EV2400 EVM Interface Board

This user's guide describes the function and operation of the EV2400 evaluation module interface board. A complete description, as well as the bill of materials and schematic are included.

Contents

List of Figures

List of Tables

1 Introduction

The EV2400 EVM interface board enables an IBM-compatible or other type PC (with the required driver for its particular platform) to communicate with the Texas Instruments SMBus and I^{2}C 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
- Optional 5-V port for powering high-power voltage drivers (future upgrade)
- Complete interface between the USB and SMBus or I^{2}C interfaces using a simple API
- Expansion port for future upgrades

1.2 Kit Contents

- EV2400 circuit module
- Standard USB cable

1.3 Ordering Information

Table 1. Ordering Information

EVM Part Number
EV2400

2 Interfaces

The EV2400 interfaces are described in the following table. The reference designators on the circuit board and the functions are also listed.

Reference Designator	Function	Details
Port 1: SMB	SMBus Interface Port	Terminal block for connecting to a target device
Port 2: I2C	I^{2}C Interface Port	Terminal block for connecting to a target device
Port 3: HDQ	HDQ and DQ Interface Ports	Future expansion port
Port 4	Single Wire Port	Future expansion port
Port 5	GPIO Port	Future expansion port

2.1 Overview

The EV2400 ports are shown in Figure 1.

Figure 1. EV2400 Ports

NOTE: The additional power input 5-V port on the EV2400 must not be connected in normal operation. Normal operation uses power from the USB port.

2.2 EV2400 Controller

The EV2400 controller is an MSP430F5529 running at 4 MHz. The controller firmware is stored in flash memory and is executed by the core at power-up.

The controller communicates with target device(s) through either: a 2-wire SMBus communication port or a 2-wire EEPROM I^2C port. The 2-wire SMBus communication port supports both SMBus and I^2C protocols. CRC-8 checksum verification for the data packets prevents data corruption over the USB.

2.3 USB Interface (USB)

The interface board connects to a USB port (version 1.1 or later) on a host computer and is powered from the port. All communication over the USB is human Interface device (HID) class. Drivers are built into Windows® and most of the operating systems.

2.4 HDQ Interface (HDQ)

This interface port is not currently supported.

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

This interface allows a host computer to interact with I^2C interfaces, such as a battery monitor device and EEPROM through a 2-wire I^2C interface. Connect the data, clock, and a ground reference (VSS) to a target device.

Pin	Name	Description
2.1	VSS	Ground return/reference for I^2C interface.
2.2	SCL	I^2C clock. Pulled up to 3.3 V with a 20-kΩ resistor. Uses bus acceleration in positive direction to allow for larger pullup.
2.3	SDA	I^2C data. Pulled up to 3.3 V with a 20-kΩ resistor. Uses bus acceleration in positive direction to allow for larger pullup.
2.4	VOUT 2	Optional voltage output (future expansion)

2.6 SMBus Interface (SMBus)

This interface allows a host computer to interact with an SMBus interface device such as a battery monitor device through a 2-wire SMBus interface. Connect the data, clock, and a ground reference (VSS) to a target device.

Pin	Name	Description
1.1	VSS	Ground return/reference for SMBus interface.
1.2	SCL	SMBus clock. Pulled up to 3.3 V with a 20-kΩ resistor. Uses bus acceleration in positive direction to allow for a larger pullup resistor.
1.3	SDA	SMBus data. Pulled up to 3.3 V with a 20-kΩ resistor. Uses bus acceleration in positive direction to allow for a larger pullup resistor.
1.4	VOUT 1	Optional voltage output (future expansion)

3 EV2400 Firmware Updater

To update the EV2400 to the latest firmware version, use the EV2400 Firmware Updater tool, which is located at http://www.ti.com/tool/ev2400, and follow these steps:

NOTE: The Battery Management Studio (bqSTUDIO) tool helps to determine the current version of the EV2400 firmware (FW) installed on a machine. To find the current version, plug in the EV2400 to a computer that has bqSTUDIO installed. After bqSTUDIO starts, the FW version is displayed in the top of the dashboard window next to the USB cable icon.

1. Download the latest EV2400 Firmware Updater tool from http://www.ti.com/tool/ev2400.
2. Open the archive with the update tool installer, and copy its contents to a temporary directory.
3. Run the installer. Take note of the location where the Firmware Updater tool is installed on the computer.
4. Connect the EV2400 that is to be updated to the computer with the EV2400 Firmware Updater tool.

NOTE: The EV2400 should remain plugged into the computer until the update is completed.

5. Ensure that no other EV2300 or EV2400 is connected to the computer being used for the firmware update.
6. Go to the location of the Firmware Updater tool installed doing Step 3.
7. Run the Firmware Updater tool.
8. The upgrader tool should detect the connected EV2400, display the current firmware version, and prompt the user to continue to update the EV2400 firmware. See Figure 2.

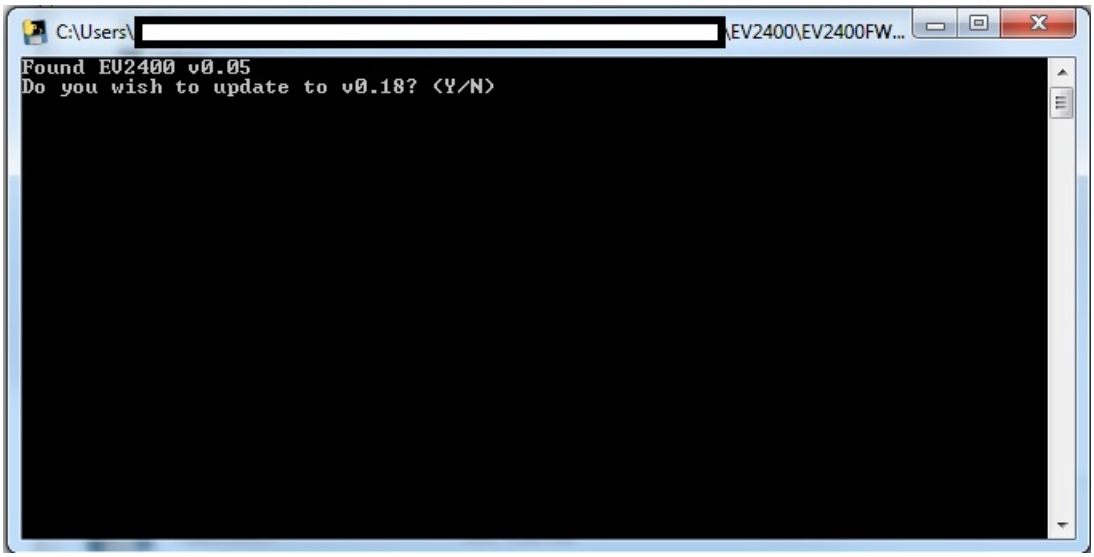

Figure 2. Firmware Update Prompt Screen

9. Type **Y** and press **Enter**.
10. The Firmware Updater tool should place the EV2400 into FW Update mode, perform a mass erase of the older EV2400 version's firmware, program the EV2400, and then reset the device. The tool will prompt the user to continue when finished. See Figure 3.

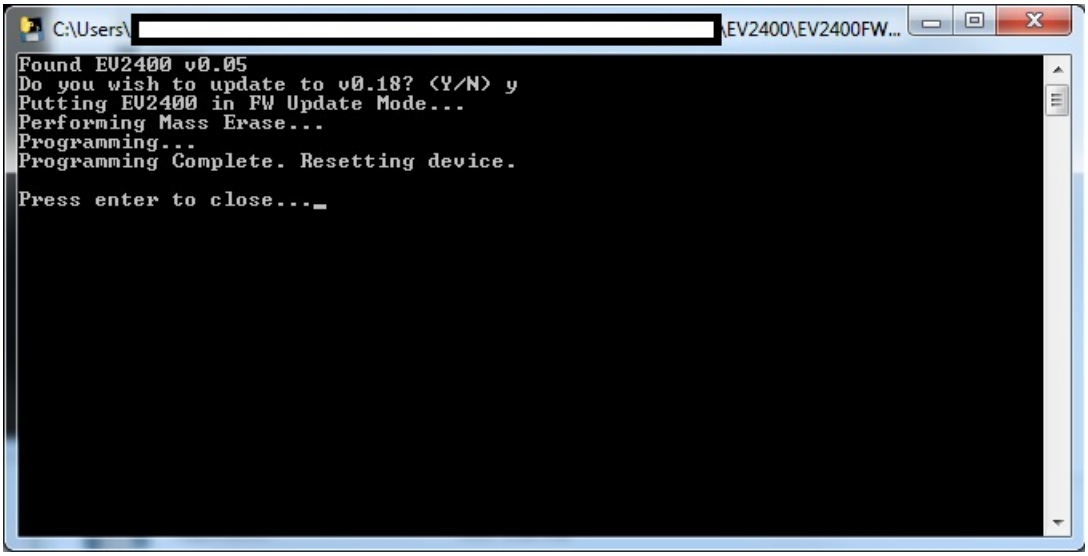

Figure 3. Update Complete Screen

11. Press **Enter** to close the Firmware Updater tool.

NOTE: If during the update the EV2400 is disconnected, it is possible for the MSP on the EV2400 to remain in FW update mode. To update the device in this mode, run the Firmware Upgrader tool at the command line with the '-s' option (for example, EV2400_Updater_v0018.exe -s).

4 EV2400 Bill of Materials, Component Placement, Schematic

This chapter includes the bill of materials, component placement on the circuit board, and schematic for the EV2400 EVM.

4.1 Bill of Materials (BOM)

Count	Reference Design	Value	Description	Size	Part Number	Manufacturer
31	C1, C2, C3, C4, C5, C6, C7, C11, C13, C15, C16, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C38, C39	0.1 µF	Capacitor, Ceramic, 25 V, X7R, 20%	0603	STD	Any
1	C12	4.7 µF	Capacitor, Ceramic, 25 V, X7R, 20%	0805	STD	Any
1	C36	2.2 nF	Capacitor, Ceramic, 25 V, X7R, 20%	0603	STD	Any
2	C37, C41	220 pF	Capacitor, Ceramic, 50 V, C0G, 5%	0603	STD	Any
1	C40	470 nF	Capacitor, Ceramic, 25 V, X7R, 20%	0603	STD	Any
2	C42, C43	12 pF	Capacitor, Ceramic, 50 V, C0G, 10%	0603	STD	Any
2	C8, C10	2.2 µF	Capacitor, Ceramic, 25 V, X7R, 20%	0603	STD	Any
3	C9, C14, C17	10 µF	Capacitor, Tantalum, 10 µF, 10 V, 20%	3216	293D106X0010A2T	Vishay
6	D1, D2, D3, D4, D5, D6	GL05T	Diode, TVS diode, Low Capacitance	SOT23	GL05T	General
3	D7, D8, D9	SSF-LXH305GD-TR	Diode. LED, 2.6 V, 25 mA	0.250 x 0.250 inch	SSF-LXH305GD-TR	Lumex
1	J1	67068-1000	Connector, USB Upstream (Type B)	0.47 x 0.67 inch	67068-1000	Molex
4	J2, J3, J4, J5	22-05-3041	Header, Friction Lock Ass'y, 4-pin Right Angle,	0.400 x 0.500 inch	22-05-3041	Molex
1	J6	PEC12DBAN	Header, Right Angle, Male 2x12-pin, 100mil spacing (12-pin strip), right-angle	0.100 inch x 12 x 2	PEC12DBAN	Sullins
1	J7	RAPC 722	Connector, 2.1mm, DC Jack w/Switch, TH	0.57 x 0.35 inch	RAPC 722	Switchcraft
1	J8	22-23-2041	Header, 4-pin Friction Lock, 100-mil spacing	0.250 x 0.400 inch	22-23-2041	Molex
0	JP1, JP2, JP3, JP4, JP5, JP6	DNP	Header, 2-pin, 100-mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	JP7	PEC02SAAN	Header, 2-pin, 100-mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
6	Q1, Q2, Q3, Q4, Q5, Q6	BSS223PW	MOSFET, Pch, –20 V, –0.39 A, 1.2 Ω	SOT323	BSS223PW	Infineon
3	Q7, Q8, Q9	2N7002W	MOSFET, Nch, 60 V, 115 mA	SOT323 [SC70]	2N7002W	Diodes
1	R1	33 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
4	R10, R11, R13, R14	20 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any

Count	Reference Design	Value	Description	Size	Part Number	Manufacturer
2	R2, R3	33 Ω	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
1	R26	470 Ω	Resistor, Chip, 1/16 W, 1%	0603	STD	Any
1	R27	51 kΩ	Resistor, Chip, 1/16 W, 1%	0603	STD	Any
1	R28	100 kΩ	Resistor, Chip, 1/10 W, 1%	0603	STD	Any
3	R39, R40, R41	200 Ω	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
1	R4	1.5 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
1	R42	47 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
3	R43, R44, R45	10 kΩ	Resistor, Chip, 1/10 W, 1%	0603	STD	Any
3	R46, R47, R48	100 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
21	R5, R6, R7, R12, R15, R16, R19, R20, R22, R24, R25, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38	10 kΩ	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
6	R8, R9, R17, R18, R21, R23	100 Ω	Resistor, Chip, 1/16 W, 5%	0603	STD	Any
1	SW1	EVQPSD02K	Switch, SMD Light-Touch, Side Operation	6.1 mm x 4.0 mm	EVQPSD02K	Panasonic
1	TP1	5VUSB	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	TP2	5VPLUG	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	TP3	3.3V	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	TP4	GND	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	5001	Keystone
1	U1	MSP430F5529IPN	IC, Mixed Signal Microcontroller	TQFP-80	MSP430F5529IPN	TI
6	U10, U11, U12, U13, U15, U18	TPS73601DBV	IC, Cap-Free, NMOS, 400mA LDO Regulator with Reverse Current Protection.	SOT23-5	TPS73601DBV	TI
1	U2	TPS2550DBV	IC, Power-Distribution Switch, Current-Limited	SOT-23-6	TPS2550DBV	TI
1	U3	TPS76333DBV	IC, Micro-Power 150-mA LDO Regulator	SOT23-5	TPS76333DBV	TI
3	U4, U5, U6	ST2329AQTR	IC, 2-bit dual supply level translator without direction control pin	10-QFN	ST2329AQTR	ST
1	U7	TPS79650DCQ	IC, Ultralow-Noise, High PSRR Fast RF, LDO, 1A, 5V	SOT223-6	TPS79650DCQ	TI

Count	Reference Design	Value	Description	Size	Part Number	Manufacturer
1	U8	TPS2113APW	IC, Auto Switching Power Mux, Rds 84 mΩ, 1A.	SO8	TPS2113APW	TI
2	U9, U14	ISL90842UIV1427Z	IC, Quad Digitally Controlled Potentiometers	TSSOP	ISL90842UIV1427Z	Intersil
1	Y1	4 MHz	Crystal, SMT Quartz Crystal	0.484 x 0.190 inch	ATS040SM	CTS
1	—		PCB		HPA500	Any
1			Plastic, Enclosure, Silkscreened, Two Custom end panels, screws		115574-501-000	PACTEC

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

4.2 EV2400 Component Placement

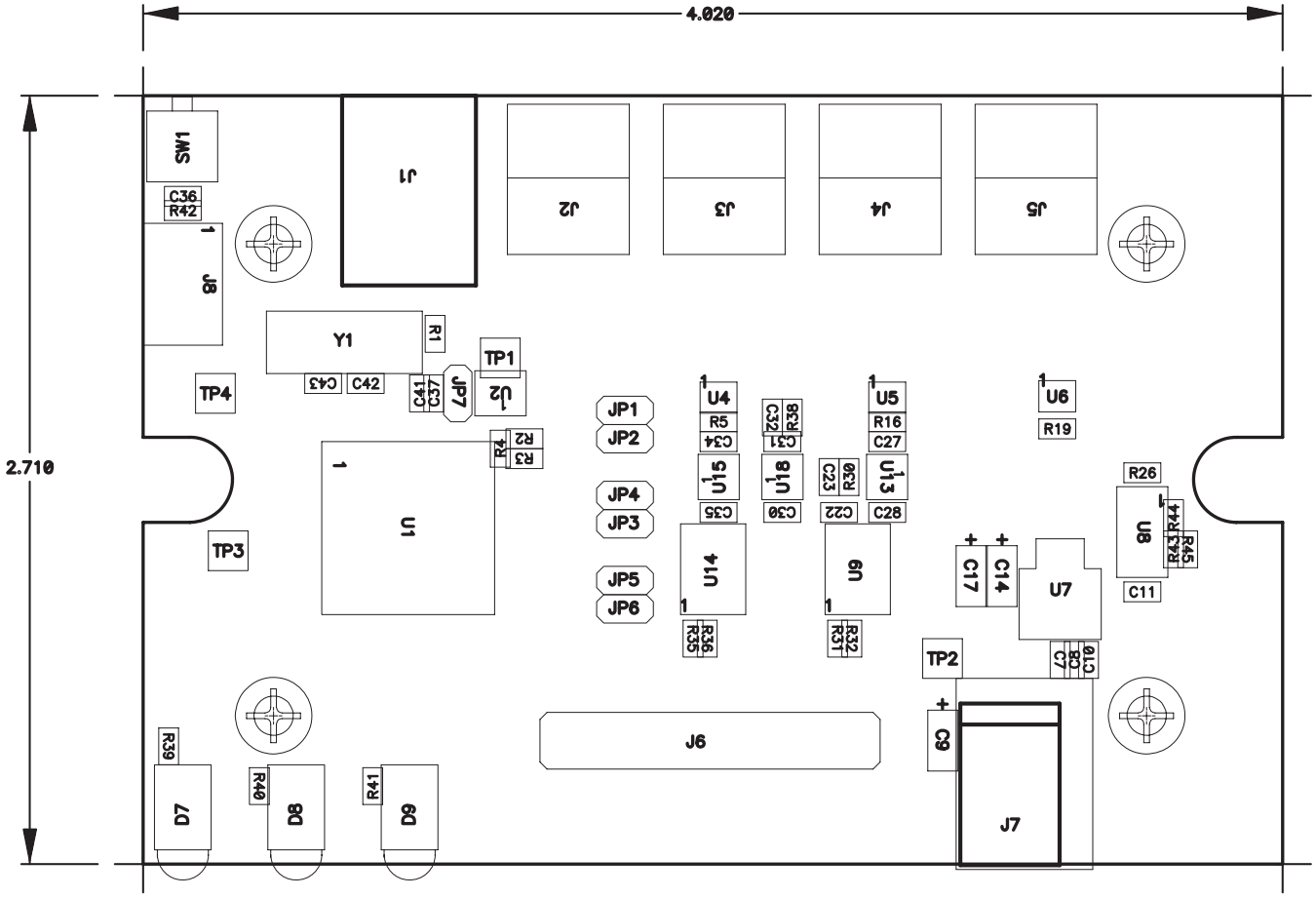

Figure 4. Top Assembly

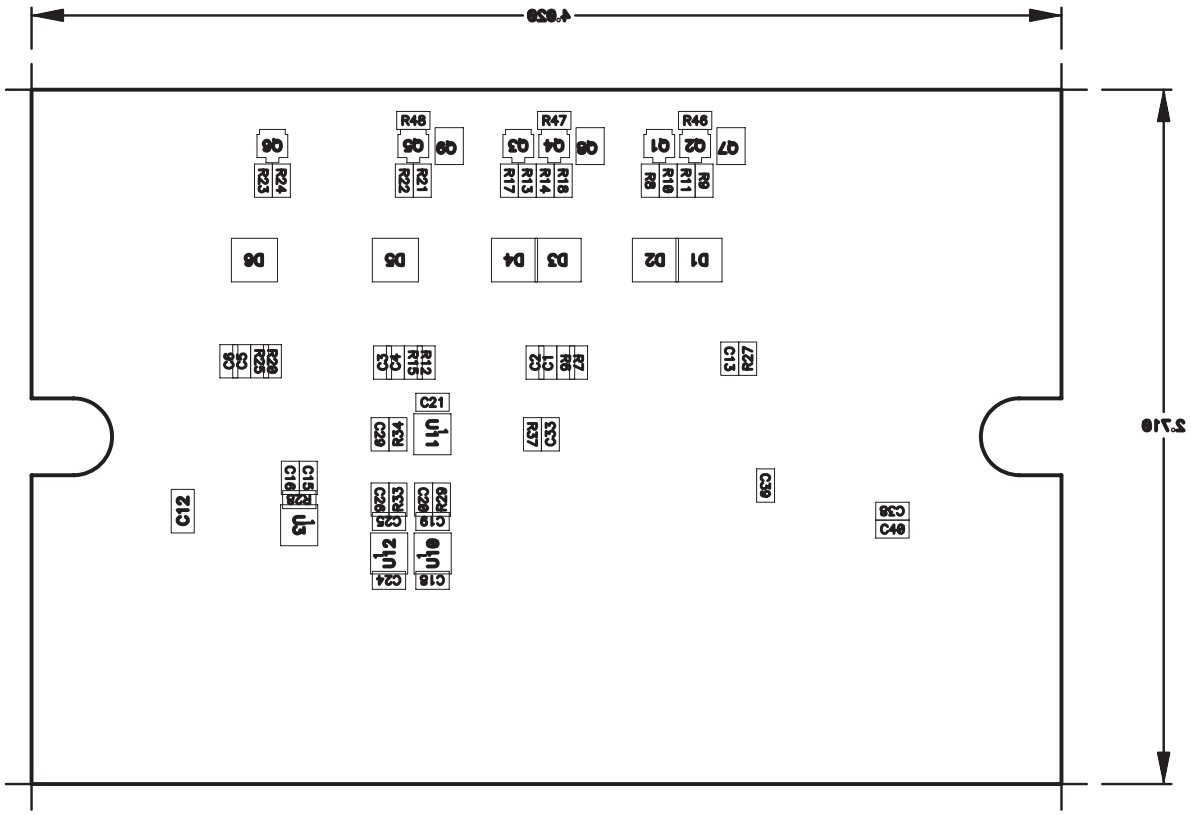

Figure 5. Bottom Assembly

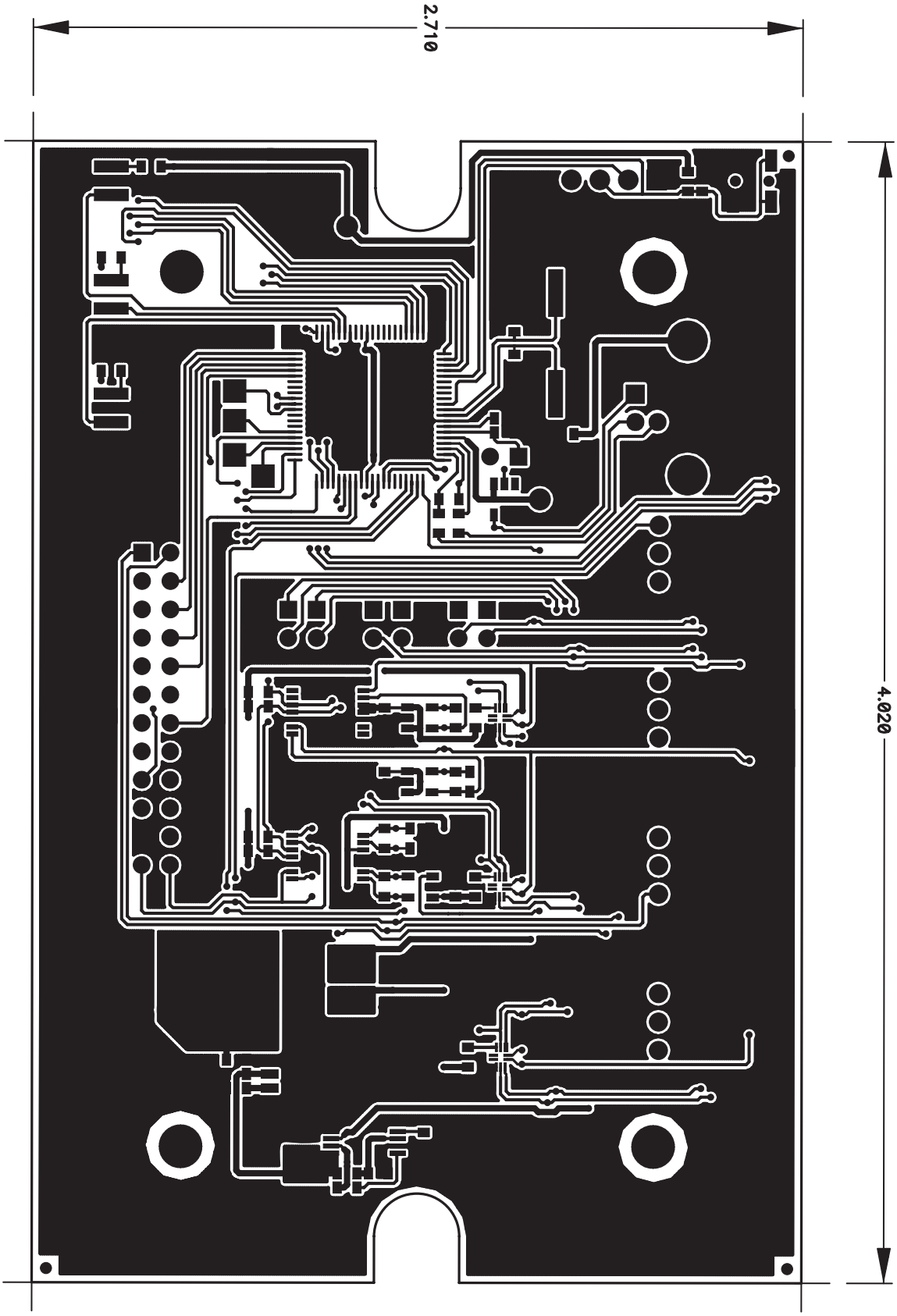

Figure 6. Board Layer 1

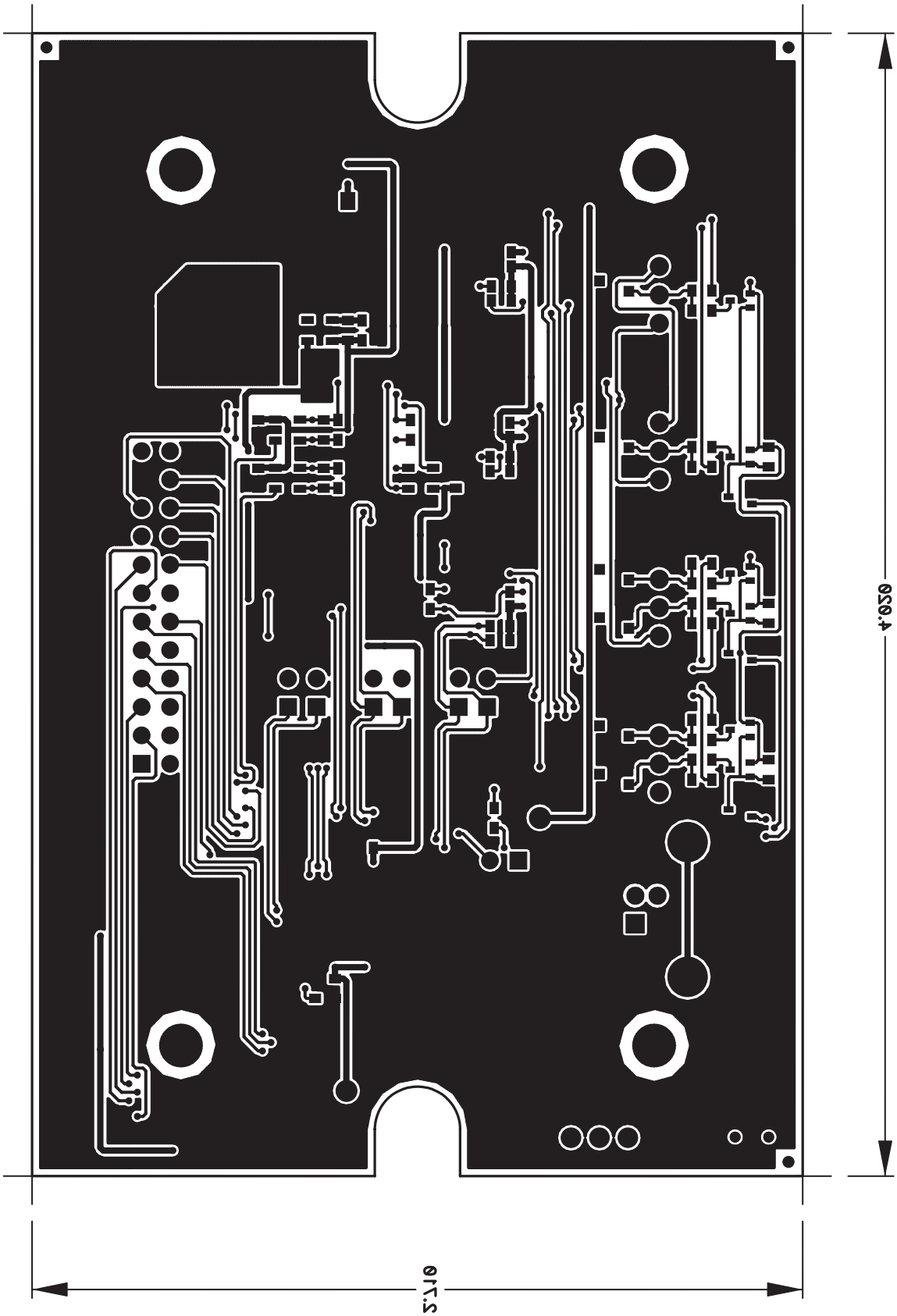

Figure 7. Board Layer 2

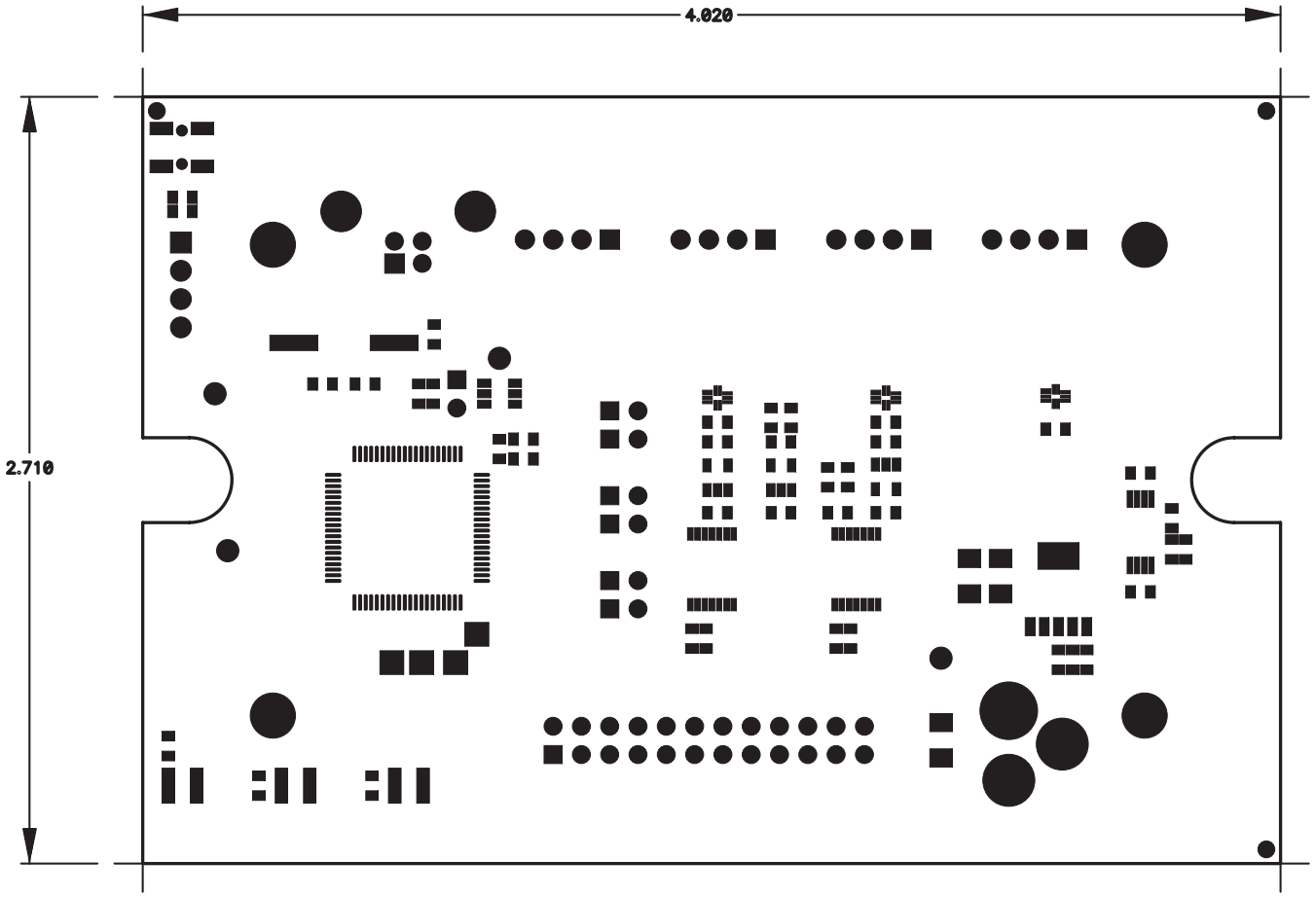

Figure 8. Solder Mask 1

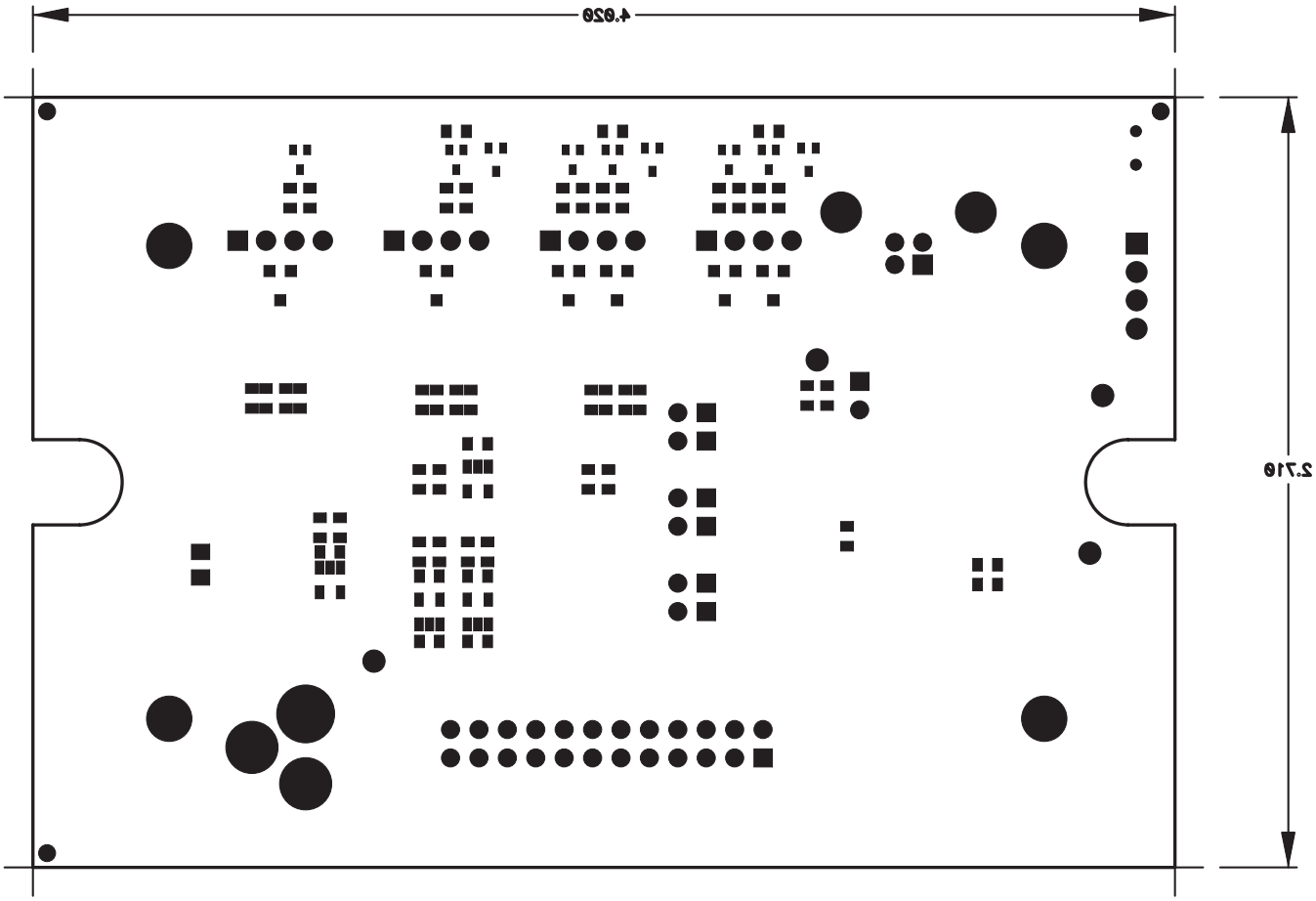

Figure 9. Solder Mask 2

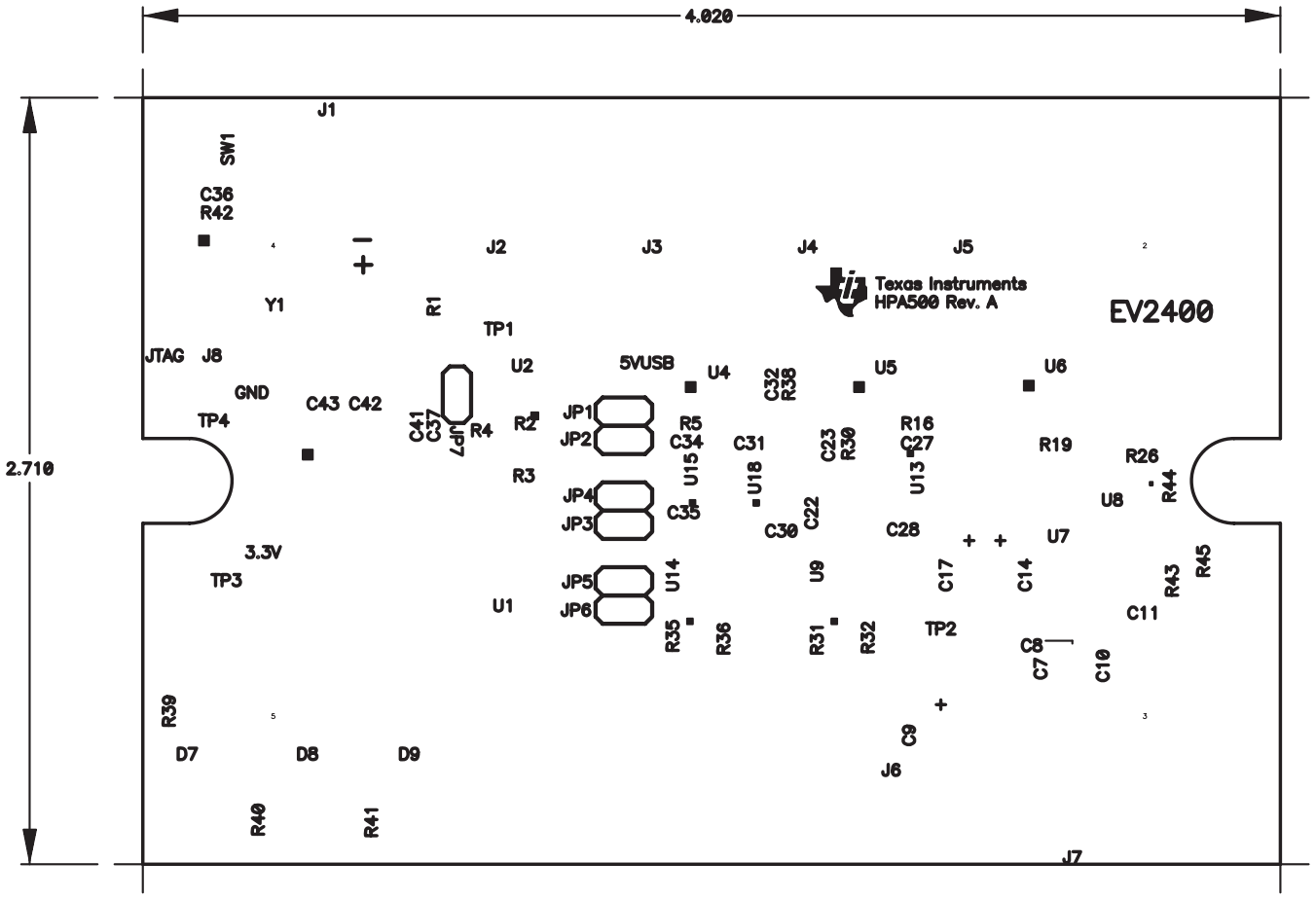

Figure 10. Silkscreen

4.3 EV2400 Schematic

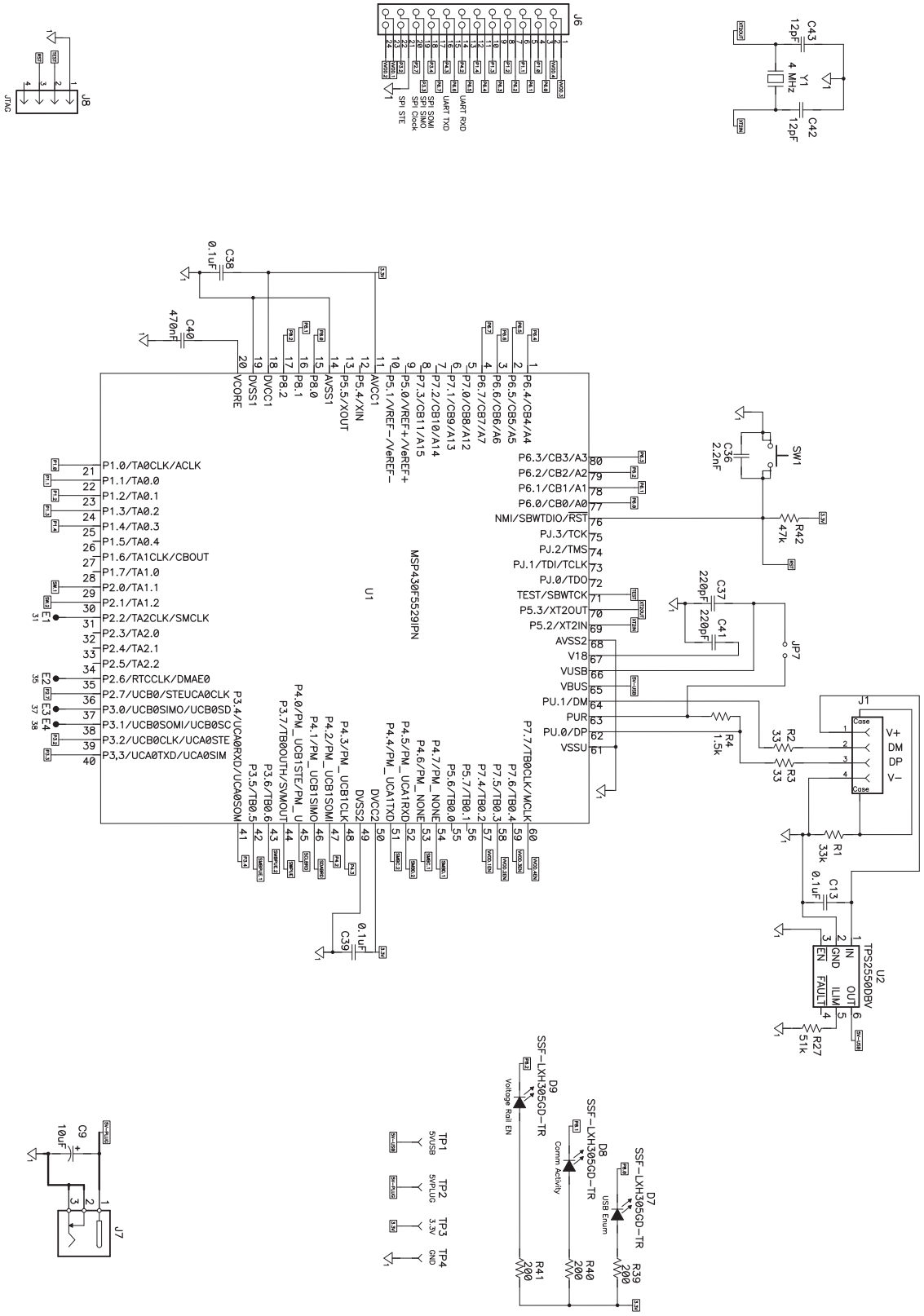

Figure 11. Schematic, Page 1

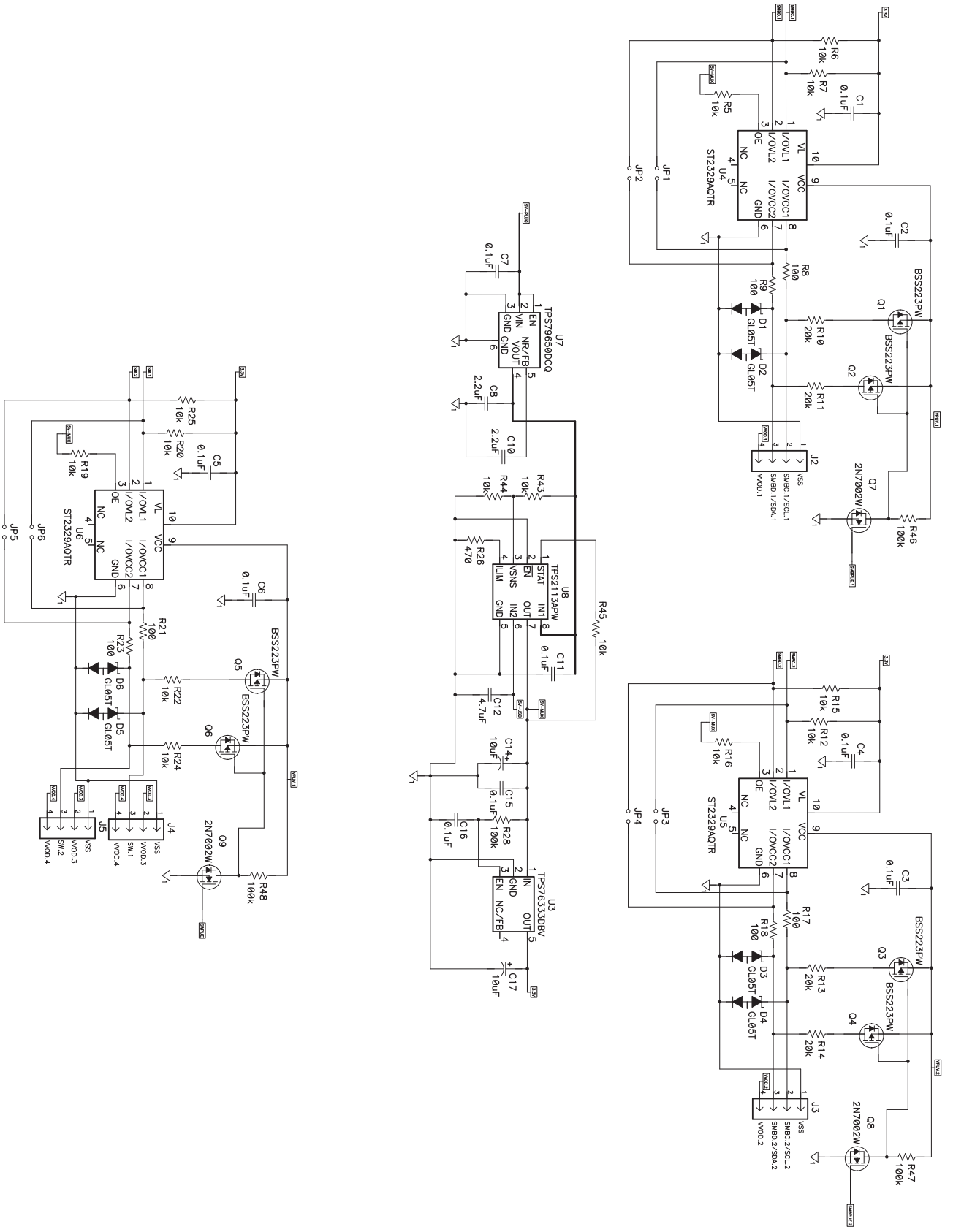

Figure 12. Schematic, Page 2

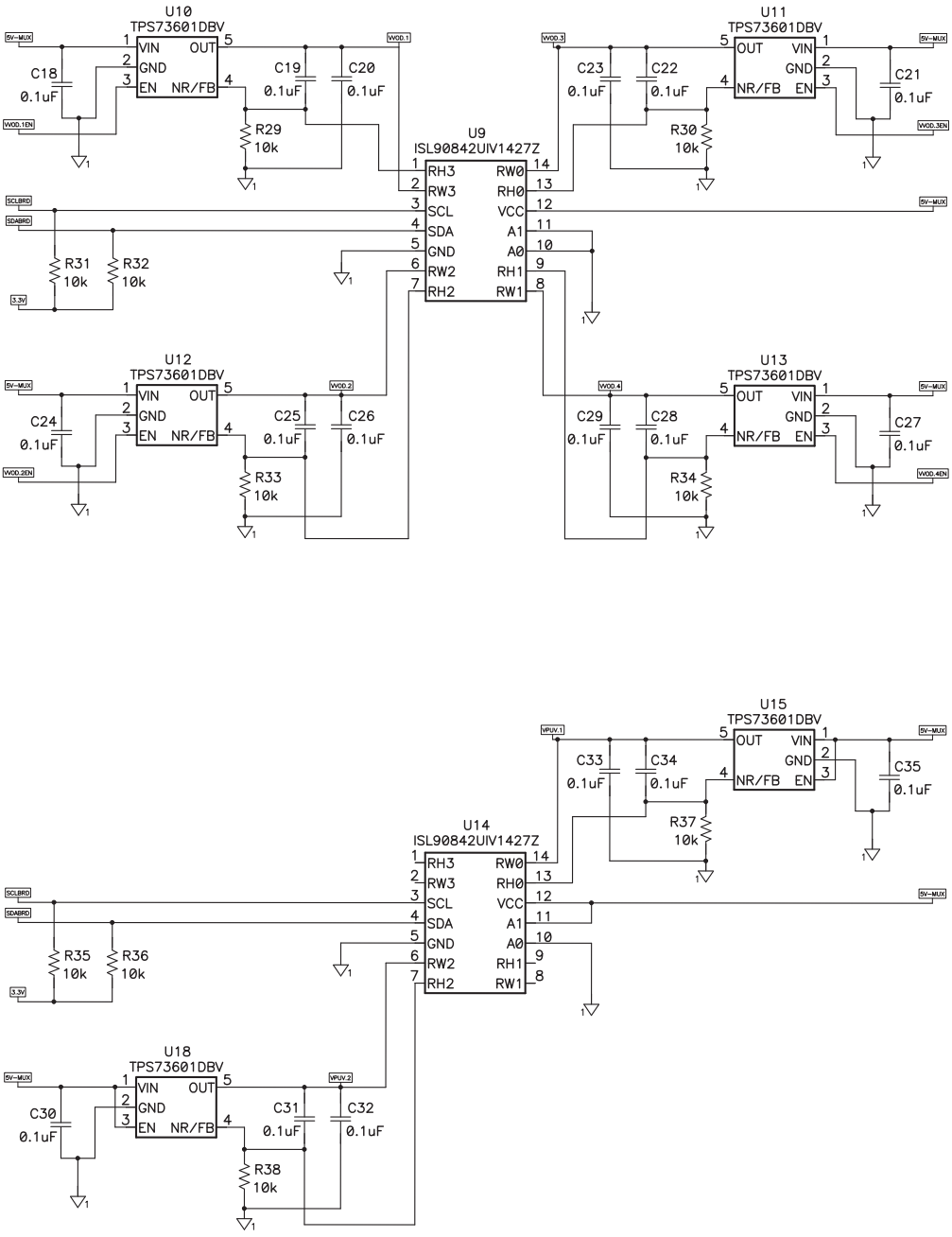

Figure 13. Schematic, Page 3

Revision History

Changes from B Revision (August 2014) to C Revision	Page
• Added the *EV2400 Firmware Updater* section	4

Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please read this user's guide and, specifically, the EVM Warnings and Restrictions notice below prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, contact a TI field representative or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

Should this evaluation board/kit not meet the specifications indicated in the user's guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Regulatory Information

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

This Class A digital apparatus complies with Canadian ICES-003. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Cet appareil numérique de la classe A est confor á la norme NMB-003 du Canada. Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'user'; autorité de s pour actionner l'équipement.

EVM Warnings and Restrictions

It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Failure to follow the guidelines may cause potential risk of personal injury, property damage, and/or unexpected operation of the EVM. If there are any questions, please contact a TI field representative before connecting and/or enabling power or other interface connections to the EVM.

During normal operation and within the EVM's recommended ratings, some circuit components including but not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks may have elevated case temperatures or contain voltages exceeding safe touch levels. These types of devices, as applicable, can be identified using the EVM schematic in this user's guide. When placing measurement probes near or on these devices during operation for evaluation purposes, precautions should be taken against inadvertent contact with surfaces of elevated temperatures and/or voltages exceeding safe touch levels.

As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

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.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

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