



# MAX5138 Evaluation Kit

## General Description

The MAX5138 evaluation kit (EV kit) provides a proven design to evaluate the MAX5138 16-bit, low-power, digital-to-analog converter (DAC). The EV kit also includes Windows® 2000/XP- and Windows Vista®-compatible software that provides a simple graphical user interface (GUI) for exercising the features of the MAX5138.

The MAX5138 EV kit PCB comes with a MAX5138BGTE+ installed. Contact the factory for free samples of the pin-compatible MAX5139GTE+ to evaluate this device.

## Ordering Information

PART	TYPE
MAX5138EVKIT+	EV Kit

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

## Features

- ◆ Windows 2000/XP- and Windows Vista (32-Bit)-Compatible Software
- ◆ Supports Standard SPI™ Interface
- ◆ USB-PC Connection (Cable Included)
- ◆ USB Powered
- ◆ 8-Pin DAC Output Signal Header
- ◆ Proven PCB Layout
- ◆ Lead(Pb)-Free and RoHS Compliant
- ◆ Fully Assembled and Tested

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3–C10, C17, C21, C23	12	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K
C2, C13, C15, C22, C24	5	10µF ±20%, 6.3V X5R ceramic capacitors (0805) TDK C2012X5R0J106M
C11, C12	2	10pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H100J
C14, C16	2	1µF ±20%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J105M
C18, C19	2	22pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H220J
C20	1	3300pF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H332K
C25	0	Not installed, ceramic capacitor (0603)
C26	1	39pF ±5%, 50V C0G ceramic capacitor (0402) Murata GRM1555C1H390G
D1	1	Green LED (0603)
FB1	1	0Ω ±5% resistor (0603)
H1	0	Not installed, 10-pin JTAG header

DESIGNATION	QTY	DESCRIPTION
H2	1	Dual-row (2 x 4) 8-pin header
H3	1	Dual-row (2 x 6) 12-pin header
JUA–JUE	0	Not installed, 2-pin headers
JU1–JU5, JU7, JU8, JU9	8	3-pin headers
JU6	1	5-pin header
P1	1	USB type-B right-angle female receptacle
R1, R8	2	0Ω ±5% resistors (0603)
R2	1	220Ω ±5% resistor (0603)
R3	1	10kΩ ±5% resistor (0603)
R4	1	2.2kΩ ±5% resistor (0603)
R5	1	1.5kΩ ±5% resistor (0603)
R6, R7	2	27Ω ±5% resistors (0603)
R16	0	Not installed, resistor (0402)
U1	1	Single 16-bit low-power DAC (16 TQFN-EP*) Maxim MAX5138BGTE+
U2	1	Low-power microcontroller (68QFN-EP*) Maxim MAXQ2000-RAX+
U3	1	93C46 type 3-wire EEPROM (8 SO) 16-bit architecture
U4	1	UART-to-USB converter (32 TQFP)

\*EP = Exposed pad.

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SPI is a trademark of Motorola, Inc.



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**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](http://www.maxim-ic.com).**

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## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U5	1	3.3V regulator (5 SC70) Maxim MAX8511EXK33+T (Top Mark: AEI)
U6	1	2.5V regulator (5 SC70) Maxim MAX8511EXK25+T (Top Mark: ADV)
Y1	1	16MHz crystal (HCM49) Hong Kong X'tals SSM1600000E18FAF

DESIGNATION	QTY	DESCRIPTION
Y2	1	6MHz crystal (HCM49) Hong Kong X'tals SSL6000000E18FAF
—	9	Shunts (JU1–JU9)
—	1	USB high-speed A-to-B cable
—	1	PCB: MAX5138 Evaluation Kit+

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com

**Note:** Indicate that you are using the MAX5138 when contacting these component suppliers.

## MAX5138 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX5138.EXE	Application program
FTD2XX.INF	USB device driver file
UNINST.INI	Uninstalls the EV kit software
USB_Driver_Help.PDF	USB driver installation help file

## Quick Start

### Required Equipment

- MAX5138 EV kit (USB cable included)
- A user-supplied Windows 2000/XP- or Windows Vista-compatible PC with a spare USB port
- One digital voltmeter (DVM)
- USB powered (use optional external power supply for enhanced performance)

**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

- 1) Visit [www.maxim-ic.com/evkitsoftware](http://www.maxim-ic.com/evkitsoftware) to download the latest version of the EV kit software, 5138Rxx.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 inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.
- 3) Verify that all jumpers (JU1–JU9) are in their default positions, as shown in Table 1.

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- 4) Connect the USB cable from the PC to the EV kit board. A **New Hardware Found** window pops up when installing the USB driver for the first time. If a window is not seen that is similar to the one described above after 30s, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows.
- 5) 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\MAX5138** (default installation directory) using the **Browse** button. During device driver installation, Windows may show a warning message indicating that the device driver Maxim uses does not contain a digital signature. This is not an error condition and it is safe to proceed with installation. Refer to the **USB\_Driver\_Help.PDF** document included with the software for additional information.
- 6) Start the MAX5138 EV kit software by opening its icon in the **Start | Programs** menu.
- 7) When the **Power Up State Of DAC Output** window appears, verify that the shunt on jumper JU6 is in the proper location on the board and press the corresponding radio button. The MAX5138 EV kit software main window appears next, as shown in Figure 1.

**Table 1. MAX5138 EV Kit Jumper Descriptions (JU1–JU9)**

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	MAX5138 $\overline{CS}$ signal connected to on-board microcontroller
	2-3	MAX5138 $\overline{CS}$ signal connected to H3-1 of on-board header H3
JU2	1-2*	MAX5138 SCLK signal connected to on-board microcontroller
	2-3	MAX5138 SCLK signal connected to H3-3 of on-board header H3
JU3	1-2*	MAX5138 DIN signal connected to on-board microcontroller
	2-3	MAX5138 DIN signal connected to H3-5 of on-board header H3
JU4	1-2	Factory Use Only. The MAX5138 EV kit software and MAXQ2000 microcontroller do not read the MAX5138 $\overline{READY}$ signal.
	2-3*	MAX5138 $\overline{READY}$ signal connected to H3-7 of on-board header H3
JU5	1-2*	MAX5138 $\overline{LDAC}$ signal connected to on-board microcontroller
	2-3	MAX5138 $\overline{LDAC}$ signal connected to H3-9 of on-board header H3
JU6	1-2	Factory Use Only. The MAX5138 EV kit software and MAXQ2000 microcontroller do not drive the MAX5138 $M/\overline{Z}$ signal.
	1-3	MAX5138 $M/\overline{Z}$ signal connected to GND. DAC outputs are set to 0V after power-up or power-on reset (POR).
	1-4	MAX5138 $M/\overline{Z}$ signal connected to H3-11 of on-board header H3
	1-5*	MAX5138 $M/\overline{Z}$ signal connected to AVDD. DAC outputs are set to midscale after power-up or power-on reset (POR).
JU7	1-2*	DVDD connected to on-board regulated +3.3V supply
	2-3	Connect an external 2.7V to 3.6V supply to the DVDD pad. The on-board microcontroller must be disconnected before connecting an external supply to DVDD greater than 3.6V. See the <i>User-Supplied Power Supplies</i> section for more information.
JU8	1-2*	AVDD connected to on-board regulated +3.3V supply
	2-3	Connect an external 2.7V to 5.25V supply to the AVDD pad
JU9	1-2*	REFIN is connected to the internal 2.440V reference. REFIN is connected to REFOUT.
	2-3	The MAX5138 reference is equal to AVDD
	Open	Connect an external reference voltage to REFIN in the 2V to AVDD range.

\*Default position.

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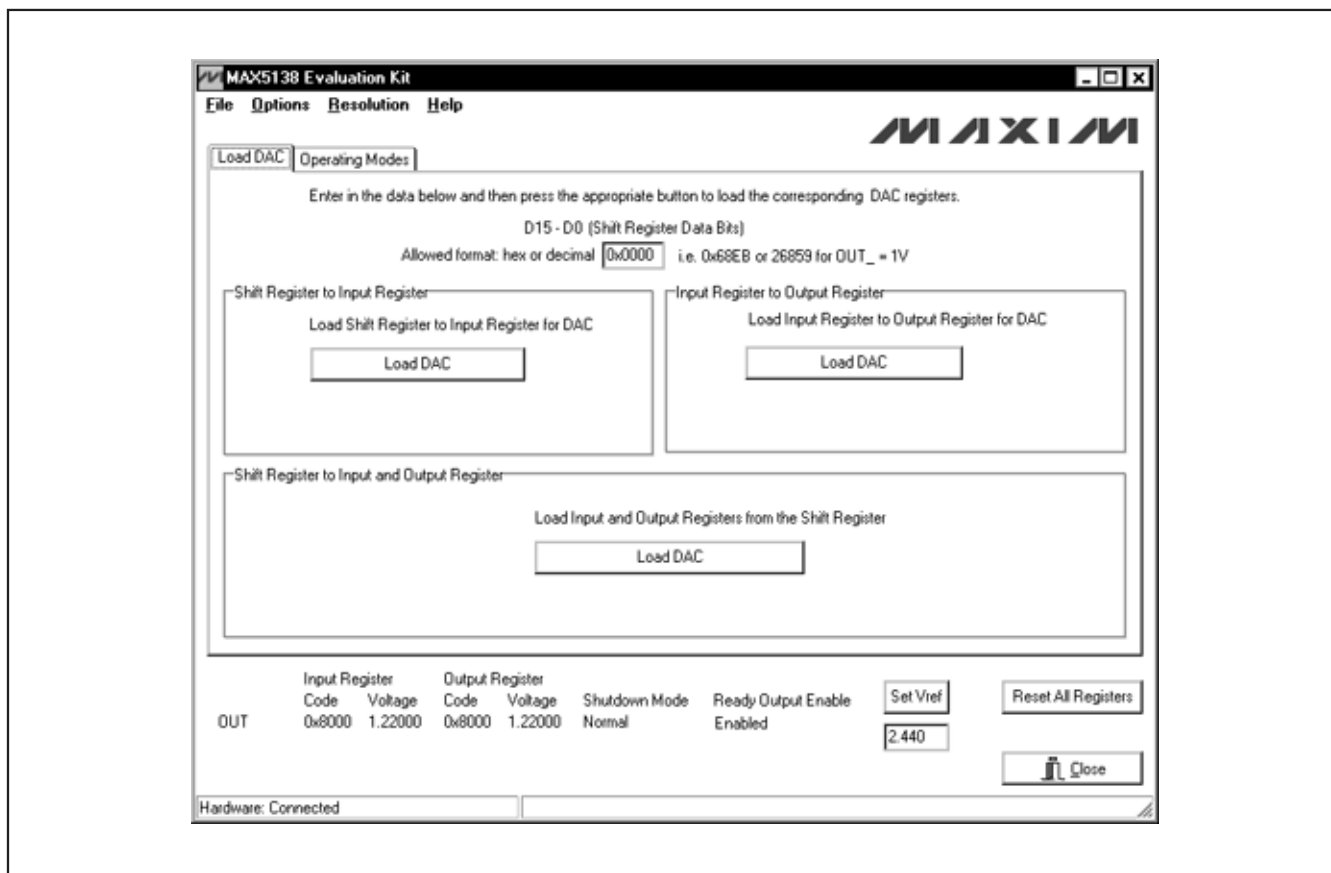


Figure 1. MAX5138 EV Kit Software Main Window (Load DAC Tab)

- 8) To measure the OUT voltage, connect the DVM between H2-1 (OUT) and H2-2 (GND).
- 9) Verify that the voltage on the DVM is approximately 1.22V.
- 10) Enter **0x68EB** into the **D15 - D0 (Shift Register Data Bits)** edit box.
- 11) In the **Shift Register to Input Register** group box, press the **Load DAC** button.
- 12) Verify that the voltage shown on the DVM is approximately 1V.

## Detailed Description of Software

The main window of the evaluation software (Figure 1) displays the voltage and code for the DAC input and output registers. In addition, the main window has two tabs. The **Load DAC** tab sheet controls all the DAC loading features of the MAX5138. The **Operating**

**Modes** tab sheet (Figure 2) controls all the DAC modes of the MAX5138. The **Load Setting(s)** button must be pressed in order to write the corresponding mode settings to the DAC.

### **Software Reset**

Press the **Reset All Registers** button to reset the MAX5138's registers and GUI to the power-on-reset (POR) state. This can be done at any time and is highly recommended after the advanced user interface is used.

### **Advanced User Interface**

A manual serial interface can be used by advanced users by selecting **Options | Interface (Advanced Users)** from the menu bar.

For SPI, click on the **3-wire interface** tab shown in Figure 3. Enter data into the **Data bytes to be written** edit box and press the **Send Now** button.

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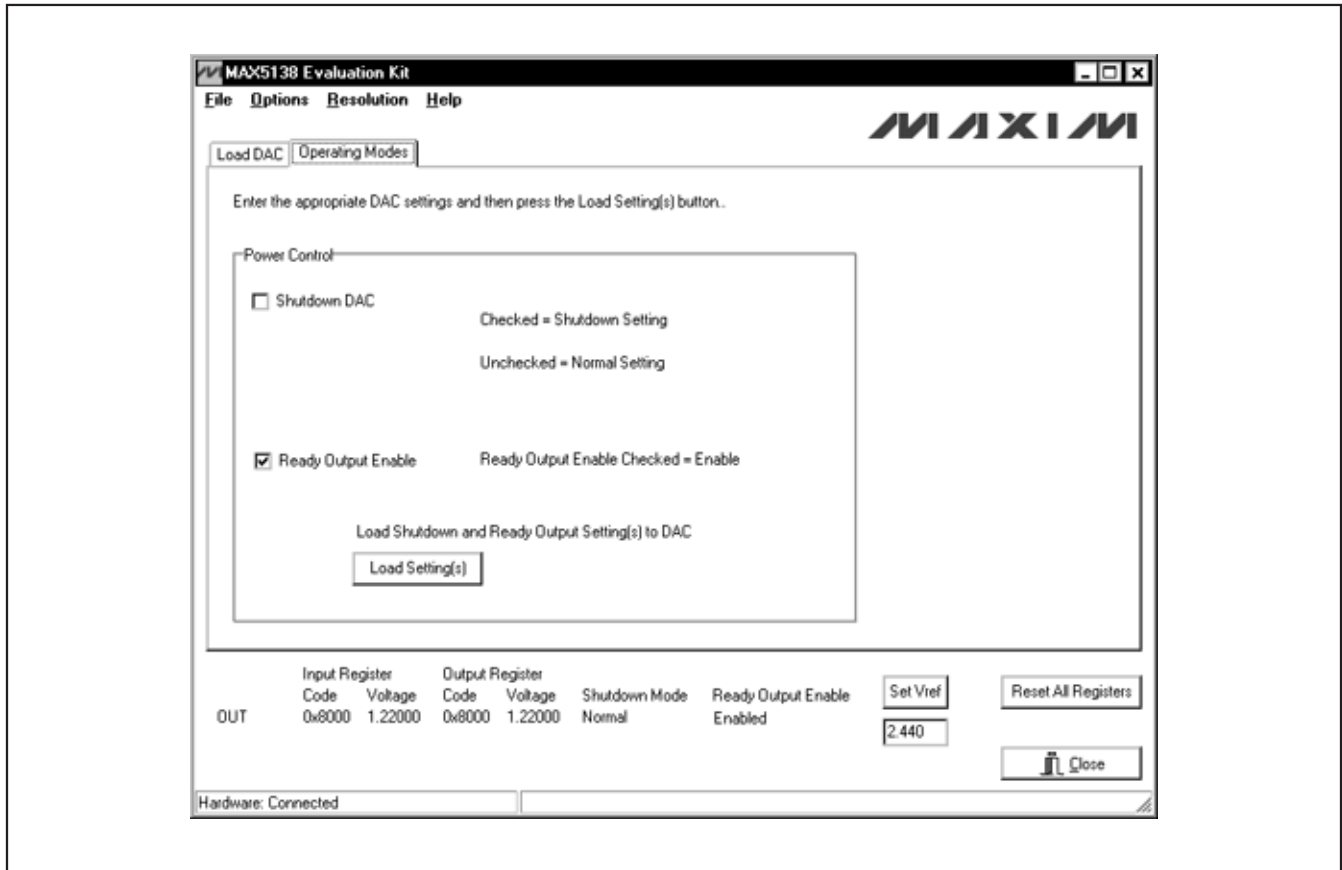


Figure 2. MAX5138 EV Kit Software Main Window (Operating Modes Tab)

## Detailed Description of Hardware

The MAX5138 EV kit provides a proven layout for the MAX5138. An on-board analog output signal header (H2), on-board digital input/output signal header (H3), and jumpers to disconnect the on-board microcontroller are all included on the EV kit.

### Reference

At power-up, the MAX5138 EV kit defaults to using the internal 2.440V reference.

To use AVDD as the reference, place the shunt on jumper JU9 in the 2-3 position. For off-board external references, connect a user-supplied reference voltage to REFIN and remove the shunt on jumper JU9. Type in the reference voltage value in the **Set Vref** edit box and press the **Set Vref** button. The MAX5138 EV kit software uses the value in the **Set Vref** edit box to calculate the input and output register voltage values and does not affect any commands to the part.

### User-Supplied SPI Interface

To use the MAX5138 EV kit with a user-supplied SPI interface, first move the shunts of jumpers JU1–JU5 and JU7 to the 2-3 position. Then apply an external 2.7V to 5.25V power supply to DVDD. Lastly, connect  $\overline{CS}$ , SCLK, DIN, and GND signals to the corresponding pins of header H3.

### User-Supplied Power Supplies

The MAX5138 EV kit is powered completely from the USB port by default. Before connecting a user-supplied power supply greater than 3.6V on DVDD, the on-board microcontroller must be disconnected. First, move the shunts of jumpers JU1–JU5, JU7, and JU8 to the 2-3 position. Then, apply an external 2.7V to 5.25V power supply to the corresponding DVDD and AVDD pads. For optimum performance, use separate supplies. Lastly, see the *User-Supplied SPI Interface* section for interface connections, if applicable.

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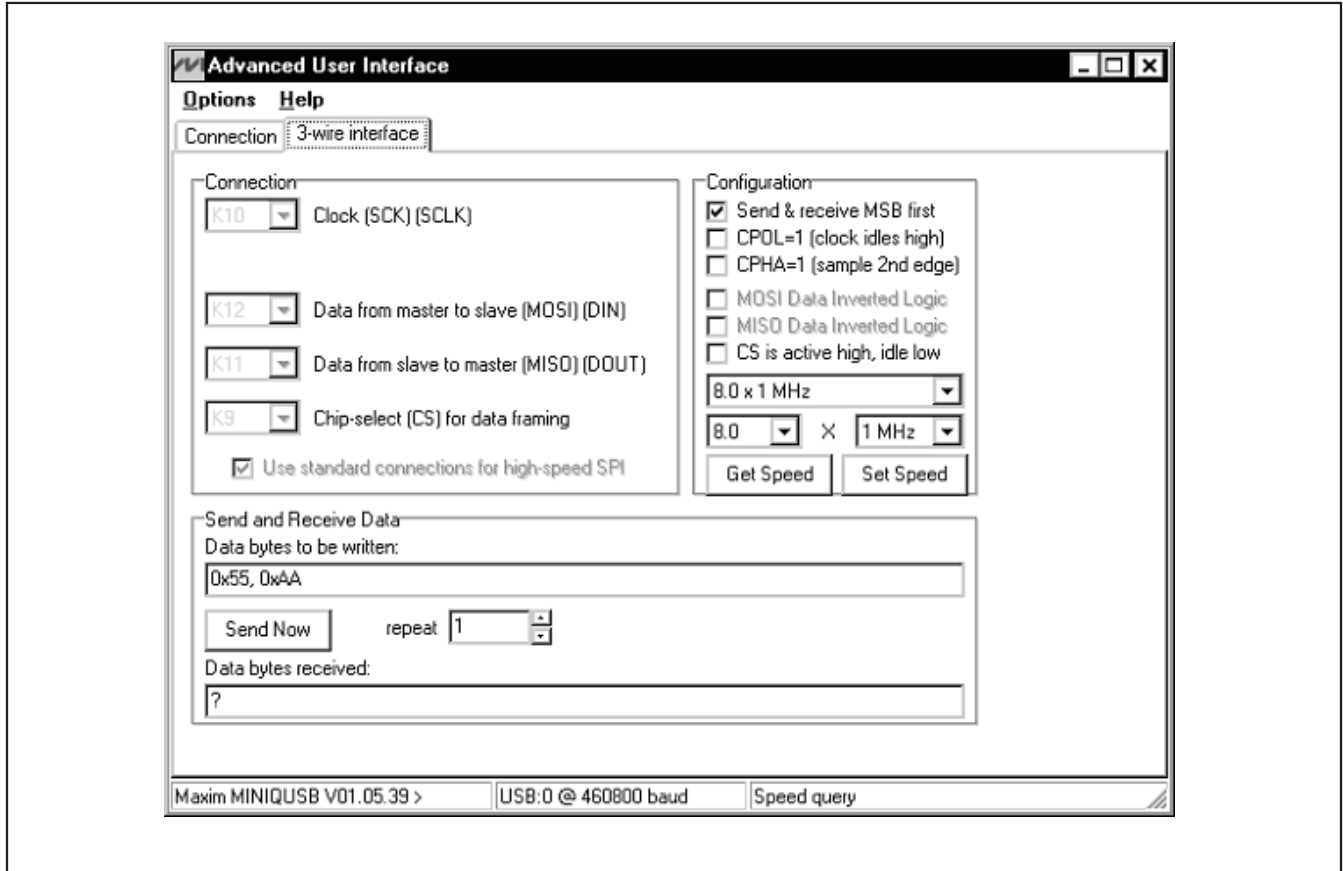


Figure 3. Advanced SPI User Interface Window (3-Wire Interface Tab)

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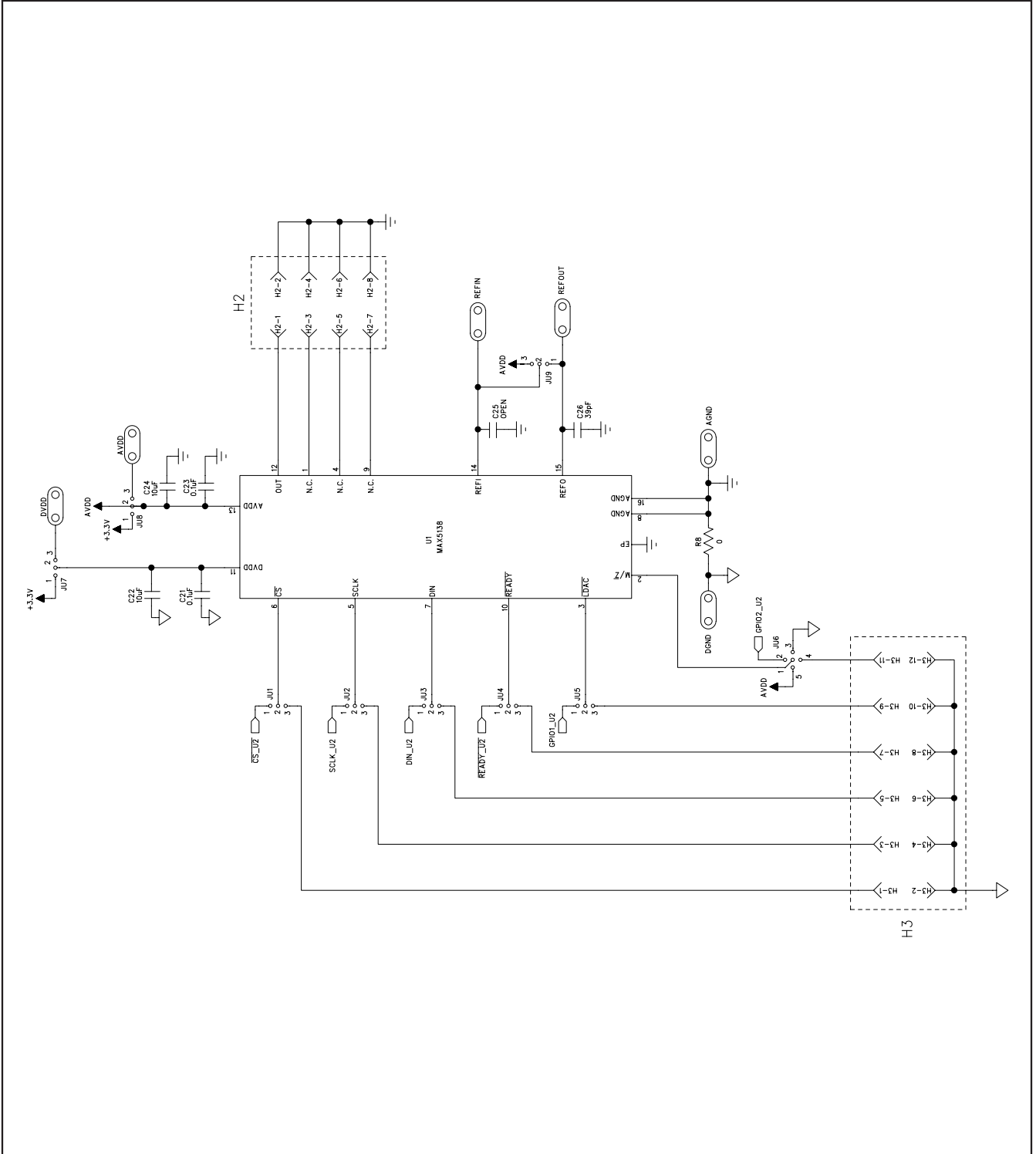


Figure 4a. MAX5138 EV Kit Schematic (Sheet 1 of 2)





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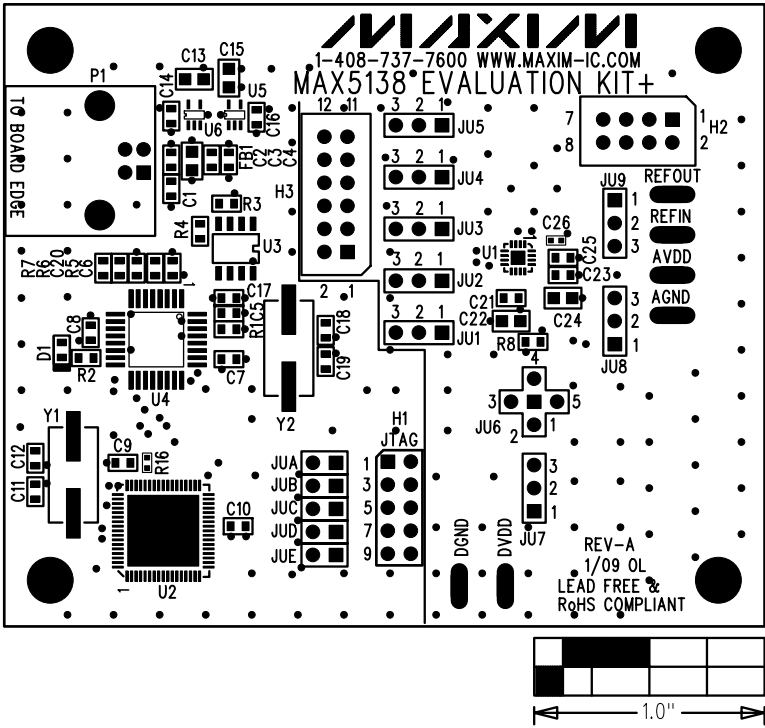


Figure 5. MAX5138 EV Kit Component Placement Guide—Component Side

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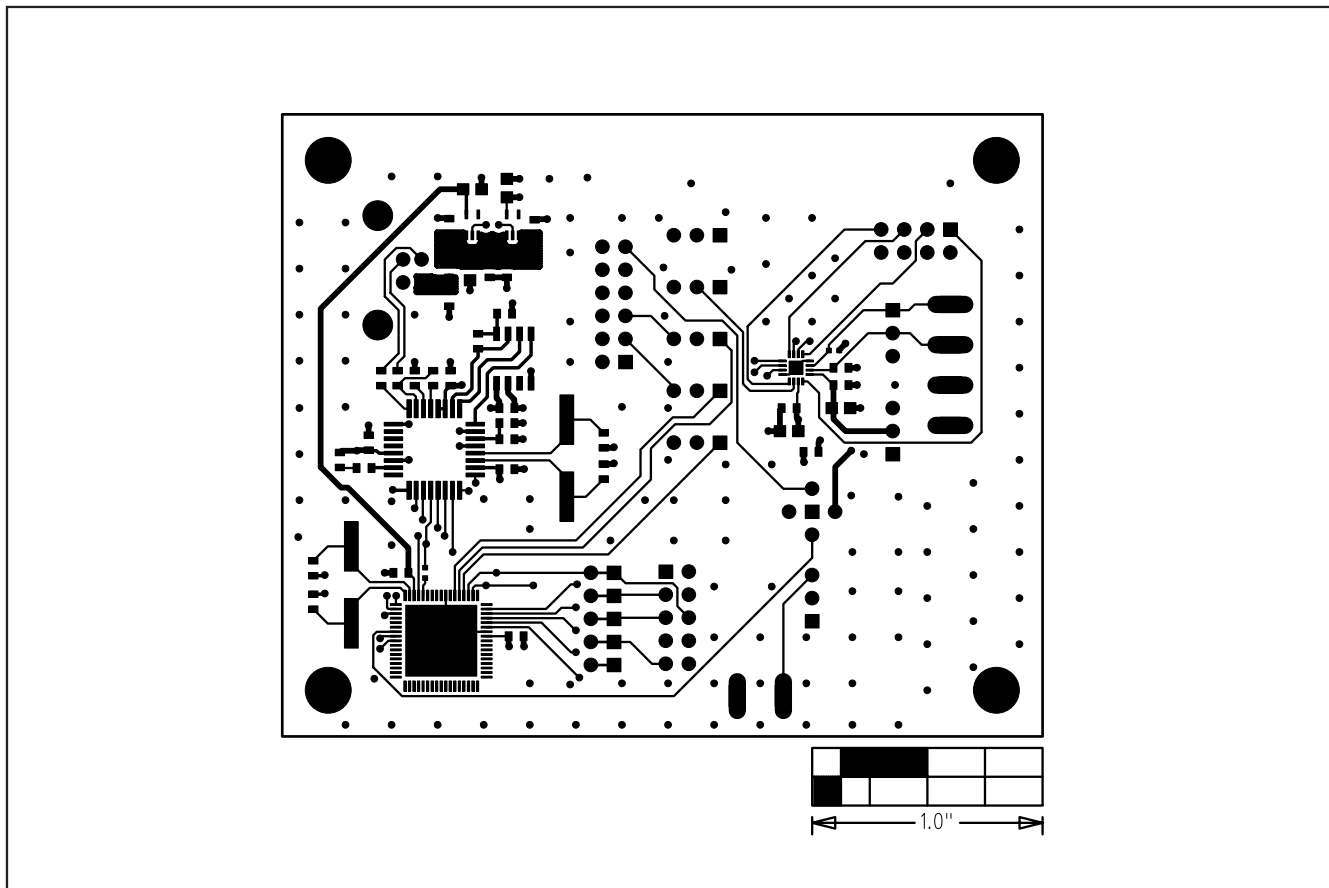


Figure 6. MAX5138 EV Kit PCB Layout—Component Side

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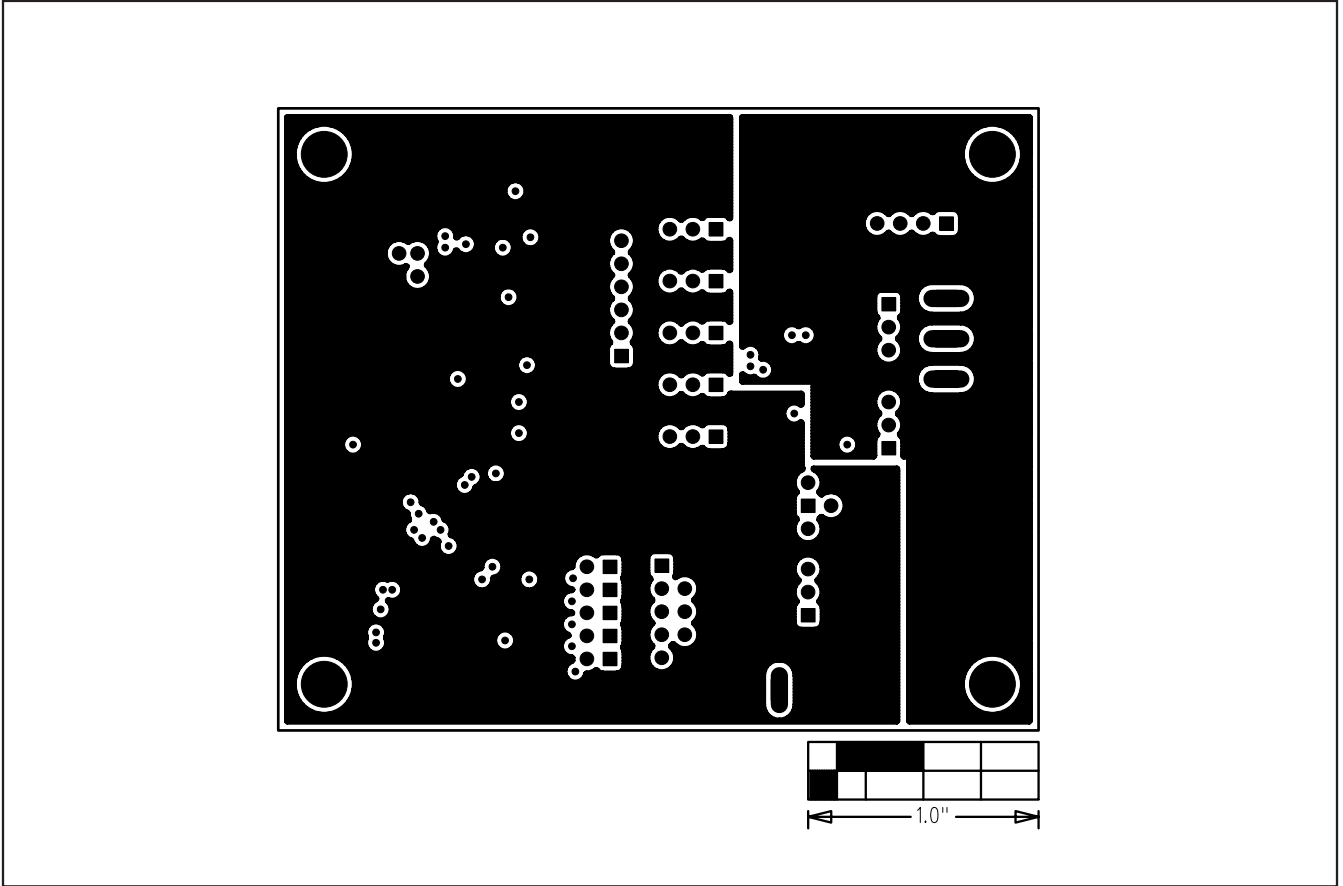


Figure 7. MAX5138 EV Kit PCB Layout—Inner Layer 2 (GND)

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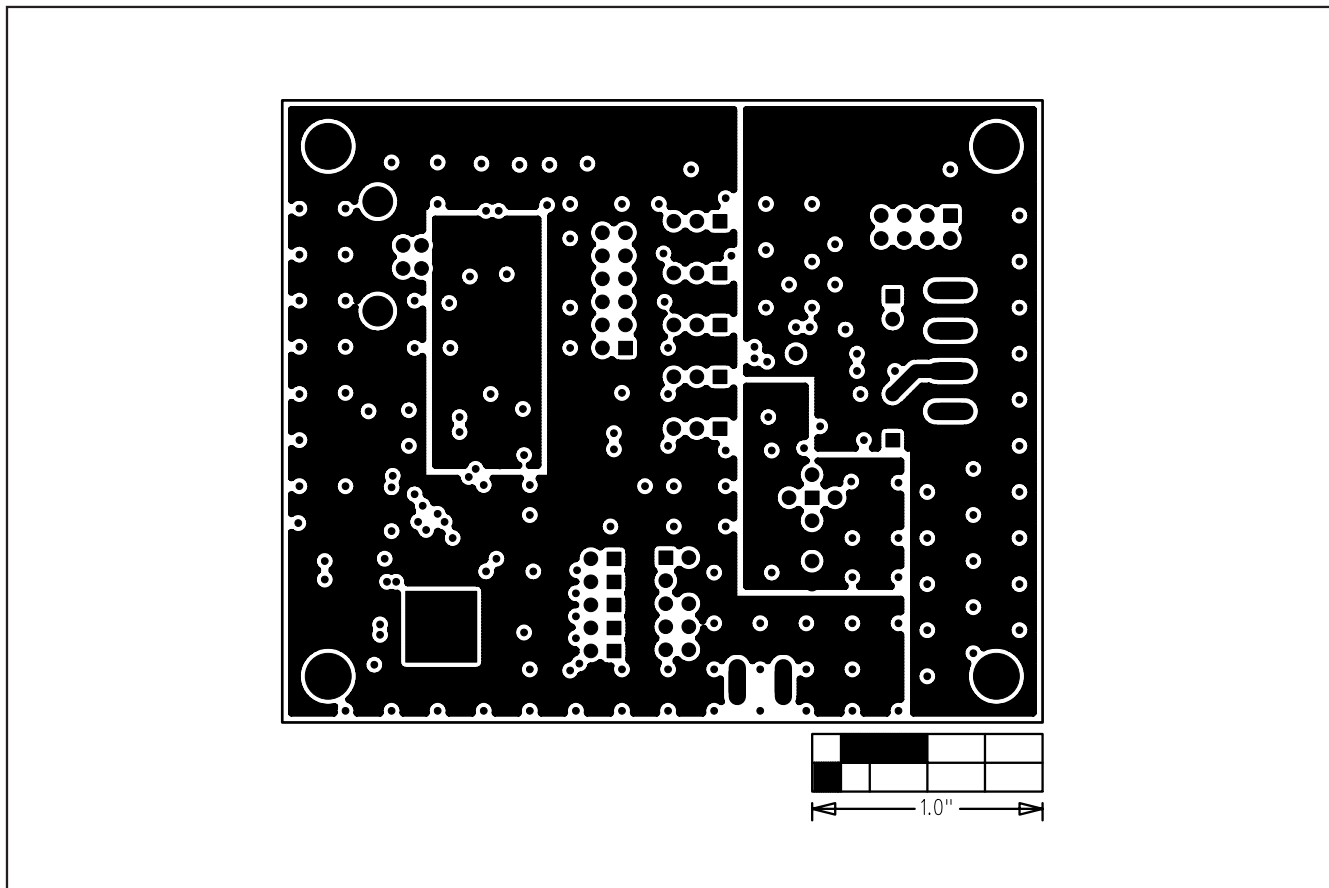


Figure 8. MAX5138 EV Kit PCB Layout—Inner Layer 3 (VDD)

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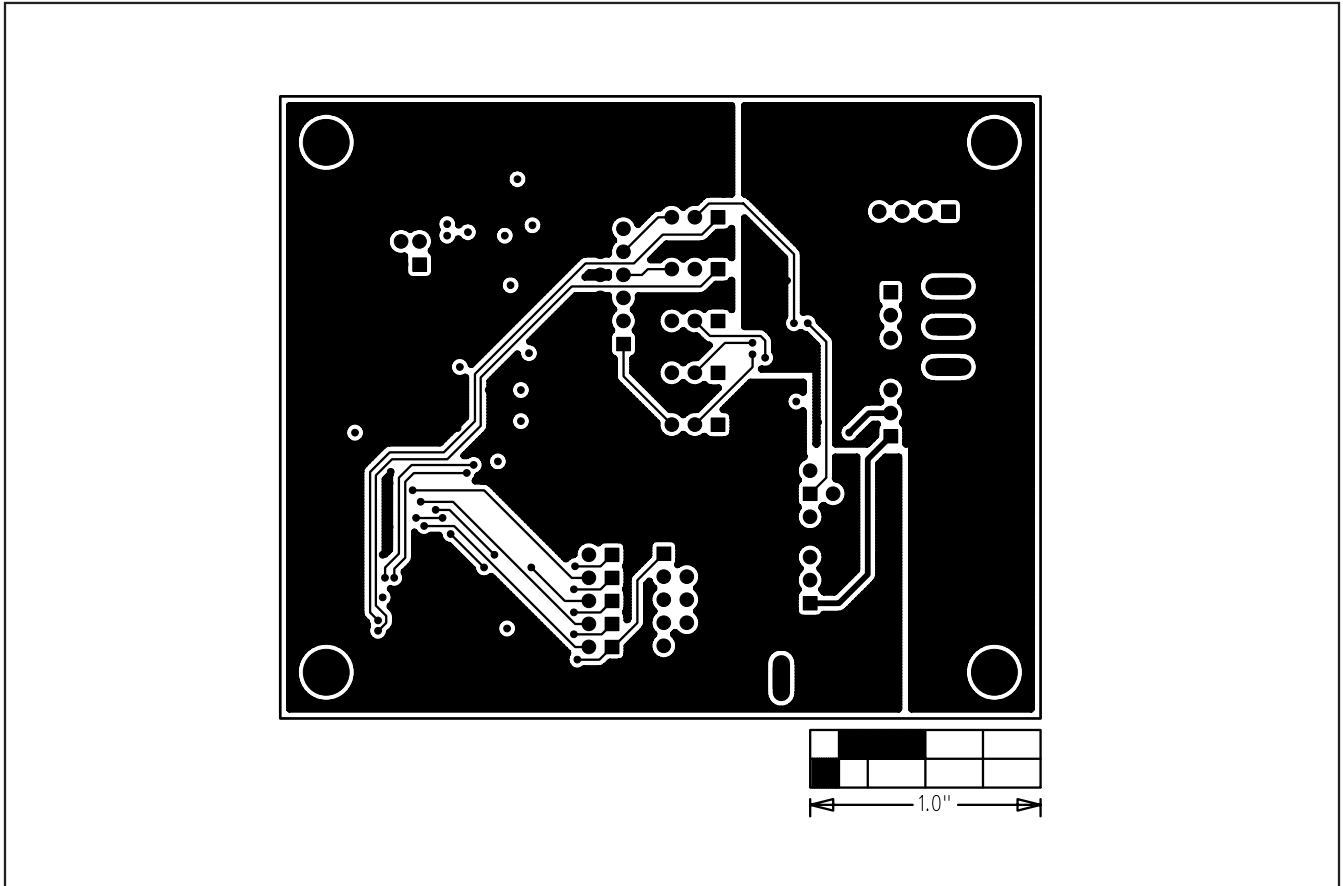


Figure 9. MAX5138 EV Kit PCB Layout—Solder Side

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