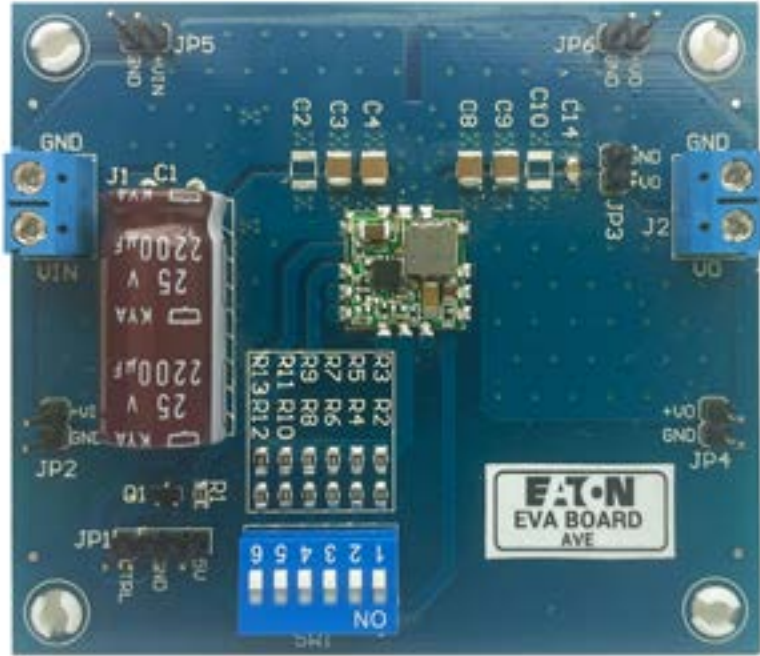


EPM12V2 Evaluation kit user guide



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Introduction

This document describes the operations of evaluation kits (EVK) concerning the Eaton’s EPM DC-DC non-isolated converter product. The EVK includes test points for all main points where probing is necessary for evaluation. The EVK supports many options for Eaton’s product configuration. Using these options, the user is allowed to test all desired electrical specifications. This guide describes the test configurations and typical equipment setup. The typical input and output waveforms are also presented.

Important notice

- Please read the product datasheet and EVK user guide before using the EVK.
- Please do not remove the product from the EVK.
- This product is an ESD sensitive component and should be tested in an ESD protected area.
- The EVK is designed to operate in clean and dust-free office or laboratory. The EVK should be protected from sunlight and sources of heat, and making sure air is flowing across the tool. Please keep it away from vibration or strong electromagnetic fields generated by electrical equipment.
- When connecting and disconnecting the power interface, please turn off the power supply to avoid accidental short circuits causing injury.
- The power connection must avoid reverse voltage application.
- During the test, the electrical rating should be kept within the range specified in the data sheet.

Description

This EVK supports user test electrical performance of Eaton’s DC-DC non-isolated converter part number EPM12V2-05R5-12R0P and EPM12V2-05R5-12R0N.

Figure 1 shows the EPM12V2 EVK (PN: EPM12V2-P-EVK, positive logic), (PN:EPM12V2-N-EVK, negative logic) and function outline. This EVK is made up of the input and output connectors and the DC/DC converter. There are six additional functions, output voltage trim function, voltage sense, remote on/off function, power good, synchronization, and sequencing.

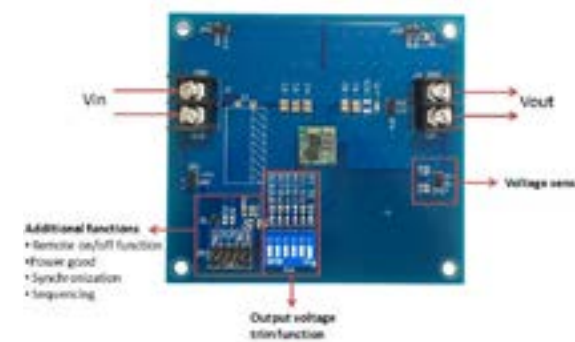


Figure 1. EPM12V2 EVK

Specifications

Table 1 shows the EPM12V2 EVK general performance specifications. The EPM12V2 EVK can deliver up to 12 A of output current and with a wide DC input. The modules can achieve high efficiency up to 91%, wide operation temperature from -40 °C to +90 °C, and has short circuit protection. Input range is from 3 V to 14.4 V, nominal input voltage is 12 V. Please refer to the product data sheet for the detailed specifications [EPM12V2 data sheet](#).

Table 1- General specifications

| | Parameter | Conditions | Minimum | Nominal | Maximum | Unit |
|--------|--------------------|--|---------|-------------------|---------|----------------|
| Input | Input voltage | | 3 | 12 | 14.4 | Vdc |
| | Input current | V _{in} =nom, no load | | 30 | | mA |
| | Start-up voltage | I _{out} =0% ~ 100% load | | 3 | | Vdc |
| Output | Voltage trim* | | 0.6 | | 5.5 | Vdc |
| | Minimum load | | 0 | | | % |
| | Output current | Full load | | | 12 | A |
| | Ripple and noise** | V _o < 1.2 V V _o ≥ 1.2 V | | 3% V _o | 50 | mVp-p mVp-p |

* The output voltage range is limited by V_{in}. (V_{out} ≤ V_{in} - 2 Vdc)

** Ripple & noise: Measured with 20 MHz bandwidth and 47 μF + 47 μF + 0.1 μF ceramic capacitor.

Test set-up

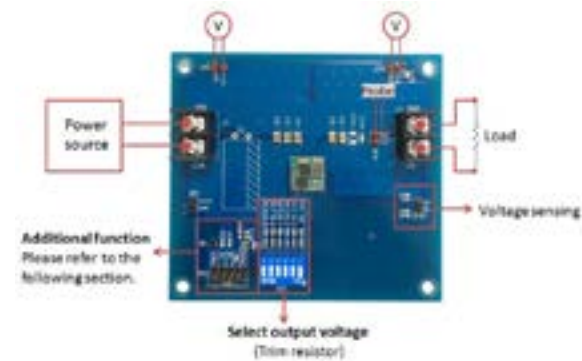


Figure 2: Test set-up example

Table 2- Pin configuration

| Connector | Function | Pin symbol | Description |
|-----------|--------------------------------|---------------------|--|
| J1 | Input terminal | VIN GND | Connect the VIN and GND terminals to the DC power source respectively. |
| J2 | Output terminal | VO GND | Connect the VO and GND terminals to the (electronic) load. |
| JP1/JP6 | Input voltage measuring point | +VIN GND | Connect the +VIN and GND terminals to the voltage meter. |
| JP2 | Functional terminal | SYNC | Synchronization can be done by using the external signal applied to the SYNC of the module. If synchronization is not being used, connect the SYNC to GND. |
| | | SEQ | The SEQ can be used when master-slave power-supply tracking is required. |
| | | PG | The Power Good signal indicates that the output voltage regulation is in the specification limits. |
| | | 5 V | For use with remote function, connect to a 5 V power supply |
| | | CTRL | Switch the module on or off through controlling CTRL (or Remote on/off) signal in positive logic or negative logic. |
| | GND | Ground. | |
| JP3 | Voltage sensing | VS+ VS- | VS+ and VS- are remote sense pins. VS+ and VS- are connected to the positive and negative terminal of the load or output respectively for voltage sensing. |
| JP4 | Output ripple measuring point | +VO GND | Connect the +VO and GND terminals to the probe with short ground lead. |
| JP5 | Output voltage measuring point | +VO GND | Connect the +VO and GND terminals to the voltage meter. |
| SW1 | Volatge trim selector | 1, 2, 3, 4, 5, 6 | Adjust the output voltage with trim resistors. There is a DIP switch with six choices for six voltages. |

Operation notes

Output voltage trim function

Using a resistor in parallel between Trim and SIG_GND (Figure 3) can adjust the output voltage of the converter. The following formula can calculate the trim resistor of the corresponding voltage.

$$R_{\text{trim}} (\text{k}\Omega) = \frac{12}{V_o - 0.6}$$

Refer to Table 3 for the basic values of the resistors and switch positions. Only one switch should be on at a time. Figure 4 is an example for trimming 5 V output voltage.

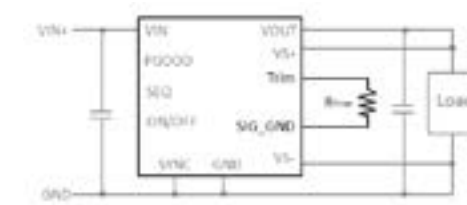


Figure 3: Voltage trim resistor diagram

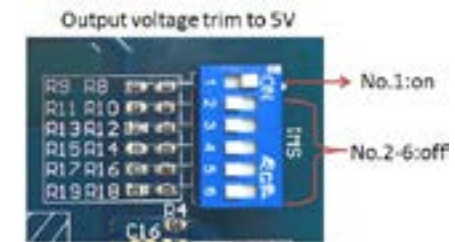


Figure 4: 5 V trimming output example

Table 3- Resistor value and switch position

| Output voltage | Calculated Rtrim | Option |
|----------------|------------------|-----------|
| 5 V | 2.7 kΩ | SW 1 : on |
| 3.3 V | 4.7 kΩ | SW 2 : on |
| 2.5 V | 6.2 kΩ | SW 3 : on |
| 1.8 V | 10 kΩ | SW 4 : on |
| 1.5 V | 13 kΩ | SW 5 : on |
| 1.2 V | 20 kΩ | SW 6 : on |

Voltage sensing

VS+ and VS- is the voltage sensing pin at the JP3 connector. VS+ and VS- are connected to the positive and negative terminal of the load respectively. This function makes the converter detect the voltage across the load without being disturbed by the impedance of the wires. The sense wire is not the main path of the system and carries a low current. It is recommended to use twisted wires for the VS+ and VS- wires or shielded cables to avoid noise and unwanted inductance. If voltage sensing is not needed, VS+ and VS- should connect to the positive and negative output terminals of the converter by using the zero-ohm resistor each.

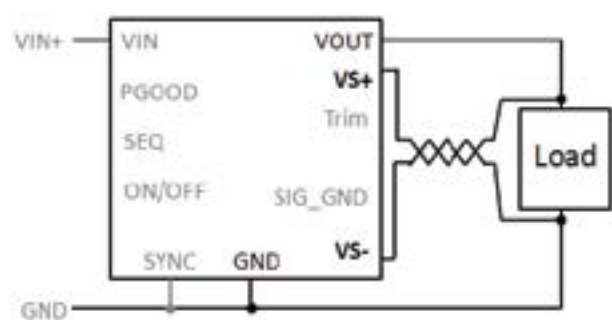


Figure 5: Voltage sense configuration

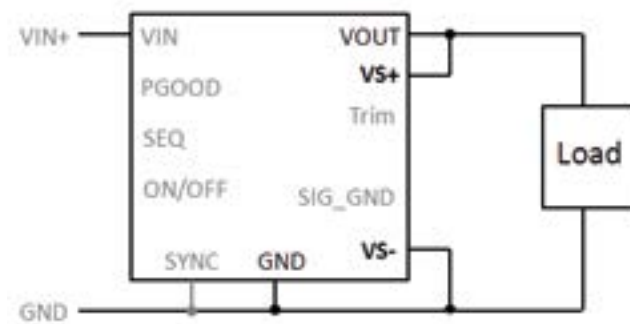


Figure 6: No voltage sense configuration

Remote on/off function

The EVK can switch the converter on or off by controlling the Remote ON/OFF signal in positive logic. If the status of ON/OFF is open or from 1.6 V to 5 V, the converter will turn on. Otherwise, if the status of ON/OFF is short to ground or from 0 V to 0.6 V, the converter will shut down.

The remote control circuit on EVK shows below. There are CTRL and 5 V pins at connector JP3. For example, when CTRL is high level, the converter will shut down. When CTRL is low level, the converter will turn on.

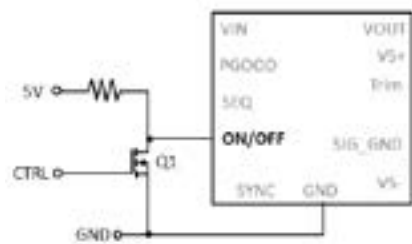


Figure 7: Remote on/off circuit diagram

Positive logic

Table 4- Remote on/off conditions

| Condition | CTRL | Q1 |
|-----------|------------|-----|
| DC-DC ON | Low level | Off |
| DC-DC OFF | High level | On |

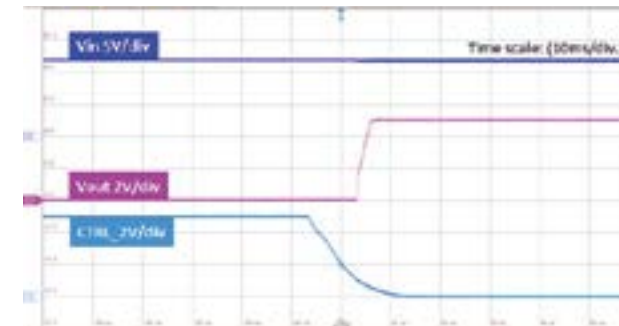


Figure 8: CNTL low level, DC-DC on

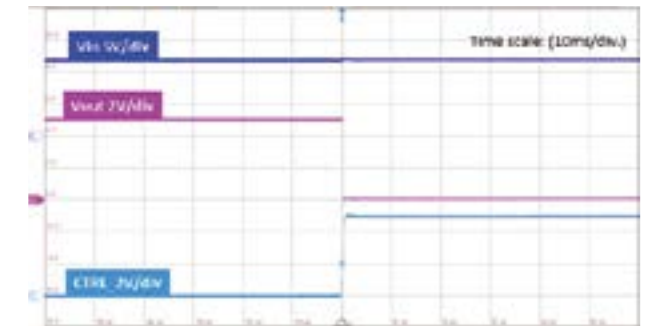


Figure 9: CNTL high level, DC-DC off

Negative logic

Table 5- Remote on/off conditions

| Condition | CTRL | Q1 |
|-----------|------------|-----|
| DC-DC ON | High level | On |
| DC-DC OFF | Low level | Off |

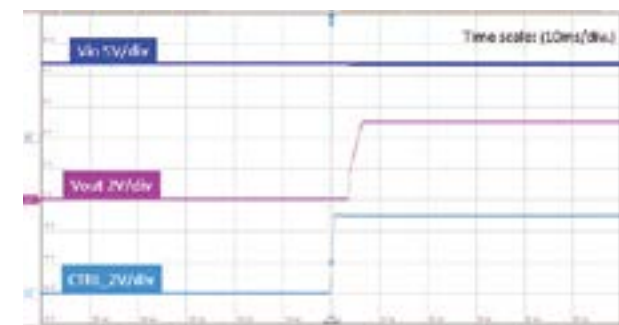


Figure 10: CNTL high level, DC-DC on

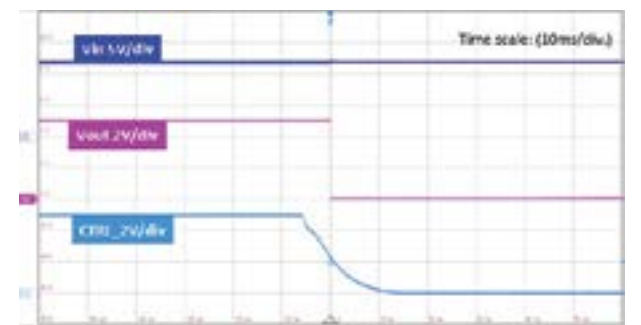


Figure 11: CNTL low level, DC-DC off

Synchronization

The frequency of EVK can be synchronized with an external signal. The external signal should be in the specified range and applied to the SYNC pin as shown in Figure 12. The converter will synchronize by the rising edge of the external signal. If the synchronization function is not needed, connect the SYNC pin to the ground.

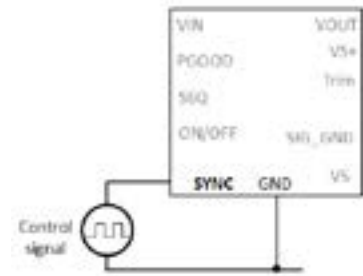


Figure 12: External signal to SYNC circuit diagram

Table 6- Synchronization general specifications

| Parameter | Minimum | Typical | Maximum | Unit |
|---------------------------------|---------|---------|---------|------|
| Synchronization frequency range | | 800 | 840 | kHz |
| High level input voltage | 2 | | | V |
| Low level input voltage | | 0.8 | | V |
| Input current SYNC | | 1 | | μA |

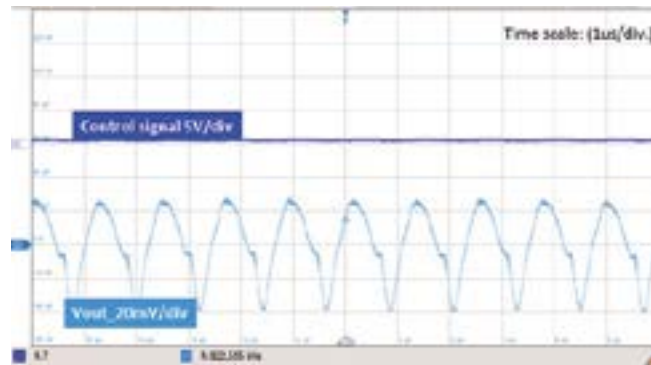


Figure 13:

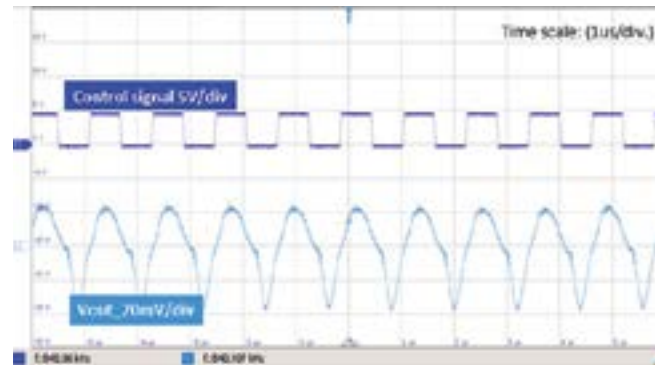


Figure 14:

Power good

The PGOOD signal can indicate the output voltage regulation is within the specification limits. This open-drain output goes low during over current, short-circuit, UVLO, overvoltage and under voltage, over temperature, or when the output is not regulated (such as a pre-bias output). The PGOOD should connect through a pull-up resistor to a source of 5 Vdc. The Power good design on EVK is shown in Figure 15.

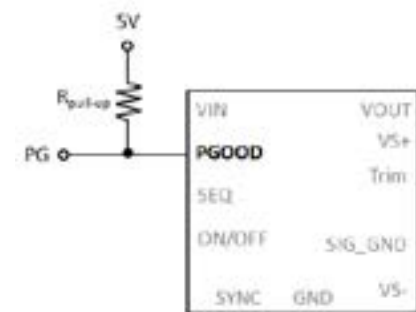


Figure 15: PGOOD circuit diagram

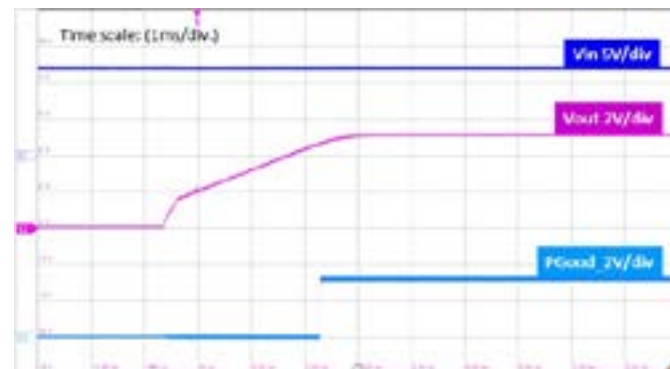


Figure 16: PGOOD curve

Output voltage sequencing

The sequencing feature can fulfill the end user to sequencing the output voltage and is achieved by dividing down the master's output voltage with a resistor network as shown in Figure 17. Rseq equals R5 on the evaluation board, and Rtrim equals R6.

When an analog voltage is applied to the SEQ pin, the output voltage tracks this voltage until the output reaches the set-point voltage. By connecting multiple modules, multiple modules can track their output voltages to the voltage applied on the SEQ pin. Besides, a small capacitor (suggested value is 100 pF) can be connected across the Rtrim. If there is no need for the sequencing feature, leave the SEQ pin open.

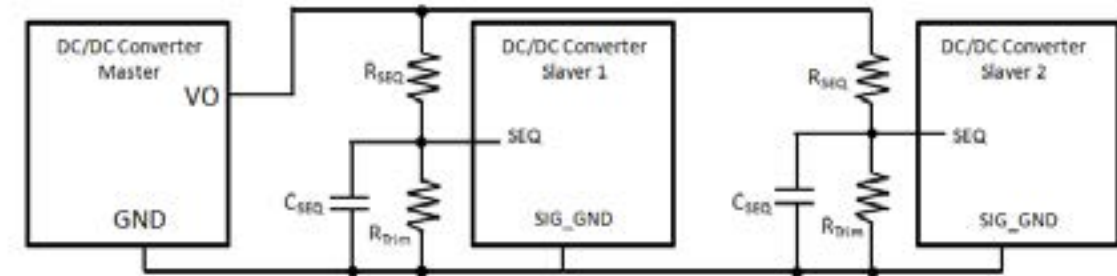


Figure 17: Sequencing circuit diagram

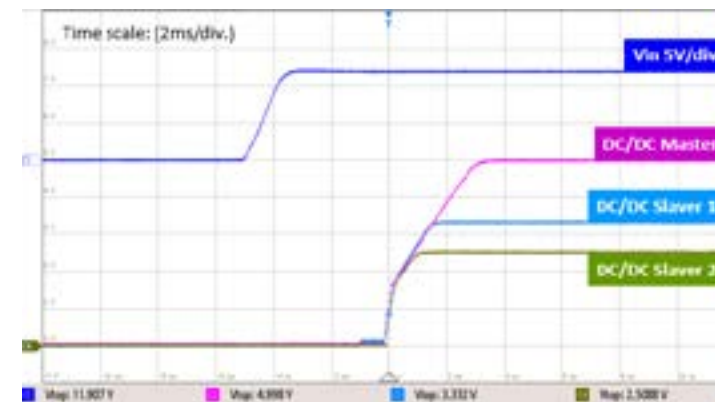


Figure 18: Sequencing curve

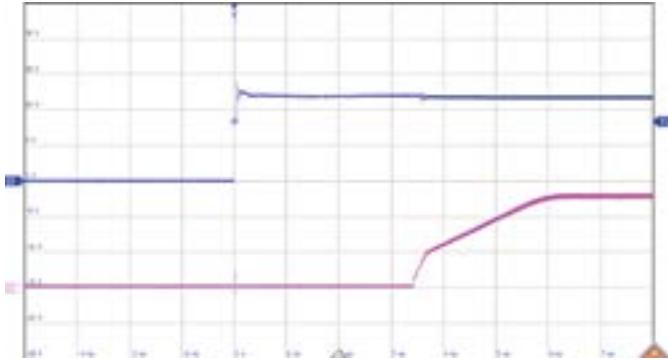
Test results

EVK set-up and operation wave form

Model number: EPM12V2 EVK

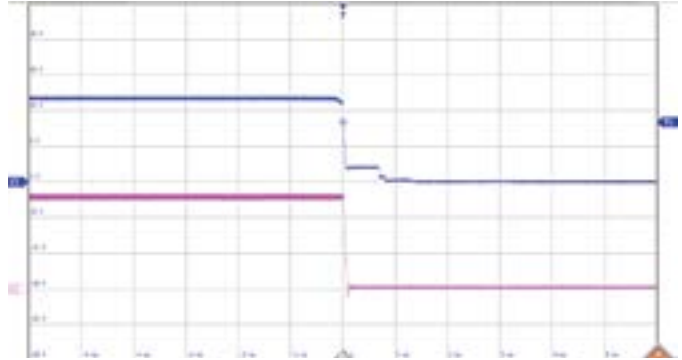
Conditions: $T_a = +25\text{ }^\circ\text{C}$, $V_{IN} = 12\text{ V}$, $V_O = 5\text{ V}$, $I_O = 12\text{ A}$ (full load). This ΔT plus ambient should remain below the specified maximum operating temperature for the module (please refer to the [EPM12V2 data sheet](#)).

Start-up



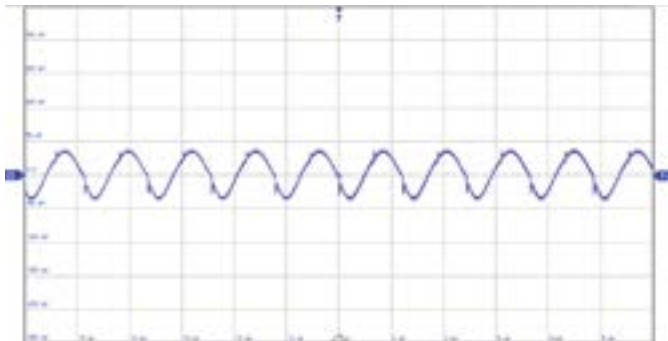
Ch1: Input voltage (5 V/div.) | Time scale: (1 ms/div.)
Ch2: Output voltage (2 V/div.)

Shut-down



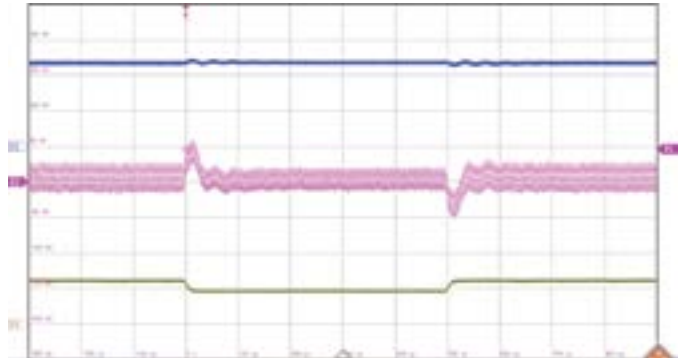
Ch1: Input voltage (5 V/div.) | Time scale: (1 ms/div.)
Ch2: Output voltage (2 V/div.)

Output ripple and noise



Ch1: Output voltage (50 mV/div.) | Time scale: (1 us/div.)

Transient response (75%-100% load)



Ch1: Input voltage (5 V/div.) | Ch4: Output current (10 A/div.)
Ch2: Output voltage (50 mV/div.) | Time scale: (100 us/div.)