19-3934; Rev 0; 1/06

MAX8538 Evaluation Kit

Evaluates: MAX8538

General Description

The MAX8538 evaluation kit (EV kit) is a fully assembled and tested circuit for evaluating the MAX8538 dual, PWM, synchronous buck controller. The EV kit uses an all-ceramic-capacitor solution to generate a 2.5V output voltage and a second 3.3V output voltage both at load currents up to 5A and an input voltage range of 4.5V to 23V. The switching frequency is set to 600kHz.

Features

- **Out-of-Phase Operation**
- **91% Efficiency**
- **600kHz Switching Frequency**
- **Independent POK_ and EN_ for Flexible Sequencing**
- **Adjustable Soft-Start and Soft-Stop for Each Output**
- **Lossless, Adjustable Hiccup Current Limit**
- **Output Overvoltage Protection**
- **28-Pin QSOP Package**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX8538EVKIT	0°C to +70°C	28 QSOP

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3	2	10µF ±20%, 25V X5R ceramic capacitors (1210) Taiyo Yuden TMK325BJ106MM or equivalent
C2, C4, C12	3	1µF ±10%, 25V X7R ceramic capacitors (1206) TDK C3216X7R1E105K or equivalent
C5, C7	2	47µF ±20%, 6.3V X5R ceramic capacitors (1812) Taiyo Yuden JMK432BJ476MM or equivalent
C6, C8	0	Not installed
C9, C10	2	0.47µF ±10%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A474K or equivalent
C11	1	10µF ±20%, 6.3V X5R ceramic capacitor (0805) TDK C2012X5R0J106M or equivalent
C13	1	1µF ±10%, 10V X5R ceramic capacitor (0603) TDK C1608X5R1A105K or equivalent
C14, C15	2	0.01µF ±10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H103K or equivalent
C16	1	27pF ±5%, 50V C0G ceramic capacitor (0402) TDK C1005C0G1H270K or equivalent
C17	1	2200pF ±10%, 50V X7R ceramic capacitor (0402) TDK C1005X7R1H222K or equivalent
C18	1	330pF ±10%, 50V X7R ceramic capacitor (0402) TDK C1005X7R1H331K or equivalent
C19	1	39pF ±5%, 50V C0G ceramic capacitor (0402) TDK C1005C0G1H390J or equivalent
C20	1	2700pF ±10%, 25V X7R ceramic capacitor (0402) Vishay VJ0402Y272KXXA or equivalent

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C21	1	470pF ±10%, 50V X7R ceramic capacitor (0402) TDK C1005X7R1H471K or equivalent
C22, C23	0	Not installed (optional: 0.01µF ±10%, 25V X7R ceramic capacitors (0402)) TDK C1005X7R1E103K or equivalent
C24, C25	0	Not installed (optional: 2200pF ±10%, 50V X7R ceramic capacitors (0603)) TDK C1608X7R1H222K or equivalent
D1, D2	2	Schottky diodes, 0.1A, 30V SOD-323 Central Semiconductor CMDSH-3 (top mark = S1)
JU1, JU2	2	3-pin headers
L1, L2	2	2.2µH inductors, 7.3A, 9.8mΩ Sumida CDEP104L-2R2
N1, N2	2	n-channel MOSFETs, dual, 20V, 18mΩ (max), SO-8 Fairchild Semiconductor FDS6898A

DESIGNATION	QTY	DESCRIPTION
R1	1	31.6kΩ ±1% resistor (0402)
R2, R6	2	10kΩ ±1% resistors (0402)
R3	1	20kΩ ±5% resistor (0402)
R4	1	750Ω ±1% resistor (0402)
R5	1	21.5kΩ ±1% resistor (0402)
R7	1	14kΩ ±1% resistor (0402)
R8	1	510Ω ±5% resistor (0402)
R9	1	33.2kΩ ±1% resistor (0402)
R10	1	2.2Ω ±5% resistor (0603)
R11	1	4.75Ω ±1% resistor (0603)
R12–R15	4	100kΩ ±5% resistors (0402)
R16, R17	2	536Ω ±1% resistors (0603)
R18, R19	0	Not installed (optional: 2Ω ±1% resistor (1206))
U1	1	MAX8538EEI
—	1	MAX8538 EV kit PC board
—	2	Shunts (position 2)

Component Suppliers

SUPPLIER	COMPONENT	PHONE	WEBSITE
Central Semiconductor	Diode	631-435-1110	www.centralsemi.com
Fairchild Semiconductor	MOSFET	972-910-8000	www.fairchildsemi.com
Kamaya	Resistors	260-489-1533	www.kamaya.com
Taiyo Yuden	Capacitor	408-573-4150	www.t-yuden.com
TDK	Capacitor	847-803-6100	www.component.tdk.com
Vishay	Capacitors, resistors	402-563-6866	www.vishay.com

Note: *Indicate you are using the MAX8538 when contacting these component suppliers.*

Quick Start

Recommended Equipment

Before beginning, the following equipment is recommended:

- 12V, 4A DC power supply
- Two voltmeters
- Two 5A loads
- Ammeter (optional)

Procedure

The MAX8538 EV kit is a fully assembled and tested. Follow the steps below to verify board operation.

1) Ensure the power supply delivers 12V.
2) Turn off the power supply. Do not turn on the power supply until all connections are completed.
3) Verify that the shunts on JU1 and JU2 are connected to ON (pins 1 and 2).
4) Connect the positive power-supply terminal to the pad on the EV kit labeled VIN.
5) Connect the power-supply ground terminal to the pad on the EV kit labeled PGND.
6) Connect a voltmeter across the VOUT1 pad on the EV kit and the PGND pad on the EV kit.

7) Connect a second voltmeter across the VOUT2 pad on the EV kit and the PGND pad on the EV kit.
8) Turn on the power supply.
9) Verify the voltage at VOUT1 is approximately 3.3V.
10) Connect a 5A load between VOUT1 and PGND.
11) Verify the voltage at VOUT1 is approximately 3.3V.
12) Verify the voltage at VOUT2 is approximately 2.5V.
13) Connect a 5A load between VOUT2 and PGND.
14) Verify the voltage at VOUT2 is approximately 2.5V.
15) Verify the voltage at VOUT1 is approximately 3.3V.

Detailed Description

This EV kit demonstrates the MAX8538 dual, PWM, synchronous buck controller. The EV kit provides a 2.5V output voltage and a second 3.3V output voltage both at load currents up to 5A and a 4.5V to 23V input voltage range.

Output-Voltage Setting (VOUT1 and VOUT2)

The resistor-divider formed by R1 and R2 sets VOUT1. The MAX8538 EV kit is shipped with the divider set so VOUT1 equals 3.3V. Change the voltage by selecting R2, the resistor from FB1 to GND, between 5kΩ and 15kΩ. Then calculate R1 by:

$$R1 = R2 \times [(VOUT1 / 0.8) - 1]$$

The resistor-divider formed by R5 and R6 sets VOUT2. The MAX8538 EV kit is shipped with the divider set so VOUT2 equals 2.5V. Change the voltage by selecting R6, the resistor from FB2 to GND, between 5kΩ and 15kΩ. Then calculate R5 by:

$$R5 = R6 \times [(VOUT2 / 0.8) - 1]$$

Note: When changing output voltages, it may be necessary to change external components to optimize the performance. Refer to the MAX8537/MAX8538/MAX8539 data sheet for more information.

Current Limits (ILIM1 and ILIM2)

The MAX8538 senses the peak inductor current through the on-resistance of the high-side MOSFET for lossless sensing. The peak current-limit threshold is set by external resistors, R16 (VOUT1) and R17 (VOUT2), along with an internal current sink of 200µA. The voltage drop across the resistor with the 200µA current through it sets the maximum peak inductor current that can flow through the high-side MOSFET. The peak inductor current is determined by the following equation:

$$I_{PEAK(MAX)} = 200\mu A \times R_{ILIM} / R_{DSON(HSFET)}$$

where R_{ILIM} is R16 for VOUT1, R_{ILIM} is R17 for VOUT2, and $R_{DSON(HSFET)}$ is the on-resistance of the high-side MOSFET. R_{ILIM} should be less than 1.5kΩ for optimum current-limit accuracy. For more details, refer to the *Current-Limit Setting* section in the MAX8537/MAX8538/MAX8539 data sheet.

Additional footprints, C22 and C23, are provided for 0.1µF ceramic capacitors when customizing the MAX8538 EV kit, and high-frequency noise needs to be decoupled.

Output Enables (EN1 and EN2)

Outputs of the MAX8538 can be turned on and off independently at EN1 and EN2. Jumper JU1, position 1-2, pulls EN1 high to turn on VOUT1; position 2-3 pulls EN1 low to turn off VOUT1. Jumper JU2, position 1-2, pulls EN2 high to turn on VOUT2; position 2-3 pulls EN2 low to turn off VOUT2.

MOSFET Snubber Circuit

The following available footprints are provided on the EV kit for MOSFET snubber circuits when customizing the MAX8538 EV kit: R18, R19, C24, and C25. For more details, refer to the RC snubber information in the *Current-Limit Setting* section of the MAX8537/MAX8538/MAX8539 data sheet.

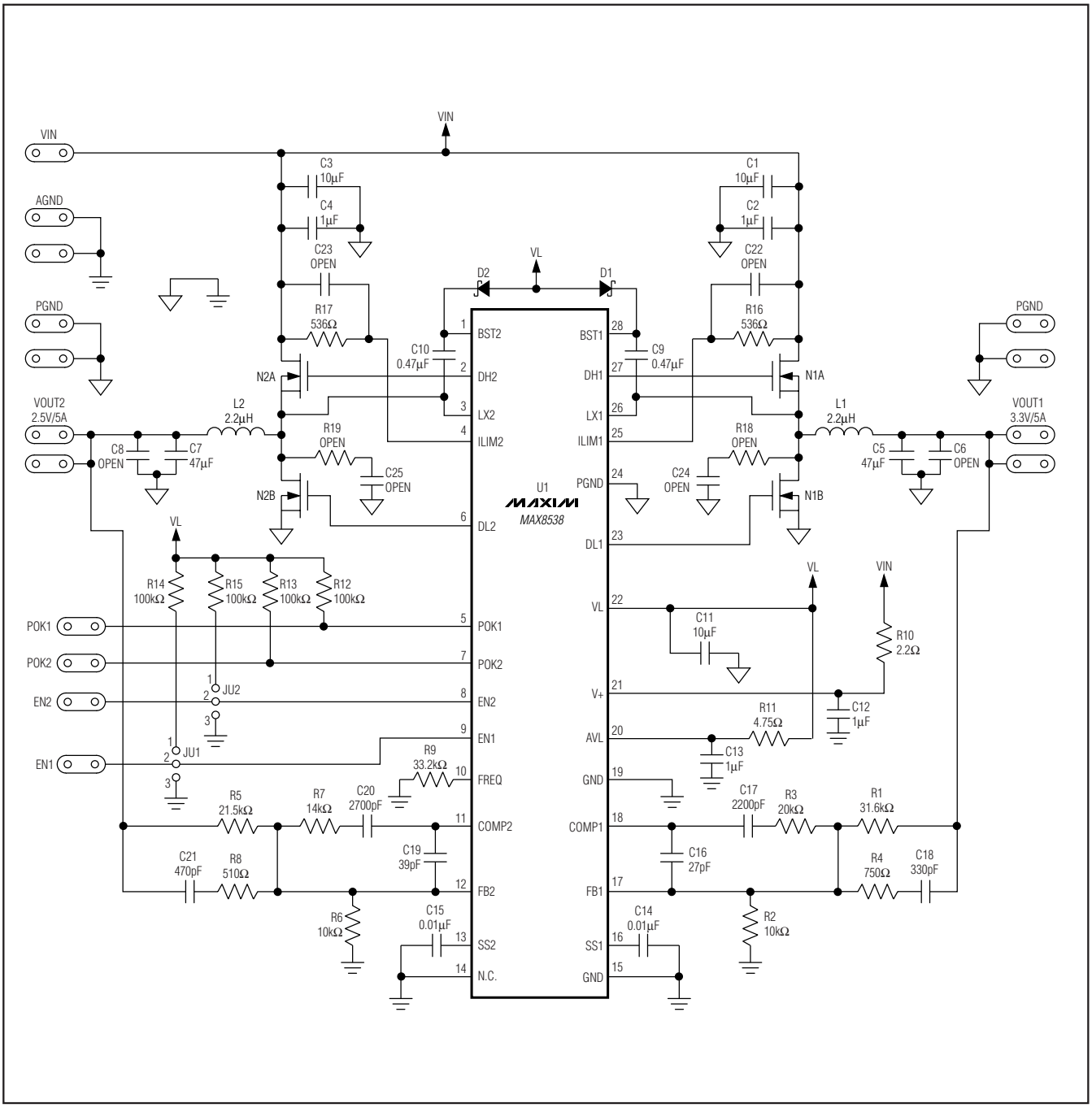

Figure 1. MAX8538 EV Kit Schematic

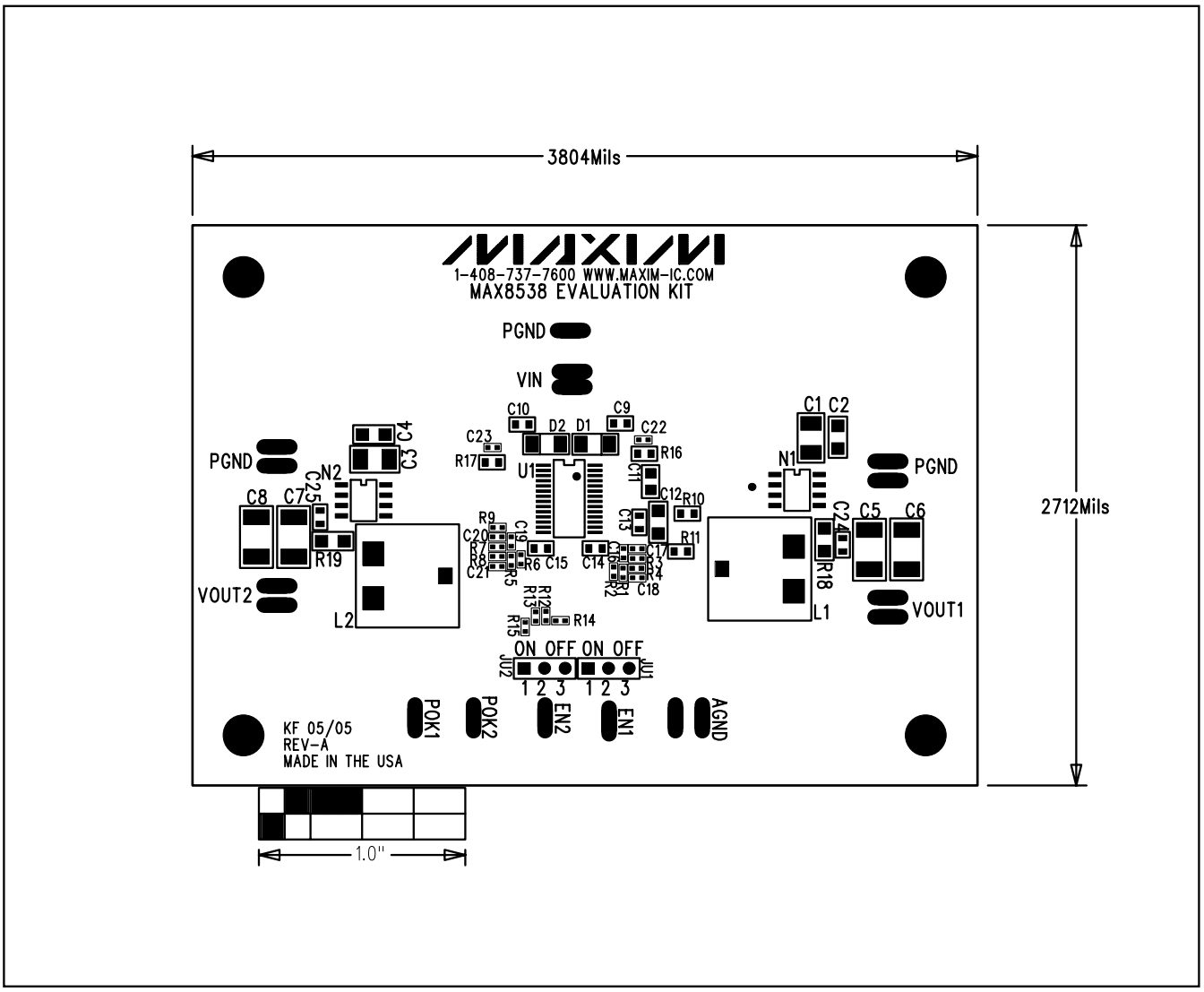

Figure 2. MAX8538 EV Kit Component Placement Guide—Component Side

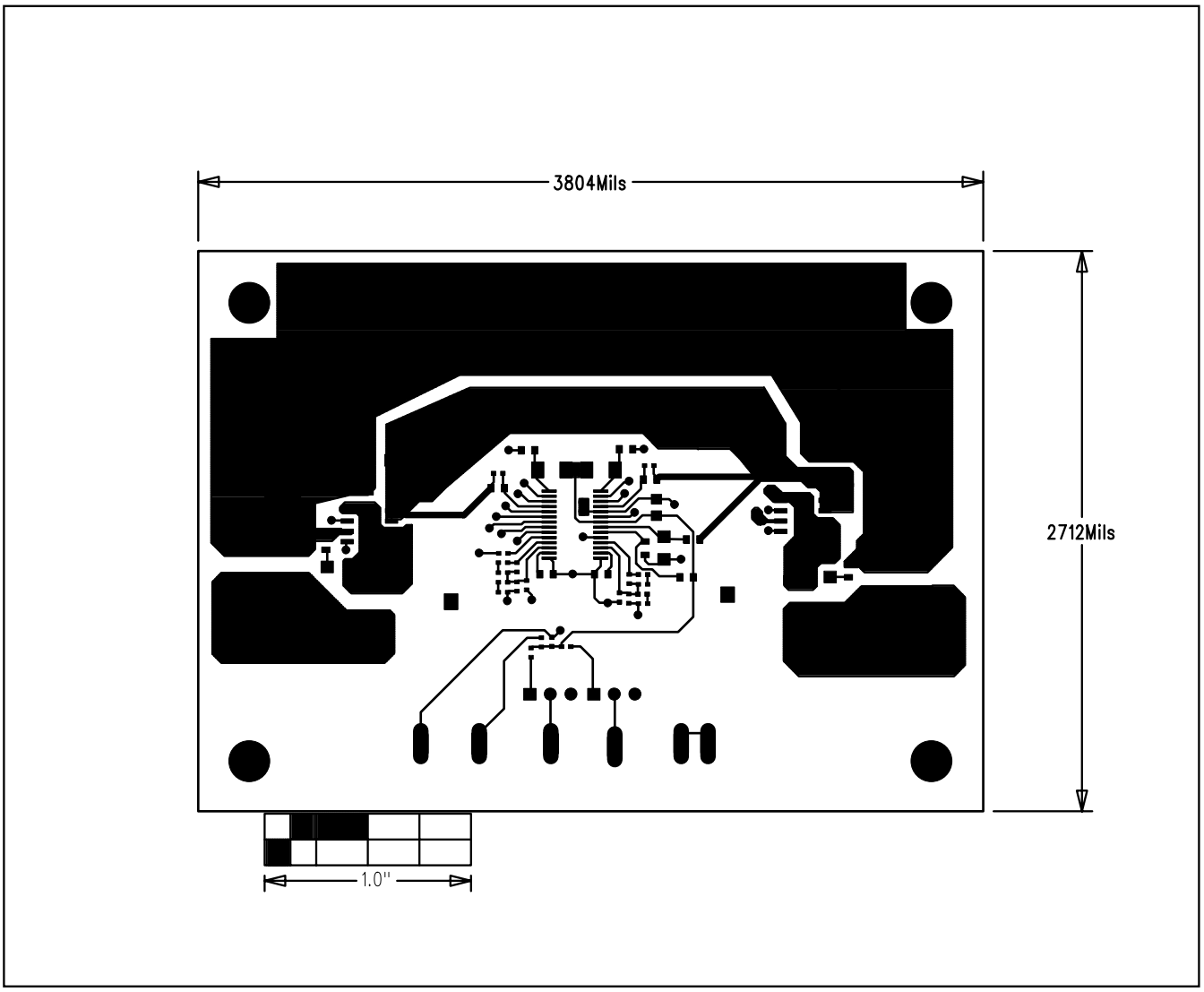

Figure 3. MAX8538 EV Kit PC Board Layout—Component Side

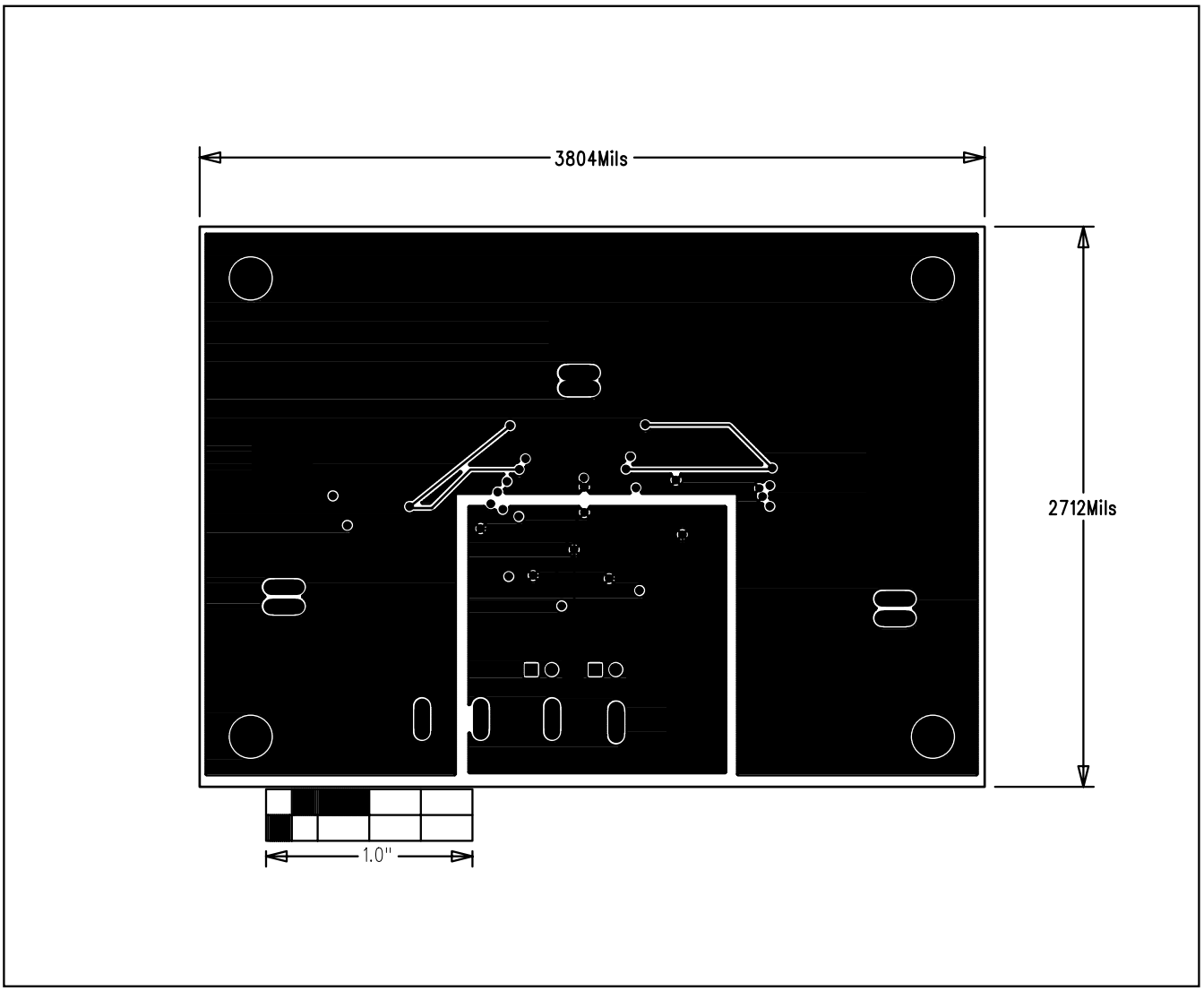

Figure 4. MAX8538 EV Kit PC Board Layout—Inner Layer 2

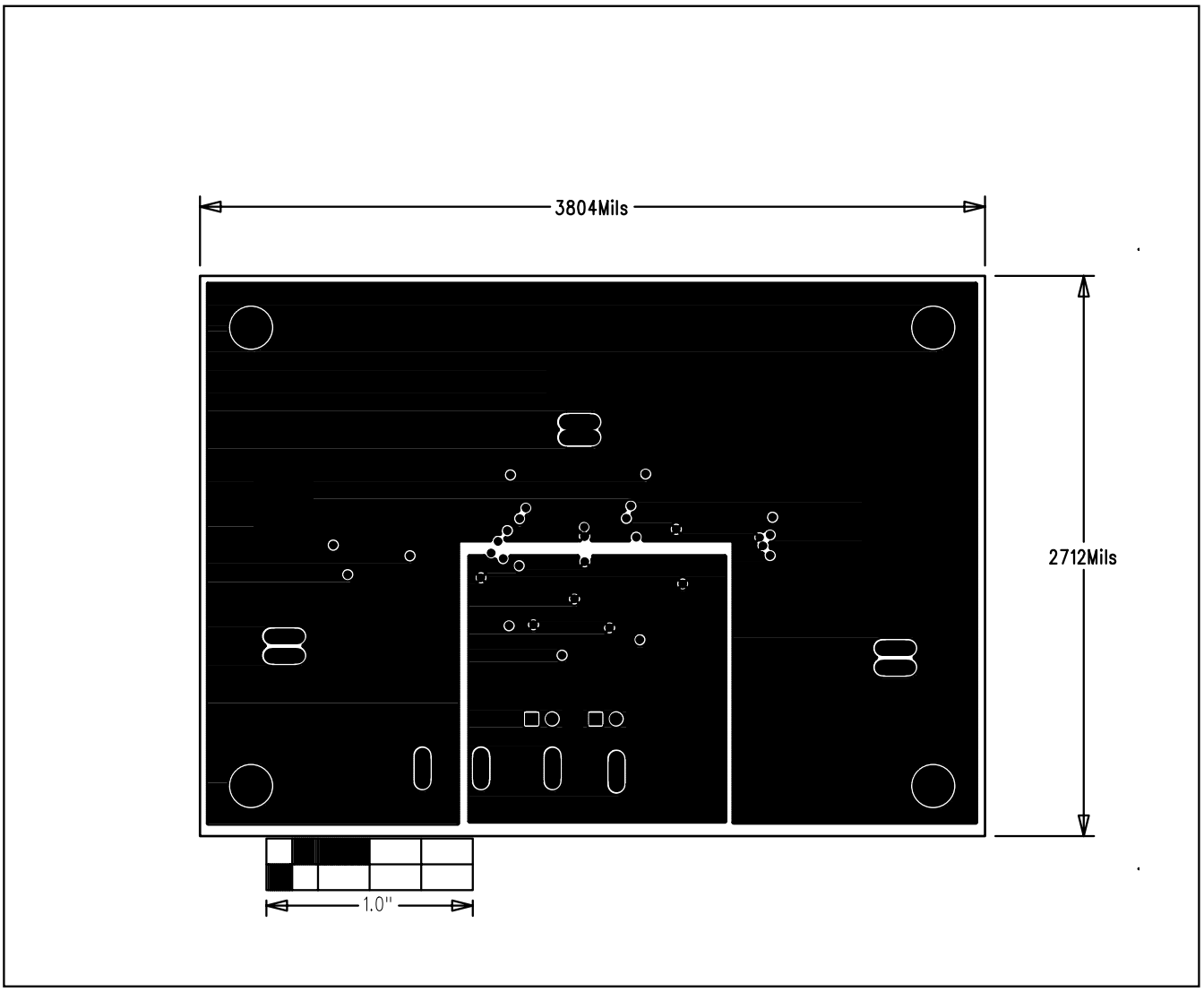

Figure 5. MAX8538 EV Kit PC Board Layout—Inner Layer 3

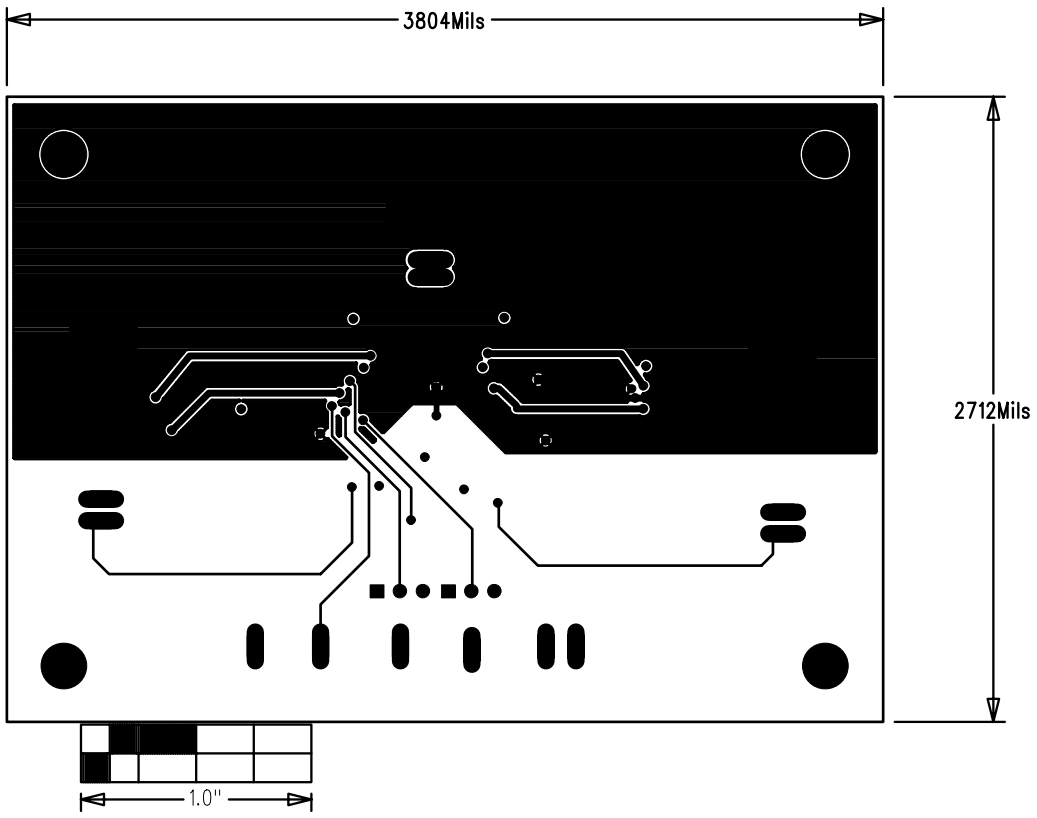

Figure 6. MAX8538 EV Kit PC Board Layout—Solder Side