

General Description

The MAX20067 evaluation kit (EV kit) is a fully assembled and tested surface-mount PCB that provides the voltages and features required for automotive thin-film transistor (TFT), liquid-crystal display (LCD) applications. The EV kit includes a synchronous boost converter, double-stage positive charge pump, double-stage negative charge pump, VCOM buffer, and gate-shading push-pull switch. The EV kit can operate from 2.7V to 5.5V input voltages and is optimized for automotive TFT-LCD applications. The EV kit can be configured to operate in stand-alone mode or in I²C mode. The boost converter is configured for a 12V output that provides at least 200mA. The positive-gate voltage regulator provides 16V output and the negative-gate voltage regulator provides -6V. The VCOM buffer provides an I²C-adjustable output voltage initially biased at 6V.

The EV kit provides an I²C interface that can operate in conjunction with the MINIQUSB+ adapter board or a third-party I²C master, such as a general-purpose microcontroller. The EV kit also includes Windows®-compatible software that provides a simple graphical user interface (GUI) for exercising the features of the IC. The EV system includes both the EV kit and the MINIQUSB+ adapter board.

Benefits and Features

- 2.7V to 5.5V Input Range
- Default Output Voltage
 - 12V Output at 200mA, (Boost Converter)
 - 16V Output at 10mA (Positive-Gate Voltage Regulator)
 - -6V Output at 3mA (Negative-Gate Voltage Regulator)
 - 6V Output at 130mA (VCOM Buffer)
- Selectable Switching Frequency (2.2MHz or 400kHz) with Spread-Spectrum Option
- Double-Stage Positive- and Negative-Regulated Charge Pumps
- Gate Shading Enabled
- Full Sequencing Flexibility
- I²C Programmability
- Dedicated GUI
- C Driver Available
- Proven PCB Layout
- Fully Assembled and Tested

Ordering Information appears at end of data sheet.

Windows is a registered trademark and registered service mark of Microsoft Corporation.

MAX20067 EV Kit Files

FILE	DESCRIPTION
MAX20067GUISetupVxx.exe	Windows GUI Installer

Quick Start

Required Equipment

- MAX20067 EV kit
- 2.7V to 5.5V, 3A power supply
- Voltmeter
- MINIQUSB+ interface board with USB cable
- User-supplied Windows-compatible PC with a spare USB port

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

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

Manual Mode

- 1) Verify that shunts are installed across pins 1-2 on jumpers J1–J9.
- 2) Connect the positive terminal of the power supply to the TFT_POWER_IN PCB pad and the negative terminal to the PGND PCB pad.
- 3) Set the power-supply TFT_POWER_IN to 5V.
- 4) Turn on the power supply.
- 5) Verify that the green LED (DS1) is on.
- 6) Verify that the boost converter (AVDD PCB pad) is 12V.
- 7) Verify that the VCOM buffer (VCOM PCB pad) regulator is 6V.
- 8) Verify that the positive-gate voltage regulator (VGON PCB pad) is approximately +16V.
- 9) Verify that the negative-gate voltage regulator (VGOFF PCB pad) is approximately -6V.

I²C Mode

- 1) Visit www.maximintegrated.com/evkitsoftware to download the latest version of the EV kit software, MAX20067GUISetupVxx.exe.
- 2) Install the EV kit software (GUI) on your PC by running the MAX20067GUISetupVxx.exe program. The EV kit software application will be installed together with the required MINIQUSB+ drivers.
- 3) Verify that shunts are installed across pins 1-2 on jumpers J1–J3 and J5–J9.
- 4) Verify that a shunt is installed across pins 2-3 on jumper J4.
- 5) Connect the MINIQUSB+ interface board's P3 header to the J10 header on the EV kit.
- 6) Connect the positive terminal of the power supply to the TFT_POWER_IN PCB pad. Connect the negative terminal of the power supply to the PGND PCB pad.
- 7) Set the power-supply TFT_POWER_IN to 5V.
- 8) Turn on the power supply.
- 9) Verify that the green LED (DS1) is on.
- 10) Launch the EV kit software application.
- 11) From the EV kit software toolbar, select **Device → Scan for Address**. The GUI scans the I²C bus for available slave addresses on the bus and selects the first one (in this case, the MAX20067 I²C address). Press **OK** once the MAX20067 I²C address has been found.
- 12) Verify that the status bar in the bottom-right corner of the GUI displays **EV Kit: Connected**, as shown in [Figure 1](#).
- 13) In the **0x02 REGULATORS CONTROL** register group box, check in order: **EN_BST**, **EN_AVDD**, **EN_VGON**, **EN_VGOFF**, and click the **Read All** button.
- 14) In the **0x03 REGULATORS POWER STATUS (Read Only)** register group box, verify that the **BST_ON**, **AVDD_ON**, **VGON_ON**, **VGOFF_ON**, and **VCOM_ON** indicators are green.
- 15) For more details on how to use the GUI and all the features available, click on the GUI **Help** menu item.

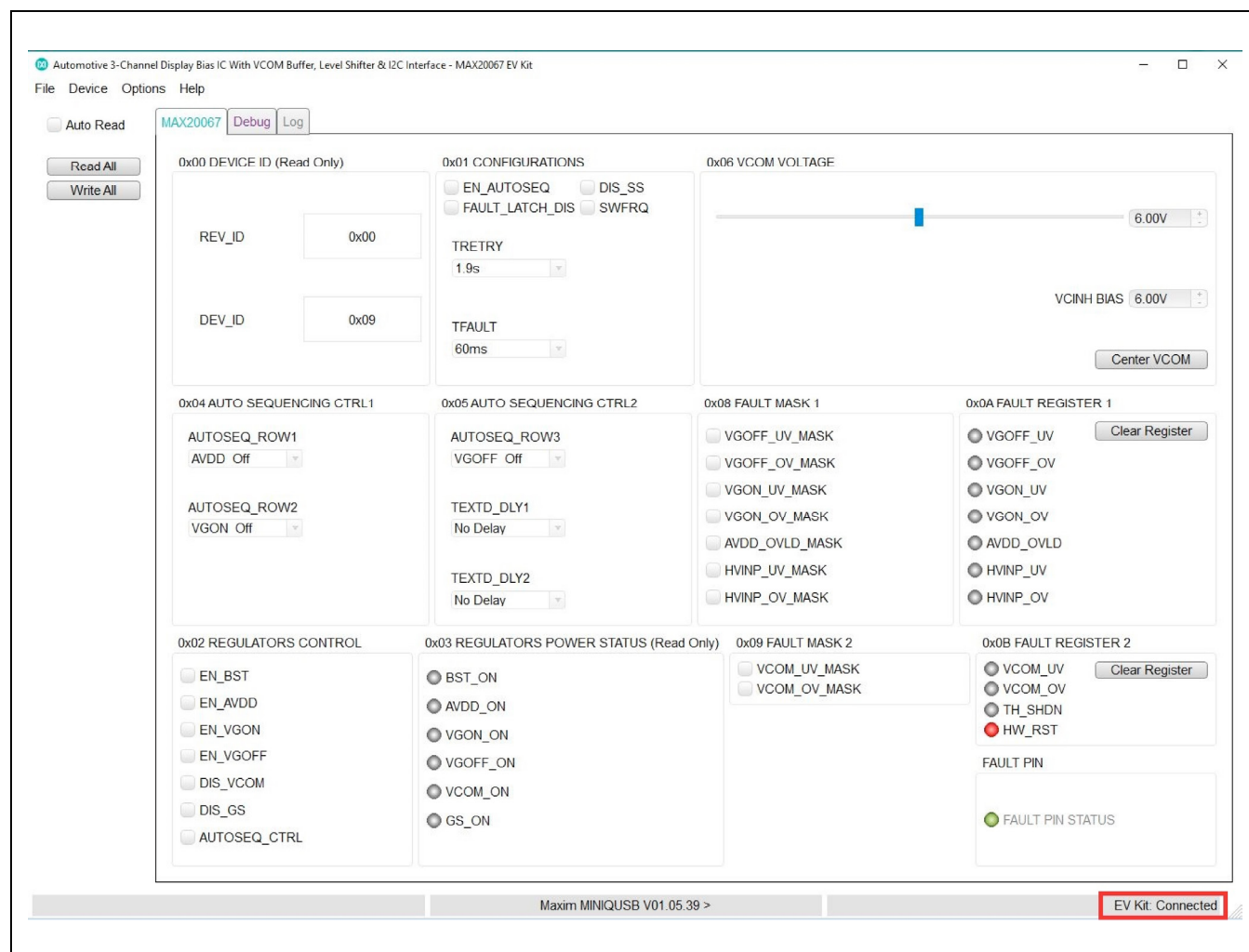


Figure 1. MAX20067 Evaluation Kit Software (GUI)

Detailed Description of Hardware

Jumper Settings

Several jumper settings in the following tables illustrate features of the MAX20067 EV kit.

Digital Domain Voltage (J1)

The EV kit exposes digital outputs (FLT, SDA, and SCL) that are referred to as the “digital domain voltage.”

Digital domain voltage can be selected between the TFT_POWER_IN voltage and the fixed 3.3V provided by the MINIUSB+. Alternatively, you can force an external voltage as digital reference (see [Table 1](#)).

I²C Slave Address (J2)

The IC’s 7-bit I²C slave address can be selected between two options through the J2 jumper setting (see [Table 2](#)).

Note: Do not leave J2 open.

Table 1. Jumper Functions (J1)

SHUNT POSITION	DIGITAL DOMAIN
1-2*	TFT_POWER_IN
2-3	3.3V (with MINIUSB+ connected)
Open	Externally provided (J1 pin 2)

*Default position.

Table 2. Jumper Functions (J2)

SHUNT POSITION	7-BIT I ² C SLAVE ADDRESS
1-2*	0x28
2-3	0x20

*Default position.

Table 3. Jumper Functions (J3)

SHUNT POSITION	DS1 POWER LED
1-2*	Connected
Open	Disconnected

*Default position.

Power LED Enable (J3)

A green LED (DS1) is used to indicate that the EV kit is powered on. The LED can be disconnected from the power supply, allowing precise current-consumption evaluation. See [Table 3](#) for shunt positions.

Supply Sequencing (J4)

The IC can be used either in stand-alone mode or I²C mode, selectable through jumper J4 settings. When the IC is used in stand-alone mode, two different supply sequencing options are available. Refer to the MAX20067 IC data sheet for more details on the supply sequencing options. See [Table 4](#) for shunt positions.

Enable (J5)

When operating in stand-alone mode, the IC can be disabled acting on the ENP pin, reducing the current consumption at its minimum value. Furthermore, an external digital signal can be used to enable/disable the IC (see [Table 5](#)).

Table 4. Jumper Functions (J4)

SHUNT POSITION	SUPPLY SEQUENCING
1-2*	Stand-alone mode (Sequencing Option 1)
2-3	I ² C mode
Open	Stand-alone mode (Sequencing Option 2)

*Default position.

Table 5. Jumper Functions (J5)

SHUNT POSITION	MAX20067
1-2*	Enabled
2-3	Disabled
Open	Externally controlled through digital signal (J5, pin 2)

*Default position.

Gate-Shading Mode (J6)

The IC provides the option to delay the fall of the GATES output. The delay can be adjusted by an external capacitor (C1). If not required, delay can be disabled through J6 jumper setting (see [Table 6](#)). **Note:** Do not leave J6 open.

VCOM Buffer Supply (J7)

The IC provides a 130mA-capable VCOM buffer. The VCOM buffer can be supplied directly with the switched output of the boost converter (AVDD), or through an external power source. See [Table 7](#) for shunt positions.

Gate-Shading Low-Level Voltage (J8)

Gate-shading low-level voltage can be set externally with a reference voltage, or the switched output of the boost converter can be used (AVDD). See [Table 8](#) for shunt positions.

Table 6. Jumper Functions (J6)

SHUNT POSITION	GATE-SHADING MODE
1-2*	No delay
2-3	1.75µs

*Default position.

Table 7. Jumper Functions (J7)

SHUNT POSITION	VCOM POWER SUPPLY
1-2*	AVDD
Open	Externally provided (VCOMP PCB pad)

*Default position.

Table 8. Jumper Functions (J8)

SHUNT POSITION	GATE-SHADING LOW-LEVEL VOLTAGE
1-2*	AVDD
Open	Externally provided (DRN PCB pad)

*Default position.

Gate-Shading High-Level Voltage (J9)

Gate-shading high-level voltage can be set externally with a reference voltage, or the output of the positive-gate voltage regulator can be used (VGON). See [Table 9](#) for shunt positions.

Output-Voltage Selection

Boost Converter

The EV kit's boost-converter output (HVINP and AVDD) is set to 12V by feedback resistors R10, R3, and R4. To generate output voltages other than 12V, select R10 + R3 in the 10kΩ to 50kΩ range, and select R4 according to the following equation:

$$R4 = (R10 + R3) \times \left(\frac{V_{HVINP}}{1.25} - 1 \right)$$

where V_{HVINP} is the desired boost output voltage. When increasing the boost output voltage, be careful not to exceed the maximum allowed voltage (18V).

Table 9. Jumper Functions (J9)

SHUNT POSITION	GATE-SHADING HIGH-LEVEL VOLTAGE
1-2*	VGON
Open	Externally provided (SRC PCB pad)

*Default position.

Positive-Gate Voltage Regulator

The EV kit's positive-gate voltage regulator output (VGON) is set to 16V by feedback resistors R22 and R20. To generate output voltages other than 16V, select R22 in the 10kΩ to 50kΩ range, and select R20 according to the following equation:

$$R20 = (R22) \times \left(\frac{V_{VGON}}{1.25} - 1 \right)$$

where V_{VGON} is the desired positive-gate voltage regulator output. When increasing the positive-gate voltage regulator output, be careful not to exceed the maximum allowed voltage (36V).

Negative-Gate Voltage Regulator

The EV kit's negative-gate voltage regulator (VGOFF) is set to -6V by feedback resistors R12 and R21. To generate output voltages other than -6V, select R12 in the 10kΩ to 50kΩ range, and select R21 according to the following equation:

$$R21 = (R12) \times (0.25 - V_{VGOFF})$$

where V_{VGOFF} is the desired negative-gate voltage regulator output. When decreasing the negative-gate voltage regulator output, be careful not to exceed the minimum allowed voltage (-24V).

VCOM Buffer

When the IC is operating in stand-alone mode, the voltage applied on the VCINH PCB pad sets the VCOM buffer output voltage. VCINH is internally biased to VCOMP/2. To generate output voltages other than VCOMP/2, select R15 in the 10kΩ to 50kΩ range, and select R16 according to the following equation:

$$R16 = R15 \times \left(\frac{V_{VCOMP}}{V_{VCOM}} - 1 \right)$$

where V_{VCOM} is the desired VCOM buffer output voltage and V_{VCOMP} is the VCOM buffer supply voltage.

To guarantee VCOM stability, the C6 capacitor may need to be increased to 1nF when VCOM voltage is adjusted through external resistors. If the IC is used in I²C mode, the VCOM buffer output voltage can be adjusted through I²C within a range of $V_{VCINH} \pm 2.5V$.

Ordering Information

PART	TYPE
MAX20067EVKIT#	EV Kit
MAX20067EVSYS#	EV System

#Denotes RoHS compliant.

MAX20067 EV Kit Bill of Materials

REF_DES	QTY	VALUE	DNI/ DNP*	DESCRIPTION	MFG PART #	MFG
C1	1	100PF	—	CAPACITOR; SMT; 0603; CERAMIC; 100pF; 50V; 10%; X7R; -55degC to +125degC; +/-15% from -55degC to +125degC	C0603C101J5RAC	KEMET
C2, C4, C5, C7, C27	5	10UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 10UF; 6.3V; TOL=20%; MODEL=CL SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R	CL10B106MQ8NRN	SAMSUNG ELECTRONICS
C3	1	1UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 25V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R	C1608X5R1E105M	TDK
C6, C11	2	100PF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 100PF; 16V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	0603YC101KAT2A	AVX
C8	1	4.7UF	—	CAPACITOR; SMT (0805); CERAMIC CHIP; 4.7UF; 50V; TOL=10%; MODEL=; TG=-55 DEGC TO +85 DEGC; TC=X5R	C2012X5R1H475K125AB	TDK
C9, C10, C15, C19, C22, C24, C28	7	0.1UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.1UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	GRM188R72A104KA35; CC0603KRX7R0BB104	MURATA; TDK
C12, C25	2	2.2UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 2.2UF; 50V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R	GRM188R61H225KE11	MURATA
C13	1	0.01UF	—	CAPACITOR; SMT; 0603; CERAMIC; 0.01uF; 50V; 10%; X7R; -55degC to +125degC	C0603C103K5RAC; GRM188R71H103K; C0603X7R500-103KNE	KEMET/MURATA/V ENKEL LTD.
C14, C18, C29, C31	4	0.1UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.1UF; 10V; TOL=10%; MODEL=C0603 SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R	C0603C104K8RAC	KEMET
C16, C23	2	1UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 50V; TOL=10%; MODEL=_MK SERIES; TG=-55 DEGC TO +85 DEGC	UMK107BJ105KA-T; C1608X5R1H105K080AB; CL10A105KB8NNN; GRM188R61H105KAAL	TAIYO YUDEN; TDK; SAMSUNG; MURATA
C17	1	10UF	—	CAPACITOR; SMT (1210); CERAMIC CHIP; 10UF; 25V; TOL=20%; MODEL=; TG=-55 DEGC TO +125 DEGC; TC=X7R;	C1210C106M3RAC; GRM32DR71E106M; C3225X7R1E106M250AC	KEMET; MURATA; TDK
C20	1	0.022UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.022UF; 25V; TOL=10%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R	GRM188R71E223K	MURATA
C21	1	1UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	GRM188R71E105KA12D; CGA3E1X7R1E105K; TMK107B7105KA; 06033C105KAT2A	MURATA; TDK; TAIYO YUDEN; AVX
C26	0	100PF	DNP	CAPACITOR; SMT (0603); CERAMIC CHIP; 100PF; 16V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	0603YC101KAT2A	AVX
C30	0	2.2UF	DNP	CAPACITOR; SMT (0603); CERAMIC CHIP; 2.2UF; 50V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R	GRM188R61H225KE11	MURATA
C35	1	0.22UF	—	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.22UF ; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	CC0603KRX7R6BB224	YAGEO

MAX20067 EV Kit Bill of Materials (continued)

REF_DES	QTY	VALUE	DNI/ DNP*	DESCRIPTION	MFG PART #	MFG
CTL, DRN, ENP, FLT, SCL, SDA, SRC, AGND, AVDD, PGND, VCOM, VGON, AGND1, AGND2, GATES, HVINP, PGND1, PGND2, VCINH, VCOMP, VGOFF, TFT_POWER_IN, FILTERED_AVDD, TFT_POWER_IN_FILTERED	24	MAXIMPAD	—	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-S; 20AWG	9020 BUSS	WEICO WIRE
D1-D4	4	MMBD4148SE	—	DIODE; SS; SMT (SOT-23); PIV=100V; IF=0.2A	MMBD4148SE	FAIRCHILD SEMICONDUCTOR
D5	0	MBR120VLSFT1G	DNP	DIODE; SCH; SMT (SOD-123LF); PIV=20V; IF=1.0A	MBR120VLSFT1G	ON SEMICONDUCTOR
DS1	1	LTST-C170GKT	—	DIODE; LED; STANDARD; GREEN; SMT (0805); PIV=2.1V; IF=0.01A	LTST-C170GKT	LITE-ON ELECTRONICS INC
DS2	1	LTST-C170EKT	—	DIODE; LED; STANDARD; RED; SMT (0805); PIV=2.0V; IF=0.02A	LTST-C170EKT	LITE-ON ELECTRONICS INC
J1, J2, J4-J6	5	PEC03SAAN	—	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS; -65 DEGC TO +125 DEGC;	PEC03SAAN	SULLINS ELECTRONICS CORP.
J3, J7-J9	4	PBC02SAAN	—	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS; -65 DEGC TO +125 DEGC;	PBC02SAAN	SULLINS ELECTRONICS CORP.
J10	1	PPTC102LJBN-RC	—	EVKIT PART-CONNECTOR; FEMALE; TH; DOUBLE ROW; 2.54MM; RIGHT ANGLE SOLDER TAIL; MATING PIN DIA 0.76MM; RIGHT ANGLE; 20PINS;	PPTC102LJBN-RC	SULLINS ELECTRONICS CORP.
L1	1	1UH	—	INDUCTOR; SMT; MAGNETICALLY SHIELDED FERRITE BOBBIN CORE; 1UH; TOL=+/-20%; 3.4A	ELL-6SH1R0M	PANASONIC
L2	1	10UH	—	INDUCTOR; SMT; FERRITE CORE; 10UH; TOL=+/-20%; 1.3A	LPS6225-103MR	COILCRAFT
L3	0	1UH	DNP	INDUCTOR; SMT (1008); CERAMIC CHIP; 1UH; TOL=+/-5%; 0.37A; -40 DEGC TO +125 DEGC	1008HS-102TJL; MDT2520- CR1R0M	COILCRAFT
R1, R2	2	1K	—	RESISTOR; 0603; 1K OHM; 1%; 100PPM; 0.10W; THICK FILM	CR0603-FX-1001ELF	BOURNS
R3	1	10.5K	—	RESISTOR; 0603; 10.5K OHM; 1%; 100PPM; 0.063W; THICK FILM	CR0603-16W-1052FT	VENKEL LTD.
R4	1	91K	—	RESISTOR; 0603; 91K OHM; 1%; 100PPM; 0.10W; THICK FILM	CRCW060391K0FK	VISHAY DALE
R5, R6, R9	3	10K	—	RESISTOR; 0603; 10K OHM; 1%; 100PPM; 0.1W; THICK FILM	CRG0603F10K	TE CONNECTIVITY

MAX20067 EV Kit Bill of Materials (continued)

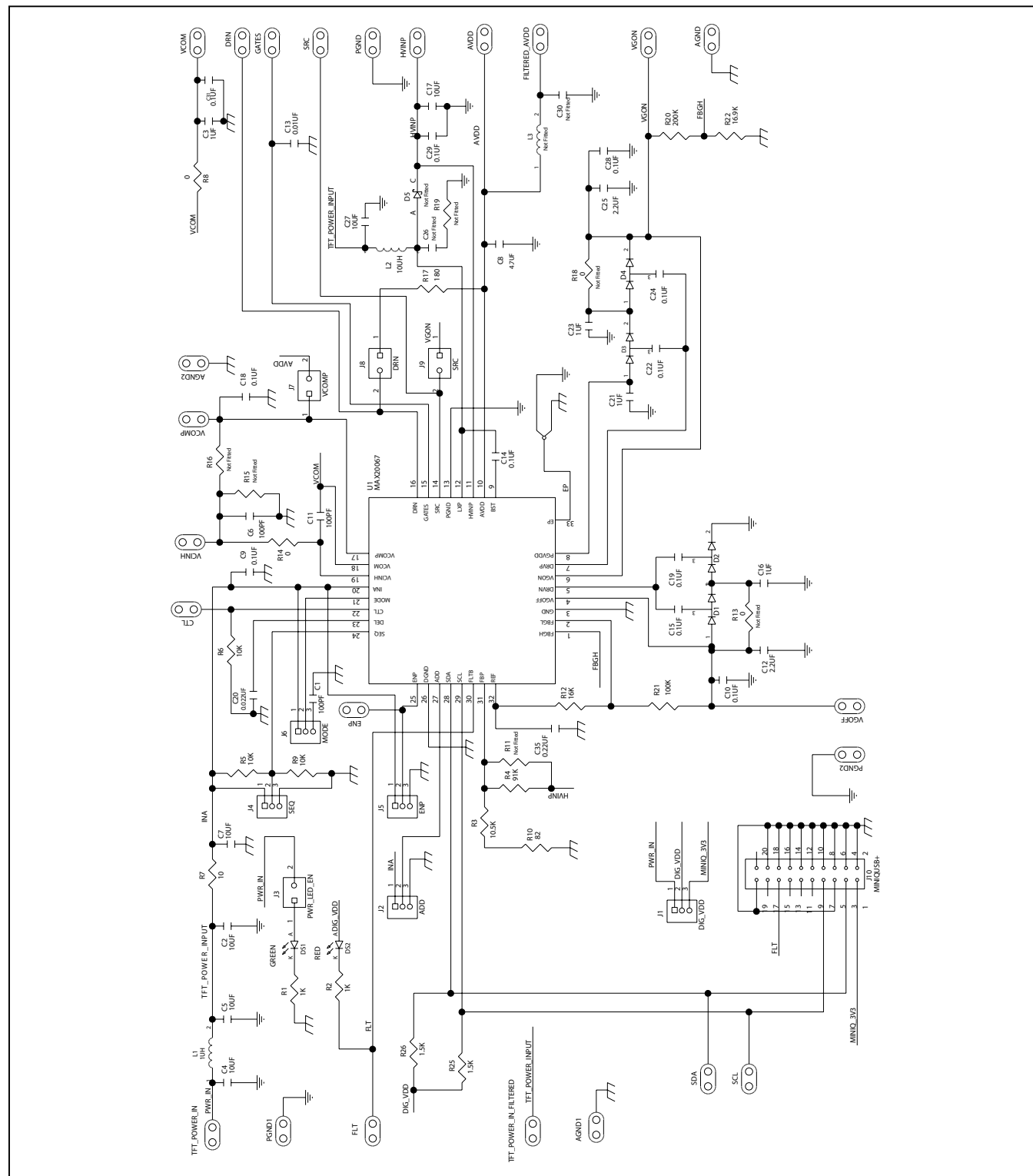
REF_DES	QTY	VALUE	DNI/ DNP*	DESCRIPTION	MFG PART #	MFG
R5, R6, R9	3	10K	—	RESISTOR; 0603; 10K OHM; 1%; 100PPM; 0.1W; THICK FILM	CRG0603F10K	TE CONNECTIVITY
R7	1	10	—	RESISTOR; 0603; 10 OHM; 1%; 100PPM; 0.1W; THICK FILM	ERJ-3EKF10R0	PANASONIC
R8, R14	2	0	—	RESISTOR; 0603; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM; FORMFACTOR	ANY	ANY
R10	1	82	—	RESISTOR; 0603; 82 OHM; 1%; 100PPM; 0.1W; THICK FILM	ERJ3EKF82R0	PANASONIC
R11	0	91K	DNP	RESISTOR; 0603; 91K OHM; 1%; 100PPM; 0.10W; THICK FILM	CRCW060391K0FK	VISHAY DALE
R12	1	16K	—	RESISTOR; 0603; 16K OHM; 1%; 100PPM; 0.25W; THICK FILM	ERJPA3F1602	PANASONIC
R13, R18	0	0	DNP	RESISTOR; 0603; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM; FORMFACTOR	N/A	N/A
R15, R16	0	10K	DNP	RESISTOR; 0603; 10K OHM; 1%; 100PPM; 0.1W; THICK FILM	CRG0603F10K	TE CONNECTIVITY
R17	1	180	—	RESISTOR; 0603; 180 OHM; 1%; 100PPM; 0.10W; THICK FILM	CRCW0603180RFB	VISHAY DALE
R19	0	10	DNP	RESISTOR; 0603; 10 OHM; 1%; 100PPM; 0.1W; THICK FILM	ERJ-3EKF10R0	PANASONIC
R20	1	200K	—	RESISTOR; 0603; 200K; 1%; 100PPM; 0.10W; THICK FILM	CRCW06032003FK	VISHAY DALE
R21	1	100K	—	RESISTOR; 0603; 100K OHM; 1%; 100PPM; 0.1W; THICK FILM	ERJ3EKF1003	PANASONIC
R22	1	16.9K	—	RESISTOR; 0603; 16.9K OHM; 1%; 100PPM; 0.10W; THICK FILM	ERJ-3EKF1692V; RC0603FR-0716K9	PANASONIC/YAGE O PHYCOMP
R25, R26	2	1.5K	—	RESISTOR; 0603; 1.5K; 1%; 100PPM; 0.10W; THICK FILM	CRCW06031K50FK	VISHAY DALE
U1	1	MAX20067	—	EVKIT PART-IC; INFC; AUTOMOTIVE 3-CHANNEL DISPLAY BIAS IC WITH LINEAR REGULATOR AND I2C INTERFACE; TQFN32-EP	MAX20067	MAXIM
—	1	—	—	PCB:MAX20067	PCB: MAX20067	MAXIM

TOTAL 92

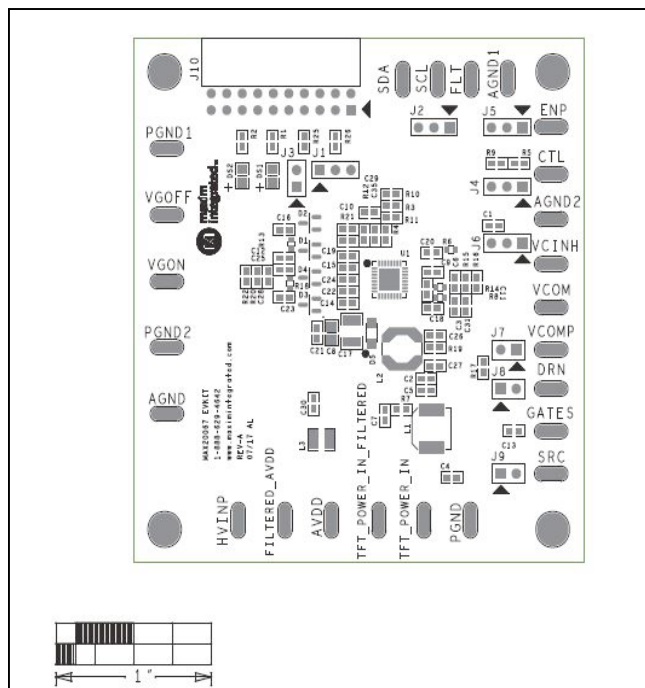
*Note: DNI = DO NOT INSTALL; DNP = DO NOT PURCHASE.

Evaluate: MAX20067

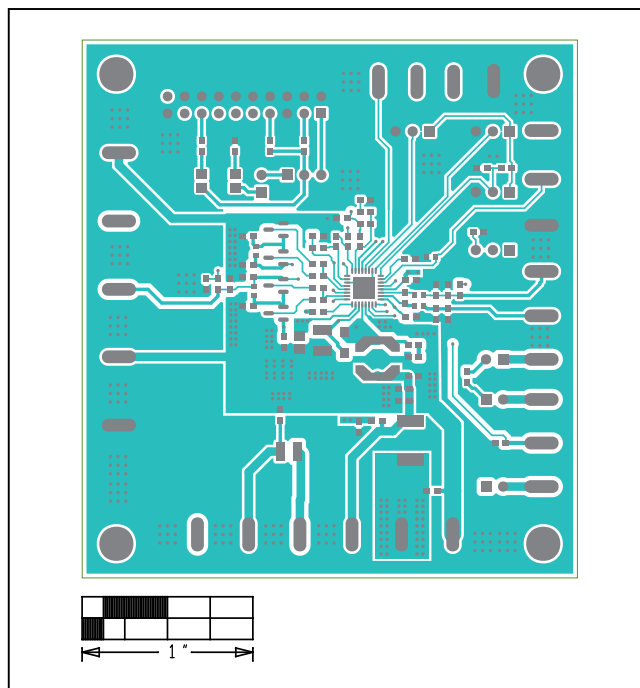
MAX20067 EV Kit Schematic



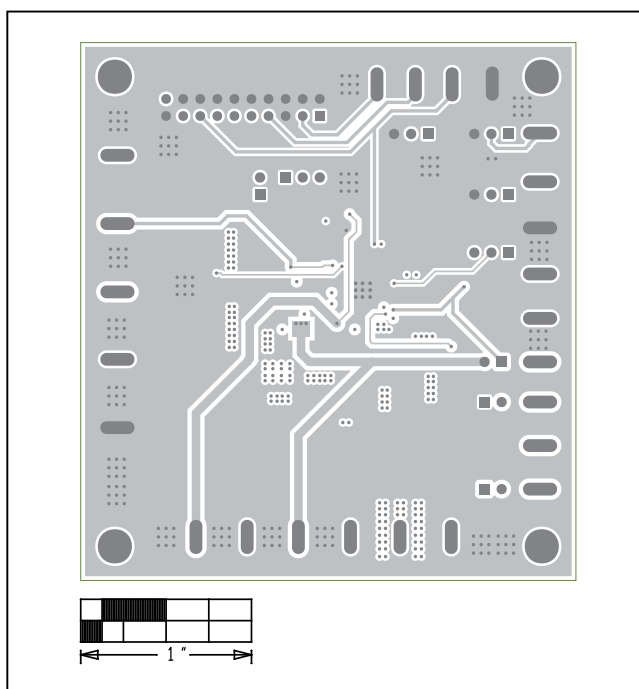
MAX20067 EV Kit PCB Layouts



MAX20067 EV Kit Component Placement Guide—Top
Silkscreen

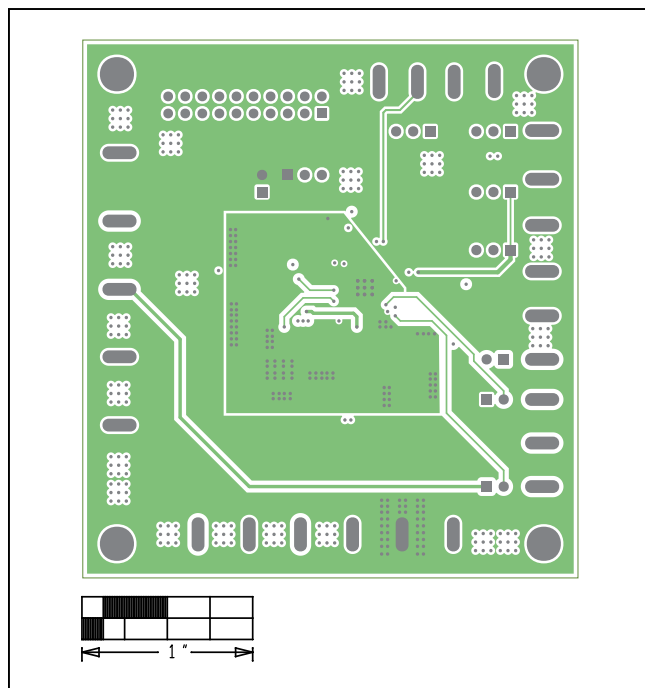


MAX20067 EV Kit PCB Layout—Top Layer

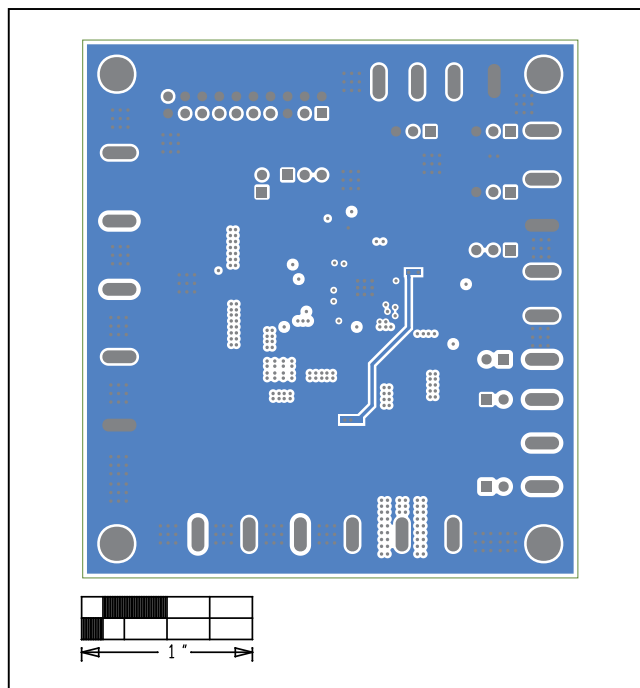


MAX20067 EV Kit PCB Layout—Internal Layer 2

MAX20067 EV Kit PCB Layouts (continued)



MAX20067 EV Kit PCB Layout—Internal Layer 3



MAX20067 EV Kit PCB Layout—Bottom Layer

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/17	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.

Maxim Integrated cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim Integrated product. No circuit patent licenses are implied. Maxim Integrated reserves the right to change the circuitry and specifications without notice at any time.