19-3903; Rev 0; 11/05

MAX8758 Evaluation Kit

Evaluates: MAX8758

General Description

The MAX8758 evaluation kit (EV kit) is a fully assembled and tested surface-mount PC board that provides the voltages and features required for active-matrix, thin-film transistor (TFT), liquid-crystal display (LCD) applications. The EV kit contains a step-up switching regulator, a positive two-stage charge pump for the TFT gate-on supply, and a negative single-stage charge pump for the TFT gate-off supply. The included high-speed operational amplifier can be used to drive the LCD backplane (VCOM) or the gamma-correction divider string, and a logic-controlled, high-voltage switch with adjustable delay.

The EV kit operates from a +2.2V to +5.5V DC supply voltage. The step-up switching regulator is configured for a +8.5V output, providing at least 330mA from 3.0V. The positive charge pump is configured for a +23V output providing at least 20mA. The negative charge pump is configured for a -8V output providing at least 20mA. The high-speed operational amplifier is configured for +4.25V, capable of providing up to ±150mA peak. The high-voltage switch can be used to delay the output of the positive charge pump's startup. The delay time is set with an external capacitor.

The MAX8758 EV kit demonstrates low quiescent current and high efficiency for maximum battery life. Operation at 1.2MHz allows the use of tiny surface-mount components. The MAX8758 TQFN package (0.8mm maximum height) with low-profile external components allows this circuit to be less than 1.25mm high.

Features

- **+2.2V to +5.5V Input Range**
- **Output Voltages**
  - **+8.5V Output at 330mA (Step-Up Switching Regulator, 3V Input)**
  - **+23V Output at 20mA (Positive Charge Pump)**
  - **-8V Output at 20mA (Negative Charge Pump)**
  - **+4.25V Output at ±150mA (Operational Amplifier, VCOM)**
- **Resistor-Adjustable Switching Regulator and Op-Amp Output Voltages**
- **Logic-Controlled, High-Voltage Switch with Adjustable Delay**
- **Greater Than 85% Efficiency (Step-Up Switching Regulator)**
- **Selectable 640kHz/1.2MHz Step-Up Switching Frequency**
- **Low-Profile, Surface-Mount Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX8758EVKIT	0°C to +70°C	24 TQFN (4mm x 4mm x 0.8mm)

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	4.7µF ±10%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J475K
C3, C4, C5	3	4.7µF ±20%, 10V X5R ceramic capacitors (1206) TDK C3216X5R1A475M
C6, C10, C14–C20	9	0.1µF ±10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H104K
C7	0	Not installed capacitor (0603)
C8	0	Not installed capacitor (1206)
C9	1	220pF ±5%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H221J
C11	1	0.22µF ±20%, 16V X5R ceramic capacitor (0603) TDK C1608X5R1C224M
C12	1	0.033µF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H333K
C13	1	0.022µF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H223K
C21	1	150pF ±5%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H151J
C22	1	1500pF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H152K
C23	1	100µF ±20%, 16V aluminum electrolytic capacitor (6.3mm x 5mm) Sanyo 16MV100UAX

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

MAX8758 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C24	1	47pF ±5%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H470J
D1	1	1A, 30V Schottky diode (S-flat) Nihon EP10QY03 Toshiba CRS02
D2, D3, D4	3	200mA, 100V dual diodes (SOT23) Fairchild MMBD4148SE (Top mark D4) Central CMPD7000 (Top mark C5C)
JU1, JU2, JU3, JU6	4	2-pin headers
JU4, JU5	2	3-pin headers
L1	1	4.7µH, 1.2A power inductor Sumida CR5D11-4R7
R1	1	200kΩ ±1% resistor (0805)
R2	1	34kΩ ±1% resistor (0805)
R3, R4	2	100kΩ ±1% resistors (0603)
R5	1	51.1kΩ ±1% resistor (0805)
R6	1	20kΩ ±1% resistor (0805)
R7, R8, R9, R11	4	100kΩ ±5% resistors (0603)
R10	1	1kΩ ±5% resistor (0603)
R12	0	Not installed, shorted by PC trace (0603)
R13	1	20Ω ±5% resistor (0805)
U1	1	MAX8758ETG (24-pin TQFN 4mm x 4mm)
—	6	Shunts
—	1	MAX8758 PC board

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor	631-435-1110	www.centralsemi.com
Fairchild	888-522-5372	www.fairchildsemi.com
Nihon	81-33343-3411	www.niec.co.jp
Sanyo	619-661-6322	www.sanyovideo.com
Sumida	847-545-6700	www.sumida.com
TDK	847-803-6100	www.component.tdk.com
Toshiba	949-455-2000	www.toshiba.com/taec

Note: *Indicate that you are using the MAX8758 when contacting these component suppliers.*

Quick Start

The MAX8758 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Do not turn on the power supply until all connections are completed.**

Recommended Equipment

- +2.2V to +5.5V, 2A DC power supply
- Voltmeter

Procedure

1) Verify that there is no shunt across jumper JU1 (switching at 1.2MHz).
2) Verify that there is a shunt installed across jumper JU2 (CTL connected to LDO).
3) Verify that there are shunts installed across JU4 and JU5 pins 2 and 3.
4) Connect the positive terminal of the power supply to the VIN pad. Connect the negative terminal of the power supply to the GND pad.
5) Turn on the power supply and verify that the step-up switching regulator output (VMAIN) is +8.5V.
6) Verify that the gate-on supply (VP) is approximately +23V.
7) Verify that the gate-off supply (VN) is approximately -8V.
8) Verify that the operational-amplifier output (VCOM) is +4.25V.
9) Verify that the high-voltage switch common (GON) is +23V.

For instructions on selecting the step-up switching regulator feedback and op-amp divider resistors for other output voltages, see the *Output-Voltage Selection* section.

Detailed Description

The MAX8758 EV kit contains a step-up switching regulator, a positive two-stage charge pump, a negative single-stage charge pump, two operational amplifiers, and a high-voltage switch matrix. The EV kit operates from a +2.2V to +5.5V DC power supply that can provide at least 2A. The switching frequency is jumper selectable

between 640kHz and 1.2MHz, but the circuit is configured to operate at 1.2MHz.

As configured and with no load on the charge pumps, the step-up switching regulator (VMAIN) generates a +8.5V output and can provide at least 350mA from +2.6V input. It also provides at least 410mA from 3V input and 600mA from 4.5V input. The step-up switching-regulator output voltage can be adjusted up to +13V with other feedback resistors. For details, see the *Output-Voltage Selection* section.

The GON consists of two positive charge-pump stages to generate approximately +23V and can provide more than 20mA. The GOFF consists of a single negative charge-pump stage to generate approximately -8V and can provide more than 20mA. Loading the GON charge pump reduces the available output current on VMAIN by three times the GON load current. Loading the GOFF reduces the available VMAIN by the amount of the GOFF current.

The operational-amplifier output VCOM is set to +4.25V and can source or sink approximately 150mA. These outputs can be reconfigured to other voltages with voltage-divider resistors. See the *Output-Voltage Selection* section for details.

The high-voltage switch between the SRC and GON pins can be used to delay the VP startup. The VP voltage is connected to the switch source (SRC) and the switch drain (GON) is used as an output. The startup delay time is set with an external capacitor at the DLP pin.

The switch between the SRC and GON pins and the switch between the GON and DRN pins can be controlled by jumpers JU2 and JU4 or by an external TTL-logic source connected to the CTL pad and JU4. See Table 2 for switch states, and refer to the *High-Voltage Switch Control* section in the MAX8758 data sheet for further information about the high-voltage switches connected to the GON pin.

Jumper Selection

Switching Frequency Selection (FREQ)

The MAX8758 EV kit features an option to choose the step-up regulator switching frequency. Jumper JU1 selects the switching frequency. Table 1 lists the selectable jumper options. The EV kit is configured for 1.2MHz operation. Optimum performance at lower frequencies may require a larger inductor value. Refer to the *Step-Up Regulator Inductor Selection* section in the MAX8758 data sheet for more information.

Table 1. Jumper JU1 Functions

SHUNT LOCATION	FREQ PIN	SWITCHING FREQUENCY
None (default)	Connected to VIN through R7	1.2MHz
Installed	Connected to GND	640kHz

High-Voltage Switch Control (CTL and MODE)

The MAX8758 EV kit features an option to control the high-voltage switches between SRC, GON, and DRN on the MAX8758. GON can be connected to SRC (connected to VP, the positive charge-pump output) or can be allowed to discharge through DRN (connected to a

Table 2. On-Board, High-Voltage Switch Control Using JU2 and JU4

JU2 SHUNT LOCATION	JU4 SHUNT LOCATION	GON OUTPUT
Installed, CTL connected to LDO	Pins 2 and 3, MODE connected to LDO	GON connected to SRC pin, SRC = VP
Not installed, CTL connected to GND through R9	Pins 2 and 3, MODE connected to LDO	GON connected to DRN pin, GON is discharged through R10
Not installed, CTL driven externally	Pins 2 and 3, MODE connected to LDO	GON connected to SRC when CTL is logic-high and connected to DRN when CTL is logic-low
Installed, CTL connected to LDO	Pins 1 and 2, MODE connected to timing capacitor C21	GON connected to SRC pin, SRC = VP
Not installed, CTL pulled to GND through R9	Pins 1 and 2, MODE connected to timing capacitor C21	GON connected to DRN pin and discharged through R10 after delay set by C21
Not installed, CTL driven externally	Pins 1 and 2, MODE connected to timing capacitor C21	GON connected to SRC on rising edge of CTL; C21 begins charging on falling edge of CTL; when MODE reaches 2.5V, GON connects to DRN

discharge resistor through JU5). Table 2 lists the selectable JU2 and JU4 jumper options. To use an external TTL source to control the high-voltage switch, leave JU2 open and connect the source to the CTL terminal. Refer to the *High-Voltage Switch Control* section in the MAX8758 data sheet for details.

Shutdown Selection ($\overline{SHDN}$)

The MAX8758 EV kit incorporates JU3 to control the $\overline{SHDN}$ pin. Table 3 lists the JU3 functions.

Table 3. Jumper JU3 Functions

SHUNT LOCATION	$\overline{SHDN}$ PIN	EV KIT OUTPUT
Not installed (default)	Connected to VIN through R8	Enabled
Installed	Connected to GND	Disabled

Connecting DRN

The MAX8758 EV kit provides options to discharge DRN through R10 either to VMAIN or to GND by using jumper JU5. Table 4 lists the JU5 functions.

Table 4. Jumper JU5 Functions

SHUNT LOCATION	DRN PIN	GON OUTPUT
Pins 1 and 2 (default)	Connected to VMAIN through R10	GON is discharged through R10 to VMAIN when GON connects to DRN
Pins 2 and 3	Connected to GND through R10	GON is discharged through R10 to GND when GON connects to DRN

Output-Voltage Selection

Step-Up Switching Regulator Output Voltage (VMAIN)

The MAX8758 EV kit's step-up switching-regulator output (VMAIN) is set to +8.5V by feedback resistors R1 and R2. To generate output voltages other than +8.5V (up to +13V), select different external voltage-divider resistors, R1 and R2. Refer to the *Output Voltage Selection* section in the MAX8758 data sheet for instructions on selecting resistors R1 and R2.

Note that changing the VMAIN voltage setting changes the VP and VN charge-pump output voltages. Also, output capacitors C3 to C5 are rated for +10V. To set the output voltage greater than +10V, use higher-voltage-rated capacitors and take care not to allow SRC (connected to VP) to exceed its 30V absolute maximum rating.

Operational-Amplifier Output Voltage (VCOM)

The MAX8758 EV kit's operational amplifier is configured as a unity-gain buffer by the PC board trace shorting NEGB and OUTB pins. The voltage at the noninverting input, POSB, is set to half of VMAIN by voltage-divider resistors (R3, R4). To set VCOM to other voltages (up to VMAIN), select different divider resistors.

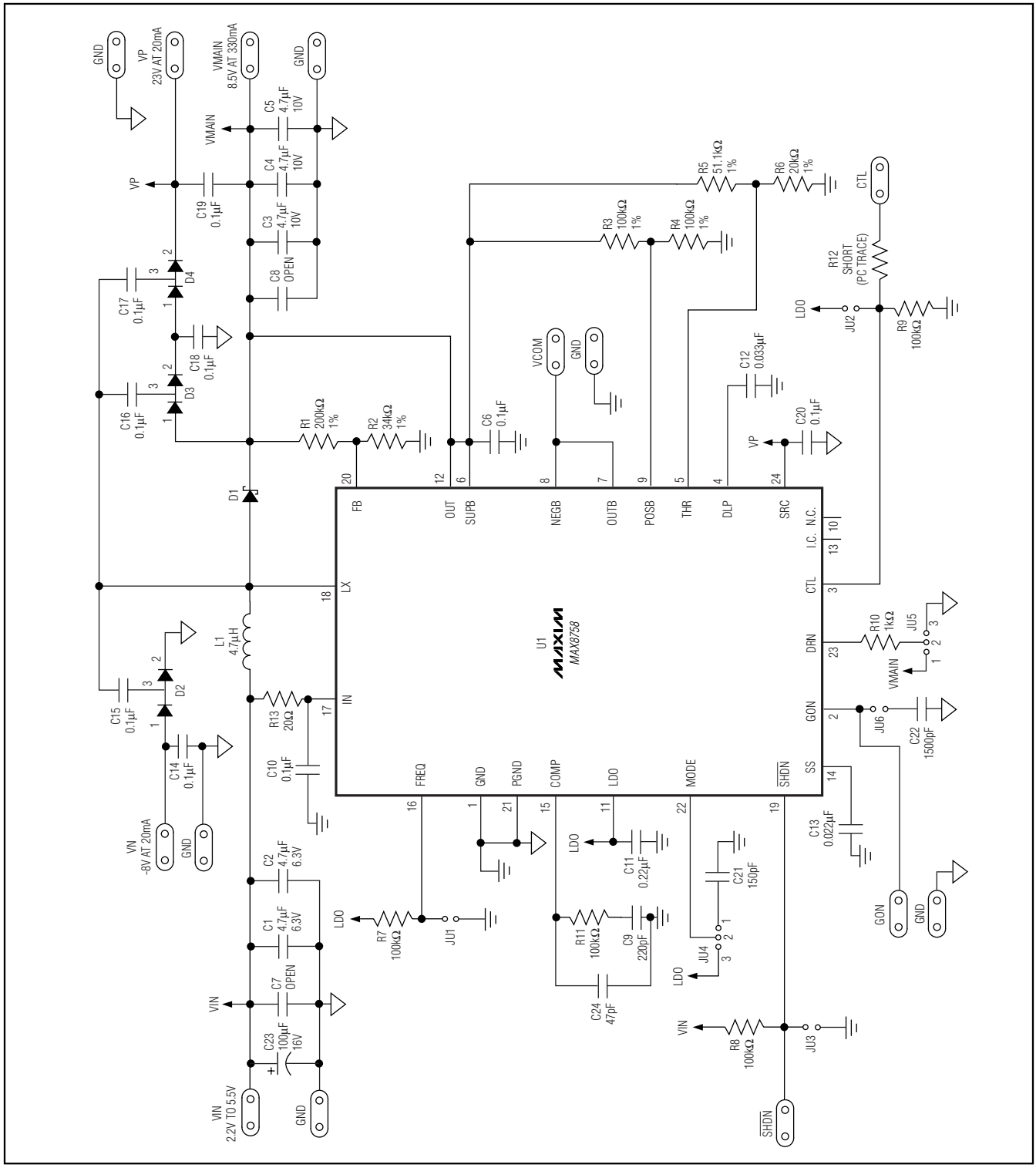


Figure 1. MAX8758 EV Kit Schematic

MAX8758 Evaluation Kit

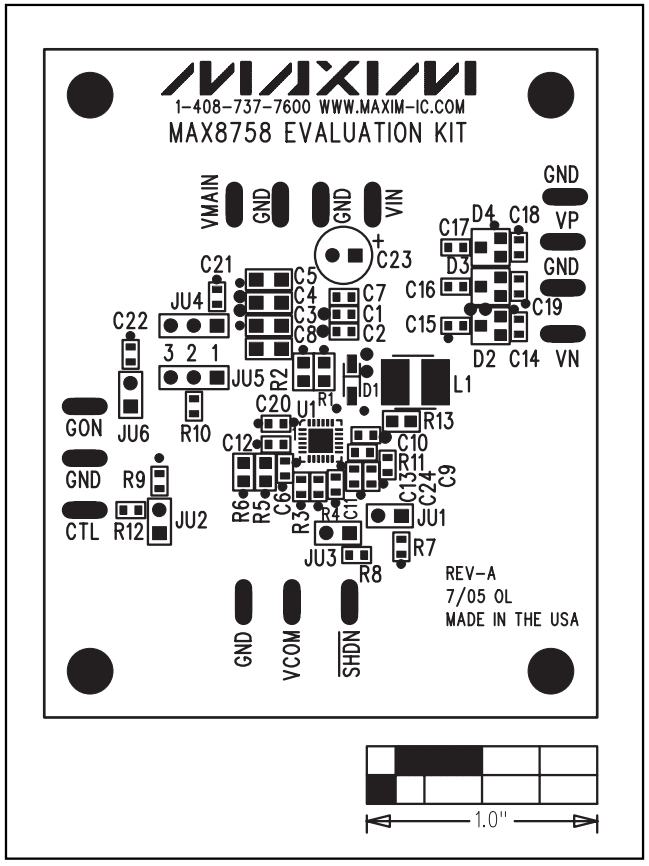


Figure 2. MAX8758 EV Kit Component Placement Guide—Component Side

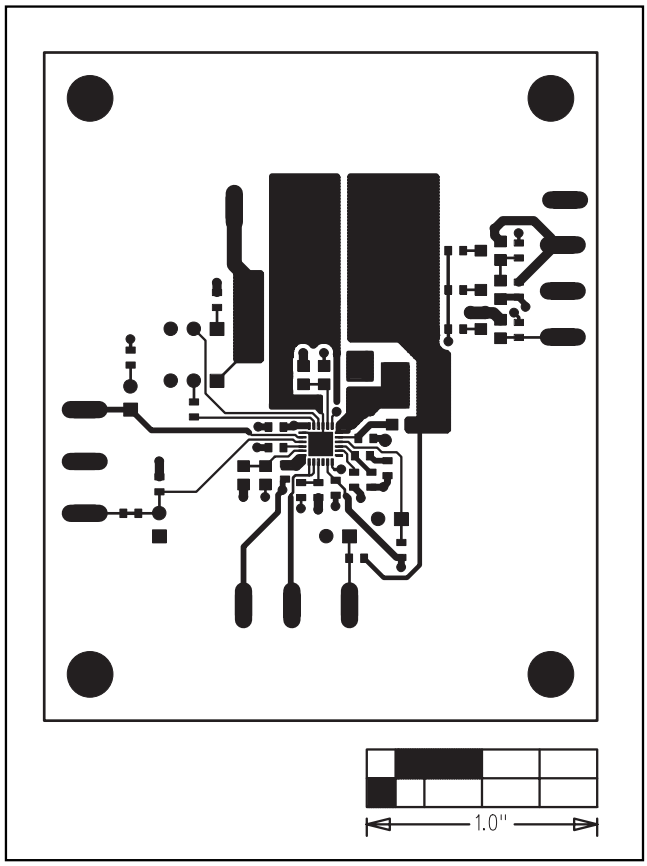


Figure 3. MAX8758 EV Kit PC Board Layout—Component Side

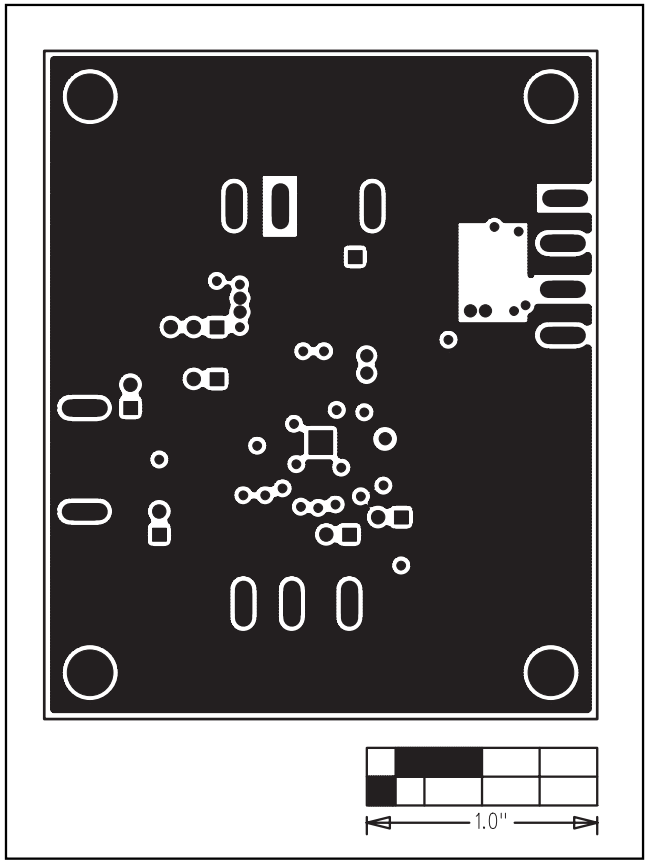


Figure 4. MAX8758 EV Kit PC Board Layout—Layer 2

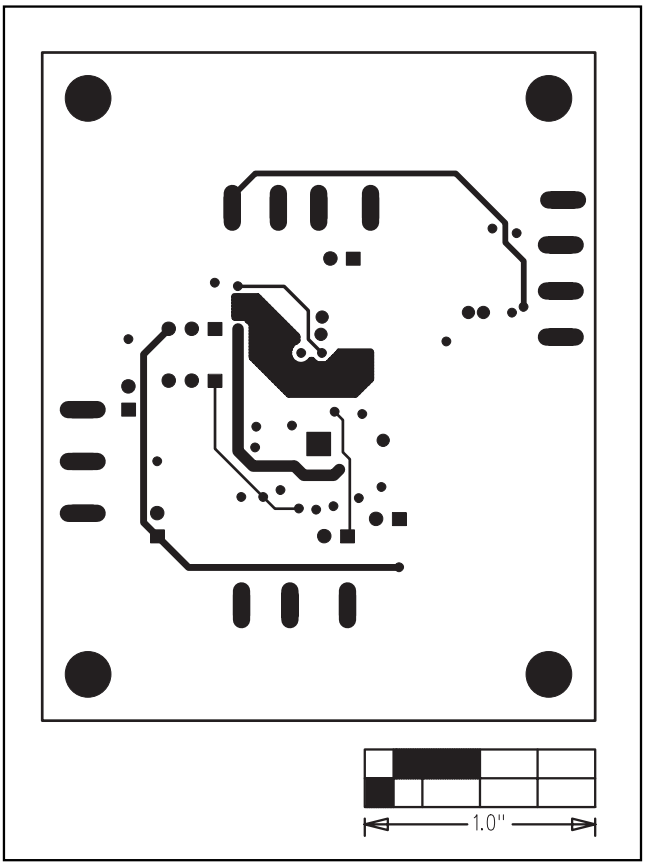


Figure 5. MAX8758 EV Kit PC Board Layout—Layer 3

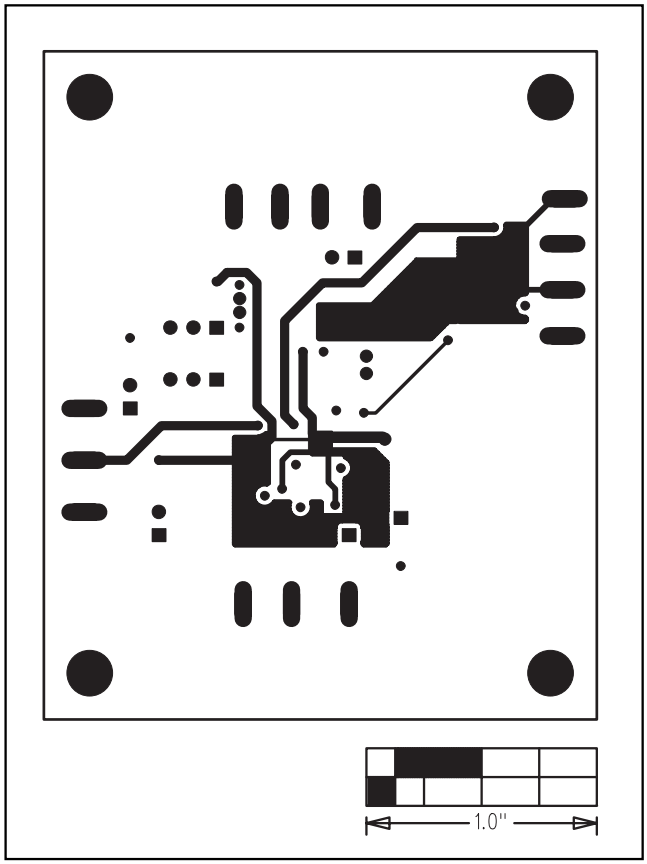


Figure 6. MAX8758 EV Kit PC Board Layout—Solder Side

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