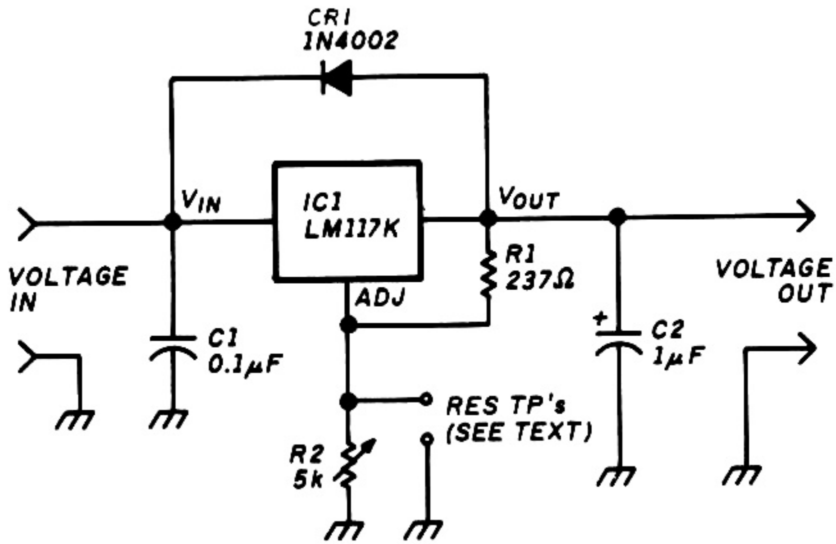
A simple battery-powered switching regulator provides 5 V out from a 9-V source with 80% efficiency and 50-mA output capability. When Q1 is on, its collector voltage rises, forcing current through the inductor. The output voltage rises, causing A1's output to rise. Q1 cuts off and the output decays through the load. The 100-pF capacitor ensures clean switching. The cycle repeats when the output drops low enough for A1 to turn on Q1. The 1-μF capacitor ensures low battery impedance at high frequencies, preventing *sag* during switching.

VARIABLE VOLTAGE REGULATOR

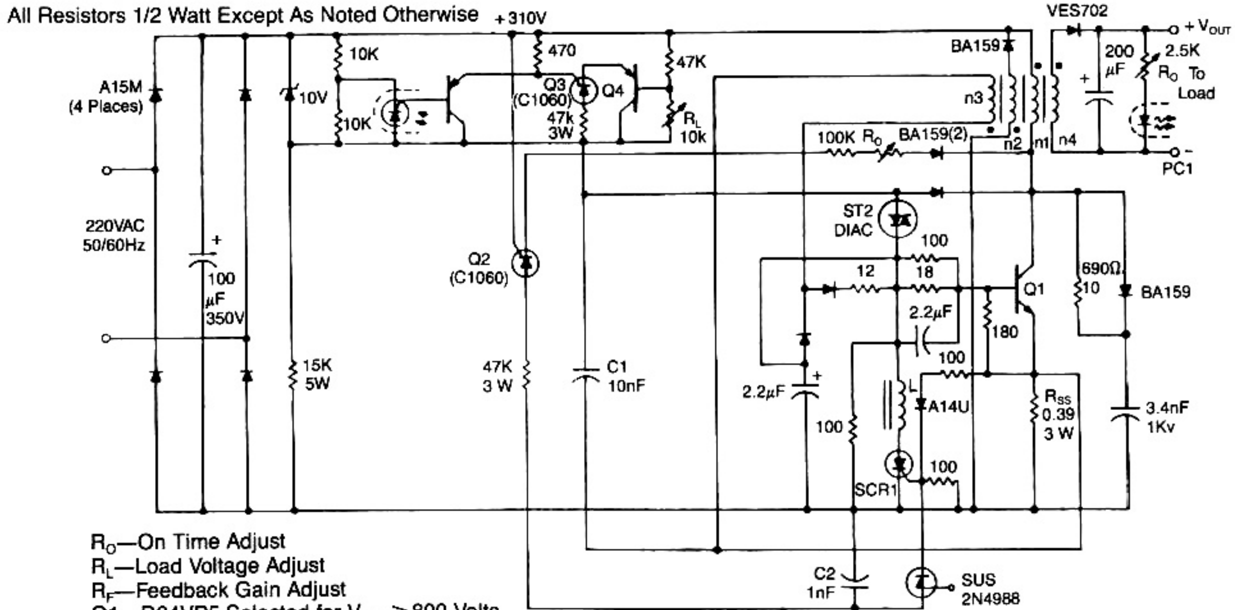


HAM RADIO

Fig. 2-9

The variable voltage regulator lets you adjust the output voltage of a fixed dc power supply between 1.2 and 37 Vdc, and will supply the output current in excess of 1.5 A. The circuit incorporates an LM117K three-terminal adjustable output positive voltage regulator in a TO-3 can. Thermal overload protection and short-circuit current-limiting constant with temperature are included in the package. Capacitor C1 reduces sensitivity to input line impedance, and C2 reduces excessive ringing. Diode CR1 prevents C2 from discharging through the IC during an output short.

SWITCHING POWER SUPPLY



RO—On Time Adjust
RL—Load Voltage Adjust
RF—Feedback Gain Adjust
Q1—D64VP5 Selected for $V_{CEV} \geq$ 800 Volts
L—25μH
SCR1 BRY55S
All Unmarked Diodes—A1148
Q4,Q5—2N6001
V_{OUT}—2 Volts ~ VDC
I_L—0 – 10 Amperes

GE

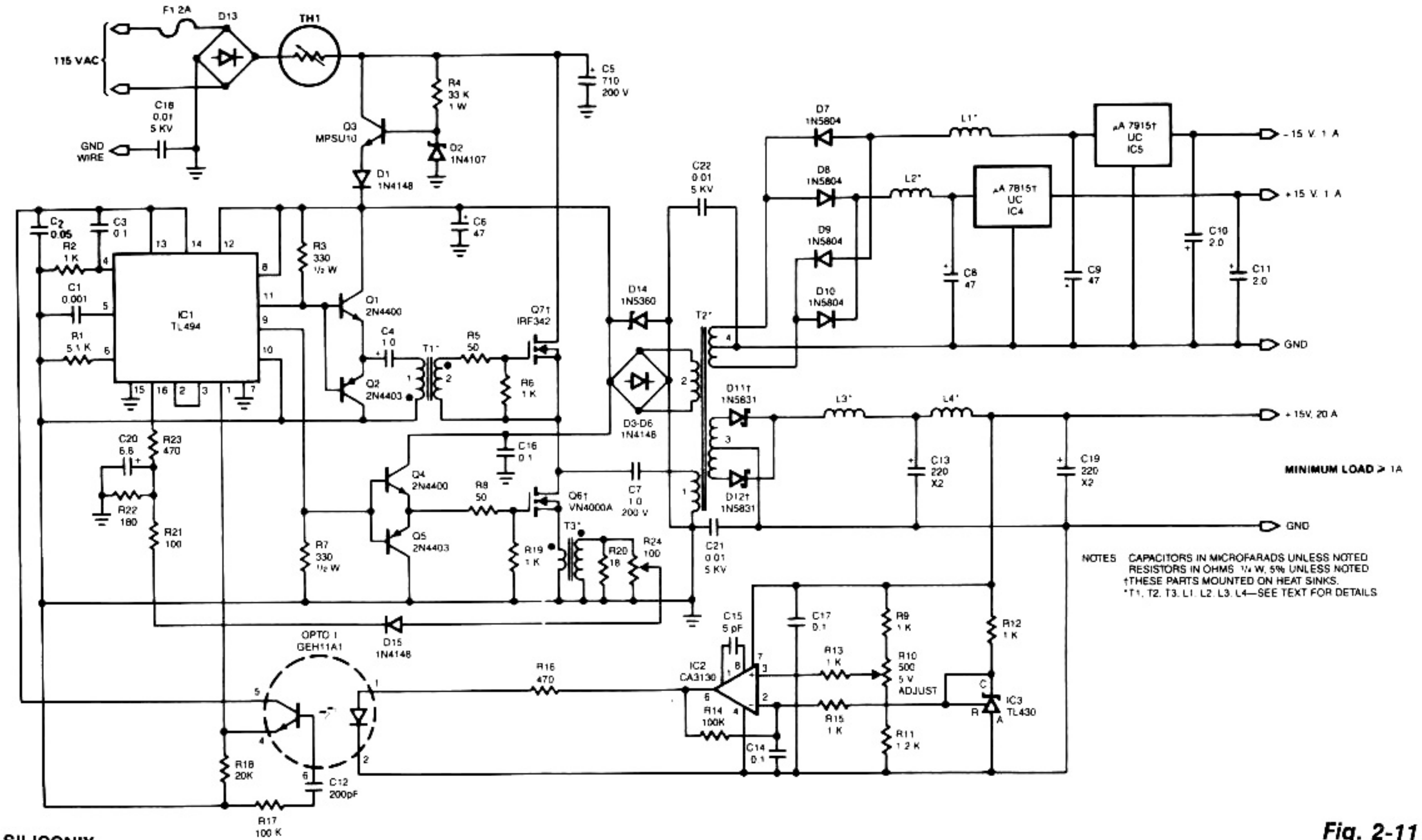
Output Transformer

Bifilar	Core—850GER 42 × 21 × 15 (LCC)	
Wound	n1—95 Turns ϕ = 0.6 mm	
Nearest	n2—96 Turns ϕ = 0.6 mm	
Core	n3—3 Turns of 4 Strands μ = 1 mm Parallel	
	n4—3 Turns μ = 0.4 mm	

Fig. 2-10

This low-voltage high-current output, switching dc power supply is running off the 220-Vac input. In this circuit, an ST2 diac relaxation oscillator, Q3, C1, and the diac, initiates conduction of the output switching transistor Q1, the on-time of which is maintained constant by a separate timing/commutation network consisting of Q2, C2, SUS, and SCR 1. The output voltage, consequently, is dependent on the duty cycle. To compensate for unwanted variations of output voltage because of input voltage or load resistance fluctuations, an H11C wired as a linear-model unilateral pnp transistor in a stable differential amplifier configuration is connected into the galvanically isolated negative-feedback loop. The loop determines the duty cycle and hence the output voltage. Of further interest in this circuit is the use of several low-current, high-voltage, 400-V V_{DRM} thyristors (Q2, Q3), which are also used as pnp remote-base transistors. Short-circuit protection is assured by coupling Q1 collector-current feedback into the turn-off circuitry via R_{SS}.

100-kHz MULTIPLE-OUTPUT SWITCHING POWER SUPPLY

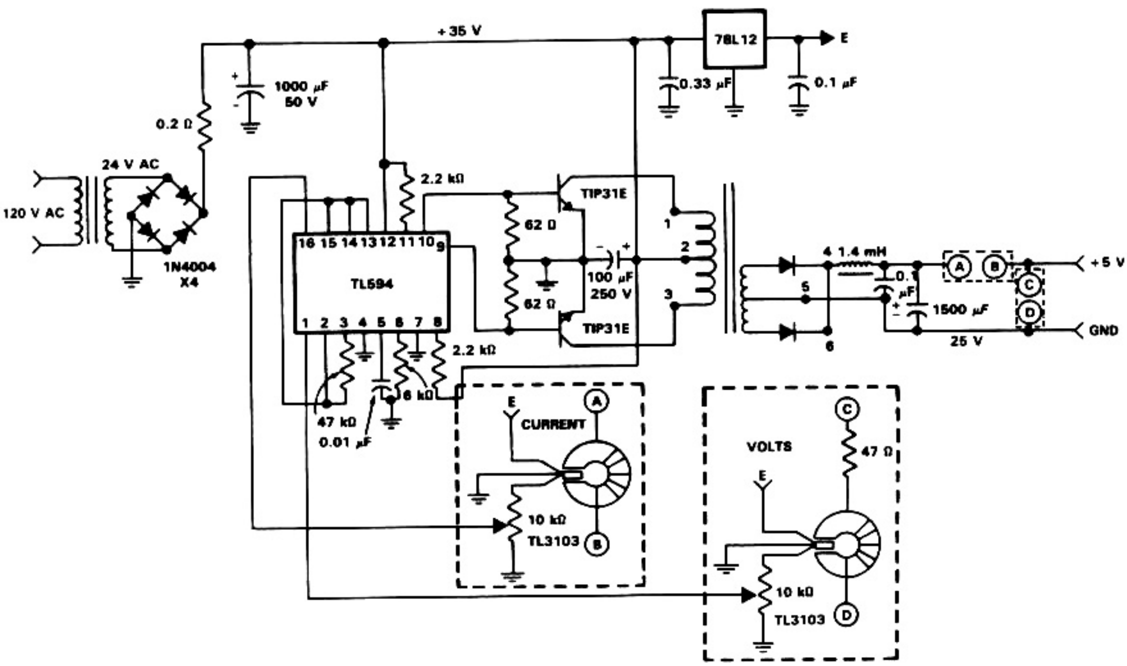


SILICONIX

Fig. 2-11

The power supply uses two VN4000A 400-V MOSPOWER FETs in a half-bridge power switch configuration. Outputs available are +5 V at 20 A and ±15 V (or ±12 V) at 1 A. Since linear three-terminal regulators are used for the low-current outputs, either ±12 V or ±15 V can be made available with a simple change in the transformer secondary windings. A TL494 switching regulator IC provides pulse-width modulation control and drive signals for the power supply. The upper MOSPOWER FET, Q7, in the power switch stage is driven by a simple transformer drive circuit. The lower MOS, Q6, since it is ground referenced, is directly driven from the control IC.

ISOLATED FEEDBACK POWER SUPPLY

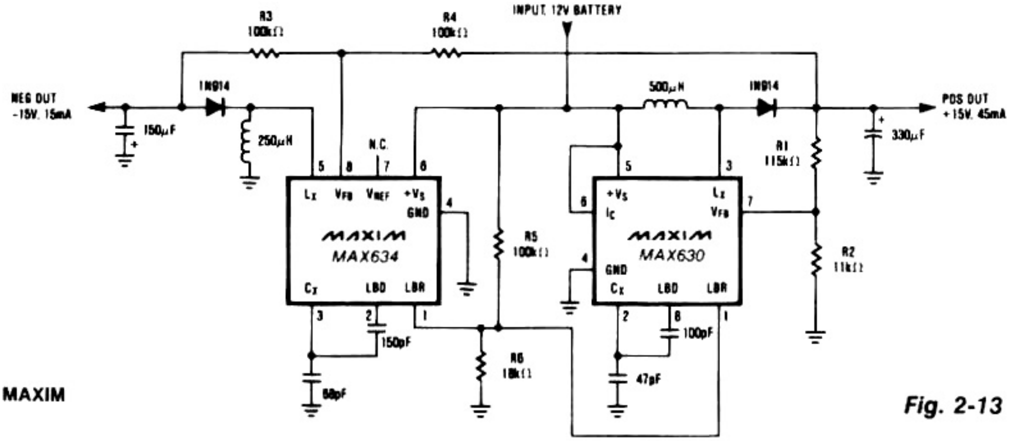


TEXAS INSTRUMENTS

Fig. 2-12

Figure 2-12 is a power supply circuit using the isolated feedback capabilities of the TL3103 for both current and voltage sensing. This supply is powered from the ac power line and has an output of 5 V at 1.5 A. Both output voltage and current are sensed and the error voltages are applied to the error amplifiers of the TL594 PWM control IC. The 24-V transformer produces about 35 V at the 1000-μF filter capacitor. The 20-kHz switching frequency is set by the 6-kΩ resistor and the 0.01-μF capacitor on pins 6 and 5, respectively. The TL594 is set for push-pull operation by tying pin 13 high. The 5-V reference on pin 14 is tied to pin 15, which is the reference or the current error amplifier. The 5-V reference is also tied to pin 2 which is the reference for the output voltage error amplifier. The output voltage and current limit are set by adjustment of the 10-kΩ pots in the TL3103 error-sensing circuits. A pair of TIP31E npn transistors are used as switching transistors in a push-pull circuit.

DUAL-TRACKING REGULATOR

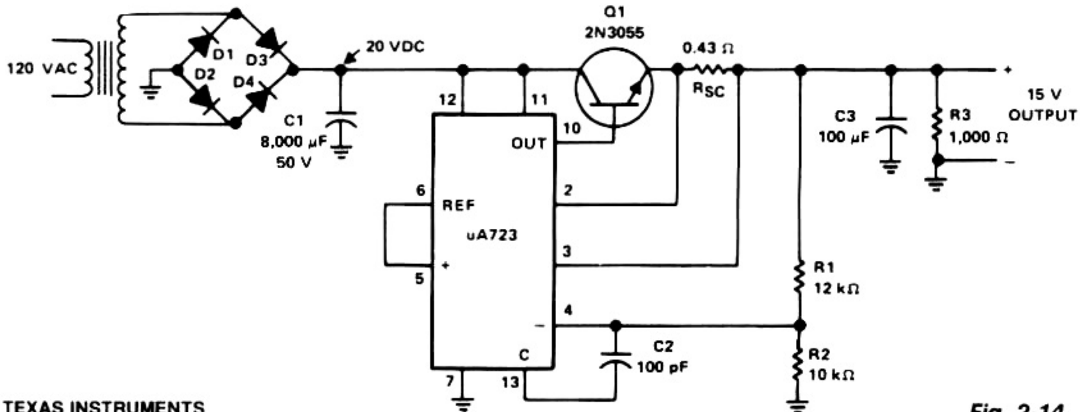


MAXIM

Fig. 2-13

A MAX634 inverting regulator is combined with a MAX630 to provide a dual tracking ± 15-V output from a 12-V battery. The reference for the −15-V output is derived from the positive output via R3 and R4. Both regulators are set to maximize output power at low battery voltages by reducing the oscillator frequency, via LBR, when V_{BATT} falls to 8.5 V.

+15-V 1-A REGULATED POWER SUPPLY



TEXAS INSTRUMENTS

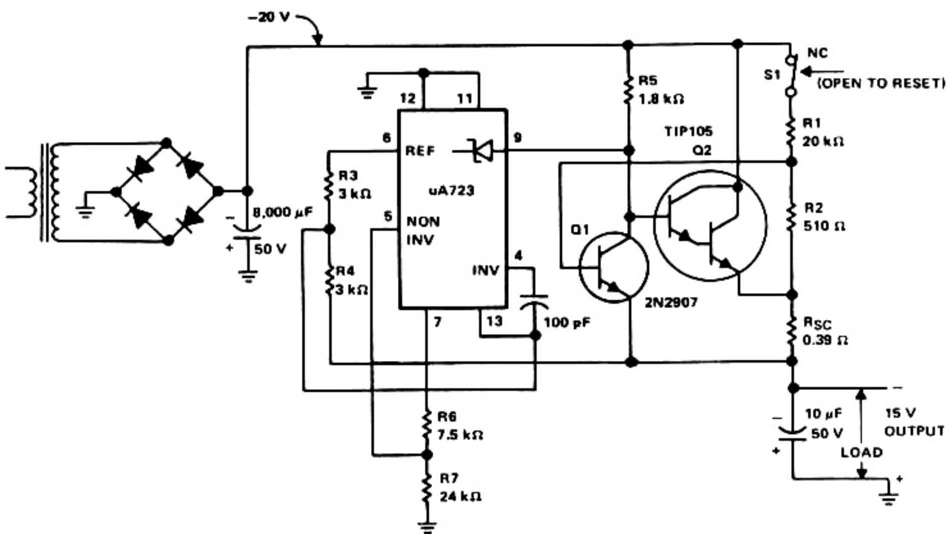
Fig. 2-14

The supply receives +20 Vdc from the rectifier/filter section. This is applied to pins 11 and 12 of the uA723, as well as to the collector of the 2N3055 series-pass transistor. The output voltage is sampled through R1 and R2, providing about 7 V with respect to ground at pin 4. The reference terminal at pin 6 is tied directly to pin 5, the noninverting input of the error amplifier. For fine trimming the output voltage, a potentiometer can be installed between R1 and R2. A 100-pF capacitor from pin 13 to pin 4 furnishes gain compensation for the amplifier.

Base drive to the 2N3055 pass transistor is furnished by pin 10 of the uA723. Since the desired output of the supply is 1 A, maximum current limit is set to 1.5 A by resistor R_{SC} whose value is 0.433 Ω.

A 100-μF electrolytic capacitor is used for ripple voltage reduction at the output. A 1-kΩ output resistor provides stability for the power supply under no-load conditions. The 2N3055 pass transistor must be mounted on an adequate heatsink.

−15-V 1-A REGULATED POWER SUPPLY

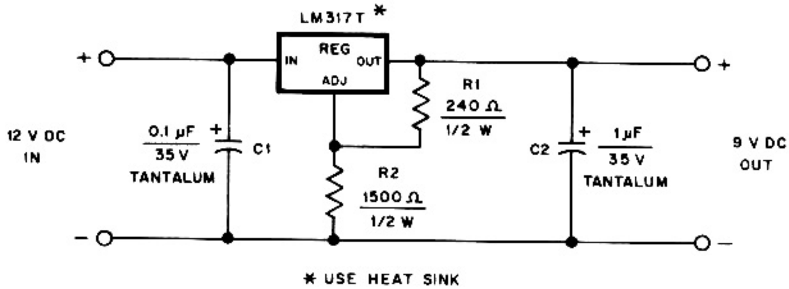


TEXAS INSTRUMENTS

Fig. 2-15

The supply receives −20 V from the rectifier/filter which is fed to the collector of the Darlington pnp pass transistor, a TIP105. The base drive to the TIP105 is supplied through resistor R5. The base of the TIP105 is driven from V_Z terminal at pin 9, which is the anode of a 6.2-V zener diode that connects to the emitter of the uA723 output control transistor. The method of providing the positive feedback required for foldback action is shown. This technique introduces positive feedback by increased current flow through resistors R1 and R2 under short-circuit conditions. This forward biases the base-emitter junction of the 2N2907 sensing transistor, which reduces base drive to the TIP105.

HAND-HELD TRANSCEIVER dc ADAPTER

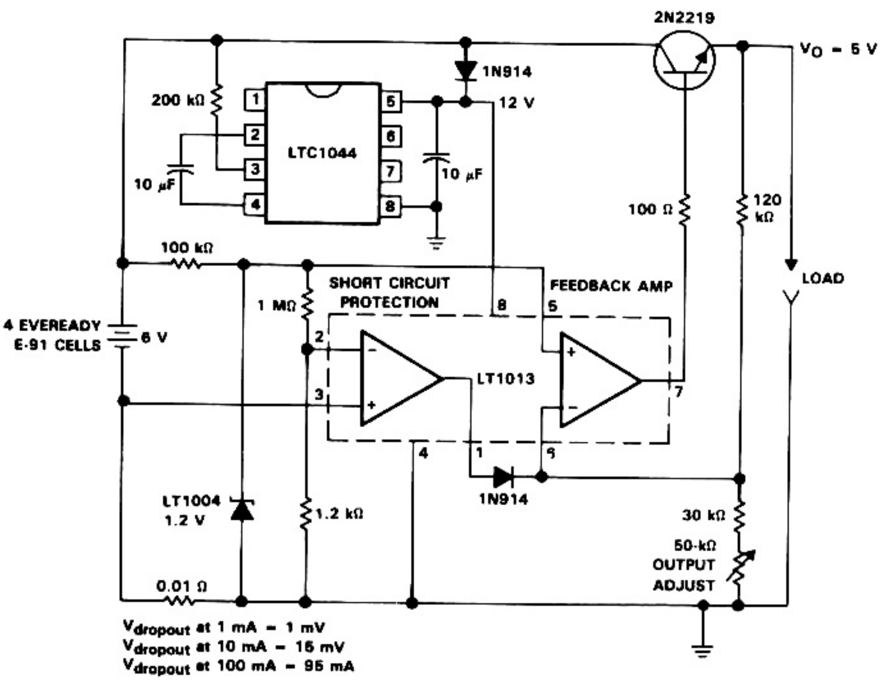


QST

Fig. 2-16

This dc adapter provides a regulated 9-V source for operating a Kenwood TR-2500 hand-held transceiver in the car. The LM317T's mounting tab is electrically connected to its output pin, so take this into account as you construct your version of the adapter. The LM317T regulator dissipates 2 or 3 W in this application, so mount it on a 1- × -2-inch piece of 1/8-inch-thick aluminum heatsink.

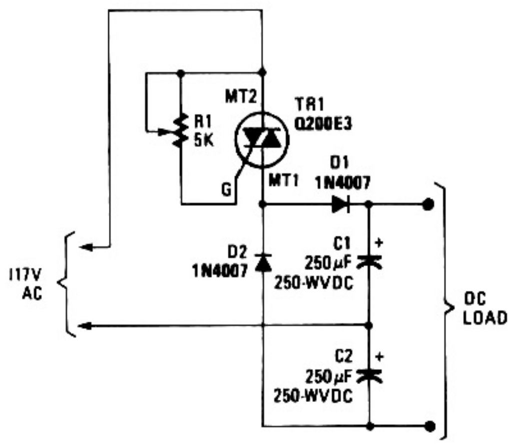
LOW-DROPOUT 5-V REGULATOR



TEXAS INSTRUMENTS

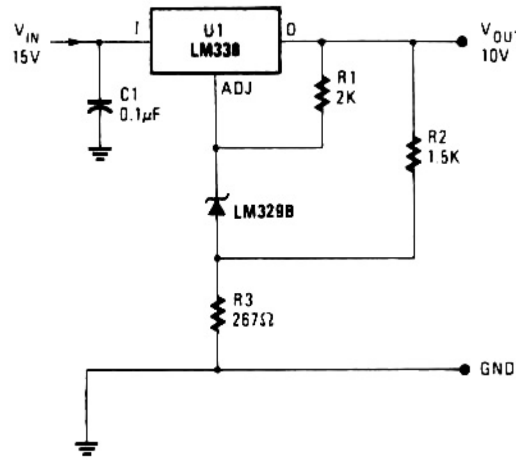
Fig. 2-17

TRIAC-CONTROLLED VOLTAGE DOUBLER



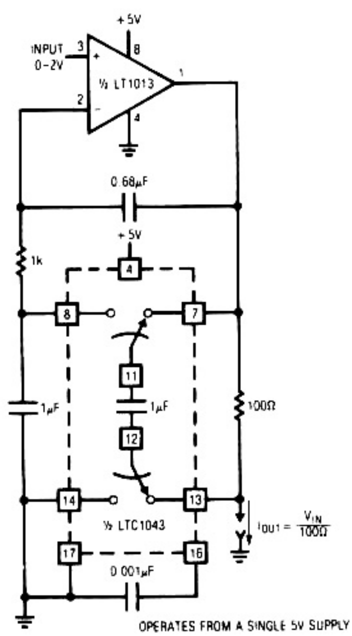
HANDS-ON ELECTRONICS *Fig. 2-18*

HIGH-STABILITY 10-V REGULATOR



POPULAR ELECTRONICS *Fig. 2-19*

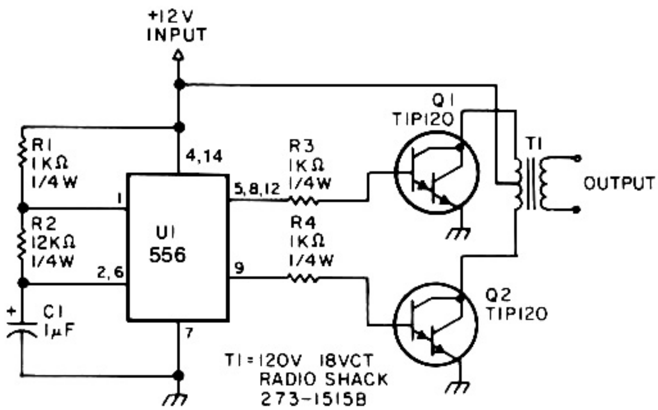
VOLTAGE-CONTROLLED CURRENT SOURCE



This is a simple, precise voltage-controlled current source. Bipolar supplies will permit bipolar output. Configurations featuring a grounded voltage-control source and a grounded load are usually more complex and depend upon several components for stability. In this circuit, accuracy and stability almost entirely depend upon the 100-Ω shunt.

LINEAR TECHNOLOGY CORP. *Fig. 7-20*

LOW-POWER INVERTER

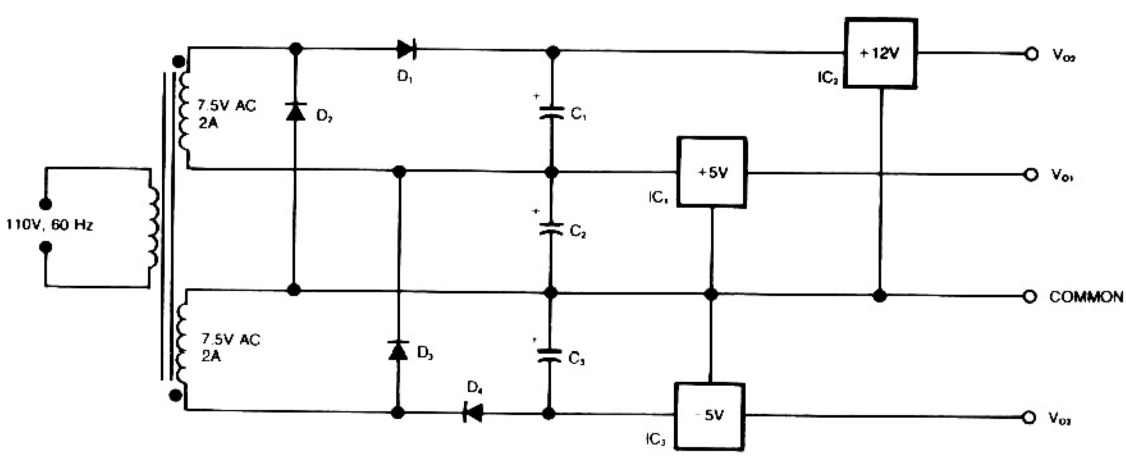


73 AMATEUR RADIO

Fig. 2-21

This low-power inverter uses only 9 parts and turns 10 to 16 Vdc into 60-Hz, 115-V square-wave power to operate ac equipment up to 25 W. The first section of the 556 timer chip is wired as an astable oscillator with R2 and C1 setting the frequency. The output is available at pin 5. The second section is wired as a phase inverter. That output is available at pin 9. Resistors R3 and R4 keep output transistors Q1 and Q2 from loading down the oscillator. The two transistors drive the transformer push-pull fashion. When one transistor is biased-on, the other is cut-off. The transformer is a 120 V/18 VCT unit that is connected backwards, so that it steps the voltage up rather than down. Oscillator circuit U1, R1, R2, and C1 operates from about 4 to 16 V with a very stable output.

THREE-RAIL POWER SUPPLY

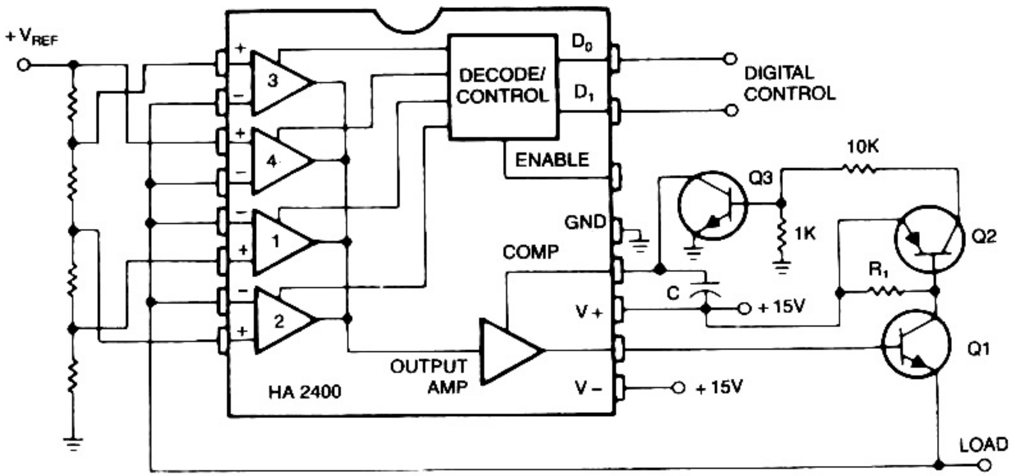


EDN

Fig. 2-22

This circuit generates three supply voltages using a minimum of components. Diodes D2 and D3 perform full-wave rectification, alternately charging capacitor C2 on both halves of the ac cycle. On the other hand, diode D1 with capacitor C1, and diode D4 with capacitor C3 each perform half-wave rectification. The full- and half-wave rectification arrangement is satisfactory for modest supply currents drawn from −5 and +12-V regulators IC3 and IC2. You can use this circuit as an auxiliary supply in an up-based instrument, for example, and avoid the less attractive alternatives of buying a custom-wound transformer, building a more complex supply, or using a secondary winding, say 18 Vac, and wasting power in the 5-V regulators.

PROGRAMMABLE POWER SUPPLY



HARRIS

Fig. 2-23

Many systems require one or more relatively low-current voltage sources which can be programmed to a few predetermined levels. The circuit shown above produces positive output levels, but could be modified for negative or bipolar outputs. Q1 is the series regulator transistor, selected for the required current and power capability. R1, Q2, and Q3 form an optional short circuit protection circuit, with R1 chosen to drop about 0.7 V at the maximum output current. The compensation capacitor, C, should be chosen to keep the overshoot, when switching, to an acceptable level.