

# MAX8649 Evaluation Kit

## Evaluates: MAX8649

### General Description

The MAX8649 evaluation kit (EV kit) is a fully assembled and tested circuit for evaluating the MAX8649 1.8A step-down regulator. The EV kit operates from a 2.5V to 5.5V supply voltage and outputs a voltage programmable from 0.75V to 1.38V at up to 1.8A. An on-board USB-to-I<sup>2</sup>C interface and EV kit software control the output voltage, operating modes, and other features of the IC.

### Features

- ◆ **1.8A Guaranteed Output Current**
- ◆ **I<sup>2</sup>C-Programmable V<sub>OUT</sub> (750mV to 1.38V in 10mV steps)**
- ◆ **Operates from 2.5V to 5.5V Input Supply**
- ◆ **On-Chip FET and Synchronous Rectifier**
- ◆ **Fixed 3.25MHz PWM Switching Frequency**
- ◆ **Synchronizes to 13MHz, 19.2MHz, or 26MHz System Clock When Available**
- ◆ **Small 1μH Inductor**
- ◆ **Initial Accuracy 0.5% at 1.25V Output**
- ◆ **2.0% Output Accuracy Over Load, Line, and Temperature**
- ◆ **Power-Save Mode Increases Light Load Efficiency**
- ◆ **Overvoltage and Overcurrent Protection**
- ◆ **Thermal-Shutdown Protection**
- ◆ **On-Board USB-to-I<sup>2</sup>C Interface**

### Ordering Information

PART	TYPE
MAX8649EV KIT+	EV Kit

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

### Component List

DESIGNATION	QTY	DESCRIPTION
C1, C4–C7, C10–C14, C25, C26, C28, C29, C31, C32	16	0.1μF ±10%, 16V X7R ceramic capacitors (0402) TDK C1005X7R1C104K Murata GRM155R71C104K
C2, C3	2	10μF ±20%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J106M Taiyo Yuden JMK107BJ106MA
C8	1	10μF ±20%, 16V X5R ceramic capacitor (1206) Murata GRM31CR61C106M TDK C3216X5R1C106M

DESIGNATION	QTY	DESCRIPTION
C9, C21, C23	3	10μF ±20%, 10V X5R ceramic capacitors (0805) TDK C2012X5R1A106M Murata GRM219R61A106K
C15, C16	2	22pF ±5%, 50V C0G ceramic capacitors (0402) TDK C1005C0G1H220J Murata GRM1555C1H220J
C17, C18	2	10pF ±5%, 50V C0G ceramic capacitors (0402) TDK C1005C0G1H100J Murata GRM1555C1H100J

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### Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C19, C20, C24, C35, C36	5	1 $\mu$ F $\pm$ 10%, 16V X5R ceramic capacitors (0603) TDK C1608X5R1C105K Murata GRM185R61C105K
C22	1	0.033 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitor (0402) TDK C1005X7R1E333K Murata GRM155R71E333K
C30	0	Not installed, ceramic capacitor (0402)
C40	1	2.2 $\mu$ F $\pm$ 10%, 6.3V X5R ceramic capacitor (0603) TDK C1608X5R0J225K Murata GRM188R60J225K
D1	0	Not installed, diode (0603)
D2	1	Dual common-cathode Schottky diode (SOT323) Central Semi CMSSH-3C LEAD FREE
D3, D4	2	Green LEDs (0603) Panasonic LNJ308G8TRA
J1	1	USB type-B receptacle Assmann AU-Y1007-R Tyco AMP 292304-1 Molex 67068-9000
J2	0	Not installed, 2 x 5 JTAG header, 0.1in (pin 7 removed)
J3	1	BNC PCB-mount jack
JU1, JU2, JU3	3	4-pin headers, 0.1in
JU4	1	5-pin header, 0.1in
JU6, JU7, JU8	3	2-pin headers, 0.1in
L1	1	1 $\mu$ H $\pm$ 30%, 2500mA, 45m $\Omega$ inductor (4.8mm x 4.6mm x 1mm) TDK VLF5010S-1RON2R5
L2	1	Ferrite bead (0603) TDK MMZ1608R301A
R1, R29	2	0 $\Omega$ resistors (0402)
R2–R8, R17, R18, R31, R33	0	Not installed, resistors (0402) R2, R3, R17, R18, R31, R33 are open; R4–R8 are PCB short
R9, R10	2	27 $\Omega$ $\pm$ 5% resistors (0402)

DESIGNATION	QTY	DESCRIPTION
R11	1	1.5k $\Omega$ $\pm$ 5% resistor (0402)
R12	1	470 $\Omega$ $\pm$ 5% resistor (0402)
R13	1	2.2k $\Omega$ $\pm$ 5% resistor (0402)
R14	1	10k $\Omega$ $\pm$ 5% resistor (0402)
R15, R25	2	196k $\Omega$ $\pm$ 1% resistors (0402)
R16, R20	2	100k $\Omega$ $\pm$ 1% resistors (0402)
R19	1	11 $\Omega$ $\pm$ 1% resistor (0402)
R21	1	37.4k $\Omega$ $\pm$ 1% resistor (0402)
R22	1	63.4k $\Omega$ $\pm$ 1% resistor (0402)
R23	1	374k $\Omega$ $\pm$ 1% resistor (0402)
R24	1	590k $\Omega$ $\pm$ 1% resistor (0402)
R26, R30	2	10k $\Omega$ $\pm$ 1% resistors (0402)
R27	1	100 $\Omega$ $\pm$ 1% resistor (0402)
R28	1	49.9 $\Omega$ $\pm$ 1% resistor (1206)
R32	1	220 $\Omega$ 5% resistor (0402)
U1	1	1.8A step-down regulator (16 WLP) Maxim MAX8649EWE+T
U2	1	Microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U3	1	USB UART (32 TQFP) FTDI FT232BL
U4	1	EEPROM (8 SO) Atmel AT93C46EN-SH-B
U5, U7	2	Adjustable-output LDO regulators (5 SC70) Maxim MAX8512EXK+T
U6, U11	2	2.5V LDO regulators (5 SC70) Maxim MAX8511EXK25+T
U8	1	Quad low-voltage level translator (14 TDFN-EP*) Maxim MAX3378EETD+
U9	1	Dual low-voltage level translator (8 SOT23) Maxim MAX3373EEKA+
U10	1	3.3V ultra-low-power series voltage reference (5 SOT23) Maxim MAX6129BEUK33+
Y1	1	16MHz crystal Suntsu SCS20B-16.000MHZ Vishay XT9S20ANA16M

\*EP = Exposed pad.

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### Component List (continued)

DESIGNATION	QTY	DESCRIPTION
Y2	1	6MHz crystal Suntsu SCS22B-6.000MHZ Vishay XT9S20ANA6M
—	1	USB cable

DESIGNATION	QTY	DESCRIPTION
—	7	Shunts, 2 positions
—	1	PCB: MAX8649 EVALUATION KIT+

### Component Suppliers

SUPPLIER	PHONE	WEBSITE
Assmann Electronic	480-897-7001	www.assmann.com
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Molex	800-786-6539	www.molex.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic Corp.	800-344-2112	www.panasonic.com
Suntsu Frequency Control	949-305-0220	www.suntsuinc.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
Tyco Electronics	800-522-6752	www.tycoelectronics.com
Vishay	402-563-6866	www.vishay.com

**Note:** Indicate that you are using the MAX8649 when contacting these component suppliers.

### MAX8649 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on the computer
MAX8649.EXE	Application program
FTD2XX.INF	USB driver file
UNINST.INI	Uninstalls the EV kit software
USB_Driver_Help.PDF	USB driver installation help file

### Quick Start

#### Recommended Equipment

- 2.5V to 5.5V power supply or battery able to deliver 1.5A
- User-supplied PC with Windows® 2000, Windows XP®, or Windows Vista® operating system and USB port

- Voltmeter
- 1.8A electronic load (or 3W load resistor 0.75Ω or greater)

**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.

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### Hardware and Software Setup

- 1) Visit [www.maxim-ic.com/evkitsoftware](http://www.maxim-ic.com/evkitsoftware) to download the latest version of the EV kit software, 8649Rxx.ZIP
  - 2) Unzip the software and run the INSTALL.EXE program to install the software on the computer.
  - 3) Preset the power supply to 3.6V.
  - 4) Turn off the power supply. **Caution: Do not turn on the power supply until all connections are completed.**
  - 5) Make sure that jumpers JU6, JU7, and JU8 are installed on the EV kit (see Table 3).
  - 6) Select the desired V<sub>DD</sub> voltage using JU4 (see Table 2).
  - 7) Connect pins 1-3 of jumpers JU1, JU2, and JU3 (see Table 1) to enable software control of the EN and VID\_ controls.
  - 8) Connect the positive power-supply terminal to the EV kit pad labeled IN.
  - 9) Connect the power-supply ground terminal to the EV kit pad labeled GND.
  - 10) If desired, connect the load between the OUT and PGND terminals.
  - 11) Connect a voltmeter from OUT to the PGND pad.
  - 12) Turn on the power supply.
  - 13) Connect the EV kit to the computer with the included USB cable.
  - 14) Note that power LED D3 lights when valid USB and IN power is present.
  - 15) When using the EV kit for the first time, a **Found New Hardware** window pops up. Follow the dialogue to install the FTD2XX driver included with the EV kit software. For more detailed information on installing the FTD2XX driver, refer to the USB\_Driver\_Help.PDF document included with the EV kit software.
  - 16) Start the EV kit software by opening its icon in the **Start** menu.
  - 17) The EV kit is now ready to communicate through the I<sup>2</sup>C interface.
- 2) Click on the **OFF** radio buttons in the **VID0** and **VID1** group boxes in the software to select mode 0.
  - 3) Select the **Mode Configuration** tab (Figure 2). In the **Mode 0** group box, select the desired output voltage from the **Output voltage(V)** drop-down list.
  - 4) Press the **Write** button in the **Mode 0** group box.
  - 5) Verify that the voltmeter indicates the voltage selected in the software.

### Detailed Description of Hardware

The MAX8649 EV kit operates from a 2.5V to 5.5V supply and provides a 0.75V to 1.38V output at up to 1.8A. The output voltage and other features are controlled through an I<sup>2</sup>C serial interface. To ease evaluation of the IC, an on-board USB-to-I<sup>2</sup>C interface is included and EV kit software provided.

Jumpers JU1, JU2, and JU3 control the EN, VID0, and VID1 signals (see Table 1). When software control is selected by connecting pins 1-3 of these jumpers, the corresponding signals are controlled by the EV kit software (see Figure 1). Note that jumper JU6 connects power (from IN) to circuitry controlling the EN, VID0, and VID1 signals. JU6 must be connected when using the software to control these signals. When measuring quiescent current of the IC, JU6 should be removed and the EN, VID0, and VID1 signals set high or low with JU1, JU2, and JU3.

Jumper JU4 sets the V<sub>DD</sub> voltage and logic level of the on-board I<sup>2</sup>C interface (see Table 2).

Jumpers JU7 and JU8 connect the I<sup>2</sup>C signals from the on-board interface to the IC (see Table 3). These jumpers must be installed when using the on-board I<sup>2</sup>C interface.

### External Synchronization

To evaluate the external synchronization feature of the IC, connect the signal source to J3 (FSYNC). Using the software, check the **Enable synchronization** checkbox and press the **Write** button in the appropriate **Mode** \_ group box in the **Mode Configuration** tab (see Figure 2). Select the signal frequency from the **External clock source (MHz)** drop-down list in the **SYNC** group box in the software **Control** tab shown in Figure 3.

### Procedure

- 1) In the EV kit software, select the **Mode Selection** tab and click on the **ON** radio button in the **EN** group box (Figure 1).

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**Table 1. Jumper Settings (JU1, JU2, JU3)**

JUMPER	SHUNT POSITION		
	1-2	1-3	1-4
JU1	Disables the IC	EV kit software controls the enable signal	Enables the IC
JU2	Sets VID0 low	EV kit software controls the VID0 signal	Sets VID0 high
JU3	Sets VID1 low	EV kit software controls the VID1 signal	Sets VID1 high

**Table 2. Jumper Settings (JU4)**

SHUNT POSITION	V <sub>DD</sub> (V)
Open	3.6
1-2	1.8
1-3	2.8
1-4	3
1-5	1.6

### **Detailed Description of Software**

On startup, the software automatically tries to detect the MAX8649 EV kit. If the EV kit is not connected or not powered, **Command Module not found, keep trying to connect?** is displayed (Figure 3). Selecting **No** puts the software in demo mode, where all options can be viewed without communicating with the IC. To connect to the IC from demo mode, check the **Auto Detect Hardware Connection** checkbox. The software GUI is organized into five tabs: **Mode Selection**, **Mode Configuration**, **Control**, **Ramp**, and **ID** (Figures 1–5).

#### **Mode Selection Tab**

The **Mode Selection** tab sheet (Figure 1) controls the three digital inputs to the IC (EN, VID0, and VID1). To use the software to control these signals, jumper JU6 must be installed and pins 1-3 of jumpers JU1, JU2, and JU3 connected on the EV kit. Using JU1, JU2, and JU3 to set these signals high or low overrides the setting in the software. VID0 and VID1 set the mode used in the **Mode Configuration** tab. Set VID0 and VID1 to off for mode 0, VID0 on and VID1 off for mode 1, VID0 off and VID1 on for mode 2, or VID0 and VID1 on for mode 3.

**Table 3. Jumper Functions (JU6, JU7, JU8)**

JUMPER	SHUNT POSITION	
	OPEN	1-2
JU6	JU6 can be left open when software control of EN, VID0, and VID1 is not used. Remove JU6 when making quiescent current measurements.	Short JU6 when using software control for the EN, VID0, or VID1 signals.
JU7	Remove JU7 and JU8 when using an external I <sup>2</sup> C master. Connect SDA to pin 2 of JU7 and SCL to pin 2 of JU8. Install pullup resistors R2 and R3.	JU7 and JU8 must be shorted to use the on-board I <sup>2</sup> C interface.
JU8		

**Table 4. LED Indicators**

LED	FUNCTION
D3	Indicates power is present at IN, and from USB
D4	Indicates the interface circuit is communicating with the computer

#### **Mode Configuration Tab**

The **Mode Configuration** tab sheet (Figure 2) controls the output voltage, forced PWM, and synchronization for each of the four VID modes. The active mode is set in the **Mode Selection** tab or with jumpers JU2 and JU3 on the EV kit.

#### **Control Tab**

The software **Control** tab sheet (Figure 3) provides controls to enable or disable the internal pulldown resistors on the digital inputs (EN, VID0, and VID1), and sets the frequency of the external clock (used when synchronization is selected in the **Mode Configuration** tab).

#### **Ramp Tab**

The **Ramp** tab sheet (Figure 4) controls the RAMP register of the IC. Refer to Table 9 and the *Ramp-Rate Control* section in the MAX8649 IC data sheet for more information.

#### **ID Tab**

The **ID** tab sheet (Figure 5) allows the chip ID information to be read from the IC.

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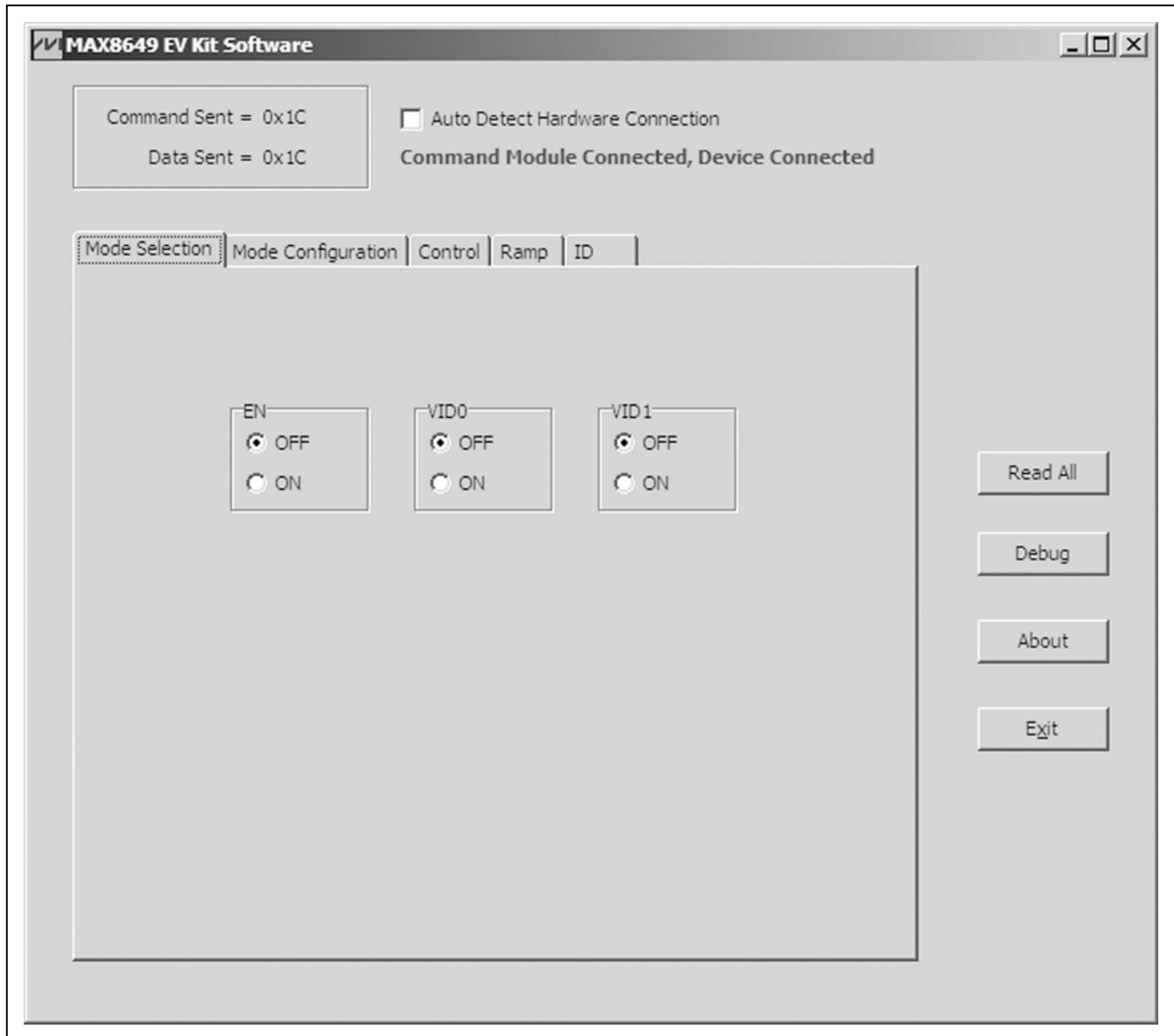


Figure 1. MAX8649 Evaluation Kit Software Main Window (Mode Selection Tab)

**Note:** Jumper JU6 must be installed and pins 1-3 of jumpers JU1, JU2, and JU3 connected to control the EN, VID0, and VID1 signals using the EV kit software.

# MAX8649 Evaluation Kit

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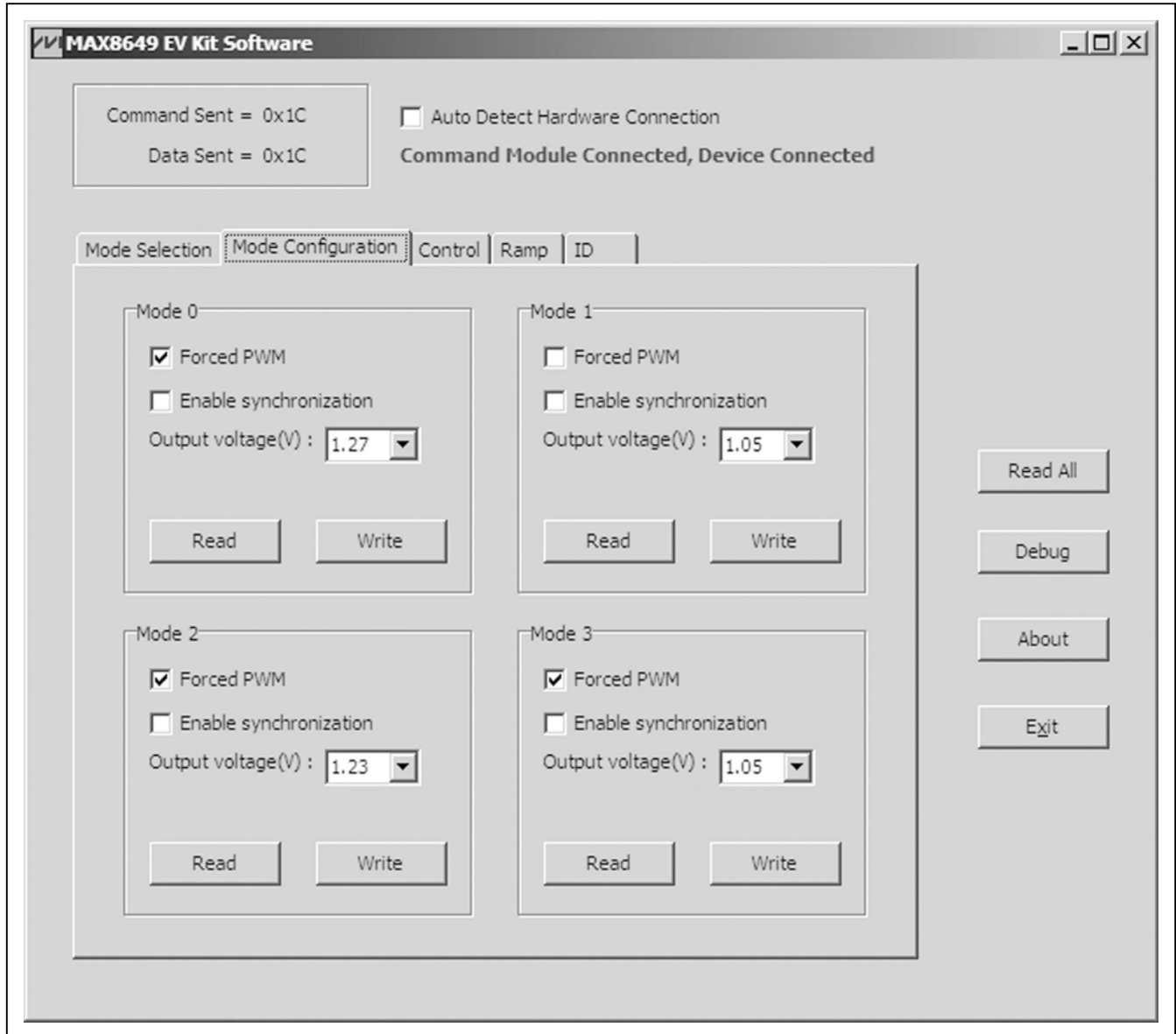


Figure 2. MAX8649 Evaluation Kit Software Main Window (Mode Configuration Tab)

# MAX8649 Evaluation Kit

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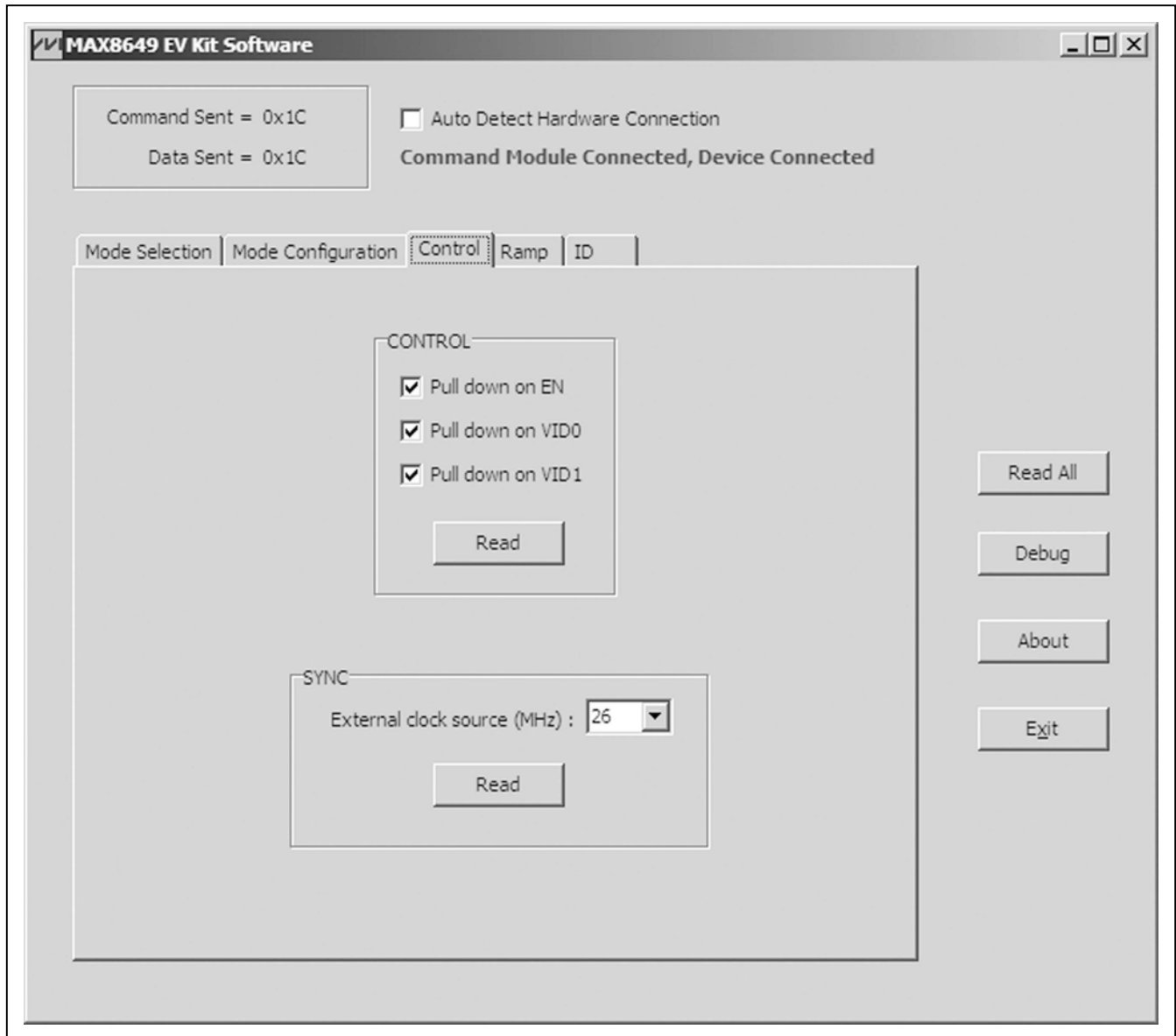


Figure 3. MAX8649 Evaluation Kit Software Main Window (Control Tab)



# MAX8649 Evaluation Kit

## Evaluates: MAX8649

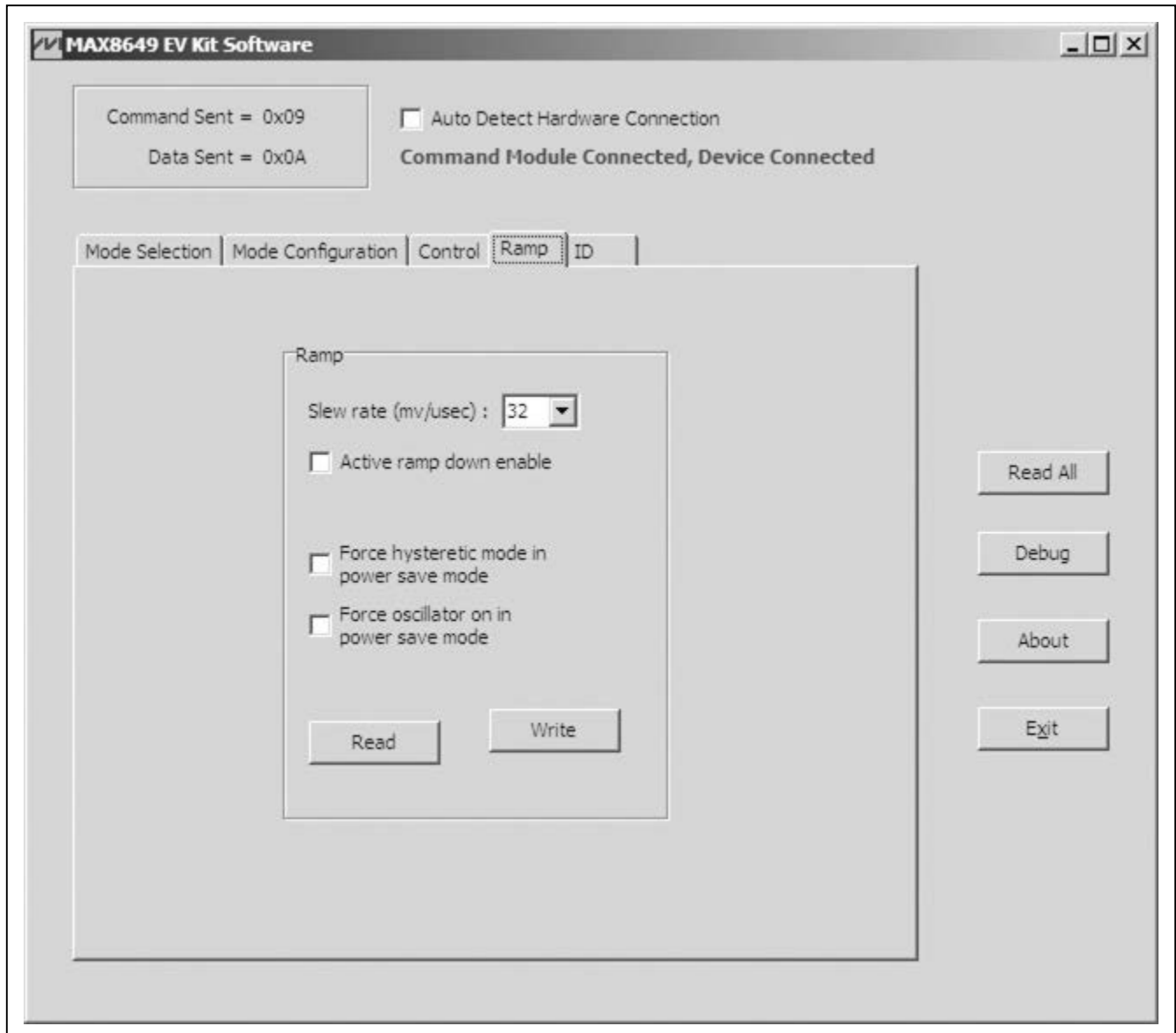


Figure 4. MAX8649 Evaluation Kit Software Main Window (Ramp Tab)

# MAX8649 Evaluation Kit

## Evaluates: MAX8649

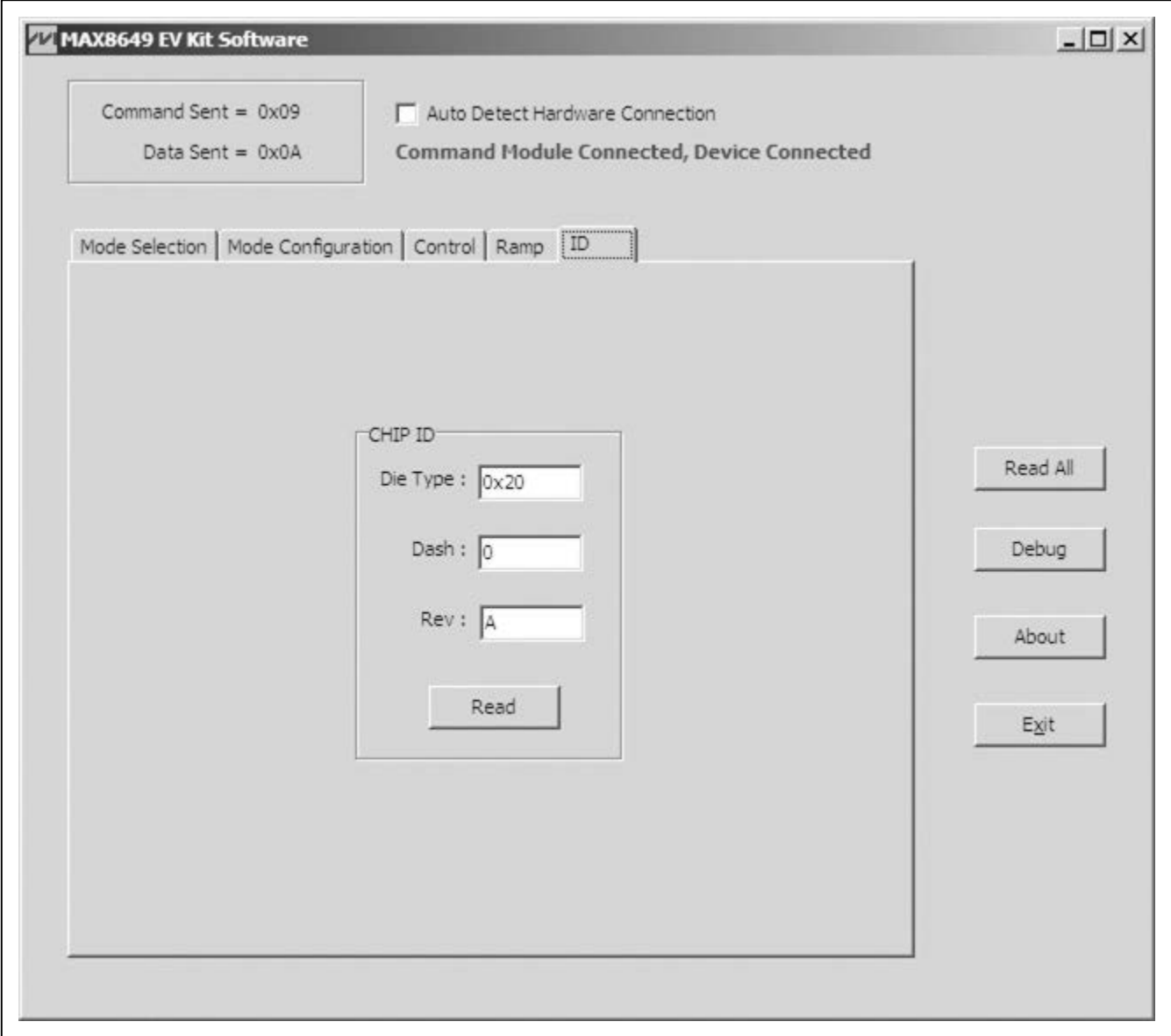


Figure 5. MAX8649 Evaluation Kit Software Main Window (ID Tab)

# MAX8649 Evaluation Kit

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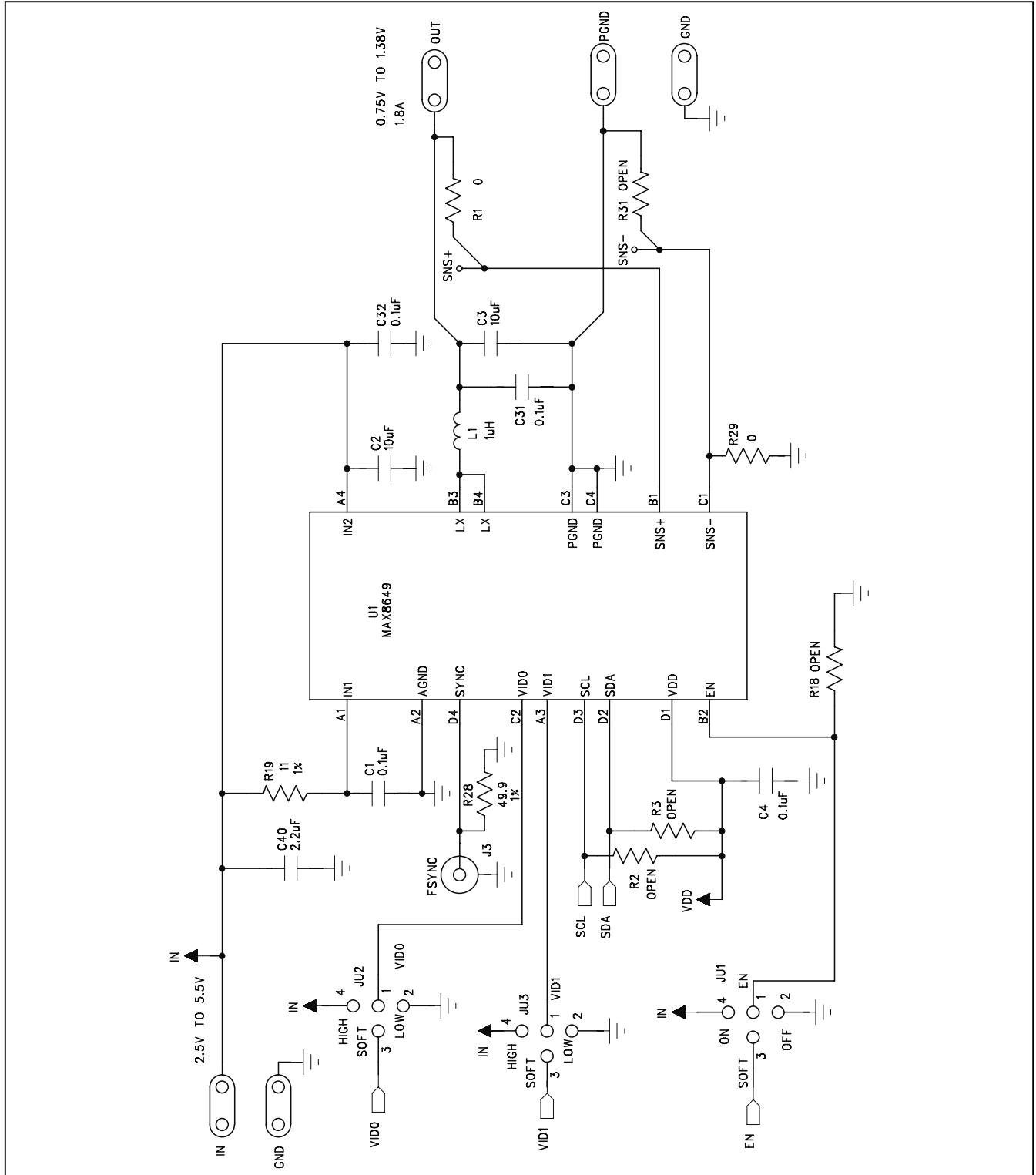


Figure 6a. MAX8649 EV kit Schematic (Sheet 1 of 3)

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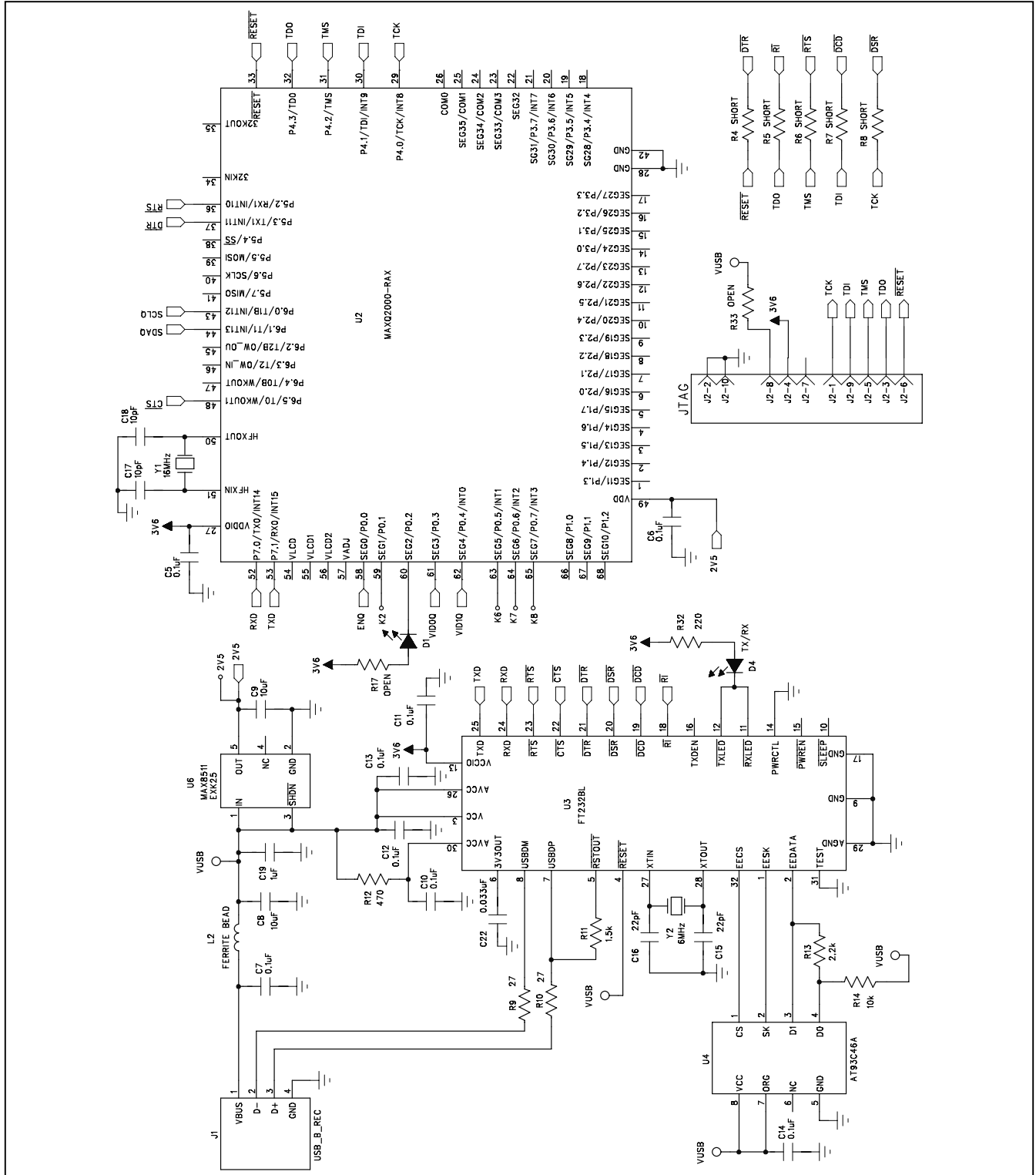


Figure 6b. MAX8649 EV kit Schematic (Sheet 2 of 3)

# MAX8649 Evaluation Kit

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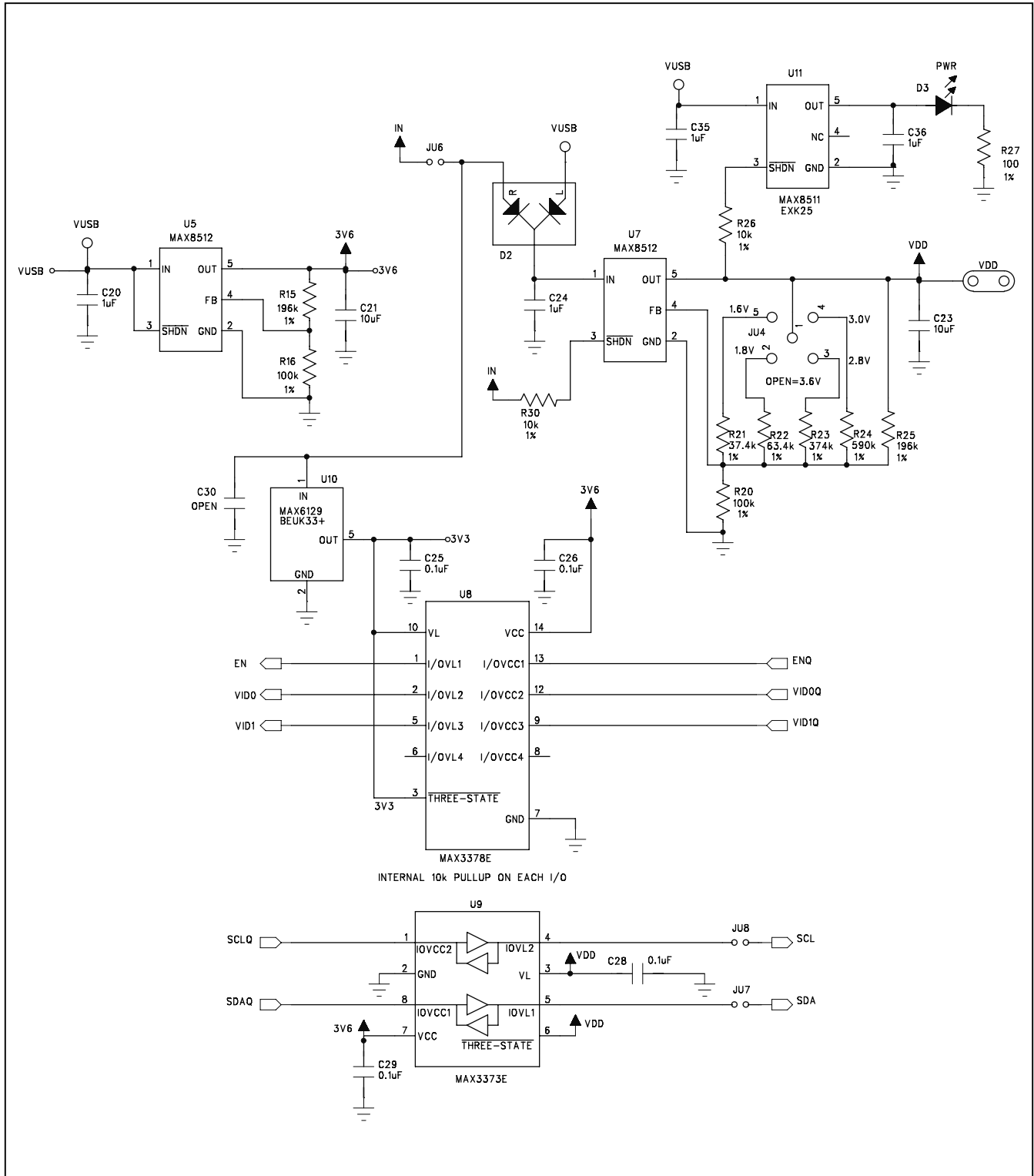


Figure 6c. MAX8649 EV kit Schematic (Sheet 3 of 3)

# MAX8649 Evaluation Kit

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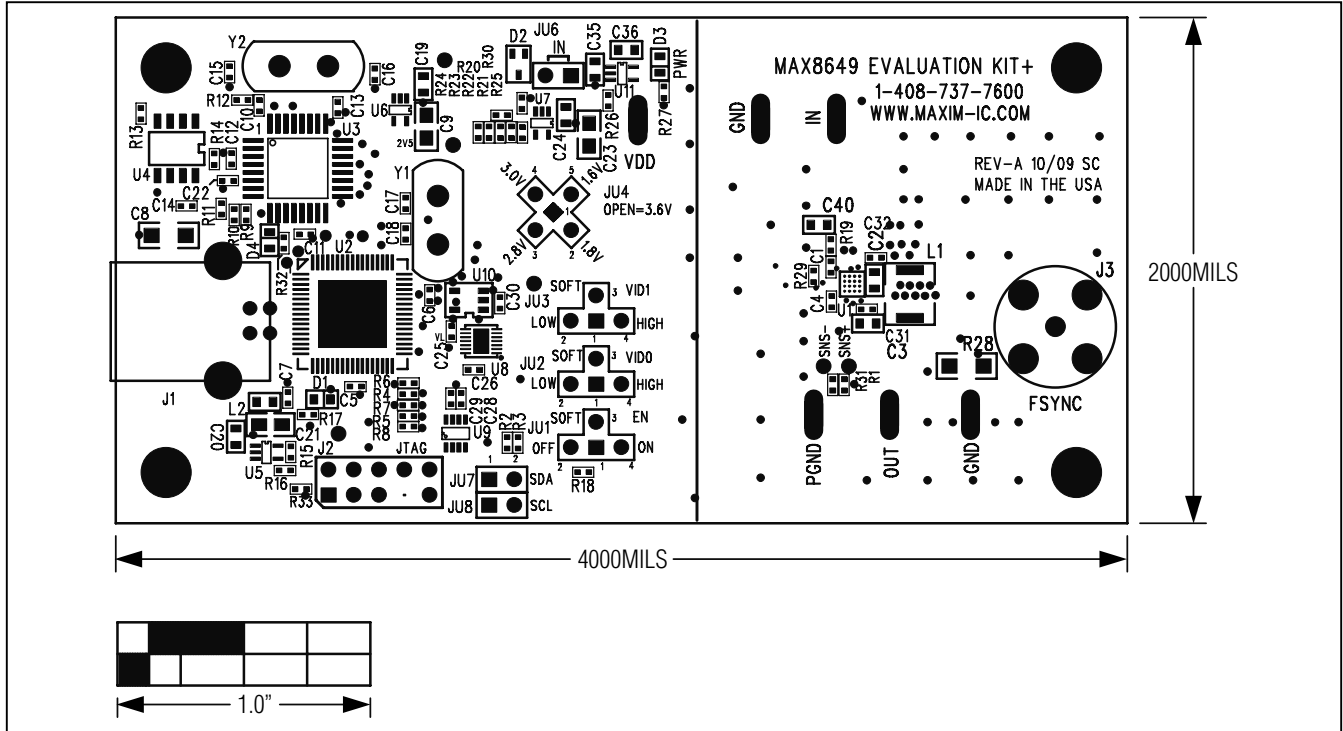


Figure 7. MAX8649 EV Kit Component Placement Guide—Component Side

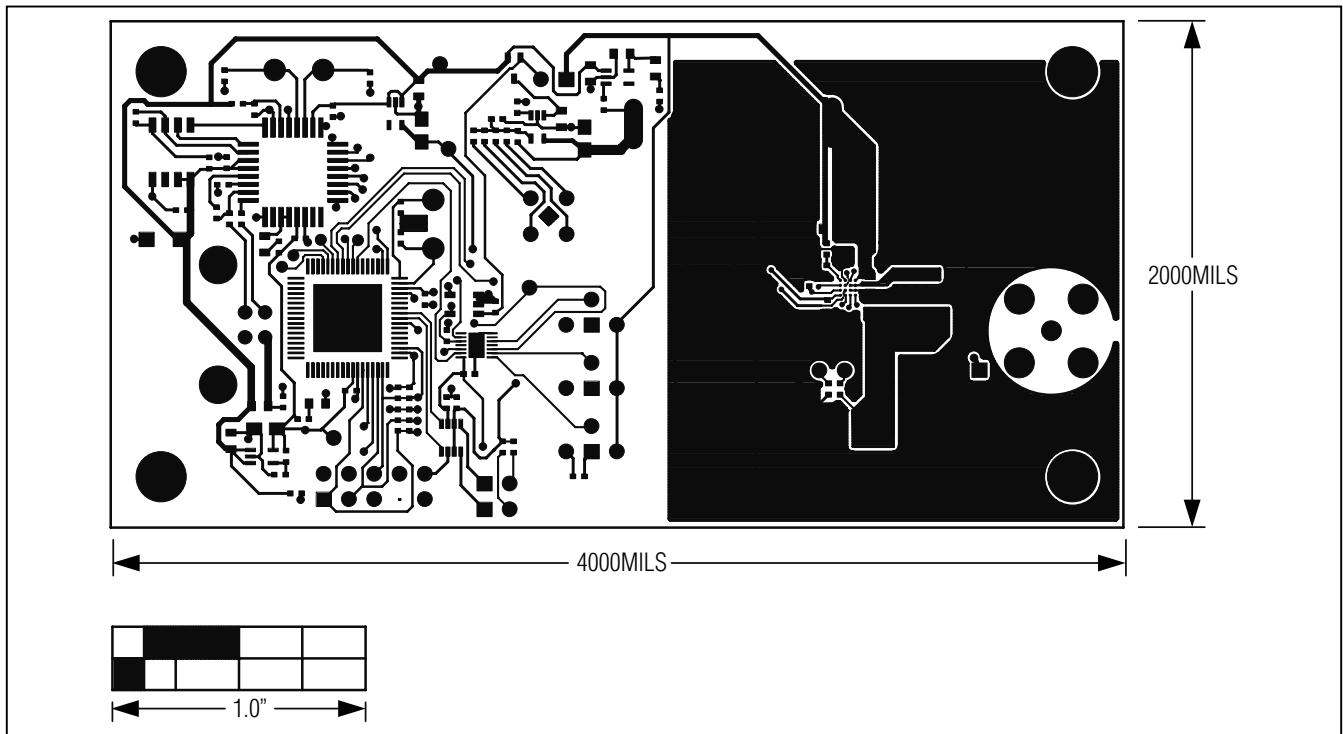


Figure 8. MAX8649 EV Kit PCB Layout—Component Side

# MAX8649 Evaluation Kit

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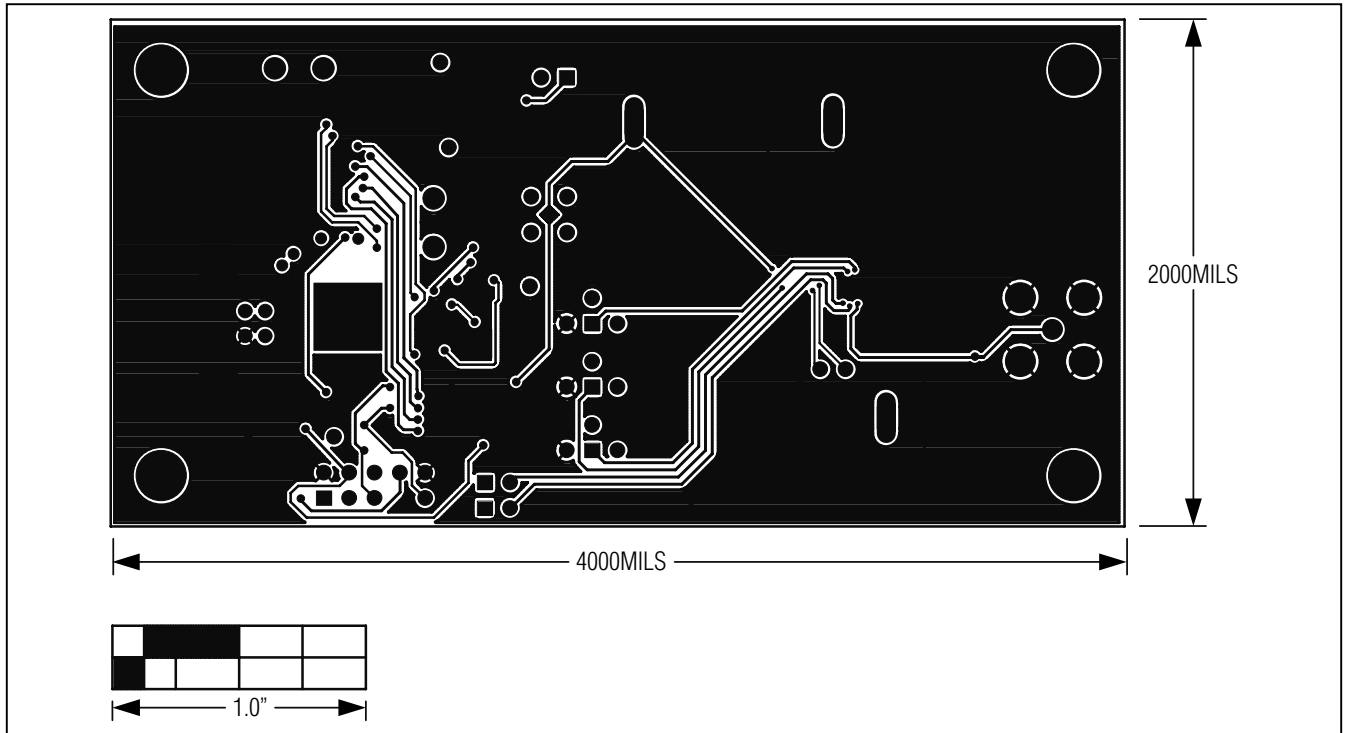


Figure 9. MAX8649 EV Kit PCB Layout— Solder Side

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### Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/10	Initial release	—



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