1 Introduction

The LM20242 synchronous rectifier Buck evaluation board is designed to provide the design engineer with a fully functional Buck power converter based on Current Mode Control to evaluate the LM20242 switching regulator IC. The evaluation board provides a 3.3 V output with 2A current capability. The input voltage ranges from 8 V to 36 V. The design operates at 300 kHz, a good compromise between conversion efficiency and solution size. The printed circuit board consists of 2 layers of 2 ounce copper on FR4 material with a thickness of 0.062 inches. This document contains the evaluation board schematic, Bill of Materials (BOM) and a quick setup procedure. For complete circuit design information, see the LM20242 36V, 2A PowerWise™ Adjustable Frequency Synchronous Buck Regulator Data Sheet (SNVS534).

The performance of the synchronous rectifier buck evaluation board is as follows:

- Input Range: 8 V to 36 V
- Output Voltage: 3.3 V, ±2%
- Output Current: 0 to 2A
- Frequency of Operation: 300 kHz
- Board Size: 2.15 X 2.0 X 0.6 inches
- Load Regulation: 0.1%
- Line Regulation: 0.1%
- Over Current Limiting
3 Powering and Loading Considerations

Read this entire page prior to attempting to power the evaluation board.

3.1 Quick Setup Procedure

1. Set the input source current limit to 1A. Turn off the input source. Connect the positive output of the input source to J1 and the negative output to J2.
2. Connect the load, with 2A capability, to J3 for the positive connection and J4 for the negative connection.
3. Leave the ENABLE pin, J9, open for normal operation.
4. Set the input source voltage to 12 V and the load to 0.1A. The load voltage should be in regulation with a nominal 3.3 V output.
5. Slowly increase the load while monitoring the load voltage at J3 and J4. It should remain in regulation with a nominal 3.3 V output as the load is increased up to 2 Amp.
6. Slowly sweep the input source voltage from 8 V to 36 V. The load voltage should remain in regulation with a nominal 3.3 V output.
7. Temporally short the ENABLE pin (J9) to GND (J2) to check the shutdown function.
8. Increase the load beyond the normal range to check current limiting while the input source is set to 12 V. The output current should limit at approximately 3.8A. The input source current limit should be increased for this step. Fan cooling is critical during this step.
3.2 **Air Flow**

Prolonged operation at full power and high ambient temperature will cause the thermal shutdown circuit within the regulator IC to activate. A fan with a minimum of 200 LFM should always be provided.

3.3 **Powering Up**

Using the ENABLE pin (J9) provided will allow powering up the input source with the current level set low. It is suggested that the load power be kept low during the first power up. Set the current limit of the input source to provide about 1.5 times the anticipated wattage of the load. As you remove the connection from the ENABLE pin to GND (J2), immediately check for 3.3 volts at the output.

A quick efficiency check is the best way to confirm that everything is operating properly. If something is amiss you can be reasonably sure that it will affect the efficiency adversely. Few parameters can be incorrect in a switching power supply without creating losses and potentially damaging heat.

3.4 **Over Current Protection**

The evaluation board is configured with cycle-by-cycle over-current protection. This function is completely contained in the LM20242. The peak current is limited to approximately 3.8A. The thermal stress on various circuit components is quite severe while in an overloaded condition, therefore limit the duration of the overload and provide sufficient cooling (airflow).

4 **Performance Characteristics**

*Figure 1* shows the conversion efficiency versus output current for several input voltage conditions.

![Figure 1. Efficiency Plots](image)
TURN-ON WAVEFORM

When applying power to the LM20242 evaluation board a soft-start sequence occurs. Figure 2 shows the output voltage during a typical start-up sequence.

![TURN-ON WAVEFORM](image)

Conditions: Input Voltage = 12 VDC, Output Current = 2A
Trace 1: Output Voltage Volts/div = 1 V
Horizontal Resolution = 5ms/div

Figure 2. Output Voltage During a Typical Start-Up

OUTPUT RIPPLE WAVEFORM

Figure 3 shows the output voltage ripple. This measurement was taken with the scope probe tip placed on the J3 load terminal and the scope probe ground "barrel" pushed against the J4 load terminal. The scope bandwidth is set to 20 MHz.

![OUTPUT RIPPLE WAVEFORM](image)

Conditions: Input Voltage = 12 VDC, Output Current = 2A,
Bandwidth Limit = 20 MHZ
Trace 1: Output Ripple Voltage Volts/div = 20 mV
Horizontal Resolution = 2 µs/div

Figure 3. Output Voltage Ripple
PRIMARY SWITCH NODE WAVEFORM

Figure 4 shows the typical SW pin voltage during continuous conduction mode (CCM).

Conditions: Input Voltage = 12 VDC, Output Current = 2A, Bandwidth Limit = 20 MHZ
Trace 1: LM20242 SW Pin Volts/div = 2 V
Horizontal Resolution = 1 µs/div

Figure 4. SW Pin Voltage During Continuous Conduction Mode (CCM)

5 Layout and Bill of Materials (BOM)

The Bill of Materials is shown in Table 1, including the manufacturer and part number.

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<th>Qty</th>
<th>Part Number</th>
<th>Description</th>
<th>Value</th>
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<td>2</td>
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Figure 5. Silkscreen

Figure 6. Component Side
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