

# MAX13256 Evaluation Kit

## Evaluates: MAX13256

### General Description

The MAX13256 evaluation kit (EV kit) is a fully assembled and tested PCB that contains the MAX13256 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 300mA 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.

Use HALO's TGMR-512V6LF transformer for 4:1 turns-ratio operation providing up to 1A load capability.

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
- ◆ Designed for 1500V<sub>RMS</sub> Isolation
- ◆ Proven PCB Layout
- ◆ Fully Assembled and Tested

Ordering Information appears at end of data sheet.

### Component List

DESIGNATION	QTY	DESCRIPTION
C1, C4	2	1 $\mu$ F $\pm$ 10%, 50V C0G ceramic capacitors (0805) Murata GRM21BR71H105K
C2, C3, C8	0	Not installed, capacitors (0603)
C5	1	0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H104K
C6	1	2.2 $\mu$ F $\pm$ 10%, 16V X7R ceramic capacitor (0805) Murata GRM21BR71C225K
C7	0	Not installed, capacitor (0805)
D1-D4	4	40V, 1A Schottky diodes (SMB) Fairchild MBRS140
D5	1	Red LED (0603)
GND, SGND	2	Black test points
JU1	1	3-pin header
JU2, JU4	2	2-pin headers
JU3	1	Not installed, 2-pin header

DESIGNATION	QTY	DESCRIPTION
R1	1	1k $\Omega$ $\pm$ 1% resistor (0603)
R2	1	750 $\Omega$ $\pm$ 5% resistor (0603)
R3	1	49.9k $\Omega$ $\pm$ 1% resistor (0603)
R4	1	10k $\Omega$ $\pm$ 5% resistor (0603)
R5-R8	0	Not installed, resistors (0603)
R9, R10	2	0 $\Omega$ $\pm$ 5% resistors (0603)
T1	1	1:1, 300mA turns transformer (6 Gull Wing) HALO TGMR-511V6LF
U1	1	H-bridge transformer driver (10 TDFN-EP) Maxim MAX13256ATB+
U2	1	5V LDO (6 TDFN-EP) Maxim MAX15007BATT+
—	3	Shunts
—	1	PCB: MAX13256 EVALUATION KIT

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### Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
HALO Electronics, Inc.	650-903-3800	www.haloelectronics.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com

**Note:** Indicate that you are using the MAX13256 when contacting these component suppliers.

### Quick Start

#### Required Equipment

- MAX13256 EV kit
- +24V, 1A DC power supply
- Electronic load capable of 200mA
- 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 JU1, JU2, and JU4 are in their default positions, as shown in Tables 1, 2, and 3.
- 2) Set the DC power supply to 24V.
- 3) Set the electronic load to 200mA 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 200mA.
- 10) Verify that the voltmeter reads approximately 22.8V.

### Detailed Description

The MAX13256 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 300mA 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 EV kit PCB is designed for 1500V<sub>RMS</sub> isolation, with 300 mil spacing between the GND and SGND planes. 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.

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**Table 1.  $\overline{\text{EN}}$  (JU1)**

SHUNT POSITION	$\overline{\text{EN}}$ 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. LDO Enable (JU4)**

SHUNT POSITION	LDO'S EN PIN	LDO OPERATION
Installed	Connects to GND	Disables the LDO
Not installed*	Not connected	Enables the LDO

\*Default position.

**Table 4. Output Configurations**

CONFIGURATION	C7	C8	D1	D2	D3	D4	R7	R8	R9	R10
Full-wave rectifier*	Not installed	Not installed	Installed	Installed	Installed	Installed	Not installed	Not installed	0Ω	0Ω
Half-wave rectifier	Not installed	Not installed	Not installed	Installed	Not installed	Not installed	0Ω	Not installed	0Ω	0Ω
Voltage doubler	Not installed	Installed	Installed	Installed	Not installed	Not installed	0Ω	Not installed	0Ω	Not installed
Bipolar outputs	1μF	Not installed	Installed	Installed	Installed	Installed	Not installed	Installed	10kΩ	0Ω
Push-pull rectifier	Not installed	Not installed	Not installed	Installed	Not installed	Installed	Not installed	0Ω	0Ω	0Ω

\*Default position.

### **On-Board LDO for Disabling the MAX13256**

The EV kit features an on-board 5V LDO (U2) for disabling the MAX13256 and powering the LED connected to  $\overline{\text{FAULT}}$ . Install a shunt in the 1-2 position on jumper JU1 to connect the  $\overline{\text{EN}}$  pin of the device to the 5V from the LDO output and disable the device. Ensure that the voltage on  $\overline{\text{EN}}$  never exceeds 6V.

Jumper JU4 is used to disable and enable the LDO, as shown in Table 3.

### **Overcurrent Limiting**

Resistor R1 sets the current-limit threshold to 650mA. To change the current-limit threshold, replace resistor R1 with a 0603 surface-mount resistor using the following equation:

$$R1(k\Omega) = 650/I_{LIM}(mA)$$

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 4 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.

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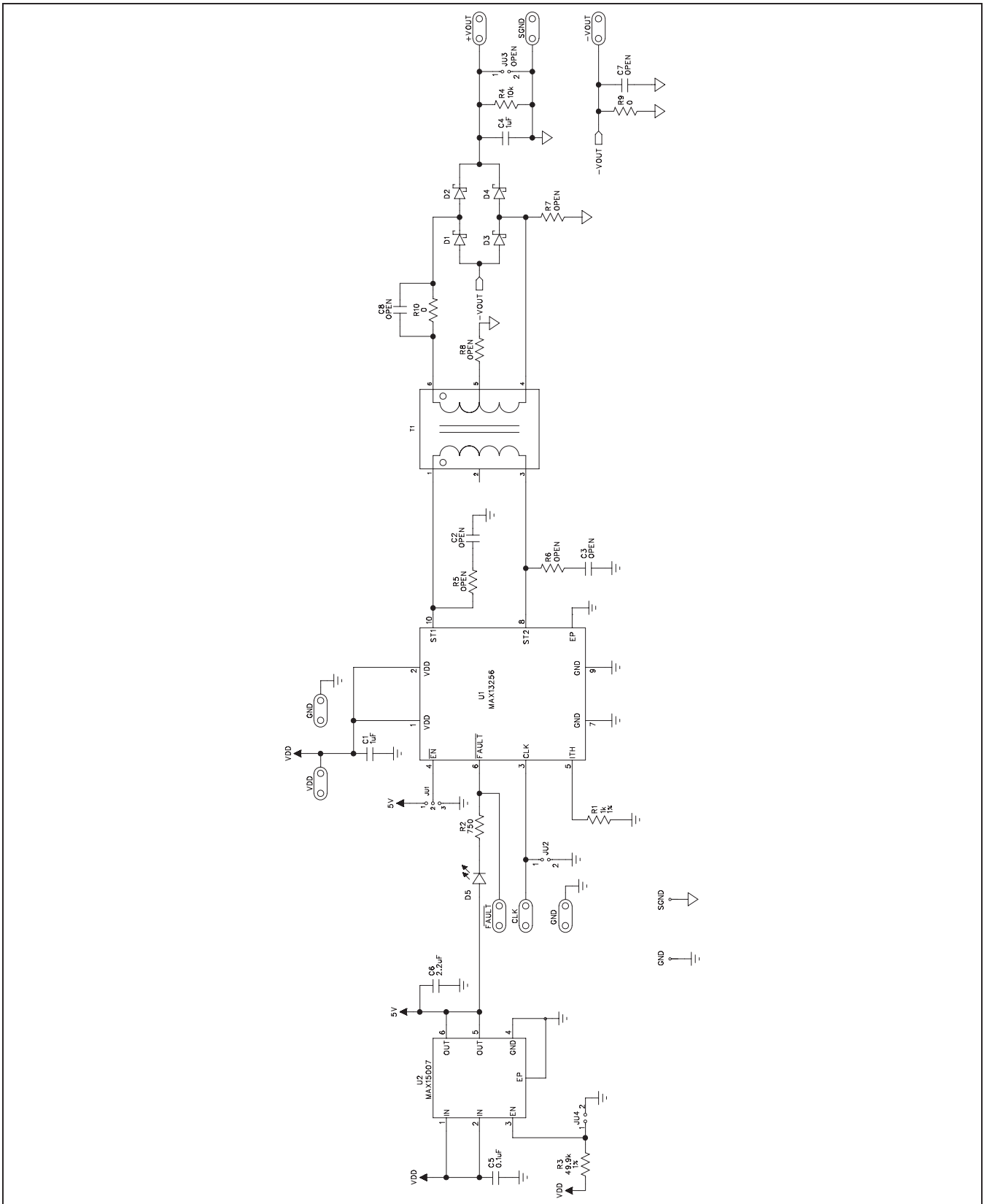


Figure 1. MAX13256 EV Kit Schematic

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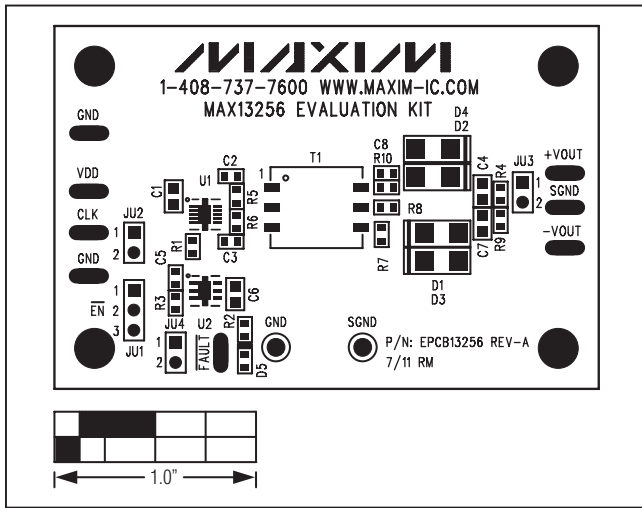


Figure 2. MAX13256 EV Kit Component Placement Guide—Component Side

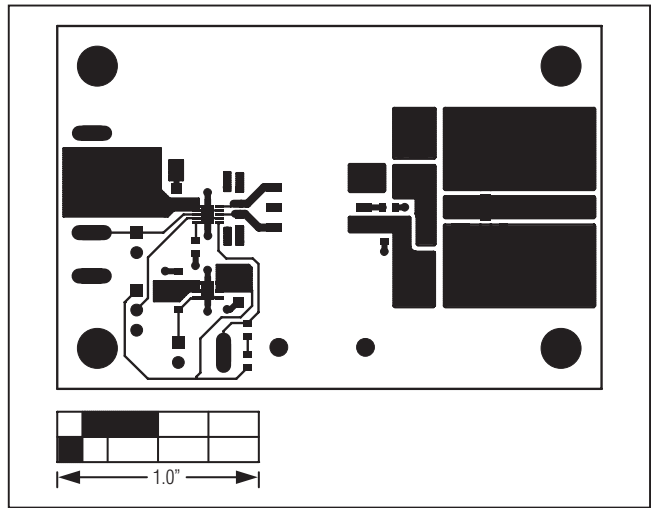


Figure 3. MAX13256 EV Kit PCB Layout—Component Side

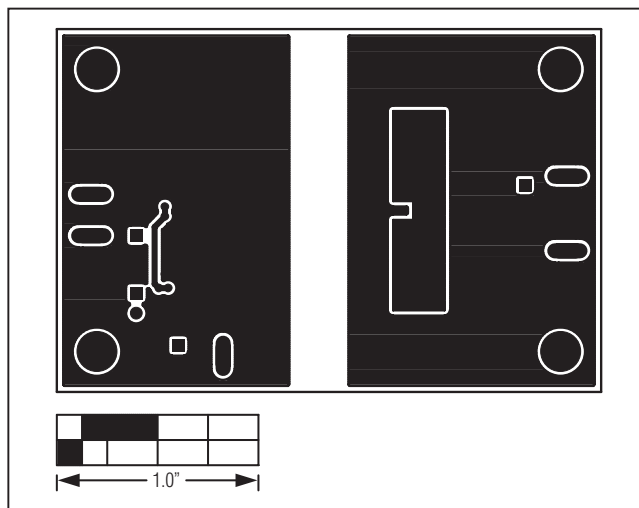


Figure 4. MAX13256 EV Kit PCB Layout—Solder Side

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### ***Ordering Information***

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<b>PART</b>	<b>TYPE</b>
MAX13256EVKIT#	EV Kit

#Denotes RoHS compliant.

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### *Revision History*

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/11	Initial release	—

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