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UNIVERSAL VOLTAGE REGULATOR

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Introduction

The power supply components to be described in this report were originally designed to power and protect Gunn diode oscillators having critical operating parameters. However, they should be suitable for a wide variety of applications due to the many electrical and mechanical options incorporated.

General Description

1. The voltage regulator card is 2.75 inches wide by 3.43 inches long, to be used with 15 pin edge connector, Cinch 50-30A-30. The associated panel and/or heatsink is designed to allow side by side placement of cards on one inch centers. The regulator circuit is designed around the Motorola integrated circuit voltage regulator MC 1469R, with the necessary flexibility of connections to satisfy most voltage regulator needs. It is especially useful when multiple output voltages are desired without the expense and space required for separate regulated supplies.

2. The overvoltage protection card is the same size and uses the same type connector as the regulator card. The heatsink and panel (Figure 15) is designed for side by side mounting with the regulator card using heatsink/panel, Figure 13. The handles used are H. H. Smith #1641.

The basic circuit is a crowbar with adjustable trip point. When the voltage across the load exceeds a predetermined level set by R2, Q1 triggers, driving the SCR Q2 into full conduction within 0.5 μsec. When Q2 is conducting the output is shorted, blowing fuse F1.

The trip point bias is derived from the unregulated supply to permit a wide range of adjustment of trip point.

Applications

1. Basic regulator for output voltage of 5 to 30 V and load current to 400 mA.

Use Thermalloy 6168B heatsink or Figure 13 heatsink and panel. Maximum heat dissipation with either is about 3.5 watts in still air.

See Figure 8 chart for components and jumpers required. Refer to Figures 6 and 9 for connections and locations.

F2, 0.5A

R1 + R2 ≃ (2 V out - 7) KΩ. R2 may be on remote panel.

R13, select for about 5 mA at desired V out.

R17 = 1.5 Ω 1/2 W.

2. Basic regulator for output voltage of 5 to 30 V and load current to 1.2 amp.

Use Figure 13 heatsink/panel for on-board control and up to 3.5 watts dissipation. For power dissipation up to 13 watts use Figure 14 heatsink and remote controls. If more than 13 watts dissipation is required the heatsink may be fan cooled or external power transistor and heatsink may be used, as in Basic Regulator No. 3.

See Figure 8 chart for components and jumpers required. Refer to Figure 6 and Figure 9 for connections and locations.

F1 - 2A

F2 - .5 A

R1 + R2 ≃ (2 V out - 7) KΩ

R13 - select for about 5 mA at desired V out.

R14 - 100 Ω

R17 - 0.5 Ω, 1 W.

3. Basic regulator for output voltage of 5 to 30 V and load current above 1.0 amp using external pass transistor.

Use Figure 13 heatsink/panel for on-board control or Figure 14 heatsink with remote control.

See Figure 8 chart for components and jumpers required. Refer to Figure 9 for connections and Figure 6 for locations.

F1, 2A

F2, .5 A

R1 + R2 (2 V out - 7) K

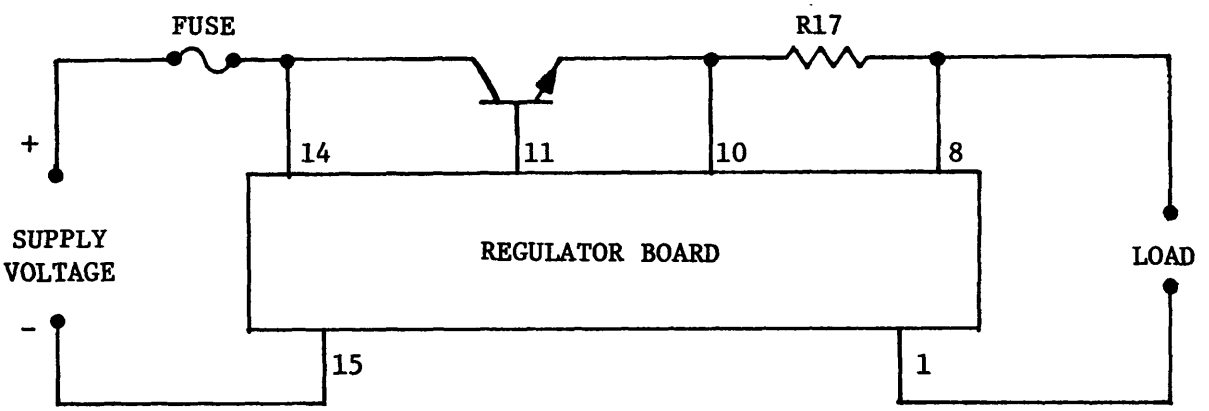
R13, select for about 5 mA at desired V out

R14, 100

R15, 100

R17 - use external current limiting resistor = 0.6/I and sufficient power rating unless using short circuit shutdown option. With this option a resistor of lower power rating may be used on the board since it does not have time to heat up before regulator shutdown.

Connect regulator board and external pass transistor as shown:



4. Basic regulator for output voltage of 30 to 70 V and load current to 1.0 amp.

Use Figure 8 chart for components and jumpers required. Refer to Figure 9 for connections and Figure 6 for locations.

F1, 2A

F2, .5A

Q3, substitute 2N 5192 (80 V rating)

D2, 1N 4001

VR2 select to provide approximately 30 V at pin 3 of MC 1469R

VR4 same as VR2

R1, 43K, R3, 6.8 K, omit R2

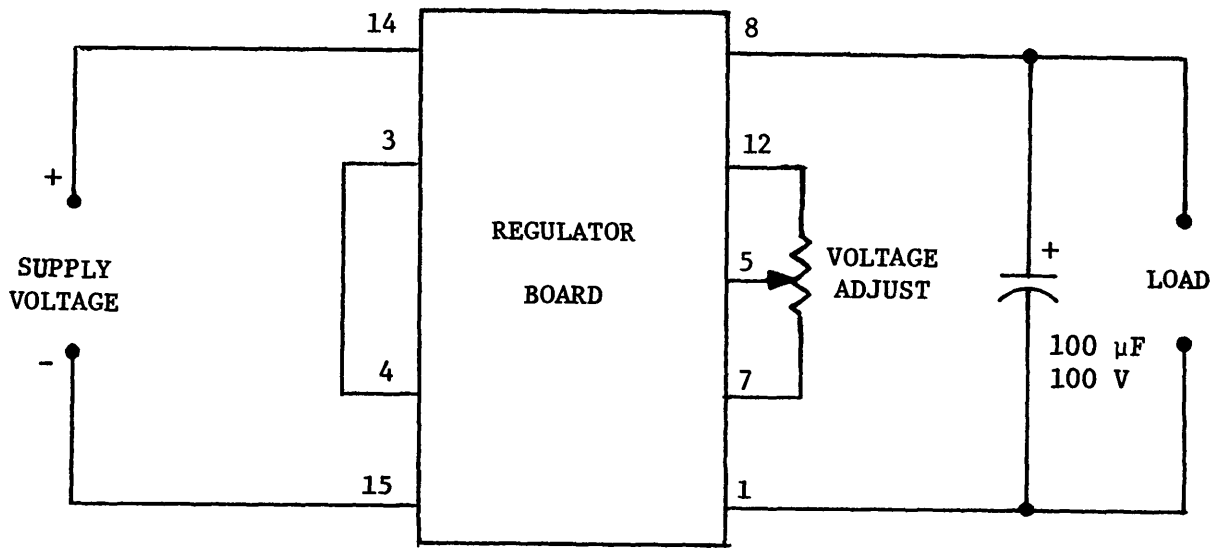
R10, 2K

Select R13, R18, and external pot to provide approximately 25 V at arm of pot with 1 mA thru divider.

R16, 4.7 K

R17, 0.5 ohm

Connect external components as shown:



Options

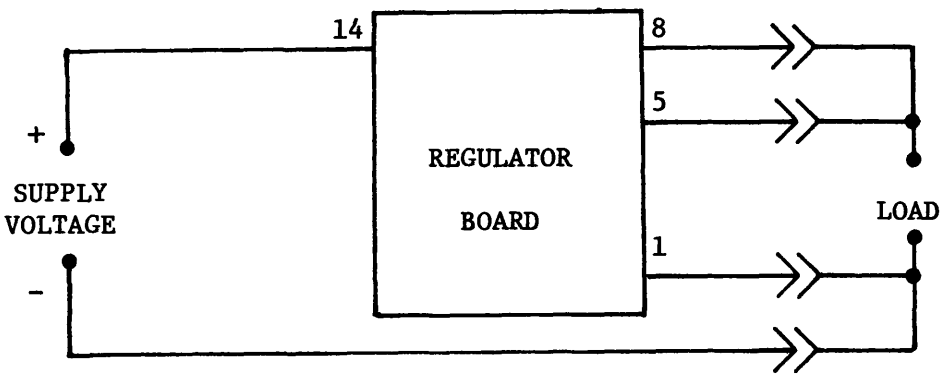
1. Remote voltage control, $V_L \leq 30$ V.

Omit potentiometer R2 and connect an equivalent remote potentiometer to terminals 3 and 4 of regulator board.

2. Remote sensing.

Omit J10 and J11 on regulator board and add J9.

Make external connections to regulator board as shows:



3. Remote metering.

If desired to monitor regulated voltage and load current over a long cable, the cable drop may be minimized by using very low current meters with series multiplier resistors. R18 may be used as the voltmeter multiplier.

The load current may be monitored by metering the voltage drop across R17 with meter current limited by R19.

4. Remote shutdown.

The regulator may be put in a standby condition with zero output by applying a positive voltage in excess of 1.2 V DC to terminal 6 on the regulator card. R9 should be selected to limit current to less than 10 mA. One mA is sufficient to shut down the regulator.

5. Thermal shutdown.

The voltage regulator 1C, and Q3 as well, may be protected from destruction due to excessively high junction temperatures by the addition of VR1, R4, R7, and R8, which are used to provide a fixed voltage of approximately 1 V at pin 2 of the regulator 1C. This will cause the regulator to shutdown when the temperature of the chip exceeds approximately 130°C, due to the negative temperature coefficient of the diode in series with pin 2 and the base-emitter junction of the shutdown transistor, both in the regulator 1C.

VR1 = 1N4733A, R4 = 100 (Vs-5), R7 = 2.0 K, R8 = 560 ohm.

6. Short circuit shutdown, manual reset.

This option will latch the regulator into shutdown condition when the voltage at junction of R12 and R13 drops more than 0.5 volt below the voltage at junction of R5 and R7. Regulator will remain shutdown until supply voltage to R4 is temporarily removed by means of S1 or remotely with a normally closed switch between Vs and terminal 2 of board. C1 delays initial voltage rise at anode of Q2, preventing shutdown at initial turn on.

S1 N-C PUSHBUTTON, Grayhill 30-2

R4 Vs - 5/.015

VR1 1N4733A

C1 100 μF, 6 V

C2 .005 μF

R5 2.0 K

R11 820 K

R12, R13 Select to provide 5 V at junction of R12 and R13 at normal output voltage

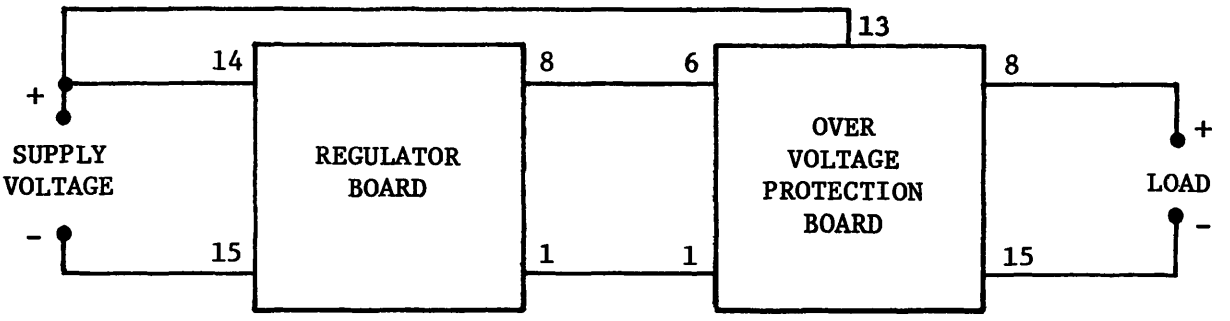
Q2 2N6027 programmable unijunction

7. Fault indication.

A fault condition indication may be obtained whenever the regulator output voltage drops below normal with proper supply voltage present by use of PL1, D1, and VR3. PL1 is a 5 V Eldema lamp, which may be on the regulator board when heat-sink/panel, Figure 13, is used, or connected to terminals 2 and 13 if remote indication is desired. D1 is a 1N4002 and serves to isolate the regulator outputs from each other when multiple regulators are connected to a common fault indicator. VR3 is a 1W zener diode; its zener voltage should be approximately Vs - (Vs - V_L) -3.

8. Overvoltage protection.

Overvoltage protection for the load may be provided by use of a separate over voltage protection board PC2-490-4, together with short circuit shutdown and fault indication options on the regulator board. With this arrangement, when an overvoltage condition occurs and the SCR on the overvoltage protection card fires, a short circuit appears at the output of the regulator card and the regulator is shut down before the fuse can blow. If the regulator transistor should short, the SCR will protect the load from overvoltage until the fuse blows. The regulator and overvoltage protection cards should be interconnected as follows:



8. Overvoltage protection (continued):

The following parts are required for the overvoltage protection board:

(1) PC board PC2-490-4

(1) Heatsink/panel, Figure 15

(1) Handle, H. H. Smith #1641

(1) Fuse holder, Littlefuse #281002

(1) Fuse, F1, Littlefuse Series 273.000

(3) Tip jacks, H. H. Smith #1501 or similar

(1) 5 K potentiometer, R2, Beckman 55LR5K with 55BW bushing mount

(1) Diode D1, 1N4002

(1) Zener diode VR1, $Vz \geq V_L$

(1) Resistor R1 = 60 (Vs - Vz)

(1) Resistor R3 = 5 K

(1) Resistor R4 = 1 megohm

(1) Resistor R5 = 100 ohm

(1) Capacitor, electrolytic, C1 = 10 μF at W.V. > Vs

(1) Capacitor, disc, C2 = .005 μF

(1) Programmable unijunction transistor Q1 = 2N6027

(1) Silicon controlled rectifier Q2 = 2N4443 (UPTO 8A)

Refer to Figure 6 for component layout and Figure 9 for circuit diagram.

When setting up the trip point, adjust R2 to set voltage at VTP to 0.6 V below desired maximum voltage at V_L.

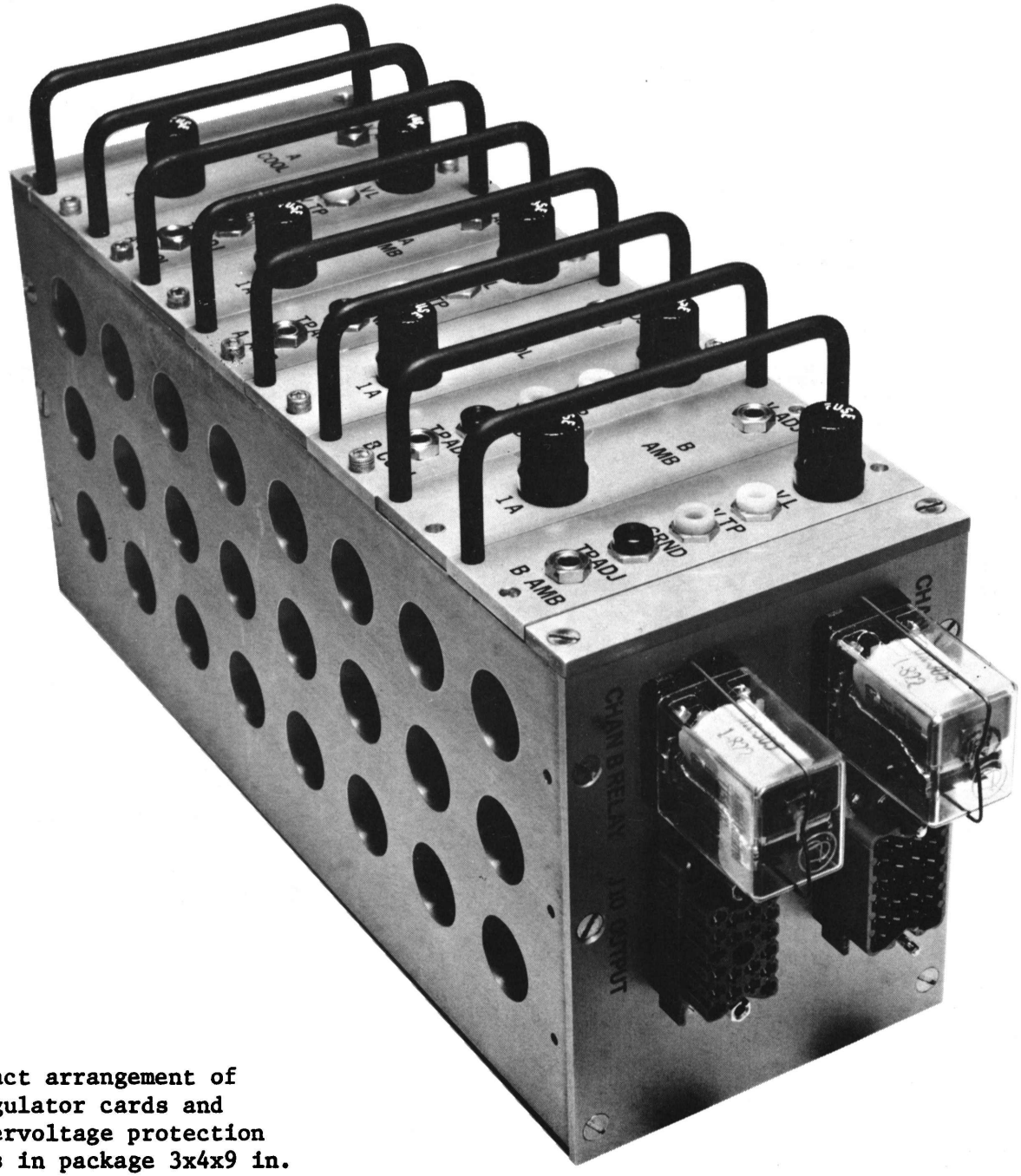


Figure 1 — Compact arrangement of 4 regulator cards and 4 overvoltage protection cards in package 3x4x9 in.

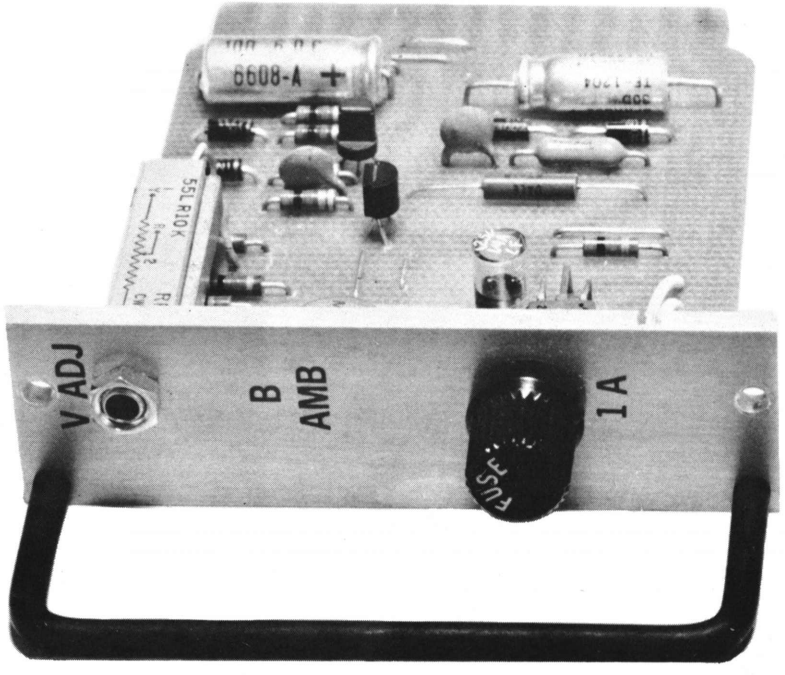


Figure 2 — Voltage regulator card with Fig. 13 panel and heatsink, and handle.

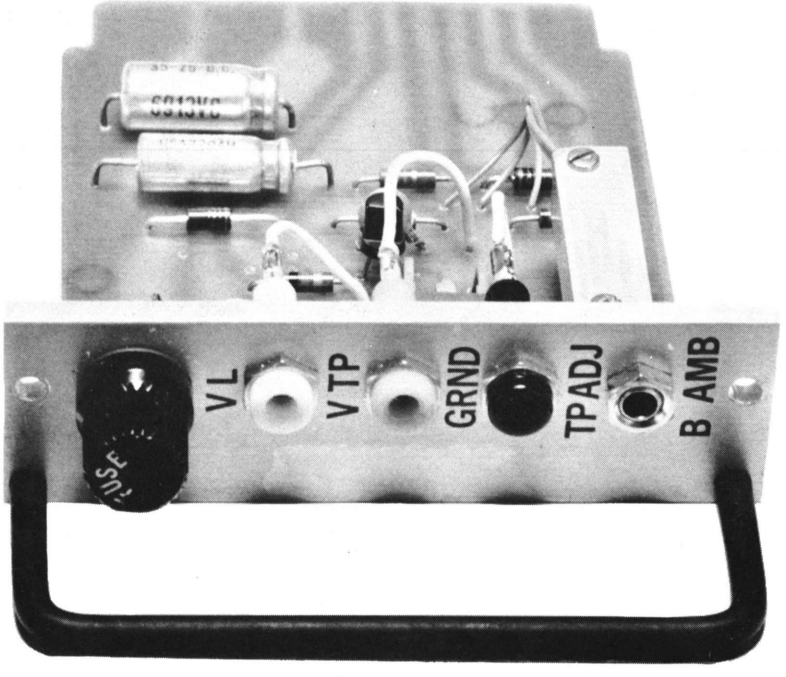


Figure 3 — Overvoltage protection card with Fig. 15 as panel/heatsink with handle.

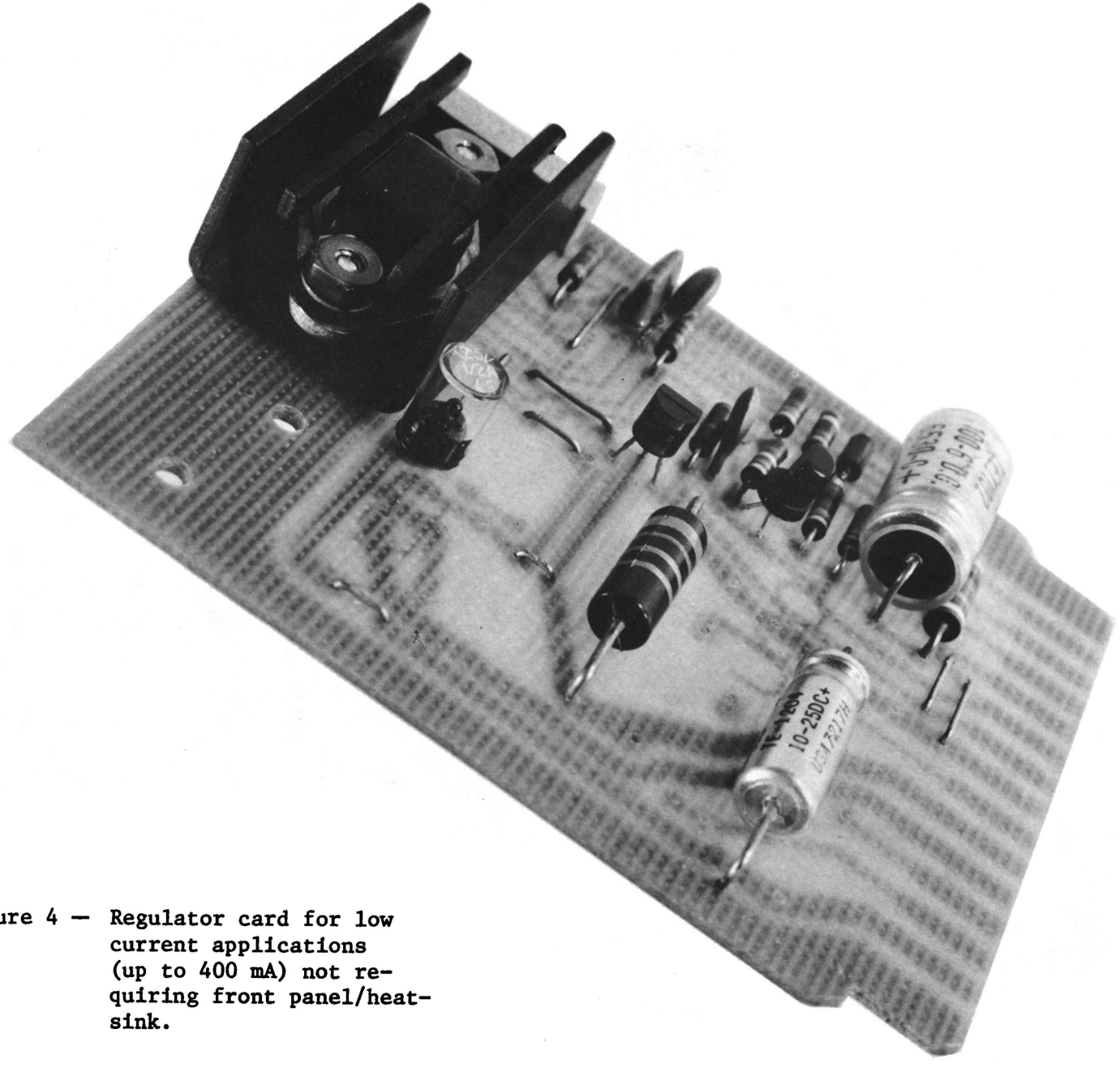


Figure 4 — Regulator card for low current applications (up to 400 mA) not requiring front panel/heat-sink.

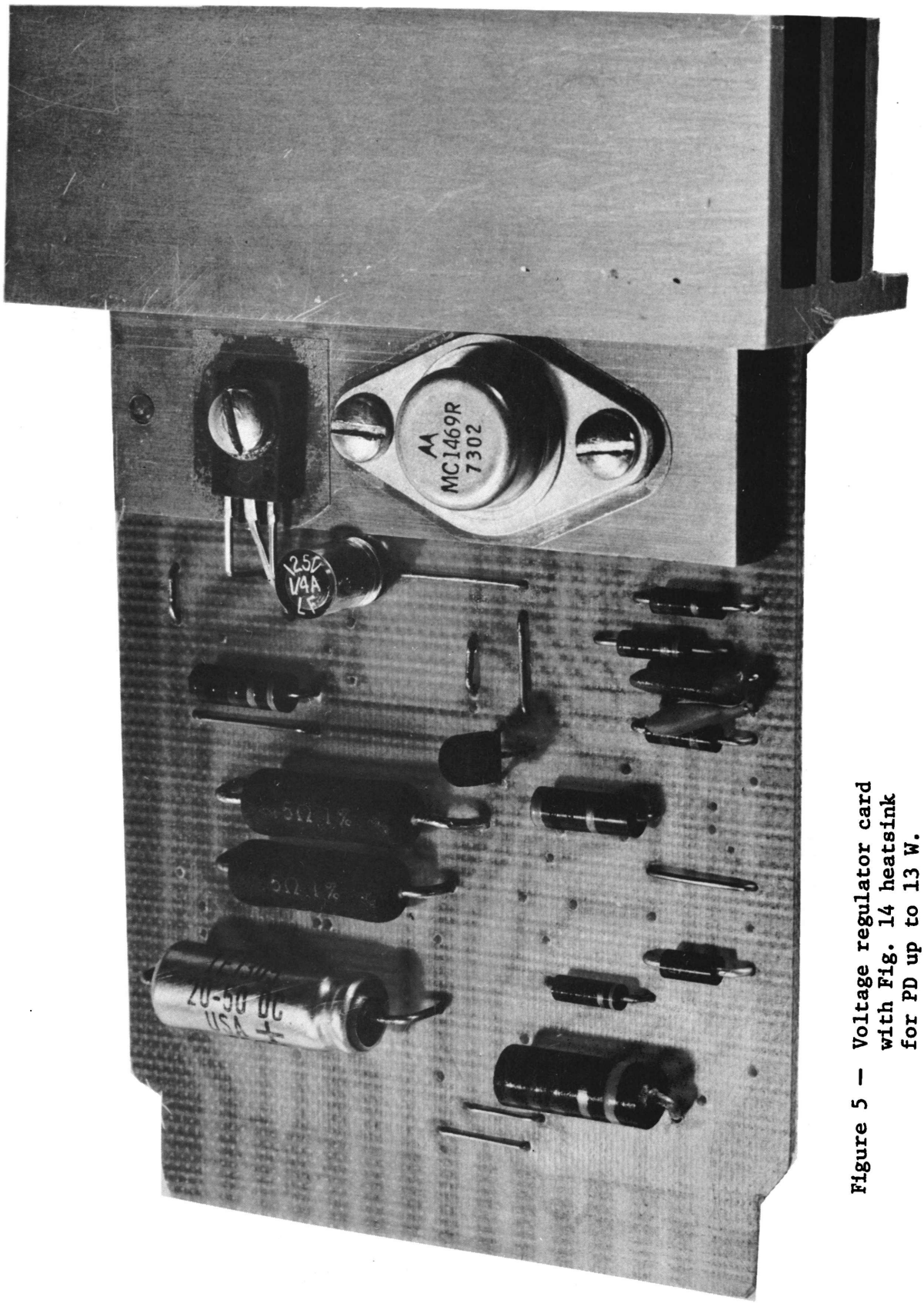


Figure 5 — Voltage regulator card with Fig. 14 heatsink for PD up to 13 W.

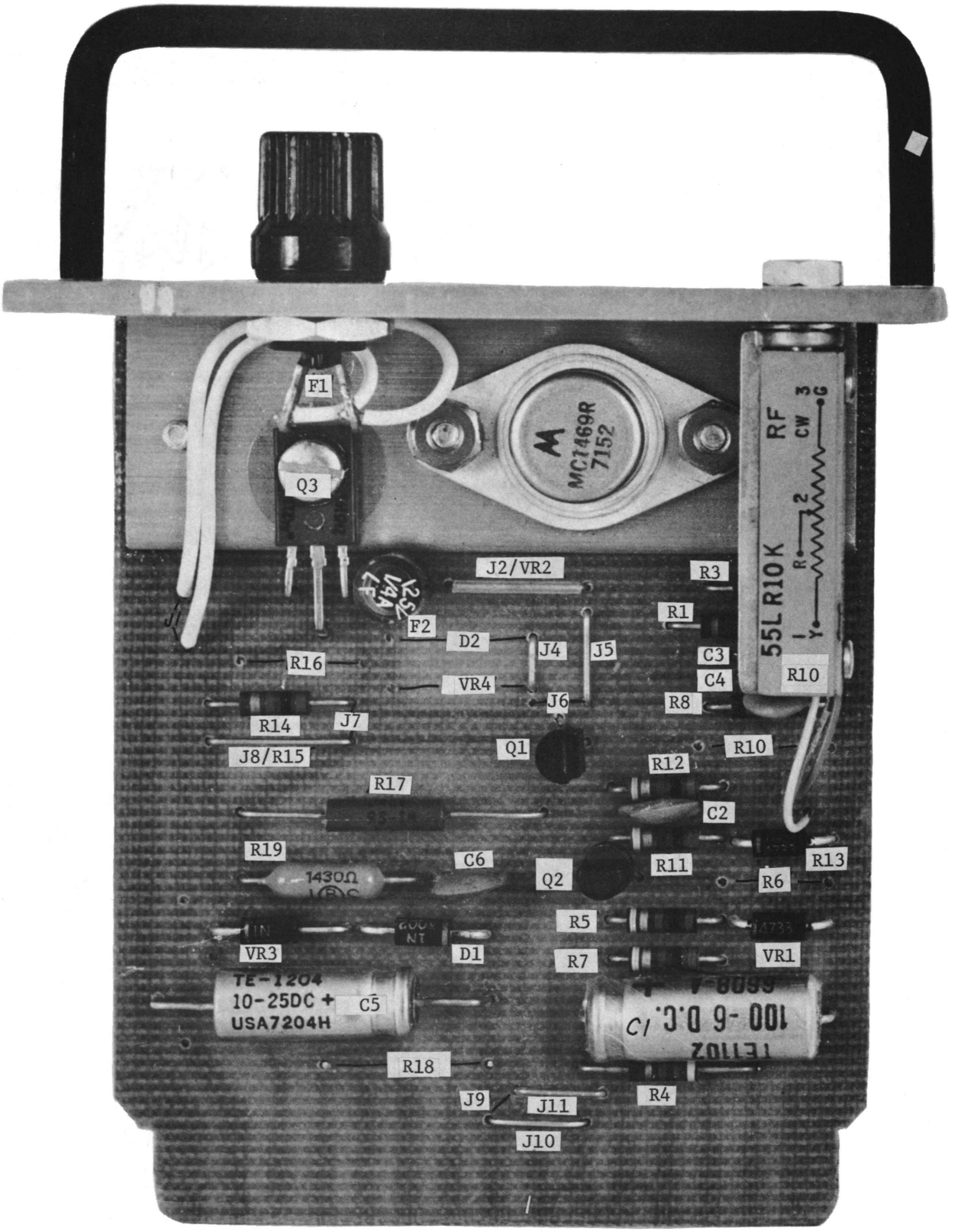


Figure 6 — Voltage regulator card assembly

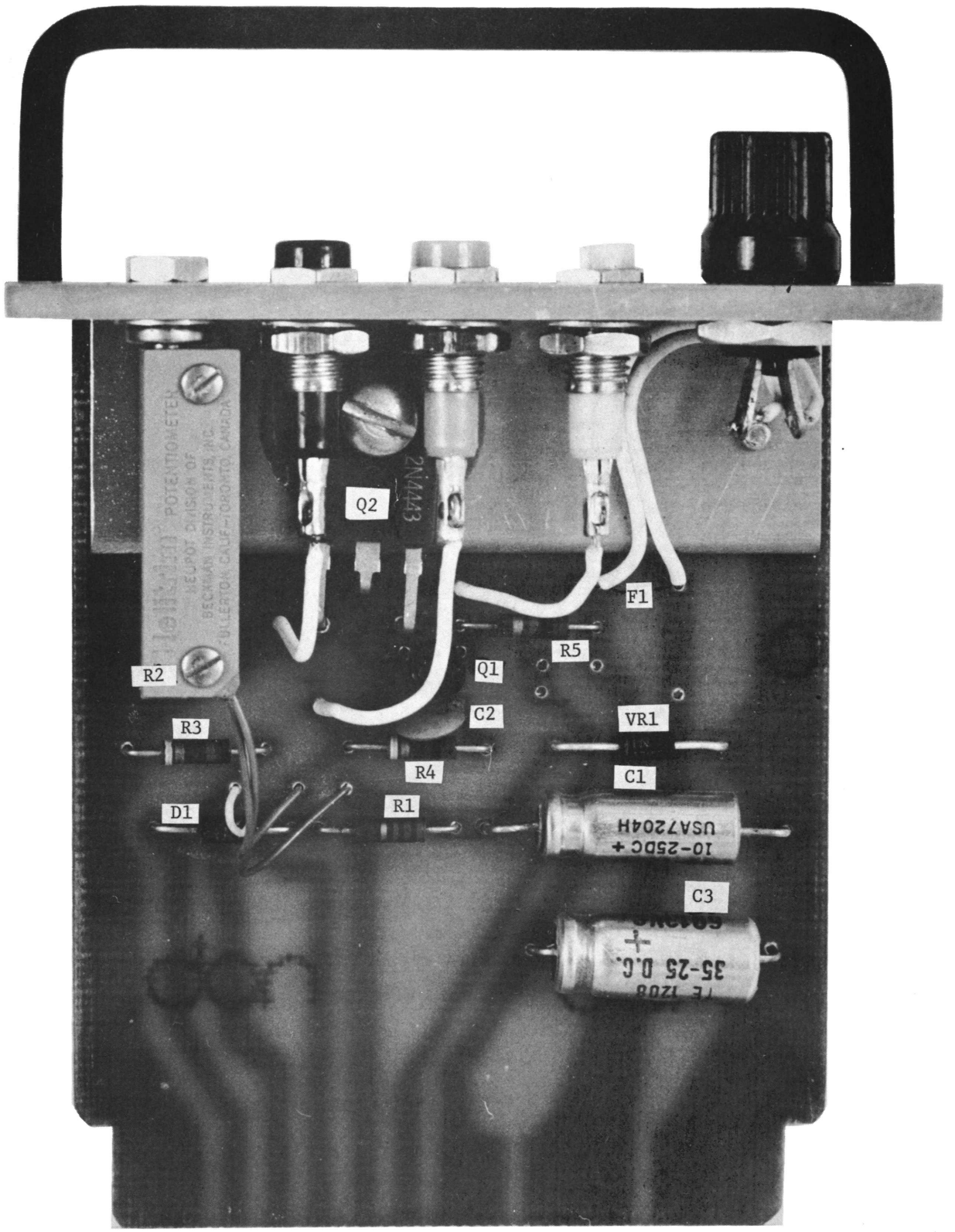


Figure 7 — Overvoltage protection card assembly

APPLICATION	COMPONENTS REQUIRED																																																	
BASIC REGULATOR	F1	F2	S1	PL1	Q1	Q2	Q3	D1	D2	VR1	VR2	VR3	VR4	C1	C2	C3	C4	C5	C6	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	PC-2.490-4
1. $V_L \leq 30$ V, $I_L \leq 400$ mA		X			X													X		X	X	X	X	X		X			X	X	X	X	X	X										X				X			
2. $V_L \leq 30$ V, $I_L \leq 1.2$ A	X	X			X		X											X			X	X	X	X			X		X	X	X	X	X	X										X	X			X			
3. $V_L \leq 30$ V, $I_L \geq 1.2$ A	X	X			X		X											X			X	X	X	X					X	X	X	X	X	X										X	X	X		X			
4. 30 V $\leq V_L \leq 70$ V, $I_L \leq 1.2$ A	X	X			X		X		X		X		X					X							X		X		X	X	X	X		X							X			X			X	X	X		
1. REMOTE VOLTAGE CONTROL																																	O																		
2. REMOTE SENSING																												X	O	O																					
3. REMOTE METERING																			X																														X	X	
4. REMOTE SHUTDOWN																																								X											
5. THERMAL SHUTDOWN										X												X													X			X	X												
6. SHORT CIRCUIT SHUTDOWN			X			X				X				X	X							O									O				X	X	X					X	X								
7. FAULT INDICATION				X				X				X																																							
8. OVERVOLTAGE PROTECTION			X	X		X		X		X		X		X	X							O									O				X	X	X					X	X								X

O - OMIT

Figure 8 — Application Chart

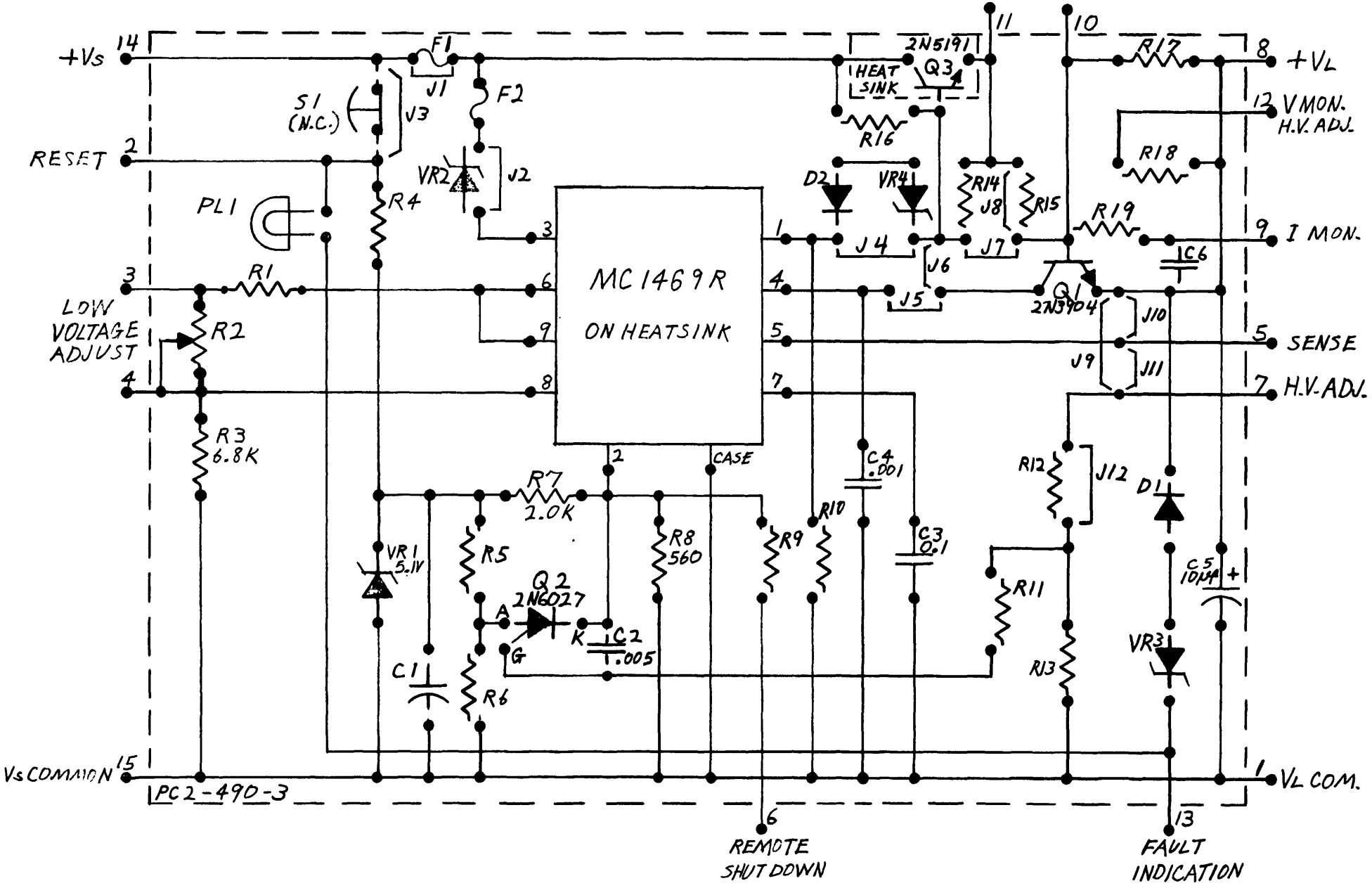
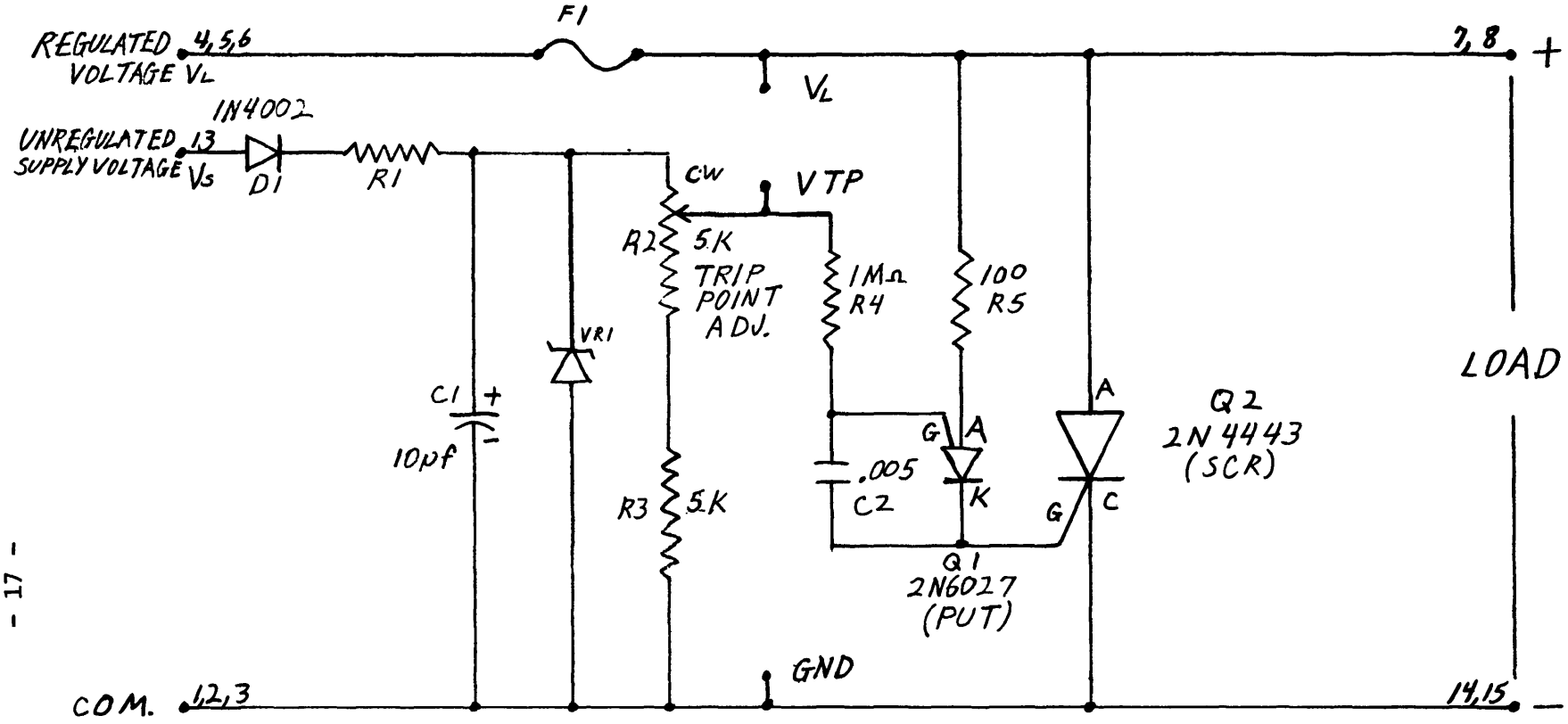


Figure 9 — Regulator Circuit Diagram



NOTES:

1. D1 & C1 PREVENT FALSE TRIGGERING FROM NEG. TRANSIENTS ON 12V BUS.
2. ADJUST R2 TO SET VOLTAGE AT VTP TO 0.6V BELOW DESIRED TRIP POINT.
3. SCR IS FULL ON WITHIN 0.5μSEC AFTER TRIP POINT IS REACHED.

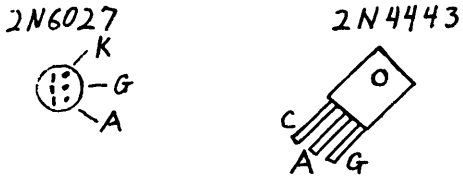


Figure 10 — Overvoltage Protection Circuit Diagram

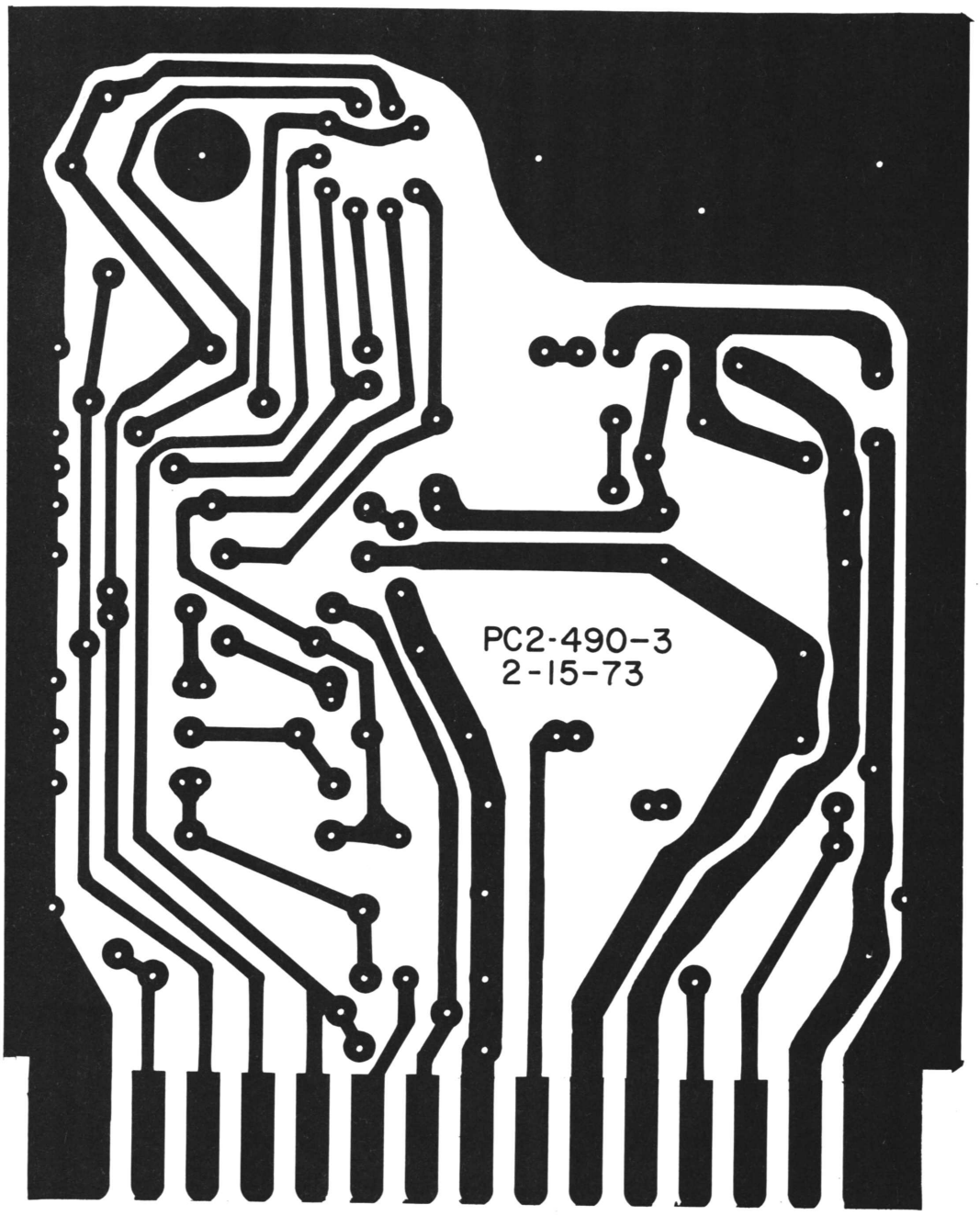


Figure 11 — Voltage Regulator Card Layout

Figure 12 — Overvoltage Protection Card Layout

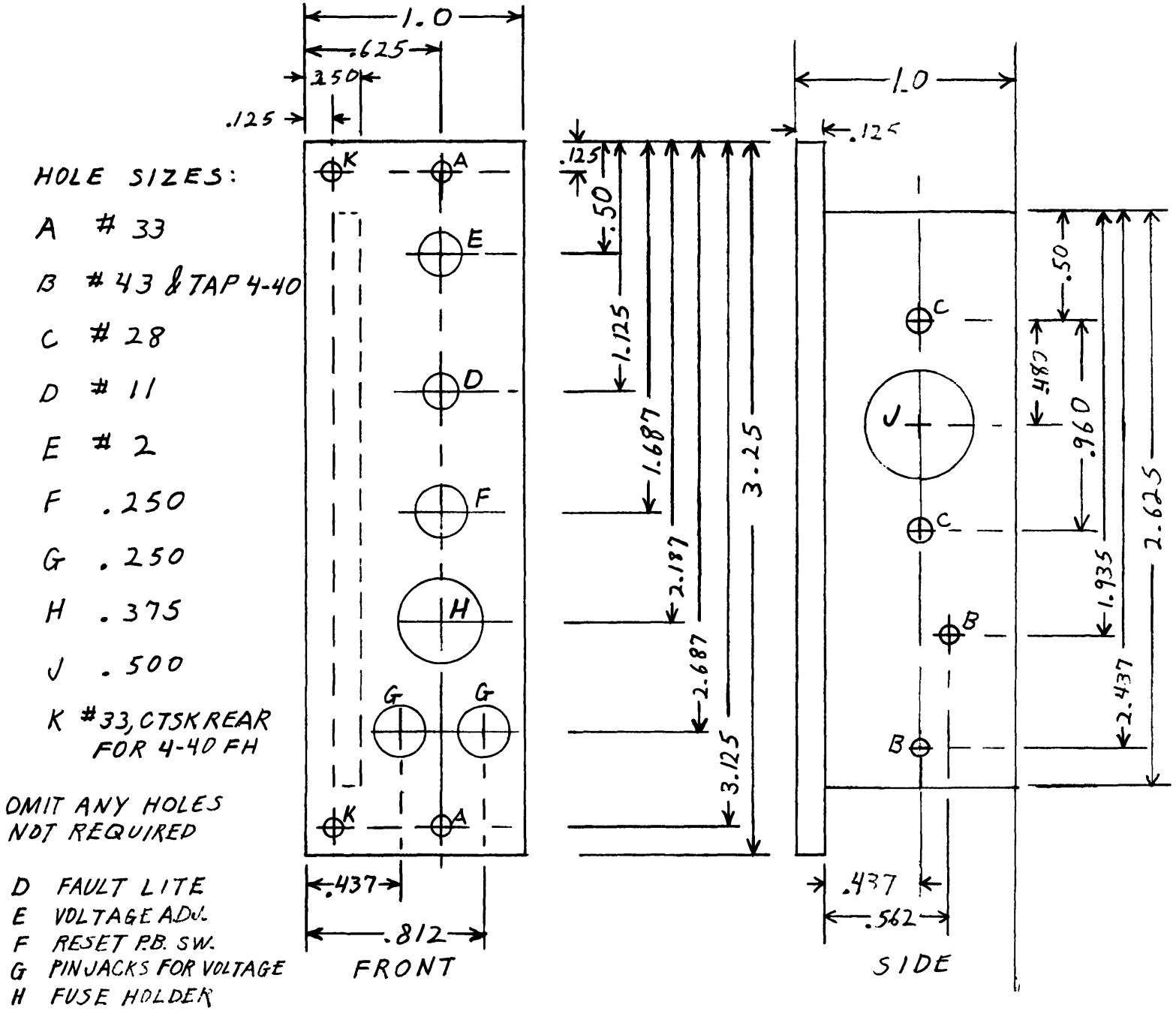


Figure 13 — Heatsink/Panel for Regulator Card

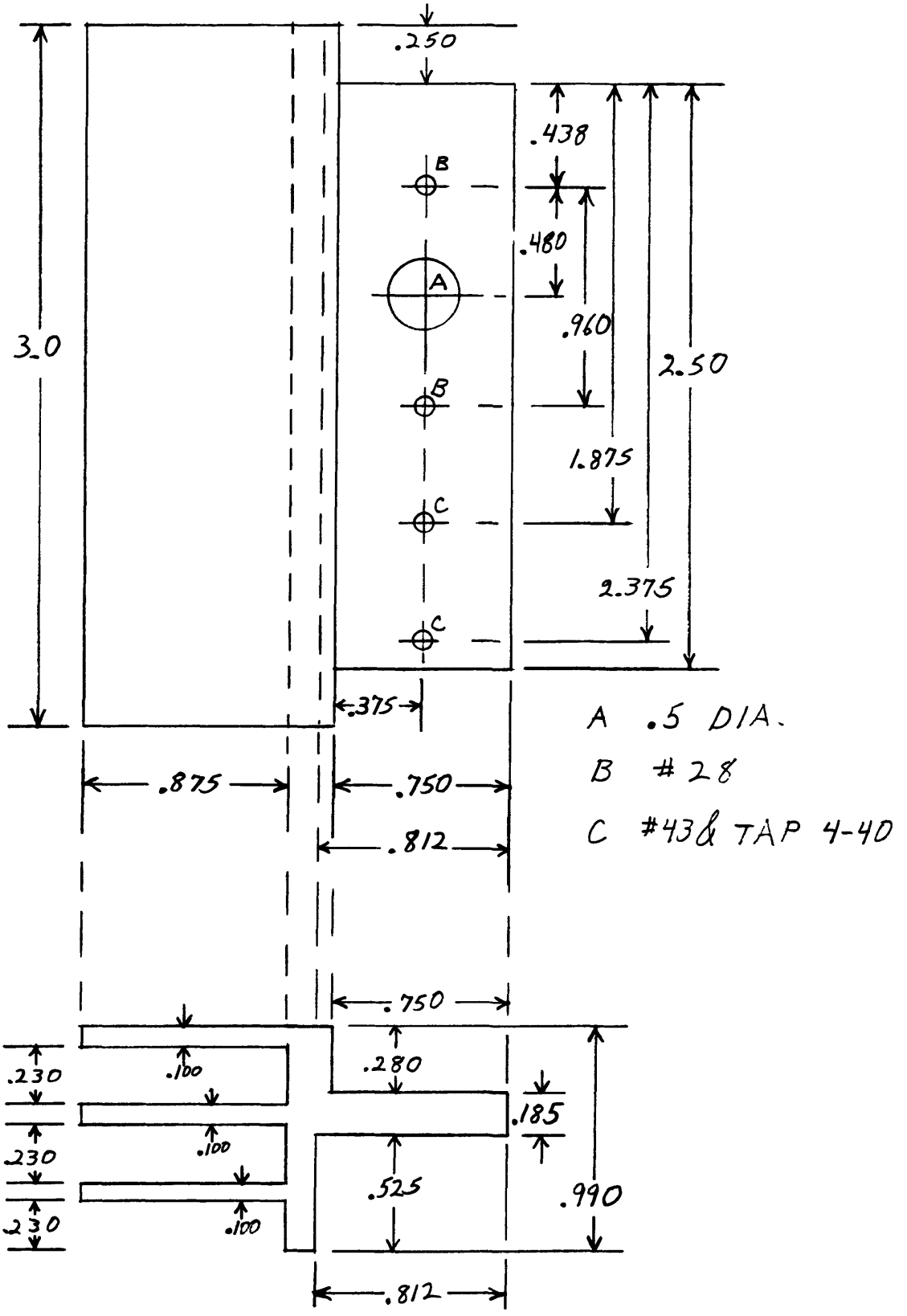


Figure 14 — 13 W Heatsink for Regulator Card

HOLE SIZES:

A #33, CTSK REAR FOR 4-40 FH

B #33

C #43, TAP 4-40

D #36, TAP 6-32

E #2

F .250

G .375

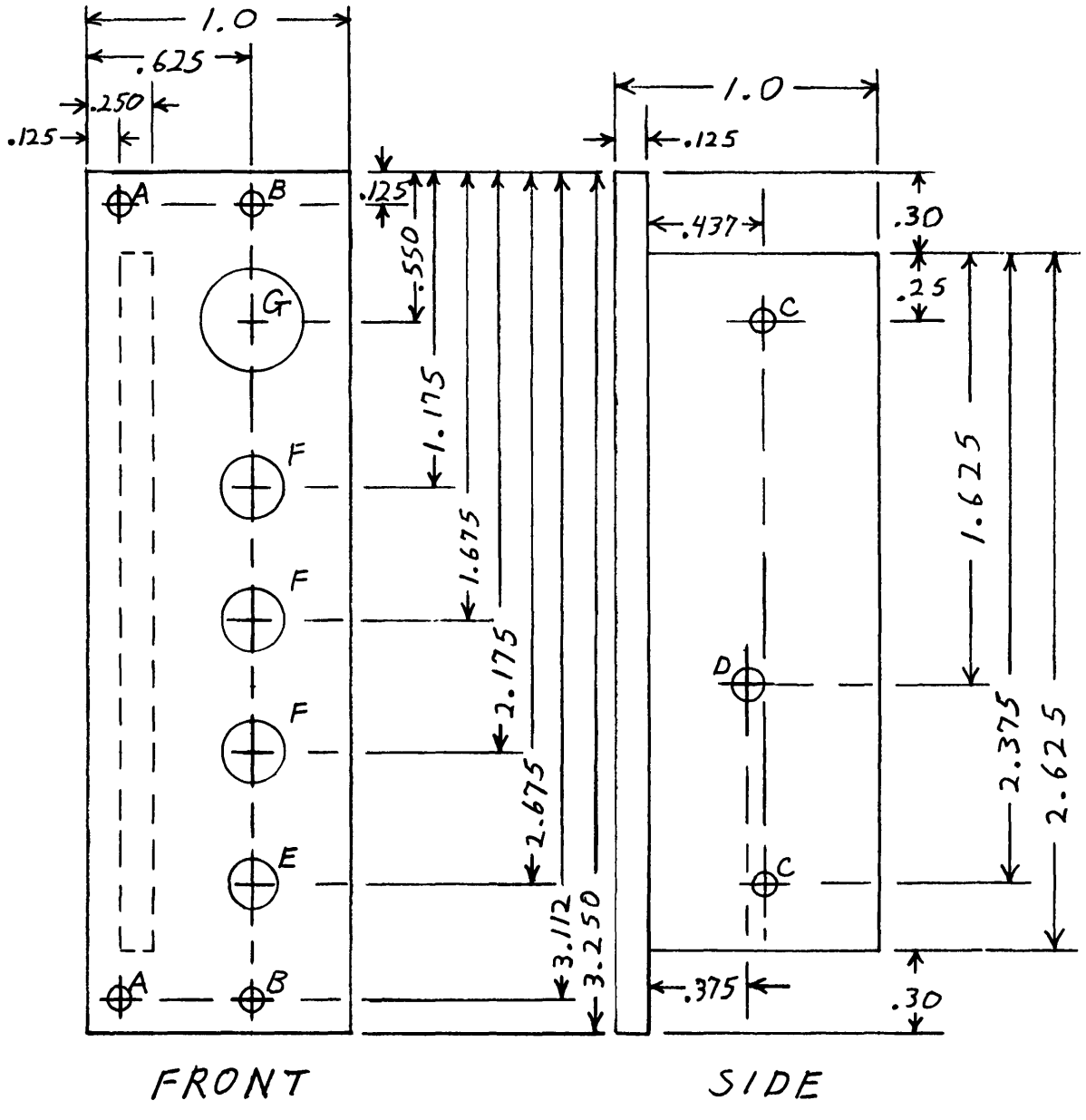


Figure 15 — Heatsink/Panel for Overvoltage Protection Card