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

Introduction

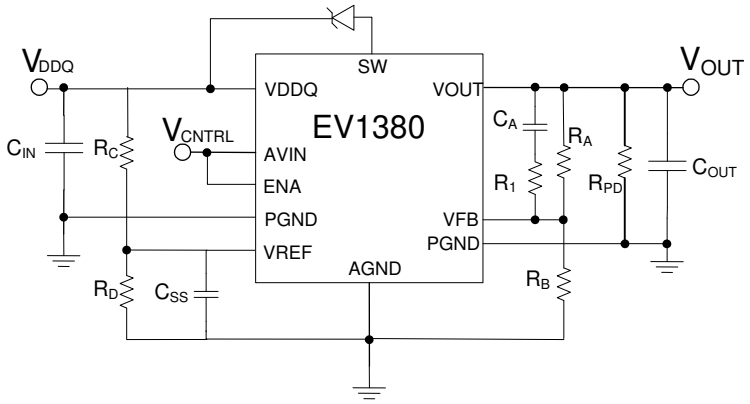
Thank you for choosing Altera Enpirion power products!

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 V_{OUT}. It is programmed so that V_{OUT} 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.



$R_C = 20\,k\Omega$, $R_D = 10\,k\Omega$
$R_A = 60.4\,k\Omega$, $R_B = 121\,k\Omega$
$C_A = 130\,pF$, $R_1 = 3.01\,k\Omega$

With this circuit, VOUT will be half of VDDQ.

Figure 1: Output voltage programming and loop compensation

Quick Start Guide

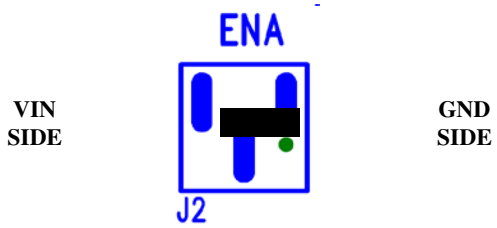


Figure 2: J2 allows control of the Enable pin.

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

the output voltage discharges. In Figure 3 the jumper is set low to disable pre-bias mode.

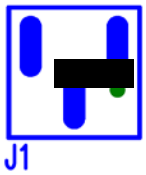


Figure 3: J1 controls EN_PB input.

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!

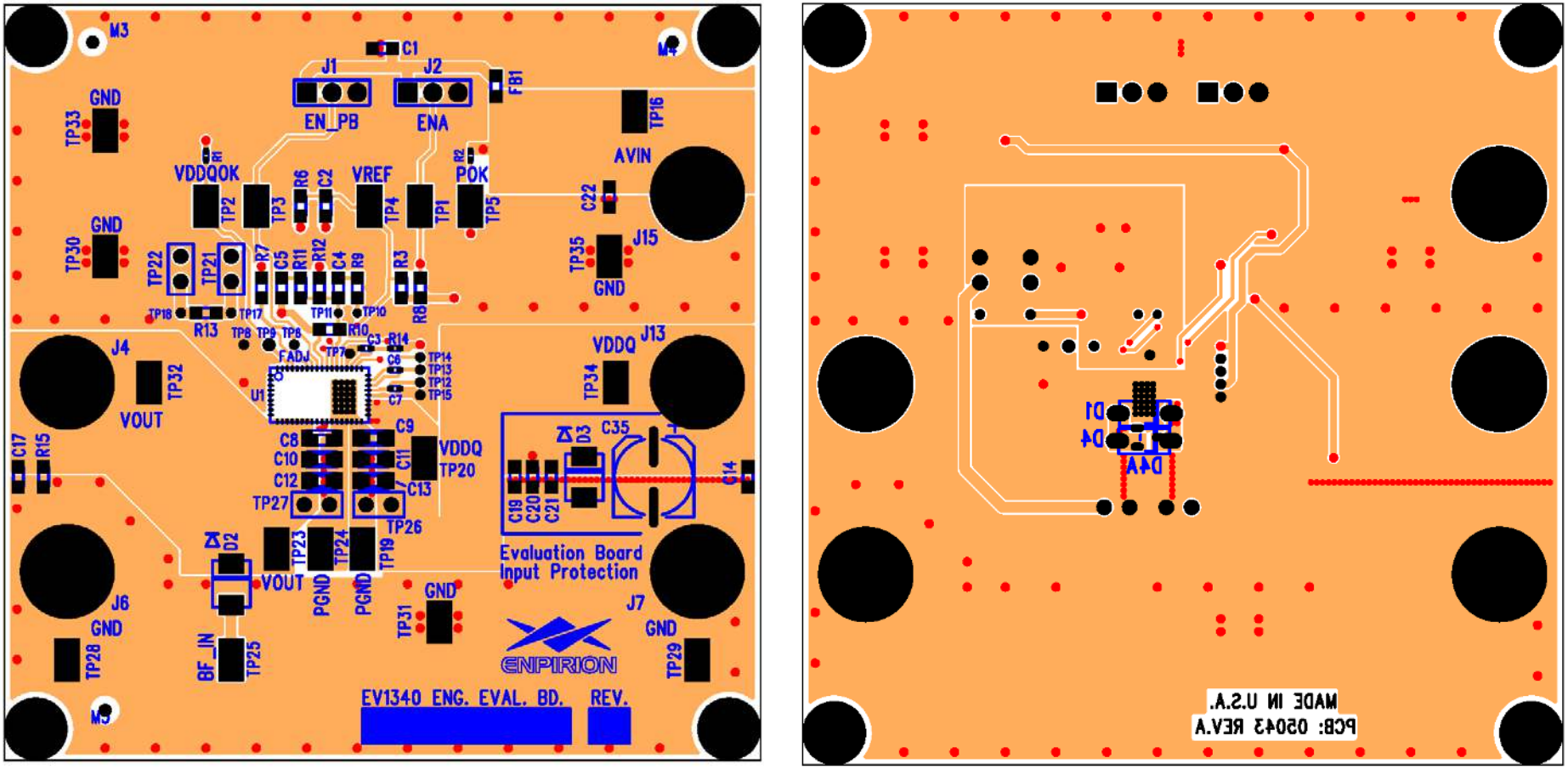


Figure 4: Evaluation Board Top Side and Bottom Side (viewed from the top) Assembly Layers.

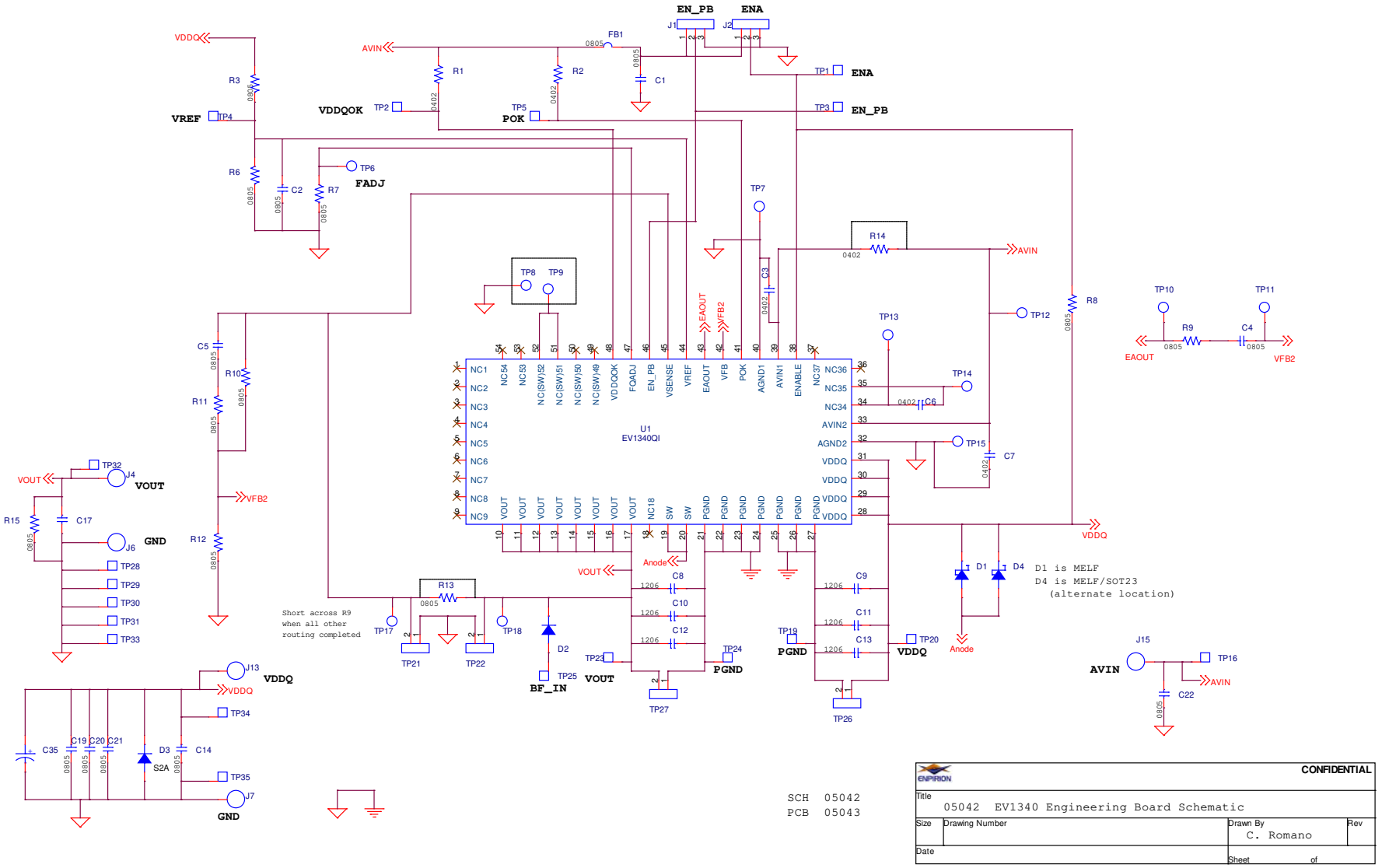
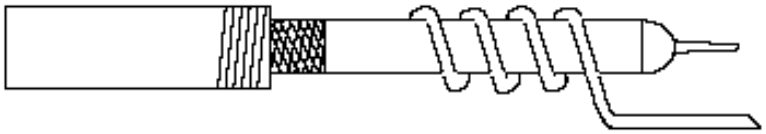


Figure 5: Evaluation Board Schematic

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).



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

Designator	Qty	Description
C1, C19-C22	5	CAP, 10uF 0805 X7R 10% 10V CERAMIC
C2	1	CAP, 15000pF 10% 50V SMD 0805 X7R CERAMIC
C5	1	CAP CERAMIC 33PF 50V NP0 0805
C8, C10	2	CAP, CER 100UF 6.3V X5R 1206
C9	1	CAP, CER 47UF 6.3V X5R 0805
C35	1	CAP, SMT ELECTROLYTIC, 150UF, 20%, 10V
C3, C4, C6, C7, C11-C14, C17, D4, R9, R13, R14	13	NOT USED
D1, D2	2	S2A DIODE
D3	1	DIODE SCHOTTKY 1A 40V MELF
FB1	1	MULTILAYER SMD FERRITE BEAD 4000MA 0805 L=TYPICAL (NOT GUARANTED)
R6	1	RES 1/10W 3.01K OHM 0.1% 0805
R2	1	RES 2.0 K OHM 1/8W 0.1% 0805 SMD
R4	1	RES 3.01K OHM 1/8W 1% 0805 SMD
R1, R7	2	RES 100K OHM 1/16W 1% 0402 SMD
R3	1	RES 60.4K OHM 1/8W 0.1% 0805 SMD
R5	1	RES 240K OHM 1/8W 0.1% 0805 SMD
R10	1	13K 1/8W 1% 0805 RESISTOR THICK FILM
J1-J3	3	CONN, VERTICAL, 3 POSITION, SMT
J6, J7, J10-J12	5	BANANA JACK
TP1-TP5, TP13-TP16, TP21, TP22, TP28-TP30	14	TEST POINT SURFACE MOUNT
U1	1	EV1380QI QFN 12A
U2	1	TRANSIENT VOLTAGE SUPPRESSOR, 6.5V, BIDIRECTIONAL, SMT

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