

SERVICE MANUAL P 40/PS 5 AND PQ 10

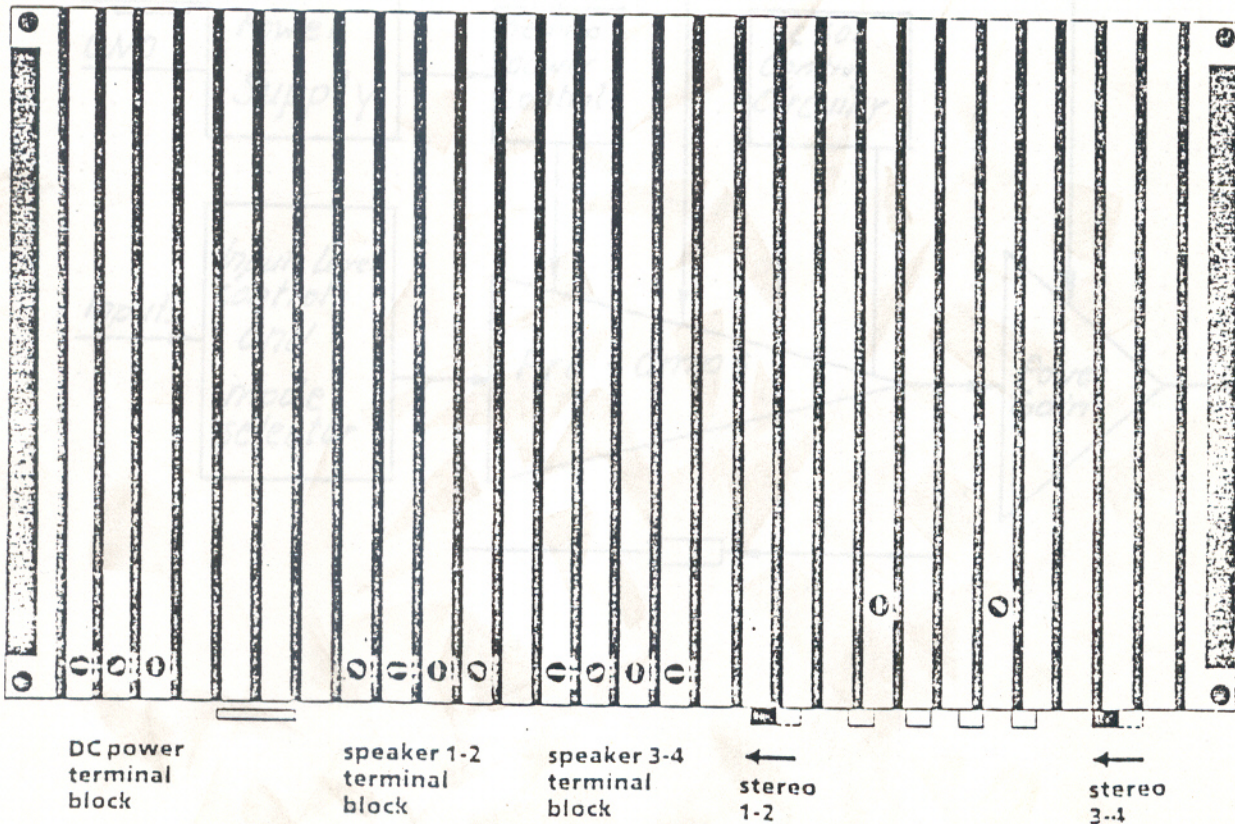
PRELUDE

This Manual is written to simplify the repair of ADS P 40/PS 5 and PQ 10 power plates. The manual consists of a detailed circuit description, trouble shooting guide, a pin location guide, schematics, finale test, thermal procedure and a spare parts list. There is not a complete list of faults, but the consistent faults are listed. If you find other common faults, feel free to write them down and add them to this list.

Good luck

EXPLANATION: Names and numbers in brackets are for PQ 10's only. For example R 603 (R 624) that means that R 624 has the same function in PQ 10's as R 603 has in P 40's and PS 5's.

a/d/s/

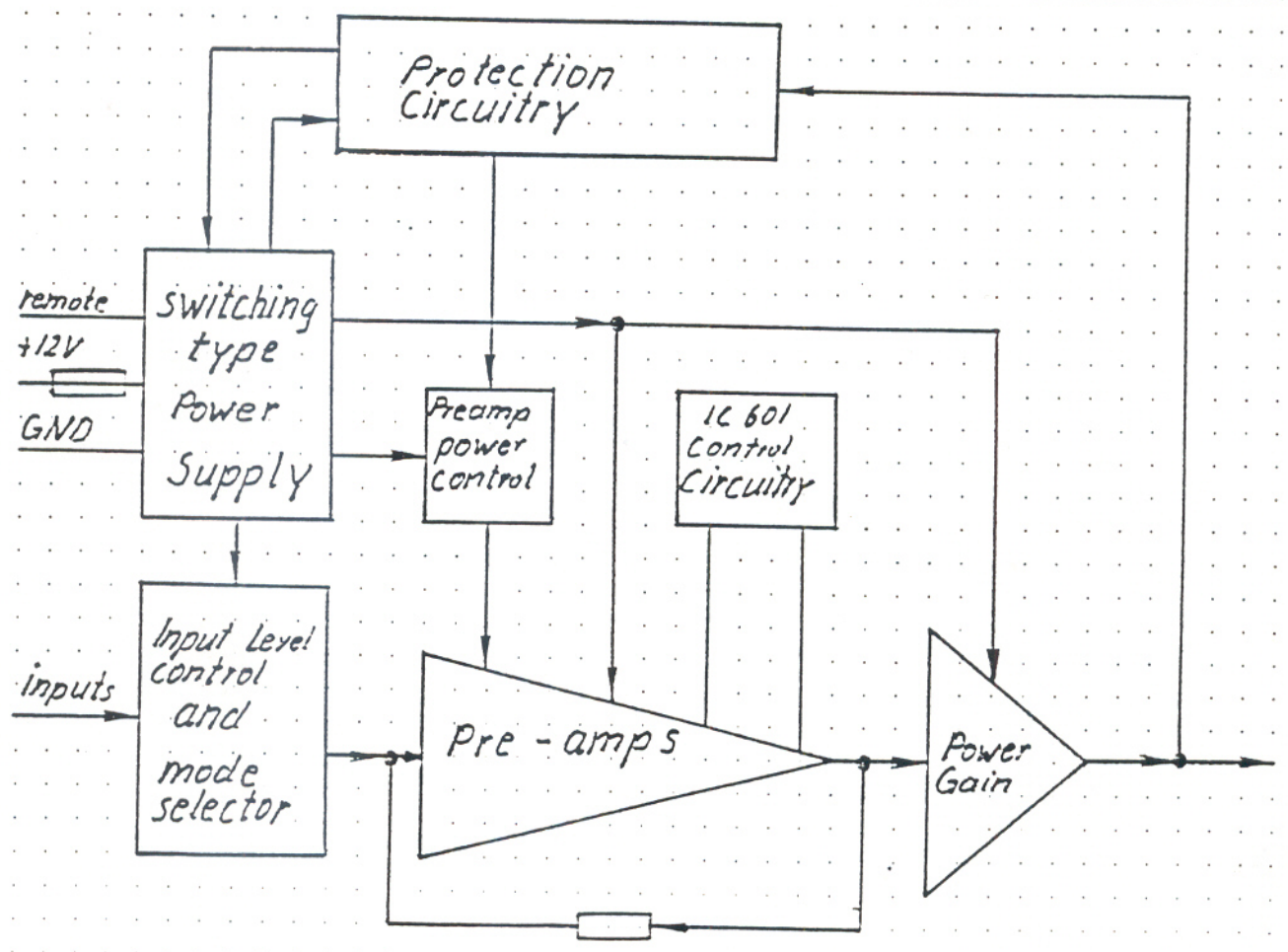


CIRCUIT DESCRIPTION

The Power Plates P 40/PS 5 and PQ 10 circuitry are located on two printed circuit boards. The largest (main) board performs four functions: Voltage gain, power gain for four and two channels respectively, protection circuitry to protect speakers, and the fourth function is a remote turn on. The smaller covered P.C. board contains the switching power supply.

BLOCK DIAGRAM

FIG. 1



Service Manual P 40/PS 5 and PQ 10

The heart of the preamp circuitry is IC 601, the footnotes a,b,c,d mark channels one, two, three and four respectively. The IC 601 is a u PC 1270 H Power amplifier Driver. It needs a positive power supply at Pin one and two, and a negative power supply at pin nine and ten. The non - inverted input is at Pin 4 of IC 601, used in P 40, PS 5 and in channel 2 and 3 of PQ 10. The inverted input is at Pin 5, uses channel 1 and 4 of PQ 10.

The output of the preamp circuitry is split in two paths. Pin 11 of the u PC 1270 H is the negative output, and pin 12 is the positive output.

Control Circuits of the u PC 1270 H (IC 601)

To compensate the phase displacement, Pin 6 is wired with a 22 pF Capacitor. The transistor circuitry of Q 601 controls the base voltage via pin 7 and 8. Wired to pin 3 is a RC network which is used to set the mute time. The gain of the circuitry is controlled by VR 601 input potentiometer.

The gain of IC 601 is set by two resistors (R 605 (R 622) feed - back resistor and R 603 (R 604) Input resistor), like an ordinary OP amp. The capacitor C603 (47 uF) is only used to block a little DC offset. In case of using a non inverted input the gain is:

$$G = 1 + \frac{\begin{matrix} R 605 \\ (R 622) \end{matrix}}{\begin{matrix} R 603 \\ (R 604) \end{matrix}} = 47.3$$

In case of using a inverted input, the gain is:

$$G = - \frac{\begin{matrix} R 605 \\ (R 622) \end{matrix}}{\begin{matrix} R 603 \\ (R 604) \end{matrix}} = - 46.3$$

Because of the small difference in gain, nobody will hear the difference in output. For example, if there is a voltage of 0.5V on the input, then the output will be as follows:

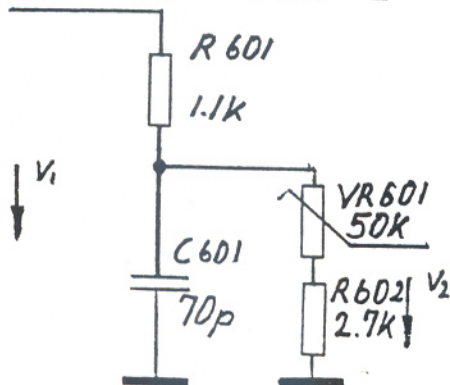
inputs		gains	=	outputs	
V1 = 0.5	*	47.3	=	23.65 V	non inverted input
V2 = 0.5	*	- 46.3	=	- 23.15 V	inverted input

This shows how little the change in gain affects the outputs.

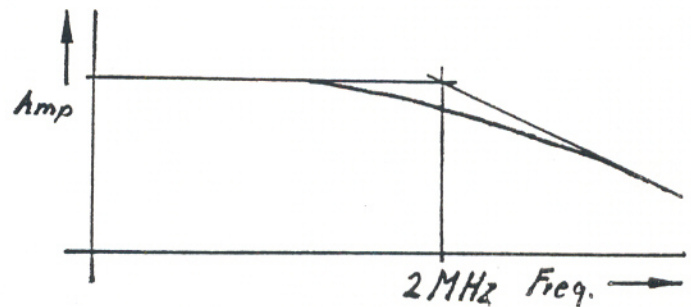
PREAMP

The signal passes a resistor and capacitor network before it enters the preamp. For better understanding in the description a simplification is made. The network is considered as two separate terms. This is possible, because they don't influence each other much. The first term filters high frequencies.

Considered Term FIG. 2



Frequency Response FIG. 3

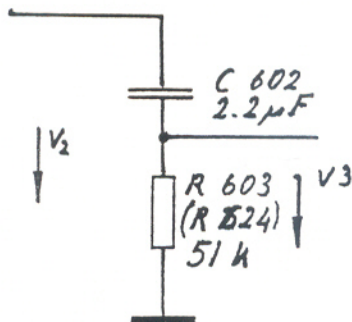


$$T = R 601 * C 601 = 0.77 \text{ ns}$$

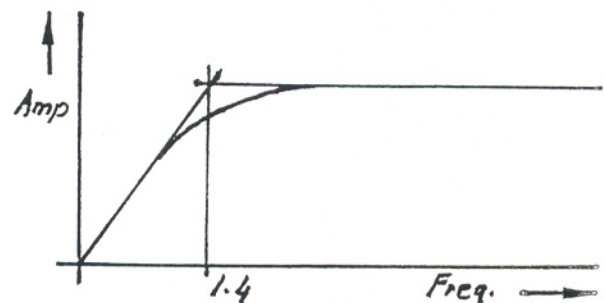
The cutoff frequency ($F=1/T/2\pi$) of this term is 2 MHz.

The second term consist of C602 and R625, R603 respectively. This term filters low frequencies.

Considered Term FIG. 4



Frequency Response FIG. 5

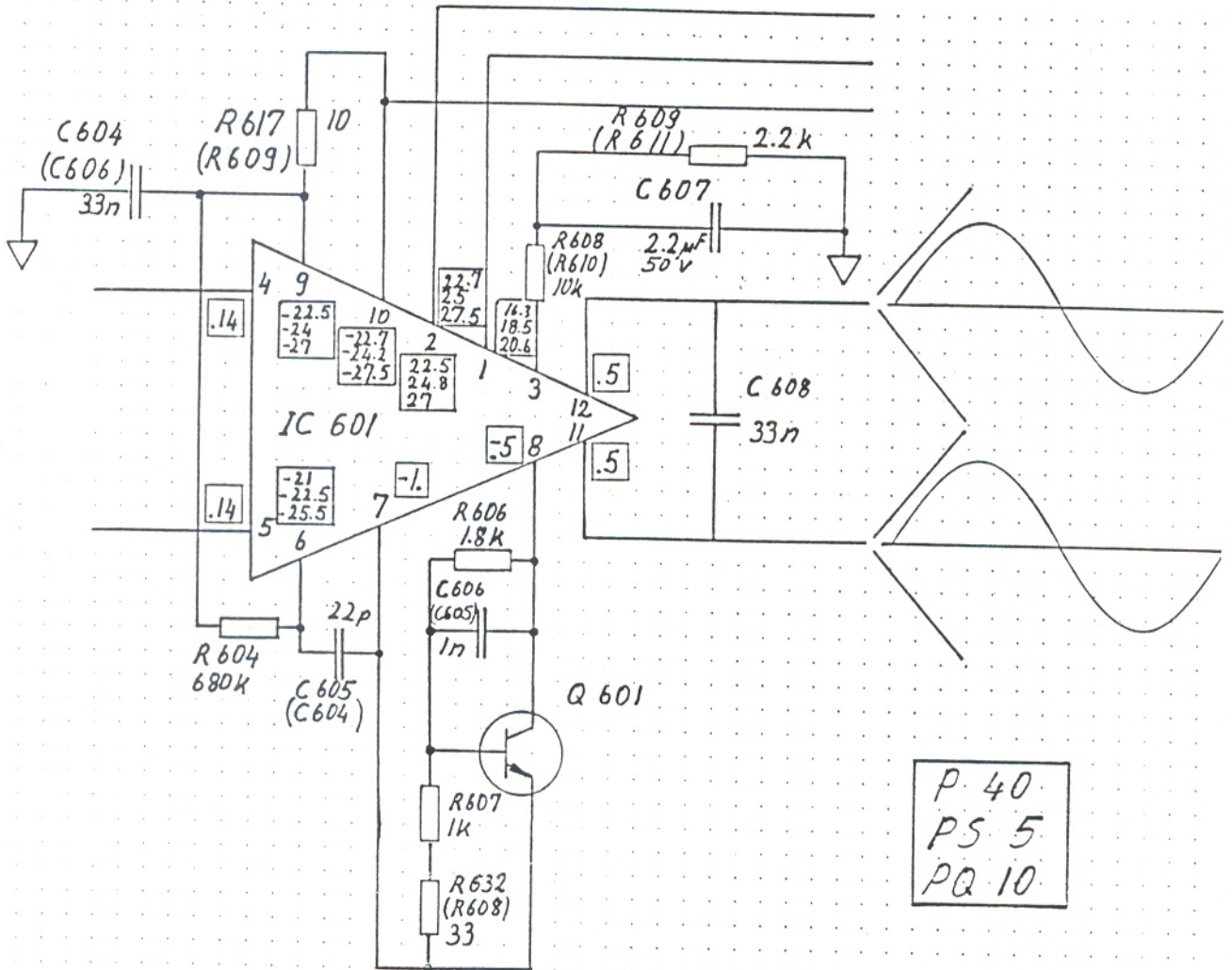


$$T = R 625 * C 602 = 0.1122 \text{ s}$$

That means, this term has a low cutoff frequency of 1.4 Hz. Therefore 1.4 Hz or higher frequencies can be transmitted with this term. Since the OP amps are built to amplify a wide range of frequencies, IC 603 or IC 601 won't influence the required frequency response, because of the high input impedance of the non inverting input of the OP amps IC 601 or IC 603 won't influence the circuitry that comes before it. In case of using the inverting input of IC 601 in PQ 10, the OP amp (IC 603) is used to change the impedance, so that this also won't influence the circuitry before it. Another reason for using an OP amp in that case is, to block the inverted feedback away from the non inverted signal.

PREAMP CIRCUIT

FIG 6



POWER AMPLIFIER

The power amps consist of two high speed power transistors (Q 602 and Q 603) in a complementary configuration. They work as a push pull power amplifier. Q 602 supplies the positive part of the signal and Q 603 supplies the negative part of the signal.

BRIDGE MODE

Power Plates can be used in stereo and bridged mode. In stereo mode each channel is used separately. The signals are pulsing around a fictitious ground.

In bridge mode however there are two amps for one channel. The speakers are connected to the positive jack only. The signals in the amps are out of phase, so a double amplitude is achieved in the speakers.

Block Diagram

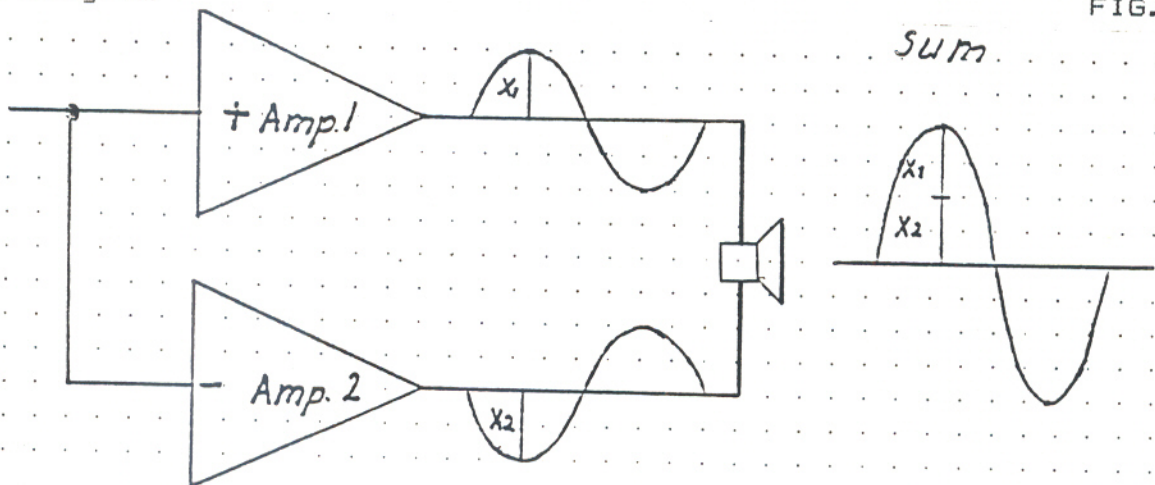


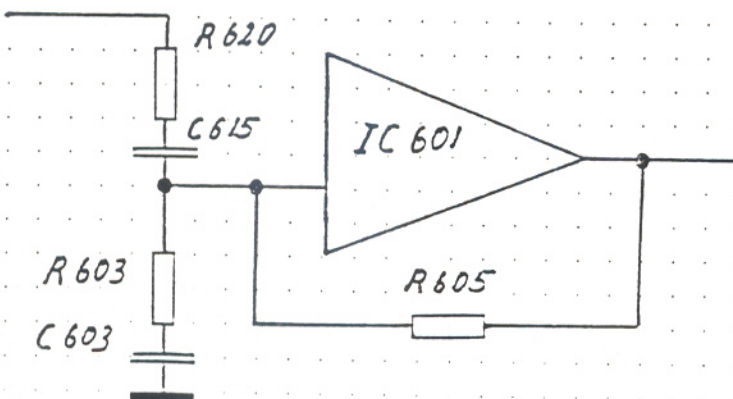
FIG. 7

The inverted input of IC 601 is used, that the channels are out of phase. The two channels are out of phase all the time in a PQ 10. The selector switch (sw 601) connects channel 1 to two preamps that are out of phase. This is possible, while using an OP amp (IC 603) for changing the impedance of the inverting input of IC 601.

In PS 5 and P 40 the two channels are in phase in stereo mode. At bridged mode, the right channel uses the inverted input of IC 601. The selector switch connects the non inverted input of the right channel (IC 601b) to ground, and the inverted input to the output of the left channel via R 620. Since R 620 = R 605, the same voltage is at the outputs.

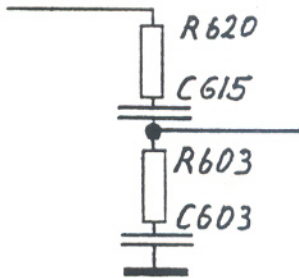
Shown are the main parts of the circuitry.

FIG. 8



To analyze the circuitry, one term is separated. This term is:

Considered Term FIG. 9



$$T1 = C 603 \cdot R 603 = 0.0517 \text{ s}$$

$$T2 = \frac{R603 \cdot C603 \cdot C615 + R620 \cdot C603 \cdot C615}{C 615 + C 603} = 0.109 \text{ s}$$

First cutoff frequency is 1.46 Hz ($F=1/T2/2\pi$)

Second cutoff frequency is 3.07 Hz ($F=1/T1/2\pi$)

Since lower frequencies than 1.4 Hz are filtered by the network before, doesn't it course a DC problem here.

For example at 20 Hz

Frequency Response FIG. 10

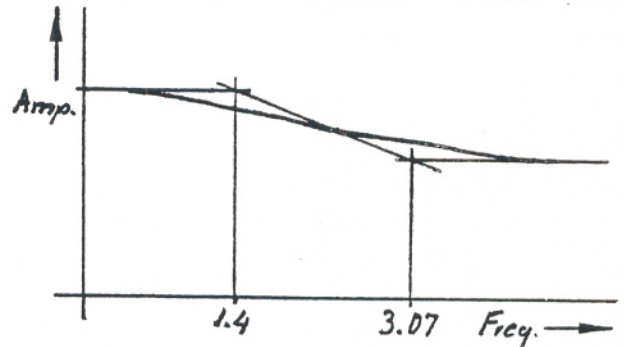
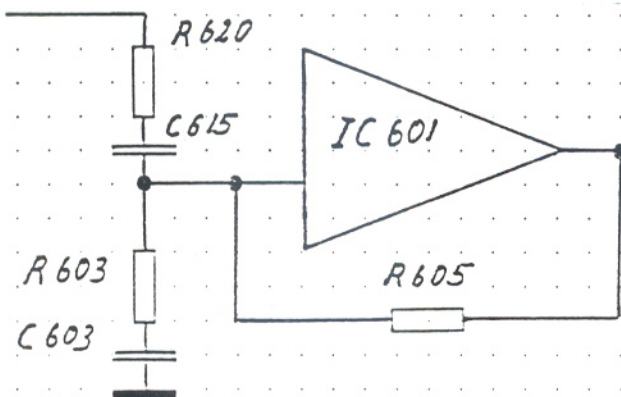


FIG. 11



Since the inverted input measures almost ground, the gain of this circuit is.

$$G = - \frac{R 605}{R 620 + XC} = - 0.93337$$

and for higher frequencies increases the gain up to 1, so that both channels have the same size.

PROTECTION CIRCUITRY

The protection circuitry is designed to protect the unit against overload, and to protect the speakers against too much DC current. This is necessary, because if too much DC current flows through a speaker voice coil, the voice coil will overheat, and the speaker will be damaged.

There are two independent circuits to protect the speakers. First there are two transistors Q 607 and Q 608, they scan the signal ground for a DC offset. If there is an offset, Q 609 turns the power supply off. Q 607 turns on, if a positive offset is detected. Q 608 turns on if there is a negative offset detected.

The second circuit is integrated in a bipolar analog integrated circuit u PC 1237 H. This is a monolithic integrated circuit designed for protecting stereo power amplifiers and loudspeakers.

REMOTE TURN ON

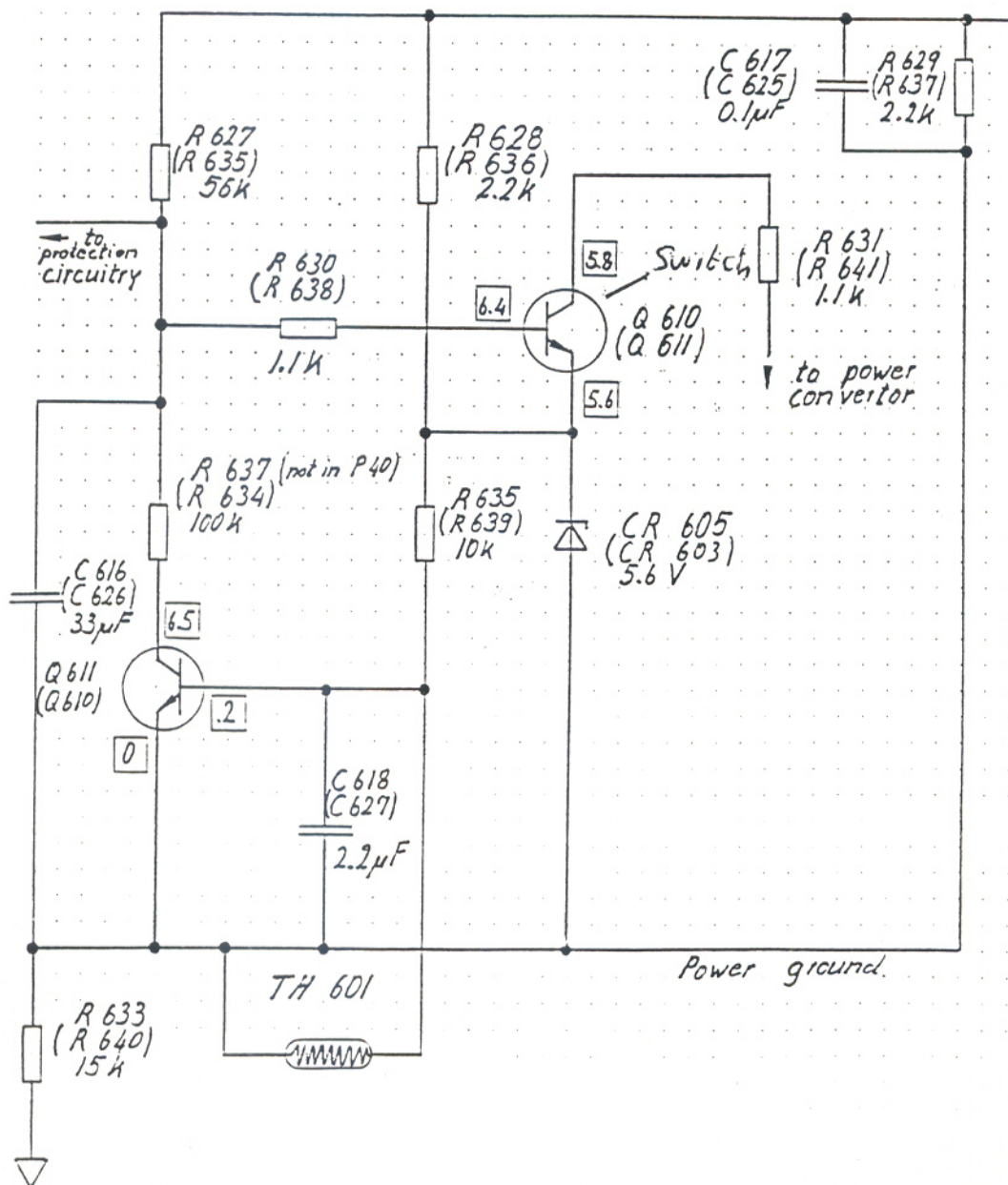
The remote turn on circuit senses the presence of 12 volts at the remote terminal. When the unit is switched on, the resistor and capacitor network consisting of R 627 (R 635) and C 616 (C 626) sets the bias voltage (6.6V) of Q 610 (Q 611). Transistor Q 610 actually turns on after 1.8 sec. This is the RC time of the circuit. Once Q 610 (Q 611) is turned on, it controls the base current of the switching transistors in the P.S.

Q 611 (Q 610) is normally not on. If the unit gets hot and the thermostat increases the resistance, the resistor capacitor combination consisting of R 628 (R 636), R 635 (R 639) and C 618 (C 627) is setting a base voltage at Q 610 (Q 611), Q 611 is pulling the base voltage of Q 610 (Q 611) down, then Q 610 (Q 611) switches off. When Q 610 is off, there is no base on P.S. transistor.

REMOTE TURN ON SCHEMATICS

remote on terminal →

FIG 13



Service Manual P 40/PS 5 and PQ 10

The output offset detection is localized at pin 2 of IC 602 and this is scanning the signal ground also. The threshold levels of IC 602 are +0.62 V and -0.17 V. If the offset is larger than these levels, the IC cuts off the positive power supply. Supplying to the preamps of the IC's 601 a,b,c,d respectively.

IC 602 has an integrated relay driver at pin 6. The relay driver is used to switch off the preamp gain in IC 601 a,b,c,d via Q 606. It does this by removing the positive power supply on IC 601, pin 2. If pin 6 of IC 602 is grounded, Q 606 is switched on. If there is +VCC on pin 6 of IC 602, Q 606 is switched off, because the base current cannot float in Q 606. This is how it removes the positive power supply on IC 601.

To protect against DC offset, pin two of IC 602 is scanning the signal ground. If the offset is a higher than the threshold levels, (+0.62 V and -0.17 V) pin 6 is switched to a high voltage (+VCC) and cuts the supply of the preamp gain.

Function of overload detection

The two resistors R 611 and R 612 in shunt to the output transistor Q 602 a,b,c,d meter the load current. The voltage drop across R 611 controls the base of Q 604 (a,b,c,d) via the diodes CR 601 (CR 616, CR 617). Q 604 a,b,c,d controls the base of Q 605 which is controlling the voltage at pin 1 of IC 602. If the voltage at pin 1 increases more than the threshold level of 0.67V, pin 6 of IC 602 will cut off the supply of the preamp gain in IC 601 pin 2.

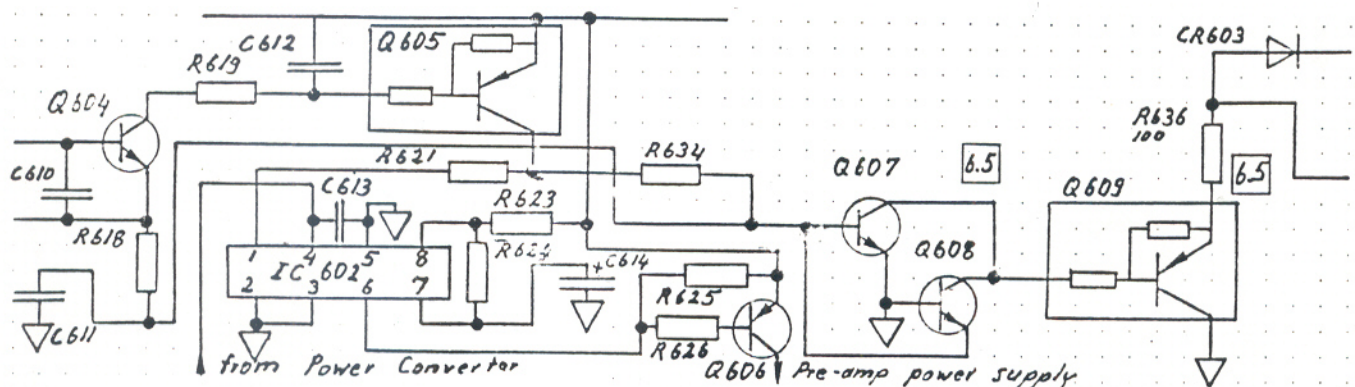
Protection against shock - noise

To suppress turn - on noise, generated by power on, a time delay circuit at pin 7 of IC 602 is used. This circuitry consists of a resistor and capacitor combination, which sets the mute time for the relay driver (pin 6 of IC 602). This mute time keeps the turn - on noise away from the speakers.

When you turn off the power switch it sometimes causes a turn - off noise. It is necessary to break off the relay driver, and then keep the power amps apart from the loud speakers, at the moment the power switch is turned off. Since it is difficult to detect the power off time from actual DC supply voltage line, the IC 602 detects this power off time from AC power supply directly via pin 4.

SCHEMATICS

FIG. 12



POWER CONVERTER

The power converter is a switching - type power supply, operating at about 25 kHz. It takes the 12 Volt automobile battery voltage and converts it to ± 22 V (± 28 V). Since a high frequency converter makes large storage capacitors unnecessary, the amplifier can be turned off almost instantaneously.

The protection circuitry and the remote turn on control, act on the amplifier by shutting the power converter off. T 802, Q 803, (Q 805) R 801, CR 806, CR 802 and (Q 610) (Q 611) provide the on and off function for the converter. If Q 610 (Q 611) is turned on, (look at description remote turn on), base current for the switching transistors (Q 801 - Q 804) then flows through CR 806, R 631 (R 641) and finally through Q 610 (Q 611) and CR 605 (CR 603) then to ground.

Current flows through CR 806 producing a 0.6 Volt drop, which provides a reverse base for the gate to cathode junction of Q 803 (Q 805) keeping it off. If Q 610 (Q 611) is turned off, then it is not reversed base at Q 803 (Q 805) and Q 803 (Q 805) shunts the base current away from the secondary winding of T 802 ensuring the power converter shuts off.

When Q 610 (Q 611) is turned on, a trickle of base current in switching transistors Q 801 - Q 804 starts flowing. Since the transistors are never identical assume Q 801 (Q 802) conducts harder. The collector current of these transistor(s) flows through the primary winding of T 801 and causes a positive voltage feedback via the secondary winding of T 802. The current feedback turns the BE junction all the way on. The base current flows through secondary windings (1-4) of T 802. Eventually, the core of T 802 saturates, and the magnetic field collapses resulting in an abrupt polarity reversal turning Q 801 (Q 802) off and Q 802 (Q 803 & Q 804) on. This process repeats itself at 25 kHz.

Current feedback is used to uphold the power supply by using a bigger load. If the collector current of the switching transistors increases, more current is floating through the secondary windings of T 801 and the primary windings of T 802. This current drives (via T 802) more base current through the transistors.

Q 801, Q 802
 RMSY Damage
 (HOT)

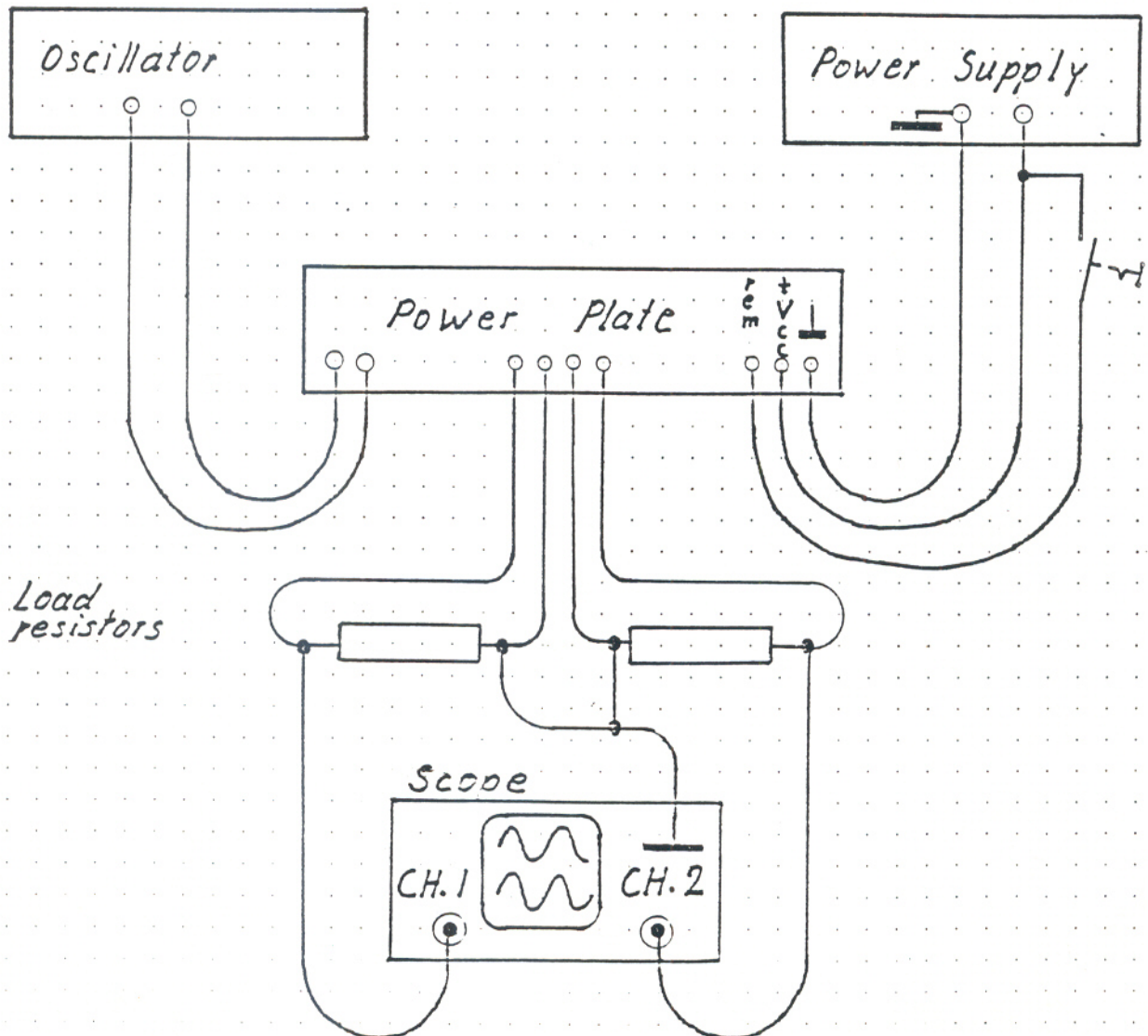
TROUBLESHOOTING GUIDE

Equipment needed: Oscilloscope 15 MHz
Oscillator
Voltage meter
Ohm meter with high voltage diode check function
for diode and transistor tests
13.5 Volts power supply (20 amperes continuous)
4 Ohms load resistor.

HOW TO FIX POWER PLATES !!!

Remove the bottom cover of the amplifier, and put it upside down on the bench. Connect a 4 Ohm resistor load to the speaker terminals. Connect the power supply and +12 V to the unit. Connect a sine wave oscillating signal to the input connectors. Show both output signals at the scope.

FIG. 15



POSSIBLE FAULTS:

1. Power Plate destroys signals

1.1. There is only a half of a sine wave on the screen, positive or negative respectively.

Check the solder junctions of the output transistors Q 602, Q 603.

1.2. There is positive offset at output channel.

The positive output transistor (Q 602) might be shorted. The potentiometer VR 601 might be bad. The feedback resistor R 605 (R 622) might be open. Check the control circuit (Q 601) of the preamps. Check the preamps.

1.3. There is a negative offset at an output channel.

Check the negative output transistor Q 603. Check feedback resistor R 605 (R 622). Check the preamp.

2. Power Plate blows fuses with 12 Volts at remote terminal

2.1. Voltage at the chassis.

Measure the chassis, it should be ground. When there is a positive voltage, relative to signal ground, one of the positive output transistors Q 602 or one of the switching transistors Q 801 - Q 802 is connected to the chassis. Replace the Mica.

2.2. No voltage at the chassis.

Fuse blows after a delayed time. Both output transistors may be shorted. Fuse blows immediately after power on. Possible a problem on the primary side of transformer T 801. Shorted switching type transistors Q 801 - Q 803 or shorted connections. Also the diodes CR 801 and CR 802 might be shorted.

3. Power plate makes thumping noise.

3.1. Power Plate makes thumping noise with 12 Volt at remote terminal.

Suspect unit tries to turn on, but protection shut down the power supply. Output transistors Q 602 Q 603 are probably shorted. There can also be an offset caused by the potentiometer VR 601 or by the preamp IC 601. Also check the protection circuit.

also amp.

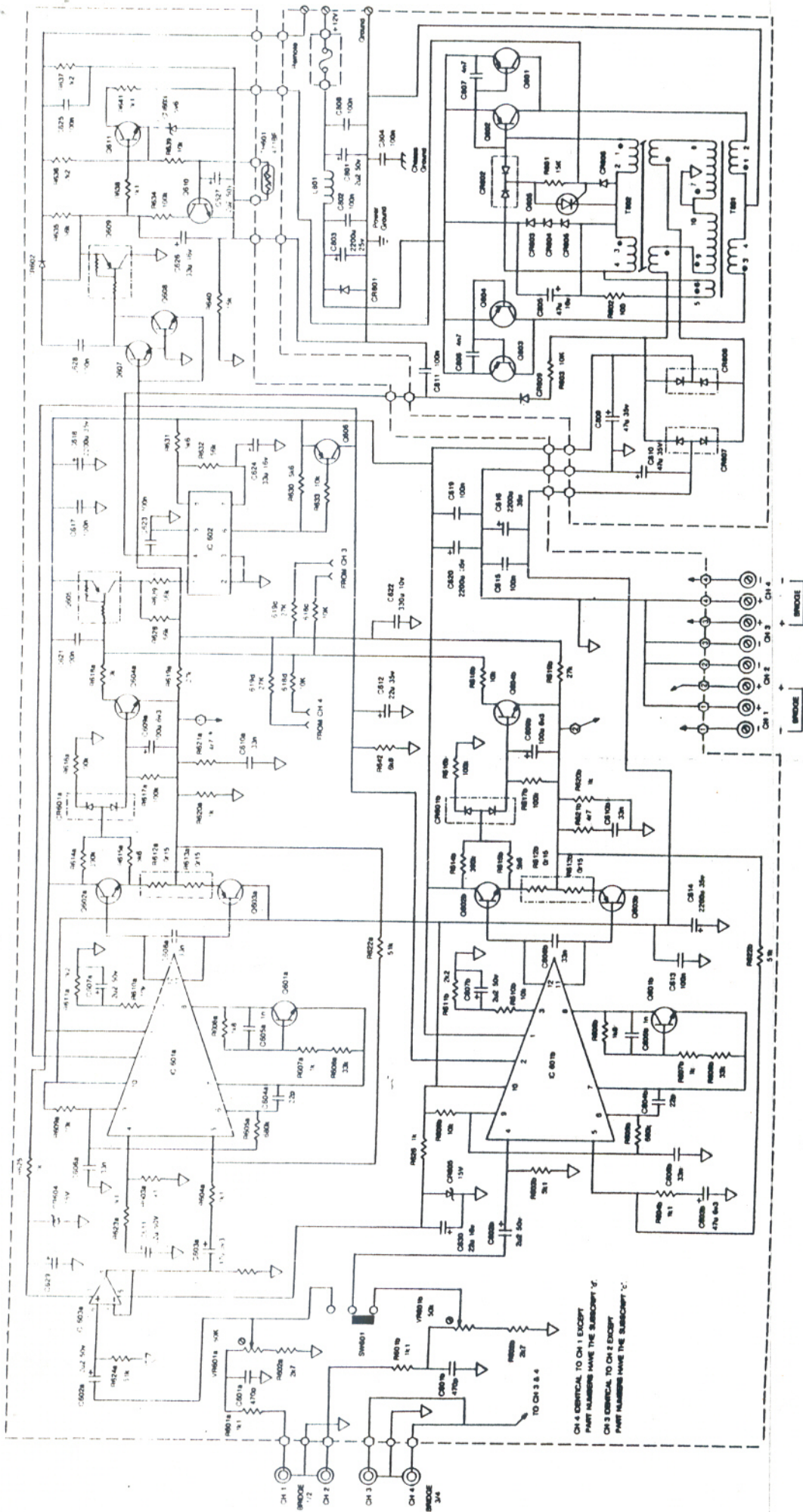
3.2. Power Plate makes thumping noise without ~~12 Volt~~ at remote terminal.

Some source of leakage current in the power converter. It is trying to turn the power converter on, and the SCR Q 803 (Q 805) is switching it off again. Suspect Q 801 - Q 804 are leaky or bad transformer T 801 - T 802.

4. Power Plate turns on without 12 Volts at remote terminal.

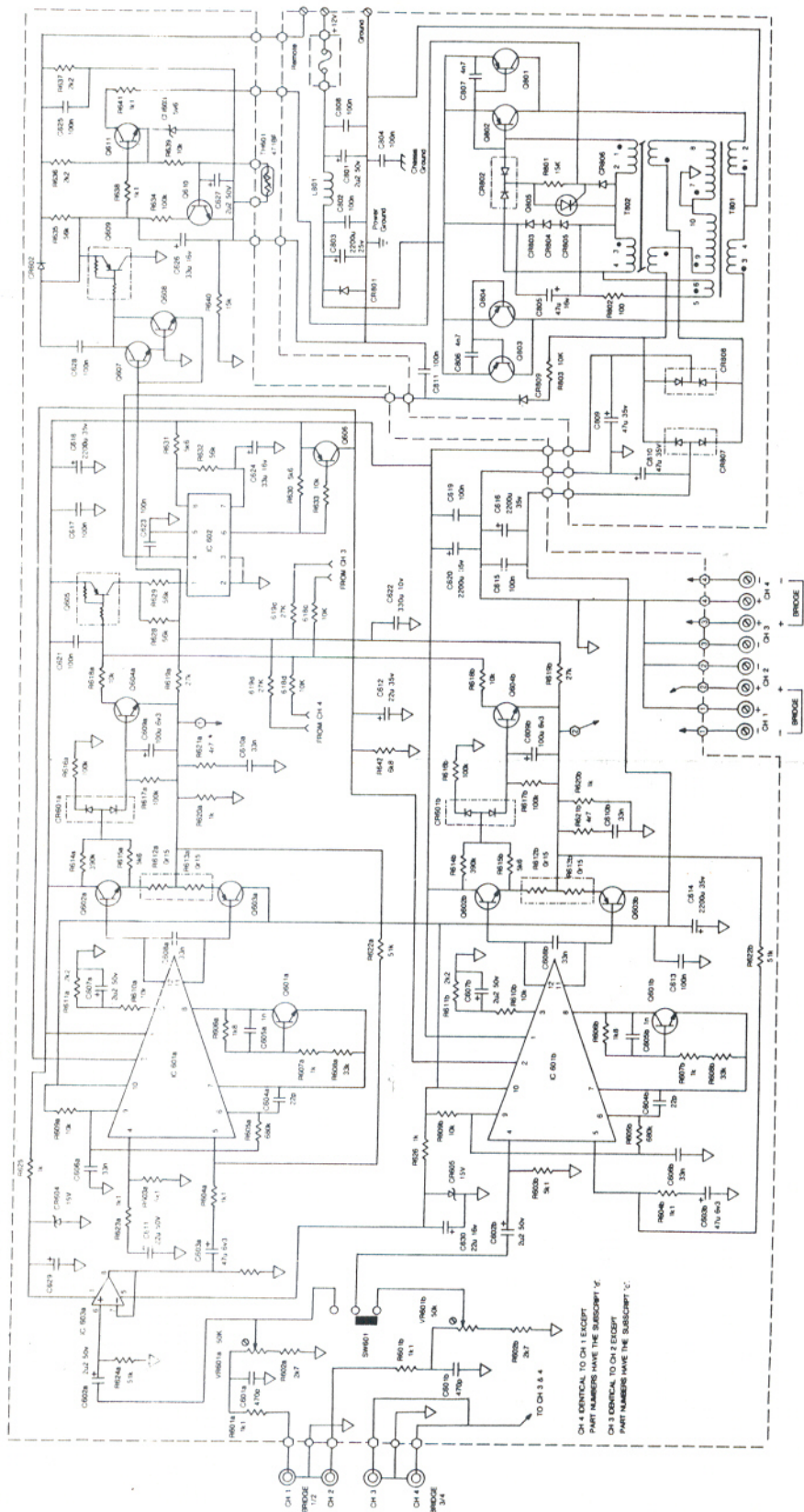
Suspect transistor Q 610 (Q 611) is shorted.

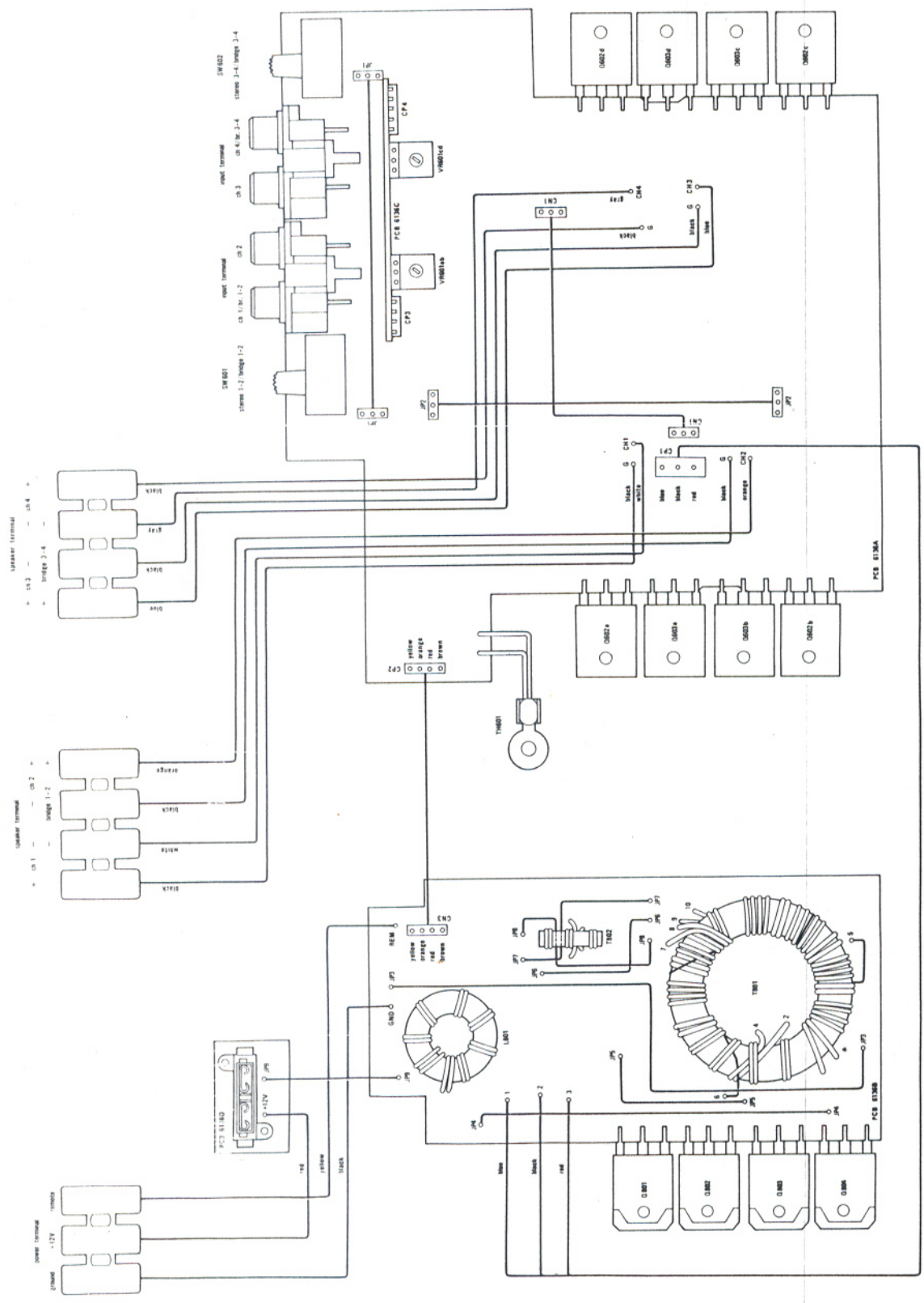
CHASSIS Ground Screw



CH 4 IDENTICAL TO CH 1 EXCEPT
PART NUMBERS HAVE THE SUBSCRIPT '4'
CH 3 IDENTICAL TO CH 2 EXCEPT
PART NUMBERS HAVE THE SUBSCRIPT '3'

Circuit Diagram





COMPONENTS AVAILABLE