

## **AN-2050 LM5006 Evaluation Board**

### **1 Introduction**

The LM5006EVAL evaluation board provides the design engineer with a fully functional buck regulator, employing the constant on-time (COT) operating principle. This evaluation board provides a 5V output over an input range of 6V to 75V. The circuit delivers load currents to 500 mA, with current limit set at a nominal 1 Amp.

The board's specification are:

- Input Voltage: 6V to 75V
- Output Voltage: 5V
- Maximum load current: 500 mA
- Minimum load current: 0A
- Current Limit: 1 Amp (nominal)
- Measured Efficiency: 94.75% ( $V_{IN} = 6V$ ,  $I_{OUT} = 100$  mA)
- Nominal Switching Frequency: 200 kHz
- Size: 2.6 in. x 1.6 in.

### **2 Theory of Operation**

Refer to the evaluation board schematic in [Figure 1](#). When the circuit is in regulation, the buck switch is on each cycle for a time determined by R1 and VIN according to the equation:

$$t_{on} = \frac{1.25 \times 10^{-10} \times (R1 + 500\Omega)}{V_{IN} - 0.5V} + 30 \text{ ns} \quad (1)$$

The on-time of this evaluation board ranges from  $\approx 4.38$   $\mu$ s at  $V_{IN} = 6V$ , to  $\approx 351$  ns at  $V_{IN} = 75V$ . The on-time varies inversely with  $V_{IN}$  to maintain a nearly constant switching frequency. At the end of each on-time the Minimum Off-Timer ensures the buck switch is off for at least 260 ns. In normal operation, the off-time is much longer. During the off-time, the load current is supplied by the output capacitor (C2). When the output voltage falls sufficiently that the voltage at FB is below 2.5V, the regulation comparator initiates a new on-time period. For stable, fixed frequency operation, a minimum of 25 mV of ripple is required at FB to switch the regulation comparator. Refer to the LM5006 data sheet for a more detailed block diagram, and a complete description of the various functional blocks.

### 3 Evaluation Board Schematic

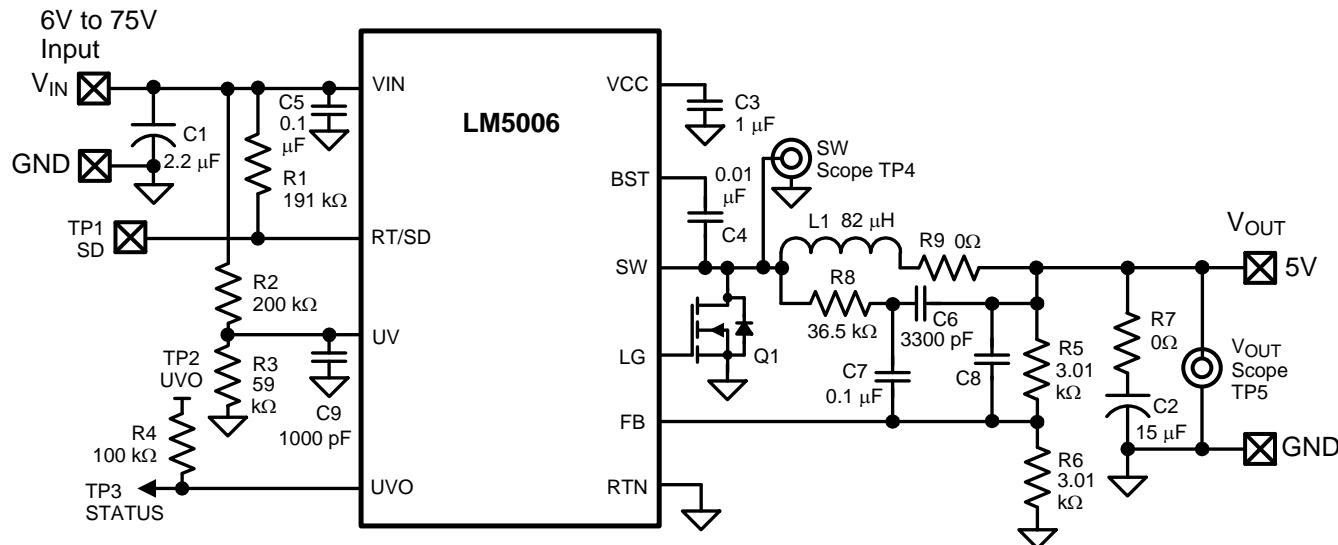


Figure 1. Complete Evaluation Board Schematic (As Supplied)

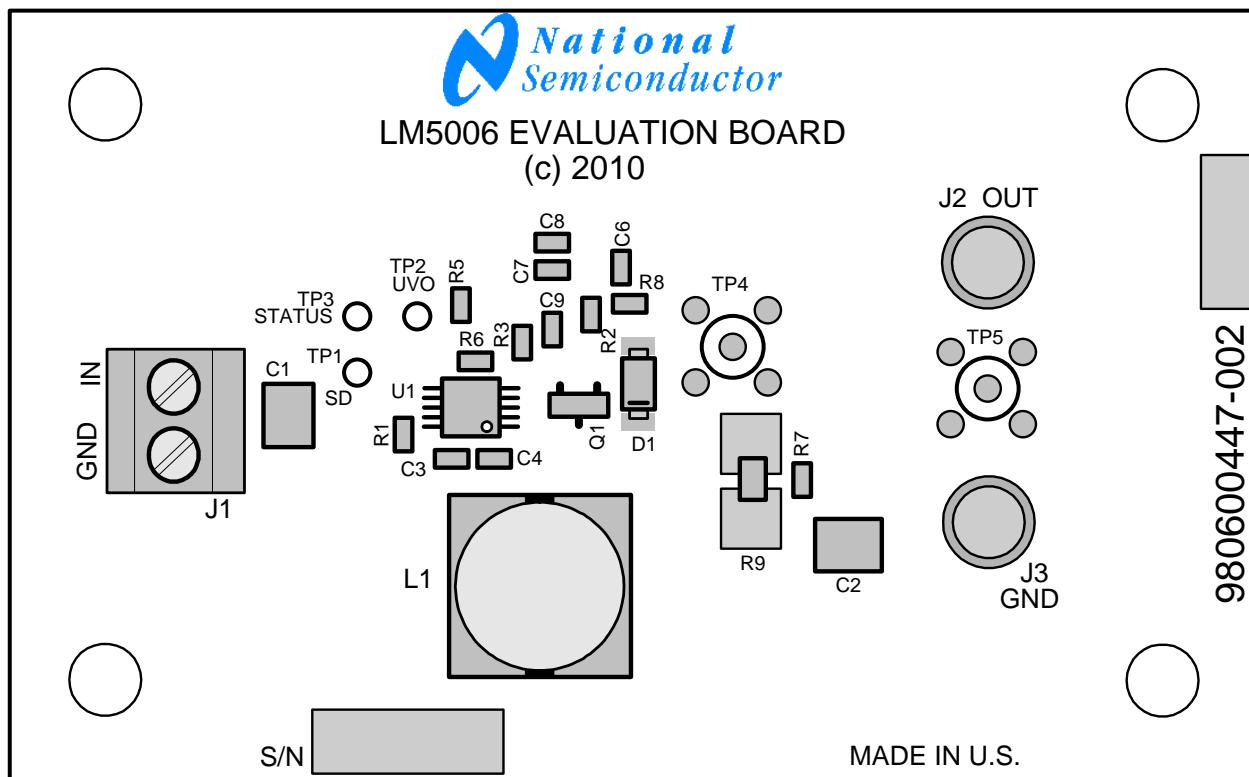
### 4 Board Layout and Probing

Figure 2 shows the placement of the circuit components. The following should be kept in mind when the board is powered:

- When operating at high input voltage and high load current, forced air flow may be necessary.
- The LM5006 may be hot to the touch when operating at high input voltage and high load current.
- Use CAUTION when probing the circuit at high input voltages to prevent injury, as well as possible damage to the circuit.
- At maximum load current, the wire size and length used to connect the load becomes important. Ensure there is not a significant drop in the wires between this evaluation board and the load.

### 5 Board Connection/Start-up

The input connections are made to the J1 connector. The load is connected to the J2 (OUT) and J3 (GND) terminals. Ensure the wires are adequately sized for the intended load current. Before start-up a voltmeter should be connected to the input terminals, and to the output terminals. The load current should be monitored with an ammeter or a current probe. It is recommended that the input voltage be increased gradually to 6V, at which time the output voltage should be 5V. If the output voltage is correct with 6V at VIN, then increase the input voltage as desired and proceed with evaluating the circuit. DO NOT EXCEED 75V AT VIN.



**Figure 2. Evaluation Board - Top Side**

## 6 Output Ripple Control

The LM5006 requires a minimum of 25 mVp-p ripple at the FB pin, in phase with the switching waveform at the SW pin, for proper operation. The required ripple can be supplied from ripple at  $V_{OUT}$ , through the feedback resistors as described in Option A.. Option B and Option C provide lower output ripple with one or two additional components.

### 6.1 Option A: Lowest Cost Configuration

In this configuration, [Figure 3](#), R7 is installed in series with the output capacitance (C2). Since  $\geq 25$  mVp-p are required at the FB pin, R7 must be chosen to generate  $\geq 50$  mVp-p at  $V_{OUT}$ , knowing that the minimum ripple current in this circuit is  $\approx 51$  mA $p$ -p at minimum  $V_{IN}$ . Using 1 $\Omega$  for R7, the ripple at  $V_{OUT}$  ranges from  $\approx 51$  mVp-p to  $\approx 280$  mVp-p over the input voltage range. If the application can accept this ripple level, this is the most economical solution. See [Figure 11](#). R8, C6, C7, and C8 are not used in this configuration.

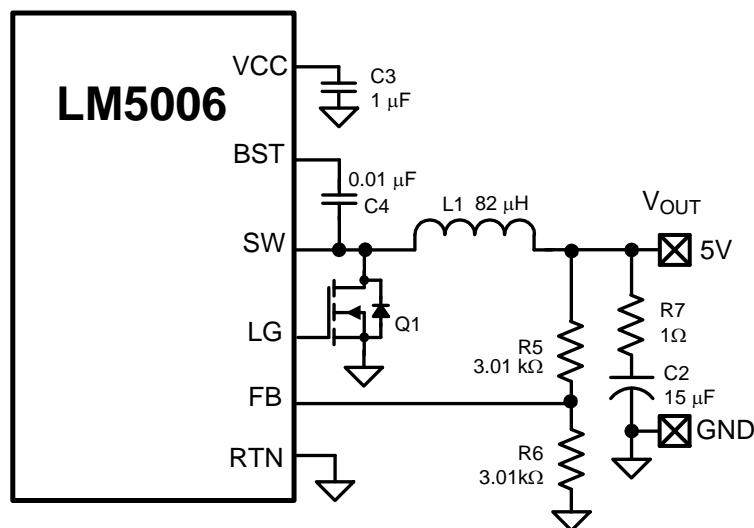


Figure 3. Lowest Cost Configuration

## 6.2 Option B: Reduced Ripple Configuration

This configuration, [Figure 4](#), generates less ripple at  $V_{OUT}$  than Option A, by the addition of one capacitor (C8) across R5.

Since the output ripple is passed by C8 to the FB pin with little or no attenuation, R7 can be reduced so the minimum ripple at  $V_{OUT}$  is  $\approx 25$  mVp-p. The minimum value for  $C_{ff}$  is calculated from:

$$C8 \geq \frac{3 \times t_{ON(max)}}{(R5//R6)} \quad (2)$$

where:

$t_{ON(max)}$  is the maximum on-time (at minimum  $V_{IN}$ )

$R5//R6$  is the parallel equivalent of the feedback resistors

The ripple at  $V_{OUT}$  ranges from 28 mVp-p to 159 mVp-p over the input voltage range. See [Figure 11](#).

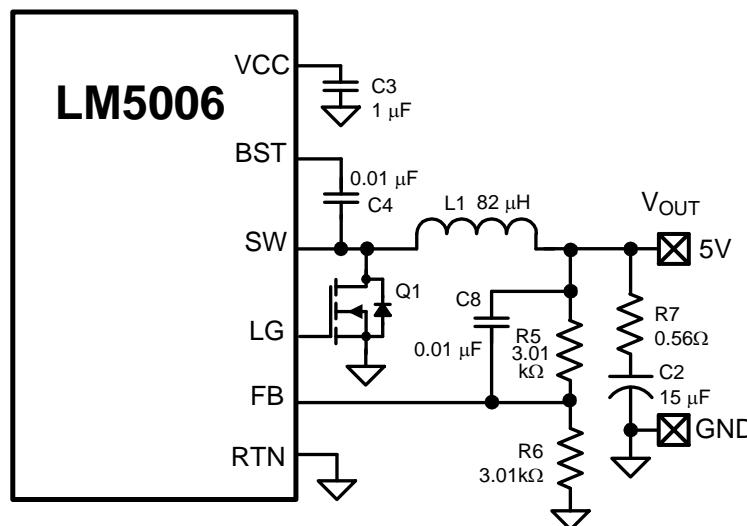


Figure 4. Reduced Ripple Configuration

### 6.3 Option C: Minimum Ripple Configuration

To obtain minimum ripple at  $V_{OUT}$ , Figure 5, R7 is set to  $0\Omega$ , and R8, C6, and C7 are added to generate the required ripple for the FB pin. In this configuration, the output ripple is determined primarily by the characteristics of the output capacitance and the inductor's ripple current. See Figure 11.

The ripple voltage required by the FB pin is generated by R8, and C6 since the SW pin switches from  $-0.1V$  to  $V_{IN}$ , and the right end of C6 is a virtual ground. The values for R8 and C6 are chosen to generate a 30-100 mVp-p triangle waveform at their junction. That triangle wave is then coupled to the FB pin through C7. The following procedure is used to calculate values for R8, C6 and C7:

1) Calculate the voltage  $V_A$ :

$$V_A = V_{OUT} - (V_{SW} \times (1 - (V_{OUT}/V_{IN}))) \quad (3)$$

where:

$V_{SW}$  is the absolute value of the voltage at the SW pin during the off-time (typically  $0.1V$  with Q1)

$V_{IN}$  is the minimum input voltage

For this circuit,  $V_A$  calculates to  $4.98V$ . This is the approximate DC voltage at the R8/C6 junction, and is used in the next equation.

2) Calculate the  $R8 \times C6$  product:

$$R8 \times C6 = \frac{(V_{IN} - V_A) \times t_{ON}}{\Delta V} \quad (4)$$

where:

$t_{ON}$  is the maximum on-time

$V_{IN}$  is the minimum input voltage

$\Delta V$  is the desired ripple amplitude at the R8/C6 junction,  $40\text{ mVp-p}$  for this example

$$R8 \times C6 = \frac{(6V - 4.98V) \times 4.38\text{ }\mu\text{s}}{0.04} = 1.12 \times 10^{-4} \quad (5)$$

R8 and C6 are then chosen from standard value components to satisfy the above product. Typically C6 is  $3000$  to  $10000\text{ pF}$ , and R8 is  $10\text{ k}\Omega$  to  $300\text{ k}\Omega$ . C7 is chosen large compared to C6, typically  $0.1\text{ }\mu\text{F}$ . The ripple at  $V_{OUT}$  is typically less than  $10\text{ mVp-p}$ . See Figure 11.

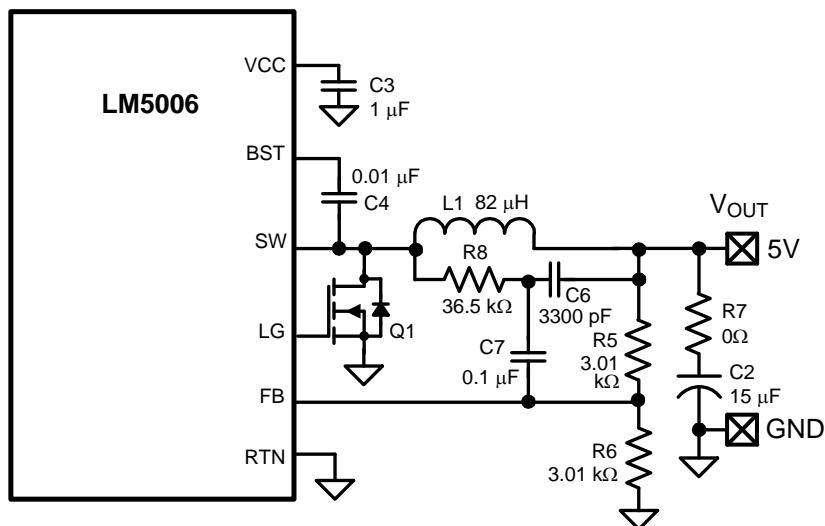


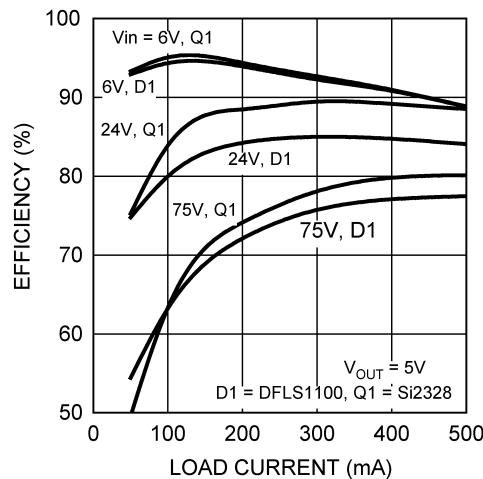
Figure 5. Minimum Output Ripple Configuration

## 7 LG (Low Side Gate) Output

As supplied, this evaluation board employs synchronous rectification by using an N-Channel MOSFET (Q1) in place of a more traditional flyback diode. This board accepts any device in a SOT-23 package, such as a Vishay Si2328. The LG output pin switches between approximately 7.5V (the VCC voltage) and ground. The LG output is capable of sourcing 250 mA, and sinking 300 mA. An external gate driver is not needed if the selected MOSFET has a total gate charge of less than 10 nC.

Use of a synchronous rectifier generally results in higher circuit efficiency due to the lower voltage drop across the MOSFET as compared to a diode. See [Figure 6](#). Another advantage of using a synchronous rectifier is that the circuit remains in continuous conduction mode, providing a relatively constant switching frequency, for all values of load current, including zero. If a flyback diode is used, the switching frequency decreases significantly at low values of load current when the circuit changes to discontinuous conduction mode.

If a flyback diode is preferred over a synchronous rectifier, remove Q1 and install a diode at the pads labeled D1. This board accepts devices such as the DFLS1100 from Diodes Inc.



**Figure 6. Efficiency Comparison at 200 kHz**

## 8 Under-Voltage Detector

The Under Voltage Detector can be used to monitor the input voltage, or any other system voltage as long as the voltage at the UV pin does not exceed its maximum rating. On this evaluation board the input voltage is monitored via resistors R2 and R3.

An appropriate pull-up voltage less than 10 volts must be connected to test point TP2-UVO on this evaluation board. R4 is the pull-up resistor for the UVO output. The under-voltage status can then be monitored at the TP3-Status test point.

On this evaluation board the UVO output switches low when the input voltage exceeds 12V, and it switches high when the input voltage is less than 11V. If it is desired to change the thresholds, the equations for determining the resistor values are:

$$R2 = \frac{V_{UVH} - V_{UVL}}{5 \mu A} = \frac{V_{UV(HYS)}}{5 \mu A} \quad (6)$$

$$R3 = \frac{R2 \times 2.5V}{V_{UVL} - 2.5V} \quad (7)$$

Where:

$V_{UVH}$  is the upper threshold at VIN

$V_{UVL}$  is the lower threshold. The threshold at the UV pin is 2.5V.

The UVO output is high when the VCC voltage is below its UVLO threshold, or when the LM5006 is shutdown by grounding the TP1-SD test point, regardless of the voltage at the UV pin.

## 9 Monitor the Inductor Current

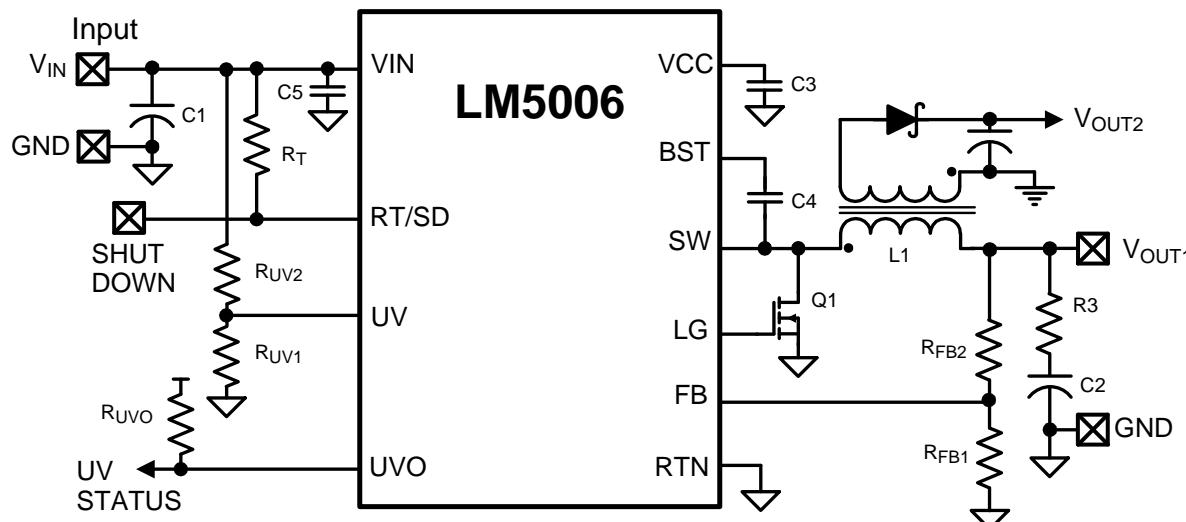
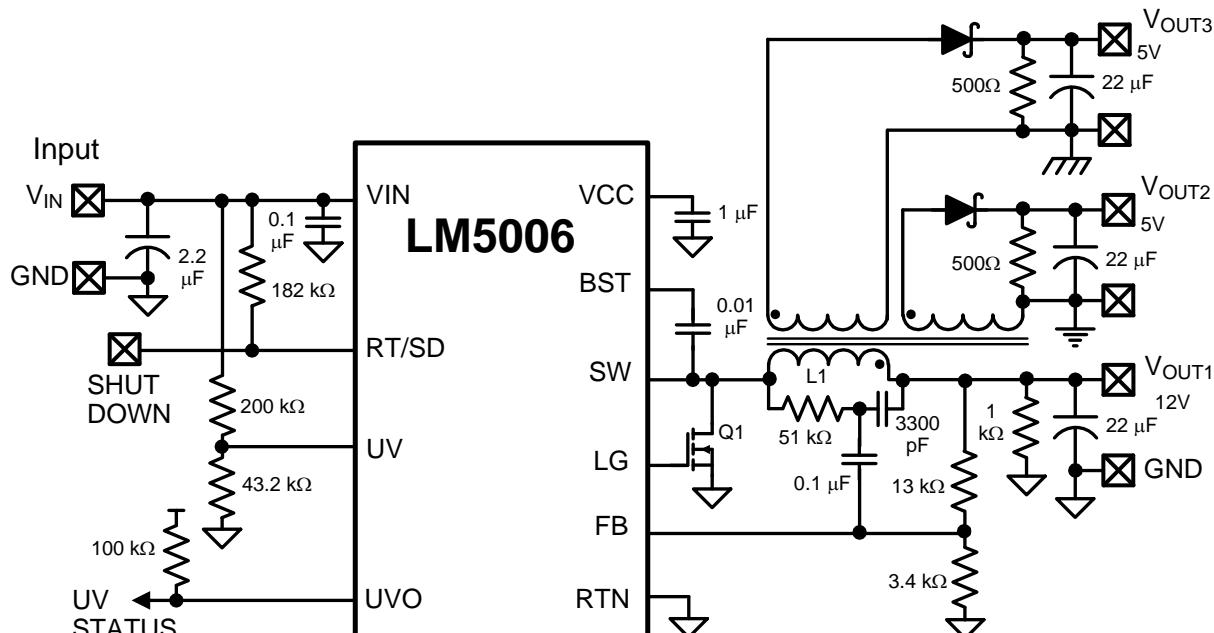
The inductor's current can be monitored or viewed on a scope with a current probe. Remove R9, and install an appropriate current loop across the two large pads where R9 was located. In this way the inductor's ripple current and peak current can be accurately determined.

## 10 Multiple Outputs

Multiple outputs can be produced by replacing the inductor (L1) with a transformer, and using a MOSFET (Q1) for synchronous rectification. The synchronous rectification is required to ensure the circuit is in continuous conduction mode at all values of the main output's load current. This ensures the secondary output voltages are correct at all times.

In [Figure 7](#), a second isolated output is provided at  $V_{OUT2}$ . Its regulation depends on the relative output voltages, current levels at the both outputs, and the design of the transformer L1. The two outputs can be isolated, or share a common ground.

[Figure 8](#) shows a circuit that provides a regulated 12V output, and two secondary 5V outputs.  $V_{OUT2}$  and  $V_{OUT3}$  can be isolated from  $V_{OUT1}$  and from each other, or share ground connections, depending on the application.


**Figure 7. Generate a Secondary Output**

**Figure 8. Generate Three Outputs**

## 11 Scope Probe Adapters

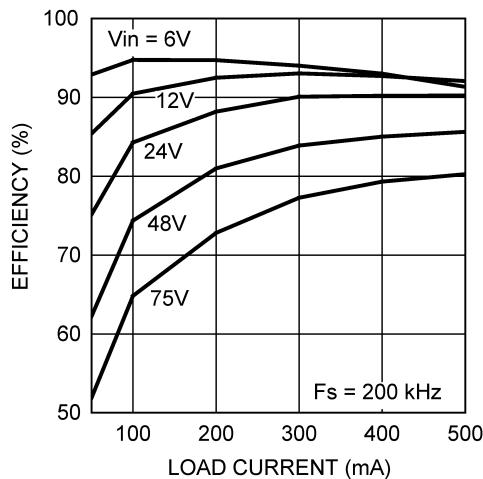
Scope probe adapters are provided on this evaluation board for monitoring the waveform at the SW pin, and at the circuit's output ( $V_{OUT}$ ), without using the probe's ground lead which can pick up noise from the switching waveforms.

## 12 Bill of Materials

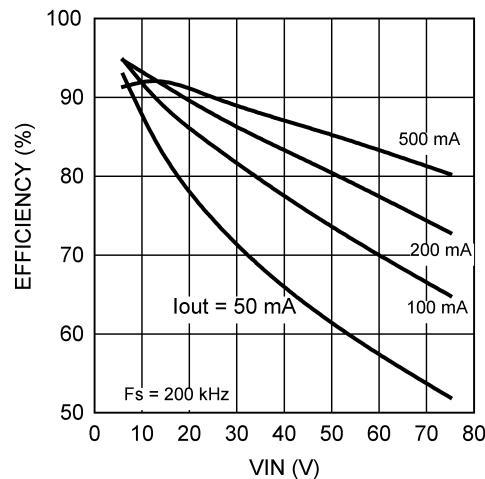
**Table 1. Bill of Materials**

Item	Description	Mfg., Part Number	Package	Value
C1	Ceramic Capacitor	TDK C3225X7R2A225M	1210	2.2 $\mu$ F, 100V
C2	Ceramic Capacitor	TDK C3225X7R1C156M	1210	15 $\mu$ F, 16V
C3	Ceramic Capacitor	TDK C1608X7R1C105K	0603	1 $\mu$ F, 16V
C4	Ceramic Capacitor	TDK C1608X7R2A103K	0603	0.01 $\mu$ F, 100V
C5	Ceramic Capacitor	TDK C2012X7R2A104M	0805	0.1 $\mu$ F, 100V
C6	Ceramic Capacitor	TDK C1608X7R2A332K	0603	3300 pF, 100V
C7	Ceramic Capacitor	TDK C2012X7R2A104M	0805	0.1 $\mu$ F, 100V
C8	Unpopulated			
C9	Ceramic Capacitor	TDK C1608X7R2A102K	0805	1000 pF, 100V
L1	Inductor	Coiltronics DR74-820-R or Wurth Electronics 744771182		82 $\mu$ H, 1A
Q1	N-Channel MOSFET	Vishay Si2328DS	SOT-23	100V, 1.5A
R1	Resistor	Vishay CRCW0603191KF	0603	191k $\Omega$
R2	Resistor	Vishay CRCW0603200KF	0603	200k $\Omega$
R3	Resistor	Vishay CRCW060359KOF	0603	59 k $\Omega$
R4	Resistor	Vishay CRCW0603100KF	0603	100 k $\Omega$
R5	Resistor	Vishay CRCW06033KO1F	0603	3.01 k $\Omega$
R6	Resistor	Vishay CRCW06033KO1F	0603	3.01 k $\Omega$
R7	Resistor	Vishay CRCW06030000Z	0603	0 $\Omega$ jumper
R8	Resistor	Vishay CRCW060336K5F	0603	36.5 k $\Omega$
R9	Resistor	Vishay CRCW06030000Z	0603	0 $\Omega$ jumper
U1	Switching Regulator	LM5006	VSSOP-10	

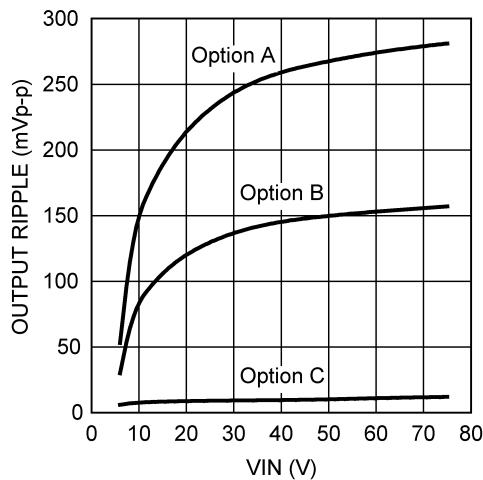
## 13 Circuit Performance



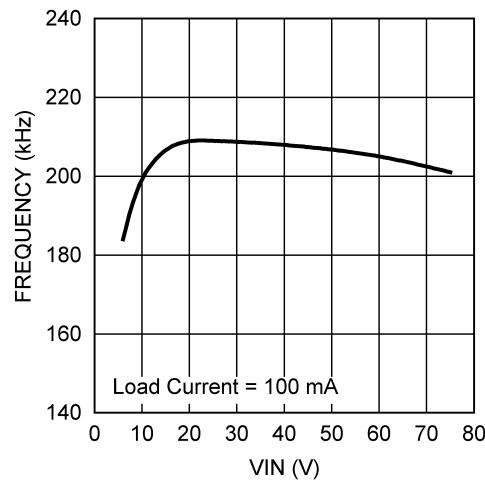
**Figure 9. Efficiency vs Load Current**



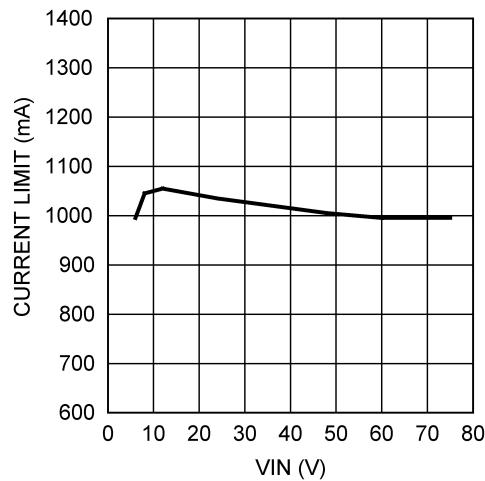
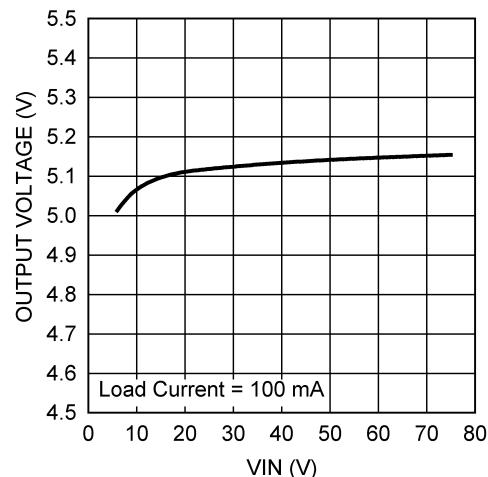
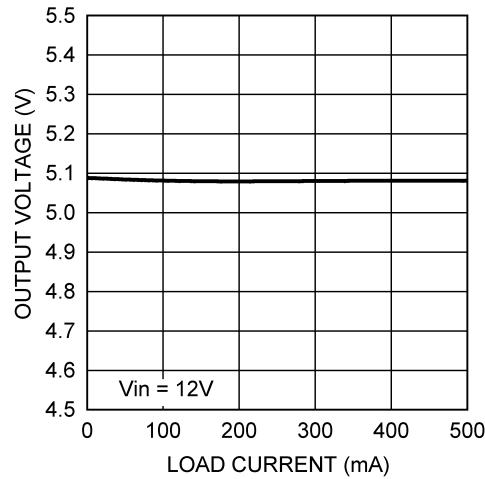
**Figure 10. Efficiency vs Input Voltage**



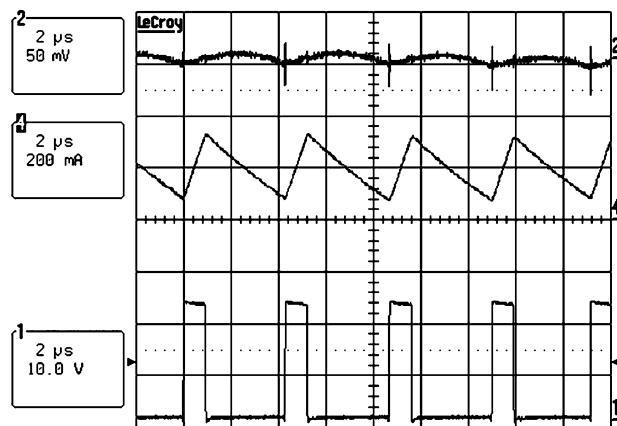
**Figure 11. Output Voltage Ripple**



**Figure 12. Switching Frequency vs. Input Voltage**


**Figure 13. Current Limit vs Input Voltage**

**Figure 14. Line Regulation**

**Figure 15. Load Regulation**

## 14 Typical Waveforms



Trace 1 = SW Pin  
 Trace 2 =  $V_{OUT}$   
 Trace 4 = Inductor Current  
 $V_{in} = 12V$ ,  $I_{out} = 200\text{ mA}$

Figure 16. Typical Waveforms

## 15 PC Board Layout

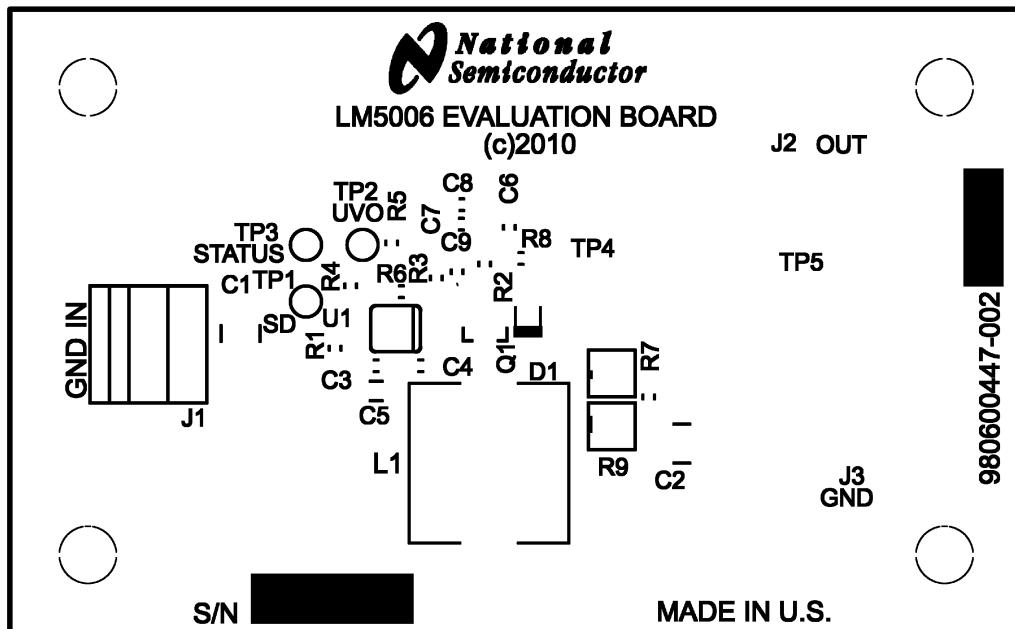


Figure 17. Board Silkscreen

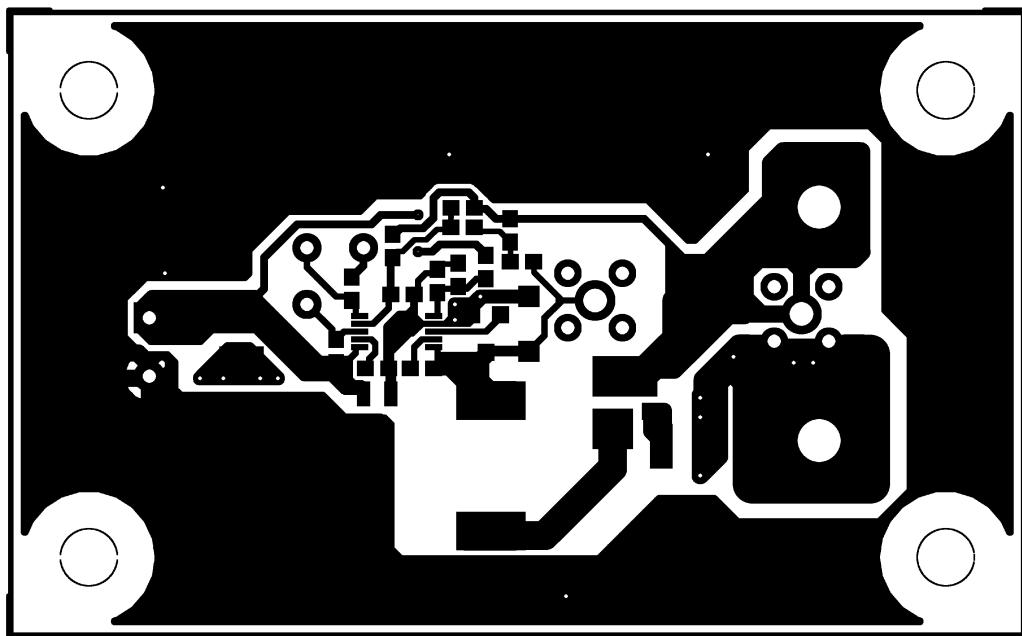


Figure 18. Board Top Layer

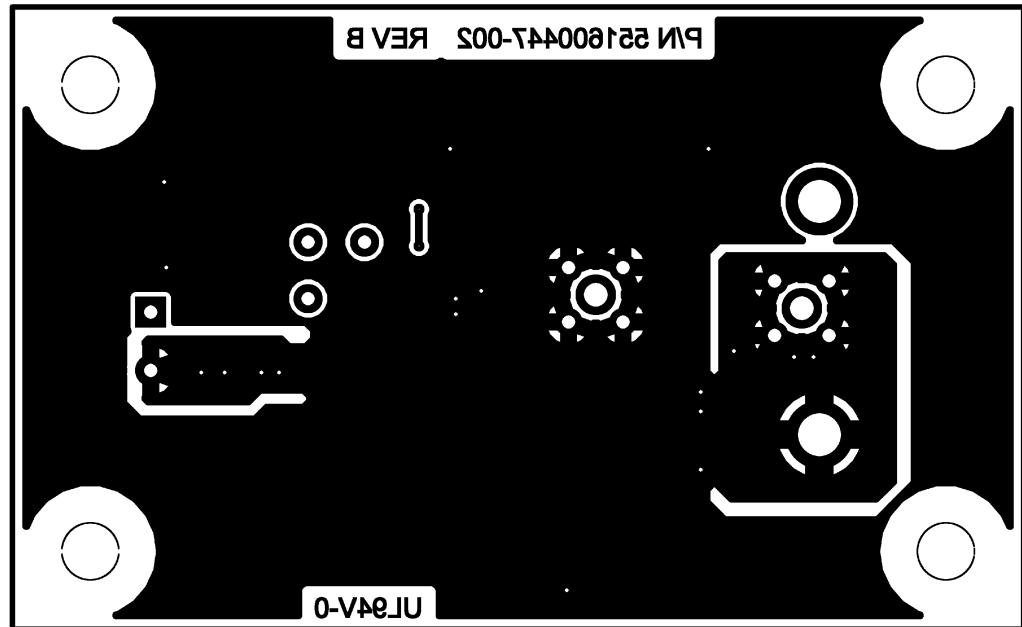


Figure 19. Board Bottom Layer (Viewed from Top)

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**Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.**

**User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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### 3 Regulatory Notices:

#### 3.1 United States

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**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

##### 3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

#### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

#### FCC Interference Statement for Class B EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### 3.2 Canada

##### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

#### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lsts/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lsts/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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2. 実験局の免許を取得後ご使用いただく。
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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lsts/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lsts/ti_ja/general/eStore/notice_02.page)  
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#### 3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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4 *EVM Use Restrictions and Warnings:*

- 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
- 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
- 4.3 *Safety-Related Warnings and Restrictions:*
- 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
- 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
- 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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