



# MAX17122 Evaluation Kit

## General Description

The MAX17122 evaluation kit (EV kit) is a fully assembled and tested surface-mount PCB that provides the voltages and features required for thin-film transistor (TFT), liquid-crystal display (LCD) TV panels. The EV kit includes a step-down regulator, step-up regulator, negative output buck-boost regulator, positive regulated charge pump, and a negative linear regulator.

The MAX17122 IC operates from +10V to +14V input voltages and is optimized for LCD TV panels running directly from +12V supplies. The step-up switching regulator is configured for a +15V output that provides at least 2.2A with an input voltage of +12V. The step-down regulator is configured for a +3.3V output that provides at least 2.5A and the buck-boost is configured for a temperature-variable -12V to -20V output that provides at least 450mA. The positive regulated charge pump is configured for a +28V output providing at least 100mA. The negative linear regulator is configured for a -7.5V output providing at least 100mA.

## Features

- ◆ +10V to +14V Input Range
- ◆ 750kHz Switching Frequency
- ◆ Output Voltages
  - +15V Output at 2.2A (Step-Up Switching Regulator)
  - +3.3V Output at 2.5A (Step-Down Switching Regulator)
  - 12V to -20V Output at 450mA (Temperature-Variable Buck-Boost Switching Regulator)
  - +28V Output at 100mA (Positive Charge Pump)
  - 7.5V Output at 100mA (Negative Linear Regulator)
  - +5V Output at 25mA (Linear Regulator VL)
- ◆ Greater than 94% Efficiency (Step-Up Switching Regulator)
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TYPE
MAX17122EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	22 $\mu$ F $\pm$ 20%, 16V X5R ceramic capacitors (1206) Murata GRM31CR61C226M Taiyo Yuden EMK316BJ226M
C3, C9, C11, C13	4	0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H104K TDK C1608X7R1H104K
C4	1	22 $\mu$ F $\pm$ 20%, 6.3V X5R ceramic capacitor (0805) Murata GRM21BR60J226M TDK C2012X5R0J226K
C5, C10	2	0.22 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E224K TDK C1608X7R1E224K

DESIGNATION	QTY	DESCRIPTION
C6, C16	2	1 $\mu$ F $\pm$ 10%, 25V X5R ceramic capacitors (0603) Murata GRM188R61E105K TDK C1608X5R1E105M
C7, C8, C15, C23, C24, C25	0	Not installed, ceramic capacitors (0603)
C12	1	2.2 $\mu$ F $\pm$ 10%, 16V X5R ceramic capacitor (0603) Murata GRM188R61C225K TDK C1608Y5V1C225ZT
C14	1	1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitor (1206) Murata GRM31MR71H105KA TDK C3216X7R1H105K
C17	1	470pF $\pm$ 10% 50V X7R ceramic capacitor (0603) Murata GRM188R71H471K TDK C1608X7R1H471K



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## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C18, C21, C22	3	22 $\mu$ F $\pm$ 20%, 25V X5R ceramic capacitors (1210) Murata GRM32ER61E226K Murata GRM32ER61E226M
C19	1	10 $\mu$ F $\pm$ 10%, 16V X5R ceramic capacitor (0805) Murata GRM21BR61C106K KEMET C0805C106K4PAC
C20	1	330pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H331K TDK C1608X7R1H331K
C26, C27	2	12pF $\pm$ 5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H120J TDK C1608COG1H120J
C28	1	15pF $\pm$ 5%, 50V C0G ceramic capacitor (0402) Murata GRM1555C1H150J TDK C1005C0G1H150J
C36	0	Not installed, through-hole OSCON capacitor (OSCON-B)
D1, D2	2	30V, 3A Schottky diodes (M flat) Toshiba CMS02
D3	1	50V, 1A Schottky diode (SMA) Fairchild SS15 Diodes, Inc. B150
D4	1	Small-signal diode (SOT23) Fairchild BAT54S Diodes, Inc. BAT54S
GATE, SS, TP1, TP2	4	Test points
JU1–JU4	4	2-pin headers
L1, L2	2	4.7 $\mu$ H, 3.5A inductors TOKO FDV0620-4R7M Sumida CDRH6D26HPNP-4R7P NEC TOKIN MPLC0730L4R7
L3	1	22 $\mu$ H, 1.6A inductor Sumida CDRH8D28NP-220N

DESIGNATION	QTY	DESCRIPTION
N1	1	High-gain, +25V npn transistor (DPAK) Fairchild KSH200 On Semi MJD200
P1	1	High-gain, -25V pnp transistor (DPAK) Fairchild KSH210 On Semi MJD210
Q1	1	-30V, 0.056 $\Omega$ p-channel MOSFET (6 SC70 PowerPAK) Vishay SiA421DJ
R1	1	365k $\Omega$ $\pm$ 1% resistor (0603)
R2	1	33.2k $\Omega$ $\pm$ 1% resistor (0603)
R3	1	39.2k $\Omega$ $\pm$ 1% resistor (0603)
R4	1	324k $\Omega$ $\pm$ 1% resistor (0603)
R5	1	182k $\Omega$ $\pm$ 1% resistor (0603)
R6, R13	2	22.1k $\Omega$ $\pm$ 1% resistors (0603)
R7, R22	2	47.5k $\Omega$ $\pm$ 1% resistors (0603)
R8	1	10k $\Omega$ $\pm$ 1% NTC resistor (0402) Murata NCP15XH103F03RC
R9	1	8.25k $\Omega$ $\pm$ 1% resistor (0603)
R10, R16	2	510 $\Omega$ $\pm$ 5% resistors (0603)
R11	1	226k $\Omega$ $\pm$ 1% resistor (0603)
R12	1	10.5k $\Omega$ $\pm$ 1% resistor (0603)
R14	1	82.5k $\Omega$ $\pm$ 1% resistor (0603)
R15, R20	2	10k $\Omega$ $\pm$ 1% resistors (0603)
R17, R18	2	100k $\Omega$ $\pm$ 5% resistors (0603)
R19, R21, R24	0	Not installed, resistors (0603) R19 is PC short; R21 and R24 are open
R23	1	7.5k $\Omega$ $\pm$ 1% resistor (0603)
U1	1	TFT LCD power supply (40 TQFN-EP*) Maxim MAX17122ETL+
—	4	Shunts
—	1	PCB: MAX17122 EVALUATION KIT+

\*EP = Exposed pad.

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## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes, Inc.	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
KEMET Corp.	864-963-6300	www.kemet.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
NEC TOKIN America, Inc.	408-324-1790	www.nec-tokinamerica.com
ON Semiconductor	602-244-6600	www.onsemi.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
TOKO America, Inc.	847-297-0070	www.tokoam.com
Toshiba America Electronic Components, Inc.	949-623-2900	www.toshiba.com/taec
Vishay	402-563-6866	www.vishay.com

**Note:** Indicate that you are using the MAX17122 when contacting these component suppliers.

### Quick Start

#### Recommended Equipment

- 10V to 14V, 5A DC power supply
- Voltmeter

#### Procedure

The MAX17122 EV kit is fully assembled and tested. Follow the steps below to verify board operation.

**Caution: Do not turn on the power supply until all connections are completed.**

- 1) Verify that shunts are not installed across jumpers JU1, JU2, and JU3.
- 2) Verify that a shunt is installed across jumper JU4.
- 3) Connect the positive terminal of the power supply to the VIN pad. Connect the negative terminal of the power supply to the PGND pads closest to VIN.
- 4) Set the power supply VIN to +12V.
- 5) Turn on the power supply and verify that the step-up switching regulator output (AVDD) is +15V.
- 6) Verify that the step-down switching regulator (3.3V) is +3.3V.

7) Verify that the buck-boost regulator (VGOFF2) is approximately -12V.

8) Verify that the positive charge-pump linear-regulator supply (VGON) is approximately +28V.

9) Verify that the negative charge-pump supply (VGOFF1) is approximately -7.5V.

### Detailed Description of Hardware

#### Jumper Settings

Several jumper settings in the following tables illustrate features of the MAX17122 EV kit.

#### Enable Inputs (EN1, EN2)

The MAX17122's enable inputs can be configured through jumpers JU1 and JU2. JU1 controls the EN1 pin, which enables the step-down regulator and gates the EN2 function as well. JU2 controls pin EN2, which enables the step-up and positive charge-pump linear regulator when EN1 is high. When EN1 is low, all power outputs are disabled. When EN\_ is high, the respective outputs are enabled. When EN\_ is low, the respective outputs are disabled. See Table 1 for jumpers JU1 and JU2 configurations.

**Table 1. Jumpers JU1 and JU2 Functions (EN1, EN2)**

SHUNT POSITION		EN1 PIN	EN2 PIN	OUTPUTS
JU1	JU2			
Installed	Installed	Connected to GND	Connected to GND	All disabled
Installed	Not installed	Connected to GND	Internally pulled high	All disabled
Not installed	Installed	Internally pulled high	Connected to GND	Step-down enabled
Not installed*	Not installed*	Internally pulled high	Internally pulled high	All enabled

\*Default position.

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## High-Voltage Stress Mode Input (JU3)

The MAX17122's high-voltage stress (HVS) mode is controlled through jumper JU3. When jumper JU3 is installed, HVS is connected to VL and the RHVS output is connected to AGND. When jumper JU3 is not installed, the HVS pin is left unconnected and the RHVS output is unconnected. See Table 2 for jumper JU3 configuration.

## Thermistor Network Connection (JU4)

The 100 $\mu$ A current from the SET pin, together with resistor R23 at SET determines the cold-temperature output voltage. The network at the NTC pin controls the transition between the warm-temperature output voltage (determined by FB3 resistors R5 and R6) and the cold-temperature output voltage. As configured, the warm-temperature output voltage is -12V, slowly transitioning at approximately +25°C to the cold-temperature output voltage level of -20V. Refer to the MAX17122 IC data sheet for more information regarding temperature compensation.

Jumper JU4 controls the thermistor network connected to the NTC pin. When JU4 is installed, thermistor R8 is connected to NTC and the behavior of the GOFF2 output voltage varies with temperature. When JU4 is not installed, NTC is connected to AGND through resistors R7 and R9 and GOFF2 output voltage is fixed. See Table 3 for jumper JU4 configuration.

## Step-Up Regulator Output-Voltage Selection (AVDD)

The EV kit's step-up switching-regulator output (AVDD) is set to +15V by feedback resistors R1 and R2. To generate output voltages other than +15V, select different external voltage-divider resistors (R1 and R2). Refer to the *Step-Up Regulator, Output Voltage Selection* section in the MAX17122 IC data sheet for more information.

## Step-Down Regulator Output-Voltage Selection (+3.3V)

The EV kit's step-down switching regulator supports both fixed and adjustable output voltages. By default, the EV kit's step-down regulator's output (3.3V) is set to the +3.3V fixed mode by connecting FB2 to GND through resistor R20. For adjustable mode (+1.5V to +3.6V), select R21 and R20 to set the desired step-down regulator output voltage. Refer to the *Detailed Description, Step-Down Regulator* section in the MAX17122 IC data sheet for instructions on selecting resistors R20 and R21.

## Buck-Boost Regulator Output-Voltage Selection (VGOFF2)

The output voltage of the step-up regulator is temperature compensated. From the warm-temperature range ((3.3V - V<sub>NTC</sub>) > 1.65V), the output voltage is set by connecting a resistive voltage-divider from the output (VGOFF2) to the +3.3V reference, with the center tap connected to FB3. Select R6 in the 10k $\Omega$  to 50k $\Omega$  range. Calculate R5 with the following equation:

$$R5 = R6 \times \frac{V_{GOFF2\_WARM} - V_{FB3}}{V_{FB3} - 3.3V}$$

where V<sub>FB3</sub>, the step-up regulator's feedback set point, is +1.65V. Place R5 and R6 close to the IC.

For cold temperatures ((3.3V - V<sub>NTC</sub>) < V<sub>SET</sub>), output voltage is set by:

$$V_{SET} = \frac{R6 \times V_{GOFF2\_COLD} + R5 \times 3.3V}{R5 + R6}$$

If the calculated V<sub>SET</sub> voltage is larger than +1.65V, then temperature compensation is disabled and the buck-boost regulator output will be VGOFF2\_WARM at all temperatures.

Calculate the SET pin resistor R<sub>SET</sub> (R23) as follows:

$$R_{SET} = \frac{V_{SET}}{100\mu A}$$

**Table 2. Jumper JU3 Function (HVS)**

SHUNT POSITION	HVS PIN	RHVS OUTPUT
Installed	Connected to VL	Connected to AGND
Not installed*	Internally pulled to GND	Unconnected

\*Default position.

**Table 3. Jumper JU4 Function (NTC)**

SHUNT POSITION	THERMISTOR NETWORK	GOFF2 OUTPUT
Installed*	Connected	Varies over temperature
Not installed	Not connected	Fixed output

\*Default position.

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## Negative Linear Regulator Output-Voltage Selection (VG OFF1)

The negative linear-regulator output (VG OFF1) is set to -7.5V by voltage-divider resistors R13 and R14. To set VG OFF1 to other voltages, adjust the negative linear-regulator output voltage (VG OFF1) by connecting a resistive voltage-divider from VG OFF1 to +3.3V with the center tap connected to FBN. Select R13 in the 20kΩ to 50kΩ range. Calculate R14 with the following equation:

$$R14 = R13 \times \frac{V_{G\text{OFF}1} - V_{FBN}}{V_{FBN} - 3.3V}$$

where  $V_{FBN} = +1V$ . Refer to the *Negative Linear Regulator, Output-Voltage Selection* section in the MAX17122 IC data sheet for instructions on selecting R13 and R14.

## Positive Charge-Pump Output-Voltage Selection (VG ON)

The positive charge-pump output (VG ON) is set to +28V by voltage-divider resistors R11 and R12. To set VG ON to other voltages, adjust the charge-pump regulator's output voltage by connecting a resistive voltage-divider from the VG ON output to AGND, with the center tap connected to FBP. Select the lower resistor of the divider R12 in the range of 10kΩ to 30kΩ. Calculate the upper resistor R11 with the following equation:

$$R11 = R12 \times \left( \frac{V_{GON}}{V_{FBP}} - 1 \right)$$

where  $V_{FBP} = +1.25V$  (typ). Refer to the *Positive Charge-Pump Linear Regulator* section in the MAX17122 IC data sheet for instructions on selecting R11 and R12.

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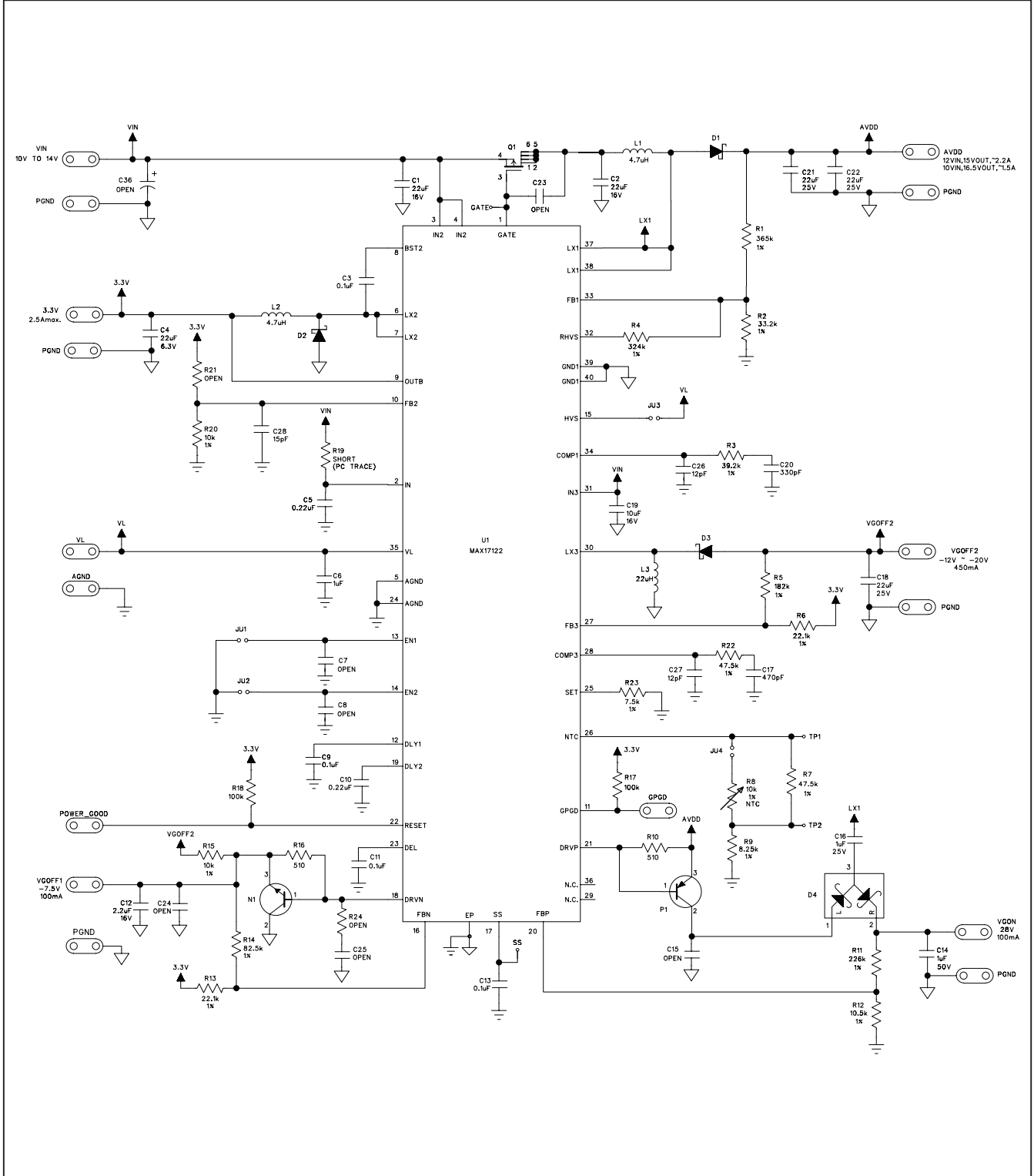


Figure 1. MAX17122 EV Kit Schematic

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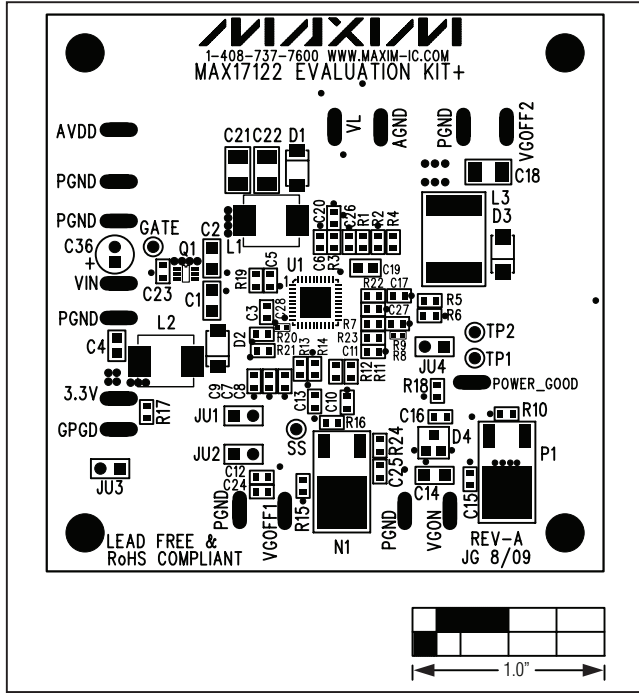


Figure 2. MAX17122 EV Kit Component Placement Guide—Component Side

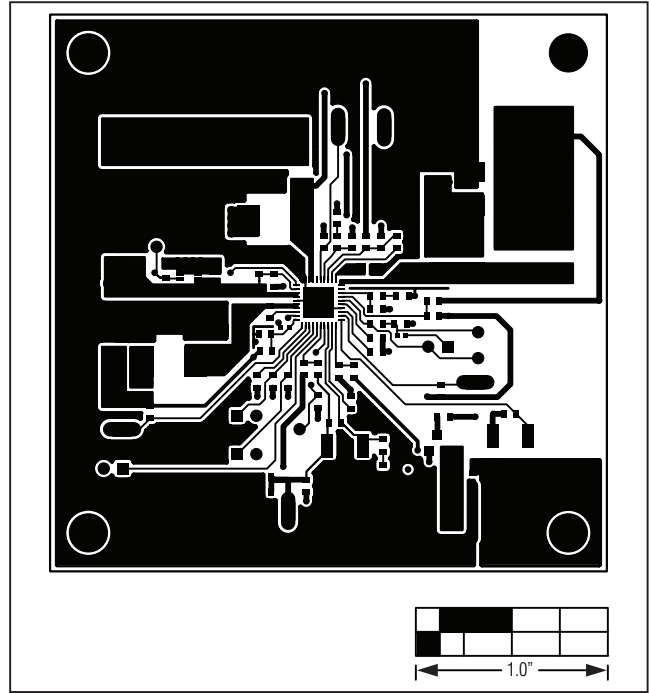


Figure 3. MAX17122 EV Kit PCB Layout—Component Side

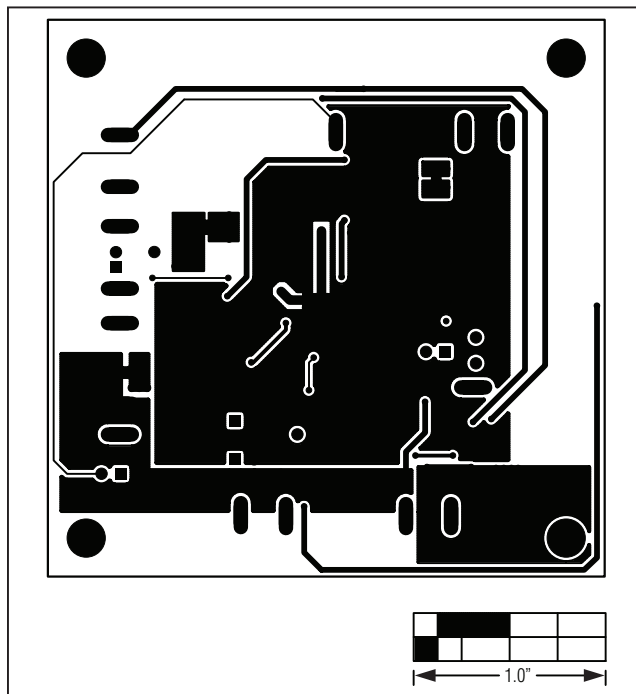


Figure 4. MAX17122 EV Kit PCB Layout—Solder Side

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