

# **TPS2590 Hot Swap Controller Evaluation Module**

---



---



---

This user's guide describes the setup and operation of the TPS2590 evaluation module.

## **Contents**

1	Introduction .....	2
2	Description .....	2
	2.1 Applications .....	2
	2.2 Features .....	2
3	EVM Block Diagram .....	3
4	Schematic .....	4
5	Bill of Materials .....	5
6	EVM PCB Layout .....	6
7	Circuit Description .....	8
	7.1 Test Points .....	8
	7.2 Connectors .....	8
	7.3 Jumpers .....	8
	7.4 Switches .....	8
8	EVM Test Setup .....	9
	8.1 Test Equipment .....	9
	8.2 Equipment Supplied .....	9
	8.3 Recommended Test Setup .....	9
	8.4 Operation .....	10
9	Test Results .....	10

## **List of Figures**

1	TPS2590EVM Block Diagram .....	3
2	TPS2590EVM Schematic .....	4
3	Component Placement (Top View) .....	6
4	Board Layout (Top View) .....	6
5	Board Layout (Bottom View) .....	7
6	Component Placement (Bottom View) .....	7
7	Equipment Connections .....	9
8	Example Scope Trace .....	10

## **List of Tables**

1	TPS2590EVM Bill of Materials .....	5
2	Test Points .....	8
3	Connectors .....	8
4	Jumpers .....	8
5	EVM Configurations .....	9

## 1 Introduction

This user's guide describes the features of the TPS2590EVM. The TPS2590 schematic, printed-circuit board (PCB) layout, and bill of materials (BOM) are provided as well as a setup and getting started.

## 2 Description

The EVM is a 3- to 18-V module using the TPS2590 or TPS2591 hot swap controller with integrated MOSFET. At power on, the output is power limited to control inrush current and protect the MOSFET. On an overcurrent condition, the controller interrupts power to the load at high speed and signals load status. Operating current, fault current and fault timer settings are hardware programmable.

### 2.1 Applications

#### Server:

- Plug-in Circuit Boards
- RAID / Disk Drive

#### Telecom:

- ATCA
- Micro-ATCA

#### General Hot Plug

### 2.2 Features

- 3- to 20-V operation
- Controlled inrush current
- Fast circuit breaker control
- Hardware programmable
  - Operating current
  - Fault current
  - Fault timer to avoid nuisance tripping
  - Latch off or retry. TPS2590 is pin selectable
- LED status display
- A slide switch controls the ENABLE signal
- The area under the TPS2590 is copper pour with vias to the internal ground to take advantage of the power pad package
- On-board transorb for overvoltage input protection
- A common diode at the output prevents a negative spike if the load is removed while powered on
- Test points available to monitor circuit operation
- Design Calculator Tool (<http://www.ti.com/product/TPS2590/toolssoftware>)

### 3 EVM Block Diagram

Figure 1 shows the EVM block diagram.

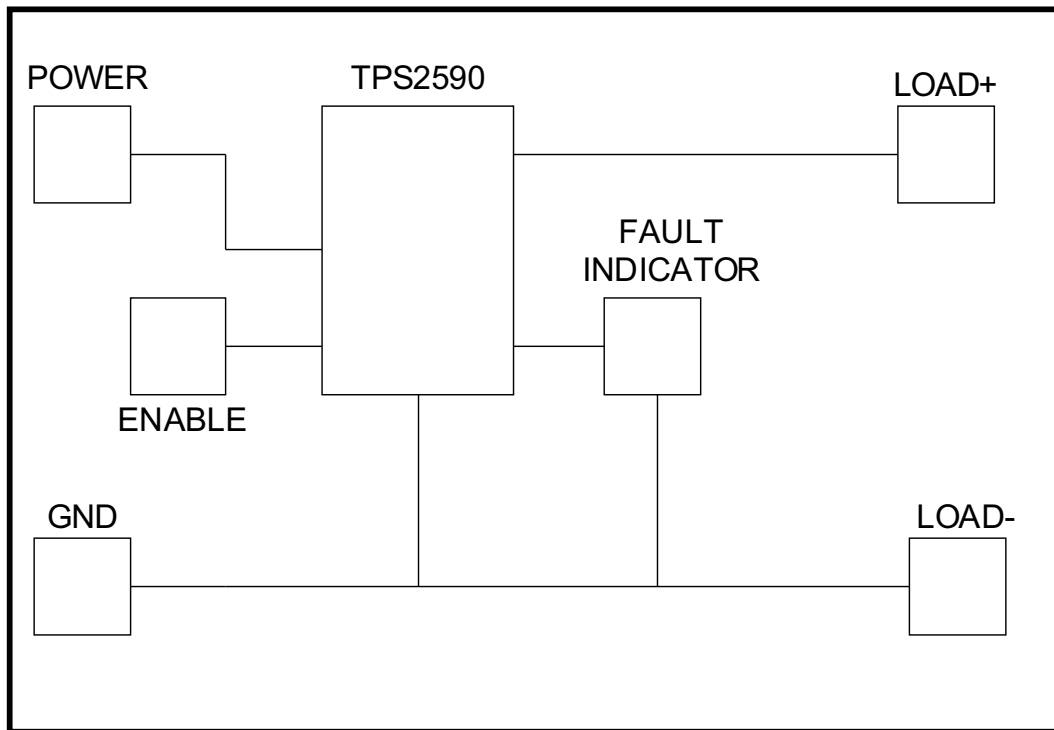


Figure 1. TPS2590EVM Block Diagram

## 4 Schematic

Figure 2 shows the EVM schematic.

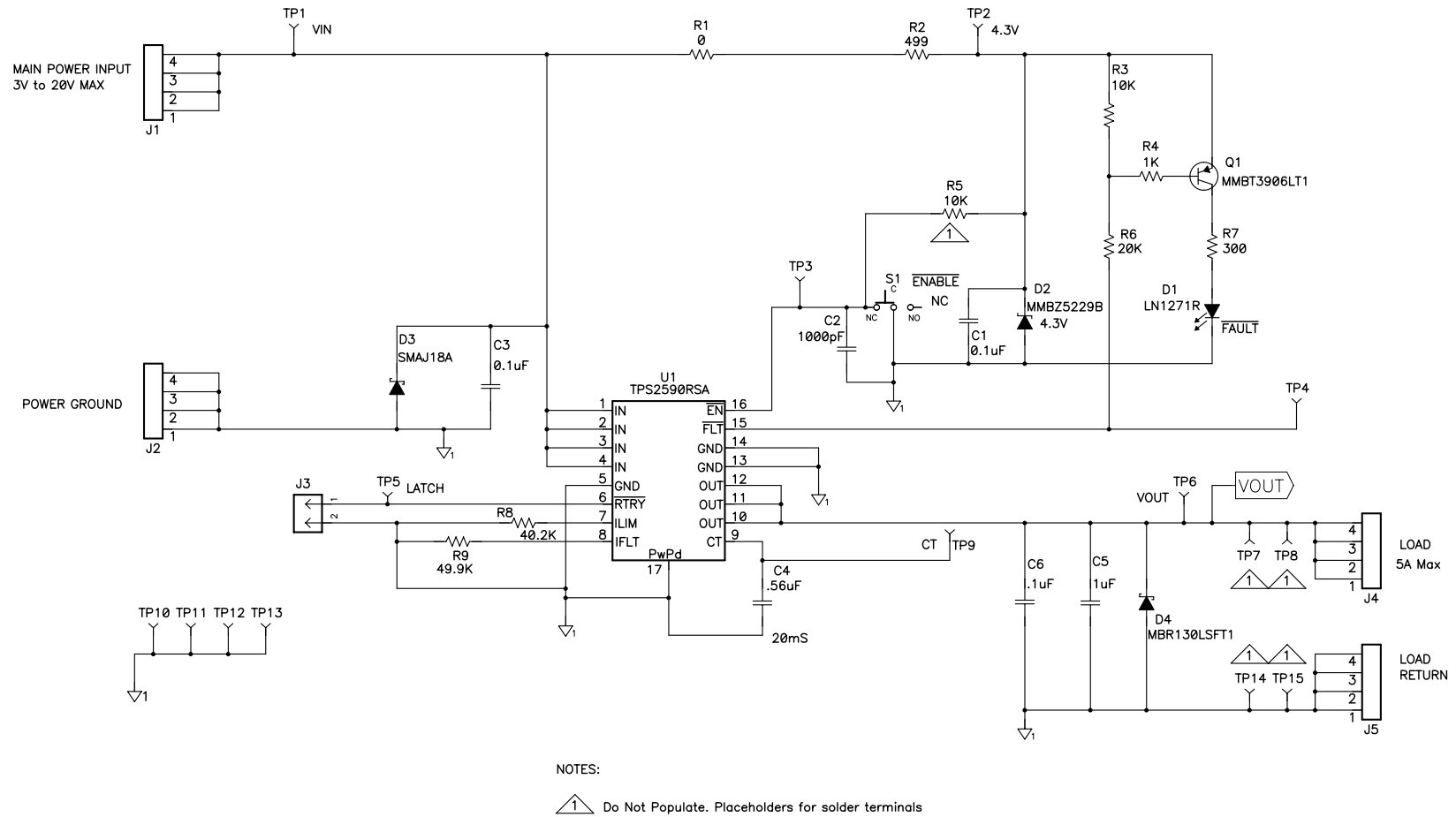


Figure 2. TPS2590EVM Schematic

## 5 Bill of Materials

Table 1 lists the BOM for the EVM.

**Table 1. TPS2590EVM Bill of Materials**

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C3	0.1uF	Capacitor Ceramic, 25V, X7R, 10%	0603	STD	muRata
1	C2	1000pF	Capacitor, Ceramic, 25V, X7R, 20%	0603	STD	muRata
1	C4	.56uF	Capacitor, Ceramic, 10V, X7R, 10%	0805	STD	muRata
1	C5	1uF	Capacitor, Ceramic, 25V, X7R, 20%	1206	STD	muRata
1	C6	.1uF	Capacitor Ceramic, 25V, X7R, 10%	0603	STD	muRata
1	D1	LN1271R	Diode, LED, Red, 20-mA, 0.9-mcd	0.068 x 0.049 inch	LN1271R	Panasonic
1	D2	MMBZ5229B	Diode, Zener, 4.3V, 350mW	SOT23	MMBZ5229B	Motorola
1	D3	SMAJ18A	Diode, SMT TVS 400W, 1-A, 18V	SMA	SMAJ18A	Diodes
1	D4	MBR130LSFT1	Diode, Schottky, 1000-mA, 30-V	SOD123	MBR130LSFT1	STD
4	J1, J2, J4, J5	7693	Screw Terminal	0.310 x 0.310 inch	7693	Keystone
1	J3	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	Q1	MMBT3906LT1	Bipolar, PNP, 40-V, 200-mA, 225-mW	SOT23	MMBT3906LT1	On Semi
1	R1	0	Resistor, Chip, 1/16W, 1%	0603	STD	Vishay
1	R2	499	Resistor, Chip, .5W, 1%	2512	STD	STD
1	R3	10K	Resistor, Chip, 1/16W, 5%	0603	STD	Vishay
1	R4	1K	Resistor, Chip, 1/16W, 1%	0603	STD	Vishay
1	R5	10K	Resistor, Chip, 1/16W, 1%	0603	STD	Vishay
1	R6	20K	Resistor, Chip, 1/16W, 5%	0603	STD	Vishay
1	R7	300	Resistor, Chip, 1/10W, 5%	0805	STD	Vishay
1	R8	40.2K	Resistor, Chip, 1/16W, 1%	0603	STD	Vishay
1	R9	49.9K	Resistor, Chip, 1/16W, 1%	0603	STD	Vishay
1	S1	09-03201-02	Switch, SPDT, Slide, PC-mount, 500-mA	0.400 x 0.100 inch	09-03201-02	EAO
7	TP1, TP2, TP3, TP4, TP5, TP6, TP9	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
4	TP10, TP11, TP12, TP13	GND	Test Point, SM, 0.150 x 0.090	0.185 x 0.135 inch	5016	Keystone
4	TP7, TP8, TP14, TP15		Test Point, 0.062 Hole	0.250 inch	5012	Keystone
1	U1	TPS2590RSA	IC, 3V to 20V Integrated FET Load Switch	QFN-16	TPS2590RSA	TI

## 6 EVM PCB Layout

Figure 3 through Figure 6 illustrate the board outline drawings.

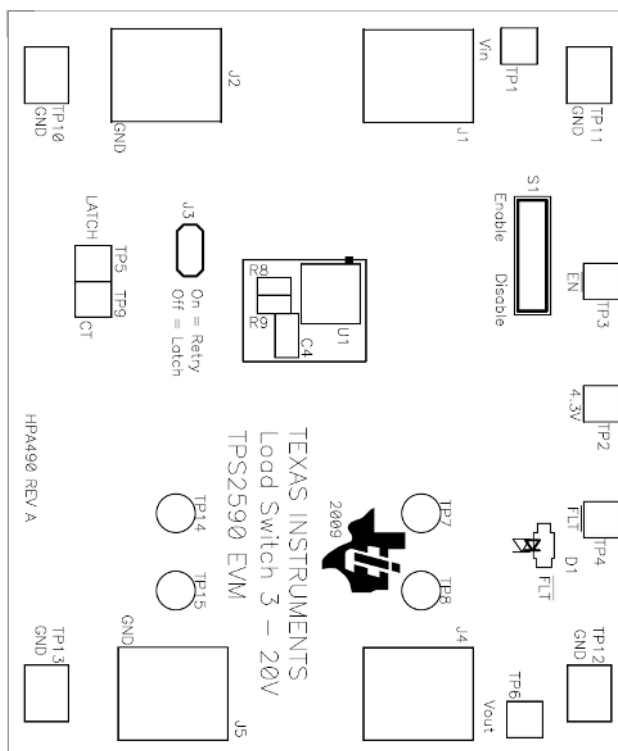


Figure 3. Component Placement (Top View)

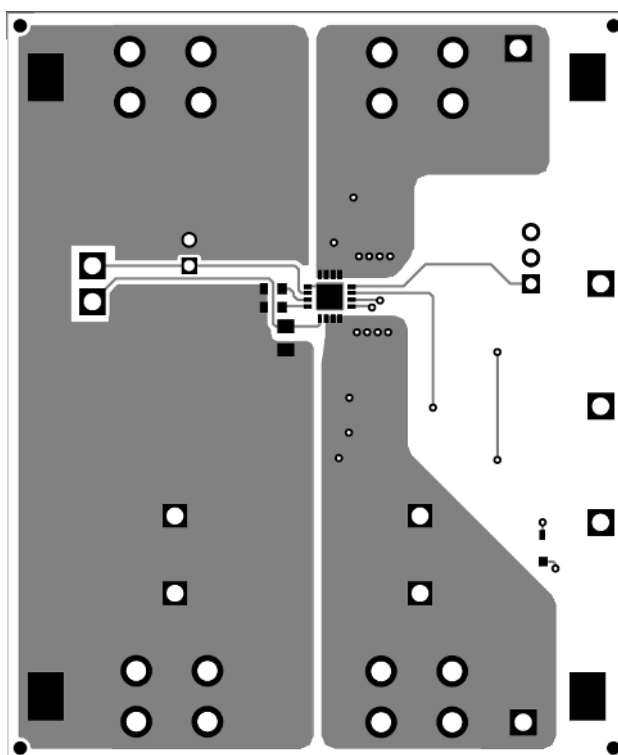
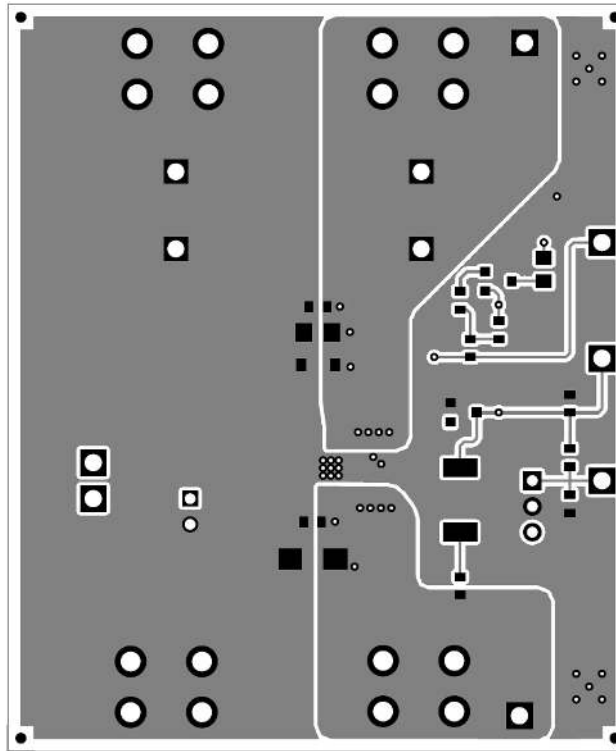
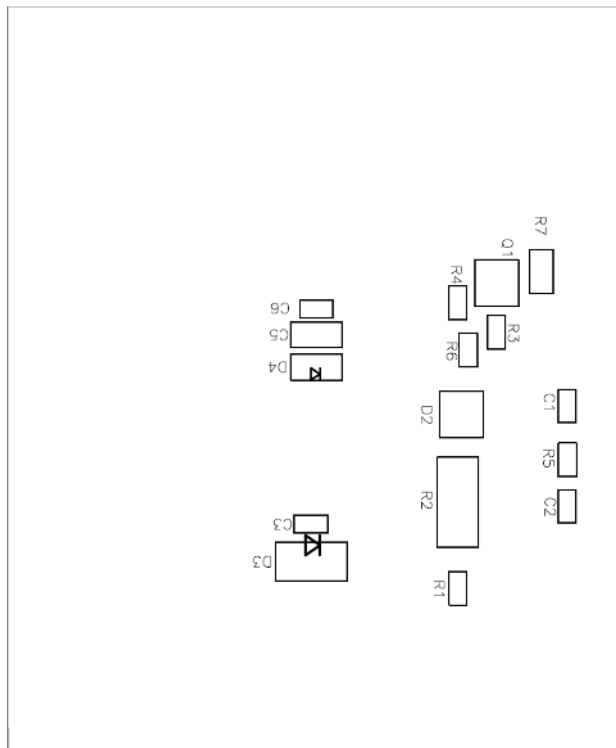


Figure 4. Board Layout (Top View)



**Figure 5. Board Layout (Bottom View)**



**Figure 6. Component Placement (Bottom View)**

## 7 Circuit Description

### 7.1 Test Points

Table 2 lists the test point descriptions.

**Table 2. Test Points**

Name	Description
VIN	Input voltage power supply
4.3 V	4.3-V reference
EN	Enable signal, high true
FLT	Fault signal, low true
LATCH	Latch signal, high true, low for retry
VOUT	Output voltage
CT	Fault timer capacitor
GND	Scope ground test point
GND	Scope ground test point
GND	Scope ground test point
GND	Scope ground test point

### 7.2 Connectors

Table 3 lists the connector descriptions.

**Table 3. Connectors**

Connector	Description
J1	Main power input, VIN
J2	Main power ground, GND
J4	Load
J5	Load ground, GND

### 7.3 Jumpers

R1 is used to disconnect the LEDs for test measurement of TPS2590 quiescent current. This 0-Ω resistor is normally installed.

Table 4 provides the jumper description of jumper J3.

**Table 4. Jumpers**

Jumper	Description
J3	TPS2590 Only Off = Latch, On = Retry

### 7.4 Switches

#### 7.4.1 Enable Switch S1

The ENABLE slide switch turns on the hot plug controller to ramp the output voltage. When the switch is off, the output is off.

#### 7.4.2 Indicators

Red LED indicator for FAULT (FLT).



## 8 EVM Test Setup

### 8.1 Test Equipment

**Voltage Source:** The input voltage source,  $V_{IN}$  is a 20-V variable dc source at 10 A.

**Oscilloscope:** A digital oscilloscope can be used to monitor the test points.

**Current Probe:** A current probe is helpful to observe turn-on characteristics of the external load.

**Recommended Wire Gauge:** Power is limited to 5 W; 18-gage wire, minimum, is recommended.

### 8.2 Equipment Supplied

The TPS2590EVM module configured with TPS2590 is supplied.

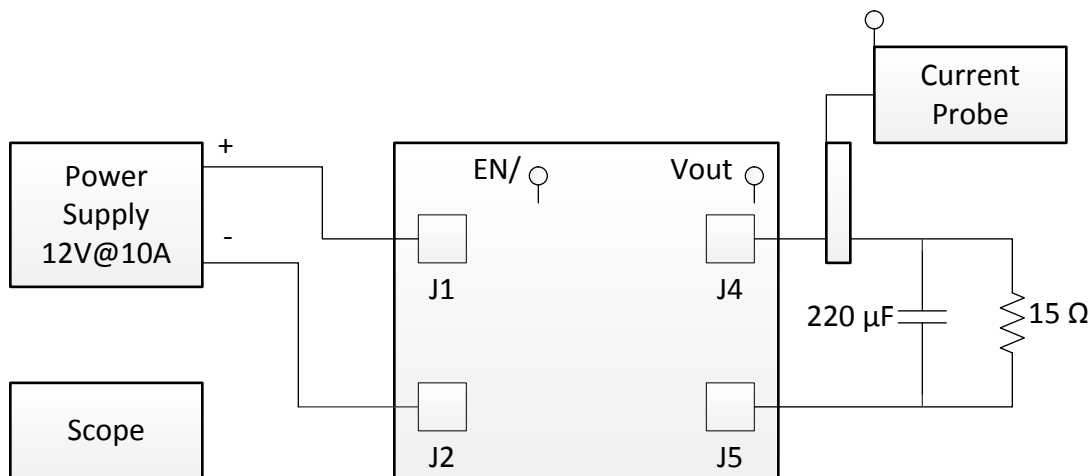
**Table 5. EVM Configurations**

Evaluation Module	Component
HPA490EVM-001	TPS2590


### 8.3 Recommended Test Setup

Figure 1 illustrates the equipment connections for power up and testing.

- Connect the positive voltage input power supply to J1 and the negative voltage to GND, J2. Connectors J1 and J2 can accept #6 ring or spade lugs.
- Connect the RC load at J4 and the load return at J5. The example here uses 220  $\mu$ F, 15  $\Omega$ .
- Scope to current probe to measure the load current.
- Scope the  $V_{OUT}$  and  $\overline{EN}$ .



Note:

 Connects to Scope

**Figure 7. Equipment Connections**

## 8.4 Operation

Use the following steps for EVM operation:

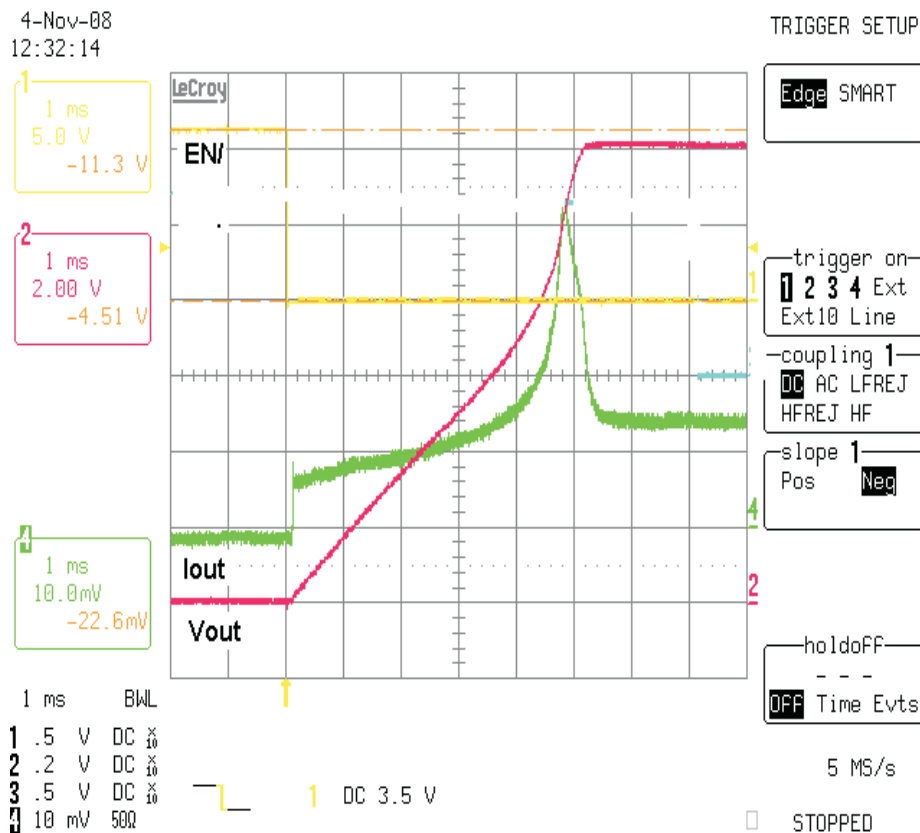
1. Turn on the power supply.
2. Trigger the scope on  $\overline{\text{EN}}$  low-going edge.
3. Slide the  $\overline{\text{EN}}$  to the  $\overline{\text{EN}}$  position as screened on the circuit board.

## 9 Test Results

Observe waveforms similar to [Figure 8](#).

- The current to the load is not constant but increases after the initial inrush. Current is low, initially, because the voltage across the internal MOSFET is initially at its highest level and the controller is power-limiting the MOSFET.
- Although the current limit,  $I_{\text{FLT}}$ , is set to 4 A, the start up current never goes above 2.2 A because of the power limiting. However, 4 A is available to the steady state load when the MOSFET is fully enhanced.
- At the end of the capacitor charge time, the current drops to the dc level powering the resistive part of the load, about 0.8 A.

Refer to [SLUS960](#) for more details.



**Figure 8. Example Scope Trace**

## Revision History

<b>Changes from Original (July 2009) to A Revision</b>	<b>Page</b>
• Added Design Calculator tool and link to the list of features. ....	2
• Changed device name in title of Figure 1. ....	3
• Changed schematic, Figure 2. ....	4
• Changed contents of BOM. ....	5
• Added Component Placement (Bottom View) image. ....	6
• Changed Board Layout (Top View) image. ....	6
• Changed Board Layout (Bottom View) image. ....	7
• Added Component Placement (Bottom View) image. ....	7
• Changed entire content of first paragraph in the Test Points section. ....	8
• Changed R9 to R1 in first paragraph of Jumpers section. ....	8

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)