QSC AUDIO

Pre-1983 QSC Products Service Manual

Table of Contents

QSC Parts Substitution Information

To minimize stocking requirements, our policy is to offer premium-grade "equal-or-better" service replacements. These components will replace production parts used in past QSC models.

Replacement parts currently shipped by QSC:	Description	Will replace:
IC-005532-OP	NE5532 dual OP-Amp	MC4458CP, MC4559, UA772
IC-000072-OP	TL072 dual OP-Amp	NE5530 *NOTE:* This IC has no direct substitute. May require some circuit modification.
PT-320400-CR	20k Rotary pot knurled shaft	Pots on all "A" series products (A21-42)
QD-000424-TH	2SD424 NPN TO-3 QSC tested	MJ15015, 2N3055, 2N6254, RCA1B01
QD-000554-TX	2SB554 PNP TO-3	SJ9282, MJ2955A, MJ15016, SJ9092, 2N6609, MJ2955, 2N2955A, 2N5876
QD-002762-TH	MJE15030 NPN TO-220 4A, 200V Vceo QSC tested	MJE15028, SJ2762, TIP31C 2N6473, UMT3584, UMT3585, FT317B, TIP31C Will also replace TO-66 packages SJ1848 & MJ3248.
QD-002763-TH	MJE15031 PNP TO-220 4A, 200V Vceo QSC tested	MJE15029, SJ2763, TIP32C, FT417B,2N6475 Will also replace TO-66 packages SJ1847 & MJ3238.
QD-003646-TX	MPS3646 NPN TO-92	MPS4264, MPS4265, MPS2369
QD-004410-TX	2N4410 NPN TO-92	MPS3646, 2N2222, MPS8099, 2N2484
QD-005771-TX	2N5771 PNP TO-92	MPS3640, MPS4258
QD-008599-TX	MPS8599 PNP TO-92	2N2906, MPS A93, 2N2906A, 2N4036

NOTES:

1. Parts not shown should be replaced by the same type only. Some of the parts used in older QSC products are no longer manufactured and are unavailable. Products needing these parts may be unrepairable.
2. Diodes should be replaced by same types. Consult schematics to see if selected parts are required (voltages shown).
3. Potentiometers not used in current products and not on this list are not available from QSC.

AMPLIFIER FEATURES/SPECIFICATIONS SUMMARY

MODEL	A3.7	A4.2	A5.1	A21	A31	A32	A41	A42
8-ohm power (each ch. driven)	95	40	80	80	125	125	200	200
4-ohm power (each ch. driven)	150	60	120	120	200	200	325	325
2-ohm power (each ch. driven)	—	—	—	150	250	250	400	400
DC fault protection	yes	yes	yes	yes	yes	yes	yes	yes
SMPTE—IM distortion (8-ohms)	0.05%	0.05%	0.05%	0.02%	0.02%	0.02%	0.02%	0.02%
Full short circuit protection	yes	yes	yes	yes	yes	yes	yes	yes
Thermal protection	yes	yes	yes	yes	yes	yes	yes	yes
Damping factor	200	200	200	200	200	200	200	200
Power supply	Single	dual	dual	dual	dual	dual	dual	dual
AC extension outlet	yes	yes	yes	yes	yes	yes	yes	yes
Output transistors	4	4	8	12	16	16	24	24
Full complementary output	yes	yes	yes	yes	yes	yes	yes	yes
Fan cooling (2-speed)	—	—	—	yes	yes	yes	yes	yes
Active balanced line inputs	yes	yes	yes	yes	yes	yes	yes	yes
XLR input jacks	—	—	—	yes	yes	yes	yes	yes
Speaker binding posts	—	—	—	yes	yes	yes	yes	yes
Bridging Switch	—	—	—	yes	yes	yes	yes	yes
Gain control (dB cal.)	yes	yes	yes	yes	yes	yes	yes	yes
Speaker level display LED's	—	—	—	—	—	yes	—	yes
TDI clipping LED	—	—	—	yes	yes	yes	yes	yes
PowerLimit control	—	—	—	—	—	yes	—	yes
Shipping weight (lbs.)	15	13	16	30	33	33	39	39

QSC Service Manual: Power Amplifier A21,A22,A31,A32,A41,A42

Modifications Second Generation June 1980

2. Circuit Description (Second Generation):

Various improvements have been incorporated in the amplifiers shipped starting June 1980. The revised series can be recognized by the use of ribbon-cable connectors and TO-66 driver transistors mounted in front of the main heat sink.

Notes for "New Series" will be included where necessary.

a. Model Listings:

This series consists of three power ranges, each in a "standard" and "deluxe" version, using the same basic chassis and main PC board. The A21, A31 and A41 ("standard") have front-mounted Gain controls and TDI indicator. The A22, A32 and A42 ("deluxe") versions also feature a 4-step LED speaker level display, TDI (True Distortion Indicator) LED, and PowerLimit control with indicator LED for each channel. All models have DC fault protection, long-term short circuit protection, automatic 2-speed fan, and thermal overload cut-outs. All models share the same well-equipped connector back panel. The internal differences are due to the three power levels.

A21-A22: uses six 150-watt transistors per channel, in a fully complementary circuit. It develops 80W-8 ohms or 120W-4 ohms (both channels driven, 20-20K, 0.1% THD).

A31-A32: uses eight 180-watt transistors per channel, in a fully complementary circuit, and develops 125W-8 ohms or 200W-4 ohms (same test conditions).

A41-A42: revised circuit uses twelve 180-watt complementary outputs per channel. The original model used 12 NPN outputs (quasi-complementary). Extra heat sinks attached to the top cover carry the extra devices. Power levels are 200W-8 ohms, and 325-watt, 4 ohms (same test conditions).

b. Balanced Input Circuit:

R1,2,3 and 4, together with the first stage of the dual op-amp IC, accept balanced line inputs and convert them to an amplified single-ended output which feeds the actual power amplifier. Note that R1 and R2 form a resistive divider. R3 and the combination of R4,R5,R6 and the Gain control form a second, matching divider. Common-mode (i.e.noise) signals on the balanced line will be treated equally by each divider, and thus no signal output appears across the terminals of the op-amp. Only the signal difference between the two inputs will be picked up and amplified.

The setting of the Gain control, together with R5,6 and 7, determines the gain of this circuit. 1% resistors (blue bodies) are used for accuracy and high common-mode rejection (50 dB minimum at full gain).

c. High and Low Frequency Rolloffs:

C1,C2 and R8 and R9 form a 2-pole (12 dB per octave) low frequency cutoff, down 1 dB at 20 Hz. C3 forms a single pole (6 dB per octave) high frequency rolloff, and the power amplifier itself has a 1-pole rolloff for feedback stability. The combined response is down 1 dB at 20K Hz.

d. Power Amp Input and Feedback:

The second stage of the dual op-amp forms the actual input to the power amplifier. The signal level at this point is about 5V rms, at rated output. R10,R11 and C5 form the negative audio feedback and compensation network. R13 and R14 form the DC feedback from the positive and negative power supplies (for centering of the output signal). Trimmer TR-1, C4 and R12 allow any dynamic power supply ripple residual to be nulled out to at least 70 dB below the program level. Quiescent ripple should be down at least 90 dB.

e. Output Transistor Structure:

Q1 and Q2 are the complementary driver transistors, which amplify the 5-10ma output from the IC op-amp to about 300 ma. D1 and D2, with trimmer TR-2, set the crossover bias just into class AB operation (slight idle current). The final output transistors add current gain to deliver the 9-15A currents needed to supply the respective power levels to the speaker load.

f. Power Supply Capacitors:

A pair of power supply capacitors is provided for each channel. QSC uses a special arrangement of power supply capacitors and output transistors (patent pending) to obtain capacitative coupling of the output without the drawbacks of a single-ended capacitor output circuit.

C12 and C13 store the DC power levels (positive and negative) for each channel, as usual. In addition, these parts carry the speaker output currents. The speaker signal is taken from the midpoint of the two capacitors, so that there is proper DC polarity across each capacitor for both polarities of the audio output signal. If the amp faults (goes DC) in either direction, one of the capacitors will be able to block the DC from the speakers. The low frequency rolloff of these parts is about 10 Hz, so there is no reduction of bass output.

A major advantage of this circuit is that by "floating" the power supply we can ground the collectors of the output transistors. This allows us to mount them directly to the metal heat sinks, without the usual mica insulator. This reduces thermal losses about 25%, especially during short circuits when the thermal loading is the greatest.

The quasi-complementary circuit, used in the early A41-A42, does not permit all of the power transistors to be grounded. We can still mount half of them on the main, grounded heat sink. The other half are direct-mounted to a pair of insulated heat sinks which are mounted to the top cover. Do not remove cover with power on; if the top heat sink is grounded even momentarily, the amp will be blown. Even in the revised full-comp A41-A42 which has a grounded upper heat sink, care should be taken not to ground out the faceplate mounted circuits with power on.

g. Short Circuit Protection:

Straight current limiting is used, to avoid the audible problems associated with more elaborate (VI limiting) schemes. The current limits are set to begin at impedances below about three ohms, to allow adequate current margin to drive realistic 4-ohms loads. Normally, such high current limits would allow excessive dissipation into short-circuit loads, and might cause the power transistors to overheat and fail before the thermal cut-out can act. To prevent this, a second circuit detects the presence of shorted or very low-impedance loads, and cuts back the long-term current limits to safe values.

The current limits (positive and negative) are determined by the voltages on the IC supply capacitors, C10 and C11. Normally, these voltages are held by zener diodes to +15V and -15V. A network formed by R24, D3 and D4 replaces the currents drawn by the IC by rectifying a small part of the output voltage. If the speaker is shorted, the output voltages are clamped to low levels, and the IC supply voltages are allowed to collapse to a lower level. This is what reduces the short circuit current limits. Trimmers TR-3 and 4 adjust the actual current limits to compensate for production variations in the output transistors. (see section 5).

h. Thermal Protection:

The fan normally runs at reduced speed for less noise. If the heat sink exceeds 55C (135F) a thermal sensor bypasses a 250 ohm resistor, raising the fan to full speed. If the heat sink exceeds 85C (185F) another thermal sensor cuts power to the amplifier until the fan brings the temperature down.

i. Faceplate Features:

Front panel Gain controls and distortion (TDI) indicator are standard. The yellow pilot LED for each channel operates from the DC power supplies.

The "TDI" LED is driven by means of a bridge rectifier, which detects positive or negative peaks from the power-amp op-amp greater than about 2.6V. Since it only takes about 1V to fully drive Q1 and Q2, the higher (2.6V) peaks only occur if the amp clips for any reason (loss of feedback control). Thus, triggering of the LED accurately indicates clipping of any form, starting at about 0.1% distortion. The clamping action of this circuit is desirable, since it limits the IC excursion to the 2.6-3V region. This prevents excessive reverse-drive to the driver transistors Q1 and Q2, and helps "drain" the IC supply voltages during short-circuit loading.

The "deluxe" A22, A32 and A42 have the following added functions, located on dual PC boards mounted to the face-plate:

First, the speaker signal is rectified by full-wave rectifier FW-1. C1 filters this value, to produce a DC level which tracks the speaker output level (envelope detection). This variable voltage drives the 4-step LED level ladder through a network of diodes and resistors (R2, 3, 4, 9, D1, 2, 3, LD8).

The PowerLimit control senses the envelope voltage in order to set the desired threshold for the power limiting compressor. A transistor, Q1, is placed in series with the Limit LED and the LED inside the photo-cell (light dependant resistor) package. Thus, Q1 will start to conduct whenever its base voltage exceeds 3.8V. Whenever the voltage from the PowerLimit control exceeds this value, the LED's begin to light, the photocell resistance is reduced, and amplifier gain is reduced in order to hold the peak output level to the value determined by the PowerLimit setting. R6 and C2 provide additional filtering to smooth the action of the compressor for minimum impact on music dynamics. Once over the compressor threshold, the compression ratio is about 6:1.

j. Fault Protection:

Each channel is separately fused. The fuse rating is higher than the electronic current limit, and thus should never blow unless an output transistor actually fails. If this happens, the fuse should remove DC power from the faulty channel.

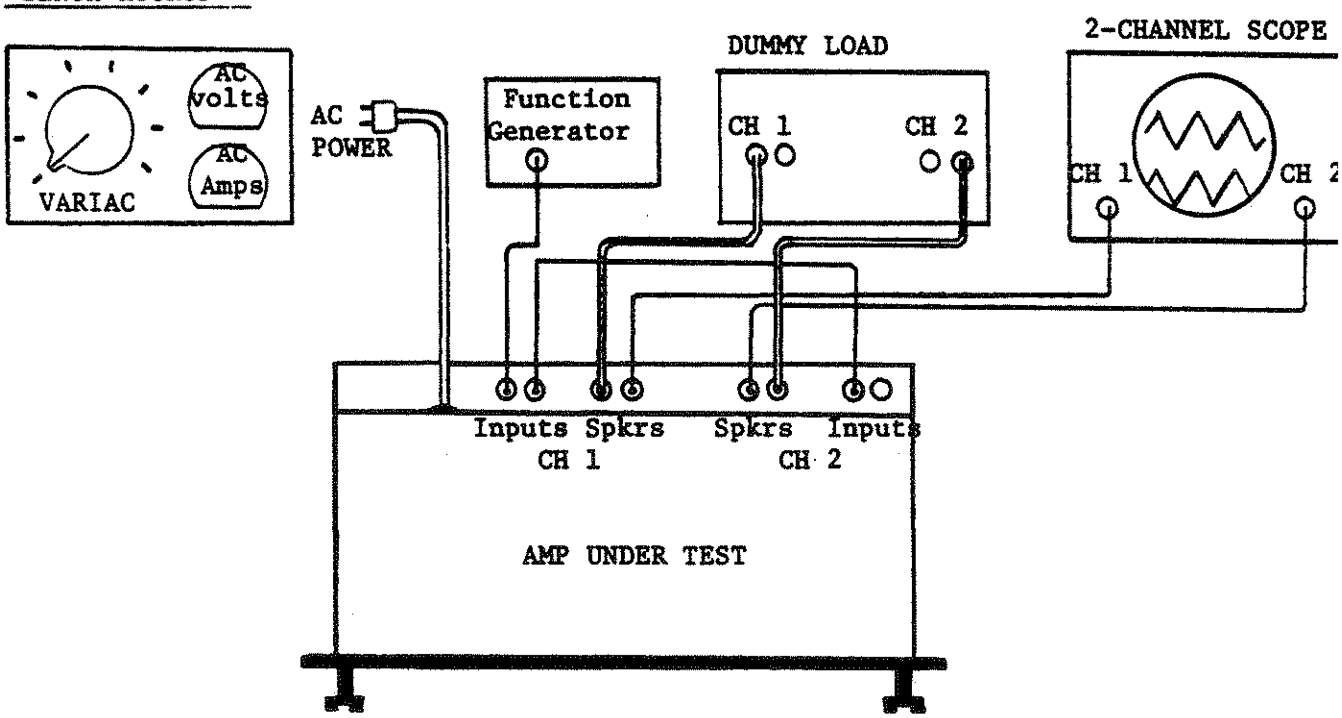
If the fuse does not blow for any reason, the DC blocking action of the power supply/output capacitors will still protect the speakers from DC faults. A blown fuse is sure sign of trouble, and attempts to replace it without bench-testing the amp only invite further damage. See Trouble-Shooting procedures, below.

3. Trouble-Shooting:

a. Set-Up:

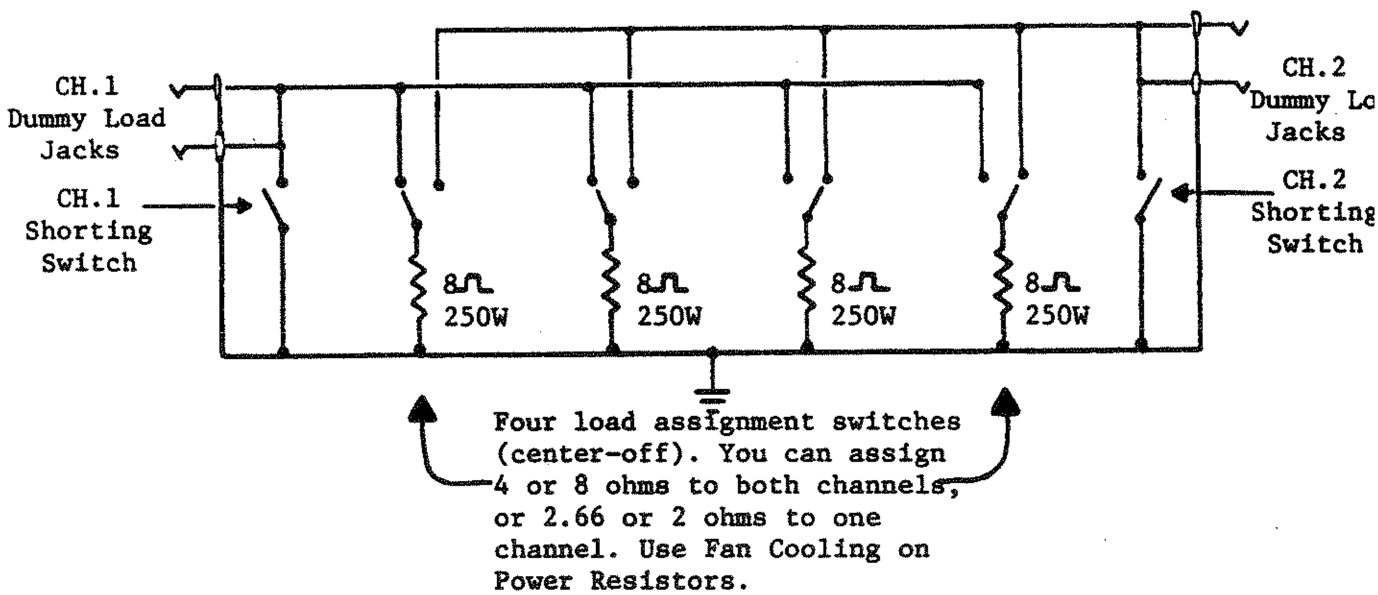
To identify service problems, the amp should be bench-tested as follows:

BENCH HOOKUP



A 10-A Variac (variable-voltage AC transformer) should be connected to the amplifier AC plug. An AC voltmeter and 0-10A AC ammeter, preferably the rms (iron-vane) type, in series with the output of the Variac, will allow measurement of amplifier AC current draw with various loads. A switchable dummy load, capable of handling the amplifier power, should be connected to the speaker outputs. A schematic is shown below, using a set of four 8-ohms resistors which can be switched to either channel at will. This permits the testing of both channels at 4 and 8 ohms, and a single channel at 2.66 and 2 ohms. A shorting switch is provided for each channel. If distortion measurements are going to be made, non-inductive resistors should be used for accurate high-frequency results. A two-channel scope is very useful for monitoring both channels simultaneously. A distortion analyzer is not absolutely necessary, but is highly valuable for confirming precision repairs, and especially for setting crossover bias and dynamic hum null.

DUMMY LOAD SCHEMATIC



When first testing an amp, start with no load on both channels, normal signal inputs and Gain settings, and with Variac on zero. Slowly raise the AC power, while watching the AC ammeter for abnormal current draws. No-load amplifier current should not exceed 1A for AC voltages up to 120V. The amplifier should develop a normal output signal by the time AC power reaches 40V-60V. If normal output appears, raise AC voltage to 120V and try the loads on each channel down to 2 ohms, while observing output power, clipping characteristics, etc. If unexplained current draws occur into no-load as you raise the AC voltage, reduce power to prevent further damage.

Symptoms may now be observed from the following list:

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b. No Output Power (Both Channels):
Bad circuit breaker?
Bad AC cord?
Bad AC switch?

If fan runs, but amp has no DC power (no yellow LED's), check power transformer connections, thermal cut-out (in series with power transformer primary) or both fault fuses may be blown. (Both channels bad).

c. No Output Power (Single Channel):
If pilot LED for one channel is out, that channel is not getting DC power. Check connections to rectifier/fuse assembly, or blown fault fuse. If fault fuse is blown, that channel has shorted transistors. Verify by replacing fuse, and carefully testing for AC current draw, using Variac as described above. See 4-b to replace power transistors. If channel comes back on, try to find out why the fuse blew. Wrong value installed? Intermittent connection at crossover diodes D1, D2? Transistors blew but then opened up (rare)?

Fuse Values:	A21-22:	GLH-7	(125V, 7A)
	A31-32:	GLH-10	(125V, 10A)
	A41-42:	ABC-12	(125-250V, 12A)

If bad channel shows yellow LED, there is DC power. Check positive and negative power supplies. If equal, power stages are OK, and you should look for signal interruption. Look for bad solder connection, especially at jacks and other large parts. Check for bad or missing IC (socket mounted). If power supplies are severly mismatched amp has developed internal DC fault, due to bad IC, driver transistors (Q1,2). Usually faulty output transistors draw current and cause the fuse to blow.

d. Very Low Output:
If output is faint or highly distorted, first be sure bridging switch (Ch.2) is set in "Normal" position. If so, suspect defective IC or driver transistors; and look for bad solder joints in the signal path. Check for proper + and -15V levels on IC supply (see 4-d).

In A41-A42, if the wiring to the upper heat sink fails, you will get normal no-load output, but power will collapse into normal loads.

e. Hums:
Eliminate external sources by removing input connections. Hum consisting of small 120-Hz peaks riding on flat baseline indicates excessive series resistance (ESR) in one of the filter capacitors. Verify which one by adding external capacitance (not while power is on!). Contact QSC for replacement capacitors.

Hum consisting of 60Hz with odd-order (180Hz, etc.) harmonics usually indicates magnetic induction from the power transformer. Check wiring, especially next to channel 1, for mis-routed wires too close to the IC and other sensitive circuits. These wires are supposed to be tied to the harness near the top of the chassis.

Loud Mechanical Hum, From Chassis: Indicates open-circuit in one of the parallel transformer primary wires. This can be verified if you note that one of the channels has lost about half its power under load, and causes the loud hum when loaded. If all external connections are good, the fault may be in the transformer (rare).

f. Blows Circuit Breaker, or draws excess current into no-load.

Isolate possible defective channel by removing fault fuses. Continued AC draw indicates bad power transformer or AC wiring short.

Otherwise, trace to defective channel.

If amp has been repaired, and still draws current, you may have to continue looking for shorted parts. Check driver transistors Q1, Q2, and clamping diodes D5, and D6. In the first generation A41 and A42, be sure top mounted heat sinks are properly insulated, especially if current draw appears after replacing cover. The revised full-comp version uses a single, metal-mounted upper heat sink.

A "soft" or mild current draw may indicate that wrong polarity transistors were used for replacements, or that one of the drivers or outputs has only partly broken down, to perhaps 20% of normal voltage ability. In A41-A42, may indicate reverse wire polarity to upper heat sink. See 4-b for wire diagram. (original series).

If amp runs normally, measure current draws into load, to see if the circuit breaker simply fails to carry its rated current. If so, replace.

Circuit Breaker Ratings:	Hold Current:	Break Current:
A21-22	3A (5A early)	4.5A (6.5A early)
A31-32	8A	11-12A
A41-42	15A	20-22A

g. Premature Clipping:

Normally, positive and negative peaks should clip at the same levels, for 4 and 8-ohms loads. If one polarity clips sooner, check the following list:

Into no-load: Indicates internal DC imbalance. Check for balanced positive and negative power supply voltages. If imbalanced, check: R13, R14 (DC centering); or defective IC. Brief loading may be necessary for initial centering.

Only into 4-ohm load: Indicates low current limit, on the side which clips sooner. See section 5 for bench adjustment of trimmers.

h. Thermal Protection and Fan Speed:
If amp cycles off after a few minutes under load, check to see if fan is jammed. It may have slipped down in its mounting enough to drag on the PC board.

Normally, the fan should start on the slow speed, and as temperature rises, kick into high. If the heat sink exceeds 85C (185F) the amplifier power should cut off, but the fan should continue on high speed. With normal ventilation, amp should reset in 30 seconds. See section 4-c for fan mounting clearances.

i. Faceplate Features:
Dead LED segments: Check for cold solder joints or bad LED. Normal LED "on" voltage should be 1.6-1.8V.

Complete failure of faceplate circuit, especially if amp stays at mid-gain for all Gain settings: Check for disconnected connector to main PC board.

If PowerLimit LED won't turn off, check the transistor Q1 for short. Check PowerLimit pot for bad solder, etc.

If PowerLimit LED won't come on, check for open solder joint or open-circuit part: Q1, PowerLimit pot, Limit LED, photocell LED, resistor R6 or D4.

If Limit LED lights brightly, but does not limit output: Check for shorted LED in photocell, or no change in resistance across photocell terminals (opposite end of package from LED terminals) when Limit LED lights up.

The TDI should start to light when the amp just begins to clip (about .1%). If dead, check LED, FW-2 rectifier, or red connector wire. Also, see section 5-c. See section 4-f for Faceplate removal.

4. Disassembly-Service Access.:

a. Top and Bottom Covers:
These covers must be removed for service access. When replacing, please be sure that the sheet metal screws re-engage their original thread pattern. Unlike machine-threaded receptacles, sheet metal screws can still be

installed even if hole alignment is upset due to chassis damage. However, failure to re-engage the original threads will result in stripping after a few removals. CAUTION, do not remove A41-A42 cover with power on. (Heat sink may short out).

b. Power Transistor Replacement:

Cover removal permits output transistor replacement on all models. Use only QSC-tested factory replacements for full-performance replacements at minimum cost. QSC will not warranty or reimburse for the use of other devices.

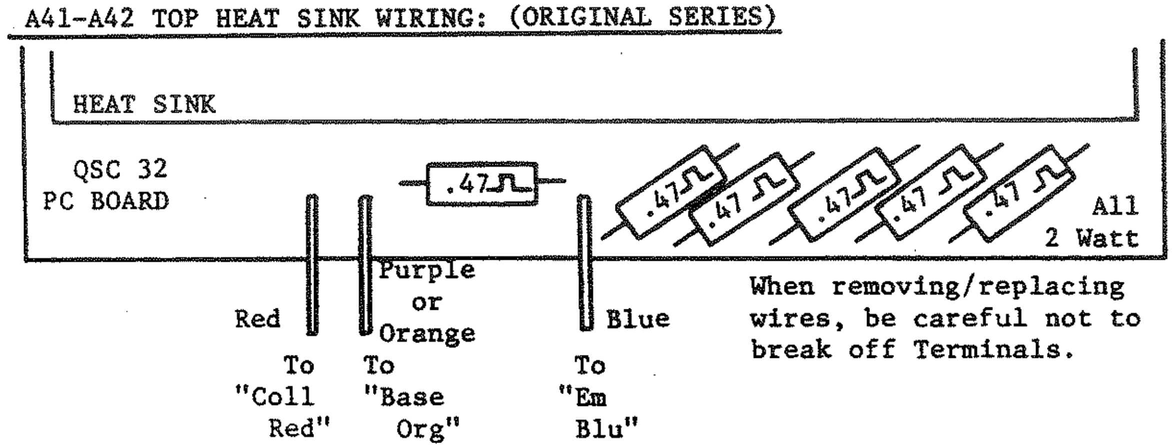
Note that no mica insulators are used under any power transistors. All devices are direct-mounted to metal for best heat transfer. Use a small amount of thermal grease under each replacement, and carefully tighten all mounting screws.

Before replacing bad devices, check the emitter resistors (.47 ohm) while devices are out-of-circuit. Replace cracked, burned, or open-circuit parts. Use only special 2-watt parts (QSC replacements) on original series; use 3-watt ceramic resistors on revised series.

To replace the top-mounted transistors in the A41-A42, the top heat sink assembly must be dismounted. If you need to disconnect the wires to the main board, be careful not to break the terminals. Carefully inspect the insulation (either nylon shoulder washers or nylon standoffs) before replacing assembly. Insulation failure at normal AC power will blow the entire channel. See following drawing for wire replacement code. (old series)

The new series uses a single, metal-mounted (grounded) heat sink for the PNP transistors. The 3-pin plug should be connected with the wires pointing up (towards cover).

A41-A42 TOP HEAT SINK WIRING: (ORIGINAL SERIES)



After replacing the faulty transistors, the (blown) fault fuse should be replaced, and the amp carefully tested as described in section 3. Especially in the A41-A42, the driver transistors may also need replacement.

c. Driver Transistor or Fan Replacement:

If bad driver transistors (Q1, Q2) are suspected, the fan assembly should be removed for access (not necessary on newer series). Cut the nylon ties holding the wires to the top of the heat sink, and remove the six screws holding the assembly to the back of the chassis. You should be able to swing the assembly up for access to the driver transistors mounted beneath.

When replacing the driver transistors, be sure not to over-tighten, or to damage the plastic housing (in models using this type). Be sure that the small heat sinks do not touch each other. Be sure to retain the rectangular washer and split-ring lock washer to absorb thermal expansion.

When replacing the fan, especially on early models, observe the following precautions. Mount the fan bracket as high as possible in its mounting holes. This is to provide maximum clearance over the PC board. There should be about 1/8" clearance under the fan blades. Be especially careful that the mounting screws are tight without being stripped. If a screw strips, drill out the hole if necessary and replace with a screw and nut. Note that the center screws go through to the capacitor mounting clamps (machine-threaded type).

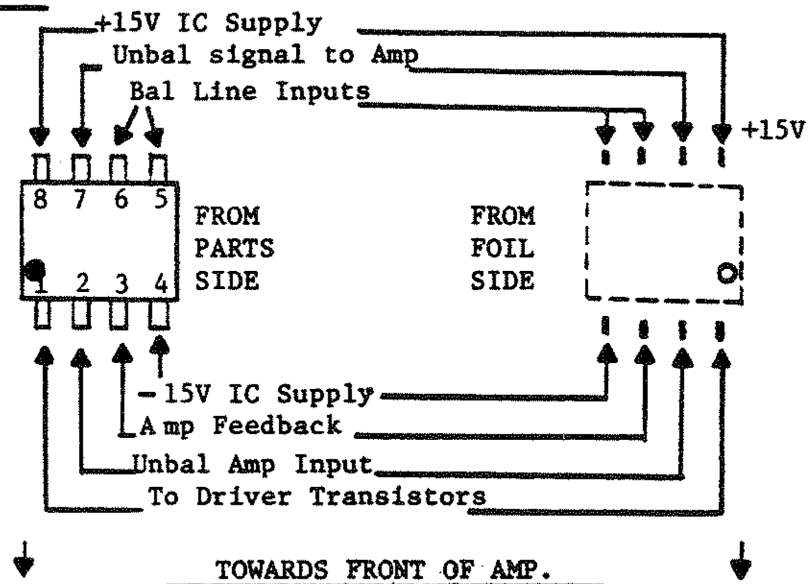
d. IC Replacement:

The only other active device in the power amp circuit is the dual IC op-amp, for each channel. The IC is socket-mounted for easy replacement if needed. Note orientation dot for correct polarity. If IC is installed backwards, IC voltages will be held to 1/2 V each. IC can usually be reversed without damage, as long as the usual precaution of power-off insertion is observed.

e. If Amp Still Won't Run:

If all the transistors and IC's have been replaced, the amp should at least run. If not, check the following areas for possible damage:

IC PIN DIAGRAM



Remove the IC and measure the IC supply voltages (on C10 and C11). Voltages should be +15V and -15V, within 5%. If not, check zener diodes Z1, Z2 or check R15, 16, 22, 23. The main power supply voltages +Vcc and -Vcc should also be within 5% of each other, even with the IC removed. Either set of voltages can affect the other, but assuming good power transistors, the main power supply voltage balance should depend on proper IC supply voltages.

After these checks, replace the IC. All power supply voltages should remain essentially the same (with no signal). If there are large changes, suspect defective DC feedback resistors R13, 14 and check the current limit trimmers in case of extreme misadjustment (all the way off). See 5-a and 5-b.

f. Faceplate Removal:

The faceplate will need removal in order to service the front-mounted circuits. Remove the four screws which hold the main PCB brackets to the lower flange of the faceplate sub-panel. Then remove the four handle screws (1/8" Allen driver). The faceplate/sub-panel assembly should now remove for access. If necessary, carefully remove the connections to the AC switch and PCB connectors. When replacing the assembly, be sure the main PCB brackets go inside the sub-panel flange.

g. Mounting Clearances:

When replacing the faceplate and cover panels, be sure to check for proper clearances, especially on the original A41/A42. In this model, the clearances between the "live" upper heat sink and the faceplate assembly is only about 1/8". The proper replacement sequence is as follows:

First, check for proper fan clearance (see 4-c). Then, replace the top cover, with insulated heat sinks attached (see 4-b). Then, observe from beneath that there is 1/8" clearance between the top-mounted heat sinks and the faceplate PC boards, main heat sink, etc. The heat sink fingers may be bent slightly to improve clearances, but maintain adequate separation between fingers for air flow.

When testing the original A41/A42 after repairs, be alert to the possibility of defective heat sink insulation. If the insulation shorts out, there will be a large current draw and the power transistors and especially the drivers will be blown. However, if you catch the problem below about 70-80V AC (on the Variac) the transistors will usually survive.

Early production units (A41/A42) used 4 metal standoffs per upper heat sink, with nylon shoulder washers insulating these parts from the heat sink. We had some problems with the nylon either cutting through or being too loose. We have substituted a nylon standoff instead which we will send upon request to replace the earlier system. Use one of the shoulder washers to center the nylon standoff in each oversize mounting hole. Use the shorter, 1/4" screws through the cover panel to avoid the problem of the screws touching in the middle of the standoff. The newer full-comp version mounts directly with metal standoffs and eliminates the insulation problems.

There is a U-shaped plastic air shroud in the A20-A30 series, mounted where the A41/A42 heat sinks would be. This part ensures that the cooling air goes through the heat sink instead of around it. It should rest right on top of the heat sink when replacing the cover.

h. Wiring Harness and Layouts:

Safe engineering practice requires that all AC wiring be "double-insulated"; in addition to the normal insulation of the wires, there must be additional separation from all metal chassis parts. This is done by tying the wires or by using extra sleeves. To maintain product safety, replace any ties which were removed for service, and restore wiring to its intended position.

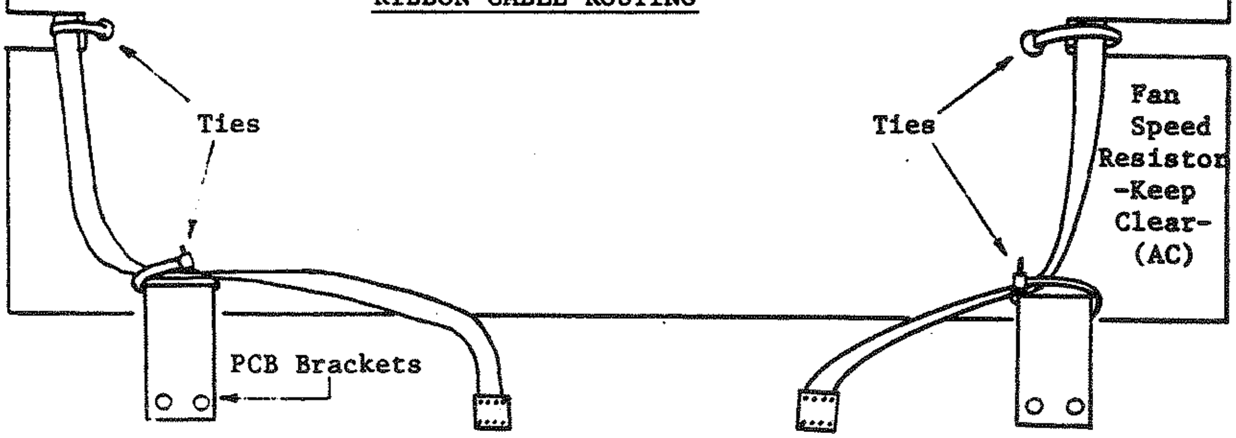
NEVER tie unprotected wires to metal surfaces, especially heat sinks. Additional sleeving is supposed to protect such wiring.

Do not let the transformer or AC wires press against the circuitry (channel 1). This can cause unwanted hum pickup, as well as a potential safety hazard.

The position of the connector wires leading to the faceplate can cause a slight (0.05%) amount of added high frequency distortion. (A22, A32, A42 only). The wires should be positioned over the wide, grounded foil traces on the front of the PC board. (see next page).

Watch for adequate clearance around the 250-ohm,15W power resistor for the fan speed control. This part gets hot enough to melt insulation, and carries AC current. Keep all wires clear, especially on the foil side. Also, be sure part is adequately mounted, so that it can't come loose and cause a shock hazard.

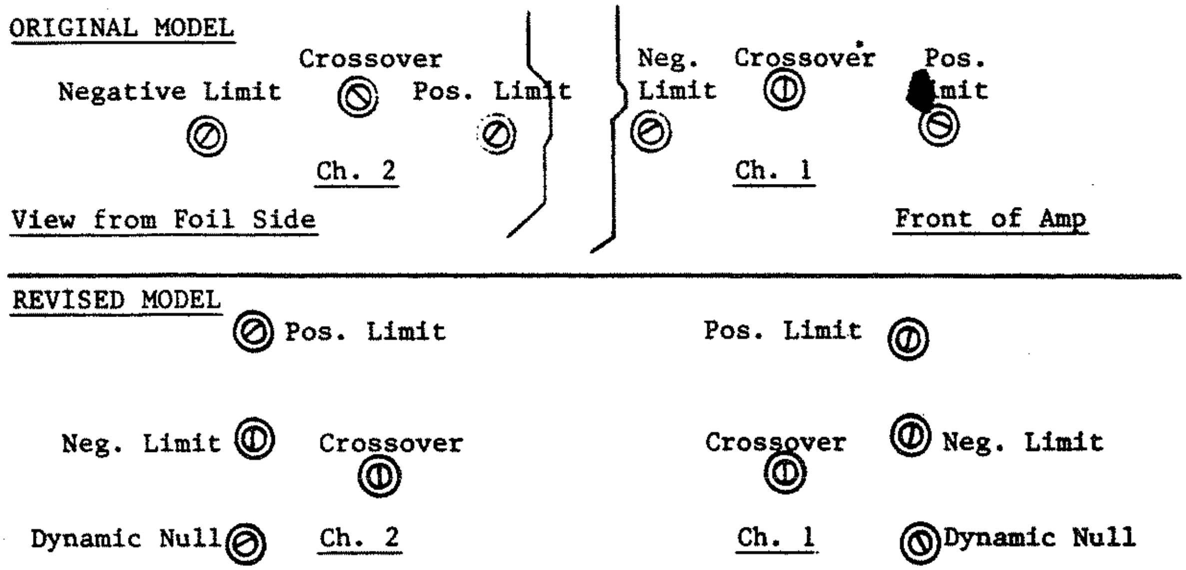
RIBBON CABLE ROUTING



i. <u>Bench Testing with Covers Off:</u>
All models can be tested briefly with covers off (to verify repairs), but fan cooling will not be effective. Be sure to prop up the A41/A42 cover so the heat sinks can't short out. It can be wedged vertically along the back of the chassis, resting on the input/output jacks, with heat sink wires still connected. The trimmer adjustments, which may require 5-10 minutes of high power operation, should be done with the top cover in place. Once you have verified that the amp is basically running, and is ready for final adjustments, mount the top cover and proceed to the next section.

5. Bench Adjustments:

Consult the drawing below for the location of the trimmers which adjust the positive and negative current limits, and the crossover bias, for each channel.



Trimmer adjustment may be made through the bottom of the main PC board, using a 1/16" flat-blade screwdriver.

a. Current Limits, A21, A22, A31, A32:

The amps are not supposed to show current limits at impedances of 4-ohms and up. Current limiting should begin at about 3-ohms. Adjustment should be made so that 2-ohm power is the same as 4-ohm power.

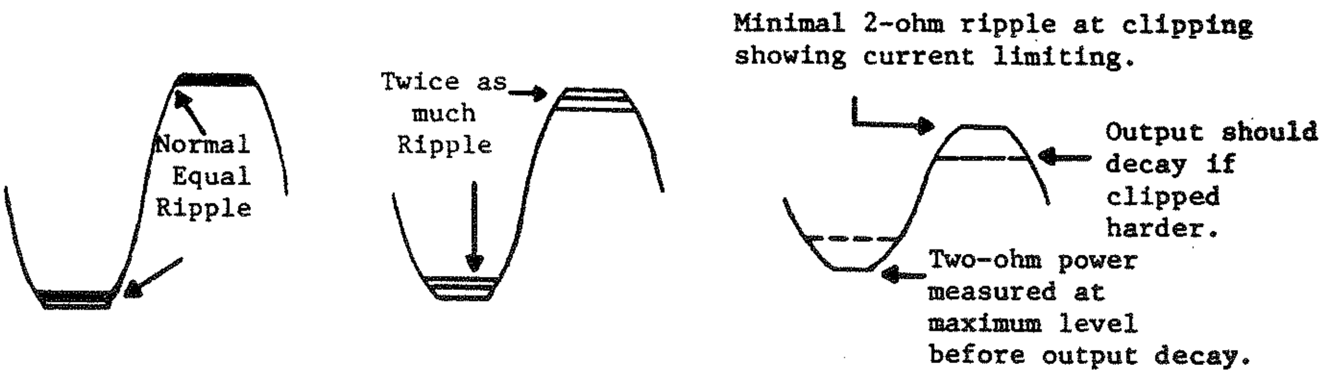
The expected circuit response can be observed by gradually raising the output power into a 2-ohm load. Just after reaching the desired power level, the output should start to clip. Pushing the output any higher should result in a perceptable "collapse" of the clipping level to a lower value. This shows the action of the time-delay current cutback (short circuit protection). This collapse is not supposed to occur at 4-ohms, no matter how hard the amp is driven.

The usual quick test is shown in the drawing on the next page. First, set the output level, into no-load, for a slight amount of clipping (1KHz typ.). Then, apply an 8-ohm load. You should see an evenly clipped output, with somewhat reduced peak levels (due to power supply loading). Also, note the "jitter" on the peaks, which shows normal power supply ripple. Presence of this ripple tells you that the amp is reaching full saturation (full voltage output).

Now switch to the 4-ohm load. You should see another slight drop in clipping level, and more ripple, as the amp delivers the higher 4-ohm power rating. If either peak is lower or seems to lack the normal ripple, that side may have inadequate current limit adjustment.

Finally, switch to the 2-ohm load. Normally, the output peak (clipping) level should collapse to a much lower level. Reduce amplifier Gain until the output recovers, and then see how high you can raise the gain before current cut-back occurs. Measure the output power at the highest point before cut-back. Note that when the current limiting works, the output voltage never comes close to the power supply voltages, and you won't see ripple on the peaks.

8,4,2 - OHM CLIPPING (FOR CURRENT LIMITS)



A. 8-ohm Clipping   B. 4-ohm Clipping   C. 2-ohm Clipping

To adjust the current limits, raise the signal level into 2-ohms until clipping just barely occurs. Increase the positive and negative current limit trimmers as necessary to obtain the desired output voltage (shown in table next page). Maintain the same amount of positive and negative clipping.

You should now obtain full-voltage output into 4-ohms, as shown by the presence of full ripple and even clipping.

Next, short-circuit the output of that channel, and measure the AC current draw, which should lie within the range shown in the table. As you can see by measuring the AC input power, and dividing by the number of output transistors, the short-circuit dissipation is less than half of the transistor thermal and safe-operating-area capacity. If the transistors are well-mounted, the amp can breeze through repeated short circuits. If desired, the short can be maintained until the thermal cut-out removes amp power, thus verifying full thermal performance and cut-out response.

The final test for proper current limits is to load both channels at 4-ohms, and reduce the Variac gradually until one or both channels goes into current limiting. ("Drops out"). This should not occur until the Variac has been reduced to the 40-60 VAC range.

If you reach the end of the trimmer range without adequate output, first check that all of the power transistors and emitter resistors are in the right places and soldered. (Varies with the different power ranges). If so, the trimmer range can be extended as follows:

To increase maximum current output: reduce R15 (positive) or R16 (negative limit) from 2.2K to 1.8K. If this fails, the driver transistor for that polarity may have to be exchanged for a higher-gain device. (mainly in older series)

	A21-A22	A31-A32	A41-A42
Volts RMS, 2-ohms (Just Before Clip)	15.5V	20V	24V
AC Current, Single Channel Shorted	2.5-3A	3.5-4.5A	5-6A
AC Current, Both Channels Shorted	4-5A	6.5-8A	8.5-10A

b. Current Limits, Early A41-A42:

The newer full-comp A41/A42 may be adjusted as above. The adjustment procedure for the old models is basically the same, but the negative trimmer may seem less responsive due to the quasi-complementary circuit. Follow the procedure above, with the following exceptions.

Use the A41-A42 values shown in table above.

You will not necessarily get even clipping into 2-ohms; the positive peak may well clip a little sooner.

Full-voltage, even clipping must be obtained into 4-ohm load, with similar ripple showing on both peaks.

After obtaining reasonably close performance into 2-ohms, switch to a shorted output. Observe the AC current draw, to make sure it is reasonably close to the desired value. Now, measure the positive and negative (+Vcc and -Vcc) supply voltages of the shorted channel. Ideally, they should be of equal and opposite values. If mismatch is greater than about 5V, adjust only the negative trimmer for better balance. If the final AC current is out of range, then adjust the positive trimmer to correct the AC current, and re-adjust the negative trimmer for correct power supply balance. This assures that the positive and negative banks of output transistors share the stress equally. After this adjustment, recheck into 2 and 4 ohms. Do not be overly concerned about exact 2-ohm performance, but be sure the 4-ohm power levels are full.

If the negative trimmer reaches its maximum limit, and you need more range, decrease R16 from 2.2K to 1.8K.

If the negative trimmer will not go low enough, decrease the resistor marked J4 (located under fan) about 25%, by paralleling additional resistance on the foil side.

c. Crossover Bias (All Models):

The crossover should be set after correct current limits are obtained. The best way is to use a distortion analyzer, and reduce the crossover notch (by turning the trimmer clockwise) until the notch is barely visible. Adjustment should be made for .1%, 20KHz distortion at about 10% power. If you notice a rise in idle current to more than about 1A (as measured on the AC Variac ammeter) after shorting the outputs long enough to kick the fan on high speed, you may have the crossover set too high. When operating for a long time, into rated loads, the crossover notch should stay fairly stable, because the crossover diodes are located where the heat sink temperature will affect them. However, during sudden overloads (like shorts) the heat sink temperature may temporarily out-race the diode response.

If you don't have a distortion analyzer, operate the amp into a non-inductive 4-ohm load (only a few watts needed for this test). Set the output voltage at about 2 volts, and use a 20KHz frequency. Carefully observe for crossover notch (turn the trimmer all the way down if necessary) and increase the trimmer until the notch just goes away.

If the notch remains large at all settings, and especially if the TDI LED won't light when clipped, the crossover diodes D1, D2 and "R21" (on A41/A42) are probably shorted, and will need replacing with the same type (1N4934). This sometimes happens when the driver transistors fail.

---

d. Dynamic Hum Null:

There is a fourth trimmer for each channel, which on the old model is accessible only from the parts side. This nulls out a small amount of hum caused when the power supply is loaded at high output powers. This setting should not need adjustment unless a filter capacitor is changed.

A distortion analyzer is required, since the hum level never exceeds 0.05%, even if mis-adjusted. Presence of hum will be observed as a vertical widening of the distortion products trace, when testing at a mid-to-high frequency. Adjust trimmer to minimize this effect. If your analyzer has a hum filter, do not use it, as it would conceal the effect.

This trimmer has nothing to do with quiescent hum. Refer to section 3-e for this symptom.

6. Schematics:

Schematics, and PCB parts diagrams (slightly reduced) are included for all three power ranges: A21-A22, A31-A32, and A41-A42. (old and new).

Notes - Various value changes were made in the balanced line input and bridging circuit of all three new models. See the "old" A41-A42 schematic to check these values on old style A20-A30 and A40 series units.

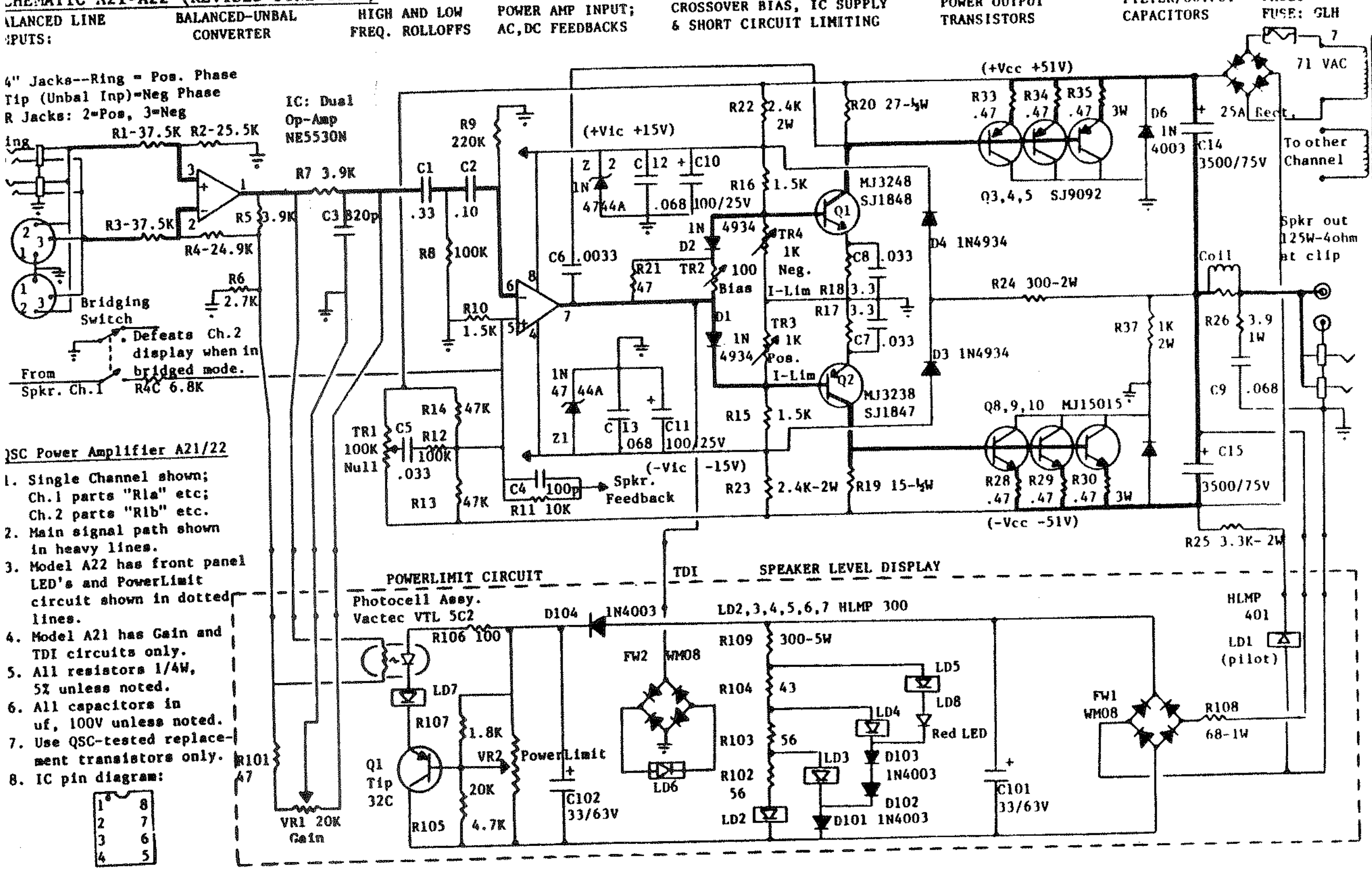
The power output stages for the A20 and A30 series have remained the same, so the new schematic can be used for old and new models, except for driver transistor type.

The "new" A40 series uses a full-complementary output section, so both old and new schematics are shown for clarity.

The PowerLimit and Gain circuit has also been revised slightly on new models. The original version is shown on the "old" A40 schematic. Note that R9 varies for each power range.

Old (QSC 33A) and new (QSC 33B) PC legends are also included.

CHEMATIC A21-A22 (REVISED JUNE 1980)

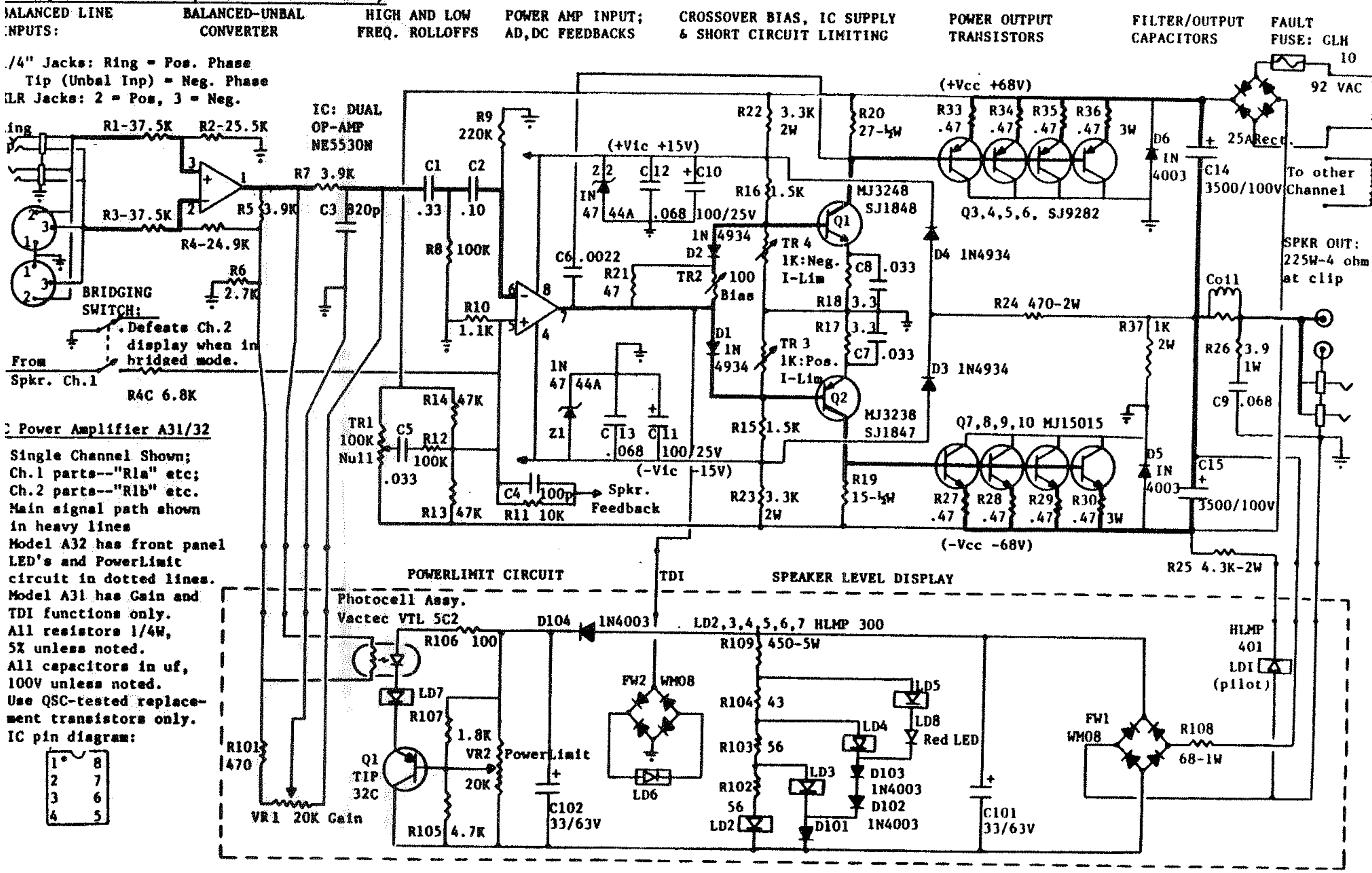


QSC Power Amplifier A21/22

1. Single Channel shown; Ch.1 parts "R1a" etc; Ch.2 parts "R1b" etc.
2. Main signal path shown in heavy lines.
3. Model A22 has front panel LED's and PowerLimit circuit shown in dotted lines.
4. Model A21 has Gain and TDI circuits only.
5. All resistors 1/4W, 5% unless noted.
6. All capacitors in uf, 100V unless noted.
7. Use QSC-tested replacement transistors only.
8. IC pin diagram:

1	8
2	7
3	6
4	5

SCHEMATIC A31-A32 (REVISED JUNE 1980)

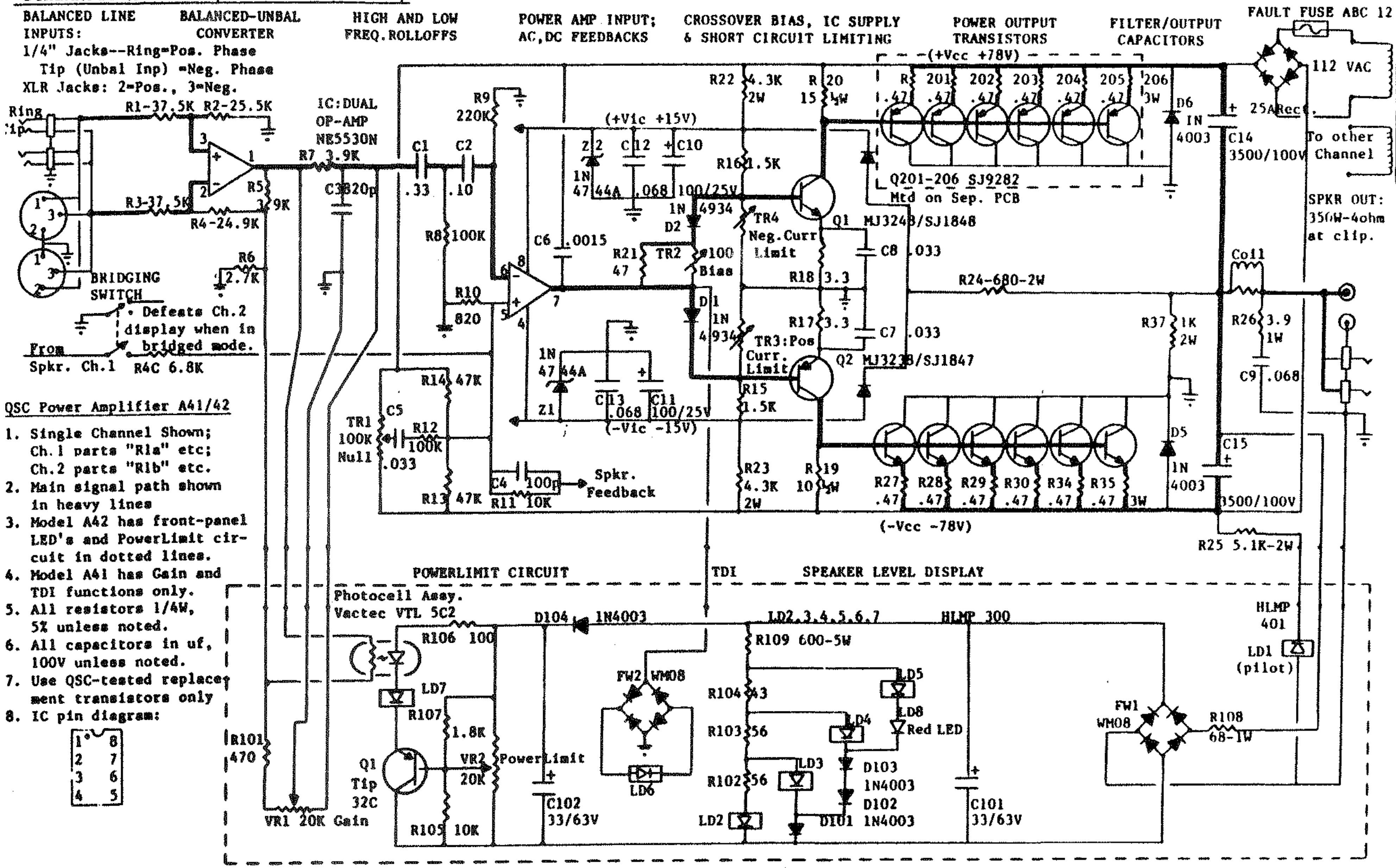


Power Amplifier A31/32

Single Channel Shown;
Ch.1 parts--"R1a" etc;
Ch.2 parts--"R1b" etc.
Main signal path shown in heavy lines
Model A32 has front panel LED's and PowerLimit circuit in dotted lines.
Model A31 has Gain and TDI functions only.
All resistors 1/4W, 5% unless noted.
All capacitors in uf, 100V unless noted.
Use QSC-tested replacement transistors only.
IC pin diagram:

1°	8
2	7
3	6
4	5

SCHEMATIC A41-A42 (REVISED JUNE 1980)

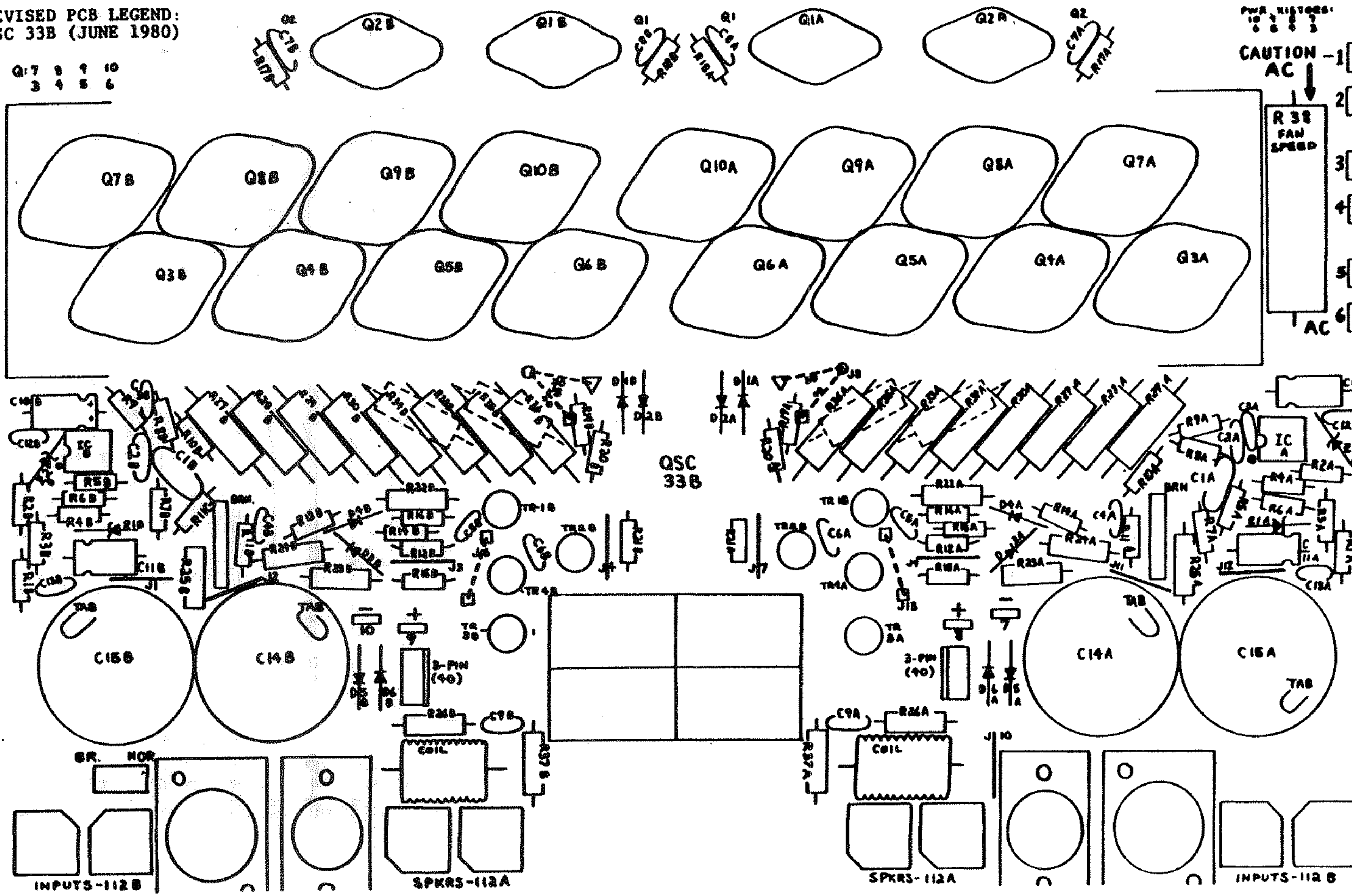


QSC Power Amplifier A41/42

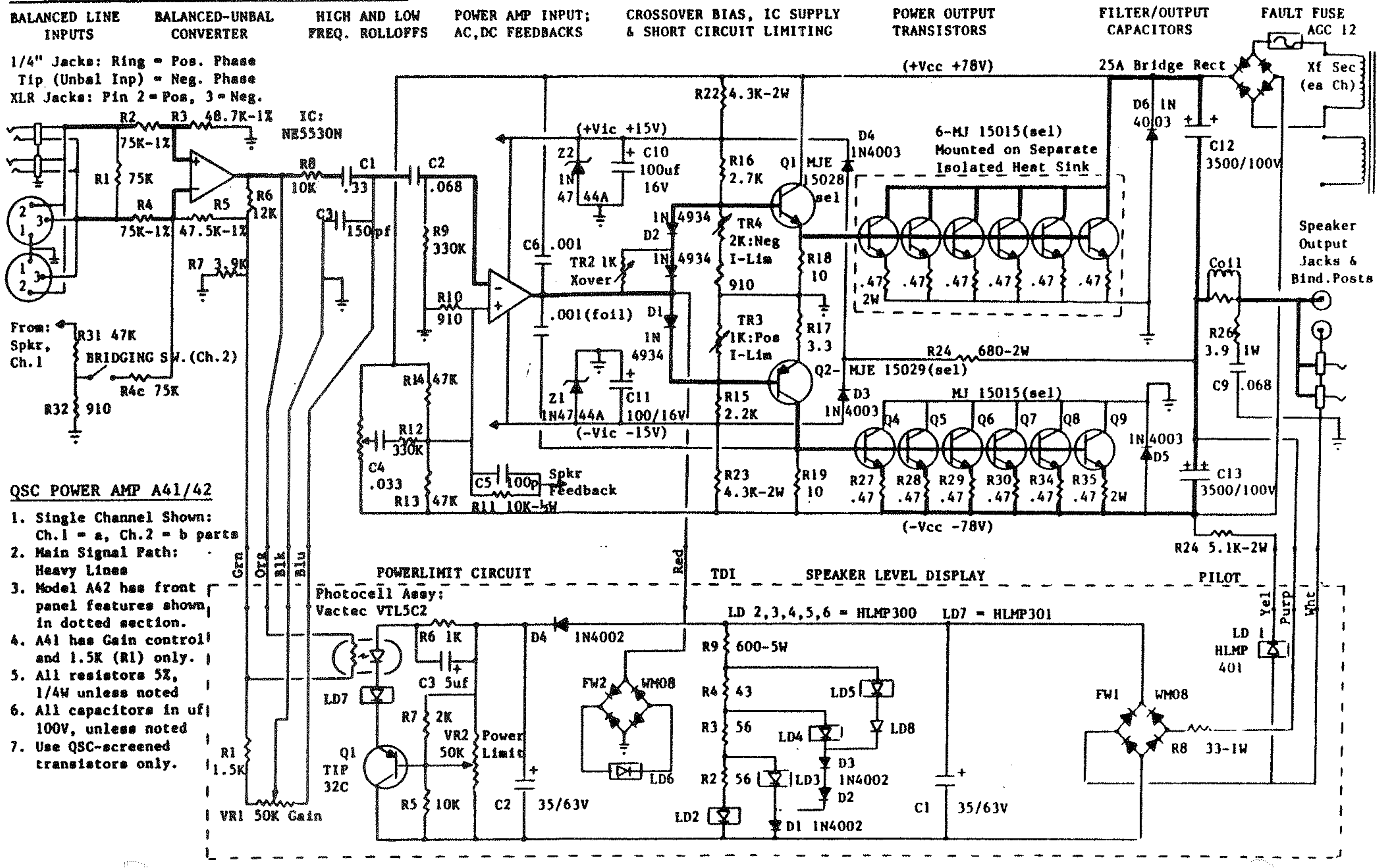
1. Single Channel Shown; Ch.1 parts "R1a" etc; Ch.2 parts "R1b" etc.
2. Main signal path shown in heavy lines
3. Model A42 has front-panel LED's and PowerLimit circuit in dotted lines.
4. Model A41 has Gain and TDI functions only.
5. All resistors 1/4W, 5% unless noted.
6. All capacitors in uf, 100V unless noted.
7. Use QSC-tested replacement transistors only
8. IC pin diagram:

1°	8
2	7
3	6
4	5

REVISED PCB LEGEND:
QSC 33B (JUNE 1980)



SCHEMATIC A41-A42 (ORIGINAL VERSION)

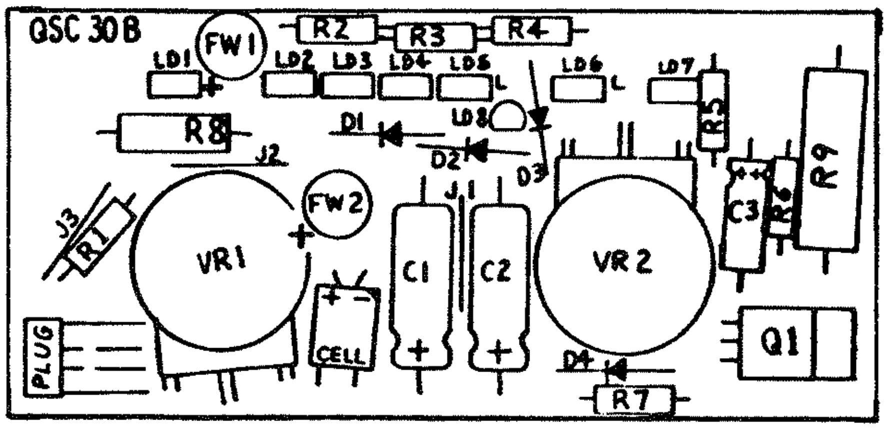


QSC POWER AMP A41/42

1. Single Channel Shown: Ch.1 = a, Ch.2 = b parts
2. Main Signal Path: Heavy Lines
3. Model A42 has front panel features shown in dotted section.
4. A41 has Gain control and 1.5K (R1) only.
5. All resistors 5%, 1/4W unless noted
6. All capacitors in uf 100V, unless noted
7. Use QSC-screened transistors only.

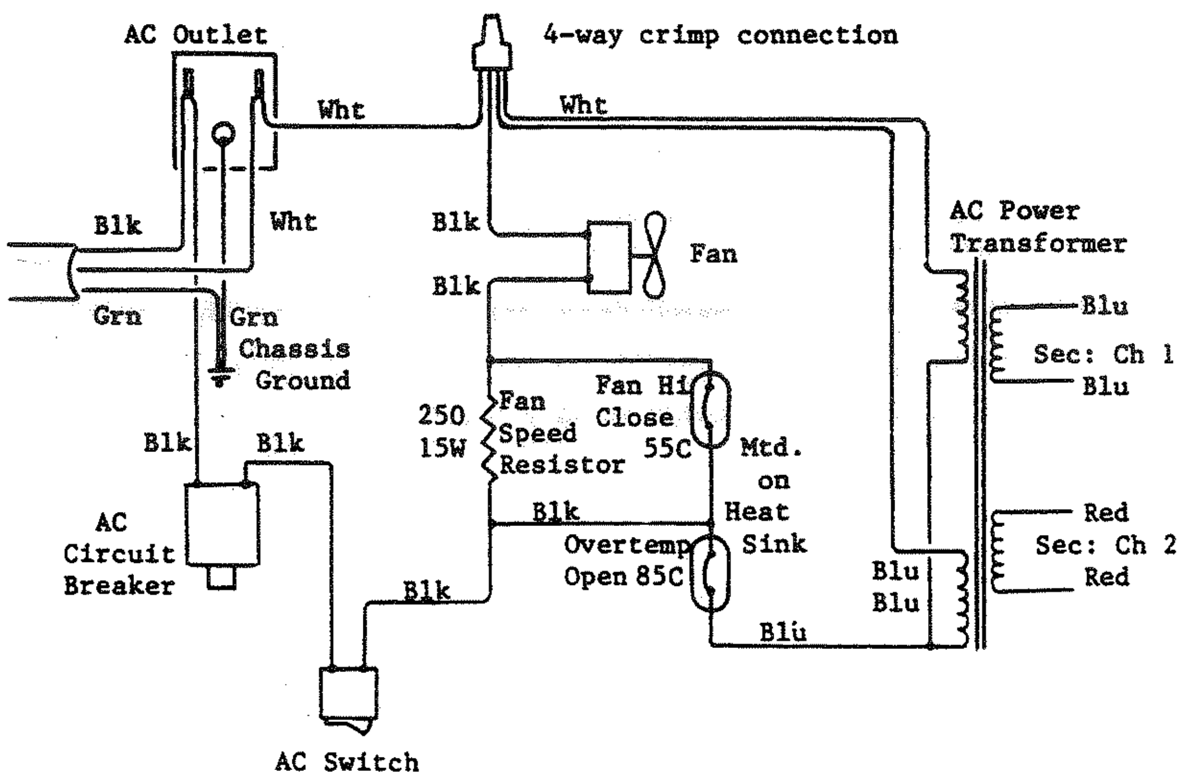
Legend (Faceplate Features)

This circuit board is mounted on the faceplate (one per channel) on the "deluxe" A22, A32, A42.



AC Wiring Diagram. (USA Version)

Export version uses 220/240V power transformer with 120V tap for the fan.



NE5530 OPAMP SUBSTITUTION

The Signetics NE5530 dual operational amplifier used in the "A" Series products has been discontinued (1982). Substituting this component with an available part may require additional modifications; depending on the product the substitution is made in. The recommended substitute is the Texas Instrument TL072 FET dual operational amplifier. The following modifications must be made to use this substitute:

1. Power Amplifiers A21-A22, A31-A32, A41-A42 (Revised June 1980, complementary output).

   Resistors R19 & R20 must be 22 ohm, 1 watt, metal oxide resistors. Resistors R17 & R18 must be 6.8 ohm, 1 watt, metal oxide resistors.

   The values of capacitors C7 & C8 may need to be altered to prevent output instability. Check the distortion waveform with no output load, an 8 ohm output load, and a 4 ohm output load with a 20kHz input signal. Look for instability at the peaks of the waveform and at zero-crossing.

2. Power Amplifiers A41 & A42 (Original Version, quasi-complementary output).

   Resistors R18 and R19 must be 22 ohm, 1 watt, metal oxide. Resistor R17 must be 6.8 ohm, 1 watt, metal oxide.

   A small value capacitor (100pF-.001uF, 50VDC) paralleling resistor R17 may be needed to prevent instability. Check the distortion waveform with no output load, an 8 ohm output load, and a 4 ohm output load with a 20kHz input signal. Look for instability at the peaks of the waveform and at zero-crossing.

3. Power Amplifiers A3.7, A4.2, and A5.1.

   Resistors R14 and R15 must be 6.8 ohm, 1 watt, metal oxide resistors.

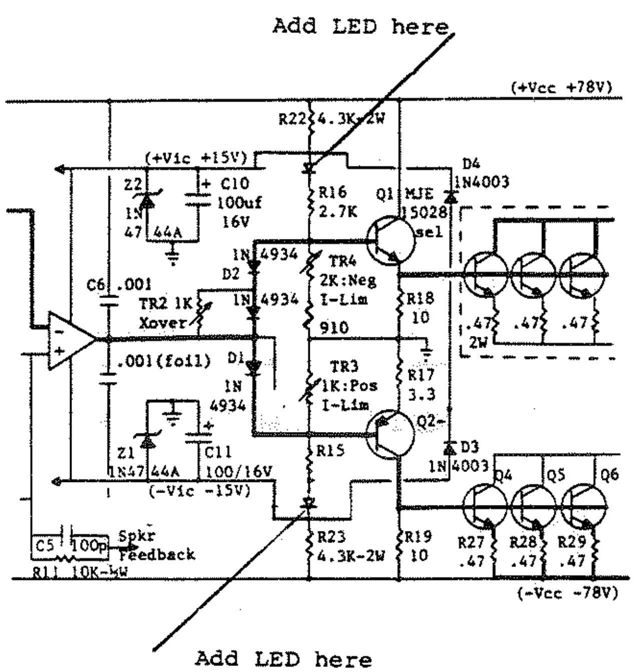
   The value of capacitor C11 may need to be altered to prevent output instability. Check the distortion waveform with no output load, an 8 ohm output load, and a 4 ohm output load with a 20kHz input signal. Look for instability at the peaks of the waveform and at zero-crossing.

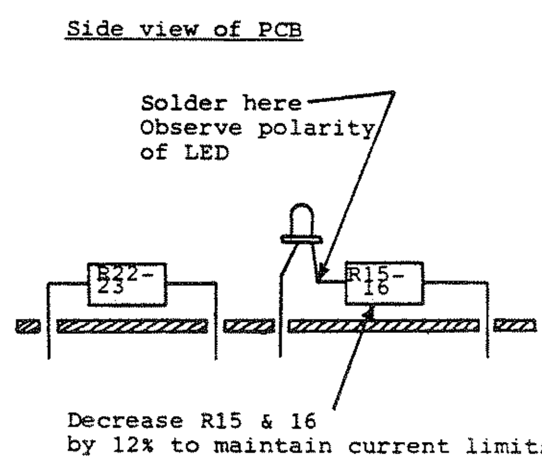
TO: All QSC Service Centers.

REF: Eliminating turn-off transients in QSC amplifiers.

Early models of the A3.7-A5.1, and the A20-30-40 series power amps may suffer from electrical noises at turn-off. If these prove objectionable, the following corrective actions may be taken:

1. Pop immediately upon turning off:
   a. Cause: inductive arc across the AC switch is coupled into associated electronic equipment.
   b. Cure: Noise may be suppressed by turning Gain controls down before turn-off. Noise may be eliminated by wiring a 600V (minimum), .047uf capacitor across the switch terminals. This will absorb the turn-off arc.
2. "Ping-Pong" or motorboating sound a few seconds after turn-off:
   a. Cause: The internal IC op-amps become unstable when the IC power supply voltage decays to about 2V. The resultant series of clicks as the main power supply finishes its discharge has never been measured at over a few watts, but may sound annoying through high efficiency speakers.
   b. Cure: To eliminate the cause, it is necessary to ensure that bias is removed from the driver transistors before the IC supply drops to 2V. The normal action of the current-limit resistors R15 and R16 will cause total shut-off of the driver transistors at a low enough voltage, but is some cases, depending on the required setting of the current limit trimmers in production, the cut-off may not occur until too late. Since ordinary LED's have a stable forward voltage of about 1.6V, adding an LED in series with both R15 and R16 will create the extra margin required to ensure full cut-off before the IC voltage decay to 2V. When this is done, R15 and R16 should be decreased by 12% to maintain original 4-ohm current limits.



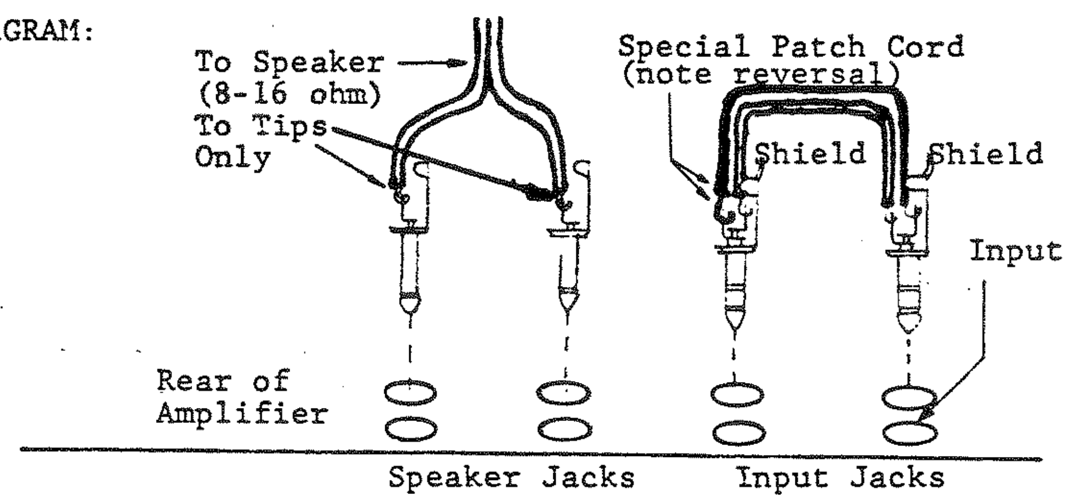


Bridged-Mono Operation of QSC A5.1 Power Amplifier

It is sometimes desired to apply the power of both channels of a stereo amplifier to a single load. This is commonly done with the "bridged-mono" hookup. This hookup effectively places both channels of the amp in series, thus delivering the combined 8-ohm per channel rating (80 + 80W) into a single 16-ohm load, or the combined 4-ohm per channel (120 + 120W) into a single 8-ohm load. As you can see, this only works where the load impedance is rather high; the single 8-ohm load draws the maximum rated power of the amplifier. 4-ohm loads must be avoided; even the 8-ohm load will stress the amp to its limit.

Since the amplifier has balanced line inputs, it is easy to make a special patch cord for bridged operation. What is required is a short, balanced cable, using stereo 1/4" plugs and two-conductor shielded cable, with the phase reversed at one end. The signal, balanced or unbalanced, should be connected to Ch. 1 as usual. The special patch cable should run from the other input of Ch. 1 to the input of Ch. 2. The Gain controls for each channel should be set to the same value; full-up is the easiest to obtain. When this is done, the same signal will appear in both channels, but out of phase (reverse polarity), so that when Ch. 1 happens to have, say +20V output, Ch. 2 will have -20V output. If the speaker is "bridged" across the outputs, it will therefore see 40V total; current flow will also double, for a power increase of four times. As mentioned above, this puts a high loading on the amplifier, so you are not getting something for nothing. The speaker must also be connected to a special cable, which consists of two 1/4" plugs, with the speaker wired to each tip only. Please note that both sides of the speaker line are now "hot", so no grounding or shared circuits may be connected to either side.

HOOKUP DIAGRAM:



Service Introduction for QSC Power Amplifiers A3.7, A4.2, A5.1

1. Scope. These three amps replace the three smallest units in our line, the old A3.6, A4.1, and A5.0. We have completely redesigned the circuit to bring it up to full professional standards. We have incorporated many improvements within a basically simple circuit, but you should refer to these notes, and the accompanying schematics, to effectively service this novel design.

2. General. Please note that the same PC card is used for all three models. The A3.7 (150W mono) uses the "A" channel only. The A4.2 (60 + 60W stereo) uses both channels, with a smaller power supply and half of the output transistors. The A5.1 (120 + 120W stereo) uses the full set of output transistors and the larger power transformer. We will refer to the A5.1 when discussing the circuit, with the understanding the the same part numbers have the same function in all three models.

3. Testing. The basic test set-up for servicing power amps should consist of:

a. Oscilloscope, for monitoring input/output waveforms;
b. Function generator, for input signals;
c. Multimeter, for measuring voltages and resistance values;
d. AC Variac, to inch up power while testing for operation;
e. AC ammeter, 0-5A, between amp and Variac, to determine presence of abnormal current draws due to shorts, and to measure normal current draws into test loads;
f. Test load, with 8,4,2 ohm settings, preferably two-channels.

Hook up the amp with signal input. Monitor speaker outputs with scope. Switch speaker load "out" and start with Variac on zero. Inch up Variac while looking for abnormal current draws (due to shorted transistors, etc.). A good amp should stabilize by the time the AC voltage reaches 40V. If so, increase AC voltage to normal, and switch in speaker loads to test output power. Full clipping should be seen into 8 and 4 ohms. Into 2 ohms, you should see a definite drop in the clipping level, showing operation of current limiting. This can also be recognized by a small peak in the leading edge, as compared to the normal, flat-topped clipping into 4 and 8-ohm loads.

A distortion analyzer, though expensive, is very useful for ensuring full performance, free of minor discrepancies. Distortion, just below clipping, should be less than .1%, 20-20KHz, although a practical limit of .15% may be necessary at 20KHz to account for semiconductor variations, particularly in the IC.

4. Basic Troubleshooting. The most common problem is shorted output transistors, indicated by a blown fault fuse in the affected channel.

Replace all four devices (two for the A4.2) in that channel, using only QSC supplied replacements to ensure full performance and reliability. Please note that the devices for each channel are "interleaved" for better heat sink sharing; trace carefully. There are equal numbers of NPN and PNP parts in each channel. No mica insulators should be used; the circuit is designed to operate with metal-to-metal contact for better cooling. The simplified mounting requirements should greatly facilitate replacements.

New output transistors should correct 90% of the problems. Further damage "upstream" is rare unless it was the cause of the problem in the first place. After replacing transistors, test the amp as described above, and refer to the following circuit description for other problems.

5. Circuit Operation. Starting at the input stage:
a. R1, R4, and R2,R3,R19, along with the first section of the IC, form the balanced-line input. This stage ignores common-mode (equal-phase) inputs, while responding to differential (push-pull) signals. If one input is grounded, the circuit will still respond to signals at the other input, so it works just as well for unbalanced inputs. R18,R21, and the Gain control are inserted in the IC feedback to adjust Gain. C5 sets the 20Hz (-1dB) low frequency rolloff, and C6 sets the 20KHz (-1dB) high frequency cutoff. At full output, there should be a 4.5V Pk (3.2Vrms) signal at the input to the second IC stage, which is the actual input to the power amp.

b. R7 and R8 provide balanced DC feedback from the power supply rails, to keep the output voltage centered. Some output loading must be present for this to work, so ignore minor imbalances in clipping unless present into 4-8 ohm loads. R5,R6 form the feedback from the speaker output, with C10 for high frequency stability.

c. The novel method of coupling the 5-10 ma output from the IC to the final power transistors is one of the major accomplishments of this circuit. The IC drives Q1 and Q2, the TO-220 driver transistors, in push-pull. R22 and R20 form a voltage divider which sets up a 1V Pk drive level to the bases of Q1, Q2. R15 and R14, the emitter resistors for Q1,Q2, provide current feedback to establish a current limit of about 300 ma coming out of Q1,Q2. This current is amplified by the complementary output transistors Q3-Q6 to drive the speakers. The best way to visualize this is to consider what happens when, say, Q1 is driven by a positive signal from the IC. Q1 is increasingly turned on, causing its collector to pull down on the positive supply rail. This 300 ma current is amplified by Q3,Q4, acting as emitter followers. The resultant high output current is coupled through C1, and drives the speaker output negative, as the positive supply rail is pulled down to ground. While this is happening, Q2,Q5,Q6 are cut off, and C2 carries the negative rail to its maximum excursion of twice the normal value. When the signal waveform reverses, Q1,A3,and Q4 are cut off, and Q2,Q5,and Q6 are driven by negative current from the IC. This pulls up on the negative rail, and is coupled through C2 to drive the speaker positive. Note that, although C1 and C2 are the bipolar power supply filter capacitors, they are connected to a completely separate winding from the power transformer. Thus they are free to "float" and can carry the speaker output signal. The advantages include only two transistor stages between the IC and speaker; fully complementary, push-pull circuit; non-insulated (no mica) power transistor mounting, and inherent DC protection for the speaker loads due to the bipolar capacitative coupling through C1 and C2.

Remember that problems in the positive side of the circuit will show up on negative peaks of the output waveform, and vice-versa.

d. The other major development consists of the improved short-circuit protection. The output current is inherently limited due to the 300 ma current limit in the driver transistors; moreover, the output currents into shorted loads will be less than the currents permitted into normal loads. This is accomplished by the IC power supply circuit R11,R10,C3,C4,D3,D4,and R9. During no-signal conditions, the IC voltage stabilizes at about +/- 14V DC. As the signal increases, the IC power supply voltage would normally fall, due to the loading of the increased current demands. However, D3 and D4 rectify part of the speaker output voltage, which keeps the IC voltages charged up to normal levels. However, if the amp is operated into shorted or nearly-shorted loads, there will be little or no output voltage to be rectified. Consequently, the IC power supply voltages fall to about +/- 7V, which cuts the available drive current in half, compared to what it would be into valid loads. C3 and C4 cause about a 1/4 sec time delay, so there can be no effect even on low frequency peaks, when using valid loads. In effect, this circuit senses the impedance of the load, without the reactive effects which can "false-trigger" some of the more conventional protection schemes.

e. Crossover bias is set by D1 and D2, which are carefully selected for forward voltage, and located next to the heat sink for thermal feedback. The bias is set just at class-B, with a very slight crossover notch, for reliable operation under heavy service and unpredictable cooling.

f. High frequency stability is established by an output circuit, R27, C12, and the small coil. C7 sets the primary high frequency pole, and sets the slew rate, which is held to a value sufficient to pass a clean 25KHz sine wave without excessively high slew rates which might permit ultrasonic oscillations with consequent speaker damage.

g. Each channel is individually powered by its own set of filter/ output capacitors (C1,C2); bridge rectifier, fault fuse, and transformer winding. The fuse is large enough to carry the full current limit of the channel, and should only blow in case of faulty output transistors or other shorts.

h. There is a thermal cutout (85C or 185F) in the AC power circuit, as well as an AC circuit breaker.

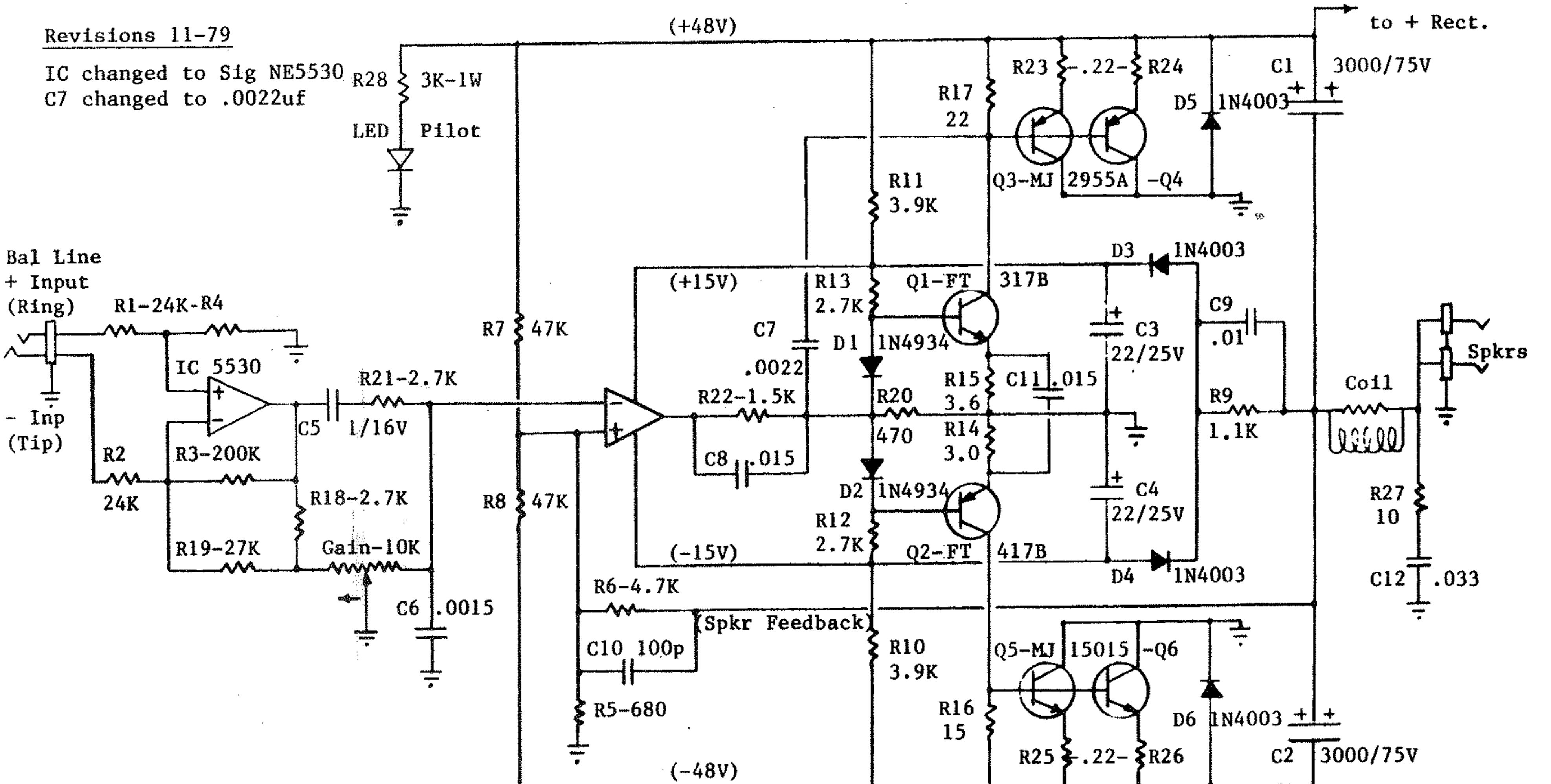
i. The amplifier is supposed to be capable of safe operation into a dead short until the thermal cutout actuates. If performing this test, do not use very low frequencies below 20Hz, as the circuit is vulnerable to damage by subsonic frequencies while shorted. This restriction does not apply into normal loads, where operation is safe at all frequencies.

QSC Power Amplifier 3.7

12-9-81

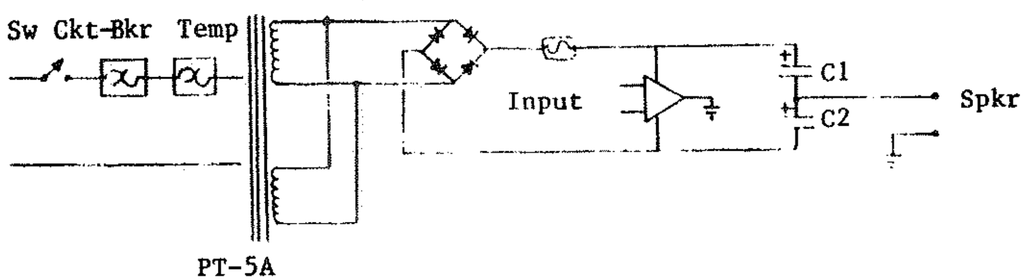
Revisions 11-79

IC changed to Sig NE5530
C7 changed to .0022uf



Power Supply Block Diagram

AC Mains   Power Transformer   Rectifiers Fault Fuses   Amp Ckts   Filter Caps   Spkrs



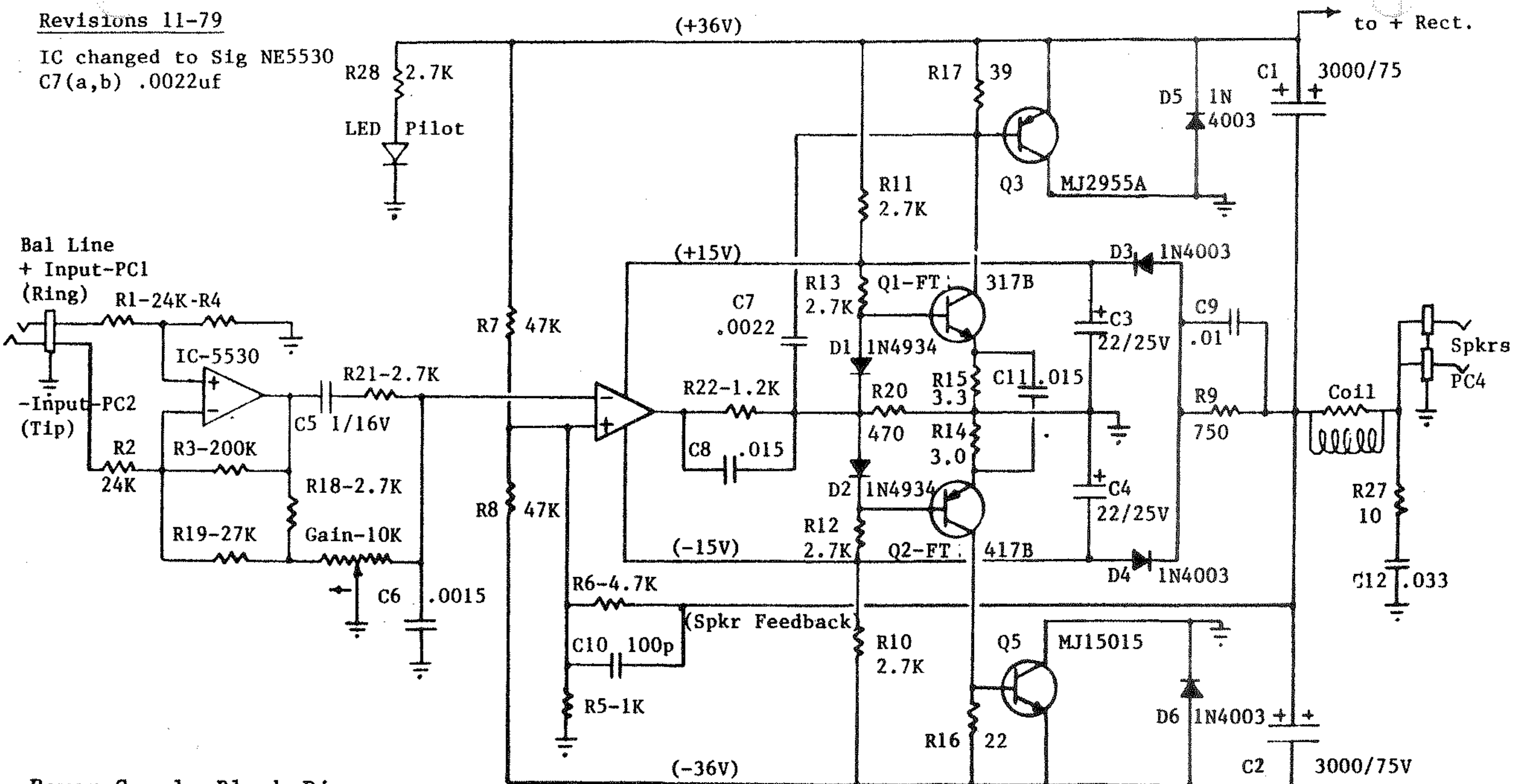
NOTES A3.7

1. One Channel only: "a" parts.
2. All resistors in ohms, ¼-½ W unless shown.
3. All capacitors in uf/100V unless shown
4. All transistors are selected for greater than minimum specs. Replace with QSC parts only.
5. D1,D2 set class-B crossover bias. Forward V = .58
6. Crossover test: small notch at 20KHz, 1-2V output.
7. Blown fault fuse on PCB means shorted output trans. Amp will need devices replaced.

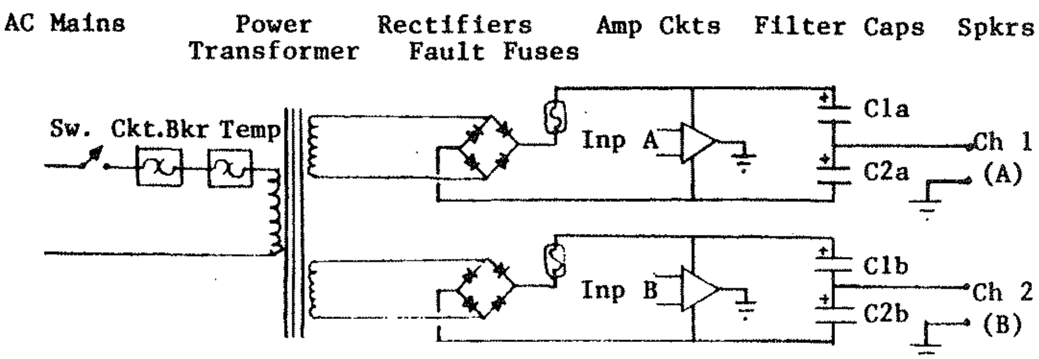
QSC P[illegible]er Amplifier 4.2 — 2-9-81

Revisions 11-79

IC changed to Sig NE5530
C7(a,b) .0022uf



Power Supply Block Diagram



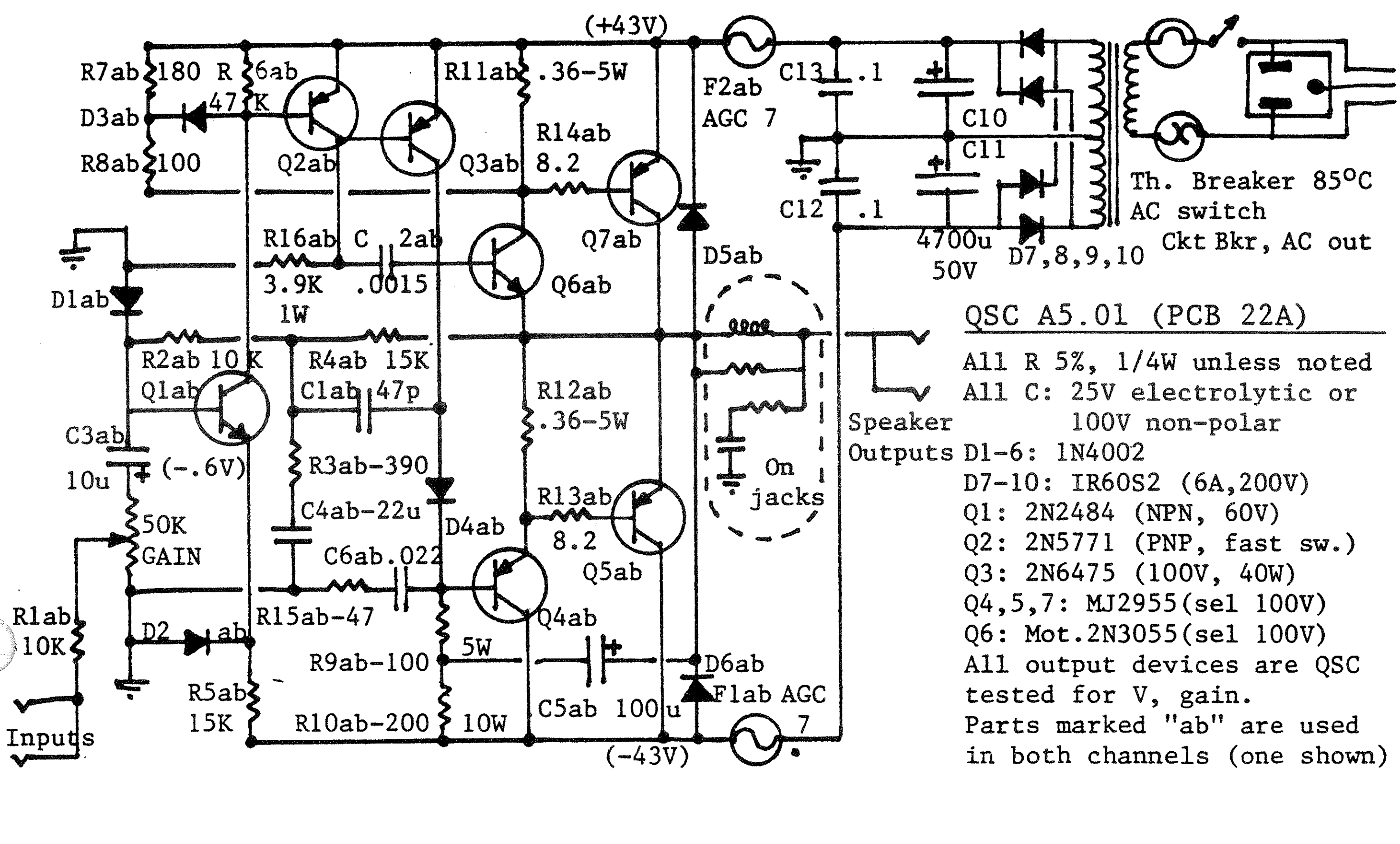
NOTES A4.2

1. One Channel shown; Ch.1 = "a" parts; Ch.2 = "b".
2. All resistors in ohms, ¼-½ W unless shown
3. All capacitors in uf/100V unless shown
4. All transistors are selected for greater than minimum specs; replace with QSC parts only.
5. D1, D2 set class-B crossover bias. Forward V = .58
6. Crossover test: small notch at 20KHz, 1-2 V output.
7. Blown fault fuse on PCB means short in output trans.
8. Note that Ch.1 (a) and Ch.2 (b) output transistors are "interleaved" for better heat sink sharing. Trace parts carefully.

QSC AUDIO PRODUCTS
1926 PLACENTIA AVENUE □ COSTA MESA, CALIFORNIA 92627

QSC POWER AMP 5.01 (and 5.0) SERVICE INSTRUCTIONS 10-77

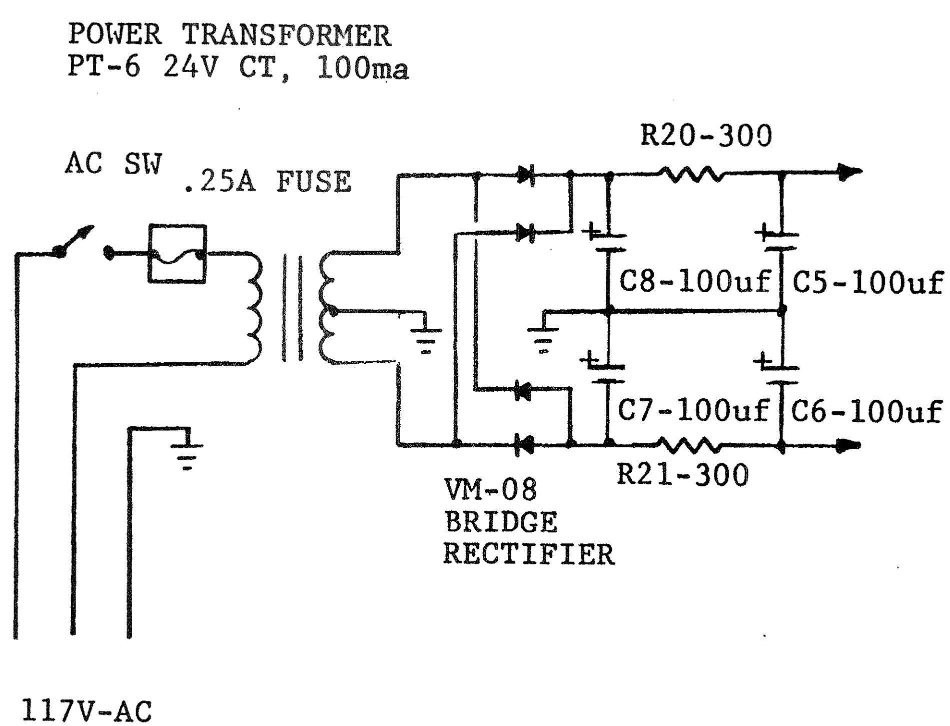
1. The QSC A5.01 consists essentially of two A3.61 circuits on the same chassis. Early A5.0 models will be found with added parts on the foil side, but the circuit is quite similar.
2. The improvements are as follows:
   a. Extruded heat sink bracket and heavier faceplate for maximum heat transfer. Specific alloys of aluminum (1100 series) are used because they have the best heat conductivity (50% better than common 6061 or 5052 alloys).
   b. As in the A3.61, the circuit polarity has been reversed to make maximum use of the superior gain/voltage of the MJ2955 output transistors.
   c. Q2 is a very fast saturated-switch type to correct a slight lag in slew rate recovery.
   d. Units will start shipping with a printed-circuit mounting plane for the jacks. This board will also contain a speaker output filter to assure stable output even with abnormally reactive loads.
3. Circuit description and testing:
   a. The "a" parts are for Channel 1; the "b" parts are for Channel 2. Common parts have no letter.
   b. If fuses are blown, the associated output transistors, and maybe Q2, will need replacement. Use only QSC factory-selected output devices for adequate voltage (100 Vceo) and gain for correct current limits. Each channel should deliver 10A peak (14V rms, 2-ohms) current limit.
   c. Testing should be done with a Variac on about 30VAC until proper operation is obtained. A good amp should work from 20-130VAC.



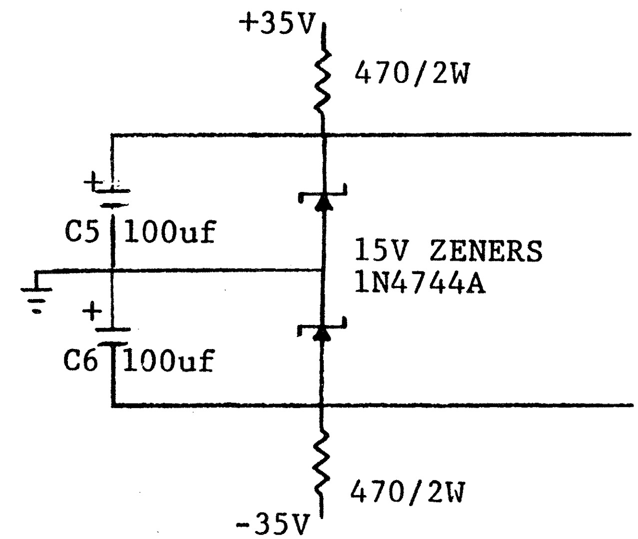
QSC A5.01 (PCB 22A)

All R 5%, 1/4W unless noted
All C: 25V electrolytic or 100V non-polar
D1-6: 1N4002
D7-10: IR60S2 (6A,200V)
Q1: 2N2484 (NPN, 60V)
Q2: 2N5771 (PNP, fast sw.)
Q3: 2N6475 (100V, 40W)
Q4,5,7: MJ2955(sel 100V)
Q6: Mot.2N3055(sel 100V)
All output devices are QSC tested for V, gain.
Parts marked "ab" are used in both channels (one shown)

POWER SUPPLY X2.2



POWER SUPPLY X1.2



NOTE: USE DOTTED PARTS OUTLINE ON PCB. THE POWER SUPPLY IS TAKEN FROM THE MAIN POWER SUPPLY ON THE 4.2 AMPLIFIER, WHICH IS 35V.

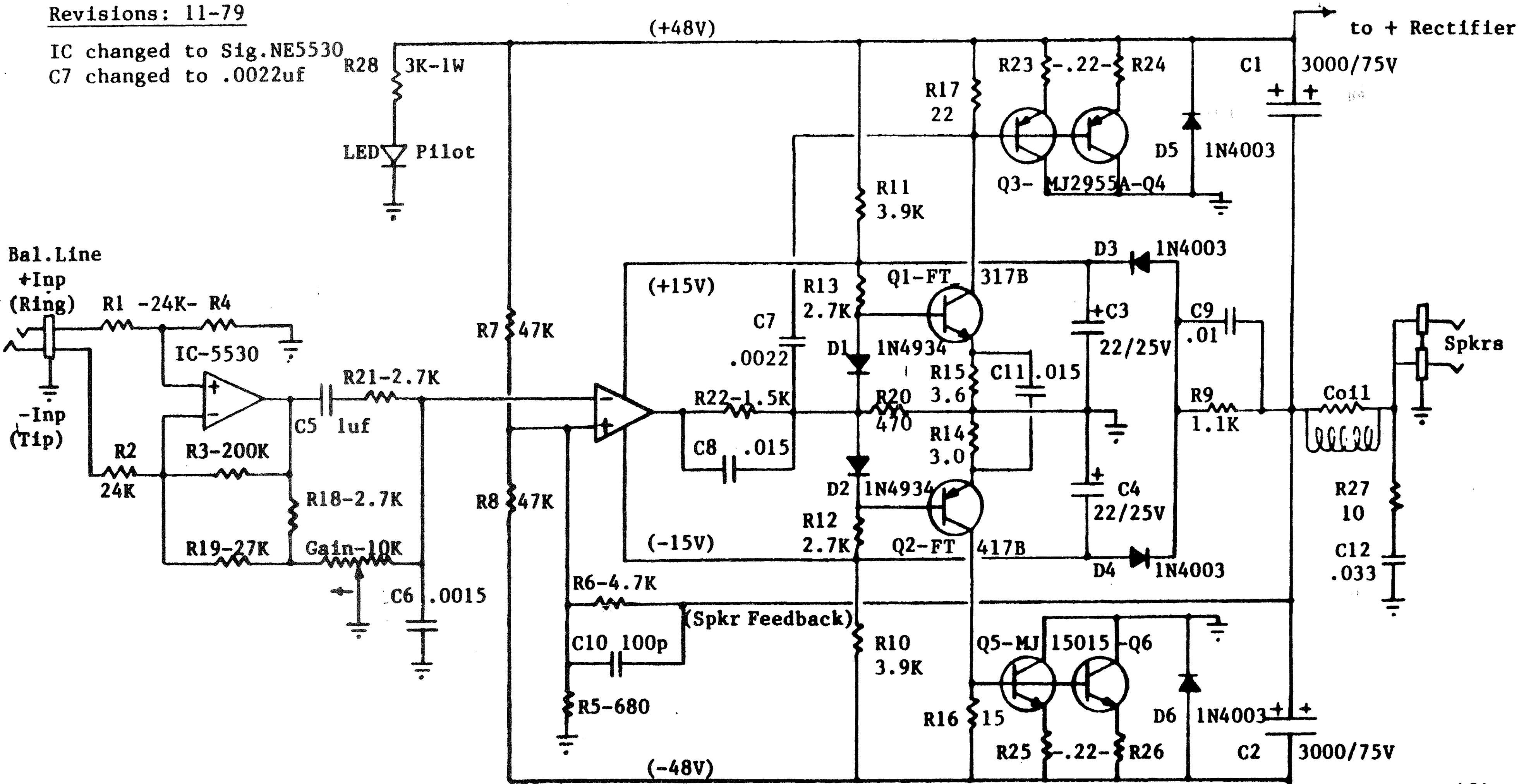
OSC AUDIO PRODUCTS

QSC Power Amplifier 5.1

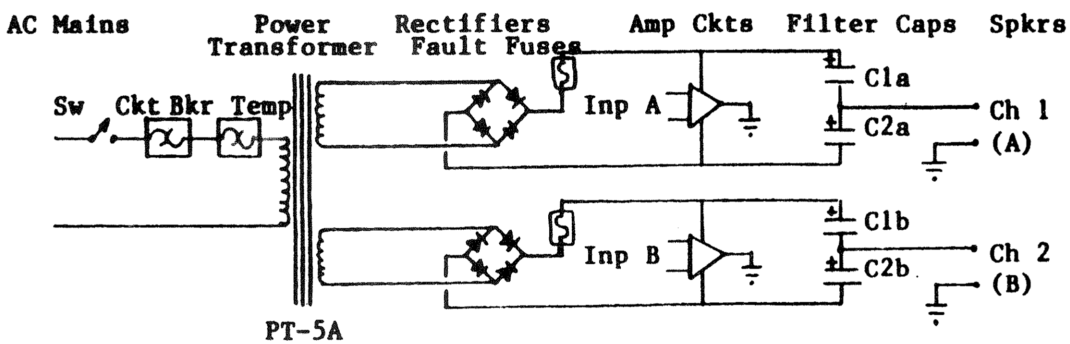
12-9-81

Revisions: 11-79

IC changed to Sig.NE5530
C7 changed to .0022uf

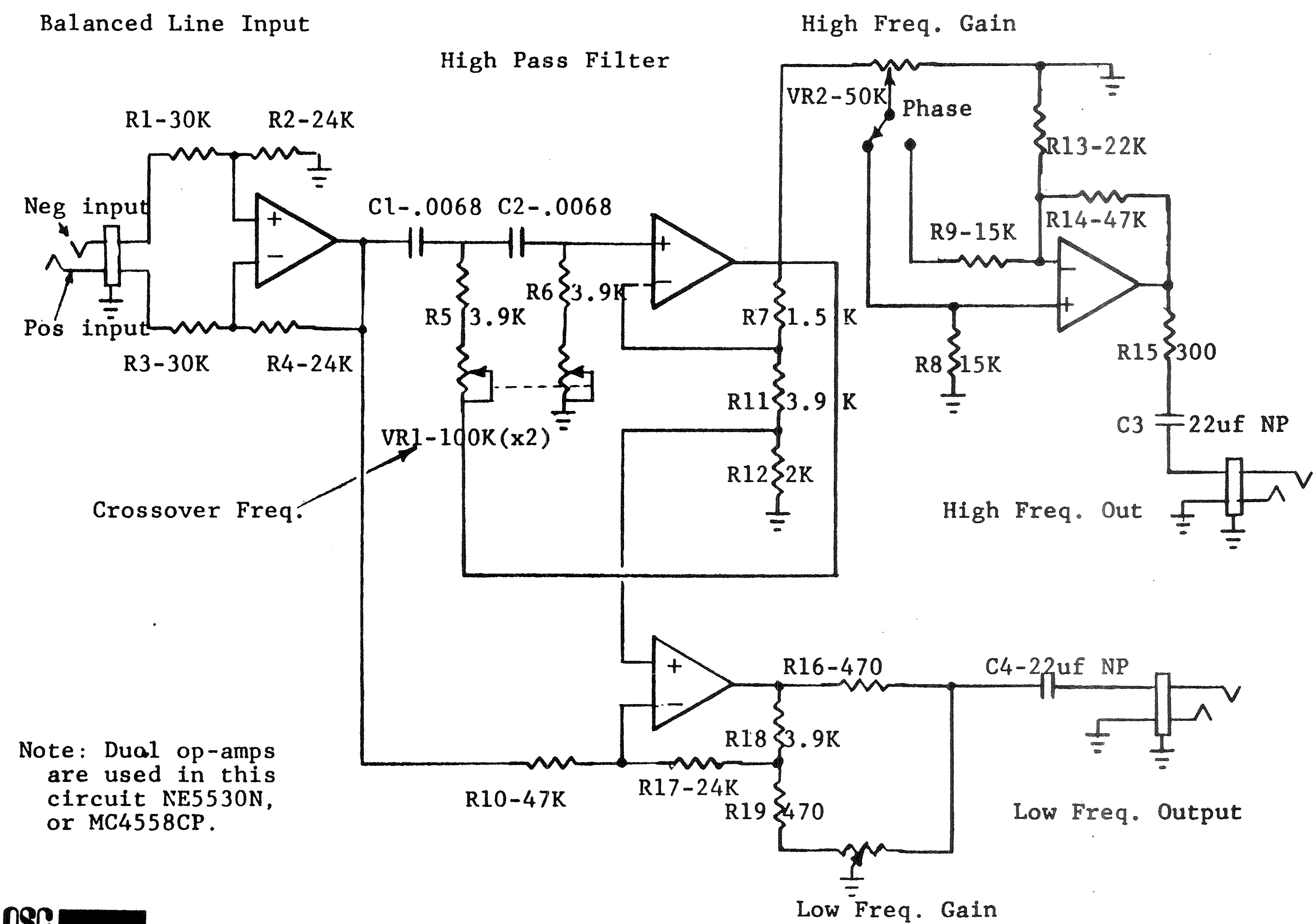


Power Supply Block Diagram



NOTES A5.1

1. One channel shown; Ch 1 = "a" parts, Ch 2 = "b".
2. All resistors in ohms, ¼-½W unless shown.
3. All capacitors in uf/100V unless shown
4. All transistors are selected for higher than minimum specs. Replace with QSC parts only.
5. D1,D2 set class-B crossover bias. Forward V =.58
6. Another Crossover test: small notch at 20KHz, 1Vout
7. Blown fault fuse on PCB means shorted output trans.
8. Note that Ch 1 (a) and Ch 2 (b) output transistors are "interleaved" for better heat sink sharing. Trace parts carefully.



Note: Dual op-amps are used in this circuit NE5530N, or MC4558CP.

OSC AUDIO PRODUCTS

X2.2 SCHEMATIC (X1.2) DRAWN BY: D. TITUS 4/21/82	POWER SUPPLY SCHEMATICS ON BACK OF THIS SHEET; SHOWS SUPPLY FOR X1.2 AMPLIFIER ALSO.

TROUBLESHOOTING CHART FOR A8.0 11-28-78

A. Current Draw

1. "Hard" short: Lift ground on both heatsinks to check for shorts
   Check D8,9--reversed?
   Lift Xistor fuses one by one: bad/shorted transistor?
   Solder Short? Red/Green DC wires reversed?
2. Short w/ DC offset (may be slight) D8,9? Output Xistor short?(note which rail)
3. "Soft" short: wrong polarity of driver, output Xistor?
   if amp runs: check crossover diodes 4,5,6, replace high-voltage parts
   if only slight: and D4,5,6 OK: sub. 8.2ohm, R16

B. DC fault(offset):With current draw: see (A)
   No current draw: output/drivers OK--check Q1,2,3 and circuit
   solder short, Q3? Wrong device, Q1,Q2? Bad D1,2? Parts missing?

C. Audio (AC) faults: amp runs, but severe clipping, esp. into load:

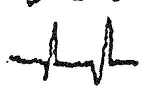
1. clipping, one side: current limit missing R14,19? Bad D3?
   Missing/unsoldered Q4,5? Fuses not in?
   Emitter-base short (solder), Q4,5? (hard to tell--sub, last resort)
2. Wrong current limit: Positive: to decrease, parallel R18(360ohm) w/ 2.7K typ.
   Negative: to decrease, parallel R15 (360ohm) w/ 2.7K typ.
   If either current limit is low, look for missing .42ohm/5W resistors,
   or bad Q7-14. Measure AC voltage (2V) across each .42ohm resistor
   under load: should match to 10%. If low, suspect Q. If high, bad .42ohm?
3. Fuse blows when first applying load (or sooner) Also--check fuses
   Incorrect fuse value?
   Intermittent solder short--check heat sink closely for alignment.
   Note: if any Q11-14 are dead, F4 will usually blow, into 4ohms load

D. Glitch (high frequency oscillation)
   Mild: usually wrong C1,2, or 3
   Severe: usually missing C1,2,3 or C4, R24, J4 (between C9 and F13)

E. Excess Distortion: Note appearance of Distortion analyzer trace:
   Severe (over 1% but runs) Reverse C6, incorrect R7,8, R4, C1,2,3
   Mild (.25% or so):


   Hum: Led 1, C6, Q1


   smooth, but excessive: Try new Q2, Q3. Check C1,2,3


   Spikes. Missing R16 (excess Xover dist)
   Purple wire hooked to D10,11 (instead of going thru R26)

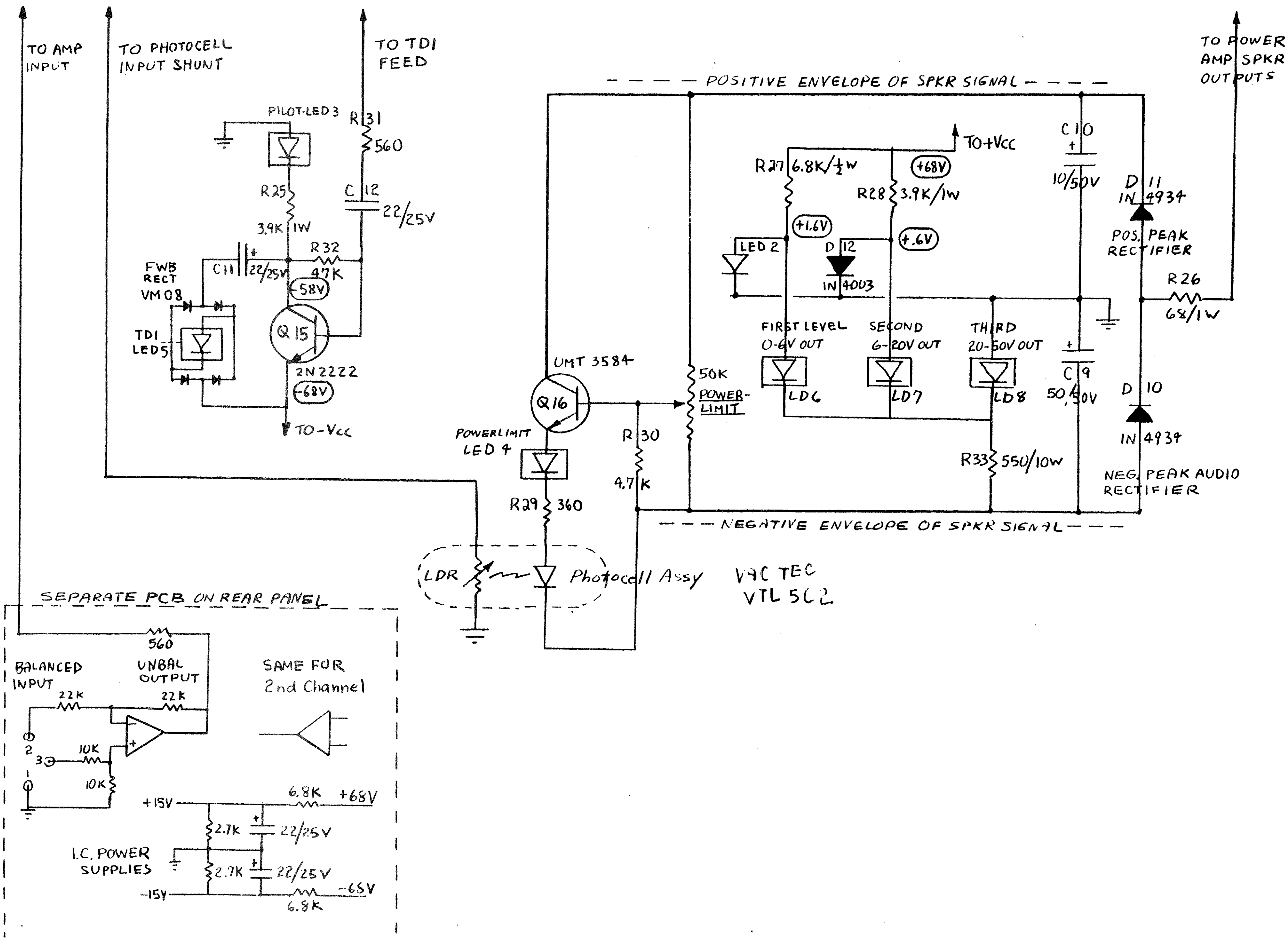
F. Feature doesn't work:

1. Level LED's: None at all: Purple Wire? R26 in? D10,11 in? If R26 burns, look
   for short after D10,11: reversed? C9 shorted? R33 (550/10W) in?
   Bad or Dim LED--usually replace. If still bad, check R27,28 in?
   Display stays on: LED 2? D12?
2. Distortion LED: Yellow Pilot LED off? Check for voltage, replace.
   If Yellow LED on: Check for voltage at Dist LED (with amp clipping).
   If no voltage: Check Q15 collector voltage? parts? VM-08 bridge?
3. PowerLimit: No Limit, No LED: Photocell in right? Check voltage at photocell
   LED, R29, Panel LED? If none,Q16 not coming on, check Powerlimit
   control, R30, shorted C10? reversed D11?
   No Limit, but Panel LED lights: TURN DOWN before blowing the circuit:
   Usually solder short at LED end of photocell.

G. No output, but amp idles OK, no DC fault:
   Assume amp works, input not getting thru: Blue wire? R1,2? shorted
   photocell solder or lead? Gain control? C5? D1?

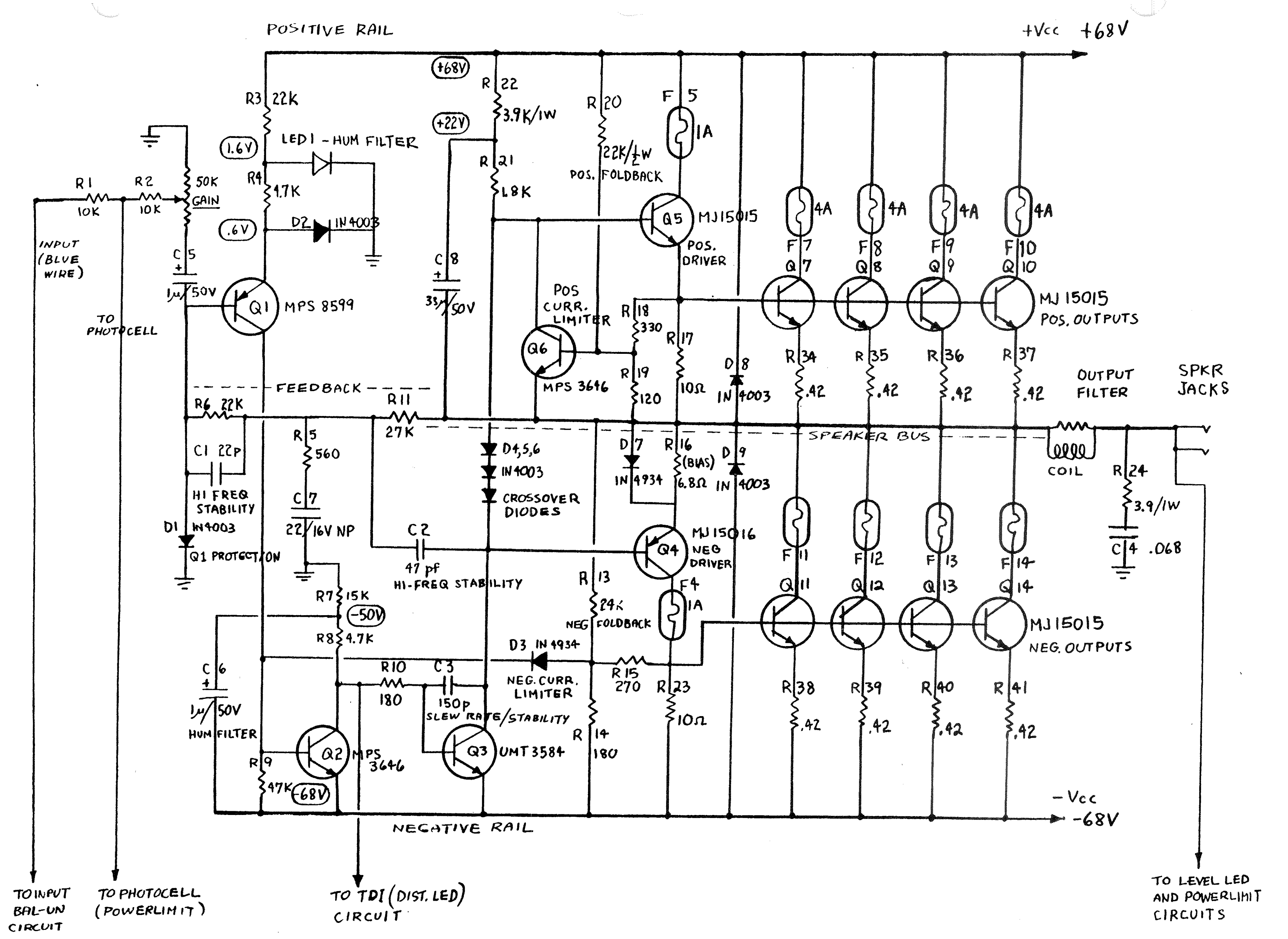
QSC POW... AMP 8.03 SCHEMATIC FOR FEATURES GROUP

3-5-79



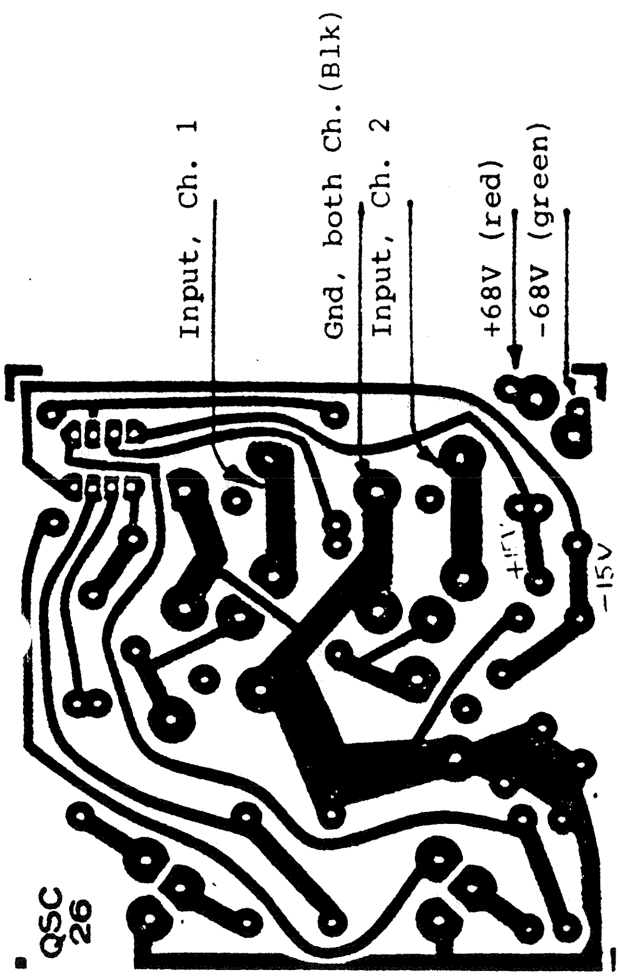
QSC POWER AMP 8.03 SCHEMATIC FOR AMPLIFIER ONLY

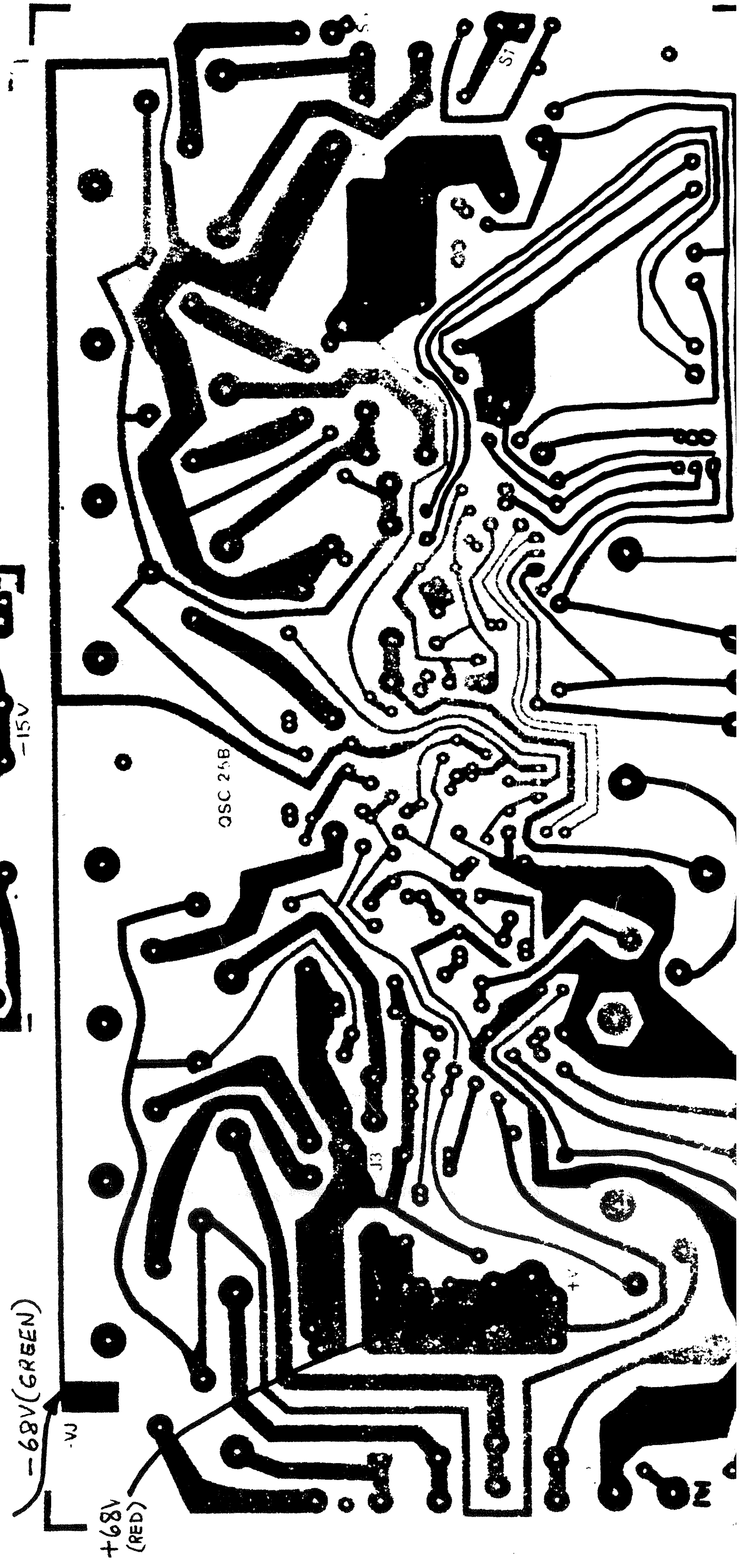
3-5-79



Lead Diagram, QSC A8.02

8-1-78





Service Bulletin, QSC Power Amplifier 8.0 — 8-1-78

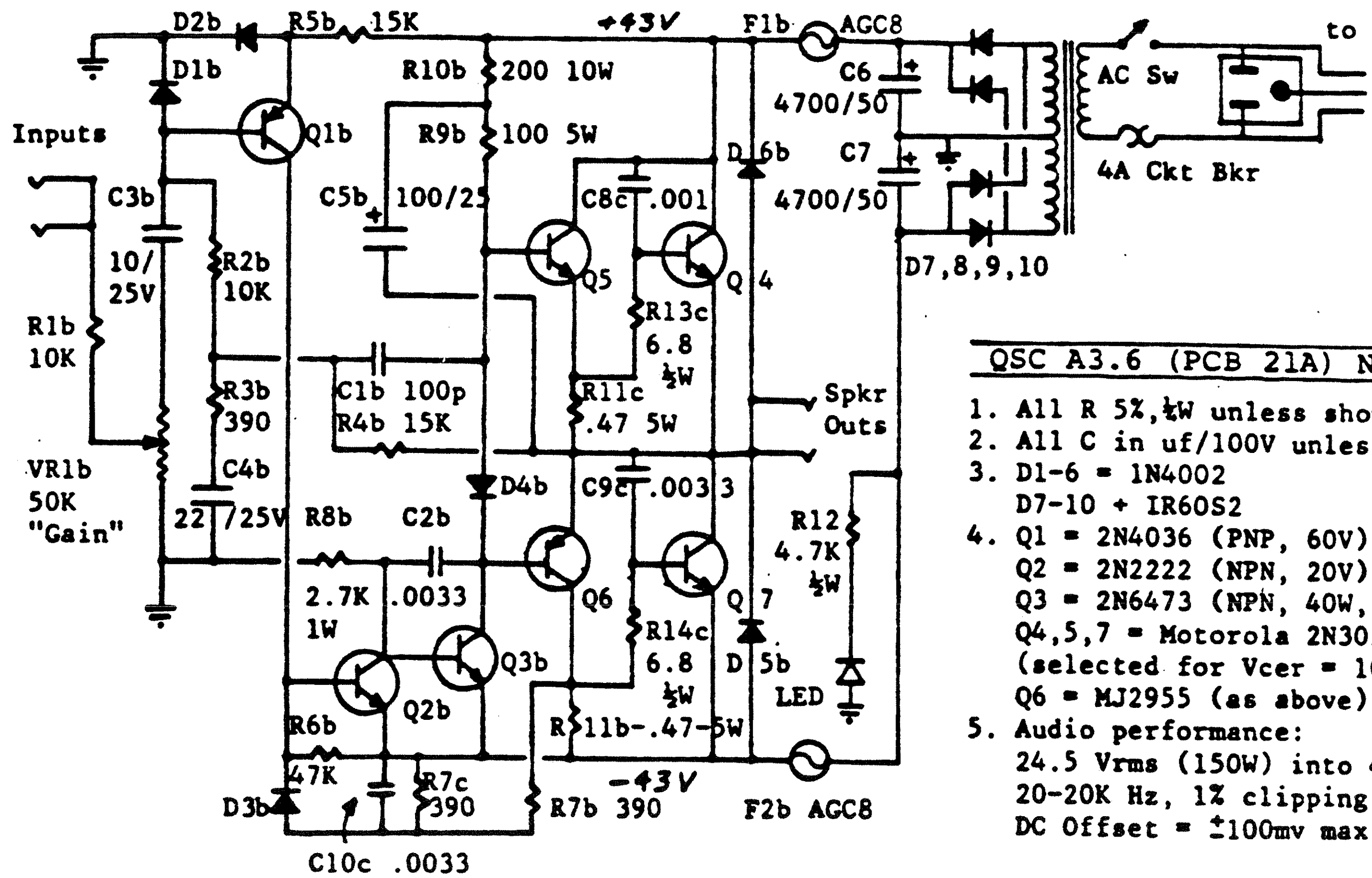
The QSC A8.0 is our latest high performance circuit. The design is based on our earlier time-tested circuit, but extra stages and added complexity was necessary to achieve the higher performance.

To simplify field repairs and closely monitor failures, QSC will replace the entire channel upon notification of problems. Please observe the following instructions to facilitate replacement.

1. Diagnosis. To ensure that the problem actually lies in the amplifier circuit, please perform the following tests:
   a. If the balanced-line input doesn't work, try the unbalanced input. If this works, the problem is in the balanced-line convertor. Check the IC, and the red/green power leads. See diagram for voltage levels.
   b. If no signal is available through the unbalanced input, check the signal input leads.
   c. If amplifier has no output at all, but the TDI (distortion) LED triggers on inputs above .6V (full Gain), check the speaker fuse. Loss of fuse removes drive to the Level LED's, to alert user that the sound has stopped.
   d. If the amplifier has DC at the outputs, especially at minimum Gain, check the connections to the filter capacitors (for both channels). After eliminating all external factors, note the problem with the defective channel prior to removal. Contact QSC for UPS Blue Label shipment of replacement circuit.
2. Removal and Replacement.
   a. Remove the three #6 screws retaining the heat sink brackets. Remove the six socket-head screws (1/8" hex driver) retaining the faceplate and handles.
   b. Detach the black leads to the AC switch. Be careful not to dislodge from the rear of the chassis. If you do, one goes to the AC circuit breaker, and the other to the left-hand terminal on the block just above the circuit breaker.
   c. Unsolder the input leads, and the red/green leads going to the input convertor. Unscrew the filter capacitor leads. Pull the speaker leads straight off, being careful not to crack the speaker fuse holder. Note that the purple lead goes to the terminal having the bus wire connecting the jacks.
   d. The faceplate/circuit/heat sink assembly should now be free. Unscrew the heat sink from the PCB's. Remove and replace the defective channel. Replace the heat sink, ensuring proper thermal contact of the metal surfaces. Refit the faceplate assembly. Consult the enclosed layout sheet to restore the soldered leads.
   e. Return the defective channel to QSC, along with the description of defect, for factory analysis and repair. (SEE 1981 POLICY)

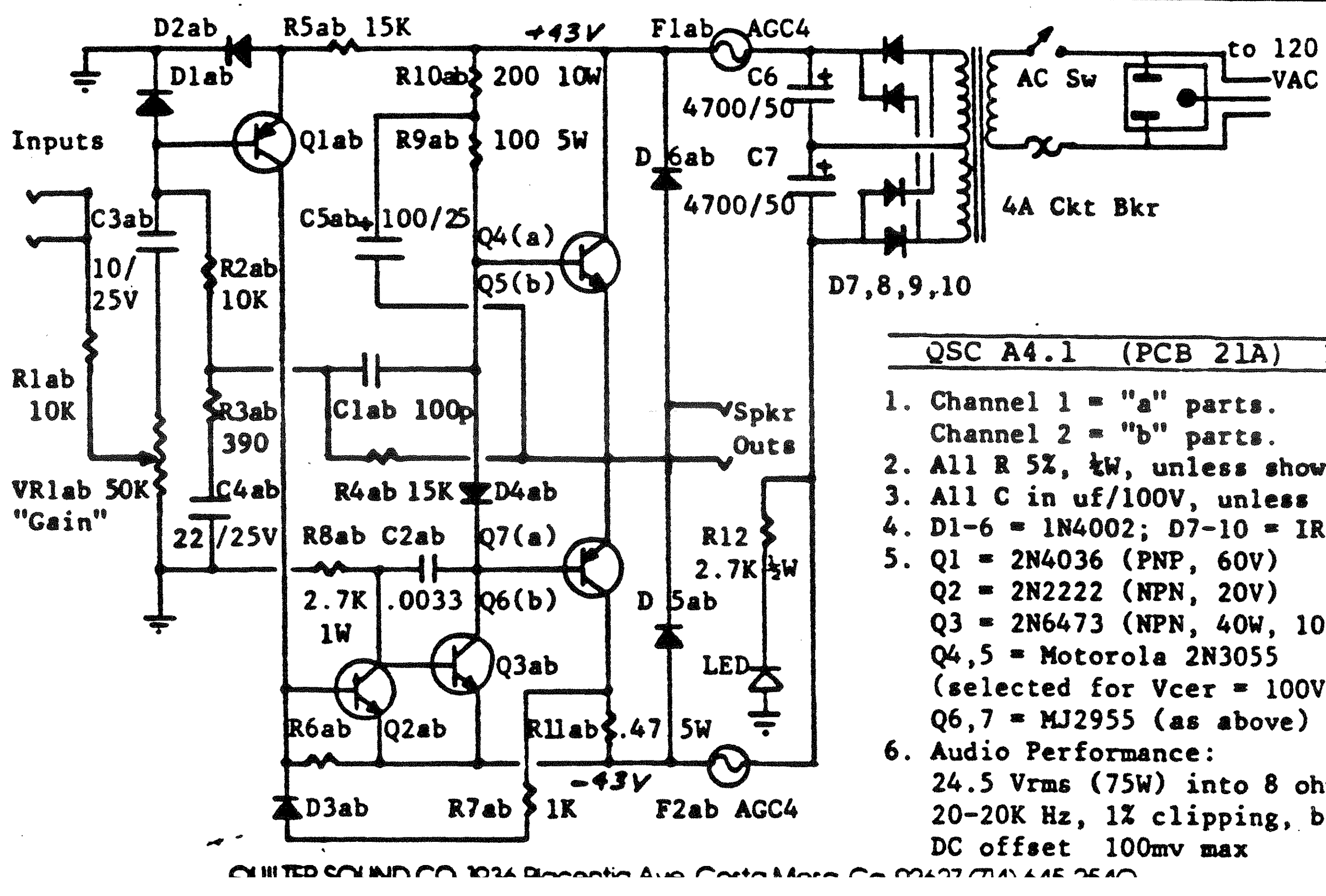
QSC AUDIO PRODUCTS

QSC A3.6 and A4.1 (PCB 21A) (May-Oct 1977) Schematics



QSC A3.6 (PCB 21A) NOTES

1. All R 5%,¼W unless shown.
2. All C in uf/100V unless shown.
3. D1-6 = 1N4002
   D7-10 + IR60S2
4. Q1 = 2N4036 (PNP, 60V)
   Q2 = 2N2222 (NPN, 20V)
   Q3 = 2N6473 (NPN, 40W, 100V)
   Q4,5,7 = Motorola 2N3055
   (selected for Vcer = 100V)
   Q6 = MJ2955 (as above)
5. Audio performance:
   24.5 Vrms (150W) into 4 ohm
   20-20K Hz, 1% clipping
   DC Offset = ±100mv max.



QSC A4.1 (PCB 21A) NOTES

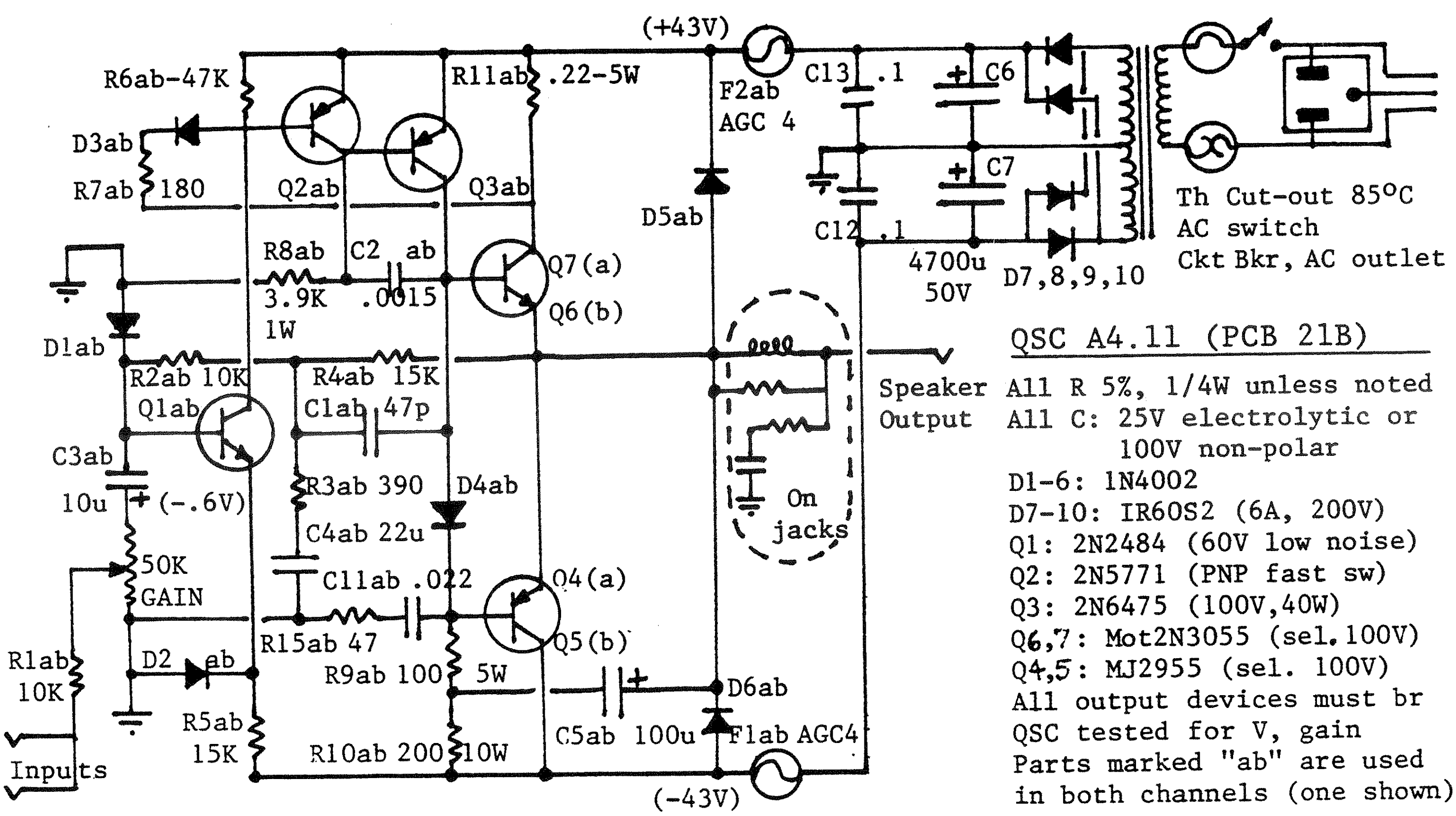
1. Channel 1 = "a" parts.
   Channel 2 = "b" parts.
2. All R 5%, ¼W, unless shown.
3. All C in uf/100V, unless shown.
4. D1-6 = 1N4002; D7-10 = IR60S2.
5. Q1 = 2N4036 (PNP, 60V)
   Q2 = 2N2222 (NPN, 20V)
   Q3 = 2N6473 (NPN, 40W, 100V)
   Q4,5 = Motorola 2N3055
   (selected for Vcer = 100V)
   Q6,7 = MJ2955 (as above)
6. Audio Performance:
   24.5 Vrms (75W) into 8 ohm
   20-20K Hz, 1% clipping, both ch.
   DC offset 100mv max

QSC AUDIO PRODUCTS

1926 PLACENTIA AVENUE □ COSTA MESA, CALIFORNIA 92627

QSC POWER AMP 4.11 SERVICE INSTRUCTIONS 10-77

1. The QSC A4.11 (PCB 21B) replaces the A4.1 (PCB 21A). The circuit is basically the same, but the overall polarity has been reversed.
2. The revisions are as follows:
   a. The polarity has been reversed to take advantage of higher gain and voltage available in the MJ2955 devices. Using the higher yields, we have been able to increase the current limits for more power into reactive loads.
   b. Q2, the shunt-driver transistor, is now from a very fast saturated-switch family. This corrects a slight turn-off lag which was causing some overshoot during slew-rate limiting (square-wave reproduction).
   c. The high frequency compensation (C1, C2) has been raised for better high-frequency reproduction.
   d. Units will start shipping with a printed-circuit mounting plane for the jacks. This circuit will also contain a speaker output filter to assure stable operation even into abnormally reactive loads.
3. Circuit description and testing:
   a. PCB 21B is used in both the A3.61(mono) and the A4.11(stereo). The "a" (Ch.1) and "b" (Ch.2) parts are used in the A4.11 version shown here.
   b. If fuses are blown the associated output transistors, as well as Q2, may need replacement. Only QSC factory-selected output replacements should be used to ensure adequate voltage (100V ceo) and proper gain for current limiting.
   c. Testing should be done with a Variac on about 30VAC until proper operation is obtained. A good amp should work from 20-130VAC.



QSC A4.11 (PCB 21B)

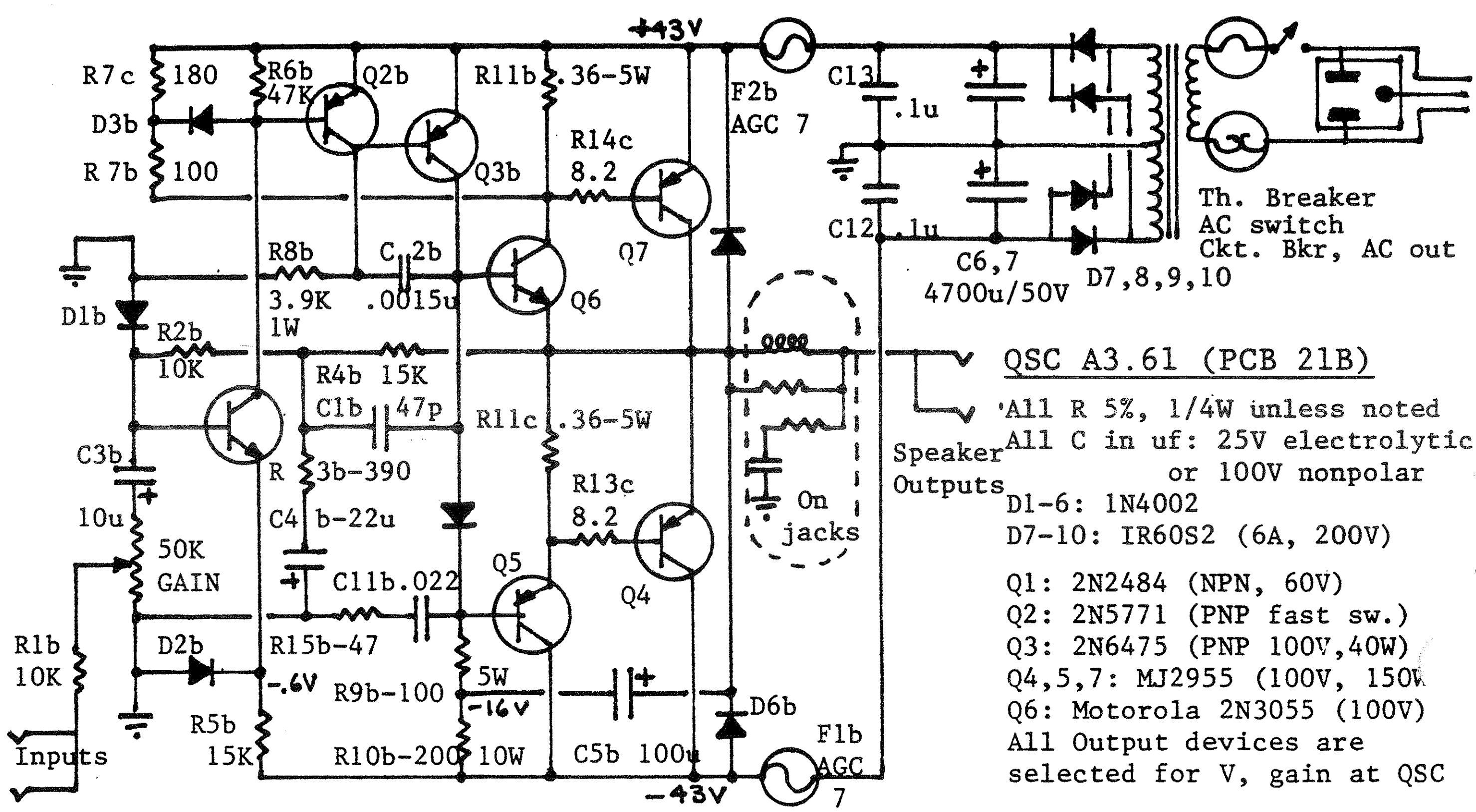
All R 5%, 1/4W unless noted
All C: 25V electrolytic or 100V non-polar
D1-6: 1N4002
D7-10: IR60S2 (6A, 200V)
Q1: 2N2484 (60V low noise)
Q2: 2N5771 (PNP fast sw)
Q3: 2N6475 (100V,40W)
Q6,7: Mot2N3055 (sel. 100V)
Q4,5: MJ2955 (sel. 100V)
All output devices must br QSC tested for V, gain
Parts marked "ab" are used in both channels (one shown)

QSC AUDIO PRODUCTS

1926 PLACENTIA AVENUE □ COSTA MESA, CALIFORNIA 92627

QSC POWER AMP 3.61 SERVICE INSTRUCTIONS 10-77

1. The QSC A3.61 (PCB 21B) replaces the A3.6 (PCB 21A). The circuit is basically the same, but the overall polarity has been reversed.
2. The revisions are as follows:
   a. The polarity has been reversed to take advantage of higher gain and voltage available in the MJ2955 devices. Using the higher yields, we have been able to increase the current limits for more power into reactive loads.
   b. Q2, the shunt-driver transistor, is now from a very fast saturated-switch family. This corrects a slight turn-off lag which was causing some overshoot during slew-rate limiting (square-wave reproduction).
   c. The high frequency compensation (C1, C2) has been raised for better high-frequency reproduction.
   d. Units will start shipping with a printed-circuit mounting plane for the jacks. This circuit will also contain a speaker output filter to assure stable output even into abnormally reactive loads.
3. Circuit description and testing:
   a. PCB 21B is used in both the A3.61 (mono) and the A4.11 (stereo). Only the "b" and "c" parts are used in the A3.61 version shown here.
   b. If fuses are blown, output transistors, as well as Q2, may need replacement. Only QSC factory selected service replacement devices should be used to ensure adequate voltage (100V ceo) and proper gain for current limiting. R13c, 14c may be changed to obtain correct currents from Q4,Q7. Correct current limits should be 10A peak (7A rms) into 2-ohm load.
   c. Testing should be done with a Variac on about 30VAC until proper operation is obtained. A good amp should work from 20VAC on up to normal 110-130V range.



QSC A3.61 (PCB 21B)

All R 5%, 1/4W unless noted
All C in uf: 25V electrolytic or 100V nonpolar
D1-6: 1N4002
D7-10: IR60S2 (6A, 200V)

Q1: 2N2484 (NPN, 60V)
Q2: 2N5771 (PNP fast sw.)
Q3: 2N6475 (PNP 100V,40W)
Q4,5,7: MJ2955 (100V, 150W
Q6: Motorola 2N3055 (100V)
All Output devices are selected for V, gain at QSC

Nulling Residual Hum in QSC A3.6-A4.1-A5.0 Series Amplifiers.

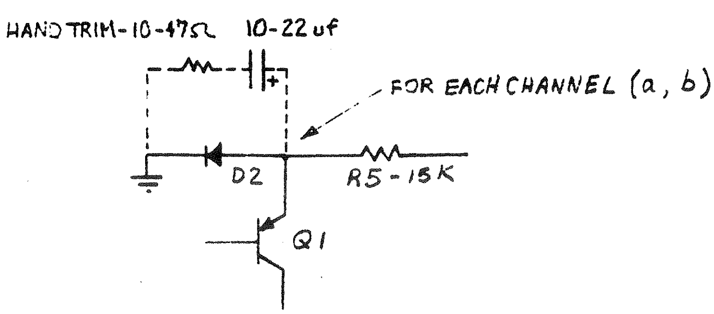
It is normal for these amplifiers to have about 30-50mv Peak-to Peak hum residual at the speaker outputs, primarily 120Hz ripple. This is enough to cause some annoyance when listening at low levels. The unwanted ripple which couples from the power supply can be largely eliminated by the following hand-trim procedure.

1. Identify the junction of D2, R5, and the emitter of Q1 (see schematic of appropriate model). This junction normally has about +0.6V DC (-0.6 on some early models having reverse-polarity transistor circuit). This voltage represents the forward-bias voltage of D2, which offsets the emitter-base voltage of Q1 so that the amp has minimal DC offset at the speakers. The bias voltage is fed through a resistor, R5, from the positive power supply. Because the diode is not a perfect .6V regulator, some ripple from the power supply is present at this point and leaks into the audio circuit.

2. To filter the ripple, an additional filter network must be added. This consists of a 10uf, 6V or higher capacitor and a series resistance which must be hand-set between about 10 and 40 ohms, for minimum hum. A 100-ohm trimmer would be convenient, or a series of fixed resistors can be tried for best results.

3. This network shall be installed between the above junction and ground (i.e. the opposite end of D2), taking care that the correct polarity is observed across the 10uf capacitor.

4. NOTE: the presence of this network may somewhat increase the turn-on thump, depending on the exact value of resistance. Using a 22-uf capacitor will give better hum rejection, but further increase turn-on thump. The thump should not affect standard loudspeakers, but further increases the advisability of using horn-protection capacitors on high-frequency drivers (in bi-amped applications).

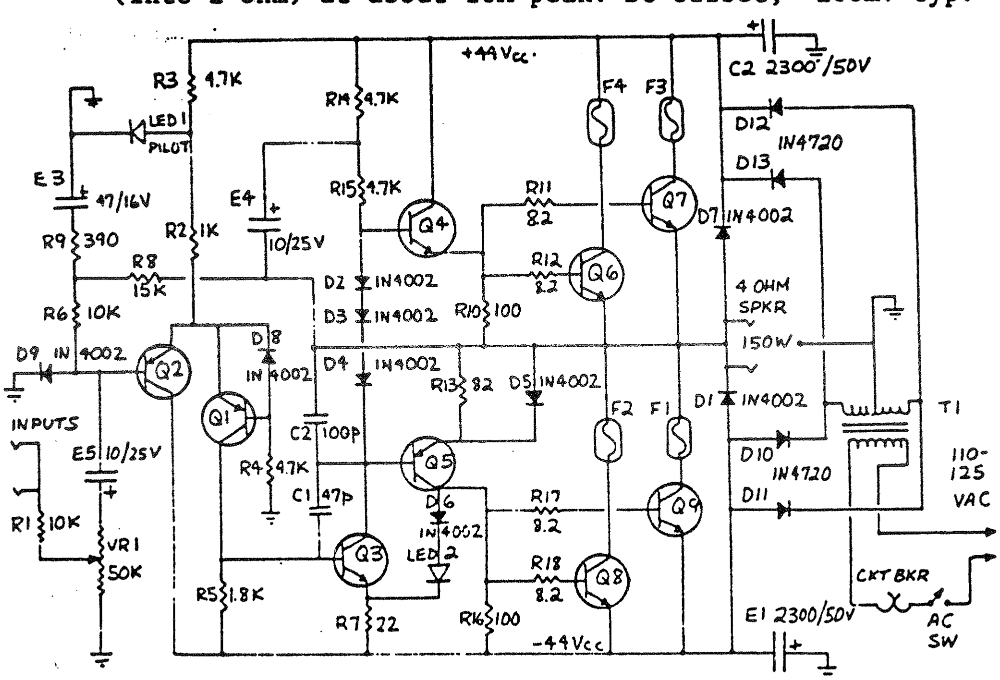


QSC AUDIO PRODUCTS

1926 PLACENTIA AVENUE ☐ COSTA MESA, CALIFORNIA 92627

QSC Power Amp 3.5 (A3.51, A3.52) Service Instructions.

1. The QSC Power amp 3.5 (revisions A3.51, A3.52) was produced from Jan 76 to Mar 77. The circuit was a fairly standard quasi-complimentary output design with differential input transistors.
2. The major problem with these units will usually be corrosion in the circuit board connector, aggravated by deformation caused by rough handling, etc. The symptoms include cutting out, unstable or wavering output into loads, "Fading power" etc. The condition is easily seen as non-linearity or notches in the output waveform, while watching on a scope. The cure is to solder the connector to the circuit board foil, working from the underneath of the unit. Be sure that the solder adheres properly without bridging together any pins on the connecter.
3. Occasionally, you will see a badly burned out circuit board. In these cases, the new A3.6 circuit can be fitted. Contact QSC for replacement and adaptation sheet.
4. In-Chassis Servicing.
   a. Remove top and bottom covers for easy access.
   b. Note the power transistor fault fuses. A single bad output transistor should result in one blown fuse with no further damge. Multiple failures may indicate damaged driver or bias diodes (D2,3,4).
   c. Testing should be performed with a Variac, scope, and dummy load (4 ohm). With no load, increase AC voltage while monitoring signal. A good amp should pass undistorted signal above 20V AC. Nominal performance at 120 VAC should be 24V RMS into 4 ohms, just at clipping, with current limiting (into 2 ohm) at about 10A peak. DC offset, -200mv typ.



QSC 09B (A3.52) Ckt.

All R in ohms
All C in uf unless noted
Q1,2 2N4036
Q3,4 2N6473
Q5 2N6475
Q6-9 RCA1B01 (2N6254)
D2,3,4 thermal bias
R13 sets idle current
R14,15 set upper cur. li
D6, LED2 set lower lim

Rev, 3-76: R2 = 1.8K
R5 = 2.7K
R7 = 10

Rev, 9-76: R14,15 = 6.8K
R10,13,16 = 22
D10-13 = IR60S2

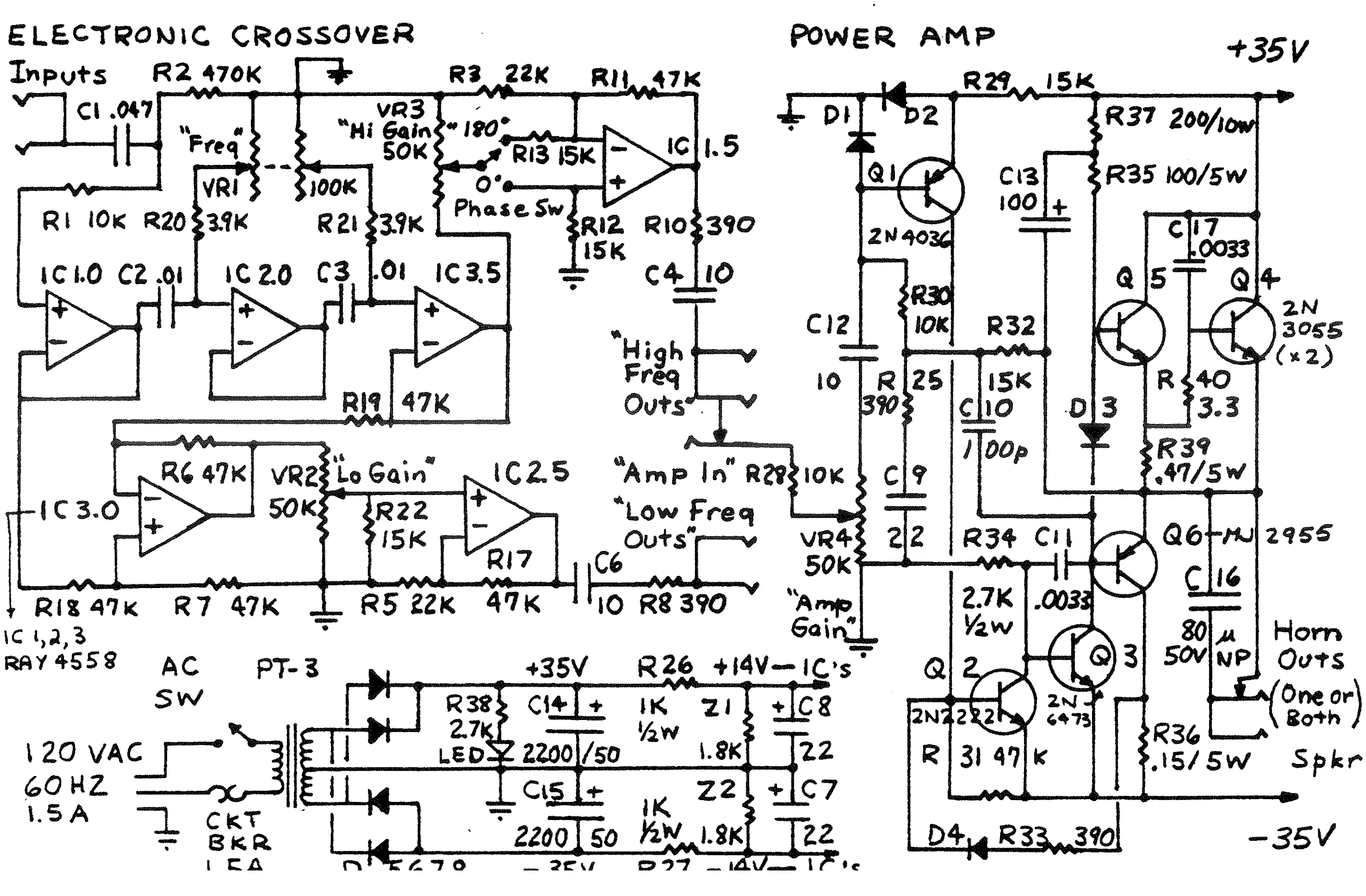
Note: QSC has determined that the Motorola MJ15015 is a superior replacement for the 2N6254, and will supply this part in the future.

QSC AUDIO PRODUCTS

1926 PLACENTIA AVENUE □ COSTA MESA, CALIFORNIA 92627

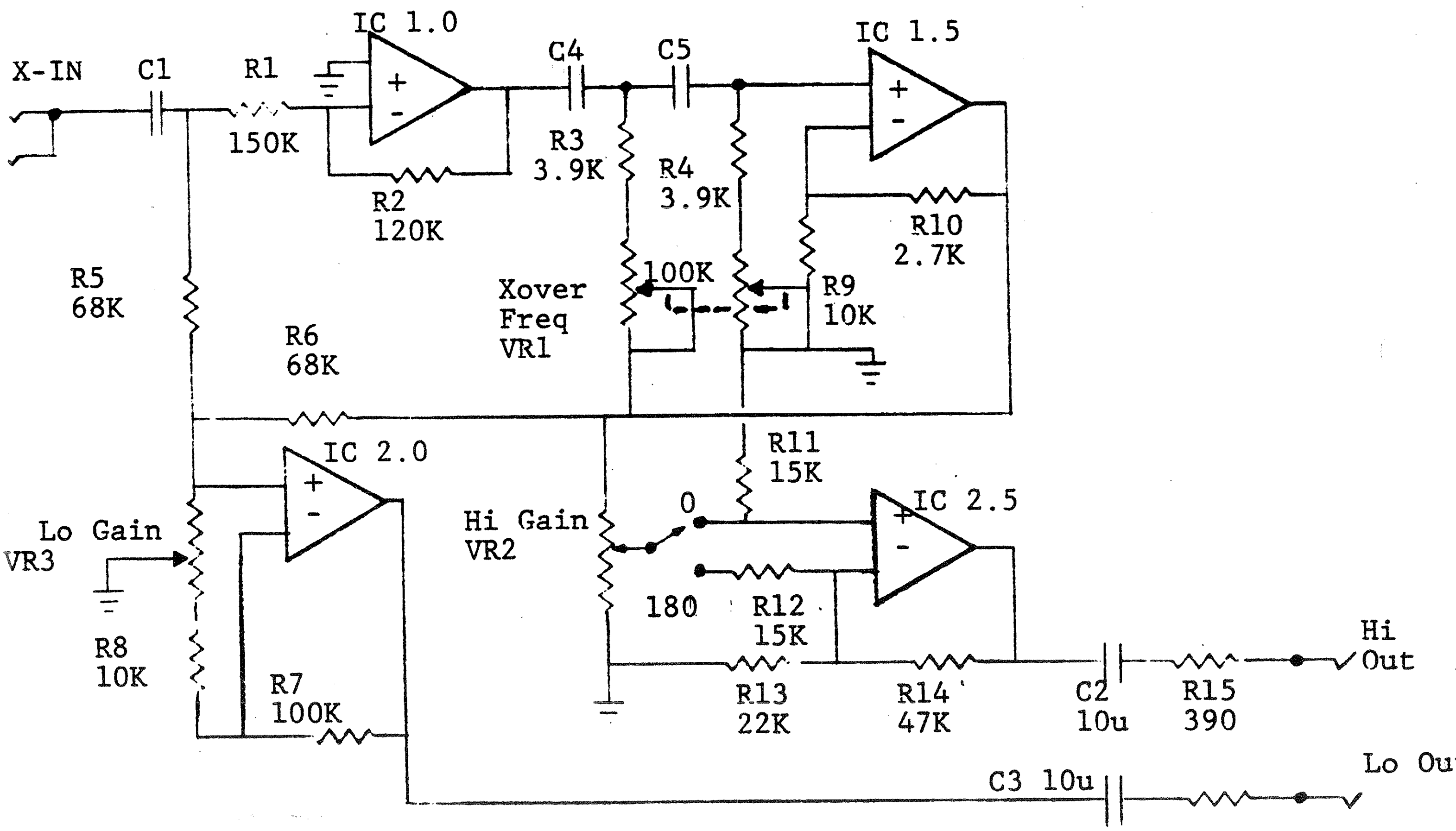
QSC ELECTRONIC CROSSOVER 1.1 SERVICE INSTRUCTIONS 4-77

1. The QSC X1.1 is a re-design of the QSC Electronic Crossover 1.0. Prior to introduction of the new style line, this circuit will be found in X1.0 chassis, labeled X1.01 on rear label.
2. Revisions are as follows:
   a. An extra buffer stage is used in the high frequency filter for sharper cut-off characteristics.
   b. The constant-voltage, constant phase low frequency circuit has been retained.
   c. The power amplifier uses two NPN output transistors to ensure full current output.
   d. The rear connector has been bypassed with permanent wiring to avoid corrosion problems.
3. All IC's are socket mounted and may be changed by removing the top cover. Be sure to remove AC cord from power, before opening.
4. The power amp performance should be:
   a. 70W rms, 4 ohms, 1% distortion, 20-18KHz.
   b. DC offset (spkr jack) 100mv DC.
   c. Note that using one or both Horn jacks inserts a series 80uf (300Hz) low-frequency blocking capacitor, to protect horn drivers from unusually low frequencies or fault currents. Measurements should thus be made from the Speaker jack.
   d. Testing should be done with a Variac, set on about 30VAC until proper operation is obtained in the power amp. The IC's should come on above about 40VAC, and should be tested at full voltage.

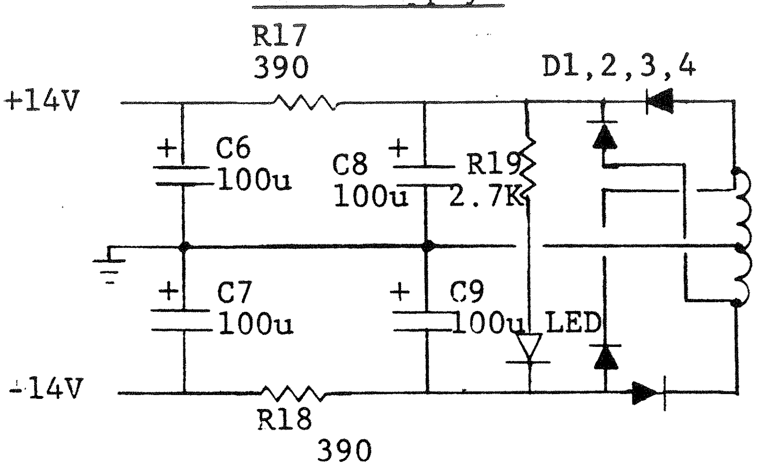


QSC ELECTRONIC CROSSOVER 2.1 SERVICE INSTRUCTIONS

1. The QSC X2.1 is a high performence sterio crossover with numerous applications in the pro audio field, the most popular being the biamp type system.
2. All IC's are socket mounted and may be changed by removing the top cover. Be sure to remove the AC cord from power, before opening.
3. Testing should be done with a Variac, set on about 30VAC until you confirm that the unit is not drawing excess current during no load operation. The IC's should come on above about 40VAC, and should be tested at full voltage.
4. For proper biamp setup please refer to the instruction sheets.
5. All IC's are MC4558cp or sub. (duel op-amp,fast)



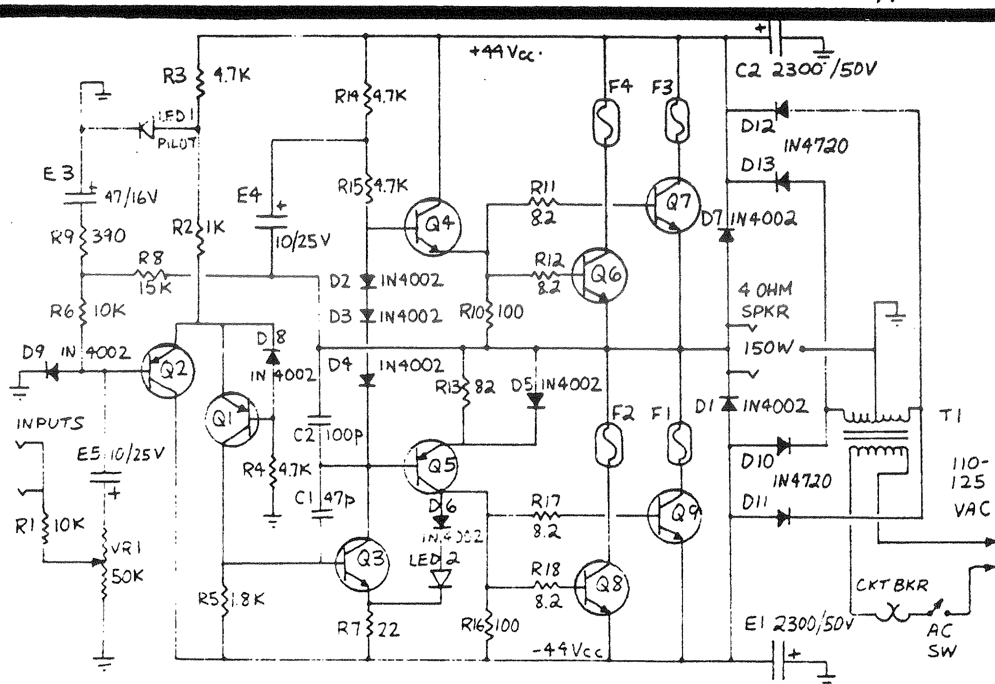
Power Supply



QSC

QSC POWER AMP 3.51 SERVICE INSTRUCTIONS

1. The QSC 3.51 circuit, QSC 09 B, replaces the original 3.5 circuit as of January 1, 1976. Input protection diodes D8, 9 and Output collector fuses F1,2,3,4 have been added for improved reliability. Power and frequency response are slightly improved.
2. Exchanging Plug-in Circuit Board:
   a. Unplug the amp from the AC current supply.
   b. Remove the top cover of the chassis for better visibility.
   c. Unscrew the 4 bolts holding on the faceplate handles. The faceplate with Circuit Board attached will now slide out of its connector in back.
   d. Carefully disconnect the two wires leading to the AC switch.
   e. Remove the Gain control knob and nut.
   f. Unscrew the four black bolts on the faceplate, and replace the old Circuit Board with the new unit.
   g. Reassemble in reverse order. Plug the AC leads to each terminal of the AC switch (in either order). Be sure the Circuit Board slides into the rear chassis connector properly. Refit handles, Gain control nut, knob, and top cover. Amp should now be ready to test.
3. In-chassis Servicing:
   a. Remove top and bottom covers for easy access to circuit.
   b. Note the power transistor fault fuses. A single bad output transistor should result in one blown fuse with no further damage. Multiple failures may indicate damaged driver or input stages, or open circuit in D2,3,4 (bias diodes). Unclip fuse to check outputs.
4. Testing:
   a. Connect amp to Variac, oscilloscope, switchable load resistors, and signal source.
   b. With no load resistance, slowly increase Variac while monitoring output signal. A good amp should pass undistorted audio above 20 VAC.
   c. Normal performance at 120 VAC: Vcc= ± 44V (no load); Power out just at clipping, 24 VRMS into 4 ohms (144 WRMS); Maximum peak current (into 2 ohms or less), 10A ± 10%; DC offset, -200 mv typ.



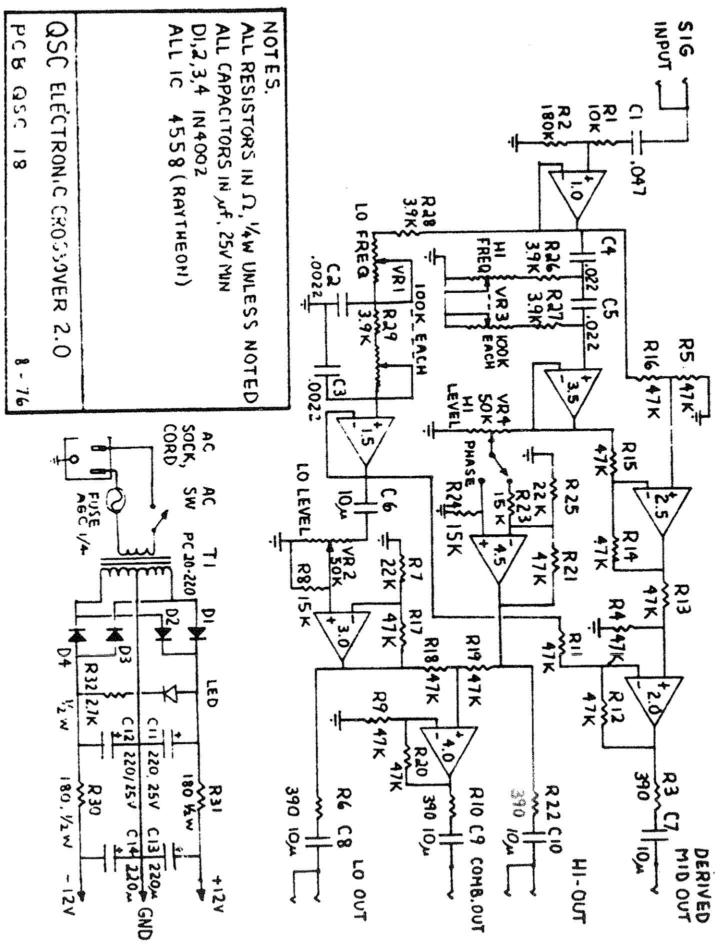
QSC 09B Ckt. Schem.

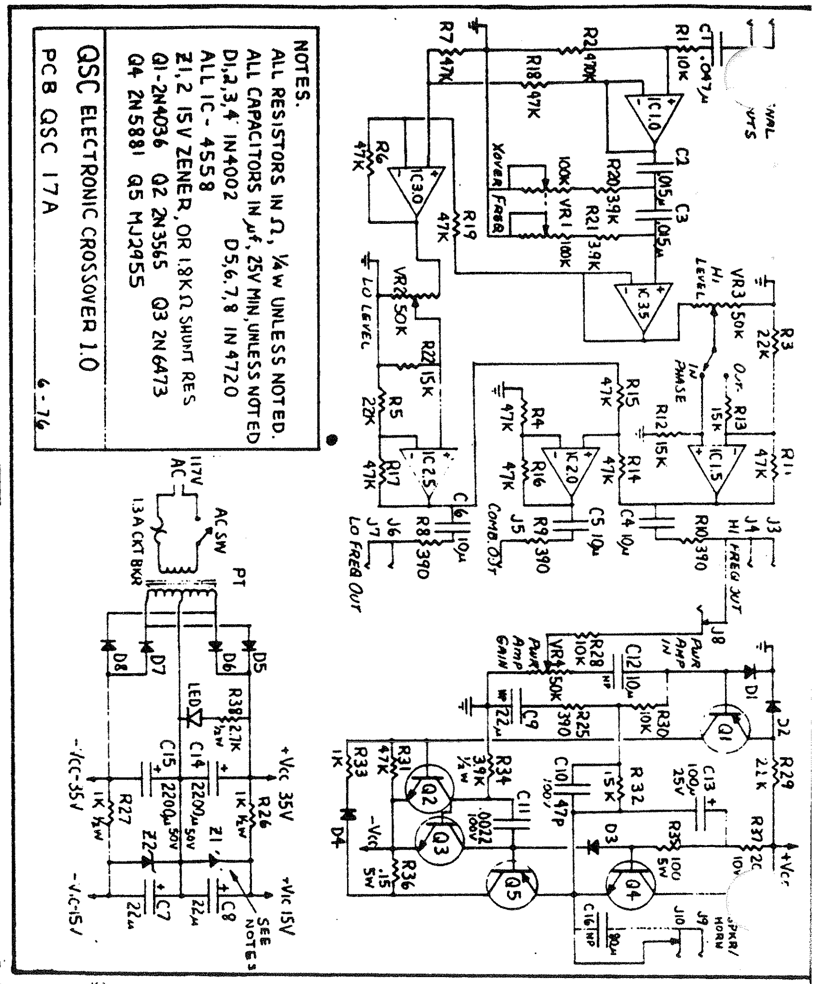
All R in ohms
All C in uf unless marked
Q1,2 2N4036
Q3,4 2N6473
Q5 2N6475
Q6-9 RCA1B01 (2N6254)
D2,3,4 - thermal bias
R13 sets idle current (100 ma at 100°C)
R14,15 set upper current limit
D6,LED2 set lower lim.

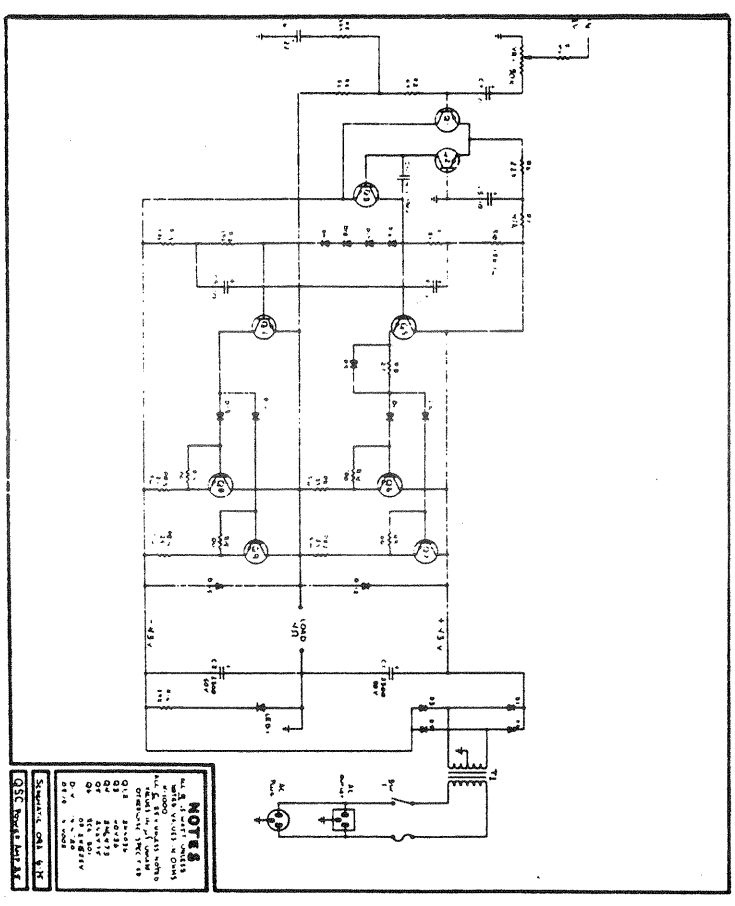
Revisions 3-76 R2 = 1.8K
R5 = 2.7K
R7 = 10K

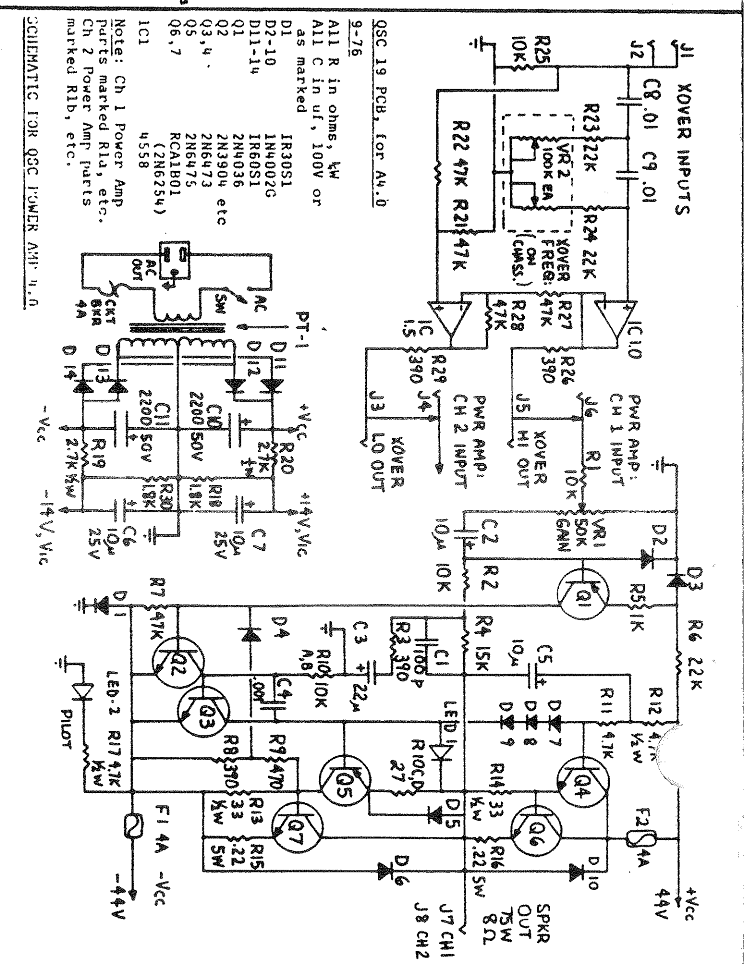
QSC AUDIO PRODUCTS

X1.0, X2.0, A4.0, A3.50 EARLY MODEL SCHEMATICS









QSC

QSC MIXER 1.0 SERVICE MANUAL

A. Disassembly and IC Service.

1. Remove four rubber feet and bottom pan to expose PCB.

2. IC's may be changed without further disassembly. All IC's are mounted in sockets at the ends of the PCB for access. IC1 - channels 5, 6. IC2 - channels 3, 4. IC3 - channels 1, 2. IC4 - Master bus and EQ, Reverb bus. IC5 - reverb driver (with Q1, Q2) and reverb pickup. IC6 - Master A and B outputs. All IC's are mounted with same polarity, note carefully. All IC's, Raytheon 4558.

3. Unless you can see a bad solder point or broken path, you will need to remove all knobs and control nuts to service the rest of the PCB.

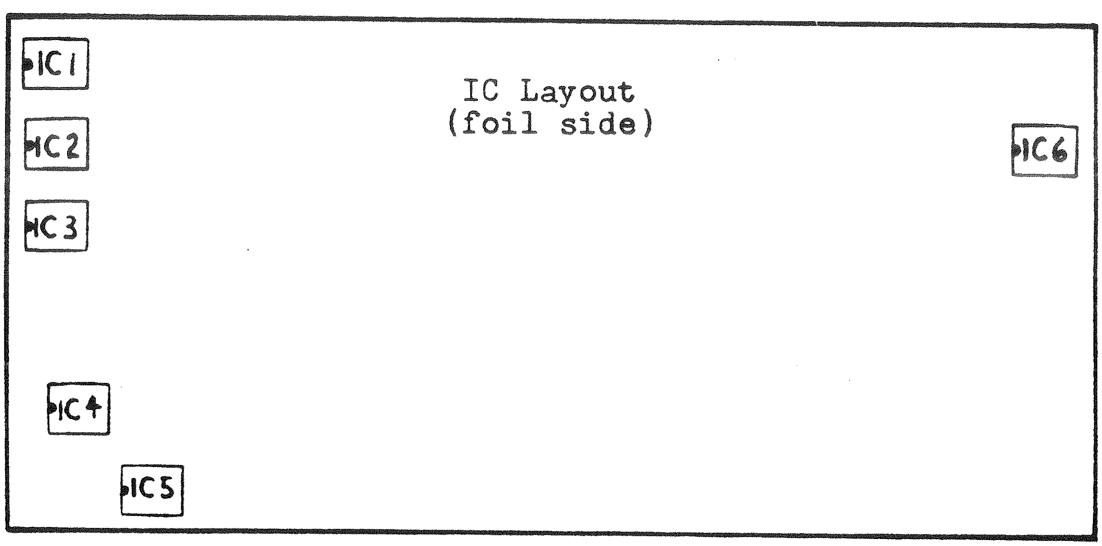
4. IMPORTANT. To avoid shock hazard to customer BE SURE that insulating sheet on base of Mixer is in place and intact before re-assembly.

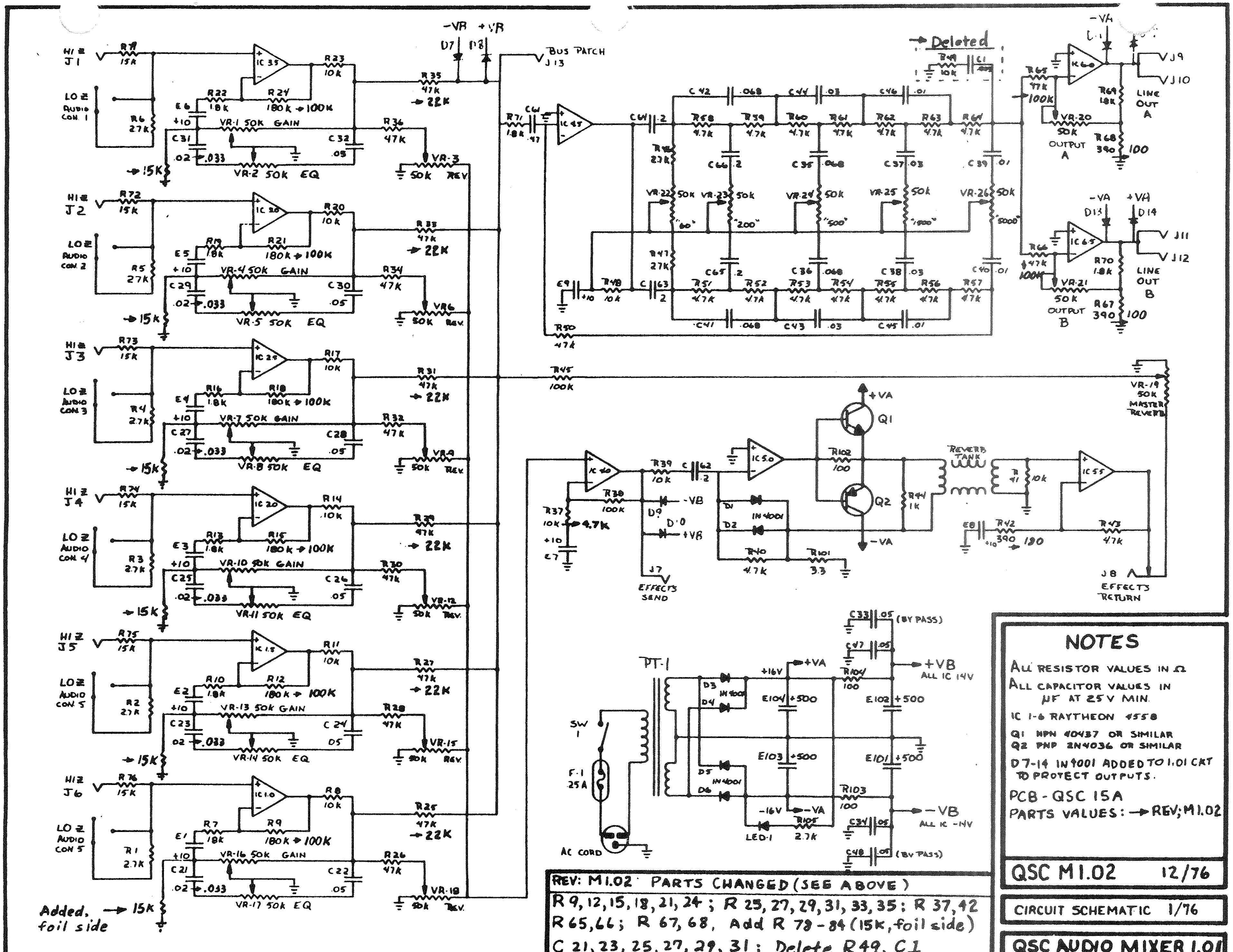
B. Troubleshooting hints.

1. The electrolytic capacitors E1 - E9 all act to decouple DC feedback from audio feedback. If open, look for reduced but clean audio response. If shorted, DC level will shift or thump when controls are turned.

2. If any controls sound scratchy or thump when turned, check for DC across the control and track down. Note that the master controls "float" because of the DC decoupling capacitor, but there should be no difference of DC level at each end of the control (within 10 MV).

3. A good unit will show good square wave response (with flat EQ settings). On full output, the slew rate limiting should turn a square wave into a triangle wave at 20 KHz.





NOTES

ALL RESISTOR VALUES IN Ω

ALL CAPACITOR VALUES IN µF AT 25V MIN.

IC 1-6 RAYTHEON 4558

Q1 NPN 40437 OR SIMILAR
Q2 PNP 2N4036 OR SIMILAR

D7-14 IN4001 ADDED TO 1.01 CKT TO PROTECT OUTPUTS.

PCB - QSC 15A

PARTS VALUES: → REV; M1.02

REV: M1.02 PARTS CHANGED (SEE ABOVE)

R 9, 12, 15, 18, 21, 24 ; R 25, 27, 29, 31, 33, 35 : R 37, 42
R 65, 66 ; R 67, 68, Add R 79 - 84 (15k, foil side)
C 21, 23, 25, 27, 29, 31 ; Delete R49, C1

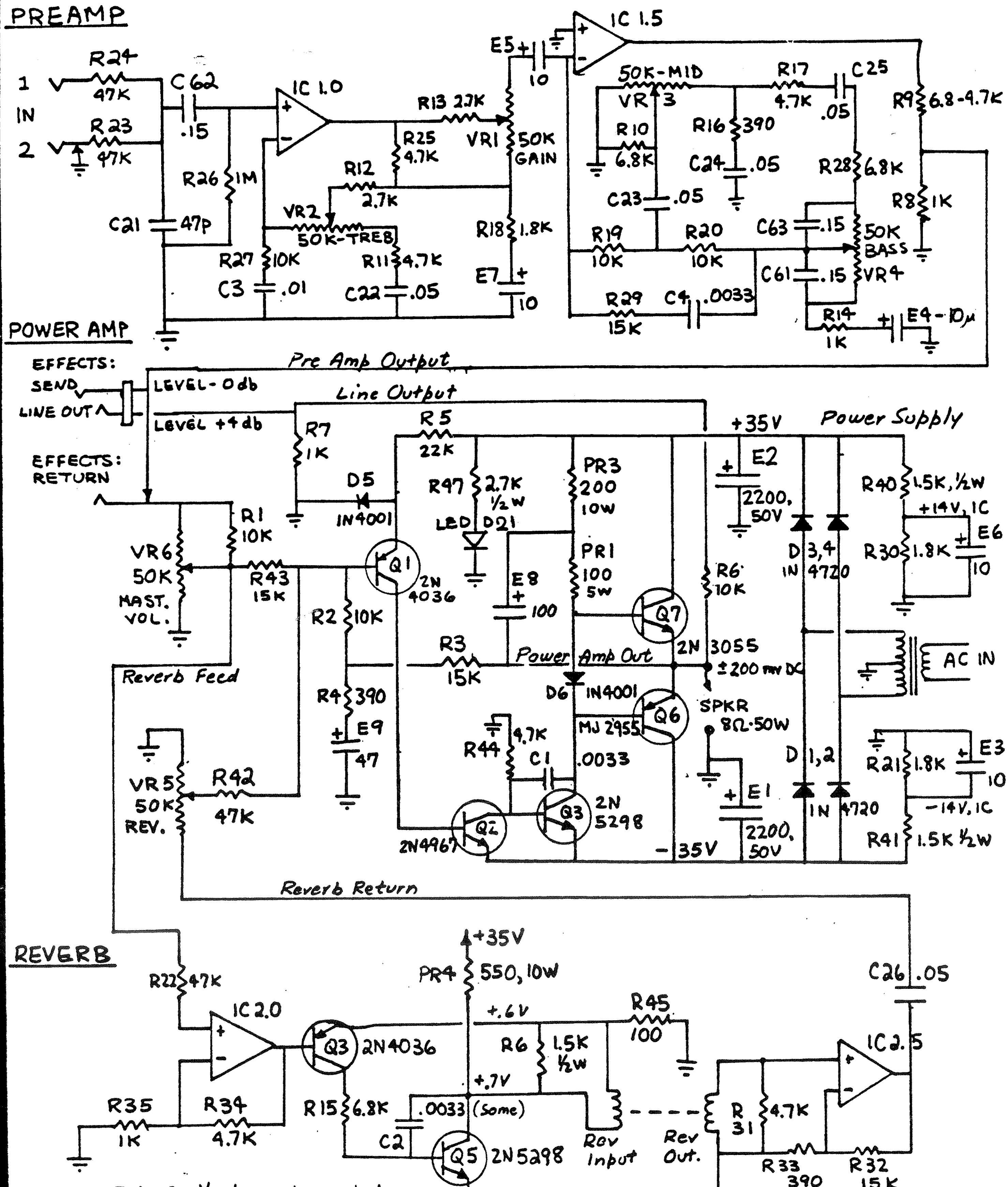
QSC M1.02 12/76

CIRCUIT SCHEMATIC 1/76

QSC AUDIO MIXER 1.01

OSC

BANTAM II SCHEMATIC 10-75

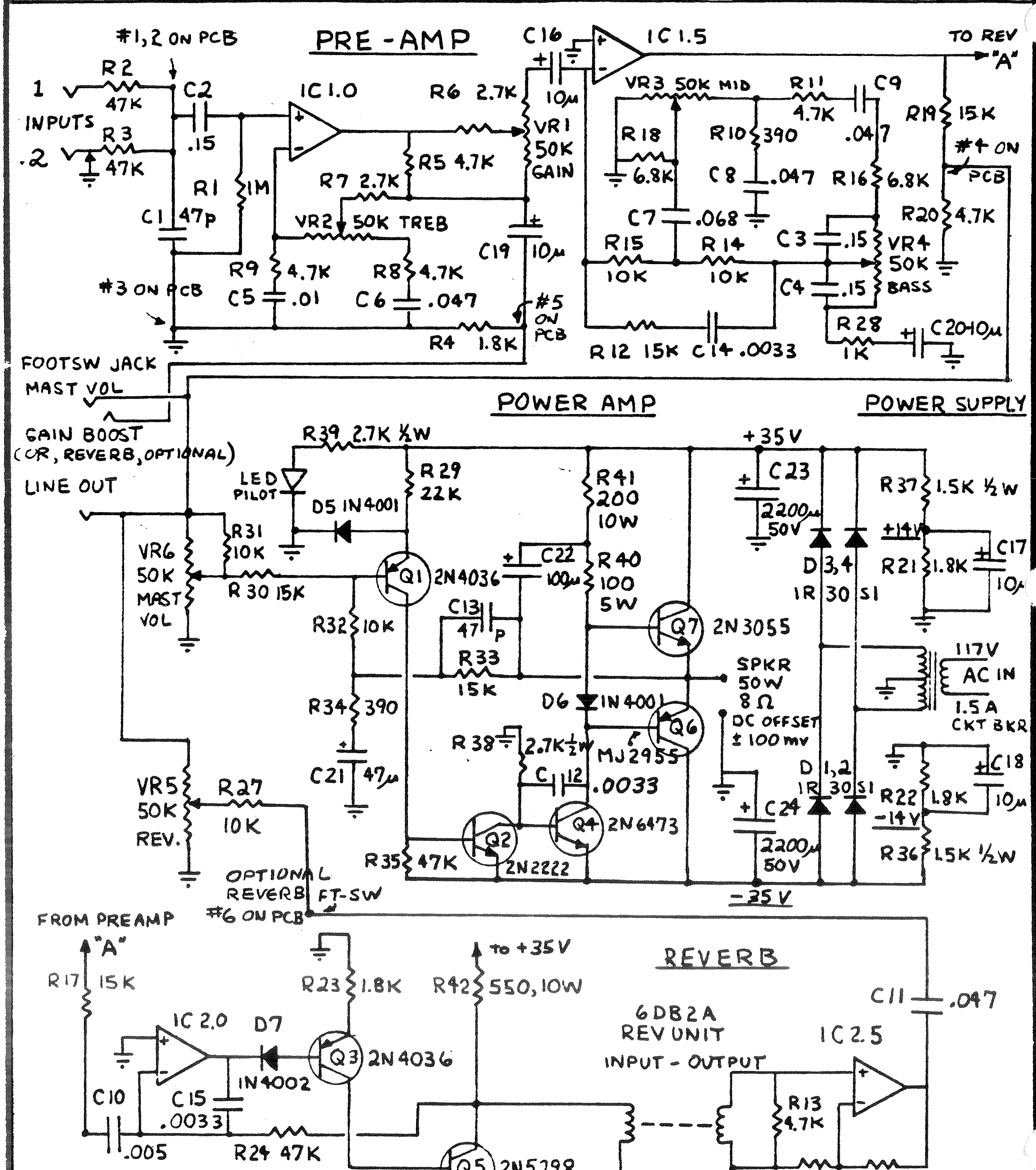


Note: All R in Ω, ¼W except as noted.
All C in μf except as noted.
Voltages shown, no signal.

MFG. By Quilter Sound Co. Costa Mesa, Calif. 92627

QSC

SAND AMP SCHEMATIC MODEL G 3.1 QSC 20.1 PCB 2-77



NOTES
1. IC 1,2 DUAL, RAY 4558
2. All R in Ω 1/4W unless noted.
3. All C in µf unless noted
4. Voltages, no signal

MFG. By Quilter Sound Co., Costa Mesa, Calif. 92627

Speaker Protection in Professional Audio Systems 8-8-78

Almost all of today's professional power amps use direct-coupled (DC) circuits for maximum fidelity and minimum cost. This technique takes maximum advantage of solid-state capabilities, but if a power transistor decides to short out, the full peak power of the amplifier may be dumped into the speakers. Despite the use of internal fuses, this may result in an uncontrollable DC flow of about twice the RMS rating. This may fry the speakers unless precautions are taken.

For rock systems, the best precaution is to use speakers that can tolerate 100% overdrive for brief periods, since heavy peaking is a fact of life is such systems. However, if smaller speakers are used, or if a defective amp is not noticed in time to shut it off, the speaker voice coils can still be burned out.

Unfortunately, all types of protection circuits involve some sacrifice of cost or performance, as reviewed below:

1. Output Transformers will not pass DC, and thus if the amp fails, the load is protected from all but a short transient. However, output transformers are costly, and limit the frequency response at both ends. Since they are not otherwise required in solid state designs, very few companies use them.
2. Output Capacitors also block DC, with only a low frequency fidelity restriction. Again, however, in preferred circuits using bipolar power supplies, they are not necessary, and a non-polar part is required at considerable extra cost.
3. Crowbar Protection. Certain manufacturers have added circuits which trigger upon detecting DC, and shut down the amp. The main problem is that low frequency pulses, such as bass drum beats, may also trigger the circuit, causing unnecessary shut-downs, which would be especially undesirable during live performance or recording sessions. In addition, these circuits are fairly costly.
4. Speaker Relays may be used in a similar fashion as the crowbar circuits, with similar problems of cost and false triggering.
5. Speaker fuses are probably the cheapest form of load protection. Fuses can protect against all forms of overdrive, audio as well as DC faults. There is still the problem of selecting the exact value for adequate protection without "nuisance blowing" on peaks. The speaker manufacturer may be able to advise as to values, but a generous supply of spare fuses, and a certain amount of experimentation, may be required. The speaker cabinets are probably the best location for fuses, since each spekaer can be individually protected. If the fuse is mounted in the amp, and one speaker becomes disconnected, the remaining speakers sharing the same fuse will not be as well protected.
6. Bi-Amping. When driving delicate horn diaphragms, it is always desirable to include a low-frequency/DC blocking capacitor, to protect against low frequency thumps or surges. The value is slected to cut off one octave below the electronic crossover frequency, to avoid degrading the damping factor within the desired frequencies. NON-POLAR electrolytic capacitors (50volt) should be used for the larger values; mylar units are available below about 8uf.

Low Frequency Protection Capacitors

Crossover Frequency	16 ohm load	8 ohm load	4 ohm load
500 Hz	40uf	80uf	160uf
800 Hz	24	50	100
1200	16	32	66
2500	8	16	32
5000	2	4	8

Note:
Use 50 volt NON-POLAR electrolytic capacitors for values above approx. 5uf; mylar units may be available in values below 8uf.

Note: If you wish to have protection one octave below the crossover frequency, divide all capacitor values by 2.

Speaker Protection Fuses

QSC provides the following estimated values, based on RMS speaker ratings. Since manufactures' ratings differ, and individual speakers may vary or age, QSC accepts no liability if these values do not protect your speakers. The speaker manufacturer should be consulted for exact recommendations.

Driver Power	Fuse Value(fast-blow)
10 watts	1 amp
30	1.5
50	2
100	3
200	4

All values are per 8 ohm speaker. For 4 ohm loads, multiply the value by 1.4. For 16 ohm loads, multiply by .7 . If fuses blow repeatedly with no speaker damage, you may wish to experiment with the next higher value.