SF22S TECHNICAL SERVICE MANUAL

Revision A
03/04/03

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Product Overview

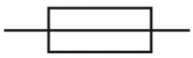
The SoundFactor SF22SP is a dual 12-inch, powered subwoofer using a fourth-order symmetrical band pass enclosure design. A built-in 500 watt (peak) amplifier accepts stereo or mono line level inputs via balanced, XLR connectors as well as single channel speaker level input via a ¼ inch phone jack. Integral signal processing includes a stereo crossover and limiting for the internal amplifier. A pair of XLR output connectors may be used to pass the input signals to another system or to send a highpassed, line-level signal to a pair of powered, full-range speakers. The SF22SP is designed to supplement and extend the low frequency performance of full-range systems in live sound and music playback applications. It is an excellent choice for use with powered full-range speakers or in systems using powered mixers. The speaker is configured for vertical orientation, but may also be used horizontally.

Explanation of Graphic Symbols

The exclamation point within an equilateral triangle is intended to alert the users to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

The lightning flash with the arrowhead symbol, within an equilateral triangle, is to alert the user to the presence of insulated “dangerous voltage” within the products enclosure that may be of sufficient magnitude to constitute a risk of electric shock to humans.

CAUTION: TO REDUCE THE RISK OF ELECTRONIC SHOCK - DO NOT REMOVE COVER. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.



The IEC fuse symbol pictured at the left represents an approved user replaceable fuse. When replacing a fuse, make sure to replace with only the correct type and fuse rating.

Specifications

SPEAKER

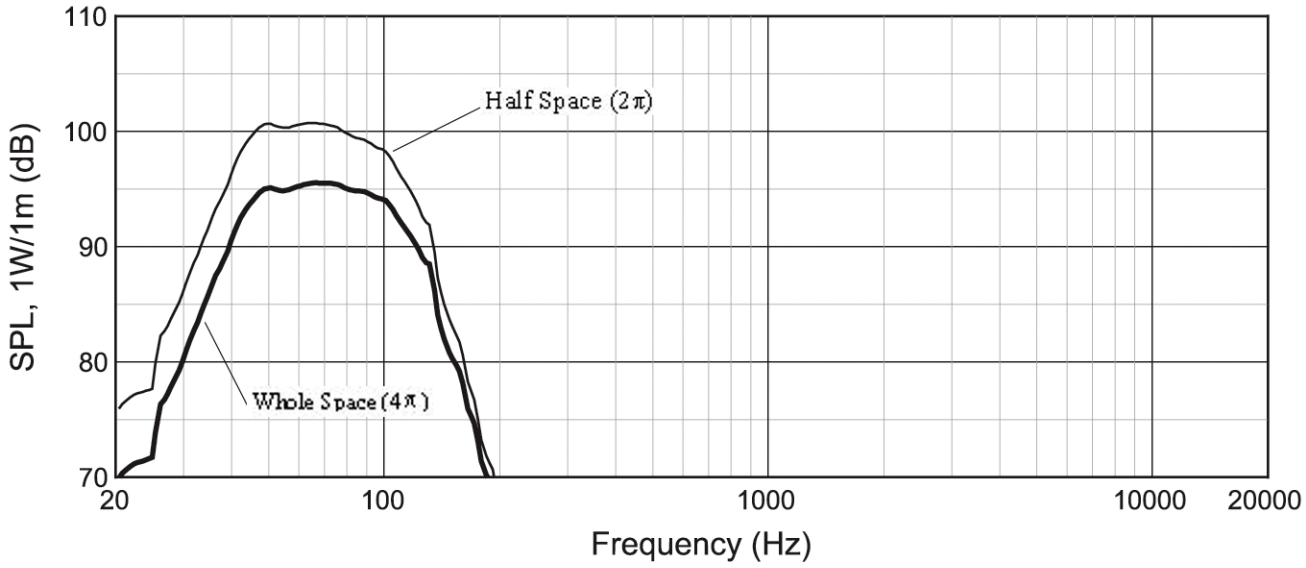
System Type:	Powered dual 12" subwoofer, band-pass enclosure
Frequency Range (-10 dB)	33 Hz - 125 Hz
Frequency Response (±3 dB):	41 Hz - 110 Hz
Nominal Impedance:	4 ohms
Rated Maximum SPL:	128 dB peak @ 1 m (3.3 ft) at 500 watts
Dimensions (H x W x D):	810.3 mm x 463.6 mm x 850.1 mm (w/casters & feet) (31.9 in x 18.25 in x 33.47 in) (w/casters & feet)
Net Weight:	57 kg (126 lbs.)
LF Driver:	2 x M212-8
Optional Accessories:	4 x swivel casters 1 x 24" pole

AMPLIFIER MODULE

Amplifier Power:	500 watts peak / 300 watts continuous
Input Connectors:	2 x XLR/F "Combi" connectors with a balanced 1/4-inch (6.35 mm) phone jack and a 3-pin female XLR connector 1 x 1/4-inch phone jack, speaker level
Input Impedance:	Nominally 20k Ohms, electronically balanced
Input Sensitivity:	0.5 volts for 300 watt output (SUB LEVEL control fully clock-wise)
Output Connectors:	2 x XLR/M
Crossover:	LPF: 100 Hz, 24 dB / Oct HPF: 25 Hz, 18 dB / Oct
Required AC Mains:	50/60 Hz (North American units are 60 Hz only); 120 and 230-240 VAC (±10%) units are available, 50 Hz
AC Line Current:	120 Volts: 1.4 A at 1/8 power with sine-wave input, 3.6 A at max. power with pink noise
	230-240 volts: 0.7 A at 1/8 power with sine-wave input, 1.8 A at max. power with pink noise
Power Consumption at Idle:	No more than 20 watts

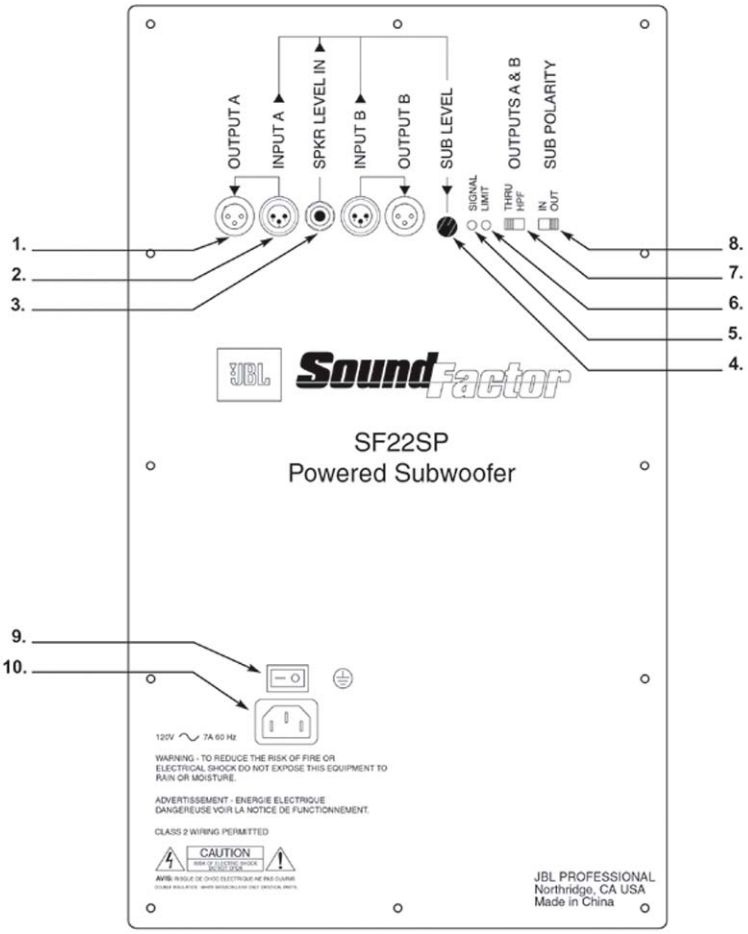
"Frequency Range" and Frequency Response" are based on half-space conditions.

Frequency Response:



Notes:
JBL Professional is continually engaged in research activities to enable further product improvement. New materials, production methods and design refinements are instituted into the existing product without notification and, therefore, the information contained within this manual is subject to change without notice. Rest assured that your JBL Professional equipment will always equal or exceed the published design specifications unless otherwise stated.

Panel Controls, Connectors And Indicators



1. **OUTPUT A & OUTPUT B CONNECTORS -** OUTPUTS A & B provide either a loop-thru or a high-passed, line level output of the signal from the INPUT A and INPUT B connectors respectively. These connectors work with the OUTPUTS A & B switch.

2. **INPUT A & INPUT B CONNECTORS -** These electronically balanced, XLR / 1/4" phone "combi" connectors accept input signal from line-level sources. a.) INPUT A and INPUT B are combined before being routed to the SF22SP Low Pass Filter (LPF) and internal amplifier. b.) INPUT A and INPUT B are also routed to the OUTPUT A and OUTPUT B connectors (see OUTPUTS A & B SWITCH below).

3. **SPKR LEVEL IN -** This 1/4" phone jack allows connecting of the speaker level output of an amplifier or powered mixer to the SF22SP internal amplifier.

4. **SUB LEVEL CONTROL -** Adjusts the input sensitivity of the subwoofer amplifier. Does not affect OUTPUTS A & B.

5. **SIGNAL -** Lights to indicate that a signal is present at INPUT A, INPUT B or the SPKR LEVEL IN.

6. **LIMIT -** Lights to indicate that the limiter circuitry has been activated. In normal operation, this light will flicker on and off. If the LIMIT light is lit continuously, it indicates that the amplifier is being driven too hard and that the volume should be reduced.

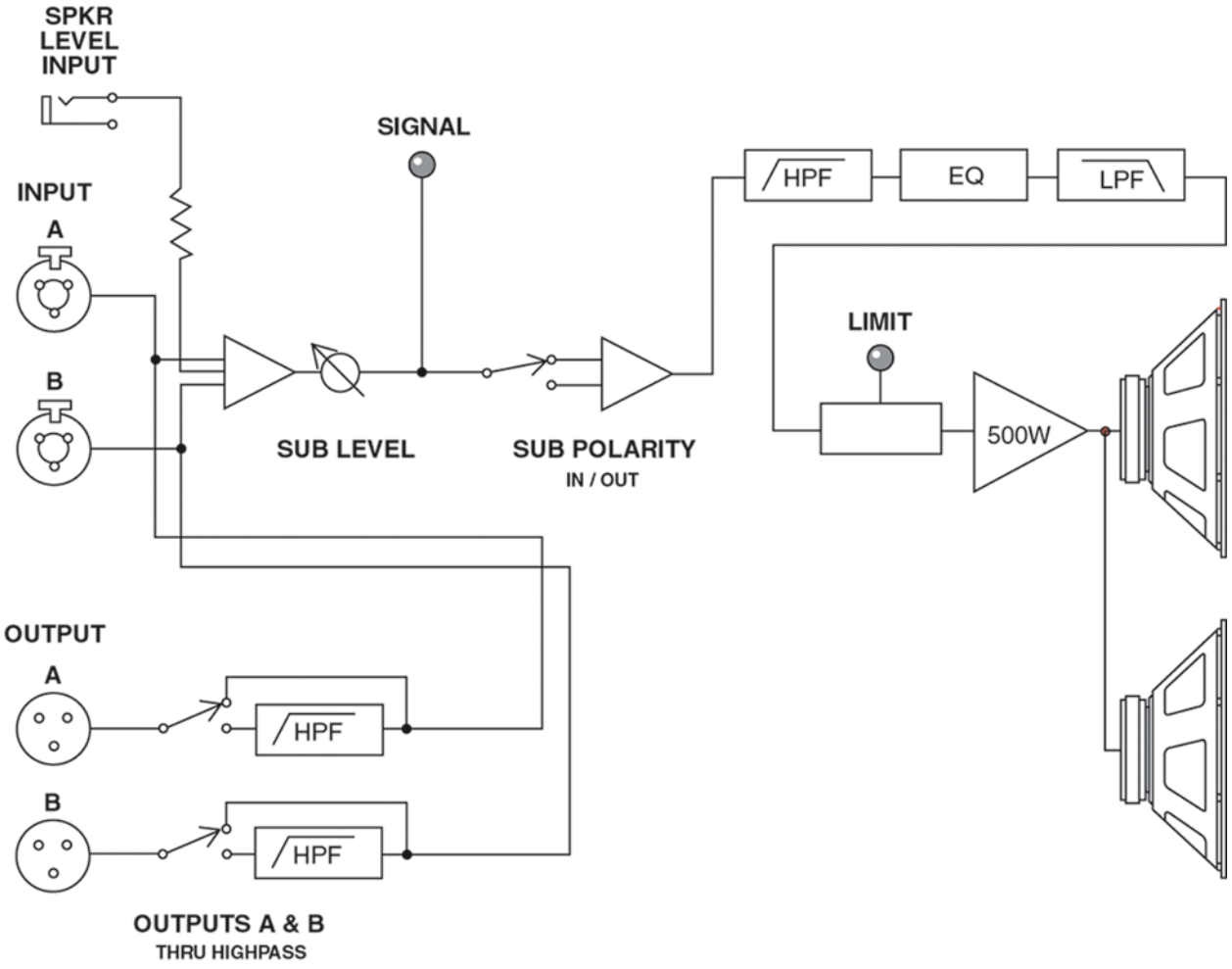
7. **OUTPUTS A & B SWITCH -** This switch affects the signal sent to the OUTPUT A & B connectors. a.) THRU: The INPUT A signal is passed directly to the OUTPUT A connector and the INPUT B signal is passed directly to the OUTPUT B connector. b.) HPF: The INPUT A signal is first passed through a 120 Hz, -6 dB High Pass Filter (HPF) before being sent to the OUTPUT A connector. The INPUT B signal is first passed through another 120 Hz, -6 dB High Pass Filter (HPF) before being sent to OUTPUT B connector.

8. **SUB POLARITY SWITCH -** This switch changes the polarity (sometimes called "phase") of the subwoofer.

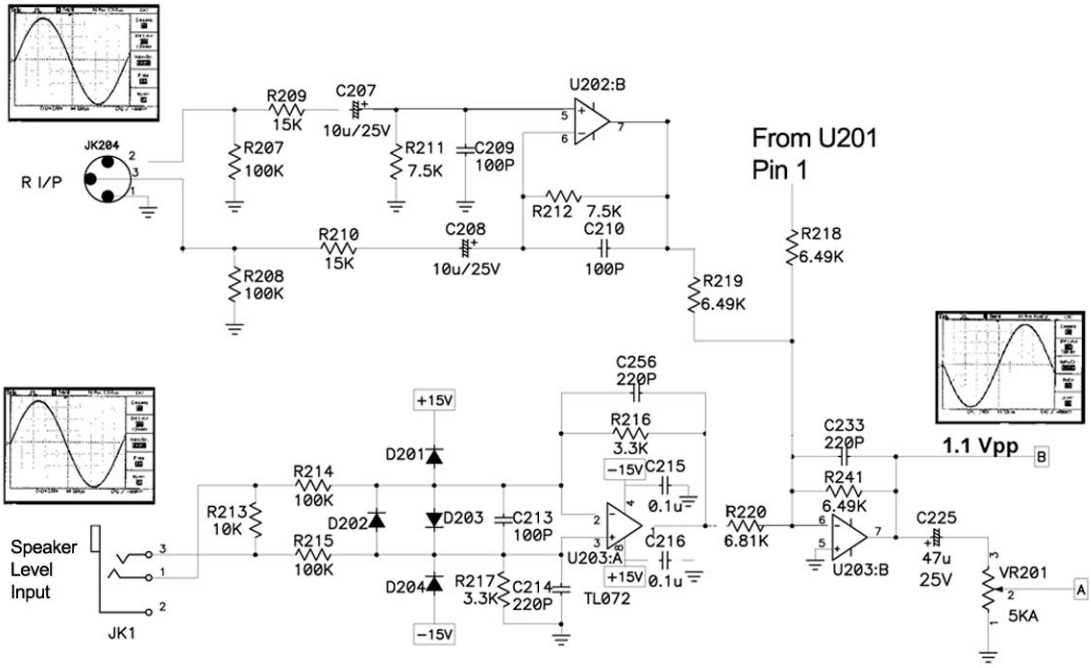
9. **POWER SWITCH -** Turns the AC power of the unit on and off. The switch illuminates to indicate that the unit is on.

10. **AC INPUT -** For attachment of the included power cable.

Block Diagram



Input Circuitry And Summing Amplifier



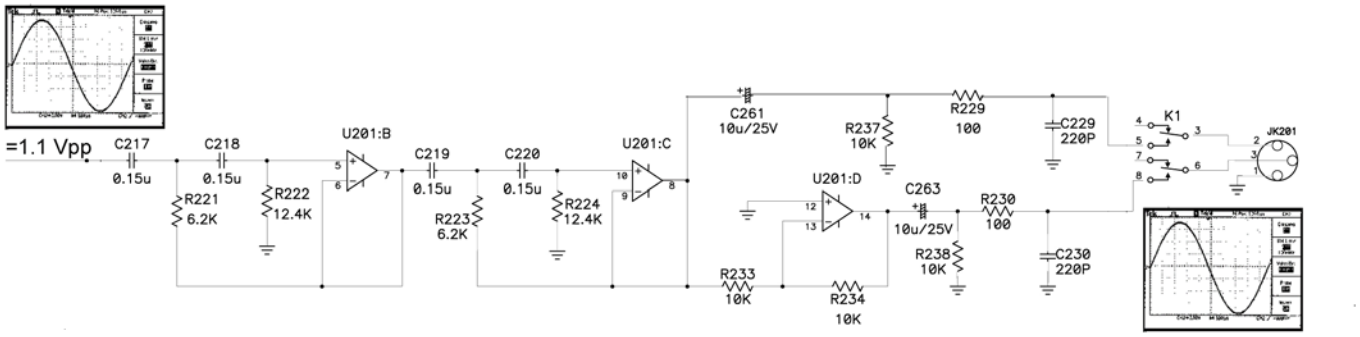
Shown above, are the line level input, the speaker level input and the summing amplifier circuits. These are the circuits that are exposed to the initial raw signal. For convenience, we will describe only one channel. The respective component numbers in parentheses are for the opposite channel.

A balanced sine wave signal at 0 dB is input from pins 2,3 of JK204 (JK202). U202: B and associated resistors R209, R211, R210 and R212 comprise a balanced to unbalanced converter/buffer with 6dB loss (x 0.5). This allows for a balanced input level up to +26dBu (44 Volts peak to peak) to be applied without clipping of the output of U202: B pin 7, which is capable of slightly more than +20dBu (22 Volts peak to peak).

The next circuit is the speaker level input. There is only one channel for the speaker level input, which is accessed by using the ¼" jack, JK1 with a balanced input signal. U203: A and associated resistors R215, R217, R214, and R256 comprise a balanced to unbalanced converter buffer stage with 30dB loss (x 0.033). This allows for high voltage speaker level signals of up to +50dBu to be applied at JK1 without overdriving the output of U203: A. The positive and negative inputs of U203: A are clamped by D201, D202, D203 and D204 to the positive and negative 15 volt supplies. This insures that the signal magnitude will be within the maximum 30-volt peak to peak amplitude swing, which will protect the integrated circuit, U203A, from damage.

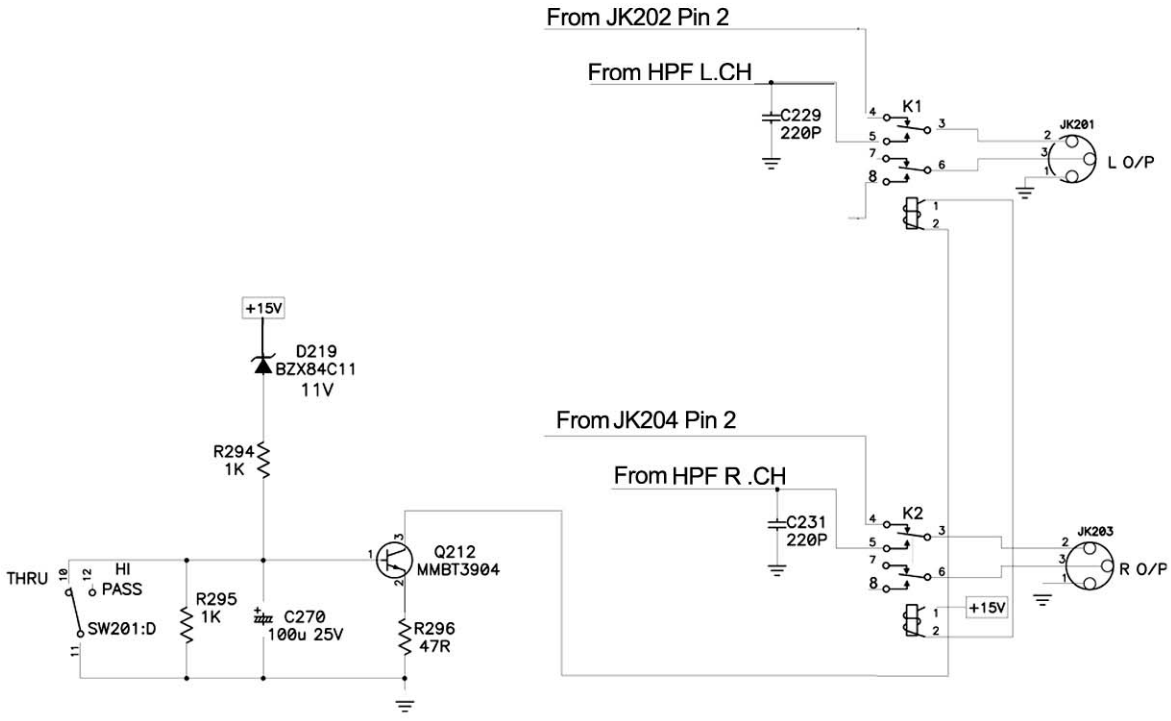
All three outputs from each of the respective channels are directly coupled through R218, R219 and R220 and then summed by U203B at unity gain (inverting). The output signal from pin 7, U203B, is then sent to the 5KΩ volume control, VR201 via coupling capacitor C225. C225 ensures no D.C. is applied to the potentiometer. Where rotating a potentiometer results in excess noise, scratching sounds, at the system output the first check should be whether D.C. voltage can be observed across the potentiometer. If voltage is measurable this indicates C225 has become "leaky" and should be replaced.

High Pass Filtering



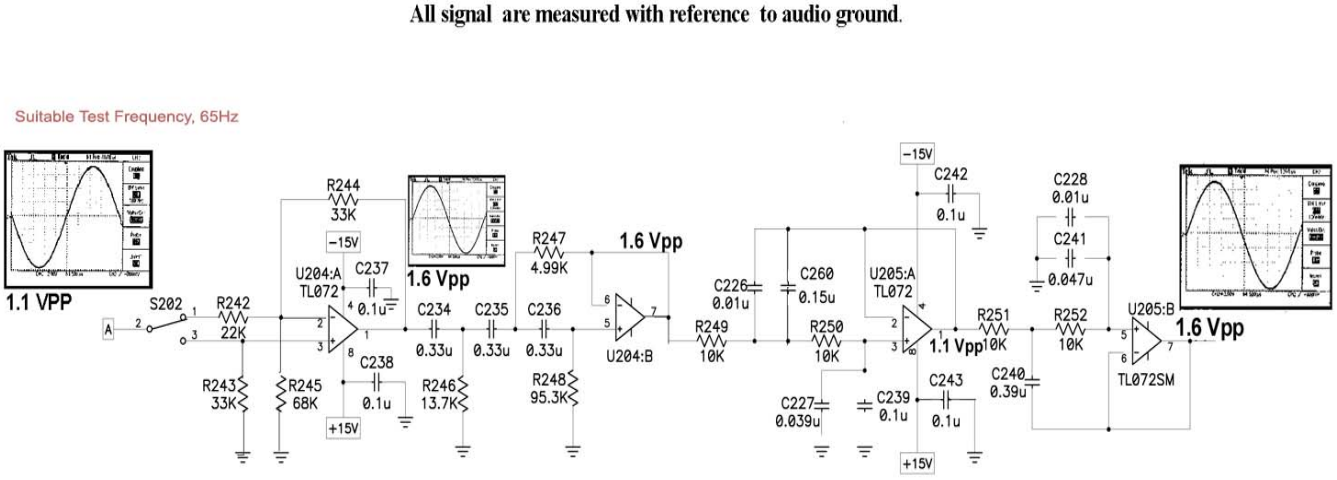
The high pass filter circuit, shown above, attenuates the low frequency components of the input signal to prevent phase interaction of externally added components, thereby providing increased sound system performance. It consists of two two-pole Butterworth filters in series, U201B and U201C, increasing low frequency rolloff to -40db/decade below the cutoff frequency of 120 Hz. The resultant signal above this frequency can then be passed on to external amplifiers for targeted and reliable sound reinforcement. The isolated audio input signal from pin 1 of U201A (pin 7 of U202B), not shown on the above circuit enters this stage at C217 (C218) and is represented by the left oscilloscope screen. Test signal frequencies well above the filter cut-off should be used. A 1KHz test signal is ideal. This signal enters U201B at pin 5 (U202C at pin 10) and is buffered and observable on the output at pin 7 of U201B (pin 8 of U202C). The technician can verify proper operation of each IC by following the schematic and viewing the output waveform on the oscilloscope screen noting any increase in distortion. Those specific points are pin 8 of U201C (pin 14 of U202D) and pin 14 of U201D (pin 1 of U202A). The waveform looks similar to the oscilloscope screen on the right as shown. At the point of any increase in distortion, the preceding stage should be thoroughly checked for proper operation.

Thru/Hpf Relay Circuit



This circuitry provides for the activation of the thru/hi-pass relay which determines the resultant sound output to JK201 and JK203. With the relay in the non-activated mode, the audio signal will remain unchanged. This is useful if the setup includes several subwoofers. With the relay in the activated position, the high pass filter is inserted into the signal path extracting everything below about 120 Hz. External sound reinforcement amplifiers driving full range loudspeakers can now be added without acoustic interference that otherwise would result from multiple loudspeakers reproducing overlapping frequency ranges as this can lead to dips or bumps in the resultant acoustic frequency response.
The RC time constant of R295 and C270 contribute to the stability of this switching circuit. Zener diode D219 ensures that the relays are only activated when stable +15V supply is available. If the +15V supply falls below around +13 volts Q212 is deprived of base current and turns off. This ensures that the relays drop out quickly when ac line power is turned off to the SF22SP avoiding audible thumps from the sound system connected to JK201 and JK203. Similarly on initial power up the relays only activate after power supplies have stabilized avoiding audible thumps from the sound system connected to JK201 and JK203. In troubleshooting this circuit for erratic operation, check these respective components. For complete non-operation, check these possibilities: missing or incorrect supply voltages at relay K2 and K1, no switching voltage at the base of Q212, an open relay or open/shorted driver transistor. Verify continuity of printed circuit board traces and that R296, R294 are not open.

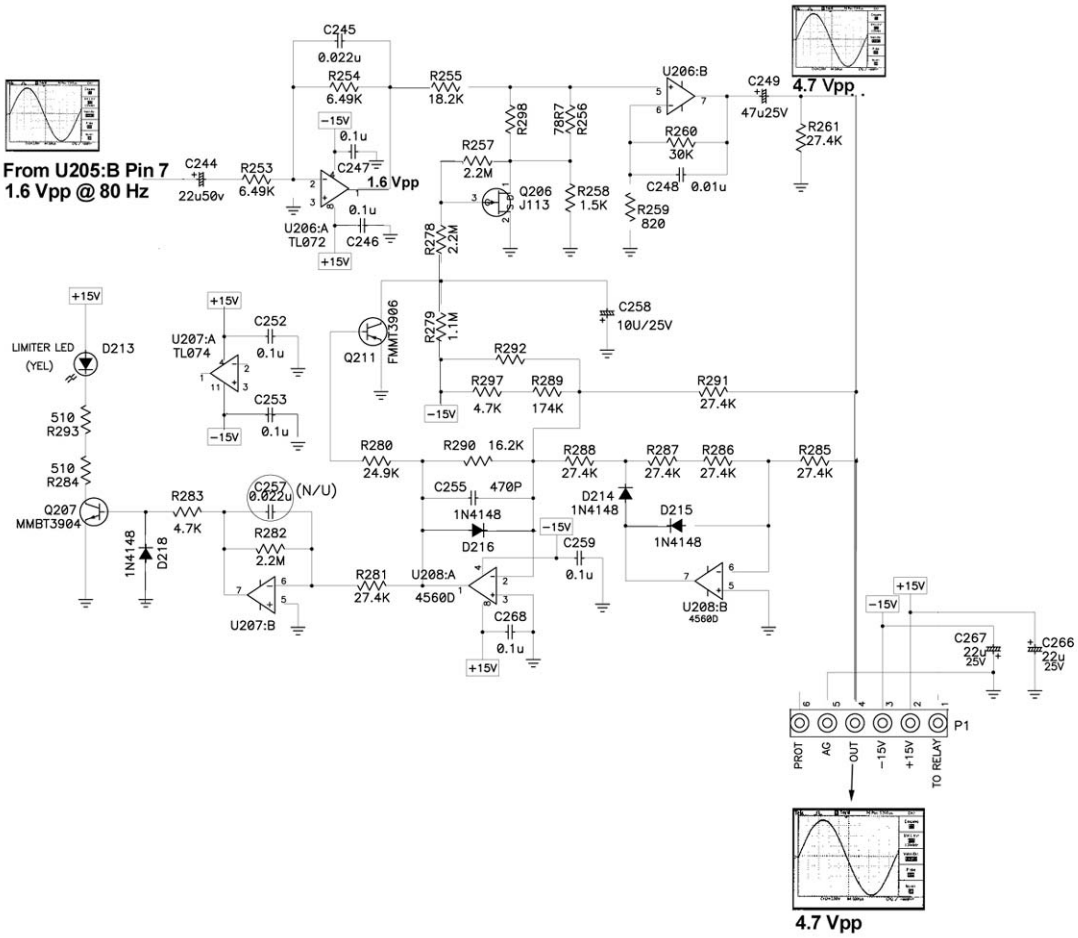
Buffered Phase Inverter Circuitry



The audio signal enters at point “A” on the diagram from volume control VR201, not shown, and is switched between the inverting and non-inverting pins 2, 3 of U204A. The resultant signal is output on pin 1 of U204A and is verified on the center oscilloscope screen. U204: B together with C234, R246, C235, R247, C236 and R248 comprise a third order (i.e. 60dB per decade roll-off) high pass filter with 0dB gain in the passband. This filter is used to restrict ultra low bass frequency response to protect the transducer in the sub-woofer from over-excursion below the system acoustic tuning frequency (port tuning).

Stages with U205A and U205B are used as the main low pass active filters for the power amplifier. This fourth order low pass filter (80dB per decade roll-off) restricts reproduced frequencies to the desired sub-woofer passband below 120Hz.

Limiter Circuitry

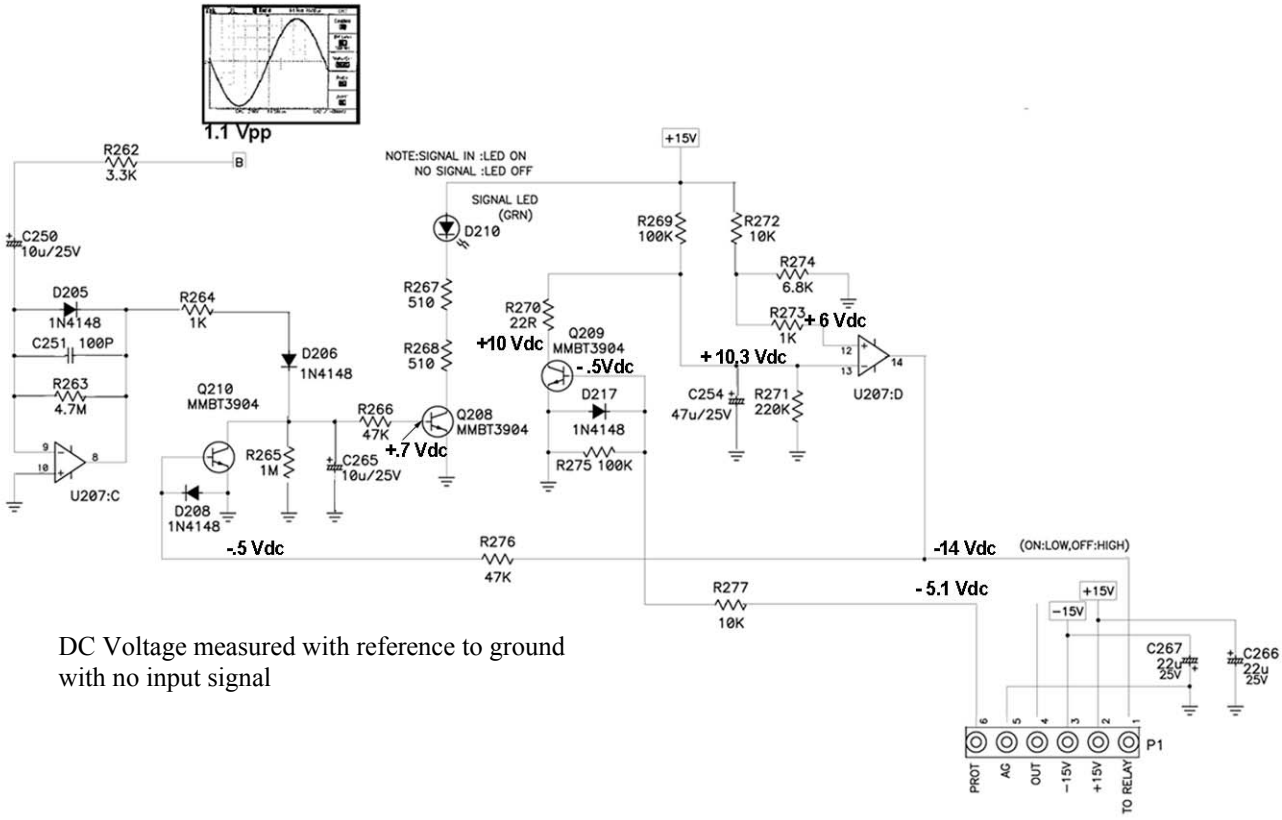


U206: A is a unity gain inverting stage that restores the signal polarity that was reversed at the summing stage U203: B

U208: B and U208: A with associated diodes resistors and capacitors form a precision rectifier and averaging circuit. Resistors R297, R289 and R292 offset the output of U208: A to a positive voltage clamped by diode D216 to one diode forward voltage drop (0.6 Volts) in the absence of a signal input on P1 pin 4. As signal level increases the voltage output at U208: A pin 1 will be driven increasingly less positive by an output d.c. voltage proportional to the average level of the audio signal at P1 pin 4. When the audio signal drives the output of the precision rectifier past the threshold voltage, set by R297, R289 and R292, the output at U208: A pin 1 becomes negative which turns off Q211. As Q211 turns off the gate drive to FET Q206 rises above the pinch-off voltage Vdss (around –6 Volts) of Q206 so that the drain source channel conducts and attenuates the signal at the input (pin 5) to the gain stage formed around U206: B. These elements compose a feedback limiter. When the audio signal from the output of U206: B exceeds a threshold the gain of the signal path is reduced to maintain the output just above the threshold level. This is done to prevent the power amplifier from being overdriven into clipping no matter how large the applied signal. While amplifier clipping may not damage the amplifier it does have the potential to damaged the loudspeaker. Additionally, as clipping distortion generates harmonics of the applied signal the sub-woofer will generate higher frequency signals, which

are directional. Sub-woofers are used on the basis that reproducing low bass provides no directional information and hence the location of the sub-woofer system is not critical. As soon as directional information emanates from the sub-woofer through harmonic distortion the sub-woofer's location is revealed to the listener thus shifting the intended sound image.
In addition to driving the base of Q211 a negative output voltage at U208: A pin 1 is inverted by the inverting stage around U207: B. The resulting positive voltage applied via R283 to the base of Q207 turns Q207 on illuminating LED D213 to indicate limiting action.
Because of the closed loop nature of the feedback limiter, troubleshooting can be confusing. To establish correct operation of the circuit elements it is often useful to "open the loop". In this instance removing Q206 will allow observations of the action of the precision rectifier stage and the transistor Q211. Using a 65Hz sine wave test signal, slowly increase the signal level looking at the output of the precision rectifier and expect to see this voltage flip from +0.6 Volts d.c. to a negative voltage, which can be driven all the way to –15V as signal level gets high enough. As the voltage at U208:A pin 1 becomes negative the voltage at the collector of Q211 (junction R278 and R 279) should become less negative, eventually approaching zero Volts. If all these conditions are met the faulty component is probably the FET. The threshold of attenuation action is dependent on the actual Vdss value of Q206, which can vary. When replacing Q206, having established proper operation of the limiter also check that the limiter prevents power amplifier clipping. If not R297 can be increased to correct this.

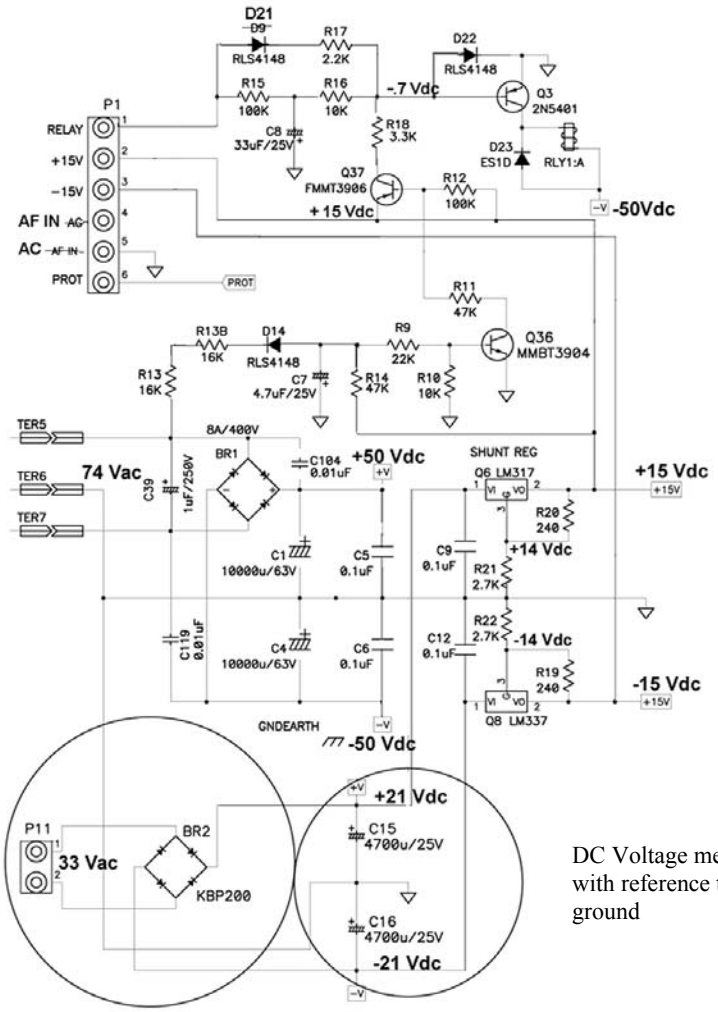
Signal Input Detection Circuitry



DC Voltage measured with reference to ground with no input signal

Input signal from pin 7 of U203B, not shown, enters this circuit at point “B” passing through R262 and is capacitively coupled by C250. U207C is configured as a high gain half-wave rectifier, which detects the signal voltage as low as 1.8 mV and toggles the output pin 8 to a high level. When D206 passes positive voltage above .7 volts, Q208 is forward biased on to allow the LED, D210, to illuminate. However, several things can occur to cause the unit to activate the protection circuitry. Excessive temperature, excessive input signal, excessive current usage can be detected but the basic premise is that the output of the +15 volt comparator U207: D must be low to activate the output relay circuit. Thus in the absence of a fault condition Q210 is held off by the negative output voltage of comparator U207: D. A fault condition detected by the protection circuitry described in the section “Output Filter Network” drives the voltage at P1 pin 6 positive. This turns on Q209 which draws charge out of C254 pulling the input to the negative input of comparator U207: D below the positive input (+6Volts) which drives the comparator output positive. A positive voltage at P1 pin 1 turns on Q210 clamping the base of Q208 low and inhibiting the signal indication LED D210. Note also that during initial power up C254 must be charged by current through R269. Until this charge establishes a voltage at the negative input pin 13 of comparator U207: D above the voltage at the positive input pin 12 the voltage at P1 pin1 cannot be negative. This is the primary mechanism of the turn-on delay circuitry described in the section “Power Supply and Relay Circuit”.

Power Supply and Relay Circuit



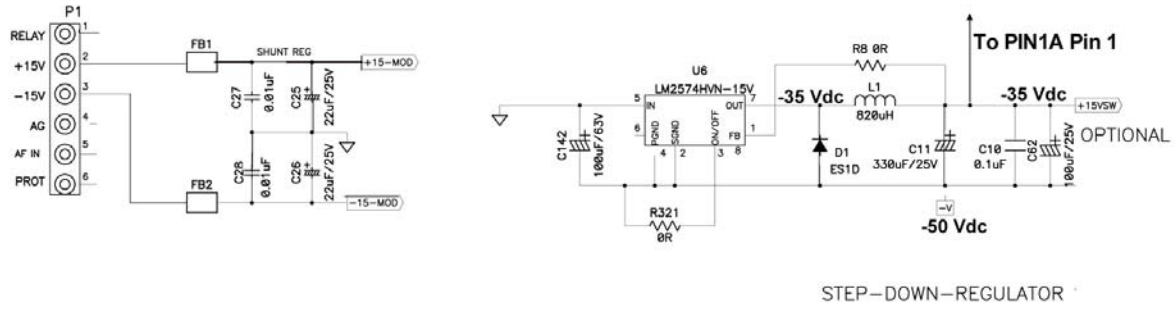
DC Voltage measured with reference to audio ground

Above is the main power supply and protection relay driver circuit for the SF22SP. The entire power supply can be broken down into two conventional supplies. Bridge rectifier BR1 converts the 74 vac from the transformer, not shown, into positive and negative 50 vdc; capacitors C1 and C4 filter this dc voltage necessary for the rails of the power amplifier. This provides 100 volts of differential signal swing from the output stage. A second bridge, BR2, is used to rectify the raw 33 vac, which is filtered by capacitors C15 and C16. The resultant voltages are further reduced and regulated by integrated circuits Q6, (LM317), and Q8, (LM337), which provide the ±15-volt supplies necessary for IC operation.

Protection relay RLY: 1 is control by transistor Q3 that must be turned on to activate the relay. Under normal operating conditions the ac voltage at TER5 is half wave rectified through D14 and smoothed by C7 to generate a negative voltage that holds transistor Q37 off. Under these conditions no base current is supplied to Q37 holding Q37 also off. A "no fault" condition as described in the sections "Signal Input Detection Circuitry" and "Output Filter Network" produces a negative voltage at P1 pin

1 which draws base current from Q3 holding Q3 on and activating RLY: 1. A fault condition will drive the voltage at P1 pin1 positive which turns Q3 off deactivating the relay. If ac line power is removed, such as by turning power off, the negative voltage derived from the incoming transformer secondary ac voltage at TER5 is held only momentarily by capacitance C7. This voltage rapidly discharges. The time constant of this discharge is shorter than the hold up time of the +15 volt regulated d.c. supply which has distributed capacitance of tens of microfarads. As a result Q36 is quickly biased on turning on Q37 and hence driving the base voltage of Q3 positive turning Q3 off and deactivating the relay. This ensures the loudspeaker load is disconnected from the amplifier output before the d.c. power supplies collapse after power is turned off removing audible thumps. On first application of ac line power, by turning the SF22SP on, all of the conditions described above must establish to allow Q3 to be turned on activating RLY: 1. On application of ac power Q36 and Q37 are held off by the rapid establishment of negative voltage at the junction of D14 anode and C7. Assuming no fault condition is detected a negative voltage is established at P1 pin 1 after a time delay primarily controlled by R269 and C254 shown in the section “Signal Input Detection Circuitry”. This delay allows all power supplies etc. to stabilize before the loudspeaker load is connected avoiding any audible turn on thumps.

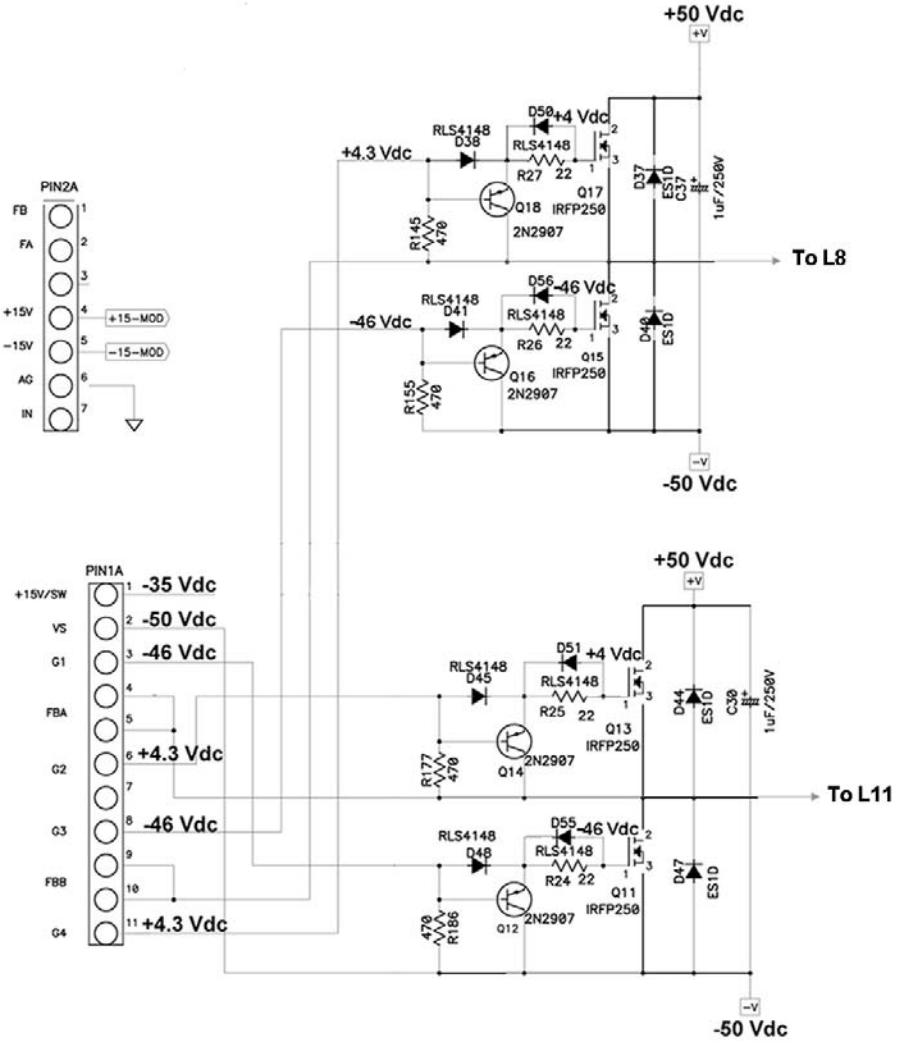
Pulse Width Power Supply



Above are the voltage supplies for the pulse width modulated amplifier module. They are situated after the main power supply on the main PCB. The positive and negative 15 volts supply shown on the left feeds the PWM functional IC's. A definite short in one of the ±15V rails can be isolated either to the PWM PCB or signal PCB by verifying if fuses FB1 and, or FB2 are open. These power supplies are derived by the linear regulators Q6 and Q8 described in the section Power Supply and Relay Circuit. Isolated switching regulator, U6, shown on the right, provides the low voltage from the negative 50volt D.C. supply that directly feeds the H-bridge driver IC's U7 and U8. This regulator is not referenced to chassis ground. Rather, it is allowed to float on an isolated ground plane and uses output feedback from after the output filter comprising L1 and C11, C10 and C62 to set its output 15 volts above the amplifier negative power supply rail (Vs, -50 Volts). Hence if measured referenced to ground this output at PIN1A Pin 1 will measure –35 volts. Voltage output failure on Pin 7, from this IC, will prevent the H-bridge driver IC's from operating correctly.

Mosfet Output

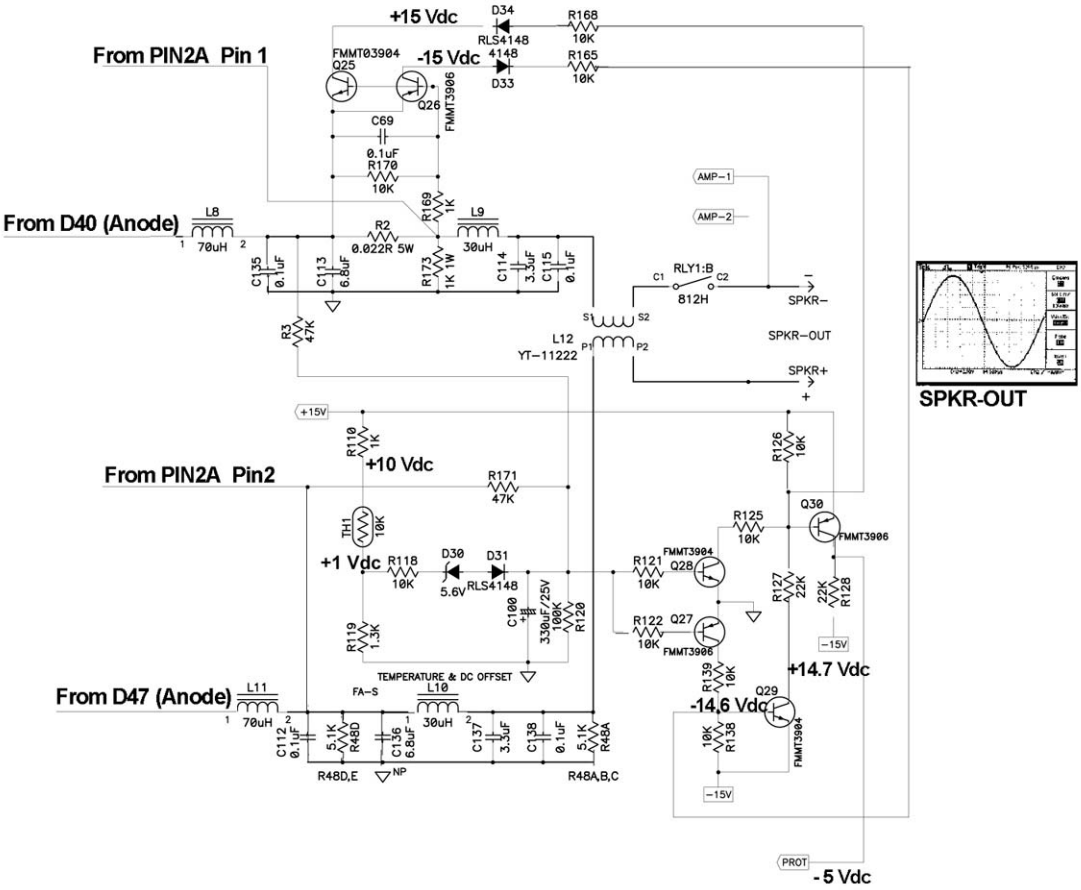
The following circuit is the output section for this subwoofer. Channel A (top) amplifies the modulated PWM carrier pulses for the negative output of this bridged amplifier. Channel B (bottom) does the same but forms the positive signal output. Specifically, switching pulses for channel A enter



at G1 (negative) and G2 (positive) of PIN1. Pulses of equal magnitude, but of the opposite polarity, enter at G3 (negative) and G4 (positive) for channel B. MOSFETs Q17 and Q15 (Q13 and Q11) alternately switch on and off according to their respective input signals to create the amplified pulse train. Rail voltages of ±50 volts allow the equal but opposite formation of this pulse train without any resolved d.c. quiescent voltage at the output of the output filters described in the section "Output Filter Network". Protection to prevent MOSFET obliteration from flyback is provided by D37 and D40 (D44 and D47).

Output Filter Network

This circuit filters out the high frequency pulse width modulation carrier square wave allowing the analog audio signal to be reproduced upon connection to a transducer. Signal from Channel A (B) enters the 4th Order LC filter from D40 (D47). This filter consists of two Second Order filters

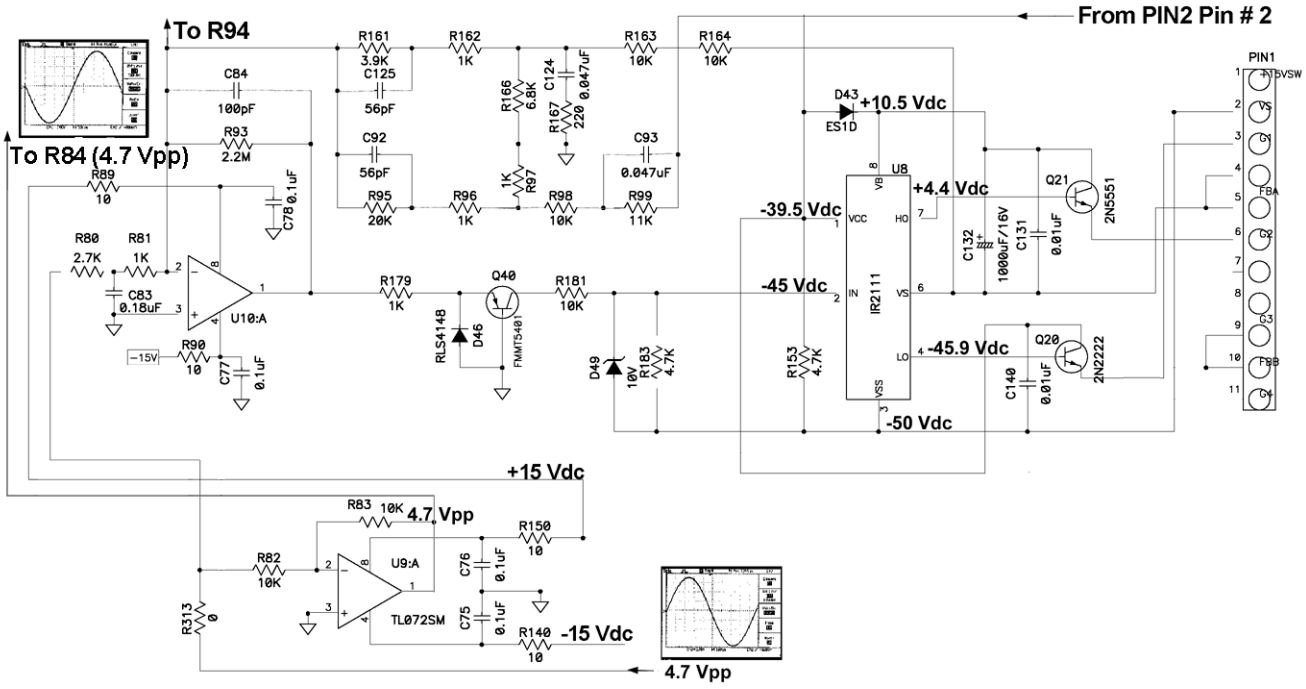


connected in series and provides –80 dB/decade of filtering.
Also shown is the initial portion of the protection circuitry that provides the detection of an abnormal problem such as heat, excessive DC offset or excessive output current.

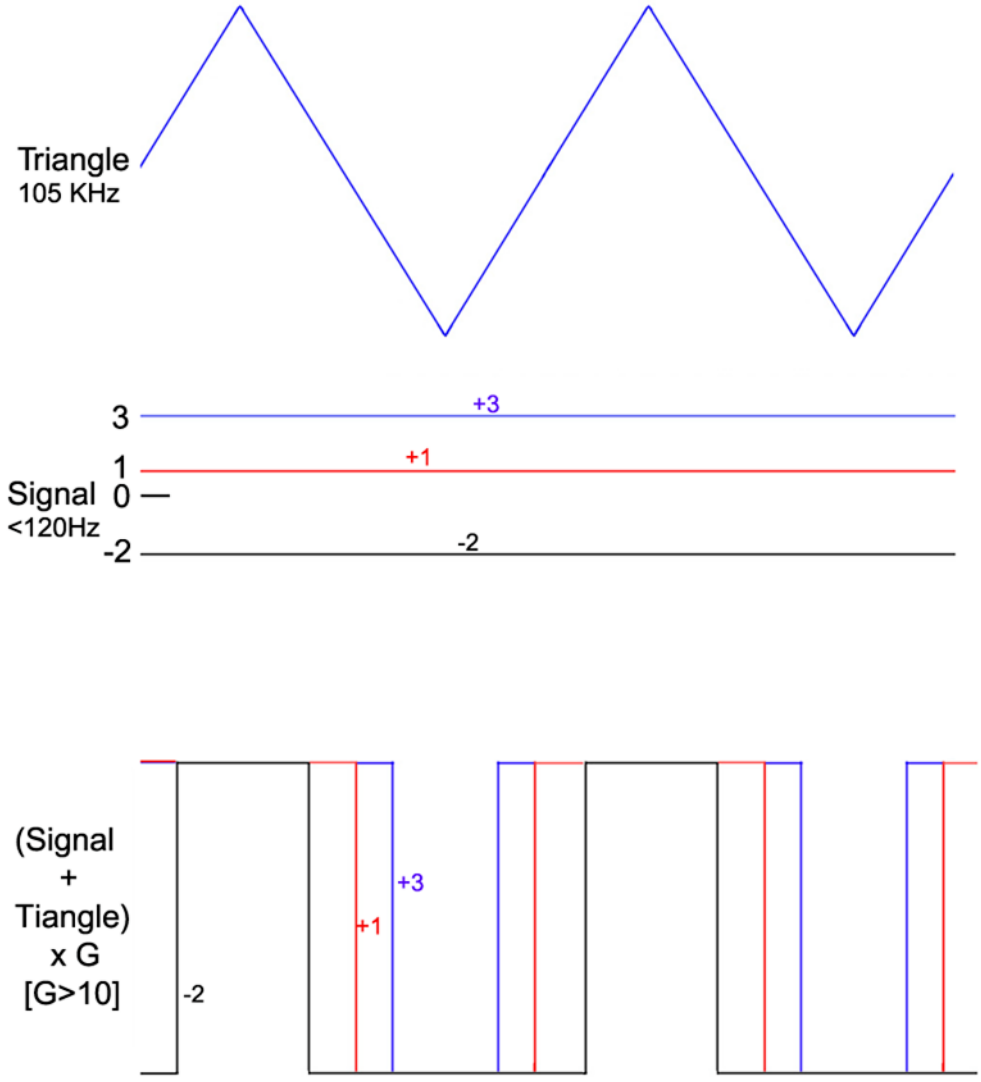
Under normal operating conditions the collector of Q30, the "PROT" line, is around 5 Volts negative. If this line is driven positive by Q30 the relay protection circuitry will disconnect the speaker by opening relay RLY1. If the amplifier temperature rises to a dangerous level NTC thermister TH1 falls in resistance such that the voltage at the junction of TH1, R119 and R118 exceeds the Zener voltage of diode D30 driving base current into Q28. When Q28 is driven into conduction base current is pulled out of Q30 driving Q30 also into conduction, which takes the "PROT" line positive deactivating relay RL1. Should either section of the amplifier-bridged output exhibit excessive d.c. that d.c voltage is fed through R3, in the case of the SPKR- output, or R 171, in the case of the SPKR+ output, to the bases of Q28 and Q27. If the d.c. voltage is positive Q28 is driven into conduction turning on Q30 and driving the "PROT" line positive. If the d.c. voltage is negative Q27 is driven into conduction applying base current into Q29, which in turn drives Q30 into conduction and drives the "PROT" line positive. If a load fault such as a short circuit occurs the excessive current drawn will create a voltage across R2 sufficient to bias either Q25 or Q26 into conduction. If the short circuit occurs on a positive going

audio signal, excessive current flows into the SPKR- terminal and hence through R2 such as to turn on Q25. Q25 then draws base current out of Q30 taking the “PROT” line positive. If the short circuit occurs on a negative going audio signal current flows out of the SPKR- terminal from R2 such that Q26 turns on and drives base current into Q29 which in turn drives Q30 into conduction and drives the “PROT” line positive. The relay control circuitry is described in the section “Signal Input Detection Circuitry”.

PWM Preamplifier and Driver



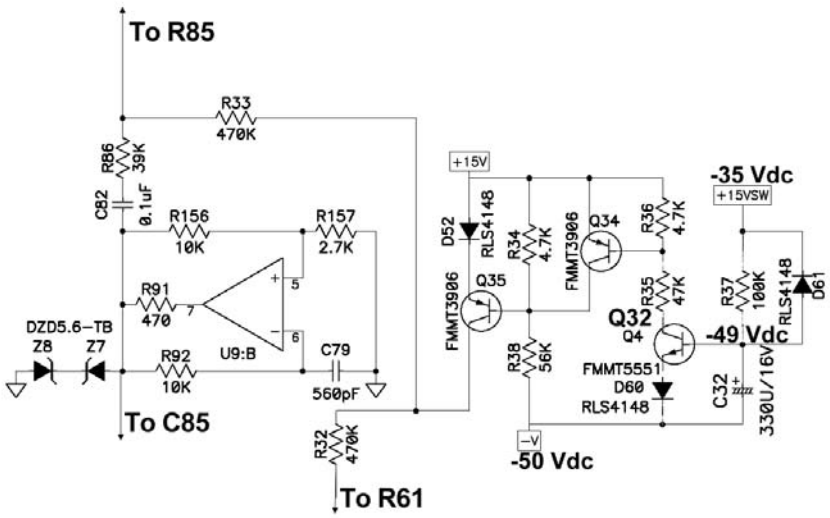
In the above circuit, the audio signal enters the amplifier and is represented on the lower right oscilloscope screen. This signal is separated at the junction of R313/R82 and fed to U10A and inverterU9A This inverter provides the opposite phase signal necessary for the creating the negative waveform (shown by the upper oscilloscope representation.) The in-phase signal enters U10A and the out of phase signal enters U10B (not shown but identical to U10A) Each summing stage formed around U10: A and U10: B also receives the sawtooth waveform output from pin 7 of U9B generator (see Triangular Waveform Generator). These summing stages have high gain and perform the function Vout=(signal+triangle)xG. As a result, the output of U10: A (or U10: B) is a pulse train. The output goes full scale positive when the input signal value and the triangle wave value net out to a negative value. The output goes full scale negative when the input signal value and the triangle wave value net out to a positive value. Hence this forms a double edge pulse width modulation. Note also the two feedback networks from U8 (U7) pin 6 and from the mid point of the output filter which help correct errors in the modulation.



The output of each operational amplifier is fed through common base transistor Q40 (Q33) and clamped to a minimum –0.6Volts by D46 (D39) to avoid reverse avalanche breakdown of Q40 (Q33). The collector output voltage is limited by D49 (D42) and enters pin 2 of U8 (U7). This IC, is the H-bridge driver, which produces a level shifted copy (pin 7) and a level shifted mirror copy (pin 4) of the pulse train generated from U10: A (U10: B). These HI and LO signals are sent to the current amplifiers Q20 and Q21 (Q23 and Q22), and, in turn, their individual outputs drive the final output mosfets, Q13 and Q11 (Q17 and Q15), shown on the “FET OUTPUT” circuit description page. The creation of this variable mark to space ratio pulse train acts as a carrier for the intended analog signal.

Triangular Waveform Generator

The below circuit provides the triangular waveform that is necessary to begin the modulation process for pulse width modulation (class D) amplification The output of this circuit is pin 7 of IC U9 and should be around 105khz +- 10%. Basically, this is a multivibrator circuit using R157/C79 to provide the oscillation necessary for waveform formation. Z7 and Z8 limit the level of this output to 6.2vpp.



Any fault in this circuit will prevent the amplifier from operating. Verification of operation at this stage can be determined by the output waveform at pin 7 U9.

Troubleshooting Guide

The purpose of the troubleshooting guide is to provide the technician with test point information that will lead to a timely, successful repair of the malfunctioning equipment. The ultimate goal of customer satisfaction should always be kept in mind.
The most effective way to troubleshoot this equipment requires the following:

- Understand the correct operation.
- Obtain as much information as possible concerning the existing abnormalities with the equipment from the customer. Ask the five questions of where, why, what, how and with whom the problem occurred. Most likely, after obtaining the answers to these questions, the technician will have a pretty good idea of where in the circuit to begin a fruitful and time efficient session of troubleshooting.

Sometimes, though, this information is not available and the technician has to proceed with caution to reproduce the problem. Once the problem has been verified, further troubleshooting of the specific defective stage by voltage, impedance and oscilloscope waveform analysis leads the technician to the faulty components or connections.

A note on component replacement: It is always wise to use the original JBL replacement components that are listed in the master parts list to insure the maximum performance of JBL equipment. For more ordering information, contact the website at www.JBLPROSERVICE.com.

Although, the SF22SP is a most reliable piece of equipment, failures do occur. They are classified according to their acuteness with respect to operation. Any failure with the PWM amplifier can cause total failure of the output.
The guide is separated into the three parts:

- Common Symptoms
- Excessive Current Drawn/Power Supply Problems
- Equipment Test Points

Please refer to the schematic diagrams for the component identification numbers that are used within this guide. Each
\Each problem exhibited is different and will require various troubleshooting methods to be initiated.

COMMON SYMPTOMS

No Operation—Completely Dead

This indicates a possible power supply problem.
Check Main fuse, F1, and verify continuity.
If open, determine short circuit origination through resistance and replace fuse. Use a variac with an isolation transformer to prevent further damage to equipment by slowly increasing the applied voltage to the equipment under observation.

The amplifier pilot lamp lights up upon turn on but the protection relay cannot be heard to disengage.

This indicates a possible protection/muting circuit problem. Verify proper input signal level to eliminate this cause for malfunction.
The technician can verify proper operation of the circuit or the existence of an open relay by checking the base voltage on Q3. Monitor and check to verify during power up. If the base voltage toggles after approximately 10 seconds after power up, the protection circuitry is working ok, and "continuity-wise" the relay checks ok, suspect a bad relay driver transistor, Q3, and/or faulty connections.

All operating voltages appear ok, but equipment has no output.

This indicates a possible open within the input circuit or associated circuitry.
Connect a sine wave input and verify signal at volume control wiper output of potentiometer.
Further troubleshoot the input PCB according to the results above by following the INPUT TEST POINTS listed under page one as outlined below.

EXCESSIVE CURRENT DRAWN/POWER SUPPLY PROBLEMS

The current increases linearly when applying only a few volts AC:

This indicates a major short in the equipment—possibly in the power supply.
Disconnect AC power and check the following items for a direct short to ground. Check major components directly hardwired to ground or across the high voltage supplies, which include the mosfet outputs
(Q11, Q13, Q15, Q17), drivers (Q23, Q22, Q21, Q20);
If ok, proceed and verify Bridge Rectifiers, BR1 and BR2.
If ok, proceed to check the clamping diodes, D40, D37, D47, and D44.
If ok, proceed to check for shorted power supply capacitors, C1, C4, C15 and C16.

The current increases more slowly. May reach 15-20 volts before current drawn becomes excessive.

This indicates a short in the secondaries of the circuit, voltage breakdown of a component or, possibly, a short in the low voltage power supply.
Disconnect the AC power so as not to add more damage and check the following:
the +- 15-volt supplies (Q6 and Q8) for a shorted component.
If ok, proceed to disconnect PWM fuses FB1 and FB2. If this corrects the high current drawn, it is safe to assume the problem lies within the PWM amplifier and
the technician should proceed to PWM TEST POINTS below.

Equipment Test Points

PAGE 1 INPUT CIRCUITRY

TP XLR IN *Should measure the input signal to verify signal integrity.

TP PIN 1 U201 Should measure sine wave signal.

TP JK201 Should measure the input signal to verify signal integrity.

TP PIN7 U203 Should measure input signal to verify signal integrity

TP PIN1 U203 Should verify operation of speaker level input IC etc.

PAGE 2 PHASE INVERSION/FILTERING/DETECTOR CIRCUITRY

TP PIN1 U204 Should measure signal input to verify phase inversion when toggling S202.

TP PIN 7 U204 Should measure for signal integrity.

TP PIN 7 U205 Should measure for signal integrity.

TP R262 Should measure phase inverted for signal integrity.

TP LEG R268 Should measure +15 volts.

TP PIN7 U207 Verify limiting circuit voltages for proper operation.

PAGE 3 SOFT START, POWER SUPPLY, FINAL OUTPUT EMI FILTERING,

PROTECTION CIRCUITRY

TP BR1, BR2, Should measure +/- 50 volts DC

TP FB1 FB2 With the absence of power, should measure continuity

TP Collector Q3 Should toggle after about 10 seconds—this indicates non-detection of any abnormalities such as temperature, DC offset, excessive current draw exist. Soft start circuitry is working ok.

TP PIN7 U6 Should read a difference voltage of +15 volts between input/output.

TP LEG OF R110 Should read +15 volts

TP LEG OF R128 Should read -15 volts

EMI 4th Order LC Filter

PAGE 4 PWM TEST POINTS FOR SWITCHING AMPLIFIER (FLOATING GND.)

TP PIN7 U9 triangular waveform 93.1KHZ FREQ

TP PIN 1 U9A Signal inversion when compared to input pin 2.

TP PIN 1, 7 U10 Output of summation of signal with triangular waveform

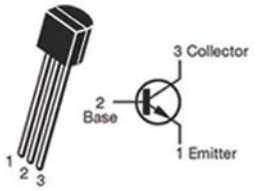
TP PIN2 U7, U8 Should be modulated sawtooth waveform

TP PIN 6 U7, U8 Should be modified square wave and these waves will be mirror copies of one another.

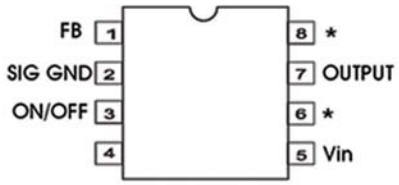
* TP = test point

Semiconductors Diagrams

MPS2N222
MPSW06, 2N5551

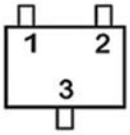


STEP-DOWN VOLTAGE REGULATOR
LM2574



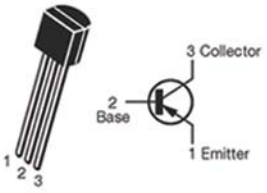
★ No internal connection, but should be soldered to PC board for best heat transfer.

* MMBT3904LTI SOT23,
* MMBT3906LTI SOT23,
* MMBT5401 LTI,
* MMBT5551 LTI

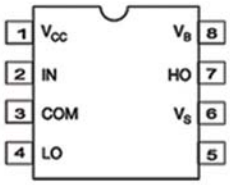


1) Emitter
2) Base
3) Collector

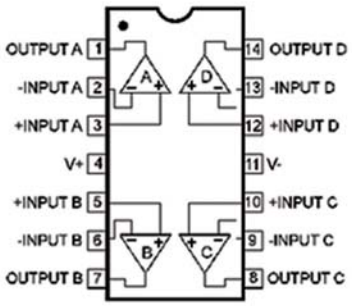
MPSW56, MPS2907A
2N5401



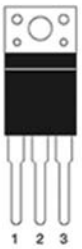
HALF-BRIDGE DRIVER
IR2111



OPAMP, QUAD DIL
TL074

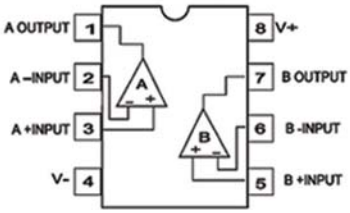


VOLTAGE REGULATOR
LM317T, LM337T

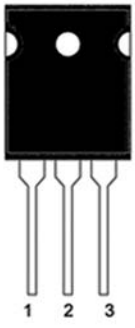


1. ADJUST
2. V OUT/TAB
3. V IN

OPAMP, DUAL
TL072CDR SO-8



MOSFET
IRFP250N



1. GATE
2. DRAIN
3. SOURCE

SF22SP
Final Test Procedure

INITIAL POWER UP TEST

Setup—Serially connect a variac, isolation transformer and ammeter. Connect unit under test to variac. Subwoofer polarity switch should be toggled to the IN phase position. Volume control at fully CCW position and no load.

- Slowly increase the variac output voltage monitoring for excessive current usage
- Idle current should be less than .5 amps
- Power switch light should be illuminated

INPUT TESTS

Setup---Monitor subwoofer output on oscilloscope with load. Volume CCW, HPF switched to THRU position.

- Apply –10 dB at 80 Hz sine wave from generator to the "A" input.
- Increase volume control fully CW. Output signal should be 22 dB, ± 1 dB.
- Toggle Sub Polarity switch to OUT position. 180-degree phase reversal should be seen on the oscilloscope.
- Repeat above test for input "B".
- Apply +10 dB at 80 Hz to speaker level ¼" phone jack. Output should be 16 dB, ± 1 dB.
- Monitor the "A" Output.
    - Sweep the input frequency above and below 120 Hz.

      Output should be constant above and below this cutoff frequency.
- Engage the HPF switch. Output should decrease below cutoff frequency.
- Perform the same test for "B" Channel.

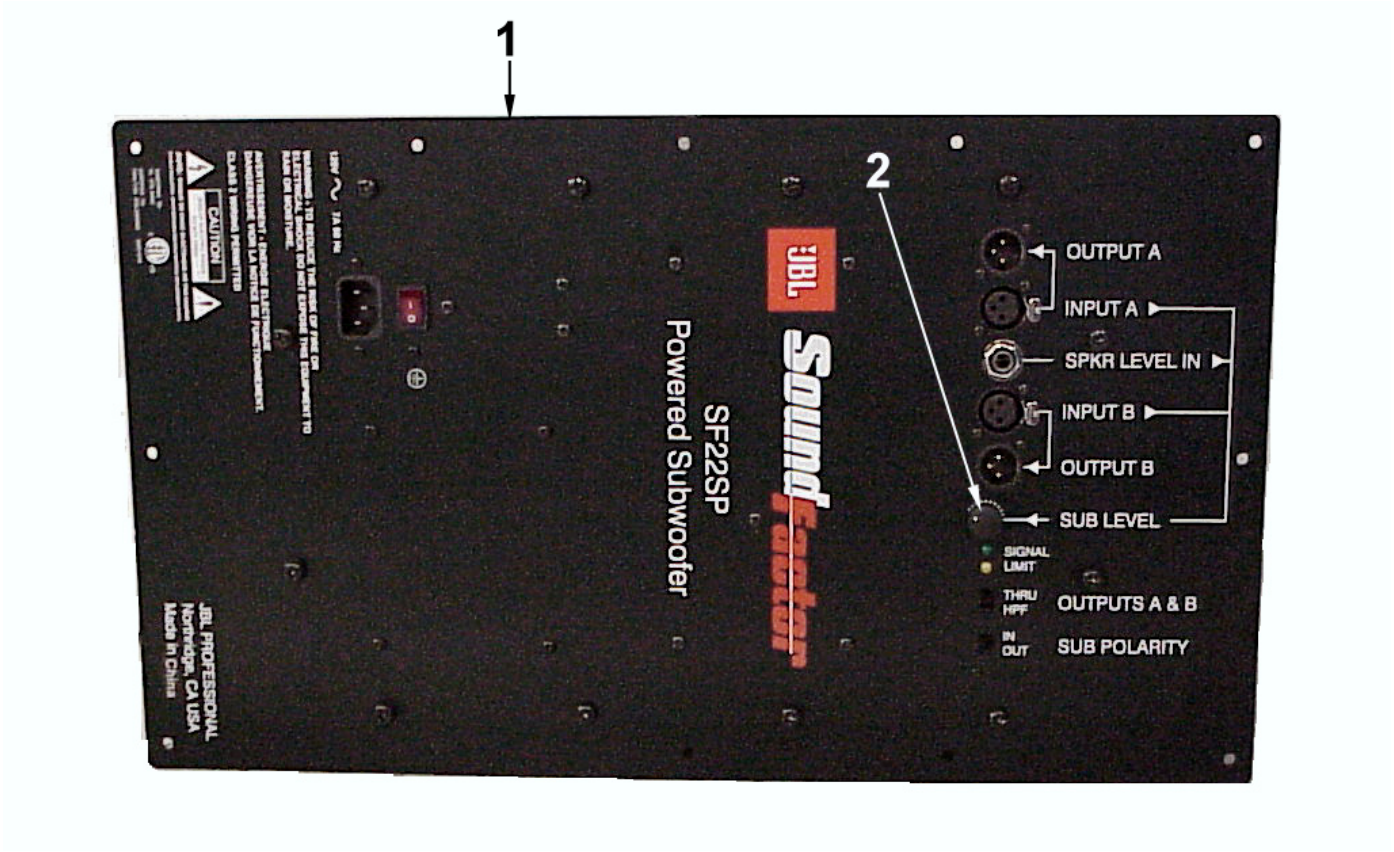
GAIN TEST

- Apply sine wave signal of 80 Hz at –10 dB to input "A".
- Measured gain should be 22 dB ± 1 dB.

OUTPUT POWER TEST

- Increase gain from generator until the limiter LED begins to illuminate.
- The output voltage, at this point, should be approximately 35 volts.

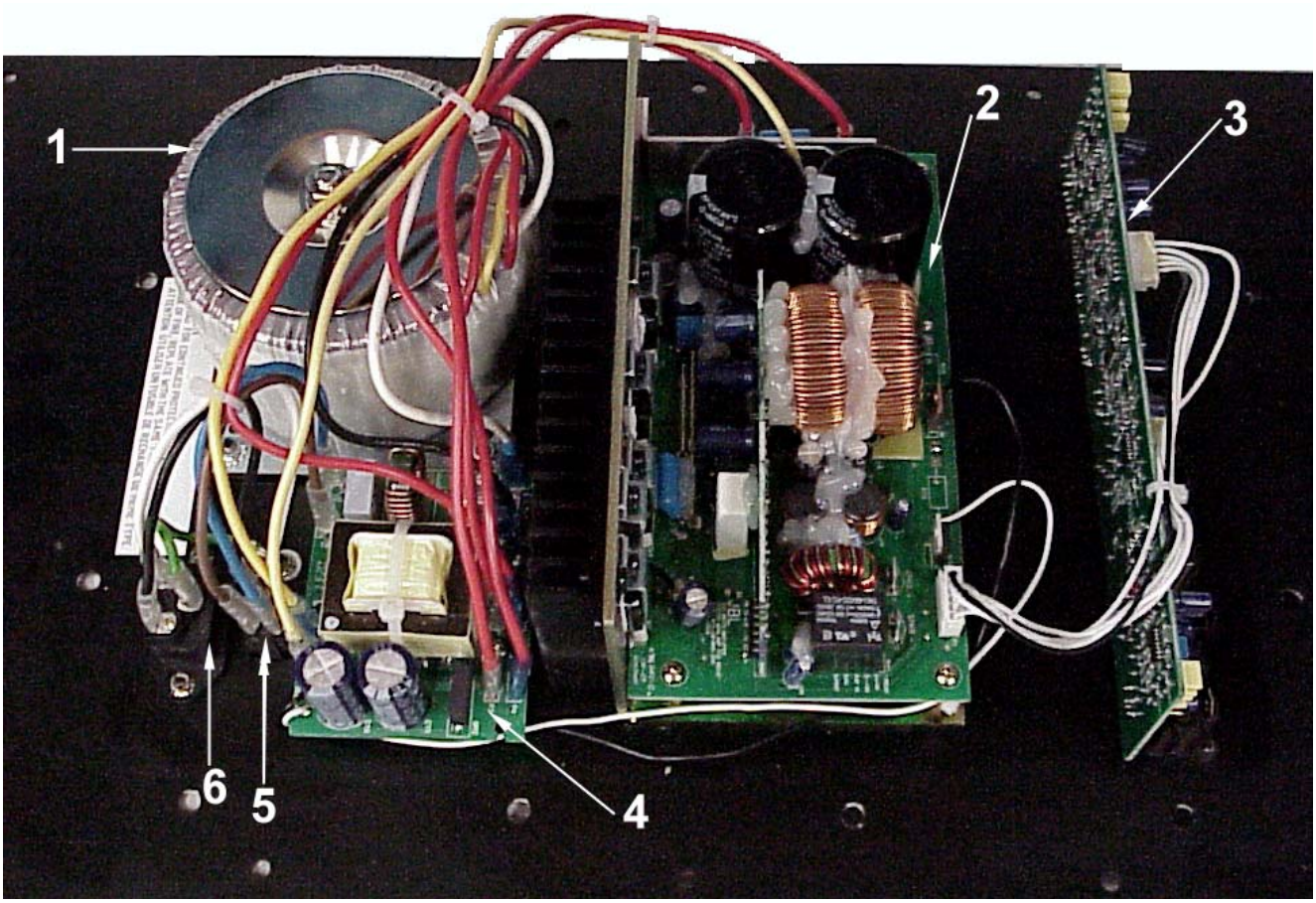
Pictorial Of Complete Amplifier Assembly



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description
1	339039-002	1	AMP SF22SP **(120V)**
	339157-002	1	AMP SF22SP **(230V)**
2	351033-001	1	PN:AC-816X11BD 16X11MM KNOB, BLACK

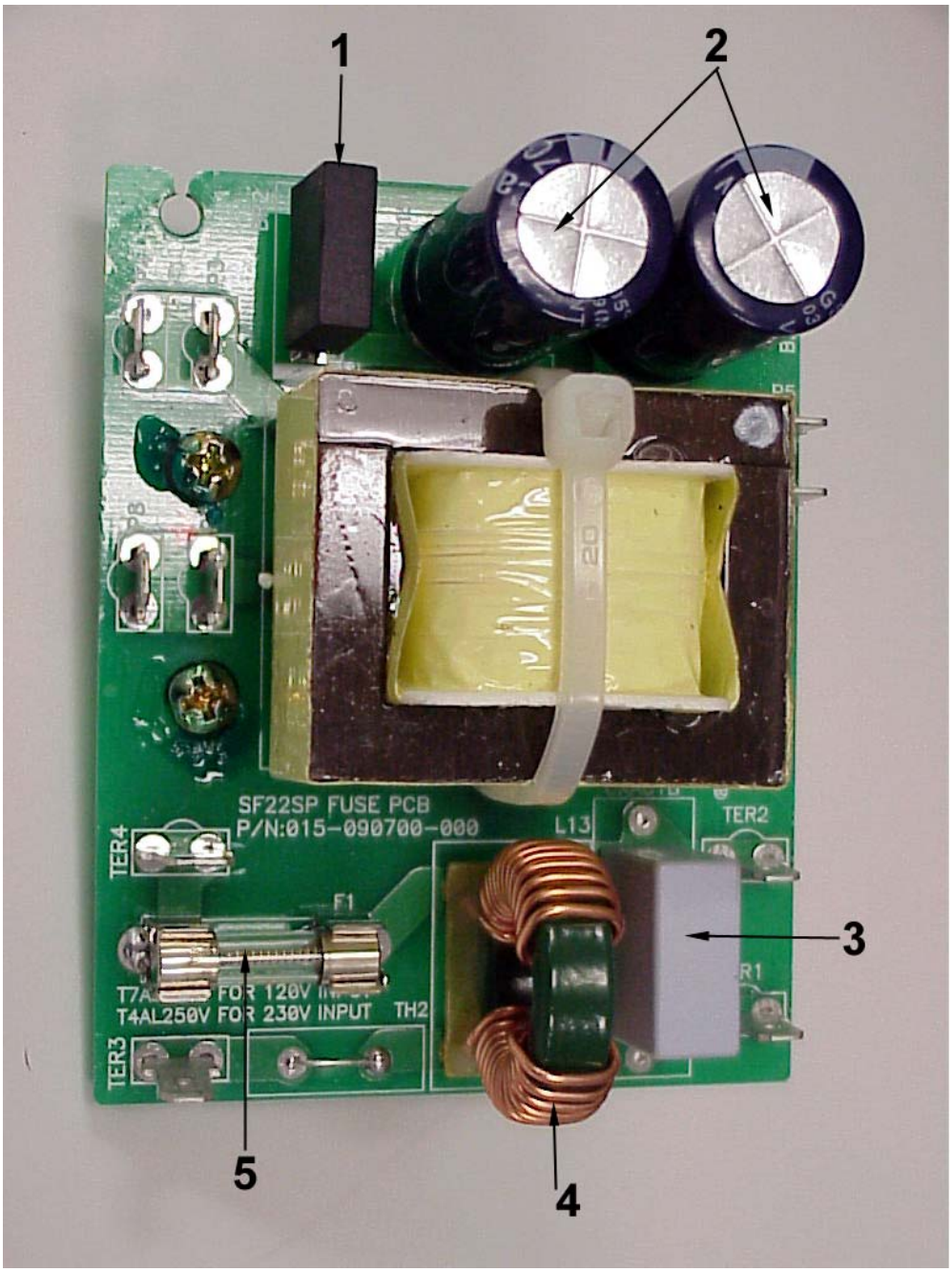
Pictorial Of Final Assembly



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description
1	351032-001	1	PN:TTO-10654-01 Torrid Transformer
2	351044-001	1	MAIN
3	351086-001	1	SF22SP Pre PCB
4	351105-001	1	FUSE/PT2 BD
5	351255-001	1	POWER SWICTH
6	351804-001	1	AC SOCKET INLET IEC

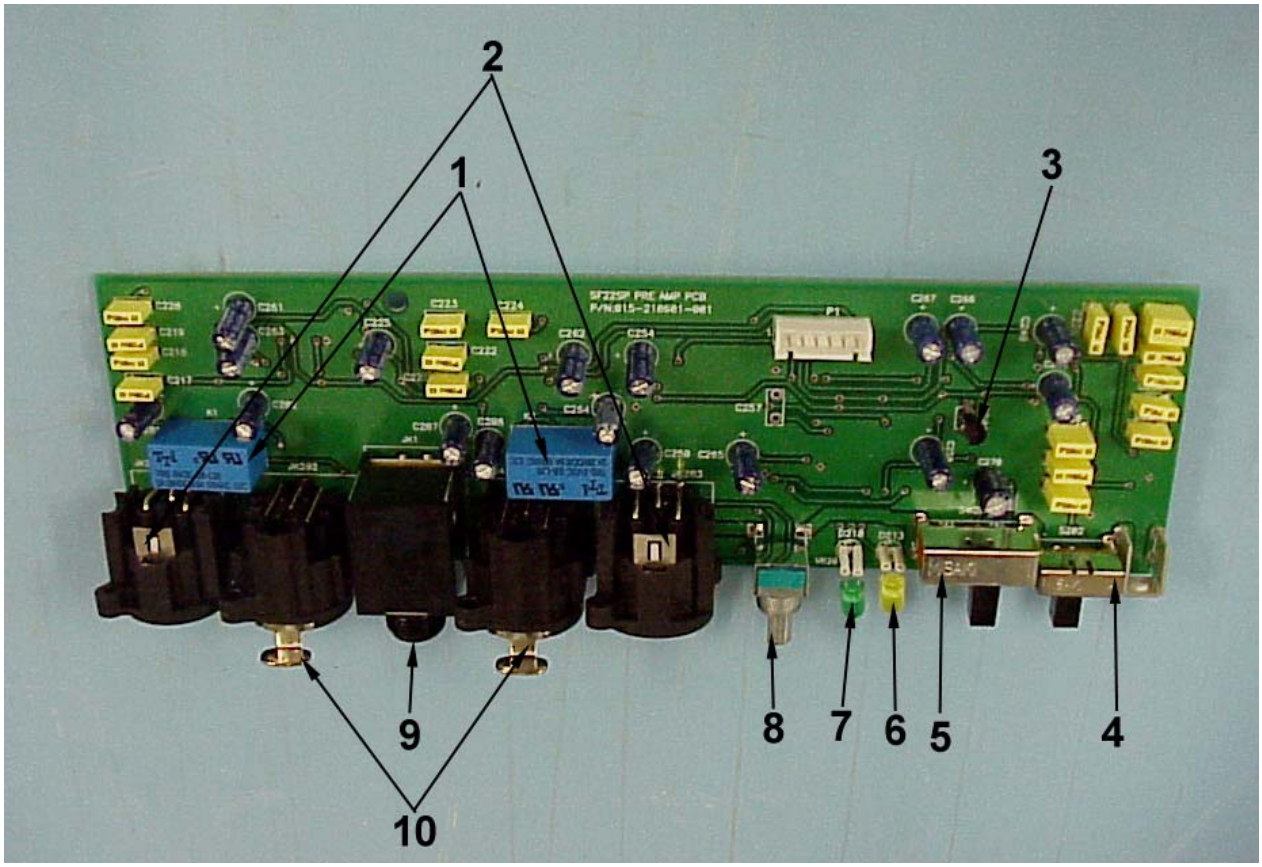
Pictorial Of Main Components On Fuse/PT2 BD



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref.Des.
1	351109-001	1	200V,2A PN:KBP202	BR2
2	351106-001	2	4700UF/25V 85C	C15,C16
3	351107-001	1	PN:XG275M224VHS2	CXAC1B
4	351108-001	1	324UH PN:XG275M224VHS2	L13
5	351110-001	1	7A/250V 5X20MM	F1

Pictorial Of Main Components On Input Board

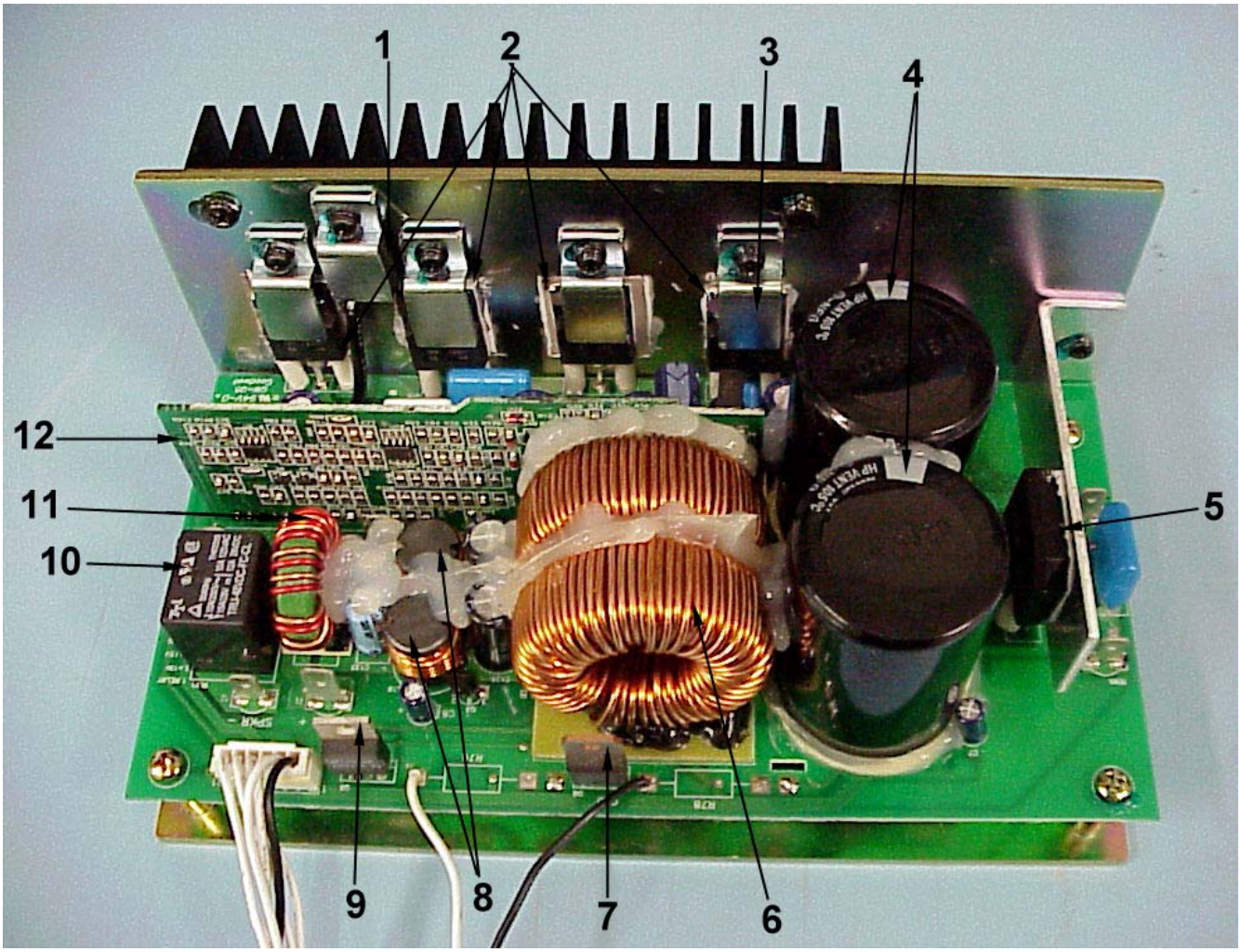


COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref.Des.
1	351104-001	2	PN:TRS-5VDC-SB-L20	K1,K2
2	351098-001	2	PN;NC3MAH	JK201,JK204
3	351090-001	1	PN:J113 TO-92 TAPING	Q206
4	351103-001	1	PN:SS004-PO12BA-PA8	S202
5	351102-001	1	PN:SS004-P242BLB-PC10	S201/SW201

Item	Part No.	Qty.	Description	Ref.Des.
6	351089-001	1	PN:LT6431-81	D213
7	351088-001	1	PN:LT6421-81	D210
8	351087-001	1	PN-:RD09L1120032-EJ	VR201
9	351100-001	1	PN:SCJ628R3 NAS1B00	JK1
10	351099-001	2	PN:NC3FAH2 (NEUTRIK)	JK202,JK204

Pictorial Of Main Components On Main Board



COMPONENT PARTS LIST

Item	Part No.	Qty.	Description	Ref.Des.
1	351047-001	1	TSE-103 K L:50MM	TH1
2	351056-001	4	PN;IRFP250N TO-247AC	Q11,13,15,17
3	351036-001	5	BRACKET FOR P. XTRS	PWR XTRS
4	351049-001	2	10000 UF/63V	C1,C4
5	351059-001	1	400V,8A,PN:RS804	BR1
6	351053-001	1	70UH PN:YT-11354-1	L8,

Item	Part No.	Qty.	Description	Ref.Des.
7	351060-001	1	PN:LM317T TO-220	Q6
8	351051-001	2	30MH YT-10033	L9,L10
9	351061-001	1	PN:LM337T TO-220	Q8
10	351070-001	1	PN:TRU-48VDC-FC-CL	RLY1
11	351052-001	1	56 UH PN:YT-11222	L12
12	351072-001	1	SF22SP DRIVE	PIN1A

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

Click here for the System Exploded View w/Parts List
http://www.jblproservice.com/pdf/Sound%20Factor/SF22SP.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/navigation/SoundFactor.html

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

JBL Incorporated, 8500 Balboa Boulevard, P.O. Box 2200, Northridge, California 91329 U.S.A.

Technical Manual

JBL SF22SP/230

SPECIFICATIONS

ACOUSTIC & ELECTRICAL SPECIFICATIONS:

- Nominal Impedance: 4 ohms
- Amplifier Power: Continous 300 W with < 0.2% THD Peak 500W
- Frequency Range: 33Hz – 125 kHz (–10dB)
- Sensitivity: 95 dB SPL (1W/1M)
- Crossover Frequency: LPF: 100Hz, 24 dB/Oct Infrasonic Filter: 25 Hz, 18 dB/Oct

SYSTEM COMPONENTS:

- Cabinet: Enclosure (Not For Sale)
- Grille: 350069-001
- Low Frequency Transducer: 300mm (12 in.) Cone Transducer (M212-8) (2)
- DC Resistance: 5.55 ohm ±.3%

AURAL SWEEP TEST SPECIFICATIONS:

A. System Aural Sweep Test: 0.5 Vrms for 300 W Output (Sub Level Control Fully Clock-Wise) Sweep 20 Hz to 150 Hz

B. L.F. Aural Sweep Test: 7.0V Input, 20 Hz to 200 Hz

PHYSICAL SPECIFICATIONS:

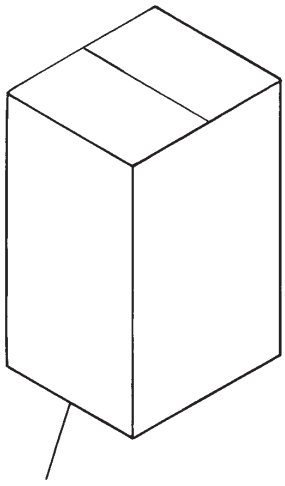
- Enclosure Dimensions: 810.3mm x 463.6mm x 850.1mm D (31.90 x 18.25 x 33.47 in.D.)
- Net Weight: 126 lbs. (57.1 kg.) (Including Casters) 339804-001

WARRANTY INFORMATION:

- Refer to Warranty Statement packed with each product.

PACKAGE

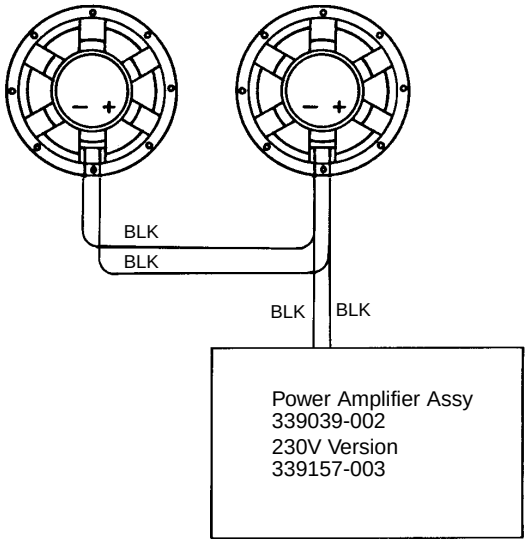
Warranty 59660
Owners Manual
350033-001



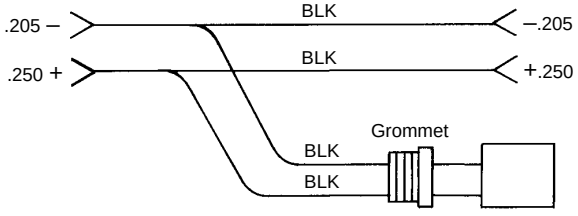
Carton
339040-01
Filler (2)
339041-001
Micro Foam (8)
49790P
Carton, Caster
350494-001
Filler, Caster
350034-001
Caster (4),
339804-001
Spkr, Pole MP255S Sub,
337315-001
Pop Sticker,
339285-001

WIRING DIAGRAM

Driver, Low Freq (2)
M212-8
339014-003

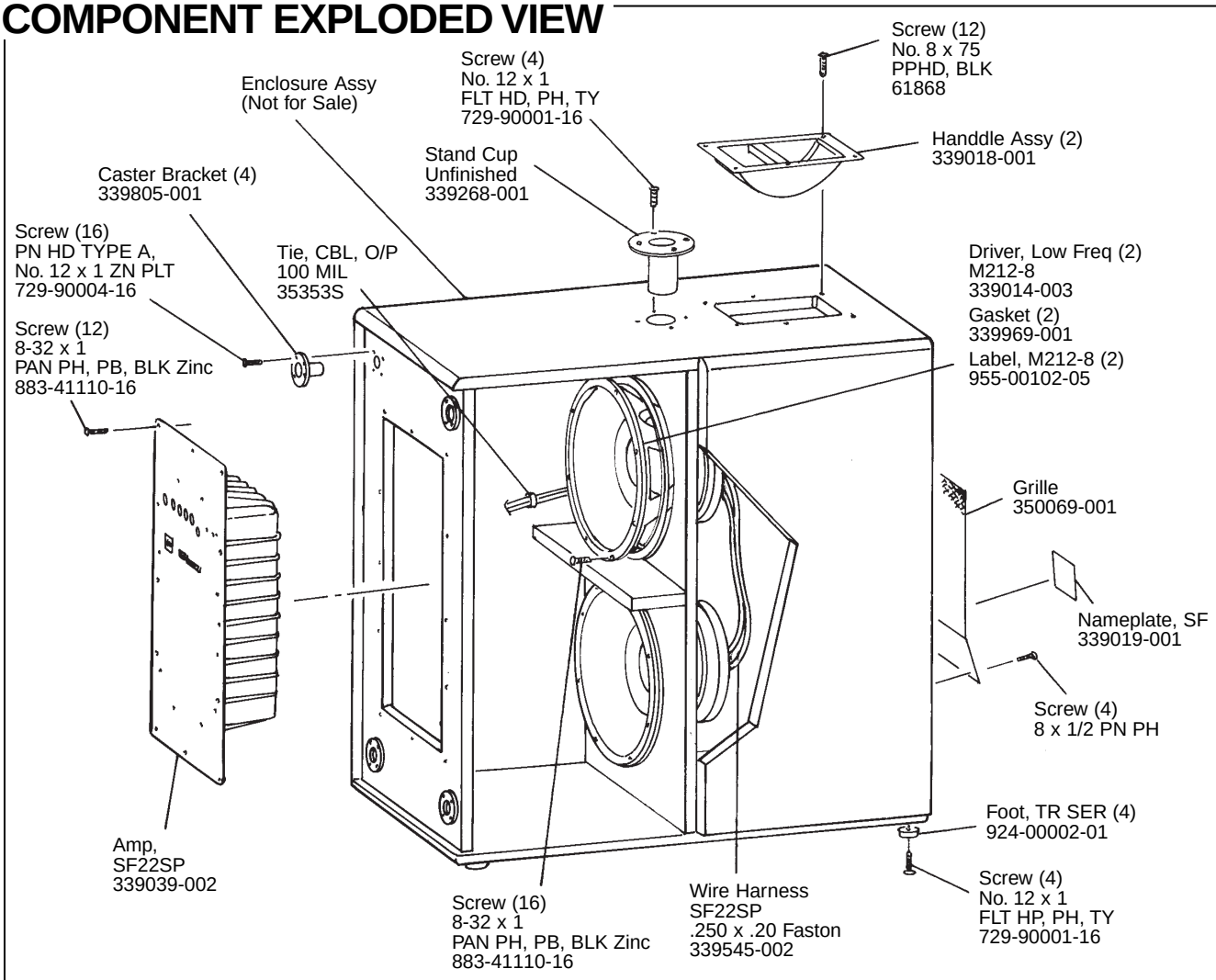


WIRE HARNESS (339545-002)

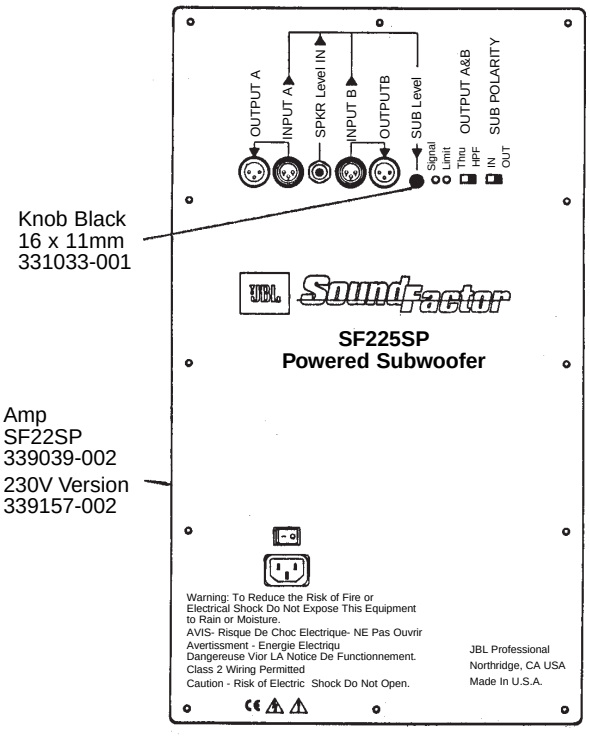


JBL SF22SP/230 REV C

COMPONENT EXPLODED VIEW



PANEL



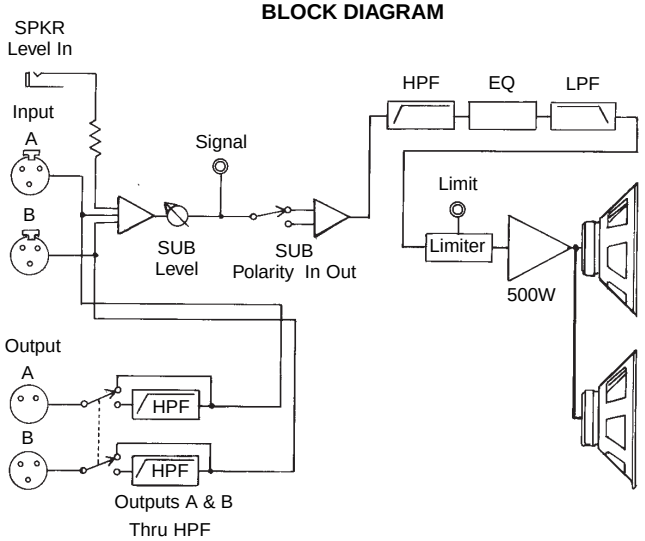
Knob Black
16 x 11mm
331033-001

Amp
SF22SP
339039-002

230V Version
339157-002

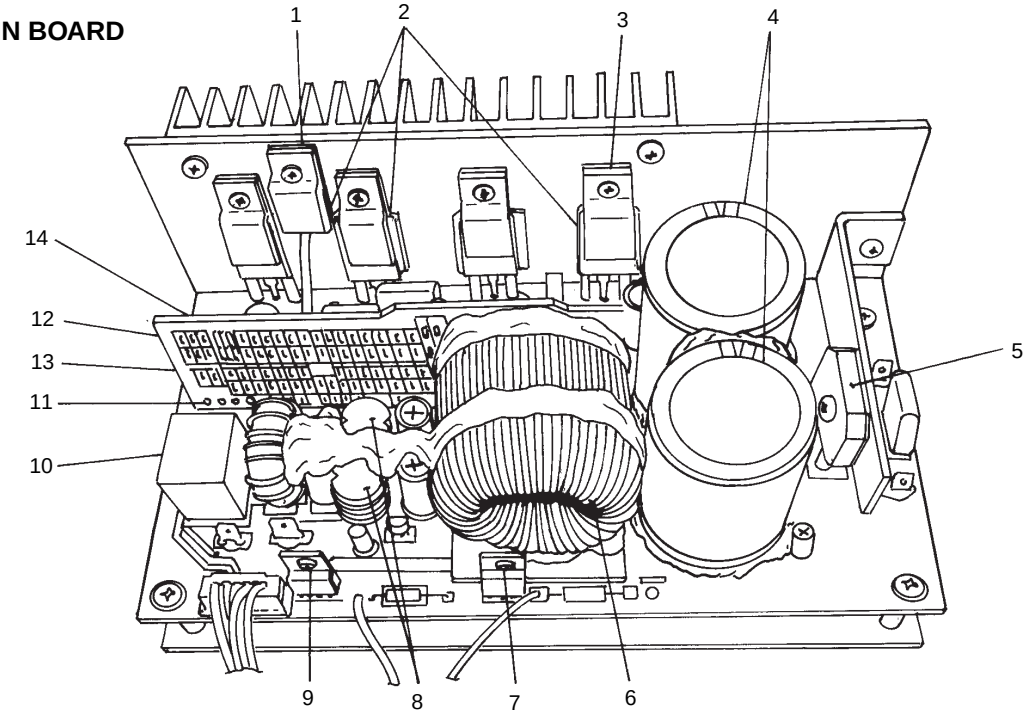
Cord AC, Line 120V
425-00000-00

BLOCK DIAGRAM



COMPONENTS

MAIN BOARD

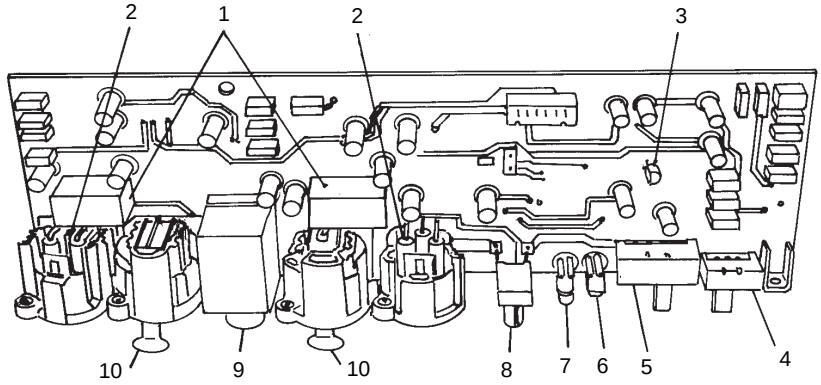


COMPONENT PARTS LIST: Main PCB 351044-001

Item	Part No.	Qty	Description	Ref. Des.
1	351047-001	1	TSE-103 K L:50MM	TH1
2	351056-001	4	IRFP250N	Q11,13,15,17
3	351036-001	5	Brkt Pwr Transistor	P. Transistors
4	351049-001	2	10000 UF63V	C1, C4
5	351059-001	1	400V, 8A	BR1
6	351053-001	1	70UH	L8
7	351060-001	1	LM317T	Q6

Item	Part No.	Qty	Description	Ref. Des.
8	351051-001	2	30MH	L9, L10
9	351061-001	2	LM337T	Q8
10	351070-001	1	48VDC RELAY	RLY1
11	351052-001	1	56 UH	L12
12	351072-001	1	SF22SP DRIVE	PIN 1 A
13	351398-001	1	7 PIN CONN	
14	331399-001	1	11 PIN CONN	

INPUT BOARD



COMPONENT PARTS LIST: Input PCB 351086-001

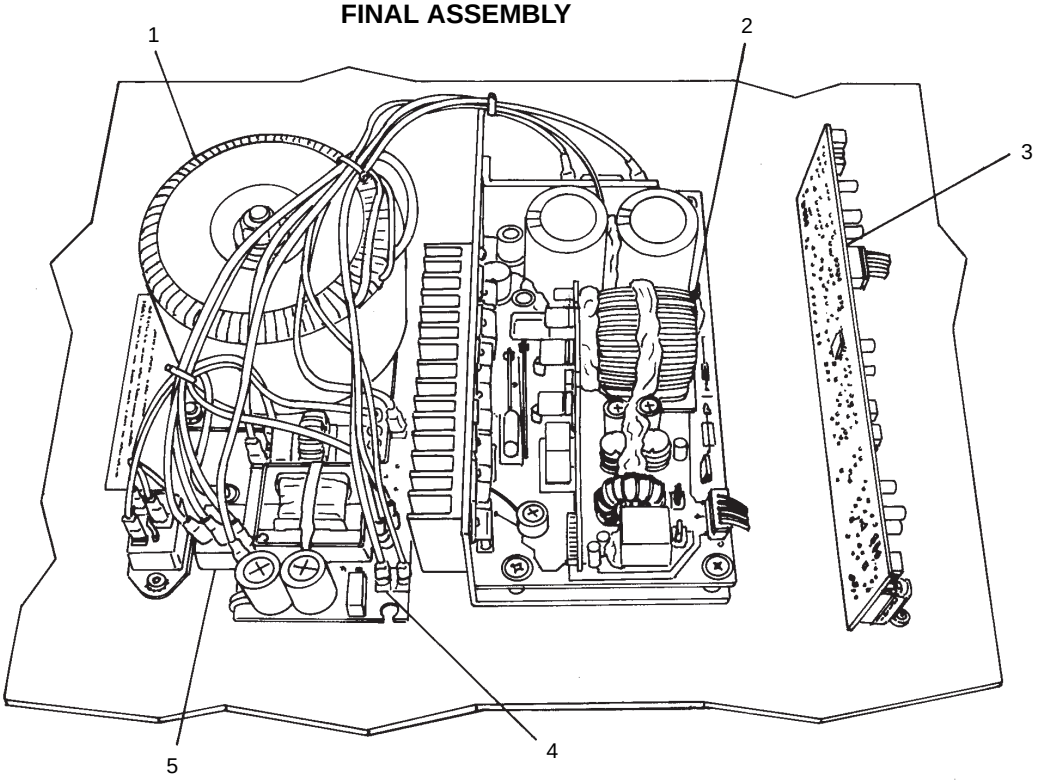
Item	Part No.	Qty	Description	Ref. Des.
1	351104-001	2	TRS-5VDC	K1, K2
2	351098-001	2	PN: NC3MAH	JK201,JK204
3	351090-001	1	J113	Q206
4	351103-001	1	PO12BA-PA8 SW	S202
5	351102-001	1	P242BLB-PC10 SW	S201/SW201

Item	Part No.	Qty	Description	Ref. Des.
6	351089-001		PN: LT6431-81	D213
7	351088-001	1	PN: LT6421-81	D210
8	351087-001	1	PN: RD09L1120032-EJ	VR201
9	351100-001	1	PN: SCJ628R3 NAS1B00	JK1
10	351099-001	2	XLR (NEUTRIK)	JK202,JK204

JBL SF22SP

COMPONENTS

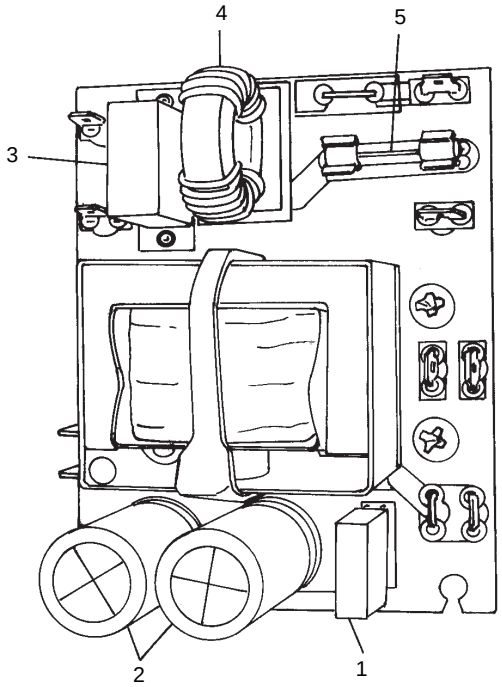
FINAL ASSEMBLY



COMPONENT PARTS LIST: Final Assembly

Item	Part No.	Qty	Description
1	351032-001	1	PN:TTO-10654-01 Toroid Transformer
2	351044-001	1	Main
3	351086-001	1	SF22SP Pre PCB
4	351105-001	1	Fuse/PT2 BD
5	351255-001		Power Switch

FUSE – PT2 BD



COMPONENT PARTS LIST: Fuse PT2 BD 351105-001

Item	Part No.	Qty	Description	Ref. Des.
1	351109-001	1	200V, 2A	BR2
2	351106-001	2	4700UF/25V 85C	C15, C16
3	351107-001	1	PN:XG275M224VHS2	CXAC18
4	351108-001	1	324UH	L13
5	351110-001	1	7A/250V 5X20MM	F1

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SF15.pdf

SF22SP/230

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120V Main Amp Schematic.pdf

120V Fuse Schematic.pdf

230V Main Amp Schematic.pdf

230V Fuse Schematic.pdf

120V/230V Pre-Amp Schematic.pdf

SF25.pdf