19-4189; Rev 0; 7/08

MAX3111E Evaluation Kit

Evaluates: MAX3111E

General Description

The MAX3111E evaluation kit (EV kit) provides a proven design to evaluate the MAX3111E SPI™/MICROWIRE™-compatible universal asynchronous receiver transmitter (UART) with RS-232 transceiver. The EV kit also includes Windows® 2000/XP/Vista®-compatible software that provides a simple graphical user interface (GUI) for exercising the features of the MAX3111E.

The MAX3111E uses the SPI/MICROWIRE interface for communication with the on-board MAXQ2000 microcontroller (µC). The on-board DIP and momentary pushbutton switches are used to configure the MAX3111E internal registers.

The EV kit can be connected to a PC serial port directly or through a straight-through extension cable. The PC is a data terminal equipment (DTE) device, and the EV kit is a data communications equipment (DCE) device.

After the EV kit and the PC serial port are configured properly, the PC sends characters to the MAX3111E. The on-board µC reads the received data from the MAX3111E and displays the characters on the on-board 7-segment LED or sends back data to the PC.

Other switches, jumpers, and pads are provided to modify the board to the numerous configurations available for the MAX3111E. Figure 1 shows a simple block diagram of the EV kit (RS-232 only).

SPI is a trademark of Motorola, Inc.

MICROWIRE is a trademark of National Semiconductor Corp.

Windows and Windows Vista are registered trademarks of Microsoft Corp.

Features

- **Both IrDA and RS-232 Communications Provided**
- **SPI/MICROWIRE-Compatible µC Interface**
- **On-Board µC Provides Flexible Configuration Possibilities**
- **Windows 2000/XP/Vista (32-Bit)-Compatible Software**
- **Lead-Free and RoHS Compliant**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX3111EEVKIT+	EV Kit

+Denotes lead-free and RoHS compliant.

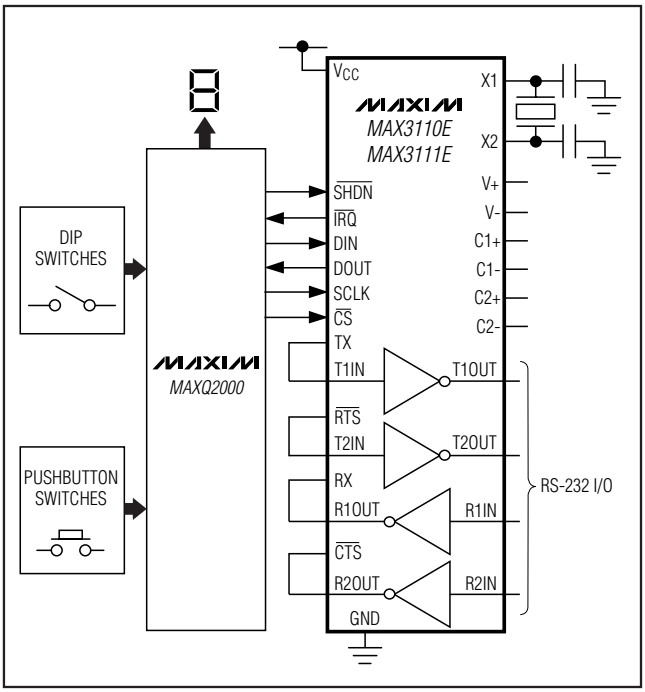


Figure 1. MAX3111E EV Kit Block Diagram (RS-232)

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.

MAX3111E Evaluation Kit

Component List

DESIGNATION	QTY	DESCRIPTION
C1–C9	9	0.1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K
C10, C11	2	39pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H390J
C12, C13	2	10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J
C14	1	10µF ±10%, 10V X5R ceramic capacitor (0805) Murata GRM21BR61A106K
D1	1	Super red, 7-segment, common cathode LED
D2, D3, D4	3	Green LEDs (0603)
D5		High-speed IR emitting diode Vishay TSHF5410
D6	1	Silicon PIN photodiode Vishay BPV22NF
J1	1	DB-9 female R/A 0.318in D-SUB serial port connector
J2	0	Not installed, vertical dual-row header (2 x 5)
JU1, JU2	2	2-pin headers
JU3, JU4	2	3-pin headers
JU5	1	20-pin (2 x 10) header
R1	1	200Ω ±5%, 8-element chip resistor network (0603 x 8)
R2, R3, R4	3	10kΩ ±5% resistors (0603)
R5, R6, R7	3	150Ω ±5% resistors (0603)
R8	1	182Ω ±1% resistor (1206)
SW1–SW4	4	Momentary pushbutton switches
SW5	1	8-position DIP switch, top-slide surface mount
SW6	1	12-position DIP switch, top-slide surface mount
U1	1	SPI/MICROWIRE-compatible UART (28 Wide SO) Maxim MAX3111ECWI+
U2	1	IrDA infrared transceiver (8 SO) Maxim MAX3120CSA+
U3	1	Microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U4	1	Digital temperature sensor (6 TDFN-EP*) Maxim MAX6626PMTT+
U5	1	LDO regulator (5 SC70) Maxim MAX8511EXK25+
U6	1	Octal buffer (20 TSSOP)
U7	1	Dual inverting buffer (8 SSOP)
Y1	1	3.6864MHz crystal ECS ECS-36-20-5PX-TR
Y2	1	16MHz crystal Hong Kong X'tals SSM1600000E18FAF
—	13	Shunts
—	1	DB9 male-to-DB9 female serial straight-through cable
—	1	PCB: MAX3111E Evaluation Kit+

**EP = Exposed pad.*

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
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX3111E when contacting these component suppliers.*

MAX3111E EV Kit Files

FILE	DESCRIPTION
MAX3111E.EXE	Application program
INSTALL.EXE	Installs the EV kit files on your computer
UNINST.INI	Uninstalls the EV kit software

Quick Start

Required Equipment

Before beginning, the following equipment is needed:

- MAX3111E EV kit (RS-232 serial cable included)
- 3.3V, 200mA DC power supply
- A user-supplied Windows 2000/XP/Vista PC with a spare serial RS-232 port

  OR
- A user-supplied Windows 2000/XP/Vista PC with a spare USB port and Maxim's USBTO232+ USB-to-COM port adapter board

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 MAX3111E 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, 3111ERxx.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–JU5) are in their default positions, as shown in Table 1 (JU1, JU2: Open. JU3, JU4: 2-3. JU5, rows 1–7: Closed. JU5, row 8: No shunt. JU5, rows 9 and 10: Open).
4) Verify that both DIP switches (SW5, SW6) are in their default positions, as shown in Tables 2 and 3 (all positions: On).
5) Connect the EV kit to the PC using the RS-232 serial cable.
6) Connect the 3.3V power supply to the +3.3V and GND pads on the EV kit board.
7) Turn on the 3.3V power supply. Verify that all segments of D1 are lit up, and D2, D3, and D4 are off.
8) Start the MAX3111E EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 2.
9) Press the SW1 momentary pushbutton switch on the EV kit board. The µC reads SW5 and SW6 DIP switch states and configures MAX3111E through a write-configuration command. Refer to the MAX3111E IC data sheet for details.

   Note: The EV kit sets the following MAX3111E register bits to a fixed logic because the µC firmware relies on these settings to function properly; a user cannot change these settings:

   $\overline{FEN}$ = 0 (FIFO Enable. Enables the receive FIFO when $\overline{FEN}$ = 0; when $\overline{FEN}$ = 1, FIFO is disabled)

   $\overline{TM}$ = 1 (Mask for T bit. $\overline{IRQ}$ is asserted if $\overline{TM}$ = 1 and T = 1)

   $\overline{RM}$ = 1 (Mask for R bit. $\overline{IRQ}$ is asserted if $\overline{RM}$ = 1 and R = 1)

   $\overline{PM}$ = 1 (Mask for Pr bit. $\overline{IRQ}$ is asserted if $\overline{PM}$ = 1 and Pr = 1)

   $\overline{RAM}$ = 1 (Mask for RA/FE bit. $\overline{IRQ}$ is asserted if $\overline{RAM}$ = 1 and RA/FE = 1)
10) On the software GUI, accept the default settings for the PC UART. Click the **Select Port** drop-down list to select the COM port that connects to the EV kit. Press the **Open** button to open and configure the PC COM port setting, as defined in the **PC UART Setting** group box. Check the status bar at the bottom of the GUI to verify that the port is opened successfully.
11) **Note:** Many PCs do not support 230.4Kbps baud rates. If this is the case, select a lower baud rate on the GUI and open the port. Change the B3–B0 settings on the EV kit board and press SW1 to configure the MAX3111E accordingly.
12) Click the up or down arrow on the spin box in the **PC Sends One ASCII Character to EV Kit** group box. The PC sends a single ASCII character to the EV kit. Verify that the 7-segment LED follows the GUI selections.

Detailed Description of Software

The EV kit is only designed to demonstrate the features of the MAX3111E. No robust error checking or flow-control algorithms are implemented. All data is in raw binary format without coding and decoding. A user should connect an oscilloscope to monitor the waveforms on the signal lines to better understand the data transactions.

The software main window includes eight group boxes, as shown in Figure 2.

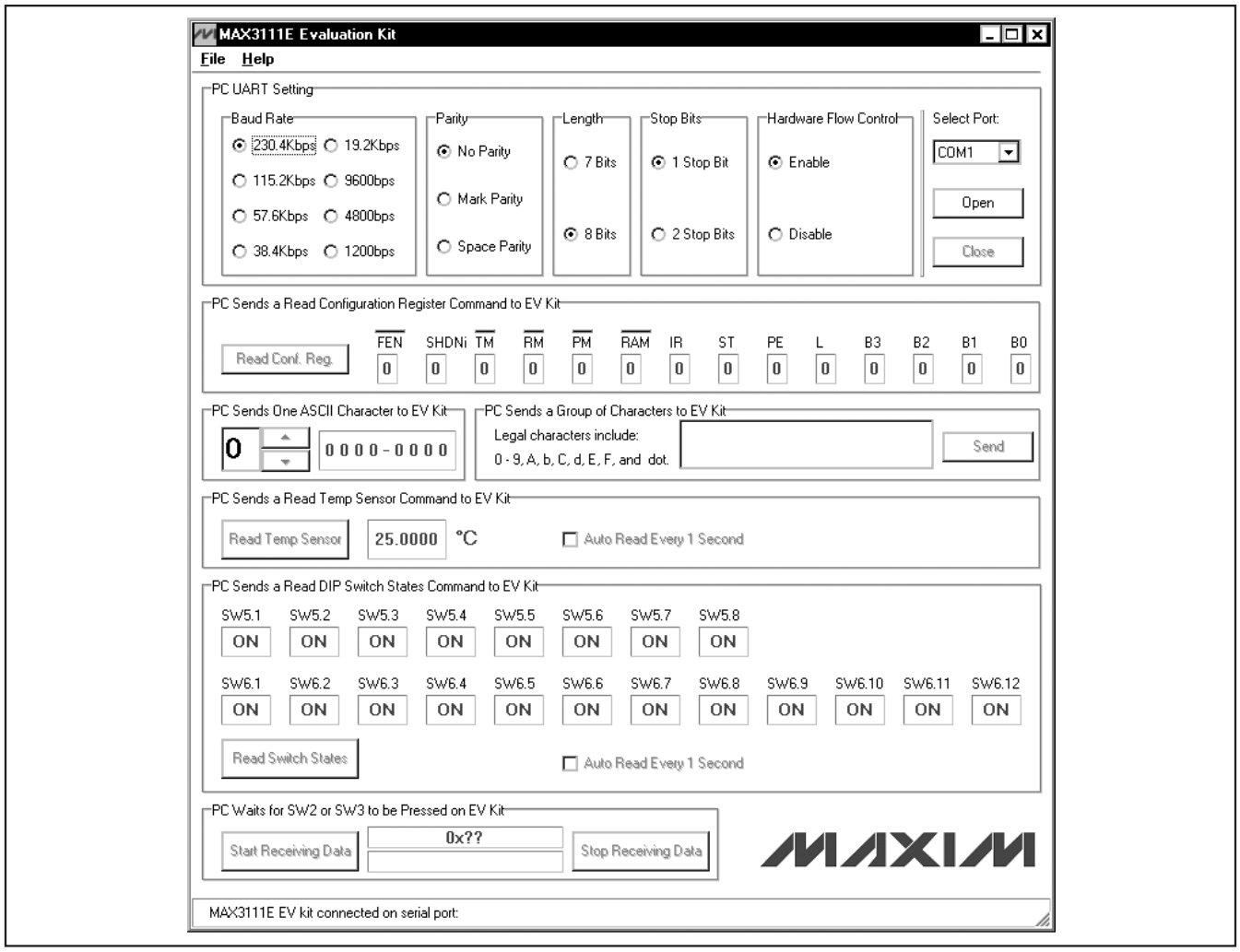


Figure 2. MAX3111E EV Kit Software Main Window

Setting the PC UART

The **PC UART Setting** group box configures the PC serial port that communicates with the EV kit to the setting in the **PC UART Setting** group box. After the **Open** button is pressed and the port is opened successfully, the PC serial port settings cannot be changed until the port is closed. To change the serial port setting, or release the serial port, close the PC serial port by pressing the **Close** button.

For the PC serial port to communicate with the EV kit, both the PC and EV kit serial ports should be configured exactly the same. Set the SW5 and SW6 DIP switches on the EV kit board appropriately and then press and release SW1. The on-board µC reads DIP switch on/off states and writes a 16-bit word to configure the MAX3111E.

Reading the MAX3111E Configuration Register

Press the **Read Conf. Reg.** button inside the **PC Sends a Read Configuration Register Command to EV Kit** group box to send a command (0x07) from the PC to the EV kit. When the µC receives and parses the meaning of the command, the µC reads the MAX3111E configuration register and groups the 14 register bits into 2 bytes. The µC then writes the 2 bytes to the MAX3111E's write-data register. The PC receives the 2 bytes of data and displays the corresponding configuration-register bits on the GUI.

Sending One ASCII Character to the EV Kit

The **PC Sends One ASCII Character to EV Kit** group box allows a user to select an ASCII character and send it to the EV kit. Depending on the UART frame length, the panel on the right displays the 7-bit or 8-bit binary digits of the ASCII character. The PC adds start, stop, and parity bits according to the current UART settings.

When the MAX3111E receives the character, it generates an interrupt request to the µC by pulling the $\overline{IRQ}$ line low. The µC moves the data from the MAX3111E and displays the single digit on the 7-segment LED.

Sending a Group of ASCII Characters to the EV Kit

The **PC Sends a Group of Characters to EV Kit** group box allows a user to type 50 characters (max) in the memo box and sends them to the EV kit. The format of the packet sent to the EV kit is as follows:

[Message Header (0x01)], [ASCII characters], [End of message (0x02)]

When the MAX3111E receives the characters, it generates interrupt requests to the µC by pulling the $\overline{IRQ}$ line low. The µC should read the data from the first-in-first-out buffer (FIFO) quickly to avoid a buffer overflow. After the µC receives an end-of-a-message byte, the µC displays the characters one after another, with approximately 0.5s of delay between each character.

Sending a Read Temp Sensor Command to the EV Kit

Press the **Read Temp Sensor** button inside the **PC Sends a Read Temp Sensor Command to EV Kit** group box to send a command (0x03) from the PC to the EV kit. When the µC receives and parses the meaning of the command, the µC gets temperature data (grouped in 2 bytes) from the on-board digital temperature sensor. The µC then writes the 2 bytes to the MAX3111E's write-data register. Lastly, the PC receives the 2 bytes of data and displays the corresponding temperature.

Check the **Auto Read Every 1 Second** checkbox to monitor the temperature continuously. Place the tip of your finger on top of U4 to change the temperature.

Sending a Read DIP Switch States Command to the EV Kit

Press the **Read Switch States** button inside the **PC Sends a Read DIP Switch States Command to EV Kit** group box to send a command (0x04) from the PC to the EV kit. When the µC receives and parses the meaning of the command, the µC gets DIP-switch data (grouped in 3 bytes). The µC then writes the 3 bytes to the MAX3111E's write-data register. The PC receives the 3 bytes of data and displays the corresponding switch states on the GUI.

Check the **Auto Read Every 1 Second** checkbox to monitor the switch on/off states. Use the tip of a pen to change the switch positions.

Do not press SW1 unintentionally. Pressing SW1 reconfigures the MAX3111E from the current DIP-switch settings.

PC Waits for SW2 or SW3 to be Pressed on EV Kit

Press the **Start Receiving Data** button inside the **PC Waits for SW2 or SW3 to be Pressed on EV Kit** group box to prepare the software GUI for receiving a 0x05 or 0x06 byte from the EV kit. Press SW2 to send 0x05 or SW3 to send 0x06 to the PC. Press the **Stop Receiving Data** button to stop the PC from listening on the opened port. Do not press SW2 or SW3 on the EV kit if the PC is not expecting to receive data. For example, pressing SW2 or SW3 after the **Stop Receiving Data** button has been pressed corrupts other receiving operations (e.g., **Read Temp Sensor** or **Read Switch States**).

Detailed Description of Hardware

The MAX3111E EV kit uses the MAXQ2000-RAX as a host µC to communicate with the MAX3111E through the SPI interface. The µC displays received characters on a 7-segment LED display. The µC also implements a master I^2C-compatible interface to communicate with the on-board MAX6626 temperature sensor.

When the MAX3111E UART works in IrDA mode, the RS-232 electrical link is used by the PC to communicate with the µC.

The EV kit is designed as a DCE device. The J1 female DB9 connector pin functions are shown in Figure 3. The EV kit TX line is connected to the PC RX line. The EV kit RX line is connected to the PC TX line. The EV kit RTS line is connected to the PC CTS line. The EV kit CTS line is connected to the PC RTS line.

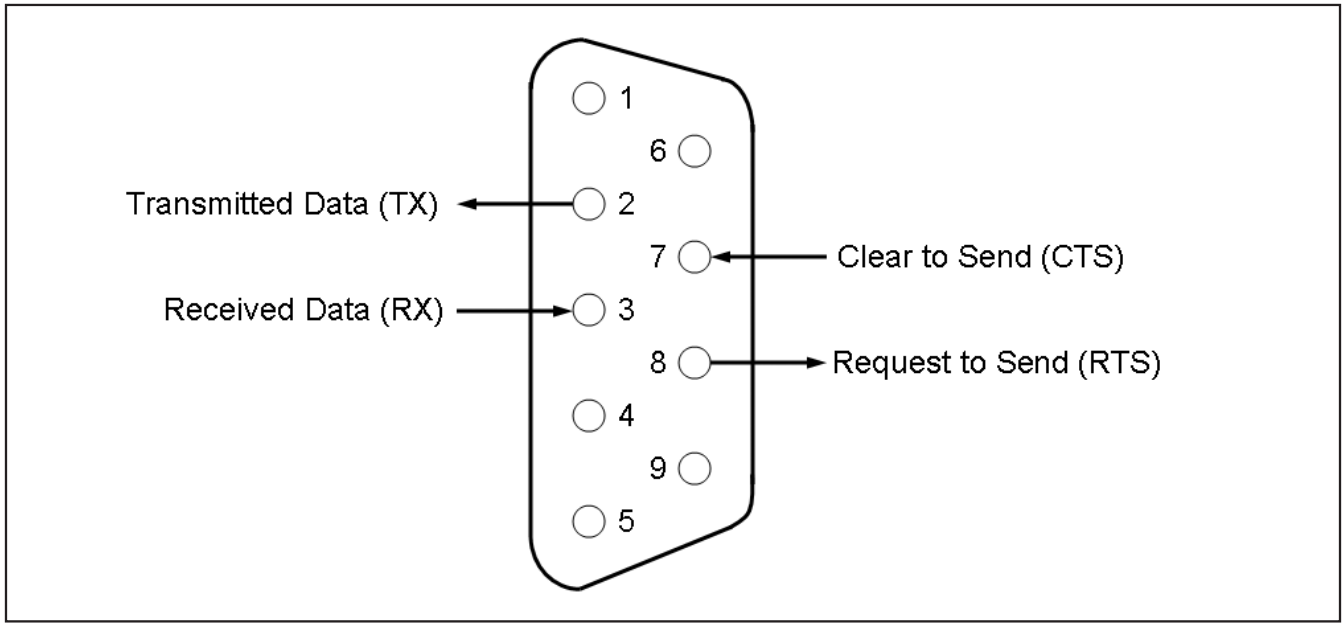


Figure 3. MAX3111E EV Kit J1 Female DB9 Connector Pin Functions

The data communication between the EV kit and the PC only requires TX and RX lines.

The logic of the $\overline{RTS}$ line (U1, pin 12) on the EV kit is controlled by the MAX3111E's RTS configuration bit. RTS = 1 sets the $\overline{RTS}$ line to logic 0. RTS = 0 sets the $\overline{RTS}$ line to logic 1. The logic of the $\overline{CTS}$ line (U1, pin 11) on the EV kit is controlled by the PC's hardware flow control (MAX3111E's $\overline{CTS}$ = 0, D3 = On. MAX3111E's $\overline{CTS}$ = 1, D3 = Off).

MAX3111E Baud-Rate Generation

Bits B3–B0 in the MAX3111E write-configuration register determine the baud-rate divisor (BRD), which divides the X1 oscillator frequency. The MAX3111E internal oscillator operates with either a 1.8432MHz or a 3.6864MHz crystal, or is driven at X1 with a 45% to 55% duty-cycle square wave. The MAX3111E IC data sheet shows baud-rate divisors for given input codes, as well as the baud rate for 1.8432MHz and 3.684MHz crystals. The generator's clock is 16 times the baud rate.

On the EV kit board, a 3.684MHz crystal is installed. A user can replace it with a 1.8432MHz crystal or remove Y1 and apply an external square wave on the EXTERNAL CLOCK pad.

A user should first set B3–B0 bits to the desired values on SW6 and then press and release SW1 to configure the MAX3111E baud-rate divisor.

Hardware Reset

Press SW4 on the EV kit to reset the µC and the MAX3111E to its initial power-on-reset (POR) state.

Jumper and Switch Settings

See Tables 1, 2, and 3 for a description of the EV kit jumpers and switch settings.

RS-232 Loopback Test

Disconnect the RS-232 serial cable from the EV kit. Place the shunts of JU1 and JU2 in the 1-2 position; set all other jumpers in their default positions. Press SW2 to send single-byte 0x05 on the TX line. The byte gets transmitted out of the MAX3111E's transmitter line and loops back to the MAX3111E's receiver line. The µC receives this byte from the MAX3111E and displays it on the 7-segment LED.

Press SW3 to send single-byte 0x06 on the TX line. The byte gets transmitted out of the MAX3111E's transmitter line and loops back to the MAX3111E's receiver line. The µC receives this byte from the MAX3111E and displays it on the 7-segment LED.

During the RS-232 loopback test, the RTS line is looped back to the CTS line.

Figure 4 shows a simple block diagram of the EV kit (IrDA and RS-232).

IR = 1 configures the MAX3111E's internal UART to provide IrDA SIR encoding and decoding. A standard IR transceiver (the MAX3120) is used to provide the IrDA communication with other IrDA SIR-compatible devices or loop back to the MAX3111E.

Follow the steps below to perform the IrDA loopback test:

1) Remove the shunts on JU1 and JU2.
2) Place a shunt on JU3, pins 1-2.
3) Place a shunt on JU4, pins 1-2.
4) Place a shunt on each row of JU5.
5) Move SW5.7 (IR) to Off position.
6) Press and release SW1.
7) Press and release SW2. Verify that D1 displays 5.
8) Press and release SW3, Verify that D1 displays 6.

The loopback test is described below:

Press SW2 (send 0x05) or SW3 (send 0x06) to send a single byte through the MAX3111E's TX line in IrDA mode. The pulses are inverted and then transmitted by the MAX3120 IR transmitter. After the IR signals are received by the MAX3120, they are inverted and sent back to the MAX3111E's RX line. The µC receives this byte and displays it on the 7-segment LED.

Blocking the space between IR emitting diode D5 and PIN photodiode with a hand stops the loopback.

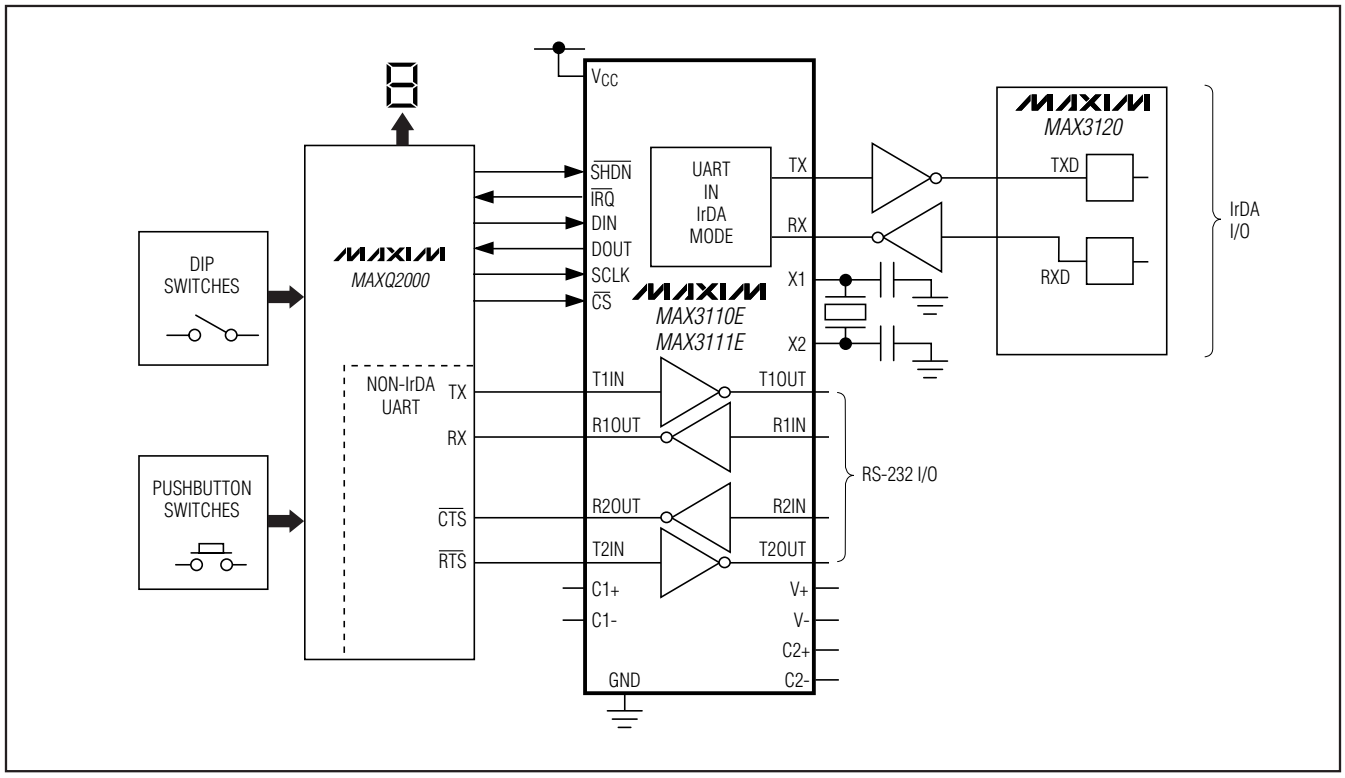


Figure 4. EV Kit Block Diagram (IR and RS-232)

Table 1. MAX3111E EV Kit Jumper Descriptions (JU1–JU5)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	Open*	Normal operation
	1-2	Short RS-232 TX and RX lines for EV kit RS-232 loopback test
JU2	Open*	Normal operation
	1-2	Short RS-232 RTS and CTS lines for EV kit RS-232 loopback test
JU3	2-3*	Normal operation
	1-2	MAX3111E RX line connected to IR module
JU4	2-3*	Normal operation
	1-2	MAX3111E TX line connected to IR module
JU5, rows 1–7	Closed*	MAX3111E connected to the on-board µC
	Open	MAX3111E connected to an external µC
JU5, row 8	No shunt	Both pins connected to GND
JU5, rows 9 and 10	Closed	PC communicates directly with the on-board µC
	Open*	PC communicates with the on-board µC through the MAX3111E

**Default position.*

Table 2. MAX3111E EV Kit DIP Switch SW5 Descriptions

SWITCH	POSITION	DIP SWITCH STATES	CONFIGURATION BITS
SW5-1	On*	SW5.1 = 0	N/A
	Off	SW5.1 = 1	N/A
SW5-2	On*	SW5.2 = 0	SHDNi = 0
	Off	SW5.2 = 1	SHDNi = 1
SW5-3	On*	SW5.3 = 0	N/A
	Off	SW5.3 = 1	N/A
SW5-4	On*	SW5.4 = 0	N/A
	Off	SW5.4 = 1	N/A
SW5-5	On*	SW5.5 = 0	N/A
	Off	SW5.5 = 1	N/A
SW5-6	On*	SW5.6 = 0	N/A
	Off	SW5.6 = 1	N/A
SW5-7	On*	SW5.7 = 0	IR = 0
	Off	SW5.7 = 1	IR = 1
SW5-8	On*	SW5.8 = 0	ST = 0
	Off	SW5.8 = 1	ST = 1

**Default position.*

Table 3. MAX3111E EV Kit DIP Switch SW6 Descriptions

SWITCH	POSITION	DIP SWITCH STATES	CONFIGURATION BITS
SW6-1	On*	SW6.1 = 0	PE = 0
	Off	SW6.1 = 1	PE = 1
SW6-2	On*	SW6.2 = 0	L = 0
	Off	SW6.2 = 1	L = 1
SW6-3	On*	SW6.3 = 0	N/A
	Off	SW6.3 = 1	N/A
SW6-4	On*	SW6.4 = 0	B3 = 0
	Off	SW6.4 = 1	B3 = 1
SW6-5	On*	SW6.5 = 0	B2 = 0
	Off	SW6.5 = 1	B2 = 1
SW6-6	On*	SW6.6 = 0	B1 = 0
	Off	SW6.6 = 1	B1 = 1
SW6-7	On*	SW6.7 = 0	B0 = 0
	Off	SW6.7 = 1	B0 = 1
SW6-8	On*	SW6.8 = 0	N/A
	Off	SW6.8 = 1	N/A
SW6-9	On*	SW6.9 = 0	$\overline{TE}$ = 0
	Off	SW6.9 = 1	$\overline{TE}$ = 1
SW6-10	On*	SW6.10 = 0	RTS = 0
	Off	SW6.10 = 1	RTS = 1
SW6-11	On*	SW6.11 = 0	Pt = 0
	Off	SW6.11 = 1	Pt = 1
SW6-12	On*	SW6.12 = 0	N/A
	Off	SW6.12 = 1	N/A

**Default position.*

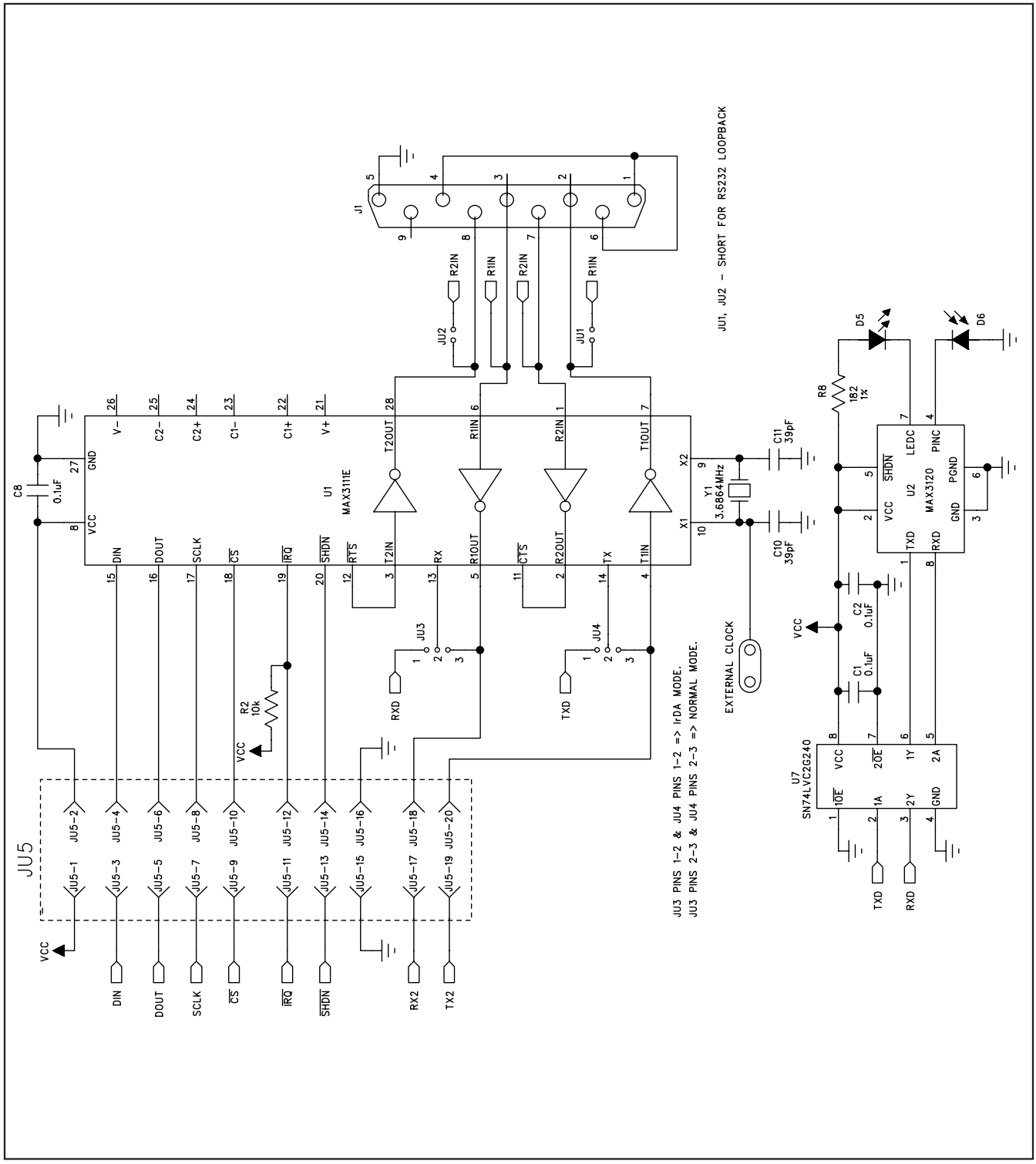


Figure 5a. MAX3111E EV Kit Schematic (Sheet 1 of 2)

MAX3111E Evaluation Kit

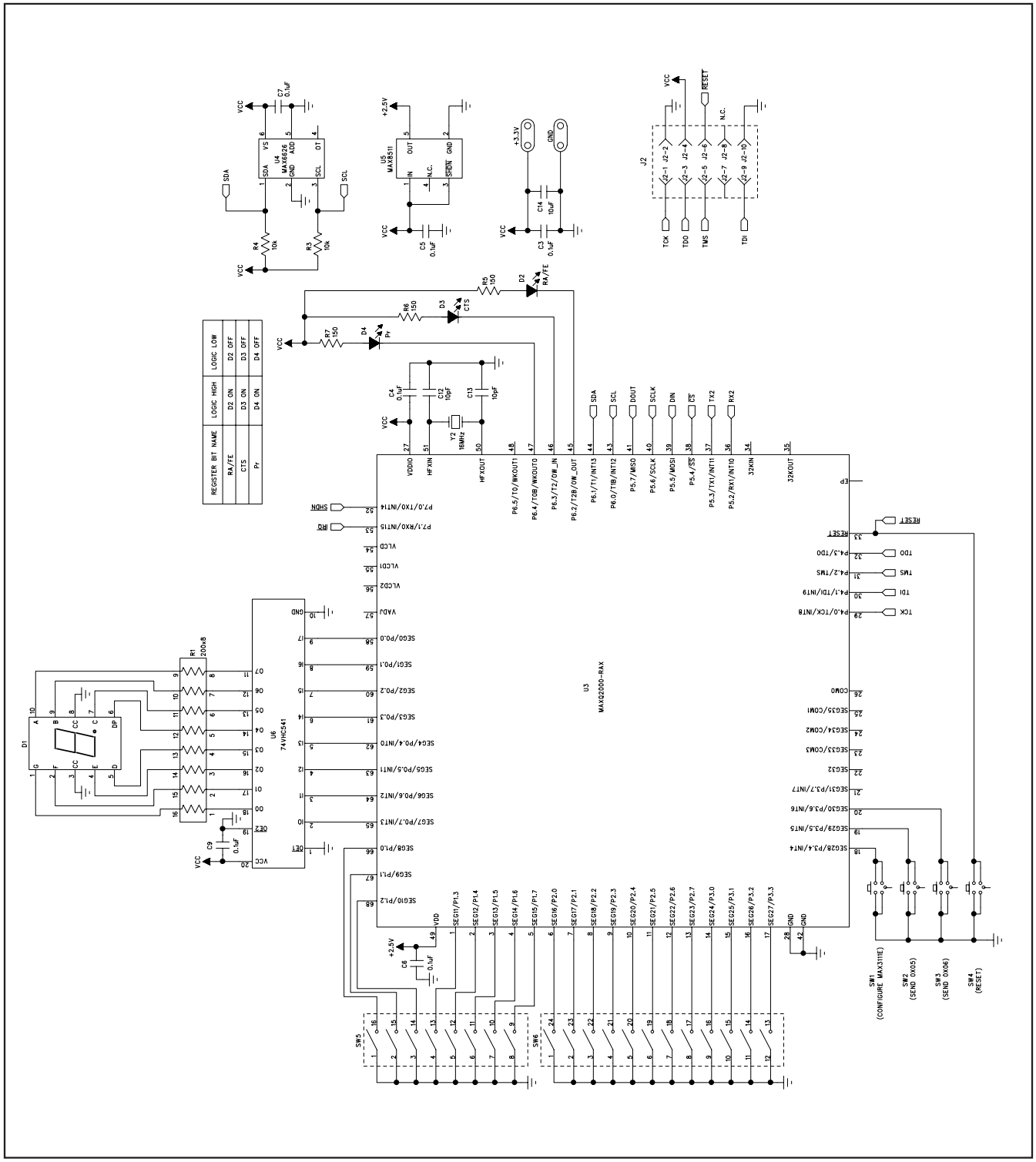


Figure 5b. MAX3111E EV Kit Schematic (Sheet 2 of 2)

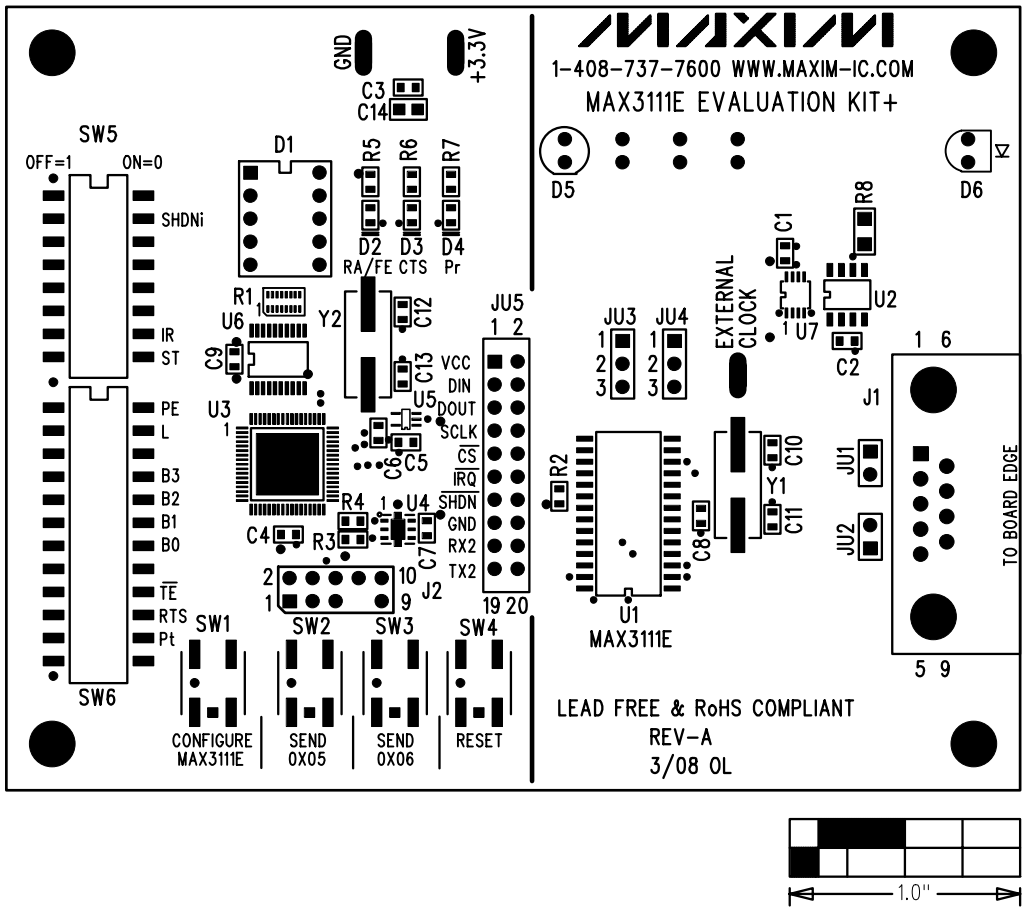


Figure 6. MAX3111E EV Kit Component Placement Guide—Component Side

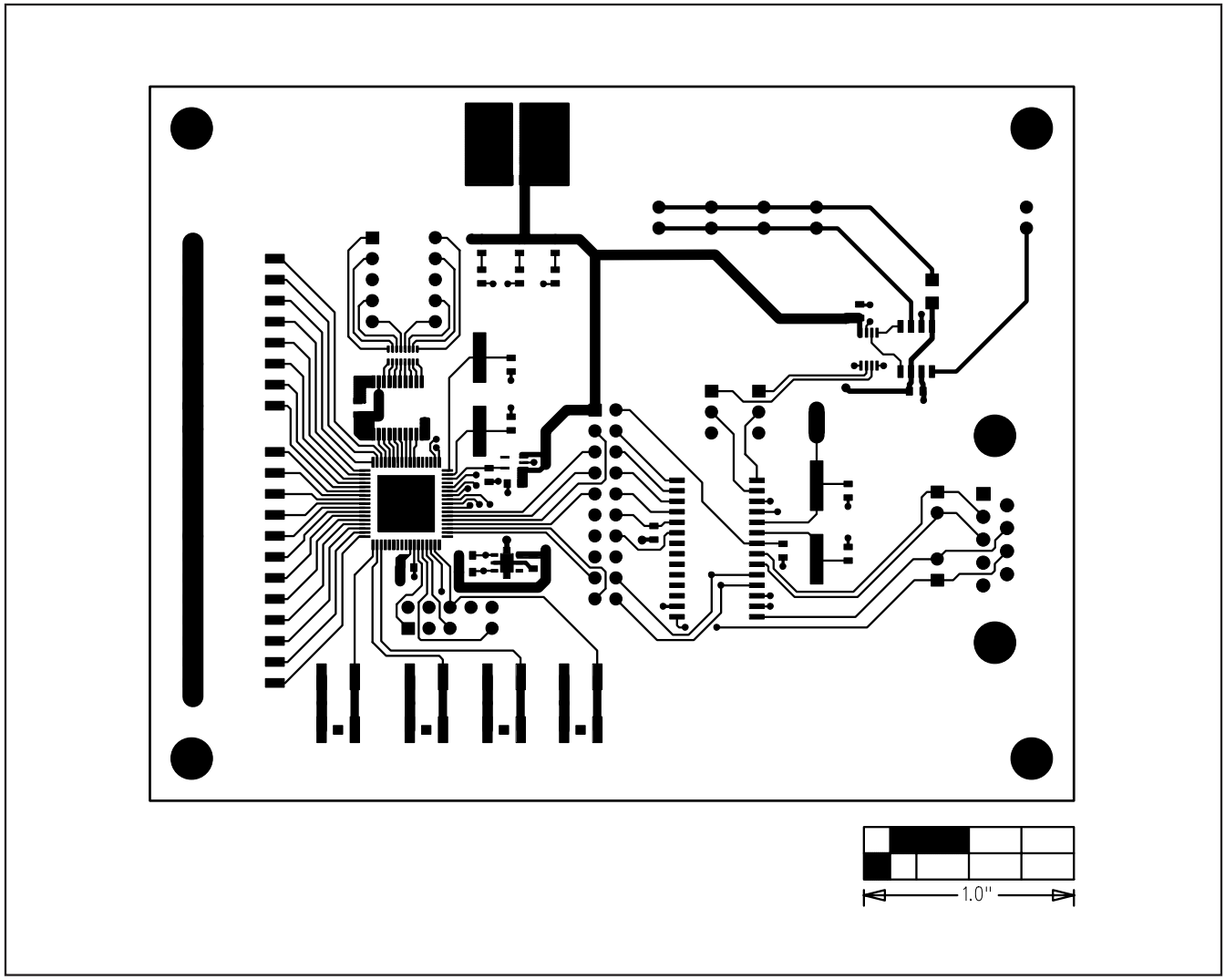


Figure 7. MAX3111E EV Kit PCB Layout—Component Side

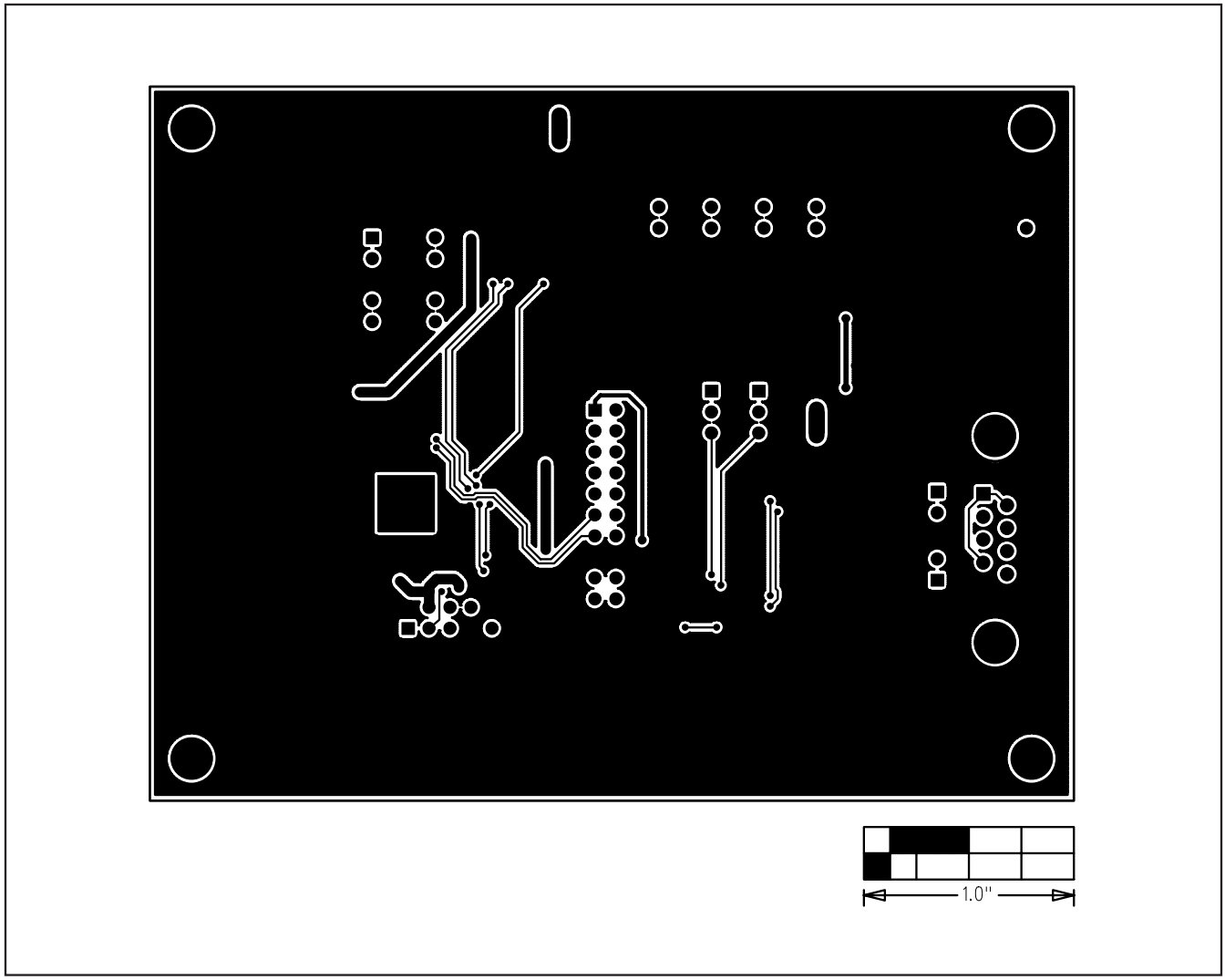


Figure 8. MAX3111E EV Kit PCB Layout—Solder Side

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