



MAX8901 Evaluation Kit

General Description

The MAX8901 evaluation kit (EV kit) is a fully assembled and tested printed-circuit board (PCB) that includes two circuits demonstrating the MAX8901A and the MAX8901B white LED (WLED) step-up DC-DC converters. Both circuits share a central WLED string and each circuit is selected by on-board jumper positions. The MAX8901B circuit includes a pushbutton circuit to provide single-wire serial-pulse dimming control for the MAX8901B IC. To evaluate the MAX8901A dimming control, an externally applied PWM signal is required. Both evaluation circuits operate from an input voltage of 2.6V to 5.5V and deliver up to 25mA (MAX8901A) or 24.75mA (MAX8901B) of regulated output current to drive from 2 to 6 series-connected WLEDs.

Ordering Information

PART	TYPE
MAX8901EVKIT+	EV Kit

+Denotes lead-free and RoHS-compliant.

Features

- ◆ Two Fully Assembled Circuits with Shared WLEDs
- ◆ Drives from 2 to 6 WLEDs
- ◆ Direct PWM (MAX8901A) or Single-Wire Serial Dimming Control (MAX8901B)
- ◆ On-Board Pushbutton for Single-Wire Serial Dimming Control (MAX8901B)
- ◆ Constant-Current Regulation for Uniform WLED Illumination
- ◆ High 87% WLED Efficiency
- ◆ 2.6V to 5.5V Input Range
- ◆ Input Overvoltage Lockout Protection (6.2V min)
- ◆ 25V (typ) Maximum Output with Overvoltage Protection
- ◆ Additional Input (VEXT_) for Powering WLEDs from a Separate Supply
- ◆ Small, Low-Profile Components
- ◆ Lead-Free and RoHS-Compliant
- ◆ Fully Assembled and Tested

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C5, C9, C10	4	1 μ F \pm 10%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A105K or equivalent
C2	1	1 μ F \pm 10%, 25V X5R ceramic capacitor (0603) TDK C1608X5R1E105M Murata GRM188R61E105K or equivalent
C3, C7, C12	3	0.022 μ F \pm 10%, 10V X5R ceramic capacitors (0402) Murata GRM155R61A223K or equivalent
C4, C8	0	Not installed, capacitors (0603)
C6	1	0.1 μ F \pm 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H104K or equivalent
C11, C13, C14	3	0.1 μ F \pm 10%, 10V X5R ceramic capacitors (0402) TDK C1005X5R1A104K or equivalent
D1, D8	2	40V, 500mA Schottky diodes (SOD323) Central Semiconductor CMDSH05-4, lead free
D2-D7	6	White LEDs Nichia NSCW215T

DESIGNATION	QTY	DESCRIPTION
JU1, JU2, JU4	3	3-pin headers Sullins PEC36SAAN (36-pin strip, cut to size as needed) Digi-Key S1012E-02-ND
JU3, JU5	2	2-pin headers Sullins PEC36SAAN (36-pin strip, cut to size as needed) Digi-Key S1012E-02-ND
JU6, JU7, JU8	0	Not installed, PCB connections—shorted (0402)
L1, L2	2	22 μ H, 470mA inductors TOKO 1069AS-220M
R1, R4	0	Not installed, resistors—PCB short (0402)
R2, R5, R6	3	100k Ω \pm 1% resistors (0402)
R3	1	20 Ω \pm 1% resistor (0402)
R7, R8	2	10k Ω \pm 1% resistors (0402)
R9	1	221k Ω \pm 1% resistor (0402)
S1	1	Momentary pushbutton switch Panasonic EVQ-PHP03T
U1	1	Maxim WLED step-up converter MAX8901BETA+ (8-pin TDFN, 2mm x 2mm)

Evaluates: MAX8901A/MAX8901B



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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U2	1	Maxim WLED step-up converter MAX8901AETA+ (8-pin TDFN, 2mm x 2mm)
U3	1	Maxim low-dropout linear regulator MAX8875EUK25+ (5-pin SOT23)
U4	1	74HC series monostable multivibrator Texas Instruments CD74HC123PW or equivalent
—	5	Shunts, 2 position

Quick Start

Recommended Equipment

Before beginning, the following equipment is needed:

- One variable DC power supply capable of supplying 2.6V to 5.5V at 500mA.
- For MAX8901A dimming-control evaluation: One logic-level PWM signal generator with variable duty cycle at a frequency between 30kHz and 100kHz is required.

MAX8901B Evaluation Procedure

The MAX8901 EV kit is fully assembled and tested and is configured for the MAX8901B evaluation circuit by default. Follow the steps below to verify operation of the

MAX8901B circuit. **Caution: Do not turn on the power supply until all connections are completed.**

- 1) Verify that a shunt is installed across pins 1-3 of jumper JU4 to enable the pushbutton circuit.
- 2) Verify that a shunt is installed on jumper JU5 to connect the pulse-generating circuit to the MAX8901B IC.
- 3) Verify that a shunt is installed from pins 1-3 of jumpers JU1 and JU2 to configure the WLED string for the MAX8901B circuit.
- 4) Preset the power-supply voltage between 2.6V and 5.5V.
- 5) Turn the power supply off. **Do not turn on the power supply until all connections are completed.**
- 6) Connect the positive terminal of the power supply to the VINB pad located on the EV kit. Connect the negative terminal of the power supply to the GNDB pad located on the EV kit. Note that the GNDA and GNDB pads are isolated from each other.
- 7) Turn on the power supply. Verify that the WLEDs are brightly lit.
- 8) Dim the WLEDs in 0.75mA steps by repeatedly pressing pushbutton S1. Verify that the WLEDs dim and return to full brightness on the 33rd button press. See Table 1 for ILED steps.
- 9) Verify that the WLEDs turn off by removing the shunt from jumper JU5.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centrasemi.com
Digi-Key Corp.	800-344-4539	www.digikey.com
Murata Mfg. Co., Ltd.	770-436-1300	www.murata.com
Nichia Corp.	248-349-9800	www.nichia.com
Panasonic Corp.	800-211-7262	www.panasonic.com
Sullins Electronics Corp.	760-744-0125	www.sullinselectronics.com
TDK Corp.	888-835-6646	www.component.tdk.com
Texas Instruments Inc.	972-644-5580	www.ti.com
TOKO	408-432-8281	www.toko.com

Note: Indicate that you are using the MAX8901A/MAX8901B when contacting these component suppliers.

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Evaluates: MAX8901A/MAX8901B

Table 1. MAX8901B WLED Current Steps

S1 PUSHBUTTON PRESS*	I _{LED} (mA)		S1 PUSHBUTTON PRESS*	I _{LED} (mA)
0	24.75		17	12.00
1	24.00		18	11.25
2	23.25		19	10.50
3	22.50		20	9.75
4	21.75		21	9.00
5	21.00		22	8.25
6	20.25		23	7.50
7	19.50		24	6.75
8	18.75		25	6.00
9	18.00		26	5.25
10	17.25		27	4.50
11	16.50		28	3.75
12	15.75		29	3.00
13	15.00		30	2.25
14	14.25		31	1.50
15	13.50		32	0.75
16	12.75		33**	24.75

*Referenced from I_{LED} = 24.75mA.

**WLED current rolls over to 24.75mA (step 0) on the 33rd step.

MAX8901A Evaluation Procedure

The MAX8901 EV kit is fully assembled and tested and is configured for the MAX8901B evaluation circuit by default. Follow the steps below to verify operation of the MAX8901A circuit. Ensure that the power supply to the MAX8901B evaluation circuit is removed. **Caution: Do not turn on the power supply until all connections are completed.**

- 1) Configure the MAX8901 EV kit for the MAX8901A evaluation circuit by installing a shunt from pins 2-3 on jumpers JU1 and JU2.
- 2) Preset the power-supply voltage between 2.6V and 5.5V.
- 3) Turn the power supply off. **Do not turn on the power supply until all connections are completed.**
- 4) Connect the positive terminal of the power supply to the VINA pad located on the EV kit. Connect the negative terminal of the power supply to the GNDA pad located on the EV kit. Note that the GNDA and GNDB pads are isolated from each other.
- 5) Preset the PWM signal generator frequency between 30kHz and 100kHz. Set the PWM duty cycle to 100% and the PWM high voltage between 1.5V and V_{VINA}. Turn the PWM signal generator output off.

- 6) Connect the positive lead of the PWM signal generator to the ONA pad. Connect the negative lead of the PWM signal generator to the GNDA pad.
- 7) Turn on the power supply. The WLEDs should not be illuminated.
- 8) Turn on the PWM signal generator output. Verify that the WLEDs are brightly illuminated.
- 9) Decrease the PWM duty cycle to 10%. Verify that the WLEDs dim.
- 10) Set the PWM duty cycle to 0% or turn off the PWM signal generator. Verify that the WLEDs turn off.

Detailed Description

The MAX8901 evaluation kit (EV kit) is a fully assembled and tested PCB that demonstrates the MAX8901_ white LED (WLED) step-up DC-DC converters. The EV kit includes two MAX8901 evaluation circuits to demonstrate the MAX8901A (PWM dimming) and the MAX8901B (single-wire serial dimming). The MAX8901A and the MAX8901B circuits share WLEDs to minimize parts count, and either circuit is selectable by jumper configuration. The EV kit is configured for the MAX8901B circuit by default. To configure the EV kit for the MAX8901A circuit, see the *MAX8901A Evaluation*

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Circuit section. When correctly configured, each MAX8901 circuit is isolated from each other. Ensure that VINB and GNDB are used when evaluating the MAX8901B, and that VINA and GNDA are used when evaluating the MAX8901A.

The MAX8901_ feature an internal soft-start that gradually illuminates the WLEDs to eliminate inrush current during startup, input overvoltage protection (6.5V max) that prevents IC switching when the input voltage becomes too high, WLED overvoltage protection (25V typ) that latches off the IC when a WLED open-circuits, and a shutdown mode that reduces current to 0.01 μ A (typ). No WLED current is present in shutdown or during an overvoltage condition if the WLED string forward voltage is greater than the input supply voltage.

MAX8901B Evaluation Circuit

The MAX8901 EV kit is configured for the MAX8901B circuit by the default jumper configuration. Ensure that a shunt is installed between pins 1-3 of jumpers JU1 and JU2 to use the MAX8901B circuit. Ensure that the input power supply is connected between VINB and GNDB pads on the EV kit. Alternatively, the WLEDs can be supplied from a separate power supply using the VEXTB pad. See the *Using an External Supply for the WLEDs* section for more details. See Table 2 for jumper configurations.

Pushbutton S1 and associated circuitry (Figure 1) provide the single-wire serial-pulse interface to program the MAX8901B WLED current. To enable the pushbutton interface, install a shunt from pins 1-3 on jumper JU4. Install a shunt on jumper JU5 to connect the pushbutton circuit to the MAX8901B IC ON terminal.

Table 2. Jumper Configurations

JUMPER	POSITION	FUNCTION
JU1	1-3	Connects the MAX8901B to the anode side of the WLED string. Ensure that a shunt is installed on pins 1-3 of jumper JU1 to use the MAX8901B circuit.
	2-3	Connects the MAX8901A to the anode side of the WLED string. Ensure that a shunt is installed on pins 2-3 of jumper JU1 to use the MAX8901A circuit.
JU2	1-3	Connects the MAX8901B to the cathode side of the WLED string. Ensure that a shunt is installed on pins 1-3 of jumper JU2 to use the MAX8901B circuit.
	2-3	Connects the MAX8901A to the cathode side of the WLED string. Ensure that a shunt is installed on pins 2-3 of jumper JU2 to use the MAX8901A circuit.
JU3	Installed	Shorts out WLEDs D2 and D3 for 4 WLED operation.
	Removed	Configures on-board WLED string for 6 WLED operation.
JU4	1-3	Enables the serial-pulse pushbutton circuit for the MAX8901B.
	2-3	Disables the serial-pulse pushbutton circuit.
JU5	Installed	Connects the serial-pulse pushbutton circuit to the MAX8901B ON terminal.
	Removed	Disconnects the serial-pulse pushbutton circuit from the MAX8901B ON terminal.
JU6	Installed (PCB short)*	Connects MAX8901_ circuitry to the on-board WLEDs.
	Removed (open)	Disconnects MAX8901_ circuitry from on-board WLEDs for evaluation of external WLEDs. See the <i>Using an External Supply for the WLEDs</i> section for more details.
JU7	Installed (PCB short)*	Selects VINB to supply the WLEDs when using the MAX8901B circuit.
	Removed (open)	Selects VEXTB to supply the WLEDs when using the MAX8901B circuit. See the <i>Using an External Supply for the WLEDs</i> section for more details.
JU8	Installed (PCB short)*	Selects VINA to supply the WLEDs when using the MAX8901A circuit.
	Removed (open)	Selects VEXTA to supply the WLEDs when using the MAX8901A circuit. See the <i>Using an External Supply for the WLEDs</i> section for more details.

*Default position.

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Evaluates: MAX8901A/MAX8901B

When power is first applied to the MAX8901B, the WLEDs are set to maximum brightness (24.75mA). To dim the WLEDs, repeatedly press S1. Each pulse reduces the WLED current by 1/33 of maximum WLED current, corresponding to 0.75mA/step. On the 33rd button press, the WLEDs will return to full brightness. To turn the WLEDs off, remove the shunt from jumper JU5 to pull ONB to GNDB. If dimming control is not required, ONB works as a simple on/off control. Drive ONB high to enable the WLEDs, or drive ONB low for shutdown.

The serial-pulse dimming-control signal can be supplied by an external pulse generator. To configure the EV kit for external serial-pulse control, remove the shunt on jumper JU5 and apply the external serial-pulse control signal to the ONB pad. Refer to the MAX8901A/MAX8901B IC data sheet for timing information.

MAX8901A Evaluation Circuit

The MAX8901 EV kit comes configured for the MAX8901B circuit and requires only simple jumper manipulation to configure the board for MAX8901A evaluation. Ensure that a shunt is installed between pins 2-3 of jumpers JU1 and JU2 to use the MAX8901A circuit with on-board WLEDs. Ensure that the input power supply is connected between the VINA and GNDA pads on the EV kit. The WLEDs can also be supplied from a separate power supply by using the VEXTA pad. See the *Using an External Supply for the WLEDs* section for more details.

When the MAX8901A is enabled by driving ONA high, soft-start is engaged and brings WLED current to maximum brightness. Apply a direct PWM logic-level signal (30kHz min, 500kHz max) to ONA to dim the WLEDs. The MAX8901A converts the PWM signal to DC WLED current proportional to the PWM signal's duty cycle (0% duty cycle corresponds to zero WLED current and 100% duty cycle corresponds to full WLED current). If dimming control is not required, ONA works as a simple on/off control. Drive ONA high to enable the WLEDs, or drive ONA low for shutdown. Resistor R3 programs maximum I_{LED} (see the *Programming the MAX8901A WLED Current* section for details).

Input Overvoltage Lockout

When V_{IN} exceeds 6.2V (min), input overvoltage lockout (OVLO) is engaged to protect the MAX8901_ from high input-voltage conditions. Once input OVLO occurs, the MAX8901_ stops switching and no WLED current flows, provided the forward voltage of the WLED string is greater than V_{IN}. When V_{IN} then falls below 6V (min), the input OVLO condition is cleared, the IC is enabled, and then enters soft-start.

WLED Overvoltage Protection

WLED overvoltage protection (OVP) occurs when the WLED output voltage rises above the WLED OVP threshold (25V typ). The WLED OVP circuitry latches off the IC when the WLED OVP threshold is exceeded. After OVP has occurred, cycle V_{IN} or toggle V_{ON} to reenable the IC and enter soft-start.

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Customizing the MAX8901 EV Kit

Using an External Supply for the WLEDs

The MAX8901 EV kit can be configured to use a separate power source to supply the WLEDs. The MAX8901 IC will remain powered from the respective VIN_ pad on the EV kit. To use an external power supply for the WLEDs, perform the following procedure for the MAX8901A (MAX8901B) circuit:

- 1) Cut the trace shorting jumper JU8 (JU7).
- 2) Install a 1 μ F capacitor in the C8 (C4) pads.
- 3) Connect a 13.2V (max) WLED supply from VEXTA (VEXTB) to GNDA (GNDB). The maximum recommended external input voltage is 2.2V per series WLED. For example, the maximum external input voltage to drive a 4-series WLED string is 8.8V.

Programming the MAX8901A WLED Current

The MAX8901A uses a sense resistor (R3) to program the maximum WLED current for 100% PWM duty cycle. The MAX8901A regulates V_{R3} to 0.5V (typ) for full-scale output current. Calculate R3 (in ohms) using the following equation:

$$R3 = \frac{500}{I_{LED(MAX)}}$$

where $I_{LED(MAX)}$ is the maximum WLED current in milliamps. Maximum WLED current is programmed to 25mA using a 20 Ω resistor.

The MAX8901B maximum WLED current is not adjustable.

Configuring the MAX8901 EV Kit for 4 WLED Operation

The MAX8901 EV kit is easily configured for 4 WLED applications. To configure for 4 WLED operation, install jumper JU3 to short out WLEDs D2 and D3.

Using Off-Board WLEDs

The MAX8901 EV kit can be configured to supply an off-board WLED string comprising 2 to 6 WLEDs. To supply an off-board WLED string, use the following procedure:

- 1) Cut the trace shorting jumper JU6.
- 2) Connect the anode of the external WLED string to the LED+ pad.
- 3) Connect the cathode of the external WLED string to the LED- pad.

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Evaluates: MAX8901A/MAX8901B

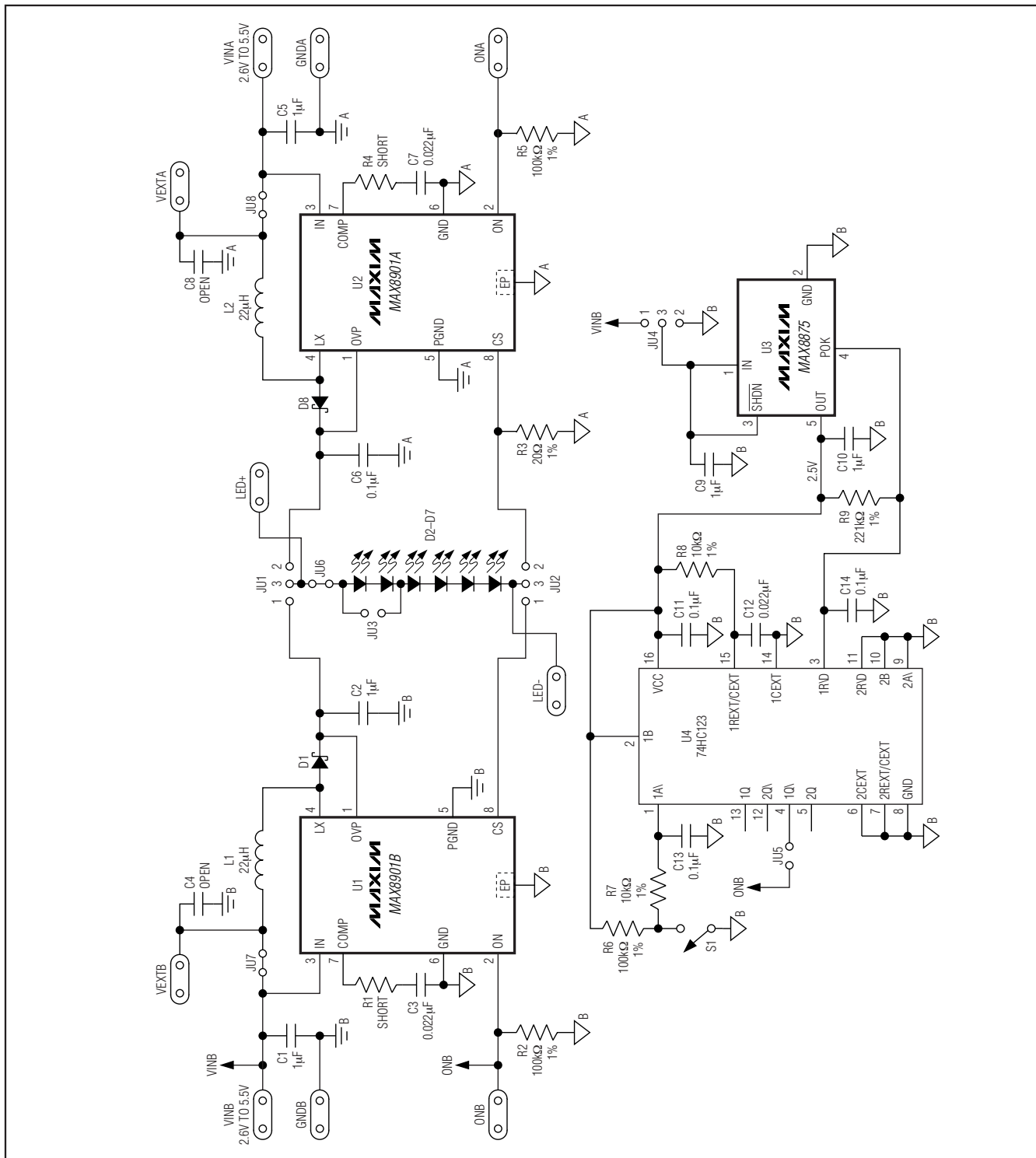


Figure 1. MAX8901 EV Kit Schematic

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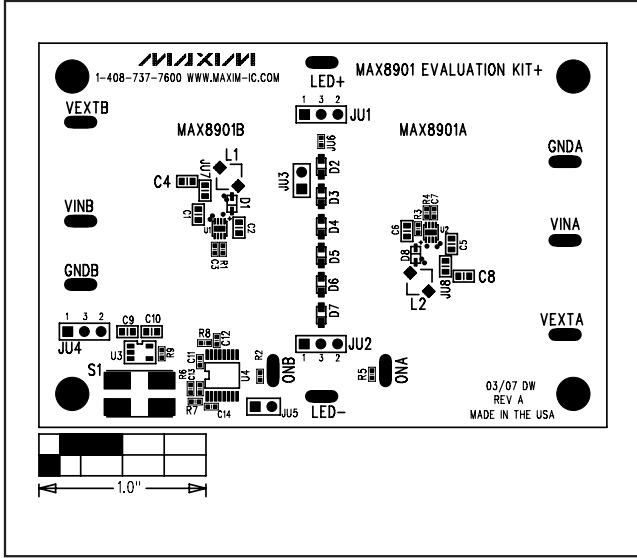


Figure 2. MAX8901 EV Kit Component Placement Guide—Top Silkscreen

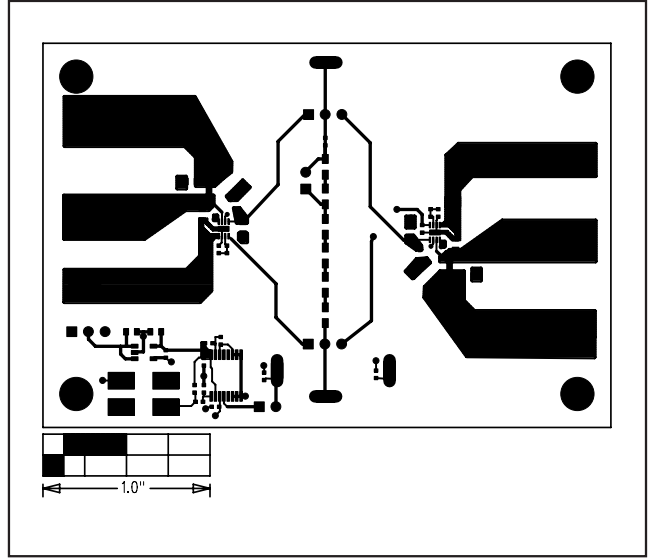


Figure 3. MAX8901 EV Kit PCB Layout—Component Side

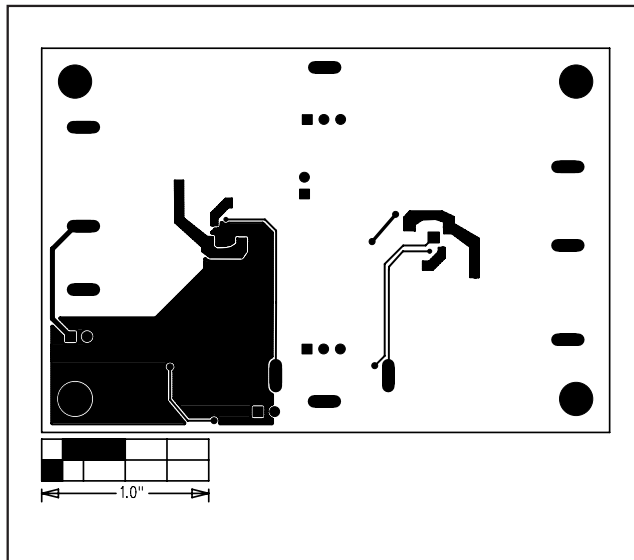


Figure 4. MAX8901 EV Kit PCB Layout—Solder Side

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