An Overvoltage Protection Circuit

This circuit uses a series pass device to disconnect the power supply from the load in the event of an overvoltage condition.

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I designed an overvoltage protection (OVP) device for use between my 13.8 V dc, 35 A Pyramid PS-35 power supply and the load. The circuit uses a series pass device that disconnects the power supply from the load. The design operates around the following parameters:

- Overvoltage set point of 15 V (adjustable)
- Maximum normal operating current of 35 A
- Minimum input voltage of 10 V dc
- Maximum input voltage of 25 V dc
- Optional latching in OVP mode
- Input and output active indicator
- Visual and audible overvoltage alarm indicators

I chose a P-channel power MOSFET (see Figure 1) with a maximum drain current capability of 78 A, a maximum **ON** resistance of 6.6 mΩ at 39 A drain current and 10 V gate voltage, with a maximum power dissipation of 40 W.

This power MOSFET is either **ON** or **OFF**, so the power dissipation is relatively low. The gate of the MOSFET is controlled by a high-speed voltage comparator. To further speed things up, I used a 1 nF capacitor across the resistor responsible for reporting the overvoltage condition and the one responsible for controlling the MOSFET.

In normal operation, the MOSFET is turned on with $V_{GS} > 10$ V. At the maximum design current of 35 A, the MOSFET would have to dissipate about 8 W as the worst case.

In the case of an overvoltage condition, the series pass MOSFET is simply shut off, removing power from whatever equipment is being powered by it.

You can choose to add the diode (D7) to enable latching mode. In that case, the voltage comparator reference is pulled low when the alarm annunciator activates, ensuring that the input has to be essentially removed before the OVP mode can be exited. Capacitor C9 prevents the unit from going into a latched OVP mode at startup or in the case of transient events.

Testing of the OVP device shutoff speed is described on the *QST* in Depth web page at **www.arrl.org/QST-in-Depth**. Based on my testing, I am comfortable saying that this OVP device responds within about 12 μs of an overvoltage event.

Building the OVP Device

See the schematic in Figure 1. Set potentiometer R12 to its center position before you power up the circuit. Then set the threshold voltage to 15 V. The five-way binding posts are rated at 35 A. I use the braided shield from some small coax to connect the ground on the board. Additional images and build details, including Gerber files for the PCB, are on the *QST* in Depth web page.

Keep the leads really short for anything that is associated with the speed of response, especially anything associated with Pins 1 and 4 of the comparator.

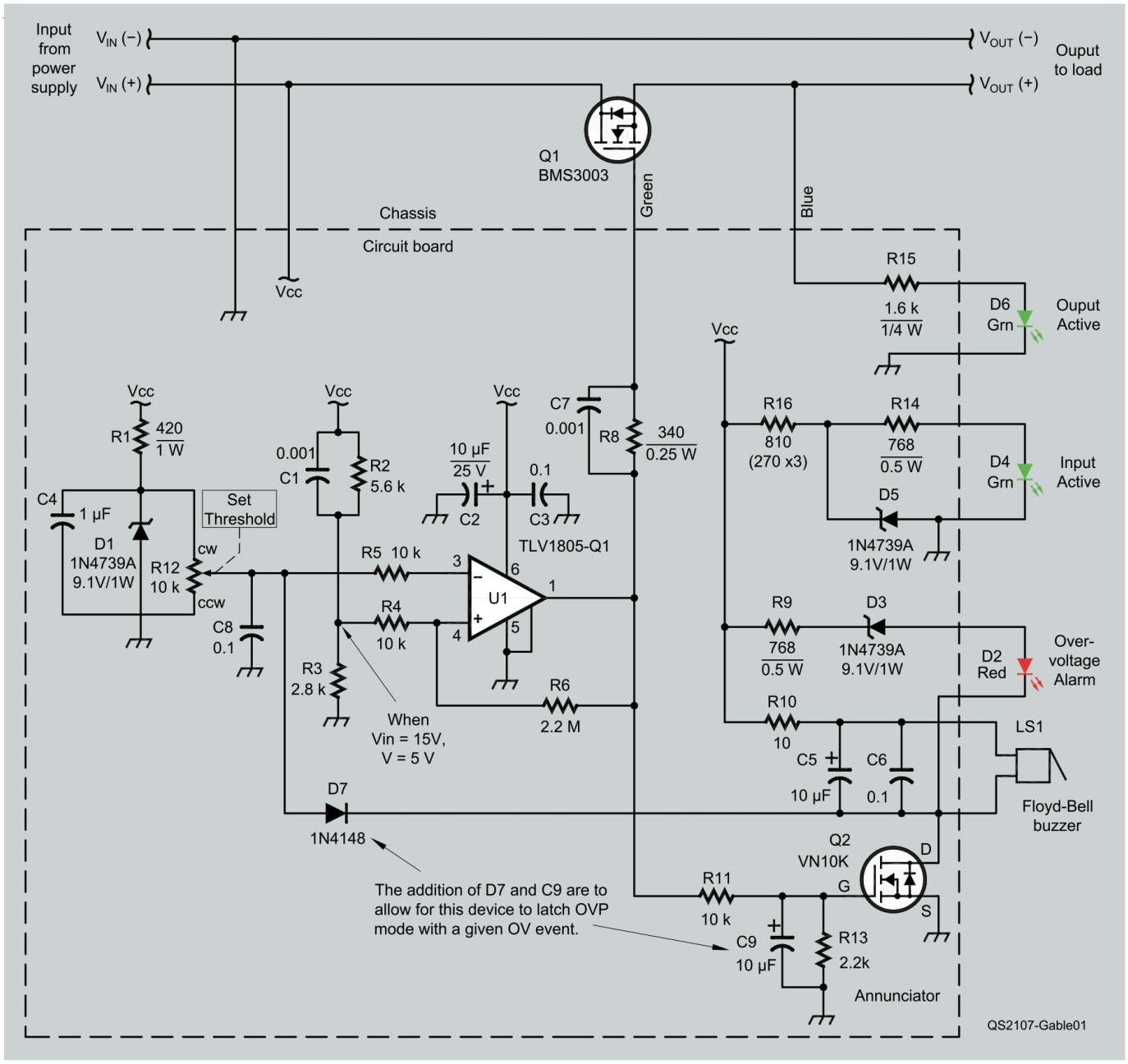

Figure 1 — The schematic diagram and bill of materials.

C1, C7 — 1 nF, 100 V, ceramic
C2, C5, C9 — 10 µF, 50 V, ceramic
C3, C6, C8 — 0.1 µF, 50 V, ceramic
C4 — 1 µF, 25 V, ceramic
D1, D3, D5 — 1N4739ATR, Zener diode, 9.1 V, 1 W, 5%; ON Semiconductor
D2 — Red LED
D4, D6 — Green LED
D7 — 1N4148 or equivalent general-purpose switching diode
LS1 — MB-09-530-S or equivalent buzzer, 5 – 30 V dc; Floyd Bell
Q1 — BMS3003-1E, MOSFET, P channel; ON Semiconductor
Q2 — VN10KN3-G, MOSFET, N channel; Microchip
R1 — 402 Ω, 1 W (or greater) 1% metal film resistor, CPF1402R00FEEE6; Vishay
R2 — 5.6 kΩ, 0.25 W (or greater), 1% resistor
R3 — 2.8 kΩ, 0.25 W, 1% resistor
R4, R5, R11 — 10 kΩ, 0.25 W, 1% resistor
R6 — 2.2 MΩ, 0.25 W, 1% resistor
R8 — 340 Ω, 0.4 W (or greater) 1% resistor, SFR2500003400FR500; Vishay
R9, R14 — 768 Ω, 0.6 W (or greater) 1% resistor, MRS25000C7680FCT00; Vishay
R10 — 10 Ω, 0.25 W (or greater) resistor
R12 — 10 kΩ, 0.1 W (or greater) trimmer potentiometer
R13 — 2.2 kΩ, 0.25 W resistor
R15 — 1.6 kΩ, 0.25 W (or greater) resistor
R16 — 810 Ω, 0.75 W (or greater) resistor [or three 270 Ω, 0.25 W resistors in series]
U1 — TLV1805-Q1, high-speed comparator; TI
Heatsink — scrap box item
Misc. — Five-way binding posts rated at 35 A; two red, two black

Amateur Extra-class licensee Ralph Gable, WA2PUX, was first licensed in 1970. He retired in 2019 from a 20-year career in electronics engineering product development. Ralph maintains a YouTube channel, "Electronics for the Inquisitive Experimenter." You can reach Ralph at **wa2pux@gmail.com**.

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