

## MAX20090B Evaluation Kit

Evaluates: MAX20090B

### General Description

The MAX20090B evaluation kit (EV kit) provides a proven design to evaluate the MAX20090B automotive high-voltage, high-brightness LED (HB LED) controller. The EV kit is set up for SEPIC configuration and operates from a 6V to 18V DC supply voltage. The EV kit is configured to deliver up to 1A to one string of LEDs. The total voltage of the string can vary from 3V to 24V. The anode of the LED string should be connected to the LED+ terminal. The cathode of the LED string should be connected to PGND.

### Features

- Configured for SEPIC Mode
- Analog Dimming Control
- Proven PCB Layout
- Fully Assembled and Tested

### Quick Start

#### Required Equipment

- MAX20090B EV kit
- 12V, 5A DC power supply
- A series-connected LED string rated at 1A
- Oscilloscope with a current probe

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

### 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 made.**

- 1) Verify that all jumpers (J1–J4) are in their default positions, as shown in [Table 1](#).
- 2) Connect the positive terminal of the 12V supply to the IN PCB pad and the negative terminal to the nearest GND1 PCB pad.
- 3) Connect the LED string across the LED+ and GND2 PCB pads on the EV kit for SEPIC configuration. The LED string voltage should be between the minimum and maximum input voltage in this configuration.
- 4) Clip the current probe on the wire connected to the LED string.
- 5) Turn on the DC power supply.
- 6) Verify that the LEDs turn on.
- 7) Verify that the oscilloscope displays approximately 1A.

### Detailed Description

The MAX20090B EV kit provides a proven design to evaluate the MAX20090B high-voltage HB LED driver with integrated high-side current sense. The EV kit is set up for SEPIC configuration and operates from a 6V to 18V DC supply voltage. The EV kit is configured to deliver up to 1A to a series LED string. The string-forward voltage can vary from 3V to 24V.

**Table 1. MAX20090B EV Kit Jumper Descriptions (J1–J4)**

JUMPER	SHUNT POSITION	DESCRIPTION
J1	1-2*	Connects the PWMDIM pin of the device to VCC through a 4.99kΩ resistor. The LEDs turn on when the input voltage goes above the UVLO level if J4 is open.
	2-3	Connects the PWMDIM pin to ground through a 4.99kΩ resistor. Need to apply an external PWM signal or a DC voltage on the PWMDIM PCB pad to turn on the LEDs when the input voltage on IN is in the operating range.
	Open	Connects the PWMDIM pin to ground if J4 is installed; otherwise, PWMDIM pin is unconnected.
J2	1-2	Connects VCC to the ICTRL pin. LED current is at the maximum value of 1.1A in this configuration.
	2-3*	ICTRL pin is now connected to a voltage-divider from VCC to ground. Adjusting R2 allows programming the LED current from 0 to 1.1A.
	Open	Disconnects the ICTRL pin of the device from the external voltage-divider on the VCC pin. Allows the user to apply an external voltage to set the LED current level.
J3	1-2*	Connects the $\overline{\text{FLT}}$ pin to VCC through a 10kΩ resistor.
	Open	No pullup on $\overline{\text{FLT}}$ pin.
J4	Open*	PWMDIM pin is controlled by the jumper J1 setting only.
	1-2*	Analog voltage on PWMDIM pin controlled by the voltage-divider of R13 and R18. Adjust R18 to vary the analog voltage on PWMDIM. Jumper J1 should be in default position.

\*Default position.

### Analog Dimming Control (ICTRL)

When J2 is installed across pins 1-2, the LED current is set at the maximum current. The ICTRL pin is connected to VCC and in this case, the LED current is given by the following equation:

$$I_{\text{LED}} = \frac{220\text{mV}}{R14}$$

When J2 is installed across pins 2-3, the ICTRL pin is connected to the voltage-divider of R1 and R2, which sets the voltage at ICTRL.

In the case of the EV kit,  $I_{\text{LED}}$  is set to 1A. If  $V_{\text{ICTRL}} < 1.2\text{V}$ , then  $V_{\text{ICTRL}}$  sets the LED current level.

Alternatively, the analog dimming can be controlled by removing the shunt on J2 and applying a voltage between 0 and 5.5V on the ICTRL PCB pad on the EV kit.

### Pulse-Dimming Input (PWMDIM)

Pulse dimming can be achieved by applying a pulsating voltage source on the PWMDIM PCB pad on the EV kit. When PWMDIM is pulled low,  $\overline{\text{DIMOUT}}$  is pulled high and the pulse-width-modulated (PWM) switching is disabled.

This can be done by installing the shunt on J1 across pins 2-3, without applying any external voltage on the PWMDIM PCB pad. The PWMDIM pin can also be controlled by an analog DC voltage on the PWMDIM pin. In this case, the dimming frequency is internally set at 200Hz. This can be achieved by installing the shunt on J1 across pins 1-2, the shunt on J4 installed across pins 1-2, and adjusting potentiometer R18. The dimming duty cycle can be adjusted from 0 to 100% duty cycle by adjusting the voltage on the PWMDIM pin from 0.2V to 3.25V.

Alternatively, PWM dimming can be achieved by applying a DC voltage between 0.2V and 3.3V on the PWMDIM PCB pad, with J1 and J4 open.

### Ordering Information

PART	TYPE
MAX20090BEVKIT#	EV Kit

#Denotes RoHS compliant.

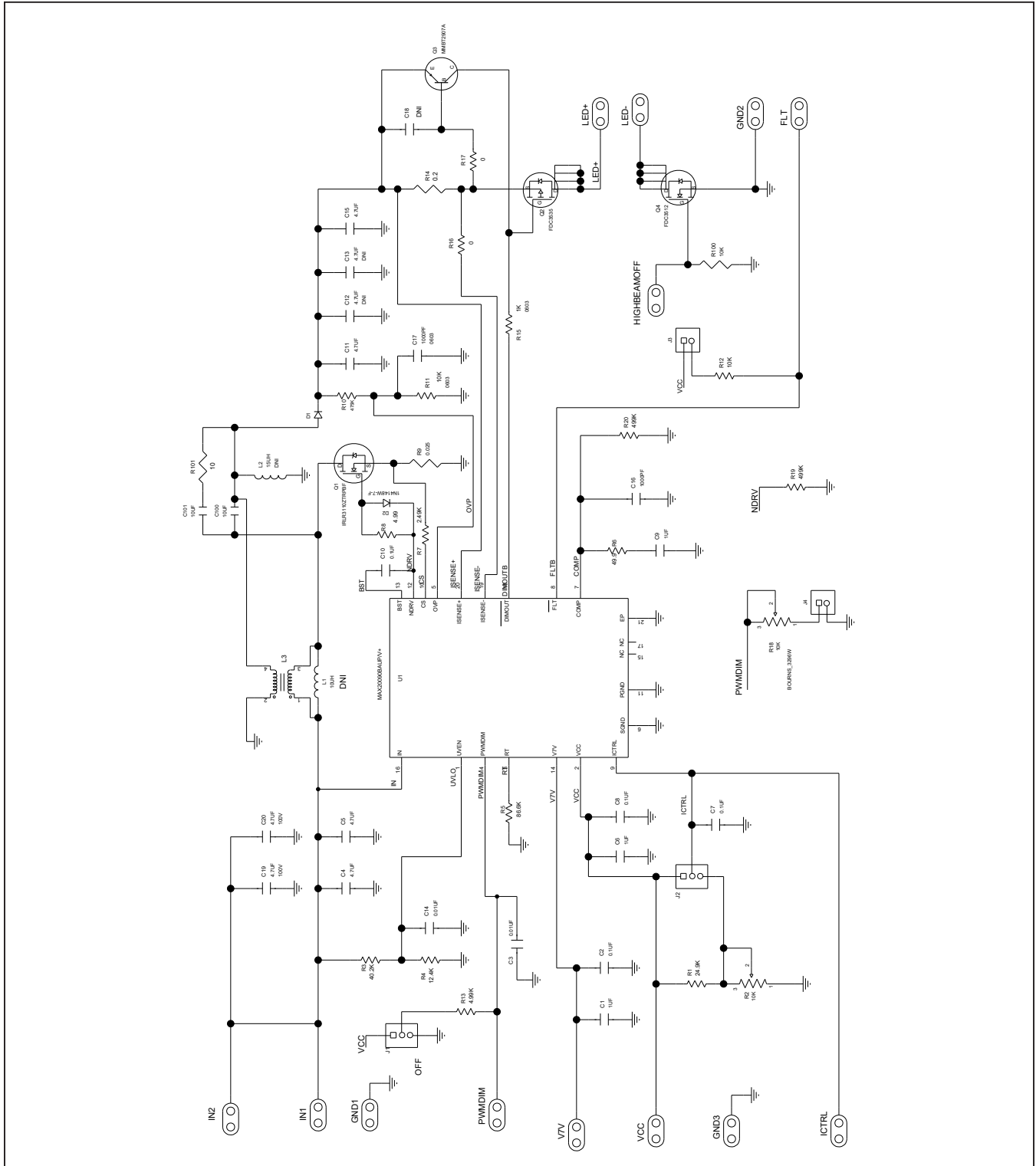
MAX20090B EV Kit Bill of Materials

ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	C1, C6, C9	3	C0603C105K4RAC; GRM188R71C105KA12;C1608X7 R1C105K080AC;EMK107B7 105KA ;GCM188R71C105KA64;CGA3E1 X7R1C105K080AC	KEMET;MURATA;TDK; TAIYO YUDEN;MURATA;TDK	1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 16V; TOL=10%; MODEL=: TG=-55 DEGC TO +125 DEGC; TC=X7R	
2	C2, C7, C8, C10	4	GCJ188R71H104KA12; GCM188R71H104K; CGA3E2X7R1H104K080AA	MURATA;MURATA;TDK	0.1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.1UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
3	C3	1	CGA3EANP02A103J080AC	TDK	0.01UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.01UF; 100V; TOL=5%; MODEL=MULTILAYER CERAMIC CHIP CAPACITOR; TC=NPO	
4	C4, C5, C11, C15, C19, C20, C12, C13	8	CGA6M3X7S2A475K200AE; CGA6M3X7S2A475K200AB	TDK;TDK	4.7UF	CAPACITOR; SMT (1210); CERAMIC CHIP; 4.7UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7S; AUTO	(C12,C13:DNI)
5	C14	1	CGA3E2X7R2A103K; C0603C103K1RA;GRM188R72A1 03KA01	TDK;KEMET;MURATA	0.01UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.01UF; 100V; TOL=10%; MODEL=X7R; TG=-55 DEGC TO +125 DEGC; TC= USE 20- 00u01-M8	
6	C16	1	GRM1885C1H102JA01; C1608C0G1H102J080AA; GCM1885C1H102JA16	MURATA;TDK;MURATA	1000PF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1000PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC	
7	C17, C18	2	GRM1885C1H102FA01	MURATA	1000PF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1000PF; 50V; TOL=1%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=C0G	
8	C100	1	GRM32DF51H106ZA01L	MURATA	10UF	CAPACITOR; SMT (1210); CERAMIC CHIP; 10UF; 50V; TOL=+80%-20%; MODEL=Y5V; TG=- 30 DEGC TO +85 DEGC; TC	
9	C101	1	UMK325BJ106KM-T	TAIYO YUDEN	10UF	CAPACITOR; SMT (1210); CERAMIC CHIP; 10UF; 50V; TOL=10%; MODEL=_MK SERIES; TG=-55 DEGC TO +85 DEGC; TC=X5R	
10	D1	1	B3100-13-F	DIODES INCORPORATED	B3100-13-F	DIODE; RECT; SMC; PIV=100V; IF=3A	
11	D2	1	1N4148W-7-F	DIODES INCORPORATED	1N4148W-7-F	DIODE; SWT; SMT (SOD-123); PIV=100V; IF=0.3A; -65 DEGC TO +150 DEGC	
12	FLT, GND1-GND3, HIGHBEAMOFF, ICTRL, IN1, IN2, LED+, LED-, PWMDIM, V7V, VCC	13	9020 BUSS	WEICO WIRE	MAXIMPAD	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-S; 20AWG	
13	J1, J2	2	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC	
14	J3, J4	2	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC	
15	L1	1	MSS1278-103ML	COILCRAFT	10UH	INDUCTOR; SMT; FERRITE CORE; 10UH; TOL=+/-20%; 5.7A	DNI
16	L2	1	MSS6132T-153ML	COILCRAFT	15UH	INDUCTOR; SMT; FERRITE; 15UH; 20%; 2.20A	DNI
17	L3	1	MSD1278T-153ML	COILCRAFT	MSD1278T-153ML	INDUCTOR; SMT; FERRITE; MSD1278T-153M; 20%; 3.25A	
18	Q1	1	IRLR3110ZTRPBF	INTERNATIONAL RECTIFIER	IRLR3110ZTRPBF	TRAN; HEXFET POWER MOSFET; NCH; DPAK; PD-(140W); I- (63A); V-(100V)	
19	Q2	1	FDC3535	FAIRCHILD SEMICONDUCTOR	FDC3535	TRAN; P-CHANNEL POWER TRENCH MOSFET; PCH; SSOT-6; PD-(1.6W); I-(-2.1A); V-(- 80V)	
20	Q3	1	MMBT2907A	FAIRCHILD SEMICONDUCTOR	MMBT2907A	TRAN; SMALL SIGNAL TRANSISTOR; PNP; SOT-23; PD- (0.35W); IC-(-0.6A); VCEO-(-60V)	

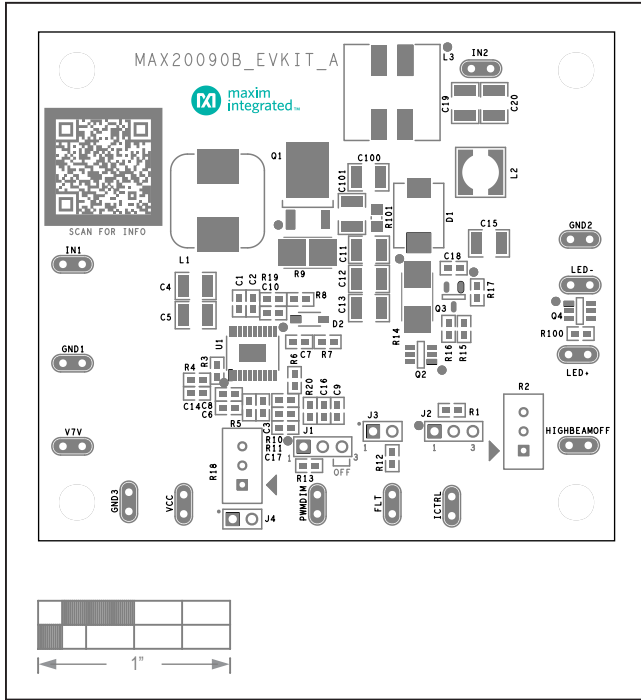
MAX20090B EV Kit Bill of Materials (continued)

ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
21	Q4	1	FDC3512	ON SEMICONDUCTOR	FDC3512	TRAN; N-CHANNEL POWERTRENCH MOSFET; NCH; SUPERSOT-6; PD-(1.6W); I-(3A); V- (80V)	
22	R1	1	CRCW060324K9FK; ERJ-3EKF2492	VISHAY DALE; PANASONIC	24.9K	RESISTOR; 0603; 24.9K OHM; 1%; 100PPM; 0.10W; THICK FILM	
23	R2, R18	2	3296W-1-103LF	BOURNS	10K	RESISTOR; THROUGH-HOLE- RADIAL LEAD; 3296 SERIES; 10K OHM; 10%; 100PPM; 0.5W; SQUARE TRIMMING POTENTIOMETER; 25 TURNS; MOLDER CERAMIC OVER METAL FILM	
24	R3	1	CRCW060340K2FK; RC0603FR-0740K2L; ERJ-3EKF4022	VISHAY DALE;YAGEO; PANASONIC	40.2K	RESISTOR; 0603; 40.2K; 1%; 100PPM; 0.10W; THICK FILM	
25	R4	1	ERJ-3EKF1242	PANASONIC	12.4K	RESISTOR; 0603; 12.4K OHM; 1%; 100PPM; 0.10W; THICK FILM	
26	R5	1	CRCW060386K6FK	VISHAY DALE	86.6K	RESISTOR; 0603; 86.6K OHM; 1%; 100PPM; 0.10W; THICK FILM	
27	R6	1	CRCW060349R9FK	VISHAY DALE	49.9	RESISTOR; 0603; 49.9 OHM; 1%; 100PPM; 0.10W; THICK FILM	
28	R7	1	CRCW06032K49FK; CR0603-FX-2491	VISHAY DALE;BOURNS	2.49K	RESISTOR; 0603; 2.49K; 1%; 100PPM; 0.10W; THICK FILM	
29	R8	1	CRCW06034R99FK	VISHAY DALE	4.99	RESISTOR; 0603; 4.99 OHM; 1%; 100PPM; 0.1W; THICK FILM	
30	R9	1	WSL2512R0250F	VISHAY DALE	0.025	RESISTOR; 2512; 0.025 OHM; 1%; 75PPM; 1.0W; METAL FILM	
31	R10	1	CRCW0603475KFK	VISHAY DALE	475K	RESISTOR; 0603; 475K OHM; 0.1%; 100PPM; 0.1W; THICK FILM	
32	R11, R12	2	CRCW060310K0FK; ERJ-3EKF1002	VISHAY DALE; PANASONIC	10K	RESISTOR; 0603; 10K; 1%; 100PPM; 0.10W; THICK FILM	
33	R13	1	CRCW06034K99FK; ERJ-3EKF4991	VISHAY DALE; PANASONIC	4.99K	RESISTOR; 0603; 4.99K; 1%; 100PPM; 0.10W; THICK FILM	
34	R14	1	WSL2512R2000F	VISHAY DALE	0.2	RESISTOR; 2512; 0.2 OHM; 1%; 75PPM; 1.0W; THICK FILM	
35	R15	1	CRCW06031K00FK; ERJ-3EKF1001	VISHAY DALE; PANASONIC	1K	RESISTOR; 0603; 1K; 1%; 100PPM; 0.10W; THICK FILM	
36	R16, R17	2	CRCW06030000ZS; MCR03EZPJ000; ERJ-3GEY0R00	VISHAY DALE;ROHM; PANASONIC	0	RESISTOR; 0603; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM	
37	R19, R20	2	CRCW0603499KFK; ERJ-3EKF4993	VISHAY DALE; PANASONIC	499K	RESISTOR; 0603; 499K OHM; 1%; 100PPM; 0.1W; THICK FILM	
38	R100	1	301-10K-RC	XICON	10K	RESISTOR; 0603; 10K OHM; 5%, 200PPM; 1/16W; THICK FILM	
39	R101	1	TNPW080510R0BE; CRT0805-BY-10R0ELF	VISHAY DALE;BOURNS	10	RESISTOR; 0805; 10 OHM; 0.1%; 25PPM; 0.125W; THICK FILM	
40	SPACER1-SPACER4	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON	
41	SU1-SU4	4	SNT-100-BK-G	SAMTEC	SNT-100-BK-G	TEST POINT; SHUNT AND JUMPER; STR; TOTAL LENGTH=6.10MM; BLACK; INSULATION=GLASS FILLED POLYESTER; CONTACT=PHOSPHOR BRONZE	
42	U1	1	MAX20090BAUP/V+	MAXIM	MAX20090BAUP/V+	EVKIT PART - IC; MAX20090BAUP/V+; AUTOMOTIVE HIGH-VOLTAGE; HIGH- BRIGHTNESS LED CONTROLLER; PACKAGE CODE: U20E+3C; PACKAGE OUTLINE: 21-100132; PACKAGE LAND PATTERN: 90- 100049; TQFN20-EP	
43	PCB	1	MAX20090B	MAXIM	PCB	PCB:MAX20090B	-
TOTAL		80					

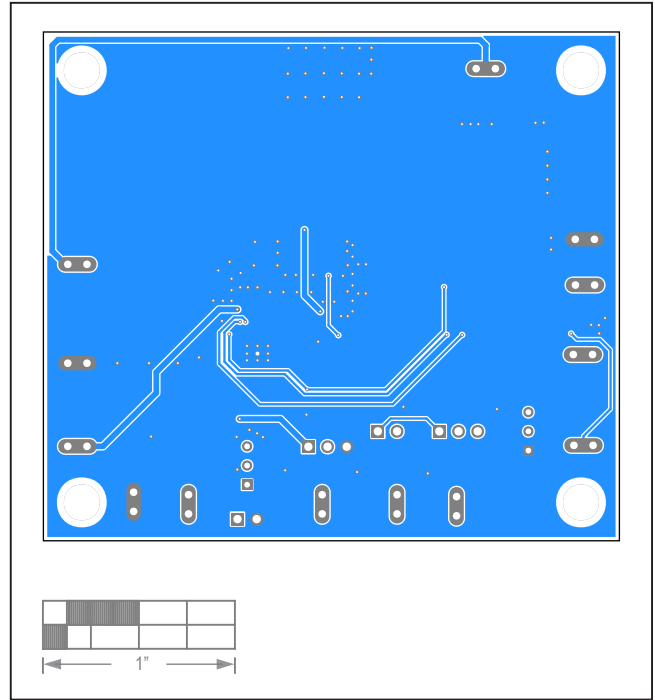
MAX20090B EV Kit Schematics



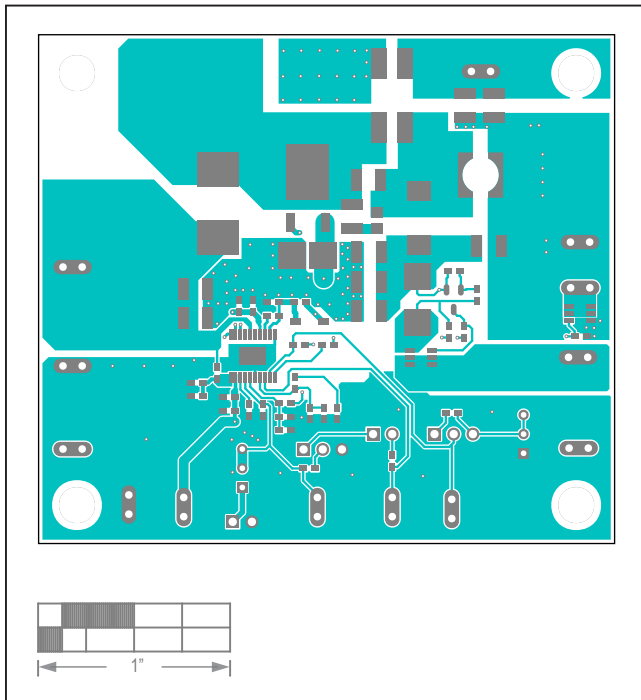
MAX20090B EV Kit PCB Layouts



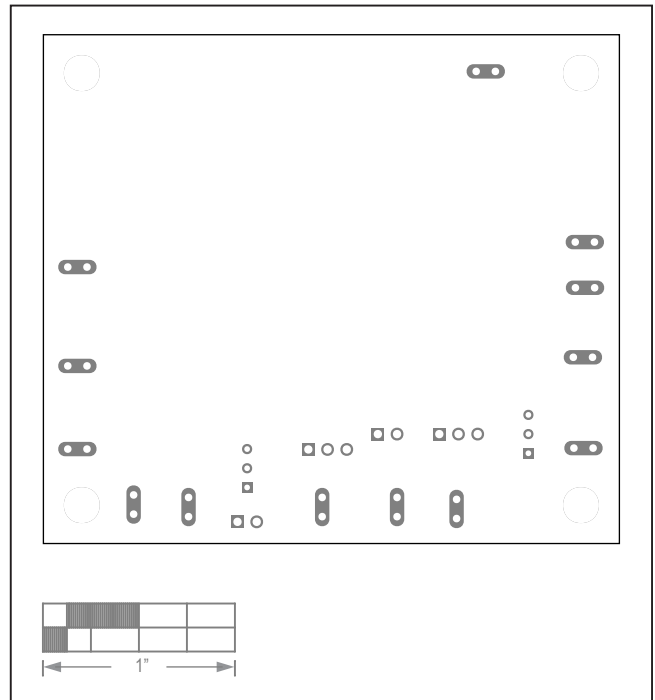
Silk Top



Bottom



Top



Silk Bottom

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/19	Initial release	—

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[390](#) [1216.1013](#) [TPS61176EVM-566](#) [TPS61197EVM](#) [TPS92001EVM-628](#) [1270](#) [1271.2004](#) [1272.1030](#) [1273.1010](#) [1278.1010](#) [1279.1002](#)  
[1279.1001](#) [1282.1000](#) [1293.1900](#) [1293.1800](#) [1293.1700](#) [1293.1500](#) [1293.1100](#) [1282.1400](#)