

Enpirion EP5388QI DC/DC Converter Module Evaluation Board

Introduction

Thank you for choosing Altera Enpirion power products!

This application note describes how to test the EP5388QI DC/DC converter using its evaluation board EP5388Q-E. In addition to this document you will also need the device datasheet.

The EP5388QI is part of a new class of DC/DC converter products, a complete power system on silicon:

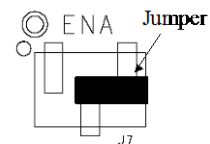
- The EP5388QI is a complete module including magnetics and requiring only ceramic input and output capacitors.
- The evaluation board is designed to offer a wide range of engineering evaluation capabilities. This includes the base configuration of an 0603 10uF input capacitor and an 1206 47uF output capacitor.
- Pads are available to populate an external divider if desired.
- Easy jumpers are provided for the following signals:
 - Enable
 - VS0-VS2 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 reverse polarity protection to safeguard the device from common setup mishaps.

Quick Start Guide

Figure 1 shows a top view of the evaluation board.

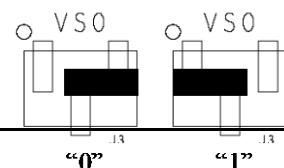
STEP 1: Set the “ENA” jumper to the Disable Position.

CAUTION: the signal pins, ENA, VS0, VS1, and VS2 must be connected to a “high” or a “low”. If left floating the state is indeterminate.



Output Disabled

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



CAUTION: the external divider is not populated. Choosing the “User Selectable” option will force the device to 100% duty cycle.

STEP 3: Connect Power Supply to the input clip leads, VIN (+) and GND 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.

STEP 4: Connect the load to the output connectors VOUT (+) and GND TP6 (-), as indicated in Figure 1. The same test points are also used to measure the DC output voltage.

STEP 5: Power up the board and move the ENA jumper to the enabled position. The EP5388QI is now powered up.

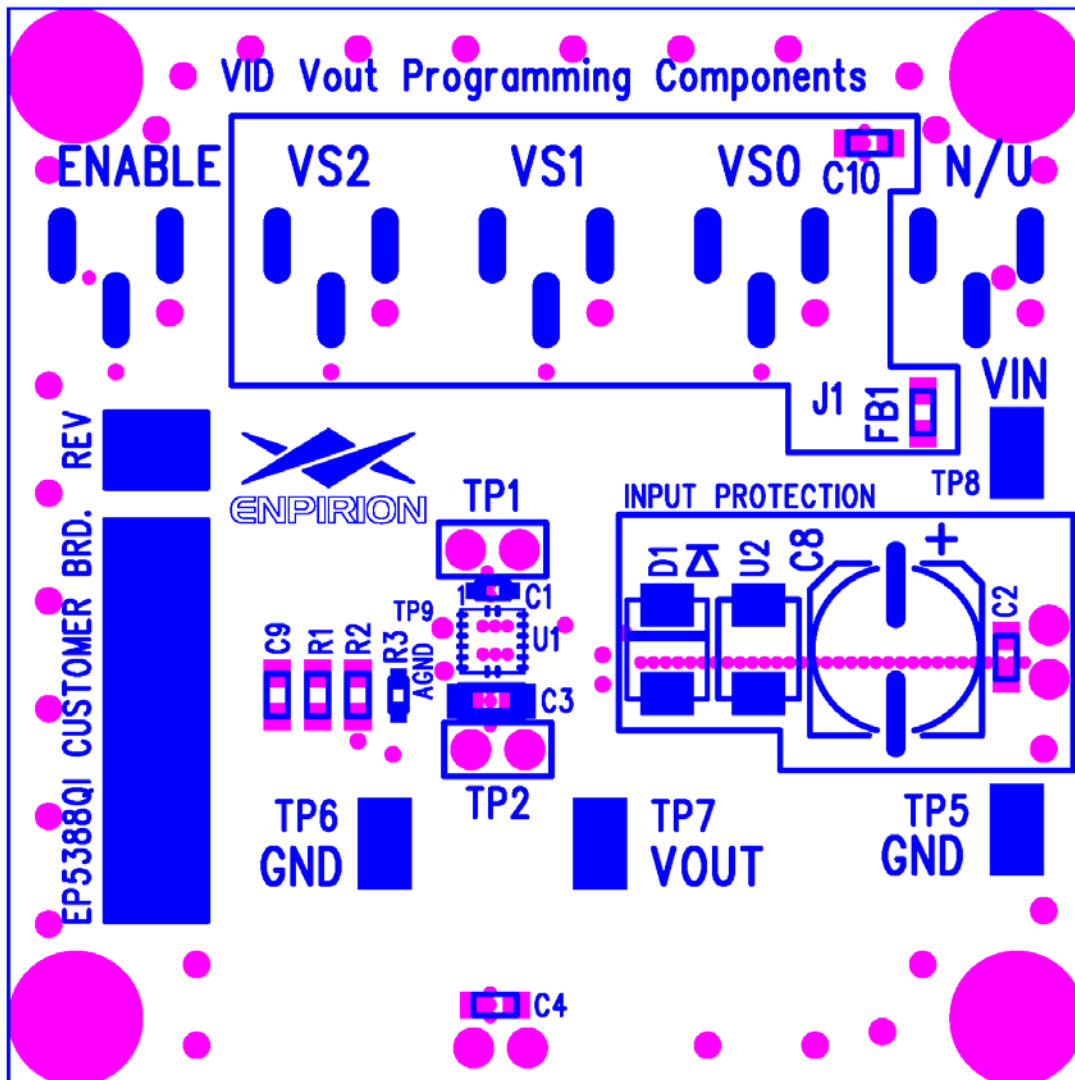


Figure 1. Evaluation Board Layout Assembly Layer

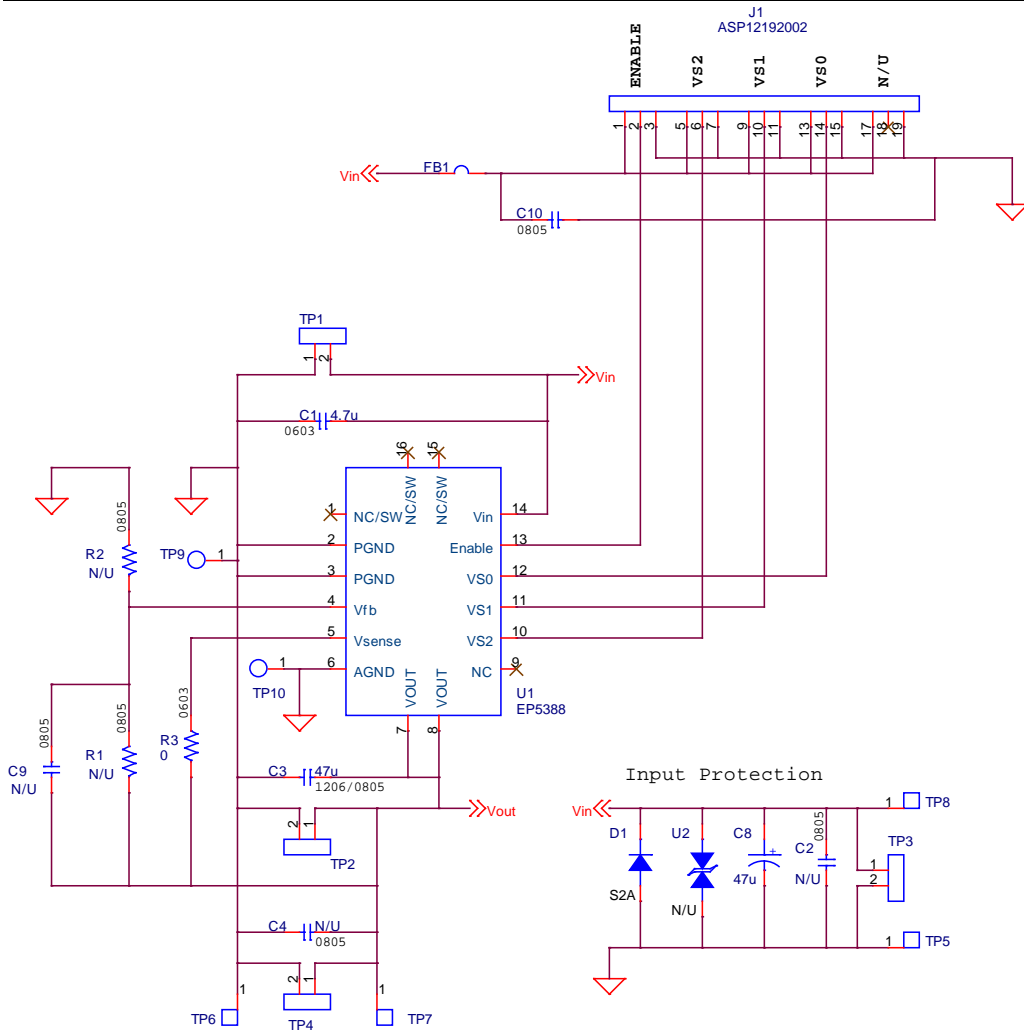


Figure 2. Evaluation Board Schematic

Output Voltage Select

Table 1. Output Voltage Select Truth Table

VS2	VS1	VS0	V _{OUT}
0	0	0	3.3V
0	0	1	2.5V
0	1	0	1.8V
0	1	1	1.5V
1	0	0	1.25V
1	0	1	1.2V
1	1	0	0.8V
1	1	1	User Selectable

The EP5388QI utilizes a 3 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

Table 1 shows the truth table for V_{OUT} selection. There are seven preset output voltage levels which can be chosen via the VSx jumpers.

CAUTION: the standard evaluation board configuration does not populate the external divider. Selecting the external divider option without populating the external divider will result in unpredictable behavior but can result in the device going into 100% duty cycle and delivering the input rail voltage to the output.

CAUTION: All signal pins must be connected to either a logic “1”, jumper to the left, or to a logic “0”, jumper to the right. Leaving the jumper open will result in an indeterminate state.

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 3, and through-hole test point pair TP2 to measure the output voltage ripple to avoid noise coupling into the probe ground lead.

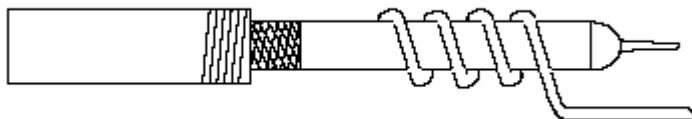


Figure 3: Balanced-impedance oscilloscope probe. Wrap bare wire around the ground shaft and bring the wire close to the probe tip. This minimizes probe loop inductance and stray noise pickup by the probe.

Using The External Voltage Divider

The EP5388-E evaluation board is designed to provide a great deal of flexibility in evaluating the performance of the Altera Enpirion DC/DC module.

Pre-tinned pads are provided to place 0805 sized resistors on the board to implement an external resistor divider to choose an output voltage other than one of the seven pre-set voltages available on the VID. See Figure 2 the eval board schematic. Figure 4 shows the the basic circuit for the external divider.

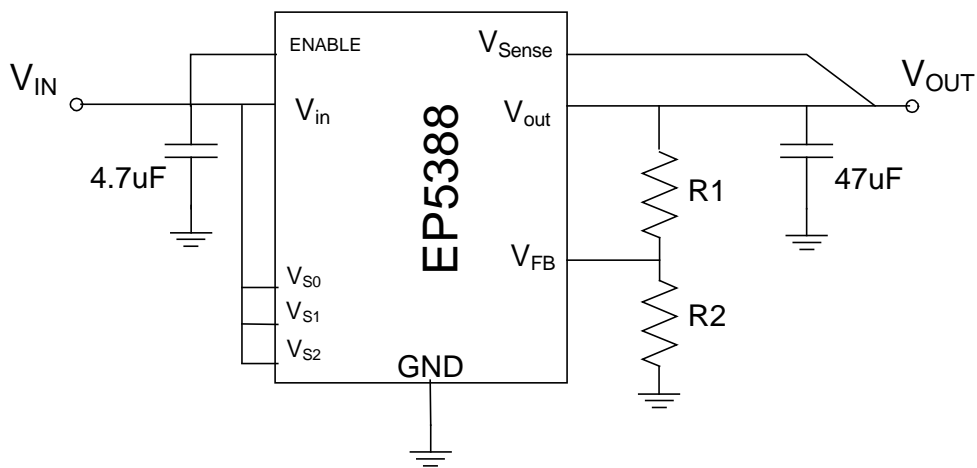


Figure 4. External divider schematic.

The output voltage is selected by the following formula:

$$V_{OUT} = 0.603V\left(1 + \frac{R_1}{R_2}\right)$$

R_1 must be chosen as 200K Ω to maintain proper loop operation. Then R_2 is given as:

$$R_2 = \frac{1.206 \times 10^5}{V_{OUT} - 0.603} \Omega$$

The external voltage divider option is chosen by setting the jumpers VS0, VS1, and VS2 to a logic “high”.

It is possible to use a 10uF output cap in external divider mode. In this case, R3 on the eval board has to be removed, and a 10pF capacitor has to be placed for C9. Please see the datasheet for more details.

Dynamically Adjustable Output

The EP5388QI 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 nominal slew rate is 1.5mV/uS.

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 requirement is 4.7uF 0603, and the board is populated accordingly. The **output** capacitance requirement is 47uF 1206 in VID mode, and can be 10uF 0805 in external feedback mode. Please see the datasheet and the section on external voltage programming.

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



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