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

JBL UREI ELECTRONIC PRODUCTS

model 6290
POWER AMPLIFIER

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SECTION I
INTRODUCTION

The JBL Model 6290 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 an amplifier 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.)

This JBL amplifier uses multiple 200-watt output devices in complementary configuration for high reliability and low distortion. At rated power into 8 ohms, these output devices are operated at less than 25% of their rated power dissipation. The benefit is high reliability and long component life.

Reliable operation is ensured through the following protection modes: current is limited under improper load or drive conditions; output relays with front panel indicators protect the loudspeaker under conditions of DC offset or excessive low-frequency transients. The relays also provide power-up, power-down, and "brown out" muting to protect loudspeakers from AC power transients. Clip indicators allow for system optimization.

The JBL amplifier may be operated in the normal stereo mode, dual mono mode, or bridged mono mode. These modes are switch selectable on the rear panel.

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 rack ears and heatsink of the amplifier are made of high grade aluminum extrusions; the chassis is fabricated of heavy gauge steel. All internal components are easily accessible through removal of top and bottom panels. Front panel graphic details are incorporated on the rear side of a polycarbonate laminate which is virtually indestructible.

The five-way output binding posts are arranged in a 19 mm (3/4 in.) array 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)	300 W	400 W
4-ohm stereo (per channel)	600 W	700 W
16-ohm bridge	600 W	700 W
8-ohm bridge	1200 W	1350 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 A-weighted.)

INPUT: Balanced bridging differential amplifier.

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

Bridged Mono and Dual Mono Modes: 20k ohms used as balanced input; 10k 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.

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

VOLTAGE AMPLIFICATION: Variable; maximum 33 dB.

RISE TIME: Less than 7 microseconds.

SLEW RATE: 50 V/microsecond into 8-ohm load.

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.)	120 W
At rated output Both channels 8-ohms	1400 W
At rated output Both channels 4-ohms	2000 W

DC OUTPUT OFFSET: ±10 millivolts maximum.

DIMENSIONS:	178 x 483 mm (7 x 19 in.)
DEPTH:**	356 mm (14 in.)
NET WEIGHT:	28.58 Kg. (63 lbs.)
SHIPPING WEIGHT:	33.11 Kg. (73 lbs.)
OPTIONAL ACCESSORIES:	Attenuator security cover.
PROTECTION CIRCUITRY:	The amplifier outputs are protected against short circuits and are stable into reactive loads. Short circuit protection is clean with no degrading characteristics. The loudspeakers are protected against amplifier failure by 2 internal relays that ground the load if excess DC voltage is detected at the output or upon

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

failure of a power supply. If the amplifier overheats, the relays open until the amplifier has cooled down. The relays are activated at turn on and turn off to prevent thumps in the loudspeaker during system power up/down.

CONTROLS: Independent detented level controls. Heavy-duty illuminated rocker-type power switches. Recessed stereo/dual mono/bridged mono mode switch located on rear panel.

INDICATORS: Individual channel clip and standby indicators. "STANDBY" indicates action of output relay.

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.

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

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. If 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 by made by the customer.

Save the carton and packing material in the event the unit must be returned for service. See Section 5.2, "Repairs and Warranty," for instructions on returning a unit.

2.2 ENVIRONMENTAL CONSIDERATIONS

The amplifier will operate satisfactorily over a range of ambient temperatures from 0°C to +50°C (+32°F to 122°F), and up to 80% non-condensing relative humidity.

If the amplifier is installed in an equipment rack, adequate ventilation must be provided in order to assure longest component life. Additional heat-producing devices should not be placed directly above or below the amplifier, but at least 1-3/4" away.

Keep any obstructions such as wire bundles and rear mounted connector panels away from fan intake area. Again, do not mount other products above or below the amplifier in such a way that would block off air flow to heatsink area. It is normal for the amplifier front panel and rack ears to become warm during operation since it is part of the heatsinking system of the amplifier. See Section 3.2.1, a note on amplifier cooling.

Since the amplifier is quite heavy, be sure the rack is capable of supporting it. When a rack is to be transported with a portable sound system, the amplifier should be supported from the rear and from below; a few pieces of angle iron secured to the sides of the rack should suffice. It is also recommended that the amplifier be placed low in the rack to minimize any tendency for the rack to tip over.

2.3 AC POWER

All JBL Power Amplifiers shipped to points 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, dual mono, and bridged mono output. The functions are as follows:

STEREO:

Independent channel operation.

DUAL MONO:

To feed both channels of the amplifier with the same input signal, the dual mono mode eliminates the need for a patch cord. The input connector goes to Channel A. The signal is internally routed to Channel A and Channel B, with both level controls active. There is no connection to Channel B input.

BRIDGED MONO:

This mode combines the power of both channels into a single mono amplifier. Input is to Channel A. Level control is by Channel A and Channel B, and output is taken from the red binding posts of Channels A and B as described in Section 2.5.5. IMPORTANT: BOTH LEVEL CONTROLS MUST BE AT SAME SETTING FOR PROPER OPERATION.

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 rear panel barrier strip. 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. Do not apply signal to the Channel B input.

2.5.3 INPUT CONNECTION, BRIDGED MONO MODE

When operating the amplifier as a high powered single-channel amplifier, only the Channel A input is used. That signal is applied "in phase" to Channel A, and internally connected, with inverted polarity, to Channel B. No signal should be applied to the Channel B input, but the Channel B level control must be at the same setting as Channel A for proper operation.

2.5.4 FIVE-WAY BINDING POST OUTPUT CONNECTORS

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 great margin of safety. 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), loosen the plastic terminal nut, wrap the stripped and twisted wire end clockwise around the terminal, and secure it by tightening the nut.

> NOTE: Tin the wire ends with solder to prevent unraveling, but avoid excess solder as it can promote cable breakage. Smaller speaker cable can be pushed through the hole in the binding post shaft, but we recommend heavier gauge cables to wrap 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.

2.5.5 ABOUT OUTPUT POLARITY AND BRIDGED MONO CONNECTION

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

In bridged mono operation the two amplifier channels are driven from the Channel A input, but Channel B is internally reversed in polarity. The speaker is connected between the two 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 Channel 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 <u>within</u> 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, though the fuse value must be chosen with care. Ideally, the value will be high enough that the fuse does not limit the peak power capability of the loudspeaker. On the other hand, the fuse value must be low enough for the fuse to actually do its job. It takes a 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. If fuses are used, consideration must be given to their location. Put them where they are accessible for ease of replacement, provide clear labelling of the replacement fuse value, and place spare fuses nearby.

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 mentioning 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 means 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 overextended and simply tear apart.

In order for manufacturers to convey some real-world specifications about their products, they must have methods to attempt simulation of real-world conditions. One often used method is to use pink noise and/or white noise techniques. Pink noise is bandwidth limited random noise, and is generally used as a simulation of "average program power;" i.e. the average power contained in a typical musical sequence, whereas white noise is not limited to any specific bandwidth or curve and as such, contains more high frequency energy. These two test the thermal overload characteristics of the device. Another test method is to sweep a sine-wave through part or all of the audio spectrum. While this method may cause less thermal overload than the pink or white noise method, it can cause larger excursions, particularly at low frequencies. This is a good test of the mechanical overload characteristics. 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 to require a low power amplifier to be operated into clipping more than occasionally, it may be safer to use a larger amplifier that will clip less frequently. In a small amp which is clipping, the average output power rises due to the increased signal density caused by distortion components. This increases thermal and mechanical stress in the speaker because the clipped waveforms place greater "G" loads on the moving parts, and large amounts of high frequency harmonics are generated which can destroy 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 small amplifier. The major drawback of the larger amplifier is that it can produce higher peak outputs that may instantly destroy a loudspeaker. Great care must be exercised to ensure that the amplifier will not be driven at too high a level, certainly never into clipping. 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 the network is 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. 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. Some special cables have merit, others may actually be detrimental, and the value will have to be determined by the user. For most applications 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, more of the amplifier power gets to the loudspeaker, and damping factor is not degraded. 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, you must first understand some basic principles.

When a signal drives a woofer, current flowing through the voice coil creates a magnetic field. This field interacts with the permanent magnetic field in the gap and forces the diaphragm/voice coil assembly to move outward. When the signal is removed, the diaphragm/voice coil assembly begins to move inward, but its momentum causes it to overshoot its resting point. This overshoot will eventually damp itself out, but you can see how unwanted cone movements are generated.

After signal is removed and the voice coil is moving inward through the magnetic field, it generates a current of opposite polarity to the original signal. This current induces a voltage or "back EMF" which travels through the speaker wire to the amplifier's output and through the amplifier to ground. The lower the amplifier's output impedance, the better the damping action on the voice coil. The result of a higher damping factor is more accurate reproduction of bass and lower midrange frequencies.

The theoretical damping factor of an amplifier may not be realized at the speaker due to added impedance of the cable. Larger gauge cables not only reduce signal losses, but they increase damping factor when long lengths are used.

To calculate damping factor, divide the speaker's rated impedance by the amplifier's output impedance. For example, an amplifier with 0.04 ohms output impedance (assuming no cable losses) at 1 kHz would have a damping factor of 200 to an 8 ohm speaker (8 / 0.04 = 200).

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		@ EIGHT ohms	
			meters	feet	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 a ground connection through the 3-wire electrical cord. There are a few instances where a hum or buzz will be noticed in the amplifier output. This is caused by a voltage potential between the audio ground from the previous piece of equipment and the mechanical ground to which the amplifier has been connected, and is called a "ground loop."

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 not the chassis of the amplifier. The next thing to try is a 3 prong to 2 prong AC adaptor between the power cord and the power outlet, to temporarily unground the amplifier. Try the amplifier with and without the ground strap on the barrier strip to 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, or can be accomplished by tying all chassis' within a rack together with a heavy (#10 or larger) wire, then connecting this wire to the cold water pipe ground.

2.10 SECURITY COVERS

In some installations it may be necessary to safeguard the amplifier gain control settings. The Model 6200SC Security Cover is available and contains enough covers for six amplifiers. Installation instructions:

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 the hole until it snaps 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, taking 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 ONLY BE OPERATED WITH THE KNOBS OR SECURITY COVER IN PLACE.

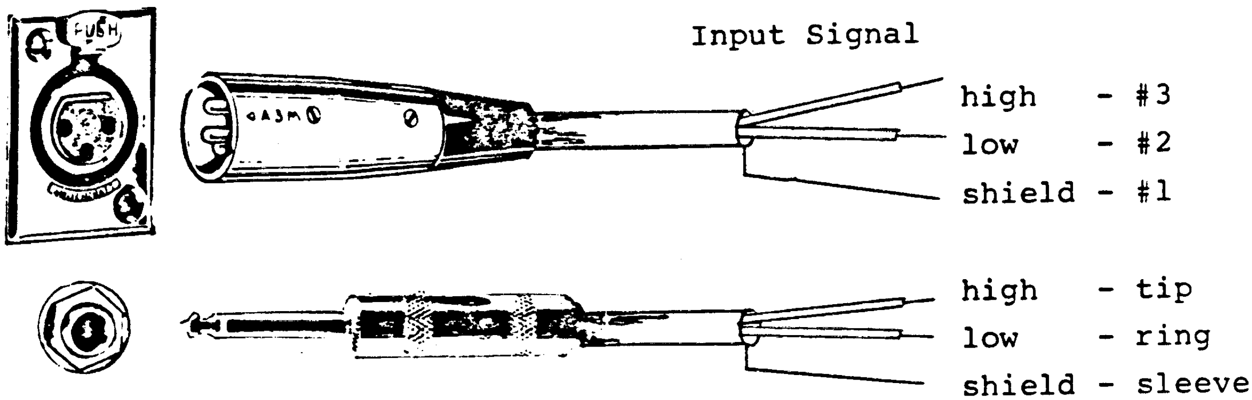


FIGURE 2-1. BALANCED INPUT CONNECTIONS*

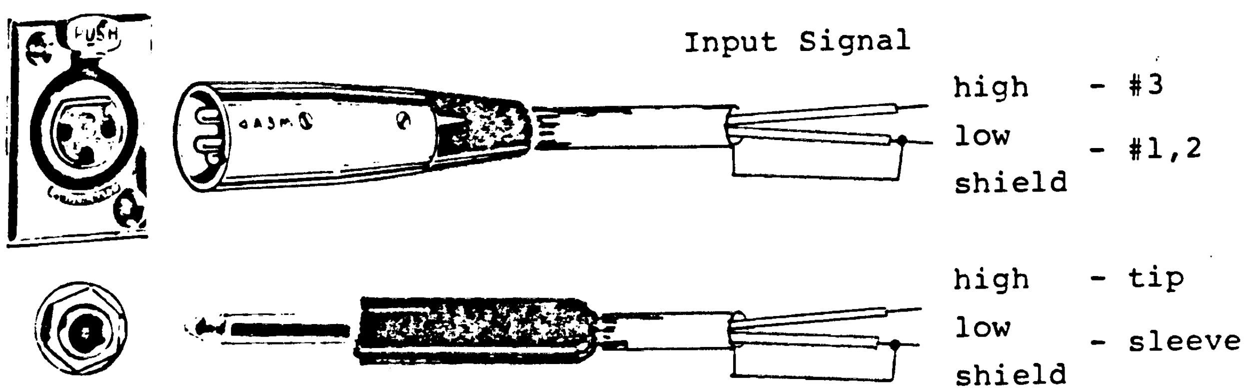


FIGURE 2-2. UNBALANCED INPUT CONNECTIONS*

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

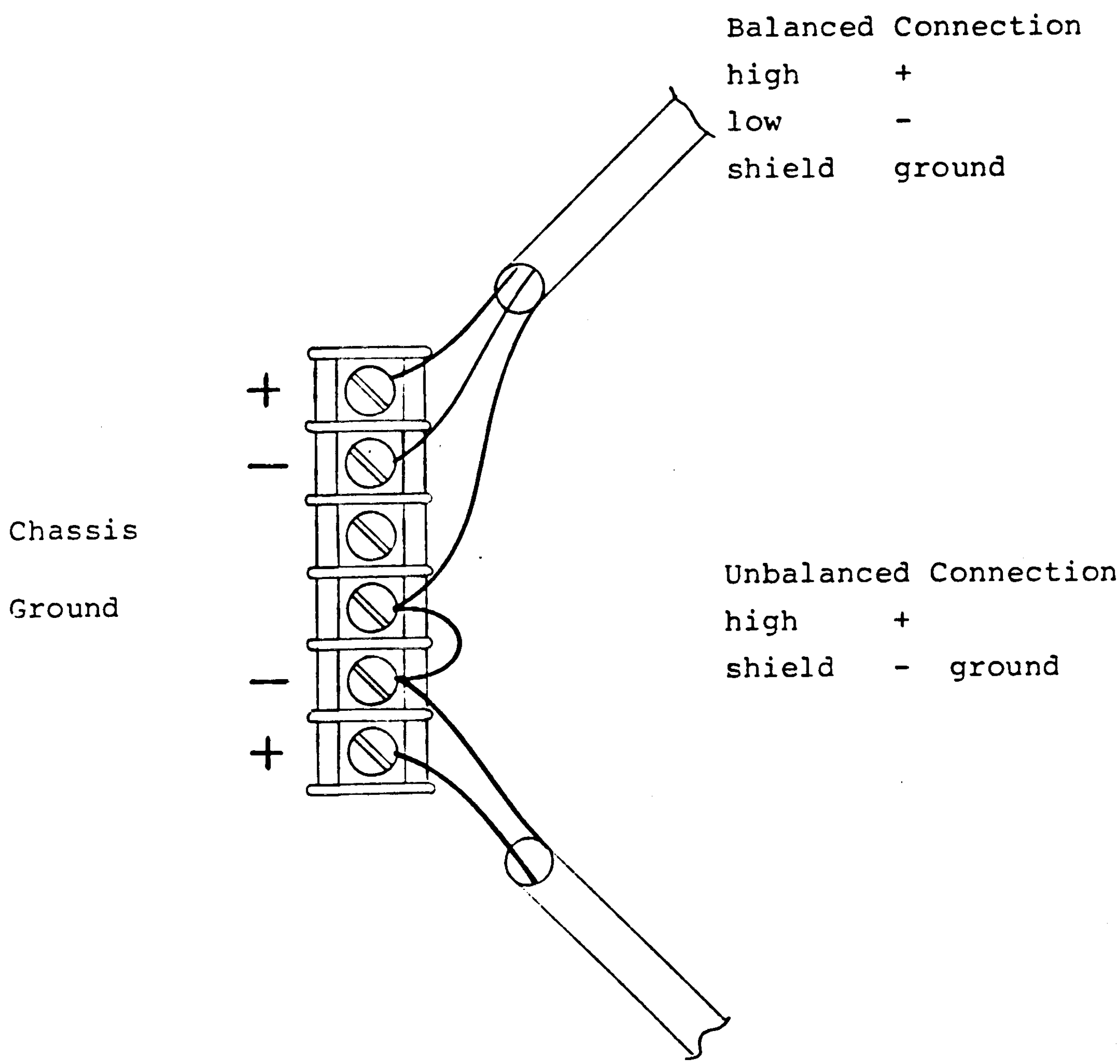


FIGURE 2-3. BARRIER STRIP CONNECTIONS

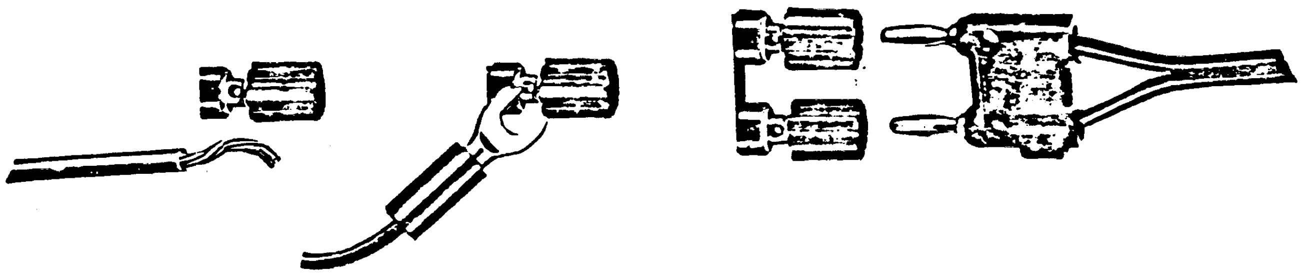


FIGURE 2-4. USE OF FIVE-WAY BINDING POSTS

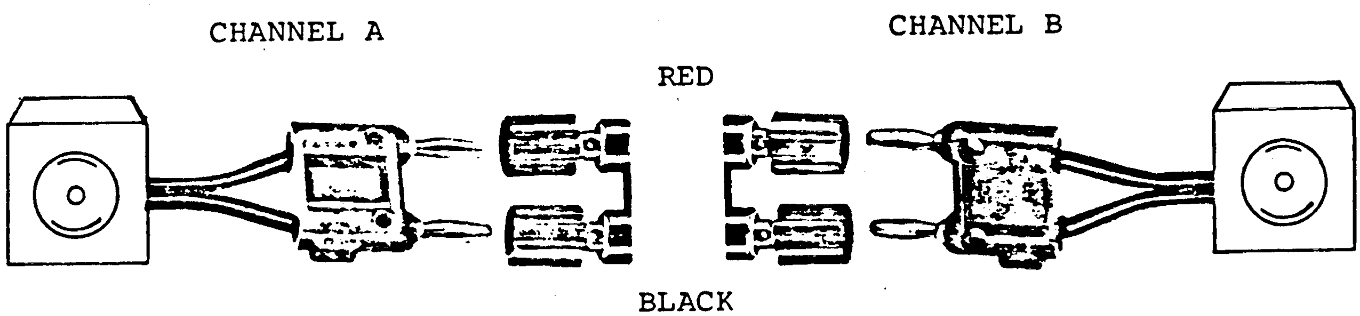


FIGURE 2-5. OUTPUT CONNECTIONS TO TWO CHANNEL SPEAKER SYSTEM

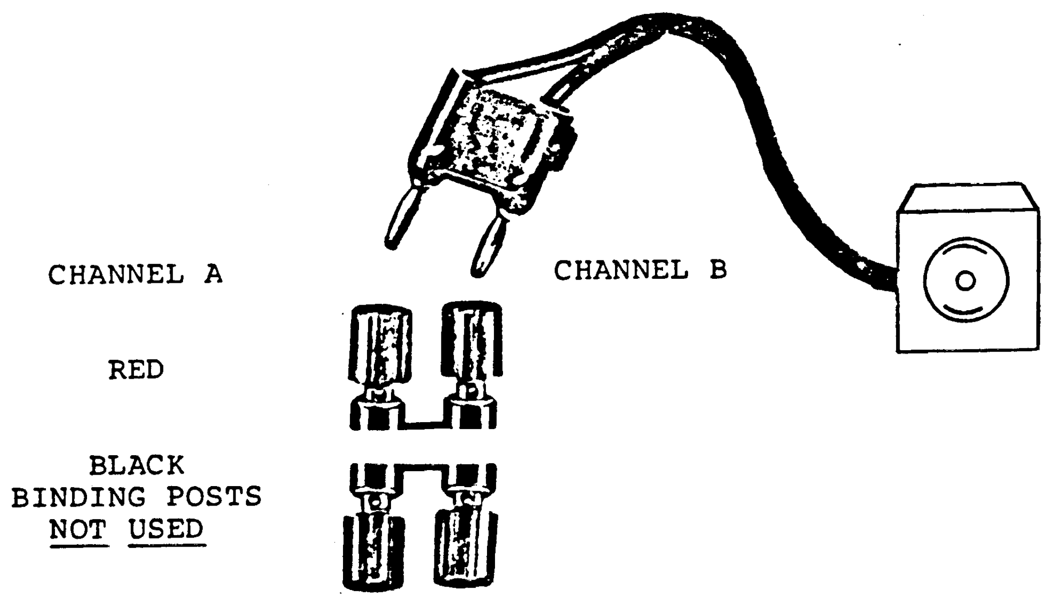


FIGURE 2-6. BRIDGED OUTPUT CONNECTION TO MONAURAL SPEAKER SYSTEM

SECTION III
OPERATING INSTRUCTIONS

3.1 GENERAL

The power amplifier should be installed and connected to the signal source and the loudspeaker system according to Section II. Set the mode switch. Set the Level controls to minimum, and after the preceding equipment is providing a stable signal, turn the power amplifier 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 indicators. No sound will be audible because the protection relays have not yet connected the output stages to the five-way binding posts.

After a few seconds, the relay will actuate as the STANDBY indicators turn off. Increase the Level controls until a suitable listening level is reached.

3.2.1 A NOTE ON AMPLIFIER COOLING

If the ventilation is insufficent, the amplifier may reach an unacceptable temperature level.

The protection circuit will open the output relays until a safe operating temperature is reached. If such thermal cycling should occur, recheck for obstructions and make sure a supply of fresh cool air is available to the rack.

3.3 CLIP INDICATORS

Overload conditions are monitored separately for each channel. The channel's front panel CLIP indicator will turn on when a signal approaches the clipping level of the output stage. The indicator will remain on long enough to be seen even if the signal is only a brief transient. To avoid audible distortion, when the LED indicator flashes often, either lower the level of the source feeding the amplifier or turn down the amplifier's Level control.

Input signal levels up to +20 dB (7.75 V RMS) can be accomodated by the input stage without overload. It is difficult to clip this stage without clipping the output, but it is possible when the amplifier's Level control is set at #28 or lower. The result of such input overdrive is audible distortion without any indication from the CLIP LED. If you feel you may have this condition, simply lower the level at the source and use a higher setting 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 average input/output level, whereas a power amplifier's sensitivity describes the input signal required to obtain maximum power output. 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 reduced 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

The following descriptions of the circuitry in the amplifier are presented so 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. Examination of the accompanying schematic will aid in understanding the following circuit descriptions.

4.1 INPUT DIFFERENTIAL AMPLIFIER

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

Two amplifier sections are used as unity gain inverters with the output of one summed to the input of the other to improve common mode cancellation. Signals which appear equally on both input terminals, such as common mode noise and hum, will be cancelled. Use of the inverting mode in both sections assures high speed, good common mode rejection and equal impedance at both input terminals. This gives 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, each channel operates normally. In the Dual Mono, Channel A input is routed to both Channel A and B differential amplifiers. In the Bridged Mono mode, the Channel A input goes to the Channel A differential amplifier, and is simultaneously inverted via the mode switch and fed to the Channel B differential amplifier. Bridging the load across outputs A and B results in twice the voltage across the load and four times the power as compared to one channel driven into the same load. The minimum load impedance in this configuration is 8 ohms.

4.3 POWER AMPLIFIER

The JBL/UREI Model 6290 Power Amplifier employs discrete transistor circuitry in the voltage amplifier and output stage. A symmetrical topology was chosen to take advantage of distortion cancellation effects and equal group delay for each half of the signal. This allows simple compensation, exceedingly wide open-loop frequency response and excellent transient intermodulation performance.

Q20-23 are configured in matching differential amplifiers loaded by the emitters of Q7 and Q9. Note that no inverting amplifiers are used. All transistors are used in current-mode, non-inverting connections. This eliminates bandwidth limiting due to Miller effect (the effective multiplication of collector-base capacitance by voltage gain), and resultant reduction of high frequency response. Looking at the "top half" of Channel A, Q23 functions as an emitter follower driving Q22 in the common base mode. The feedback signal at R37 is subtracted from the input at this point. Collector current from Q22 is cascode connected to the emitter of Q7, which is also common base connected. Q7 functions as a non-inverting current to voltage converter with exceedingly high low frequency voltage gain and a dominant pole at 24 kHz with an 8 ohm load. Closed loop gain rolls off at 6 dB/octave to the unity gain crossover (somewhere beyond 2 Mhz).

A conventional bias transistor with delta Vbe multiplication spreads the collectors of the upper and lower transconductance amplifiers to compensate for the Vbe drop of the output devices. The bias transistor is, of course, fastened to the heatsink assembly in order to temperature track the output devices.

The output stage is a full complementary Darlington configuration. Again, full complementary is chosen to assure symmetrical amplification.

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 collectors of the transconductance stage to the output line and into the load. This protects the output stage from destruction.

4.4 RELAY DRIVER/OUTPUT DC DETECTOR

The output relay K1 is driven by transistors Q19 and Q24. Diode CR11 shorts out back EMF from the relay coil. Resistor R28 provides a current source for the STANDBY indicator when the relay is open. The emitter of Q19 is clamped to ground by Q24 when the -15 VDC is fully charged. Q19 turns ON when the base voltage becomes positive with respect to ground. When Q19 is ON the collector becomes approximately 0 volts and the relay turns on. Current which would have gone to the STANDBY indicator is shunted by diode CR10.

The relay is driven by IC3B through current limiting resistor R43. IC3B and associated components perform several functions: capacitor C51 detects +15 VDC voltage change which is rectified and stored by CR12, CR19 and C13 to provide turn-on delay; resistor R33 senses DC on the amplifier output; and resistor R46 with thermistor R47 determines overtemperature conditions. These circuits are diode OR-ed to the inputs of the operational amplifier which is configured as a Schmitt trigger. Resistor R44 negates input offset and R42 provides hysteresis for all circuits except overtemperature, for which resistor R45 provides hysteresis. Positive voltage on the output of the operational amplifier causes the relay to turn on, negative voltage turns it off.

4.5 CLIP CIRCUIT

In the clip detector circuit, transistor Q18 is normally turned ON, shunting current away from CLIP LED DS3. The peak output voltage of the amplifier is sensed through diode CR9 and resistor R24 and turns the transistor OFF, which turns the LED ON. Capacitor C1 provides peak stretching, enabling transient, short duration peaks to be seen.

4.6 POWER SUPPLY

The power supply is conventional. The AC voltage from the transformer is rectified by the bridge rectifier and filtered by the storage capacitors. The high voltage, high current DC is used in the voltage and output amplifier stages. An additional winding from the transformer is rectified and regulated to supply ±15 VDC for the operational amplifiers, and +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.

INTRODUCTION

In the unlikely event that your JBL 6290 amplifier needs to be serviced, the following disassembly procedure is recommended whenever the serviceman wants access to the transistors mounted on the inside of each circuit board.

This amplifier was designed so that all of the circuitry is accessible for probing (with power on if you wish) upon removal of only the top and bottom covers. If a problem is isolated to an electrical component, most can be removed from the circuit board by unsoldering the exposed lead while gently tugging on the part. Parts mounted below the board require module removal as detailed below.

6290 MODULE REMOVAL INSTRUCTIONS
(From Serial #3171 and up)

1. Place amplifier flat on bench with fan facing towards you and line cord on the left. Remove cover and unplug red 8 pin and 5 pin connectors near front panel.

2. Remove the following Faston single blade connectors from PC board using your hand or sturdy pair of needle-nose pliers to grasp the barrel of the connector. DO NOT PULL ON WIRES, as this may seriously weaken the strength of the connection. (Rocking the connector from side to side while pulling the connector helps in removal).

   Remove: A. Black wire that is bundled with cables going to red 5 pin connector. (This is the input ground).

   B. Black, red, and green wires coming from right side of amplifier. (These are the high voltage power supply wires).

   C. Two white wires from transformer at pink Faston connectors. (Low voltage AC).

3. Turn amplifier over. Remove cover and diconnect the same wires as on previous side. Refer to Fig. B.

4. Remove the five most rearward screws on each side of chassis (a total of ten) and gently pull heatsink/fan assembly towards you - approximately one inch.

   Locate power switch on right side of front panel (Channel B) and carefully, using needle-nose pliers to grasp barrel of Faston connector, remove white wire, white and small green wire, and lower black wire.

   Remove connector containing large blue and small white wire from right side transformer. The heatsink/fan assembly can now be set on its back with PC boards facing up for service.

5. When ready to reassemble, move heatsink/fan assembly back into the position it was in before it was set on its back. Reconnect wires to transformer, switch, and PC board. (See Fig. A for switch wire locations).

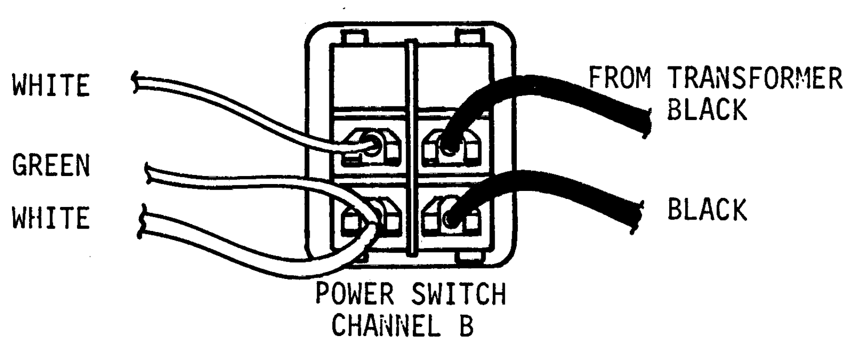
6. Tip the heatsink/fan assembly slightly backward while moving it in toward front of amplifier. Looking on the right side at bottom PC board, gently move assembly so board moves into slot in sheetmetal. At the same time, take care that top PC board also moves into its slot.

7. Reinstall ten screws by adjusting chassis until holes line up. Install cover and turn amplifier over. Reconnect all wires, install top cover, and verify proper operation.

Suggestion: When disassembling, hang white transformer wires and red and black HVDC wires over front panel to keep out of the way.

Hang red five pin over pot bracket to keep it out of the way.

FIG. A



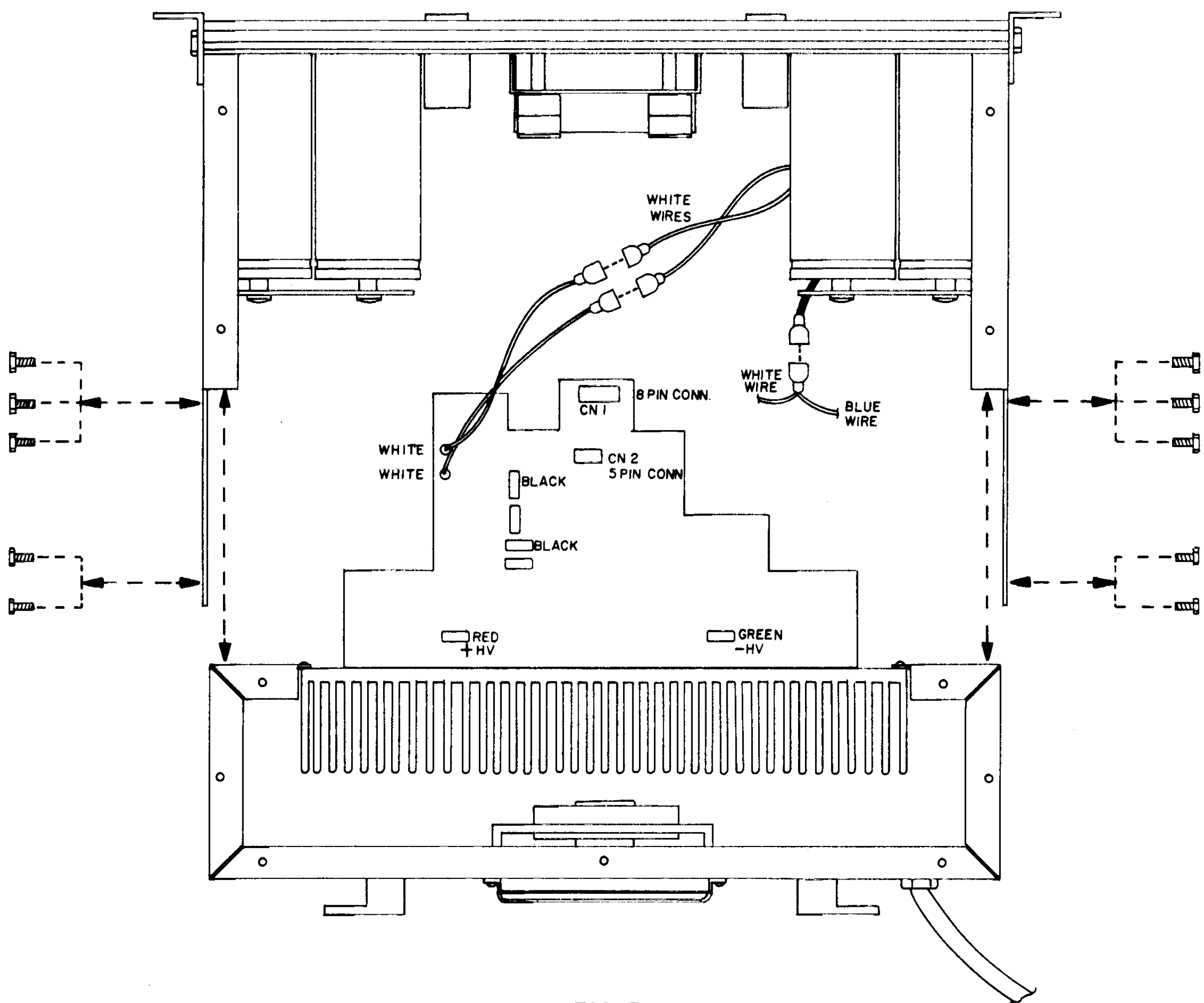
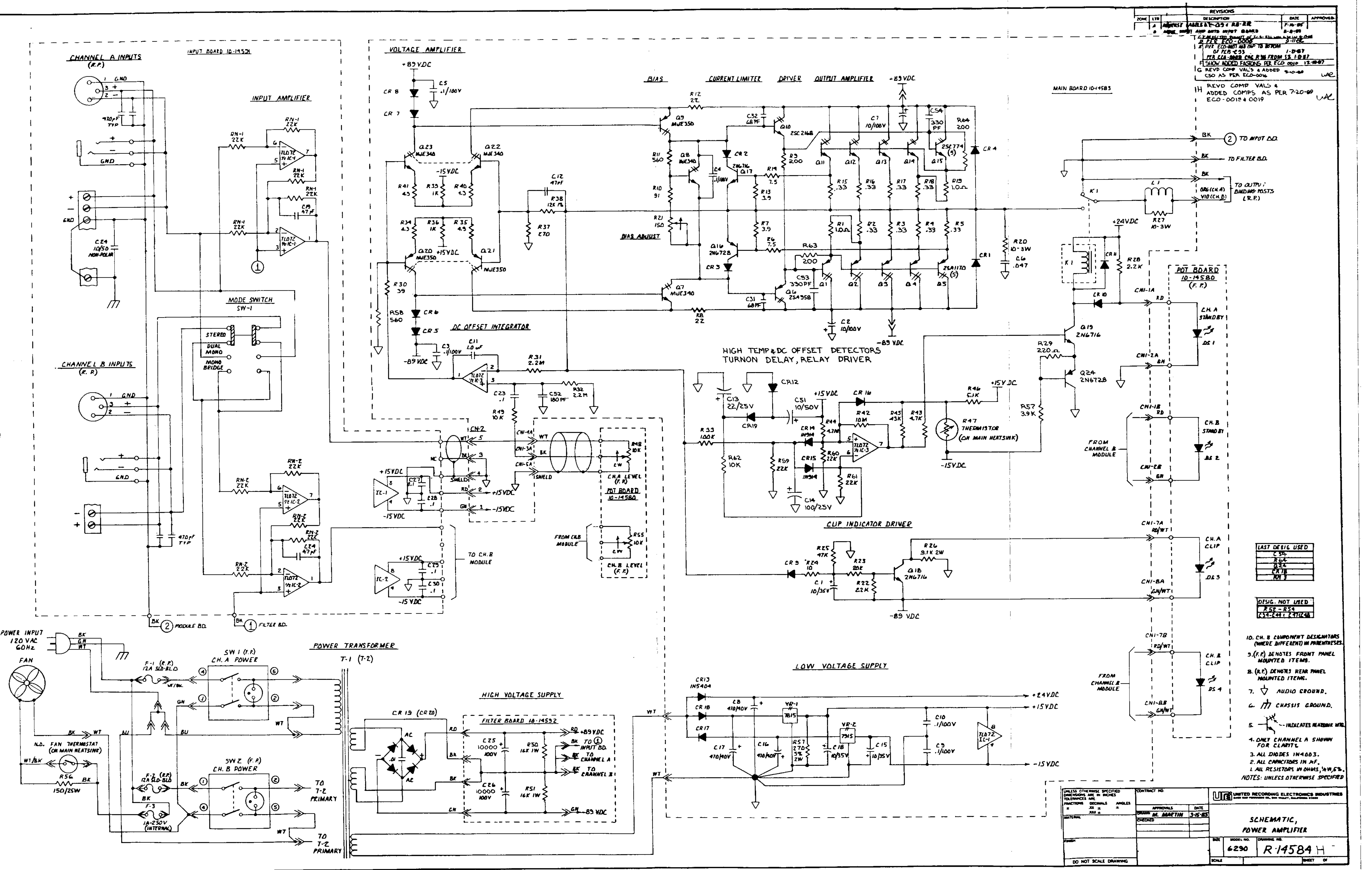


FIG. B

BOTTOM VIEW

NOTE: SOME WIRES AND COMPONENTS OMITTED FOR CLARITY.


CHANNEL A INPUTS (R.P.)
INPUT BOARD 10-14551
INPUT AMPLIFIER
MODE SWITCH SW-1
STEREO
DUAL MONO
MONO BRIDGE
CHANNEL B INPUTS (R.P.)
VOLTAGE AMPLIFIER
BIAS
CURRENT LIMITER
DRIVER
OUTPUT AMPLIFIER
BIAS ADJUST
DC OFFSET INTEGRATOR
MAIN BOARD 10-14583
TO INPUT BD.
TO FILTER BD.
TO OUTPUT BINDING POSTS (R.P.)
POT BOARD 10-14580 (F.P.)
HIGH TEMP & DC OFFSET DETECTORS TURNON DELAY, RELAY DRIVER
THERMISTOR (ON MAIN HEATSINK)
CH. A STANDBY
CH. B STANDBY
FROM CHANNEL B MODULE
CH. A LEVEL (F.P.)
CH. B LEVEL (F.P.)
TO CH. B MODULE
CLIP INDICATOR DRIVER
CH. A CLIP
CH. B CLIP
MODULE BD.
FILTER BD.
POWER INPUT 120 VAC 60Hz
FAN
POWER TRANSFORMER
SW 1 (F.P.) CH. A POWER
SW 2 (F.P.) CH. B POWER
N.O. FAN THERMOSTAT (ON MAIN HEATSINK)
HIGH VOLTAGE SUPPLY
FILTER BOARD 10-14552
LOW VOLTAGE SUPPLY
TO T-2 PRIMARY
LAST DESIG USED
DESIG. NOT USED
10. CH. B COMPONENT DESIGNATORS (WHERE DIFFERENT) IN PARENTHESES.
9. (F.P.) DENOTES FRONT PANEL MOUNTED ITEMS.
8. (R.P.) DENOTES REAR PANEL MOUNTED ITEMS.
7. AUDIO GROUND.
6. CHASSIS GROUND.
5. INDICATES HEATSINK MTD.
4. ONLY CHANNEL A SHOWN FOR CLARITY.
3. ALL DIODES 1N4003.
2. ALL CAPACITORS IN µF.
1. ALL RESISTORS IN OHMS, 1/4W, 5%.
NOTES: UNLESS OTHERWISE SPECIFIED
REVISIONS
UNITED RECORDING ELECTRONICS INDUSTRIES
SCHEMATIC, POWER AMPLIFIER
6290
R-14584 H
DO NOT SCALE DRAWING