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19-4310; Rev 0; 10/08

# MAX17065 Evaluation Kit

Evaluates: MAX17065

## General Description

The MAX17065 evaluation kit (EV kit) is a fully assembled and tested surface-mount PCB that evaluates the high-efficiency MAX17065 organic LED (OLED) driver. The MAX17065 EV kit operates from a +2.3V to +4.5V single power supply and includes dual switch-mode power-supply (SMPS) outputs, one LDO, and dual regulated charge pumps for an OLED panel.

The MAX17065 EV kit provides an on-board I²C/SMBus™ interface and is connected to the computer through the universal serial bus (USB) port. The EV kit includes Windows® 2000/XP- and Windows Vista®-compatible software that provides a graphical user interface (GUI) for control of the MAX17065's output voltages, switching frequency, operating mode, current limit, and SMPS and charge-pump enables.

*SMBus is a trademark of Intel Corp.*

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## Features

- **+2.3V to +4.5V Input Range**
- **85% Efficiency (VIN = +3.3V, $I_{VP}$ = $I_{VN}$ = 120mA)**
- **+5.35V/120mA Positive and -4.5V/120mA Negative SMPS (-5V to -0.5V Adjustable Negative SMPS, Component Change Required)**
- **+1.9V/60mA LDO**
- **+6.5V/2mA Positive and -4V/2mA Negative Regulated Charge Pumps (+5.5V to +9V Adjustable Positive and -5V to -0.5V Adjustable Negative Charge Pump)**
- **1.2MHz PWM Switching Frequency (Selectable 600kHz, Component Change Required)**
- **On-Board I²C/SMBus Interface Control Through USB**
- **Shutdown Control**
- **Fully Assembled and Tested**

## Ordering Information

| PART | TYPE | PC INTERFACE |
|---|---|---|
| MAX17065EVKIT+ | EV Kit | USB |

*+Denotes lead-free and RoHS-compliant.*

## Component List

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C1, C12, C14 | 3 | 10µF ±10%, 16V X5R ceramic capacitors (0805) KEMET C0805C106K4PACTU |
| C2, C3 | 2 | 22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J or TDK C1608C0G1H220J |
| C4 | 1 | 0.033µF ±10%, 16V X5R ceramic capacitor (0603) Taiyo Yuden EMK107BJ333KA |
| C5–C10, C17, C18, C28, C29, C30, C34 | 12 | 0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K Murata GRM188R71C104K |
| C11, C13, C19, C20, C21, C35–C39 | 10 | 1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C105K TDK C1608X5R1C105K |
| C15, C16 | 2 | 10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J TDK C1608C0G1H100J |
| C22 | 1 | 0.01µF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H103K TDK C1608X7R1H103K |
| C23 | 1 | 2200pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H222K TDK C1608X7R1H222K |
| C24, C25 | 2 | 470pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H471K TDK C1608X7R1H471K |
| C26 | 1 | 2.2µF ±10%, 10V X5R ceramic capacitor (0603) Murata GRM188R61A225K TDK C1608X5R0J225K |
| C27, C31, C32 | 3 | 4.7µF ±10%, 10V X5R ceramic capacitors (0805) Murata GRM219R61A475K TDK C2012X5R1A475K |

**EP = Exposed pad.*



**For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.**

# MAX17065 Evaluation Kit

## Component List (continued)

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C33 | 1 | 10µF ±10%, 6.3V X5R ceramic capacitor (0603)<br>TDK C1608X5R0J106K<br>Murata GRM188R60J106M |
| H1 | 0 | Not installed, 2 x 5-pin JTAG header |
| JU1 | 1 | 2-pin header |
| JU2, JU5, JU6 | 3 | 3-pin headers |
| JU3, JU4 | 0 | Not installed, 2-pin headers |
| L1 | 1 | Ferrite bead (0603)<br>TDK MMZ1608R301A<br>Murata BLM18SG700 TN1 |
| L2, L3 | 2 | 4.7µH, 0.75A, 0.18Ω inductors<br>TDK VLF3010ST-4R7MR75<br>Taiyo Yuden NR3010T4R7M (0.24Ω) |
| P1 | 1 | USB series-B right-angle PC-mount receptacle<br>Assmann Electronic AU-Y1007-R |
| R1, R2 | 2 | 27Ω ±5% resistors (0603) |
| R3 | 1 | 1.5kΩ ±5% resistor (0603) |
| R4 | 1 | 470Ω±5% resistor (0603) |
| R5 | 1 | 2.2kΩ ±5% resistor (0603) |
| R6 | 1 | 10kΩ ±5% resistor (0603) |
| R7 | 1 | 169kΩ ±1% resistor (0603) |
| R8 | 1 | 100kΩ ±1% resistors (0603) |
| R9–R13 | 0 | Not installed, resistors—short by PCB trace (0402) |
| R14, R15 | 2 | 33.2kΩ ±1% resistors (0603) |
| R16 | 0 | Not installed, resistor—short by PCB trace (0603) |
| R17 | 1 | 1MΩ ±5% resistor (0603) |
| R18–R21 | 0 | Not installed, resistors (0603) |
| R22, R23 | 2 | 100Ω ±1% resistors (0603) |
| U1 | 1 | OLED driver (28 TQFN)<br>Maxim MAX17065ETI+ |
| U2 | 1 | Microcontroller (68 QFN-EP*)<br>Maxim MAXQ2000-RAX+ |
| U3 | 1 | 2.5V LDO regulator (5 SO70)<br>Maxim MAX8511EXK25+ |
| U4 | 1 | Adjustable output LDO regulator (5 SO70)<br>Maxim MAX8512EXK+ |
| U5 | 1 | UART-to-USB converter<br>FTDI FT232BL (32 TQFP) |
| U6 | 1 | 93C46 type 3-wire EEPROM<br>Atmel AT93C46A-10SU-2.7 (8 SO) |
| U7, U8 | 2 | Logic level translators (10 µMAX®)<br>Maxim MAX1840EUB+ |
| Y1 | 1 | 16MHz crystal |
| Y2 | 1 | 6MHz crystal |
| — | 4 | Shunts |
| — | 1 | PCB: MAX17065 Evaluation Kit+ |

**EP = Exposed pad.*

## Component Suppliers

| SUPPLIER | PHONE | WEBSITE |
|---|---|---|
| Assmann Electronic | 480-897-7001 | www.assmann.com |
| KEMET Corp. | 864-963-6300 | www.kemet.com |
| Murata Electronics North America, Inc. | 770-436-1300 | www.murata-northamerica.com |
| Taiyo Yuden | 800-348-2496 | www.t-yuden.com |
| TDK Corp. | 847-803-6100 | www.component.tdk.com |

***Note:*** *Indicate that you are using the MAX17065 when contacting these component suppliers.*

## MAX17065 EV Kit Files

| FILE | DESCRIPTION |
|---|---|
| INSTALL.EXE | Installs the EV kit files on your computer |
| MAX17065.EXE | Application program |
| FTD2XX.INF | USB Driver file |
| UNINST.INI | Uninstalls the EV kit software |
| TROUBLESHOOTING_USB.PDF | USB driver installation help file |

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## Quick Start

### Recommended Equipment

Before beginning, the following equipment is needed:

- MAX170655 EV kit (USB cable included)
- A user-supplied Windows® 2000/XP or Windows Vista PC
- +2.3V to +4.5V, 1A power supply (VIN)
- Available USB port

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

### Procedure

The MAX17065 EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: 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, 17065Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
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) Verify that jumpers are in their default positions as follows:

| JUMPER | SHUNT POSITION |
|---|---|
| JU1 | Installed |
| JU2, JU5, JU6 | 1-2 |

4) Connect the positive terminal of the VIN power supply to the VIN pad. Connect the ground terminal of the VIN power supply to the PGND pad.
5) Connect the USB cable from the PC to the EV kit board. A **Building Driver Database** window pops up in addition to a **New Hardware Found** message when installing the USB driver for the first time. If you do not see a window that is similar to the one described above after 30 seconds, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows. Refer to the TROUBLESHOOTING_USB.PDF document included with the software if you have any problems during this step.
6) 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\MAX17065** (default installation directory) using the **Browse** button.
7) Set the VIN power supply and enable its output.
8) Start the MAX17065 program by opening its icon in the **Start** menu.
9) Normal device operation is verified when **CMAXQUSB HW: Connected. MAX17065 device connected.** is displayed at the bottom left of the MAX17065 EV kit window.
10) Set the switching frequency = 1.2MHz, negative SMPS = -4.5V, positive and negative current limits = 0.7A, positive charge-pump output = +6.5V, and negative charge-pump output = -4V (Figure 1).

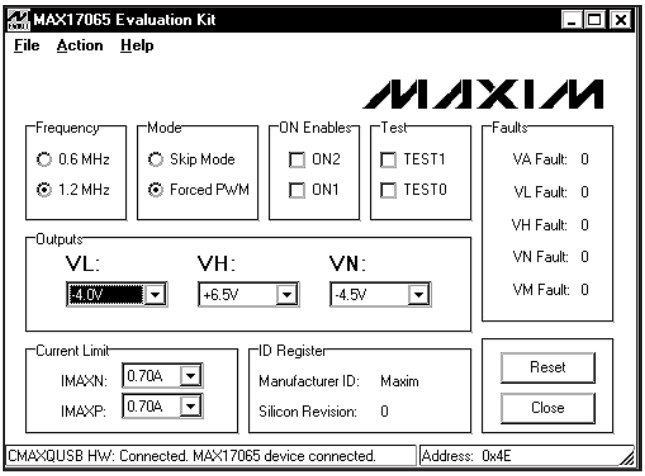


*Figure 1. MAX17065 EV Kit Software Suggested Setup*

## Detailed Description of Software

### User-Interface Panel

The program's main window (Figure 2) is navigated by using a mouse or a combination of the Tab and Arrow keys. The MAX17065 EV kit software provides controls for the following software-configurable features: **Frequency** and **Mode** selection, **ON Enables**, **Outputs** configuration, **Faults** detection, **Current Limit** settings, and **Manufacturer ID/Silicon Revision** detection. Changes to the controls result in a write operation that updates the appropriate registers of the MAX17065. A status bar is also provided at the bottom of the program's main window and is used to verify command module and device connectivity. A **Device Search** option is located in the **Action** menu bar should the user want to switch from **Demo Mode** to normal operation.

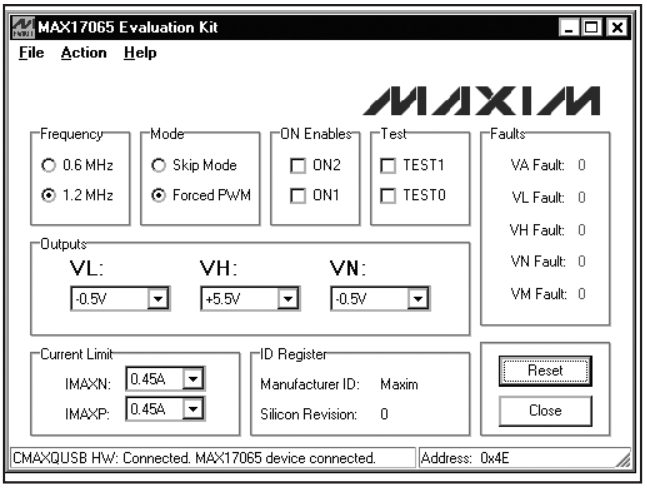


*Figure 2. MAX17065 EV Kit Software Main Window*

### Frequency Selection

The MAX17065 can be operated at either 0.6MHz or 1.2MHz. To set the desired frequency, select the appropriate radio button in the **Frequency** group box. The default frequency setting is 0.6MHz, but the EV kit is designed for 1.2MHz. Component changes are required when selecting different frequencies. Refer to the MAX17065 IC data sheet for more information regarding frequency selection.

### Operating Mode

The MAX17065 can be operated in either **Skip Mode** or **Forced PWM**. To set the desired operating mode, select the appropriate radio button in the **Mode** group box. The default operating mode is **Forced PWM**. Refer to the MAX17065 IC data sheet for more information regarding modes of operation.

### ON Enables and Test

The **ON2** and **ON1** bits enable/disable the various outputs of the MAX17065, according to Table 1. To set either bit high, check the respective **ON_** checkbox in the **ON Enables** group box.

**Table 1. ON2 and ON1 Control**

| ON2 | ON1 | VA OUTPUT | VH, VL OUTPUTS | VP, VN OUTPUTS |
|---|---|---|---|---|
| 0 | 0 | Off | Off | Off |
| 0 | 1 | On | On | Off |
| 1 | 0 | On | On | On |
| 1 | 1 | On | On | On |

Setting **TEST1** and **TEST0** checkboxes prevents the VL, VH, VP, and VN outputs. In this mode, the output can be driven by external voltage sources. Setting either **TEST_** bit to 1 in the **Test** group box disables the discharge function. Refer to the MAX17065 IC data sheet for more information regarding the test bits.

### Fault Detection

The MAX17065's **Faults** read-only register monitors the OLED controller's operating state, output, and thermal faults. When a fault is detected, the corresponding bit is changed from logic 0 to logic 1 and the font color is changed to red. Refer to the MAX17065 IC data sheet for more information regarding the **Faults** register.

### Outputs

The MAX17065 allows for software control of the charge-pump and negative SMPS outputs. Select the appropriate voltages from the **VL:**, **VH:**, and **VN:** drop-down lists to set the desired voltages. The default settings are **VL: -0.5V**, **VH: +5.5V**, and **VN: -0.5V**.

### Current Limit

The MAX17065 software allows the user to set current limits for the negative and positive switching power supplies. To set the current limits, select the desired current limit from the **IMAXN:** and **IMAXP:** drop-down lists in the **Current Limit** group box. The default current-limit settings are **IMAXN: 0.45A** and **IMAXP: 0.45A**.

### Manufacturer ID/Silicon Revision Detection

The **ID Register** group box shows the manufacturer ID and silicon revision information of the MAX17065 IC. This information is read upon initial start-up.

### Simple I²C/SMBus Commands

There are two methods for communicating with the MAX17065: through the normal user-interface panel (Figure 2) or through the I²C/SMBus commands, available by selecting the **Interface Diagnostic Window** menu item from the **Action** menu bar. The **Maxim Command Module Interface** window pops up and includes a **2-wire interface** tab that allows for execution of simple I²C/SMBus commands.

The SMBus dialog boxes accept numeric data in binary, decimal, or hexadecimal. Hexadecimal numbers should be prefixed by $ or 0x. Binary numbers must be exactly eight digits. See Figure 3 for an illustration of this tool.

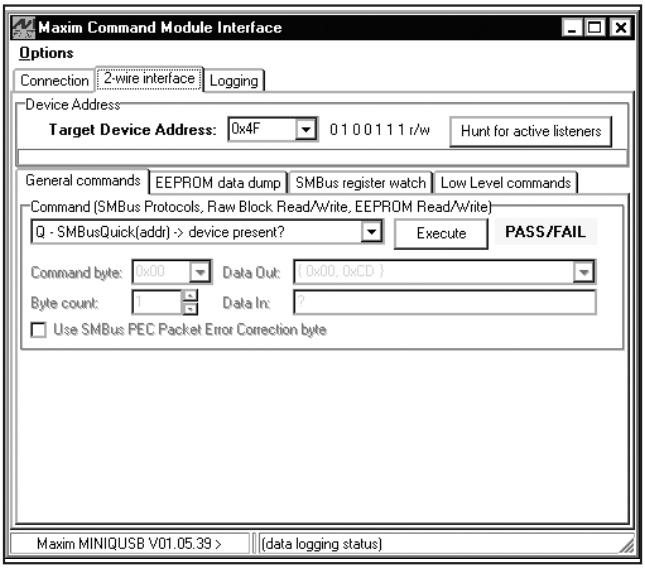


*Figure 3. Interface Diagnostic Window*

## Detailed Description of Hardware

The MAX17065 evaluation kit (EV kit) is a fully assembled and tested surface-mount PCB that evaluates the high-efficiency MAX17065 organic LED (OLED) driver. The MAX17065 EV kit provides an on-board I²C/SMBus interface and is connected to the computer through the USB port. The EV kit includes Windows 2000/XP- and Windows Vista-compatible software that provides a GUI for control of the MAX17065's output voltages, switching frequency, operating mode, current limit, and SMPS and charge-pump enables. The MAX17065 EV kit operates from a +2.3V to +4.5V single power supply.

The MAX17065 includes dual SMPS outputs (+5.35 fixed positive and -5V to -0.5V adjustable negative), one LDO (+1.9V/60mA), and dual regulated charge pumps (+5.5V to +9V positive and -5V to -0.5V negative) for an OLED panel.

### Shutdown Control

The MAX7065 can be placed in shutdown mode through jumper JU1 (see Table 2). When connected to GND or left open, the VD output is enabled with four rising CLK edges. When connected to VDDIO, the MAX17065's VD is enabled without a CLK signal.

**Table 2. Jumper JU1 Function**

| SHUNT POSITION | $\overline{SHDN}$ PIN | LDO OUTPUT (VD) |
|---|---|---|
| Installed* | Connected to VDDIO | Always on |
| One pin | Internally connected to GND | Enabled with four rising CLK edges |

**Default position.*

### User-Supplied VDDIO Input

The MAX17065's VDDIO supply is powered from the USB port by default. Move the shunt of JU2 to the 2-3 position to apply your own +1.6V to +3.6V power supply at the VDDIO pad. See Table 3 for jumper JU2 configuration. VDDIO voltage decides the $\overline{SHDN}$ and CLK logic levels. When CLK is driven by an external signal, jumper JU2 can be placed in a 2-3 position to allow external VDDIO voltage.

**Table 3. Jumper JU2 Function**

| SHUNT POSITION | VDDIO PIN |
|---|---|
| 1-2* | Powered from +3.3V USB supply |
| 2-3 | Powered from external +1.6V to +3.6V supply |

**Default position.*

### User-Supplied I²C/SMBus Interface

To use the MAX17065 EV kit with a user-supplied I²C/SMBus interface, first move the shunts of JU5 and JU6 to the 2-3 position. Then connect your SDA and SCL signals to the corresponding SDA and SCL pads on the MAX17065 EV kit board. **Note:** The I²C/SMBus interface is not available until VD is enabled by either $\overline{SHDN}$ = VDDIO or four rising CLK edges because SDA and SCL are pulled up by internal 10kΩ resistors.

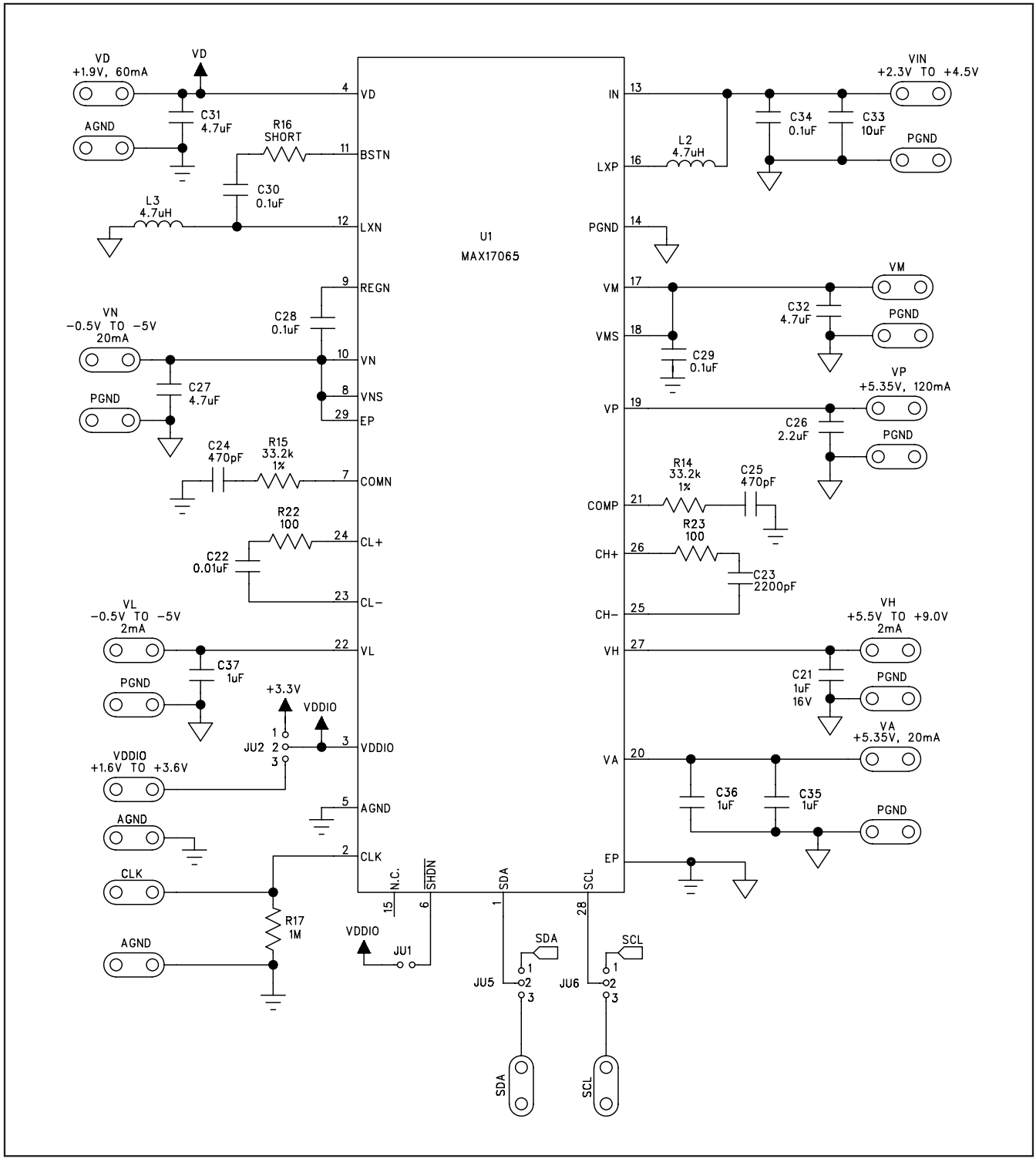


*Figure 4a. MAX17065 EV Kit Schematic (Sheet 1 of 2)*

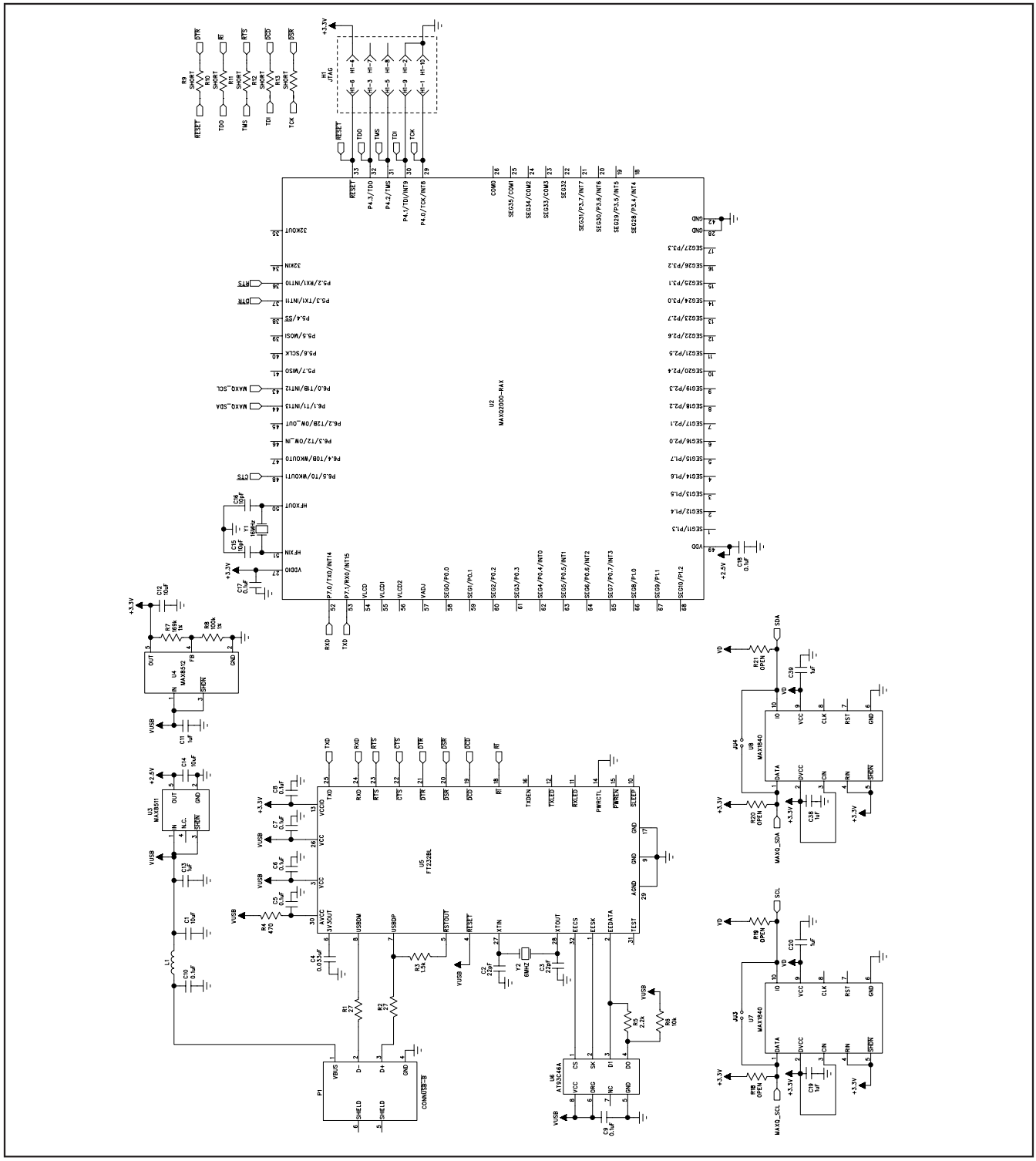

Figure 4b. MAX17065 EV Kit Schematic (Sheet 2 of 2)

# MAX17065 Evaluation Kit

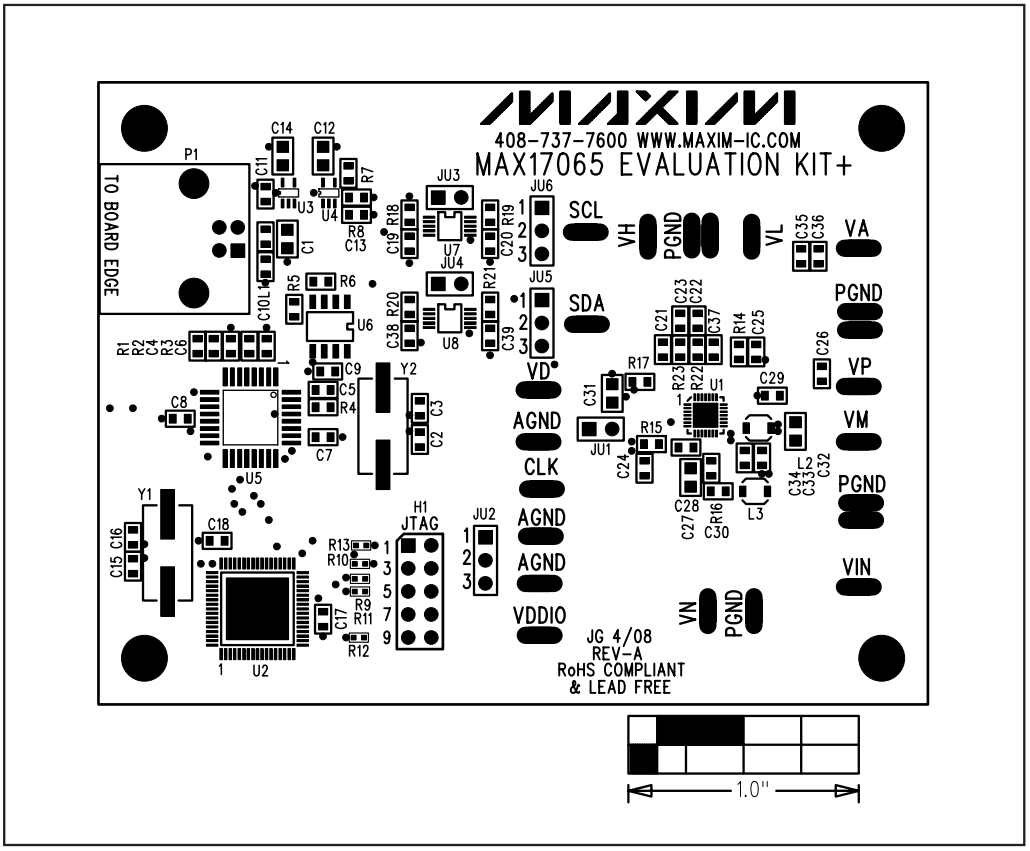


*Figure 5. MAX17065 EV Kit Component Placement Guide—Component Side*

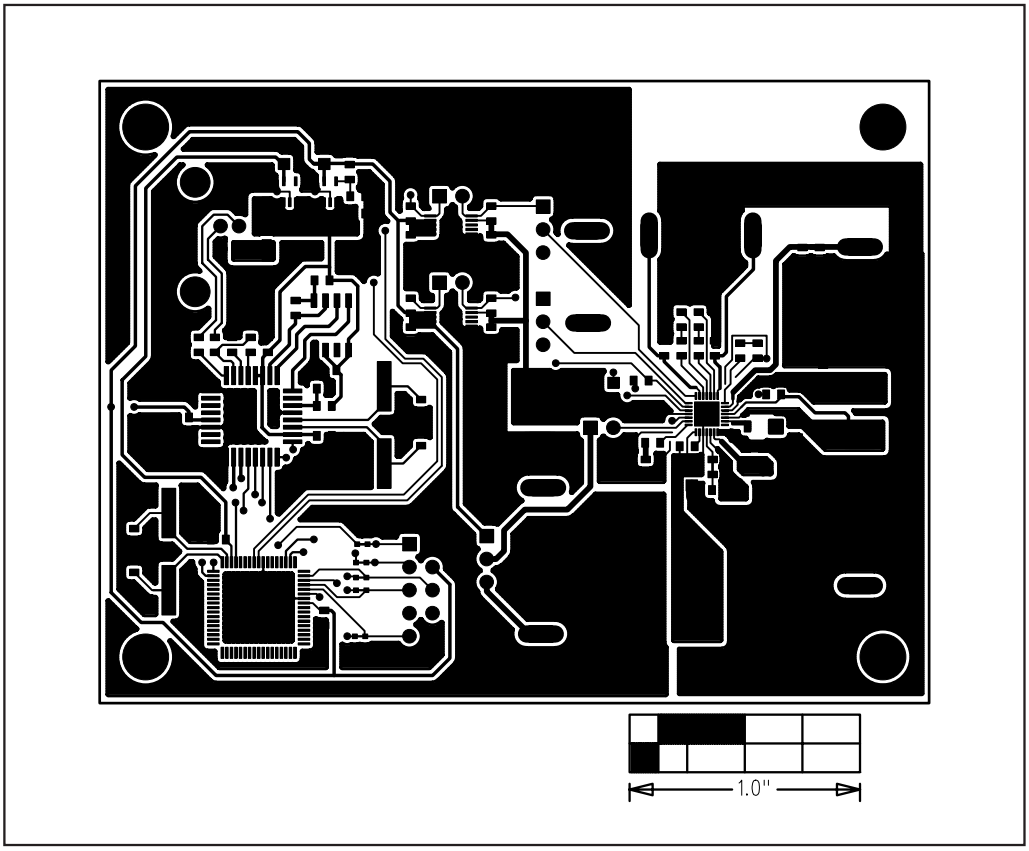


*Figure 6. MAX17065 EV Kit PCB Layout—Component Side*

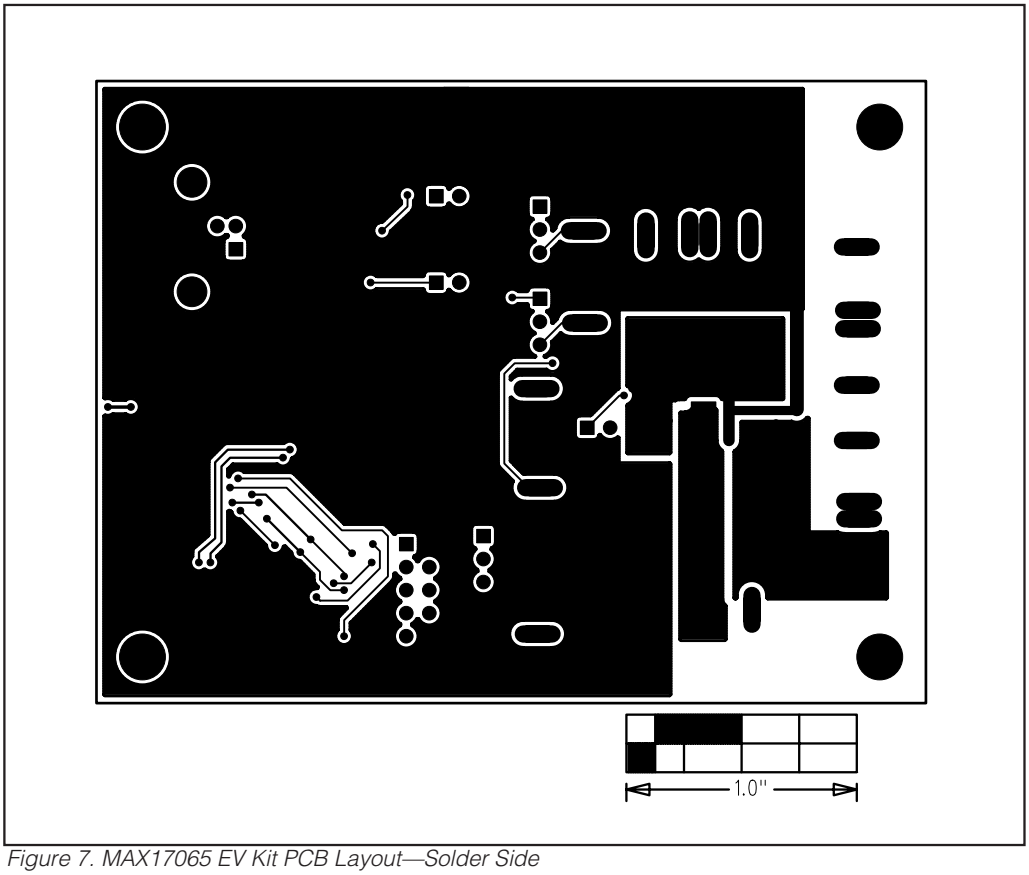


*Figure 7. MAX17065 EV Kit PCB Layout—Solder Side*

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