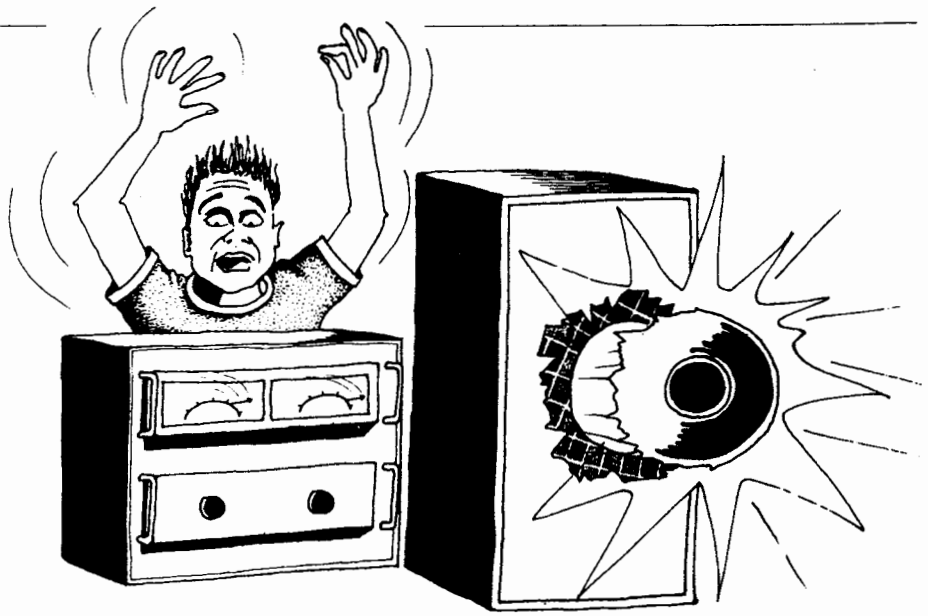
Loudspeaker Protector



This unit affords both dc and over-power protection of loudspeakers or loudspeaker systems rated at up to 1500 watts! The unit requires no power supply and has no discernible audible effect on sound quality, making it suitable for both hi-fi and sound reinforcement applications.

YOU'VE JUST unpacked and connected that shiny new 400 watt amplifier you've always wanted, and you lower the tonearm expectantly. There's a short detonation, and smoke gently and silently curls from the speaker grille cloth. Nobody had pointed out to you that those bargain basement speakers could only handle 15 watts.

Never, you say? You always check such things? Murphy's Law lies in wait: power amps fail occasionally, and a shorted output transistor can connect the power supply directly to the speaker coil, applying a steady 30 to 50 volts DC, usually enough to char the coil or rip the mountings apart.

A solution to this is the ETI Signal Powered Loudspeaker Protector. It is applicable to almost all speakers, and can fit inside the cabinet itself. Since the unit is powered by the audio signal, there are no batteries to fuss with, and unlike a fuse, it automatically resets when the overload is removed. It can also tell the difference between applied DC and low-frequency signals, and can be adjusted to cut out at a desired signal level without tripping on loud but harmless transients.

The self-powering feature is not only convenient, but adds no audible distortion to the signal, even with low-wattage amplifiers having rather high output impedances.

This is done in this case by placing a fullwave rectifier across the speaker lines and charging a 1000u capacitor through a 47 ohm resistor. The worst possible load presented to the speaker line is therefore 47 ohms and this is only while charging the capacitor and for signal voltages in excess of 12 V. This ensures that the unit has no discernible effect on audio quality but makes possible a truly 'set-and-forget' loudspeaker protector that can be mounted inside the loudspeaker enclosure if desired.

The protector tests for both dc and over-power, which can be adjusted by a preset on the board to suit a particular loudspeaker or application. The circuit also uses a new filter design with an almost 'brick wall' response enabling it to be connected to very high power amps. This is discussed in more detail in the 'How it Works' section.

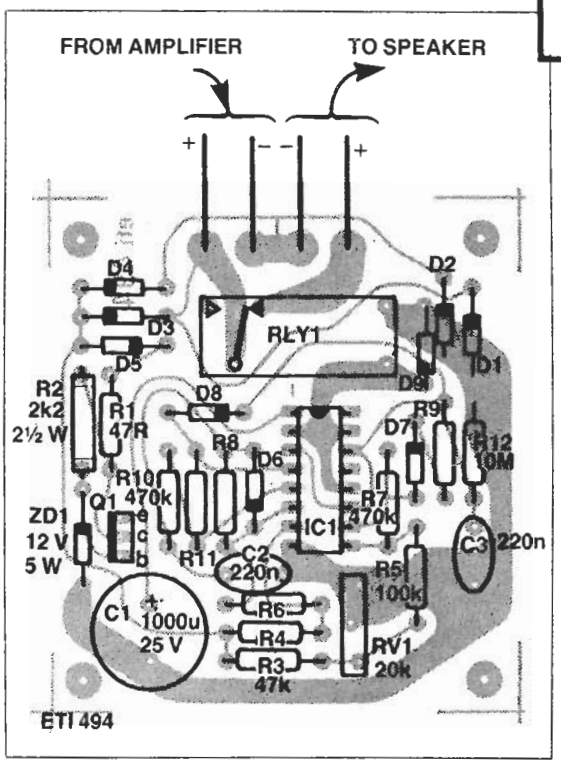
The maximum power that can be applied to the unit is determined by the type of regulator transistor (Q1) used. We have specified a TIP31C for this device which has a 100V collector-to-emitter breakdown voltage. Since the emitter is at 12V, the maximum voltage that can be applied to the unit is 112V. This is equivalent to an amp capable of supplying approximately 784 watts into an 8 ohm load or 1568 watts into a 4 ohm load. If the amplifier to be used is capable of powers greater than these the regulator transistor should be substituted for a device with a higher V_{ceo} rating. The relay pulls around 40 mA when operated, so power dissipation in the regulator transistor will be around 4 watts when dropping 100 volts. Although this is not a particularly high dissipation it is high enough to lie outside the Safe Operating Area rating of many high voltage transistors, so be careful when choosing an alternate regulator transistor.

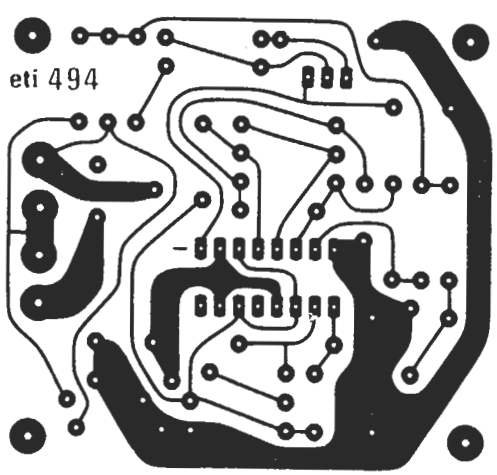
Construction

Construction is straightforward since all of the components are mounted on the pc board. The usual precautions should to taken to ensure that all polarised components have been mounted with the correct orientation. The IC used is a CMOS type and is therefore static sensitive. Solder this last and preferably using an grounded soldering iron. It is a wise precaution to discharge yourself before handling the device by first touching an grounded metal appliance.

It is a wise precaution to space the 2.5W resistor, R2, off the pc board slightly. In the case of a high powered loudspeaker going faulty with dc this component will get quite hot and spacing improves ventilation around the component and prevents the possibility of charring the pc board. If you can't obtain a 2.5 watt type (e.g. Philips PR52), then a 5W type may be substituted.

Before mounting the unit check operation by connecting around 20V dc across the speaker input terminals on the pc board. The relay should cut in after about one tenth of a second. If the protector passes this test connect the speaker wiring. If the preset is turned fully down (turn it counter-clockwise when viewing the board with the components on top and the relay to the right) the relay will cut in when the power exceeds around 20 watts for an extended period. The protector allows transients to the full supply rail to pass but will prevent a continuous 20W from being applied to the loudspeaker. To increase this, turn the preset clockwise until the desired response is achieved.



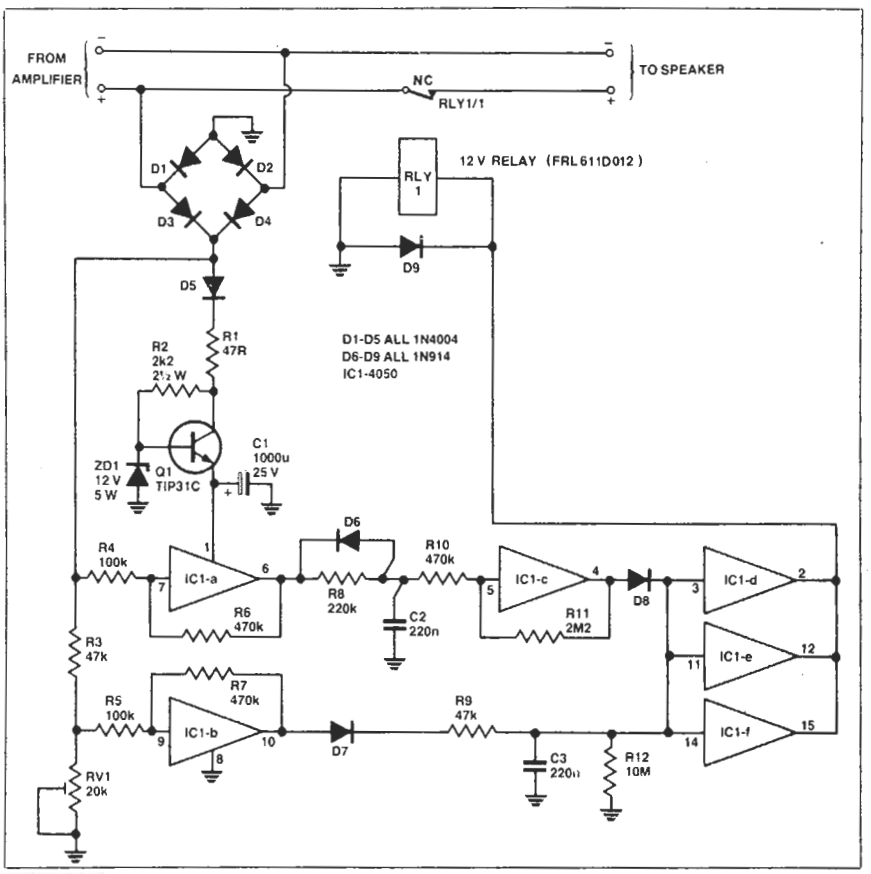


HOW IT WORKS

The signal from the power amp is rectified by the fullwave rectifier formed by D1-D4. The output of this is fed through a 12V regulator circuit formed by Q1 and its associated resistors and zener diode, and charges the electrolytic capacitor, C1. The output of the rectifier is also fed to the input of the dc sense and over-power detection circuitry.

IC1 gates a and c form the dc filter. Resistors R4 and R6 form a Schmitt trigger with a small deadband. When the signal goes above the trigger voltage the output of the trigger swings hard to the positive supply rail of the IC, charging C2 through the 220k resistor, R8. Resistors R10 and R11 with gate c form a second Schmitt trigger monitoring the voltage across C2. If the voltage across C2 reaches the trigger voltage of this second Schmitt, gates d, e and f are activated, pulling in the relay contacts and disconnecting the loudspeaker. It takes about 100 ms to charge C2 through R8, and on normal audio content the output of gate 'a' will be driven low before this occurs, discharging C2 rapidly through D6. Only signals which do not have a zero crossing for longer than 100 ms will trigger the protector.

The over-power protector consists simply of a voltage divider feeding a third Schmitt trigger. Whenever the signal voltage exceeds the trigger voltage the output of gate 'b' is driven high and C3 starts to charge. If this condition persists for long enough the output gates are turned on and the relay pulls in. Note that both the dc and over-power sense circuits charge C3 when activated. The circuits are decoupled from this capacitor by diodes so that, once charged, C3 can only be discharged by the parallel resistor R12 (the effect of the input impedance of the gates is negligible). Since it takes about one second to discharge this capacitor, the relay will hold in for this time. The protector therefore reconnects the loudspeaker approximately one second after the fault condition has been removed.



PARTS LIST

Resistors (all ½W, 5% unless noted)

R1	47R
R2	2k2, 2½W
R3,9	47k
R4,5	100k
R6,7,10	470k
R8	220k
R11	2M2
R12	10M
RV1	20k min. trimpot

Capacitors

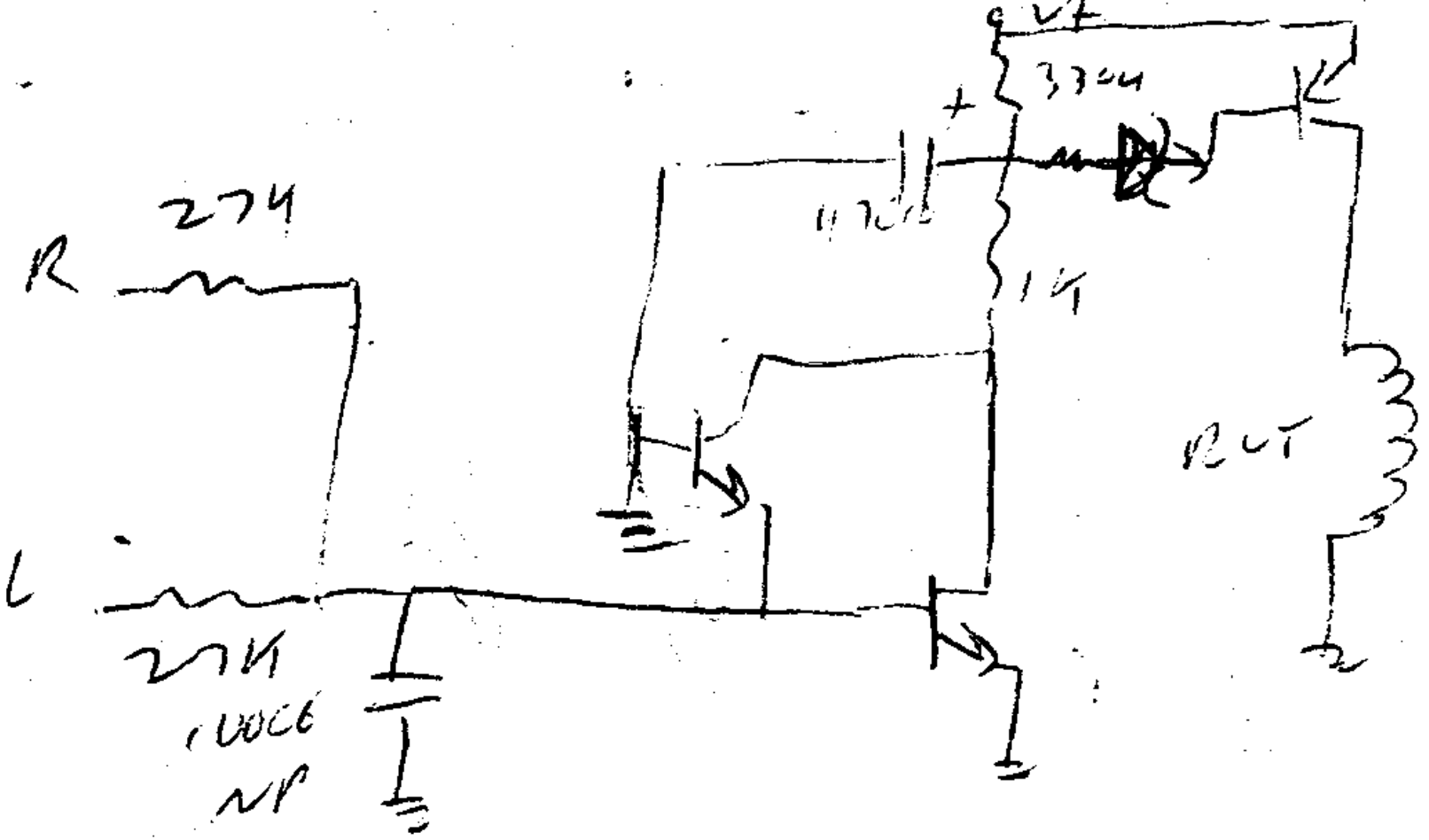
C1	1000u/25V electro
C2,3	220n

Semiconductors

D1-5	1N4004, EM404
D6-9	1N914, 1N4148
IC1	4050 hex buffer
Q1	TIP31C
ZD1	12V, 5W zener

Miscellaneous

pc board; RL1 — Fujitsu FRL611D012, 12 volt SPDT 10A contacts or Guardian 1345-IC-12D or similar relay (pc mount type).



SPKR SAVER

Fig. A

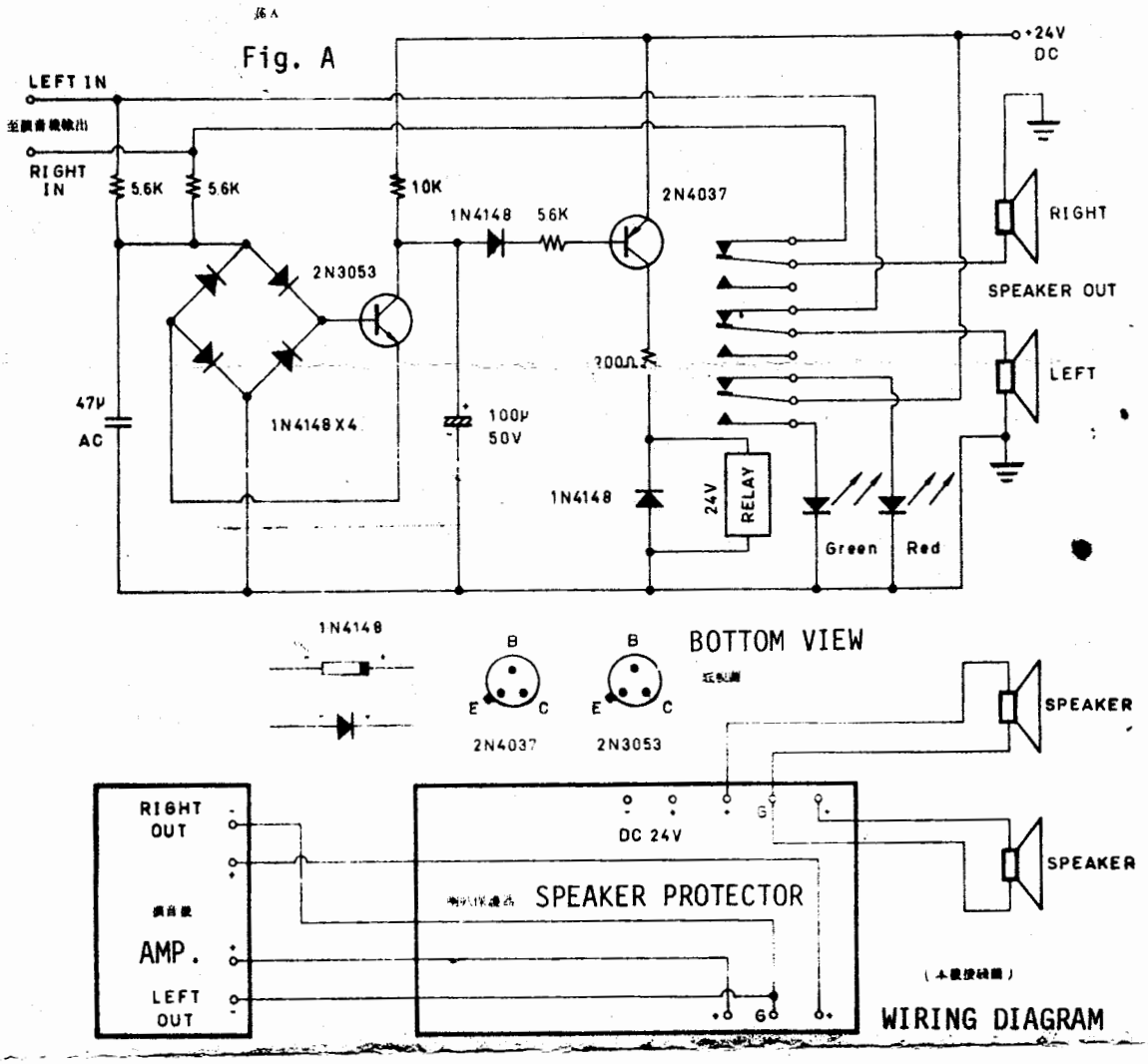


Fig. B

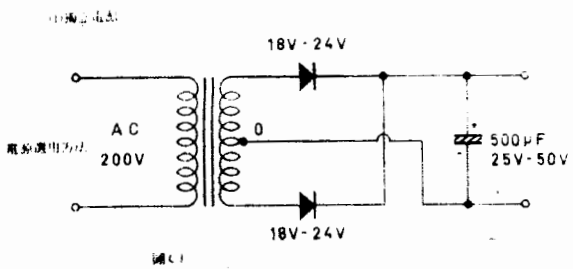


Fig.C1 Separate Power Supply

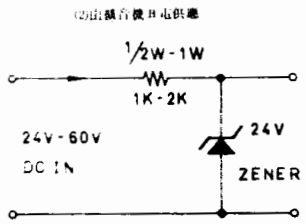


Fig.C2 From B Supply of Amp.

TEST PROCEEDURE:

- After soldering,check it twice,then connected to mains,the relay will be closed between 5 sec.,(Notice:when connected to mains,the relay is open, Under the normal condition,the unit was not drawn any current). If the condition was O.K. the delay time of unit was waiting the amplifier working correctly and connected the loudspeaker.
- Another section of DC test,used Rx1 rang of multimeter or 9V battery, connected to input of loudspeaker,if the unit was open circuit,the circuit of this unit was good service for you.
- The power supply as fig. C1,2.
- Connection between amplifier and speaker protector as fig. B.
- Indication of red and green LED:green LED indicated working normal,if the amplifier was unnormal or DC current appeared,red LED lighted.

NEW IDEAS

Speaker overload protector

MANY OF THE LOWER-PRICED AMPLIFIERS available today do not provide any overload protection for your speakers. The purpose of the circuit shown in Fig. 1 is to remedy that shortcoming.

Relay RY1 is six-volt DPDT unit rated at 3-5 amps. One set of contacts is wired in series with each speaker so that when the relay is *not* energized, the contacts are closed and the circuits between the speakers and the amp are complete.

The input to the circuit is taken from your amplifier's speaker-output terminals or jacks. If the right-channel signal is sufficiently large to charge C1 to a potential that is greater than the breakdown voltage of Q1's emitter, a voltage pulse will appear across R7. Similarly, if the left-channel signal is sufficiently large to charge C2 to a potential that is greater than the breakdown voltage of Q2's emitter, a pulse will appear across R7. The pulse across R7 triggers SCR1, a sensitive gate SCR ($I_{GT} < 15$ mA, where I_{GT} is the gate trigger-current), that latches in a conducting state and energizes RY1. The action of the relay will interrupt both speaker circuits, and the resulting silence should alert you to the problem. Cut back the volume on your amplifier, then press and release S1 to reset the circuit and restore normal operation.

The circuit can be adjusted to trip at any level from 15 to 150-watts RMS. To calibrate, deliberately feed an excessive signal to the right input of the speaker protector and adjust R3 until RY1 energizes. Do the same with the left channel, this time adjusting R4. The circuit is now calibrated and ready for use.

—Willie Ward

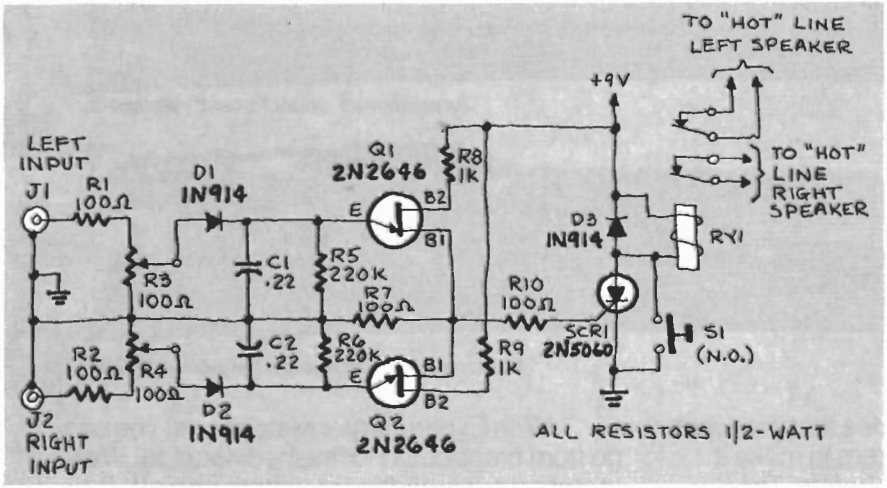


FIG. 1

SPEAKER-OVERLOAD PROTECTOR

In the December 1981 issue of **Radio-Electronics,** a circuit for a speaker-overload protector, by Mr. Willie Ward appeared in the "New Ideas" section. The design is simple and efficient, except that there has been a misinterpretation between the text and the circuit schematic. In the text, the right-channel signal is re-

ferred to as capacitor one (C1), contrary to the schematic which refers C1 to the left-channel input. The same error occurs when it is mentioned in that last paragraph that the right input is calibrated by resistor number three, which is opposite to what appears in the schematic.

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