EV2300 EVM Interface Board

This user's guide describes the function and operation of the EV2300 evaluation module. This guide includes a complete description of the EV2300 EVM, as well as a bill of materials, and schematic.

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1 Introduction

This EVM interface board enables an IBM-compatible or other type (with required driver for the particular platform) PC to communicate with Texas Instruments SMBus, HDQ, or DQ interface gas gauges via a Universal Serial Bus (USB) port. In addition to this board, PC software is required to interpret the gas gauge data to complete the evaluation system.

1.1 Features

- Fully powered from the USB port
- Capable of providing a 25-mA 3.3-V source
- Complete interface between USB and SMBus, I^2C, and HDQ (8/16) interfaces using a simple API

1.2 Kit Contents

- EV2300 circuit module
- Standard USB cable

1.3 Ordering Information

Table 1. Ordering Information

EVM Part Number
EV2300

2 Interfaces

The EV2300 interfaces are described in the following table. The reference designators on the circuit board and the functions are also listed.

Reference Designator	Function	Function
HDQ and SMB	SMBus, HDQ, and DQ Interface ports	Terminal block for connecting to a target device
I^2C	E^2PROM I^2C Interface	Terminal for connecting to a target E^2PROM or I^2C interface battery monitor
USB	USB Interface	Interface to host computer

2.1 Overview

The EV2300 is enclosed and is provided as shown.

2.2 EV2300 Controller

The EV2300 controller is a bq8012 running at 4 MHz. The controller firmware is stored in flash memory and is executed by the core at power-up after the boot ROM code verifies the integrity words.

The controller communicates with target device(s) through either: a 2-wire SMBus communication port, a 1-wire HDQ port, or a 2-wire E^2PROM I^2C port. The 2-wire SMBus communication port supports both SMBus and I^2C protocols.

2.3 USB Interface (USB)

The interface board connects to a USB port (version 1.1) on a host computer and is powered from the port. All communication over the USB is proprietary and does not fit any USB-defined device classes. Therefore communication with the device requires a loader and driver from Texas Instruments.

The loader enumerates the device (determines it is present on the USB), then loads the EV2300 controller firmware for the USB interface. Once the firmware load is complete, the loader sends a command to the USB interface IC to execute the new program and the loader driver exits. A new driver takes control and enumerates the EV2300 and makes the device present to programs running on the host.

The installer for the USB EVB installs:

1. A loader driver
2. A binary to load onto the USB interface IC
3. An EV2300 controller driver for direct access to the device
4. An EV2300 DLL for application access to the device

2.4 HDQ Interface (HDQ)

This interface allows a host computer to interact with a slave or target device through the two-wire SMBus or the one-wire HDQ interfaces. The ports are labeled with the corresponding signal names above each port connector. Connect the signal and a ground reference (GND), and optionally VOUT, to a target device.

The two-wire interface supports SMBus version 1.1 byte, word, block transactions with and without PEC. The SMBus limits the capacitance on each line (Data and Clock) to 100 pF. The EV2300 places 8 pF on each line, so a device may place up to 92 pF total. If the capacitive load approaches or exceeds 100 pF, SMBus communication may not be reliable.

Pin	Name	Description
1	GND	Ground return/reference for HDQ interface
2	VOUT	Controlled EEPROM power. Supplies 5 VDC to a target EEPROM IC
3	HDQ	HDQ one-wire interface. Pulled up to 3.3-V rail with a 10-kΩ resistor
4	VCC	Supplies 3.3 VDC to a target. Current load should be limited to 30 mA

2.5 I^2C/EEPROM Interface (I^2C)

This interface allows a host computer to interact with a target E^2PROM or other I^2C interface device such as a battery monitor device through a two-wire I^2C interface. The interface contains a controlled power pin, the I^2C clock and data lines, and a ground reference.

Pin	Name	Description
1	GND	Ground return. Connected to the SMD and HDQ GND
2	SCL	I^2C clock. This line must be pulled up by the target.
3	SDA	I^2C data. This line must be pulled up by the target.
4	VOUT	Controlled EEPROM power. Supplies 5 VDC to a target EEPROM IC

2.6 SMBus Interface (SMBus)

Pin	Name	Description
1	GND	Ground reference
2	SMBC	SMB clock pin. This pin is pulled to 3.3 VDC through a 10-kΩ resistor. Do not exceed 5.6 VDC on this pin.
3	SMBD	SMB data pin. This pin is pulled to 3.3 VDC through a 10-kΩ resistor. Do not exceed 5.6 VDC on this pin.
4	NC	Not connected on this board. This pin is floating.

3 EV2300 Bill of Materials, Component Placement, Schematic

This chapter includes the schematic, component placement on the circuit board, and a listing of the bill of materials for the EV2300 EVM.

3.1 Bill of Materials (BOM)

Qty	Ref Des [1]	Description [2] [3] [4]	Size	MFR	Part Number
10	C1-C7, C10-C12, C15, C20	Capacitor, ceramic, 0.1 µF, 25 V, X7R, 10%	603	TDK	C1608X7R1E104KT
0	C13	Open	603		
2	C16, C21	Capacitor, POSCAP 4.7 µF, 35 V, 20%	6032 ©)	AVX	TAJC475K035R
1	C18	Capacitor, ceramic, 2200 pF, 50 V, C0G, 10%	603	TDK	C1608C0G1H222KT
1	C19	Capacitor, ceramic, 150 pF, 50 V, C0G, 10%	603	TDK	C1608C0G1H151KT
2	C8, C9	Capacitor, ceramic, 22 pF, 50 V, C0G, 10%	603	TDK	C1608C0G1H220KT
0	D1-D7, D9, D13-D15, D17	Open	0.068 × 0.049		
2	D12, D19	Diode, LED, green, 20 mA, 0.9 mcd	0.068 × 0.049	Panasonic	LN1371G-(TR)
1	D20	Diode, LED, red, 20 mA, 0.9 mcd	0.068 × 0.049	Panasonic	LN1271R-(TR)
3	D21-D23	Diode, dual, 250 mA, 70 V	SOT23	Vishay-Liteon	BAW56GS08
5	D8, D10, D11, D16, D18	Diode, low capacitance, TVS	SOT23	General Semi	GL05T
1	J1	Connector, USB upstream (Type B)	0.47" × 0.67"	Molex	67068-1000
3	J13-J15	Header, friction lock assembly, 4-pin right angle	0.400 x 0.500	Molex	22-05-3041
1	J2	Header, 11 pin, 100 mil spacing, (36-pin strip)	121100	Sullins	PTC36SAAN
0	J3-J5, J8-J11	Open	0.038"		
1	J7	Header, 2 pin, 100 mil spacing, (36-pin strip)	0.100 × 2"	Sullins	PTC36SAAN
1	Q1	Transistor, NPN, high-performance, 500 mA	SOT23	Fairchild	MMBT2222A
1	Q2	MOSFET, P-ch, –12 V, 4 A, 51 mΩ	SOT23	Vishay	Si2335DS
4	R1, R14, R16, R19	Resistor, chip, 10 kΩ, 1/16 W, 5%	603	Std	Std
12	R13, R15, R21–R24, R26, R27, R45, R46, R49, R50	Resistor, chip, 100 Ω, 1/16 W, 5%	603	Std	Std
3	R18, R42, R43	Resistor, chip, 1 MΩ, 1/16 W, 1%	603	Std	Std
1	R2	Resistor, chip, 15 kΩ, 1/16 W, 5%	603	Std	Std
7	R3–R5, R32–R34, R39	Resistor, chip, 100 kΩ, 1/16 W, 5%	603	Std	Std
3	R30, R51, R52	Resistor, chip, 620 Ω, 1/16 W, 5%	603	Std	Std
2	R31, R41	Resistor, chip, 10 Ω, 1/16 W, 5%	603	Std	Std
1	R35	Resistor, chip, 61.9 kΩ, 1/16 W, 1%	603	Std	Std
1	R53	Resistor, chip, 0 Ω, 1/16 W, 5%	603	Std	Std

(1) Reference designators marked with an asterisk (*) cannot be substituted. All other components can be substituted with equivalent manufacturers components.
(2) These assemblies are ESD sensitive, ESD precautions should be observed.
(3) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
(4) These assemblies must comply with workmanship standards IPC-A-610 Class 2.

Qty	Ref Des [1]	Description [2] [3] [4]	Size	MFR	Part Number
1	R54	Resistor, chip, 113 kΩ, 1/16 W, 0.1%	603	Vishay	TNPW06031133BT9RT1
1	R6	Resistor, chip, 1.5 kΩ, 1/16 W, 5%	603	Std	Std
0	R7, R10-R12, R17, R20, R25, R28, R36-R38, R40	Open	603		
2	R8, R9	Resistor, chip, 33 Ω, 1/16 W, 5%	603	Std	Std
0	SW1	Open	5 mm × 5 mm		
2	U1, U2	IC, Single bus buffer gate with 3-state output, with negative enable	DCK	TI	SN74LVC1G125DCK
1	U3	IC, Single bus buffer gate with 3-state output, with positive enable	DCK	TI	SN74LVC1G126DCK
1	U4	IC, USB, general purpose, device controller	0.480 × 0.480"	TI	TUSB3210PM
1	U5	IC, ultra low-power LDO regulator, 3.3 V, 50 mA	SOT23-5	TI	TPS77033DBV
1	U6	IC, Advance gas gauge	DBT38	TI	bq8015DBT
1	Y1 or Y4	Crystal, high performance, 12.00 MHz, SMT	0.126 × 0.126	Citizen or Daishinku	CSA-309-12.000MABJ or DSX630G-12.00 MHz
0	Y2 or Y3	Crystal, 32.768 MHz, 7-12 pF capacitance	1,9 mm × 5 mm	Daishinku or ECS	DST520G-32.768kHz or ECS-0.327-8-14
1	N/A	Plastic enclosure, bone, Texas Instruments silkscreen		PacTec	84107-501-039
		Wire Cable Assembly[5]			
1	Mate	Connector, female, 0.100 centers		22-01-30 47	Molex
4	N/A	Terminals, crimp, tin		08-50-011 4	Molex
	N/A	Wire, insulated 22 Awg, red, 18 inches (±3 inches) (VOUT)		Any	Any
	N/A	Wire, insulated 22 Awg, white, 18 inches (±3 inches) (SCL)		Any	Any
	N/A	Wire, insulated 22 Awg, black, 18 inches (±3 inches) (GND)		Any	Any
	N/A	Wire, insulated 22 Awg, brown, 18 inches (±3 inches) (SDA)		Any	Any
1	N/A	Heatshrink 1"		Any	Any

(5) Make one EEPROM connector wire assembly for each assembly produced, from J15 mate, 4 - 22 AWG wires and crimp terminals. Wire colors for pin numbers are listed below. Strip and tin flying leads 0.25 inches from end of wire.
Red - pin #4 (signal VOUT)
Brown - pin #3 (signal SDA)
White - pin #2 (signal SCL)
Black - pin #1 (GND)

3.2 EV2300 Component Placement

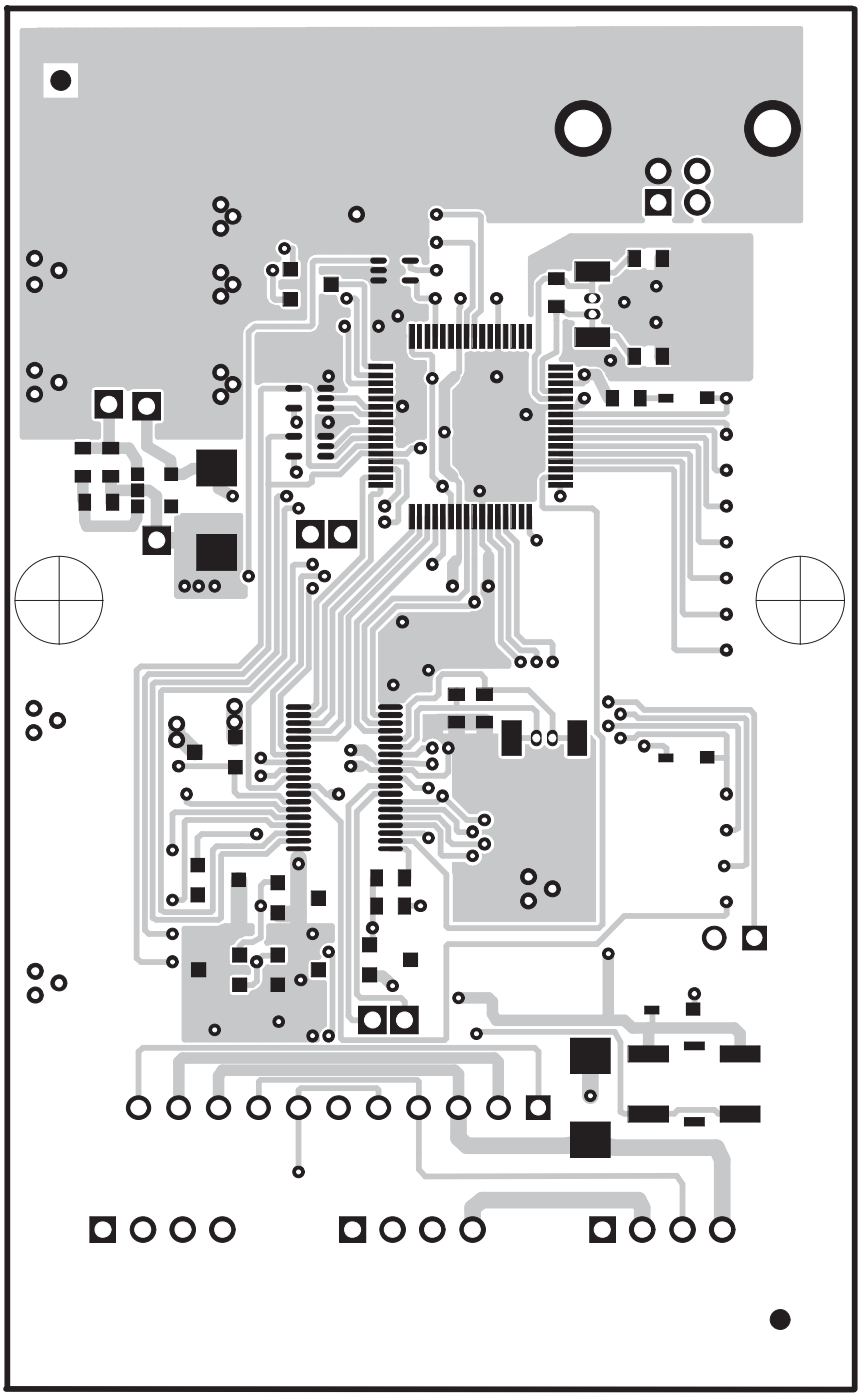


Figure 1. Board Layer 1

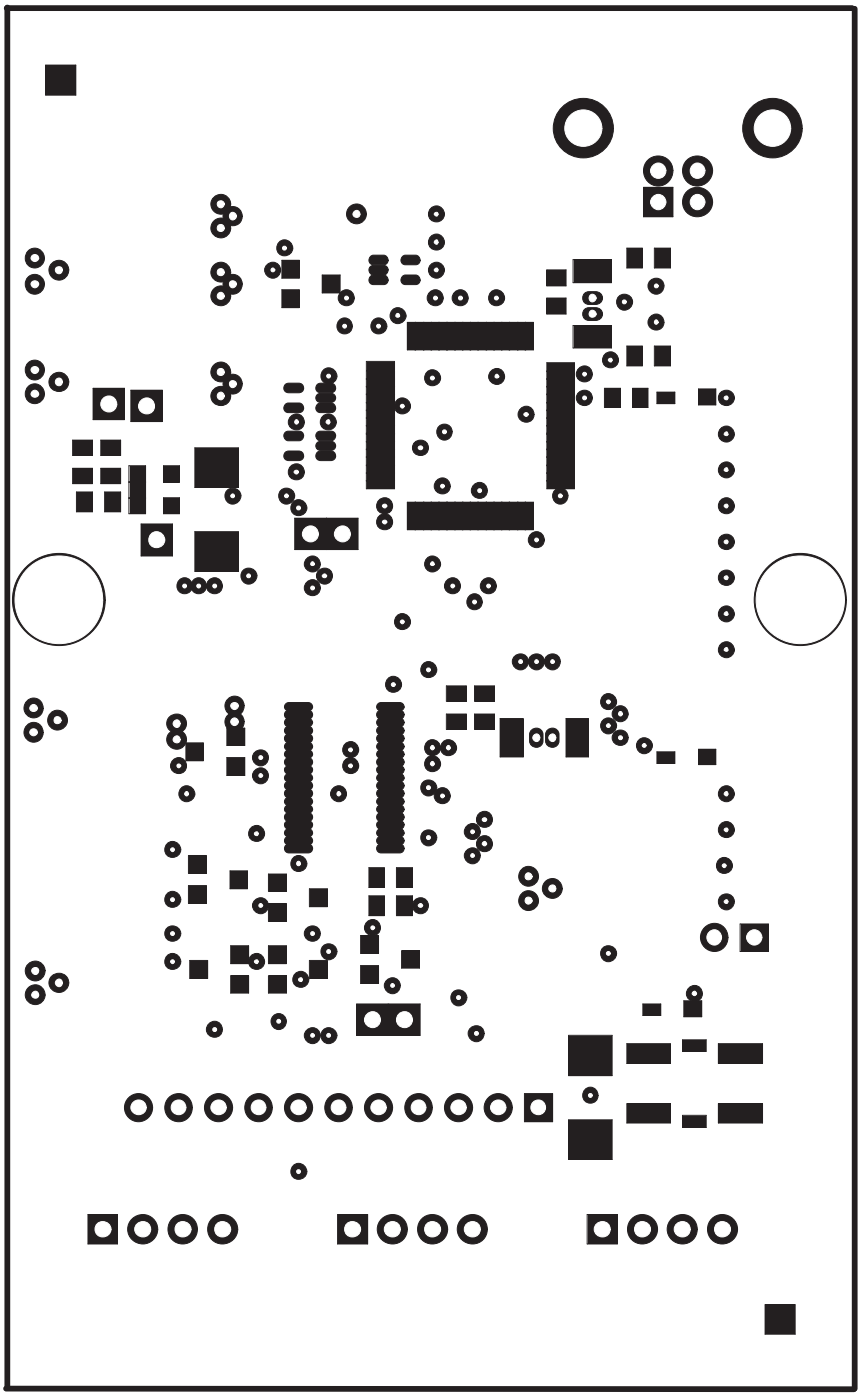


Figure 2. Solder Mask 1

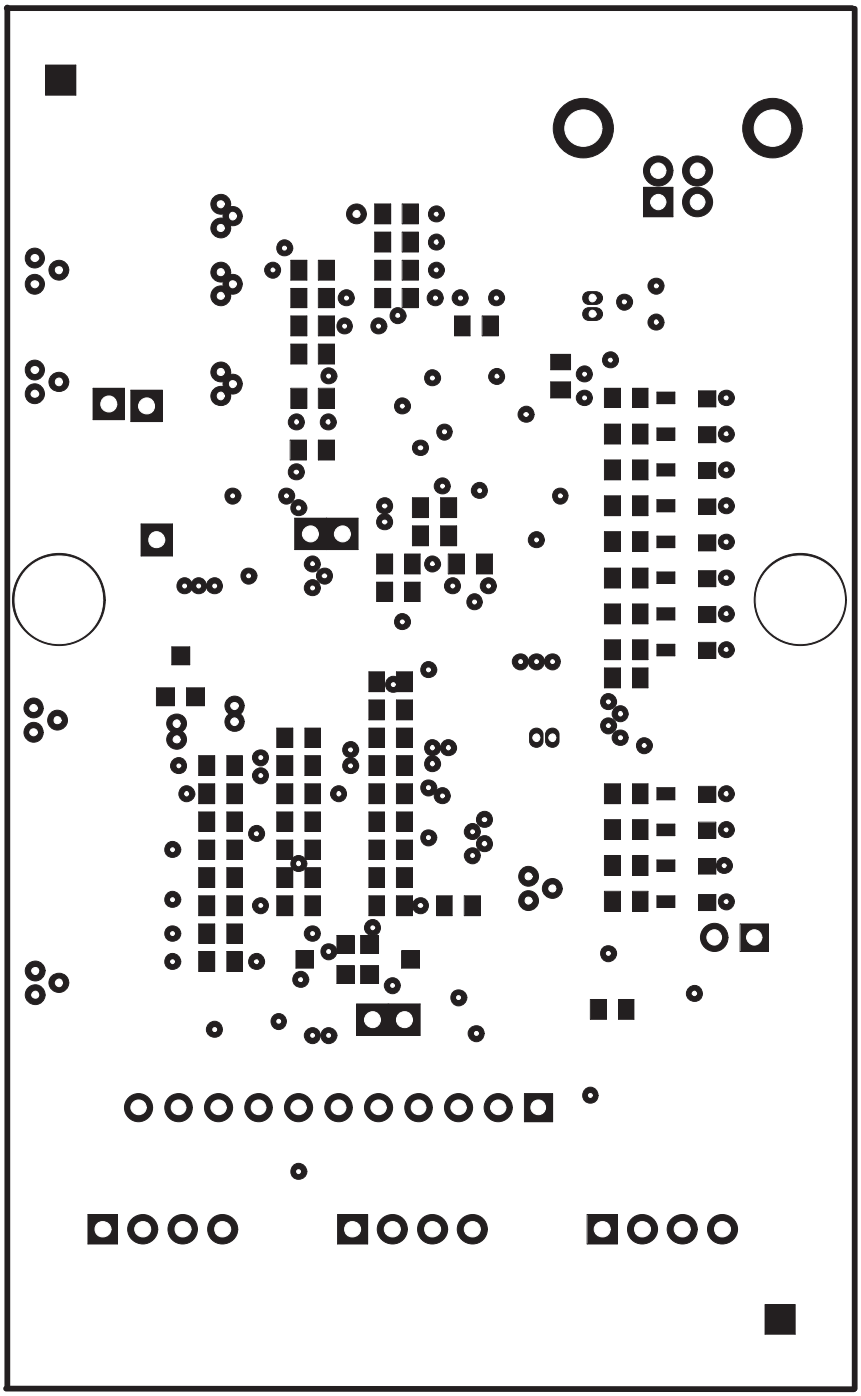


Figure 3. Solder Mask 2

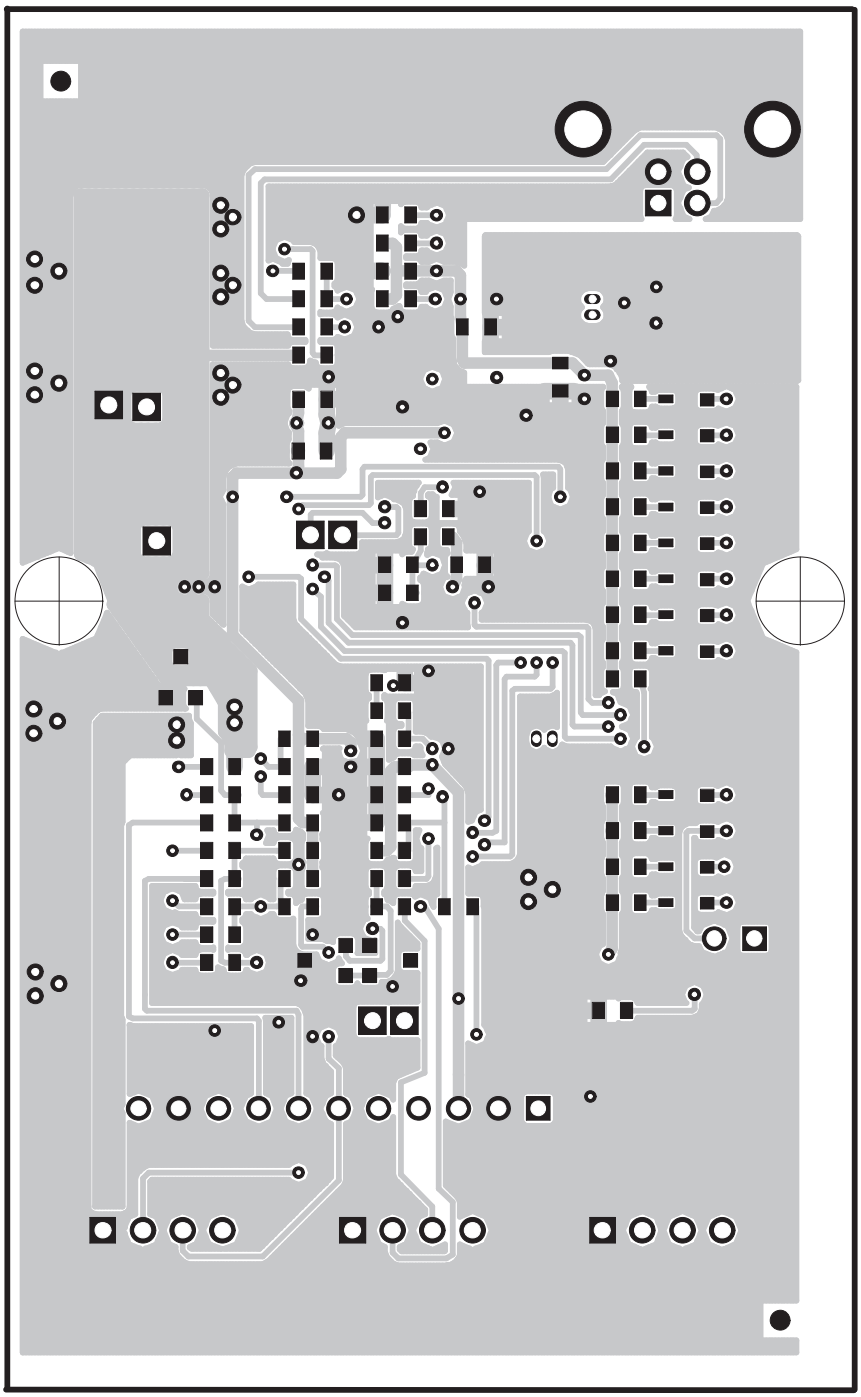


Figure 4. Board Layer 2

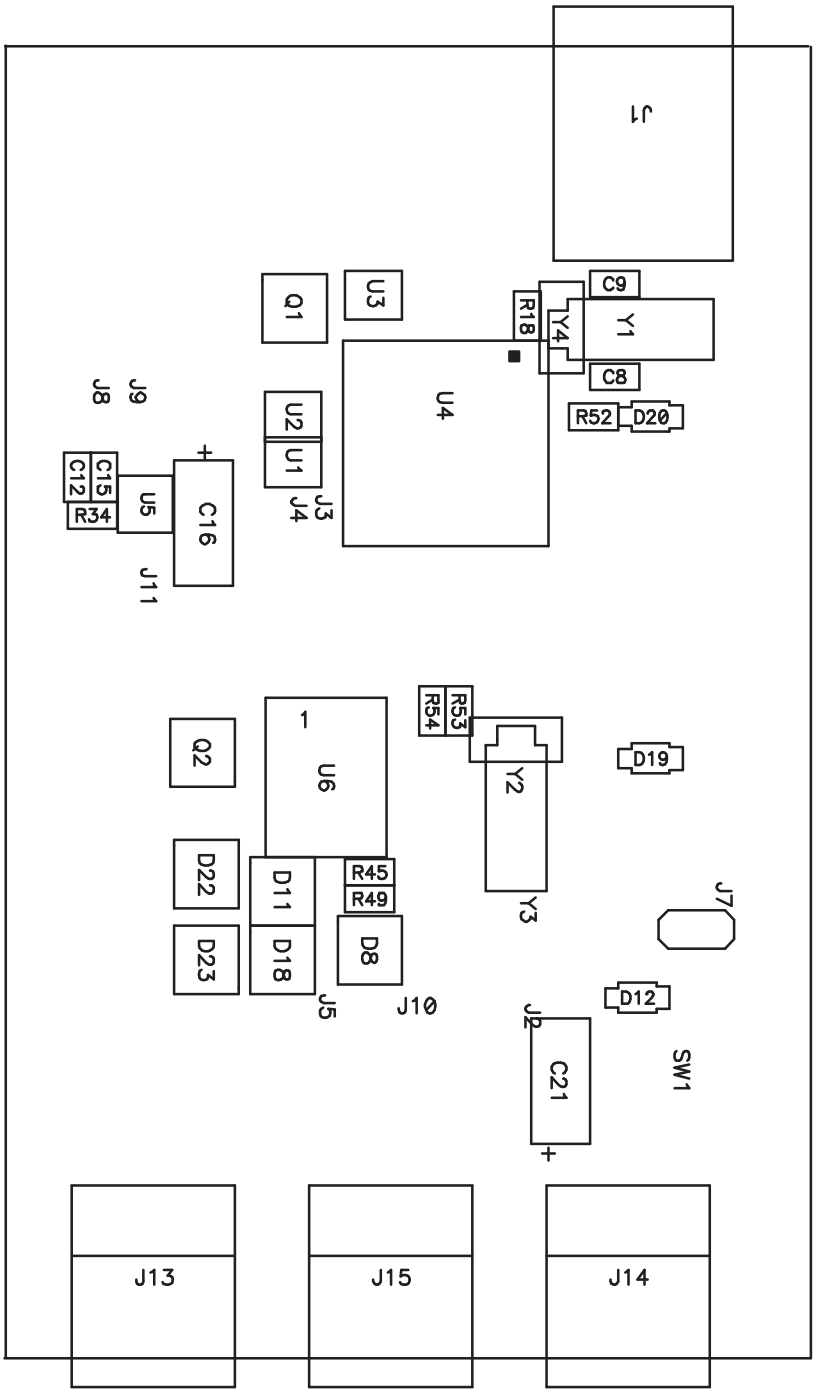


Figure 5. Component Placement 1

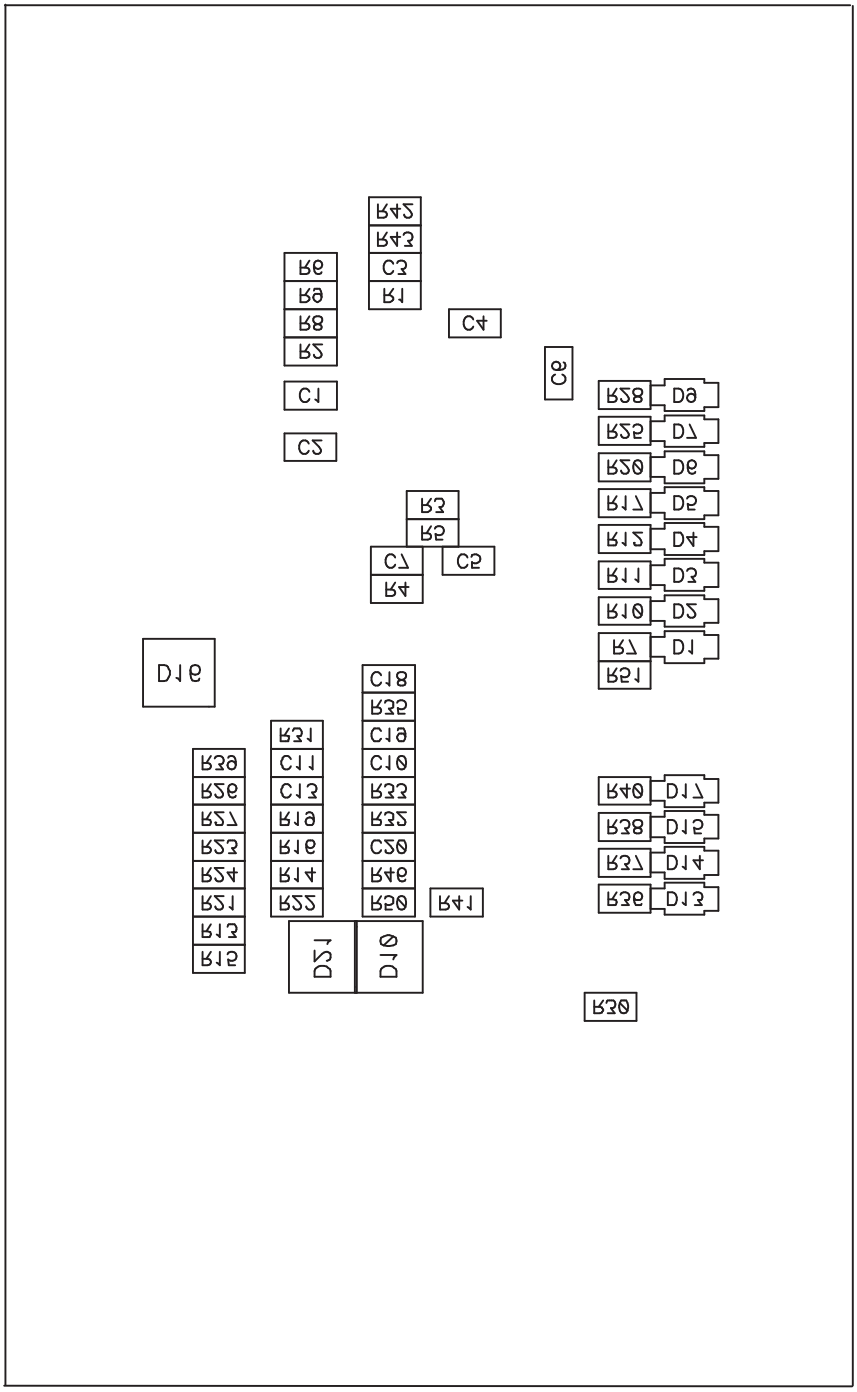


Figure 6. Component Placement 2

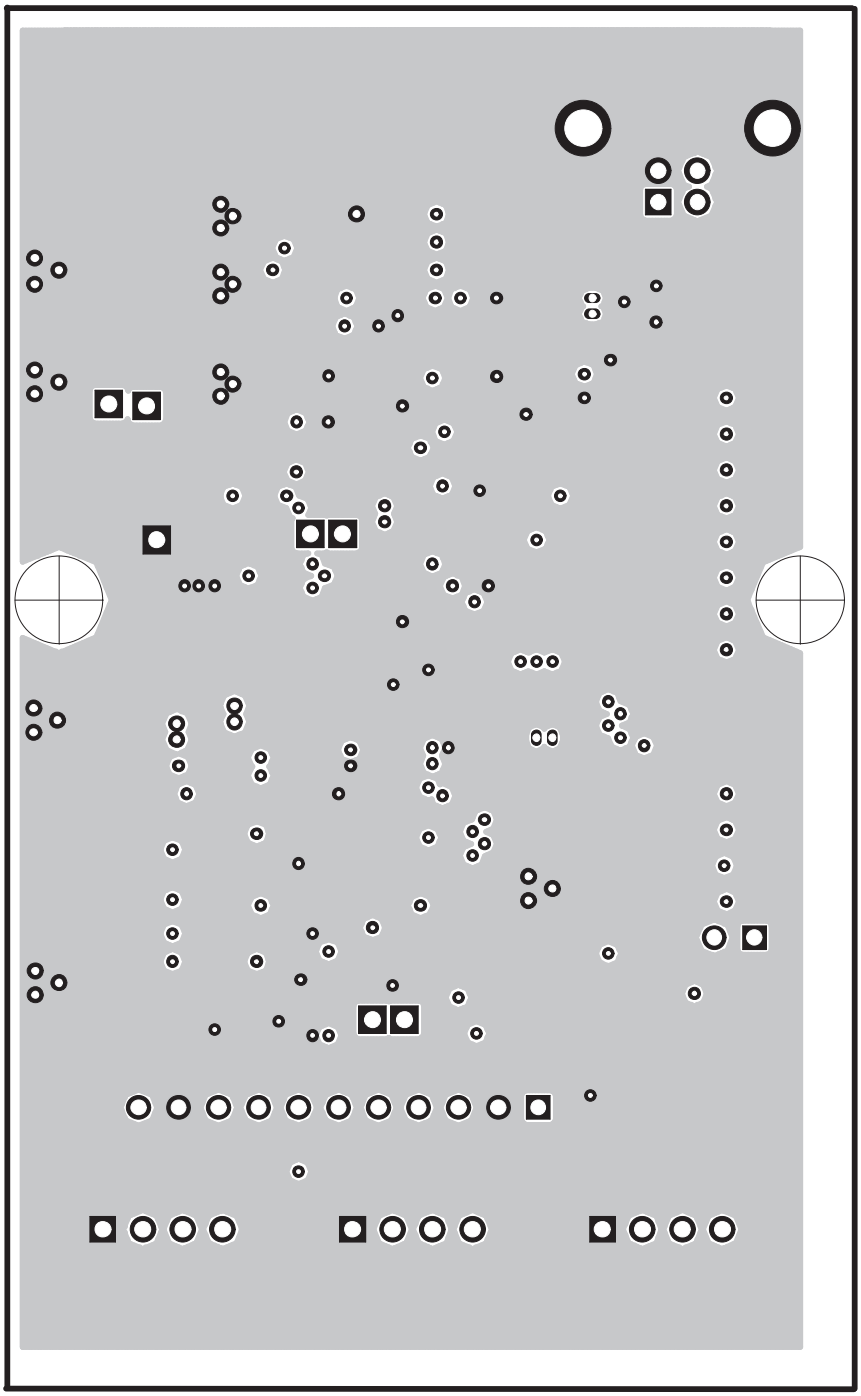


Figure 7. Internal Board Layer 1

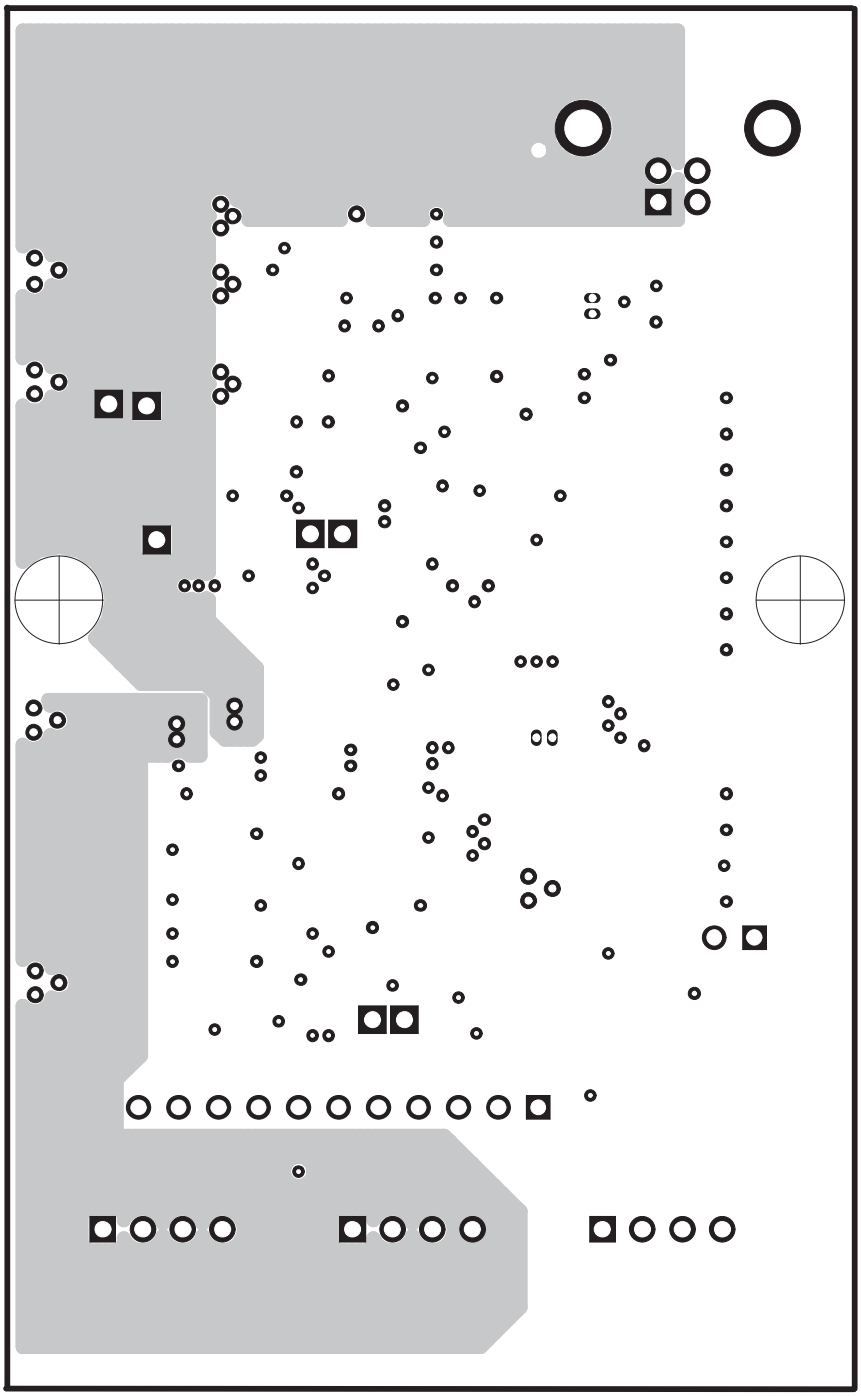
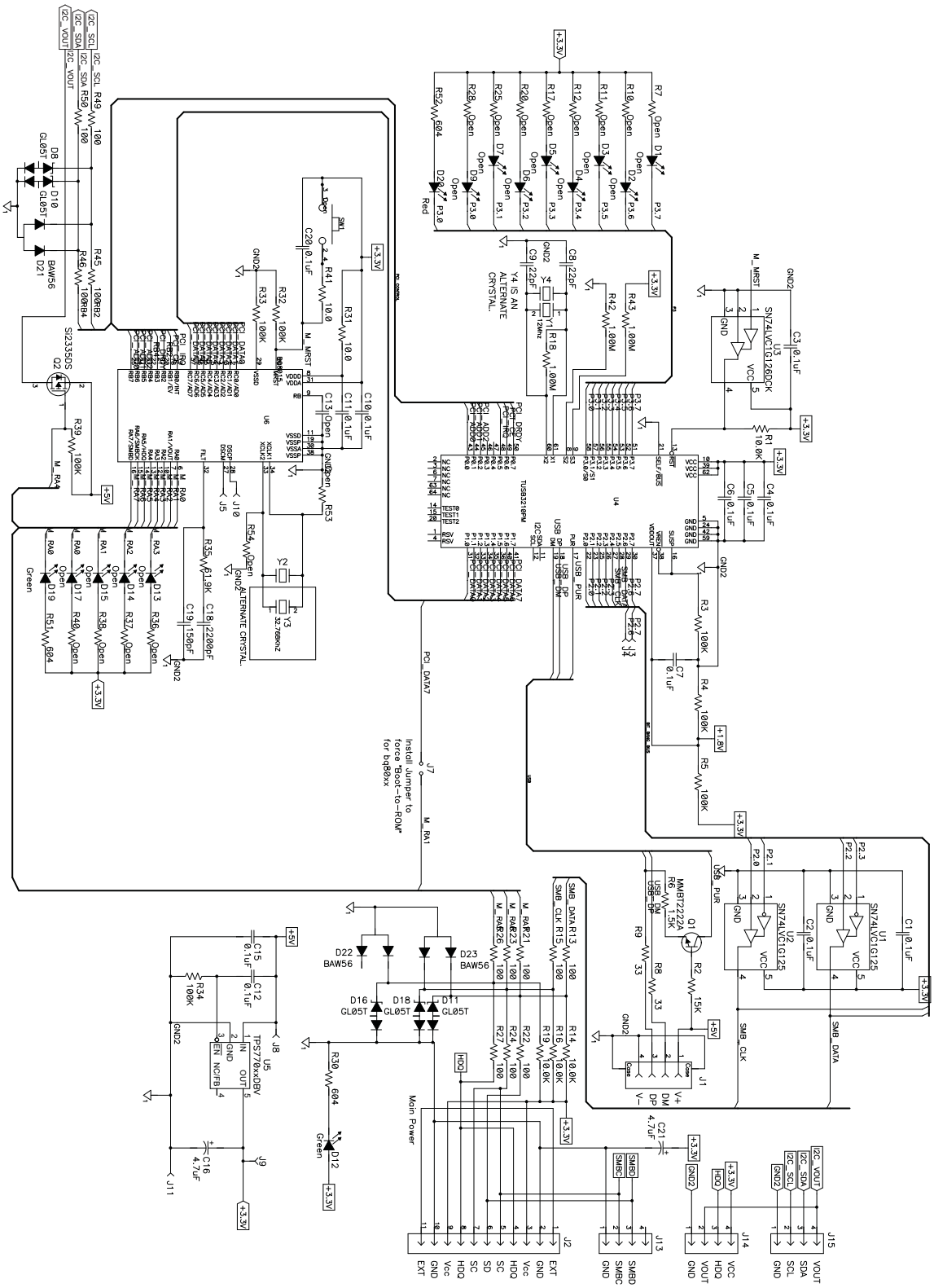


Figure 8. Internal Board Layer 2

3.3 EV2300 Schematic



Revision History

Changes from A Revision (February 2005) to B Revision **Page**

- Changed label 3
- Changed HDQ Interface pin names 4

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from B Revision (December 2011) to C Revision **Page**

- Added Schematic 16

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

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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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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2. 実験局の免許を取得後ご使用いただく。
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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.

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