TPS2590 Hot Swap Controller Evaluation Module

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

Contents

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)

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3   EVM Block Diagram

Figure 1 shows the EVM block diagram.
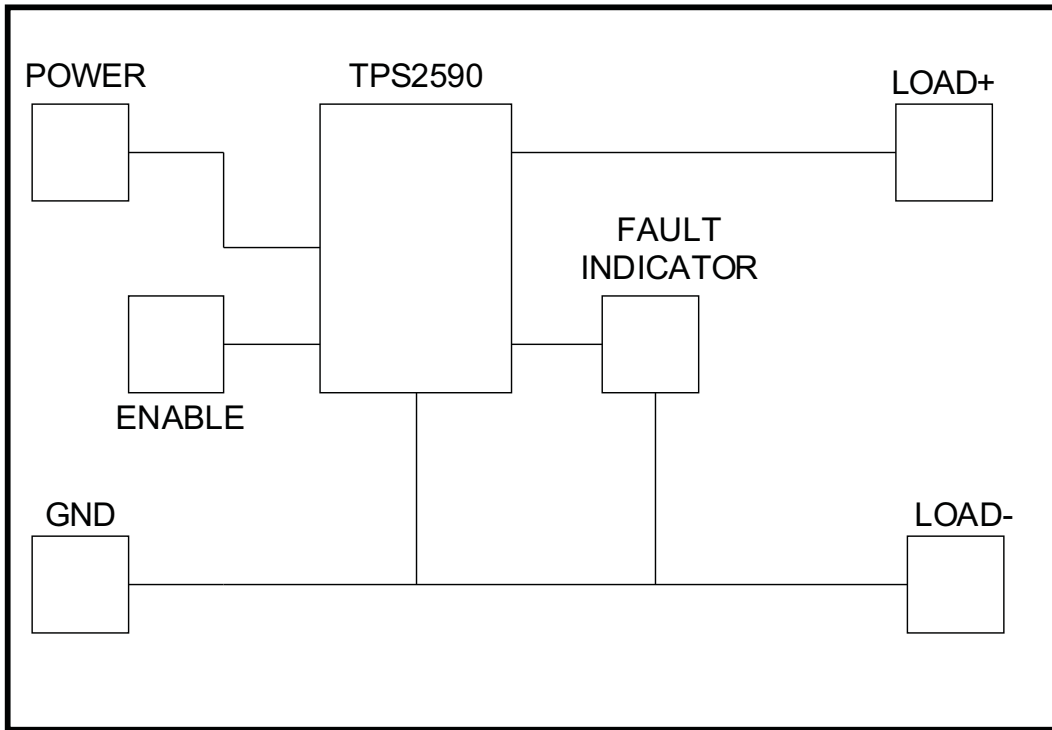
Figure 1. TPS2590EVM Block Diagram
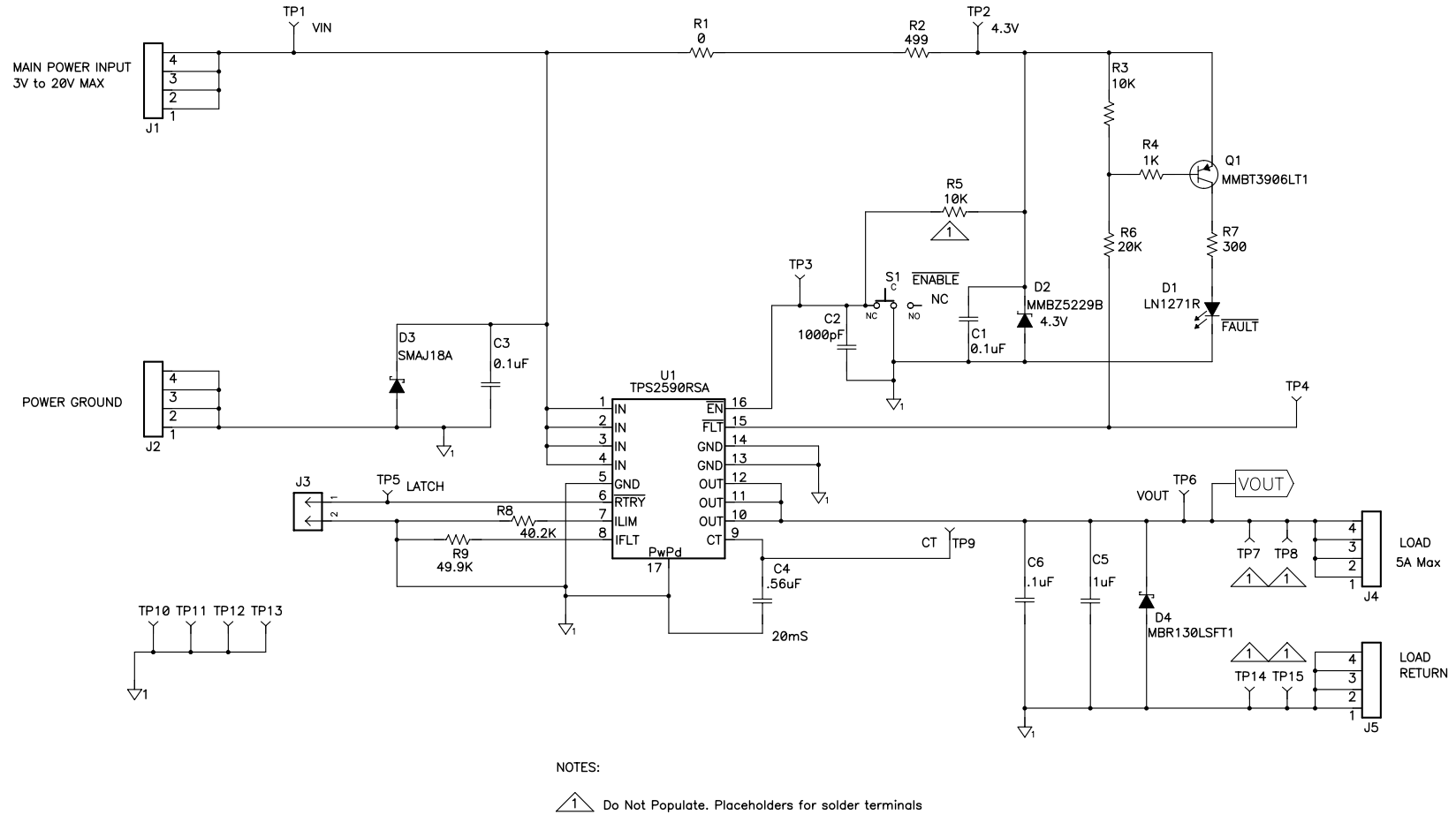
4   Schematic

Figure 2 shows the EVM schematic.

Figure 2. TPS2590EVM Schematic

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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

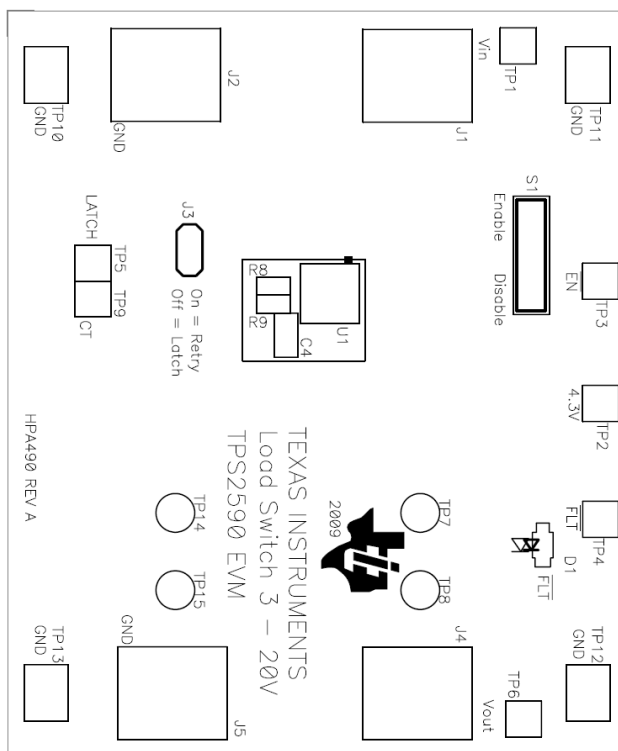Figure 3 through Figure 6 illustrate the board outline drawings.
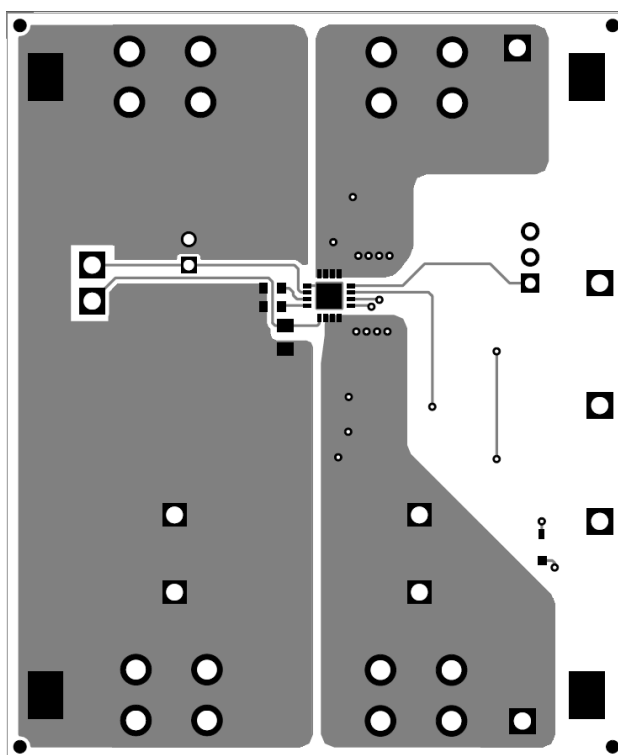

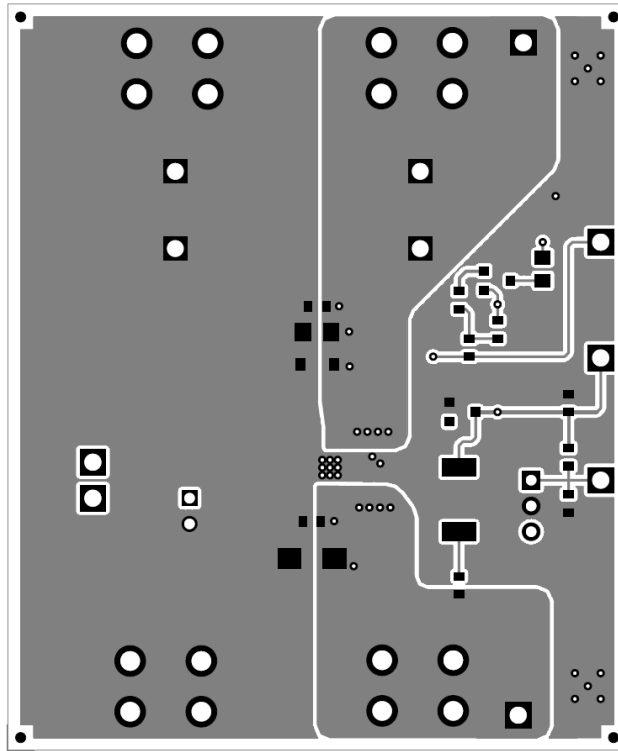**Figure 3. Component Placement (Top View)**

Figure 4. Board Layout (Top View)
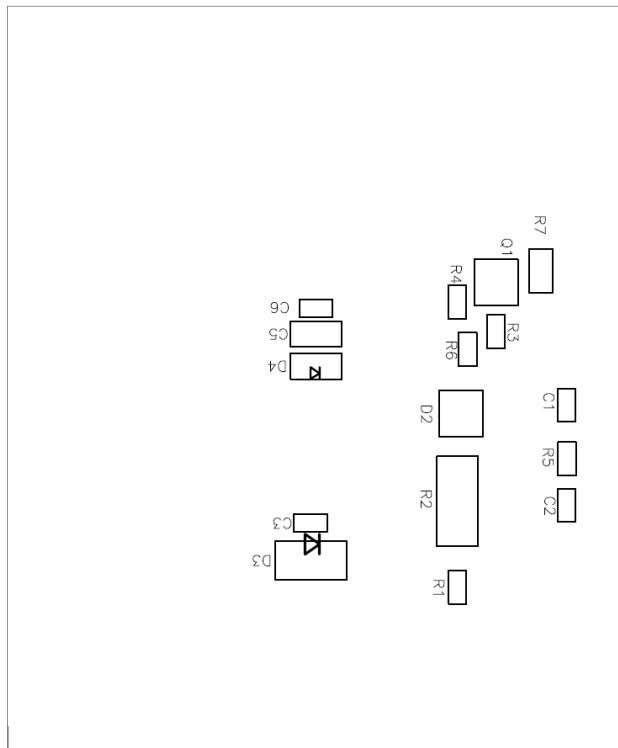
Figure 5. Board Layout (Bottom View)

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
$\overline{\text{EN}}$	Enable signal, high true
$\overline{\text{FLT}}$	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 ($\overline{\text{FLT}}$).

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 Gague: 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 µF, 15 Ω.
- Scope to current probe to measure the load current.
- Scope the V_{OUT} and $\overline{EN}$.
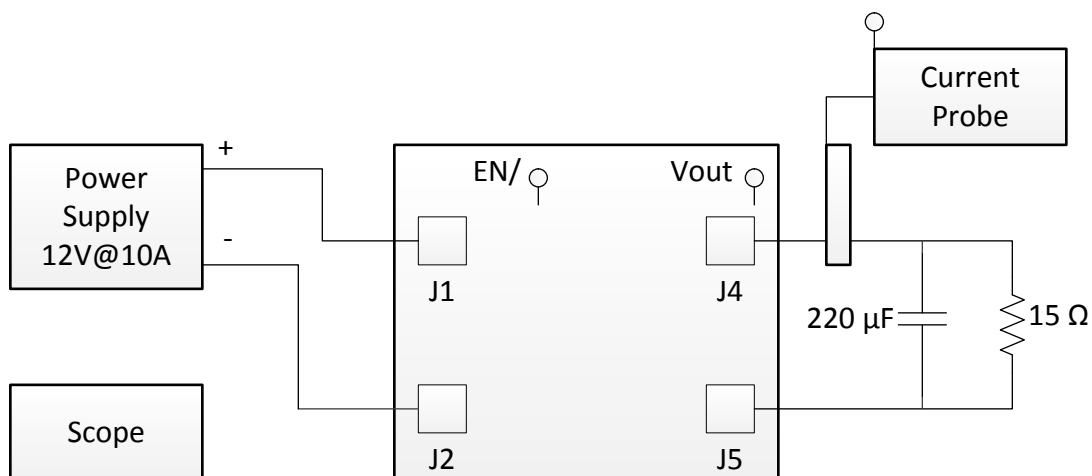
Note:

○   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 $\overline{EN}$ low-going edge.
3. Slide the $\overline{EN}$ to the $\overline{EN}$ 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_{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.
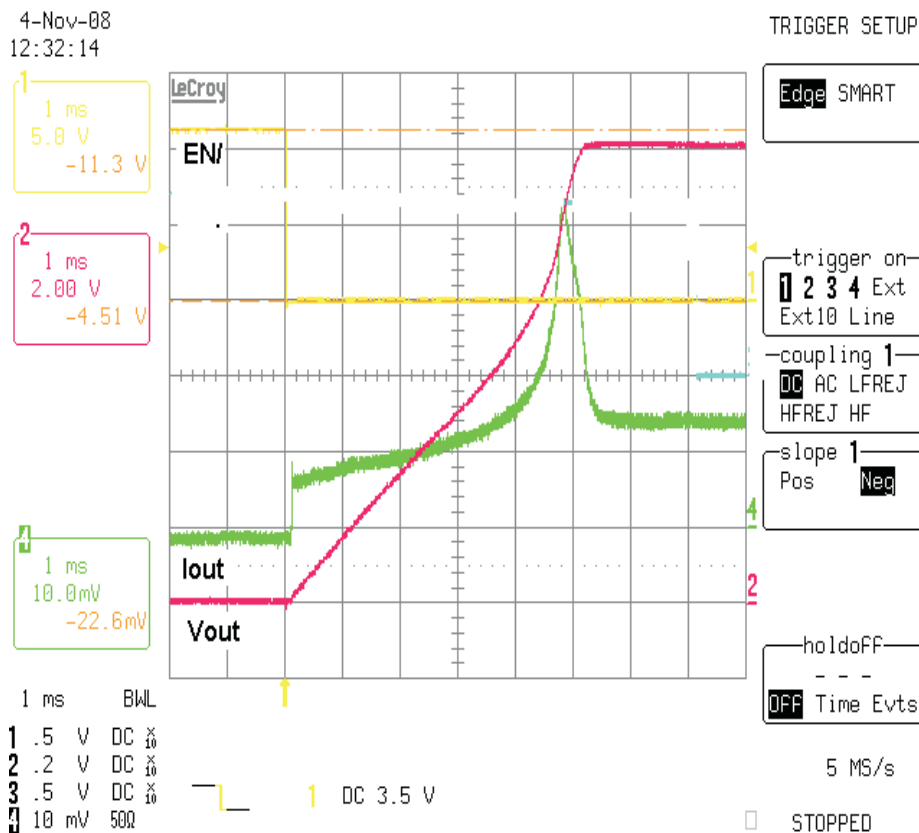
Refer to SLUS960 for more details.

Figure 8. Example Scope Trace

Revision History

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