The ZR2431 Low Voltage Shunt Regulator in SMPS Control Loops

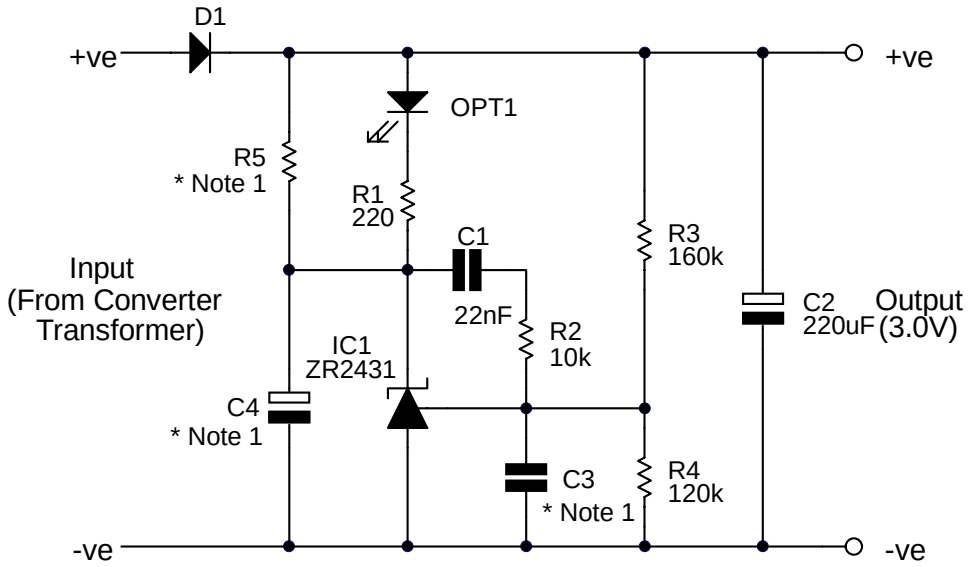

Figure 1
The ZR2431 used within a SMPS Control/Feedback Loop.
Note 1: C3, C4 and R5 are optional components. See text.

Switch-Mode Power Supply Controller

The circuit shown in Figure 1 is commonly used in the control loop of switch-mode power supplies. The output voltage is sensed via R3/R4 by the ZR2431 and the IC controls the current passed through an opto-coupler and hence feeds back output voltage status to the switching regulator. The minimum supply voltage on which this popular circuit can be used is set by the minimum cathode voltage of the regulator IC plus the forward voltage drop of the opto-coupler LED. Previously, the voltage drop of old references possessing a minimum

cathode voltage of 2.5V, added to an opto-coupler voltage drop of around 1.2V meant that the circuit was not viable below 4V. Unlike old versions of the 431, the reference voltage of the ZR2431 is 1.23V and its minimum cathode voltage fractionally below this. Consequently, the ZR2431 allows supplies with outputs down to 2.5V to utilise this circuit topology.

The capacitor C1 is not required for correct operation of the ZR2431. It has been included as it is frequently needed to stabilise the overall control loop of the switch-mode power supply of which Figure 1 is only a part. The ZR2431 is normally stable without additional components in the circuit shown but if any problems are observed, one or more of the following steps should provide a cure:-

1) Keep the operating current of the ZR2431 above 2mA. This can be done by selecting a suitable load at the photo-transistor end of the opto-coupler or by adding R5 with the value 470 ohms.

2) Add C4, with a value of 1μF. Connected to this low impedance point, the capacitor should have little if any effect on the control loop of the power supply yet will guarantee stability of the ZR2431.

3) Some supplies use a compensation resistor wired in series with capacitor C1 (in this case R2). If such a resistor has been included, a small capacitor (1nF) located in the position C3 can be an effective stabilising component and may be a preferable alternative to adding the capacitor C4.