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Technical Manual

PR&E Document #75-16

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Page No.	Revision	Comments
ALL	A	New Release.
ALL	B	Corporate Name Change

EXP-11
ACCESSORY MODULE MAINFRAME
TECHNICAL MANUAL

1.0 GENERAL INFORMATION

This chapter contains an introduction to the EXP-11 Accessory Module Mainframe Technical Manual, an overview of the EXP-11's features, and specification and warranty information.

1.1 INTRODUCTION

Congratulations on your decision to join the growing ranks of Pacific Research & Engineering Corporation (PR&E) broadcasters. PR&E is in the business of supplying the finest audio systems to the world's leading broadcast facilities. Your decision to go with PR&E means that you expect more than simple working hardware. Please be assured that it is our strong desire to provide each of our customers with the kind of products, systems, documentation and support that we would specify if we were in your position.

We invite your comments and suggestions for improvement of this document, and of all our services. By constant attention to our customer's needs, we will continue to earn our reputation for excellence, and to refine our understanding of the requirements of the marketplace.

This manual is designed to provide the information required to understand, install, operate, and maintain the EXP-11 Accessory Module Mainframe. It is assumed that the reader has a working knowledge of audio devices, systems, and installation practices. To obtain the maximum benefit of the mainframe's capabilities, as well as the capabilities of the individual processing modules, it is strongly recommended that the Installation, Set-Up and Operation, and Equipment Description chapters of this manual be read completely prior to installing the unit.

Each EXP-11 is thoroughly tested and "burned-in" prior to packing for shipment. Should you encounter any difficulty during installation or initial operation, we recommend that you contact PR&E for assistance.

1.2 OVERVIEW

The EXP-11 Accessory Module Mainframe accepts the same equalization and voice processing modules as used in our ABX and AMX series consoles. Each EXP-11 is a powered mainframe housing unit, configured for a particular application by the installation of appropriate plug-in accessory modules. The plug-in regulated power supply assembly is installed in the rear of the mainframe, and each unit will

accommodate up to eleven plug-in accessory modules.

At present, there are three different modules available for use in the EXP-11 mainframe: a Monaural Equalizer Module, a Stereo Equalizer Module, and a Voice Processing Module. The Monaural Equalizer Module provides both equalization and filter facilities in one compact module; the Stereo Equalizer Module provides two separate, but coupled, three band equalizers; and the Voice Processor Module provides a switch-insertable equalizer which covers the frequency range normally required for voice signal correction and/or enhancement, as well as a second section containing the expander, compressor, and de-esser systems. These modules are described in detail in Chapters 3 and 4 of this document.

All mainframe positions are universal, so the three modules may be installed in the unit in any order or combination, as specified by the customer. Each module has a corresponding connector located on the rear panel of the mainframe, and the accessory system can be wired directly to the console's patch connectors for dedicated processing, or to a patch bay system.

1.3 SPECIFICATIONS

Following is a list of specifications for the EXP-11 Accessory Modules:

INPUTS

Source Impedance	600 ohms, or less.
Input Impedance	Greater than 40K ohms, balanced.
Input Level	Nominal -10 dBu.
Input Headroom	Greater than 30 dB above nominal input.

OUTPUTS

Load Impedance	600 ohms, minimum.
Source Impedance	40 ohms, unbalanced.
Output Level	Nominal -10 dBu.
Maximum Output Level	+20 dBu.

POWER REQUIREMENTS

Fully configured EXP-11	50 watts @117 VAC, ±10%, 60 Hz

NOTE: 0 dBu corresponds to an amplitude of 0.775 volts RMS regardless of the impedance of the circuit. It is the same voltage value as 0 dBm measured in a 600 ohm circuit. This enables convenient level measurement with meters calibrated for 600 ohm circuits.

1.4 WARRANTY INFORMATION

This product carries a manufacturer's warranty which is subject to the following guidelines and limitations:

A) Except as expressly excluded hereinafter, Pacific Research & Engineering Corporation ("Seller") warrants equipment of its own manufacture against faulty workmanship or the use of defective materials for a period of one (1) year from date of shipment to Buyer. The liability of the Seller under this Warranty is limited to replacing, repairing or issuing credit (at the Seller's discretion) for any equipment, provided that Seller is promptly notified in writing within five (5) days upon discovery of such defects by Buyer, and Seller's examination of such equipment shall disclose to its satisfaction that such defects existed at the time shipment was originally made by seller, and Buyer returns the defective equipment to Seller's place of business in Carlsbad, California, packaging and transportage prepaid, with return packaging and transportage guaranteed.

B) Equipment furnished by Seller but manufactured by another shall be warranted only to the extent provided by the other manufacturer.

C) Thermal filament devices such as lamps and fuses are expressly excluded from this warranty.

D) The warranty period on equipment or parts repaired or replaced under warranty shall expire upon the expiration date of the original warranty.

E) This Warranty is void for equipment which has been subject to abuse, improper installation, improper operation, improper or omitted maintenance, alteration, accident, negligence (in use, storage, transportation or handling), operation not in accordance with Seller's operation and service instructions, or operation outside of the environmental conditions specified by Seller.

F) This Warranty is the only warranty made by Seller, and is in lieu of all other warranties, including merchantability and fitness for a particular purpose, whether expressed or implied, except as to title and to the expressed specifications contained in this manual. Seller's sole liability for any equipment failure or any breach of this Warranty is as set forth in subparagraph A) above; and Seller shall not be liable or responsible for any business loss or interruption, or other consequential damages of any nature whatsoever, resulting from any equipment failure or breach of this warranty.

2.0 INSTALLATION

This chapter provides instruction in the proper installation of the EXP-11. Included are sections outlining general installation guidelines, cable preparation, mainframe configuration, audio connections, grounding and shielding, power connection, and module options.

2.1 GENERAL GUIDELINES

The EXP-11 should be carefully unpacked and inspected for any shipping damage. If the inspection reveals any damage, immediately file a claim with the delivering carrier. The packing material should be kept as evidence of mishandling, as well as to allow return of the equipment to the factory, if necessary.

The packed items should include the EXP-11 (with accessory modules installed), the power cord, a spare parts kit (as described in Section 5.3), and a connector kit (PR&E #76-67). This connector kit is used to prepare the audio input/output cables (as outlined in Section 2.2), and contains the following:

DESCRIPTION	QTY	PR&E#
MOLEX Connector Housing, 9 Pin	11	15-604
MOLEX Connector Housing, 12 Pin	11	15-605
MOLEX Connector Pins, Male	225	15-3

The installation of the EXP-11 is very simple. Signal and AC power connections are made to the connectors located on the rear of the mainframe.

The mainframe requires 4 rack units of height (7") in a standard rack width of 19". The depth of the EXP–11 from the rack rails is 15.75", however, it is recommended that the installation allow an additional two inches to accommodate rear panel connections and cable bends.

Because the power supply is internal to the EXP-11, adequate ventilation of the rear mounted regulator heat sinks must be provided for the proper dissipation of heat. The supply is designed for convection cooling by use of a conservatively designed power transformer and a large regulator heatsink mounted on the rear of the power supply assembly. The power transformer used in the EXP-11 is a toroidal type which exhibits a low radiated hum field, thereby reducing the need to isolate this frame from sensitive magnetic equipment.

NOTE: Care should be taken to avoid locating the frame within six feet of any intense electromagnetic hum fields such as those produced by large power transformers and motors. Likewise, cables to and from the frame should be routed to achieve maximum practical distance from AC mains power wiring. Particular attention should be paid to some of the low-cost, supposedly "professional", power amplifiers which have appeared in the marketplace. In many cases the low cost has been partially achieved through the use of small core power transformers operating at or on the edge of saturation. While these units may operate to their own specifications, the electromagnetic fields they radiate may impair the performance of the EXP-11 or neighboring equipment such as tape recorders, cassette decks and cartridge machines.

2.2 CABLE PREPARATION

Before beginning the installation, a plan should be drawn up showing how the system will be interconnected. All cables and connectors should be tagged with numbers and/or legends, and logged.

Only unspliced (preferably new) cables should be used in connecting the mainframe. Audio connections should be made with 2-conductor stranded insulated foil shielded cable with drain wire. The cable used should be equivalent to Belden types 8451, 9451, or 8761.

The Molex pins are designed so that the short tab "ears" are crimped onto the stripped wire to make the electrical connection, while the long "ears" are crimped over the insulated section of the wire to help support the connection. See Figure 2.1 for an example of a properly crimped Molex pin.

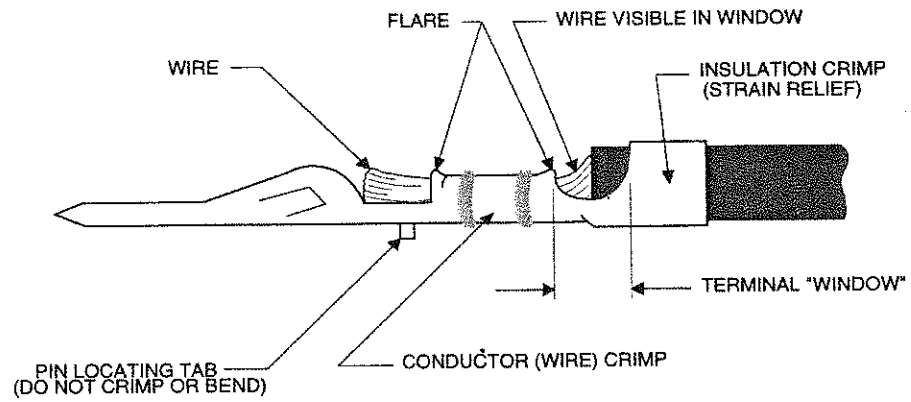


FIGURE 2.1
MOLEX CRIMP PIN

Insulation jacket and foil shield on cables should be stripped back about 1.5 inches. The shield drain wire should be sleeved with heat-shrink tubing leaving about 3/16 inch wire exposed. Strip the insulation of each signal wire back about 3/16 inch.

NOTE: It is very important to sleeve the shield drain wire and the shield (at cable ends) with heat-shrink tubing. This is the only means of assuring an installation according to recommended grounding procedures.

In order to crimp, insert the short ears of the Molex crimp pin into notch "B" of the crimping tool (PR&E #70-3), with the ears poin g toward the letter "B". Insert the wire into the terminal so that the stripped portion is between the short crimp ears, and the insulation is between the long crimp ears. Crimp the short ears.

Now place the long ears of the pin into tool notch "A", with the ears pointing toward the letter "A". Crimp the long ears over the insulated section of wire.

NOTE: When using Molex Crimping Tool #HTR-1719-C (PR&E #70-5), place a pin into slot #20-24

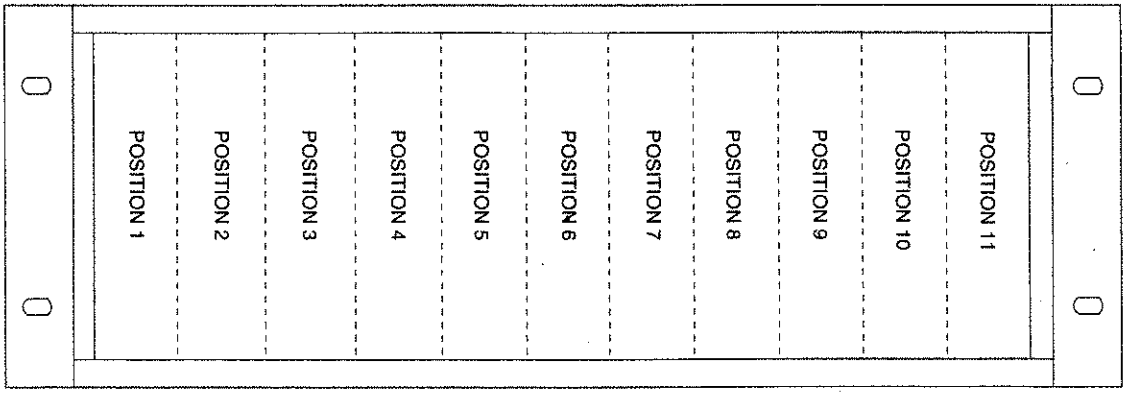
with the long ears on the "WIRE SIDE" of the tool and pointing toward the words "WIRE SIDE. Place the wire into the tool from the "WIRE SIDE", and then crimp the pin.

Logic control cables, when used, should be fabricated in a similar manner using 22 gauge multiple conductor, non-shielded, jacketed cable. The number of conductors required should be determined by application.

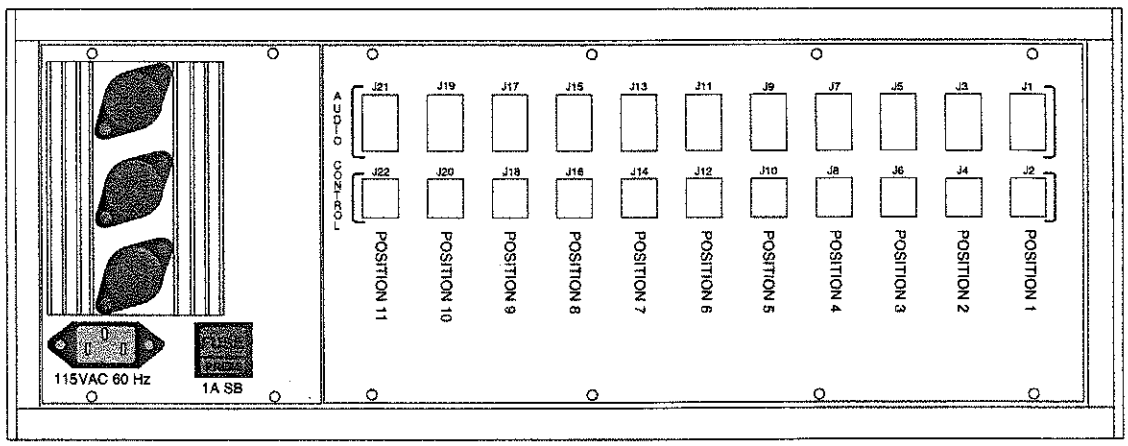
Once the pins are crimped, they may be inserted and locked into the nylon connector housing (a click can be felt indicating that the locking ears on the pin have set). If a pin is inserted in the wrong connector position, or it is desired to make a circuit change, use the connector pin extractor tool (PR&E #70-4) to release the pin and press it out of the connector housing.

2.3 MAINFRAME CONFIGURATION

The EXP-11 mainframe is factory configured to each order by the installation of the Voice Processing, Monaural and Stereo Equalizer modules in customer specified locations. Each of the processing modules



FRONT VIEW



REAR VIEW

FIGURE 2.2 MAINFRAME CONFIGURATION

installed in the front of the EXP-11 frame will have a corresponding audio connector located on the rear panel. There are also control connectors on the rear panel which have been provided for possible use in the future, but are not used by the existing processing modules. See Figure 2.2 for examples of the front and rear mainframe configurations.

2.4 AUDIO CONNECTION

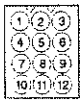
A standard connection theme is used throughout most PR&E equipment designs - the use of 3, 6, 9 and 12 pin Molex connectors for audio wiring. This system of pin assignments takes advantage of the three pin per row design of the Molex connectors and, therefore, makes visual inspection of the finished wiring easier. As viewed from the rear of the product, the shields (if connected) are always connected to the left pins, the low wires (black) to the center pins and the high wires (red) to the right pins.

While this inspection will not indicate if a connector is in the correct position, it will verify proper shield and polarity connection.

Complete information relative to audio input and output terminations is contained in Figure 2.3. Good wiring practice calls for care in making each connection, and in neatness of cable layout.

MONAURAL EQUALIZER MODULE

AUDIO



AUDIO WIRING				
		Pin Number		
Signal	Connector	Shield	Low	High
Mono Equalizer Input	Audio	1	2	3
-No Connection-	Audio	4	5	6
Mono Equalizer Output	Audio	7	8	9
-No Connection-	Audio	10	11	12

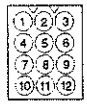
STEREO EQUALIZER MODULE

AUDIO

AUDIO WIRING				
		Pin Number		
Signal	Connector	Shield	Low	High
Stereo EQ Input/Left	Audio	1	2	3
Stereo EQ Input/Right	Audio	4	5	6
Stereo EQ Output/Left	Audio	7	8	9
Stereo EQ Output/Right	Audio	10	11	12

VOICE PROCESSOR MODULE

AUDIO



AUDIO WIRING				
		Pin Number		
Signal	Connector	Shield	Low	High
Voice Processor Input	Audio	1	2	3
-No Connection-	Audio	4	5	6
Voice Processor Output	Audio	7	8	9
-No Connection-	Audio	10	11	12

FIGURE 2.3 MODULE WIRING CONFIGURATIONS

2.4.1 Input Signal

The input signal fed to each module of the EXP-11 should be applied from a source of 600 ohms or less. The level should be -10 dBu (245 mVRMS), which corresponds to the nominal patch point level of all PR&E consoles and most auxiliary processing equipment.

The input circuits are balanced differential amplifiers, and can accommodate both balanced and unbalanced signal sources.

2.4.2 Output Signal

Because the processing devices are unity gain, the output level of each module will be identical to its applied input level. The outputs are unbalanced with a nominal source impedance of about 40 ohms, and are capable of driving 600 ohm loads if necessary.

2.5 GROUNDING & SHIELDING

Grounding in modern broadcast equipment is more critical than with older devices of more limited band-pass capabilities. Achieving low impedance system ground with a small piece of equipment is relatively easy. However, the problem becomes progressively more difficult as the overall system becomes larger. When designing consoles and accessories, much thought is given to system grounding requirements and the elimination of DC path ground loops.

When grounding the EXP-11, observe the following guidelines:

A) The shield wires interconnecting a console and a piece of auxiliary equipment should be connected at the console end only, and should not be terminated to the ground of the auxiliary equipment.

B) Ensure that the auxiliary equipment is connected to a "clean" ground by the power cord assembly, or by the addition of a separate ground wire connected between the chassis and the station's common earth ground.

NOTE: A preferred method of connecting the line shields in a system is to connect **both** ends of every shield to **all** affiliated equipment. However, this method is only satisfactory if every component shares a common earth ground. This can be accomplished using isolated ground receptacles tied to the station's "technical" ground.

Buzz pickup is generally electrostatic, due to capacitive pickup between an audio line and a power line. When shielded lines are used this should be no problem, unless the audio lines are run in the same wire-way or area as a power line. Radio-frequency interference can also manifest itself as a buzz in the program audio. With the extensive RF bypassing and ground-plane techniques used in the EXP-11 and its processing modules, and with shielded lines external to the unit, RF interference generally is easily controlled.

2.6 POWER CONNECTION

The EXP-11 is designed to operate at 115 VAC, 60 Hz, and requires a line fuse with a 1 ASB rating. Should the fuse ever need to be replaced, replace with the proper type only. The appropriate 3-wire power cord (supplied with the equipment) should be installed between the EXP-11 and the AC mains.

WARNING: Do not defeat the safety ground in any way. To do so may provide a potentially dangerous condition to the operator.

2.7 MODULE OPTIONS

This section describes the Monaural and Stereo Equalizer Module internal option switches, and their function.

2.7.1 Monaural Equalizer Option Switch

The Monaural Equalizer Module is equipped with an internal option switch which allows the bass response to always be shelf-mode on cut regardless of the setting of the front panel peak/shelf switch. With this option switch (S5) set in the ON position, the front panel peak/shelf switch controls only the boost mode. The purpose of this function is to recognize the realities of low frequency equalization of speech, music or mixed program material. While it is very desirable to have both peak and shelf options available in the boost function, it is very rare to use the reciprocal of the peak mode in cut functions. Since the peak is the more often selected boost mode, the option switch eliminates the need to be constantly shifting the peak/shelf switch between boost and cut operation. For the location of the internal switch, see Figure 2.4.

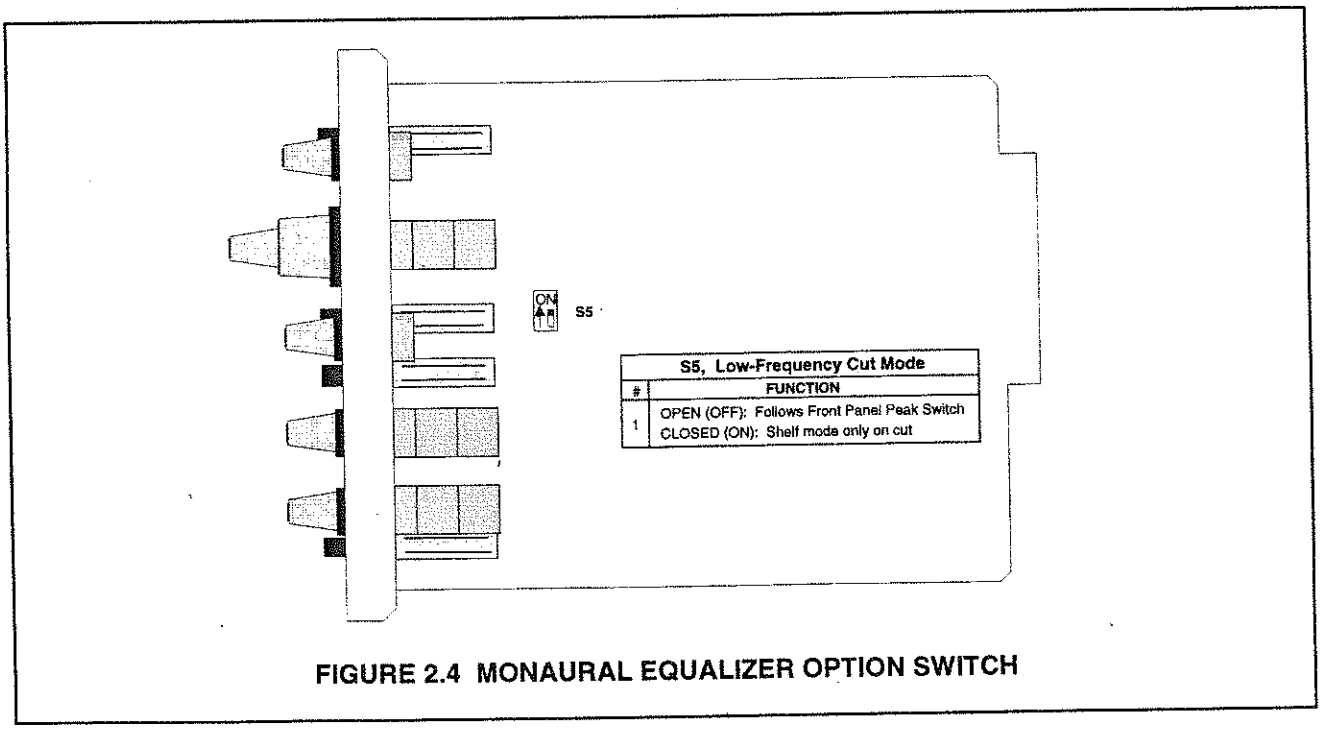


FIGURE 2.4 MONAURAL EQUALIZER OPTION SWITCH

2.7.2 Stereo Equalizer Option Switches

The Stereo Equalizer Module is equipped with internal option switches which allow the bass response to always be shelf-mode on cut regardless of the setting of the front panel peak/shelf switch. Unlike the Monaural Equalizer Module, this module requires that two internal switches, left (S2) and right (S102), be set to invoke this option. With these option switches set in the ON position, the front panel peak/shelf switch controls only the boost mode. The purpose of this function is to recognize the realities of low frequency equalization of speech, music or mixed program material. While it is very desirable to have both peak and shelf options available in the boost function, it is very rare to use the reciprocal of the peak mode in cut functions. Since the peak is the more often selected boost mode, the option switch eliminates the need to be constantly shifting the peak/shelf switch between boost and cut operation. For the locations of the internal switches, see Figure 2.5.

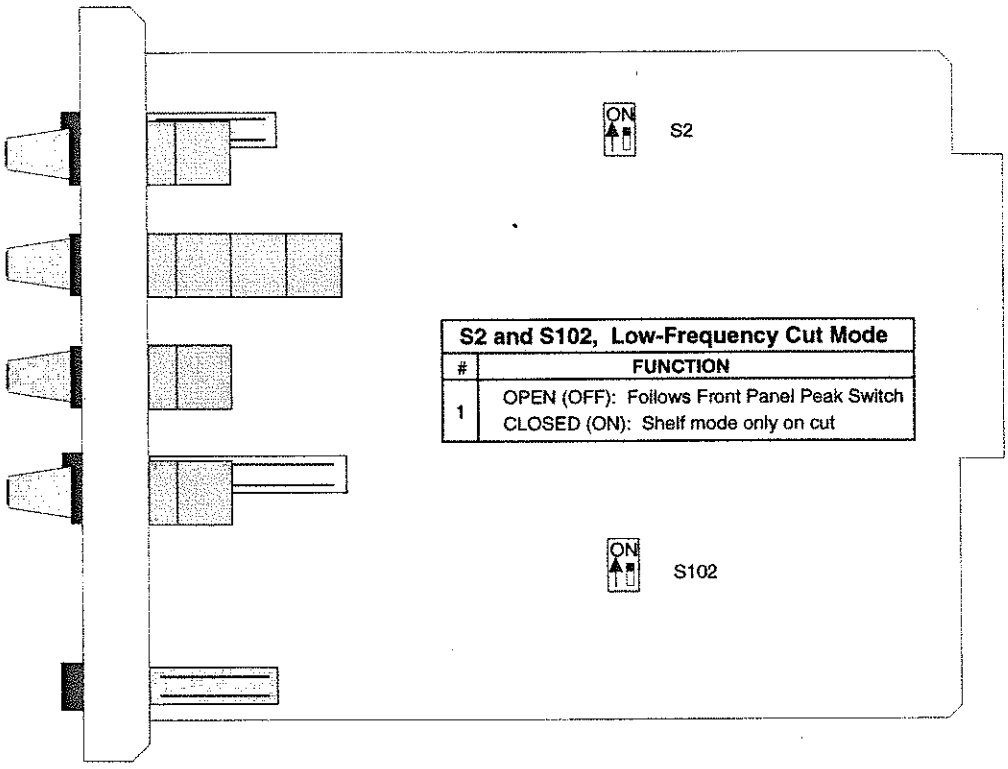


FIGURE 2.5 STEREO EQUALIZER OPTION SWITCHES

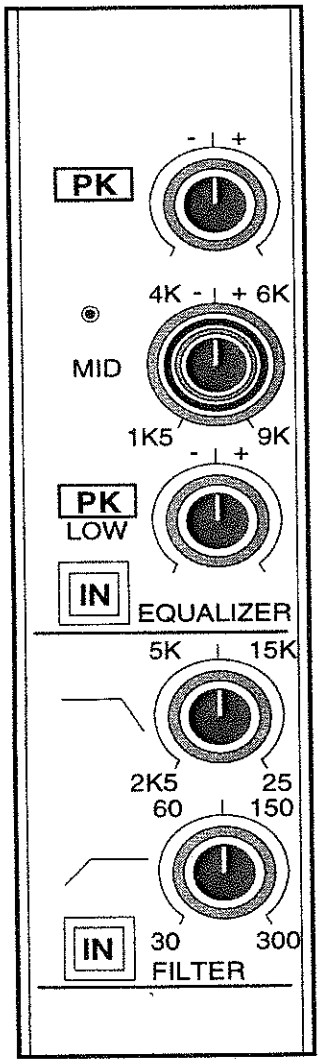
NOTE: Be sure to set both left (S2) and right (S102) option switches identically to prevent differences in low frequency amplitude and phase response between the two channels.

3.0 OPERATION

This chapter describes the operation of each of the three modules which can be inserted into the EXP–11 mainframe. Included are sections describing the Monaural Equalizer, Stereo Equalizer, and Voice Processor Module's front panel controls. For a detailed description of the module components, and their function, see Chapter 4 of this document.

3.1 MONAURAL EQUALIZER MODULE

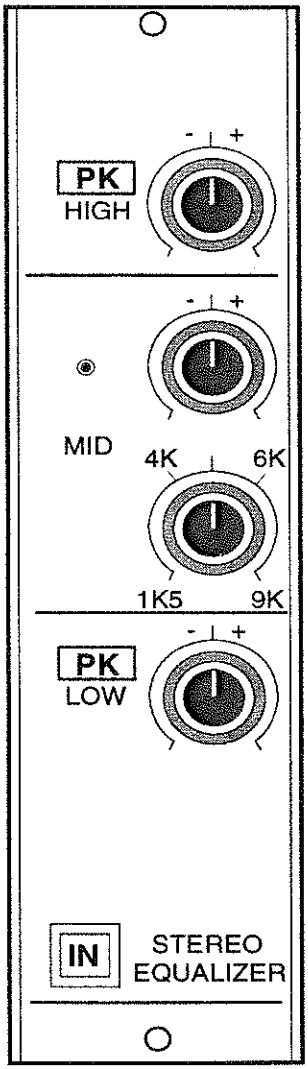
This section contains a figure illustrating the Monaural Equalizer Module's front panel controls, along with descriptions of the function of each.



- The HIGH control adjusts the amount of boost and cut of the high frequencies. The center frequency of operation is 9 kHz. The PK button switch changes the shape of the equalization curves from shelving to peaking.
- The outer knob of the concentric MID control tunes the operating frequency of this stage, while the inner knob adjusts the amount of boost and cut. The frequency tuning range is 1.5 kHz to 9 kHz.
- The LOW control adjusts the amount of boost and cut of the low frequencies. The center frequency of operation is 80 Hz. The PK button switch changes the shape of the equalization curves from shelving to peaking. An internal option switch (as described in Section 2.7.1) can set the cut mode as shelving in recognition of real-life equalizer applications.
- The IN button switch inserts the three-band equalizer system into the signal path.
- The high and low pass control knobs set the cutoff frequencies of the two tunable 18 dB/octave filters.
- The IN button switch inserts the filter system into the signal path.

3.2 STEREO EQUALIZER MODULE

This section contains a figure illustrating the Stereo Equalizer Module's front panel controls, along with descriptions of the function of each.



- The HIGH control adjusts the amount of boost and cut of the high frequencies. The center frequency of operation is 9 kHz. The PK button switch changes the shape of the equalization curves from shelving to peaking.

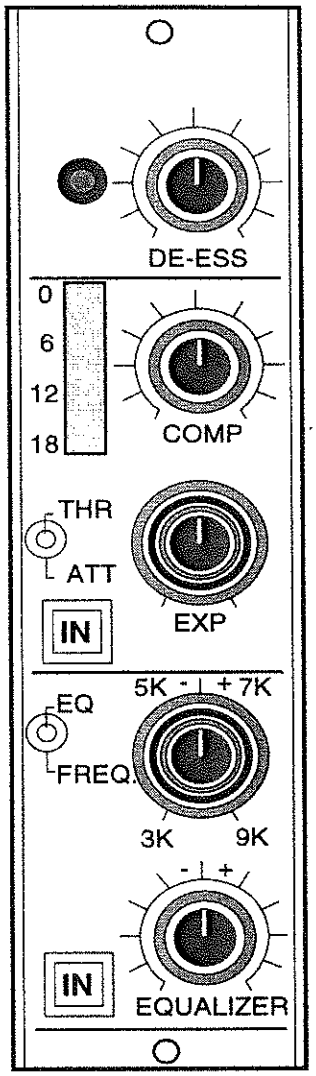
- The upper knob of the two MID controls tunes the center frequency of this stage, while the lower knob adjusts the amount of boost and cut. The frequency tuning range is 1.5 kHz to 9 kHz. The "automatic parametric" feature of this circuit continuously increases the "Q" of the equalizer with increasing amounts of boost and cut.

- The LOW control adjusts the amount of boost and cut of the low frequencies. The center frequency of operation is 80 Hz. The PK button switch changes the shape of the equalization curves from shelving to peaking. Internal option switches (as described in Section 2.7.2) can set the cut mode as shelving in recognition of real-life equalizer applications.

- The IN button switch inserts the three-band equalizer system into the signal path.

3.3 VOICE PROCESSOR MODULE

This section contains a figure illustrating the Voice Processor Module's front panel controls, along with descriptions of the function of each.



- The DE-ESS potentiometer sets the threshold of operation for the de-essing control circuitry. The LED illuminates to indicate de-essing action.
- The COMPressor control sets the fixed gain value of the compressor VCA. Since the threshold of the compressor is fixed, the COMPressor control has the same effect as the traditional compressor input control.
- The LED dot/bar graph display is used to indicate both the amount of expander attenuation and the degree of compression. The expander attenuation is displayed as single illuminated segments (dots) while a bar graph is used to indicate the gain reduction of the compressor.
- The EXPander ATTenuation knob controls the amount of static attenuation and the EXPander THRESHOLD knob adjusts the sensitivity of the expander control circuits.
- The IN button inserts the expander, compressor and de-esser into the audio signal path.
- The FREQuency sweep knob selects the frequency of operation, and the EQualizer knob adjusts the degree of boost and cut of the high frequency equalizer.
- The low frequency knob adjusts the amount of boost and cut of the low frequency equalizer.
- The IN button inserts the equalizer into the circuit path.

4.0 EQUIPMENT DESCRIPTION

This chapter contains descriptions of the EXP-11's components and modules. Included are sections describing the mainframe, power supply assembly, Monaural Equalizer Module, Stereo Equalizer Module, and Voice Processor Module.

4.1 MAINFRAME

The EXP-11 mainframe assembly will accommodate up to eleven plug-in accessory modules. The interconnections are accomplished through a mother board connected to a rear panel PC board by ribbon cables.

Each input position is wired universally to accept any of the three processing modules. Power is distributed to the accessory modules from the power supply assembly, which plugs into an edge connector mounted on the rear of the mother board.

The mother board and the interconnect board contain no components other than the connectors themselves, thereby isolating all of the active components to removable modules. This design approach minimizes system "downtime" by providing the option of simply replacing any defective module with a "spare" module.

EXP-11 interconnection is detailed in the diagram in Section 6.1 of this document.

4.2 POWER SUPPLY ASSEMBLY

4.2.1 Function

The regulated power supply is a plug-in assembly, installed in the rear of the mainframe. It provides power for all of the audio and logic circuits in the EXP-11. The design employs a single toroidal power transformer and a straightforward regulator design. The AC mains supply is protected against faults by a 1 ASB fuse located on the rear of the power supply assembly. The power supply is protected against load faults by power and current limiting internal to the IC regulators.

4.2.2 Circuitry

The bipolar 20 volt, .75 amp, audio supply is configured by two identical +20 volt monopolar supplies which are powered from two separate windings of power transformer T1. The first secondary of T1 (wires E10 and E11) is rectified by diode bridge CR7, filtered by capacitor C1, and regulated by series regulator U1. The various small components around the regulator are used to set the output voltage and improve the noise and transient response of the regulator. The second secondary of T1 (wires E12 and E13) is rectified by diode bridge CR8, filtered by capacitor C2, and regulated by series regulator U2. These high current, low noise regulators are of a plug-in integrated circuit design, and are mounted on the heat sink located on the outside of the power supply bracket.

The monopolar 12 volt, 1 amp, logic supply uses the same circuit topology as the audio supplies. The third secondary of T1 (wires E14 and E15) is rectified by diode bridge CR9, filtered by capacitor C3, and regulated by series regulator U3. The various small components around the regulator are used to set the output voltage and improve the noise and transient response of the regulator. This regulator is also mounted on the heat sink located on the outside of the power supply bracket.

The common point on these three supplies is the central grounding point for the entire system, and is distributed from this point as "Audio Common" and "Logic Common". This point is also tied to "Earth Ground" and "Chassis Ground".

4.3 MONAURAL EQUALIZER MODULE

4.3.1 Function

The Monaural Equalizer Module provides both equalization and filter facilities in one compact module. The tunable filter section consists of high-pass and low-pass filters. The equalizer section, which may be switched in and out independently of the filter section, contains bass and treble equalizers which are each independently switchable from peaking to shelving modes. The midrange equalizer is adjustable both with regard to the amount and to the frequency of equalization, and covers a mid-band frequency range of approximately 1.5 kHz to 9 kHz.

4.3.2 Circuitry

A balanced differential amplifier (U1) is used for the input to the equalizer module. This amplifier operates at unity gain, and is intended for operation with signals at the console interstage nominal level of -10 dBu.

Capacitors C13, C14 and C16, along with the resistors R11, R13 and R15, are the frequency-determining components for the high-pass filter using U2 as the active element. The resistors are in series with the three-section potentiometer used for tuning. The remaining components around this stage keep the bandpass shape constant at the various cutoff frequencies. In its bandpass, this stage has an essentially flat amplitude response and unity gain. Capacitors C67, C68 and C69, operating with resistors R67, R68 and R69 are the frequency determining components for the lowpass filter, which uses U9 as the active element. The resistors are in series with the three-section potentiometer used for tuning.

The bass and treble equalizers have been combined into a single stage. The signal is applied to R23, which is connected to the non-inverting input of amplifier U3A. Feedback is applied to the inverting input of the amplifier via R26.

Between R23 and R26 is a potentiometer (HIGH) whose wiper is connected to ground via capacitor C42. When the wiper is at the R23 end of the pot, the high frequency components of the signal are rolled off by the action of C42 to ground. When the wiper is at the R26 end of the pot, C42 reduces the feedback at high frequencies causing the gain at those frequencies to increase. R40 stops the bypass at a high frequency and, therefore, forms a "shelf" in the treble amplitude response. For the peak response characteristic, capacitor C42 is resonated by a synthesized inductor formed by U5 and its associated

circuitry. When this inductor is entered into the circuit by operating switch S4, the series combination of C42 and the inductor form a resonant circuit, and the boost and cut are at the resonant frequency.

Also connected between R23 and R26 is a second potentiometer (LOW) whose wiper is connected to ground via a synthesized inductor formed by the circuitry around U4. When the wiper is at the R23 end of the pot, the pass components of the program signal are rolled off by the action of the inductor bypassing the low frequencies to ground. When the wiper is at the R26 end of the pot, the inductor reduces the feedback at low frequencies, causing the gain at those frequencies to increase. The inductor is effectively in series with R32, which forms a shelf in the bass response. At each end of the bass potentiometer are capacitors which are shorted out in the shelving mode. Those capacitors are unshorted in the peaking mode (by the action of the LOW PK switch), in which case they work with the inductor to form a resonant circuit. The capacitor used in the low frequency cut mode may be shunted by internal option switch S5 to produce the "forced-shelf-on-cut" feature of the equalizer.

As with the bass and treble equalizer, the midrange equalizer is of unity gain. It is based on the circuitry around U3B. The wiper of the boost/cut control is connected to a relatively complex resonant circuit using U6 and both halves of U7. The circuitry is configured in a manner such that at the boost end of the amplitude control the input signal is bandpassed and applied to summer U3B, causing an increase in the overall amplitude response. At the cut end of the control the bandpass signal is applied as negative feedback, causing a dip in the amplitude response.

4.4 STEREO EQUALIZER MODULE

4.4.1 Function

The Stereo Equalizer Module consists of two identical sets of circuitry under the control of dual channel potentiometers and switches. It contains two separate, but coupled, three band equalizers. High and low frequency equalization is switchable between peaking and shelving modes. Midrange equalization is adjustable with regard to both the amount and the frequency of equalization, and covers a mid-band frequency range of approximately 1.5 kHz to 9 kHz.

4.4.2 Circuitry

NOTE: For simplicity's sake, only the left channel is described below.

A balanced differential amplifier (U1) is used for the input to the equalizer module. This amplifier operates at unity gain, and is intended for operation with input signals at the console interstage nominal level of -10 dBu.

The bass and treble equalizers have been combined into a single stage. The signal is applied to R12, which is connected to the non-inverting input of amplifier U2A. Feedback is applied to the inverting input of the amplifier via R16. Between R12 and R16 is a potentiometer (HIGH) whose wiper is connected to ground via capacitor C42. When the wiper is at the R12 end of the pot, the high frequency components of the signal are rolled off by the action of C42 bypass to ground. When the wiper is at the R16 end of the pot, C42 reduces the feedback at high frequencies, causing the gain at those frequencies

to increase. R40 stops the bypass at a high frequency and, therefore, forms a "shelf" in the treble amplitude response. For the peak response characteristic, capacitor C42 is resonated by a synthesized inductor formed by U4 and its associated circuitry. When this inductor is entered into the circuit by operating switch S3, the series combination of C42 and the inductor form a resonant circuit so that the boost and cut are at the resonant frequency.

Also connected between R12 and R16 is a second potentiometer (LOW), whose wiper is connected to ground via a synthesized inductor formed by the circuitry around U3. When the wiper is at the R12 end of the pot, the low frequency components of the signal are rolled off by the action of the inductor bypass to ground. When the wiper is at the R16 end of the pot, the inductor reduces the feedback at low frequencies, causing the gain at those frequencies to increase. The inductor is effectively in series with R32, which forms a "shelf" in the bass response. At each end of the bass potentiometer are capacitors which are shorted out in the shelving mode. Those capacitors are unshorted in the peaking mode by the action of the LOW PK switch, in which case they form a resonant circuit with the inductor. The capacitor used in the low frequency cut mode may be shunted by internal option switch S2 to produce the "forced-shelf-on-cut" feature of the equalizer.

NOTE: When producing the "forced-shelf-on-cut" feature on the left channel (S2), ensure that the right channel (S102) is set identically in order to prevent differences in low frequency amplitude and phase response between the two channels.

The midrange equalizer is a resonant type. This equalizer is adjustable with regard to both the degree and the frequency of equalization. As with the bass and treble equalizers, the midrange equalizer is of unity gain, and is based on the circuitry around U2B. The wiper of the boost/cut control is connected to a relatively complex resonant circuit using U5 and both halves of U6. This resonant circuit is tunable from about 1.5 kHz to about 9 kHz. The circuitry is configured in a manner such that at the boost end of the amplitude control the input signal is bandpassed and applied to summer U2B, causing an increase in the overall amplitude response. At the cut end of the control, the bandpass signal is applied as negative feedback, causing a dip in the amplitude response.

4.5 VOICE PROCESSOR MODULE

4.5.1 Function

The Voice Processor Module contains two major function sections. The first section is a switch-insertable equalizer, which covers the frequency range normally required for voice signal correction and enhancement. The second section contains the expander, compresser, and de-esser systems. The expander threshold and attenuation are used to achieve noise reduction during pauses in speech, while the compressor provides signal "smoothing and density". The de-esser senses and operates only on the treble region which provides adjustable control over excessive sibilance without the undesirable side effects of broadband designs.

4.5.2 Circuitry

A balanced differential amplifier U1A is used for the input to the module. This amplifier operates at unity gain and is intended for operation with signals at the console interstage nominal level of -10 dBu.

The bass equalizer is formed by the circuitry around amplifier U2A and synthesized inductor U2B. This circuit operates at unity gain when the wiper of bass control R201 is set for flat response, mid-rotation. Rotating the control counterclockwise attenuates the bass components of the program material into the input of U2A. Clockwise rotation attenuates the bass components of the feedback signal, increasing the gain of U2A at those frequencies. The inductor circuitry of U2B resonates with capacitor C12 in the boost mode, producing a peaking type response. The treble equalizer is also of unity gain, and is configured using the circuitry around U3A , U3B, U4A and U4B. The wiper of TREBLE control R204 is connected to a resonant circuit using U3B and both halves of dual amplifier U4. This resonant circuit is tunable from 3 kHz to 9 kHz using the two sections of frequency control R202/203. The entire bass and treble equalizer section is switched in or bypassed using EQUALIZER switch S1.

The output of the equalizer switch is routed to the expander/compressor section. This circuit has been designed specifically for producing a smooth, dense sound. The basic control element in the compressor is an integrated voltage-controlled amplifier (VCA) using U19 and buffer amplifier U5. The output of the VCA buffer is connected to COMPRESSOR IN/OUT switch S3.

The VCA output signal is also routed to the compressor control system using U6A and U6B. This path includes frequency determining network R139, R52 and C40 to eliminate "pumping" or "ducking" due to strong bass content in program material. The components around CR5, CR6, and CR7 are for the reduction of ripple on the AGC control bus. This technique contributes significantly to the excellent low frequency distortion performance of the compressor, while retaining an extremely fast recovery time.

The AGC voltage is applied to the precision OR circuit using U9B and U9C. The output of the OR is applied, along with a DC signal from front panel COMPressor control R207, to U9D and then to the control port of the VCA U19. Trimmer R93 is used to null the distortion within the VCA circuit itself.

The audio signal which drives the input of the VCA is also routed to the expander side-chain control circuitry using U7 and U8. The output of this chain is also a DC signal which is applied to the precision OR circuit which controls the VCA. The sensitivity of the expander side-chain is determined by the setting of the front panel EXPander THReshold control. The degree of gain-reduction in the absence of audio is determined by the setting of the front panel EXPander ATTenuation control.

The output of OR circuit U9C and U9D, as applied to U9D, represents the compression portion of the gain-control signal. It is metered by using display driver circuit U20 and front panel LED display DS-3. Trimmer R92 is the calibration control for the display. When the gain-reduction voltage generated by the compressor circuitry is greater than the attenuation voltage from the expander circuitry, mode-switch comparator U9A operates switching transistor Q2. This changes the voltage on display driver U20 pin 9 so that the display is switched from a dot display (expansion) to a bar-graph display (compression). In this manner, the same display is utilized to show both the expansion and compression modes.

The "O dB" LED is illuminated at all times. In a similar manner, the "18 dB" LED is dimly illuminated to provide a scale-length reference in darkened control rooms. The "18 dB" LED will be illuminated to a "normal" level when 18 dB of compression is used, and will be lit to a greater degree when 20 dB of compression is used. This is accomplished by connecting both the 18 dB and 20 dB driver outputs to the last LED segment. The display is calibrated by applying a low-level signal (below the threshold of compression), setting the EXPander THReshold control to minimum, setting 12 dB of gain-reduction using the EXPander ATTenuation control, and adjusting R92 to illuminate the "12" LED.

The audio output from the VCA is routed to the de-esser section. The audio path circuitry involves U10, U11, and U12. The output of VCA buffer amplifier U12A is applied to the control system using U14 and U15A. The sensivity of this control loop is adjusted by front panel DE-ESS control R208. Treble content in the program material above the threshold set by the DE-ESS control will produce a DC control voltage at output U15A, which is applied to the control port of the VCA. The control voltage is monitored by the DE-ESS LED indicator, which is driven by U15B. The output of the de-essing circuitry is routed through internal level-match trimmer control R118 to the output buffer and to front panel IN/OUT switch S3. R105 is used to null the internal distortion of the de-esser VCA.

5.0 MAINTENANCE

This chapter contains sections describing routine maintenance, installation and servicing tools, spare parts, and replacement parts for the EXP-11.

5.1 ROUTINE MAINTENANCE

Routine maintenance is usually limited to checking all button switches for proper operation and keeping panel surfaces clean. The panel surfaces are finished with a baked polyurethane paint and may be cleaned with a weak solution of dishwashing detergent.

The knobs used for the module's rotary controls are attached to the pot and switch shafts with collets instead of set screws. The machined brass collets provide the advantages of true alignment and concentricity with the axis of rotation, no set screws to score the shaft , the ability to clutch slip when excessive force is applied, and no holes in the side of the knob for the set screws. To remove a collet knob, carefully "pop" off the top cap of the knob and use a collet knob wrench (PR&E #70-44) to loosen the nut on the collet. Once the nut is loosened, the collet should release from the shaft. This nut should not need to be removed unless the collet refuses to release.

If it should become necessary to remove a module from the mainframe, use the module pull/extractor tool (PR&E #70-43). First, remove the top and bottom module retaining screws. Then remove the stainless steel button-head hex screw from the removal tool threaded opening on the face of the module. Screw PR&E tool #70-43 into the opening, and extract the module by pulling it directly out of the mainframe assembly.

5.2 TOOLS

The following tools may be desired for installing and servicing the EXP-11 and its processing modules. If you already have a PR&E console, you probably own these tools. If not, they can be purchased for a nominal charge.

DESCRIPTION	PR&E#
MOLEX Connector Pin Crimp Tool	70-3
MOLEX Connector Pin Extractor Tool	70-4
MOLEX Connector Pin Crimp Tool (#HTR-1719-C)	70-5
PR&E Module Pull/Extractor Tool	70-43
Wrench for collet knobs	70-44

5.3 SPARE PARTS KIT

The following kit of spare parts is supplied with each EXP-11 mainframe at no charge. This kit is provided to support initial installation.

DESCRIPTION	QTY	PR&E#
Fuse, 1 ASB	2	30-8
Regulator, Variable, LM350K	2	20-30
Bridge, Diode, FW-100	1	11-1
Diode, 1N4001	3	11-7

5.4 REPLACEMENT PARTS

Most of the components used are standard items of general availability. However, should difficulty be encountered locating any of the items, PR&E maintains a stock of replacement parts. The power supply transformer, Schadow button switches, and all engraved button caps are manufactured to custom design specifications and are, therefore, available only from PR&E.

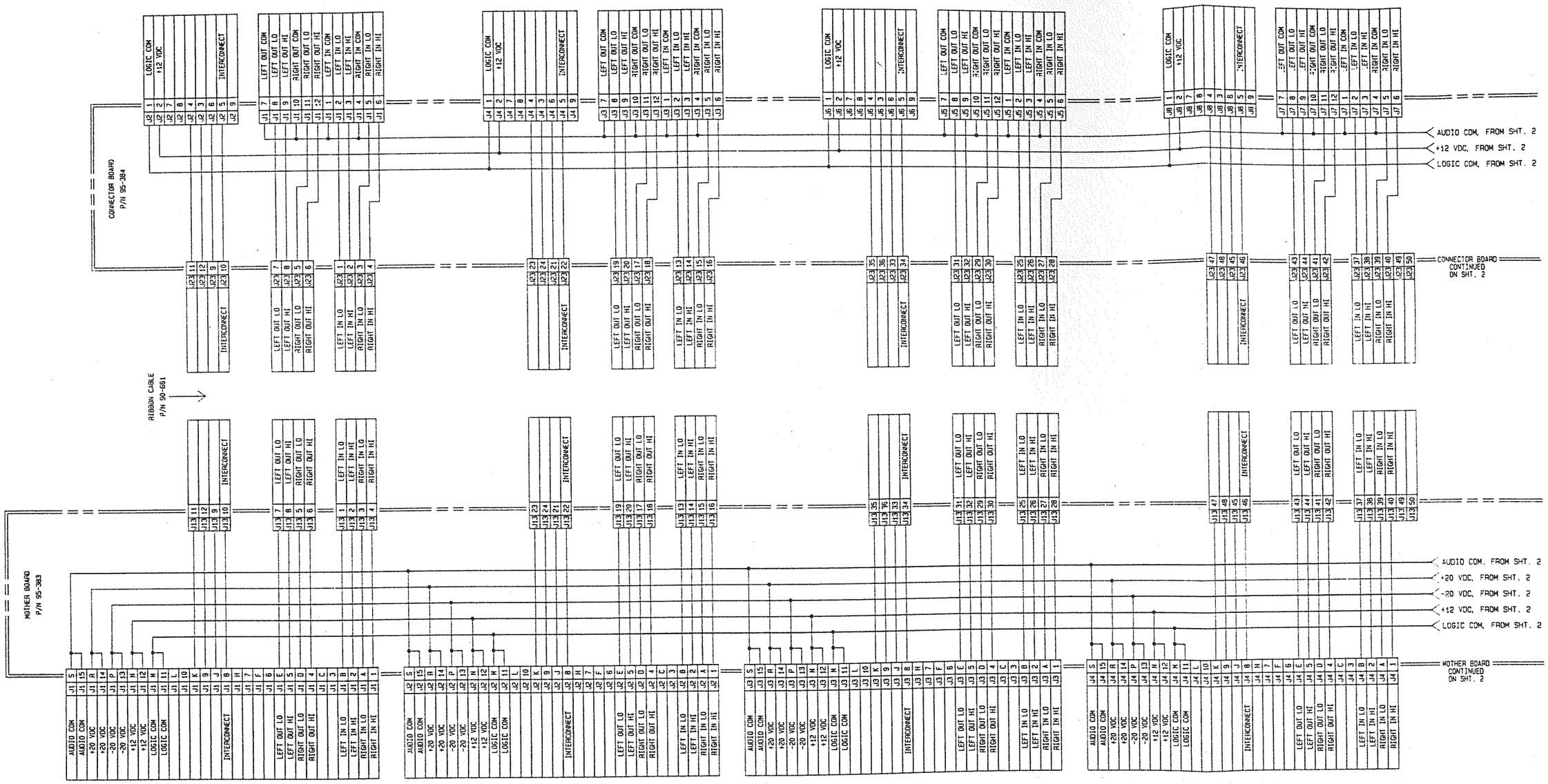
Following is a partial list of parts and assemblies used in the EXP-11, and the PR&E part number for easy reference:

DESCRIPTION	PR&E#
Accessory Modules	
Monaural Equalizer Module	99-415
Stereo Equalizer Module	99-416
Voice Processor Module	99-296
Capacitors	
Electrolytic, Low Leakage, 10µF, 25V, Radial	60-67
Electrolytic, 10µF, 25V, Radial, NP	60-84
Electrolytic, 22µF, 16V, Radial	60-55
Electrolytic, 22µF, 25V, Radial	60-76
Electrolytic, 100µF, 25V, Radial	60-52
Electrolytic, 220µF, 16V, Radial	60-44
Electrolytic, 4700µF, 35V, Radial	60-94
Tantalum, .47µF, 35V	65-15
Tantalum, 10.0µF, 25V	65-5
Tantalum, 10µF, 20V	65-6
Caps	
Blue (for S110 knob)	32-123
Red (for S110 knob)	32-125
Yellow (for S110 knob)	32-126
Diodes	
1N4001	11-7
1N914B	11-13
Fuse Holder	30-711

DESCRIPTION	PR&E#
Insulator, for TO-220AB, Silpad	31-3
Integrated Circuits	
Driver Display Dot/Bar LM3914	20-65
Voltage-Controlled Amplifier 2151 DBX	20-63
Opamp, DIP, NE5534N	20-28
Opamp, Dual, LF353N	20-32
Opamp, Dual, 8-pin DIP, NE5532N	20-53
Wide Band Width Quad JFET Input Opamp LF347N	20-64
Knob, 11MM, 1/8" Shaft, Grey	32-120
Knob Assembly, for SIFAM S110 Knob	90-327-1
Knob Assembly, for SIFAM S150 Knob	90-327-2
LED, Array, Red	12-59
LED, Red	12-53
Potentiometers	
Concentric Triple, 10K Linear	24-105
Concentric Dual, 10K CW Log	24-118
Dual, 10K Linear	24-109
Quad, 10K CCW Log	24-110
Single, 10K, Linear	24-102
Single, 10K CW Log	24-98
Triple, 10K, 2K, 10K CCW Log	24-103
Triple, 2K CCW Log	24-104
Power Supply Assembly	99-382
Regulators	
Variable, 1.5A, Pos., LM317T	20-49
Variable, 1.5A, Neg., LM337T	20-59
Screw, Binder Head, #6-32 X 1/4", Nylon	37-111
Transistor, NPN, MPS6560	7-11
Trimpot, Single-Turn, 72PR10K	24-54

6.0 DIAGRAMS & SCHEMATICS

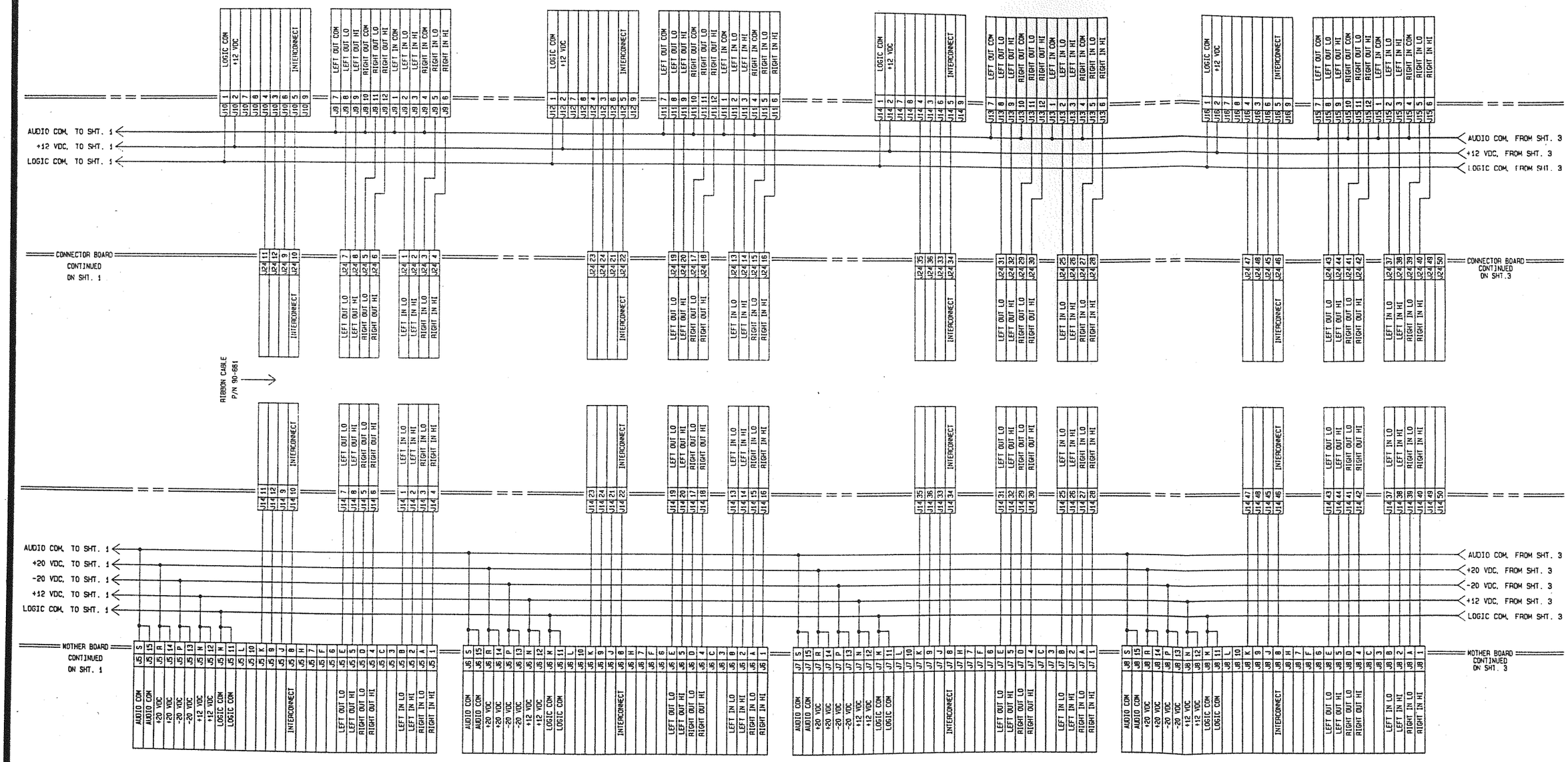
This chapter is made up of the following diagrams and schematics:



PACIFIC RESEARCH & ENGINEERING

6.1 INTERCONNECTION DIAGRAM
(SHEET 1 OF 3)

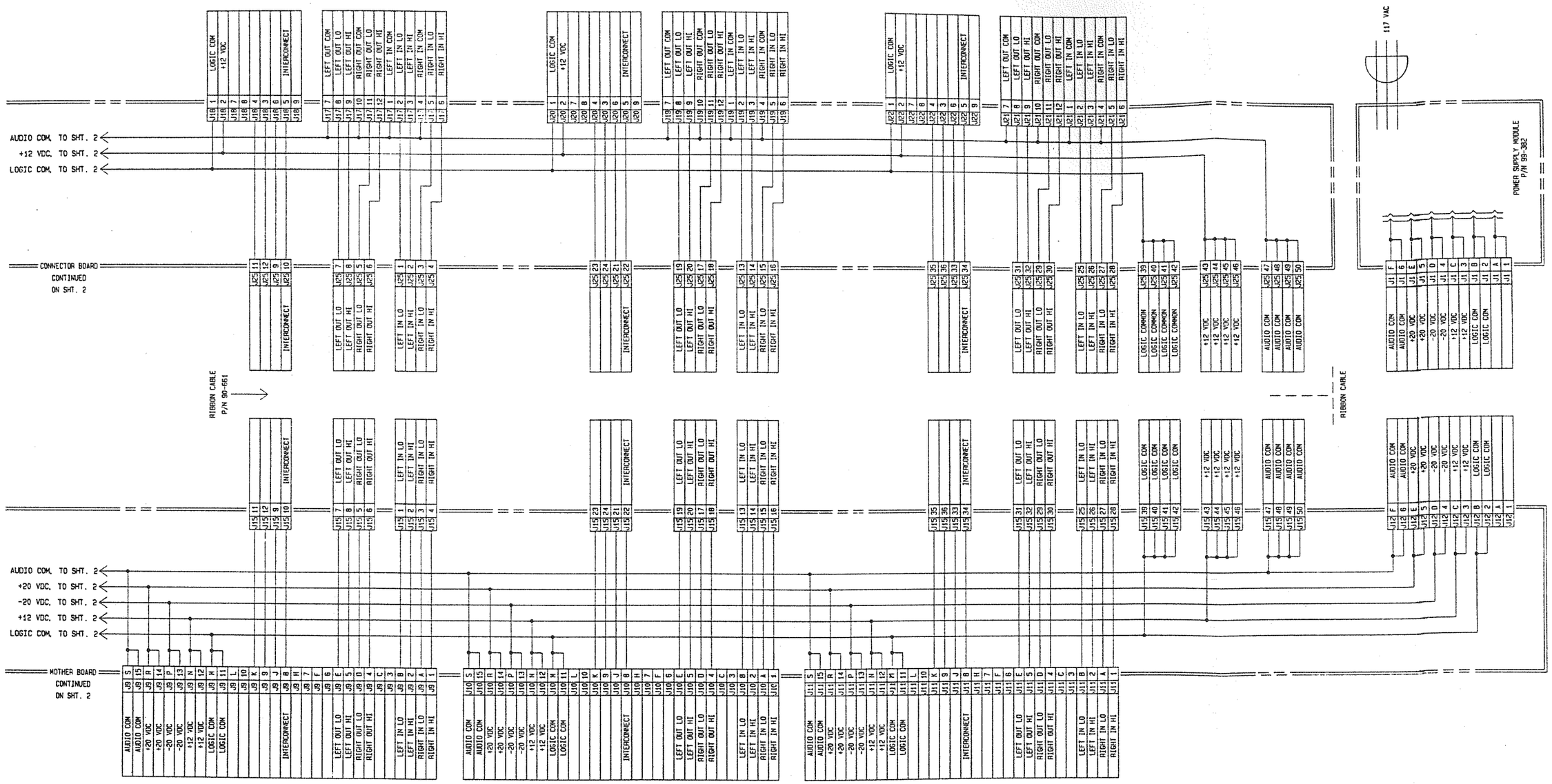
94-380



PACIFIC RESEARCH & ENGINEERING

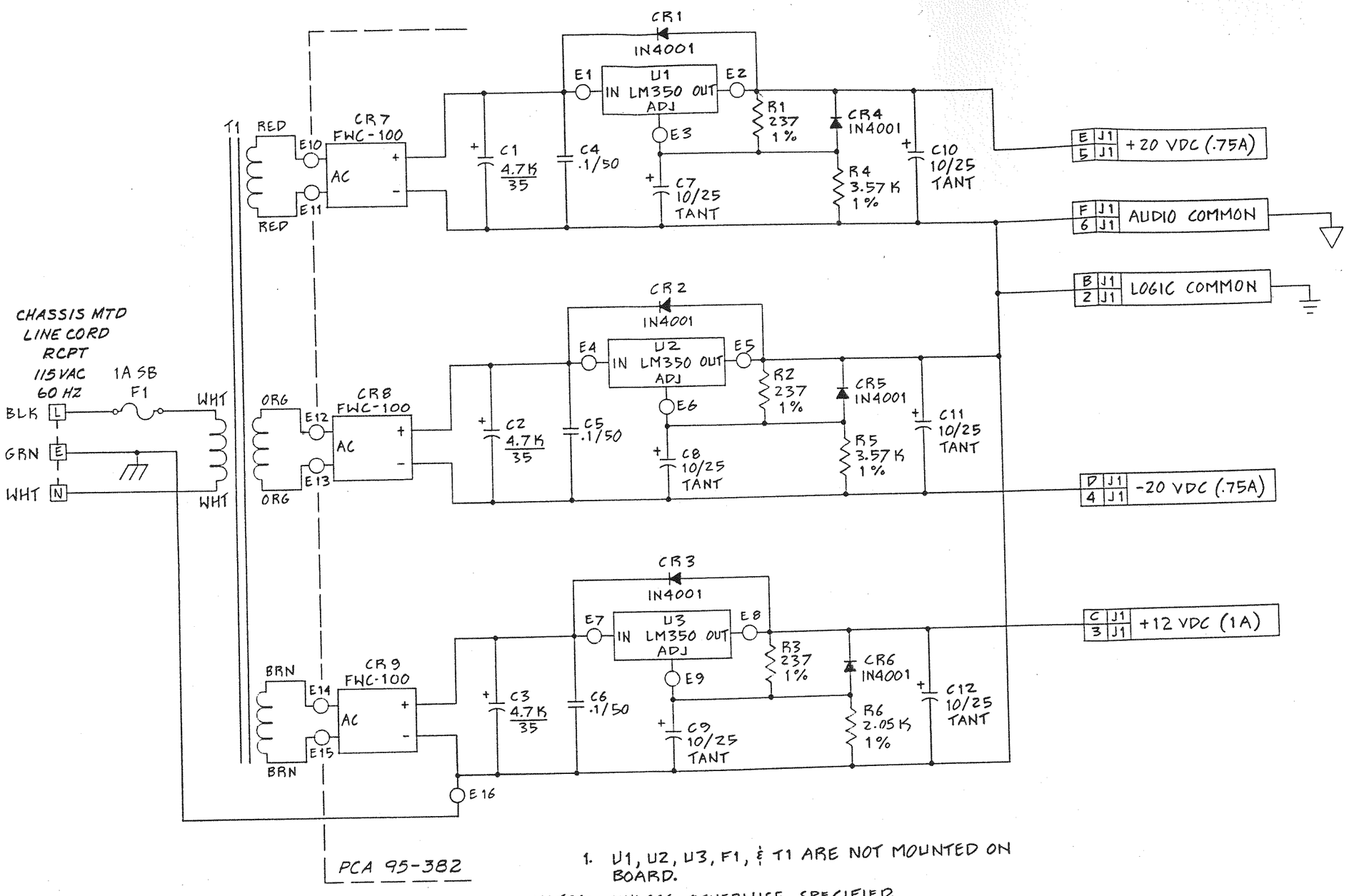
6.1 INTERCONNECTION DIAGRAM

(SHEET 2 OF 3)



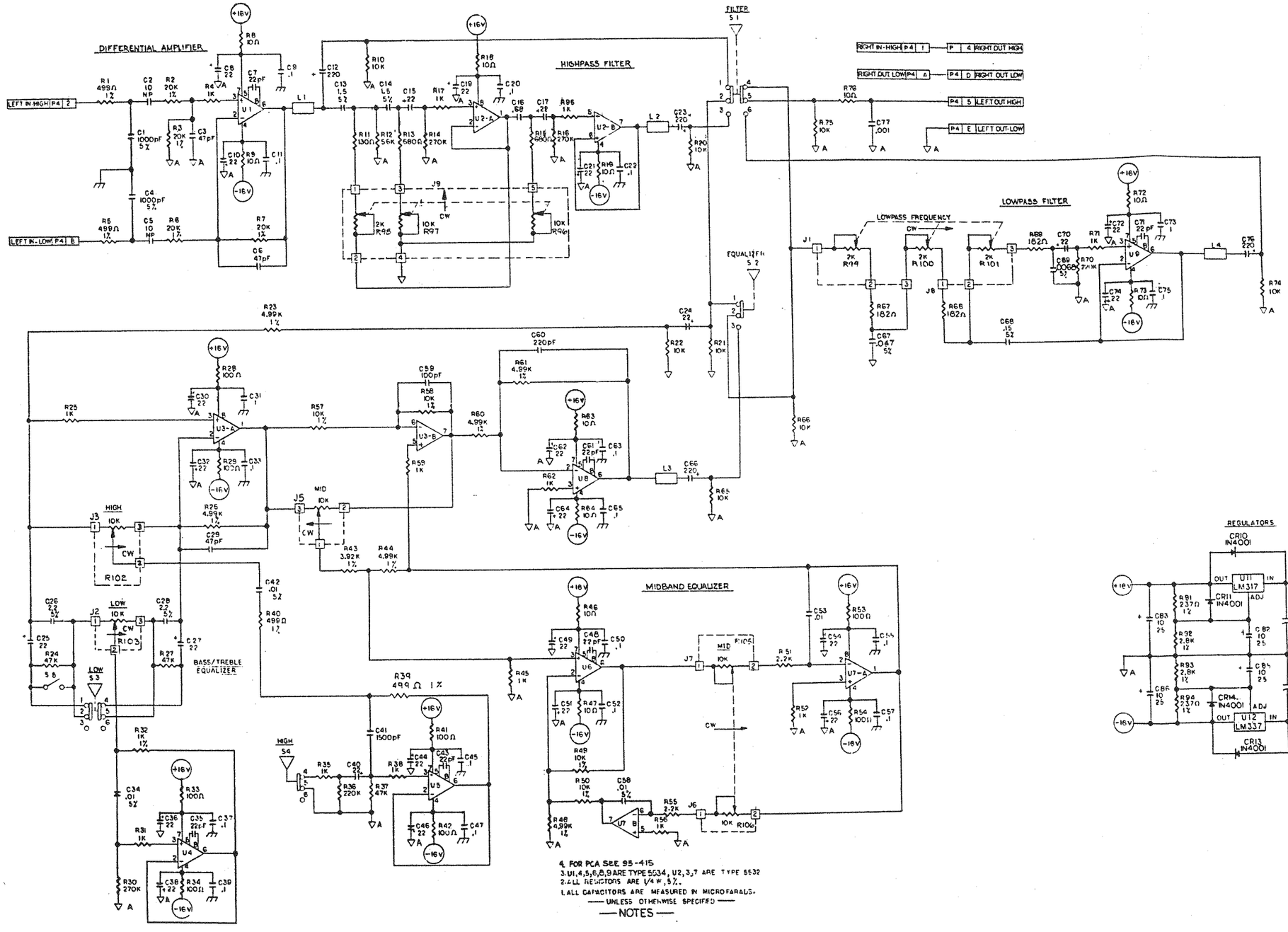
PACIFIC RESEARCH & ENGINEERING

6.1 INTERCONNECTION DIAGRAM
(SHEET 3 OF 3)



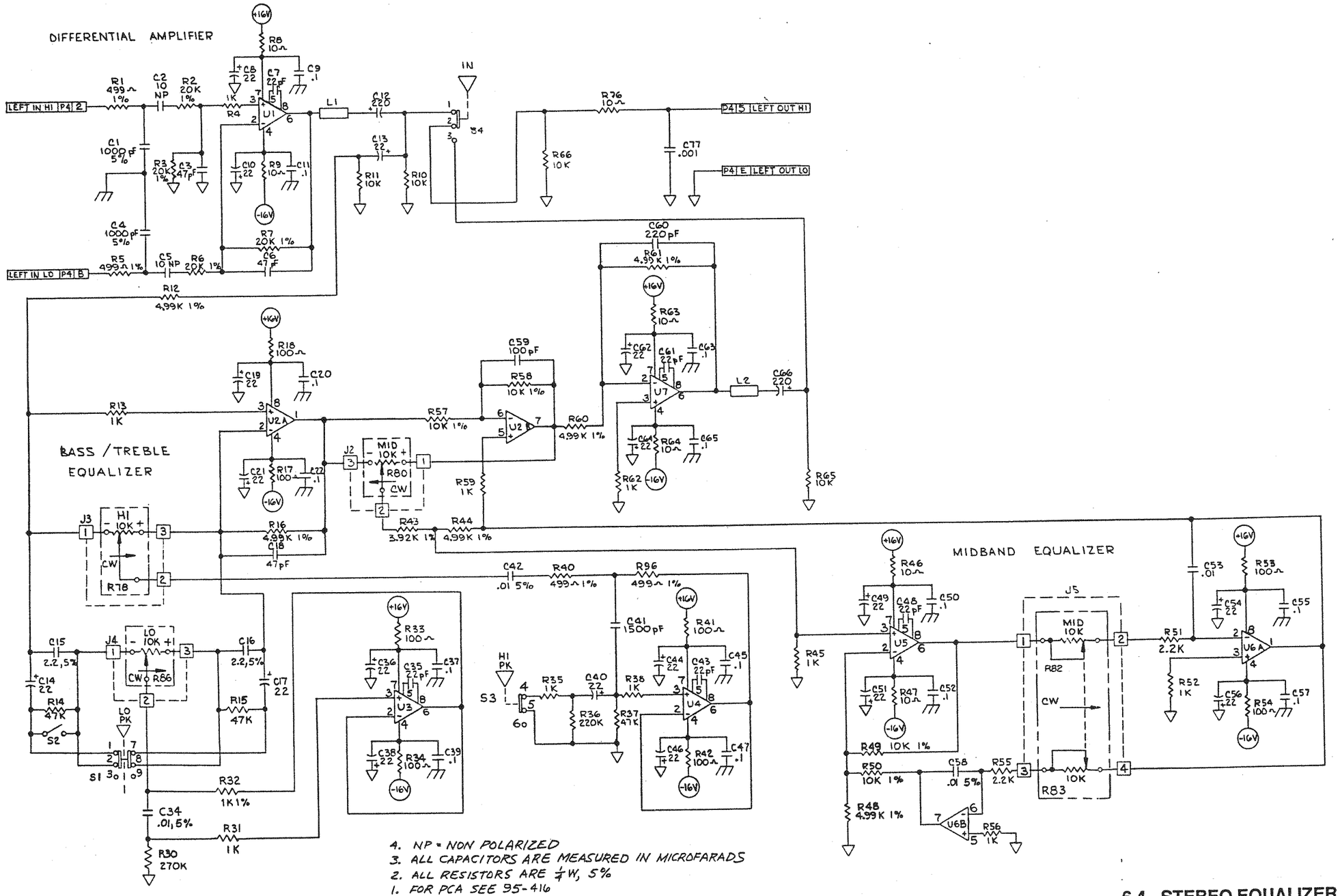
1. U1, U2, U3, F1, & T1 ARE NOT MOUNTED ON BOARD.

NOTES: UNLESS OTHERWISE SPECIFIED.



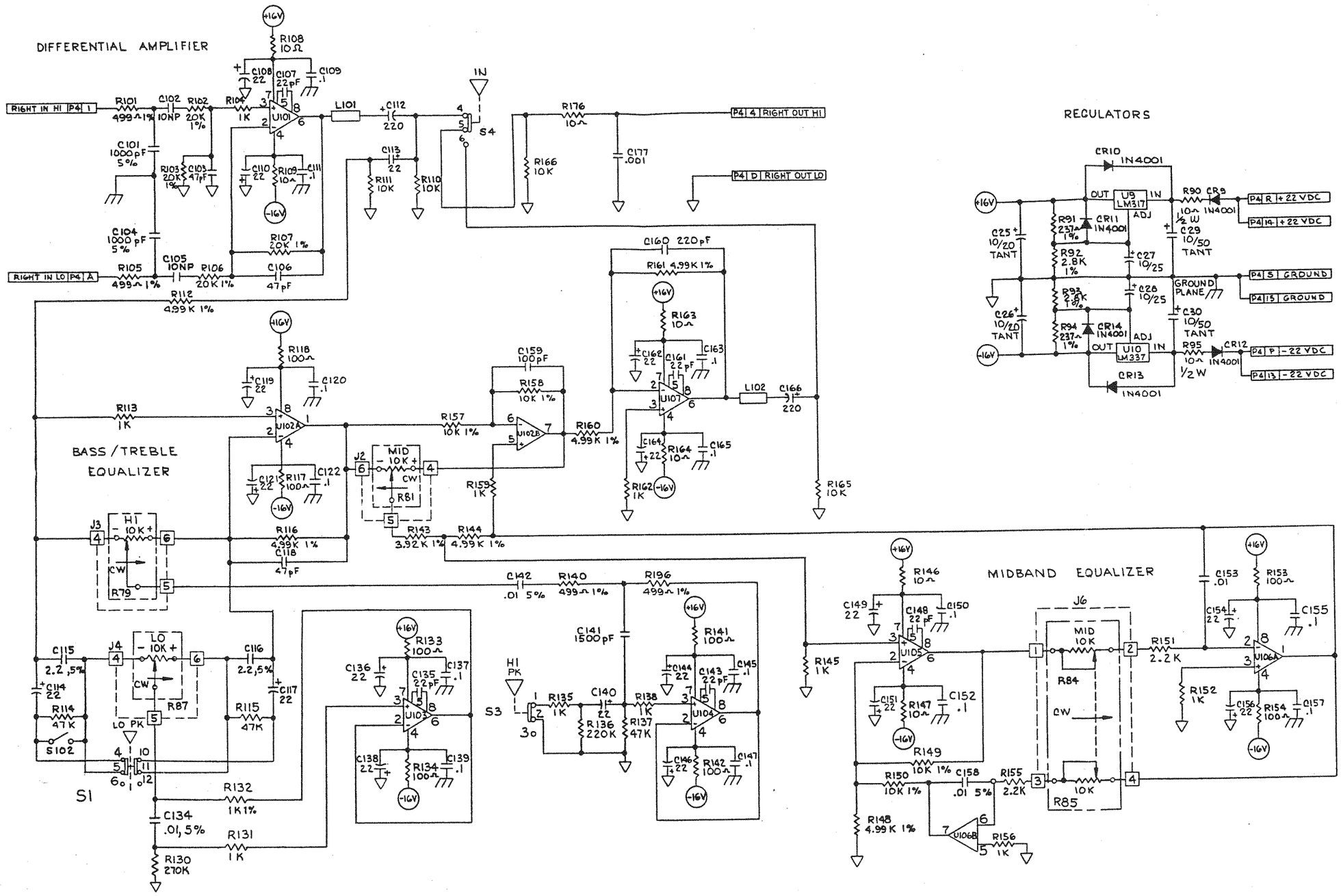
PACIFIC RESEARCH & ENGINEERING

6.3 MONAURAL EQUALIZER MODULE SCHEMATIC



6.4 STEREO EQUALIZER MODULE SCHEMATIC
(SHEET 1 OF 2)

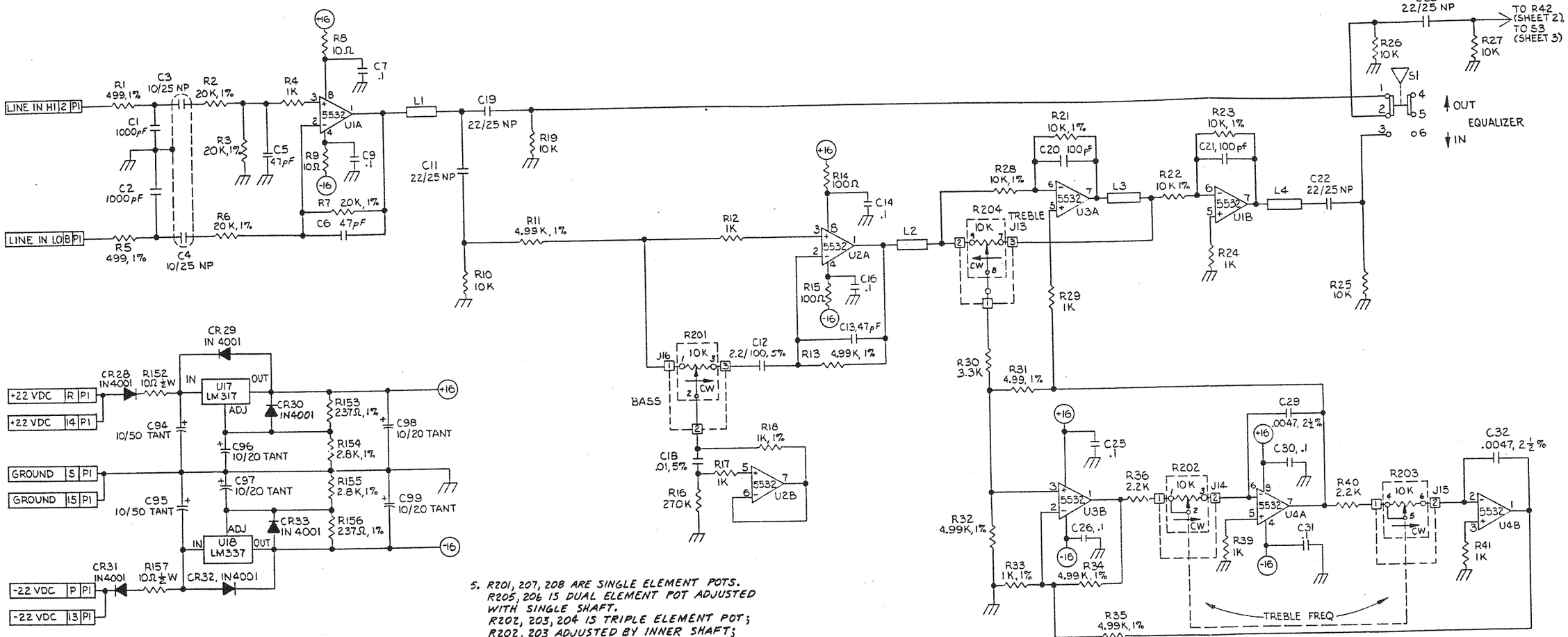
92-416



PACIFIC RESEARCH & ENGINEERING

6.4 STEREO EQUALIZER MODULE SCHEMATIC

(SHEET 2 OF 2)



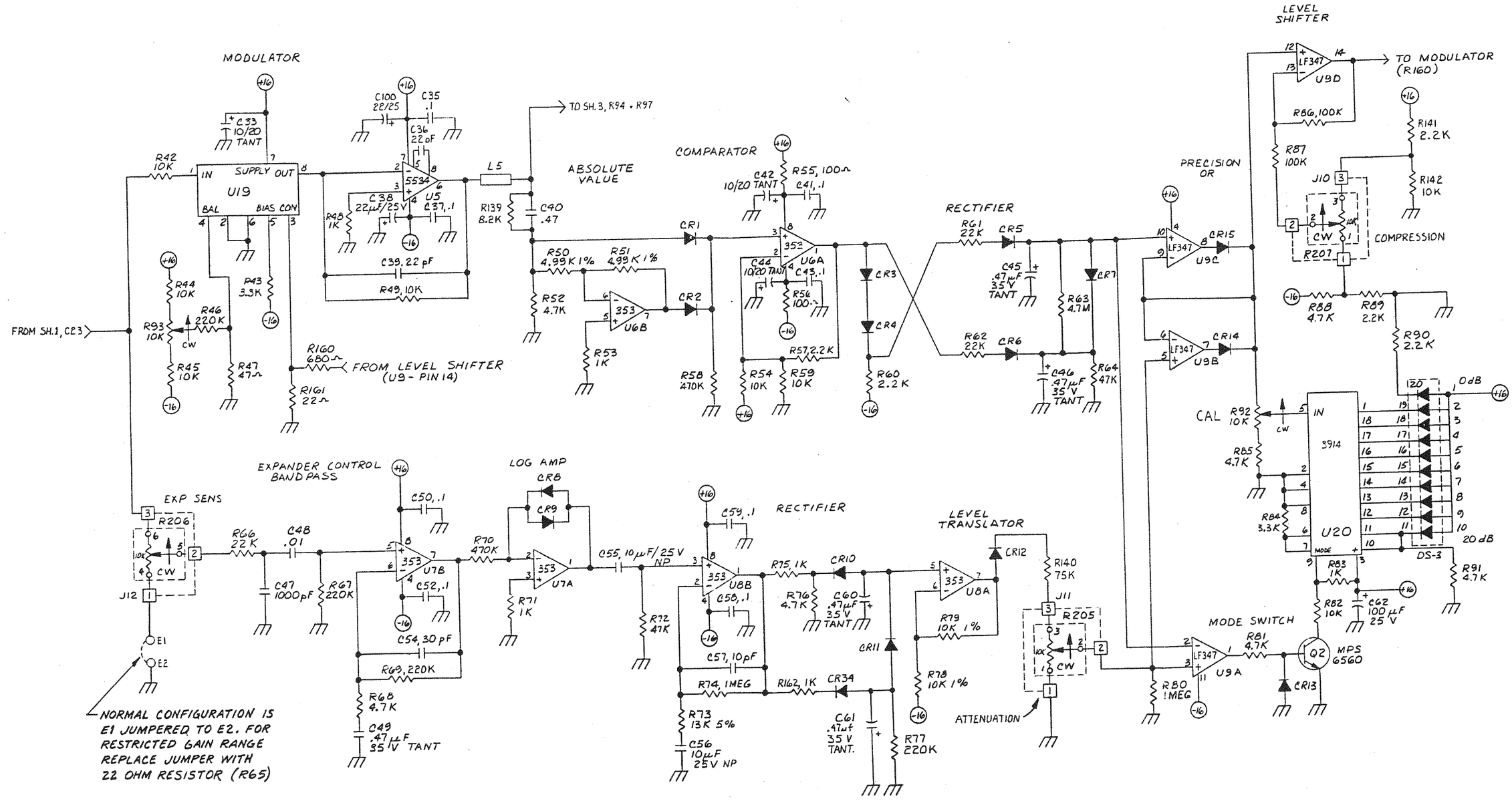
REGULATORS

5. R201, 207, 208 ARE SINGLE ELEMENT POTS. R205, 206 IS DUAL ELEMENT POT ADJUSTED WITH SINGLE SHAFT. R202, 203, 204 IS TRIPLE ELEMENT POT; R202, 203 ADJUSTED BY INNER SHAFT; R204 ADJUSTED BY CONCENTRIC OUTER SHAFT.
4. NP = NON POLARIZED
3. ALL DIODES ARE IN914B
2. ALL CAPACITORS ARE MEASURED IN MICROFARADS
1. ALL RESISTORS ARE ¼W, 5%

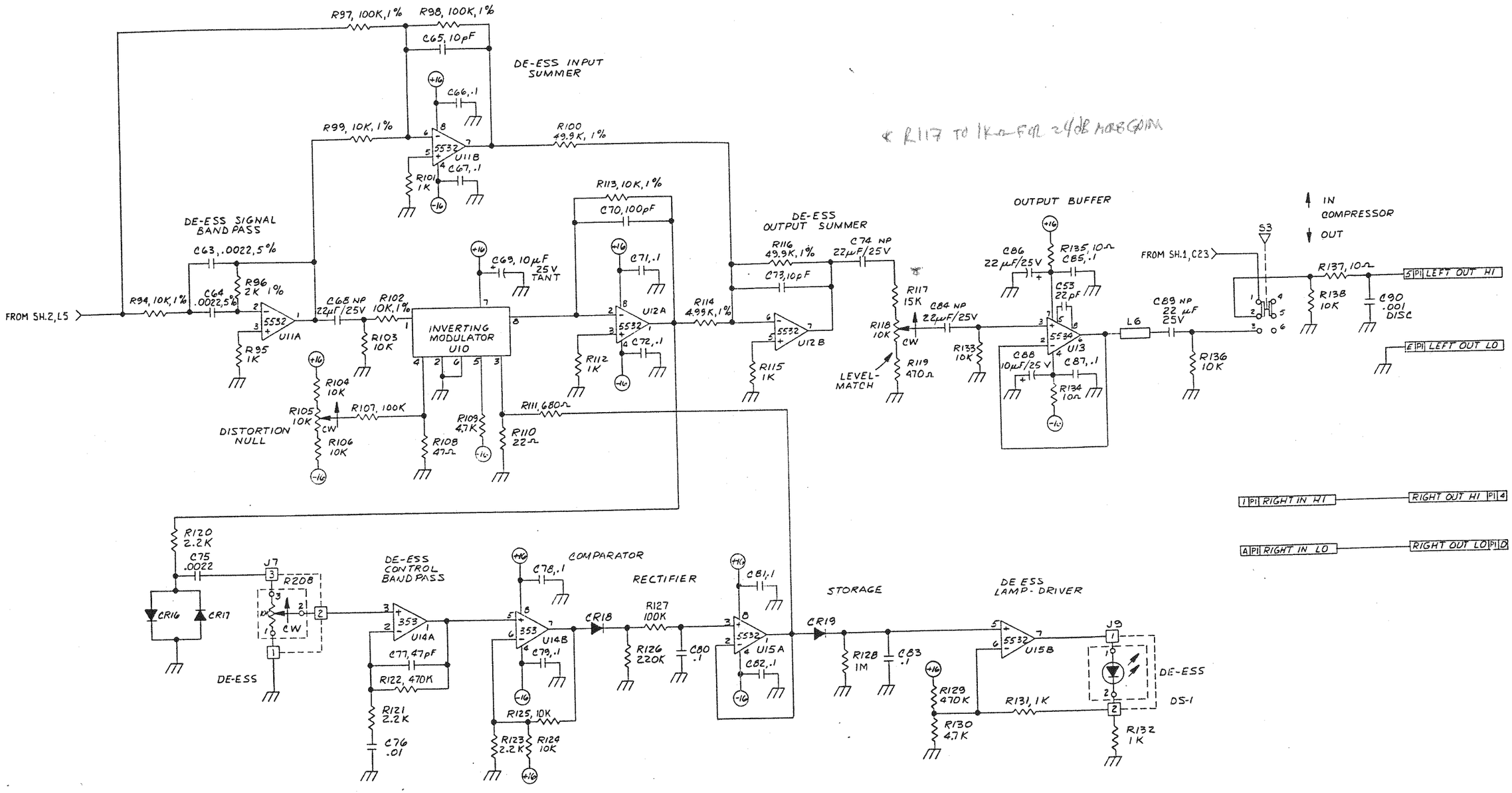
NOTES: UNLESS OTHERWISE SPECIFIED

PACIFIC RESEARCH & ENGINEERING

6.5 VOICE PROCESSOR MODULE SCHEMATIC
(SHEET 1 OF 3)



6.5 VOICE PROCESSOR MODULE SCHEMATIC
(SHEET 2 OF 3)



* R117 TO 1K Ω FOR 24dB HDRM GAIN

6.5 VOICE PROCESSOR MODULE SCHEMATIC
(SHEET 3 OF 3)