

MAX17019 Evaluation Kit

Evaluates: MAX17019

General Description

The MAX17019 evaluation kit (EV kit) presents the MAX17019 high input-voltage quad-output controller in a typical application setup. The EV kit operates from a 5.5V to 38V input range.

High-voltage controller A is used to generate a 5V rail that serves as supply for the other three rails. These rails are generated by two switching converters (rails B and C), and one push-pull linear regulator (rail D). The supplies for converters B and C and regulator D are accessible but must be less than 6V.

The MAX17019 also has an internal fixed 5V linear regulator capable of supplying 50mA. The EV kit operates at 0.5MHz (VOUTA and VOUTC) and at 1MHz switching frequency (VOUTB). The EV kit has superior line- and load-transient response.

Ordering Information

| PART | TYPE |
|----------------|--------|
| MAX17019EVKIT+ | EV Kit |

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

Features

- ◆ **5.5V to 38V Input Range with 42V Transient Capability**
- ◆ **Internal 5V Linear Regulator with 50mA Load Capability**
- ◆ **Output Voltages**
 - VOUTA: 5V Up to 4A Peak Current, Adjustable from 1V to 5.5V**
 - VOUTB: 3.3V Up to 2.5A Peak Current, Adjustable from 0.75V to 4V**
 - VOUTC: 1.2V Up to 4A Peak Current, Adjustable from 0.75V to 4V**
 - VOUTD: 2.5V Up to 2A Current, Adjustable from 0.5V to V_{IND}**
- ◆ **Four Power-Good LEDs Help Monitor the Output Voltages**
- ◆ **0.5MHz Switching Frequency (5V and 1.2V Outputs)**
- ◆ **1MHz Switching Frequency (3.3V Output)**
- ◆ **Independent Enable Inputs and Power-Good Outputs**
- ◆ **Overvoltage and Undervoltage Fault Protection**
- ◆ **Thermal-Fault Protection**
- ◆ **48-Pin (6mm x 6mm) Thin QFN Package**
- ◆ **Fully Assembled and Tested**

Component List

| DESIGNATION | QTY | DESCRIPTION |
|-------------------|-----|---|
| C1, C2 | 2 | 4.7µF ±10%, 50V X7R ceramic capacitors (1210) Murata GRM32ER71H475K AVX 12105C475KAT2A |
| C3 | 1 | 22µF, 50V aluminum electrolytic capacitor (6.3mm x 6mm) SANYO 50CE22KX |
| C4, C11, C20, C24 | 4 | 4.7µF ±10%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J475K Murata GRM188R60J475K |

| DESIGNATION | QTY | DESCRIPTION |
|--------------|-----|--|
| C5, C25, C33 | 3 | 1µF ±10%, 6.3V X5R ceramic capacitors (0402) TDK C1005X5R0J105K Taiyo Yuden JMK105BJ105MV Murata GRM155R60J105K |
| C6 | 1 | 1µF ±10%, 50V X7R ceramic capacitor (0805) Murata GRM21BR71H105K |

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

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Component List (continued)

| DESIGNATION | QTY | DESCRIPTION |
|--------------------|-----|---|
| C7, C17, C21, C29 | 4 | 0.1 μ F \pm 10%, 10V X5R ceramic capacitors (0402) TDK C1005X5R1A104K Taiyo Yuden LMK105BJ104KV Murata GRM155R60J104K |
| C8, C12, C13 | 0 | Not installed, ceramic capacitors (0402) |
| C9 | 1 | 150 μ F, 6.3V low-ESR capacitor (B case) SANYO 6TPE150MAZB NEC TOKIN PSLB0J157M(35) |
| C10, C32, C35 | 0 | Not installed, ceramic capacitors (B case) |
| C14 | 1 | 680pF \pm 10%, 50V X7R ceramic capacitor (0402) TDK C1005X7R1H681K Taiyo Yuden UMK105BJ681KW Murata GRM155R71H681K |
| C15, C28, C36, C37 | 0 | Not installed, ceramic capacitors (0805) |
| C16, C26, C34 | 3 | 10 μ F \pm 20%, 6.3V X5R ceramic capacitors (0805) TDK C2012X5R0J106M or Taiyo Yuden AMK212BJ106MG Murata GRM21BR60J106M |
| C18, C30 | 2 | 1000pF \pm 10%, 50V X7R ceramic capacitors (0402) TDK C1005X7R1H102K Taiyo Yuden UMK105BJ102KW Murata GRM155R71H102K |
| C19, C22 | 2 | 330 μ F, 4V low-ESR capacitors (D case) SANYO 4TPF330ML (12m Ω) NEC TOKIN PSLD0G337M(15) |
| C23 | 1 | 2200pF \pm 10%, 50V X7R ceramic capacitor (0402) TDK C1005X7R1H222K Taiyo Yuden UMK105BJ222KW Murata GRM155R71H222K |
| C27 | 1 | 10 μ F \pm 10%, 6.3V X5R ceramic capacitor (0805) TDK C2012X5R0J106K Murata GRM21BR60J106K |

| DESIGNATION | QTY | DESCRIPTION |
|-------------------------------|-----|--|
| C31 | 1 | 0.22 μ F \pm 10%, 10V X5R ceramic capacitor (0402) TDK C1005X5R0J224K Taiyo Yuden JMK105BJ224KV Murata GRM155R60J224K |
| C38 | 1 | 100nF \pm 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H104K Murata GRM188R71H104K |
| D1 | 1 | 250mA, 50V Schottky diode (SOT323) Central Semi CMSSH-3E |
| D2–D5 | 4 | Green surface-mount LEDs (0805) |
| JU1 | 1 | 4-pin header |
| L1 | 1 | 4.7 μ H, 7A, 20m Ω inductor (7mm x 7mm x 4mm) Würth 744311470 |
| L2 | 1 | 2.2 μ H, 13A, 11.5m Ω inductor (7mm x 7mm x 4mm) Würth 744311220 |
| L3 | 1 | 1 μ H, 6.8A, 14.2m Ω inductor (5.8mm x 6.2mm x 3mm) TOKO FDV0530-1R0M NEC TOKIN MPLC0525L1R0 |
| N1-A, N1-B | 2 | Dual 60V n-channel MOSFETs (8 SO) Fairchild HUFA76413DK8T |
| POKA–POKD, REFIND, SYNC, VTTR | 7 | Test points |
| R1 | 1 | 10 Ω \pm 5% resistor (0402) |
| R2, R21, R30, R31 | 4 | 0 Ω resistors (0402) |
| R3, R20, R24, R29 | 0 | Not installed, resistors (0402) |
| R4 | 0 | Not installed, resistor (0603) |
| R5 | 1 | 40.2k Ω \pm 1% resistor (0603) |
| R6, R8, R10, R22, R23 | 5 | 10k Ω \pm 1% resistors (0603) |
| R7 | 1 | 34k Ω \pm 1% resistor (0603) |
| R9 | 1 | 6.04k Ω \pm 1% resistor (0603) |
| R11–R14 | 4 | 100k Ω \pm 5% resistors (0402) |
| R15 | 1 | 16.5k Ω \pm 5% resistor (0402) |
| R16–R19 | 4 | 4.02k Ω \pm 5% resistors (0603) |

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Component Suppliers (continued)

| DESIGNATION | QTY | DESCRIPTION |
|-------------|-----|--|
| R25 | 1 | 51Ω ±5% resistor (0402) |
| R26 | 1 | 0.004Ω ±1% 1/4W resistor (1206) Vishay (Dale) WSL12064L000FEA |
| R27, R28 | 0 | Not installed, resistors—short (PC trace) (0612) |
| R32 | 1 | 82.5kΩ ±5% resistor (0402) |
| R33 | 1 | 1kΩ ±5% resistor (0603) |

| DESIGNATION | QTY | DESCRIPTION |
|-------------|-----|---|
| SW1 | 1 | 5-position, low-profile DIP switch |
| U1 | 1 | Quad output controller (48 TQFN-EP*) Maxim MAX17019ATM+ |
| — | 1 | PCB: MAX17019 EVALUATION KIT+ |

*EP = Exposed pad.

Component Suppliers

| SUPPLIER | PHONE | WEBSITE |
|--------------------------------|--------------|--------------------------|
| Central Semiconductor Corp. | 631-435-1110 | www.centralsemi.com |
| Fairchild Semiconductor | 888-522-5372 | www.fairchildsemi.com |
| Murata Americas | 770-436-1300 | www.murataamericas.com |
| NEC TOKIN America, Inc. | 408-324-1790 | www.nec-tokinamerica.com |
| SANYO NA Corp. | 619-661-6835 | www.sanyodevice.com |
| Taiyo Yuden | 800-348-2496 | www.t-yuden.com |
| TDK Corp. | 847-803-6100 | www.component.tdk.com |
| TOKO America, Inc. | 847-297-0070 | www.tokoam.com |
| Vishay | 402-563-6866 | www.vishay.com |
| Würth Elektronik GmbH & Co. KG | 201-785-8800 | www.we-online.com |

Note: Indicate that you are using the MAX17019 when contacting these component suppliers.

Quick Start

Recommended Equipment

- MAX17019 EV kit
- 5.5V to 38V DC power supply
- Four digital multimeters (DMMs)
- 100MHz dual-trace oscilloscope

Procedure

The MAX17019 EV kit is a fully assembled and tested surface-mount board. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

- 1) Ensure that the circuit is connected correctly to the power supply and dummy loads prior to applying any power.
- 2) Set SW1 (1, 10) to the off position ($\overline{\text{SHDN}} = \text{VBATT}$, MAX17019 disabled).
Set SW1 (2, 9) to the on position (ONA = VDD, VOUTA enabled).
Set SW1 (3, 8) to the on position (ONB = VDD, VOUTB enabled).

Set SW1 (4, 7) to the on position (ONC = VDD, VOUTC enabled).

Set SW1 (5, 6) to the on position (OND = VDD, VOUTD enabled).

- 3) Connect the first DMM across the VOUTA and GND pads.
- 4) Connect the second DMM across the VOUTB and GND pads.
- 5) Connect the third DMM across the VOUTC and GND pads.
- 6) Connect the fourth DMM across the VOUTD and GND pads.
- 7) Turn on the power supply and adjust input voltage to 12V.
- 8) Set SW1 (1, 10) to the on position ($\overline{\text{SHDN}} = \text{VBATT}$, MAX17019 activated).
- 9) All LEDs should be lit; verify that the output voltages are VOUTA = 5V, VOUTB = 3.3V, VOUTC = 1.2V, and VOUTD = 2.5V.

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Troubleshooting

Output Rails Do Not Come Up

The MAX17019 output rails incorporate undervoltage shutoff and stay off until the corresponding ON_ switch is toggled. Make sure the supplies to the rails are high enough to allow it to regulate. Also check if the current limit on the power supply is set high enough for the initial startup current spike.

Current Capability Seems Too Low

The current capability listed in the data sheet is the peak ripple current. DC current may be 30% lower. If the supply rails are cascaded, allow for lower external load currents. Also check the current limit on the power supply.

Load Regulation Seems Low

The control algorithm in the MAX17019 utilizes a load-line architecture. This architecture improves stability and step response at the cost of a weaker load response. It may be necessary to set the output voltage higher to fulfill accuracy requirements.

Detailed Description of Hardware

5V Output-Voltage Setting (VOUTA)

The MAX17019 EV kit is shipped with FBA connected to resistors R5 and R6, which sets the VOUTA voltage to 5V.

To change the output voltage to a value between 1V and 5.5V, remove R5. Calculate R5 using the following equation:

$$R5 = R6 \times \left(\frac{V_{OUTA}}{V_{FBA}} - 1 \right)$$

where $V_{FBA} = 1V$ and $R6 = 10k\Omega \pm 1\%$. For an output voltage of 1V, place a short across R5 and leave R6 open.

3.3V Output-Voltage Setting (VOUTB)

The MAX17019 EV kit is shipped with FBB connected to resistors R7 and R8, which sets the VOUTB voltage to 3.3V.

To change the output voltage to a value between 0.75V and 4V, remove R7. Calculate R7 using the following equation:

$$R7 = R8 \times \left(\frac{V_{OUTB}}{V_{FBB}} - 1 \right)$$

where $V_{FBB} = 0.75V$ and $R8 = 10k\Omega \pm 1\%$. For an output voltage of 0.75V, place a short across R7 and leave R8 open.

1.2V Output-Voltage Setting (VOUTC)

The MAX17019 EV kit is shipped with FBC connected to resistors R9 and R10, which sets the VOUTC voltage to 1.2V.

To change the output voltage to a value between 0.75V and 4V, remove R9. Calculate R9 using the following equation:

$$R9 = R10 \times \left(\frac{V_{OUTC}}{V_{FBC}} - 1 \right)$$

where $V_{FBC} = 0.75V$ and $R10 = 10k\Omega \pm 1\%$. For an output voltage of 0.75V, place a short across R9 and leave R10 open.

2.5V Output-Voltage Setting (VOUTD)

The MAX17019 EV kit is shipped with FBD connected to resistors R22 and R23, which sets the VOUTD voltage to 2.5V. The voltage at FBD tracks the REFIND voltage, which is pulled up to the 1.25V reference output voltage VREF through resistor R33.

To change the VOUTD output voltage to a value between 0.5V and V_{IND} , remove R22. Calculate R22 using the following equation:

$$R22 = R23 \times \left(\frac{V_{OUTD}}{V_{FBD}} - 1 \right)$$

where $V_{FBD} = V_{REFIND} = 1.25V$ and $R23 = 10k\Omega \pm 1\%$.

Make sure the internal losses $P_{REGD} = (V_{IND} - V_{OUTD}) \times I_{OUTD}$ do not violate the thermal limits of the IC (refer to the MAX17019 IC data sheet).

Independent Enable Inputs and Power-Good Outputs

Separate enable inputs and independent open-drain power-good outputs allow flexible power sequencing. Switch SW1 is provided to control the ONA-OND enable inputs and the SHDN input. Table 1 summarizes SW1's function.

To display which of the outputs are in regulation, power-good LED indicators D2-D5 are also provided.

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Table 1. Switch SW1 Settings

| SW1 | | PIN CONTROL | MAX17019 OUTPUT |
|-------|-----|--|--|
| SW1-A | Off | $\overline{\text{SHDN}}$ pin is connected to GND | Shutdown mode (all outputs disabled) |
| | On | $\overline{\text{SHDN}}$ pin is connected to VBATT | MAX17019 enabled (all outputs depend on SW1 position settings) |
| SW1-B | Off | ONA pin is connected to GND | Disables VOUTA, VOUTA = 0V |
| | On | ONA pin is connected to VDD | Enables VOUTA, VOUTA = 5V |
| SW1-C | Off | ONB pin is connected to GND | Disables VOUTB, VOUTB = 0V |
| | On | ONB pin is connected to VDD | Enables VOUTB, VOUTB = 3.3V |
| SW1-D | Off | ONC pin is connected to GND | Disables VOUTC, VOUTC = 0V |
| | On | ONC pin is connected to VDD | Enables VOUTC, VOUTC = 1.2V |
| SW1-E | Off | OND pin is connected to GND | Disables VOUTD, VOUTD = 0V |
| | On | OND pin is connected to VDD | Enables VOUTD, VOUTD = 2.5V |

Note: As configured, the MAX17019 EV kit is shipped with all SW1 settings in the off position.

Frequency Selection (FREQ)

The switching frequency of the MAX17019 kit can be adjusted by removing resistor R24 and installing a short across resistors R20 or R21. As configured, the MAX17019 EV kit operates at 0.5MHz (VOUTA and VOUTC) and at 1MHz switching frequency (VOUTB). When changing the switching frequency, refer to the MAX17019 IC data sheet for the proper component selections and calculations for the inductors and output capacitors.

Table 2. Switching-Frequency Selection

| FREQ PIN | SWITCHING FREQUENCY | | |
|--|---------------------|--------|--------|
| | VOUTA | VOUTB | VOUTC |
| Connected to VDD through open resistor R24 | 250kHz | 500kHz | 250kHz |
| Connected to REF through open resistor R20 | 375kHz | 750kHz | 375kHz |
| Connected to GND through 0Ω resistor R21* | 500kHz | 1MHz | 500kHz |

*Default position.

Table 3. Jumper JU1 Functions

| SHUNT POSITION | IND CONNECTS TO REGULATOR |
|----------------|---|
| 1-2* | VOUTA |
| 1-3 | VOUTB |
| 1-4 | VOUTC (only for custom setups with VOUTC > VOUTD) |

*Default position.

Source/Sink Linear-Regulator Input (IND)

The MAX17019 EV kit includes a jumper (JU3) to select which of the step-down switching regulators (VOUTA–VOUTC) powers the push-pull linear regulator (VOUTD).

By default, the 2.5V VOUTD output stage is powered from the IND input when a shunt is installed across jumper JU1 pins 1-2 or pins 1-3, but not pins 1-4.

A user may want to set up VOUTC to 2.5V and VOUTD to 1.25V for DDR RAM use. VOUTC can be set for 2.5V using the equation from the *1.2V Output-Voltage Setting (VOUTC)* section. For DDR RAM applications, VOUTD can also track the REFIND voltage to provide a 1.25V output. Remove R23 and replace R22 with a 0Ω resistor. Under these two cases, JU1 may be configured to all three settings.

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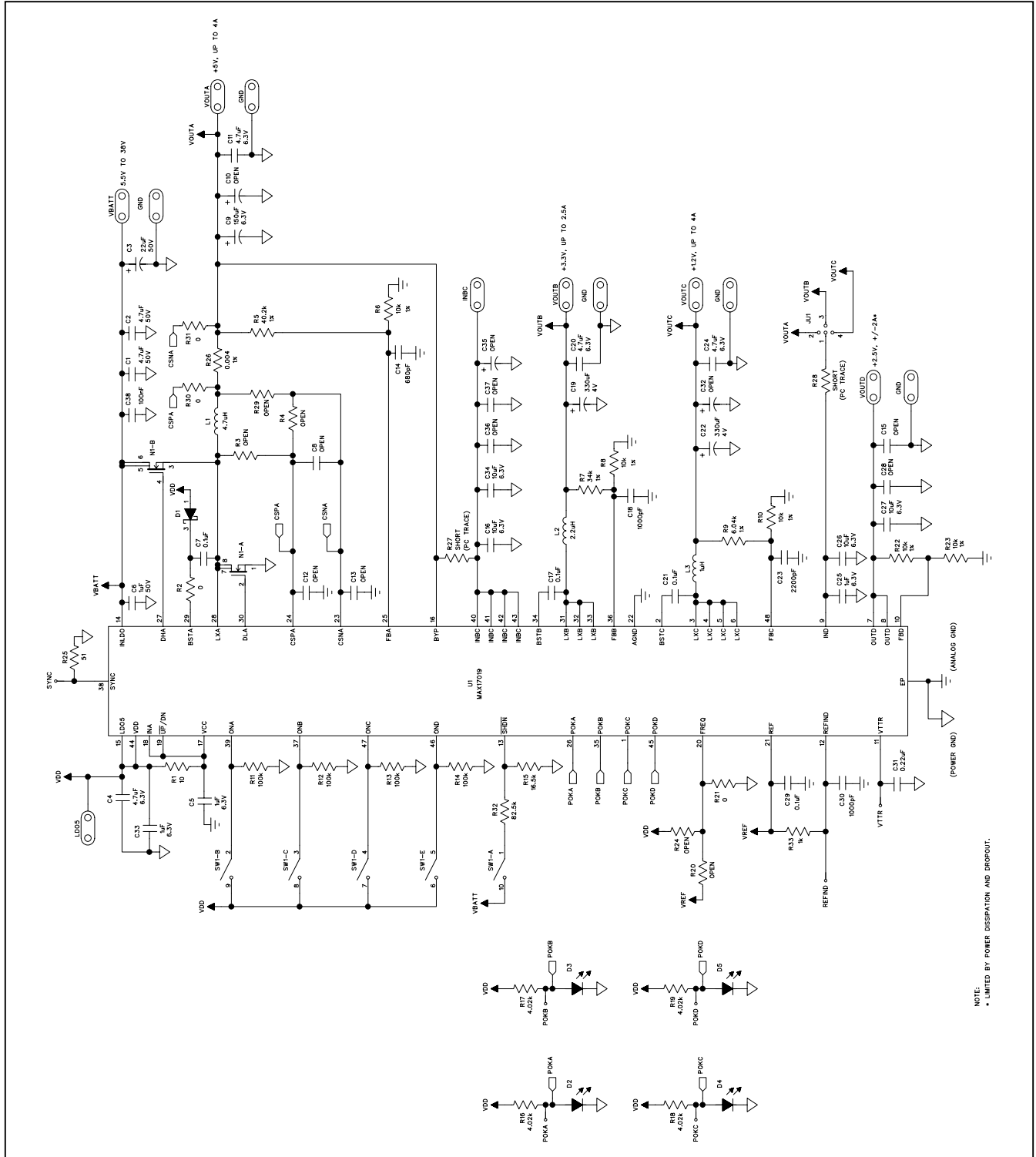


Figure 1. MAX17019 EV Kit Schematic

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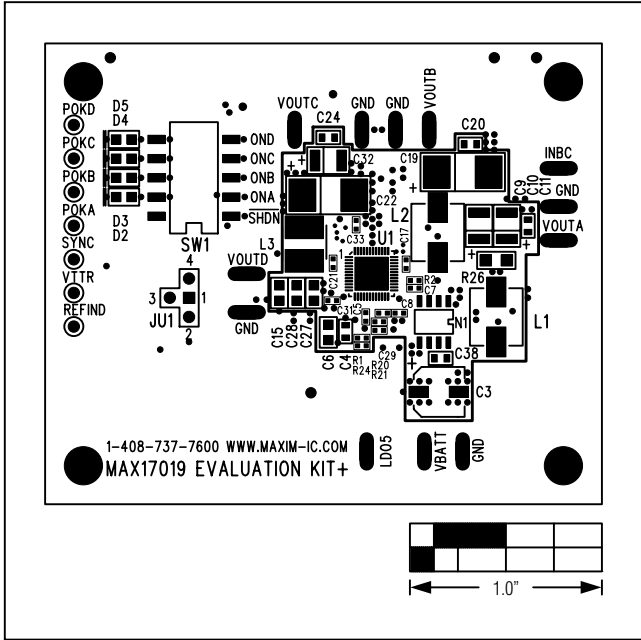


Figure 2. MAX17019 EV Kit Component Placement Guide—Component Side

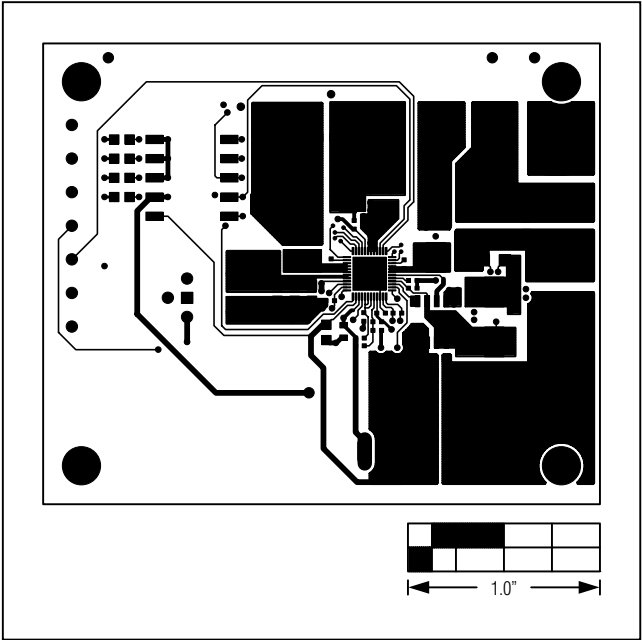


Figure 3. MAX17019 EV Kit PCB Layout—Component Side

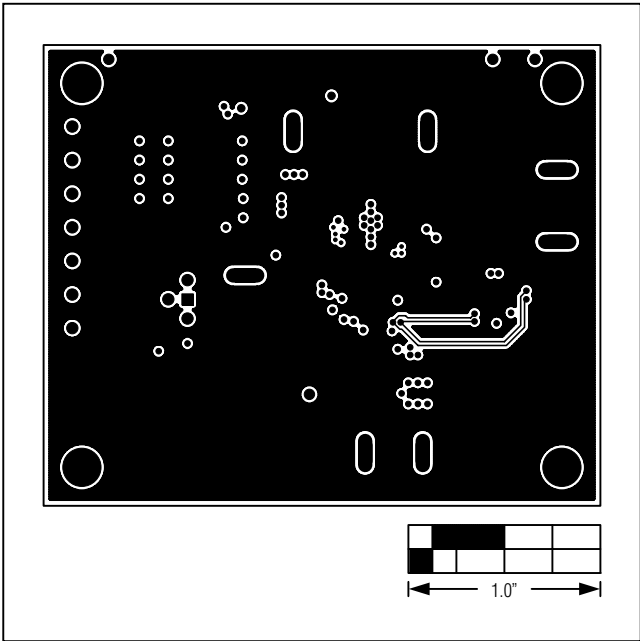


Figure 4. MAX17019 EV Kit PCB Layout—Layer 2

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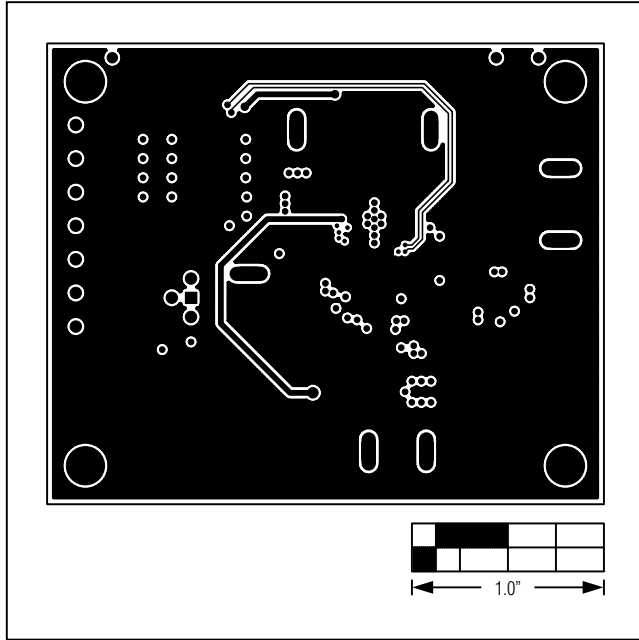


Figure 5. MAX17019 EV Kit PCB Layout—Layer 3

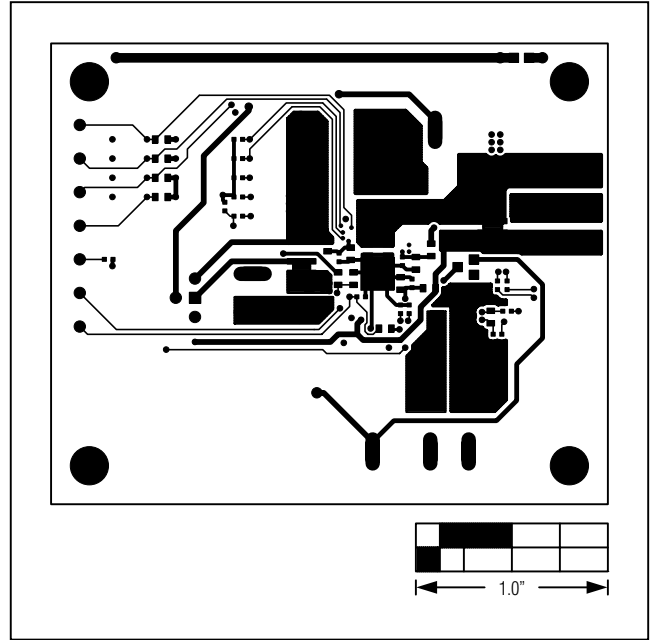


Figure 6. MAX17019 EV Kit PCB Layout—Solder Side

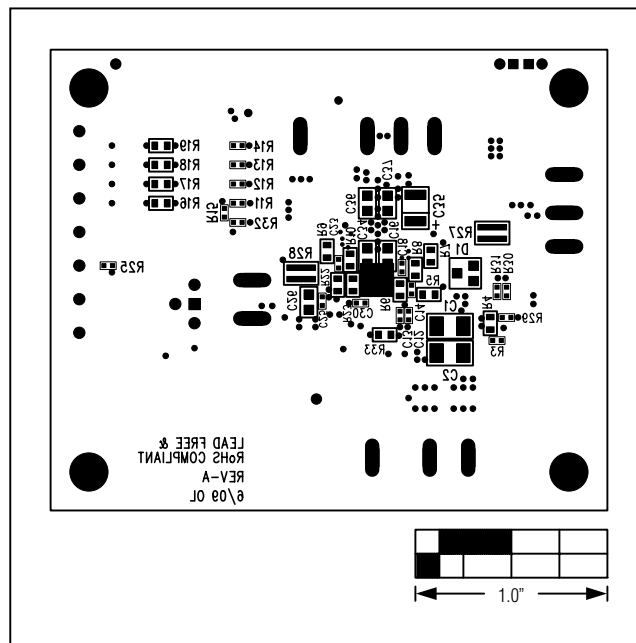


Figure 7. MAX17019 EV Kit Component Placement Guide—Solder Side

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Features

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|-----------------|---------------|--|---------------|
| 0 | 9/09 | Initial release | — |
| 1 | 4/15 | Deleted automotive reference from the <i>General Description</i> section | 1 |



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