19-0601; Rev 1; 6/09

MAX8660 Evaluation Kit/Evaluation System

Evaluate: MAX8660/MAX8660A/MAX8660B/MAX8661

General Description

The MAX8660 evaluation kit (EV kit) is a fully assembled and tested PCB that accepts an input from 2.6V to 6.0V and provides the output voltages and power-management features used by applications processors. The MAX8660 integrates four step-down DC-DC regulators and four LDO linear regulators. Additional features include on/off control for outputs, low-battery detection, reset output, and a 2-wire I²C serial interface.

The MAX8660 evaluation system (EV system) includes a MAX8660 EV kit and a Maxim CMAXQUSB+ serial-interface board. The CMAXQUSB+ board connects to a PC's USB port and allows the transfer of I²C to the MAX8660 EV kit.

The MAX8660 EV kit comes with the MAX8660 installed, but can also be used to evaluate the MAX8660A, MAX8660B, and MAX8661.

Features

- **Optimized for Marvell PXA3xx and PXA168 Applications Processors**
- **Four Synchronous Step-Down DC-DC Regulators**
- **Four LDO Linear Regulators**
- **2MHz Switching Allows Small Components**
- **Low 20µA Deep-Sleep Current**
- **Low-Battery Monitor and Reset Output**
- **40-Pin, 5mm x 5mm x 0.8mm Thin QFN Package**
- **Fully Assembled and Tested**
- **Includes Microsoft Windows® 98SE/2000/XP®-Compatible Evaluation Software**

Component List

DESIGNATION	QTY	DESCRIPTION
C1–C9	9	10µF ±20%, 6.3V X5R ceramic capacitors (0805) TDK C2012X5R0J106M Murata GRM21BR60J106K
C10, C21	2	0.1µF ±10%, X5R ceramic capacitors (0402) TDK C1005X5R1A104K Murata GRM155R61A104K
C11, C12, C15–C18	6	4.7µF ±20%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J475M Murata GRM188R60J475K
C13	1	2.2µF ±20%, 6.3V X5R ceramic capacitor (0603) TDK C1608X5R0J225M Murata GRM188R60J225K
C19, C20	2	1µF ±20%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J105M Murata GRM188R60J105K

Component List continued on next page.

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Ordering Information

PART	TYPE	I²C INTERFACE BOARD
MAX8660EVKIT+	EV Kit	Not included
MAX8660EVCMAXQU+	EV System	CMAXQUSB+

+Denotes lead(Pb)-free and RoHS compliant.

Note: *The MAX8660 EV kit software is included with the MAX8660 EV kit, but is designed for use with the complete EV system. The EV system includes both the Maxim CMAXQUSB+ board and the EV kit. If the Windows software will not be used, the EV kit board can be purchased without the Maxim CMAXQUSB+ board.*

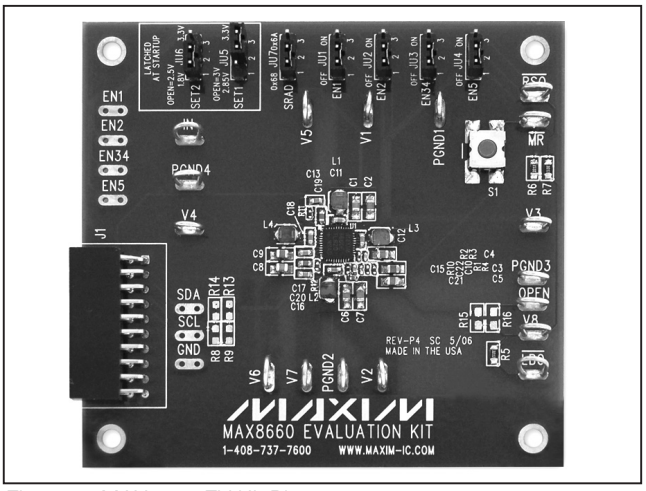

Figure 1. MAX8660 EV Kit Photo

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C22	1	0.47µF ±10%, X5R ceramic capacitor (0402) Murata GRM155R60J474K
J1	1	2 x 10 right-angle receptacle (0.1in) Samtec SSW-110-02-S-D-RA Methode Electronics RS2R-20-G
JU1–JU7	7	3-pin headers
L1, L3	2	1.2µH, 2.1A, 50mΩ inductors (3mm x 2.8mm x 1.2mm max) TOKO 1098AS-1R2 (DE2812C)
L2	1	2.0µH, 1.9A, 67mΩ inductor (3mm x 2.8mm x 1.2mm max) TOKO 1098AS-2R0 (DE2812C)
L4	1	4.7µH, 1.3A, 130mΩ inductor (3mm x 2.8mm x 1.2mm max) TOKO 1098AS-4R7 (DE2812C)
R1	1	1.82MΩ ±1% resistor (0402)
R2	1	80.6kΩ ±1% resistor (0402)
R3	1	1MΩ ±1% resistor (0402)
R4	1	56.2kΩ ±1% resistor (0402)
R5, R6, R7	3	300kΩ ±5% resistors (0805)
R8, R9, R16	0	Not installed, resistors (0805)
R10	1	20Ω ±5% resistor (0402)
R11, R12	2	0Ω resistors (0402)
R13, R14, R15	0	Not installed, resistors—PCB short
S1	1	Momentary pushbutton switch Panasonic EVQ-PHP03T
U1	1	Power-management IC (40 TQFN) Maxim MAX8660ETL+
—	7	Shunts, 2-position
—	1	PCB: MAX8660 EVALUATION KIT+

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic Corp.	800-344-2112	www.panasonic.com
TDK Corp.	847-803-6100	www.component.tdk.com
TOKO America, Inc.	847-297-0070	www.tokoam.com

Note: *Indicate that you are using the MAX8660 when contacting these component suppliers.*

Quick Start

Recommended Equipment

- Computer with USB port running Windows 98SE/2000/XP
- CMAXQUSB+ interface board
- USB A-to-B cable (included with MAX8660 EV system)
- 2.6V to 6.0V power supply capable of supplying 4A
- Voltmeters
- Loads

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

Procedure

The MAX8660 EV kit comes with Windows-compatible software that allows easy evaluation of the I²C serial interface. This software requires the CMAXQUSB+ interface board. Alternatively, the MAX8660 EV kit can be evaluated with a user-supplied I²C master, or it can be partially evaluated (at power-up default voltages only) without an I²C master. This document assumes that the CMAXQUSB+ interface board is being used.

The MAX8660 EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Note:** Do not turn on the power supply until all connections are completed.

1) Visit **www.maxim-ic.com/evkitsoftware** to download the latest version of the EV kit software.
2) Install the EV kit software on your computer by running the INSTALL.EXE program. The program files are copied and icons are created in the Windows **Start** menu.
3) Enable outputs V1, V2, and V5 by placing the shunts across pins 2-3 of JU1, JU2, and JU4 of the MAX8660 EV kit.
4) Place the shunt of JU3 across pins 1-2 to allow software control of REG3 and REG4 enables.
5) Select the desired V1 and V2 output voltage with JU5 and JU6 (see Table 1).
6) Place the shunt of JU7 across pins 1-2 to set the I²C address to 0x68.
7) Preset the power supply to 3.8V. Turn the power supply off.
8) Connect the positive power-supply terminal to the EV kit pad labeled IN.
9) Connect the power-supply ground terminal to the

Table 1. Jumper Functions

JUMPER	PIN	POSITION		
		1-2	2-3	OPEN
JU1	EN1	Shutdown REG1	Enable REG1	Drive EN1 with an external source.
JU2	EN2	Shutdown REG2	Enable REG2	Drive EN2 with an external source.
JU3	EN34	REG3 and REG4 enables are controlled individually through the I²C interface (shutdown by default).	Enable REG3 and REG4	Drive EN34 with an external source.
JU4	EN5	Shutdown REG5	Enable REG5	Drive EN5 with an external source.
JU5*	SET1	V1 is 2.85V	V1 is 3.3V	V1 is 3.0V
JU6*	SET2	V2 is 1.8V	V2 is 3.3V	V2 is 2.5V
JU7	SRAD	I²C address is 0x68	I²C address is 0x6A	—

**Regulation voltage for REG1 and REG2 is latched when the corresponding regulator starts up. Changing the JU5 or JU6 jumper position while the regulator is running has no effect until power or enable is cycled.*

EV kit pad labeled PGND4.

10) Connect the loads from the regulator outputs (V_) to the nearest PGND_ pad on the EV kit.

11) Connect the voltmeters from the regulator outputs (V_) to the nearest PGND_ pad on the EV kit.

12) On the CMAXQUSB+ board, use JU1 to select 3.3V, and set both SW1 DIP switches to ON to enable the I²C pullup resistors.

13) Connect J1 of the MAX8660 EV kit to P3 of the CMAXQUSB+.

14) Turn on the power supply.

15) Connect the USB cable from the PC to the CMAXQUSB+ board. A **Building Driver Database** window pops up in addition to a **New Hardware Found** message. If you do not see a window that is similar to the one described above after 30 seconds, remove the USB cable from the CMAXQUSB+ and reconnect it. Administrator privileges are required to install the USB device driver on Windows 2000/XP. Refer to the TROUBLESHOOTING_USB.PDF document included with the software for more information.

16) Follow the directions of the **Add New Hardware Wizard** to install the USB device driver. Choose the **Search for the Best Driver for your Device** option. Specify the location of the device driver to be **C:\Program Files\MAX8660** (default installation directory) using the **Browse** button.

17) Start the MAX8660 EV kit software by opening its icon in the **Start** menu. The main interface window appears, as shown in Figure 2.

18) With a voltmeter, verify that V8 is 3.3V.

19) Verify that $\overline{LBO}$ and $\overline{RSO}$ are high.

20) Verify that V1 and V2 are at the voltage set by jumpers JU5 and JU6.

21) Verify that V5 is 1.8V.

22) Enable the other outputs by clicking the checkboxes in the **Enable Regulators** section of the window.

23) With the voltmeters, verify that the other outputs are powered.

Detailed Description of Hardware

Regulator Outputs (V1–V8)

The MAX8660 EV kit has eight power-supply outputs: four step-down DC-DC regulators (V1–V4) and four LDO regulators (V5–V8). Refer to the MAX8660/MAX8661 data sheet for more information on these regulators.

REG1, REG2, and REG5 are individually enabled or disabled with jumpers JU1, JU2, and JU4 (see Table 1).

REG3 and REG4 are enabled or disabled with JU3 and the I²C interface. See Table 1 and refer to the *REG3/REG4 Enable (EN34, EN3, EN4)* section of the MAX8660/MAX8661 data sheet for more information.

Output voltage for REG1 and REG2 are set by jumpers JU5 and JU6, as shown in Table 1.

REG6 and REG7 are enabled or disabled only through the I²C interface.

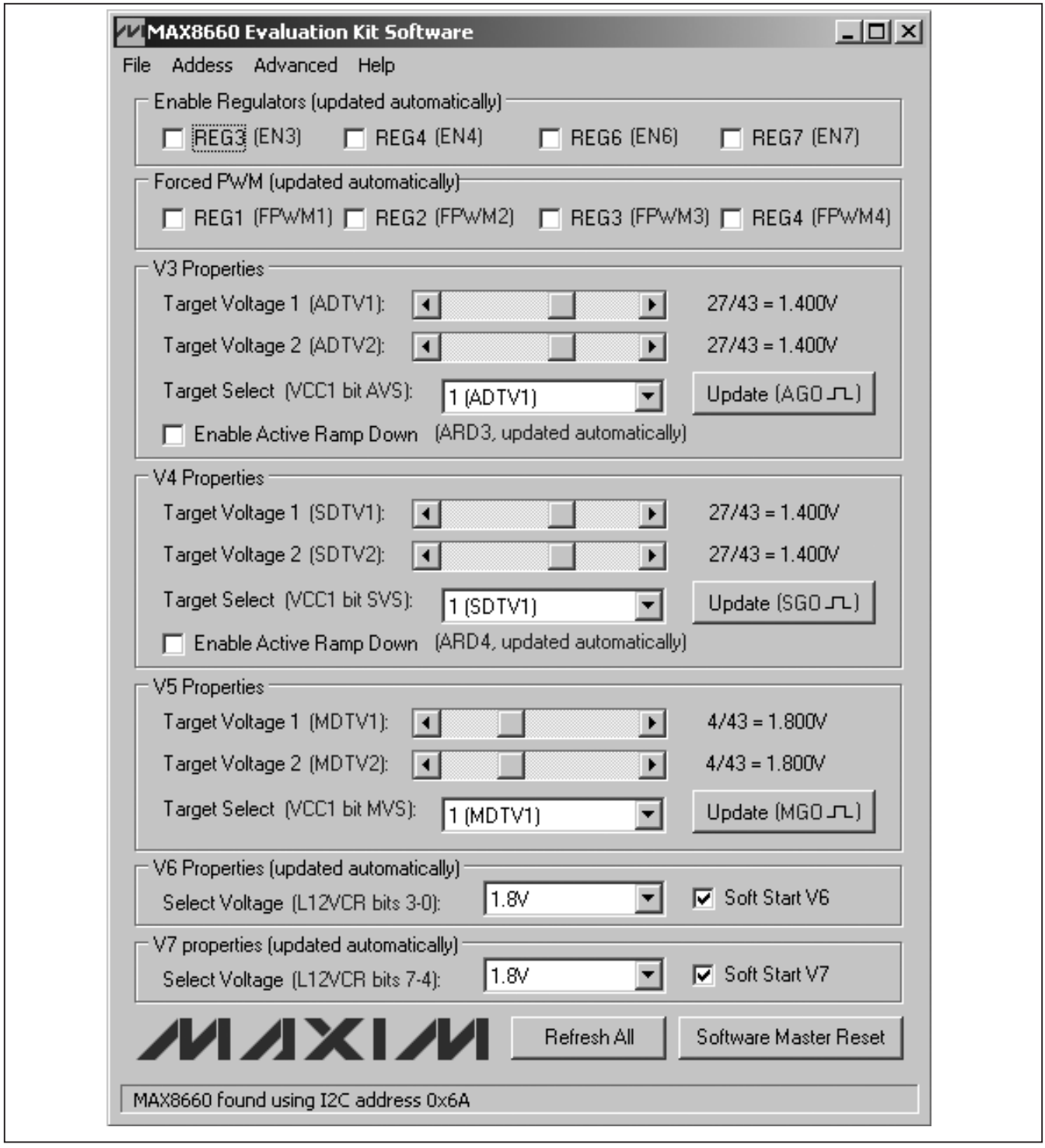

Figure 2. MAX8660 EV Kit Software Main Interface Window

Reset ($\overline{MR}$, $\overline{RSO}$)

Driving the $\overline{MR}$ input low or pressing the S1 button on the EV kit resets the MAX8660 internal registers to their default values and forces $\overline{RSO}$ low. V8 falling below 2.2V also generates a reset. Additionally, entering UVLO or OVLO due to an invalid V_{IN} generates a reset. Refer to the *Reset Output* (*$\overline{RSO}$*) *and $\overline{MR}$ Input* section of the MAX8660/MAX8661 data sheet for more information.

The software detects long (two second) reset events and ensures that the settings shown in the main window match the MAX8660 internal I²C registers. Fast reset events reset the MAX8660, but may not be detected by the software. If this occurs, the software settings and the MAX8660 registers may not match. Use the **Refresh All** or **Software Master Reset** button to re-synchronize the MAX8660 and the software.

While S1 is depressed, the software cannot communicate with the board. Make sure that test leads and scope probes do not rest on the button.

Low-Battery Detection ($\overline{LBO}$)

The low-battery output ($\overline{LBO}$) is an open-drain output that pulls low when the battery voltage (V_{IN}) drops below the low-battery threshold. The EV kit comes with the low-battery threshold set to 3.2V falling and 3.6V rising. This threshold can be adjusted by changing resistors R1, R2, and R3. Refer to the *Low-Battery Detector* (*$\overline{LBO}$, LBF, LBR*) section of the MAX8660/ MAX8661 data sheet for information on selecting these resistor values.

I²C Interface

To use the CMAXQUSB+ board for the I²C interface, connect J1 on the MAX8660 EV kit to the MAX SMBus™-compatible interface connector on the CMAXQUSB+ board. Use jumper JU1 on the CMAXQUSB+ board to select the 3.3V pullup supply and set both SW1 DIP switches to ON to enable the pullups. Use the USB cable provided to connect the CMAXQUSB+ board to the computer.

When the CMAXQUSB+ is not used, connect the user-supplied SDA and SCL signals directly to the SDA and SCL pads on the EV kit. Optional pullup resistors R8 and R9 may be used to pull these signals up to the V1 supply. Optional series resistors R13 and R14 can also be used. Before installing these series resistors, first cut the traces shorting the R13 and R14 pads.

SMBus is a trademark of Intel Corp.

Evaluating the MAX8660A, MAX8660B or MAX8661

The MAX8660 EV kit comes with the MAX8660 installed, but it can also be used to evaluate the MAX8660A, MAX8660B, and the MAX8661. To evaluate a different part, carefully remove the IC from the MAX8660 EV kit and replace with the MAX8660A, MAX8660B, or MAX8661. When evaluating the MAX8661, short pins 1-2 of jumpers JU1 and JU5 and connect pad V1 to PGND1.

Detailed Description of Software

Follow the procedures in the *Quick Start* section to install the MAX8660 EV kit software and CMAXQUSB+ drivers.

Before starting the MAX8660 EV kit software, connect the MAX8660 EV kit to the CMAXQUSB+ interface board's MAX SMBus-compatible interface connector. Connect the CMAXQUSB+ interface to the computer with the USB A-to-B cable. LED1 on the CMAXQUSB+ board lights, indicating that it is being powered from the USB port. Connect a 2.6V to 6.0V power supply to the IN pad, and ground at the PGND4 pad.

On startup, the software automatically recognizes the MAX8660 and brings up the main interface window (see Figure 2).

Troubleshooting

If the software does not recognize the MAX8660, check the following:

1) Check LED1 on the CMAXQUSB+ board. If the LED is not lit, verify that the USB cable properly connects the CMAXQUSB+ board to a functioning USB port on the computer.
2) On the MAX8660 EV kit, measure the voltage from V8 to PGND_. If it is not 3.3V, check the power input to the MAX8660 EV kit. A 2.6V to 6.0V power supply must be connected from IN and PGND4.
3) Make sure the $\overline{MR}$ button on the MAX8660 EV kit is not being pressed. Keep leads and scope probes away from the pushbutton.
4) Make sure the MAX8660 EV kit is properly connected to the MAX SMBus connector on the CMAXQUSB+ board. Make sure the VDD select jumper on the CMAXQUSB+ board is set to 3.3V. With a voltmeter, verify the SDA-to-GND and SCL-to-GND voltages on the MAX8660 EV kit are 3.3V.

Main Interface Window

All of the I²C functions of the MAX8660 are accessed through the main interface window, as shown in Figure 2.

Enable Regulators

The **Enable Regulators** section of the main window has checkboxes for **REG3, REG4, REG6**, and **REG7**. Click a checkbox to enable the corresponding regulator. Click the box again to remove the check and disable the regulator. Note that REG3 and REG4 can be forced on with jumper JU3. In this case, disabling REG3 or REG4 with the software has no effect.

Forced PWM

The **Forced PWM** section of the main window has checkboxes for the four step-down regulators. Click a checkbox to put the corresponding regulator in forced PWM. Click the box again to remove the check and return the regulator to normal mode.

V3, V4, and V5 Properties

The main window has sliders for setting the two target voltages for **V3, V4,** and **V5**. Drag the slider with the mouse to set the desired target voltage. To change the output of the MAX8660, select the active target voltage in the **Target Select** box under the sliders, and then click the **Update** button to the right. A checkbox is also provided to enable or disable the active ramp-down feature.

V6 and V7 Properties

To change the **V6** and **V7** voltage, select the desired voltage in the **Select Voltage** box. A **Soft Start** checkbox is also provided. When the soft-start box is checked, the regulator disables then reenables during a voltage change to force the soft-start ramp during the transition.

Refresh All and Software Master Reset

The **Refresh All** button sends all the I²C commands necessary to put the MAX8660 in the state indicated in the main window. This is automatically done when communication is reestablished after a power failure.

The **Software Master Reset** button sends the I²C commands necessary to put the MAX8660 registers to the default power-on state of the MAX8660.

Manually Sending I²C Commands

In addition to the controls on the main window, the MAX8660 software allows the I²C commands to be entered manually. To bring up the **Maxim Command Module Interface** window (see Figure 3), select **Advanced** from the menu bar then select **Interface**. Enter the device address (0x68 or 0x6A) under **Target Device Address**, or click the **Hunt for active listeners** button to automatically find the I²C address. Under **Command** select **1 – SMBusWriteByte(addr,cmd,data8)**. Under **Command byte** enter the register address, and under **Data Out** enter the data byte to write to the register. Note that the byte can be entered in hexadecimal prefixed with "0x", or in binary with no prefix.

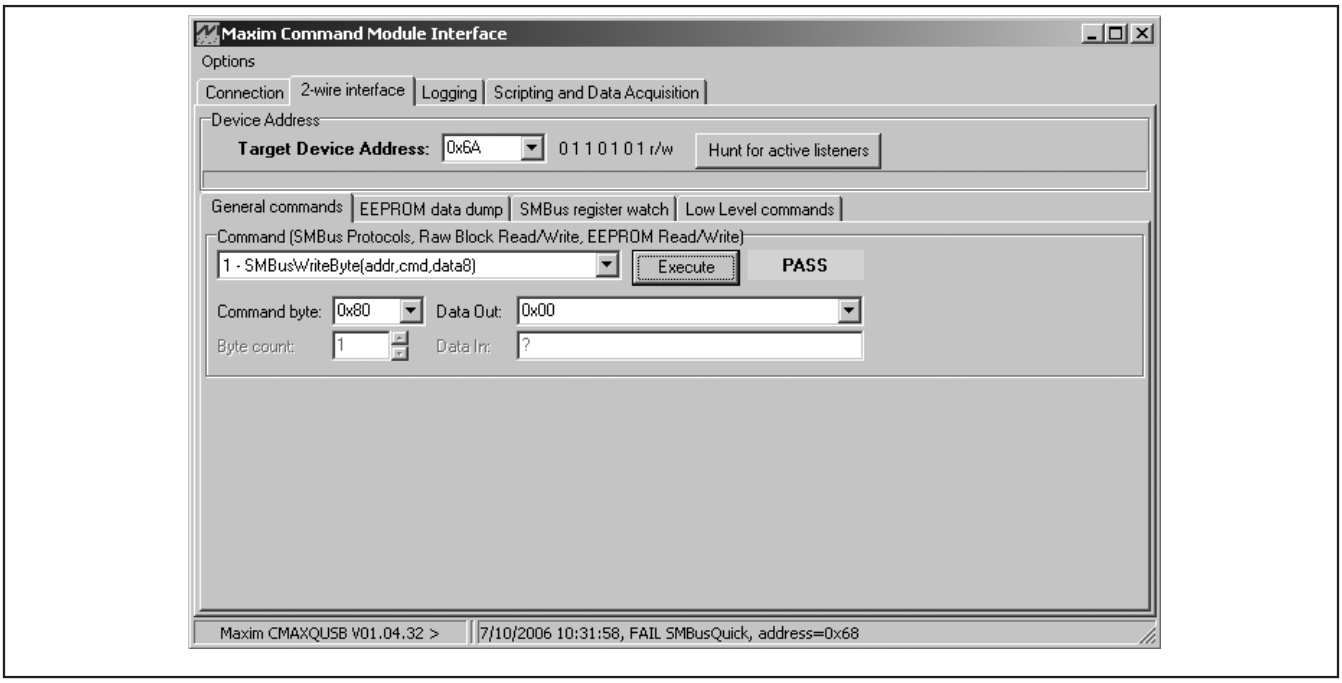

Figure 3. Maxim Command Module Interface Window

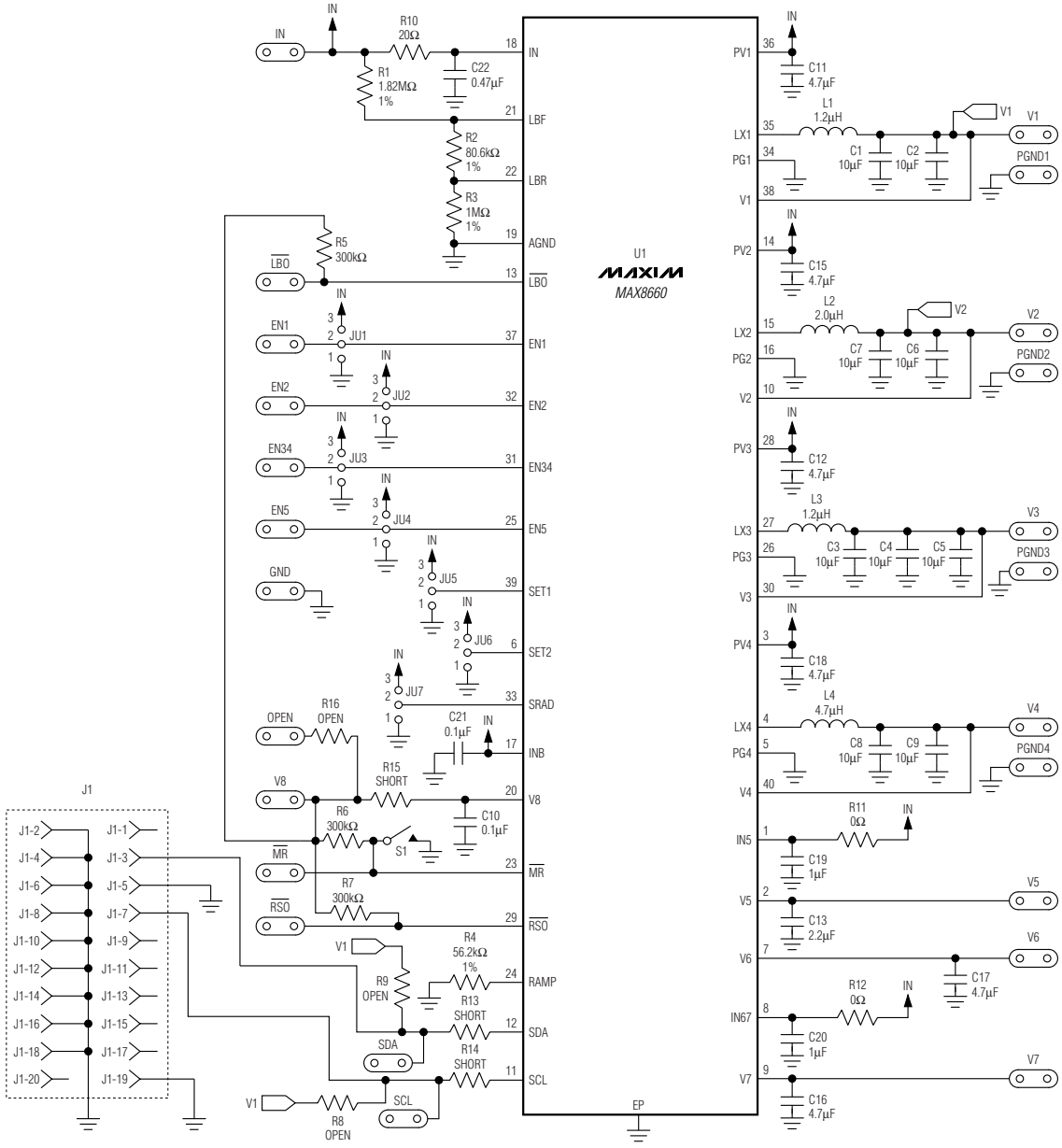

Figure 4. MAX8660 EV Kit Schematic

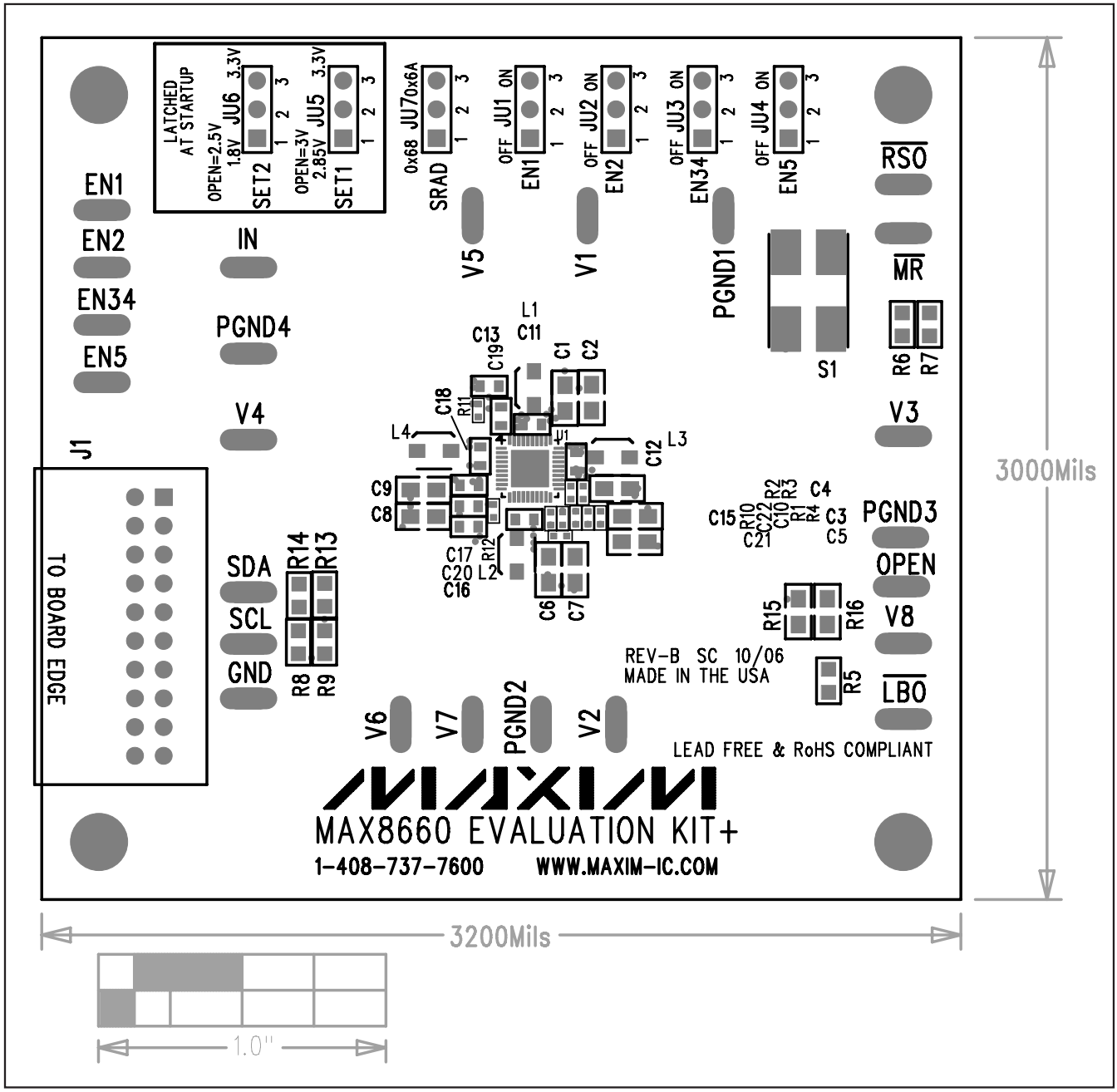

Figure 5. MAX8660 EV Kit Component Placement

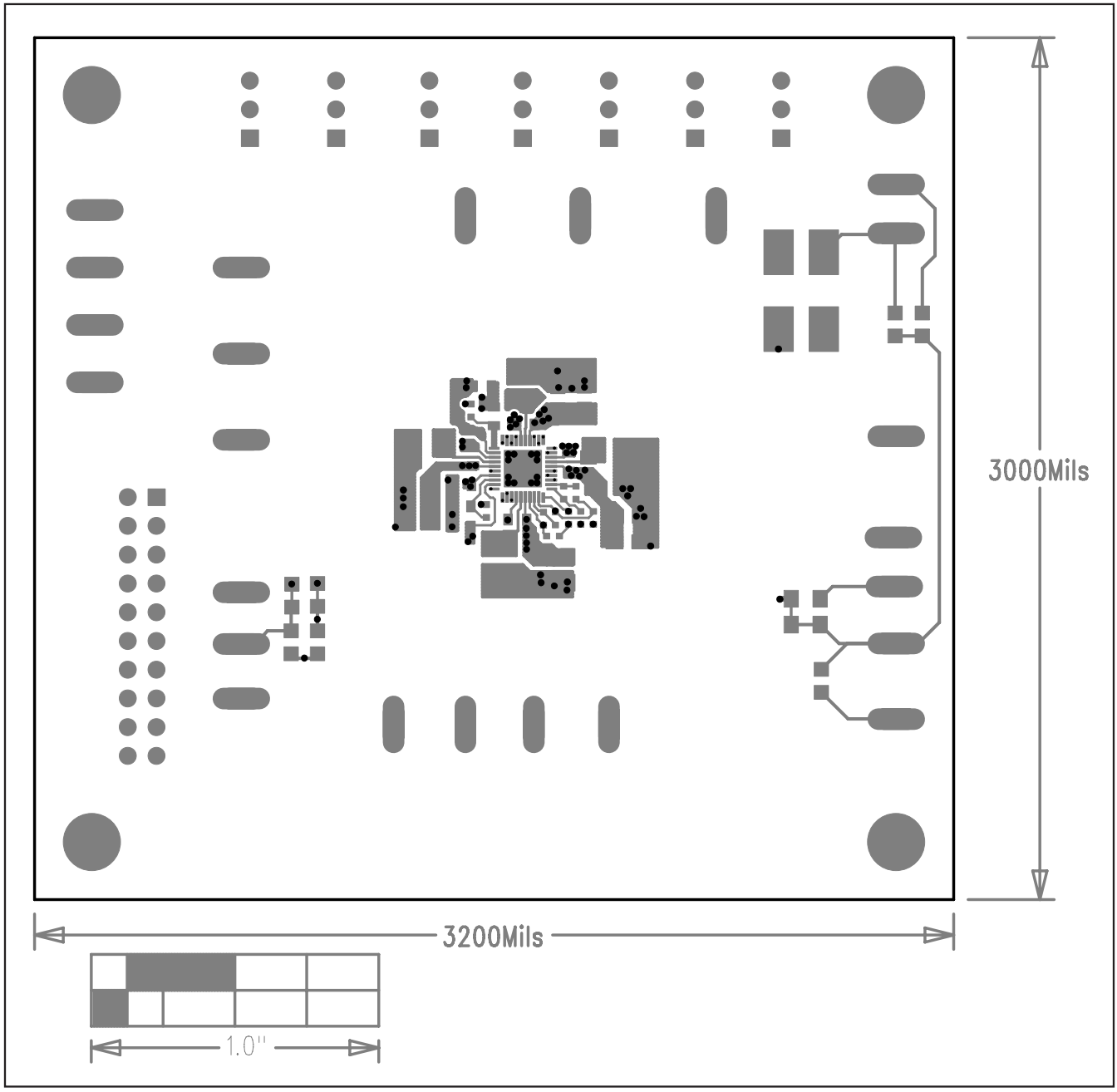

Figure 6. MAX8660 EV Kit PCB Layout—Component Layer 1

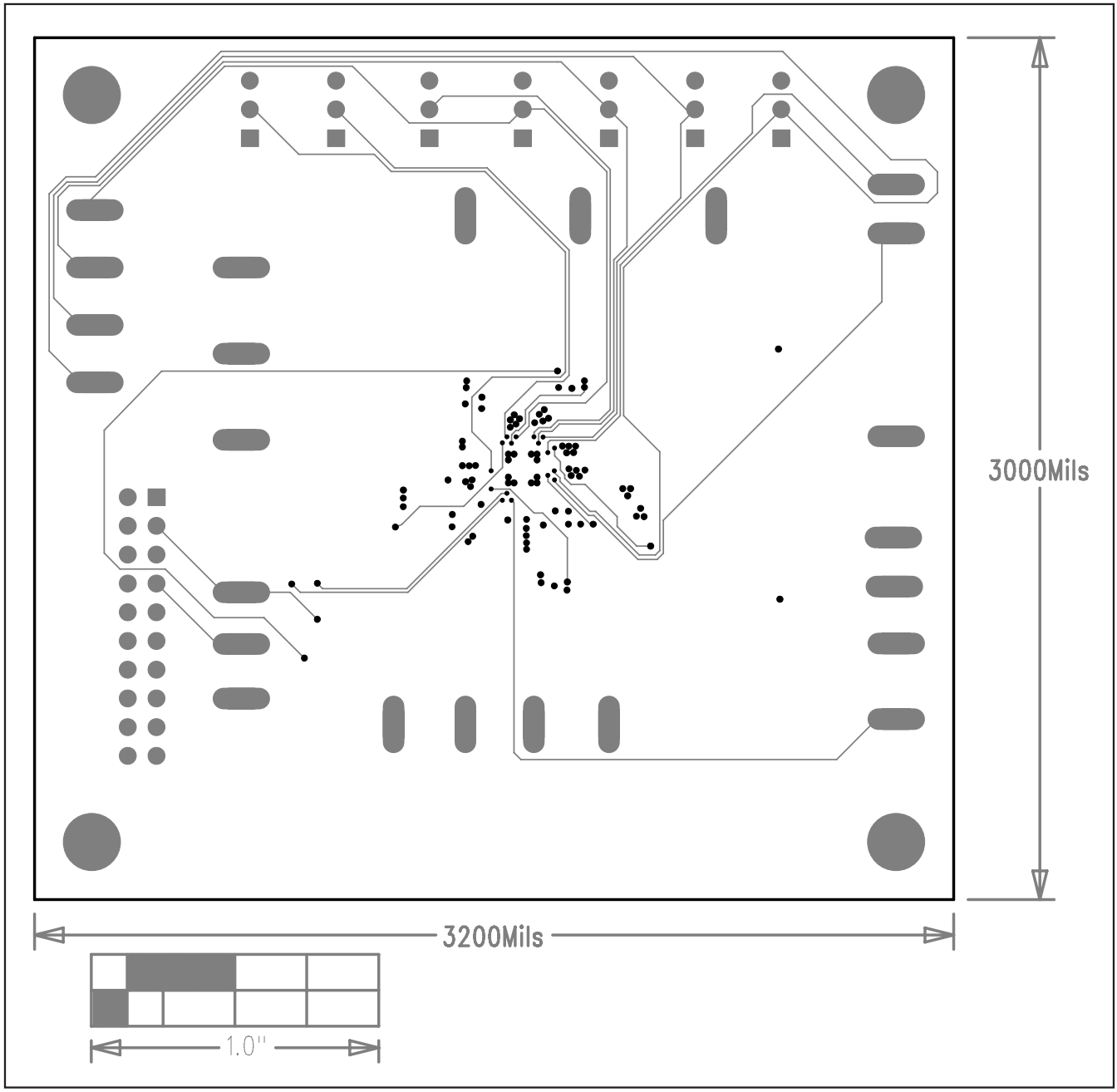

Figure 7. MAX8660 EV Kit PCB Layout—Digital Layer 2

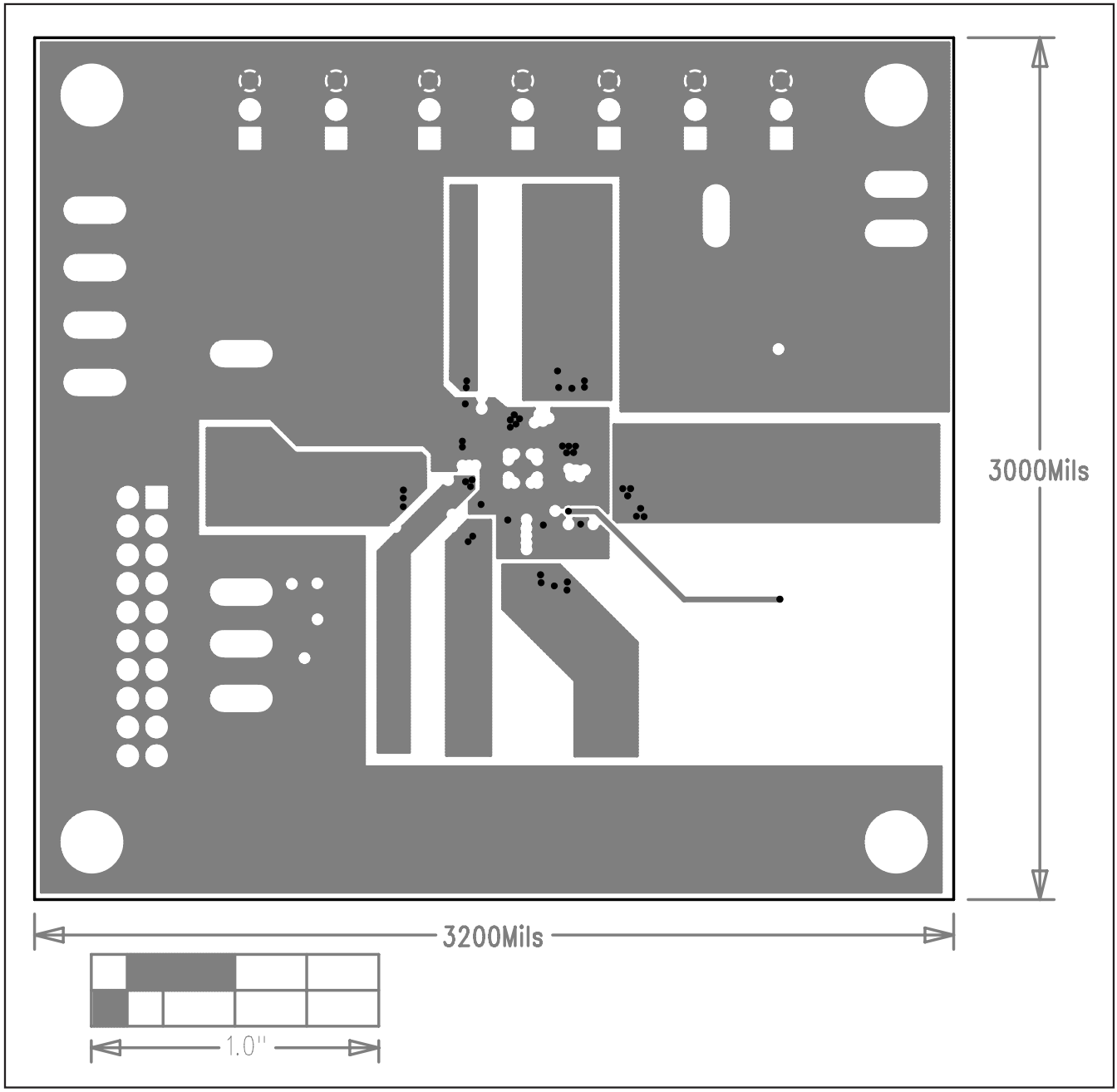

Figure 8. MAX8660 EV Kit PCB Layout—Power Layer 3

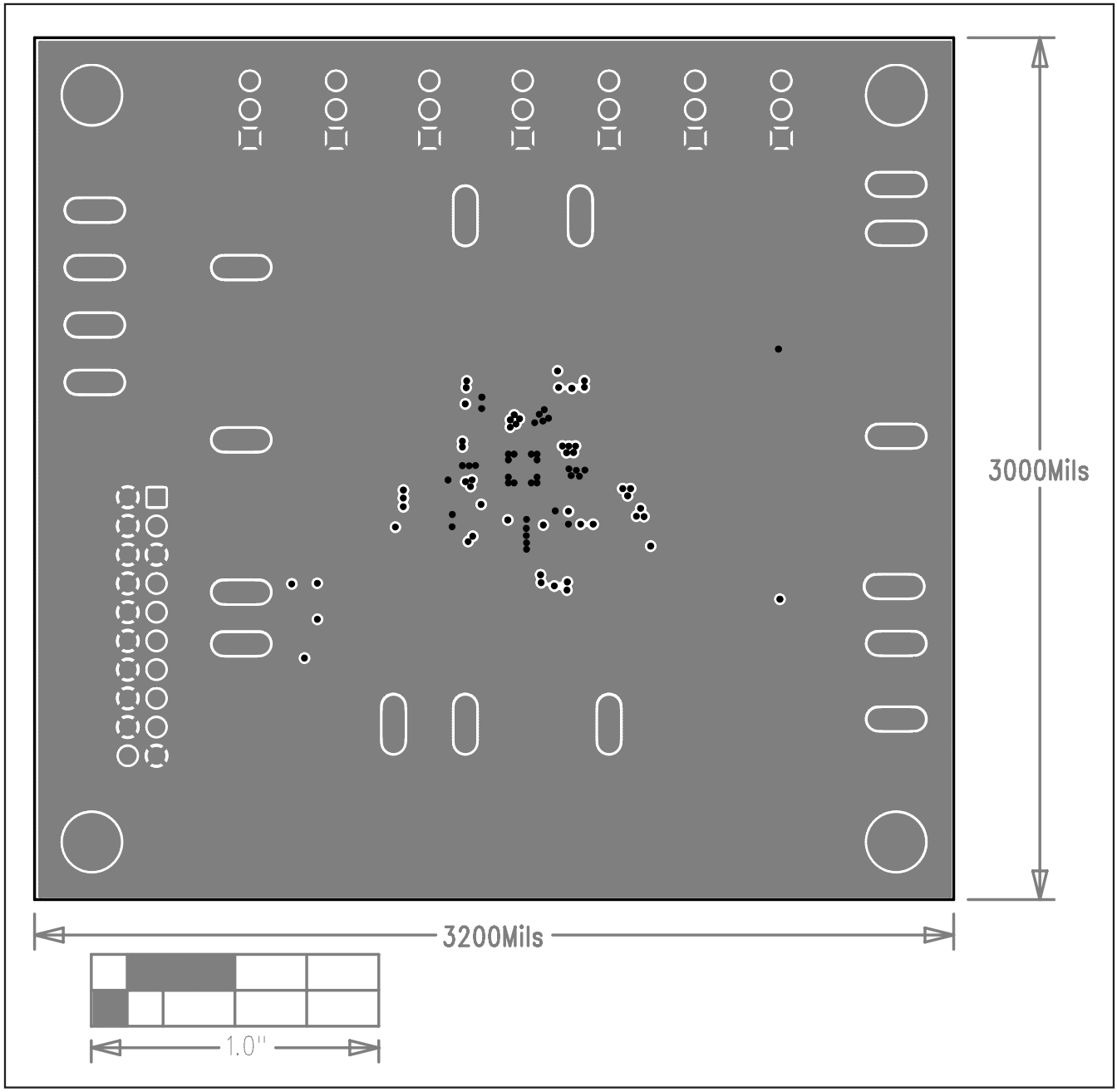

Figure 9. MAX8660 EV Kit PCB Layout—Ground Layer 4

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/06	Initial release	—
1	6/09	Added MAX8660B	1–12