SMP-900A

AM STEREO MATRIX PROCESSOR

INSTALLATION AND OPERATION MANUAL

PRELIMINARY

Circuit Research Labs, Inc.
2522 W. Geneva Drive
Tempe, Az. 85282 U.S.A.
602-438-0888

SMP-900A
AM STEREO MATRIX PROCESSOR

INSTALLATION AND OPERATION MANUAL

Manufactured under one or more of the following U.S. patents:

3,582,964	4,393,346	4,406,923
4,350,845	4,398,158	4,609,878
4,383,229	4,679,239	

PROPRIETARY NOTICE

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P/N 10145 DWNG 11-8500-01 Rev. PRELIMINARY

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* NOT AVAILABLE AT TIME OF PUBLICATION

SECTION 1 - GENERAL

1.1 SAFETY INFORMATION

1.1.1 DEFINITIONS OF SAFETY SYMBOLS

****
WARNING
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THE WARNING SIGN DENOTES A HAZARD. IT CALLS ATTENTION TO A PROCEDURE, PRACTICE, CONDITION, OR THE LIKE, WHICH, IF NOT CORRECTLY PERFORMED OR ADHERED TO, COULD RESULT IN DAMAGE TO THE UNIT.

CAUTION: **The CAUTION sign denotes a precaution. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in the unit not performing properly.**

NOTE: The NOTE sign denotes important information. It calls attention to procedure, practice, condition, or the like which is necessary to highlight.

1.1.2 IMPORTANT SAFEGUARDS

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings in this manual violates safety standards of design, manufacture, and intended use of this equipment. Circuit Research Labs Inc. assumes no liability for the customer's failure to comply with these requirements.

READ ALL INSTRUCTIONS. All safety and operating instructions should be read before the equipment is operated.

GROUND AND POWER CONNECTIONS. To minimize shock hazard, this equipment must be connected to an electrical ground. Grounding is accomplished by proper use of the three-conductor AC power cable supplied with the equipment. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground at the power outlet. This equipment must only be operated from the type of AC line power source specified. See Section 2.2 for power line AC voltage selection.

TRANSIENT VOLTAGE PROTECTION. In areas where power fluctuations and voltage spikes are present on the AC power line additional protection may be necessary.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE. Do not operate this equipment in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

WATER AND MOISTURE. Do not operate this equipment near water or in areas with wet floors. Do not operate this equipment in high humidity atmosphere where condensation forms on the equipment.

ATTACHMENTS. Do not use attachments not recommended by the manufacturer.

VENTILATION. This equipment should never be placed near or over a heat register or other source of heated air. This equipment should not be placed in a built in installation or rack unless proper ventilation is provided.

PARTS REPLACEMENT AND/OR MODIFICATION. The maintenance instructions in this manual are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in this manual. Do not replace components with the power cable connected. Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to this equipment.

1.2 INTRODUCTION

FEATURES:

- -NRSC Pre-Emphasis and Filtering Characteristic
- -Gated Input Gain Reduction
- -Patented Overshoot-Corrected Filtering Technique Removes Out-of-band Components Without Loss of Peak Modulation
- -Selectable Low-frequency Tilt Correction Circuit Improves the Modulation Capability of Many Plate-modulated Transmitters
- -Adjustable Stereo Enhance Circuitry
- -10 Segment Input Peak Indicator with 28 dB Range
- -Programmable 1 dB step Peak Limiting Control
- -Rugged 1 3/4" Rack-mount Chassis With Integral RFI Protection

The CRL SMP-900A was designed to prevent potential loss in station coverage which could result if FM processors were used with AM stereo. Also included in this unit is a monaural support circuit and a very effective single channel negative limiter to prevent AM stereo decoders from being overloaded.

The SMP is the ideal choice to upgrade a stereo audio processing chain to meet the NRSC (National Radio Systems Committee) Voluntary National Standard of January 10, 1987. This transmission standard defines specific pre-emphasis and filtering requirements which are intended to help solve many of the technical concerns in AM broadcasting. The pre-emphasis curve was developed to allow receiver manufacturers to employ a complementary de-emphasis characteristic in wideband radios while improving the frequency response of narrower and medium-bandwidth radios. The filter specification, which limits transmitted audio bandwidth to 10 kHz, is intended to greatly reduce much of the interference between stations by reducing the conditions that cause 'splatter' effects (see Figure 1-1). An 11 kHz cutoff frequency option can also be selected via a rear panel switch. This option, in many cases, can also yield a significant reduction in occupied bandwidth (this mode does not conform to NRSC requirements).

A gated input gain reduction circuit is included which provides >20 dB of input gain control to prevent detrimental limiting effects by maintaining consistent levels into the limiter circuits. This eliminates 'pumping' and other processing artifacts caused by excessive peak limiting.

A resonant low pass clipping filter is used to prevent excessive clipping harmonics which could result in higher intermodulation artifacts. This patented filter eliminates these excessive clipping harmonics, allowing the user to increase limiting to obtain maximum loudness capability without audible distortion.

In addition, the SMP-900A includes a selectable tilt correction circuit, which compensates for the low frequency phase shift common in many plate-modulated transmitters. This often results in an ability to increase the overall modulation level by several percent.

Programmable 1 dB per step peak limiting circuitry is provided with a range from 0 to +4 dB. This circuitry selects the amount of instantaneous gain reduction (limiting) applied to the audio signal.

An adjustable stereo enhance circuit is included that increases the gain in the L + R matrix to provide an increase in apparent stereo separation.

To aid the user in properly setting the audio level into the unit, each channel has a separate 10 segment peak-reading LED input level meter with a range from -20 to +2 dB. A red overload LED is also provided as one segment of the indicator. Additional indicators are included to monitor the activity of filter overshoot-correction circuitry.

Audio interfacing is done through the use of a barrier connector strip on the back panel. Inputs and outputs are active-balanced and fed through second-order RFI suppression filters.

The SMP accepts either 115 or 230 volts AC (selectable by programming the back panel power module), 48-440 Hz. The unit is housed in a steel enclosure for maximum RFI immunity and conforms to a standard 1 3/4" rack height measurement. A rack slide mount is available as an option.

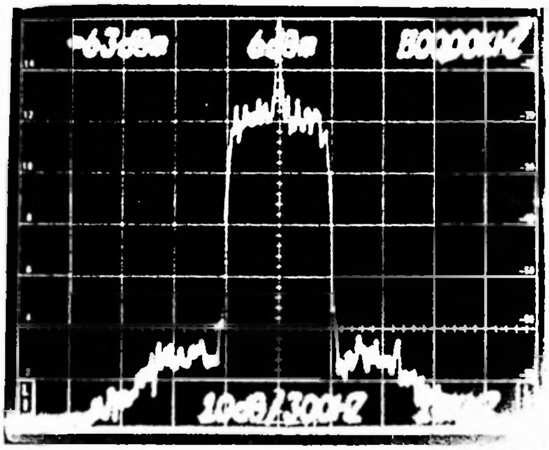

FIGURE 1-1 TYPICAL TRANSMITTED SPECTRUM
(Laboratory transmitter, 15 minute peak-store display; V:10 dB/div., H: 10 kHz/div., 300 Hz resolution, monaural program).

WARRANTY

CIRCUIT RESEARCH LABS, INC. warrants products to be free of defects in materials and workmanship for a period of one year from the date of purchase. This warranty does not apply to products that have been damaged due to improper handling during shipping, or by negligence, improper use, or alterations not authorized by Circuit Research Labs, Inc.

In no event shall Circuit Research Labs, Inc. be liable for any loss of anticipated profits, incidental or consequential damages or any other losses incurred by the purchaser in connection with the operation of any CRL product.

PLACE
STAMP
HERE

Circuit Research Labs, Inc.
2522 W. Geneva Drive
Tempe, Az. 85282

CIRCUIT RESEARCH LABS, INC.
WARRANTY RECORD

MODEL # ____________________ SERIAL # ____________________

DATE OF PURCHASE ____

PURCHASED FROM ____

A return authorization number must be obtained before any equipment may be returned to the factory. Call 602-438-0888 for the number and mark it on the outside of the shipping carton. Otherwise, the equipment may not be accepted.

Detach Here

CIRCUIT RESEARCH LABS, INC.
WARRANTY REGISTRATION

MODEL # ____________________ SERIAL # ____________________

CUSTOMER NAME ____

COMPANY NAME ____

ADDRESS ____

CITY, STATE, ZIP ____

TELEPHONE # (   ) _____ __________

PURCHASE DATE ____

PURCHASE FROM ____

1.3 WARRANTY

PRODUCT WARRANTY

Circuit Research Labs, Incorporated warrants its products to be free of defects in materials and/or workmanship. This warranty shall extend for a period of (1) year from the date the product was originally shipped to the user.

Circuit Research Labs' warranty does not apply to products that have been damaged due to and/or subjected to improper handling by shipping companies, negligence, accidents, improper use, or alterations not authorized by Circuit Research Labs, Incorporated.

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. CIRCUIT RESEARCH LABS, INCORPORATED WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE WHATSOEVER, WHETHER BASED UPON ALLEGATIONS OF NEGLIGENCE, BREACH OF WARRANTY, OR OTHERWISE. THIS DISCLAIMER OF INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDES, BUT IS NOT LIMITED TO, PROPERTY DAMAGES, LOSS OF PROFITS, LOSS OF TIME OR OTHER LOSSES OR INCONVENIENCE RESULTING FROM ANY DEFECT IN THE MATERIAL OR WORKMANSHIP OF THIS PRODUCT OR ANY OTHER CONNECTION WITH THE PURCHASE, OPERATION OR USE OF THIS PRODUCT. (SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU).

PRODUCT CHANGES

Circuit Research Labs Inc. reserves the right to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications. While many previously sold products are later upgraded by field bulletins, Circuit Research Labs Inc. reserves the right to do so without incurring any liability or obligations to modify or update any equipment previously sold.

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NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 10142 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

National Radio Systems Committee
c/o NAB Science & Technology
1771 N Street, N.W.
Washington, D.C. 20077-6316

AM Tomorrow's Sound Wave

From: AM Radio Station Call Letters: ____________________

Address: ____________________

City: ____________________ State: __________ Zip: __________

Phone: (______) ____________________

☐ I have implemented the 75 microsecond preemphasis and 10 kHz audio bandwidth specifications contained in the NRSC voluntary national standard. Please count my station as being compatible with new NRSC receivers.

____________________ ____________________

Authorized Station Representative Date

1.4 NRSC VOLUNTARY STANDARD COMPLIANCE RECORD

Please return the enclosed post paid card to the NRSC, so that broadcast equipment manufacturers, receiver manufacturers, and the trade press can be informed as to the progress of conversion to the voluntary national standard.

If this card is missing notify Circuit Research Labs Inc or:

National Radio Systems Committee
c/o NAB Science & Technology
1771 N Street, N.W.
Washington, D.C. 20077-6316

1.5 SMP-900A SPECIFICATIONS

ELECTRICAL

INPUTS	(Ref. 0 dBm=0.775 VRMS)
Type:	Active balanced (differential)
Impedence:	>10K ohms bridging
Termination:	Selectable 600 ohms
Level (adjustable):	<-10 to +20 dBm; ref. to 0 dB indication on front panel level meter
OUTPUTS	
Type:	Active balanced (differential)
Impedence:	100 ohms (to drive 600 ohm load)
Level (adjustable):	<-20 to +18 dBm; ref. to 100% negative mod. level, as established internally
Monaural output:	Provides summed limited signal with separate tilt correct provision to drive monaural standby transmitter or to bypass the stereo exciter
FREQUENCY RESPONSE	(0 dB ref. at 400 Hz, +10 dBm input/output)
9.5 kHz filter bandwidth selected:	50 Hz to 8 kHz; +0/-1.5 dB -3 dB at 9.5 kHz >30 dB atten. at 10.5 kHz >40 dB atten. at 11.0 kHz Conforms to NRSC standard using required dynamic measurement method
11 kHz filter bandwidth selected:	50 Hz to 10 kHz; +0/- 1.5 dB - 3 dB at 11 kHz >30 dB atten. at 13.5 kHz
Proof Mode:	50 Hz to 15 kHz; +0/- 1.0 dB
HARMONIC DISTORTION	(+10 dBm input/output, 20 kHz bandwidth)
9.5 or 11 kHz BW:	<0.25% over selected operating bandwidth, at or below 100% negative modulation level
Proof mode:	<0.1%
S+N/N:	>60 dB in operate mode >65 dB in proof mode
STEREO SEPARATION	
Operate mode:	>35 dB over selected operating BW, >45 dB typical
Proof mode:	>50 dB
CROSSTALK	
Operate mode:	L+R to L-R or L-R to L+R, >35 dB over selected operating BW, >40 dB typical
Proof mode:	>40 dB

INPUT GAIN REDUCTION:	Input leveling AGC; selectable in 2 dB increments to 8 dB, >20 dB overall range; Strapped for stereo operation
LIMITING:	Selectable in 1 dB increments from 0 to +4 dB; dual band, crossover frequency: 3.5 kHz
SINGLE CHANNEL LIMITER:	Adjustable threshold from OFF to -50%; used to prevent more than -70% envelope modulation produced by a single channel (required by Motorola C-QUAM® system)
STEREO ENHANCE:	Adjustable 0 to +3 dB
PRE-EMPHASIS:	Follows NRSC standard pre-emphasis characteristic, 20 Hz to 10 kHz, when front panel ***PRE-EMPHASIS*** switch is in ***STD*** position. Continuously variable via front panel ***HI-FREQ EQUALIZATION*** control when front panel ***PRE-EMPHASIS*** switch is in ***VAR.*** position
BASS PRE-EMPHASIS:	Internally selectable bass boost function can be placed in circuit to improve apparent low frequency response of many AM receivers
ASYMMETRY:	Adjustable threshold allows up to +150% positive peak modulation
TILT CORRECT:	Selectable circuit allows correction of low frequency phase shift found in some plate-modulated transmitters
INDICATORS:	1. Dual 10-Segment LED-type input level meters with a 22 dB (28 dB with OVLD) dynamic range 2. L + R and L - R limit indicators monitor activity of patented overshoot-corrected filter circuitry
MODE SWITCH:	Selects operate, proof, Reverse, and Left only for test and set up purposes

GENERAL

OPERATING TEMP. RANGE:	32 to 122 degrees F (0 to 50 degrees C)
POWER REQUIREMENTS:	100-130 or 200-250 VAC, 48-440 Hz, 20 VA maximum, EMI suppressed, IEC connector standard
OPERATING HUMIDITY:	0-95% RH, non condensing
OPERATING ALTITUDE:	0-15,000 feet AMSL
SHIPPING WEIGHT:	18 lbs. (including standard accessories)
DIMENSIONS:	19" (48.3 cm) W, 1.75" (4.5 cm) H, 16" (40.6 cm) D, including protruding controls and connectors.

Product specifications are subject to change without notice because of technology updates and product improvements.

C-QUAM is a registered trademark of Motorola, Inc.

SECTION 2 - INSTALLATION

2.1 GENERAL

The front panel of the SMP-900A is pictured in Figure 2-1 and the back panel is pictured in Figure 2-2.

****
WARNING
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DO NOT PLUG IN THIS UNIT UNTIL THE POWER LINE SWITCH HAS BEEN CHECKED AND/OR SET FOR THE CORRECT AC POWER LINE VOLTAGE AS PER SECTION 2.3. IT IS IMPORTANT TO CAREFULLY FOLLOW THE PROCEDURES LISTED BELOW IN SECTION 2.2 BEFORE POWER-UP OF THIS UNIT.

FIGURE 2-1 SMP-900A FRONT PANEL

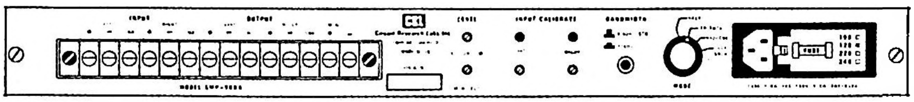


FIGURE 2-2 SMP-900A BACK PANEL

2.2 BEFORE POWER-UP

1. Set the power line module as per Section 2.3

2. Set the internal jumpers as required for the intended system application as per Section 2.4.

3. Connect the unit as per Section 2.6.

4. Set the switches and controls to the initial settings listed in Section 2.7.2.

2.3 POWER LINE AC VOLTAGE SELECTION

The SMP-900A is equipped with a power line module on the back panel with an integral line voltage PCB selector so that the unit can be operated in areas having various line voltage availabilities. The unit is shipped to USA destinations set-up for a line voltage of 115/120 VAC, using a 1/4 ampere, slow-blow type fuse. To set-up the unit for a different line voltage see Figure 2.3 and follow the procedure below.

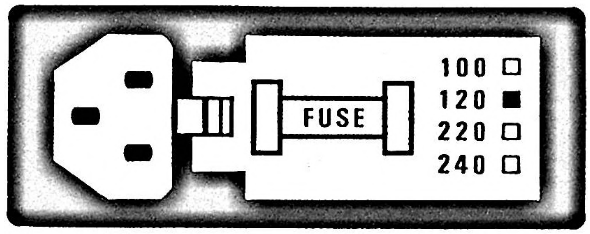


FIGURE 2-3 LINE VOLTAGE SELECTION

Note: The power line module used may vary from the one shown above.

1. Disconnect the power cord from the module. Open the compartment containing the fuse and the PCB voltage selector by pushing in on the raised lever adjacent to the power plug receptacle.

2. Remove the PCB voltage selector and position it so that the red line on the edge of the PCB corresponds to the opening in the cover opposite the legend for the desired line voltage.

3. Insert the PCB voltage selector firmly into the module slot.

4. Remove the fuse from the fuse holder on the back of the compartment cover. Select a fuse as listed below and insert the fuse in the fuse holder.

100 to 130 VAC operation	1/4 ampere, slow-blow type
200 to 250 VAC operation	1/8 ampere, slow-blow type

NOTE: Operation of the unit on 200-250 VAC will require replacement of the plug that is used to connect the unit to the AC line.

5. Close the compartment cover and insert the line cord into the receptacle on the module.

2.4 INTERNAL JUMPERS

The SMP is equipped with internal jumpers to configure the unit to individual operational requirements. Set the jumpers as applicable for the individual station requirements. (DO NOT adjust potentiometers R43, R44, R102, R146, R195, R225, and R251 on the PCB at this time. See Section 6.2 for making these adjustments).

JUMPER	FACTORY POSITION	FUNCTION OF JUMPER
J5	INSTALLED	+15 V DISCONNECT JUMPER. The positive DC power connection between the power supply and the circuitry is broken when this jumper is removed.
J6	INSTALLED	-15 V DISCONNECT JUMPER. The negative DC power connection between the power supply and the circuitry is broken when this jumper is removed.
J9	TERM	TERMINATING OR BRIDGING INPUT JUMPER, LEFT. In the ***TERM*** position, the input has a 600 ohm termination. The ***BRIDGE*** position presents an impedence of >10K ohms.

CAUTION: J9 and J13 must be in the same relative position.

JUMPER	FACTORY POSITION	FUNCTION OF JUMPER
J10	OUT	BASS CLIP JUMPER, LEFT. This jumper selects the low frequency response of the input leveling AGC circuitry. In the ***OUT*** position the low frequency response is flat. In the ***IN*** position the G/R circuits do not respond to frequencies below 100 Hz. The ***OUT*** position is recommended for most applications.

CAUTION: J10 and J14 must be in the same relative position.

JUMPER	FACTORY POSITION	FUNCTION OF JUMPER
J11	IN	BASS PRE-EMPHASIS JUMPER, LFET. The ***IN*** position produces a response peak at approximately 105 Hz of approximately 3 dB above 400 Hz reference. It also produces a rapid roll-off below 100 Hz to prevent the transmission of subsonic information. This position is used to improve the apparent low frequency response of many receivers. It may also increase the performance of some plate modulated transmitters that are unable to tolerate subsonic information. In the ***OUT*** position, the frequency response is flat. Low frequency filtering also helps reduce interference to the AM stereo pilot. (See Figure 6-4).

CAUTION: J11 and J15 must be in the same relative position.

J13	TERM	TERMINATING OR BRIDGING INPUT JUMPER, RIGHT. In the ***TERM*** position, the input has a 600 ohm termination. The ***BRIDGE*** position presents an impedence of >10K ohms.

CAUTION: J9 and J13 must be in the same relative position.

J14	OUT	BASS CLIP JUMPER, RIGHT. This jumper selects the low frequency response of the input leveling AGC circuitry. In the ***OUT*** position the low frequency response is flat. In the ***IN*** position the G/R circuits do not respond to frequencies below 100 Hz. The ***OUT*** position is recommended for most applications.

CAUTION: J10 and J14 must be in the same relative position.

J15	IN	BASS PRE-EMPHASIS JUMPER, RIGHT. The ***IN*** position produces a response peak at approximately 105 Hz of approximately 3 dB above 400 Hz reference. It also produces a rapid roll-off below 100 Hz to prevent the transmission of subsonic information. This position is used to improve the apparent low frequency response of many receivers. It may also increase the performance of some plate modulated transmitters that are unable to tolerate subsonic information. In the ***OUT*** position, the frequency response is flat. Low frequency filtering also helps reduce interference to the AM stereo pilot. (See Figure 6-4).

CAUTION: J11 and J15 must be in the same relative position.

J17	OUT	MONO TILT CORRECT. This jumper is used in conjunction with R102 (internally on PCB) and the ***MONO OUT*** control (back panel) to provide tilt correction to the signal at the ***MONO OUT*** terminals. When the jumper is in the ***IN*** position R102 adjusts the correction circuitry used to compensate for low frequency phase shift (see Section 2.7.4).
J18	L - R	L - R LIMIT. This jumper is used in troubleshooting the asymmetry circuit. To verify the unit is producing asymmetrical audio, move the jumper to the ***L+R POS*** position. Increasing the front panel ***ASYMMETRY*** control will cause the L-R LED (now reading L+R positive limiting) to flash less often or not at all as the control is increased. After troubleshooting is completed, return jumper to ***L-R*** position.

J19	NORM	AUX 2	These jumpers are provided for future options and each must must remain in the ***NORM*** position.
J20	NORM	AUX 1	

NOTE: When jumpers J21 and J22 are used in the ***L+R/L-R*** positions the single channel limiter function is defeated.

J21	L	DECODE. This jumper programs the SMP for discrete or matrix output. The ***L*** position provides left channel audio output. The ***L+R*** position provides an L + R audio output at the ***LEFT CHANNEL AUDIO OUTPUT*** terminal.
J23	R	DECODE. This jumper programs the SMP for discrete or matrix output. The ***R*** position provides right channel audio output. The ***L-R*** position provides an L - R audio output at the ***RIGHT CHANNEL AUDIO OUTPUT*** terminal.

J26	NORM	AUX 2	These jumpers are provided for future options and each must remain in the ***NORM*** position.
J27	NORM	AUX 1	

2.5 PCB LED INDICATORS

POWER SUPPLY PCB INDICATORS

Apply AC Line power to the unit and verify that the power supply voltages are present. The voltages are present when DS1 and DS2, the red LED's on the main PCB, as listed below, are illuminated. IF DS1 and/or DS2 ARE NOT illuminated go to Section 5.3, TROUBLESHOOTING.

LED	VOLTAGE	COMMENTS
DS1	+15 VDC +/- 400 mVDC	Fixed; measure at TP4
DS2	-15 VDC +/- 400 mVDC	Fixed; measure at TP5

GATE LED INDICATOR

This LED is illuminated when the gate circuitry is activated. This freezes all gain control action when the level drops below the gate threshold (-20 dB).

LED	DESCRIPTION
DS3	Gate Indicator

2.6 INTERCONNECTIONS

2.6.1 GENERAL

The SMP-900A is designed to interface with many types of broadcast equipment. See Figure 2.4 for some typical applications for this unit within the overall system. This unit may be wired for either balanced or unbalanced operation and is always placed immediately before the transmitter in the audio path.

2.6.2 BALANCED LINE CONNECTIONS

Most broadcast equipment is designed for balanced line operation. Connect as per FIGURE 2.5. The SMP-900A has two input and two output connections. A two conductor shielded cable should be used (Belden #8451 or equivalent) with a red and black twisted pair inside a shielded covering. Connect the red lead to + terminal on the barrier strip, the black lead to the – terminal on the barrier strip, and the shield (ground) to *GND* terminal on the barrier strip. THE CABLE SHIELD SHOULD BE CONNECTED TO GROUND AT THE SOURCE END ONLY TO PREVENT GROUND LOOPS.

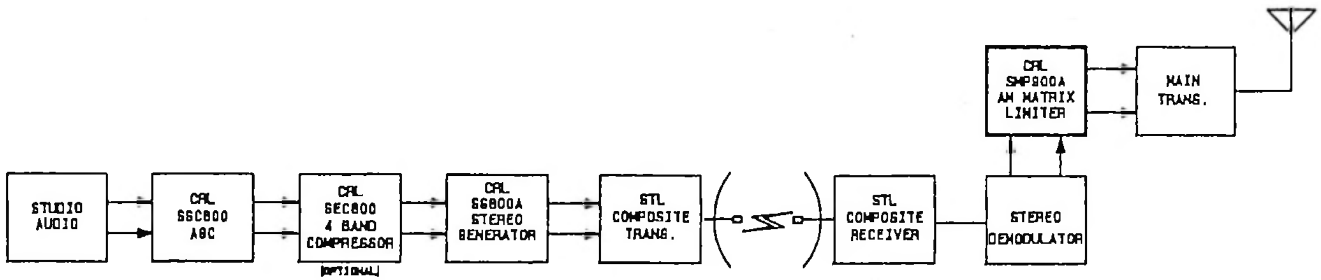
2.6.3 UNBALANCED LINE CONNECTIONS

Connect the equipment EXACTLY as shown in Figure 2.6 for operation with unbalanced line equipment. The SMP-900A has two input and two output connections.

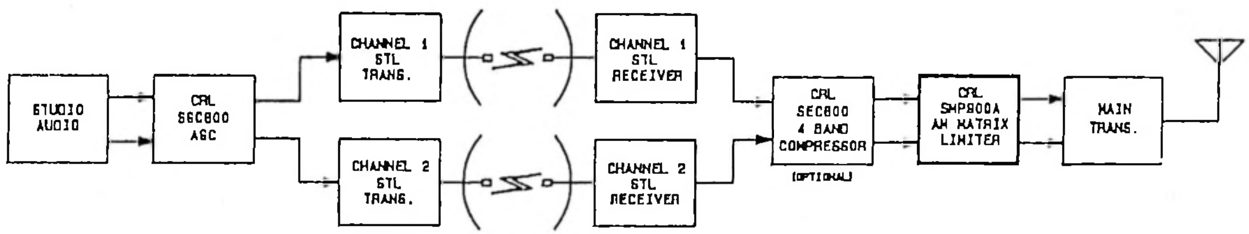
NOTE: When using unbalanced input connections only, the shield is connected to the ground terminal and the negative (-) terminal is connected to the ground by a jumper wire as shown in Figure 2-6.

CAUTION: When using unbalanced output connections, the shield must be connected to the ground terminal. The negative (-) output terminal must be left unconnected. This equipment does not use transformers; therefore, accidental grounding of the negative (-) output terminal will short half of the output circuit. Also, the output levels will be 6 dB lower than the balanced output levels. Unbalanced operation is not recommended in most applications since RFI supression is most effective when a balanced-line connection is used.

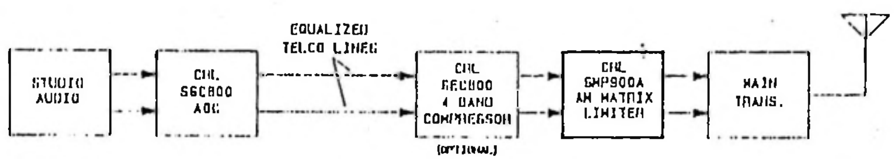
FIGURE 2-4 TYPICAL SYSTEM CONFIGURATIONS



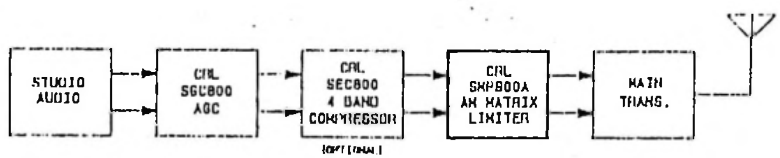
(A) USE WITH COMPOSITE STL



(B) USE WITH DISCRETE STL



(C) USE WITH TELEPHONE LINES



(D) CO-LOCATED STUDIO/TRANSMITTER SITE

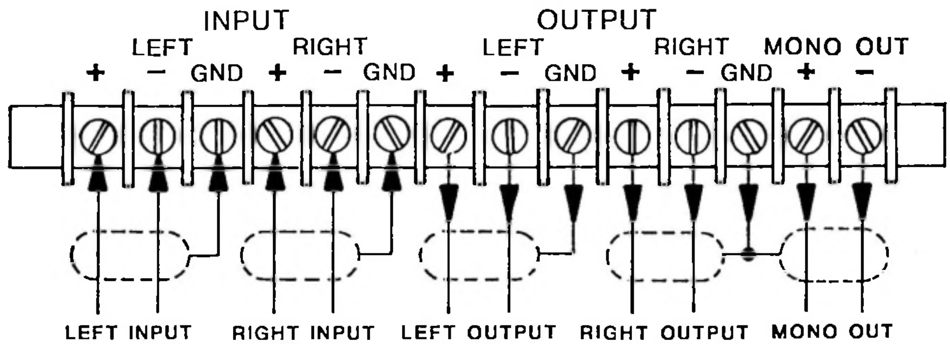


FIGURE 2-5 BALANCED LINE CONNECTIONS

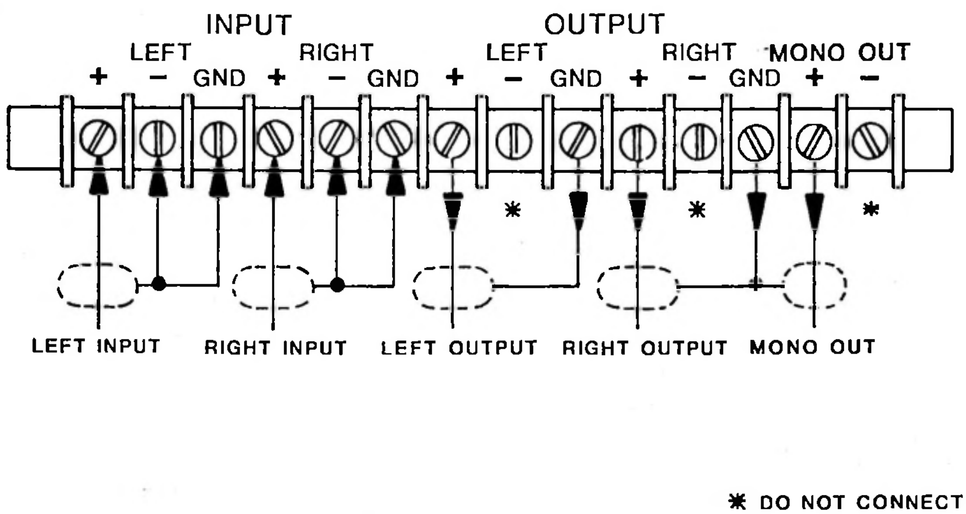


FIGURE 2-6 UNBALANCED LINE CONNECTIONS

2.7 INITIAL SET-UP

2.7.1 GENERAL

The following procedure is given to aid in interfacing and setting up the SMP for general program requirements. It is recommended that the entire manual be read first to become familiar with all of the capabilities of this unit.

1. Verify that the unit is set for the correct AC line voltage (see Section 2.3).
2. Connect audio input and output as per Section 2.6.
3. Verify that the internal jumpers are set properly, as per Section 2.4.
4. Verify that the controls and switches are set as per the table below.

INITIAL CONTROL SETTINGS

CONTROL OR SWITCH	SETTING
INPUT AGC G/R	-8
PRE-EMPHASIS	STD
EQUALIZATION	OFF (fully CCW)
STEREO ENHANCE	FULLY CCW
LIMITING	+4
OUTPUT, L + R	FULLY CCW (20 turns or more)
OUTPUT, L - R	FULLY CCW (20 turns or more)
ASYMMETRY	FULLY CCW (20 turns or more)
TILT CORRECT	OFF
INPUT CALIBRATE LEFT*	FULLY CCW (20 turns or more)
INPUT CALIBRATE RIGHT*	FULLY CCW (20 turns or more)
BANDWIDTH*	9.5 kHz (Out)
MODE*	OPERATE

CAUTION: When setting up the SMP with an older transmitter it may be desirable to use less than full limiting to void damage to the transmitter or antenna system. The higher settings are used to more easily identify peak limiting levels.

* Located on back panel

5. Verify that the stereo pilot tone is switched off. It must remain off during all processing alignment.

6. Perform the set up procedure for each section ONLY in the order listed in the following table. The procedures listed as REQUIRED must be performed for each unit.

CAUTION: The installation sequence must be followed at all times. Failure to observe this may result in reduced performance.

SET UP SUMMARY

PROCEDURE	SECTION	STATUS
Input Level	2.7.2	REQUIRED
Modulation	2.7.3	REQUIRED
Tilt Correct	2.7.4	As Required*
Single Channel Limiter	2.7.5	REQUIRED, C-QUAM® system
Asymmetry	2.7.6	As Required*
Stereo Enhance	2.7.7	As Required*
Monaural Output	2.7.8	As Required, may be adjusted separately

*The use and set up of the features listed in these sections are optional depending on the system requirements, however the procedure MUST BE performed in the order listed in the above table.

2.7.2 INPUT LEVEL

NOTE 1: The best balance will be obtained by using a monaural source to insure the same input material to both channels.

NOTE 2: When this unit is used with a CRL SGC-800 or SPP-800, the input levels can be set using the SGC/SPP internal noise generator as a simulated monaural program source (see SGC/SPP manual for more information).

1. Feed a line level program signal through the system to the inputs on the SMP-900A. All equipment prior to the SMP should be set for normal operation.

2. Increase the setting of the SMP-900A ***INPUT CALIBRATE LEFT*** control (back panel) until the LED above the control is illuminated approximately 10-20% of the time. The 0 dB indicator segment on the front panel level meter may also be used, since its function is the same as this back panel LED.

NOTE: The OVLD LED (front panel) should never illuminate with normal program material.

3. Increase the setting of the SMP-900A ***INPUT CALIBRATE RIGHT*** control (back panel) until the LED above the control is illuminated approximately 10-20% of the time. The 0 dB indicator segment on the front panel level meter may also be used, since its function is the same as this back panel LED. When using a monaural source both rear panel LEDs should light at the same time.

NOTE: The OVLD LED (front panel) should never illuminate with normal program material.

4. If unable to get the LED indicator to illuminate in the above steps after 20 complete clockwise rotations, the input sensitivity may need to be modified (see Section 6.4).

2.7.3 MODULATION

The following subsections describe modulation set up using an oscilloscope (preferred method) and the set up using a modulation monitor (alternate method) for properly obtaining accurate L+R and L-R output levels. It is absolutely essential to carefully follow these procedures in order to insure that proper L+R amplitude and L-R phase modulation limits are accurately controlled internally in the AM stereo exciter so that the maximum transmitted separation is not degraded.

The set up procedure using an oscilloscope is the preferred set up method since it does not rely on the various AM stereo modulation monitors as the alignment tool. Experience has shown that although the various AM Stereo Modulation monitors indicate extremely useful information, they tend to respond ambiguously on noise generator signals and program material which may cause the following adjustments of the L-R to L+R modulation levels to be less accurate.

An alternate set up procedure using a modulation monitor is also included. This method requires an AM Stereo Modulation Monitor (with an L-R metering mode) for L+R and L-R Output Alignment. It is strongly recommended that the method using the oscilloscope be used for setup accuracy. When the modulation monitor method is used, the procedure using the oscilloscope should be studied, since it will help in understanding the procedure.

NOTE: A modulation monitor is nothing more than an indirect indicating device which shows peaks, balances, and associated nulls. All of these indications may be directly displayed on an oscilloscope in instantaneous displays.

SET UP PROCEDURE USING AN OSCILLOSCOPE

CAUTION: The output level of the SMP-900A should never be set such that the negative modulation capability of the transmitter is exceeded.

1. Verify that AM Stereo Exciter is properly calibrated.

CAUTION: All of preliminary procedures starting with Section 2.7.1 must be completed before proceeding.

2. Feed a balanced left and right monaural noise or program signal through the system to the SMP-900A.

CAUTION: If the L-R indicator on the SMP-900 is flashing while the L+R indicator is not, an out of phase condition exists ahead of the SMP-900. Before continuing, reverse one of the input channel "+" and "-" polarities to the system to correct this condition.

L+R MODULATION ADJUSTMENT

3. Carefully adjust the ***OUTPUT (L + R)*** control on the SMP for the desired total envelope negative peak modulation as indicated by the station's monaural Modulation Monitor or as referenced by an Oscilloscope operating at 2mS or 5mS horizontal sweep rate while monitoring the RF envelope.

CAUTION: Be sure the point at which the modulated envelope is monitored is properly selected as being a location that accurately represents the actual transmitted signal into the antenna system.

L-R MODULATION ADJUSTMENT

4. Move the SMP-900 ***MODE*** switch (back panel) to the ***LEFT ONLY*** position. Connect an Oscilloscope to the "+" RIGHT OUTPUT terminal and chassis ground on the SMP-900. Adjust the oscilloscope ***VERTICAL GAIN*** control for a full screen peak to peak display. While observing the total envelope modulation on the monitor, adjust the SMP ***OUTPUT (L − R)*** control slowly clockwise until the oscilloscope indicates the best "NULL" (minimum output) at the ***RIGHT OUTPUT*** terminal on the SMP-900. Do not continue to increase the ***OUTPUT (L − R)*** control beyond this point. Temporarily turn off the transmitter for this adjustment if observed residual RF prevents proper nulling resolution. Turn the transmitter back on after nulling is completed.

NOTE: This adjustment method insures the best possible matching of the L-R to L+R modulation limit levels since it maximizes separation when the right channel output is nulled.

INITIAL MODULATION CHECK

5. Set the ***MODE*** switch to the ***OPERATE*** position on the SMP-900. Verify that the total peak modulation as indicated on the Modulation Monitor Peak Flasher or Oscilloscope is at the same level as previously obtained.

NOTE: The modulation densities are different for both channels as compared to a single channel. The average peak meter readings on some monaural modulation monitors may indicate as much as 10% greater for both channels as compared to the left only reading but the PEAK indicator should remain comparatively equal if the transmitter is in good condition.

FINAL MODULATION CHECK

6. Move the SGC/SPP-800 QNOISE switch (back panel) to the ***OUT*** position. Feed a monaural program signal through the system at normal operating level. Retouch the settings of the SMP-900A ***INPUT CALIBRATE – LEFT*** and ***RIGHT*** controls as necessary (back panel) until the LEDs above each control flash on program peaks. The 0 dB indicator segment on the front panel level meters may also be used, since their function is the same as this back panel LED. When using a monaural source both rear panel LEDs should light at the same time.

NOTE: The OVLD LEDs (front panel) should never illuminate with normal program material.

FINE TUNING

7. For best results, fine tune either SMP input control for the best "NULL" as shown on the Stereo Modulation Monitor when it is set in the L-R position. If a modulation monitor is not available, adjust the controls for equal peak flashes on the 0 dB input indicators.

MODULATION RE-ADJUSTMENT

8. If additional total envelope modulation is desired, the above procedure should be repeated using the SMP-900A ***OUTPUT (L + R)*** control to set the envelope modulation. The ***OUTPUT (L – R)*** control is then set to maximize the stereo separation as described above and displayed on the Stereo Modulation Monitor.

SET UP USING A MODULATION MONITOR

CAUTION: The output level of the SMP-900A should never be set such that the negative modulation capability of the transmitter is exceeded.

L+R MODULATION ADJUSTMENT

1. Initially adjust the L+R output control on the SMP-900A for a total negative peak flasher modulation to the desired maximum level as referenced by the station's monaural modulation monitor.

NOTE: The readings between left and right channels should be equal as indicated on the stereo modulation monitor.

L - R MODULATION ADJUSTMENT

2. Switch the Stereo Modulation Monitor to the R position and set the ***MODE*** switch (back panel) on the SMP-900A to ***LEFT ONLY*** position. Adjust the ***OUTPUT (L - R)*** control for a minimum right channel reading as indicated on the Stereo Monitor. The right channel meter sensitivity of the modulation monitor may need to be increased. Fine tune the ***OUTPUT (L - R)*** control for a minimum modulation indication in the right channel modulation.

2.7.4 TILT CORRECT SET-UP

NOTE: This adjustment can be performed either using test equipment or dynamically with program material. Although the method employing test equipment will yield greater accuracy at a single frequency, the dynamic set-up method is preferred in most cases. This is due to the fact that the average tilt (or phase shift) can be corrected over a wider range of frequencies when program material is used.

METHOD #1: SET-UP USING TEST EQUIPMENT

1. Obtain the following test equipment (or equivalent):

MODEL	MFG.	NOTES
AG-51	Potomac	Audio Generator (Set the output switch to L+R)
2445	Tektronix	Oscilloscope (5 MHz minimum response, dual channel)

2. Turn the SMP ***OUTPUT LEVEL*** control fully CCW (counter-clockwise).

3. Disconnect the SMP *AUDIO INPUT* connections (back panel). Connect the audio generator to the *AUDIO INPUT* connections. Feed a 100 Hz tone to the unit at a level 6 dB higher than the level at which the OVLD indicator illuminates.

NOTE: If the audio generator is set for a +10 dBm output level when the front panel meter indicates +2, the specified level can be obtained by increasing the generator output level by 10 dB to +20 dBm. Other generator output levels can be accommodated by adjusting the SMP *INPUT CALIBRATE* control.

4. Increase the settings of the SMP *G/R* and *LIMITING* switches to maximum settings (-8 and +4 respectively).

5. Connect an oscilloscope across the R. F. input of the modulation monitor (or other suitable R. F. monitor point in the transmission system).

6. Set the SMP *OUTPUT LEVEL* control as required to obtain about -70% modulation, as observed on the oscilloscope or modulation monitor. The display will be highly clipped as shown in the figures on the following page.

****
WARNING
****

TO AVOID DAMAGE, THE TRANSMITTER SHOULD BE OPERATED FOR A FEW SECONDS AT A TIME ONLY.

NOTE: If the modulation envelope as viewed on the oscilloscope appears as in Figure 2-7, no tilt correction is necessary and the following procedure should not be performed.

7. If tilt is present as shown in Figure 2-8, enable the tilt correct circuitry by rotating the front panel *TILT CORRECT* potentiometer until it just 'clicks' on.

8. If tilt is present, as shown in Figure 2-8, adjust the *TILT CORRECT* control to obtain a waveform similar to Figure 2-7. Over-correction will resemble Figure 2-9 and cause poor performance. Turn *TILT CORRECT* control counter-clockwise to correct.

9. After adjustment has been made, disconnect the generator and reconnect the program audio to the SMP *AUDIO INPUT* connections. Recalibrate the SMP *INPUT CALIBRATE* and *OUTPUT LEVEL* controls for normal operation. Return the *G/R* and *LIMITING* switches to their previous positions.

10. If the results indicated cannot be obtained or if the display initially appears overcorrected as per Figure 2-11, turn the ***TILT CONTROL*** control fully CCW until a "click" is heard. The condition of transmitter modulating components should be checked; also, the presence of inadequate A. C. coupling at the transmitter audio input or modulator should be investigated and corrected before attempting to repeat the procedure.

METHOD #2: SET-UP USING PROGRAM AUDIO AND OSCILLOSCOPE

NOTE: In lieu of program material, the pulsed-USASI noise function on the CRL SGC-800 may be used.

1. Feed normal monaural program audio through the processing system including the SMP and transmitter. The pre-emphasis function should be disabled. (SMP ***PRE-EMPHASIS*** switch set to ***VAR*** and the ***HI FREQ EQUALIZATION*** set fully CCW).

2. Connect an oscilloscope across the R. F. input of the modulation monitor or other suitable monitor point (use an oscilloscope of at least 5 MHz bandwidth).

3. Decrease the SMP ***OUTPUT LEVEL*** control to a point where the transmitter peak modulates at about -70%, as observed on the modulation monitor (or oscilloscope).

4. Increase the SMP ***INPUT CALIBRATE*** control such that the ***OVLD*** indicator flashes to a point where it is illuminated most of the time with program audio present. Increase the settings of the SMP ***G/R*** and ***LIMITING*** switches to maximum settings (-8 and +4 respectively). Demodulated audio will be distorted during this adjustment.

NOTE: If a multi-band compressor (such as the CRL SEC-800 or SEP-800) is present in the system, the ***LOW*** band control should be increased to a setting fully clockwise, while the ***M1***, ***M2***, and ***HIGH*** band controls should all be set fully counter clockwise. This will make the low frequency components easier to see on the oscilloscope. BE SURE TO LOG SETTINGS OF THESE CONTROLS SO THEY CAN BE RETURNED TO THEIR ORIGINAL POSITIONS AFTER ADJUSTMENT IS MADE.

5. As viewed on the oscilloscope, it should be noted if bass notes clip in a similar tilted manner as shown in the photo of Figure 2-8. If this is the case, proceed to step 6. If the clipped bass information appears similar to Figure 2-7, no correction is necessary.

NOTE: It is easiest to determine the presence of tilt by observing the negative portion of the modulation envelope.

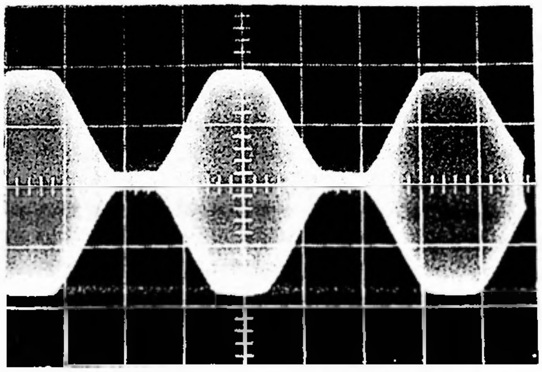


FIGURE 2-7 NORMAL MODULATION ENVELOPE
(No Tilt Present)

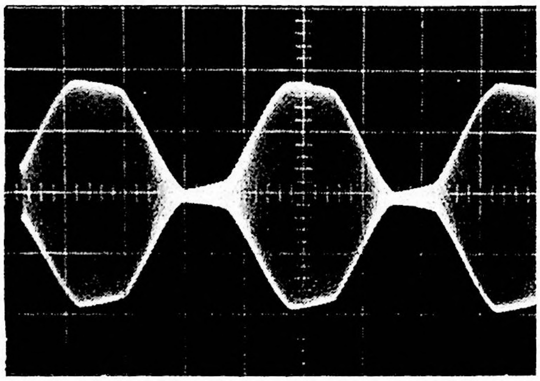


FIGURE 2-8 UNDER-CORRECTED MODULATION ENVELOPE
(Tilt Present)

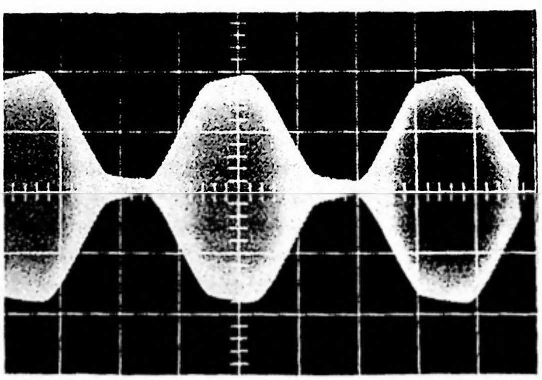


FIGURE 2-9 OVER-CORRECTED MODULATION ENVELOPE

6. If tilt is present as described above, enable the tilt correction circuitry by rotating the ***TILT CORRECT*** control clockwise until it just 'clicks' on.

7. Adjust the SMP front panel ***TILT CORRECT*** control such that bass clipping is horizontal (as in Figure 2-7). The trace should be studied for several minutes as the adjustment is made to verify that the majority of low frequency tilt is removed.

CAUTION: Be careful not to over-correct, as shown in Figure 2-11. Damage to the transmitter may result if tilt is left significantly over-corrected.

8. If this adjustment cannot be successfully made, or if the waveform initially tilts in the manner as shown in Figure 2-11, the transmission system requires troubleshooting (see METHOD 1, Step #10).

9. Readjust the SMP input and output level controls for normal program operation (decrease input level and increase output level). Return SMP ***PRE-EMPHASIS*** switch to the ***STD*** position (or ***VAR*** position with the ***HI FREQ EQUALIZATION*** control at the previous setting). Return the ***G/R*** and ***LIMITING*** switches to their previous positions.

2.7.5 SINGLE CHANNEL LIMITER

1. Set the SMP-900A ***MODE*** switch (back panel) to the ***LEFT ONLY*** position.

F-C.C. LIMIT 70%

2. Adjust the ***SGL CH LIM*** control (back panel) until the total envelope negative peak modulation is reduced to 70% to 75% as indicated by the modulation monitor, stereo modulation monitor L+R negative peak flasher, or as referenced by an oscilloscope operating at 2mS or 5mS horizontal sweep rate. Higher settings of the SMP ***LIMITING*** switch will make this adjustment easier to make.

3. Return the ***MODE*** switch (back panel) to the ***OPERATE*** position.

CAUTION: The negative peak monaural or L+R indication on the modulation monitor will now vary from a maximum modulation indication (caused by pure monaural L+R) as initially set by the L + R control to a minimum modulation indication (caused by pure single channel) as established by the ***SGL CH LIMIT*** control. This will depend on how much stereo is present in the program material being transmitted. The positive modulation will normally not be affected by the single channel limiter.

2.7.6 ASYMMETRY SET-UP

NOTE: Verify that the station transmitter, as per manufacturer's specifications and condition is capable of producing the positive modulation desired.

1. Feed a line level program signal through the system to the input on the SMP-900A. All equipment prior to the SMP should be set for normal operation.

2. Adjust the ***ASYMMETRY*** control clockwise until the desired positive modulation level as indicated on the modulation monitor is achieved.

NOTE: It may be desirable to use higher initial settings of the ***G/R*** and ***LIMITING*** switches to magnify the effect of the ***ASYMMETRY*** control. This increases the density of the program material providing a higher amount of peak modulation which enables the upper limit of positive peak modulation to be set accurately.

3. If the asymmetry control increases negative modulation, check for phase reversal of SMP output connections.

4. Return the ***G/R*** and ***LIMITING*** switches to the normally used positions.

2.7.7 STEREO ENHANCE

The stereo enhance circuitry can be enabled at this time by rotating the ***STEREO ENHANCE*** control clockwise. See Section 3.2.6 for a description of the operation of this control.

2.7.8 MONAURAL OUTPUT

The monaural output is via the back panel ***MONO OUT*** connections. This output is typically used as follows:

1. It provides a temporary output so that the processing system can be used before the AM stereo system has been installed. It is assumed that the program material feeding the system is stereo and temporarily summed to monaural by the SMP900A.

NOTE: The SMP-900A and associated units can be used with a monaural processing chain (see Appendix for the required connections).

2. This output can be used to drive a monaural auxiliary transmitter for standby operation.

SET UP PROCEDURE

CAUTION: If the SMP-900A is being used to drive an auxiliary transmitter the stereo set up should be done first starting with Section 2.7.

1. Verify that the input levels are set as per Section 2.7.2.

2. Connect an oscilloscope or modulation monitor to a suitable monitoring point that accurately represents the actual transmitted signal into the antenna system.

3. Increase the setting of the ***MONO OUT*** control (back panel) until negative modulation peaks as observed on the oscilloscope or modulation monitor are between 90 and 95%.

CAUTION: The output level of the SMP-900A should never be set such that the negative modulation capability of the transmitter is exceeded.

NOTE: The asymmetry has been previously set for the main transmitter in Section 2.7.6. Verify that the auxiliary transmitter is capable of the positive peak modulation previously set for the main transmitter. If the positive peak capability is significantly less than the main transmitter it may be desirable to reduce the asymmetry using the procedure in Section 2.7.6.

4. If the asymmetry has not previously been set see Section 2.7.6, steps 2 to 3 (including notes).

5. The tilt correct circuitry can be enabled using internal jumper J17. The adjustment is made using the procedure in Section 2.7.4 using internal PCB trimmer potentiometer R102 instead of the front panel control.

2.8 GUIDELINES FOR SYSTEM SOUND SETTING

The following chart should be followed for the initial settings after the previous alignments have been completed. The rest of the chart should be used for reference to insure that the final combination of sound settings are within the recommended ranges.

NOTE: Settings outside these ranges may indicate incorrect alignment of individual units in the system.

Please read the notes after the chart on page 2-22.

SYSTEM SOUND SETTING GUIDE

SUGGESTED CONTROL SETTINGS

FORMAT	SGC-800 G/R	SGC-800 OPER	SGC-800 BAND	SEC-800 G/R	SEC-800 OPER	SEC-800 LIM/COMP	SMP-900A G/R	SMP-900A LIM
Rock								
Heavy 1	-12	F	DUAL	-12	M	L	-8	+4
Heavy 2	-12	F	BOTH	-9	F	C	-6	+3
Heavy 3	-9	F	DUAL	-9	F	L	-6	+3
Medium 1	-9	F	BOTH	-9	M	C	-6	+3
Medium 2	-9	M	DUAL	-6	F	C	-4	+3
Medium 3	-9	M	BOTH	-6	F	L	-4	+2
Soft 1	-6	M	DUAL	-9	S	C	-4	+2
Soft 2	-6	M	BOTH	-6	M	C	-2	+1
Soft 3	-6	S	WIDE	-6	S	L	-2	+1
Beautiful Music								
Heavy	-9	M	DUAL	-9	M	C	-6	+2
Medium	-6	S	BOTH	-6	S	C	-4	+1
Soft	-3	S	WIDE	-3	S	C	-2	0
Country								
Heavy	-9	F	DUAL	-9	M	C	-6	+3
Medium	-6	M	BOTH	-6	M	C	-4	+2
Soft	-3	S	WIDE	-3	S	C	-2	+1
Talk								
Heavy	-12	M	DUAL	-12	M	L	-6	+4
Medium	-9	M	BOTH	-9	M	L	-4	+3
Soft	-6	S	BOTH	-6	S	L	-4	+2
Classical								
Heavy	-9	S	BOTH	-9	S	C	-4	+2
Medium	-6	S	BOTH	-6	S	C	-2	+1
Soft	-3	S	WIDE	-3	S	C	-2	0
Easy Listening								
Heavy	-9	M	BOTH	-9	M	C	-6	+3
Medium	-6	M	BOTH	-6	M	C	-4	+2
Soft	-6	S	BOTH	-6	S	C	-2	+2

See notes on page 2-22.

SGC-800 dynafex NOISE REDUCTION USAGE

In conjunction with any of the above control settings, the SGC-800 dynafex noise reduction circuitry can be activated. The front panel ***THRESHOLD*** control should be set to obtain the maximum amount of noise reduction during program pauses without audible expansion artifacts. It may be desirable to change the positions of internal jumpers J11 and J19 to optimize the dynafex operating VCR bandwidth for the program format (see Section 2.4 of the SGC manual).

NOTE: The ***BAND – MULTI/WIDE*** switch on the SEC-800 may be set as desired for dynamic equalization .

CAUTION: If the SEC-800 compressor is not being used with the system add 3 to 6 db to the SGC-800 G/R levels.

SECTION 3 - OPERATING INSTRUCTIONS

3.1 GENERAL

The purpose of this section is to describe the operation of the switches, indicators, and controls on the SMP-900A. A thorough understanding of this section will enable the user to get the most from this unit. Each switch, indicator, and control is described as to its operation and purpose. See Section 2.7 and 2.8 for information on set up of the unit using these controls

3.2 FRONT PANEL SWITCHES, INDICATORS, AND CONTROLS

3.2.1 POWER LED INDICATOR

A red LED is used as a power on indicator.

3.2.2 G/R - MONO SUPPORT SWITCH

The ***G/R – MONO SUPPORT*** switch sets the signal level to the circuits that control the range of gain reduction. For example, when the switch setting is -4, the output of the unit will be held constant even though the input may drop as much as 4 dB below the calibrated input level. If the input level drops 6 dB, the output will drop only 2 dB. Input signals may increase as much as 15 dB above the "0" dB indication on the LED input level meter and not be affected by the setting of this switch, since G/R action is automatic above "0". Proper setting of this switch is determined by the sound the user is trying to achieve. The amount of apparent loudness increase is most noticeable when switching from -2 to -4 and from -4 to -6.

CAUTION: It is suggested that the user select a G/R setting as low as possible to accomplish the objectives. Most users choose -2 or -4. Also, it is assumed that the audio applied to the unit is already gain controlled and compressed as desired. Unprocessed audio should not be directly applied since this circuit is not designed to operate over an extremely wide dynamic range.

NOTE: Since the left and right AGC amplifiers are L + R controlled, this tends to support monaural loudness during heavy stereophonic transmissions. Care should be used in the amount of G/R used since the amount of compression action will vary 6 dB between monaural and single channel inputs causing additional compression.

3.2.3 PRE-EMPHASIS SWITCH

This switch is provided to select either a fixed NRSC (National Radio Standards Committee) standard pre-emphasis character-istic in the ***STD*** position or a user adjustable variable pre-emphasis characteristic in the ***VAR*** position. The ***STD*** pre-emphasis function is characterized by a single zero at 2122 Hz and a single pole at 8700 Hz, as defined by the NRSC. This is essentially a 75 us pre-emphasis characteristic rolled off at higher frequencies such that the maximum gain is 10 dB at 10 kHz.

NOTE: If undesirable modulation artifacts are present when using the ***STD*** position due to transmitter or antenna deficiencies, the ***VAR*** position should be used to troubleshoot the system (see note in Section 3.2.5).

In the ***VAR*** position, the desired pre-emphasis is set by the ***HI FREQ. EQUALIZATION*** control (see Section 3.2.5).

3.2.4 INPUT LEVEL INDICATOR

The input indicator displays the input signal level for each channel. The readout is in logarithmic notation as indicated by the scale and is always peak reading. The red ***OVLD*** indicator will begin to illuminate when the signal level is 8 dB above the 0 dB calibration reference level.

3.2.5 HI FREQ EQUALIZATION

This control provides a continuously variable high frequency pre-emphasis of the program material.

NOTE: This control is activated only when the ***PRE-EMPHASIS*** switch is in the ***VAR*** position.

When this control is rotated clockwise, the amount of pre-emphasis (emphasis at higher frequencies) is increased. When it is set to approximately the 2:00 position, the pre-emphasis is essentially the same as when the ***PRE-EMPHASIS*** switch is in the ***STD***. position. The use of this control allows the user to set the pre-emphasis between 0 (none) and the NRSC ***STD*** setting (2:00) or slightly higher than this standard setting (fully clockwise).

NOTE: The ***HI FREQ EQUALIZATION*** control may be used in lieu of the ***PRE-EMPHASIS - STD*** switch setting if undesirable modulation artifacts are present. If this is necessary, the user should determine the reason for not being able to use the ***STD*** setting so that the problem can be corrected. Generally, the inability to pass an audio pre-emphasis characteristic is caused by a poor impedence match between the transmitter and antenna system at higher audio frequencies.

3.2.6 STEREO ENHANCE

The single turn ***STEREO ENHANCE*** control is a variable gain L-R amplifier inserted prior to the matrix L-R limiting network. Positioned at this point in the circuit, it has the potential of increasing the L-R gain by as much as 3 db. While extreme settings may tend to create a 'hole in the center', it is known that FM stations are already using special 'stereo enhancement' equipment in attempts to increase the stereo effects in program material. In AM stereo, it can be used to provide an undistorted increase in received stereo loudness because of the greater matrix modulation capability (see Section 5.2). It also allows the station to simply sound more stereo than a competing station. While it is not recommended to be used in excess, it can be used to effectively offset some of the separation deficiencies which are present in both existing AM transmission and receiver technologies. This control must be adjusted only in the sequence specified in Section 2.7.1 in the 'SET UP SUMMARY' table. It must remain fully CCW during other sections of the setup procedure.

3.2.7 L + R AND L - R INDICATORS

The L + R LED is used to show when the limiting circuitry built into the overshoot compensated low-pass filter is being activated in the L + R channel. This indicator should begin to flash as the setting of the ***LIMITING*** switch is increased. Jumper J18 can be moved to the ***L + R POS*** position to verify that the unit is producing asymmetrical audio. When this is done, increasing the front panel ***ASYMMETRY*** control will cause the L - R LED (now reading L + R positive limiting) to flash less often or not at all as the control is increased. This jumper should be returned to the ***L − R*** position for normal operation.

The L - R LED is used to show when the limiting circuitry built into the overshoot compensated low pass-filter is being activated in the L - R channel.

NOTE: The L - R indicator will be illuminated almost constantly during the presence of out-of-phase program material.

3.2.8 OUTPUT - LIMITING SWITCH

This switch is used to select the amount of instanteous gain reduction (limiting) applied to the audio signal. Lower settings (0, +1, or +2) will provide well controlled but less dense program audio. Higher settings (+3 or +4) will produce very dense and louder but still tightly controlled audio. The setting of this switch is entirely up to the user depending on the desired 'on-air' apparent loudness.

3.2.9 OUTPUT - (L + R)

This control is provided to adjust the audio output level of the SMP. The control is adjusted so that the proper modulation level is supplied to the transmitter.

3.2.10 OUTPUT - (L - R)

This control is provided to adjust the stereo audio level of the SMP. The control is adjusted so that the program material is transmitted with proper and maximum stereo separation.

3.2.11 ASYMMETRY CONTROL

The ***ASYMMETRY CONTROL*** is used to adjust the amount of asymmetry or positive peak audio present in the L + R channel only. This control is increased to the point at which the desired asymmetry is observed on a modulation monitor or oscilloscope.

CAUTION: The use of this control may produce greater received stereo crosstalk distortions which may at times be audible (generally during full single channel transmission).

NOTE 1: If negative envelope modulation increases as the SMP ***ASYMMETRY*** control is increased, this indicates that the polarity of the signal at the output connection of the SMP is reversed. This connection should be reversed before proceeding.

NOTE 2: When this control is at its maximum clockwise setting, the SMP is capable of producing greater than +150% positive modulation peaks. If the control is at its maximum and the desired result is not obtained, check the positive modulation capability of the transmitter.

3.2.12 TILT CORRECT CONTROL

The ***TILT CORRECT*** control is used to adjust the correction circuitry which compensates for low frequency 'tilt' (phase shift) found in some plate-modulated transmitters. The operation of this control is enabled by rotating the control clockwise until it 'clicks' ***ON.*** This function is not normally required with transmitters that do not have a plate modulation transformer. The SMP will work without using the tilt correction circuitry, however higher peak modulation capability will likely result when the circuitry is enabled and correctly adjusted, as required (see Section 2.7.4).

3.3 REAR PANEL CONTROLS AND SWITCHES

3.3.1 LEVEL - SGL. CH. LIM.

The ***SGL CH LIMITER*** control is a 20 turn potentiometer which adjusts the negative peak limit level of the single channel audio sound level independent of the L+R and L-R Limit levels. Separate control from the L+R and L-R planes is provided in order to allow a protection system which will prevent accidental single channel transmissions (one channel dead) from creating possible distortion in the receiver decoding processes as recommended by the AM stereo transmission system manufacturers. When using the SMP-900A with exciters having a single channel limiter it is recommended that the single channel limiter in the exciter be defeated and the single channel limiter in the SMP-900A be used. The use of the single channel limiter is required when using a C-QUAM system exciter. See Section 2.7.5 for set up instructions.

3.3.2 LEVEL - MONO OUT

The ***MONO OUT*** control is a 20 turn potentiometer which adjusts the balanced monaural output for feeding an auxiliary or standby transmitter. This control provides independent control of this signal. This output can be used as a temporary output so that the processing system can be used before the AM stereo system has been installed. It can also be used to drive a monaural auxiliary transmitter for standby operation. See Section 2.7.8 for set up of this control for its various uses.

3.3.3 INPUT CALIBRATE LEFT CONTROL AND INDICATOR

An ***INPUT CALIBRATE LEFT*** control is provided to adjust the audio input signal level to the input amplifier. A LED indicator (located above the control) is provided for proper setting of the input level. This LED should flash during program peaks (see Section 2.7 for set up). This LED is a duplicate of the 0 dB indicator segment on the front panel level meter.

3.3.4 INPUT CALIBRATE RIGHT CONTROL AND INDICATOR

An ***INPUT CALIBRATE RIGHT*** control is provided to adjust the audio input signal level to the input amplifier. A LED indicator (located above the control) is provided for proper setting of the input level. This LED should flash during program peaks (see Section 2.7 for set up). This LED is a duplicate of the 0 dB indicator segment on the front panel level meter.

3.3.5 BANDWIDTH SELECT SWITCH

This switch selects the cutoff frequency of the internal low-pass filter. In the ***STD*** (out) position a 9.5 kHz filter characteristic is enabled, corresponding to the NRSC stopband specification. In the ***11 kHz*** position (in), the SMP does not conform to the NRSC stopband specification. See Figure 3-1 for a typical transmitted spectrum comparison between the two filter selections when used with a laboratory transmitter.

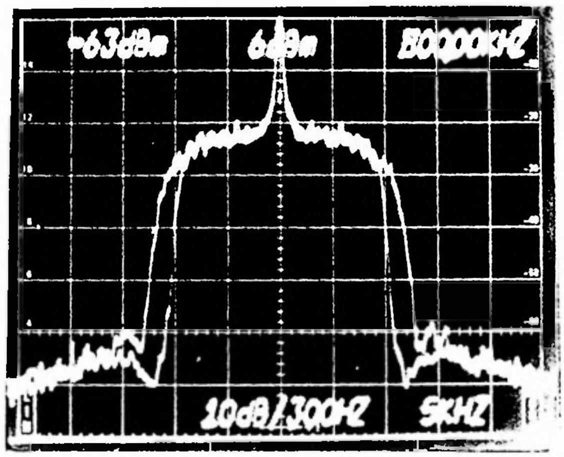


FIGURE 3-1 TYPICAL TRANSMITTED SPECTRUM COMPARISON (9.5/11 kHz Bandwidth Selection, 15 minute peak-store display; V:10 dB/div, H: 5 kHz/div., 300 Hz resolution; monaural program).

3.3.6 MODE SWITCH

The ***MODE*** switch selects the mode of operation for the SMP-900A as described in the table below.

SETTING	DESCRIPTION
PROOF	In this position all equalization and matrix processing elements are bypassed except the single channel limiters. During proof measurements, the ***SGL. CH. LIM*** CONTROL (back panel) must be temporarily turned fully CCW to avoid affecting the single channel measurements
OPERATE	In this position all functions in the SMP-900A are enabled.
REVERSE	In this position the phase of one of the channels is reversed at the input amplifier. This position is used for proper adjustment of the L - R output level.
LEFT ONLY	This position is used during alignment to allow precision matching of the L + R and L - R modulation signals (see Section 2.7.3).

SECTION 4 - DESCRIPTION OF THE NRSC STANDARD*

4.1 GENERAL

On January 10, 1987, the NRSC (National Radio Systems Committee) approved an Interim Voluntary National Standard pertaining to the use of audio pre-emphasis and occupied bandwidth filtering in AM broadcasting. The NRSC believes that implementation of the standard by all stations will reduce AM interference, increase useful AM service area, and encourage the production of higher fidelity AM receivers. The standard applies to both monaural and stereophonic AM broadcast stations. The NRSC consists of interested parties including broadcast station representatives, receiver manufacturers, broadcast equipment manufacturers (including CRL), and others.

4.2 PRE-EMPHASIS/DE-EMPHASIS

The purpose of the NRSC pre-emphasis/de-emphasis standard is to create a transmission/reception system where (1) AM broadcast stations will know, with certainty, the likely audio response characteristics of AM receivers, and (2) AM receiver manufacturers will know, with certainty, the likely audio response characteristics of AM broadcasts. A 'matching' of pre-emphasis and de-emphasis is expected to improve the consumer's overall satisfaction with the technical quality of listening to AM radio.

Most AM stations have used pre-emphasis to varying extents. This pre-emphasis is employed in an attempt to compensate for the 'narrow' response of most AM receivers. If AM pre-emphasis is not controlled, one station may interfere with AM receivers listening to neighboring stations located on adjacent AM channels.

The response of the chosen pre-emphasis curve is shown in Figure 4-1. It is characterized by a single zero with a break frequency at 2122 Hz, along with a single pole with a break frequency at 8700 Hz. This curve has been found to improve the frequency response of narrower and medium-bandwidth radios, while allowing receiver manufacturers to employ a simply-derived complementary de-emphasis characteristic in wideband radios. It is also felt that the amount of boost at high frequencies (+10 dB at 10 kHz) is not excessive in terms of transmitters being able to operate normally with the curve employed.

* Adapted in part from the actual text of the standard. A complete copy of the standard is available from Circuit Research Labs, Inc., upon request.

4.3 FILTERING

The standard also includes a specification for the maximum audio bandwidth transmitted by AM broadcast stations.

Implementation of a bandwidth specification can reduce second-adjacent channel interference and thereby lead to (1) a significant reduction of interference as perceived on "wideband" AM receivers; (2) a corresponding increase in the interference-free service areas of AM stations; and (3) an incentive for the further building of AM "wideband" receivers.

The specification of the chosen stopband characteristic is shown graphically in Figure 4-2. It is implemented through the use of appropriate and carefully designed audio low-pass filters as the final filtering prior to modulation. Compliance is measured dynamically, to take all audio processing functions into account. A specially derived pulsed-noise test signal is used as the modulating waveform (complete details of compliance measurement for both pre-emphasis and filtering functions are contained in the full NRSC specification).

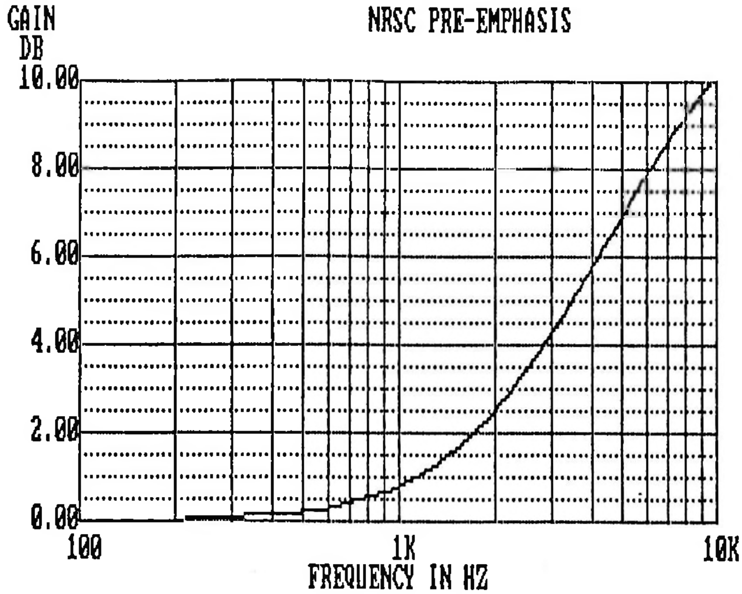


FIGURE 4-1 NRSC PRE-EMPHASIS CHARACTERISTIC

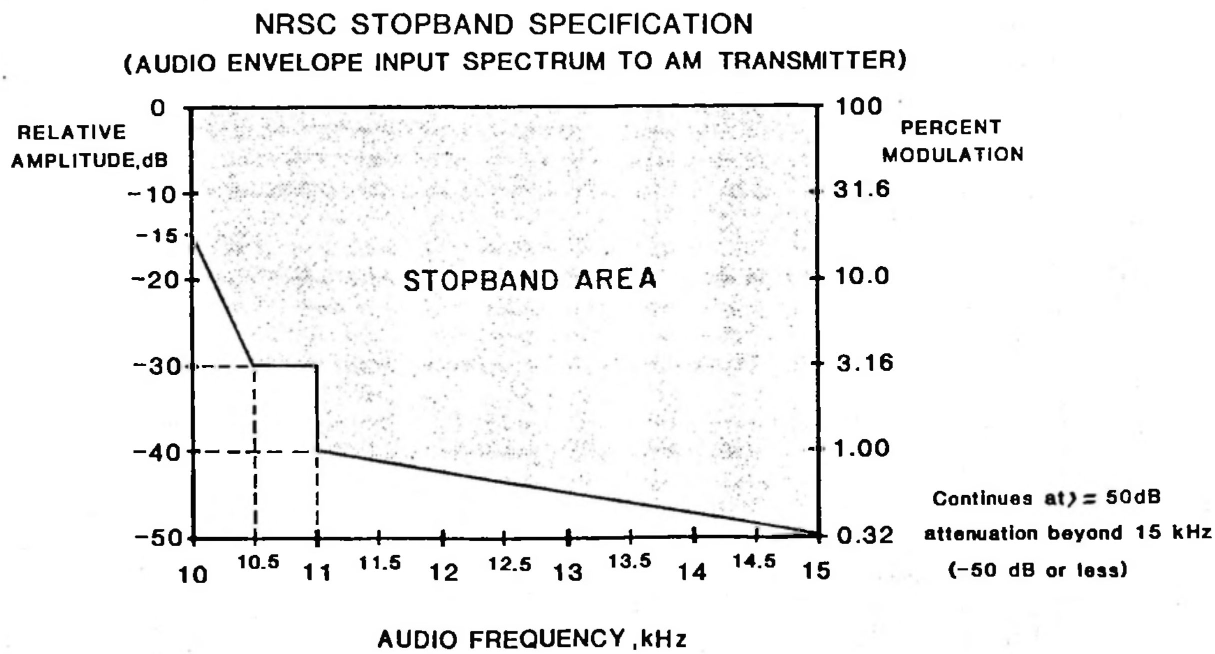


FIGURE 4-2 NRSC STOPBAND SPECIFICATION

SECTION 5 - AUDIO PROCESSING FOR AM STEREO

5.1 PROCESSING REQUIREMENTS

Matrix type limiting is used to improve AM stereo versus AM monaural compatibility. AM stereo/monaural transmission is not as compatible as its FM counterpart where separate left and right FM type limiting is employed.

In FM stereo transmission, the left and right channel information can be fundamentally described as sent via the same transmission path during equal and alternate time periods. At any instant in time, the total modulation is equal to the sum of the audio channel being transmitted and the fixed amplitude stereo pilot. When properly balanced, this system results in the 100% left channel only, 100% right channel only, and 100% both channels (monaural during stereo) audio limits being equal to each other. This has formed the basis for the separate left and right channel limiting requirements which limit both channels to the same amplitude.

AM stereo broadcasting requires a different type of stereo audio limiting called stereo matrix limiting. In AM stereo the processing action has been shifted to the matrixed sum and difference axis of the stereo sound field. This processing method significantly differs from the previous FM conventional types which operate on the left and right channel axis.

Matrix processing is used to achieve monaural versus stereo transmission compatibility. In AM stereo, the algebraic sum and difference of left and right channels occur prior to the points of the modulation. This difference as compared to FM stereo transmissions is what makes conventional audio processing incompatible and matrix processing necessary.

Figures 5-1, 5-2, and 5-3 are included in this section to show the X-Y lissajous patterns produced at the right and left outputs of the station's limiters or stereo modulation monitor. If the limiters have L+R and L-R outputs instead, the patterns at these outputs will be shifted counter clockwise by 45 degrees from those illustrated. These figures are often more helpful in checking for proper processing alignment by showing more information about what is being transmitted than a modulation monitoring system.

5.2 CONVENTIONAL LIMITING

Figure 5-1 illustrates the oscilloscope X-Y display of the right and left limiter outputs of conventional stereo limiters. When applied to AM stereo transmissions, the amplitude limit levels of the left and right channels must be set equal to each other for proper stereo balancing. As shown, the limit levels are perpendicular to the right and left channel axis and intersect with each other to form the L+R and L-R modulation limits. They form the perimeter of the "box" in the illustration. The L+R axis represents the main monaural component transmitted by the AM envelope of the transmitter and the L-R axis represents the main stereo information component transmitted by the phase modulation of the carrier frequency. As long as the program input is mostly monaural, this limiting system produces nearly full 100% envelope modulation and nearly a straight line along the L+R axis and monaural reception remains normal.

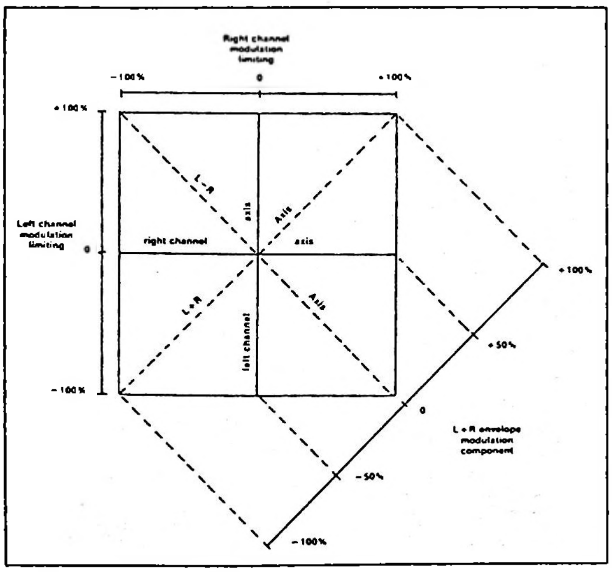


FIGURE 5-1 CONVENTIONAL STEREO LIMITING

The figure also shows that this type of limiting creates serious monaural transmission and reception problems during varying stereo conditions. When stereo inputs temporarily shift to the full left only (vertical) or right only (horizontal) modulation axis, stereo reception is acceptable but monaural is not. The L+R modulation component is forced to drop to 50% as is shown by the dotted line intersection of the lower right modulation scale with the tips of the left channel or right channel limit levels. This indicates an immediate 6 db drop in loudness in monaural reception. Obviously this is an unacceptable condition to AM broadcasters since the existing monaural coverage as well as the monaural loudness is reduced. Although most stereo program material does not contain significant amounts of single channel passages, this form of limiting causes significant losses of monaural loudness and coverage on nearly all stereo program material. The losses are usually directly proportional to the stereo content and become greater as separation increases.

5.3 FULL MATRIX LIMITING

Figure 5-2 represents the oscilloscope X-Y display of the right and left limiter outputs of full monaural support matrix limiting. With this system, the output levels of the L+R and L-R are adjusted for equal modulation levels which is the point of maximum separation. As shown, the amplitude limit levels are perpendicular to the L+R and L-R axis and intersect with each other at the left channel and right channel axis. They form the perimeter of 'diamond' in the illustration.

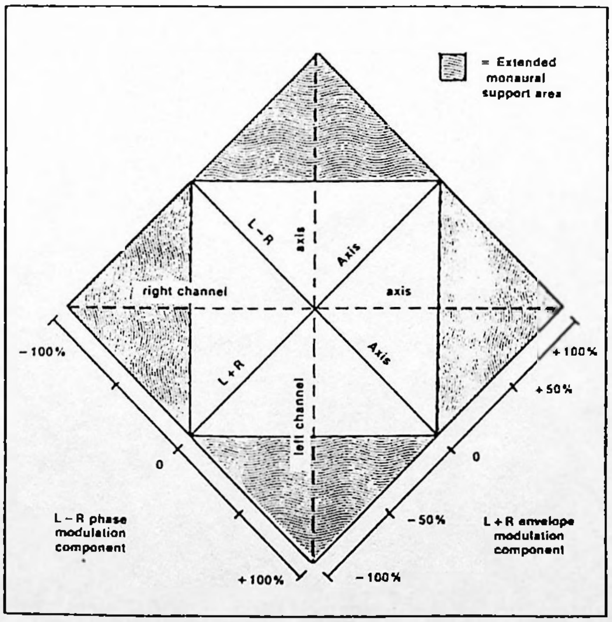


FIGURE 5-2 FULL MATRIX LIMITING

When stereo inputs temporarily shift to the full left only or the right only axis, these limit levels allow the L+R component to remain at a 100% modulation which maintains full monaural reception compatibility during such transmissions. The dotted area shown in the illustration shows the increased areas of monaural support modulation produced by this system as compared to the earlier conventional left and right limiting which is illustrated by the un-dotted area of the "box" in the center.

Further analysis shows that stereo reception will have a 6 db increase in the single channel reception. While this is going to be noticeable to listeners, critical listening tests have demonstrated this to be far more acceptable than the loss of 6 db in monaural loudness. Also, note that the majority of stereo program contents do not contain full single channel transmissions.

5.4 CRL MODIFIED MATRIX LIMITING

When using light and moderate amounts of limiting, full matrix processing produces outstanding results in both monaural and stereo. Heavy amounts of limiting or processing can produce different results. Heavy or extreme levels of audio processing as demanded by many existing AM radio stations may cause certain types of overloads in present stereo decoding and reception techniques. In an effort to reduce the chances of these problems, a modified full matrix processing has been developed by Circuit Research Labs, Inc.

Figure 5-3 represents the oscilloscope X-Y display of the right and left limiter outputs of the CRL modified monaural support matrix limiting system. The significant difference between this limiting pattern and the one shown in figure 2 is visible in the left and right bottom corners of the pattern. Here, the corners formed by the L+R and L-R axis are removed by an adjustable single channel limiting network. This system allows full monaural compatibility during most stereo conditions, but causes a reduction of L-R and negative peak L+R modulation levels during left only or right only stereo conditions. In the illustration, the single channel limits are shown set for a left or right only L+R negative limit of 70% instead of the 100% level which would occur without such limiting.

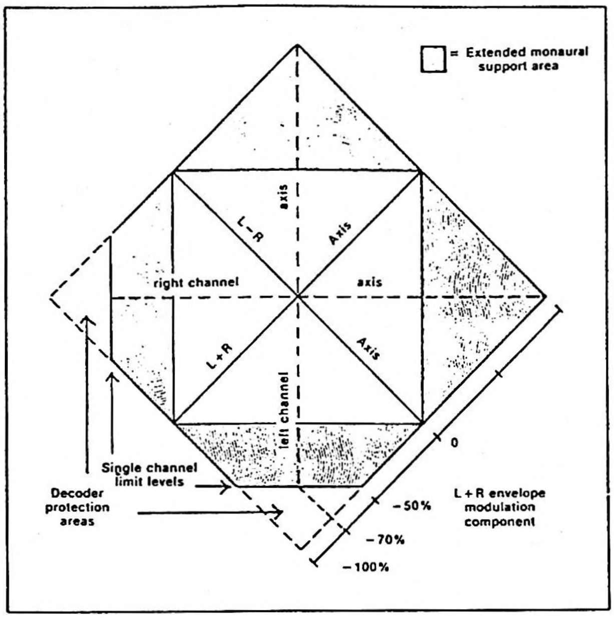


FIGURE 5-3 CRL MODIFIED MATRIX LIMITING

This modified matrix system is designed to reduce the potential problem areas associated with stereo transmissions. At the removed corners shown in the figure, both L+R and L-R modulations are at maximum and can cause decoding difficulties. If high density negative peak L+R modulations are allowed to consistantly reduce the transmitter carrier, the L-R decoding process has little or no carrier to demodulate. The result can be that either stereo decoding returns to monaural or produces distortions. Depending upon the degree of processing used and maximum L+R modulation depth, the single channel limiting network can be adjusted to the level which prevents or greatly reduces such stereo receiving problems. If the feature is not desired, it can also be adjusted totally out of circuit.

SECTION 6 - THEORY OF OPERATION

6.1 GENERAL

This section contains theory of operation for the SMP-900A. A detailed block diagram of the SMP is found in the Appendix. A schematic drawing and PCB parts placement drawing is also found in the Appendix.

6.2 POWER SUPPLY

AC power is supplied to the unit via a standard 3-conductor power cable which plugs into a connector on the back panel of the unit. This connector is an integral part of the AC input module. AC power is applied to power transformer T1 via the AC input module. This module consists of fuse F1, an RFI filter, and a voltage selection PCB. The power transformer has dual windings to permit powering from either 100 to 130 VAC or 200 to 250 VAC. A PCB located inside the AC input module is positioned to select the transformer winding combination required for each input voltage.

************ WARNING ************	**SEE SECTION 2.3 FOR INSTRUCTIONS ON SELECTING THE AC INPUT VOLTAGE. OPERATION ON 200-250 VAC WILL ALSO REQUIRE REPLACEMENT OF THE AC PLUG AND FUSE.**

Power transformer T1 provides two separate AC supply voltages from which the separate DC voltages required by the SMP are derived. A separate secondary winding on T1 provides the operating voltages for the full wave bridge rectifier consisting of CR3, CR4, CR5, and CR6. The pulsating DC voltage is filtered by C10 and C11. The DC voltage from the rectifier is fed to voltage regulators U1 and U2 which develop the two regulated outputs of +15 VDC and -15 VDC. CR1 & CR2 are employed as protection diodes. The circuitry is well bypassed on each supply line through the use of several decoupling capacitor sets. DS1 illuminates when a positive DC voltage is present at TP4 with respect to ground at TP3. DS2 illuminates when a negative DC voltage is present at TP5 with respect to ground at TP3. Jumper J5 disconnects positive DC power from the circuitry when it is removed. Jumper J6 disconnects negative DC power from the circuitry when it is removed.

A separate secondary winding on T1 provides the operating voltages for the ***V LED*** full wave bridge rectifier consisting of CR7, CR8, CR10, & CR12. The pulsating DC voltage is filtered by C6. The DC voltage from the rectifier is fed to voltage regulator U3 which develops the regulated ***V LED*** output voltage. CR11 is employed as a protection diode. This voltage can be measured at TP1 with respect to ground at TP6.

6.3 SIGNAL CIRCUITRY

TEXT FOR THIS SECTION NOT AVAILABLE AT TIME OF PUBLICATION

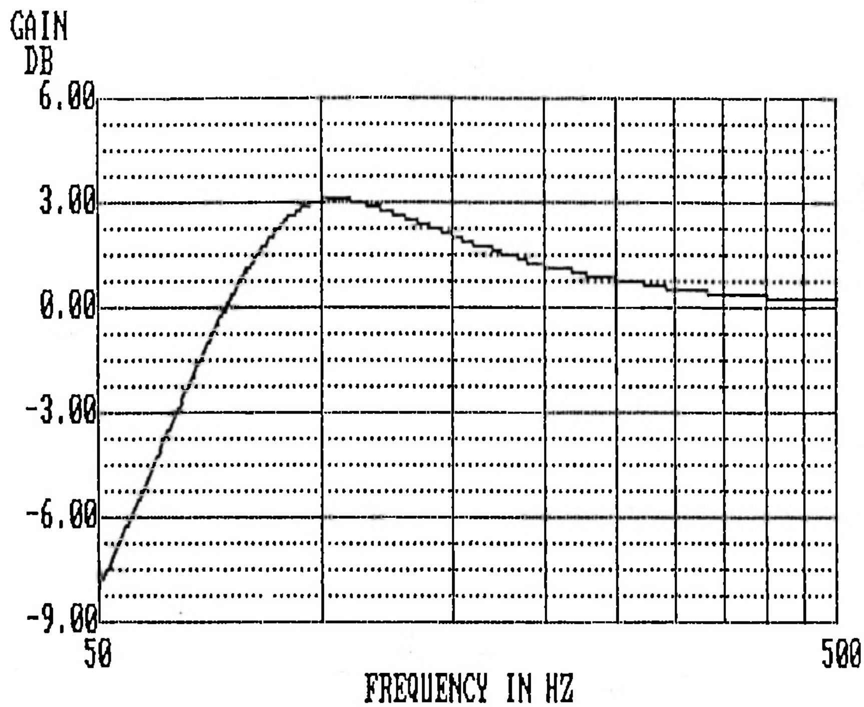


FIGURE 6-4 BASS PRE-EMPHASIS FILTER RESPONSE

SECTION 7 - MAINTENANCE, TROUBLESHOOTING, AND CUSTOMIZATION

7.1 PREVENTIVE MAINTENANCE

A minimum amount of preventive maintenance is required to insure optimum performance of this unit. If a regular preventive maintenance schedule is not in existence, Circuit Research Labs suggests the following check list be performed on a periodic basis.

1. Check to insure that the input and output cables are properly connected to their respective terminals. Inspect the cables to make sure they are in good physical condition. (FRAYED WIRES CAN SHORT OUT, CAUSING INTERMITTENT FAILURES).

2. Check to insure that all switches and indicators are secure and in good working condition.

3. Remove any dirt or dust around the unit. This may not immediately affect the unit, but long term exposure may.

4. Keep all liquids away from the unit. Accidental spillage can result in serious damage to the unit and will void the warranty.

7.2 ALIGNMENT PROCEDURES

7.2.1 GENERAL

Several types of internal alignment in the SMP-900A are provided. These alignments are used mainly for manufacturing purposes but can be used in the field if certain component replacements are found to be necessary.

7.2.3 TEST EQUIPMENT REQUIRED (or Equivalent)*

MODEL	MFG.	NOTES
AG-51	Potomac	Audio Generator (Set the output switch to L+R; attenuator to 20 dB for a 0 dBm output level; frequency to 1 kHz)
IX-51	Potomac	Input transformer(s) (Set to the 600 ohm position)
AA-51	Potomac	Audio Analyzer (Set the input switch to L or R as required)
8050A	Fluke	Digital Multimeter (AC voltmeter section required)

2445 Tektronix Oscilloscope
(5MHz minimum, dual channel)

*All test equipment must be properly calibrated.

CAUTION: **The generator specified above has a balanced output connection for direct connection to the SMP-900A. When using a generator with unbalanced output, connect as per Section 2.6.3.**

7.2.3 SWITCH AND CONTROL SETTINGS FOR ALIGNMENT

CAUTION: **Write down the control settings so they can be returned to these settings after alignment, as specified at the end of this procedure.**

CONTROL OR SWITCH	SETTING
G/R SWITCH:	0
PRE-EMPHASIS SWITCH:	Set to VAR. position
EQUALIZATION - HI FREQ:	Fully CCW
STEREO ENHANCE:	Fully CCW
LIMITING:	0
OUTPUT - (L + R):	As previously adjusted
OUTPUT - (L - R):	As previously adjusted
ASYMMETRY:	Fully CCW
TILT CORRECT:	Fully CCW (off)
SCC. CH. LIM*:	Fully CCW
MONO OUT*:	As previously adjusted
INPUT CALIBRATE CONTROLS*: (screwdriver adjustment)	As previously adjusted
BANDWIDTH*:	9.5 kHz (STD)
MODE*:	Normal

*Located on back panel

7.2.4 ALIGNMENT PROCEDURE

INPUT LEVEL BALANCE

1. Connect a signal generator to the left and right inputs on the SMP900A. Feed a 1Khz signal at normal system level to the SMP.

2. Adjust the ***INPUT CALIBRATE - RIGHT*** control (back panel) until LED above the control just begins to illuminate. The 0 dB indicator segment on the front panel level meter may also be used, since its function is the same as this back panel LED.

3. Set the SMP ***MODE*** switch to the ***REVERSE*** position.

4. Connect an oscilloscope or AC voltmeter to TP-25 to monitor the L+R signal.

NOTE: This point should be used as it monitors the L + R signal path after processing circuits.

5. Adjust the ***INPUT CALIBRATE LEFT*** control (back panel) for a null i.e. minimum signal (should be -50 dB or better).

OPERATE L-R ENCODE NULLING

1. Place that the rear panel ***MODE*** switch is in the ***NORMAL*** position.

2. Connect an oscilloscope or AC voltmeter to TP-38 to monitor the L-R signal.

NOTE: This point should be used as it monitors the L - R signal path after the processing circuits.

3. Adjust the PCB mounted ***L-R ENCODE NULL*** control (R251) for a null, i.e. minimum signal (should be -50 dB or better).

OPERATE MATRIX DECODE NULLING

1. Verify that the rear panel ***MODE*** switch is in the ***NORMAL*** position.

CAUTION: Steps #2 and #3 are very critical adjustments. If the controls are not set as close as possible a loss of separation will occur.

2. Connect an AC voltmeter to TP31. Adjust the ***OUTPUT (L + R)*** control for EXACTLY .500 volts RMS +/-.001 volts.

3. Set the ***MODE*** switch (SMP-900A back panel) to the ***REVERSE*** position. Connect an AC voltmeter to TP33. Adjust the ***OUTPUT (L - R)*** control for EXACTLY .500 volts RMS +/- .001 volts.

4. Set the ***MODE*** switch to the ***NORMAL*** position. Connect an AC voltmeter or oscilloscope to the SMP ***OUTPUT - RIGHT*** terminals (back panel).

5. Disconnect the signal from the ***INPUT - RIGHT*** terminals. Connect a short between the +, -, and GND ***RIGHT*** input terminals. (If an AG-51 or equivalent is being used, set it to send a left only signal).

6. Adjust the PCB mounted LEFT DE-MATRIX control (R195) for a null, i.e. minimum signal (should be -50 dB or better).

7. Connect an AC voltmeter or oscilloscope to the ***OUTPUT - LEFT*** terminals (back panel).

8. Remove the short that was connected across the ***RIGHT*** input terminals in step #4. Reconnect the signal to the ***RIGHT*** input terminals. Disconnect the signal from the ***INPUT - LEFT*** terminals. Connect a short between the +, -, and GND ***LEFT*** input terminals. (If an AG-51 or equivalent is being used, set it to send a right only signal).

9. Adjust the PCB mounted ***RIGHT DE-MATRIX*** control (R225) for a null, i.e. minimum signal (should be -50 dB or better).

PROOF ENCODE NULLING

CAUTION: Proof encode nulling must be completed exactly as per this procedure to prevent control interaction. The adjustment is very sensitive.

NOTE: Verify that a signal is being sent to the ***RIGHT*** input terminals as per step #7 above.

1. Set the SMP ***MODE*** switch (back panel) to the ***PROOF*** position. Monitor the signal at the SMP ***OUTPUT - LEFT*** terminals (back panel) (previously connected in step #6 above).

2. Adjust the PCB mounted ***PROOF ENCODE L + R*** control (R44) for a null, i.e. minimum signal (should be -60 dB or better).

3. Connect an AC voltmeter or oscilloscope to the SMP ***OUTPUT - RIGHT*** terminals (back panel).

4. Remove the short that was connected across the ***LEFT*** input terminals. Reconnect the signal to the ***LEFT*** input terminals. Disconnect the signal from the ***INPUT - RIGHT*** terminals. Connect a short between the +, -, and GND ***RIGHT*** input terminals. (If an AG-51 or equivalent is being used, set it to send a right only signal).

5. Adjust the PCB mounted ***PROOF ENCODE L − R*** control (R43) for a null, i.e. minimum signal (should be -60 dB or better).

6. Remove the short across the ***RIGHT*** input terminals. Reconnect the signal to the ***RIGHT*** inputs.

ASYMMETRY CALIBRATION

1. Turn the front panel ***ASYMMETRY*** control fully CCW (20 turns or more).

2. Set the DVM for a full scale reading of 2.0 VDC.

3. Measure and record the DC voltage present at the common point of R115 and R139 (right side of R115). This voltage should be approximately +1.4 VDC.

4. Monitor the DC voltage present at the common point of R140 and R141 (left side of R140). Adjust PCB potentiometer R146 so that this DC voltage is equal and opposite in polarity to the voltage measured in the previous step.

SEPARATION VERIFICATION

1. Set the ***MODE*** switch on the SMP-900A (back panel) to the ***OPERATE*** position.

2. Feed a signal from a signal generator at 1 kHz to both inputs on the SMP.

3. Adjust the SMP ***OUTPUT (L + R)*** control to +10 dBm as measured on an AC voltmeter.

4. Turn the SMP ***OUTPUT (L − R)*** control fully CCW.

5. Set the SMP ***MODE*** switch (back panel) to the ***LEFT ONLY*** position.

6. Monitor the SMP ***OUTPUT − RIGHT*** signal using an AC voltmeter.

7. Rotate the ***L − R*** control of the SMP CW for the best null.

8. Set the SMP ***MODE*** switch (back panel) to the ***OPERATE*** position.

9. Connect/set the signal generator to feed a left only signal to the SMP.

10. Measure the right output with the AC voltmeter. Verify that is is at or exceeds the specification listed in Section 1.5.

11. Repeat steps #7 to #9 for the other channel.

12. Repeat steps #7 to #9 for both channels in the proof mode.

FINAL CONTROL SETTINGS

1. To obtain accurate left and right output levels the ***OUTPUT (L + R)*** and ***(L − R)*** controls must be set as per Section 2.7.3

2. Return the other control settings to their previous positions as per the caution statement in Section 6.2.3.

7.3 TROUBLESHOOTING

7.3.1 GENERAL

The items listed below should be checked before troubleshooting the SMP:

1. Check for input and output levels causing overloads to the unit or the equipment following it. Make certain any additional equipment which may be connected to the unit is not being over-driven.

2. Check for failures in monitoring or other test equipment if measurements are erratic. Strong RF fields can make some test equipment give strange results. Poor equipment grounds and incorrect grounding of balanced line interconnects will cause problems that are not faults within the SMP. It is a good idea to use an oscilloscope to verify testing.

3. Since this is audio equipment, don't be afraid to listen to the unit while it is in operation. A pair of good quality, 600 ohm or higher impedence headphones can be used to bridge across the input and output. Listening can quickly locate a bad unit or clear a suspected unit.

7.3.2 Suggested Component Checks

This section lists typical failure conditions followed by components and other factors that could cause that failure mode.

SYMPTOM	PROBABLE CAUSE

THIS SECTION NOT AVAILABLE AT TIME OF PUBLICATION

7.4 CUSTOMIZATION

THIS SECTION NOT AVAILABLE AT TIME OF PUBLICATION

7.5 FACTORY SERVICE

In the event this unit must be returned to the factory for repair, IN or OUT of warranty, Circuit Research Labs requires that a RETURN AUTHORIZATION (RA) NUMBER be obtained from the CUSTOMER SERVICE department. Call CRL prior to shipment at 602-438-0888 for this number or the equipment will be returned without being serviced. In order to insure prompt service, the following information must also be included with the returned unit:

1. The return authorization number CLEARLY MARKED ON THE OUTSIDE of the shipping container. (See example below)

2. Description of trouble which includes:
   a. The symptom description
   b. The unit switch settings when the trouble was detected
   c. A short description of the facility in which the unit is used.

3. Approximate date of purchase and the serial number of the unit - This will aid in the determination of billing for warranty or out of warranty repairs.

   All repairs must be shipped PRE-PAID (via United Parcel Service when shipped in the USA) to:

   Circuit Research Labs, Inc.
   3240 S. Fair Lane
   Tempe, Arizona 85282 USA
   Att: CUSTOMER SERVICE
   RA #____________________

SECTION 8 - APPENDIX

A. GENERAL

AM4S SYSTEM INFORMATION

1. SGC-800. This is a split band AGC amplifier that maintains a constant level and tonal balance into the following unit. It contains USASI noise generator for system set up and an optional phase rotator for removing asymmetry from voices.
2. SEC-800. This is a stereo 4 band compressor with gating in each band. It provides a very dense, controlled signal that results in improved stereo coverage and loudness. The output of each of the 4 bands has a control that allows the "mix" of lows, mid-range, and highs to be adjusted to create a specific sound to suit the stations format. It dynamically equalizes program material for a consistant sound balance.
3. SMP-900B. This is a matrix processor for AM stereo. L+R and L-R are processed separately. It is designed to support mono loudness and prevent any loss of coverage.

SUGGESTED INITIAL SETTINGS

SGC-800:	G/R:	-9	EQ:	12 to 2 o'clock
	GATE:	Off	OPERATION:	M

This unit is connected between the console and the phone lines or aural STL with the other units at the transmitter site. The 0 dB input indicator segment should flash on peaks and the red OVLD LED should not flash with normal program material.

SEC-800:	G/R:	-6	OPERATION:	M
	LIMIT/COMPRESS:	Compress	WIDE/MULTI:	Multi
	GATE:	-20	BAND CONTROLS:	12:00

This unit is generally connected to the phone lines or dual channel STL receivers at the transmitter site. The 0 dB input indicator should flash on peaks about 10 to 20 percent of the time. The red OVLD LED should not flash with normal program material.

SMP-900A:	G/R:	-4	LIMITING: +1
	PRE-EMP:	STD	

The statement above concerning the input indicators LED's applies here also. This unit is quite different from most limiters. PLEASE READ THE MANUAL CAREFULLY, and contact CRL if you need help at 602-438-0888.

NOTE: This equipment is designed to sound good on typical consumer radios. It may sound overly bright on studio monitors. The CRL MDF-800 Monitor De-Emphasis Filter should be used in conjunction with the station modulation monitor to judge the right sound. Various types of radios should also be used. Change only one control at a time and PLEASE READ THE MANUAL.

USING THE SMP900A STEREO MATRIX PROCESSOR IN MONAURAL

When the SMP-900A is connected to a monaural program console the user will need to make a pad using six (6) 150 ohm 5%, 1/2 watt resistors as per the figure below. The pad is connected as per this figure. When a stereo program console is used, other processing equipment between the console and the SMP-900 input is connected as per the applicable equipment manual (for stereo operation).

The output of the SMP-900A is then connected using the ***MONO OUT*** connection on the back panel (600 ohms balanced). The ***LEVEL - MONO OUT*** control is used to adjust the required modulation. This output uses all the AGC processing and asymmetry circuitry in the SMP. The tilt correction circuit is separately included in this configuration, however it must be adjusted internally (see Section 2.7.8).

ALTERNATE METHOD TO USE SMP-900A IN MONAURAL APPLICATIONS:

1. Remove the top cover from the unit.

2. Move the ***DECODE*** jumper J21 to the ***L + R*** position. This results in an L + R signal being available at the ***OUTPUT - LEFT*** terminals on the back panel (this signal represents a monaural output).

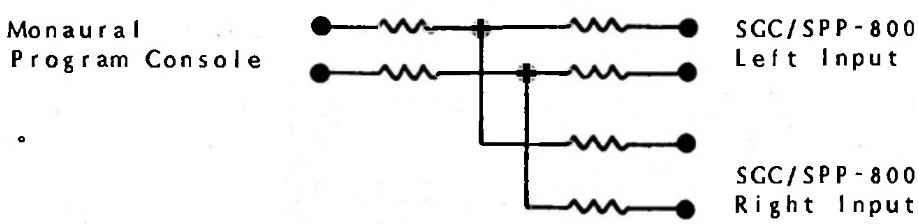
3. Replace the top cover.

4. Connect the ***OUTPUT - LEFT*** terminals to the transmitter input.

5. Use the ***OUTPUT (L + R)*** control on the front panel to adjust the modulation as required.

NOTE: The ***L - R*** control has no effect on operation in this configuration.

6. The front panel ***TILT CORRECT*** control may be used as desired (see Section 2.7.4).

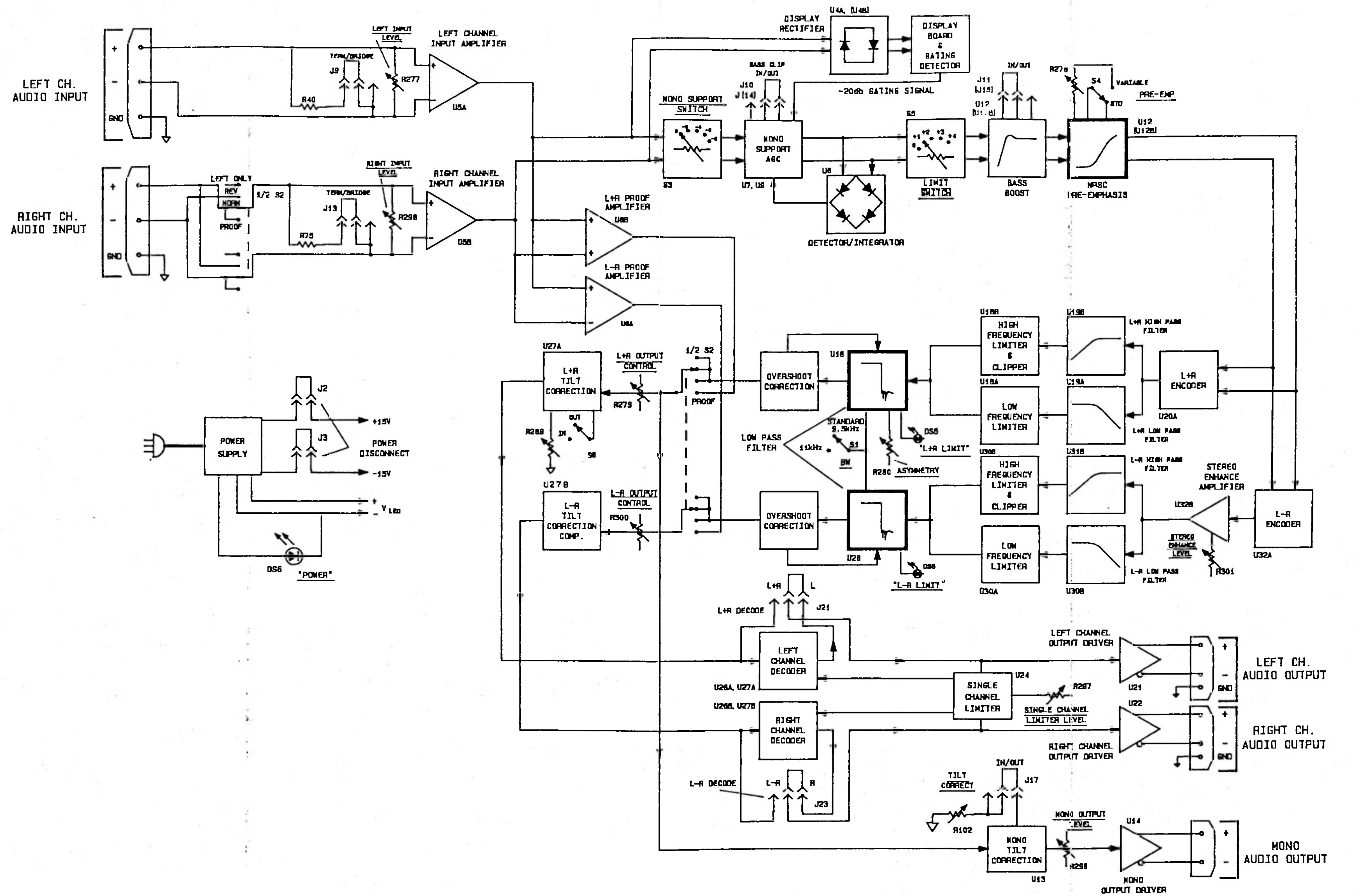


All resistors are 150 ohms, 5%, 1/4 watt

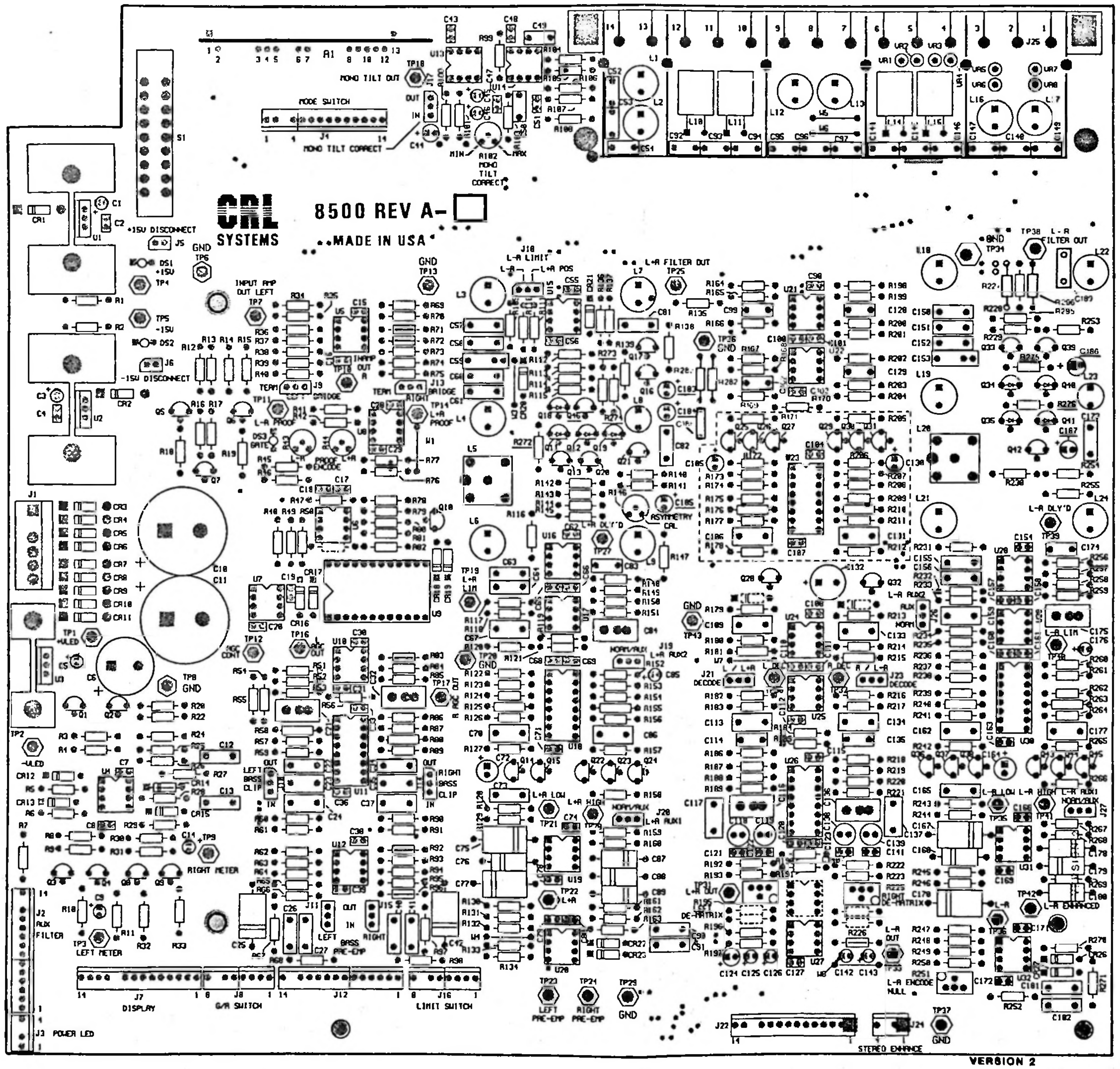
PARTS LIST SMP-900A

DES.	DESCRIPTION	P/N	DES.	DESCRIPTION	P/N

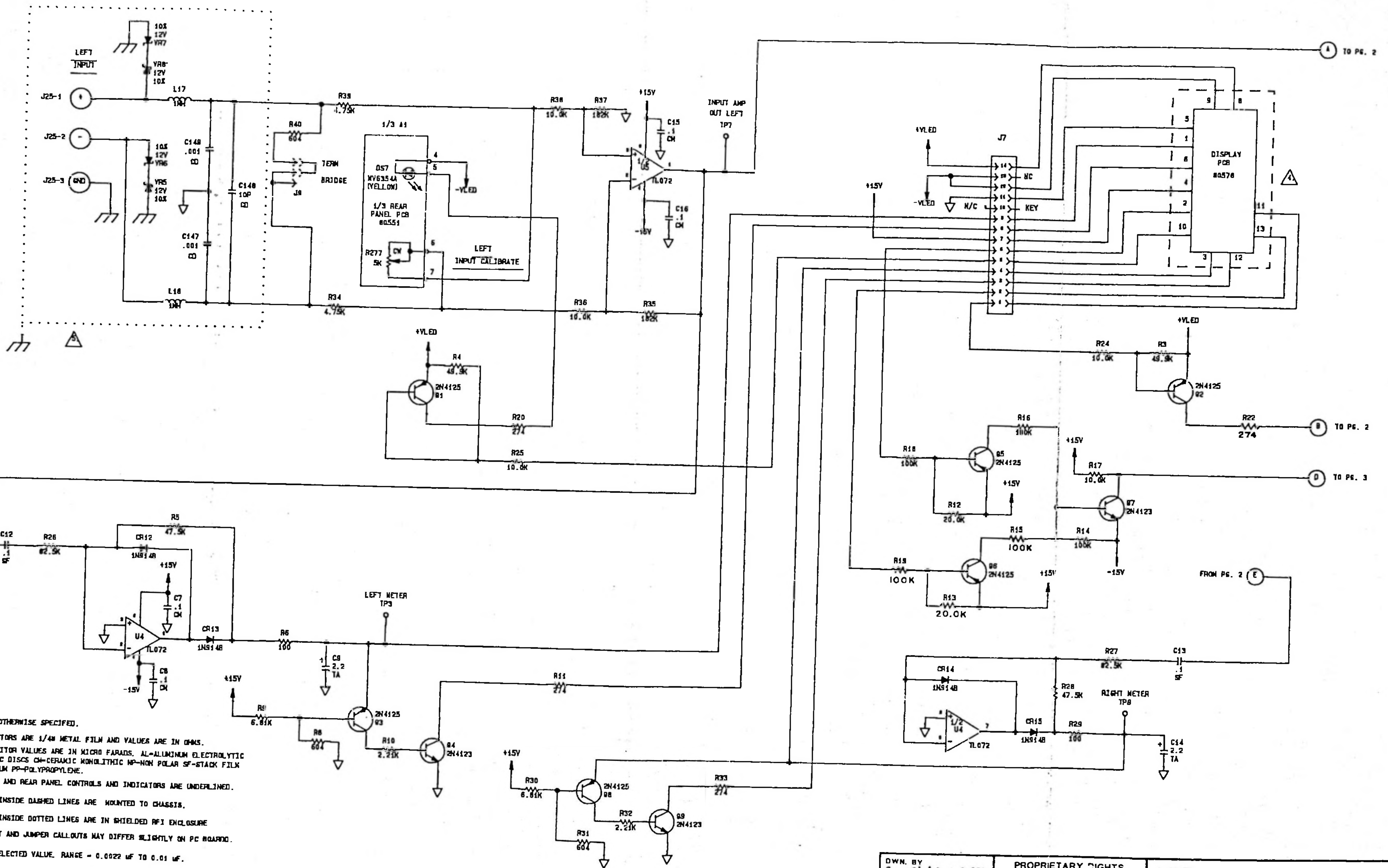
THIS SECTION NOT AVAILABLE AT TIME OF PUBLICATION



C. BLOCK DIAGRAM



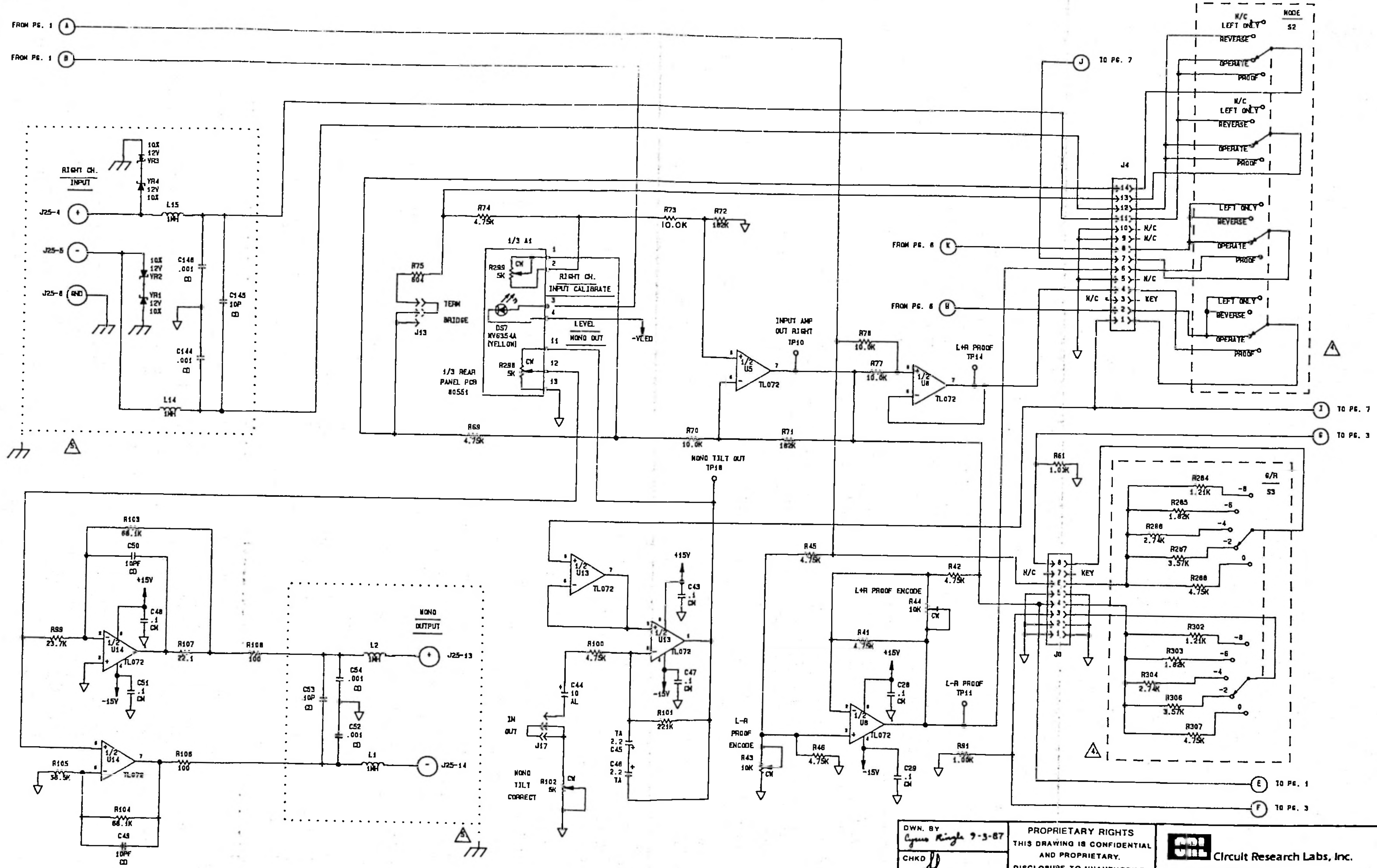
D. PC BOARD LAYOUT DIAGRAM



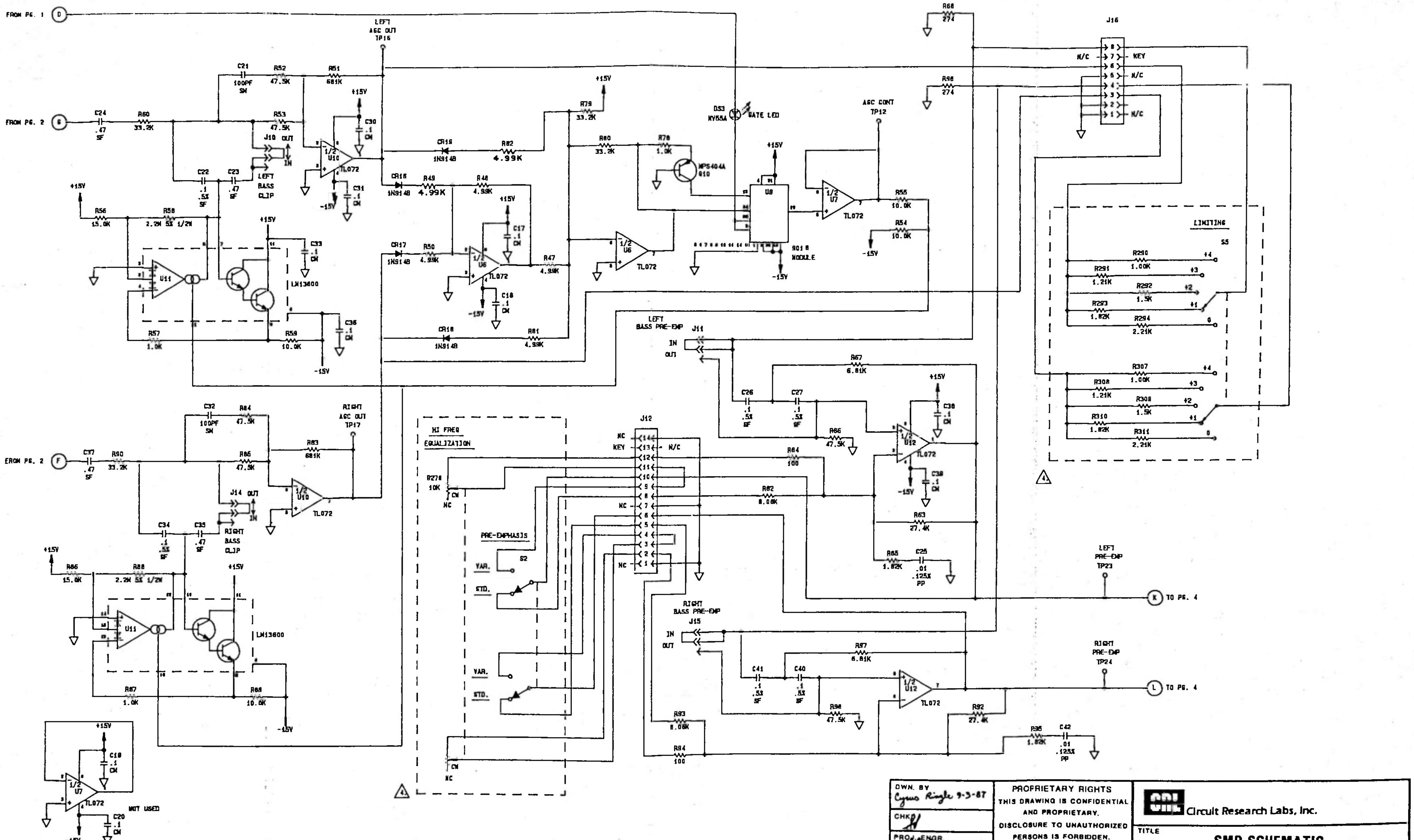
NOTES: UNLESS OTHERWISE SPECIFED.

1. ALL RESISTORS ARE 1/4W METAL FILM AND VALUES ARE IN OHMS.
2. ALL CAPACITOR VALUES ARE IN MICRO FARADS. AL-ALUMINUM ELECTROLYTIC CM-CERAMIC DISCS CM-CERAMIC MONOLITHIC NP-NON POLAR SF-STACK FILM TA-TANTALUM PP-POLYPROPYLENE.
3. ALL FRONT AND REAR PANEL CONTROLS AND INDICATORS ARE UNDERLINED.
4. CIRCUITS INSIDE DASHED LINES ARE MOUNTED TO CHASSIS.
5. CIRCUITS INSIDE DOTTED LINES ARE IN SHIELDED RFI ENCLOSURE
6. TEST POINT AND JUMPER CALLOUTS MAY DIFFER SLIGHTLY ON PC BOARDS.
7. FACTORY SELECTED VALUE. RANGE - 0.0022 uF TO 0.01 uF.

DWN. BY Cyrus Ringlet 9-3-87	PROPRIETARY RIGHTS THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. DISCLOSURE TO UNAUTHORIZED PERSONS IS FORBIDDEN.	Circuit Research Labs, Inc.
CHKD		TITLE SMP SCHEMATIC
PROJ. ENGR. 9-3-87	PRELIMINARY	TYPE / SIZE B / DWG. NO. 02-8500-01 / REV X-1
MECH.		MODEL TYPE SMP-900A / SCALE NONE / SHEET 1 OF 8
DOC. Paul Scanlon 9-3-87		



DWN. BY Cyrus Ringle 9-3-87	PROPRIETARY RIGHTS THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. DISCLOSURE TO UNAUTHORIZED PERSONS IS FORBIDDEN.	CRL Circuit Research Labs, Inc.	
CHKD		TITLE SMP SCHEMATIC	
PROJ. ENGR. 9-3-87	PRELIMINARY	TYPE SIZE B · DWG. NO. 02-8500-01	REV X-1
MECH.		MODEL TYPE SMP-900A · SCALE NONE	SHEET 2 OF 8
DOC.			



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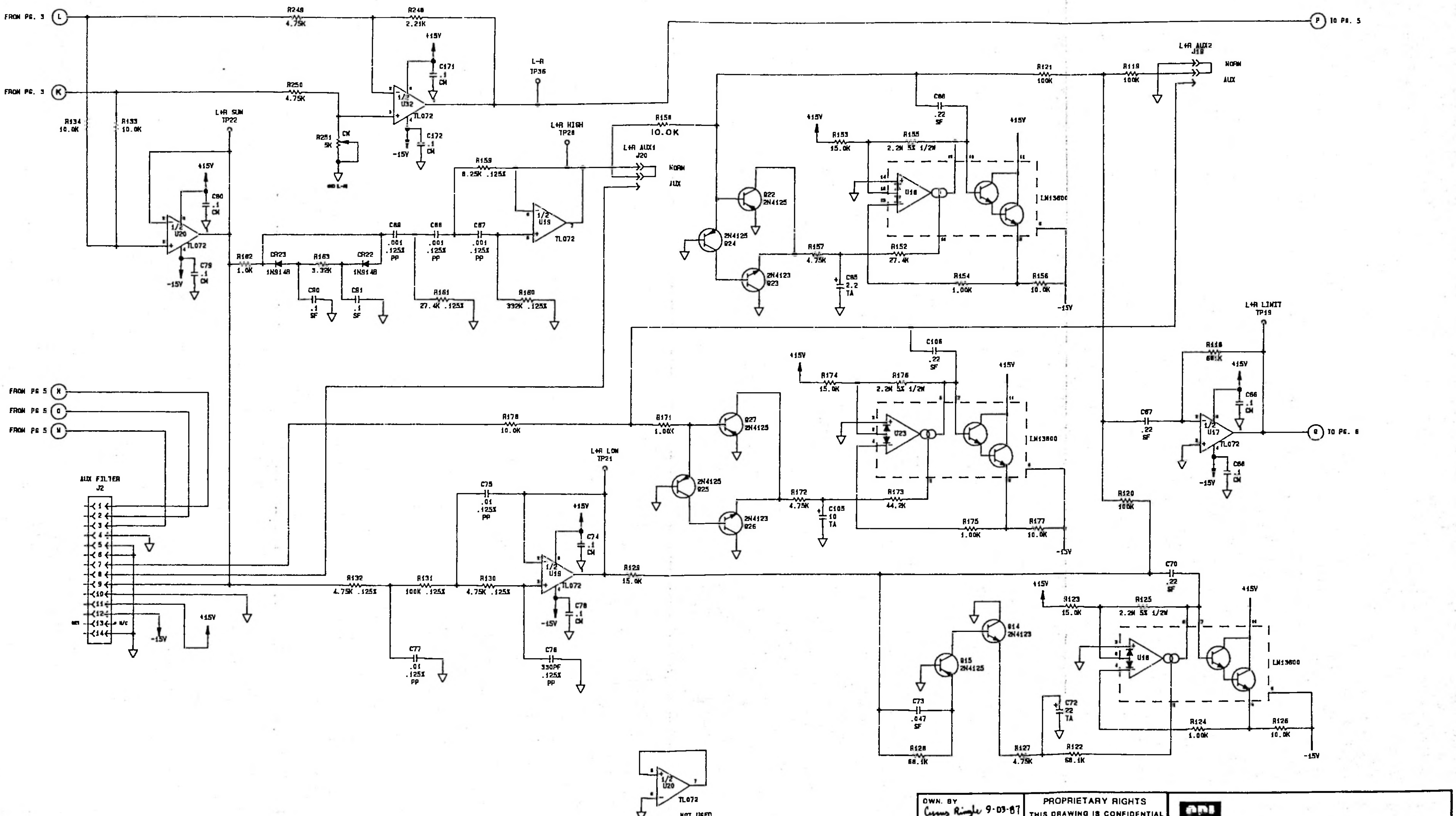
CHKD		TITLE SMP SCHEMATIC	
PROJ. ENGR. 9-3-87			
MECH.	PRELIMINARY	TYPE / SIZE B / DWG. NO. 02-8500-01	REV X-1
DOC.		MODEL TYPE SMP-900A / SCALE NONE	SHEET 3 OF 8



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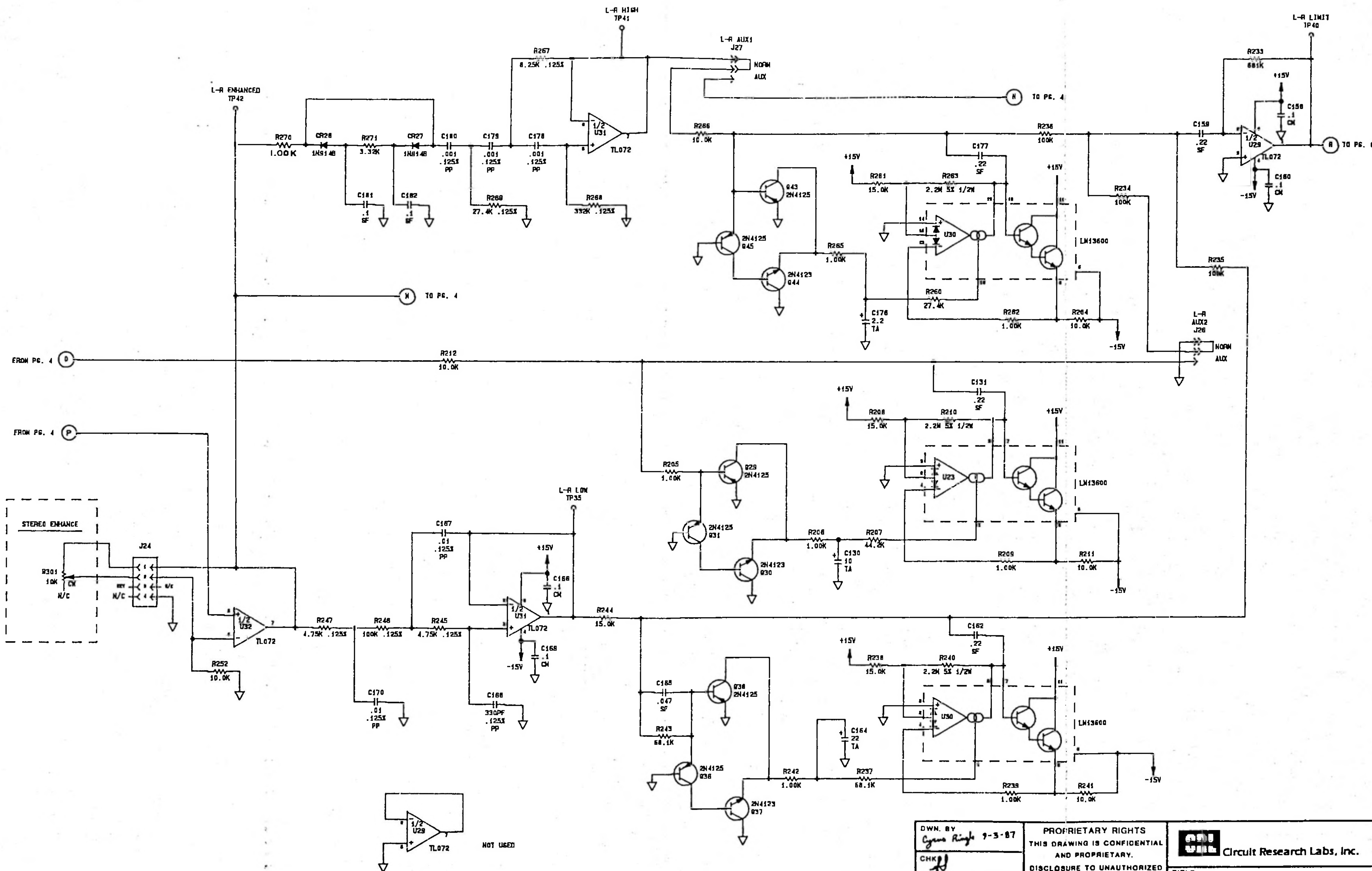
CHKD		TITLE SMP SCHEMATIC
PROJ. ENGR.		
MECH.	PRELIMINARY	TYPE · SIZE B · DWG. NO. 02-8500-01 · REV X-1
DOC.		MODEL TYPE SMP-900A · SCALE NONE · SHEET 4 OF 8



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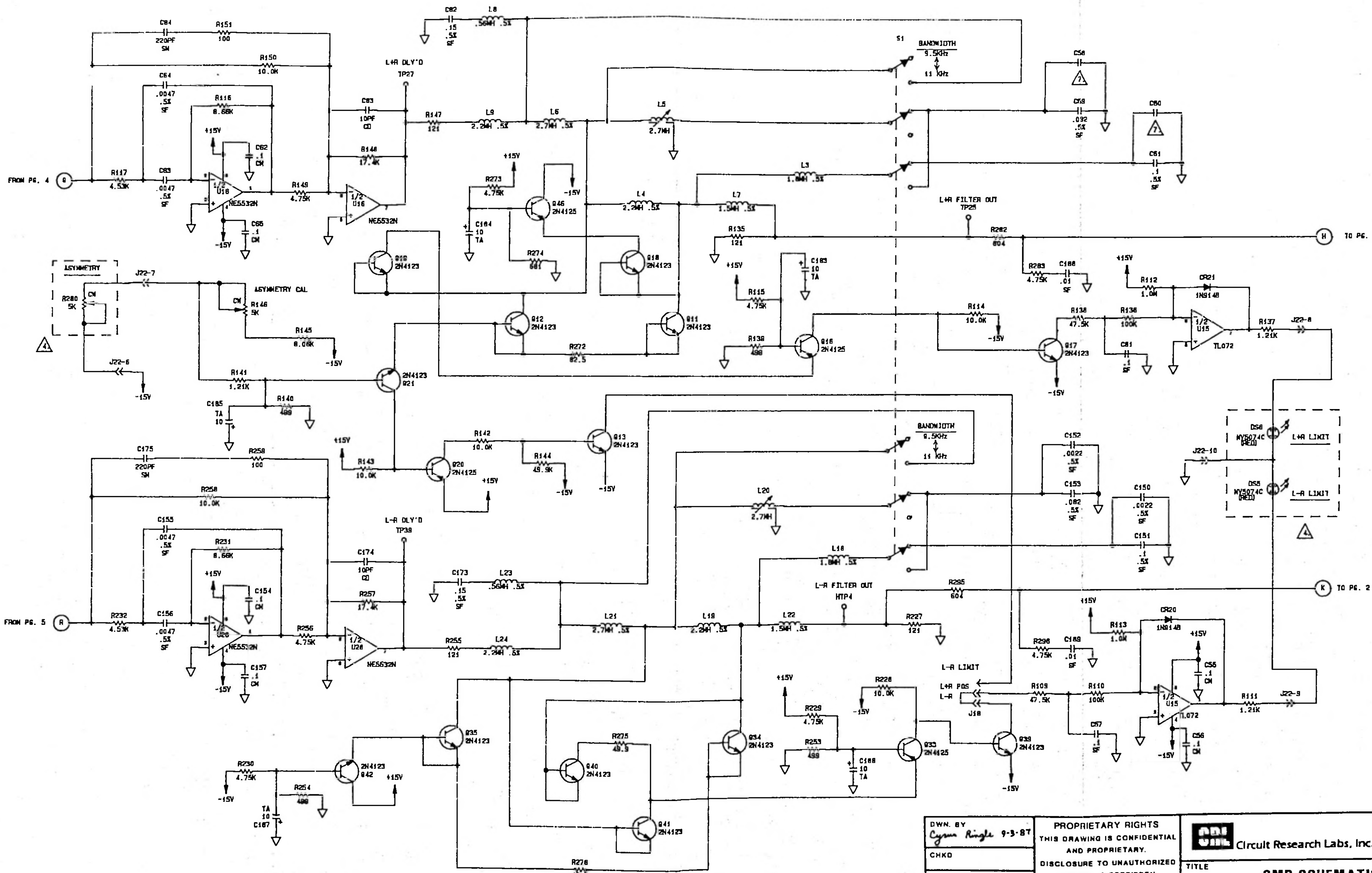
CHK		TITLE SMP SCHEMATIC
PROJ. ENGR. 9-3-87	PRELIMINARY	TYPE — SIZE B — DWG. NO. 02-8500-01 — REV X-1
MECH.		MODEL TYPE SMP-900A — SCALE NONE — SHEET 5 OF 8
DOC.		



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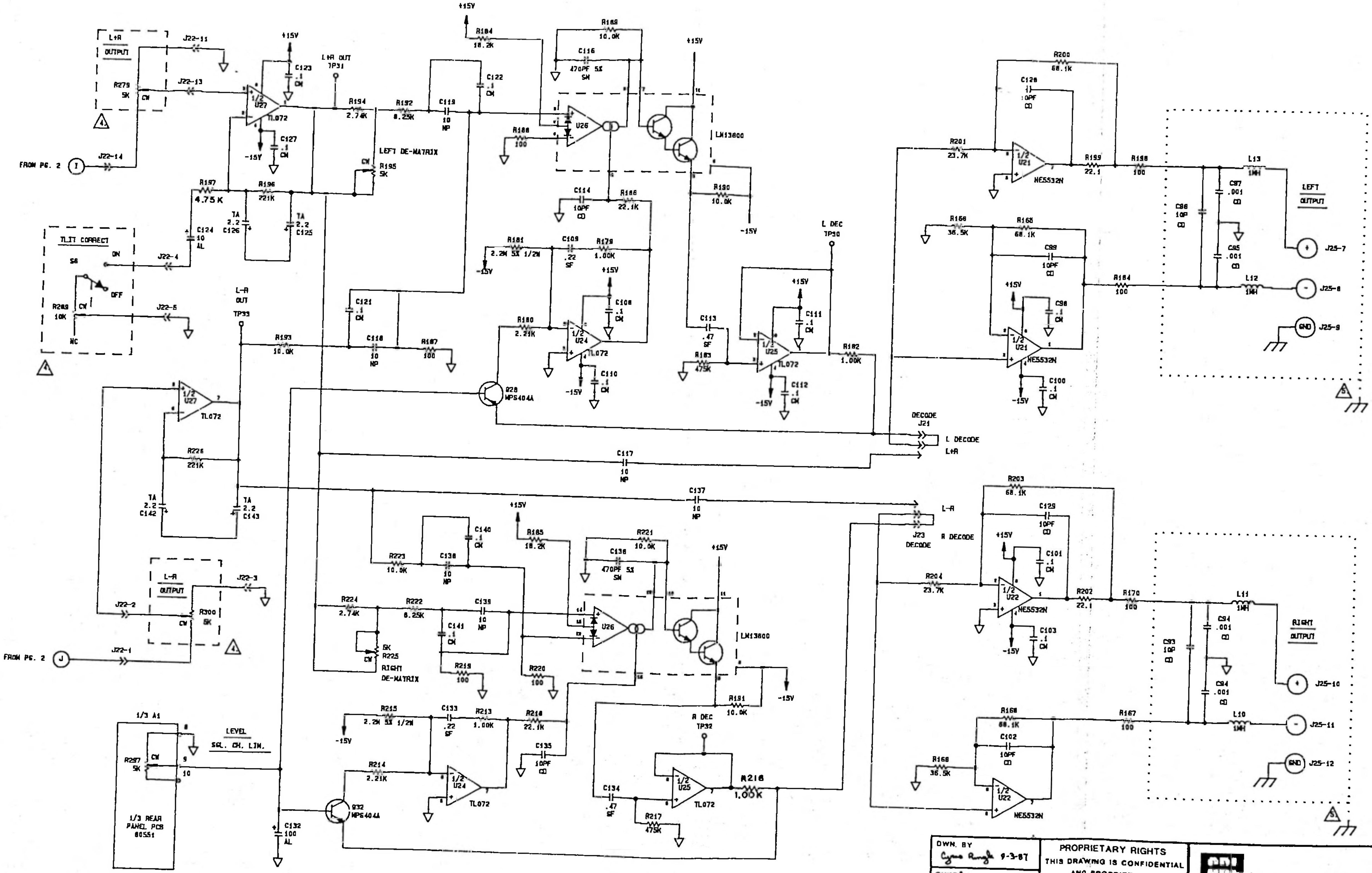
PROJ. ENGR.	PRELIMINARY	TYPE / SIZE B / DWG. NO. 02-8500-01 / REV X-1
MECH.		MODEL TYPE SMP-900A / SCALE NONE / SHEET 6 OF 8
DOC.		



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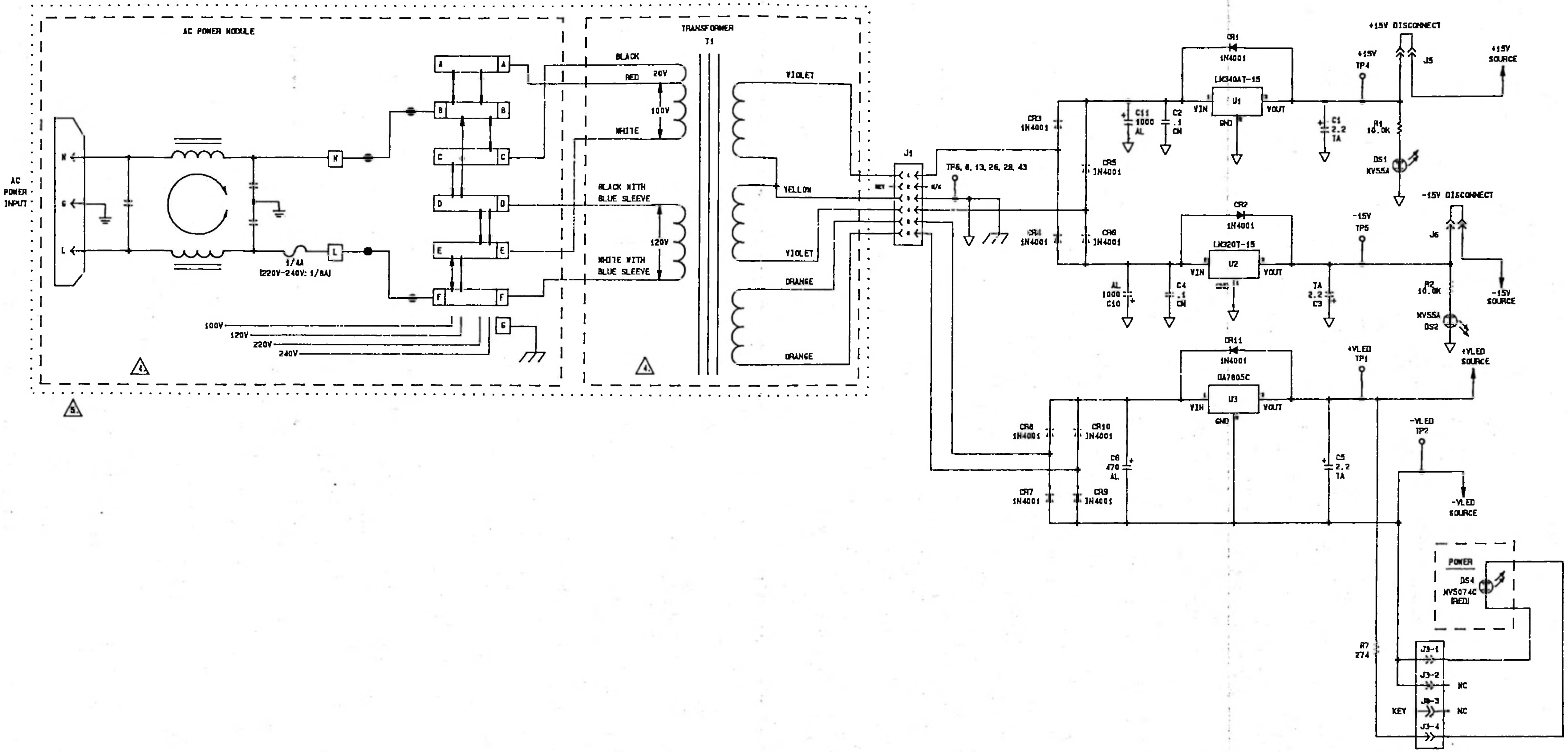
CHKD.		TITLE SMP SCHEMATIC	
PROJ. ENGR. 9-3-87	PRELIMINARY	TYPE / SIZE B / DWG. NO. 02-8500-01	REV X-1
MECH.		MODEL TYPE SMP-900A	SCALE NONE
DOC.			SHEET 7 OF 8



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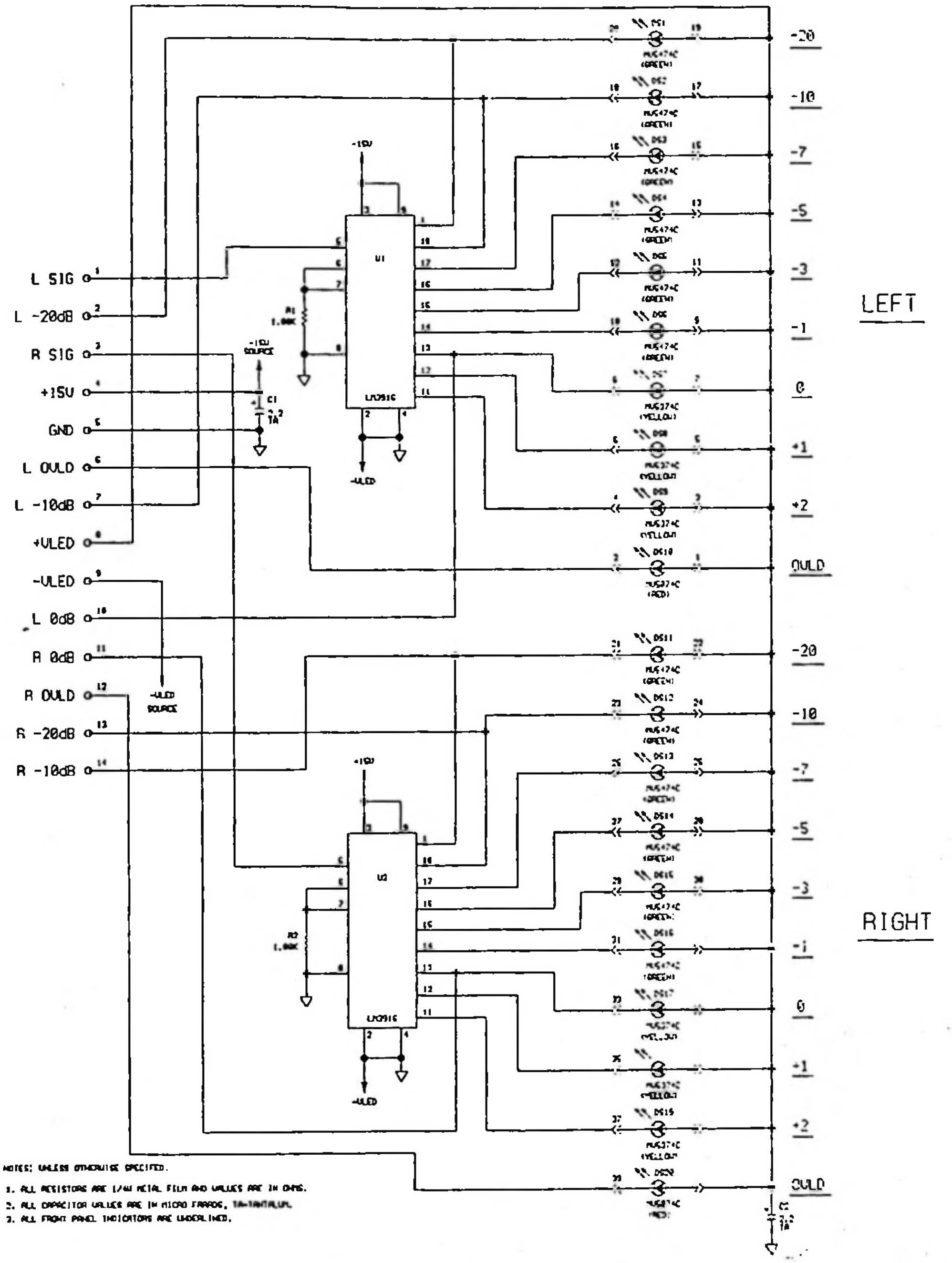
CHKD		TITLE SMP SCHEMATIC	
PROJ. ENGR. 9-3-87	PRELIMINARY	TYPE / SIZE B / DWG. NO. 02-8500-01	REV X-1
MECH.		MODEL TYPE SMP-900A	SCALE NONE / SHEET 8 OF 8
DOC.			



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTORS ARE 1/4W METAL FILM AND VALUES ARE IN OHMS.
2. ALL CAPACITOR VALUES ARE IN MICRO FARADS, TA=TANTALUM.
3. ALL FRONT PANEL INDICATORS ARE UNDERLINED.

ORIG. Cyrus Ringl 07-22-87	Circuit Research Labs, Inc.			
CHKD Pau Stae 7/22/87	TITLE LED INDICATOR SCHEMATIC (STEREO)			
PROJ. ENGR Hak 7-22-87	TYPE	SIZE A	DWG. NO. 02-6100-02	REV A-1

This product has been supplied with a preliminary manual. The final version of the operation manual will be completed soon.

Please complete and return this card to receive the appropriate manual when it becomes avalalble.

MODEL NUMBER________________ SERIAL NUMBER________________

STATION CALL LETTERS or COMPANY ________________________

ATTN:____

ADDRESS______________________________________

CITY____________________ STATE________ ZIP____________

Circuit Research Labs, Inc.
2522 W. Geneva Drive
Tempe, Az. 85282 U.S.A.
602-438-0888

PRELIMINARY