LSR28P

Technical Service Manual

Rev. A

3/14/2003

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PRODUCT OVERVIEW

The Linear Spatial Reference, LSR, series of professional active loudspeakers is especially designed for professional applications. Its two-way architecture employing a 1-inch damped titanium-composite tweeter and an 8-inch, Differential Drive with Dynamic Braking Voice Coil woofer reproduces the audible spectrum effortlessly.

The woofer's patented, Differential Drive Mechanism provides a greater voice coil surface area allowing the LSR28P to better dissipate excessive voice coil heat. Since voice coil heat directly affects the compression of the cone, the sound from traditional speakers will deteriorate when used during long sessions. JBL has effectively devised a method of releasing this heat. More aptly, by spreading the heat over a larger surface area so that it is absorbed by the surrounding magnetic structure, this reduction has caused two noticeable advantages--longer useful transducer life and a flatter impedance curve throughout the frequency spectrum. What this means to the user is that the LSR28P will exhibit consistent performance at low, medium and high levels of volume during the entire musical session.

The Dynamic Braking Coil prevents excessive speaker cone excursion during those high levels. Although, the LSR28P does require a pre-amp to provide a nominal -10db level to be used for proper operation, the LSR28P provides the final signal frequency processing and power amplifier modules.

The composite signal is efficiently separated into the low and high frequency components by utilizing BI-amplified topology for signal dispensation. Each frequency-specific element is sent to the respective power amplifier. For the low frequency section, a discrete, push-pull Darlington-configured amplifier is employed with a measured gain of 15 or an increase of 23dB. For the high frequency section, an integrated circuit capable of being driven to 100 watts of continuous output with a gain of 14 is used.which is comparable to a 21db gain. Both amplified signals are sent to the matched low and high frequency proprietary transducers for audible reproduction. Employing this method of frequency separation eliminates the total harmonic and phase distortion that commonly is associated with passive networks.

The final result is a time-independent, smooth, and distortion-free sound at all levels of output! And, since the entire LSR Series has been designed with the philosophy incorporating the best components available to attain the highest performance possible

for a particular targeted area, they are able to faithfully reproduce their respective frequency range. For the LSR28P, the entire audio range from a low of 50Hz extending to 20KHz.and beyond with a crossover frequency of 1.7KHz is reproduced. (The frequency response for the LSR28P amplifier is shown graphically on the following page.) Needless to say, they have become the standard speaker monitors used in professional studios and by audiophiles alike.

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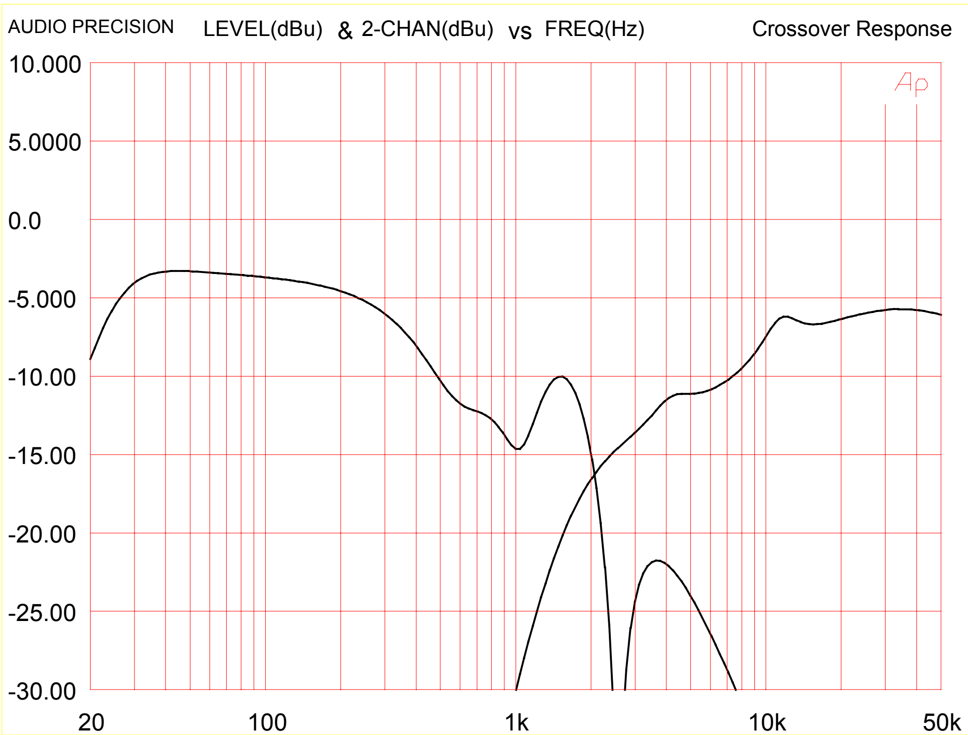
OVERALLFREQUENCY RESPONSE

The frequency response of the output from the crossover system is shown in the figure below.



When a system under test shows a different result in the frequency response test, as shown above, using a +4dBu input signal to the XLR connector with no DIP switches selected, the source of the error can be investigated by referring to the following sections located within the troubleshooting guide.

SAFETY PRECAUTION STATEMENT

There are no user servicible parts inside! Attempting to repair this product or opening the cabinet will expose the user to hazardous high voltage. Servicing and repair should be referred to authorized technical personnel only.

LIABILITY WAIVER

JBL PROFESSIONAL IS NOT LIABLE FOR ANY DIRECT OR INDIRECT DAMAGE TO THIS OR ANY ASSOCIATED PROPERTY ARISING FROM THE USAGE OR THE INABILITY TO USE THIS PRODUCT.

SPECIFICATIONS

ACOUSTIC & ELECTRICAL SPECIFICATIONS

Power Consumption: 220W, (IEC 265) P

Power Capacity: High F 100W, Low F 250 W

Power Requirements: 115/230VAC, 50/60 Hz (user selectable)

Frequency Response: 50 Hz - 20 kHz (+1, -1.5db)

Sensitivity (XLR Input): +4dB, 96dB, @1 Meter
(1/4" Input): -10dB, 96dB, @ 1 Meter
(All DIP Switches Set Off) +4dBu Signal

Crossover Frequency: 1.7 kHz

Signal Input: XLR Balanced with pin 2 Hot @ 120k Ohm impedance

SYSTEM COMPONENTS

Cabinet Resonance Frequency: 38 Hz

Low Frequency Transducer
JBL #(218F) 203mm (8 in.) Cone
DC Resistance: 1.8-ohm ± 10%
Differential Drive, Dynamic Braking

High Frequency Transducer:
JBL# (053Ti)
DC Resistance: 3.5 ohm - 3.8 ohm

Amplifier:
Low Frequency: Class A-B Discrete
High Frequency: Class A-B, Monolithic
THD@ ½ Power: <0.05%

AURAL SWEEP TEST SPECIFICATIONS

(XLR Input All DIP Switches set default off)

System Aural Sweep Test: 1.5V Input, 20 Hz to 30 kHz

L.F. Aural Sweep Test: 7.0V Input, 20 Hz to 5 kHz

H.F. Aural Sweep Test: 1.5V Input, 200 Hz to 20 kHz

PHYSICAL SPECIFICATIONS

Enclosure Dimensions: 406mm x 330mm x 324mm D
(16.0 x 13.0 x 12.75 in. D)

Net Weight: 45 lbs. (20.5 kg.)

WARRANTY INFORMATION

All JBL LSR products carry the transferable, JBL Professional Limited Warranty covering all defects in material and workmanship for a full five years from the original date of purchase. Electronic components and circuitry is warranted for three years. For more specific information, consult the warranty card that is packed with the product.

Click here to view the JBL Limited Warranty Statement
http://www.jblpro.com/pub/technote/warranty.pdf

ESSENTIAL TOOLS

In order to successfully service and maintain this speaker system, the technician should have, at a minimum, the following test instruments.

Oscilloscope, at least 20 MHz bandwidth

Digital Multimeter, with a minimum of 50kohm Impedance for various troubleshooting

Line Voltage Variac with Ammeter for measuring proper voltage/ current consumption.

Hand tools (i.e. screwdrivers, pliers' etc.)

4 ohm resistive load capable of handling 500 watts continuous.

Serial Number specific schematic diagram

SERVICE PROTOCOLS

The maintenance of an electronic system can be divided into many sequential processes that have to be explicitly followed in order to achieve a final result. Partial repair or incomplete repair will not suffice for the professional technician intent on complete customer satisfaction and will not adequately restore proper operation to a malfuntioning unit.

Today's audio requirements necessitate that the electronics engineer design amplifier circuitry to operate within very tight standards or tolerances. Extended high and low frequency circuit attributes demand that the components that are used within the circuitry be of excellent quality and are able operate within the designated parameters to produce the desired results. The *Q Point* or operating point defines the class of operation of the specific amplifier. Both the low and high frequency amplifiers operate in the range of class AB operation. This not only is efficient, but also avails the designer to achieve those desired results. In addition, electronic equipment will only properly operate if the circuit is operating at 100% efficiency. In order to achieve the efficiency the service technician needs to apply a sort of fault analysis, approaching each breakdown from the standpoint of cause and effect analysis. Since electronic troubleshooting is synonymous with fault analysis, as applied to the parameters of the circuit under observation, it must be methodically continued until successful completion or repair.

The skill that is necessary to successfully troubleshooting electronics to the specific faulty component requires that the technician understand how the equipment correctly operates. Obtaining an accurate, serial number-coordinated schematic diagram is also an essential tool. Then, by determining what is operating correctly and what is not, the technician can eliminate the electronic circuitry not associated with the fault and concentrate on the problem area. Testing for typical voltages and oscilloscope waveforms at various test points and, as a last resort, initiating methodical signal tracing can usually isolate the fault to a particular stage. Further diagnoses within that stage will usually reveal the root cause of the failure. Most often, the root cause will reduce to a defective part, faulty trace or intermittent connection. Sometimes there are several root causes that interact with one another causing erroneous measurements and, subsequently, inaccurate diagnoses of the malfunction. In these instances, the technician needs patience and persistence to accurately diagnose and then repair the problem to restore proper operation.

Many times a faulty or intermittent connection at the leg of a component that is supposedly attached to a specific trace will appear to be okay when in reality it is not. These "cold solder joints" occur because of several different reasons. Either the joint did not get hot enough for the solder to bind the trace and the component leg together. Sometimes, metal fatigue can break the connection. Oxidation or contamination at the solder joints can occur especially if the unit is operated within a very humid atmosphere. In any case, the technician needs to be aware that physics is constantly at work and can cause variety of acute symptoms to occur.

Unfortunately, several scenarios are not as straightforward. If the observed behavior is an oscillation, a very high total harmonic distortion or simply a DC voltage seen on the outputs, these abnormalities will be seen throughout the amplifier. Additionally, a single part can cause other parts to fail and, consequently, will require all defective components be replaced concurrently to restore proper operation. This is especially true of modern amplifier design that includes the LSR Series. In order to attain the phase and distortion-less sound, the discreet topology of the main amplifier is capacitor-less. This design was intended and does enable the listener to hear the input media more accurately albeit at the expense of a more difficult and time consuming troubleshooting analysis.

Most of the repairs that are necessary to the LSR monitor system can be traced either to the PCB connections at the component legs to an actual failure of the electromechanical components . . . intermittent DIP switches, noisy potentiometers, faulty connectors. The printed circuit boards and their respective Surface Mount Technology components are reliable. The problems that do arise, and all electronic equipment will exhibit problems eventually, can usually be attributed to the failure of the larger through-hole components.

A WORD ON BALANCED AND UNBALANCED INPUTS

In order to achieve an undistorted sound, the installation technician has to connect the LSR28P properly. The introduction of noise, hums, pops and whistles in the sound media detracts from the audience's understanding, and ultimately, their comprehension whether that media is of a vocal or musical nature. So, it is of critical importance that the Audio System be correctly installed.

There are three methods of connecting the source output to the source input of the LSR28P System. Each method has its own attributes and the NUETRIK Combo connector can accommodate all methods of hookup, however, the quietist and most universally accepted method of hookup for the professional environment is the first method or "balanced input."

The first method of hookup, called a "balanced input", of which the LSR28P was designed, uses XLR connectors throughout the system. The actual reason why this is a more accepted method of hookup is the fact that XLR connectors utilize three conductors. Each conductor has a purpose—one conductor for the hot lead, one conductor for the audio ground and, lastly, one conductor for the chassis ground, which is connected to the shield of the input cable. This third conductor, the shield, which is terminated at the LSR28P, eliminates extraneous noise that would ordinarily be induced into the input leads or ground plane and carried onward to the amplification process.

The second method of hookup, called an "unbalanced input", is by using ¼" phone plug which is predominantly used within the semiprofessional environment.

The phone plug can be plugged into the center of the Nuetrik connector. Again, each method will work but the ¼" phone plug method is more susceptible to inducing the annoying hum that is commonly referred to as a ground loop due to the fact that the chassis ground and audio ground are hard wired together. This condition will occur especially if a large distance separates the monitor and preamplifier allowing differing levels of voltage potential to reside upon the ground plane. The unwanted signal is admitted into the system via the input circuitry and, or the power supply.

If the unwanted signal enters the input circuitry, it is usually through input cable induction and, most of the time, the hum that will be induced is a 60cycle hum. If the unwanted signal enters through the power supply the entire amplifier will be affected. In order to avoid this scenario, the technician should use a 3-conductor cable, preferably shielded R58 coaxial cable. Again, two of the conductors carry the signal and the other conductor is connected to the chassis ground.

If the "unbalanced input" method must be used, termination of the ground must be done at the input to the LSR28P. This will avert the above possible problems by preventing a complete circuit forming and possible internal electronic circuit damage resulting from a malfunction or internal a.c. short of either equipment.

BALANCED AND UNBALANCED CONNECTIONS

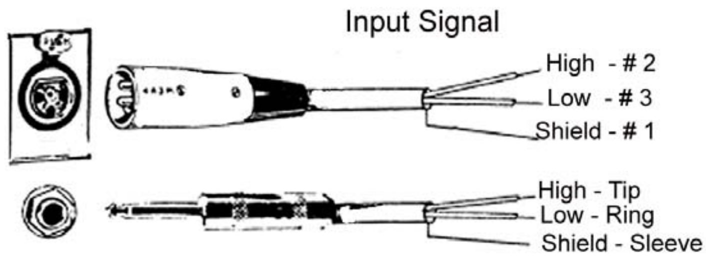


Figure 1. Balanced Input Connections*

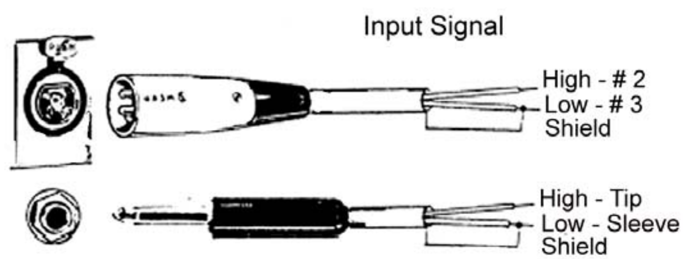
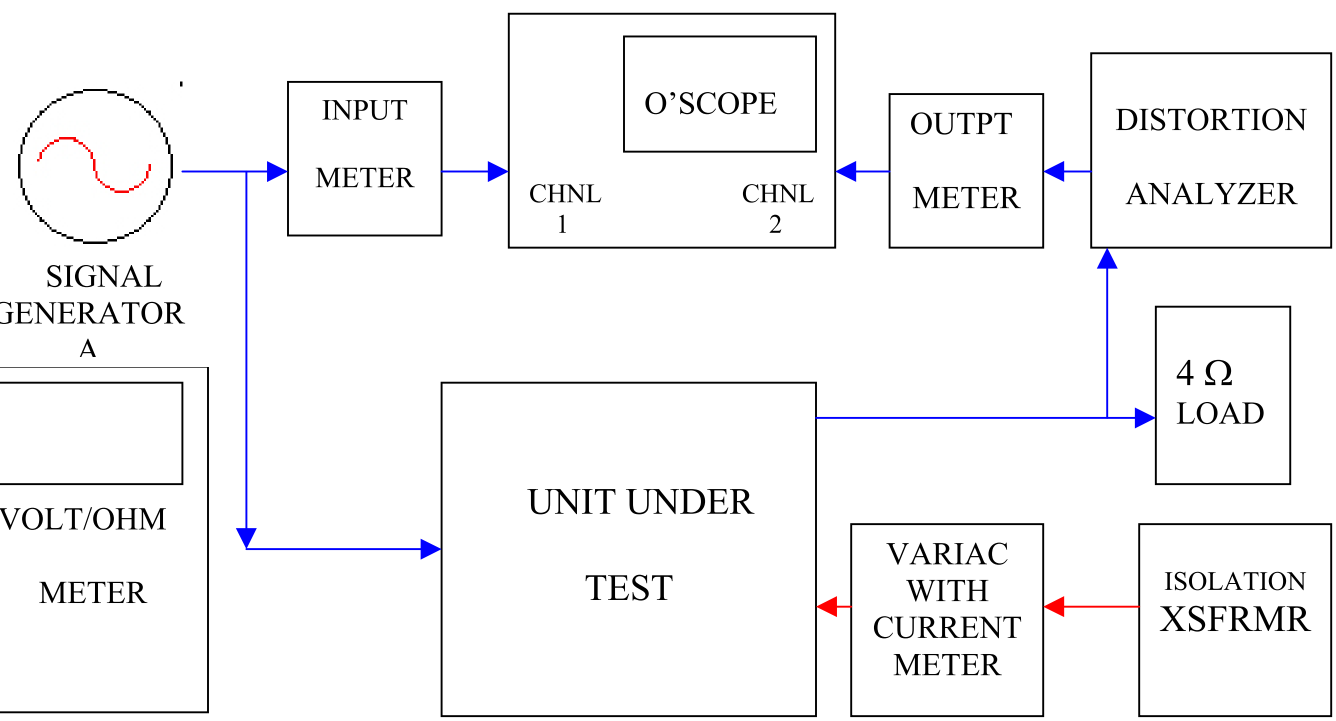


Figure 2. Unbalanced input Connections*

SUGGESTED INSTRUMENT SETUP



The third method of connecting signal to the LSR28P is still an unbalanced hookup and is a variation of the above XLR method by using a two-conductor cable or RCA cable with two XLR adapters at each end or two Tip/Ring/Sleeve connectors at each end.

The Tip/Ring/Sleeve connectors are also commonly referred to as 1/4" connectors and can be used with the LSR28P's Neutrik connectors. The popularity of TRS connectors is related to their early use and acceptance within the consumer audio industry. The tip of the TRS connector or the center conductor of the phonograph cable is the “hot” lead and should be connected to Pin 2 of the XLR connector for signal transfer. The use of the RCA connector is, by far, the least expensive method of hookup, the noisiest and most problematic, too. They are simply two conductors one hot and one cold, however, they do connect both grounds together and have caused many problems including damaging equipment. They are not recommended for professional sound systems.

THEREFORE, IT IS HIGHLY RECOMMENDED THAT THE TECHNICIAN USE A THREE-CONDUCTOR CABLE WITH XLR CONNECTORS TO CONNECT THE PREAMPLIFIER OR SOURCE TO
THE LSR 28P MONITOR

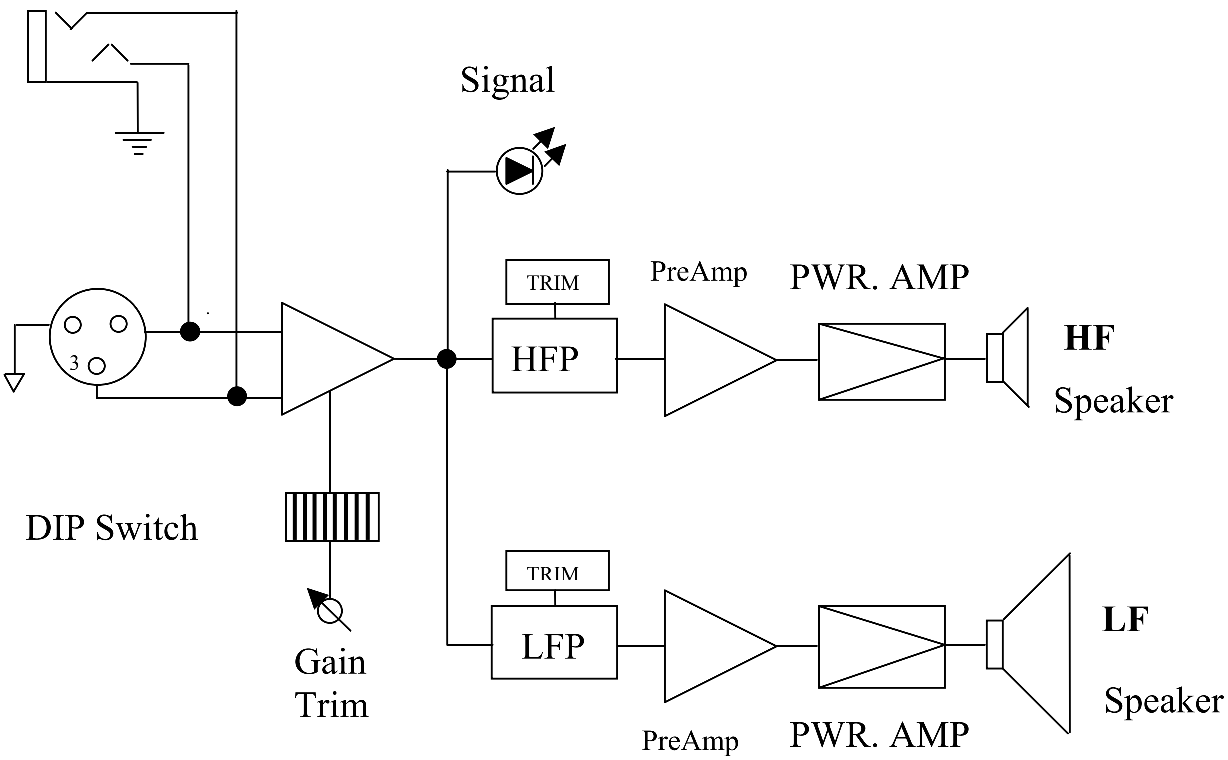
INPUT SENSITIVITY

The LSR28P is very versatile in that the input audio sensitivity can be adjusted. Monitor inputs are normally at nominal levels of +4 dBu or –10dbv. These input levels are called professional and semiprofessional, respectively, and reflect the type of connectors used for hookup. The nominal level for the XLR input is +4 dBu and -10 dBv for the 1/4" TRS input. If less sensitivity is needed to match other brands of professional or semiprofessional equipment, 4,8, or 12 dB of signal attenuation can be inserted in the input line by using the DIP switches on the back of the LSR28P. See the illustration below:

Located on the right of the Neutrik connector but before the power switch, is a bank of switches that are accessible with the use of a pen or a very small screwdriver. These are the DIPswitches.

- Switch 1-enables the input trim potentiometer when switched to the up position. This potentiometer is located to the left of the bank of DIPswitches and can be accessed with a small screwdriver. This allows the user to attenuate the input level from the fixed; factory set default of +4 dBu to a variable input level from +4 dBu to –12 dBu.
- Switch 2—attenuates the input level by a fixed 4 dBu
- Switch 3—attenuates the input level by a fixed 8 dBu.
- Switch 4—aligns the bass response to roll off at 24 dB per Octave
- Switch 5—aligns the bass response to roll off at 36 dB per Octave corresponding to a –2 dB bass response
- Switch 6—keeps the bass response at 36 dB per Octave but Increases the emphasis of bass frequencies +2 dB
- Switch 7—attenuates only the High Frequency amplifier Input level by -2 dB.
- Switch 8—enhances the High Frequency amplifier input Level by +2 dB

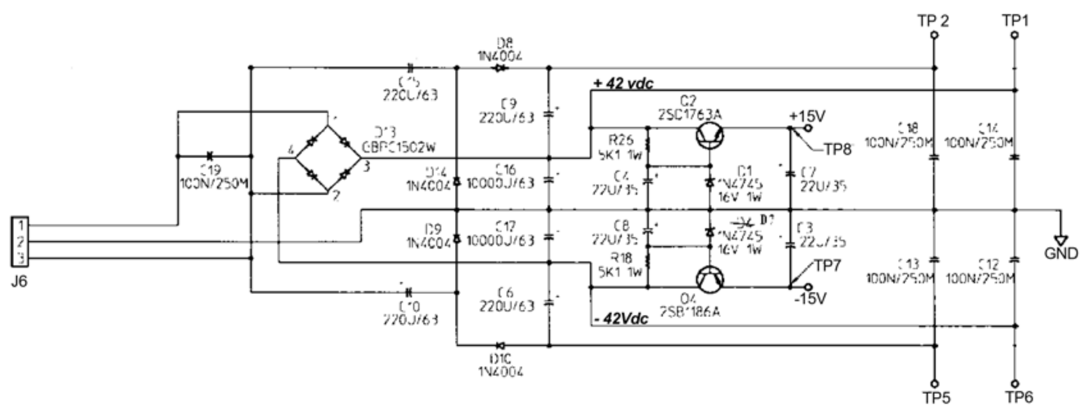
BLOCK DIAGRAM
LSR28P



THEORY AND CIRCUIT DESCRIPTIONS

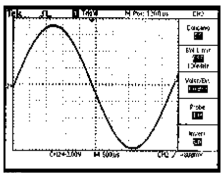
POWER SUPPLY

Initially, raw alternating current enters the LSR28P from the IEC connector on the signal input processing board and is directly connected to the power switch S3 through the main fuse F1. . From there, it travels to the voltage selector switch that determines which primary on the transformer connected. The voltage that has been selected is then connected to the toroidal transformer and stepped down to a more useful voltage. This voltage then enters the main PCB, where it is rectified or transformed to positive and negative Direct Current by bridge rectifier D13. It is filtered by capacitors C16 and C17. . . the end result is a stable power supply of nominally positive and negative 36 volts. Mainly, this voltage is used for the rails of the power amplifiers, which provide a full voltage swing from peak to peak of 78 volts. The rectified voltage is also passed through a resistive ladder network which steps down the magnitude further and is regulated at positive and negative 15 volts to drive the housekeeping/fault detection circuitry. Voltage doubling circuitry supplies the positive and negative 70 volts necessary to supply the drivers and predrivers. By utilizing this bootstrap configuration, the adjacent stages are prevented from scavenging the voltage from the rails during demanding informational or musical passages.

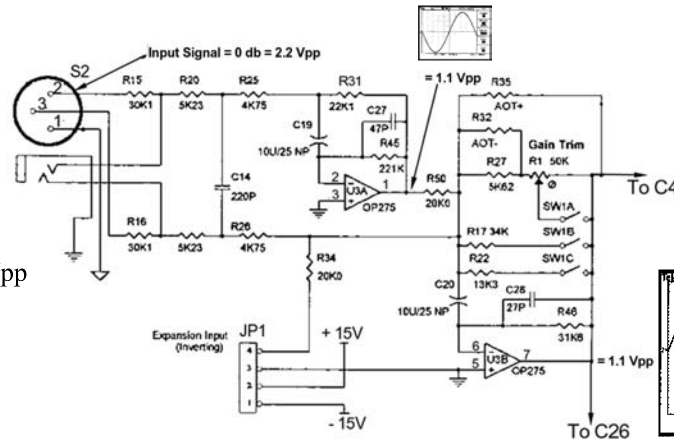


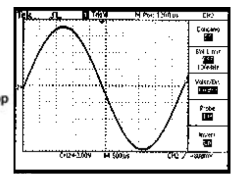
The main power transformer that is employed in this product has its core in the form of a toroid. This physical shape provides better magnetic flux permeability between the primary and secondary windings, and, thus, has a better instantaneous power delivering ability than conventional bundled, stamped-steel. cores. A lower hysteresis loss also is beneficial since less heat is generated. It has long been known that the toroid allows better flux lockup between the primary and secondary windings and, therefore, a better instantaneous voltage delivery than traditional transformers. The combination of using this type of transformer and the bootstrap circuitry almost guarantee that sufficient voltage will be available on demand for full bass response. . . without the “bottoming out’ of the low frequency driver at crucial moments in the music.

INPUT BUFFER AMPLIFIER



Input = 0 dB/2.2 Vpp
@ 100 Hz

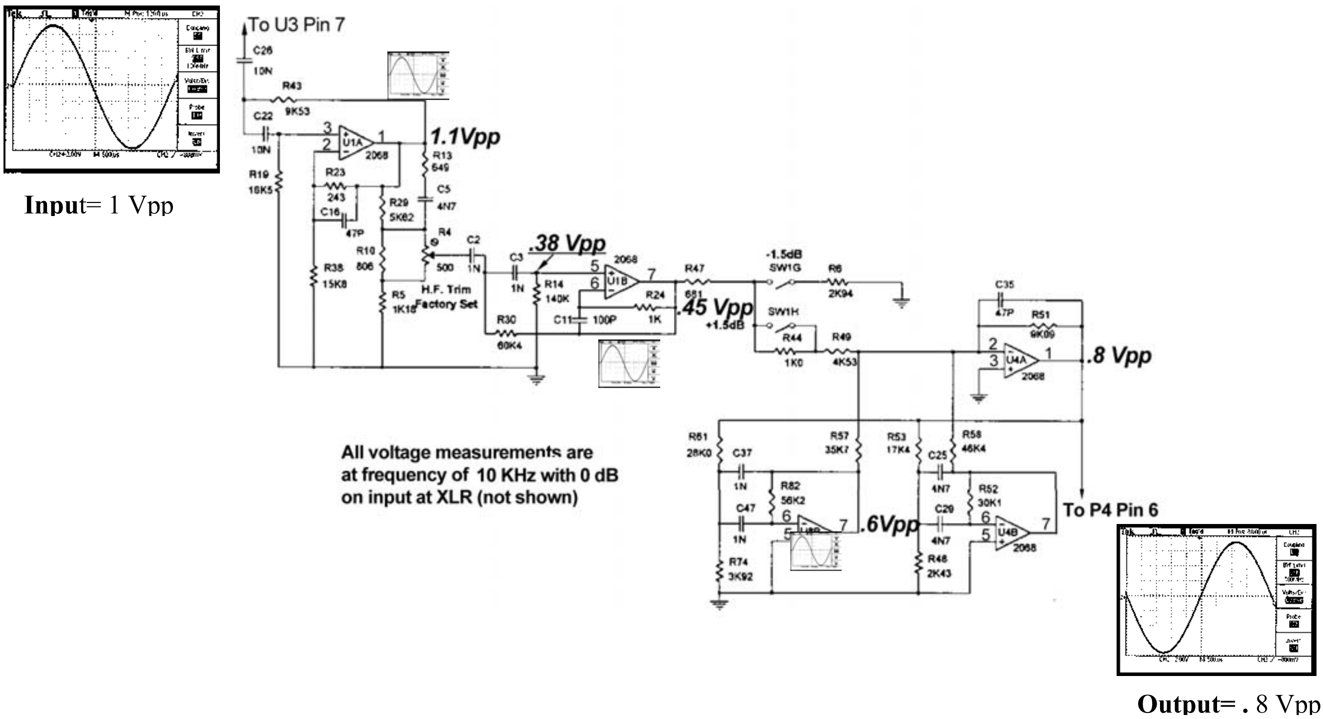




Output= 1.1 Vpp

The integrated circuit, U3, provides several functions. U3A is used as an input buffer amplifier which isolates the source signal from deterioration caused by the user selectable DIP switches, SW1A.,B,AND C. The resultant gain of U3B will vary depending upon which DIP switches are enabled. The final composite signal on pin 7, U3B, is sent to coupling capacitors C4 and C26 which provide access to the low and high frequency processing circuits, respectfully.

HIGH FREQUENCY PROCESSING



The circuit, shown above, is used for the high frequency processing of the input signal. Physically, it is located on the input circuit board. Its purpose is to actively filter out or attenuate the low frequency component from the composite signal leaving only the high frequencies to be contoured by the user and, eventually, sent to power amplifier for final amplification.

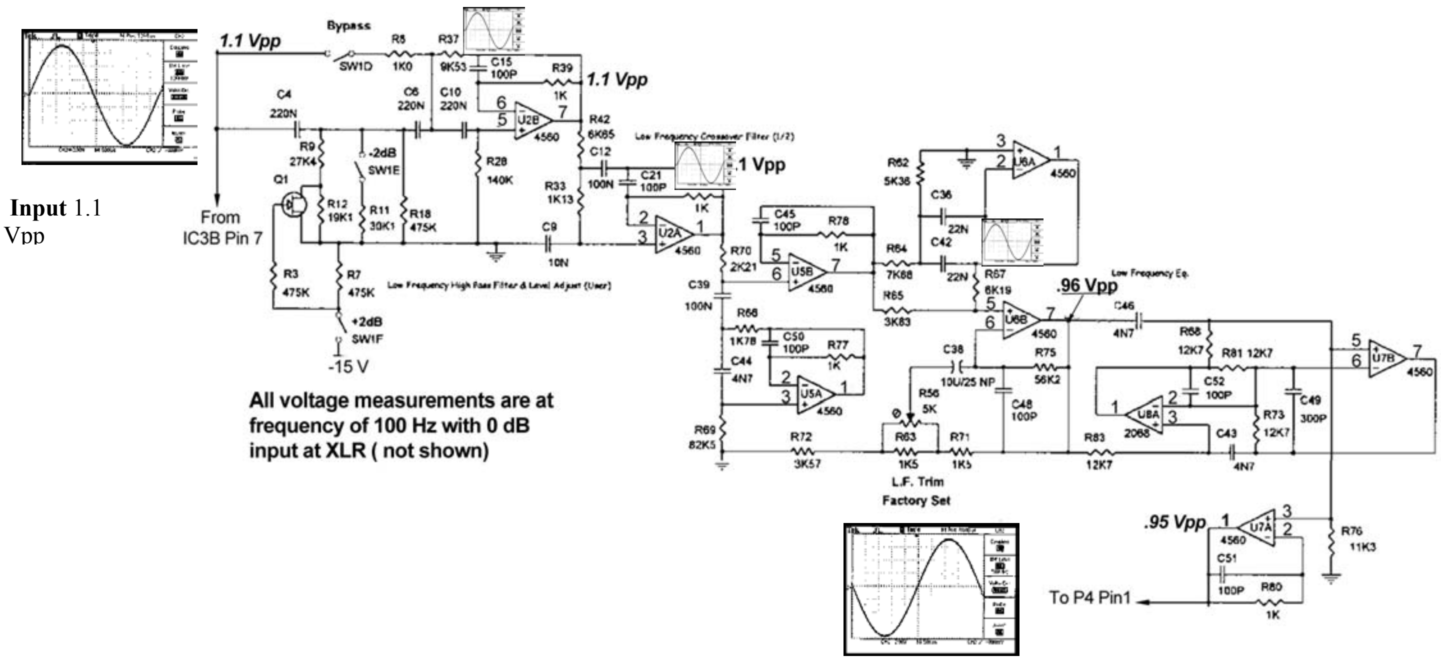
Specifically, signal from the previous stage enters the non-inverting input pin 3 of integrated circuit U1A through coupling capacitor C26. U1A, acting as a second order high pass filter, attenuates signals below the critical frequency, according to the equation:

$f(c) = 1/[2\pi(R1R2C1C2)1/2] =$ where $R1 = 9k\Omega$, $R2 = 10k\Omega$, $C1 = C2 = 10nF$
$= 1.677kHz$

Because of this relationship, the frequency response will “roll-off” or be attenuated at a rate of –40 dB per decade assuring a gain of .707 volts at this critical frequency.

Integrated circuit U1B is configured as a buffer amplifier to isolate the effects of the user selectable high frequency “trim” potentiometer, R4, and includes some additional second-order filtering. Partial equalization occurs from components R13 and C5. The signal enters at pin 5 and pin 6 of this IC whereby unwanted noise is eliminated through CMRR, and it is amplified from a signal voltage of .38V to a usable voltage level of .45 volts. The signal exits at pin 7. Enabling of SW1G and SW1H cause signal frequency equalization boosts or cuts to occur. These can be attributed to the effects of U4A and B along with U8.

LOW FREQUENCY PROCESSING



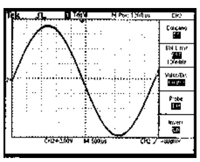
Input 1.1 Vpp

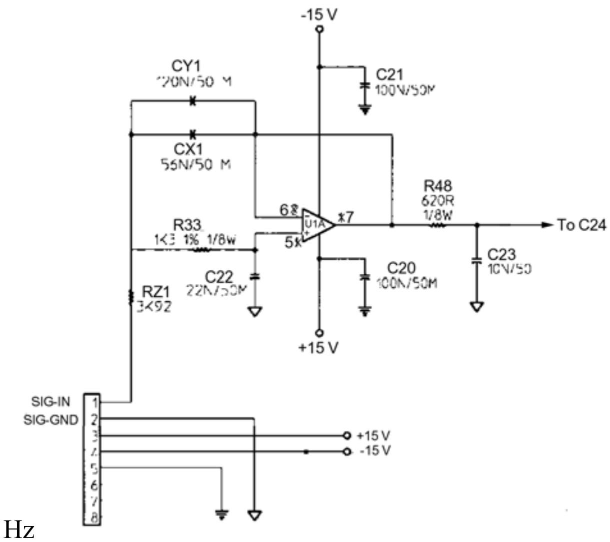
Output=. 95 Vpp

This is the processing circuitry for the low frequency spectrum. We are interested in this circuit, shown above, because it provides the signal path that will discriminate the low frequency component from the composite signal and filters that component out by actively rejecting high frequency signals above the high critical frequency.

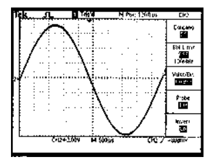
This circuit is located on the input printed circuit board and is instituted after the isolation buffer integrated circuit, U3. The signal then enters the operational amplifier U2B where the signal is contoured +/- 2dB by the user selectable DIP switches SW1B and SW1F. The MOSFET detector Q1 performs this additive or subtractive operation in conjunction with U2B.Integrated circuit U2A forms a second order low pass filter while U5 and U6 form band-pass filters offset by the low frequency trimming resistor, R63.

FINAL LOW FREQUENCY FILTER





Input= .95Vpp @ 100 Hz



Ouput= .95 Vpp

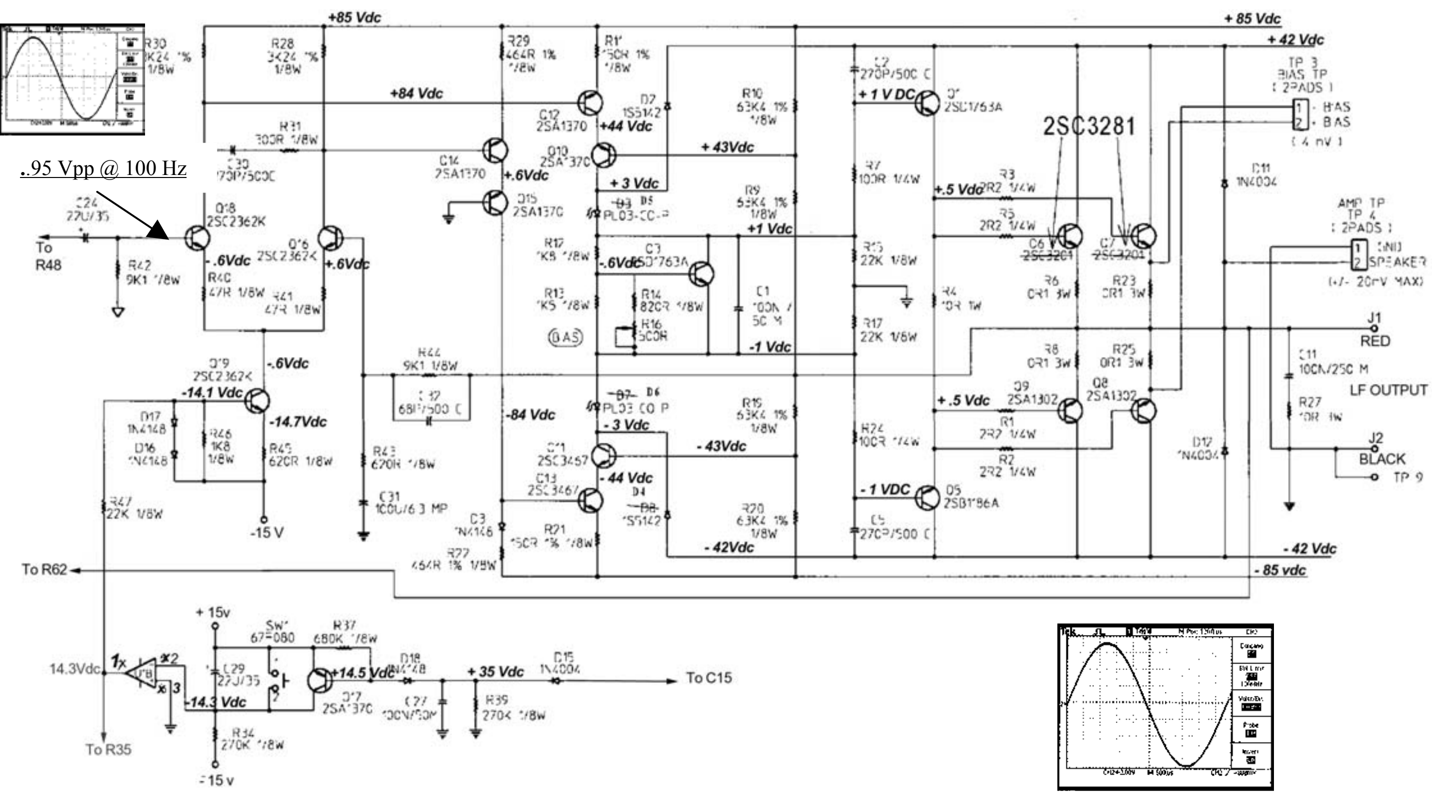
The two-pole active Butterworth low pass filter, shown above, is situated on the main PCB board. Circuit-wise, it is located immediately before entering the main low frequency amplifier. It effectively removes any ultra high frequency noise that might have slipped by the main filtering or been induced in the interface input cabling after the main filtering and attenuates that signal at a rate of -40 dB after the critical frequency. The circuits main purpose is to verify that only low frequencies are passed on to the low frequency amplifier reducing the possibility of damage to the low frequency transducer. It has a first order filter consisting of R21 in combination with the total capacitance of CX1 and CY1, and a second order filter using R33 and C22.The critical frequency for this filter can be calculated using the equation:

Critical Frequency = 1/{(2π)(R1R2C1C2)1/2} where R1 = R21, R2 = R33
C1 = CX1, C2 = CY1
= 1.467 kHz

LOW FREQUENCY OUTPUT AMPLIFIER WITH MUTED POWER UP AND THERMAL SHUTDOWN

The low frequency amplifier uses discrete components configured in a push-pull drive architecture operating in the class AB region and have a measurable gain of 15.25 dB.

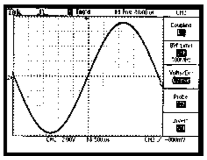
The voltage rails for the power amplifier are positive and negative 42 volts as rectified by bridge BR1 located in the Power Supply Module. The output transistors are driven by the preceding stages and thermally biased by Q5.On initial power up charge builds up at C27 and turns Q17 off after a short pause of about 4 seconds. The comparator U1B then toggles taking its output high and biasing on the constant current source at Q19 and hence enabling the low frequency power amplifier. On power down C27 looses charge allowing Q17 to turn on and discharge C29 such that comparator U1B then toggles taking its output low and holding off the constant current source at Q19 and hence disabling the low frequency power amplifier to prevent any noise occurring.



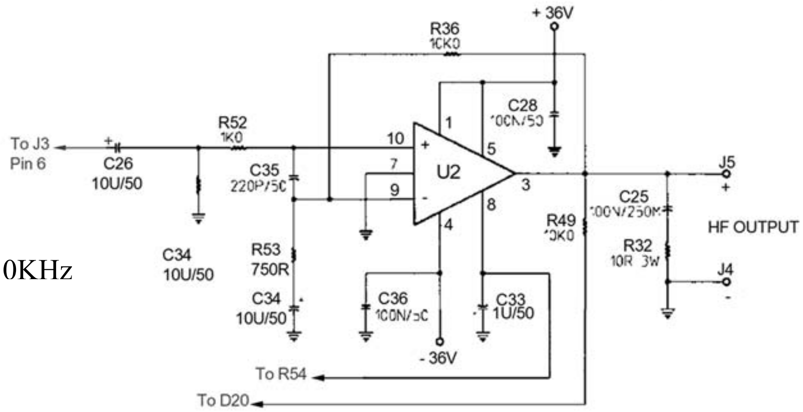
Output=14 Vpp @ **J1** (Red Wire)

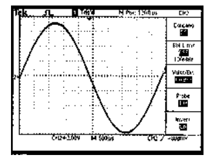
Excessive operating temperatures cause thermal switch (SW') to short activating buffer amplifier to mute the input differential amplifier and, thus, shutting down this module.

HIGH FREQUENCY AMPLIFIER



Input = . 8Vpp @ 10KHz





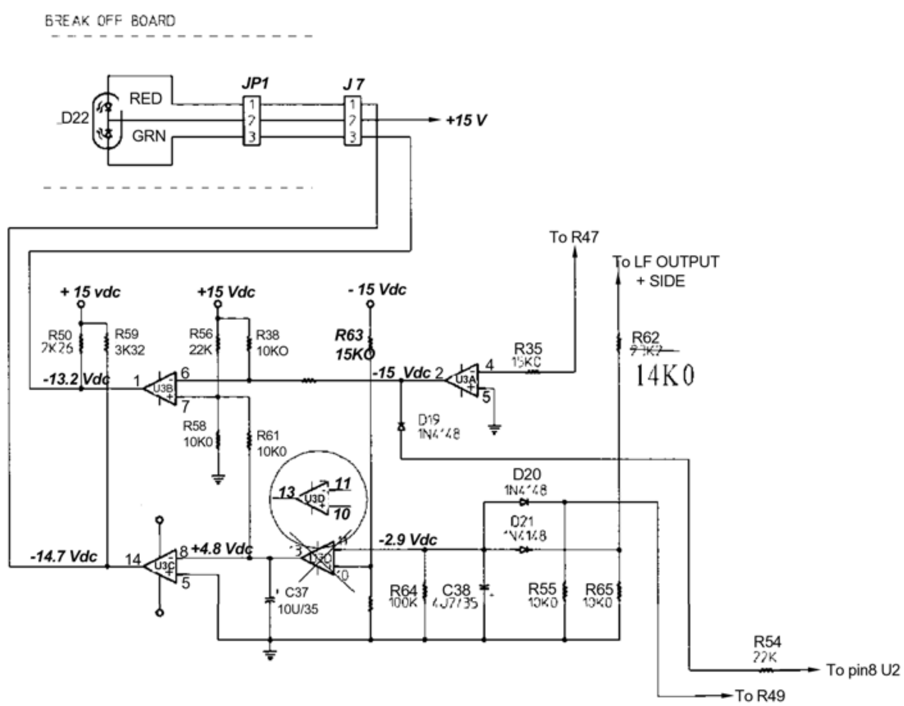
Output = 11.8 Vpp

The circuit shown above is the high frequency power amplifier used in the LSR28P. It uses an LM3886T operational power amplifier in a non-inverting configuration with the normal peripheral components to provide proper equalization and operation. The nominal operating voltage of positive and negative 36V is applied to the IC via pin 4 and pins 1 and 5, respectively. Further power supply filtering is performed by C#^ and C28. The negative feedback resistor, R36, in conjunction with R53 determine the amplifier's closed-loop gain according to the equation:

GAIN = 1/B where B = attenuation of feedback network
= R53/(R53 + R36) = .06976
= 1/. 06976 = 14.33 = 14.3

Signal input from the previous printed circuit board is capacitively coupled by C25 and serially reduced by R52 and connected to the inverting input of the IC. Operating stability is added when the inverting input is referenced to ground through the shunt of R53 and C34. C35 is shunted across the inverting and non-inverting inputs utilizing the properties of common mode rejection, thereby eliminating any ultra -high frequency noise through signal cancellation. Offset voltage is detected at the output of the IC at pin 3, which connects to the detection/mute circuits via R49. The polarity of an abnormal DC voltage is determined by the detection circuitry and is processed accordingly.

FAULT INDICATION CIRCUITRY



The detection circuitry for the LSR28P revolves around the quad comparator NJM2901N (U3). There are a number of individual faults monitored for including voltage offset on both the low and high frequency amplifiers, excessive current usage by the unit, and an over-limit input signal level resulting in clipping. Providing that the circuitry is functioning correctly, the basic power operational status is active when the green LED illuminates. When this occurs, verification of proper audio operation is still necessary. If, however, the red LED or a combination of the red and green LED's illuminate, the circuitry has detected a fault or there is a fault in the detection circuitry itself. In either case, the muting circuitry will be instantaneously activated to turn off the drive to the power outputs and, hence, avoid the possibility of damaging the transducers

From the above circuit, U3D in combination with U3C detects voltage offset from the low and high frequency amplifiers through D21/R62 and D20/R54, respectfully, illuminating the red led. They also detect excessive output or clipping through the network of R62/R65/R64 and C38. Clipping indicates that the signal-input level is too high. U3A detects thermal shutdown and power supply problems through R35 and R47.

TROUBLESHOOTING GUIDE

The purpose of the troubleshooting guide is twofold.

First, this guide will enable the service technician to become familiar with the operating characteristics of the unit and to accurately diagnose and repair the associated symptoms that indicate malfunctioning circuitry. Secondarily, this guide will help the technician to decrease the total repair time needed to correct faulty circuitry by improving his/her troubleshooting skills and ,thus, increasing the profitability of the service department.

The actual electronic repair process can be separated into two components, which determine the total repair time—diagnoses of the problem and repair of the problem.. The repair time of the equipment will vary minutely, but, statistically it will be consistent, therefore, it is already defined as a specific amount of time. The only other factor that can impact the total repair time is the diagnoses time. By becoming familiar with the operation of the equipment, its design faults and attributes, one's skill at diagnosing the symptoms of faulty circuitry will increase over time. And, thus, the diagnosis time will decrease.

Since the old adage of "time is money" is very apropos in all societies, so it is with electronic repair. The technician, therefore, must be time efficient with respect to diagnosing and repairing equipment.

- Visually inspect product. Many times a customer's problem with a unit can be located just by visually inspecting the product for gross faults. This visual inspection can also determine if the equipment has been abused when a claim for warranty service is involved.

- Verify the fault that the customer is experiencing. If unable to reproduce the customer's complaint, notify the customer of your findings and obtain more information about the complaint.
- Verify complaint and repair product as necessary if in product is eligible for in warranty status.
- If product is out of warranty, contact the customer with an estimate of the repair charges.

Note: It is the policy of JBL Professional to always give the customer "the benefit of doubt" concerning decisions of eligibility of warranty coverage. This not only is a good business practice in the long run but also promotes customer good faith and satisfaction.

Wait for approval or denial of estimate and note the time and date of customer's decision.

- If customer approves, repair unit and verify proper operation
- If customer denies, wrap up set and returns to same.

<u>If at all possible perform a Safety Checkout before returning set to customer regardless if unit is repaired or not.</u>

INITIAL SYSTEM TROUBLESHOOTING

The majority of problems in use will be with electro-mechanical components; DIP Switches SW1, switches SW2 and SW3, potentiometers R1, R4 and R56. Before dis-assembling a faulty LSR28P system check the action of these electro-mechanical elements as follows:

- **System Fails to Power Up**

    1. First check the fuse is intact. In addition to observing that the Green LED does not illuminate, listen closely to the loudspeaker drivers at switch on. If a barely audible thump occurs a couple of seconds after switching the power on and some low level noise can be heard at these speakers the problem is not the power switching, check that the Neutrik Combo connector is not damaged and try applying signal to each connector style in turn (XLR and Jack). If no noises can be heard operate the power switch SW3 several times with no power cord attached and then retry powering up. If operation is restored replace the switch. Similarly exercise the voltage selector switch SW2 and replace if indicated by the test.
    2. If the fuse blows the fault is most likely in the main board. Refer to the guide “Amp Assembly Troubleshooting LSR28P” .
    3. If neither of the above checks leads to a fix, proceed to dis-assemble the input board assembly and carry out appropriate checks below.

- **No output at either loudspeaker**

    Exercise trimmer R1 by turning from end to end a few times. Select a lower system gain (-4dB or -8dB at DIP switches SW1B or SW1C). If either of these actions restores signal replace trimmer R1.

- **No output at high frequency loudspeaker**

    Exercise trimmer R4 by turning from end to end a few times (remove the hole plug nearer to the DIP switches to gain access to this trimmer). If this action restores signal trimmer R4.

A) Initial Setup

Connect board under test to a +/- 15v power supply at connector P4 pin 3 to +15v, pin 4 to -15v and pin 2 ground. Connect a sinewave signal generator (or a function generator) to the XLR input connector with output level set to +4dBu (3.5 volts peak to peak). Turn generator off.

B) Power Supply Test

Verify that +15V and -15V supplies are at the correct levels.

C) Power Switching Test

Use an ohmmeter or continuity tester to ensure that both the power switch SW3 and line voltage selector switch SW2 operate correctly by metering between IEC connector S1 active pin and connector P2 pins 2 and 4 and between IEC connector S1 neutral pin and connector P2 pins 1 and 3 with the voltage selector SW2 at 115V. Check continuity between connector P2 pins 2 and 3 with the voltage selector SW2 at 230V.

D) Quick Signal Tests

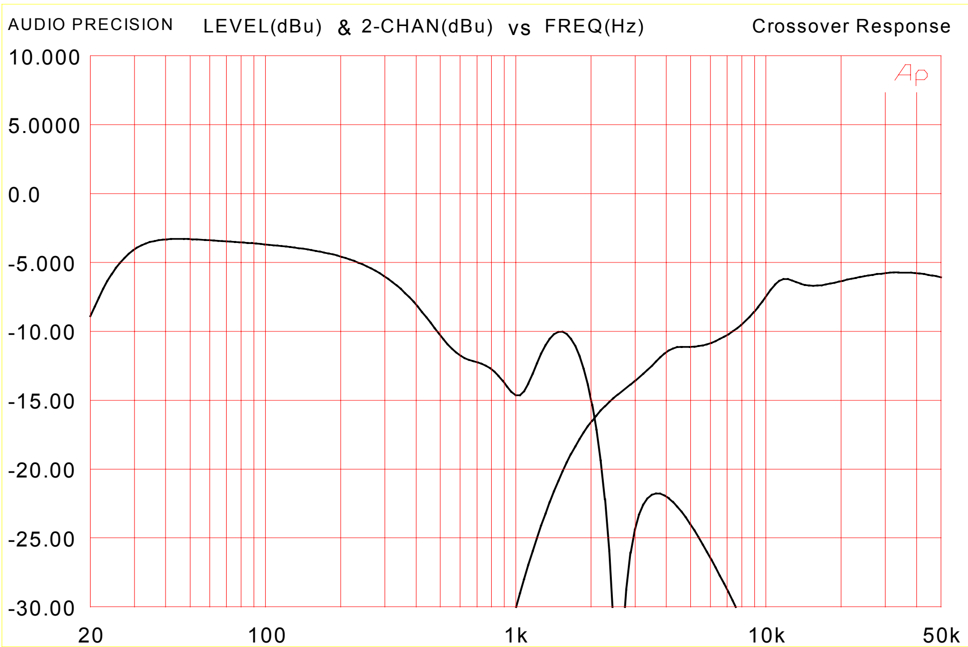
Note: In the majority of cases faults that occur which are not merely failures of electromechanical components (see above) will be faults with semiconductor components. In this case that means FET Q1 or I.C. op. amps. U1-8. Loss of output or high noise or distortion can usually be easily isolated to a particular integrated circuit:

- For the **low frequency** path apply a sine wave signal at 440 Hz and check signal integrity at U1 pin 1, U1 pin 7, U5 pin 7, U6 pin 7 and U7 pin 1. The first test point in this sequence where signal degrades or disappears locates the faulty IC.
- For the **high frequency** path apply a sine wave signal at 4,400 Hz and check signal integrity at U2 pin 7, U2 pin 1 and U4 pin 1. The first test point in this sequence where signal degrades or disappears locates the faulty IC.
- In a case where no output is present for **either signal path** check signal integrity at U3 pin 1 and U3 pin 7. If signal is absent, noisy or distorted at either of these test points change U3.

<u>The following section discusses frequency response details enabling in depth troubleshooting of out of specification system performance.</u>

OVERALL FREQUENCY RESPONSE

The response of both outputs from this crossover system are shown in the figure below.



Where the system under test shows a different result in a frequency response test using a +4dBu input signal to the XLR connector with no DIP switches selected the source of the error can be investigated by referring to the following sections.

Low Frequency Signal Path Gain

The curves in the figure below plot the frequency response from a +4dBu input signal at the outputs of U2 pin 1, U5 pin 7, U6 pin 7 and U7 pin 1.

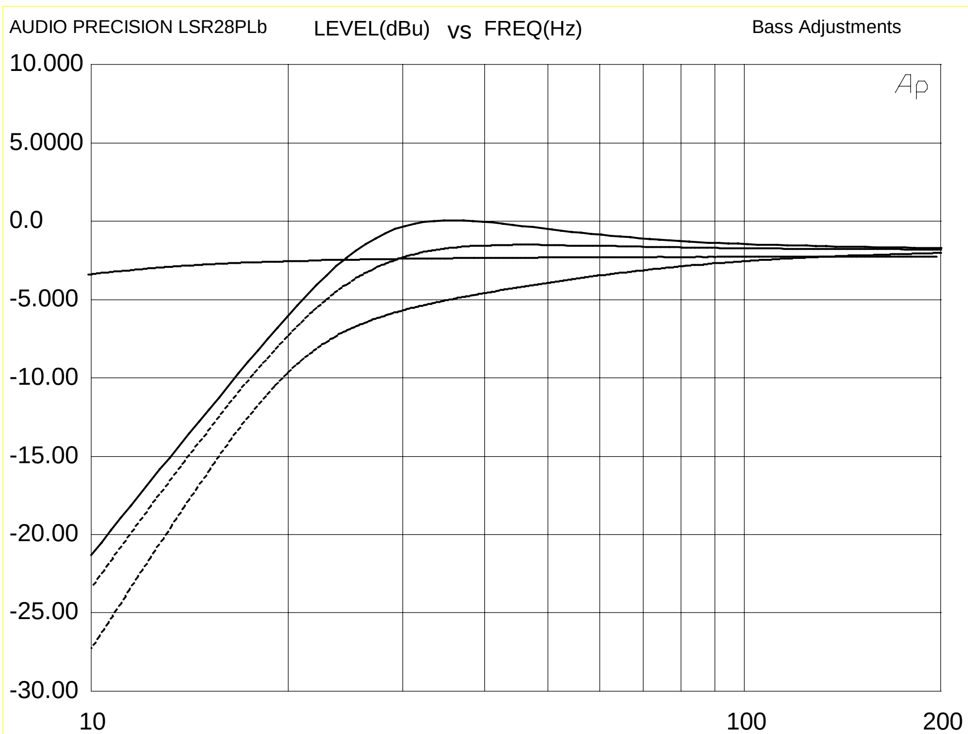
U2A acts as a second order low pass filter as shown by the top curve. U5A and B form a bell equalization cut centered on about 600Hz. U6 A and B form a second bell equalization cut centered at about 1KHz. U7 A and B along with U8A form a notch filter at around 2.6KHz.

The response at any point along the signal path relies on an accurate frequency response characteristic from preceding stages. The curves in the figure allow ready identification of a stage which is causing frequency response errors. An inaccuracy in a single section can result in gross inaccuracies in the overall response result.

- The curve with a drooping response below 80Hz is the result of selecting the -2dB bass cut switch SW1E.
- The curve with extended bass response is the result of selecting the Bypass switch SW1D.
- The curve with flat response down to about 30Hz with a well damped roll-off below 30Hz is the standard response with all switches down.

The action of the bass response DIP switches SW1 D, E and F can be checked by examining the frequency response at U2 pin 7. The four possible response curves are plotted on the figure below.

- The curve with a boost centered around 35Hz is the result of selecting the +2dB bass boost switch SW1F. If this curve is not obtained but other responses are correct change Q1.
- The curve with a drooping response below 80Hz is the result of selecting the -2dB bass cut switch SW1E.
- The curve with extended bass response is the result of selecting the Bypass switch SW1D.
- The curve with flat response down to about 30Hz with a well-damped roll-off below 30Hz is the standard response with all switches down.



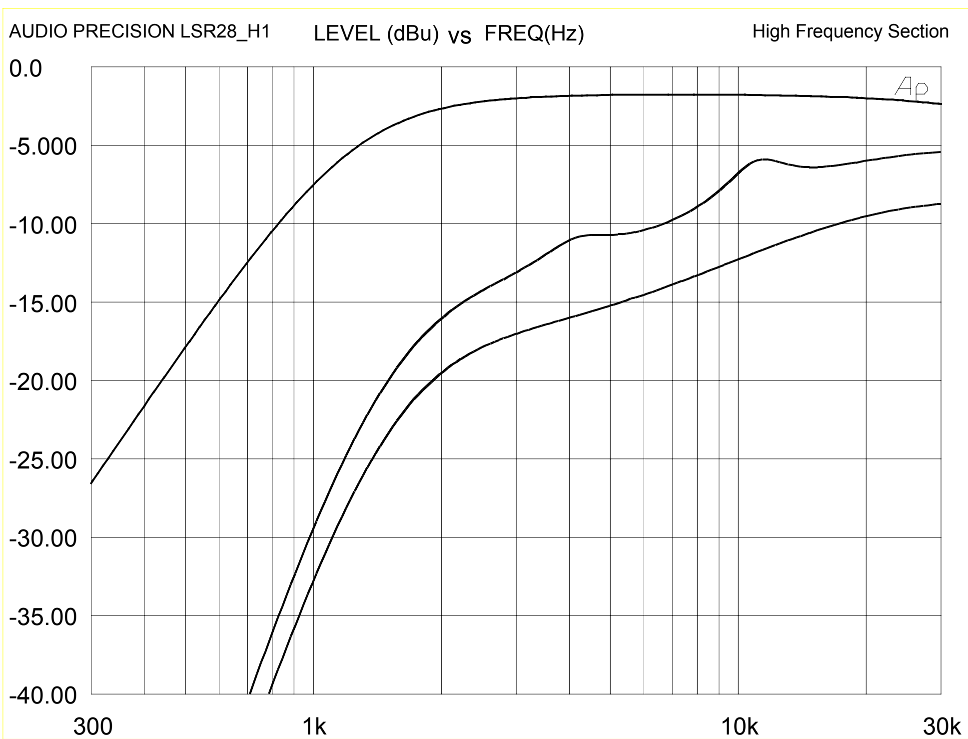
The response at any point along the signal path relies on an accurate frequency response characteristic from preceding stages. The curves in the figure allow ready identification of a stage, which is causing frequency response errors. An inaccuracy in a single section can result in gross inaccuracies in the overall response result.

HIGH FREQUENCY SIGNAL PATH GAIN

The curves in the figure below, which are taken with trimmer R4 at minimum (fully ccw) plot the frequency response from a +4dBu input signal at the outputs of U1 pin 1, U1 pin 7 and U4 pin 1.

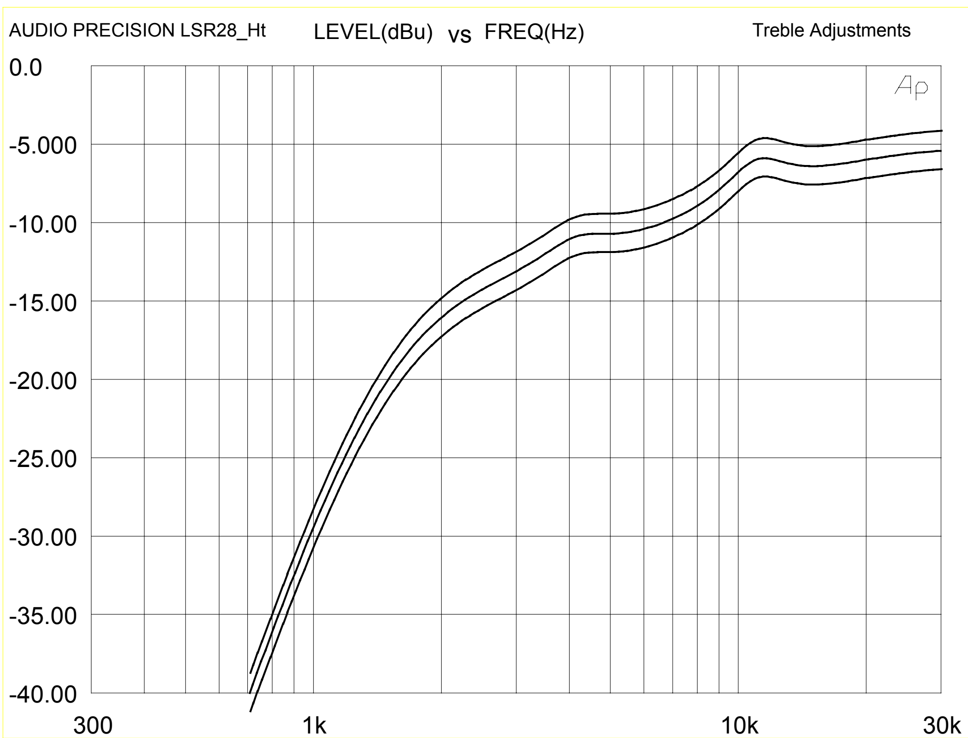
U1A acts as a second order high pass filter as shown by the top curve. U1B acts as a buffer to the passive shelving equalization R13, C5 etc. and provides a further second order high pass filter. U4 A and B along with U8B form twin bell equalization boosts centered at about 4.3KHz and 11KHz.

The response at any point along the signal path relies on an accurate frequency response characteristic from preceding stages. The curves in the figure allow ready identification of a stage, which is causing frequency response errors. An inaccuracy in a single section can result in gross inaccuracies in the overall response result.



RESPONSE CURVES DEPICTING DIP SWITCH SELECTION

DIP switches SW1G and H adjust the gain of the stage around U4A. The effect of selecting these switches is shown in the curves at the figure below. The highest gain curve is the result of selecting SW1H whereas the lowest gain curve is the result of selecting SW1G. The middle curve is the standard response with no DIPswitches selected.



TROUBLESHOOTING MAIN AMPLIFIER

Setup: The quickest and most efficient way to operate the LSR28P Main amplifier board is to use a known, good LSR28P input PCB. Connect the boards together using an 8-pin connecting cable assembly. Attach the secondary of the main power transformer (JBL# 562-00032-00) to J6 on the main amplifier and the primary to P2 on the input PCB. Connect the low frequency output to an 8-ohm load and the high frequency output to a 4-ohm load. Verify the signal generator is turned off and connect the output of the generator using an XLR connector to the input jack of the LSR28P, located on the input board assembly. A representative bench setup is shown on page 11.

Note: all voltages used within this manual are measured from chassis ground to the discussed test point if not specified.

Powerup: Apply ac line power to the power transformer through a Variac so as to maintain control over this voltage if abnormal problems exist. Make sure that the transformer is configured for the proper voltage applied via SW2. Monitor the current, +15V supply, and the input voltage.

Note: If excessive current is drawn while the input voltage is in the range of 20V, power down the unit and proceed to the "Excessive line current test."

If the current drawn stays within 1 to 2 amps and the +15 volt supply stays within regulation, verify other voltages. Main rectifier voltage should be about +/- 36v (D13) at TP1 and TP6, respectively. The bootstrap voltage, at TP5, should be about -70v and, TP2, about +70v. If these voltages are non-existent or abnormal, proceed to "Main Voltage Tests."

If the voltage checks okay, verify that the bias diodes, D5 and D6, are illuminating. This indicates the bias circuit is working. Next, verify if the mute circuit is working by measuring the voltage at pin 6 of U1 and cathode of D19 is around -15 V, and then remove power to transformer. The mute line, pin 6 of U1 should toggle and go high to +15v immediately (200ms). Then, re-power the board and verify that the initial voltage is high and then toggles to a low in about 2 seconds. If abnormal, proceed to "Amplifier muting tests."

Low Frequency Amplifier

Measure across emitters of Q7 and Q8 (TP3), for 4mVDC +/- 300uV (20mA). If required adjust bias pot, R16. Measure at low frequency amp output (+LF test point TP4) and confirm less than +/- 50mV of offset. Turn on generator A and adjust frequency to 900Hz. Adjust oscillator amplitude to obtain 50V P/P at amp output. The waveform should be a nice sine wave, with perhaps, a small hint of clipping.

The amplifier will begin to clip at around 55 V P/P. If the amp prematurely clips, verify that the input signal is not clipped. This can be measured at the junction of R48 and C23. Upon reaching the 50 V P/P clipping plateau at the amp output, there should be around 3.2V P/P at the input to the amp. If one or more of the above tests fails, proceed to "Low Frequency Power Amplifier Test."
Adjust oscillator for 3.2V P/P at pin 1 of U1. Verify voltage at input to the filter, pin 1 of J3, is about 2.4V P/P. If not proceed to "Low Frequency Filter Test."

High Frequency Amplifier

Turn off the signal generator. Measure at high frequency amplifier output (+HF test point J5 ref. J4) and confirm less than +/- 50mV of offset. Now, turn on the signal generator and adjust frequency to 3KHz. Adjust oscillator amplitude to obtain 45VP/P at amplifier output. The waveform should be a nice clean sine wave, with perhaps, a small hint of clipping. The amplifier will begin to clip around 50V P/P; the amplifier input can be measured at the junction of R52 and C26. With 45V P/P at the amplifier output there should be around 3.1 V P/P at the input to the amp. If one or more of the above tests fail, proceed to "High Frequency Power Amplifier Test."

Note: The integrated power amplifier will begin to shutdown due to thermal limitations after only a few seconds. Do not be misled that a fault condition exists if the output is not as expected after several seconds of testing.

Excessive Line Current Test

Verify correct voltage levels, polarity and that the following parts are not shorted:
C16, C17 (main filters) and D11, D12 (low frequency power amp), D12-10, D14, C10, C15, C6, C9 (+/- 70V) at the legs of the doubler capacitors). No section of D13 (Main Bridge) should be shorted. Verify that the + 15V and -15V supplies are not shorted. Return to " Powerup" when the fault is fixed.

Measure across Q7 and Q8 emitters using DC Voltmeter. Slowly ramp up input voltage never allowing more than 4 amps of current to be pulled from Variac. The voltage across the emitters (TP3) should be less than 5mv. If the voltage is excessive, refer to "Low Frequency Power Amplifier Test".
Measure at +HF test (ref. J4) using DC voltmeter. Slowly ramp up input line voltage never allowing more than 40W to be pulled from Variac. The voltage at the output pin, pin 3 of U2, should be less than +/- 50mV. Monitor the temperature of U2, with your finger. The temperature should be warm slightly but not excessively. The temperature should not rise more than 10 degrees C after a few minutes of 'idle" operation. If any of the above voltages are incorrect refer to "High Frequency Power Amplifier Test."

MAIN VOLTAGE TESTS

+/- 15V Supply Test

Slowly ramp up the Variac, never allowing the supplies to exceed +/-16V. Measure + 15V and -15V supplies at Q2 and Q4. Both should be the correct value +/-15V, respectively.

If a supply is very close to the ground potential (Less than +/- 100mV) check for shorts on the +/- 15V supplies lines. IC's and reference diodes, D1 or D4; could be open or incorrect reference bias sources R18 and R26; open series pass devices Q2 and Q4; If the initial +/- 36V supply is absent, proceed to "+/- 36V Supply Test".

If a supply is out of specification (deviation of more than .5V but not close to ground potential) check for:

Incorrect value of D1, D4, R18 or R26;
Proper polarity on C4 and C8;
Excessive current being pulled (Do U1-U3 run hot? etc.);

Verify that Q2 or Q4 is not shorted from base to emitter.

If supply voltage is abnormally is high verify that:

D1 and D4 are of correct type and are not open
R18 and R26 are the correct value
Q2 is a 2SD1763A and that Q4 is a 2SB1186A
Q2 and Q4 are not shorted Base to collector, or collector emitter

(+/- 36V Supply Test)

Look for traces between main bridge, D13, and the main filter capacitors, C16, C17. Look of open traces between D13 and power input connector, J1. Verify that D13 is not open. Return to "Main Test Loop" after fault found.

(+/- 70V Supply Test)

The low frequency power amp high voltage stages might be pulling excessive current. Check for correct value of R28 and R30 (3.24K) and verify 1.4 VDC across them when board is powered. Check for correct value of R22, R29, (464 ohms), R21, and R11 (150 ohms) and verify 870mVDC (+/- 100mV) across them when board is powered. Check for correct values of R6, R23 and R25 (0.1 ohms, 3W) and verify <5 mV (or similar to bias setting) across them when board is powered. If any of the above is not true proceed to "Low Frequency Power Amp Test."

Amplifier Muting Test.

Power up boards and measure voltage at junction of D15, R29 and C27. The voltage should be around 34 VDC. If voltage is negative check polarity of D18;
If okay, power up board while monitoring the collector of Q17. The voltage should ramp from zero to around -8V in around 2 seconds (at which time LED's, D5 and D6 should illuminate) and eventually toggle to -15V. If collector remains close to zero or at a somewhat positive voltage check for collector to emitter short on Q17; for incorrect value R34; and for

shorted SW1; To verify correct operation, interrupt power while monitoring collector of Q17. The voltage should quickly change to + 15 and, eventually, zero volts. If it does not, check for open C29 and, or Q17;
With negative voltage applied to pin 6 of U1B, pin 7 of U1B should be at +15V. If not, check for short or open trace around pins 5 and 6 or replace the defective IC U1.

Low Frequency Power Amplifier Test

Amplifier pulls excessive power when board is connected.

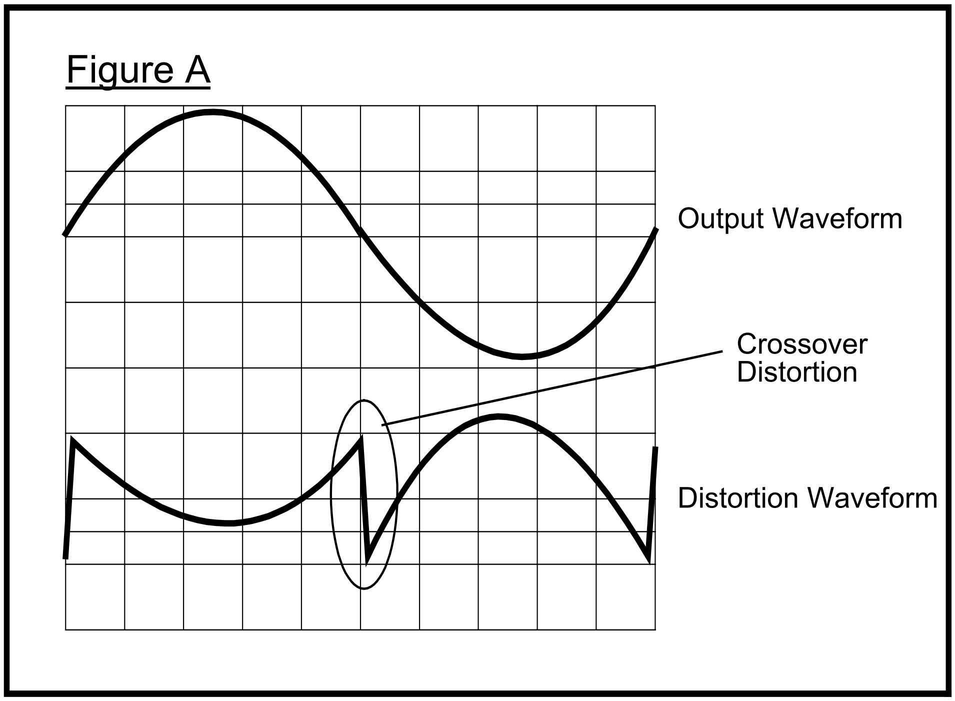
Verify correct values of Q6, Q7 (2SC3201), Q8, Q9 (2SD1763A), and Q5 (2SB1186A). Check that D11 and D12 are not shorted and for proper polarity. Look for possible shorts in the areas where these parts are. All the above parts form the “Current Amplifier” (providing voltage gain).

If output voltage is centered (close to ground potential), look for shorts to ground on output leg (+LF test point TP4).

If output voltage is centered (+LF test point TP4), and output leg is not shorted, there could be a problem with the bias reference. Jumper across C1. Power unit. If excessive current is not pulled, bring AC supply to full (120VAC). Measure across R11 and R21. The voltage across these parts should not be any greater than 2.5 VDC. Measure resistance of R11 and R21, the correct value is 150 ohms. If R11 or R21 values is incorrect, or if voltage across these parts is excessive proceed to “Voltage Amp Test” if R11 and R21 testing does not uncover a problem, and shorting C1 does bring the power consumption to normal, proceed to “Bias Reference Test.” Remove jumper across C1

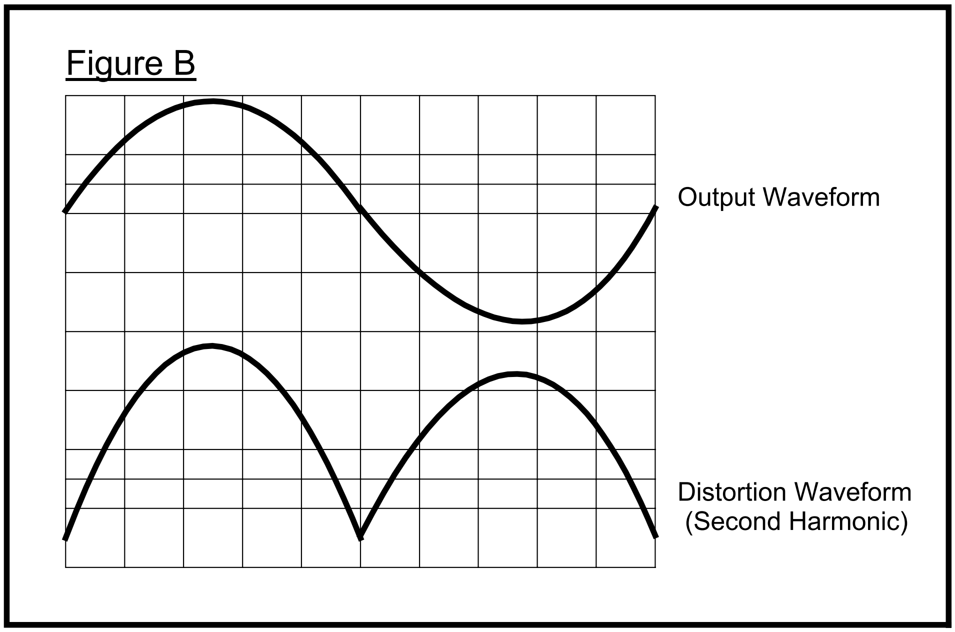
If the output voltage is offset (+LF test point) from ground there could be a problem in the voltage amp. Jumper across C1 and then bring this point to ground. If the output voltage centers itself, remove jumper and proceed to “Voltage Amplifier Test.” If the output voltage does not center, then the problem is in the current amplifier. Check for shorts on all elements (Base to emitter, base to collector, collector to emitter) of Q6, Q7, Q8 and Q9.

Crossover Distortion in Output



Refer to Figure A above and note the character of crossover distortion. This is caused by both halves of the output stage (Q6, Q7 on positive side, and Q8 , Q9 on the negative side) being turned off right around crossover (crossover from positive drive to negative drive). This actually takes a small chunk (sometimes only visible in distortion waveform) out of the center of the output waveform. This also causes some harmonic distortion (Note the curved portions of the "Distortion Waveform"). Remove input signal to amp and measure DC voltage across emitters of Q7 and Q8 . Bias adjustment, R16, should allow adjustment from zero volts to well over 10mV. If not proceed to "Bias Reference Test".

Excessive Second harmonic distortion in output



Refer to Figure B above and note the character of second harmonic distortion. This is caused by an imbalance in amplifying capability in either the current amplifier or the voltage amplifier. Note that the "Distortion Waveform" could also be inverted in relation to above depending on the polarity of the imbalance. Place a probe on the output of the amp and adjust for around 40V P/P if the condition of the board allows this much voltage. Visually note the characteristics of the waveform and then probe on both sides of C1. C1 is across the input to the current amp. If the waveform visibly appears almost identical to the output waveform (same P/P voltage, same waveform shape) then the problem lies in the voltage amp. Proceed to "Voltage Amp Test". If there is much difference between the output waveform and the waveforms measured at C1 there is probably a problem in the current amp.

- No output from the amplifier when driven.

  Verify signal base of Q18. If there is no signal refer to 'Low Frequency Filter Test". Verify that 1UB pin 7 is close to +15 volts. If not refer to "Amplifier Muting Test." If all of the above is correct, refer to "Voltage Amplifier Test."

- Does Amplifier oscillate? Does Amplifier roll off too soon at high frequencies?

Check all components that affect high frequency stability and response; C11, R27 (output loading), C2, C5 (Current amp stabilizers), C30, R31 and C32.

- Is there crossover distortion in the output?

  To verify this note the character of crossover distortion. This is caused by both halves of the output stage (Q6, Q7 on positive side, and Q8, Q9 on the negative side) being turned off right around crossover (crossover from positive drive to negative drive). This actually takes a small chunck (sometimes only visible in distortion waveform) out of the center of the output waveform. This also causes some harmonic distortion (Note the curved portions of the "Distortion waveform'). Remove input signal to amplifier and measure DC voltage across emitters of Q7 and Q8. Bias adjustment, R16, should allow adjustment from zero volts to well over 10mV. If not proceed to "Bias Reference Test".

- Is there excessive second harmonic distortion in output?

  Note the character of second harmonic distortion. This is caused by an imbalance in amplifying capability in either the current amplifier or the voltage amplifier. Note that the "Distortion Waveform" could also be inverted in relation to above depending of the polarity of the imbalance. Place a probe on the output of the amplifier and adjust for around 40VP/P if the condition of the board allows this much voltage. Visually note the characteristics of the waveform and then probe on both sides of C1. C1 is across the input to the current amp. If the waveform visibly appears almost identical to the output waveform (same P/P voltage, same waveform shape) then the problem lies in the voltage amp. Proceed to "Voltage Amplifier Test". If there is much difference between the output waveform and the waveforms measured at C1 there is probably a breakdown in the current amplifier.

Bias Reference Test

The purpose of the bias reference circuit is to provide bias to the driver and output transistors to just barely turn them on. Q10 is a positive current source and Q11 is a negative current source. The voltage between the collectors of Q10 and Q11 is regulated by bias reference.

A voltage of around 0.6V is required across the base emitter junction of a transistor to begin to turn it on. Since a total of 4 junctions are in the current amp (Q6, Q7, Q8 and Q9) the bias reference needs to have around 2.4 V (4 drops) across it to turn on all four transistors in the current amplifier.

The range of adjustment is very small (Between 1.7V and 2.8V when R16 is adjusted from stop to stop). The reason the adjustment is small is because a small amount of change in voltage across the reference produces a radical bias current change in the output stage (due to the logarithmic relationship between base emitter voltage to collector current). Too great a range results in a control that is too sensitive and very hard to adjust correctly.

As a transistor heats up it requires less and less base emitter voltage to obtain the same collector current. If a bias reference voltage remains constant, and the output and the driver transistors begin to heat up, the current amp will draw more and more current, eventually destroying itself. This is why the reference transistor, Q3 is mounted to the heatsink: as the outputs (Q4 through Q9) and drivers (Q1, Q5) heat up so does Q3. This action regulates the output bias current and keeps it constant with temperature.

a. Excessive power pulled from AC line.
   This is due to excessive voltage across the reference. The range (measure across C1) should be 1.7V to 2.8V. If not check R12, R13, R14, R16 and Q3.

b. Crossover distortion in output waveform.
   This is due to inadequate voltage across the reference. The range (measure across C1) should be 1.7V to 2.8V. If not check R12, R13, R14, R16 and Q3.

- After amplifier heats up, bias current, and power pulled from AC line increases.

This is due to bias circuit not tracking the current amplifier with temperature. Make sure that all of the transistors, Q3, Q6, Q7, Q8 and Q9 make good thermal contact with heatsink (hardware is tight, adequate thermal grease is on devices, insulators and heatsink) If all of this is okay replace Q3.

Bias Set Procedure

The following steps are necessary to set the bias on the LSR28P low frequency amplifier module, PCB 510-00032-XX rev (any).
Connect a 2-Ohm load (250Watts0 to the red and the black leads of the amplifier. While maintaining 120VAC, 60 Hz, turn the unit on.

Set the signal generator to 900Hz and to 0.2 Vrms approximately.
Using a distortion analyzer and an oscilloscope, turn the bias trim pot (R16) CW until distortion spikes just disappear, and the THD+N reading is below 0.1 %
Turn oscillator off, while keeping the amplifier on.
Verify the power is between 10 and 20 watts and that D.C. voltage across TP3 is less than 5mV.

Voltage Amplifier Test.

Turn the signal generator off. Disconnect 2-ohm load. Lift one side of R44. Connect base of Q16 to base of Q18. Power up amplifier. Verify that the voltage at U1B pin 7 is around +15 volts. If not, refer to "Amplifier Muting Test."

1. Front end and Current Source

Verify 1.2V across anode of D17 to cathode of D16. If incorrect check D17, D16, R46, R45 and Q19. Verify voltage across R45 (600mV). Verify resistance of R45 (620 ohms).

The voltage at the collector of Q19 should be -650mV. If voltage is substantially lower, look for a short from collector to emitter of Q19.

The voltage at both bases of Q18 and Q16 should be very close to ground potential (the base of Q18 will always be at a slightly negative voltage) and the emitters should be at -650mV. The voltage drop across R40 and R41 should be around 30mV. Both drops should match within +/-20%. If all above is not correct check Q16, Q18, R40 and R41.

The voltage drop across R30 and R28 should be 1.6V for both devices +/-20%. If voltages are not matched, or if they are higher or lower, verify values of R30 and R28 (3K24), R29 (464ohm) and R11 (150 ohm), and check for open or shorted elements in Q18, Q16, Q14 or Q12

. 2. Upper Class A drive

Verify that voltage across R11 equals 870mV +/- 20%. If incorrect, check Q12 for open or shorted elements.

Check the voltage at the base of Q10. This should be half way between the positive supply voltage and the output node. V(base Q10) = (36+V(output))/2. For example, if the output is offset to -10V the voltage at the base of Q10 will equal (36-10)/2 = 13V. Under normal conditions when the output is at zero volts the base of Q10 is at +18 volts. If incorrect check values of R9 and R10 (63K4). If R9 and R10 are correct, replace Q10.

3. Level shifter

Verify that voltage across R29 equals 870mV +/- 20%. If incorrect, check Q14 for open or shorted elements.

Verify that the voltage at the emitter of Q15 is +600mV. If incorrect check Q15 and Q14 for shorts and opens

Verify that the voltages across R29 and R22 are the same (+/- 10%) If not check values of R22, and R29 (464 ohms). Verify that D3 isn't open, shorted or reversed. If the above checked okay, verify value of R21 (150 ohms), and check Q13.

4. Lower Class A drive

Verify that voltage across R21 equals 870mV +/- 20%. If incorrect, check Q13 for open or shorted elements.

Check the voltage at the base of Q11. This should be half way between the negative supply voltage and the output node. From the formula:

V(base)=(+36+V)(output))/2.

For example, if the output is offset to +10V the voltage at the base of Q11 will equal (-36+10)/2= -13V. Under normal conditions when the output is at zero volts the base of Q11 is at -18 volts. If incorrect, check values of R20 and R19 (63K4). If R20 and R19 are correct, replace Q11.

Remove power. Remove jumper across bases of Q18 and Q16. Re-solder lifted end R44 back into the circuit board. Turn generator A on and power up board. Verify that output is centered and undistorted. Turn down oscillators and reconnect 2ohm load. Bring up oscillator level and verify that the output is centered and undistorted.

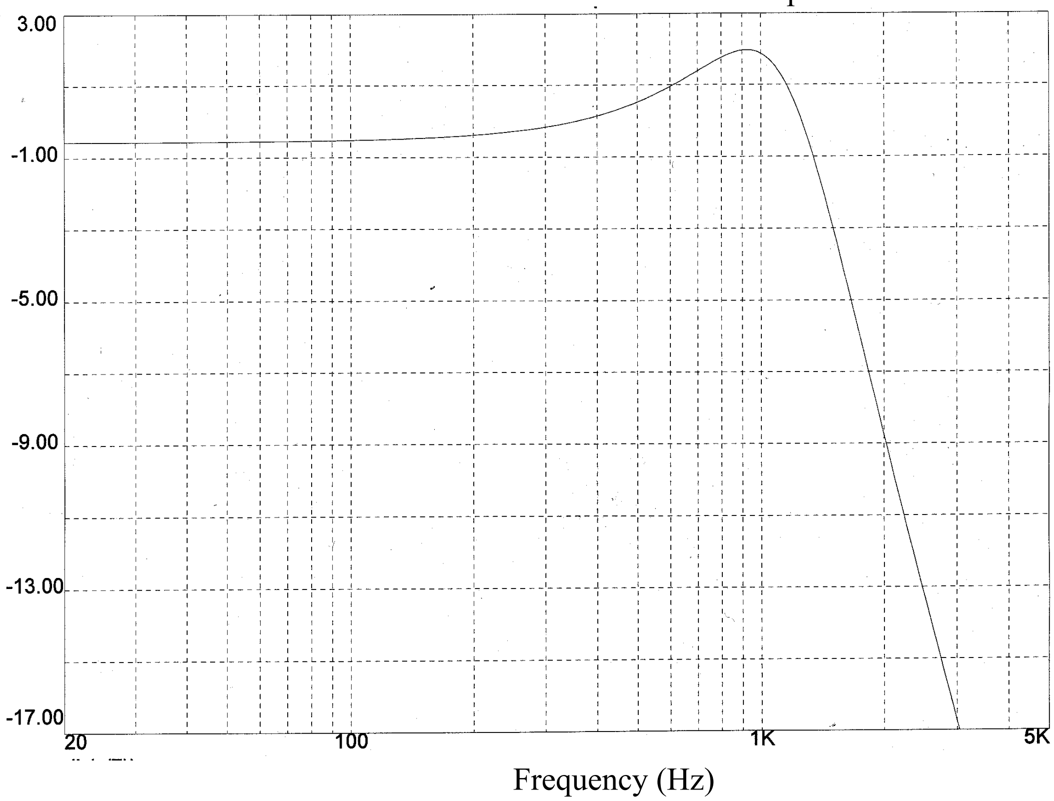
Low Frequency Filter Test

Turn on generator output A, adjust frequency for 900Hz, and adjust oscillator level to obtain 3V P/P at the input to the filter, pin 1 of J3. Move probe to junction of R48 and C23.

The curve on the graph shown above represents the transfer function in dB of the first filter section at U1A when this section is operating properly.

> Sweep the oscillator frequency and note if the readings are reasonably, close to the values indicated in the plot above (+/-10%) For example, with a filter that operates normally, the output will be 2.8 P/P at 20Hz, 3.2V P/P at 500Hz, 3.75v P/P at 900 Hz, 1.1 V P/P at 2 kHz, 150mV P/P at 5 kHz and 33 mV P/P at 10 kHz.

Low Pass Filter Response



This is a low-pass filter with the half power point at 1500 Hz. If the response is incorrect check the values of RZ1, R33, CY1, CX1 and C22. If these values are okay, check the values of C23, C24, R48 and R42.

High Frequency Power Amplifier Test

- HF Amplifier pulls excessive current when board is powered up

  If the output of the amplifier, pin 3 of U2, is centered (around ground potential) check for a short from ground to the output pin, pin 3 of U2. If no shorting problem is found replace U2.

  If the output pin, pin 3, is offset to one of the rails the power consumption should go to normal idle level (Less than 20W) when the 4-ohm load is removed. If it does not check for shorting from the output, pin 3, to either the +36 V or -36V supplies. If not shorted replace U2.

  If the output is offset, and the power consumption goes down to normal with the load removed, check the following:

  Verify that the input to the amp, pin 10, is close to the ground potential. If not close, check for shorts surroundings pin 10. If no shorts are found replace U2. Verify that pin 9 reflects the output-offset polarity, i.e. the voltage across R36 should be insignificant. If not look for shorts surrounding pin 9 and verify values of R36, r53 and C34. If no problem found replace U2.

- No output from the HF amplifier when driven.

  Verify input to the amp on pin 10. If no signal is present verify that there is signal at J3 pin 6. If signal is present at pin 6 of J3 verify values of C26, R51and R52. Look for shorts at pin 10 of U2. If nothing is found in above testing replace U2.

  The amplifier should be out of muting. Verify that U3A pin 2 is at -15 volts and that U2 pin 8 is about -3V. If the muting pin is substantially lower, replace U2. If the voltage goes higher than around -5V, and the turn on delay is operating properly replace U2. If the voltage at U3A pin 2 is incorrect refer to “Amplifier Mute Test” above.

- Is the gain of the amplifier low or high?

  (The gain should be equal to x14).The gain from pin 10 to pin 3 should be around x14 (23dB).

- Does amp oscillate?

  Verify correct values of C35, C25, C28, and C36. Is there an oscillation on the rails that is not being filtered? If all this is okay and gain test above has been passed, replace U2

- Is output distorted?

  Verify pin 8 of U2 measures approximately -3volts. If not refer to "Amplifier Mute Test" above. If the input and mute circuits do measure okay replace U2 anyway..

Indicator LED control

- Is the green LED not illuminated?

  Verify -15 volts at U3 pin 2. if not refer to "Amplifier Mute Test" above.

  Check for around 0 volts at pin 6 of U3. if not found check value of R38 and R57 (both 10Kohms). If these are correct, replace U3.

  Verify -7.5 volts at U3 pin 10. if not found check value of R60 and R63 (both 10kohms). If these are correct, replace U3.

  Check for 0 volts at U3 pin 11. If not check D.C. offsets at both power amplifier outputs. If substantial negative offset detected refer to "Low Frequency Power Amplifier Test" and to "High Frequency Power Amplifier Test". If these are correct, replace U3.
  Verify around 5 volts at U3 pin 7. If not check value of R61, R58 (both 10K ohm) and R56 (22k ohm). If these are correct, replace U3.

  Check for approximately -12.5 volts at U3 pin 1. If voltage at U3 pin 1 is close to -15 volts replace U3. If the voltage at pin 1 of U3 is more than -15 volts but less than -12.5 volts check value of R50 (2K26). If U3 pin 1 is close to +15 volts replace the LED.

- Is the red (or amber color) LED illuminated?

  Verify -7.5 volts at U3 pin 10. If not found check value of R60 and R63 9both 10Kohms). If these are correct, replace U3.

  Check for 0 volts at U3 pin 11. If not check D.C. offsets at both power amplifier outputs. If substantial negative offset is detected refer to "Low Frequency Power Amplifier Test" and to "High frequency Power Amplifier Test." If these measure correctly, replace U3.

Verify around 5 volts at U3 pin 8. If not, replace U3.

Check continuity from U3 pin 14 to J7 pin 1. If correct, replace U3.

Apply an input signal at 500Hz sufficient to produce 50 volts peak to peak at the low frequency amplifier output and observe that the red LED illuminates.

- Does the LED constantly show Green, Amber or erratically extinguish?.

Check for less than -8 volts D.C. at U3 pin 11. If not check that D20 is the correct type and polarity and that C38 is correct polarity. Check values of R62 (14K ohm), R65 (10K ohm) and R64 (100K ohm). If all these are okay, replace U3.

Verify -7.5 volts at U3 pin 10. If not check values of R63 and R60 (Both 15 K ohm). If these are okay, replace U3.

Check that U3 pin 13 is at -15 volts. If not check for check for short to this trace or reversed polarity (or short circuit failure) at C37. If these are okay, replace U3.

Check for approximately -12.5 volts at U3 pin 14. If the voltage at U3 pin 14 is close to -15 volts replace U3. If the voltage at pin 14 of U3 is more than -15 volts but less than -12.5 volts check value of R59 (3K32). If U3 pin 14 is close to +15 volts, replace the LED.

FINAL TEST PROCEDURES

For the final test of the LSR28P, the following check out procedures can be followed. If the technician measures radically different values for the individual tests, the amplifier should be troubleshot and repaired to conform to factory specifications.

Power up Test

Verify that the unit to be tested is turned off. Then, connect to a variac with isolated power supply if possible. Slowly increase the output voltage from the variac, watching for excessive current drawn. If current is correct (below an 1 amp) verify that the power led located on the front HF driver is green

Verify the quietness. There should be no hum from the unit.
If there is, this indicates a problem in the internal circuitry and should be checked further for correct wire wrapping.

Gain Test

Set up the unit as shown on page 11 and verify volume control is turned fully counter clockwise. Apply a –10 dB input signal and slowly turn the volume control clockwise noting the signal on the oscilloscope. If the signal is erratic, this will be displayed on the oscilloscope and indicates a faulty volume control..
Set the frequency on the signal generator to 100 Hz. The LF output level should be approximately equal to +13 dB +/- 2 dB
Change the frequency to 5 KHz. The HF output level should be approximately +5 dB +/- 2dB.

Distortion Test

Set up the unit as shown on page 11. Apply a –10 dB signal to the input and an 8 ohm load to the output
For the LF amplifier

Increase the voluume control until the LF output is equal to +10 dB. Set the input frequency around 100 hz and verify the distortion level is below .1%.

For the HF amplifier

Turn the volume control clockwise to an output level of +10 dB. The distortion level should be under .1% as read on the distortion analyzer.

Rated Power

LF Output

frequency—100 Hz. Input level should be variable from –10 dB to 10 dB with a 2ohm load on output. The onset of clipping should occur at about 130 watts

Hf Output

Frequency—5 Khz, Input level should be variable from –10 dB to 10 dB with an 8 Ohm load on output. The onset of clipping of this amplifier should occur at about 50 watts

D.C. Offset

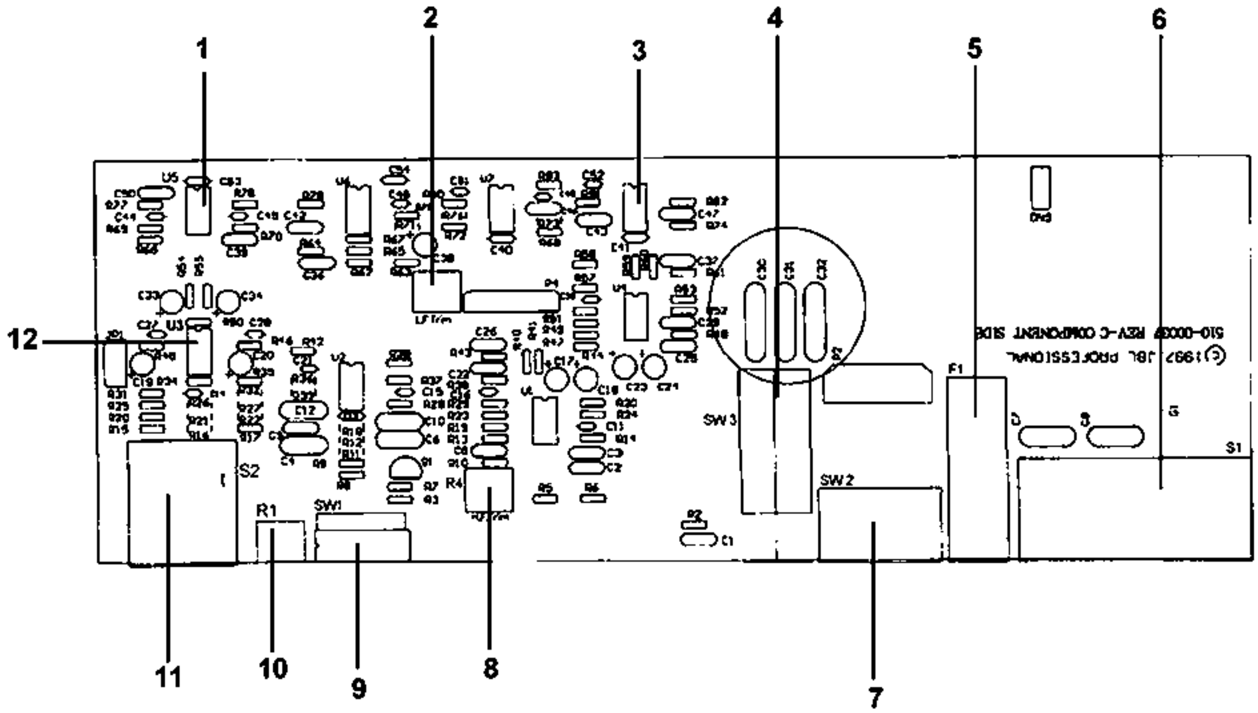
Offset should measure 0v +/- 10 mV at the output terminals of either amplifier.

Click here to view component exploded view

http://www.jblproservice.com/pdf/LSR%20Series/LSR28P.pdf

LSR28P

COMPONENT EXPLODED VIEW

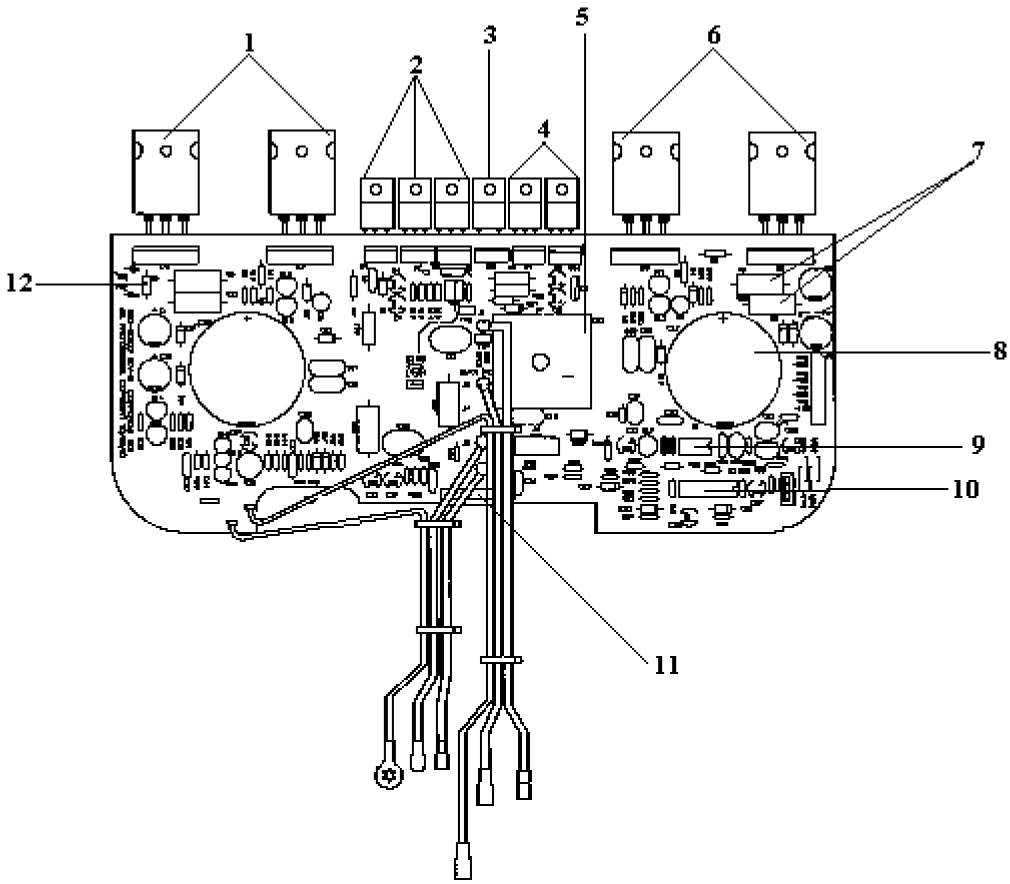


COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref. Des.
1	684-00003-00	3	IC,NJM4560D	U2,U5,U6,U7
2	660-00027-01	1	RES.TRIM POT 5K	R56
3	684-00000-00	3	IC,NJM2068D	U1,U4,U8
4	546-00004-00	1	SW, Power	SW3
5	452-00003-01	1	FUSE HOLDER(Body Only)	F1
6	424-00079-01	1	CONN,IEC,AC POWER	S1

Item	Part No.	Qty.	Description	Ref. Des.
7	546-00005-00	1	SW, Voltage Selector	SW2
8	660-00027-00	1	RES,TRM POT 500	R4
9	548-00018-01	1	SW,DIP,8 WAY	SW1
10	660-00027-02	1	RES.TRIM POT 50K	R1
11	424-00080-01	1	CONN,XLR COMBO	S2
12	680-00019-00	1	IC, OP275	U3

COMPONENT EXPLODED VIEW

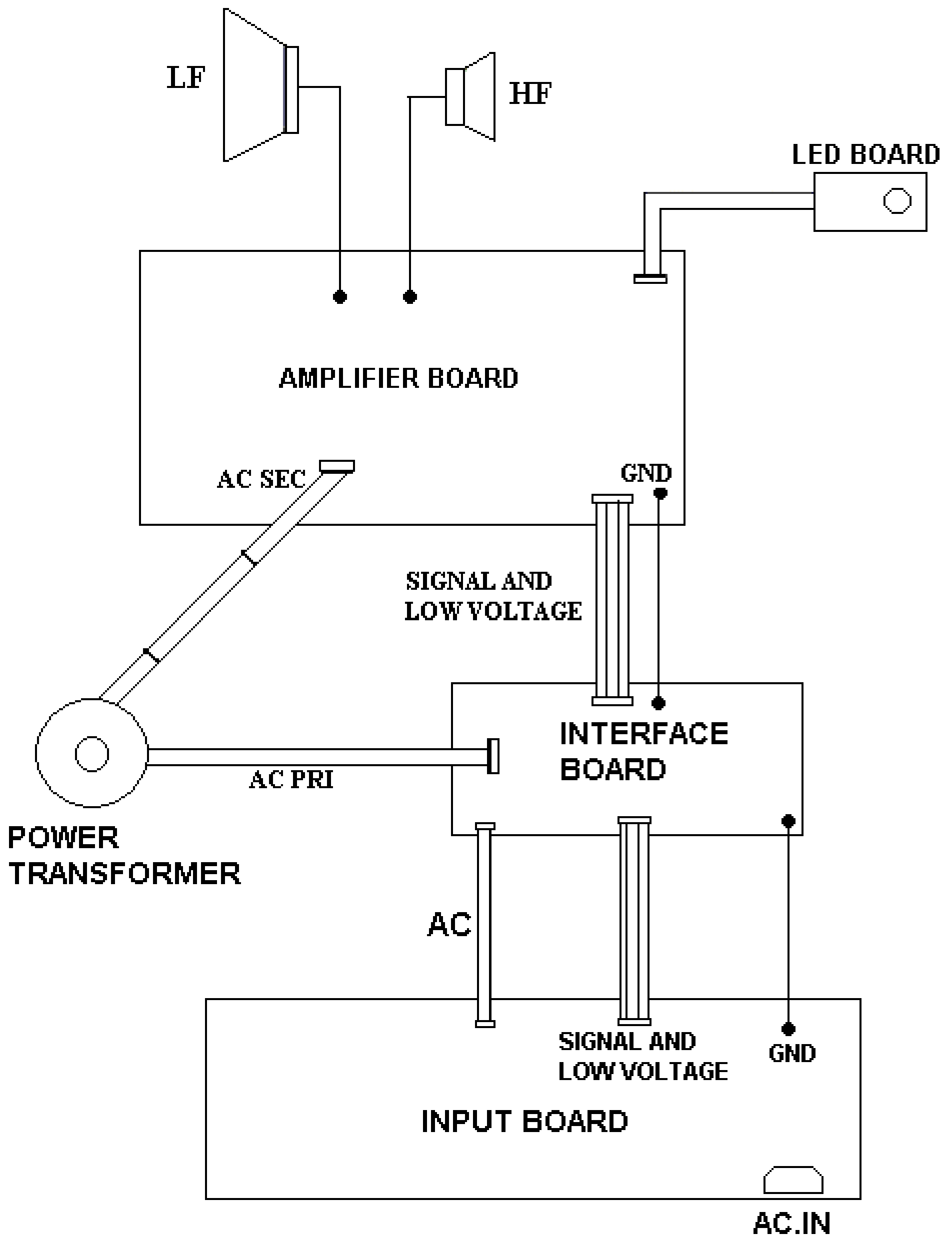


COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref. Des.
1	682-00011-00	2	XSTR,NPN, 2SC3281	Q6,Q7
2	682-00006-00	3	XSTR, NPN, 2SD1763A	Q1,Q2,Q3
3	548-00015-00	1	SW, THERM, 67F090	SW1
4	682-00007-00	2	XSTR, PNP 2SB1186A	Q4,Q5
5	676-00016-00	1	DIODE,BRIDGE,KBPC1502W	D13
6	682-00010-00	2	XSTR, PNP, 2SA1302	Q8,Q9

Item	Part No.	Qty.	Description	Ref. Des.
7	632-71008-50	4	RES.10 OHM 5% 3W	RR6,R8,R23,R25
8	604-06109-60	2	CAP,10,000 UF, 63V	C16,C17
9	684-00003-00	1	IC,NJM4560D	U1
10	684-00006-00	1	IC,NJM2901N	U3
11	72-0015	1	IC.LM3886	U2
12	633-32207-50	4	RES,FUSE,2.2 OMH	R1,R2.R3.R5

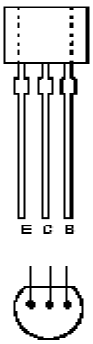
Wiring Diagram LSR28P



SEMICONDUCTOR PINOUTS

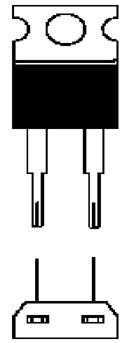
SMALL SIGNAL TRANSISTOR

2SC2362

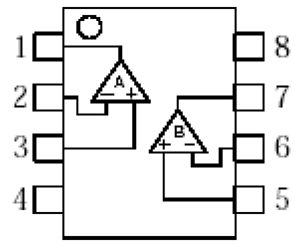


SW1

67FO80

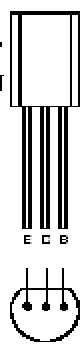


OP AMP



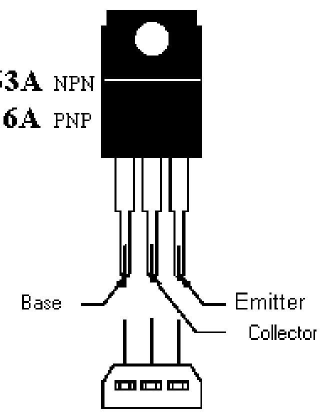
4560D/2068/OP275

2SA1370 PNP
2SC3467 NPN

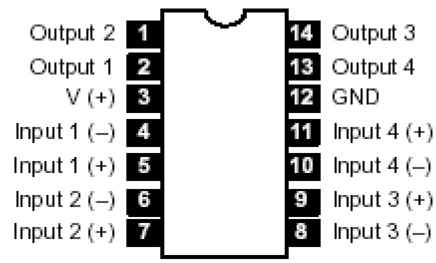


DRIVERS TRANSISTORS

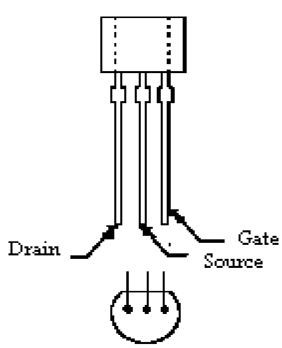
2SD1763A NPN
2SB1186A PNP



2901N COMPARATOR

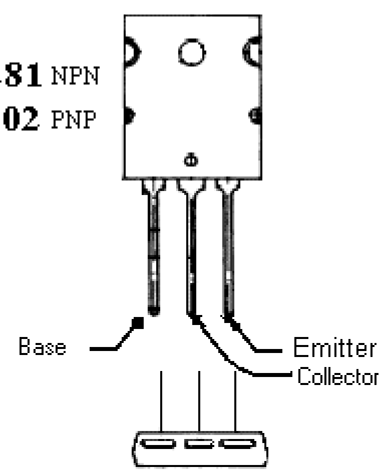


JFET TRANSISTOR

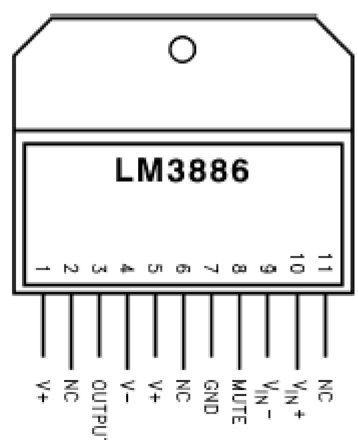


POWER TRANSISTORS

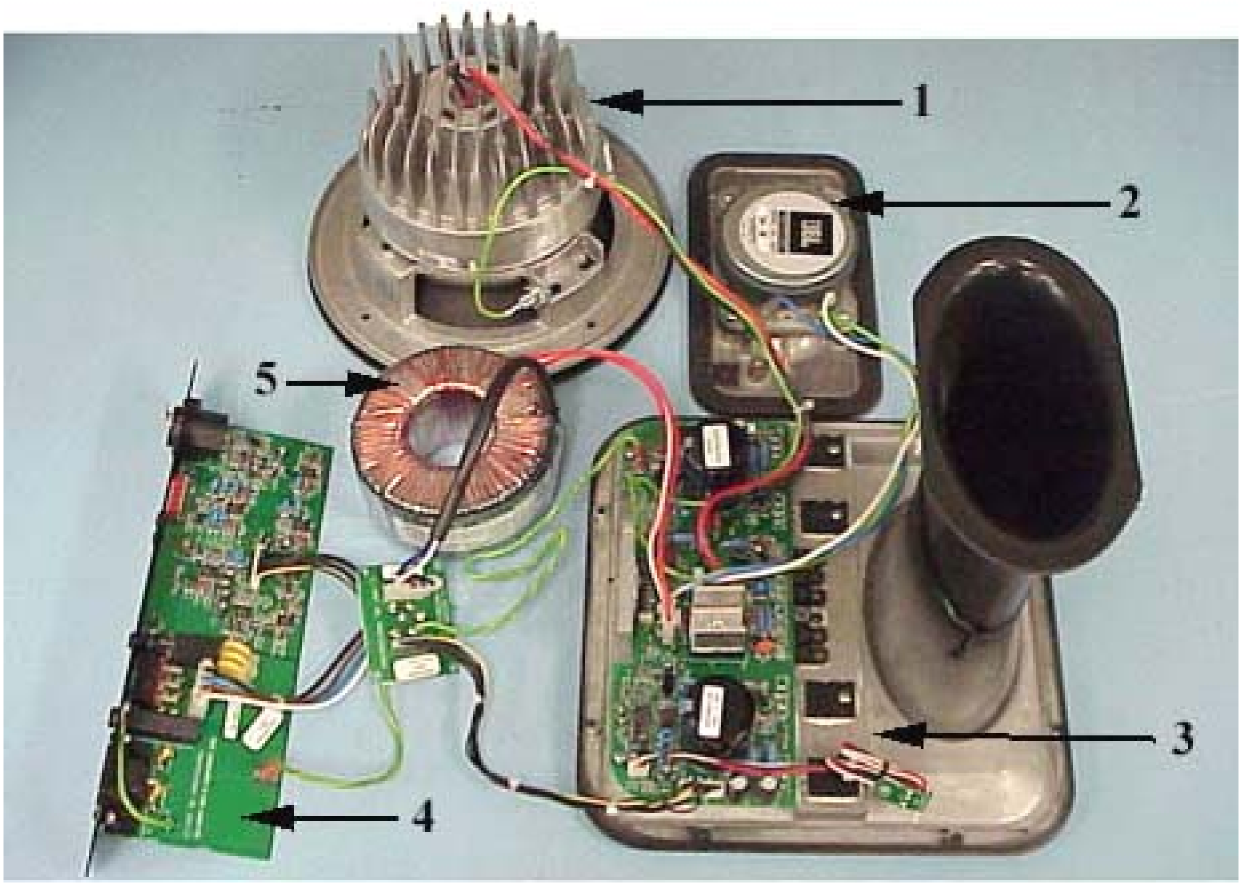
2SC3281 NPN
2SA1302 PNP



POWER IC



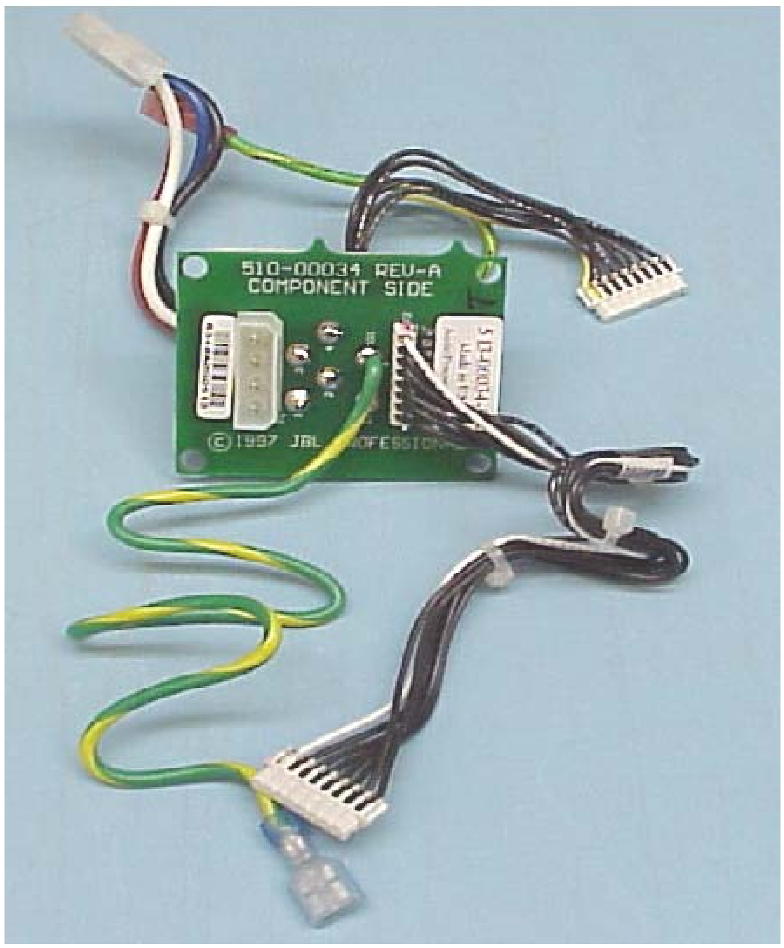
PICTORIAL OF COMPLETE AMPLIFIER ASSEMBLY



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description
1	124-58002-00x	1	Speaker low freq. 218F
2	123-10003-00X	1	Speaker H F M/I 053TI
3	226-00013-00	1	Main Amp Assy W/Heatsink
4	226-00012-00	1	Signal Input Assy
5	562-00032-00	1	Transformer

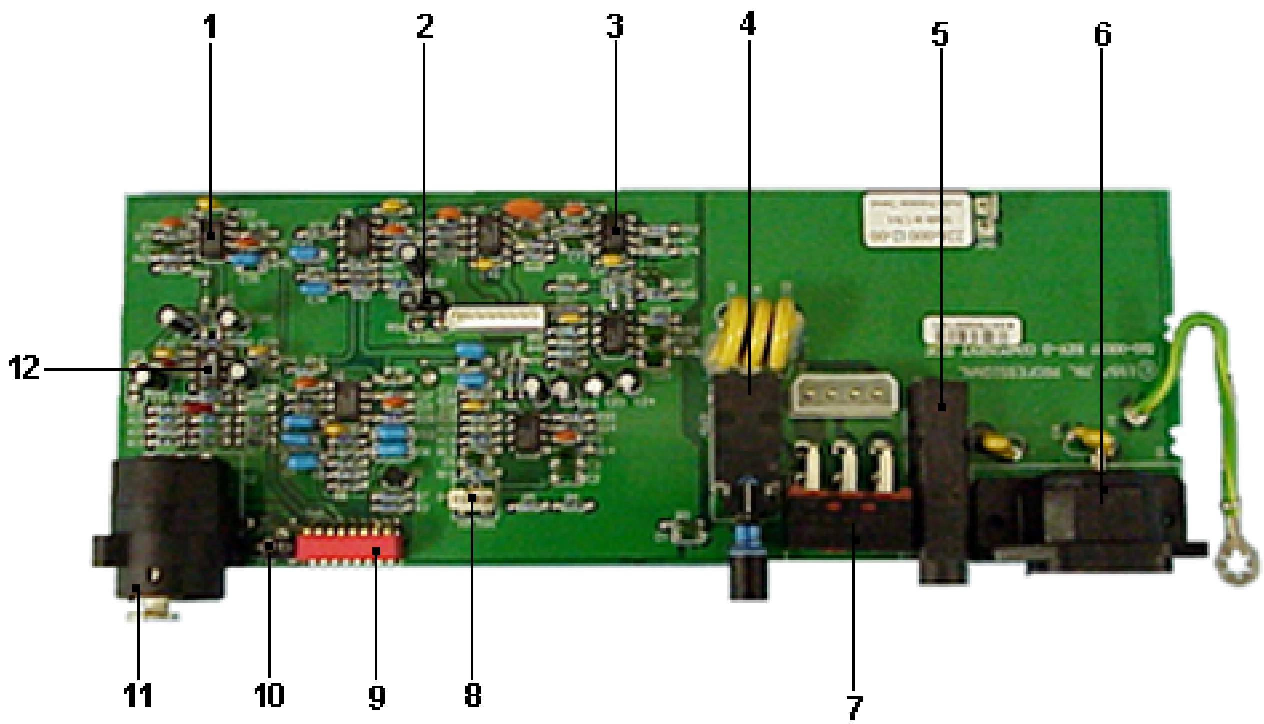
PICTORIAL OF INTERFACE PCB ASSEMBLY



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description
1	513-00034-01	2	Interface Cable Assembly

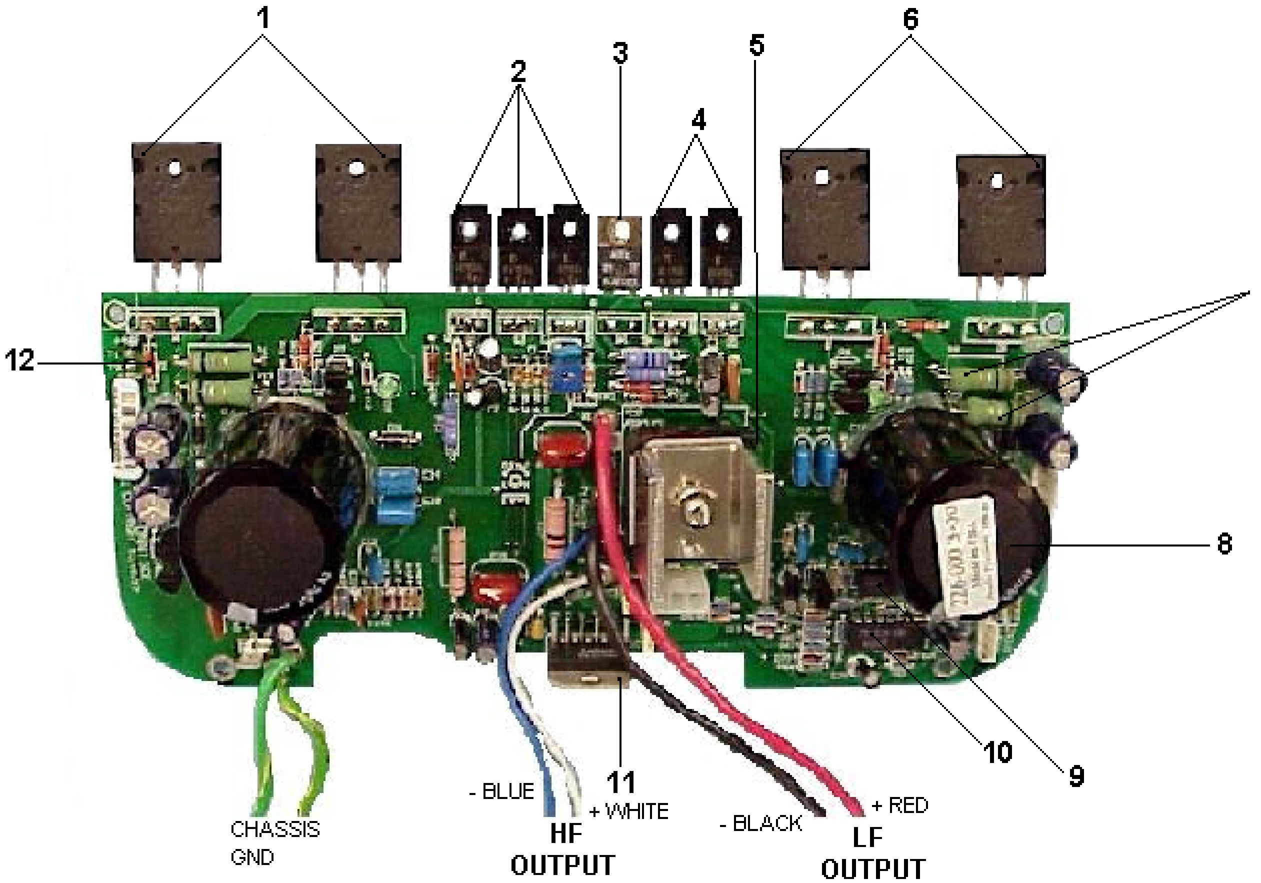
PICTORIAL OF INPUT PCB ASSY



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref.Des.	Item	Part No.	Qty.	Description	Ref.Des.
1	684-00003-00	3	IC,NJM4560D	U2,U5,U6,U7	7	546-00005-00	1	SW, Voltage Selector	SW2
2	660-00027-01	1	RES.TRIM POT 5K	R56	8	660-00027-00	1	RES,TRM POT 500	R4
3	684-00000-00	3	IC,NJM2068D	U1,U4,U8	9	548-00018-01	1	SW,DIP,8 WAY	SW1
4	546-00004-00	1	SW, Power	SW3	10	660-00027-02	1	RES.TRIM POT 50K	R1
5	452-00003-01	1	FUSE HOLDER(Body Only)	F1	11	424-00080-01	1	CONN,XLR COMBO	S2
6	424-00079-01	1	CONN,IEC,AC POWER	S1	12	680-00019-00	1	IC, OP275	U3

COMPONENT EXPLODED VIEW



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref.Des.
1	682-00011-00	2	XSTR,NPN, 2SC3281	Q6,Q7
2	682-00006-00	3	XSTR, NPN, 2SD1763A	Q1,Q2,Q3
3	548-00015-00	1	SW, THERM, 67F090	SW1
4	682-00007-00	2	XSTR, PNP 2SB1186A	Q4,Q5
5	676-00016-00	1	DIODE,BRIDGE,KBPC1502W	D13
6	682-00010-00	2	XSTR, PNP, 2SA1302	Q8,Q9

Item	Part No.	Qty.	Description	Ref.Des.
7	632-71008-50	4	RES.10 OHM 5% 3W	R6,R8,R23,R25
8	604-06109-60	2	CAP,10,000 UF, 63V	C16,C17
9	684-00003-00	1	IC,NJM4560D	U1
10	684-00006-00	1	IC,NJM2901N	U3
11	72-0015	1	IC.LM3886	U2
12	633-32207-50	4	RES,FUSE,2.2 OMH	R1,R2.R3.R5

Click here for the Master Parts Listing

http://www.jblproservice.com/pdf/LSR%20Series/LSR28P%20AMP%20BOM.pdf

Click here to view the JBL Professional Electronic Failure QA Codes

http://www.jblproservice.com/protected/Domestic%20pdf/Electronic%20QA%20Codes.pdf

Click here for Schematics

http://www.jblproservice.com/pdf/LSR%20Series/LSR28P%20Schematics.pdf

Limited Warranty

The JBL Warranty on professional loudspeaker products (except for enclosures) remains in effect for five years from the date of the first consumer purchase. JBL amplifiers are warranted for three years from the date of original purchase. Enclosures and all other JBL products are warranted for two years from the date of original purchase.

Who Is Protected by This Warranty?
Your JBL Warranty protects the original owner and all subsequent owners so long as: A.) Your JBL product has been purchased in the Continental United States, Hawaii or Alaska. (This Warranty does not apply to JBL products purchased elsewhere except for purchases by military outlets. Other purchasers should contact the local JBL distributor for warranty information.); and B.) The original dated bill of sale is presented whenever warranty service is required.

What Is Covered by the JBL Warranty?
Except as specified below, your JBL Warranty covers all defects in material and workmanship. The following are not covered: Damage caused by accident, misuse, abuse, product modification or neglect; damage occurring during shipment; damage resulting from failure to follow instructions contained in your Instruction Manual; damage resulting from the performance of repairs by someone not authorized by JBL; claims based upon any misrepresentations by the seller; any JBL product on which the serial number has been defaced, modified or removed.

Who Pays for What?
JBL will pay all labor and material expenses for all repairs covered by this warranty. Please be sure to save the original shipping cartons because a charge will be made if replacement cartons are requested. Payment of shipping charges is discussed in the next section of this warranty.

How to Obtain Warranty Performance
If your JBL product ever needs service, write or telephone us at JBL Incorporated (Attn: Customer Service Department), 8500 Balboa Boulevard, P.O. Box 2200, Northridge, California 91329 (818/893-8411). We may direct you to an authorized JBL Service Agency or ask you to send your unit to the factory for repair. Either way, you'll need to present the original bill of sale to establish the date of purchase. Please do not ship your JBL product to the factory without prior authorization.

If transportation of your JBL product presents any unusual difficulties, please advise us and we may make special arrangements with you. Otherwise, you are responsible for transporting your product for repair or arranging for its transportation and for payment of any initial shipping charges. However, we will pay the return shipping charges if repairs are covered by the warranty.

Limitation of Implied Warranties

ALL IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE LENGTH OF THIS WARRANTY.

EXCLUSION OF CERTAIN DAMAGES

JBL'S LIABILITY IS LIMITED TO THE REPAIR OR REPLACEMENT, AT OUR OPTION, OF ANY DEFECTIVE PRODUCT AND SHALL NOT INCLUDE INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS AND/OR DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS AND EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

NOTE: There may be a difference between this Warranty and the Warranty in your Instruction Manual. In the event of a difference, this Warranty will prevail.

JBL Incorporated
59660 9/84 8500 Balboa Blvd., P.O. Box 2200, Northridge, California 91329

LSR 28P Bi-Amplifier
Bill of Materials

JBL

Document #	Revision
900-00022	G

Level	Qty.	Reference	JBL P/N			Dwg. No.	Description	UOM	Manufacturer	Mfr. Part #	S/C
1.	**1**		**226**	**00013**	**00**	**226-00013**	**Power Amplifier Assembly**	**EA**			
1. 1.	1		921	00009	00	921-00009	CANOE CLIP, BINDER HD, BLACK	EA	FASTEX	254-080845-00-0108	E
1. 2.	1		385	00060	10	385-00060	PORTED HEATSINK, LSR, BLACK (DIE CAST)	EA			C
1. 3.	.35		460	00009	00	460-00009	Heatsink, Thermal Joint Compound (Note 1)	GR	Thermalloy	249 (1oz tube), 252 (5lbs)	M
1. 4.	5		472	00000	00	472-00000	INSULATOR, MICA, TO3-P (SUPPLIED W/OUTPUTS) *Note 5*	EA	Toshiba	AC-262-P50	E
1. 5.	1		701	90000	04	701-90000	Screw,4-40 X 1/4 W/Sq-cone washer,Pan,Ph,Zinc	EA			M
1. 6.	11		701	90001	06	701-90001	Screw,4-40 X 3/8 W/Sq-cone washer,Pan,Ph,Zinc	EA			M
1. 7.	1		701	90002	10	701-90001	Screw,4-40 X 5/8 W/Sq-cone washer,Pan,Ph,Zinc	EA			M
1. 8.	1		800	20000	00	800-00000	Nut, 4-40, Hex, Washer Base, Zinc, L.C.S.	EA			M
1. 9.	1		840	90000	03	840-90000	WASHER, #4, SHOULDER, BLACK, NYLON, .031 TALL	EA	Keystone	3049	M
1. 10.	1		844	00197	02		Washer, #4 X .26 - .46 OD X .010 - .031 Tall, Flat, Nylon, Mica or Fiber	EA			M
1. 11.	3.00E-04		910	00003	00	910-00003	Adhesive, low strength metal Thread locking (Note 2)	GR	Locktite Corp	22221 (10ml),22241 (250ml)	E
1. 12.	**1**		**513**	**00038**	**00**	**513-00038**	**PCB, FINAL, Main Board**	**EA**			**C**
1. 12. 1.	REF		500	00042		500-00042	Schematic, Main Board, LSR 28P	N/A			
1. 12. 2.	REF		054	000032		05400032.ZIP	GERBER FILES, MAIN BOARD	N/A			
1. 12. 3.	1		510	00032	B	510-00032	PCB-Raw, LSR main board	EA			M
1. 12. 4.	1	J7	424	00024	00	424-00023	CONN, SHROUDED HEADER, VERT, 3-PIN, .100", PCB	EA	Molex	22-43-8030	E
1. 12. 5.	1	J3	424	00029	00	424-00023	CONN, SHROUDED HEADER, VERT, 8-PIN, .100", PCB	EA	Molex	22-43-8080	E
1. 12. 6.	1	J6	424	00065	00	424-00065	CONN,MINI-FIT JR, HEADER, 1X3, PCB	EA	Molex	39-30-2035	E
1. 12. 7.	.1		460	00009	00	460-00009	Heatsink, Thermal Joint Compound (Note 1)	GR	Thermalloy	249 (1oz tube), 252 (5lbs)	M
1. 12. 8.	1		460	00010	00	460-00010	Heatsink, Formed, Bridge Sink	EA			M
1. 12. 9.	1	SW1	548	00015	00	548-00004	SW, THERM, CLOSE AT 90C, 67F090, TO-220/2	EA	Phillips, Airpax	67F090	E
1. 12. 10.	1	GND	560	00000	00	560-00000	TERM, .250" FASTON, MALE, PCB TAB	EA	Amp	63824-1	M
1. 12. 11.	1	C38	600	03475	60	600-00000	CAP, ELEC, 85C, 25V, 4.7uF, 20%, RADIAL	EA	Panasonic		
1. 12. 12.	6	C3 C4 C7 C8 C24 C29	600	04226	60	600-00000	CAP, ELEC, 85C, 35V, 22uF, 20%, RADIAL	EA	Panasonic	ECE-A1VU220B	M
									Surge	SSG35V220M	
1. 12. 13.	1	C33	600	05105	60	600-00000	CAP, ELEC, 85C, 50V, 1.0UF, 20%, RADIAL	EA	Panasonic	ECE-A1HU010B	M
1. 12. 14.	3	C26 C34 C37	600	05106	60	600-00000	CAP, ELEC, 85C, 50V, 10UF, 20%, RADIAL	EA	Panasonic	ECE-A1HU100B	M
			600	04106	60		Or 35V equivalent		Surge	SSG35V100M	
1. 12. 15.	4	C6 C9 C10 C15	600	06227	60	600-00000	CAP, ELEC, 85C, 63V, 220uF, 20%, RADIAL	EA	Panasonic	ECE-A1JU221B	M
									Surge	SSG63V221M	
1. 12. 16.	1	C31	603	00107	60	603-00000	CAP, ELEC, NP, 6.3V, 100uF, 20%, RADIAL	EA	Panasonic	ECE-A0JN101SB	M
									Surge	SNR6R3V101M	
1. 12. 17.	2	C16 C17	604	06109	60	604-06828	CAP, ELEC, LARGE, 85C, 63V, 10,000UF, 20%, PCB	EA	Panasonic	ECO-S1JP103EA	M
1. 12. 18.	5	C12 C13 C14 C18 C19	607	20104	50	607-20000	CAP, MFILM, 250V, .1uF, 5%, RADIAL, *note6*	EA	Panasonic	ECQ-E2104JSB	M
									Surge	SRM250V104JL-7.5	
1. 12. 19.	1	C23	608	05103	50	608-05000	CAP, SMFILM, 50V, .010uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H103JL3	M
1. 12. 20.	4	C1 C20 C21 C27	608	05104	50	608-05000	CAP, SMFILM, 50V, .10uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H104JL3	M
1. 12. 21.	1	CY1	608	05124	50	608-05000	CAP, SMFILM, 50V, .12uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H124JLW	M
									Nissei	MMT124J50B	
1. 12. 22.	1	C22	608	05223	50	608-05000	CAP, SMFILM, 50V, .022uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H223JLW	M
1. 12. 23.	1	CX1	608	05563	50	608-05000	CAP, SMFILM, 50V, .056uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H563JLW	M
1. 12. 24.	2	C28 C36	608	08104	50	608-05000	CAP, SMFILM, 100V, .10uF, 5%, RADIAL	EA	Panasonic	ECQ-V1104JMW	M
1. 12. 25.	2	C11 C25	610	20104	00	610-20000	CAP, MPROP, 250V, .1uF, 10%, HI-RIPPLE, RADIAL	EA	Cornell Dublier	DPM2P1K	M
									Farad Electronics	PPD250P10K0	
1. 12. 26.	1	C35	613	08221	50	613-08005	CAP, CERAMIC, 100V, 220pF, 5%, RADIAL	EA			
1. 12. 27.	3	C2 C5 C30	613	08271	50	613-29001	CAP, CERAMIC, 100V, 270pF, 5%, RADIAL	EA			M
			613	29271	51		CAP, CERAMIC, 500V, 270pF, 5%, Y5E, RADIAL		Nicola	L5Y5E4B271J	

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1. 12. 28.	1	C32	613	08680	50	613-29005	CAP, CERAMIC, 100V, 68pF, 5%, NPO, RADIAL	EA	Nicola	EC215-680CLTB	M
			613	29680	50		CAP, CERAMIC, 500V, 68pF, 5%, NPO, RADIAL		Nicola	L8NPO4B680J	
1. 12. 29.	2	RXB1 RYB1	630	20000	50	630-20000	RES, CF, 1/8W, ZERO, 5%	EA			M
1. 12. 30.	1	R52	630	21001	50	630-20000	RES, CF, 1/8W, 1K, 5%	EA			M
1. 12. 31.	1	R13	630	21501	50	630-20000	RES, CF, 1/8W, 1.5K, 5%	EA			M
1. 12. 32.	2	R12 R46	630	21801	50	630-20000	RES, CF, 1/8W, 1K8, 5%	EA			M
1. 12. 33.	2	R42 R44	630	21901	51	630-20000	RES, CF, 1/8W, 9K1, 5%	EA			M
1. 12. 34.	1	R51	630	22002	50	630-20000	RES, CF, 1/8W, 20K, 5%	EA			M
1. 12. 35.	5	R15 R17 R47 R54 R56	630	22202	50	630-20000	RES, CF, 1/8W, 22K, 5%	EA			M
1. 12. 36.	2	R34 R39	630	22703	50	630-20000	RES, CF, 1/8W, 270K, 5%	EA			M
1. 12. 37.	1	R31	630	23000	50	630-20000	RES, CF, 1/8W, 300, 5%	EA			M
1. 12. 38.	2	R40 R41	630	24706	50	630-20000	RES, CF, 1/8W, 47, 5%	EA			M
1. 12. 39.	3	R43 R45 R48	630	26200	50	630-20000	RES, CF, 1/8W, 620, 5%	EA			M
1. 12. 40.	1	R37	630	26803	50	630-20000	RES, CF, 1/8W, 680K, 5%	EA			M
1. 12. 41.	1	R14	630	28200	50	630-20000	RES, CF, 1/8W, 820, 5%	EA			M
1. 12. 42.	8	R36 R38 R49 R55 R57 R58 R61 R65	631	21002	10	631-20000	RES, MF, 1/8W, 10K, 1%	EA			M
1. 12. 43.	1	R64	631	21003	10	631-20000	RES, MF, 1/8W, 100K, 1%	EA			M
1. 12. 44.	1	R33	631	21301	10	631-20000	RES, MF, 1/8W, 1.3K, 1%	EA			M
1. 12. 45.	1	R62	631	21402	10	631-20000	RES, MF, 1/8W, 14.0K, 1%	EA			M
1. 12. 46.	2	R11 R21	631	21500	10	631-20000	RES, MF, 1/8W, 150, 1%	EA			M
1. 12. 47.	3	R35 R60 R63	631	21502	10	631-20000	RES, MF, 1/8W, 15K, 1%	EA			M
1. 12. 48.	1	R50	631	22211	10	631-20000	RES, MF, 1/8W, 2.21K, 1%	EA			M
1. 12. 49.	2	R28 R30	631	23241	10	631-20000	RES, MF, 1/8W, 3.24K, 1%	EA			M
1. 12. 50.	1	R59	631	23321	10	631-20000	RES, MF, 1/8W, 3.32K, 1%	EA			M
1. 12. 51.	1	RZ1	631	23921	10	631-20000	RES, MF, 1/8W, 3.92K, 1%	EA			M
1. 12. 52.	2	R22 R29	631	24640	10	631-20000	RES, MF, 1/8W, 464, 1%	EA			M
1. 12. 53.	4	R9 R10 R19 R20	631	26342	10	631-20000	RES, MF, 1/8W, 63.4K, 1%	EA			M
1. 12. 54.	1	R53	631	27500	10	631-20000	RES, MF, 1/8W, 750, 1%	EA			M
1. 12. 55.	1	R4	632	51006	50	632-40000	RES, MOF, 1W, 10, 5%	EA			M
1. 12. 56.	2	R18 R26	632	55101	50	632-40000	RES, MOF, 1W, 5.1K, 5%	EA			M
1. 12. 57.	2	R32 R27	632	71006	50	632-40000	RES, MOF, 3W, 10, 5%	EA			M
1. 12. 58.	4	R6 R8 R23 R25	632	71008	50	632-40000	RES, MOF, 3W, .10, 5%	EA			M
1. 12. 59.	2	R7 R24	633	31000	50	633-30000	RES, FUSE, 1/4W, 100, 5%	EA			M
1. 12. 60.	4	R1 R2 R3 R5	633	32207	50	633-30000	RES, FUSE, 1/4W, 2.2, 5%	EA			M
1. 12. 61.	1	R16	660	00013	00	660-00011	RES, 5mm TRIM, CERMET, VERT, 1/2W, 500	EA	Panasonic	EVM-MAGA01B52	E
									C & K	TR06P501	
1. 12. 62.	7	D3 D16 D17 D18 D19 D20 D21	675	00000	00	675-00000	SEMI, DIODE, SIG, 75V, 200mA, 1N4148, DO-35	EA	Toshiba, Taitron, Surge	1N4148	M
1. 12. 63.	2	D2 D4	675	00001	00	675-00001	SEMI, DIODE, SIG, 250V, 200mA, 1SS142, DO-35	EA	Rohm	1SS142	M
1. 12. 64.	7	D8 D9 D10 D11 D12 D14 D15	676	00003	00	676-00000	SEMI, DIODE, RECT, 400V, 1A, 1N4004, DO-41	EA	Motorola, Surge	1N4004	M
1. 12. 65.	1	D13	676	00016	00	676-00015	SEMI, DIODE, BRIDGE, 200V, 15A, KBPC1502W, KBPC-W	EA	Surge, Liteon, Diodes Inc.,Collmer Semi.	KBPC1502W	M
1. 12. 66.	2	D1 D7	677	00060	00	677-00043	SEMI, DIODE, ZENER, 16V, 1W, 1N4745A, DO-41	EA	Diodes Inc., Surge	1N4745A	M
1. 12. 67.	2	D5 D6	678	00007	00	678-00006	SEMI, DIODE, LED, GREEN, DIFF, RND, 3MM, VERT	EA	P-tec	PL03-CD-P	E
1. 12. 68.	1	D22	678	00013	00	678-00013	LED Lamp-T1, Bi-Color, R/G, RND, 3MM	EA	Kingbright	L-3WSRSGW-CC	E
1. 12. 69.	5	Q10 Q14 Q15 Q17 Q12	680	00007	00	680-00007	SEMI, X-ISTOR, PNP, SIG, 2SA1370, SC-51	EA	Sanyo	2SA1370	E
1. 12. 70.	2	Q11 Q13	680	00008	00	680-00007	SEMI, X-ISTOR, NPN, SIG, 2SC3467, SC-51	EA	Sanyo	2SC3467	E
1. 12. 71.	3	Q16 Q18 Q19	680	00010	00	680-00009	SEMI, X-ISTOR, NPN, SIG, 2SC2362K, TO-92	EA	Sanyo	2SC2362K	E
1. 12. 72.	3	Q1 Q2 Q3	682	00006	00	682-00006	SEMI, TRANSISTOR, NPN, PWR, 2SD1763A, TO-220FP	EA	Rohm	2SD1763A	M

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1. 12. 73.	2	Q4 Q5	682	00007	00	682-00007	SEMI, TRANSISTOR, PNP, PWR, 2SB1186A, TO-220FP	EA	Rohm	2SB1186A	M
1. 12. 74.	2	Q8 Q9	682	00010	00	682-00010	SEMI, TRANSISTOR, PNP, PWR, 2SA1302, TO-3P(L) *Note 5*	EA	Toshiba	2SA1302	M
1. 12. 75.	2	Q6 Q7	682	00011	00	682-00011	SEMI, TRANSISTOR, NPN, PWR, 2SC3281, TO-3P(L) *Note 5*	EA	Toshiba	2SC3281	M
1. 12. 76.	1	U1	684	00003	00	684-00003	SEMI, IC-ANA, NJM4560D, DUAL OP-AMP, DIP-8	EA	NJRC	NJM4560D	M
1. 12. 77.	1	U3	684	00006	00	684-00006	SEMI, IC-ANA, NJM2901N, QUAD COMP, DIP-14	EA	NJRC	NJM2901N	M
1. 12. 78.	1	U2	684	00015	00	684-00015	SEMI, IC-ANA, LM3886T, 150W AUDIO AMP, TA11B	EA	National Semi	LM3886T	M
1. 12. 79.	1		704	41100	12	701-41000	Screw, 10-32 X 3/4, Pan, Ph, Zinc, L.C.S.	EA			M
1. 12. 80.	1		803	30100	00	800-30000	Nut, 10-32, K Lock, Zinc, L.C.S.	EA			M
1. 12. 81.	1		910	00001	00	910-00001	Adhesive, clear RTV (Note 4)	GR			M
1. 12. 82.	5.00E-05		910	00004	00	910-00004	Adhesive, low strength plastic Thread locking (Note 3)	GR	Locktite Corp	42540 (20ml),42561 (1lb)	E
1. 12. 83.	**1**		**256**	**00047**	**01**	**256-00047**	**Cable Ass'y, LED, LSR 28P**	**EA**			**C**
1. 12. 83. 1.	1		424	00038	00	424-00037	CONN, SPRING-BOX, 3-PIN, .100", IDC	EA	Molex	22-43-3030	E
1. 12. 83. 2.	18		580	22400	00	580-00000	Wire, Stranded, 24 AWG, Black, UL1007	IN			M
1. 12. 83. 3.	18		580	22420	00	580-00000	Wire, Stranded, 24 AWG, Red, UL1007	IN			M
1. 12. 83. 4.	18		580	22490	00	580-00000	Wire, Stranded, 24 AWG, White, UL1007	IN			M
1. 12. 83. 5.	2		925	00001	00	925-00001	Cable, Tie, Nylon, .1W X 4.5L	EA	Richco	WIT-18R	M
1. 12. 84.	**1**	**J4 J5**	**256**	**00051**	**00**	**256-00051**	**Cable Ass'y, Hi-Freq, Speaker Leads, LSR28P**	**EA**			**C**
1. 12. 84. 1.	18		580	21890	00	580-00000	Wire, Stranded, 18 AWG, White, UL1007	IN			M
1. 12. 84. 2.	1		560	00006	00	560-00006	TERM,Faston,.110 X .020,Fem,Un-ins,22-18 AWG	EA	Amp	2-520125-2,2-520124-2 (reel)	M
1. 12. 84. 3.	18		580	21860	00	580-00000	Wire, Stranded, 18 AWG, Blue, UL1007	IN			M
1. 12. 84. 4.	1		560	00004	00	560-00004	TERM,Faston,.205 X .020,Fem,Un-ins,22-18 AWG	EA	Amp		M
1. 12. 84. 5.	16		580	21654	10	580-00000	Wire, Stranded, 16 AWG, Green/Yellow, UL1015	IN			M
1. 12. 84. 6.	1		560	00020	00	560-00002	TERM, #6 RING, INTERNAL TOOTH	EA	Amp 61793-1 or	Keystone 7312	E
1. 12. 84. 7.	3		560	00001	00	560-00001	TERM, AMP-IN, 18-14AWG	EA	Amp	770060-1	E
1. 12. 84. 8.	2		925	00001	00	925-00001	Cable, Tie, Nylon, .1W X 4.5L	EA	Richco	WIT-18R	M
1. 12. 85.	**1**	**J1 J2**	**256**	**00052**	**00**	**256-00052**	**Cable Ass'y, Lo-Freq, Speaker Leads**	**EA**			**C**
1. 12. 85. 1.	18		580	21600	10	580-00000	Wire, Stranded, 16 AWG, Black, UL1015	IN			M
1. 12. 85. 2.	1		560	00007	00	560-00007	TERM,Faston,.187 X .032,Fem,Full-ins,22-18 AWG	EA	Amp	2-520820-2,2-520819-2 (reel)	M
1. 12. 85. 3.	18		580	21620	10	580-00000	Wire, Stranded, 16 AWG, Red, UL1015	IN			M
1. 12. 85. 4.	2		560	00003	00	560-00003	TERM,Faston,.250 X .032,Fem,Un-ins,22-18 AWG	EA	Amp		M
1. 12. 85. 5.	18		580	21654	10	580-00000	Wire, Stranded, 16 AWG, Green/Yellow, UL1015	IN			M
1. 12. 85. 6.	3		560	00001	00	560-00001	TERM, AMP-IN, 18-14AWG	EA	Amp	770060-1	E
1. 12. 85. 7.	2		925	00001	00	925-00001	Cable, Tie, Nylon, .1W X 4.5L	EA	Richco	WIT-18R	M
1. 13.	**1**		**226**	**00012**	**00**	**226-00012**	**Input Electronics Assembly**	**EA**			**C**
1. 13. 1.	1		440	00017	00	440-00017	Signal Input Panel, LSR 28P, Finished and Silk Screened	EA	Mida Metal		M
1. 13. 2.	1		701	11010	06	700-00000	Screw, 4-40 x 3/8, Flat, Phil, Black Zinc	EA			M
1. 13. 3.	6		701	41110	08	700-00000	Screw, 4-40 x 1/2, Pan, Ph, Black Zinc	EA			M
1. 13. 4.	2		701	41810	10	700-00000	Screw, M3 x 10 mm, Pan, Ph, Black, LCS	EA			M
1. 13. 5.	2		800	00000	00	800-00000	Nut, 4-40, Hex, Zinc, L.C.S.	EA			M
1. 13. 6.	6		800	36000	00	800-00000	Nut, Hex, 4-40, With nylon insert	EA			M
1. 13. 7.	1		885	00043	00	885-00043	INPUT JACK COVER, LSR28P	EA			
1. 13. 8.	1		923	00016	00	923-00016	SWITCH CAP, POWER, LSR	EA	E-Switch	TAG BLACK	E
1. 13. 9.			**513**	**00037**	**00**	**513-00037**	**PCB Signal Input, LSR 28P**	**EA**			**C**
1. 13. 9. 1.	REF.		500	00043		500-00043	Schematic, Signal Input, LSR 28P	N/A			
1. 13. 9. 2.	REF.		054	00037		05400037.ZIP	Gerber Files, Signal Input, LSR 28P	N/A			
1. 13. 9. 3.	1		510	00037	00	510-00037	PCB Raw, Signal Input, LSR 28P	EA			M
1. 13. 9. 4.	**1**		**256**	**00054**	**02**	**256-00054**	**Cable Ass'y**	**EA**			**C**
1. 13. 9. 4. 1.	1		560	00001	00	560-00001	TERM, AMP-IN, 18-14AWG	EA	Amp	770060-1	E

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1. 13. 9. 4. 2.	1		560 00020 00	560-00002	TERM, #6 RING, INTERNAL TOOTH	EA	Amp	61793-1	E
1. 13. 9. 4. 3.	3.25		580 21654 10	580-00000	Wire, Stranded, 16 AWG, Green/Yellow, UL1015	IN			M
1. 13. 9. 5.	1	P4	424 00029 00	424-00023	CONN, SHROUDED HEADER, VERT, 8-PIN, .100", PCB	EA	Molex	22-43-8080	
1. 13. 9. 6.	1	S1	424 00079 01	424-00079	CONN, IEC, AC POWER	EA	Switchcraft	EAC333	E
							Schurter	GSP1.4107.1	
							PDI	42R65	
1. 13. 9. 7.	1	S2	424 00080 01	424-00080	CONN, XLR COMBO 1/4 PHONE JACK, HORIZONTAL MOUNT	EA	Neutrik	NCJ6FK-H	E
1. 13. 9. 8.	1	P2	424 00090 00	424-00090	Conn, Disk Drive PWR VERTICAL HEADER, 1X4, PCB	EA	Molex	15-24-4049	
1. 13. 9. 9.	1	F1	452 00003 01	452-00001	Fuseholder, Body Only, PCB Mount	EA	Littlefuse	345101-010	E
1. 13. 9. 10.	1	SW3	546 00004 00	546-00004	SW, Power, Push Button, Panel Mount, DPST, PCB	EA	E-Switch	P227EE1C	E
1. 13. 9. 11.	1	SW2	546 00005 00	546-00005	SW, Voltage Selector, 120V / 230V, DPDT, UL/CSA, PCB	EA	C & K Clayton Div.	V802-12MA08Q	E
							Marquardt	4021.4723	
1. 13. 9. 12.	1	Q1	548 00017 00	548-00017	SEMI, TRANSISTOR, J-FET N, SWITCH, J113, TO-92	EA	Motorola, Taitron, Fairchild, National	J113	M
1. 13. 9. 13.	1	SW1	548 00018 01	548-00018	SW, DIP, 8 WAY, SPST, RIGHT ANGLE	EA	C & K Newton Div.	BD08AV2	E
							APEM	DA-08	
							E-Switch	KAS2108E	
							Lamb	DA-08	
1 13. 9. 14.	1	GND	560 00000 00	560-00000	TERM, .250" FASTON, MALE, PCB TAB	EA	Amp	63824-1	M
1. 13. 9. 15.	6	C17 C18 C23 C24 C33 C34	600 04106 60	600-00000	CAP, ELEC, 85C, 35V, 10uF, 20%, RADIAL	EA	Panasonic	ECE-A1VU100B	M
			600 05106 60		or 50V equivalent		Surge	SSG35V100M	
							Taitron	TNR10M35	
1. 13. 9. 16.	3	C19 C20 C38	603 03106 60	603-00000	CAP, ELEC, NP, 25V, 10uF, 20%, RADIAL	EA	Panasonic	ECE-A1EN100SB	M
							Surge	SNR25V100M	
							Taitron	TNR10M25	
1. 13. 9. 17.	5	C1 C2 C3 C37 C47	606 05102 50	606-05000	CAP, FILM, 50V, .0010uF, 5%, RADIAL	EA	Panasonic	ECQ-B1H102JF3	M
1. 13. 9. 18.	1	C14	606 05221 00	606-05000	CAP, FILM, 50V, 220pF, 10%, RADIAL	EA	Panasonic	ECQ-B1H221KFW	M
1. 13. 9. 19.	6	C5 C25 C29 C43 C44 C46	606 05472 50	606-05000	CAP, FILM, 50V, .0047uF, 5%, RADIAL	EA	Panasonic	ECQ-B1H472JF3	M
1. 13. 9. 20.	3	C9 C22 C26	608 05103 50	608-05000	CAP, SMFILM, 50V, .01uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H103JF3	M
1. 13. 9. 21.	2	C12 C39	608 05104 50	608-05000	CAP, SMFILM, 50V, .10uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H104JL3	M
1. 13. 9. 22.	2	C36 C42	608 05223 50	608-05000	CAP, SMFILM, 50V, .022uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H223JLW	M
							Nissei	MMT223J50B	
1. 13. 9. 23.	3	C4 C6 C10	608 05224 50	608-05000	CAP, SMFILM, 50V, .22uF, 5%, RADIAL	EA	Panasonic	ECQ-V1H224JLW	M
							Nissei	MMT224J50B	
1. 13. 9. 24.	8	C11 C15 C21 C45 C48 C50 C51 C52	613 08101 60	613-08005	CAP, CERAMIC, 100V, 100pF, 20%, RADIAL	EA			M
1. 13. 9. 25.	1	C28	613 08270 50	613-08005	CAP, CERAMIC, 100V, 27pF, 5%, NPO, RADIAL	EA	Tecate	CMR-100/270JN15T	M
					CAP, CERAMIC, 100V, 27pF, 5%, RADIAL		Nicola	EC215-270CLTB	
			613 05270 50		CAP, CERAMIC, 50V, 27pF, 5%, RADIAL				
1. 13. 9. 26.	1	C49	613 08301 51	613-08001	CAP, CERAMIC, 100V, 300pF, 10%, Y5E, RADIAL	EA			M
1. 13. 9. 27.	3	C16 C27 C35	613 08470 50	613-08005	CAP, CERAMIC, 100V, 47pF, 5%, NPO, RADIAL	EA	Tecate	CMR-100/470JN15	M
					CAP, CERAMIC, 100V, 47pF, 5%, RADIAL		Nicola	EC215-470CLTB	
					CAP, CERAMIC, 100V, 47pF, 5%, RADIAL		Taitron	TCDS470J100NPOB	
			613 05470 50		CAP, CERAMIC, 50V, 47pF, 5%, RADIAL				
1. 13. 9. 28.	2	C7 C8	613 55102 60	613-55000	CAP, CERAMIC, ACROSS-THE-LINE, 250VAC, 1000pF, 20%, RADIAL	EA	Panasonic	ECK-ATS102MB	S
								ECK-DNA102MB	
								ECK-DNB102MB	
							Welson	KL11B102MAC400V	
1. 13. 9. 29.	3	C30 C31 C32	613 55103 70	613-55000	CAP, CERAMIC, ACROSS-THE-LINE, 250VAC, .01uF,	EA	Panasonic	ECK-ATS103MF	S

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Level	Qty.	Reference	JBL P/N	Dwg. No.	Description	UOM	Manufacturer	Mfr. Part #	S/C
					+80/-20%, Radial			ECK-DNA103ZV	
								ECK-DNB103ZV	
							Welson	KL16FZ103ZAC400V	
1. 13. 9. 30.	5	C13 C40 C41 C53 C54	626 00001 00	600-00000	CAP, CERAMIC, MONOLITHIC, 50V, .10uF, 20%, Radial	EA	Tecate	CMR-050/104 MZ27B	M
							Taitron	TMRS104K50X7RB-42-B	
1. 13. 9. 31.	1	R2	631 21000 10	631-20000	RES, MF, 1/8W, 100, 1%	EA			M
1. 13. 9. 32.	8	R8 R24 R36 R39 R44 R77 R78 R80	631 21001 10	631-20000	RES, MF, 1/8W, 1.0K, 1%	EA			M
1. 13. 9. 33.	1	R33	631 21131 10	631-20000	RES, MF, 1/8W, 1.13K, 1%	EA			M
1. 13. 9. 34.	1	R76	631 21132 10	631-20000	RES, MF, 1/8W, 11.3K, 1%	EA			M
1. 13. 9. 35.	1	R5	631 21181 10	631-20000	RES, MF, 1/8W, 1.18K, 1%	EA			M
1. 13. 9. 36.	4	R68 R73 R81 R83	631 21272 10	631-20000	RES, MF, 1/8W, 12.7K, 1%	EA			M
1. 13. 9. 37.	1	R22	631 21332 10	631-20000	RES, MF, 1/8W, 13.3K, 1%	EA			M
1. 13. 9. 38.	2	R14 R28	631 21403 10	631-20000	RES, MF, 1/8W, 140K, 1%	EA			M
1. 13. 9. 39.	2	R63 R71	631 21501 10	631-19999	RES, MF, 1/8W, 1.5K, 1%	EA			M
1. 13. 9. 40.	1	R79	631 21542 10	631-20000	RES, MF, 1/8W, 15.4K, 1%	EA			M
1. 13. 9. 41.	1	R38	631 21582 10	631-20000	RES, MF, 1/8W, 15.8K, 1%	EA			M
1. 13. 9. 42.	1	R19	631 21652 10	631-20000	RES, MF, 1/8W, 16.5K, 1%	EA			M
1. 13. 9. 43.	1	R53	631 21742 10	631-20000	RES, MF, 1/8W, 17.4K, 1%	EA			M
1. 13. 9. 44.	1	R66	631 21781 10	631-20000	RES, MF, 1/8W, 1.78K, 1%	EA			M
1. 13. 9. 45.	1	R12	631 21912 10	631-20000	RES, MF, 1/8W, 19.1K, 1%	EA			M
1. 13. 9. 46.	2	R34 R50	631 22002 10	631-20000	RES, MF, 1/8W, 20K, 1%	EA			M
1. 13. 9. 47.	1	R70	631 22211 10	631-20000	RES, MF, 1/8W, 2.21K, 1%	EA			M
1. 13. 9. 48.	1	R31	631 22212 10	631-20000	RES, MF, 1/8W, 22.1K, 1%	EA			M
1. 13. 9. 49.	1	R45	631 22213 10	631-20000	RES, MF, 1/8W, 221K, 1%	EA			M
1. 13. 9. 50.	1	R23	631 22430 10	631-20000	RES, MF, 1/8W, 243, 1%	EA			M
1. 13. 9. 51.	1	R48	631 22431 10	631-20000	RES, MF, 1/8W, 2.43K, 1%	EA			M
1. 13. 9. 52.	1	R9	631 22742 10	631-20000	RES, MF, 1/8W, 27.4K, 1%	EA			M
1. 13. 9. 53.	1	R61	631 22802 10	631-20000	RES, MF, 1/8W, 28.0K, 1%	EA			M
1. 13. 9. 54.	1	R6	631 22941 10	631-20000	RES, MF, 1/8W, 2.94K, 1%	EA			M
1. 13. 9. 55.	4	R11 R15 R16 R52	631 23012 10	631-20000	RES, MF, 1/8W, 30.1K, 1%	EA			M
1. 13. 9. 56.	1	R46	631 23162 10	631-20000	RES, MF, 1/8W, 31.6K, 1%	EA			M
1. 13. 9. 57.	1	R17	631 23402 10	631-20000	RES, MF, 1/8W, 34.0K, 1%	EA			M
1. 13. 9. 58.	1	R72	631 23571 10	631-20000	RES, MF, 1/8W, 3.57K, 1%	EA			M
1. 13. 9. 59.	1	R57	631 23572 10	631-20000	RES, MF, 1/8W, 35.7K, 1%	EA			M
1. 13. 9. 60.	1	R65	631 23831 10	631-20000	RES, MF, 1/8W, 3.83K, 1%	EA			M
1. 13. 9. 61.	1	R74	631 23921 10	631-20000	RES, MF, 1/8W, 3.92K, 1%	EA			M
1. 13. 9. 62.	1	R49	631 24531 10	631-20000	RES, MF, 1/8W, 4.53K, 1%	EA			M
1. 13. 9. 63.	1	R58	631 24642 10	631-20000	RES, MF, 1/8W, 46.4K, 1%	EA			M
1. 13. 9. 64.	2	R25 R26	631 24751 10	631-20000	RES, MF, 1/8W, 4.75K, 1%	EA			M
1. 13. 9. 65.	3	R3 R7 R18	631 24753 10	631-20000	RES, MF, 1/8W, 475K, 1%	EA			M
1. 13. 9. 66.	6	R40 R41 R54 R55 R59 R60	631 24756 10	631-20000	RES, MF, 1/8W, 47.5, 1%	EA			M
1. 13. 9. 67.	2	R20 R21	631 25231 10	631-20000	RES, MF, 1/8W, 5.23K, 1%	EA			M
1. 13. 9. 68.	1	R62	631 25361 10	631-20000	RES, MF, 1/8W, 5.36K, 1%	EA			M
1. 13. 9. 69.	2	R27 R29	631 25621 10	631-20000	RES, MF, 1/8W, 5.62K, 1%	EA			M
1. 13. 9. 70.	2	R75 R82	631 25622 10	631-20000	RES, MF, 1/8W, 56.2K, 1%	EA			M
1. 13. 9. 71.	1	R30	631 26042 10	631-20000	RES, MF, 1/8W, 60.4K, 1%	EA			M
1. 13. 9. 72.	1	R67	631 26191 10	631-20000	RES, MF, 1/8W, 6.19K, 1%	EA			M
1. 13. 9. 73.	1	R13	631 26490 10	631-20000	RES, MF, 1/8W, 649, 1%	EA			M
1. 13. 9. 74.	1	R42	631 26651 10	631-20000	RES, MF, 1/8W, 6.65K, 1%	EA			M
1. 13. 9. 75.	1	R47	631 26810 10	631-20000	RES, MF, 1/8W, 681, 1%	EA			M

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Level	Qty.	Reference	JBL P/N	Dwg. No.	Description	UOM	Manufacturer	Mfr. Part #	S/C
1. 13. 9. 76.	1	R64	631 27681 10	631-20000	RES, MF, 1/8W, 7.68K, 1%	EA			M
1. 13. 9. 77.	1	R10	631 28060 10	631-20000	RES, MF, 1/8W, 806, 1%	EA			M
1. 13. 9. 78.	1	R69	631 28252 10	631-20000	RES, MF, 1/8W, 82.5K, 1%	EA			M
1. 13. 9. 79.	1	R51	631 29091 10	631-20000	RES, MF, 1/8W, 9.09K, 1%	EA			M
1. 13. 9. 80.	2	R37 R43	631 29531 10	631-20000	RES, MF, 1/8W, 9.53K, 1%	EA			M
1. 13. 9. 81.	1	R4	660 00027 00	660-00027	RES, TRIM POT, 500 Ohm, 10mm, Horiz Mount, Screwdriver Adjust	EA	Piher	PTC10LH05-501A2020	M
1. 13. 9. 82.	1	R56	660 00027 01	660-00027	RES, TRIM POT, 5K Ohm, 10mm, Horiz Mount, Screwdriver Adjust	EA	Piher	PTC10LH05-502A2020	M
1. 13. 9. 83.	1	R1	660 00027 02	660-00027	RES, TRIM POT, 50K Ohm, 10mm, Horiz Mount, Screwdriver Adjust	EA	Piher	PTC10LH05-503A2020	M
1. 13. 9. 84.	1	U3	680 00019 00	680-00019	Dual Op Amp, JFET, OP275, DIP8	EA	Analog Devices	OP275 GP	E
1. 13. 9. 85.	3	U1 U4 U8	684 00000 00	684-00000	SEMI, IC-ANA, NJM2068D, LOW NOISE DUAL, DIP-8	EA	NJRC	NJM2068D	E
1. 13. 9. 86.	4	U2 U5 U6 U7	684 00003 00	684-00003	SEMI, IC-ANA, NJM4560D, DUAL OP-AMP, DIP-8	EA	NJRC	NJM4560D	M
1. 14.			**513 00034 01**	**513-00034**	**Interface Board Assembly**				
1. 14. 1.	1		359 00071 06	359-00071	GASKET, FOAM	EA			E
1. 14. 2.	1	P1	424 00090 00	424-00090	Conn, Disk Drive PWR VERTICAL HEADER, 1X4, PCB	EA	Molex	15-24-4049	E
1. 14. 3.			**256 00044 01**	**256-00044**	**Cable Assembly Low Level Audio**	**EA**			
1. 14. 3. 1.	1		424 00043 00	424-00037	CONN, SPRING-BOX, 8-PIN, .100", IDC	EA	Molex	22-43-3080	E
1. 14. 3. 2.	1	S3	424 00057 00	424-00037	CONN, BOARD-IN, 8-PIN, .100", IDC	EA	Molex	22-43-2080	E
1. 14. 3. 3.	31.5		580 22400 00	580-00000	Wire, Stranded, 24 AWG, Black, UL1007	IN			M
1. 14. 3. 4.	4.5		580 22440 00	580-00000	Wire, Stranded, 24 AWG, Yellow, UL1007	IN			M
1. 14. 4.			**256 00045 01**	**256-00045**	**Cable Set AC Line. LSR28P**	**EA**			
1. 14. 4. 1.	4		560 00001 00	560-00001	TERM, AMP-IN, 18-14 AWG	EA	Amp	770060-1	E
1. 14. 4. 2.	5		580 21800 10	580-00000	Wire, Stranded, 18 AWG, Black, UL1015	IN			M
			580 21600 10		Wire, Stranded, 16 AWG, Black, UL1015				
1. 14. 4. 3.	5		580 21810 10	580-00000	Wire, Stranded, 18 AWG, Brown, UL1015	IN			M
			580 21610 10		Wire, Stranded, 16 AWG, Brown, UL1015				
1. 14. 4. 4.	5		580 21860 10	580-00000	Wire, Stranded, 18 AWG, Blue, UL1015	IN			M
			580 21660 10		Wire, Stranded, 16 AWG, Blue, UL1015				
1. 14. 4. 5.	5		580 21890 10	580-00000	Wire, Stranded, 18 AWG, White, UL1015	IN			M
			580 21690 10		Wire, Stranded, 16 AWG, White, UL1015				
1. 14. 4. 6.	1		424 00091 00	424-00091	CONN, DISK DRIVE PWR 1X4	EA	Molex	15-24-4048	
1. 14. 4. 7.	4		424 00091 01	424-00091	CONN, TERMINAL	EA	Molex	02-08-1201	M
			424 00091 02		CONN, TERMINAL		Molex	02-08-1202	
1. 14. 5.	**1**		**256 00048 01**	**256-00048**	**Audio/PSU Cable, LSR28P**				
1. 14. 5. 1.	1		424 00043 00	424-00037	CONN, SPRING-BOX, 8-PIN, .100", IDC	EA	Molex	22-43-3080	
1. 14. 5. 2.	1		424 00057 00	424-00037	CONN, BOARD-IN, 8-PIN, .100", IDC	EA	Molex	22-43-2080	E
1. 14. 5. 3.	63		580 22400 00	580-00000	Wire, Stranded, 24 AWG, Black, UL1007	IN			M
1. 14. 5. 4.	9		580 22440 00	580-00000	Wire, Stranded, 24 AWG, Yellow, UL1007	IN			M
1. 14. 5. 5.	3		925 00001 00	925-00001	Cable, Tie, Nylon, .1W X 4.5L	EA	Richco	WIT-18R	M
1. 14. 6.	**1**		**256 00053 01**	**256-00053**	**Cable Ass'y, Ground**	**EA**			**C**
1. 14. 6. 1.	1		560 00001 00	560-00001	TERM, AMP-IN, 18-14AWG	EA	Amp	770060-1	E
1. 14. 6. 2.	1		560 00010 00	560-00007	TERM,Faston,.250 X .032,Fem,Full-ins,16-14 AWG	EA	Amp	3-350820-2,3-350819-2 (reel)	E
1. 14. 6. 3.	12		580 21654 10	580-00000	Wire, Stranded, 16 AWG, Green/Yellow, UL1015	IN			M
1. 14. 7.	**1**		**256 00053 02**	**256-00053**	**Cable Ass'y, Ground**	**EA**			**C**
1. 14. 7. 1.	1		560 00001 00	560-00001	TERM, AMP-IN, 18-14AWG	EA	Amp	770060-1	E
1. 14. 7. 2.	1		560 00010 00	560-00007	TERM,Faston,.250 X .032,Fem,Full-ins,16-14 AWG	EA	Amp	3-350820-2,3-350819-2 (reel)	E
1. 14. 7. 3.	7		580 21654 10	580-00000	Wire, Stranded, 16 AWG, Green/Yellow, UL1015	IN			M

Definitions on Source Code Column

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SC = Source Code

C = Contractual single source of supply.

E = Engineering considerations dictate single source of supply.

M = Multiple sources acceptable (please consult our engineering staff to determine critical selection parameters).

S = Safety considerations dictate single source of supply.

Blank = Undefined at this time.

Note 1 = Used between D13 and heatsink (460-00010-00), on Q1- Q9, on SW1, U2 and on the 4 mica insulators (472-00000-00).

Note 2 = Used on threads of 3/8" 4-40 hardware (701-90001-06) and 1/4" 4-40 hardware (701-9000-06) that is used to secure Q6-Q9, U2 and SW1 to main heatsink (385-00060-00).

Note 3 = A small drop needs to be placed on VR16 (trimmer and body) after adjusting bias so bias will not drift with vibration.

Note 4 = RTV to be placed under C6, C9, C10, C15, C16, and C17 during assembly

Note 5 = Alternative output devices may be used in the Subwoofer design. Note that the output devices must be installed in pairs as shown below. Note that an alternative mica insulator needs to be used and is also listed with each alternativ

Note 6 = Approved 2nd sources for same value, type and tolerance specified herein are:

Capacitors: Aerovox, AVX, Kmet, Nicola, Nissei, Nichicon, Rubycon, Taitron, Transcend Electronic, Inc., United-Chemicon

Resistors: SEI, KOA, Taitron, Royal Ohm

Level	Qty.	Reference	JBL P/N			Dwg. No.	Description	UOM	Manufacturer	Mfr. Part #	S/C
Alternative output pair one.											
(1. 3. 50.)	2	Q8 Q9	682	00014	00	682-00014	SEMI, TRANSISTOR, PNP, PWR, 2SA1553, TO-3P(L)	EA	Toshiba	2SA1553	M
(1. 3. 51.)	2	Q6 Q7	682	00015	00	682-00014	SEMI, TRANSISTOR, NPN, PWR, 2SC4029, TO-3P(L)	EA	Toshiba	2SC4029	M
1. 3. 65.	4		472	00000	00	472-00000	INSULATOR, MICA, TO3-P (SUPPLIED W/TOSH OUTPUTS)	EA	Toshiba	AC-262-P50	E
Alternative output pair two.											
(1. 3. 50.)	2	Q8 Q9	682	00016	00	682-00016	SEMI, TRANSISTOR, PNP, PWR, 2SB1317, TO-3P(L)	EA	Panasonic	2SB1317	M
(1. 3. 51.)	2	Q6 Q7	682	00017	00	682-00016	SEMI, TRANSISTOR, NPN, PWR, 2SD1975, TO-3P(L)	EA	Panasonic	2SD1975	M
(1. 3. 65.)	4		472	00003	00	472-00003	INSULATOR, MICA, TO3-P / TO3-P(L)	EA	Thermalloy	56-02-101	E
Alternative output pair three.											
(1. 3. 50.)	2	Q8 Q9	682	00018	00	682-00018	SEMI, TRANSISTOR, PNP, PWR, 2SA1386, TO-3P	EA	Sanken	2SA1386	M
(1. 3. 51.)	2	Q6 Q7	682	00019	00	682-00018	SEMI, TRANSISTOR, NPN, PWR, 2SC3519, TO-3P	EA	Sanken	2SC3519	M
(1. 3. 65.)	4		472	00003	00	472-00003	INSULATOR, MICA, TO3-P / TO3-P(L)	EA	Thermalloy	56-02-101	E
Alternate output pair four.											
(1. 3. 50.)	2	Q8 Q9	682	00020	00	682-00020	SEMI, TRANSISTOR, PNP, PWR, 2SA1294, TO-3P	EA	Sanken	2SA1294	M
(1. 3. 51.)	2	Q6 Q7	682	00021	00	682-00020	SEMI, TRANSISTOR, NPN, PWR, 2SC3263, TO-3P	EA	Sanken	2SC3263	M
(1. 3. 65.)	4		472	00003	00	472-00003	INSULATOR, MICA, TO3-P / TO3-P(L)	EA	Thermalloy	56-02-101	E

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JBL PROFESSIONAL

SERVICE PROCEDURES

July 1, 1998

ELECTRONIC FAILURE CODES

The following codes are an expanded version of the existing electronic failure codes. These codes should be used for all electronics excluding networks in speaker enclosures. Network failures should continue to use the transducer failure codes. Please utilize these codes on every warranty claim submitted to JBL Professional. Exclusion of these codes will result in the return of warranty claims.

We have designed these codes to be as simple and self-explanatory as possible. The failures are categorized by component, of which there is a heading. The actual failures are listed under the headings, and that is the code that should be used. Should you have problems deciding which code to use, please contact JBL Professional Technical department.

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ELECTRONIC FAILURE
Q.A. CODES

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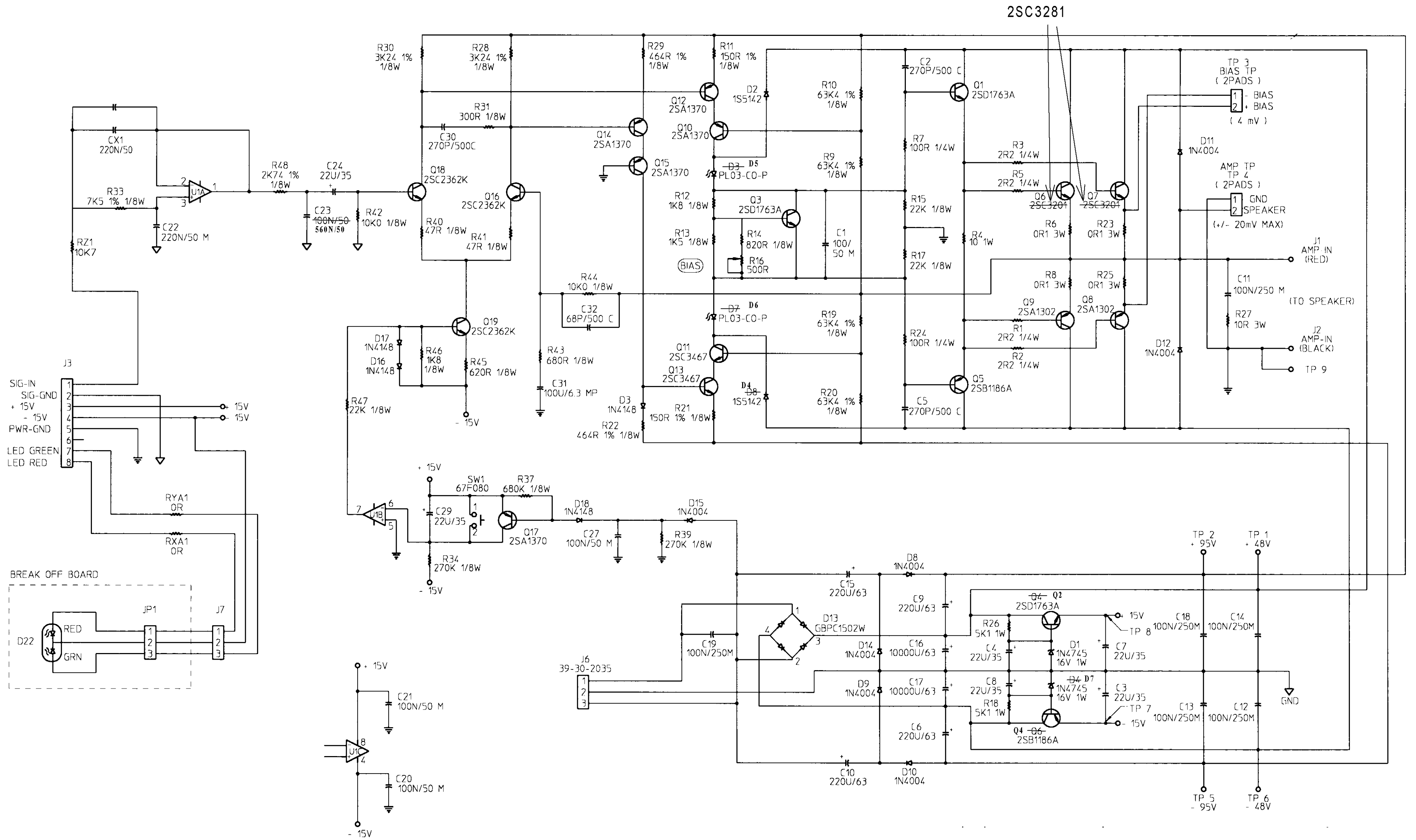
Q.A. CODE	DESCRIPTION OF DEFECT	WARRANTY STATUS	Q.A. CODE	DESCRIPTION OF DEFECT	WARRANTY STATUS
10.010	**IC (Specify)**		10.058	Capacitor - Value Changed	IN
10.011	IC - Open	IN	10.059	Capacitor - Broken	IN
10.012	IC - Burned *	OUT			
10.013	IC - Shorted	IN	**10.060**	**DIODE/RECTIFIER/BRIDGE (Specify)**	
10.014	IC - Thermally Sensitive	IN	10.061	Open	IN
10.015	Noisy	IN	10.062	Burned *	OUT
10.016	Not Secured to Heat Sink	IN	10.063	Shorted	IN
10.017	IC - Wrong Part (installed at factory)	IN	10.064	Thermally Sensitive	IN
			10.065	Wrong Part (installed at factory)	IN
10.020	**TRANSISTOR (Specify)**				
10.021	Transistor - Open	IN	**10.070**	**INDUCTOR (Specify)**	
10.022	Transistor - Burned *	OUT	10.071	Inductor - Open	IN
10.023	Transistor - Shorted	IN	10.072	Inductor - Burned	IN
10.024	Transistor - Thermally Sensitive	IN			
10.025	Transistor - Noisy	IN	**10.080**	**LED/LCD/VU METER (Specify)**	
10.026	Transistor - Not Secured to Heat Sink	IN	10.081	No Characters/Missing	IN
10.027	Transistor - Wrong Part	IN	10.082	No Back Light	IN
		IN	10.083	Broken	IN
10.030	**FET (Specify)**		10.084	Meter - Defective	IN
10.031	FET - Open	IN	10.085	Bezel - Broken	IN
10.032	FET - Burned *	OUT			
10.033	FET - Shorted	IN	**10.090**	**RELAY (Specify)**	IN
10.034	FET - Thermally Sensitive	IN	10.091	Relay - Intermittent	IN
10.035	FET - Noisy	IN	10.092	Relay - Will Not Engage	IN
10.036	FET - Not Secured to Heat Sink	IN	10.093	Relay - Pitted Contacts	IN
10.037	FET - Wrong Part	IN			IN
			10.100	**POTENTIOMETER (Specify)**	
10.040	**RESISTOR (Specify)**		10.101	Potentiometer - Dirty / Scratchy	IN
10.041	Resistor - Open	IN	10.102	Potentiometer - Open	IN
10.042	Resistor - Burned *	OUT	10.103	Potentiometer - Broken, Cracked	IN
10.043	Resistor - Shorted	IN	10.104	Potentiometer - Wrong Part (installed at factory)	IN
10.044	Resistor - Thermally Sensitive	IN			
10.045	Resistor - Noisy	IN	**10.110**	**SWITCH (Specify)**	
10.046	Resistor Pack Cracked	IN	10.111	Switch - Intermittent	IN
10.047	Resistor - Wrong Part	IN	10.112	Switch - Broken	IN
			10.113	Switch - Will Not Close	IN
10.050	**CAPACITOR (Specify)**		10.114	Switch - Noisy	IN
10.051	Capacitor - Open	IN			
10.052	Capacitor - Burned *	OUT	**10.120**	**FUSE (Specify)**	
10.053	Capacitor - Shorted	IN	10.121	Fuse - Open	IN
10.054	Capacitor - Thermally Sensitive	IN	10.122	Fuse - High Resistance	IN
10.055	Capacitor - Noisy	IN	10.123	Fuse - Wrong	IN
10.056	Capacitor - Leaky	IN	10.124	Fuse - Loose	IN
10.057	Capacitor - Dried Up	IN			

JBL PROFESSIONAL

ELECTRONIC FAILURE
Q.A. CODES

Q.A. CODE	DESCRIPTION OF DEFECT	WARRANTY STATUS	Q.A. CODE	DESCRIPTION OF DEFECT	WARRANTY STATUS
10.130	**CONNECTOR (Specify)**		10.192	Cables - Noisy	IN
10.131	Connector - Intermittent	IN	10.193	Cables - Cut - Partially Open	IN
10.132	Connector - Broken	IN	10.194	Cables - Connector Installed Wrong	IN
10.133	Connector - Missing Pins	IN	10.195	Cables - Burned	IN
10.134	Connector - Installed Backwards	IN			
10.135	Connector - Loose	IN	**10.200**	**Components/Touching Shorted**	
10.140	**PCB (Specify)**		**10.300**	**SOLDER PROBLEMS (Specify)**	
10.141	PCB - Broken Trace	IN	10.301	Cold Solder	IN
10.142	PCB - Burned Trace *	OUT	10.302	No Solder	IN
10.143	PCB - Cracked	IN	10.303	Splashes	IN
10.144	PCB - Bad Feedthrough/via	IN			
10.145	PCB - Chemical Damage	IN	**10.400**	**MECHANICAL – (Specify)**	
10.146	PCB - Exchange Amp Board	IN	10.401	Broken Binding post	IN
10.147	PCB - Exchange Signal Input Board	IN	10.402	Broken Fuse Holder	IN
10.148	PCB - Exchange DSP Board	IN	10.403	Open Line Cord	IN
10.149	PCB - Exchange A/C Input Board	IN	10.404	Broken/Missing Knob	IN
			10.405	Dented Chassis	OUT
10.150	**REGULATORS – (Specify)**		10.406	Damaged Front Panel	OUT
10.151	Regulators - Open	IN	10.407	Broken Fan	OUT
10.152	Regulators - Burned *	OUT	10.408	Stopped/ Slow Fan	IN
10.153	Regulators - Shorted	IN	10.409	Packing	IN
10.154	Regulators - Thermally Sensitive	IN	10.410	Noisy Fan	OUT
10.155	Regulators - Noisy	IN			
10.156	Regulators - Broken	IN	**10.500**	**SOFTWARE (Specify)**	
10.157	Regulators - Out of Regulation	IN	10.510	Upgrade Software	IN
10.158	Regulators - Wrong Part	IN	10.520	Upgrade Hardware	IN
			10.530	Reset to Factory Software	IN
10.160	**BULB/LAMP - (Specify)**				
10.161	Open	IN	**10.600**	**ADJUSTMENT (Specify)**	
			10.601	Adjust Voltage	IN
10.170	**TRANSFORMER - (Specify)**		10.602	Adjust Bias	IN
10.171	Transformer - Open	IN	10.603	Adjust Meter	IN
10.172	Transformer - Burned *	OUT	10.604	Adjust Chassis	IN
10.173	Transformer - Noisy	IN			
10.174	Transformer - Shorted	IN	**10.700**	**MISC/HARDWARE (Specify)**	
10.175	Transformer - Loose	IN	10.701	Screw - Missing (from factory)	IN
			10.702	Screw - Broken (from factory)	IN
10.180	**CRYSTAL - (Specify)**		10.703	Screw - Loose (from factory)	IN
10.181	Crystal - Dead	IN	10.704	No Problems Found	
10.182	Crystal - Wrong Frequency	IN	10.705	Return As Is	
10.183	Crystal - Thermally Sensitive	IN	10.706	Customer Attempted Repairs	OUT
			10.707	Received in for Repairs Missing Parts	OUT
10.190	**CABLES - (Specify)**			***COULD BE CONSIDERED IN-WARRANTY AS**	
10.191	Cables - Open	IN		**DETERMINED BY TECHS EVALUATION**	

8 7 6 5 4 3



2. U1 : NJM 4560D

1. THE SCHEMATIC CORESPONDS TO RAW PCB 510-00032-00

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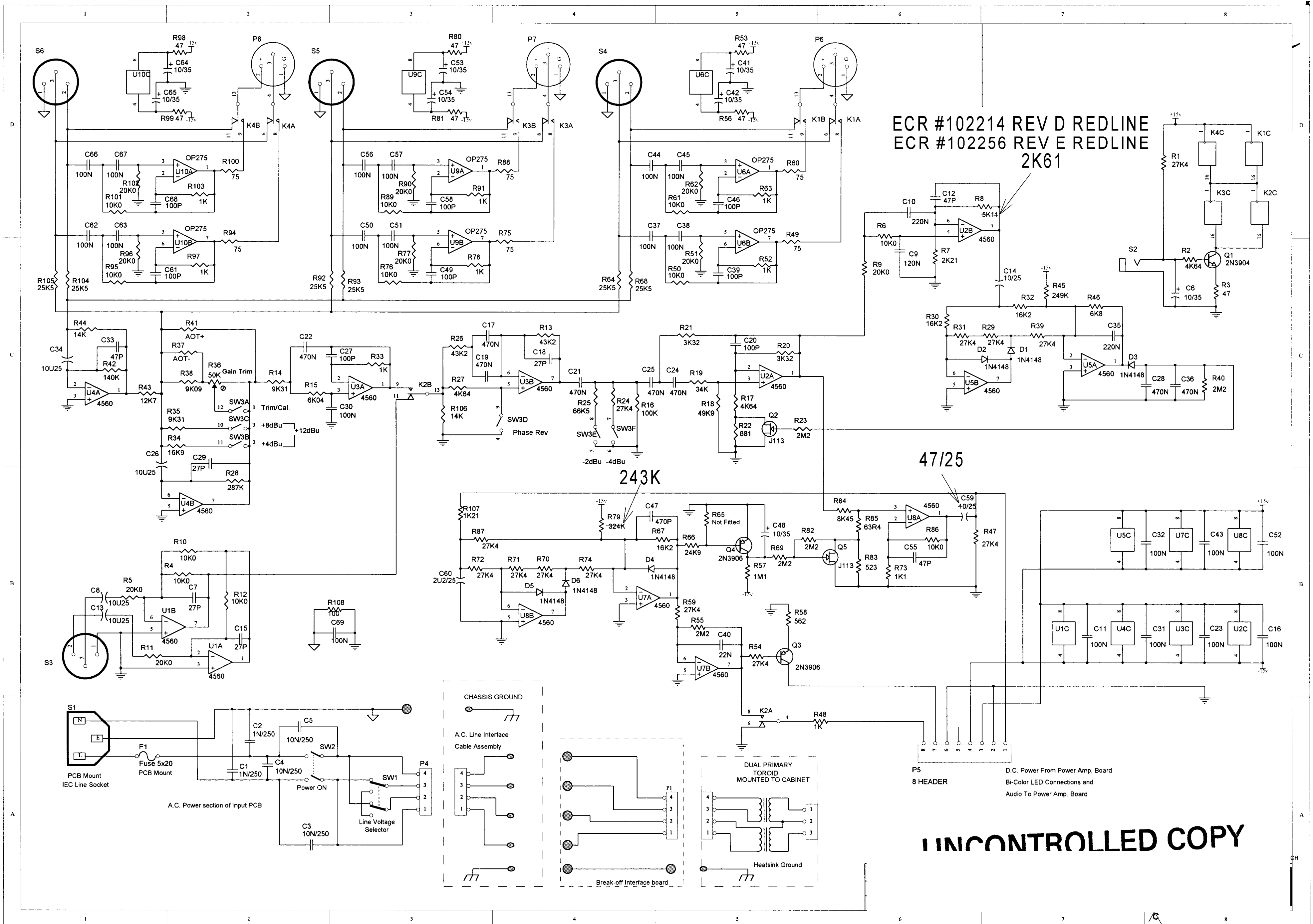
NOTES: (UNLESS OTHERWISE SPECIFIED)

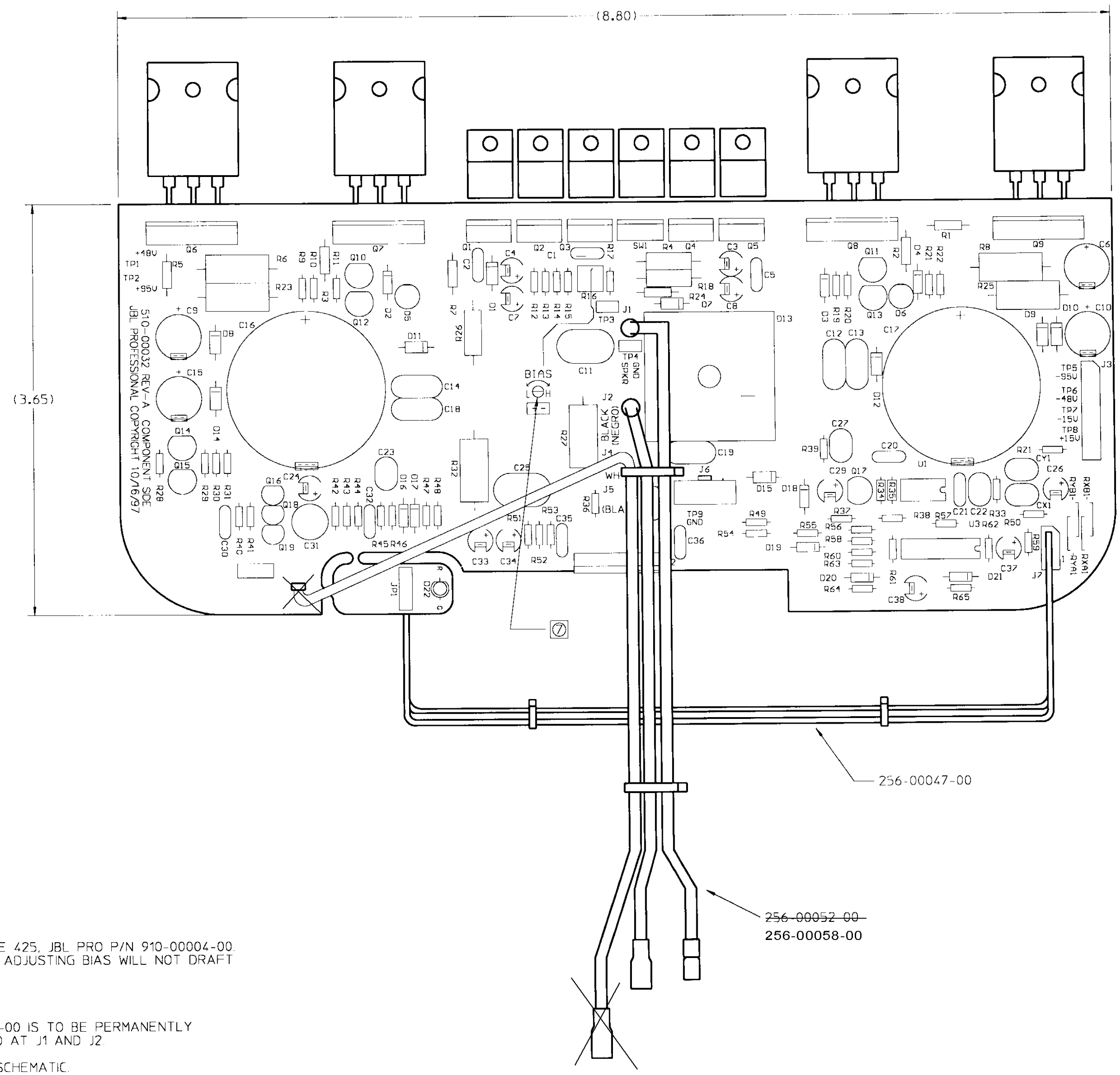
8 7 6 5 4 3 2 1



ECR #102214 REV D REDLINE
ECR #102256 REV E REDLINE
2K61
243K
47/25
S6
S5
S4
S3
S2
S1
P8
P7
P6
P5
P4
P1
OP275
4560
Gain Trim
Trim/Cal.
+8dBu
+4dBu
+12dBu
Phase Rev
-2dBu -4dBu
Not Fitted
PCB Mount
IEC Line Socket
Fuse 5x20
PCB Mount
Power ON
Line Voltage
Selector
A.C. Power section of Input PCB
CHASSIS GROUND
A.C. Line Interface
Cable Assembly
Break-off Interface board
DUAL PRIMARY
TOROID
MOUNTED TO CABINET
Heatsink Ground
8 HEADER
D.C. Power From Power Amp. Board
Bi-Color LED Connections and
Audio To Power Amp. Board

C D E

NO	DESCRIPTION
32-00	MAIN BOARD ASSY, LSR12P



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USE 0.00005 GRAMS OF LOCTITE 425, JBL PRO P/N 910-00004-00, OR EQUIVALENT ON R17 AFTER ADJUSTING BIAS WILL NOT DRAFT WITH VIBRATION.

NONE

WIRE ASSEMBLY P/N 256-00052-00 IS TO BE PERMANENTLY ATTACHED TO THE MAIN BOARD AT J1 AND J2.

SEE DWG 500-00040 FOR THE SCHEMATIC.

SEE DOCUMENT 900-00021 FOR THE BILL OF MAT'L.

S: (UNLESS OTHERWISE SPECIFIED)

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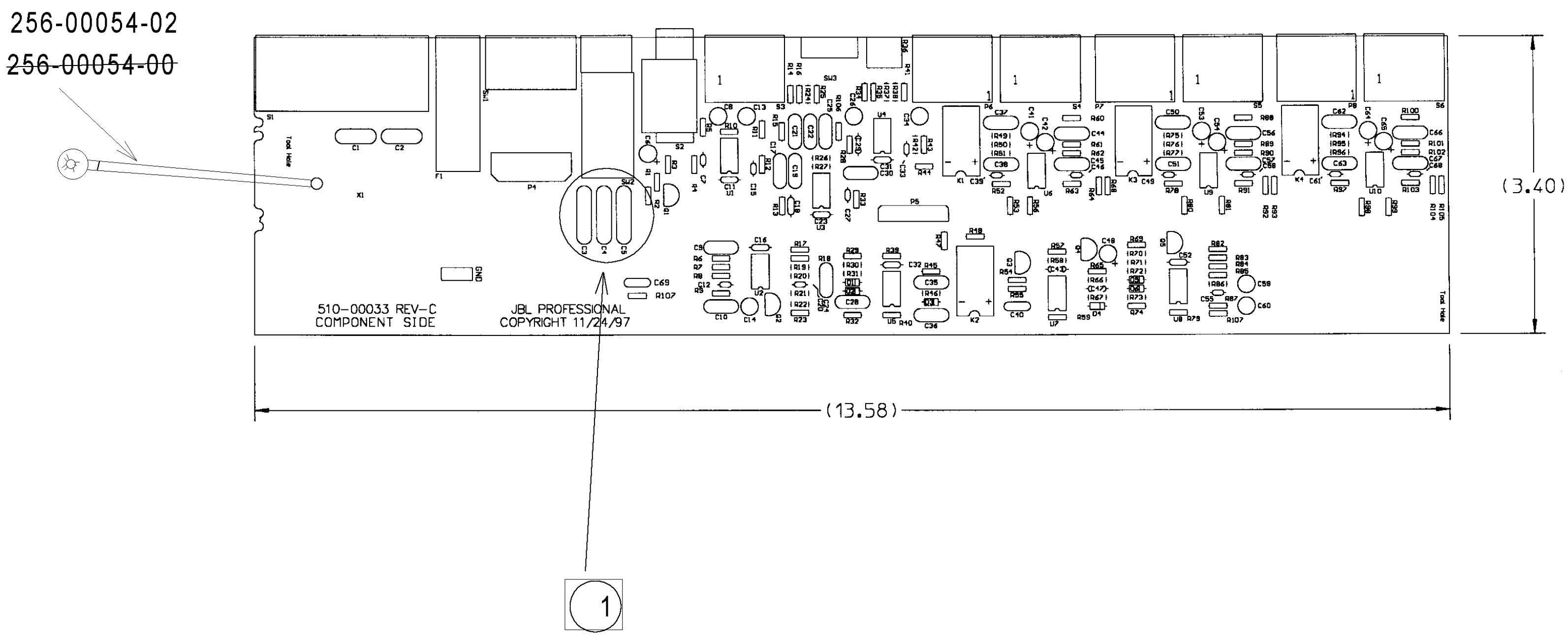
PART NO	DESCRIPTION
513-00033-00	PCB ASSY, SIGNAL-IN, LSR12P



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NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ADD HOT MELT ADHESIVE ACROSS TOPS OF CAPACITORS C3, C4, C5

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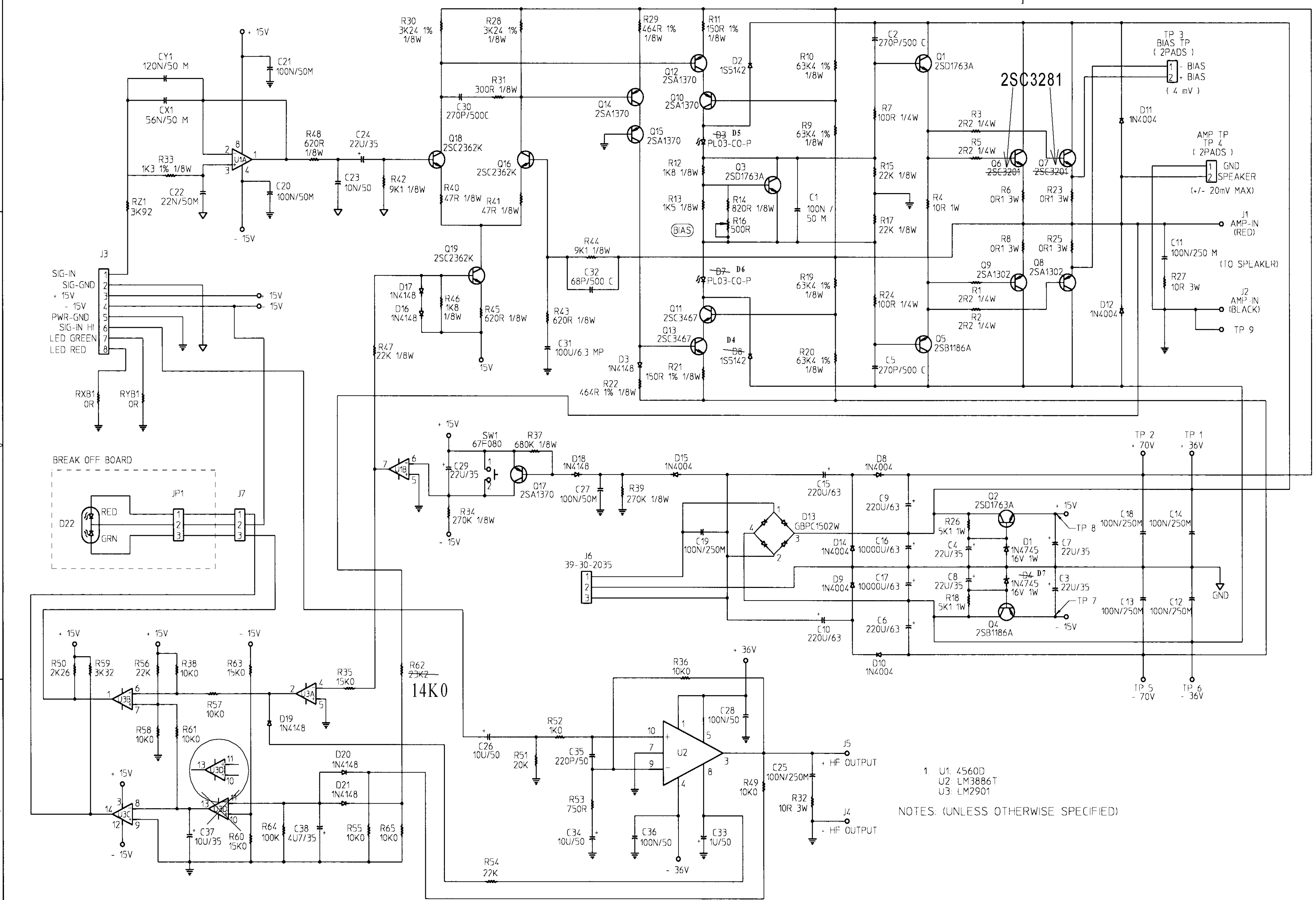
REVISIONS

CHG	LTR	DESCRIPTION	DRFT	CHK	DATE	APPR
101879	A	RELEASE FOR PRODUCTION	YUKI		2/27/98	

8 7 6 5 4 3 2 1

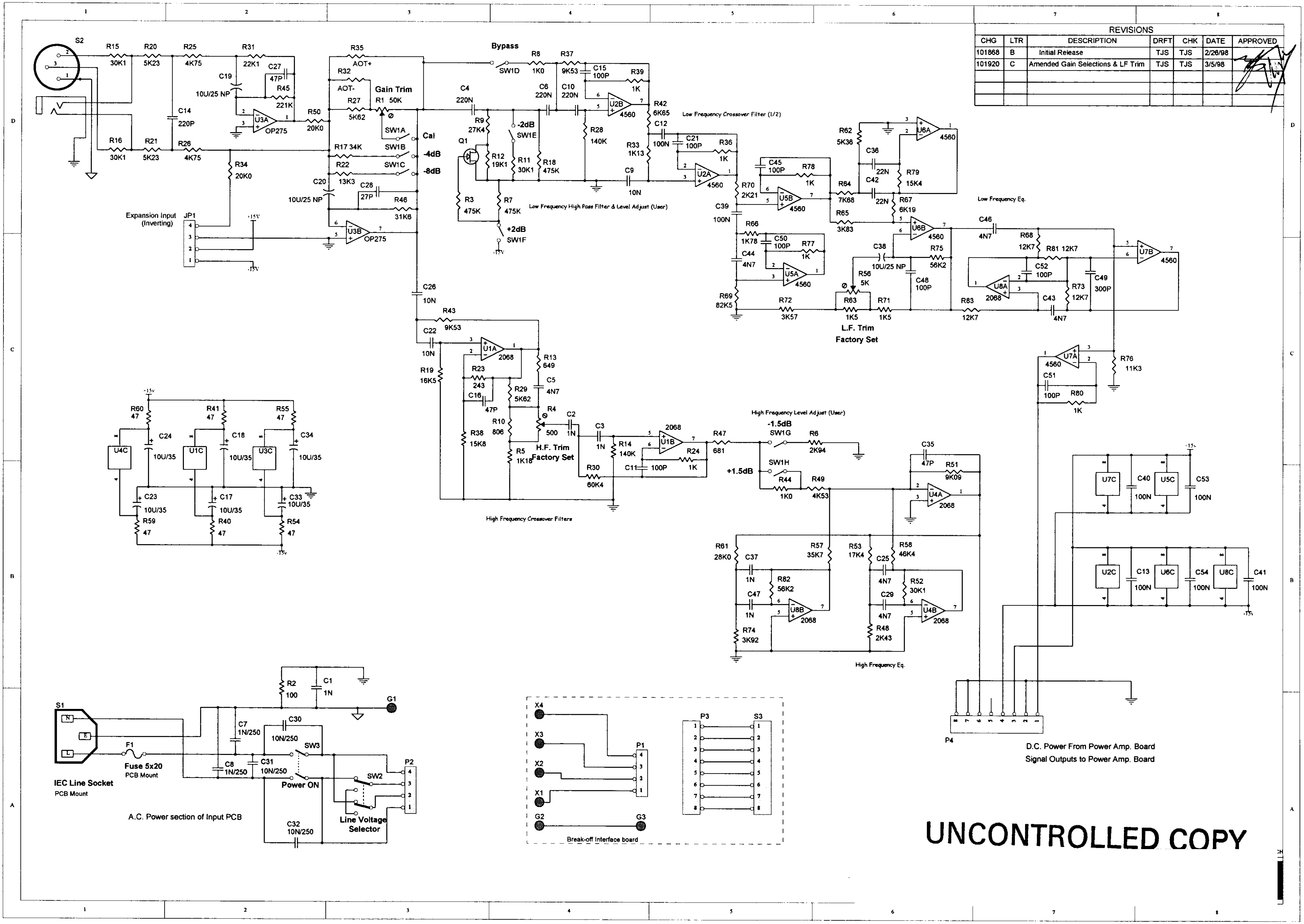


1 U1: 4560D
U2: LM3886T
U3: LM2901

NOTES: (UNLESS OTHERWISE SPECIFIED)

DO NOT SCALE DRAWING | LSR 28 | SCALE 1 / 1 | SHEET 1 OF 1

8 7 6 5 4 3 2 1



REVISIONS

CHG	LTR	DESCRIPTION	DRFT	CHK	DATE	APPROVED
101868	B	Initial Release	TJS	TJS	2/26/98	
101920	C	Amended Gain Selections & LF Trim	TJS	TJS	3/5/98	

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