A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

Low-voltage solid-state regulated power supply

The design for a simple low-voltage regulated power supply has been submitted by Mr J. Goding, 15 Yarrabee Court, Mount Waverly, Vic. 3149.

In the amateur journals and in electronic textbooks, there are many circuits for transistor-regulated power supplies. Most of these, however, are unsuitable for the delivery of output voltages below about six volts. Those circuits capable of giving low output voltages are almost always rather complex—often requiring a separate negative supply—or do not give very good regulation.

While there is nothing original in the circuit presented, it employs a couple of ideas that may not be widely known. The circuit is simple, uses readily available parts, and is capable of quite good performance. The output voltage drops less than 30mV for a full 500mA load. Hum and noise are well below 20mV. The supply is protected against overload or accidental short circuit of the output. The output voltage may be varied between about 2 and 4 volts, making the supply very suitable for Fairchild microcircuits which require 3.6V±10pc.

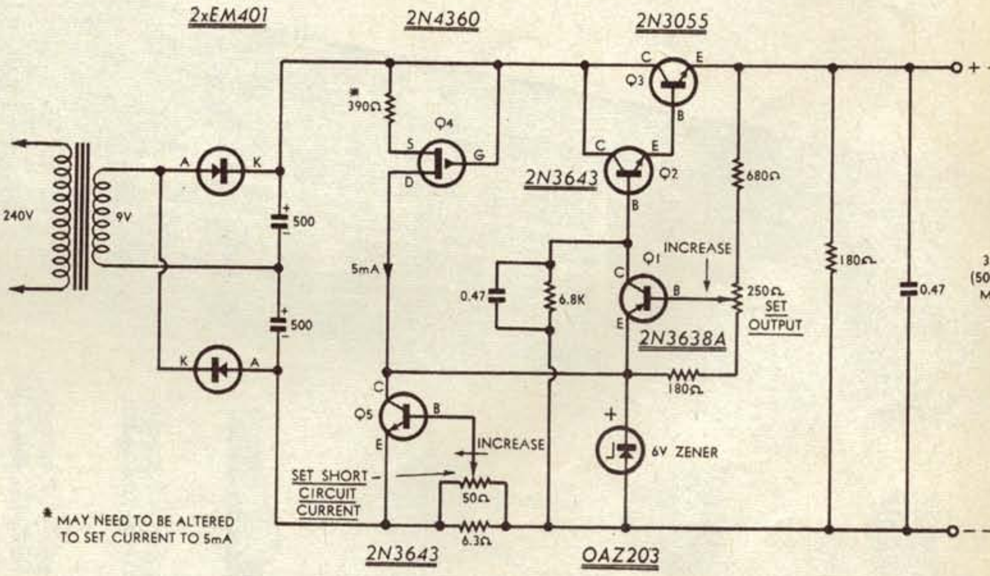
As in all regulated supplies, the output voltage is sampled, and compared with a reference voltage (the voltage of the 6V zener diode.) Any difference, or "error," between the two is amplified by transistor Q1 and presented to the series regulating transistors Q2 and Q3—in a Darlington configuration—in such a way that the "error" is corrected.

In conventional supplies, NPN transistors are often used throughout with the zener voltage less than the output voltage. Since zener diodes are not very satisfactory below about 6V (they are also hard to get), another approach is needed. In order to use a 6V zener diode, a PNP transistor is used for Q1 and NPN transistors for Q2 and Q3. The collector of Q1 is at about 3.8V and its emitter at 6V. Hence the collector is 2.2V negative with respect to its emitter. The base of Q1 is set at about 0.6V negative with respect to the emitter. Thus Q1 amplifies in a perfectly normal way.

The base current for Q2 is derived from the collector of Q1. With no load on the output of the supply, the entire collector current of Q1 passes through the 6.8K resistor. As current is drawn from the supply, more collector current passes into the base of Q2—this is in addition to the constant current through the 6.8K resistor. This system is capable of good regulation because the comparator amplifier Q1 is supplied with its operating voltage from a regulated source.

Another unusual idea incorporated into the supply is the use of a field effect transistor Q4 in series with the zener diode. Q4 acts as a "constant-current diode" and supplies a constant current of about 5mA to the zener diode regardless of supply voltage variations. Since the zener voltage of a particular diode depends primarily on the current through it, the zener voltage is held more constant than is usually possible with a resistive feed from an unregulated source.

Because of production spreads in the 2N4360 FET, it may be necessary to alter the source resistor somewhat in order to set the current through the zener diode at about 5mA. The current



This low-voltage supply uses both NPN and PNP transistors to allow the use of a 6V zener diode for the reference voltage.

must not be too large, or Q4 may overheat.

The protection circuit employs only one transistor, one resistor and one potentiometer. In view of its simplicity and usefulness, it should not be omited. As the current drawn from the supply increases, the voltage developed across the 6.3-ohm resistor increases. The base-emitter voltage of transistor Q5 also increases. When the base-emitter voltage of Q5 reaches about 0.6V, the transistor starts to conduct and progressively shunts the zener diode. This reduces the reference voltage and hence the output voltage.

As the output current increases above the threshold of protection—set by the 50-ohm potentiometer—the output voltage falls, eventually reaching zero. If the control is set to give a threshold of 500mA, the short circuit current is less than 600mA.

Editorial note: It should be possible to use a normal bi-polar transistor instead of the field effect transistor as a constant-current device. The production spread will be less, and the design more economical.

A Simple Noughts and Crosses Machine

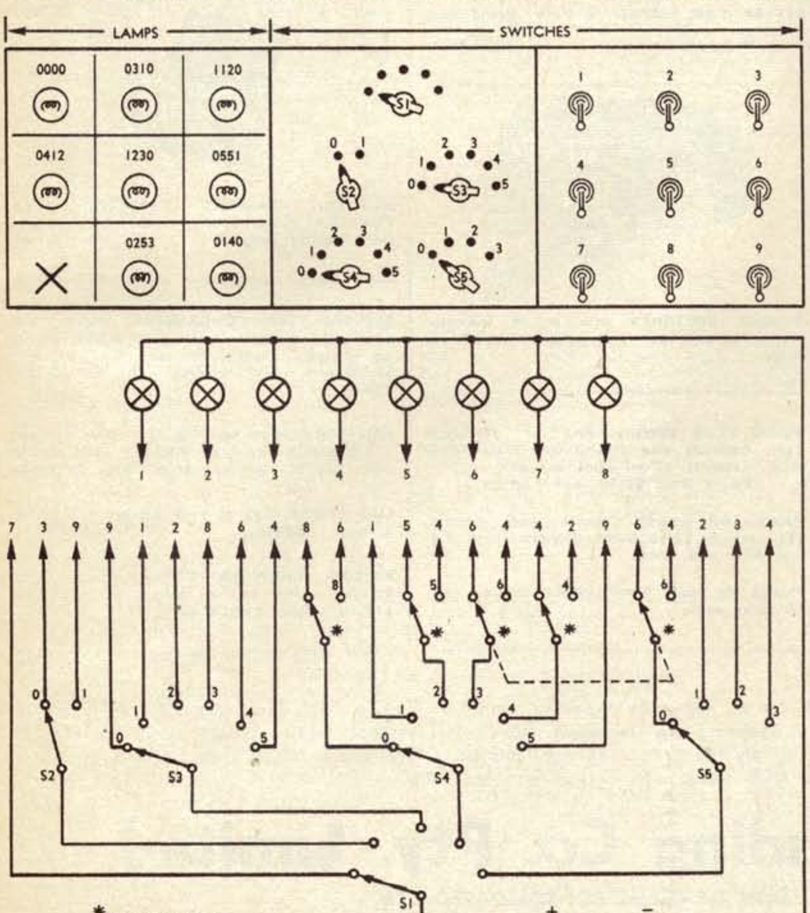
A circuit submitted by Mr Martyn Sayers, 18 Young Street, Mount Kuring-Gai, N.S.W. 2080, is an attempt to design an unbeatable noughts and crosses machine.

Mr Sayers claims that the machine cannot be beaten, but will always win or draw against logical play. The chief disadvantage is that the machine must always go first, taking the bottom left-hand square. The game is played on a piece of paper with the pattern drawn in the usual way and with an X (for the machine) in the bottom left-hand corner. After each move by the opposing player, the machine indicates the move to be recorded on its behalf by a lamp lighting in the appropriate square.

With the machine already occupying square 7 in the bottom left corner, the player makes his first move by writing a nought (0) in the square he selects. He then sets switches S2 to S5 according to the combination adjacent to the lamp on the panel in the chosen square. For example, if the player wanted to place his 0 in the top right-hand corner (square 3), he would set S2 to 1, S3 to 1, S4 to 2, and S5 to 0, although the position of S5 is of no account in this example. The player then rotates switch S1 one position, the lamp in square 7 (indicating the machine's initial move) goes out, and another lamp will light to indicate the machine's next move. This is written (X) on the written diagram on the paper.

The player makes his next and succeeding moves writing a nought in the appropriate square and operating the equivalent toggle on the panel of toggle switches. Switches are fitted in positions 4, 5, 6 and 8 with dummy switches in the other positions. After making his second move by depressing the toggle switch corresponding to the selected square, the player rotates switch S1 another position to discover the machine's next move. This procedure is repeated using the toggle switches on this panel until the game is completed. While some of the toggles are dummies, the guest player need not know this.

Editor's Note: Although the machine always wins or draws against logical play, it is unable to cope with illogical moves by the player. The "program" assumes that in every case the player will make the obvious move to prevent a row of Xs. If the player does not make this move by oversight or by deliberate tactics, the machine is not capable of sensing the possible alternative "win" pattern. Following the choice of certain initial blocking moves by the player, the machine will always play for a draw oblivious of any winning opportunities which may occur. If a player makes one specific initial move followed by one of two illogical moves ignoring a threat of a row of Xs, the machine will allow the player to complete a row of 0s because it cannot foresee such an action by the player! As soon as the way to beat the machine is discovered, its amusement value will decrease rapidly. More sophisticated designs which really are infallible have been developed and may typically be seen at fetes, etc. Perhaps one of our readers may be able to work out a more proficient machine without getting into circuitry which is too forbidding.



TOP: A possible panel arrangement for the noughts and crosses machine. BOTTOM: The circuit of this simple device.

FURTHER NOTES ON BROADCAST-BAND FRAME AERIAL

Mr J. H. Wheller, 29 Budwood Terace, Auchenflower, Qld. 4066, submitted an idea for a frame-type broadcast-band aerial which was published in these columns in the February, 1969 issue.

Since then, Mr Wheller has been deluged with letters seeking further information. He is unable to cope with all this mail and has therefore asked that the following be published to answer most of the queries he has received.

The aerial is on a 4ft x 4ft square frame made of 1in x 1½in pine screwed together and with one diagonal bracing strut. The frame is mounted on a 10ft pole so that it can be firmly fastened in the desired position. The feed to the receiver should preferably be of TV twin lead-in wire, or otherwise of a lightly twisted pair of wires.

Unsolder the earthy-end of the receiver input coil from earth or chassis, and attach a wire long enough to reach outside the case. Join one wire of the feeder to this lead; the other wire is then taken to the aerial terminal of the receiver. To ascertain the value of tuning capacitor required, use a variable capacitor initially to find the optimum value, and then substitute fixed capacitors to give the same capacitance.

For the foil use clean shiny foil from cigarette cartons. Cut this into 1in strips and wind round the horizontal members of the frame in spiral form, numbering the strips. The odds go shiny side up and the evens shiny side down, all with an overlap. Join top and bottom at the centres, and tape with PVC sticky tape. The aerial consists of three turns of 16 gauge insulated wire or one turn of tri-core (the cores being soldered so as to be in series).

If the aerial is not in a straight line with two stations, the system will discriminate between the two signals. The null is only two degrees wide.

Mr Wheller comments: I am at present working on a tuneable filter to insert in the mains lead to stop unwanted RF signals entering the receiver via this lead. I am also working on a larger aerial to increase the signal strength of wanted stations."

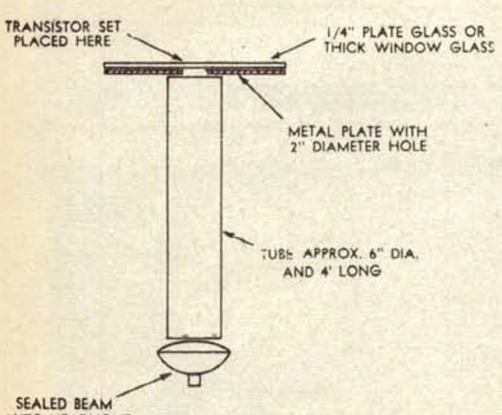
AID FOR SERVICING PRINTED BOARDS

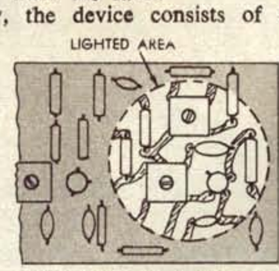
A simple device to help in servicing transistor radios has been submitted by Mr A. D. Fuller, 406 Pennant Hills Road, Pennant Hills, N.S.W., 2120.

Some readers, including servicemen, may have the job of finding a fault in a transistor radio without a copy of the circuit or the printed wiring layout. There are so many different models that even servicemen seem to have diagrams in only a few cases. It can be an exasperating job trying to trace out the circuit of a section suspected to be faulty. I have found it is almost impossible to relate the printed wiring to the parts on the other side of the board without assistance from the device I have produced.

The idea behind the device is to send a near parallel beam of light up to a glass plate to give sharp shadows of components, etc. placed on it. The transistor radio is placed on the glass plate, first with the printed wiring side down, and then with the parts side down. A sketch is made in each case of the area of interest. It is then a fairly simple matter to draw out the circuit and trace the fault.

Basically, the device consists of a suitable tube about 4ft long by 6in diameter with a sealed beam car headlight at one end. The tube is mounted vertically with the lamp at the bottom, and the top end covered with a metal plate with a 2in diameter hole in it and a glass plate over the hole. If a diffused light is required for any reason, opal or ground glass can be used.





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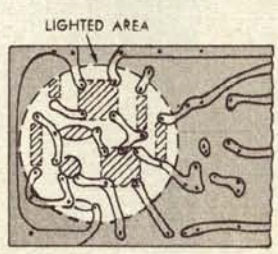

VIEWED FROM PRINTED WIRING SIDE