BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP PLEASE READ THE SECTION ON UNPACKING AND INSPECTION

UREI
ELECTRONIC
PRODUCTS

model 6215
POWER AMPLIFIER

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PREFACE

This instruction manual has been prepared to enable you to achieve optimum utility and performance from your JBL amplifier. We encourage you to read it and to make use of the material contained in it.

This product was manufactured for JBL by UREI, Inc.

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SECTION I
INTRODUCTION

The JBL Model 6215 power amplifier has been designed to meet the most critical professional sound requirements. It is rugged and road-worthy, conservatively rated, and can handle reactive loads with ease.

The engineering design approach stresses the optimization of each stage, allowing high slew rate and relatively low loop gain. Overall feedback has been held to a minimum and is employed only to stabilize the gain and the operating point. This design approach results in amplifiers with excellent performance under the most demanding dynamic input and load conditions. As evidence of the stress on dynamic rather than static or steady-state distortion mechanisms, transient intermodulation distortion measures less than 0.03% by the DIM 100 test. (Leinonen, Otala, and Curl, "A Method for Measuring Transient Intermodulation Distortion (TIM)", Journal of the Audio Engineering Society, Vol. 25, No. 4, April, 1977, pp. 170-177.)

Reliable operation of the amplifier is ensured through the following protection modes: Current is limited under improper load or drive conditions. An output relay, with front panel LED indication, protects the loudspeaker load under conditions of DC offset or large low-frequency transients. The relay also provides power-up, power-down, and "brown out" muting to protect loudspeakers from AC power transients generated anywhere in the signal path. LED's on the front panel indicate the onset of clipping and standby mode.

The JBL Model 6215 amplifier may be operated in the normal stereophonic mode, dual monophonic mode, or bridged monophonic mode. Rear panel switching sets these modes, obviating the need for patch cords, level matching, etc.

Active differential input circuitry offers the benefits of balanced operation without the use of input transformers. Input connections may be made via 3-pin XL-type connector, three-conductor (TRS) 6.3 mm (1/4 in.) phone jack, or barrier strip. The barrier strip has separate terminals for audio ground and chassis ground.

The five-way output binding posts are arranged on 19 mm (3/4 in.) center so that bridged as well as normal connections may be made with standard dual banana plugs, bare wire, or terminal lugs.

1.1 SPECIFICATIONS

OUTPUT POWER:

	Rated Power 20 Hz-20 kHz	Midband Power 1 kHz
8-ohm stereo (per channel)	35 W	40 W
4-ohm stereo (per channel)	45 W	50 W
16-ohm bridge	45 W	50 W
8-ohm bridge	90 W	100 W

Rated Power is minimum continuous sine wave output per channel, with both channels driving their rated load over a power bandwidth of 20 Hz to 20 kHz. Maximum total harmonic or intermodulation distortion measured at any power level from 250 milliwatts to rated power is less than 0.1% for 8 ohm stereo and 16 ohm bridge, 0.2% for 4 ohm stereo and 8 ohm bridge.

Midband Power is maximum output power at onset of clipping, both channels driven with 1 kHz sine wave, THD 1%.

TRANSIENT INTERMODULATION DISTORTION: .03% max at rated output

FREQUENCY RESPONSE: +0, -1 dB, 20 Hz to 20 kHz, at any level up to rated output

NOISE: At least 100 dB below rated output (15.7 kHz noise bandwidth)

INPUT: Balanced bridging differential amplifier

INPUT IMPEDANCE: 40k ohms used as balanced input; 20k ohms used as unbalanced (single-ended) input

MAXIMUM INPUT LEVEL: +20 dB* (7.75 V rms)

INPUT SENSITIVITY: 1.1 V for rated output into 8-ohm load

VOLTAGE AMPLIFICATION: Variable; maximum 24 dB

RISE TIME: Less than 7 microseconds

SLEW RATE: 6 V/microsecond into 8-ohm load

*In these specifications, where dB refers to a specific level, the 0 dB reference is 0.775 volts RMS unless otherwise noted.

DAMPING FACTOR: With 8-ohm load, greater than 200 at any frequency from 20 Hz to 1 kHz

CHANNEL SEPARATION: Greater than 60 dB at 1 kHz

POLARITY: Output signal is in phase with pin 3 of XL-type connector, tip of 6.3 mm (1/4 in.) phone jack and the barrier strip "+" terminal

AC POWER: Typical AC power consumption

At idle (approx.)	30 W
At rated output Both channels 8-ohms	170 W
At rated output Both channels 4-ohms	220 W

DC OUTPUT OFFSET: ±10 millivolts maximum

DIMENSIONS:	45 x 483 mm (1-3/4 x 19 in.)
DEPTH:**	231 mm (9-1/8 in.)
NET WEIGHT:	4.76 kg (10.5 lbs)
SHIPPING WEIGHT:	5.6 kg (12.5 lbs)

OPTIONAL ACCESSORIES: Model 6201SC attenuator security cover, and 70 V output transformers

PROTECTION CIRCUITRY: The amplifier output is protected against short circuit and is stable into reactive loads. Short circuit protection is clean with no odd degrading characteristics. The loudspeakers are protected against amplifier failure by an internal relay which disconnects the load from the amplifier output and connects it to ground. The circuit also prevents thumps in the loudspeaker during system power up/down. The relay also disconnects the load if excess DC voltage is detected at the output or upon failure of amplifier power supply. If the amplifier

**Allow a minimum of 51 mm (2 in.) behind amplifier for connections and cooling air flow.

overheats due to a lack of ventilation the relay opens until the amplifier has begun to cool down.

CONTROLS: Independent channel level controls are detented. Illuminated rocker-type power switch. Rear panel recessed stereo/dual mono/bridged mono mode switch.

INDICATORS: Individual channel clip indicator LEDs. STANDBY LED indicates action of output protection circuit.

CONNECTORS:

Input: 3-pin XL-type 3 conductor 6.3 mm (1/4 in.) phone jacks and barrier strip. May be wired balanced or unbalanced.

Ground: Chassis ground and audio ground connected with removable shorting strap on rear panel barrier strip

Output: Color coded 5-way binding posts on 19 mm (3/4 in.) centers. 1/4" headphone jack on front panel.

Power: 1.5 m (5-foot) 3-wire AC power cord with U-ground male connector

The front panel and rack ears of the amplifier are made of aluminum extrusions; the chassis is fabricated of heavy gauge aluminum. Front panel graphic details are incorporated on the rear side of a polycarbonate laminate.

SECTION II
INSPECTION AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your JBL Power Amplifier was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit.

Save the carton and packing in the event the unit must be returned for service. If shipping damage is evident, do not destroy any of the packing material or the carton, and immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the customer.

2.2 ENVIRONMENTAL CONSIDERATIONS

This amplifier has been constructed to operate satisfactorily with program material at normal room temperature and humidity. This presumes a free, unrestricted flow of cooling air to reach the amplifier. When the amplifier is mounted in a rack it is important to ensure that cool air is allowed to reach the amplifier, and that heated air is allowed to flow away from the amplifier. In most cases this will only require ventilation grills to be provided so cool air can enter the rack at the bottom and hot air can exhaust at the top through natural convection.

Additional heat-producing devices should not be placed directly above or below the amplifier, but at least 1-3/4" away.

In some installations it may be necessary to provide forced air cooling to the amplifier and the space in which it is mounted. The amplifier has thermo-protective circuits that will operate if the amplifier overheats. This will happen for one or more of the following reasons:

1. Insufficient natural air flow.

2. Average power and duty cycle of the program material too high.

3. High ambient air temperature in which the amplifier is operating.

It is not possible to state exact requirements for air flow because of the number of variables, but in most cases fans with 70-120 CFM will provide sufficient air flow.

2.3 AC POWER

All JBL Power Amplifiers shipped to destinations in the USA and Canada are wired for 120 VAC 60 Hz operation. Amplifiers wired for operation on any other voltage are identified as such with a sticker on the rear panel and a tag attached to the amplifier power cord.

WARNING

BE SURE TO VERIFY BOTH THE ACTUAL LINE VOLTAGE AND THE VOLTAGE FOR WHICH THE AMPLIFIER HAS BEEN WIRED BEFORE CONNECTING AC POWER. APPLICATION OF EXCESSIVE VOLTAGE TO THE POWER SUPPLY MAY RESULT IN EXTENSIVE DAMAGE WHICH IS NOT COVERED BY THE WARRANTY.

To comply with most electrical codes this amplifier is supplied with a three-conductor AC power cable, the grounding pin of which is connected to the chassis. In some installations this may create ground loop problems when an AC potential exists between conduit ground and audio ground. This will be evidenced by hum or buzz in the amplifier output. If this should occur please refer to Section 2.9 for suggestions. Proper grounding of the amplifier is important for both noise and safety reasons. Be aware that unless the amplifier is properly grounded, a safety hazard can exist. JBL accepts no responsibility for legal actions or for direct, indirect or consequential damages that may result from violation of electrical codes.

2.4 AMPLIFIER MODE SWITCH

A recessed switch on the rear panel provides for convenient change of amplifier mode from stereo to dual mono and bridged mono output. The switch may be actuated with a small screwdriver. The functions are as follows:

Stereo:

Input to Channel A. Output is on Channel A and level is controlled by Channel A level control.

Input to Channel B. Output is on Channel B and level is controlled by Channel B level control.

Dual Mono:

If both channels of the amplifier are driving the same signal to different loudspeakers the dual mono mode saves a patch cord or Y-cord. Input is to Channel A. Output on Channel A is controlled by the Channel A Level control. Output on Channel B is controlled by the Channel B Level control. Input B is not used.

Bridged Mono:

This mode makes the stereo amplifier into a single mono amplifier with the power of both channels combined. Input is to Channel A. Level control is by Channel A Level control and output is taken from the red binding posts of Channels A and B as described in Section 2.5.5.

2.5 EXTERNAL CONNECTIONS

2.5.1 INPUT CONNECTIONS, GENERAL

Input signal wires should be shielded cable, and connected in accordance with standard wiring practice to either the three-conductor 6.3 mm (1/4 in) phone jacks, the XL-type connectors or the barrier strip on the back of the chassis. See Figures 2-1, 2-2 and 2-3.

NOTE: The JBL Amplifier input connectors are wired as follows:

PHONE JACK	XL-TYPE CONNECTOR	BARRIER STRIP CONNECTION
Tip	Pin #3	+ or HIGH
Ring	Pin #2	- or LOW
Sleeve	Pin #1	AUDIO GROUND

For a given channel, either the XL-type connector, the phone jack or the barrier strip may be used. Since all three connectors are wired in parallel, however, only one should be used at a given time (unless it is specifically desired to loop a signal through the amplifier input).

The amplifier will not unbalance floating or balanced input sources since the input circuits consist of balanced differential amplifiers. To use an unbalanced source, wire the signal carrying conductor of the cable from that source to XL-type pin 3 (phone plug tip), and wire the shield to XL-type pin 1 (phone plug sleeve). The unused connector terminal, pin 2 (ring), should also be connected to shield ground. Unbalanced connections are simplified by using two-conductor standard phone plugs because they automatically short the ring and sleeve together when inserted in the input jacks.

2.5.2 INPUT CONNECTION, DUAL MONO MODE

When operating the amplifier as two independent amplifiers, but with the same program signal, only the Channel A input need be used. Set the mode switch to Dual Mono. There is no need to apply signal to the Channel B input.

2.5.3 INPUT CONNECTION, BRIDGED MONO MODE

When operating the amplifier as a single-channel amplifier, only the Channel A input is used. The signal from Channel A is brought back polarity inverted to drive Channel B. In the bridged mono mode Channel B input control is not used.

2.5.4 FIVE-WAY BINDING POST OUTPUTS

Five-way binding post outputs have been chosen because they allow connections to be made quickly, they facilitate polarity reversals for speaker "phasing," and they can handle high current with a greater margin of safety than phone jacks. See Figure 2-4.

The preferred connection method is to use a dual banana plug for each speaker cable. Simply insert each plug into the corresponding channel's red and black binding posts. See Figure 2-5.

In the absence of a dual banana plug (or two single banana plugs), there are other alternatives. To connect stranded speaker cable, loosen the plastic terminal nut, wrap the stripped and twisted wire end clockwise around the terminal, and secure it by tightening the nut.

> NOTE: It is preferable to tin the wire ends with solder to prevent unraveling. Avoid excess solder as it can promote cable breakage. Smaller speaker cable could be pushed through the hole in the binding post shaft, but we recommend using heavier gauge cables that ought to be wrapped around the shaft.

If a lug is installed on the cable, loosen the terminal nut, push one "leg" of the lug through the hole in the shaft, and tighten the nut.

A 6.3mm (1/4") phone jack has been provided on the front panel for headphone. The tip is connected to Channel A output, ring is Channel B output, and the sleeve is ground. The headphone output is current limited and will not affect the main output(s) if shorted.

2.5.5 OUTPUT POLARITY AND BRIDGED MONO CONNECTION

In normal stereo operation (or dual mono), a positive-going signal applied to an input's pin #3, the phone jack tip, or the + terminal of the barrier strip will cause a positive-going signal to appear at the corresponding channel's red output binding post.

In bridged mono operation the two amplifier channels are driven from Channel A input, and Channel B's polarity is reversed internally. The speaker cable is then connected to the two channels' red binding posts (the black posts are not used in

bridged mono mode). In this case, a positive-going signal applied to the Channel A input appears as a positive going signal at the Channel A red binding post and as a negative-going signal at the B red binding post. See Figure 2-6.

NOTE: The two channels' binding posts are clustered to facilitate mono connection across the red posts with a standard dual banana plug. DO NOT CONNECT THE TWO RED BINDING POSTS TO EACH OTHER, and DO NOT GROUND EITHER SIDE OF THE OUTPUT IN BRIDGED MONO MODE.

2.6 INPUT IMPEDANCE AND TERMINATION

Audio engineering has its roots in the telephone industry, and "600 ohm circuits" (together with their predecessors, "500 ohm circuits") are carry-overs from telephone transmission practices. Long audio transmission lines, like their video counterparts, must be properly sourced from and terminated in equipment which matches their characteristic impedance if optimum frequency response and noise rejection are to be achieved.

However, transmission line theory and techniques are not only unnecessary but impractical within modern recording studios, broadcast studios and other local audio systems where transmission circuits are seldom more than several hundred feet in length. The advent of negative feedback circuitry and solid-state electronics has spawned modern audio amplifiers and other signal processing devices having source impedances of only a few ohms. They are essentially indifferent to load impedances and, by varying their output current inversely to changes in load impedance, maintain the same output voltage into any load impedance above a rated minimum, with no change in frequency response.

Modern audio systems, therefore, utilize amplifiers and other active devices which have very low output impedances and high (10k to 50k ohm) input impedances. These products may thus be cascaded (operated in series), or many inputs may be connected to a single output of a preceding device, without regard to impedance matching. Switching and patching is simplified because double loads and unterminated bugaboos are essentially eliminated. Floating (ungrounded) transformer outputs minimize ground loop problems, and differential transformerless input circuitry (or input transformers) minimize common mode noise or interference which may be induced into the interconnecting wires or cables.

Where audio must be transmitted through cables or wire pairs of more than several hundred feet in length, however, transmission line termination practices should still be observed.

This amplifier has input impedances of 40,000 ohms when used

in a balanced, differential input configuration, and 20,000 ohms when used unbalanced (one side grounded). This makes the amplifier suitable for use with any normally encountered source impedance, low or high. Therefore, there are only two situations which will require an input load at the amplifier:

1) when the source requires a 600 ohm load, such as a passive equalizer, older vacuum tube equipment, etc.

2) when the source is a transmission line such as a telephone line.

   In some instances it may prove beneficial to treat the input feed to the power amplifier as a transmission line to lower its impedance and its susceptibility to noise pickup.

Input load resistors, if required, may most conveniently be attached to the barrier strip connector of the amplifier.

2.7 APPROPRIATELY RATED LOADS

2.7.1 IT IS THE USER'S RESPONSIBILITY TO AVOID OVERPOWERING

It is essential that the amplifier be used with loudspeakers of suitable impedance that can handle the amplifier's power output. We realize this is not always easy to determine, especially since speaker power ratings have not been standardized. Nonetheless, JBL IS NOT RESPONSIBLE FOR DAMAGE TO LOUDSPEAKERS RESULTING FROM OVERPOWERING.

Fuses may be inserted in series with the loudspeaker to protect against overpowering. The fuse value must be chosen with some care. Ideally, the value will be high enough that the fuse does not excessively reduce the capability of the loudspeaker to handle peak transients which are above its continuous power rating. On the other hand, the fuse value must be low enough that the fuse can actually do its job. It takes some period of time to heat the fuse element enough to cause it to melt and break the circuit. If it takes too long, the loudspeaker may go first. Obviously, delayed action (slo-blo) fuses are not acceptable for use here. Also, if fuses are used, consideration must be given to their location. Put them where they are accessible for ease of replacement and provide clear labelling of the replacement fuse value. Place spare fuses nearby for ease of replacement with the correct type.

2.7.2 MORE ABOUT LOUDSPEAKER POWER RATINGS

While there is no cut-and-dried method to establish an appropriate amplifier power for a given speaker system, certain guidelines do exist. If a loudspeaker manufacturer specifies "to

be used with amplifiers rated at no more than 'x' watts," then neither speaker nor amplifier warranty is likely to cover damage if a larger amplifier is used. If the amplifier power is only recommended, or if a power rating is given without mentionioning the amplifier, then the question as to whether the amplifier is "safe" becomes more difficult to answer.

Loudspeakers usually fail due to one of two factors: thermal or mechanical overload. Thermal overload means overheating, and is almost always caused by applying too high a level of sustained, average power; the voice coil insulation may burn and short circuit, the coil may deform due to the heating and scrape in the gap, and, in some cases, speaker cones have been known to burst into flame. Mechanical overload is another way of describing excessive diaphragm/voice coil travel. A single very high power transient, especially at lower frequencies, can literally tear a loudspeaker apart. Sometimes mechanical overload is more gradual, with the voice coil "bottoming" against the magnetic assembly until it is deformed; a compression driver diaphragm can strike the phase plug and shatter, or the suspension can be over-extended and simply tear apart.

The frequency and waveform of a signal have a lot to do with the destructive potential of a given power output. Band limited pink noise is somewhat akin to "average program" power, although the meaning of such a rating depends heavily on crest factor (peak to average noise voltage) and specific frequency limits. Unfiltered or unweighted white noise stresses the tweeters more than the woofers. Swept sine waves may cause less thermal heating, but can cause larger excursions at low frequencies. With compression drivers, the mechanical power handling capability is approximately quadrupled simply by raising the minimum crossover frequency by an octave. If any conclusion can be drawn, it is this:

> NO SINGLE POWER RATING REALLY DESCRIBES THE POWER HANDLING CAPABILITY OF ANY LOUDSPEAKER OR LOUDSPEAKER SYSTEM. ALSO, WHEN A LOUDSPEAKER SYSTEM IS MULTI-AMPLIFIED, i.e. A HIGH FREQUENCY DRIVER IS CONNECTED DIRECTLY TO THE POWER AMPLIFIER OUTPUT, A SERIES PROTECTION CAPACITOR IS STRONGLY RECOMMENDED TO REDUCE THE POSSIBILITY OF ACCIDENTAL DAMAGE TO THE DRIVER DIAPHRAGM. CONSULT THE MANUFACTURER OF THE DRIVER AND HORN FOR RECOMMENDATIONS ON PROTECTION CAPACITOR TYPES AND VALUES.

2.7.3 SOMETIMES A LARGER AMPLIFIER CAN BE SAFER

If the desired sound level is high enough that it requires a low powered amplifier to be operated at a fairly high distortion level (e.g., well into clipping), it may be safer to use a larger amplifier that will be free of distortion. It is true that in a small amp which is clipping, peak power is restricted by the size

of the amplifier's power. However, the average power output rises due to the increased signal density caused by distortion components. Not only does this increase the thermal stress, it also increases mechanical stress because the squared waveforms place greater "G" loads on the moving parts, and abnormally high proportions of high frequency harmonics are generated which can fry the tweeter voice coils.

A more powerful amplifier which is able to generate the desired peak sound level without clipping avoids the large increase in average power (thermal) and the high acceleration (mechanical) stresses caused by the overdriven small amplifier. The major drawback of the larger amplifier is that it can produce higher peak outputs that may instantly destroy a loudspeaker. Therefore, great care must be exercised to ensure that the amplifier will not be driven at too high a level, certainly never at a clip. This can be accomplished either by knowing the program material (if recorded) and setting levels accordingly, or by using peak limiters (with live or unknown program material).

2.7.4 REMEMBER THE DIVIDING NETWORK (CROSSOVER)

If the amplifier is connected to a multi-way loudspeaker system that includes a passive, high-level dividing network (crossover), be sure to consider its presence. The network should be rated to handle the amplifier's power. Pre-packaged speaker system power ratings already take the crossover into account.

If you obtain separate components and assemble a system, the chances are that the higher frequency drivers will be rated at less power than the woofer(s). This works out overall because the higher frequency drivers tend to be more efficient (more sound per watt). In fact, higher sensitivity in the high frequency components usually requires some attenuation to be applied in the dividing network (remember, a 3 dB more sensitive driver must be driven with half the power to generate the same sound level).

For example, consider a typical two-way system with a 200 watt woofer and 50 watt high frequency compression driver. The woofer, 1 meter from its enclosure, generates 100 dB SPL with 1 watt at its input, and the compression driver, 1 meter from its horn, generates 106 dB SPL at 1 watt input. If both components are driven by a 200 watt program signal, the compression driver will be 6 dB too loud (four times the level of the woofer). Therefore, the crossover network must provide 6 dB of attenuation for the compression driver, lowering its input power to 50 watts. The 200 watt amplifier turns out to be perfectly suited to driving this system, even though one driver is rated at just 50 watts.

2.8 SPEAKER CABLES

2.8.1 TYPE OF WIRE

A number of companies offer various special "speaker cables" which are claimed to vastly improve the signal delivered from amplifier to loudspeaker system. Without going into great details, suffice it to say that some special cables have merit, others may actually be detrimental, and overall the value will have to be determined by the user. In our opinion, for most applications just two factors need to be considered: DC resistance and durability.

Generally, the larger the wire gauge, the better. DC resistance is lower with larger wire, and hence more of the amplifier power gets to the loudspeaker (and damping factor is not degraded; see Section 2.8.2). More strands of wire in a given wire gauge are beneficial because they let the cable handle more flexing without fatigue.

2.8.2 DAMPING FACTOR

The higher the damping factor of an amplifier, the greater its ability to control unwanted speaker cone movements -- especially at low frequencies. To understand how a high damping factor improves sound quality, one must first understand the underlying principles.

When an amplifier drives a woofer, current flowing through the voice coil creates a magnetic field which interacts with the permanent magnetic field in the gap and forces the diaphragm/voice coil assembly to move. Consider what happens when the resting cone is accelerated to a maximum velocity by a signal pulse; the maximum signal builds up, and the voice coil/diaphragm assembly tracks the current, moving outward proportionately. When the current returns to zero, the suspension and the air mass loading the diaphragm pull it back toward its original resting position, and momentum tends to cause overshoot past that point.

In the absence of an applied signal, the voice coil is moving through a magnetic field, and it generates a current opposite to that of the original driving signal. This current induces a voltage or "back EMF" at the amplifier's output terminals.

The back EMF travels through the amplifier's output source impedance to ground. The lower that impedance, the better the "braking" action on the voice coil; a direct short across the coil (zero ohms) would allow minimal overshoot. Low impedance equals high damping factor, so the benefits of high damping factor become obvious -- tighter control of the loudspeaker. The result is more accurate reproduction of the signal.

The theoretical damping factor of an amplifier may not be realized at the speaker because cables always have a finite resistance or impedance; the back EMF must also travel through the cable, so the damping becomes less. Hence, larger gauge cables not only reduce signal losses, they improve performance by affecting damping factor less than smaller gauge cables.

2.8.3 CALCULATING LOSSES IN SPEAKER CABLE

WIRE DIAM. (mm) SOLID	A.W.G. WIRE GAUGE	DC RESISTANCE PER 30 m (100 ft) OF TWO-CONDUCTOR CABLE (OHMS)	CABLE LENGTH WHICH WILL PRODUCE A ONE dB POWER LOSS @ FOUR ohms meters	feet	@ EIGHT ohms meters	feet
4.115	6	0.08	366	1200	740	2425
3.264	8	0.13	244	800	488	1600
2.588	10	0.20	145	475	290	950
2.05	12	0.32	91	300	183	600
1.63	14	0.52	58	190	114	375
1.29	16	0.82	37	120	73	240
1.02	18	1.32	23	75	46	150
0.813	20	2.08	15	50	30	100
0.643	22	3.30	9	30	18	60

POWER LOSSES IN SPEAKER CABLES

This chart may be consulted to establish the approximate power loss (and damping factor degradation) for various wire gauges.

2.9 GROUNDING

For safe operation the amplifier must be connected to a good mechanical ground. This provides for a current path for any voltage which should appear on the chassis due to a fault in the amplifier. This current path will result in blowing the main power supply fuse. Without this current path, the amplifier would present a shock hazard. In addition, a good quality ground on the chassis provides shielding from external fields and minimizes radiation of internal fields to the outside world. To comply with safety regulations in many localities and to protect our customers, we provide this product with a ground connection through the 3-wire electrical cord. In many situations this will present no problem. But there are instances where a hum or buzz will be noticed in the amplifier output due to a phenomenon known as a ground loop. This results when there is a significant potential between the audio ground from the previous piece of equipment and the mechanical ground to which the amplifier has been connected.

If this is the case, the first attempt at a solution should be to remove the strap on the rear panel barrier strip which connects audio ground and chassis. Audio ground will then be referenced from the signal source and the chassis ground will be separate and still connected to mechanical ground. In some instances, the voltage difference between the grounds will be so great that a direct connection to mechanical ground is not possible without hum in the amplifier output. Check for this using a 3 prong to 2 prong AC adaptor between the power cord and the power outlet, temporarily ungrounding the amplifier. Try the amplifier both with and without the ground strap on the barrier strip. Determine which connection works best. Remember, however, that for safety you must still have a connection to chassis ground. This is normally made through a properly grounded third pin connection.

2.10 SECURITY COVERS

In some installations it may be necessary to safeguard the amplifier gain control settings from deliberate or accidental misadjustment. For this purpose the Model 6201SC Security Cover is made available. The 6201SC contains enough individual covers for six amplifiers. Installation is simple:

1) Remove the two Level control knobs. If they are on too tight to be removed by fingers, use a pair of long nose pliers to grasp the bar on the knob and pull outwards. Wrap the jaws of the pliers with masking tape to prevent scratching of the knob.

2) If necessary, adjust the gain controls using a small screwdriver.

3) Press each of the security covers into place to cover the holes in the front panel. Make sure they snap firmly into place.

To remove the cover, slip your fingernail under the edge of the cover and pry it up and off. Alternately, a small screwdriver or knife blade may be used, giving due care not to scratch the front panel.

IMPORTANT: DO NOT POKE YOUR FINGERS OR METAL TOOLS INTO THE AMPLIFIER WHEN THE KNOBS ARE OFF. THERE IS THE POSSIBILITY OF SEVERE SHOCK HAZARD DUE TO THE HIGH VOLTAGE/HIGH CURRENT DC USED TO POWER THIS DEVICE. THE AMPLIFIER SHOULD NOT BE OPERATED WITHOUT EITHER THE KNOBS OR SECURITY COVERS IN PLACE.

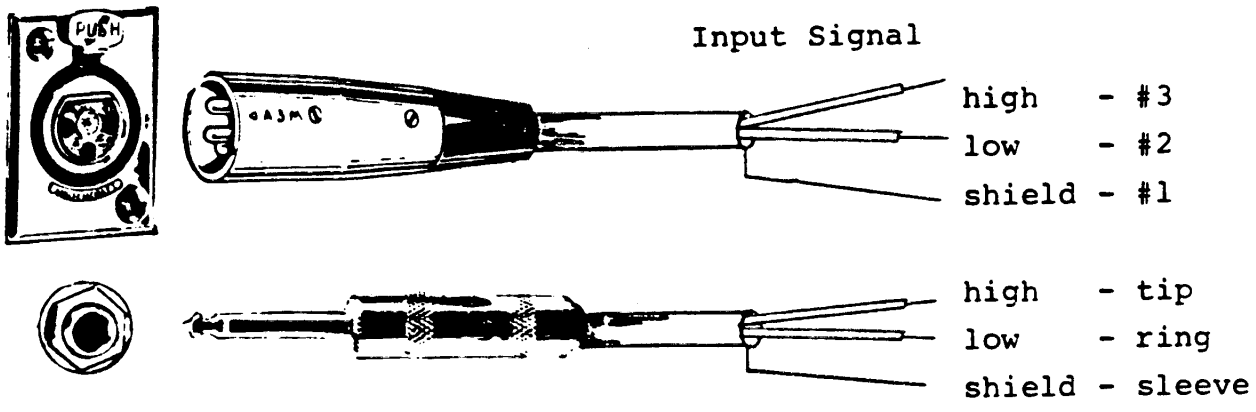

FIGURE 2-1. BALANCED INPUT CONNECTIONS*

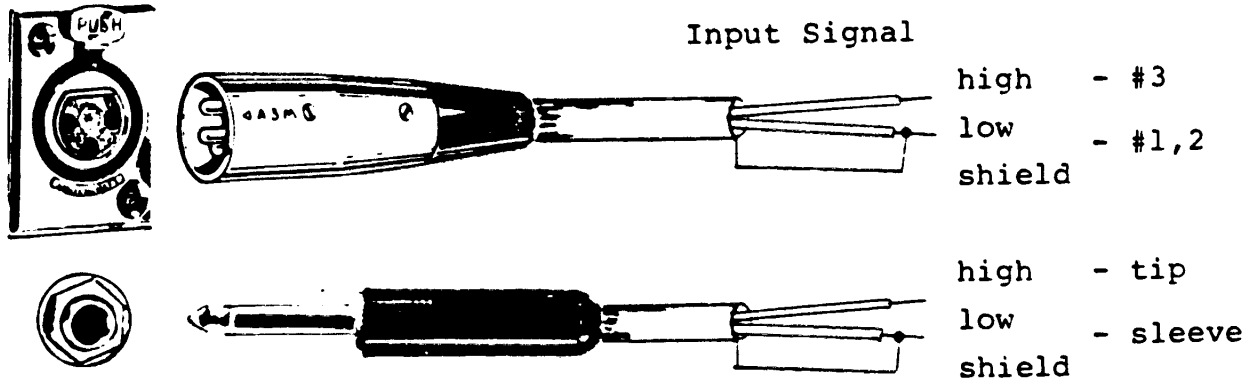

FIGURE 2-2. UNBALANCED INPUT CONNECTIONS*

* For a given channel, use either XL-type or phone jack, not both. For mono operation, use only Channel A.

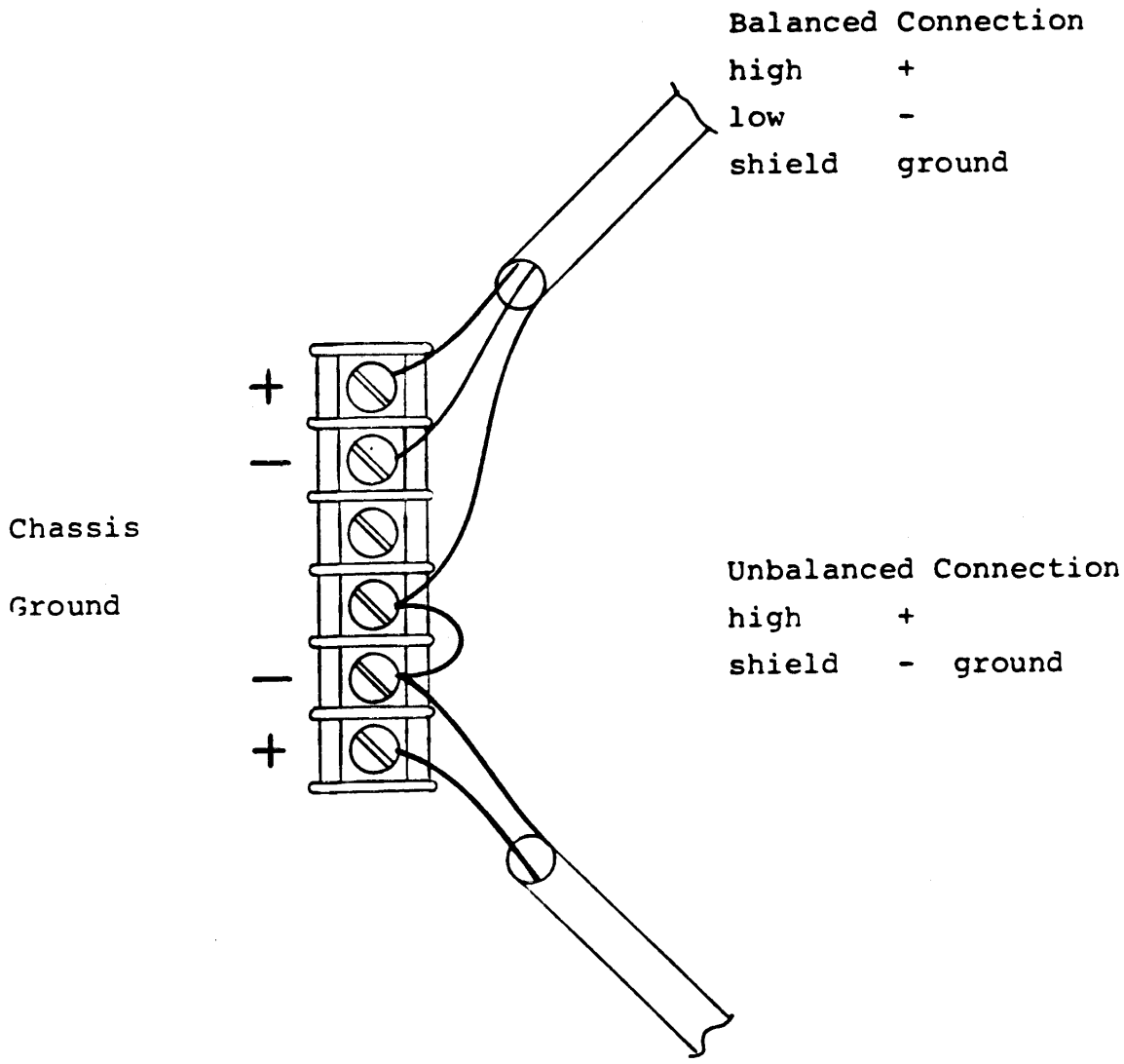

FIGURE 2-3. BARRIER STRIP CONNECTIONS

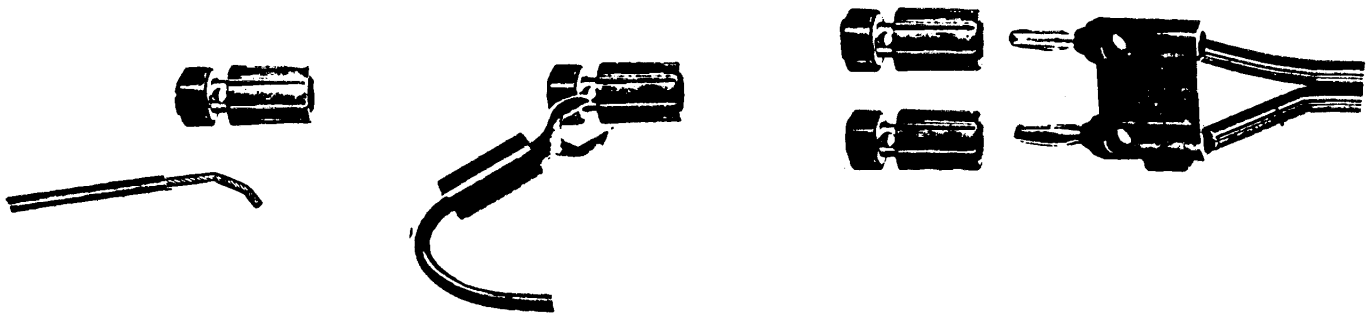

FIG. 2-4. TYPES OF CONNECTIONS THAT CAN BE USED ON FIVE-WAY BINDING POST

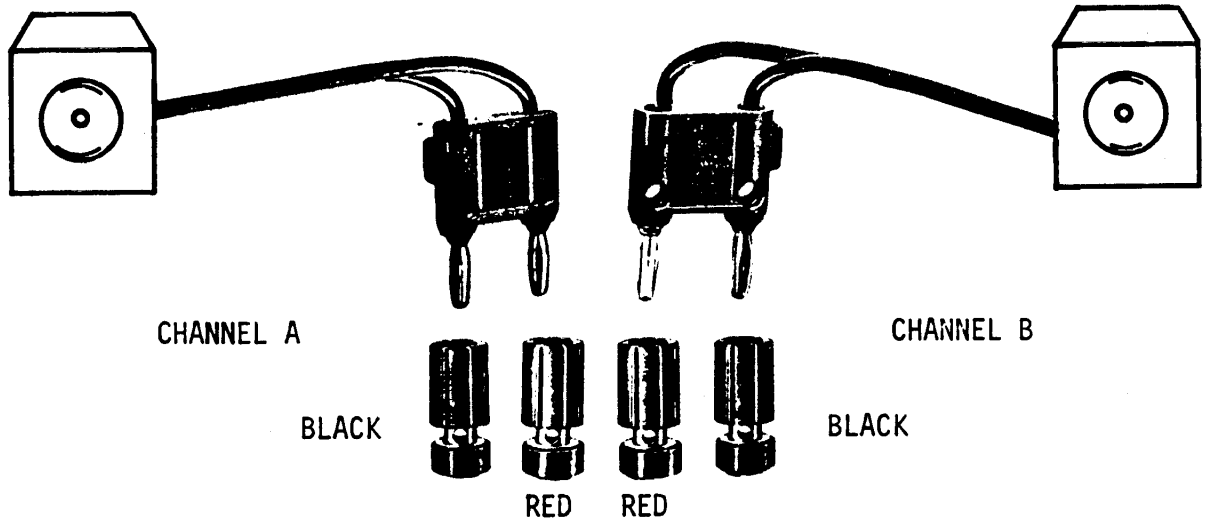

FIG. 2-5. OUTPUT CONNECTIONS FOR TWO CHANNEL SPEAKER SYSTEM

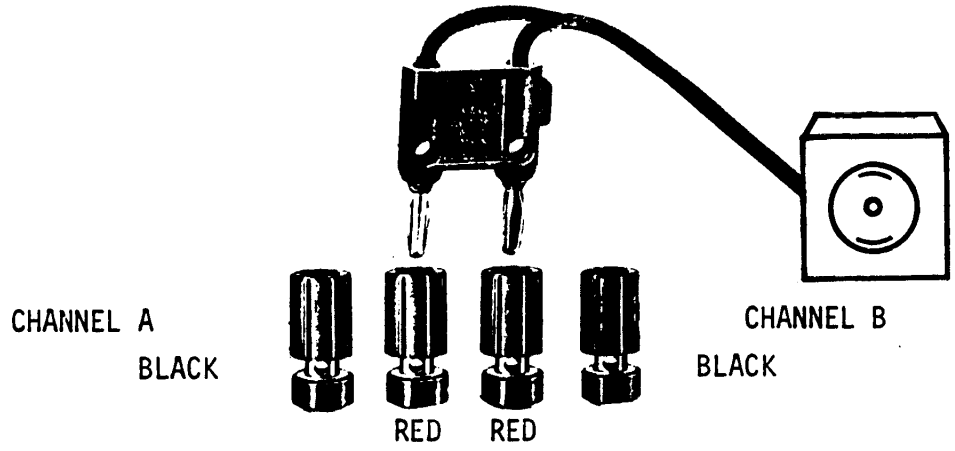

FIG. 2-6. BRIDGED OUTPUT CONNECTION FOR MONAURAL SPEAKER SYSTEM

SECTION III
OPERATING INSTRUCTIONS

3.1 GENERAL

The power amplifier should be installed and connected to both the signal source and the loudspeaker system according to Section II. Set the mode switch as appropriate. Set the Level controls to minimum. Then, after the preceding equipment is turned on to provide a stable input signal, the power amplifier may be turned on.

NOTE: IT IS ALWAYS A SAFE OPERATING PRACTICE TO TURN THE POWER AMPLIFIER ON LAST, AND TURN IT OFF FIRST. THIS PREVENTS ANY POSSIBLE TURN-ON/TURN-OFF TRANSIENTS OR EXCESS LEVELS THAT MIGHT BE GENERATED IN THE LINE LEVEL SIGNAL PROCESSING EQUIPMENT FROM REACHING THE LOUDSPEAKERS.

3.2 TURN ON AND SYSTEM CHECK

Apply program material, and be ready to monitor the speaker output. Turn on the POWER switch, and observe the STANDBY LED. Initially, it will turn on for a few seconds. No sound will be audible (regardless of Level control setting) because the protection relay has not yet connected the output stages to the output connectors.

After a few seconds, the relay will actuate as the STANDBY LED turns off. At this point, bring up the Level controls until a suitable listening level is reached.

3.2.1 THERMAL PROTECTION

Although the need for adequate cooling of the amplifier was briefly discussed under Section II, 2.2, it is important to understand what happens if the amplifier overheats.

The amplifier will get hot when operated over a period of time at medium to high output levels. Under normal conditions, the amplifier does not overheat. However, if a fault exists or if the ventilation is not sufficient, the temperature may rise to a point which could cause damage to individual components. The protection circuit then opens the output relay until a safe operating temperature is re-established. If such thermal cycling should occur, check whether cooling air flow over the amplifier is insufficient or the heated air cannot be vented away from the amplifier.

3.3 CLIP INDICATORS

The channel's front panel CLIP LED will turn on whenever signals approach the clipping level at the output stage, enabling

the operator to take appropriate action. This LED will remain on long enough to be seen even if the excess signal is only a brief transient. To avoid audible distortion, when the LED indicator flashes more than occasionally, either lower the level of the source feeding the amplifier or turn down the amplifier's Level control. Overload conditions are monitored separately for each channel.

The input differential amplifiers are of sufficient sensitivity to be driven to full output by any medium or high line level source; an input of +3 dB (1.1 V rms) will produce rated output into 8 ohms. The Level control comes after the input stage. Therefore, signal levels up to a maximum of +20 dB (7.75 V rms) can be accomodated without overload. There is little likelihood of clipping in this stage without at the same time clipping the output; it is only possible when the amplifier's Level control is set at #28 or lower. The symptom of such input overdrive is audible distortion without any indication from the CLIP LED. In such cases, simply lower the signal level at the source and use a higher number on the amplifier's Level control.

3.3.1 ABOUT SENSITIVITY RATINGS

With regard to sensitivity ratings, power amplifiers are unique. Other audio signal processing and mixing equipment sensitivity describes the <u>average</u> input/output level, whereas a power amplifier's sensitivity describes the input signal required to obtain <u>maximum</u> power output. Therefore, if a mixer, equalizer, or other device is rated at +4 dB nominal output, that average level could continuously overdrive the power amplifier. This is why a level control is provided on the amplifier. By turning down the level at the amplifier, input sensitivity is effectively reduced to match the source so that only peaks drive the amplifier to full output. With a mixer, equalizer, etc. rated at -10 dB to -15 dB nominal output, little or no attenuation is required in the power amplifier.

SECTION IV
THEORY OF OPERATION

IMPORTANT NOTE

The following descriptions of the circuitry used in the amplifier are presented here in order that the professional user may have a general understanding of how the amplifier works. They are not intended as a guide for service. Service on this product should be performed only by qualified technicians. THERE ARE NO USER SERVICEABLE PARTS INSIDE.

In the following descriptions the component designations for Channel A are used.

4.1 INPUT DIFFERENTIAL AMPLIFIER

The input differential amplifier is comprised of IC1 A and B and associated components. Input signals are coupled to the amplifier after passing through one of three input connector types and passing across RF suppression capacitors C31 and C32.

Two amplifier sections are used as unity gain inverters with the output of one summed to the input of the other to afford common mode cancellation. Thus signals which appear equally on both input terminals, such as common mode noise and hum, will be cancelled and unequal signals, such as legitimate input signals, will be summed. Use of the inverting mode in both sections assures high speed, good common mode rejection and equal impedance at both input terminals, a substantial advantage over less expensive single amplifier topologies.

4.2 MODE SWITCH

The rear panel mode switch allows the amplifier to operate in the Stereo, Dual Mono or Bridged Mono modes. In the Stereo mode, the switch is out of the circuit and each channel input goes to its respective output. In the Dual Mono mode, the output of the Channel A differential amplifier is routed to both Channel A and B gain controls. The signal to the Channel B gain control is "impedance-switched", whereby the extremely low output impedance of the Channel A input amplifier becomes the source for the potentiometer rather than the higher impedance source from Channel B input amplifier through resistor R65. In the Bridged Mono mode, output from the Channel A amplifier is routed through IC2A configured as an inverting amplifier. The output of IC2A is "impedance-switched" to the input of the Channel B amplifier.

The internal gain-match adjustment allows the level of the signal at the output of Channel B to be adjusted to the same level as the output of Channel A. This is done by making the

loss through IC2A exactly equal to the gain through Channel A. Channel B, therefore, produces a mirror-image signal of Channel A: i.e. equal voltage but opposite polarity. Bridging the load across outputs A and B results in twice the voltage across the load and four times the power of one channel alone into the same load. The minimum load impedance in this configuration is 8 ohms.

4.3 SHORT CIRCUIT PROTECTION

The output short circuit protection is the simplest kind. Only non-feedback type current sensing is used. Under overload conditions, current is shunted from the input of the output stage to the output line and into the load. This quite effectively protects the output stage from destruction.

4.4 RELAY DRIVER/OUTPUT DC DETECTOR

The output relay K1 is driven by transistor Q13. Diode CR13 shorts out back EMF from the relay coil. Resistor R50 provides a current source for the STANDBY LED when the relay is open. The emitter of Q13 is clamped at -0.6 volts by R45 and CR11. Therefore, the transistor will turn ON when the voltage on its base becomes positive with respect to ground. When the transistor is ON the collector becomes approximately 0 volts and the relay turns on. Current which would have gone to the STANDBY LED is shunted by diode CR12.

The relay is driven by IC2D through current limiting resistor R44. The circuits configured around IC2D perform several functions. A resistor to each low voltage power supply rail in combination with capacitor C8 provide turn-on delay. Resistors R9 and R21 sense excess DC on the outputs of the amplifiers and resistor R20 with thermistor R22 determine overtemperature operation of the heatsink. All of these circuits are diode OR-ed to the inputs of the operational amplifier which is configured as a Schmitt trigger. Resistor R19 overcomes any possible input offset and R7 is positive feedback hysteresis for all circuits except overtemperature, for which resistor R18 provides hysteresis. The output of the operational amplifier is normally positive to turn the relay on and goes negative to turn it off.

4.5 CLIP CIRCUIT

In the clip detector circuit, transistor Q11 is normally turned ON, shunting current away from CLIP LED DS1. The peak output voltage of the amplifier as it approaches the power supply rail voltage is sensed through diode CR8 and resistor R62 and turns the transistor OFF, thereby turning the LED ON. Capacitor C25 provides peak stretching to enable transient peaks of short duration to be seen.

4.6 POWER AMPLIFIER

The signal from the gain control is coupled to the base of transistor Q1. Transistors Q1 and Q2 form a differential amplifier circuit that maintains exact zero DC voltage at the output of the amplifier. Feedback from the output is coupled through resistor R24 and to the base of transistor Q2, and also is coupled through resistor R8 to the inverting input of IC2-C. The output of IC2-C is coupled through R10 to the base of transistor Q1. Whenever the output of the amplifier attempts to go negative or positive it causes transistor Q2 to conduct more or less; this causes Q1 to conduct more or less, thus controlling the operation of IC3.

The signal from the collector of transistor Q1 is coupled directly to the base of transistor Q3. The signal from the collector of Q3 is coupled to input pin 7 of IC3-A. Input pin 1 is driven from the output of IC3-A by the voltage swing of C14.

Resistors R39, R49, coil L1 and capacitor C22 provide stable operation under all load conditions.

4.7 POWER SUPPLY

The power supply is conventional. The AC voltage from transformer T1 is rectified by bridge rectifier BR1 and filtered by the large storage capacitors C29 - C30. The resulting high voltage, high current DC is used in the voltage and output amplifier stages. This supply is then regulated to supply $\pm$ 15 VDC for the operational amplifiers, and is also zener regulated to supply + 24 VDC for the relay coil.

SECTION V MAINTENANCE

5.1 General

This Amplifier is all solid state, ruggedly constructed and uses the finest components. As such, it will provide years of trouble free use with normal care. All parts are conservatively rated for their application. NO SPECIAL PREVENTIVE MAINTENANCE IS REQUIRED. THERE ARE NO USER SERVICEABLE PARTS INSIDE.

The metal and plastic surfaces of the Amplifier may be cleaned with a damp cloth. In case of heavy dirt, a non-abrasive household cleaner such as Formula 409 or Fantastik® may be used. DO NOT SPRAY THE CLEANER DIRECTLY ONTO THE FRONT OF THE UNIT AS IT MAY DESTROY THE LUBRICANTS USED IN THE SWITCHES AND CONTROLS! Spray onto a cloth and then use the cloth to clean the unit.

5.2 Repairs and Warranty

This JBL/UREI Audio Amplifier is warranted by the manufacturer to the original purchaser against defects in material and workmanship for a period of three years from the date of purchase. Complete terms of the Limited Warranty are stated on the Warranty Card packed with this manual. We suggest that you retain a copy of your dated sales receipt for proof of warranty status should that be necessary.

If you wish to return the unit for service, please call or write to the Customer Service Department at the Service address listed on the title page of this manual for a Return Authorization Number. All products returned to the factory must be accompanied by a Return Authorization Number, and must be shipped prepaid. COD shipments will not be accepted.

For prompt service, ship the unit to the factory with the RA number marked on the shipping label. Use the original factory carton; if necessary call or write the factory at the service address listed on the title page of this manual to secure a new carton at a nominal charge. The Amplifier is heavy, and shipping to the factory is at the customer's risk; do not take a chance with inadequate packing materials. Be sure that it is well packed in a sturdy carton, with shock absorbing material such as styrofoam pellets or "bubble-pack" surrounding the unit. Pay particular attention to protecting the controls and switches and make sure that the unit cannot drift around in the shipping box. Shipping damage caused by inadequate packing is not covered by the JBL/UREI warranty. Tape a note to the top of the unit describing the problem, include your name and a phone number where we may contact you if necessary, and give us instructions for returning the product. We will pay return shipping costs on any repair covered under the terms of this warranty.

Field repairs are not normally authorized during the warranty period, and repair attempts by unqualified personnel may invalidate the warranty.

Customers outside the USA should contact their local JBL/UREI Professional Products dealer for warranty assistance. Do not return products to the factory unless you have been given specific instructions to do so.

> WARNING: The full AC line voltage, as well as high voltage/high current DC are present at several points inside the chassis. Refer servicing to qualified technical personnel.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADD "R" DESIGNATOR & VALUE CHANGES	8-3-84	
	B		1-3-85	
	C			

INPUT BOARD ASSY 10-/4872

CHANNEL A INPUT

CHANNEL B INPUT

UNUSED DEC'S
CR15

LAST DESIGNATIONS USED	
R 76	IC 3
C 37	SW 2
CR 14	Q 13
DS 3	VR 2

INPUT AMPLIFIER

A LEVEL

B LEVEL

MODE SWITCH SW-1 (R.P.)

STEREO

DUAL MONO

MONO BRIDGE

MONO BRIDGE INVERTER

BRIDGE GAIN BALANCE

CLIP INDICATOR CHANNEL A

CLIP INDICATOR CHANNEL B

OUTPUT D.C. DETECTOR, OVER-TEMPERATURE & TURN-ON DELAY

DRIVER

OUTPUT AMPLIFIER

OUTPUTS (R.P.)

CH.A — BLK — BLACK, ORG — RED

CH.B — VIO — RED, BLK — BLACK

HEADPHONE JACK (F.P.)

CH.A ORG/WHT

CH.B VIO/WHT

BLK/WHT

TO STAR GROUND

POWER SUPPLY

POWER SW-2 (F.P.)

WHT, GRN, BLK

F-1 LINE FUSE (EXTERNAL)

F-2 LINE FUSE (INTERNAL)

T-1

BR-1

+30V, +15V, GND, -15V, -30V

OP AMP POWER CONNECTION (TYP.)

+15V, -15V

R22 HEATSINK THERMISTOR

9. (F.P.) DENOTES FRONT PANEL MOUNTED ITEMS.
8. (R.P.) DENOTES REAR PANEL MOUNTED ITEMS.
7. CHASSIS GROUND.
6. AUDIO GROUND.
5. RELAY (K1) SHOWN DE-ENERGIZED
4. INDICATES HEATSINK ATTACHMENT
3. ALL OP AMPS ARE TYPE TL084
2. 4 RESISTORS R27&R75 MAY NOT BE USED. VALUES SET AT FACTORY
1. ALL RESISTORS ARE IN OHMS. ¼ W, 5%

NOTES: UNLESS OTHERWISE SPECIFIED

CONTRACT NO.		UNITED RECORDING ELECTRONICS INDUSTRIES
APPROVALS	DATE	SCHEMATIC
DRAWN M. R. MARTIN	3-3-86	POWER AMPLIFIER
CHECKED		SIZE D; MODEL NO 6215; DRAWING NO R14875 E
		SCALE; SHEET 1 OF 1