

## 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.

## 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  $\overline{\text{EN}}$  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  $\overline{\text{FAULT}}$  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:

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

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

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 91 $\Omega$  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	0 $\Omega$	Not installed	Not installed	0 $\Omega$
Half-wave rectifier	Not installed	Not installed	Not installed	Installed	Not installed	Not installed	0 $\Omega$	Not installed	0 $\Omega$	0 $\Omega$
Voltage doubler	Installed	Not installed	Installed	Installed	Not installed	Not installed	Not installed	Not installed	0 $\Omega$	0 $\Omega$
Bipolar outputs	Not installed	1 $\mu$ F	Installed	Installed	Installed	Installed	0 $\Omega$	Installed	Not installed	10k $\Omega$
Push-pull rectifier	Not installed	Not installed	Not installed	Installed	Not installed	Installed	0 $\Omega$	0 $\Omega$	Not installed	0 $\Omega$

\*Default position.

## Component Suppliers

SUPPLIER	WEBSITE
Fairchild Semiconductor	<a href="http://www.fairchildsemi.com">www.fairchildsemi.com</a>
HALO Electronics, Inc.	<a href="http://www.haloelectronics.com">www.haloelectronics.com</a>
Murata Electronics North America, Inc.	<a href="http://www.murata-northamerica.com">www.murata-northamerica.com</a>
Panasonic	<a href="http://www.industrial.panasonic.com">www.industrial.panasonic.com</a>
TDK Corporation	<a href="http://www.tdk.com">www.tdk.com</a>
Vishay Intertechnology	<a href="http://www.vishay.com">www.vishay.com</a>

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

## Ordering Information

PART	TYPE
MAX25256EVKIT#	EV Kit

#Denotes RoHS compliance.

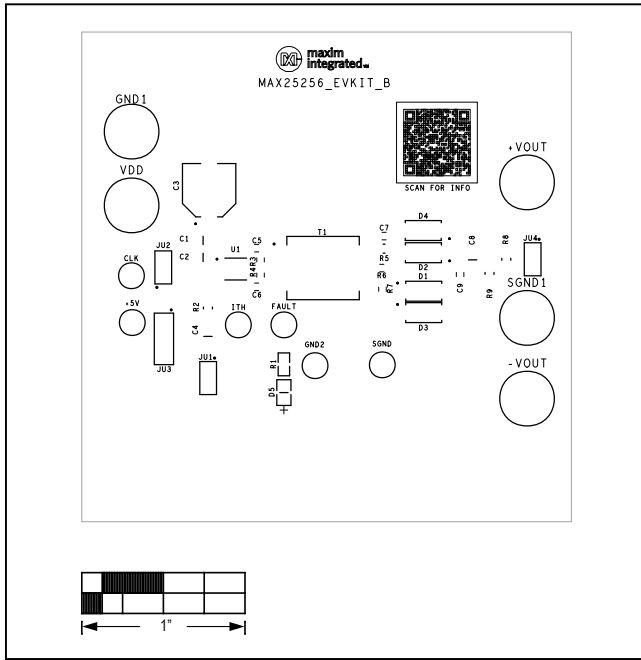
MAX25256 EV Kit Bill of Materials

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;CL21B105KBF NNN;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;RMCFO805JG10K0	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				

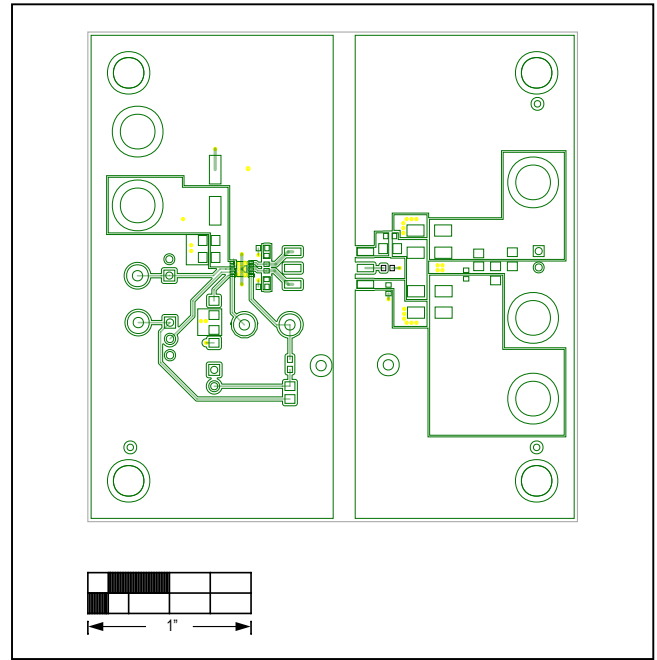
NOTE: DNI--> DO NOT INSTALL(PACKOUT) ; DNP--> DO NOT PROCURE.



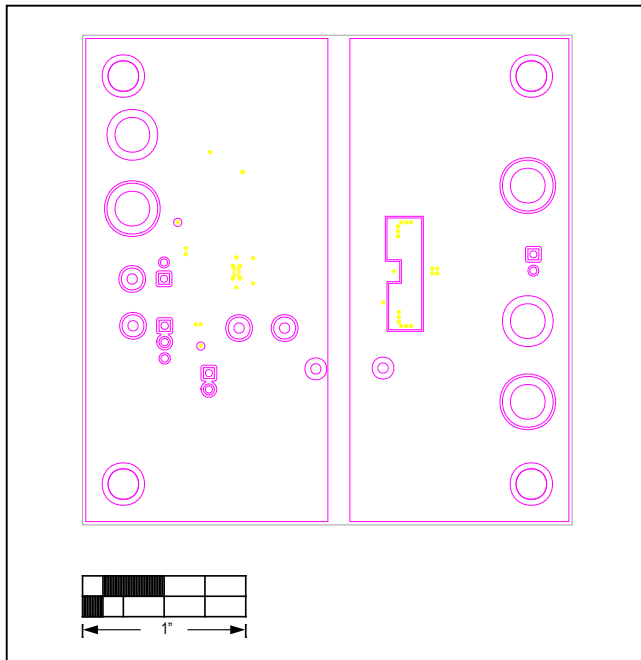
MAX25256 EV Kit PCB Layout Diagrams



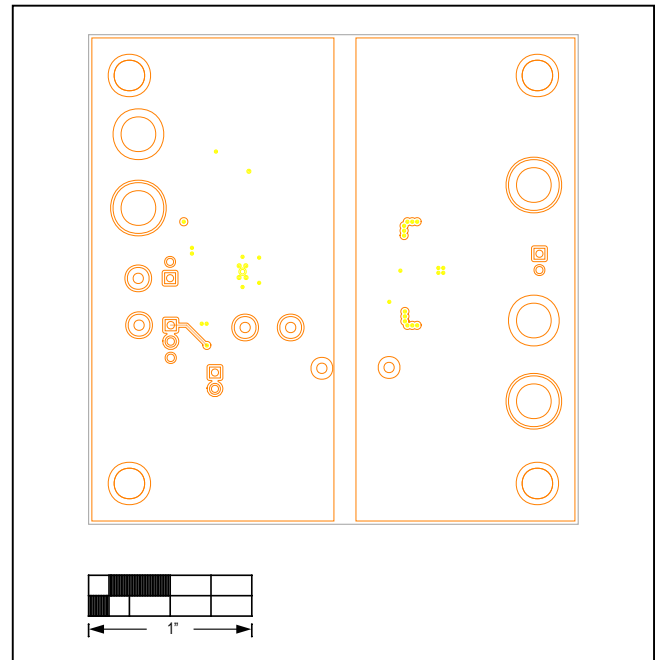
MAX25256 EV Kit PCB Layout—Silkscreen Top



MAX25256 EV Kit PCB Layout—Top View

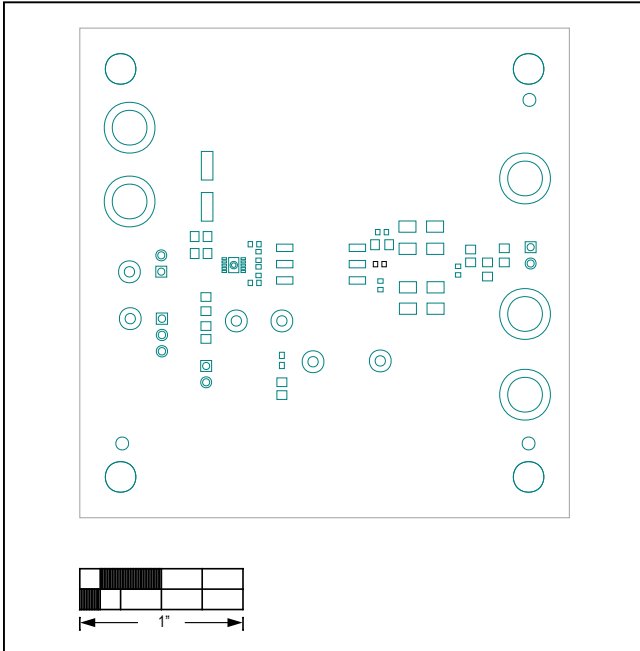


MAX25256 EV Kit PCB Layout—Internal Layer 2

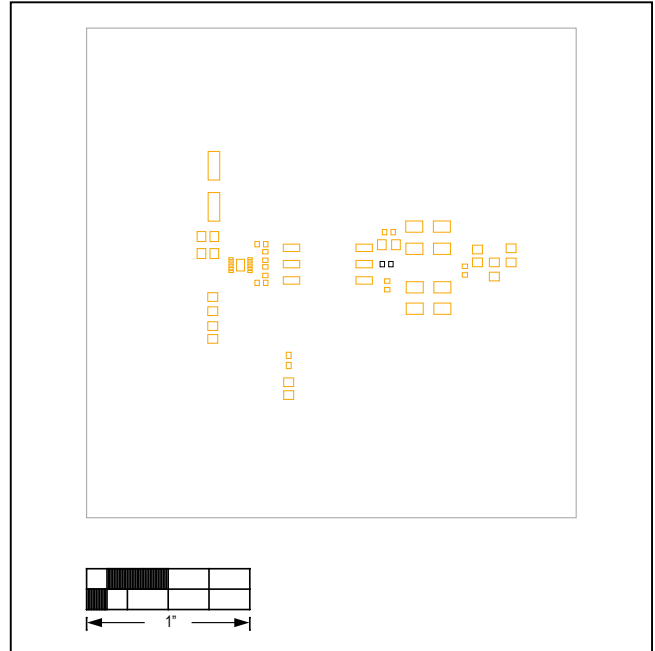


MAX25256 EV Kit PCB Layout—Internal Layer 3

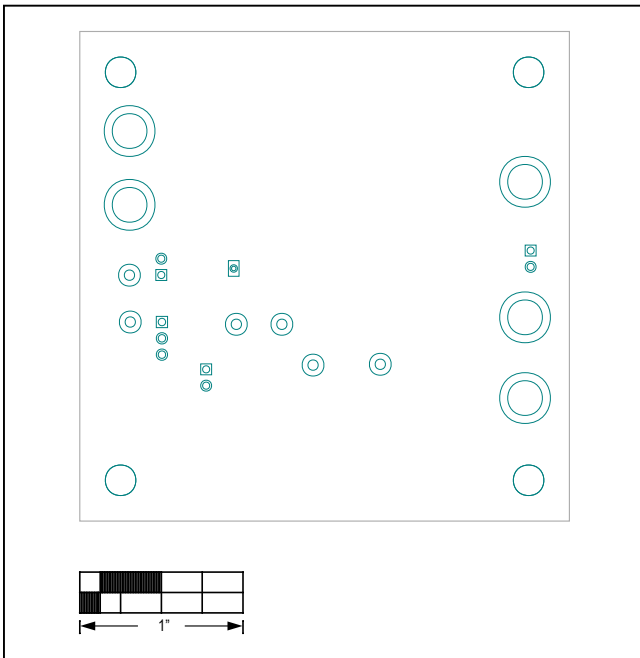
MAX25256 EV Kit PCB Layout Diagrams (continued)



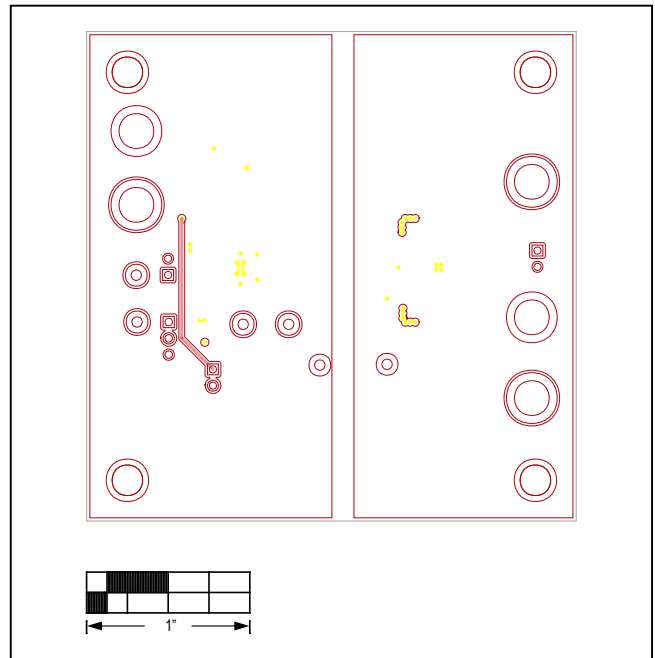
MAX25256 EV Kit PCB Layout—Mask Top



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	<i>General Description</i> - removed paragraph reference to HALO's transformer; <i>Features</i> and <i>Detailed Description</i> - removed reference to 1500V <sub>RMS</sub> 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); <i>Component Suppliers</i> table - added suppliers; <i>MAX25256 EV Kit Bill of Materials</i> - corrected line 2, added line 3; <i>MAX25256 EV Kit PCB Layout Diagrams</i> - replaced all layouts	1-4, 6, 7
2	5/21	<i>MAX25256 EV Kit Bill of Materials</i> updated	4
3	5/21	Replaced <i>Bill of Materials</i>	4
4	6/21	Updated <i>General Description</i> , <i>Quick Start</i> , and <i>Detailed Description</i>	1, 2

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