# MAX25256 Evaluation Kit

# Evaluates: MAX25256

## General Description

The MAX25256 evaluation kit (EV kit) is a fully assembled and tested PCB that contains the MAX25256 10W isolated H-bridge DC-DC converter. The EV kit operates from an 8V to 36V DC power source and the on-board 1:1 turns-ratio transformer from HALO sets the output voltage range from 6.8V to 34.8V with a 215mA current limit.

The EV kit provides greater than 90% overall efficiency at +24V between 2.2W and up to 8.3W output power using an H-bridge DC-DC converter topology. Input-ripple current and radiated noise are minimized by the inherent balanced nature of the design with no interruption in the input current. Undervoltage lockout (UVLO), adjustable current limit, and thermal shutdown provide for a robust 10W isolated supply. The surface-mount transformer provides galvanic isolation with the output powered from a full-wave rectifier circuit, reducing the output-voltage ripple.

The EV kit circuit is configured as a full-wave rectifier, with an output voltage that follows the input voltage but is configurable for other topologies including a voltage doubler, bipolar outputs, half-wave rectification, and a push-pull rectifier.

The device is available in a 10-pin (3mm x 3mm) TDFN package with an exposed pad.

## Features

- 8V to 36V Input Supply Range
- Up to 90% Efficiency
- Full-Wave Rectified Output
- Configurable for a Voltage Doubler, Bipolar Half-Wave Rectifier, and Push-Pull Rectifier Outputs
- Internal or External Clock Operation Option
- Proven PCB Layout
- Fully Assembled and Tested

## Quick Start

### Required Equipment

- MAX25256 EV kit
- +24V, 1A DC power supply
- Electronic load capable of 150mA
- Ammeter
- Voltmeter

### Procedure

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

**Caution: Do not turn on the power until all connections are completed.**

1) Verify that jumpers JU2, and JU3 are in their default positions, as shown in Table 1 and Table 2.
2) Set the DC power supply to 24V.
3) Set the electronic load to 150mA and disable the output.
4) Connect the voltmeter between the +VOUT and SGND PCB pads on the EV kit.
5) Connect the ammeter between the +VOUT PCB pad on the EV kit and the positive terminal on the electronic load. The negative terminal on the electronic load is connected to the SGND PCB pad on the EV kit.
6) Connect the power supply between the VDD and GND PCB pads on the EV kit.
7) Turn on the power supply.
8) Enable the electronic load.
9) Verify that the ammeter reads approximately 150mA.
10) Verify that the voltmeter reads approximately 22.8V.

***Ordering Information* appears at end of data sheet.**



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## Detailed Description

The MAX25256 EV kit is a 10W, isolated H-bridge DC-DC converter that provides an unregulated output that is two diode-voltage drops less than its input supply, with respect to the isolated ground. In the default configuration, the maximum load is limited by the device and the on-board transformer.

The device is an integrated primary-side controller and H-bridge driver for isolated power-supply circuits. The device contains an on-board oscillator, protection circuitry, and internal MOSFETs to provide up to 215mA of current to the transformer's primary winding. The device can be operated using the internal 425kHz oscillator, or driven by an external clock to synchronize multiple devices and control EMI behavior. Regardless of the clock source being used, an internal flip-flop stage guarantees a fixed 50% duty cycle, preventing DC current flow in the transformer as long as the clock's period is constant.

The device operates from a single-supply voltage and includes UVLO and an active-low enable input for controlled startup. If the input voltage at VDD falls below 6.3V, or the $\overline{EN}$ input is pulled above 2V, the device shuts down and ST1 and ST2 are high impedance.

The device features an adjustable output current limit at the transformer driver outputs (ST1 and ST2). When the current reaches the limit for longer than the 1.2ms blanking time, the drive outputs are disabled and the $\overline{FAULT}$ output asserts. The drivers are reenabled after the 38.2ms autoretry time. If a continuous fault condition is present, the duty cycle of the fault current is approximately 3%.

The bottom PCB GND plane under device U1 is utilized as a thermal heatsink for power dissipation of the device's thermally enhanced TDFN package with exposed pad. Test points GND and SGND are provided on the PCB for probing the respective ground planes, or to connect the GND and SGND planes for nonisolated evaluation of the circuit.

### Clock Source

The device has two modes of operation: internal oscillator or external clock. To use the internal 425kHz oscillator, place a shunt in the 1-2 position on jumper JU2. When using an external clock, remove the shunt from JU2 and apply a clock signal on the CLK PCB pad on the EV kit. An internal flip-flop divides the external clock by two, generating a switching signal with a guaranteed 50% duty cycle. As a result, the device outputs switch at 1/2 the external clock frequency.

### Overcurrent Limiting

Resistor R2 sets the current-limit threshold to 650mA. To change the current-limit threshold, replace resistor R2 with a 0603 surface-mount resistor using the following equation:

$$R2\,(k\Omega) = 650 / I_{LIM}\,(mA)$$

where $I_{LIM}$ is the desired current threshold in the range of 215mA < $I_{LIM}$ < 650mA.

An overcurrent or overtemperature condition triggers a fault on the device and the red LED (D5) turns on.

### Evaluating Other Transformer Configurations

The EV kit PCB layout provides an easy method to reconfigure transformer T1 secondary windings for other configurations, including a half-wave rectifier, voltage doubler, bipolar outputs, and other full-wave-rectifier configurations. Use Table 3 to reconfigure the device for the appropriate output configuration.

### Output Snubbers

For VDD greater than 27V, use a simple RC snubber circuit on ST1 and ST2 to ensure that the peak voltage is less than 40V during switching. Maxim recommends installing 91Ω 0603 surface-mount resistors at R5 and R6, and 330pF 0603 surface-mount capacitors at C2 and C3 when operating under these conditions.

## Table 1. $\overline{EN}$ (JU3)

| SHUNT POSITION | $\overline{EN}$ PIN | DEVICE OPERATION |
|---|---|---|
| 1-2 | Connects to 5V | Disables the device |
| 2-3* | Connects to GND | Enables the device |

**Default position.*

## Table 2. Clock Mode (JU2)

| SHUNT POSITION | CLK PIN | OSCILLATOR/CLOCK OPERATION |
|---|---|---|
| Installed* | Connected to GND | Internal oscillator |
| Not installed | Not connected | External clock; apply a clock signal to the CLK PCB pad on the EV kit |

**Default position.*

## Table 3. Output Configurations

| CONFIGURATION | C7 | C9 | D1 | D2 | D3 | D4 | R5 | R6 | R7 | R9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Full-wave rectifier* | Not installed | Not installed | Installed | Installed | Installed | Installed | 0Ω | Not installed | Not installed | 0Ω |
| Half-wave rectifier | Not installed | Not installed | Not installed | Installed | Not installed | Not installed | 0Ω | Not installed | 0Ω | 0Ω |
| Voltage doubler | Installed | Not installed | Installed | Installed | Not installed | Not installed | Not installed | Not installed | 0Ω | 0Ω |
| Bipolar outputs | Not installed | 1µF | Installed | Installed | Installed | Installed | 0Ω | Installed | Not installed | 10kΩ |
| Push-pull rectifier | Not installed | Not installed | Not installed | Installed | Not installed | Installed | 0Ω | 0Ω | Not installed | 0Ω |

**Default position.*

## Component Suppliers

| SUPPLIER | WEBSITE |
|---|---|
| Fairchild Semiconductor | www.fairchildsemi.com |
| HALO Electronics, Inc. | www.haloelectronics.com |
| Murata Electronics North America, Inc. | www.murata-northamerica.com |
| Panasonic | www.industrial.panasonic.com |
| TDK Corporation | www.tdk.com |
| Vishay Intertechnology | www.vishay.com |

***Note:*** *Indicate that you are using the MAX25256 when contacting these component suppliers.*

## Ordering Information

| PART | TYPE |
|---|---|
| MAX25256EVKIT# | EV Kit |

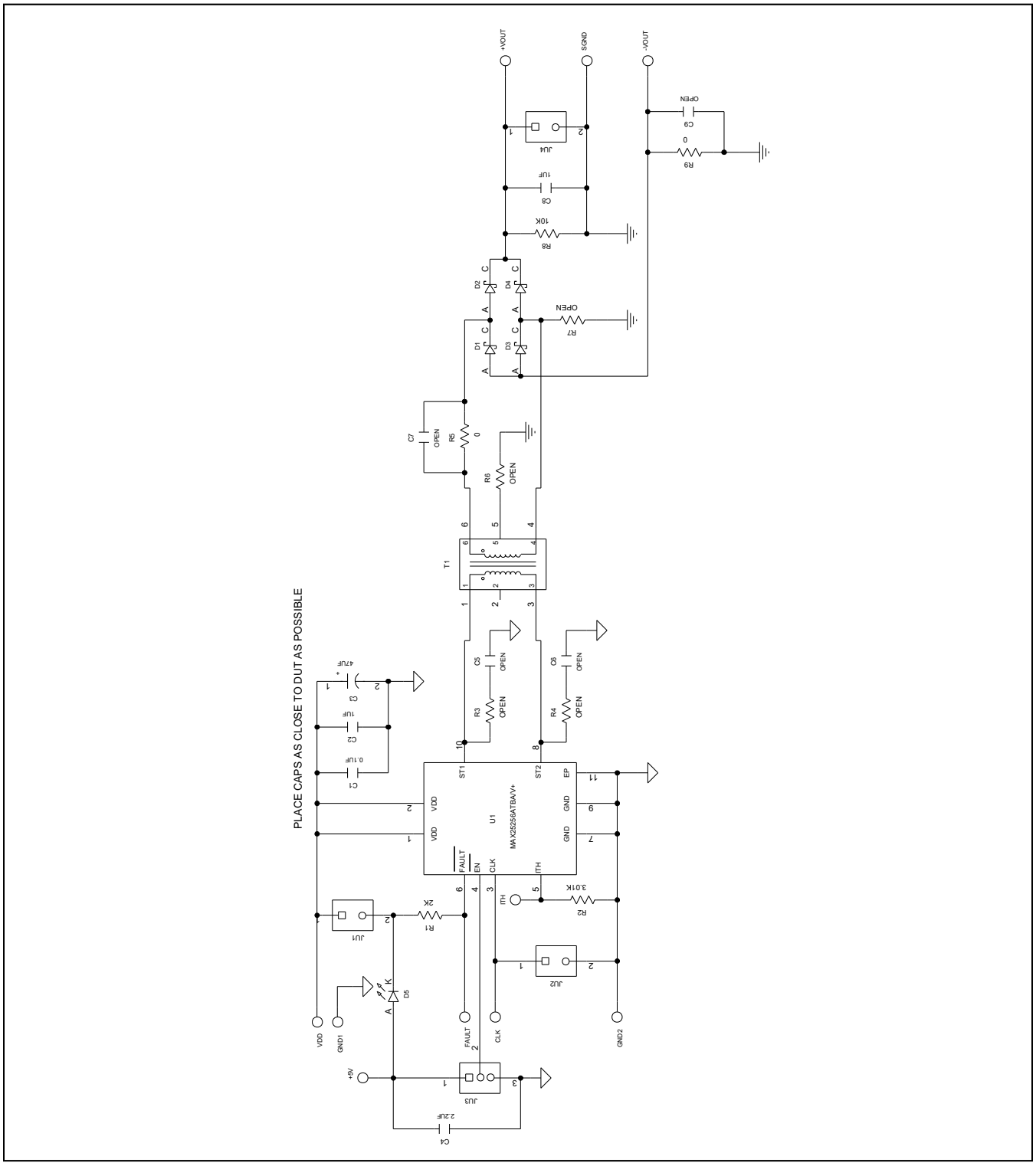
*#Denotes RoHS compliance.*

## MAX25256 EV Kit Bill of Materials

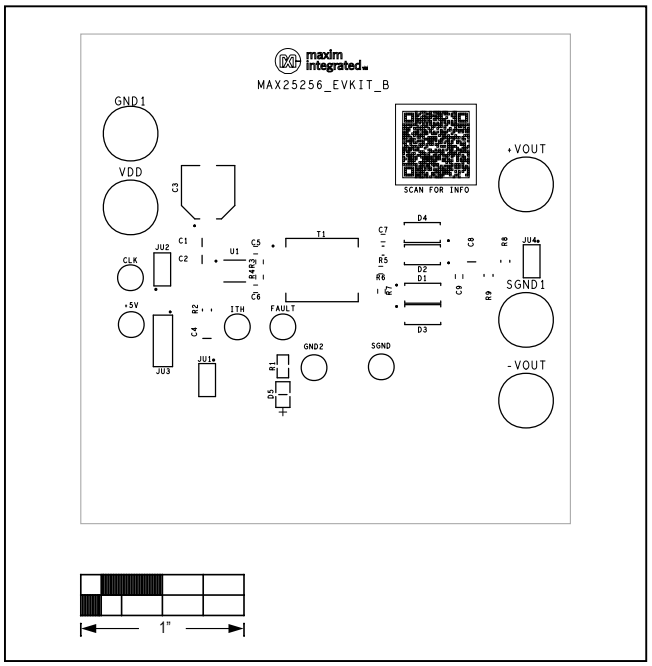
| ITEM | REF_DES | | QTY | MFG PART # | MANUFACTURER | VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 1 | +5V, CLK, FAULT, GND2, ITH, SGND | | 6 | 5012 | KEYSTONE | N/A | TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; |
| 2 | +VOUT, -VOUT, GND1, SGND1, VDD | | 5 | 575-4 | KEYSTONE | 575-4 | RECEPTACLE; JACK; BANANA; 0.203IN [5.2MM] DIA X 0.218IN [5.5MM] L; 0.203D/0.218L; NICKEL PLATED BRASS |
| 3 | C1 | | 1 | GCM21BR71H104KA37 | MURATA | 0.1UF | CAP; SMT (0805); 0.1UF; 10%; 50V; X7R; CERAMIC |
| 4 | C2 | | 1 | CGA4J3X7R1H105M125AB | TDK | 1UF | CAP; SMT (0805); 1UF; 20%; 50V; X7R; CERAMIC |
| 5 | C3 | | 1 | EEE-FK1H470P | PANASONIC | 47UF | CAP; SMT (CASE_E); 47UF; 20%; 50V; ALUMINUM-ELECTROLYTIC |
| 6 | C4 | | 1 | 08053C225KAT2A;TMK212B7225KG; GRM21BR71E225KA73;GRT21BR71E225KE13 | AVX;TAIYO YUDEN;MURATA;MURATA | 2.2UF | CAP; SMT (0805); 2.2UF; 10%; 25V; X7R; CERAMIC |
| 7 | C8 | | 1 | GRM21BR71H105KA12;CL21B105KBFNNN;C2012X7R1H105K085AC;UMK212B7105KG | MURATA;SAMSUNG ELECTRONICS;TDK;TAIYO YUDEN | 1UF | CAP; SMT (0805); 1UF; 10%; 50V; X7R; CERAMIC |
| 8 | D1-D4 | | 4 | BYS10-45HE3_A | VISHAY | BYS10-45HE3_A | DIODE; SCH; SMA (DO-214AC); PIV=45V; IF=1.5A |
| 9 | D5 | | 1 | SML-LXT0805GW | LUMEX OPTOCOMPONENTS INC. | SML-LXT0805GW-TR | DIODE; LIGHT EMITTING GREEN; SMT (0805); IF(PEAK)=0.15A; I(STEADY)=0.025A; PD=0.105W; VF=2.0V |
| 10 | JU1, JU2, JU4 | | 3 | PEC02SAAN | SULLINS | PEC02SAAN | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS |
| 11 | JU3 | | 1 | PEC03SAAN | SULLINS | PEC03SAAN | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS |
| 12 | MH1-MH4 | | 4 | 9032 | KEYSTONE | 9032 | MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON |
| 13 | R1 | | 1 | RNCP0603FTD2K00 | STACKPOLE ELECTRONICS INC. | 2K | RES; SMT (0603); 2K; 1%; +/-100PPM/DEGC; 0.1250W |
| 14 | R2 | | 1 | CRCW08053K01FK | VISHAY DALE | 3.01K | RES; SMT (0805); 3.01K; 1%; +/-100PPM/DEGC; 0.1250W |
| 15 | R5, R9 | | 2 | CRCW08050000ZS;RC2012J000 | VISHAY;SAMSUNG ELECTRONICS | 0 | RES; SMT (0805); 0; JUMPER; JUMPER; 0.1250W |
| 16 | R8 | | 1 | ERJ-6GEYJ103;RMCF0805JG10K0 | PANASONIC;STACKPOLE ELECTRONICS | 10K | RES; SMT (0805); 10K; 5%; +/-200PPM/DEGC; 0.1250W |
| 17 | SU1-SU4 | | 4 | SNT-100-BK-G | SAMTEC | SNT-100-BK-G | TEST POINT; SHUNT AND JUMPER; STR; TOTAL LENGTH=6.10MM; BLACK; INSULATION=GLASS FILLED POLYESTER; CONTACT=PHOSPHOR BRONZE |
| 18 | T1 | | 1 | TGMR-511V6LF | HALO ELECTRONICS, INC | TGMR-511V6LF | TRANSFORMER; SMT; 1:1CT; POWER TRANSFORMER |
| 19 | U1 | | 1 | MAX25256ATBA/V+ | MAXIM | MAX25256ATBA/V+ | EVKIT PART - IC; DRV; AUTOMOTIVE; 36V H-BRIDGE TRANSFORMER DRIVER FOR ISOLATED SUPPLIES; PACKAGE CODE: T1033Y+1C; PACKAGE OUTLINE DRAWING; 21-0137; PACKAGE LAND PATTERN: 90-0003; TDFN10-EP |
| 20 | PCB | | 1 | MAX25256 | MAXIM | PCB | PCB:MAX25256 |
| 21 | R3, R4, R6, R7 | DNP | 0 | N/A | N/A | OPEN | RESISTOR; 0603; OPEN; FORMFACTOR |
| 22 | C5-C7, C9 | DNP | 0 | N/A | N/A | OPEN | CAPACITOR; SMT (0603); OPEN; FORMFACTOR |
| TOTAL | | | 41 | | | | |

**NOTE:** DNI--> DO NOT INSTALL(PACKOUT) ; DNP--> DO NOT PROCURE.

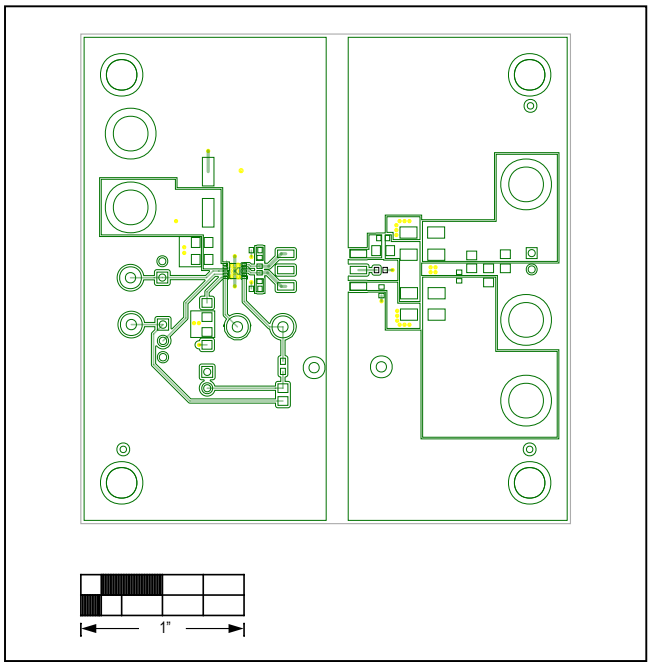
## MAX25256 EV Kit Schematic



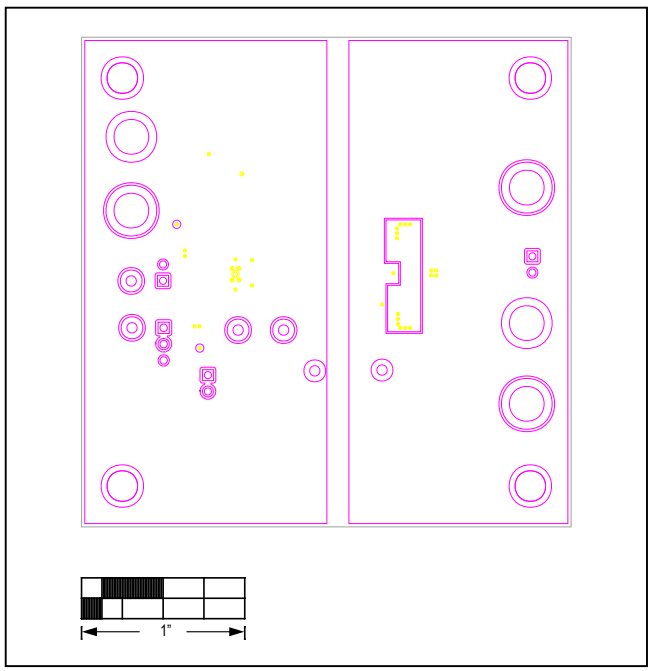
## MAX25256 EV Kit PCB Layout Diagrams



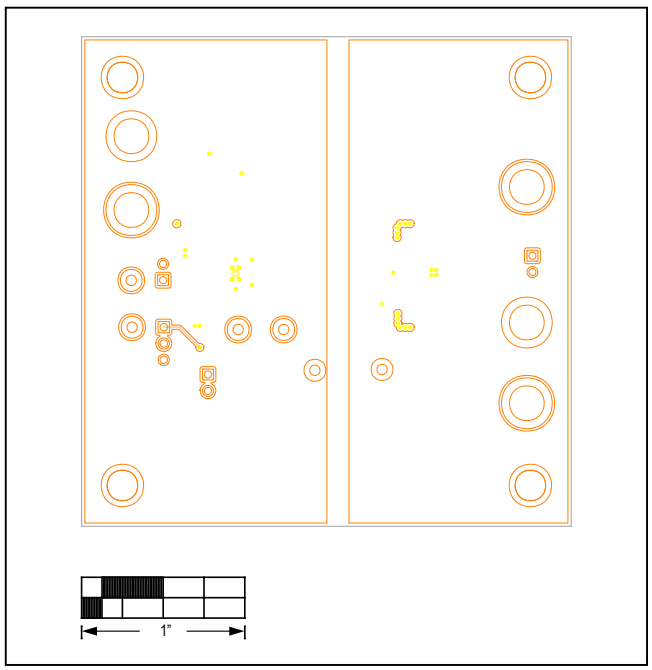

*MAX25256 EV Kit PCB Layout—Silkscreen Top*




*MAX25256 EV Kit PCB Layout—Top View*

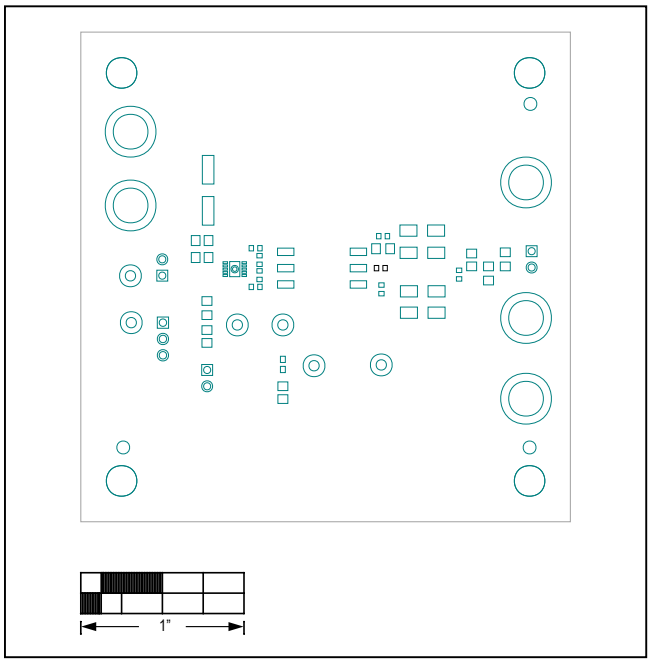



*MAX25256 EV Kit PCB Layout—Internal Layer 2*

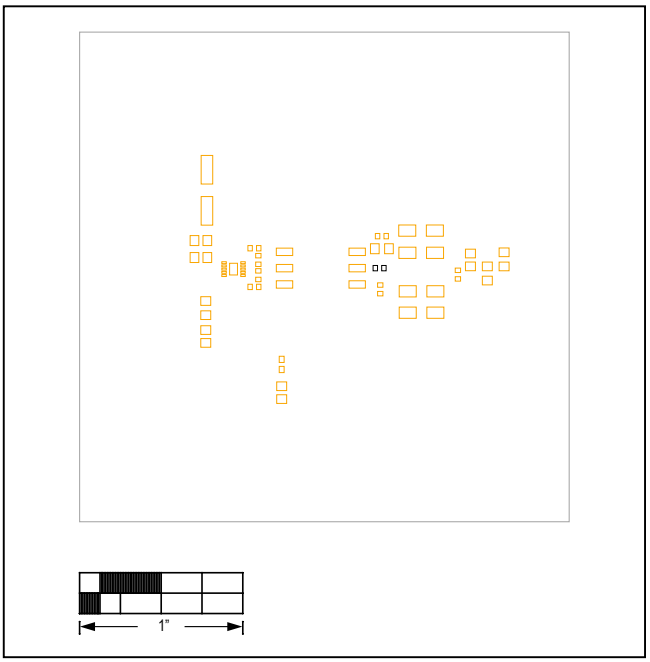



*MAX25256 EV Kit PCB Layout—Internal Layer 3*

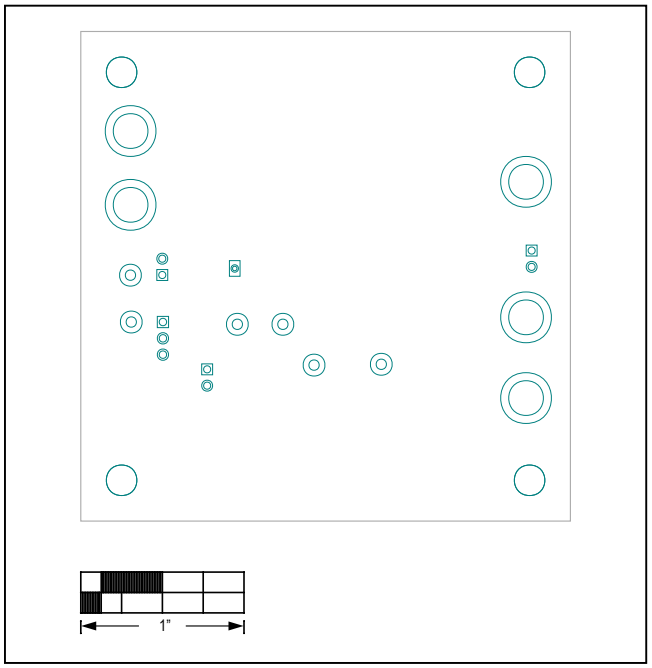
## MAX25256 EV Kit PCB Layout Diagrams (continued)



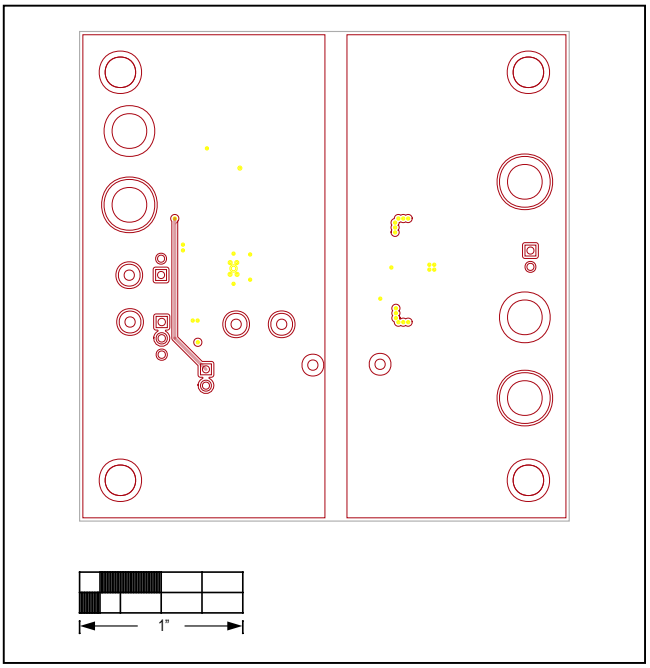

*MAX25256 EV Kit PCB Layout—Mask Top*




*MAX25256 EV Kit PCB Layout—Paste Top*




*MAX25256 EV Kit PCB Layout—Mask Bottom*




*MAX25256 EV Kit PCB Layout—Bottom View*

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 10/20 | Initial release | — |
| 1 | 4/21 | *General Description* - removed paragraph reference to HALO's transformer; *Features* and *Detailed Description* - removed reference to 1500$V_{RMS}$ Isolation; removed section On-Board LDO for Disabling the MAX25256; Table 3 renumbered the column headers (C7 to C9; C8 to C7, R8 to R6, R10 to R5); *Component Suppliers* table - added suppliers; *MAX25256 EV Kit Bill of Materials* - corrected line 2, added line 3; *MAX25256 EV Kit PCB Layout Diagrams* - replaced all layouts | 1-4, 6, 7 |
| 2 | 5/21 | *MAX25256 EV Kit Bill of Materials* updated | 4 |
| 3 | 5/21 | Replaced *Bill of Materials* | 4 |
| 4 | 6/21 | Updated *General Description*, *Quick Start*, and *Detailed Description* | 1, 2 |