PMC-450

PEAK MODULATION CONTROLLER

FOR AM BROADCAST

INSTALLATION AND OPERATION MANUAL

THE PROFESSIONAL'S CHOICE

CRL SYSTEMS

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PMC-450
PEAK MODULATION CONTROLLER

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 10082 DWNG 11-2500-01 Rev. A-1

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SECTION 1 - GENERAL

1.1 SAFETY INFORMATION

1.2 DEFINITIONS OF SAFETY SYMBOLS

****
WARNING
****

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.

1.3 IMPORTANT SAFEGUARDS

1.4 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.

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

1.6 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 2.3 for power line AC voltage selection.

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

1.8 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.

1.9 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.

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

1.11 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.

1.12 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.

1.13 INTRODUCTION

1.14 FEATURES:

1.15
- -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
- -22 dB Range, 10 Segment Input Peak Indicator
- -Programmable 1 dB step Peak Limiting Control
- -Rugged 1 3/4" Rack-mount Chassis With Integral RFI Protection
- -Adjustable High Frequency EQ
- -Adjustable Mid Range Presence

1.16 The CRL PMC-450 incorporates designs originally developed for AM stereo. Gain reduction, pre-emphasis, filtering, and limiting are combined to permit maximum loudness with minimum distortion.

1.17 The PMC is the ideal choice to upgrade a monaural 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).

1.18 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.

1.19 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.

1.20 In addition, the PMC-450 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.

1.21 Programmable 1 dB per step peak limiting circuitry is provided with a range from 0 to +5 dB. This circuitry selects the amount of instantaneous gain reduction (limiting) applied to the audio signal.

1.22 To aid the user in properly setting the audio level into the unit, a 10 segment peak-reading LED input level meter with a range from -20 to +2 dB is provided. 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.

1.23 Audio interfacing is done through the use of a barrier connector strip on the back panel. The Input and output is active-balanced and fed through second-order RFI suppression filters.

1.24 The PMC 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.

1.25 The Mid Range Presence control allows for the adjustment of mid-band audio frequencies especially the voice area between 1kHz and 4kHz. The control can add up to 6dB of mid-range presence.

1.26 The EQ Control controlls the pre-emphasis curve and includes a detent position that implements the NRSC Standard Pre-emphasis curve.

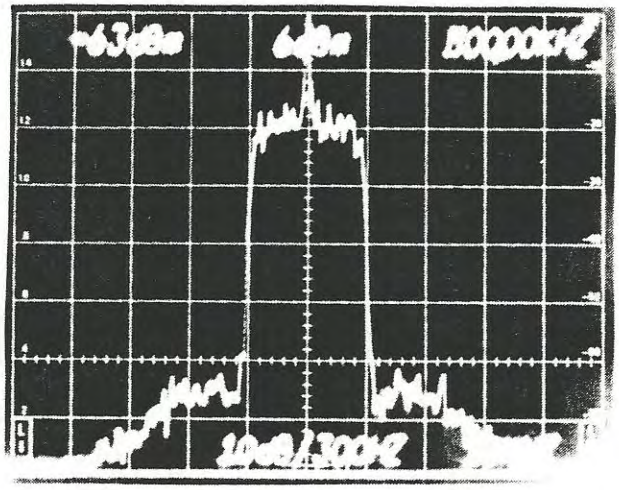

FIGURE 1-1 TYPICAL TRANSMITTED SPECTRUM
(Laboratory transmitter, 15 minute peak-store display;
V:10 dB/div., H: 10 kHz/div., 300 Hz resolution

1.27 WARRANTY

PRODUCT WARRANTY

1.28 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.

1.29 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.

1.30 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

1.31 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.

1. 32 NRSC VOLUNTARY STANDARD COMPLIANCE RECORD

1.33 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.

1.34 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

1.35 PMC-450 SPECIFICATIONS

ELECTRICAL

INPUT	(Ref. 0 dBm=0.775 VRMS)
Type:	Active balanced (differential)
Impedance:	>10K ohms bridging
Termination:	Selectable 600 ohms
Level (adjustable):	<-10 to +20 dBm; ref. to 0 dB indication on front panel level meter
OUTPUT	
Type:	Active balanced (differential)
Impedance:	100 ohms (to drive 600 ohm load)
Level (adjustable):	<-20 to +20 dBm; ref. to 100% negative modulation level, as established internally
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; +/- 0.5 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:	>65 dB in operate mode >75 dB in proof mode
INPUT GAIN REDUCTION:	Input leveling AGC; selectable in 2 dB increments to 8 dB, >20 dB overall range
LIMITING:	Selectable in 1 dB increments from 0 to +5 dB; dual band, crossover frequency: 3.5 kHz
HI-FREQ EQUALIZATION:	Follows NRSC standard pre-emphasis characteristic, 20 Hz to 10 kHz, when front panel HI-FREQ EQUALIZATION control is in NRSC position. The control is continuously variable from the OFF position to the MAX

	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. 10-Segment LED-type input level meter with a 22 dB (28 dB with OVLD) dynamic range 2. +/- limit indicators monitor activity of patented overshoot-corrected filter circuitry

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.
MID RANGE PRESENCE:	Allows the adjustment of mid-band audio frequencies especially in voice area between 1 and 4 kHz. Can add up to 6 dB of mid-range presence.

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

SECTION 2 - INSTALLATION

2.1 GENERAL

2.2 The front panel of the PMC-450 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 2.4. IT IS IMPORTANT TO CAREFULLY FOLLOW THE PROCEDURES LISTED BELOW IN SECTION 2.3 BEFORE POWER-UP OF THIS UNIT.

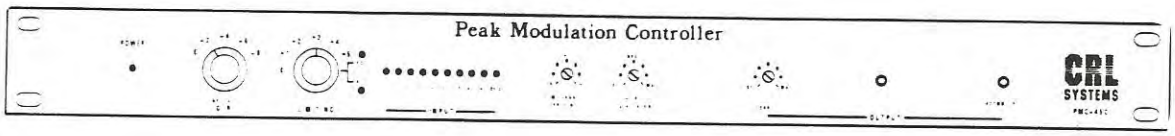


FIGURE 2-1 PMC-450 FRONT PANEL

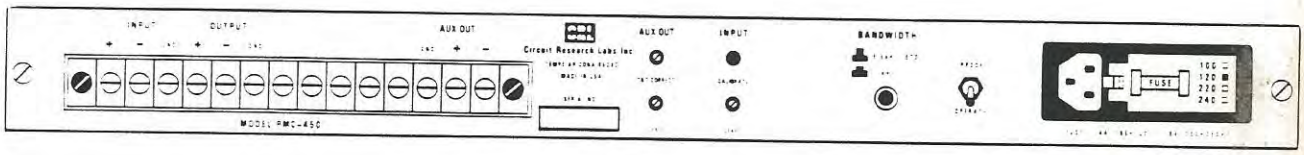


FIGURE 2-2 PMC-450 BACK PANEL

2.3 BEFORE POWER-UP

1. Set the power line module as per Section 2.4
2. Set the internal jumpers as required for the intended system application as per Section 2.6.
3. Connect the unit as per Section 2.11.
4. Set the switches and controls to the initial settings listed in Section 2.21.

2.4 POWER LINE AC VOLTAGE SELECTION

2.5 The PMC-450 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.

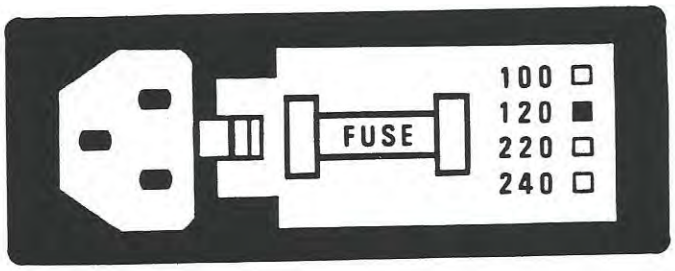


FIGURE 2-3 LINE VOLTAGE SELECTION

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.

2.6 INTERNAL JUMPERS

2.7 The PMC 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 potentiometer R146 on the PCB at this time. See Section 6.3 for making this adjustment).

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. In the ***TERM*** position, the input has a 600 ohm termination. The ***BRIDGE*** position presents an impedance of >10K ohms.
J10	OUT	BASS CLIP JUMPER. 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.
J11	IN	BASS PRE-EMPHASIS JUMPER. 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 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.
J17	OUT	TILT CORRECT. This jumper is used in conjunction with the ***TILT CORRECT*** control (back panel) to provide tilt correction to the signal at the ***AUX OUT*** terminals. When the

jumper is in the ***IN*** position the ***TILT CORRECT*** control adjusts the correction circuitry used to compensate for low frequency phase shift (see Section 2.25).

2.8 PCB LED INDICATORS

2.9 POWER SUPPLY PCB INDICATORS

2.10 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 6.4, TROUBLESHOOTING.

LED	VOLTAGE	COMMENTS
DS1	+15 VDC +/- 50 mVDC	Fixed; measure at TP4
DS2	-15 VDC +/- 50 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

2.11 INTERCONNECTIONS

2.12 GENERAL

2.13 The PMC-450 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.

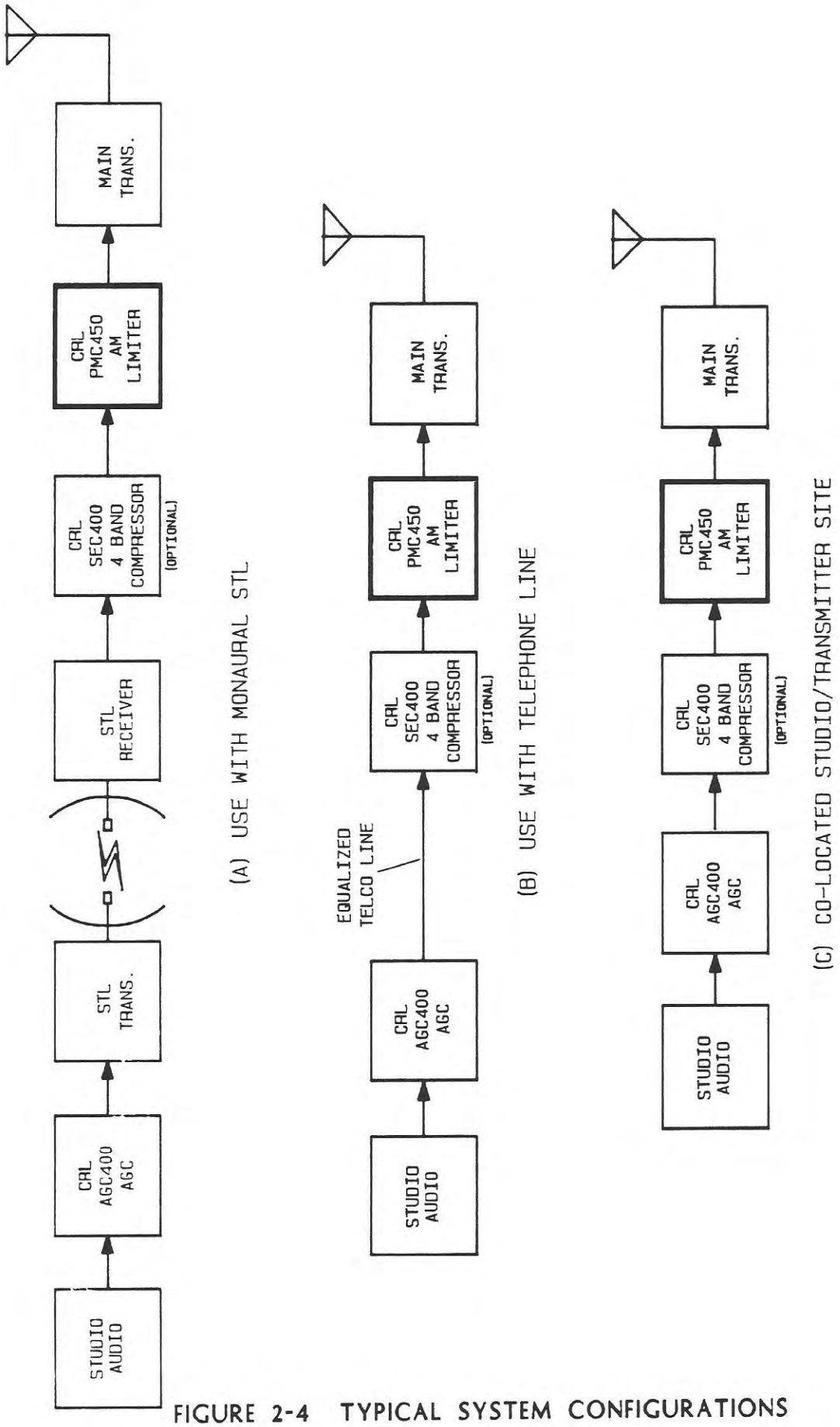


FIGURE 2-4 TYPICAL SYSTEM CONFIGURATIONS

2.14 BALANCED LINE CONNECTIONS

2.15 Most broadcast equipment is designed for balanced line operation. Connect as per FIGURE 2.5. The PMC-450 has one input and one main output connection. An auxiliary output connection is also provided for driving a second transmitter. 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.

2.16 UNBALANCED LINE CONNECTIONS

2.17 Connect the equipment EXACTLY as shown in Figure 2.6 for operation with unbalanced line equipment. The PMC-450 has one input and one main output connection. An auxiliary output connection is also provided for driving a second transmitter.

NOTE: When using the unbalanced INPUT connection 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 an unbalanced output, 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 level will be 6 dB lower than the balanced output level. Unbalanced operation is not recommended in most applications since RFI suppression is most effective when a balanced-line connection is used.

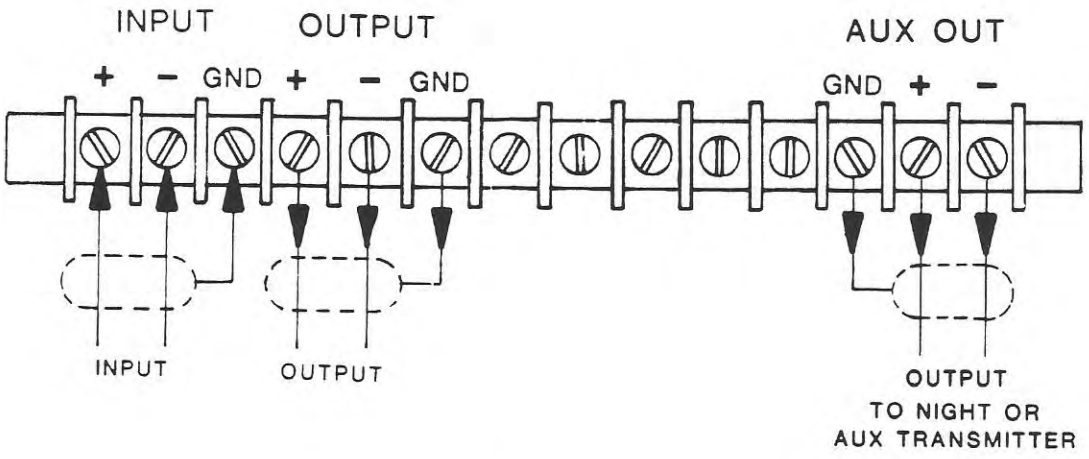


FIGURE 2-5 BALANCED LINE CONNECTIONS

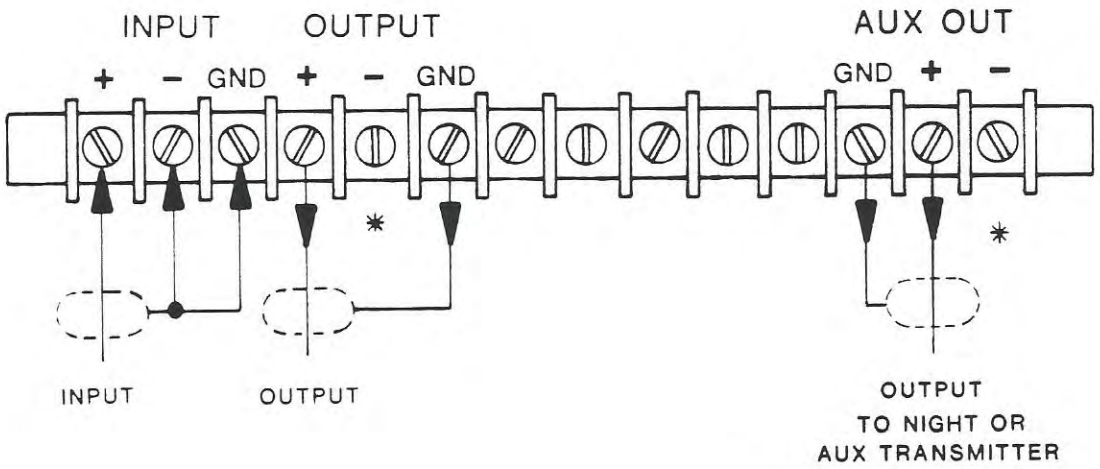


FIGURE 2-6 UNBALANCED LINE CONNECTIONS

2.18 INITIAL SET-UP

2.19 GENERAL

2.20 The following procedure is given to aid in interfacing and setting up the PMC 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 2.4).

2. Connect audio input and output as per Section 2.11.

3. Verify that the internal jumpers are set properly, as per Section 2.6.

2.21 SET-UP PROCEDURE

2.22 INITIAL CONTROL SETTINGS

CONTROL OR SWITCH	SETTING
INPUT AGC G/R	-8
MID-RANGE PRESENCE	FULLY CCW
HIGH FREQUENCY EQUALIZATION	NRSC
TILT CORRECT	OFF
LIMITING	+5
OUTPUT - LEVEL	FULLY CCW (20 turns or more)
ASYMMETRY	FULLY CCW (20 turns or more)
INPUT CALIBRATE*	FULLY CCW (20 turns or more)
BANDWIDTH*	9.5 (Out)
PROOF/OPERATE*	OPERATE

* Located on back panel

CAUTION: When setting up the PMC with an older transmitter it may be desirable to use less than full limiting to avoid damage to the transmitter or antenna system.

2.23 SET-UP PROCEDURE

1. Feed a line level program signal through the system to the input on the PMC-450. All equipment prior to the PMC should be set for normal operation.

2. Increase the setting of the PMC-450 ***INPUT CALIBRATE*** 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.

NOTE: If unable to get the LED indicator to illuminate in the above step after 20 complete clockwise rotations, the input sensitivity may need to be adjusted (see Section 6.4).

3. Increase the setting of the ***OUTPUT LEVEL*** control (front panel) clockwise until the negative modulation peaks, as observed on the modulation monitor or oscilloscope are peaking at 90-95%. The setting of this control is dictated by the negative modulation capability of the transmitter.

CAUTION: The output level of the PMC-450 should never be set such that the negative modulation capability of the transmitter is exceeded.

4. When the output level control is properly set, the ***G/R*** (input AGC) switch and the ***LIMITING*** switches should be reduced to the desired settings as required by the program format. The suggested initial settings are:

SWITCH	SETTING
G/R	-4
LIMITING	+2

5. The asymmetry and tilt correct functions may be enabled as required (see Sections 2.24 and 2.25).

2.24 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 PMC-450. All equipment prior to the PMC 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 PMC output connections.

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

2.25 TILT CORRECT SET-UP

NOTE: This procedure should be done only after all other adjustments have been completed.

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.

2.26 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 PMC ***OUTPUT LEVEL*** control fully CCW (counter-clockwise).

3. Disconnect the PMC ***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 PMC ***INPUT LEVEL*** control.

4. Increase the settings of the PMC ***G/R*** and ***LIMITING*** switches to maximum settings (-8 and +5 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 PMC ***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 PMC ***AUDIO INPUT*** connections. Recalibrate the PMC ***INPUT LEVEL*** 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.

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

NOTE: In lieu of program material, the pulsed-USASI noise function on the CRL AGC-400 may be used.

1. Feed normal program audio through the processing system including the PMC and transmitter. The pre-emphasis function should be disabled. (PMC: Rotate the ***MID BAND PRESENCE*** and ***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 PMC ***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 PMC ***INPUT LEVEL*** 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 PMC ***G/R*** and ***LIMITING*** switches to maximum settings (-8 and +5 respectively). Demodulated audio will be distorted during this adjustment using these settings.

NOTE: If a multi-band compressor (such as the CRL SEC-400 or SEP-400B) 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.

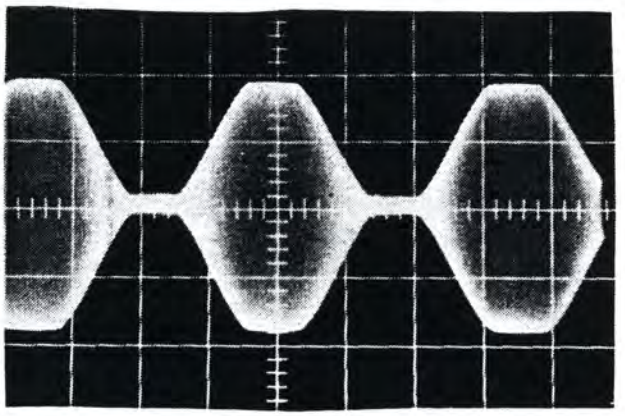


FIGURE 2-7 NORMAL MODULATION ENVELOPE
(No Tilt Present)

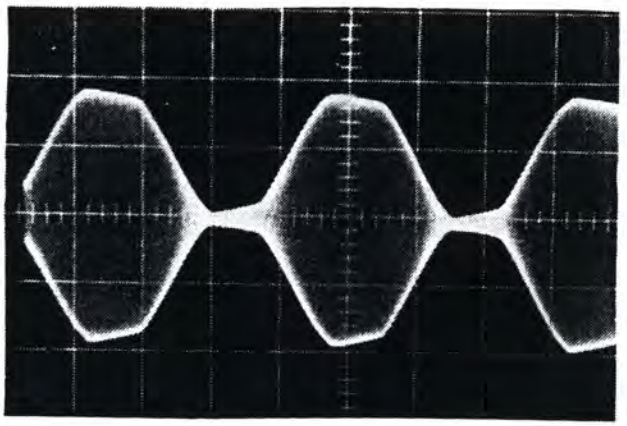


FIGURE 2-8 UNDER-CORRECTED MODULATION ENVELOPE
(Tilt Present)

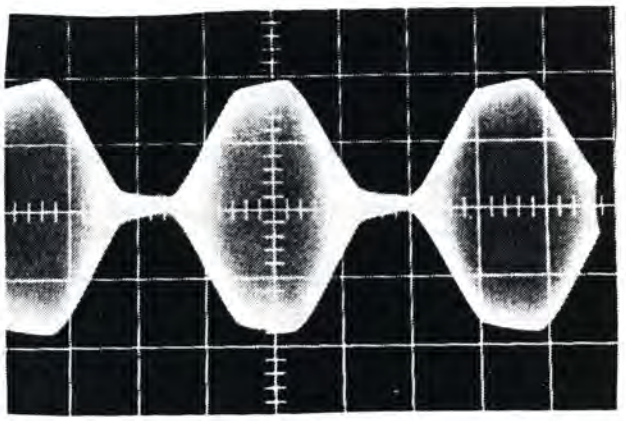


FIGURE 2-9 OVER-CORRECTED MODULATION ENVELOPE

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 PMC 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.

********* WARNING *********
BE CAREFUL NOT TO OVER-CORRECT, AS SHOWN IN FIGURE 2-9. 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 PMC input and output level controls for normal program operation (decrease input level and increase output level). Return the ***MID BAND PRESENCE***

control and ***HI FREQ EQUALIZATION*** control at the previous setting. Return the ***G/R*** and ***LIMITING*** switches to their previous positions.

2.28 AUXILIARY OUTPUT

2.29 The auxiliary output is via the back panel ***AUX OUT*** connections. This output is typically used to drive an auxiliary transmitter for day/night operation.

2.30 SET UP PROCEDURE

1. Verify that the input level is set as per Section 2.21.

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 ***AUX 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 PMC-400A 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 2.24. 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 2.24. If the asymmetry has not previously been set see Section 2.24, steps 2 to 3 (including notes).

4. The tilt correct circuitry can be enabled using internal jumper J17. The adjustment is made using the procedure in Section 2.25 using the ***TILT CORRECT*** control located on the back panel.

NOTE: The tilt correction adjustment differs slightly from the procedure described in Section 2.25 in that a multiturn potentiometer is used.

2.31 GUIDELINES FOR SYSTEM SOUND SETTING

2.32 The following chart should be followed for the initial settings after the previous alignments have been completed. The chart should also 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.

2.33 AGC-400 dynafex NOISE REDUCTION USAGE

2.34 In conjunction with any of the above control settings, the 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 AGC manual).

NOTE: The ***BAND - MULTI/WIDE*** switch may be set as desired for dynamic equalization on the SEC-400.

CAUTION: If the SEC-400 is not being used with the system add 3 to 6 db to the AGC-400 G/R levels.

SYSTEM SOUND SETTING GUIDE

SUGGESTED CONTROL SETTINGS

	AGC-400			SBC-400			PMC-450	
FORMAT	G/R	OPER	BAND	G/R	OPER	LIM/ COMP	G/R	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

SECTION 3 - OPERATING INSTRUCTIONS

3.1 GENERAL

3.2 The purpose of this section is to further describe the operation of the switches, indicators, and controls on the PMC-450. 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.

3.3 FRONT PANEL SWITCHES, INDICATORS, AND CONTROLS

3.4 POWER LED INDICATOR

3.5 A red LED is used as a power on indicator.

3.6 G/R (Input AGC) SWITCH

3.7 The ***G/R*** (Input AGC) 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 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.

3.8 MID RANGE PRESENCE

3.9 The ***MID RANGE PRESENCE*** control allows the adjustment of the mid-band audio frequencies primarily in the voice area between 1kHz and 4kHz. The control can add up to 6 dB of mid-range presence.

3.10 HI-FREQ EQUALIZATION

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

3.12 When this control is rotated clockwise, the amount of pre-emphasis (emphasis at higher frequencies) is increased. When set to the ***NRSC*** (detent) position the NRSC (National Radio Standards Committee) standard pre-emphasis characteristic is implemented.

3.13 The ***NRSC*** 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 ***NRSC*** position due to transmitter or antenna deficiencies, the ***HI-FREQ EQUALIZATION*** control should be rotated counter clockwise towards the ***OFF*** position and used to troubleshoot the system. If this is necessary, the user should determine the reason for not being able to use the ***NRSC*** setting so that the problem can be corrected. Generally, the inability to pass an audio pre-emphasis characteristic is caused by a poor impedance match between the transmitter and antenna system at higher audio frequencies.

3.14 The use of this control allows the user to set the pre-emphasis between ***OFF*** (none), the ***NRSC*** setting (12:00), or higher than this standard setting, ***MAX*** (fully clockwise).

3.15 INPUT LEVEL INDICATOR

3.16 The input indicator displays the input signal level. 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.

3.17 TILT CORRECT CONTROL

3.18 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 PMC 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 2.25).

3.19 POSITIVE AND NEGATIVE LIMIT INDICATORS

3.20 The positive and negative limit indicators are used to show when the limiting circuitry built into the overshoot compensated low-pass filter is being activated. These indicators should begin to flash as the setting of the ***LIMITING*** switch is increased. When the asymmetry function is enabled (see Section 2.24), the positive indicator should flash less often than the negative indicator (or not at all).

3.21 OUTPUT - LIMITING SWITCH

3.22 This switch is used to select the amount of instantaneous 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, +4, or +5) 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.

3.23 OUTPUT - LEVEL CONTROL

3.24 The ***OUTPUT LEVEL*** control is provided to adjust the audio output level of the PMC. The control is adjusted so that the proper modulation level is supplied to the transmitter.

3.25 ASYMMETRY CONTROL

3.26 The ***ASYMMETRY CONTROL*** is used to adjust the amount of asymmetry or positive peak audio present in the output signal. This control is increased to the point at which the desired asymmetry is observed on the modulation monitor. As this control is increased clockwise the positive limit LED indicator will flash less often.

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

NOTE: When this control is at its maximum clockwise setting, the PMC 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.

3.27 REAR PANEL CONTROLS AND SWITCHES

3.28 INPUT CALIBRATE CONTROL AND INDICATOR

3.29 An ***INPUT CALIBRATE*** 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 2.23 for set up). This LED is a duplicate of the 0 dB indicator segment on the front panel level meter.

3.30 BANDWIDTH SELECT SWITCH

3.31 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 PMC 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.

3.32 PROOF/OPERATE SWITCH

3.33 This switch selects either ***PROOF*** (bypass) or ***OPERATE*** mode of operation. In the ***PROOF*** position the input amplifier connects directly to the output amplifier. In the ***OPERATE*** position all functions in the PMC are enabled.

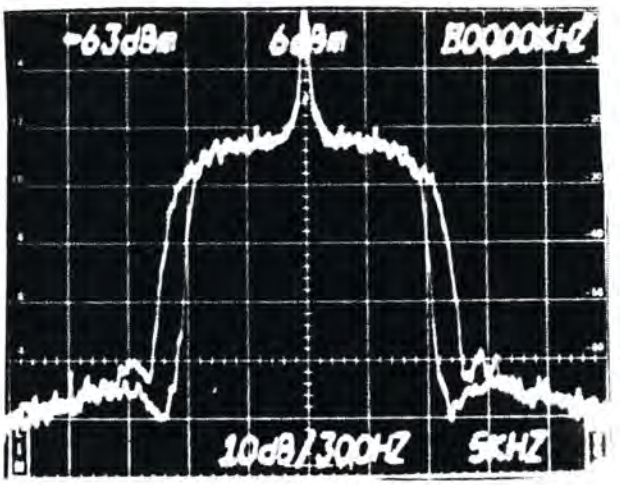


FIGURE 3-1 TYPICAL TRANSMITTED SPECTRUM COMPARISON (9.5/11 kHz Bandwidth Selection, 15 minute peak-store display; V:10 dB/div, H: 5 kHz/div., 300 Hz resolution)

3.34 AUXILIARY OUTPUT - TILT CORRECT CONTROL

3.35 The ***AUX OUT - TILT CORRECT*** control is a 20 turn potentiometer which adjusts 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 Jumper J17 located internally on the PCB (see Section 2.6). This function is not normally required with transmitters that do not have a plate modulation transformer. The PMC 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 2.25).

3.36 AUXILIARY OUTPUT - LEVEL CONTROL

3.37 The ***AUX OUT - LEVEL*** control is a 20 turn potentiometer which adjusts the balanced monaural output for feeding an auxiliary transmitter (for day/night operation). This control provides independent control of this signal. See Section 2.28 for set up of this control.

SECTION 4 - DESCRIPTION OF THE NRSC STANDARD*

4.1 GENERAL

4.2 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.

4.3 PRE-EMPHASIS/DE-EMPHASIS

4.4 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.

4.5 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.

4.6 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.

4.7 FILTERING

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

4.9 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.

4.10 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).

SECTION 5 - THEORY OF OPERATION

5.1 GENERAL

5.2 This section provides theory of operation for the PMC450. For the purposes of definition, the circuitry is divided into functional sub-assemblies. Refer to the block diagram and schematic diagram in section 7 as required for the following description.

5.3 POWER SUPPLY

5.4 See schematic page 5. AC power is supplied to the unit via a standard 3-conductor IEC 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 C input module is positioned to select the transformer winding combination required for each input voltage.

WARNING

SEE SECTION 2.4 FOR INSTRUCTIONS ON SELECTING THE AC INPUT VOLTAGE. OPERATION ON 200-250 VAC WILL ALSO REQUIRE REPLACEMENT OF THE AC PLUG AND FUSE.

5.5 Power transformer T1 is a triple output with a center tapped winding for the +/- 15 volt supply. This 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. The power supply's +15 VDC and -15 VDC rails are bypassed on each supply line by several .01 monolithic capacitors. DS1 illuminates when a positive DC voltage is present at TP-4 with respect to ground. DS2 illuminates when a negative DC voltage is present at TP-5 with respect to ground. 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.

5.6 A separate secondary winding on T1 provides the operating voltages for the ***V LED*** full wave bridge rectifier consisting of CR7, CR8, CR9, & CR10. 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 positive 5 volt supply. This voltage can be measured at TP-1 with respect to the supply's negative potential at TP2.

5.7 SIGNAL CIRCUITRY

5.8 AUDIO INPUT

5.9 Audio input to the unit is connected at rear panel terminal strip J25 (refer to schematic sheet 1). Terminal 1 is high (+), terminal 2 is low (-), and terminal 3 is ground. Back-to-back protective 12-volt zener diodes clamp the signal to ground if the input level exceeds 12 volts on any line in any polarity. A single-section LC low-pass filter consisting of C147, C148, C149, L16, and L17 is connected at this point in the audio path to prevent RF interference with the internal circuitry.

5.10 At this point, jumper J9, ***BRIDGE/TERM***, allows selection of a 600 Ohm resistive termination across the input line, or a 10K bridging input. The rear panel ***INPUT LEVEL control***, R332, is connected at this point allowing adjustment of the input level.

5.11 Balanced input amplifier U5 converts the input to an unbalanced source. Three outputs are provided from U5. The signal may be monitored at U5 pin 1 (pin 7).

A. The output of U5 pin 1 is applied to the left channel meter amplifier U4 pin 2. U4 is a rectifier that provides a DC signal for Display Driver U1 located on PCB 80575. This pulsating DC signal may be monitored at the cathode of CR13.

B. The second output from U5 pin 1 is used for the PROOF circuit (see schematic page 1). The output of U5 pin 1 is applied to the rear panel ***PROOF/OPERATE*** switch through resistor R78. The proof signal is connected to front panel ***OUTPUT LEVEL*** control R326 (see schematic page 4). The proof signal may be monitored at the common pole of the ***PROOF/OPERATE*** switch when in the 'PROOF' position.

C. The third output of U5 provides input to the ***G/R*** switch S3.

5.12 AGC CONTROL LOOP

5.13 Wide band audio signal from the ***G/R*** switch is applied to the ***BASS CLIP*** jumper J10 through C24 and R60 (see schematic page 2). When J10 is in the ***OUT*** position C22 and C23 are in parallel. This enables the ***MONO SUPPORT*** VCR U11 (Voltage Controlled Resistor) to act on lower frequencies thus preventing a percussive effect when large amounts of

gain reduction are switched in via the ***G/R*** switch. When J10 is in the ***CLIP*** position C23 is out of the circuit and only C22 provides signal to U11. The use of this jumper function is subjective.

5.14 The output of the ***BASS CLIP*** circuit feeds signal to U10 pin 2 through R53. U10 is part of the ***INPUT AGC***. C21 and R52 in the feedback of U10 is part of a compensation network required for implementation of the NRSC pre-emphasis curve.

5.15 U10 outputs two signals. The ***INPUT AGC*** output signal may be monitored at the cathode of CR16. One signal is utilized as a sample voltage which is applied to a precision rectifier U6 through CR16, CR19, R49 and R82. The other half of U6 drives the control module U9 and the peak control circuit consisting of R78 and Q10. The output of U9 drives buffer amplifier U7. This signal is applied to the control ports of U11 pin 1. As the current at this port increases the shunt path to ground decreases, U11 pin 5 and 7, causing more gain reduction. See the Customization Section of this manual concerning modification of the release time of the AGC circuit. The other half of U11 is not used. It it terminated to prevent it from causing noise.

5.16 See schematic page 1 and 'FRONT PANEL CONTROL BOARD' schematic. The display board is used to acquire the ***GATING*** signal. Whenever pin 1 of U1 goes to a high state the ***-20*** signal is output to Q6 though J1-14 and resistor R19. When U1 pin 1 is in a low state the -20 LED is on. The ***GATING*** signal that controls the AGC circuitry is derived from the combined action of Q6 and Q7 and is applied to pin 22 of U9 (see schematic page 2). Whenever the input signal falls 20 dB below gain reduction the gain of the AGC circuitry is frozen preventing noise build-up. An internal indicator LED, DS3 is illuminated whenever the AGC is gated.

5.17 BASS PRE-EMPHASIS and NRSC PRE-EMPHASIS

5.18 The second output signal of U10 is applied to the ***LIMITING*** switch S4 located on the front panel. The output of S4 is then routed to the ***BASS PRE-EMPHASIS*** circuit comprised of J11, non-inverting ports of U12, C26, C27, R66 and R67. If J11 is in the ***IN*** position C26 and C27 are in the circuit. When in the ***OUT*** position these capacitors are out of the circuit. Refer to Figure 5.1 which typifies the frequency response of this circuit.

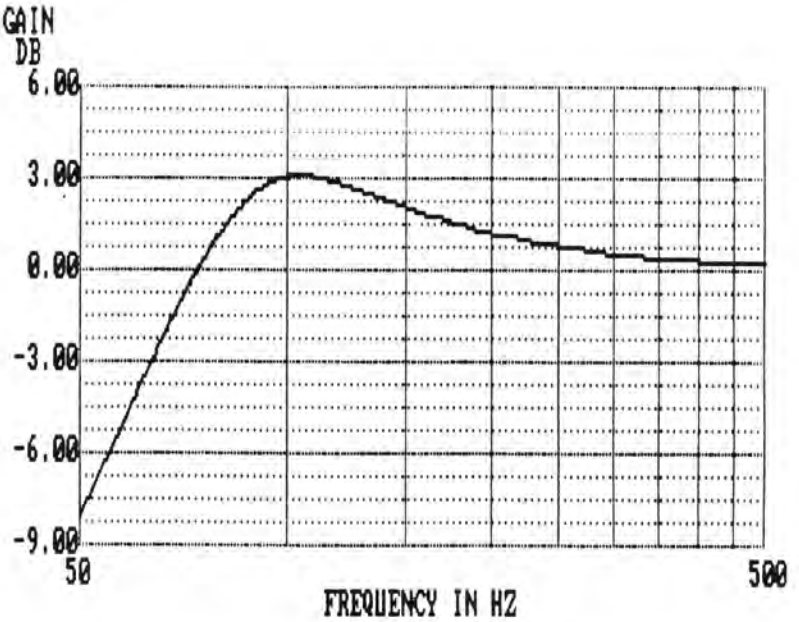


FIGURE 5.1 BASS PRE-EMPHASIS FILTER RESPONSE

5.19 Also associated with U12 is the NRSC pre-emphasis composed of C25, R65, R62 and R63. When the front panel ***HI FRBQ BQUALIZATION*** control is in its detent position the primary NRSC pre-emphasis curve is implemented. The variable control R62 is adjusted during factory calibration to attain the correct gain necessary through U12 so the NRSC pre-emphasis has the correct response when the ***HI FRBQ BQUALIZATION*** control is in the NRSC (detent) position. When the ***HI FRBQ BQUALIZATION*** is fully clockwise, up to 2 dB more pre-emphasis at 10kHz is added as measured at pin 1 of U12, than the NRSC pre-emphasis detent position.

5.20 TRI-BAND LIMITER

5.21 The crossover frequencies for the tri-band limiter are 1kHz and 4kHz.

5.22 Refer to schematic page 3. The output of U20 pin 1 is applied to a diode peak limiting circuit composed of CR23, CR22, C90, C91 and R163. Its function is to limit high frequency peaks to minimize distortion in the following limiter. The signal is then applied to a high pass filter network consisting of C89, C88, C87, R161, R160, R159 and U19 pin 7. The audio from U20 pin 1 is also low pass filtered by the RC network R132, R131, R130, C77, C76, C75, C190, and U19 pin 1.

5.23 See schematic page 6. The mid-band circuit is composed of a high pass and low pass filter connected in series to form a band pass function. The pre-emphasized audio is applied to the ***MID RANGE PRESENCE*** control, R3A, located on the front panel. The output of this control applies a signal to the input of U35 pin 3. The output of U35 is applied to a high pass filter consisting of C198, C197, C195, R286, R285, R284 and U34 pin 1.

5.24 The output of U34 pin 1 drives the low pass filter components C195, C205, C206, R283, R285, R294 and U34 pin 5. The ***MID RANGE PRESENCE*** control forms a input attenuator to the input of the band pass section thus enhancing those frequencies in the voice band very important for clarity and presence. The control can add an additional 6 dB of voice presence.

5.25 The output of U34 pin 7 drives the mid-band limiter U23.

NOTE

The mid-band limiter section composed of U23, Q25, Q26, Q27 and associated passive components will not be described. Its operation is similar to its counter-part U18 and associated components.

5.26 See schematic page 3. The high pass limiter section consists of components U18, Q22, Q23, Q24, R157, C85 and C86. U18 functions as a VCR (Voltage Controlled Resistor). When the peak voltage applied to Q22 or Q24 is greater than .6 volts the transistors will begin to conduct.

5.27 Both the positive and negative peaks are limited. The resulting current charges C85 through resistor R157. Control current is applied through R152 to U18 pin 16. The more current applied to the control port, the lower the shunt path to ground and therefore more limiting action will take place.

5.28 The low pass limiter section consists of components U18, Q14, Q15, R128, R127, C72 and C73. Asymmetrical waveforms are a characteristic of voices and are located in the audio spectrum below 200Hz. These low frequencies are part of the asymmetrical signal controlled in following stages. Only the higher frequency positive going peaks are limited using the RC section of C73 and R128. Since positive peaks have been limited the asymmetry signal is 180 degrees out of phase. U17 serves to invert the signal.

5.29 U17 serves as the summing amplifier for the outputs of the limiter stages through resistors R119, R121, and R120. The limited signal my be monitored at TP-9.

5.30 DELAY EQUALIZER and OUTPUT FILTER

5.31 Refer to schematic page 4. The output of U17 drives the delay equalizer formed by U16 and the network composed of R117, R116, R148, R149, R150, R151, C63, C64, C83, and C84. The output of U16 pin 7 is applied to the input source resistor R147 of the output filter.

5.32 The low pass filter exceeds to the NRSC stopband specification (EIA-549). Refer to Figure 5.2 showing the output spectrum of this PMC450. The filter is composed of L8, L9, L6, L5, L4, L7, L3, C82, C58, C59, C60, and C61. The filter has two possible bandwidth positions using the rear panel ***BANDWIDTH*** switch S1. S1 is a 6 pole double throw device. When S1 is in the NRSC standard ***9.5Khz*** position (OUT) all the components in the filter are functional. If S1 is switched to the ***15kHz*** position (IN) L6 is shorted out. C60 and C61 are floating. C58 and C59 are disconnected from the low side of L5 and switched to the low side of L3. The output of L7 is terminated by R135 and is also connected to a shelving filter composed of R278, R277 and C188. This filter is the final component used to implement the NRSC pre-emphasis. It also minimizes high frequency overshoots in the transmitter.

5.33 Overshoot correction for this filter is provided by transistors Q11, Q12, Q18, and Q19.

5.34 The clipping threshold for Q19 is provided by Q16 and its associated voltage divider R115, R139 and C183. The collector of Q16 is routed to the base Q17. Whenever the collector of Q17 attains -.6 volts U15 will invert the signal and cause the output at pin 7 of U15 to illuminate DS22 the, ***NEG*** LED, on the front panel. Clipping bias for Q18 is provided by Q46 and its associated voltage divider R273, R274 and C184.

5.35 Whenever the collector of Q13 attains -.6 volts U15 will invert the signal and cause pin 1 to illuminate DS21, the ***POS*** LED, on the front panel. As the asymmetry control is rotated clockwise the ***POS*** LED will begin to illuminate less as more asymmetry is generated.

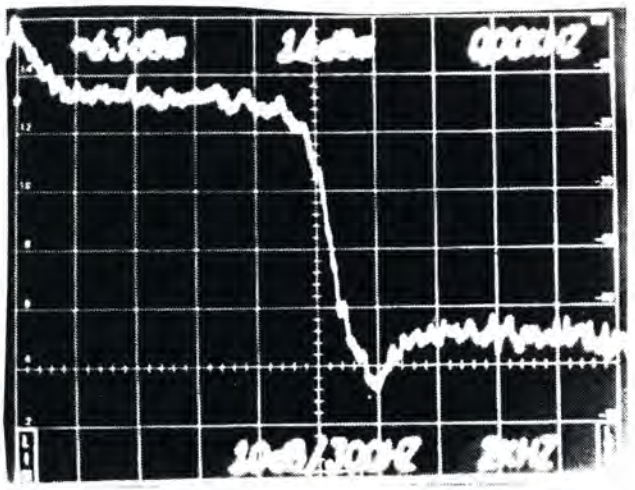


FIGURE 5.2 OUTPUT SPECTRUM OF PMC

5.36 The emitters of Q16, Q21, and Q46 have a "Ferrite Bead" placed over their emitter leads to prevent high frequencies from being generated during clipping.

5.37 ASYMMETRY GENERATION

5.38 Asymmetry control circuitry is formed by the ***ASYMMETRY*** control, R328 located on the front panel, and a voltage divider composed of R146, R145, R141, R140 and C185. As the ***ASYMMETRY*** control is turned clockwise the bias voltage on Q12 becomes more negative causing the threshold of clipping to move toward the top of the audio peaks. This form of generation of asymmetry does not necessitate monitoring the amplitude and phase of asymmetrical peaks. Therefore polarity switching techniques that generate noise are not required.

5.39 If there is question as to the presence of asymmetry on the modulated RF carrier refer to the Troubleshooting section of the manual for further assistance.

5.40 The output of the filter is applied to the PROOF/OPERATE switch located on the rear panel (see schematic page 1) and routed through the Operate position. From the common pole of the ***PROOF/OPERATE*** switch the audio signal is routed to the output control R326 located on the front panel (see schematic page 4) and to the non-inverting input of U13 pin 5 the buffer for the AUX OUTPUT circuitry (see schematic page 5). The signal from the wiper is applied to U27 pin 3.

5.41 TILT CORRECTION

5.42 Refer to "FRONT PANEL CONTROL BOARD" schematic. The ***TILT CORRECT*** control on the front panel, R6, allows low frequency compensation for plate modulated transmitters. When the ***TILT CORRECT*** control is fully counter clockwise S1 associated with R6 disconnects the potentiometer from the circuit. When S6 is ON the gain of U27 is increased as the wiper voltage potential gets closer to ground. Frequencies lower than approximately 50Hz are phase shifted through C126 and C125.

5.43 AUXILIARY OUTPUT

5.44 The AUDIO OUTPUT located on the I/O barrier strip on the rear panel has the AUX OUT LEVEL control R331 (see schematic page 2) associated with it. Also located on the rear panel is the AUX OUT TILT CORRECT control, R330.

5.45 U13 pin 5 has signal impressed on it from the ***PROOF/OPERATE*** switch. U13 (pin 7) is used as the buffer for the other half of U13 which serves as the tilt correction amplifier. The output of U13 pin 1 is applied to the ***MONO OUTPUT*** control R331. The output of the control drives the differential output amplifier U14. 100 ohm resistors R106 and R108 are used to protect the amplifier output under short circuit conditions at the output terminals. A single-section LC low-pass RFI filter consisting of C53, C54, C52, L1, and L2 is connected to the output terminal strip at J25-13 and J25-14.

5.46 OUTPUT CIRCUIT

5.47 Amplifier U21 is configured as a differential balanced output. R198 and R164 serve to protect the outputs under a shorted condition at the output terminals. The output signal is applied to a single-section LC low-pass RFI filter consisting of C95, C96, C97, L12, and L13 is connected to the output terminal strip J25-7, J25-8 and J25-9.

SECTION 6 - MAINTENANCE, TROUBLESHOOTING, AND CUSTOMIZATION

6.1 PREVENTIVE MAINTENANCE

6.2 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.

6.3 ALIGNMENT PROCEDURES

6.4 EQUIPMENT REQUIRED

AG-51 AUDIO GENERATOR.
AA-51 AUDIO ANALYZER.
OSCILLOSCOPE.
FREQUENCY COUNTER.
DIGITAL MULTIMETER.

6.5 EQUIPMENT CONNECTIONS

6.6 Connect the balanced output cable of the audio generator to the balanced inputs of the PMC450.

6.7 Connect the balanced outputs of the PMC450 to one of the impedance matching transfomers that come with Potomac analyzer equipment. Set the impedance to 600 ohms on the transformer. Connect the output of the transfomer to the input of the distortion analyzer.

6.8 INITIAL EQUIPMENT SETTINGS

Audio Generator (AG-51): 400 Hz, L+R, 10 dB ATTEN, OPERATE. LOW DIST
Audio Analyzer (AA-51): VM, +10 dB Range, R input.
Digital Multimeter (DMM): 20 VDC Range.
Oscilloscope: .5 V/div., 50 ms SWEEP.

PMC 450:

G/R = '0'
OUTPUT LIMITING = '0'
MIDRANGE PRESENCE = '0'
HIGH FREQ EQ = 'OFF'
OUTPUT LEVEL = FULL CCW.
ASYMMETRY = FULL CCW.
TILT CORRECT = 'OFF'

BANDWIDTH (rear) = 9.5 KHz (OUT).
ROOF/OPERATE (rear) = 'OPERATE' (down).
MONO TILT CORRECT (rear) = FULL CCW.
MONO OUTPUT (rear) = FULL CCW.

6.9 INITIAL JUMPER SETTINGS

J5, J6 = REMOVED.
J9 = 'TERM'.
J10, J11 = 'OUT'.

6.10 INTERNAL CONTROL SETTINGS

NOTE: **Do not change the factory setting unless there is factual information indicating circuit malfunction. Please contact CRL for further assistance.**

R62, R146, R305 = mid-range.

6.11 POWER SUPPLY CHECK

220 VAC CHECK

Set Power Module voltage selector to '220 VAC' position.

Measure voltages:
TP-4: +15 VDC (+14.60 to +15.40 VDC).
TP-5: -15 VDC (-14.60 to -15.40 VDC).
TP-2: + 5 VDC (+ 4.75 to + 5.25 VDC).

110 VAC CHECK

Set Power Module voltage selector to '110 VAC' position.

Measure voltages:
TP-4: +15 VDC (+14.60 to +15.40 VDC).
TP-5: -15 VDC (-14.60 to -15.40 VDC).
TP-2: + 5 VDC (+ 4.75 to + 5.25 VDC).

6.12 INPUT LEVEL ADJUSTMENT

Set DMM to AC DECIBELS.
Connect DMM probe to left side of R35.

Adjust PMC 450 INPUT LEVEL control (rear) for DMM reading of +3.6 to +3.8 dB.

Check PMC 450 front display and rear panel "0" LEDs on.

AG-51 to 4 dB ATTEN. (+16dB out)

Check PMC 450 for all front panel display LEDs on.

AG-51 to 5 dB ATTEN. (+15dB out)

Check PMC 450 front display "OVERLOAD" LED off.

AG-51 to 10 dB ATTEN.
Move J9 to "BRIDGE".

DMM reading +9.25 to +9.75 dB.

Move J9 to "TERM".
Connect DMM probe to TP-7.

DMM reading +6.5 to +7.0 dB.

6.13 GATE CIRCUIT TEST

AG-51 to 31 dB ATTEN.
Check PMC 450 "GATE" LED on (left-rear section of PCB).
AG-51 to 30 dB ATTEN.

Check PMC 450 "GATE" LED off.

6.14 G/R TEST

PMC 450 G/R switch set to "0".
DMM set to AC DECIBELS.

PMC 450 G/R SETTING:	DMM reading (TP-7):
0	-12.85 to -13.35 dB
-2	-10.75 to -11.25 dB
-4	-9.05 to -9.55 dB
-6	-6.65 to -7.15 dB
-8	-4.75 to -5.15 dB

AG-51 to 16 dB ATTEN.

DMM reading +8.15 to +8.65 dB.

AG-51 to 10 dB ATTEN.

DMM reading +8.15 to +8.65 dB.

AG-51 to 0 dB ATTEN.

DMM reading +8.25 to +8.75 dB.

6.15 BASS PRE-EMPHASIS CIRCUIT TEST

AG-51 to 100 Hz, 10 dB ATTEN.
PMC 450 G/R switch to '0'.
Connect DMM probe to rear side of R67.

DMM reading -12.25 to -12.75 dB.

Move J11 to 'IN'.

DMM reading -9.25 to -9.75 dB.

Move J11 to 'OUT'.

6.16 LIMITING TEST

AG-51 to 400 Hz.

PMC 450 LIMITING	DMM reading (rear side R67)
+1	-10.75 to -11.25 dB
+2	- 9.25 to - 9.75 dB
+3	- 7.75 to - 8.25 dB
+4	- 6.45 to - 6.95 dB
+5	- 4.50 to - 5.25 dB

PMC 450 LIMITING switch to '0'.

6.17 NRSC PRE-EMPHASIS CALIBRATION AND TEST

Check DMM probe on rear side of R67.
PMC 450 HIGH FREQ EQ control to 'NRSC' detent.
AG-51 to 200 Hz.
DMM RELATIVE switch IN.

AG-51 to 10 KHz.

Adjust R62 for DMM reading of +11.6 dB (initial setting).

AG-51 to 1 KHz.

DMM reading +0.5 to +1.0 dB.

AG-51 to 5 KHz.

DMM reading +7.5 to +8.0 dB.

DMM RELATIVE switch OUT.
PMC 450 HIGH FREQ EQ control to "OFF".
AG-51 to 3 KHz.
DMM probe to TP-9.

DMM reading +2.5 to +3.5 dB.

DMM probe to right side of R129.

DMM reading -41 dB (approx.).

DMM probe to left side of R158.

DMM reading -17.0 to -18.0 dB.

AG-51 to 4.5 KHz.

DMM reading -13.0 to -14.0 dB.

DMM probe to right side of R129.

DMM reading -51 dB (approx.).

DMM probe to TP-9.

DMM reading +2.5 to +3.5 dB.

6.18 MID-RANGE PRESENCE CALIBRATION

Check DMM probe to TP-9.
Check DMM set to AC DECIBELS.
AG-51 to 200 Hz.
DMM RELATIVE switch IN.
PMC 450 MID-RANGE PRESENCE control to "+3" (detent).
AG-51 to 2 KHz.

Adjust R305 (PCB) for +2.60 dB reading on DMM.

PMC 450 MID-RANGE PRESENCE control full CCW.

6.19 FILTER ADJUSTMENT AND TEST

Connect Frequency Counter to left side of R35.

AG-51 to 200 Hz.
Adjust PMC 450 OUTPUT LEVEL control for +10 dBm reading on AA-51.
AG-51 to 10.9 KHz (+/- 5 Hz).
AA-51 to -30 dB range.

NOTE

To obtain null in next step you may have to increase value of C60 (MAX .01 uF).

Adjust L5 (PCB) for null less than -30 dBm (typ -34 dBm).

6.20 ASYMMETRY ADJUSTMENT AND TEST

Check PMC 450 ASYMMETRY control full CCW.
DMM to DC VOLTS.
DMM probe to front side of R139.
DMM reading +1.37 to +1.45 VDC (remember reading).
DMM probe to left side of R140.

Adjust R146 for same NEGATIVE voltage (as front side of R139) within .01 volts.

PMC 450 LIMITING switch to "+5".
AG-51 to 1 KHz.

Check PMC 450 for both LIMITING LEDs on.

AG-51 to 100 Hz, 0 dB ATTEN.
PMC 450 G/R switch to "-8".
Oscilloscope probe to left side of R196.

Adjust PMC 450 OUTPUT LEVEL for 2 Vpp waveform.

PMC 450 ASYMMETRY control full CW.

Waveform's negative-going peaks no longer clipped (positive peaks still clipped).

Check PMC 450 "POS" LIMITING LED off.

PMC 450 ASYMMETRY control full CCW.

Check PMC 450 "POS" and "NEG" LIMITING LEDs on.

6.21 TILT CORRECT TEST

PMC 450 TILT CORRECT control full CW.

Waveform tilts approx. 30 degrees near positive and negative peaks.

PMC 450 TILT CORRECT control full CCW.

PMC 450 LIMITING switch to "0".

6.22 MONO OUTPUT TEST

Check AG-51 set to 100 Hz, 0 dB ATTEN.
Scope probes to "MONO OUTPUT" terminals.
PMC 450 "MONO OUTPUT" control (rear) full CW.
PMC 450 "MONO TILT CORRECT" (rear) full CW.

Waveform tilts approx. 30 degrees near positive and negative peaks.

PMC 450 "MONO TILT CORRECT" (rear) full CCW.
Move J17 to "OUT".
PMC 450 "MONO OUTPUT" control (rear) full CCW.

6.23 PREPARATION FOR SPECIFICATION MEASUREMENT

PMC450 control settings:

G/R switch	"0"
LIMITING switch	"0"
MID-RANGE PRESENCE control	"0"
HI FREQ EQUALIZATION control	"OFF"
TILT CORRECT control	"OFF"
ASYMMETRY control	full CCW.
PROOF/OPERATE switch (rear)	"OPERATE" (down).

BANDWIDTH (rear) to 9.5 KHz (OUT).
AUX OUT LEVEL and TILT CORRECT controls (rear) full CCW.
AG-51 to 400 Hz, 10 dB ATTEN.

Check AA-51 set to VM, +10 dBm RANGE.

Check PMC 450 display LEDs indicate "0".

Check PMC 450 J10 and J11 set to "OUT".

Adjust PMC 450 OUTPUT LEVEL for +10 dBm reading on AA-51.

6.24 TOTAL HARMONIC DISTORTION

PMC 450 G/R switch to "-4".

OPERATE MODE (MAX): .25%.
PROOF MODE (MAX): .10%.

6.25 FREQUENCY RESPONSE (400 Hz REFERENCE LEVEL)

PMC 450 G/R switch to "0".
AG-51 to 20 dB ATTEN.

6.26 SIGNAL TO NOISE/NOISE RATIO (400 Hz REFERENCE LEVEL)

PMC 450 G/R switch to "0".
OPERATE MODE (MIN): -65 dB.
PROOF MODE (MIN): -75 dB.

6.27 INTERMODULATION DISTORTION

AG-51 to "IM SIG", +10 dB ATTEN.
AA-51 to "IMD", .3% RANGE.

6.28 TROUBLESHOOTING

6.29 GENERAL

6.30 The items listed below should be checked before troubleshooting the PMC:

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 PMC. 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 impedance headphones can be used to bridge across the input and output. Listening can quickly locate a bad unit or clear a suspected unit.

6.31 SUGGESTED COMPONENT CHECKS

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

6.33 To aid in the troubleshooting of this equipment it is suggested that an oscilloscope be used. Place a probe for each channel at appropriate test points in the main audio signal paths. This will help narrow down the defective circuit. If you need help, please call CRL for further assistance.

SYMPTOM	PROBABLE CAUSE
No power LED. No input display. No output.	Unit not powered up. Bad AC power cord. Blown fuse. Check Power Supply.
No input display.	Bad input pots. Replace U5.
Input display OK, Sounds clipped.	Defective output amp U21 (U22).

NEG LED is on more than POS LED	Asymmetry control not fully counter clockwise.
No Auxiliary Output (rear panel).	Replace U14, or U13.
Intermittent output	Defective PROOF/OPERATE switch. Check I/O connections.
Sounds muddy	Replace U11,U9 module. EQ pot bad
No pre-emphasis.	Check HI FREQ EQUALIZATION control. Replace U12
Cannot vary pre-emphasis	Bad HI FREQ EQUALIZATION control.
Has weak output in operate mode and Input AGC not functional	Replace U6
Unit has output but no display.	Replace U1 (U2) on display PCB.
No asymmetry control No positive peaks above 100%	Bad asymmetry pot. Verify symptom with oscilloscope at output terminals of PMC-450

6.34 CUSTOMIZATION

6.35 REASON FOR MODIFICATION: Slow down the release time of the INPUT AGC.

6.36 SOLUTION: Install a resistor in series with pin 24 of U6.

6.37 SUGGESTED RESISTOR VALUES:

6.38 Values can be 5%. 1/4 watt, carbon film. Values listed are 1%, 1/4 watt, metal film.

82.5K
90.1K
100K
121K
150K

6.39 The higher the resistor value, the slower the release time. Through experimentation at CRL it has been found that values greater than 150K degrade the loudness quality of the voices Values less than 82.5K do not produce a release time much slower than units shipped from the factory. At the factory a 100K resistor was chosen.

WARNING

Do not use solder wick or any other type of utility that sinks large amounts of heat away from the iron. Doing so may damage the solder pad and circuit foil.

THE WARRANTY WILL BE VOID

Use a solder sucker such as a PALADIN.

6.40 PROCEDURE:

1. Remove the eight Phillips screws from the top of the PMC-450. Remove the lid and set it aside.

2. On the main PCB find the resistor outlined with dash marks located just above the upper left hand corner of U6 (black module). This resistor has the designation "AGC RELEASE" on the board. The chosen resistor value will be placed here. See page 7-11, PC BOARD LAYOUT DIAGRAM.

3. Remove the jumper wire that is located at the AGC RELEASE position.

4. Remove any debris that may have accumulated in the chassis or on the PCB before proceeding.

5. Make sure the PMC-450 is not powered up at this time.

NOTE

It is suggested that two best choice values be chosen. Place the two resistors on a Single Pole Double Throw switch. Switch the resistors in and out of circuit. This will enable the user to determine the BEST value. The release time may be observed at TP-12, "AGC CONT".

6. Solder a length if wire approximately 1 inch long to the COMMON POLE of a Single Pole Double Throw switch.

7. Solder one of the two chosen resistors values to one of the switched poles.

8. Solder the other resistor to the remaining switched pole.

9. Solder the two free ends of each resistor together.

10. Solder the the wire attached to the COMMON POLE to either solder pad at the specified resistor location for this modification.

11. Solder the two attached resistors to the other solder pad associated with this modification.

12. Power up the PMC-450.

13. Send program audio containing voice material into the PMC-450 and listen to the outputs with headphones or a monitor system while switching the two chosen resistors back and forth. Use various MONO SUPPORT and LIMIT levels.

14. After choosing the resistor, REMOVE POWER from the PMC-450.

15. Remove the chosen resistor from the switch and install it in the PMC-450 on top of the PCB. The resistor maybe soldered to the board from the top.

CAUTION: Make sure the leads of the resistor are not too long or they will short to the floor of the chassis.

16. Re-install the chassis lid on the unit using the eight 6-32 X 1/4 Phillips head screws.

17. Put unit back into service.

This completes the modification.

6.41 EXPECTED RESULTS:

6.42 For values of 82K to 90K the voices will remain loud but will still contain a bit of audible IM distortion. With values of 100K to 150K the IM distortion will be reduced more. Values above 150K will affect the loudness of the voices more drastically.

6.43 FACTORY SERVICE

6.44 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 7 - APPENDIX

A. SYSTEM SET-UP

AM4 SYSTEM INFORMATION

1. AGC-400. This is a split band AGC amplifier that maintains a constant level and tonal balance into the following unit. It contains a USASI noise generator for system set up and an optional phase rotator for removing asymmetry from voices.
2. SEC-400. This is a monaural 4 band compressor with gating in each band. It provides a very dense, controlled signal that results in improved 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. PMC-450. This unit is designed to provide the necessary final audio peak control for maximum transmitted coverage and loudness. It includes circuitry to implement the NRSC standard.

SUGGESTED INITIAL SETTINGS

AGC-400:	G/R:	-9	EQ:	12 to 2 o'clock
	GATE:	On	OPERATION:	M
	dynafex:	Off	BAND:	Both

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-400:	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 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.

PMC-450:	G/R:	-4	LIMITING:	+2
	PRE-EMPHASIS:	STD.	B/W (Rear Panel):	9.5 kHz (STD)
	TILT CORRECT:	OFF		

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-400 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 for each processing module.

B. PARTS LIST FOR PMC-450

ABBREVIATIONS USED IN PART DESCRIPTIONS

CAPACITORS

AL	Aluminum Electrolytic	NP	Non-Polorized Electrolytic	RA	Radial Lead
AX	Axial Lead	PC	Polycarbonate	SF	Stack Film (metalized polyester)
CD	Ceramic Disc	PE	Polyester Film	SM	Silver Mica
CM	Ceramic Monolithic	PP	Polypropylene Film	TA	Tantalum
FT	Ceramic Feed-Thru	PS	Polystyrene Film	TUB	Tubular

HARDWARE

EXT	External	MS	Machine Screw	SOH	Slotted Oval Head
EXTR	Extruded	NY	Nylon	SPH	Slotted Pan Head
FPH	Flat Phillips Head	PL	Plated	SS	Stainless Steel
HDWR	Hardware	POH	Phillips Oval Head	ST REL	Strain Relief
INSUL	Insulator	RL	Rolled	STDOFF	Standoff
INT	Internal	SBH	Slotted Binder Head	WASH	Washer
LOCK	Lockwasher				

RESISTORS and POTENTIOMETERS

ADJ	Adjust	LIN	Linear Taper	RLOG	Reverse Log Taper
AUD	Audio Taper	MF	Metal Film	RT	Right
CC	Carbon Composition	PANEL	Panel Mounted	T	Turn
CE	Cermet	PC	PC Board Mounted	TRIM	Trimmer
CF	Carbon Film	POT	Potentiometer	VAR	Variable
DIP	Dual In-line Package	RES	Resistor	WW	Wire Wound

SEMICONDUCTORS and INTEGRATED CIRCUITS

DIG	Digital	PGA	Pin Grid Array	SOIC	Surface Mount IC
DIP	Dual In-line Package	PWR	Power	SOT	Surface Mount Xstr
GE	Germanium	REG	Regulator	TO-x	Package Style
IC	Integrated Circuit	SI	Silicon	XSTR	Transistor
LIN	Linear	SIG	Small Signal		

GENERAL

ACC	Accessories	MOD	Modification	SILI	Silicon Impregnated
ADJ	Adjust	NY	Nylon	STDOFF	Standoff
AL	Aluminum	PANEL	Panel Mounted	STOF	Standoff
ALUM	Aluminum	PC	PC Board Mounted	STR	Straight
ASSY	Assembly	PL	Plated	SW	Switch
AX	Axial Lead	POS	Position	TERM	Terminal
BKT	Bracket	PT11	Potcore, 11mm x 7mm	TIF	Tension Insertion Force
BLK	Black	PT18	Potcore, 18mm x 11mm	TP	Test Point
COND	Conductors	PUSH	Push Button	TOG	Toggle
EXT	External	PWR	Power	TRIM	Trimmer
EXTR	Extruded	RA	Radial Lead	TUB	Tubular
FEM	Female	REG	Regulator	TW	Twisted Wire
IN	Inch	REV	Revision	VAR	Variable
IND	Inductor	RF	Radio Frequency	VERT	Vertical
INSUL	Insulator	RL	Rolled	XFMR	Transformer
INT	Internal	ROT	Rotary	ZIF	Zero Insertion Force
INTF	Interface	RT	Right Angle		
KV	Kilovolt	SB	Slow Blow (fuse)		

MAIN PC BOARD

DES.	DESCRIPTION	P/N
	PC BOARD, 8550	13922
C1	CAP,TA,2.2 UF,20%,25V,RA	12290
C2	CAP,CM,.1 UF,10%	11945
C3	CAP,TA,2.2 UF,20%,25V,RA	12290
C4	CAP,CM,.1 UF,10%	11945
C5	CAP,TA,2.2 UF,20%,25V,RA	12290
C6	CAP,AL,470 UF,20%,50V,RA	12000
C7	CAP,CM,.1 UF,10%	11945
C8	CAP,CM,.1 UF,10%	11945
C10	CAP,AL,1000 UF,20%,50V,RA	11995
C11	CAP,AL,1000 UF,20%,50V,RA	11995
C13B	CAP,SF,.1 UF,5%,.3IN	12253
C14	CAP,TA,2.2 UF,20%,25V,RA	12290
C15	CAP,CM,.1 UF,10%	11945
C16	CAP,CM,.1 UF,10%	11945
C17	CAP,CM,.1 UF,10%	11945
C18	CAP,CM,.1 UF,10%	11945
C19	CAP,CM,.1 UF,10%	11945
C20	CAP,CM,.1 UF,10%	11945
C21	CAP,SM,180 PF,.125%	30325
C22	CAP,PE,.1 UF	12060
C23	CAP,SF,.47 UF,5%,.3 IN	12285
C24	CAP,SF,.47 UF,5%,.3 IN	12285
C25	CAP,PE,.022 UF,.125%	12020
C26	CAP,PE,.1 UF	12060
C27	CAP,PE,.1 UF	12060
C30	CAP,CM,.1 UF,10%	11945
C31	CAP,CM,.1 UF,10%	11945
C33	CAP,CM,.1 UF,10%	11945
C36	CAP,CM,.1 UF,10%	11945
C38	CAP,CM,.1 UF,10%	11945
C39	CAP,CM,.1 UF,10%	11945
C43	CAP,CM,.1 UF,10%	11945
C44	CAP,AL,10 UF,20%,25V,RA	11970
C45	CAP,TA,2.2 UF,20%,25V,RA	12290
C46	CAP,TA,2.2 UF,20%,25V,RA	12290
C47	CAP,CM,.1 UF,10%	11945
C48	CAP,CM,.1 UF,10%	11945
C49	CAP,CD,10 PF,10%,1KV	11930
C50	CAP,CD,10 PF,10%,1KV	11930
C51	CAP,CM,.1 UF,10%	11945
C52	CAP,CD,.001 UF,10%,1KV	11967
C53	CAP,CD,10 PF,10%,1KV	11930
C54	CAP,CD,.001 UF,10%,1KV	11967
C55	CAP,CM,.1 UF,10%	11945
C56	CAP,CM,.1 UF,10%	11945
C57	CAP,SF,.1 UF,5%,.3 IN	12253
C58	CAP,PP,.0022 UF,2.5%,.3 IN	12110
C59	CAP,SF,.082 UF,.25%,.3 IN	12249
C60	CAP,PP,.0022 UF,2.5%,.3 IN	12110
C61	CAP,PE,.1 UF	12060
C62	CAP,CM,.1 UF,10%	11945
C63	CAP,PP,.0047 UF,.125%	12121
C64	CAP,PP,.0047 UF,.125%	12121
C65	CAP,CM,.1 UF,10%	11945
C66	CAP,CM,.1 UF,10%	11945
C67	CAP,SF,.22 UF,5%,.3 IN	12260
C68	CAP,CM,.1 UF,10%	11945
C69	CAP,CM,.1 UF,10%	11945
C70	CAP,SF,.22 UF,5%,.3 IN	12260
C71	CAP,CM,.1 UF,10%	11945
C72	CAP,TA,22 UF,20%,25V,RA	12300
C73	CAP,SF,.047 UF,5%,.3 IN	12245
C74	CAP,CM,.1 UF,10%	11945
C75	MATCHD CAP,PE,.033 UF,.25%	30020
C76	CAP,PP,.0033 UF,2.5%	12115
C77	MATCHED CAP,PE,.022 UF,,25%	30010
C78	CAP,CM,.1 UF,10%	11945
C81	CAP,SF,.1 UF,5%,.3 IN	12253
C82	CAP,SF,.15 UF,5%,.3 IN	12255
C83	CAP,CD,10 PF,10%,1KV	11930
C84	CAP,SM,220 PF,1%	12177
C85	CAP,TA,2.2 UF,20%,25V,RA	12290
C86	CAP,SF,.22 UF,5%,.3 IN	12260
C87	CAP,PP,.001 UF,.125%	12090
C88	CAP,PP,.001 UF,.125%	12090
C89	CAP,PP,.001 UF,.125%	12090
C90	CAP,SF,.1 UF,5%,.3 IN	12253
C91	CAP,SF,.1 UF,5%,.3 IN	12253
C98	CAP,CM,.1 UF,10%	11945
C99	CAP,CD,10 PF,10%,1KV	11930
C100	CAP,CM,.1 UF,10%	11945
C104	CAP,CM,.1 UF,10%	11945
C105	CAP,TA,10 UF,20%,25V,RA	12295
C106	CAP,SF,.22 UF,5%,.3 IN	12260
C107	CAP,CM,.1 UF,10%	11945
C117	CAP,NP,10 UF,25V,RA	11975
C123	CAP,CM,.1 UF,10%	11945
C124	CAP,AL,10 UF,20%,25V,RA	11970
C125	CAP,TA,2.2 UF,20%,25V,RA	12290
C126	CAP,TA,2.2 UF,20%,25V,RA	12290
C127	CAP,CM,.1 UF,10%	11945
C128	CAP,CD,10 PF,10%,1KV	11930
C144	CAP,CD,.001 UF,10%,1KV	11967
C145	CAP,CD,10 PF,10%,1KV	11930
C146	CAP,CD,.001 UF,10%,1KV	11967
C147	CAP,CD,.001 UF,10%,1KV	11967
C148	CAP,CD,10 PF,10%,1KV	11930
C149	CAP,CD,.001 UF,10%,1KV	11967
C183	CAP,TA,10 UF,20%,25V,RA	12295

MAIN PC BOARD

DES.	DESCRIPTION	P/N
C184	CAP,TA,10 UF,20%,25V,RA	12295
C185	CAP,TA,10 UF,20%,25V,RA	12295
C188	CAP,PP,.01 UF,.25%,630	12130
C190	MATCHED CAP,PE,.022 UF,.25%	30010
C195	MATCHED CAP,PE,.022 UF,.25%	30010
C196	CAP,PP,.01 UF,.125%	12130
C197	MATCHED CAP,PE,.0022 UF,.25%	30010
C198	MATCHED CAP,PE,.0022 UF,.25%	30010
C203	CAP,CM,.1 UF,10%	11945
C204	CAP,CM,.1 UF,10%	11945
C205	CAP,PP,.01 UF,.125%	12130
C206	CAP,PP,330 PF,2.5%	12150
C207	CAP,CM,.1 UF,10%	11945
C208	CAP,CM,.1 UF,10%	11945
CR1	DIODE,SI,1A,50V,1N4001	12800
CR2	DIODE,SI,1A,50V,1N4001	12800
CR3	DIODE,SI,1A,50V,1N4001	12800
CR4	DIODE,SI,1A,50V,1N4001	12800
CR5	DIODE,SI,1A,50V,1N4001	12800
CR6	DIODE,SI,1A,50V,1N4001	12800
CR7	DIODE,SI,1A,50V,1N4001	12800
CR8	DIODE,SI,1A,50V,1N4001	12800
CR9	DIODE,SI,1A,50V,1N4001	12800
CR10	DIODE,SI,1A,50V,1N4001	12800
CR11	DIODE,SI,1A,50V,1N4001	12800
CR12	WIRE JUMPER,.4 IN	16460
CR14	DIODE,SI,100MA,100V,1N914B	12790
CR15	DIODE,SI,100MA,100V,1N914B	12790
CR16	DIODE,SI,100MA,100V,1N914B	12790
CR19	DIODE,SI,100MA,100V,1N914B	12790
CR20	DIODE,SI,100MA,100V,1N914B	12790
CR21	DIODE,SI,100MA,100V,1N914B	12790
CR22	DIODE,SI,100MA,100V,1N914B	12790
CR23	DIODE,SI,100MA,100V,1N914B	12790
DS1	LED,RED,MV55A	13700
DS2	LED,RED,MV55A	13700
DS3	LED,RED,MV55A	13700
J1	CONN,MALE,6 PIN,.156IN MOLEX	12707
J4	CONN,MALE,4 PIN,.1IN MOLEX	12701
J5	CONN,MALE,MINI-JUMP,.1IN,2 POS	12710
J6	CONN,MALE,MINI-JUMP,.1IN,2 POS	12710
J9	CONN,MALE,MINI-JUMP,.1IN,3 POS	12710
J10	CONN,MALE,MINI-JUMP,.1IN,3 POS	12710
J11	CONN,MALE,MINI-JUMP,.1IN,3 POS	12710
J17	CONN,MALE,MINI-JUMP,.1IN,3 POS	12710

DES.	DESCRIPTION	P/N
J18	WIRE,JUMPER,SOLID,22GA	17120
J22	CONN,FEMALE,RT,PC,.1IN MOLEX	12635
J24	CONN,FEMALE,RT,PC,.1IN MOLEX	12635
J25	CONN,BARRIER,14 TERM,RT PC	12608
L1	IND,1.0 MH,10%,RA	12570
L2	IND,1.0 MH,10%,RA	12570
L3	MATCHED IND,1.8 MH,.25%,RA	30480
L4	MATCHED IND,2.2 MH,.25%,RA	30490
L5	IND,VAR,2.7 MH,PT11	12574
L6	MATCHED IND,2.7 MH,.25%,RA	30500
L7	MATCHED IND,1.5 MH,.25%,RA	30470
L8	MATCHED IND,.56 MH,.25%,RA	30440
L9	MATCHED IND,2.2 MH,.25%,RA	30490
L14	IND,1.0 MH,10%,RA	12570
L15	IND,1.0 MH,10%,RA	12570
L16	IND,1.0 MH,10%,RA	12570
L17	IND,1.0 MH,10%,RA	12570
Q2	XSTR,SI,SIG,PNP,2N4125	15980
Q6	XSTR,SI,SIG,PNP,2N4125	15980
Q7	XSTR,SI,SIG,NPN,2N4123	15970
Q8	XSTR,SI,SIG,PNP,2N4125	15980
Q9	XSTR,SI,SIG,NPN,2N4123	15970
Q10	XSTR,SI,SIG,PNP,MPS404A	15990
Q11	XSTR,SI,SIG,NPN,2N4123	15970
Q12	XSTR,SI,SIG,NPN,2N4123	15970
Q13	XSTR,SI,SIG,NPN,2N4123	15970
Q14	XSTR,SI,SIG,NPN,2N4123	15970
Q15	XSTR,SI,SIG,PNP,2N4125	15980
Q16	XSTR,SI,SIG,PNP,2N4125	15980
Q17	XSTR,SI,SIG,NPN,2N4123	15970
Q18	XSTR,SI,SIG,NPN,2N4123	15970
Q19	XSTR,SI,SIG,NPN,2N4123	15970
Q20	XSTR,SI,SIG,PNP,2N4125	15980
Q21	XSTR,SI,SIG,NPN,2N4123	15970
Q22	XSTR,SI,SIG,PNP,2N4125	15980
Q23	XSTR,SI,SIG,NPN,2N4123	15970
Q24	XSTR,SI,SIG,PNP,2N4125	15980
Q25	XSTR,SI,SIG,PNP,2N4125	15980
Q26	XSTR,SI,SIG,NPN,2N4123	15970
Q27	XSTR,SI,SIG,PNP,2N4125	15980
Q46	XSTR,SI,SIG,PNP,2N4125	15980
R1	RES,10.0 K,1%,1/4W,MF	14150
R2	RES,10.0 K,1%,1/4W,MF	14150
R3	RES,49.9 K,1%,1/4W,MF	17140

MAIN PC BOARD

DES.	DESCRIPTION	P/N
R7	RES, 274 OHM, 1%, 1/4W, MF	17140
R13	RES, 20.0 K, 1%, 1/4W, MF	14435
R14	RES, 100 K, 1%, 1/4W, MF	14180
R15	RES, 100 K, 1%, 1/4W, MF	14180
R17	RES, 10.0 K, 1%, 1/4W, MF	14150
R19	RES, 100 K, 1%, 1/4W, MF	14180
R20B	RES, 274 OHM, 1%, 1/4W, MF	14630
R24	RES, 10.0 K, 1%, 1/4W, MF	14150
R27	RES, 82.5 K, 1%, 1/4W, MF	15070
R28	RES, 47.5 K, 1%, 1/4W, MF	14850
R29	RES, 100 OHM, 1%, 1/4W, MF	16510
R30	RES, 6.81 K, 1%, 1/4W, MF	14900
R31	RES, 604 OHM, 1%, 1/4W, MF	14910
R32	RES, 2.21 K, 1%, 1/4W, MF	14420
R33	RES, 274 OHM, 1%, 1/4W, MF	14630
R34	RES, 4.75 K, 1%, 1/4W, MF	14810
R35	RES, 182 K, 1%, 1/4W, MF	14370
R36	RES, 10.0 K, 1%, 1/4W, MF	14150
R37	RES, 182 K, 1%, 1/4W, MF	14370
R38	RES, 10.0 K, 1%, 1/4W, MF	14150
R39	RES, 4.75 K, 1%, 1/4W, MF	14810
R40	RES, 604 OHM, 1%, 1/4W, MF	14910
R47	RES, 4.99 K, 1%, 1/4W, MF	14820
R48	RES, 4.99 K, 1%, 1/4W, MF	14820
R49	RES, 4.99 K, 1%, 1/4W, MF	14820
R51	RES, 681 K, 1%, 1/4W, MF	14970
R52	RES, 221 K, 1%, 1/4W, MF	14540
R53	RES, 47.5 K, 1%, 1/4W, MF	14850
R54	RES, 10.0 K, 1%, 1/4W, MF	14150
R55	RES, 10.0 K, 1%, 1/4W, MF	14150
R56	RES, 15.0 K, 1%, 1/4W, MF	14290
R57	RES, 2.2 MEG, 1%, 1/4W, MF	14410
R58	RES, 1.00K, 5%, 1/2W, CF	14040
R59	RES, 10.0 K, 1%, 1/4W, MF	14150
R60	RES, 33.2 K, 1%, 1/4W, MF	14690
R61	RES, 1.00 K, 1%, 1/4W, MF	14040
R62	POT, BUTTON, 5K, 1/2W, CF	15160
R63	RES, 3.57 K, 1%, 1/4W, MF	14660
R65	RES, 825OHM, 1%, 1/4W, MF	15080
R66	RES, 47.5 K, 1%, 1/4W, MF	14850
R67	RES, 6.81 K, 1%, 1/4W, MF	14900
R68	RES, 274 OHM, 1%, 1/4W, MF	14630
R71	WIRE, JUMPER, .5 IN.	16470
R72	WIRE, JUMPER, .5 IN.	16470
R76	RES, 100 OHM, 1%, 1/4W, MF	16510
R78	RES, 1.00 K, 1%, 1/4W, MF	14040
R79	RES, 33.2 K, 1%, 1/4W, MF	14690
R80	RES, 33.2 K, 1%, 1/4W, MF	14690
R82	RES, 4.99 K, 1%, 1/4W, MF	14820
R83	WIRE, JUMPER, .5 IN	16470
R86	RES, 15.0 K, 1%, 1/4W, MF	14290
R87	RES, 1.00 K, 1%, 1/4W, MF	14040
R88	RES, 2.2 MEG, 5%, 1/2W, CF	14410
R89	RES, 10.0 K, 1%, 1/4W, MF	14150
R93	WIRE, JUMPER, .5 IN.	16470
R96	WIRE, JUMPER, .5 IN.	16470
R99	RES, 23.7 K, 1%, 1/4W, MF	14560
R100	RES, 4.75 K, 1%, 1/4W, MF	14810
R101	RES, 221 K, 1%, 1/4W, MF	14540
R103	RES, 68.1 K, 1%, 1/4W, MF	14950
R104	RES, 68.1 K, 1%, 1/4W, MF	14950
R105	RES, 36.5 K, 1%, 1/4W, MF	14740
R106	RES, 100 OHM, 1%, 1/4W, MF	16510
R107	RES, 22.1 OHM, 1%, 1/4W, MF	14510
R108	RES, 100 OHM, 1%, 1/4W, MF	16510
R109	RES, 47.5 K, 1%, 1/4W, MF	14850
R110	RES, 100 K, 1%, 1/4W, MF	14180
R111	RES, 1.00 K, 1%, 1/4W, MF	14040
R112	RES, 1.00 MEG, 1%, 1/4W, MF	14070
R113	RES, 1.00 MEG, 1%, 1/4W, MF	14070
R114	RES, 10.0 K, 1%, 1/4W, MF	14150
R115	RES, 4.75 K, 1%, 1/4W, MF	14810
R116	RES, 8.66 K, 1%, 1/4W, MF	15082
R117	RES, 4.53 K, 1%, 1/4W, MF	14795
R118	RES, 681 K, 1%, 1/4W, MF	14970
R119	RES, 100 K, 1%, 1/4W, MF	14180
R120	RES, 100 K, 1%, 1/4W, MF	14180
R121	RES, 100 K, 1%, 1/4W, MF	14180
R122	RES, 68.1 K, 1%, 1/4W, MF	14950
R123	RES, 15.0 K, 1%, 1/4W, MF	14290
R124	RES, 1.00 K, 1%, 1/4W, MF	14040
R125	RES, 2.2 MEG, 5%, 1/2W, CF	14410
R126	RES, 10.0 K, 1%, 1/4W, MF	14150
R127	RES, 4.75 K, 1%, 1/4W, MF	14810
R128	RES, 68.1 K, 1%, 1/4W, MF	14950
R129	RES, 15.0 K, 1%, 1/4W, MF	14290
R130	RES, 10.0 K, 1%, 1/4W, MF	14150
R131	RES, 10.0 K, 1%, 1/4W, MF	14150
R132	RES, 10.0 K, 1%, 1/4W, MF	14150
R135	RES, 121 OHM, 1%, 1/4W, MF	14270
R136	RES, 100 K, 1%, 1/4W, MF	14180
R137	RES, 1.00 K, 1%, 1/4W, MF	14040
R138	RES, 47.5 K, 1%, 1/4W, MF	14850
R139	RES, 499 OHM, 1/4W, 1%, MF	14872
R140	RES, 499 OHM, 1/4W, 1%, MF	14872
R141	RES, 1.21 K, 1%, 1/4W, MF	14100
R142	RES, 10.0 K, 1%, 1/4W, MF	14150
R143	RES, 10.0 K, 1%, 1/4W, MF	14150

MAIN PC BOARD

DES.	DESCRIPTION	P/N
R144	RES,49.9 K,1%,1/4W,MF	17140
R145	RES,8.06 K,1%,1/4W,MF	17410
R146	POT,BUTTON,5 K,20%,1/2W,CE	15160
R147	RES,121 OHM,1%,1/4W,MF	14270
R148	RES,17.4 K,1%,1/4W,MF	14327
R149	RES,4.75 K,1%,1/4W,MF	14810
R150	RES,10.0 K,1%,1/4W,MF	14150
R151	RES,100 OHM,1%,1/4W,MF	16510
R152	RES,27.4 K,1%,1/4W,MF	14600
R153	RES,15.0 K,1%,1/4W,MF	14290
R154	RES,1.00 K,1%,1/4W,MF	14040
R155	RES,2.2 MEG,5%,1/2W,CF	14410
R156	RES,10.0 K,1%,1/4W,MF	14150
R157	RES,4.75 K,1%,1/4W,MF	14810
R158	RES,10.0 K,1%,1/4W,MF	14150
R159	RES,8.25 K,1%,1/4W,MF	15040
R160	RES,332 K,1%,1/4W,MF	14720
R161	RES,27.4 K,1%,1/4W,MF	14600
R162	RES,1.00 K,1%,1/4W,MF	14040
R163	RES,3.32 K,1%,1/4W,MF	14650
R164	RES,49.9 OHM,1%,1/4W,MF	14835
R165	RES,68.1 K,1%,1/4W,MF	14950
R166	RES,36.5 K,1%,1/4W,MF	14740
R171	RES,1.00 K,1%,1/4W,MF	14040
R172	RES,4.75 K,1%,1/4W,MF	14810
R173	RES,44.2 K,1%,1/4W,MF	14798
R174	RES,15.0 K,1%,1/4W,MF	14290
R175	RES,1.00 K,1%,1/4W,MF	14040
R176	RES,2.2 MEG,5%,1/2W,CF	14410
R177	RES,10.0 K,1%,1/4W,MF	14150
R178	RES,10.0 K,1%,1/4W,MF	14150
R196	RES,221 K,1%,1/4W,MF	14540
R197	RES,4.75 K,1%,1/4W,MF	14810
R198	RES,49.9 OHM,1%,1/4W,MF	14835
R199	RES,22.1 OHM,1%,1/4W,MF	14510
R200	RES,68.1 K,1%,1/4W,MF	14950
R201	RES,23.7 K,1%,1/4W,MF	14560
R208	RES,15 K,1%,1/4W,MF	14290
R209	RES,1.00 K,1%,1/4W,MF	14040
R210	RES,2.2 MEG,5%,1/2W,CF	14410
R211	RES,10.0 K,1%,1/4W,MF	14150
R226	WIRE,JUMPER,.5 IN.	16470
R272	RES,82.5 OHM,1%,1/4W,MF	15025
R273	RES,4.75 K,1%,1/4W,MF	14810
R274	RES,681 OHM,1%,1/4W,MF	14980
R277	RES,4.75 K,1%,1/4W,MF	14810
R278	RES,604 OHM,1%,1/4W,MF	14910
R283	RES,6.81 K,1%,1/4W,MF	14900
R284	RES,1.21 K,1%,1/4W,MF	14100
R285	RES,44.2 K,1%,1/4W,MF	14798

DES.	DESCRIPTION	P/N
R286	RES,3.83 K,1%,1/4W,MF	14663
R287	RES,15.0 K,1%,1/4W,MF	14290
R288	RES,12.1 K,1%,1/4W,MF	14220
R289	RES,15.0 K,1%,1/4W,MF	14290
R294	RES,8.06 K,1%,1/4W,MF	17410
R295	RES,82.5 K,1%,1/4W,MF	15070
R296	WIRE,JUMPER,.5 IN	16470
R297	WIRE,JUMPER,.5 IN	16470
R306	RES,1.82 K,1%.1/4W,MF	14140
R307	RES,3.32 K,1%,1/4W,MF	14650
R308	RES,6.49 K,1%,1/4W,MF	14887
R309	RES,15 KOHM,1%,1/4W,MF	14290
R310	NOT USED	
R311	RES,4.75 K,1%,1/4W,MF	14810
R312	RES,2.21 K,1%,1/4W,MF	14420
R313	RES,825 OHM,1%,1/4W,MF	15080
R314	RES,1.82 K,1%,1/4W,MF	14140
R315	RES,2.67 K,1%,1/4W,MF	14438
R316	RES,4.75 K,1%,1/4W,MF	14810
R317	RES,12.1 K,1%,1/4W,MF	14220
R318	NOT USED	
R326	POT,MULTI,22T,5 K	15124
R328	POT,MULTI,22T,5 K	15124
S1	SWITCH,6PDT,PUSH	15615
S3	SWITCH,ROT,2P,2-6	15546
S4	SWITCH,ROT,2P,2-6	15546
TPxx	CONN,MINI TUB,.062x.328 IN (26)	12740
U1	REG,+15V,LM340AT-15,TO-220	14002
U2	REG,-15V,LM320T-15,TO-220	14001
U3	REG,+15V,UA7805C,TO-220	14032
U4	IC,LIN,TLO72CP	13590
U5	IC,LIN,TLO72CP	13590
U6	IC,LIN,TLO72CP	13590
U7	IC,LIN,TL072CP	13590
U9	CRL MODULE,901B	80461
U10	IC,LIN,TL072CP	13590
U11	IC,LIN,LM13600N	13600
U12	IC,LIN,TL072CP	13590
U13	IC,LIN,TL072CP	13590
U14	IC,LIN,NE5532N	13610
U15	IC,LIN,TL072CP	13590
U16	IC,LIN,NE5532N	13610
U17	IC,LIN,TL072CP	13590
U18	IC,LIN,LM13600N	13600
U19	IC,LIN,TL072CP	13590
U21	IC,LIN,NE5532N	13610
U23	IC,LIN,LM13600N	13600
U23	WIRE,JUMPER,22GA(R92 PIN 1 to 3)	17120

MAIN PC BOARD

DES.	DESCRIPTION	P/N
U27	IC,LIN,TL072CP	13590
U34	IC,LIN,TLO72CP	13590
U35	IC,LIN,TLO72CP	13590
VR5	REG,ZENER,12V,10%	14015
VR6	REG,ZENER,12V,10%	14015
VR7	REG,ZENER,12V,10%	14015
VR8	REG,ZENER,12V,10%	14015
W1	WIRE,JUMPER,.5 IN.	16470
W2	WIRE,JUMPER,.3 IN.	16450
W3	WIRE,JUMPER,.5 IN.	16470
W4	WIRE,JUMPER,.5 IN.	16470
W5	WIRE,JUMPER,.5 IN.	16470
W6	WIRE,JUMPER,.5 IN.	16470
W7	WIRE,JUMPER,.5 IN.	16470
W8	WIRE,JUMPER,.5 IN.	16470
XJ5	CONN,FEM,MINI-JUMP,.1IN	12660
XJ6	CONN,FEM,MINI-JUMP,.1IN	12660
XJ9	CONN,FEM,MINI-JUMP,.1IN	12660
XJ10	CONN,FEM,MINI-JUMP,.1IN	12660
XJ11	CONN,FEM,MINI-JUMP,.1IN	12660
XJ17	CONN,FEM,MINI-JUMP,.1IN	12660
XL1	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL2	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL3	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL4	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL6	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL7	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL8	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL9	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL16	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XL17	HDWR,SPACER,CHOKE,NYLON,TO-5	13410
XQ16	FERRITE BEAD,40-200 MHZ	12557
XQ21	FERRITE BEAD,40-200 MHZ	12557
XQ46	FERRITE BEAD,40-200 MHZ	12557
XU1	HDWR,HEATSINK,PC MOUNT,647	13162
XU2	HDWR,HEATSINK,PC MOUNT,647	13162
XU3	HDWR,HEATSINK,EXTR,BLACK	13160
XU4	SOCKET,DIP,8 PIN	15380
XU5	SOCKET,DIP,8 PIN	15380
XU6	SOCKET,DIP,8 PIN	15380
XU7	SOCKET,DIP,8 PIN	15380
XU9	SOCKET,DIP,24 PIN	15370
XU10	SOCKET,DIP,8 PIN	15380
XU11	SOCKET,DIP,16 PIN	15350
XU12	SOCKET,DIP,8 PIN	15380

QTY.	DESCRIPTION	P/N
XU13	SOCKET,DIP,8 PIN	15380
XU14	SOCKET,DIP,8 PIN	15380
XU15	SOCKET,DIP,8 PIN	15380
XU16	SOCKET,DIP,8 PIN	15380
XU17	SOCKET,DIP,8 PIN	15380
XU18	SOCKET,DIP,16 PIN	15350
XU19	SOCKET,DIP,8 PIN	15380
XU21	SOCKET,DIP,8 PIN	15380
XU23	SOCKET,DIP,16 PIN	15350
XU27	SOCKET,DIP,8 PIN	15380
XU34	SOCKET,DIP,8 PIN	15380
XU35	SOCKET,DIP,8 PIN	15380
1	SHIELD,RF,STEREO,RADIO LINE	11851
4	SHIELD,RF,DIVIDER,RADIO LINE	11853
2	HDWR,MS,SBH,6.32 X 1/4,YELLOW	13325
2	HDWR,HEX NUT,6.32X1/4,SILVER	13200
3	HDWR,HEX NUT,4.40X1/4,SILVER	13190
3	HDWR,MS,SPH,4.40 X 5/16	13295
3	HDWR,INSUL,SILI PAD	13240
3	HDWR,LOCKWASH,INT TOOTH #4	13271
1	PC BOARD,6120,REAR ADJ INTF	13926
3	POT,22 TURN,5K,CE,TOP ADJ	15125
1	LED,YELLOW,T 1 3/4	13673
1	HDWR,SPACER,.250 LED	13235
12	CONN,MALE,F-POST	12715
1	HDWR,NYLON,SWITCH CAP	13395
1	PC BOARD,6115,VERSION 1	13867
1	LED,RED,T1	13685
2	RES,MULTI,22T,5K,ON 6120 BRD	15124
1	HDWR,SPACER,LED,.350x.170,NYL	13436

CHASSIS PARTS LIST

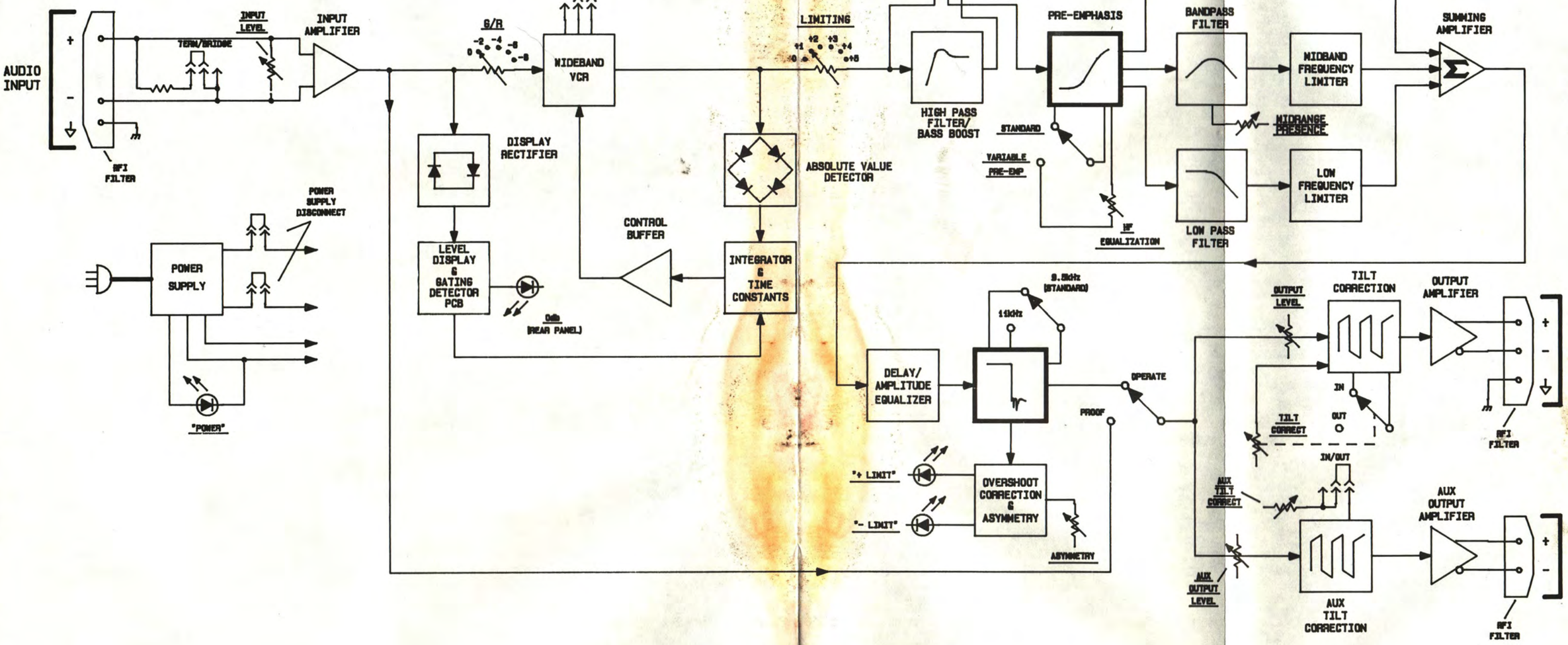
QTY.	DESCRIPTION	P/N
1	ASSY,PCB,8550,PMC450 MAIN PCB	80197
1	CHASSIS, 19 X 1 3/4 X 14	12325
1	PANEL,REAR,PMC450	12852
1	PANEL,FRONT,PMC450	12854
1	SOCKET,AC INPUT FILTER	16645
1	XFMR,TOROID,RADIO LINE	15916
1	XFMR,HDWR,WASH,50MM STEEL	15917
1	XFMR,HDWR,WASH,70MM NEOPRENE	15919
1	XFMR,HDWR,WASH,50MM NEOPRENE	15918
1	HDWR,MS,SBH,6.32 X 5/8,SILVER	13324
1	HDWR,GND LUG,INT LOCK,#6	13140
1	HDWR,HEX NUT,6.32X1/4,SILVER	13200
4"	WIRE,22AWG,.009PVC,GREEN	16250
1	HDWR,GROMMET,1/4 IN	13131
5	CONN,FEM,PINS,.156IN MOLEX	12625
1	CONN,FEM,6 PIN,.156IN MOLEX	12647
1	CONN,POLAR. KEY,.156IN MOLEX	12648
4	HDWR,MS,FPH,6.32 X 1/4,YELLOW	13328
4	HDWR,KEP NUT,6.32X1/4,SILVER	13203
1	HDWR,INSUL,NOMEX	13244
2	HDWR,MS,SBH,4.40 X 1/4	13322
1	SWITCH,TOGGLE,SPDT,MINI	15580
	SUPPLY,TUBING,SPEC.,1/4,B	15441
2	HDWR,KNOB,SKIRT,AL,1/4IN	13250
2	HDWR,CABLE TIE,NYLON,4 IN	13060
1	HARNESS,PMC450	80282
1	FUSE,1/4 X 1 1/4, 1/4A SB	13042
1	LID,RADIO	13725
8	HDWR,MS,FPH,6.32 X 1/4,YELLOW	13328
1	SHIPPING BAG,18 X 24,RADIO	15331
2	SHIPPING END BLOCK,RADIO	15242
1	SHIPPING BOX,RADIO	15241
1	FUSE,1/4x1/4,1/8A SB	13045
1	ACC,LABEL,SERIAL NO.	10022
1	ACC,LABEL PATENT	10020
1	ASSY,PC BOARD,6150,PMC450	80504
	INCLUDED ACCESSORIES	
1	POWER CORD	16435
1	MANUAL	10082
1	UNIT CABLE STRAP	17590
4	SCREW,RACK MOUNTING	13290
4	WASHER,RACK MOUNTING	13460
	OPTIONAL ACCESSORIES	
1	RACK SLIDE ASSEMBLY	12318

QTY.	DESCRIPTION	P/N
1	ASSY,PCB,6150	80504
	CONSISTING OF:	
	1 PC BOARD,6150,DISPLAY	13923
	C1 CAP,TA,2.2 UF,20%,25V	12290
	C2 CAP,TA,2.2 UF,20%,25V	12290
	R2 RES,1.00 K,1%,1/4W,MF	14040
	R3 RES,DUAL,10K	15224
	R4 RES,DUAL,10K	15224
	R6/S1 RES,VAR,W/WS,10K,ALPHA	15226
	J1 CONN,MALE,.1,MOLEX,16	12717
	J2 CONN,MALE,.1,MOLEX,10	12716
	J3 WIRE,24 AWG,WHITE	16420
	TO S1	
	J4 TO	
	S1 WIRE,24 AWG,WHITE	16420
	U2 IC,LIN,LM3916N	13570
	XU2 SOCKET,DIP,18 PIN	15360
	XDS11 SOCKET,SIP,20 PIN	15372
	LED,GREEN,T-1	13674
	LED,GREEN,T-1	13674
	LED,GREEN,T-1	13674
	LED,GREEN,T-1	13674
	LED,GREEN,T-1	13674
	LED,GREEN,T-1	13674
	LED,YELLOW,T-1	13676
	LED,YELLOW,T-1	13676
	LED,YELLOW,T-1	13676
	LED,RED,T-1	13684
	DS21 LED,RED,T-1	13684
	DS22 LED,RED,T-1	13684
2	HDWR,SPACER,LED,.350x.170,NYL	13436

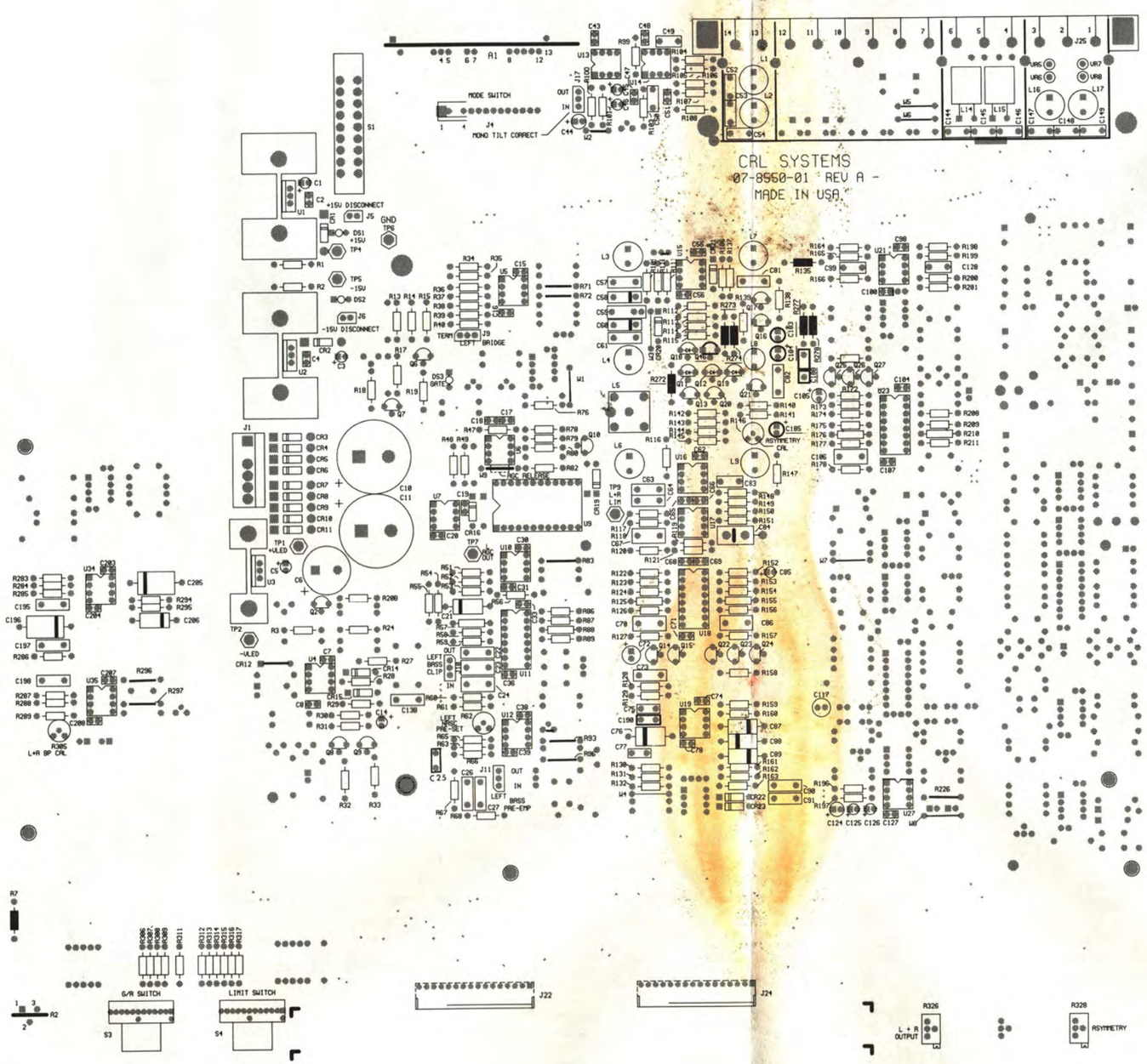
ADDITIONAL ACCESSORIES

DESCRIPTION	P/N
UNIT SPARE PARTS KIT, AGC400	10200
UNIT SPARE PARTS KIT, BAP2000	10209
UNIT SPARE PARTS KIT, PMC400A	10204
UNIT SPARE PARTS KIT, SCA300B	10208
UNIT SPARE PARTS KIT, SEC400	10202
UNIT SPARE PARTS KIT, SEC800	10203
UNIT SPARE PARTS KIT, SG800A	10207
UNIT SPARE PARTS KIT, SGC800	10201
UNIT SPARE PARTS KIT, SMP850	10206
UNIT SPARE PARTS KIT, SMP900A	10205
RACK SLIDE KIT (1 PAIR)	SLR
PRE-EMPHASIS/LOWPASS FILTER BOARD (for SG800A)	SG-OPT1

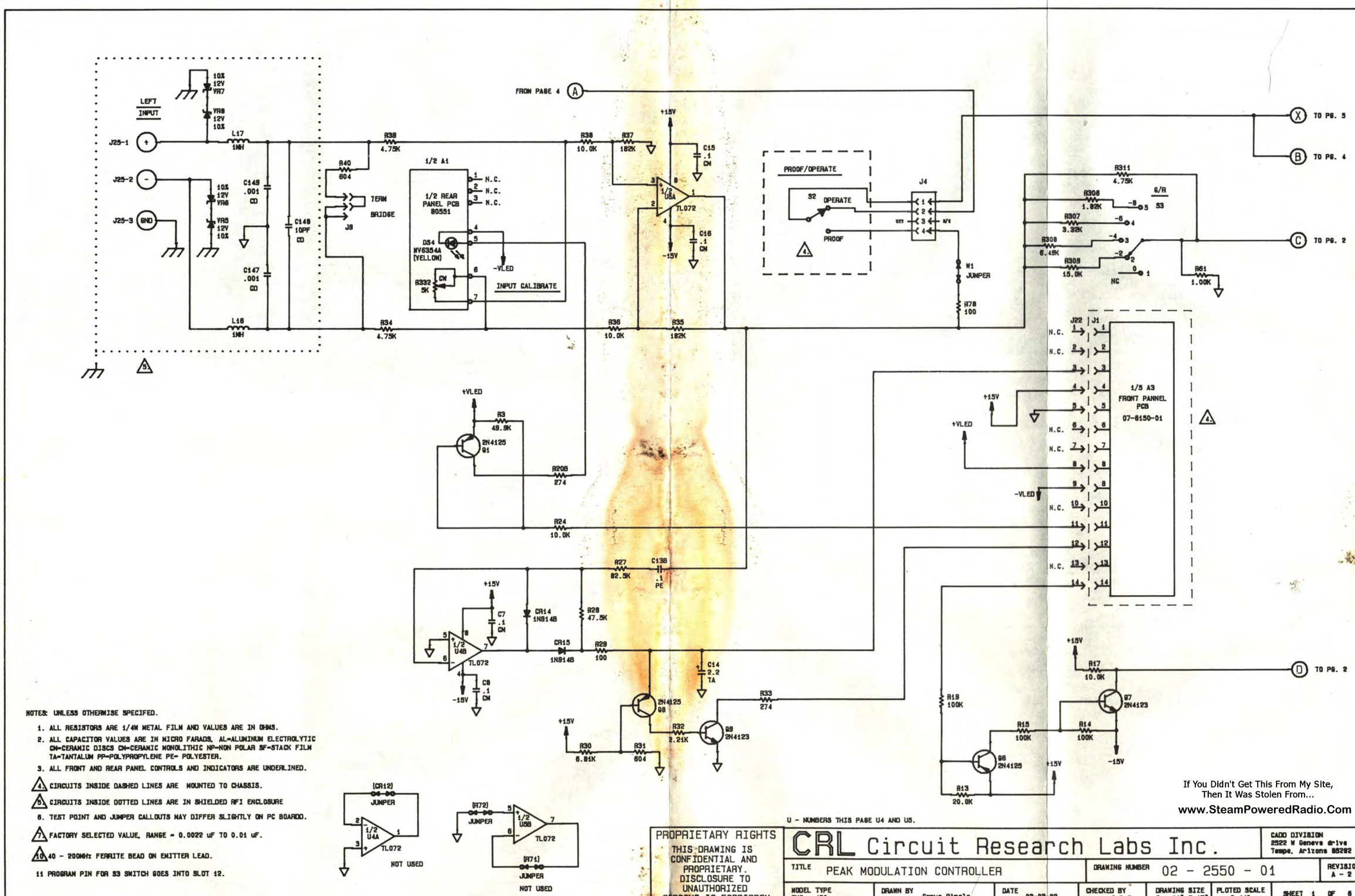
DESCRIPTION	P/N
SYSTEM SPARE PARTS KIT, AM-2 MONO	10220
SYSTEM SPARE PARTS KIT, AM-4 MONO	10221
SYSTEM SPARE PARTS KIT, AM-2 STEREO	10222
SYSTEM SPARE PARTS KIT, AM-4 STEREO	10223
SYSTEM SPARE PARTS KIT, FM-1G	10224
SYSTEM SPARE PARTS KIT, FM-2G	10225
SYSTEM SPARE PARTS KIT, FM-3	10226
SYSTEM SPARE PARTS KIT, FM-4G	10227
SYSTEM SPARE PARTS KIT, SCA-2	10228
3 UNIT SECURITY COVER	SC-03
4 UNIT SECURITY COVER	SC-04
DIGITAL PRE-EMPHASIS/LOWPASS FILTER BOARD (for SG800A or SMP850)	SG-OPT2



PMC-450 PEAK MODULATION CONTROLLER



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 PE= POLYESTER.
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 BOARDD.

7. FACTORY SELECTED VALUE, RANGE = 0.0022 uF TO 0.01 uF.

10. 40 - 200MHz FERRITE BEAD ON EMITTER LEAD.

11 PROGRAM PIN FOR S3 SWITCH GOES INTO SLOT 12.

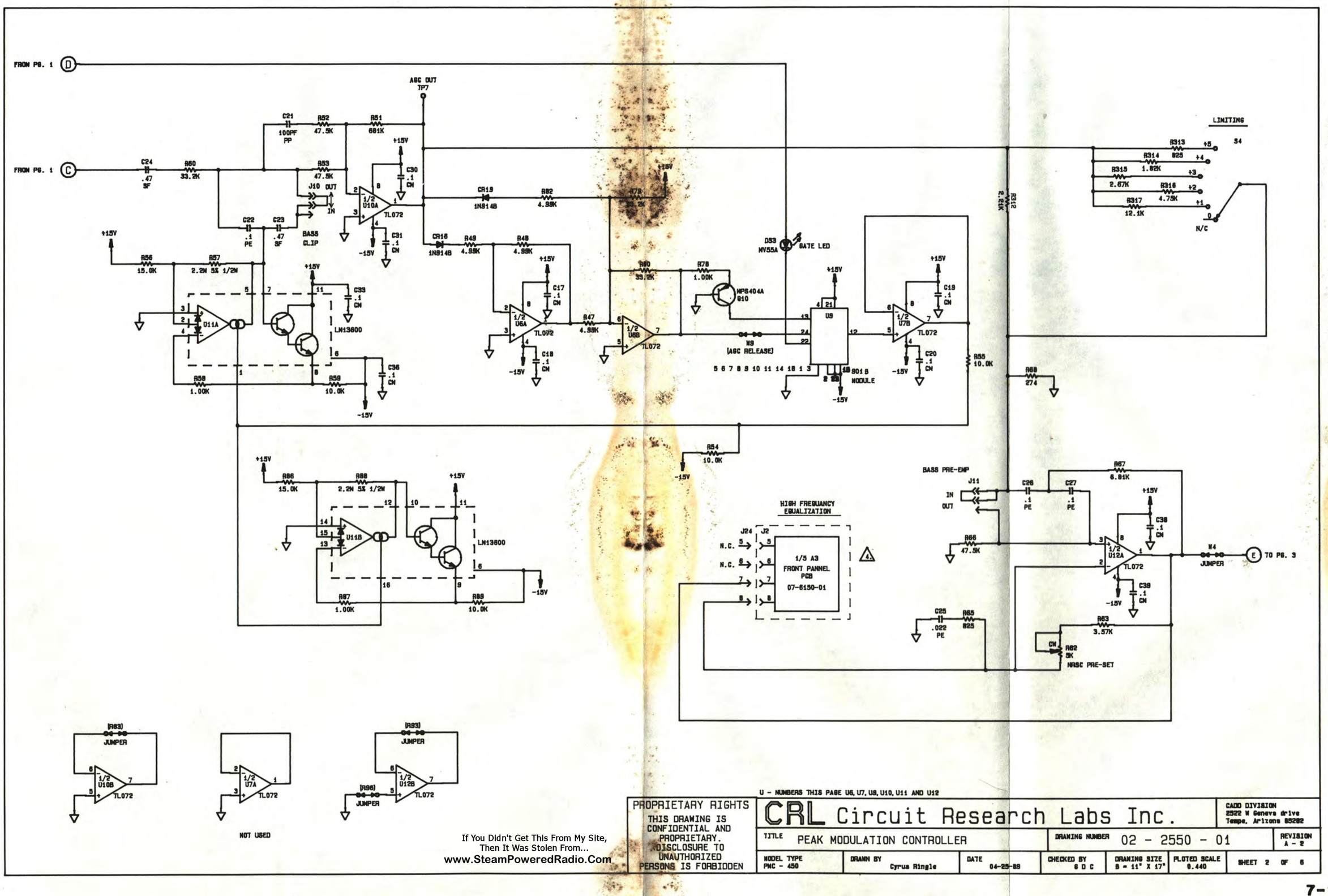
U - NUMBERS THIS PAGE U4 AND U5.

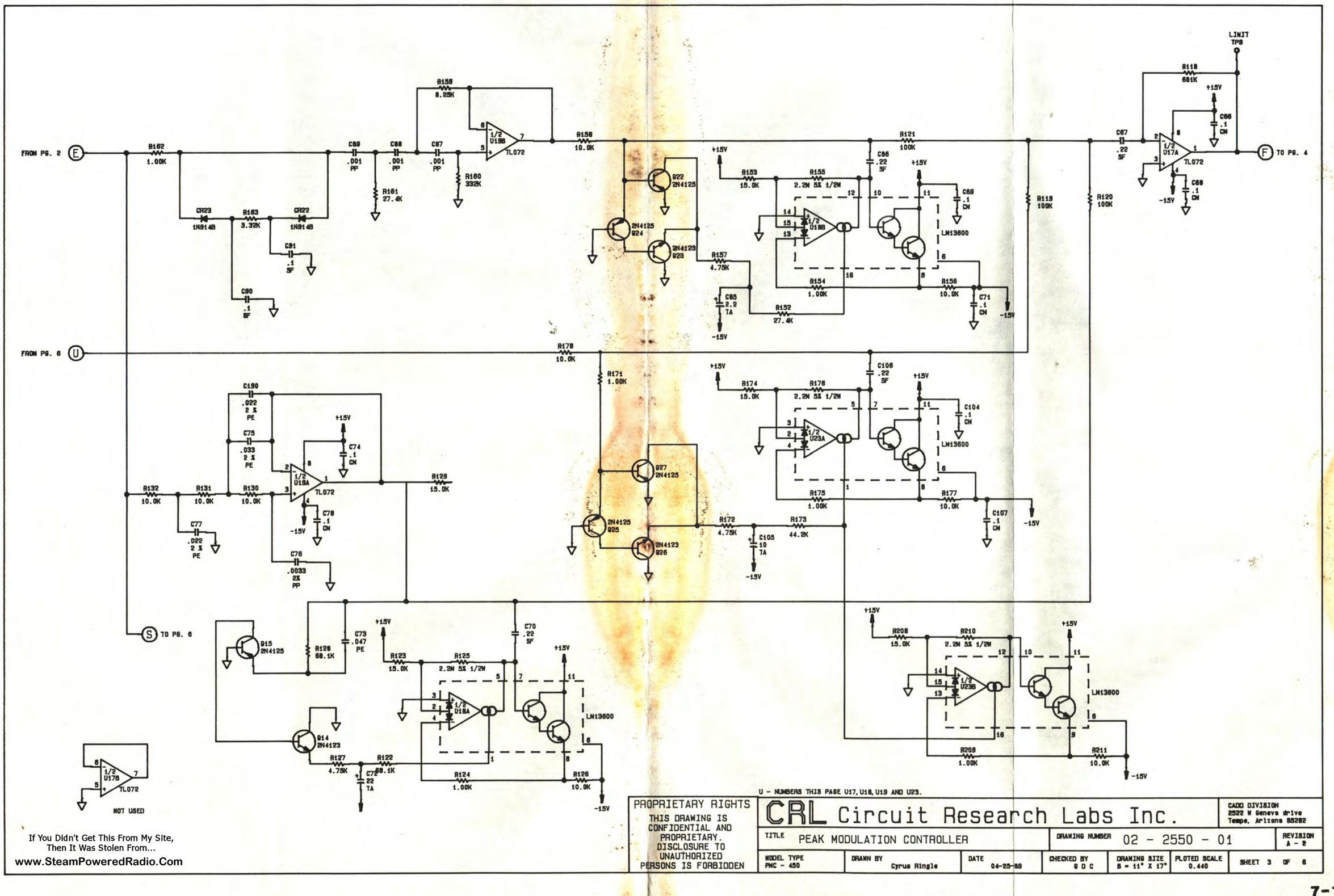
CRL Circuit Research Labs Inc.

CADD DIVISION
2522 W Geneva drive
Tempe, Arizona 85282

TITLE	DRAWING NUMBER	REVISION
PEAK MODULATION CONTROLLER	02 - 2550 - 01	A - 2

MODEL TYPE	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	SHEET
PMC - 450	Cyrus Ringle	03-03-89	G D C	B = 11" X 17"	0.440	1 OF 6





U - NUMBERS THIS PAGE U17, U18, U19 AND U23.

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CADD DIVISION
2522 W Geneva drive
Tempe, Arizona 85282

TITLE	DRAWING NUMBER	REVISION
PEAK MODULATION CONTROLLER	02 - 2550 - 01	A - 2

MODEL TYPE	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	SHEET
PNC - 450	Cyrus Ringle	04-25-89	G D C	B - 11" X 17"	0.440	3 OF 6

FROM PG. 3 (F)

C84 220PF SM
R151 100
R150 10.0K
C64 .0047 PP
R116 8.66K
C63 .0047 PP
R117 4.53K
+15V
C62 .1 CM
U16A 1/2 NE5532N
-15V
C65 .1 CM
R149 4.75K
C83 10PF CD
R148 17.4K
U16B 1/2 NE5532N
R147 121
L9 2.2MH
L6 2.7MH
L4 2.2MH
C82 .15 SF
L8 .56MH
L3 5.6MH
L7 1.5MH
R135 121

S1 BANDWIDTH
9.5KHz
11 KHz
L5 6.7MH
C58 .0022 PP
C59 .082 SF
C60 (7)
C61 .1 PE

R278 604
A TO PG. 1
R277 4.75K
C188 .01 PE

+15V
R112 1.0M
CR21 1N914B
R138 47.5K
R136 100K
U15B 1/2 TL072
R137 1.00K
J22-16
J1-16
- LIMIT
1/5 A3 FRONT PANNEL PCB 07-8150-01
+ LIMIT
J1-15
J22-15 (4)

R114 10.0K
-15V
Q17 2N4123
C81 .1 PE
R115 4.75K
Q16 2N4125
-15V
R139 499
C183 10 TA
L25 FERRITE BEAD (10)
+15V
R113 1.0M
CR20 1N914B
+15V
C55 .1 CM
N3 JUMPER
R109 47.5K
R110 100K
U15A 1/2 TL072
C57 .1 PE
C56 .1 CM
-15V

Q18 2N4123
Q12 2N4123
Q11 2N4123
Q19 2N4123
L26 FERRITE BEAD (10)
R272 82.5

R145 8.06K
-15V
ASYMMETRY CAL
R146 5K CM
ASYMMETRY
R328 5K CM
R141 1.21K
2N4123 Q21
R142 10.0K
Q20 2N4125
+15V
R143 10.0K
TA 10 C185
R140 499
-15V
Q13 2N4123
+15V
R273 4.75K
-15V
R144 49.9K
-15V
Q46 2N4125
L27 FERRITE BEAD (10)

R200 68.1K
C128 10PF CD
R201 23.7K
U21B 1/2 NE5532N
R199 22.1
R198 49.9
N5 JUMPER
L15 1MH
C146 .001 CD
C145 10PF CD
C144 .001 CD
AUDIO OUTPUT
J25-4 (+)
J25-5 (-)
J25-6 (GND)
L14 1MH
N6 JUMPER

R166 36.5K
R165 68.1K
C99 10PF CD
+15V
C98 .1 CM
U21A 1/2 NE5532N
R164 49.9
C100 .1 CM
-15V
(5)

OUTPUT LEVEL
R326 5K CM
FROM PG. 1 (B)
+15V
C123 .1 CM
U27A 1/2 TL072
-15V
C127 .1 CM
C117 10 NP
N7 JUMPER
R274 681
C184 10 TA
R197 4.75K
C124 10 AL
R196 221K
C126 2.2 TA
C125 2.2 TA
N8 JUMPER
U27B 1/2 TL072
(R226) JUMPER
NOT USED

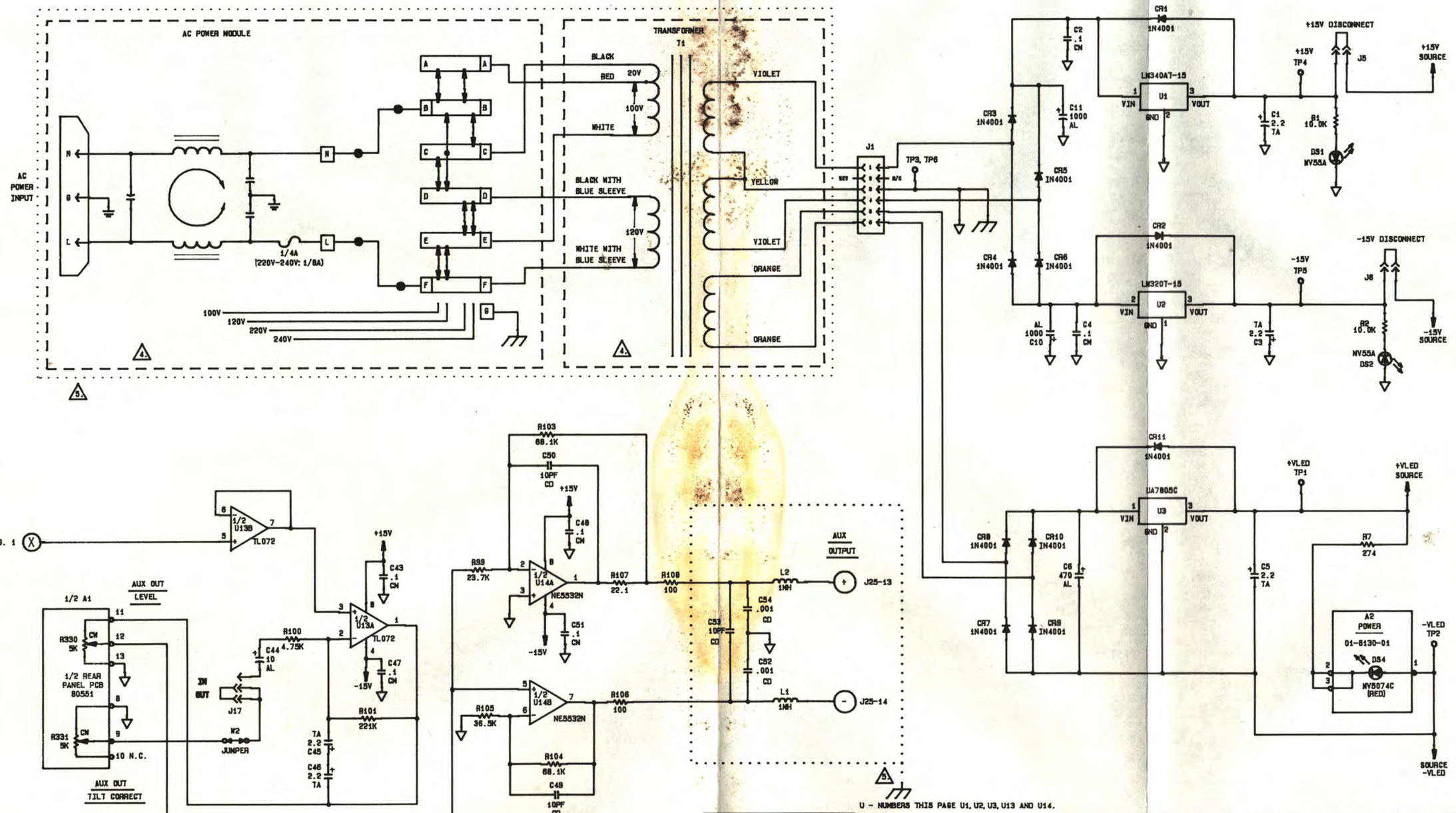
TILT CORRECT
S1 ON J4 J2 J24
OFF
J3
R6 10K CW
NC
1/5 A3 FRONT PANNEL PCB 07-8150-01
(4)

U - NUMBERS THIS PAGE U15, U16, U21 AND U27.

CRL Circuit Research Labs Inc.
CADD DIVISION 2522 W Geneva drive Tempe, Arizona 85282

TITLE	DRAWING NUMBER	REVISION
PEAK MODULATION CONTROLLER	02 - 2550 - 01	A - 2

MODEL TYPE	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	SHEET
PMC - 450	Cyrus Ringle	04-25-89	G D C	B = 11" X 17"	0.440	4 OF 6



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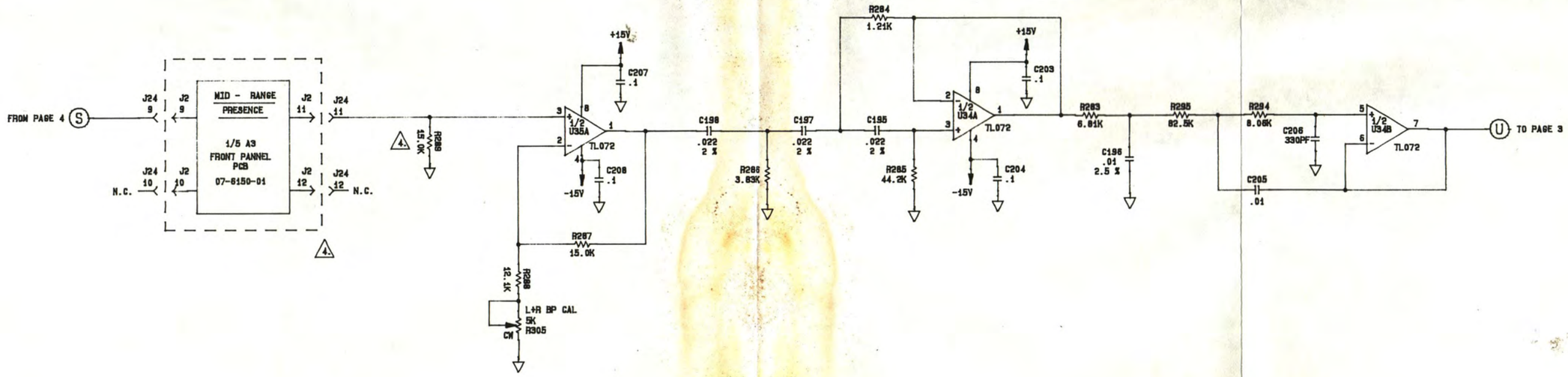
2522 W Geneva drive
Tempe, Arizona 85282

TITLE: PEAK MODULATION CONTROLLER			DRAWING NUMBER: 02 - 2550 - 01			REVISION: A - 2
MODEL TYPE: PMC - 450	DRAWN BY: Cyrus Ringle	DATE: 04-25-89	CHECKED BY: G D C	DRAWING SIZE: B - 11" X 17"	PLOTED SCALE: 0.440	SHEET 5 OF 6



U - NUMBERS THIS PAGE U34 AND U35.

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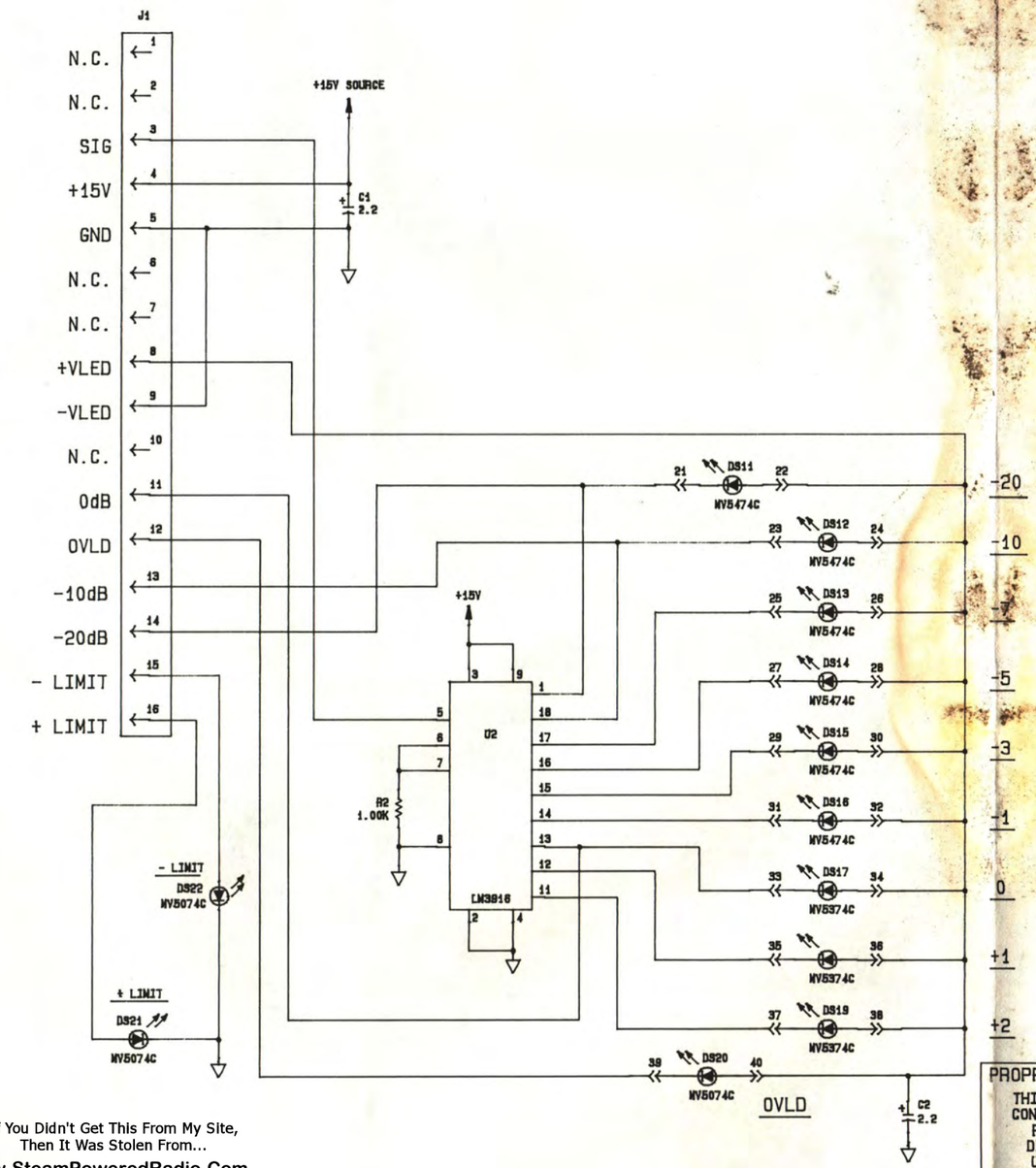
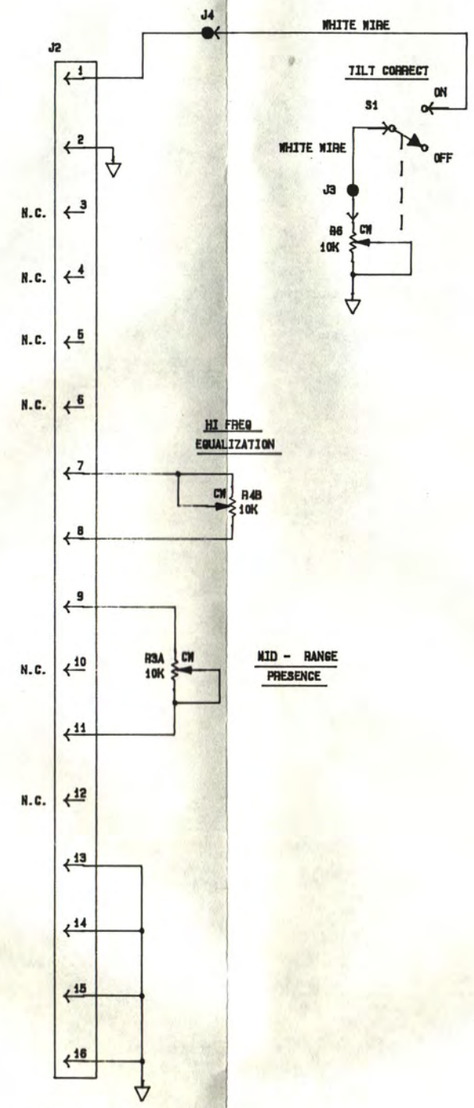
CADD DIVISION
2522 N Geneva drive
Tempe, Arizona 85282

TITLE	DRAWING NUMBER	REVISION
PEAK MODULATION CONTROLLER	02 - 2550 - 01	A - 2

MODEL TYPE	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	SHEET
PMC - 450	Cyrus Ringle	06-26-89	G D C	B - 11" X 17"	0.440	6 OF 6





NOTES: UNLESS OTHERWISE SPECIFED.

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2. ALL CAPACITOR VALUES ARE IN MICRO FARADS, TA=TANTALUM.
3. ALL FRONT PANEL INDICATORS ARE UNDERLINED.

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CADD DIVISION
2522 N Geneva drive
Tempe, Arizona 85282

TITLE	DRAWING NUMBER	REVISION
FRONT PANEL CONTROL BOARD	02 - 6150 - 01	A - 1

MODEL TYPE	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	SHEET
PWC - 450	Cyrus Ringle	09-26-88	G D C	B - 11" X 17"	0.440	1 OF 1