

MAX17613AEVKIT# Evaluation Kit

Evaluates: MAX17613A - 4.5V to 60V, 3A Current-Limiter with OV, UV and Reverse Protection

General Description

The MAX17613AEVKIT# evaluation kit (EV kit) is a fully assembled and tested circuit board that demonstrates the MAX17613A 4.5V to 60V, 3A, overvoltage (OV), undervoltage (UV) protector with forward current limit and reverse current block in a 20-pin TQFN-EP package. The EV kit can be configured to demonstrate adjustable overvoltage, undervoltage, three current-limit types (Autoretry, Continuous, and Latchoff) with different current-limit thresholds (from 0.15A to 3A). For more details about the IC benefits and features, refer to the MAX17613 IC data sheet.

Features

- 4.5V to 40V Operating Voltage Range (Remove the TVS Diode to Extend the Operating Voltage Range up to 60V)
- Features a 40V TVS Diode (D1) across the Input and Schottky Diode across the Output Terminals
- Evaluates Undervoltage-Lockout (UVLO), Overvoltage-Lockout (OVLO), Three Current Limit Types, and Current-Limit Threshold
- UVLO Programmed to 4.5V
- OVLO Programmed to 36V
- Jumper-Configurable Current Limit
- Jumper-Configurable Current Limit Type
- Programmable Startup Blanking Time
- Features Fault Indication Signals ($\overline{\text{UVOV}}$, $\overline{\text{FLAG}}$)
- Proven PCB Layout
- Fully Assembled and Tested

Quick Start

Recommended Equipment

- MAX17613AEVKIT#
- 60V, 5A DC power supply
- 4 Multimeters
- Adjustable load (0A to 3.5A)
- USB-A male to USB-B male cable or 5V DC power supply

Equipment Setup and Test Procedure

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

Caution: Do not turn on power supply until all connections are complete.

- 1) Verify that all jumpers are in their default positions.
- 2) Connect the USB cable to J1 from a computer or connect a 5V DC power supply to TP3.
- 3) Verify that LED1 is on.
- 4) Verify the JU6 jumper is installed.
- 5) Set the 60V DC power supply to 5V and connect to IN (J2). Verify that OUT (J3/TP8) is 5V.

[Ordering Information](#) appears at end of data sheet.

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- 6) Gradually increase the DC power-supply voltage to observe that the device enters lockout mode by verifying the OUT voltage (TP8) begins drooping and fault signal \overline{UVOV} (TP4) goes low (to approximately 0V) when input reaches approximately 36V.
- 7) Gradually decrease the DC power-supply voltage to observe that the device exits lockout mode by verifying the OUT voltage (TP8) is recovered close to the input voltage level and the fault signal \overline{UVOV} (TP4) goes high (approximately 5V) when the input voltage reaches approximately 34.8V.
- 8) Set the DC power-supply voltage to 24V and connect the adjustable load between OUT and GND terminals and a multimeter in series to measure the current. Gradually increase the load current and verify that the OUT goes down and \overline{FLAG} goes low when the load current increases above 0.3A.
- 9) The jumper JU1 can be configured to change the current limit as shown in [Table 1](#). Verify various current-limit operations by repeating step 8.

CAUTION: The negative input test should be performed by applying negative input voltage (VIN) across input terminals at J2 only when the output capacitors connected at the OUT terminals are fully discharged and 5V BUS at J1 is not supplied.

Detailed Description

The EV kit circuit can be configured to evaluate user-defined UVLO and OVLO thresholds using resistor-dividers. The overcurrent threshold is determined by external resistors connected to the SET1 pin and is configurable through jumper JU1. Using jumper JU4, the EV kit circuit can be configured to evaluate Autoretry, Continuous, and Latchoff current limit types. LED1 on the EV kit indicates availability of logic power for annunciation signals (\overline{UVOV} and \overline{FLAG}) and EN. Device offers a programmable startup blanking time that enables charging of large capacitances on the output during startup and when recovering from a fault condition. Connecting a capacitor from the TSTART pin to GND programs the startup blanking time. The EV kit can be configured to enable or disable the IC operation using Jumper JU5. The EV kit provides on-board output capacitors to enable a demonstration of the MAX17613A protection features. For more details about the IC benefits and features, refer to the MAX17613 IC data sheet.

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Input Power Supply

The EV kit is powered by a user-supplied 4.5V to 60V power supply connected between input connector (J2) terminals.

Setting the Current-Limit Threshold

The EV kit features a jumper (JU1) to select the current-limit threshold. Install a jumper as shown in [Table 1](#) to change the current-limit threshold. The current limit can be programmed between 0.15A to 3A. The current limit (I_{LIM}) is programmed by the resistor R_{SET1} connected at the SET1 pin. Use the following equation to calculate the current-limit setting resistor:

$$R_{SET1} = \frac{4500}{I_{LIM}}$$

where, I_{LIM} is the desired current limit in mA and R_{SET1} is in k Ω .

Do not use R_{SET1} smaller than 1.5k Ω .

Current-Limit Type Selection

The EV kit features a jumper (JU4) to select different current limit type responses (see [Table 2](#)). For more details about each current limit type, refer to the MAX17613 IC data sheet.

Table 1. Current-Limit Threshold Jumper (JU1) Settings

| SHUNT POSITION | CURRENT-LIMIT THRESHOLD |
|----------------|-----------------------------------|
| 1–2 | Adjustable using the resistor pot |
| 3–4* | 0.3A |
| 5–6 | 1.5A |
| 7–8 | 3A |

*Default Position

Table 2. Current-Limit Type Selection (JU4)

| SHUNT POSITION | CURRENT-LIMIT TYPE |
|----------------|--------------------|
| 1–2 | Latchoff |
| 2–3 | Continuous |
| Not Installed* | Autoretry |

*Default Position

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Enable

Connect a USB-A male connector from the computer to the USB-B female connector, J1, or an external 5V supply to TP3 and GND. This provides 5V to V_{BUS} and to the EN pin (JU5 connects V_{BUS} to EN by default). Choose the (JU5) setting to enable or disable operation of the MAX17613A (see [Table 3](#)). Driving the EN pin high or low makes the device enable or disable, respectively.

Undervoltage-Lockout / Overvoltage-Lockout (UVLO/OVLO) Programming

The UVLO threshold for input voltage is set through the R11, R12 resistive divider. Use the following equation to calculate the value of R12 for a required undervoltage threshold level:

$$R12 = \frac{R11}{\left(\frac{V_{UVLO}}{V_{REF}} - 1\right)}$$

where,

R11 = Can be chosen as 2.2M Ω

V_{REF} = 1.5V (typ)

V_{UVLO} = Required undervoltage protection threshold

The OVLO threshold for input voltage is set through the R9, R10 resistive divider. Use the following equation to calculate the value of R10 for a required overvoltage threshold level:

$$R10 = \frac{R9}{\left(\frac{V_{OVLO}}{V_{REF}} - 1\right)}$$

where,

R9 is chosen between 450k Ω and 500k Ω

V_{REF} = 1.5V (typ)

V_{OVLO} = Required overvoltage protection threshold

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Startup Blanking Time Programming (TSTART)

Connecting a capacitor from the TSTART pin to GND programs the startup blanking time. The below equation ensures proper value of C_{TSTART} when connected at the TSTART pin for successful startup of the board especially when OUT is connected to a large capacitance.

$$C_{TSTART} \geq \frac{3.33 \times C_{OUT(MAX)} \times V_{IN(MAX)}}{I_{LIM}}$$

The startup time (t_{TSTART}) is related to the startup capacitor by the following equation:

$$t_{TSTART} = 300 \times C_{TSTART}$$

where,

C_{TSTART} = TSTART pin capacitance in nF

$C_{OUT(MAX)}$ = Maximum output capacitance in μ F

$V_{IN(MAX)}$ = Maximum input voltage in V

I_{LIM} = Programmed current limit in mA

t_{TSTART} = Startup blanking time in μ s

Output-Load Capacitor

Use JU6 to connect the OUT pins to the OUT test point (TP8) and output connector J3 (see [Table 4](#)). Use jumper JU7 to connect output to 470 μ F capacitor (see [Table 5](#)).

Table 3. Enable Jumper (JU5) Settings

| SHUNT POSITION | DESCRIPTION | MAX17613A OUTPUT |
|----------------|---------------------------|------------------|
| 1-2* | EN Connected to V_{BUS} | ON |
| Not Installed | EN pin Unconnected | ON |
| 2-3 | EN Connected to GND | OFF |

*Default Position

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Table 4. Output Jumper (JU6) Settings

| SHUNT POSITION | DESCRIPTION |
|----------------|---------------------------------|
| Installed* | OUT is connected to TP8 and J3 |
| Not Installed | OUT is not connected TP8 and J3 |

*Default Position

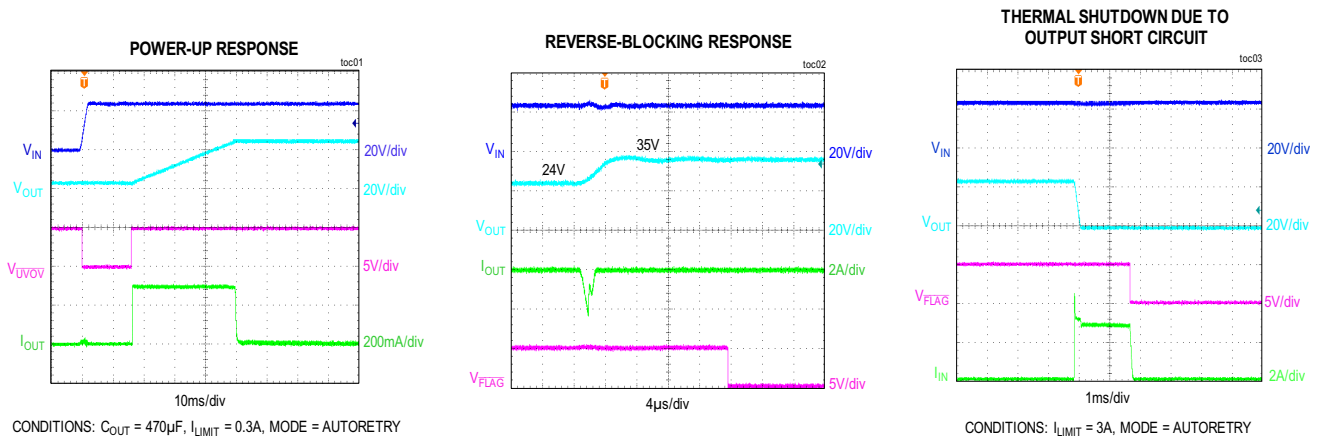
Table 5. Output Load Capacitor (JU7) Settings

| SHUNT POSITION | DESCRIPTION |
|----------------|-----------------------------------|
| Installed | OUT is connected to C4 and C7 |
| Not Installed* | OUT is not connected to C4 and C7 |

*Default Position

MAX17613AEVKIT# EV Kit Performance Report

($C_{IN} = 0.47\mu F$, $C_{OUT} = 4.7\mu F$, $V_{IN} = 24V$, $T_A = +25^\circ C$. Autoretry mode, unless otherwise noted.)



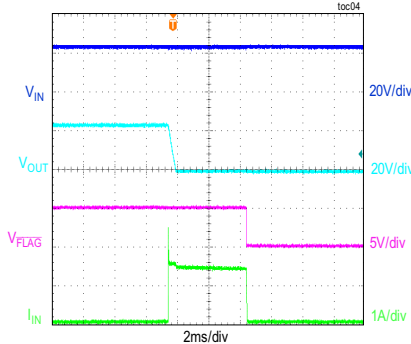
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MAX17613AEVKIT# EV Kit Performance Report (continued)

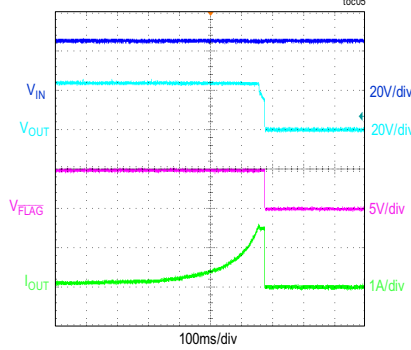
($C_{IN} = 0.47\mu\text{F}$, $C_{OUT} = 4.7\mu\text{F}$, $V_{IN} = 24\text{V}$, $T_A = +25^\circ\text{C}$. Autoretry mode, unless otherwise noted.)

OUTPUT SHORT-CIRCUIT RESPONSE



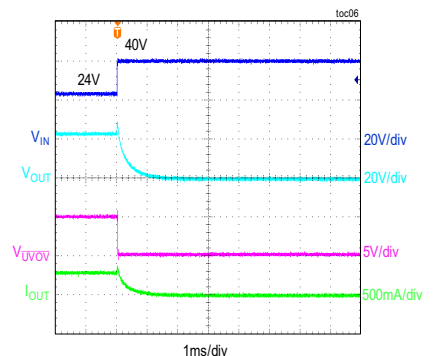
CONDITIONS: $I_{LIMIT} = 1.5\text{A}$, AUTORETRY MODE

CURRENT-LIMIT RESPONSE



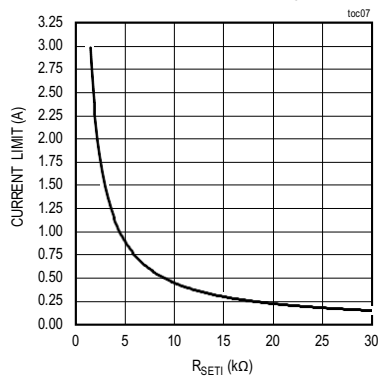
CONDITIONS: $V_{IN} = 24\text{V}$, $I_{LIMIT} = 1.5\text{A}$,
SHORT ON OUT WITH CONTROLLED OUT CURRENT SLEW RATE

INPUT OVERVOLTAGE FAULT RESPONSE

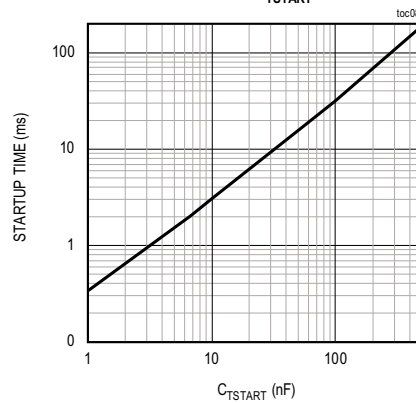


CONDITIONS: $I_{LIMIT} = 3\text{A}$, AUTORETRY MODE, $R_{LOAD} = 80\Omega$

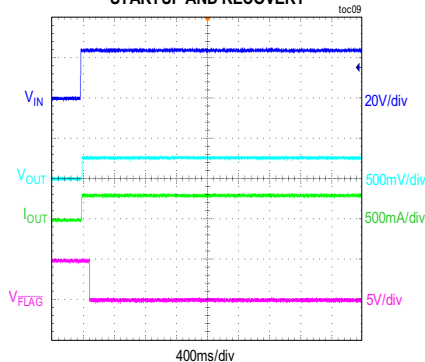
CURRENT LIMIT vs. R_{SET1}



STARTUP TIME vs. C_{TSTART} CAPACITOR

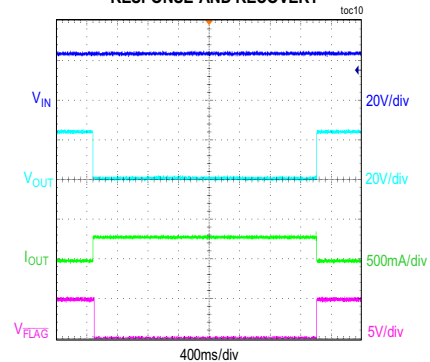


OVER CURRENT FAULT DURING
STARTUP AND RECOVERY



CONDITIONS: $V_{IN} = 24\text{V}$, $I_{LIMIT} = 0.3\text{A}$, $R_{OUT} = 0.9\Omega$,
CONTINUOUS MODE

OVERCURRENT FAULT
RESPONSE AND RECOVERY



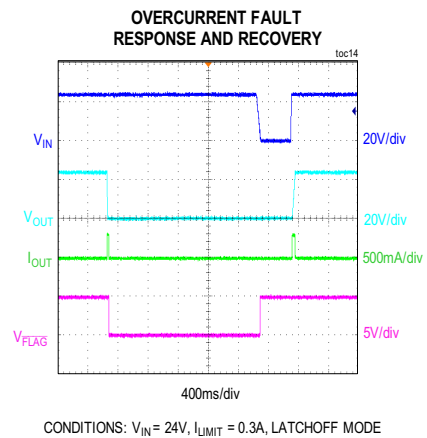
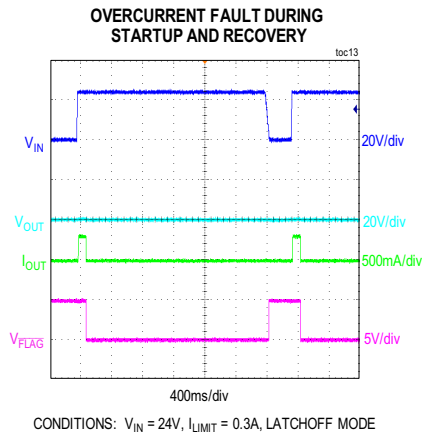
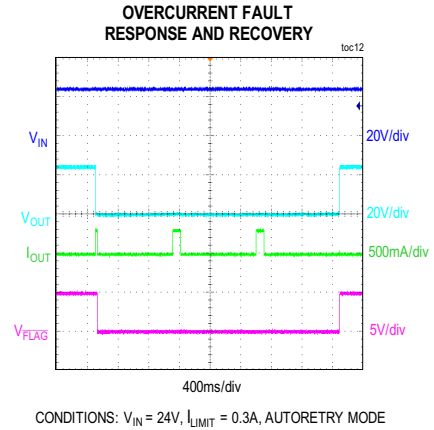
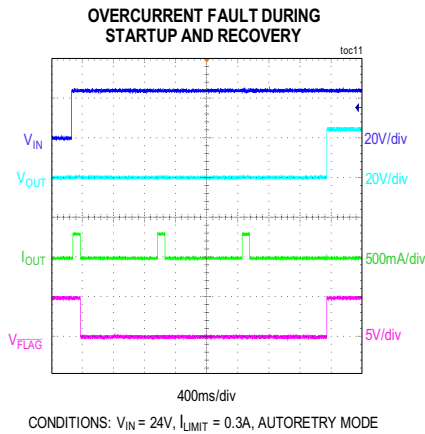
CONDITIONS: $V_{IN} = 24\text{V}$, $I_{LIMIT} = 0.3\text{A}$, $R_{OUT} = 0.9\Omega$,
CONTINUOUS MODE

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($C_{IN} = 0.47\mu\text{F}$, $C_{OUT} = 4.7\mu\text{F}$, $V_{IN} = 24\text{V}$, $T_A = +25^\circ\text{C}$. Autoretry mode, unless otherwise noted.)



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Component Suppliers

| SUPPLIER | WEBSITE |
|---------------------|--|
| Bourns, Inc | www.bourns.com |
| Murata Americas | www.murata.com |
| Panasonic Corp. | www.panasonic.com |
| Little fuse | www.littelfuse.com |
| TE connectivity | www.te.com |
| SULLINS | www.sullinscorp.com |
| LUMEX | www.lumex.com |
| KEYSTONE | www.keyelco.com |
| Amphenol | www.amphenol.com |
| DIODES INCORPORATED | www.diodes.com |

Note: Indicate that you are using the MAX17613A when contacting these component suppliers.

Ordering Information

| PART | TYPE |
|-----------------|--------|
| MAX17613AEVKIT# | EV Kit |

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MAX17613AEVKIT# EV Kit Bill of Materials

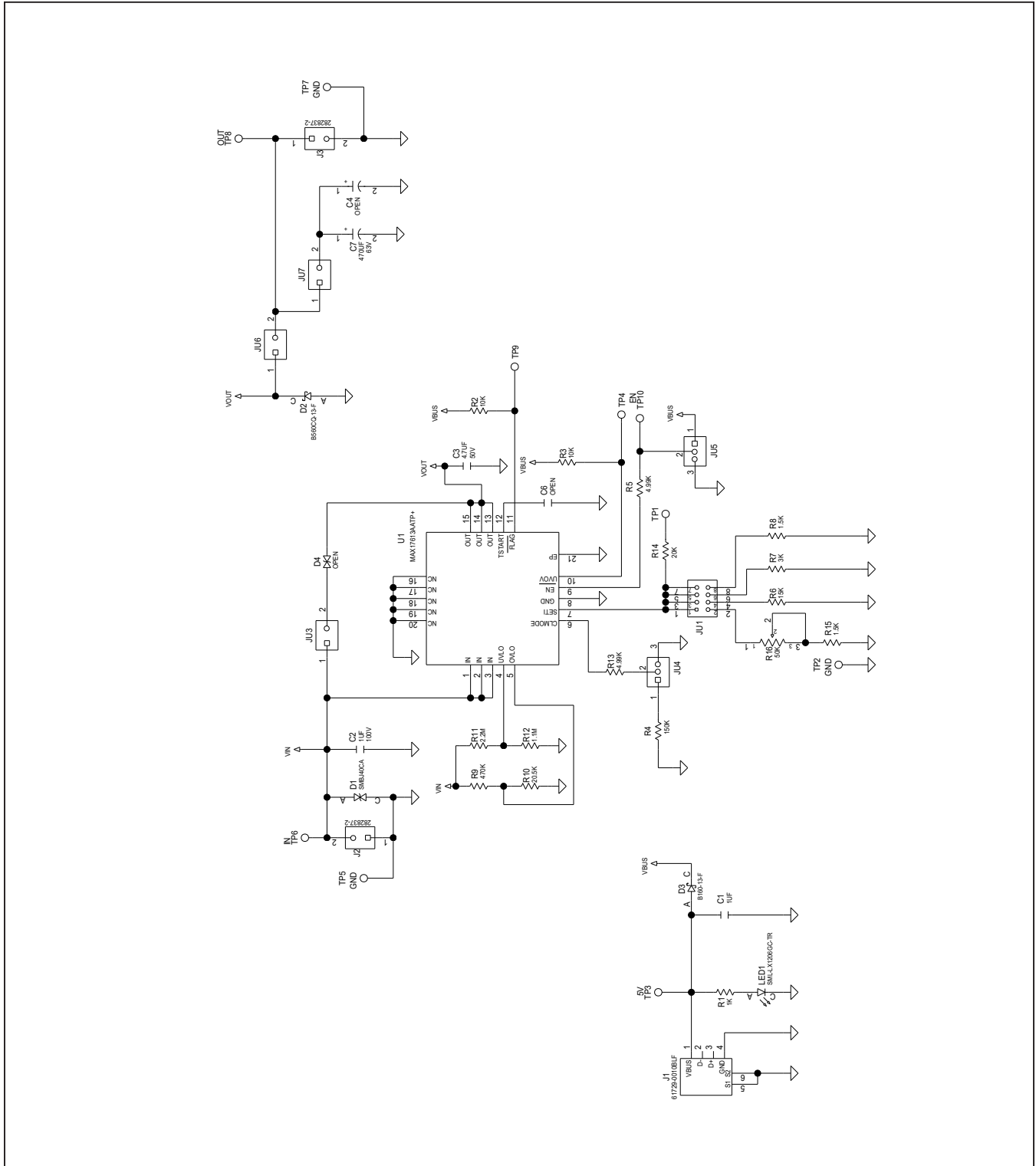
| S.No | Designator | Description | Quantity | Manufacturer Part Number |
|------|------------------------------|--|----------|---------------------------------|
| 1 | C1 | 1µF, SMT Capacitor-X7R/25V (0603) | 1 | Murata GRM188R71E105KA12 |
| 2 | C2 | 1µF, SMT Capacitor-X7R/100V (1206) | 1 | Murata GRM31CR72A105KA01 |
| 3 | C3 | 4.7µF, SMT Capacitor-X7R/50V (1206) | 1 | Murata GRJ31CR71H475KE11L |
| 4 | C7 | 470µF, PTH Aluminum Capacitor-63V | 1 | Panasonic EEUFR1J471B |
| 5 | D1 | 40V,600W, TVS Diode (DO-214AA) | 1 | Littlefuse SMBJ40CA |
| 6 | D2 | 60V, 5A, Diode (DO-214AB) | 1 | DIODES INCORPORATED B560CQ-13-F |
| 7 | D3 | Power Schottky Diode, 60V, 1A (SMA) | 1 | DIODES INCORPORATED B160-13-f |
| 8 | LED1 | 2.2V, 20mA, LED (1206) | 1 | Lumex SML-LX1206GC-TR |
| 9 | R1 | 1kΩ, SMT Resistor 1% 100PPM (0805) | 1 | |
| 10 | R2, R3 | 10kΩ, SMT Resistor 1% 100PPM (0402) | 2 | |
| 11 | R4 | 150kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 12 | R5, R13 | 4.99kΩ, SMT Resistor 1% 100PPM (0402) | 2 | |
| 13 | R6 | 15kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 14 | R7 | 3kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 15 | R8 | 1.5kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 16 | R9 | 470kΩ, SMT Resistor 1% 100PPM (0603) | 1 | |
| 17 | R10 | 20.5kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 18 | R11 | 2.2MΩ, SMT Resistor 1% 100PPM (0603) | 1 | |
| 19 | R12 | 1.1MΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 20 | R14 | 20kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 21 | R15 | 1.5kΩ, SMT Resistor 1% 100PPM (0402) | 1 | |
| 22 | R16 | 50kΩ, 0.5W, Trimmer Potentiometers 10% , 100PPM | 1 | BOURNS 3296W-503LF-ND |
| 23 | U1 | 4.5V to 60V, 3A Current-Limiter with OV, UV and Reverse Protection | 1 | MAXIM MAX17613AATP+T |
| 24 | TP1, TP2, TP4, TP5, TP7, TP9 | Black Test Point | 6 | KEYSTONE 5001 |
| 25 | TP3, TP6, TP8 | Red Test Point | 3 | KEYSTONE 5000 |
| 26 | SU1, SU3-SU7 | Shunt Connector, Black Closed Top | 6 | SULLINS STC02SYAN |
| 27 | J1 | USB B connector | 1 | Amphenol 61729-0010BLF |
| 28 | J2, J3 | 2-Pin Green PC Terminal Block | 2 | TE Connectivity 282837-2 |
| 29 | JU1 | 2x4 Dual-Row Header | 1 | SULLINS PBC04DAAN |
| 30 | JU3, JU6, JU7 | 2-Pin Single-Row Header | 3 | SULLINS PEC02SAAN |
| 31 | JU4, JU5 | 3-Pin Single-Row Header | 2 | SULLINS PEC03SAAN |
| 32 | C6 | OPEN, SMT Capacitor (0603) | 0 | |
| 33 | C4 | OPEN, Capacitor, 470µF, 12.5mm Dia (PTH) | 0 | |
| 34 | D4 | OPEN, 40V,600W, TVS Diode (DO-214AA) | 0 | |

| Default Jumper Table | |
|----------------------|----------------|
| Jumper | Shunt Position |
| JU1 | 3-4 short |
| JU3 | Open |
| JU4 | Open |
| JU5 | 1-2 short |
| JU6 | short |
| JU7 | Open |

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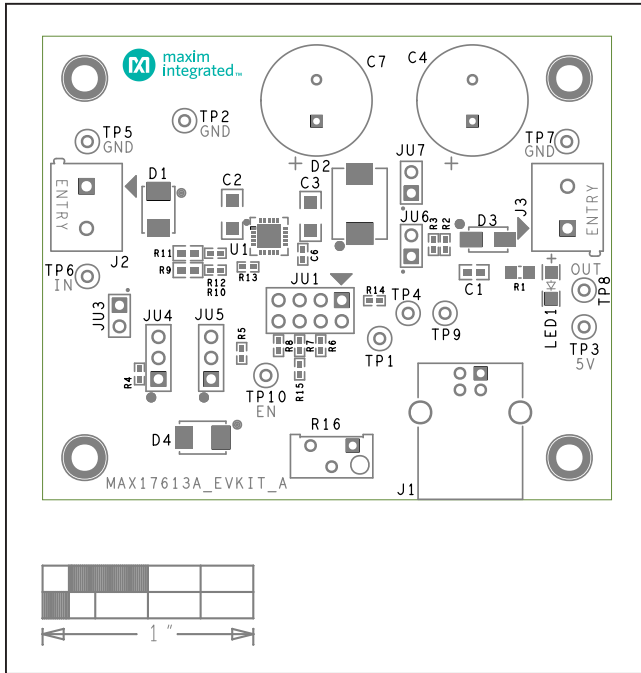
MAX17613AEVKIT# EV Kit Schematic



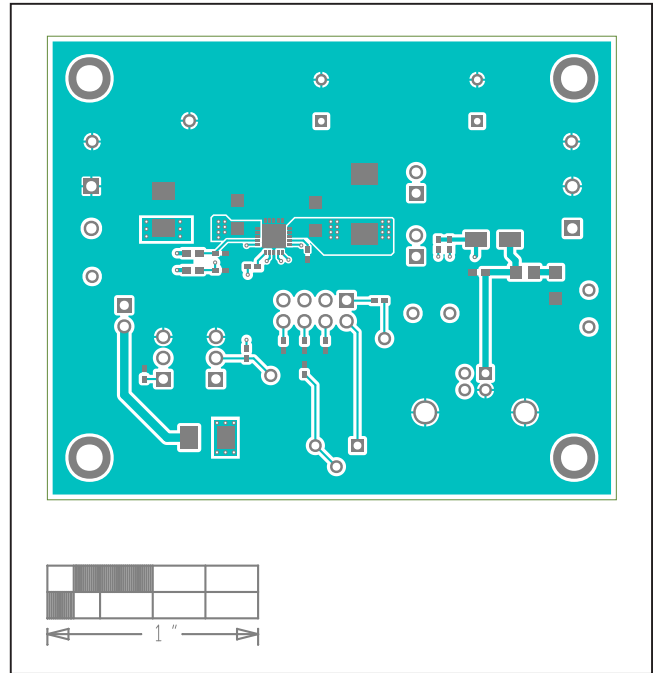
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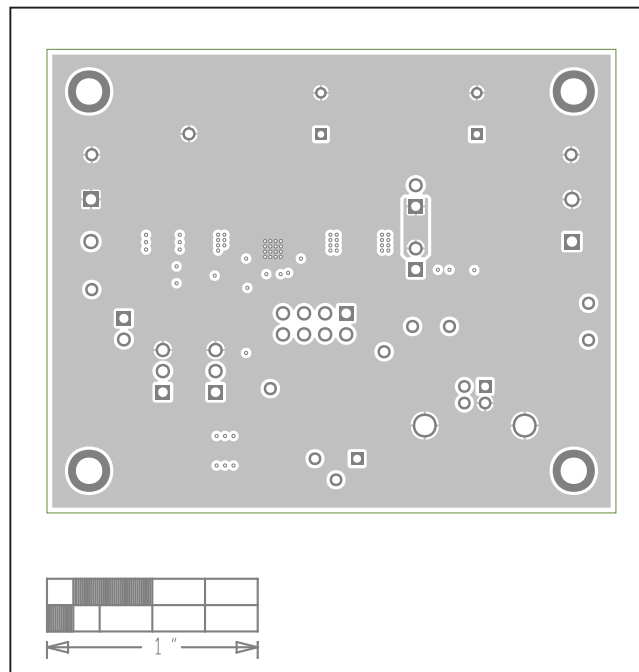
MAX17613AEVKIT# EV Kit PCB Layout



MAX17613AEVKIT# EV Kit—Top Silkscreen



MAX17613AEVKIT# EV Kit—Top Layer

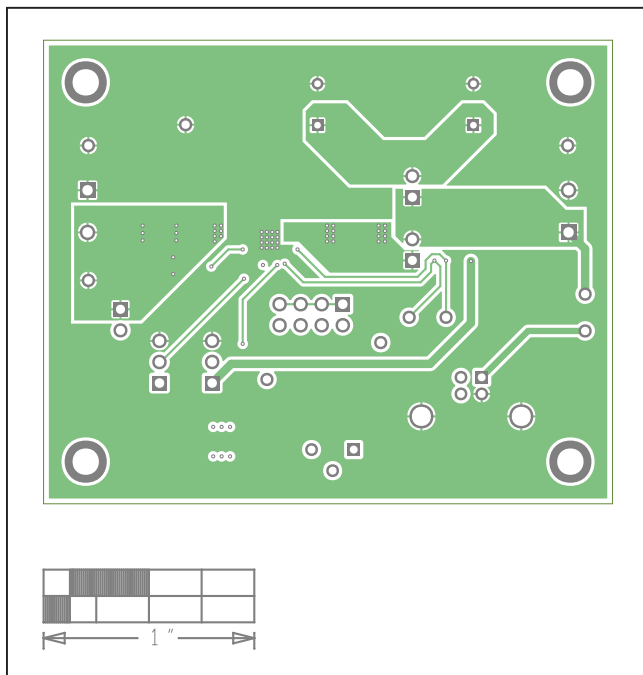


MAX17613AEVKIT# EV Kit—Layer 2

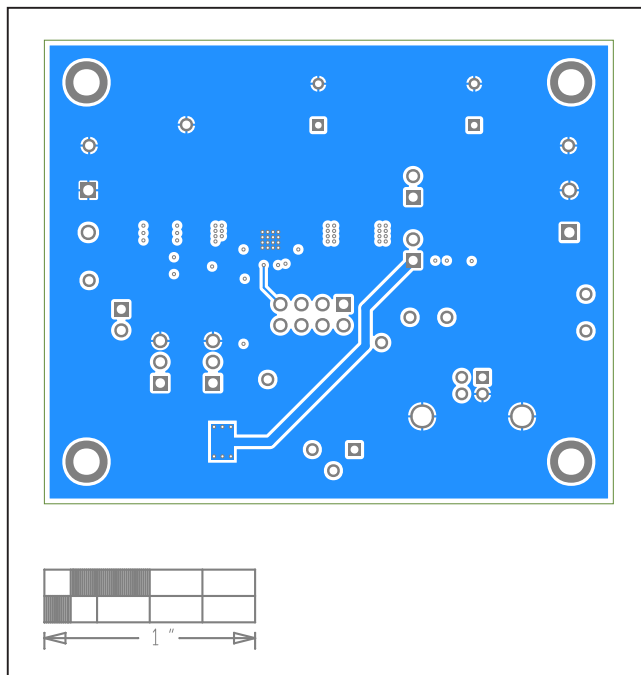
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MAX17613AEVKIT# EV Kit PCB Layout (continued)



MAX17613AEVKIT# EV Kit—Layer 3



MAX17613AEVKIT# EV Kit—Bottom Layer

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Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|-----------------|---------------|-----------------|---------------|
| 0 | 4/19 | Initial release | — |

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at <https://www.maximintegrated.com/en/storefront/storefront.html>.

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