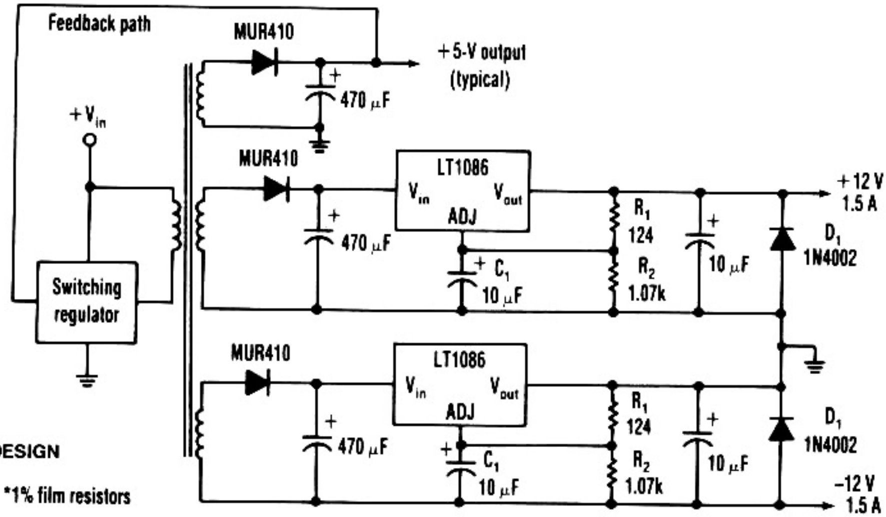
EFFICIENT NEGATIVE VOLTAGE REGULATOR



ELECTRONIC DESIGN

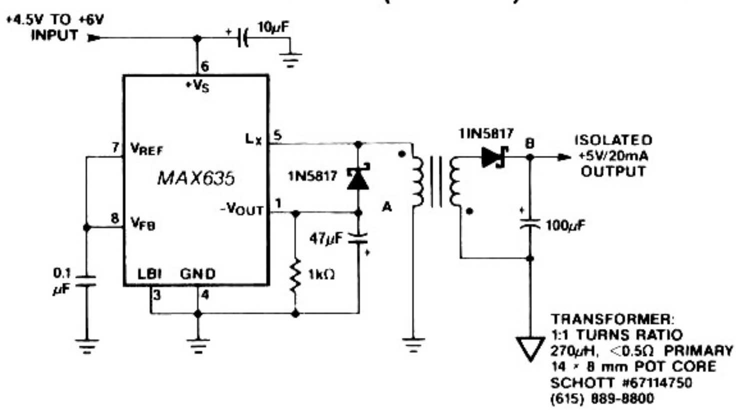
Fig. 2-24

One way to provide good negative-voltage regulation is with a low-dropout positive-voltage regulator operating from a well-isolated secondary winding of a switch-mode circuit transformer. The technique works with any positive-voltage regulator, although highest efficiency occurs with low-dropout types.

Under all loading conditions, the minimum voltage difference between the regulator V_{IN} and V_{OUT} pins must be at least 1.5 V, the LT1086's low-dropout voltage. If this requirement isn't met, the output falls out of regulation. Two programming resistors, R1 and R2, set the output voltage to 12 V, and the LT1086's servo the voltage between the output and its adjusting (ADJ) terminals to 1.25 V. Capacitor C1 improves ripple rejection, and protection diode D1 eliminates common-load problems.

Since a secondary winding is galvanically isolated, a regulator's 12 V output can be referenced to ground. Therefore, in the case of a negative-voltage output, the positive-voltage terminal of the regulator connects to ground, and the −12 V output comes off the anode of D1. The V_{IN} terminal floats at 1.5 V or more above ground.

5 V-TO-ISOLATED 5 V (AT 20 mA) CONVERTER



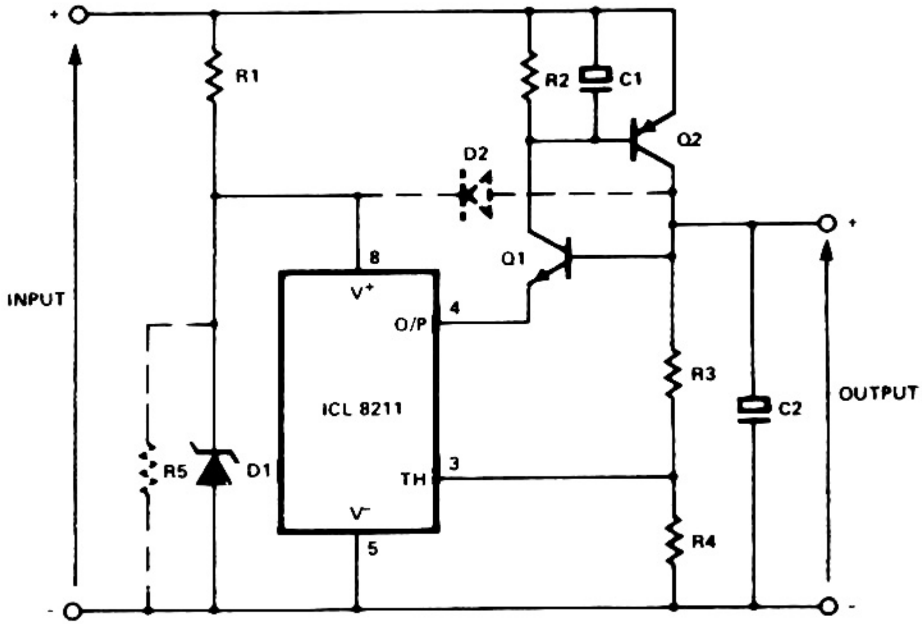
MAXIM

Fig. 2-25

5 V-TO-ISOLATED 5 V (AT 20 mA) CONVERTER (cont.)

In this circuit, a negative output voltage dc-dc converter generates a −5-V output at pin A. In order to generate −5 V at point A, the primary of the transformer must fly back to a diode drop more negative than −5 V. If the transformer has a tightly coupled 1:1 turns ratio, there will be a 5 V plus a diode drop across the secondary. The 1N5817 rectifies this secondary voltage to generate an isolated 5-V output. The isolated output is not fully regulated since only the −5 V at point A is sensed by the MAX635.

POSITIVE REGULATOR WITH npn AND pnp BOOST

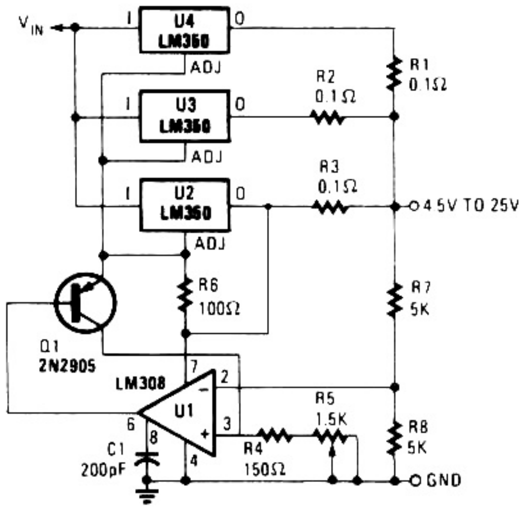


INTERSIL

Fig. 2-26

In the circuit, Q1 and Q2 are connected in the classic SCR or thyristor configuration. Where higher input voltages or minimum component count are required, the circuit for thyristor boost can be used. The thyristor is running in a linear mode with its cathode as the control terminal and its gate as the output terminal. This is known as the remote base configuration.

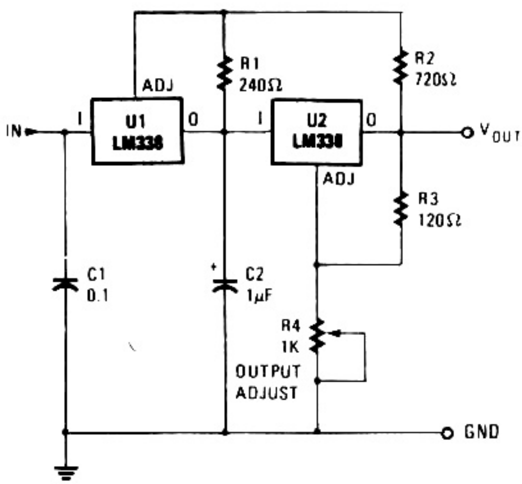
TRACKING PREREGULATOR



POPULAR ELECTRONICS

Fig. 2-27

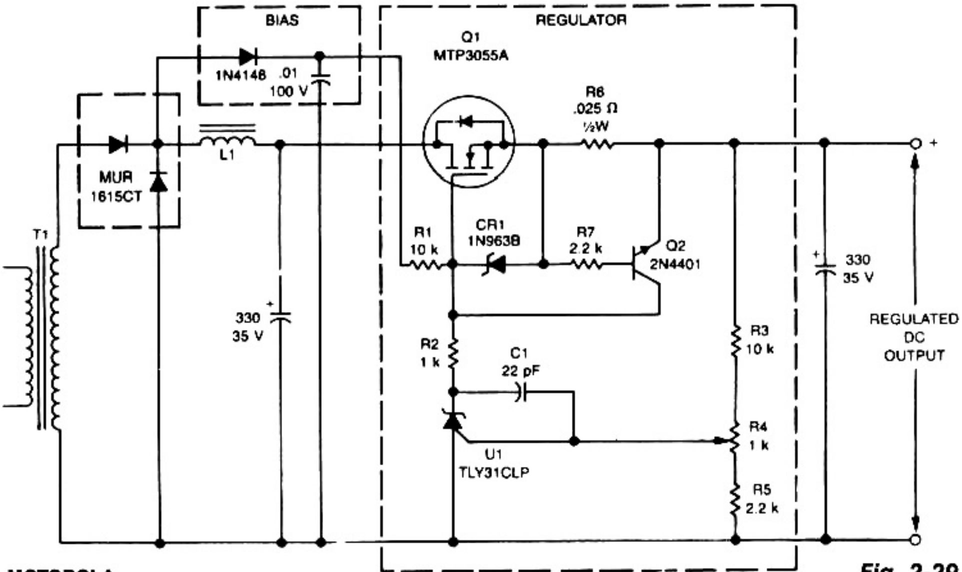
ADJUSTABLE 10-A REGULATOR



POPULAR ELECTRONICS

Fig. 2-28

LOW-COST LOW-DROPOUT LINEAR REGULATOR



MOTOROLA

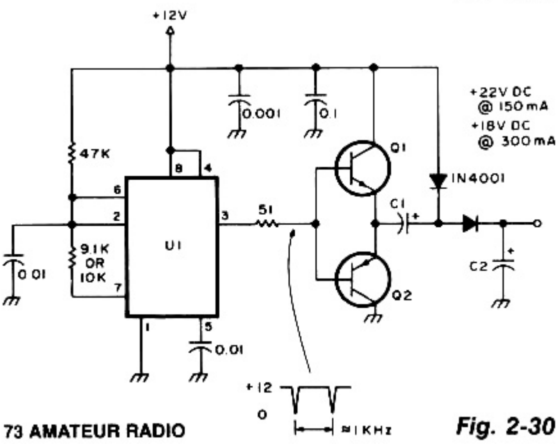
Fig. 2-29

This linear post regulator provides 12 V at 3 A. It employs TL431 reference U1 which, without additional amplification, drives TMOS MTP3055A gate Q1 series pass regulator. Bias voltage is applied through R1 to Q1's gate, which is protected against overvoltage by diode CR1. Frequency compensation for closed-loop stability is provided by C1.

Key performance features are:

Dropout voltage:	0.6 V	Load regulation:	10 mV
Line regulation:	± 5 mV	Output ripple:	10 mV pk-pk

VOLTAGE DOUBLER



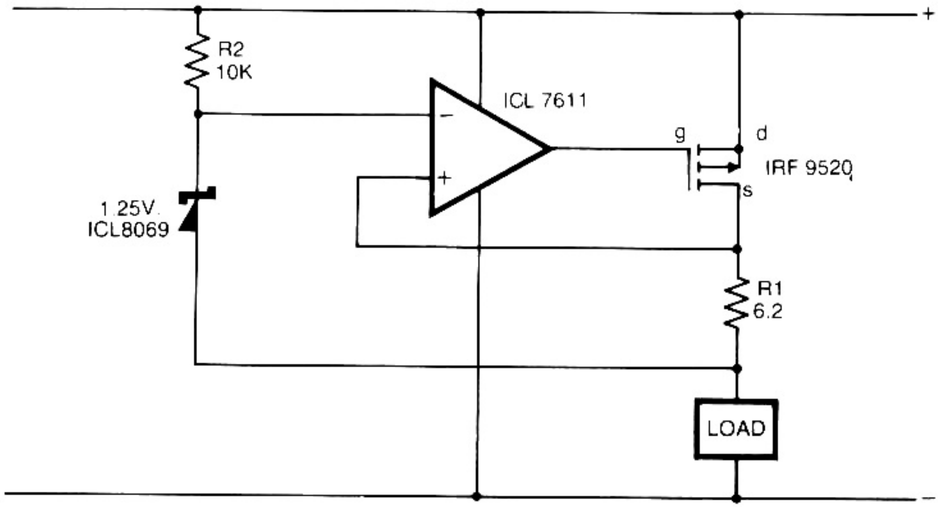
73 AMATEUR RADIO

Fig. 2-30

This circuit drives relays of 24 and 18 Vdc from a 12-V power supply. Use this circuit with almost any pnp or npn power transistor.

Parts: U1: NE 555 timer. C1 and C2: 50 μF/25 Vdc. Q1: TIP29, TIP120, 2N4922, TIP61, TIP110, or 2N4921. Q2: TIP30, TIP125, 2N4919, TIP62, TIP115, or 2N4918.

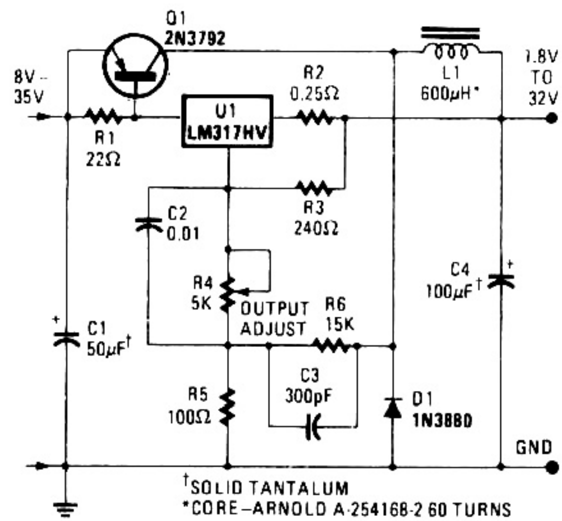
SAFE CONSTANT-CURRENT SOURCE



ELECTRONIC ENGINEERING **Fig. 2-31**

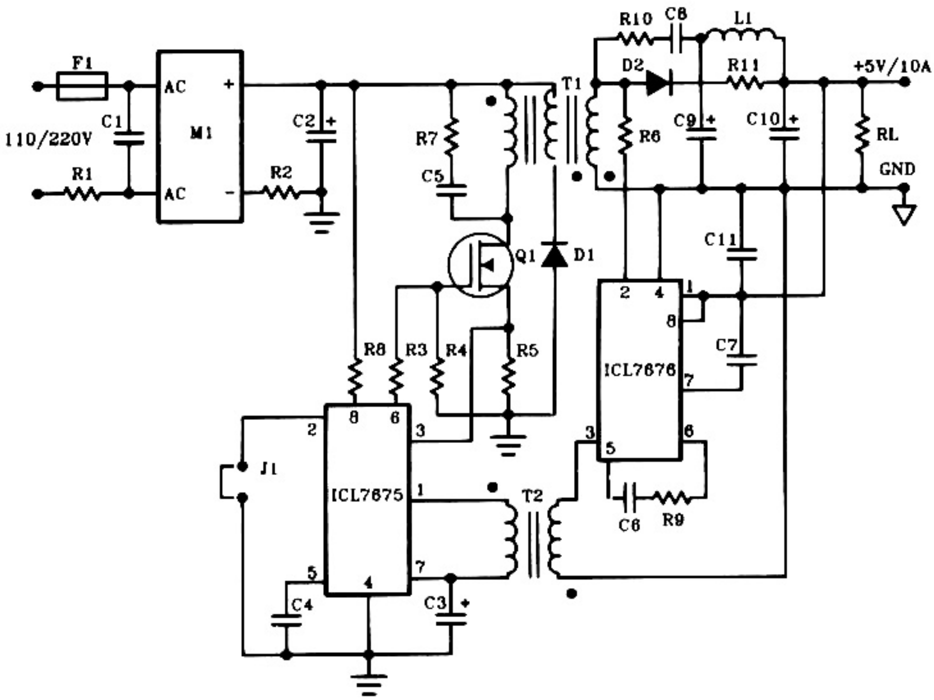
In the circuit shown, a CMOS op amp controls the current through a p-channel HEXFET power transistor to maintain a constant voltage across R1. The current is given by: $I = V_{REF}/R_1$. The advantages of this configuration are: (a) in the event of a component failure, the load current is limited by R1; and (b) the overhead voltage needed by the op amp and the HEXFET is extremely low.

LOW-COST 3-A SWITCHING REGULATOR



POPULAR ELECTRONICS **Fig. 2-32**

50-W OFF-LINE SWITCHING POWER SUPPLY



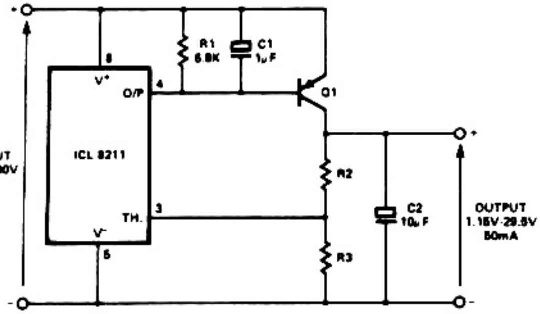
Component Values Table

C1	0.022 μF/400V	R1	100Ω at 25°C	L1	25 μH
C2	470 μF/250V	R2	1Ω/1W	D1	1N4937
C3	470 μF/16V	R3	10Ω/0.25W	D2	MBR1035
C4	220 pF/100V	R4	100 kΩ/0.25W	T1	Lp = 9 mH, n = 1:15
C5	470 pF/500V	R5	0.33Ω/1W	T2	50 μH, n = 1:3
C6	2200 pF/500V	R6	10 kΩ/0.25W	F1	Fuse 1 A/SB
C7	270 pF/500V	R7	390Ω/2W	M1	Diode Bridge
C8	39 pF/500V	R8	22 kΩ/10W	Q1	BUZ80A/IXTP4N80
C9	11,000 μF/6.3V	R9	68Ω/0.25W		(220VAC)
C10	10 μF/16V	R10	10Ω/0.5W	Q1	GE IRF823
C11	0.047 μF/10V	R11	3.3Ω/0.5W		(110VAC)
		RL	5Ω/10W		

INTERSIL *Fig. 2-33*

The schematic shows a 50-W power supply with a 5-V 10-A output. It is a flyback converter operating in the continuous mode. The circuit features a primary side and secondary side controller with full-protection from fault conditions such as overcurrent. After the fault condition has been removed, the power supply will enter the soft-start cycle before recommencing normal operation.

POSITIVE REGULATOR WITH pnp BOOST



INTERSIL

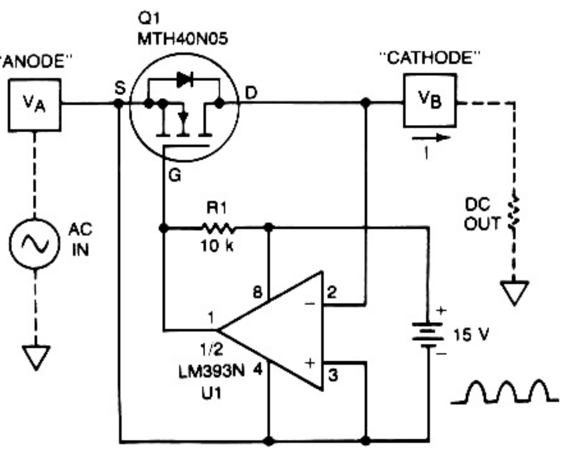
Fig. 2-34

The IC8211 provides the voltage reference and regulator amplifier, while Q1 is the series pass transistor. R1 defines the output current of the IC8211, while C1 and C2 provide loop stability and also act to suppress feedthrough of input transients to the output supply. R2 and R3 determine the output voltage as follows:

$$V_{OUT} = 1.5 \times \frac{R_2 + R_3}{R_3}$$

In addition, the values of R2 and R3 are chosen to provide a small amount of standing current in Q1, which gives additional stability margin to the circuit. Where accurate setting of the output voltage is required, either R2 or R3 can be made adjustable. If R2 is made adjustable, the output voltage will vary linearly with the shaft angle; however, if the potentiometer wiper was to open the circuit, the output voltage would rise. In general, therefore, it is better to make R3 adjustable, since this gives fail-safe operation.

LOW FORWARD-DROP RECTIFIER CIRCUIT



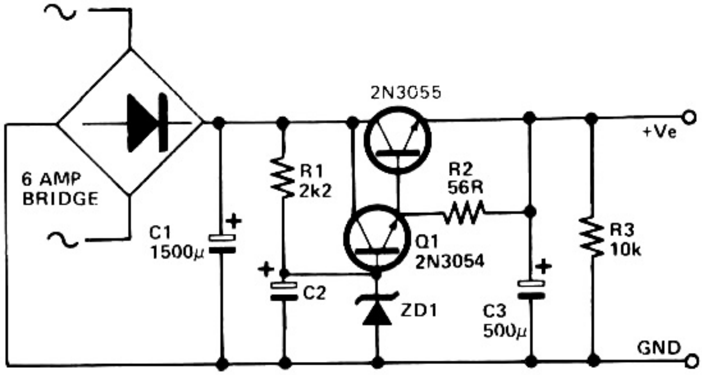
MOTOROLA

Fig. 2-35

A TMOS power FET, Q1, and an LM393 comparator provide a high-efficiency rectifier circuit. When V_A exceeds V_B, U1's output becomes high and Q1 conducts. Conversely, when V_B exceeds V_A, the comparator output becomes low and Q1 does not conduct.

The forward drop is determined by Q1's on resistance and current I. The MTH40N05 has an ON resistance of 0.028 Ω; for $I = 10$ A, the forward drop is less than 0.3 V. Typically, the best Schottky diodes do not even begin conducting below a few hundred mV.

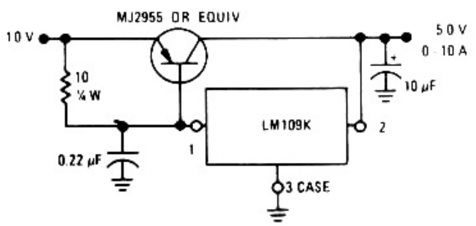
LOW-RIPPLE POWER SUPPLY



ELECTRONICS TODAY INTERNATIONAL **Fig. 2-36**

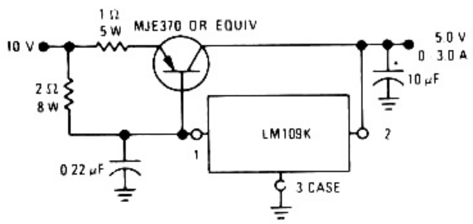
This circuit can be used where a high current is required with a low-ripple voltage (such as in a high-powered class AB amplifier when high-quality reproduction is necessary). Q1, Q2, and R2 can be regarded as a power-Darlington transistor. ZD1 and R1 provide a reference voltage at the base of Q1. ZD1 should be chosen thus: $ZD_1 = V_{out} - 1.2$. C2 can be chosen for the degree of smoothness as its value is effectively multiplied by the combined gains of Q1/Q2, if 100 μF is chosen for C2, assuming minimum hfe for Q1 and Q2, $C = 100 \times 15(Q1) \times 25(Q2) = 37{,}000$ μF.

5.0-V/10-A REGULATOR



MOTOROLA **Fig. 2-37**

5.0-V/3.0-A REGULATOR



MOTOROLA **Fig. 2-38**