Enpirion EV1380QI 8A DC/DC Converter w/Integrated Inductor Evaluation Board

Introduction

Thank you for choosing Altera Enpirion power products!

This user guide is applicable to evaluation boards with part number 04171 as labeled on the back side of the PCB. Along with this document you will also need the latest device datasheet.

- The EV1380QI features integrated inductor, power MOSFETS, Controller, bulk of the compensation Network, and protection circuitry against system faults. This level of integration delivers a substantial reduction in footprint and part count over competing solutions. The evaluation board is optimized for ease of use through programming options, clip leads, test points etc.
- The EV1380QI features a customer programmable output voltage by means of a resistor divider. This evaluation board, as shipped is populated with one option for Vol. It is programmed so that Vol will be half of VDDQ.
- The EV1380QI includes the bulk of the compensation network internally. However, an external phase-lead (zero) capacitor and resistor is required in addition to two resistor dividers to set the output voltage. This network is shown in Figure -1. Appropriate component values allow for optimum compensation for a given VDDQ voltage and choice of loop bandwidth. The values in Figure 1 are as populated on the eval board, and have been optimized for VDDQ = 1.5V. The circuit in Figure 1 will be stable for lower values of VDDQ as well. For VDDQ higher than 1.5V, please see the datasheet to calculate the resistor divider and compensation values.
- A footprint is provided for a SMC connector (not populated) for S_IN. A clock source may be applied to S_IN to synchronize the device switching frequency to the external source. S_OUT will output a clock signal synchronous with the switching frequency. S_OUT of one EV1380QI may be connected to S_IN of another EV1380QI.
- Jumpers or test points are provided for ease of logical 1/0 programming of the following signals:
  - Enable (ENA)
  - Master/Slave ternary input
  - EN_PB input
Enable may also be controlled using an external switching source by removing the jumper and applying the enable signal to the middle pin and ground.

- The board comes with input decoupling and reverse polarity protection to guard the device against common setup mishaps.

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### Quick Start Guide

**Figure 2: J2 allows control of the Enable pin.**

The jumper on Enable pin as shown is in disable mode. When jumper is between the middle and right pins the signal pin is connected to ground or logic low. When the jumper is between the left and middle pins, the signal pin is connected to AVIN or logic High.

**WARNING:** complete steps 1 through 6 before applying power to the EV1380QI evaluation board.

**STEP 1:** Set the “ENA” jumper to the Disable Position. See Figure 2 above.

**STEP 2:** Set the EN_PB jumper J1 to the desired position. See Figure 3. Pulling it low disables the pre-bias mode operation. Pulling this jumper high or letting it float will allow monotonic start-up with a pre-biased output. In pre-bias mode, VOUT will not discharge very quickly. Therefore, you may need to apply a small load (~10mA) at shut-down to ensure that

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\[
R_C = 20 \, k\Omega \quad R_D = 10 \, k\Omega \\
R_A = 60.4 \, k\Omega \quad R_B = 121 \, k\Omega \\
C_A = 130 \, pF \quad R_i = 3.01 \, k\Omega
\]

With this circuit, VOUT will be halve of VDDQ.
the output voltage discharges. In Figure 3 the jumper is set low to
disable pre-bias mode.

Figure 3: J1 controls EN_PB input.

**STEP 3:** Assuming parallel operation is not needed, leave the M/S jumper not
populated (floating).

**CAUTION:** Except ENA, no other jumpers can be changed while the
EV1380QI is powered on. Doing so could result in damage to the part.

**STEP 4:** Connect the VDDQ Power Supply to the input power connectors,
VDDQ (J7) and GND (J11) as indicated in Figure 4 and set the power
supply to the desired voltage (≤1.8V). For VDDQ more than 1.5V, the
loop compensation values will have to be adjusted according to the
datasheet.

**CAUTION:** Be mindful of the polarity and magnitude. Even though the
evaluation board comes with reverse polarity protection diodes, it may not
protect the device for all conditions.

**CAUTION:** The OCP circuit does not operate properly on these boards.
Do not short VOUT or attempt to draw load currents beyond 8A.
Program VDDQ lab power supply over-current limit to 5.5A to additionally
protect the EV1380 if VOUT is shorted.

**STEP 5:** Connect AVIN power supply to the input connectors AVIN (J12) and
GND (J11) as indicated in Figure 4 and set the power supply to the
desired voltage (≤3.6V).

**CAUTION:** The AVIN power connection on this board has no reverse
polarity or voltage clamping protection on it.

**STEP 6:** Connect the load to the output connectors VOUT (J6) and GND (J10),
as indicated in Figure 4.

**STEP 7:** Power up the board by turning on the AVIN power supply first and then
the VDDQ supply. Next, move the ENA jumper to the enabled position.
The EV1380QI is now powered up and VOUT should be half of VDDQ.
You are free to make Efficiency, Ripple, Line/Load Regulation, Load transient, Power OK, and temperature related measurements.

**STEP 7A: Power Up/Down Behavior** – Remove ENA jumper and connect a pulse generator (output disabled) signal to the middle pin of ENA and Ground. Set the pulse amplitude to swing from 0 to 2.5 volts. Set the pulse period to 10msec., duty cycle to 50% and fast transition (<1usec.) Hook up oscilloscope probes to ENA, POK and V_OUT with clean ground returns. Enable pulse generator output. Observe the V_OUT voltage ramps as ENA goes high and again as ENA goes low.

**STEP 8:** You can also operate the board by leaving the ENA jumper in the high position. Then apply AVIN to the board. Next, turn on the VDDQ supply. The output will ramp up and down as half of VDDQ all the time.

**ALWAYS** power down device before changing any board level components!
Figure 4: Evaluation Board Top Side and Bottom Side (viewed from the top) Assembly Layers.
Figure 5: Evaluation Board Schematic
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 surface mount 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 calibrated series ammeters or accurate shunt resistors. This is especially important for measuring efficiency.

3. Use a low-loop-inductance probe tip shown below to measure $V_{OUT}$ and switching signals to avoid noise coupling into the probe ground lead. Output ripple and load transient deviations are conveniently measured at TP19. For more accurate ripple measurement, please refer to Enpirion App Note regarding this subject (www.altera.com/enpirion).

![Probe Tip Image]

4. The board includes a pull-up for the POK signal and ready to monitor the power OK status.

5. A soft-start capacitor is populated on the board to provide a reasonable soft-start time. It can be changed as needed.

6. Please note that the OCP circuit on these boards does not operate properly. See the caution statement in step 4 in the quick start section.

Input and Output Capacitors

Please refer to the BOM section for the value of input caps and output caps used on this evaluation board, which is the result of combination for better performance and smaller footprints.

NOTE: Capacitors must be X5R or X7R dielectric formulations to ensure adequate capacitance over operating voltage and temperature ranges.
### Bill of Materials

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### Contact Information

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