



MAX1636 CPU Supply Evaluation Kit

General Description

The MAX1636 CPU supply evaluation kit (EV kit) circuit is intended for converting high-voltage battery power into a low-voltage supply rail for next-generation notebook CPU cores. The output is digitally adjustable between 1.25V and 2V, in 50mV increments. The input range is +7V to +22V. It delivers up to 7A output current with greater than 87% efficiency. The MAX1636 features $\pm 1\%$ DC output accuracy over all conditions of line, load, and temperature. The fully assembled and tested EV kit has excellent dynamic response to correct for fast load transients.

This EV kit is very specific to notebook CPU core power supplies, and includes a digital-to-analog converter (DAC), op-amp buffer, and other high-performance components tailored to this demanding application. However, the MAX1636 is a general-purpose, stand-alone device that can be used without the DAC; see the MAX1636 data sheet for standard application circuits.

Ordering Information

| PART | TEMP. RANGE | IC PACKAGE |
|-----------------|--------------|------------|
| MAX1636CPUEVKIT | 0°C to +70°C | 20 SSOP |

Features

- ◆ +7V to +22V Input Voltage Range
- ◆ Digitally Adjustable 1.25V to 2V Output Voltage
- ◆ 7A Output Current Capability
- ◆ $\pm 1\%$ DC Output Accuracy
- ◆ Efficiency = 87%, $V_{IN} = 7V$, $V_{OUT} = 1.7V$ (at $I_{OUT} = 3A$)
- ◆ Fast MOSFETs for Low Switching Losses
- ◆ Tight PC Board Layout for Low Switching Losses
- ◆ Power-Good Output
- ◆ 300kHz Switching Frequency
- ◆ Overvoltage and Undervoltage Protection
- ◆ Surface-Mount Construction
- ◆ Fully Assembled and Tested

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Component List

| DESIGNATION | QTY | DESCRIPTION |
|---------------------|-----|---|
| C1, C2, C3, C4 | 4 | 10 μ F, 25V ceramic capacitors Tokin C34Y5U1E106Z or United Chemicon/Marcon THCR50E1E106ZT |
| C5, C7, C8, C9, C10 | 5 | 0.1 μ F ceramic capacitors |
| C11 | 1 | 1500pF ceramic capacitor |
| C12 | 1 | 1 μ F ceramic capacitor |
| C13 | 1 | 4.7 μ F, 16V tantalum capacitor Sprague 595D475X0016A2B |
| C14, C15, C16 | 3 | 470 μ F, 6.3V, 30m Ω low-ESR tantalum capacitors Kemet T510X477M006 |
| C14, C15, C16, C17 | 4 | or 470 μ F, 4V, 55m Ω low-ESR tantalum caps Sprague 594D477X0004R2T |
| C18 | 0 | Open |
| D1 | 1 | Schottky diode SGS-Thomson STPS2L25U, International Rectifier 10BQ040, or Motorola MBRS130LT3 |
| D2 | 1 | Schottky diode Central Semiconductor CMPSH-3 |

| DESIGNATION | QTY | DESCRIPTION |
|-------------|-----|---|
| L1 | 1 | 2.2 μ H power inductor Panasonic P1F2R0HL, Coiltronics UP4-2R2, or Coilcraft DO5022P-222HC |
| N1 | 1 | N-channel MOSFET Fairchild FDS9412, International Rectifier IRF7803, or Siliconix Si9804DY |
| N2 | 1 | N-channel MOSFET Fairchild FDS6680, International Rectifier IRF7801, or Siliconix Si4420DY |
| R1 | 1 | 0.010 Ω , 1%, 1W resistor Dale WSL-2512-R010F |
| R2 | 1 | 10k Ω , 0.1% resistor Dale TNPW-1206 series |
| R3 | 1 | 110k Ω , 0.1% resistor Dale TNPW-1206 series |
| R4 | 1 | 13.7k Ω , 0.1% resistor Dale TNPW-1206 series |
| R5 | 1 | 51 Ω , 5% resistor |
| R6, R15 | 2 | 100k Ω , 5% resistors |



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Component List (continued)

| DESIGNATION | QTY | DESCRIPTION |
|-----------------------|-----|---|
| R7 | 1 | 20Ω, 5% resistor |
| R8–R12, R14, R15, R16 | 8 | 1MΩ, 5% resistors |
| SW1 | 1 | Four-position dip switch |
| U1 | 1 | MAX1636EAP (20-pin SSOP) |
| U2 | 1 | MAX5480BEEE (16-pin QSOP) |
| U3 | 1 | MAX4332ESA (8-pin SO) or MAX4163ESA (alternate type with lower supply current but slightly degraded accuracy) |
| None | 1 | MAX1636 PC board |
| None | 1 | MAX1636 data sheet |
| JU3, JU4, JU5 | 3 | 2-pin header |

Component Supplier

| SUPPLIER | PHONE | FAX |
|-------------------------|----------------|----------------|
| AVX | (803) 946-0690 | (803) 626-3123 |
| Central Semiconductor | (516) 435-1110 | (516) 435-1824 |
| Coilcraft | (847) 639-6400 | (847) 639-1469 |
| Dale-Vishay | (402) 564-3131 | (402) 563-6418 |
| Fairchild | (408) 721-2181 | (408) 721-1635 |
| International Rectifier | (310) 322-3331 | (310) 322-3332 |
| IRC | (512) 992-7900 | (512) 992-3377 |
| Kemet | (864) 963-6300 | (864) 963-6521 |
| Motorola | (602) 303-5454 | (602) 994-6430 |
| Panasonic | (201) 348-7522 | (201) 392-4441 |
| Sanyo | (619) 661-6835 | (619) 661-1055 |
| SGS-Thomson | (617) 259-0300 | (617) 259-9442 |
| Siliconix | (408) 988-8000 | (408) 970-3950 |
| Sprague | (603) 224-1961 | (603) 224-1430 |
| Sumida | (847) 956-0666 | (847) 956-0702 |
| Tokin | (408) 432-8020 | (408) 434-0375 |
| Vishay/Vitramon | (203) 268-6261 | (203) 452-5670 |

Note: Please indicate that you are using the MAX1636 when contacting these component suppliers.

Quick Start

The MAX1636 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.**

- 1) Connect a +7V to +22V supply voltage to the VIN pad. Connect ground to the GND pad.
- 2) Connect a voltmeter and load, if any, to the VOUT pad.
- 3) Turn on the power supply to the board. Verify that the output voltage is 2V (SW1 set to all zeros).
- 4) Set switch SW1 per Table 1 to get the desired output voltage. Input power may need to be cycled off and on for new voltage settings to take effect.

Table 1. Output Voltage Settings

| D3 | D2 | D1 | D0 | V _{OUT} (V) |
|----|----|----|----|----------------------|
| 0 | 0 | 0 | 0 | 2.00 |
| 0 | 0 | 0 | 1 | 1.95 |
| 0 | 0 | 1 | 0 | 1.90 |
| 0 | 0 | 1 | 1 | 1.85 |
| 0 | 1 | 0 | 0 | 1.80 |
| 0 | 1 | 0 | 1 | 1.75 |
| 0 | 1 | 1 | 0 | 1.70 |
| 0 | 1 | 1 | 1 | 1.65 |
| 1 | 0 | 0 | 0 | 1.60 |
| 1 | 0 | 0 | 1 | 1.55 |
| 1 | 0 | 1 | 0 | 1.50 |
| 1 | 0 | 1 | 1 | 1.45 |
| 1 | 1 | 0 | 0 | 1.40 |
| 1 | 1 | 0 | 1 | 1.35 |
| 1 | 1 | 1 | 0 | 1.30 |
| 1 | 1 | 1 | 1 | 1.25 |

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Detailed Description

The MAX1636 EV kit provides a digitally adjustable output voltage between 1.25V and 2V from a +7V to +22V input supply. The output voltage is digitally adjusted by the MAX5480, a multiplying DAC, which sums a variable output current into the FB feedback node. This DAC operates in voltage-output mode and relies on the precise MAX1636 REF output to generate an accurate reference current. The DAC has buffer amplifiers on the input and output to prevent the R2R ladder in the MAX5480 from excessively loading the reference or interacting with the normal FB resistor-divider impedance. The buffered DAC output swings 0V to REF - 1LSB. Refer to Table 1 for the digital-to-analog (D/A) codes.

The MAX1636 IC is rated for 30V input; however, the EV kit is restricted to 22V operating range (25V absolute maximum) due to the ratings of external components and minimum duty-factor limitations.

Table 2. Jumper JU2 Functions

| SHUNT LOCATION | MAX1636 SKIP PIN | OPERATING MODE |
|----------------|------------------|---|
| Off | Connected to GND | Idle mode, pulse-skipping operation for highest light-load efficiency |
| On | Connected to VCC | Low-noise mode, fixed-frequency PWM operation. |

The 2-pin header JU3 selects the operating frequency. Table 3 lists the selectable jumper options. The EV kit's components are selected for 300kHz operation. Component values might need to be changed if 200kHz operation is selected (refer to the *Design Procedure* section in the MAX1636 data sheet). Synchronize the oscillator to an external clock signal by driving the SYNC pad with a 5V amplitude pulse train in the 240kHz to 350kHz frequency range.

Table 3. Jumper JU3 Functions

| SHUNT LOCATION | MAX1636 SYNC PIN | FREQUENCY (kHz) |
|----------------|------------------|-----------------|
| Off | Connected to VCC | 300 |
| On | Connected to GND | 200 |

The 2-pin header JU4 selects the overvoltage protection. The 2-pin header JU5 selects the shutdown mode. Table 4 lists the selectable jumper options.

Table 4. Jumper JU4 and JU5 Selection

| SHUNT LOCATIONS | | OVP PIN TIED TO | SHDN PIN TIED TO | RESULT |
|-----------------|-----|-----------------|------------------|-------------------------------|
| JU4 | JU5 | | | |
| Off | Off | VCC | VIN | RUN mode, OVP enabled |
| Off | On | VCC | GND | Standby mode, VL output alive |
| On | Off | GND | VIN | RUN mode, OVP disabled |
| On | On | GND | GND | Total shutdown mode |

Latched Fault Protection

The MAX1636 contains a latched fault-protection circuit that disables the IC when the output is overvoltage or undervoltage (or when thermal shutdown is triggered). Once disabled, the supply won't attempt to restart until input power is cycled or until $\overline{\text{SHDN}}$ (JU5) is cycled. A fault condition can be triggered by overloading the output, overvoltageing the output (which can happen when changing the D/A code settings), or by touching sensitive compensation or feedback nodes.

Optional +5V Chip-Supply Input

An optional +5V supply input (Figure 1) can power the IC and gate drivers to improve efficiency. The idea is to power the IC from an efficient source (the +5V system supply, typically 95% efficient) instead of relying on the inefficient internal VL linear regulator. To test this feature, cut the trace at V+ and connect V+ to VL to disable the linear regulator, and connect an external +5V, 50mA supply to the optional input.

Alternate Op Amp for Lower Supply Current

The MAX4332 op amp provided with this kit is very accurate but draws up to 500μA supply current. For improved supply current draw with a slight (0.4%) degradation in output voltage accuracy, replace the MAX4332 with a MAX4163, which draws 25μA (typ).

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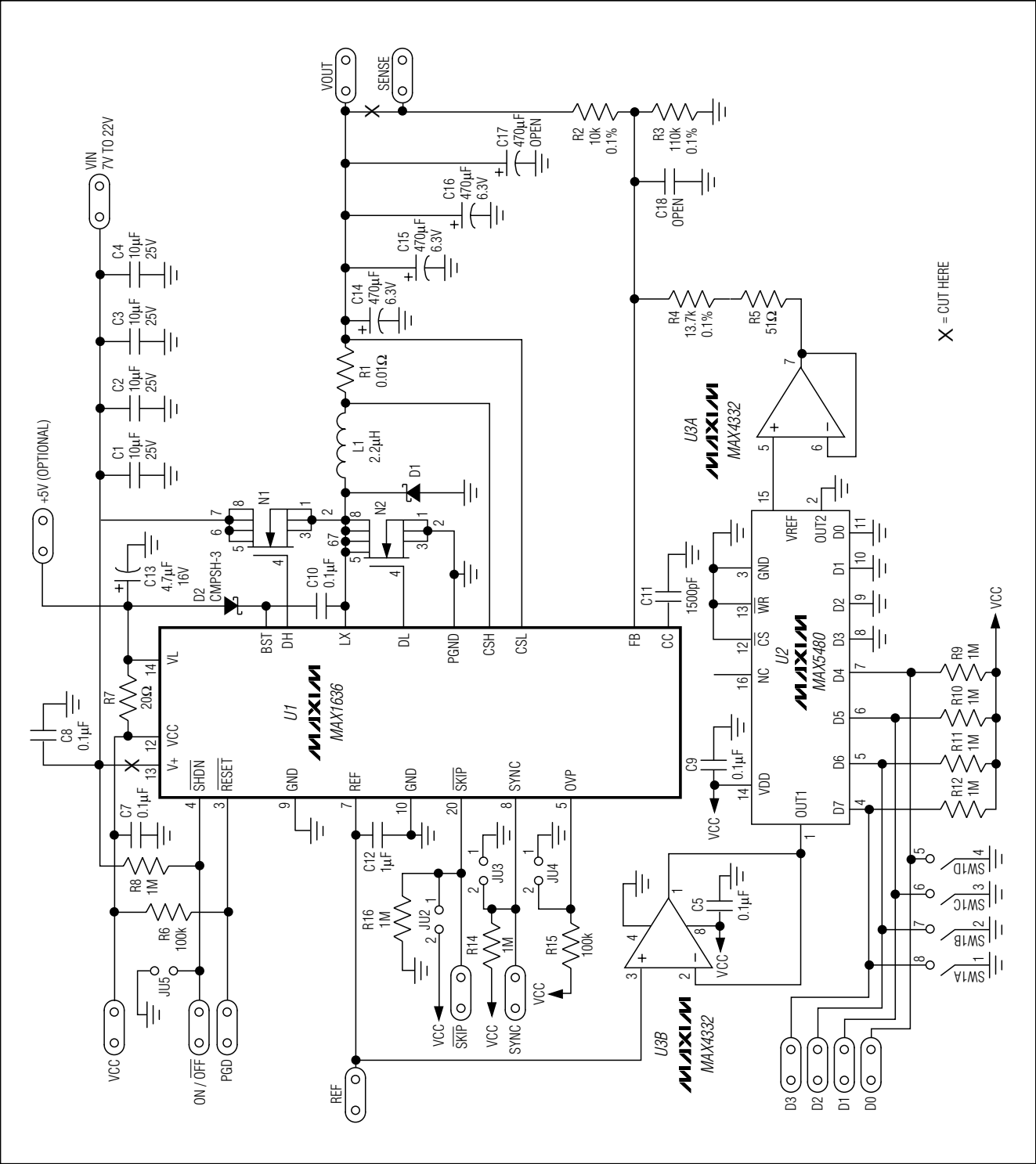


Figure 1. MAX1636 EV Kit Schematic

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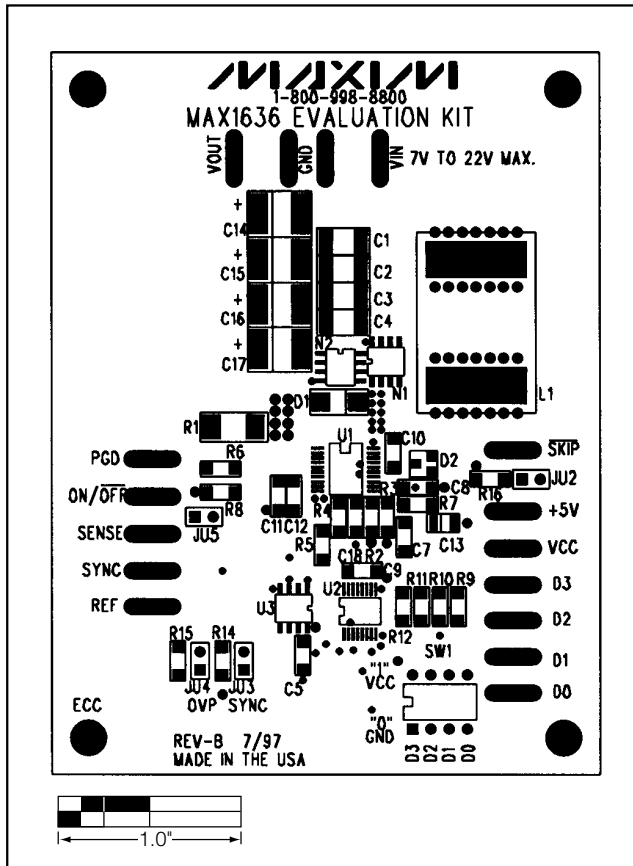


Figure 2. MAX1636 EV Kit Component Placement Guide—Component Side

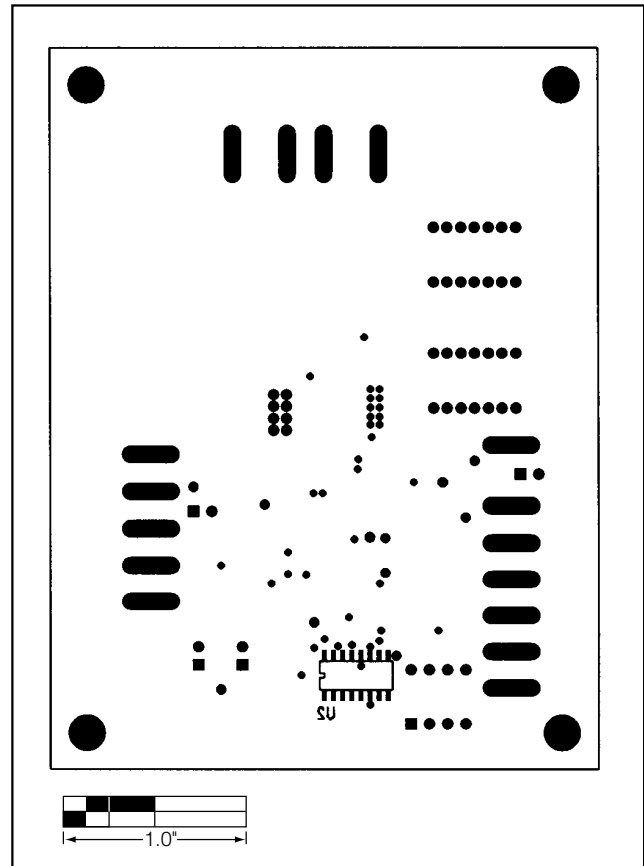


Figure 3. MAX1636 EV Kit Component Placement Guide—Solder Side

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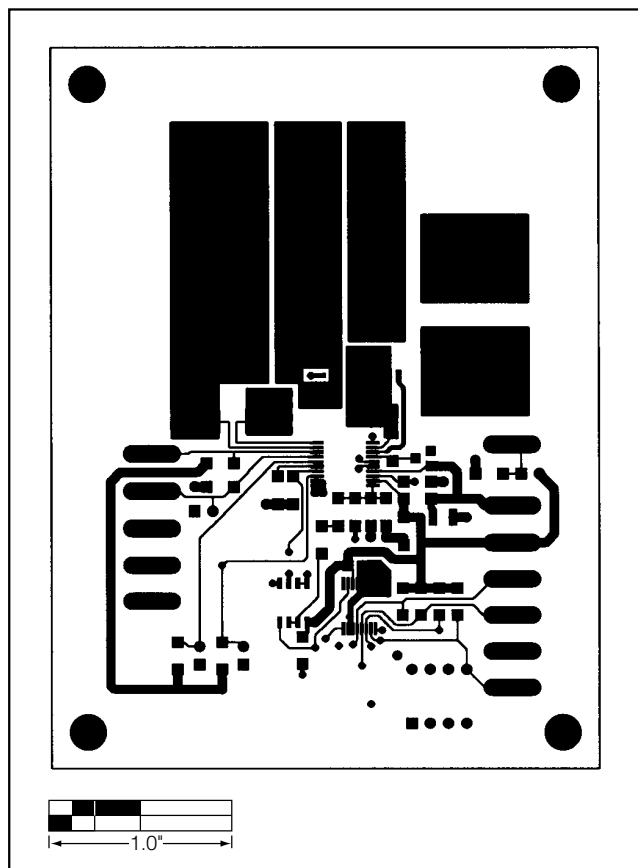


Figure 4. MAX1636 EV Kit PC Board Layout—Component Side

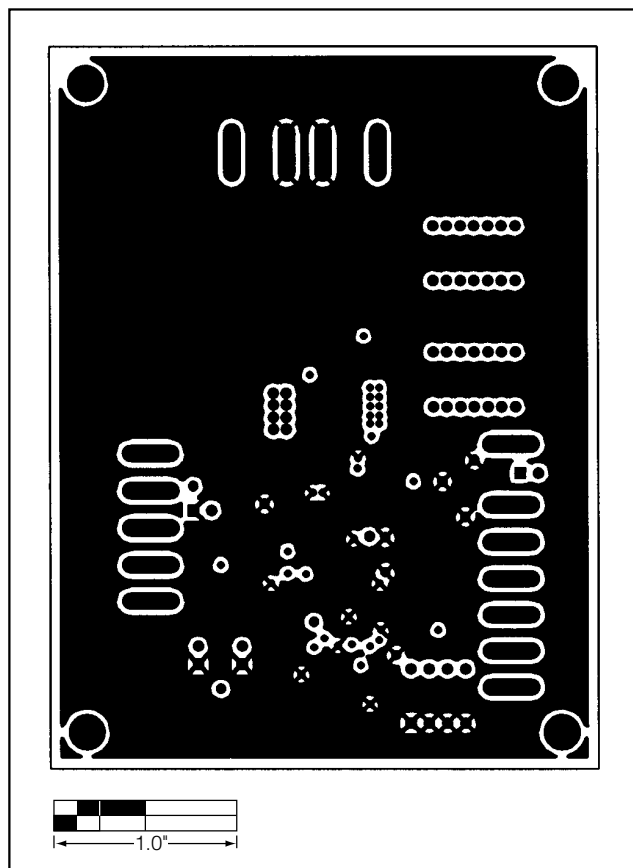


Figure 5. MAX1636 EV Kit PC Board Layout—Two Internal GND Planes

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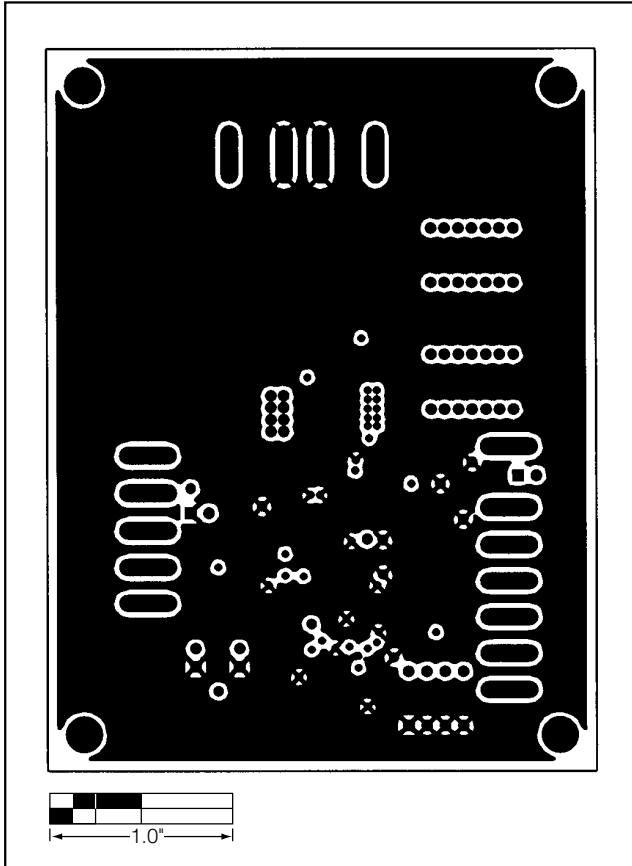


Figure 6. MAX1636 EV Kit PC Board Layout—Three Internal GND Planes

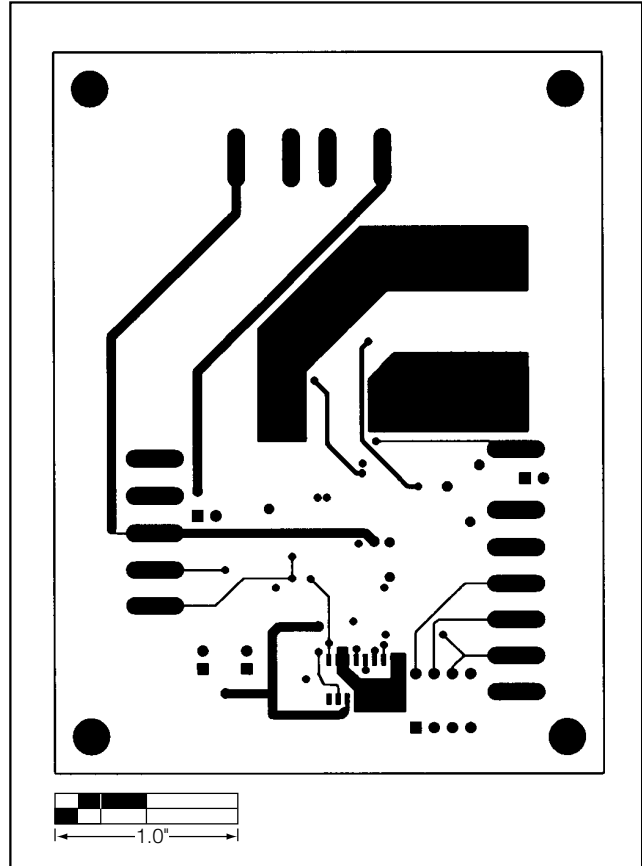


Figure 7. MAX1636 EV Kit PC Board Layout—Solder Side

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