19-4132; Rev 0; 5/08

MAX17020 Evaluation Kit

Evaluates: MAX17020

General Description

The MAX17020 evaluation kit (EV kit) demonstrates the MAX17020's standard application circuit. This dual Quick-PWM™ synchronous DC-DC converter steps down high-voltage batteries and/or AC adapters, generating main supplies for notebook computers. The MAX17020 EV kit provides dual 1.5V (V_{OUT1}) and 1.05V (V_{OUT2}) output voltages from a 6V to 24V battery-input range. It delivers at least 6A output current for the 1.5V output, and 10A for the 1.05V output. Both outputs are adjustable between 0.7V and 5.5V. An external unregulated charge pump generates an 8V (VSEC) auxiliary voltage capable of delivering 2mA from the 1.5V output.

The MAX17020 also has an internal fixed 5V low-dropout (LDO) linear regulator capable of supplying 100mA, and an always-on 3.3V, 5mA real-time clock (RTC) supply.

The MAX17020 EV kit operates at 400kHz/300kHz switching frequency (1.5V/1.05V, respectively) and has superior line- and load-transient response.

For 5V and 3.3V output evaluation, the MAX8778 EV kit can be used. The MAX17020 is a pin-for-pin replacement of the MAX8778.

Features

- **6V to 24V Input Range**
- **3.3V, 5mA RTC Power (Always On)**
- **Internal 5V, 100mA Linear Regulator (Adjustable from 0.6V to 4V)**
- **Output Voltages:**
  - **1.05V at 10A$_{MIN}$ (V_{OUT2}, Dynamic Adjustable from 0 to 2V) or Preset 3.3V**
  - **1.5V at 6A$_{MIN}$ (V_{OUT1}, Adjustable from 0.7V to 5.5V)**
  - **8V$_{MIN}$ at 2mA (Charge-Pump Output)**
- **Dynamic 0 to 2V REFIN2 Input on Second Output**
- **400kHz/300kHz Switching Frequency (1.5V/1.05V, Respectively)**
- **Power-Good (PGOOD1 and PGOOD2) Indicators**
- **Secondary Feedback Input Maintains Charge Pump**
- **32-Pin, 5mm x 5mm Thin QFN Package**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX17020EVKIT+	EV Kit

+Denotes lead-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
BYP, GATE, PGOOD1, PGOOD2, REFIN2	0	Not installed, test points
C2–C5	4	10µF ±20%, 25V X5R ceramic capacitors (1210) TDK C3225X7R1E106M AVX 12103D106M Taiyo Yuden TMK325BJ106MM
C6, C13, C18, C21, C23	5	1µF ±20%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A105M Murata GRM188R61A105M AVX 0603ZD105MAT
C7	0	Not installed, capacitor (D case)
C8	1	330µF, 2.5V, 9mΩ low-ESR capacitor (D case) SANYO 2R5TPE330M9
C9, C10, C14–C17, C20, C22	8	0.1µF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E104K TDK C1608X7R1E104K
C11, C12	2	470µF, 2.5V, 7mΩ low-ESR capacitors (D case) SANYO 2R5TPF470M7L
C19	1	4.7µF ±10%, 6.3V X5R ceramic capacitor (0805) TDK C2012X5R0J475K or Taiyo Yuden JMK212BJ475KG
D1, D2	2	100V, 200mA, dual diodes (SOT23) Fairchild MMBD4148SE (Top Mark: D4) Central Semi CMPD7000 Lead Free (Top Mark: C5C)
D3, D4	2	Green LEDs, clear SMD (0805)
JU1, JU2	2	3-pin headers
L1	1	2.2µH, 12A, 5.2mΩ inductor Cooper Bussmann HC7-2R2-R 2.2µH, 12.5A, 5.4mΩ inductor Sumida CEP125NP-2R2MC
L2	1	1µH, 20A, 1.6mΩ inductor Cooper Bussmann HC7-1R0-R 1µH, 16.5A, 2.5mΩ inductor Sumida CEP125NP-1R0MC

Quick-PWM is a trademark of Maxim Integrated Products, Inc.

MAX17020 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
N1, N3	2	N-channel MOSFETs (PowerPAK SO-8) Fairchild FDS6298 (SO-8) Vishay/Siliconix Si7634DP
N2, N4	2	N-channel MOSFETs (PowerPAK SO-8) Fairchild FDS8670 (SO-8) Vishay/Siliconix Si7336ADP
Q1	1	N-channel MOSFET (SOT23) Fairchild 2N7002 (Top Mark: 702) Zetex ZVN3306F (Top Mark: MC)
R1, R8, R12, R16, R20, R28, R29	7	0Ω resistors (0603)
R2, R3	2	4.7Ω ±5% resistors (0603)
R4, R5	2	1kΩ ±5% resistors (0603)
R6	1	590kΩ ±1% resistor (0603)
R7	1	200kΩ ±1% resistor (0603)
R9, R10, R11, R13, R14, R15, R18, R19, R27, R31	0	Not installed, resistors (0603)
R17	1	10Ω ±5% resistor (0603)
R21	1	80.6kΩ ±1% resistor (0603)
R22–R25, R30	5	100kΩ ±5% resistors (0603)
R26	1	140kΩ ±1% resistor (0603)
SW1	1	4-position, low-profile DIP switch
U1	1	Dual synchronous DC-DC converter (32-pin TQFN-EP*, 5mm x 5mm) Maxim MAX17020ETJ+
—	1	PCB: MAX17020 Evaluation Kit+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX Corporation	843-946-0238	www.avxcorp.com
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Cooper Bussmann	916-941-1117	www.fairchildsemi.com
Fairchild Semiconductor	888-522-5372	www.cooperet.com
IRC, Inc.	361-992-7900	www.irctt.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
SANYO North America Corp.	619-661-6835	www.sanyodevice.com
Sumida Corp.	847-545-6700	www.sumida.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com
Zetex Semiconductors	631-360-2222	www.zetex.com

Note: *Indicate that you are using the MAX17020 when contacting these component suppliers.*

Quick Start

Recommended Equipment

Before beginning, the following equipment is needed:

- MAX17020 EV kit
- One 6V to 24V, 100W DC power supply
- Two dummy loads capable of sinking 10A or greater
- Three voltmeters

Procedure

The MAX17020 EV kit is a fully assembled and tested surface-mount PCB. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

1) Verify that there is no shunt across JU1.
2) Verify that there is a shunt across JU2, pins 1-2.
3) Verify that all SW1 settings are in the open positions.
4) Connect a voltmeter across the VOUT1 and GND pads.
5) Connect a voltmeter across the VOUT2 and GND pads.
6) Connect a voltmeter across the VSEC and GND pads.
7) Turn on the power supply.
8) Verify that the output voltages are VOUT1 = 1.5V, VOUT2 = 1.05V and VSEC = 8V.

Detailed Description of Hardware

1.5V Output-Voltage Setting (V_{OUT1})

The MAX17020 provides a fixed 1.5V output (V_{OUT1}) when FB1 is connected to VCC (R8 = 0Ω, R9/R10 = open) or a fixed 5V output when FB1 is connected to GND (R10 = 0, R9 = open).

V_{OUT1} can also be adjusted from 0.7V to 5.5V using a resistive voltage-divider formed by R9 and R10. The MAX17020 regulates FB1 to a fixed reference voltage (0.7V).

The adjusted output voltage is:

$$V_{OUT1} = V_{FB1}(1 + R9/R10)$$

where V_{FB1} = 0.7V.

To change the output voltage to a value between 0.7V and 5.5V, set R10 equal to 49.9kΩ ±1%. Calculate R9 using the equation:

$$R9 = R10 [(V_{OUT1}/V_{FB1}) - 1]$$

where V_{FB1} = 0.7V.

Refer to the MAX17020 IC data sheet for selection of output capacitor and inductor values for different output voltages.

1.05V Output-Voltage Setting (V_{OUT2})

The MAX17020 provides a fixed 1.05V output (V_{OUT2}) when REFIN2 is connected to RTC (R12 = 0Ω, R11 = open), or a fixed 3.3V output when REFIN2 is connected to VCC (R11 = 0).

V_{OUT2} can also be adjusted from 0 to 2V using a resistive voltage-divider formed by R13 and R15. REFIN2 sets the feedback-regulation voltage ($V_{OUT2} = V_{REFIN2}$).

To change the output voltage to a value between 0 and 2V, set R15 equal to 49.9kΩ ±1%. Calculate R13 using the equation:

$$R13 = R15 [(V_{REF}/V_{OUT2}) - 1]$$

where V_{REF} = 2V.

By changing the voltage at REFIN2, the MAX17020 can be used in applications that require multiple dynamic-output voltages. Control FET Q1 changes the voltage at REFIN2 by switching resistors in and out of the resistor network. An external signal at GATE can control Q1 and the voltage at REFIN2.

Refer to the MAX17020 IC data sheet for selection of output capacitor and inductor values for different output voltages.

LDO Voltage Setting (LDO)

The MAX17020 provides a fixed 5V, 100mA output linear regulator (LDO) when LDOREFIN is connected to GND (R20 = 0Ω, R18/R19 = open), or a fixed 3.3V linear output when LDOREFIN is connected to VDD (R19 = 0Ω, R18/R20 = open).

LDO voltage can also be adjusted from 0.6V to 4V. LDOREFIN sets the LDO regulation voltage ($V_{LDO} = 2 \times V_{LDOREFIN}$) for a 0.3V to 2V LDOREFIN range.

$$V_{LDOREFIN} = V_{REF} [R20/(R18 + R20)]$$

where V_{REF} = 2V.

8V Output-Voltage Setting (VSEC)

An external unregulated charge pump is connected to VOUT1 and generates an $8V_{MIN}$ (VSEC) auxiliary voltage capable of delivering 2mA from the 1.5V output. When the SECFB voltage drops below its 2V feedback threshold, the MAX17020 issues an ultrasonic pulse. This forces a switching cycle, allowing the external unregulated charge pump to be refreshed. Refer to the *Ultrasonic Mode ($\overline{SKIP}$ = Open or REF)* section in the MAX17020 IC data sheet for more information.

To change the VSEC refresh voltage, set R7 = 200kΩ ±1%. Calculate R6 using the equation:

$$R6 = R7\ [(V_{SEC}/V_{SECFB}) - 1]$$

where V_{SECFB} = 2V.

To disable the secondary feedback, connect SECFB to VDD by installing R31 with a 200kΩ resistor. Uninstall the secondary feedback resistors R6 and R7.

Jumper and Switch Settings

The switching frequency of the MAX17020 is adjusted by changing jumper JU1. As configured, the MAX17020 EV kit operates at 400kHz/300kHz. When changing the switching frequency, refer to the MAX17020 IC data sheet for the proper component selection and calculations for the MOSFETs, inductors, and output capacitors.

Table 1. Jumper JU1 Functions (Switching-Frequency Selection)

SHUNT POSITION	TON PIN	FREQUENCY V_{OUT1}/V_{OUT2} (kHz)
1-2	Connected to VDD	200/300
2-3	Connected to GND	400/500
Not installed*	Pulled to REF	400/300 (as shipped)

**Default position.*

Table 2. Jumper JU2 Functions (Operating-Mode Selection)

SHUNT POSITION	$\overline{SKIP}$ PIN	OPERATING MODE
1-2*	Connected to VDD	Low-noise, forced fixed-frequency PWM operation
2-3	Connected to GND	Automatic, high-efficiency, pulse-skipping operation at light loads
Not installed	Floating	Ultrasonic mode

**Default position.*

Table 3. Switch SW1 Settings

SWITCH SETTINGS		PIN CONTROL	MAX17020 OPERATION
SW1-A	Off (Open)	Control FET Q1 is on Control FET Q1 is off	Resistor R14 is switched in and out of the resistor network changing REFIN2 voltage. (**Note:** R14 is not populated in the default circuit.)
	On (Short)		
SW1-B	Off (Open)	ON1 pin is connected to VDD	Enables SMPS1, V_{OUT1} = 1.5V; VSEC = 8V
	On (Short)	ON1 pin is connected to GND	Disables SMPS1, V_{OUT1} = 0V; VSEC = 0V
SW1-C	Off (Open)	ON2 pin is connected to VDD	Enables SMPS2, V_{OUT2} = 1.05V
	On (Short)	ON2 pin is connected to GND	Disables SMPS2, V_{OUT2} = 0V
SW1-D	Off (Open)	ONLDO pin is connected to VIN	Enables LDO output, VLDO = 5V
	On (Short)	ONLDO pin is connected to GND	Disables LDO output, VLDO = 0V

Note: *As configured, the MAX17020 EV kit is shipped with all SW1 settings in the off positions.*

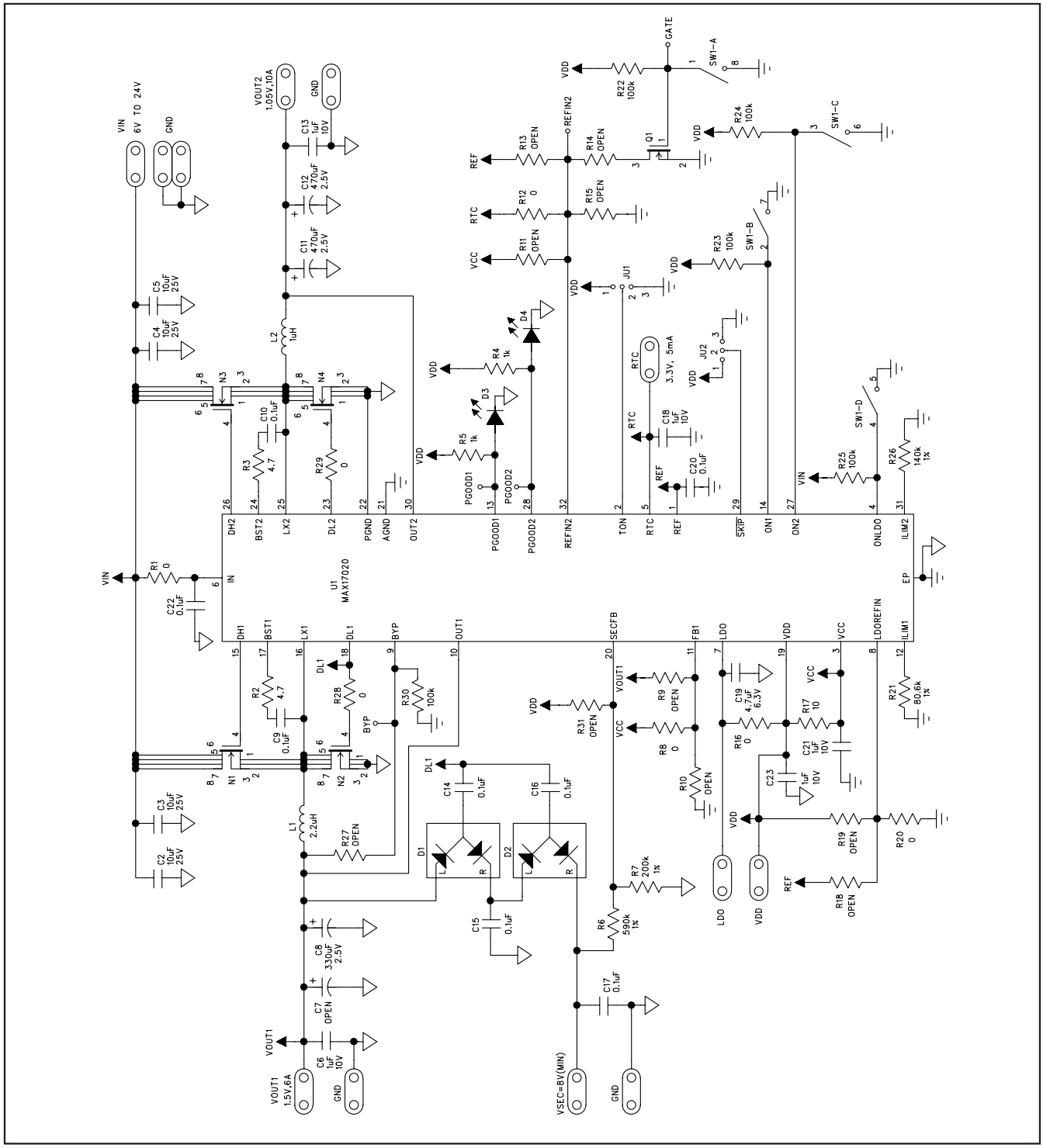

Figure 1. MAX17020 EV Kit Schematic

MAX17020 Evaluation Kit

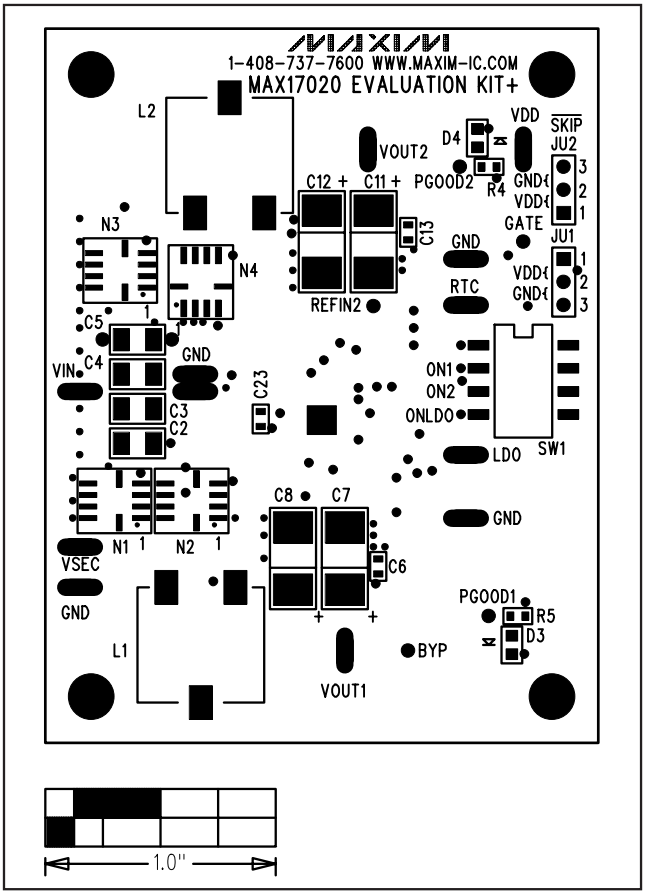

Figure 2. MAX17020 EV Kit Component Placement Guide—Component Side

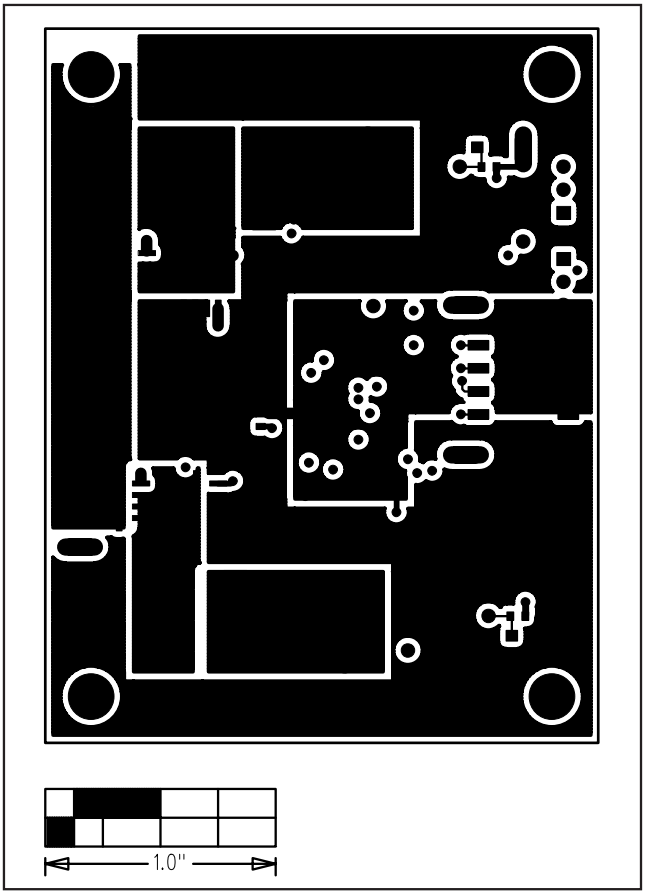

Figure 3. MAX17020 EV Kit PCB Layout—Component Side

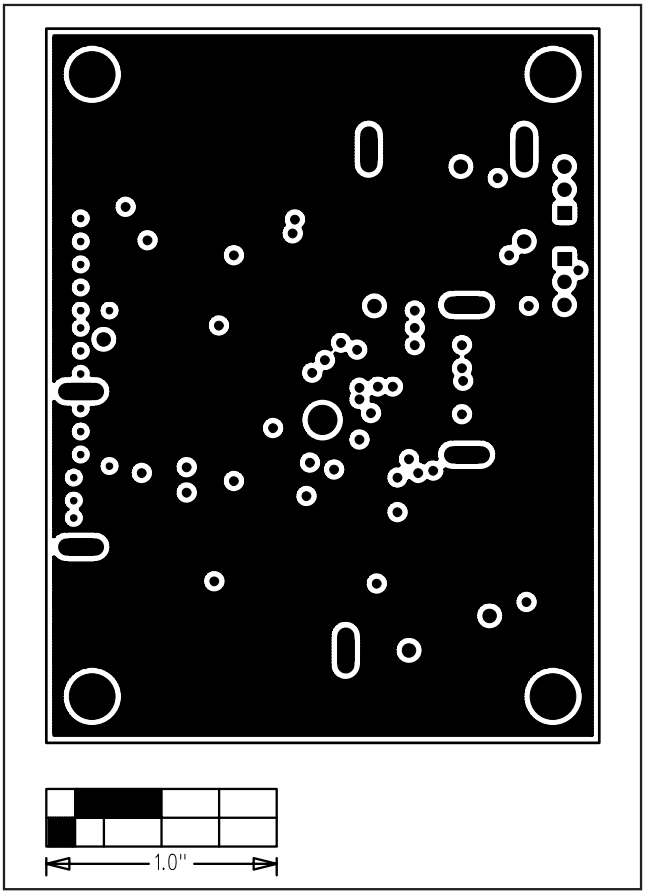

Figure 4. MAX17020 EV Kit PCB Layout—Layer 2 (PGND Plane)

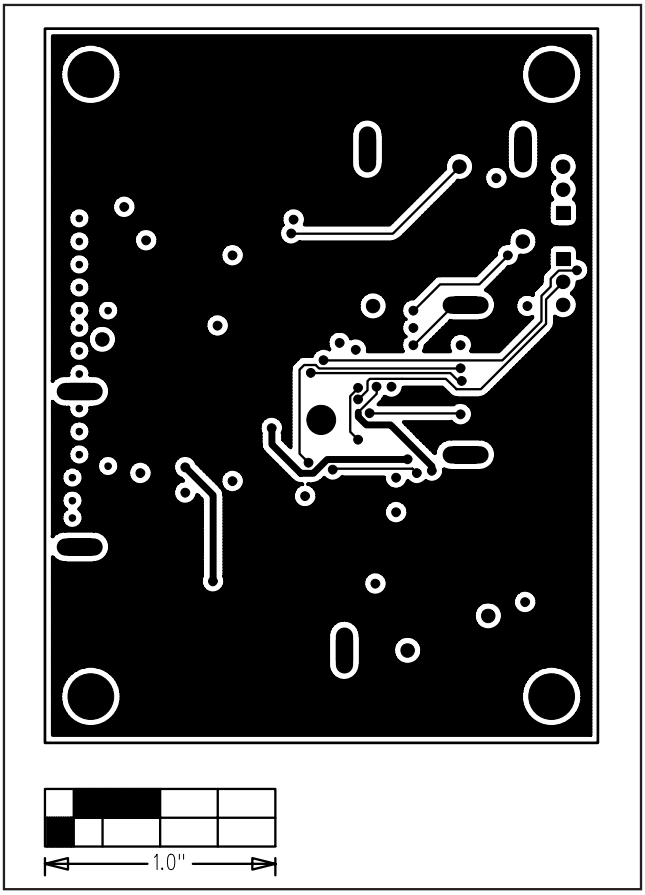

Figure 5. MAX17020 EV Kit PCB Layout—Layer 3 (PGND/Signal Layer)

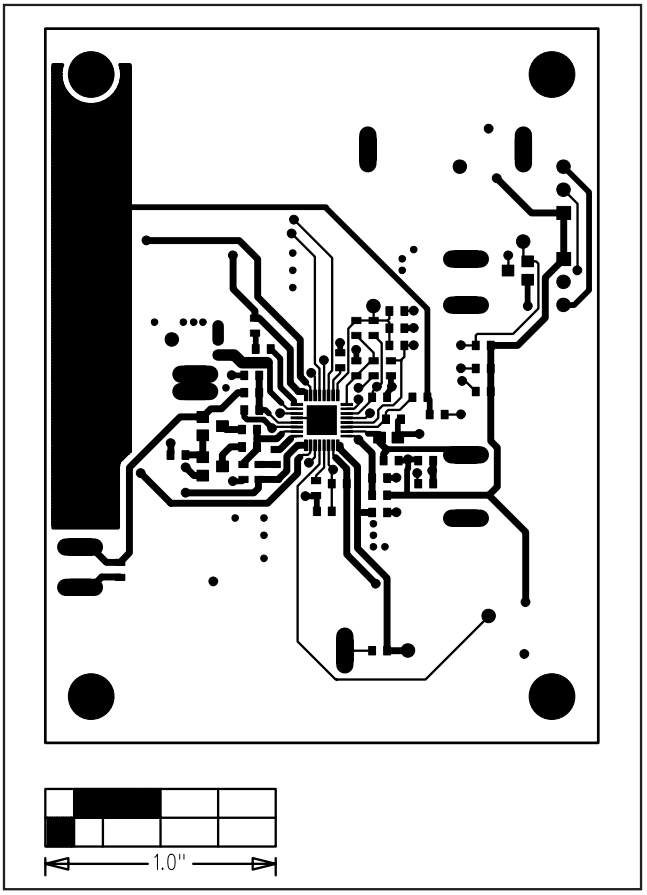

Figure 6. MAX17020 EV Kit PCB Layout—Solder Side

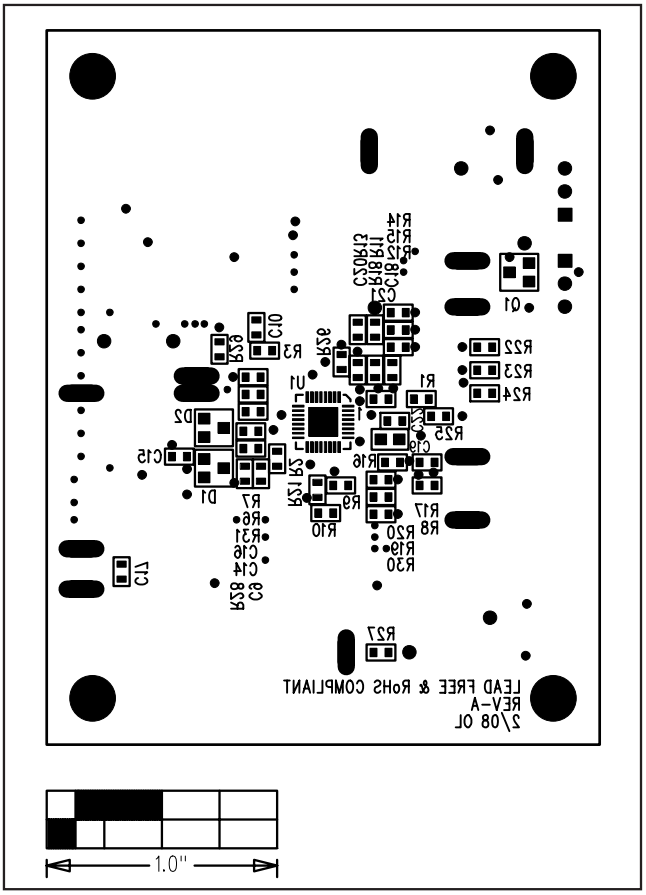

Figure 7. MAX17020 EV Kit Component Placement Guide—Solder Side