Enpirion EP53x8xQI DC/DC Converter Module Evaluation Board

Introduction

This application note describes how to test the following EP53x8xQI converters using the Enpirion 3x3 Module EVAL BOARD shown in Fig. 1: EP5368LQI, EP5368HQI, EP5388LQI, EP5388HQI, EP53A8LQI, and EP53A8HQI. In addition to this document you will also need the device datasheet.

The EP53x8xQI converters are part of a new class of DC/DC converter products, a complete power system on silicon:

- These devices are complete modules including magnetics, and require only ceramic input and output capacitors.
- The evaluation board is designed to offer a wide range of engineering evaluation capabilities. This includes the base configuration of an 0603 input capacitor and an 0805 output capacitor.
- Pads are available to add up to one additional input capacitor and up to two additional output capacitors to allow for evaluation of performance over a wide range of input/output capacitor combinations.
- Pads are available to populate an external divider if desired.
- Easy jumpers are provided for the following signals:
  - Enable
  - VS0-VS3 output voltage select
- Numerous test points are provided as well as clip leads for input and output connections
- The board comes with input decoupling, and input reverse polarity protection to safeguard the device from common setup mishaps.

Quick Start Guide

STEP 1: Set the "ENABLE" jumper to the Disable Position.

Jumper

Output Disabled

> **CAUTION**: the signal pins ENA, VS0, VS1, VS2, and VS3 must be connected to a logic "high", jumper to the left, or a logic "low", jumper to the right. If left floating the state is indeterminate.
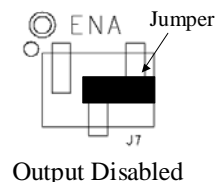
STEP 2: Connect a power supply to the input test points, TP8 (+) and TP5 (-) as indicated in Figure 1. The same test points can also be used to measure the input voltage.

CAUTION: be mindful of the polarity and the voltage magnitude. If V_{IN} is greater than 6V, the board may get damaged. If the input voltage polarity is wrong, diode D1 will conduct, and draw excessive input current.

STEP 3: Set the output voltage select pins for the desired output voltage. Refer to Tables 1 and 2 to determine the setting.

CAUTION: the external resistor divider is not populated in the standard board configuration. Choosing the "EXT" option for the EP53x7LQI without the external resistors R1 and R2 will result in unpredictable behavior.
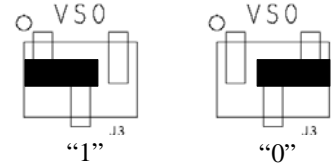
STEP 4: Connect the load to the output connectors TP7 (+) and TP6 (-), as indicated in Figure 1.The same test points are also used to measure the DC output voltage.
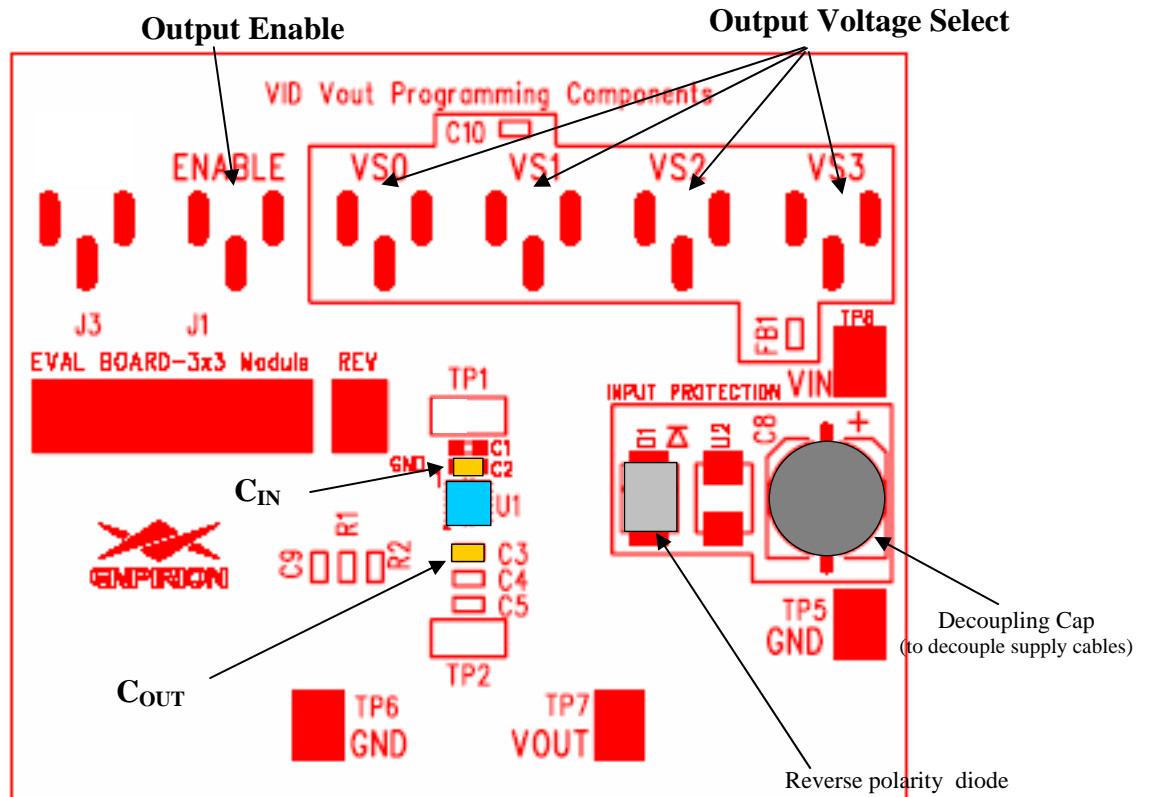

Figure 1. Evaluation Board Layout.

STEP 5: Move the ENABLE jumper to the enabled position, and power up the board. The EP53x8xQI should now be operational.

Output Voltage Select

Table 1. EP53x8LQI Output Voltage Select Truth Table

VS3	VS2	VS1	VS0	VOUT
0	0	0	0	1.50
0	0	0	1	1.45
0	0	1	0	1.40
0	0	1	1	1.35
0	1	0	0	1.30
0	1	0	1	1.25
0	1	1	0	1.20
0	1	1	1	1.15
1	0	0	0	1.10
1	0	0	1	1.05
1	0	1	0	1.00
1	0	1	1	0.95
1	1	0	0	0.90
1	1	0	1	0.85
1	1	1	0	0.80
1	1	1	1	EXT

Table 2. EP53x8HQI Output Voltage Select Truth Table

VS3	VS2	VS1	VS0	VOUT
0	0	0	0	3.3
0	0	0	1	3.2
0	0	1	0	3.1
0	0	1	1	3.0
0	1	0	0	2.9
0	1	0	1	2.8
0	1	1	0	2.7
0	1	1	1	2.6
1	0	0	0	2.5
1	0	0	1	2.4
1	0	1	0	2.3
1	0	1	1	2.2
1	1	0	0	2.1
1	1	0	1	2.0
1	1	1	0	1.9
1	1	1	1	1.8

The EP53x8xQI utilizes a 4 pin output voltage select scheme. The output voltage is programmed by setting the VSx jumpers to either a logic "1" or a logic "0" as described in the Quick Start section

Tables 1 and 2 show the truth table for V_{OUT} selection. There are fifteen preset output voltage levels for the EP53x8LQI, and sixteen preset levels for the EP53x8HQI.

Test Recommendations

To guarantee measurement accuracy, the following precautions should be observed:

1. Make all input and output voltage measurements at the board using the test points provided. This will eliminate voltage drop across the line and load cables that can produce false readings.
2. Measure input and output current with series ammeters or accurate shunt resistors. This is especially important when measuring efficiency.
3. Use a balanced impedance probe tip as shown in Figure 2, and through-hole test point pair TP2 to measure the output voltage ripple to avoid noise coupling into the probe ground lead.
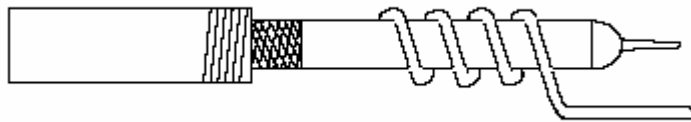

Figure 2: Balanced-impedance oscilloscope probe. Wrap bare wire around the ground shaft and bring the wire close to the probe tip. This minimizes probe loop inductance and stray noise pickup by the probe.

Using The External Voltage Divider

The EP53x8xQI evaluation board is designed to provide a great deal of flexibility in evaluating the performance of the Enpirion DC/DC module.

Pre-tinned pads are provided to place 0805 sized 1% resistors on the board to implement an external resistor divider for the EP53x8LQI to choose an output voltage other than one of the pre-set voltages available on the VID. See Figure 3 for the basic circuit.
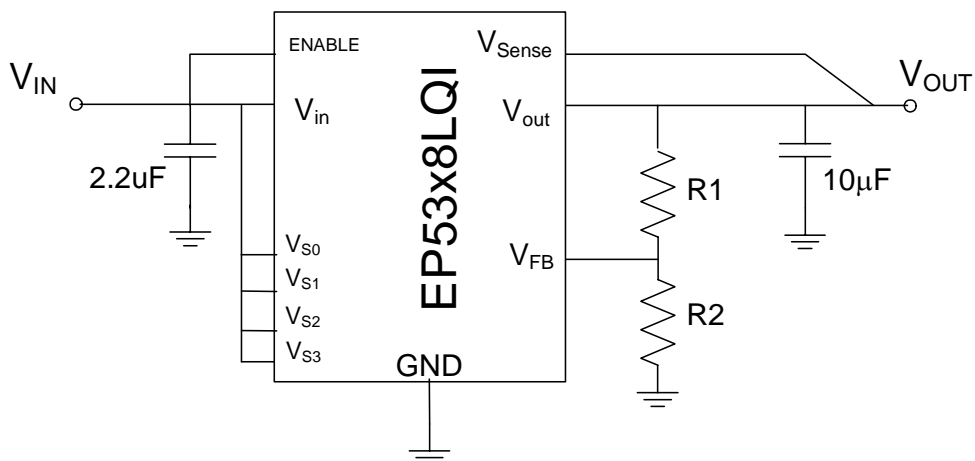
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Figure 3. External divider schematic for the EP53x8LQI.

The output voltage is selected by the following formula:

$$V_{OUT} = 0.6V\left(1 + \frac{R1}{R2}\right)$$

R_1 must be chosen as 237kΩ to maintain control loop stability. Then R_2 is given as:

$$R_2 = \frac{142.2 x 10^3}{V_{OUT} - 0.6}\Omega$$

The external voltage divider option is chosen by setting the jumpers VS0 – VS3 to a logic "high".

Dynamically Adjustable Output

The EP53x8xQI is designed to allow for dynamic switching between the predefined voltage levels by toggling the VID pins. The inter-voltage slew rate is optimized to prevent excess undershoot or overshoot as the output voltage levels transition. The slew rate is defined in the datasheet.

This feature can be tested by connecting the VSx jumper center pins to logic driver to toggle between the various V_{OUT} states.

Input and Output Capacitors

The **input** capacitance is a single 0603 X5R MLCC. Please see the part datasheet for the exact value. There are pre-tinned pads that allows for one additional 0603 capacitor to experiment with input filter performance.

The **output** capacitance requirement is a single X5R MLCC. Please see the datasheet for the exact value. The board has pre-tinned pads for up to 2 additional 0805 output capacitors.

> **NOTE:** Capacitors must be X5R or X7R dielectric formulations. Do not use Y5V or any similar dielectric.
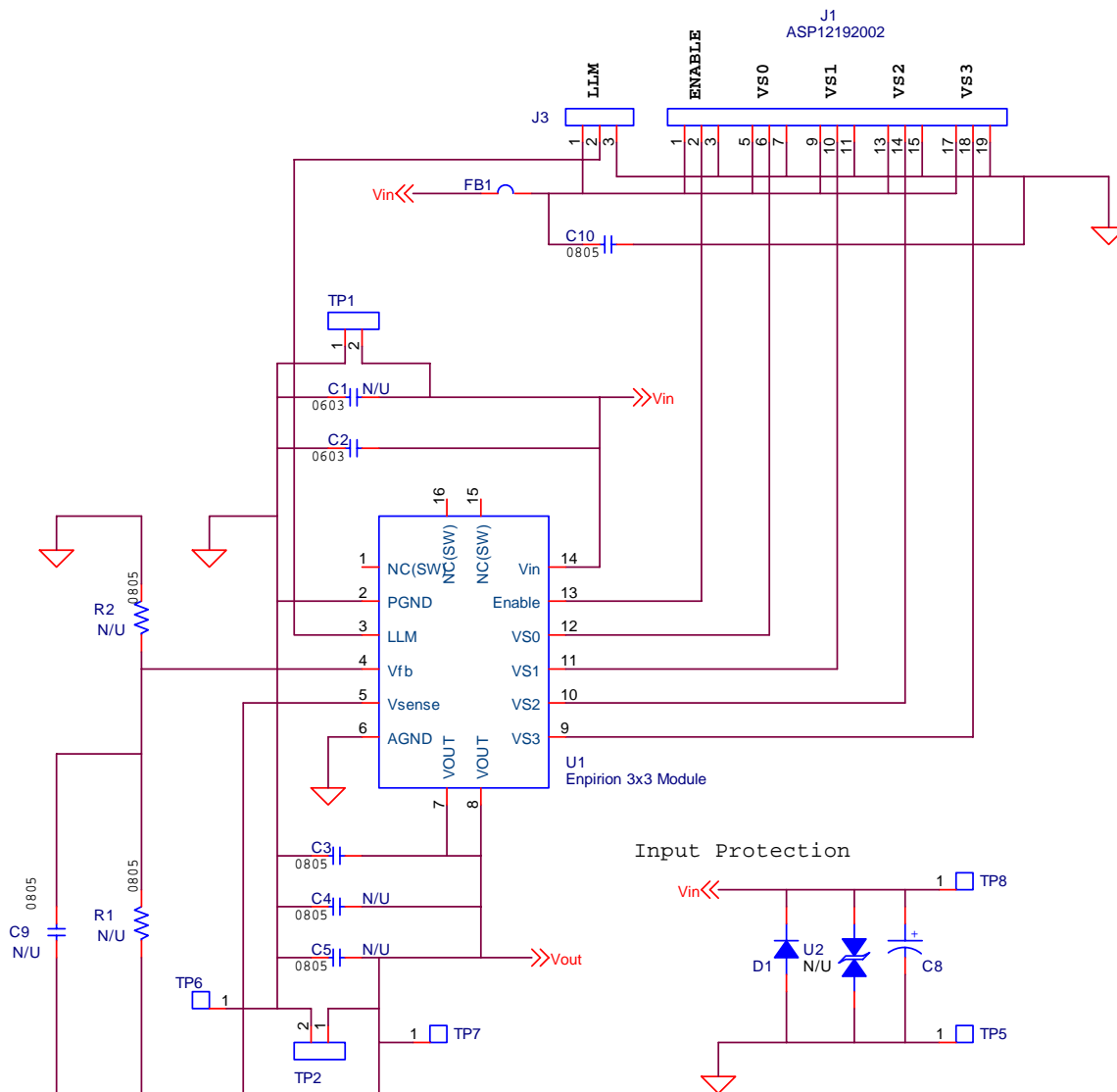
Preliminary

Figure 4: 3x3 Module Evaluation Board Schematic

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