



MAX13362 Evaluation Kit

General Description

The MAX13362 evaluation kit (EV kit) provides a proven design to evaluate the MAX13362 24-channel automotive contact monitor. 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 MAX13362. The MAX13362 EV kit printed circuit board (PCB) comes with a MAX13362ATL/V+ installed.

Features

- ◆ Accepts 9VDC to 28VDC Battery Supply
- ◆ Windows 2000/XP/Vista (32-Bit)-Compatible Software
- ◆ USB PC Connection (Cable Included)
- ◆ Lead(Pb)-Free and RoHS-Compliant
- ◆ SPI™ Interface Terminals
- ◆ Proven PCB Layout
- ◆ Fully Assembled and Tested

Ordering Information

PART	TYPE
MAX13362EVKIT+	EV Kit

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	47µF ±10%, 50V aluminum electrolytic capacitor (6.3mm diameter; Panasonic VS series size D8) Panasonic ECG EEE-1HA470XP
C2, C11, C46	0	Not installed, capacitors (1206)
C3, C45	2	0.1µF ±10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H104K
C4	1	0.033µF ±10%, 16V X5R ceramic capacitor (0603) Taiyo Yuden EMK107BJ333KA
C5–C9, C17, C18, C37, C47	9	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K
C10	1	2.2µF ±10%, 10V X7R ceramic capacitor (0805) Murata GRM21BR71A225K
C12, C13, C14, C19–C29, C32–C36, C41–C44, C52	24	47000pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H473K
C15, C16	2	10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J

DESIGNATION	QTY	DESCRIPTION
C30, C31	2	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C38, C40, C55	3	10µF ±20%, 16V X5R ceramic capacitors (1206) Murata GRM31CR61C106M
C39, C54	2	1µF ±10%, 16V X5R ceramic capacitors (0603) TDK C1608X5R1C105K
C48–C51, C53	0	Not installed, capacitors (0603)
D1, D3	2	Red LEDs (0805)
D2	1	Diode, 1N4001 (DO41)
F1	1	60V, 0.14A Raychem polyswitch (1812) Tyco MINISMDC014F
H1–H4	4	10-pin headers
J1	1	USB series B right-angle PC-mount receptacle
J2	1	2 x 9 dual-row header
J3	0	Not installed
JU1	1	3-pin header
JU2–JU9	8	2-pin headers
L6	1	Ferrite bead TDK MMZ1608R301A (0603)

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
P0-P23	0	Not installed
R1, R2	2	27 Ω \pm 5% resistors (0603)
R3	1	1.5k Ω \pm 5% resistor (0603)
R4, R7	2	470 Ω \pm 5% resistors (0603)
R5	1	2.2k Ω \pm 5% resistor (0603)
R6	1	10k Ω \pm 5% resistor (0603)
R8	1	0 Ω resistor (0603)
R10, R11, R17, R18, R19	5	100 Ω \pm 5% resistors (0603)
R12-R16	0	Not installed, resistors—short (PC trace) (0402)
R20	1	330 Ω \pm 5% resistor (0603)
R21	1	33k Ω \pm 5% resistor (0603)
SW0-SW3, SW23	5	PCB-mount toggle switches, SPDT, ON-OFF-ON (7103)
SW4-SW22	19	PCB-mount toggle switches, SPDT, ON-ON (7101)
TB1	1	Terminal block
U1	1	24-channel automotive switch monitor (40 TQFN) Maxim MAX13362ATL/V+

DESIGNATION	QTY	DESCRIPTION
U2	1	3.3V LDO, 40V input (8 SO-EP*) Maxim MAX15007AASA+
U3	1	3.3V LDO regulator (5 SC70) Maxim MAX8511EXK33+
U4	1	Microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U5	1	USB UART (32-pin TQFP, 7 x 7) FTDI FT232BL
U6	1	93C46 type 3-wire EEPROM (8 SO) Atmel AT93C46A-10SU-2.7
U7	1	2.5V LDO regulator (5 SC70) Maxim MAX8511EXK25+
Y2	1	16MHz crystal (HCM49 surface mount)
Y3	0	Not installed, crystal
Y4	1	6MHz crystal (HCM49 surface mount)
—	16	Shunts
—	1	USB high-speed A-to-B cable, 5ft (1.5m)
—	1	PCB: MAX13362 Evaluation Kit+

*EP = Exposed pad.

MAX13362 EV Kit Files

FILE	DESCRIPTION
MAX13362.EXE	Application program
FTD2XX.INF	USB device driver file
USB_Driver_Help.PDF	USB driver installation help file

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
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
Tyco Electronics/M/A-COM	978-442-5000	www.macom.com

Note: Indicate that you are using the MAX13362 when contacting these component suppliers.

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Quick Start

Recommended Equipment

- MAX13362 EV kit (USB cable included)
- A user-supplied Windows 2000/XP- or Windows Vista-compatible PC with a spare USB port
- Power supply, 9VDC to 28VDC at 400mA

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 MAX13362 EV kit is fully assembled and tested. Follow the steps below to verify board operation.

- 1) Visit www.maxim-ic.com/evkitsoftware to download the latest version of the EV kit software, 13362Rxx.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.
- 4) Connect the external 9VDC to 28VDC power supply to terminal block TB1.
- 5) Connect the USB cable from the PC to the EV kit board. A **Building Driver Database** window will pop 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 30s, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows 2000/XP/Vista.

- 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\MAX13362** (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.
- 7) Start the MAX13362 EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 1.
- 8) Press function key F1 to configure the EV kit for wetting current 10mA, interrupts enabled, continuous mode operation.
- 9) Flip the switches SW0–SW23 on the EV kit, and observe the updated switch status shown on the GUI. When the switch lever is moved towards U1, the switch is closed to switch ground SWGND. Switches 0, 1, 2, 3, and 23 connect to VBAT when the lever is moved away from U1, and are open when the lever is centered.

Detailed Description of Software

The software automatically performs SPI transfers to update the device, unless the **Options | Polling** menu item has been unchecked. The main window of the evaluation software is shown in Figure 1.

Configuration data is written to the MAX13362 by clicking the buttons **Write00xxx**, **Write10xx**, and **Write01xx**. When writing configuration data, 32-bit SPI transfers are performed regardless of $\overline{\text{INT}}$. Status is updated as a result of configuration writes. Status can be read from the MAX13362 without changing configuration, by clicking the button **Write11xx**.

The software cannot read back the values written to the device registers.

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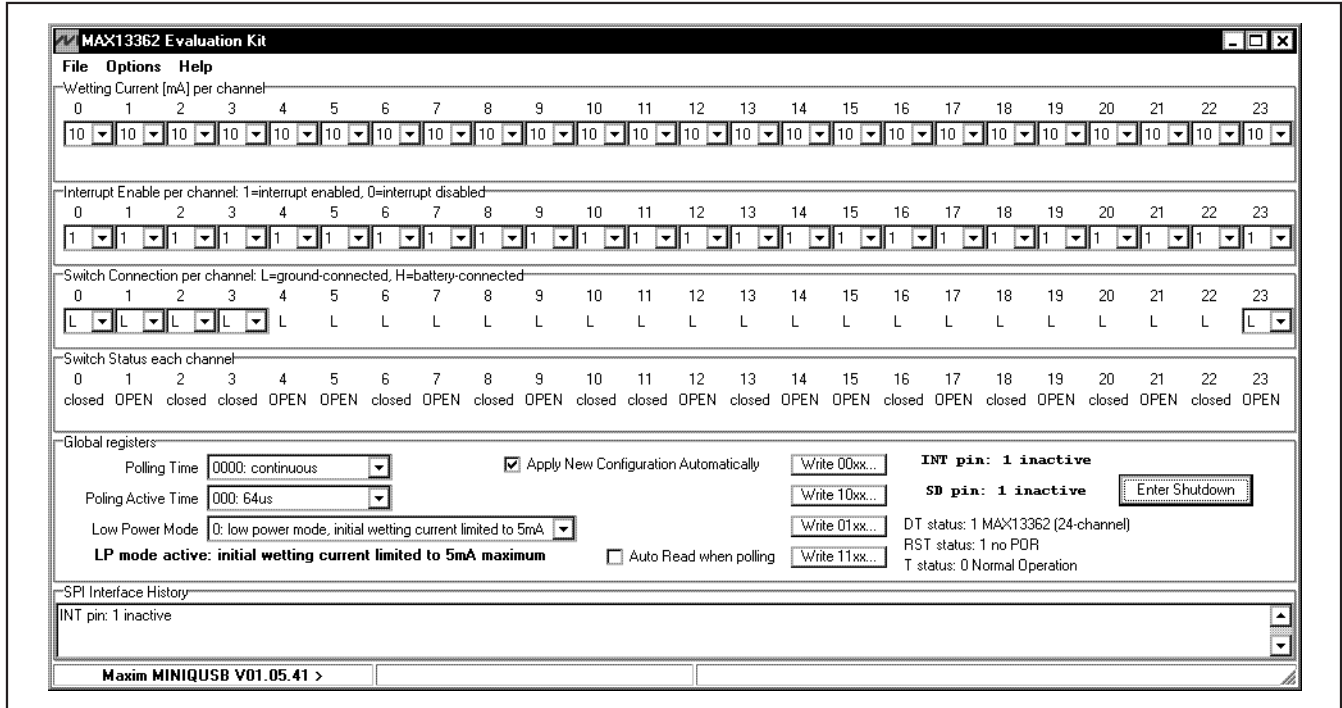


Figure 1. MAX13362 EV Kit Software Main Window

Evaluating Continuous Mode Operation—Conditional Read

When **Polling Time** is set to 0000 (continuous mode), the $\overline{\text{INT}}$ pin is actually used as a data-available status indicator. The software requests updated $\overline{\text{INT}}$ status by pulsing $\overline{\text{CS}}$ low and then high. The $\overline{\text{INT}}$ pin will go high in response to $\overline{\text{CS}}$ low logic level, and after $\overline{\text{CS}}$ returns high then $\overline{\text{INT}}$ will indicate whether new data is available. If $\overline{\text{INT}}$ is high, the software immediately knows that there has not been any change in the switches. However, if $\overline{\text{INT}}$ goes low in response to the $\overline{\text{CS}}$ low-to-high pulse, then the software drives $\overline{\text{CS}}$ low again and uses a standard 32-bit SPI transfer to read the updated status. This 32-bit transfer is repeated unless $\overline{\text{INT}}$ remains high after $\overline{\text{CS}}$ returns high.

Evaluating Polling Mode Operation

When **Polling Time** is not 0000, the $\overline{\text{INT}}$ pin conditions the standard 32-bit SPI transfer. When the $\overline{\text{INT}}$ pin is low, the software drives $\overline{\text{CS}}$ low and performs a 32-bit SPI transfer. If the $\overline{\text{INT}}$ pin is high, no transfer occurs.

Evaluating Hardware Shutdown

The software drives the $\overline{\text{SD}}$ pin low to drive the MAX13362 into hardware shutdown. Exiting shutdown requires driving $\overline{\text{SD}}$ high and also rewriting all three command words.

Detailed Description of Hardware

The MAX13362 EV kit provides a proven layout for the MAX13362. An on-board 3.3V LDO regulator, SPI interface pads, and easy-to-use USB-PC connection are included on the EV kit.

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Evaluates: MAX13362

Table 1. MAX13362 EV Kit Jumper Descriptions

JUMPER	SIGNAL	SHUNT POSITION	FUNCTION
JU1	EN	1-2*	Enable MAX15007 3.3V LDO
		2-3	Disable MAX15007 3.3V LDO
JU2	IN0	1-2*	Configure SW0 for low-side input
		Open	Configure SW0 for VBAT input
JU3	IN1	1-2*	Configure SW1 for low-side input
		Open	Configure SW1 for VBAT input
JU4	IN2	1-2*	Configure SW2 for low-side input
		Open	Configure SW2 for VBAT input
JU5	IN3	1-2*	Configure SW3 for low-side input
		Open	Configure SW3 for VBAT input
JU6	IN23	1-2*	Configure SW23 for low-side input
		Open	Configure SW23 for VBAT input
JU7	SWGND	1-2*	Connects switch ground SWGND to ground
		Open	Use external connection for switch ground return
JU8	VDD	1-2*	U1 VDD is powered by U2 MAX15007 3.3V LDO
		Open	An external supply must be connected to VDD
JU9	U2 IN	1-2*	Power U2 MAX15007 from external battery supply VS
		Open	Disconnect U2 MAX15007 from battery supply VS. An external supply must be connected to VDD (header J2, pin 5).
J2	\overline{SD}	1-2*	Connects \overline{SD} to on-board 3.3V microcontroller
		Open	External microcontroller must connect to \overline{SD}
	DGND	3-4	DGND test points; spare shunt storage
		Open*	DGND test points; spare shunt storage
	VDD	5-6	Powers VDD from USB (U7 MAX8511) instead of battery supply. (Requires JU1 = 2-3 to disable U2 MAX15007.)
		Open*	VDD is independent from 3.3V microcontroller power supply. VDD must be powered by either U2 or by an external user-supplied power source. See the <i>User-Supplied SPI Interface</i> section
	SDI	7-8*	Connects SDI to on-board 3.3V microcontroller
		Open	External microcontroller must connect to SDI
	\overline{CS}	9-10*	Connects \overline{CS} to on-board 3.3V microcontroller
		Open	External microcontroller must connect to \overline{CS}
	SDO	11-12*	Connects SDO to on-board 3.3V microcontroller
		Open	External microcontroller must connect to SDO
	CLK	13-14*	Connects CLK to on-board 3.3V microcontroller
		Open	External microcontroller must connect to CLK
	\overline{INT}	15-16*	Connects \overline{INT} to on-board 3.3V microcontroller
		Open	External microcontroller must connect to \overline{INT}
	DGND	17-18*	DGND test points; spare shunt storage
		Open	DGND test points; spare shunt storage

*Default position.

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Power Supplies and Ground Returns

An external high-voltage battery (28VDC max) connects to the board through terminal block TB1. External 9VDC to 28VDC VBAT power must be provided for normal operation.

An on-board LDO regulator, MAX15007 (U2), supplies 3.3V power for the MAX13362 (U1). Input protection on VBAT consists of a series diode (D2) to protect against reverse polarity connection, and also a self-resetting polyfuse (F1) to protect against overcurrent faults.

Because the EV kit demonstrates the low quiescent current of the DUT, there is no other circuitry connected to VBAT besides U1 and its external 3.3V LDO regulator.

The USB interface powers on-board MINIQUSB-equivalent circuitry, providing the SPI interface to the software. Refer to the MINIQUSB User's Manual for a detailed description of the microcontroller circuit.

There are three ground returns. All switch returns SW0–SW23 connect to switch ground. The switch-associated capacitors connect to analog ground. The microcontroller and its associated circuitry connect to digital ground. Switch ground connects to analog ground through jumper JU7. Analog ground connects to digital ground through 0Ω SMT resistor R8.

Measuring Supply Current

There are three distinct ways to power the EV kit. The factory-default configuration uses an on-board low-dropout linear regulator (U2, MAX15007) to power U1 VDD from the battery. In this mode, the battery supply current is the sum of U1 VS load current, plus U1 VDD load current, plus the quiescent current of the MAX15007 (11μA nominal for 5μA load current). The MAX15007 can be shut down using jumper JU1. The on-board microcontroller is powered from the USB interface.

To power the EV kit using independent external VS and VDD supplies, remove the shunts from JU8 and JU9 (disconnecting the MAX15007 regulator). Connect the external VDD supply to header H2 pin 7. The on-board MAXQ2000 microcontroller is limited to 3.3V. For 5V VDD, see the *User-Supplied SPI Interface* section. Connect a DVM to J2 pin 5 to monitor the VDD supply at U1, and compensate for a possible current measurement voltage drop.

Finally, the EV kit can be configured to power VDD from the USB port, regulated by U3 MAX8511. In this mode, the battery current powers VS only, and VDD current is not measured.

Table 2. Jumper Configuration for Measuring Supply Current

SUPPLY CURRENT MEASUREMENT	U1 VDD SOURCE	JU1 SHUNT POSITION	JU8 SHUNT POSITION	JU9 SHUNT POSITION	J2 VDD SHUNT POSITION
Combined: I _{VS} = U1 VS current + U1 VDD current + U2 quiescent current	U2 MAX15007 LDO, powered by battery	1-2	1-2	1-2	Open
Independent: I _{VS} = U1 VS current I _{VDD} = U1 VDD current	External supply	2-3	Open	Open	Open
VS only: I _{VS} = U1 VS current I _{VDD} not measured	U3 MAX8511 LDO, powered by USB	2-3	Open	Open	1-2

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User-Supplied SPI Interface

To use the MAX13362 EV kit with a user-supplied SPI interface, first remove all shunts from J2. Next, apply an external 3.3V power supply to J2 pin 5 (VDD). Connect

external SPI \overline{CS} , SCLK, DIN, and DOUT signals to the corresponding \overline{CS} , CLK, SDO, and SDI test points on the MAX13362 EV kit board. See Table 3. Configure SPI for CPOL = 0, CPHA = 1, SCLK = 4MHz.

Table 3. Header J2 External SPI Bus Connections

J2 PIN	LABEL	MAX13362 SIGNAL	EXTERNAL CONNECTION
1	\overline{SD}	\overline{SD}	Shutdown input to MAX13362
3	DGND	DGND	Digital ground return
5	VDD	VDD	External 3.3V power supply
7	SDI	SDI	SPI data input to MAX13362, output from SPI master
9	\overline{CS}	\overline{CS}	SPI chip-select input to MAX13362
11	SDO	SDO	SPI data output from MAX13362, input to SPI master
13	CLK	CLK	SPI clock input to MAX13362
15	\overline{INT}	\overline{INT}	Interrupt output from MAX13362
17	DGND	DGND	Digital ground return

Evaluates: MAX13362

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Evaluates: MAX13362

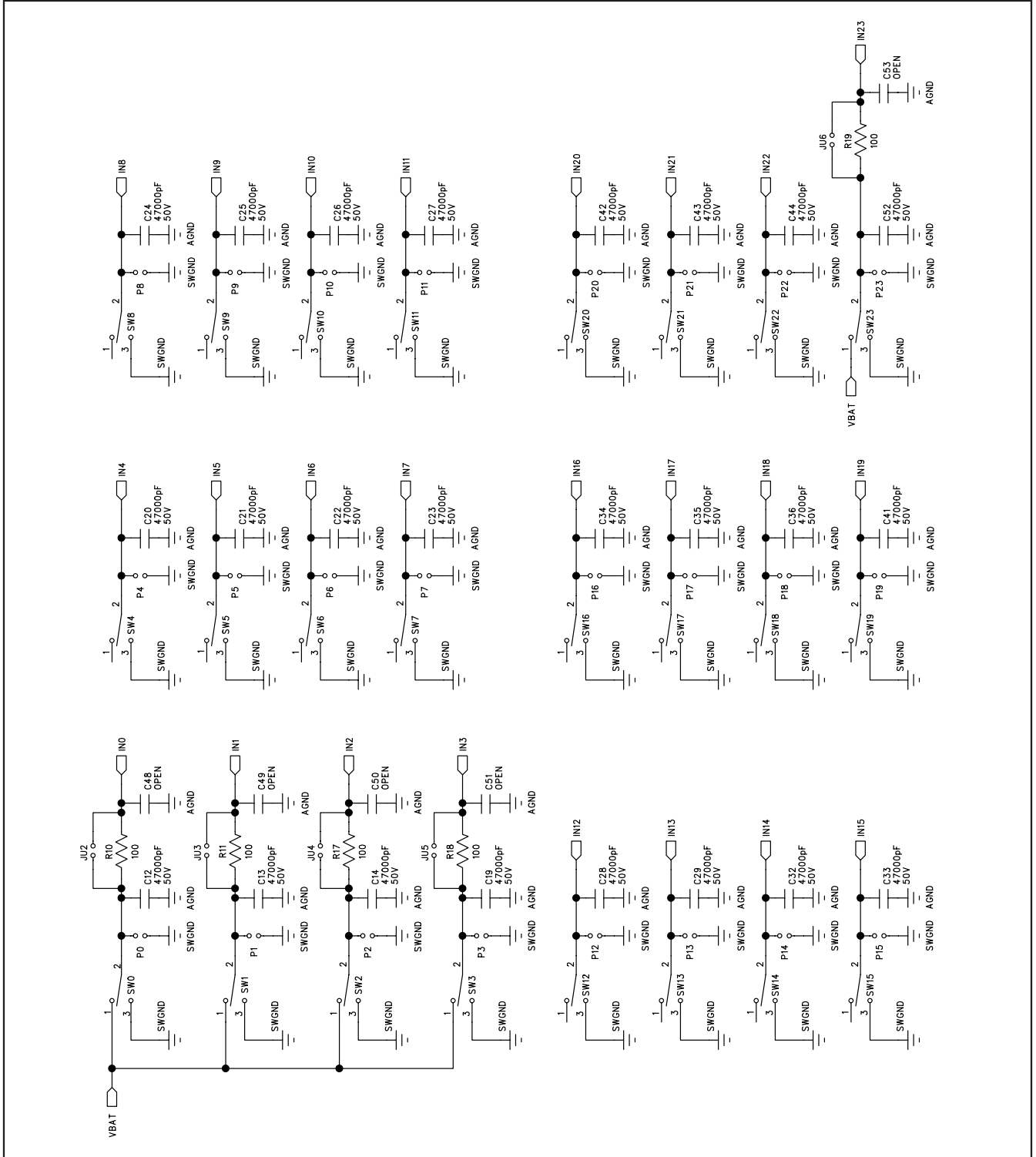
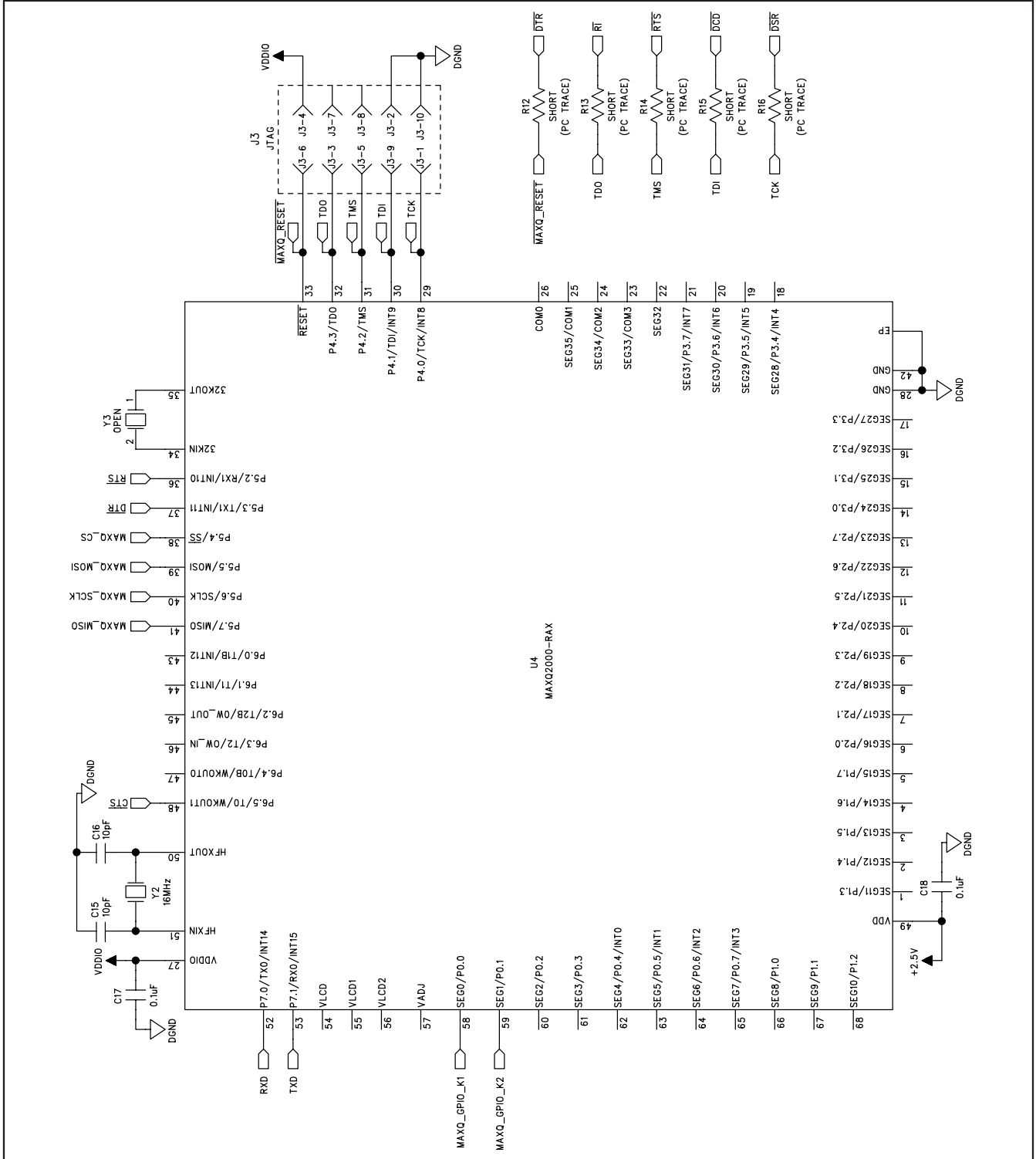


Figure 2b. MAX13362 EV Kit Schematic (Sheet 2 of 4)

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Evaluates: MAX13362

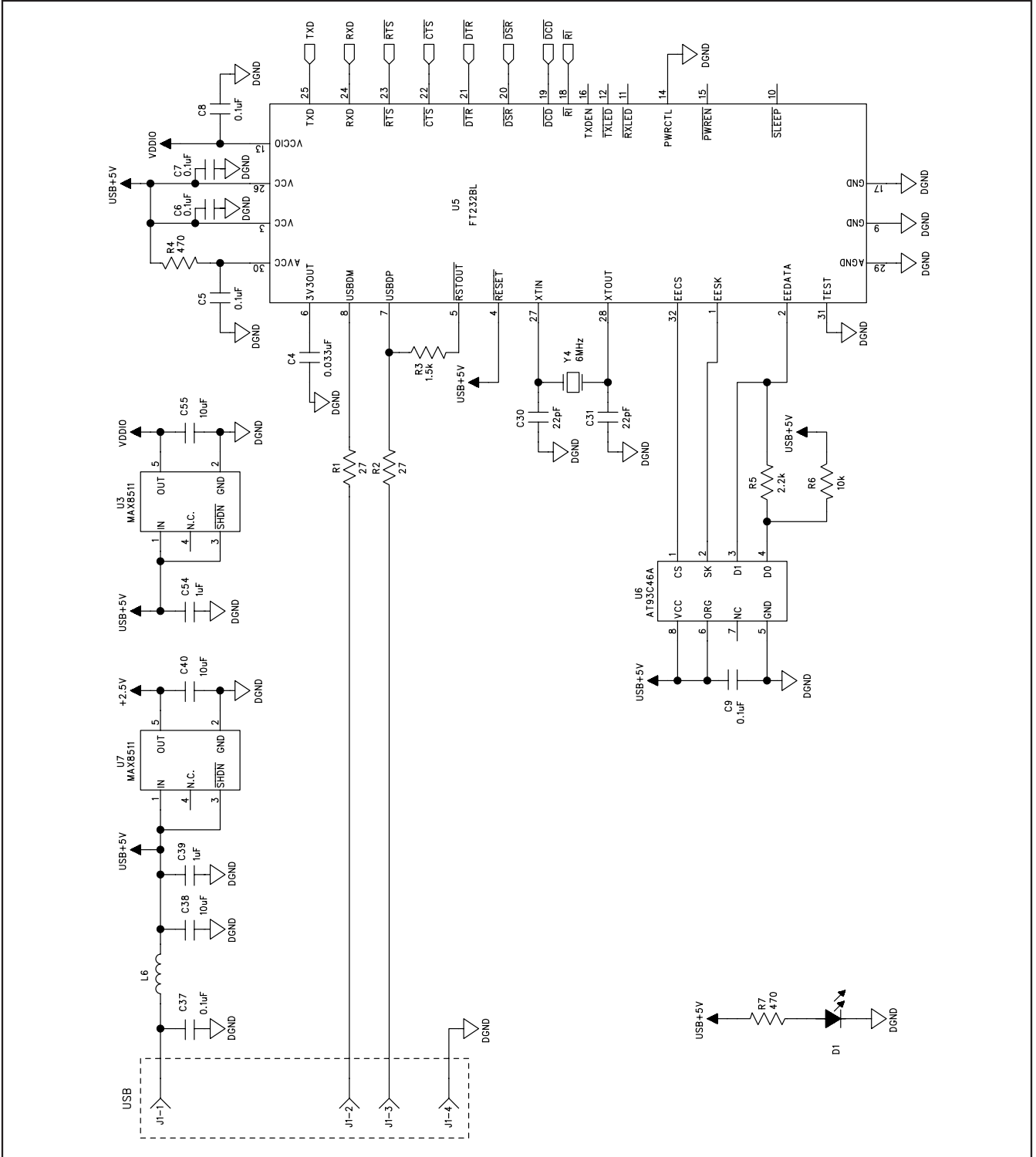


Figure 2d. MAX13362 EV Kit Schematic (Sheet 4 of 4)

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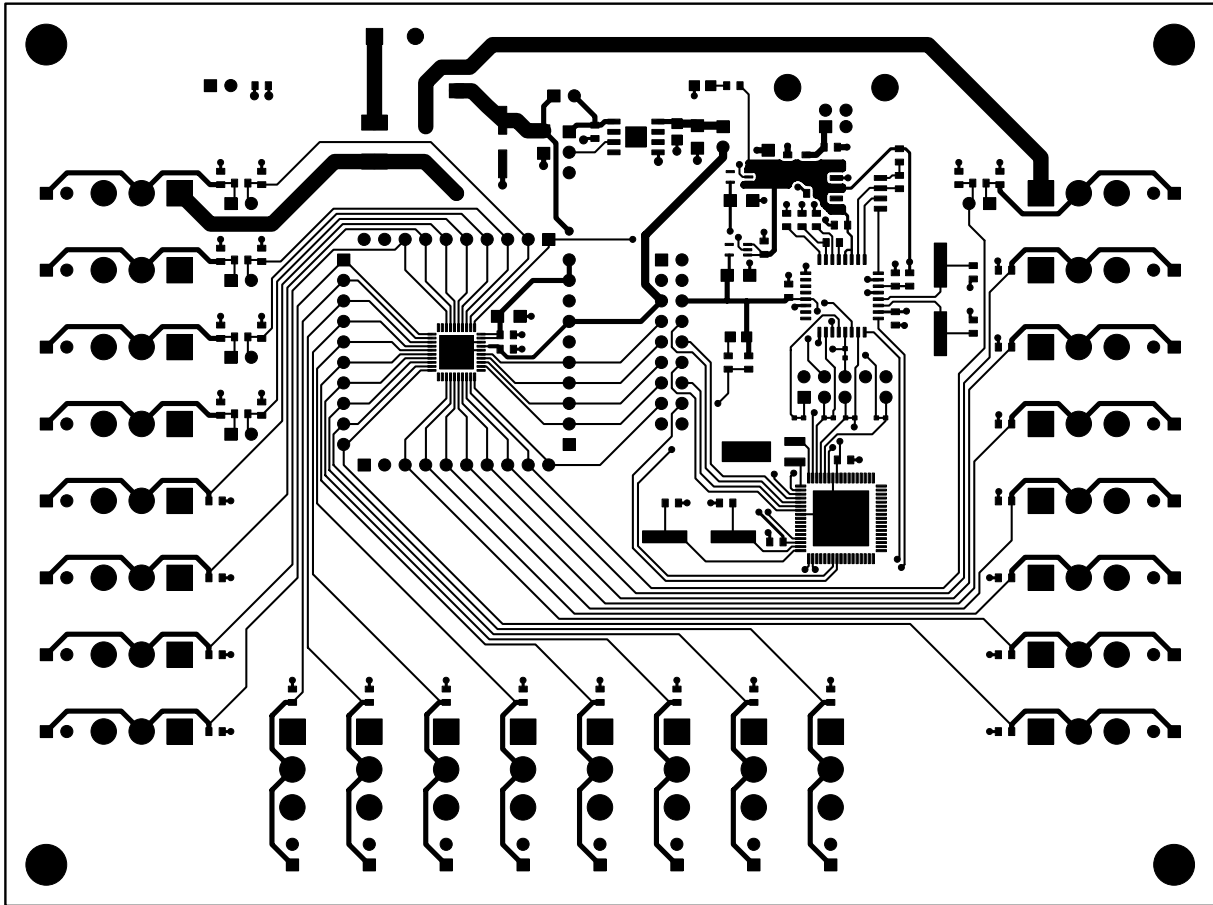


Figure 4. MAX13362 EV Kit PCB Layout—Component Side

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Evaluates: MAX13362

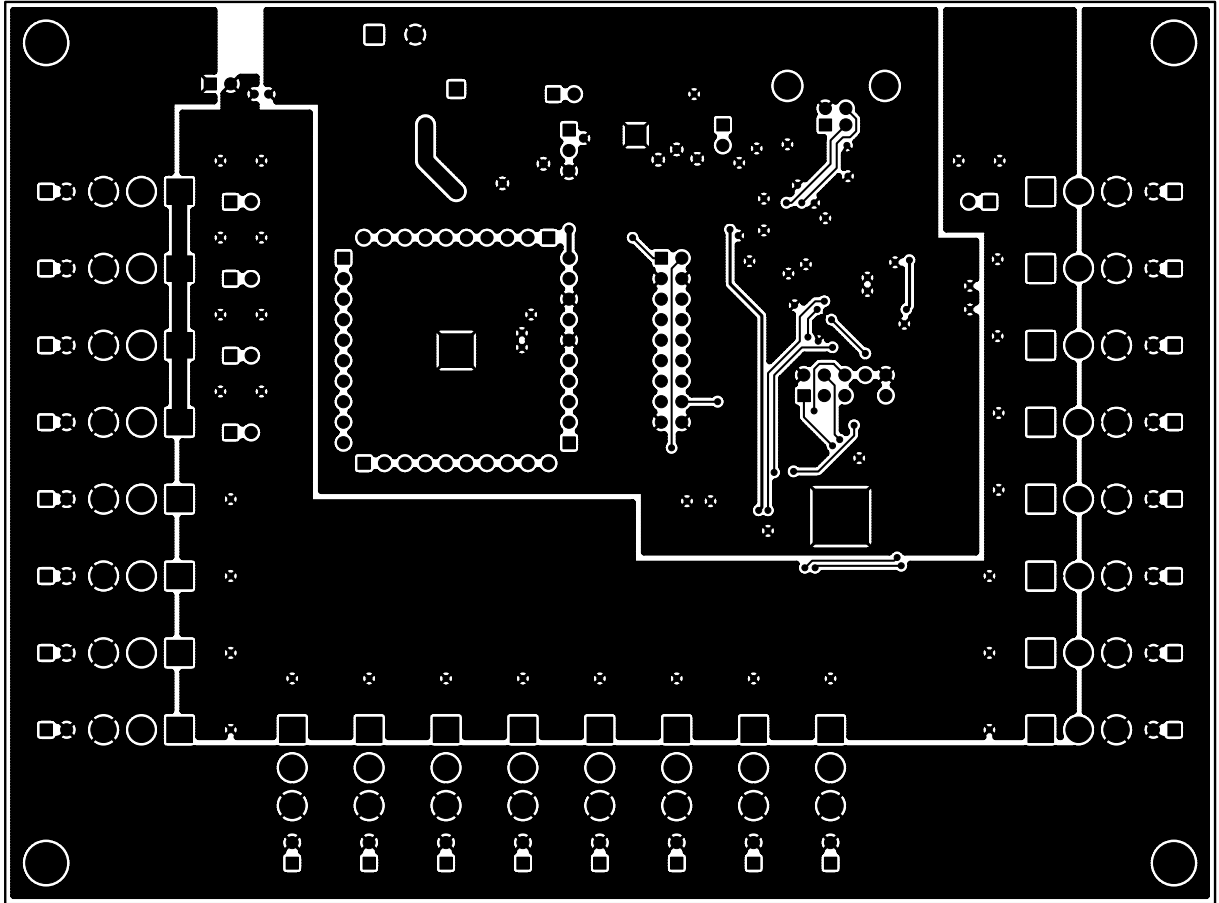


Figure 5. MAX13362 EV Kit PCB Layout—Solder Side

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