19-2900; Rev 0; 12/07

MAX17014 Evaluation Kit

Evaluates: MAX17014

General Description

The MAX17014 evaluation kit (EV kit) is a fully assembled and tested surface-mount printed-circuit board (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 switching regulator, a step-up switching regulator, a positive two-stage charge pump for the TFT gate-on supply, a negative single-stage charge pump for the TFT gate-off supply, and two high-current operational amplifiers (op amps).

The EV kit operates from a DC supply voltage of +10.8V to +13.2V, as configured. The step-down switching regulator is configured for a +3.3V output providing at least 2A. The step-up switching regulator is configured for a +16V output providing at least 1.5A. The positive charge pump is configured for a +35V output providing at least 50mA. The negative charge pump is configured for a -6V output providing at least 100mA. High-frequency operation (1.2MHz) allows the use of tiny surface-mount components to minimize the thickness of LCD panel designs.

The EV kit features two high-performance operational amplifiers (op amps) designed to drive the LCD backplane (VCOM). Power to the VCOM amplifiers comes from the step-up switching regulator output.

Features

- **+10.8V to +13.2V Input Range**
- **Output Voltages**
  - **+3.3V at 2A (Step-Down Switching Regulator)**
  - **+16V at 1.5A (Step-Up Switching Regulator)**
  - **+35V at 50mA (Positive Charge Pump)**
  - **-6V at 100mA (Negative Charge Pump)**
- **Adjustable Output Voltages (External Resistors)**
- **1.2MHz Switching Frequency (600kHz Selectable)**
- **Two High-Speed Op Amps**
- **Low-Profile Surface-Mount Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX17014EVKIT+	EV Kit

+Denotes lead-free and RoHS-compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2, C3	3	10µF ±20%, 16V X5R ceramic capacitors (1206) Murata GRM31CR61C106K TDK C3216X5R1C106M
C4, C7, C11, C14, C17, C21, C22–C25	10	0.1µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H104K TDK C1608X7R1H104K
C5	1	22µF ±10%, 6.3V X5R ceramic capacitor (1206) Taiyo Yuden EMK316BJ226ML Murata GRM31CR60J226M
C6	0	Not installed, capacitor (1206)
C8, C15	2	1µF ±10%, 16V X5R ceramic capacitors (0603) Murata GRM188R71C105K TDK C1608X5R1C105K
C9	1	220pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H221K TDK C1608X7R1H221K

DESIGNATION	QTY	DESCRIPTION
C10	1	0.22µF ±10%, 10V X7R ceramic capacitor (0603) Taiyo Yuden LMK107BJ224KA TDK C1608X7R1A224K
C12, C13	2	0.15µF ±10%, 16V X7R ceramic capacitors (0603) Taiyo Yuden EMK107BJ154KA TDK C1608X7R1E154K
C16, C18, C19	3	10µF ±20%, 25V X5R ceramic capacitors (1210) Taiyo Yuden TMK325BJ106MM TDK C3225X5R1E106M
C20	1	330pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H331K TDK C1608X7R1H331K
C26	1	1µF ±10%, 50V X7R ceramic capacitor (1206) Murata GRM31MR71H105KA TDK C3216X7R1H105K

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C27, C29, C30, C31	0	Not installed, capacitors (0603)
C28	1	100pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H101J TDK C1608C0G1H101J
C32	0	Not installed, capacitor (1210)
D1, D2	2	30V, 3A Schottky diodes (M-flat) Toshiba CMS02 (TE12L,Q)
D3, D4, D5	3	100V, 200mA dual ultra-fast diodes (SOT23) Fairchild MMBD4148SE (Top Mark: D4) Central Semiconductor CMPD1001S Lead Free (Top Mark: L21)
D6	1	100V, 200mA single ultra-fast diode (SOT23) Fairchild MMBD4148 (Top Mark: 5H) Central Semiconductor CMPD1001 Lead Free (Top Mark: L20)
EN1, EN2, MODE, REF, VL	5	Test points Keystone 5000
JU1, JU3, JU4, JU5	4	2-pin headers
JU2, JU6	2	3-pin headers
L1	1	Low-profile 4.7µH, 3.5A inductor (2mm height) TOKO FDV0620-4R7M Würth S06100032
L2	1	Low-profile 2.4µH, 2.6A inductor (1.8mm height) TOKO 1124BS-2R4M (2.4µH) Würth 744052002 (2.5µH)
R1	1	150kΩ ±1% resistor (0603)
R2	1	23.7kΩ ±1% resistor (0603)
R3	1	158kΩ ±1% resistor (0603)
R4, R6, R17	3	13.3kΩ ±1% resistors (0603)
R5	1	82.5kΩ ±5% resistor (0603)
R7	1	2.2kΩ ±1% resistors (0603)
R8–R11, R19	5	20kΩ ±1% resistors (0603)
R12, R13, R20	3	0Ω ±5% resistors (0603)
R14, R21, R22, R23	4	100kΩ ±5% resistors (0603)
R15	1	1kΩ ±5% resistor (0603)
R16	1	357kΩ ±1% resistor (0603)
R18	0	Not Installed, resistor (0603)
U1	1	Low-cost multiple-output power supply for LCD TVs (48-pin thin QFN, 7mm x 7mm) Maxim MAX17014ETM+
—	5	Shunts, 0.1in centers
—	1	PCB: MAX17014 Evaluation Kit+

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor	516-435-1110	www.centralsemi.com
Fairchild Semiconductor	408-822-2000	www.fairchildsemi.com
Murata Mfg. Co., Ltd.	770-436-1300	www.murata.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-390-4373	www.component.tdk.com
TOKO America, Inc.	847-297-0070	www.tokoam.com
Toshiba America Electronic Components, Inc.	949-455-2000	www.toshiba.com/taec
Würth Electronik GmbH & Co. KG	201-785-8800	www.we-online.com

Note: *Indicate that you are using the MAX17014 when contacting these component suppliers.*

Quick Start

Recommended Equipment

Before beginning, the following equipment is needed:

- +10.8V to +13.2V, 3A DC power supply
- Digital multimeters (DMMs)

Procedure

The MAX17014 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) Connect the positive terminal of the DC power supply to the VIN pad. Connect the negative terminal of the DC power supply to the PGND pad.
2) Preset the power supply to +12V and disable the output.
3) Verify that the jumpers follow the default settings in Table1.
4) Turn on the power supply.
5) Verify that the step-down regulator output (OUT) is +3.3V.
6) Verify that the step-up regulator output (AVDD) is +16V.
7) Verify that the gate-on supply (VGON) is +35V.
8) Verify that the gate-off supply (VGOFF) is -6V.
9) Verify that the op-amp outputs (VCOM1, VCOM2) are +8V.

Table 1. Default Jumper Settings

JUMPER	SHUNT POSITION
JU1	Not installed
JU2	2-3
JU3	Installed
JU4	Installed
JU5	Installed
JU6	1-2

Detailed Description

The MAX17014 EV kit evaluates the MAX17014 multiple-output power-supply IC, which is designed primarily for TFT LCD panels used in monitors and TVs. The EV kit contains a step-down switching regulator to generate the logic supply rail, a step-up switching regulator to generate the source driver supply, and two charge-pump regulators to generate the gate driver supplies. The EV kit also includes two high-performance op amps designed to drive the LCD back plane (VCOM). Although the IC specifies a +8V to +16.5V input range, the EV kit is optimized for +10.8V to +13.2V input supply.

Jumper Selection

Several jumper settings in the following tables illustrate features of the MAX17014 EV kit.

Switching Frequency Selection (FSEL)

The step-down and step-up regulators on the MAX17014 EV kit switch at the same frequency, but are 180° out-of-phase with each other. The EV kit features a 2-pin jumper (JU1) to select the operating frequency. The EV kit is optimized for 1.2MHz switching frequency; proper operation at 600kHz may require component changes. Table 2 lists the selectable JU1 jumper options.

Table 2. Jumper JU1 Functions

SHUNT POSITION	FSEL PIN CONNECTED TO	EV KIT FREQUENCY
Not installed*	VL (through pullup resistor R21)	1.2MHz
Installed	GND	600kHz

**Default position.*

High-Voltage Switch Mode (MODE)

The MAX17014 EV kit features an option to select the operating mode (delay or no delay) for the high-voltage switches. On the rising edge of the CTL pin, GON connects to SRC. On CTL's falling edge, GON may connect immediately to DRN (no delay), or GON may connect to DRN after a delay set by capacitor C9. Refer to the *High-Voltage Switch Control* section in the MAX17014 IC data sheet for a more detailed description of the two modes of operation. Jumper JU2 selects the high-voltage switch mode for the MAX17014. Table 3 lists the selectable JU2 jumper options.

Table 3. Jumper JU2 Functions

SHUNT POSITION	MODE PIN CONNECTED TO	HIGH-VOLTAGE SWITCH MODE
1-2	C9	Delay set by C9
2-3*	VL	No delay
Not installed	Unconnected	Not allowed

**Default position.*

Step-Down and Negative Charge-Pump Regulator Enable Input (EN1)

The MAX17014 EV kit features a jumper (JU3) to control the step-down and negative charge-pump regulator enable input (EN1). By default, a shunt is installed across JU3 to provide EN1 logic-high. When EN1 is

Table 4. Jumpers JU3 and JU4 Functions

SHUNT POSITION		STEP-DOWN AND NEGATIVE CHARGE-PUMP REGULATOR	STEP-UP AND POSITIVE CHARGE-PUMP REGULATOR
JU3	JU4		
Installed*	Installed*	Enabled	Enabled
Installed	Not installed	Enabled	Disabled
Not installed	X	Disabled	Disabled

**Default position.*
X = Don't care.

Table 5. Jumper JU5 Functions

SHUNT POSITION	CTL PIN CONNECTED TO	MAX17014 HIGH-VOLTAGE SWITCH CONFIGURATION
Installed*	VL	GON pin connected to SRC pin
Not installed	GND (through resistor R14)	GON pin connected to DRN pin
Not installed (external logic controller connected to CTL pad)	External logic controller	GON pin connected to SRC pin (CTL driven high)
		GON pin connected to DRN pin (CTL driven low)

**Default position.*

logic-high, both the OUT and the VGOFF outputs are enabled. Removing the shunt disables the OUT and the VGOFF outputs. Refer to the *Power-Up Sequence* section in the MAX17014 IC data sheet for a more detailed description of the OUT and VGOFF power-up sequence. Table 4 lists the selectable JU3 jumper options.

Step-Up and Positive Charge-Pump Regulator Enable Input (EN2)

The MAX17014 EV kit features a jumper (JU4) to control the step-up and positive charge-pump regulator enable input (EN2). By default, a shunt is installed across JU4 to provide EN2 logic-high. When EN2 and EN1 are logic-high, both the AVDD and the VGON outputs are enabled. EN2 is inactive when EN1 is low. Refer to the *Power-Up Sequence* section in the MAX17014 IC data sheet for a more detailed description of the AVDD and VGON power-up sequence. Table 4 lists the selectable JU4 jumper options.

High-Voltage Switch Control Input (CTL)

Jumper JU5 configures the setting to control the high-voltage switch control pin (CTL) of the MAX17014 IC. Switches between the SRC and GON pins and the GON and DRN pins can also be controlled by an external logic controller connected to the CTL pad. See Table 5 for switch states and refer to the *High-Voltage Switch Control* section in the MAX17014 IC data sheet for further information about the high-voltage switches connected to the GON pin.

VGON Discharge Path

The MAX17014 EV kit features a method to configure the VGON discharge path using resistor R15 and jumper JU6. When CTL is low, GON may be connected to DRN, allowing VGON to discharge through resistor R15. JU6 selects the discharge path by connecting R15 to AVDD (through diode D6) or to PGND. Table 6 lists the selectable JU6 jumper options.

Table 6. Jumper JU6 Functions

SHUNT POSITION	DRN PIN CONNECTED TO	VGON DISCHARGED TOWARD
1-2*	AVDD (through resistor R15 and diode D6)	AVDD
2-3	PGND (through resistor R15)	PGND

**Default position.*

Output Voltage Selection

Step-Down Switching-Regulator Output Voltage (OUT)

The MAX17014 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 (OUT) is set to the +3.3V fixed mode by connecting FB2 to GND through resistor R19. For adjustable mode (+1.25V to +5V), select R18 and R19 to set the desired step-down regulator output voltage. Refer to the *Detailed Description*, *Step-Down Regulator* section in the MAX17014 IC data sheet for instructions on selecting resistors R18 and R19.

Step-Up Switching-Regulator Output Voltage (AVDD)

The MAX17014 EV kit's step-up switching-regulator output (AVDD) is set to +16V by feedback resistors R3 and R4. To generate output voltages other than +16V (VIN to +20V), select different external voltage-divider resistors. Refer to the *Design Procedure, Step-Up Regulator* section in the MAX17014 IC data sheet for instructions on selecting the feedback resistors.

Positive Charge-Pump Output (VGON)

The positive charge-pump output (VGON) is set to +35V by voltage-divider resistors R16 and R17. To set VGON to other voltages (up to approximately 3 x AVDD, 44V max), select different divider resistors. Refer to the *Design Procedure, Charge-Pump Regulators, Output Voltage Selection* section in the MAX17014 IC data sheet for instructions on selecting resistors R16 and R17.

Negative Charge-Pump Output (VGOFF)

The negative charge-pump output (VGOFF) is set to -6V by voltage-divider resistors R1 and R2. To set VGOFF to other voltages (0V to -AVDD), select different divider resistors. For VGOFF lower than -16V, select C15 with a higher voltage rating. Refer to the *Design Procedure, Charge-Pump Regulators, Output Voltage Selection* section in the MAX17014 IC data sheet for instructions on selecting resistors R1 and R2.

Op-Amp Output Voltages (VCOM1, VCOM2)

The MAX17014 EV kit's op-amp outputs (VCOM1, VCOM2) are designed to drive the LCD backplane (VCOM). Both op amps are configured as unity gain buffers by resistors R12 and R13. Using external voltage-divider resistors, each op amp's output is set for one half of the AVDD output voltage. To generate output voltages other than +8V, select different external voltage-divider resistors (R8–R11).

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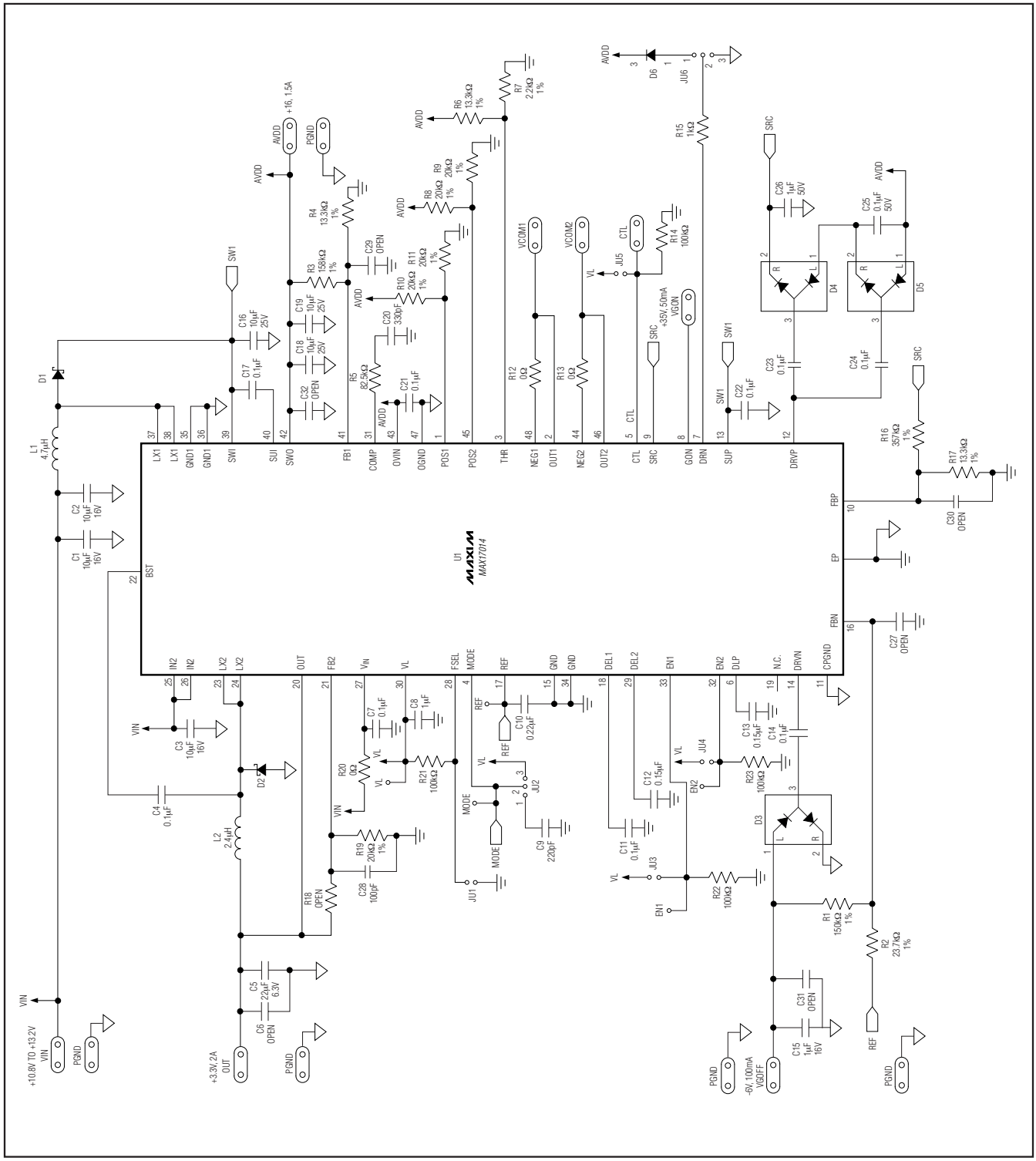

Figure 1. MAX17014 EV Kit Schematic

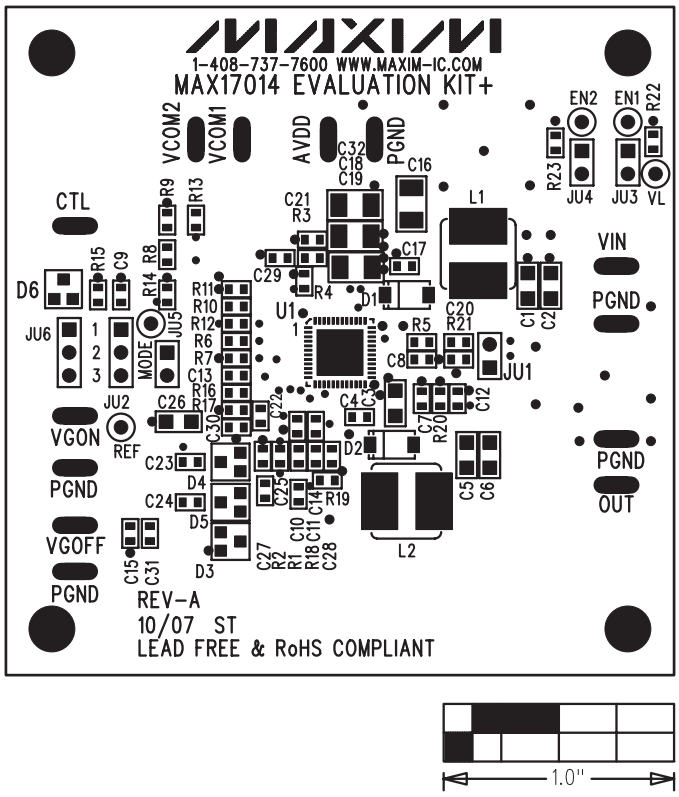

Figure 2. MAX17014 EV Kit Component Placement Guide—Component Side

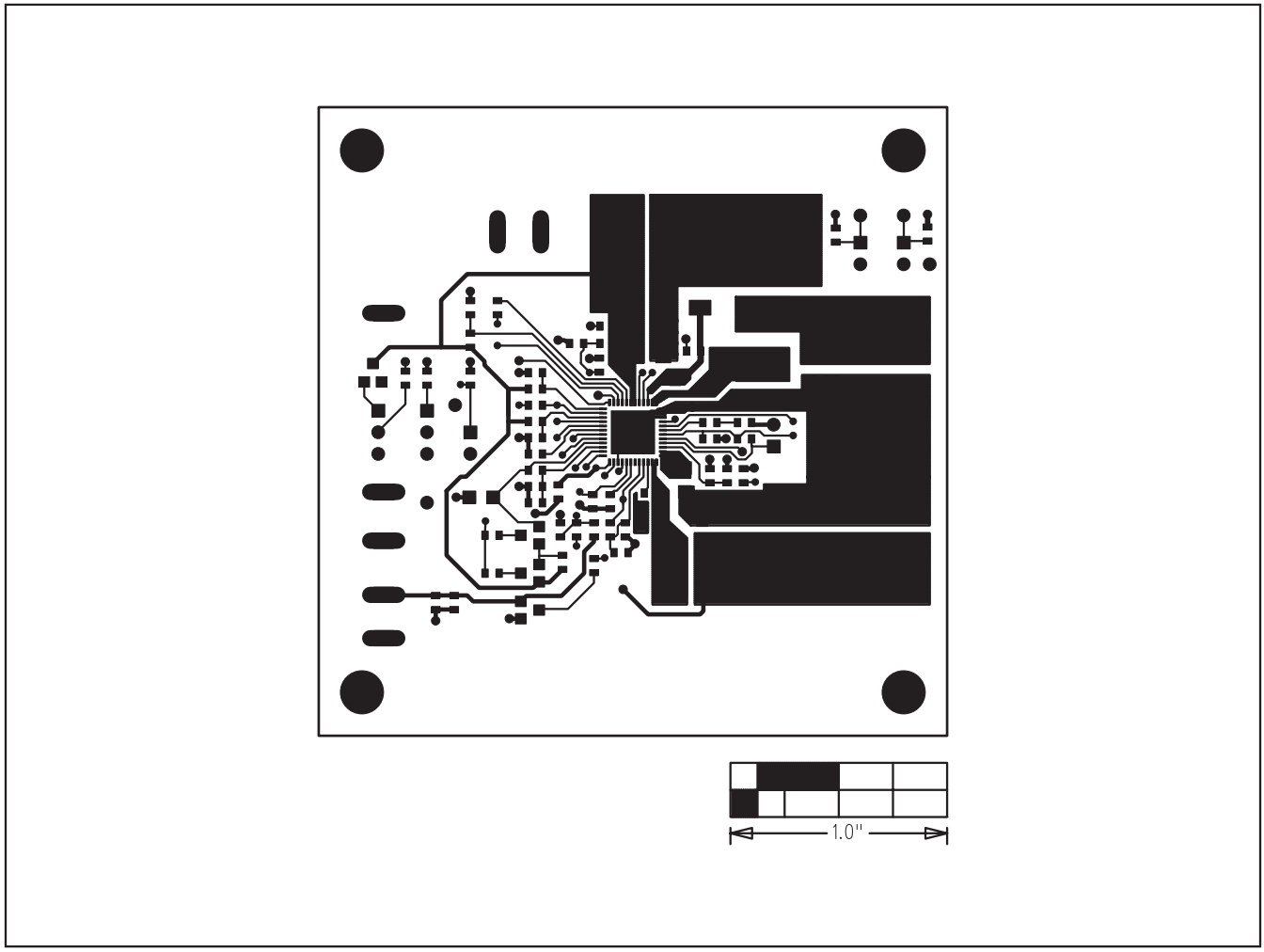

Figure 3. MAX17014 EV Kit PCB Layout—Component Side

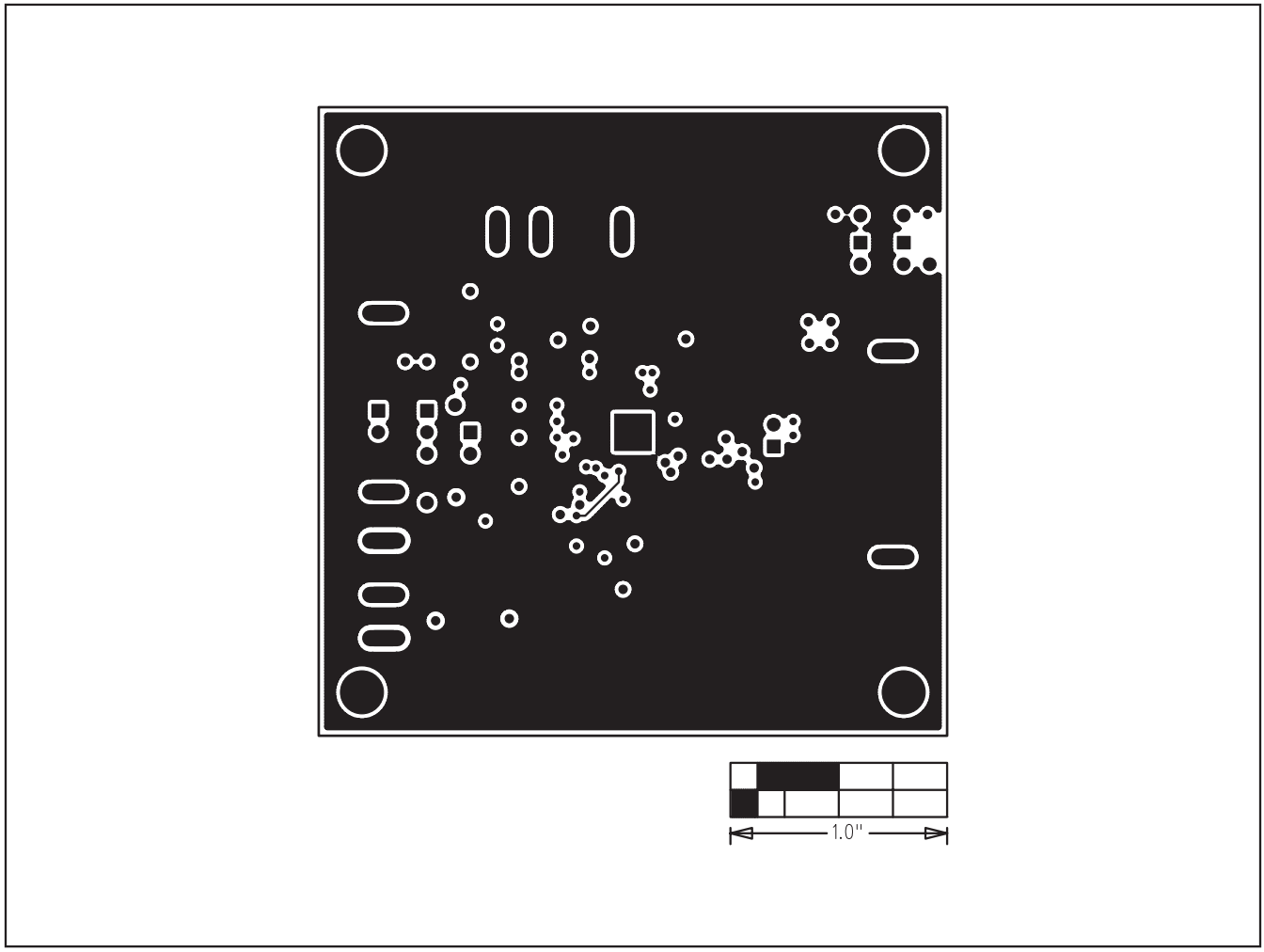

Figure 4. MAX17014 EV Kit PCB Layout—Internal Layer 2 (PGND Plane)

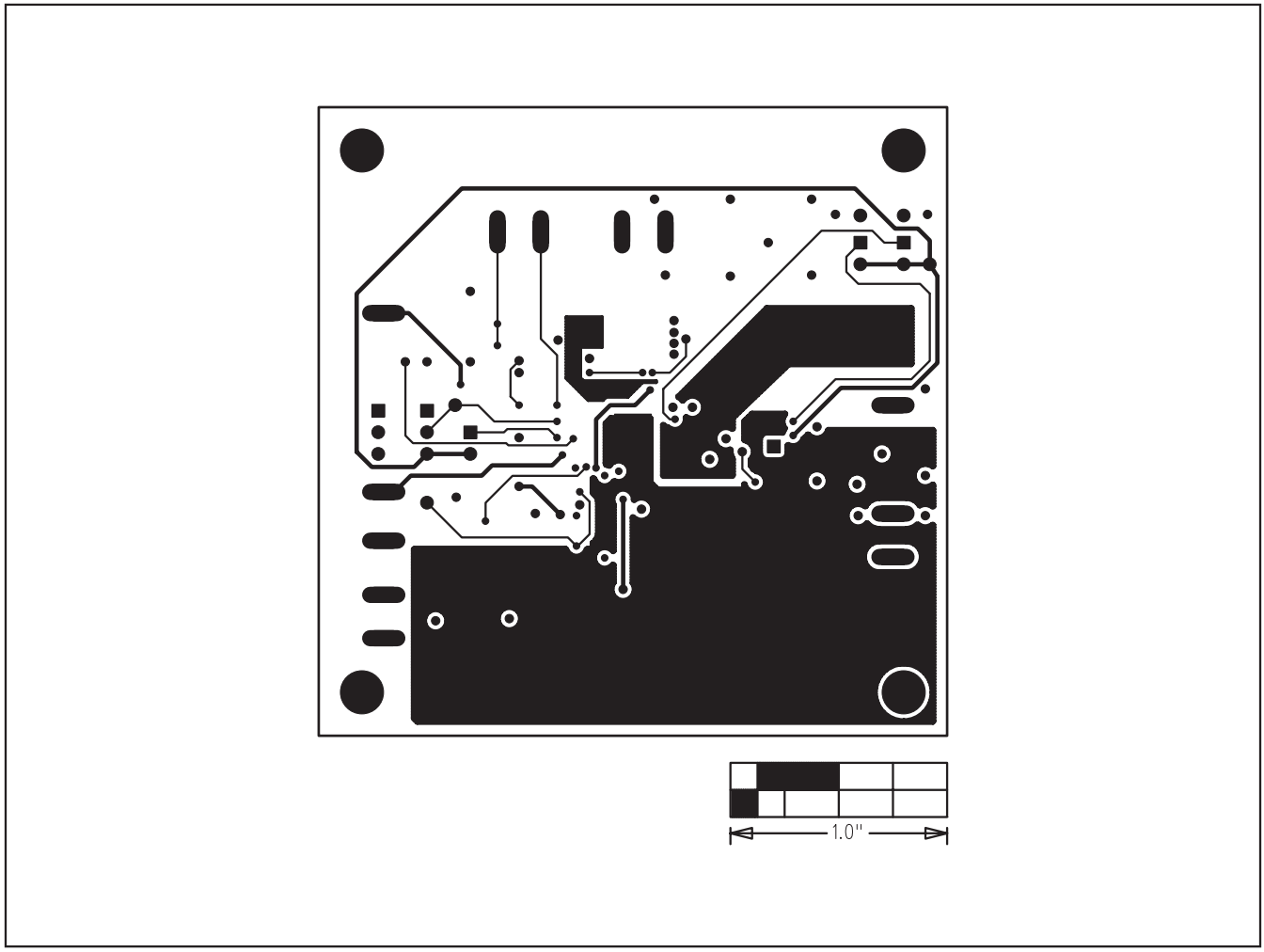

Figure 5. MAX17014 EV Kit PCB Layout—Internal Layer 3 (Signal/GND Plane)

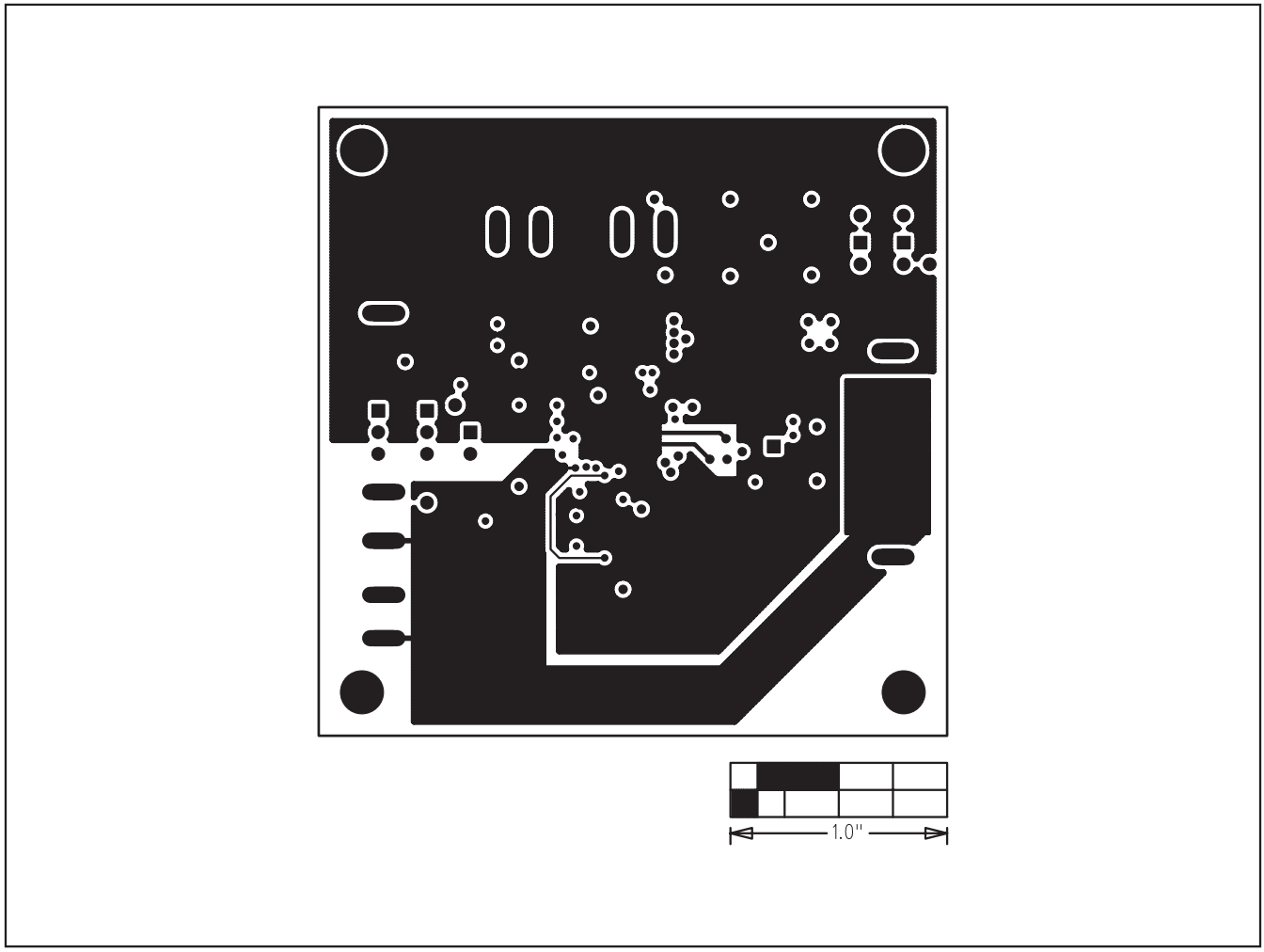

Figure 6. MAX17014 EV Kit PCB Layout—Solder Side