Application Report
SLVA784–June 2016

Enable Functionality and Adjusting Undervoltage Lockout for TPS57112-Q1

MSA-ASP

ABSTRACT

This document describes the TPS57112-Q1 device Enable pin functionality and provides possible risks associated with driving the Enable (EN) pin voltage higher than VIN pin voltage. This application note is also applicable for TPS57114-Q1 and TPS54388-Q1 devices as they belong to the same family as TPS57112-Q1.

1 Introduction

The TPS57112-Q1 device is a full-featured 6-Vin, 2-A, synchronous step-down current-mode converter with two integrated metal–oxide–semiconductor field-effect transistors (MOSFETs). When the EN pin is left floating, the device turns off when the input voltage falls below 2.6 V. If an application requires a higher undervoltage lockout (UVLO), use the EN pin as shown in Figure 1 to adjust the input voltage UVLO by using two external resistors. The *TPS57112-Q1* datasheet, SLVSAL8 (*Enable Functionality and Adjusting Undervoltage Lockout* section) provides the detailed design procedure to calculate the values of R1 and R2.

When the enable undervoltage lockout is set using this method, it ensures that the EN pin voltage is less than the VIN voltage. This is the recommended method of driving the EN pin, if higher than 2.6 V undervoltage lockout is desired.

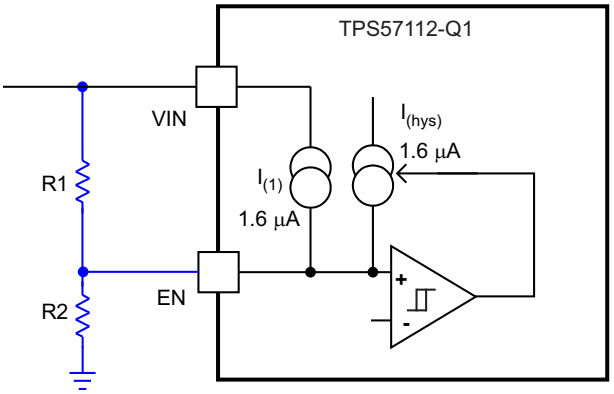


Figure 1. Adjustable Undervoltage Lockout Using External Voltage Divider to VIN Pin

Some applications, like driving EN pin using CAN inhibit signal or driving EN pin through some external logic, may require using digital control for the EN pin. In such cases, there is a possibility that the EN pin voltage is higher than the VIN voltage. This application note explains the risk of driving the EN pin voltage higher than the VIN voltage and provides recommendations to address this issue.

2 Interaction Between EN Pin and VIN Pin

Internally, the EN pin is connected via a 10-kΩ resistor and a p-channel metal-oxide-semiconductor (PMOS) to the VIN supply, as shown in Figure 2. When the EN pin voltage is greater than a diode drop above VIN (0.5 V, typical), the body diode of the PMOS becomes forward biased causing the EN pin to provide the supply for the TPS57112-Q1 device. Due to this incorrect drive, when the EN pin voltage is larger than VIN by around 1.3 V, typical, the device will shut down. When the $V_{EN} – V_{VIN}$ voltage is between 1.1 V and 1.3 V, the device may enter into hiccup mode due to the UVLO comparator hysteresis as shown in Figure 3.

Therefore, it is always advisable to have the EN voltage to be below the VIN voltage under all conditions to avoid incorrect biasing of the device.

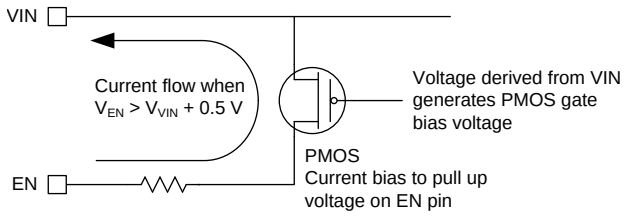
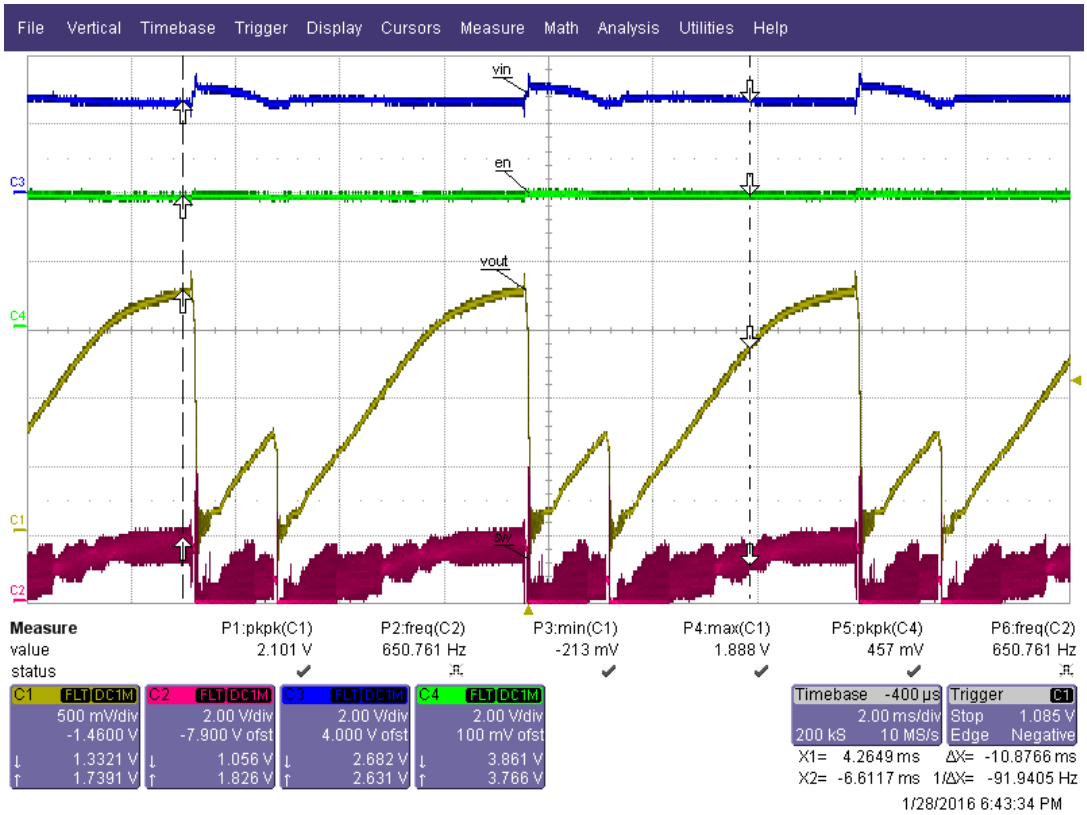


Figure 2. Internal Drive Structure of EN and VIN Pins



C1 (Yellow trace): Output voltage
C2 (Red trace): SW pin voltage
C3 (Blue trace): Input voltage
C4 (Green trace): EN pin voltage

Figure 3. Vout Oscillation Observed on TPS57112-Q1 EVM With V_{VIN} = 3 V, V_{EN} = 4.1 V, Vout = 1.8 V

3 Impact of Product Change Notification #PCN20140408000A on This Behavior

For device material which incorporates the product change notification PCN20140408000A, circuitry is added to clamp the EN voltage to around 2.8 V internally as shown in Figure 4. With this change, it was observed that the device does not shut down when $V_{EN} > V_{VIN}$ by 1.3 V. Also, it does not show any unstable behavior.

This was tested using the TPS57112-Q1 EVM with V_{VIN} = 3 V, V_{EN} = 4.1 V to 4.5 V, Vout = 1.8 V. Even with material that includes this PCN, it is not recommended to drive the EN pin with a voltage higher than the VIN pin.

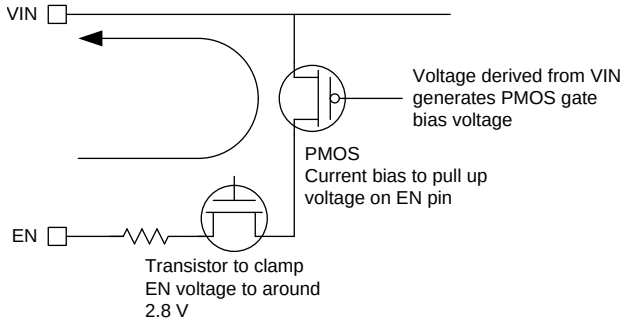


Figure 4. Internal Drive Structure of EN and VIN Pins With PCN20140408000A

4 Conclusion

When it is necessary to use the undervoltage lockout voltage higher than the default UVLO voltage, TI recommends the use of a resistor divider to VIN as shown in Figure 1. If this method cannot be used, customers should make sure that EN pin voltage is less than the VIN voltage.

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