19-3525; Rev 0; 11/04

MAX1513 Evaluation Kit

General Description

The MAX1513 evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board that provides voltages and features required for active-matrix, thin-film transistor (TFT), liquid-crystal displays. The EV kit contains a step-up switching regulator for TFT source driver supply, a positive two-stage charge pump and linear postregulator for the TFT gate-on (GON) supply, a negative one-stage charge pump and linear postregulator for the TFT gate-off (GOFF) supply, a gamma reference, and a low-voltage logic supply.

The EV kit operates from a DC supply voltage of +2.7V to +5.5V. The step-up switching regulator is configured for a +15V output at 500mA from a +4.5V to +5.5V input voltage. The positive charge pump and postregulator are configured for a +25V output using a single-stage charge pump providing 25mA. The negative charge pump and postregulator are configured for a -10V output using a single charge-pump stage providing 50mA. The gamma reference is configured for +14.7V providing 50mA. The low-voltage logic linear regulator is configured for +3.3V providing 500mA.

The MAX1513 EV kit demonstrates low-quiescent current and high efficiency (90%), and features overload protection for the input and all outputs. Up to 1.5MHz operation allows the use of tiny surface-mount components and results in a circuit height less than 1.8mm.

The MAX1513 EV kit can be also used to evaluate the MAX1514, which is a MAX1513 without a gamma linear-regulator controller and a buffer amplifier.

Features

- **+4.5V to +5.5V Input Range**
- **Output Voltages**
  - **+15V Output at 500mA (Step-Up Switching Regulator)**
  - **+25V Output at 25mA (Positive Charge Pump and Linear Postregulator)**
  - **-10V Output at 50mA (Negative Charge Pump and Linear Postregulator)**
  - **+14.7V Output at 50mA (Gamma Reference Regulator)**
  - **+3.3V Output at 500mA (Low-Voltage Logic Supply)**
- **90% Efficiency**
- **1.5MHz Step-Up Switching Frequency (Selectable: 430kHz/750kHz/1.5MHz)**
- **Low-Profile Surface-Mount Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX1513EVKIT	0°C to +70°C	20 TQFN 4mm × 4mm

Note: *To evaluate the MAX1514, request a MAX1514ETP free sample with the MAX1513 EV kit.*

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C7	2	10µF ±20%, 6.3V X5R ceramic capacitors (0805) Taiyo Yuden JMK212BJ106MG or TDK C2012X5R0J106M
C2	1	10µF ±20%, 16V POSCAP (D10) Sanyo 16AQU10M
C3	1	0.22µF ±10%, 50V X7R ceramic capacitor (0805) TDK C2012X7R1H224K
C4, C5	0	Not installed, capacitor (0603)
C6	1	2.2µF ±10%, 6.3V X5R ceramic capacitor (0603) Taiyo Yuden JMK107BJ225KA or TDK C1608X5R0J225K

DESIGNATION	QTY	DESCRIPTION
C8	1	1µF ±10%, 10V X5R ceramic capacitor (0603) Taiyo Yuden LMK107BJ105KA TDK C1608X5R1A105K
C9–C12, C17–C21	9	0.1µF ±10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H104K
C13, C14	2	0.47µF ±20%, 16V X5R ceramic capacitors (0603) TDK C1608X5R1C474M
C15	1	0.47µF ±10%, 25V X7R ceramic capacitor (0805) TDK C2012X7R1E474K

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.

MAX1513 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C16	1	0.22µF ±10%, 10V X5R ceramic capacitor (0603) TDK C1608X5R1A224K
C22	1	100µF ±20%, 16V aluminum electrolytic capacitor (6.3mm x 5mm) Sanyo 16MV100UAX
D1	1	1.0A, 30V Schottky diode (S-flat) Nihon EP10QY03 (top mark Y9k) or Toshiba CRS02 (top mark S2)
D2, D3, D4	3	200mA, 100V dual diodes (SOT23) Fairchild MMBT4148SE (top mark D4) or Central Semiconductor CMPD7000 (top mark C5C)
D5	0	Not installed, diode (SOT23)
JU1	1	2-pin header
JU2	0	Not installed, 2-pin header (shorted by PC trace)
JU3	0	Not installed, 3-pin header
JU4	0	Not installed, 3-pin header (pins 1 and 2 are shorted by PC trace)
JU5	1	3-pin header
L1	1	2.2µH, 3.3A power inductor Sumida CLS7D16-2R2NC
N1	1	3A, 20V n-channel MOSFET (SOT23) Fairchild FDN339AN (top mark 339)
Q1	1	3A, 60V pnp bipolar transistor (SOT-223) Fairchild NZT660
Q2, Q3	2	200mA, 40V pnp bipolar transistors (SOT23) Fairchild MMBT3906 (top mark 2A) or Central Semiconductor CMPT3906 (top mark C2A)
Q4, Q5	2	200mA, 40V npn bipolar transistors (SOT23) Fairchild MMBT3904 (top mark 1A) or Central Semiconductor CMPT3904 (top mark C14)
R1	1	110kΩ ± 1% resistor (0603)
R2, R6, R8, R10	4	10kΩ± 1% resistors (0603)
R3	1	249kΩ ±1% resistor (0603)
R4	1	24.3kΩ ±1% resistor (0603)
R5	1	191kΩ ±1% resistor (0603)
R7	1	107kΩ ±1% resistor (0603)
R9	1	16.5kΩ ±1% resistor (0603)
R11	1	120kΩ ±5% resistor (0603)
R12, R23	2	100kΩ ±5% resistors (0603)
R13	1	10Ω ±5% resistor (0603)
R14, R20	0	Not installed, resistors (0603)
R15	1	680Ω ±5% resistor (0603)
R16	1	1.5kΩ ±5% resistor (0603)
R17	1	3.6kΩ ±5% resistor (0603)
R18	1	6.80kΩ ±5% resistor (0603)
R19	1	909Ω ±1% resistor (0603)
R21	1	182kΩ ±1% resistor (0603)
R22	1	1MΩ ±1% resistor (0603)
None	2	Shunts
None	1	MAX1513 PC board
U1	1	MAX1513ETJ (4mm x 4mm 20-pin thin QFN)

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
Central Semiconductor	631-435-1110	631-435-1824	www.centralsemi.com
Fairchild	888-522-5372	—	www.fairchildsemi.com
Sanyo	619-661-6322	619-661-1055	www.sanyovideo.com
Sumida	847-545-6700	847-545-6720	www.sumida.com
TDK	847-803-6100	847-390-4405	www.component.tdk.com
Toshiba	949-455-2000	949-859-3963	www.toshiba.com/taec

Note: *Indicate that you are using the MAX1513 when contacting these component suppliers.*

Quick Start

The MAX1513 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

- 4.5V to 5.5V, 3A DC power supply
- Voltmeters

Connections and Setup

1) Verify that there is no shunt across jumper JU1.
2) Verify that there is a shunt across pins 1 and 2 of JU5.
3) Connect the positive terminal of the power supply to the PIN pad. Connect the negative terminal of the power supply to the GND pad closest to PIN.
4) Turn on the power supply and verify that the step-up regulator output (VMAIN) is +15V.
5) Verify that the positive linear-regulator output (GON) is +25V.
6) Verify that the negative linear-regulator output (GOFF) is -10V.
7) Verify that the logic-supply linear-regulator output (VLOG) is +3.3V.
8) Verify that the gamma-reference linear-regulator output (VGAM) is +14.7V.

For instructions on selecting the feedback resistors for other output voltages, refer to the *Output Voltage Selection* section in the MAX1513/MAX1514 IC data sheet.

Detailed Description

The MAX1513 EV kit contains a step-up switching regulator, a positive two-stage charge pump with positive high-voltage linear regulator, a negative one-stage charge pump with negative high-voltage linear regulator, a linear regulator for gamma reference, and a linear regulator for low-voltage logic supply. The EV kit operates from a +4.5V to +5.5V DC power supply. The switching frequency is 1.5MHz.

The step-up switching regulator (VMAIN) generates a +15V output and can provide at least 500mA from +4.5V to +5.5V. The TFT gate-on supply (GON) uses one of the two positive charge-pump stages to generate +25V and can deliver 25mA. The TFT gate-off supply (GOFF) uses a charge-pump stage to generate -10V and provides 50mA. The gamma reference (VGAM) is set to +14.7V using a linear regulator and an external pnp bipolar pass transistor and provides 50mA. The logic voltage supply (VLOG) is set to +3.3V using a linear regulator and an external pnp bipolar pass transistor and provides 500mA. All five outputs can be adjusted (refer to the *Output Voltage Selection* section in the MAX1513/MAX1514 IC data sheet).

Jumper Selection

Shutdown Mode

The MAX1513 EV kit features a shutdown mode that reduces the MAX1513 quiescent current to less than 150µA. The 2-pin jumper JU1 and 3-pin jumper JU5 control the shutdown mode and the frequency selection for the MAX1513 EV kit. Table 1 lists the selectable jumpers' options.

Positive Charge Pumps

The positive charge pump of the MAX1513 EV kit features an option to cascade up to two charge pumps' stages. The first stage of the positive charge pump can be connected to the source from PIN or VMAIN. Jumpers JU2 and JU3 configure the number of stages and select the voltage source for the positive charge pump on the MAX1513 EV kit. Table 2 lists jumper JU2 and JU3 options. The default configuration of the

Table 1. Jumpers JU1 and JU5 Functions

JU5 SHUNT LOCATION	JU1 SHUNT LOCATION	$\overline{\text{SDFR}}$ PIN	MAX1513 EV KIT OUTPUT
Pins 1 and 2 (default)	Not installed (default)	Connected to PIN through R23	MAX1513 enabled with 1.5MHz switching frequency
Pins 2 and 3	Not installed	Connected to REF pin through R23	MAX1513 enabled with 750kHz switching frequency
Not installed	Not installed	Floating	MAX1513 enabled with 430kHz switching frequency
Don't care	Installed	Connected to GND	MAX1513 disabled

Note: *For switching frequencies other than 1.5MHz, adjust inductor L1, output capacitor C2, and the current-sense components R20, C11, and R19. Refer to the* Design Procedure *section of the MAX1513/MAX1514 IC data sheet.*

Table 2. Jumpers JU2 and JU3 Functions

JU3 SHUNT LOCATION	JU2 SHUNT LOCATION	GON RANGE
Not installed (default)	Shorted by PC trace	Up to 2 x VMAIN—voltage drops
Pins 1 and 2	Not installed; PC trace	Up to 3 x VMAIN—voltage drops
Pins 2 and 3	Not installed; PC trace	Up to PIN + 2 x VMAIN—voltage drops

charge pumps of the MAX1513 EV kit is a single charge pump powered from VMAIN. Refer to the *Charge Pumps* section of the MAX1513/MAX1514 IC data sheet for information on selecting a charge-pump configuration.

Output Voltage Selection

Step-Up Switching-Regulator Output Voltage

The MAX1513 EV kit's step-up switching-regulator output (VMAIN) is set to +15V by feedback resistors R1 and R2. To generate output voltages other than +15V, select different external voltage-divider resistors (R1, R2). Refer to the *Output Voltage Selection* section of the MAX1513/MAX1514 IC data sheet. Select an alternative output capacitor if VMAIN is set for higher than C2's (16V) rating.

Gate-On Linear-Regulator Output Voltage

The MAX1513 EV kit's positive linear-regulator output (GON) is set to +25V by feedback resistors R5 and R6. To generate output voltages other than +25V, select different external voltage-divider resistors (R5, R6) and adjust the charge-pump input source and number of stages accordingly. Refer to the *Output Voltage Selection* section of the MAX1513/MAX1514 IC data sheet.

Gate-Off Linear-Regulator Output Voltage

The MAX1513 EV kit's negative linear-regulator output (GOFF) is set to -10V by feedback resistors R3 and R4. To generate output voltages other than -10V, select different external voltage-divider resistors (R3, R4). Refer to the *Output Voltage Selection* section of the MAX1513/MAX1514 IC data sheet. Select an alternative output capacitor if GOFF is set for lower than C14's (16V) rating.

Gamma Linear-Regulator Output Voltage

The MAX1513 EV kit's gamma linear-regulator output (VGAM) is set to +14.7V by feedback resistors R7 and R8. To generate output voltages other than +14.7V, select different external voltage-divider resistors (R7, R8). Refer to the *Output Voltage Selection* section of the MAX1513/MAX1514 IC data sheet. Select an alternative output capacitor if VGAM is set for higher than C13's (16V) rating.

Logic Voltage Supply Linear-Regulator Output Voltage

The MAX1513 EV kit's logic voltage supply linear-regulator output (VLOG) is set to +3.3V by feedback resistors R9 and R10. To generate output voltages other than +3.3V, select different external voltage-divider resistors (R9, R10) and an appropriate input voltage source. Refer to the *Output Voltage Selection* section of the MAX1513/MAX1514 IC data sheet.

Evaluating the MAX1514

To evaluate the MAX1514 with the MAX1513 EV kit, replace the MAX1513ETP with a MAX1514ETP.

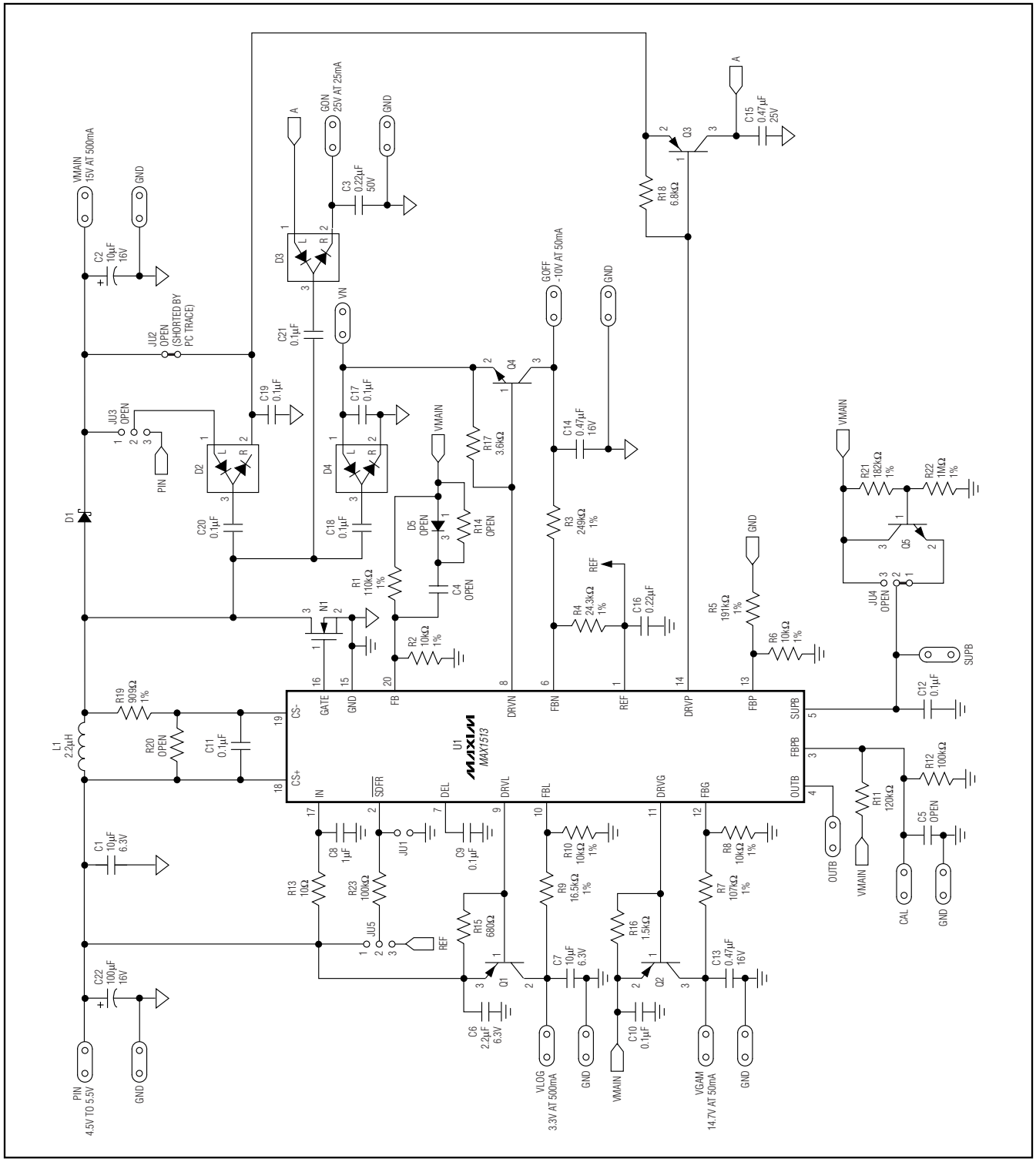


Figure 1. MAX1513 EV Kit Schematic

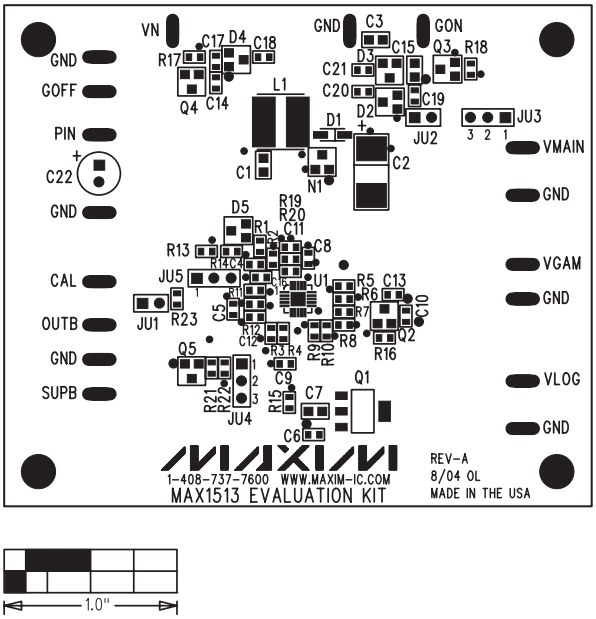


Figure 2. MAX1513 EV Kit Component Placement Guide—Component Side

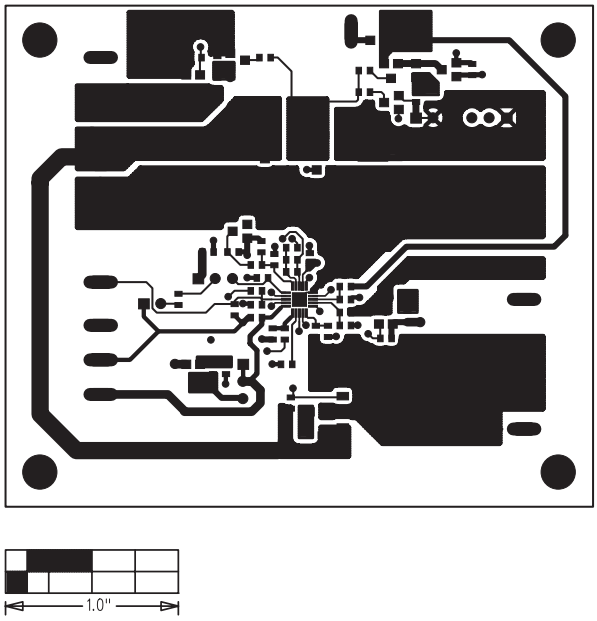


Figure 3. MAX1513 EV Kit PC Board Layout—Component Side

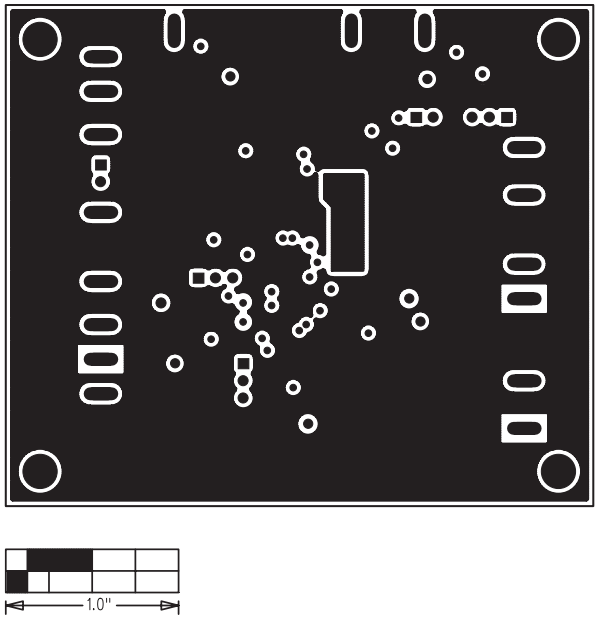


Figure 4. MAX1513 EV Kit PC Board Layout—Layer 2 (GND)

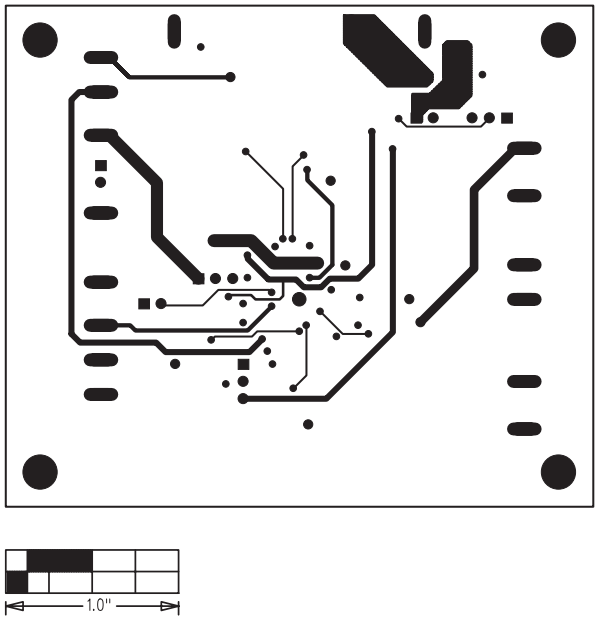


Figure 5. MAX1513 EV Kit PC Board Layout—Layer 3

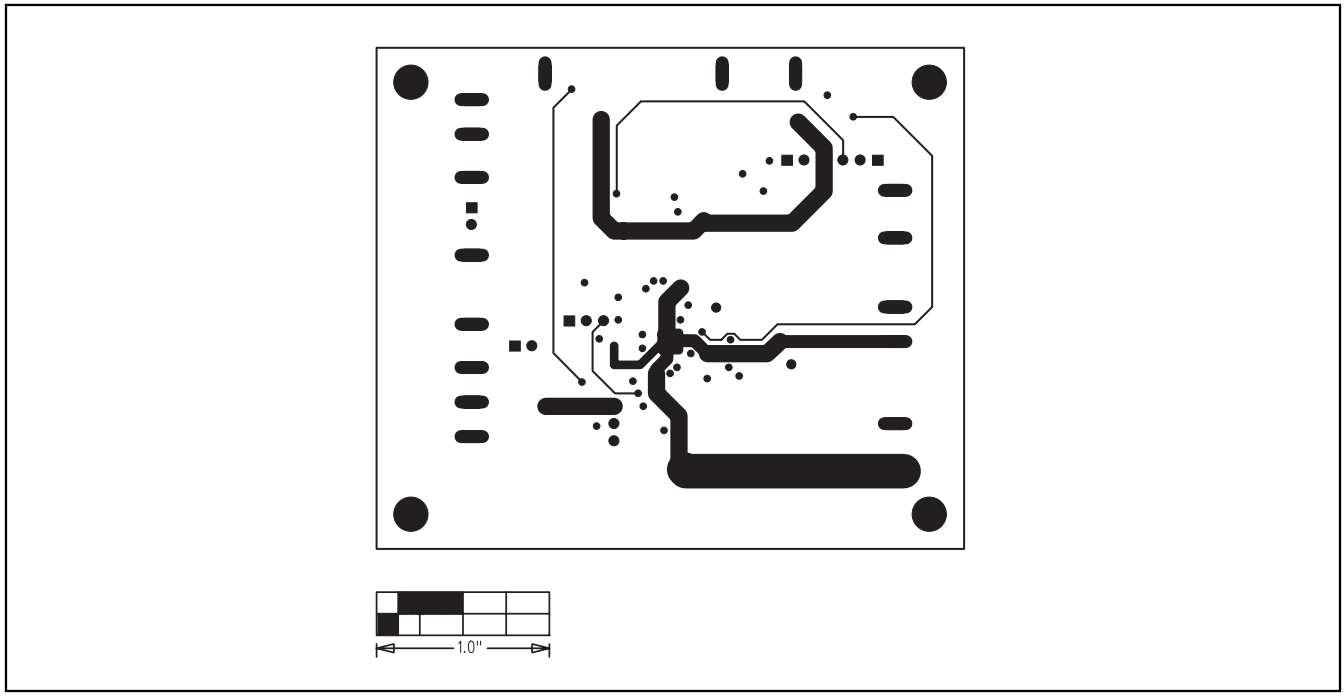


Figure 6. MAX1513 EV Kit PC Board Layout—Solder Side

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