

## MAX20050 Evaluation Kit

Evaluates: MAX20050/MAX20052

### General Description

The MAX20050 evaluation kit (EV kit) demonstrates the MAX20050 and MAX20052, 1.5A synchronous buck LED drivers with integrated MOSFETs.

The EV kit operates from a DC supply voltage from 4.5V to 65V and the switching frequency is fixed at 400kHz. Spread-spectrum mode (SSM) is enabled for EMI improvement. The EV kit demonstrates both analog and pulse-width modulation (PWM) dimming. The EV kit also demonstrates short LED, open LED, and overtemperature fault protection.

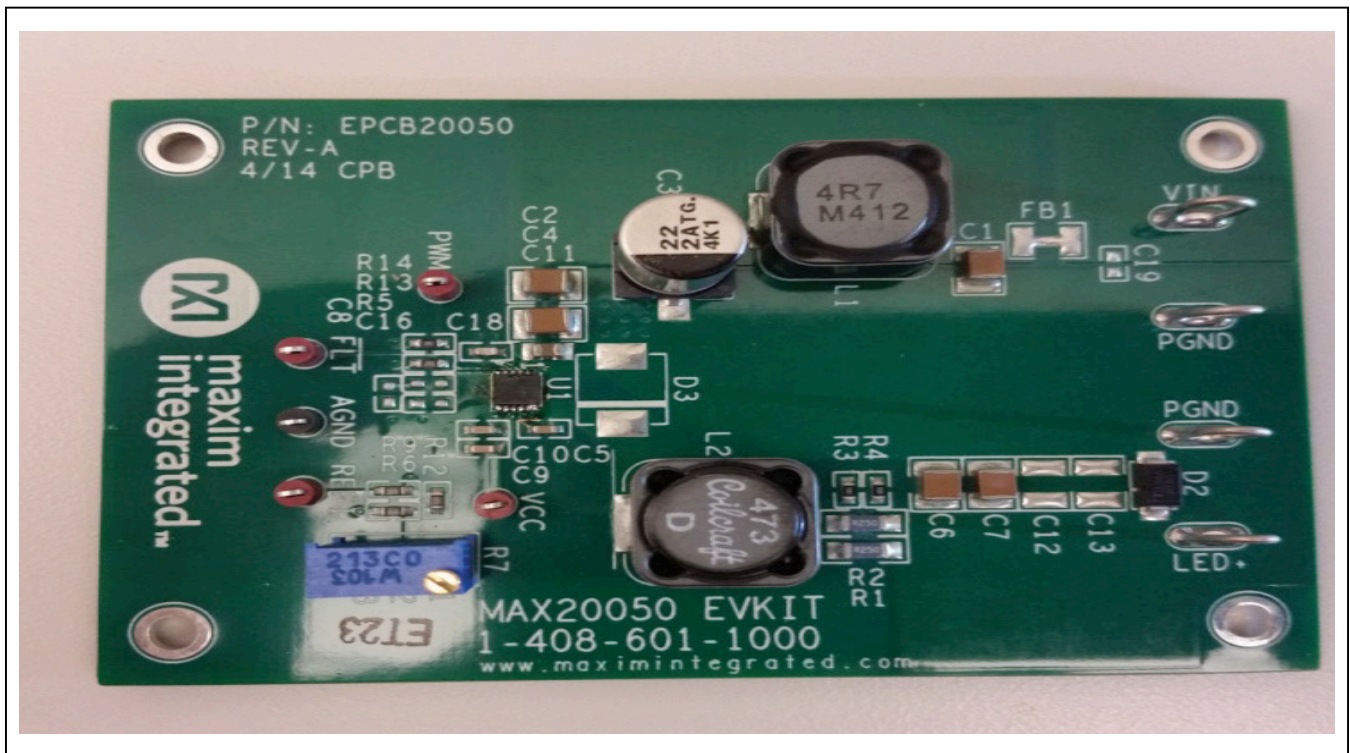
The EV kit comes with a MAX20052ACTV IC, which can be installed to evaluate the 2.1MHz switching frequency device. See the *Evaluating the MAX20052* section for more information.

### Features and Benefits

- 4.5V to 65V Input Voltage
- Drives 1 to 16 LEDs
- 0A to 1.5A LED Current
- Demonstrates Undervoltage-Lockout and Output Short Protection
- Demonstrates Current-Limit and Thermal-Shutdown Feature
- Demonstrates 5V, 10mA LDO Output Capability
- Proven PCB Layout and Thermal Design
- Fully Assembled and Tested

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

### MAX20050 EV Kit Photo



## Quick Start

### Required Equipment

- MAX20050 EV kit
- 5V to 65V, 4A DC power supply
- Two digital voltmeters (DVMs)
- One series-connected HB LED string rated to no less than 2A
- Current probe to measure the HB LED current
- Small flat-blade screwdriver to turn the potentiometer wiper adjustment pin

### Procedure

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

- 1) Connect the HB LED string anode to the LED+ PCB pad and the cathode to the PGND PCB pad.
- 2) Connect the first DVM across the LED+ and PGND PCB pads.
- 3) Connect the second DVM across the REFI test point and the AGND test point.
- 4) Connect the power supply to the VIN PCB pad and the power-supply ground to the PGND PCB pad.
- 5) Clip the current probe across the wire connecting the HB LED string to the EV kit
- 6) Turn on the power supply and set it to a voltage greater than the maximum HB LED string voltage, but less than the 65V maximum input voltage.
- 7) Use the screwdriver to turn the potentiometer until the second DVM reads 1.14V.
- 8) Measure the HB LED current using the current probe and verify that the current is 1.5A.
- 9) Verify that the first DVM shows the expected LED string voltage.
- 10) Use the screwdriver to turn the potentiometer until the second DVM reads 0.67V.
- 11) Measure the HB LED current using the current probe and verify that the current is 0.75A.

## Detailed Description of Hardware

The MAX20050 EV kit demonstrates the MAX20050 1.5A synchronous buck LED driver with integrated MOSFETs. The device consists of a fully synchronous step-down converter with integrated MOSFETs. The device is capable of driving a series string of LEDs at up to 1.5A, with a minimum number of external components. The device is a fixed-frequency average current-mode step-down LED driver. The device uses high-side current regulation, meaning a current-sense resistor is placed on the high side of the LED string, and the voltage across the current-sense resistor is sensed and used to regulate the LED current. The device offers both analog and PWM dimming. The device features internal error amplifier compensation. Refer to the MAX20050–MAX20053 IC data sheet for recommended inductor values to ensure stable operation.

### Analog Dimming

The EV kit demonstrates the analog dimming feature of the device. R6 and R7 form a resistor-divider between  $V_{CC}$  and AGND. R6 is a 10k $\Omega$  resistor and R7 is a 10k $\Omega$  potentiometer, with the wiper shorted to the high side of the potentiometer. Using a flat-blade screwdriver, turn the wiper adjustment pin clockwise to increase the voltage on the REFI input. Turn the wiper adjustment pin counter-clockwise to decrease the voltage on the REFI input. The REFI input allows for analog dimming of the HB LED string. A REFI input voltage of 0.2V or less turns off the LED driver. A REFI input voltage between 0.2V and 1.2V provides linear dimming of the HB LED string. A REFI input voltage greater than 1.2V sets the HB LED string current to maximum current (based on the current-sense resistor).

Alternatively, the analog dimming input can be set with a power supply. Remove R12 and connect the power supply directly to the REFI test point to perform analog dimming with a power supply. Be careful not to violate the absolute maximum voltage rating of  $V_{CC} + 0.3V$  (refer to the *Absolute Maximum Ratings* section in the MAX20050–MAX20053 IC data sheet).

**PWM Dimming**

The EV kit demonstrates the PWM dimming feature of the device. Connect a PWM signal to the PWM test point. Vary the duty cycle to increase or decrease the intensity of the HB LED string. The PWM input of the device has 2V (max) rising threshold and a 0.8V (min) falling threshold so it is compatible with 3.3V and 5V logic level signals. The PWM input is pulled up to  $V_{CC}$  through an external 10k $\Omega$  resistor on the EV kit.

**Fault Indicator**

The EV kit demonstrates the fault-protection features of the device. The device offers shorted-LED, open-LED, and overtemperature protection. The  $\overline{FLT}$  output is an open-drain, active-low fault indicator. Refer to the *Fault Pin Behavior* section in the MAX20050–MAX20053 IC data sheet for more information.

**Acoustic Noise**

High input voltage combined with PWM dimming can cause acoustic noise in certain applications. The acoustic

noise comes from the electrostrictive effect of ferroelectric ceramics. If this is a concern, consider using low-acoustic-noise capacitors on the output, such as the Murata GJ8 series capacitors, or Rubycon polymer multi-layer (PML) capacitors.

**Evaluating the MAX20052**

The EV kit is capable of evaluating the MAX20052 with some minor modifications. The MAX20052 has a switching frequency of 2.1MHz. To accommodate the higher switching frequency, L2 should be decreased to 10 $\mu$ H. The MAX20052 is only suitable for applications where the maximum input voltage is less than 40V.

**Evaluating the MAX20051 and MAX20053**

The MAX20051 and MAX20053 offer external error amplifier compensation and a 2A current limit in a 14-pin TSSOP-EP package. To evaluate these devices, use the MAX20051 EV kit.

## Component List

| PART               | QTY | DESCRIPTION   |
|--------------------|-----|---|
| C1, C2, C4, C6, C7 | 5   | 2.2 $\mu$ F $\pm$ 10%, 100V X7R ceramic capacitors (1210) |
| C3                 | 1   | 22 $\mu$ F, 100V electrolytic capacitor (Size F)          |
| C5, C10            | 2   | 0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitors (0603)  |
| C9                 | 1   | 1 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitor (0603)     |
| C11                | 1   | 0.47 $\mu$ F $\pm$ 10%, 100V X7R ceramic capacitor (0805) |
| C18                | 1   | 100pF $\pm$ 5%, 50V C0G ceramic capacitor (0603)          |
| C19                | 0   | Not installed, ceramic capacitor                          |
| D2                 | 1   | 80V, 1A Schottky diode (SMA) Diodes, Inc. B180A-13-F      |
| D3                 | 0   | Not installed, Schottky diode                             |
| FB1                | 1   | Inductor—PCB short  |

| PART             | QTY | DESCRIPTION  |
|------------------|-----|--|
| L1               | 1   | 4.7 $\mu$ H $\pm$ 20%, 6.2A inductor Coilcraft MSS1278T-472ML  |
| L2               | 1   | 47 $\mu$ H $\pm$ 20%, 2.9A inductor Coilcraft MSS1278T-473ML   |
| R1, R2           | 2   | 0.25 $\Omega$ $\pm$ 1% resistors (1206)                        |
| R3, R4           | 2   | 10 $\Omega$ $\pm$ 1% resistors (0603)                          |
| R6, R9, R13, R14 | 3   | 10k $\Omega$ $\pm$ 1% resistors (0603)                         |
| R7               | 1   | 10k $\Omega$ $\pm$ 10% potentiometer Bourns Inc. 3296W-1-103LF |
| R12              | 1   | 0 $\Omega$ $\pm$ 5% resistor (0603)                            |
| U1               | 1   | LED driver (12 TDFN-EP*) MAX20050ATC/V+                        |
| —                | 1   | LED driver (12 TDFN-EP*) MAX20052ATC/V+                        |
| —                | 1   | PCB: MAX20050 EVKIT  |

\*EP = Exposed pad.

## Component Suppliers

| SUPPLIER            | PHONE        | WEBSITE                |
|---------------------|--------------|------------------------|
| Bourns Inc.         | 951-781-5500 | www.bourns.com         |
| Coilcraft, Inc.     | 847-639-6400 | www.coilcraft.com      |
| Diodes Incorporated | 805-446-4800 | www.diodes.com         |
| Murata Americas     | 770-436-1300 | www.murataamericas.com |

**Note:** Indicate that you are using the MAX20050 when contacting these component suppliers.

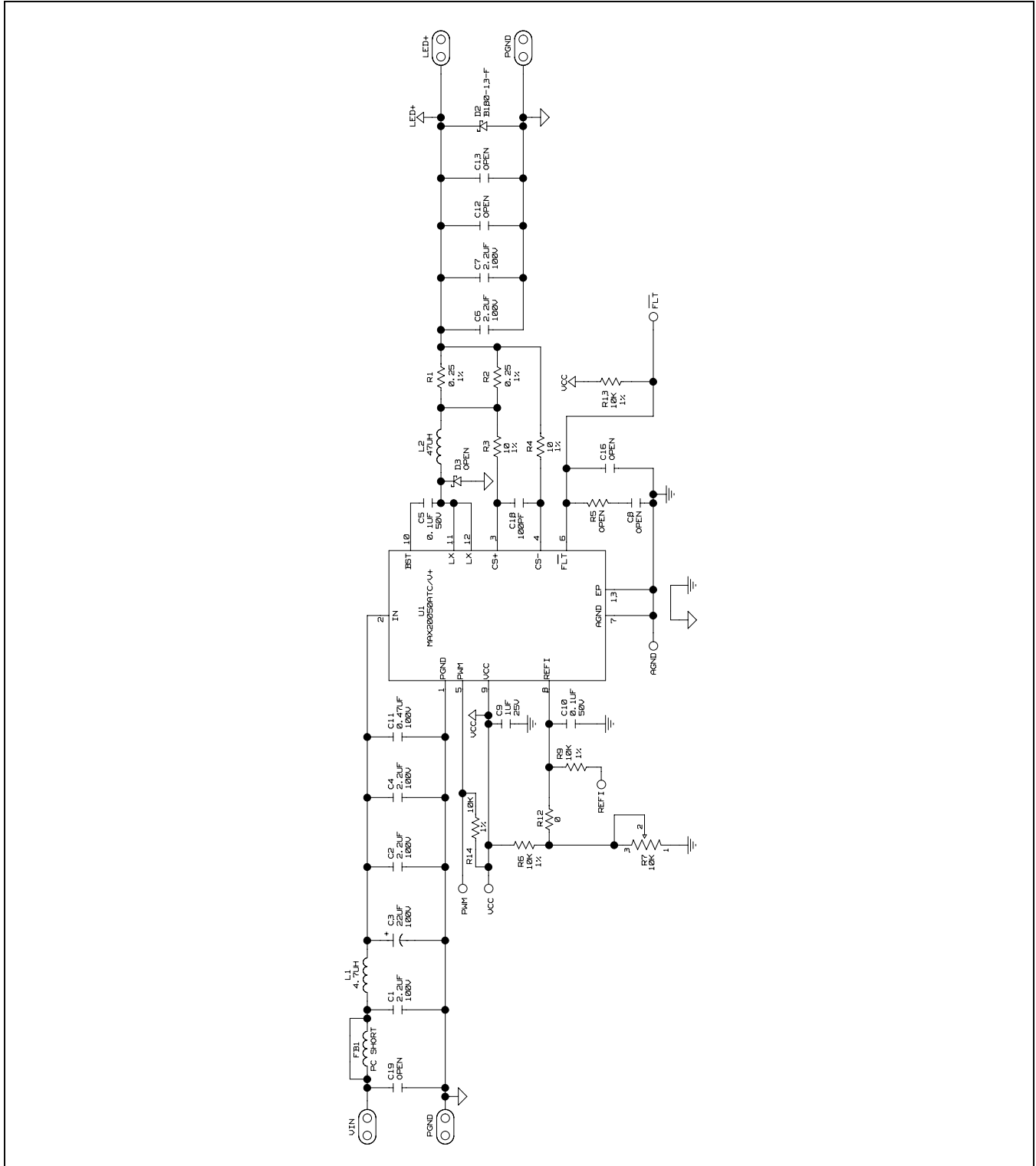


Figure 1. MAX20050 EV Kit Schematic

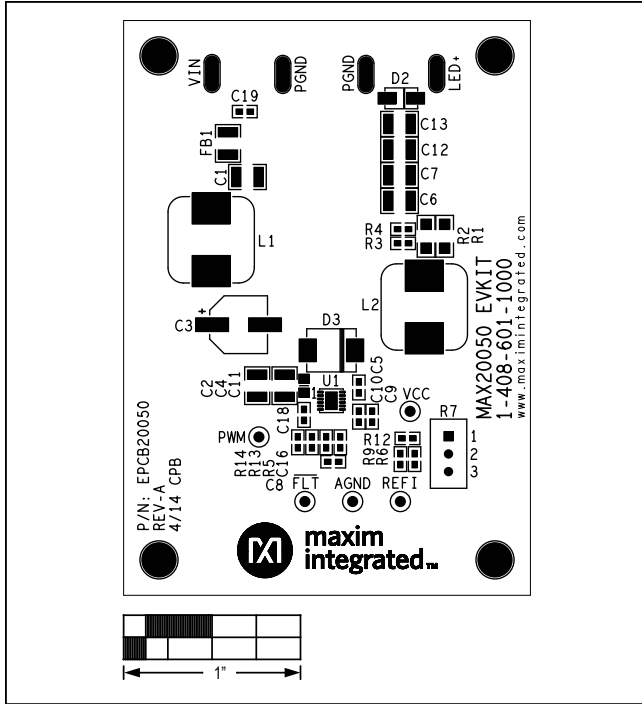


Figure 2. MAX20050 EV kit Component Placement Guide—Component Side

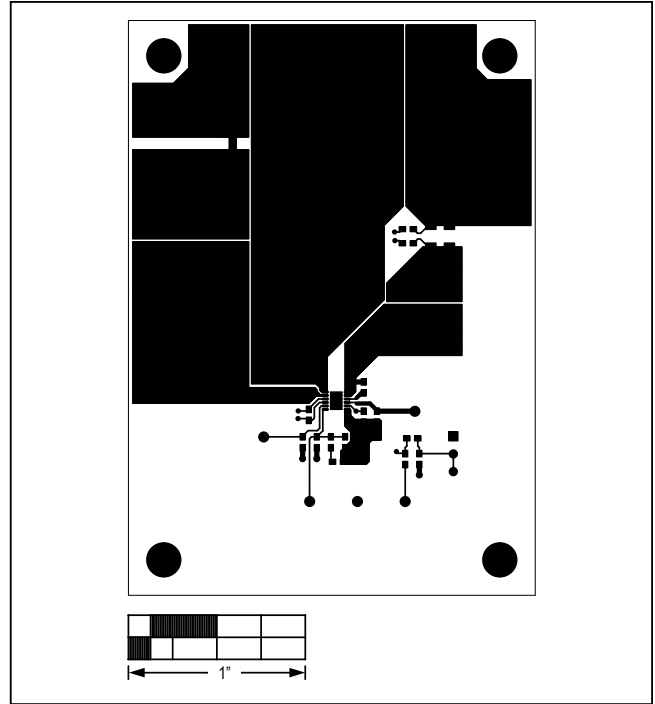


Figure 3. MAX20050 EV Kit PCB Layout—Component Side

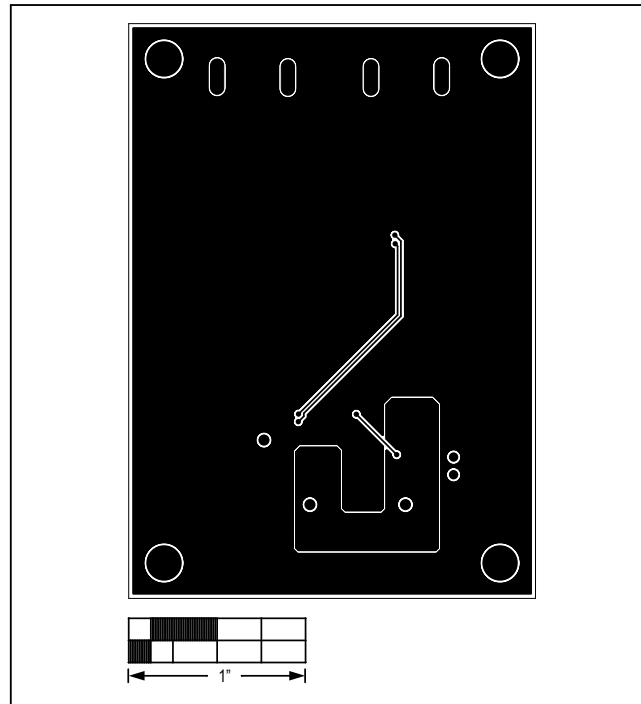


Figure 4. MAX20050 EV Kit PCB Layout—Solder Side

### Ordering Information

| PART           | TYPE   |
|----------------|--------|
| MAX20050EVKIT# | EV Kit |

#Denotes RoHS compliant.

### Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION     | PAGES CHANGED |
|-----------------|---------------|-----------------|---------------|
| 0               | 2/15          | Initial release | —             |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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