

Undervoltage and Overvoltage Control For The TPS2490 and TPS2491

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ABSTRACT

This application note provides a simple circuit for adding undervoltage and overvoltage control to the TPS2490 and TPS2491 hotswap controllers. Standard operation of the TPS2490 and TPS2491 hotswap controllers are described in detail in datasheet SLVS503.

1 Circuit Operation

The TPS2490/91 devices do not have undervoltage and overvoltage pins as standard functions. However, they do have an enable (EN) pin which has a rising input threshold of 1.35 V +/- 0.03 V and a falling input threshold of 1.25 V +/- 0.03 V. The circuit presented here uses the EN pin to exercise UV/OV control over the TPS2490/91.

2 UV Control

The comparator (U2) has a high impedance output unless an OV condition exists. That leaves R₁ and R₂ to set the UV threshold at the EN pin. (Although R₇, R₈, and R₁₁ do influence the UV level slightly higher). Referring to Figure 1, the equation for calculating UV is;

$$V_{UV} = V_Q + \left(\frac{(R_1 + R_Q)}{R_Q} \right) (V_{TH} - V_Q)$$

Where:

- V_{TH} = 1.35 +/- 0.3 V (rising voltage) and 1.25 +/- 0.03 (falling voltage), at the ENABLE pin

$$V_Q = V_{REF} \left(\frac{R_8}{R_7 + R_8} \right) \left[\frac{R_2}{\left(\frac{R_7 \times R_8}{R_7 + R_8} \right) + R_{11} + R_2} \right]$$

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- V_{REF} = 4 +/- 0.1 Volts (voltage at VREF Pin)

$$R_Q = \frac{R_2 \left(R_{11} + \left(\frac{(R_7 \times R_8)}{(R_7 + R_8)} \right) \right)}{\left(\frac{(R_7 \times R_8)}{(R_7 + R_8)} \right) + R_{11} + R_2}$$

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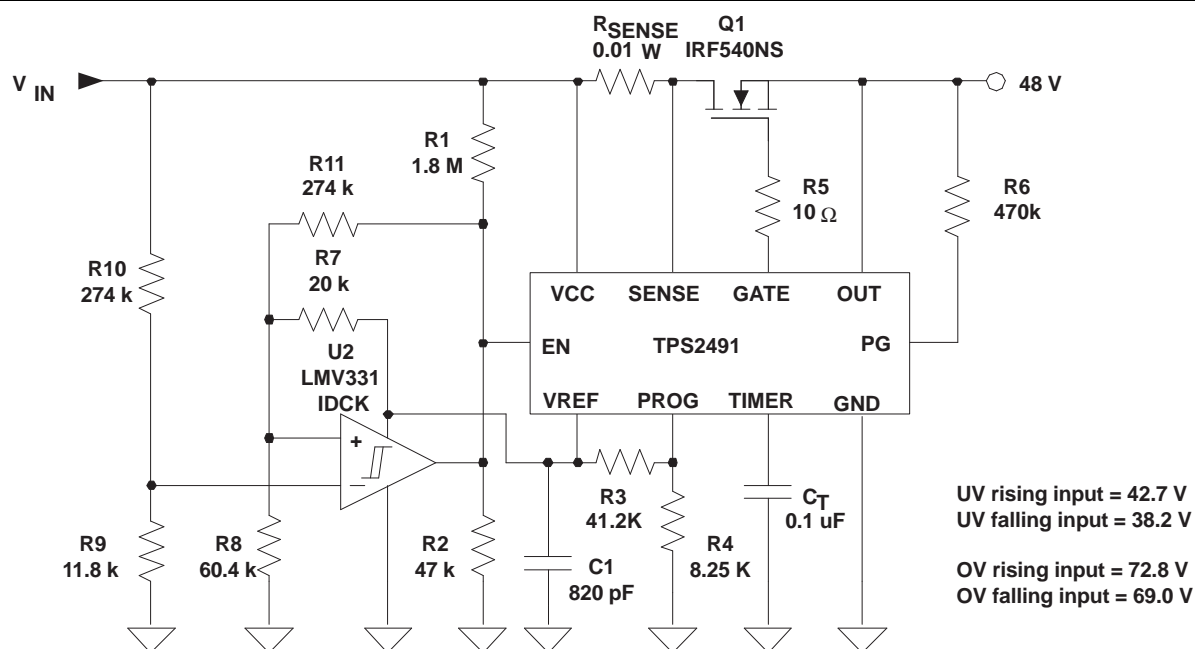


Figure 1. TPS2491 OV/UV Circuit

To select UV resistors R_1 and R_2 the following equations are used.

$$R_1 + R_2 \sim 2 \text{ M}\Omega$$

$$R_1 = R_2 \left(\left(\frac{V_{UV}}{1.35} \right) - 1 \right)$$

Where:

- V_{UV} = desired UV level

2.1 OV Control

An OV control signal is generated by the U2 comparator, which directly drives the ENABLE pin of U1. When an OV condition occurs the open collector output of U2 pulls the 2490 ENABLE pin low, thus shutting off power to the load.

The noninverting input of U2 is set to a 3-V reference level using the VREF output of U1 and the R7/R8 voltage divider. The inverting input of U2 is driven by the R9/R10 voltage divider which senses input voltage level. R11 is used to set hysteresis.

The nominal 60-μA current draw for the U2 comparator is low enough to allow it to be powered by the VREF output of U1. Therefore it is unnecessary to have voltage regulation circuitry to power the U2 comparator from V_{IN}.

$$\text{Rising } V_{OV} = \frac{V_{REF} \times R_8(R_9 + R_{10})}{R_9(R_7 + R_8)}$$

$$\text{Falling } V_{OV} = \frac{V_{REF} \times R_8 \times R_{11}(R_9 + R_{10})}{R_8 \times R_9 \times R_{11} + R_7 \times R_8 \times R_9 + R_7 \times R_9 \times R_{11}}$$

To select OV resistors R9 and R10 the following equations are used.

- $R_9 + R_{10} \sim 500 \text{ k}\Omega$
- $R_{10} = \frac{V_{OV} \times R_9(R_7 + R_8)}{V_{REF} \times R_8} - R_9$

Where

- V_{OV} = desired OV level

It is recommended that the UV resistors, R1 and R2, are selected first. The OV resistors, R9 and R10 second, and the hysteresis resistor, R11 last. These equations are not exact and some iterative derivation of values will most likely be required. A starting value for R11 can be calculated using the following equation.

$$R_{11} = \frac{R_7 \times R_8(V_{REF} \times R_8(R_9 + R_{10}) - V_{HYST} \times R_9(R_7 + R_8))}{(R_7 + R_8)^2(V_{HYST} \times R_9)}$$

Where;

- V_{REF} = Voltage at 2490 VREF Pin
- V_{HYST} = Desired OV hysteresis voltage

2.2 Summary

A circuit for providing overvoltage and undervoltage control of the TPS2490/91 has been presented. Methods for selecting resistor values to provide the desired OV/UV levels have been provided.

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