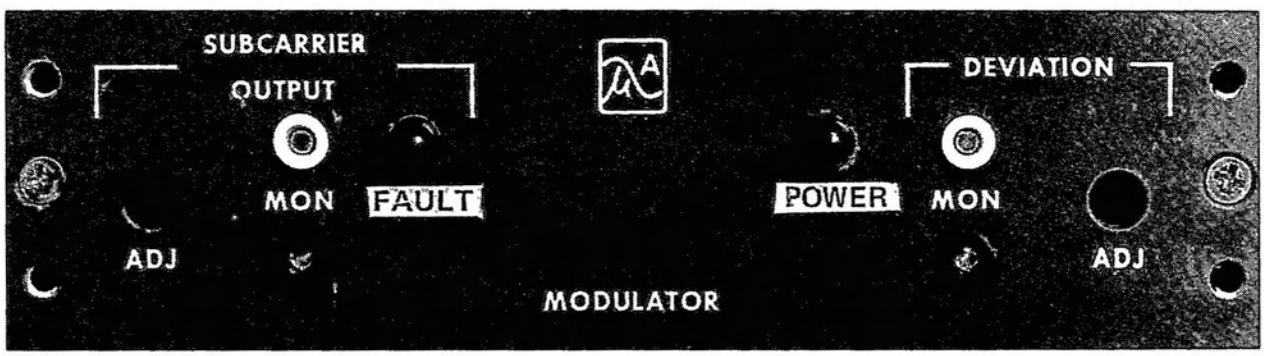
PN 808727

PAC 4
MODULATOR



INSTRUCTION MANUAL

MICROWAVE ASSOCIATES
COMMUNICATIONS
A M/A-COM COMPANY

SECTION 1
EQUIPMENT DESCRIPTION

GENERAL

The PAC-4 Modulator (Figure 1-1) produces a broadcast quality, frequency-modulated subcarrier, for use in a frequency-division-multiplexed system with video and other baseband signals. Design flexibilities allow a choice of domestic or CCIR frequencies and simultaneous uses of up to four PAC-4 Modulators. Power for the PAC-4 (and other PAC series units) is supplied by the PAC PS Power Supply. PAC series components are listed in Table 1-1.

The PAC-4 is housed in a PAC series case and is 1.7 inches high (4.32 cm) by 5.5 inches wide (13.97 cm) by 8.5 inches deep (21.59 cm) and weighs 3.0 pounds (1.36 kg.) maximum. The PAC-4 can be mounted in a special rack mounting panel frame which is 19 inches wide (48.26 cm) by 1.75 inches high (4.45 cm) and holds up to three PAC series units. All connections are made from the rear of the PAC-4.

THEORY OF OPERATION

Refer to the functional block diagram (Figure 1-2) and the schematic diagram located in Section 5 during this discussion.

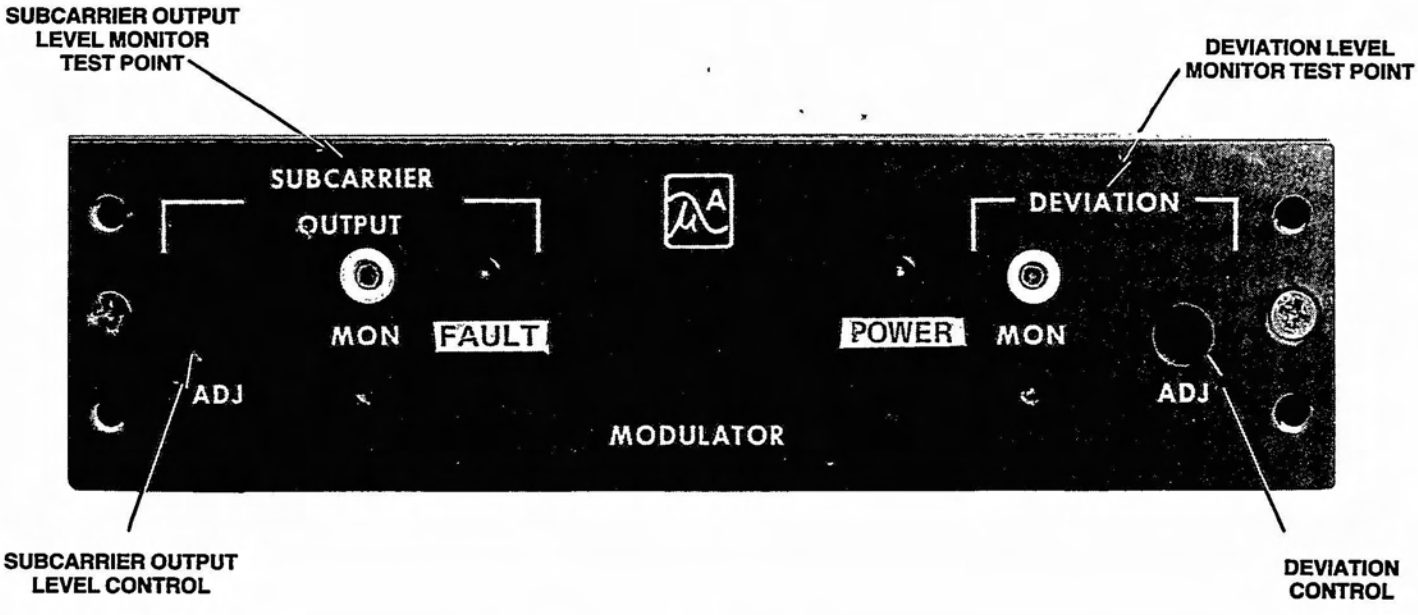
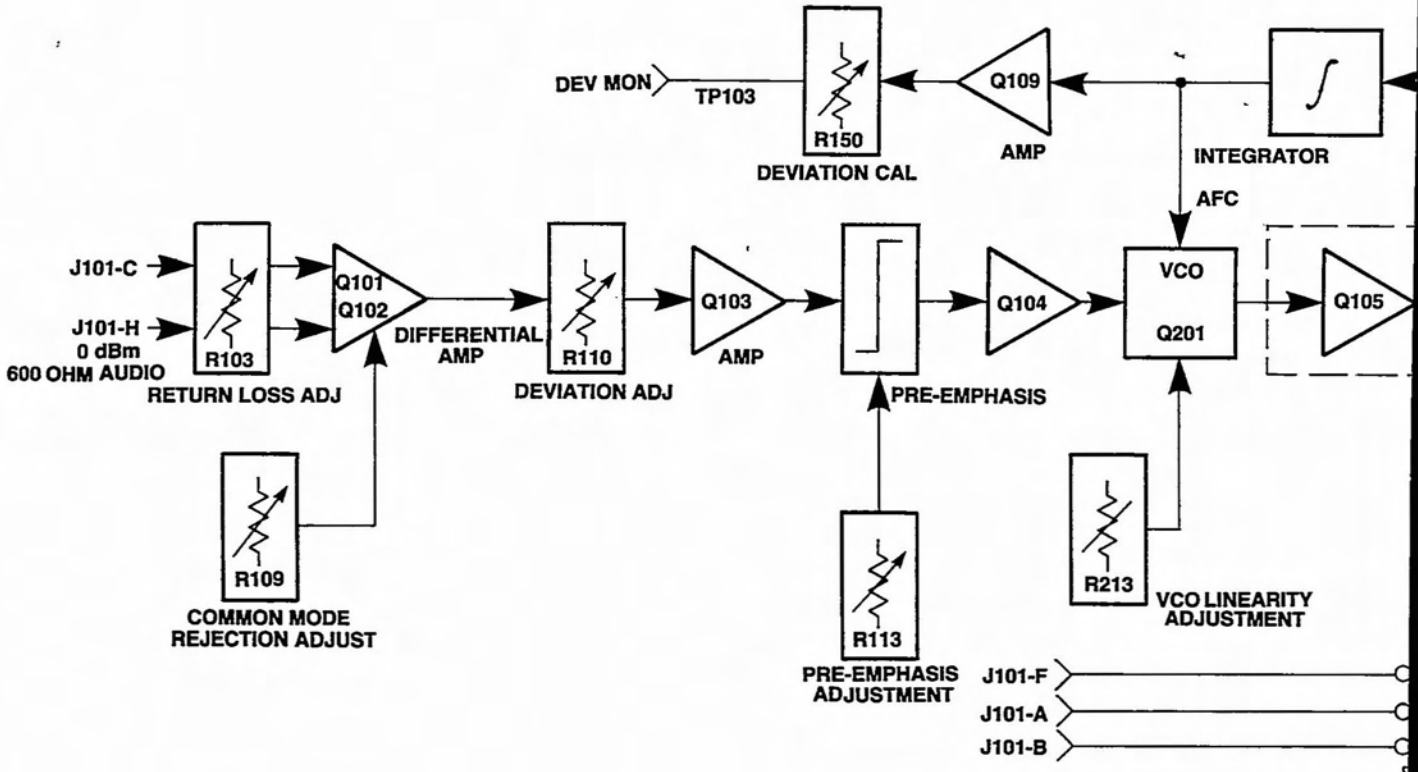


Figure 1-1. PAC-4 Modulator


DEV MON
TP103
R150
DEVIATION CAL
Q109
AMP
INTEGRATOR
AFC
J101-C
J101-H
0 dBm
600 OHM AUDIO
R103
RETURN LOSS ADJ
Q101
Q102
DIFFERENTIAL
AMP
R110
DEVIATION ADJ
Q103
AMP
PRE-EMPHASIS
Q104
VCO
Q201
Q105
R109
COMMON MODE
REJECTION ADJUST
R113
PRE-EMPHASIS
ADJUSTMENT
R213
VCO LINEARITY
ADJUSTMENT
J101-F
J101-A
J101-B

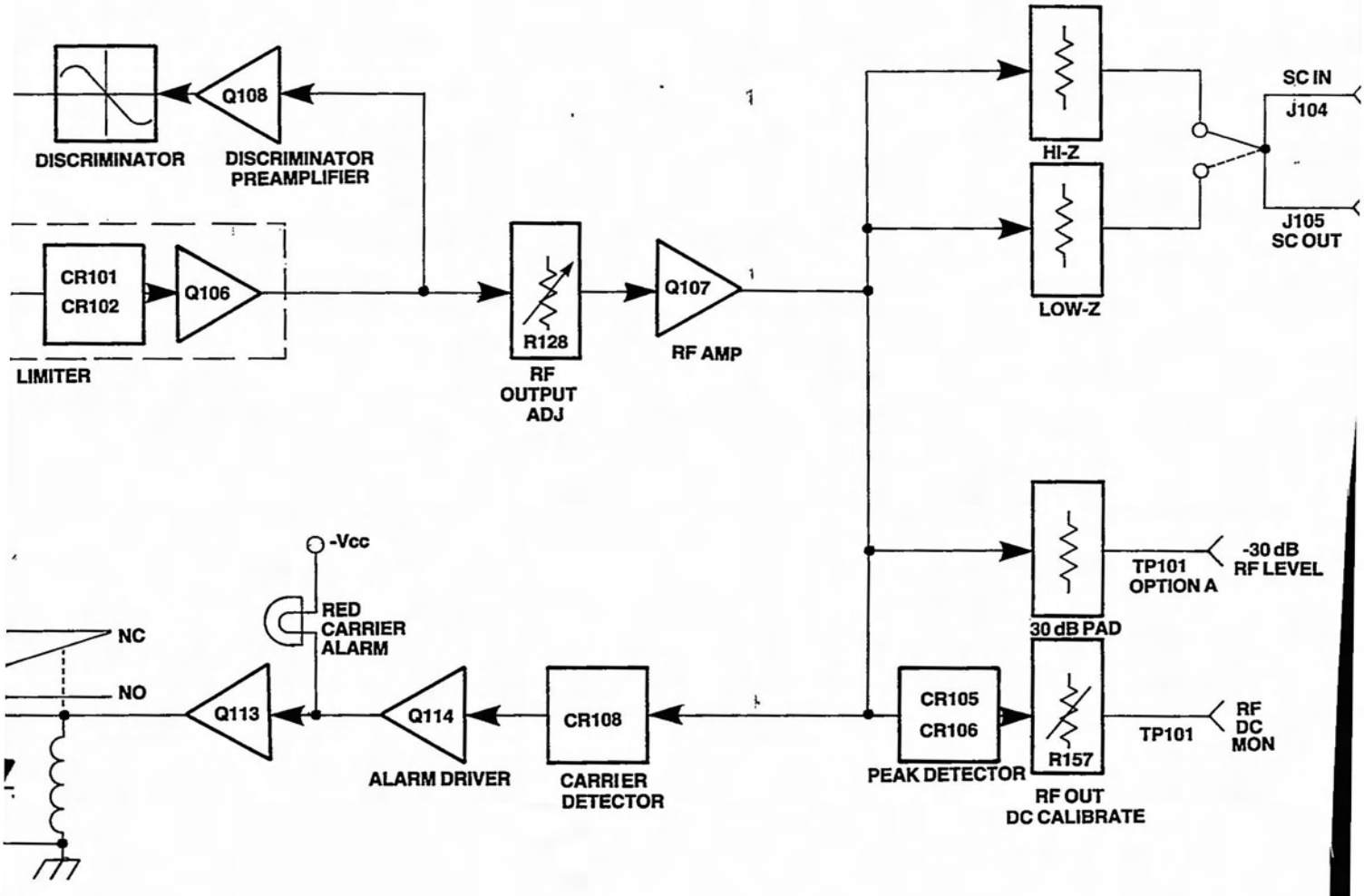


Figure 1-2. PAC-4 Modulator, Block Diagram

Table 1-1. PAC Series Components

DESCRIPTION	PART NUMBER
PAC-4 PROGRAM AUDIO MODULATOR COMPONENTS	
Modulator Unit (includes carrier fail alarm and fault lamp)	801870
AC Power Harness (one per ac powered PAC-4)	801882
DC Power Harness (one per dc powered PAC-4)	803093
PAC-5 PROGRAM AUDIO DEMODULATOR COMPONENTS	
Program Audio Demodulator	805293
AC Power Harness (one per ac powered PAC-5)	805953
DC Power Harness (one per dc powered PAC-5)	805954
Audio Hot Standby Switch (Specify ac or dc) contains all necessary ac/dc power harnesses)	804424
VIDEO LOW PASS FILTER	
Available Video Low Pass Filter Frequencies: 4.2, 4.5, 5.0, 5.8, and 6.5 MHz (specify)	
PAC Style Case for Panel Mounting	807480
Plug-In Module Style for use with Hot-Standby Radio Only	805352
AC Power Supply	801859
Rack Panel Mounting Frame	801851
Blank Panel (to cover unused spaces in rack panel mounting frame)	801869
75 ohm BNC Termination	803387
Coax Cable (BNC Plugs each end, specify length)	800192

AUDIO STAGES. Audio input to the PAC-4 Modulator is a nominal 0 dBm into 600 ohm balanced load. R103 is in parallel with the input and is adjusted for a maximum return loss. The input is first applied to a differential amplifier consisting of Q101 and Q102. R109 is the common mode rejection. The differential amplifier serves two purposes: first, it takes as input, a balanced signal and has, as output, an unbalanced signal; second, it provides rejection of common mode signals, such as 60 Hz hum.

The differential amplifier is coupled to the next amplifier, Q103, through deviation adjustment R110. The pre-emphasis network, consisting of parallel combination R116, PRE-EMP ADJ, and C105, is in series with the output of Q103 and the input of the next amplifier Q104. The output of Q104 controls oscillator deviation.

OSCILLATOR

The oscillator is series tuned using a varactor as the tuning element. Positive feedback from the emitter of Q102 to the junction of capacitors C203 and C208, which form a voltage divider across the tank circuit, sustains oscillation. The varactor CR201, has voltage variable junction capacitance. DC bias voltage across the diode controls this capacitance. Varying the bias, and hence capacitance, varies the frequency of oscillation. Pre-emphasis audio from Q104 varies the voltage across CR201. This audio is predistorted by the network CR202 through CR204 and R206 and R207 to compensate for distortion introduced by CR201 in the modulation process. The VCO linearity adjustment, R213, is adjusted for minimum distortion. Thus, an FM signal is generated.

A sample of the PAC-4 subcarrier output of the limiter stage is amplified by Q108 and demodulated in a discriminator consisting of CR103, CR104 and a balanced network of resistors and capacitors. At the subcarrier frequency, neither diode conducts. However, as the frequency changes, due to either drift or modulation, a voltage output results. These variations are integrated by the combination R205, C208 and R214 to produce an automatic frequency control (AFC) voltage proportional to drift alone which keeps the oscillator on the subcarrier frequency. A plug can be inserted between E101 and E102 to provide a constant AFC voltage for testing purposes.

SUBCARRIER OUTPUT

The output of the oscillator is taken from the collector of Q201 and fed to the limiter consisting of Q105, Q106, and back-to-back diodes CR101 and CR102. Q105 amplifies the signal to a level high enough to saturate the limiting diodes CR101 and CR102. Q106 is a high impedance input and low impedance output emitter follower. Its high input impedance allows it to act as a buffer by drawing low input current from the limiting diodes. The output of Q106 follows two paths: it drives Q108, the discriminator preamplifier, and, in the other path, flows through voltage divider R128, the RF output adjustment potentiometer. Output from R128 is amplified by Q107. Subcarrier output from the PAC-4 is taken from the collector circuit of Q107.

OUTPUT CIRCUITS

There are several possible output circuits, depending on which connections are made. Either high impedance (1K nominal) or low impedance (75 ohm) subcarrier outputs are available in the PAC-4. As shown on the schematic, only one jumper wire needs to be relocated, from E128 to E114, to change from Hi-Z to Low-Z.

There is a standard peak subcarrier level calibrated voltage output at TP101. CR106 and CR105 are the peak detectors. C134 and potentiometer R157 (RF output calibration) form a low pass filter.

Option A provides -30 dB RF level (-30 dB with reference to output) at TP101 instead of the SC level voltage.

Option B provides a DPST alarm relay output at TP101. This relay is normally closed while the PAC-4 has subcarrier output and power applied. The alarm circuit operates as follows: CR101 peak rectifies a sample of the SC RF output and biases Darlington transistor Q114 off. When the subcarrier is lost, the base of Q114 is biased negative, Q114 conducts and turns on DS101, carrier alarm LED and turns off relay driver Q113. The relay turned off, contacts J101A and J101F are opened and contacts J101A and J101B are closed.

ON-BOARD VOLTAGE REGULATOR

The regulator works as follows: a voltage driver across the output of the circuit, consisting of CR109, R154 and R155, provides a reference voltage for Q112. Q112 shunts the bias of Q111 to ground. Q111 and Q112 are connected in a Darlington configuration to ground. As Q112 conducts, it removes drive from Q111 and shuts off Q110. However, as the output of Q110 is reduced, so is the drive to Q112. This, in turn, causes Q110 to conduct again. This feedback regulation maintains the output of the regulator at -16.5 Vdc. The voltage driver R147 and R148 establishes a reference AFC voltage at E101 for oscillator testing. C133 serves as a low impedance return to ground for the audio circuits.

NOTCH FILTER

Each PAC-4 Modulator contains a notch filter tuned to its frequency of operation. The notch filter is used to remove any signal or noise content within the output frequency range of the PAC-4.

The use of the notch filter results in higher signal-to-noise ratio in the PAC-4 output than would have been possible if the input signal were not filtered. The notch filter is not used, however, in a PAC-4 which is furthest electrically from the microwave transmitter in a multi or single PAC-4 system. In either case, the subcarrier input of this PAC-4 is terminated in 75 ohms. Information on the external connection of the PAC-4 is given in the installation section of this manual.

SPECIFICATIONS

Subcarrier Frequencies	
Domestic	4.83 MHz, 5.2 MHz, 5.8 MHz, 6.2 MHz, 6.8 MHz, 7.5 MHz, and 8.3 MHz
CCIR	7.02 MHz, 7.5 MHz, 8.065 MHz and 8.59 MHz
Program Audio Input	
Level	0 dBm ±4 dB P-P Test Tone
Impedance	600 ohms balanced
Return Loss	26 dB
Pre-Emphasis	Standard, 75 μs Optional, 50 μs
RF Subcarrier Output	
Modulation	Frequency Modulation
Level	100 mV P-P nominal
Adjustable Range	20 mV P-P to 150 mV P-P
Impedance	Standard High Impedance, bridged Optional 75 ohms, unbalanced
Deviation (1 kHz Test Tone at 0 dBm)	Minimum ±50 kHz Nominal ±75 kHz Maximum ±100 kHz
Power Requirements	
Voltage	Standard -22V ±2 Vdc Optional -48 Vdc
Current	100 mA Nominal (with alarm on) 160 mA nominal
Ripple	50 mV maximum
Physical Characteristics	
Size	1.7 (h) x 5.5 (w) x 8.5 (d) (4.32 x 13.97 x 21.59cm)
Environmental	
Ambient Temperature	
Operational	-30° to +60° C
Meets All Specs	-10° to +40° C
Relative Humidity	0 to 95% (+10° to +40° C

SECTION 2
INSTALLATION

MECHANICAL

The PAC-4 Modulator (and other PAC series units) mounts in a special PAC series rack mounting frame. This panel holds up to three PAC series units. Blank panels cover unused spaces. Figure 2-1 shows the mounting of a PAC series case in the panel.

ELECTRICAL

PAC-4 front panel controls and indicators are shown in Figure 2-2 and listed in Table 2-1. Table 2-2 lists the rear panel connections and their functions. The locations of the rear panel connectors are shown in Figure 2-3.

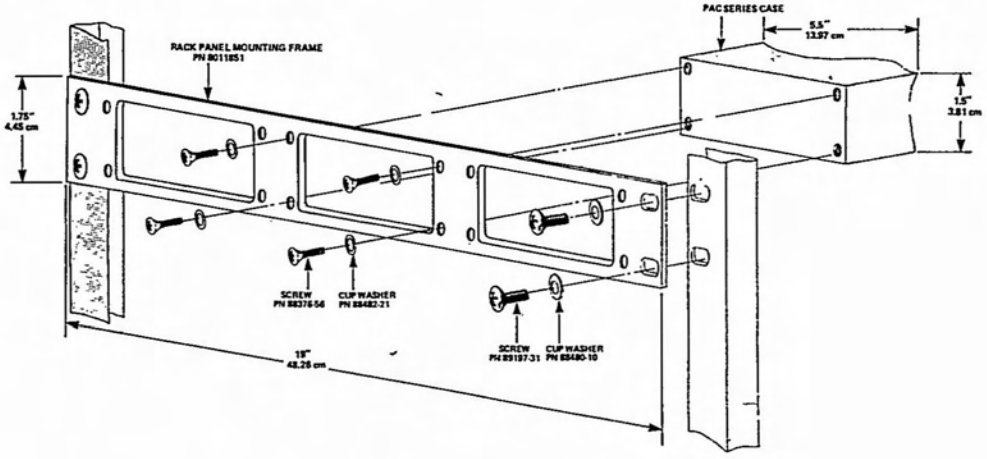


Figure 2-1. Mounting of a PAC Series Case

Table 2-1. Front Panel Controls and Indicators

LEGEND	CONTROL OR CONNECTOR	FUNCTION
Subcarrier Adjustment	R128	Adjusts subcarrier output level.
Subcarrier MON (white) Subcarrier MON (black)	TP103 TP104	Measure calibrated dc voltage across these test jacks to Monitor RF output at TP103 is hot, TP 104 is ground.
Subcarrier Fault (option B only)		Lights is Subcarrier output fails
POWER		
Deviation MON (white) Deviation MON (black)	TP101 TP102	Measure calibrated ac voltage output across these jacks to monitor deviation. TP101 is hot.
Deviation Adjustment	R110	Adjusts deviation.

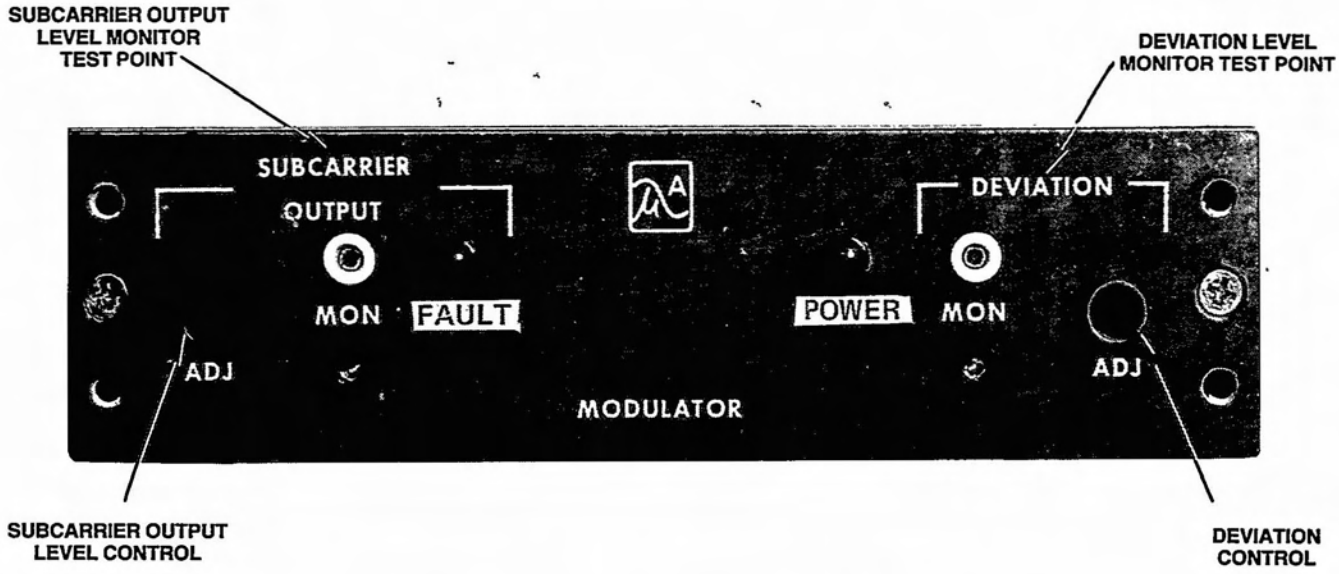


Figure 2-2. Front Panel Controls and Indicators

Table 2-2. Rear Panel Controls and Connections

LEGEND	CONTROL OR CONNECTOR	FUNCTION
Control	J101	Power, Alarm, Audio Inputs
Subcarrier Notch Filter In Subcarrier Notch Filter Out	J102 J103	Notch Filter removes noise and undesired energy from subcarrier frequency
Baseband (+SUBCXR) In Baseband (+SUBCXR(s)) Out	J104 J105	Bridged, high impedance output
SUBCXR MON CAL	J106	Sets subcarrier monitor voltage

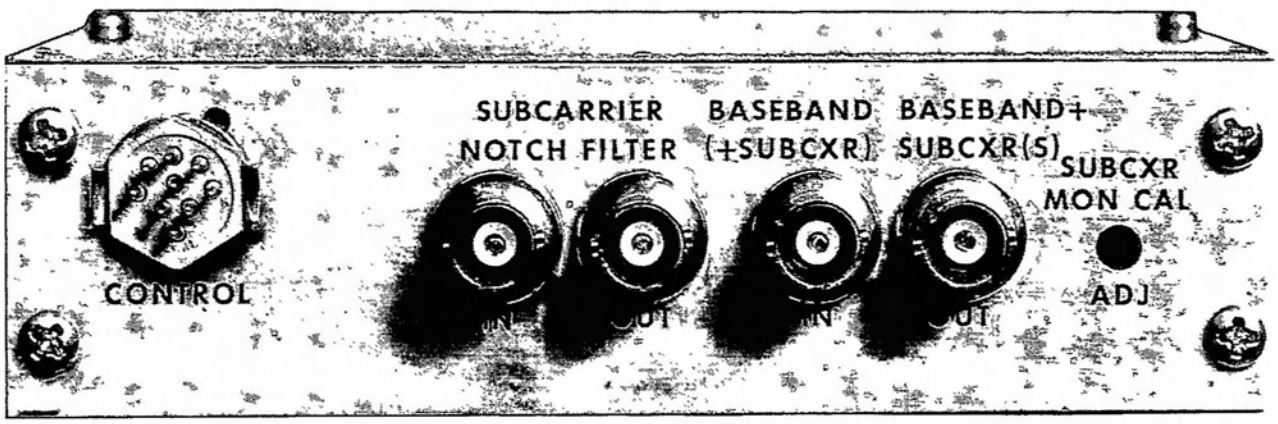


Figure 2-3. Rear Panel Connections

Up to four PAC-4 Modulators can be daisy chained (Figure 2-4). Note that the furthest from the microwave transmitter must be terminated in 75 ohms at J104, subcarrier input, and does not use the internal notch filter. Its subcarrier output, at J105, is connected to either notch filter input of the next PAC-4 in the chain, J102, notch filter input or to the subcarrier input of the microwave transmitter. Each PAC-4 in the daisy chain, except for the unit furthest from the microwave transmitter, uses the notch filter. On these units, the notch filter output, J103, is connected to the subcarrier input, J104, by a short BNC-to-BNC 75 ohm jumper cable.

A single control connector, J101, serves as the audio input and power supply input connector. Separate leads are brought out from the power cable (Figure 2-5) as the 600 ohm balanced audio input. The two connectors on the cable, plug into the PAC-4 and PAC-5 respectively. Alarm switch (optional) outputs are also on J101. Table 2-3 lists the pin connectors of J101.

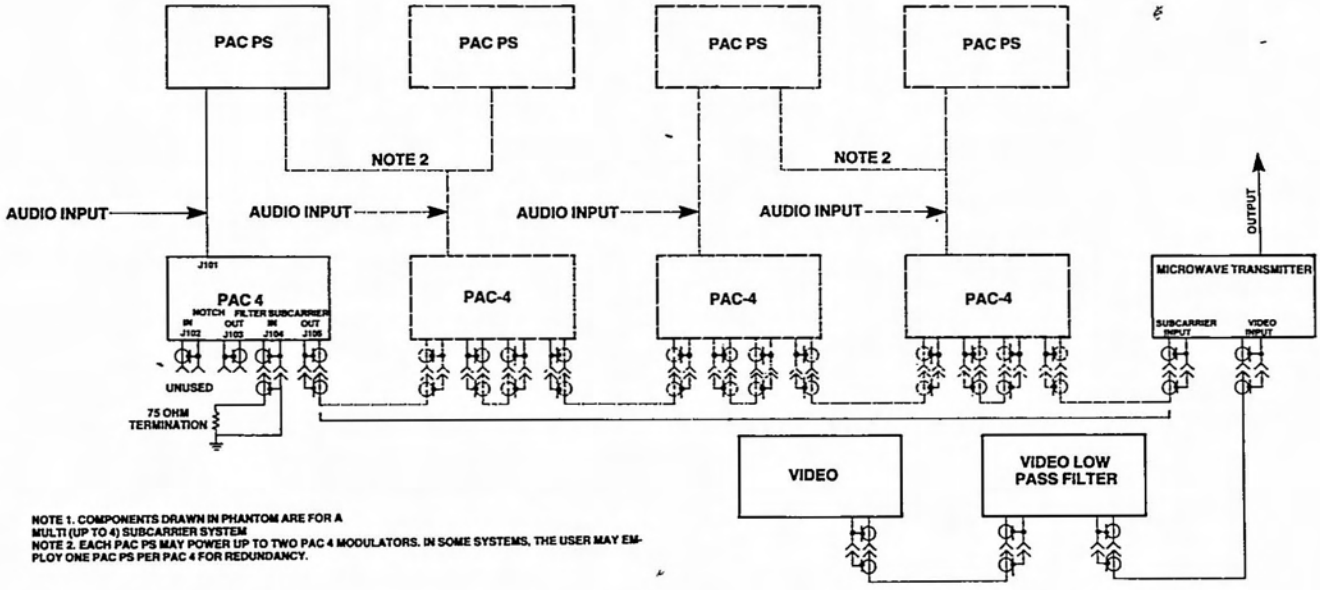


Figure 2-4. PAC-4 Daisy Chain

Table 2-3. Connections

CONNECTION	FUNCTION
A	Alarm relay common (option B)
B	Alarm relay N.O.(option B)
C	600 ohm balanced audio input
D	Ground
E	-Vdc input power
F	Alarm relay N.C.
H	600 ohm balanced audio input
J	Unused
K	Ground

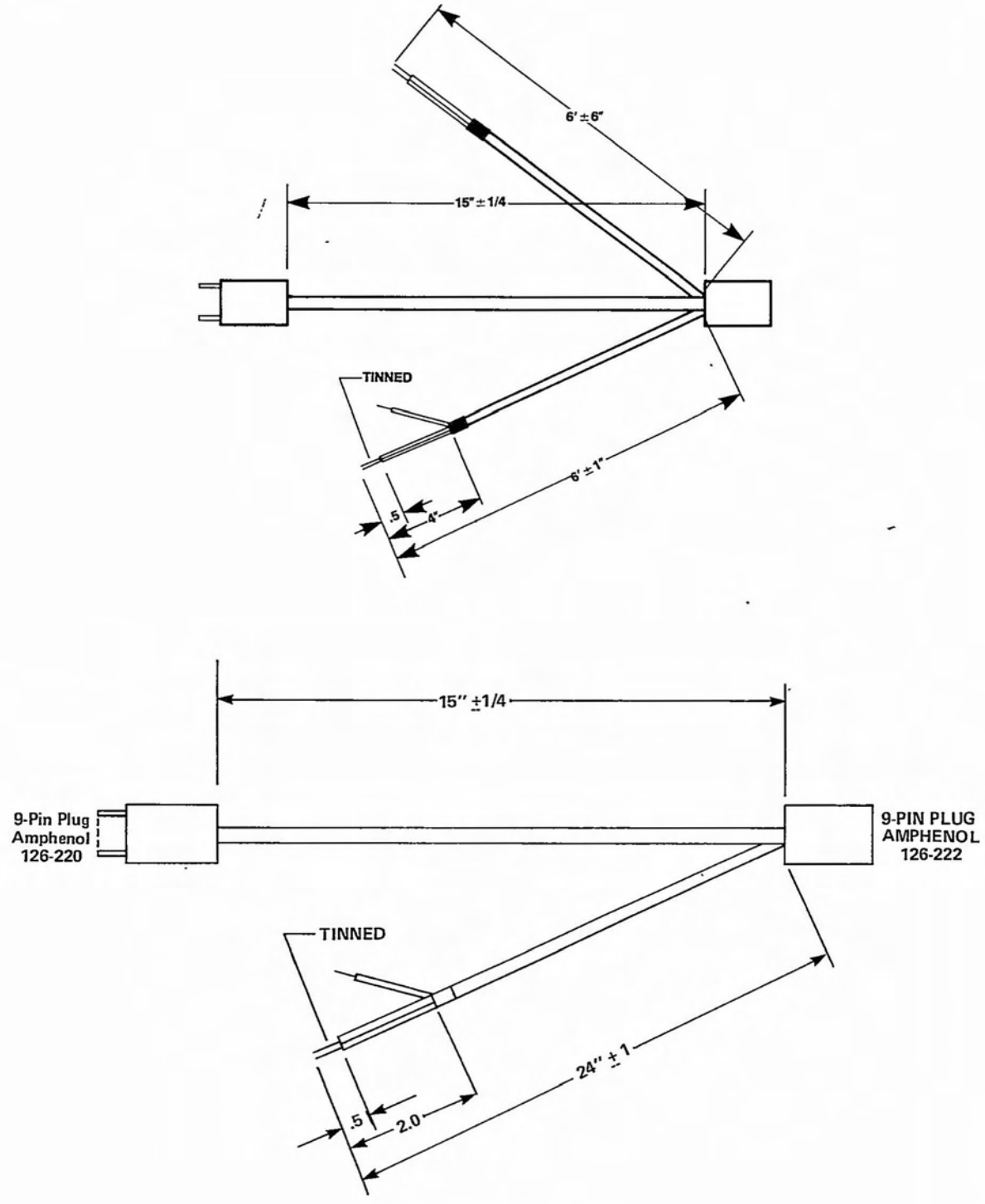


Figure 2-5. Power Cables
(AC Above DC Below)

SECTION 3
OPERATING INSTRUCTIONS

CONTROLS AND INDICATORS

There are two controls and indicators on the front panel of the PAC-4 (Figure 3-1).

The subcarrier output control adjusts the output level of the PAC-4. The level is set at the factory for 50 mV peak-to-peak. The MON test point monitors a DC voltage proportional to the subcarrier level. It is factory pre-set to read 0.5 Vdc for 50 mV subcarrier output.

The deviation control adjusts the carrier deviation for:

1. 75 kHz peak deviation with 0 dBm 1 kHz Test Tone and 75 μ s pre-emphasis input.

2. 100 kHz peak deviation with 0 dBm 1 kHz Test Tone and 50 μ s pre-emphasis input.

The voltages at the monitor test point are 0.75 Vac for 75 kHz peak deviation, as measured on a high impedance, RMS voltmeter.

INITIAL OPERATION

The PAC-4 is operated as follows:

1. Apply -22 ± 2 Vdc at 60 mA maximum.

2. Allow unit to warm for ten minutes.

3. Apply audio input. The signal level should be 0 dBm for 75 kHz peak deviation with 1 kHz test tone input. Measure the voltage at the deviation monitor test point on the front panel with high impedance voltmeter. The measurement should be 0.75 Vac for 75 kHz deviation. If the voltage is not 0.75 Vac, use the deviation adjust control to change the reading accordingly.

4. Measure the voltage at the subcarrier monitor test point with a high impedance voltmeter. The reading should be 0.5 Vdc for 50 mV subcarrier output. If the reading differs, adjust accordingly.

5. The PAC-4 is now ready for "On The Air" use. If the user wishes to conduct a full proof of performance test on the PAC-4, sections 5 through 8 of the alignment procedure in the maintenance and troubleshooting section of this manual supply the necessary procedures.

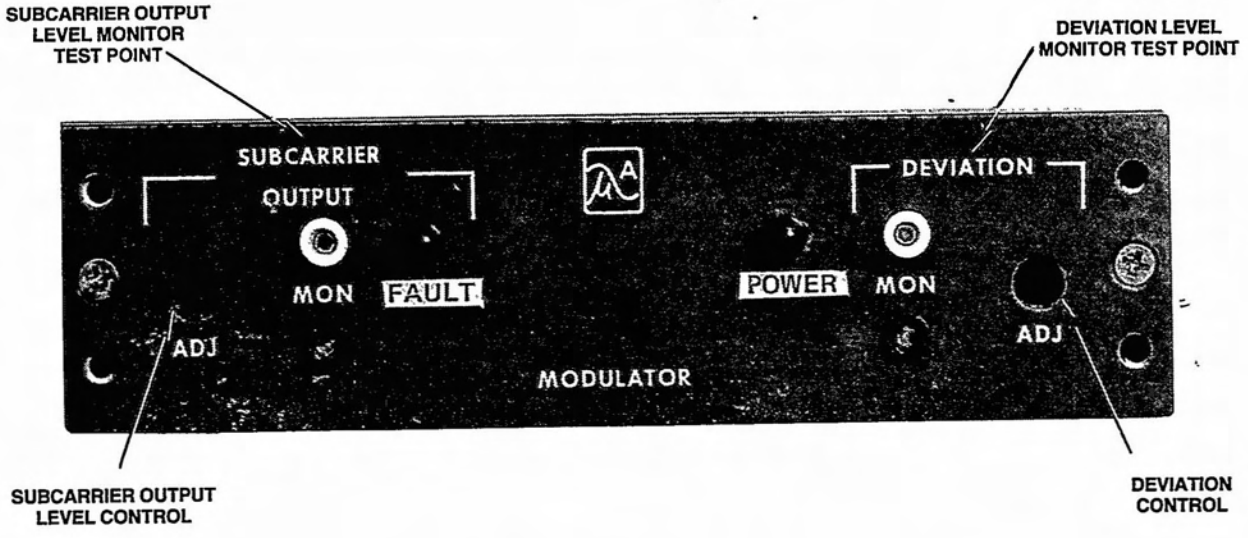


Figure 3-1. Front Panel Controls and Indicators

SECTION 4
MAINTENANCE AND TROUBLESHOOTING

MAINTENANCE

The PAC-4 Modulator is factory aligned and does not require adjustment when first placed into service. Maintenance should be performed at regular intervals by qualified service personnel. The user should re-read the Theory of Operation section of this manual and become familiar with the block diagram before attempting to service or align the PAC-4. This section contains a complete alignment procedure for the PAC-4 which will enable the user to make desired measurements of the PAC-4's performance. Remember: measurements are only as accurate as the equipment used to make them.

Spot checks of RF subcarrier output and deviation can be made at front panel test points. The measurement at the deviation test point (Hi-Z input VTVM/Scope) will be 0.75 Vac for 75 kHz peak deviation.* The subcarrier Monitor Testpoint is at a DC potential proportional to the PAC-4 output. The level is set for 0.5 Vdc for 50 mV output.

*0 dBm Test Tone

TROUBLESHOOTING

The information contained in the Theory of Operation section of this manual, the block diagram, and the alignment procedure should be sufficient for most troubleshooting. However, here are a few suggestions:

1. The PAC-4 does not have current limiting in its on board regulator circuit and is susceptable to damage from input voltages greater than -24 Vdc.

2. If Q110, Q111, or Q112 fails, replace all three (a good rule-of-thumb is "if one goes, they all go").

3. If Q101 or Q102 in the audio input circuit should fail, replace both.

ALIGNMENT PROCEDURES

The purpose of this test procedure is to tune the PAC-4 Modulator to a predetermined subcarrier frequency so that it will satisfactorily produce a frequency-modulated subcarrier which can be used to carry separate RF information in a Microwave Transmission Link. Table 4-1 consists of recommended test equipment.

This includes the following:

1. Module Set-Up
2. Plug-In Test
3. Oscillator Tuning
4. Modulator Audio Tuning
5. Subcarrier Notch Filter Tuning
6. RF Output Level and Final Tuning
7. Optional Procedures

Table 4-1. Recommended Test Equipment

EQUIPMENT	MANUFACTURER (OR EQUIV)
Audio Oscillator	GR1310A
Distortion Analyzer	Hewlett Packard HP334A
Frequency Counter	
RF Amplifier (Optional)	
AM/FM Modulation Meter	Marconi TF2300A
Oscilloscope	Tektronix 547
Unbalanced-to-Balanced Transformer	Marconi TM6221
RMS Voltmeter	Hewlett Packard HP3400A
BNC Terminations	2-75 ohm
PAC-PS and Control Cable	
Multimeter	Simpson 260

MODULE SET-UP

Step 1. Remove top and bottom covers.

Step 2. Preset R103, R109, R110, R116, R128, R150 and R157 to exact midrange position.

Step 3. Preset C124 to minimum or maximum capacitance as determined below.

Frequency	C124
5.8, 6.2	minimum
6.8, 7.5, 8.3	maximum

Step 4. Remove slugs from L104, L015, L106 and L201. Coat inside of coils with Dow Corning 3145 RTV adhesive and replace slugs so that coils are at minimum inductance (slugs all the way out).

Step 5. Install tuning cover on bottom of modulator.

Step 6. Connect 5.6K 1/4 W resistor across E101, E102 and then shorting strap across resistor.

PLUG-IN TEST

Step 1. Set up test equipment as in Figure 4-1.

Step 2. When power is applied to the Modulator, there should be an indication on the frequency counter. If there is none, refer to the optional procedure. Do not continue this procedure until the modulation passes this test.

NOTE

DO NOT apply modulation until MODULATION AUDIO TUNING starts.

OPTIONAL PROCEDURE

Step 1. To be used only if modulator fails Plug-In Test.

Step 2. Re-check equipment set-up to comply with Figure 4-1.

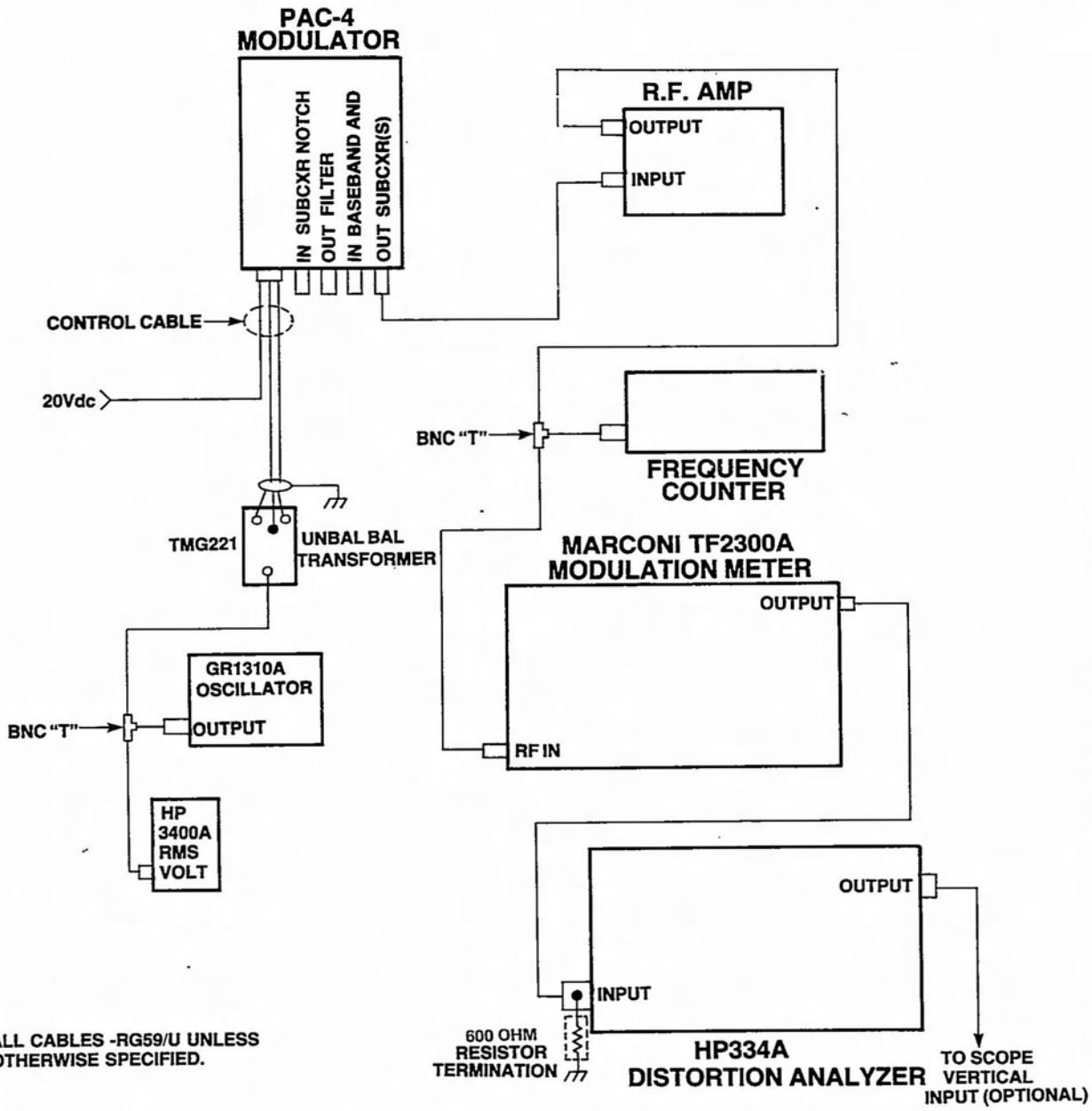


Figure 4-1. Test Equipment Set-Up

Step 3. Tune slug of L201 halfway in, if there is still no indication on frequency counter, go on to next step.

Step 4. Turn R128 to maximum (full CW) if there is still no indication of frequency counter, a failure is indicated. Reject unit and troubleshoot.

OSCILLATOR TUNING

Step 1. Tune slug of L201 until frequency counter indicates desired subcarrier frequency.

Step 2. Remove across shorting strap, and connect voltmeter (2.5 range) across the 5.6K resistor.

Step 3. Tune C121 for maximum output as indicated on voltmeter.

Step 4. Tune C124 CCW. The voltmeter indication will rise slightly and then drop sharply as C124 is rotated. Set for 0 Vdc output meter. Note: In some circumstances, certain frequencies will require an additional capacitor at C143 in order to obtain OV indication. Values are shown.

Frequency	Value-C143	
5.8	10 pF to 15 pF	
6.2	0 pF to 5 pF	
6.8	0 pF	Will not require C143
7.5	0 pF	
8.3	0 pF	

Step 5. Frequency indicated on counter should be the desired subcarrier frequency. Remove the voltmeter leads. The frequency will change approximately ±3 kHz. Readjust C124 for desired subcarrier frequency ±10 kHz.

MODULATION AUDIO TUNING

This section is sub-divided into the following progressive catagories. They must be in order.

1. Return Loss Adjustment
2. Pre-Emphasis Adjustment
3. Deviation Adjustment
4. Distortion Adjustment
5. Calibration

RETURN LOSS ADJUSTMENT

Step 1. Remove control connector and place on ohm meter (RX100) across pins C and H of module control jack J101.

Step 2. Adjust R103 for exactly 600 ohms.

Step 3. Replace control connector.

PRE-EMPHASIS ADJUSTMENT

NOTE

Pre-emphasis may alternately be adjusted for a flat response when played into the Marconi Modulation Meter.

Step 1. Connect a X1 scope probe to the minus (-) side of connector C206 (junction of R121 and Q104 collector); connect the other end of the scope probe to the RMS Voltmeter (0 dBm scale).

Step 2. Adjust the GR1310A oscillator frequency to 15 kHz and the output level to obtain a -3 dBm reading on the RMS voltmeter.

Step 3. Change the GR1310A oscillator frequency to 300 Hz. Do not change output level.

Step 4. Switch RMS voltmeter range to -10 dB and adjust R116 for a reading of -10 dB if Modulator has 75 μs pre-emphasis (-6.6 dB if Modulator has 50 μs pre-emphasis).

Step 5. Repeat Steps 2 through 4 until the pre-emphasis curve complies with the configurations in Table 4-2.

Step 6. Remove scope probe.

Table 4-2. Pre-Emphasis Curves

GR1310A OSCILLATOR FREQUENCIES	LEVEL ON RMS VOLTMETER	
	75 μs	50 μs
15 kHz	-3.0 dB ref	-3.0 db ref
11 kHz	-5.6 ±0.5 dB	-0.54 ±0.5 dB
3 kHz	-15.4 ±5 dB	-13.9 ±5 dB
300 kHz	-20.0 ±0.1 dB	-16.6 ± 0.1 dB

DEVIATION ADJUSTMENT

Step 1. Set GR1310A oscillator frequency at 1 kHz and adjust output level for 0 dBm on RMS voltmeter (Figure 4-1).

Step 2. Set up meter as outlined below:

a. Turn function switch to position 1.

b. Tune oscillator for maximum indication on meter.

c. Adjust RF level control to obtain a meter indication in the high end of the black level area of the meter.

d. Turn function switch to position 5 and check calibration. Points should fall to the set line on the meter. If not, adjust SET CAL FM recessed potentiometer until meter needle is exactly at set line.

e. Turn function switch to position 2 and tune oscillator to position meter needle exactly at set line.

f. Turn function switch to position 3 and read deviation.

g. Make sure all other controls are set as follows:

CONTROL	SETTING
Range	150 kHz deviation
Max Modulator frequency	15 kHz
De-Emphasis	75 μs or 50 μs as required

Step 3. Adjust R110 for 75 kHz or 100 kHz deviation on modulation meter, as required.

DISTORTION ADJUSTMENT

Step 1. Set up distortion analyzer as follows:

a. Set function switch to set level position.

b. Set meter range switch to set level position.

c. Turn sensitivity switch (black) to maximum.

d. Turn sensitivity vernier (red) for full scale deflection on meter.

e. Set frequency range switch to X100 position.

f. Set large frequency dial to 10.

g. Set Mode switch to MANUAL.

h. Turn function switch to distortion.

i. Tune large frequency dial and balance control for minimum on meter.

j. Set mode switch to AUTOMATIC.

k. Turn meter range switch to obtain suitable reading. This will be the total harmonic distortion, of the Modulator.

Step 2. Adjust R123 for minimum distortion, must be less than 0.5% THD.

CALIBRATION

Step 1. Re-check deviation by repeating Deviation steps.

Step 2. Re-check distortion by repeating Distortion Adjustment steps.

Step 3. Connect a X1 scope probe to the front panel DEVIATION MOD test point. Connect the other end to the RMS Voltmeter. Adjust R110 for a 0.75 Vrms reading on VTVM representing 75 kHz peak deviation. If Modulator deviation has been set to 100 kHz in Step 3 of Deviation Adjustment, then instead adjust R110 for a 1.0 Vrms reading on VTVM.

SUBCARRIER NOTCH FILTER TUNING

Step 1. Connect Modulator as shown in Figure 4-2.

Step 2. Tune L104, L106 and L105 in that order for minimum vertical deflection on scope.

RF OUTPUT LEVEL AND FINAL TUNING

Step 1. Reverse scope cable and 75 BNC termination on module so that Subcarrier Notch Filter IN is terminated and Baseband + Subcarrier (s) OUT is connected to scope vertical input.

Step 2. Adjust R128 for a 50 mV indication on scope (1cm of vertical deflection with gain control set at 0.50).

Step 3. Connect dc voltmeter (2.5 Vdc range) across front panel (subcarrier output) test points.

Step 4. Adjust R157 for 0.5 Vdc indication on voltmeter.

Step 5. Set up equipment as in Figure 4-1.

Step 6. Recheck subcarrier frequency without modulation. If frequency has changed, repeat Step 6 of Oscillator Tuning procedure.

Step 7. Apply snopak to L201, L104, L105 and L106 and replace top and bottom covers.

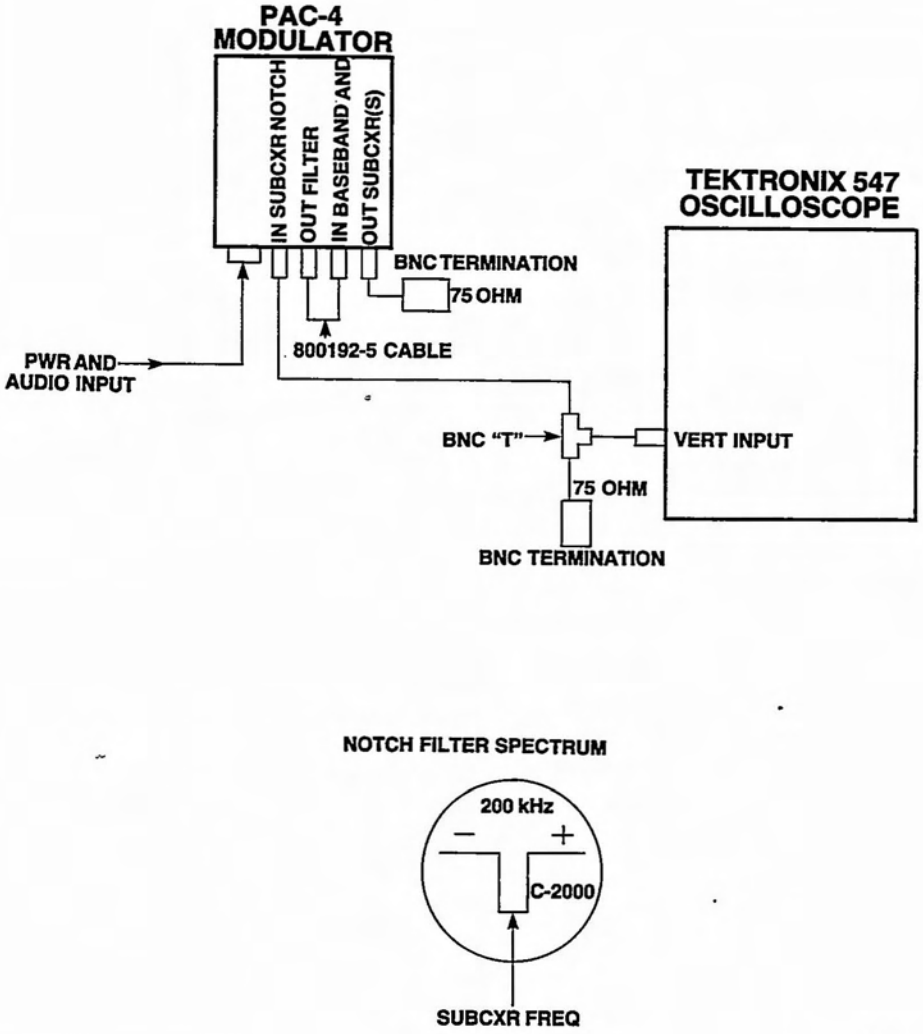
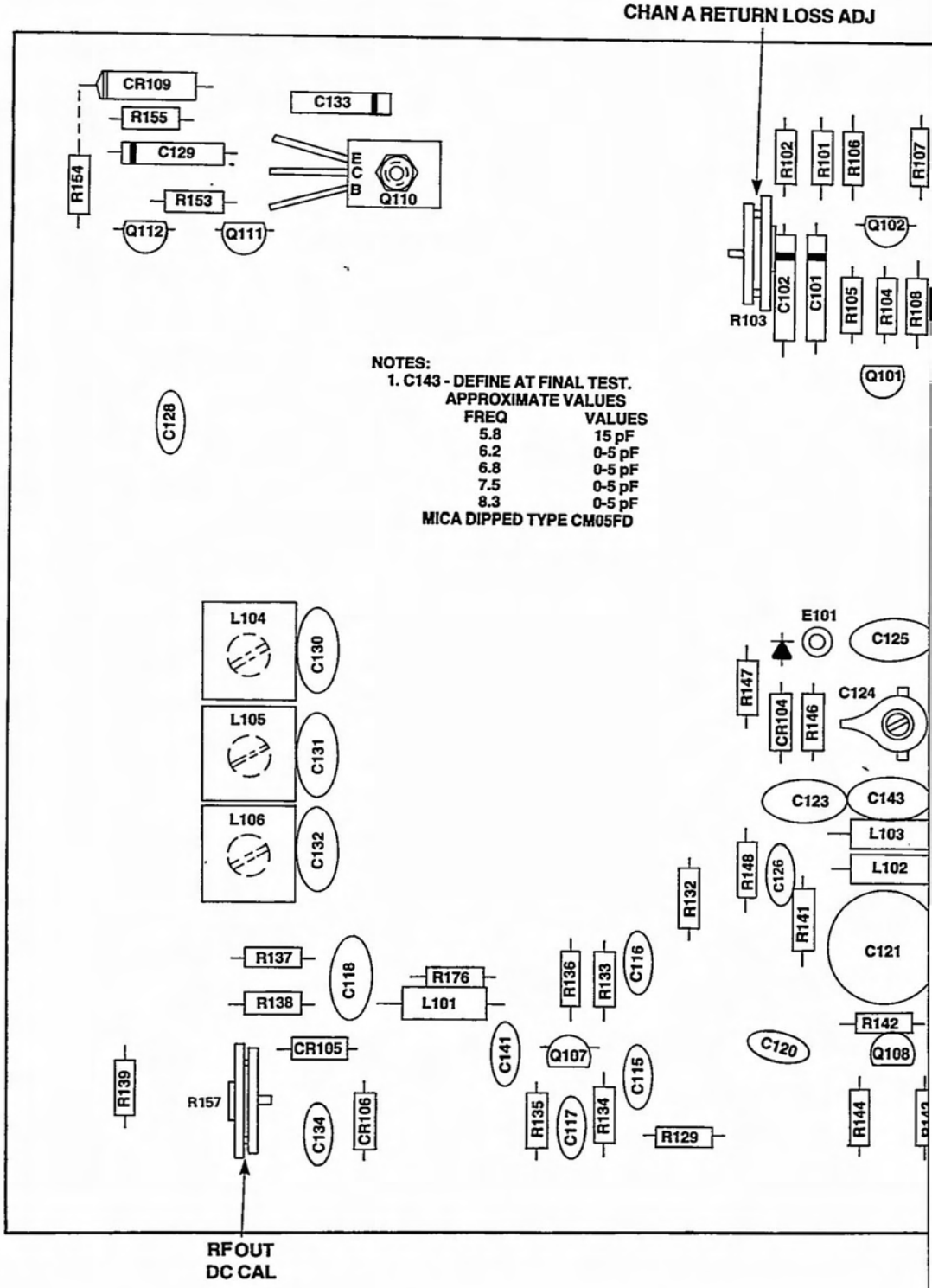


Figure 4-2. Subcarrier Notch Filter Tuning Set-up.

SECTION 5
DIAGRAMS


CHAN A RETURN LOSS ADJ
CR109
R155
C133
C129
R154
R153
Q112
Q111
E
C
B
Q110
R102
R101
R106
R107
Q102
R103
C102
C101
R105
R104
R108
Q101
NOTES:
1. C143 - DEFINE AT FINAL TEST.
APPROXIMATE VALUES
FREQ VALUES
5.8 15 pF
6.2 0-5 pF
6.8 0-5 pF
7.5 0-5 pF
8.3 0-5 pF
MICA DIPPED TYPE CM05FD
C128
L104
C130
L105
C131
L106
C132
E101
C125
R147
C124
CR104
R146
C123
C143
L103
L102
R148
C126
R141
C121
R132
R137
R138
C118
R176
L101
R136
R133
C116
R142
Q108
C120
CR105
C141
Q107
C115
R139
R157
C134
CR106
R135
C117
R134
R129
R144
RF OUT
DC CAL

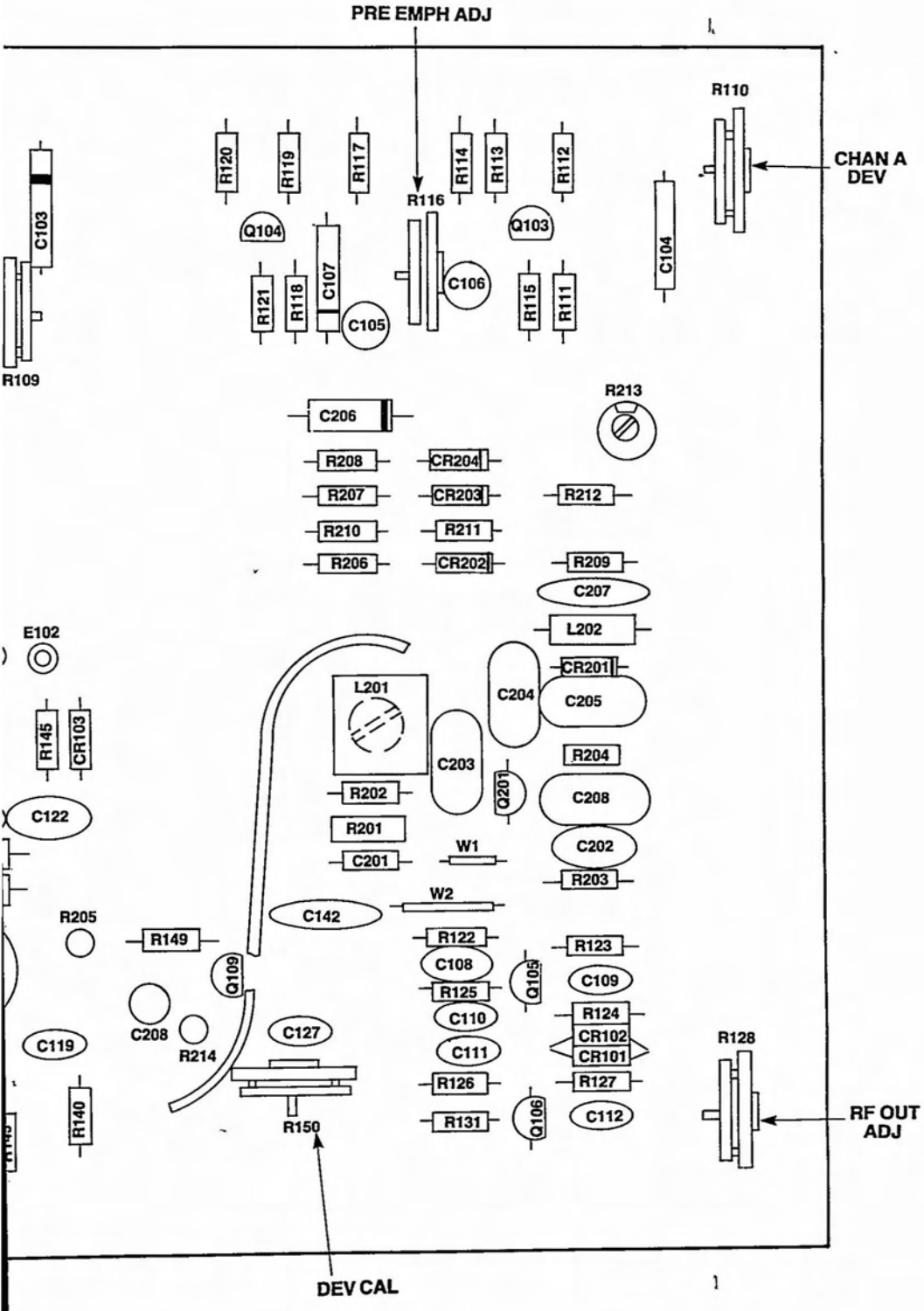
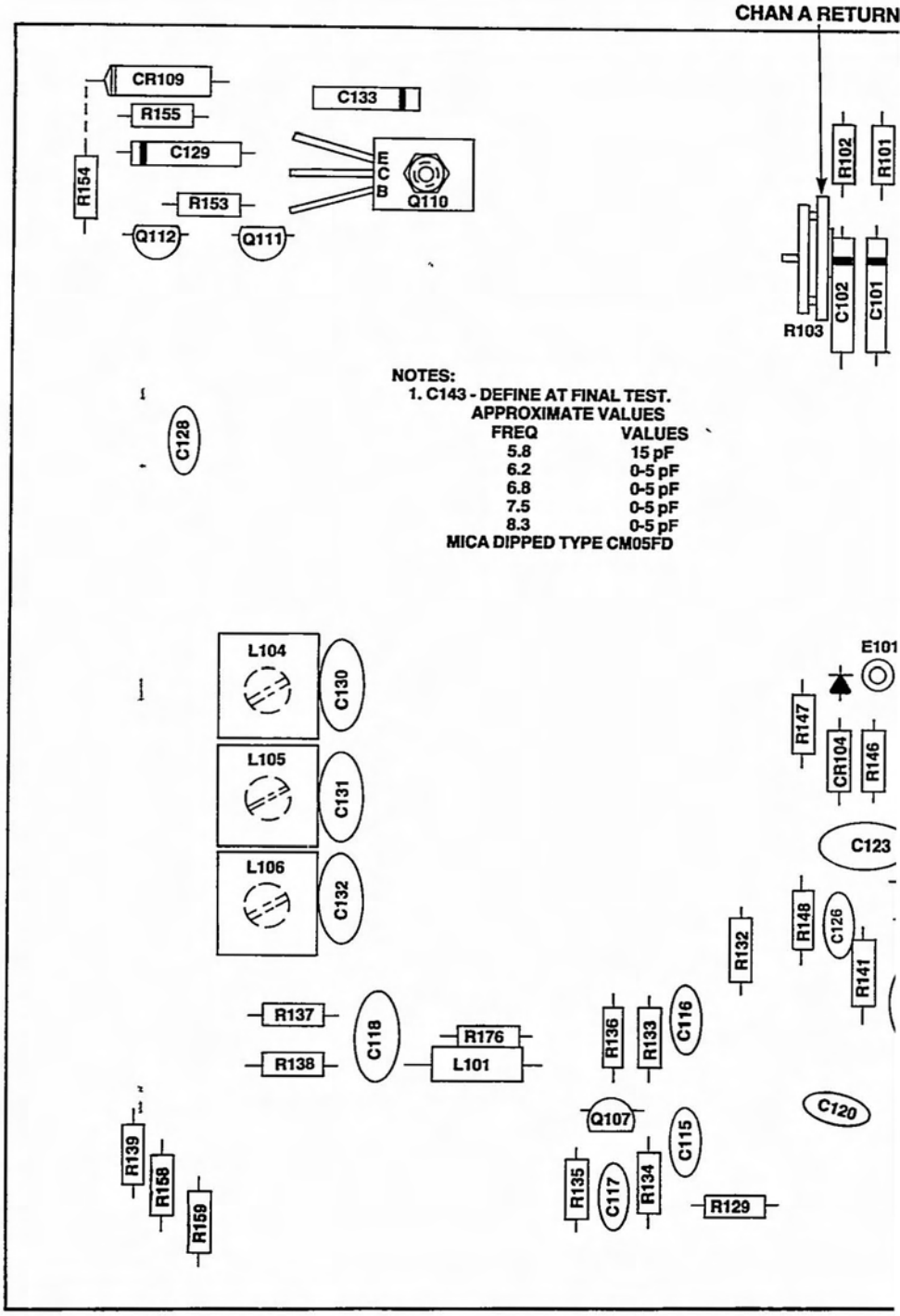


Figure 5-1. PAC-4 Modulator-Component Locations (No Options) PN 801878


CHAN A RETURN
CR109
R155
C133
C129
R154
R153
Q112
Q111
E
C
B
Q110
R102
R101
C102
C101
R103
NOTES:
1. C143 - DEFINE AT FINAL TEST.
APPROXIMATE VALUES
FREQ VALUES
5.8 15 pF
6.2 0-5 pF
6.8 0-5 pF
7.5 0-5 pF
8.3 0-5 pF
MICA DIPPED TYPE CM05FD
C128
L104
C130
L105
C131
L106
C132
E101
R147
CR104
R146
C123
R148
C126
R141
R132
R137
R138
C118
R176
L101
R136
R133
C116
Q107
C120
C115
R135
C117
R134
R129
R139
R158
R159

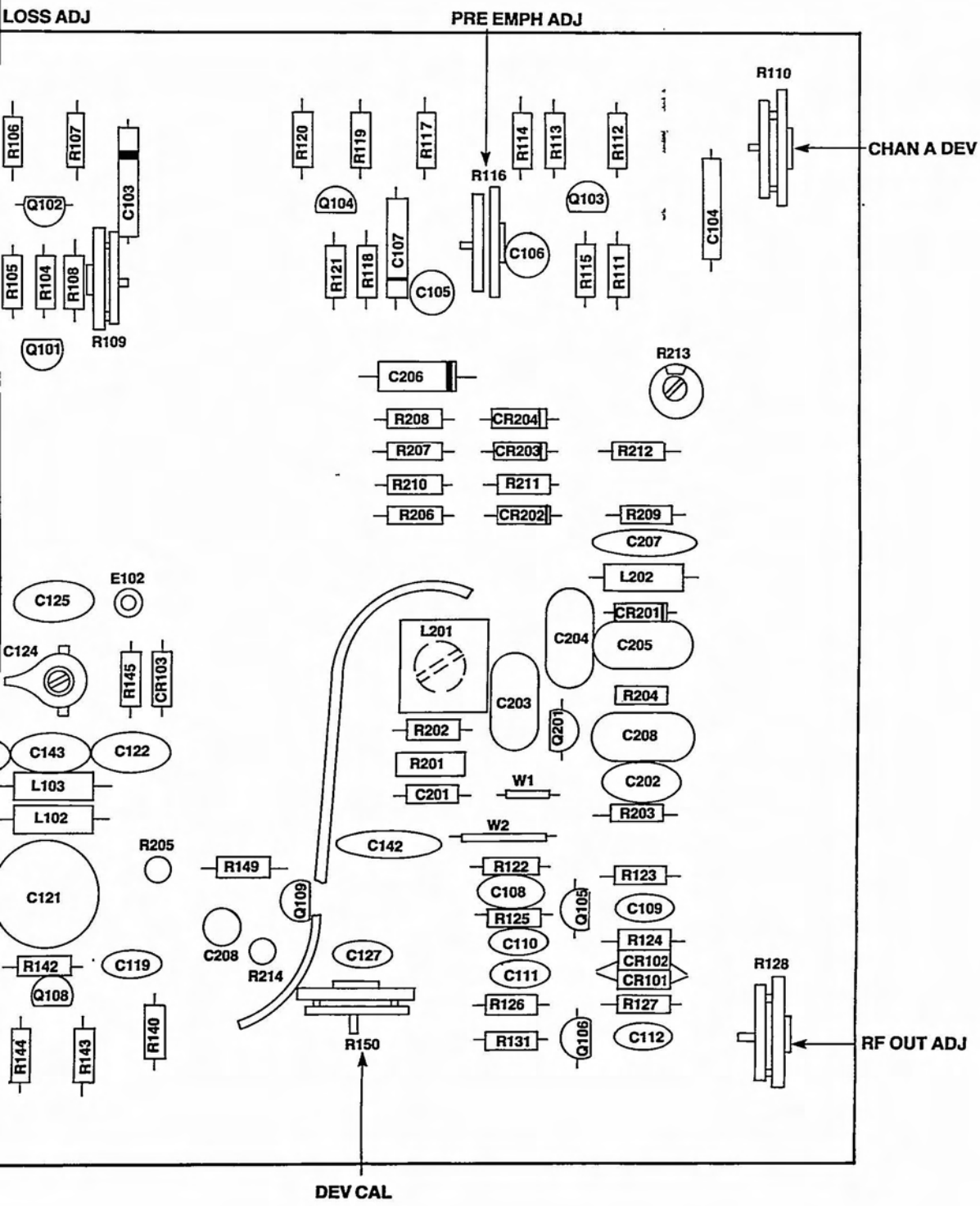
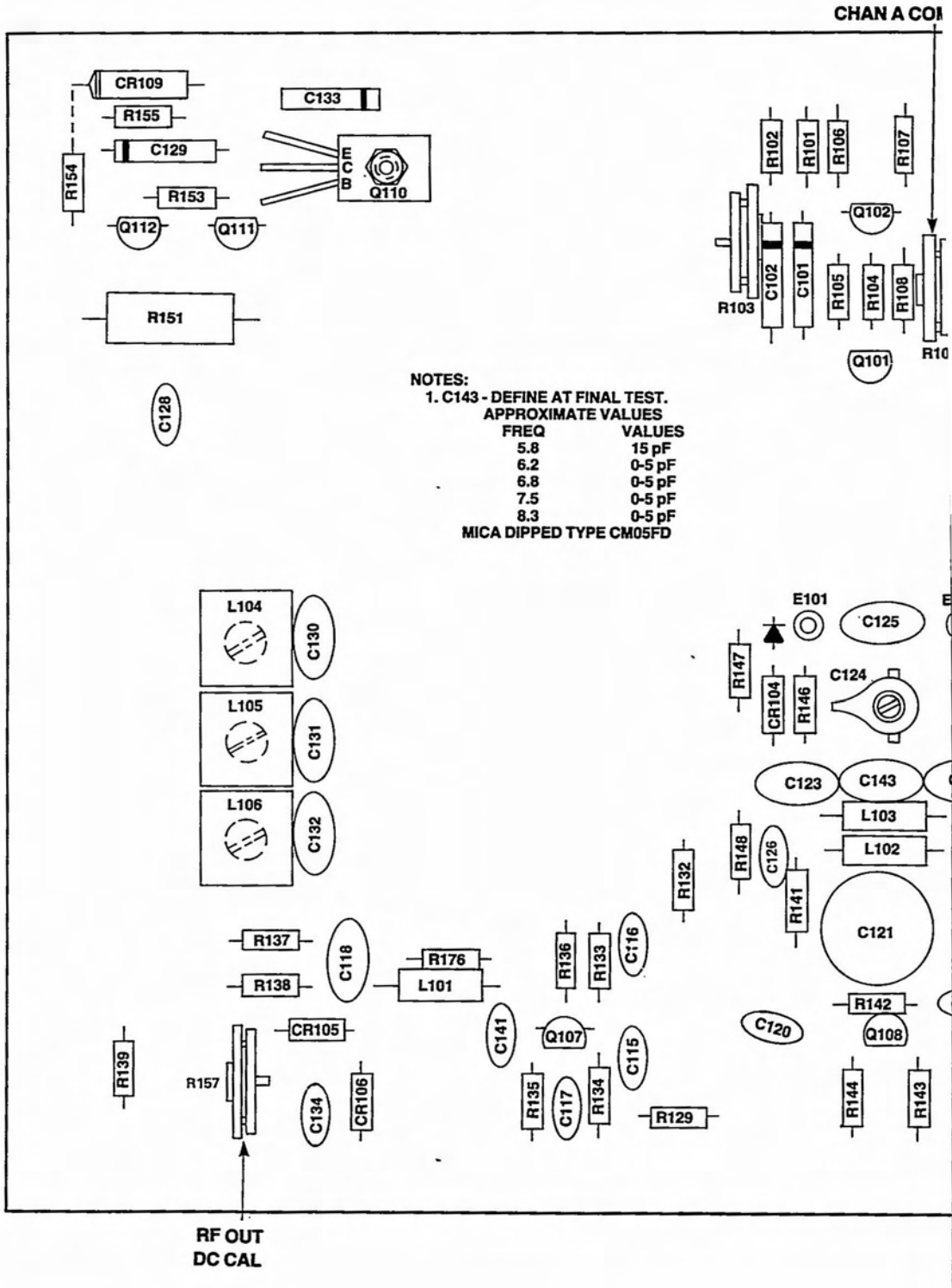


Figure 5-2. PAC-4 Modulator-Component Locations (Option A) PN 801878


CHAN A CO
CR109
R155
C133
C129
R154
R153
Q110
Q112
Q111
R151
C128
R102
R101
R106
R107
Q102
R103
C102
C101
R105
R104
R108
Q101
R10
NOTES:
1. C143 - DEFINE AT FINAL TEST.
APPROXIMATE VALUES
FREQ VALUES
5.8 15 pF
6.2 0-5 pF
6.8 0-5 pF
7.5 0-5 pF
8.3 0-5 pF
MICA DIPPED TYPE CM05FD
L104
C130
L105
C131
L106
C132
E101
C125
R147
C124
CR104
R146
C123
C143
L103
L102
R148
C126
R141
R132
C121
R137
C118
R138
R176
L101
R136
R133
C116
R142
C120
Q108
CR105
C141
Q107
C115
R139
R157
C134
CR106
R135
C117
R134
R129
R144
R143
RF OUT
DC CAL

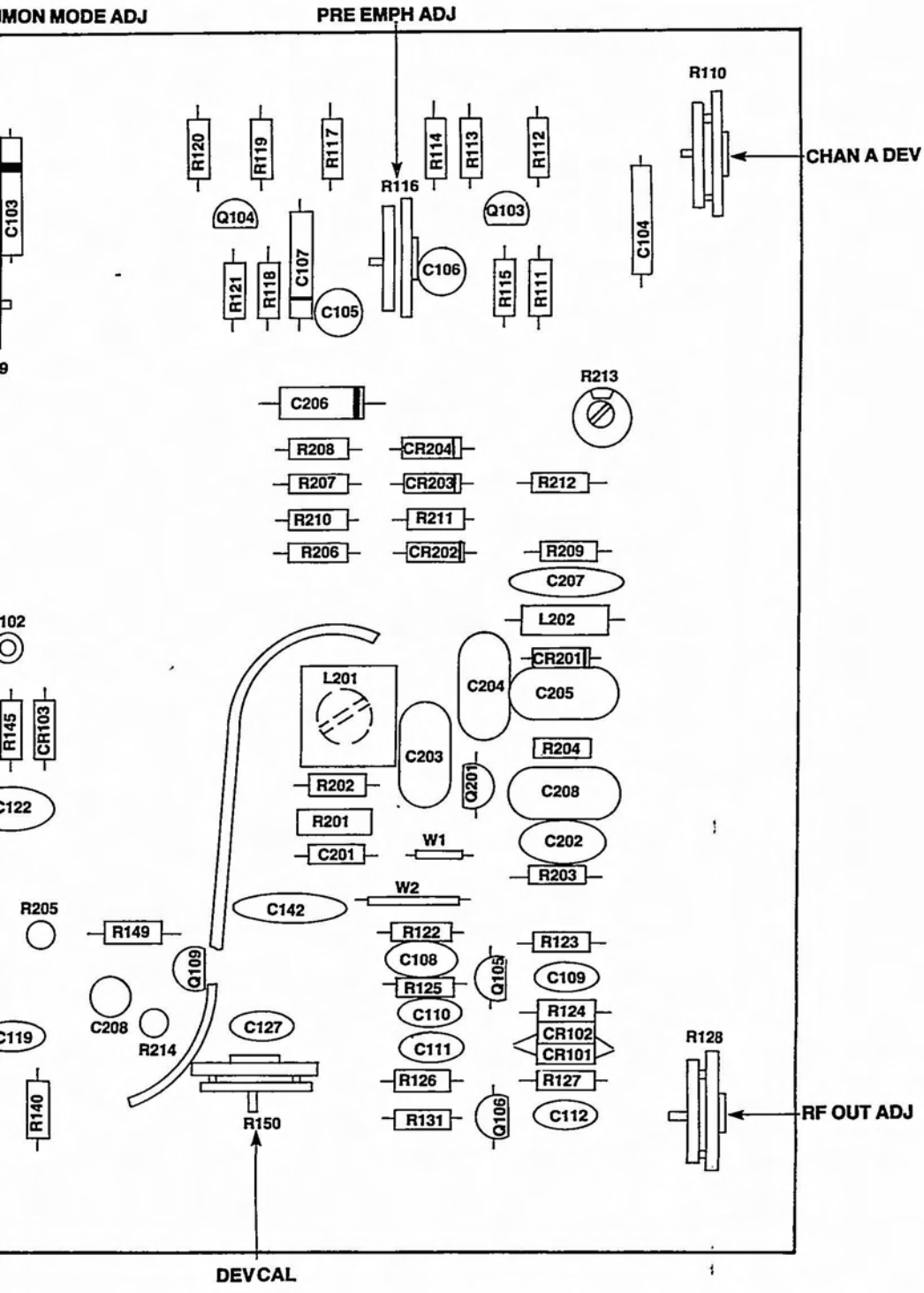
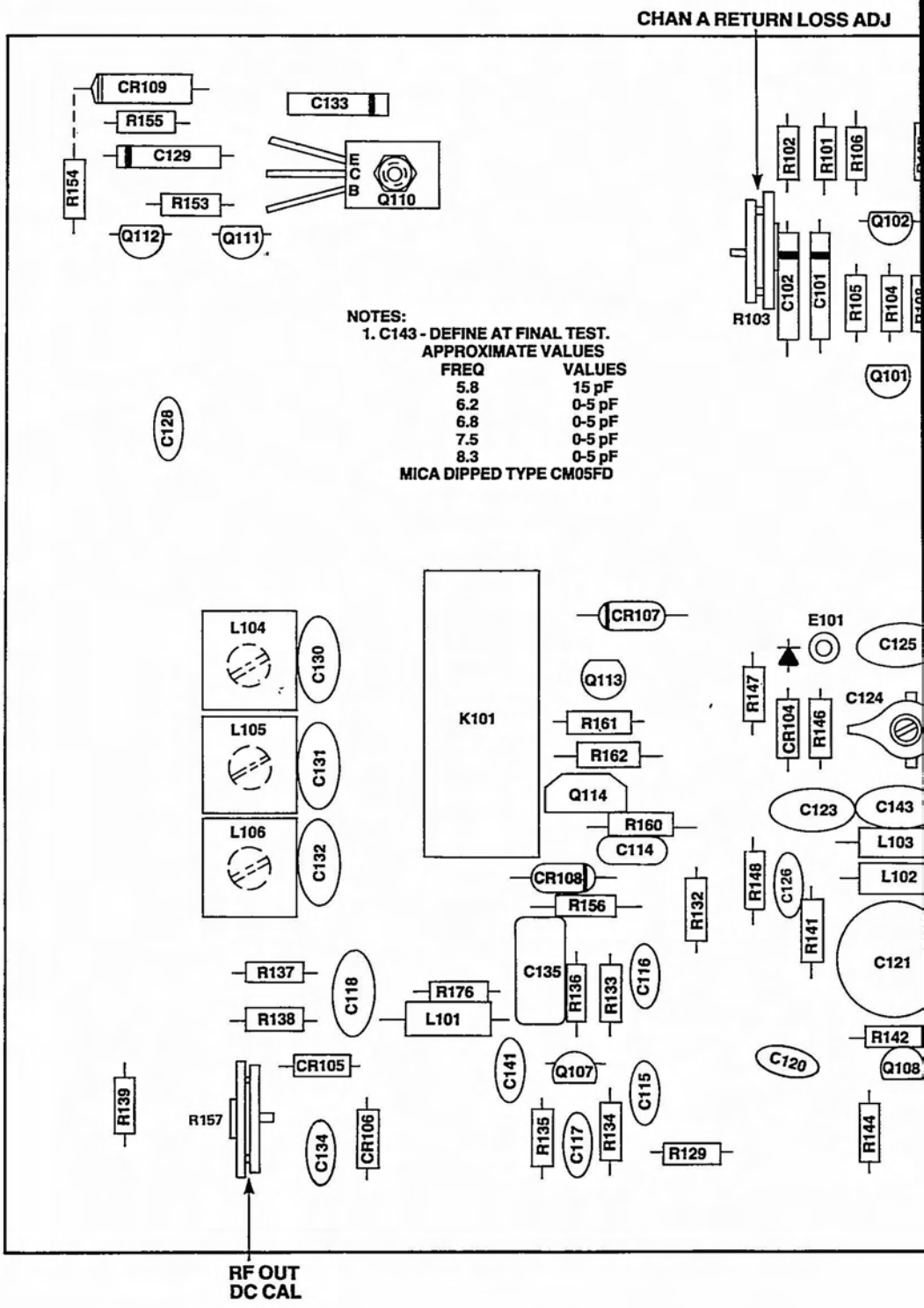


Figure 5-3. PAC-4 Modulator-Component Locations (Option B) PN 801878


CHAN A RETURN LOSS ADJ
CR109
R155
C129
R154
R153
Q112
Q111
C133
E
C
B
Q110
R102
R101
R106
Q102
R103
C102
C101
R105
R104
Q101
NOTES:
1. C143 - DEFINE AT FINAL TEST.
APPROXIMATE VALUES
FREQ VALUES
5.8 15 pF
6.2 0-5 pF
6.8 0-5 pF
7.5 0-5 pF
8.3 0-5 pF
MICA DIPPED TYPE CM05FD
C128
L104
C130
L105
C131
L106
C132
K101
CR107
Q113
R161
R162
Q114
R160
C114
CR108
R156
R132
C135
R136
R133
C116
R137
R138
C118
R176
L101
C141
Q107
C115
R135
C117
R134
R129
R139
R157
CR105
C134
CR106
E101
C125
R147
C124
CR104
R146
C123
C143
L103
L102
R148
C126
R141
C121
R142
C120
Q108
R144
RF OUT
DC CAL

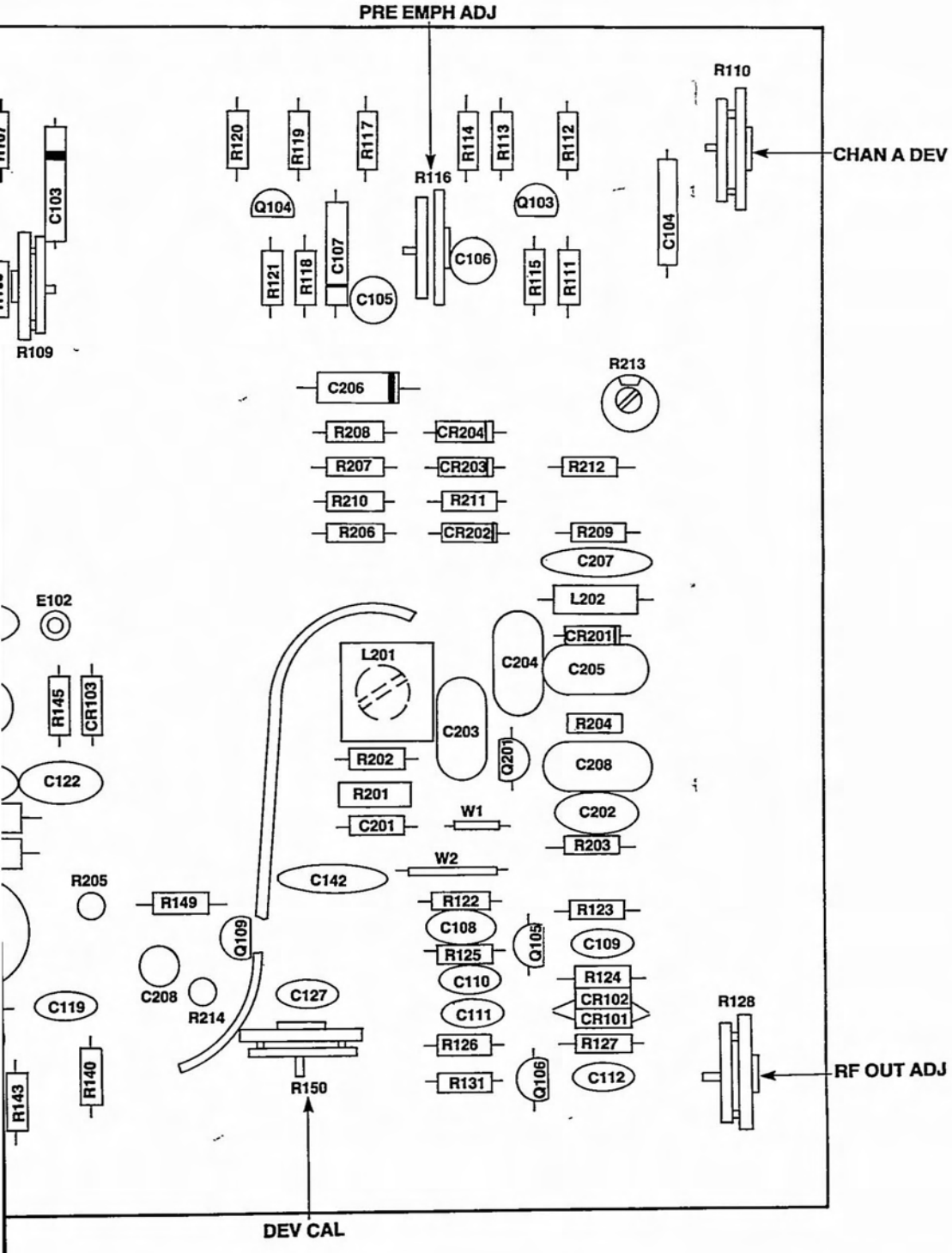
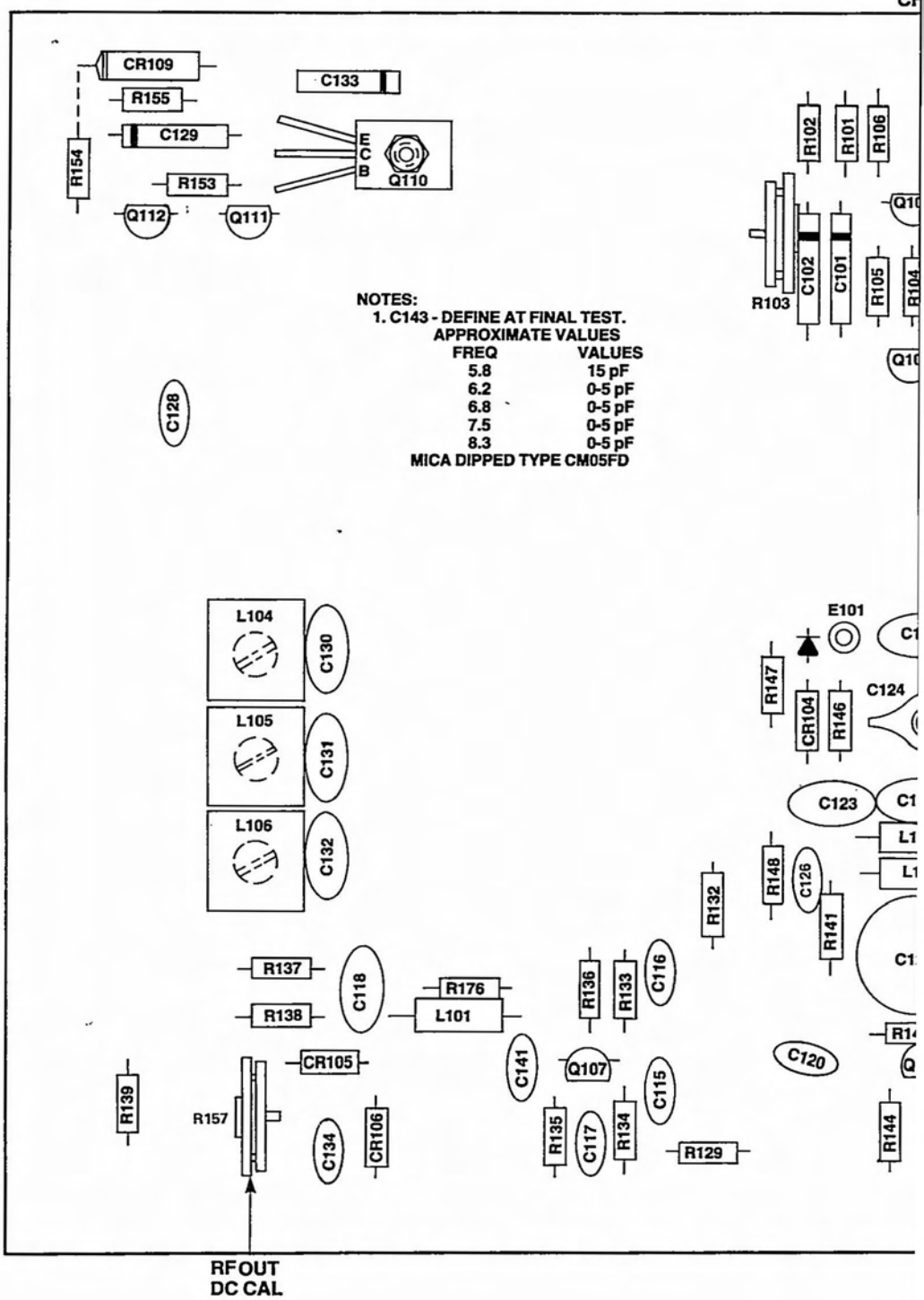


Figure 5-4. PAC-4 Modulator-Component Locations (Option C) PN 801878


CR109
R155
C129
R154
R153
Q112
Q111
C133
E
C
B
Q110
R102
R101
R106
R103
C102
C101
R105
R104
NOTES:
1. C143 - DEFINE AT FINAL TEST.
APPROXIMATE VALUES
FREQ VALUES
5.8 15 pF
6.2 0-5 pF
6.8 0-5 pF
7.5 0-5 pF
8.3 0-5 pF
MICA DIPPED TYPE CM05FD
C128
L104
C130
L105
C131
L106
C132
E101
R147
CR104
R146
C124
C123
R148
C126
R141
R132
R137
R138
C118
R176
L101
R136
R133
C116
CR105
C141
Q107
C115
R139
R157
C134
CR106
R135
C117
R134
R129
C120
R144
RF OUT
DC CAL

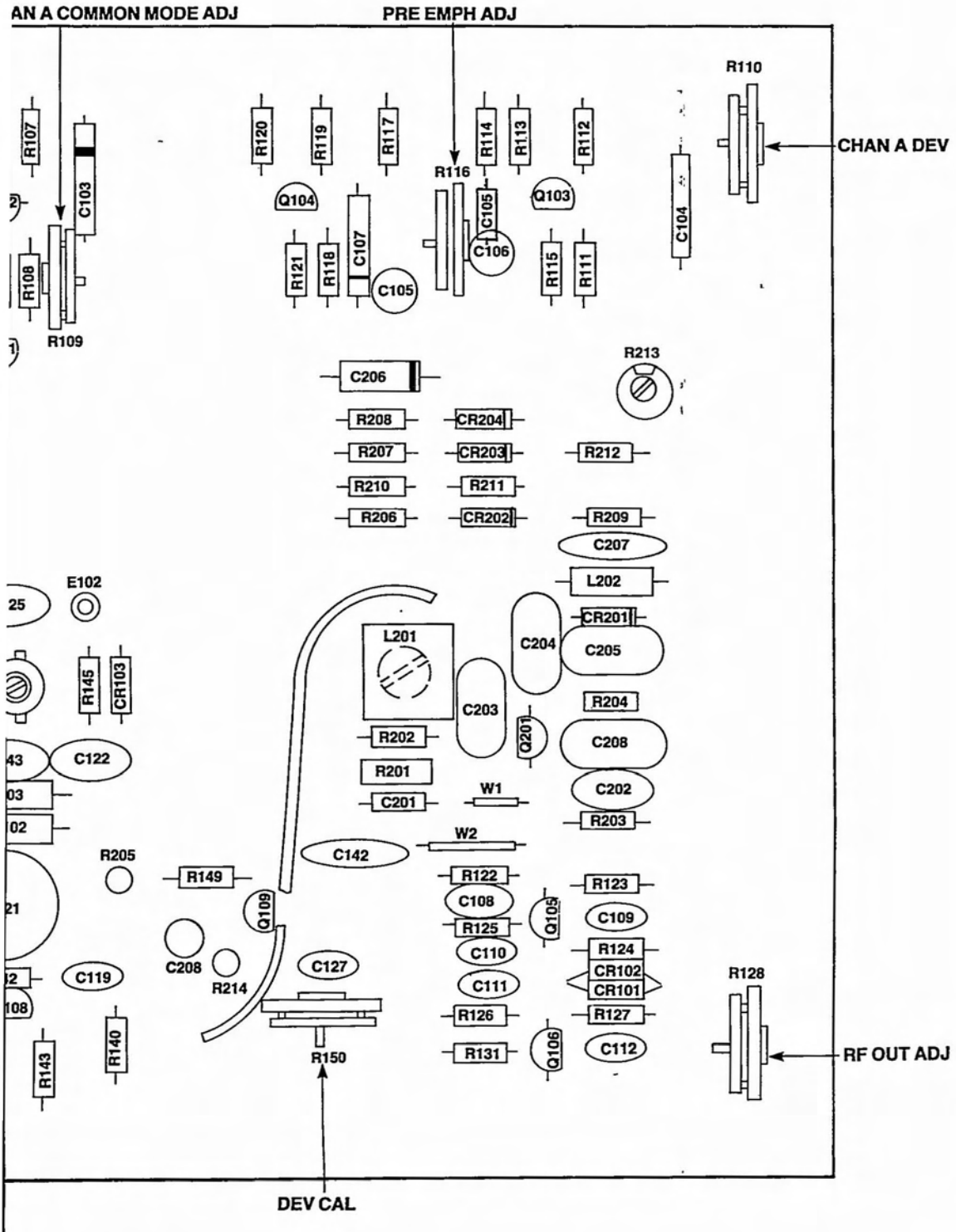
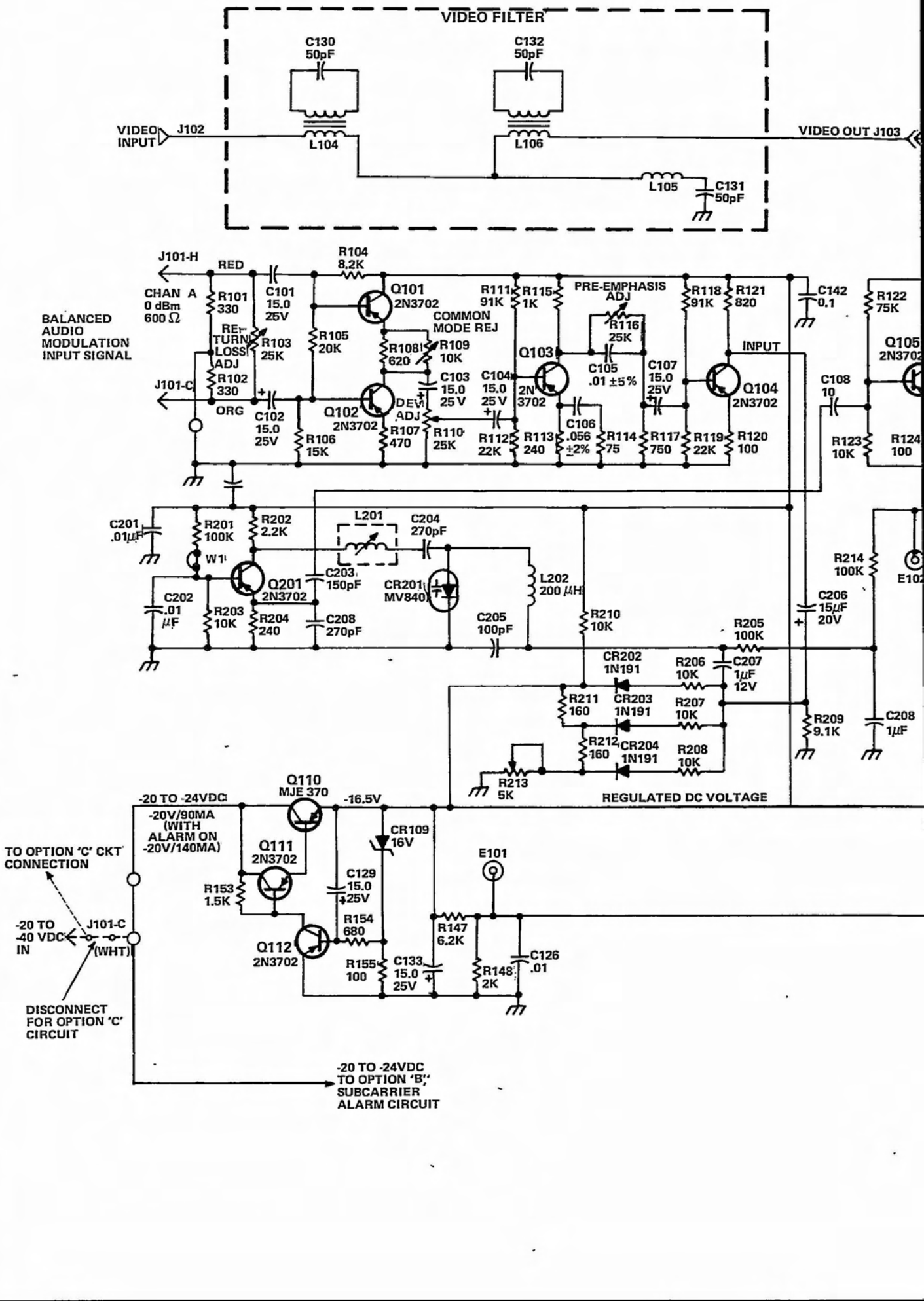


Figure 5-5. PAC-4 Modulator-Component Locations (Option D) PN 801878


VIDEO FILTER
C130 50pF
C132 50pF
VIDEO INPUT
J102
L104
L106
VIDEO OUT J103
L105
C131 50pF
J101-H
RED
CHAN A 0 dBm 600 Ω
BALANCED AUDIO MODULATION INPUT SIGNAL
R101 330
RETURN LOSS ADJ
R103 25K
R102 330
J101-C
ORG
C101 15.0 25V
C102 15.0 25V
R104 8.2K
R105 20K
R106 15K
Q101 2N3702
Q102 2N3702
COMMON MODE REJ
R108 620
R109 10K
DEV ADJ
R107 470
R110 25K
C103 15.0 25 V
C104 15.0 25 V
R111 91K
R112 22K
R115 1K
R113 240
Q103 2N3702
PRE-EMPHASIS ADJ
R116 25K
C105 .01 ±5%
C106 .056 ±2%
R114 75
R118 91K
R117 750
C107 15.0 25V
R121 820
R119 22K
R120 100
INPUT
Q104 2N3702
C142 0.1
C108 10
R122 75K
Q105 2N3702
R123 10K
R124 100
C201 .01μF
R201 100K
W1
R202 2.2K
L201
C204 270pF
Q201 2N3702
C203 150pF
CR201 MV840
L202 200 μH
C202 .01 μF
R203 10K
R204 240
C208 270pF
C205 100pF
R210 10K
R214 100K
E102
C206 15μF 20V
R205 100K
CR202 1N191
R206 10K
C207 1μF 12V
R211 160
CR203 1N191
R207 10K
R209 9.1K
C208 1μF
R212 160
CR204 1N191
R208 10K
R213 5K
REGULATED DC VOLTAGE
-20 TO -24VDC
Q110 MJE 370
-16.5V
-20V/90MA (WITH ALARM ON -20V/140MA)
CR109 16V
Q111 2N3702
E101
C129 15.0 25V
R153 1.5K
R154 680
R147 6.2K
Q112 2N3702
R155 100
C133 15.0 25V
R148 2K
C126 .01
TO OPTION 'C' CKT CONNECTION
-20 TO -40 VDC IN
J101-C
(WHT)
DISCONNECT FOR OPTION 'C' CIRCUIT
-20 TO -24VDC TO OPTION 'B' SUBCARRIER ALARM CIRCUIT

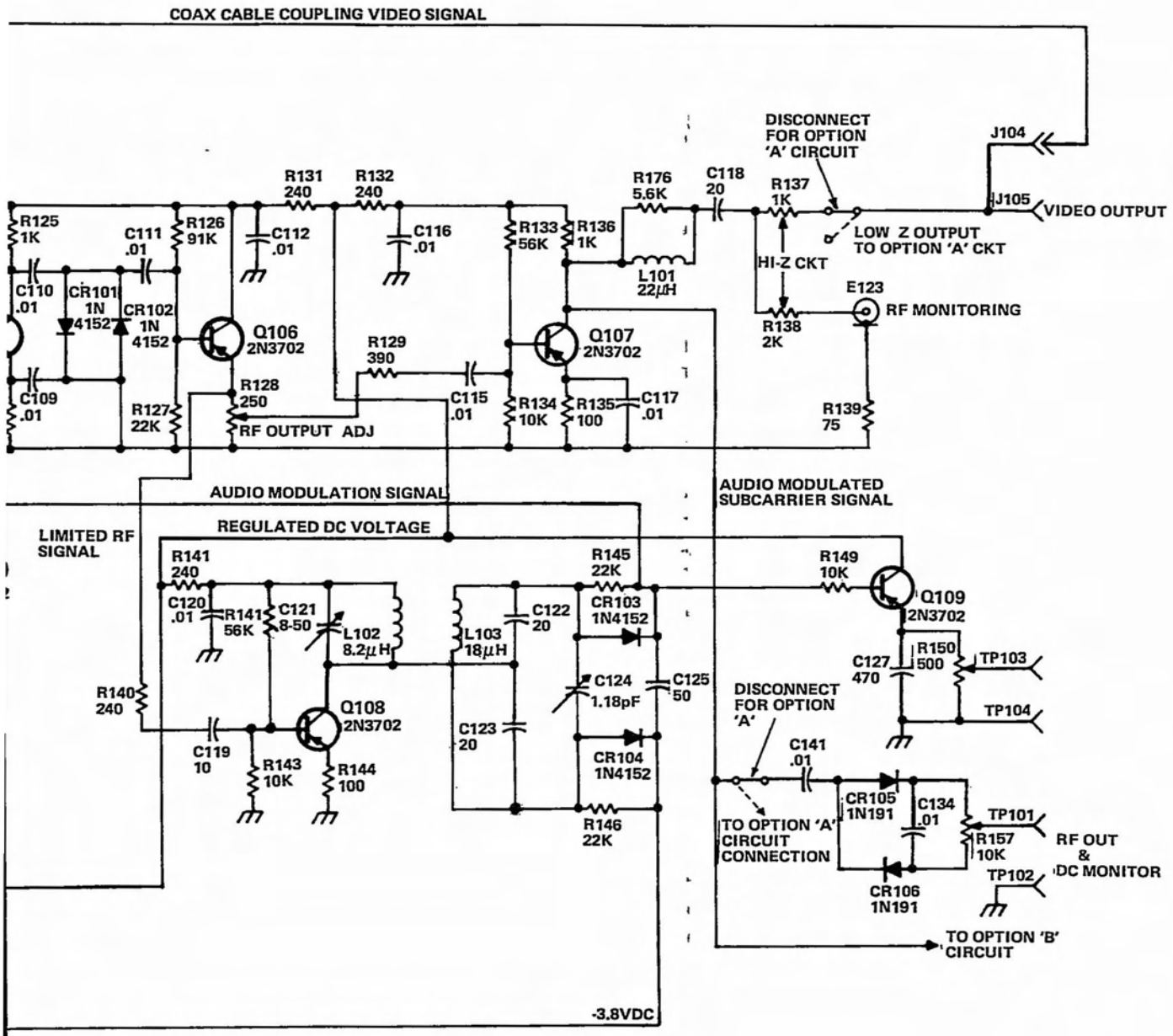


Figure 5-6. PAC-4 Modulator-Schematic Diagram
PN 801878

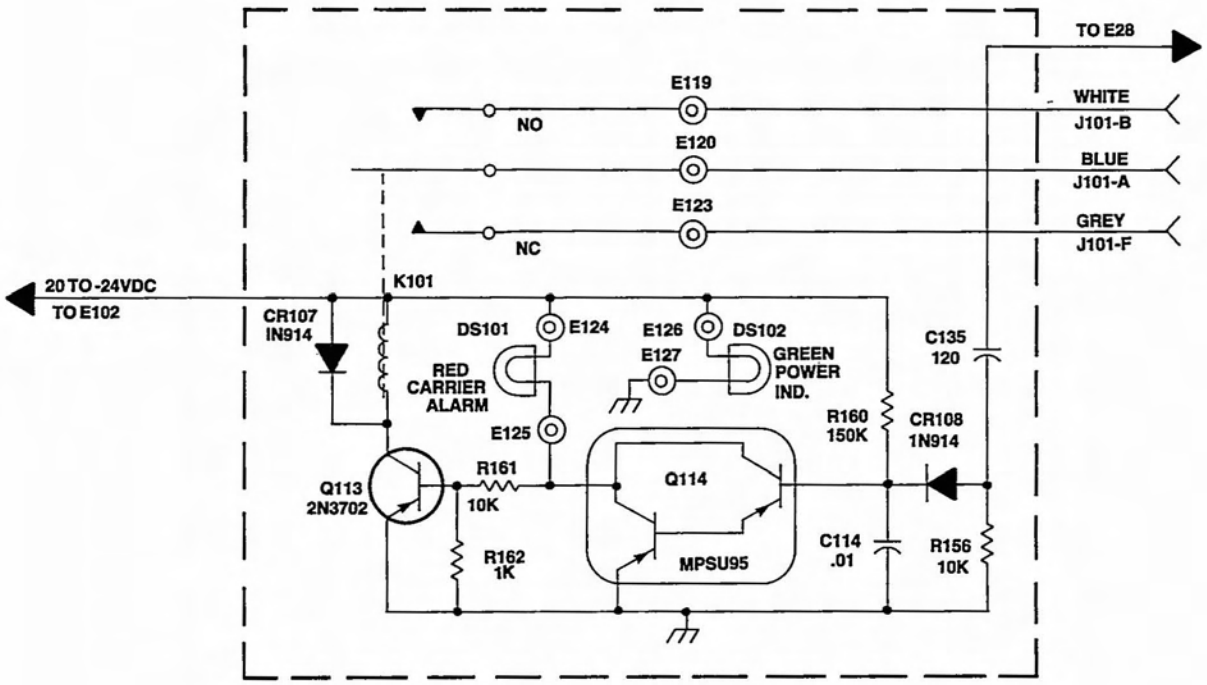


Figure 5-7. PAC-4 Modulator-Schematic Diagram
(Additional Components Option B) PN 801878

SECTION 6
PARTS LISTS

SUBCARRIER MODULE PN 801870

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	PWB Assembly	801878	MAC
	Lamp, Green, 24V	89904-17	Shelly Associates
	Lamp, Red, 24V	89904-13	
	Test Point, Black	88513-02	Sealectro 14-0070200
	Test Point, White	88513-01	Sealectro 14-0070209
	Lug, Solder	88520-25	H.H. Smith 1497
	Connector, UG657/u	88358-7	Amphenol 31-102
	Connector, 9 Pin	89799-2	Amphenol 126-219

REF DES	DESCRIPTION	PART NO.	SIMILAR TO

SUBCARRIER MODULE PWB PN 801878

Module Assy, Subcarrier Modulator	801887	MAC
PWB	801879	MAC

CAPACITORS

All capacitors are in microfarads unless otherwise specified.

C101			
C102	15, 25V, 20%, Tantalum	89719-10	
C103			
C104			
C105	0.01, 100V, 5%	88212-81	Seacar
C106	0.056, 200V, 2%	88212-75	Paktron
C107	15, 25V, 20%, Tantalum	89719-10	Hilton SWT25Z15
C108	10 pF, 5%, SM	89116	CM05ED100J03
C109			
C110	0.01, 20%	89014	Sprague
C111			
C112			
C114	0.01, 20%	87211	Vitramon CK06BX103K
C115			
C116	0.01, 20%	89014	Sprague
C117			
C118	20 pF, 5%, SM	89008-5	
C119	0.01, 20%	89014	Sprague
C120			
C121	Variable, 8-50 pF	89100-2	Erie
C122	20 pF, 5%, SM	89008-5	
C123			
C124	Variable 1-18 pF	89100-17	Sprague-Goodman GSG080A
C125	51 pF, 5%, SM	89098	CM05ED510J03
C126	0.01, 20%	89014	Sprague
C127	470 pF, 10%	89082	CM05ED470J03
C128	0.01, 20%	89014	Sprague
C129	15, 25V, Tantalum	89719-10	Hilton SWT25Z15
C130			
C131	51 pF, 5%, SM	89098	CM05ED510J03
C132			

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
C133	15, 25V, 20%, Tantalum	89719-10	Hilton SWT35Z25
C134	0.01, 20%	89014	Sprague
C135	120 pF, 5%	89017-12	CM05ED121J03
C141	.01, 20%	89014	Sprague
C142	0.1, 20%	88212-16	
C201	0.01	87211	Vitramon CK05BX103K
C202	0.01, 20%	89014	Sprague
C203	150pF	89017-23	CM05ED151J03
C204	270 pF	89141	CM05ED271J03
C205	100pF	89086	CM05ED101J03
C206	15, 25V, 10%, Tantalum	89719-10	Hilton SWT25Z15
C207	1, 12V, Non-Polar	89719-12	NPC
C208	1, 35V, Non-Polar	89719-51	Hilton DST 1-35-NPK
	DIODES		
CR101 CR102 CR103 CR104	1N4152	89439-13	
CR105 CR106	1IN191	89439-14	
CR109 CR110 CR111	Zener, 16 Vdc, 1W, 5%	89439-16	
CR201	MV840	89439-15	
CR202 CR203 CR204	1N191	89439-14	
	TERMINALS		
E101 E102	Standoff	88249	CTC
	INDUCTORS		

All inductors are in microhenries unless otherwise specified.

L101	22	89161-01	Delevan 1537-44
L102	8.2	87264	Delevan 1537-34
L103	18	87268	Delevan 1537-42
L104	Inductor	89169-18	AC8004
L105	Inductor	89169-17	AC8002
L106	Inductor	89169-18	AC8004
L201	Inductor	89169-16	AC8003
L202	200	87239	Delevan 1537-90

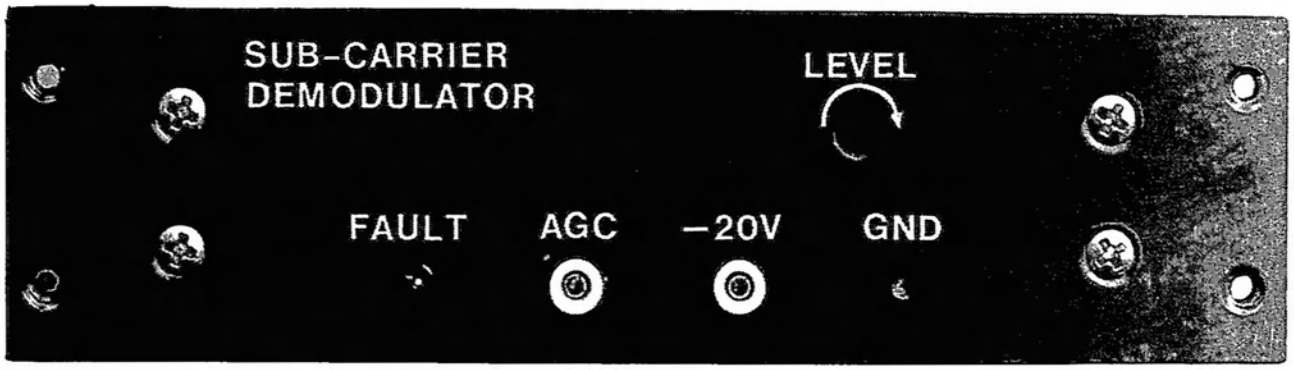
REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	TRANSISTORS		
Q101			
Q102			
Q103			
Q104			
Q105	2N3702	87223-5	
Q106			
Q107			
Q108			
Q109			
Q110	MJE370	87223-11	Motorola
Q111			
Q112	2N3702	87223-5	
Q201			
	RESISTORS		
All resistances are in ohms and all resistors are 1/4W, 5% unless otherwise specified.			
R101	330	89205	RC07GF331J
R102			
R103	Potentiometer, 25K	88453-15	
R104	8.2K	89237	RC07GF822J
R105	20K	89200-14	RC07GF203J
R106	15K	89275	RC07GF153J
R107	470	89234	RC07GF471J
R108	620	89200-10	RC07GF621J
R109	Potentiometer, 10K	88453-14	CTSX201R103B
R110	Potentiometer, 25K	88453-15	
R111	91K	89200-16	RC07GF912J
R112	22K	89228	RC07GF223J
R113	240	89228	RC07GF241J
R114	75	89280	RC07GF2750J
R115	1K	89220	RC07GF102J
R116	Potentiometer, 25K	88453-15	
R117	750	89487	RC07GF751J
R118	91K	89200-16	RC07GF913J
R119	22K	89228	RC07GF223J
R120	100	89202	RC07GF101J
R121	820	89207	RC07GF821J
R122	75K	89200-8	RC07GF753J
R123	10K	89227	RC07GF103J
R124	100	89202	RC07GF101J
R125	1K	89220	RC07GF102J
R126	91K	89200-16	RC07GF913J
R127	22K	89228	RC07GF223J
R128	Potentiometer, 250	88453-19	CTSX201R251B
R129	390	89180	RC07GF391J
R130			

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
R131	240	89200-4	RC07GF241J
R132			
R133	56K	89238-36	RC07GF563J
R134	10K	89227	RC07GF103J
R135	100	89202	RC07GF101J
R136	1K	89220	RC07GF102J
R137			
R138	2K	89488	RC07GF202J
R139	75	89280	RC07GF759J
R140	240	89200-4	RC07GF241J
R141			
R142	56K	89238-36	RC07GF563J
R143	10K	89227	RC07GF103J
R144	100	89202	RC07GF103J
R145	22K	89228	RC07GF223J
R146			
R147	6.2K	89200-5	RC07GF622J
R148	2K	89488	RC07GF202J
R149	10K	89227	RC07GF103J
R150	Potentiometer, 500	88453-20	CTSX201R500B
R151	300, 5%, 5W, Wirewound	88539-15	
R153	1.5K	89236	RC07GF152J
R154	680	89206	RC07GF681J
R155	100	89202	RC07GF101J
R157	Potentiometer, 10K	88453-14	
R162	1K	89220	RC07GF102J
R176	5.6K	89226	RC07GF562J
R201	100K	89278	RC07GF104J
R202	2.2K	89222	RC07GF222J
R203	10K	89227	RC07GF103J
R204	240	89200-4	RC07GF241J
R205	100K	89178	RC07GF104J
R206			
R207	10K	89227	RC07GF103J
R208			
R209	9.1K	89200-12	RC07GF912J
R210	10K	89227	RC07GF103J
R211	160	89200-13	RC07GF161J
R212			
R213	Potentiometer, 5K	88453-32	Heitron 62PR
R214	100K	89278	RC07GF104J

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	THE FOLLOWING ARE USED IN THE VARIOUS PAC-4 OPTIONS		
	OPTION A (-30 dB RF Pad)		
R158	1.2K	89221	RC07GF122J
R159	82	89238-44	RC07GF820J
	OPTION B (Carrier Alarm)		
C114	0.01, 20%	87211	Vitramon CK06BX103K
C135	120 pF, 5%	89012-12	CM05ED121J03
CR107	1N914A	89405	GE
CR108			
K101	Relay	89990-30	Magnicraft W104MPCX-3
Q113	2N3702	87223-5	
Q114	MPS-U95	89888-6	Motorola
R156	10K	89227	RC07GF103J
R160	150K	88246	RC07GF154J
R161	10K	89227	RC07GF103J
R162	1K	89220	RC07GF102J
	OPTION C (-48 Vdc Input)		
R151	300, 5W, 5%, Wirewound	88539-15	
	OPTION D (50 μ sec Pre-Emphasis)		
C105	6800 pF, 1%	88212-83	Paktron 682F01PP460

PN 808728

PAC-5
DEMODULATOR



INSTRUCTION MANUAL

MICROWAVE ASSOCIATES
COMMUNICATIONS
A MACOM COMPANY

SECTION 1
EQUIPMENT DESCRIPTION

GENERAL

The PAC-5 Demodulator (Figure 1-1) recovers broadcast quality audio from a frequency-division-multiplexed composite signal consisting of frequency modulated RF subcarriers and a baseband video (or other) signal. Design flexibilities allow a choice of EIA or CCIR standards. The 75 ohm wideband output is usable to 60 kHz for telemetry, alarm, control, data or VF channels above program audio. Available as options are the PAC Audio Hot Standby Switch and the PAC Power Supply. The Audio Hot Standby Switch is connected to two PAC-5 Audio Demodulators; a primary and a backup unit, and will automatically switch to the backup unit in event of failure. It is described in a separate manual. The PAC Power Supply is rated at -22.0 Vdc at 500 mA and will power two PAC-5's. It is also described in a separate manual.

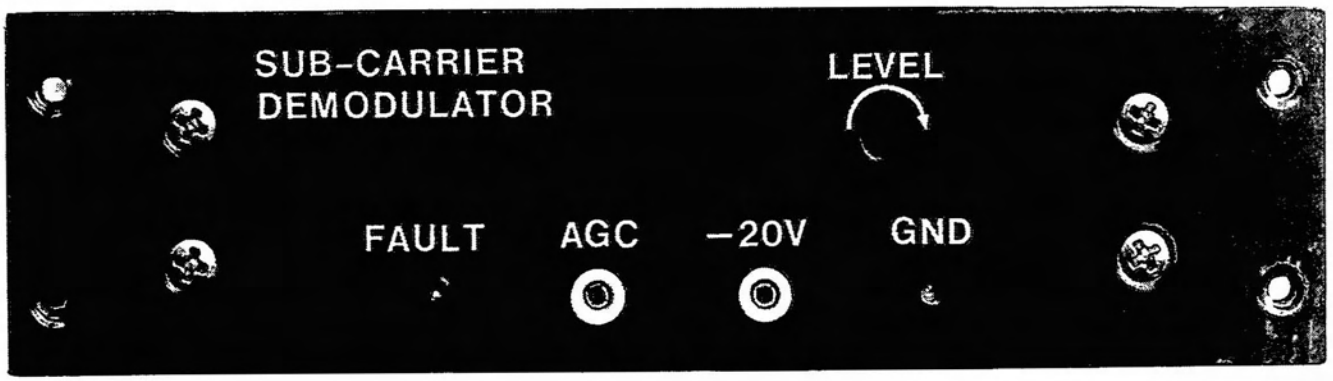


Figure 1-1. PAC-5 Demodulator

Equipment Description

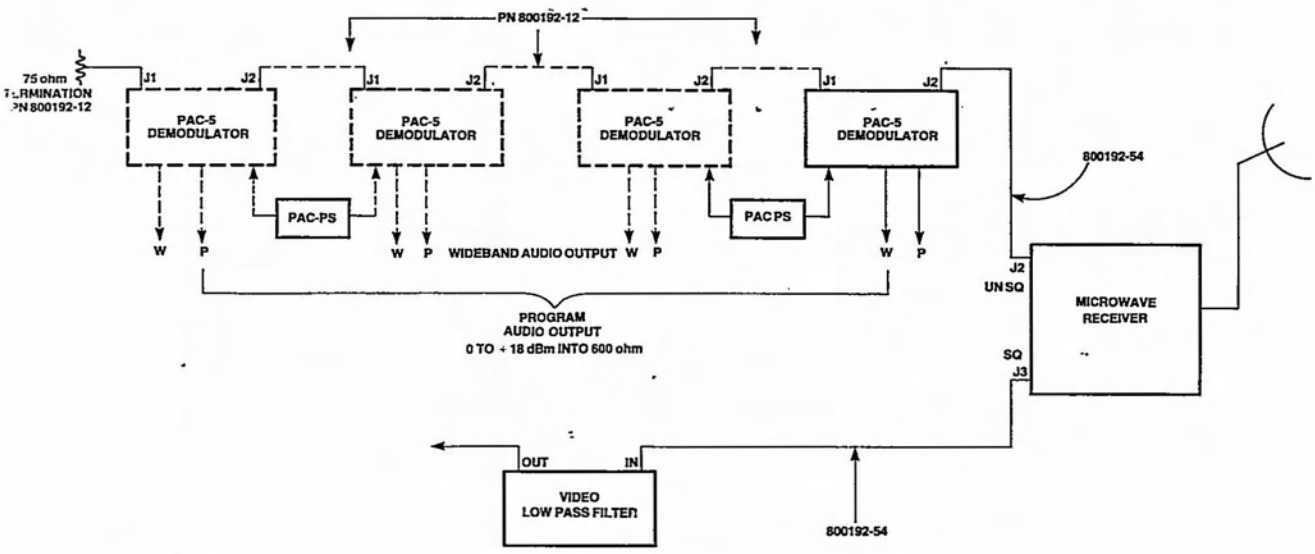
There are many possible PAC Series Systems. Three possible systems are described below.

System A (Figure 1-2) consists of a maximum number of four daisy chained PAC-5's and provides program audio and wideband audio outputs. The last PAC-5 in the chain should be terminated in 75 ohms using either a 75 ohm termination or connecting it to a video (or picture) monitor or similiar equipment.

System B (Figure 1-3) is similiar to System A except that it features redundancy through the use of backup PAC-5's and the PAC Audio Hot Standby Switches.

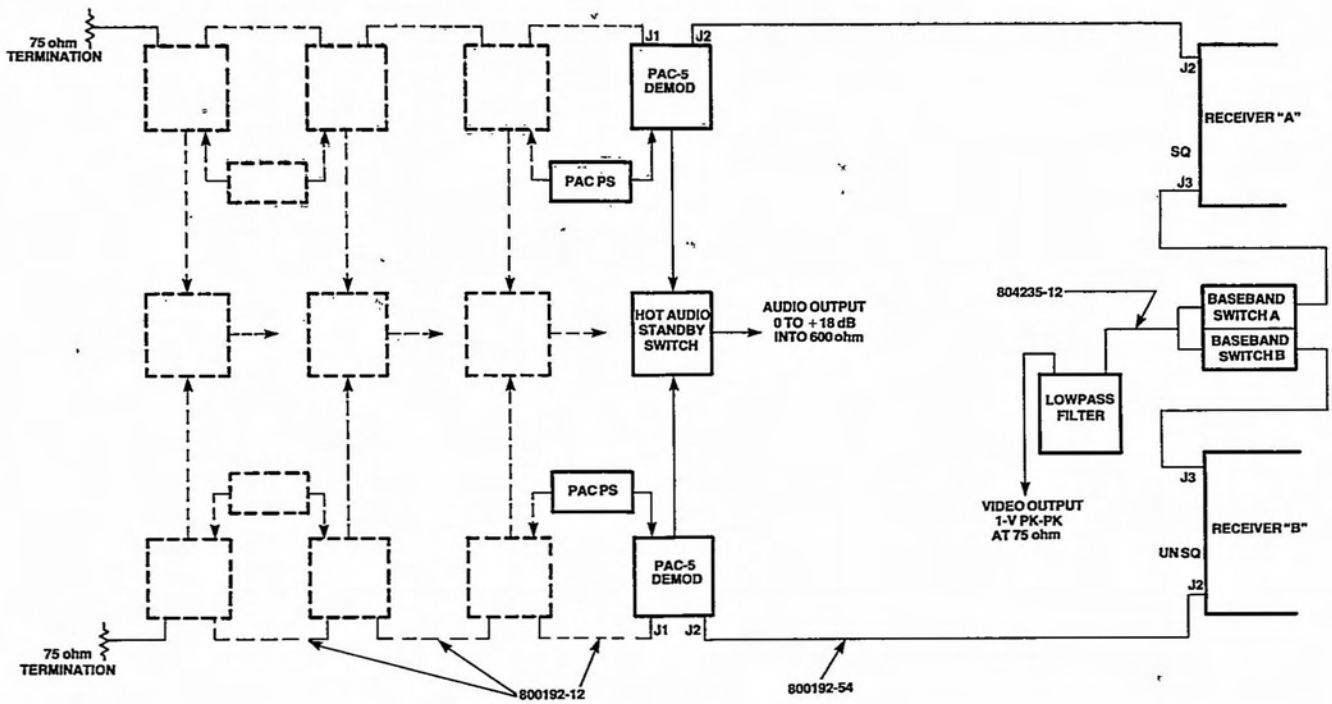
System C (Figure 1-4) is a duplex system featuring both the PAC-5 Demodulator and the PAC-4 Modulator for transmission and reception of up to four (program) channels.

PAC System Components are listed in Table 1-1.



NOTES:
LOW PASS FILTER IS RACK MOUNTED.

Figure 1-2. PAC Series, System A



NOTES:
LOW PASS FILTER IS MOUNTED IN SWITCH OVER SHELF.

Figure 1-3. PAC Series, System B

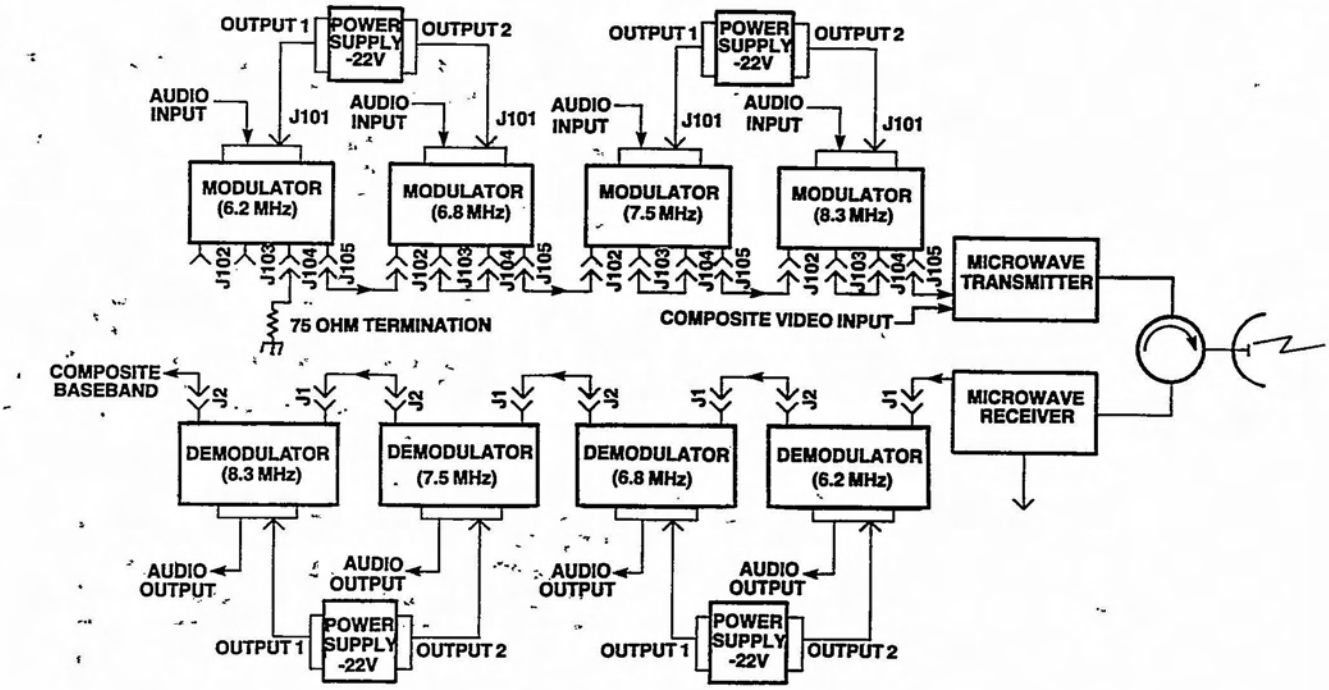


Figure 1-4. PAC Series, System C

Table 1-1. PAC Series Components

DESCRIPTION	PART NUMBER
PAC-4 PROGRAM AUDIO MODULATOR COMPONENTS	
Modulator Unit (includes carrier fail alarm and fault lamp)	801870
AC Power Harness (one per ac powered PAC-4)	801882
DC Power Harness (one per dc powered PAC-4)	803093
PAC-5 PROGRAM AUDIO DEMODULATOR COMPONENTS	
Program Audio Demodulator	805293
AC Power Harness (one per ac powered PAC-5)	805953
DC Power Harness (one per dc powered PAC-5)	805954
Audio Hot Standby Switch (Specify ac or dc) contains all necessary ac/dc power harnesses)	804424
VIDEO LOW PASS FILTER	
Available Video Low Pass Filter Frequencies: 4.2, 4.5, 5.0, 5.8, and 6.5 MHz (specify)	
PAC Style Case for Panel Mounting	807480
Plug-In Module Style for use with Hot-Standby Radio Only	805352
AC Power Supply	801859
Rack Panel Mounting Frame	801851
Blank Panel (to cover unused spaces in rack panel mounting frame)	801869
75 ohm BNC Termination	803387
Coax Cable (BNC Plugs each end, specify length)	800192

THEORY OF OPERATION

SUBCARRIER INPUT. The PAC-5 Demodulator functions as a single conversion superheterodyne receiver as shown in the functional block diagram (Figure 1-5). The input to the PAC-5 is composite video (baseband video and subcarriers) and is connected to J1 or J2. The PAC-5 input is designed for high impedance bridging. The signal is first amplified by Q1 and then filtered by a subcarrier preselector filter. The component values of this filter depend on which subcarrier frequency group is desired. There are three filters for the six subcarrier frequencies – corresponding filters and frequencies are listed in Table 1-2 with the Local Oscillator crystal frequencies.

The output of the filter is mixed with the output of the Crystal controlled Local Oscillator (Q2) in dual-gate mosfet Q3. Rectified RF from pin 8 of U1 is used as AGC voltage for the mixer and varies the potential, and thus the gain, on G1 of Q3.

The 10.7 MHz IF strip of the PAC-5 consists of FL1, U2 and U3. The 10.7 MHz output of the mixer (the difference of the LO and SC frequencies) is filtered by FL1 and amplified in IF Amp U1.

Integrated circuit U3 is a combined IF Amplifier/Quadrature Detector (FM Demodulator). A phase shift network is connected between pins 9 and 10 to obtain the phase shift necessary (90°) for quadrature detection. Pin 8 is the wideband audio output of U3 and may contain such information as data subcarriers, telemetry or the 19 kHz pilot signal and L-R channel information for a stereo system.

Table 1-2. Frequency Dependant Components

SUBCARRIER FREQUENCY (MHz)	USE	PAC-5 805293-XX	CRYSTAL FREQUENCY (MHz)	CRYSTAL 89525-XX	MODULE 805220-XX
4.83	Domestic	-5	15.53	-32	-2
5.2	Domestic	**	15.9	**	**
5.8	Domestic	-6	16.5	-34	-3
6.2	Domestic	-1	16.9	-28	-1
6.8	Domestic	-2	17.5	-29	-1
7.02	CCIR	**	17.72	**	-1
7.5	Domestic/CCIR	-3	18.2	-30	-1
8.065	CCIR	**	18.765	**	-1
8.3	Domestic	-4	19.0	-47	-1
8.59	CCIR	**	19.29	**	**

** Special Order

AUDIO OUTPUT. The wideband audio output is routed through two signal paths. One path consists of wideband audio amplifiers Q7 and Q8 and 75 ohm output at position 6 on the output terminal strip. Resistor R47 is the output level adjust.

The other signal path (program audio) consists of amplifiers Q13 and Q14, a pi network low pass filter, notch filter, adjustable de-emphasis and a bridged class B power operational amplifier. The bridge amplifier consists of amplifiers of U4B, Q17 and Q18 as the inverting input and U4C, Q15 and Q16 as the non-inverting input. The output transformer, T1, has a single primary and a step-up center tapped, 600 ohm secondary. The adjustments in this stage are as follows:

1. Notch Filter: C54 adjusts the frequency of the filter; R66 adjusts the depth of the null.

2. De-emphasis: R67 adjusts the crossover point of the de-emphasis curve. For 50 μ sec de-emphasis, C60 should be changed to 680 pF.

3. Output Level: R70 adjusts the program audio output level of the PAC-5 to a maximum of +18 dBm into 600 ohm.

ALARM AND FAULT. Diodes CR4 and CR5 act as a low level peak detector on the output of the IF Amplifier U1. Normally, in the presence of a subcarrier, the base of Q4 is biased and there is voltage across potentiometer R30. Resistor R30 is used to set alarm and fault threshold. Integrated circuit U2 is a dual op amp array. One op amp, connected as a comparator, has its input at pin 2 and its output at pin 1. When the potential at the wiper arm of R30 and connected to U2 through R31, normally negative, approaches 0, the op amp switches ON lamp driver Q5 and switches OFF relay driver Q6, activating the fault lamp and alarm relay. The normally energized relay also acts as a power failure alarm since, when power is lost, the relay de-energizes and closes the NO contacts, thus activating the external alarm. The other op amp is connected as a buffer and provides detected IF voltage at E10.

ON BOARD REGULATED POWER SUPPLY. The power input to the PAC-5 is -21.5 to -56 Vdc at 160 mA. An on-board regulator circuit provides regulated -20 Vdc and -15 Vdc for the PAC-5. The circuit is divided into three inter-active parts:

1. a referenced voltage regulator with feedback
2. a dependent voltage regulator
3. a short circuit current limiter

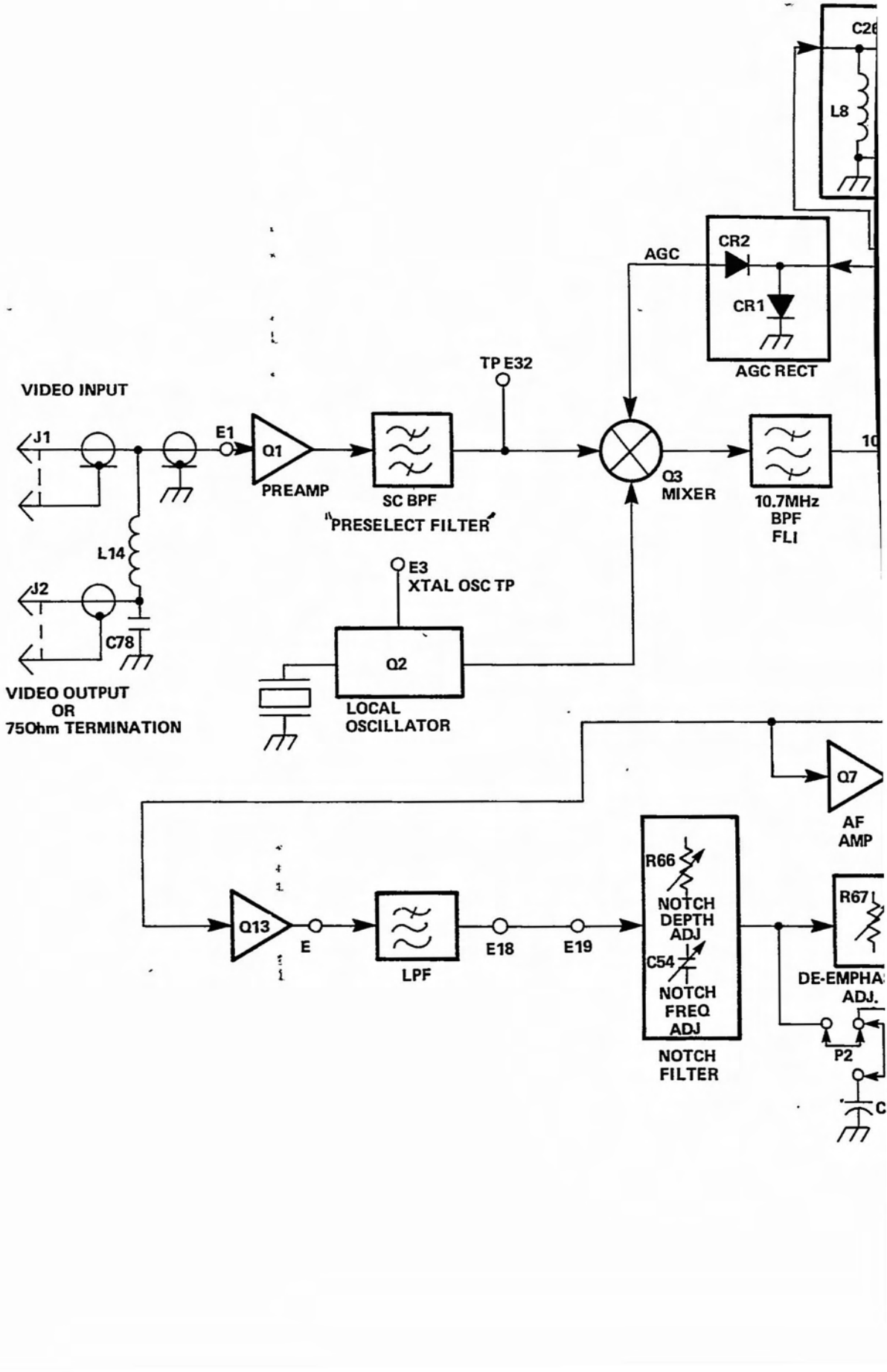
The referenced voltage regulator operates as follows: the base and emitter of pass transistor Q19 are referenced by a differential amplifier consisting of Q11 and Q12. The base of Q11 is held at -9 volts by CR8. Transistor Q12 amplifies the error voltage of the output of Q19 as taken across a voltage divider consisting of CR9, potentiometer R59 (voltage adjust) and R60. The output of this amplifier holds the collector voltage of Q19 at -20 volts.

The dependent voltage source consists of emitter follower Q20 and a voltage divider R92 and R93. Its output voltage will be 3/4 the collector voltage of Q19. The base of Q20 is held at -15.6 volts by the voltage divider, thus referencing the output by the equasion V_{BQ} V_{BEQ} = -15 volts.

The short circuit current limiter, consisting of R52, R53, R54, R55, Q9, Q10 and CR7, works as follows: when excessive current flows through R52, Q9 is turned ON. This, in turn, switches Q10 ON and removes bias from Q11, thereby shutting down Q19 and thus the voltage output.

SPECIFICATIONS

Subcarrier Frequencies	
Domestic	4.83 MHz, 5.2 MHz, 5.8 MHz 6.2 MHz, 6.8 MHz, 7.5 MHz, and 8.3 MHz
CCIR	7.02 MHz, 7.5 MHz, 8.065 MHz, and 8.59 MHz
RF Subcarrier Input	
Level	100 mV P-P +10 dB, -3 dB
High Impedance	high impedance, unbridged
Program Audio Output (w/75 kHz peak deviation)	
Level	+18 dBm for 75 kHz peak deviation at 1 kHz TT
Output Range	0 dBm to +18 dBm
Impedance	
Standard	600 ohms
Optional	150 ohms
Return Loss	26 dB
De-Emphasis	
Standard	75 microsecond
Optional	50 microsecond
Signal-to-Noise (40 Hz to 15 kHz, 0 dBm to +18 dBm output	70 dB (ref 75 kHz pk deviation)
Total Harmonic Distortion (40 Hz to 15 kHz)	1% maximum
Frequency Response	
40 Hz to 100 Hz	±0.75 dB
100 Hz to 7500 Hz	±0.5 dB
7500 Hz to 15000 Hz	±0.75 dB
Wideband Audio Output (w/75 kHz deviation)	
Level	300 mV RMS nominal
Impedance	75 ohms, unbalanced
Frequency Response	40 Hz to 60 kHz (no filter)
Power Requirements	
Voltage	-21.5 to -56 Vdc
Ripple	200 mV P-P
Current	150 mA nominal
Physical Characteristics	
Size	1.75"(h) x 5.5"(w) x 10.0"(d) (4.46 x 13.97 x 25.4 cm)
Weight	2.25 lbs (1.02 kg)
Environmental Conditions	
Ambient Temperature	
Operational	-30 to +60°C
Meets All Specs	-10 to +40 °C
Relative Humidity	0 to 95% (+10 to +40°C)


C26
L8
CR2
AGC
CR1
AGC RECT
TP E32
VIDEO INPUT
J1
E1
Q1
PREAMP
SC BPF
PRESELECT FILTER
Q3
MIXER
10.7MHz
BPF
FLI
L14
E3
XTAL OSC TP
J2
C78
Q2
VIDEO OUTPUT
OR
75Ohm TERMINATION
LOCAL
OSCILLATOR
Q7
AF
AMP
R66
NOTCH
DEPTH
ADJ
R67
Q13
E
LPF
E18
E19
C54
NOTCH
FREQ
ADJ
DE-EMPHA
ADJ.
NOTCH
FILTER
P2

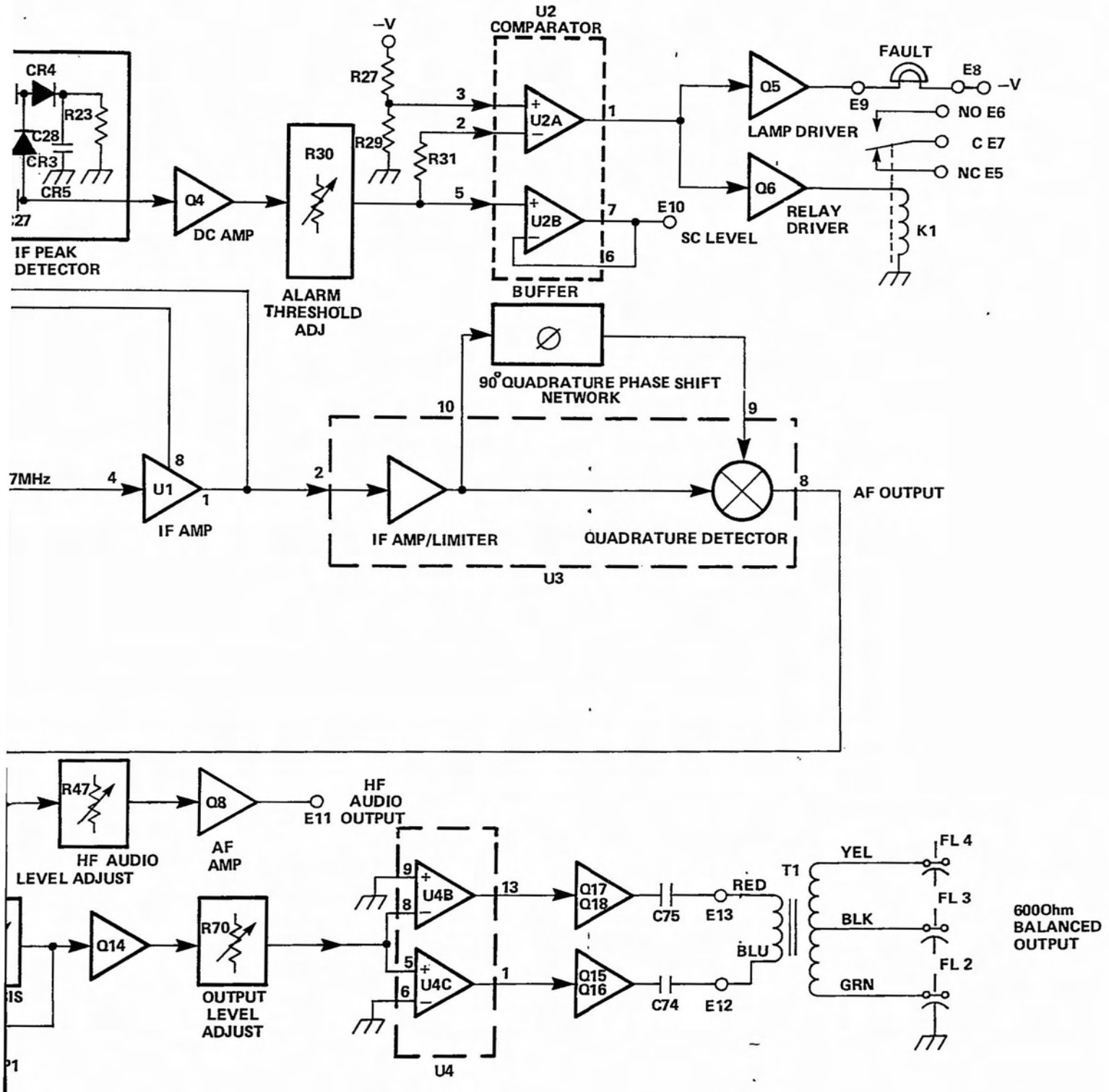


Figure 1-5. PAC-5 Demodulator-Functional Block Diagram

SECTION 2
INSTALLATION

GENERAL

Mechanical and electrical installation of the PAC-5 depends on the number of PAC-5's used and the system in which they are used. Accordingly, the installation procedures in this section are broad in scope and can be adapted to a variety of installations.

MECHANICAL

PAC series cases are identical in height and width (PAC-4, PAC-5, PAC-6, PAC Power Supply and Audio Hot Standby Switch) and mount in a special rack panel mounting frame (PN 801851) which has cutouts for three units. Blank panels (PN 801669) cover unused spaces. Figure 2-1 shows how a PAC series case is mounted. Table 2-1 lists the hardware necessary to install three PAC series cases or blank panels on the rack panel mounting frame.

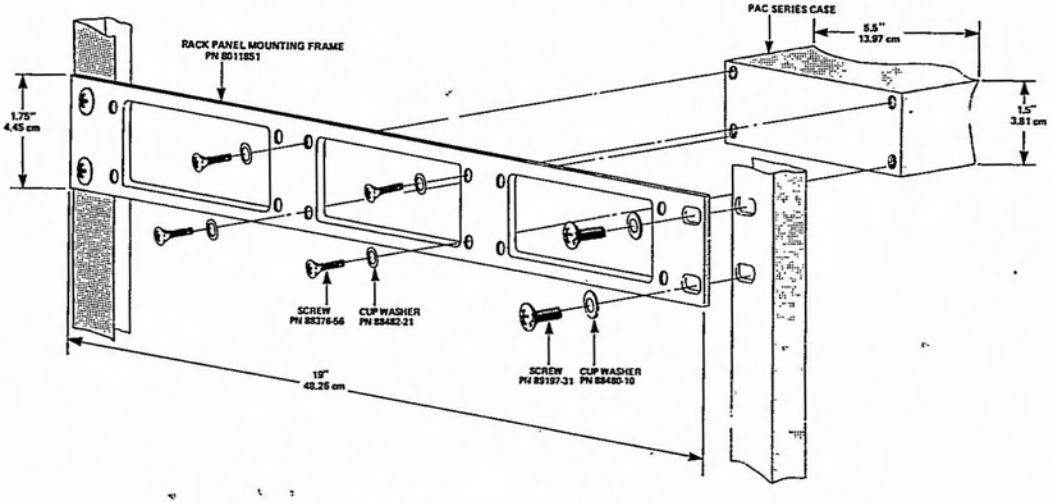


Figure 2-1. Mounting of a PAC Series Case.

Table 2-1. PAC Series Mounting Hardware

1. PAC Series Case or Blank Panel to Rack Panel Mounting Frame.			
QTY	**ITEM**	**DESCRIPTION**	**MAC PN**
12	Screw	1/2 in. 6-32 Phillips Head	88376-56
12	Cupwasher	for 6-32 Screw	88482-21
2. Rack Panel Mounting Frame to MAC 19" (482.6 mm) Equipment Rack.			
QTY	**ITEM**	**DESCRIPTION**	**MAC PN**
4	Screw	1/2 in. 10-32 Phillips Head	89197-31
4	Cupwasher	For 10-32 Screw	88480-10
3. Miscellaneous			
	Rack Panel Mounting Frame		PN 801851
	Blank Panel (to cover unused spaces)		PN 801869

ELECTRICAL

Figure 2-2 is a rear view of the PAC-5 and shows all electrical connections. Figure 2-3 shows the optional PAC-5 DC Power Harness (PN 905954) and optional PAC-5 AC Power Harness (PN 805953). The same installation procedure is used irregardless of which harness is used. Electical installation is done as follows:

POWER. Connect a power supply, -21.5 Vdc to -56 Vdc at 160 mA, as follows:

-Vdc to lug 5 -Vdc
ground to lug 1 ground

COMPOSITE VIDEO INPUT. Connect composite video input via 75 ohm cable to J1 (BNC Female).

COMPOSITE VIDEO OUTPUT. Depending on what system configuration is used, there are three possibilities: (Figure 2-4 shows a typical PAC System).

a. BNC (M) to BNC (M) 75 ohm cable from J2 composite video output to J1 of another PAC-5.

b. BNC (M) to BNC (M) 75 ohm cable from J2 composite video output to input of video/picture monitor.

c. Connect 75 ohm termination MAC PN 803387 to J2 composite video output.

600 OHM AUDIO. Conect a 600 ohm (or optional 150) balanced line between lug 2 and lug 4. Lug 3 is centertap.

WIDEBAND AUDIO OUTPUT. Connect a 75 ohm line between lug 6 (hot) and lug 1 (ground).

ALARM. The alarm circuit can be connected between either:

a. normally closed lugs 7 and 9 (alarm activated by normally opening contacts).

b. normally open lugs 8 and 9 (alarm activated by closing contacts).

PAC-5 installation is now complete. If the user wishes to conduct a proof of performance test, he should follow the alignment procedure in Section 4.

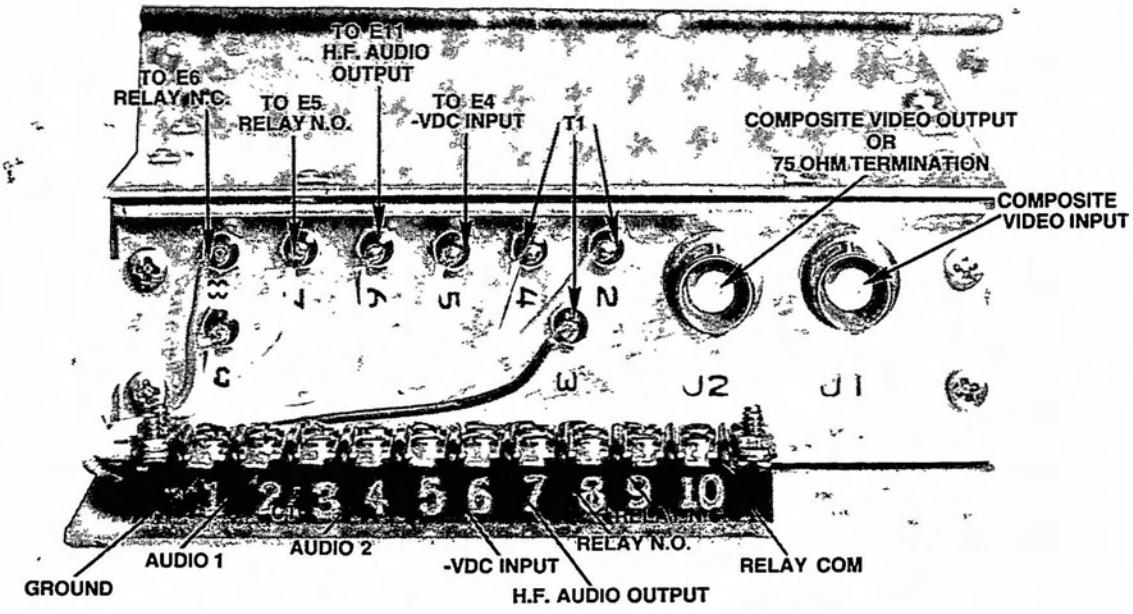


Figure 2-2. PAC-5 Demodulator-Rear View

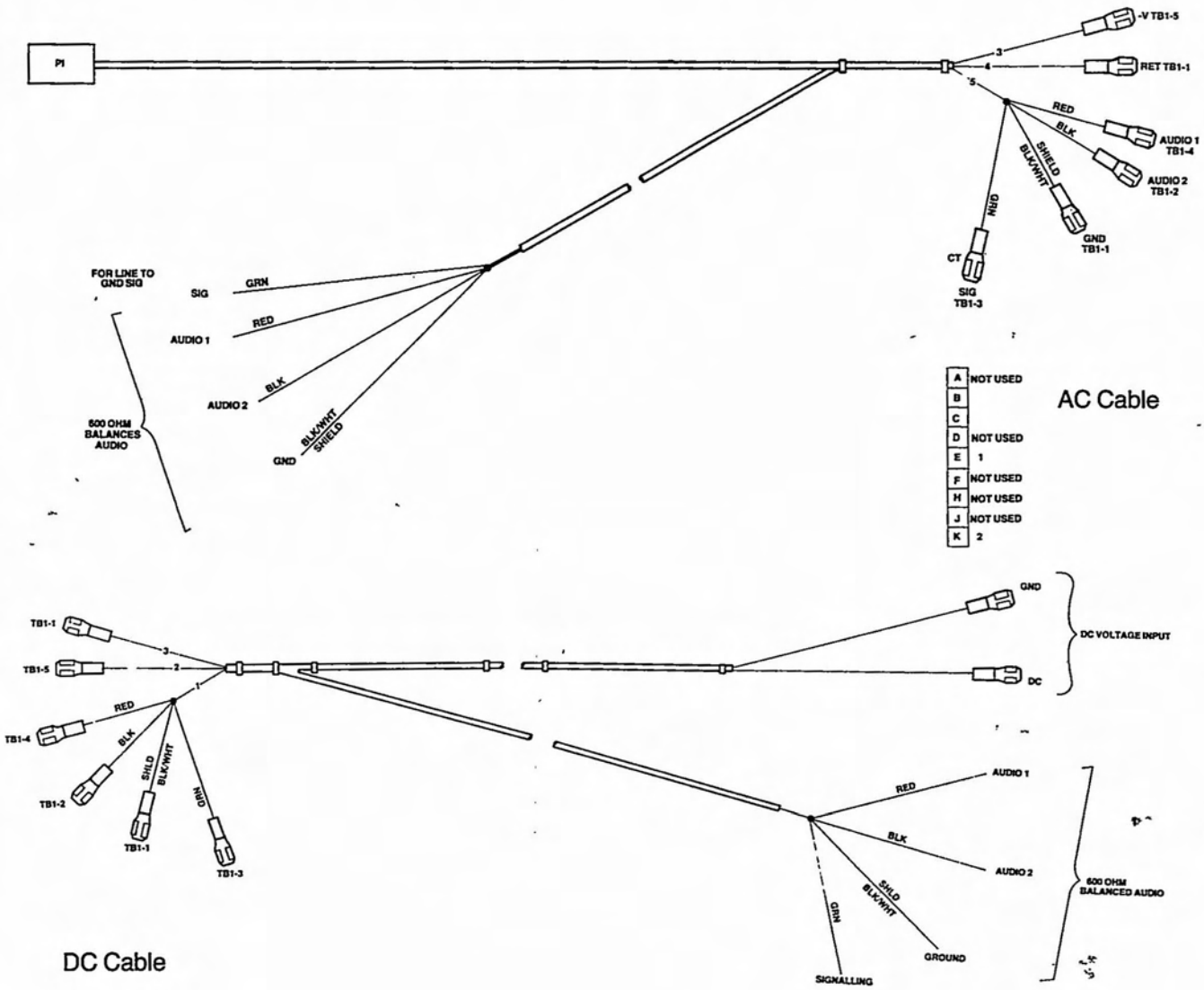


Figure 2-3. Optional AC/DC Power Harness

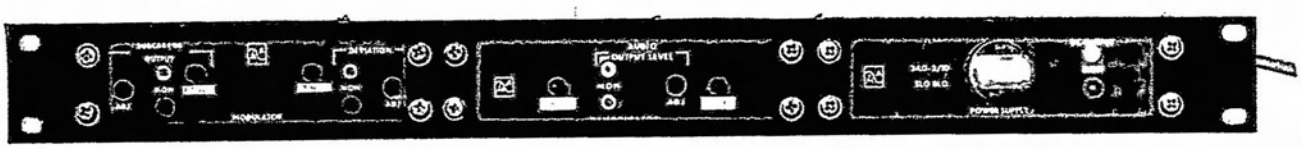


Figure 2-4. Typical PAC System

SECTION 3
OPERATING INSTRUCTIONS

GENERAL

The PAC-5 (Figure 3-1) is normally in continuous operation. It is not necessary to adjust any of the internal controls for normal use. The only adjustment necessary is to set the 600 ohm audio output to the desired level.

INITIAL TURN ON PROCEDURE.

Step 1. Apply power.

Step 2. Fault lamp will light.

Step 3. Apply composite video containing sufficient subcarrier for PAC-5 operation.

Step 4. Fault lamp will extinguish.

Step 5. Fault lamp remains on, check that there is sufficient subcarrier present at the input, J1. The voltage at the AGC Test Point on the front panel should measure -1.5V or more (more negative with respect to ground). If the subcarrier input is sufficient, adjust the alarm threshold per the Alignment Procedure in Section 4.

Step 6. Adjust the 600 ohm (or optional 150 ohm) audio output, as necessary, using the front panel (if used).

Step 7. Check the wideband audio output (if used). The PAC-5 can now be placed in service.

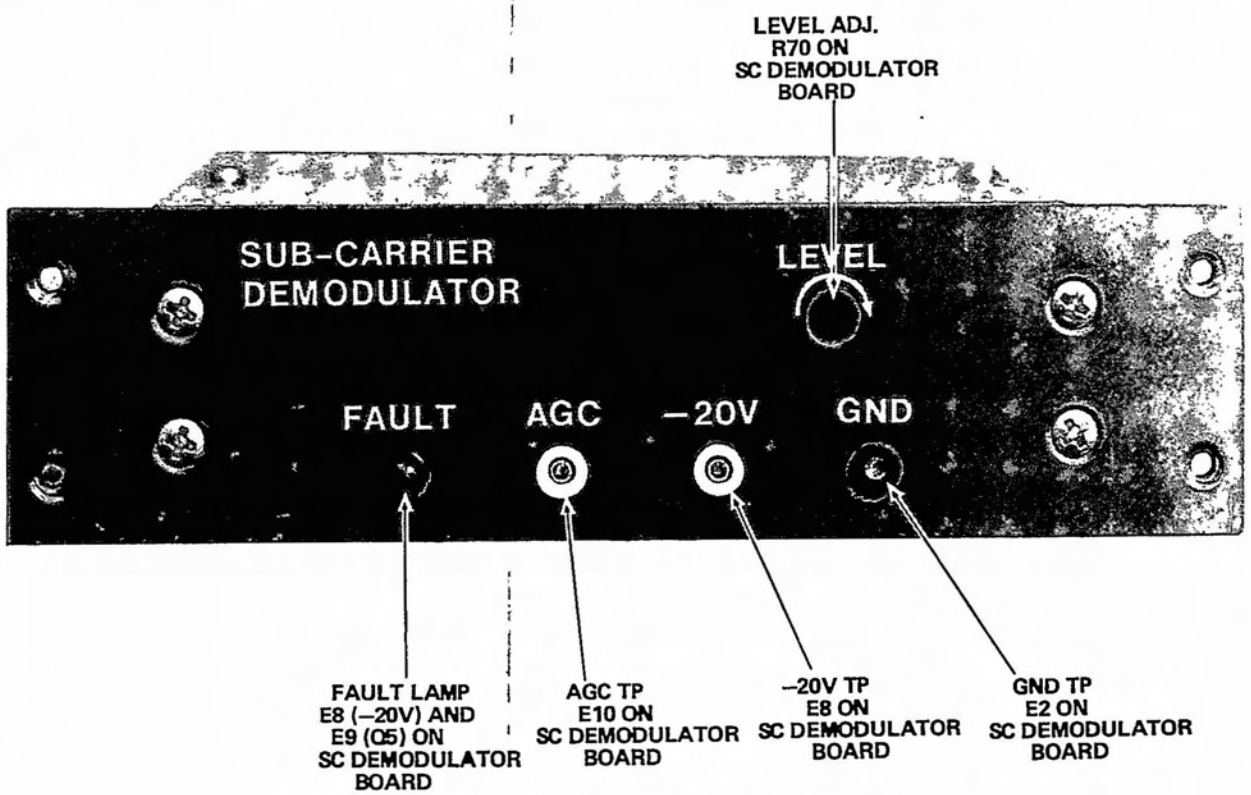


Figure 3-1. Front Panel Controls and Indicators

SECTION 4
MAINTENANCE AND TROUBLESHOOTING

GENERAL

This section contains information on the maintenance, troubleshooting, alignment and the frequency changing procedure of the PAC-5 Demodulator. The user may perform all adjustments except those on the subcarrier preselector filter which is factory aligned and may not be field adjusted.

MAINTENANCE

Maintenance consists of checking all external connections and all operating parameters of the PAC-5 at regular intervals. An alignment procedure flow chart (Figure 4-1) is provided to enable the user to make and record any necessary measurements and adjustments.

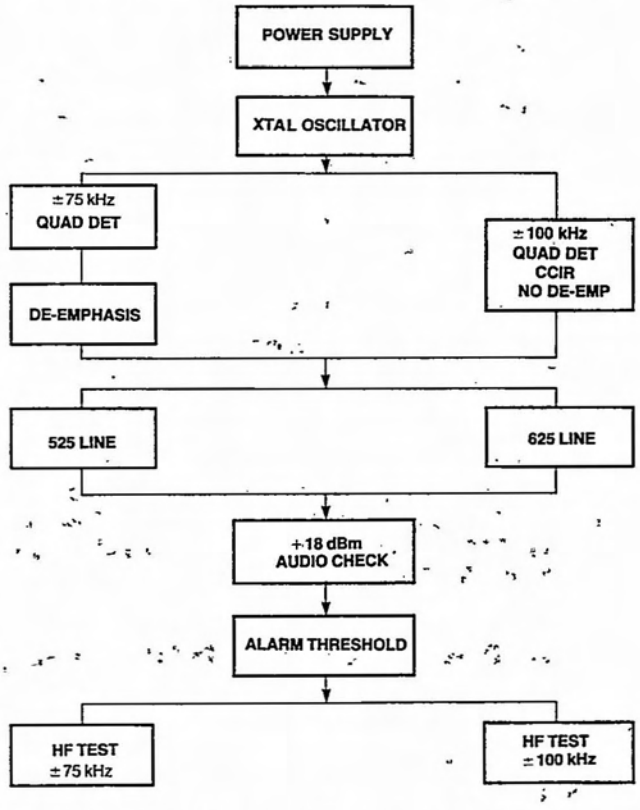


Figure 4-1. Alignment Procedure Flow Chart

CHANGING FREQUENCIES

There are three different subcarrier preselect filters in the PAC-5. The user may change subcarrier frequencies merely by changing crystals only if the same subcarrier preselect filter is used for both frequencies. Subcarrier preselector filter frequency groups, crystal frequencies and crystal part numbers are given in theory of operation (Table 2-2) section of this manual. Follow the oscillator adjustments of the alignment procedure steps after changing crystals. The position of crystal and on-board-test points are shown in Figure 4-2.

ALIGNMENT PROCEDURE

The necessary equipment for alignment is listed in Table 4-1. Before attempting to make any measurements or adjustments on the PAC-5, the user should re-read Theory of Operation section and study the Block Diagram and Schematic Diagram. The user should also record each measurement as it is made on the log sheet.

Table 4-1. Test Equipment

EQUIPMENT	MANUFACTURER'S TYPE OR EQUIVALENT
Standard Modulator	PAC-4
Distortion Analyzer	Hewlett Packard HP334A
Power Supply	PAC-PS (-21.5 to -56 Vdc @ 160 mA)
75 Ohm Load	Tektronix 011-0102-00
Frequency Counter	Hewlett Packard HP5314A
BAL-UNBAL Transformer	Marconi TM 6221
Multimeter	Simpson 260
RMS Voltmeter	HP 3400A
Digital Voltmeter	Fluke 8000A

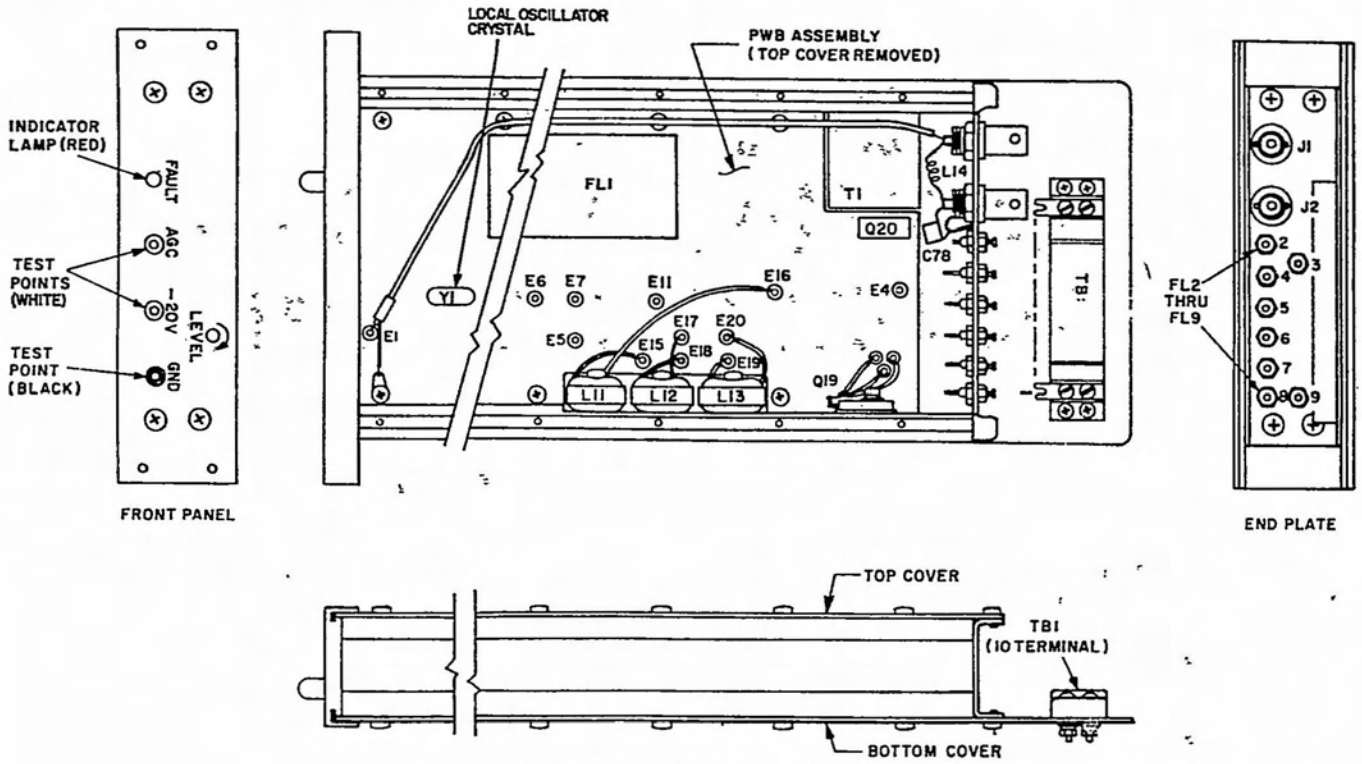


Figure 4-2. Test Point and Crystal Positions

POWER SUPPLY ADJUSTMENTS

Step 1. Connect the DVM to E30 and chassis

Step 2. Adjust R59 for -20.0 ±0.01V as on DVM

Step 3. Seal R59 with sno-pake.

Step 4. Connect the DVM to E32 and chassis.

Step 5. Check for -15.0V ±0.5V (not adjustable). If voltage is out of spec, Q20 is faulty or components on load side (E32) are at fault.

OSCILLATOR ADJUSTMENT

Step 1. Connect the VOM (-) to E3 and (+) to chassis (3V or 8V scale).

Step 2. Insert crystal.

Step 3. Adjust L6 for maximum indication on VOM. Do **not** seal coil.

QUADRATURE DETECTOR ADJUSTMENTS (AT 400 Hz ±75 kHz)

NOTE
Be sure the blue plug is in position P1.
For CCIR, (±100 kHz), see below.
(The subcarrier Audio demodulator is refered to as **SCAD** for brevity in the procedure.)

Step 1. Apply a 400 Hz modulated signal to SCAD from standard modulator; use ±75 kHz deviation at RF level = −20 ±2 dBm.

Step 2. Connect balanced audio output from SCAD through BAL-UNBAL transformer to distortion analyzer with 600 ohm load.

Step 3. Adjust L9 for maximum level. If the audio level exceeds +10, then reduce level by adjusting R70 (on front panel). L9 will peak in two places; use peak that occurs with slug nearest top of can.

Step 4. Measure distortion. Adjust L10 for minimum distortion.

NOTE
Distortion will rise and then dip in two places. Leave L10 at best setting.

Do **not** readjust L9. Seal L9 only with sno-pak.

Step 5. Recheck distortion. Level will be different from original setting. Distortion should be better than 1.0%. If level has dropped more than 2 dB, C35 or C36 is out-of-tolerance and will have to be replaced.

75 μ sec DE-EMPHASIS ADJUSTMENT (IF USED)

Step 1. Set distortion analyzer to voltmeter.

Step 2. Reset Modulator to 300 Hz and set SCAD output level at 0 dBm.

Step 3. Change frequency to approximatly 5 kHz.

15 kHz NOTCH ADJUSTMENTS 525 LINE (625 Line, See Note)

Step 1. Reset Modulator to exactly 15,734 Hz ±5 Hz (use frequency counter, recheck frequently).

Step 2. Set distortion analyzer to voltmeter.

Step 3. Select C55 for maximum reduction of voltmeter reading (approximatly 400 pF).

Step 4. Alternately adjust C54 and R66 for maximum reduction of voltmeter reading. If C54 is at either end of adjustment, C55 will require an alternate value.

Step 5. Remove modulation from Standard Modulator.

Step 6. Solder C55 permanently in place.

NOTE

For 625 line systems, use 15,625 kHz in place of 15,734 Hz throughout notch adjustments.

ALARM THRESHOLD ADJUSTMENTS

Step 1. Check level of SC signal at input to SCAD. Must be -20 dBm ±0.5 dB.

Step 2. Insert (-) lead of DVM into AGC test points on front panel, (+) lead to GND.

Step 3. Adjust R30 for a 1.5V indication.

Step 4. Remove SC signal from SCAD. The red lamp should light and relay should operate.

SET WIDEBAND AUDIO LEVEL (±75 kHz)

Step 1. Reapply modulation to standard Modulator at the deviation level of ±75 kHz with a 20 kHz test tone.

Step 2. Connect 75 ohm load and coax cable with test clips to the distortion analyzer.

Step 3. Set distortion analyzer on voltmeter.

Step 4. Connect test coax to FL5 (center) and chassis.

Step 5. Adjust R47 for an indication of 0.3 Vrms.

Step 6. Increase modulation frequency to 60 kHz.

Step 7. Check and record SCAD output level changes (in dB).

CCIR QUADRATURE DETECTOR ADJUSTMENTS (±100 kHz)

NOTE

Be sure plug is in position P2.

Step 1. Apply at 400 Hz modulated to SCAD from the standard Modulator at ±100 kHz deviation at RF level = -20 dBm ±2 dB.

Step 2. Connect balanced audio output from SCAD through BAL-UNBAL transformer to distortion analyzer (with 600 ohm load).

Step 3. Adjust L9 for maximum level. If the level exceeds +10, then reduce the level by adjusting R70 (on front panel). L9 will peak in two places; use the peak that occurs with slug nearest top of can.

Step 4. Measure the distortion. Adjust L10 for minimum distortion.

NOTE

The distortion will rise and then dip in two places. Leave L10 at the best setting. Do **not** readjust L9. Seal only L9 with sno-pake.

Step 5. Recheck distortion. The level will be differnet from the original setting. Distortion should be less than 0.3%. (Spec: 0.4%) If the level has dropped more than 2 dB, C35 or C36 is out-of-tolerance and will have to be replaced.

MAXIMUM LEVEL AUDIO CHECK

Step 1. Reset the modulation frequency to 400 Hz.

Step 2. Adjust R70 LEVEL control on front panel of SCAD to increase output level to +18 dBm.

Step 3. Recheck distorion and record all data at 50 Hz and 400 Hz.

Step 4. Reduce input level to standard 20 dB. Do **not** reset R70. Check and record frequency response from SCAD and record data. Check response at 40 Hz, 80 Hz, 400 Hz, 4 kHz, 10 kHz, 10 kHz and 15 kHz.

Step 5. Remove modulation from standard Modulator. Check and record S/N ratio (+18 dBm - Noise dBm = S/N).

WIDEBAND AUDIO LEVEL (±100 kHz)

Step 1. Reapply modulation to standard Modulator at the deviation level of ±100 kHz with a 20 kHz test tone.

Step 2. Connect 75 ohm load and coax cable with test clips to the distortion analyzer.

Step 3. Set distortion analyzer on voltmeter.

Step 4. Connect center conductor of test coax to 6 and shield to chassis.

Step 5. Adjust R47 for an indication of 0.3 Vrms.

Step 6. Incease modulation frequency to 60 kHz.

Step 7. Check and record SCAD output level change (in dB).

DATA SHEET

CCIR (±100 kHz) DISTORTION	±75 kHz
_____ % at 50 Hz	_____ % at 50 Hz
_____ % at 400 Hz	_____ % at 400 Hz
AUDIO RESPONSE:	
_____ dB at 40 Hz	_____ dB at 40 Hz
_____ dB at 80 Hz	_____ dB at 80 Hz
REFERENCE AT 400 HZ:	REFERENCE AT 400 Hz:
_____ dB at 4 kHz	_____ dB at 4 kHz
_____ dB at 10 kHz	_____ dB at 10 kHz
_____ dB at 15 kHz	_____ dB at 15 kHz
S/N RATIO (Ref = +18 dBm)	
_____ dB	_____ dB
ALARMS:	
_____ Front Panel Lamp:	_____ OK
_____ Relay:	_____ OK

Figure 4-3. PAC-5 Data Sheet

SECTION 5
DIAGRAMS

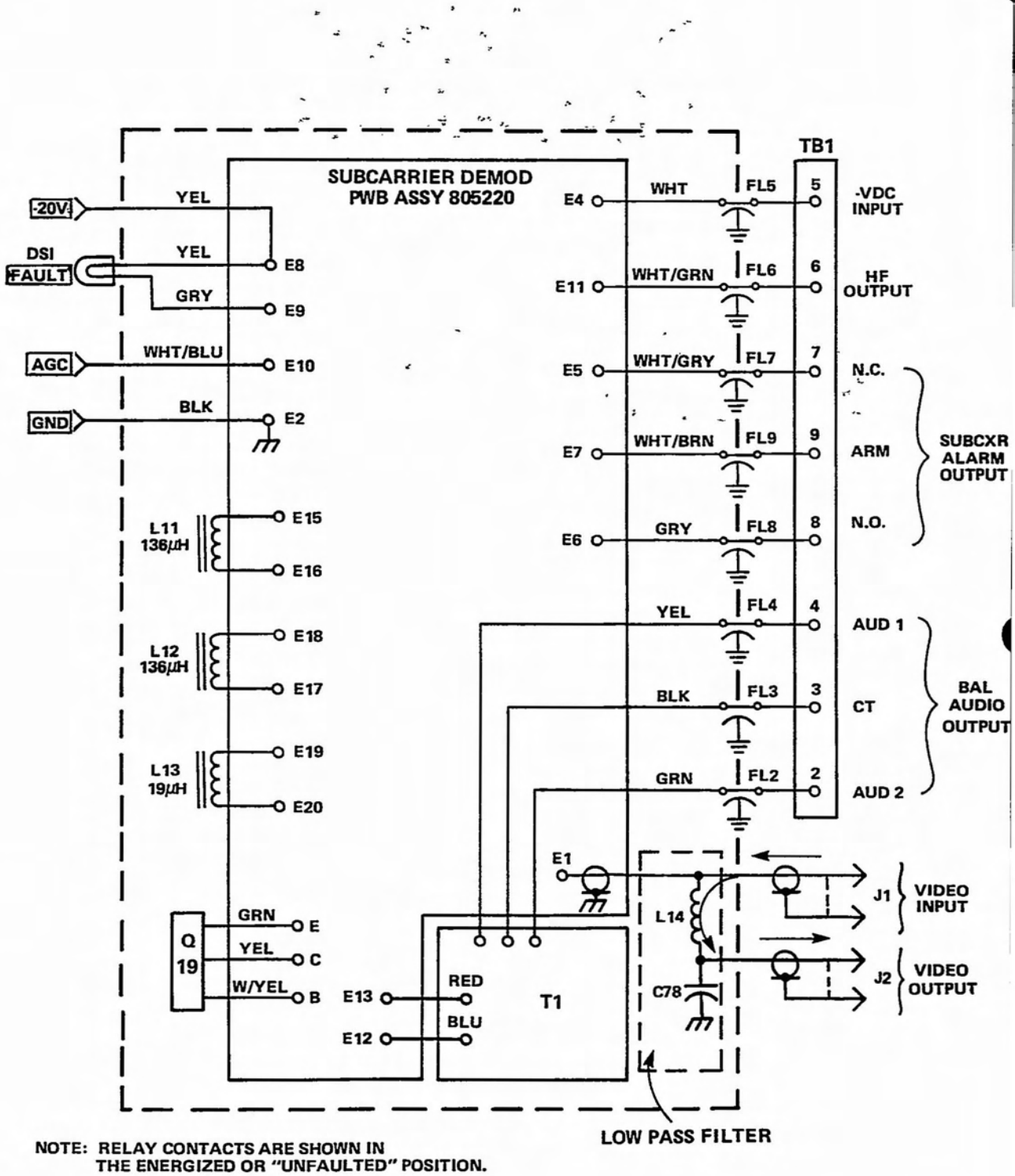
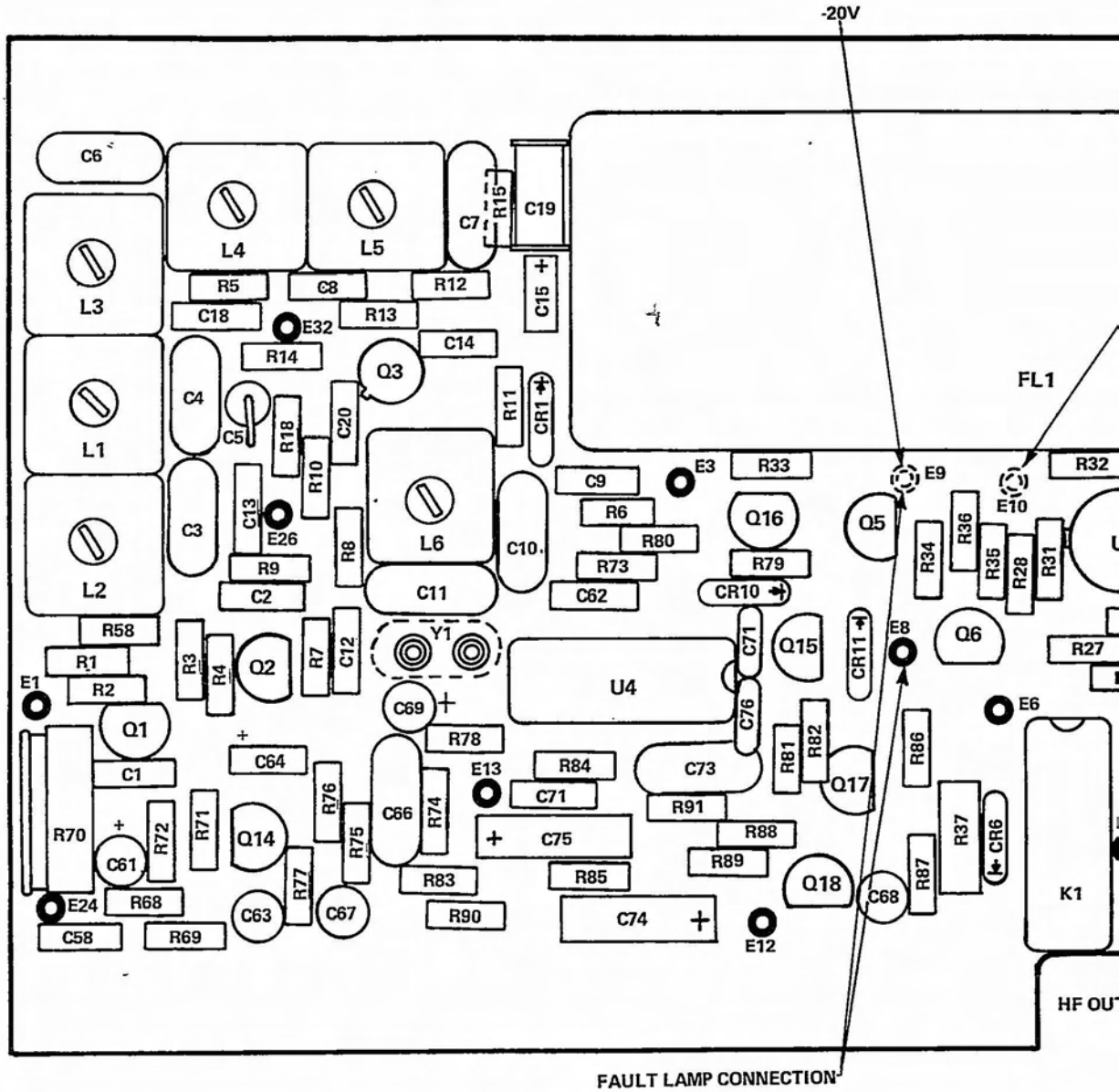


Figure 5-1. PAC-5 Demodulator-Wiring Diagram PN 805293


-20V
FL1
C6
L4
L5
C7
R15
C19
L3
R5
C8
R12
C15
C18
R13
E32
C14
R14
Q3
C4
C5
R18
C20
R11
CR1
L1
R10
E3
R33
E9
E10
R32
C9
C3
C13
E26
L6
C10
R6
Q16
Q5
R36
L2
R8
R80
R34
R35
R28
R31
R9
R73
R79
C2
C11
C62
CR10
R58
Y1
C71
Q15
CR11
E8
Q6
R27
R1
R3
R4
Q2
R7
C12
U4
E1
R2
C69
C76
E6
Q1
R78
R81
R82
R86
C64
C1
E13
R84
C73
Q17
R76
C66
R74
C71
R91
R70
C61
R72
R71
Q14
R75
C75
R88
R37
CR6
R77
R83
R85
R89
K1
E24
R68
C63
C67
R90
Q18
C68
R87
C58
R69
C74
E12
HF OUT
FAULT LAMP CONNECTION

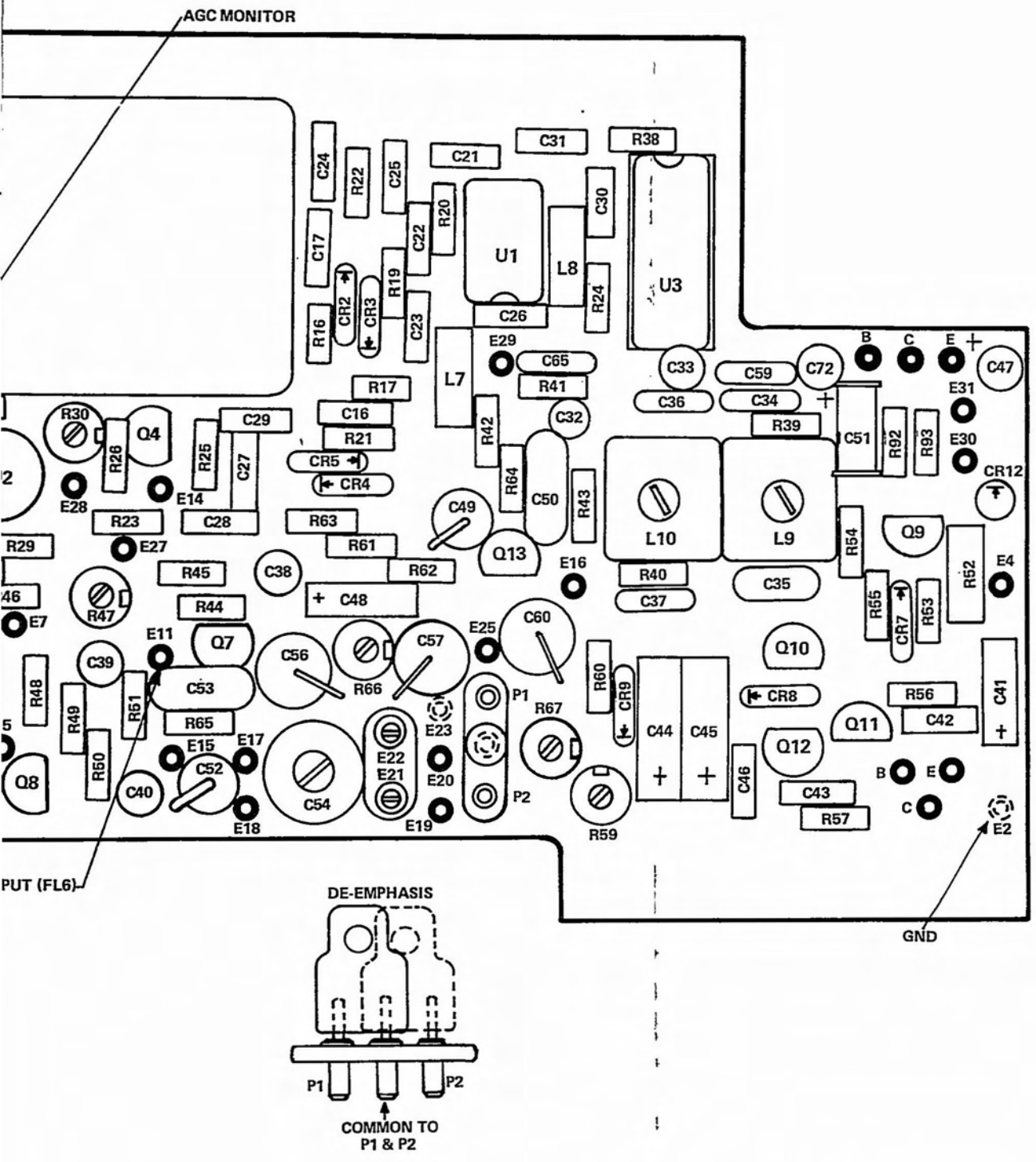
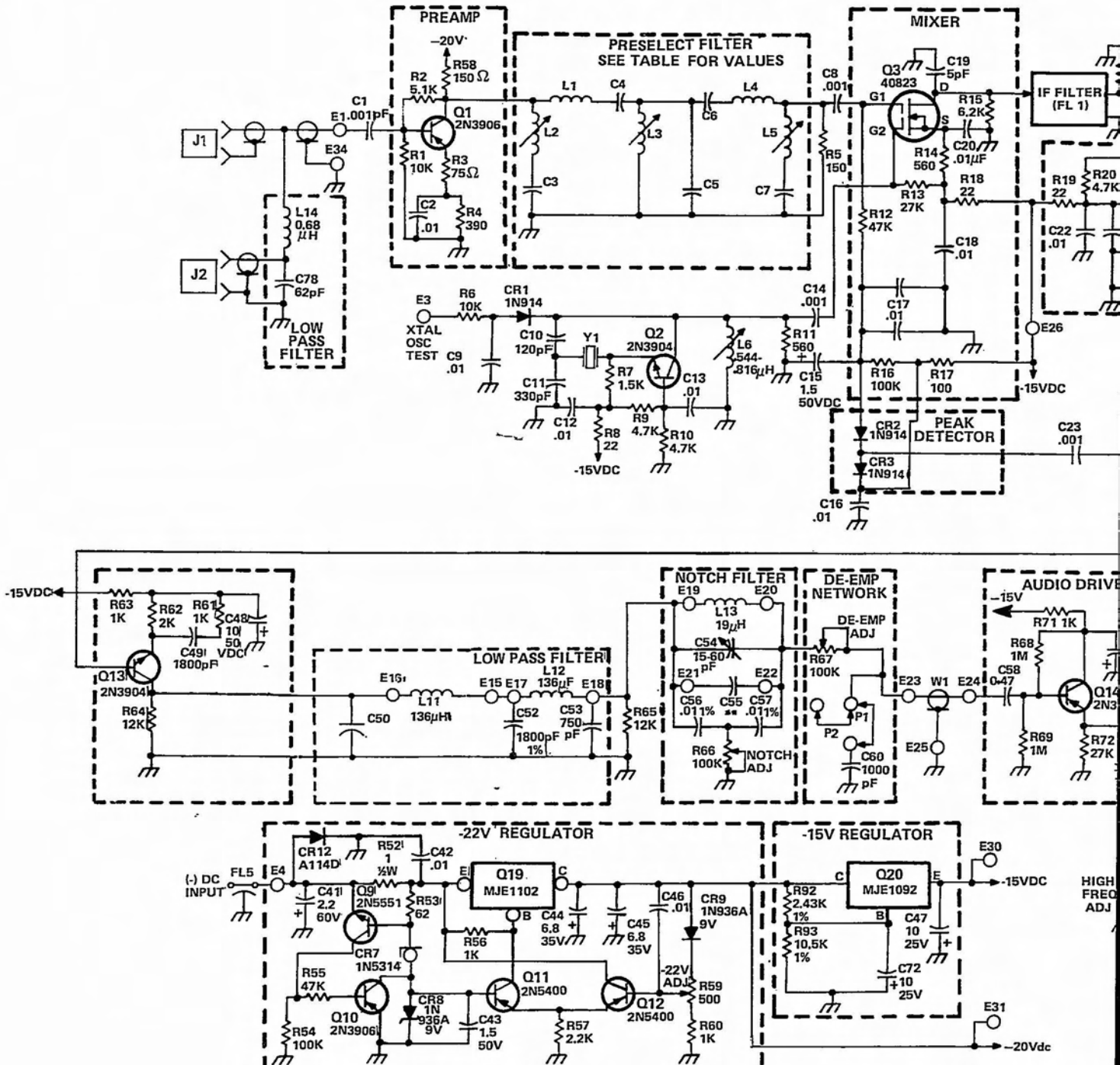
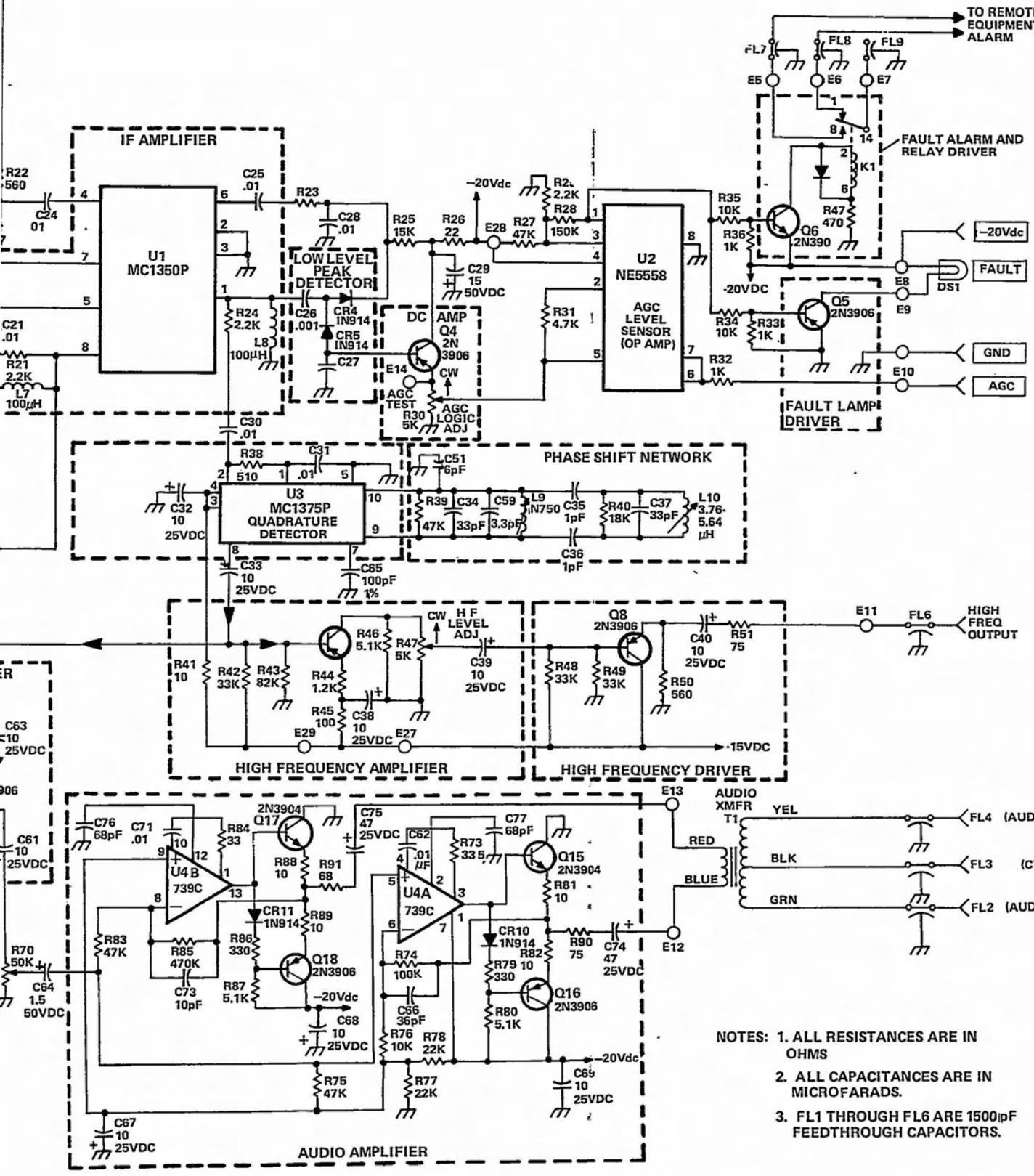


Figure 5-2. PAC-5 Demodulator-Component Location
PN 805220

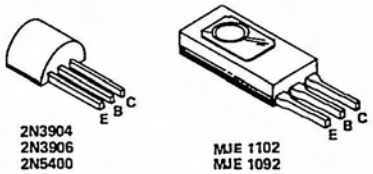


PRESELECT FILTER VALUES

	L1	L2	L3	L4	L5	C3	C4	C5	C6	C7
G1	8.0-12.0	5.44-8.16	.544-.816	8.0-12.0	17.6-24.4	30	47	640	47	39
G2	54.4-81.6	26.4-39.6	.162-.198	54.4-81.6	26.4-39.6	20	12	.0051	12	47
G3	17.6-26.4	3.76-5.64	.376-.564	17.6-26.4	12.0-18.0	56	33	.0015	33	75



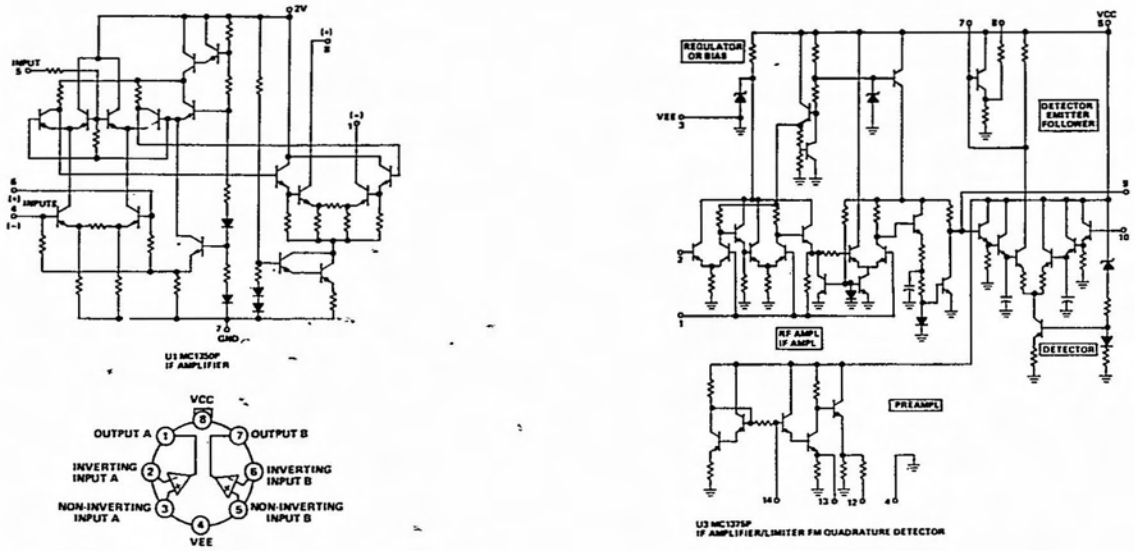
NOTES:
1. ALL RESISTANCES ARE IN OHMS
2. ALL CAPACITANCES ARE IN MICROFARADS.
3. FL1 THROUGH FL6 ARE 1500pF FEEDTHROUGH CAPACITORS.



2N3904
2N3906
2N5400

MJE 1102
MJE 1092

Figure 5-3. PAC-5 Demodulator-Schematic Diagram
PN 805220



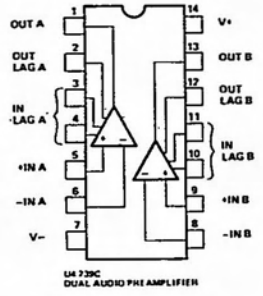


Figure 5-4. Integrated Circuit Scematic Diagrams

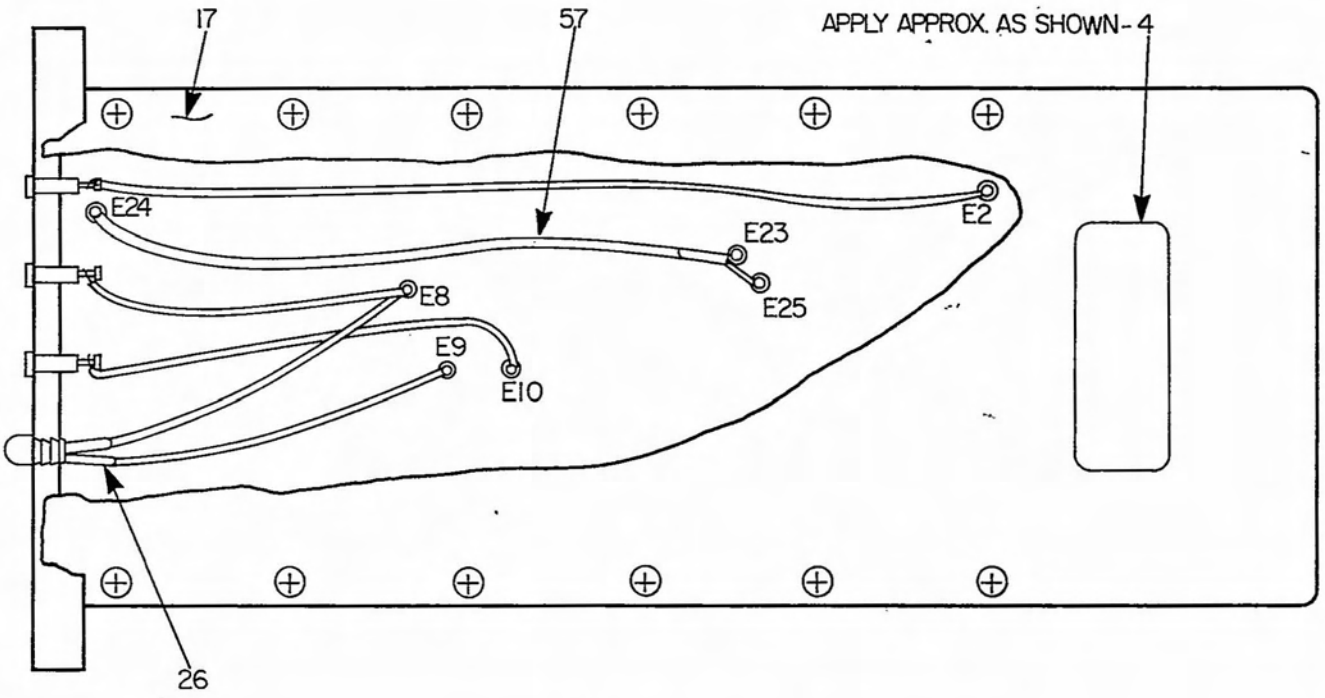


Figure 5-5. Front Panel to PWB Connections

SECTION 6
PARTS LISTS

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
SUBCARRIER DEMODULATOR PN 801293			
	6.2 MHz	PN 805293-1	MAC
	6.8 MHz	PN 805293-2	MAC
	7.5 MHz	PN 805293-3	MAC
	8.3 MHz	PN 805293-4	MAC
	4.83 MHz	PN 805293-5	MAC
MAC	5.80 MHz	PN 805293-6	MAC

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
SUBCARRIER DEMODULATOR MODULE ASSY PN 805293			
	6.2, 6.8, 7.5, 8.3 MHz	PN 805220-1	MAC
	4.83 MHz	PN 805220-2	MAC
	5.8 MHz	PN 805220-3	MAC
	Test Point (White)	88513-1	Sealectro 14-7-209
	Test Point (Black)	88513-2	Sealectro 14-00-702
	Lamp, Red	89904-13	Shelly Assoc. BEPHBA07RBP
	Insulator, Mica	805660-1	MAC
	Lug, Ground	88520-25	H.H.Smith 1497
	Lug, Ground	88520-20	Zierick 11B
	Lug, Ground	88520-28	Zierick 502
	Connector, BNC Female	89397	UG625/U
	Coax Cable, 50 ohm	805298-6	MAC
	Coax Cable	800415-16	RG 188
	Quick Disconnect Terminal	89892-10	MAC
	CAPACITORS		
All capacitors are in picofarads unless otherwise specified.			
C78	62	89008-18	DM5EC620F
	FILTERS		
FL2			
FL3			
FL4			
FL5	1500 pF	88212-15	Erie 1250-003
FL6			
FL7			
FL8			
FL9			
	INDUCTORS		
All inductors are in microhenries unless otherwise specified.			
L11			
L12	136	89169-11	AC 8005
L13	19	89169-22	AC 8006
L14	0.68	803380-21	MAC
	TRANSISTORS		
Q19	MJE 1102	87223-28	Motorola
Q20	MJE 1092	87223-29	Motorola
	TRANSFORMERS		
T1	600 Ohm Secondary	805374-1	MAC
	TERMINAL BLOCK		
TB1	10 Position	89973-76	ETC 33110-3329-79

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	CRYSTALS		
Y1	15.530	89825-32	
	16.900	89825-28	
	17.500	89825-29	
	18.200	89825-30	
	19.000	89825-47	
	16.500	89525-34	
SUBCARRIER DEMODULATOR PWB ASSY PN 805220			
	Filter, 10.7 MHz	805302	MAC
	Plug, Shorting	88510-42	CTC 461-2871-01-03-16
	IC Socket, 14 Pin DIP	89980-78	Augat 314-AG39D
	Socket	85357-9	CTC 450-3388-01-03
	CAPACITORS		
All capacitors are in microfarads unless otherwise specified.			
C1	0.001, 200V, 1%	87210	Vitramon CK05BX102K
C2	0.01, 200V	87211	Vitramon CK06BX103K
C3	30pF	89017-58	CM05ED300J03
C4	47pF	88212-1	CM05ED470J03
C5	680pF, 400V, 1%	88212-65	Paktron PP481
C6	47pF	88212-1	CM05ED470J03
C7	39pF	89097	CM05ED390J03
C8	0.001, 200V, 1%	87210	Vitramon CK05BX102K
C9	0.01	87211	Vitramon CK06BX103K
C10	120pF	89017-12	CM05ED121J03
C11	330pF	89089	CM05ED331J03
C12	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C13			
C14	0.001, 200V, 1%	87210	Vitramon CK05BX102K
C15	1.5, 50V	89016	Kenet K1R5W50
C16			
C17	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C18			
C19	5pF	89017-50	CM05ED050J03
C20			
C21	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C22			
C23	0.001, 200V, 1%	87210	Vitramon CK05BX102K
C24	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C25			

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
C26	0.001, 200V, 1%	87210	Vitramon CK05BX102K
C27	0.1	88212-14	CK06BX104K
C28	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C29	1.5, 50V	89016	Kemet K1R5W50
C30	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C31			
C32	10, 25V	89719-9	
C33			
C34	33pF	89008-14	DM5EC330F
C35	1pF, 5%		DM5CC010A
C36			
C37	35pF	89008-14	DM5EC330F
C38			
C39	10, 25V	89719-9	Hilton SWT25Z210
C40			
C41	2.2, 60V	89719-14	SWT60Z22
C42	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C43	1.5, 50V	89016	Kemet K1R5W50
C44	6.8, 35V	89060	CS13BF685K
C45			
C46	0.01, 200V, 1%	87211	Vitramon CK06BX103K
C47	10, 25V	89719-9	Hilton SWT25Z10
C48	10, 50V	89719-16	Hilton SWT50Z10
C49	1800pF, 400V, 1%	88212-66	Paktron PP481
C50	750pF	89008-35	DM15
C51	6pF	89007-20	CM05ED060J03
C52	1800pF, 400V, 1%	88212-66	Paktron PP481
C53	750pF	89008-35	DM15
C54	Variable 15-60pF	88136	Erie
C55	Selected at test		
C56	0.01, 200V, 1%	88212-68	Paktron PP460
C57			
C58	0.47	89719-37	Erie 8131-050-651-474
C59	3.3pF, N750	89017-66	
C60	1000pF, 400V, 2%	88212-68	Paktron PP481
C61	10, 25V	89719-9	Hilton SWT25Z10
C62	0.01	87211	Vitramon CK06BX103K
C63	10, 25V	89719-9	Hilton SWT25Z10
C64	1.5, 50V	89016	Kemet K1R5W50
C65	100pF, 1%	89008-22	DM-5FY101
C66	36pF	89094	CD155Q36
C67			
C68	10, 25V	89719-9	Hilton SWT25Z10
C69			

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
C71	0.01	87211	CK06BX103K
C72	10, 25V	98719-9	
C73	10pF	89116	CD15C5Q1
C74	47, 25V	89719-19	H.H.Hilton
C75			
C76	68pF, 1%	89008-19	DM5
	DIODES		
CR1			
CR2			
CR3	1N914	89440-37	
CR4			
CR5			
CR6			
CR7	1N5314	89440-68	
CR8	1N936A, Zener, 9V	89436	
CR9			
CR10	1N914	89440-37	
CR11			
CR12	A114D	89440-10	
	TERMINALS		
E1			
E2			
E3			
E4			
E5			
E6			
E7			
E8			
E9			
C62	0.01	87211	Vitramon CK06BX103K
C63	10, 25V	89719-9	Hilton SWT25Z10
C64	1.5, 50V	89016	Kemet K1R5W50
C65	100pF, 1%	89008-22	DM-5FY101
C66	36pF	89094	CD155Q36
C67			
C68	10, 25V	89719-9	Hilton SWT25Z10
C69			
C71	0.01	87211	CK06BX103K
C72	10, 25V	98719-9	
C73	10pF	89116	CD15C5Q1
C74	47, 25V	89719-19	H.H.Hilton
C75			
C76	68pF, 1%	89008-19	DM5

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	DIODES		
CR1			
CR2			
CR3	1N914	89440-37	
CR4			
CR5			
CR6			
CR7	1N5314	89440-68	
CR8	1N936A, Zener, 9V	89436	
CR9			
CR10	1N914	89440-37	
CR11			
CR12	A114D	89440-10	
	TERMINALS		
E1			
E2			
E3			
E4			
E5			
E6			
E7			
E8			
E9			
E10	Terminal	89383	CT3653-2
E11			
E12			
E13			
E14			
E15			
E16			
E17			
E18			
E19			
E20			
E21	Terminal, Slotted	88510-39	CTC1028-2
E22			
E23			
E24			
E25			
E26			
E27	Terminal	89383	CTC3653-2
E28			
E29			
E30			
E31			
E32			
	RELAYS		
K1	Relay	89980-45	Sigma 191TE1C1-12G

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
	INDUCTORS		
All inductors are in microhenries unless otherwise specified.			
L1	8.0-12.0	89161-42	Cambion 7106-16
L2	5.44-8.16	89161-59	Cambion 7106-15
L3	0.544-0.816	89169-41	Cambion 7106-09
L4	8.0-12.0	89161-42	Cambion 7106-16
L5	17.6-26.4	89161-30	Cambion 7160-18
L6	0.544-0.816	89169-41	Cambion 7160-09
L7	100	89169-29	Delevan
L8			
L9	3.76-5.64	89161-58	Cambion 7106-14
L10			
	TRANSISTORS		
Q1	2N3906	89727	Motorola
Q2	2N3904	89700	Motorola
Q3	40823	87223-72	RCA
Q4	2N3906	89727	Motorola
Q5			
Q6	2N3904	89700	Motorola
Q7			
Q8	2N3906	89727	Motorola
Q9	2N5551	87223-63	
Q10	2N3906	89727	Motorola
Q11	2N5400	87223-54	
Q12			
Q13	2N3904	89700	Motorola
Q14	2N3906	89727	Motorola
Q15	2N3904	89700	Motorola
Q16	2N3906	89727	Motorola
Q17	2N3904	89700	Motorola
Q18	2N3906	89727	Motorola
	RESISTORS		
All resistors are 1/4W,5% unless otherwisew specified.			
R1	10K, 1/8W, 5%	89260	RC05GF103J
R2	5.1K, 1/8W,5%	89260-32	RC05GF512J
R3	75, 1/8W,5%	89260-33	RC05GF750J
R4	390	89180	RC07GF391J
R5	150, 1/8W, 5%	89260-28	RC05GF151J
R6	10K, 1/8W, 5%	89260	RC07GF103J
R7	1.5K, 1/8W, 5%	89260-64	RC05GF152J
R8	22, 1/8W, 5%	89260-62	RC05GF220J
R9	4.7K, 1/8W, 5%	89260-60	RC05GF472J
R10			
R11	560, 1/8W, 5%	89260-41	RC05GF561
R12	47K, 1/8W, 5%	89260-68	RC05GF473J
R13	27K, 1/8W, 5%	89260-52	RC05GF273J

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
R14	560, 1/8W, 5%	89260-41	RC05GF561J
R15	6.2K, 1/8W, 5%	89260-65	RC05GF622J
R16	100K, 1/8W, 5%	89260-26	RC05GF104J
R17	100, 1/8W, 5%	89260-18	RC05GF101J
R18	22, 1/8W, 5%	89260-62	RC05GF220J
R19			
R20	4.7K, 1/8W, 5%	89260-60	RC05GF472J
R21	2.2K, 1/8W, 5%	89260-43	RC05GF222J
R22	560, 1/8W, 5%	89260-41	RC05GF561J
R23	1.5K, 1/8W, 5%	89260-64	RC05GF152J
R24	2.2K, 1/8W, 5%	89260-43	RC05GF222J
R25	15K, 1/8W, 5%	89260-50	RC05GF153J
R26	22, 1/8W, 5%	89260-62	RC05GF220J
R27	47K, 1/8W, 5%	89260-68	RC05GF473J
R28	150K, 1/8W, 5%	89260-70	RC05GF154
R29	2.2K, 1/8W, 5%	89260-43	RC05GF222J
R30	Potentiometer, 5K	88453-32	Helitrim 62PR
R31	4.7K, 1/8W, 5%	89260-60	RC05GF472J
R32	1K	89220	RC07GF102J
R33	1K, 1/8W, 5%	89260-24	RC05GF103J
R34	10K, 1/8W, 5%	89260	RC05GF103J
R35			
R36	1K, 1/8W 5%	89260-24	RC05GF102J
R37	470, 1/2W, 5%	88027	RC20GF511J
R38	510, 1/8W, 5%	89260-48	RC05GF511J
R39	47K, 1/8W, 5%	89260-68	RC05GF473J
R40	18K, 1/8W, 5%	89260-56	RC05GF183J
R41	10, 1/8W, 5%	89260-61	RC05GF100J
R42	33K, 1/8W, 5%	89260-16	RC05GF333J
R43	82K, 1/8W, 5%	89260-69	RC05GF823J
R44	1.2K, 1/8W, 5%	89260-63	RC05GF122J
R45	100, 1/8W, 5%	89260-18	RC05GF101J
R46	5.1K	89260-32	RC05GF512J
R47	Potentiometer, 5K	88453-32	Heletrim 62PR
R48	33K, 1/8W, 5%	89260-16	RC05GF334J
R49			
R50	560, 1/8W, 5%	89260-41	RC05GF561J
R51	75, 1/8W, 5%	89260-33	RC05GF750J
R52	1, 1/2W, 5%	88538-9	RC20GF010J
R53	62, 1/8W, 5%	89260-30	RC05GF620J
R54	100K, 1/8W, 5%	89260-26	RC05GF104J
R55	47K, 1/8W, 5%	89260-68	RC05GF473J
R56	1K, 1/8W, 5%	89260-24	RC05GF102J
R57	2.2K, 1/8W, 5%	89260-43	RC05GF222J
R58	150, 1/8W, 5%	89260-28	RC05GF151J
R59	Potentiometer	88453-36	Helitrim 62 PR
R60	1K, 1/8W, 5%	89260-24	RC05GF102J
R61			
R62	2K, 1/8W, 5%	89260-19	RC05GF202J
R63	1K, 1/8W, 5%	89260-24	RC05GF102J

Parts List

REF DES	DESCRIPTION	PART NO.	SIMILAR TO
R64	12K, 1/8W, 5%	89260-66	RC05GF123J
R65			
R66	Potentiometer, 100K	88453-65	Helitrim 62 PR
R67			
R68	1M, 1/8W, 5%	89260-72	RC05GF105J
R69			
R70	Potentiometer, 50K	88453-16	CTSX201R503B
R71	1K, 1/8W, 5%	89260-24	RC05GF102J
R72	27K, 1/8W, 5%	89260-52	RC05GF102J
R73	33, 1/8W, 5%	89260-23	RC05GF330J
R74	100K, 1/8W, 5%	89260-26	RC05GF104J
R75	47K, 1/8W, 5%	89260-68	RC05GF473J
R76	10K, 1/8W, 5%	89260	RC05GF103J
R77	22K, 1/8, 5%	89260-67	RC05GF223J
R78			
R79	330, 1/8W, 5%	89260-31	RC05GF331J
R80	5.1K, 1/8W, 5%	89260-32	RC05GF512J
R81	10, 1/8W, 5%	89260-61	RC05GF100J
R82			
R83	47K, 1/8W, 5%	89260-68	RC05GF473J
R84	33, 1/8W, 5%	89260-23	RC05GF330J
R85	470K, 1/8W, 5%	89260-71	RC05GF474J
R86	330, 1/8W, 5%	89260-31	RC05GF331J
R87	5.1K, 1/8W, 5%	89260-32	RC05GF512J
R88	10, 1/8W, 5%	89260-61	RC05GF100J
R89			
R90	75	89280	RC05GF750J
R91	68	89482	RC05GF680J
R92	2.43K, 1/8W, 1%	89311	RN55D2R43F
R93	10.5K, 1/8W, 1%	89256-78	RN55D10R5F
	INTEGRATED CIRCUITS		
U1	MC1350P	89976-70	Motorola
U2	NE5558 or MC1458	89976-22	Signetics or Motorola
U3	MC1375P	89976-71	Motorola
U4	MA739C	89976-9	Fairchild

REF DES	DESCRIPTION	PART NO.	SIMILAR TO

The following components differ for:

SUBCARRIER DEMODULATOR PWB ASSY PN 805220-2

C3	20pF	89017-57	CM05ED020J03
C4	12pF	89085	CM05FD120J503
C5	0.0051, 200V, 1%	88212-69	
C6	12pF	89085	CM05FD120J503
C7	47pF	88212-1	CM05ED 420J03
L1	54.4-81.6	89161-65	Cambion 7106-21
L2	26.4-39.6	89161-64	Cambion 7106-19
L3	0.162-0.816	89161-41	Cambion 7106-4
L4	54.4-81.6	89161-65	Cambion 7106-21
L5	26.4-39.6	89161-64	Cambion 7106-19
L6	0.544-0.816	89161-41	Cambion 7106-9

SUBCARRIER DEMODULATOR PWB ASSY PN 805220-3

C3	56pF	80917-77	CM05ED560J03
C4	33pF	89139	CM05ED330J03
C5	0.0015, 400V, 1%	88212-74	Paktron PD-480
C6	33pF	89139	CM05ED330J03
C7	75pF	89017-78	CM05ED750J03

INDUCTORS

L1	17.6-26.4	89151-77	Caddell-Burns 6709-18
L2	3.76-5.64	89161-75	Caddell-Burns 6709-14
L3	0.376-0.564	89161-74	Caddell-Burns 6709-8
L4	17.6-26.4	89161-77	Caddell-Burns 6709-18
L5	12.0-18.0	89161-76	Caddell-Burns 6709-77
L6	0.554-0.816	89169-41	Cambion 7106-9

PAC
POWER SUPPLY

GENERAL

The PAC PS Power Supply (Figure 1-1) is a solid-state, regulated supply which provides a -22 Vdc output at a maximum 500 mA in continuous duty. It is used to power PAC series devices, such as the PAC-4 Modulator or the PAC-5 Demodulator. The supply can operate from either 115 Vac or 230 Vac input from 50 to 400 Hz. The supply features current limiting at 600 mA output. A neon lamp on the front panel indicates a blown fuse.

MECHANICAL

The Power Supply comes in a PAC series case measuring 5.5 inches wide by 1.6 inches high by 8.0 inches deep (13.97 x 4.06 x 20.32 cm) and weighs only 2.8 pounds (1.27 kg.). It is normally mounted in a PAC series rack mounting frame which is 19 inches wide by 1.75 inches high (48.26 x 4.45 cm) and holds three PAC series units. The -22 Vdc test point and the fuseholder/neon lamp are on the front panel for easy access.

THEORY OF OPERATION

The reader may wish to refer to Figure 1-2 for the following discussion.

The Power Supply has a regulated output of -22 volts at 500 mA, suitable for operation of two PAC series units; for example, two PAC-4 Modulators, two PAC-5 Demodulators, or a PAC-4 Modulator and a PAC-5 Demodulator.

The transformer has dual primary windings; series connected for 230 Vac operation or parallel connection for 115 Vac operation. A bridge rectifier is connected across the 26 Vac secondary. The output of the rectifier is filtered by a pair of 2300 μF capacitors.

The regulator circuit uses a series pass transistor with short circuit limiting.

The circuit operates as follows: Q4 and Q2 are Darlington connected; Q4 is the pass transistor; and Q2 is the driver. The base of Q2 is referenced by Q3 which is biased by potentiometer R3. Resistor R3 is part of a series-parallel circuit consisting of CR1,R1 and R2. Resistor R3 is adjusted to feed a portion of the output voltage back to Q3 as a reference. Q1 acts as a current limiting transistor. When maximum current (approximately 600 mA) is drawn through R5, the resulting voltage drop causes the emitter-to-base junction of Q1 to be turned ON, pulling the base of Q2 to ground potential thereby shutting down the supply. Diode CR6 acts to keep the base of Q3 from floating. Capacitor C1 provides a low impedance AC return to ground. Ferrite lead Z1 prevents high frequency oscillations in the current limiting circuit.

INSTALLATION

Figure 1-3 shows an exploded view of installation of the Power Supply in the PAC series rack mounting frame. Figure 1-4 shows optional power cables for use with the PAC-4 Modulator and the PAC-5 Demodulator. One end of each cable plugs into the rear panel connector on the Power Supply and the other end has lugs for connection to the terminal boards on the rear of the PAC series units. Lug connections and plug pins are given in Figure 1-4. Refer to the appropriate instruction manual for connections on the units.

MAINTENANCE AND TROUBLESHOOTING

Corrective maintenance procedures should be required on the Power Supply since (1) the input line is fused by FL1, (2) the transients are supressed by the winding resistance of transformer T1, and (3) the load current limiting provided by transistor Q1.

In the event of a regulator circuit failure, the series pass transistor rarely needs to be replaced, but it is adviseable to replace Q1, Q2 and even Q3 even if only one of these transformers has failed.

The output voltage is adjustable to -22 $\pm$ 2.0 Vdc by the use of potentiometer R3. This adjustment should be set to provide precisely the -22 Vdc output.

To change the Power Supply from 120 to 240 Vac operation, remove the top and bottom covers of the unit. Refer to the component layout diagram, Figure 1-5. Cut the buss straps available on the top of the printed circuit board and add a buss strap between the red and the orange leads.

The Power Supply assembly diagram is shown in Figure 1-6.

PARTS LIST

The list contains the necessary information for ordering replacement parts for the PAC PS Power Supply.

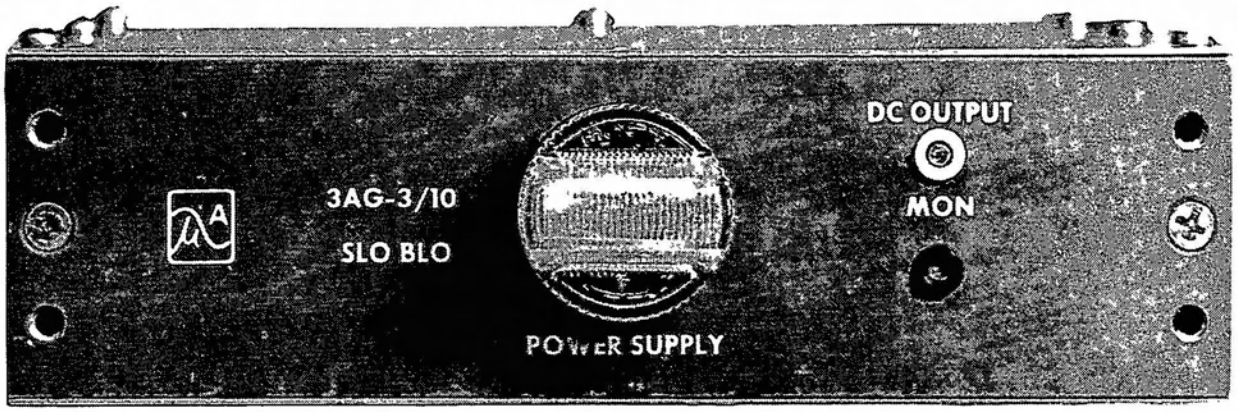


Figure 1-1. PAC Power Supply

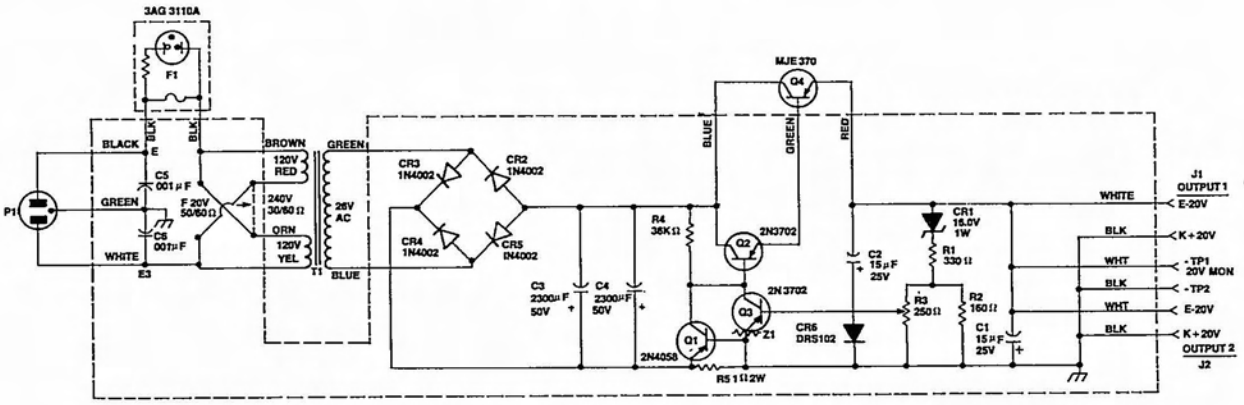


Figure 1-2. Power Supply Schematic Diagram

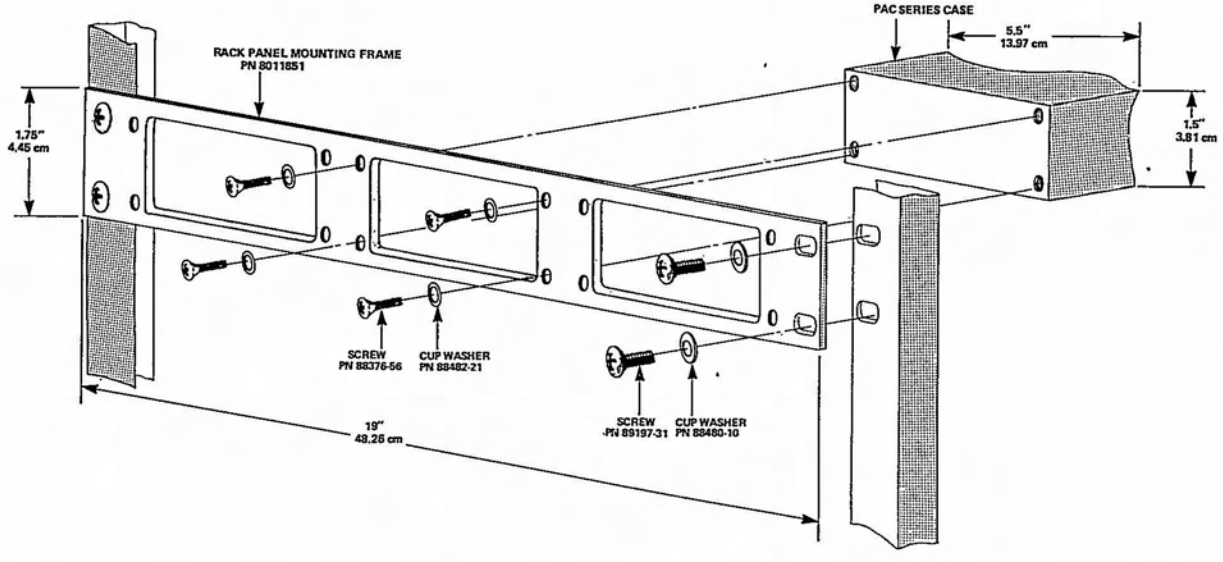


Figure 1-3. PAC Series Rack Mounting Frame

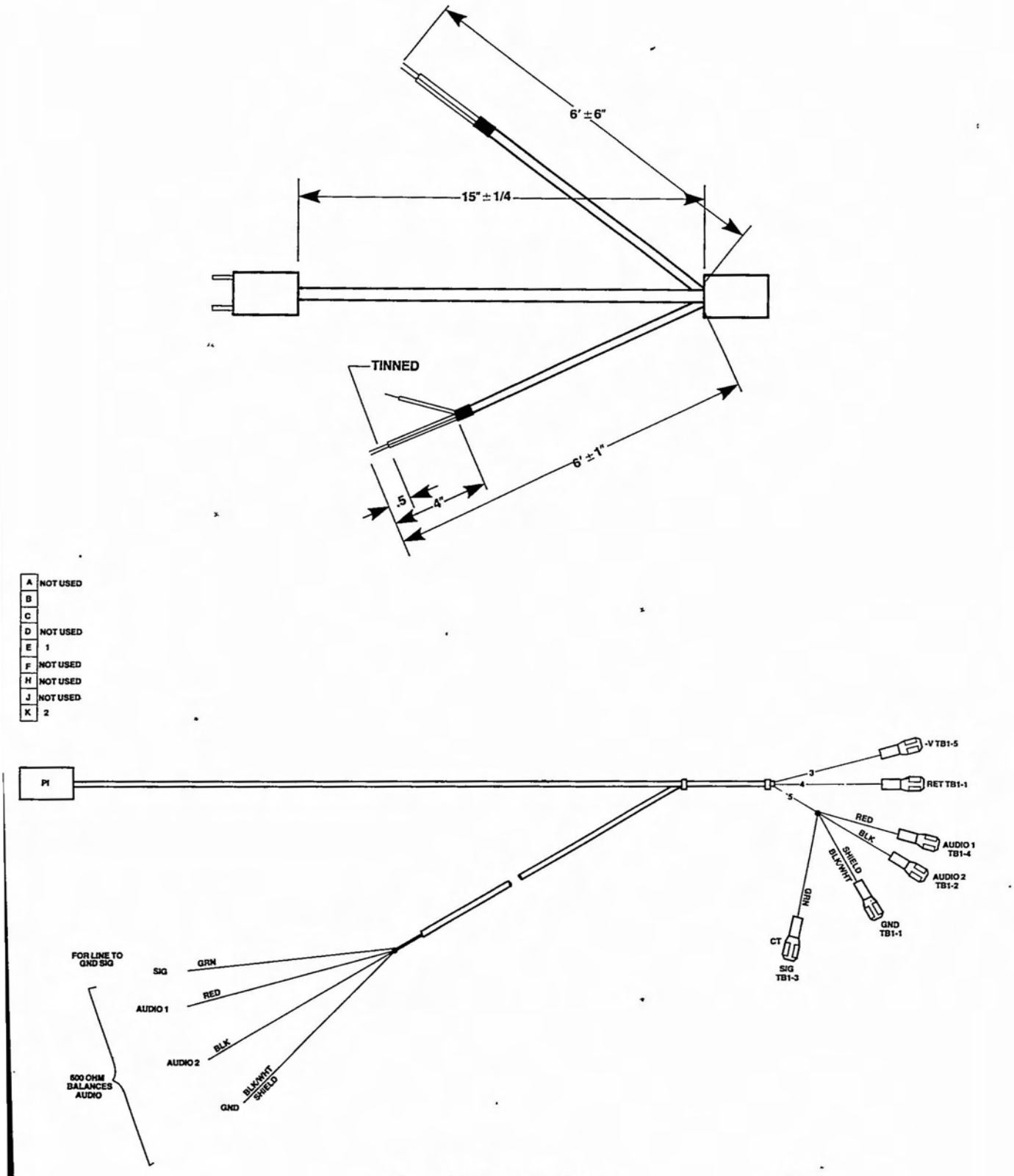


Figure 1-4. Power Cables
(AC Above DC Below)

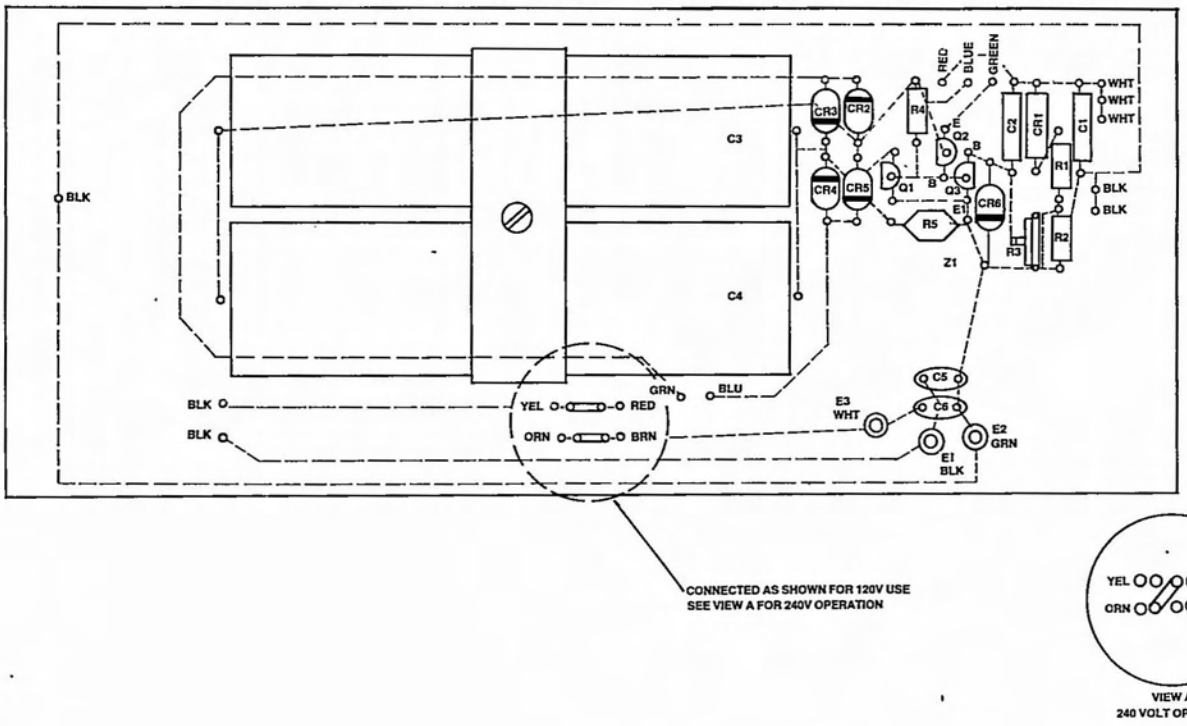


Figure 1-5. Power Supply, Component Location

REF DES	DESCRIPTION	MAC PART NO	SIMILAR TO

PRINTED CIRCUIT BOARD ASSEMBLY PN 801868

CAPACITORS

All capacitors are in microfarads unless otherwise specified.

C1 C2	15, 25V	89719-10	Hilton SWT25V15M
C3 C4	2300, 50V	89719-11	Sprague 39D238G050JT4
C5	0.001	88212-10	Erie 801-000-X5F0-102K

DIODES

CR1	Zener, 16.0V, 1V, 5%	89439-16	Schaner SZ16.0A
CR2 CR3 CR4	1N4002	89431	Motorola
CR5 CR6			

FUSES

F1	0.3 Amp, 125V, 3AG	88200-5	Little Fuse 313-300

CONNECTORS

J1 J2	9 pin, Type 34	88350-5	

PLUGS

P1	Cord, 3 conductor, 18GA	88305-2	Falmat F-17237-B

TRANSISTORS

Q1	2N4058	87223-10	
Q2 Q3	2N3702	87223-5	
Q4	MJE370	87223-11	

RESISTORS

All resistors are in ohms, 1/4W, 5% unless otherwise specified.

R1	330	89205	RC07GF331J
R2	160	89200-13	RC07GF161J
R3	Potentiometer, 25	88453-19	CTS X201R251B
R4	1, 1W, 10%, Wirewound	88539-12	Ward-Leonard RS2X1

TRANSFORMER

T1	MP11200	801889	Lambda

PAC-SERIES AUDIO HOT STANDBY SWITCH

GENERAL

The PAC-Series Audio Hot Standby Switch (Figure 1-1) provides uninterrupted program audio channel service by an automatic switchover function to a Standby PAC-Series Modulator or Demodulator whenever a subcarrier failure in the primary PAC-Series Demodulator.

A front panel rotary selector switch permits manual override of relay switching action for test or maintenance purposes. Table 1-1 identifies the Audio Hot Standby Switch options according to their use. Table 1-2 lists performance specifications of the Audio Hot Standby Switch.

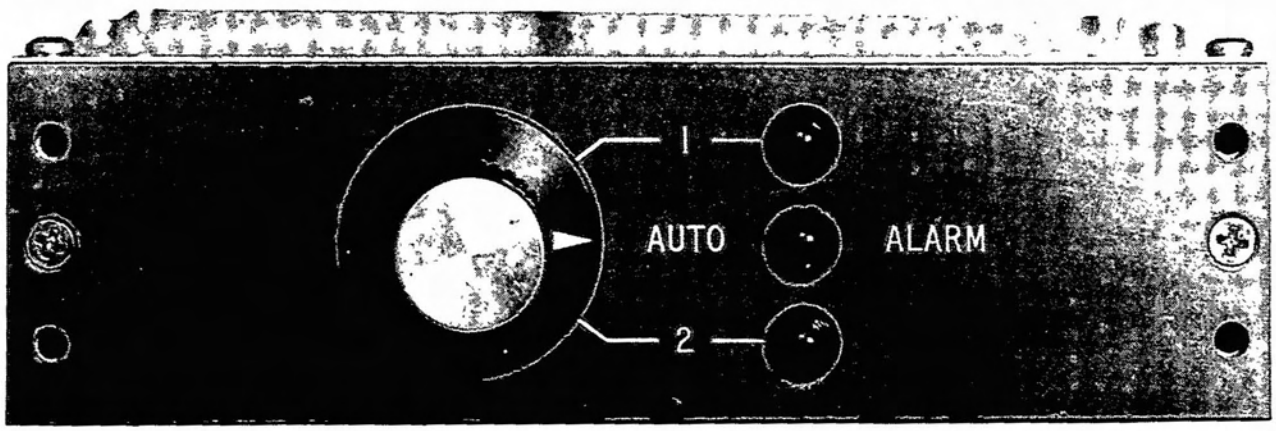


Figure 1-1. PAC Series Audio Hot Standby Switch

Table 1-1. Hot Standby Switch Options

MAC PN	VERSION (USED WITH)
804424-1 804424-2 804424-4	PAC-4 (AC) PAC-5 (AC) PAC-5 (DC)

Table 1-2. Performance Specifications

Operation	Automatic fault actuated relay switching or manual override.
Audio Input/Output	
Level	0 to 18 dBm per system requirements
Impedance	600 ohms balanced
Supply Voltage	-20 to -24 Vdc at 125 mA

MECHANICAL DESCRIPTION

The PAC Series Audio Hot Standby Switch is designed for mounting in a standard PAC-Series 19 inch rack bezel which occupies one unit of vertical rack space (1-3/4 inches). The module measures approximately 5-1/2 inches wide by 1-1/2 inches high by 8-1/2 inches long (13.97 x 3.81 x 21.59 cm.).

Front panel consists of a three-position rotary selector switch (1-AUTO ALARM-2) and three LED indicator lights.

Four cables and connectors, located at the rear of the module (Figure 1-2) provide the required electrical connections with the PRIMARY and STANDBY PAC-Series Modulators or Demodulators and two PAC-PS Power Supplies.

Fanning leads connect to PAC-5 Demodulator's terminal board. Audio Hot Standby Switch units, when used with PAC-4 Modulators, have multipin plugs which connect to control plug J201.

THEORY OF OPERATION

The Audio Hot Standby Switch is normally operated in the automatic mode with rotary mode selector switch (1-AUTO ALARM-2) in the AUTO ALARM position. Switch positions 1 and 2, with the front panel rotary switch provides an operational check of either the PRIMARY/ON-LINE or STANDBY channels.

In the following discussion, a PAC Series "Unit" can be either a PAC-4 Modulator or a PAC-5 Demodulator, depending on application.

In the automatic operating mode, the PAC Series Audio Hot Standby Switch module provides automatic switchover to a Standby PAC Series unit whenever a subcarrier failure occurs in the on-line unit, as indicated by the unit's carrier alarm relay. Both units are equipped with carrier alarm options when used with the hot standby configuration. The units' carrier alarm circuit supplies alarm relay contacts to the Audio Hot Standby Switch module when loss of subcarrier occurs in either a primary or backup unit.

Table 1-3 lists the switch position functions.

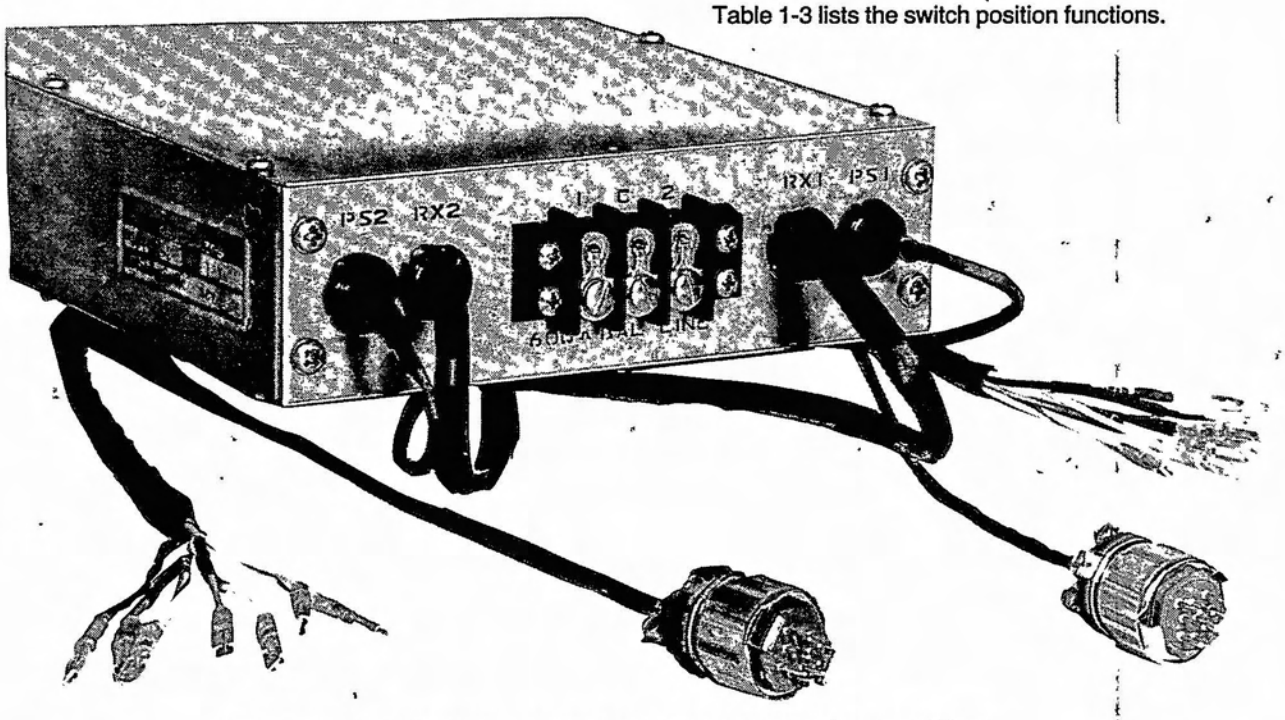


Figure 1-2. PAC Series Audio Hot Standby Switch- Rear View

Table 1-3. Switch Functions

SWITCH POSITION	INDICATOR LAMPS	FUNCTION
AUTO	AUTO,1	Primary Demodulator in use,normal operation.
AUTO	AUTO,2	Fault in primary Demodulator, standby Demodulator in use.
1	1	Automatic switching overridden-primary Demodulator manually selected.
2	2	Automatic switching overridden-standby Demodulator manualy selected.

In the PAC Series Audio Hot Standby switching system schematic diagram (Figure 1-3), RX1 is the primary unit and RX2 the backup unit. Plugs P1 and P2 are connected to their respective power supplies. When the Audio Hot Standby Switch is in the automatic mode, the failure of the primary unit will cause pin A of J1 to be grounded by the unit carrier fault relay. Current will flow from the power supply connected to P1 or P2 or both power supplies (NOTE: CR1 and CR2 isolate each power supply from the failure of the other). Relays K1 and K2 will switch from the primary unit to the backup unit (relay contact pin 14 to pin 8 for backup unit and pin 14 to pin 1 for the primary unit.).

If the Audio Hot Standby Switch has switched to the backup unit, then it will not switch in the event of that unit's failure.

When the Audio Hot Standby Switch is manually switched to either unit 1 (primary) or unit 2 (backup), it will not switch and will stay in the selected position.

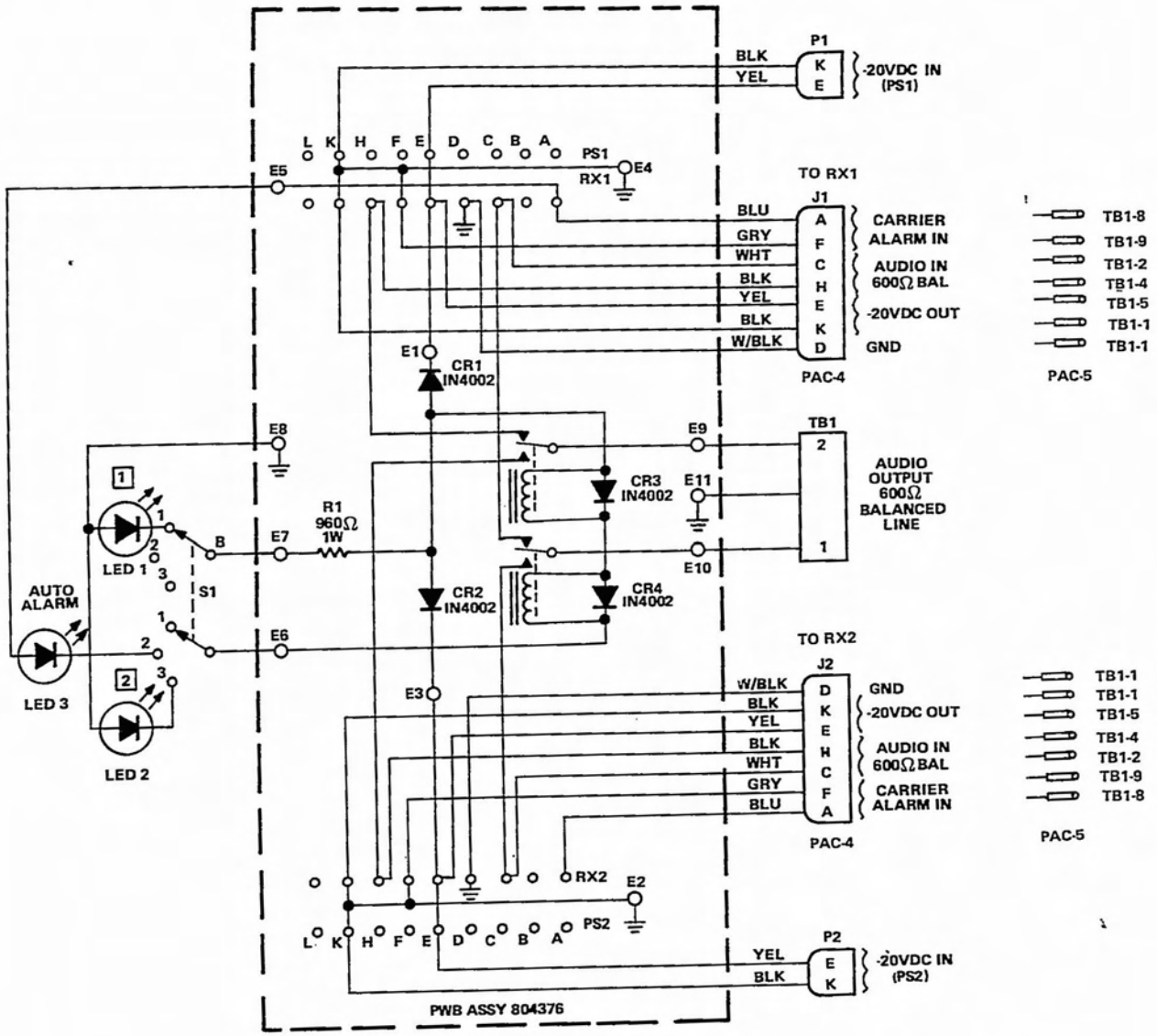


Figure 1-3. PAC Series Audio Hot Standby Switch- Schematic Diagram

INSTALLATION

The PAC Audio Hot Standby Switch mounts in a standard PAC series rack mounting panel (Figure 1-4).

The 600 ohm balanced audio output is available via a terminal strip on the rear of the unit. The center screw (Figure 1-2) is grounded and cannot be used to carry signals. The two outer positions (marked "1" and "2") are the 600 ohm balanced output.

Plugs P1 and P2 connect to the rear panels of the primary and backup PAC PS Power Supplies, respectively.

Connectors J1 and J2 are either jacks, which connect to the primary and the backup PAC-4's respectively (Figure 1-2) or are fan-outs, which connect to the terminal boards on the primary and back-up PAC-5's respectively. The terminal board connections are listed in Table 1-4.

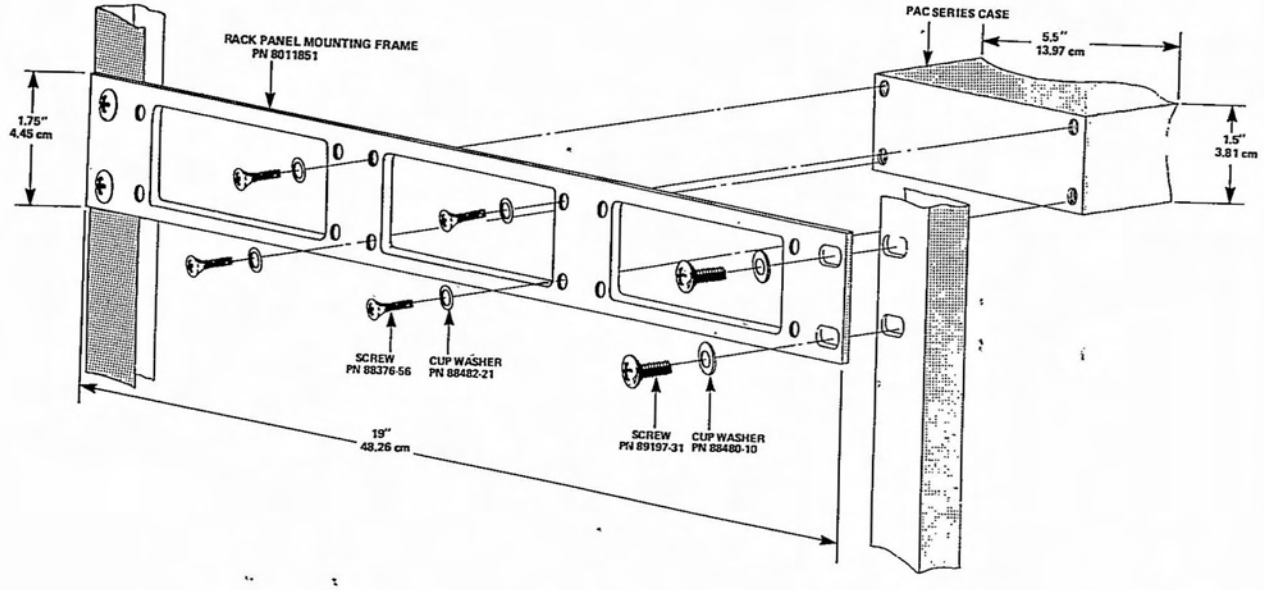


Figure 1-4. PAC Series Rack Mounting Frame

Table 1-4. Terminal Board Connections

COLOR	FROM SWITCH TERMINAL	TO PAC-5 TB1	FUNCTION
Blue	K	-1 Chassis Ground	Ground
Yellow/Orange	E	-5 (White)	-20 VDC
White/Green	F	-9 (White/Brown)	Alarm
White/Red	A	-8 (Grey)	Alarm
Black	H	-4 (White/Black/Yellow)	Audio
White/Black	D	-1 (Black)	Audio
White	C	-2 (Green)	Audio

MAINTENANCE AND TROUBLESHOOTING

MAINTENANCE. Operation of the Audio Hot Standby Switch should be checked at regular intervals. All connections should be checked for continuity. Other than these precautions, there is no maintenance required for the Audio Hot Standby Switch.

TROUBLESHOOTING. The Audio Hot Standby Switch schematic provides sufficient information for troubleshooting. Diodes, relay coils, and relay contacts can be checked for continuity and input voltages can be measured using a VOM, such as a Simpson 260. The component location diagram (Figure 1-5) is provided to aid in troubleshooting.

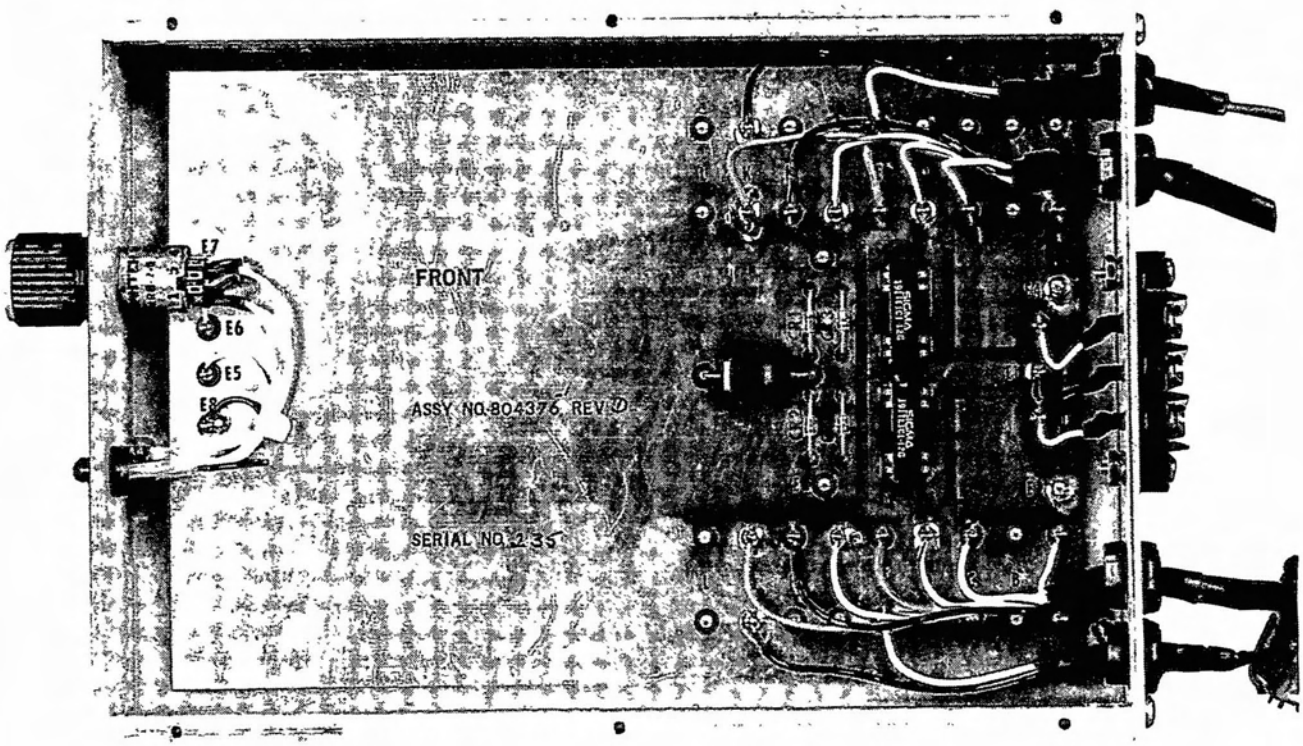


Figure 1-5. PAC Series Audio Hot Standby Switch- Component Locations

VIDEO LOW PASS FILTER

The Video Low Pass Filter is used in systems with the PAC-4 and PAC-5. It is used to pass video baseband signals below the filter's cutoff frequency. Input and output connectors are type BNC. Figure 1-1 is an outline drawing of the filter which is mounted in a PAC series case. Filter configurations are listed in Table 1-1.

The Video LPF is installed in a PAC Series Rack Mounting Frame, as are other PAC Series units, shown in Figure 1-2.

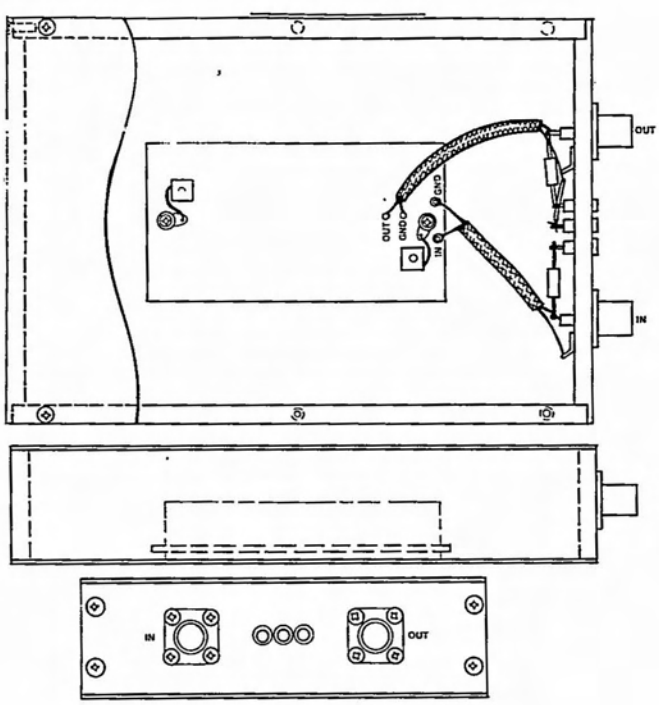


Figure 1-1. Video Low Pass Filter

Table 1-1. Video Low Pass Filter Configurations

CUT-OFF FREQUENCY	PART NUMBER
4.2	807480-1
4.5	807480-2
5.0	807480-3
5.5	807480-4
5.8	807480-5
6.5	807480-6

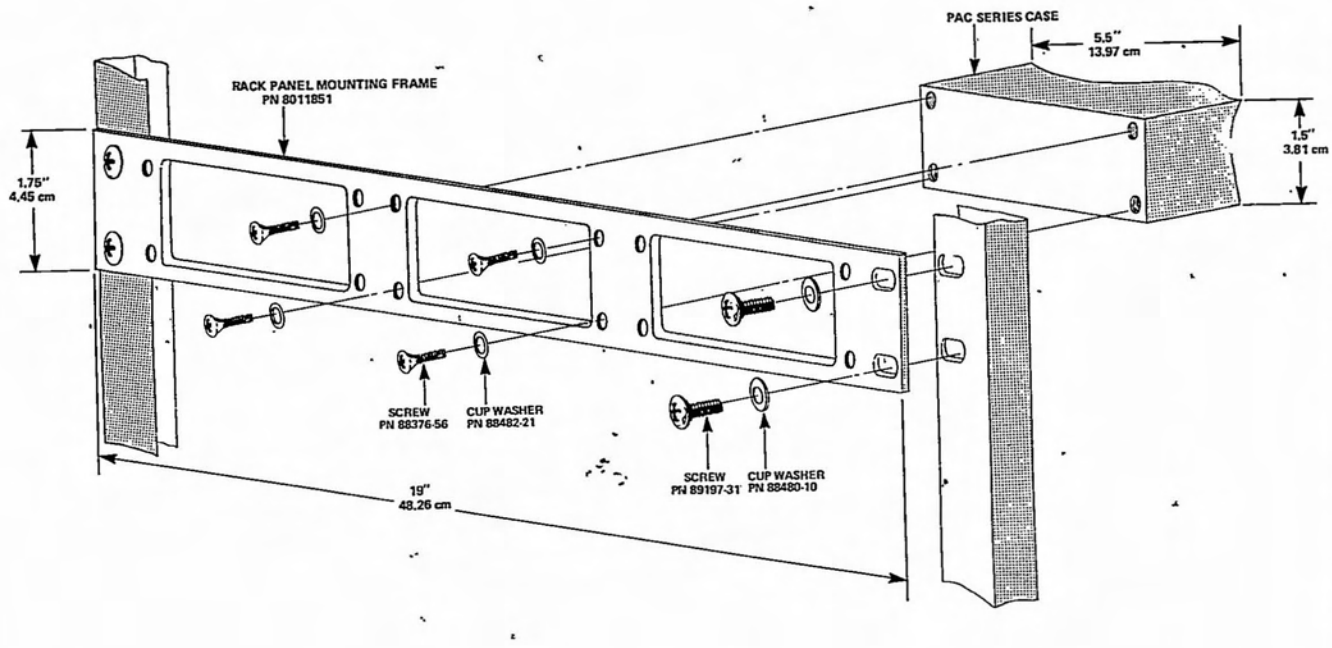


Figure 1-2. PAC Series Mounting Frame