

Using the UCC24610EVM-693

User's Guide



Literature Number: SLUU450
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UCC24610EVM-693 Secondary-Side Synchronous Rectifier Controller Diode Replacement Demonstration Board

1 Introduction

This demonstration board is intended for use to evaluate efficiency improvements gained by synchronous rectification compared with schottky diode rectification in low-power 5-V output circuits. System output power level should be limited to 10 W or less (depending on the MOSFET used). The board is designed for demonstration purposes only and thermal performance is not guaranteed. Forced cooling may or may not be necessary. Maximum reverse blocking voltage, including spikes, must be less than 50-V peak. The diode to be replaced must be arranged such that its anode is connected to GND (refer to [Figure 1](#)). Use with any other diode connection arrangement may result in damage.

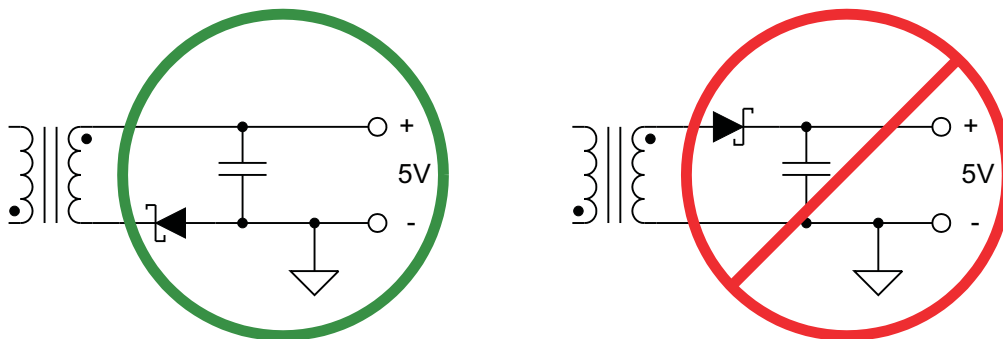


Figure 1. Replaced Diode's Anode Must Be Connected to GND

In situations with Discontinuous Conduction (DCM) of inductor current, the SR-controller is self-commutating. In situations with Continuous Current (CCM) in the inductor, the SYNC input may be used to avoid possible reverse conduction of the SR-MOSFET when the power-stage primary-side switch turns on.

2 Installation

To install the demonstration board, remove the diode to be emulated. Connect the VS pin of the board to the anode pad of the host circuit, and connect the VD pin of the board to the cathode pad of the host circuit. Connect the VCC terminal to the 5-V output with a short piece of wire. For DCM applications, the installation is complete.

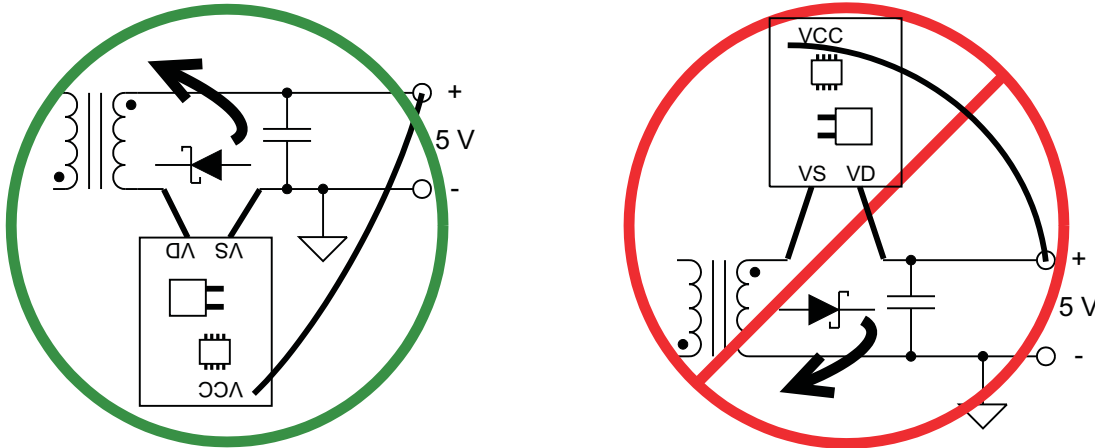


Figure 2. Demonstration Replacement Card Connection for DCM Application

In CCM applications, a primary-side-derived signal is coupled into the SYNC terminal as described below in this user guide.

Although the demonstration board may be applied to the circuit across an existing negative-leg diode and will function correctly without removing that diode, efficiency comparison results may be inaccurate because of parasitic losses attributable to the diode's high junction capacitance.

An optional D-Pak SMT Heatsink may be mounted on the demonstration board by the user to increase the thermal dissipation capability of the board if a higher-power application results in excess SR-MOSFET case temperatures. Forced airflow from a fan can also help extend the power level to be evaluated.

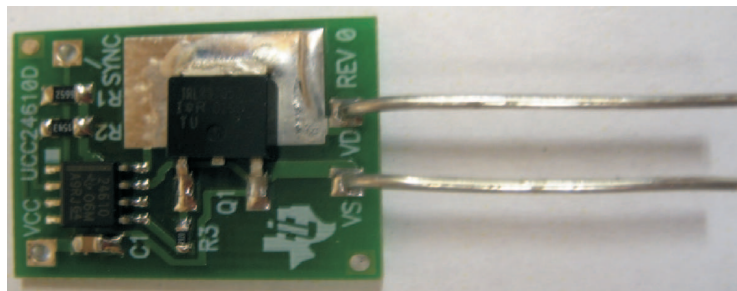


Figure 3. Pictorial View of Daughter Card

3 Detailed Installation Instructions for use of SR Demonstration Board

The SR Demonstration Board is pre-programmed for:

1. $T_{ON} = \sim 1\mu\text{s}$ using 66.5 k Ω , and
2. $T_{OFF} = \sim 5.5\mu\text{s}$ using 154 k Ω .

Adjust T_{ON} and T_{OFF} resistor values for your system board by the following procedure:

1. Observe the ringing at turn-on of the schottky diode during the flyback period under maximum-load, low-line conditions. Measure the time it takes for this ringing to dampen completely. Set the initial T_{ON} resistance so that the T_{ON} time is equal to the complete dampening time.
2. Observe the resonant ringing at turn-off of the schottky diode after the flyback period under maximum-load, high-line conditions. Measure the period of this resonant ringing, and set the initial T_{OFF} resistance so that the T_{OFF} time is equal to the resonant period.

These resistances can be re-adjusted later for optimal performance after observing SR waveforms under all of the various operational conditions with the Demonstration board in place. See [UCC24610 datasheet](#) for T_{ON} and T_{OFF} design information and resistance selection.

Attach VS "pin" to ground-referenced anode pad of existing schottky diode.

Attach VD "pin" to cathode pad of existing schottky diode.

Attach VCC "pad" to 5-V output node of system board with a short piece of flexible wire.

4 DCM Applications

For DCM applications, the system board may now be powered up and operation evaluated.

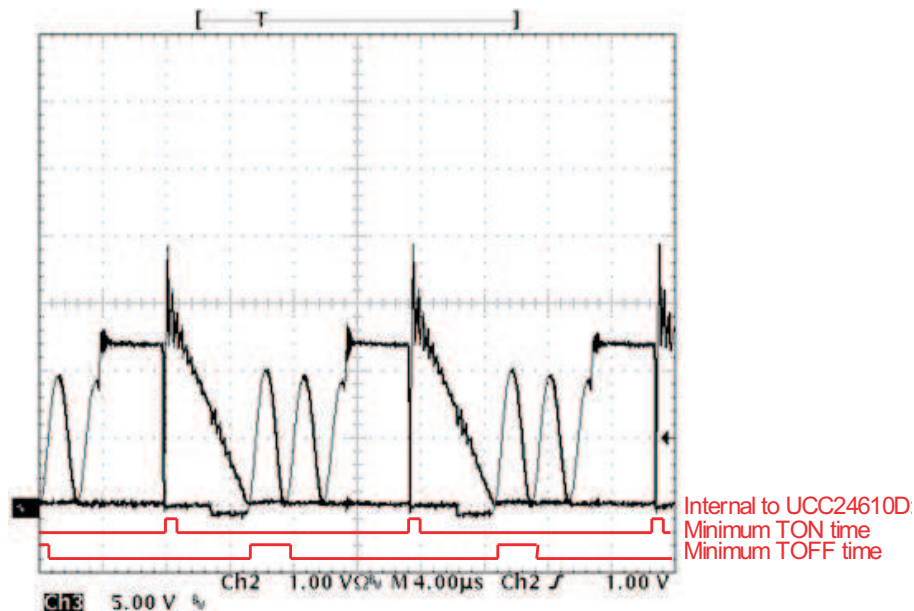


Figure 4. DCM Example Waveforms With Internal T_{ON} and T_{OFF} Timing

5 CCM Applications

For CCM applications, it is important to feed forward a SYNC signal from the primary side to turn-off the SR-MOSFET to prevent cross-conduction with the primary-side MOSFET. Attach SYNC “pad” to a synchronization signal derived on the system board. The [UCC24610](#) controller requires a negative-going SYNC signal referenced to VCC to trigger turn-off of the SR-MOSFET. This can be achieved with a low-value capacitor connected from the primary-side MOSFET drain to the SR controller SYNC input. A series resistor helps to reduce peak currents in the SYNC path. The current return path can be through existing primary-to-secondary stray capacitance, EMI-suppression capacitance, or a dedicated return capacitance. See [Figure 5](#) below showing CCM-Flyback application. LLC applications are similar.

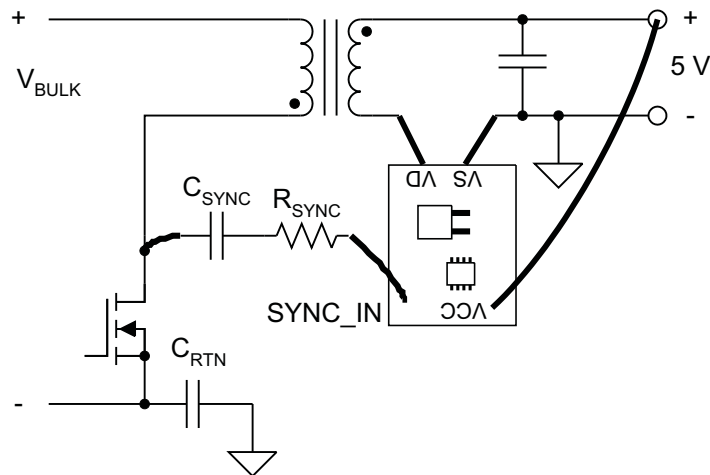


Figure 5. Connection Diagram for CCM-Flyback Application

See [UCC24610](#) datasheet for SYNC application design information and capacitance selection.

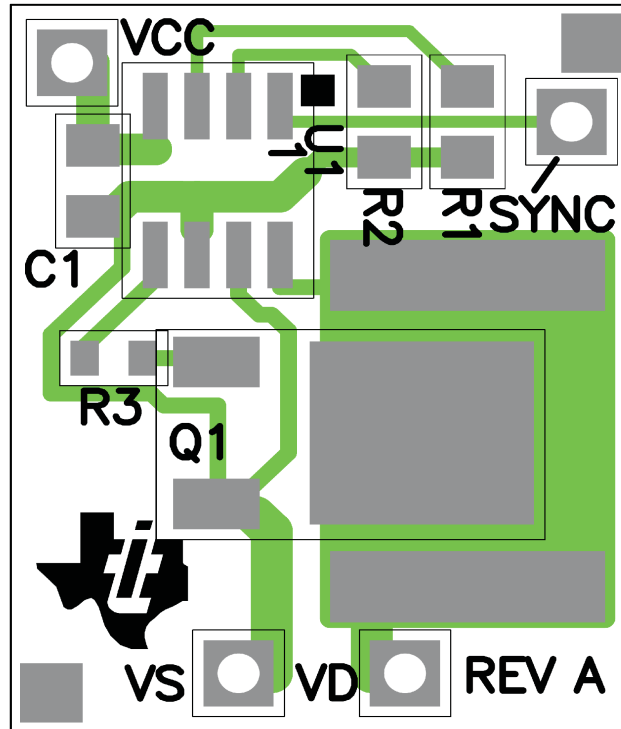


Figure 6. Component Placement

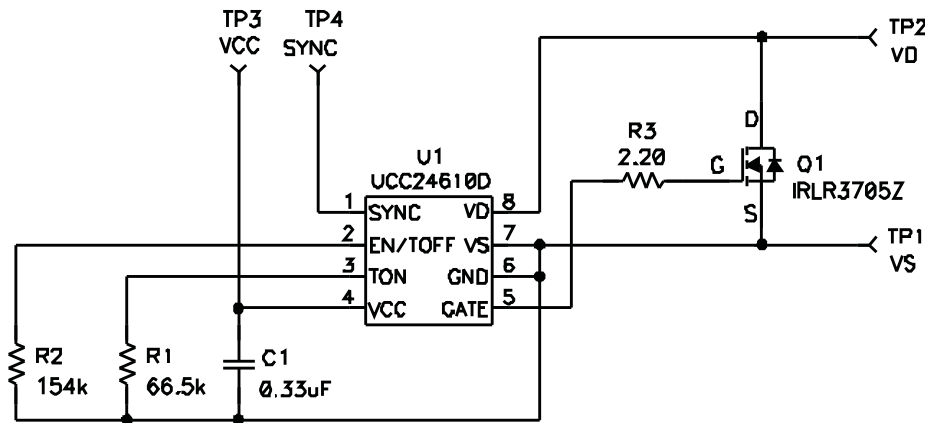


Figure 7. Schematic of Demonstration Card

Notes:

1. Do not exceed 50 V across VD to VS.
2. Connect VS to anode pad of diode (GND).
3. Connect VD to cathode pad of diode.
4. Connect VCC to 5-V output of mother board.
5. Connect SYNC (if used) with capacitor network to primary-side MOSFET drain.

6 List of Materials

Table 1. List of materials⁽¹⁾

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
1	C1	Capacitor, ceramic, 0.33 μ F, 16 V, X7R, \pm 10%, 0805	Std	Std
1	Q1 ⁽²⁾	MOSFET, N-channel, 55 V, 42 A, 8 m Ω , DPAK	IRLR3705ZPBF	International Rectifier
1	R1 ⁽³⁾	Resistor, chip, 66.5 k Ω , 1/8 W, \pm 1%, 0805	Std	Std
1	R2	Resistor, chip, 154 k Ω , 1/8 W, \pm 1%, 0805	Std	Std
1	R3	Resistor, chip, 2.20 Ω , 1/10 W, \pm 1%, 0603	Std	Std
1	VS	Test point, AWG 18, 1.25 inch length	Std	Std
1	VD	Test point, AWG 18, 1.25 inch length	Std	Std
0	VCC	Test point, 0.050 Hole, no pop.	Std	Std
0	SYNC_IN	Test point, 0.050 Hole, no pop.	Std	Std
1	U1	GREEN Rectifier Controller Device, SO-8	UCC24610D	Texas Instruments

⁽¹⁾ Optional heatsink, such as Aavid 573100D00000G, may be added.

⁽²⁾ MOSFET, Q1, sized for approximate 10W application.

⁽³⁾ Values for R1, R2, and R3 may be changed to suit user's specific application.

7 References

1. [UCC24610 GREEN Rectifier™ Controller Device, Datasheet, SLUSA87](#)

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 5 V and the output voltage range of 5 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 50° C. The EVM is designed to operate properly with certain components above 50° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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