

TPS2330 48-V Telecom Hot Swap Evaluation Module and Interface Card

User's Guide

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Preface

Read This First

How to Use This Manual

This document contains the following chapters:

- ☐ Chapter 1—Introduction
- ☐ Chapter 2—48-V Telecom Hot Swap
- ☐ Chapter 3—Schematics of the EVM and the Interface Card
- ☐ Chapter 4—Layouts of the EVM and the Interface Card
- ☐ Chapter 5—Setup of the EVM
- ☐ Chapter 6—Test Points

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This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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Introduction

Fast development of telecommunications and networks has accelerated growth of products with hot-plug capability to ensure that systems are always on. Many hot-swap or hot-plug devices are already available in the worldwide market. However, most such devices are for low-voltage applications, whereas 48-V is a standard voltage in most communication systems. The TPS23xx series of hot-swap controllers are principally designed for low voltage applications, but can also be used in very high voltage systems if appropriately designed.

The TPS2330 is a Texas Instruments hot-swap controller that eliminates high-frequency hot-plug or hot-removal transients, reduces inrush current, and provides overcurrent protection. To demonstrate this hot-swap controllability at high-voltage systems, an evaluation module has been developed, as presented in this user's guide. The evaluation module (EVM) can help designers evaluate the hot-swap controller and simulate hot-insertion and hot-removal actions under varied conditions.

Users will need a 48-V dc voltage supply to test the operation of the EVM.

48-V Telecom Hot-Swap EVM

With the rapid growth of internet and telecommunications in general, more and more electronic systems are required to run continuously. Therefore, redundant systems or modules may be required to prevent the crashing of systems. While redundant systems have proved feasible, they are also very costly. Further, a simple redundant system as a backup is often inadequate because any errant part in the backup can jeopardize the whole system. Thus, we should develop ways to update the system regularly or remove errant parts and insert new modules while the system is still running. Central to such requirements for today's electronic systems is the hot-plug or hot-swap capability.

The TPS2330 is a single-channel hot-swap controller that uses external N-channel MOSFETs in hot-swap applications. The device integrates features such as overcurrent protection, inrush current control, output-power status reporting, and separation of load transients from actual load increases, which are the critical requirements for hot-swap applications. For a detailed description of functions and characteristics of the TPS2300, refer to the data sheet, literature number SLVS265A. Check data sheet and ordering information on Web site:

<http://focus.ti.com/docs/prod/productfolder.jhtml?genericPartNumber=TPS2331>

Because telecommunications applications often use -48-V or 48-V power supplies, a few external components (including a Zener diode and a resistor) are needed to make the TPS2330 suitable to meet the voltage requirements. To assist designers in the evaluation of the hot-swap controllers for such high-voltage applications, a set of evaluation modules has been developed: one is the 48-V telecom hot-swap EVM, and the other is an interface card.

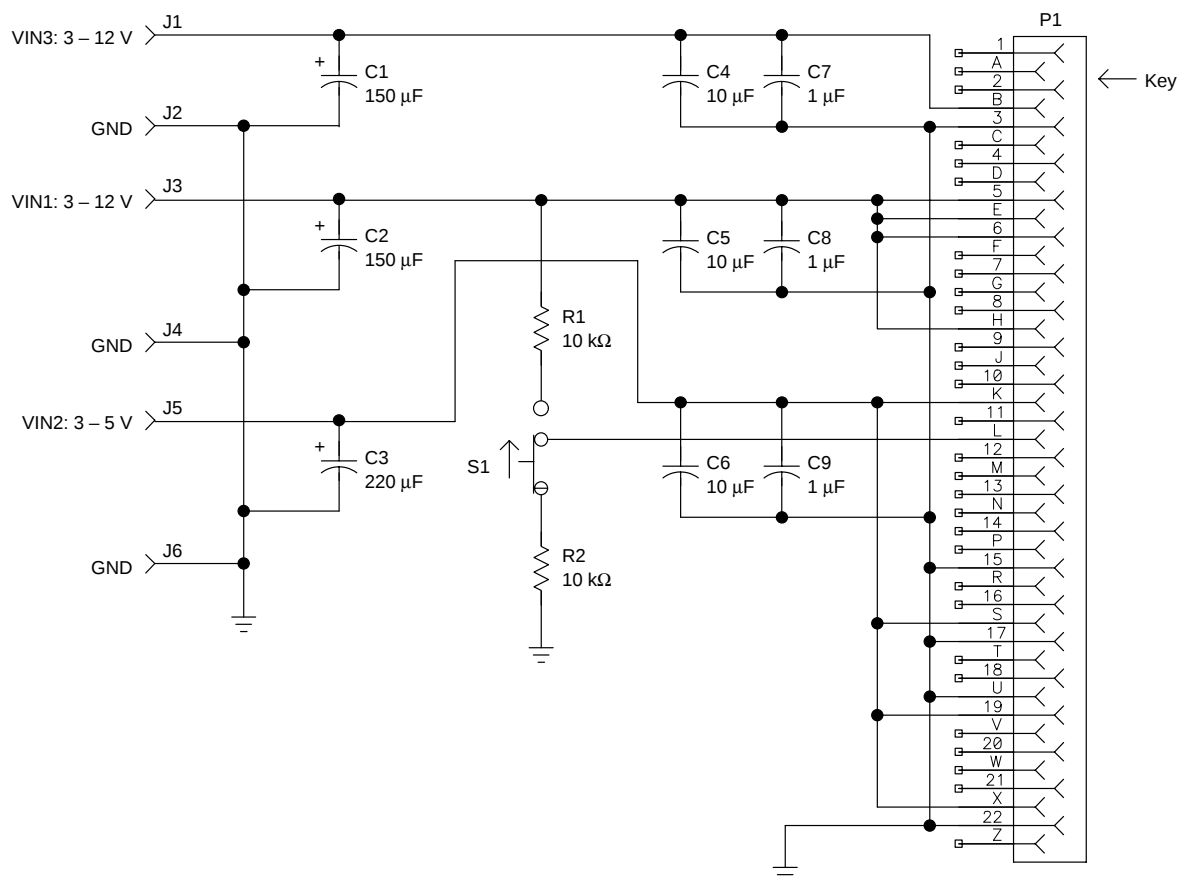
The following chapters will present the schematics, layouts, and evaluation procedures for the EVM.

Schematics of the EVM and the Interface Card

The evaluation kit includes two boards: one is the hot-swappable TPS2330EVM-184 48-V hot-swap EVM (SLVP184 board) where the TPS2330 controls voltage ramp-up and reduces inrush current during hot-plug events; the other is an interface card (SLVP155 board) that supplies power to the 48-V hot-swap board.

Figures 3–1 and 3–2 show the schematic of the interface card and the schematic of the hot-swappable EVM respectively.

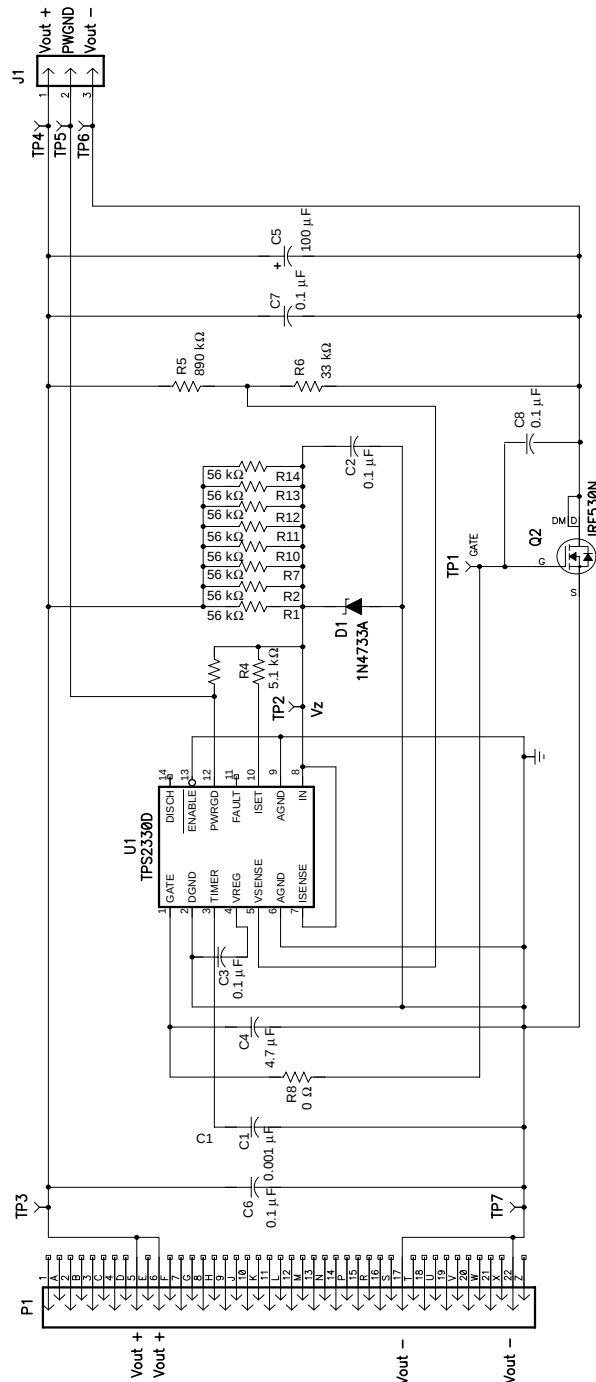
Figure 3–1. Schematic of the Interface Card (SLVP155)



Because the interface card was originally designed for universal application purposes, some of the components shown in the schematic above may not be on the board when shipped with this EVM kit. Refer to the bill of materials table for a complete component list.

A key is installed in the edge connector on the interface board (SLVP155) to ensure that the hot-swap board can only be inserted the right direction.

Figure 3–2. Schematic of the 48-V Hot-Swap EVM (SLVP184)



The bills of materials (BOM) for both boards are shown in Tables 3–1 and 3–2, respectively.

Table 3–1. Components on the Interface Card (SLVP155), Bill of Materials

Ref Des	Qty	Part Number	Description	Mfg	Size
C1, C2, C3	Not used				
C4, C6	Not used				
C5	1	12061C104KAT2A	Capacitor, ceramic, 0.1- μ F, 1100-V, +X7R, 10%, Y5V	Taiyo Yuden	1210
C7, C8, C9	Not used				
J3, J4	2	3267	Connector, banana jack, uninsulated	Pomona	
J1,J2,J5, J6	Not used				
P1	1	50–22SN–11	Connector, 44-pin edge w/mtg tabs (for 0.062" PCB)	Cinch	
R1, R2	Not used	Std	Resistor, chip, 10 k Ω , 1/10 W, 5%	Std	1206
S1	Not used	EG1218	SW–1C–200 MA–SL		
TP1	1	240–345	Test point, red, 1 mm	Farnell	
TP5	1	240–333	Test point, black, 1 mm	Farnell	
TP2–TP3	Not used				
TP4,TP6	Not used				
Key	1	50–PK–3	Key for P1 (Newark #57F3275)	Cinch	
	4	534–1804	Spacer, aluminum, 4–40 female, 0.625" long	Mouser	
	4		Screw, pan head phillips, 4–40 $\times$ 0.25"		

Table 3–2. Components on the 48-V Hot-Swap EVM (SLVP184), Bill of Materials

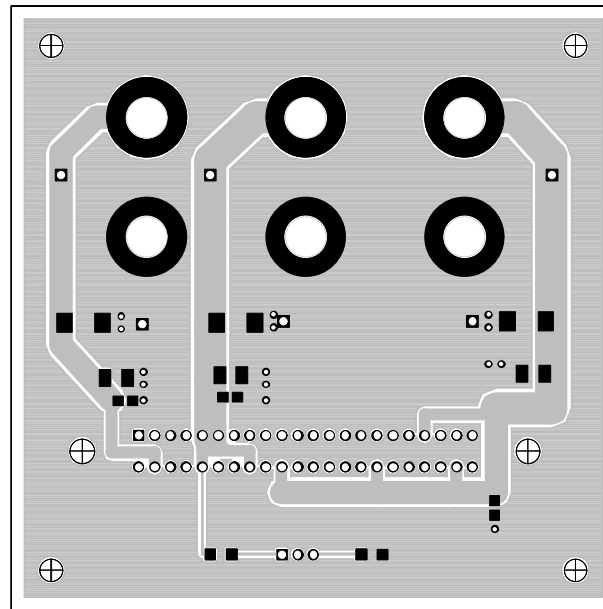
RefDes	Qty	Part Number	Description	Mfg	Size
C1	1	08055A102JAT2A	Capacitor, ceramic, 0.001- μ F, 50-V, COG, 5%	AVX	805
C3	1	GRM4034X7R104K50V	Capacitor, ceramic, 0.1- μ F, 25-V, X7R, 10%	Murata	805
C2, C6, C7	3	12061C104KAT2A	Capacitor, ceramic, 0.1- μ F, 100-V, X7R, 10%	AVX	1206
C4	1	GMK316F475Z	Capacitor, ceramic, 4.7- μ F, 35-V	Taiyo-Yuden	1206
C5	1	SEK101M100ST	Capacitor, OS-CON, 100- μ F, 100-V, 20%	Sanyo	0.500"
C8	1	C0805C104k5RAC	Capacitor, ceramic, 0.1- μ F, 50-V, 10%	Kemet	805
P1	1	NA	Connector, 44-pin dual edge PCB pattern	NA	
D1	1	1N4733A	Diode, Zener, 5.1-V, 49-mA, 1W	On Semi	DO-41
J1	1	PTC36SAAN	Header, 3-pin, 100-mil spacing, (36-pin strip)	Sullins	
R4	1	Std	Resistor, chip, 5.1 k Ω , 1/8-W, 1%	Std	805
R6	1	Std	Resistor, chip, 33 k Ω , 1/10-W, 5%	Std	805
R8	1	Std	Resistor, chip, 0- Ω , 1/8-W, 5%	Std	805
R3	1	Std	Resistor, chip, 100 k Ω , 1/8-W, 5%	Std	805
R5	1	Std	Resistor, chip, 890 k Ω , 1/8-W, 5%	Std	805
R1, R2, R7, R10, R11, R12, R13, R14	8	Std	Resistor, chip, 56 k Ω , 1/8-W, 5%	Std	1206
U1	1	TPS2330ID	IC, single hot-swap power controller w/circuit breaker and PG	TI	SO14
TP5	1	240-333	Test point, black, 1 mm	Farnell	
TP1-TP4, TP6, TP7	6	240-345	Test point, red, 1 mm	Farnell	
Q2	1	IRF530N	MOSFET, N-ch,100-V, 17A, .11-m Ω	IRF	TO-22 OAB

C4 and C8 on SLVP184 adjust the output turnon ramp-up rate and propagation delay time. Reducing the capacitance of C8 will increase the output ramp-up speed, and decreasing the value of C4 will reduce the output turnon delay time and increase the output ramp-up rate.

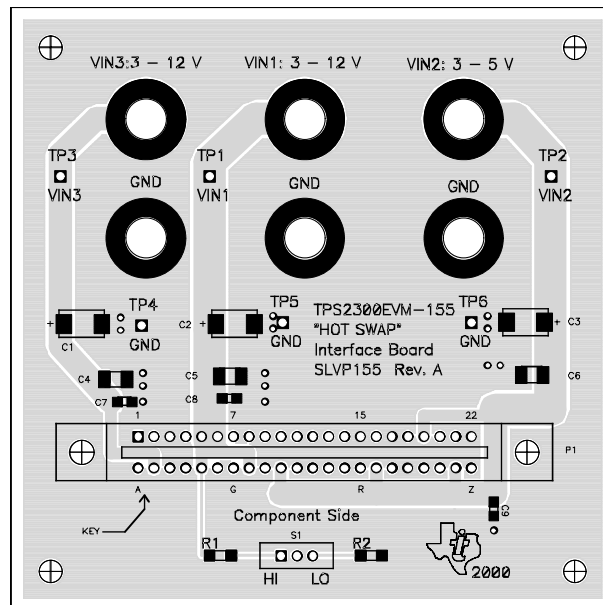
Layouts of the EVM and the Interface Card

The following figures illustrate the placements of the components and the top-layer layouts for both the 48-V hot-swap EVM and the interface card respectively. All the components are placed on the top layers except for the 0.1- μ F capacitor (C8) on SLVP184 that has now been included on the bottom layer. (The bottom layers are mainly ground planes).

Figure 4–1. Top Layer of the Interface Card and Placement of the Components

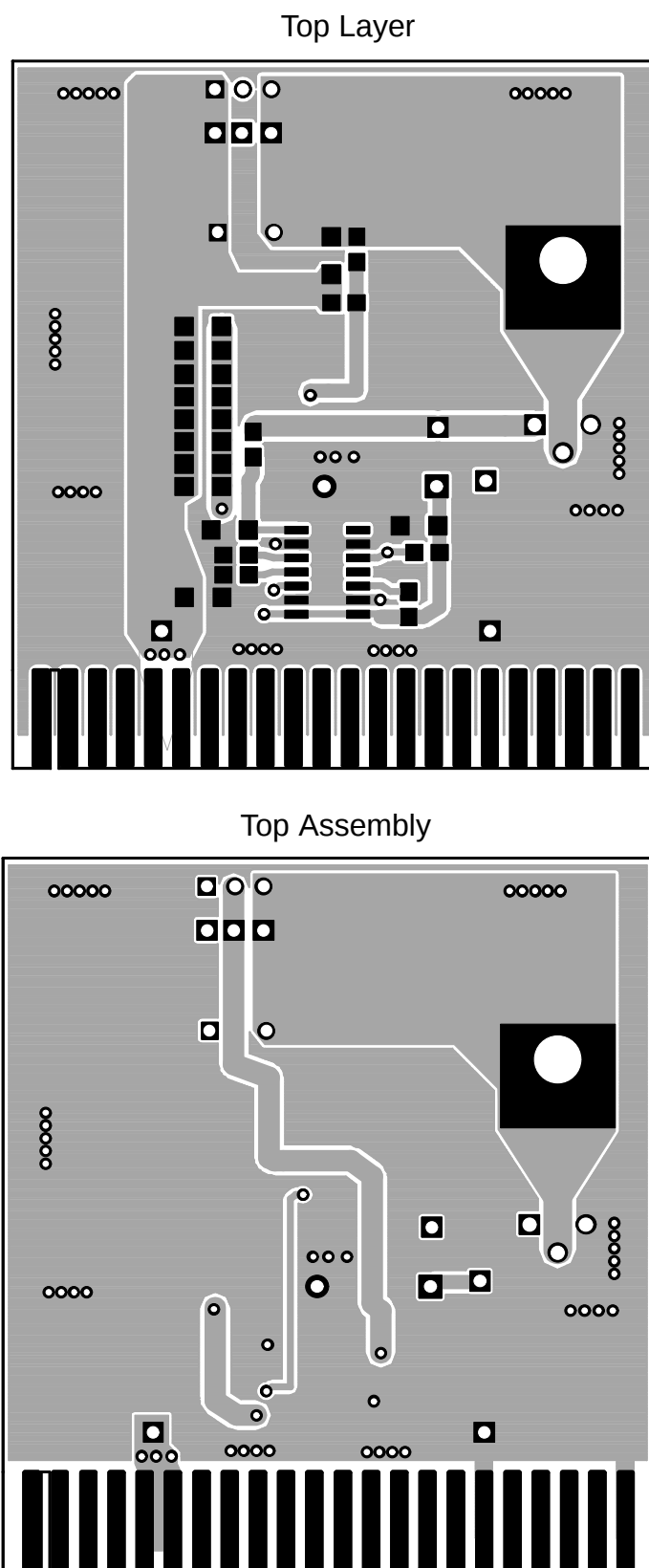


Top Layer



Top Assembly

Figure 4–2. Top Layer of the 48-V Hot-Swap EVM and Placement of Components





Setup of the EVM

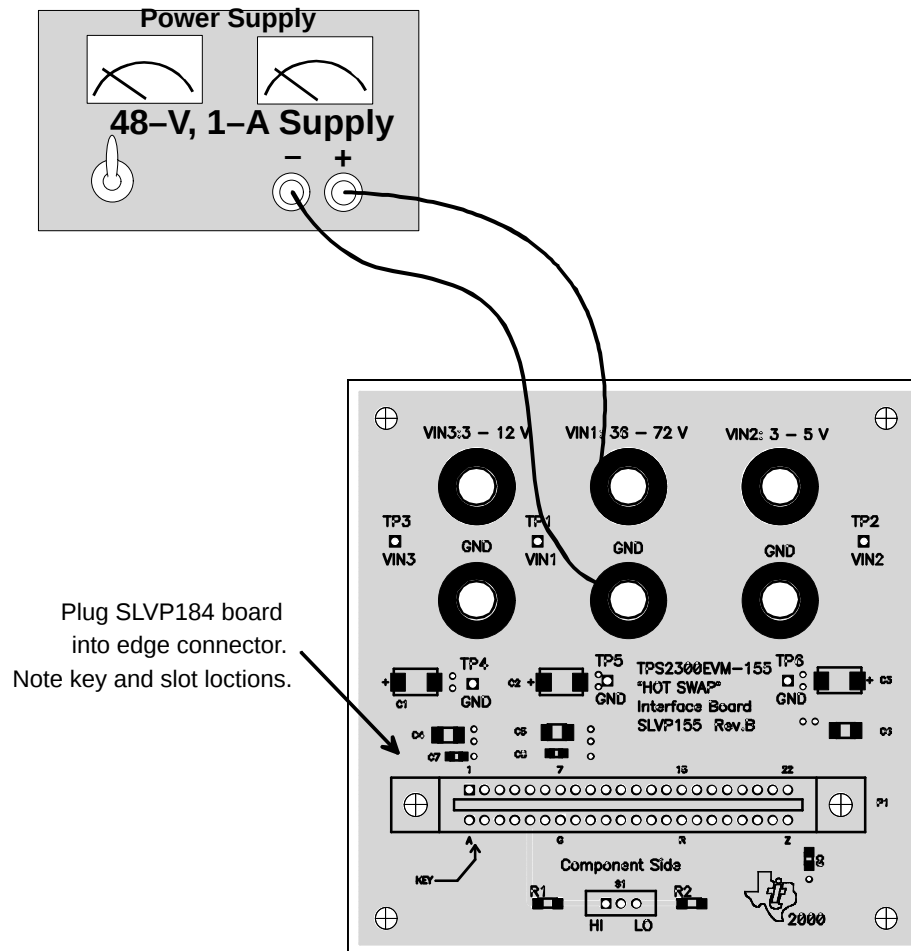
For proper operation of the EVM, one 48-V power supply, and a voltage meter or an oscilloscope are required.

Refer to the setup diagram in Figure 5–1 and follow these steps for hot plug testing:

- 1) Verify that the power-supply voltage is set at 48 V. Make sure the supply has the capability to provide the current loads need. Turn off the supply.
- 2) Connect a meter or oscilloscope to monitor the voltages from Vout+ (pin 1 of J1) to Vout– (pin 2 of J1) on the SLVP184 board.
- 3) Plug the supply into the interface card; connect the supply from IN1 to ground. Then turn on the power supply. Check the voltage from VIN1 to GND, which should be about 48 V.
- 4) Plug the hot-swap board (SLVP184) into the interface board (SLVP155). The key installed between pins 1 and 2 of the edge connector insures that the board can only be inserted in the correct direction.
- 5) Test points or headers are provided for oscilloscope probes and/or multi-meters. Read the voltage from the multimeters connecting from Vout+ to Vout– on SLVP184. The value of the meter should be about 48 V. Otherwise, the board may have problems or the testing may not be correct.
- 6) Unplug the SLVP184 board from the interface card.

More evaluations such as adding loads to the output rails, can be performed by following procedures similar to those presented above.

Figure 5–1. Evaluation Setup of the Hot-Swap Board EVM



Test Points

Two test points are available on the interface card (SLVP155):

TP1 – VIN1 (input voltage)

TP5 – GND (ground)

On the 481-V hot-swap EVM, there are total 7 test points:

TP1 – Gate of the IRF530N MOSFET

TP2 – Input (VIN) of TPS2330

TP3 – VIN+ (EVM positive input rail, same as Vout+)

TP4 – Vout+ (EVM positive output rail, same as VIN+)

TP5 – Power-good output

TP6 – Vout– (EVM negative output rail)

TP7 – VIN– (EVM negative input rail)

