TECHNICAL NOTE

INTEGRATED CIRCUIT POWER SUPPLIES¹

Power supplies are a central part of any conditioning apparatus. With the advent of solid-state logic as a means of providing the control functions necessary in conditioning studies, the properties of the power supply have become a matter of some concern. Electro-mechanical logic equipment is very tolerant of the power supply output signal, while solid-state equipment is very sensitive to relatively small changes in power supply output. Four properties are important in a good power supply for solid-state equipment. These are: (a) line regulation, the ability of the power supply to maintain a constant output voltage despite changes in the voltage of the AC input, (b) load regulation, the ability of the power supply to maintain a constant output voltage as the current requirements of the load change, (c) ripple voltage, the amount of sinusoidal voltage variation in the output voltage due to the fact that the input voltage is alternating current, and (d)

output voltage stability, the ability of the power supply to maintain a constant output voltage that does not change as a function of time (due to temperature or other changes in the power supply).

Essentially all commercially available power supplies that are suitable for solid-state logic equipment are very expensive. Fortunately, there are now available a number of integrated circuit devices that allow the experimenter to construct easily a power supply that meets or exceeds the specifications of commercially available units and is roughly 20% of the cost of the commercial units. Figure 1 illustrates the circuit diagram of an integrated circuit power supply that can be constructed with such a device. The integrated circuit

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Fig. 1. List of components for + and - 12-V, 2-A power supply:

SW ₁	SPST switch	T ₁	2N5193 transistor
F ₁	2-A fuse	T ₂	2N5190 transistor
XF ₁	Triad 24-V, 2-A, center-tapped transformer, #F41X	R ₃ , R ₄	0.2-Ω, 2-W, 10% resistors
B ₁	Varo 2-A bridge rectifier, #VS247	C ₅ , C ₆	0.01-μF capacitors
C ₁ , C ₂	500-μF, 25-V electrolytic capacitors	IC ₁	SG3501 integrated circuit voltage regulator
C ₃ , C ₄	100-μF, 25-V electrolytic capacitors	R ₅	50-kΩ, 2-W potentiometer
R ₁ , R ₂	100-Ω, 1-W, 10% resistors	C ₇ , C ₈	10-μF, 15-V electrolytic capacitors

is a dual voltage tracking regulator.² It contains, among other parts, 24 transistors on a single chip. The two external transistors are added to increase the current carrying capacity of the integrated circuit. Other external components serve to assist in the regulation and filtering of the output voltage.

The outputs of the power supply may be shorted to ground without damage since the integrated circuit device has internal current limiting. Should the integrated circuit fail in normal use, the output transistor(s) will burn open and protect the load from overvoltages. There are, however, some unusual circumstances in which a failure could short the collector to the emitter of the output transistor(s) and apply the input voltage to the load. It is important to realize that the semiconductor devices are highly reliable, that nearly all failures will burn the output transistor *open* and protect the load, and that most commercial power supplies have similar rare dangers for the load.

The output voltages of the power supply are balanced to within 1% of one another. The line and load voltage regulation is an unusual 0.01%, and the maximum variation in output voltage due to temperature fluctuations is 1%. The unit has a very low standby current drain, and thus can be left on for extended periods of time, even if not being used. The unit will operate in a temperature range of 0° to 70°C.

²Complete specifications on the device and circuits for suggested applications may be obtained from the manufacturer. The device is an SG3501 obtainable from Silicon General, 7382 Bolsa Avenue, Westminster, CA 92683.

The circuit diagram shown in Figure 1 is for a 2-A, + and - 12-V power supply. This particular voltage is that commonly used in solid-state logic devices sold by psychological suppliers. The output levels of the power supply can be modified by replacing only the transformer (XF_1) and the diode bridge (B_1). It is unnecessary to replace the output transistors (T_1 and T_2) since their ratings are sufficient for all possible modifications. By substituting a transformer and a diode bridge capable of carrying 4 A and using heat sinks for the output transistors, one can increase the output current capacity up to a maximum of 4 A. By substituting a transformer with a different voltage output, one can vary the voltage output of the power supply anywhere in the range of 8 to 24 V. Potentiometer R_5 provides for adjustment of the output voltage.

The unit can be constructed simply and quickly, as there are relatively few parts. In the authors' model, all components were contained on and within a 0.05 by 0.13 by 0.13 m chassis box. The two power transistors were mounted directly to the chassis, with appropriate mica insulators and silicon grease, and the chassis served as heat sink. All other components were mounted on a small piece of perforated board. The unit was constructed from new parts at a cost of \$32.

The authors' two units are used to replace commercially available power supplies to power solid-state scheduling equipment. They have seen nearly continuous use for a year, and show no noticeable change in operating characteristics.

G. C. JERNSTEDT and
W. F. WHITE
Dartmouth College