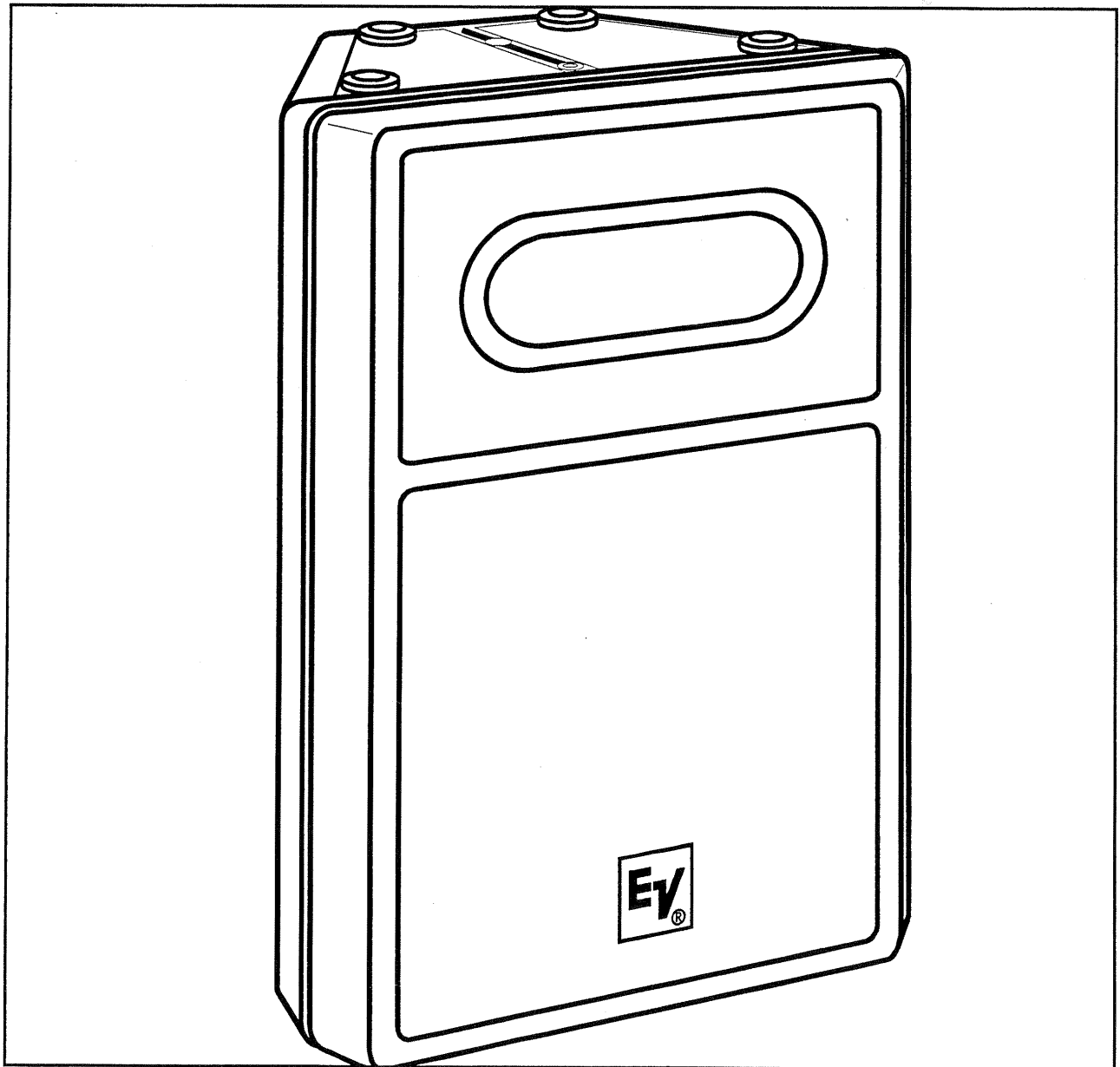




Electro-Voice[®]

Sb120a/CE Amplifier Service Notes

SERVICE MANUAL



SB120A/CE AMPLIFIER

'CE' CERTIFIED SB120A SERVICE NOTES

The EV Sb120a/CE amplifier consists of two PCB assemblies; a switching power supply, and a switching (Class D amplifier). All of the power supply circuitry on the primary side of the power transformer is not isolated from the AC mains, thus an isolation transformer is **HIGHLY RECOMMENDED** when servicing this assembly. The $\pm 80\text{VDC}$ power supply output *is* isolated, so the amplifier's 'ground' *is* Earth Ground when used with the power supply. The amplifier's back plate and output return lug are also earth ground connections.

Switching Power Supply Description:

The power supply schematic indicates two 'ground' symbols: (live mains) and (earth). If an isolation transformer is used, the oscilloscope probe grounds may be connected to either of these nodes, **but not at the same time** as these two grounds are separated by high voltage. Oscilloscope measurements can be meaningless or even dangerous if the scope's ground is connected to anything other than earth and an isolation transformer is not used.

The power supply topology is a special type which corrects the Power Factor of the mains while at the same time providing an isolated and loosely regulated $\pm 80\text{VDC}$ to the amplifier. The topology is a unique combination of a **'boost' topology** commonly used for as a power factor corrected 'pre-regulator' and a **'push-pull forward converter' topology**. This hybrid topology has the advantage of supplying an **isolated and regulated high power $\pm 80\text{VDC}$** with a **power factor corrected input**, but requiring far fewer components than a traditional switch-mode solution providing both these features. As shown in figure 1, the mains voltage is

rectified, then fed through an energy storage power inductor (L2, used as a 'boost' inductor). The output of the inductor is fed to the center tap of a 'push-pull' power transformer. In a normal push-pull converter the transistors, Q1 and Q2 are switched on and off with a specific dead time, feeding the transformer with a high frequency alternating voltage.

In the push-pull boost topology, the transistors are never both off at the same time. When operating is the 'boost' state, the conducting time of the transistors is overlapping and thus shorting the transformer primary. This is the same condition as when a standard boost converter has it's single transistor on and is charging the boost inductor, L2.

The switching durations and overlap times (determined by the control IC, U2) serve to correct the power factor and regulate the output voltage. In this case 'power factor' does not refer to a phase shift of mains voltage and current, but to the high harmonic content present in the input current waveform caused by the large electrolytic bulk input capacitors. (These capacitors and poor power factor are also present in amplifiers with traditional linear power supplies). The Sb120a/CE power supply topology serves to control how the mains input current charges the bulk capacitors, C3 and C4. It's goal is to make the input current's shape look exactly the same as the input voltage's shape - sinusoidal. Figure 2 shows two mains current waveforms for equivalent power delivery, one with poor PF, the other with corrected PF.

The secondary voltage of the transformer is rectified and directly fed to the bulk storage capacitors, which charge to the peak secondary voltage, unlike the traditional push-pull converter which would need two large inductors in the output filter.

Figure 1 — Block diagram of Boost Push-Pull Forward Converter with Active Power Factor Correction

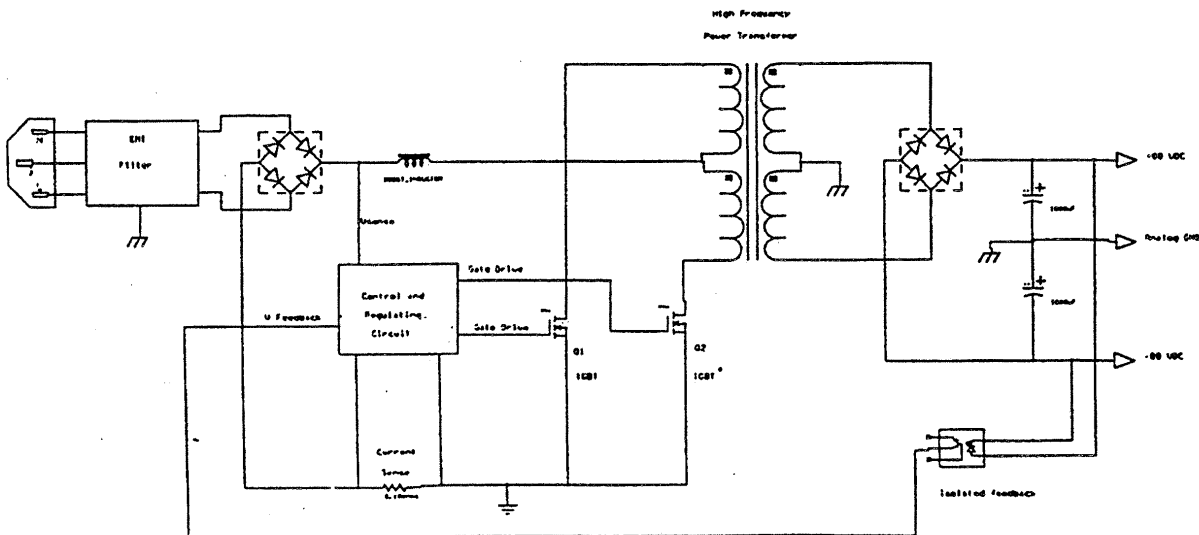
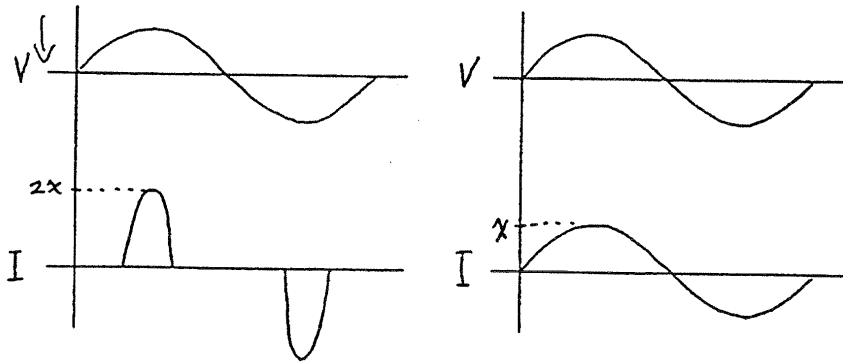


Figure 2 — Mains input current waveforms for corrected and uncorrected power supplies



a) Mains U and I with Poor Power Factor

b) Mains U and I with very good Power Factor

AMPLIFIER DESCRIPTION:

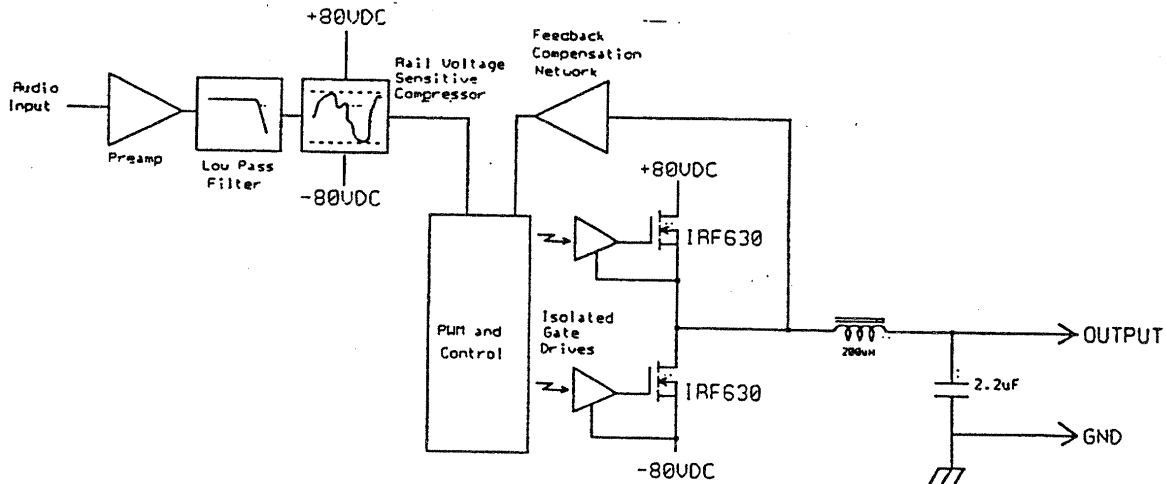
The Sb120a/CE amplifier operates very similarly to the original non-certified Sb120a, but the use of a special control IC, U3, has replaced much of the discrete circuitry. The topology is termed 'Class D' because the power stage operates in a non-linear mode. There are disadvantages to this (circuit complexity, RF interference, etc.), but in a powered speaker application it's advantages outweigh the disadvantages. Because the output devices in a class D amplifier act like open or closed switches, the power devices only experience high voltage and high current for nanoseconds each switching cycle, rather than continuously like the familiar class AB audio amplifier. Because of this, class D amplifiers are at least three times more efficient than their linear equals.

Most class D amplifiers use Pulse Width Modulation (or PWM) to encode the audio signal into a 'digital' (this term used loosely) format. The theory behind PWM is simple. It cannot be argued that the 'average DC value' of a perfect bi-polar square wave is zero, not matter how high the voltages are. If the

positive half period of the square wave is 100 volts for 1uS and the negative half period is -100 volts for 1uS, the average is still zero. Because of this symmetry, a square wave is said to have 50% 'duty cycle'. What if the duty cycle were instantly change to 60%? This means that the positive portion of the pulse would now be longer than the negative portion. The average is no longer zero, but some value *greater than zero*. A pulse width modulator is a circuit which instantly changes a pulse train's duty cycle greater or less than 50% in direct response to the audio input. Switching power supplies operate in much the same way except that the duty cycle doesn't change in response to an audio signal, but a DC 'reference signal' which changes in response to line and load conditions.

The resulting high-power PWM pulse train is continuously 'averaged' by a two pole LC output filter to convert the high-voltage, high-frequency signal back into a high power amplified version of the original audio signal.

Figure 3—



POWER SUPPLY DETAILS: (REFER TO ATTACHED SCHEMATIC DIAGRAM)

Mains voltage is supplied through the IEC/RF filter assembly mounted to the amplifier back plate. Referring to the power supply schematic further RF filtering is performed by C8-12 and L4. The SCR, D25, and surrounding circuitry comprise a soft-start function. At turn-ON power is delivered to the Sb120a/CE assembly through R7, a 56 power resistor. C13 will eventually charge through R8, causing D25 to latch ON, thus bypassing the 56 soft-start resistor. If D25 has failed, R7 will become very hot, and limit the amplifier output power.

The rectified (but still not filtered) mains voltage is supplied to the center tap of the push-pull power transformer through the 'boost' energy storage inductor (as well as RF filter inductor L4).

When both ends of the transformer primary are pulled low through Q1 and Q2, the transformer will look like a closed switch, thus causing the boost inductor's current to ramp up, storing energy in its magnetic field. If either Q1 or Q2 now opens (not both!) the boost inductor's field will begin collapsing, thus coupling energy through the transformer and into the bulk capacitors, C3 and C4.

The center tap of the power transformer sees extremely high voltage spikes (several hundred volts) associated with the leakage inductance of the topology. C6, R37, D1 and D16 serve as snubbers to protect Q1 and Q2. The power FET, Q3, and all associated circuitry act as a powerful 'active' snubber. If the voltage spikes get large enough, they trigger the gate of snubber FET Q3, causing it to turn on. This effectively shunts the spike energy to ground.

Mains current is sensed by R5. This information is delivered to the control IC via the 'shunt' line.

The power supply circuitry is powered by a slave winding on the power transformer (pins 8 and 9) which steals enough energy to power the control electronics. This +22Vdc source is supplied through D11, D17, and filtered by C1. Since this winding is located on the same transformer core as the output winding, any increase in output voltage will also cause an increase in the voltage present at transformer pins 8 and 9. Overvoltage conditions are sensed by the D12 network connected to pin 8. If this voltage gets too high (which would destroy the amplifier), SCR D13 is latched on, thus shutting down the entire power supply. The supply can only be restarted by cycling the mains power off and then on to reset the SCR.

To provide voltage regulation, the $\pm 80\text{VDC}$ output voltage is sensed across R35,36 and used to drive the shunt regulator U5, which is in turn used to provide a control current to the TL191 opto-isolator. An isolated feedback voltage directly proportional to

the $\pm 80\text{V}$ output is now present across R34.

The specialized power factor correction control IC, U2, uses mains voltage level, mains voltage shape, mains current shape, and voltage feedback from R34 as control inputs. Its output is a pulse stream from pin 16 that is used in conjunction with the IC's clock signal to provide necessary gate drive signals to the power IGBT's, Q1 and Q2. Logic circuits U3 and U4 help accomplish this as well as make sure that both gate drive signals are never both low at the same time. This is especially necessary at start-up, when the control IC has not had a chance to stabilize.

Q4 and Q5 are simply buffered and semi-regulated voltage sources derived from the +22V source.

AMPLIFIER DETAILS:

It is recommended that during troubleshooting the amplifier PCB assembly be powered by a $\pm 15\text{VDC}$ bench supply and a variable 0 to $\pm 80\text{VDC}$ bench supply. It is not required that the high voltage supply be regulated, but it should be fused. Before connecting the $\pm 15\text{VDC}$ supply, one should disable the resistor/zenor regulator by disconnecting one leg of both R37 and R38. The control section can now be powered-up independently from the power section.

The audio input is applied to connectors on the small PCB (amplifier schematic), and is passed through RF filters before being applied to the differential input U1/A. Buffering, gain adjustment, and high pass filtering is accomplished by U1/B and U1/C. R54 provides +0, -6dB gain control before passing through the uniquely configured hard-knee compressor circuit, U5/A and U7. U7 has no effect until the output of U5/A (pin 1) surpasses either reference voltage present at the U6 comparator pins 5 and 6. When this happens, C23 will begin charging, causing U7 to 'suck' a mirror image current from U5 pin 2's input node. This serves to attenuate the audio signal, and prevent hard clipping of the audio waveform, regardless of how bad the $\pm 80\text{V}$ power supply rail voltages are sagging. Compressors are typically noisy, therefore this one is configured to pass audio only when necessary to prevent clipping, not all the time, when its output noise would be more objectionable.

Op-amp U5/B is configured as a comparator, to change the bi-color LED from green to red during hard limiting conditions.

Back to the amp schematic the low pass signal is passed on to the error amplifier inside the PWM control IC, U3, to be converted to two 'digital' signal streams delivered out U3 pins 4 and 7. These two ± 15 volt, approximately 130kHz signals (one is an inverted replica of the other) are fed to the high-speed optocouplers, U1 and U2. Resistors R20-23 serve to assure a finite 'dead time' between the fall

of one output pulse and the rise of the corresponding pulse. This is insurance that both power FETs will never turn on at the same time. The input side of both optocouplers is referenced to earth ground. The output of U1 is referenced to -80VDC, the output of U1 is referenced to the source pin of FET Q4 - this 'pseudo-ground' bounces back and forth between $\pm 80V$ at 130Khz, with Q4's gate drive signal riding on top. This signal is not easily measured without a differential oscilloscope probe, but it is usually not necessary to do so.

The optically isolated gate drive signals are buffered by Q1,6 and Q2,5 before being applied to the gates of the power FETs, Q3 and Q4. The modulated switching action of Q3,4 causes a variable duty cycle square wave to be applied to the left side of the output filter, L1. C3 and C4 finish the LC filter section, with a -3dB point at about 7.6 KHz. C30,31 and L3 are RF filters. The gate drive circuitry is powered by the $\pm 80V$ rails, through R1 and R2, and regulated and filtered by D3,6 and C5-8.

Comparator output U6-14 serves as a start-up delay, to keep both gate drive outputs inactive for a few seconds until all power sources have stabilized. After a few seconds, the U6-14 output will fall to approximately -15V to enable the amplifier.

U3's triangle wave present on pin 2 bounces back and forth between the threshold voltages set at pins 1 and 3. The resistor on pin 18 programs the input current into the internal clock circuit which then sets the frequency of the triangle wave (approximately 130khz).

All passive components surrounding and including U4/D comprise the 'error amplifier' and 'feedback compensation.' This frequency dependent circuit adjusts the amount of feedback gain so as to maximize feedback within the audio passband but at the same time provide an adequate margin of stability. As gain is increased, THD+N is improved, but too much causes the amplifier to oscillate.

Be aware that the presence of the feedback loop will usually prevent **any** circuit operation unless everything is functioning correctly. It is usually very helpful during troubleshooting of the amplifier to use $\pm 15V$ bench power supplies across D9 and D10 (lift one end of R41 and R14), and then bring the high voltage up slowly with an isolated, rectified, and filtered variac output. While bring up the high voltage, use a scope probe to monitor the center point of L2. If a DC voltage proportional to the variac output is seen, this indicates a fault. The problem should be solved before increasing the variac any further.

A normal amplifier should display a stable rounded 130khz 'square' wave, with the square wave's corners becoming increasingly sharper as the voltage

increases. You should connect an 8 Ω load to the amplifier's output to damp the Q of the LC output filter. Otherwise the output square wave may not appear stable.

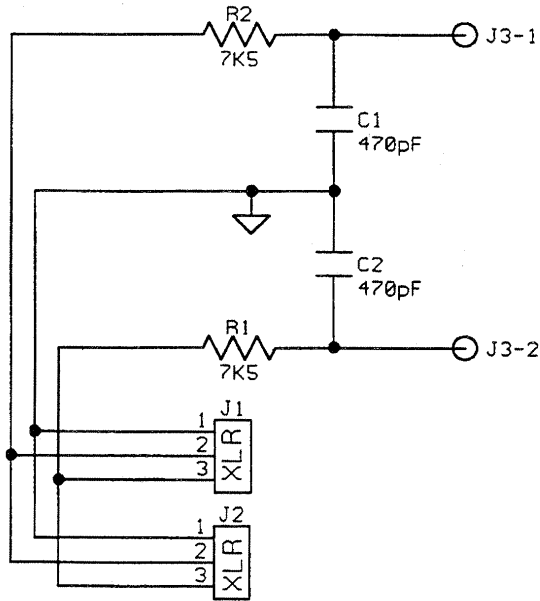
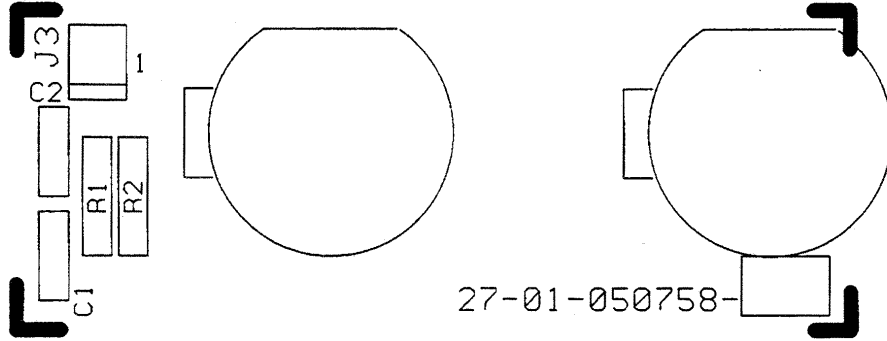
The importance of 'dead time' becomes evident when one observes that unlike the power supply circuitry, an immediate failure would occur if both amplifier FETs were ON at the same time. Therefore the gate drive signals are delayed in such a way that prevents this from occurring. A short time exists between every switching cycle when both FETs are OFF.

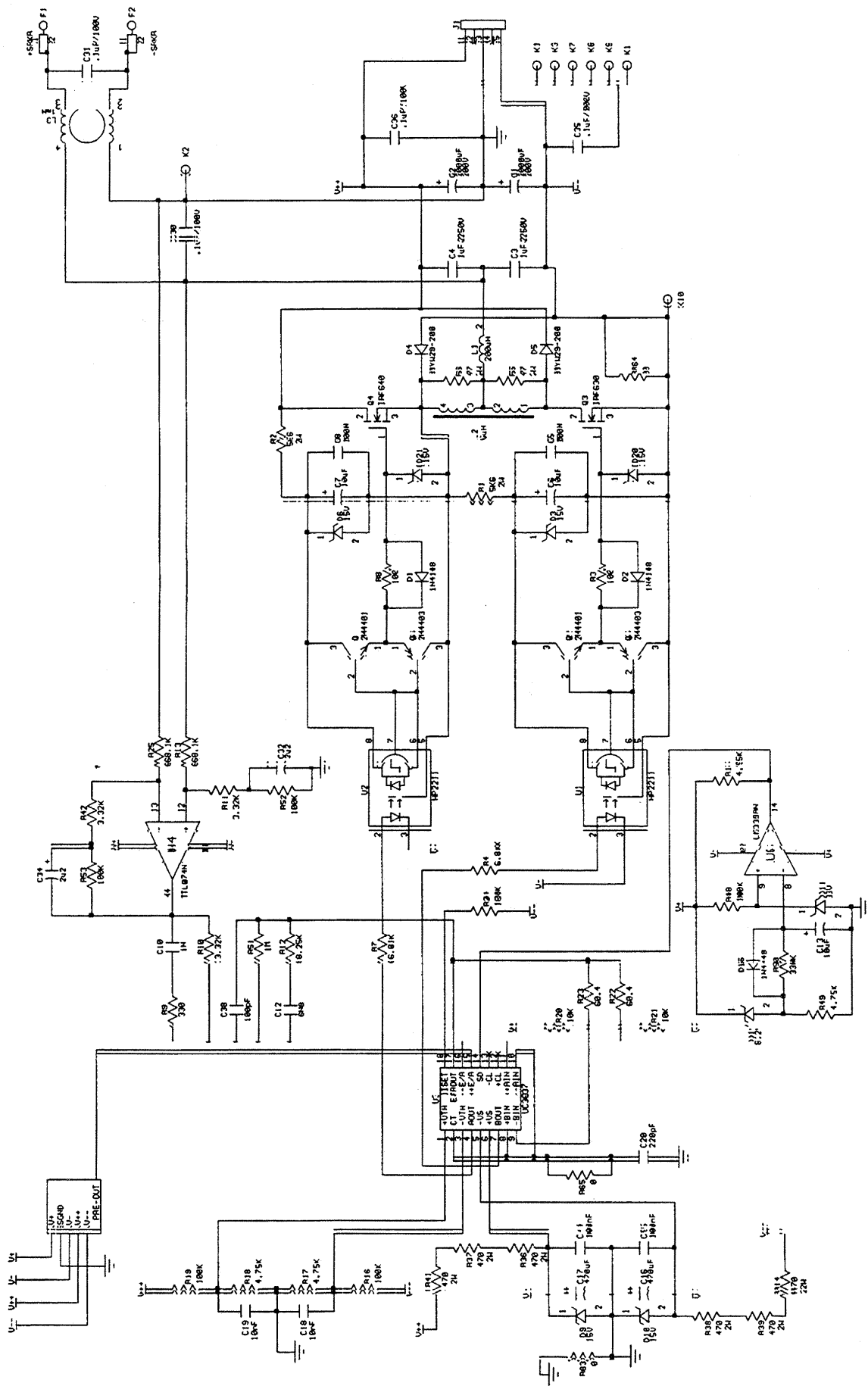
A small 1 volt 130 KHz signal will be 'leftover' at the amplifier's output and will harmlessly ride along with the audio signal. This normal 'residual' signal should not be misdiagnosed as an oscillation.

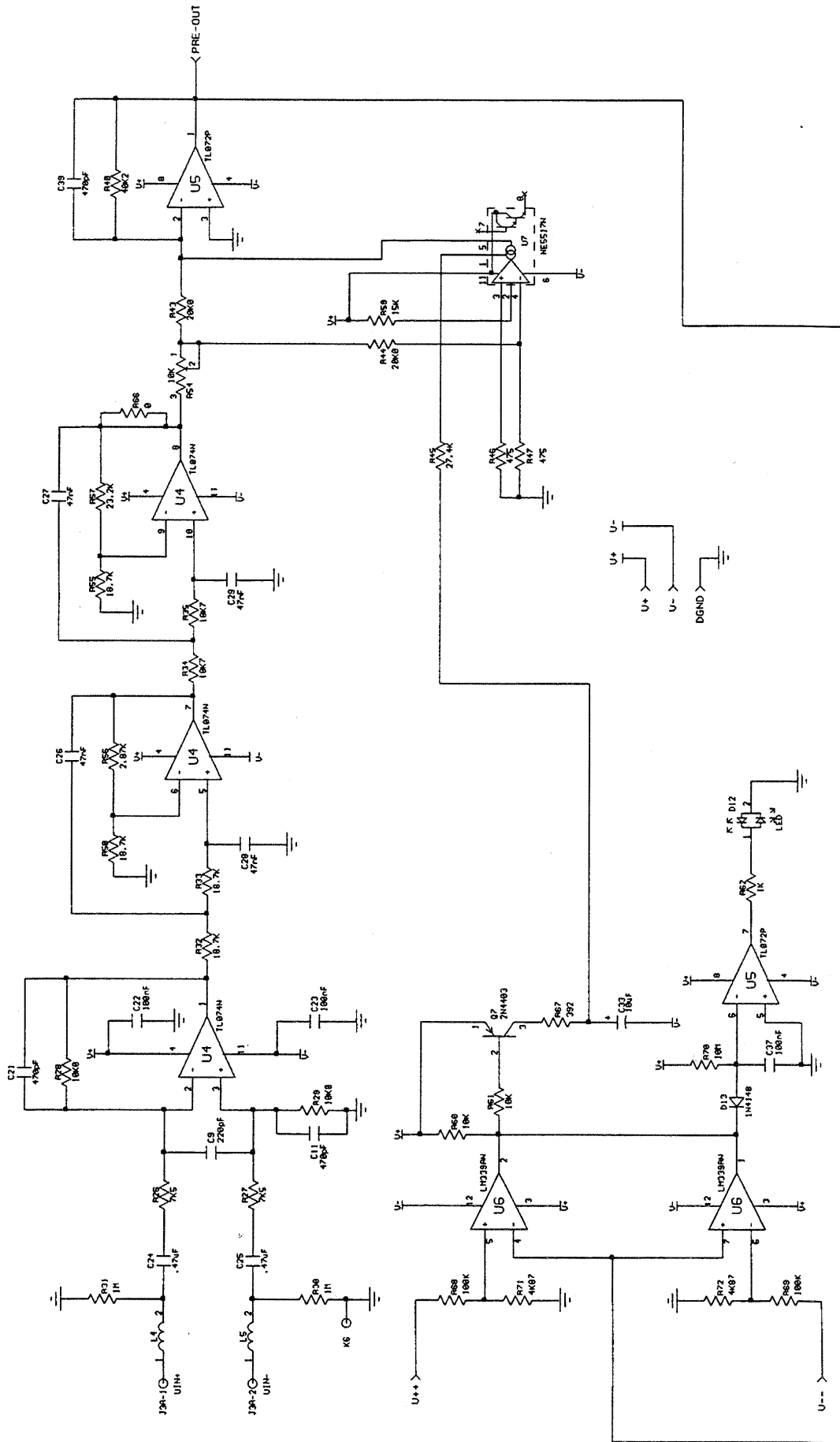
If the power FETs fail, they will usually fail as a short circuit, applying high voltage out of the gate pin back into the gate drive circuitry. Typically, one should make certain that all the semiconductors in each gate drive circuit are functional before replacing the FETs and powering up the amplifier.

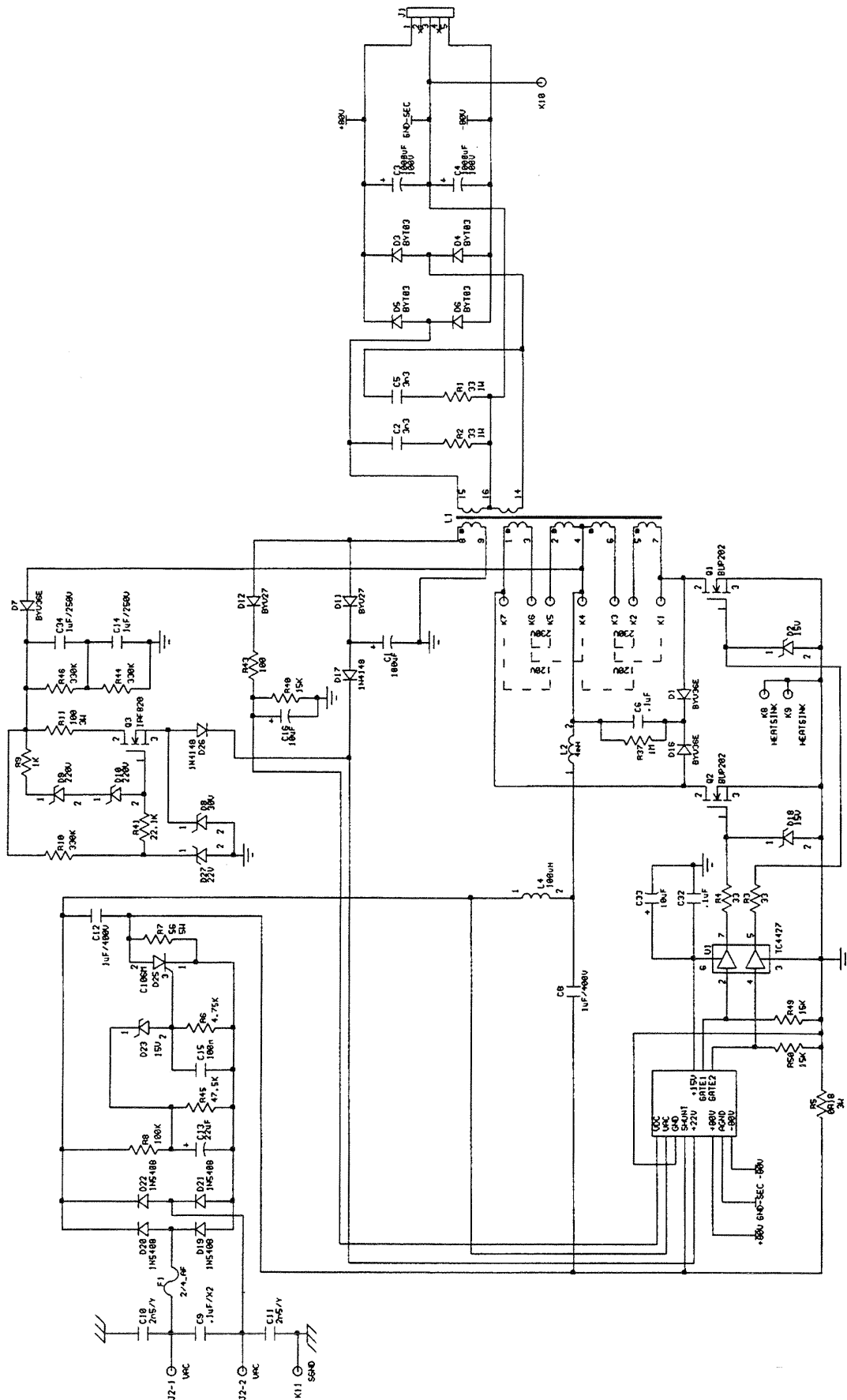
Keep in mind that the IRF630 power FETs are extremely rugged devices, however they will fail under the following conditions:

1. If the amplifier output is short circuited or applied to an abnormally low impedance.
2. The devices are not properly mounted to the heatsink (loose bolts or insulation failure)
3. An overvoltage condition occurs from the power supply
4. ESD precautions are not followed (NOTE: Damage caused by ESD may not show up for days, weeks or months!)

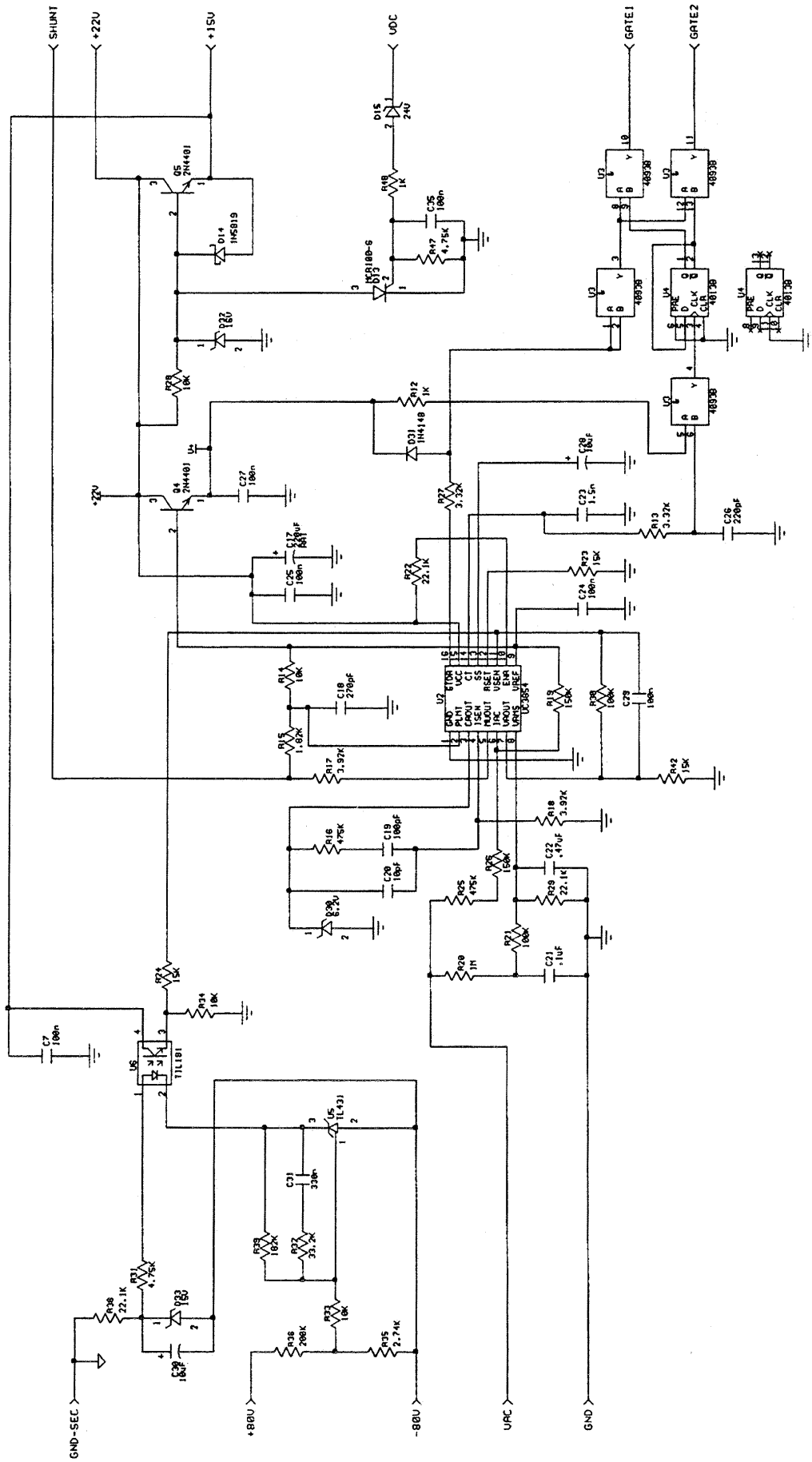


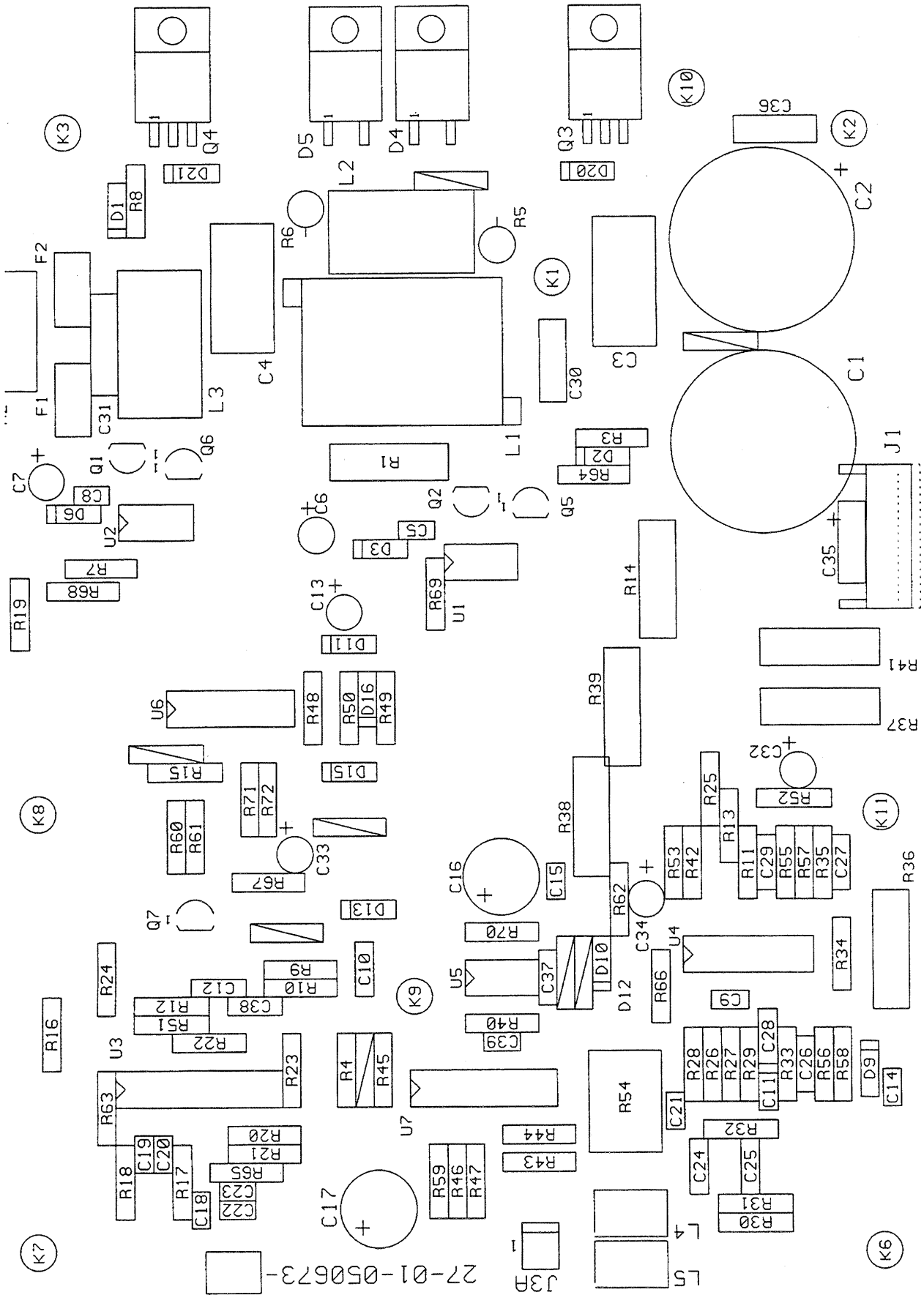


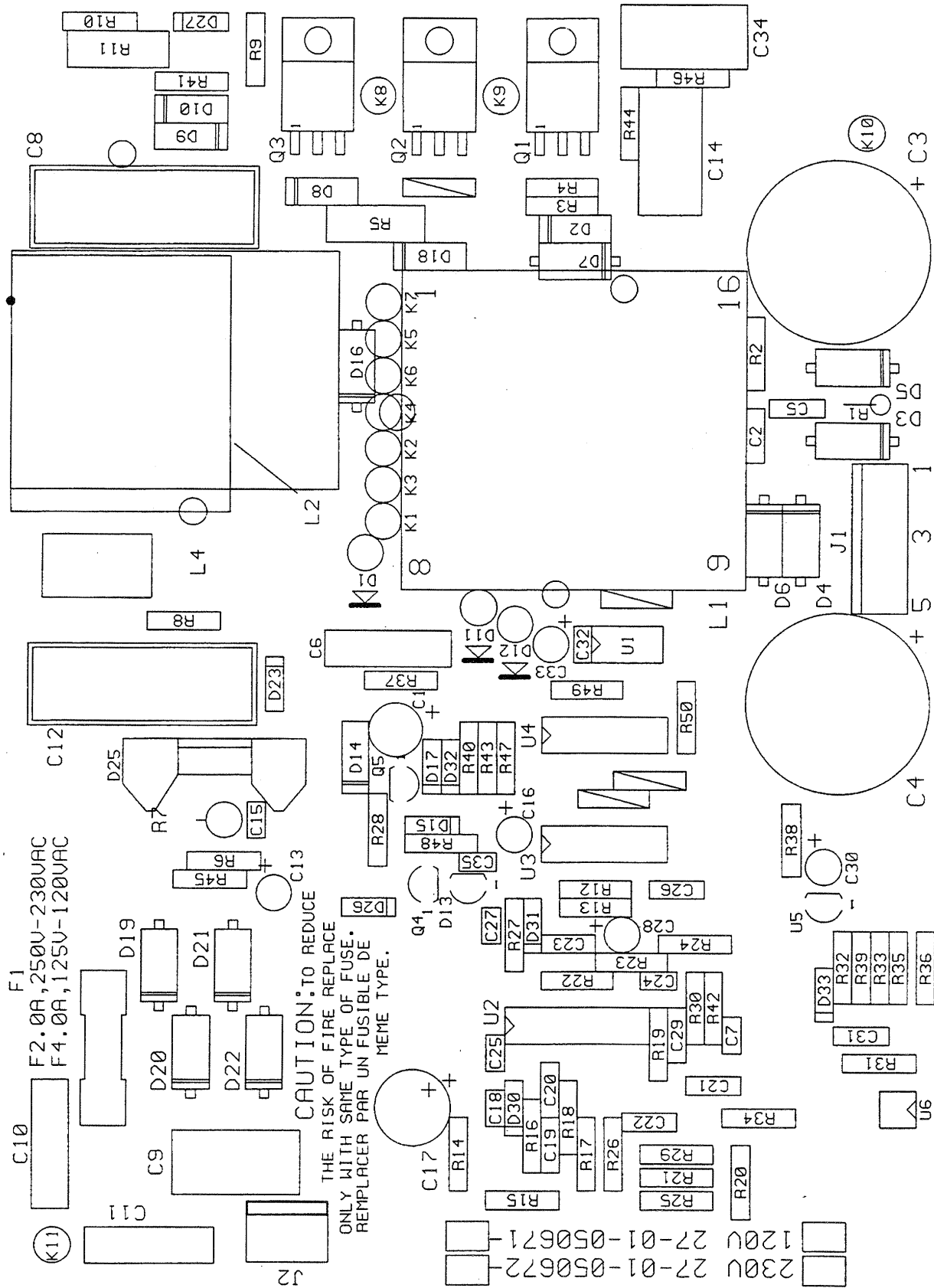




SB120A/CE AMPLIFIER







SB120A/CE AMPLIFIER

| DESCRIPTION | PART NUMBER |
|--|--------------------|
| CONN XLR FEMALE VERTICAL PC MOUNT (J1) | 21-01-051067 |
| CONN MALE XLR VERTICAL PC MOUNT PLASTIC (J2) | 21-01--51375 |
| CONN IEC FILTERED (FL1) | 21-05-050981 |
| PC BOARD ASSEMBLY POWER SUPPLY | 27-01-050672 |
| CAP 100UFD/25V RAD AL ELECT (C1) | 15-01-026794 |
| CAP 220 MF 35V ELEC AL RAD (C17) | 15-01-028924 |
| CAP 10MF 35V ELEC RADIAL (C16, C30, C28, C33) | 15-01-037019 |
| CAP 1UF 250V (C14, C34) | 15-01-051004 |
| CAP 0.1UF 630V (C6) | 15-01-051007 |
| CAP 1000UF 100V ELECT (C3, C4) | 15-01-051008 |
| CAP 1UF 400V (C8, C12) | 15-01-051009 |
| CAP 0.1UF (C9) | 15-01-051010 |
| CAP 2500PF (C10, C11) | 15-01-051011 |
| CAP 22UFD/50V AL ELECT (C13) | 15-01-124504 |
| CAP 100PF 10% 50V (C19) | 15-02-027455 |
| CAP 270PF 10% 100V (C18) | 15-02-028025 |
| CAP 10PF 5% 500V NON POLAR (C20) | 15-02-100009 |
| CAP 100NF 20% 50V-X7R CER (C7, C15, C24, C25, C27, C32, C35) | 15-02-122891 |
| CAP .001SMFD, 5%, 50V MYLAR (C23) | 15-06-027320 |
| CAP 0.33UF POLY 50V 5% (C31) | 15-06-051005 |
| CAP 0.0033UF 400V POLY/FOIL (C2, C5) | 15-06-051006 |
| CAP 0.47UF POLY 5% 63V (C22) | 15-06-051012 |
| CAP 0.1UF POLY 5% 63V (C21, C29) | 15-06-051048 |
| IC UC3854N PFC CONTROL (U2) | 17-01-050723 |
| IC TC4427 FET DRIVER DUAL (U1) | 17-01-050727 |
| IC CD14093BE QUAD NAND (U3) | 17-01-050730 |
| IC TL431ACLP SHUNT REG TO92 (U5) | 17-01-050731 |
| IC TIL191 OPTO-COUPLER (U6) | 17-01-050733 |
| IC 14013 CMOS DUAL D-FLIP (U4) | 17-01-125047 |
| NUT KEPS HEX 4-40 | 28-02-027389 |
| NUT HEX 4-40 STL CD | 28-02-102413 |
| WSHR LK-SPLIT #4 .025THK | 28-03-110502 |
| RESISTOR .18 OHM 3W 5% (R5) | 47-01-051015 |
| RESISTOR 33 OHM 5% (R3, R4) | 47-01-102042 |
| RESISTOR 330K OHM 1/4W 5% (R10, R44, R46) | 47-01-104541 |
| RESISTOR 100 OHM 3W 10% (R11) | 47-02-051014 |
| RESISTOR 150K OHM 1/4W 1% MF (H19, H26) | 47-03-026837 |
| RESISTOR 100K OHM 1/4W 1% MF (R8, R21, R30) | 47-03-028173 |
| RESISTOR 2.74K OHM 1/4W 1% MF (R35) | 47-03-028174 |
| RESISTOR 200K OHM 1/4W 1% MF (R36) | 47-03-028230 |

SB120A/CE AMPLIFIER**Replacement Parts List**

| DESCRIPTION | PART NUMBER |
|---|---------------------|
| RESISTOR 15K OHM 1/4W 1% MF (R23, R24, R40, R42, R49 R50) | 47-03-028238 |
| RESISTOR 47.5K OHM 1/4W 1% MF (R45) | 47-03-028260 |
| RESISTOR 3.32K OHM 1/4W 1% MF (R13, R27) | 47-03-037660 |
| RESISTOR 100 OHM 1/4W 1% MF (R39) | 47-0037770 |
| RESISTOR 182K OHM 1/4W 1% MF (R39) | 47-03-038216 |
| RESISTOR 475K OHM 1/4W 1% MF (R16, R26) | 47-03-038217 |
| RESISTOR 56 OHM 5W (R7) | 47-03-051013 |
| RESISTOR 33 OHM 1W (R1, R2) | 47-03-051058 |
| RESISTOR 33.2K OHM 1/4W 1% MF (R32) | 47-03-109128 |
| RESISTOR 10K OHM 1/4W 1% MF (R14, R28, R33, R34) | 47-03-109437 |
| RESISTOR 1K OHM 1/4W 1% MF (R9, R12, R46) | 47-03-121532 |
| RESISTOR 22.1K OHM 1/4W 1% MF (R22, R29, R38, R41) | 47-03-122953 |
| RESISTOR 1M OHM 1/4W 1% MF (R20, R37) | 47-03-124488 |
| RESISTOR 1.82K OHM 1/4W 1% MF (R15) | 47-03-124646 |
| RESISTOR 4.75K OHM 1/4W 1% MF (R6, R31, R47) | 47-03-124672 |
| RESISTOR 3.92K OHM 1/4W 1% MF (R17, R18) | 47-03-124838 |
| DIODE ZENER 16V 1N4745A (D32) | 48-01-028045 |
| DIODE ZENER 6.2V 1N5234 (D30) | 48-01-028163 |
| DIODE ZENER 15V 5% 1N5245B (D23, D33) | 48-01-028580 |
| DIODE ZENER 22V 1/2W 1N5251B (D27) | 48-01-038403 |
| DIODE ZENER 24V 1/2W 5% (D15) | 48-01-050715 |
| DIODE ZENER 30V 3.25W BZT03 (D8) | 48-01-050717 |
| DIODE BYV36E 1000V (D1, D7, D16) | 48-01-050719 |
| DIODE BYV27-200 200V 2A (D11, D12) | 48-01-050720 |
| DIODE BYT03-400 400V 3A (D3, D4, D5, D6) | 48-01-050722 |
| DIODE 1N5819 45V 1A SCHOT (D14) | 48-01-051016 |
| DIODE ZENER 200V 1W (D9) | 48-01-051089 |
| DIODE ZENER 240V 1W (D10) | 48-01-051090 |
| DIODE ZENER 15V 5% 5W 1N5352B (D2, D16) | 48-01-121752 |
| DIODE 75V 10MA 1/2W 1N4448 (D17, D26, D31) | 48-01-122601 |
| RECT SILICON CONTROLLED 400 AMP (D13) | 48-02-051017 |
| RECT SILICON CONTROLLED 600 AMP SENSE GATE (D26) | 48-02-051018 |
| XSTR 2N4401 SIL NPN (Q4, Q5) | 48-03-028816 |
| XSTR IRF820 FET 2.5A 500V (Q3) | 48-03-050726 |
| RECT IN5408 1000V 3A (D19, D20, D21, D22) | 48-03-050729 |
| XSTR BUP202 IGBT 12A 1000V (Q1, Q2) | 48-03-050736 |
| FUSE CLIP 5MM PC CLIP .016 | 51-04-038147 |
| FUSE 5X20MM NB 2A (F1) | 51-04-051023 |
| FUSE 5X20MM 4A (F1) | 100-130 vac version |
| INDUCTOR 100UH 2.5A (L4) | 56-01-051021 |

SB120A/CE AMPLIFIER**Replacement Parts List**

| DESCRIPTION | PART NUMBER |
|---|--------------------|
| INDUCTOR 7 MH E-E CORE (L2) | 56-01-051345 |
| XFMR POWER TRA-EV39 (L1) | 56-08-051019 |
| PC BOARD ASSEMBLY AMP | 27-01-050673 |
| CAP 2.2 MF 35V ELEC AL RAD (C32, C34) | 15-01-028851 |
| CAP 10MF 35V ELECT RADIAL (C6, C7, C13, C33) | 15-01-037019 |
| CAP 1UF 250V (C3, C4) | 15-01-051004 |
| CAP 1000UF 100V ELECT (C1, C2) | 15-01-051008 |
| CAP 0.1UF 250V 10% (C31) | 15-01-051039 |
| CAP 0.1UF 100V 7.5MM LD SP (C30, C35, C36) | 15-01-051047 |
| CAP 470 UF 25V AL ELEC RAD (C16, C17) | 15-01-051173 |
| CAP 100PF 10% 50V CERAMIC (C9, C20) | 15-02-051063 |
| CAP 470PF 10% 500-1000V CER (C11, C21, C39) | 15-02-100035 |
| CAP 100NF 20% 50V-X7R CER (C5, C8, C14, C15, C22, C23, C37) | 15-02-122891 |
| CAP .001 5% 50V (C10) | 15-06-026823 |
| CAP .047MF 5% 50V (C26, C27, C28, C29) | 15-06-027367 |
| CAP .01 MF 10% (C18, C19) | 15-06-027395 |
| CAP .0068UF 100V 5% (C12) | 15-06-038151 |
| CAP 0.47UF POLY 5% 63V 0.2" (C24, C25) | 15-06-051012 |
| IC LM339 QUAD COMPARATOR (U6) | 17-01-028867 |
| IC NE5517N O.T.A. (U7) | 17-01-028907 |
| IC UC3637N (U3) | 17-01-050724 |
| IC HCPL2211 (U1, U2) | 17-01-050732 |
| IC TL074CN QUAD OP-AMP (U4) | 17-01-124461 |
| IC TL072CP DUAL OP-AMP (U5) | 17-01-124688 |
| NUT KEPS HEX 4-40 | 28-02-027389 |
| NUT HEX 4-40 STL CD | 28-02-102413 |
| WSHR LK-SPLIT #4 .025THK | 28-03-110502 |
| WSHR SHOULDER NYLON | 28-04-125012 |
| LED DUAL T1 3/4 RED/GRN (D12) | 39-01-050261 |
| RES 5.6 KHM 2W 5% CF OR MO (H1, H2) | 47-01-051031 |
| RES 47 OHM 2W 5% CF OR MO (H5, H6) | 47-01-051032 |
| RES 470 OHM 2W 55 CF OR MO (H14, H36, H37, H38, H39, H41) | 47-01-051033 |
| RES 475 OHM 1/4W 1% CF OR M (H46, H47) | 47-01-051034 |
| RES 392 OHM 1/4W 1% CF OR M (H67) | 47-01-051035 |
| RES 330 OHM 55 .25W CF AX (R9) | 47-01-102066 |
| RES 330 KHM 5% .25W CF AX (R50) | 47-01-104541 |
| RES 10 MHM 5% .25W CF AX (R70) | 47-01-107373 |
| RES 180 KHM 5% .25W CF AX (R24) | 47-01-109298 |
| RES 6.81 KHM 1% .25W MF AX (R4, R7) | 47-03-027374 |
| RES 18.7 KHM 1% .25W MF (R32, R33, R34, R35, R55, R58) | 47-03-028175 |

SB120A/CE AMPLIFIER**Replacement Parts List**

| DESCRIPTION | PART NUMBER |
|---|--------------------|
| RES 7.5 KHM 1% .25W MF (R26, R27) | 47-03-028234 |
| RES 4.75 KHM 1% .25W MF (R17, R18, R49) | 47-03-028242 |
| RES 68.1 KHM 1% .25W MF (R13, R25) | 47-03-028245 |
| RES 47.5 KHM 15 .25W MF (R15) | 47-03-028260 |
| RES 3.32 KHM 1% .25MF AX (R10, R11, R42) | 47-03-037660 |
| RES 100 OHM 1% .25W MF AX (R3, R6) | 47-03-037770 |
| RES 27.4 KHM 1% .25 MF AX (R45) | 47-03-038599 |
| RES 8.25 KHM 1% .25 MF AX (R12) | 47-03-039173 |
| RES 40.2 KHM 1% .25W MF AX (R40) | 47-03-109430 |
| RES 20 KHM 1% .25W MF AX (R43, R44) | 47-03-109434 |
| RES 10 KHM 1% .25W MF AX (R20, R21, R28, R29, R60, R61) | 47-03-109437 |
| RES 100 KHM 1% .25W MF AX (R16, R19, R48, R52, R53, R68, R69) | 47-03-119305 |
| RES 1 KHM 1% .25W MF AX (R62) | 47-03-121532 |
| RES 23.2 KHM 1% .25W MF AX (R57) | 47-03-123022 |
| RES 15 KHM 1% .25W MF AX (R59) | 47-03-124484 |
| RES 1 MHM 1% .25W MF AX (R30, R31, R51) | 47-03-124488 |
| RES 60.4 OHM 1% .25W MF AX (R22, R23) | 47-03-124607 |
| RES 2.87 KHM 1% .25W MF AX (R56) | 47-03-124650 |
| RES 4.87 KHM 1% .25W MF (R71, R72) | 47-03-125138 |
| POT 10 KHM LINEAR TAPER (R54) | 47-06-050071 |
| DIODE ZENER 8.2V 400MA (D15) | 48-01-026636 |
| DIODE ZENER 15V 5% 1N5245B (D3, D6, D9, D10, D20, D21) | 48-01-028580 |
| DIODE BYW29-200 200V 8A 25 (D4, D5) | 48-01-050721 |
| DIODE 75V 10 MA .5W 1N4448 (D1, D2, D13, D16) | 48-01-122601 |
| DIODE ZENER 3.0V .5W 120MA (D11) | 48-01-124636 |
| XSTR 2N4403 PNP SIL (Q5, Q6, Q7) | 48-03-027334 |
| XSTR 2N4401 SIL NPN (Q1, Q2) | 48-03-028816 |
| XSTR IRF630 FET 9.5A 200V (Q3, Q4) | 48-03-050725 |
| INDUCTOR 200UH (L1) | 56-01-050060 |
| INDUCTOR COUPLED (L2) | 56-01-050061 |
| INDUCTOR 1MH (L3) | 56-01-051041 |
| FERRITE BEAD 3L COIL (L4,L5) | 56-01-051045 |
| PC BOARD ASSEMBLY INPUT | 27-01-050758 |
| CAP 470PF 10% 500-1000V CER (C1, C2) | 15-02-100035 |
| RES 7.5 KHM 1% .25W MF (R1, R2) | 47-03-028234 |
| SCR MCH 6-32X1/4 PHP STL/ZN | 28-01-115517 |
| SCR MCH 8-32X5/8 RHP STL | 28-01-115729 |
| SCR MCH 4-40X3/8 PHP STL BO | 28-01-124545 |
| SCR ROLOX 6-32X3/8 FT HD PHL | 28-01-124965 |
| NUT KEPS HEX 4-40 | 28-02-027389 |

| DESCRIPTION | PART NUMBER |
|--|--------------|
| NUT KEPS HEX 6-32X1/4 | 28-02-114116 |
| NUT KEPS HEX 8-32 STL CD W* | 28-02-114122 |
| WSHR LOCK-EXT PT#6 .020THK | 28-03-110480 |
| WSHR LK-SPLIT #4 .025THK | 28-03-110502 |
| WSHR SHOULDER | 28-04-051307 |
| WSHR NYLON FLAT | 28-04-051397 |
| WSHR FL 1/4X9/16 OD STL CD | 28-04-109340 |
| WSHR FL SPCL NON-METALLIC | 28-04-115911 |
| WSHR FIBER THICK BLACK | 28-04-124764 |
| SPACER RD CLEAR HOLE 1/4" DIAMETER | 28-07-050459 |
| SPACER #6-32X0.25 1/4" DIAMETER | 28-07-050980 |
| STANDOFF 6-32X1.5 .25 HEX ALUM | 28-08-037618 |
| STANDOFF .75L X .25 HEX AL MALE/FEMALE | 28-08-051263 |
| STANDOFF .75L X .25 HEX AL FEMALE/FEMALE | 28-08-051265 |
| POWER SWITCH | 51-02-124582 |

Sb120A CE Voltage Conversion

100-130 Vac Version Jumper Placement

K1-K3, K2-K4, K4-K6, K5-K7 (K4 has two jumper holes)

Install 4 Amp fuse

Remove 200-250 Vac label if present

200-250 Vac Version Jumper Placement

K2-K3, K5-K6

Install 2 Amp fuse

Add 200-250 Vac label

Notes

Notes

Electro-Voice[®]

600 Cecil Street, Buchanan, MI 49107
800/234-6831, 616/695-6831, 616/695-1304 Fax

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Part Number 534876—9803