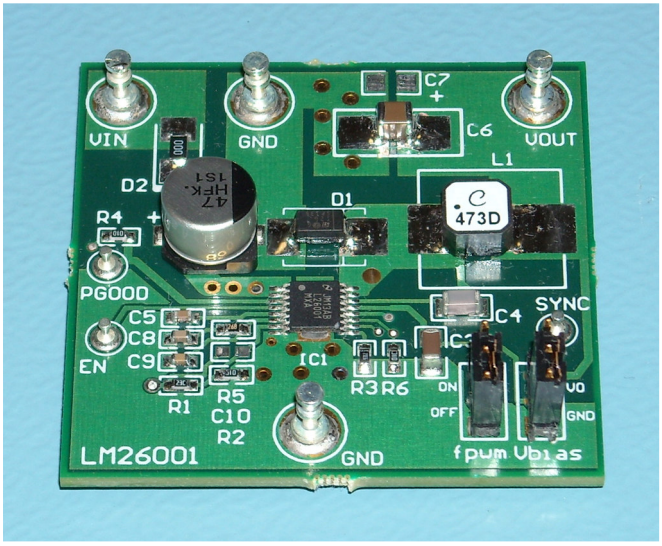
Non-Synchronous Buck with LM26001 – 3.3V @ 500mA

- Input 3.5 ..35V DC
- Output 3.3V @ 500mA
- Controller LM26001-Q1
- Free-Running switching frequency of 400 kHz, synchronized to 450 kHz
  All measurements were done with external synchronization to 450 kHz!
- Modified LM26001 Evaluation Board



1 Startup

The startup waveform is shown in Figure 1. The input voltage is set at 12V, with no load on the 3.3V output.

Channel C1: **12V Input voltage**
2V/div, 5ms/div

Channel C2: **3.3V Output voltage**
1V/div, 5ms/div

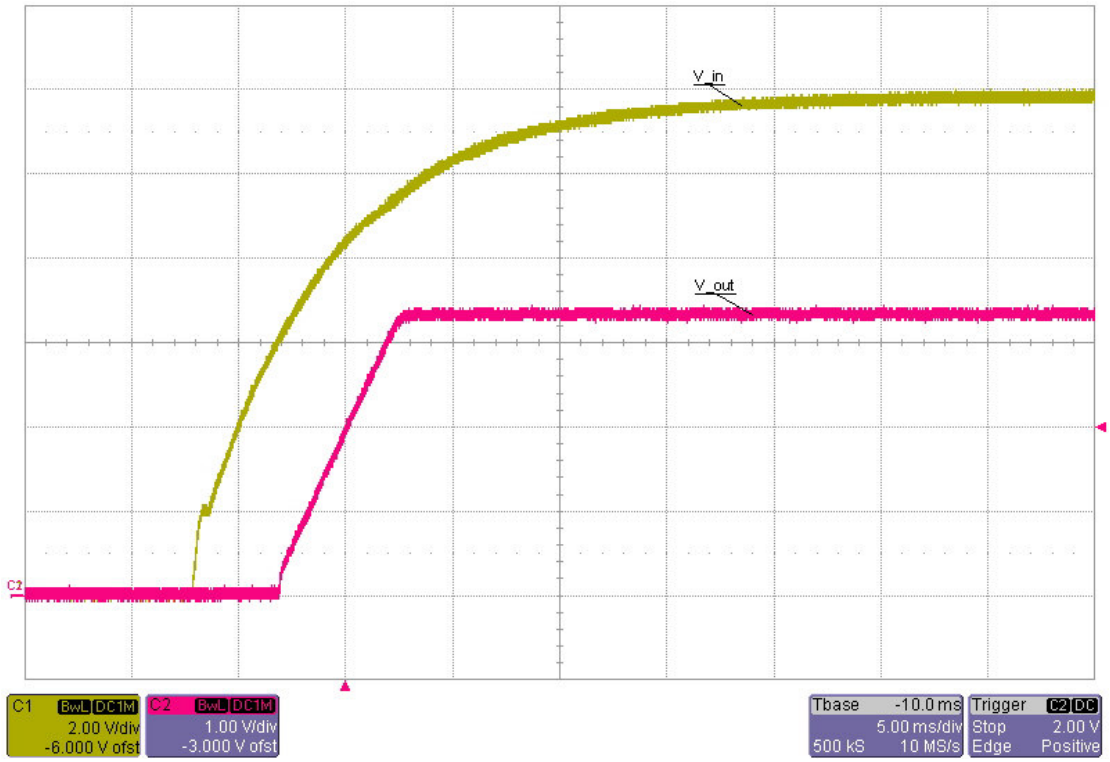


Figure 1

2 Shutdown

The shutdown waveform is shown in Figure 2. The input voltage is set at 12V with a 500mA load on the 3.3V output.

Channel C1: **12V Input voltage**
2V/div, 5ms/div

Channel C2: **3.3V Output voltage**
1V/div, 5ms/div

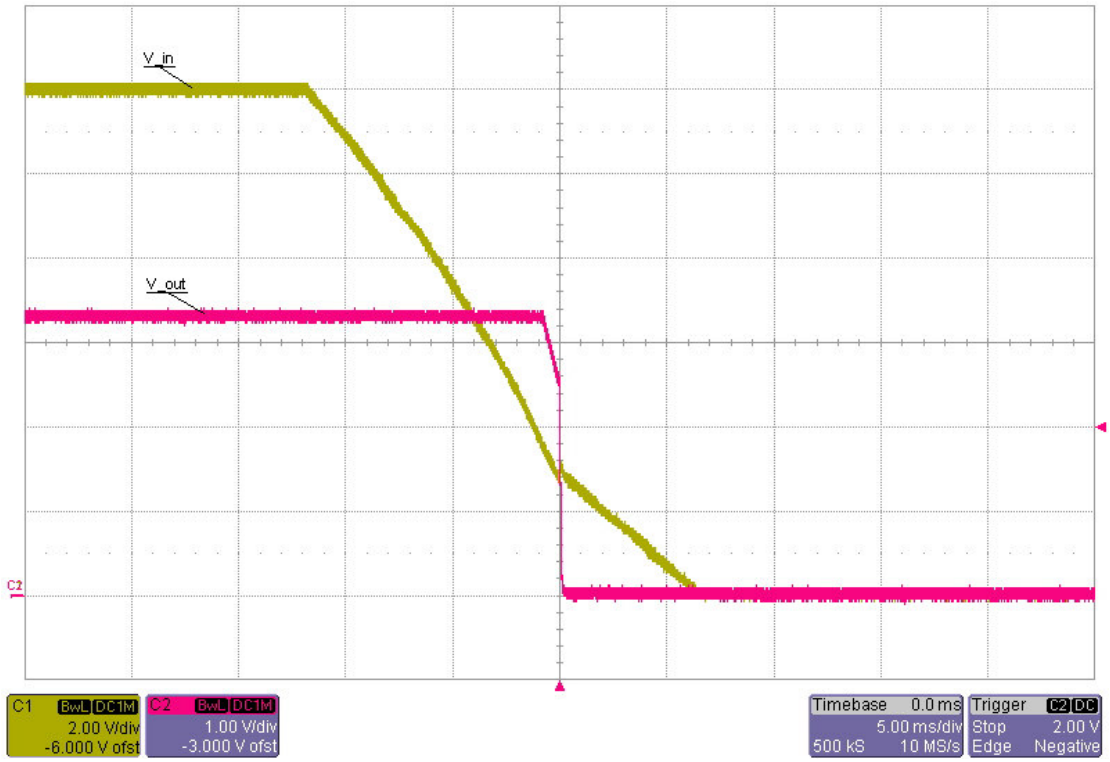


Figure 2

3 Efficiency

The efficiency and load regulation are shown in Figure 3 and Figure 4.

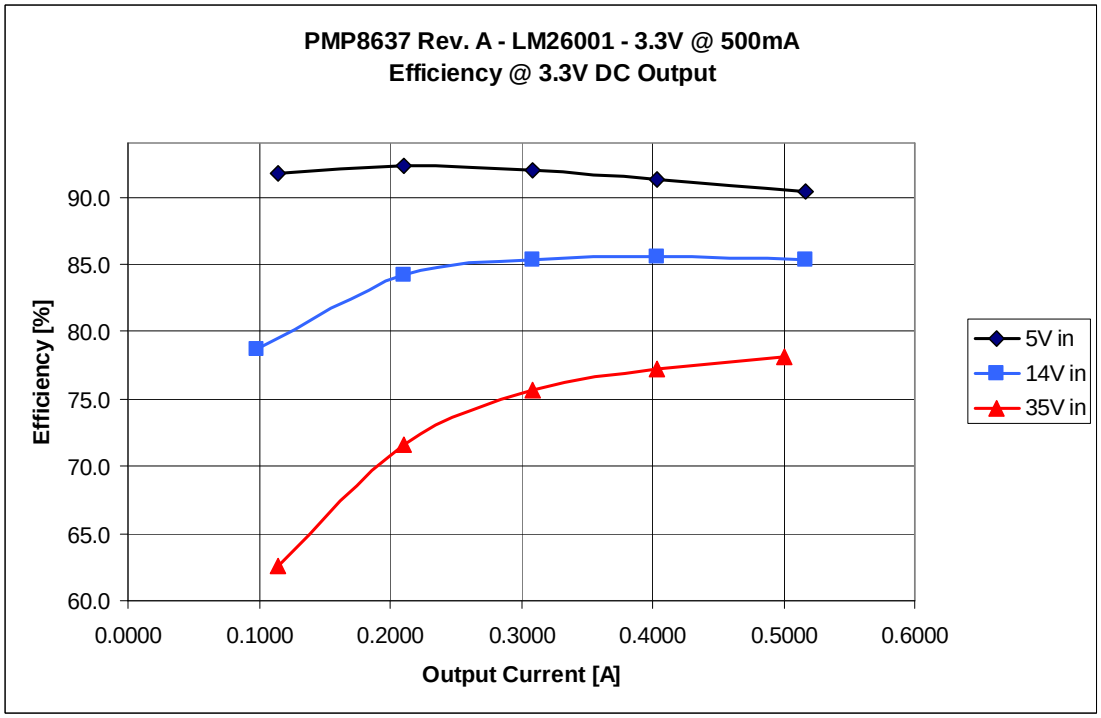


Figure 3

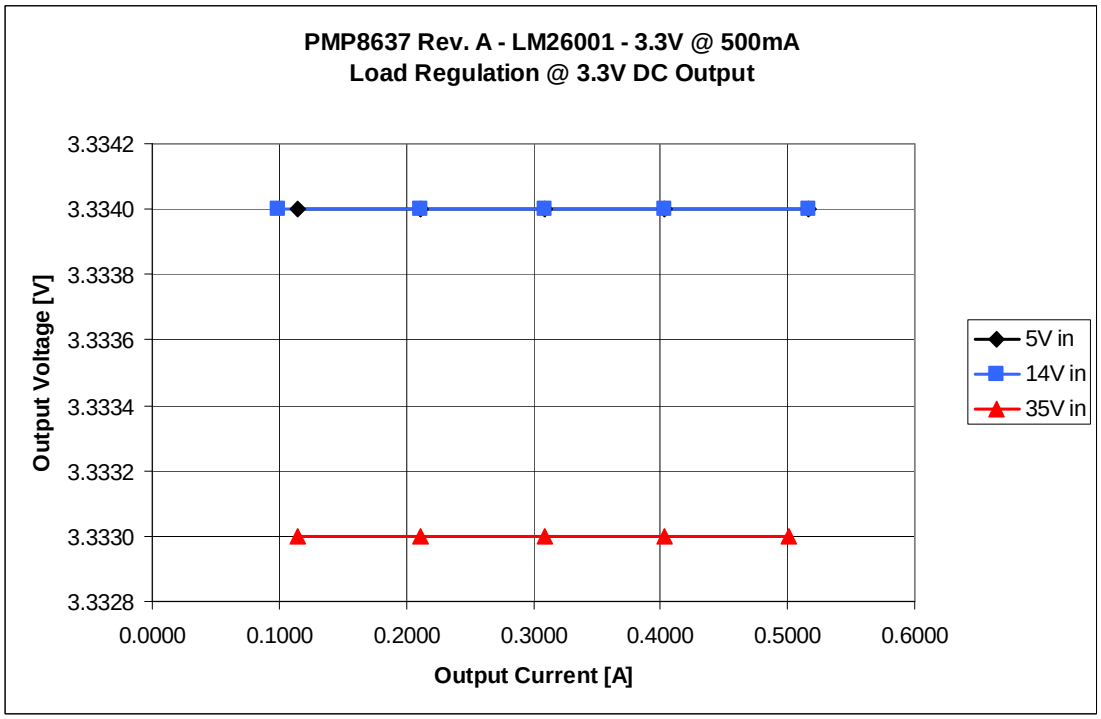


Figure 4

4 Load step

The response to a load step and a load dump for the 3.3V output at an input voltage of 14V is shown in Figure 5.

Channel C2: **Output voltage**, -84mV undershoot (-2.5%), 86mV overshoot (+2.6%)
50mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 250mA to 500mA and vice versa
200mA/div, 1ms/div

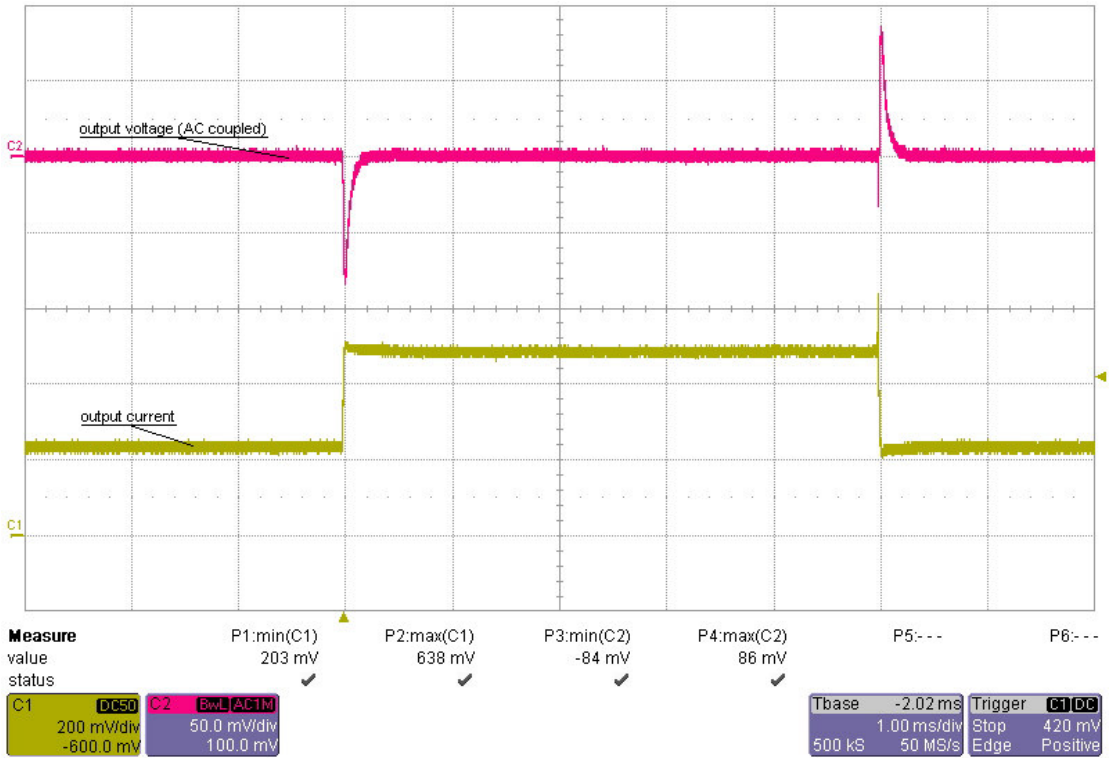


Figure 5

5 Frequency response

Figure 6 shows the loop response at 5V, 14V and 35V input voltage and a load of 500mA.

5V input

- 55 deg phase margin @ crossover frequency 18.1 kHz
- -17 db gain margin

14V input

- 65 deg phase margin @ crossover frequency 19.8 kHz
- -18 db gain margin

35V input

- 74 deg phase margin @ crossover frequency 19.2 kHz
- -16 db gain margin

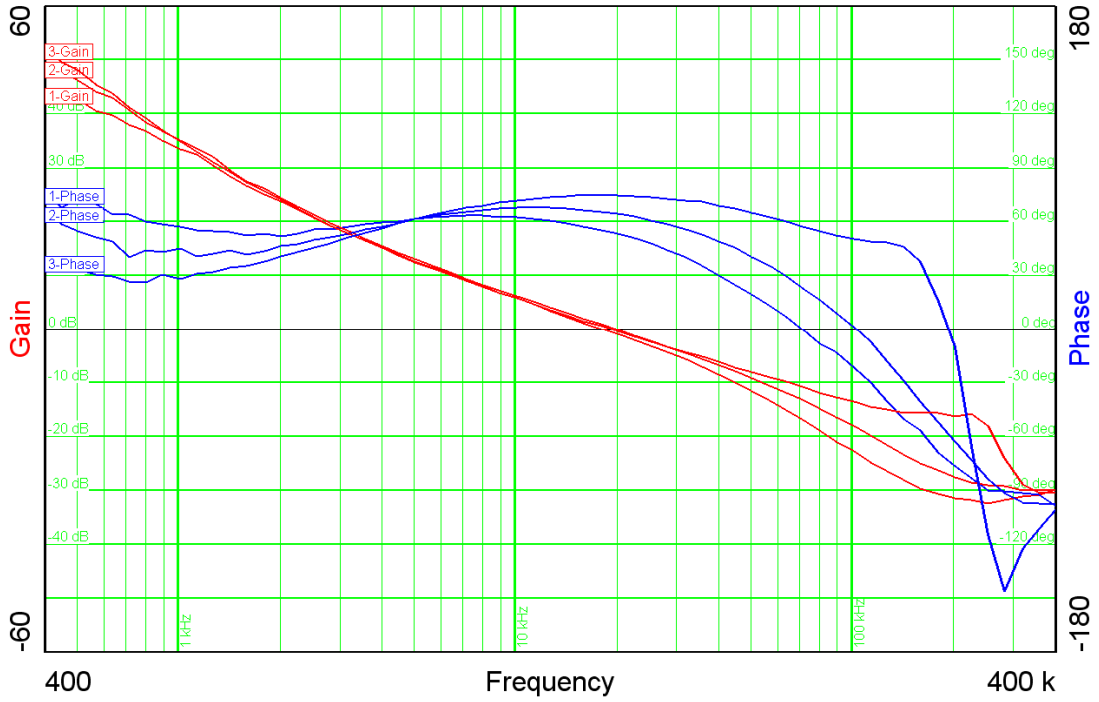


Figure 6

6 Switching Node

The drain-source voltage on the switching node is shown in Figure 7. The image was captured with 35V input and 500mA load.

Channel C2: **Drain-source voltage**, -2.0V minimum voltage, 37.0V maximum voltage 10V/div, 1us/div

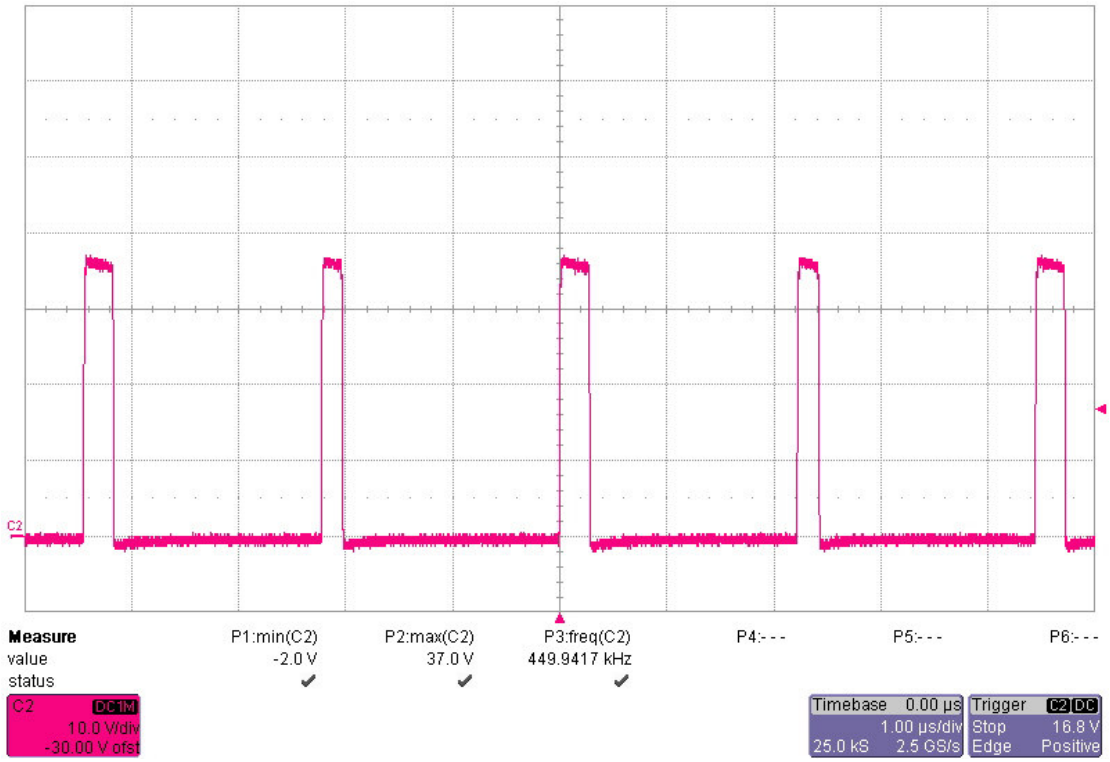


Figure 7

7 Thermal measurement

The thermal image (Figure 8) shows the circuit at an ambient temperature of 21 °C with an input voltage of 14V and a load of 500mA.

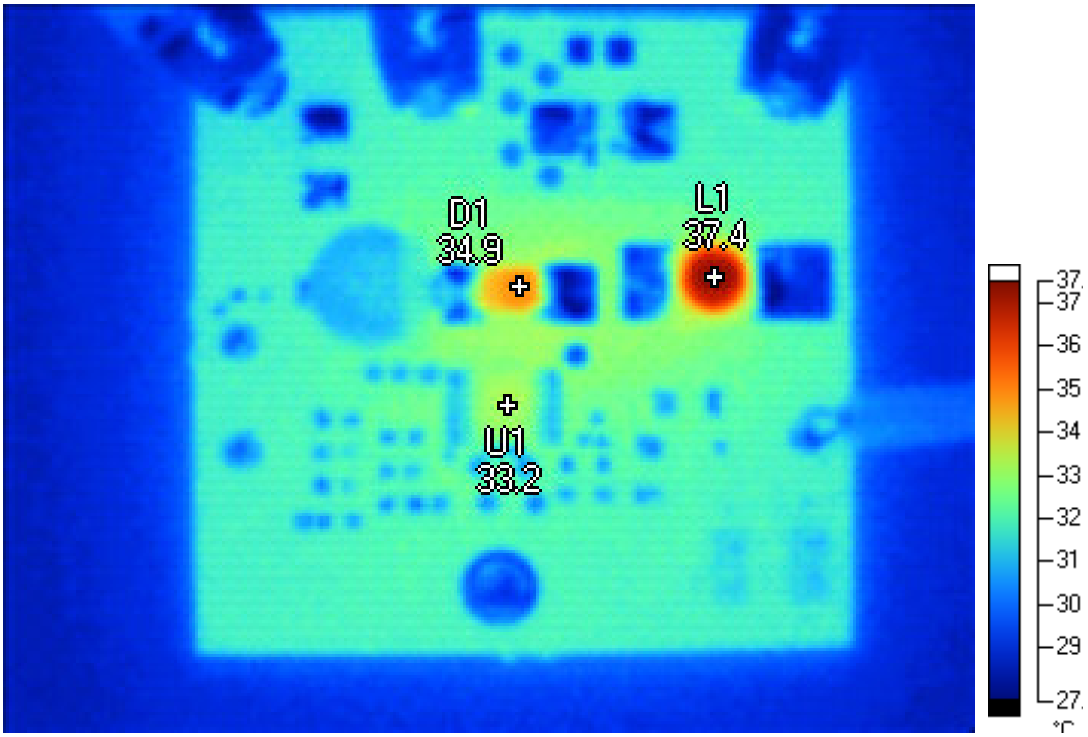


Figure 8

Markers

Label	Temperature	Emissivity	Background
D1	34.9 °C	0.95	21.0 °C
L1	37.4 °C	0.95	21.0 °C
U1	33.2 °C	0.95	21.0 °C

EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMER

For Feasibility Evaluation Only, in Laboratory/Development Environments. The EVM is not a complete product. It is intended solely for use for preliminary feasibility evaluation in laboratory / development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical / mechanical components, systems and subsystems. It should not be used as all or part of a production unit.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.

Certain Instructions. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output ranges are maintained at nominal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be indentified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of this agreement. This obligation shall apply whether Claims arise under the law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate TI components for possible use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (https:www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265