AMIGO AM

Installation, Operation and Technical Manual

CRL SYSTEMS®

Circuit Research Labs, Inc. Tempe, Arizona U.S.A.

PROPRIETARY INFORMATION

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Section 1 - General

1.1 General

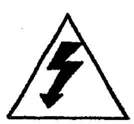
This section covers:

- General safety information.
- Precautions.
- An introduction to AMIGO AM
- Warranty information.
- Unit upgrade policy.
- Electrical and Mechanical Specifications.

1.2 Safety Information

The following paragraphs are definitions of notes that will be found throughout this manual.

1.2.1 Danger symbol.



Danger: Danerous voltages capable of causing death, are present in this unit. Use extreme caution when handling, testing, and adjusting.

1.2.2 Caution Statement.

Caution: The Caution 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.

1.2.3 Warning Statement.

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

1.2.4 Note Statement.

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

1.2.5 General Precautions

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.

1.2.6 Read All Instructions.

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

1.2.7 Ground And Power Connections.

To minimize shock harzard, 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/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.

1.2.8 Transient Voltage Protection.

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

1.2.9 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.

1.2.10 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.

1.2.11 Attachments.

Do not use attachments not recommended by the manufacturers.

1.2.12 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.

1.2.13 Parts Replacement And / Or Modification.

The maintenance instructions in this manual are for use by qualified personnel only. To avoid electrical 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.

1.3 Introduction

1.3.1 General

The Amigo AM is a complete audio processing system. Included are a Dual Band AGC, 3 Band Limiter, NRSC Output Filtering plus a full set of processing controls to adjust your station's sound.

1.3.2 Features:

- Quality stereo for your listeners
- Maintains mono loudness and coverage
- A complete matrix processing system
- Very easy to install and operate
- NRSC compliant
- Rugged 1 3/4" rack mount chassis with integral RFI protection

1.4 Standard Accessories.

1.4.1 What comes with AMIGO AM.

The following accessories are standard.

- 1 - Installation, Operation and Technical Manual.
- 4 - Rack mount screws and washers.
- 1 - Detachable AC cordset

1.5 Warranty

1.5.1 Product Warranty Term.

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.

1.5.2 Conditions

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

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

1.6 Product Changes.

1.6.1 Updates.

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.

1.7 Specifications

INPUT (Reference 0 dBm = 0.775 VRMS)

TYPE: Active balanced (differential)

IMPEDANCE: 600 ohms termination or 10 kohms balanced bridging (selectable)

LEVEL CONTROL: -25 to 0 dBm, or -5 to +15dBm range (internal jumpers select range).

BALANCE CONTROL: +/- 2dB range

METERING: Dual 10 segment LED input level meter with 28 dB dynamic range

AUDIO FILTERING: 12kHz 4th order lowpass

STEREO OUTPUT

TYPE: Active balanced (differential)

IMPEDANCE: < 100 ohms balanced (for 600 ohm loads)

LEVEL CONTROL: -5 to +15 dBm or -15 to +5dBm for 100% modulation (internal jumpers select range).

MONAURAL OUTPUT

Provides an auxiliary monaural output to drive a standby transmitter. Separate rear panel Output Level Control (- 20 dBm to +18 dBm) and internal Tilt Correct Control included.

FREQUENCY RESPONSE

(0 dB ref. at 400 Hz, +10dBm input/output, measured 10dB below gain reduction threshold)

9.5 kHz FILTER: 50 Hz to 8 kHz; +/-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-1 standard using required dynamic measurement method

11 kHz FILTER: 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, +/-1.0 dB

HARMONIC DISTORTION

(+10 dBm input/output, 20 kHz bandwidth, measured 5dB below gain reduction threshold)

9.5 or 11 kHz BW: <0.6% over selected operating bandwidth at or below 100% negative modulation level

PROOF MODE: < 0.25%

S+N/N (+10 dBm input/output, 20 kHz bandwidth)

> 60 dB in operate mode, > 65 dB in proof mode

STEREO SEPARATION and CROSSTALK

OPERATE MODE: > 25 dB over selected operating bandwidth

PROOF MODE: > 40 dB

INPUT COMPRESSION

Input leveling dual band AGC. Range is internally selectable in 3 dB increments, 0dB to 15dB. Overall range > 25dB. Gating internally selectable for -10 dB or -20 dB. Dual band crossover frequency is 212 Hz. Attack times are program dependent. Release times for Low, High and Wide bands are internally selectable (Slow,Med or Fast).

STEREO ENHANCE

Internally selectable amount of enhancement and threshold level

LOW FREQUENCY ENHANCE

Adjustable boost from 0 to +4.5 dB via front adjustment. Band center at 90 Hz.

MID RANGE PRESENCE

Adjustable boost from 0 to +4.5 dB via front adjustment. Band center at 3.1 kHz.

HI FREQUENCY EQUALIZATION

Adjustable boost from 0 to over +10 dB at 10 kHz via front panel adjustment. A detente position at 12 o'clock is calibrated for NRSC-1 standard pre-emphasis.

LIMITING

Adjustable from 0 dB to +5 dB via front panel adjustment. Control adjusts drive level in to a 3 band limiter. Limiter crossover frequencies are 480 Hz and 3.65 kHz.

ASYMMETRY

Adjusts positive peak modulation from 95% to +140% via front panel adjustment

TILT CORRECT

Adjusts phase shift correction for pre-1980 transmitters (plate modulated) via front panel control. For solid state and PWM type transmitters, an OFF position defeats the correction.

L-R LEVEL

Adjustable from -6 dB to +3dB via front panel adjustment. Used to adjust stereo channel balance, or to reduce the amount of transmitted stereo information. 12 o'clock position factory calibrated for +/-0dB.

L-R BANDWIDTH

Internally selectable 4th order low pass filter to reduce L-R (stereo) bandwidth to 5 kHz. A companion all pass filter is selectable in the L+R path to maintain channel separation specifications. This feature is very useful for stations that have a narrow band directional antenna system.

SINGLE CHANNEL LIMITER

Adjustable from -60% to -80% via front panel adjustment. Used to prevent more than -70% envelope modulation produced by a single channel (required by Motorola C-QUAM ® System).

MODE SWITCH

Rear panel switch selects Operate, Proof, Reverse, and Left Only for test and set up.

BANDWIDTH SWITCH

Rear panel switch selects either a 9.5 kHz (NRSC) or 11 kHz bandwidth.

GENERAL SPECIFICATIONS

POWER REQUIREMENTS: 100-130 or 200-250 VAC, 48-440 Hz, 25 VA maximum. EMI suppressed, IEC connector standard.

OPERATING TEMPERATURE RANGE: 0 to 50 degrees C (32- 122 degrees F).

OPERATING HUMIDITY: 0 to 95% relative humidity, non- condensing.

OPERATING ALTITUDE: 0 to 4,572 meters (0-15,000 feet) AMSL

DIMENSIONS: 48.3 cm W, 4.5 cm H, 40.6 cm D (19" x 1.75" x 16") including protruding controls and connectors.

SHIPPING WEIGHT: 8.2 kg (18 lbs) including standard accessories.

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Section 2 - Installation

2.1 Preparation for Installation

This sections covers the procedures that must be followed to prepare the AMIGO AM for installation. Do not mount the AMIGO AM in an equipment rack until the internal jumpers have been checked (see 2.1.3).

2.1.1 AC Voltage Selection

Caution: Do not connect the AMIGO AM to AC Power until the Power Entry Module has been checked and/or set for the correct AC Voltage.

AMIGO AM is equipped with a Power Entry Module located on the rear panel. Inside the Power Entry Module is a voltage selector card. The card is used to set the proper AC line voltage for the AMIGO AM.

The card has 4 positions: 100VAC, 120VAC, 220VAC and 240VAC. Refer to Table 2-1 to determine the correct card position. Table 2-1 also lists the correct fuse size for each voltage.

A. Checking card position

Table 2-1 AC Line Voltage Selection

Card Position	AC Voltage Range	Fuse Rating
100	95 to 110VAC	1/4 AMP Slo-Blo
120	110 to 130VAC	1/4 AMP Slo-Blo
220	210 to 230VAC	1/8 AMP Slo-Blo
240	230 to 250VAC	1/8 AMP Slo-Blo

1. Locate the clear plastic cover located on the right side of the Power Entry Module.

2. Look through the plastic cover. A small card is located at the bottom. The card is light green in color with white lettering. A large white colored number will be visible on the card. The number will be either 100, 120, 220 or 240. This number indicates which AC line voltage the Power Entry Module has been programmed for. If the number is not correct, the following procedure explains how to change the card position and check fuse size.

B. Changing the card position and fuse

1. Disconnect the power cord from the module. Open the compartment containing the fuse and the voltage selector card by sliding the clear plastic cover to the left side of the module.

2. Remove the voltage selector card. This is done by pulling firmly on the edge of the card. Pull the card straight back. A small hole is located in the card that may be used to help remove the card.

3. Look at the top and bottom of the card. Two numbers are located on each side of the card. Turn the card so the correct number will be visible after the card is installed.

4. Install the voltage selector card firmly into the module slot. Make sure the correct number is still visible.

5. Remove the fuse from the fuse holder on the back of the compartment cover. Check the fuse to make sure it is the correct size for the voltage selected. If it is not the correct size, select a fuse as listed in Table 2-1 and insert the fuse in the fuse holder.

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

2.1.2 Power Cord Information

A. AC Power Inlet Connector

The AMIGO AM is connected to a power source through the Power Entry Module. This module contains a standard male IEC 320 AC power inlet connector.

B. Detachable Cordset (supplied with AMIGO AM)

The AMIGO AM is supplied with a detachable cordset. The cordset is designed to plug into the Power Entry Module. The power cord plug is intended for North American 120 Volt/60 Hz operation. The plug may require replacement with a type matching the power source (refer to TABLE 2-2 for power cord conductor identification). Optionally, a cordset may be substituted which already has the correct power source plug. Any cordset may be used that mates with a IEC 320 "Cold" Connector.

Table 2-2 Power Cord Conductor Identification

CORD SET CONDUCTOR	COLOR	ALTERNATE COLOR
Line (Hot or Ungrounded)	BROWN	BLACK
Neutral (grounded)	BLUE	WHITE
Grounding (Earthing)	GREEN/ YELLOW	GREEN

2.1.3 Internal Programming Jumpers

The AMIGO AM is equipped with internal jumpers to customize the unit to your requirements. This section contains instructions for checking the AMIGO AM internal programming jumpers. Tables 2-3 through 2-5 list each jumper, the factory set position and a brief description of its function. Check each jumper to ensure it is in the correct position.

1. REMOVE TOP COVER. Using a #1 Phillips Head Screwdriver, remove 8 screws holding the cover in place. Remove the top cover and set aside.

2. CHECK EACH JUMPER POSITION. Check the position of each jumper to ensure that it is placed in the correct position. TABLE 2-3 through 2-5 may be used as a guide. Several jumpers are located underneath the AGC circuit board. To access these jumpers, remove the 2 screws located along the right edge of the board.

3. REPLACE TOP COVER.

Table 2-3 Input and Output Jumpers

Jumper	Factory Set Position	Name and Function of Jumper
J10, J11	LOW (-5 to +20dBm)	**INPUT SENSITIVITY:** Selects input sensitivity range. Either LOW (-5 to +20dBm) or HIGH (-25 to 0dBm) may be selected. All 4 jumpers must be in the same position (HIGH or LOW).
J10A, J11A	TERM (600 ohms)	**INPUT IMPEDANCE:** Selects input impedance. Either TERM (600 ohms) or BRIDGE (10kohms) may be selected. Both jumpers are normally set for TERM. For monaural operation, set J10A to TERM and J11A to BRIDGE.
J16, J16A	HIGH (-5 to +15dBm)	**OUTPUT LEVEL:** Selects output level range. Either HIGH (-5 to +15dBm) or LOW (-15 to +5dBm) may be selected. Both jumpers must be in the same position.
J17	L	**OUTPUT MODE:** Selects the type of output signal present on the "Left Channel Barrier Strip Terminals (rear panel)." Either L or L+R may be selected. Select L for stereo operation, L+R for monaural operation.
J17A	R	**OUTPUT MODE:** Selects the type of output signal present on the "Right Channel Barrier Strip Terminals (rear panel)." Either R or L-R may be selected. R is normally selected.

Figure 2-1 Input Jumpers

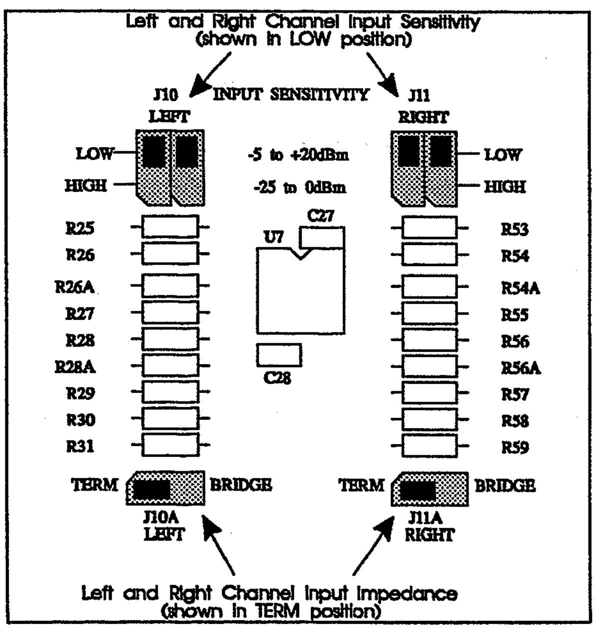


Figure 2-2 Output Jumpers

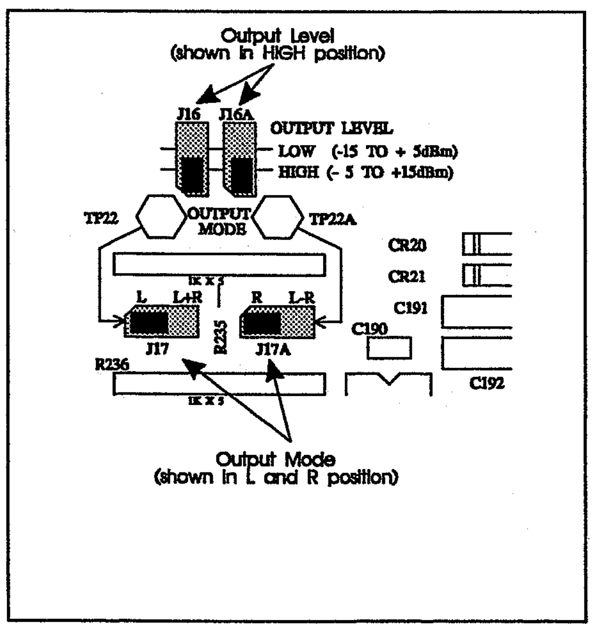


Table 2-4 Processing Jumpers

Jumper	Factory Set Position	Name and Function of Jumper
J4, J5	12 dB	**AGC DRIVE:** Selects the amount of AGC control performed by AMIGO AM. May be set for 0dB, 3dB, 6dB, 9dB, 12dB or 15dB. Smaller numbers (6dB for example) produce less control. Larger numbers produce more control. 12dB is best for most applications. Use -9 when using our SGC800 Studio AGC.
J6, J7, J8	MED	**AGC SPEED:** Selects the Release Time for the AGC. May be set for SLOW, MED or FAST. SLOW will produce less loudness, but better quality. FAST produces more loudness, but with less quality. MED is best for most applications.
J2	HIGH	**ENHANCE LEVEL:** Selects the amount of Stereo Enhancement added to the programming. May be set for LOW or HIGH. HIGH is best for most applications.
J3	HIGH	**SENSITIVITY CONTROL:** Setss the sensitivity of stereo enhancement circuitry. May be set for HIGH or LOW. When LOW is selected, more stereo separation must be present before enhancement will begin. When HIGH is selected, less stereo separation must be present before enhancement. HIGH is best for most applications.
J19, J20	IN	**PHASE PROCESSOR:** Selects whether the Phase Processor circuitry is used. May be set for IN or OUT. When IN is selected, the Phase Processor is used. When OUT is selected, the Phase Processor is not used. Phase Processing improves the loudness and quality of speech and vocals. IN is best for most applications.
J7	-20 dB	**GATE LEVEL:** Selects the audio signal level that AGC Gating occurs. Gating prevents noise, hiss and hum from being amplified during program pauses. May be set for -10dB or -20dB. -20dB is best for most applications. Use -10 when using our SGC800 Studio AGC.

Figure 2-3 AGC Drive, Speed & Stereo Enhance Jumpers

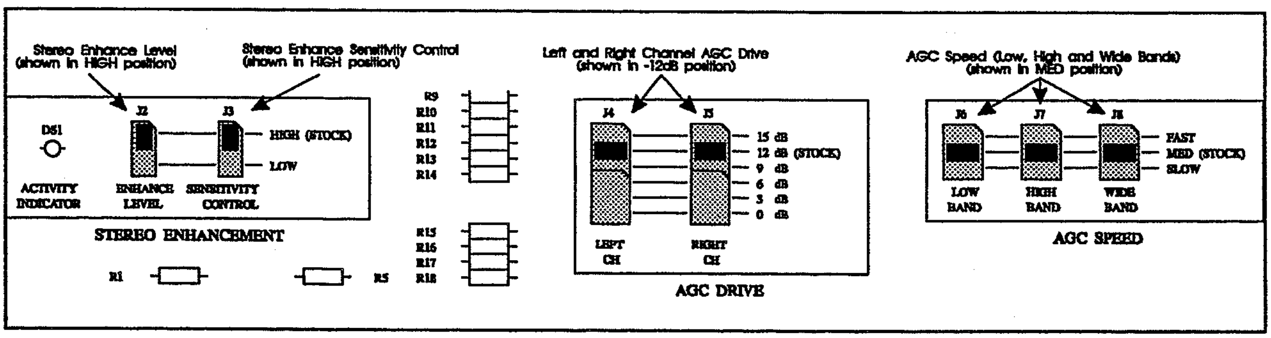


Figure 2-4 Phase Processor Jumper

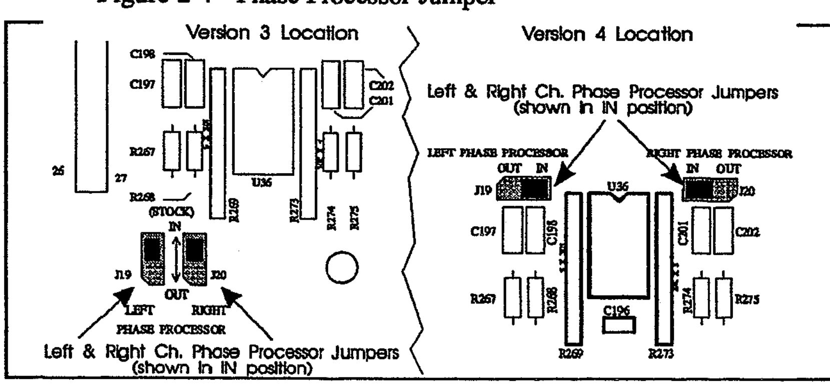


Figure 2-5 Gate Level Jumper

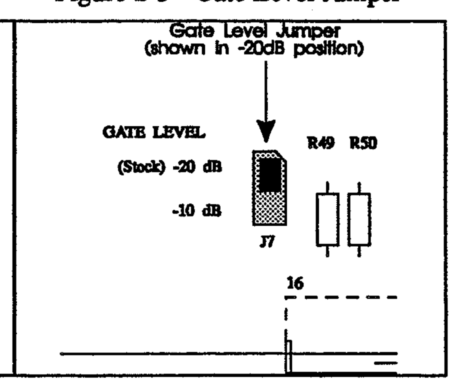


Table 2-5 Special Jumpers

Jumper	Factory Set Position	Name and Function of Jumper
J9	OUT	**MONO TILT CORRECT:** Enables tilt correction circuitry for the Auxiliary Mono Output terminals (rear panel). Setting the jumper to IN will enable tilt correction. OUT disables tilt correction. The jumper position depends upon the type of transmitter used. Set to OUT for all "PDM" and Solid State type transmitters. Set to IN for any tube type transmitter which uses a Modulation Transformer or Reactor.
J13	OUT	**NARROWBAND L-R:** Enables a special 5kHz lowpass filter in the L-R (stereo) limiter. Setting the jumper to IN enables the filter, OUT disables the filter. Enabling the filter reduces the amount of transmitted high frequency power. This feature is intended for stations with narrowband antenna systems. Note that J13 and J12 MUST be set in the same position (IN or OUT). See 3.7 for more information.
J12	OUT	**L+R NARROWBAND DELAY EQUALIZER:** Enables the L+R narrowband delay equalizer. Setting the jumper to IN enables the equalizer, OUT disables the equalizer. This jumper MUST be set to the same position as J13 (Narrowband L-R).
J3, J4	INSTALLED	**+15V, -15V POWER SUPPLY:** Used for power supply testing only. Removing the jumpers disconnect the power supply from all circuitry.
J500, J501	OUT	**L+R, L-R HF SHELF:** Enables a high frequency shelving filter to improve the high frequency modulation capability of plate modulated transmitters. Setting the jumper to IN enables theHF Shelf, OUT disables the HF Shelf. If using a plate modulated transmitter, set both jumpers to IN. For all other transmitter types, set both jumpers to OUT. **NOTE:** Version 3 circuit boards DO NOT contain J500 and J501. In order to enable the HF Shelf on this version, a 4.75 kohm 1/4W 1% resistor (included with the rack mounting hardware) must be installed on the main circuit board at R154 and R239 (see figure 2-11). DO NOT install these resistors unless you want to enable the HF Shelf for operation with a plate modulated transmitter.

Figure 2-6 Tilt Correction Jumper

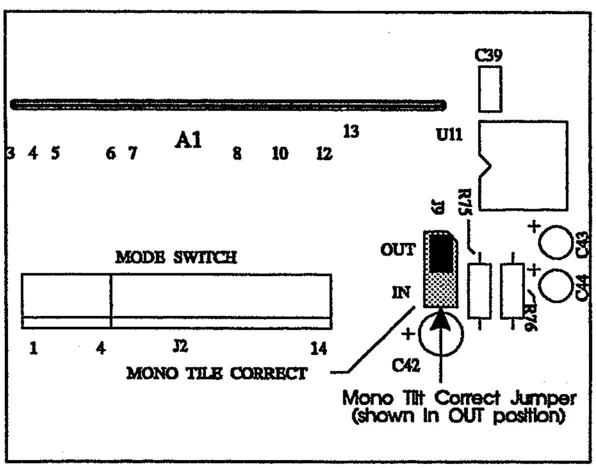


Figure 2-7 Power Supply Jumpers

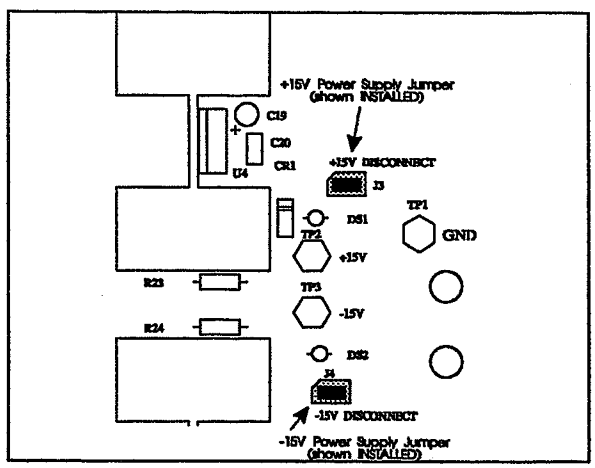


Figure 2-8 Narrowband L-R Filter Jumper

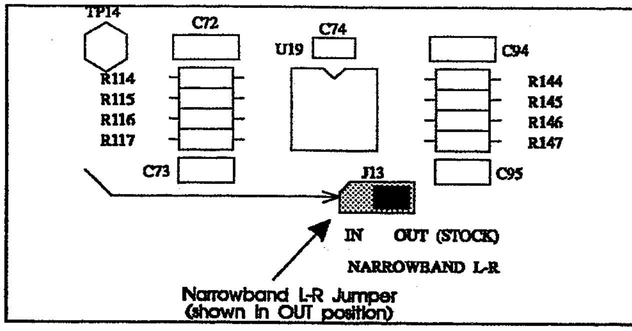


Figure 2-9 Narrowband L+R Delay Equalizer

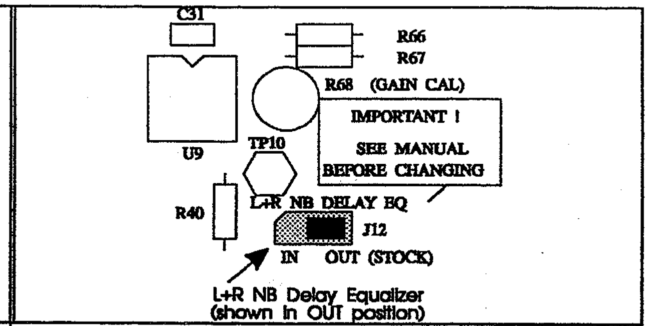


Figure 2-10 L+R & L-R HF Shelf Jumper

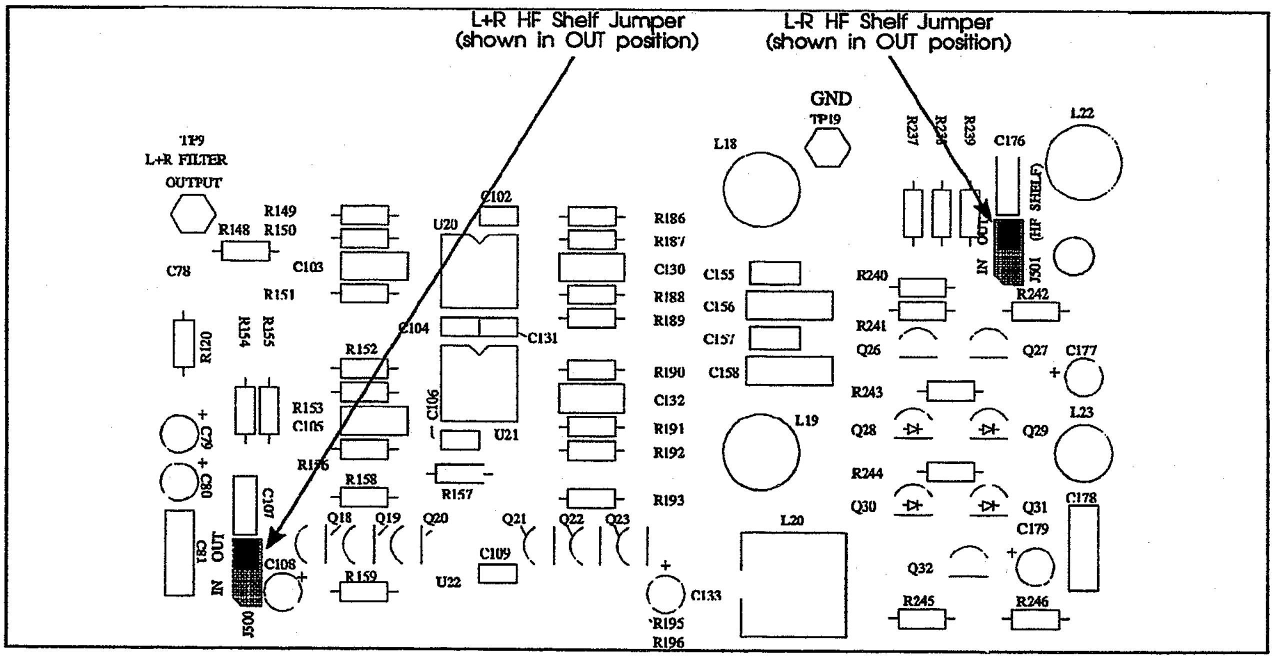
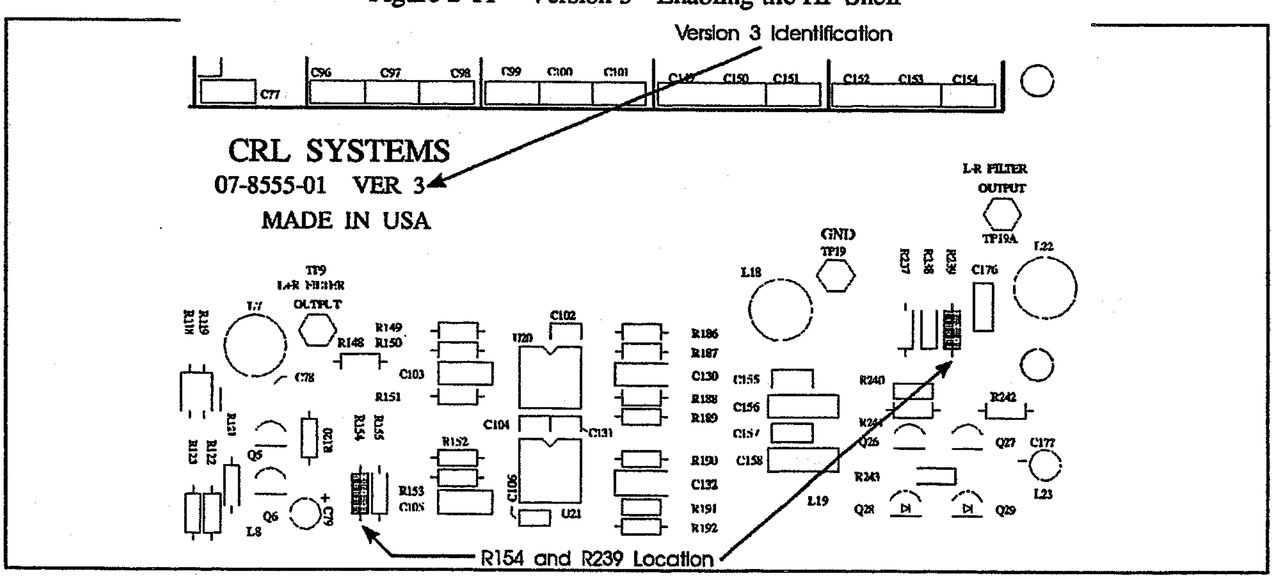


Figure 2-11 Version 3 - Enabling the HF Shelf



2.2 System Configurations

This section covers the various ways the AMIGO AM may be installed in a broadcast station.

2.2.1 General Information

AMIGO AM was designed to operate as a stand alone processor (no other audio processing is required). All audio processing functions (AGC, compression, limiting and audio filtering) are provided by AMIGO AM. Any equipment that was previously used to provide these functions will be replaced by AMIGO AM. If the studio and transmitter are at different locations, a Studio AGC may be used with AMIGO AM (see 2.2.2).

Always install AMIGO AM at the transmitter location. AMIGO AM produces a precisely limited audio signal. Attempting to send this signal from the studio to a remote transmitter site through a telephone line or Aural STL will cause the signal to ring and overshoot. The overhsoots will require the modulation level to be reduced as much as 30 to 40%. To maximimize the performance and coverage area of the transmission system, always install AMIGO AM at the transmitter location.

2.2.2 Using AMIGO AM with a Studio AGC

If the studio and transmitter are at different locations, a Studio AGC may be used with AMIGO AM. The studio AGC is installed at the studio location, AMIGO AM at the tranmsitter location. The purpose of the studio AGC is to protect the studio to transmitter link (telephone lines or aural STLs) from overloads and clipping. In addition, the studio AGC will maxamize the signal-to-noise ratio of the link. This happens because the link can be safely driven with a higher signal level.

When using a studio AGC, our SGC800 is recommended. The SGC800 is one of the cleanest processors available, finding application in satellite up-links, down links, and hundreds of broadcast stations throughout the world. Exclusive Dynafex Noise Reduction (patented by CRL) effective removes noise from virtually any noisy source. SGC800 offers the following features:

- Advanced dual-band AGC, exhibiting very low distortion.
- Gating to prevent amplification of background noise during pauses.
- Exclusing Dynafex Noise Reduction, patented by CRL.
- Front panel equalization control to allow fine tuning of the program tonal balance (similiar to a bass/treble control).
- 1 unit rack space requirement.

NOTE: AMIGO AM is a very high quality audio processor. When chosing a studio AGC, audio quality is very important. The studio AGC s quality must be as good as that produced by AMIGO AM. If it is not, the quality of your stations sound will not be as good as it could be.

When using a studio AGC, our SGC800 is recommented. The SGC800 is one of the cleanest processors available

2.2.3 Standard AMIGO AM Connections

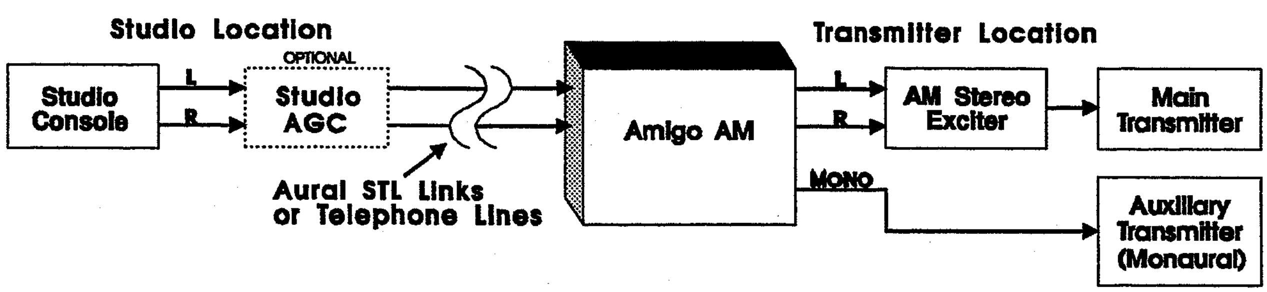
Standard AMIGO AM connections are pictured in Figure 2-10.

If the studio and transmitter are at the same location, AMIGO AMs input is connected to the studio console.

If the studio and transmitter are at different locations, a studio AGC may be connected between the console and studio-to-transmitter link. Using a studio AGC is optional (see 2.2.2).

AMIGO AMs stereo output is connected to the AM Stereo Exciter. The mono output is connected to an auxiliary (standby) monaural transmitter.

Figure 2-12 Standard AMIGO AM Connection



2.2.4 Connecting 2 Stereo Transmitters

Connecting 2 stereo transmitters to AMIGO AM is pictured in Figure 2-11. AMIGO AMs input is connected the same as shown in figure 2-10. The stereo output is connected to a stereo distribution amplifier. The distribution amplifier outputs are connected to the AM stereo exciters.

There are 2 general requirements when chosing or building a stereo distribution amplifer. First, each output must have its own gain control. These gain controls are used to adjust the modulation level of each transmitter.

The second requirement is the distribution amplifiers frequency responce. The frequency response must be - 3dB from about 0.1Hz to at least 20kHz. If these specifications are not met, AMIGO AMs precisely limited ouput will be affected. Ringing and overshoots that occur in the distribution amplifier will force the modulation level to be lowered. A lower modulation level will decrease the coverage area of your station. To avoid this problem, only use a high quality distribution amplifier.

2.2.5 Using AMIGO AM in Mono

Connecting AMIGO AM for mono is illustrated in figure 2-12. Note that the input is connected to both Left and Right channels. This is required in order for AMIGO AM to operate properly. The main transmitter is connected to a L+R (mono) output. This output is configured by an internal programming jumper to appear at the Left Channel Output terminals. An auxiliary (standby) transmitter may be connected to the Auxiliary Mono Ouput.

Three internal programming jumpers must be set for AMIGO AM to operate properly in mono:

- **Set J10A to TERM, J11A to BRIDGE.** These jumpers will configure AMIGO AMs input impedance for 600 ohms (see Table 2-3).
- **Set J17 to L+R.** This will configure AMIGO AM to provide a mono signal at the Left Channel Output Terminals (see Table 2-3).

2.3 Rack Mounting.

After the internal programming jumpers have been set, AMIGO AM can be mounted in an equipment rack. The rack should be constructed of metal and must be grounded to the transmitter site grounding system. This precaution will minimize RF feedback and interference.

2.3.1 Rack Requirements

The AMIGO AM is designed to mount in a standard 19-inch (48.26cm) equipment rack. The equipment height is 1.75 inches (4.45cm), requiring 1 Unit of rack space. The equipment depth is 17 inches (43.2cm), including all protruding connectors. The total depth required to mount the AMIGO AM is 18 inches

Figure 2-13 Connecting 2 Stereo Transmitters

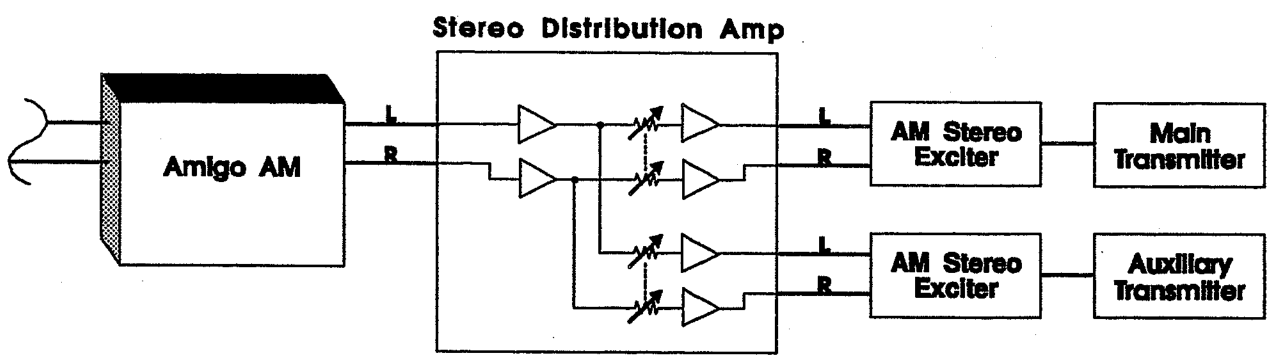
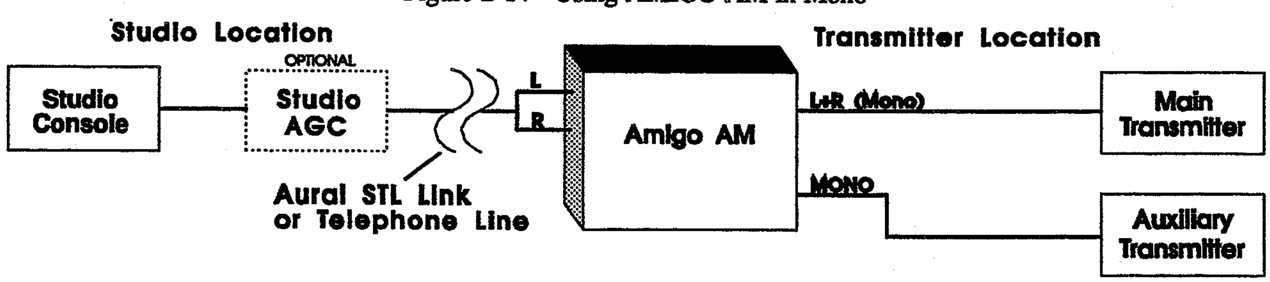


Figure 2-14 Using AMIGO AM in Mono



(45.7cm). This allows room for power and signal connections, and air circulation.

2.3.2 Mounting Hardware and Installation

Mounting hardware is included with the AMIGO AM. Included are four screws and four nylon bushings. Nylon bushings are included to prevent the screws from scratching the front panel.

1. Place a bushing on each of the screws. The screw head must face the concave side of the bushing.

2. Hold the AMIGO AM in the desired rack position. Be certain that each of the front panel mounting holes is aligned with a mounting hole in the equipment rack.

3. Insert a screw through each of the four front panel mounting holes, and tighten.

2.4 AMIGO AM Wiring

2.4.1 General Information

Careful attention to wiring and grounding is very important.

Always used two conductor shielded audio cable such as Belden 8451 (red and black twisted pair inside a shielded covering) to interconnect the equipment, including the console. Failure to use shielded cable most likely will cause problems. Unshielded wiring will pick up noise from fluorescent lighting, automotive ignition noise, motors starting and stopping, and RF interference.

Connect the shield at one end only when installing a length of shielded cable,. Connecting the shield at both ends may cause a ground loop or hum.

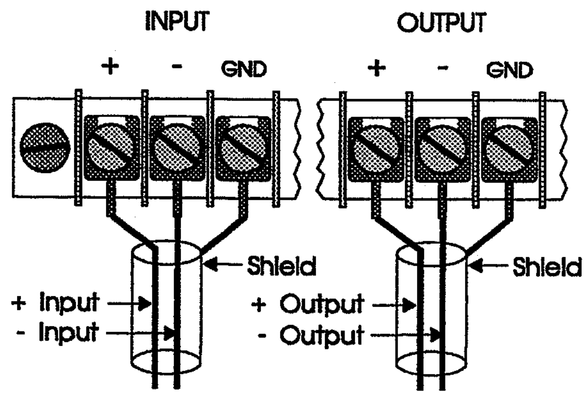
Grounding is equally important. Ungrounded equipment is likely to pick up noise. Ideally, all equipment should be grounded to a common point such as an equipment rack. The rack should then be grounded to the station's main ground point or the power line ground. Installations at transmitter sites is even more critical due to the large amounts of RF energy. All equipment racks should be connected to the transmitter's ground terminal with heavy copper strap. Oftentimes, the transmitter installation manual will offer information that is helpful to the installation of a ground system.

This unit may be wired for either balanced or unbalanced operation. Most broadcast equipment is designed for balanced line operation. **Unbalanced operation is not recommended** since RFI and hum suppression is most effective when a balanced line connection is used.

2.4.2 Wiring for Balanced Operation

Wiring for balanced operation is pictured in Figure 2-13.

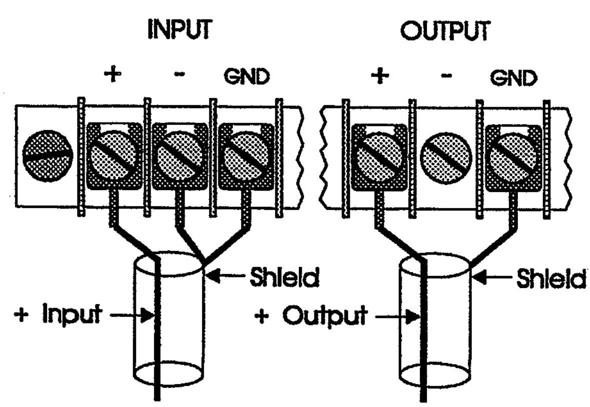
Figure 2-15 Wiring for Balanced Operation



2.4.3 Wiring for Unbalanced Operation

Wiring for unbalanced operation is pictured in Figure 2-14. Note that the Input - terminal is connected to the ground terminal. Also note that the Output - terminal is not connected. AMIGO AM does not use a transformer output. Accidental grounding of the negative (-) output terminal will short half of the output circuit. Also, the output levels will be 6 dB lower than the balanced output levels.

Figure 2-16 Wiring for Unbalanced Operation



2.4.4 Standard AMIGO AM Wiring

Standard wiring is pictured in Figure 2-15. All shields are connected in this illustration. Please note that the shield should only be connected on one end of each cable. Generally, the shield is connected on the end of the cable coming from the Output Terminals of a piece of equipment. The end of the cable going to the Input Terminals of another piece of equipment is left unconnected.

2.4.5 Wiring AMIGO AM for Mono

Wiring AMIGO AM for Mono is pictured in Figure 2-15. Please note that the input cable is connected to both left and right channels. Normally, the input cable is connected to the left channel. Two small jumper wires are then connected from the left channel + and - terminals to the right channel + and - terminals. Also note that the output to the main transmitter is connected to the left channel output.

2.4.6 Installation is now complete.

The installation of AMIGO AM is now complete. The following items should now be completed:

- Check and set AC Input Module (see 2.1.1)
- Check internal programming jumpers (see 2.1.3)
- Mount AMIGO AM in an equipment rack (see 2.1.6)
- Wire AMIGO AM inputs and outputs (2.3.4 or 2.3.5)

The following section of this manual will cover the operation, setup procedure and sound setting for AMIGO AM.

Figure 2-17 Standard AMIGO AM Wiring

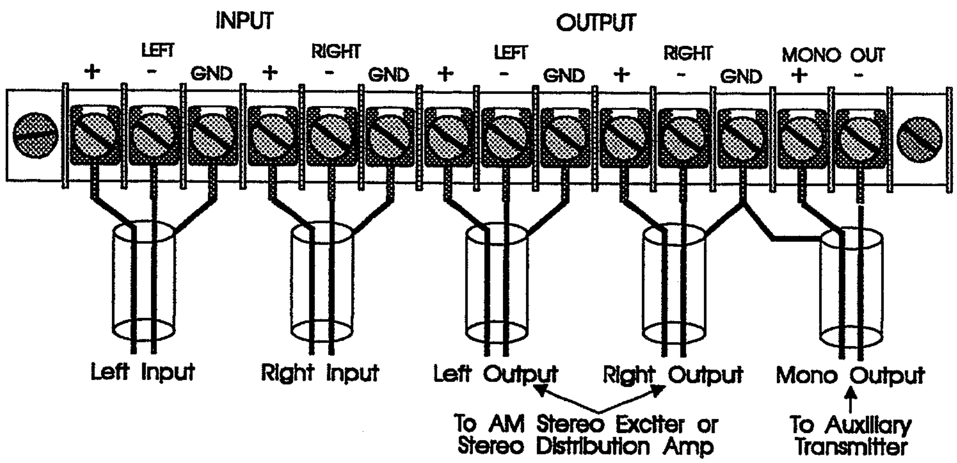
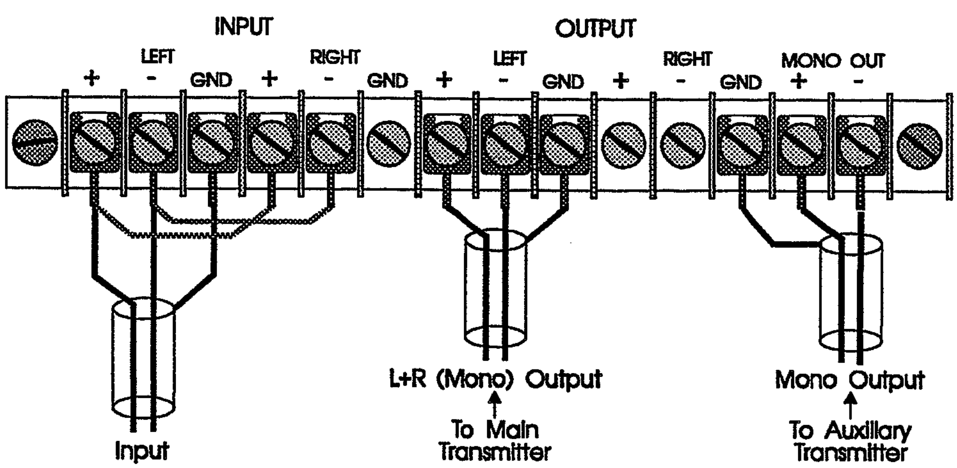


Figure 2-18 Wiring AMIGO AM for Mono



Section 3 - Operation

3.1 General

This section contains:

3.2 Front Panel Controls

The front panel layout of AMIGO AM is pictured in Figure 3-1. All important controls are located on the front panel, and are designed to make installation quick and easy. The controls are grouped into 4 convenient sections:

Input Level Section

Processing Adjust Section

Output Section

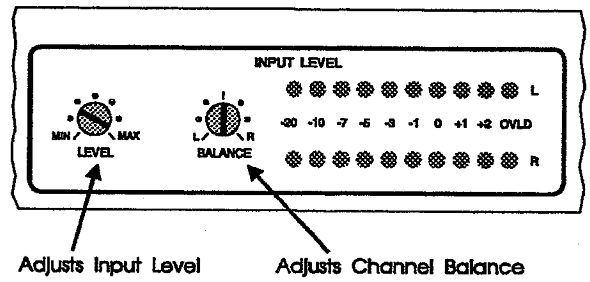
Stereo Adjust Section

3.2.1 Input Level Section

The Input Level Section is pictured in Figure 3-2 and contains:

- *Input Level Control* adjusts left and right channel input level. Turning the control clockwise increases the input level, while turning the control counter-clockwise decreases the input level.
- *Input Balance Control* adjusts input channel balance. Turning the control counter-clockwise increases the left channel input level, while turning the control clockwise increases the right channel input level. Normally, the control is set at the 12 o'clock position.
- *Input Level Meter* displays left and right channel input level. Any change made with the Input Level or Balance control is displayed on the meter. This feature makes input level and balance adjustments quick and easy. Meter calibration is in decibles and reads from -20dB to +2dB. A Red Overload LED is included to indicate when the input level is too high.

Figure 3-2 Input Level Section

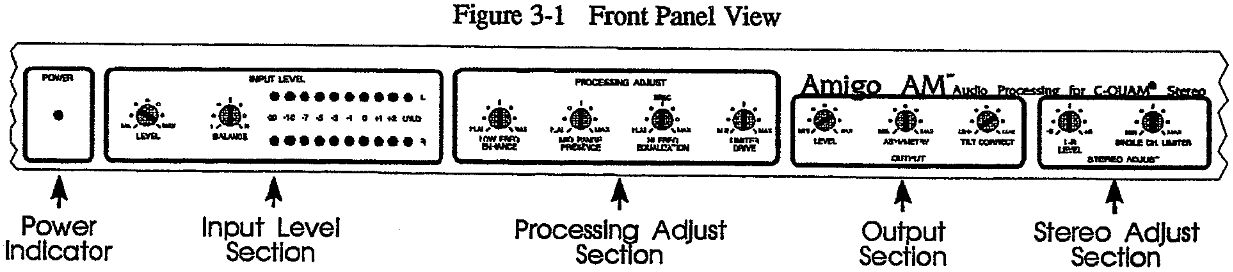


3.2.2 Processing Adjust Section

The Processing Section is pictured in Figure 3-3 and contains:

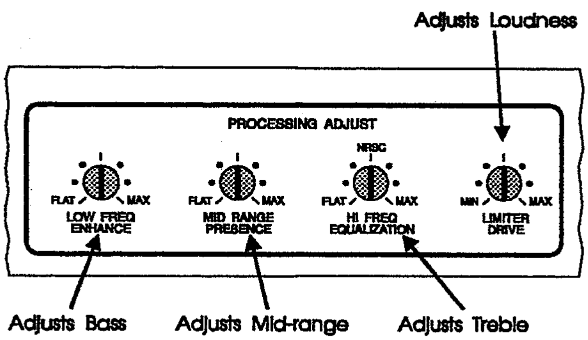
- *Low Frequency Enhance Control* adds bass to your sound. Turning the control clockwise increases the amount of bass. The control range is from +1dB to +4.5dB of boost at about 90Hz.
- *Mid Range Presence Control* adds mid range presence. Turning the control clockwise increases the amount of mid range. The control range is from 0dB to +4.5dB of boost at 3.1kHz.
- *High Frequency Equalization Control* adds treble. Turning the control clockwise increases the amounts of treble. A NRSC detent is located at the 12 o'clock position. The NRSC position adds the exact amount of high frequency equalization specified by NRSC Standards. The control range is from 0dB to +12dB of boost at 9.5kHz.

Figure 3-1 Front Panel View



- *Limiter Drive Control* adjusts loudness. Turning the control clockwise increases loudness, counter-clockwise decreases loudness. The control range is from 0dB to 6dB of limiting. There is always a compromise between loudness, sound quality and coverage area. Increasing loudness lessens quality, but increases your stations coverage area. Less loudness improves quality, but decreases coverage area. The 12 o'clock position is designed to provide the best compromise between loudness, quality and coverage area.

Figure 3-3 Processing Adjust Section

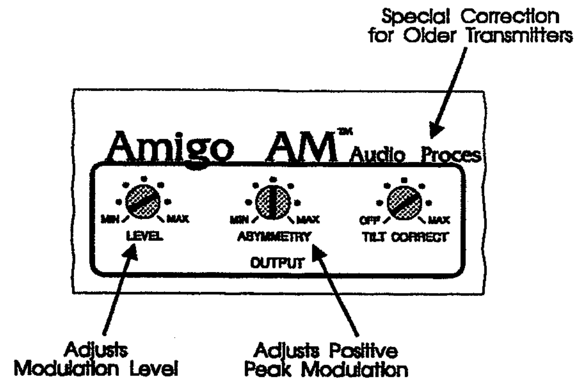


3.2.3 Output Section

The Output Section is pictured in Figure 3-4 and contains:

- *Output Level Control* adjusts the transmitter modulation level. This control has been specially designed to adjust monaural and stereo modulation at the same time. This feature eliminates the difficulty of setting monaural and stereo modulation usually experienced with other audio processors.
- *Asymmetry Control* adjusts the amount of monaural positive peak modulation.
- *Tilt Correction Control* is only used with tube type transmitters that contain a modulation transformer or reactor. PDM and solid state transmitters DO NOT require this correction. Tilt Correction compensates for low frequency "tilt" (phase shift) found in plate modulated transmitters. Proper compensation will generally allow the modulation level to be increased as much as 20 to 30%.

Figure 3-4 Output Section

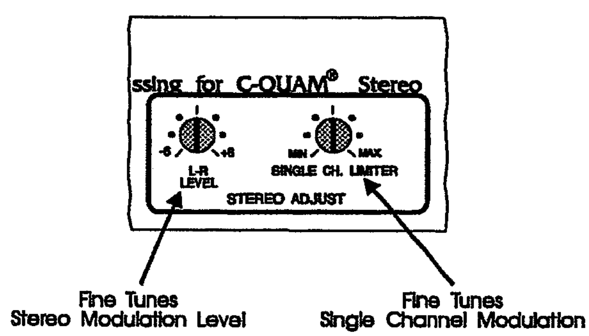


3.2.4 Stereo Adjust Section

The Stereo Section is pictured in Figure 3-5 and contains:

- *L-R Level Control* allows fine tuning of the stereo modulation level, or to reduce the amount of transmitted stereo information. The 12 o'clock position is factory calibrated to produce the optimum amount of stereo modulation in case a stereo modulation monitor is not available to make this adjustment.
- *Single Channel Limiter Control* fine tunes the maximum negative modulation level that can be produced by a single channel. This feature is required to ensure proper operation of AM stereo receivers. The 12 o'clock position is designed to produce the approximate amount of required limiting (-70%) in case a stereo modulation monitor is not available to make this adjustment. Turning the control fully counterclockwise will disable single channel limiting. This should be done before conducting "proof-of-performance" tests.

Figure 3-5 Stereo Adjust Section



3.3 Rear Panel Controls

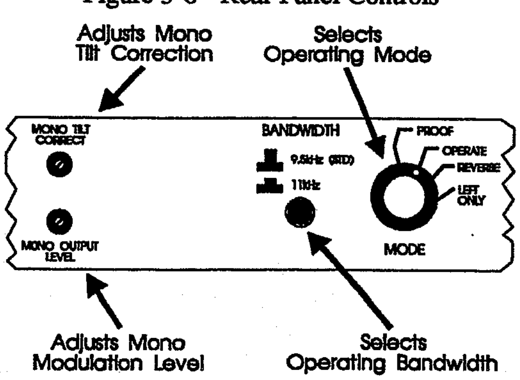
The rear panel controls are pictured in Figure 3-6. Included are:

- *Mode Switch* selects the operating mode. Four modes are available: Proof, Operate, Reverse and Left Only.

SWITCH POSITION	DESCRIPTION
Proof	All equalization and processing circuits are bypassed except single channel limiting.
Operate	Normal position of the Mode Switch. In this position, all functions of AMIGO AM are enabled.
Reverse	This position reverses the polarity or phase of the right channel input. This position is occasionally used to test for an input polarity reversal.
Left Only	This position disconnects the right channel input. This mode is used during setup to fine tune the L-R Level and Single Ch. Limiter Controls.

- Bandwidth Switch selects the operating bandwidth. Two positions are available, 9.5kHz (NRSC) and 11kHz. Normally, the switch is set for the 9.5kHz (NRSC) position.
- *Mono Output Level* adjust the mono output modulation level for an auxiliary transmitter. Please note this is a 22 turn control.
- *Mono Tilt Correct* adjusts the mono output tilt correction for an auxiliary transmitter. Please note that this control only works when internal programming jumper J9 is set to IN. Also note this is a 22 turn control.

Figure 3-6 Rear Panel Controls



3.4 Setup Procedure

This sections begins with the initial adjustment of your audio processing chain (studio console, studio AGC and AMIGO AM). Then, fine tuning your station's sound is covered.

3.4.1 Getting Started

The first step can be time consuming and a little boring, but it is very important. Before doing anything else, look over the installation and setup information included in this manual, and that for any other processor which will be used (such as a Studio AGC). The goal is to understand the basic operation of each control located on the processor. If you are not sure about a control or are confused, call us (or the manufacturer of other equipment used). There is no such thing as a dumb question!

The audio chain must be adjusted from beginning to end. In other words, the Studio AGC (if used) is adjusted first, then AMIGO AM.

Finally, initial adjustments should be made with the transmitter turned OFF.

3.4.2 Start with the Studio Console

Play some every day programming at normal operating levels. If the console operators normally like to "pin" the VU meter, you should do the same. The point is to simulate normal operating levels.

TIP: If possible, play monaural programming. This will make the adjustment of input levels and channel balance much faster and more accurate. It will also be much easier to identify any audio phasing problems (where the + and - wiring connections are reversed)..

3.4.3 Adjusting the Studio AGC

If a Studio AGC is used, it is adjusted first. Start with the input level adjustment or calibration. Next, set the AGC for about 9dB of gain reduction. Sometimes a control is provided for this adjustment, other times the amount of gain reduction is adjusted with the input level control. Next, set the release time to Medium or mid-scale. If the processor includes Gating, always turn it ON. Finally, set the output level to the desired level (usually +4dBm to +8dBm). **NOTE:** If using our SGC800 Studio AGC, refer to section 3.9 for recommended settings.

Note: If the AGC will be driving a STL or phone lines, make sure the output amplitude of the AGC is not too high. A level that is too high will cause distortion.

STLs usually include a peak deviation meter that can be used to check this. If the meter shows excessive deviation, turn the AGC output level down.

Phone lines are harder to check. In addition, they must be checked at the transmitter end. This check can be made with an oscilloscope. Look for clipping on the audio peaks. If an oscilloscope is not available, a pair of high impedance headphones (600 ohms or greater) can be used. Connect them across the phone line. Listen carefully for distortion or an edgy ragged sound.

3.4.4 Initial Control Settings

The next step is to setup AMIGO AM. Begin by setting each control listed in Table 3-1 to the position indicated.

Table 3-1 Initial Control Settings

CONTROL	INITIAL SETTING
Input Level	MIN
Input Balance	12 o'clock
Low Freq Enhance	12 o'clock
Mid Range Presence	12 o'clock
Hi Freq Equalization	12 o'clock
Limiter Drive	12 o'clock
Output Level	MIN
Asymmetry	MIN
Tilt Correct	OFF
L-R Level	12 o'clock
Single Ch Limiter	12 o'clock
Mode (rear panel)	Operate
Bandwidth	9.5kHz or as required
Mono Output Level	Fully counter clockwise (22 turns)
Mono Tilt Correct	Fully counter clockwise (22 turns)

3.4.5 Input Level Adjustment

Turn the LEVEL Control clockwise while watching the Input Level Meter. Adjust the control until the 0 LED is flashing regularly. The +1 LED and +2 LED may flash occasionally, but should not be flashing all the time. **The Red OVLD LEDs should never flash.**

3.4.6 Input Balance Adjustment

This check must be made with monaural programming. Check the Input Meter to see if the LEDs are flashing the same on each channel. If they are not, adjust the Balance Control until they are.

3.4.7 Output Level Adjustment

Note: Before beginning this step, double check the Output Level Control to make sure it is turned fully counter-clockwise.

In this step you will adjust the monaural modulation of your transmitter. The modulation level may be monitored with an oscilloscope, monaural modulation monitor or stereo modulation monitor. If using a modulation monitor, observe the negative L+R (monaural) modulation. If using an oscilloscope, observe an RF sample of the transmitters output.

Begin by turning the transmitter ON. Slowly turn the Output Level Control clockwise while observing the negative L+R modulation level. Adjust the control until the desired negative peak modulation level is reached (usually 90% to 95%).

TIP: If you are making this adjustment with a modulation monitor, set the monitors peak flasher to the desired modulation level (95% for example). Adjust the Output Level Control until the peak flasher just begins to flash. Make sure the monitors -100% flasher does not light. If it does, turn the Output Level down slightly.

If the modulation level is very low even with the Output Level Control turned fully clockwise, there may be a polarity reversal in the AMIGO AM input or output wiring. First, turn the Output Level Control fully clockwise. Next, try turning the rear panel MODE Switch to REVERSE. If this corrects the problem, reverse the right channel input + and - wiring connections. Also return the Mode Switch to the OPERATE position. If that does not fix the problem, return the Mode Switch to the OPERATE position. Then try reversing the right channel output + and - connections. One of these polarity changes (input or output) should correct the problem.

3.4.8 Tilt Correct Adjustment

This adjustment is only required if you have a tube type transmitter using a modulation transformer or reactor. If you have a PDM or solid state transmitter, skip this step. This section begins with some general information on tilt correction, followed by an adjustment procedure.

Tilt correction is required to compensate for low frequency phase shift and rolloff in the transmitter. If left uncorrected, low frequency square waves (or clipped wave forms) will be tilted. Tilting will cause a loss of peak modulation which will result in less loudness and coverage area.

Figure 3-7 shows what a low frequency square wave looks like on a transmitter that does not need tilt correction. Notice that the positive and negative peaks are perfectly straight. Figure 3-8 shows a transmitter that does need tilt correction. Notice that the positive and negative peaks are tilted.

Figure 3-7 Normal Modulation (no tilt present)

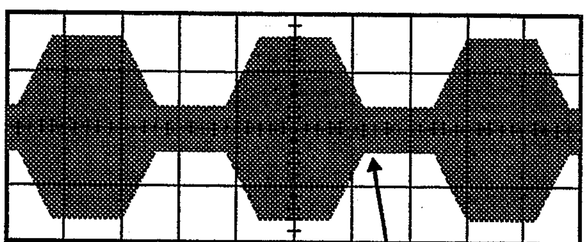
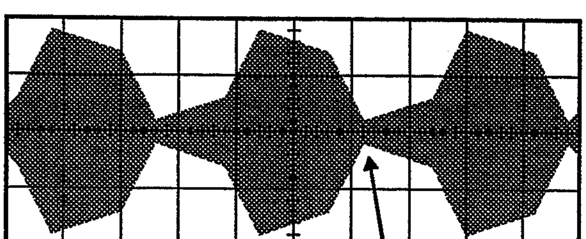


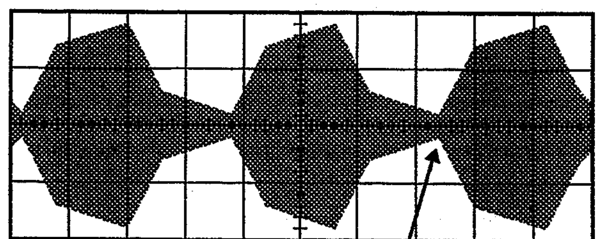
Figure 3-8 Uncorrected Modulation (tilt present)



The loss of peak modulation is illustrated by comparing Figure 3-7 and 3-8 The tilting in Figure 3-8 causes the peak modulation to be 80%. When the tilting is corrected, the peak modulation will decrease to 60% as shown in Figure 3-7. This allows the transmitters modulation level to be increased significantly. Increasing the modulation from 60% to 80% is a 13% (2.5dB) increase in loudness, and will result in a larger coverage area.

Figure 3-9 shows too much tilt correction. Notice that the positive and negative peaks are tilted in the opposite direction as the uncorrected peaks (Figure 3-8). Also notice that the peak modulation level has increased to 80%. When adjusting the Tilt Correct Control, the goal is to straighten the peaks. Too little or too much correction will cause the peaks to be tilted in one direction or the other.

Figure 3-9 Over-corrected Modulation



The best way to adjust tilt correction is to observe an RF sample (from the transmitter) with an oscilloscope. If an oscilloscope is not available, a modulation monitor can be used but it is more difficult to make an accurate adjustment.

This adjustment will be made with program material. Although using a signal generator will produce greater accuracy at a single frequency, program material is the preferred signal source. This is due to the fact that the average tilt can be corrected over a wider range of frequencies when program material is used.

Tilt Correction Procedure:

1. Turn AMIGO AMs Output Level Control to produce about 70% negative modulation.

2. The following control changes are intended to produce highly clipped audio wave forms. The audio being transmitted will be very distorted. First, note the setting of the Input Level Control so it may be reset when the procedure is completed. Next, turn the Input Level Control until the Red OVLD LEDs on the Input Meter

begin to flash. Finally, set the controls listed in Table 3-2 to the positions indicated.

Table 3-2 Control Settings to Adjust Tilt Correction

CONTROL	SETTING
Low Freq Enhance	MAX
Mid Range Presence	FLAT
Hi Freq Equalization	FLAT
Limiter Drive	MAX

3. If using an oscilloscope, observe the negative peaks of bass or low frequency notes as they occur. If they are tilted, correction is needed. Turn the Tilt Correct Control clockwise slightly until it "clicks" on. Slowly turn the control clockwise while observing the clipped low frequency notes. Adjust the control until the tilting is removed. Keep in mind that if too much correction is applied, the tilting will reappear in the opposite direction.

4. If using a modulation monitor, observe the negative peak modulation. Keep in mind that this method is not as accurate as using an oscilloscope. The goal of this method is to apply correction until the lowest peak modulation level is observed. Adjustments must be made slowly. In addition, the affect of each adjustment should be observed for several moments to determine if the peak modulation has decreased or increased. Slowly turn the Tilt Correct Control clockwise while observing the peak modulation. As the control is turned clockwise, the peak modulation will decrease. Eventually as the control is turned clockwise, a position will be found that causes the peak modulation to increase. When this position is found, turn the control counterclockwise until the lowest amount of peak modulation is observed.

5. If it was not possible to make the correction, turn the Tilt Correct Control to the OUT position. The condition of transmitter modulating components should be checked before attempting to repeat this procedure. In addition, check for the presence of inadequate (too small in value or defective) AC coupling capacitors at the transmitter audio input or modulator.

6. Tilt Correction should now be completed. Turn the Input Level control back to its original position. Next, set the controls listed in Table 3-3 to the positions indicated. Finally, the Output Level Adjustment will have to be made again (repeat section 3.4.7).

Table 3-3 Control Settings after Tilt Correction

CONTROL	SETTING
Low Freq Enhance	12 o'clock
Mid Range Presence	12 o'clock
Hi Freq Equalization	12 o'clock
Limiter Drive	12 o'clock

3.4.9 Asymmetry Adjustment

In this step you will adjust the transmitters monaural positive peak modulation. A modulation monitor should be used to make this adjustment. Using an oscilloscope to make an accurate adjustment is very difficult. If a modulation monitor is not available, you have two options. First, leave the Asymmetry Control in the MIN position. Second, turn the Asymmetry Control to the 12 o'clock position. This will produce about 110% positive peak modulation. If your have a PDM or Solid State transmitter, turning the control to 12 o'clock is a good option. If your have a tube type transmitter with a modulation transformer (or reactor), the best option is to leave the control in the MIN position. Oftentimes, these types of transmitters do not handle positive peak modulation above 100% to 105% without causing distortion.

Begin by setting the modulation monitor to measure L+R (monaural) positive peak modulation. Slowly turn the Asymmetry Control clockwise while observing the L+R positive peak modulation. Adjust the control until the desired positive peak modulation level is reached (usually 115% to 125%).

If the positive peak modulation does not change when turning the Asymmetry Control: two problems can cause this to happen. Begin by checking the negative peak modulation. See if the negative peak modulation changes when the Asymmetry Control is turned. If it does, there is a wiring problem (the output polarity is reversed).

If the negative peak modulation does not change when turning the Asymmetry Control in the previous check: there is probably a transmitter problem. For some reason, the transmitter can not produce positive peak modulation. The best option at this point to to leave the Asymmetry Control in the MIN position. As soon as possible, the transmitter should be checked to determine the problem.

Turn the transmitter OFF. Reverse the Left Channel Output + and - wiring connections. Also, reverse the Right Channel Output + and - wiring connections. Next, turn AMIGO AMs Output Level and Asymmetry Controls fully counter-clockwise. Finally repeat the Output Level Adjustment (see 3.4.7) and Asymmetry Adjustment (see 3.4.9).

3.4.10 Stereo Balance Adjustment

In this step you will fine tune the stereo balance to produce the best possible channel separation. A stereo modulation monitor is required to make this adjustment. If one is not available, leave the L-R Level Control in the 12 o'clock position.

1. Turn the rear panel Mode Switch to the LEFT ONLY position.

2. Set the stereo modulation monitor to measure right channel modulation.

3. Very little right channel modulation should be observed on the monitor.

4. The L-R Level Control is adjusted to produce the smallest amount of right channel modulation. Try turning the control clockwise, then counter-clockwise. Leave the control in the position that produces the smallest amount of right channel modulation. Typically, the right channel modulation should be -25dB to -30dB.

3.4.11 Single Channel Limiter Adjustment

In this step you will fine tune the single channel limiter. A monaural or stereo modulation monitor is required to make this adjustment. If one is not available, leave the Single Ch Limiter Control in the 12 o'clock position.

1. The rear panel Mode Switch should still be in the LEFT ONLY position.

2. Set the modulation monitor to measure negative L+R (monaural) modulation. Adjust the Single Ch Limiter Control until the modulation monitor shows -70% peak modulation.

TIP: Set the monitors peak flasher to 70% Turn the control counter-clockwise until the peak flasher stops flashing. Then turn the control clockwise until the peak flasher just starts to flash.

3. Turn the rear panel Mode Switch to the Operate position.

3.4.12 Final Checks

The basic adjustment of AMIGO AM is now complete. Before proceeding, it is a good idea to watch the input level meter and the modulation level of the transmitter for awhile. Sometimes a slight adjustment needs to be made.

Begin with the Input Meter. Make sure the red OVLD Leds never flash. Next, watch the negative and positive peak modulation L+R (monaural) levels. Make sure -100% and +125 limits are not exceeded.

3.4.13 Monaural Output Adjustments

Note: If the auxiliary transmitter will require tilt correction, internal programming jumper J9 must be set to IN. The factory set position for this jumper is OUT. The Mono Tilt Correction control is disabled in the OUT position.

This section covers the setup procedure for AMIGO AM to drive a monaural auxiliary transmitter. Please note that the stereo setup should be done before starting this procedure (section 3.4.1 through 3.4.12).

1. Make sure the rear panel Mono Output Level and Mono Tilt Correct controls are turned fully counter-clockwise. Both controls are 22 turn potentiometers, so be sure to turn each control at least 22 turns.

2. Connect an oscilloscope or modulation monitor to a RF sample output of the auxiliary transmitter.

3. Turn the MONO OUT control clockwise until the desired negative modulation peaks as observed on the oscilloscope or modulation monitor (usually about 95%).

Note: The asymmetry has been previously set for the main transmitter in Section 3.4.9. Verify that the auxiliary transmitter is capable of the positive peak modulation previously set for the main transmitter. For example, if the main transmitter's positive peak modulation was set for 120%, the auxiliary transmitter should be producing positive peaks of about 120%. If the positive peak capability of the auxiliary transmitter is significantly less than the main transmitter it may be desirable to reduce the amount of positive peak modulation to a level that the auxiliary transmitter can produce using the procedure in Section 3.4.9.

4. If the auxiliary transmitter requires tilt correction, the adjustment is made using the procedure in Section 3.4.8 using the rear panel control (instead of the front panel control described in 3.4.8).

3.5 Using AMIGO AM in Mono

This section describes the differences in the setup procedure (section 3.4) if you are using AMIGO AM in mono.

Basically, the setup procedure for using AMIGO AM in mono is almost identical to the stereo setup procedure. The only difference is that two stereo adjustments do not need to be made.

3.5.1 Mono Setup Procedure.

1. Perform the adjustments in section 3.4.1 to 3.4.9.

2. Skip section 3.4.10 (Stereo Balance Adjustment). This sections covers the adjustment of the L-R LEVEL Control. Leave this control in the 12 o'clock position.

3. Skip section 3.4.11 (Single Channel Limiter Adjustment). This sections covers the adjustment of the SINGLE CH. LIMITER Control. Leave this control in the 12 o'clock position.

4. Perform the adjustments in section 3.4.12 and 3.4.13.

3.6 Adjusting Your Station's Sound

3.6.1 General Guidelines

The last step in setting up an audio processing chain is the most fun. The hard work of installing the equipment is done, and now it is time to make the equipment produce the type of sound you want.

Before starting, a few general guidelines:

1. Do most of your critical listening with a radio or stereo that you are used to listening to. It will be more comfortable for you. But be sure to listen to other radios too. All radios and stereos generally sound different from each other. Sometimes it is necessary to make an compromise when making adjustments. For example, if the amount of bass is adjusted when listening to a naturally bassy radio, other radios will sound thin or lacking in bass. In this situation, the bass should be set to sound good in the other radios, but not too boomy in the first radio.

2. Make one adjustment at a time. Listen to the change and evaluate the difference. Then make the next adjustment. Making many adjustments at the same time can make it very difficult to decide which adjustment caused a particular difference.

3. The best way to learn what each processing control does is to try it. Do not be afraid to play with the controls! Any of the 4 controls located in the Processing Adjust Section can be safely turned through the entire range. Try turning each control throughout its range. Listen to each change. Some changes may be subtle and difficult to notice. Other changes will be very noticeable. The experience you gain by playing with the controls will be very useful later on.

3.6.2 Start by listening to your station for a while.

Before making any changes, listen to your station for awhile. Then compare your station to other stations in the area. As you listen, think about the following items:

- How does the Bass sound (too much, not enough or just right) ?
- How does the Mid Range (voices for example) sound (too much, not enough or just right) ?
- How is the station loudness (too much, not enough or just right) ? When judging loudness, it is best to compare your station's loudness to another station in your area. Try to remember how your loudness compared to the other station before AMIGO AM was installed. Then compare that to your loudness now. This might help you decide if your loudness is OK.
- How is your station's audio quality (very good or too distorted) ? Like judging loudness, audio quality should be judged by comparing your quality to another station in the area. Also, try to remember how your quality compared before AMIGO AM was installed.

- How does the the audio fade at the end of a song (too much, not enough or just right) ?

After making an evaluation of your station's sound, you should have a fairly good idea of any changes you would like to try.

3.6.3 Adjusting Bass and Mid Range

Adjusting Bass and Mid Range is very easy. Both of these controls were set to the 12 o'clock position initially. If you would like a different amount of bass or mid-range, try the settings in the following tables.

Table 3-4 Recommended Bass Settings

Station Format	Low Freq Enhance Setting
Music	12 to 2 o'clock
Talk	3 o'clock

Table 3-5 Recommended Mid-Range Settings

Desired Sound	Mid Range Presence Setting
Warm (less brightness)	9 to 10 o'clock
Standard Brightness	11 to 1 o'clock
Bright	2 to 3 o'clock
Very Bright	3 o'clock to MAX

After making the change, listen to your station for awhile. Also compare your station to others in your area. Do you like that change, was it too much or not enough ? If you do not like the change, try changing the control again. By using this procedure (listening, control change, listening, and so on), you will quickly learn which setting you like best.

3.6.4 Adjusting Loudness and Quality

Loudness and quality are both controlled by the Limiter Drive Control. There is always a compromise between loudness, sound quality and coverage area. Increasing loudness lessens quality, but increases your stations coverage area. Less loudness improves quality, but decreases coverage area. The 12 o'clock position is designed to provide the best compromise between loudness, quality and coverage area.

If you want more loudness, try turning the Limiter Drive Control clockwise. Try the 1 o'clock position, then the 2 o'clock position, and finally the 3 o'clock position. The amount of audible distortion will increase as the control is turned up. The trick in producing maximum loudness and coverage is to find the control setting that produces objectionable distortion (distortion that will be noticed by your listeners). Once this point is found, turn the control down slightly.

TIP: Sometimes hearing distortion is difficult until excessive amount are present. Hearing subtle amounts of distortion involves training the ear to know what to listen for. Once you know what to listen for, even small amounts of distortion are easy to hear.

The best type of programming to hear distortion is music with female vocals. Try to find a song where the singer has alot of substained notes. For example, she may sing a word and stretch out the word for several seconds at a steady volume.

Listen carefully to each substained note or word. Is it clear and smooth, or is it rough and edgy ? If it is rough sounding, you are probably hearing distortion. Next, try listening to a different song or even a different singer. If you still hear a rough edge on the substained notes, you definitely are hearing distortion

Table 3-6 Recommended Loudness Settings

Desired Loudness & Quality	Limiter Drive Setting
Fair loudness, Excellent quality	10 to 11 o'clock
Loud, Very Good quality	12 o'clock
Very loud, Fair quality	1 to 2 o'clock
Extreme loudness, Poor quality	3 o'clock to MAX

Note: Loudness is also controlled by the AGC Speed programming jumpers (J6, J7 and J8). These jumpers were factory set to the Medium position. Changing these jumpers to Fast will increase loudness, while SLOW will decrease loudness.

If quality is the objective instead of loudness, try turning the Limiter Drive Control counter-clockwise. Try the 11 o'clock position, then the 10 o'clock position. Experiment with different settings until you find the one you like. The following table lists control settings to produce various amounts of loudness and quality.

3.6.5 Adjusting the amount of audio fade

The amount of fading that occurs at the end of a song is determined by the amount of AGC gain reduction used. Large amounts of AGC gain reduction will reduce or eliminate fading. Smaller amounts of gain reduction will allow a larger, more natural fade.

AGC gain reduction is produced by AMIGO AM and the Studio AGC (if used). The amount of gain reduction produced by AMIGO AM is controlled by internal programming jumpers (J4 and J5). These jumpers are factory set for 12dB.

If the audio fades too much, change J4 and J5 to 15 dB. If a Studio AGC is used, try increasing the amount of gain reduction it produces before changing J4 and J5.

If the audio does not fade enough, change J4 and J5 to 9 dB. If a Studio AGC is used, try decreasing the amount of gain reduction it produces before changing J4 and J5.

3.7 Stereo Distortion Problems

3.7.1 General

Occasionally, excessive amounts of stereo distortion can be heard in stereo receivers. This type of distortion affects high frequency sounds. Instead of sounding smooth and clear, they will have a "spitting" sound. For example, the letter "s" will sound more like the letter "p" or "f."

This problem is usually is caused by a poor impedance match between the transmitter and antenna system at higher audio frequencies. This situation is sometimes found in stations using a highly directional pattern. It also occurs sometimes when 2 stations are multiplexed into a single antenna.

3.7.2 5kHz Stereo Filter

AMIGO AM includes a 5kHz Stereo Filter to reduce the effects of this problem if it occurs. This filter reduces the bandwidth of the stereo information (L-R) from 9.5kHz to 5.0kHz. Mono information is not affected in any way. The net result of this filter is a reduction of transmitted power at frequencies above 5kHz. This results in less reflected power (from the antenna system back into the transmitter) and less distortion.

3.7.3 Using the 5kHz Stereo Filter

If the stereo distorting described above occurs, we recommend that you try enabling the special 5kHz Stereo Filter. The filter is enabled by moving J13 (Narrow band L-R) and J12 (L+R Narrowlband Delay Equalizer) to the IN position (see Table 2-5).

After the filter is enabled, listen to your station to see if the amount of stereo distortion is reduced. If it is, the problem was probably caused by a poor impedance match between the transmitter and antenna system at higher audio frequencies.

If the amount of distortion was reduced, but is still objectionable, you can reduce the distortion more by turning the L-R Level Control counterclockwise. Doing so will decrease your stations stereo channel separation, but it will reduce the remaining distortion. The trick in making this adjustment is to turn the control counterclockwise enough to eliminate the distortion, but not any more that that. This will preserve as much channel separation as possible. Start by turning the control counter clockwise to about 11 o'clock. Then listen to your audio on a AM stereo receiver. If the amount of distortion is reduced enough, leave the control at 11 o'clock. If the distortion is still too noticeable, try turning the control to 10 o'clock. Then listen to the stereo receiver again. Continue this process until the amount of distortion has been reduced to your satisfaction.

3.8 Proof of Performance Measurements

3.8.1 PreparingAMIGO AM for a proof

1. Turn the rear panel Mode Switch to "Proof."

2. Note the position of the Single Ch. Limiter control.

3. Turn the Single Ch. Limiter control fully counter clockwise. The control will "click" as it reaches the counter clockwise position.

4. AMIGO AM is now prepared for testing. All AGC, limiting and filter circuit stages have been bypassed.

3.8.2 Putting AMIGO AM back On The Air

1. Turn the Mode Switch to "Operate."

2. Turn the Single Ch. Limiter control to the position noted in step 2 above.

3. AMIGO AM is now ready for on-the-air operation.

3.9 Recommended SGC800 Settings

If you are using our SGC800 Studio AGC with AMIGO AM, the control settings presented in Table 3-7 are recommended for the SGC800. Please note that the last two controls in the table are located inside the SGC800 on the main circuit board.

In addition, two changes in jumper settings are recommended for AMIGO AM. First, the Gate Level jumper, J7 should be set for -10 dB. This jumper is located on the main circuit board (see figure 2-5). Second, the AGC Drive jumpers, J4 and J5, should be changed to -9 dB. These jumpers are located on the AGC/Stereo Enhance circuit board (see figure 2-3).

These recommended settings are the result of feedback from our customers during the final field testing phase of AMIGO AM's development.

Figure 3-10 SGC800 Recommended Settings

CONTROL	SETTING
G/R	-12
OPERATION	M or F
GATE	ON
BAND	BOTH
EQ	1 o'clock
THRESHOLD	-40
J11, J19 (Internal Jumpers)	HIGH
R31 (Internal Gate Level)	-25

Section 4 - Technical

4.1 GENERAL

This section covers the theory of operation for AMIGO AM. The factory test procedure is also included.

NOTE: For the purposes of definition, the circuitry description is divided into functional sub-assemblies. The left channel will be described only. The right channel is identical in function to the left channel. Parts in the right channel are referenced by ( ). After matrixing the L+R circuits will be described only except where the L-R circuitry differs and will be referenced by ( ). Refer to the schematic diagram in Appendix A as required for the following description.

4.2 Power Supply

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 (refer to schematic page 8). This connector is an integral part of the AC input module. AC power is applied to power transformer T1 via the AC input module. This module consists of fuse F1, an RFI filter, and a voltage selection PCB. The power transformer has dual windings to permit powering from either 100 to 130 VAC or 200 to 250 VAC. A PCB located inside the AC input module is positioned to select the transformer winding combination required for each input voltage.

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 C24 and C23. The DC voltage from the rectifier is fed to voltage regulators U4 and U5 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 many .1 monolithic capacitors. DS1 illuminates when a positive DC voltage is present at TP2 with respect to ground. DS2 illuminates when a negative DC voltage is present at TP3 with respect to ground. Jumper J3 disconnects positive DC power from the circuitry when it is removed. Jumper J4 disconnects negative DC power from the circuitry when it is removed.

A separate secondary winding on T1 provides the operating voltages for the V LED full wave bridge rectifier consisting of CR7, CR8, CR9, & CR10. The pulsating DC voltage is filtered by C25. The DC voltage from the rectifier is fed to voltage regulator U6 which develops the regulated V LED positive 5 volt supply. This voltage can be measured at TP4 with respect to the supply's negative potential at TP5.

4.3 Audio Input

Audio input to the unit is connected at rear panel terminal strip J15 (refer to schematic page 1). Protective 13 volt transient suppressers (VR1 to VR8) clamp the signal to ground if the input level exceeds 13 volts on any line in any polarity. A single section LC low-pass filter consisting of C153, C153, C154, L16, and L17 (C149, C150, C151, L14, and L15) is connected at this point in the audio path to prevent RF interference with the internal circuitry. The output of the left channel filter is routed to the Input Amplifier Stage. The output of the right channel filter is routed to the rear panel Mode Switch via J2.

4.4 Input Amplifier Stage

Left channel audio is received from the input RFI filter, right channel from the rear panel Mode Switch via J2 pins 13 and 14. Jumper J10A (J11A), BRIDGE/TERM, allows selection of a 600 Ohm resistive termination across the input line, or a 10K bridging input. The front panel INPUT LEVEL Control, R6, is connected at this point allowing adjustment of the input level. Balanced input amplifier U7 converts the input to an unbalanced source. The gain of U7 is set with the INPUT SENSITIVITY jumper J10 (J11). The output of the stage appears at U7 pin 1 (U7 pin 7). This signal is routed to the front panel Input Balance Stage via J14.

4.5 Input Balance Stage

This stage is located on the front panel circuit board (refer to schematic page 1). The audio input is received from the Input Amplifier Stage via J1 pin 2 (J1 pin 4). R9 and R10 (R4 and R5) attenuate the signal to compensate for the gain of U1. The gain of U1 is set by R7, R8 (R2 and R3) and the setting of the front panel Input Balance Control R11. Turning R11 counter-clockwise increases the gain of the left channel and decreases the gain of the right channel. The output of the stage appears at U1 pin 1 (U1 pin 7). This signal is routed to the main circuit board via J1 pin 1 (J1 pin 5) to the Left Balance Amp Output test point TP8 (Right Balance Amp Output test point TP7).

The signal at TP8 (TP7) is routed to 3 locations:

1. Input Meter (see 4.6)
2. Proof Amplifier (see 4.23)
3. Phase Processor Stage (see 4.7)

4.6 Input Meter

The input meter consists of a Meter Rectifier and Overload Detector located on the main circuit board and LED Display Driver located on the front panel circuit board (refer to schematic page 1).

The left channel Meter Rectifier, U10, receives its input from the Left Balance Amp Output test point TP8 (TP7). U10 is a full wave rectifier, with filtering performed by R43 and C36 (R71 and C38). The pulsating DC signal may be monitored at the positive side of C36 (C38). This signal is routed to the Overload Detector and the LED Display Driver.

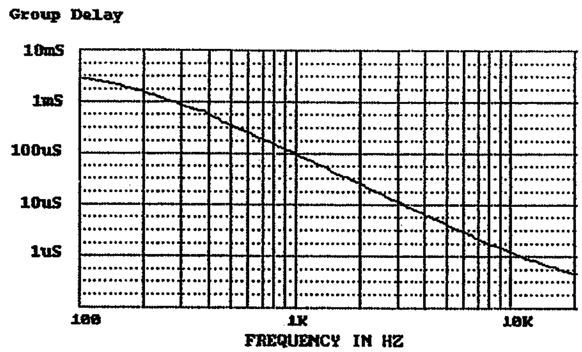
The Overload Detector consists of Q1 and Q2 (Q3 and Q4). When the signal at Q1's emitter exceeds about +2.6 volts, Q1 and Q2 conduct. When Q2 conducts, the cathode of the front panel Overload Led is pulled to ground which causes it to illuminate.

LED Display Driver U2 (U3) receives its input via J8 pin 1 (J8 pin 3). U2 (U3) is a "VU type" display driver and contains all the circuitry necessary to drive the front panel LEDs.

4.7 Phase Processor Stage

The phase processor consists of U36 and associated resistors and capacitors (refer to schematic page 2). This stage receives its input at R267 from the Left Balance Amp Output test point TP8 (TP7). The input signal is also connected to the Phase Processor IN/OUT jumper J19 (J20). The stage consists of 2 "constant" amplitude phase shift amplifiers, U36/B and U36/A (U36/D, U36/C). Each amplifier has a flat frequency response, but produces a group delay which is a function of frequency. The group delay is greatest at low frequencies, and decreases as the frequency increases (see Figure 4-1). The frequency at which the greatest change in delay vs. frequency is approximately 150Hz. This frequency is determined by the RC time constant of R267 and C197. This frequency has been found to be very effective by CRL engineers in reducing the amount of asymmetry present in male and female voices. The phase rotator output, U36/A pin 1, is routed to J19. J19 is used to select whether the Phase Rotator Stage is active. Placing the jumper in the IN position puts the stage in the signal path. The OUT position bypasses the stage. The output of the stage, J19 center pin, is routed to Input Lowpass Filter Stage (see 4.8).

Figure 4-1 Phase Processor Group Delay



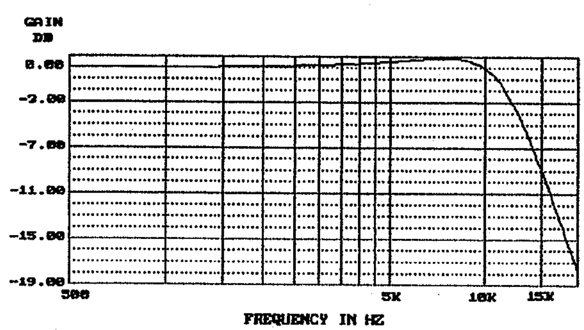
4.7.1 The Purpose of Phase Processing

The purpose of the phase processor is to reduce the asymmetry present in speech signals so excessive and unnecessary amounts of gain reduction and limiting will not occur. A signal is asymmetrical when the positive and negative peaks are not equal in amplitude. For example, the positive peak may be .5 volts while the negative peak is only .25 volts. In this example, the amount of asymmetry is 2 to 1 (.5 V divided by .25 V). If the amount of asymmetry is not reduced, following AGC and Limiting circuitry will not operate as effectively. Consider the same example where the positive peak is twice the amplitude as the negative peak. When the following AGC and Limiting stages sample the signal, the positive peak would appear to be twice the amplitude as normal. This would cause gain reduction and limiting to occur. When the negative peak is sampled, it would appear to be half the amplitude of the positive peak. This would cause AGC and Limiting stages to recover or increase the amplitude of the signal. Now, consider what would happen with a signal that is not asymmetrical. If the non-asymmetrical signal's peaks are about the same amplitude as previous signals (ones that occurred a fraction of a second earlier), no gain reduction or limiting will occur. Finally, compare what happens with a asymmetrical versus the non-asymmetrical wave form. The asymmetrical wave form caused gain reduction and limiting, then both stages recovered. The non-asymmetrical wave form caused no gain reduction or limiting to occur. Clearly, the asymmetrical wave form caused unnecessary amounts of gain reduction and limiting when compared to a non-asymmetrical wave form.

4.8 Input Lowpass Filter

The input lowpass filter consists of U35 and associated components (refer to schematic page 2). The filter receives its input from the Phase Processor jumper J19 (J20). U35/B and U35/A (U35/D and U35/C) form a 4th order lowpass filter with a cutoff frequency of 12kHz (see figure 4-2). The filters output is routed to the mid-range presence equalizer stage (see 4.9). The filtered output may be monitored at TP300 (TP301).

Figure 4-2 Input Filter Response

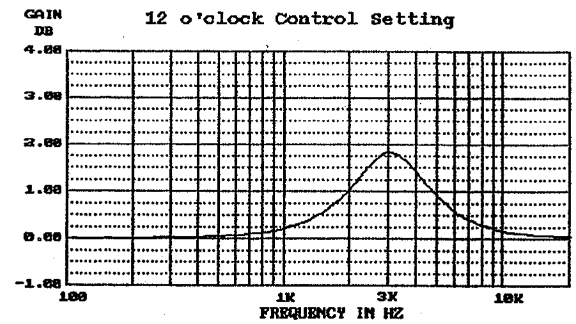


4.9 Mid Range Presence Equalizer

NOTE: This equalizer is located on the main circuit board for units containing a Version 4 circuit board. Earlier versions do not include this equalizer on the main circuit board. Instead, it is located on a special equalizer circuit board mounted above the main circuit board. The schematic for this special circuit board is included at the end of the schematic section.

The mid range presence equalizer consists of U38, U37 and associated components (refer to schematic page 2). The equalizer receives its input from the input lowpass filter at TP300 (TP301). The signal is routed to the front panel Mid Range Presence Control, R19, through R411 (R422). The output of R19 is routed to a fixed Q bandpass filter formed by U38/C and U38/D (U38/A and U38/B). The center frequency of 3.09kHz is determined by R409 (R420). The "Q" is determined by R408 (R419). The bandpass output appears at U38 pin 14 (U38 pin 7). U37/A (U37/B) adds the bandpass output to the incoming audio signal to produce the final mid range presence equalizer (see figure 4-3). The equalizer output is routed to the AGC stage via J6 pin 24 (J6 pin 26). This signal may be monitored at TP400 (TP401).

Figure 4-3 Mid Range Presence Equalizer



4.10 AGC and Stereo Enhance Stage

This stage is located on the AGC/Stereo Enhance circuit board (refer to schematic pages 2 and 3). The audio path through the stage is described in 4.10.1, AGC Control Circuitry in 4.10.2, Stereo Enhance Circuitry in 4.10.3 and Gating in 4.10.4.

4.10.1 AGC Audio Path

The left channel audio input is received from the Mid Range Presence Equalizer via J1 pin 24 (J1 pin 26). From J1 the signal is routed to the Left Ch. AGC Drive jumper J4 (J5). The jumper allows the AGC Drive level to be programmed in 3dB steps from 0dB to -15dB of gain reduction. Next, the signal is connected to the Low-band and High-band crossover networks. R30 and C10 (R55 and C27) form the low-band crossover, R85 and C39 (R127 and C66) form the high-band crossover. The crossover frequency is set at 212 Hz. The output of each crossover network is connected to a AGC/Compressor amplifier.

The operation of the low-band compressor is described in the following text. The high-band operation is the same as the low-band. R27, R26 and U3/A form a variable "Tee" network. U3/A simulates the shunt resistor in the network. U3/A is a semiconductor voltage controlled resistor (patented by CRL, U.S. Pat. #4,393,346). The resistance of U3/A is controlled by a control signal current, connected to pin 1. When the control current is very small, the resistance of U3/A will be approximately 2.2 Megohms. The loss through the "Tee" network will be minimal. As the control current increases, the resistance of U3/A will decrease. This will produce a greater loss through the network. The output of the "Tee" network is capacitively coupled by C7 to buffer amplifier U2/A at pin 2. U2/A pin 1 is the output of the low-band compressor. The output signal can be monitored at TP2. The signal is then routed to summing amplifier U1/A and AGC control circuitry (see 4.10.2). U1/A adds the Low-band and High-band compressor outputs together along with a stereo enhancement signal (see 4.10.3). The summing amplifier output (U1/A pin 1) is routed to two locations. First, to the Stereo Enhance control circuitry (see 4.10.3). Second, to the front panel Low Frequency Enhance circuitry (see 4.11).

The following text is a basic description of how the control circuitry operates U3/A to produce gain reduction. The control circuitry monitors the signal amplitude coming from the output of each band. As the signal amplitude increase, the control circuitry produces a larger control current. The larger control current then increases the loss through the "Tee" network. The increased loss reduces the signal amplitude coming from the output of the band. If the signal amplitude decreases, the control current will decrease. This will then cause the signal amplitude to increase. This is the basis of how gain reduction works.

4.10.2 AGC Control Circuitry

The control circuitry receives its input from TP2 (Left Low-band Compressor Output) and TP9 (Left High-band Compressor Output). TP2 is connected to the low-band full-wave rectifier stage and voltage level translator (U4/A and U5/A). TP9 is connected to the high-band full-wave rectifier stage and voltage level translator (U11/A and U12/A). The rectified signals are translated to approximately -12.0 V, with signal peaks going in the positive direction (towards 0 V). These signals may be seen at U5/A pin 1 (low band) and U12/A pin 1 (high band). Next, the rectifiers are diode coupled to transistor threshold detectors. The low-band rectifier output (U5A pin 1) is coupled through CR4 to the low- band threshold detector Q5. Q5's base voltage is 0 V. Q5 will conduct whenever the emitter voltage is more positive than +.65 V. Q5's collector is connected through R68 to U6 (CRL Module #8055). R68 controls the attack time of the low-band (decreasing the value of R68 will decrease the attack time). Module #8055 contains integration capacitors and a proprietary passive control network. This network provides the capability to automatically adjust its release time as audio density changes. The low-band release time range is controlled by J6. The high-band threshold detector (Q6) operates in the same manner as the low-band.

The low-band and high-band rectifier outputs are also diode coupled to the wide-band threshold detector (Q4). CR3 and CR14 provide a diode "OR" function. Which ever band rectifier output that has the greatest amplitude will be coupled to Q4's emitter. Q4's base voltage is -2.7 V. Q1 will conduct whenever its emitter voltage is more positive than -2.05 V. Q4's collector is connected through R66 to U6, with R66 controlling the wide-band attack time. The wide-band release time range is controlled by Q7. Q7 operates as a current source. J8 is used to select the release time range. Q7's base is also connected to the Gate Level Detector (see Part D).

U6 (CRL Module #8055) has two outputs, low-band control (pin 5) and high-band control (pin 7). Each of these control outputs is routed to a linearizing network. The low-band linearizer consists of U10/A, Q8, Q9 and associated components. The high-band network consists of U10/B, Q11, Q12 and associated components. Each linearizing network compensates the control voltage so that a given change in control voltage will produce a linear "dB" change in gain reduction. If linearization was not used, the time constants (attack and release) would operate differently depending upon the amount of gain reduction. For example, if 3 dB of gain reduction were used, the attack and release times would be faster than the attack and release times with 12 dB of gain reduction. Each linearizing network also converts the control voltage input to a current output. The current outputs are then routed to the VCR control inputs. The low-band control input is U3/A pin 1, high-band is U9/A pin 1.

4.10.3 Stereo Enhance Circuitry

The stereo enhance circuit receives a sample of the left and right channel high-band compressor output signals (refer to schematic page 2). These signals are capacitively coupled, attenuated and then connected to a differential voltage controlled amplifier U7. U7 derives a L-R (stereo) signal which is routed to the left and right channel AGC summation amplifiers U1/A and U1/B. R118 is included to compensate for any DC offset in U7. The gain of U7 is controlled by the control circuit consisting of U14, U13, U15 and Q10.

Signals from AGC summing amplifier U1 pin 1 from the left channel, and pin 7 from the right channel are routed to the L+R absolute value detector U13, and to L-R sense amplifier U14. The output of U14 pin 1 is sent to the Sensitivity Control and Enhance Level jumpers J3 and J2. This signal may be monitored at TP16.

The Sensitivity Control jumper, J3, selects the amount of AC voltage that is rectified by U15/B utilizing diodes CR30 and CR31. The rectified signal may be monitored at TP24. The signal is filtered by C69, R149 and R148 and then routed to the base of Q10. When the collector of Q10 goes to ground the enhance circuitry is activated. The attack/release time of enhancement is determined by the current through C68 sourced from pin 1 of precision current rectifier U15 with resistors R147, R143, R144, and R145.

The Enhance Level jumper, J2, varies the amount of (L-R) signal fed to the absolute value circuit comprised of R147, R146, R108, R109, and U15/A.

Diode CR29 across the input of U13/B prevents the output from going above .7 volts positive. As the output at U13 pin 7 goes more negative, the amount of enhancement increases. This voltage will vary from very near ground to approximately -13.5 volts. The enhance control signal can be monitored at TP20.

The diode drops across CR19, CR20, CR21 and resistor R113 in series with the control port of U7 pin 1 prevents the voltage controlled amplifier from turning on when the control voltage from pin 7 of U13 is at -13.5 volts (no stereo enhancement). The output at pin 7 of U13 also drives the Activity Indicator LED DS1. As the control voltage is varied by U13 pin 7, the output of U7 pin 8 sends an L-R (stereo) signal to the inputs of left and right channel AGC summing amplifier U1 through resistors R22 and R49.

4.10.4 Gating

Gating thresholds of -10dB and -20dB are provided by the Input Meter Stage (refer to schematic page 1). Left and right channel signals are routed from the Front Panel circuit board via J2 to R49, R50, R51, R52 and Gate Level jumper J7. The Gate Level jumper selects either the -10dB or -20dB signal. Logic level translation is provided by Q2, Q1 and Q3. When a front panel -10dB or -20dB (depending upon J7's position) LED turns on, Q7's base voltage is forced to -14.7 V. This stops Q7 from conducting, therefore stoping all release time activity. This effectively locks the AGC/Compressor at the amount of gain reduction what was occurring before the gate level detector turned on. When the front panel LED turns off, Q7's base voltage will return to approximately -13 V. Normal release time activity will then resume.

Gating circuitry is included to freeze the gain controlling action of signals which fall 10dB or 20 dB below the threshold of gain reduction. This action prevents amplification of background noise during pauses in the program, and smoothes the processing of speech. Without gating, speech could be over-processed for an instant after a pause. This occurs as the AGC recovers (increases its gain) during the pause, and then has to quickly reduce its gain after the pause. During the time interval between the resumption of the speech and the point where the AGC has reduced its gain (the attack time of the AGC control circuitry), the output level of the AGC will be too high. This higher level can cause excessive amounts of limiting (and possibly distortion) in the following limiter stages. Gating eliminates this problem by preventing the AGC from increasing its gain during pauses.

4.11 Low Frequency Enhance Stage

This stage is located on the Front Panel circuit board (refer to schematic page 4). The input signal comes from the Left and Right Channel Stereo Enhanced Output test points, TP6 and TP5. The signal is routed through J14 pin 9 (pin 10) to C7 (C4). The low frequency enhance stage consists of C7, C8, R20, R15, R18 and U4. These components form a 2nd order Tchebyschyeff high-pass filter. The front panel Low Freq Enhance control sets the amount of bass boost produced by the filter. Refer to Figure 4-4 and 4-5 which typifies the frequency response of this circuit. The filter output, U4 pin 1 (pin 7), is routed to the Limiter Drive Circuit.

Figure 4-4 Low Frequency Enhance for Music

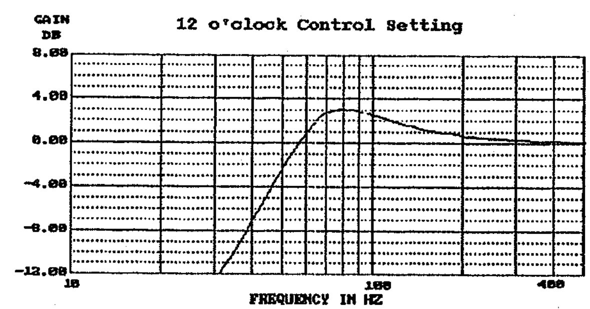
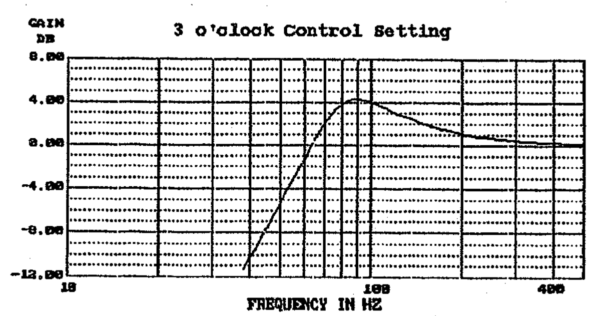


Figure 4-5 Low Frequency Enhance for Talk



4.12 Limiter Drive Circuit

The stage is located on the Front Panel circuit board (refer to schematic page 4). This circuit is a simple voltage divider consisting of R33, 1/2 of R31 and R30 (R32, 1/2 of R31 and R25). The input is received from the Low Frequency Enhance Stage. The divider output is routed to the High Frequency Equalization Stage.

4.13 High Frequency Equalization Stage

The stage is located on the Front Panel circuit board (refer to schematic page 4). The High Frequency Equalization stage is composed of U5/A, C11, R28, R27, R29 and 1/2 of R26 (U5/B, C9, R24, R23, R22 and 1/2 of R26). When the front panel HI FREQ EQUALIZATION control is in its detent position the primary NRSC pre-emphasis curve is implemented. The variable control R29 (R22) is adjusted during factory calibration to attain the correct gain necessary through U5 so the left and right channel NRSC pre-emphasis has the correct response when the HI FREQ EQUALIZATION control is in the NRSC (detent) position. These controls also optimize the channel to channel tracking. When the HI FREQ EQUALIZATION is fully clockwise, up to 2 dB more pre-emphasis at 10kHz is added as measured at pin 1 (pin 7) of U5, than the NRSC pre-emphasis detent position. The output signal is routed to the Matrix Encoding Amplifiers located on the Main circuit board via J3 pin 1 (pin 2).

4.14 Matrix Encoding Amplifiers

The matrix encoding amplifier stages produce a L+R (monaural signal) and L-R (stereo signal) for following limiter stages. Each encoder receives its input from the High Frequency Equalization stage via J14 pin 1 (pin 2).

4.14.1 L+R Encoding Amplifier

The L+R Encoding Amplifier consists of U18/A and R112 (refer to schematic page 4). A precision resistor network, R112, is used to produce the L+R signal, eliminating the need for any calibration. The encoders output may be observed at TP12 (L+R Encode). The L+R signal is routed to the L+R Tri-Band Limiter Stage.

4.14.2 L+R Encoding Amplifier

The L-R Encoding Amplifier consists of U33/A, R231 and R232 (refer to schematic page 5). Precision resistor networks, R231 and R232, are used to produce the L-R signal, eliminating the need for any calibration. The encoders output may be observed at TP21 (L-R Encode). The L-R signal is routed to the L-R Tri-Band Limiter Stage.

4.15 L+R/L-R Tri-Band Limiter Stage

The L+R and L-R Tri-band Limiters receive their inputs from the Matrix Encoding Amplifiers. The signal is first split into 3 bands using 3rd order filters: Low-band (50Hz to 480Hz), Mid-band (480Hz to 3.65kHz) and High-band (3.65kHz to 9.5kHz). The low-band filter consists of U17/A (U32/A) and associated components. The mid-band filter consists of U3/A, U2, U3A/A (U3/B, U1, U3A/B) and associated components. The high-band filter consists of U17/B (U32/B) and associated components. The output of each filter is then routed to a fast peak limiter. The operation of each limiter is described separately.

4.15.1 Low-band Limiter

The low-band limiter's input is at R108 (R227). Q13 and Q14 (Q33, Q34 and Q35) are limiting threshold detectors. U16/A is the limiting element. This element is a semiconductor voltage controlled resistors (patented by CRL, U.S. Pat. #4,393,346). The operation of this element is identical to those used in the AGC Stage (see 4.10). The input signal is applied to the threshold detectors through R107. Note that 2 threshold detectors are used in the L+R limiter, while 3 are used in the L-R limiter. The L+R detector only limits negative peaks. Positive peaks are not limited to help produce additional positive peak modulation in the transmitter. The L-R detector limits negative and positive peaks since asymmetrical modulation is not useful in the L-R modulation. The threshold detectors are coupled to the limiting element through R106, C63 and R101 (R225, C166 and R220). R106 and C63 (R225 and C166) determine the attack time constant. R101 and C63 (R220 and C166) determine the release time constant.

4.15.2 Mid-band Limiter

The mid-band limiter's input is at R165 (R200). Q18, Q19 and Q20 (Q21, Q22 and Q23) are limiting threshold detectors. U22/A (U22/B) is the limiting element. The threshold detectors are coupled to the limiting element through R159, C108 and R160 (R194, C133 and R195). R159 and C108 (R194 and C133) determine the attack time constant. R160 and C108 (R195 and C133) determine the release time constant.

4.15.3 High-band Limiter

The high-band limiter's input is at R142 (R262). The signal is first applied to a diode peak limiting circuit composed of CR18, CR19, C92, C93 and R143 (CR20, CR21, C191, C192 and R263). Its function is to limit high frequency peaks to minimize distortion in the following limiter. Q15, Q16 and Q17 (Q36, Q37 and Q38) are limiting threshold detectors. U16/B (U31/B) is the limiting element. The threshold detectors are coupled to the limiting element through R137, C87 and R132 (R257, C184 and R252). R137 and C87 (R257 and C184) determine the attack time constant, with R132 and C87 (R252 and C184) determining the release time constant.

4.15.4 Summer and Wide band Peak Limiter

The output of each limiter is summed by U15/A (U30/A). The summed output is routed to a diode limiter consisting of U15/B, CR500, R500, R503 and R504 (U30/B, CR501, CR502, R505, R508 and R509). Note that 1 diode is used in the L+R limiter, while 2 are used in the L-R limiter. The L+R limiter only limits negative modulation peaks. Positive peaks are not limited to help produce additional positive peak modulation in the transmitter. The L-R section limits negative and positive peaks since asymmetrical modulation is not useful in the L-R modulation. The output of the Tri-band Limiter stage may be observed at TP9B (L+R Limit) and TP20 (L-R Limit)

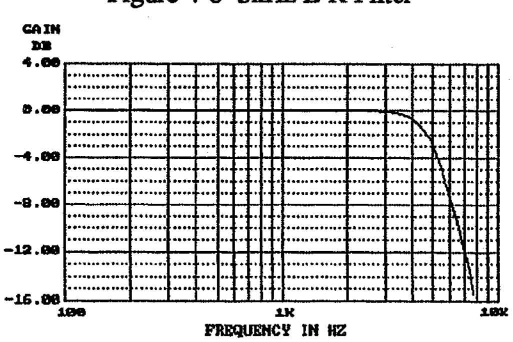
4.16 Output Filter Stage

The Output Filter stage consists of a selectable 5kHz Narrow band L-R Low-pass Filter and companion L+R All-pass circuit, L+R/L-R Delay Equalizers and L+R/L-R Output Filters (refer to schematic page 6). The operation of each section is described separately.

4.16.1 Narrow band L-R Filter

The 5kHz Narrow band L-R filter receives its input from the L-R Tri-Band Limiter. J13 allows the filter to be connected in- circuit or bypassed. U19, C94, R144 to R147, C72 and R114 to R117 form a 4th order low-pass filter (see figure 4-6).

Figure 4-6 5kHz L-R Filter



4.16.2 L+R All-pass Circuit

The L+R All-pass circuit receives its input from the L+R Tri-Band Limiter. J12 allows the circuit to be connected in-circuit or bypassed. U9, C32, C33, R34 to R40 and R66 to R68 form the all- pass circuit. R39 is used to calibrate the circuit to produce the same delay characteristics as the L-R low-pass filter. R68 adjusts the circuit for unity gain.

4.16.3 L+R/L-R Delay Equalizers

The output of J12 (J13) drives the delay equalizer formed by U14 (U29) and the network composed of R96, R95, R131, R130, R129, R128, C56, C57, C85, and C83 (R215, R214, R250, R251, R248, R249, C159, C160, C183 and C181). The output of U14 pin 7 (U29 pin 7) is applied to the input source resistor R127 (R247) of the output filter.

4.16.4 L+R/L-R Output Filters

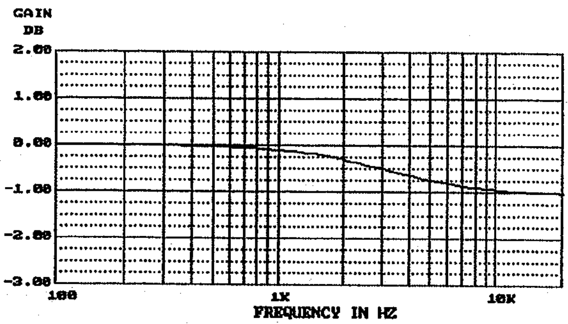
The low pass filter exceeds NRSC stop band specification (EIA- 549). The filter is composed of L8, L9, L6, L5, L4, L7, L3, C81, C51, C52, C53, and C54 (L23, L24, L21, L20, L19, L22, L18, C178, C155, C156, C157, and C158). The filter has two possible bandwidth positions using the rear panel BANDWIDTH 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 11kHz position (IN) L6 (L21) are shorted out. C53 and C54 (C155 and C156) are floating. C51 and C52 (C157 and C158) are disconnected from the low side of L5 (L20) and switched to the low side of L3 (L16). The output of L7 (L22) is terminated by R148 (R237) and is also routed to a high frequency shelving filter.

4.16.5 HF Shelving Filter

The shelving filter is composed of J500, R155, R154 and C107 (J501, R238, R239 and C176). This filter is included to minimizes high frequency overshoots common in plate modulated transmitters. J500 (J501) is used to enable or disable the filter. The filter operates by reducing high frequency peak modulation above 3kHz by about 1dB (see figure 4-7).

NOTE: J500 and J501 are only included on Version 4 Main Circuit Boards. The HF Shelving filters on Version 3 circuit boards are enabled by installing 4.75kohm resistors at R154 and R239. The resistors are not installed when the filters are not used.

Figure 4-7 HF Shelving Filter Response



4.16.6 Overshoot Correction

Overshoot correction for this filter is provided by transistors Q9, Q10, Q7, and Q11 (Q30, Q28, Q29 and Q31). The clipping threshold for Q11 is provided by Q6 and its associated voltage divider R91, R121 and C79. The collector of Q6 is routed to the base Q5. Whenever the collector of Q5 attains -.6 volts U13/B will invert the signal and cause the output at pin 7 of U13 to illuminate DS4, L+R Peak Limiting LED. Clipping bias for Q7 is provided by Q8 and its associated voltage divider R122, R123 and C80.

In the L-R path clipping threshold for Q30 and Q28 is provided by Q32 and voltage divider R245, R246 and C179. Q26 sets the clipping threshold for Q29 and Q31. The collector of Q26 is routed to the base of Q27. Whenever the collector of Q27 attains -.6 volts U13/A will invert the signal and cause pin 1 to illuminate DS3, L-R Peak Limiting LED.

The emitters of Q6, Q8, Q12, Q32 and Q26 have a "Ferrite Bead" placed over their emitter leads to prevent high frequencies from being generated during clipping.

4.16.7 Asymmetry Control

Asymmetry control circuitry is formed by the ASYMMETRY control, R35 located on the front panel, and a voltage divider composed of R126, R94, R125, R124 and C82. 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.

4.17 Mode Switch

The output of the L+R and L-R sections of the filter are applied to the MODE switch located on the rear panel (see schematic page 7) and routed through the Proof, Operate, Reverse, or Left Only positions. From the common poles of the MODE switch the L+R and L-R signals are routed to the Tilt Correction Stage.

4.18 Tilt Correction Stage

The Tilt Correct control on the front panel, R36, allows low frequency compensation for plate modulated transmitters (refer to schematic page 7). When the Tilt Correct control is fully counter-clockwise S1 associated with R36 disconnects the potentiometer from the circuit. When S1 is ON the gain of U26/A is increased as the wiper voltage potential gets closer to ground. Frequencies lower than approximately 50Hz are phase shifted through C126 and C125. Tilt correction is utilized only in the L+R channel. In the L-R channel C147 and C148 compensate for the Tilt correction occurring in the L-R channel. This prevents lose of separation at low frequencies when Tilt Correction is applied.

4.19 Matrix Decoders

The L+R and L-R signals are summed at pin 3 of U25/A to recover the Left channel information. The L+R and L-R signals are subtracted by sending the L+R signal to pin 14 (non-inverting) of U25 and the L-R signal to pin 13 (inverting) of U25 to recover the Right channel information. Variable controls R181 and R212 are adjusted so the inputs ports of U25 have the correct signal levels to decode the Left and Right channel information. The decoded signals may be monitored at TP17A (Left Single Ch. Limiter Out) and TP17 (Right Single Ch. Limiter Out).

4.20 Single Channel Limiters

Single Channel Limiting is accomplished by taking a sample of the output of U24 pin 1 (pin 7) and routing it back to the emitter of Q24 (Q25). As the Single Ch. Limiter control, located on the front panel, is turned clockwise the voltage on the base of Q24 (Q25) gets closer to ground potential. Absolute limiting is done by Q24 (Q25). As the transistor begins to conduct the collector sends a DC component that varies with the audio signal to the input of U23 pin 2 (pin 6). The output of U23 drives current into the control ports of U25 pin 1 (pin 16). U25 is configured as a VCA

(Voltage Controlled Amplifier). As the current increases, a very fast AGC action takes place within the VCA.

Turning R42 fully counterclockwise turns S2 Off. This disconnects R43 from ground, forcing the voltage at Q25's base to +5V. This effective prevents any single channel limiting from occurring. This feature is useful when making "proof-of-performance" measurements.

4.21 Output Stage

The Output Stage consists of the Output Level Control circuit and Output Amplifiers (refer to schematic page 7). The left and right channel single channel limiter outputs (TP17A and TP17) are routed to a L+R and L-R matrix encoder. L+R and L-R signals are required for the front panel Output Level control. U2B/B, R184/E and R184/D produce the L+R signal. U2B/A, R184/B, R184/C and R185 produce the L-R signal. These signals are then routed to front panel Output Level control via J18 pins 9 and 10.

The front panel Output Level control was designed to adjust L+R and L-R output levels at the same time. This feature greatly simplifies the adjustment of modulation levels. The L+R signal is received through J4 pin 9. It is then applied to one section of the Output Level control, R34. U6/A serves as a buffer amplifier, with the output appearing at U6 pin 1. The output is routed to the matrix decoders via J4 pin 2.

The L-R signal is received through J4 pin 10. It is then applied to one section of the Output Level control, R34. The wiper of R34 is connected to the front panel L-R Level control. U6/B serves as a buffer, with the output appearing at U6 pin 7. R45 is used to calibrate the 12 o'clock detent position of the L-R Level control. The output is routed to the matrix decoders via J4 pin 3.

U34/B, R236/E and R236/D form a precision matrix decoder. Left channel audio appears at the output, U34 pin 7. J17 is an Output Decoding jumper. Either Left Channel or L+R (mono) may be selected. Right channel audio is decoded by U34/A, R236/B, R236/C and R236A. J17A selects either a Right Channel or L-R signal.

J16 and J16A select the Output Level Range. In the Low position, the signal is attenuated by approximately 10dB. No attenuation occurs in the High position. The output of these jumpers can be observed at TP22 and TP22A. These signal are routed to the Output Amplifiers.

Output Amplifiers U20 (U21) are configured for balanced outputs. R149 and R186 (R152 and R157) serve to protect the outputs under a shorted condition at the output terminals. C103 and C130 (C105 and C132) compensate U20 (U21) so it can drive high capacitance loads. The output signal is applied to a single-section LC low-pass RFI filter consisting of C99 to C101, L12, and L13 (C96 to C98, L10, and L11) is connected to the output terminal strip J15- 7, J15-8 and J15-9 (J15-10, J15-11, and J15-13).

4.22 Auxiliary Output Stage

The auxiliary output stage provides a separate monaural output to drive an auxiliary transmitter (refer to schematic page 7). The L+R signal is received from the wiper of rear panel Mode Switch, S2. U11/B is a buffer amplifier. U11/A is a selectable Tilt Correction circuit. The operation of this circuit is the same as described in section 4.18. Jumper J9 is used to enable or disable the tilt correction. The Tilt Correction control, R280, is located on rear panel control circuit board (A1). The tilt correction output appears at U11 pin 1. This signal is routed to the Mono Output control which is also located on the rear panel circuit board. The wiper of this control is connected to a balanced output amplifier, U12. R82 and R84 serve to protect the outputs under a shorted condition at the output terminals. C41 and C46 compensate U12 so it can drive high capacitance loads. The output signal is applied to a single-section LC low-pass RFI filter consisting of C75 to C77, L1, and L2 is connected to the output terminal strip J15-13 and J15-14.

4.23 Proof Amplifier

The proof amplifier consists of U8 and associated components (refer to schematic page 1). Left and right channel audio is received from TP8 and TP7. U8/A, R32 and R33 produce a L+R signal. This signal is routed to the L+R Proof position of the rear panel Mode Switch.

U8/B and R60 through R65 produce a L-R signal. R62 and R63 are included to align the stage. The L-R output is routed to the L-R Proof position of the rear panel Mode Switch.

4.24 FACTORY TEST PROCEDURE

A. EQUIPMENT REQUIRED

AUDIO GENERATOR (Potomac Inst. AG-51)

AUDIO ANALYZER (Potomac Inst. AA-51)

2 CHANNEL OSCILLOSCOPE

FREQUENCY COUNTER

DIGITAL MULTIMETER (DMM)

AMIGO AM REFERENCE UNIT

B. EQUIPMENT CONNECTIONS

Connect AG-51 L and R Outputs to AMIGO AM inputs.

Connect AA-51 L and R Inputs to AMIGO AM outputs.

C. EQUIPMENT SETTINGS

Audio Generator (AG-51): 400 Hz, LOW DIST, L+R, 10 dB Atten.

Audio Analyzer (AA-51): VM, +10 dB RANGE.

Digital Multimeter (DMM): 20 VDC

Oscilloscope: SENSITIVITY = .5 mV/div, 5 mS/div

INITIAL AMIGO AM CONTROL SETTINGS:

FRONT PANEL:

INPUT LEVEL = "MAX"

INPUT BALANCE = 12 o'clock

LOW FREQ ENHANCE = "FLAT"

MID RANGE PRESENCE = "FLAT"

HI FREQ EQUALIZATION= "FLAT"

LIMITER DRIVE = "MIN"

OUTPUT LEVEL = "MAX"

ASYMMETRY = "MIN"

TILT CORRCT = "OFF"

L-R LEVEL = 12 o'clock

SINGLE CH LIMITER = "MIN"

REAR PANEL:

MODE SW. = "OPERATE"

BANDWIDTH = "9.5 KHz" (out)

MONO TILT CORRECT = full CCW

MONO OUTPUT LEVEL= full CCW

D. INITIAL JUMPER SETTINGS

MAIN CIRCUIT BOARD:

J10,J11 (4 jumpers)="LOW"

J10A,J11A = "TERM"

J16,J16A = "HIGH"

J17 = "L"

J17A = "R"

J19,J20 = "IN"

J7 = "-20 dB"

J9,J12,J13 = "OUT"

J500,J500 **(not on Ver 4)** = "OUT"

J3,J4 = REMOVED

AGC/STEREO ENHANCE BOARD:

J2,J3 = "HIGH"

J4,J5 = "0dB"

J6,J7,J8 = "MED"

NOTE: On Version 3 Main PCB, R154 and R239 are not installed. They are installed on Version 4.

E. INTERNAL CONTROL SETTINGS

ALL button pots set to mid-range.

F. POWER SUPPLY CHECK

220 VAC CHECK

* Set Power Module voltage selector to "220 VAC". Measure voltages:

TP-2: +15 VDC (+14.60 to +15.40 VDC).

TP-3: -15 VDC (-14.60 to -15.40 VDC).

TP-4: + 5 VDC (+ 4.75 to + 5.25 VDC).

120 VAC CHECK

* Set Power Module voltage selector to "120 VAC".

Measure voltages:

TP-2: +15 VDC (+14.60 to +15.40 VDC).

TP-3: -15 VDC (-14.60 to -15.40 VDC).

TP-4: + 5 VDC (+ 4.75 to + 5.25 VDC).

* Install J3 and J4.

Check TP-2 and TP-3 voltages remain within specification.

G. INPUT AMP, BALANCE AMP and INPUT METER

* AG-51 to 25 dB ATTEN, 400 Hz.

* Ch.1 Scope probe to TP-8 (Left Balance Amp Out).

* Ch.2 Scope probe to TP-7 (Right Balance Amp Out).

* Scope to "X-Y" display, 1V/Div, AC Input.

* Adjust INPUT BALANCE control for "In-phase" X-Y Scope Trace.

Check INPUT BALANCE control setting from 11 to 1 o'clock.

* DMM probe to TP-8.

* DMM to AC DECIBELS, 20 V scale.

Check for DMM reading of 5.8 dB (+5.5 to +6.1 dB).

* DMM probe to TP-7.

Check for DMM reading of 5.8 dB (+5.5 to +6.1 dB).

Check Input Meter "0" LEDs on.

*Turn INPUT BALANCE Control full CW.

Check Input Meter reading: Left Ch = "-1" Right Ch. = "+2"

*Turn INPUT BALANCE Control full CCW.

Check Input Meter reading: Left Ch = "+2" Right Ch. = "-1"

*Turn INPUT BALANCE Control to 12 o'clock.

* AG-51 to 15 dB ATTEN.

Check Input Meter for all LEDs on.

* AG-51 to 18 dB ATTEN.

Check Input Meter "OVERLOAD" LEDs (only) off.

* AG-51 to 31 dB ATTEN.

* Move J10A and J11A to "BRIDGE".

Check Input Meter "0" LEDs on.

* Move J10A and J11A to "TERM".

* Move J10 and J11 (4 jumpers) to "HIGH".

* AG-51 to 46 dB ATTEN.

Check Input Meter "0" LEDs on.

* Move J10 and J11 (4 jumpers) to "LOW".

H. PHASE PROCESSOR TEST

* AG-51 to 25 dB ATTEN, about 155 Hz.

* Ch.1 Scope probe to TP-300 (Left Input Filter Out).

NOTE: TP-1 on 8565 PCB for 1st 25 units.

* Ch.2 Scope probe to TP-301 (Right Input Filter Out).

NOTE: TP-2 on 8565 PCB for 1st 25 units.

* Scope to "X-Y" display, 1V/Div, AC Input.

Check Scope for "In-phase" X-Y trace.

* Move J19 to "OUT."

Check Scope for about "180 degree out-of-phase" X-Y trace.

* Move J19 to "IN."

I. INPUT FILTER TEST

* AG-51 to 25 dB ATTEN, 400 Hz.

* Ch.1 Scope probe to TP-300 (Left Input Filter Out).

NOTE: TP-1 (Left Mid Range Eq Out) on 8565 PCB for 1st 25 units.

* Ch.2 Scope probe to TP-301 (Right Input Filter Out).

NOTE: TP-2 (Right Mid Range Eq Out) on 8565 PCB for 1st 25 units.

* Scope to "X-Y" display, 1V/Div, AC Input.

Check Scope for "In-phase" X-Y trace.

* DMM Probe to TP-300.

NOTE: TP-1 on 8565 PCB for 1st 25 units.

Check for DMM reading of 5.8 dB (+5.5 to +6.1 dB).

* Set DMM to Relative.

Adjust AG-51 Frequency for DMM reading of -3.0 dB (about 12 kHz).

Check AG-51 Frequency for 12 kHz (11.5 to 12.5 kHz).

Check Scope for "In-phase" X-Y trace (less than .2 Div spreading).

J. MID RANGE EQUALIZER TEST

* AG-51 to 25 dB ATTEN, 400 Hz.

* Ch.1 Scope probe to TP-400 (Left Mid Range Eq Out).

NOTE: TP-1 on 8565 PCB for 1st 25 units.

* Ch.2 Scope probe to TP-401 (Right Mid Range Eq Out).

NOTE: TP-2 on 8565 PCB for 1st 25 units.

* Scope to "X-Y" display, 1V/Div, AC Input.

Check Scope for "In-phase" X-Y trace.

* DMM Probe to TP-400.

NOTE: TP-1 on 8565 PCB for 1st 25 units.

Check for DMM reading of 5.8 dB (+5.5 to +6.1 dB).

* Set DMM to Relative.

* Turn MID RANGE PRESENCE control to "MAX."

* Adjust AG-51 Frequency for highest DMM reading (about 3.0 kHz).

Check AG-51 Frequency for 3.0 kHz (2.9 to 3.1 kHz).

Check DMM reading +4.8 dB (4.5 to 5.0 dB).

Check Scope for "In-phase" X-Y trace (less than .2 Div spreading).

* Turn MID RANGE PRESENCE control to "FLAT."

K. GATE CIRCUIT TEST

* AG-51 to 47 dB ATTEN, 400 Hz.

Check GATE LED on (front-right side of Top PCB).

* AG-51 to 43 dB ATTEN.

Check GATE LED off.

* Move J7 to "-10 dB."

* AG-51 to 37 dB ATTEN.

Check GATE LED on.

* AG-51 to 33 dB ATTEN.

Check GATE LED off.

* Move J7 to "-20 dB."

L. AGC TEST

* AG-51 to 25 dB ATTEN, 100 Hz.

* Ch.1 Scope probe to TP-6 on Top PCB (Enhanced Out L).

* Ch.2 Scope probe to TP-5 on Top PCB (Enhanced Out R).

* Scope to "X-Y" display, 1V/Div, AC Input.

Check Scope for "In-phase" X-Y trace (less than .1 Div spreading).

* DMM Probe to TP-6.

Check for DMM reading of 3.9 dB (+3.0 to +5.0 dB).

* AG-51 to 1 kHz.

Check for DMM reading of 3.1 dB (+2.5 to +3.5 dB).

Check Scope for "In-phase" X-Y trace (less than .1 Div spreading).

* Move J4 and J5 (Top PCB) to "12 dB."

Check for DMM reading of 3.7 dB (+3.4 to +4.0 dB).

Check Scope for "In-phase" X-Y trace (less than .1 Div spreading).

* Set DMM for Relative.

* Move J8 to "FAST."

Check for DMM reading of +0.58 dB (+0.4 to +0.65 dB).

* Move J8 to "SLOW."

Check for DMM reading of -0.4 dB (-0.3 to -0.5 dB).

* Move J8 to "MED."

* AG-51 to 100 Hz.

* DMM Relative Off.

Check for DMM reading of 4.2 dB (+3.9 to +4.5 dB).

Check Scope for "In-phase" X-Y trace (less than .1 Div spreading).

M. STEREO ENHANCE CALIBRATION & TEST

* AG-51 to 15 dB ATTEN, 1 kHz.

* Ch.1 Scope probe to TP-8 on Top PCB (Offset Cal).

* Scope to 500uS/Div sweep, .2V/Div, DC Input.

* Turn BALANCE control full CCW.

Adjust R118 on Top PCB (Offset Cal.) for symmetrical waveform around ground (less than 100 mV DC offset). If setting of R118 is not between 6 and 12 o'clock, replace U7 and recalibrate.

Check that waveform has no distortion or glitches.

Check Activity LED (DS1) on.

* Turn BALANCE control to 12 o'clock.

Check Activity LED (DS1) off.

* Move J4 and J5 (Top PCB) to "0 dB."

N. LOW FREQ ENHANCE Control TEST

* AG-51 to 35 dB ATTEN, 1 kHz.

* Ch.1 Scope probe to TP-13A (Left LF/HF Equalizer Output).

* Ch.2 Scope probe to TP-13 (Right LF/HF Equalizer Output).

* Scope to "X-Y" display, 50 mV/Div, DC Input.

* DMM Probe to TP-13A.

Check Scope for "In-phase" X-Y trace (less than .1 Div spreading).

* DMM scale to 2 V.

Check for DMM reading of -24 dB (-22 to -26 dB).

* Set DMM to Relative.

* AG-51 to 100 Hz.

Check for DMM reading of +2.1 dB (+1.8 to +2.4 dB).

* Turn LOW FREQ ENHANCE control to "MAX."

Check for DMM reading of +6.6 dB (+6.0 to +7.2 dB).

Check Scope for "In-phase" X-Y trace (less than .3 Div spreading).

* Turn LOW FREQ ENHANCE control to "MIN."

O. HI FREQ EQUALIZATION Control CALIBRATION & TEST

* AG-51 to 400 Hz.

* Turn DMM Relative off, then back ON.

* AG-51 to 7 kHz.

* Turn HI FREQ EQUALIZATION control to 12 o'clock NRSC detent.

Adjust R26 (Front PCB) for DMM reading of +10.0 dB.

Adjust R22 for Scope trace with no spreading. Trace should also form a perfect diagonal line.

* Turn HI FREQ EQUALIZATION control to "FLAT."

P. LIMITER DRIVE Control TEST

* AG-51 to 400 Hz.

* Turn LIMITER DRIVE control to 12 o'clock detent.

Check for DMM reading of +2.5 dB (+2.3 to +2.7 dB).

* Turn LIMITER DRIVE control to "MAX."

Check for DMM reading of +6.6 dB (+6.1 to +7.1 dB).

Q. L+R and L-R Encoding TEST

* LIMITER DRIVE at "MAX."

* AG-51 at 400 Hz.

* DMM probe to TP-12 (L+R Encode) on Main PCB.

Check for DMM reading of -17.2 dB (-16 to -18 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "L-R."

Adjust BALANCE control for lowest DMM reading (greater than -50 dB).

Check that BALANCE control is between 11 and 1 o'clock.

* DMM probe to TP-21 (L-R Encode) on Main PCB.

Check for DMM reading of about 0 dB (-.5 to +.5 dB).

* AG-51 Output Sw. to "L+R."

Check for DMM reading of greater than -50 dB.

* LIMITER DRIVE to "MIN."

R. L+R and L-R BAND OUTPUT TEST

* AG-51 to 35 dB ATTEN, 200 Hz.

* AG-51 Output Sw. to "L."

* Ch.1 Scope probe to TP-9B (L+R Limit).

* Ch.2 Scope probe to TP-20 (L-R Limit).

* Scope to "X-Y" display, 200 mV/Div, DC Input.

Check that DC Offset is less than .4 Div. If Offset is to great in left or right direction, replace U15. If Offset is to great in up or down direction, replace U30.

* Set Scope to AC Inputs.

Check Scope for "In-phase" X-Y trace (less than .5 Div total spreading).

Sweep AG-51 from 200 Hz to 10 kHz while watching the amount of spread. The spread should never exceed .5 Div total.

S. L-R NARROWBAND FILTER TEST

* AG-51 to 35 dB ATTEN, 400 Hz.

* AG-51 Output Sw. to "L-R."

* DMM Probe to TP-14.

Check for DMM reading of -8 dB (-7 to -9 dB).

* Set DMM to Relative.

Adjust AG-51 for DMM reading of -3.0 dB (at about 5 kHz).

Check AG-51 frequency between 4.9 and 5.1 kHz.

T. L+R NARROWBAND DELAY EQ. CALIBRATION TEST

* AG-51 to 35 dB ATTEN, 2 kHz.

* AG-51 Output Sw. to "L."

* Ch.1 Scope probe at TP-14.

* Ch.2 Scope probe to TP-10.

* Scope to "X-Y" display, 200 mV/Div, AC Input.

Adjust R39 (Delay) to reduce (as much as possible) the scope trace spreading.

* DMM Probe to TP-9B (L+R Limit).

Check for DMM reading of -14 dB (-13 to -15 dB).

* Set DMM to Relative.

* DMM Probe to TP-10 (L+R NB Delay EQ).

Adjust R68 (Gain Cal) for DMM reading of 0.00 dB (-0.01 to +0.01 dB).

U. L+R FILTER ADJUSTMENT

* AG-51 to 400 Hz, 35 dB ATTEN.

* AG-51 Output Sw. to "L+R."

* DMM Probe to TP-9 (L+R Filter Output).

Check DMM reading of -9.9 dB (-9 to -11 dB).

* Set DMM to Relative.

* Frequency Counter to TP-8 (Left Balance Amp Out).

* AG-51 to 10.900 KHz (10.895 to 10.905 KHz).

NOTE:

To obtain null in next step you may have to increase C51's value (MAX .01 mfd).

Adjust L5 for best null (DMM reading greater than -50 dB).

V. L-R FILTER ADJUSTMENT

* AG-51 at 400 Hz, 35 dB ATTEN.

* AG-51 Output Sw. to "L-R."

* DMM Probe to TP-19A (L-R Filter Output).

Check DMM reading of -9.9 dB (-9 to -11 dB).

* Set DMM to Relative.

* Frequency Counter at TP-8 (Left Balance Amp Out).

* AG-51 at 10.900 KHz (10.895 to 10.905 KHz).

NOTE:

To obtain null in next step you may have to increase C157's value (MAX .01 mfd).

Adjust L20 for best null (DMM reading greater than -50 dB).

W. 9.5 KHz SEPARATION ADJUSTMENT

* AG-51 to 9.5 kHz (9.49 to 9.51 KHz), 35 dB ATTEN.

* AG-51 Output Sw. to "L."

* Ch.1 Scope probe to TP-9 (L+R Filter Output).

* Ch.2 Scope probe to TP-19A (L-R Filter Output).

* Scope to "X-Y" display, 50 mV/Div, AC Input.

Tweek L20 to minimize waveform spreading.

X. ASYMMETRY CIRCUIT ADJUSTMENT

* DMM to DC VOLTS.

* Check ASYMMETRY control full CCW.

* DMM probe to front side of R121.

Check for DMM reading of +1.35 to +1.50 VDC (remember reading).

* DMM probe to TP-9A (Asymmetry).

Adjust R126 (Asymmetry Cal.) for same NEGATIVE voltage (as front side of R121) within .01 volts.

* Turn front panel ASYMMETRY control to "MAX."

Check for DMM reading of -3.4 VDC (-3.0 to -3.8 VDC)

* Turn front panel ASYMMETRY control to "MIN."

Y. LEFT CHANNEL AND RIGHT CHANNEL DECODING ADJUSTMENT

Check that rear panel MODE SW is in "Operate."

* AG-51 to 1 kHz, 35 dB ATTEN.

* AG-51 Output Sw. to "L+R."

* DMM probe to TP-12 (L+R Encode).

* DMM to AC dB, 2V scale.

Check for DMM reading of -24 dB (-22 to -26 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "L-R."

Tweek INPUT BALANCE control to null DMM reading (-50 dB typical).

BALANCE control should be between 11 and 1 o'clock.

* Turn DMM Relative off.

* DMM probe to TP-17A (Left Sng Ch Lim Out).

* AG-51 Output Sw. to "L+R."

Check for DMM reading of -10.7 dB (-10 to -12 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "R."

Adjust R181 (Left De-Matrix) for best DMM null (greater than -45 dB).

* DMM probe to TP-17 (Right Sng Ch Lim Out).

* AG-51 Output Sw. to "L+R."

Check for DMM reading of -10.9 dB (-10 to -12 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "L."

Adjust R212 (Right De-Matrix) for best DMM null (greater than -45 dB).

Z. PROOF ENCODE ADJUSTMENT

* Rear Panel MODE switch to "PROOF".

* AG-51 Output Sw. to "L+R."

* DMM probe to TP-17A (Left Sng Ch Lim Out).

NOTE: connecting a scope probe also will make it easier to find the null in the following steps.

* Turn DMM Relative off.

Check for DMM reading of -5 dB (-4 to -6 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "R."

Adjust R62 (L-R Proof Encode) for best DMM null (greater than -65 dB).

* DMM probe to TP-17 (Right Sng Ch Lim Out).

NOTE: connecting a scope probe also will make it easier to find the null in the following steps.

* AG-51 Output Sw. to "L+R."

Check for DMM reading of -5.7 dB (-4.5 to -6.5 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "L."

Adjust R63 (L+R Proof Encode) for best DMM null (greater than -65 dB).

* Rear Panel MODE switch to "OPERATE".

AA. SINGLE CH. LIMITER CONTROL TEST

* DMM probe to TP-18A (Sng Ch Lim Ref).

* DMM to DC Volts, 20 V scale.

Check SINGLE CH. LIMITER control is turned fully CCW.

Check for DMM reading of +5.0 VDC (+4.75 to +5.25 VDC).

* Turn SINGLE CH. LIMITER control to 12 o'clock.

Check for DMM reading of +2.6 VDC (+2.5 to +2.7 VDC).

* Turn SINGLE CH. LIMITER control to "MAX."

Check for DMM reading of +3.6 VDC (+3.4 to +3.8 VDC).

* Turn SINGLE CH. LIMITER control to "MIN."

AB. L-R LEVEL CONTROL CALIBRATION

Check Rear Panel MODE switch is in "OPERATE".

Check L-R LEVEL CONTROL is set to 12 o'clock detent position.

* DMM probe to TP22 (Left Output Mode).

* DMM to AC, dB, 2 V scale.

* AG-51 at 1 kHz, 35 dB ATTEN.

* AG-51 Output Sw. to "L+R."

Check for DMM reading of -17 dB (-16 to -18 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "R."

Adjust R45 on Front PCB for best DMM null (greater than -45 dB).

* DMM probe to TP22A (Right Output Mode).

* Turn DMM Relative off.

Check for DMM reading of -17.5 dB (-16.5 to -17.5 dB).

* Set DMM to Relative.

* AG-51 Output Sw. to "L."

Check for DMM reading (null) greater than -45 dB.

AC. SINGLE CH. LIMITER TEST

* Ch.1 Scope probe to TP-17A (Left Sng Ch Lim Out).

* Scope to "100uS/Div sweep, 2 V/Div, DC Input.

* AG-51 to 3 kHz, 25 dB ATTEN.

* AG-51 Output Sw. to "L."

* J4 and J5 (Top PCB) to 12 dB.

* HI FREQ EQUALIZATION and LIMITER DRIVE controls to "MAX."

* Check SINGLE CH LIMITER control is fully CCW.

Check scope for waveform, approximately 8 V peak-to-peak. Both peaks rounded.

* Turn SINGLE CH LIMITER control slightly clockwise until it clicks.

Check scope for waveform, approximately 6 V peak-to-peak. Positive peak clipped, negative peak just rounded.

* Turn SINGLE CH LIMITER control fully CCW.

* Ch.1 Scope probe to TP-17 (Right Sng Ch Lim Out).

* AG-51 Output Sw. to "R."

Check scope for waveform, approximately 8 V peak-to-peak. Both peaks rounded.

* Turn SINGLE CH LIMITER control slightly clockwise until it clicks.

Check scope for waveform, approximately 6 V peak-to-peak. Positive peak clipped, negative peak just rounded.

* Turn SINGLE CH LIMITER control fully CCW.

* HI FREQ EQUALIZATION and LIMITER DRIVE controls fully CCW.

AD. MAIN OUTPUT AMP TEST

* Connect AA-51 Left and Right Inputs to AMIGO AM Left and Right outputs.

* AA-51 to VM, L input, 0 dB RANGE.

* AG-51 to 200 Hz, 25 dB ATTEN.

* AG-51 Output Sw. to "L+R."

Check J4 and J5 (Top PCB) in "12 dB" position.

Check OUTPUT LEVEL control fully CW.

Check for AA-51 reading of -1.5 dBm (-1 to -2 dBm).

* Turn OUTPUT LEVEL control fully CCW.

Check for AA-51 reading of -13 dBm (-12 to -14 dBm).

* Switch AA-51 to R input.

Check for AA-51 reading of -13 dBm (-12 to -14 dBm).

NOTE: Reading should not change much when switching from L to R Ch.

* Turn OUTPUT LEVEL control fully CW.

Check for AA-51 reading of -1.5 dBm (-1 to -2 dBm).

* Move J16 and J16A to "LOW."

Check for AA-51 reading of -11.5 dBm (-11 to -12 dBm).

* Switch AA-51 to L input.

Check for AA-51 reading of -11.5 dBm (-11 to -12 dBm).

* Move J16 and J16A to "HIGH."

AD. MONO OUTPUT AMP TEST

* Connect AA-51 Right Input to AMIGO AM Mono output.

* AA-51 to VM, R input, +10 dB RANGE.

* AG-51 to 200 Hz, 25 dB ATTEN.

* AG-51 Output Sw. to "L+R."

Check J4 and J5 (Top PCB) in "12 dB" position.

* Turn rear panel MONO OUTPUT LEVEL control fully CW.

Check for AA-51 reading of +9.5 dBm (+9 to +10 dBm).

AE. ASYMMETRY/TILT CORRECTION TEST

* AG-51 to 100 Hz, 25 dB ATTEN.

* AG-51 Output Sw. to "L+R."

Check J4 and J5 (Top PCB) in "12 dB" position.

Turn LOW FREQ ENHANCE and LIMITER DRIVE controls to "MAX."

* Ch.1 Scope probe to "+ Left Ch Output" on rear panel barrier strip.

* Scope to "2mS/Div sweep, 1 V/Div, DC Input.

Check waveform on scope for slight clipping on both peaks.

Both peaks should be about the same amplitude (about +/- 2 V peak).

* Turn the ASYMMETRY control fully CW.

Check scope waveform for no clipping on Positive Peak.

* Turn the ASYMMETRY control fully CCW.

* Turn TILT CORRECT control to "MAX".

Check waveform clipped peaks for "tilting" (approx. 45 degrees, with trailing edge at a higher amplitude than leading edge).

* TILT CORRECT control to "OFF".

AF. MONO TILT CORRECT TEST

* Scope probe to "+ MONO OUTPUT" (rear barrier strip).

* Turn MONO OUTPUT control (rear) fully CW.

* Scope to 5 V/Div.

Waveform should be clipped on positive and negative peaks.

* Move J9 to "IN".

* Turn MONO TILT CORRECT control (rear) to fully CW.

Check waveform clipped peaks for "tilting" (approx. 45 degrees, with trailing edge at a higher amplitude than leading edge).

* Turn MONO TILT CORRECT control fully CCW.

* Move J9 to "OUT".

AG. REFERENCE UNIT COMPARISON

Do X-Y Comparison to Reference Unit.

AH. PREPARATION FOR SPECIFICATION MEASUREMENT

* INPUT BALANCE control: 12 o'clock

* LOW FREQ ENHANCE control: CCW

* MID RANGE PRESENCE control: CCW

* HI FREQ EQUALIZATION control: CCW

* LIMITER DRIVE control: CCW

* OUTPUT LEVEL control: MAX

* ASYMMETRY control: CCW

* TILT CORRECT control: CCW

* L-R LEVEL control: 12 o'clock

* SINGLE CH LIMITER control: CCW

* J4 and J5 (Top PCB) to "0 dB."

AI. SPECIFICATION MEASUREMENT

* AG-51 Left & Right Outputs connected to AMIGO AM Left & Right Inputs.

* AG-51 to Low Dist, 400 Hz, L+R Output, 10 dB ATTEN, BAL, 600 OHMS and Operate.

Adjust INPUT LEVEL control so Input Meter shows 0 dB.

* Connect AA-51 Left and Right Inputs to AMIGO AM Left and Right outputs.

(1) Do Power Supply Measurements.

(2) Do "Operate Mode" THD Measurements.

* AG-51 to 15 dB ATTEN.

(3) Do "Proof Mode" THD Measurements.

* AG-51 to 10 dB ATTEN.

(4) Do Crosstalk Measurements.

(5) Do Channel Separation Measurements.

* AG-51 to 20 dB ATTEN.

(6) Do Frequency Response Measurements.

* AG-51 to 10 dB ATTEN.

(7) Do Signal/Noise Measurements (Add +10 dB to Readings). This is to compensate for the difference beteeen the 400 Hz tone amplitude and 100% modulation peak amplitude.

Section 5 - Matrix Processing

5.1 Processing Requirements

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

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

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

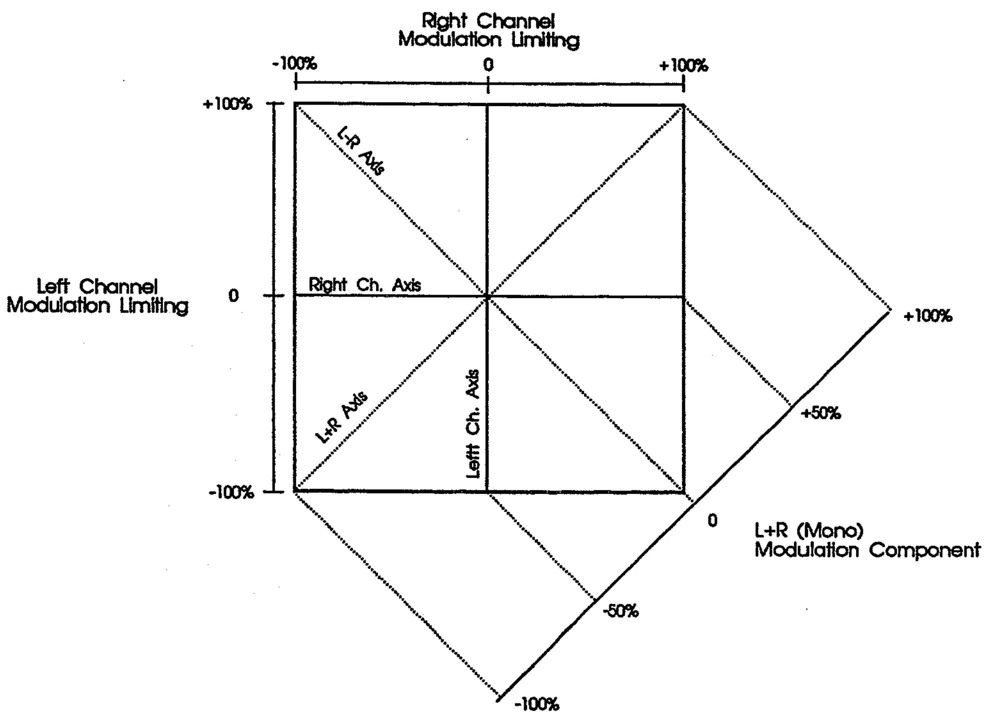
Matrix processing is used to achieve monaural versus stereo transmission compatibility. In AM stereo, the algebraic sum and difference of left and right channels occur prior to the points of the modulation. This difference as compared to FM stereo transmissions is what makes conventional audio processing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

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

5.2 Conventional Limiting

Figure 5-1 illustrates the oscilloscope X-Y display of the right and left limiter outputs of conventional stereo limiters. When applied to AM stereo transmissions, the amplitude limit levels of the left and right channels must be set equal to each other for proper stereo balancing. As shown, the limit levels are perpendicular to

Figure 5-1 Conventional Stereo Limiting



the right and left channel axis and intersect with each other to form the L+R and L-R modulation limits. They form the perimeter of the "box" in the illustration. The L+R axis represents the main monaural component transmitted by the AM envelope of the transmitter and the L-R axis represents the main stereo information component transmitted by the phase modulation of the carrier frequency. As long as the program input is mostly monaural, this limiting system produces nearly full 100% envelope modulation and nearly a straight line along the L+R axis and monaural reception remains normal.

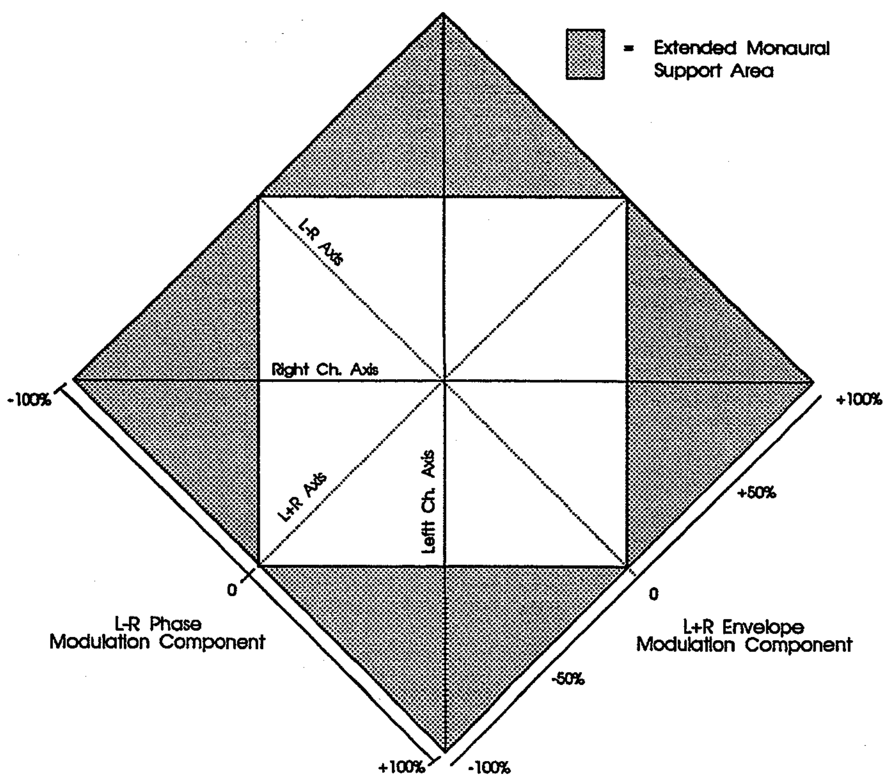
The figure also shows that this type of limiting creates serious monaural transmission and reception problems during varying stereo conditions. When stereo inputs temporarily shift to the full left only (vertical) or right only (horizontal) modulation axis, stereo reception is acceptable but monaural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

5.3 Full Matrix Limiting

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

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

Figure 5-2 Full Matrix Limiting



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

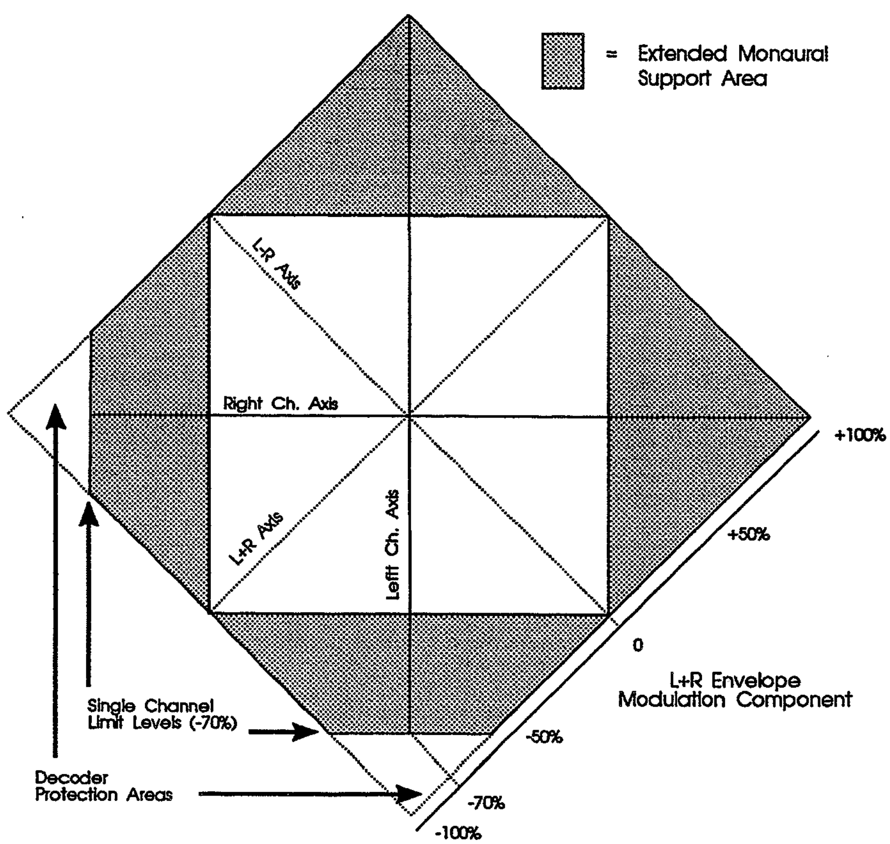
5.4 CRL Modified Matrix Limiting

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

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

This modified matrix system is designed to reduce the potential problem areas associated with stereo transmissions. At the removed corners shown in the figure 5-3, both L+R and L-R modulations are at maximum and can cause decoding difficulties. If high density negative peak L+R modulations are allowed to consistently reduce the transmitter carrier, the L-R decoding process has little or no carrier to demodulate. The result can be that either stereo decoding returns to monaural or produces distortions. Depending upon the degree of processing used and maximum L+R modulation depth, the single channel limiting network can be adjusted to the level which prevents or greatly reduces such stereo receiving problems.

Figure 5-3 CRL Modified Matrix Limiting



Section 6 - NRSC-1 and NRSC-2 Standards

6.1 General History

During the years 1986 through 1988, an extensive investigation into the effects of limiting AM broadcast transmission emissions was conducted in the U.S. by the National Radio Systems Committee (a committee of AM broadcast stations, AM receiver manufacturers, and broadcast equipment suppliers (including CRL), and others jointly sponsored by the National Association of Broadcasters and Electronic Industries Association).

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.

On June 24, 1988 NRSC-1 was adopted by the EIA as EIA-549, a standard establishing NRSC AM Pre-emphasis/De-emphasis and broadcast audio transmission bandwidth specifications. It should be noted that the amount of pre-emphasis specified by this standard is recommended, but not mandatory.

In September 1988, NRSC-2 was adopted by the EIA as EIA/IS-51, a standard to limit AM emissions and thereby control occupied bandwidth of MW AM broadcast stations. The standard was subsequently adopted by the Federal Communications Commission on April 12, 1989, for implementation beginning June 30, 1990.

6.2 NRSC-1 Pre-emphasis/De-emphasis

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

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

The response of the chosen pre-emphasis curve is shown in Figure 6-1. 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 wide-band radios (see figure 6-2). 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.

Figure 6-1 NRSC-1 Pre-emphasis

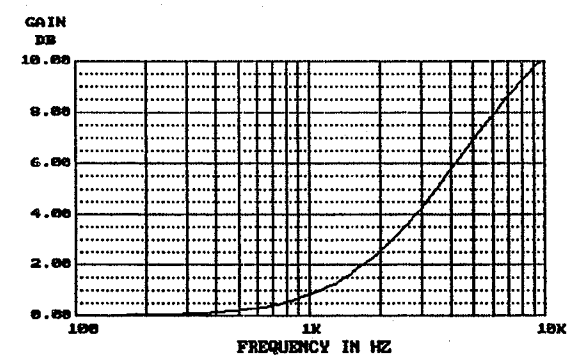
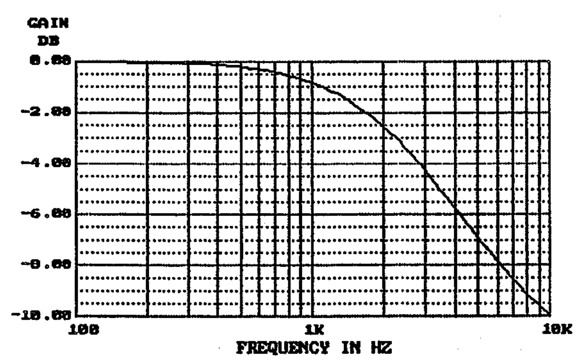


Figure 6-2 NRSC-1 De-emphasis



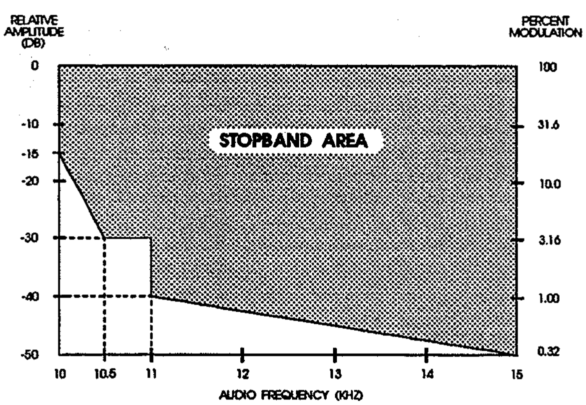
6.3 NRSC-1 Audio Filtering

The NRSC-1 standard also includes a specification for the maximum audio bandwidth transmitted by AM broadcast stations.

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

The specification of the chosen stopband characteristic is shown graphically in Figure 6-3. 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-1 specification).

Figure 6-3 NRSC-1 Audio Stopband Specification



NRSC Stopband Specification
(Audio Envelope Input Spectrum to AM Transmitter)

6.4 NRSC-2 Standard

NRSC-2 is a standard to limit AM emissions and thereby control occupied bandwidth of MW AM broadcast stations. As previously discussed, this standard was adopted by the Federal Communications Commission on April 12, 1989, for implementation beginning June 30, 1990. Basically, this standard (and correcponding FCC rule) specifies the maximum occupied bandwidth of an AM station. In addition, the standard specifies a standardized test to ensure compliance with the specifications. The specification is commonly refered to as an RF Mask. The specifications for this RF Mask are presented in Table 6-1 and Figure 6-4.

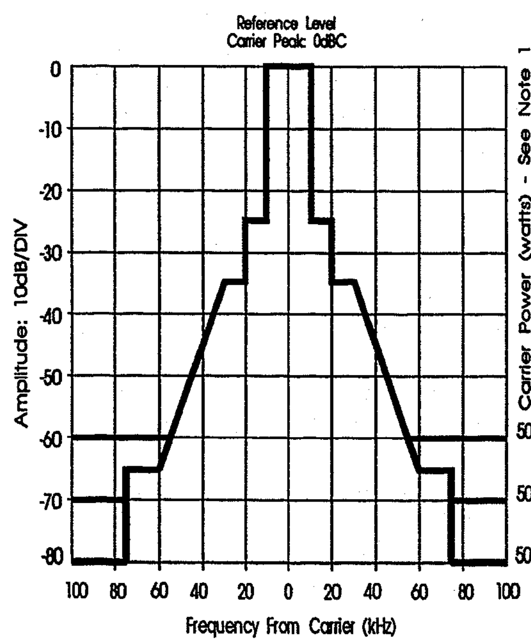
Table 6-1 NRSC-2 RF Mask Specification

Frequency Band Relative to Carrier (+/- kHz)	Attenuation Relative to Carrier (dB)
0 to 10	0
10 to 20	greater than -25
20 to 30	greater than -35
30 to 60	greater than -(5 + 1dB/kHz) from carrier (see note 1)
60 to 75	-65 (see note 1)
above 75	-80 (see note 1)

Note 1: For carrier power levels between 50 and 5000 watts, the maxium limit is -(43 + 10log(carrier power in watts) or the value listed in the table, whichever is the smaller amount of attenuation. For carrier power levels below 50 watts, the limit is -60dB relative to the

Figure 6-4 NRSC-2 RF Mask

Maximum Limits for AM Broadcast RF Emissions



6.5 Other Advantages of NRSC Standards

In addition of reducing adjacent channel interference, the improvements brought about by NRSC-1 and NRSC-2 can improve audio signal quality, and can increase coverage area.

6.5.1 Improved Signal Quality

Restricting the signal bandwidth modulating a transmitter reduces the amount of CCIF Second-order Difference Intermodulation Distortion generated by the transmitter. This type of distortion may be measured by modulating the transmitter with a pair of equal-amplitude sine waves separated in frequency by 1 kHz, then measuring the amplitude of the difference product found at 1 kHz. The percentage of distortion may then be calculated. Measurements were made on 3 MW transmitters (50 KW PDM, 50 KW Doherty, and 10 KW plate modulated). All three transmitters were found to exhibit significant amounts of this type of distortion (typically 4 to 7%). Furthermore, the amount of distortion generated increases with higher frequency pairs (i.e. a 5/6 kHz pair generates more distortion than a 4/5 kHz pair). Since this type of distortion product always folds back into the lower audio spectrum, audio quality can be improved by restricting the audio bandwidth which modulates the transmitter.

6.5.2 Improved Coverage Area

In many cases, coverage area may be improved as well. If the audio bandwidth modulating the transmitter is not well controlled, information beyond 9.5 kHz will be transmitted. This information will not be reproduced by the listener's receiver and may cause interference in the adjacent channel. Transmitting information beyond 9.5 kHz only wastes valuable transmitter power. If this wasted power is used to transmit information that can be reproduced in the listener's receiver, additional loudness and coverage may be achieved.

6.6 Additional Information

The information contained in this section was adapted in part from the actual text of the EIA-549 (NRSC-1) and EIA/IS-51 (NRSC-2) standards. A complete copy of the standards is available from Circuit Research Labs, Inc. upon request.

Appendix - A

Part Lists
and
Schematics

REF	DESCRIPTION	P/N
	UNIT ASSEMBLY	
	Consists of:	
Qty:1	CHASSIS,AM AMIGO	80199
Qty:12	HDWR,MS,SBH,6.32X1/4,YELLOW	13325
Qty:1	LID,RADIO,.50,17X14	13725
Qty:8	HDWR,MS,FPH,6.32X1/4,YELLOW	13328
Qty:1	SHIPPING,BAG,RADIO,18X24	15331
Qty:1	SHIPPING,END BLOCKS,TOP PAD,SET	15242
Qty:1	SHIPPING BOX	15241
Qty:1	CONN,UNIT STRAPS	17590
Qty:4	HDWR,WSHR,PC,#10,9/16X1/16	13460
Qty:4	HDWR,MS,POH,10.32X5/8,BLK	13290
Qty:1	WIRE,AC CRD,110VAC,SJT18/3,2	16435
Qty:1	ACC,MANUAL,AM AMIGO	
Qty:1	ACC,LABEL,SERIAL NO.,AM AMIGO	
Qty:2	RES,1/4W,4.75 KOHM,1%,MF	14810
Qty:1	ACC,LABEL,PATENT	10020
	CHASSIS ASSEMBLY	
	Consists of:	
Qty:1	CHASSIS, 19 X 1 3/4 X 14	12325
Qty:1	PANEL,REAR,AM AMIGO	13016
Qty:1	SOCKET,AC,INPUT,FILTER,MODULE	16645
Qty:1	XFMER,W/WASHER & RUBBER PADS	15916
Qty:1	HDWR,MS,SBH,6.32 X 5/8 SILV	13324
Qty:1	HDWR,GND LUG,INT LOCK,#6	13140
Qty:1	HDWR,HEX NUT,6.32X1/4,SILV	13200
Qty:1	CONN,FEM,6PIN,.156IN SPACING	12647
Qty:6	CONN,FEM,PINS,.045IN	12626
Qty:5	CONN,FEM,PINS,.156 IN	12625
Qty:1	CONN,FEM,POLARIZING KEY,.156IN	12648
Qty:1	HDWR,GROMMENT,1/4 INCH	13131
Qty:3	WIRE,22AWG,.009PVC,GREEN	16250
Qty:1	FUSE,1/4IN,SB,1/4A	13042
Qty:4	HDWR,MS,FPH,6.32X1/4 YELLOW	13328
Qty:1	SWITCH,#20	80790
Qty:1	HDWR,KNOB,SKT,PLAST,1/4,BL	13260
Qty:1	PANEL,FRONT,AM AMIGO	13015
Qty:4	HDWR,KEP NUT,6.32X1/4,SILV	13203
Qty:1	HARNESS,REAR,SMP950/AM AMIGO	80332
Qty:1	PCB,6155,AM AMIGO	80579
Qty:1	HDWR,INSUL,NOMAX	13242
Qty:3	HDWR,MS,SBH,4.40X1/4,SILV	13322
Qty:1	PCB,8555,AM AMIGO	80578
Qty:1	PCB,8565,AM AMIGO	80577
Qty:1	PCB,8556,PARAMETRIC	
Qty:2	HDWR,NY,STDOFF,SWNAP IN 3/4	

REF	DESCRIPTION	P/N
Qty:1	HDWR,STDOFF,6.32X1/4,3/4	
Qty:1	HARNESS,8556 ASSY	
Qty:5	HDWR,MS,SBH,6.32X1/4,YELLOW	13325
Qty:1	CABLE,FLAT,27COND,2.5IN	16502
Qty:1	HDWR,PHONOLIC INSUL,AC MODULE	10055
	6155 FRONT PANEL PCB ASSEMBLY	80579
	Consists of:	
C1	CAP,CM,.1uf,20%	11945
C2	CAP,TA,2.2uf,25V	12290
C3	CAP,TA,2.2uf,25V	12290
C4	CAP,SF,.1uf,63V,5%	12253
C5	CAP,SF,.1uf,63V,5%	12253
C6	CAP,CM,.1uf,20%	11945
C7	CAP,SF,.1uf,63V,5%	12253
C8	CAP,SF,.1uf,63V,5%	12253
C9	CAP,PE,.022uf,100V.5%	12020
C10	CAP,CM,.1uf,20%	11945
C11	CAP,PE,.022uf,100V.5%	12020
C12	CAP,CM,.1uf,20%	11945
DS1	LED,RED,T-1	13684
DS2	LED,GREEN,T-1	13674
DS3	LED,GREEN,T-1	13674
DS4	LED,GREEN,T-1	13674
DS5	LED,GREEN,T-1	13674
DS6	LED,GREEN,T-1	13674
DS7	LED,GREEN,T-1	13674
DS8	LED,GREEN,T-1	13674
DS9	LED,GREEN,T-1	13674
DS10	LED,GREEN,T-1	13674
DS11	LED,GREEN,T-1	13674
DS12	LED,GREEN,T-1	13674
DS13	LED,GREEN,T-1	13674
DS14	LED,YELLOW,T-1	13676
DS15	LED,YELLOW,T-1	13676
DS16	LED,YELLOW,T-1	13676
DS17	LED,YELLOW,T-1	13676
DS18	LED,YELLOW,T-1	13676
DS19	LED,YELLOW,T-1	13676
DS20	LED,RED,T-1	13684
DS21	LED,RED,T-1	13684
J1	CONN,MALE.10PIN,.1IN,MOLEX	12704
J2	CONN,MALE.16PIN,.1IN,MOLEX	12717
J3	CONN,MALE.10PIN,.1IN,MOLEX	12704
J4	CONN,MALE.10PIN,.1IN,MOLEX	12704
R1	RES,1/4W,274 OHM,1%	14630
R2	RES,1/4W,9.09K OHM,1%	17420
R3	RES,1/4W,6.04K OHM,1%	14116
R4	RES,1/4W,1.0K OHM,1%	14040
R5	RES,1/4W,806 OHM,1%	15075

REF	DESCRIPTION	P/N
R6	RES,VAR,DUAL,10K,205,NO DETENT	15224
R7	RES,1/4W,9.09K OHM,1%	17420
R8	RES,1/4W,6.04K OHM,1%	14116
R9	RES,1/4W,1.0K OHM,1%	14040
R10	RES,1/4W,806 OHM,1%	15075
R11	RES,VAR,DUAL,10K,205,W/DETENT	15224
R12	RES,1/4W,1.0K OHM,1%	14040
R13	RES,1/4W,1.0K OHM,1%	14040
R14	RES,1/4W,61.9K OHM,1%	17380
R15	RES,VAR,DUAL,10K,205,W/DETENT	15224
R16	RES,1/4W,3.92K OHM,1%	14665
R17	RES,1/4W,4.99K OHM,1%	14820
R18	RES,1/4W,61.9K OHM,1%	17380
R19	RES,VAR,DUAL,10K,205,W/DETENT	15224
R20	RES,1/4W,3.92K OHM,1%	14665
R21	RES,1/4W,4.99K OHM,1%	14820
R22	RES,TRIM,BUTTON,10K	15140
R23	RES,1/4W,4.99K OHM,1%	14820
R24	RES,1/4W,825 OHM,1%	15080
R25	RES,1/4W,2.49K OHM,1%	17240
R26	RES,VAR,DUAL,10K,205,W/DETENT	15224
R27	RES,1/4W,4.99K OHM,1%	14820
R28	RES,1/4W,825 OHM,1%	15080
R29	RES,TRIM,BUTTON,10K	15140
R30	RES,1/4W,2.49K OHM,1%	17240
R31	RES,VAR,DUAL,10K,205,W/DETENT	15224
R32	RES,1/4W,6.04K OHM,1%	14116
R33	RES,1/4W,6.04K OHM,1%	14116
R34	RES,VAR,DUAL,10K,205,NO DETENT	15224
R35	RES,VAR,10K,PV,20%	15228
R36	RES,VAR,W/SWITCH,10K,PV,20%	15226
R37	WIRE,JUNPER,.5IN	16470
R38	RES,1/4W,1MEG OHM,1%	14070
R39	RES,VAR,DUAL,10K,205,W/DETENT	15224
R40	RES,1/4W,6.81K OHM,1%	14900
R41	RES,1/4W,16.9K OHM,1%	14297
R42	RES,VAR,W/SWITCH,10K,PV,20%	15226
R43	RES,1/4W,15K OHM,1%	14290
R44	RES,1/4W,10K OHM,1%	14150
R45	RES,TRIM,BUTTON,1K,20%	15150
R46	RES,1/4W,1.21K OHM,1%	14100
U1	IC,LIN,TL072CP,DUAL OPAMP	13590
U2	IC,LIN,LM3916,SEG DRIVER	13570
U3	IC,LIN,LM3916,SEG DRIVER	13570
U4	IC,LIN,TL072CP,DUAL OPAMP	13590
U5	IC,LIN,TL072CP,DUAL OPAMP	13590
U6	IC,LIN,TL072CP,DUAL OPAMP	13590
XDS1	HDWR,SPACER,NY,LED,BIVAR	13397
XDS2	HDWR,SPACER,NY,LED,BIVAR	13397
XDS12	HDWR,SPACER,NY,LED,BIVAR	13397
XU1	SOCKET,8PIN	15380
XU2	SOCKET,16PIN	15350

REF	DESCRIPTION	P/N
XU3	SOCKET,8PIN	15380
XU4	SOCKET,8PIN	15380
XU5	SOCKET,8PIN	15380

8555 MAIN PCB ASSEMBLY 80578

Consists of:

REF	DESCRIPTION	P/N
C1	CAP,PE,.0022UF,5%	12008
C2	CAP,SM,250PF,1%	12175
C3	CAP,PE,.0022UF,5%	12008
C4	CAP,CM,.1UF,10%	11945
C5	CAP,CM,.1UF,10%	11945
C6	CAP,CM,.1UF,10%	11945
C7	CAP,PE,.0082UF,5%	12040
C8	CAP,CM,.1UF,10%	11945
C9	CAP,PE,.0022UF,5%	12008
C10	CAP,PE,.0082UF,5%	12040
C11	CAP,PE,.0082UF,5%	12040
C12	CAP,CM,.1UF,10%	11945
C13	CAP,CM,.1UF,10%	11945
C14	CAP,PE,.0082UF,5%	12040
C15	CAP,PE,.0082UF,5%	12040
C16	CAP,PE,.0022UF,5%	12008
C17	CAP,SM,250PF,1%	12175
C18	CAP,PE,.0082UF,5%	12040
C19	CAP,TA,2.2UF,20%,25V	12290
C20	CAP,CM,.1UF,10%	11945
C21	CAP,CM,.1UF,10%	11945
C22	CAP,TA,2.2UF,20%,25V	12290
C23	CAP,AL,1000UF,20%,50V,RA	11995
C24	CAP,AL,1000UF,20%,50V,RA	11995
C25	CAP,AL,470UF,20%,50V,RA	12000
C26	CAP,TA,2.2UF,20%,25V	12290
C27	CAP,CM,.1UF,10%	11945
C28	CAP,CM,.1UF,10%	11945
C29	CAP,CM,.1UF,10%	11945
C30	CAP,CM,.1UF,10%	11945
C31	CAP,CM,.1UF,10%	11945
C32	CAP,PE,.02UF,5%,100V	12025
C33	CAP,PE,.02UF,5%,100V	12025
C34	CAP,SF,.47UF,5%	12285
C35	CAP,CM,.1UF,10%	11945
C36	CAP,TA,2.2UF,20%,25V	12290
C37	CAP,SF,.47UF,5%	12285
C38	CAP,TA,2.2UF,20%,25V	12290
C39	CAP,CM,.1UF,10%	11945
C40	CAP,CM,.1UF,10%	11945
C41	CAP,CD,10PF,10%	11930
C42	CAP,AL,10UF,20%,25V,RA	11970
C43	CAP,TA,2.2UF,20%,25V	12290
C44	CAP,TA,2.2UF,20%,25V	12290

REF	DESCRIPTION	P/N
C45	CAP,CM,.1UF,10%	11945
C46	CAP,CD,10PF,10%	11930
C47	CAP,CM,.1UF,10%	11945
C48	CAP,CM,.1UF,10%	11945
C49	CAP,CM,.1UF,10%	11945
C50	CAP,PE,.1UF,5%	12060
C51	CAP,PE,.0022UF,5%	12008
C52	CAP,SF,.082UF,5%	12249
C53	CAP,PE,.0047UF,5%	12009
C54	CAP,PE,.1UF,5%	12060
C55	CAP,CM,.1UF,10%	11945
C56	CAP,PE,.0047UF,5%	12009
C57	CAP,PE,.0047UF,5%	12009
C58	CAP,CM,.1UF,10%	11945
C59	CAP,SF,.47UF,5%	12285
C60	CAP,CM,.1UF,10%	11945
C61	CAP,SF,.22UF,5%	12260
C62	CAP,CM,.1UF,10%	11945
C63	CAP,TA,22UF,20%,25V	12300
C64	DO NOT USE	
C65	CAP,CM,.1UF,10%	11945
C66	CAP,PE,.033UF,5%,100V	12030
C67	DO NOT USE	
C68	CAP,PE,.0033UF,5%	12045
C69	CAP,PE,.033UF,5%,100V	12030
C70	CAP,CM,.1UF,10%	11945
C71	CAP,CM,.1UF,10%	11945
C72	CAP,PE,.02UF,5%,100V	12025
C73	CAP,PE,.01UF,5%,100V	12011
C74	CAP,CM,.1UF,10%	11945
C75	CAP,CD,.001UF,10%	11967
C76	CAP,CD,10PF,10%	11930
C77	CAP,CD,.001UF,10%	11967
C78	CAP,PE,.1UF,5%	12060
C79	CAP,TA,10UF,20%,25V	12295
C80	CAP,TA,10UF,20%,25V	12295
C81	CAP,SF,.15UF,5%	12255
C82	CAP,TA,10UF,20%,25V	12295
C83	CAP,CD,10PF,10%	11930
C84	CAP,CM,.1UF,10%	11945
C85	CAP,SM,220PF,1%	12177
C86	CAP,CM,.1UF,10%	11945
C87	CAP,TA,2.2UF,20%,25V	12290
C88	CAP,SF,.22UF,5%	12260
C89	CAP,PE,.001UF,5%	12007
C90	CAP,PE,.001UF,5%	12007
C91	CAP,PE,.001UF,5%	12007
C92	CAP,PE,.1UF,5%	12060
C93	CAP,PE,.1UF,5%	12060
C94	CAP,PE,.02UF,5%,100V	12025
C95	CAP,PE,.002UF,5%,100V	12035
C96	CAP,CD,.001UF,10%	11967

REF	DESCRIPTION	P/N
C97	CAP,CD,10PF,10%	11930
C98	CAP,CD,.001UF,10%	11967
C99	CAP,CD,.001UF,10%	11967
C100	CAP,CD,10PF,10%	11930
C101	CAP,CD,.001UF,10%	11967
C102	CAP,CM,.1UF,10%	11945
C103	CAP,CD,10PF,10%	11930
C104	CAP,CM,.1UF,10%	11945
C105	CAP,CD,10PF,10%	11930
C106	CAP,CM,.1UF,10%	11945
C107	CAP,PE,.01UF,5%	12011
C108	CAP,TA,10UF,20%,25V	12295
C109	CAP,CM,.1UF,10%	11945
C110	CAP,SF,.22UF,5%	12260
C111	CAP,CM,.1UF,10%	11945
C112	CAP,CM,.1UF,10%	11945
C113	CAP,SF,.22UF,5%	12260
C114	CAP,CM,.1UF,10%	11945
C115	CAP,CM,.1UF,10%	11945
C116	CAP,SF,.47UF,5%	12285
C117	CAP,CD,10PF,10%	11930
C118	CAP,PP,470PF,2.5%	12160
C119	CAP,AL,10UF,NON POL,25V,RA	11975
C120	CAP,AL,10UF,NON POL,25V,RA	11975
C121	CAP,CM,.1UF,10%	11945
C122	CAP,CM,.1UF,10%	11945
C123	CAP,CM,.1UF,10%	11945
C124	CAP,AL,10UF,20%,25V,RA	11970
C125	CAP,TA,2.2UF,20%,25V	12290
C126	CAP,TA,2.2UF,20%,25V	12290
C127	CAP,CM,.1UF,10%	11945
C128	CAP,CM,.1UF,10%	11945
C129	CAP,CM,.1UF,10%	11945
C130	CAP,CD,10PF,10%	11930
C131	CAP,CM,.1UF,10%	11945
C132	CAP,CD,10PF,10%	11930
C133	CAP,TA,10UF,20%,25V	12295
C134	CAP,SF,.22UF,5%	12260
C135	CAP,AL,100UF,20%,25V,RA	11980
C136	CAP,SF,.22UF,5%	12260
C137	CAP,CM,.1UF,10%	11945
C138	CAP,SF,.47UF,5%	12285
C139	CAP,CD,10PF,10%	11930
C140	CAP,CM,.1UF,10%	11945
C141	CAP,PP,470PF,2.5%	12160
C142	CAP,AL,10UF,NON POL,25V,RA	11975
C143	CAP,AL,10UF,NON POL,25V,RA	11975
C144	CAP,CM,.1UF,10%	11945
C145	CAP,CM,.1UF,10%	11945
C146	CAP,CM,.1UF,10%	11945
C147	CAP,TA,2.2UF,20%,25V	12290
C148	CAP,TA,2.2UF,20%,25V	12290

REF	DESCRIPTION	P/N
C149	CAP,CD,.001UF,10%	11967
C150	CAP,CD,10PF,10%	11930
C151	CAP,CD,.001UF,10%	11967
C152	CAP,CD,.001UF,10%	11967
C153	CAP,CD,10PF,10%	11930
C154	CAP,CD,.001UF,10%	11967
C155	CAP,PE,.0047UF,5%	12009
C156	CAP,PE,.1UF,5%	12060
C157	CAP,PE,.0022UF,5%	12008
C158	CAP,SF,.082UF,5%	12249
C159	CAP,PE,.0047UF,5%	12009
C160	CAP,PE,.0047UF,5%	12009
C161	CAP,CM,.1UF,10%	11945
C162	CAP,SF,.47UF.5%	12285
C163	CAP,CM,.1UF,10%	11945
C164	CAP,SF,.22UF,5%	12260
C165	CAP,CM,.1UF,10%	11945
C166	CAP,TA,22UF,20%,25V	12300
C167	DO NOT USE	
C168	CAP,CM,.1UF,10%	11945
C169	CAP,PE,.033UF,5%,100V	12030
C170	DO NOT USE	
C171	CAP,PE,.0033UF,5%	12045
C172	CAP,CM,.1UF,10%	11945
C173	CAP,PE,.033UF,5%,100V	12030
C174	CAP,CM,.1UF,10%	11945
C175	CAP,CM,.1UF,10%	11945
C176	CAP,PE,.01UF,5%	12010
C177	CAP,TA,10UF,20%,25V	12295
C178	CAP,SF,.15UF,5%	12255
C179	CAP,TA,10UF,20%,25V	12295
C180	CAP,CM,.1UF,10%	11945
C181	CAP,CD,10PF,10%	11930
C182	CAP,CM,.1UF,10%	11945
C183	CAP,SM,220PF,1%	12177
C184	CAP,TA,2.2UF,20%,25V	12290
C185	CAP,CM,.1UF,10%	11945
C186	CAP,SF,.22UF,5%	12260
C187	CAP,PE,.001UF,5%	12007
C188	CAP,PE,.001UF,5%	12007
C189	CAP,PE,.001UF,5%	12007
C190	CAP,CM,.1UF,10%	11945
C191	CAP,PE,.1UF,5%	12060
C192	CAP,PE,.1UF,5%	12060
C193	CAP,PE,.001UF,5%	12007
C194	CAP,PE,.0047UF,5%	12009
C195	CAP,CM,.1UF,10%	11945
C196	CAP,CM,.1UF,10%	11945
C197	CAP,PE,.047UF,5%	12050
C198	CAP,PE,.047UF,5%	12050
C199	CAP,PE,.0047UF,5%	12009
C200	CAP,PE,.001UF,5%	12007

REF	DESCRIPTION	P/N
C201	CAP,PE,.047UF,5%	12050
C202	CAP,PE,.047UF,5%	12050
C300	CAP,PE,.01UF,5%	12010
C301	CAP,PE,.001UF,5%	12007
C302	CAP,PE,.0047UF,5%	12009
C303	CAP,PE,.01UF,5%	12010
C304	CAP,PE,.01UF,5%	12010
C305	CAP,PE,.0047UF,5%	12009
C306	CAP,PE,.001UF,5%	12007
C307	CAP,PE,.01UF,5%	12010
C400	CAP,PE,.0022UF,5%	12008
C401	CAP,PE,.0022UF,5%	12008
C402	CAP,CM,.1UF,10%	11945
C403	CAP,CM,.1UF,10%	11945
C404	CAP,PE,.0022UF,5%	12008
C405	CAP,PE,.0022UF,5%	12008
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	DIODE,SI,100MA,100V,1N914B	12790
CR13	DIODE,SI,100MA,100V,1N914B	12790
CR14	DIODE,SI,100MA,100V,1N914B	12790
CR15	DIODE,SI,100MA,100V,1N914B	12790
CR16	DIODE,SI,100MA,100V,1N914B	12790
CR17	DIODE,SI,100MA,100V,1N914B	12790
CR18	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
CR500	DIODE,SI,SCHOTTKY,1N5711	12804
CR501	DIODE,SI,SCHOTTKY,1N5711	12804
CR502	DIODE,SI,SCHOTTKY,1N5711	12804
DS1	LED,RED,MV55A	13700
DS2	LED,RED,MV55A	13700
DS3	LED,RED,MV55A	13700
DS4	LED,RED,MV55A	13700
J1	CONN,FEM,RT,PC,.1,MOLEX,10P	12634
J2	CONN,MALE,14 PIN,.1IN,MOLEX	12703
J3	CONN,MALE,MINI-JUMP,.1IN,1 X 2	12710
J4	CONN,MALE,MINI-JUMP,.1IN,1 X 2	12710
J5	CONN,MALE,6 PIN,.156IN SPACING	12707
J6	CONN,FEM,27 COND,TIF,STR	12685
J7	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J8	CONN,FEM,RT,PC,.1,MOLEX,16P	12635

REF	DESCRIPTION	P/N
J9	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J10	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J10	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J10A	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J11	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J11	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J11A	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J12	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J13	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J14	CONN,FEM,RT,PC,.1,MOLEX,10P	12634
J15	CONN,BARRIER,14 TERM,RT PC	12608
J16	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J16A	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J17	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J17	CONN,MALE,MINI-JUMP,.1IN,1 X 3	12710
J18	CONN,FEM,RT,PC,.1,MOLEX,10P	12634
L1	COIL,1MH,10%,RA	12570
L2	COIL,1MH,10%,RA	12570
L3	COIL,1.8MH,10%,RA	12562
L4	COIL,2.2MH,10%,RA	12580
L5	COIL,VAR,2.7MH,PT11	12574
L6	COIL,2.7MH,10%,RA	12564
L7	COIL,1.5MH,10%,RA	12561
L8	COIL,.56MH,15%,RA	12558
L9	COIL,2.2MH,10%,RA	12580
L10	COIL,1MH,10%,RA	12570
L11	COIL,1MH,10%,RA	12570
L12	COIL,1MH,10%,RA	12570
L13	COIL,1MH,10%,RA	12570
L14	COIL,1MH,10%,RA	12570
L15	COIL,1MH,10%,RA	12570
L16	COIL,1MH,10%,RA	12570
L17	COIL,1MH,10%,RA	12570
L18	COIL,1.8MH,10%,RA	12562
L19	COIL,2.2MH,10%,RA	12580
L20	COIL,VAR,2.7MH,PT11	12574
L21	COIL,2.7MH,10%,RA	12564
L22	COIL,1.5MH,10%,RA	12561
L23	COIL,.56MH,15%,RA	12558
L24	COIL,2.2MH,10%,RA	12580
L25	FERRITE BEAD	12557
L26	FERRITE BEAD	12557
L27	FERRITE BEAD	12557
L28	FERRITE BEAD	12557
L29	FERRITE BEAD	12557
Q1	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q2	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q3	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q4	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q5	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q6	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q7	XSTR,SI,SIGNAL,NPN,2N4123	15970

REF	DESCRIPTION	P/N
Q8	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q9	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q10	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q11	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q12	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q13	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q14	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q15	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q16	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q17	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q18	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q19	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q20	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q21	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q22	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q23	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q24	XSTR,SI,SIGNAL,PNP,MPS404A	15990
Q25	XSTR,SI,SIGNAL,PNP,MPS404A	15990
Q26	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q27	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q28	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q29	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q30	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q31	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q32	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q33	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q34	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q35	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q36	XSTR,SI,SIGNAL,PNP,2N4125	15980
Q37	XSTR,SI,SIGNAL,NPN,2N4123	15970
Q38	XSTR,SI,SIGNAL,PNP,2N4125	15980
R1	RES,1/4W,24.9 KOHM,1%,MF	17250
R2	RES,1/4W,137 KOHM,1%,MF	17435
R3	RES,1/4W,19.1 KOHM,1%,MF	14333
R4	RES,1/4W,10.7 KOHM,1%,MF	14153
R5	RES,1/4W,187 KOHM,1%,MF	17440
R6	RES,1/4W,27.4 KOHM,1%,MF	14600
R7	WIRE,JUMPER,.5 IN	16470
R8	DO NOT USE	
R9	RES,1/4W,10.0 KOHM,1%,MF	14150
R10	DO NOT USE	
R10A	RES,1/4W,10.0 KOHM,1%,MF	14150
R10B	RES,1/4W,10.0 KOHM,1%,MF	14150
R11	RES,1/4W,27.4 KOHM,1%,MF	14600
R12	RES,1/4W,10.7 KOHM,1%,MF	14153
R13	RES,1/4W,19.1 KOHM,1%,MF	14333
R14	RES,1/4W,187 KOHM,1%,MF	17440

REF	DESCRIPTION	P/N
R15	RES,1/4W,24.9 KOHM,1%,MF	17250
R16	RES,1/4W,137 KOHM,1%,MF	17435
R17	RES,1/4W,10.0 KOHM,1%,MF	14150
R18	WIRE,JUMPER,.5 IN	16470
R19	DO NOT USE	
R20	DO NOT USE	
R20A	RES,1/4W,10.0 KOHM,1%,MF	14150
R20B	RES,1/4W,10.0 KOHM,1%,MF	14150
R21	RES,1/4W,150 OHM,1%,MF	14320
R22	RES,1/4W,150 OHM,1%,MF	14320
R23	RES,1/4W,10.0 KOHM,1%,MF	14150
R24	RES,1/4W,10.0 KOHM,1%,MF	14150
R25	RES,1/4W,10.0 KOHM,1%,MF	14150
R26	RES,1/4W,1.0 MEGOHM,1%,MF	14070
R26A	RES,1/4W,4.99 KOHM,1%,MF	14820
R27	RES,1/4W,82.5 KOHM,1%,MF	15070
R28	RES,1/4W,1.0 MEGOHM,1%,MF	14070
R28A	RES,1/4W,4.99 KOHM,1%,MF	14820
R29	RES,1/4W,82.5 KOHM,1%,MF	15070
R30	RES,1/4W,10.0 KOHM,1%,MF	14150
R31	RES,1/4W,604 OHM,1%,MF	14910
R32	RES,1/4W,10.0 KOHM,1%,MF	14150
R33	RES,1/4W,10.0 KOHM,1%,MF	14150
R34	RES,1/4W,806 OHM,1%,MF	15075
R34A	RES,1/4W,1.82 KOHM,1%,MF	14140
R35	RES,1/4W,909 OHM,1%,MF	15110
R36	RES,1/4W,49.9 OHM,1%,MF	14835
R37	RES,1/4W,475 OHM,1%,MF	14091
R37A	RES,1/4W,3.92 KOHM,1%,MF	14665
R38	RES,1/4W,6.81 KOHM,1%,MF	14900
R38A	RES,1/4W,30.1 OHM,1%,MF	17285
R39	RES,TRIM,BUT,50 OHM,LIN,20%,CER	15177
R40	RES,1/4W,2.21 KOHM,1%,MF	14420
R41	RES,1/4W,100 KOHM,1%,MF	14180
R42	RES,1/4W,44.2 KOHM,1%,MF	14798
R43	RES,1/4W,100 OHM,1%,MF	16510
R44	RES,1/4W,3.83 KOHM,1%,MF	14663
R45	RES,1/4W,24.9 KOHM,1%,MF	17250
R46	RES,1/4W,1.0 KOHM,1%,MF	14040
R47	RES,1/4W,274 OHM,1%,MF	14630
R48	RES,1/4W,274 OHM,1%,MF	14630
R49	RES,1/4W,20.0 KOHM,1%,MF	14435
R50	RES,1/4W,20.0 KOHM,1%,MF	14435
R51	RES,1/4W,20.0 KOHM,1%,MF	14435
R52	RES,1/4W,20.0 KOHM,1%,MF	14435
R53	RES,1/4W,10.0 KOHM,1%,MF	14150
R54	RES,1/4W,82.5 KOHM,1%,MF	15070
R54A	RES,1/4W,4.99 KOHM,1%,MF	14820
R55	RES,1/4W,1.0 MEGOHM,1%,MF	14070
R56	RES,1/4W,1.0 MEGOHM,1%,MF	14070
R56A	RES,1/4W,4.99 KOHM,1%,MF	14820
R57	RES,1/4W,82.5 KOHM,1%,MF	15070
R58	RES,1/4W,10.0 KOHM,1%,MF	14150
R59	RES,1/4W,604 OHM,1%,MF	14910
R60	RES,1/4W,4.75 KOHM,1%,MF	14810
R61	RES,1/4W,4.75 KOHM,1%,MF	14810
R62	RES,VAR,BUT,10K,1/2W,20%	15140
R63	RES,VAR,BUT,10K,1/2W,20%	15140
R64	RES,1/4W,4.75 KOHM,1%,MF	14810
R65	RES,1/4W,4.75 KOHM,1%,MF	14810
R66	RES,1/4W,1.50 KOHM,1%,MF	14110
R67	RES,1/4W,499 OHM,1%,MF	14465
R68	RES,TRIM,BUT,1 KOHM,LIN,20%,CER	15150
R69	RES,1/4W,100 KOHM,1%,MF	14180
R70	RES,1/4W,44.2 KOHM,1%,MF	14798
R71	RES,1/4W,100 OHM,1%,MF	16510
R72	RES,1/4W,24.9 KOHM,1%,MF	17250
R73	RES,1/4W,3.83 KOHM,1%,MF	14663
R74	RES,1/4W,1.0 KOHM,1%,MF	14040
R75	RES,1/4W,4.75 KOHM,1%,MF	14810
R76	RES,1/4W,221 KOHM,1%,MF	14540
R77	RES,1/4W,23.7 KOHM,1%,MF	14560
R79	RES,1/4W,68.1 KOHM,1%,MF	14950
R80	RES,1/4W,68.1 KOHM,1%,MF	14950
R81	RES,1/4W,36.5 KOHM,1%,MF	14740
R82	RES,1/4W,100 OHM,1%,MF	16510
R83	RES,1/4W,22.1 OHM,1%,MF	14510
R84	RES,1/4W,100 OHM,1%,MF	16510
R85	RES,1/4W,47.5 KOHM,1%,MF	14850
R86	RES,1/4W,100 KOHM,1%,MF	14180
R87	RES,1/4W,1 KOHM,1%,MF	14040
R88	RES,1/4W,1 MEGOHM,1%,MF	14070
R89	RES,1/4W,1 MEGOHM,1%,MF	14070
R90	RES,1/4W,10.0 KOHM,1%,MF	14150
R91	RES,1/4W,4.75 KOHM,1%,MF	14810
R92	RES,1/4W,82.5 OHM,1%,MF	15025
R93	WIRE,JUMPER,.5 IN	16470
R94	RES,1/4W,12.1 KOHM,1%,MF	14220
R95	RES,1/4W,8.66 KOHM,1%,MF	15082
R96	RES,1/4W,4.53 KOHM,1%,MF	14795
R97	RES,1/4W,33.2 KOHM,1%,MF	14690
R98	RES,1/4W,100 KOHM,1%,MF	14180
R99	RES,1/4W,100 KOHM,1%,MF	14180
R100	RES,1/4W,90.9 KOHM,1%,MF	15115
R101	RES,1/4W,68.1 KOHM,1%,MF	14950
R102	RES,1/4W,15.0 KOHM,1%,MF	14290
R103	RES,1/4W,1 KOHM,1%,MF	14040
R104	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R105	RES,1/4W,10.0 KOHM,1%,MF	14150
R106	RES,1/4W,4.75 KOHM,1%,MF	14810
R107	RES,1/4W,1.0 KOHM,1%,MF	14040
R108	RES,1/4W,10.0 KOHM,1%,MF	14150
R109	RES,1/4W,13.3 KOHM,1%,MF	14273
R110	RES,1/4W,73.2 KOHM,1%,MF	15005

REF	DESCRIPTION	P/N
R111	RES,1/4W,10.2 KOHM,1%,MF	14149
R112	IC,SIP,10K,4610-102-103I	13642
R114	RES,1/4W,1.00 KOHM,1%,MF	14040
R115	RES,1/4W,49.9 OHM,1%,MF	14835
R116	RES,1/4W,4.53 KOHM,1%,MF	14795
R117	RES,1/4W,301 OHM,1%,MF	14670
R118	RES,1/4W,100 KOHM,1%,MF	14180
R119	RES,1/4W,1 KOHM,1%,MF	14040
R120	RES,1/4W,47.5 KOHM,1%,MF	14850
R121	RES,1/4W,499 OHM,1%,MF	14872
R122	RES,1/4W,475 OHM,1%,MF	14091
R123	RES,1/4W,5.62 KOHM,1%,MF	17350
R124	RES,1/4W,1.0 KOHM,1%,MF	14040
R125	RES,1/4W,3.32 KOHM,1%,MF	14650
R126	RES,TRIM,BUT,10 KOHM,LIN,20%,CER	15140
R127	RES,1/4W,121 OHM,1%,MF	14270
R128	RES,1/4W,17.4 KOHM,1%,MF	14327
R129	RES,1/4W,4.75 KOHM,1%,MF	14810
R130	RES,1/4W,10.0 KOHM,1%,MF	14150
R131	RES,1/4W,100 OHM,1%,MF	16510
R132	RES,1/4W,27.4 KOHM,1%,MF	14600
R133	RES,1/4W,15.0 KOHM,1%,MF	14290
R134	RES,1/4W,1 KOHM,1%,MF	14040
R135	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R136	RES,1/4W,10.0 KOHM,1%,MF	14150
R137	RES,1/4W,4.75 KOHM,1%,MF	14810
R138	RES,1/4W,10.0 KOHM,1%,MF	14150
R139	RES,1/4W,11.8 KOHM,1%,MF	14253
R140	RES,1/4W,200 KOHM,1%,MF	14450
R141	RES,1/4W,30.1 KOHM,1%,MF	17280
R142	RES,1/4W,1 KOHM,1%,MF	14040
R143	RES,1/4W,3.32 KOHM,1%,MF	14650
R144	RES,1/4W,2.49 KOHM,1%,MF	17240
R145	RES,1/4W,182 OHM,1%,MF	14380
R146	RES,1/4W,9.31 KOHM,1%,MF	15090
R147	RES,1/4W,200 OHM,1%,MF	14460
R148	RES,1/4W,121 OHM,1%,MF	14270
R149	RES,1/4W,49.9 OHM,1%,MF	14835
R150	RES,1/4W,68.1 KOHM,1%,MF	14950
R151	RES,1/4W,75.0 KOHM,1%,MF	15010
R152	RES,1/4W,49.9 OHM,1%,MF	14835
R153	RES,1/4W,68.1 KOHM,1%,MF	14950
R154	RES,1/4W,4.75 KOHM,1%,MF	14810
R155	RES,1/4W,604 OHM,1%,MF	14910
R156	RES,1/4W,75.0 KOHM,1%,MF	15010
R157	RES,1/4W,49.9 OHM,1%,MF	14835
R158	RES,1/4W,4.75 KOHM,1%,MF	14850
R159	RES,1/4W,1.69 KOHM,1%,MF	14137
R160	RES,1/4W,44.2 KOHM,1%,MF	14798
R161	RES,1/4W,15.0 KOHM,1%,MF	14290
R162	RES,1/4W,1 KOHM,1%,MF	14040
R163	RES,1/2W,2.2 MEGOHM,5%,CF	14410

REF	DESCRIPTION	P/N
R164	RES,1/4W,10.0 KOHM,1%,MF	14150
R165	RES,1/4W,10.0 KOHM,1%,MF	14150
R166	RES,1/4W,1 KOHM,1%,MF	14040
R167	RES,1/4W,2.21 KOHM,1%,MF	14420
R168	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R169	RES,1/4W,1 KOHM,1%,MF	14040
R170	RES,1/4W,475 KOHM,1%,MF	14870
R171	RES,1/4W,18.2 KOHM,1%,MF	14350
R172	RES,1/4W,18.2 KOHM,1%,MF	14350
R173	RES,1/4W,22.1 KOHM,1%,MF	14500
R174	RES,1/4W,100 OHM,1%,MF	16510
R175	RES,1/4W,100 OHM,1%,MF	16510
R176	RES,1/4W,10.0 KOHM,1%,MF	14150
R177	RES,1/4W,8.25 KOHM,1%,MF	15040
R178	RES,1/4W,10.0 KOHM,1%,MF	14150
R179	RES,1/4W,10.0 KOHM,1%,MF	14150
R180	RES,1/4W,10.0 KOHM,1%,MF	14150
R181	RES,MULTI,22T,5 KOHM,LIN,10%,CER	15125
R182	RES,1/4W,221 KOHM,1%,MF	14540
R183	RES,1/4W,4.75 KOHM,1%,MF	14810
R184	IC,RES,SIP,10K,4610-102-103I	13642
R185	IC,RES,SIP,10K,4610-102-103I	13642
R186	RES,1/4W,49.9 OHM,1%,MF	14835
R187	RES,1/4W,22.1 OHM,1%,MF	14510
R188	RES,1/4W,68.1 KOHM,1%,MF	14950
R189	RES,1/4W,36.5 KOHM,1%,MF	14740
R190	RES,1/4W,22.1 OHM,1%,MF	14510
R191	RES,1/4W,68.1 KOHM,1%,MF	14950
R192	RES,1/4W,36.5 KOHM,1%,MF	14740
R193	RES,1/4W,4.75 KOHM,1%,MF	14810
R194	RES,1/4W,1.0 KOHM,1%,MF	14040
R195	RES,1/4W,44.2 KOHM,1%,MF	14798
R196	RES,1/4W,15.0 KOHM,1%,MF	14290
R197	RES,1/4W,1 KOHM,1%,MF	14040
R198	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R199	RES,1/4W,10.0 KOHM,1%,MF	14150
R200	RES,1/4W,10.0 KOHM,1%,MF	14150
R201	RES,1/4W,1 KOHM,1%,MF	14040
R202	RES,1/4W,2.21 KOHM,1%,MF	14420
R203	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R204	RES,1/4W,1 KOHM,1%,MF	14040
R205	RES,1/4W,475 KOHM,1%,MF	14870
R206	RES,1/4W,22.1 KOHM,1%,MF	14500
R207	RES,1/4W,100 OHM,1%,MF	16510
R208	RES,1/4W,100 OHM,1%,MF	16510
R209	RES,1/4W,10.0 KOHM,1%,MF	14150
R210	RES,1/4W,8.25 KOHM,1%,MF	15040
R211	RES,1/4W,10.0 KOHM,1%,MF	14150
R212	RES,MULTI,22T,5 KOHM,LIN,10%,CER	15125
R213	RES,1/4W,221 KOHM,1%,MF	14540
R214	RES,1/4W,8.66 KOHM,1%,MF	15082
R215	RES,1/4W,4.53 KOHM,1%,MF	14795

REF	DESCRIPTION	P/N
R216	RES,1/4W,33.2 KOHM,1%,MF	14690
R217	RES,1/4W,100 KOHM,1%,MF	14180
R218	RES,1/4W,100 KOHM,1%,MF	14180
R219	RES,1/4W,90.9 KOHM,1%,MF	15115
R220	RES,1/4W,68.1 KOHM,1%,MF	14950
R221	RES,1/4W,15.0 KOHM,1%,MF	14290
R222	RES,1/4W,1 KOHM,1%,MF	14040
R223	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R224	RES,1/4W,10.0 KOHM,1%,MF	14150
R225	RES,1/4W,1 KOHM,1%,MF	14040
R226	RES,1/4W,1 KOHM,1%,MF	14040
R227	RES,1/4W,10.0 KOHM,1%,MF	14150
R228	RES,1/4W,13.3 KOHM,1%,MF	14273
R229	RES,1/4W,73.2 KOHM,1%,MF	15005
R230	RES,1/4W,10.2 KOHM,1%,MF	14149
R231	IC,RES,SIP,10K,4610-102-103I	13642
R232	IC,RES,SIP,10K,4610-102-103I	13642
R235	IC,RES,SIP,1K,4610-102-103I	13642
R236	IC,RES,SIP,1K,4610-102-103I	13642
R236A	IC,RES,SIP,1K,4610-102-103I	13642
R237	RES,1/4W,121 OHM,1%,MF	14270
R238	RES,1/4W,604 OHM,1%,MF	14910
R239	RES,1/4W,4.75 KOHM,1%,MF	14810
R240	RES,1/4W,10.0 KOHM,1%,MF	14150
R241	RES,1/4W,5.62 KOHM,1%,MF	17350
R242	RES,1/4W,475 OHM,1%,MF	14091
R243	WIRE,JUMPER,.5 IN	16470
R244	WIRE,JUMPER,.5 IN	16470
R245	RES,1/4W,5.62 KOHM,1%,MF	17350
R246	RES,1/4W,475 OHM,1%,MF	14091
R247	RES,1/4W,121 OHM,1%,MF	14270
R248	RES,1/4W,4.75 KOHM,1%,MF	14810
R249	RES,1/4W,17.4 KOHM,1%,MF	14327
R250	RES,1/4W,10.0 KOHM,1%,MF	14150
R251	RES,1/4W,100 OHM,1%,MF	16510
R252	RES,1/4W,27.4 KOHM,1%,MF	14600
R253	RES,1/4W,15.0 KOHM,1%,MF	14290
R254	RES,1/4W,1 KOHM,1%,MF	14040
R255	RES,1/2W,2.2 MEGOHM,5%,CF	14410
R256	RES,1/4W,10.0 KOHM,1%,MF	14150
R257	RES,1/4W,1 KOHM,1%,MF	14040
R258	RES,1/4W,10.0 KOHM,1%,MF	14150
R259	RES,1/4W,11.8 KOHM,1%,MF	14253
R260	RES,1/4W,200 KOHM,1%,MF	14450
R261	RES,1/4W,30.1 KOHM,1%,MF	17280
R262	RES,1/4W,1 KOHM,1%,MF	14040
R263	RES,1/4W,3.32 KOHM,1%,MF	14650
R264	DO NOT USE	
R265	RES,1/4W,8.25 KOHM,1%,MF	15040
R266	RES,1/4W,3.83 KOHM,1%,MF	14663
R267	RES,1/4W,22.1 KOHM,1%,MF	14500
R268	RES,1/4W,22.1 KOHM,1%,MF	14500

REF	DESCRIPTION	P/N
R269	IC,RES,SIP,10K,4610-102-103I	13642
R270	DO NOT USE	
R271	RES,1/4W,3.83 KOHM,1%,MF	14663
R272	RES,1/4W,8.25 KOHM,1%,MF	15040
R273	IC,RES,SIP,10K,4610-102-103I	13642
R274	RES,1/4W,22.1 KOHM,1%,MF	14500
R275	RES,1/4W,22.1 KOHM,1%,MF	14500
R300	RES,1/4W,909 OHM,1%,MF	15110
R301	RES,1/4W,3.83 KOHM,1%,MF	14663
R302	RES,1/4W,8.25 KOHM,1%,MF	15040
R303	RES,1/4W,2.49 KOHM,1%,MF	17240
R304	RES,1/4W,909 OHM,1%,MF	15110
R305	RES,1/4W,3.83 KOHM,1%,MF	14663
R306	RES,1/4W,8.25 KOHM,1%,MF	15040
R307	RES,1/4W,909 OHM,1%,MF	15110
R401	RES,1/4W,47.5 KOHM,1%,MF	14850
R402	RES,1/4W,100 KOHM,1%,MF	14180
R403	RES,1/4W,47.5 KOHM,1%,MF	14850
R404	RES,1/4W,100 KOHM,1%,MF	14180
R405	RES,1/4W,36.5 KOHM,1%,MF	14740
R406	RES,1/4W,36.5 KOHM,1%,MF	14740
R407	RES,1/4W,36.5 KOHM,1%,MF	14740
R408	RES,1/4W,22.1 KOHM,1%,MF	14500
R409	RES,1/4W,30.1 KOHM,1%,MF	17280
R410	RES,1/4W,36.5 KOHM,1%,MF	14740
R411	RES,1/4W,3.32 KOHM,1%,MF	14650
R412	RES,1/4W,47.5 KOHM,1%,MF	14850
R413	RES,1/4W,100 KOHM,1%,MF	14180
R414	RES,1/4W,47.5 KOHM,1%,MF	14850
R415	RES,1/4W,100 KOHM,1%,MF	14180
R416	RES,1/4W,36.5 KOHM,1%,MF	14740
R417	RES,1/4W,36.5 KOHM,1%,MF	14740
R418	RES,1/4W,36.5 KOHM,1%,MF	14740
R419	RES,1/4W,22.1 KOHM,1%,MF	14500
R420	RES,1/4W,30.1 KOHM,1%,MF	17280
R421	RES,1/4W,36.5 KOHM,1%,MF	14740
R422	RES,1/4W,3.32 KOHM,1%,MF	14650
R500	RES,1/4W,11.8 KOHM,1%,MF	14253
R501	RES,1/4W,33.2 KOHM,1%,MF	14690
R502	RES,1/4W,2.2 MEGOHM,1%,MF	14413
R503	RES,1/4W,8.25 KOHM,1%,MF	15040
R504	RES,1/4W,182 KOHM,1%,MF	14370
R505	RES,1/4W,11.8 KOHM,1%,MF	14253
R506	RES,1/4W,33.2 KOHM,1%,MF	14690
R507	RES,1/4W,2.2 MEGOHM,1%,MF	14413
R508	RES,1/4W,8.25 KOHM,1%,MF	15040
R509	RES,1/4W,182 KOHM,1%,MF	14370
S1	SWITCH,6PDT,PUSH	15615
TP1	CONN,TEST POINT	12740
TP2	CONN,TEST POINT	12740
TP3	CONN,TEST POINT	12740
TP4	CONN,TEST POINT	12740

REF	DESCRIPTION	P/N
TP5	CONN,TEST POINT	12740
TP5A	CONN,TEST POINT	12740
TP5B	CONN,TEST POINT	12740
TP6	CONN,TEST POINT	12740
TP7	CONN,TEST POINT	12740
TP8	CONN,TEST POINT	12740
TP9	CONN,TEST POINT	12740
TP9A	CONN,TEST POINT	12740
TP9B	CONN,TEST POINT	12740
TP10	CONN,TEST POINT	12740
TP11	CONN,TEST POINT	12740
TP12	CONN,TEST POINT	12740
TP13	CONN,TEST POINT	12740
TP13A	CONN,TEST POINT	12740
TP14	CONN,TEST POINT	12740
TP15	CONN,TEST POINT	12740
TP16	CONN,TEST POINT	12740
TP16A	CONN,TEST POINT	12740
TP17	CONN,TEST POINT	12740
TP17A	CONN,TEST POINT	12740
TP18	CONN,TEST POINT	12740
TP18A	CONN,TEST POINT	12740
TP19	CONN,TEST POINT	12740
TP19A	CONN,TEST POINT	12740
TP20	CONN,TEST POINT	12740
TP21	CONN,TEST POINT	12740
TP22	CONN,TEST POINT	12740
TP22A	CONN,TEST POINT	12740
TP300	CONN,TEST POINT	12740
TP301	CONN,TEST POINT	12740
TP400	CONN,TEST POINT	12740
TP401	CONN,TEST POINT	12740
U1	IC,LIN,TL072CP,DUAL OPAMP	13590
U2	IC,LIN,TL072CP,DUAL OPAMP	13590
U3	IC,LIN,TL072CP,DUAL OPAMP	13590
U3A	IC,LIN,TL072CP,DUAL OPAMP	13590
U4	REG,LM340AT-15	14002
U5	REG,LM320T-15	14001
U6	REG,FXD,+5V,UA7805C	14032
U7	IC,LIN,TL072CP,DUAL OPAMP	13590
U8	IC,LIN,TL072CP,DUAL OPAMP	13590
U9	IC,LIN,TL072CP,DUAL OPAMP	13590
U10	IC,LIN,TL072CP,DUAL OPAMP	13590
U11	IC,LIN,TL072CP,DUAL OPAMP	13590
U12	IC,LIN,NE5532N,HIGH PREF DUAL	13610
U13	IC,LIN,TL072CP,DUAL OPAMP	13590
U14	IC,LIN,NE5532N,HIGH PREF DUAL	13610
U15	IC,LIN,TL072CP,DUAL OPAMP	13590
U16	IC,LIN,LM13600N,DUAL OTA	13600
U17	IC,LIN,TL072CP,DUAL OPAMP	13590
U18	IC,LIN,TL072CP,DUAL OPAMP	13590
U19	IC,LIN,TL072CP,DUAL OPAMP	13590

REF	DESCRIPTION	P/N
U20	IC,LIN,NE5532N,HIGH PREF DUAL	13610
U21	IC,LIN,NE5532N,HIGH PREF DUAL	13610
U22	IC,LIN,LM13600N,DUAL OTA	13600
U23	IC,LIN,TL072CP,DUAL OPAMP	13590
U24	IC,LIN,TL072CP,DUAL OPAMP	13590
U25	IC,LIN,LM13600N,DUAL OTA	13600
U26	IC,LIN,TL072CP,DUAL OPAMP	13590
U27	IC,LIN,TL072CP,DUAL OPAMP	13590
U28	IC,LIN,TL072CP,DUAL OPAMP	13590
U29	IC,LIN,NE5532N,HIGH PREF DUAL	13610
U30	IC,LIN,TL072CP,DUAL OPAMP	13590
U31	IC,LIN,LM13600N,DUAL OTA	13600
U32	IC,LIN,TL072CP,DUAL OPAMP	13590
U33	IC,LIN,TL072CP,DUAL OPAMP	13590
U34	IC,LIN,TL072CP,DUAL OPAMP	13590
U35	IC,LIN,TL074CN,QUAD OPAMP	13592
U36	IC,LIN,TL074CN,QUAD OPAMP	13592
U37	IC,LIN,TL072CP,DUAL OPAMP	13590
U38	IC,LIN,TL074CN,QUAD OPAMP	13592
VR1	DIODE,500W,13V,TRANSZORB	12803
VR3	DIODE,500W,13V,TRANSZORB	12803
VR5	DIODE,500W,13V,TRANSZORB	12803
VR7	DIODE,500W,13V,TRANSZORB	12803
XJ3	CONN,FEM,MINI-JUMP,.1IN	12660
XJ4	CONN,FEM,MINI-JUMP,.1IN	12660
XJ7	CONN,FEM,MINI-JUMP,.1IN	12660
XJ9	CONN,FEM,MINI-JUMP,.1IN	12660
XJ10	CONN,FEM,MINI-JUMP,.1IN	12660
XJ10	CONN,FEM,MINI-JUMP,.1IN	12660
XJ10A	CONN,FEM,MINI-JUMP,.1IN	12660
XJ11	CONN,FEM,MINI-JUMP,.1IN	12660
XJ11	CONN,FEM,MINI-JUMP,.1IN	12660
XJ11A	CONN,FEM,MINI-JUMP,.1IN	12660
XJ12	CONN,FEM,MINI-JUMP,.1IN	12660
XJ13	CONN,FEM,MINI-JUMP,.1IN	12660
XJ16	CONN,FEM,MINI-JUMP,.1IN	12660
XJ16A	CONN,FEM,MINI-JUMP,.1IN	12660
XJ17	CONN,FEM,MINI-JUMP,.1IN	12660
XJ17A	CONN,FEM,MINI-JUMP,.1IN	12660
XJ500	CONN,FEM,MINI-JUMP,.1IN	12660
XJ501	CONN,FEM,MINI-JUMP,.1IN	12660
XU1	SOCKET,DIP,8 PIN	15380
XU2	SOCKET,DIP,8 PIN	15380
XU3	SOCKET,DIP,8 PIN	15380
XU3A	SOCKET,DIP,8 PIN	15380
XU4	HDWR,HEATSINK,PC MOUNT,647	13162
XU5	HDWR,HEATSINK,PC MOUNT,647	13162
XU4	HDWR,HEATSINK,EXTRA,BLACK	13163
XU5	HDWR,HEATSINK,EXTRA,BLACK	13163
XU6	HDWR,HEATSINK,EXTR, BLACK	13160
XU7	SOCKET,DIP,8 PIN	15380
XU8	SOCKET,DIP,8 PIN	15380

REF	DESCRIPTION	P/N
XU9	SOCKET,DIP,8 PIN	15380
XU10	SOCKET,DIP,8 PIN	15380
XU11	SOCKET,DIP,8 PIN	15380
XU12	SOCKET,DIP,8 PIN	15380
XU13	SOCKET,DIP,8 PIN	15380
XU14	SOCKET,DIP,8 PIN	15380
XU15	SOCKET,DIP,8 PIN	15380
XU16	SOCKET,DIP,16 PIN	15350
XU17	SOCKET,DIP,8 PIN	15380
XU18	SOCKET,DIP,8 PIN	15380
XU19	SOCKET,DIP,8 PIN	15380
XU20	SOCKET,DIP,8 PIN	15380
XU21	SOCKET,DIP,8 PIN	15380
XU22	SOCKET,DIP,16 PIN	15350
XU23	SOCKET,DIP,8 PIN	15380
XU24	SOCKET,DIP,8 PIN	15380
XU25	SOCKET,DIP,16 PIN	15350
XU26	SOCKET,DIP,8 PIN	15380
XU27	SOCKET,DIP,8 PIN	15380
XU28	SOCKET,DIP,8 PIN	15380
XU29	SOCKET,DIP,8 PIN	15380
XU30	SOCKET,DIP,8 PIN	15380
XU31	SOCKET,DIP,16 PIN	15350
XU32	SOCKET,DIP,8 PIN	15380
XU33	SOCKET,DIP,8 PIN	15380
XU34	SOCKET,DIP,8 PIN	15380
XU35	SOCKET,DIP,14 PIN	15340
XU36	SOCKET,DIP,14 PIN	15340
XU37	SOCKET,DIP,8 PIN	15380
XU38	SOCKET,DIP,14 PIN	15340
Qty:3	HDWR,INSUL,SILI PAD	13240
Qty:1	HDWR,MS,SPH,4.40 X 5/16	13295
Qty:1	HDWR,HEX NUT,4.40 X 1/4,SILVER	13190
Qty:1	HDWR,LOCKWASH,INT TOOTH #4	13271
Qty:1	PC BOARD,6120,REAR ADJ INTF	13926
Qty:2	RES,MULTI,22T,5 KOHM,LIN,10%,CER	15125
Qty:8	CONN,MALE,F-POST	12715
Qty:2	HDWR,MS,SPH,6.32 X 3/8	13330
Qty:1	HDWR,NYLON,SWITCH CAP	13395
Qty:2	HDWR,HEX NUT,6.32 X 1/4,SILVER	13200
Qty:4	HDWR,MS,SBH,6.320 X 1/4,YELLOW	13325
Qty:5	BRACKET,SHIELD,RF,DIV (QTY 5)	11853
Qty:1	BRACKET,SHIELD,RF,STEREO	11851
Qty:4	HDWR,LOCKWASH,INT TOOTH #6	13270
Qty:2	HDWR,STDOFF,6.32X1/4,5/8,M/F,SWIV	13209
Qty:2	HDWR,STDOFF,6.32X1/4,5/8,F/F	13211
Qty:4	HDWR,NOMEX,W/TAPE	13239

8556 MID RANGE EQUALIZER PCB
NOTE: This board is only used in conjunction with a Version 3 Main PCB. Products with a Version 4 Main PCB include this circuitry on the Main PCB.

Consists of:

REF	DESCRIPTION	P/N
	PC BOARD 8556	
C1	CAP,CM,.1UF,10%	11945
C2	CAP,PE,.0022UF,5%	12008
C3	CAP,PE,.0022UF,5%	12008
C4	CAP,CM,.1UF,10%	11945
C5	CAP,AL,10uf,25V,RA	11970
C6	CAP,PE,.0022UF,5%	12008
C7	CAP,PE,.0022UF,5%	12008
C8	CAP,CM,.1UF,10%	11945
C9	CAP,AL,10uf,25V,RA	11970
J1	CONN,MALE,14P,RA.1	12691
R1	RES,1/4W,47.5 KOHM,1%,MF	14850
R2	RES,1/4W,100 KOHM,1%,MF	14180
R3	RES,1/4W,47.5 KOHM,1%,MF	14850
R4	RES,1/4W,100 KOHM,1%,MF	14180
R5	RES,1/4W,36.5 KOHM,1%,MF	14740
R6	RES,1/4W,36.5 KOHM,1%,MF	14740
R7	RES,1/4W,36.5 KOHM,1%,MF	14740
R8	RES,1/4W,22.1 KOHM,1%,MF	14500
R9	RES,1/4W,30.1 KOHM,1%,MF	17280
R10	RES,1/4W,36.5 KOHM,1%,MF	14740
R11	RES,1/4W,3.32 KOHM,1%,MF	14650
R12	RES,1/4W,47.5 KOHM,1%,MF	14850
R13	RES,1/4W,100 KOHM,1%,MF	14180
R14	RES,1/4W,47.5 KOHM,1%,MF	14850
R15	RES,1/4W,100 KOHM,1%,MF	14180
R16	RES,1/4W,36.5 KOHM,1%,MF	14740
R17	RES,1/4W,36.5 KOHM,1%,MF	14740
R18	RES,1/4W,36.5 KOHM,1%,MF	14740
R19	RES,1/4W,22.1 KOHM,1%,MF	14500
R20	RES,1/4W,30.1 KOHM,1%,MF	17280
R21	RES,1/4W,36.5 KOHM,1%,MF	14740
R22	RES,1/4W,3.32 KOHM,1%,MF	14650
TP1	CONN,TEST POINT	12740
TP2	CONN,TEST POINT	12740
U1	IC,TLO72CP	13590
U2	IC,TLO74CN	13592

REF	DESCRIPTION	P/N
	8565 AGC/STEREO ENHANCE PCB	80577
	Consists of:	
C1	CAP,AL,10uF,20%,25V,RA	11970
C2	CAP,AL,10uF,20%,25V,RA	11970
C3	CAP,CM,.1uf,20%,50V	11945
C4	CAP,CM,.1uf,20%,50V	11945
C5	CAP,CM,.1uf,20%,50V	11945
C6	CAP,CD,10pf,10%,1KV	11930
C7	CAP,SF,.1uf,5%,63V,RA	12253
C8	CAP,CM,.1uf,20%,50V	11945
C9	CAP,AL,10uf,NON POL,25V,RA	11975
C10	CAP,SF,.1uf,5%,63V,RA	12253
C11	CAP,CD,10pf,10%,1KV	11930
C12	CAP,CM,.1uf,20%,50V	11945
C13	CAP,CM,.1uf,20%,50V	11945
C14	CAP,CM,.1uf,20%,50V	11945
C15	CAP,CM,.1uf,20%,50V	11945
C16	CAP,CM,.1uf,20%,50V	11945
C17	CAP,CM,.1uf,20%,50V	11945
C18	NOT USED	
C19	CAP,CM,.1uf,20%,50V	11945
C20	CAP,CM,.1uf,20%,50V	11945
C21	CAP,CM,.1uf,20%,50V	11945
C22	CAP,CM,.1uf,20%,50V	11945
C23	CAP,CD,10pf,10%,1KV	11930
C24	CAP,SF,.1uf,5%,63V,RA	12253
C25	CAP,AL,10uf,NON POL,25V,RA	11975
C26	CAP,CM,.1uf,20%,50V	11945
C27	CAP,SF,.1uf,5%,63V,RA	12253
C28	CAP,CD,10pf,10%,1KV	11930
C29	CAP,CM,.1uf,20%,50V	11945
C30	CAP,AL,10uf,NON POL,25V,RA	11975
C31	CAP,CM,.1uf,20%,50V	11945
C32	CAP,AL,10uf,NON POL,25V,RA	11975
C33	CAP,SM,820pf,1%,, 12195	
C34	CAP,CM,.1uf,20%,50V	11945
C35	CAP,AL,10uf,NON POL,25V,RA	11975
C36	CAP,SF,.1uf,5%,63V,RA	12253
C37	CAP,CM,.1uf,20%,50V	11945
C38	CAP,AL,10uf,NON POL,25V,RA	11975
C39	CAP,SF,.1uf,5%,63V,RA	12253
C40	CAP,CD,10pf,10%,1KV	11930
C41	CAP,SF,.22UF,5%,63V,RA	12260
C42	CAP,SF,.22UF,5%,63V,RA	12260
C43	CAP,CD,10pf,10%,1KV	11930
C44	CAP,CM,.1uf,20%,50V	11945
C45	CAP,CM,.1uf,20%,50V	11945
C46	CAP,CM,.1uf,20%,50V	11945
C47	CAP,CM,.1uf,20%,50V	11945

REF	DESCRIPTION	P/N
C48	NOT USED	
C49	CAP,CM,.1uf,20%,50V	11945
C50	CAP,CM,.1uf,20%,50V	11945
C51	CAP,CM,.1uf,20%,50V	11945
C52	CAP,CM,.1uf,20%,50V	11945
C53	CAP,CM,.1uf,20%,50V	11945
C54	CAP,CM,.1uf,20%,50V	11945
C55	CAP,CM,.1uf,20%,50V	11945
C56	CAP,CM,.1uf,20%,50V	11945
C57	CAP,CM,.1uf,20%,50V	11945
C58	CAP,CM,.1uf,20%,50V	11945
C59	CAP,CM,.1uf,20%,50V	11945
C60	CAP,CM,.1uf,20%,50V	11945
C61	CAP,CM,.1uf,20%,50V	11945
C62	CAP,CM,.1uf,20%,50V	11945
C63	CAP,SF,.1uf,5%,63V,RA	12253
C64	CAP,AL,10uf,NON POL,25V,RA	11975
C65	CAP,CM,.1uf,20%,50V	11945
C66	CAP,SF,.1uf,5%,63V,RA	12253
C67	CAP,CD,10pf,10%,1KV	11930
C68	CAP,SF,.47uf,5%,63V,RA	12285
C69	CAP,TA,22uf,20%,25V,RA	12300
CR1	DIODE,SI,100MA,100V,1N914B	12790
CR2	DIODE,SI,100MA,100V,1N914B	12790
CR3	DIODE,SI,100MA,100V,1N914B	12790
CR4	DIODE,SI,100MA,100V,1N914B	12790
CR5	DIODE,SI,100MA,100V,1N914B	12790
CR6	DIODE,SI,100MA,100V,1N914B	12790
CR7	DIODE,SI,100MA,100V,1N914B	12790
CR8	DIODE,SI,100MA,100V,1N914B	12790
CR9	DIODE,SI,100MA,100V,1N914B	12790
CR10	DIODE,SI,100MA,100V,1N914B	12790
CR11	DIODE,SI,100MA,100V,1N914B	12790
CR12	DIODE,SI,100MA,100V,1N914B	12790
CR13	DIODE,SI,100MA,100V,1N914B	12790
CR14	DIODE,SI,100MA,100V,1N914B	12790
CR15	DIODE,SI,100MA,100V,1N914B	12790
CR16	DIODE,SI,100MA,100V,1N914B	12790
CR17	DIODE,SI,100MA,100V,1N914B	12790
CR18	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
CR24	DIODE,SI,100MA,100V,1N914B	12790
CR25	DIODE,SI,100MA,100V,1N914B	12790
CR26	DIODE,SI,100MA,100V,1N914B	12790
CR27	DIODE,SI,100MA,100V,1N914B	12790
CR28	DIODE,SI,100MA,100V,1N914B	12790
CR29	DIODE,SI,100MA,100V,1N914B	12790
CR30	DIODE,SI,100MA,100V,1N914B	12790

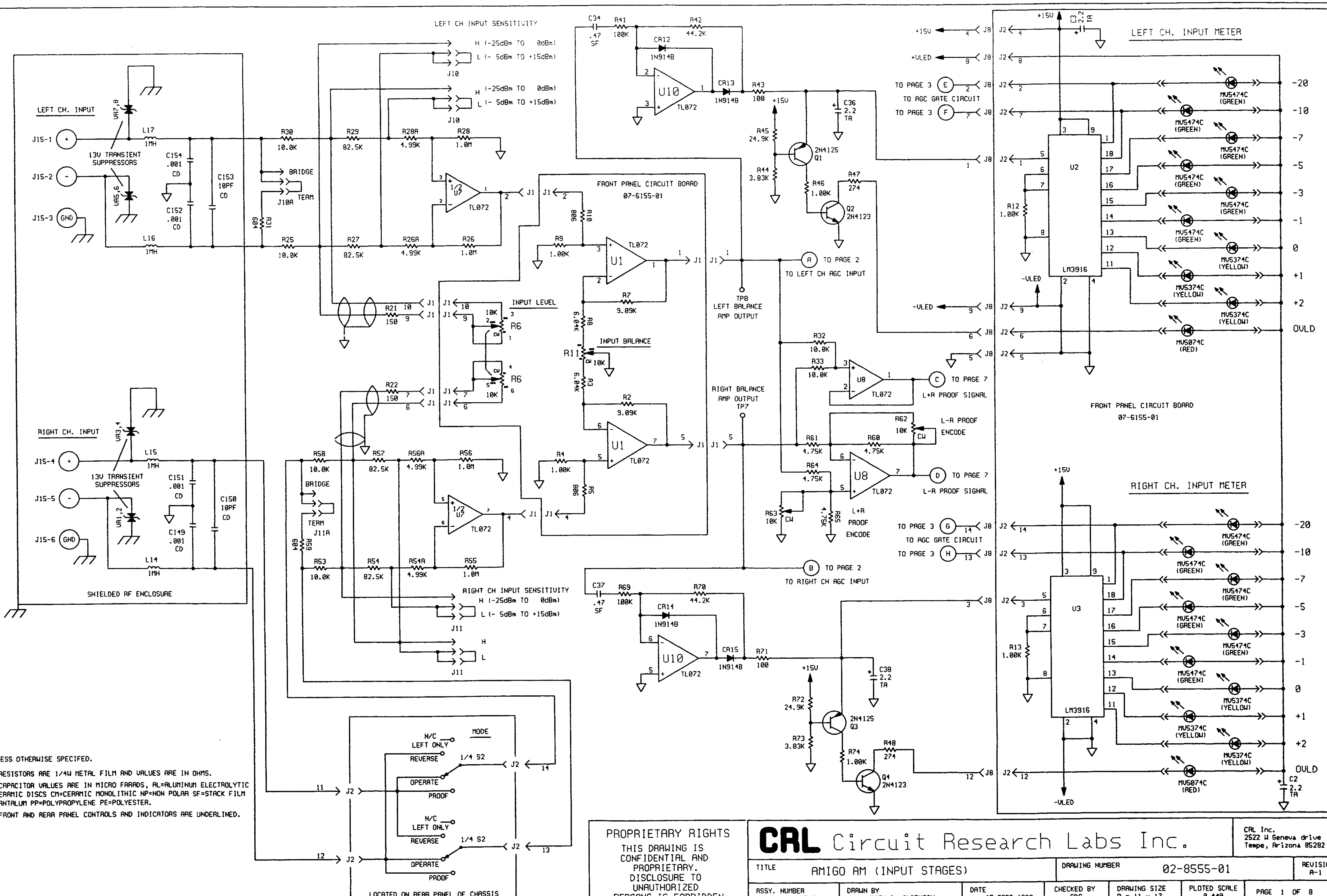
REF	DESCRIPTION	P/N
CR31	DIODE,SI,100MA,100V,1N914B	12790
DS1	LED,DISCR,RED,MV55A,6MW,4MA	13700
DS2	LED,DISCR,RED,MV55A,6MW,4MA	13700
J1	CONN,FEM,27,COND,RT	12687
J2	CONN MALE MINI .1,3POS	12712
J3	CONN MALE MINI .1,3POS	12712
J4	2 CONN MINI JMP 2x3	12713
J5	2 CONN MINI JMP 2x3	12713
J6	CONN MINI JMP 2x3	12713
J7	CONN MINI JMP 2x3	12713
J8	CONN MINI JMP 2x3	12713
Q1	XSTR,SILI,SIGNL,PNP,2N4125	15980
Q2	XSTR,SILI,SIGNL,PNP,2N4125	15980
Q3	XSTR,SILI,SIGNL,NPN,2N4123	15970
Q4	XSTR,SILI,SIGNL,PNP,MPS404A	15990
Q5	XSTR,SILI,SIGNL,PNP,MPS404A	15990
Q6	XSTR,SILI,SIGNL,PNP,MPS404A	15990
Q7	XSTR,SILI,SIGNL,NPN,2N4123	15970
Q8	XSTR,SILI,SIGNL,PNP,2N4125	15980
Q9	XSTR,SILI,SIGNL,PNP,2N4125	15980
Q10	XSTR,SILI,SIGNL,NPN,2N4123	15970
Q11	XSTR,SILI,SIGNL,PNP,2N4125	15980
Q12	XSTR,SILI,SIGNL,PNP,2N4125	15980
R1	RES,1/4W,825 OHM,1%MF	15080
R2	RES,1/4W,182 OHM,1%MF	14380
R3	RES,1/4W,392 OHM,1%MF	14780
R4	RES,1/4W,604 OHM,1%MF	14910
R5	RES,1/4W,3.92K OHM,1%MF	14665
R6	RES,1/4W,1.0K OHM,1%MF	14040
R7	RES,1/4W,2.0K OHM,1%MF	17270
R8	RES,1/4W,3.01K OHM,1%MF	14645
R9	WIRE,JUMPER,.5 IN	16470
R10	RES,1/4W,392 OHM,1%MF	14780
R11	RES,1/4W,1.0K OHM,1%MF	14040
R12	RES,1/4W,1.82K OHM,1%MF	14140
R13	RES,1/4W,2.74K OHM,1%MF	14440
R14	RES,1/4W,4.75K OHM,1%MF	14810
R15	WIRE,JUMPER,.5 IN	16470
R16	RES,1/4W,392 OHM,1%MF	14780
R17	RES,1/4W,1.0K OHM,1%MF	14040
R18	RES,1/4W,1.82K OHM,1%MF	14140
R19	RES,1/4W,2.74K OHM,1%MF	14440
R20	RES,1/4W,4.75K OHM,1%MF	14810
R21	RES,1/4W,7.5K OHM,1%MF	14990
R22	RES,1/4W,20.0K OHM,1%MF	14435
R23	RES,1/4W,10.0K OHM,1%MF	14150
R24	RES,1/4W,10.0K OHM,1%MF	14150
R25	RES,1/4W,1.0MEG OHM,1%MF	14070
R26	RES,1/4W,68.1K OHM,1%MF	14950
R27	RES,1/4W,68.1K OHM,1%MF	14950
R28	RES,1/2W,2.2MEG OHM,1%CF	14410
R29	RES,1/4W,1.0K OHM,1%MF	14040

REF	DESCRIPTION	P/N
R30	RES,1/4W,7.5K OHM,1%MF	14990
R31	RES,1/4W,4.99K OHM,1%MF	14820
R32	RES,1/4W,15.0K OHM,1%MF	14290
R33	RES,1/4W,10.0K OHM,1%MF	14150
R34	RES,1/4W,10.0K OHM,1%MF	14150
R35	RES,1/4W,10.0K OHM,1%MF	14150
R36	RES,1/4W,10.0K OHM,1%MF	14150
R37	RES,1/4W,121K OHM,1%MF	14260
R38	RES,1/4W,100K OHM,1%MF	14180
R39	RES,1/4W,10.0K OHM,1%MF	14150
R40	RES,1/4W,20.0K OHM,1%MF	14435
R41	RES,1/4W,20.0K OHM,1%MF	14435
R42	RES,1/4W,20.0K OHM,1%MF	14435
R43	RES,1/4W,10.0K OHM,1%MF	14150
R44	RES,1/4W,1.0K OHM,1%MF	14040
R45	RES,1/4W,7.5K OHM,1%MF	14990
R46	RES,1/4W,10.0K OHM,1%MF	14150
R47	RES,1/4W,10.0K OHM,1%MF	14150
R48	RES,1/4W,10.0K OHM,1%MF	14150
R49	RES,1/4W,20.0K OHM,1%MF	14435
R50	RES,1/4W,1MEG OHM,1%MF	14070
R51	RES,1/4W,68.1K OHM,1%MF	14950
R52	RES,1/4W,68.1K OHM,1%MF	14950
R53	RES,1/2W,2.2MEG OHM,1%CF	14410
R54	RES,1/4W,1.0K OHM,1%MF	14040
R55	RES,1/4W,7.5K OHM,1%MF	14990
R56	RES,1/4W,4.99K OHM,1%MF	14820
R57	RES,1/4W,15.0K OHM,1%MF	14290
R58	RES,1/4W,10.0K OHM,1%MF	14150
R59	RES,1/4W,10.0K OHM,1%MF	14150
R60	RES,1/4W,121K OHM,1%MF	14260
R61	RES,1/4W,20.0K OHM,1%MF	14435
R62	RES,1/4W,10.0K OHM,1%MF	14150
R63	RES,1/4W,100K OHM,1%MF	14180
R64	RES,1/4W,10.0K OHM,1%MF	14150
R65	RES,1/4W,2.21K OHM,1%MF	14420
R66	RES,1/4W,39.2K OHM,1%MF	14760
R67	RES,1/4W,2.21K OHM,1%MF	14420
R68	RES,1/4W,82.5K OHM,1%MF	15070
R69	RES,1/4W,2.21K OHM,1%MF	14420
R70	RES,1/4W,22.1K OHM,1%MF	14500
R71	RES,1/4W,22.1K OHM,1%MF	12500
R72	RES,1/4W,10.0K OHM,1%MF	14150
R73	RES,1/4W,22.1K OHM,1%MF	12500
R74	RES,1/4W,10.0K OHM,1%MF	14150
R75	RES,1/4W,12.1K OHM,1%MF	14220
R76	RES,1/4W,33.2K OHM,1%MF	14690
R77	RES,1/4W,75.0K OHM,1%MF	15010
R78	RES,1/4W,1.0K OHM,1%MF	14040
R79	RES,1/4W,100K OHM,1%MF	14180
R80	RES,1/4W,1MEG OHM,1%MF	14070
R81	RES,1/4W,68.1K OHM,1%MF	14950

REF	DESCRIPTION	P/N
R82	RES,1/4W,68.1K OHM,1%MF	14950
R83	RES,1/2W,2.2MEG OHM,1%CF	14410
R84	RES,1/4W,1.0K OHM,1%MF	14040
R85	RES,1/4W,7.5K OHM,1%MF	14990
R86	RES,1/4W,4.99K OHM,1%MF	14820
R87	RES,1/4W,15.0K OHM,1%MF	14290
R88	RES,1/4W,90.9K OHM,1%MF	15115
R89	RES,1/4W,90.9K OHM,1%MF	15115
R90	RES,1/4W,7.5K OHM,1%MF	14990
R91	RES,1/4W,18.2K OHM,1%MF	14350
R92	RES,1/4W,75.0K OHM,1%MF	15010
R93	RES,1/4W,19.6K OHM,1%MF	14298
R94	RES,1/4W,10.0K OHM,1%MF	14150
R95	RES,1/4W,10.0K OHM,1%MF	14150
R96	RES,1/4W,121K OHM,1%MF	14260
R97	RES,1/4W,20.0K OHM,1%MF	14435
R98	RES,1/4W,100K OHM,1%MF	14180
R99	RES,1/4W,10.0K OHM,1%MF	14150
R100	RES,1/4W,10.0K OHM,1%MF	14150
R101	RES,1/4W,10.0K OHM,1%MF	14150
R102	RES,1/4W,10.0K OHM,1%MF	14150
R103	RES,1/4W,2.21K OHM,1%MF	14420
R104	RES,1/4W,10.0K OHM,1%MF	14150
R105	RES,1/4W,10.0K OHM,1%MF	14150
R106	RES,1/4W,4.99K OHM,1%MF	14820
R107	RES,1/4W,4.99K OHM,1%MF	14280
R108	RES,1/4W,10.0K OHM,1%MF	14150
R109	RES,1/4W,10.0K OHM,1%MF	14150
R110	WIRE,JUMPER,.5 IN	16470
R111	RES,1/4W,1.0K OHM,1%MF	14040
R112	RES,1/4W,1.0K OHM,1%MF	14040
R113	RES,1/4W,10.0K OHM,1%MF	14150
R114	RES,1/4W,10.0K OHM,1%MF	14150
R115	RES,1/4W,100 OHM,1%MF	16510
R116	RES,1/4W,10.0K OHM,1%MF	14150
R117	RES,1/4W,121 OHM,1%MF	14270
R118	RES,TRIM,BUT,1K,LIN,20%	15150
R119	RES,1/4W,22.1K OHM,1%MF	14500
R120	RES,1/4W,4.75K OHM,1%MF	14810
R121	RES,1/4W,15.0K OHM,1%MF	14290
R122	RES,1/4W,1MEG OHM,1%MF	14070
R123	RES,1/4W,68.1K OHM,1%MF	14950
R124	RES,1/4W,68.1K OHM,1%MF	14950
R125	RES,1/2W,2.2MEG OHM,1%CF	14410
R126	RES,1/4W,1.0K OHM,1%MF	14040
R127	RES,1/4W,7.5K OHM,1%MF	14990
R128	RES,1/4W,15.0K OHM,1%MF	14290
R129	RES,1/4W,4.99K OHM,1%MF	14820
R130	RES,1/4W,90.9K OHM,1%MF	15115
R131	RES,1/4W,90.9K OHM,1%MF	15115
R132	RES,1/4W,7.5K OHM,1%MF	14990
R133	RES,1/4W,18.2K OHM,1%MF	14350

REF	DESCRIPTION	P/N
R134	RES,1/4W,75.0K OHM,1%MF	15010
R135	RES,1/4W,19.6K OHM,1%MF	14298
R136	RES,1/4W,10.0K OHM,1%MF	14150
R137	RES,1/4W,10.0K OHM,1%MF	14150
R138	RES,1/4W,121K OHM,1%MF	14260
R139	RES,1/4W,20.0K OHM,1%MF	14435
R140	RES,1/4W,10.0K OHM,1%MF	14150
R141	RES,1/4W,100K OHM,1%MF	14180
R142	RES,1/4W,1.0K OHM,1%MF	14040
R143	RES,1/4W,49.9K OHM,1%MF	17140
R144	RES,1/4W,100K OHM,1%MF	14180
R145	RES,1/4W,100K OHM,1%MF	14180
R146	RES,1/4W,10.0K OHM,1%MF	14150
R147	RES,1/4W,20.0K OHM,1%MF	14435
R148	RES,1/4W,10.0K OHM,1%MF	14150
R149	RES,1/4W,49.9K OHM,1%MF	17140
R150	RES,1/4W,100K OHM,1%MF	14180
R151	NOT USED	
R152	RES,1/4W,475K OHM,1%MF	14870
R153	RES,1/4W,10.0K OHM,1%MF	14150
R154	RES,1/4W,392 OHM,1%MF	14780
R155	RES,1/4W,10.0K OHM,1%MF	14150
TP1	CONN,TEST POINT	12740
TP2	CONN,TEST POINT	12740
TP3	CONN,TEST POINT	12740
TP4	CONN,TEST POINT	12740
TP5	CONN,TEST POINT	12740
TP6	CONN,TEST POINT	12740
TP7	CONN,TEST POINT	12740
TP8	CONN,TEST POINT	12740
TP9	CONN,TEST POINT	12740
TP10	CONN,TEST POINT	12740
TP11	CONN,TEST POINT	12740
TP12	CONN,TEST POINT	12740
TP13	CONN,TEST POINT	12740
TP14	CONN,TEST POINT	12740
TP15	CONN,TEST POINT	12740
TP16	CONN,TEST POINT	12740
TP17	CONN,TEST POINT	12740
TP18	CONN,TEST POINT	12740
TP19	CONN,TEST POINT	12740
TP20	CONN,TEST POINT	12740
TP21	CONN,TEST POINT	12740
TP22	CONN,TEST POINT	12740
TP23	CONN,TEST POINT	12740
TP24	CONN,TEST POINT	12740
U1	IC,LIN,TL072CP,DUAL OPAMP	13590
U2	IC,LIN,TL072CP,DUAL OPAMP	13590
U3	IC,LIN,LM13600N,DUAL,OTA	13600
U4	IC,LIN,TL072CP,DUAL OPAMP	13590
U5	IC,LIN,TL072CP,DUAL OPAMP	13590
U6	MODULE,8055	80445

REF	DESCRIPTION	P/N
U7	IC,LIN,LM13600N,DUAL,OTA	13600
U8	IC,LIN,TL072CP,DUAL OPAMP	13590
U9	IC,LIN,LM13600N,DUAL,OTA	13600
U10	IC,LIN,TL072CP,DUAL OPAMP	13590
U11	IC,LIN,TL072CP,DUAL OPAMP	13590
U12	IC,LIN,TL072CP,DUAL OPAMP	13590
U13	IC,LIN,TL072CP,DUAL OPAMP	13590
U14	IC,LIN,TL072CP,DUAL OPAMP	13590
U15	IC,LIN,TL072CP,DUAL OPAMP	13590
XJ2	CONN FEM MINI-JUMP,.1IN	12660
XJ3	CONN FEM MINI-JUMP,.1IN	12660
XJ4	CONN FEM MINI-JUMP,.1IN	12660
XJ5	CONN FEM MINI-JUMP,.1IN	12660
XJ6	CONN FEM MINI-JUMP,.1IN	12660
XJ7	CONN FEM MINI-JUMP,.1IN	12660
XJ8	CONN FEM MINI-JUMP,.1IN	12660
XU1	SOCKET DIP 8 PIN	15380
XU2	SOCKET DIP 8 PIN	15380
XU3	SOCKET DIP 16 PIN	15350
XU4	SOCKET DIP 8 PIN	15380
XU5	SOCKET DIP 8 PIN	15380
XU6	24 - SOCKET PINS	15355
XU7	SOCKET DIP 16 PIN	15350
XU8	SOCKET DIP 8 PIN	15380
XU9	SOCKET DIP 16 PIN	15350
XU10	SOCKET DIP 8 PIN	15380
XU11	SOCKET DIP 8 PIN	15380
XU12	SOCKET DIP 8 PIN	15380
XU13	SOCKET DIP 8 PIN	15380
XU14	SOCKET DIP 8 PIN	15380
XU15	SOCKET DIP 8 PIN	15380



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 CD=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.

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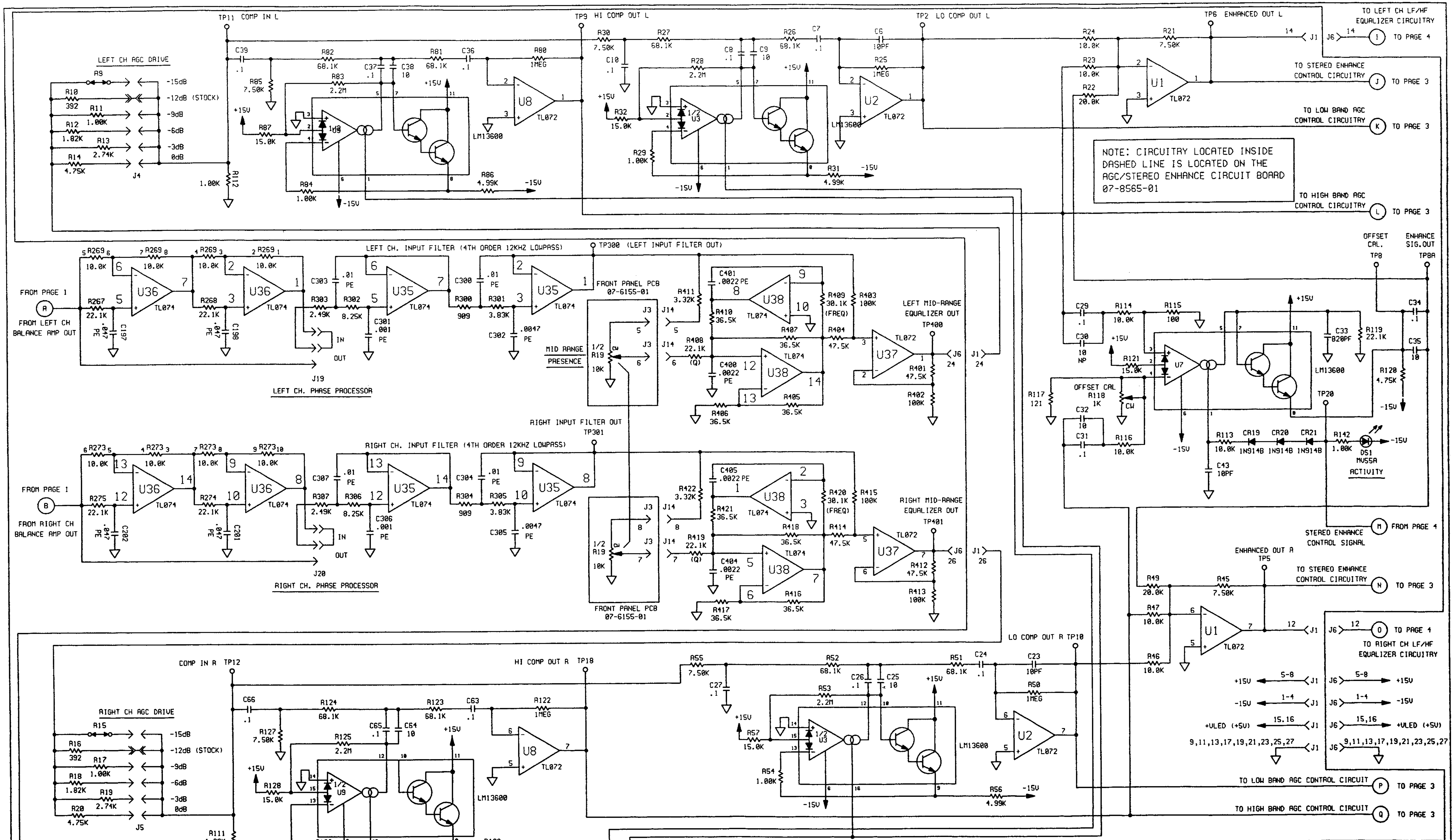
TITLE	AMIGO AM (INPUT STAGES)	DRAWING NUMBER	02-8555-01	REVISION A-1

ASSY. NUMBER	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	PAGE
07-8555-01	GARY D. CLARKSON	15 SEPT 1993	GDC	B = 11 x 17	0.440	1 OF 8



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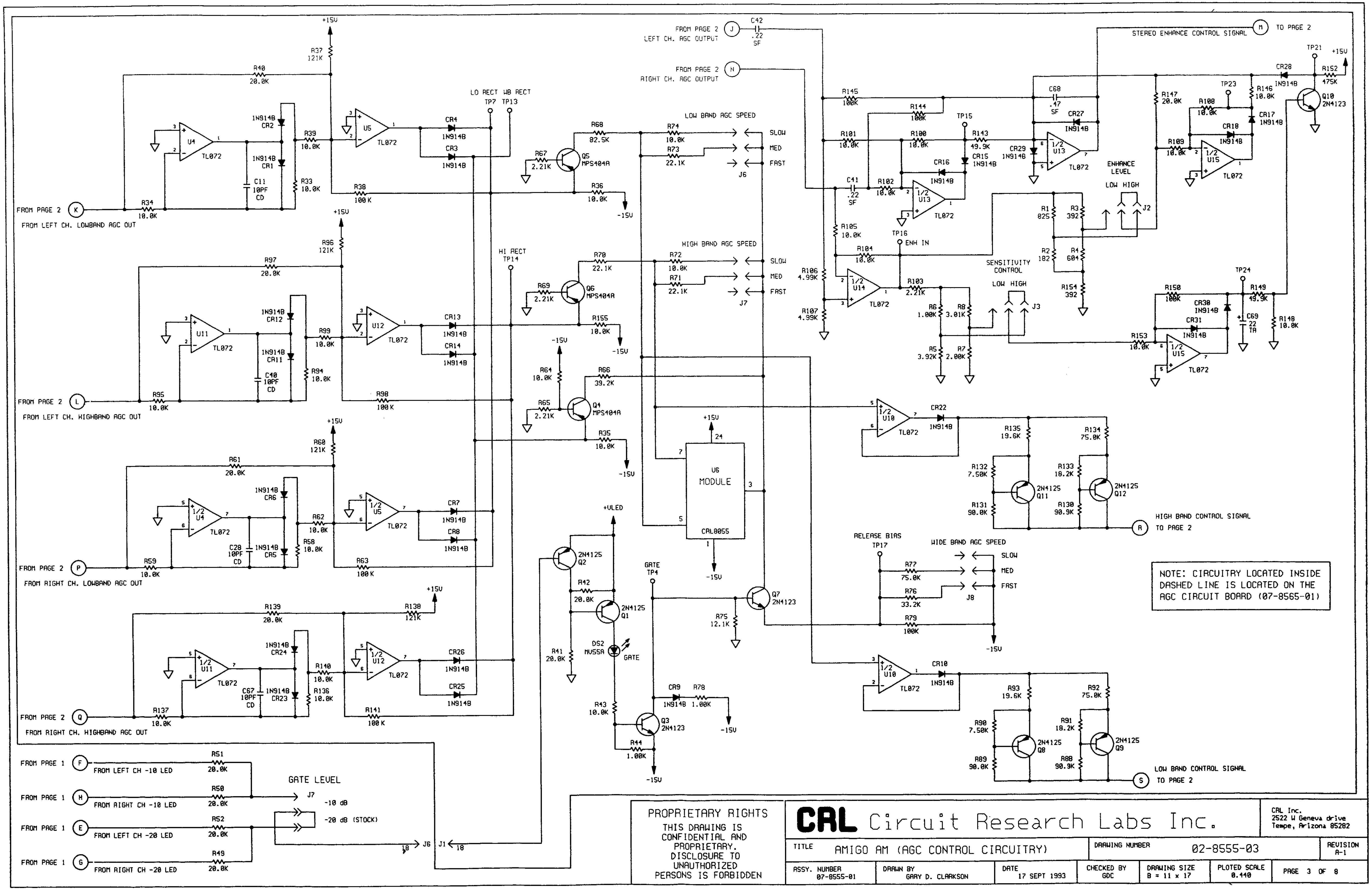
TITLE	AMIGO AM (AGC & STEREO ENHANCE)	DRAWING NUMBER	02-8555-02	REVISION A-1

ASSY. NUMBER	DRAWN BY	DATE	CHECKED BY	DRAWING SIZE	PLOTED SCALE	
07-8555-01	GARY D. CLARKSON	17 SEPT 1993	GDC	B = 11 x 17	0.440	PAGE 2 OF 8



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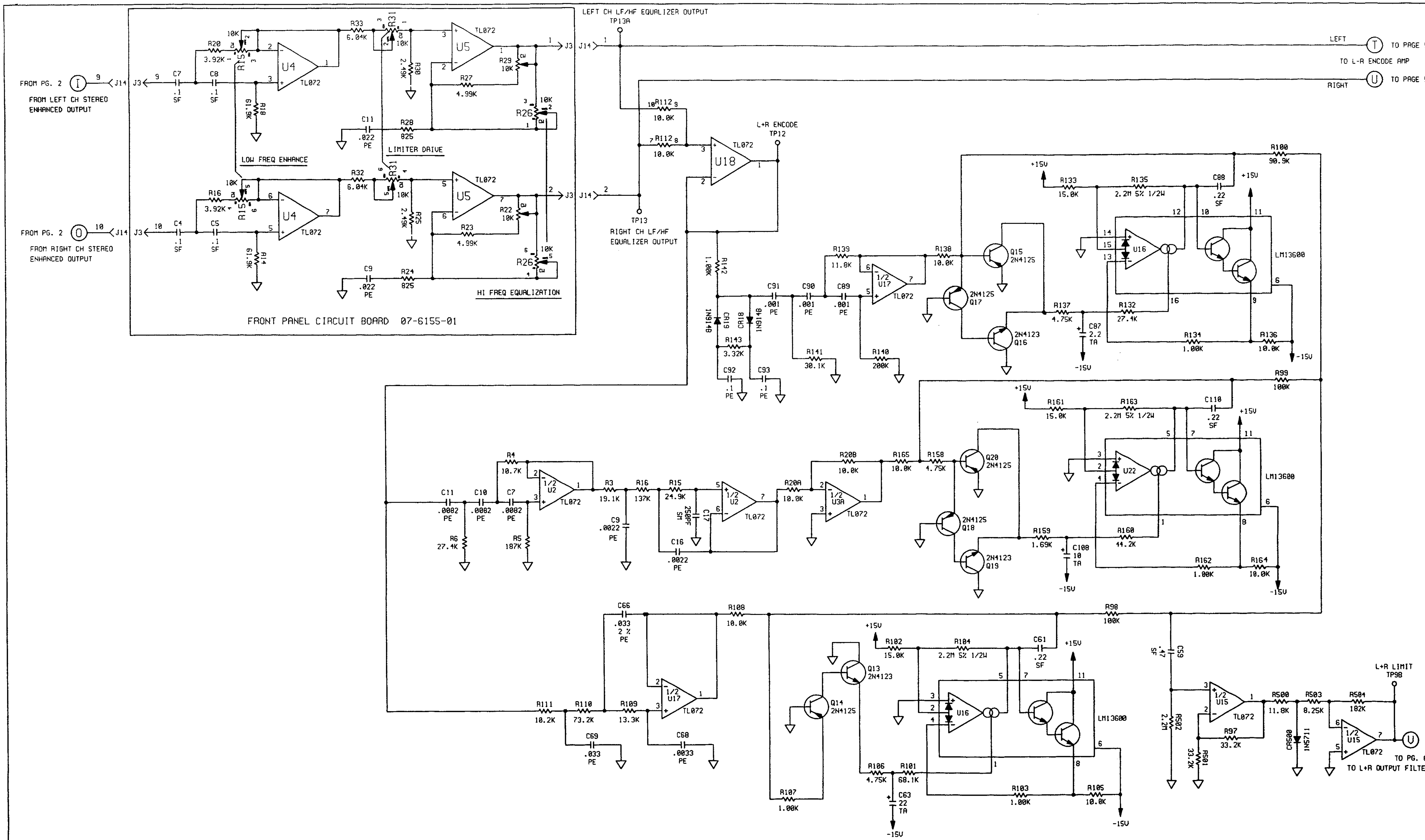
TITLE	AMIGO AM (AGC CONTROL CIRCUITRY)		DRAWING NUMBER 02-8555-03		REVISION A-1
ASSY. NUMBER 07-8555-01	DRAWN BY GARY D. CLARKSON	DATE 17 SEPT 1993	CHECKED BY GDC	DRAWING SIZE B = 11 x 17	PLOTED SCALE 0.440



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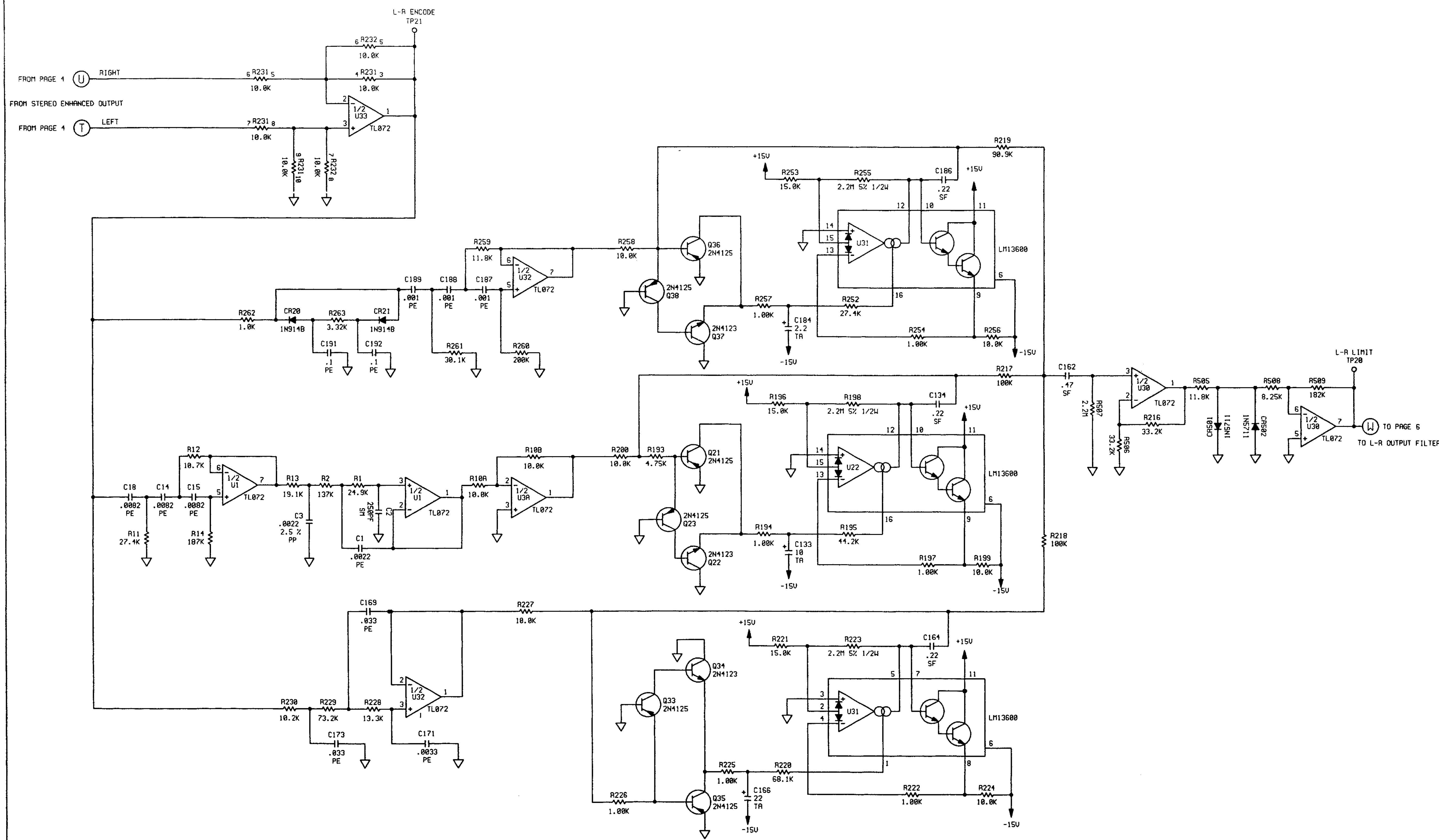
TITLE AMIGO AM (LF/HF EQ & L+R LIMITER)			DRAWING NUMBER 02-8555-04			REVISION A - 1
ASSY 07-8555-01	DRAWN BY GARY D. CLARKSON	DATE 22 SEPT 1993	CHECKED BY G D C	DRAWING SIZE B = 11" X 17"	PLOTED SCALE 0.440	PAGE 4 OF 8



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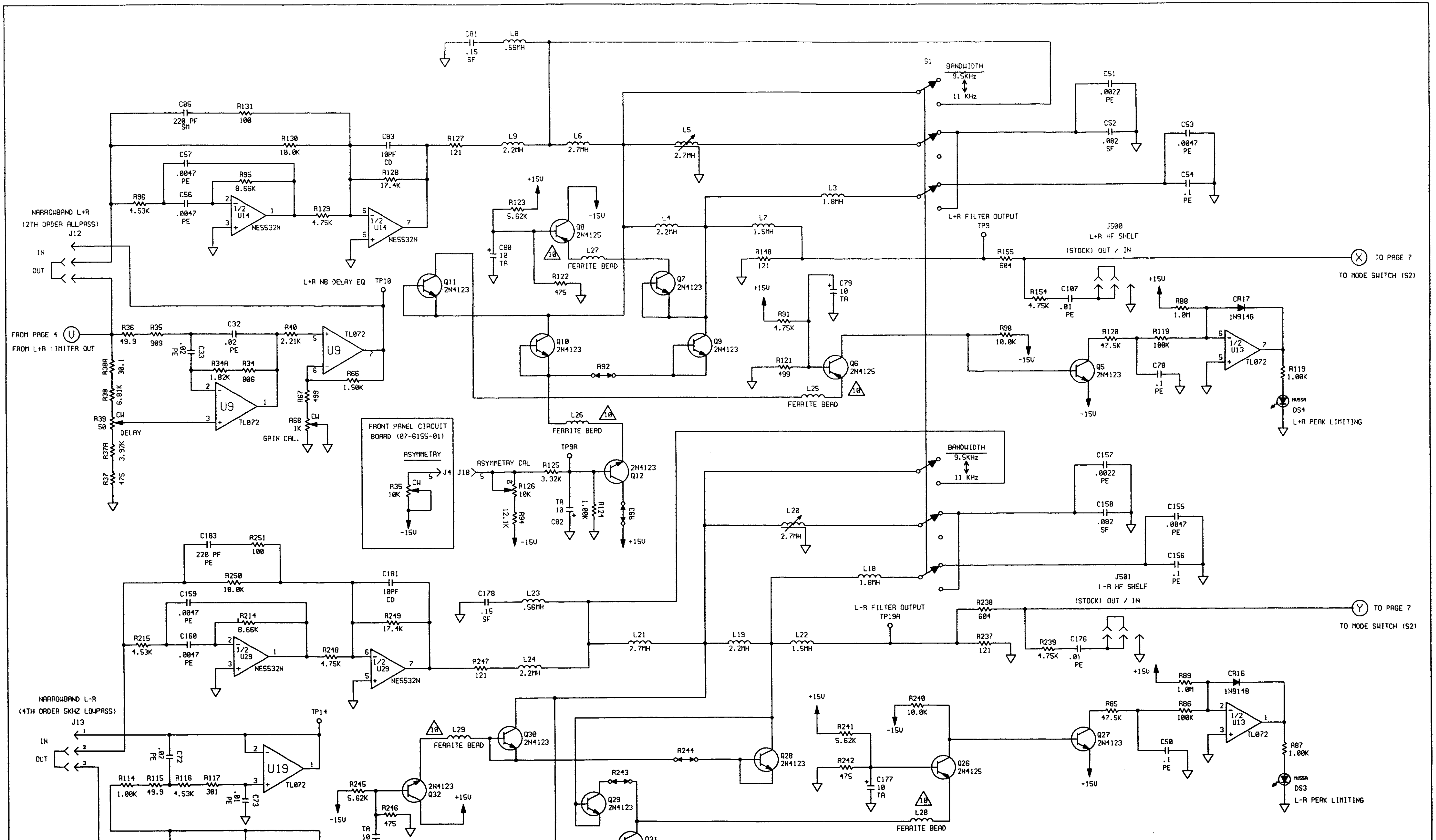
TITLE AMIGO AM (L-R LIMITER)			DRAWING NUMBER 02-8555-05		REVISION A - 1
ASSY 07-8555-01	DRAWN BY GARY D. CLARKSON	DATE 22 SEPT 1993	CHECKED BY G D C	DRAWING SIZE B = 11" X 17"	PLOTED SCALE 0.440
SHEET 5 OF 8					



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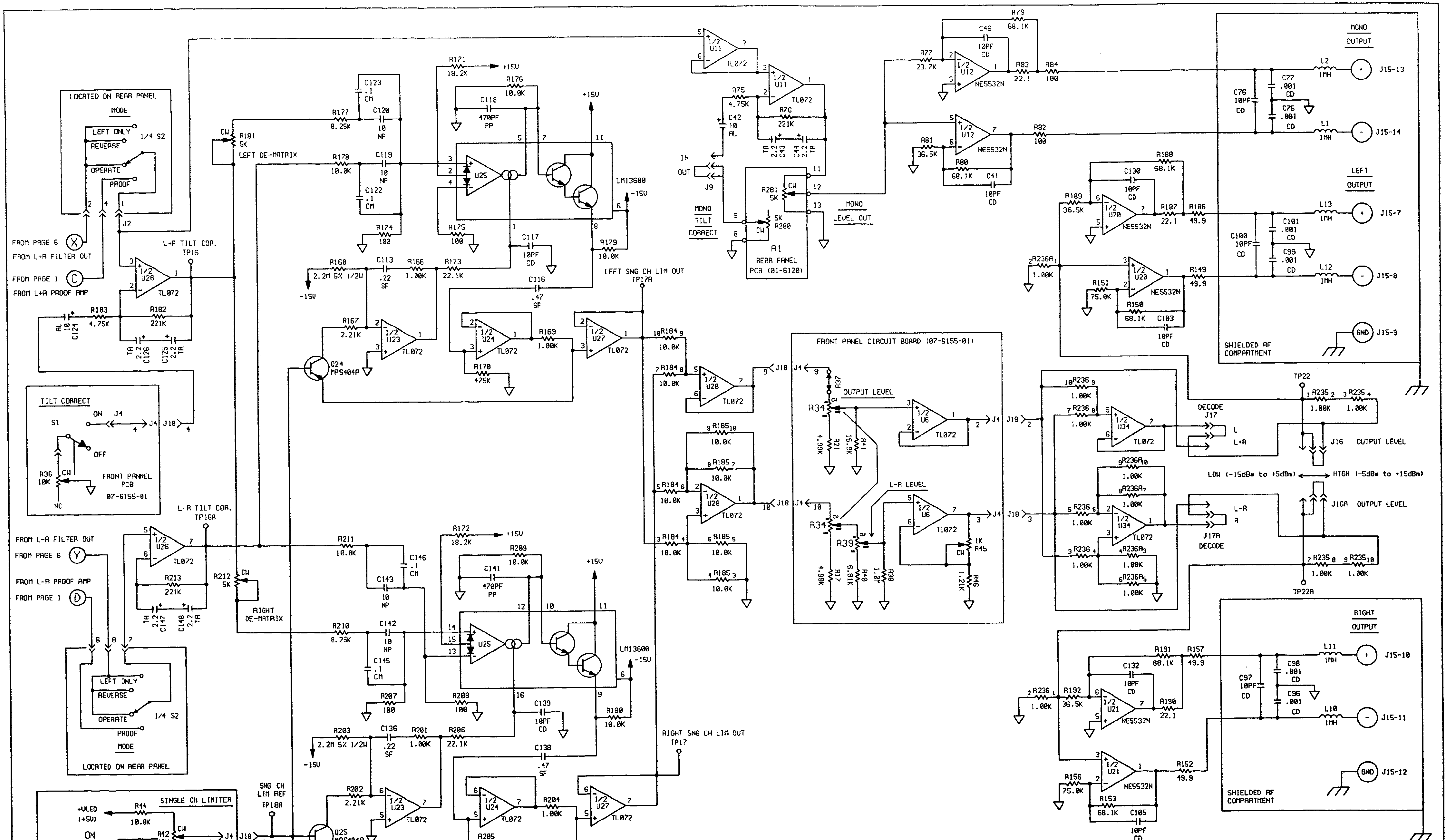
TITLE: AMIGO AM (L+R & L-R OUTPUT FILTERS)			DRAWING NUMBER: 02-8555-06			REVISION: A - 1
ASSY: 07-8555-01	DRAWN BY: GARY D. CLARKSON	DATE: 23 SEPT 1993	CHECKED BY: G D C	DRAWING SIZE: B = 11" X 17"	PLOTED SCALE: 0.440	PAGE 6 OF 8



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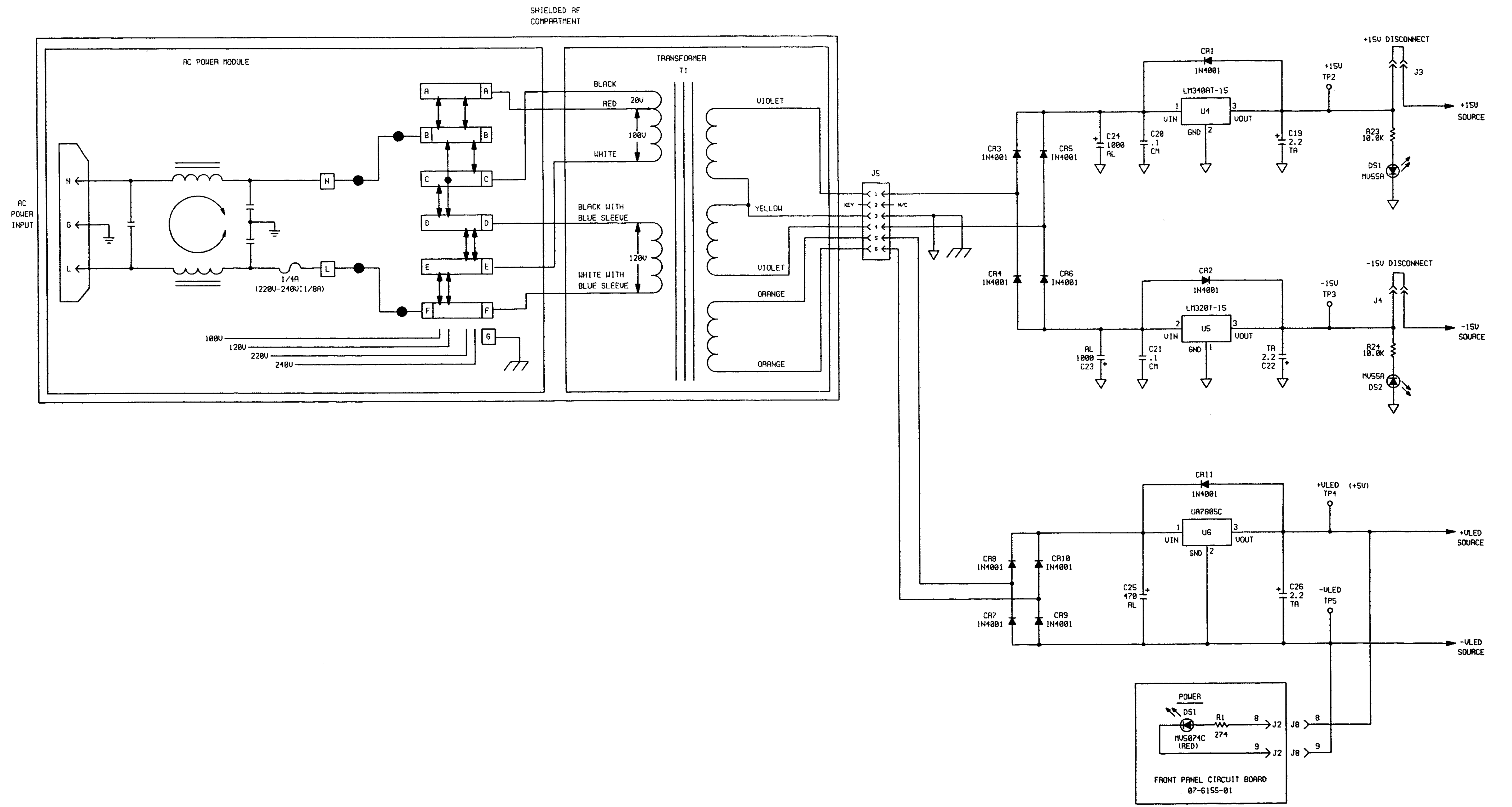
TITLE AMIGO AM (OUTPUT STAGES)		DRAWING NUMBER 02-8555-07			REVISION A - 1
ASSY 07-8555-01	DRAWN BY GARY D. CLARKSON	DATE 23 SEPT 1993	CHECKED BY G D C	DRAWING SIZE B = 11" X 17"	PLOTED SCALE 0.440

PAGE 7 OF 8



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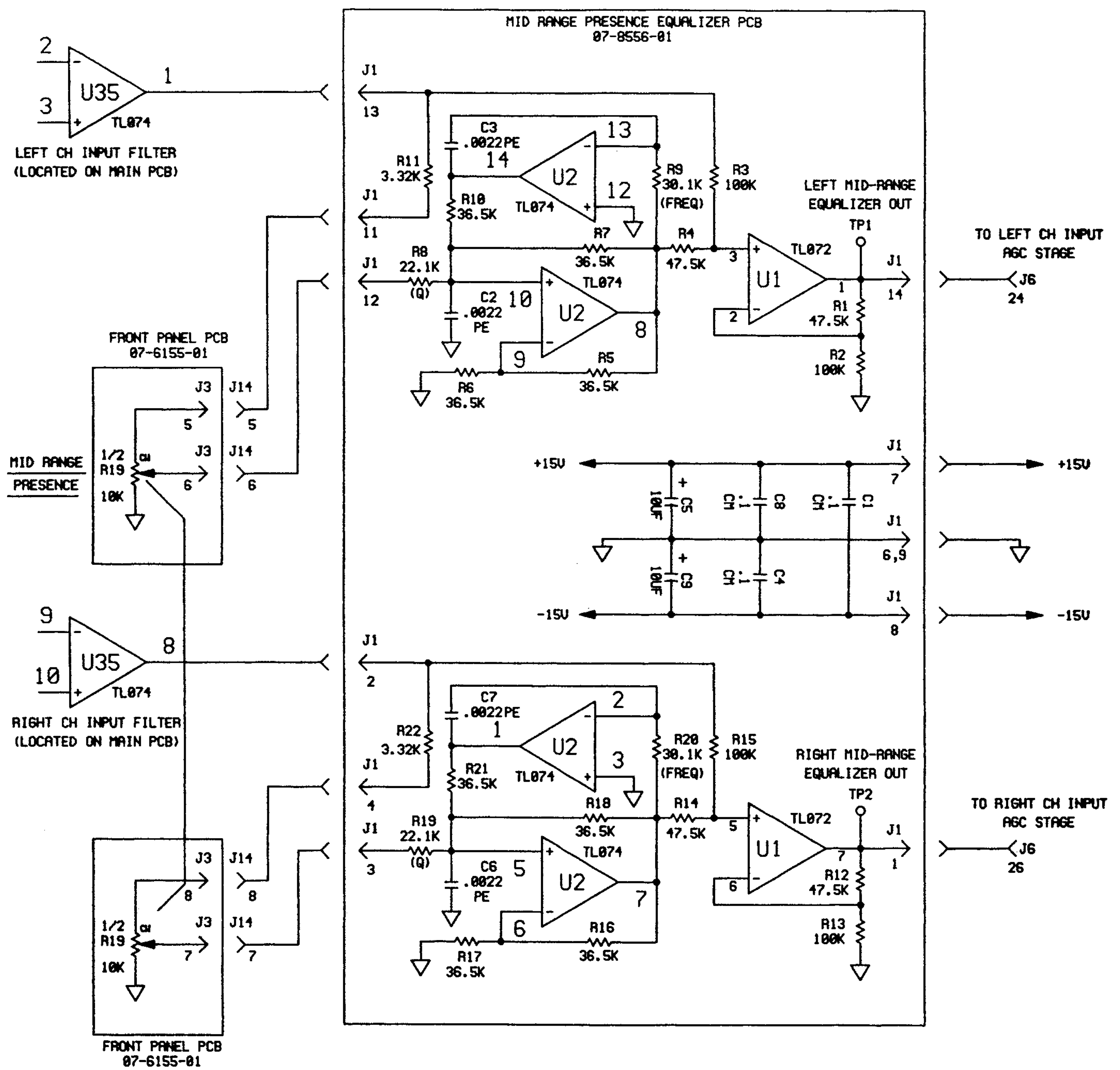
TITLE AMIGO AM (POWER SUPPLY)			DRAWING NUMBER 02-8555-08			REVISION A - 1	
ASSY 07-8555-01	DRAWN BY GARY D. CLARKSON	DATE 23 SEPT 1993	CHECKED BY G D C	DRAWING SIZE B = 11" X 17"	PLOTED SCALE 0.440	PAGE 8 OF 8	



NOTE: This schematic only applies to products containing a VERSION 3 Main Circuit Board. Products containing a VERSION 4 circuit board do not contain a 07-8556-01 Mid Range Presence Equalizer circuit board. The equalizer circuitry is included on the Main Circuit Board in those versions.

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TITLE AMIGO AM MID RANGE EQUALIZER			DRAWING NUMBER 02-8556-01			REVISION A-1
ASSY. NUMBER 07-8556-01	DRAWN BY G.D. CLARKSON	DATE 25 SEPT 1993	CHECKED BY GDC	DRAWING SIZE A = 8.5 x 11	PLOTED SCALE 0.440	PAGE 1 OF 1