Using the LP8758-E0EVM Evaluation Module

User's Guide

Literature Number: SNVU503
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The LP8758-E0EVM Evaluation Module

This user's guide describes the operation of the evaluation module for the LP8758-E0 DC-DC Step-Down Converter from Texas Instruments (TI). See the LP8758-E0 data sheet. This user's guide also provides design information including the schematic and Bill of Materials (BOM).

1 Overview

The LP8758-E0EVM customer evaluation module demonstrates the LP8758-E0 device from TI. The LP8758-E0 is designed to meet the power management requirements for low-power processors in mobile phones, network cards, and similar applications. The device contains four step-down DC-DC converter cores, which provides four output voltage rails. This document includes information regarding user software available on the web and design documentation including schematics and a bill of materials.

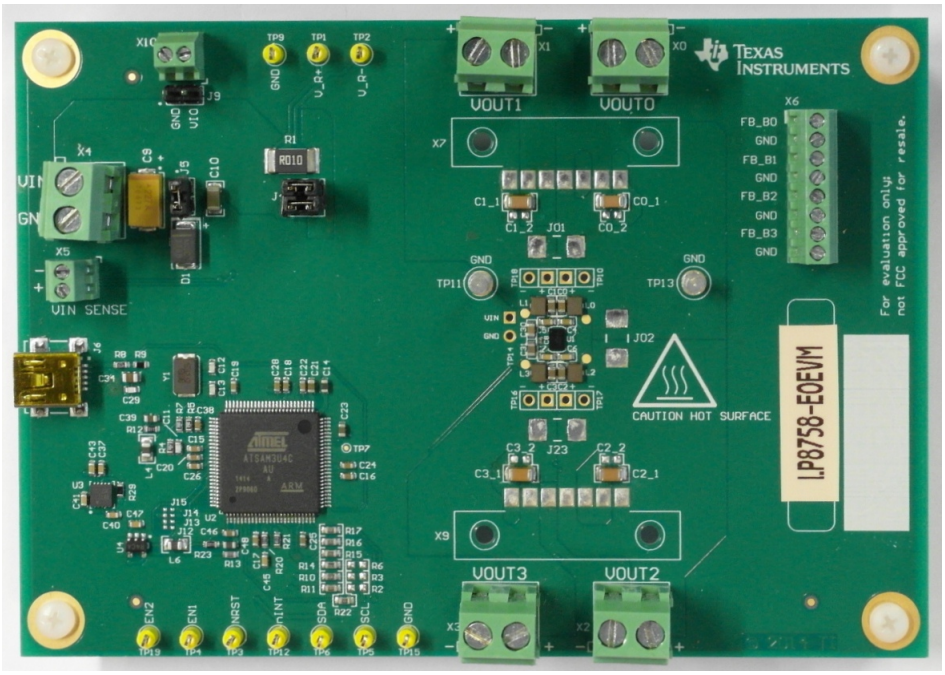


Figure 1. LP8758-E0EVM

2 Quick Setup Guide

Many of the components on the LP8758-E0EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD-handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

On opening the LP8758-E0EVM package, ensure that the following items are included:

- LP8758-E0 Evaluation Board
- USB Cable

If any of the items are missing, contact the closest Texas Instruments Product Information Center to inquire about a replacement.

2.1 Cautions and Warnings

The EVM is designed to operate by professionals who have received appropriate technical training. Please read this document before operating the EVM. Surfaces or components near the LP8758-E0 device may become hot if high load is used.

WARNING

Warning Hot surface.

Contact may cause burns.

Do not touch

2.2 Installing/Opening the Software

The EVM software is controlled through a graphical user interface (GUI). The software communicates with the EVM through an available USB port. The minimum hardware requirements for the EVM software are:

- IBM PC-compatible computer running a Microsoft Windows® XP or newer operating system
- Available USB port
- Mouse

The latest downloadable software is available at www.ti.com. Download the zip file onto a local hard drive, then unzip this folder. Run the LP8758-xxEVM_GUI_Setup installer. Connect the EVM to the PC with the USB cable. Refer to Figure 1.

1. With the power supply disconnected from the unit under test (UUT), start the LP8758-xxEVM software from Start menu.
2. On the Evaluation SW window bottom right corner the text “Hardware connected” should appear. Refer to Figure 2.

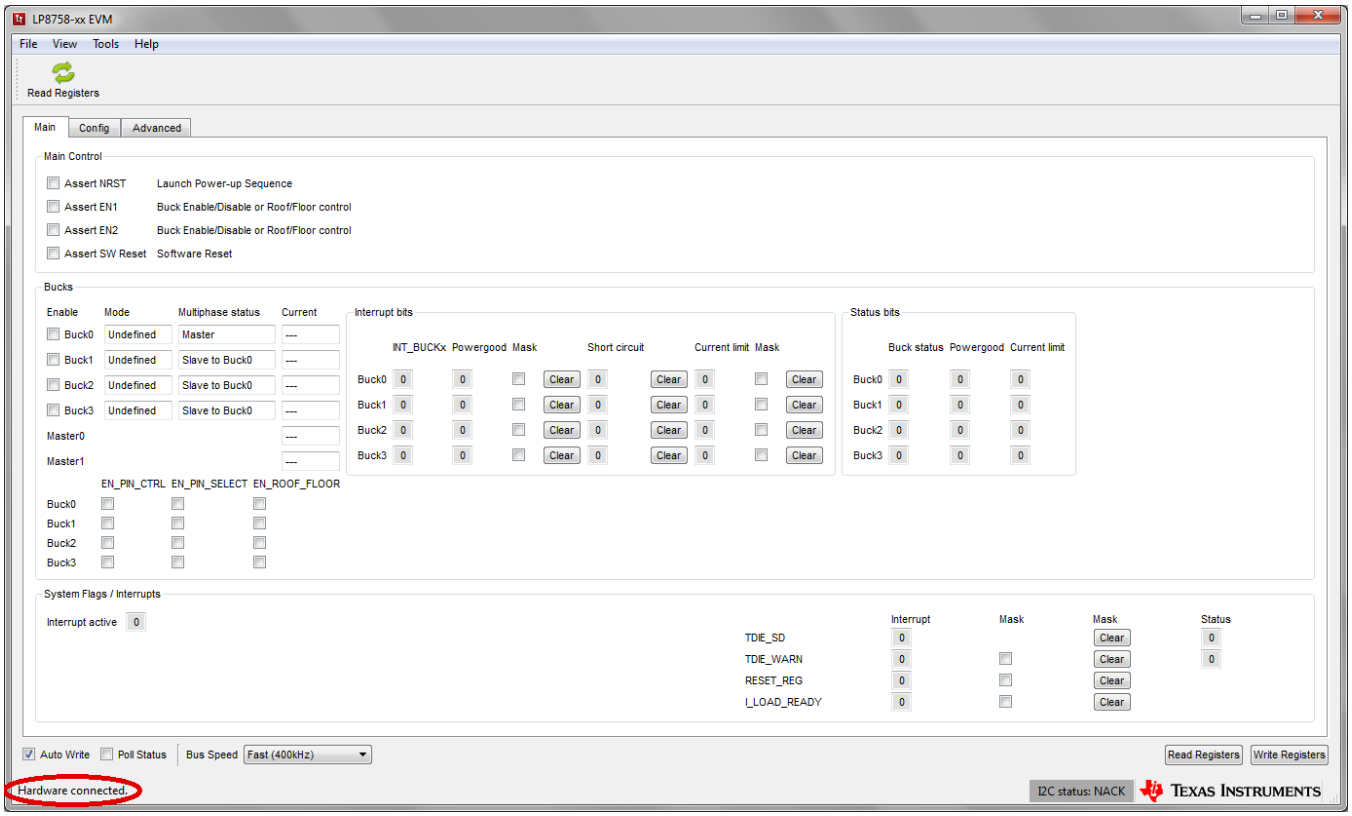


Figure 2. Evaluation Software Graphical User Interface (GUI) When Board Connected

2.3 Power Supply Setup

To power up the EVM, one power supply is needed. For full-load testing of the LP8758-E0EVM, a DC-power supply capable of at least 10 A and 4 V is required. 5 A is suggested as a practical minimum for partial load. The power supply is connected to the EVM using connector X4. The power supply and cabling must present low impedance to the UUT; the length of power supply cables must be minimized. Remote sense, using connector X5, can be used to compensate for voltage drops in the cabling.

With the power supply disconnected from the UUT, set the supply to 3.7 V DC and the current limit to 5 A minimum. Set the power supply output OFF. Connect the power supply's positive terminal (+) to VIN and negative terminal (–) to GND on UUT (X4 Power-in terminal block). Check that jumpers on the boards are set as shown in Figure 1 (factory default jumper configuration).

Set power supply output ON, then continue with the following steps:

1. On Evaluation software GUI, click on Assert NRST. See Figure 3: Marking “1”.
2. Click on Read Registers button. You should see "I2C status: ready" message on the bottom of the GUI close to the Read Registers button. See Figure 3: Marking “2”.
3. Check that Buck0, Buck1, Buck2 and Buck3 are enabled: Marking "3".
4. Click on Assert EN1. See Figure 3: Marking “4”.
5. Click on Read Registers button.
6. Check that the GUI indicates "PFM" under "Mode" and "Single" under "Multiphase status" of all bucks. See Figure 3: Marking “5”. The EVM is now ready for testing with default register settings loaded.

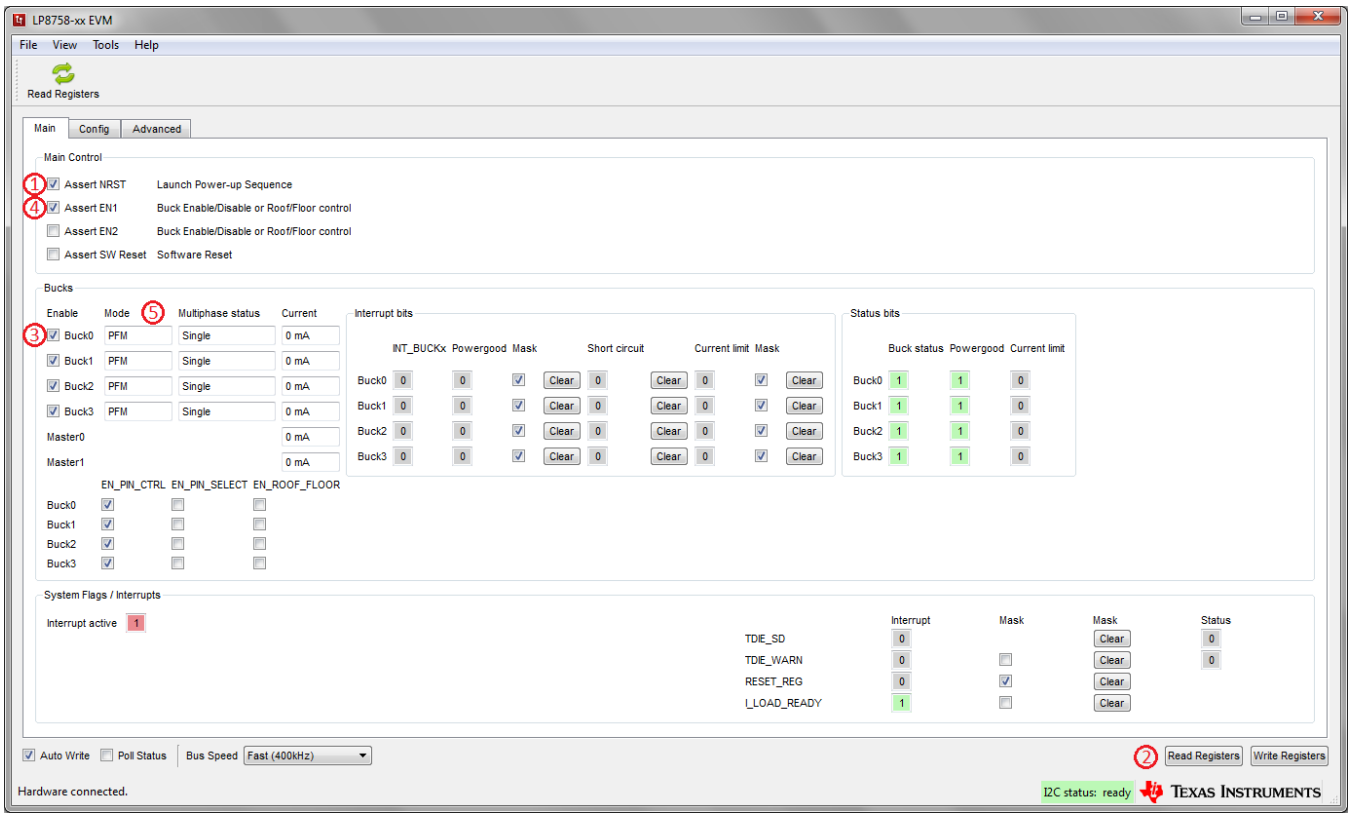


Figure 3. Evaluation Software GUI Showing Steps Needed to Power Up the LP8758-E0

2.4 Notes on Efficiency Measurement Procedure

Output Connections: An appropriate electronic load or high-power system source meter instrument, specified for operation down to 500 mV, is desirable for loading the UUT. The maximum load current is specified as 4 A per core. Be sure to choose the correct wire size when attaching the electronic load. A wire resistance that is too high causes a voltage drop in the power distribution path which becomes significant compared to the absolute value of the output voltage. Connect an electric load to X0 (Buck0), X1 (Buck1), X2 (Buck2) or X3 (Buck3). To avoid power surges or possible shocks, TI advises to set to sink 0 A prior to connecting the load.

Voltage drop across the PCB traces yields inaccurate efficiency measurements. For the most accurate voltage measurement at the EVM, use X5 or TP14 to measure the input voltage (VIN and GND) and X6 to measure the output voltage (Positive to FB_B0 (for Buck0), FB_B1 (for Buck1), FB_B2 (for Buck2) or FB_B3 (for Buck3) and negative to GND position). See Figure 4.

To measure the current flowing to or from the UUT, use the current meter of the DC power supply or electric load as long as it is accurate. Some power source ammeters may show offset of several milliamps, thus yielding inaccurate efficiency measurements. In order to perform very accurate I_Q measurements on the UUT, disconnect input protective Zener diode D1 by removing the shunt J5 from the board. When connected, this diode causes some leakage, especially on high VIN voltages.

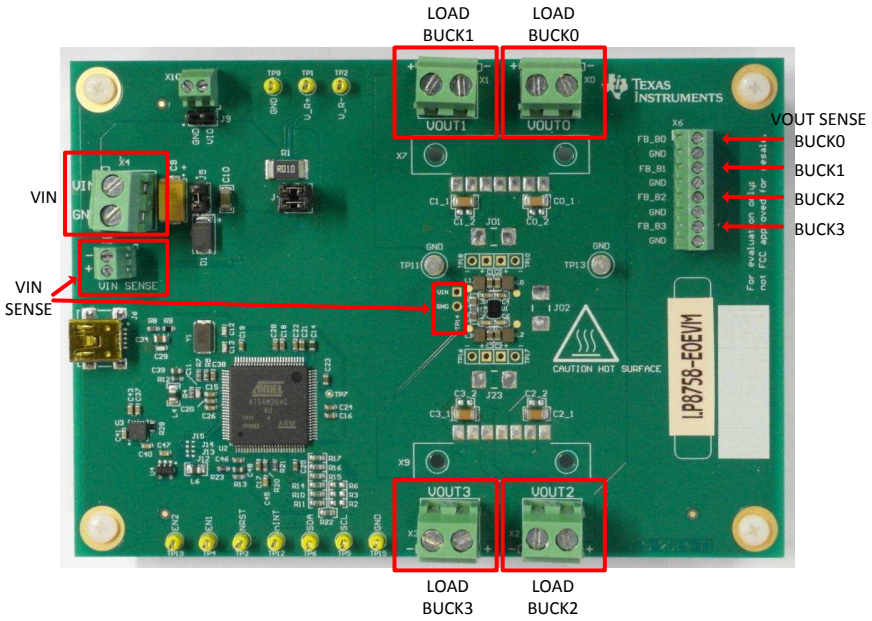


Figure 4. Connections for Efficiency Measurement

3 GUI Overview

The evaluation software has the following tabs: Main, Config, and Advanced. The three tabs together provide the user access to the whole register map of LP8758-E0.

3.1 Main Tab

The Main tab has the elemental controls for the EVM and provides a view to the chip status. Starting from top, the main controls are:

- Assert NRST: This checkbox will assert 1.8 V voltage to LP8758-E0 NRST pin. This pin will enable the chip internal voltage reference and bias circuitry.
- Assert EN1: This checkbox will assert 1.8 V voltage to LP8758-E0 EN1 pin. Asserting EN1 may enable the buck regulator(s) or switch to different output voltage level, depending on the register settings.
- Assert EN2: This checkbox will assert 1.8 V voltage to LP8758-E0 EN2 pin. Asserting EN2 may enable the buck regulator(s) or switch to different output voltage level, depending on the register settings.

- Assert SW Reset: To perform a complete software reset to the chip, assert this checkbox.

NOTE: The recommended start-up sequence for LP8758-E0 is to first assert NRST, then write all needed configuration bits by using the GUI, and then enable buck regulators by ENx pin or EN_BUCKx bits.

The "Bucks" section provides status information and enable controls for all the four buck cores. On the left of the section is the check-box for the buck enable bit. The "Mode" field provides information on each of the buck core and can have any of the values given in Table 1:

Table 1. Mode Information

Buck Mode	
Disabled	Buck state machine in 'disable'
Start-up	Buck state machine in 'start-up'. May occur when too much loading is present when powering-up the buck.
PWM	Pulse Width Modulation
PFM	Pulse Frequency Modulation
Sleeping	Multi-phase slave is passive

The "Multiphase status" info field tells whether a buck core is configured as a single, a master or a slave. The field also tells how many phases are active if buck is in multi-phase operation. The "Current" field gives the result of the buck converter load current measurement operation. Output currents of each buck core and total output current of master are shown on the fields.

The "System Flags / Interrupts" as well as the "Interrupt bits" and the "Status bits" inside the "Bucks" section give data on system faults and warnings. If the interrupt is set for any reason the Interrupt active field shows ‘1’ on red background. The flag causing the interrupt is also set on the Main tab. Interrupts on the LP8758-E0 device can only be cleared by writing ‘1’ to associated registers. Any individual flag can be cleared by clicking the "Clear" button next to each flag field. Some of the flags also have a mask bits. If "Mask" check-box of certain flag is checked, the interrupt is not generated. The "Status" bits shows the current status of the faults.

At the bottom of the GUI window is the "Auto Write" checkbox. If "Auto Write" is checked (default) any checking, un-checking or pull-down menu selections immediately launches I^2C writes to the chip register(s). If not checked, the user can update the chip registers to correspond the configuration selected on the GUI by clicking "Write Registers".

If "Poll Status" is selected the software sends a query to the LP8758-E0 at a fixed interval in order to detect the status of the chip, including operation mode, multi-phase status, and output current. If not selected, user can read the registers by applying "Read Registers". "Bus Speed" pull-down menu selections are given in the Table 2 and are instantly applied for System I^2C.

Table 2. I^2C-Compatible Bus Support

Bus Speed Selection	Explanation
Fast (400 kHz)	Fast I^2C-compliant operation at 400 kHz
High-Speed (3.4 MHz)	HS I^2C-compliant data transfer with master codes.

3.2 Other Tabs

The "Config" and "Advanced" tabs provide the user with pull-down menus and check-boxes for the part of the register space that is not covered by the Main tab, such as output voltage control. These controls are self-explanatory. Refer to the LP8758-E0 data sheet for explanation of the functions.

3.3 Direct Register Access

The "Tools" pull-down menu hosts another way of accessing the LP8758 registers. The "Direct Register Access" tool can be used to read or write any register. When using direct register access, un-checking the poll status check-box is recommended. This way the GUI only does the reads and writes commanded from the direct access dialog.

When "Direct Register Access" window is opened, the registers shown on the register map are read from the device and updated on the map. Single register can be read by selecting it from the register map and clicking the "Read Register" button. At the top right corner of the window is the "Update Mode" pull-down menu. If "Immediate" is selected (default) the register value is written to the device immediately when bit or register value is changed on the "Direct Register Access" window. If "Manual" mode is selected the register value is written by clicking the "Write Register" button.

There are three ways to change the Register Value:

1. Double clicking the "Current Value" field of the register and entering new value in hexadecimal format (Figure 5)
2. Flipping the single bit of the register by double-clicking it (Figure 6)
3. Selecting a new value from the drop-down menus of the "Field View" (Figure 7)

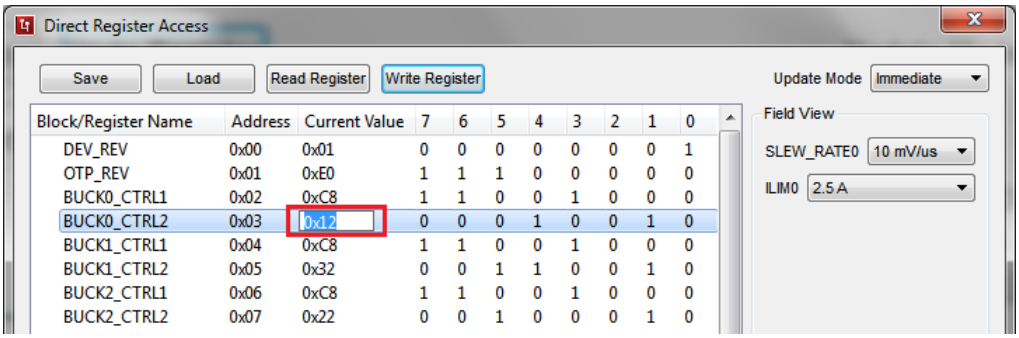


Figure 5. Entering New Register Value on the "Current Value" Field

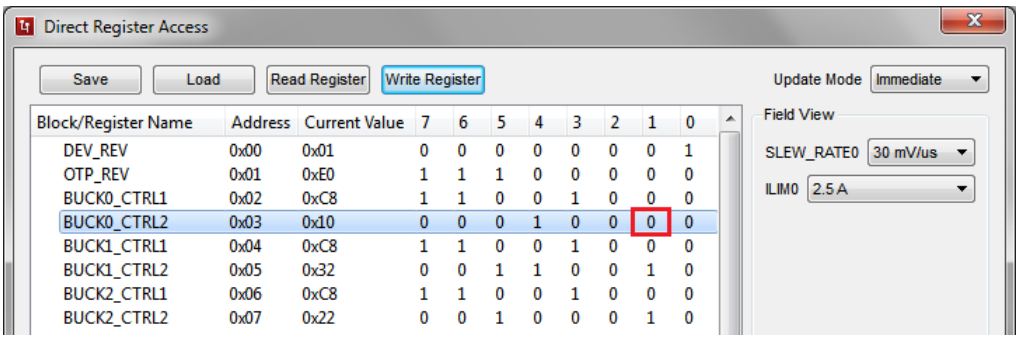


Figure 6. Flipping single Bit By Double-clicking

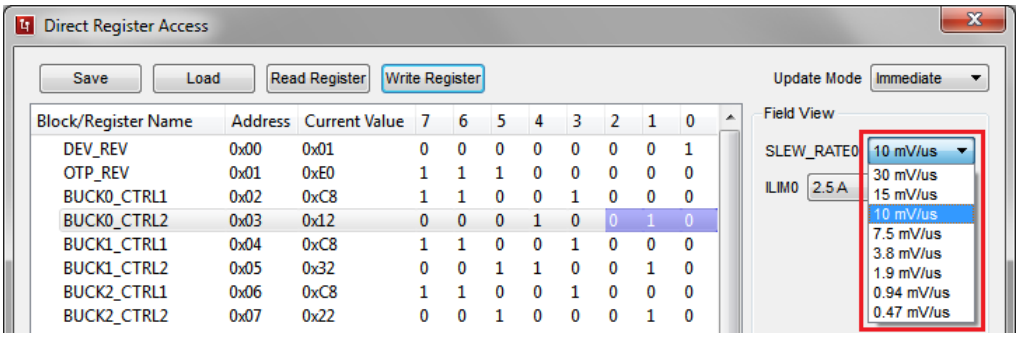


Figure 7. Selecting Value from "Field View"

Register values can be saved to a text file by using the "Save" button on the top of the window. Respectively register settings can be loaded from text file by using the "Load" button.

3.4 Console

To show or hide the console, toggle the option in View pull-down menu. The console can be used to access the LP8758-E0 registers. Registers can be read or written simply by referring to the logical registers by their name. The console has a number of integrated macros that are listed in Table 3.

Table 3. Console Macros

Command	Parameters	Explanation
register_name	= register value | -	Write a value to writable I^2C register or logical register. If no parameter given, returns the current register value. The logical register names are the same as given in the datasheet, and must be in uppercase. Example: BUCK0_VSET = 40
wait	(time)	Wait for time given in ms. Useful in loops.
iout	(buck number)	Returns the measured load current of the chosen buck core.
0x	address = data or address[bits] = data	I^2C read or write command. addr = value examples: 0x12 = 0xaa 0x12[7] = 1 0x12[3:0] = 15

The console supports use of scripts. If a text file containing commands supported by the console is stored in the same folder with the evaluation software executable, then the script can be launched from the console by typing the text file name, like script.txt.

4 Bill of Materials

Designator	Description	Manufacturer	Part Number	Qty.
!PCB	Printed Circuit Board	Any	SV601110-001 REV A	1
C0, C1, C2, C3, C30, C31	CAP, CERM, 22µF, 10V, ±20%, X5R, 0603	Samsung	CL10A226MP8NUNE	6
C0_1, C1_1, C2_1, C3_1	CAP, CERM, 22µF, 10V, ±10%, X7R, 1206	MuRata	GRM31CR71A226KE15L	4
C4, C5, C6, C7	CAP, CERM, 10µF, 6.3V, ±20%, X5R, 0603	MuRata	GRM188R60J106ME47D	4
C8	CAP, CERM, 0.1uF, 10V, +/-10%, X5R, 0201	Samsung	CL03A104KP3NNNC	1
C9	CAP, TANT, 220µF, 10V, ±10%, 0.05Ω, 7343-31 SMD	AVX	TPSD227K010R0050	1
C10	CAP, CERM, 100µF, 6.3V, ±20%, X5R, 1206	MuRata	GRM31CR60J107ME39L	1
C11, C29	CAP, CERM, 10pF, 50V, +/-5%, C0G/NP0, 0603	MuRata	GRM1885C1H100JA01D	2
C12, C13	CAP, CERM, 15pF, 100V, +/-5%, C0G/NP0, 0603	MuRata	GRM1885C2A150JA01D	2
C14, C21, C23, C39, C48	CAP, CERM, 10uF, 16V, +/-20%, X5R, 0603	Taiyo Yuden	EMK107BBJ106MA-T	5
C15, C16, C17, C18, C19, C20, C22, C24, C25, C26, C28, C38, C46	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	MuRata	GRM188R71E104KA01D	13
C34	CAP, CERM, 10uF, 16V, +/-10%, X5R, 0805	Taiyo Yuden	EMK212BJ106KG-T	1
C37, C41, C43, C45, C47	CAP, CERM, 1uF, 25V, +/-10%, X5R, 0603	MuRata	GRM188R61E105KA12D	5
C40	CAP, CERM, 0.01uF, 50V, +/-10%, X5R, 0603	MuRata	GRM188R61H103KA01D	1
D1	Diode, Zener, 5.6V, 5W, SMB	Micro Commercial Co	SMBJ5339B-TP	1
H1, H2, H3, H4	MACHINE SCREW PAN PHILLIPS 4-40	B&F Fastener Supply	NY PMS 440 0050 PH	4
H5, H6, H7, H8	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C	4
J0, J1A, J2A, J3A	RES, 0 ohm, 5%, 0.063W, 0402	Vishay-Dale	CRCW04020000Z0ED	4
J4	Header, TH, 100mil, 2x2, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-D	1
J5, J9	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	2
J6	Conn Rcpt Mini USB2.0 Type B 5POS SMD	TE Connectivity	1734035-2	1
L0, L1, L2, L3	Inductor, Shielded, Metal Composite, 470nH, 3.9A, 0.029 ohm, SMD	TDK	VLS252010HBX-R47M	4
L4, L6	Inductor, Wirewound, Ferrite, 10uH, 0.12A, 0.5 ohm, SMD	Taiyo Yuden	LB2012T100KR	2
R1	RES, 0.01 ohm, 1%, 3W, 2512 High Power Current Sense Chip Resistor	Bourns	CRA2512-FZ-R010ELF	1
R4	RES, 6.80k ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-076K8L	1
R5, R7	RES, 39.0 ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-0739RL	2
R8	RES, 47.0k ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-0747KL	1
R9	RES, 27.0k ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-0727KL	1
R10, R11, R13, R14, R15, R16, R17, R22	RES, 0 ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06030000Z0EA	8
R12, R23	RES, 1.00 ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-071RL	2
R20, R21	RES, 1.00k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW06031K00FKEA	2
R29	RES, 470k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW0603470KJNEA	1
SH-J9, SH-J10, SH-J12	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA	3

Designator	Description	Manufacturer	Part Number	Qty.
TP1, TP2, TP3, TP4, TP5, TP6, TP9, TP12, TP15, TP19	Test Point, TH, Miniature, Yellow	Keystone	5004	10
TP11, TP13	Terminal, Turret, TH, Double	Keystone	1502-2	2
U1	LP8758-E0 Four Output Step-Down DC-DC Regulator, YFF0035	Texas Instruments	LP8758A1E0YFFR	1
U2	AT91SAM ARM-based Flash MCU, LQFP100	Atmel	ATSAM3U2CA-AU	1
U3	Dual Linear Regulator with 300 mA and 150 mA Outputs and Power-On-Reset, 10-pin LLP, Pb-Free	Texas Instruments	LP3996SD-1833/NOPB	1
U4	SOT-23 Precision Low Dropout Voltage Reference	Texas Instruments	LM4132AMF-2.5/NOPB	1
X0, X1, X2, X3, X4	PC terminal block, Pitch: 5.08 mm, Number of positions: 2	Phoenix Contact	1715721	5
X5, X10	Phoenix Contact screw terminal 2 way, 2.54mm pitch	Phoenix Contact	1725656	2
X6	Phoenix Contact screw terminal 8 way, 2.54mm pitch	Phoenix Contact	1725711	1
Y1	Crystal, 12MHz, 18pF, SMD	Abracon Corporation	ABM3-12.000MHZ-B2-T	1

5 Board Layout

This section describes the board layout of the LP8758-E0EVM. See the LP8758-E0 data sheet for specific PCB layout recommendations.

The board is constructed on a 4-layer PCB. Figure 8 shows the top view of the entire board and Figure 9 through Figure 14 show the component placement, layout and 3D view close to the LP8758-E0 device. Vias under the LP8758-E0 are filled microvias from top layer to the GND plane (layer 2), buried vias between 2nd-layer and 3rd-layer and microvias from 3rd-layer to bottom layer.

Routing is mostly done on top and bottom layers. Top layer contains the copper areas connecting the VOUT pads of the inductors and output capacitors together and to the load terminals. 2nd layer is the ground plane and 3rd layer contains the VIN copper area and copper areas for the VOUT nets. Also the bottom layer contains large copper area filled with ground. Input capacitors are placed as close to the LP8758-E0 device as possible for keeping the critical VIN and GND traces short. Output capacitors and inductors are placed around the input capacitors. Using the 0603 size input and output capacitors and 2.5 x 2 mm size inductors the total solution size is about 86.6 mm^2.

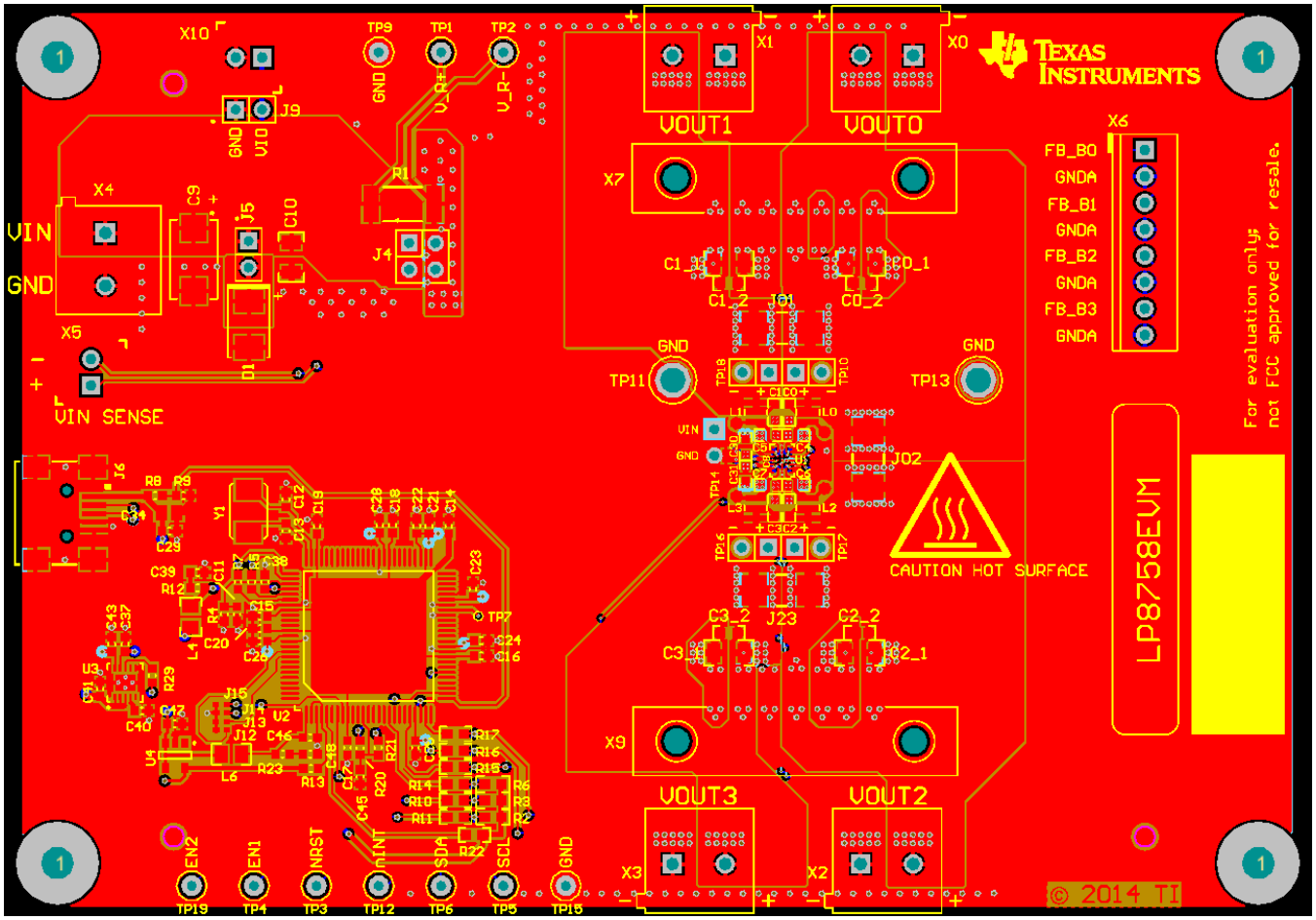


Figure 8. Top View of the LP8758-E0EVM

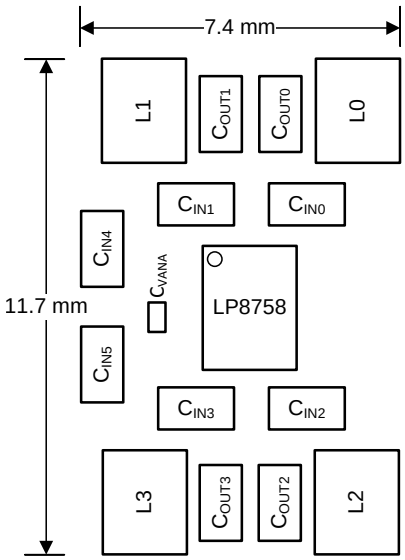
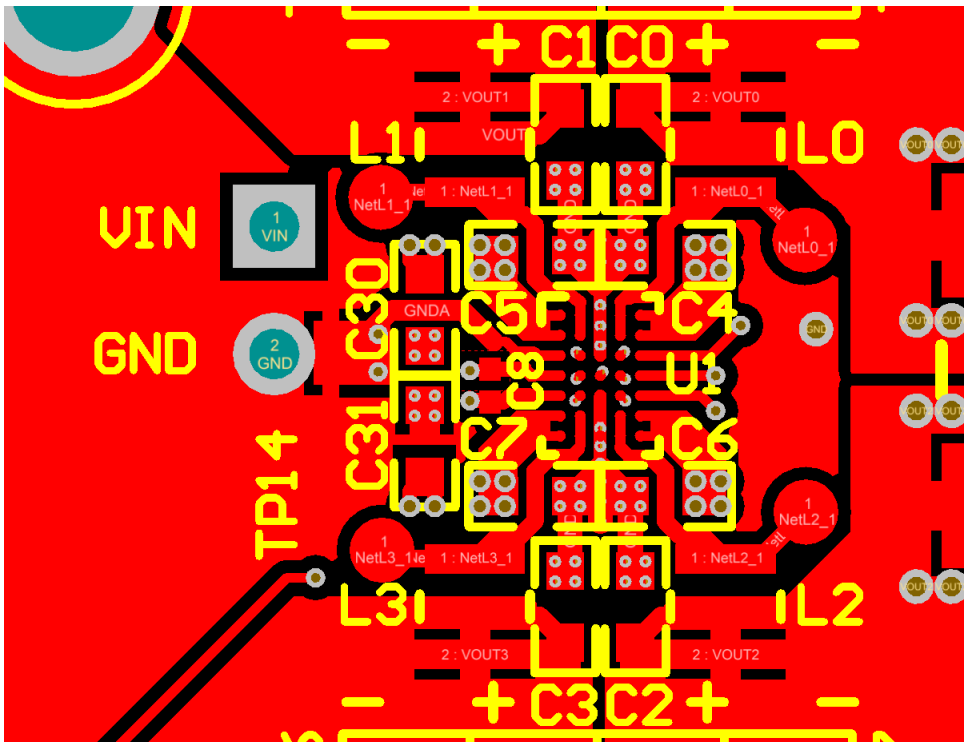
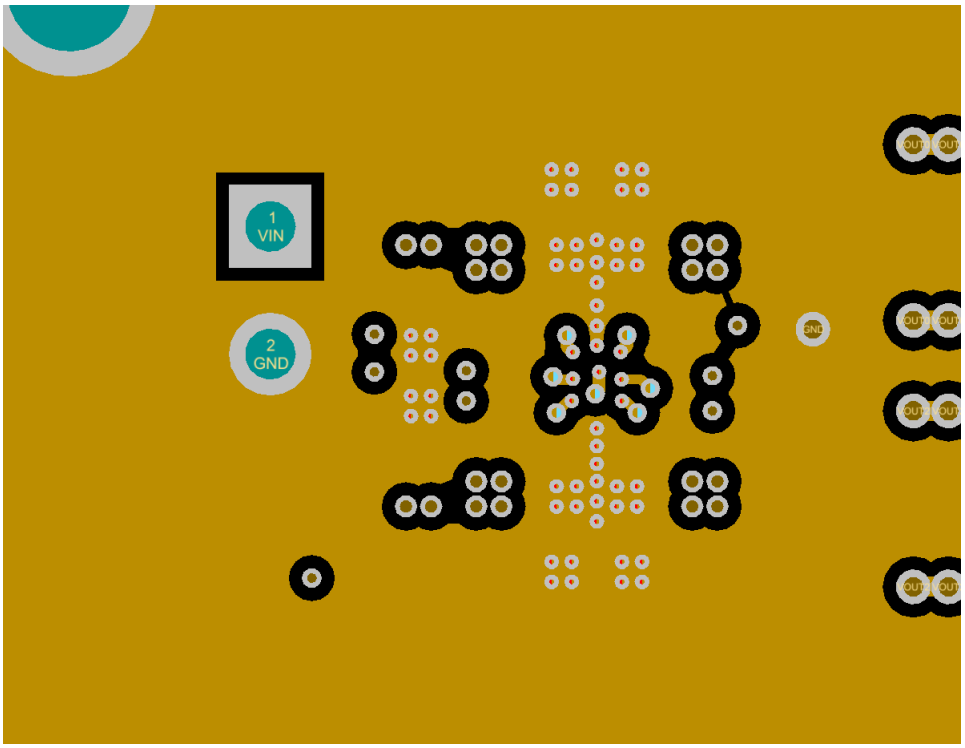


Figure 9. Component Placement near the LP8758-E0 Device



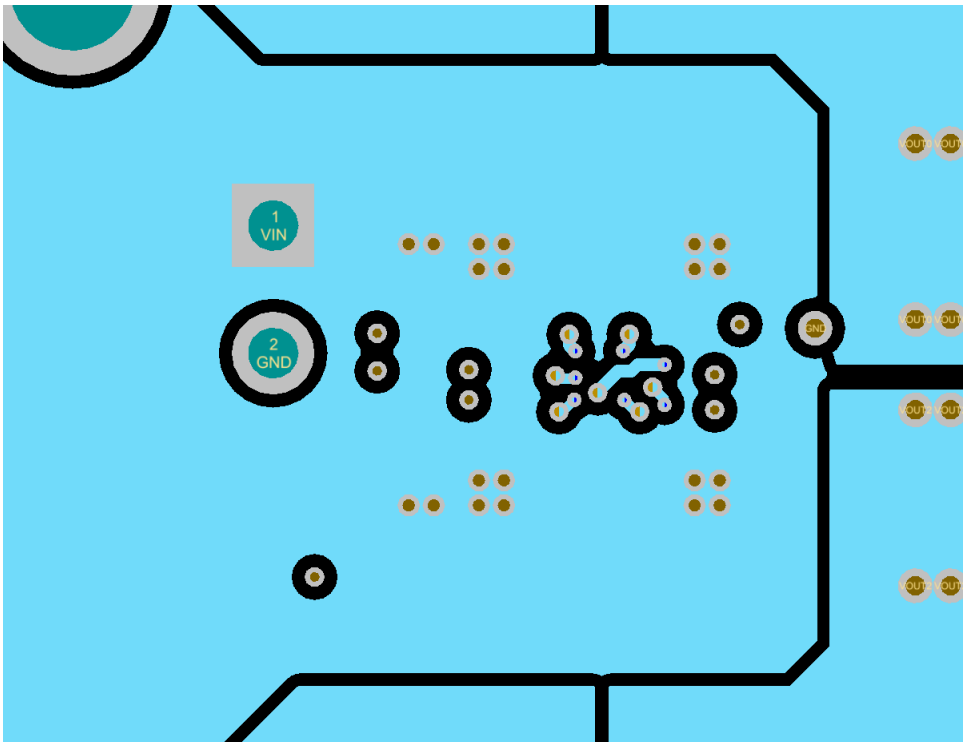
Input capacitors are placed close to the LP8758-E0 and routed on top layer. GND nets are connected to the GND plane (2nd layer) with microvias. VIN nets are connected to the VIN plane (3rd layer) with vias in pads of the input capacitors. VOUT pads of the output capacitors and inductors are connected together with large copper area.

Figure 10. Top Layer



GND plane kept intact under the high current traces to provide shortest possible return path for high frequencies.

Figure 11. Second Layer (GND)



Plane kept intact around the LP8758-E0 device.

Figure 12. Third Layer (VIN)

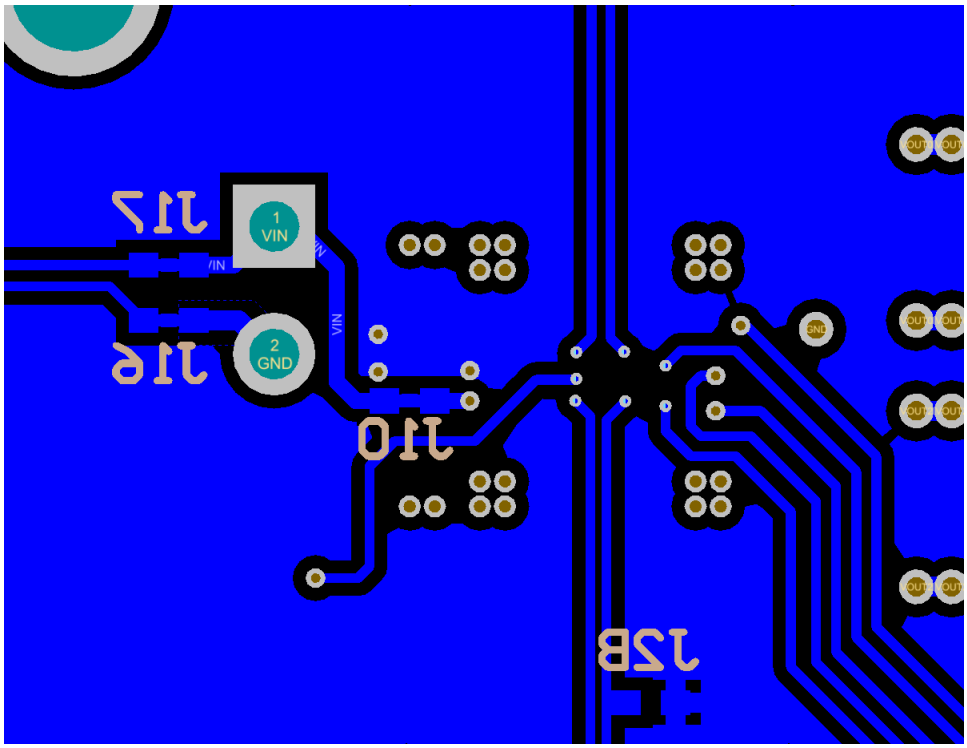


Figure 13. Bottom Layer and Silk

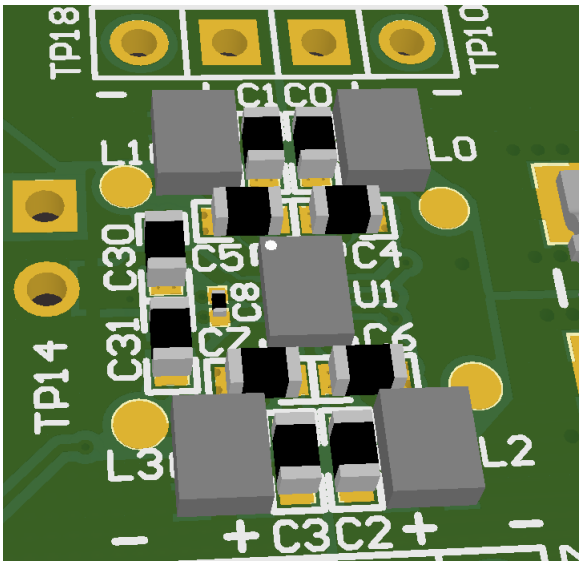
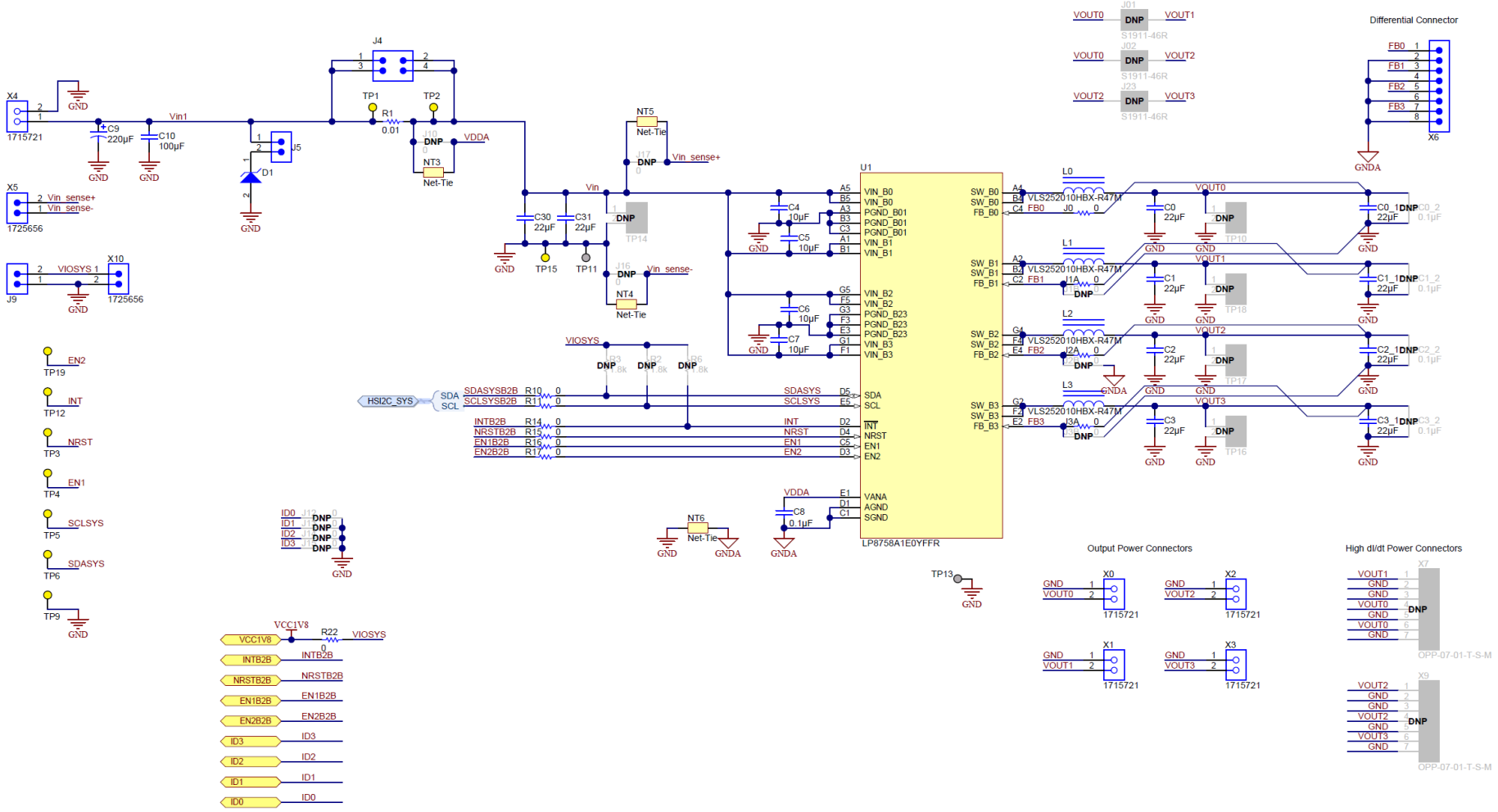


Figure 14. 3-D View Showing the LP8758-E0 Device and Nearest Components

6 LP8758-E0EVM Schematic



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   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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