MAX1452 Evaluation System

General Description

The MAX1452 evaluation system (EV system) includes a MAX32625PICO board and the MAX1452 evaluation kit (EV kit). Windows® 10 compatible software provides a user-friendly interface for exercising the feature of the IC. MAX1452 EV kit includes interface circuitry to communicate between the IC and the MAX32625 PICO board and it comes with the 16-pin SSOP MAX1452AAE+ installed.

MAX1452 EV System Files

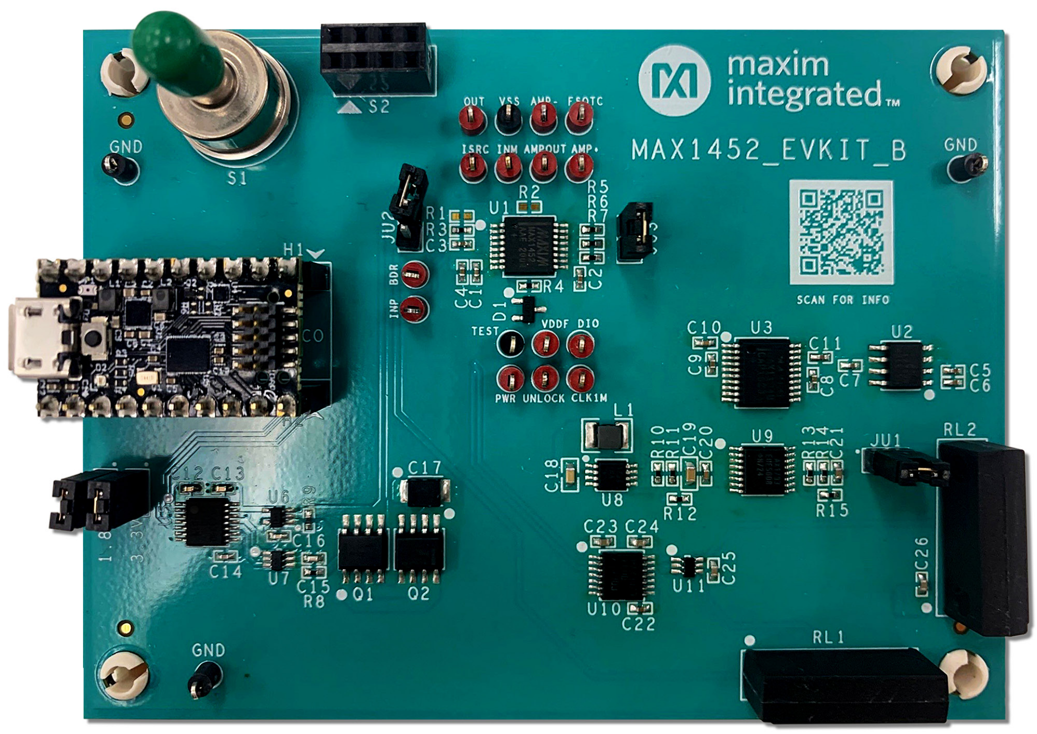
FILE	DESCRIPTION
MAX1452EVKit.exe	PC GUI Program
MAX1452Adapter.bin	Firmware

Benefits and Features

- USB Powered
- Sensor Socket on the EV board
- On-Board ADC to read the OUT Voltage of MAX1452
- Windows 10-compatible software
- User-Friendly Graphical User Interface (GUI)
- Proven PCB Layout
- Fully Assembled and Tested

***Ordering Information* appears at end of data sheet.**

MAX1452 EV Kit Photo



Windows is a registered trademark and registered service mark of Microsoft Corporation.

Quick Start

Required Equipment

- MAX1452 EV system (USB cable included)
- Windows 10 PC with two spare USB port
- Digital Multimeter

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV system software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

The EV system is fully tested and ships in two pieces: the MAX1452 EV kit board and the MAX32625PICO. Follow the steps to verify board operation.

1) Visit **www.maximintegrated.com/evkitsoftware** to download the latest version of the EV system software, MAX1452.zip. Save the EV system software to a temporary folder and uncompress the ZIP file.
2) Install the EV system software on your computer by running the **MAX1452EVkit.exe** program inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.
3) Configure the MAX1452 in digital mode. Verify that all the jumpers (JU1–JU3) are in their default positions, as shown in Table 1.
4) Plug the MAX32625PICO board into the EV kit.
5) Connect the USB cable from the PC to the MAX-32625PICO board. LED D2 on the MAX32625PICO begins to blink green.
6) When the EV kit GUI is launched, select the right **COM Port selection** from the window appears, select the right **COM port** from the Port Collection window and click **Connect**. (See Figure 1).
7) A delay of a few seconds is possible for the GUI to read all the EEPROM values. Wait until the main window appears.
8) Click **Read T-index** and verify that the temperature reading matches the current room temperature.

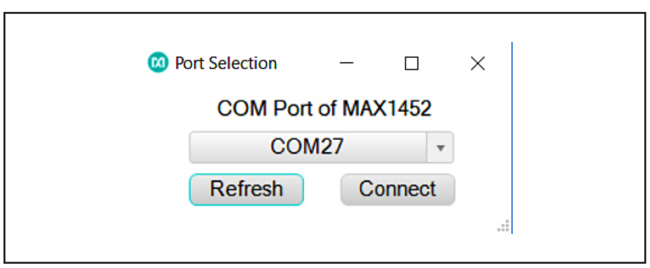


Figure 1. Port selection window

9) Select **VDD** from the **Signal** drop-down list in the **Output MUX** group box, and select the duration to 4.53s.
10) Connect **DMM** to OUT test point, click the **Enable Output** button and verify that the reading value is approximately 5V.
11) Remove the shunt on JU3 (UNLOCK pin to GND) to enter the analog mode, and remove JU1 to restart the **VDD** supply voltage and restore it. **It is not possible to communicate with MAX1452 when it is in analog mode.**

Detailed Description of Software

The MAX1452 EV system software enables full access to the MAX1452 registers, flash EEPROM, configuration settings, and special calibration functions. MAX1452 EV kit allows users to control and compensate the MAX1452 based sensor-compensation circuits.

Software Start up

Configure MAX1452 in digital mode to launch the software. Digital mode can be enabled either by having the **Control Register** (Secure Lock) function set to zero, or by asserting the **Un-Lock** pin high. The Un-lock pin can be asserted on the EV kit board by installing Jumper, J3. In this document, all GUI operations are performed in digital mode, also referred as **Calibration Operation Mode**.

A delay of a few seconds is possible for the GUI to read all register values of **flash EEPROM**, **Splash Window** (See Figure 2) is shown while reading EEPROM. Communications and baud rate synchronized when the GUI is started. The MAX1452 is ready to process commands from the PC.

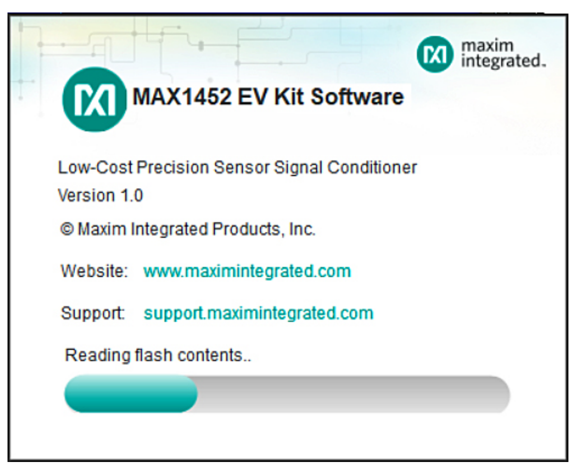


Figure 2. MAX1452 EV kit GUI

Note: All DAC register updates from the flash EEPROM are suspended when IC is in digital mode, temperature index analog to digital conversions continue but do not redirect the tables index pointer automatically, and the analog output is tri-stated unless commanded to output one of several different internal voltages.

System Power

To power off the system, slide off the System Power, slide on the **System Power** button to power up the system. System Power is a default in **On**. Communications and baud rate are synchronized when System Power is slide on.

Register Setting Tab

The user can edit all the parameters with a **white window area** using the software. The **parameters** can be edited by adding a new value in the edit box, selecting from a **drop-down list**, or by the click of a button. The revised value is written to the corresponding MAX1452 register automatically. All entries can be in **hexadecimal** or **decimal** format.

FSODAC, FSOTCDAC, ODAC, and OTCDAC

Values in each one of the **FSODAC**, **FSOTCDAC**, **ODAC**, and **OTCDAC** registers can be changed by the corresponding block, as shown in Figure 3. The sign bit does not apply to FSODAC and FSOTCDAC. The **Configuration Register** value is updated automatically as the ODAC and OTCDAC sign bits are changed. Values for these parameters can be selected to be in decimal or hexadecimal format.

IRO and PGA

The **IRO** and **PGA** control block set values of IRO (including IRO sign) and PGA values. The **Configuration Register** value is updated automatically as the ODAC and the OTCDAC sign bits are updated. Values for these parameters can be selected to be in decimal or hexadecimal format.

Sensor Polarity

This button corresponds to the **PGA sign** bit in the **Configuration Register**. To invert the polarity of the input signal, press to switch to negative. The **Configuration Register** value is updated automatically as the PGA sign bit is changed.

Figure 3. Register Controls

Functional Buttons

The **Update Registers from Flash** button updates all DAC and configuration registers from the flash memory of MAX1452. **FSODAC** and **ODAC** are updated from the lookup tables' locations pointed to by the **FSODAC/ODAC** index. It is important to note that the control program does automatically update the registers on the power-up of the EV kit or the start of the GUI. Upon powering up a **pre-programmed device**, the user should execute **Update Registers** from Flash in order to update the values in the **value display** boxes.

The **Copy Registers to Flash** button copies the register values displayed on the screen to the flash memory of the DUT. All 176 locations of the FSODAC lookup table in the flash memory are filled with the value in the **FSODAC** register display box shown on the GUI. All 176 locations of the ODAC lookup table in the flash memory are filled with the value in the **ODAC** register display box shown on the GUI. All previously written flash data is lost.

The **Read T-Index** button reads the internal temperature ADC and displays the return value in decimal format. The **T-Index** value is applied to the temperature conversion formula given in the MAX1452 IC data sheet and the resulting value (in °C) is displayed.

Output Mux

Select the IC output signal from the Signal drop-down list within the **Output MUX** group box. Refer to Table 15 (ALOC definition) in the MAX1452 IC datasheet for more information about the available signals.

Select the duration for which the selected **Signal** remains available on the OUT/DIO pin from the **Duration** drop-down list. A readout device (voltmeter) is required to read the output.

Press the **Enable Output** button to output the selected **Signal** onto the OUT pin.

User Data

There are 52 bytes available for user data in the flash memory. This data can be rewritten several times and provides a means for storing serial numbers, manufacturing date, test result data, etc. By clicking the **Set** button, any data typed in the **edit box** will be written to **flash memory** immediately.

Configuration Register

The **Configuration Register Value** displays the current value of the configuration register.

The **Configuration Register Setting** group box can be used to set **CLK1M output driver**, **Oscillator frequency** and external **RISRC** and **RSTC**. It is not recommended to change the factory preset **Oscillator frequency** (1MHz nominal).

The **Secure Lock status** can be read and write. By selecting **Enable**, **Secure Lock** is set (CL[7:0] = 0xFF), Secure Lock is disabled (CL[7:0] = 0x00) by selecting **Disable**.

Flash Tab

The **Flash** tab sheet (Figure 5) is used to read or modify the contents of the internal flash memory of MAX1452.

To read the flash memory, press the **Read from DUT Flash** button. The contents of the FSODAC and ODAC lookup tables are shown in the **FSODAC/ODAC Lookup Table.** The user can use the **Decimal** button to switch the values in the **FSODAC/ODAC Lookup Table** between hexadecimal format and decimal format. The CONFIG, OTCDAC, FSOTCDAC and the CONTROL LOCATION flash memory values are shown in the corresponding edit boxes at the left. The general-purpose user bytes is displayed in the **User Data memo** box.

Press the **Save Flash to File** button to save the contents of the flash to a file. The user is prompted for a file name.

There are two ways to modify the contents of the flash memory:

1) Manually change the contents on this tab sheet and press **Enter** button to write the contents to the active device.
2) Press the **Load Flash from File** button to copy the contents of a file to the flash memory of the active device. The user is prompted for a file name.

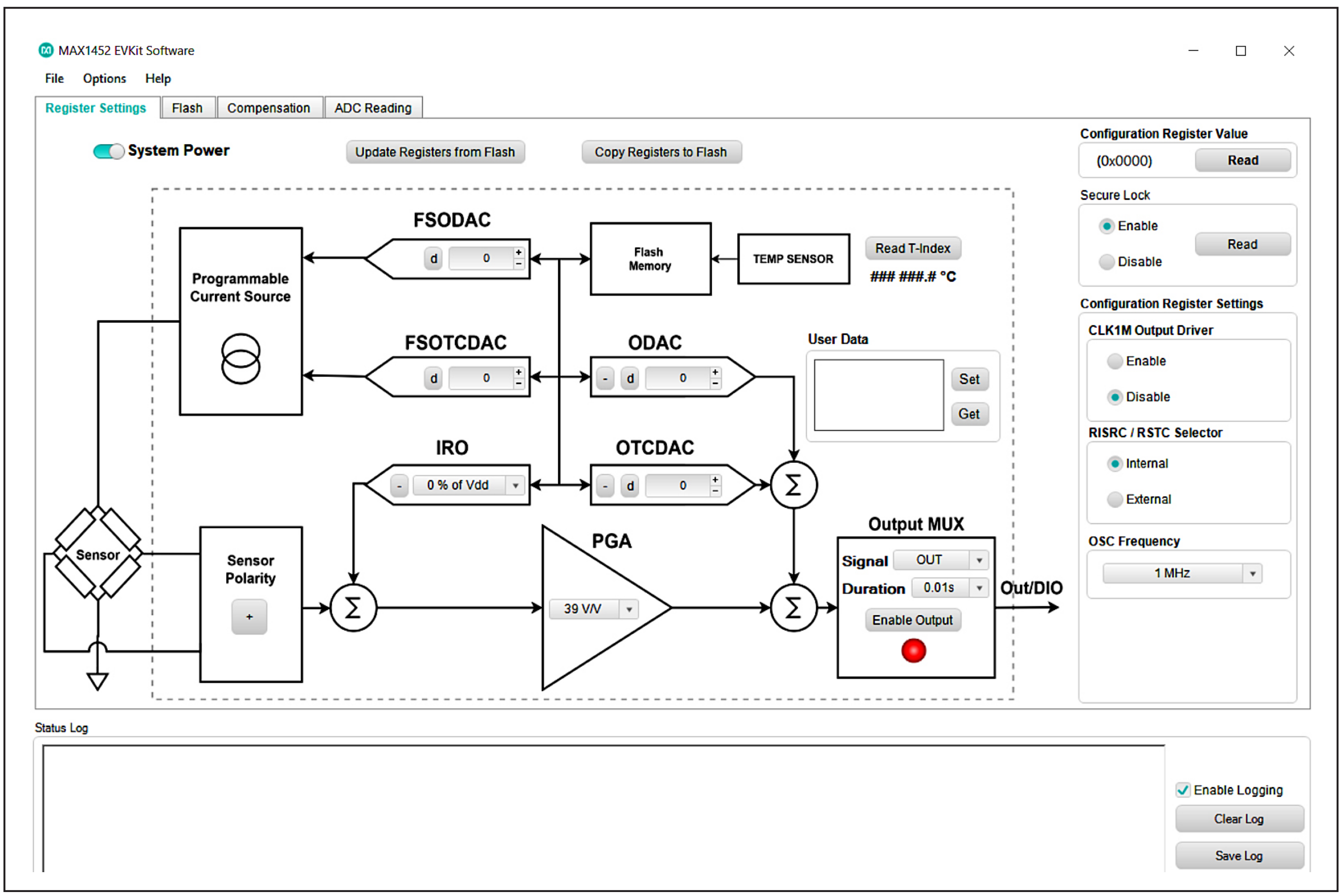


Figure 4. MAX1452 EV System Software Main Window (Register Settings Tab)

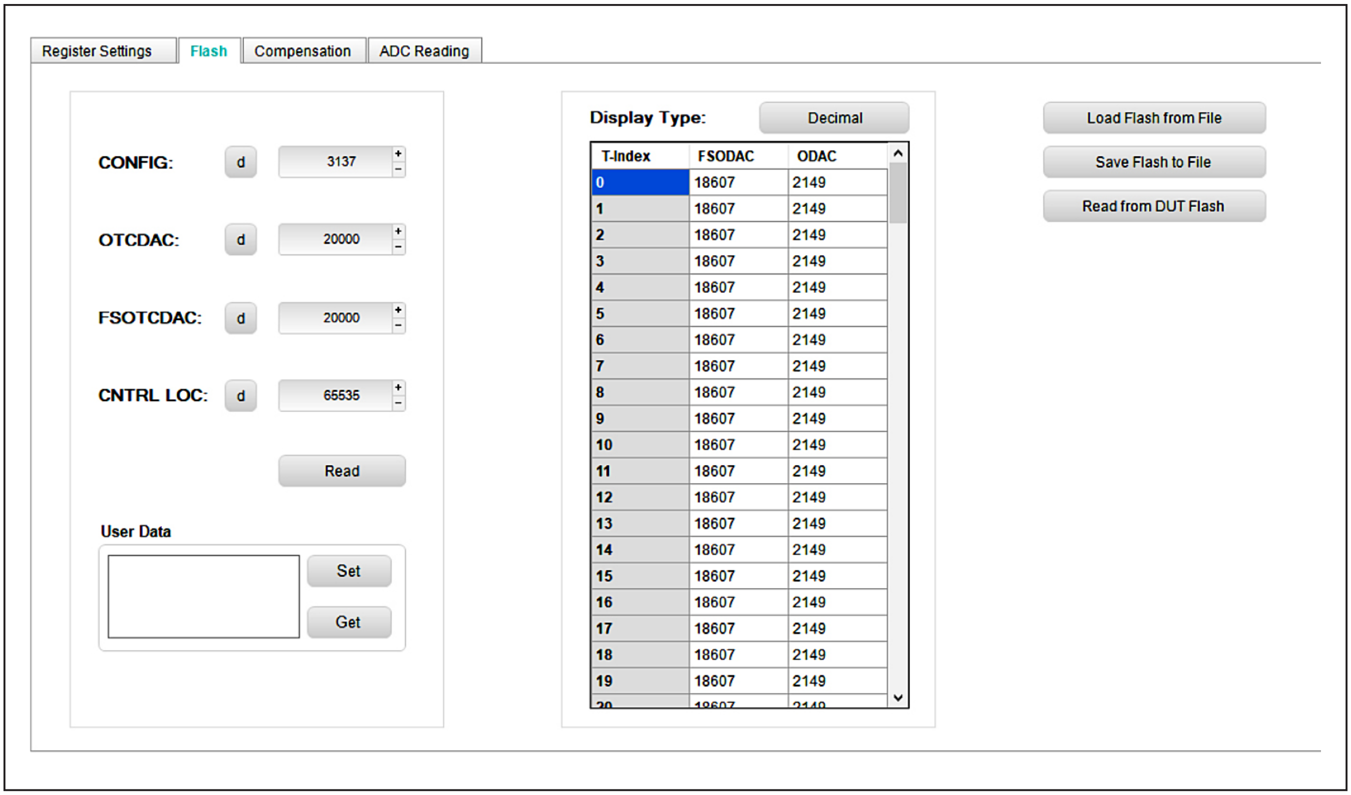


Figure 5. MAX1452 EV System Software Main Window (Flash Tab)

Compensation Tab

The **Compensation** tab can compensate and program the MAX1452 sample. The compensation tab simplifies the process of compensating virtually any sensor connected to a MAX1452 EV kit. The software walks the user through a series of steps designed to calculate the correction coefficients needed for compensation. Once the coefficients are calculated, the flash tables are programmed, and the user now has a compensated sensor.

The procedure is performed by the compensation software with the following steps.

1) Start Compensation, load initial values into respective registers.
2) Set Reference Temperature.
3) Set Pressure to P_{MAX}.
4) Measure the Output Voltage V_{OUT} (P_{MAX}).
5) Set the Pressure to P_{MIN}.
6) Measure the Output Voltage V_{OUT} (P_{MIN}).
7) Measure the Current V_{BRIDGE}.
8) Calculate Current Span = V_{OUT} (P_{MAX}) - V_{OUT} (P_{MIN}).
9) Calculate the Ideal V_{BRIDGE} = Current V_{BRIDGE} x Target_span/Current span.
10) Use the FSODAC to set the ideal V_{BRIDGE}.
11) Use the Offset DAC to set output to desired offset.
12) Set the Next temperature.
13) Repeat the steps 3–11.
14) After the sensor has been calibrated at two temperature points, the entire table is compiled using linear interpolation.
15) Store the Compiled tables into Flash.
16) Stop Compensation

To start the Compensation process, some of the parameters have to be determined and set in the corresponding locations:

Absolute Error: Accuracy required

Target Span: This will normally be 4.000V

Target Offset: This will normally be 0.5V

Initial values

There are default coefficients that are loaded into the registers (e.g. based on mean values of Offset, FSO, and Bridge Resistance) and serve as the compensation starting point. This can speed up the Compensation process. There are two ways to determine an initial value set:

1) If the performance of the sensor is not known, it is possible to enter the start values directly into the registers, and then see the effects of these values by selecting **Display PGA output** and **Display Bridge Voltage** in the **Register** tab. If the output is within reasonable limits, the user can use it as initial values to start the Compensation procedure.

2) If the performance of the sensor is known and a starting set has already been derived, the user can **Load values** from the file.

Detailed Procedure for calibration process is described in following flow charts. See Figures 7 and 8. The calibration process indicated a recommended method for calibrating sensors in association with MAX1452. Filled in initial values and target accuracy, span, and offset, the program starts with the first temperature point and will repeat the same procedure for the second temperature. After calibrating MAX1452 at two temperature points, the GUI calculates and fills in the FSODAC and ODAC and values of the rest of the 174 temperature index.

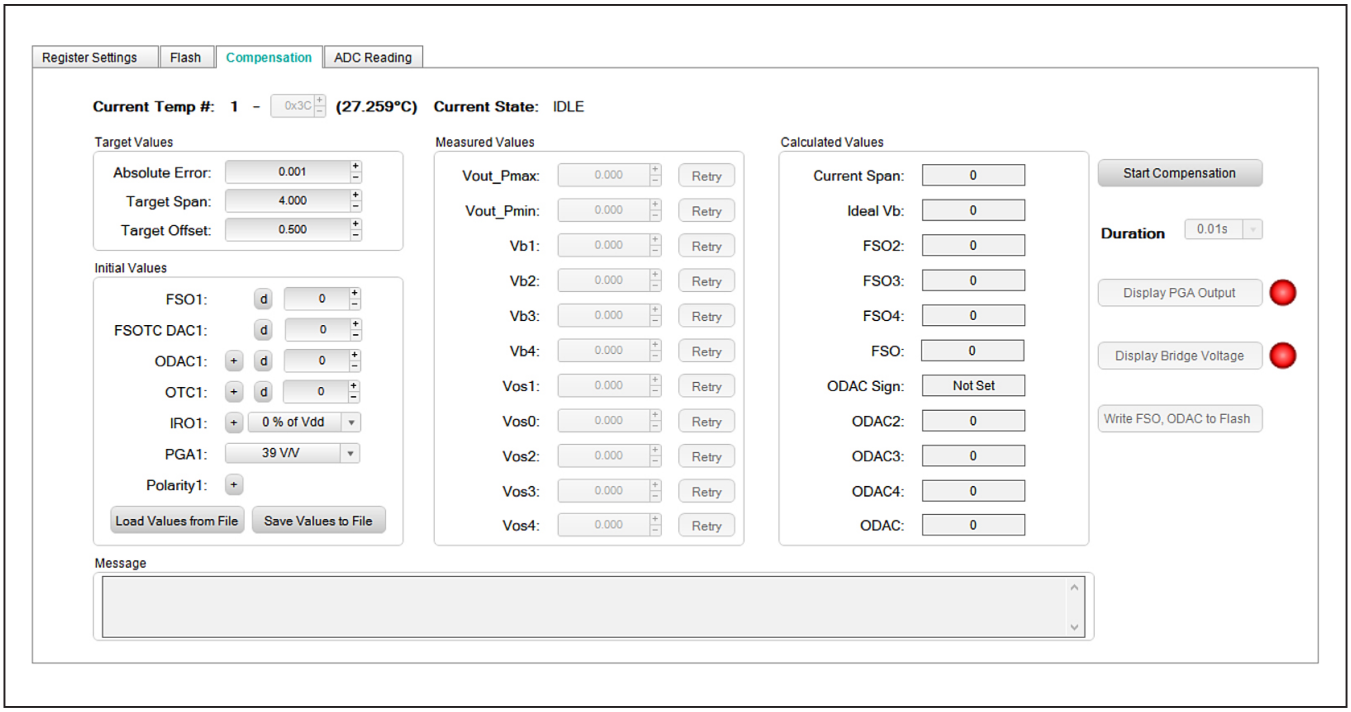


Figure 6. MAX1452 EV System Software Main Window (Compensation Tab)

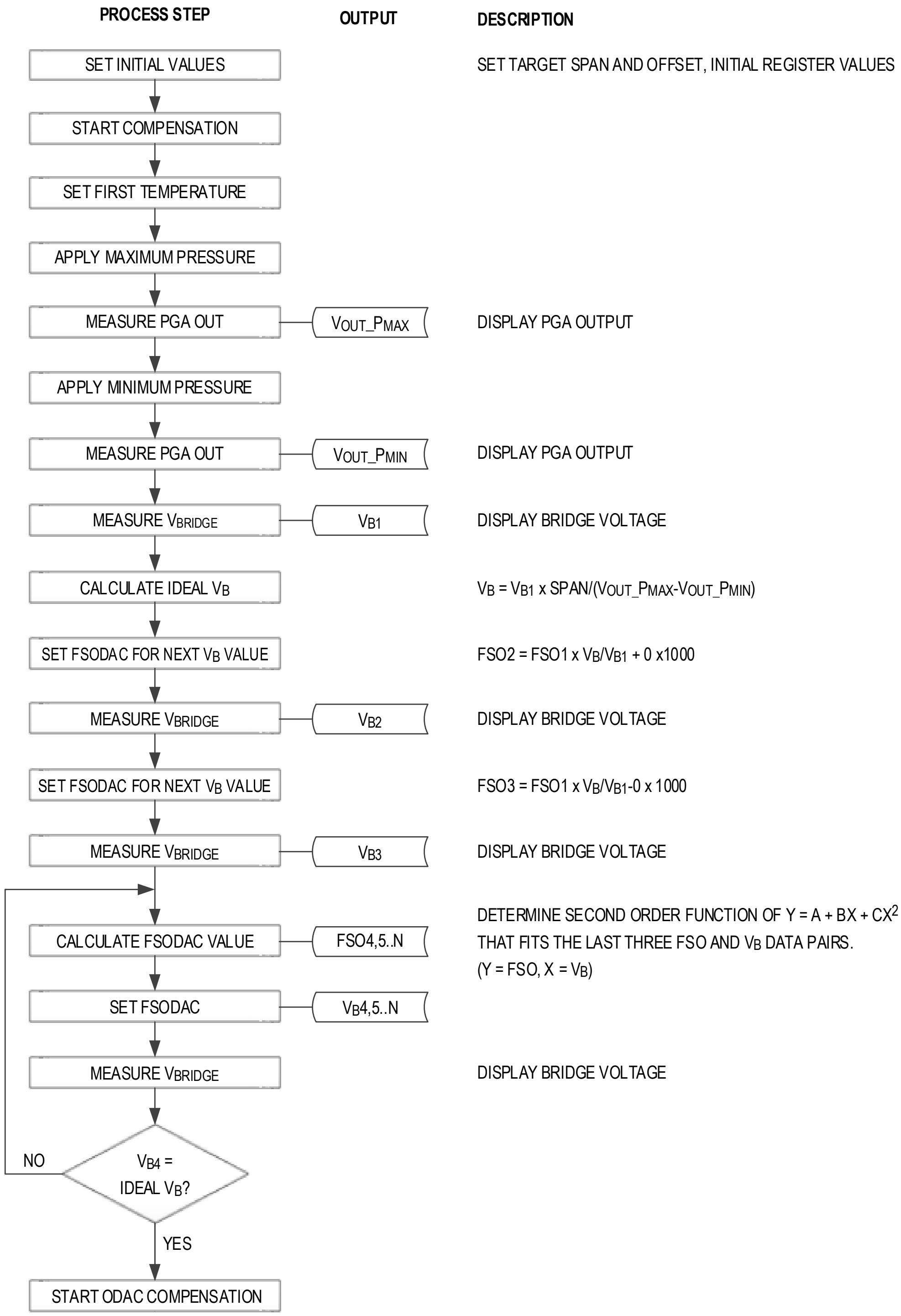


Figure 7. Detailed Procedure for calibration process (Page 1)

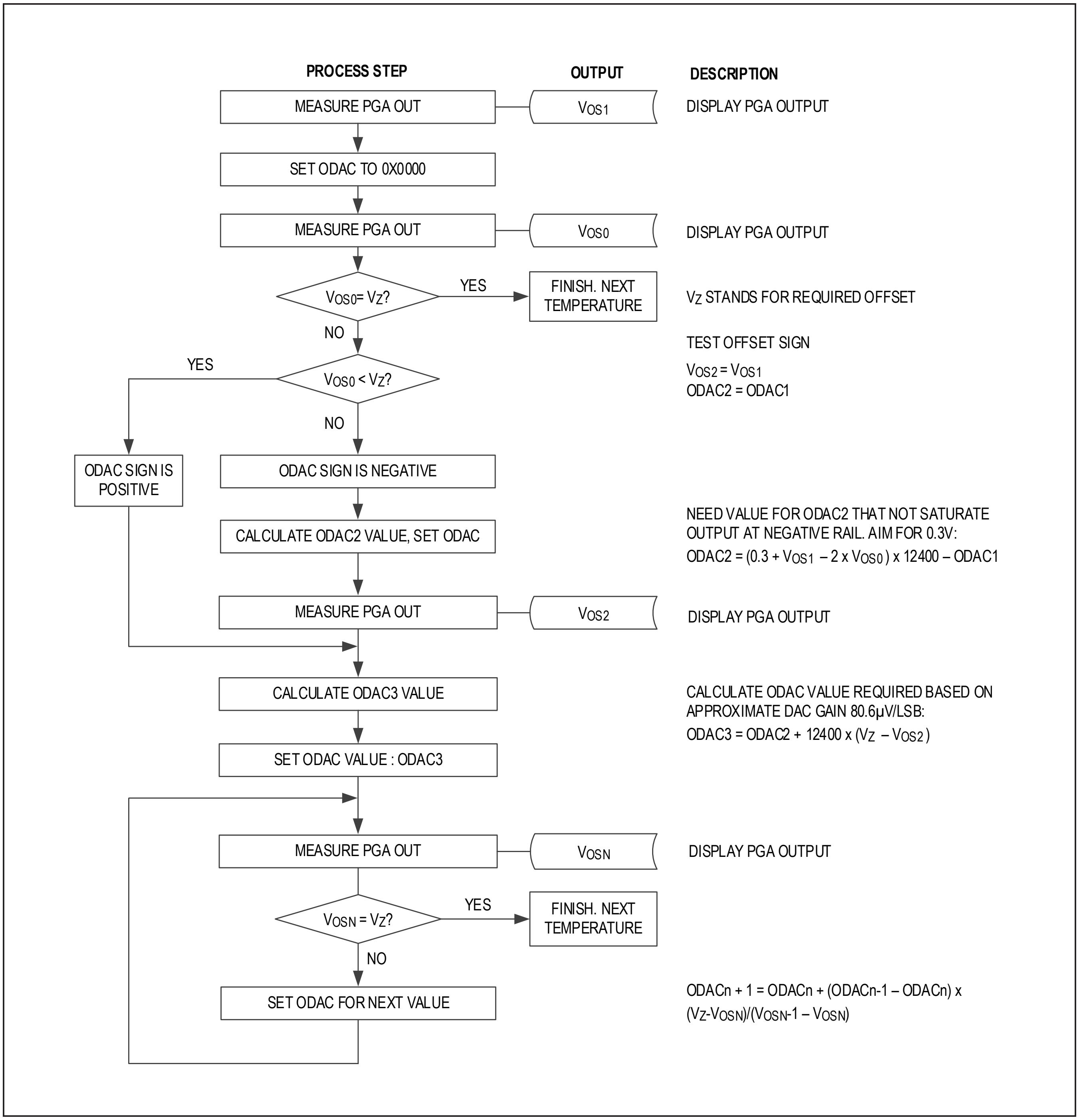


Figure 8. Detailed Procedure for calibration process (Page 2)

ADC Reading Tab

MAX1452EV kit has an on-board 16-bit ADC device (MAX1134) to read the voltage of the OUT signal of MAX1452 while in analog mode. The **ADC Reading** tab sheet has a **Scope** to display the output of the ADC. When the IC is operating in analog mode, slide on **ADC Power** to enable ADC reading. Click **Capture** to start one time reading of ADC samples defined by the selection of the **Number of Samples**. Check the **Auto Read OUT** checkbox to start the continuous ADC conversion. The **Scope** receives new ADC values approximately every 1ms. **Note:** Please only **enable ADC Power** when IC in **analog mode**, do not **turn on ADC reading** when IC in **digital mode**, this is because the multiplexer switches inside MAX1452 are typically 2kΩ and therefore can not drive low impedance loads on the OUT pin.

Detailed Description of Hardware

The MAX1452 EV system includes a MAX32625PICO and MAX1452 EV board. The EV system also includes Windows 10 compatible software that provides a simple graphical user interface (GUI) for exercising the features of the IC. The EV board includes interface circuitry to communicate between the IC and MAX32625PICO board. The EV board comes installed with a MAX1452AAE+ in a 16-pin SSOP package.

The EV system utilizes the MAX32625PICO Arm Cortex-M4 microcontroller to interface with the GUI and optionally provides power to the MAX1452. MAX1452 EV board contains jumpers to test MAX1452 in both analog and digital mode. A list of all the jumpers and their respective functions as shown in Table 1.

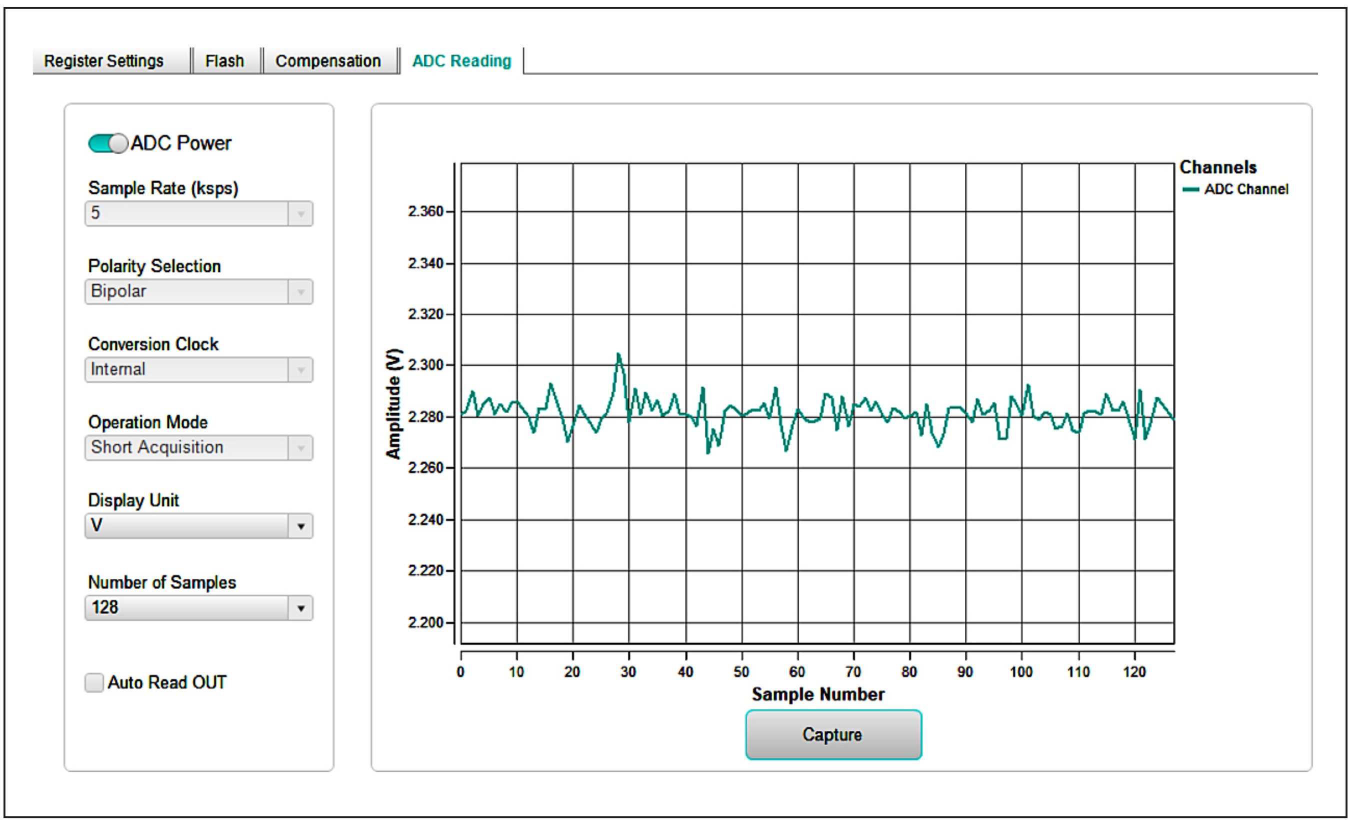


Figure 9. MAX1452 EV System Software Main Window (ADC Reading Tab)

Powering the EV system

The MAX1452 EV system is powered directly from the MAX32625PICO through USB to Micro USB cable. JU1 must be connected to supply power from MAX32625PICO. 3.3V jumper must be connected for communication between MAX32625PICO to the MAX1452 IC.

Table 1. Description of Jumpers

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	The On-board LDO provide 5V output to the EV System
	Open	Disconnect the output of the on-board LDO
JU2	1-2	Connect DIO to V_{OUT} for single- pin programming
	Open*	Disconnect DIO to V_{OUT}
JU3	1-2*	Unlock MAX1452 digital interface and place the part in digital mode
	Open	Unlock pin low and set secure lock byte to place the part in analog mode
1.8V	1-2	MAX32625PICO board provides 1.8V output
	Open*	Disconnect output of 1.8V
3.3V	1-2*	MAX32625PICO board provides 3.3V output to the EV system
	Open	Disconnect the output 3.3V of MAX32625PICO board

**Indicates default jumper position.*

Ordering Information

PART	TYPE
MAX1452EVSYS#	EV System (EV kit + Master Board)
MAX1452BEVKIT#	Rev B EV kit
MAX32625PICO#	Master Board

#Denotes RoHS compliant

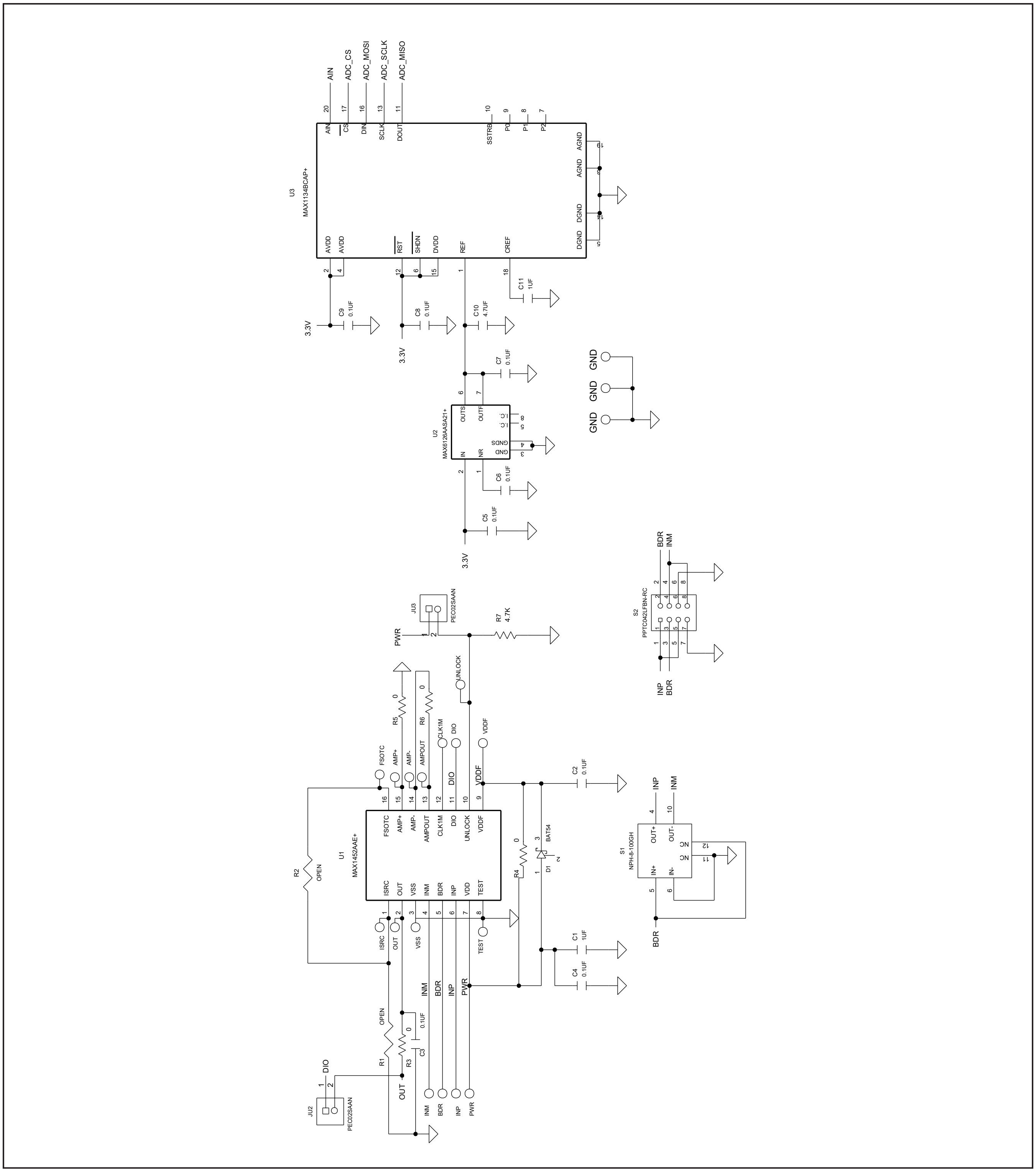
MAX1452BEVKIT# Bill of Materials

ITEM	REF_DES		QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	1.8V, 3.3V, JU1-JU3		5	PEC02SAAN	SULLINS	PEC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS
2	C1, C11, C14, C16, C22		5	C0402C105K8PAC; CC0402KRX5R6BB105	KEMET; YAGEO	1UF	CAP; SMT (0402); 1UF; 10%; 10V; X5R; CERAMIC
3	C2-C9		8	GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB	MURATA;TDK; TAIYO YUDEN; TDK	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC
4	C10, C20		2	C0402C475M7PAC; GRM155R60G475M; GRM155R60J475ME47	KEMET; MURATA; MURATA	4.7UF	CAP; SMT (0402); 4.7UF; 20%; 4V; X5R; CERAMIC
5	C12, C13, C21, C23-C26		7	GRM155R61A106ME44; GRM155R61A106ME11; 0402ZD106MAT2A; CL05A106MP5NUNC	MURATA; MURATA; AVX; SAMSUNG	10UF	CAP; SMT (0402); 10UF; 20%; 10V; X5R; CERAMIC
6	C15		1	GRM155R60J106ME44; GRM155R60J106ME47; C1005X5R0J106M050BC; CL05A106MQ5NUN; C0402C106M9PAC	MURATA;MURATA; TDK; SAMSUNG ELECTRONICS; KEMET	10UF	CAP; SMT (0402); 10UF; 20%; 6.3V; X5R; CERAMIC
7	C17		1	T520B227M006ATE045; TCJB227M006R0200	KEMET; AVX	220UF	CAP; SMT (3528); 220UF; 20%; 6.3V; TANTALUM
8	C18		1	GRM188R60G476ME15	MURATA	47UF	CAP; SMT (0603); 47UF; 20%; 4V; X5R; CERAMIC
9	C19		1	GRM188R60J476ME15	MURATA	47UF	CAP; SMT; 47UF; 20%; 6.3V; X5R; CERAMIC CHIP;
10	D1		1	BAT54	ON SEMICONDUCTOR	BAT54	DIODE; SCH; SMT (SOT-23); PIV=30V; IF=0.2A
11	GND1-GND3		3	5001	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
12	H1, H2		2	PPPC101LFBN-RC	SULLINS ELECTRONICS CORP.	PPPC101LFBN-RC	CONNECTOR; FEMALE; THROUGH HOLE; HEADER CONNECTOR; STRAIGHT; 10PINS
13	L1		1	LQH32CN220K23	MURATA	22UH	INDUCTOR; 1210; 22UH; +/-10%; 0.25A; -40DEGC TO +85DEGC
14	MTH1-MTH4		4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
15	Q1, Q2		2	FDS8958B	ON SEMICONDUCTOR	FDS8958B	TRAN; DUAL N AND P-CHANNEL POWER TRENCH MOSFET; DCH; SO-8; PD-(2W); I-(N+6.4A; P-4.5A); V-(N+30V; P+30V)
16	R3-R6		4	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
17	R7		1	CRCW04024K70FK; MCR01MZPF4701	VISHAY DALE; ROHM SEMICONDUCTOR	4.7K	RES; SMT (0402); 4.7K; 1%; +/-100PPM/DEGC; 0.0630W
18	R8		1	ERJ-2RKF5100	PANASONIC	510	RES; SMT (0402); 510; 1%; +/-100PPM/DEGC; 0.1000W
19	R9		1	ERA-2AEB113	PANASONIC	11K	RES; SMT (0402); 11K; 0.10%; +/-25PPM/DEGC; 0.0630W
20	R10		1	ERJ-2RKF1004	PANASONIC	1M	RES; SMT (0402); 1M; 1%; +/-100PPM/DEGC; 0.1000W

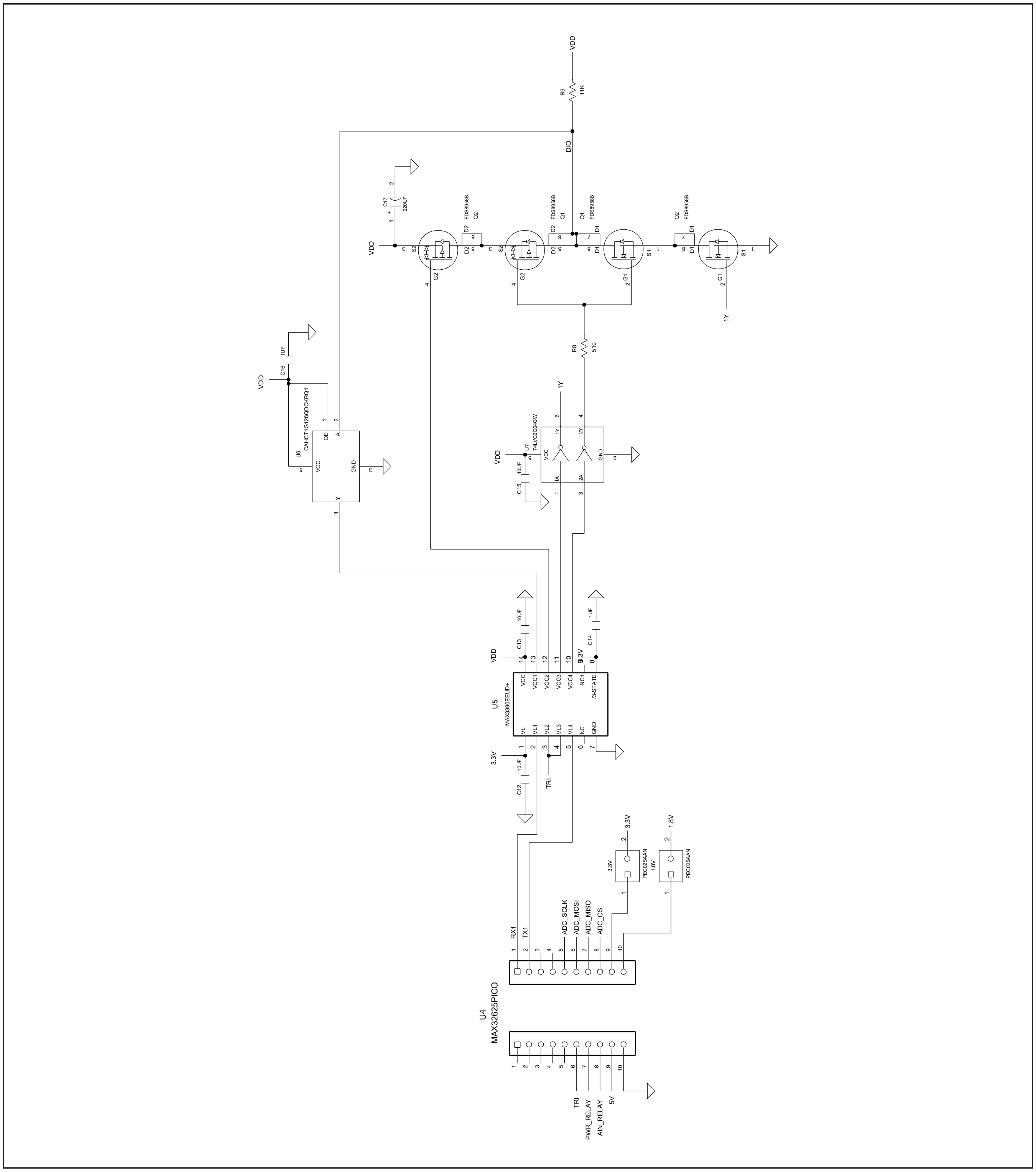
MAX1452BEVKIT# Bill of Materials (continued)

ITEM	REF_DES		QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
21	R11		1	ERJ-2RKF3402	PANASONIC	34K	RES; SMT (0402); 34K; 1%; +/-100PPM/DEGC; 0.1000W
22	R12, R15		2	CRCW040210K0FK; RC0402FR-0710KL	VISHAY DALE; YAGEO PHICOMP	10K	RES; SMT (0402); 10K; 1%; +/-100PPM/DEGC; 0.0630W
23	R13		1	CRCW0402100KFK; RC0402FR-07100KL	VISHAY;YAGEO	100K	RES; SMT (0402); 100K; 1%; +/-100PPM/DEGC; 0.0630W
24	R14		1	ERJ-2RKF3002	PANASONIC	30K	RES; SMT (0402); 30K; 1%; +/-100PPM/DEGC; 0.1000W
25	RL1, RL2		2	3570-1333-053	COMUS INTERNATIONAL	3570-1333-053	RELAY; SPST; 3570 1333 SERIES; GENERAL PURPOSE SIP; WITH DIODE; THROUGH HOLE; 5V; RCOIL = 500 OHM; RINSULATION = 1000G OHM; 1A; SOCKETED VERSION
26	S1		1	NPH-8-100GH	NOVA SENSOR	NPH-8-100GH	IC; SNSR; 15PSI; STRAIGHT; WHEATSTONE BRIDGE; SOLID STATE MEDIUM PRESSURE SENSORS; TO-8
27	S2		1	PPTC042LFBN-RC	SULLINS ELECTRONICS CORP.	PPTC042LFBN-RC	CONNECTOR; FEMALE; THROUGH HOLE; DUAL ROW HEADER; STRAIGHT; 8PINS
28	TP1-TP16		16	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
29	U1		1	MAX1452AAE+	MAXIM	MAX1452AAE+	IC; SNSR; LOW-COST PRECISION SENSOR; SIGNAL CONDITIONER ; SSOP16
30	U2		1	MAX6126AASA21+	MAXIM	MAX6126AASA21+	IC; VREF; ULTRA-HIGH PRESCISION; ULTRA-LOW NOISE; SERIES VOLTAGE REFERENCE; NSOIC8
31	U3		1	MAX1134BCAP+	MAXIM	MAX1134BCAP+	IC; ADC; 16-BIT ADC; 150KSPS; SSOP20
32	U5		1	MAX3390EEUD+	MAXIM	MAX3390EEUD+	IC; TRANS; 15KV ESD-PROTECTED; 1UA; 16MBPS; QUAD LOW-VOLTAGE LEVEL TRANSLATOR; TSSOP14
33	U6		1	CAHCT1G126QDCKRQ1	TEXAS INSTRUMENTS	CAHCT1G126QDCKRQ1	IC; BUF; SINGLE BUS BUFFER GATE WITH 3-STATE OUTPUT; SC70-5
34	U7, U11		2	74LVC2G04GW	NEXPERIA	74LVC2G04GW	IC; INV; DUAL INVERTER; SOT363-6
35	U8		1	MAX1795EUA+	MAXIM	MAX1795EUA+	IC; VCON; LOW-SUPPLY-CURRENT;STEP-UP DC-DC CONVERTERS WITH TRUE SHUTDOWN; UMAX8
36	U9		1	MAX1793EUE50+	MAXIM	MAX1793EUE50+	IC; VREG; LOW-DROPOUT LOW IQ 1A LINEAR REGULATOR; TSSOP16
37	U10		1	MAX3379EEUD+	MAXIM	MAX3379EEUD+	IC; TRANS; 15KV ESD-PROTECTED; 1 MICROAMPERE; 16MBPS; QUAD LOW-VOLTAGE LEVEL TRANSLATOR; TSSOP14
38	PCB		1	MAX1452	MAXIM	PCB	PCB:MAX1452
39	R1, R2	DNP	0	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR
TOTAL			88				

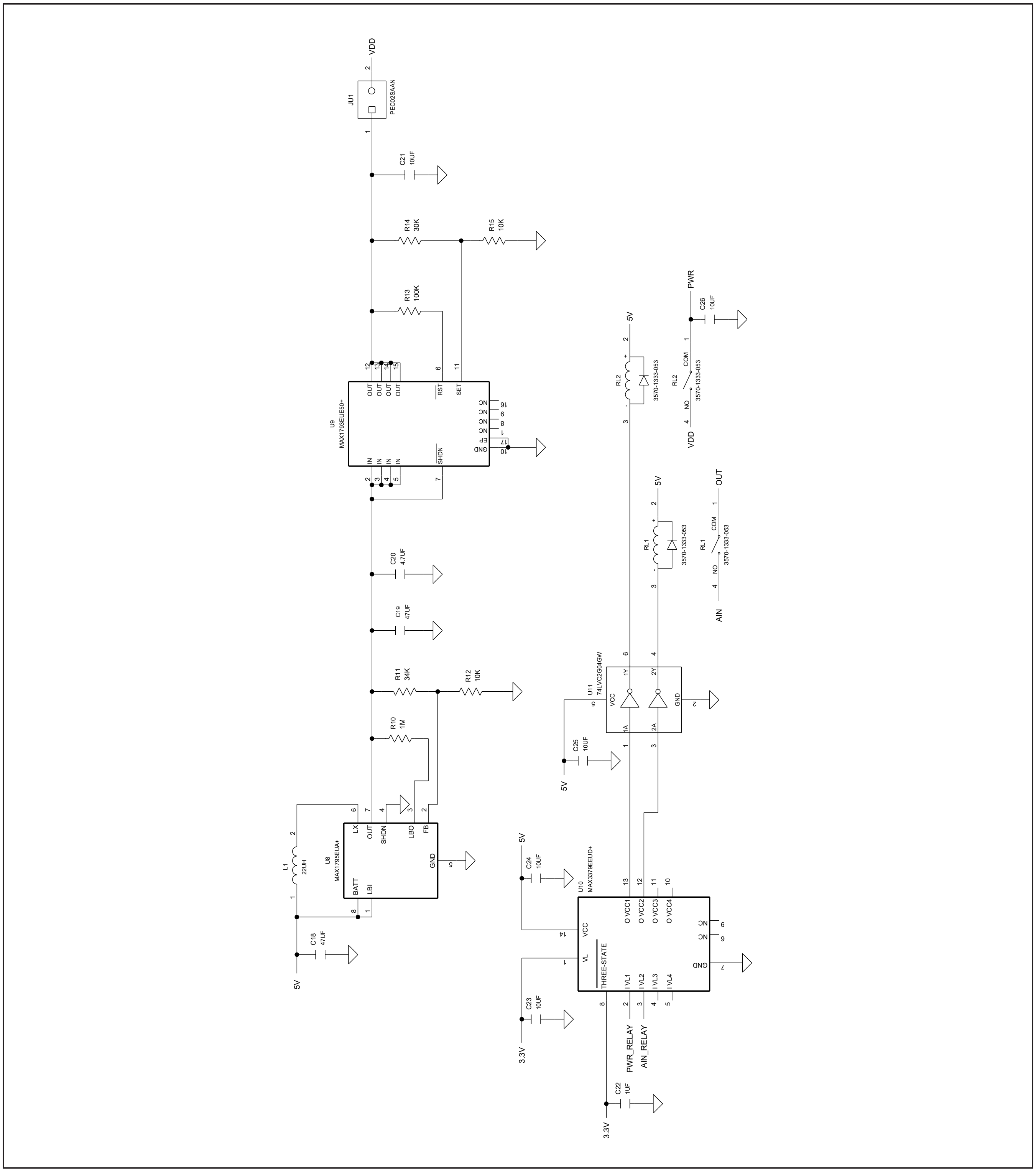
MAX1452 EV System Schematic Diagram



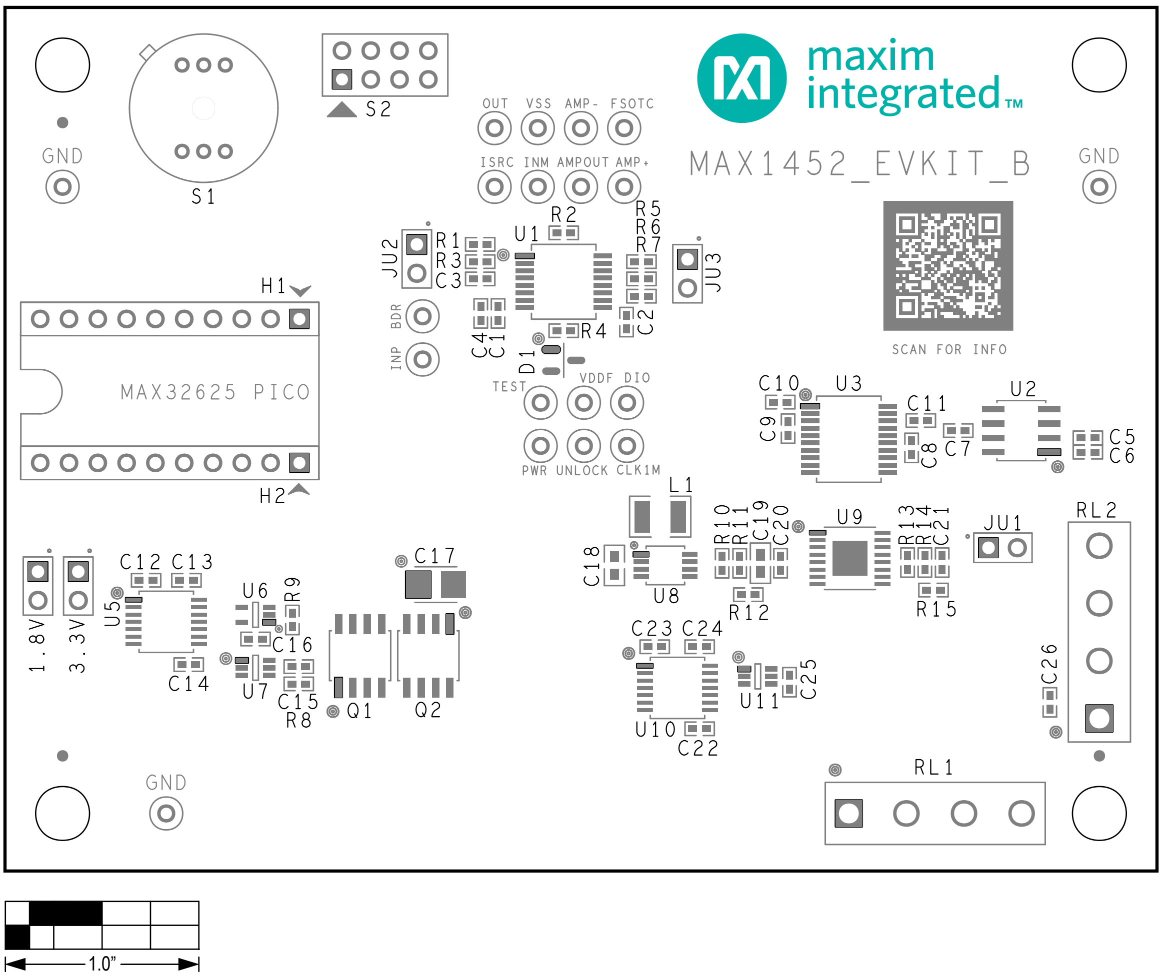
MAX1452 EV System Schematic Diagram (continued)



MAX1452 EV System Schematic Diagram (continued)

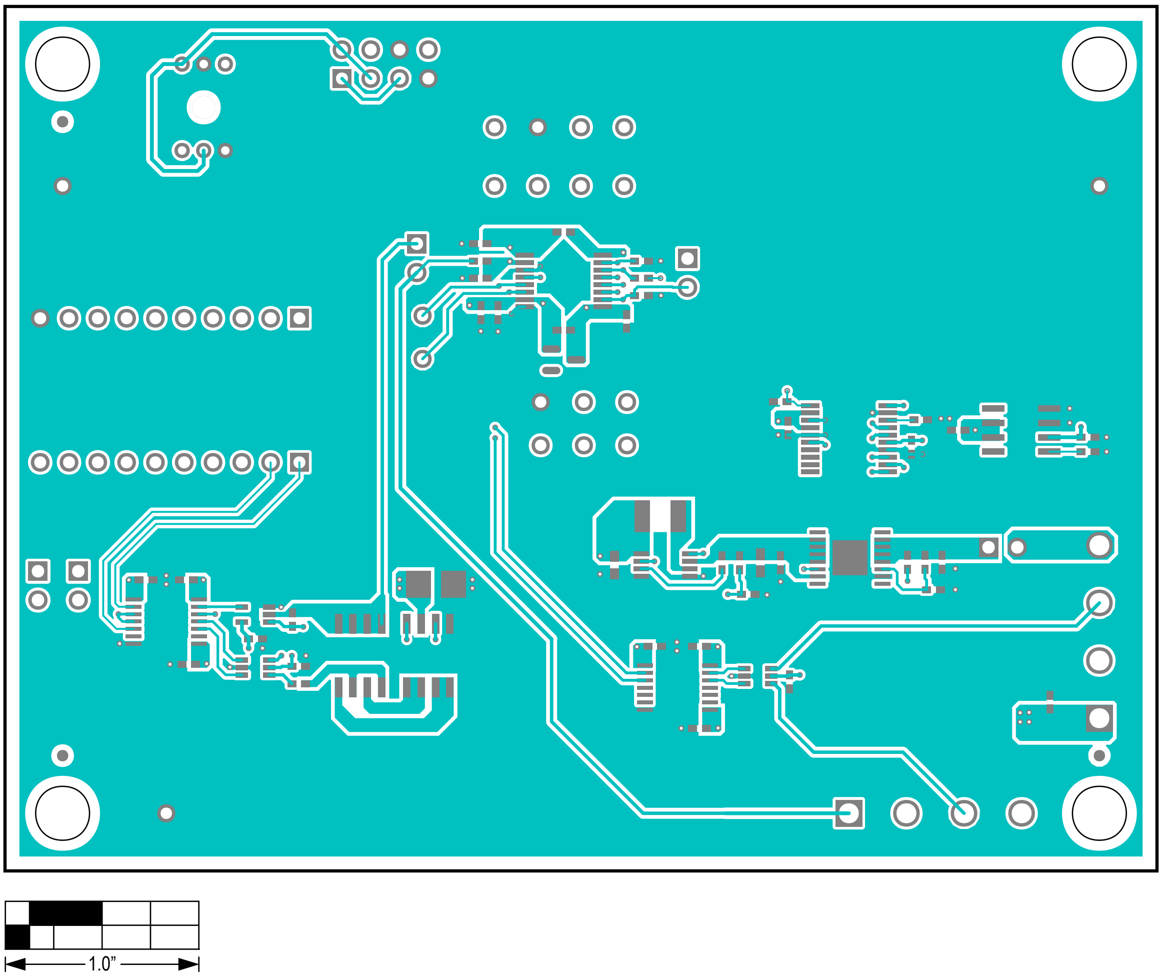


MAX1452 EV System PCB Layout Diagrams



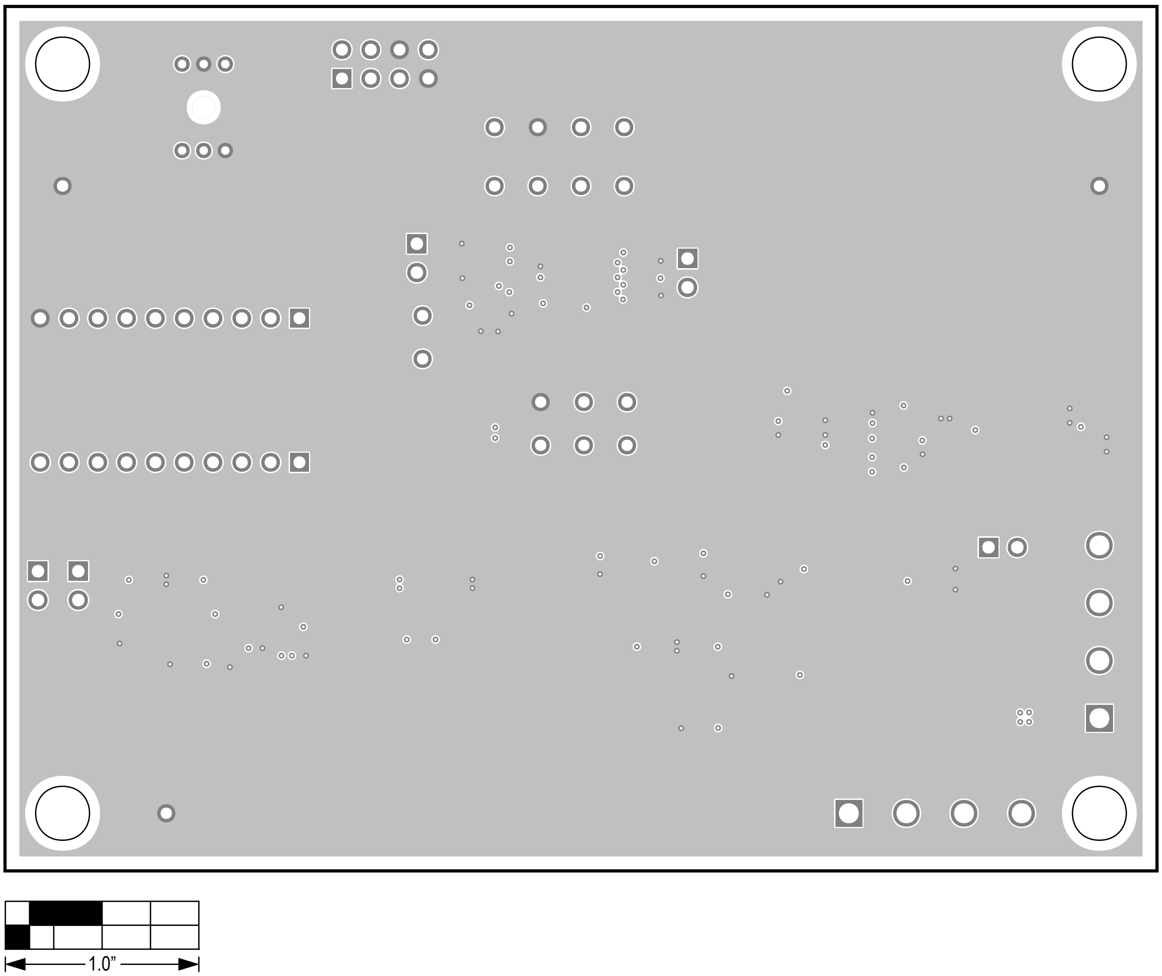
MAX1452 EV System Component Placement Guide—Top Silkscreen

MAX1452 EV System PCB Layout Diagrams (continued)



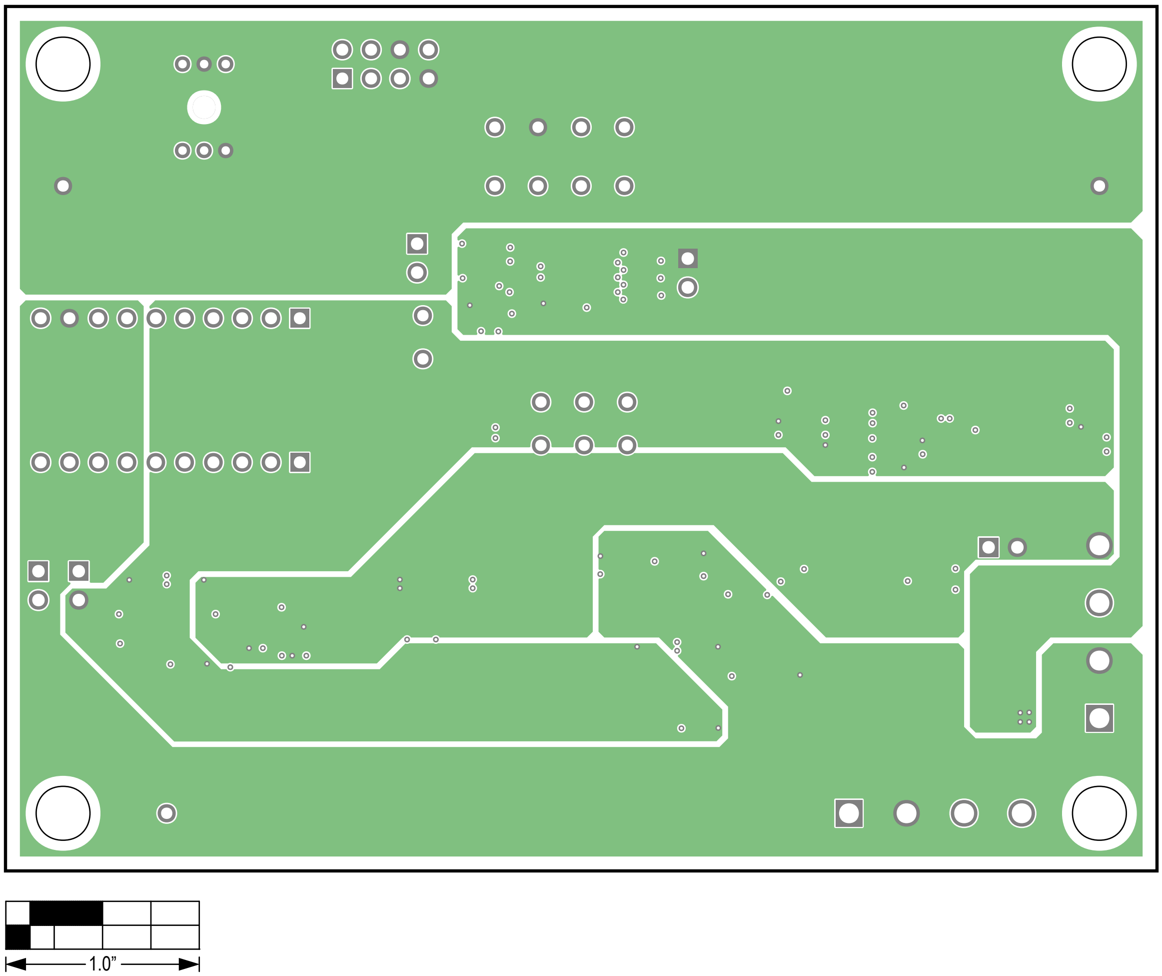
MAX1452 EV System PCB Layout Diagram—Top Layer

MAX1452 EV System PCB Layout Diagrams (continued)



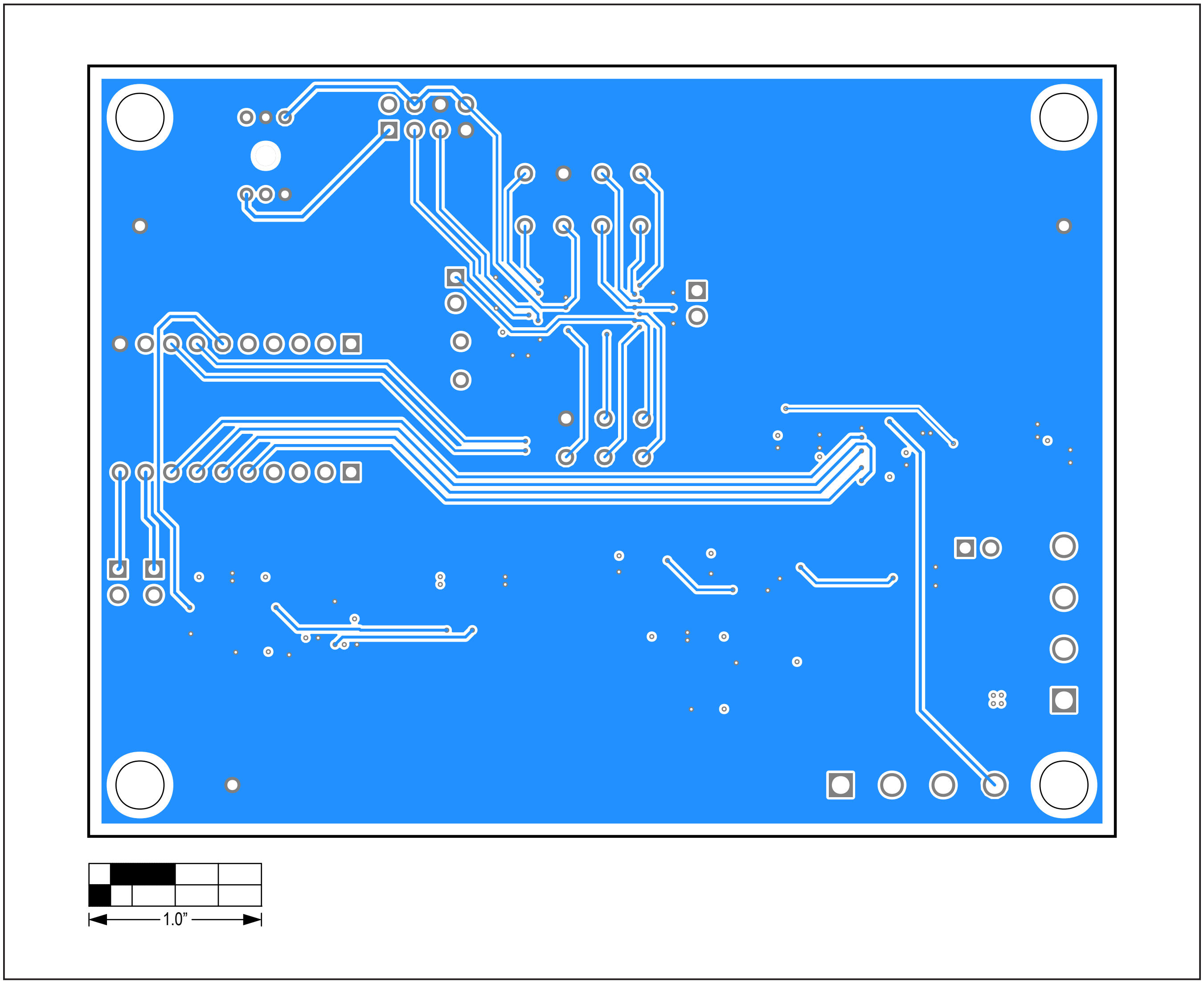
MAX1452 EV System PCB Layout Diagram—Internal 2

MAX1452 EV System PCB Layout Diagrams (continued)



MAX1452 EV System PCB Layout Diagram—Internal 3

MAX1452 EV System PCB Layout Diagrams (continued)



MAX1452 EV System PCB Layout Diagram—Bottom Layer

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/21	Release for Market Intro	—

