19-3841; Rev 0; 10/05

# MAX8716 Evaluation Kit

Evaluates: MAX8716

## General Description

The MAX8716 evaluation kit (EV kit) demonstrates the MAX8716's standard application circuit. This dual-PWM synchronous DC-DC converter steps down high-voltage batteries and/or AC adapters, generating main supplies for notebook computers.

The MAX8716 EV kit provides dual +5V and +3.3V output voltages from +6V to +24V battery input range. It delivers up to 5A output current for the +5V output and 5A for the +3.3V output with 95% efficiency. The EV kit operates at 300kHz switching frequency and has superior line- and load-transient response.

This EV kit is a fully assembled and tested circuit board. Both outputs are adjustable between +1.0V and +5.5V by changing feedback resistors R19, R20, R21, and R22.

## Features

- **+6V to +24V Input Voltage Range**
- **Output Voltages**
  **+3.3V at 5A (Adjustable from +1.0V to +5.5V)**
  **+5.0V at 5A (Adjustable from +1.0V to +5.5V)**
- **300kHz Switching Frequency**
- **Independently Selectable PWM, Skip, and Low-Noise-Mode Operation**
- **Independent Power-Good Outputs**
- **Low-Profile Components**
- **Fully Assembled and Tested**

## Ordering Information

| PART | TEMP RANGE | IC PACKAGE |
|---|---|---|
| MAX8716EVKIT | 0°C to +70°C | 24 Thin QFN (4mm x 4mm) |

## Component List

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C1, C3 | 2 | 10µF ±20%, 25V X5R ceramic capacitors (1210)<br>TDK C3225X7R1E106M<br>AVX 12103D106M<br>Taiyo Yuden TMK325BJ106MM |
| C2 | 0 | Not installed (1210) |
| C4, C6 | 0 | Not installed (E case) |
| C5 | 1 | 220µF, 4V, 40mΩ low-ESR capacitor (D case)<br>Sanyo 4TPC220M |
| C7 | 1 | 150µF, 6.3V, 40mΩ low-ESR capacitor (D case)<br>Sanyo 6TPC150M |
| C9, C11, C14, C18 | 4 | 1µF ±20%, 10V X5R ceramic capacitors (0805)<br>Taiyo Yuden LMK212BJ105KG or<br>TDK C2012X7R1C105MKT |
| C10, C17 | 2 | 0.1µF ±10%, 50V X7R ceramic capacitors (0603)<br>Murata GRM188R71H104K or equivalent |
| C12 | 1 | 0.22µF, 16V X5R ceramic capacitor (0805)<br>Taiyo Yuden EMK212BJ224KG |
| C24, C25 | 0 | Not installed (0603) |
| D1, D2 | 2 | 1A, 30V Schottky diodes<br>Nihon EP10QY03 or<br>Toshiba CRS02 |
| D3 | 1 | 100mA, 30V dual Schottky diode (SOT23) common anode<br>Central Semiconductor CMPSH-3A |
| JU1, JU2 | 2 | 4-pin headers |
| JU3, JU4 | 2 | 3-pin headers |
| JU5, JU6, JU12, JU14 | 0 | Not installed (short jumpers) |
| L1, L2 | 2 | 5.7µH, 5.8A, 10.3mΩ power inductors<br>Sumida CDEP105-5R7NC |
| N1, N3 | 2 | n-channel MOSFETs (8-pin SO)<br>Fairchild FDS6612A |
| N2, N4 | 2 | n-channel MOSFETs (8-pin SO)<br>Fairchild FDS6670A |
| R1, R2 | 2 | 0.007Ω ±1%, 1/2W resistors (2010)<br>IRC LR2010-01-R0007-F or<br>Dale WSL-2010-R0007F |
| R3 | 1 | 20Ω ±5% resistor (0805) |
| R4, R14 | 2 | 100kΩ ±5% resistors (0603) |
| R5, R6 | 0 | Not installed (short PC trace) (0603) |
| R10, R16 | 2 | 3Ω ±5% resistors (0603) |
| R19–R24 | 0 | Not installed (0603) |
| U1 | 1 | MAX8716ETG (24-pin thin QFN 4mm x 4mm) |
| — | 4 | Shunts |
| — | 1 | MAX8716 rev B PC board |

## Component Suppliers

| SUPPLIER | PHONE | WEBSITE |
|---|---|---|
| Central Semiconductor | 631-435-1110 | www.centralsemi.com |
| Dale-Vishay | 402-564-3131 | www.vishay.com |
| Fairchild | 888-522-5372 | www.fairchildsemi.com |
| IRC | 361-992-7900 | www.irctt.com |
| Kemet | 864-963-6300 | www.kemet.com |
| Murata | 770-436-1300 | www.murata.com |
| Nihon | 847-843-7500 | www.niec.co.jp |
| Sanyo | 619-661-6835 | www.sanyodevice.com |
| Sumida | 847-545-6700 | www.sumida.com |
| Taiyo Yuden | 800-348-2496 | www.t-yuden.com |
| TDK | 847-803-6100 | www.component.tdk.com |
| Toshiba | 408-526-2459 | www.toshiba.com |

***Note:*** *Indicate that you are using the MAX8716 when contacting these component suppliers.*

## Quick Start

### Recommended Equipment

Before you begin, the following equipment is needed. **Do not turn on the power until all connections are made:**

- +6V to +24V power supply, battery, or notebook AC adapter
- DC bias power supply, +5V at 100mA
- Dummy loads capable of sinking 5A each
- Digital multimeters (DMMs)
- 100MHz dual-trace oscilloscope

### Procedure

1) Ensure that the circuit is connected correctly to the supplies and dummy loads prior to applying any power.
2) Verify that the shunts are across:
   (a) JU4 pins 1 and 2 (ON1 high, OUT1 (+3.3V) enabled)
   (b) JU3 pins 1 and 2 (ON2 high, OUT2 (+5.0V) enabled)
   (c) JU1 pins 1 and 2 ($\overline{SKIP1}$ high, OUT1 in forced-PWM mode)
   (d) JU2 pins 1 and 2 ($\overline{SKIP2}$ high, OUT2 in forced-PWM mode)
3) Turn on the battery power prior to +5V bias power; otherwise, the output UVLO timer times out and the FAULT latch is set, disabling the regulator outputs until +5V power is cycled or ON1/ON2 is toggled.
4) Verify that the output voltages are $V_{OUT1}$ = +3.3V and $V_{OUT2}$ = +5.0V

## Detailed Description

### Jumper Settings

**Table 1. Jumper JU4 Functions (Output Voltage OUT1 Control)**

| JU4 | ON1 PIN | OUT1 |
|---|---|---|
| 1 and 2 (default) | Connected to VDD | OUT1 is enabled, $V_{OUT1}$ = 3.3V |
| 2 and 3 | Connected to GND | OUT1 is disabled |
| Not installed | ON1 must be driven by an external signal connected to ON1 pad | OUT1 operation depends on the external ON1 signal levels |

**Table 2. Jumper JU3 Functions (Output Voltage OUT2 Control)**

| JU3 | ON2 PIN | OUT2 |
|---|---|---|
| 1 and 2 (default) | Connected to VDD | OUT2 is enabled, $V_{OUT2}$ = 5.0V |
| 2 and 3 | Connected to GND | OUT2 is disabled |
| Not installed | ON2 must be driven by an external signal connected to ON2 pad | OUT2 operation depends on the external ON2 signal levels |

**Table 3. Jumper JU1 Functions (Low-Noise-Mode Control for OUT1)**

| JU1 | $\overline{SKIP1}$ PIN | OPERATIONAL MODE |
|---|---|---|
| 1 and 2 (default) | Connected to VDD | OUT1 is in forced-PWM mode (fixed frequency) |
| 1 and 4 | Connected to REF | OUT1 is in low-noise mode |
| 1 and 3 | Connected to GND | OUT1 is in pulse-skipping mode |

**Table 4. Jumper JU2 Functions (Low-Noise-Mode Control for OUT2)**

| JU2 | $\overline{SKIP2}$ PIN | OPERATIONAL MODE |
|---|---|---|
| 1 and 2 (default) | Connected to VDD | OUT2 is in forced-PWM mode (fixed frequency) |
| 1 and 4 | Connected to REF | OUT2 is in low-noise mode |
| 1 and 3 | Connected to GND | OUT2 is in pulse-skipping mode |

### *Evaluating Other Output Voltages*

The MAX8716 provides a fixed +3.3V output (OUT1) when FB1 is connected to VCC (R6 = 0) and a fixed +5.0V output (OUT2) when FB2 is connected to VCC (R5 = 0).

OUT1 and OUT2 can also be adjusted from +1.0V to +5.5V by using a resistive voltage-divider formed by R21, R22 (R6 = open) and R19, R20 (R5 = open). The MAX8716 regulates FB1 and FB2 to a fixed reference voltage (+1.0V).

The adjusted output voltages are:

$$V_{OUT1} = V_{FB1} (1 + R21 / R22)$$

where $V_{FB1}$ = +1.0V, and:

$$V_{OUT2} = V_{FB2} (1 + R19 / R20)$$

where $V_{FB2}$ = +1.0V.

# MAX8716 Evaluation Kit

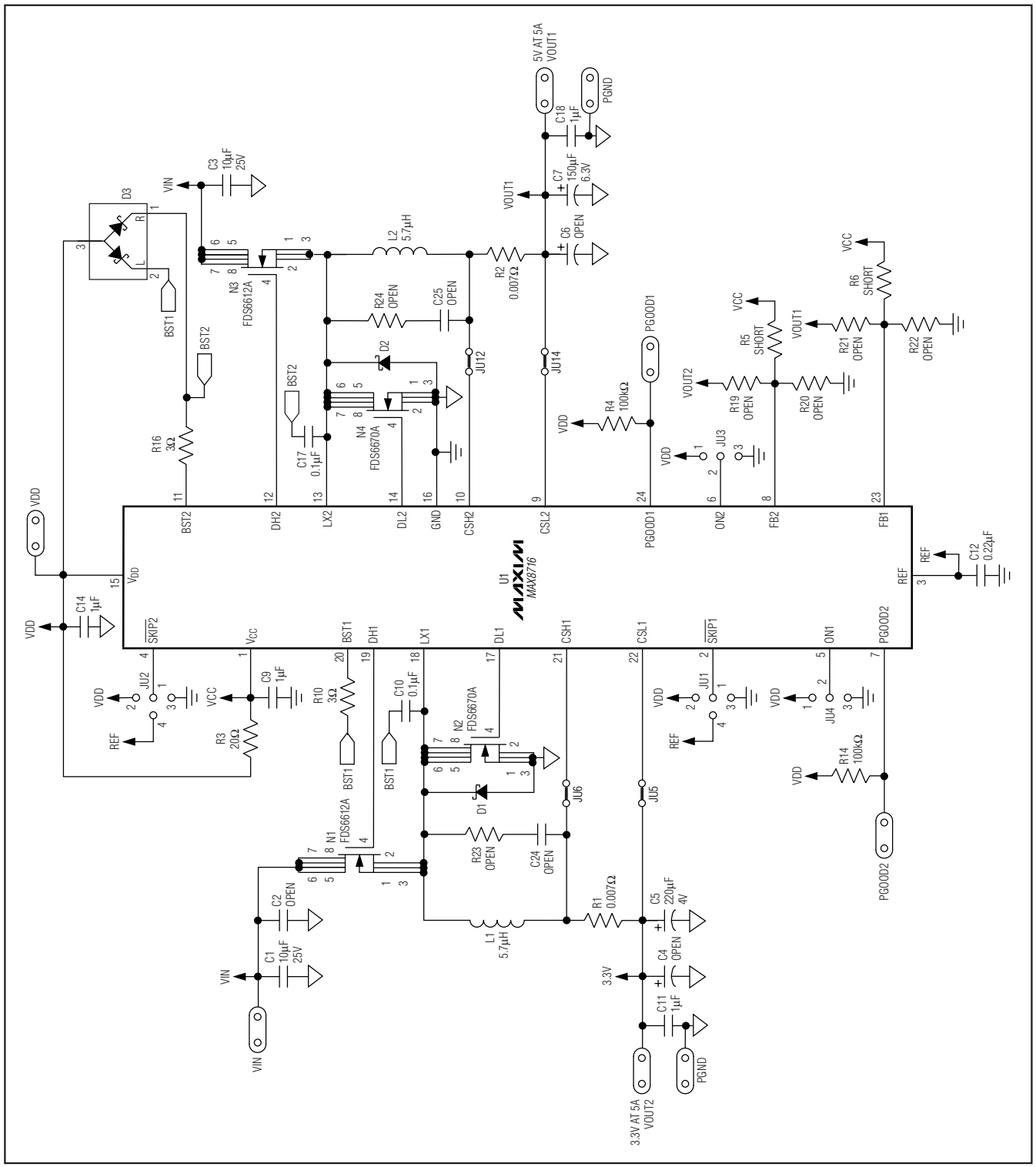


*Figure 1. MAX8716 EV Kit Schematic*

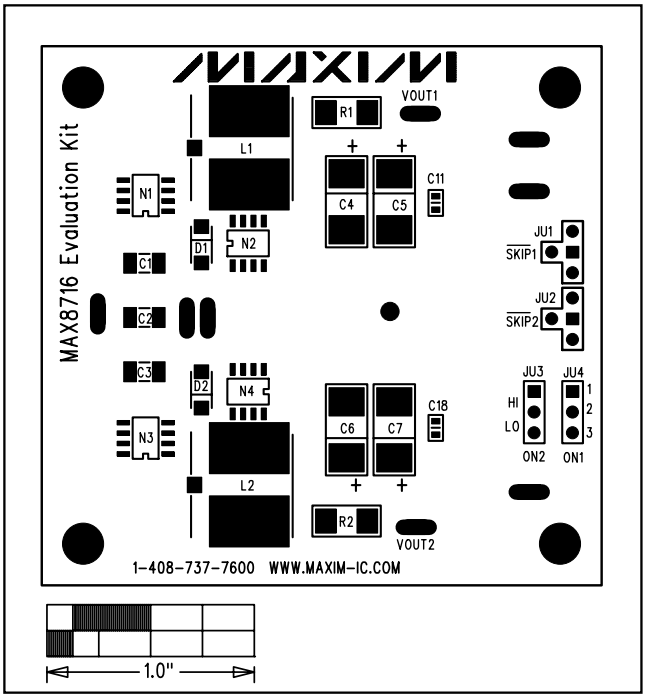


*Figure 2. MAX8716 EV Kit Component Placement Guide—Component Side*

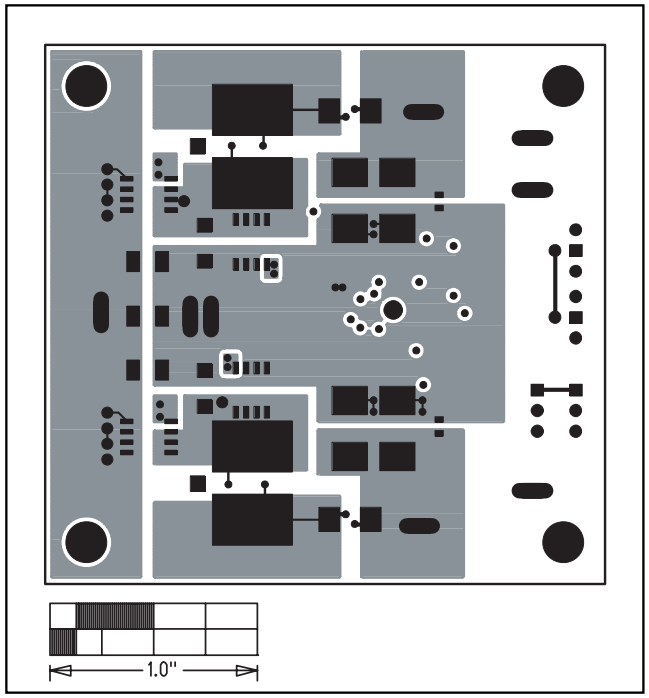


*Figure 3. MAX8716 EV Kit PC Board Layout—Component Side*

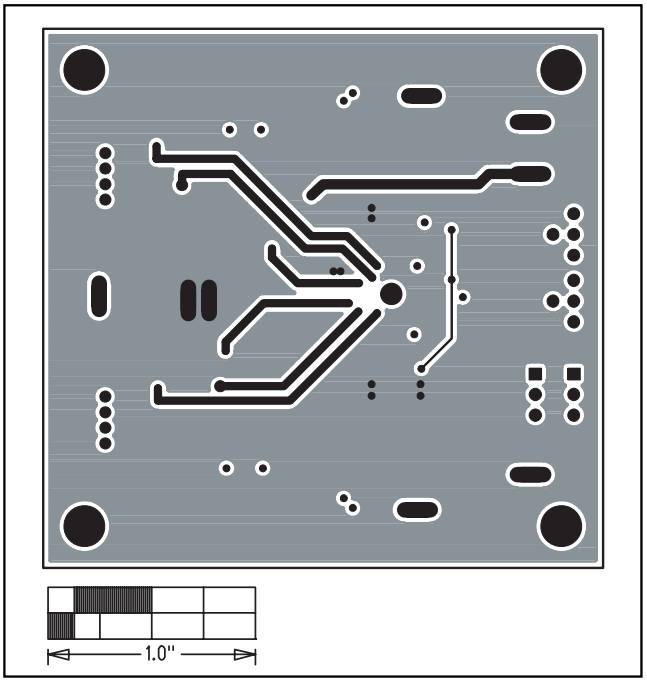


*Figure 4. MAX8716 EV Kit PC Board Layout—Internal Layer 2, PGND/Signal Plane*

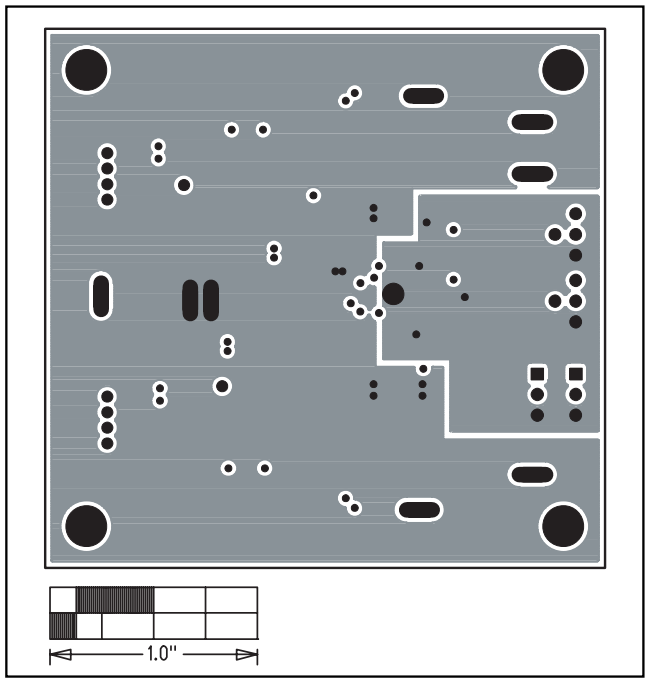


*Figure 5. MAX8716 EV Kit PC Board Layout—Internal Layer 3, PGND/GND Layer*

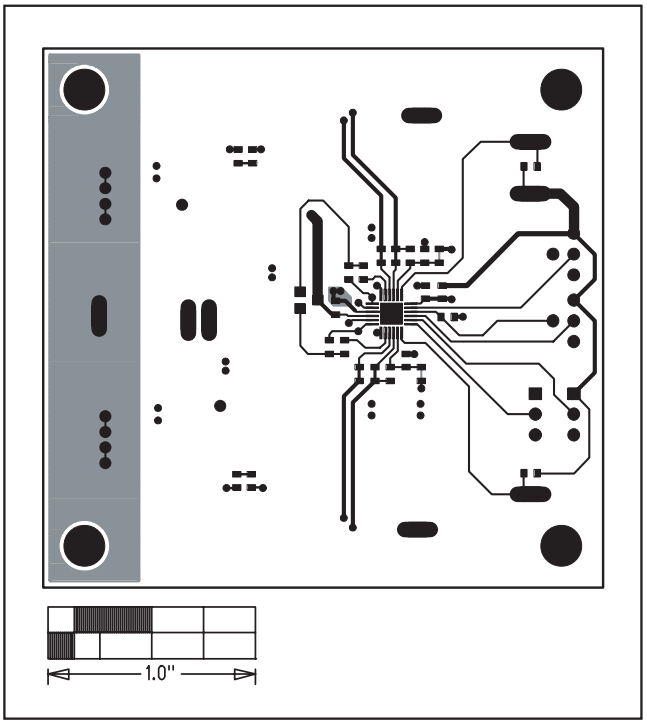


*Figure 6. MAX8716 EV Kit PC Board Layout—Solder Side*

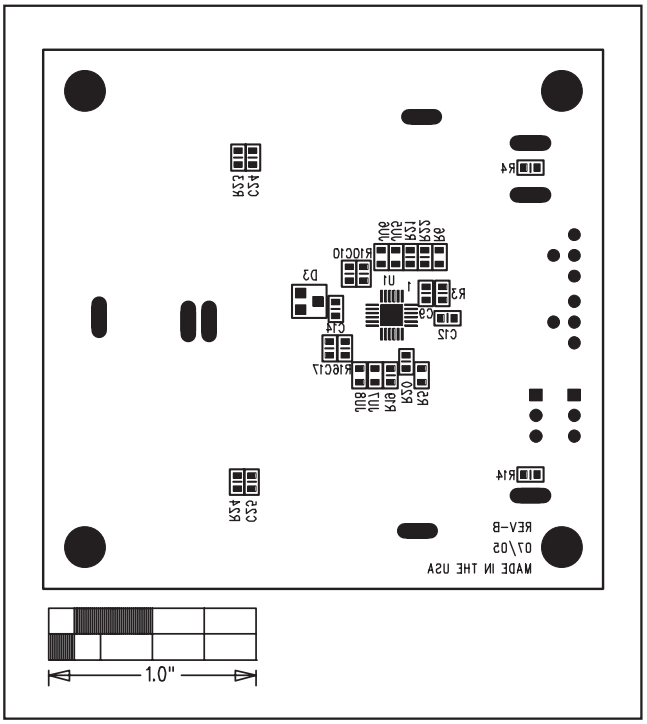


*Figure 7. MAX8716 EV Kit Component Placement Guide—Solder Side*

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