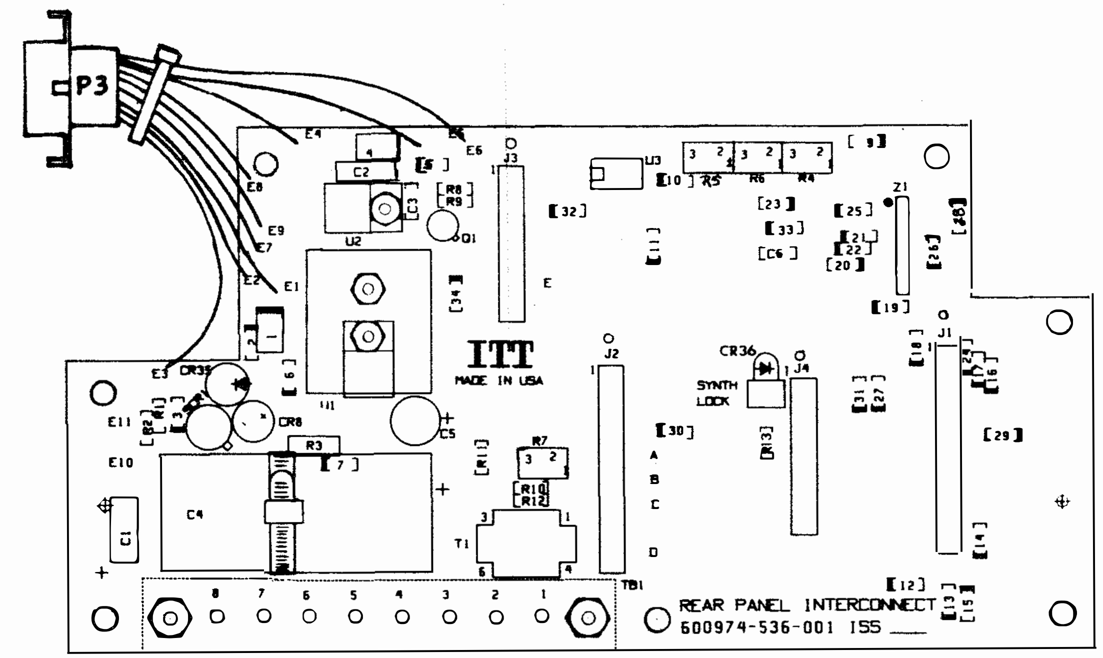
DISPLAY DECODER PCB ASSEMBLY		
C	600975-536	C



WIRE LIST FOR P3

FROM P3 PIN NO.	TO BOARD TERM. NO.	WIRE COLOR	WIRE LENGTH INCHES	ITEM
1	E1	BROWN	3.00 [76,20]	52
2	E2	WHT/RED	3.00 [76,20]	58
3	E3	GREEN	3.75 [95,25]	56
4	E4	WHT/YEL	3.75 [95,25]	59
5	E5	YEL	4.00 [101,60]	55
6	E6	ORANGE	4.25 [107,95]	54
7	E7	VIOLET	3.50 [88,90]	57
8	E8	RED	3.50 [88,90]	53
9	E9	RED	3.50 [88,90]	53

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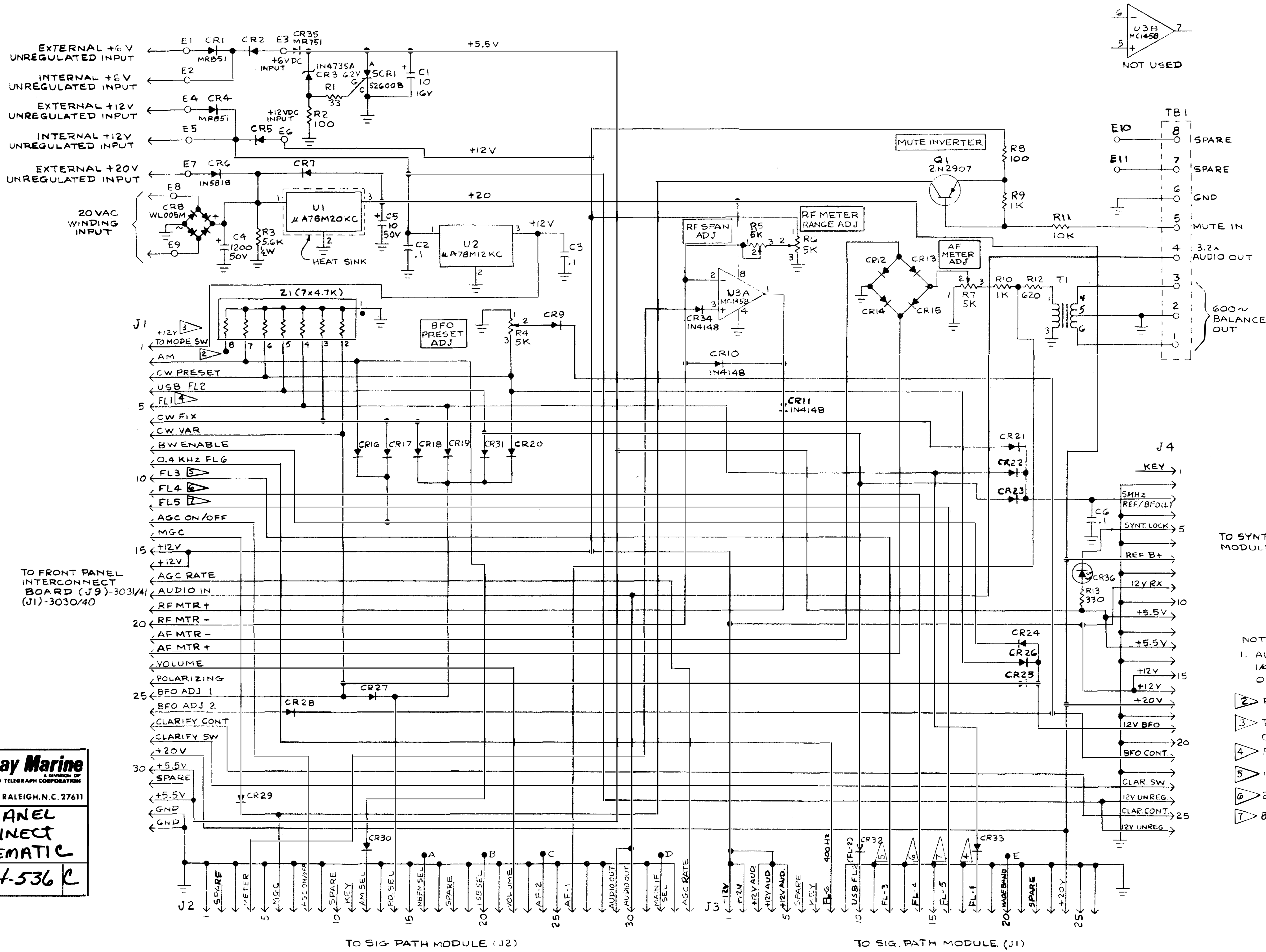
REAR PANEL INTERCONNECT PCB ASSEMBLY

C | 600974-536 | B



LAST USED

C6	T1
CR33	TB1
E11	U3A
J4	
Q1	
R12	
SCR1	

NOTES:
1. ALL CAPACITORS ARE IN μF, ALL RESISTORS ARE IN OHMS, 1/4 W, 5%, ALL DIODES ARE IN4004, UNLESS OTHERWISE SPECIFIED.

2. PIN 8 OF Z1 NOT USED

3. THIS LINE IS CURRENT LIMITED TO 50mA. DO NOT CONNECT TO OTHER LOADS.

4. RTTY FOR 3030/31; LSB FOR 3040/41.

5. 1KHz FOR 3030/31; 2KHz FOR 3040/41

6. 2KHz FOR 3030/31; 8KHz FOR 3040/41

7. 8KHz FOR 3030/31, RTTY FOR 3040/41

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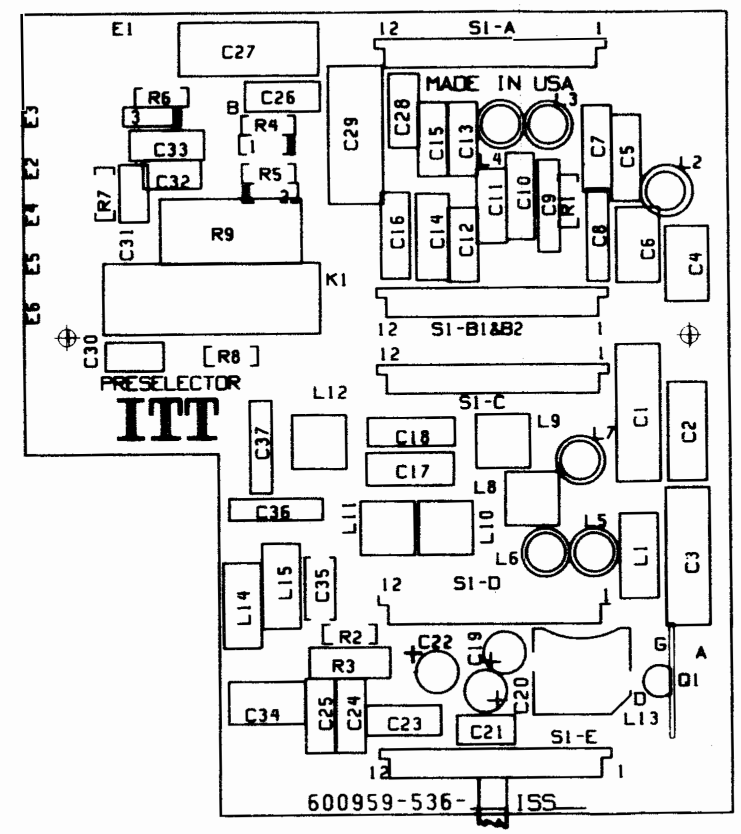
REAR PANEL INTERCONNECT PCB SCHEMATIC

D 620974-536 C



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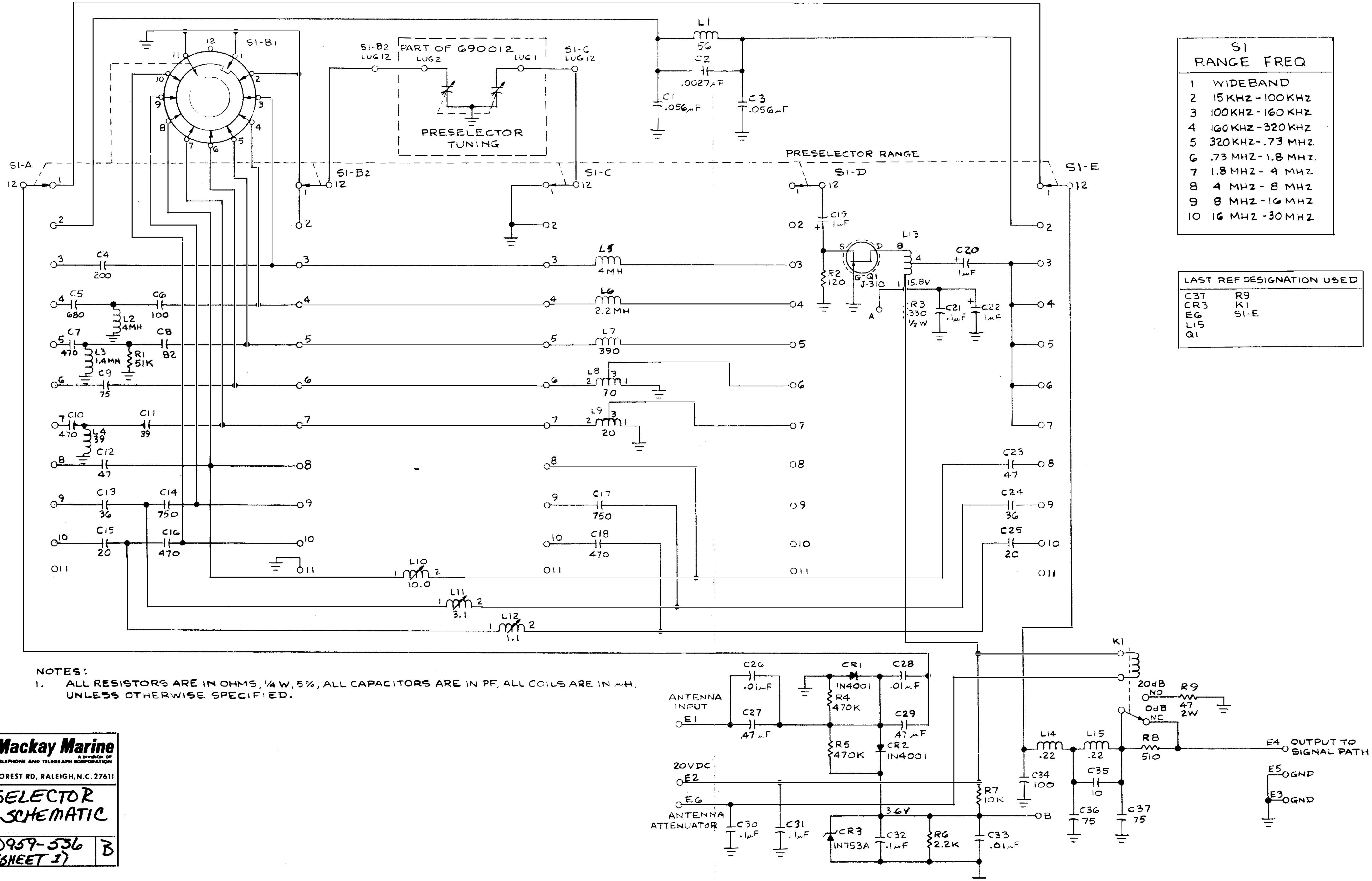
PRESELECTOR PCB ASSEMBLY

C	600959-536	C



S1 RANGE	FREQ
1	WIDEBAND
2	15KHZ-100KHZ
3	100KHZ-160KHZ
4	160KHZ-320KHZ
5	320KHZ-.73 MHZ.
6	.73 MHZ-1.8 MHZ.
7	1.8 MHZ- 4 MHZ
8	4 MHZ - 8 MHZ
9	8 MHZ - 16 MHZ
10	16 MHZ - 30 MHZ

LAST REF DESIGNATION USED	
C37	R9
CR3	K1
E6	S1-E
L15	
Q1	

NOTES:
1. ALL RESISTORS ARE IN OHMS, ¼ W, 5%, ALL CAPACITORS ARE IN PF, ALL COILS ARE IN μH, UNLESS OTHERWISE SPECIFIED.

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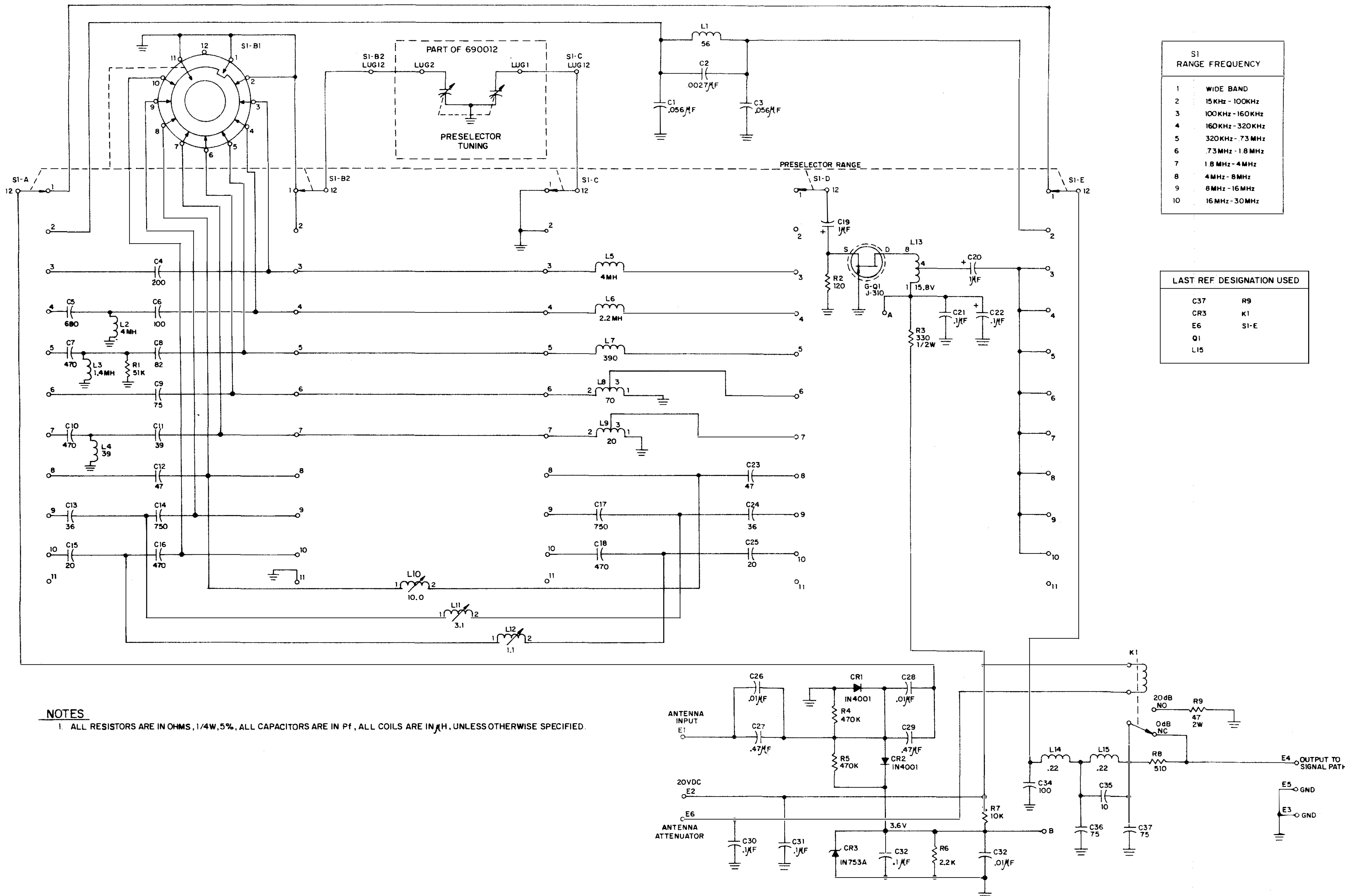
PRESELECTOR PCB SCHEMATIC

D 620959-536 (SHEET 1) B



S1 RANGE	FREQUENCY
1	WIDE BAND
2	15KHz - 100KHz
3	100KHz - 160KHz
4	160KHz - 320KHz
5	320KHz - .73MHz
6	.73MHz - 1.8MHz
7	1.8MHz - 4MHz
8	4MHz - 8MHz
9	8MHz - 16MHz
10	16MHz - 30MHz

LAST REF DESIGNATION USED	
C37	R9
CR3	K1
E6	S1-E
Q1	
L15	

NOTES

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%, ALL CAPACITORS ARE IN Pf, ALL COILS ARE IN µH, UNLESS OTHERWISE SPECIFIED.

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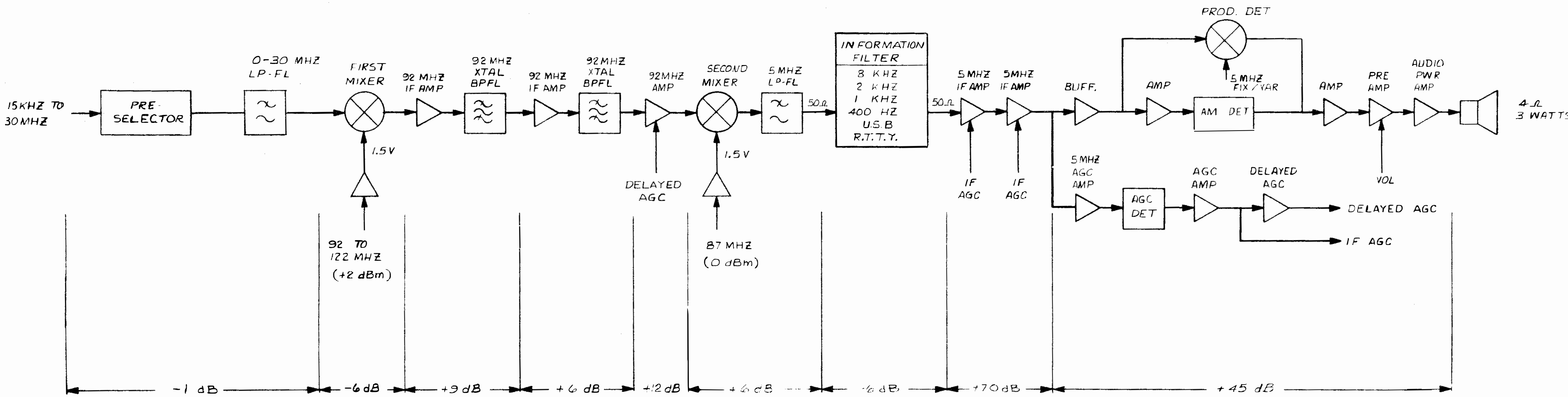
PRESELECTOR PCB SCHEMATIC

D 620959-536 (SHEET 2)



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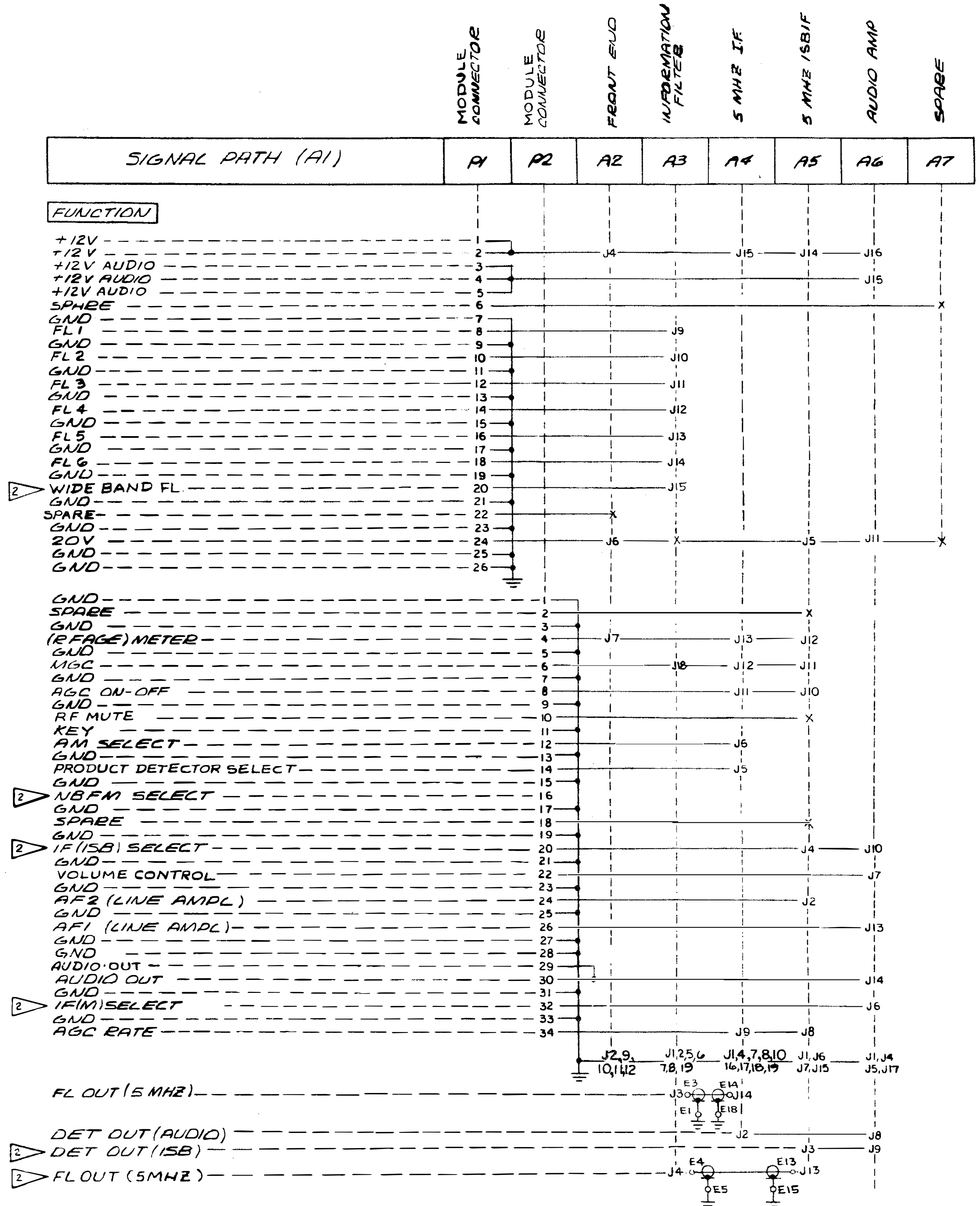
SIGNAL PATH BLOCK DIAGRAM

D	690013-028-001	B



NOTES:

1. "X" INDICATES THERE IS A PIN LOCATION ON MOTHER BOARD AND RESPECTIVE SUB-BOARDS (A2-A7). THESE ARE SPARE LOCATIONS AND HAVE NO "J" NUMBER.

2> THIS FUNCTION IS NOT USED IN THE RECEIVER 3030/3031 AND 3040/3041.

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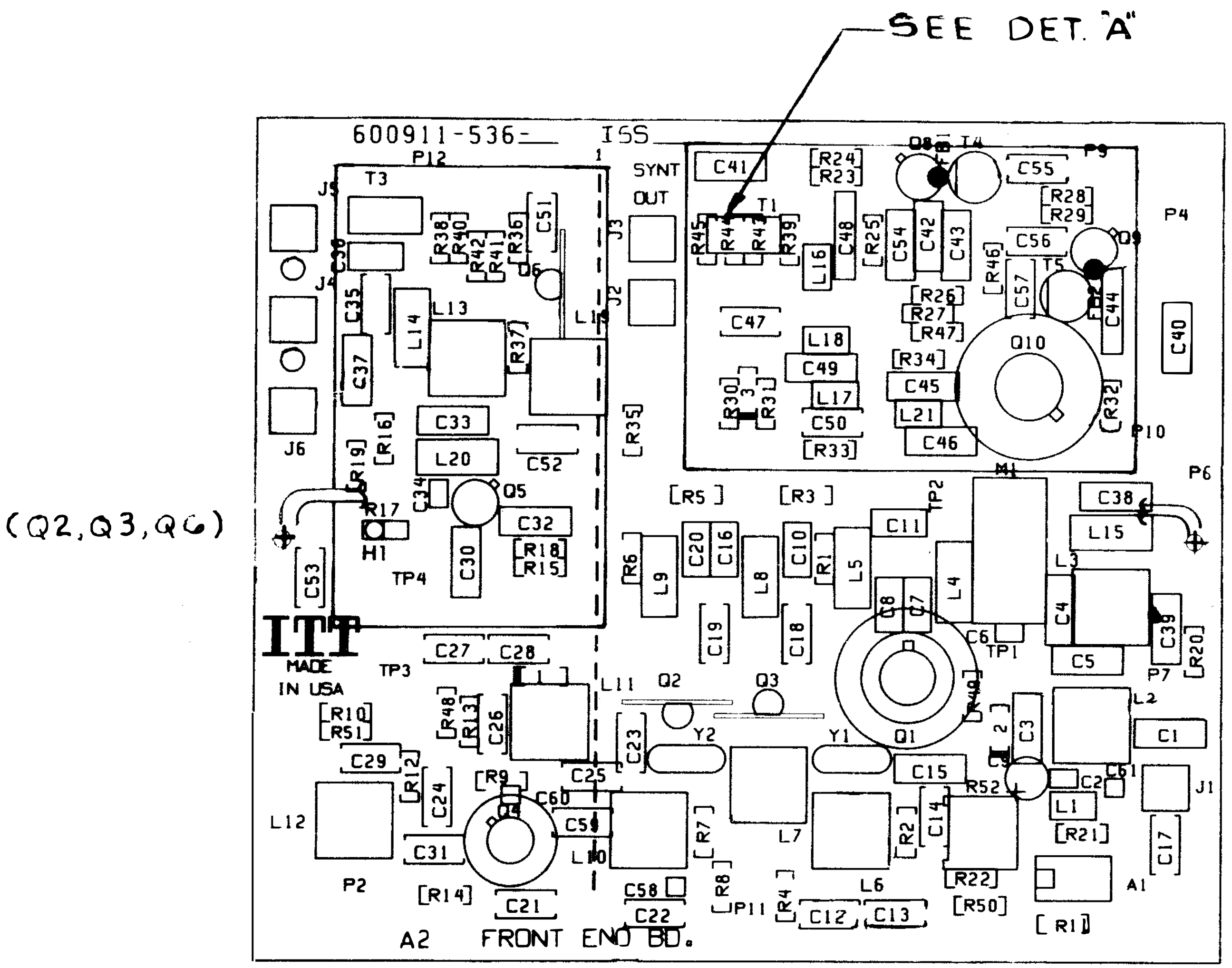
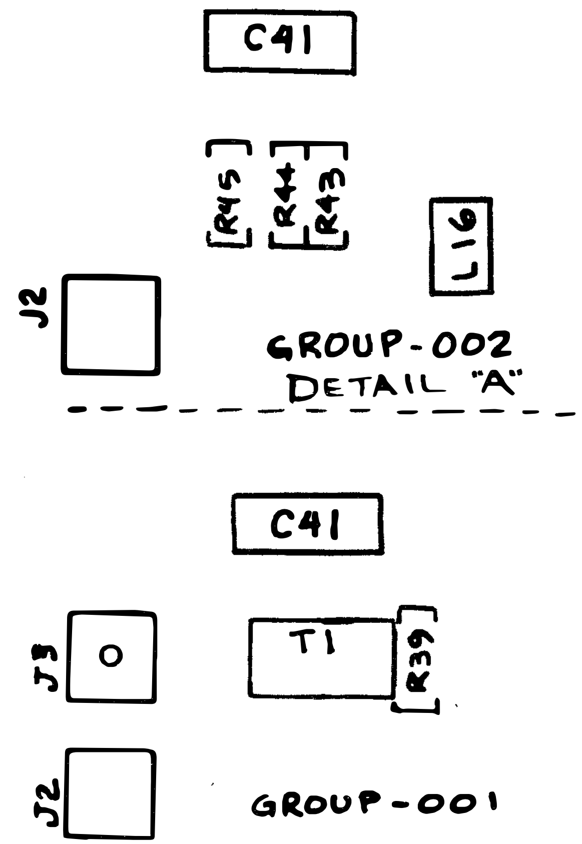
SIGNAL PATH MOTHER BOARD SCHEMATIC

D	620916-536-001	C





DETAIL "A"
NO SCALE

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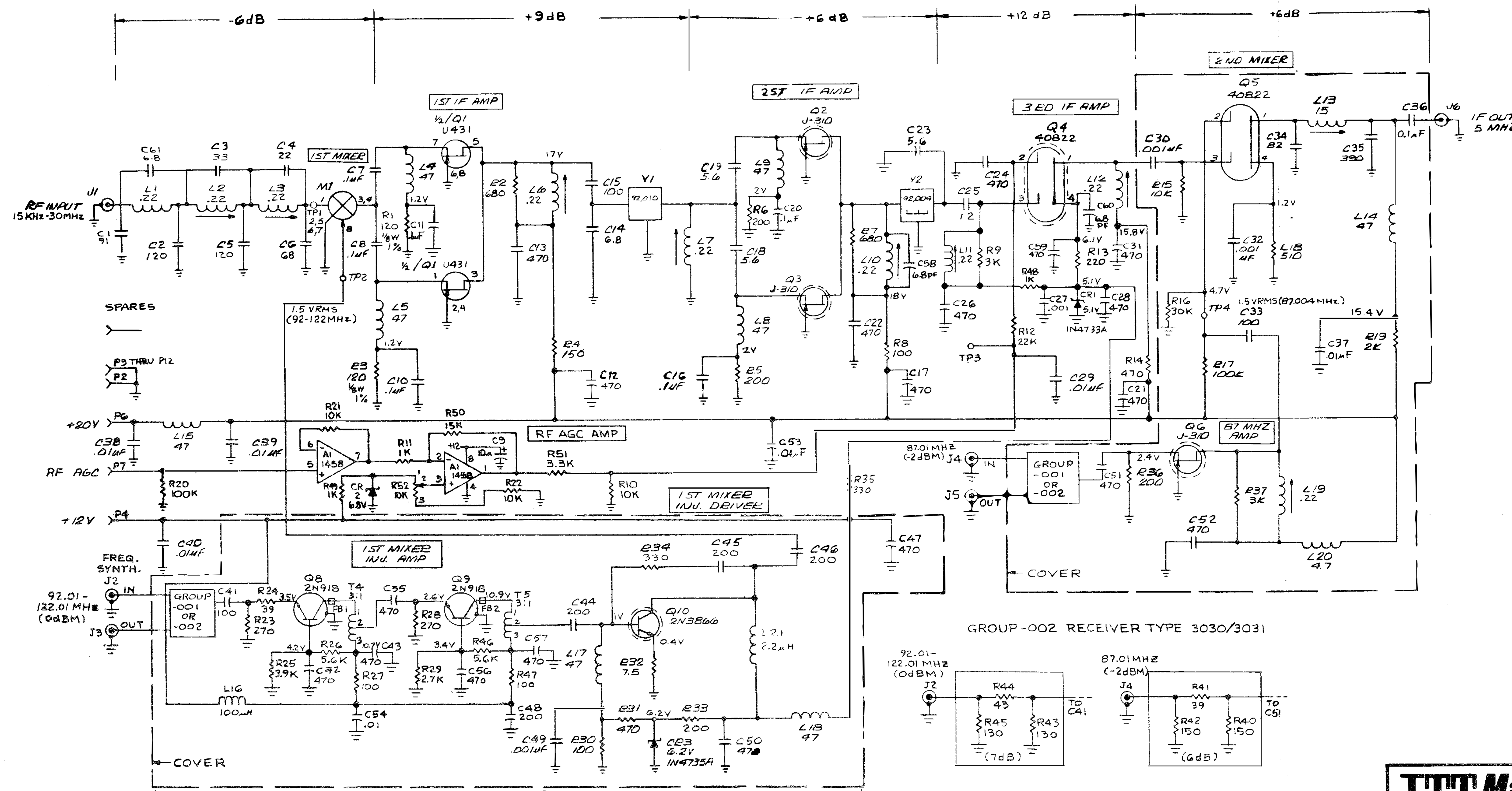
FRONT END PCB ASSEMBLY		
C	600911-536	C



NOTES:
1. ALL CAPACITORS ARE IN PF AND ALL RESISTORS ARE IN OHMS, 1/4W, 5%
ALL COILS IN μH, UNLESS OTHERWISE SPECIFIED.
2. ALL TRANSISTORS EXCEPT Q5, Q7, Q8 & Q9 HAVE HEAT SINKS.

LAST REF DES USED			
-001		-002	
C61	CR3	C61	CR3
P12	L20	P12	L20
J6	M1	J6	M1
Q10	T3	Q10	T2
Y2	R52	Y2	R52
A1		A1	

NOT USED			
-001		-002	
R40		R38	T1
R41		R39	T3
R42	Q7	C1	Q7
R43			
R44		J3	
R45	P8	J5	P8

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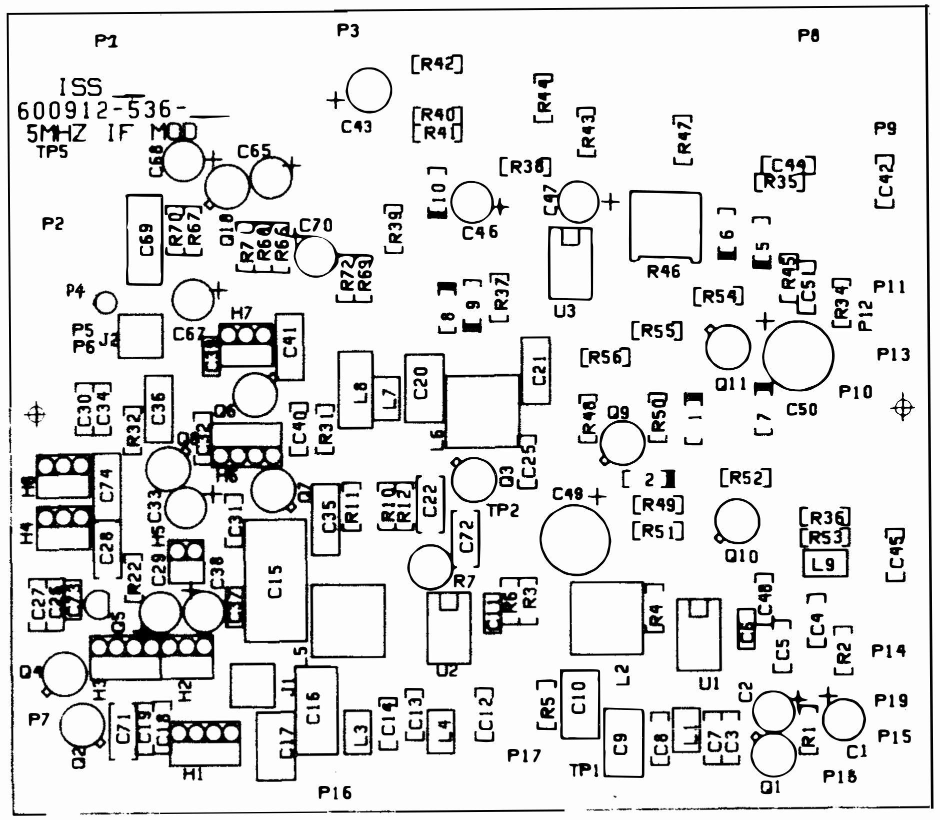
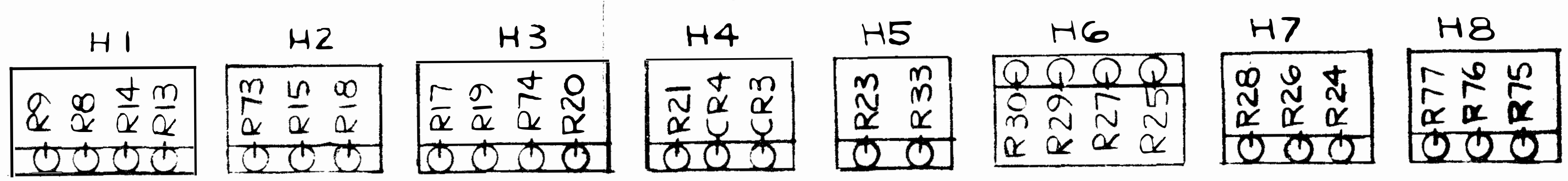
FRONT END PCB SCHEMATIC

D | 620911-536 | B





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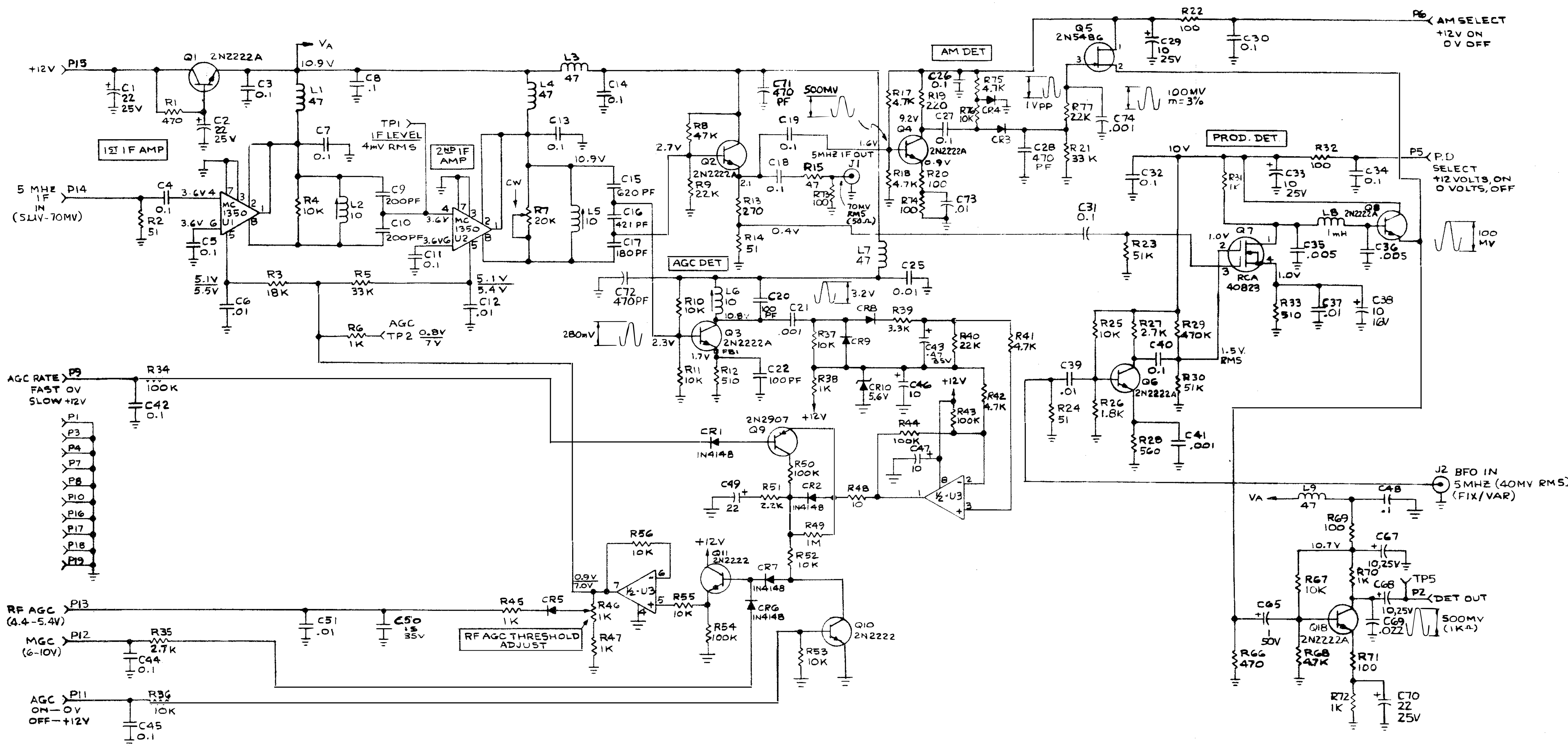
IF / AGC PCB ASSEMBLY		
C	600912 - 536	D



GROUP - 002

NOTES:

1. ALL CAPACITORS ARE IN µFD. AND ALL RESISTORS ARE IN OHMS, 1/4 W, 5%. ALL COILS IN µH, UNLESS OTHERWISE SPECIFIED.
2. ALL DIODES ARE 1N4148.
3. D.C. VOLTAGE MEASUREMENTS $\frac{X\ VOLTS}{Y\ VOLTS}$ WHERE X IS MEASURED FOR 10µV INPUT, Y IS MEASURED FOR 10mV INPUT. A.C. VOLTAGES MEASURED WITH 1mV INPUT.

DESIGNATIONS			
LAST USED		NOT USED	
C74	Q18	C23	Q12-17
CR10	RT1	C24	
J2	U3	C49	
L9		C66	
P19		C52-64	
		R57-65	
		R16	

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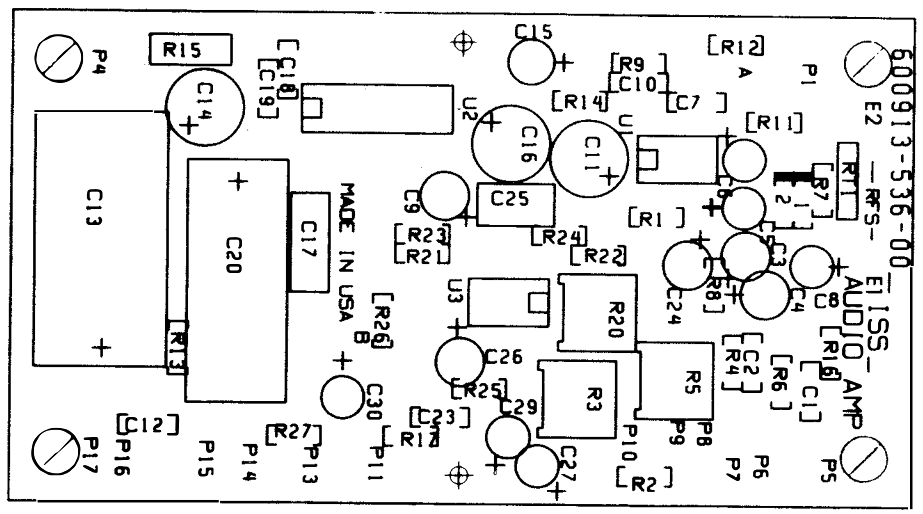
IF/AGC PCB SCHEMATIC

D 620912-536 B



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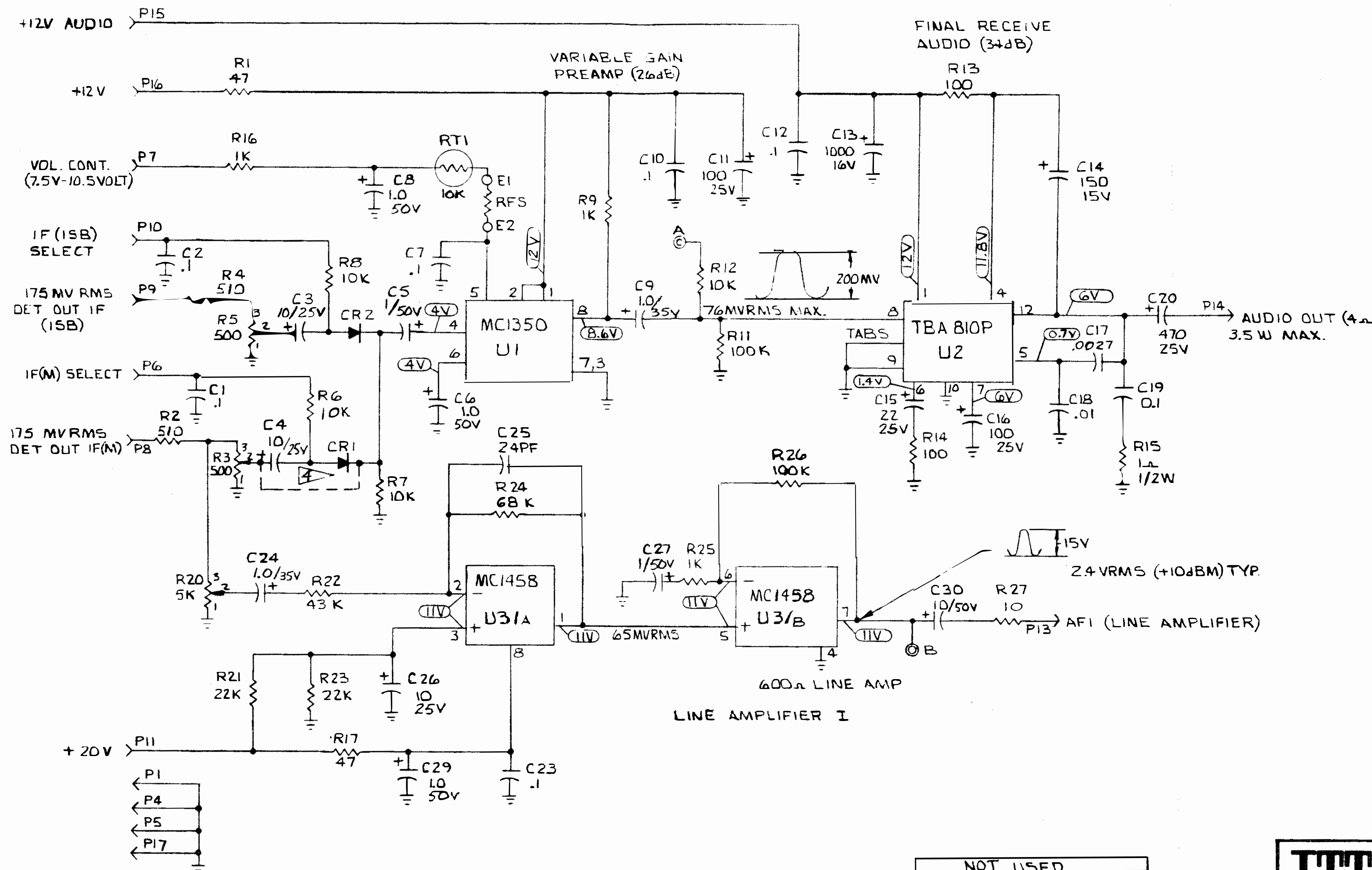
AUDIO AMPLIFIER
PCB ASSEMBLY

C	600913-536	D



NOT USED	
-001	-002
P2,3,12 R18,19 C 21,22,28	P2,3,6,9,10,12 R18,19 C 21,22,28

NOTES:

1. ALL RESISTORS ARE IN OHMS 1/4W ±5% AND ALL CAPACITORS ARE IN µFD UNLESS OTHERWISE SPECIFIED.
2. LAST USED: C30, CR2, R27, U3, P17, RT1.
3. ALL DIODES ARE IN4148.

4 THE FOLLOWING PARTS ARE NOT USED IN GROUP -002: P6, P9, P10, R4-R8, CR1, CR2, C1 THRU C4. ADD JUMPER FROM C4+ TO CR1 CATHODE.

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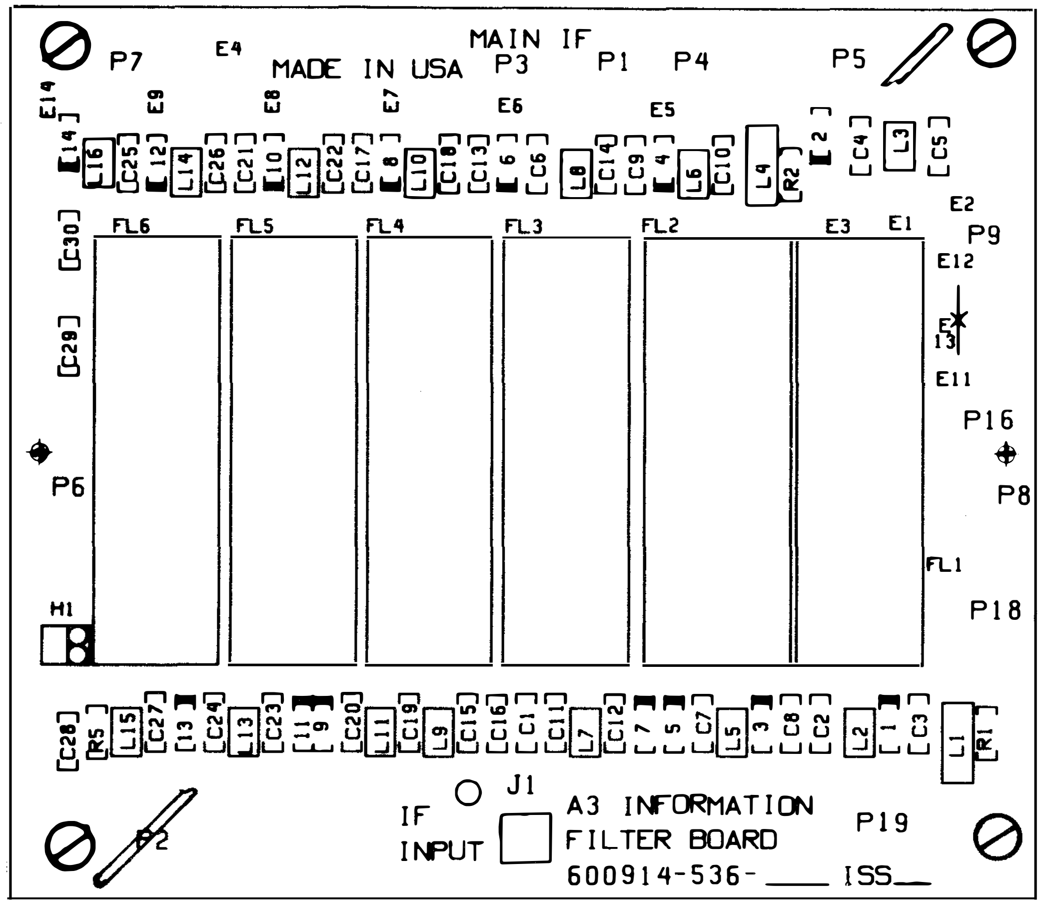
AUDIO AMPLIFIER PCB SCHEMATIC

C	620913-536	D



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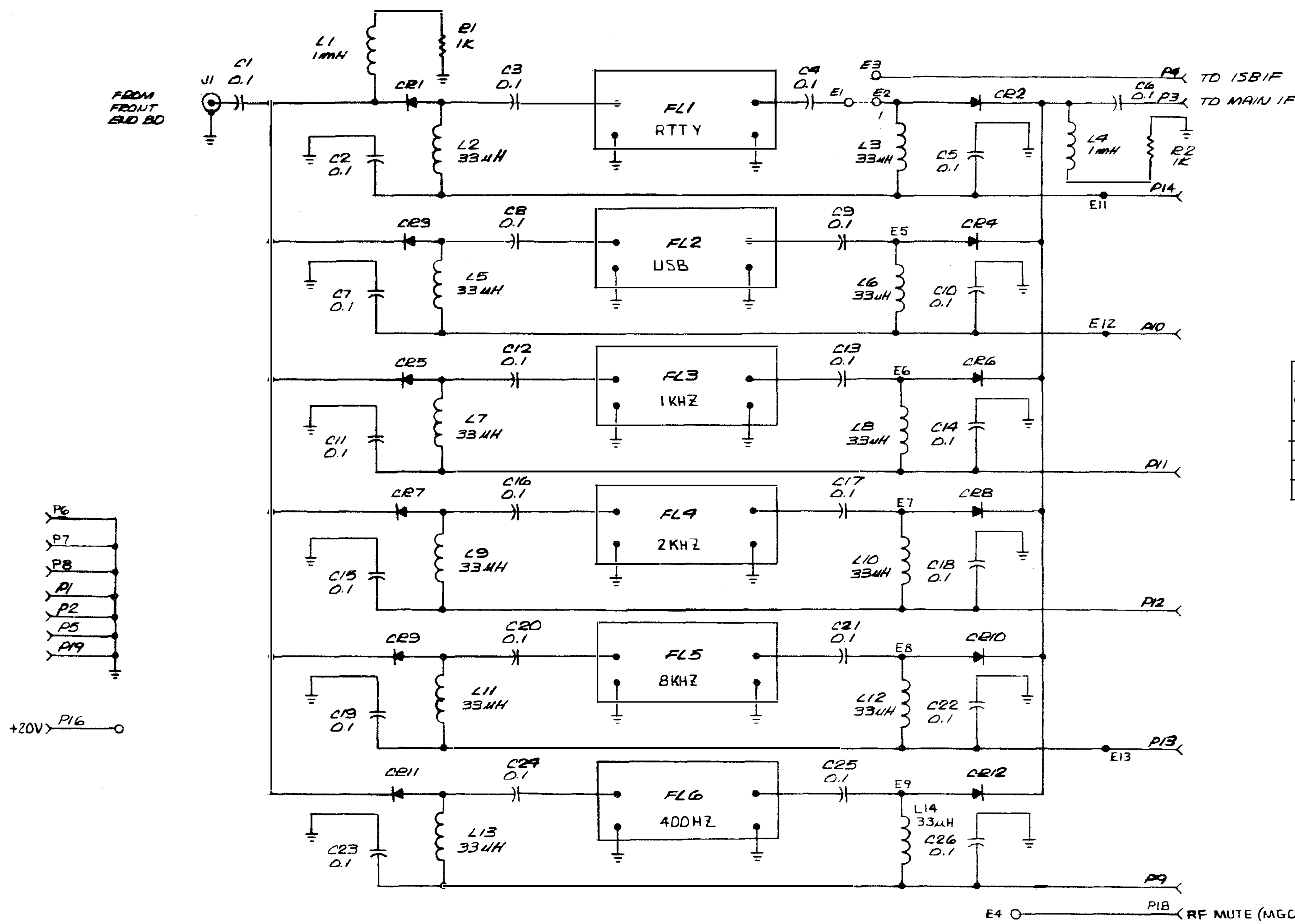
INFORMATION FILTER PCB ASSEMBLY		
C	600914-536	D



FILTER COMPLEMENT & STRAPPING OPTIONS								
GROUP	FL1	FL2	FL3	FL4	FL5	FL6	STRAP	STRAP
001	RTTY	USB	1KHZ	2KHZ	8KHZ	400	E1-E2	—
002	NONE	USB	1KHZ	2KHZ	8KHZ	400	E1-E2	E11-E12
003	LSB	USB	2KHZ	8KHZ	NONE	400	E1-E2	E12-E13
004	LSB	USB	2KHZ	8KHZ	RTTY	400	E1-E2	—
005	RTTY	USB	1KHZ	2KHZ	8KHZ	400	E1-E2	—

3

NOTES:

1. ALL CAPACITORS ARE IN UF AND ALL RESISTORS ARE IN OHMS, 1/4W UNLESS OTHERWISE SPECIFIED.
2. ALL DIODES ARE IN4148.

3 FUTURE USE ONLY.

4 SEE TABLE

5 THIS TABLE REFLECTS DESIG. INFO. FOR GRP-005 (SH.5), DESIG. ADDITIONS ON ALL OTHER GRPS. SHOULD CONFORM TO GRP-005 TO AVOID CIRCUIT & BD. MKG CONFLICTIONS.

5

LAST REF DES USED		NOT USED
C30	R5	P17
CR15	J1	
FL6	E13	
L16	P19	

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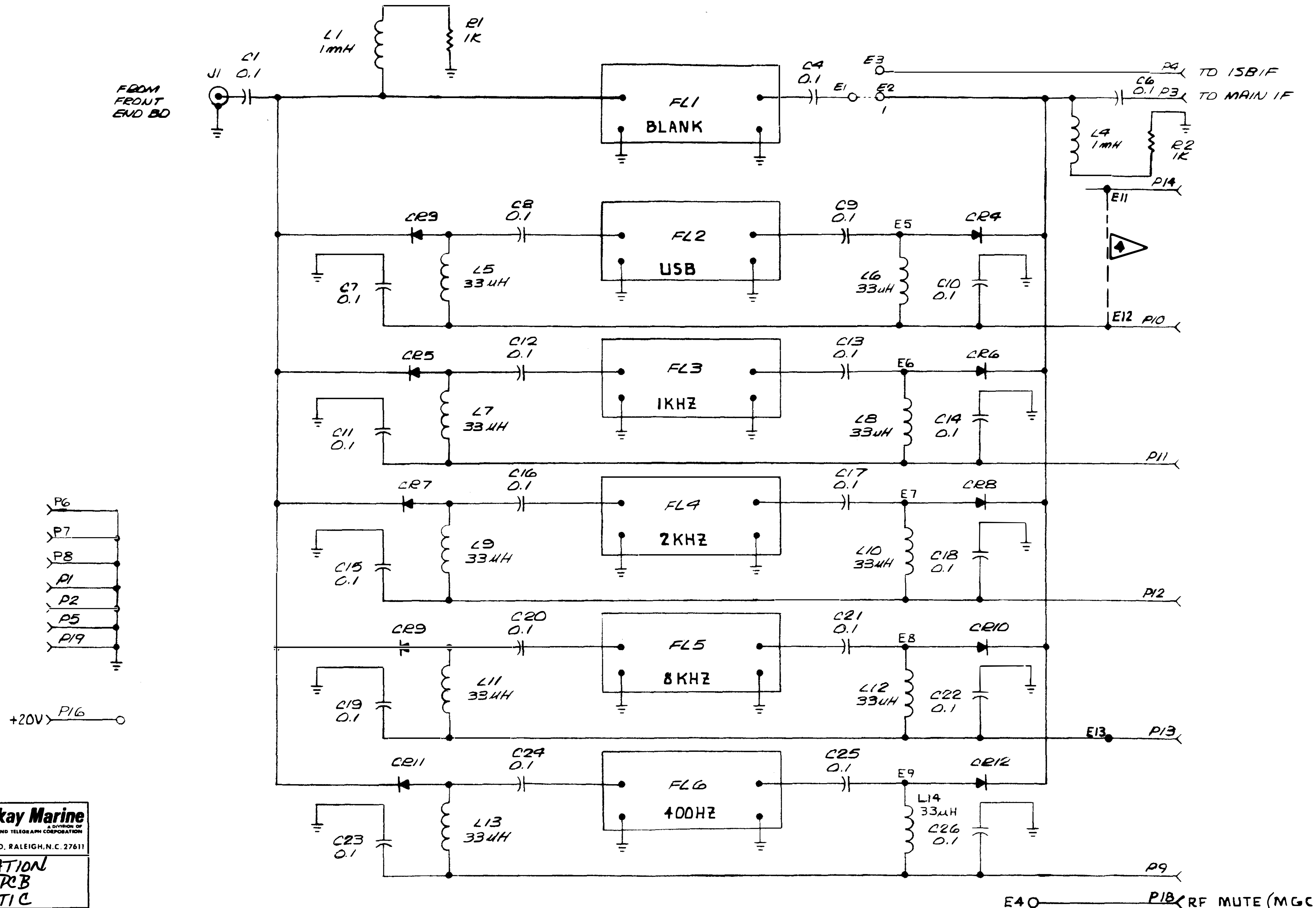
INFORMATION FILTER PCB SCHEMATIC

D | 620914-536 (SHEET 1) | D



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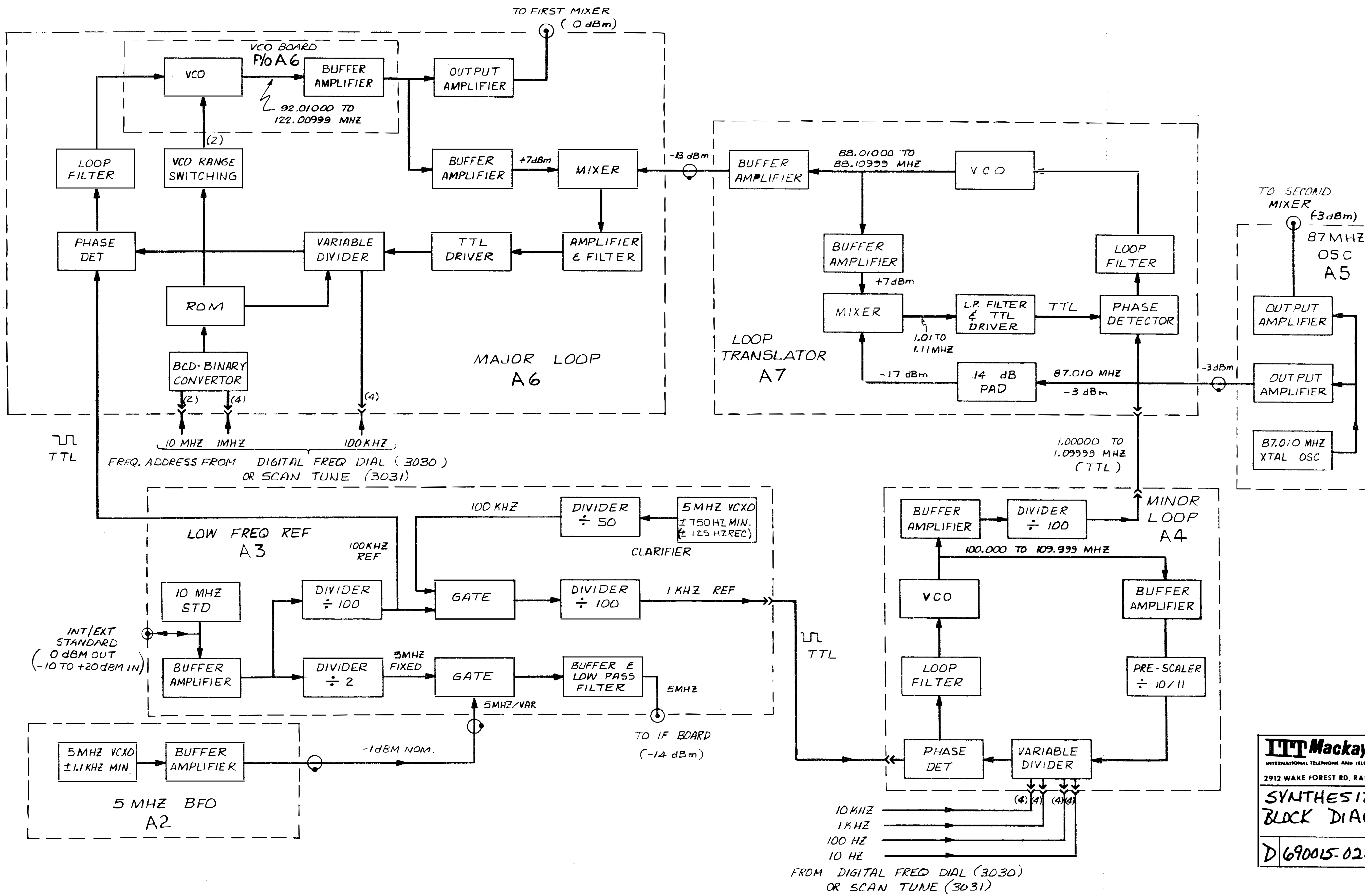
INFORMATION FILTER PCB SCHEMATIC

D 620914-536 (SHEET 2)



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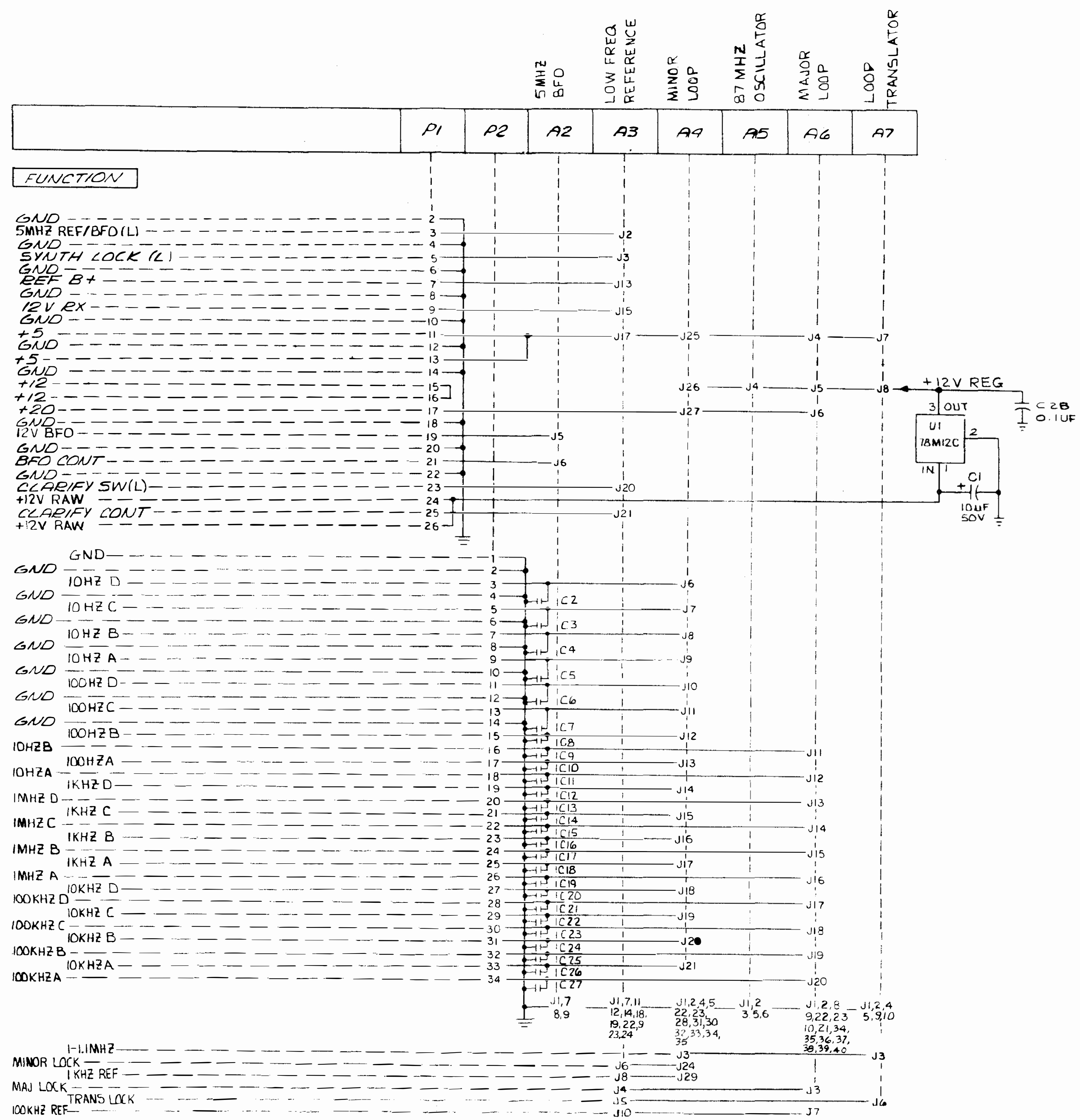
SYNTHESIZER BLOCK DIAGRAM

D 690015-028-001 B

NOTES:
ALL CAPACITORS ARE 0.01uF UNLESS OTHERWISE SPECIFIED.



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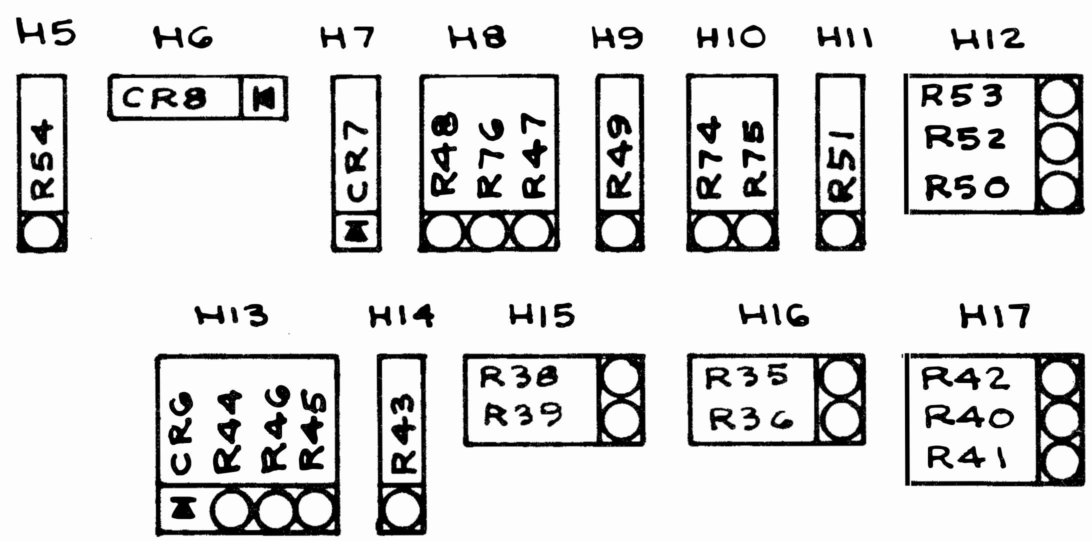
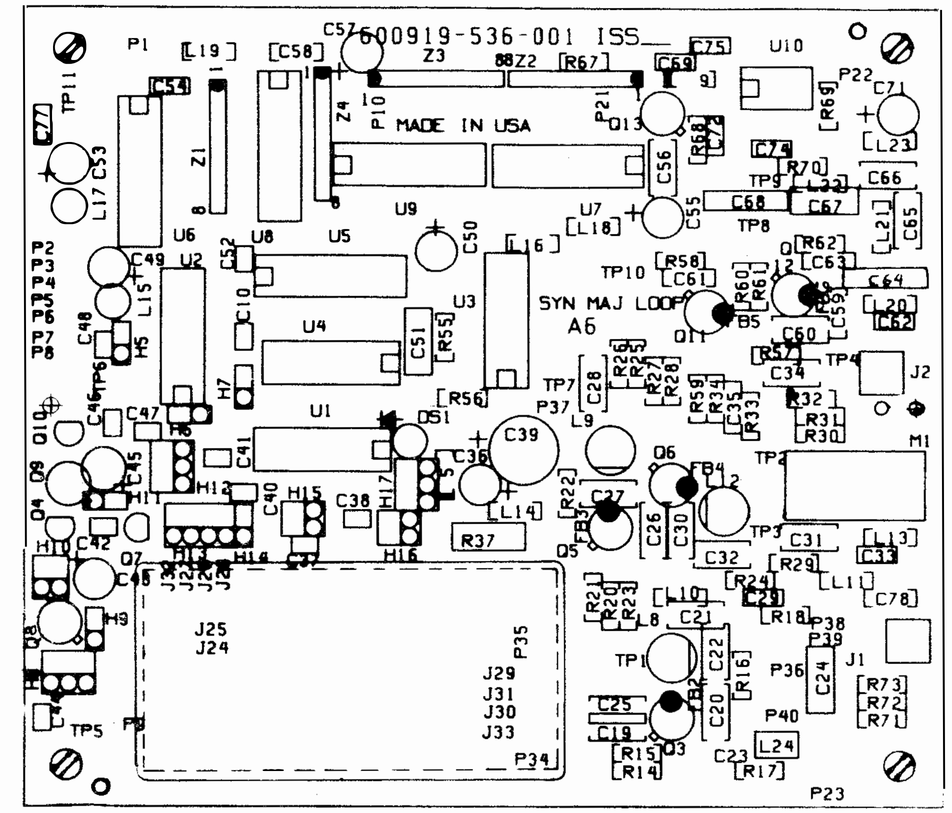
SYNTHESIZER MOTHER BOARD SCHEMATIC

D	620925-536-001	B

RESISTOR MOUNTS





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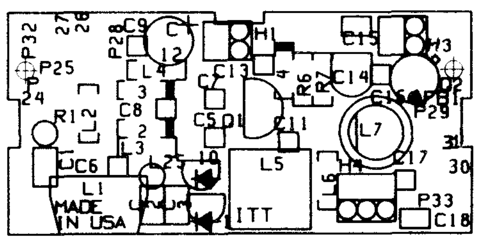
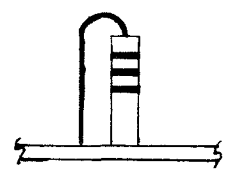
MAJOR LOOP
PCB ASSEMBLY

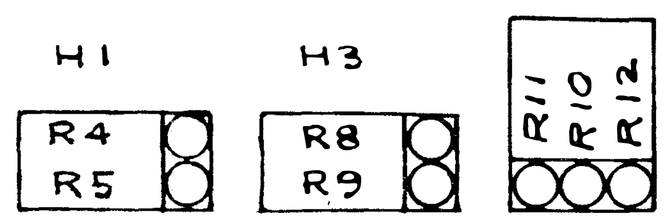
C	600919-536	D





DETAIL
R1 & L25 ARE
FREE STANDING

RESISTOR MOUNTS



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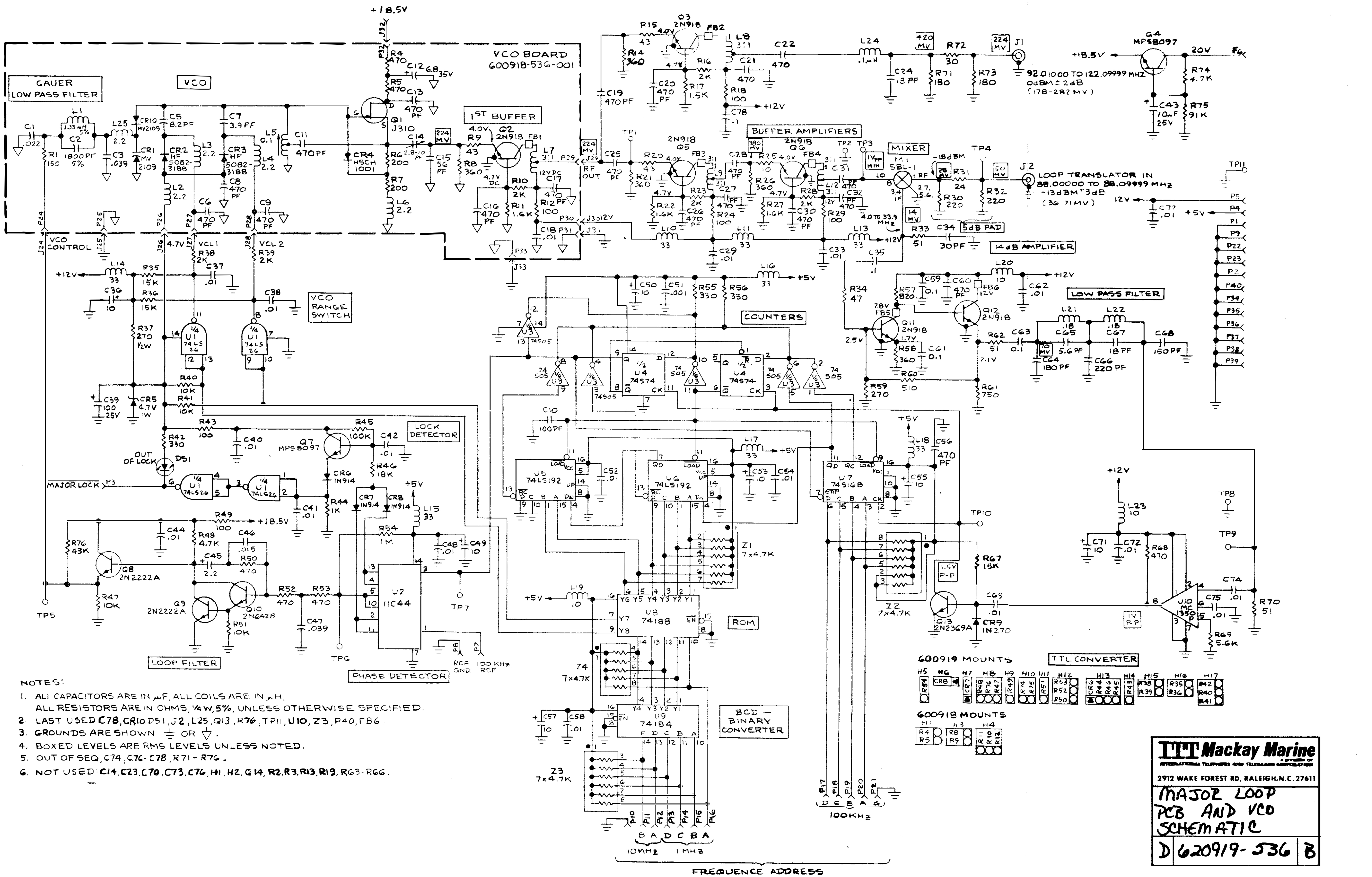
MAJOR LOOP
VCO PCB
ASSEMBLY

C	600918 - 536	C



NOTES:

1. ALL CAPACITORS ARE IN μF, ALL COILS ARE IN μH, ALL RESISTORS ARE IN OHMS, 1/4 W, 5%, UNLESS OTHERWISE SPECIFIED.
2. LAST USED C78, CR10 DS1, J2, L25, Q13, R76, TP11, U10, Z3, P40, FB6.
3. GROUNDS ARE SHOWN ⏚ OR ▽.
4. BOXED LEVELS ARE RMS LEVELS UNLESS NOTED.
5. OUT OF SEQ, C74, C76-C78, R71-R76.
6. NOT USED: C14, C23, C70, C73, C76, H1, H2, Q14, R2, R3, R13, R19, R63-R66.

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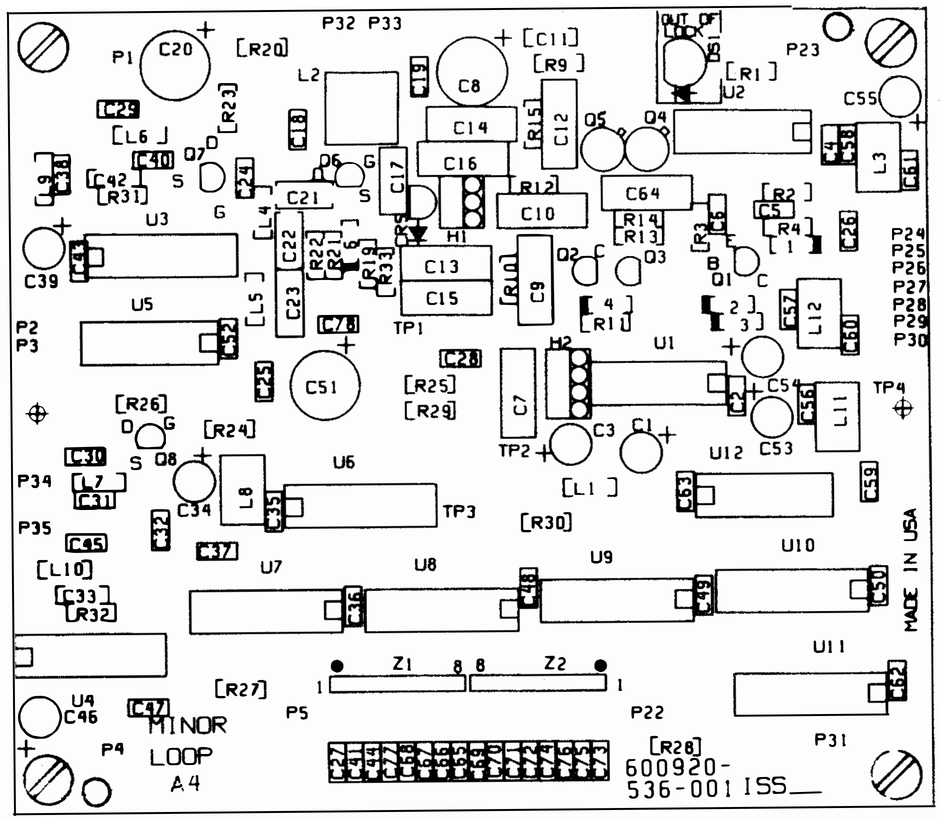
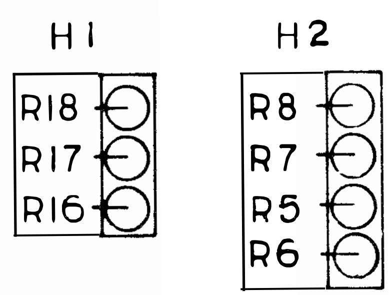
MAJOR LOOP PCB AND VCO SCHEMATIC

D	620919-536	B





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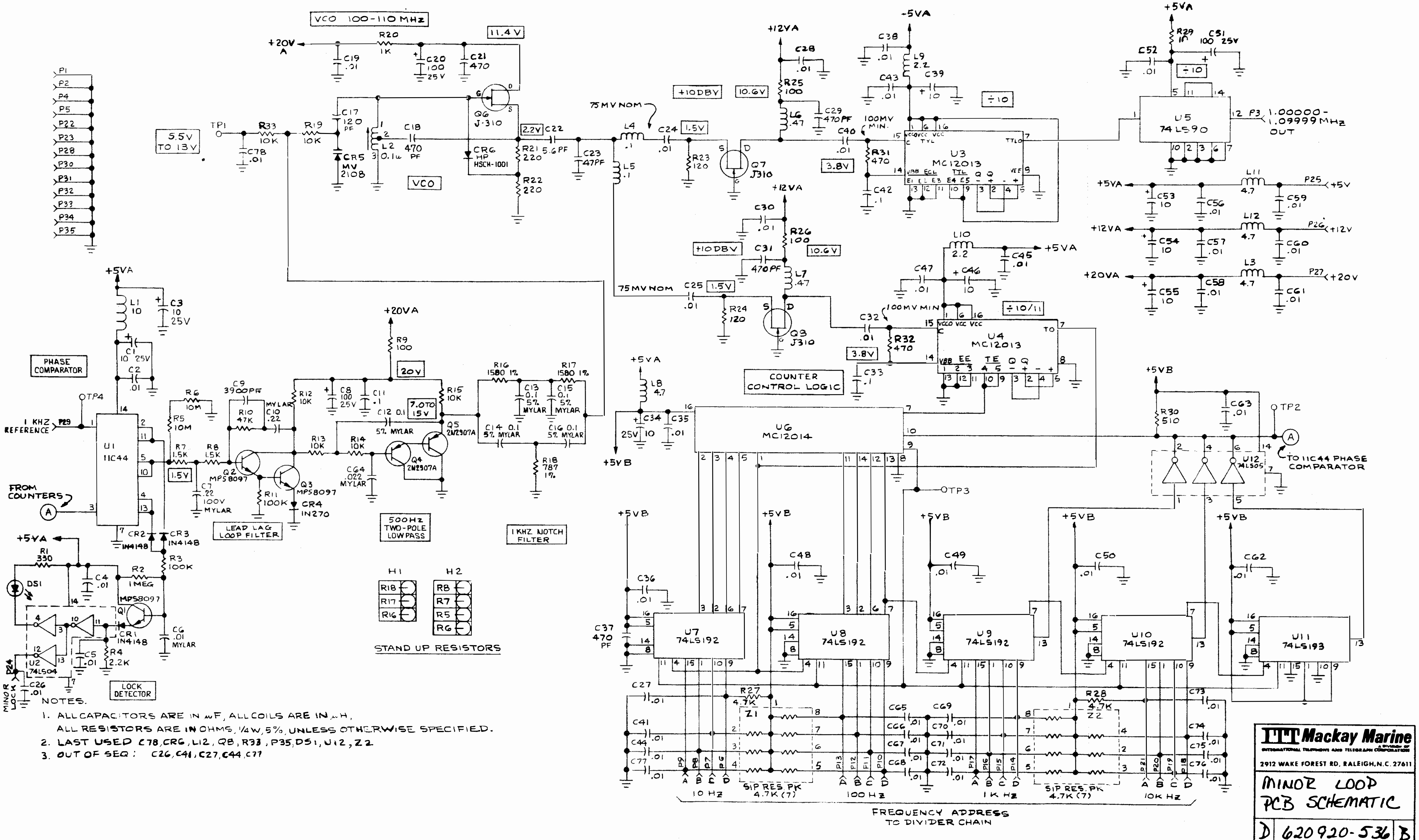
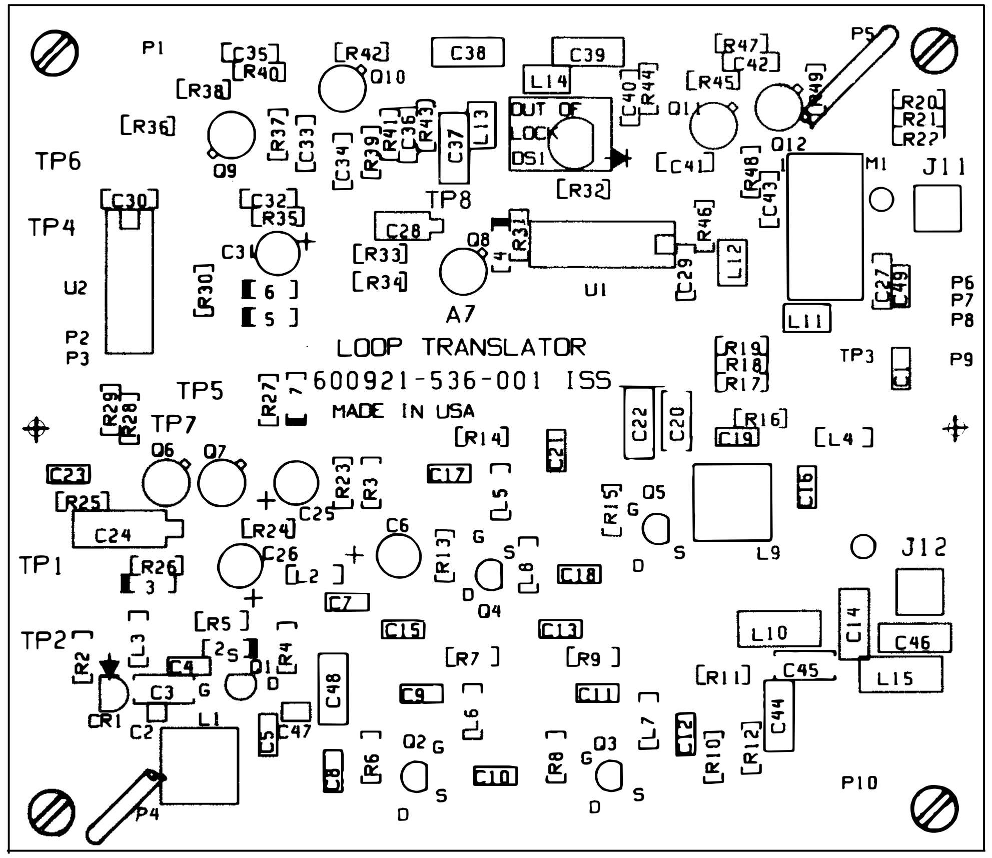
MINOR LOOP PCB ASSEMBLY

C	600920-536	B



NOTES:

1. ALL CAPACITORS ARE IN µF, ALL COILS ARE IN µH, ALL RESISTORS ARE IN OHMS, 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.
2. LAST USED C78, CR6, L12, Q8, R33, P35, DS1, U12, Z2
3. OUT OF SEQ: C26, C41, C27, C44, C77



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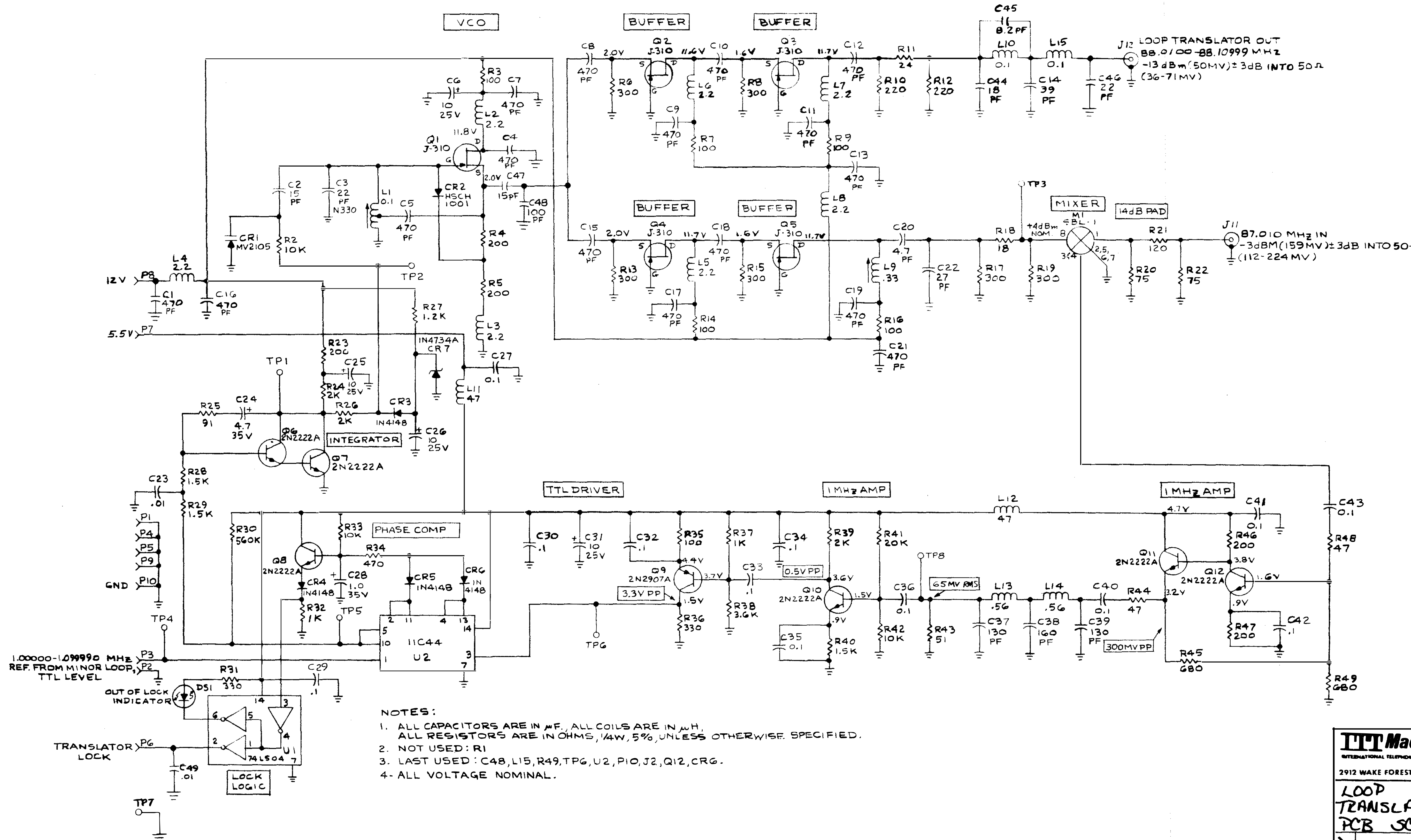
LOOP TRANSLATOR PCB ASSEMBLY		
C	600921-536	C



NOTES:

1. ALL CAPACITORS ARE IN μF., ALL COILS ARE IN μH, ALL RESISTORS ARE IN OHMS, 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.
2. NOT USED: R1
3. LAST USED: C48, L15, R49, TP6, U2, P10, J2, Q12, CR6.
4- ALL VOLTAGE NOMINAL.

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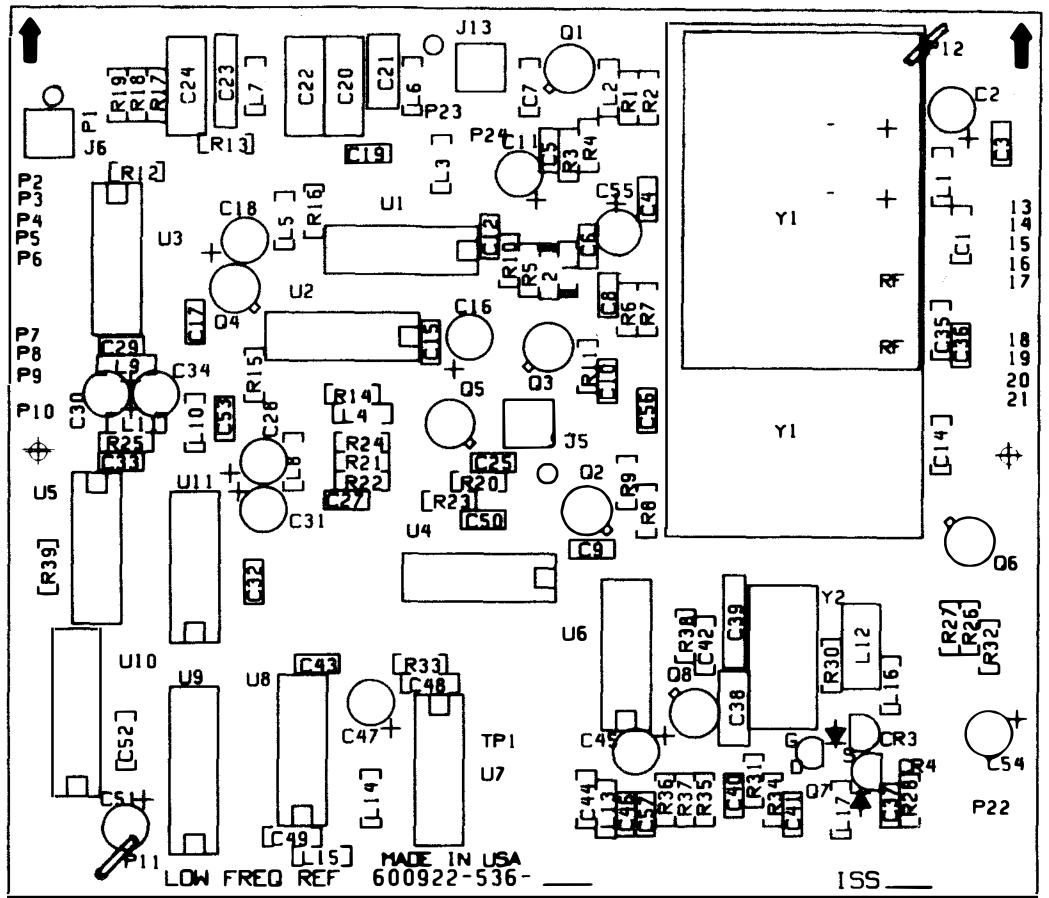
LOOP TRANSLATOR PCB SCHEMATIC

D	620921-536	B



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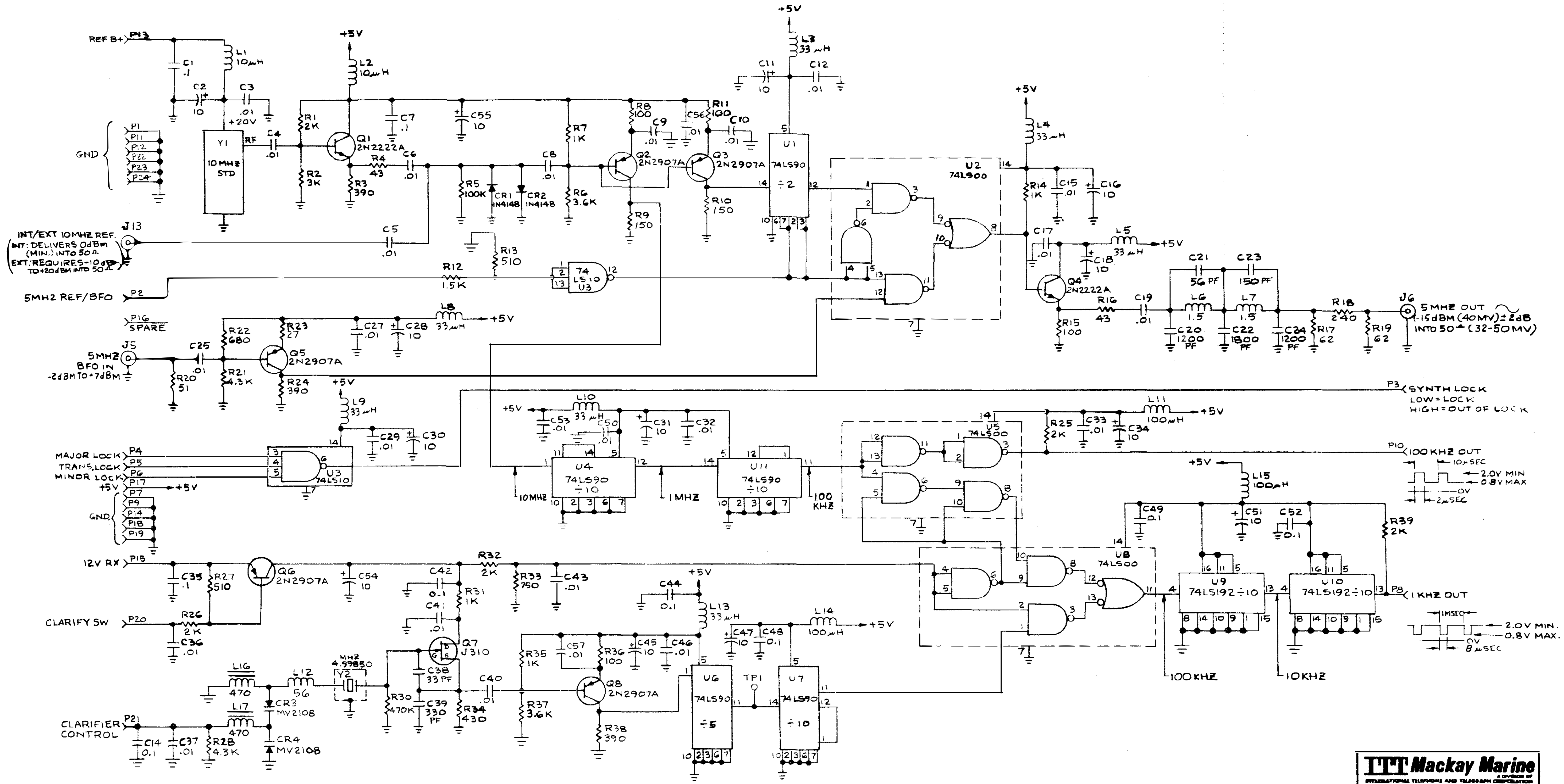
LOW FREQUENCY REFERENCE PCB ASSEMBLY

C	600922-536	C



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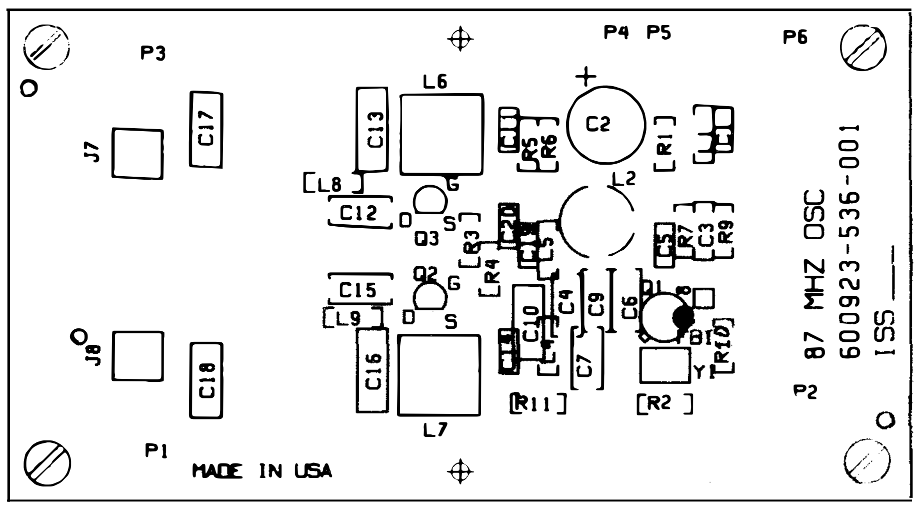
LOW FREQUENCY REFERENCE PCB SCHEMATIC

D | 620922-536 | B

NOTES:
1. ALL CAPACITORS ARE IN MFD. AND ALL RESISTORS ARE IN OHMS. 1/4 W. 5%
ALL COILS IN μH. UNLESS OTHERWISE SPECIFIED.
2. LAST USED C57, CR3, E18, J13, L17, Q8, R39, U11, Y2, TP1
3. NOT USED - R29, C13, C14, C26
4. OUT OF SEQUENCE U11, C53-C56, C13, C14, C50



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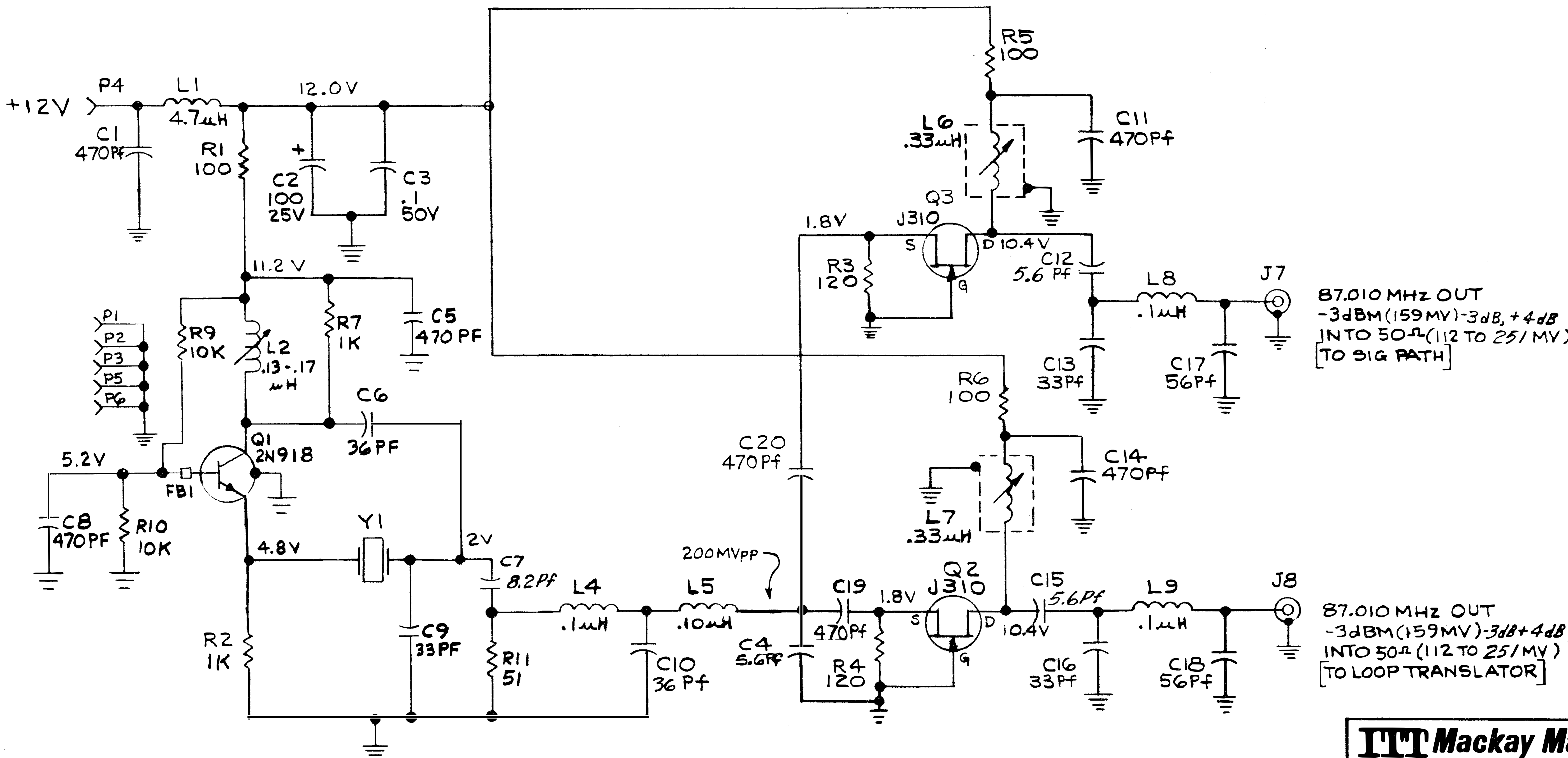
87 MHz OSCILLATOR PCB ASSEMBLY		
C	600923-536	D



NOTE:

1- ALL CAPACITORS ARE IN uF AND ALL RESISTORS ARE IN OHMS 1/4 WATT 5% UNLESS OTHERWISE SPECIFIED.

2. LAST USED: C20, R11, L9, Q3, Y1, P6, FB1.

3. NOT USED: C4, L3, R8

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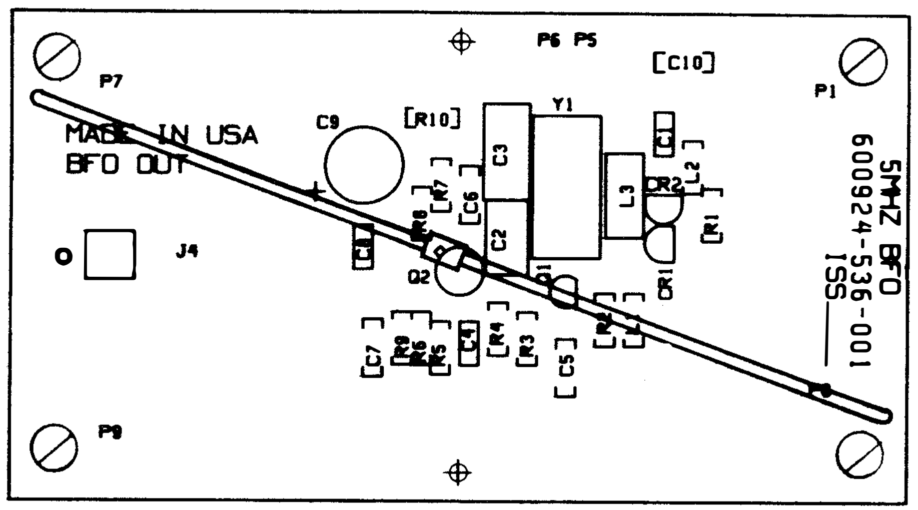
87 MHz OSCILLATOR PCB SCHEMATIC		
B	620923-536	D



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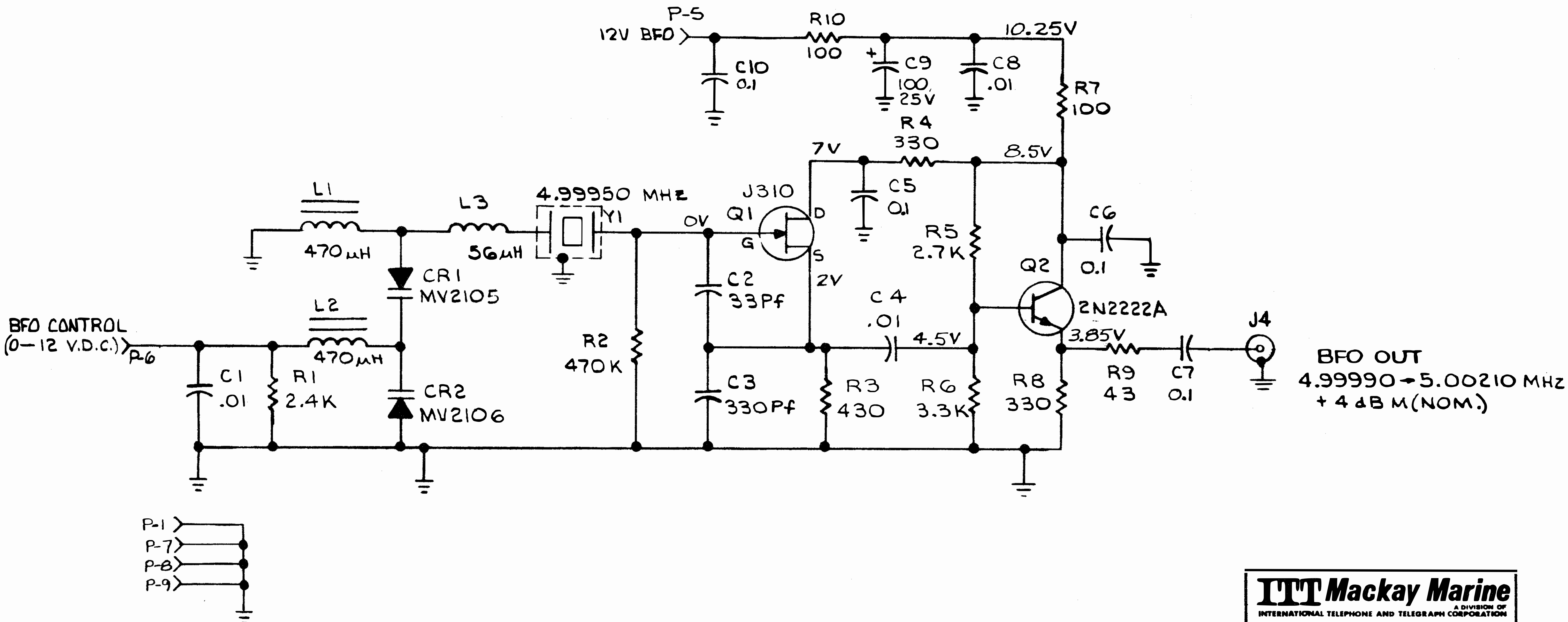
BFO PCB ASSEMBLY		
B	600924-536	B



NOTES:

1. ALL CAPACITORS ARE IN MFD. AND ALL RESISTORS ARE IN OHMS, 1/4 WATT 5% UNLESS OTHERWISE SPECIFIED.
2. LAST USED REF SYMBOLS C10, CR2, R10, Q2, Y1, P9, & L3.
3. NOT USED ARE P2, 3 & 4.

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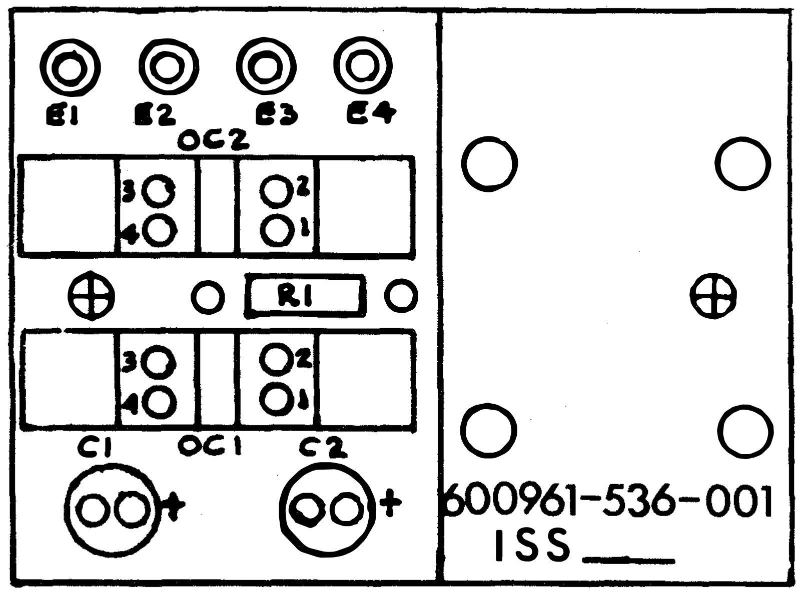
BFO PCB SCHEMATIC		
B	620924-536	B



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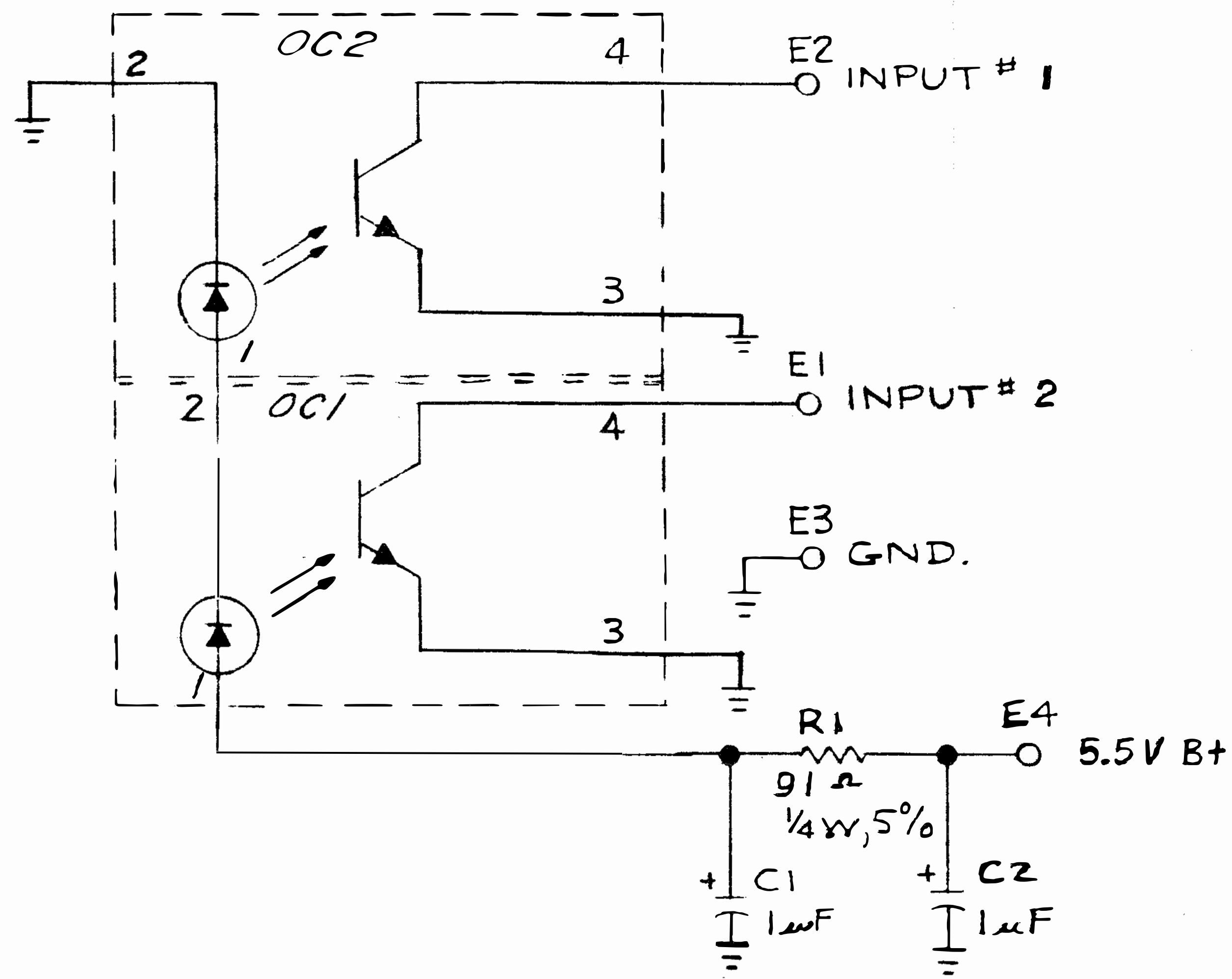
OPTO-COUPLER PCB ASSEMBLY		
C	600961-536	B



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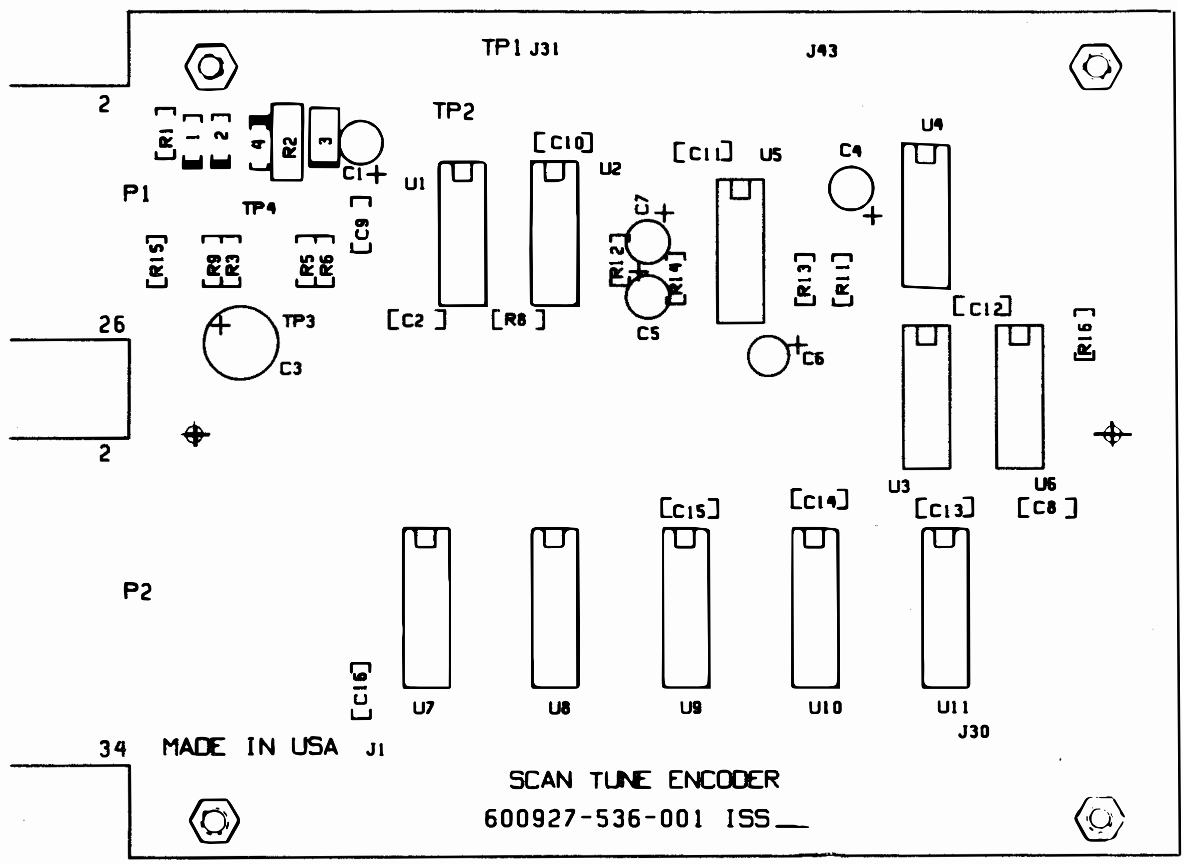
OPTO - COUPLER
PCB SCHEMATIC

3	620961-536	B



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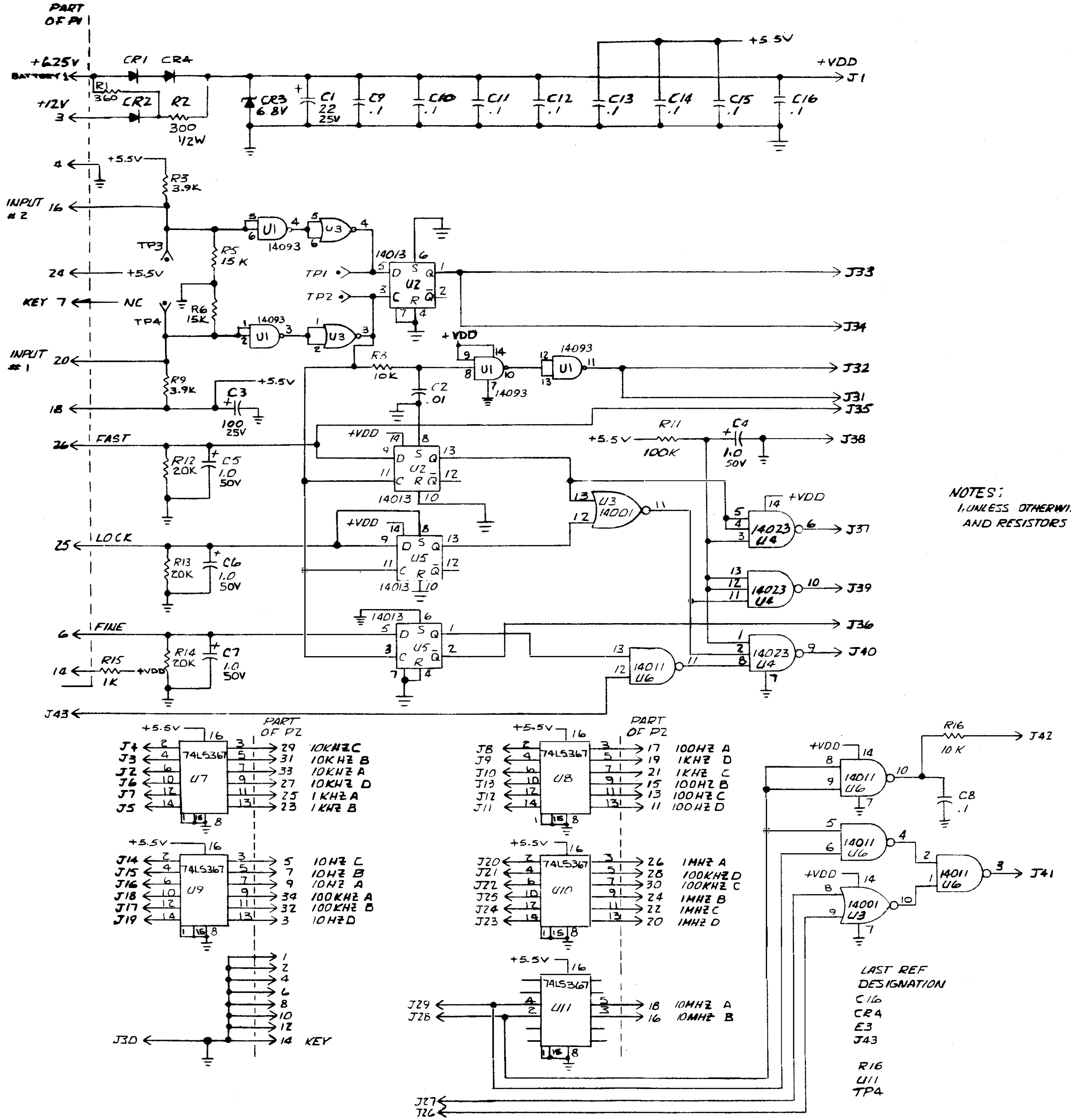
SCAN TUNE ENCODER PCB ASSEMBLY

C	600927-536	D



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE MICROFARADS AND RESISTORS ARE OHMS ±5% 1/4 W.

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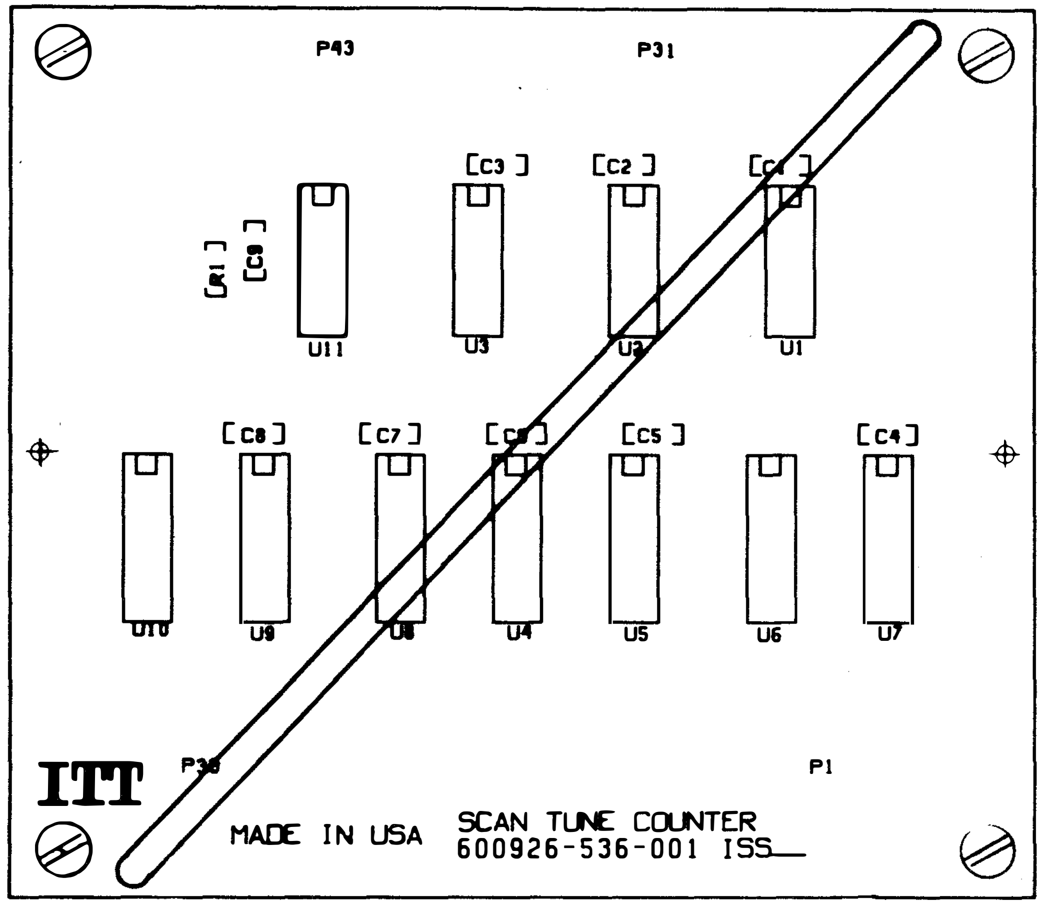
SCAN TUNE ENCODER PCB SCHEMATIC

D	620927-536	C



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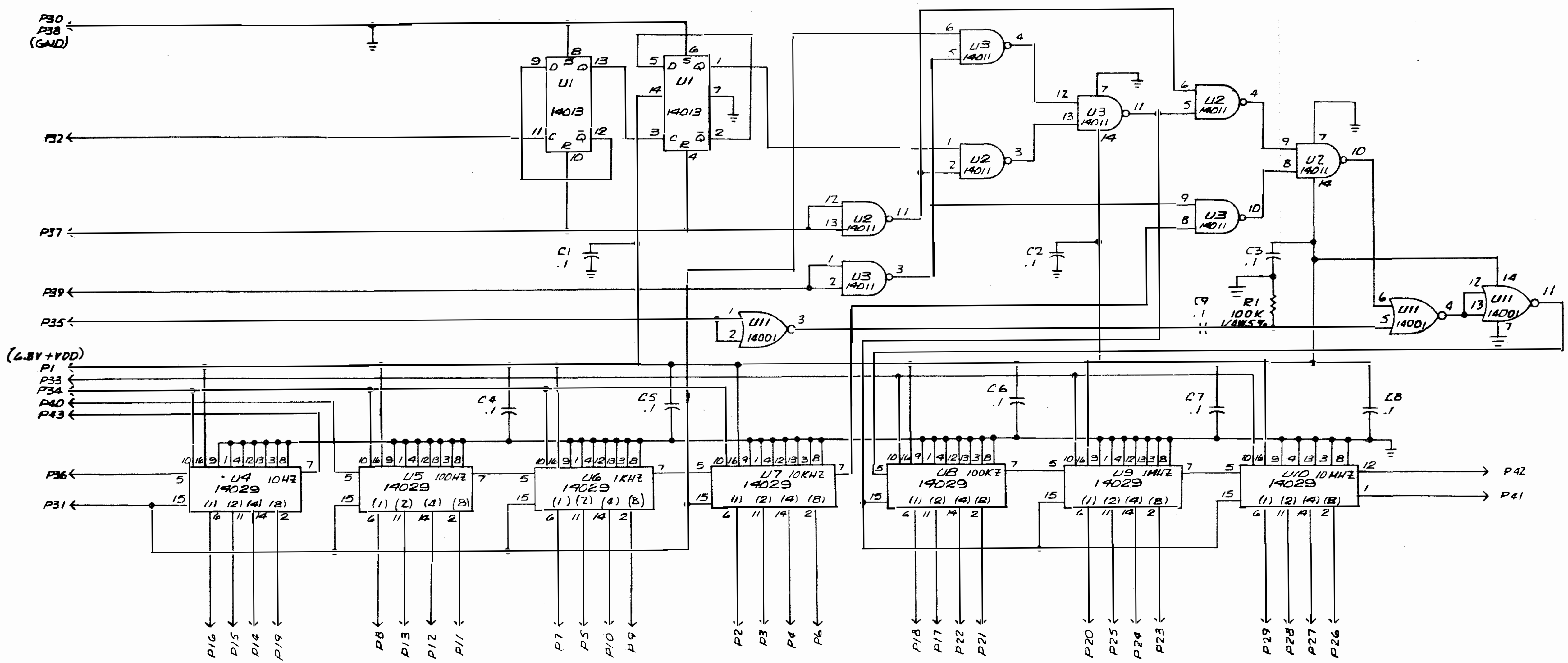
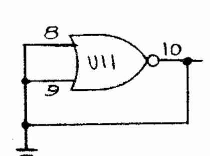
SCAN TUNE COUNTER PCB ASSEMBLY

C	600926-536	C



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITORS ARE MICROFARADS.

NOT USED



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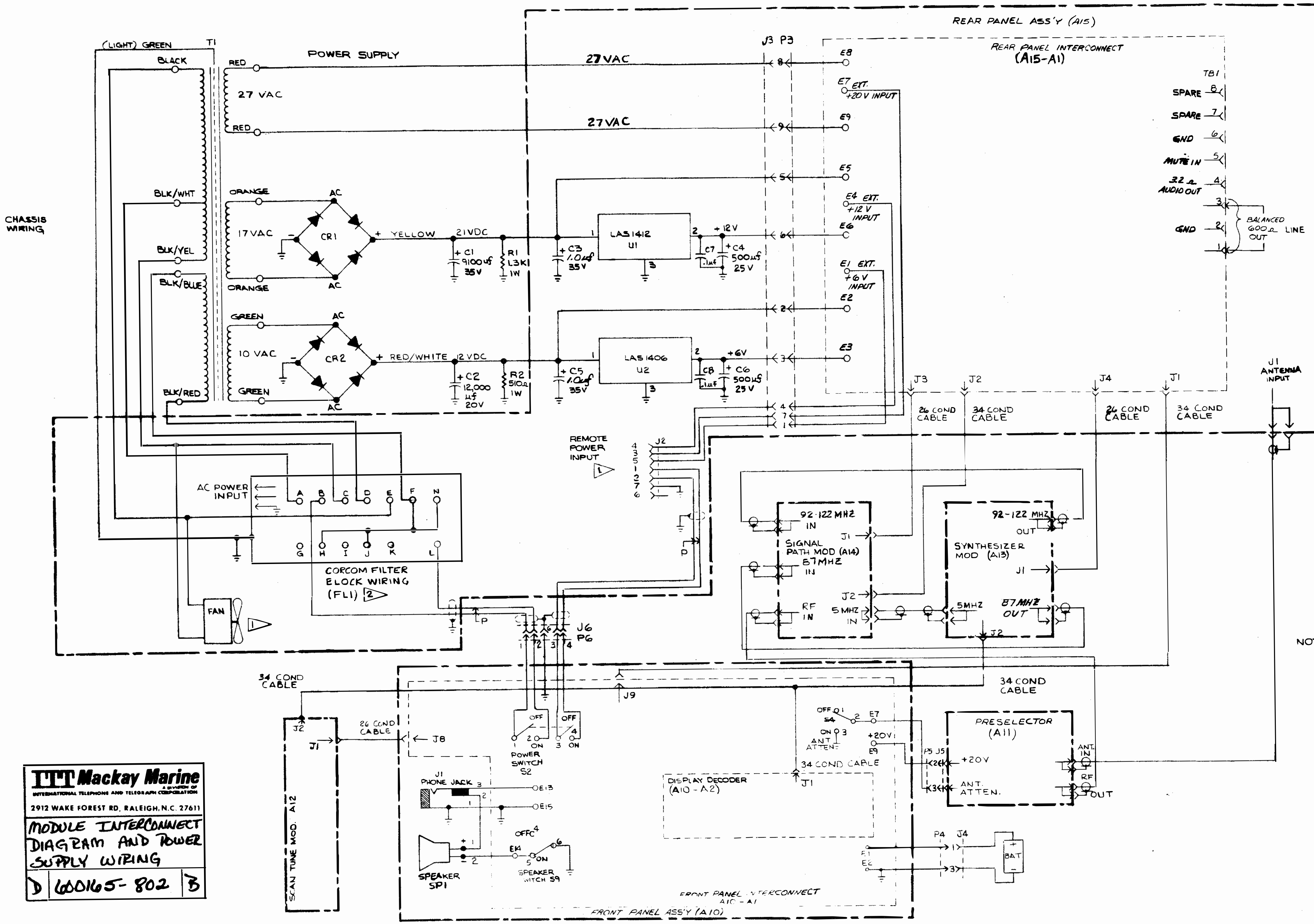
SCAN TUNE COUNTER PCB SCHEMATIC

D	620926-536	B



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MODULE INTERCONNECT DIAGRAM AND POWER SUPPLY WIRING

D | 600165-802 | B

NOTES:

1. SEE L/M (600165-800) FOR GROUPS WHICH USE THE REMOTE POWER CONNECTOR AND FAN.
2. INTERNAL STRAPPING OF 6J4 FILTER BLOCK:
   - A. FOR 100V OPERATION: A & B; C & D; E & F ARE SHORTED
   - B. FOR 120V OPERATION: B, C & D; E & F ARE SHORTED
   - C. FOR 220V OPERATION: A & B; D & E ARE SHORTED.
   - D. FOR 240V OPERATION: B & C; D & E ARE SHORTED

EB3039
SYNTHESIZED RECEIVER

INTRODUCTION

With the exception of the front panel configuration and preselector printed circuit board, the EB3039 is identical to the 3031A.

FRONT PANEL CONFIGURATION

The EB3039 front panel configuration is almost identical to that of the 3031A. The only differences are as follows:

1. Color.

2. Receiver nomenclature and vendor identification.

3. Inclusion of VN (very narrow), N (narrow), INT (intermediate), and WIDE under the IF BANDWIDTH kHz pushbuttons.

PRESELECTOR PC BOARD

The preselector PC board (600959-536-002) installed in the EB3039 is strapped so that the preamplifier is used in all tuned (100 kHz to 30 MHz) positions. (The WIDEBAND and .015-.10 positions of the PRESELECTOR BAND MHz switch are not tunable.)