



# MAX17075 Evaluation Kit

Evaluates: MAX17075

## General Description

The MAX17075 evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board that provides the voltages and features required for active-matrix thin-film transistor (TFT), liquid-crystal display (LCD) panels in LCD monitors and LCD TVs. The EV kit contains a step-up switching regulator, a two-stage positive charge pump for the TFT gate-on supply, a single-stage negative charge pump for the TFT gate-off supply, and a high-current op amp. Also included is a logic-controlled high-voltage switch array, with capacitor control delay, for the positive gate-driver supply. A capacitive dummy load is provided at the high-voltage switch output for ease of testing without an attached panel.

The MAX17075 EV kit is designed to operate from a DC supply voltage of +2.5V to +5.5V. At +5V ( $\pm 10\%$ ) nominal input voltage, the step-up switching regulator provides a +13V output and up to 500mA. The positive charge pump provides a +30V output and up to 30mA. The negative charge pump provides a -7V output and up to 60mA. The high-current op amp provides a +6.5V output that can source or sink 500mA peak current. The high-voltage switch array is controlled by external logic.

The MAX17075 switches at 1.2MHz, allowing the use of tiny surface-mount components. The MAX17075 thin QFN package (0.8mm maximum height) with low-profile external components allows this circuit to be less than 3mm high.

## Features

- ◆ **+2.5V to +5.5V Input-Voltage Range**
- ◆ **Output Voltages (+4.5V to +5.5V Input Voltage)**
  - +13V Output at 500mA (Step-Up Switching Regulator)
  - +30V Output at 30mA (Positive Charge Pump)
  - 7V Output at 60mA (Negative Charge Pump)
  - High-Current Op Amp ( $\pm 500\text{mA}$  Peak Current)
- ◆ **1.2MHz Switching Frequency**
- ◆ **All Output Voltages are Resistor Adjustable**
- ◆ **Logic-Controlled High-Voltage Switches with Capacitor Control Delay**
- ◆ **Low-Profile Surface-Mount Components**
- ◆ **Lead(Pb)-Free and RoHS Compliant**
- ◆ **Fully Assembled and Tested**

## Ordering Information

PART	TYPE
MAX17075EVKIT+	EV Kit

+Denotes lead(Pb)-free RoHS compliant.

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	10 $\mu\text{F}$ $\pm 20\%$ , 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J106M TDK C1608X5R0J106M
C3, C4	2	10 $\mu\text{F}$ $\pm 20\%$ , 25V X5R ceramic capacitors (1206) Murata GRM31CR61E106M TDK C3216X5R1E106M
C5	1	1 $\mu\text{F}$ $\pm 10\%$ , 6.3V X5R ceramic capacitor (0402) Murata GRM155R60J105K TDK C1005X5R0J105K
C6	1	1 $\mu\text{F}$ $\pm 10\%$ , 25V X5R ceramic capacitor (0603) Murata GRM188R61E105K TDK C1608X5R1E105K
C7	1	1000pF $\pm 10\%$ , 50V X7R ceramic capacitor (0805) Murata GRM216R71H102K TDK C2012X7R1H102K

DESIGNATION	QTY	DESCRIPTION
C8	1	0.033 $\mu\text{F}$ $\pm 10\%$ , 16V X7R ceramic capacitor (0603) Murata GRM188R71C333K TDK C1608X7R1E333K
C9	1	0.22 $\mu\text{F}$ $\pm 10\%$ , 6.3V X5R ceramic capacitor (0402) Murata GRM155R60J224K TDK C1005X5R0J224K
C10, C14	2	1 $\mu\text{F}$ $\pm 10\%$ , 50V X7R ceramic capacitors (1206) Murata GRM31MR71H105KA TDK C3216X7R1H105K
C11, C15, C16, C17	4	0.1 $\mu\text{F}$ $\pm 10\%$ , 50V X7R ceramic capacitors (0603) Murata GRM188R71H104K TDK C1608X7R1H104K
C12	1	220pF $\pm 10\%$ , 50V X7R ceramic capacitor (0402) Murata GRM155R71H221K TDK C1005X7R1H221K



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## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C13	1	0.01 $\mu$ F $\pm$ 10%, 10V X5R ceramic capacitor (0402) Murata GRM155R61A103K TDK C1005X5R1A103K
C18	1	1500pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H152K TDK C1608X7R1H152K
C19	0	Not installed, capacitor (1206)
C20	0	Not installed, capacitor (0402)
C21	1	0.22 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitor (0603) Murata GRM188R71E224K TDK C1608X7R1E224K
D1	1	3A, 30V Schottky diode (M-Flat) Toshiba CMS02 (Top Mark: S2)
D2, D3, D4	3	220mA, 100V dual diodes (SOT23) Fairchild MMBD4148SE (Top Mark: D4)
JU1	1	3-pin header
JU2, JU3	2	2-pin headers
L1	1	3 $\mu$ H, 3A <sub>DC</sub> inductor Sumida CDRH6D28-3R0
Q1	0	Not installed, transistor (SOT223) Recommended: 20V, 1A npn transistor (SOT223) Fairchild BCP68

DESIGNATION	QTY	DESCRIPTION
Q2	0	Not installed, transistor (SOT223) Recommended: -20V, -1.5A pnp transistor (SOT223) Fairchild BCP69
R1	1	10 $\Omega$ $\pm$ 5% resistor (0603)
R2	0	Not installed, 100 $\Omega$ $\pm$ 5% resistor (0603) recommended
R3, R4, R5, R7	4	100k $\Omega$ $\pm$ 1% resistors (0603)
R6	1	13.7k $\Omega$ $\pm$ 1% resistor (0603)
R8	1	187k $\Omega$ $\pm$ 1% resistor (0603)
R9, R16	2	20k $\Omega$ $\pm$ 1% resistors (0603)
R10	1	82k $\Omega$ $\pm$ 5% resistor (0603)
R11	1	8.45k $\Omega$ $\pm$ 1% resistor (0603)
R12	1	10k $\Omega$ $\pm$ 1% resistor (0603)
R13	1	10k $\Omega$ $\pm$ 5% resistor (0603)
R14	1	1k $\Omega$ $\pm$ 5% resistor (0603)
R15	1	464k $\Omega$ $\pm$ 1% resistor (0603)
R17	1	10k $\Omega$ SMT cermet trimmer, 9 to 15 turns
U1	1	Boost regulator (24 TQFN) Maxim MAX17075ETG+
—	3	Shunts
—	1	PCB: MAX17075 Evaluation Kit+

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Sumida Corp.	847-545-6700	www.sumida.com
TDK Corp.	847-803-6100	www.component.tdk.com
Toshiba America Electronic Components, Inc.	949-623-2900	www.toshiba.com/taec

**Note:** Indicate that you are using the MAX17075 when contacting these component suppliers.

## Quick Start

### Required Equipment

Before beginning, the following equipment is needed:

- +4.5V to +5.5V, 5A DC power supply
- One voltmeter

## Procedure

The MAX17075 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 a shunt is installed across pins 2-3 of jumper JU1 (VCOM unbuffered).

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- 2) Verify that a shunt is installed across jumper JU2 (VGON internally connected to SRC).
- 3) Verify that no shunt is installed across jumper JU3 (VGON is not connected to capacitive dummy load C18).
- 4) Connect the positive terminal of the power supply to the VIN pad on the EV kit. Connect the negative terminal of the power supply to the PGND pad next to the VIN pad.
- 5) Turn on the power supply and set the supply to +4.5V.
- 6) Verify that the step-up switching regulator output (AVDD) is +13V.
- 7) Verify that the gate-on supply (VGON) is +30V.
- 8) Verify that the gate-off supply (VGOFF) is -7V.
- 9) Verify that the op-amp output (VCOM) is +6.5V.

## **Detailed Description of Hardware**

The MAX17075 EV kit contains a step-up switching regulator, a positive charge pump, a negative charge pump, a high-current op amp, and a high-voltage switch array. The EV kit is configured to operate from a DC power supply between +2.5V and +5.5V that provides at least 5A. The MAX17075 switching frequency is 1.2MHz.

With +5V input voltage, the step-up switching regulator (AVDD) generates a +13V output and provides at least 500mA. The step-up switching regulator output voltage can be adjusted up to +18V by replacing feedback resistors R8 and R9 (refer to the *Design Procedure, Step-Up Regulator, Output-Voltage Selection* section in the MAX17075 IC data sheet). Operation at significantly higher output voltages could reduce the available output current and require changes in component values or component voltage rating.

The gate-on (VGON) supply consists of a two-stage positive charge pump that generates +30V and provides greater than 30mA. This output can be adjusted up to approximately +3xAVDD by replacing feedback resistors R15 and R16 (refer to the *Design Procedure, Charge-Pump Regulators, Output-Voltage Selection* section in the MAX17075 IC data sheet).

The VGOFF supply consists of a negative charge pump that generates -7V and provides > 60mA. This output can be adjusted from approximately 0 to -AVDD by replacing feedback resistors R6 and R7 (refer to the *Design Procedure, Charge-Pump Regulators, Output-Voltage Selection* section in the MAX17075 IC data sheet).

The MAX17075 provides a high-current op amp that sources or sinks 500mA peak current. The op amp output is configured for +6.5V (AVDD/2).

The MAX17075 contains two high-voltage switches that operate in a complementary fashion. One of the switches provides a connection between the COM (VGON PCB pad) and SRC pins. The other switch provides a connection between the COM and DRN pins. The switches are controlled by an external TTL logic signal connected to the CTL pad.

When CTL is high, VGON is connected to SRC, charging VGON to the voltage of the positive charge pump at the SRC pin. When CTL is low, VGON is connected to DRN, allowing VGON to discharge toward AVDD (through resistor R14). The MAX17075 EV kit also features a capacitive dummy load of 1500pF (C18) at the VGON output pad that can be connected through jumper JU3 to simulate a TFT panel load for testing the switch array.

The high-voltage switch delay time can be configured by replacing capacitor C8. Refer to the *Power-Up Sequence and Soft-Start* section in the MAX17075 IC data sheet for additional details.

## **Jumper Selection**

### **Op-Amp Output (VCOM)**

Jumper JU1 configures the op-amp output (VCOM) on the MAX17075 EV kit. The op-amp output (VCOM) of the MAX17075 EV kit can be buffered with a push-pull output stage, or unbuffered. See Table 1 for JU1 shunt positions.

**Table 1. JU1 Jumper Selection (VCOM)**

SHUNT POSITION	VCOM
1-2*	Buffered
2-3**	Unbuffered
None	Not connected

\*Install appropriate transistors Q1, Q2, and resistor R2 to buffer the VCOM output. See the Component List.

\*\*Default position.

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## High-Voltage Switch Control (CTL)

Jumper JU2 configures the positions of the high-voltage switch control pin (CTL) of the MAX17075 IC. The CTL pin can be controlled by an external logic controller connected to the EV kit's CTL pad. Remove the shunt from jumper JU2 before connecting an external controller to the CTL pad. See Table 2 for JU2 shunt positions.

## High-Voltage Switch Output (VGON) Dummy Load

The MAX17075 EV kit features a capacitive dummy load of 1500pF (C18) at the VGON output pad to simulate a TFT panel load to test the switch array. When testing with an actual LCD panel, disconnect the dummy load. Jumper JU3 connects and disconnects the dummy load. Table 3 lists the selectable JU3 jumper options.

## Output-Voltage Selection

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

The MAX17075 EV kit's step-up switching-regulator output (AVDD) is set to +13V by feedback resistors R8 and R9. To generate output voltages other than +13V (up to +18V), select different voltage-divider resistors. Operation at significantly higher output voltages could reduce the available output current, and require changes in component values or voltage rating for capacitors C3 and C4. Refer to the *Design Procedure*,

*Step-Up Regulator, Output-Voltage Selection* section in the MAX17075 IC data sheet for instructions on selecting resistors R8 and R9.

### Positive Charge-Pump Output (SRC)

The positive charge-pump output (SRC) is set to +30V by voltage-divider resistors R15 and R16. To set SRC to other voltages (up to approximately 3xAVDD, limited to +36V), select different voltage-divider resistors. Refer to the *Design Procedure, Charge-Pump Regulators, Output-Voltage Selection* section in the MAX17075 IC data sheet for instructions on selecting resistors R15 and R16.

### Negative Charge-Pump Output (VGOFF)

The negative charge-pump output (VGOFF) is set to -7V by voltage-divider resistors R6 and R7. To set VGOFF to other voltages (from 0 to -AVDD approximately), select different voltage-divider resistors. Refer to the *Design Procedure, Charge-Pump Regulators, Output-Voltage Selection* section in the MAX17075 IC data sheet for instructions on selecting resistors R6 and R7.

### Op-Amp Output (OUT)

The op-amp output (OUT) is set to +6.5V by voltage-divider resistors R3 and R4. To set the outputs to other voltages (from 0 to AVDD), select different voltage-divider resistors.

**Table 2. JU2 Jumper Selection (CTL)**

SHUNT POSITION	CTL PIN CONNECTED TO	HIGH-VOLTAGE SWITCH CONFIGURATION
Installed	VIN	COM pin connected to SRC pin COM pin disconnected from DRN pin
Not installed*	GND through resistor R5	COM pin connected to DRN pin COM pin disconnected from SRC pin
None	External logic controller through the CTL pad	CTL driven by external logic controller CTL high: COM pin connected to SRC pin CTL low: COM pin connected to DRN pin

\*Default position.

**Table 3. JU3 Jumper Selection (C18)**

SHUNT POSITION	VGON	OPERATION
Installed	Connected to C18	Dummy load testing
Not installed*	Not connected to C18	Normal operation, no load

\*Default position.

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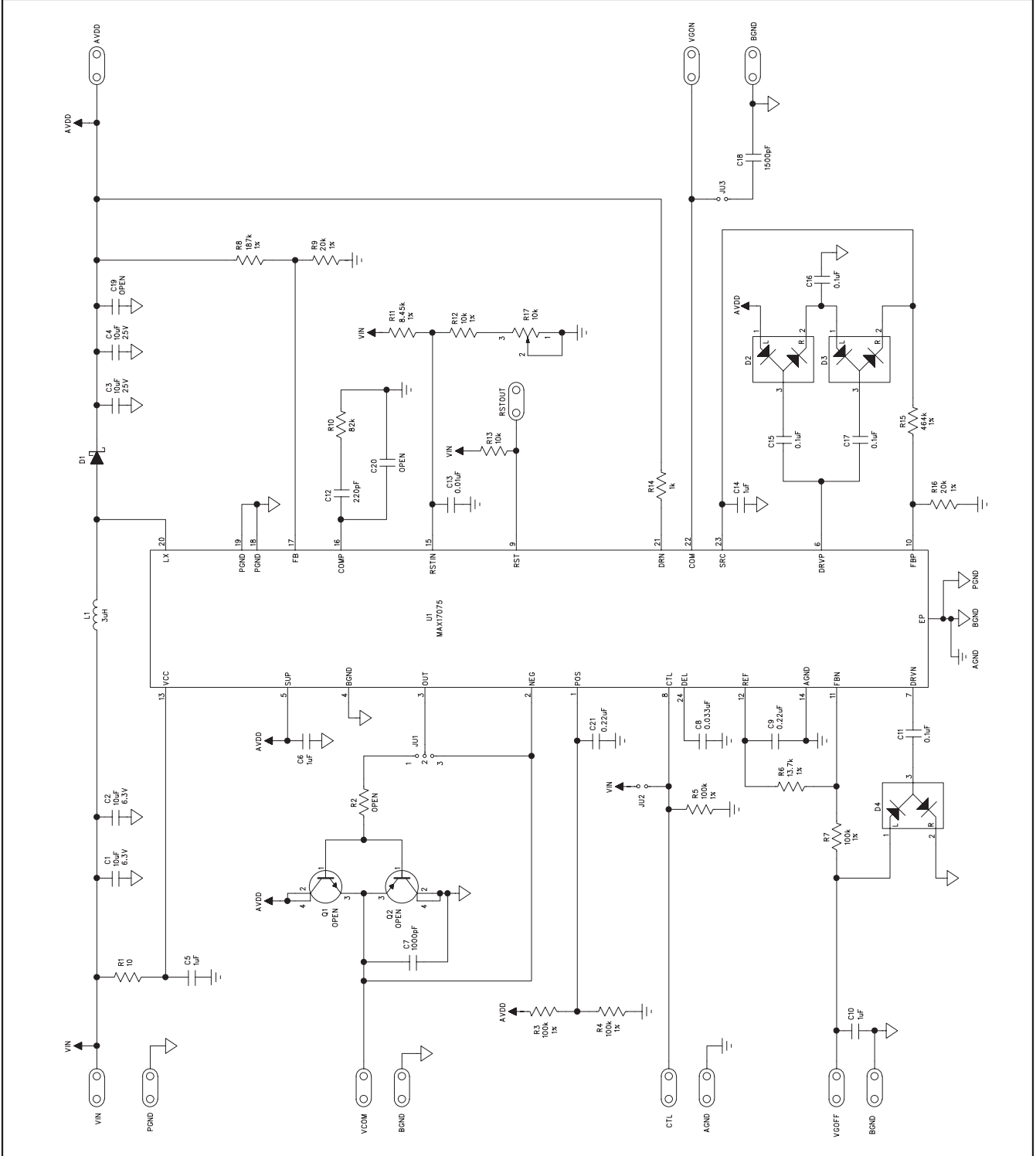


Figure 1. MAX17075 EV Kit Schematic

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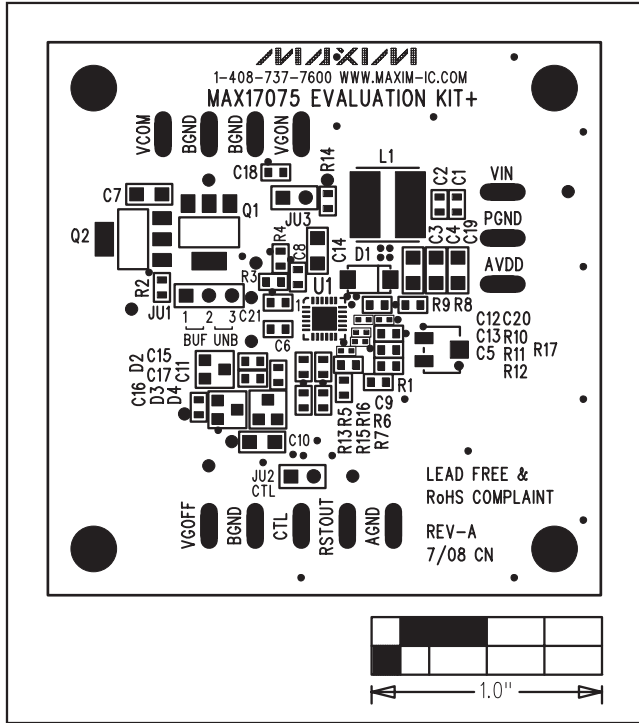


Figure 2. MAX17075 EV Kit Component Placement Guide—Component Side

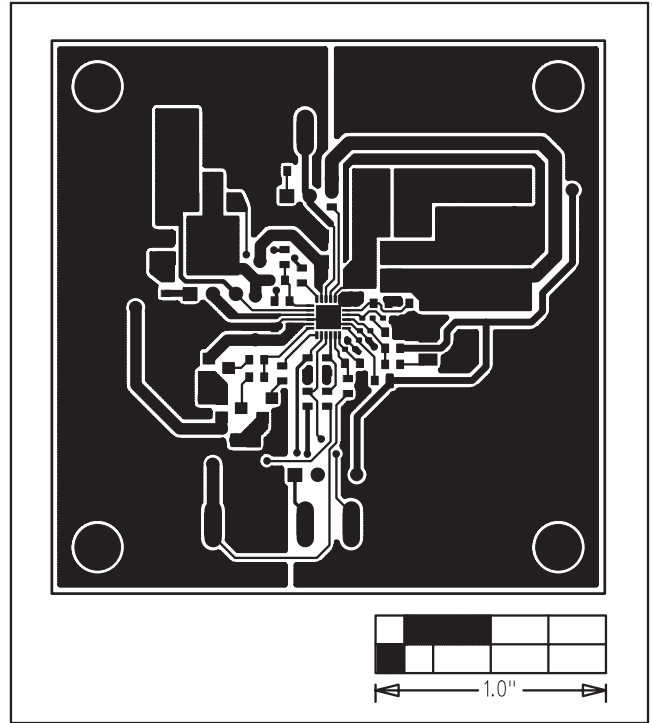


Figure 3. MAX17075 EV Kit PCB Layout—Component Side

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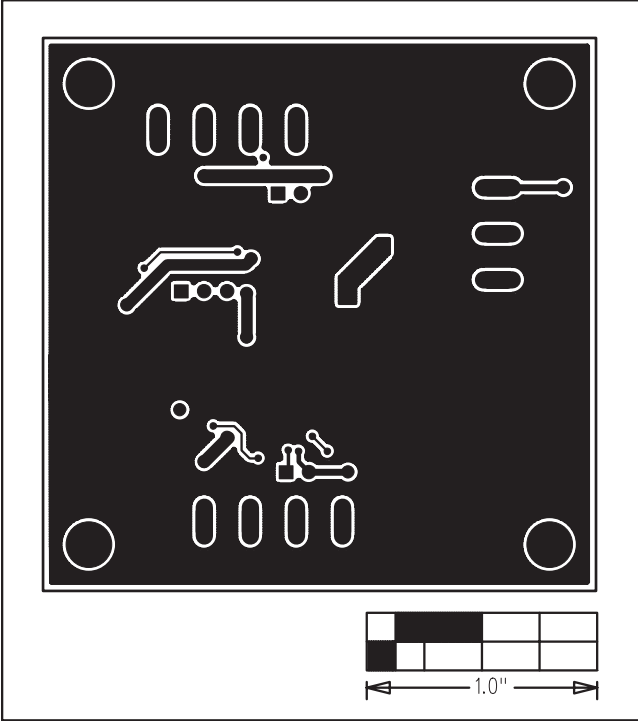


Figure 4. MAX17075 EV Kit PCB Layout—Solder Side

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