

502

INSTRUCTION MANUAL  
MODEL 1500B RECEIVER

December 1971

FREDERICK ELECTRONICS CORPORATION  
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FREDERICK ELECTRONICS CORPORATION

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ERRATA SHEET

Model 1500B

REFERENCE	CORRECTION
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Figure 6-3

Added -2 and -3 configurations as shown below:

	CENTER FREQ. (Hz)	BAND- WIDTH (Hz)	Y1 (kHz)	Y2 (kHz)	C47	C48	C49	C50	C51	C61	C62	C63	C64	C65
-2	1900	1200	9001.9	8998.1	.03	.04	.01	.04	.03	.03	-	.033	-	.03
-3	2000	1200	9002	8998	.03	.04	.01	.04	.03	.02	-	.033	-	.02

Figure 7-5, Parts List

Added item 59, part number 1MD-1-103J capacitor, .01, 5%, 100V, Elmenco

Added item 60, part number 1MD-1-303J capacitor, .03, 5%, 100V, Elmenco

Added item 61, part number 1MD-1-203J capacitor, .02, 5%, 100V, Elmenco

ECN

6-1-72

Figures 6-4 and 7-6

The secondary winding connection of audio output transformer T6 to pin 22 will vary for different speaker output impedances as listed:

<u>COLOR</u>	<u>Z</u>
Yellow	4Ω
White	8Ω
Green	16Ω

6-9-72

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ERRATA SHEET

Model 1500B (cont.)

REFERENCE	CORRECTION
Figures 6-3 and 7-5	Added -4 configuration as shown below.

	CENTER FREQ. (Hz)	BAND- WIDTH (Hz)	Y1 (kHz)	Y2 (kHz)	C47	C48	C49	C50	C51	C61	C62	C63	C64	C65
-4	1700	1200	9001.7	8998.3	.04	.10	.04	.10	.04	.04	-	.03	-	.04

Figure 7-5

Added item 62, part number MF575 capacitor .10, 5%, 100V, Paktron, FEC part number 029047.

ECN 1927  
DJK

8-4-75

Figure 7-2

1. Item 37 should read JSR 325-30-5106-NXE-AAG switch assembly ITT, quantity 1 (FEC part no. 723956).

2. Delete item 38.

ECN 2036  
DJK

11/26/75

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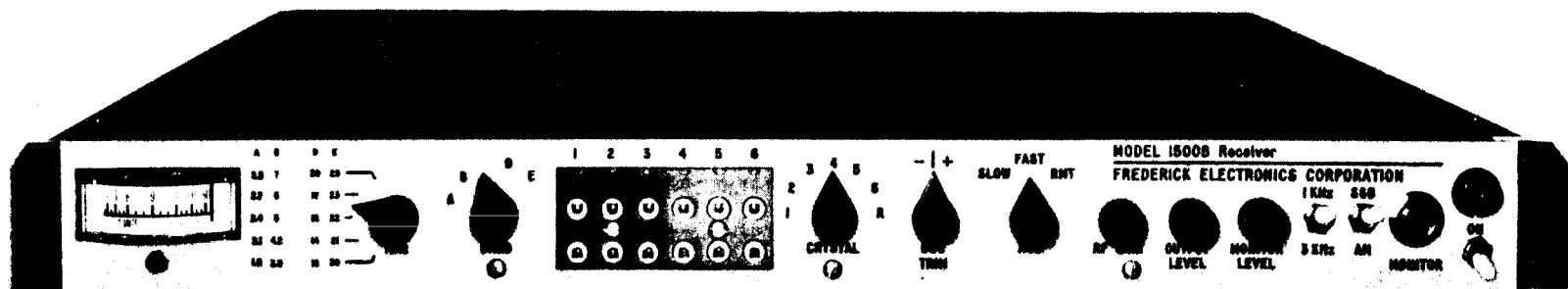


Figure 1-1. Model 1500B Receiver

# SECTION I

## INTRODUCTION

### 1.1 PURPOSE OF EQUIPMENT

The Frederick Electronics Corporation (FEC) Model 1500B Receiver provides optimum reception of FSK (F1) and AME (A3H) signals in the range of 10 kHz to 29 MHz. The Receiver is crystal-controlled and designed for use with an external FSK Demodulator such as the FEC Model 1200. When used with the Model 1200, the Receiver accepts AGC information from the Demodulator and maintains an ideal environment for the Demodulator's Detectors and patented Decision Threshold Computer.

The Receiver preselects the desired signal at its antenna input circuit, converts this signal to a 9 MHz IF and then to an audio frequency signal. Separate amplifier stages change the audio signal into a form suitable for driving both an external demodulator and a monitoring device. The output to the demodulator is rated at a nominal level of 0 dbm; the monitoring output is rated at approximately 1/4 watt into a 16-ohm load.

The Receiver utilizes highly selective filter circuits, a low-noise beam deflection mixer, and a product detector (FSK only) to reduce the effects of cross modulation to a level substantially below that of conventional communications receivers.

Frequency tuning of the Receiver is accomplished by selecting different crystals which are plugged into sockets on the front panel. As many as six crystals can be plugged in at any one time. An optional frequency synthesizer further simplifies tuning by providing crystal control on any frequency within the Receiver's range. In this case, frequency selection is effected by dialing the desired frequency.

A built-in noise generator allows the operator to peak the Receiver for optimum sensitivity at the tuned frequency.

### 1.2 PHYSICAL DESCRIPTION

The Model 1500B Receiver contains plug-in IF, Audio/AGC, and Power supply printed circuit boards and fixed Preselector, Mixer, and Local Oscillator printed circuit boards. Front Panel items include an S-meter, six crystal sockets and associated trim capacitors, a headphone jack, and various controls and switches. The Receiver is conveniently packaged for mounting in a standard 19-inch equipment rack. The unit requires a rack space of 1-3/4 inches and weighs approximately 10 pounds.

### 1.3 SPECIFICATIONS

Specifications for the Receiver are shown in Table 1-1.

Table 1-1. Specifications, Model 1500B

ANTENNA INPUT . . . . .	Nominal 50 ohms, unbalanced.																					
NOISE GENERATOR . . . . .	Approximately 1 microvolt in the standard 3 kHz bandwidth over range of Receiver (injected at antenna terminal).																					
SENSITIVITY . . . . .	The Receiver requires the following carrier levels for a 10 db $\frac{S+N}{N}$ :																					
	<table border="0" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: center;"><u>Frequency</u> <u>In MHz</u></th> <th style="text-align: center;"><u>SSB</u> <u>Level</u></th> <th style="text-align: center;"><u>AM Level</u></th> </tr> </thead> <tbody> <tr> <td>1.7-3.5 MHz</td> <td>0.3 uV</td> <td>1.5 uV</td> </tr> <tr> <td>3.5-7 MHz</td> <td>0.3 uV</td> <td>1.5 uV</td> </tr> <tr> <td>7-13 MHz</td> <td>0.4 uV</td> <td>2.0 uV</td> </tr> <tr> <td>13-20 MHz</td> <td>0.5 uV</td> <td>2.5 uV</td> </tr> <tr> <td>20-29 MHz</td> <td>0.6 uV</td> <td>3.0 uV</td> </tr> <tr> <td>10-550 kHz</td> <td>0.6 uV</td> <td>3.0 uV</td> </tr> </tbody> </table> <p>AM is modulated 30% with 1 kHz tone.</p>	<u>Frequency</u> <u>In MHz</u>	<u>SSB</u> <u>Level</u>	<u>AM Level</u>	1.7-3.5 MHz	0.3 uV	1.5 uV	3.5-7 MHz	0.3 uV	1.5 uV	7-13 MHz	0.4 uV	2.0 uV	13-20 MHz	0.5 uV	2.5 uV	20-29 MHz	0.6 uV	3.0 uV	10-550 kHz	0.6 uV	3.0 uV
<u>Frequency</u> <u>In MHz</u>	<u>SSB</u> <u>Level</u>	<u>AM Level</u>																				
1.7-3.5 MHz	0.3 uV	1.5 uV																				
3.5-7 MHz	0.3 uV	1.5 uV																				
7-13 MHz	0.4 uV	2.0 uV																				
13-20 MHz	0.5 uV	2.5 uV																				
20-29 MHz	0.6 uV	3.0 uV																				
10-550 kHz	0.6 uV	3.0 uV																				
*FREQUENCY RANGE. . . . .	10 kHz to 550 kHz and 1.7 MHz to 29 MHz in 6 bands.																					
**FSK SELECTIVITY (F1). . . . .	1.0 kHz bandwidth at -6 db. 3.6 kHz bandwidth at -60 db (output center frequency is 2.5 kHz).																					
**AME SELECTIVITY (A3H) . . . . .	2500 Hz bandwidth at -6db.																					
IMAGE RESPONSE. . . . .	Minimum of 50 db down.																					
ADJACENT CHANNEL INTERFERENCE THRESHOLD. . . . .	60 db at 10 kHz from center frequency. 100 db at 50 kHz from center frequency.																					
INTERMEDIATE FREQUENCY. . . . .	9 MHz.																					
AUTOMATIC GAIN CONTROL. . . . .	<u>Internal</u> : Fast or slow release. <u>External</u> : Slow release. <u>AM</u> : Slow release.																					

Table 1-1. (cont.)

RECEIVER OUTPUT . . . . .	600 ohms, variable for a nominal 0 dbm.
MONITOR OUTPUTS . . . . .	<u>Speaker or headphones</u> : 16 ohms, 1/4 watt.
POWER REQUIREMENTS. . . . .	115/230 vac, 47 to 63 Hz, 20 watts nominal. (Internal switch change needed for 230 volt operation.)
TEMPERATURE RANGE . . . . .	0° to 50° C.
DIMENSIONS. . . . .	Depth: 17 inches Width: 19 inches Height: 1-3/4 inches

\*Since the Receiver IF is within the operating range (9 MHz), signals may not be received within this IF channel. Reception in the 13.5 and 18.0 MHz channels is possible only with special crystals at 22.5 and 27 MHz, respectively. Reduced sensitivity occurs at several frequencies due to internal spurious outputs generated by the Local Oscillator and BFO. These frequencies are listed in Table 3-3 of this manual.

\*\*Selectivity is determined by crystal filter/audio filter. Center frequency for FSK reception (F1) of passband is determined by BFO crystal frequency. The Receiver is available in a range of selectivities and center frequencies as requested by the customer. It is not recommended that field modifications be attempted for the purpose of varying the specifications.

## SECTION II

### INSTALLATION

#### 2.1 UNPACKING AND INSPECTION

Carefully unpack and remove the Model 1500B from its shipping container. Inspect the unit for damage. If any damage is found, file a written claim with the shipping agency. Send a copy of this claim to Frederick Electronics Corporation.

#### 2.2 POWER REQUIREMENTS

The Receiver is shipped ready to operate directly on 105-130 volt, 47-63 Hz ac current. Power is applied to the Receiver by plugging its power cord into an ac outlet. Provision is made for operation from a 230-volt source by repositioning switch S1 located on power supply board N0724 in the Model 1500B.

#### CAUTION

Switch must be in correct position before the Receiver can operate on 230 volts. Serious damage will result if the Receiver is connected to 230 volts without this change.

#### 2.3 MOUNTING

The Receiver is designed to mount in a standard 19-inch equipment rack. A vertical rack space of 1-3/4 inches is required.

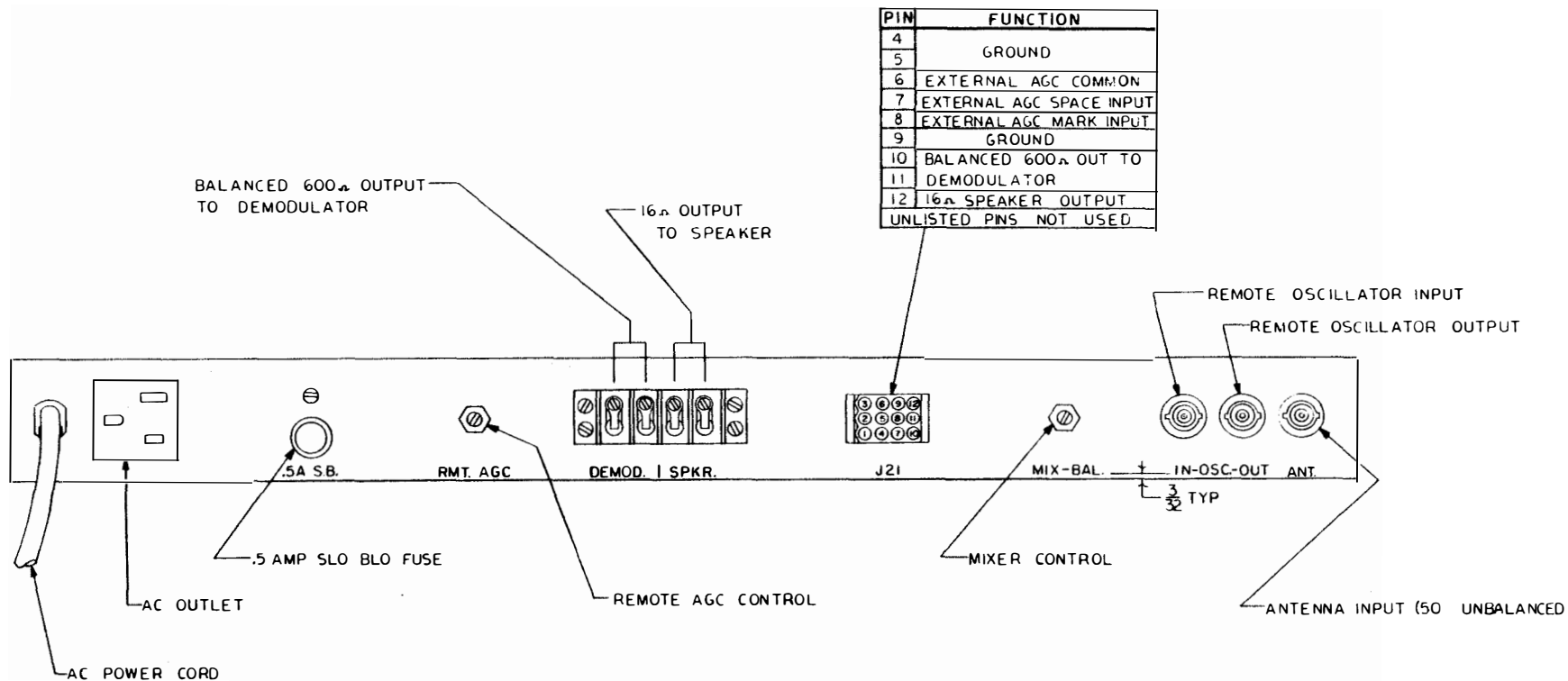
#### 2.4 REAR PANEL CONNECTIONS (Refer to Figure 2-1.)

##### 2.4.1 ANTENNA

The RF signal input circuit to the Receiver is designed to operate from any antenna having a transmission line impedance of 50 ohms, unbalanced. Antenna connections are made to a BNC connector located at the rear of the Receiver. Detailed information on the subject of antennas and transmission lines is found in the Radio Amateur's Handbook and the A.R.R.L. Antenna Book, both published by the American Radio Relay League, Newington, Connecticut, U.S.A.

##### 2.4.2 SPEAKER

Two outputs for driving external permanent magnet speakers are provided at the rear of the Receiver. One output is at terminals 1 and 2 (ground) of TB1. The other output is at pins 9 (ground) and 12 of J1. This latter output is convenient when a



NOTES

1. STENCIL APPROXIMATELY AS SHOWN  $\frac{1}{8}$  HIGH.

Figure 2-1. Rear Panel Connections

single plug is used to interconnect the Receiver and Demodulator. Speaker voice coil impedances can be almost any standard value, although maximum efficiency will be obtained with 16-ohm impedances.

#### 2.4.3 HEADPHONES

A headphone jack labeled MONITOR is located on the Receiver front panel. This jack is wired so that the speaker or speakers are disconnected when headphones are plugged in. Headphone impedance is not critical, and any commercial headphone should function satisfactorily.

#### 2.4.4 DEMODULATOR

Two outputs are also provided for driving an associated Demodulator. Both provide a 0 dbm, 600 ohm balanced output. One output is at terminals 3 and 4 of TB1; the other output is at pins 10 and 11 of J21.

The Model 1500B is often used with demodulators utilizing a 2550 Hz audio center frequency. Since the standard audio output is 2500 Hz, the BFO oscillators should be offset 50 Hz to produce the desired output. The BFO associated with bands A, B, and C should be adjusted for a frequency of 9002.550 kHz and the BFO used with bands D, E, and L should be adjusted for a frequency of 8997.450 kHz.

#### 2.4.5 REMOTE AGC

Remote AGC signals are accepted at pins 6, 7, and 8 of J21. The remote circuitry is specifically designed to operate with an FEC Model 1200 FSK Demodulator.

#### 2.4.6 REMOTE LOCAL OSCILLATOR

The remote local oscillator input and output connections are provided through a pair of BNC connectors. The remote input is specifically designed for use with an FEC Model 1550 Synthesizer unit but will operate from a signal source with a 1 vpp input.



## SECTION III

### OPERATION

#### 3.1 GENERAL

This section contains complete operating instructions for the Receiver. It includes a tabular list of each control and indicator (Table 3-1), information on the use of the controls and indicators, procedures for tuning the Receiver, and special instructions for operating the Receiver with an FEC Model 1200 FSK Demodulator.

Table 3-1. Controls and Indicators

Power ON switch . . . . .	Controls ac power to Receiver.
Power ON lamp . . . . .	Lights to indicate that power is applied to equipment.
MONITOR jack. . . . .	Provides headphone reception of received signal.
SSB AM switch . . . . .	<u>SSB position</u> : selects a product detector for FSK mode of operation. <u>AM position</u> : selects an AM detector for AME mode of operation.
1 kHz 3 kHz switch. . . . .	<u>1 kHz position</u> : selects a 1 kHz bandwidth. <u>3 kHz position</u> : selects a 3 kHz bandwidth.
MONITOR LEVEL control . . . . .	Adjusts audio level at speaker terminals and MONITOR jack.
OUTPUT LEVEL control. . . . .	Adjusts audio level to external Demodulator.
RF GAIN control . . . . .	Varies gain of mixer and IF stages by setting the AGC threshold.
AGC SLOW FAST RMT switch. . . . .	<u>SLOW position</u> : Selects internal AGC with slow release time constant for FSK operation. <u>FAST position</u> : Selects internal AGC with fast release time constant for FSK operation. <u>RMT position</u> : Selects external AGC input and slow release time constant for FSK operation.

AGC SLOW FAST RMT switch (cont.)  
(FSK operation only) . . . . .

NOTE

During AM operation  
the AGC switch must  
be placed in the RMT  
position without a  
remote signal input.

OSC TRIM -/+ control . . . . . Permits crystal frequency to be  
"pulled" slightly to either side  
of channel for fine tuning adjust-  
ments.

CRYSTAL switch . . . . . Positions 1 thru 6: Select any  
one of six front panel crystal  
sockets.  
R position: Selects a remote os-  
cillator input to determine  
Receiver operating frequency.

NOTE

This input is normally  
used with an FEC Model  
1550 Synthesizer.

CRYSTAL sockets. . . . . Six standard HC6/U crystal sockets  
that accept any parallel-resonant  
crystal in range of Receiver.  
Each socket has an associated trim  
capacitor located above the sockets.

BAND switch. . . . . Selects frequency range of Receiver  
tuning.  
A (black) position: 1.7 to 3.5 MHz  
B (green) position: 3.5 to 7 MHz  
C (yellow) position: 7 to 13 MHz  
D (red) position: 13 to 20 MHz  
E (blue) position: 20 to 29 MHz  
L (white) position: 10 kHz to  
550 kHz

MHz (Preselector) control. . . . . Used in conjunction with BAND  
switch to peak preselector tuning.  
Has approximate frequency settings  
within each selected band. Fre-  
quency settings are color-coded to  
agree with BAND switch positions.  
(This control is not used on low  
frequency band L.)

- S-UNITS meter . . . . . Indicates accuracy of tuning and relative strength of received signals. Meter is calibrated in S-units from 1 to 9, and in decibels above S9 (0 to +90 db).
- Noise pushbutton switch . . . . . Activates noise generator and allows Receiver to be peaked for optimum reception.  
(below S-UNIT meter)
- RMT. A.G.C. control . . . . . Adjusts remote AGC gain. FSK operation only.  
(rear panel)
- MIX-BAL. control. . . . . Adjusts mixer balance. This is a maintenance adjustment and must not be attempted by the operator.  
(rear panel)

3.2 USE OF CONTROLS

3.2.1 BAND SELECTOR SWITCH

The BAND selector switch permits the operator to cover the six different frequency ranges of the Receiver. This switch is used in conjunction with the MHz preselector control to tune the Receiver to a specific frequency. (There is no preselector control setting for the L band.) Each band of the selector switch is identified by a different-colored letter of the alphabet (A thru E and L). Settings of the MHz control are color-coded to agree with the band selected. In this manner, the operator immediately knows the band he has selected and the approximate frequency setting within that band.

If the desired frequency coincides with the dividing point between bands, always choose the band which produces the higher S-meter reading.

3.2.2. MHz CONTROL

The MHz control is a variable tuning control that peaks the preselector tuning. After a particular band is selected by the BAND switch, the MHz control is adjusted to the approximate frequency being used. This control is inoperative on the L band. Frequency settings indicated on the control are not intended to pinpoint the exact operating frequency, but they will narrow down the tuning until the operator can zero-in on the desired frequency. The S-meter is a valuable aid in peaking the MHz control.

3.2.3 S-METER

The S-meter provides a visual means of determining when the MHz preselector control is properly tuned, as well as an indication of relative signal strength. To the experienced operator, the S-meter can provide valuable information about receiving conditions.

The S meter is calibrated in S-units from 1 to 9, and in decibels above S9 to +90 db. Readings on the S-meter will be correct only when the RF GAIN control is at maximum sensitivity (fully clockwise).

#### 3.2.4 NOISE SWITCH

The noise pushbutton switch (located below the S-meter) activates a noise generator which permits the Receiver to be peaked at the preselector for optimum reception. No signal other than the noise signal is necessary for this adjustment. After the MHz preselector is set to the approximate frequency desired, the noise pushbutton should be depressed and held while the MHz control is adjusted for maximum reading on the S-meter.

#### NOTE

If care is not taken, the preselector may be peaked at an image frequency. To avoid this condition, make sure that the MHz preselector control is set to the desired frequency.

The noise generator signal may be used for emergency alignment of the Receiver when no other signal source is available. In addition, the noise generator provides a test for Receiver operation, since failures (including local oscillator failure) will result in no noise output when the pushbutton is depressed.

#### 3.2.5 RF GAIN CONTROL

The RF GAIN control varies the gain of the mixer and IF amplifier stages by setting a fixed threshold in the AGC circuits. Maximum gain is obtained with the control rotated fully clockwise.

#### 3.2.6 CRYSTAL SELECTOR SWITCH

The CRYSTAL selector switch is a seven-position switch that permits the operator to choose the exact frequency of operation. Associated with the numbered positions of this switch are correspondingly numbered crystal sockets and trim capacitors. To change frequency, the operator first inserts the proper crystal into any empty socket. Second, the operator must tune in the signal and adjust the crystal trim capacitor (located directly above the crystal socket) for a maximum reading on the S-meter. (See paragraph 3.3.) The R position of this switch enables the Receiver to accept the input from an external synthesizer.

#### 3.2.7 CRYSTAL FREQUENCY

The local oscillator crystal frequency is determined by the mode of operation and the band selected. Table 3-2 and Figure 3-1

show the relationship of the received signal to the local oscillator frequency. In the FSK mode (SSB), the crystal frequency is 9 MHz above the carrier frequency on bands A, B, C, and L and 9 MHz below the carrier on bands D and E.

In the AM mode the crystal frequency is 9001.4 kHz above the carrier on bands A, B, C, and L and 8998.6 kHz below the carrier on bands D and E. The crystal is 1.4 kHz above the FSK crystal frequency in order to center the audio channel (300 to 3000 Hz) in the IF crystal filter band-pass.

Table 3-2. Signal Frequency vs. Crystal Frequency

BAND	FREQUENCY RANGE	CRYSTAL RANGE MHz (+1.4 kHz for AM)
A	1.7 MHz - 3.5 MHz	10.7 - 12.5
B	3.5 MHz - 7 MHz	12.5 - 16
C	7 MHz - 13 MHz (excluding 9 MHz IF Channel)	16 - 22
D	13 MHz - 20 MHz	4 - 11
E	20 MHz - 29 MHz	11 - 20
L	10 MHz - 550 kHz	9.010 - 9.550

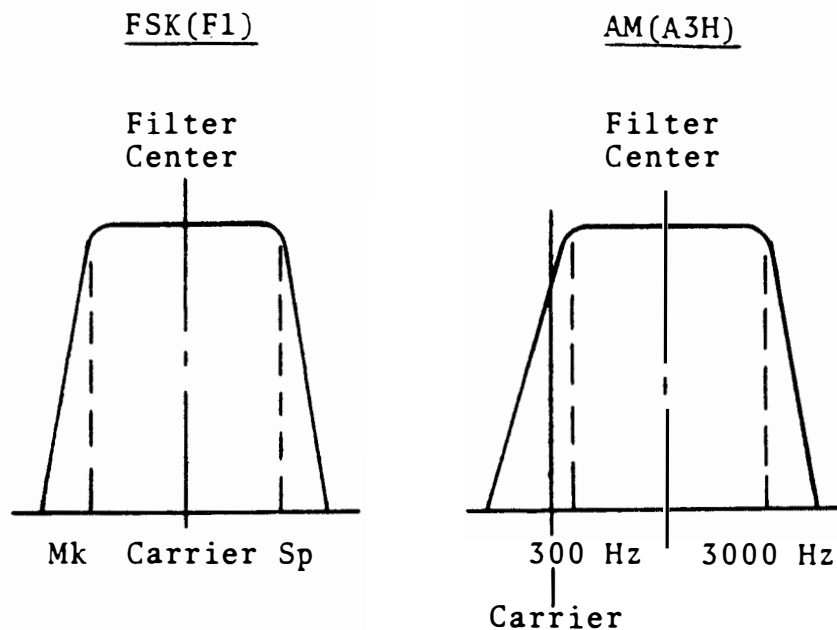
Table 3-3 lists certain frequencies that cannot be received by the Model 1500B because of spurious interference. Crystals used should meet the following specifications:

Crystal Specifications

Mode of oscillation: 4,000-22,000 kHz, AT cut  
 Shunt capacitance: 7 Pf (maximum)  
 Resistance: 75 to 25 ohms  
 Maximum drive: 10 milliwatts (4,000-9,999 kHz)  
                   4 milliwatts (10,000-22,000 kHz)  
 Load capacity: 32 Pf  
 Temperature Tolerance: -10<sup>o</sup> to +60<sup>o</sup> C within 0.0005%  
 Holder: HC6/U

3.2.8 OSC TRIM CONTROL

The OSC TRIM control permits the frequency of the crystal local oscillator to be varied slightly around its center frequency for optimum tuning of the received signal. (Recall that each



NOTES

- (1) The F1 Filter Center frequency is the same as the "assigned" center frequency.
- (2) The A3H center frequency is 1.4 kHz above the carrier frequency.
- (3) For F1 reception:  
Local oscillator crystal = Carrier Frequency  $\pm$ 9 MHz.
- (4) For A3H reception:  
Local oscillator crystal = Carrier Frequency  $\pm$ 9 MHz  
+1.4 kHz

Figure 3-1 Relationship Of FSK And AM Reception

Table 3-3. INTERNAL SPURIOUS FREQUENCIES

OPERATING FREQUENCY KHz	BAND	*LOCAL OSCILLATOR FREQUENCY KHz	BFO FREQUENCY KHz	LOWEST ORDER SPURIOUS PRODUCT EQUAL TO IF	CARRIER LEVEL (uV) FOR 10db $\frac{S+N}{N}$		SPURIOUS FREQUENCY TYPICAL
					ADJACENT FREQUENCIES MAXIMUM	TYPICAL	
3,002.5	A	12,002.5	9,002.5	3LO-3BFO	0.3	0.2	2.0
3,603.0	B	12,603.0	9,002.5	5LO-6BFO	0.3	0.2	2.0
5,403.5	B	14,403.5	9,002.5	5LO-7BFO	0.3	0.2	6.0
6,003.3	B	15,003.3	9,002.5	3LO-4BFO	0.3	0.2	30.0
9,002.5	C	18,002.5	9,002.5	LO-BFO	0.4	0.2	Receiver Blocked
11,255.0	C	20,255.0	9,002.5	4LO-8BFO	0.4	0.2	8.0
12,005.0	C	21,005.0	9,002.5	3LO-6BFO	0.4	0.2	300 for 3db $\frac{S+N}{N}$
13,500.0	D	4,500.0	8,997.5	2LO	0.5	0.3	Receiver Blocked
13,500.0	D	4,500.0	None (AM)	2LO	2.5	1.5	Receiver Blocked
14,999.16	D	5,999.16	8,997.5	3LO-BFO	0.5	0.3	8.0
18,000.0	D	9,000.0	8,997.5	LO	0.5	0.3	Receiver Blocked
18,000.0	D	9,000.0	None (AM)	LO	2.5	1.5	Receiver Blocked
20,997.5	E	11,997.5	8,997.5	3LO-3BFO	0.6	0.4	0.5
21,597.0	E	12,597.0	8,997.5	5LO-6BFO	0.6	0.4	2.0
23,396.5	E	14,396.5	8,997.5	5LO-7BFO	0.6	0.4	8.0
23,996.67	E	14,996.67	8,997.5	3LO-4BFO	0.6	0.4	2.0
25,196.0	E	16,196.0	8,997.5	5LO-8BFO	0.6	0.4	4.0
26,997.5	E	17,997.5	8,997.5	LO-BFO	0.6	0.4	30.0
29,245.0	E	20,245.0	8,997.5	4LO-8BFO	0.6	0.4	6.0

\*NOTE: If the local oscillator internal crystal frequency is a subharmonic of an indicated lowest order frequency, particularly if a 4-7 MHz crystal third harmonic is coincident with a spurious generating lowest order frequency slight degradation in the  $\frac{S+N}{N}$  can occur as some spurious output may be generated and appear as a small increase in the noise level.

crystal is trimmed individually when it is initially installed and the OSC TRIM control is centered for this adjustment.) In general, the amount of variation possible is proportional to the frequency of the crystal selected. Normally, the Receiver is tuned with the OSC TRIM control set to its center position (indicated by a vertical line). The OSC TRIM control is then used to optimize the input signal by rubbering the IF frequency slightly.

Extreme accuracy in the FSK mode can only be obtained with the aid of the tuning indicator associated with the external Demodulator. For example, if a Model 1200 FSK Demodulator is being used, the OSC TRIM control is rotated + and - from the vertical line until the Demodulator's tuning meter reads maximum. The Model 1200 instruction manual explains this tuning procedure in more detail.

### 3.2.9 AGC SWITCH

The AGC switch is used in the FSK (F1) mode to select either an internally generated automatic gain control signal or externally generated signal from which AGC signals are derived. In either case, the gain of the Receiver is automatically regulated in inverse proportion to the strength of the received audio signal. The overall result is that the output level of the Receiver tends to remain constant regardless of variations in input signal strength.

The SLOW position of the AGC switch provides a fast attack and a slow release time constant for the reception of FSK signals. Slow AGC is desirable for normal receiving conditions, since it inserts just enough delay to suppress noise buildup during momentary absences of either the mark or space tone.

The FAST position of the AGC switch provides a fast attack and fast release time constant. Fast AGC is more beneficial when receiving conditions include rapid signal fades. One objectionable feature of fast AGC is that noise buildup can occasionally become excessive. This is because the Receiver recovers rapidly and allows noise to appear in the output.

The RMT position of the AGC switch selects mark and space input signals from an external Demodulator such as the FEC Model 1200. An AGC control voltage is then derived from these external signals.

The RMT position is also used during the AM mode to disable the normal AGC input path. The AGC signal is then generated from the AM detector output so that the Receiver gain is controlled solely by the carrier amplitude. In this mode, all inputs to the remote AGC connector pins must be disconnected.

### 3.2.10 OUTPUT LEVEL CONTROL

The OUTPUT LEVEL control adjusts the level of the audio



output. Maximum output is obtained with the control rotated fully clockwise.

### 3.2.11 MONITOR LEVEL

The MONITOR LEVEL control adjusts the level of the audio amplifier feeding the headphone jack and external speaker terminals. Maximum output is obtained with the control rotated fully clockwise.

## 3.3 OPERATING THE RECEIVER (FSK RECEPTION)

Before operating the Receiver, make sure that it is properly installed as described in Section II of this manual. The Receiver can now be tuned to any frequency within its range by means of the following step-by-step procedures:

1. Insert crystal of proper frequency into any unused socket on front panel. (Refer to paragraph 3.2.7.)
2. Set CRYSTAL switch to match socket number selected above.
3. Set power switch to ON. Pilot lamp will light indicating that receiver is operative.
4. Rotate RF GAIN control fully clockwise. S-meter needle will drop to zero.
5. Rotate MONITOR LEVEL control clockwise until a low volume hiss is heard from speaker or headphones.
6. Set AGC switch to SLOW.
7. Set AM-SSB switch to SSB.
8. Set 1 kHz-3 kHz switch to 1 kHz.
9. Rotate OSC TRIM control to center line.
10. Set BAND switch to band containing desired frequency.
11. Rotate MHz preselector control to number approximating desired frequency. Tune to signal by rotating MHz control for maximum reading on S-meter. With a small screwdriver adjust crystal trim capacitor for a maximum reading on S-meter. After crystal trimmer is adjusted once for a given frequency the Receiver can be returned to the correct frequency by centering the OSC TRIM control, selecting the crystal, and rotating the MHz control for a maximum reading on the S-meter.

## NOTE

Avoid peaking Receiver at an image frequency by making sure that the MHz control is set to the scale reading corresponding to the desired frequency. Although it will be necessary to rock the MHz control back and forth around the indicated frequency, the final scale setting will always be fairly close to the desired frequency.

12. With a strong signal present on the frequency just tuned, rotate OUTPUT LEVEL control clockwise until Receiver provides a zero dbm signal into 600-ohm line of external Demodulator. The Demodulator should have some type of level meter to indicate zero dbm. When this point is reached, the Demodulator's level control can be used to control its gain.
13. Adjust OSC TRIM control for a maximum reading on Demodulator tuning meter. (See paragraph 3.2.8.) After this adjustment is made the Receiver is properly tuned.

### 3.4 OPERATING THE RECEIVER (AM RECEPTION)

Perform steps 1-5 in paragraph 3.3, then proceed as follows:

6. Set AGC switch to RMT and disconnect any external AGC inputs.
7. Set AM-SSB switch to AM.
8. Set 1 kHz-3 kHz switch to 3 kHz.
9. Perform step 10 of paragraph 3.3.
10. Perform step 11 of paragraph 3.3.
11. Perform step 12 of paragraph 3.3.

SECTION IV  
THEORY OF OPERATION

4.1 FUNCTIONAL DESCRIPTION

A functional block diagram of the Model 1500B Receiver is shown in Figure 4-1. Frequency shift keying (FSK) or AM signals in the range of 10 kHz to 550 kHz and 1.7 MHz to 29 MHz are routed from the antenna to the appropriate section of a 6-band preselector. The preselector is fixed-tuned on the 10 kHz to 550 kHz band, and tunable on all other bands. A built-in noise generator allows the operator to peak the preselector in the absence of a signal. Output signals from the preselector are connected to a beam deflection mixer circuit.

The beam deflection mixer circuit combines the preselected signal with a local crystal oscillator signal or an external synthesizer signal to produce a 9 MHz IF signal. Inherent characteristics of the mixer circuit provide a signal output which is low in noise content and virtually free of cross modulation.

Local oscillator crystals are selected so that the difference between the desired input signal and the crystal frequency is nominally 9 MHz. A front panel OSC TRIM control provides fine adjustment of the oscillator frequency. To facilitate Receiver tuning, provision is made at the front panel to accept up to six plug-in crystals for any specified frequency within the 10 kHz to 29 MHz range. Crystals are selected by a front panel rotary switch; an additional switch position permits the output of a remote frequency synthesizer to be selected. FEC produces a Model 1550 Synthesizer Unit that is specifically designed for use with the Receiver. The Synthesizer provides crystal-controlled dialing of any desired frequency within the Receiver's range.

The 9 MHz IF output from the beam deflection mixer circuit is passed through a 6-pole crystal-lattice filter. This filter has a center frequency of 9 MHz, and provides sharp skirt selectivity to produce a 3.0 kHz band-pass. The filter output is amplified by two tuned IF stages and connected to either a product detector (SSB mode) or an active envelope detector (AM mode). The SSB mode is used for FSK reception and the AM mode is used for AM reception.

In the FSK (SSB) mode, the product detector converts the 9 MHz IF signal to a 2.5 kHz audio signal. The BFO injection signal is supplied by one of two crystal oscillators, as determined by the frequency band selected. The resultant 2.5 kHz output from the product detector is normally routed by the bandwidth switch to a 1 kHz 3-pole band-pass filter.

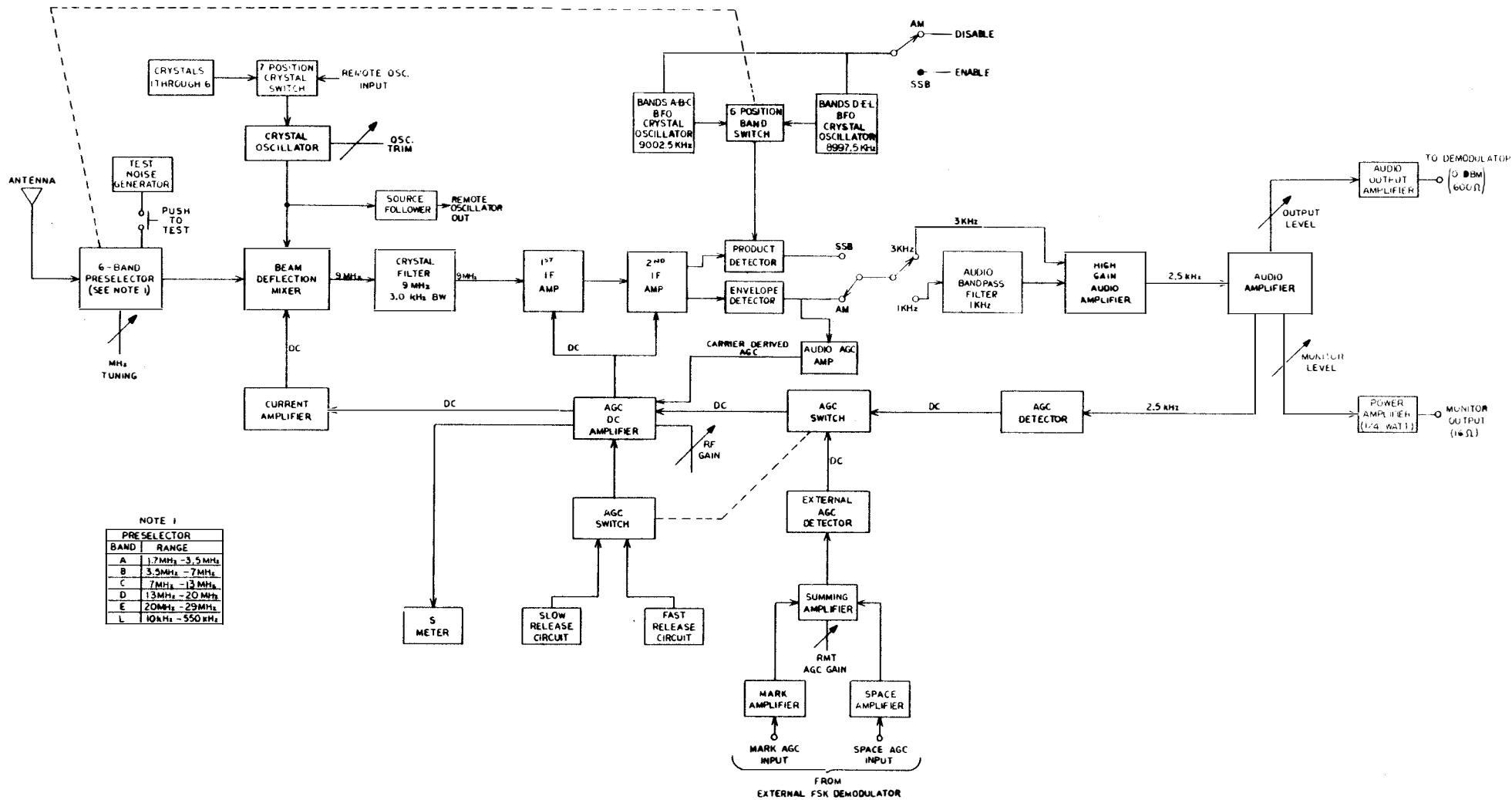


Figure 4-1. Functional Block Diagram D1796A

In the AM mode, the active envelope detector converts the 9 MHz IF to a 300 to 3000 Hz audio frequency. This audio is normally routed by the bandwidth switch directly to the audio amplifier (3 kHz bandwidth).

The 1 kHz band-pass filter has a center frequency of 2.5 kHz, and provides sharp skirt selectivity to produce an ideal band-pass for FSK signals. A low level audio amplifier provides the signal from the filter or directly from the AM envelope detector to an audio distribution amplifier. This latter amplifier distributes the audio signal to an output amplifier, a monitor amplifier, and an AGC detector.

The audio output amplifier is a push-pull circuit with 600-ohm terminals for matching the input of an external Demodulator. The OUTPUT LEVEL control permits the audio signal to be varied up to a nominal 0 dbm.

The Monitor output amplifier is also a push-pull circuit with 16-ohm terminals for driving an external speaker or headphones. The MONITOR LEVEL control permits the audio signal to be adjusted to a suitable listening level.

The FSK (SSB mode) AGC circuits include a detector, fast and slow release circuits, several dc amplifiers, and an external input circuit. The AGC attempts to hold the Receiver output level constant despite changes in input signal strength. The AGC switch permits selection of either an internally generated control voltage with slow or fast release times, or an externally generated signal voltage (with slow release time) from an associated Demodulator. The internal AGC voltage is derived from the 2.5 kHz audio signal; the signal is successively detected, filtered, and amplified to produce an average dc level that reflects the audio amplitude. The resultant average dc level provides negative feedback to the cathode circuits of the beam deflection mixer stages and to both IF amplifier stages. If the signal received at the antenna begins to fade, the generated AGC voltage tends to increase the mixer and detector gain and, thus, a constant output from the Receiver is maintained. Similarly, increases in signal strength reduce the gain of both stages to produce the same effect.

The external circuits used to derive the AGC control voltage are designed for operation with an FSK Demodulator such as the Frederick Electronics Model 1200. Mating of the Receiver and the Model 1200 produces an ideal environment for the Detectors and patented Decision Threshold Computer (DTC) in the FSK Demodulator. Mark and space tones from the Demodulator are separately amplified, and the resultant outputs are combined in a summing amplifier. An AGC detector then extracts the dc signal strength variations in the same manner as described for the internal AGC detector. The

remaining operation is identical to that of the internal AGC circuit.

The AGC switch on the Receiver has positions designated SLOW, FAST, and RMT. The first two positions are used with the internal AGC circuit and function as follows: SLOW AGC provides a fast attack and a slow release. This mode provides ideal conditions for FSK operation by providing sufficient delay in release to suppress noise during momentary absences of the mark or space signal. FAST AGC provides both fast attack and fast recovery times. This mode of operation is advantageous only during the reception of rapidly fading signals.

The RMT (remote) position of the AGC switch selects the external Demodulator signal previously described. This mode of operation uses only the slow internal AGC time constant.

In AM operation, the switch must be in RMT with no signal connections so that AGC can be generated directly from the AM detector circuits. Carrier derived AGC voltage is taken from the envelope detector circuit, amplified, and then applied to the AGC dc amplifier.

The S-METER provides visual indication of both Receiver tuning and relative signal strength. The S-METER is connected in the AGC dc amplifier circuit.

## 4.2 CIRCUIT DESCRIPTION

### 4.2.1 PRESELECTOR (Refer to Figure 6-1.)

The preselector comprises six switch-selectable RF filters, a wave trap, and a noise generator. Five of these circuits, covering the 1.7 to 29 MHz range, consist of a 4-pole high-Q toroidal filter and a tunable RF network. The remaining circuit, covering the 10 kHz to 550 kHz range, consists of a 4-pole high-Q toroidal filter without the tunable RF network. In operation, the preselector circuits accept RF signals thru the ANT connector from any unbalanced antenna having a transmission line impedance of 50 ohms. The signals are directed to the proper preselector circuit by means of BAND switch S1. For example, signals in the range of 1.7 to 3.5 MHz are directed to the band A preselector.

The tunable portion (1.7 to 29 MHz) of the preselector consists of the front panel MHz control (C1) and inductors L1 through L5. Each inductor is associated with a different preselector section. When a specific frequency range is selected by the BAND switch, the proper inductor is connected to C1. Manual adjustment of C1 will then peak the preselector to the desired frequency. C1 is switched out of the fixed-tuned portion (10 kHz to 550 kHz) of the preselector circuit.

The wave trap consists of a 9 MHz series-resonant crystal (Y1) located at the output of the preselector circuits. The wave trap provides a low impedance path to ground for signals at or near the 9 MHz IF of the Receiver.

The noise generator consists of the base-emitter junction of Q1, and pushbutton switch S1. When S1 is depressed, the switch completes the dc path to ground through L3. The base-emitter junction is back-biased and breaks down in the reverse direction, generating large junction noises. The overall result is a wide, even spectrum of white noise throughout the RF range. The reverse junction current is sufficiently limited by R4 to prevent permanent damage to the transistor.

#### 4.2.2 MIXER STAGE (Refer to Figure 6-2.)

The mixer stage consists of dual beam deflection tube circuits V1 and V2 and a 9 MHz crystal filter. V1 and V2 mix the received signal with a local oscillator signal to generate a difference IF signal of 9 MHz. The beam deflection tube is unique in that its elements are so arranged that the cathode and control grid form an electron gun, and the deflecting electrodes form an electron lens. Together the gun and lens direct a beam of electrons towards the plates in a manner similar to that of the cathode-ray tube. Thus, the total tube current is varied by the input signal at the control grid and the division of tube current between the plates is varied by the local oscillator signal at the deflecting electrodes.

The input signal from the preselector is connected to control grid (pin 3) of V1.

The input signal from the local oscillator is connected to deflecting electrode pins 8 and 9 of V1 and V2, respectively. The local oscillator is also connected to pins 9 and 8 of V1 and V2, respectively, by unbalanced-to-balanced transformer T2. Thus, the mixer is balanced both with respect to the input signal and the local oscillator signal. The signal voltage variations on the control grid vary the total tube current, and the local oscillator signal variations at the deflecting electrodes control the division of this current between the plates. The resultant mixing action produces sum and difference frequencies at the output of mixing transformer T1.

Both the input signal frequency and the local oscillator frequency (and its noise component) are attenuated in the mixer output. Since the input signal current is divided between the plates of V1 in a push-pull configuration approximately 35 db suppression is provided at the output of balanced plate load T1. Maximum suppression is provided by proper adjustment of R2. (Refer to Section V for adjustment procedure.) The local oscil-

lator input is also connected in a push-pull configuration controlling current deflection of each pair of deflecting electrodes. Thus, the local oscillator and noise components are suppressed approximately 30 db at the output of T1. Optimum balance is provided by proper adjustment of R1. (Refer to Section V for adjustment procedure.)

Of the remaining frequencies in the mixer output, only the 9 MHz difference frequency is coupled to the IF stage. The other frequencies are eliminated by the highly selective crystal filter circuit.

The crystal filter is a modularized 6-pole crystal-lattice filter with a center frequency of 9 MHz and a bandwidth of 3.0 kHz. The filter is driven from the secondary of T1. In operation, the 9 MHz mixer output is passed through the filter and connected to the input of the first IF amplifier. Unwanted signals in the mixer output are rejected by the sharp skirt selectivity of the crystal-lattice filter.

#### 4.2.3 LOCAL OSCILLATOR (Refer to Figure 6-2.)

The local oscillator uses a single transistor (Q3) as a wide band crystal oscillator circuit that provides a nominal 32 pf load for any one of six switch-selectable parallel resonant crystals. Individual crystal frequencies are chosen so that the difference between the received signal frequency and the crystal frequency is always 9000.0 kHz for FSK reception and 9001.4 kHz for AM reception. Crystals for the AM mode are 1.4 kHz above the IF crystal filter frequency so that the carrier is positioned at the edge of the skirt of the filter. This permits an upper sideband to pass thru the 3 kHz filter and provide an audio bandwidth of at least 2500 Hz after detection. On bands A, B, C, and L the crystal frequency must be above the received signal; on bands D and E crystal frequency must be below the received signal.

Individual crystal frequencies can be varied slightly to compensate for small frequency discrepancies by means of an individual crystal trim capacitor (located above and adjacent to the crystal sockets). Operational adjustment of the local oscillator frequency is provided by front panel OSC TRIM control C8 in any crystal position. Adjustment of either trim control alters the value of the tuned circuit capacitance to a small degree, thereby varying the resonant frequency. The amount of frequency variation possible is proportional to the frequency of the crystal.

The crystal oscillator has a direct sample output from its emitter to rear panel connector J26, pin 1. The oscillator input to the mixer is routed by S1 to buffer amplifier Q2 before connection to balance transformer T2.



The CRYSTAL selector switch has an extra position (R) which selects a signal from an external oscillator or frequency synthesizer via a rear panel connector. A companion synthesizer unit, the Model 1550, is available from FEC and is designed to operate with the Model 1500B. The Synthesizer eliminates crystal changing and permits convenient dial selection of any desired frequency in the range of the Receiver.

The Synthesizer or external oscillator input is applied to wide band amplifier Q1 to raise the input to the required operating level. The amplifier has a 13 db gain and requires a nominal 1 vpp input for proper operation of the Receiver.

#### 4.2.4 IF AMPLIFIERS (Refer to Figure 6-3.)

The IF amplifiers consist of two inductively coupled, tuned input cascode amplifiers (Z1 and Z2). The 9 MHz IF signal from the crystal filter is coupled by T1 to the input of Z1. The secondary of T1 is tuned by adjusting C4. (See Section V.) The output of Z1 is coupled to an identical second IF amplifier. The output of Z2 is, in turn, coupled by T3 to both the AM envelope detector and the SSB product detector. Both IF amplifiers are controlled by an AGC voltage at pin N. The AGC inputs to each amplifier are electrically isolated from each other by RFC choke L5 to prevent RF signal feed-over. RF is also isolated from the AGC bus by L3.

Alignment procedures for tuning the IF amplifiers are listed in Section V of this manual.

#### 4.2.5 PRODUCT DETECTOR (Refer to Figure 6-3.)

The product detector consists of operational amplifier Z3, and FSK mode beat frequency oscillators (BFO) Q1 and Q2. The detector circuit heterodynes the input IF signal with the BFO output to generate a 2.5 kHz audio FSK signal. Both oscillators are Pierce and are functionally identical.

Two BFO's are utilized in the FSK mode to insure that an increase in the received signal frequency always results in an increase in the detected signal frequency when operating in the HF region. This is in accordance with current communications standards. The Q1 circuit operates 2.5 kHz above the 9 MHz IF signal and is enabled on bands A, B, and C to match the input signal inversion (i.e., local oscillator signal is 9 MHz above the input RF signal). The opposite oscillator (Q2) is enabled on bands D, E, and L and operates 2.5 kHz below the 9 MHz IF. Both oscillators are disabled during AM operation.

During AM operation the active envelope detector is used for all input bands.

Z3 is essentially a differential pair with a third transistor used as a constant current source. The current source is modulated by the 9 MHz IF signal, while the division of this current in the differential pair is controlled by the selected Pierce oscillator input signal. This mixing action is analogous to that described in paragraph 4.2.2 for the beam deflection mixer. The resultant difference frequency is an audio tone of  $2.5 \text{ kHz} \pm$  the shift frequency. It is routed to the input of the AM-FSK diode selector circuit via audio transformer T4, and a low-pass filter.

#### 4.2.6 AM DETECTOR AND AGC AMPLIFIER (Refer to Figure 6-3.)

The AM Detector is an active envelope detector circuit consisting of operational amplifier Z4, and low-pass filter L2-C28-C29. In concept, Z4 can be replaced by a diode in series with the low-pass filter. The current drive to the output stage of Z4 is increased by external potentiometer R42 to the point where it is biased near cutoff and approximates a diode rectifier. However, even though the output stage is nearly cut off, all other stages of Z4 are operating in their linear range and can provide gain for small signal inputs. The detected output from Z4 is filtered by the low-pass filter to produce an audio dc output to the bandwidth selector circuit of the AGC amplifier.

The AGC amplifier consists of operational amplifier Z5. The amplified output from Z5 is rectified by CR7 and filtered by C55 to produce a dc level to the AGC dc amplifier. This produces a carrier derived AGC level in order to keep the envelope detector operating in its optimum range.

In AM operation, CR6 is reverse biased by -12 vdc at pin P, thereby allowing normal operation of Z5. In SSB operation, +12 vdc at pin P clamps the output of Z5 to +12 volts reverse biasing CR7 and, thereby, taking the carrier derived AGC voltage out of the AGC loop.

#### 4.2.7 AM-FSK SELECTOR CIRCUIT (Refer to Figure 6-3.)

The AM-FSK selector consists of AM-SSB switch S4 and signal control diodes CR3 and CR4. When the AM-SSB switch is in the SSB position, S4 provides +12 vdc at P to forward bias CR4 and reverse bias CR3. This allows the signal from T4 to pass thru CR4 to the bandwidth selector (i.e., 1 kHz or 3 kHz). Since the +12 vdc blocks CR3, the audio detector output is disabled. In the AM position, S4 applies -12 volts at P allowing the audio from the AM Detector to pass thru CR3 while blocking CR4.

#### 4.2.8 AUDIO BANDWIDTH SELECTOR CIRCUIT (Refer to Figure 6-3.)

The audio bandwidth selector consists of 1 kHz-3kHz switch S5, a 1 kHz band-pass filter, and a diode control circuit. The 1 kHz-

3kHz selector switch applies bias at pins X and Z. This bias either enables a path thru the filter or a path around the filter (3 kHz). When the 1 kHz position is selected a +12 vdc is applied at pin X and a -12 vdc is applied at pin Z. This action opens the path thru CR9 to the filter and from the filter thru CR11. The 1 kHz audio band-pass filter consists of R33 and R36, C47 thru C51 and L12 thru L14. The audio band-pass filter is a 3-pole Butterworth filter with a center frequency of 2.5 kHz. The sharp skirt selectivity of the filter yields an optimum band-pass for FSK signals.

When the 3 kHz position is selected the input levels are reversed and an unfiltered path thru CR10 and CR12 is enabled. Signals passing thru the bandwidth selector are amplified by a low-level audio amplifier Q3 and coupled to audio distribution amplifier Q1.

#### 4.2.9 AUDIO AMPLIFIERS (Refer to Figure 6-4.)

The audio amplifiers consist of a distribution amplifier, a monitor amplifier, and an output amplifier. Amplifier Q1 distributes the audio signal to the monitor and output amplifiers, and to the AGC circuit.

The audio monitor amplifier consists of driver stage Q11 and push-pull power amplifier stage Q12-Q13. This circuit provides an audio power output of approximately 1/4-watt into an external 16-ohm speaker. The audio monitor circuit also includes a MONITOR jack which accepts any standard impedance headphones. Insertion of the headphone plug into the MONITOR jack disconnects the speaker. The monitor output level is adjustable by means of MONITOR LEVEL control R6.

The audio output amplifier consists of driver stage Q8 and push-pull amplifier Q9-Q10. This circuit provides an audio output into 600-ohm terminals for matching the input of the external Demodulator. OUTPUT LEVEL control R5 permits the audio signal level to be varied up to a maximum of +10 dbm.

#### 4.2.10 AGC CIRCUITS (Refer to Figure 6-4.)

4.2.10.1 FSK Operation. The AGC circuits comprise internal detector Q2-Q3, dc amplifiers Q4-Q5, current drivers Q6-Q7, remote mark-space amplifiers Q17-Q18, summing amplifier Q14, and remote detector Q15-Q16. These circuits function to maintain a constant output from the Receiver despite variations in the input signal. In operation, the AGC control voltages are developed from either the internal audio or from a remote input signal. The remote input signal consists of the mark and space audio from an external demodulator.

The 2.5 kHz audio signal at the collector of Q1 is coupled thru T1 to the bases of active detector Q2-Q3. The resultant rectified negative-going detector pulses are routed thru AGC switch S3 to the base of Q4. If RF GAIN control R4 is set at minimum gain (maximum negative), negative voltage is coupled through CR1 to increase current flow in Q4. This action tends to reduce the current in Q5, causing a corresponding increase in the Q6 current and a decrease in the Q7 current. The overall effect of the operation is to reduce Receiver gain by feeding back a positive voltage to the cathode of mixer stage V1 and to IF amplifiers Z1 and Z2.

During normal signal reception the RF GAIN control is rotated to some higher gain position (slider moves towards ground). As a result, less negative voltage is coupled thru CR1 and the detected audio signal assumes control of the circuit. Current in Q4 thru Q7 will thus vary in accordance with the detected signal, causing more or less Receiver gain. Strong signals increase the negative feedback; thereby, reducing Receiver gain. Weak signals decrease the feedback to produce the opposite effect.

The slow and fast positions of the AGC switch permit the operator to choose the most favorable operating conditions for a given receiving condition. Slow AGC is normally desirable for receiving FSK signals, since a slow release time introduces the proper amount of delay to suppress noise during momentary signal fadeouts. The slow release circuit in the Receiver consists of capacitor C8 and resistors R14-R15. Release time is approximately 7.5 seconds.

Fast AGC is desirable for receiving FSK signals during rapid fades, since Receiver sensitivity recovers quickly enough to follow the changing signal. The fast release circuit consists of capacitor C7 and resistors R14-R15. Release time is approximately 1.1 seconds.

The external signal input to the AGC circuit consists of mark and space tones from an external FSK Demodulator such as the FEC Model 1200. The mark tone is connected across pins 8 and 6 of rear panel Molex connector J21; the space tone is connected across pins 7 and 6 of the same connector. These tones are coupled through their respective transformers (T2 and T3) and connected to separate amplifiers: Q17 for the mark and Q18 for the space. The tone outputs are summed by amplifier Q14 and the resultant collector signal is coupled through T4 to active detector Q15-Q16. The detected output is then routed through the remote position of the AGC switch and applied to the base of Q4. From this point on, circuit operation is identical to that of the internal AGC.

External AGC is controlled by potentiometer R3. Adjustment of R3 varies the amount of degenerative feedback applied to Q14. Maximum gain is obtained with the slider of R3 at ground; minimum gain is obtained with the slider at the other extreme.

4.2.10.2 AM Operation. During AM operation, the AGC level is derived from the negative dc output from AM amplifier Z5, via CR7 from pin A. The signal is applied to Q4 at pin M, and develops an average dc level in the same manner that the FSK AGC level is derived. In the AM mode it is required that the operator place the AGC switch in remote and remove all external inputs.

4.2.11 POWER SUPPLY (Refer to Figure 6-5.)

The power supply consists of a +12 vdc full-wave rectifier, a -12 vdc full-wave rectifier, a +150 vdc full-wave bridge rectifier, and a 6.3 volt filament transformer. The rectifier circuits furnish all dc operating voltages for the transistors and the vacuum tube in the Receiver. The 6.3 volt filament transformer provides ac filament voltage for the vacuum tubes.

## SECTION V

### ALIGNMENT

#### 5.1 GENERAL

The Model 1500B Receiver has been carefully aligned at FEC by trained personnel using precision test equipment. Alignment will be necessary only if the Receiver has been tampered with or component parts have been replaced in the mixer and/or IF section(s). Before attempting any alignment of a malfunctioning Receiver, always investigate and eliminate all other possible causes of the malfunction.

The alignment is divided into four separate procedures:

- (1) BFO And 2nd Mixer Oscillator Adjustment
- (2) IF Alignment
- (3) Mixer Balance Adjustment
- (4) AM AGC Level Adjustment

Each procedure can be performed independently when a component which affects only one circuit is replaced. For example, if either mixer tube is replaced only the mixer balance adjustment must be performed. When a complete alignment is required it is essential that the procedures be performed in the order presented. Allow at least 1/2 hour warmup time before starting alignment.

### **CAUTION**

Only qualified personnel should work on the Receiver.

#### 5.2 REQUIRED TEST EQUIPMENT

The following test equipment (or equivalent) is required to align the unit:

- (a) Electronic Counter, Transistor Specialties, Inc. Model 373.
- (b) AC Voltmeter, Hewlett-Packard Model 403B.
- (c) RF Signal Generator, Clemens Mfg. Co. Model SG-83B.
- (d) Oscilloscope, Tektronix Model 535A.

### 5.3 INITIAL CONTROL SETTINGS

Initial settings of all front panel controls are listed below. Unless otherwise stated, these settings should be maintained throughout the alignment procedures.

POWER switch . . . . . ON  
OUTPUT LEVEL control . . . . . Maximum clockwise  
RF GAIN control . . . . . Maximum clockwise  
AGC switch . . . . . RMT  
OSC TRIM control . . . . . Center  
CRYSTAL switch . . . . . R  
BAND switch . . . . . C  
MHz control . . . . . Approximately 9 MHz  
Bandwidth Switch . . . . . 1 kHz  
AM-SSB switch . . . . . SSB

### 5.4 BFO OSCILLATOR ADJUSTMENT (Refer to Figure 7-5.)

The BFO oscillator outputs should be checked whenever it is necessary to replace faulty components in one of the oscillator circuits. Only the circuit actually affected by the replacement must be checked; but, it is recommended that the complete procedure be performed since the test equipment is already connected.

The Model 1500B is often used with demodulators utilizing a 2550 Hz audio center frequency. Since the standard audio output is 2500 Hz, the BFO oscillators should be offset 50 Hz to produce the desired output. The BFO in Step 2 should be adjusted for a frequency of 9002.550 kHz and the BFO in Step 3 should be adjusted for a frequency of 8997.450 kHz.

1. Connect Counter lead to TP2 on board N0767; connect common lead to chassis.

2. Adjust C40 for a 9002.500 kHz  $\pm$ 1 Hz reading on Counter.
3. Set BAND switch to D and connect Counter to TP3. Adjust C42 for a 8997.500 kHz  $\pm$ 1 Hz reading on Counter.
4. Disconnect Counter and restore controls to initial settings.

#### 5.5 IF ALIGNMENT (Refer to Figures 7-3 and 7-5.)

The IF alignment should be performed whenever components in the tuned 1st mixer output (on N0846) or the tuned first and second IF amplifiers (on N0767) are replaced. In addition, when components in the 1st mixer circuit are replaced the mixer balance must be adjusted.

1. Connect Signal Generator lead to center pin of rear panel ANT connector. Connect common lead to chassis. Set Generator and Receiver for any convenient operating frequency (approximately 1 microvolt input). Insert proper frequency crystal in socket 1 and set CRYSTAL switch to position 1.
2. Connect Voltmeter leads across DEMOD terminal of rear panel terminal strip. Set BAND switch to proper position and tune Receiver for maximum audio output.
3. Adjust C8 on board N0846 for a maximum reading on Voltmeter.
4. Adjust C4, C13, and C21 on board N0767 for a maximum reading on Voltmeter.
5. Disconnect test equipment and restore controls to initial settings.

#### 5.6 MIXER BALANCE ADJUSTMENT (Refer to Figure 7-3.)

The mixer balance must be adjusted whenever components in the balanced 1st mixer circuit or in the associated tuned IF output circuit are replaced.

When replacing the 7360 tube in V1 or V2 on the mixer printed circuit board (N0971/N0973) it is recommended that the new tube be seasoned for approximately 3 or 4 hours before attempting to balance the mixer. Seasoning is accomplished with the tube in its normal operating position and all voltages applied.

1. Connect Generator lead to center pin of rear panel ANT



connector. Connect common lead to chassis. Monitor Generator frequency with Counter.

2. Remove 9.000 MHz crystal from board N0730. Adjust Generator frequency to 9000.000 kHz and set output level to approximately 100 microvolts.
3. Connect Voltmeter and Oscilloscope across DEMOD terminals on rear panel terminal strip. Adjust rear panel MIX-BAL potentiometer for minimum output level on Voltmeter.
4. Disconnect Generator lead from ANT connector and connect to OSC-IN connector.

## **WARNING**

HIGH VOLTAGE is carried on exposed track adjacent to R1. Use extreme caution while adjusting R1; high voltage can result in death on contact. Adjust oscillator balance potentiometer R1 on board N0846 for minimum output level on Voltmeter.

5. Repeat steps 3 and 4 until minimum output is obtained after both adjustments.

### NOTE

If either control is at its end limit, proper balance has not been obtained and it may be necessary to switch one of the mixer tubes (V1 or V2 on N0846).

6. Disconnect test equipment and replace 9.000 MHz crystal on board N0730. Return controls to initial settings.

### 5.7 AM AGC LEVEL ADJUSTMENT (Refer to Figure 7-5.)

The AM AGC level adjustment does not need to be adjusted for proper alignment of the Receiver; but, it should be checked periodically for optimum operation.

1. Set AM-SSB switch to AM. Connect Voltmeter to TP1 on N0767.
2. Adjust R42 on board N0767 for a 0.12 vdc level.
3. Disconnect test equipment and return controls to initial settings.

### 5.8 OSC TRIM CONTROL ADJUSTMENT

The OSC TRIM adjustment is normally required only during the initial Receiver calibration at the factory or after a major component change in the local oscillator circuit. This procedure should be performed before the initial local oscillator adjustment described in paragraph 5.9.

The following symbols are used in the adjustment procedure:

$f_c$  = nominal (marked) crystal frequency

$+\Delta f$  = number of Hz above  $f_c$

$-\Delta f$  = number of Hz below  $f_c$

Proceed as follows:

1. Insert any crystal in the range of 4000 kHz to 6000 kHz in crystal socket 1. Set CRYSTAL switch to position 1.
2. Connect Counter to rear panel OSC OUT connector.
3. Rotate OSC TRIM control full counterclockwise and note Counter reading ( $-\Delta f$ ).
4. Rotate OSC TRIM control full clockwise and note Counter reading ( $+\Delta f$ ).
5. Adjust crystal trim capacitor located above crystal socket 1 until  $|\Delta f| = |\Delta f|$ .
6. Rotate OSC TRIM control to setting where local oscillator reading equals  $f_c$ . Loosen locking screw of OSC TRIM knob and rotate knob pointer to zero center position. Tighten locking screw.

## 5.9 LOCAL OSCILLATOR ADJUSTMENT (Refer to Figure 7-4.)

The local oscillator crystal adjustment is not necessary for proper alignment of the Receiver. The oscillator can be set up with this procedure when the exact local oscillator frequency is desired or it can be set up to match the actual input signal as described in paragraph 3.2.7 of this manual.

1. Insert operating crystals in desired crystal position. Connect Counter to rear panel OSC OUT connector. Connect oscilloscope to J2 on N0848 with a high impedance (1 meg/7 Pf) probe.
2. Set CRYSTAL switch to each position and check that the oscillator output is at least 3 VPP. Remove oscilloscope probe.
3. Set CRYSTAL switch to each position and adjust trimmer capacitors (located directly above crystal) for proper operating frequency on counter.
4. Rotate OSC TRIM control from - to + ends of scale and check that frequency range is at least  $\pm 50$  Hz per MHz of the crystal frequency.

SECTION VI  
SCHEMATIC DIAGRAMS

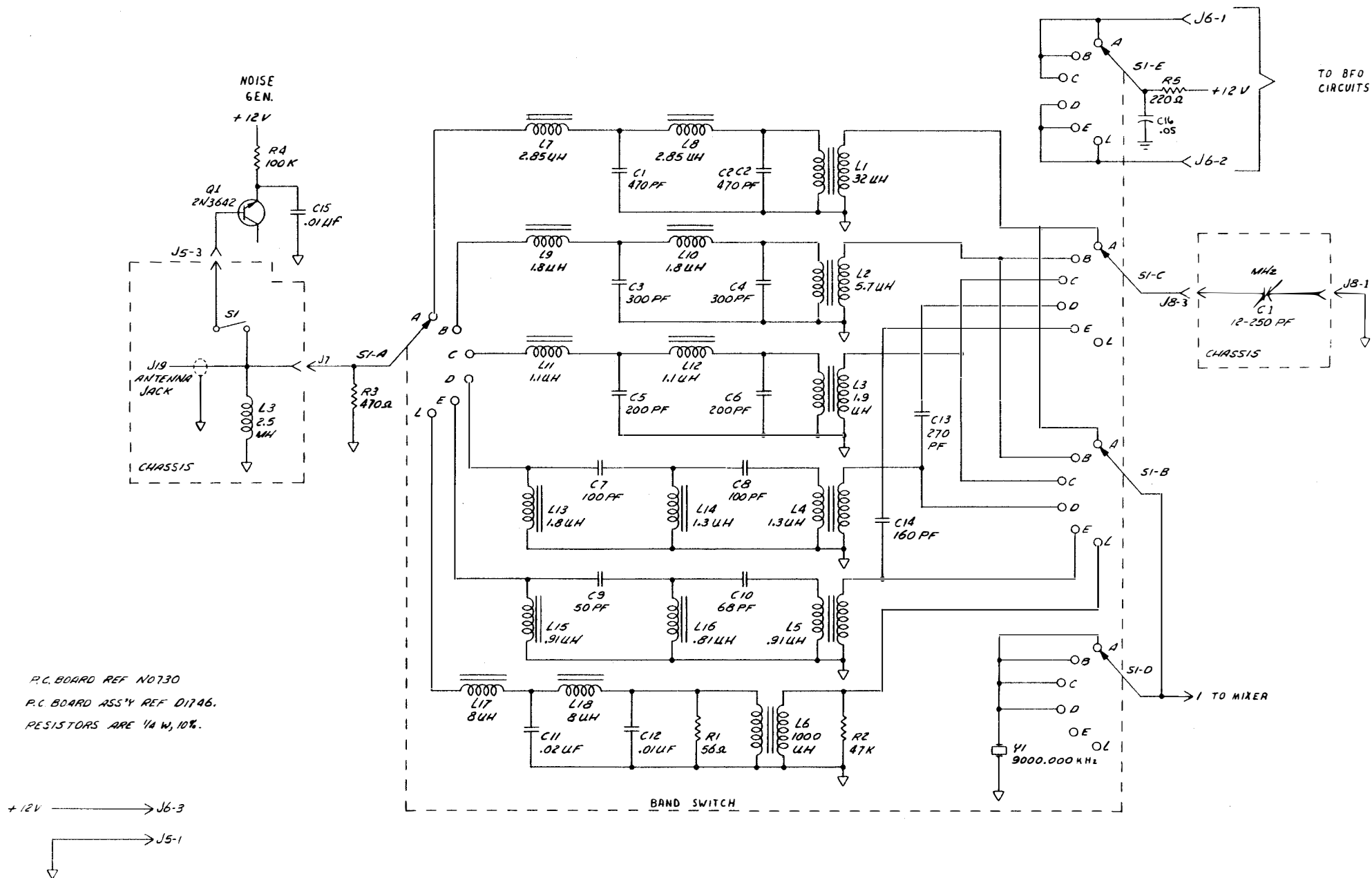


Figure 6-1. Preselector, Schematic Diagram  
N0730-J5 thru J8-D1745B

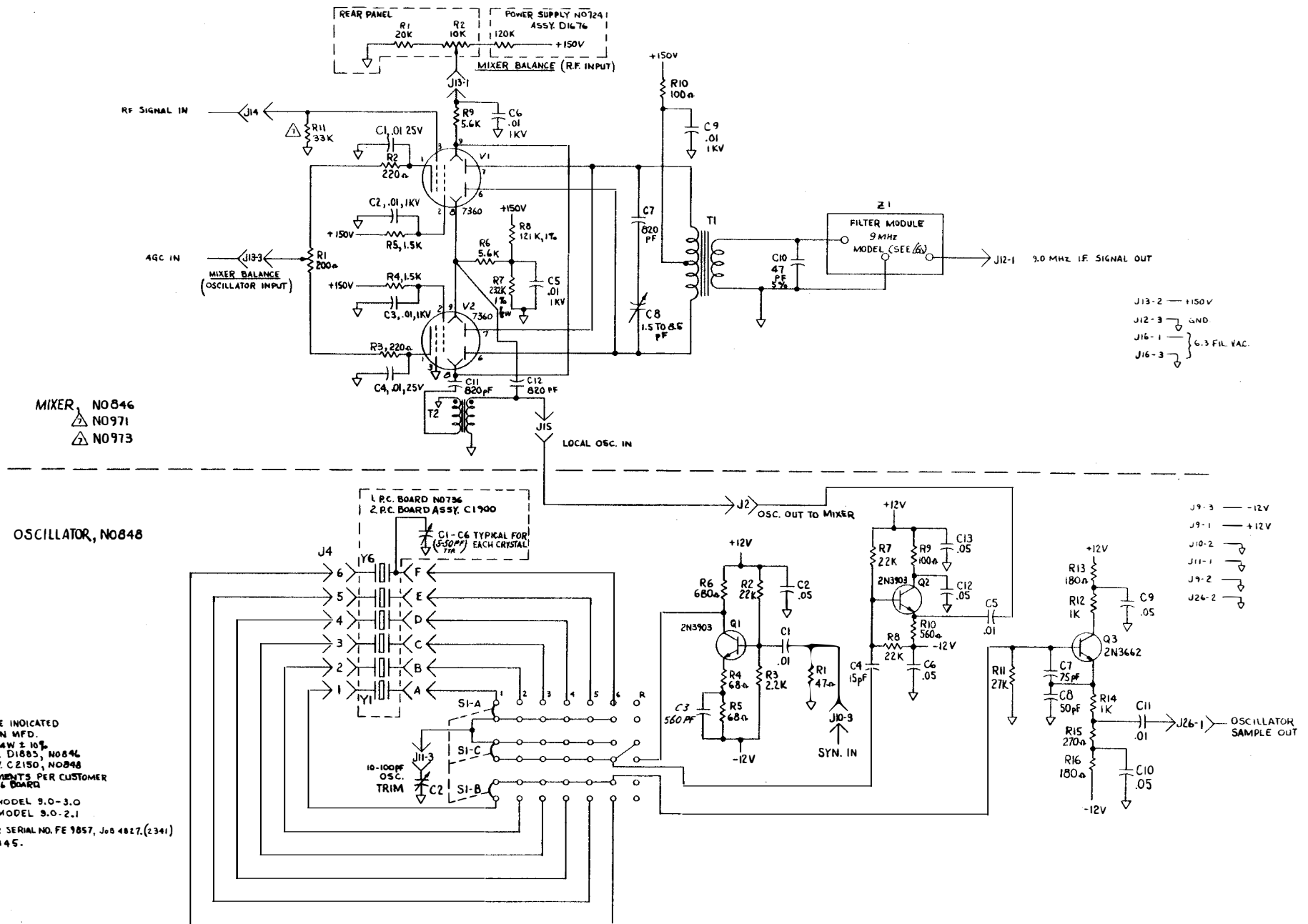


Figure 6-2. Mixer And Local Oscillator, Schematic Diagram  
N0848/N0971-J9 thru J16 & J26-D1882F

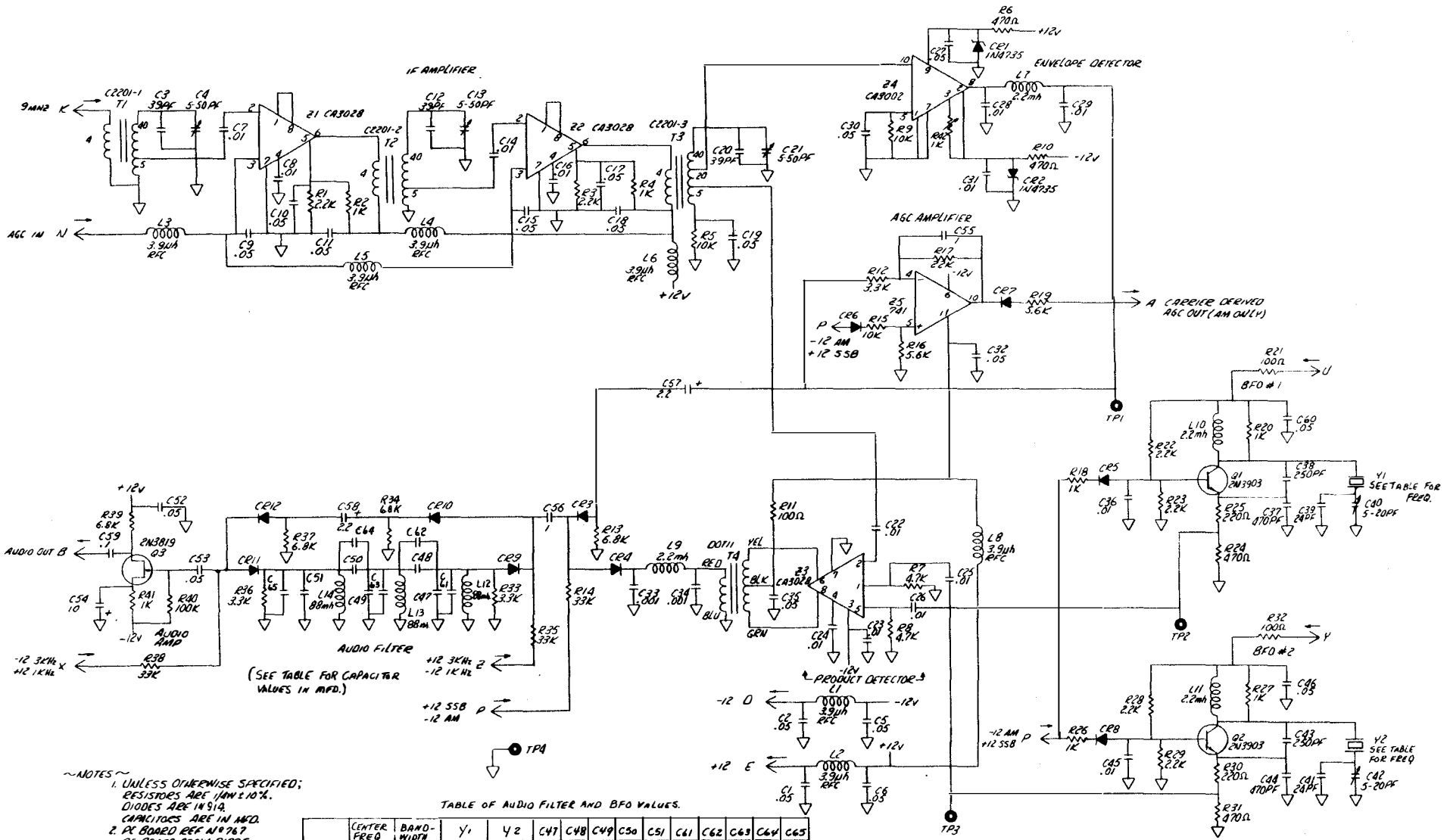


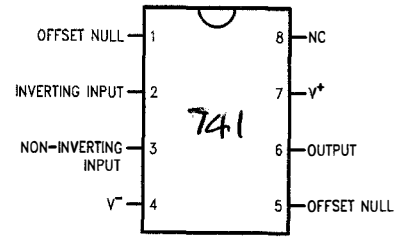
TABLE OF AUDIO FILTER AND BFO VALUES.

	CENTER FREQ	BAND-WIDTH	Y1	Y2	C47	C48	C49	C50	C51	C61	C62	C63	C64	C65
STANDARD	2500 HZ	1200 HZ	9002.5KHZ	8997.5KHZ	.04	.018	.015	.018	.09	N/A	N/A	N/A	N/A	N/A
-1	1900 HZ	600 HZ	9001.9 KHZ	8998.1 KHZ	.04	.0048	.0068	.0068	.04	.030	.068	.05	.0048	.033

Figure 6-3. IF, BFO, And Detector, Schematic Diagram N0767-J2-D1794D

LAST REF DESIGNATOR  
 R-42  
 C-65  
 T-4  
 L-14  
 Q-3  
 CR-12

Dual-In-Line or S.O. Package



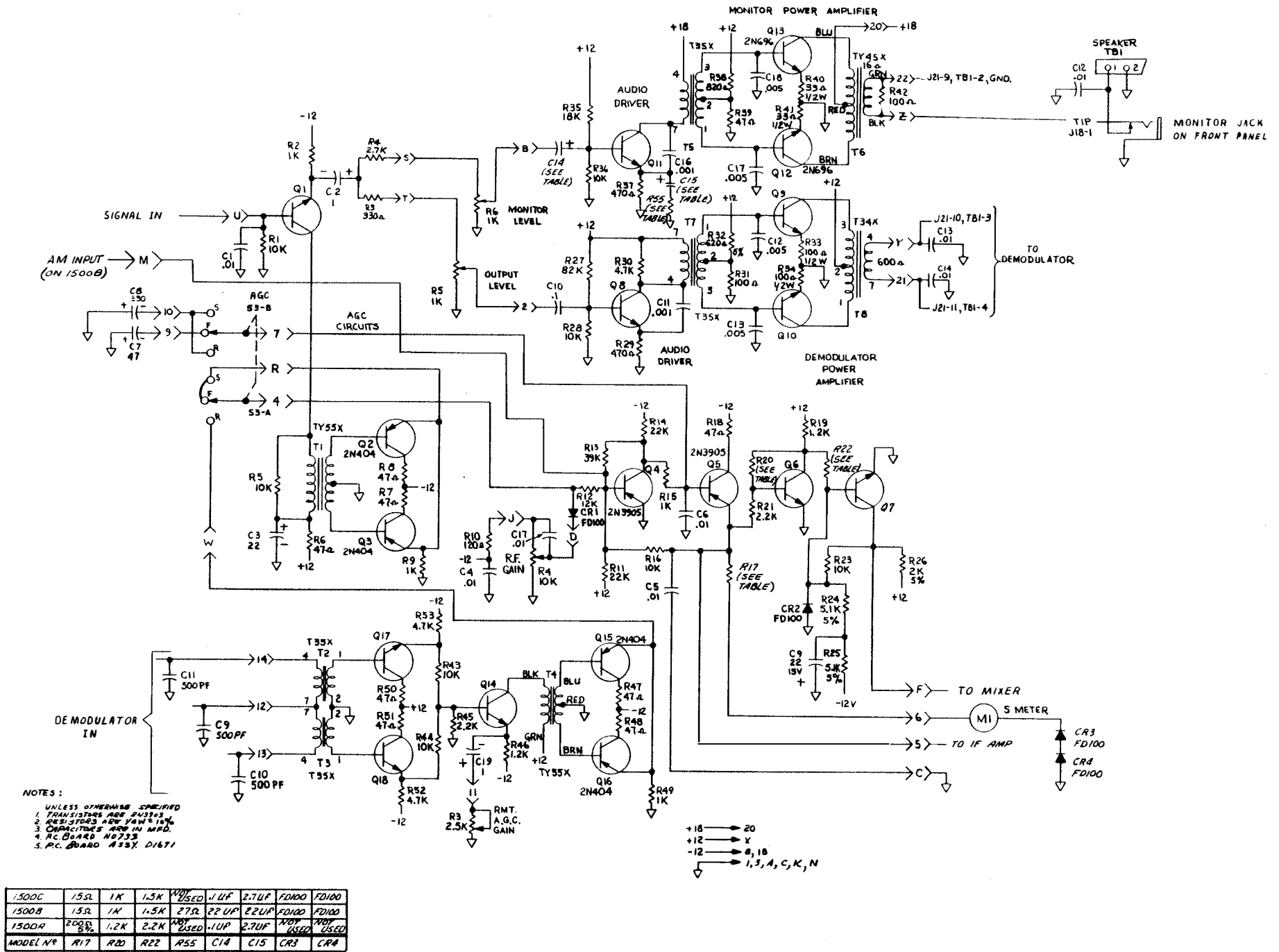


Figure 6-4. Audio And AGC, Schematic Diagram  
N0733-J3-D1670D



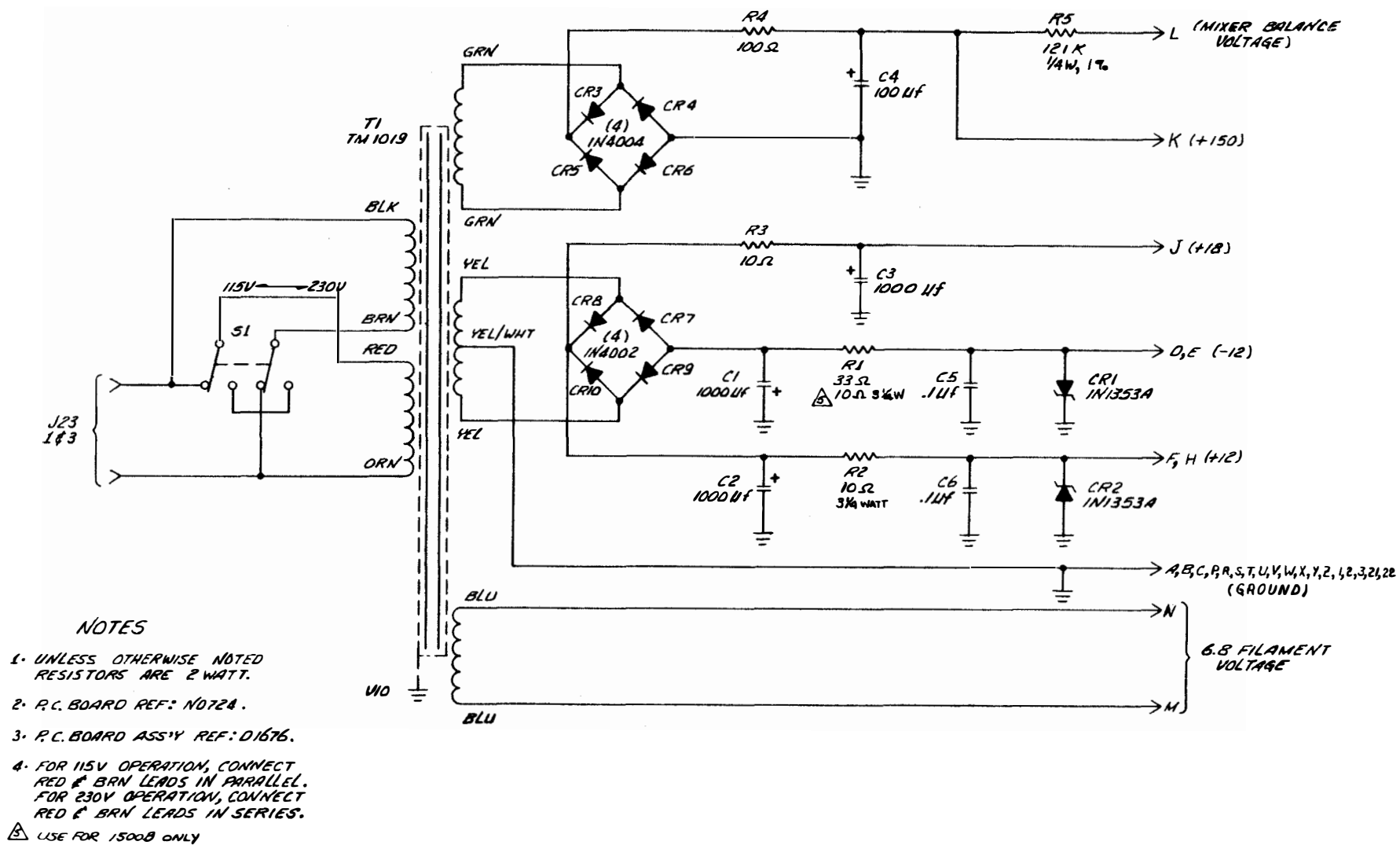


Figure 6-5. Power Supply, Schematic Diagram  
N0724-J1-C1899D

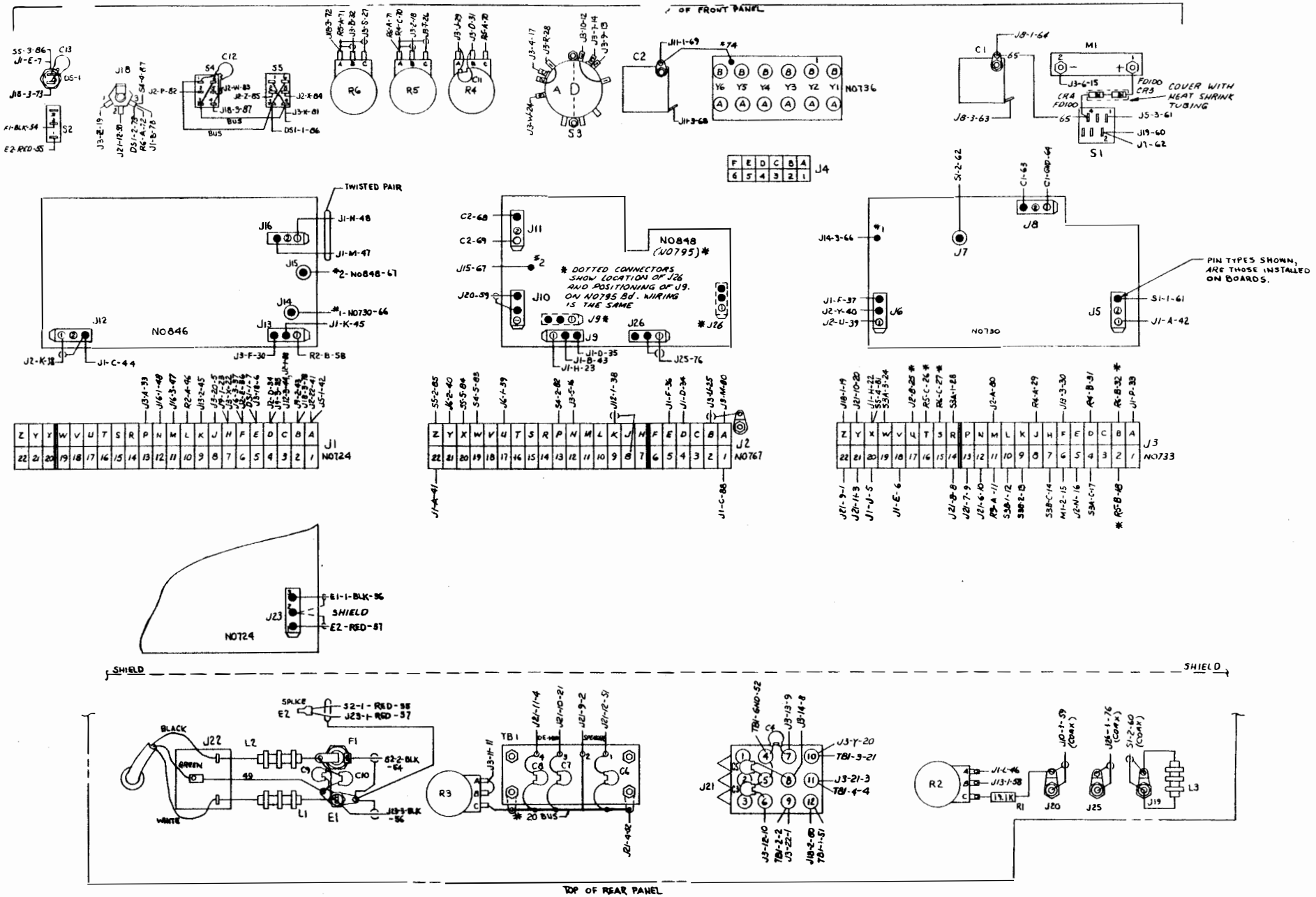
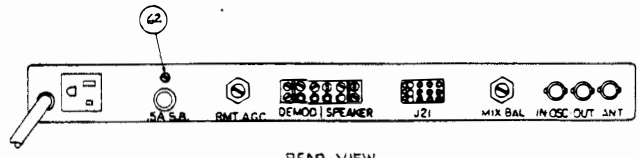
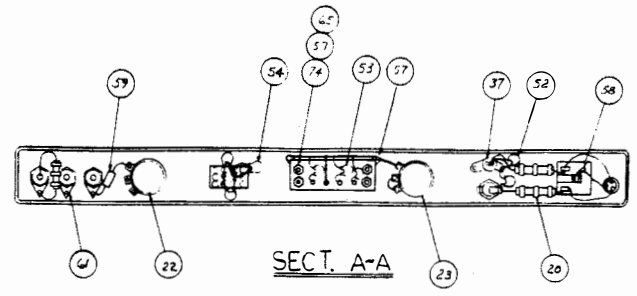


Figure 6-6. Wiring Diagram  
D1772E

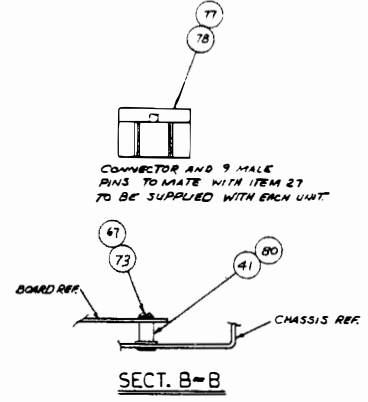
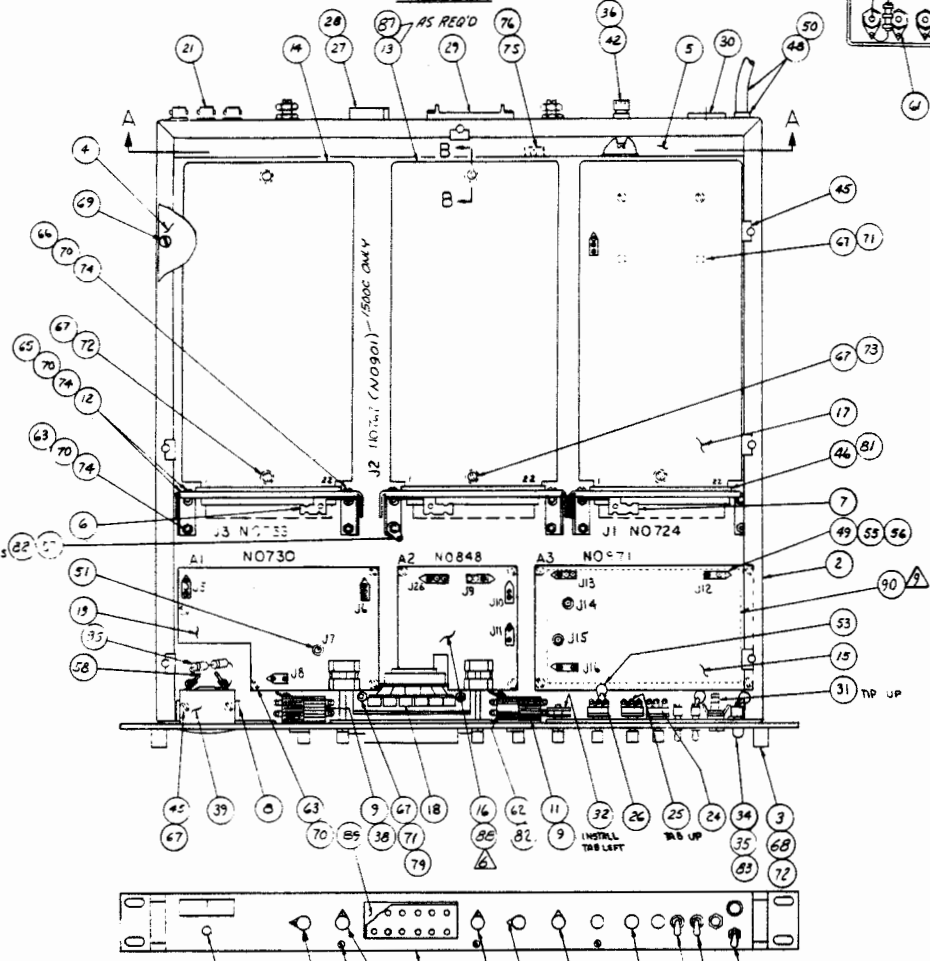
SECTION VII  
PART REPLACEMENT DRAWINGS



REAR VIEW



SECT. A-A



SECT. B-B

NOTE: INSTALL ON BOTTOM OF CHASSIS A 5 1/2" X 2 1/2" PIECE OF FISH PAPER BETWEEN MTG. HOLES OF NO 971

NOTES-

1. STENCIL AS SHOWN.
2. PLASTIC SLEEVING AS REQUIRED
3. CRYSTALS ARE OPTIONAL
4. DO NOT STENCIL BOARD NO. FOR REF. ONLY.
5. WIRING DIAGRAM REF 1500 B - D1772 1500 C - D1984

- ⚠ USE ITEM 22 (NO 848 B4) FOR DUAL SPACE DIVERSITY APPLICATION WITH ONE SET OF CHANNEL CRYSTALS.
- ⚠ USE ITEM 16 (NO 848 B4) FOR ALL OTHER APPLICATIONS INCLUDING USE WITH 1550 OR OTHER REMOTE OSCILLATORS.
- ⚠ CRYSTAL COVERS ARE OPTIONAL.
- ⚠ EFFECTIVE AFTER SERIAL NO. FE-9837, JOB 4827 & 2341

Figure 7-1. Model 1500B, Assembly D1765I



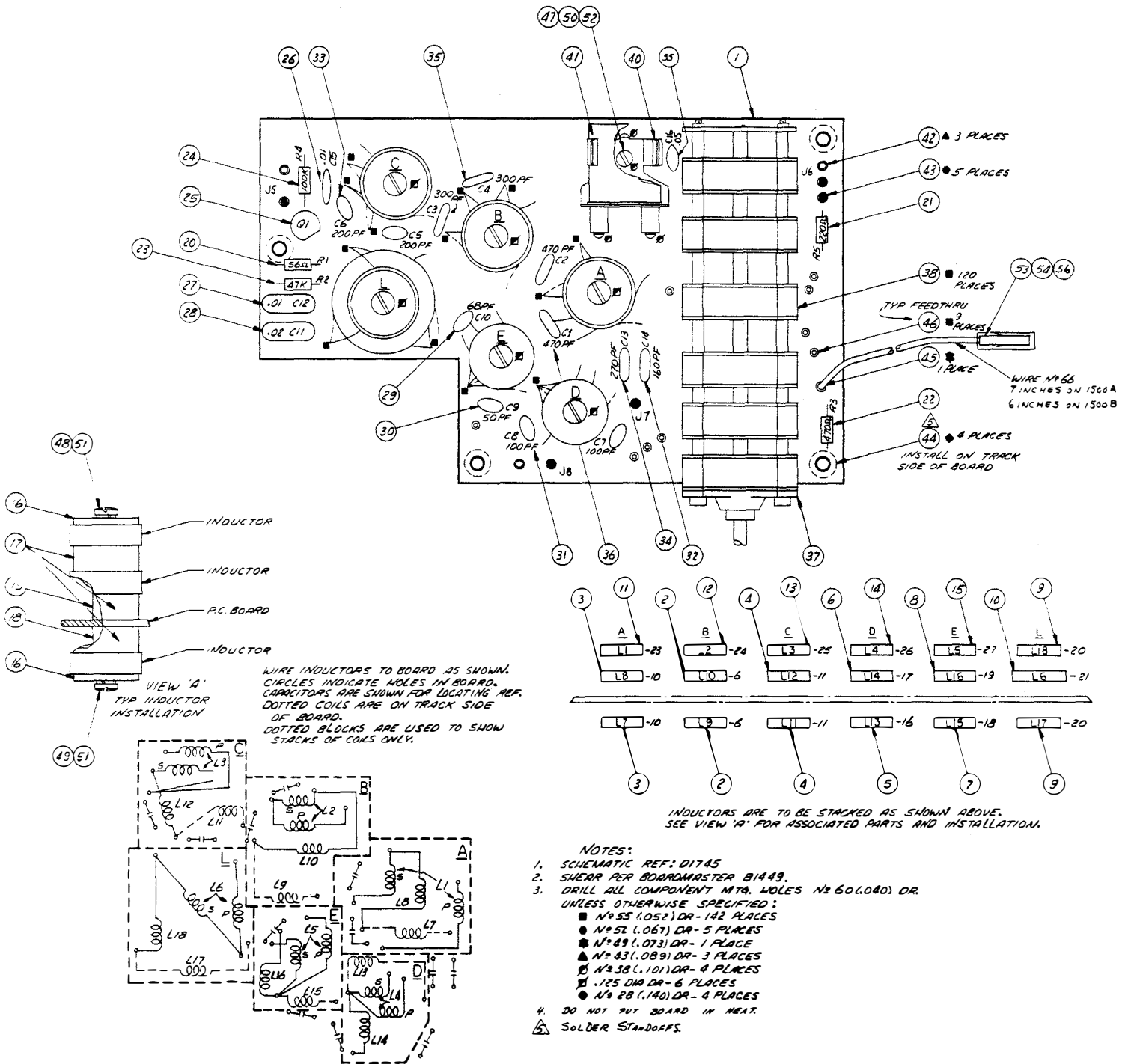


Figure 7-2. Preselector, Board Assembly  
N0730-J5 thru J8-D1746D

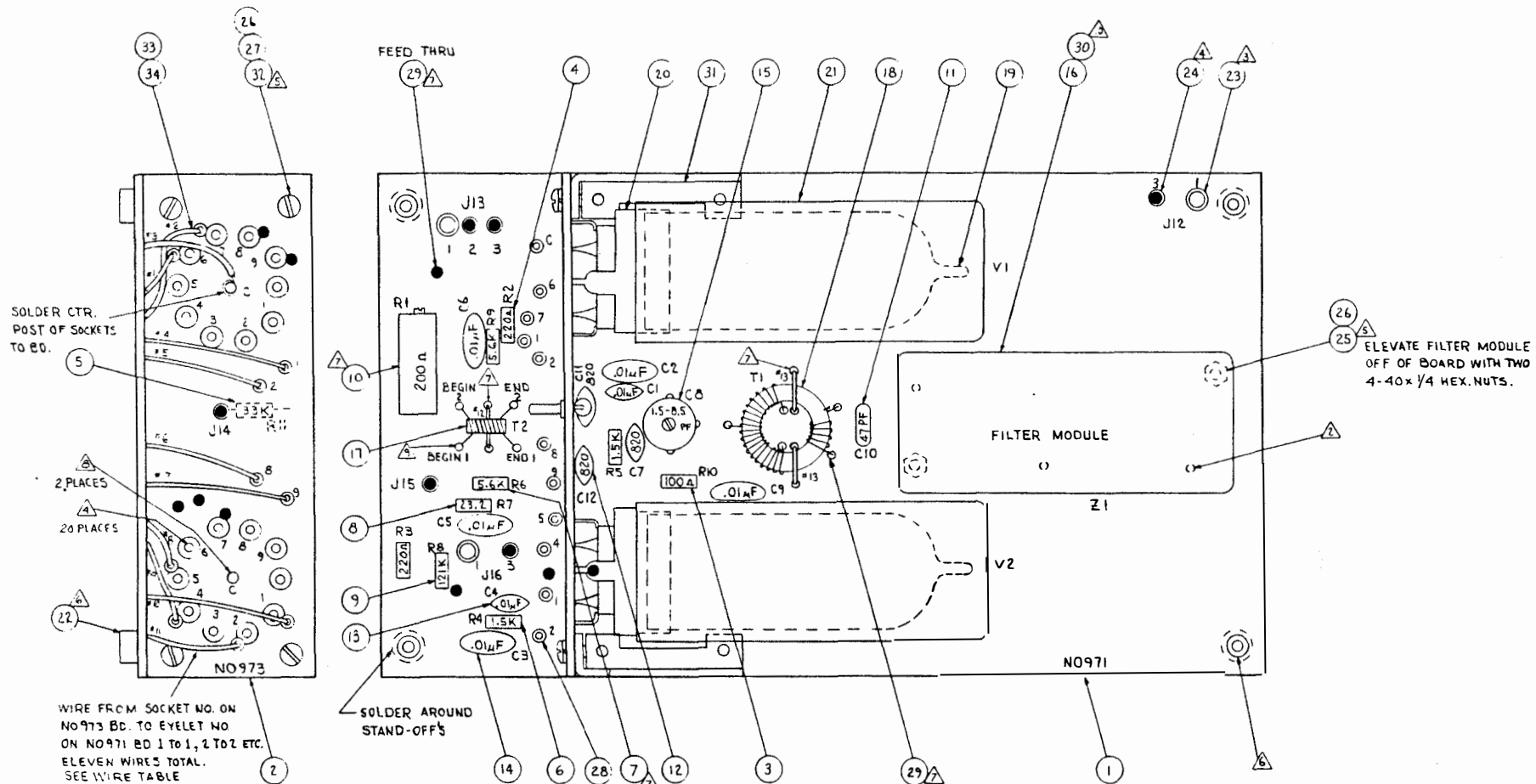
ITEM	REQ D	PART NO	DESCRIPTION	MATL OR MFG	MATL SPEC OR CAT PART NO	FINISH	FINISH SPEC	CRT BY
54	1	1425-1R	CONNECTOR	ALLEX				
55	1	5835SU03Z	CAPACITOR, .05 MFD, 25V	ERIE				
50	1	1561TLB	TERMINAL, FEMALE	MOLEX				
57	6"		WIRE #20 GA STRANDED	ALPHA	WHITE			
52	1		NUT, #2-56 x 3/16 AF	SST				
51	12		WASHER, #2 SPLIT LOCK					
50	1		WASHER, #2 SPLIT LOCK					
49	6		SCREW, #2-40 x 3/8 Bd Hd					
48	6		SCREW, #2-40 x 1/8 Bd Hd					
47	1		SCREW, #2-56 x 3/16 Bd Hd	SST				
46	9	5-8065	EYELET	U.S.				
45	1	2059	EYELET	STIMPSON				
44	4	1300-13	STANDOFF	CTC				
43	5	R62-3-ET	STAKE DIN- MALE	BEID CHAIN				
42	3	M98-102-ET	STAKE DIN- FEMALE	BEID CHAIN				
41	1	ML TYPE CR19U	CRYSTAL 9MHz SERIES RES	ERIE				
40	1	8000-A-63	CRYSTAL SOCKET	AUGAT				
39								
38	5	JSR-325-1010	SECTION, NON-SHORTING 1000	ITT	TYPE JSR 325			
37	1	JSR-325-30-6	SWAPT & DETENT ASSY, 6 POS	ITT	SEE DRAWING 1-118			
36	2	DM15-471N	CAPACITOR 470 PF, 500V, 5%	ARCO				
35	2	DM15-301N	300 PF					
34	1	DM15-271N	270 PF					
33	2	DM15-201N	200 PF					
32	1	DM15-161N	160 PF					
31	2	DM15-101N	100 PF					
30	1	DM15-500J	50 PF					
29	1	DM15-600J	60 PF, 500V, 5%					
28	1	1MD-1-203J	.02 UF, 100V, 5%					
27	1	1MD-1-203J	.02 UF, 100V, 5%	ARCO				
26	1	5835-150-103Z	CAPACITOR .01 UF, 25V	ERIE				
25	1	2N3642	TRANSISTOR	FARWELL				
24	1		RESISTOR 100K, 1/4W, 10%	A/B				
23	1		47K					
22	1		470Ω					
21	1		220Ω					
20	1		RESISTOR 50Ω, 1/4W, 10%	A/B				
19	6	81090-2	NYLON ROD, THREADED	F.E.C.				
18	6	81452-1	NYLON ROD					
17	18	81098	SPACER					
16	12	81453	WASHER					
15	1	C1146-27	TOROID INDUCTOR					
14	1	-26						
13	1	-25						
12	1	-24						
11	1	-23						
10	1	-21						
9	2	-20						
8	1	-19						
7	1	-18						
6	1	-17						
5	1	-16						
4	2	-11						
3	2	-10						
2	2	G1146-6	TOROID INDUCTOR					
1	1	N0730B	P.C. BOARD	REC.				

Figure 7-2. Parts List

56	1	1425-1A	CONNECTOR	MOLEX					
55	1	15855-54503Z	CAPACITOR .05 MFD 25V	FRE					
54	1	15617L8	TERMINAL, FEMALE	MOLEX					
53	6		WIRE #20 GA STRANDED	ALPHA	WHITE				
52	1		WUT, #256, 3/16 AF	SST					
51	12		WASHER, #2 SPLIT LOCK						
50	1		WASHER, #2 SPLIT LOCK						
49	6		SCREW, #8-30x3/4 8J JD						
48	6		SCREW, #8-30x3/4 8J JD						
47	1		SCREW, #2-56, 3/16 8J 4A SST						
46	9	5-8065	EWELET	U.S.					
45	1	2059	EWELET	STAMPON					
44	4	1300-13	STANDOFF	CTC					
43	5	R62-3-ET	STAKE PIN - MALE	8010 2411					
42	3	M93-102-ET	STAKE PIN - FEMALE	8010 2411					
41	1	W4 TYPE CR19U	CRYSTAL 9 MHz SERIES RES	ERIE					
40	1	8000-A-63	CRYSTAL SOCKET	AUGAT					
39									
38	5	JSR-325-1010	SECTION, NON-SUPPORTING	ITT	FREE JSR 325				
37	1	LSR-325-30-6	SHAFT & DETENT ASSY, 6-POS	ITT	03, 04, 11, 14				
36	2	DM15-471J	CAPACITOR 470 PF 50V 5% ARCO						
35	2	DM15-301J	300 PF						
34	1	DM15-271J	270 PF						
33	2	DM15-201J	200 PF						
32	1	DM15-161J	160 PF						
31	2	DM15-101J	100 PF						
30	1	DM15-500J	50 PF						
29	1	DM15-580J	58 PF 500V 5%						
28	1	DM15-203J	20 PF 500V 5%						
27	1	DM15-103J	10 PF 500V 5% ARCO						
26	1	15835-140-03Z	CAPACITOR .01UF, 25V	ERE					
25	1	2N3642	TRANSISTOR	VAICU, LG					
24	1		RESISTOR 100K, 1/4W, 10% AB						
23	1		47K						
22	1		470Ω						
21	1		220Ω						
20	1		RESISTOR 56Ω, 1/4W, 10% AB						
19	6	B1090-2	NYLON ROD, THREADED	F.E.C.					
18	6	B1052-1	NYLON ROD						
17	12	B1098	SPACER						
16	12	B1053	WASHER						
15	1	C1186-27	TOROID INDUCTOR						
14	1	-26							
13	1	-25							
12	1	-24							
11	1	-23							
10	1	-21							
9	2	-20							
8	1	-19							
7	1	-18							
6	1	-17							
5	1	-16							
4	2	-11							
3	2	-10							
2	2	C1146-6	TOROID INDUCTOR						
1	1	N0730B	P.C. BOARD	F.E.C.					
ITEM	REQD	PART NO	DESCRIPTION	MAT'L OR REF	MAT'L SPEC OR CAT PART NO	FINISH	FINISH SPEC	CHK BY	

Figure 7-2. Parts List





NOTES:

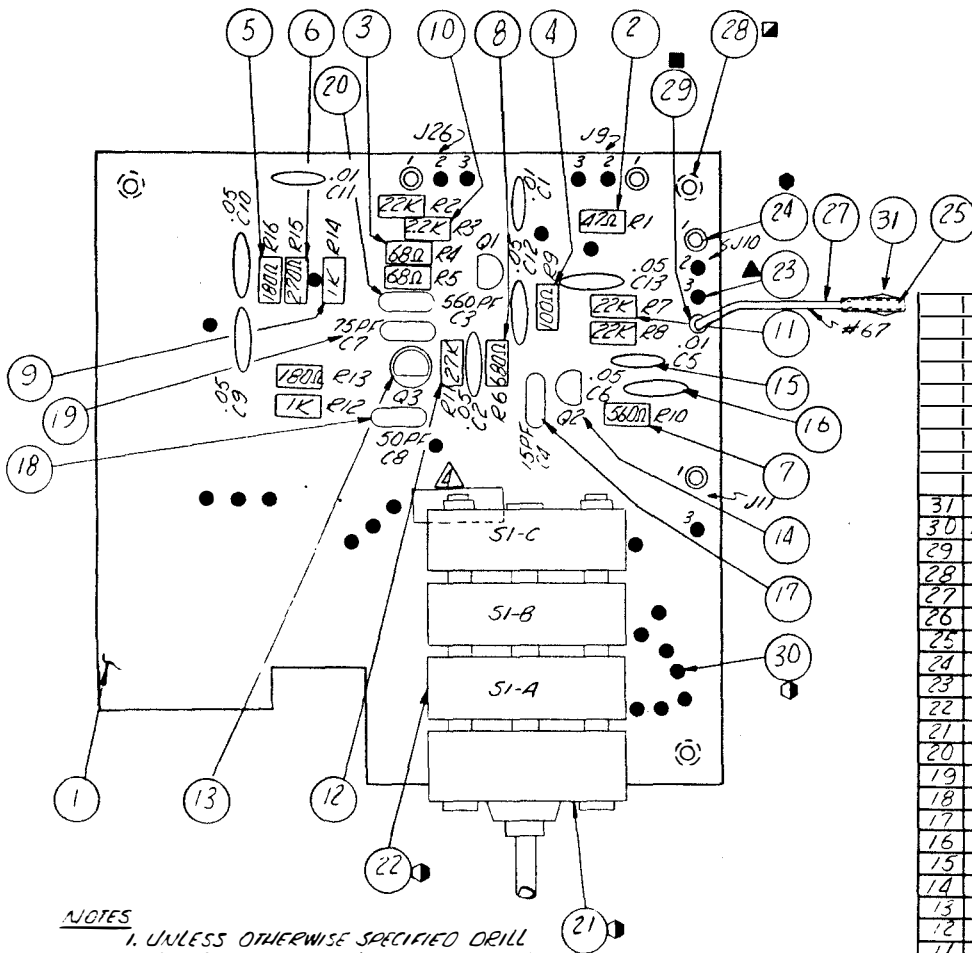
1. DRILL ALL HOLES  $\#60(.040)$  DIA., UNLESS OTHERWISE INDICATED.
- 2 DRILL  $\#49(.073)$  DIA.
- 3 DRILL  $\#43(.089)$  DIA.
- 4 DRILL  $\#52(.063)$  DIA.
- 5 DRILL  $\#8(.125)$  DIA.
- 6 DRILL  $\#64(.140)$  DIA.
- 7 DRILL  $\#55(.052)$  DIA.
- 8 DRILL  $\#29(.136)$  DIA.
- 9 DRILL  $\#70(.078)$  DIA.
- 10 ON 1500B USE MODEL 9.0-3.0 (ITEM16)  
ON 1500C USE MODEL 9.0-2.1 (ITEM30)
11. REF. SCHEMATIC D1882

WIRE TABLE

A. REQ'D	WIRE LENGTH
1	7/16
2	7/8
3	9/16
4	1
5	3/4
6	3/4
7	1
8	5/16
9	3/4
10	5/8
11	5/8
12	5/16
13	5/16

Figure 7-3. Mixer, Board Assembly  
N0971-J12 thru J16-D2145



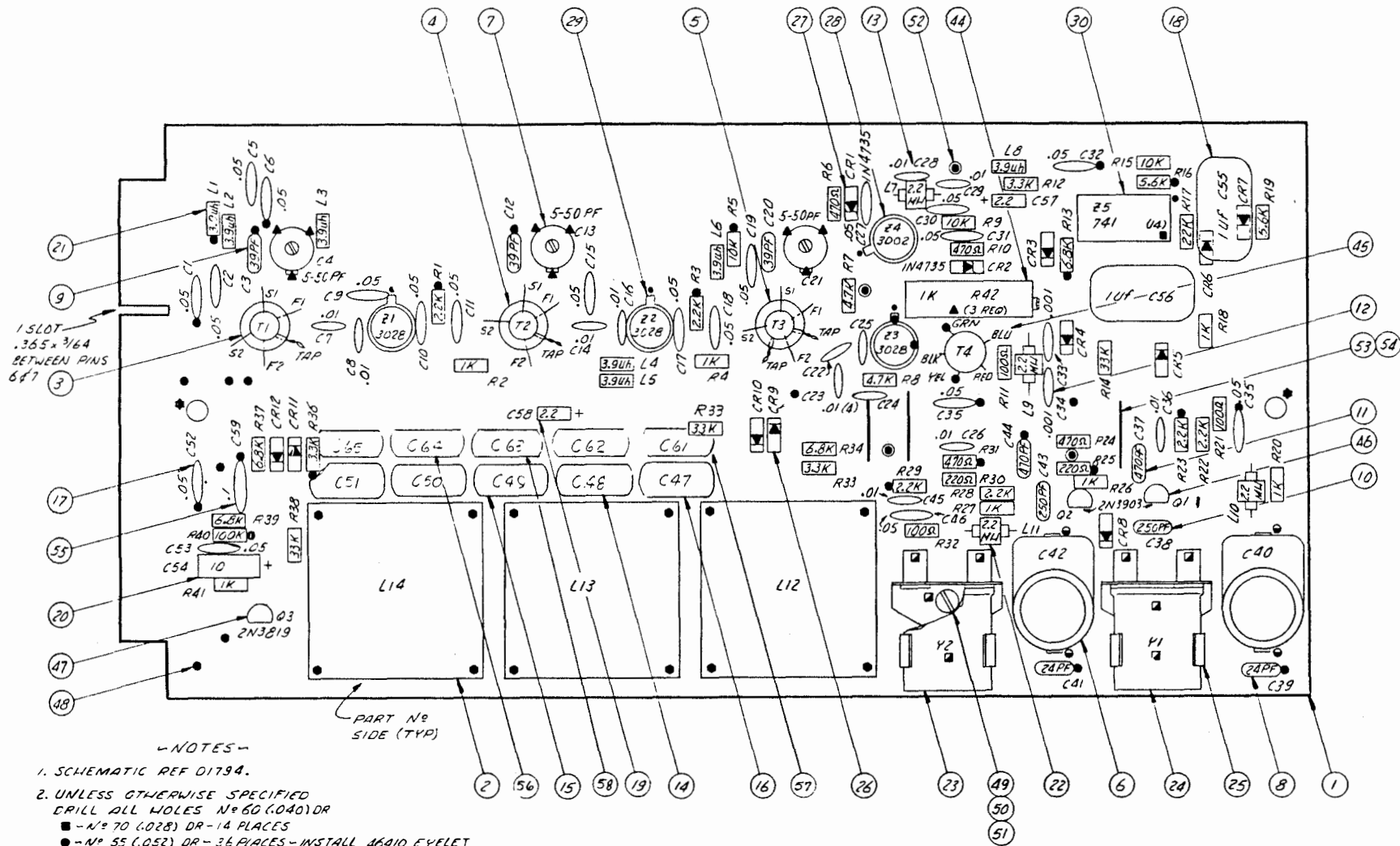


**NOTES**

1. UNLESS OTHERWISE SPECIFIED DRILL COMPONENT MTS. HOLES N° 60(.040)DR
  - N° 49(.073) DR
  - N° 43(.089) DR
  - ▲ N° 52(.063) DR
  - ▴ 9/64(.140) DR
  - ① N° 55(.052) DR
2. SOLDER AROUND STANDOFF & MALE PINS.
3. DO NOT PUT BOARD IN HEAT.
4. INSTALL TAPE BETWEEN SWITCH & TRACK
5. SCHEMATIC REF D1882

ITEM	REQD	PART NO	DESCRIPTION	MAT'L OR MFR	MAT'L SPEC OR CAT PART NO	FINISH	FINISH SPEC	CKT SYM
31	1	1625-1R	CONNECTOR	MOLEX				
30	19	46410	EYELET	BEES				
29	1	2059	EYELET	STIMPSON				
28	3	1300-13	STANDOFF	CTC				
27	1		WIRE 20GA(WHT) 3" LG	ALPHA				
26								
25	1	1561TLB	FEMALE PIN	MOLEX				
24	4	M93-102-ET	FEMALE STAKE PIN	MOLEX				
23	7	R62-3-ET	MALE STAKE PIN	MOLEX				
22	3	JSR 325-1010	SWITCH SECTION 12 POS	ITT				
21	1	JSR-325-30-7EAAH	SHAFT & DETENT ASS'Y 7POS	ITT				
20	1	DM-15-561J	CAPACITOR 560PF, 500V	ELMEVCO				
19	1	DM-15-750J	75PF, 500V	ELMEVCO				
18	1	DM-15-500J	50PF, 500V	ELMEVCO				
17	1	DM-15-150J	15PF, 500V	ELMEVCO				
16	6	585545U5032	.05MF, 25V	ERIE				
15	3	583545U1032	CAPACITOR .01MF, 25V	ERIE				
14	2	2N3903	TRANSISTOR	MOT				
13	1	2N3862	TRANSISTOR	G.E				
12	1		RESISTOR 27K 1/4W ±10%	AB				
11	3		22K					
10	1		2.2K					
9	2		1K					
8	1		680Ω					
7	1		560Ω					
6	1		270Ω					
5	2		180Ω					
4	1		100Ω					
3	2		88Ω					
2	1		RESISTOR 47Ω, 1/4W ±10%	AB				
1	1	N0848	PC BOARD	TEC				

Figure 7-4. Local Oscillator, Board Assembly  
N0848-J! .hru J11 & J26-C2150B



-NOTES-

1. SCHEMATIC REF D1794.
2. UNLESS OTHERWISE SPECIFIED DRILL ALL HOLES  $N\#60(.040)$  DR
  - -  $N\#70(.028)$  DR - 14 PLACES
  - -  $N\#55(.052)$  DR - 36 PLACES - INSTALL 16A10 EYELET
  - ▲ -  $N\#55(.052)$  DR - 12 PLACES
  - ⊙ -  $N\#52(.063)$  DR - 4 PLACES - INSTALL R62-3-ET STAKE PIN
  - ⊚ -  $N\#52(.063)$  DR - 12 PLACES
  - ▣ -  $N\#38(.101)$  DR - 8 PLACES
  - -  $\cdot 10.901A$  - 4 PLACES
  - ⊛ -  $\cdot 156$  DIA - 2 PLACES
3. CLEAN BOARDS BEFORE INSTALLATION OF ITEM 7.

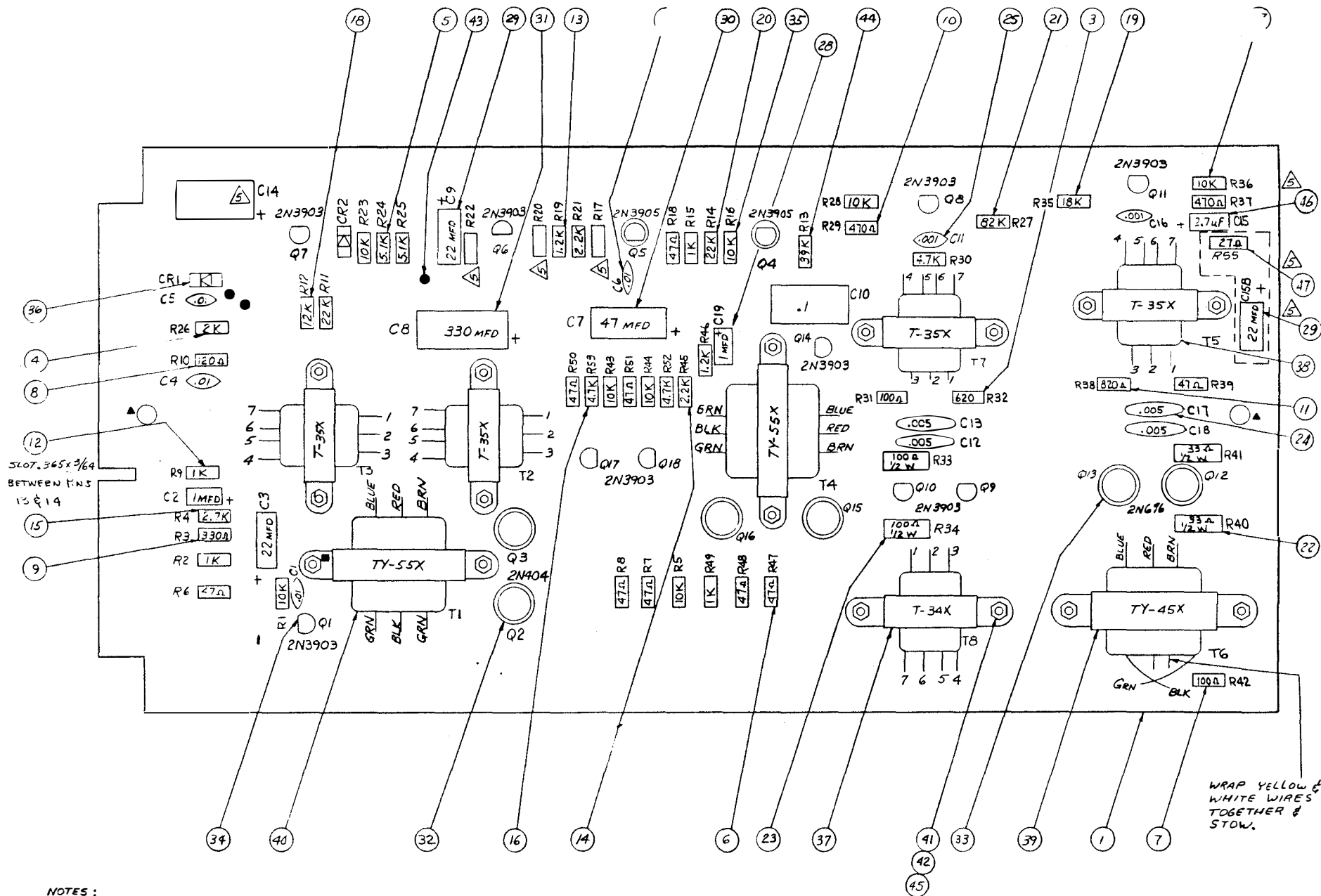
TABLE OF AUDIO FILTER & BFO VALUES

	CENTER FREQ.	BAND-WIDTH	Y1	Y2	C47	C48	C49	C50	C51	C61	C62	C63	C64	C65
STANDARD	2500HZ	1200HZ	90025HZ	89975HZ	.04	.018	.025	.018	.04	N/A	N/A	N/A	N/A	N/A
-1	900HZ	600HZ	90019HZ	89981HZ	.04	.0068	.0068	.0068	.04	.033	.0068	.05	.0068	.033

Figure 7-5. IF, BFO, And Detector, Board Assembly  
N0767-J2-D1795D

1	58	-	1MD-1-523	CAPACITOR .05 5% 100V	ELMENCO				
2	57	-	1MD-1-232J	CAPACITOR .033 5% 100V	ELMENCO				
5	56	-	1MD-1-683J	CAPACITOR .0068 5% 100V	ELMENCO				
1	55	1	5815Y5U1032	CAPACITOR .1UF 25V	ERIE				
AK	54	AIR		TUBING, N° 22 SA NATURAL	BELOEN				
AK	53	AIR		WIRE, N° 22 SA SOLID	BELOEN				
4	52	4	R62-3-ET	STAKE PIN (MALE)	B.C.				
2	51	2		NUT, N° 2-56 x 3/16 AF	SST				
2	50	2		WASHER, 1/2 SPLIT LOCK	SST				
2	49	2		SCREW, N° 2-56 x 3/16 80/HA	SST				
AK	48	AIR	46410	EYELET	BERG				
1	47	1	2N3819	TRANSISTOR	TI				
2	46	2	2N3903	TRANSISTOR	MOTOROLA				
1	45	1	00-T11	TRANSFORMER	UTC				
1	44	1	3067P-1-102	POTENTIOMETER	BOURN				
1	43	1		RESISTOR 100K 1/4W 5% AB					
3	42	3		33K					
1	41	1		22K					
3	40	3		10K					
4	39	4		5.3K					
2	38	2		5.6K					
2	37	2		4.7K					
3	36	3		3.3K					
6	35	6		2.2K					
7	34	7		1K					
4	33	4		470Ω					
2	32	2		220Ω					
3	31	3		RESISTOR 100Ω 1/4W 5% AB					
1	30	1	06E77A1333	INTEGRATED CIRCUIT	WATSON				
3	29	3	CA3023A	INTEGRATED CIRCUIT	PCA				
1	28	1	CA3002	INTEGRATED CIRCUIT	PCA				
2	27	2	1N3735A	DIODE	MOTOROLA				
10	26	10	1N3714	DIODE	GE				
2	25	2	8000-463	CRYSTAL SOCKET	AUGAT				
1	24	1	PER TABLE	CRYSTAL 32 PF	INT				
1	23	1	PER TABLE	CRYSTAL 32 PF	INT				
4	22	4	70F22341	CHOKE 2.2 MH	MILLER				
7	21	7	00-3-9	CHOKE 3.3 2A	WYTRON				
1	20	1	500106X30212	CAPACITOR .01UF 20V	SPRAGUE				
2	19	2	1500123X301542	2.2UF 15V	SPRAGUE				
2	18	2	MF325	11F 100V	PANTRON				
20	17	20	5855Y5U50321	.05UF 25V	ERIE				
2	16	2	1MD-1-403J	.04UF 100V	ELMENCO				
-	15	1	1MD-1-253J	.025UF 100V	ELMENCO				
-	14	2	1MD-1-183J	.018UF 100V	ELMENCO				
13	13	13	5835Y5U10321	.01UF 25V	ERIE				
2	12	2	301X5F102K	.501UF 1KV	ERIE				
2	11	2	DM-15-471J	470PF 500V	ELMENCO				
2	10	2	DM-15-251J	250PF 500V	ELMENCO				
2	9	3	DM-15-330J	33PF 500V	ELMENCO				
2	8	2	DM-15-240J	24PF 500V	ELMENCO				
3	7	3	WT10MA15501	5-50PF	AMPREX				
2	6	2	CV11B200	CAPACITOR 5-20PF	ERIE/CAL				
1	5	1	C2201-3	COIL ASS'Y	FEC				
1	4	1	C2201-2	COIL ASS'Y					
1	3	1	C2201-1	COIL ASS'Y					
3	2	3	80974	INDUCTOR					
1	1	1	N0767A	P.C. BOARD	FEC				
REQD	ITEM	REQD	PART NO	DESCRIPTION	MFG OR MFR	MAX L SPEC OR CAT PART NO	FINISH	FINISH SPEC	CHT BYM

Figure 7-5. Parts List



- NOTES:
1. SCHEMATIC REF. D1670
  2. UNLESS OTHERWISE SPECIFIED  
DRILL ALL MTG HOLES #60(.040)
  3. ▲ NO. 32 DR. (.156) 2 PLACES
  4. ■ NO. 38 DR. (.101) 16 PLACES
  - ⊠ SEE TABLE BELOW FOR COMPONENT  
VALUE AND ITEM N<sup>o</sup>.

Figure 7-6. Audio And AGC, Board Assembly  
N0733-J3-D1671C

1	1	50	WR		RESISTOR 1.5K 1/4W 10%	A-B				
1	1	49	WR		RESISTOR 15Ω 1/4W 10%	A-B				
		48								
NIR	1	47	NIR		RESISTOR, 27Ω 1/4W ±10%	A-B				
1	NIR	46	1	V500275X3015A2	CAPACITOR 2.7MΩ 5V	SPRAGUE				
16	16	45	16		NUT, HEX 2-5/16 3/16 AF	BRASS			NI-P	
1	1	44	1		RESISTOR, 39K 1/4W ±10%	A-B				
NIR	NIR	43	NIR		WIRE 22 GA SOLID	ALPHA				
16	16	42	16		WASHER, NO. 2 SLIT LOCK	PHOS. BRZ			NI-P	
16	16	41	16		SCREW, 2-5/16 X 1/4 LG BD.HD.	BRASS			NI-P	
2	2	40	2	TY-55X	TRANSFORMER	TRIAD				
1	1	39	1	TY-45X						
4	4	38	4	T-35X						
1	1	37	1	T-34X	TRANSFORMER	TRIAD				
2	2	36	2	FD 100	DIODE	FAIRCHILD				
2	2	35	2	2N3905	TRANSISTOR	G.E.				
10	10	34	10	2N3903		MOT.				
2	2	33	2	2N696		TI				
4	4	32	4	2N404	TRANSISTOR	G.E.				
1	1	31	1	V500-337X700652	CAPACITOR, 330 MFD, 6V	SPRAGUE				
1	1	30	1	V500-476X7006B21	47 6V					
2	4	29	2	V500-226X7015B21	22 15V					
2	2	28	2	V500-05X9335A21	1 35V					
2	1	27	2	192P-10492	.1 200V	SPRAGUE				
4	4	26	4	V5835-75U-10321	.01 25V	ERIE				
2	2	25	2	B01-XSF-102K1	.001 1KV	ERIE				
4	4	24	4	835XSV0502 Z	CAPACITOR, .005 MFD, 100V	ERIE				
2	2	23	2		RESISTOR, 100Ω, 1/2 W 10%	A-B				
2	2	22	2		33Ω, 1/2 W 10%					
1	1	21	1		82K 1/4W, 10%					
2	2	20	2		22K					
1	1	19	1		18K					
1	1	18	1		12K					
8	8	17	8		10K					
3	3	16	3		4.7K					
1	1	15	1		2.7K					
2	2	14	3		2.2K					
2	2	13	3		1.2K					
5	5	12	4		1K					
1	1	11	1		820Ω					
2	2	10	2		470Ω					
1	1	9	1		330Ω					
1	1	8	1		120Ω					
2	2	7	2		100Ω					
9	9	6	9		47Ω 1/4W, 10%					
2	2	5	2		5.1K 1/4W, 5%					
1	1	4	1		2K					
1	1	3	1		620Ω					
NIR	NIR	2	1		RESISTOR, 200Ω, 1/4W ±5%	A-B				
1	1	1	1	NO733A	P.C. BOARD	FEC				
1500C	1500B	ITEM	1500A	PART NO	DESCRIPTION	MAT'L OR MFR	MAT'L SPEC OR CAT PART NO	FINISH	FINISH SPEC	CKT SYM

Figure 7-6. Parts List

5	1	1	50	WIR		RESISTOR 1.5K 1/4W 10%	A-B												
	1	1	49	WIR		RESISTOR 15Ω 1/4W 10%	A-B												
			48																
6	WIR	1	47	WIR		RESISTOR, 27Ω 1/4W ±10%	A-B												
	1	WIR	46	1	V500275X3015A2	CAPACITOR 2.74μF 5V	SPRAGUE												
	16	16	45	16		NUT, HEX 2-56 3/16 AF	BRASS											NI-P	
	1	1	44	1		RESISTOR, 39K 1/4W ±10%	A-B												
	WIR	WIR	43	WIR		WIRE 22 GA SOLID	ALPHA												
	16	16	42	16		WASHER, NO. 2 SPLIT LOCK	7-35 B02												NI-P
	16	16	41	16		SCREW, 2-56 x 1/4 S BD. HD.	DRAVO												NI-P
	2	2	40	2	TY-55X	TRANSFORMER	TRIAD												
	1	1	39	1	TY-45X														
	4	4	38	4	T-35X														
	1	1	37	1	T-34X	TRANSFORMER	TRIAD												
	2	2	36	2	FD 100	DIODE	FAIRCHILD												
	2	2	35	2	2N3905	TRANSISTOR	G.E.												
	10	10	34	10	2N3903		MOT.												
	2	2	33	2	2N696		TI												
	4	4	32	4	2N404	TRANSISTOR	G.E.												
	1	1	31	1	V500-337X786652	CAPACITOR, 330 MFD, 6V	SPRAGUE												
	1	1	30	1	V50D-475X700682		47 6V												
7	2	4	29	2	V50D-226X901582		22 15V												
	2	2	28	2	V50D-105X923512		1 35V												
8	2	1	27	2	V92P-10492		.1 200V	SPRAGUE											
	4	4	26	4	V835-Y5U-1032		.01 25V	ERIE											
	2	2	25	2	B0-XSF-102K		.001 1KV	ERIE											
	4	4	24	4	V35X5V0502 Z	CAPACITOR, .005 MFD, 100V	ERIE												
	2	2	23	2		RESISTOR, 100Ω, 1/2 W 10%	A-B												
	2	2	22	2		33Ω 1/2 W 10%													
	1	1	21	1		82K 1/4W, 10%													
	2	2	20	2		22K													
	1	1	19	1		18K													
	1	1	18	1		12K													
	8	8	17	8		10K													
	3	3	16	3		4.7K													
	1	1	15	1		2.7K													
9	2	2	14	3		2.2K													
	2	2	13	3		1.2K													
	5	5	12	4		1K													
	1	1	11	1		820Ω													
	2	2	10	2		470Ω													
	1	1	9	1		330Ω													
	1	1	8	1		120Ω													
	2	2	7	2		100Ω													
	9	9	6	9		47Ω 1/4W, 10%													
	2	2	5	2		5.1K 1/4W, 5%													
	1	1	4	1		2K													
	1	1	3	1		520Ω													
10	WIR	WIR	2	1		RESISTOR, 200Ω, 1/4W ±5%	A-B												
	1	1	1	1	NO733A	P. C. BOARD	FEC												
	1500C	1500B	ITEM	1500A	PART NO	DESCRIPTION	MAT'L OR WFR	MAT'L SPEC OR CAT. PART NO	FINISH	FINISH SPEC	CKT SYM								

Figure 7-6. Parts List



## APPENDIX A

### SPECIAL APPLICATION DATA

#### A.1 GENERAL

This Appendix contains useful application data for operating the 1500B Receiver in communication systems utilizing various transmission modes.

#### A.2 DEFINITIONS

Definitions of the terms used in the following examples are listed below:

$f_c$  = Carrier frequency of transmitter or exciter (herein called exciter) as indicated by the frequency settings, whether or not the carrier is suppressed.

$f(1500B)$  = Operating frequency of 1500B used to calculate the crystal frequencies or to set the frequency switches on an associated 1550 Synthesizer.

$f_x$  = Calculated 1500B crystal frequency.

A1 = Modulation designator for on-off keying of a continuous-wave (CW) carrier by the modulating signal, without the use of any other modulation.

F1 = Modulation designator for Frequency-Shift-Keying (FSK) where the frequency of a continuous-wave carrier is shifted between two predetermined frequencies by the modulating signal.

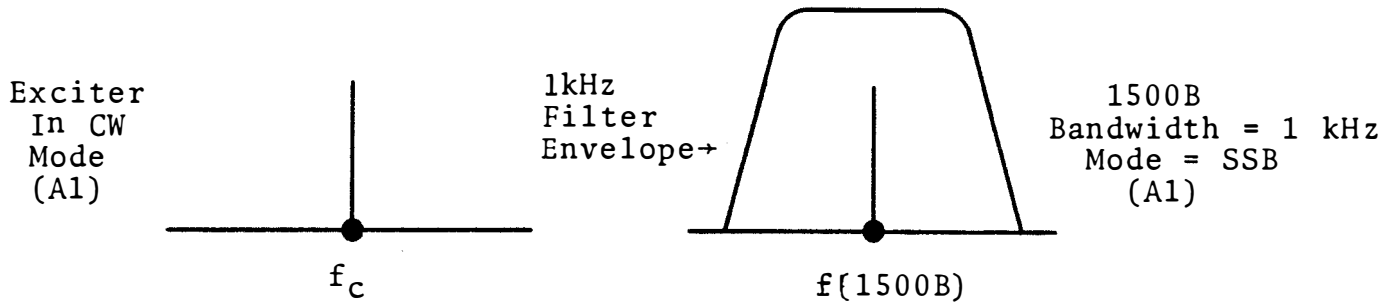
A7J = Designator for keying (any type of keying: on-off, amplitude, frequency-shift, etc.) by a modulating signal of independent sub-carriers in frequency division multiplex systems, which in turn amplitude-modulate a continuous wave-carrier.

Example: Single sideband, suppressed carrier, single sub-carrier (single sideband emissions with suppressed carrier modulated only by a single sub-carrier are classified as if the sub-carrier were the main carrier.)

A3H = Designator for amplitude-modulation of a continuous-wave carrier by the modulating signal.

Example: Single sideband, full carrier.

### A.3 CW OPERATION



$$f_c = f(1500B)$$

#### FREQUENCY OF CRYSTAL ( $f_x$ )

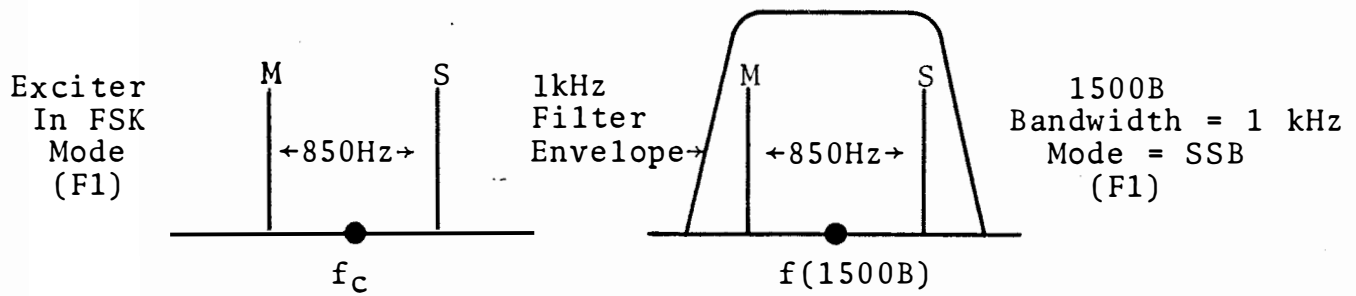
Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c - 9.0 \text{ MHz}$

### A.4 FSK OPERATION

The frequency shift (850 Hz), audio center frequency (2550 Hz), and the mark-space tone relationship in the following examples are typical figures which can vary with individual customer requirements.

A.4.1 METHOD 1



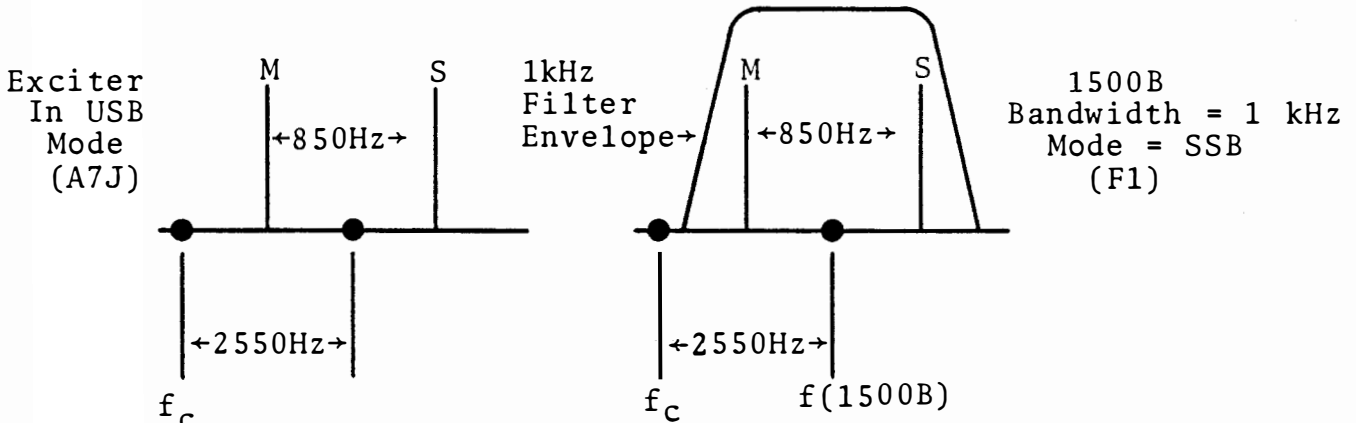
$$f_c = f(1500B)$$

FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c - 9.0 \text{ MHz}$

A.4.2 METHOD 2



$$f_c + 2550 \text{ Hz} = f(1500B)$$

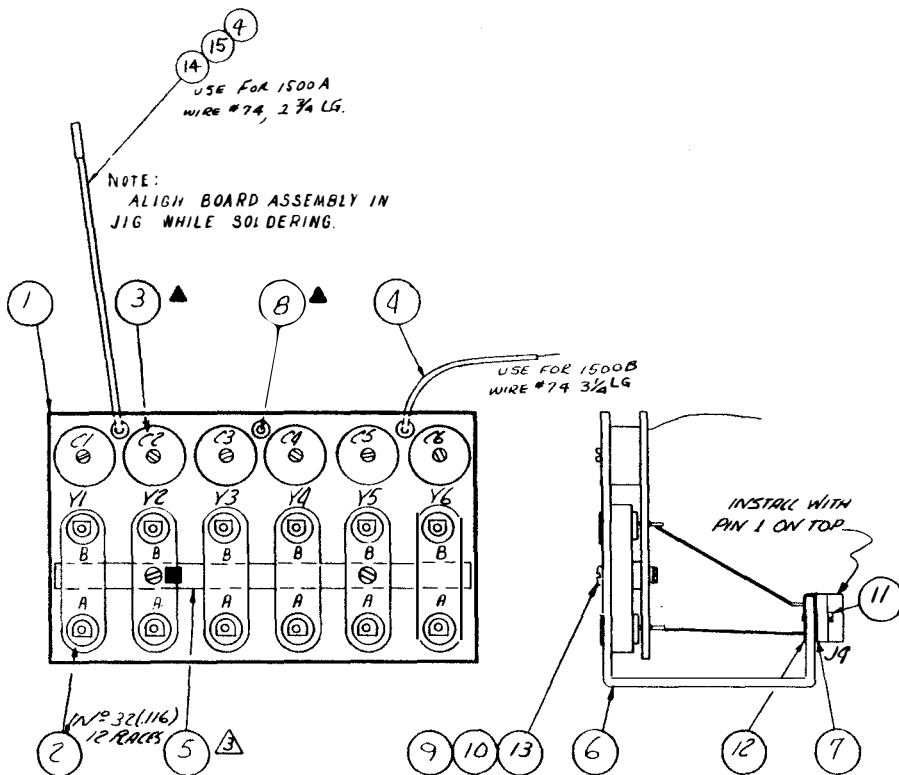
FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 2550 \text{ Hz} + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c + 2550 \text{ Hz} - 9.0 \text{ MHz}$

ITEM	REQ D	PART NO	DESCRIPTION	MAT'L OR MFR	MAT'L SPEC OR CAT. PART NO	FINISH	FINISH SPEC	CKT BYM
27	1	4361	RESISTOR, 10Ω, 3/4W, 5%	OHMITE				
28	13	56064	EYELET	U.S.				
25	1		WASHER, N°6 FLAT	SST				
24	4R		TWINE, N°20 GA, NATURAL	ALPHA				
23	4R		WIRE, N°20 GA, SOLID	ALPHA				
22	4		WASHER, N°6 INT. TOOTH	SST				
21	4		SCREW, N°6-32, 1/8", 1/4"	SST				
20	1		SCREW, N°6-32, 5/16", 3/4"	SST				
19	16	2059	EYELET	STIMPSON				
18	5	1246-12	STANDOFF	ETC				
17	3	202-3-2T	STAKE PIN, MALE	BEID CHAIN				
16	1	TW1015	TRANSFORMER	TURNS, INC.				
15	1	6126	SWITCH, DPDT	C. WIRT				
14	2	1N1353A	DIODE, ZENER	MOT				
13	4	1N4004	DIODE	MOT				
12	4	1N4002	DIODE	ITT				
11	2	845X5V0104Z	CAPACITOR 100 UF 100V	ERIE				
10	3	590M80P56L4	CAPACITOR 1000 UF 25V	SPRAGUE				
9	1	590107P50H4B	CAPACITOR 100 UF 250V	SPRAGUE				
8	1		RESISTOR 100 Ω 2W 10%	AB				
7	1		33 Ω 2W 10%	AB				
6	1	4361	10 Ω 3/4W 5%	OHMITE				
5	1		10 Ω 2W 10%	AB				
4	1	RN60D121F	RESISTOR 12K 1/4W 1%	AB				
3	1	B1173	SWITCH PLATE	FEC				
2	1	B1144-1	HEAT SINK	FEC				
1	1	N0724	P.C. BOARD	FEC				

Figure 7-7. Parts List



WIRING CHART

Y1-B	TO	M-1
Y1-A	..	M-A
Y2-B	..	M-2
Y2-A	..	M-B
Y3-B	..	M-3
Y3-A	..	M-C
Y4-B	..	M-4
Y4-A	..	M-D
Y5-B	..	M-5
Y5-A	..	M-E
Y6-B	..	M-6
Y6-A	..	M-F

USE 24 GA. BUS WIRE

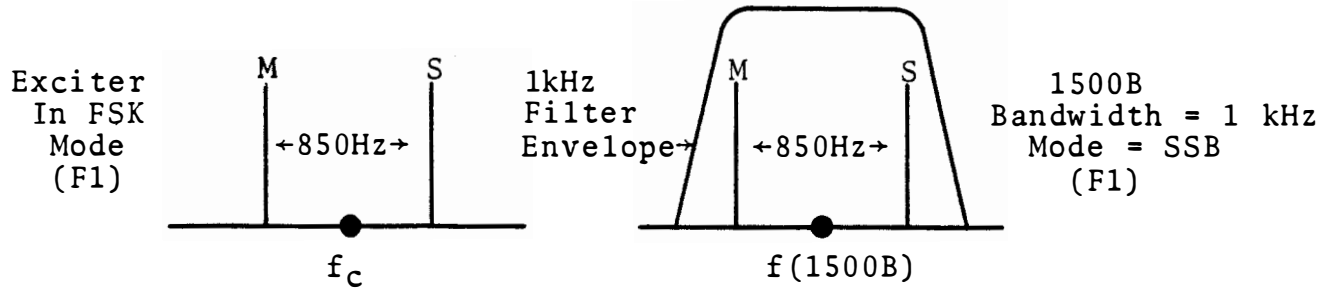
NOTES

1. ▲ N°55(.052)DR.-21 PAGES
- 1/8(.125)DR.-2 PAGES
2. CRYSTAL FREQ. DEPENDS ON CUSTOMERS REQUIREMENTS.
- ▲ ALIGN HOLES ON SPACER (ITEM 5) WITH HOLES ON PC BOARD BEFORE SOLDERING CRYSTAL SOCKETS TO BOARD.
4. WIRE 11 (ITEM 7) PER WIRING CHART
5. SCHEMATIC REF D1674
6. **DO NOT CLEAN THIS BOARD!**  
BECAUSE IT REMOVES LUBRICANT ON ITEM 3.
7. DO NOT PUT BOARD IN HEAT.
8. REF SCHEMATIC D1802

ITEM	REQD	PART NO	DESCRIPTION	MATL OR MFR	MATL SPEC OR CAT PART NO	FINISH	FINISH SPEC	CKT SYM
15	1	1625-1R	CONNECTOR	MOORE				
14	1	13817L	FEMALE PIN	MOORE				
13	2		NUT N° 8-40 x 1/4 AF				55T	
12	2	25263-4E-24	NUT N° 8	TANNERMAN				
11	2		SCREW, SELF TAP N° 4-40 x 3/8				55T	
10	2		WASHER, N° 4 INT. TOOTH				55T	
9	2		SCREW, N° 4-40 x 5/8 BH				55T	
8	3	5606A	EYELET	US				
7	1	251-06-30-160	CONNECTOR	C-I				
6	1	B/451	CRYSTAL MTG BRACKET	FEC				
5	1	B/455	SPACER	FEC				
4	AIR		WIRE - 20GA. STR	ALPHA				
3	6	HT10MAJ550	CAPACITOR, TRIM	AMPEREX				
2	6	05-0810-01	CRYSTAL SOCKET	ELCO				
1	1	N°736	PC BOARD	FEC				

Figure 7-8. Crystal Holder, Assembly  
N0736-J4-C1900C

A.4.1 METHOD 1



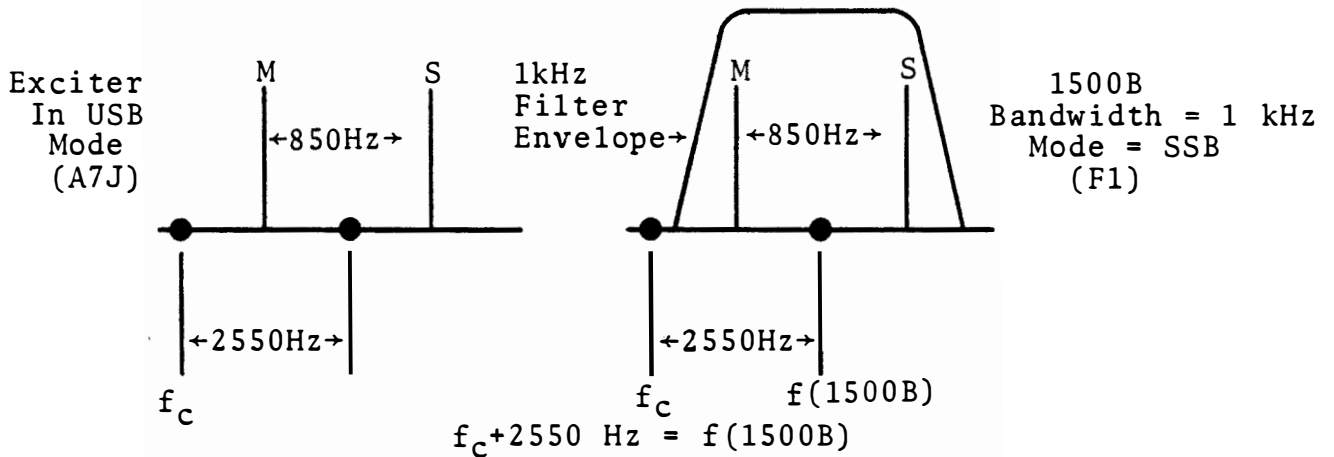
$$f_c = f(1500B)$$

FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c - 9.0 \text{ MHz}$

A.4.2 METHOD 2

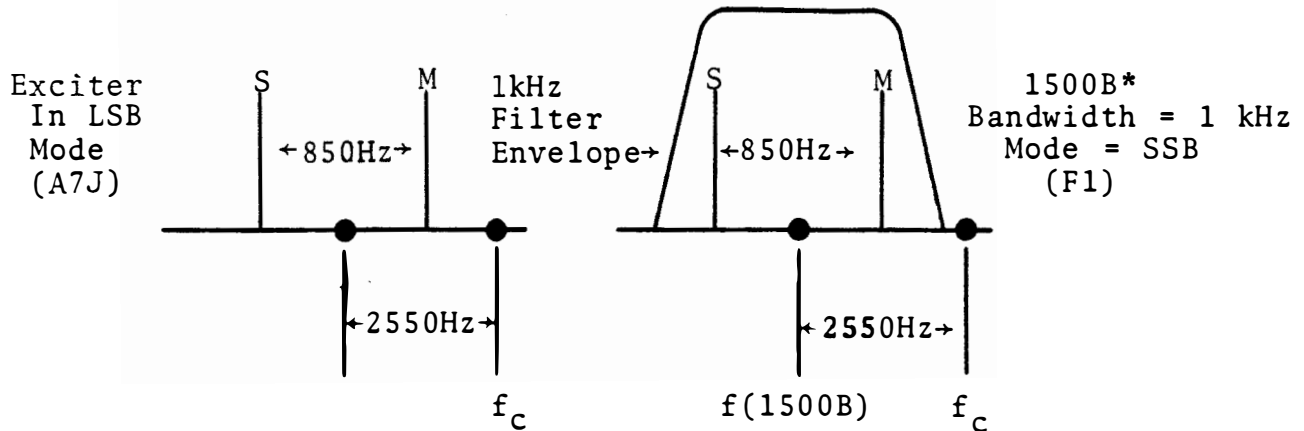


FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 2550 \text{ Hz} + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c + 2550 \text{ Hz} - 9.0 \text{ MHz}$

A.4.3 METHOD 3



$$f_c - 2550 \text{ Hz} = f(1500B)$$

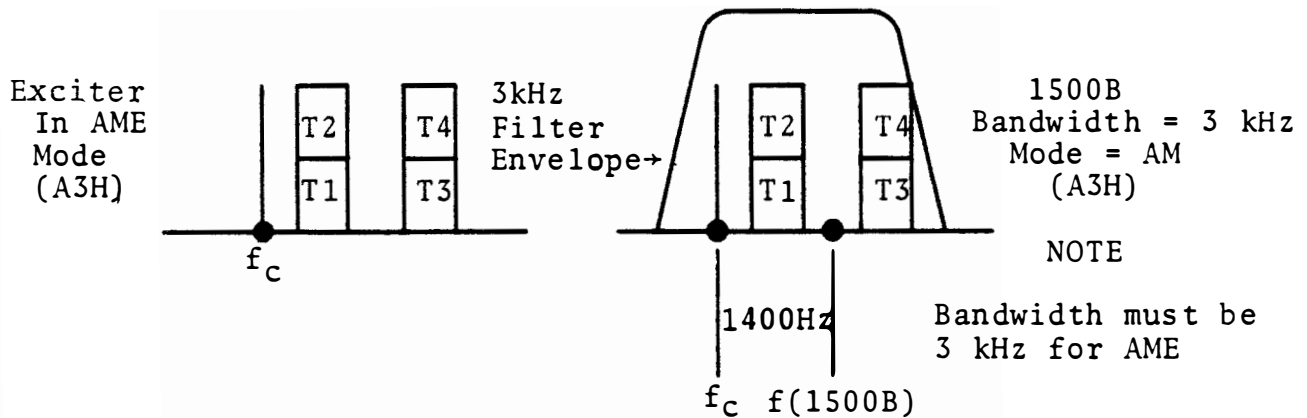
\* 1200 and 1203 Converters - Place NORMAL/REVERSE switch in REVERSE

FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c - 2550 \text{ Hz} + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c - 2550 \text{ Hz} - 9.0 \text{ MHz}$

A.5 AME OPERATION (SELCALL)



NOTE

Bandwidth must be 3 kHz for AME

$$f_c + 1400 \text{ Hz} = f(1500B)$$

FREQUENCY OF CRYSTAL ( $f_x$ )

Bands A thru C and L:  $f_x = f(1500B) + 9.0 \text{ MHz}$   
 $= f_c + 1400 \text{ Hz} + 9.0 \text{ MHz}$

Bands D and E:  $f_x = f(1500B) - 9.0 \text{ MHz}$   
 $= f_c + 1400 \text{ Hz} - 9.0 \text{ MHz}$