

***TPS2330/TPS2331, TPS5102
InfiniBandSM Bulk Power
Evaluation Module and
Interface Card***

User's Guide

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Read This First

How to Use This Manual

This document contains the following chapters:

- Chapter 1—Introduction
- Chapter 2—InfiniBand Bulk Power EVM
- 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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Introduction

The TPS2330/TPS2331 is a Texas Instruments hot swap controller that eliminates high-frequency hot-plug or hot-removal transients, reduces inrush current, and provides overcurrent protection. The TPS5102 is a dual-channel dc-to-dc controller, designed for notebook PC power but suitable for many other dc/dc applications. The InfiniBandSM Trade Association (IBTA), led by seven computing-industry leaders and supported by more than 200 computer, network and electronics companies, is developing a new common I/O specification to deliver a channel-based, switched-fabric technology that the entire industry can adopt.

One of the core components of an InfiniBand system is an InfiniBand module or card, and a hot-swappable power-management solution is essential in each InfiniBand module/card. Using the TPS233x hot-swap controller and the TPS5102 dc/dc controller achieves the required power management specified in Infiniband Specification 1.0 released in October 2000.

The evaluation module (EVM) and interface card can help designers evaluate the devices and simulate hot-insertion and hot-removal actions under varied conditions.

Users need a dc voltage supply to test the operation of the EVM.



InfiniBand Bulk-Power EVM

The TPS2330/TPS2331 single-channel hot-swap controller uses external N-channel MOSFETs as high-side switches in power applications. The devices integrate 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 and TPS2301, refer to the data sheet, literature number SLVS265A. Check data sheet and ordering information on website:

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

The TPS5102 is a dual-channel high-efficiency controller that drives a synchronous-rectifier buck converter. With PWM and skip operating modes, dead-time control, and very low quiescent current, the controller allows power to be conserved under all load conditions. For a detailed description of functions and characteristics of the TPS5102, refer to the data sheet, literature number SLVS239. Check data sheet and ordering information on website:

<http://focus.ti.com/docs/prod/productfolder.jhtml?genericPartNumber=TPS5102>

Refer to the data sheets to select appropriate peripheral components for the controllers. For different applications, a gate capacitor at the TPS2330/TPS2331 GATE output may be required to limit excessive inrush current or very heavy load. Recommended input capacitors can help hold the input voltage in the designed range.

To learn more about InfiniBand power-management requirements, users can go to www.infinibandta.org for a copy of the InfiniBand specification 1.0, and can also read the application report Power-Management Solutions for InfiniBand I/O Modules, from Texas Instruments on

<http://www.ti.com/sc/docs/psheets/abstract/apps/slva093.htm>

To assist designers in the evaluation of the hot-swap controllers, a set of evaluation modules has been developed: one is the InfiniBand bulk power EVM, and the other is an interface card.



Schematics of the EVM and the Interface Card

To demonstrate a hot-plug or hot-removal application, the evaluation system includes two boards: one is the hot-swappable InfiniBand bulk power EVM (SLVP185 board) where the TPS2331 and TPS5102 reside and control power MOSFETs; the other is an interface card (SLVP155 board) that supplies power and a control signal to the InfiniBand bulk power EVM.

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

Since 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 3–1 for a complete components list.

When testing the EVM, set the slide switch S1 on the interface card (SVLP155) to HI (marked on the board), because the hot-swap controller TPS2331 is an active-high enabling device. The user can replace the TPS2331 with TPS2330 in order to evaluate the latter, but will need to switch S1 to LO to perform the evaluation.

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

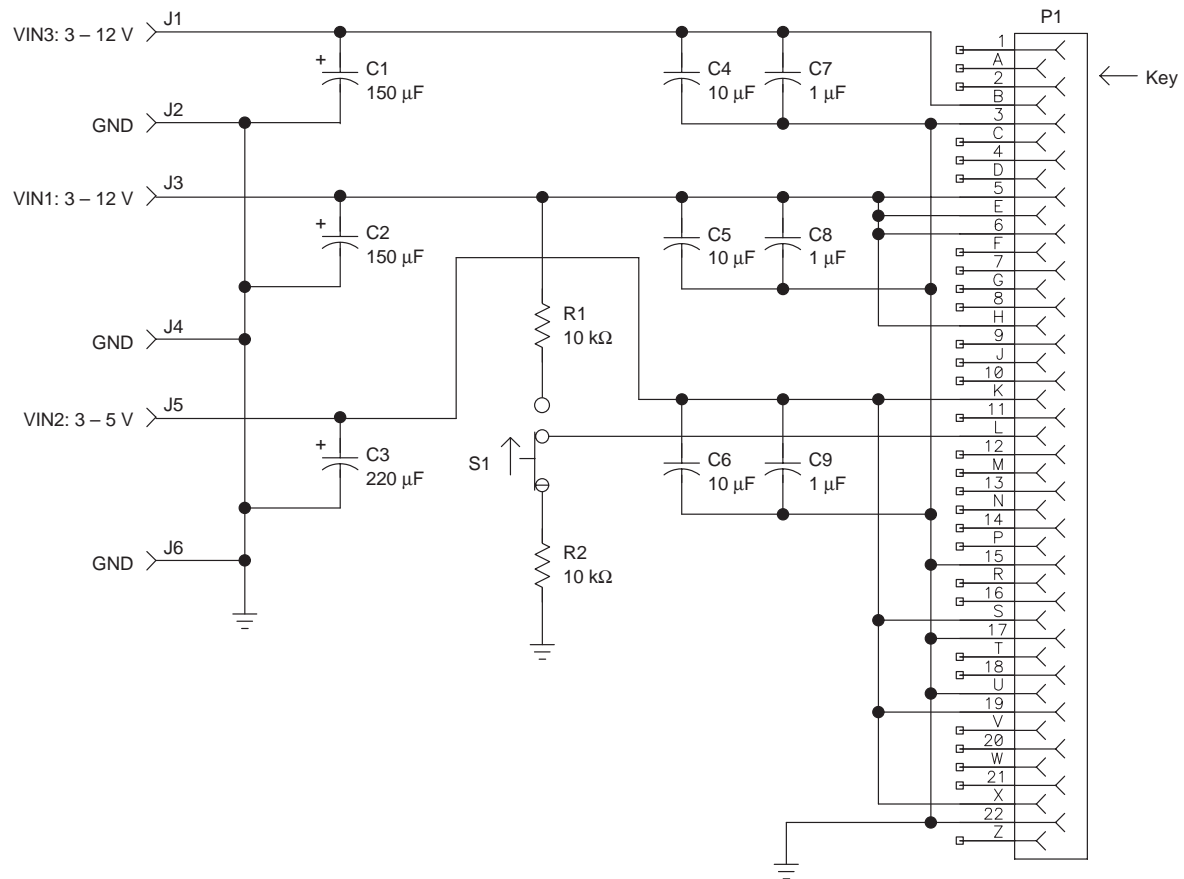
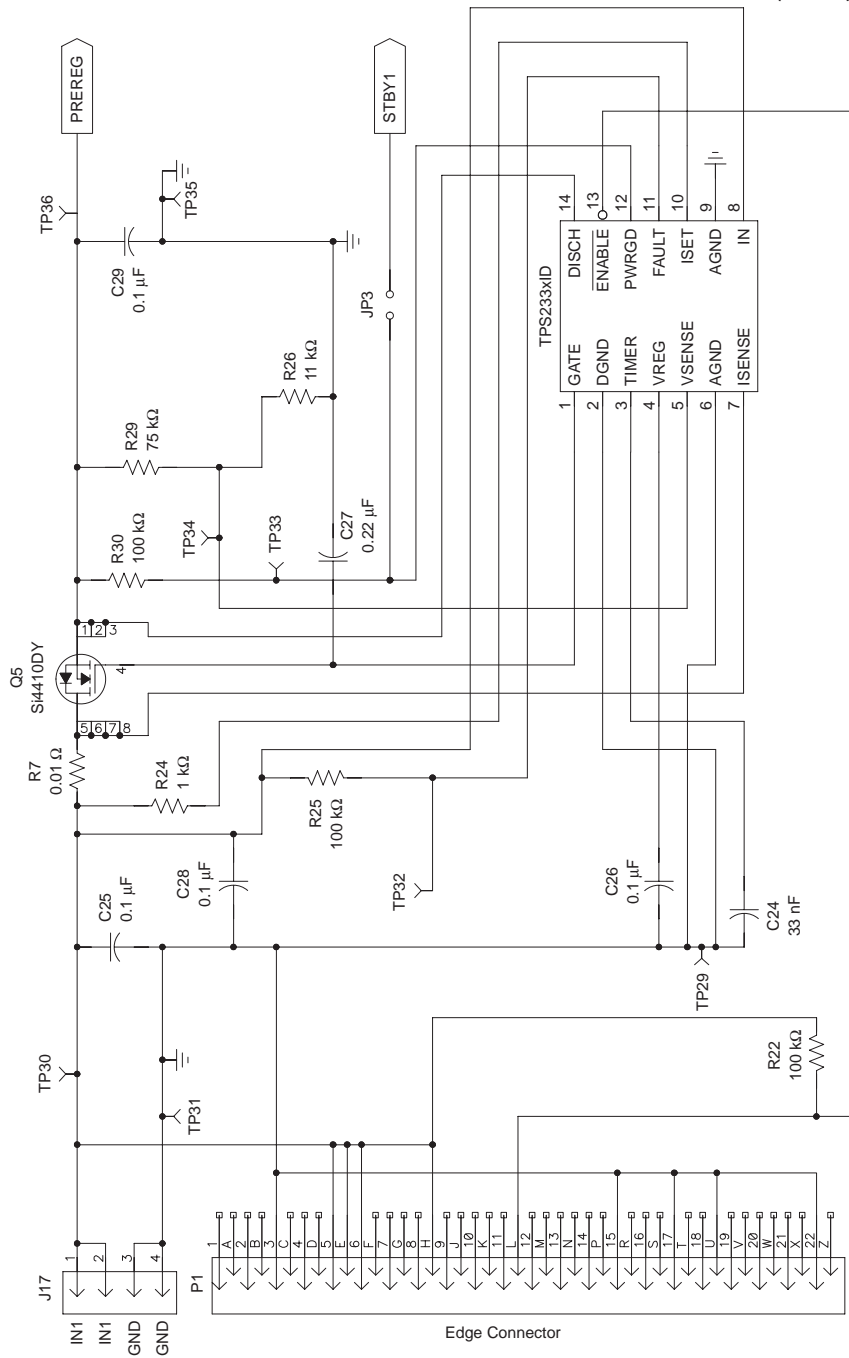
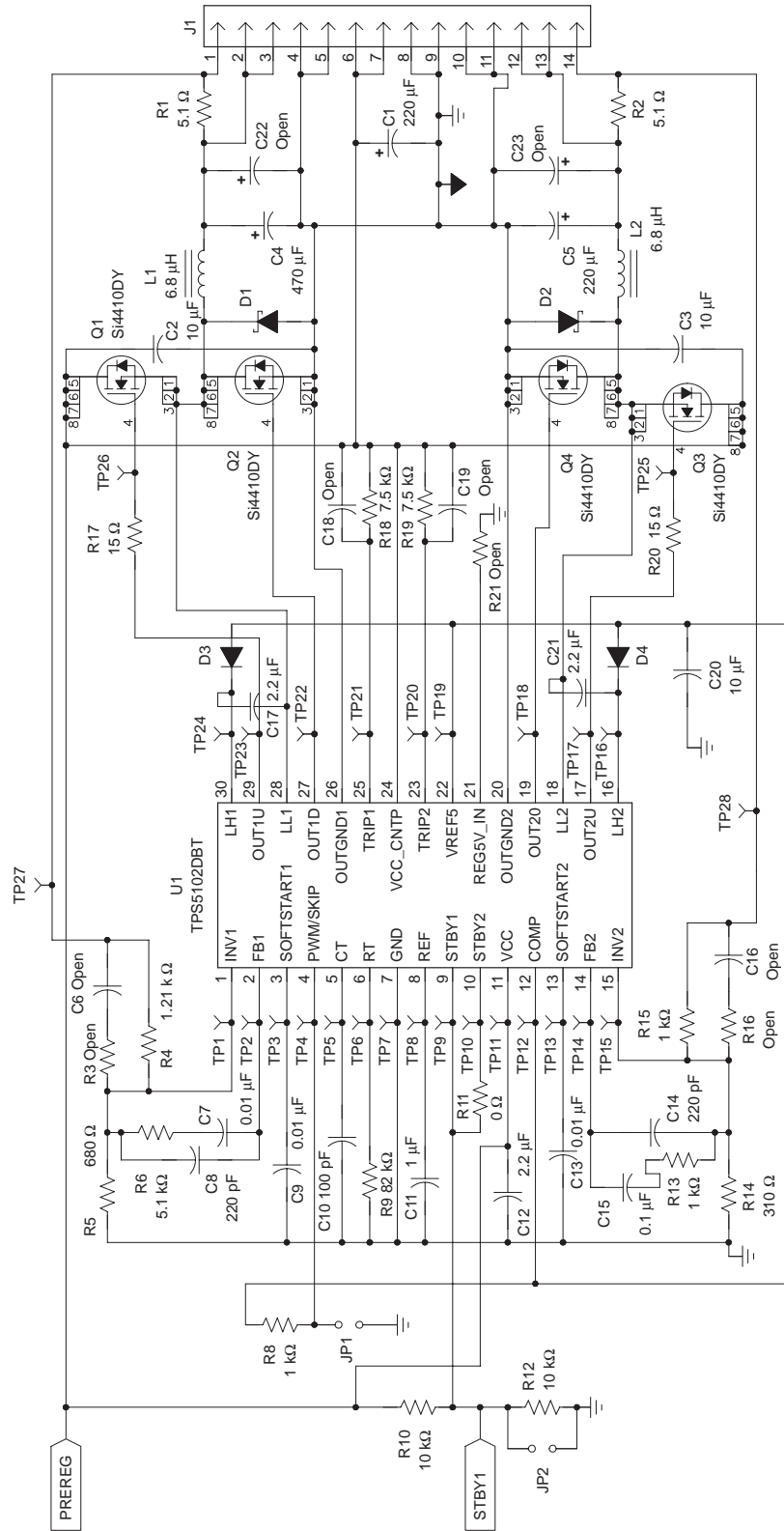


Figure 3–2. Schematic of the InfiniBand Bulk Power Evaluation Module (EVM) (Part 1)



NOTE: A 14-V Zener diode in parallel with C25 is recommended for noisy applications to limit the input voltage within the operation range of TPS2331

Figure 3–2. Schematic of the InfiniBand Bulk Power Evaluation Module (EVM) (Part 2)(Continued)



The schematic for InfiniBand bulk power EVM (Figure 3–2) shows three jumpers (JP1, JP2, and JP3). JP1 is used to set the dc/dc converter stage in PWM (normal) or skip (power-saving) mode. For normal operation, short JP1, then the converter will be in PWM mode. JP2 is used to shut down the dc/dc converter when it is shorted, so this jumper should not be shorted if the dc/dc conversion is required. JP3 should be shorted for InfiniBand bulk power evaluation because the InfiniBand specification recommends the power-good signal of the hot-swap stage to enable the dc/dc converter.

A 14-V Zener diode in parallel with C25 is recommended if the backplane power is noisy or has potential high voltage spikes, higher than 14 V.

Several components along with the jumpers and test points are only for evaluation purposes and are not necessary for the hot-swap and/or dc/dc applications. Refer to the data sheets to optimize your designs.

A key is installed in the edge connector on the interface board (SLSP155) to ensure that the board can only be inserted in the correct direction.

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, C3 | Not used | | | | |
| C2 | 1 | LSR100/16DK125 | Capacitor, tantalum, 100- μ F, 16 V, 10% | NEMCO | D Case |
| C4, C6 | Not used | | | | |
| C5 | 1 | GMK325F106ZH | Capacitor, ceramic, 10- μ F, 35-V | Taiyo Yuden | 1210 |
| C7, C9 | Not used | | | | |
| C8 | 1 | GRM40X7R105K16 | Capacitor, ceramic, 1- μ F, 16 V | MuRata | 0805 |
| 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 | 2 | Std | Resistor, chip, 10 k Ω , 1/10 W, 5% | Std | 1206 |
| S1 | 1 | 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 InfiniBand Bulk Power EVM (SLVP185), Bill of Materials

| RefDes | Qty | Part Number | Description | MFR | Size |
|-----------------|-----|-----------------|---|-------------|------------------|
| C7,C9,C13 | 3 | GRM40X7R103K25 | Capacitor, ceramic, 0.01 μ F, 25 V | MuRata | 805 |
| C25,C26,C28,C29 | 4 | C0805C104K5RAC | Capacitor, ceramic, 0.1 μ F, 50 V | Kemet | 805 |
| C15 | 1 | C0805C104K5RAC | Capacitor, ceramic, 0.1 μ F, 50 V | Kemet | 805 |
| C27 | 1 | PCCC1832TR–ND | Capacitor, ceramic, 0.22 μ F, 25 V | Panasonic | 805 |
| C11 | 1 | GRM40X7R105K16 | Capacitor, ceramic, 1 μ F, 16 V | MuRata | 805 |
| C24 | 1 | GRM40X7R333K25 | Capacitor, ceramic, 33 nF, 16 V | MuRata | 805 |
| C10 | 1 | GRM40X7R105K16 | Capacitor, ceramic, 100 pF, 16 V | MuRata | 805 |
| C8 | 2 | GRM33X7R221K6 | Capacitor, ceramic, 220 pF, 16 V | MuRata | 805 |
| C14 | | GRM33X7R221K6 | Capacitor, ceramic, 220 pF, 16 V | MuRata | 805 |
| C6,C16,C18,C19 | 4 | OPEN | OPEN | | 805 |
| C12,C17,C21 | 3 | GMK316F225ZG | Capacitor, ceramic, 2.2 μ F, 35 V | Taiyo Yuden | 1206 |
| C2,C3 | 2 | GMK325F106ZH | Capacitor, ceramic, 10 μ F, 35 V | Taiyo Yuden | 1210 |
| C20 | 1 | GRM325F106ZH | Capacitor, ceramic, 10 μ F, 35 V | Taiyo Yuden | 1210 |
| C5 | 1 | 10TPB220M | Capacitor, POSCAP, 220 μ F, 4 V | Sanyo | D Case |
| C4 | 1 | 4TPB470M | Capacitor, POSCAP, 470 μ F, 4 V | Sanyo | D Case |
| C22,C23 | 2 | OPEN | OPEN | | D Case |
| C1 | 1 | RV–35V221MH10–R | Capacitor, electrolytic, 220 μ F, 35 V | ELNA | 10 \times 10mm |
| P1 | 1 | N/A | 44-pin edge | N/A | |
| D1 | 2 | MBRS340T3 | Diode, Schottky, 40 V, 3 A | Motorola | SMC |
| D2 | | MBRS340T3 | Diode, Schottky, 40 V, 3 A | Motorola | SMC |
| D3 | 2 | SD103–AWDICT | Diode, switching, 200 mA, 40 V | Diodes Inc | DL–35 |
| D4 | | SD103–AWDICT | Diode, switching, 200 mA, 40 V | Diodes Inc | DL–35 |
| J17 | 1 | PTC36SAAN | Header, 4-pin, 100 mil spacing, (36-pin strip) | Sullins | |
| J1 | 1 | PTC36SAAN | Header, 14-pin, 100 mil spacing, (36-pin strip) | Sullins | |
| L1,L2 | 2 | DO3316P–682 | Inductor, SMT, 6.8 μ H, 4.4 A, | Coilcraft | |
| JP1,JP2,JP3 | 3 | PTC36SAAN | Header, 2-pin, 100 mil spacing, (36-pin strip) | Sullins | |
| R11 | 1 | Std | Resistor, chip, 0 Ω , 1/10 W, 5% | Std | 805 |
| R8,R13,R15 | 3 | Std | Resistor, chip, 1 k Ω , 1/10 W, 5% | Std | 805 |
| R4 | 1 | Std | Resistor, chip, 1.21 k Ω , 1/10 W, 1% | Std | 805 |
| R1,R2 | 2 | Std | Resistor, chip, 5.1 Ω , 1/10 W, 5% | Std | 805 |
| R6 | 1 | Std | Resistor, chip, 5.1 k Ω , 1/10 W, 5% | Std | 805 |
| R18,R19 | 2 | Std | Resistor, chip, 7.5 k Ω , 1/10 W, 5% | Std | 805 |
| R10 | 2 | Std | Resistor, chip, 10 k Ω , 1/10 W, 5% | Std | 805 |
| R12 | | Std | Resistor, chip, 10 k Ω , 1/10 W, 5% | Std | 805 |
| R17,R20 | 2 | Std | Resistor, chip, 15 Ω , 1/10 W, 5% | Std | 805 |
| R9 | 1 | Std | Resistor, chip, 82 k Ω , 1/10 W, 5% | Std | 805 |
| R14 | 1 | Std | Resistor, chip, 310 Ω , 1/10 W, 1% | Std | 805 |
| R5 | 1 | Std | Resistor, chip, 680 Ω , 1/10 W, 1% | Std | 805 |
| R3,R16,R21 | 3 | Std | OPEN | | 805 |
| R24 | 1 | Std | Resistor, chip, 1 Ω , 1/8 W, 5% | Std | 1206 |
| R26 | 1 | Std | Resistor, chip, 11 Ω , 1/8 W, 5% | Std | 1206 |

Table 3–2. Components on the InfiniBand Bulk Power EVM (SLVP185), Bill of Materials (Continued)

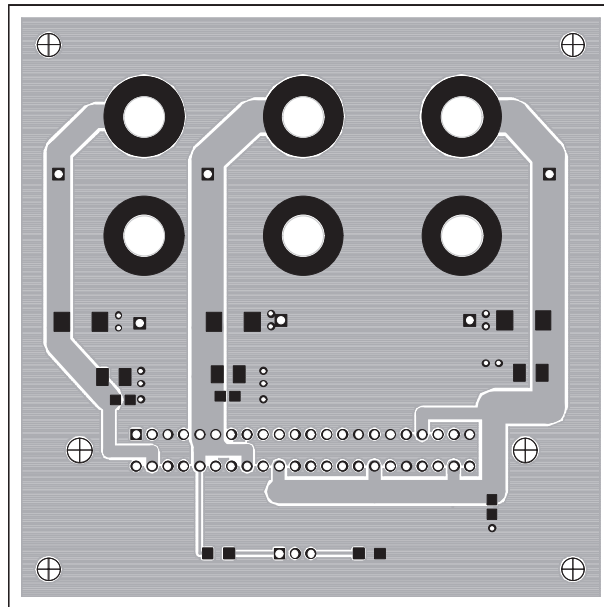
| RefDes | Qty | Part Number | Description | MFR | Size |
|---|-----|------------------------|---|-----------|-------|
| R29 | 1 | Std | Resistor, chip, 75 Ω , 1/8 W, 5% | Std | 1206 |
| R22,R25,R30 | 3 | Std | Resistor, chip, 100 Ω , 1/8 W, 5% | Std | 1206 |
| R7 | 1 | WSL-2512-01, 1% R86 | Resistor, chip, 0.01 Ω , 1 W, 1% | Dale | 2512 |
| U2 | 1 | TPS2330ID | Single hot-swap P/controller w/circuit breaker and PG | TI | SO14 |
| U1 | 1 | TPS5102DBT | IC, dual controller, PWM/skip mode | TI | DBT30 |
| TP7,TP29,TP31, TP35 | 4 | 240-333 | Test point, black, 1 mm | Farnell | |
| TP1-TP6,TP8-TP28, TP30,TP32, TP33,TP34,TP36 | 32 | 240-345 | Test point, red, 1 mm | Farnell | |
| Q1-Q5 | 5 | Si4410DY | MOSFET, N-ch, 30 V, 10-A, 13-m Ω | Siliconix | SO8 |
| Shunts for JP1, JP2 | 2 | 929950-00 | Jumper shunt | 3M | |



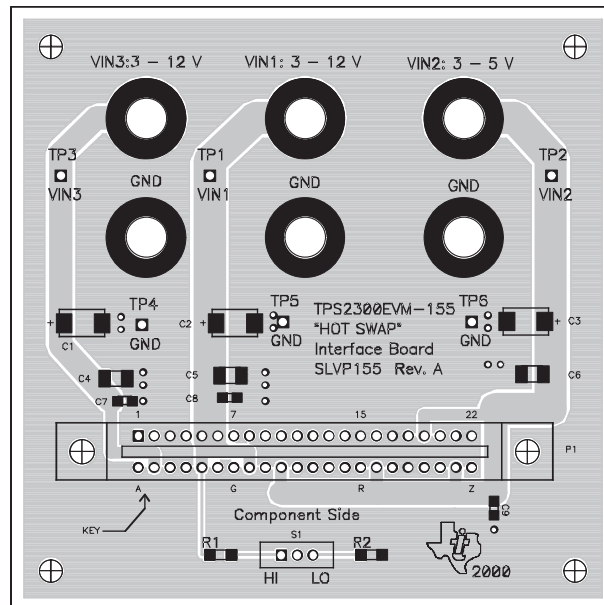
Layouts of the EVM and the Interface Card

The following figures illustrate the placements of the components and the top-layer layouts for both the InfiniBand bulk power EVM and the interface card respectively. All the components are placed on the top layers only. The bottom layers are ground planes except for a few short traces on the InfiniBand bulk power EVM.

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

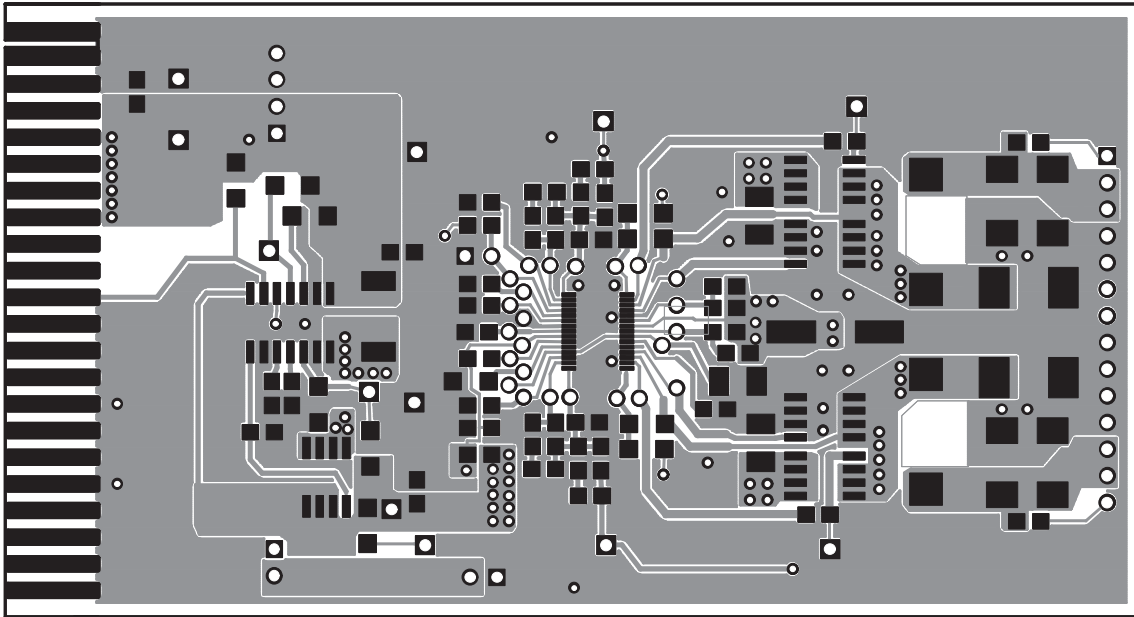


Top Layer

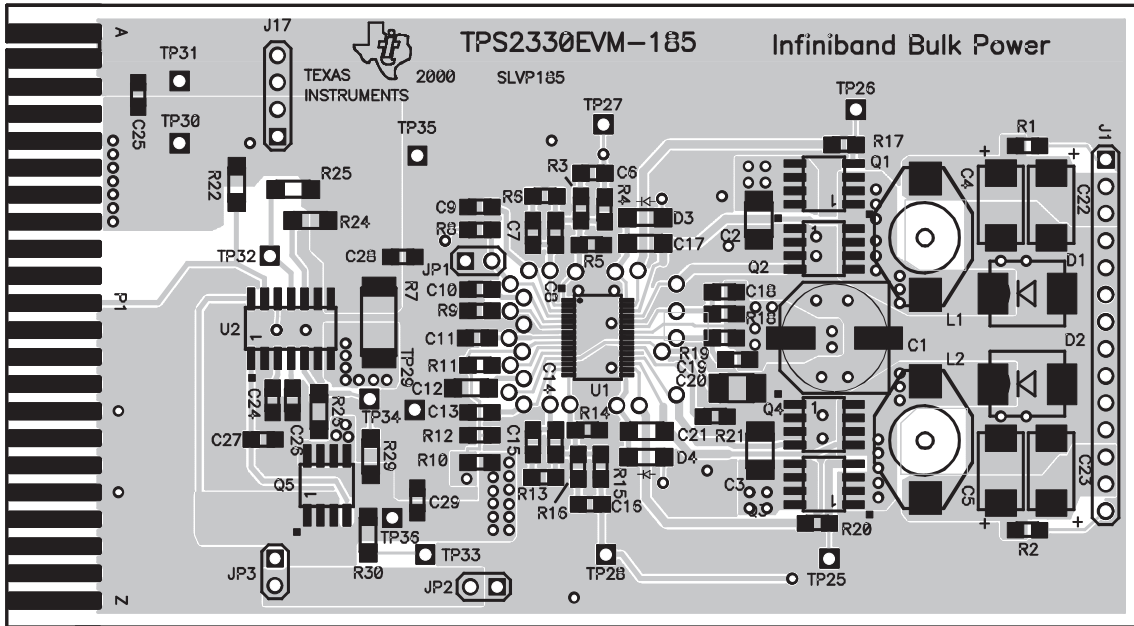


Top Assembly

Figure 4–2. Top Layer of the InfiniBand Bulk Power EVM and Placement of Components



Top Layer



Top Assembly



Setup of the EVM

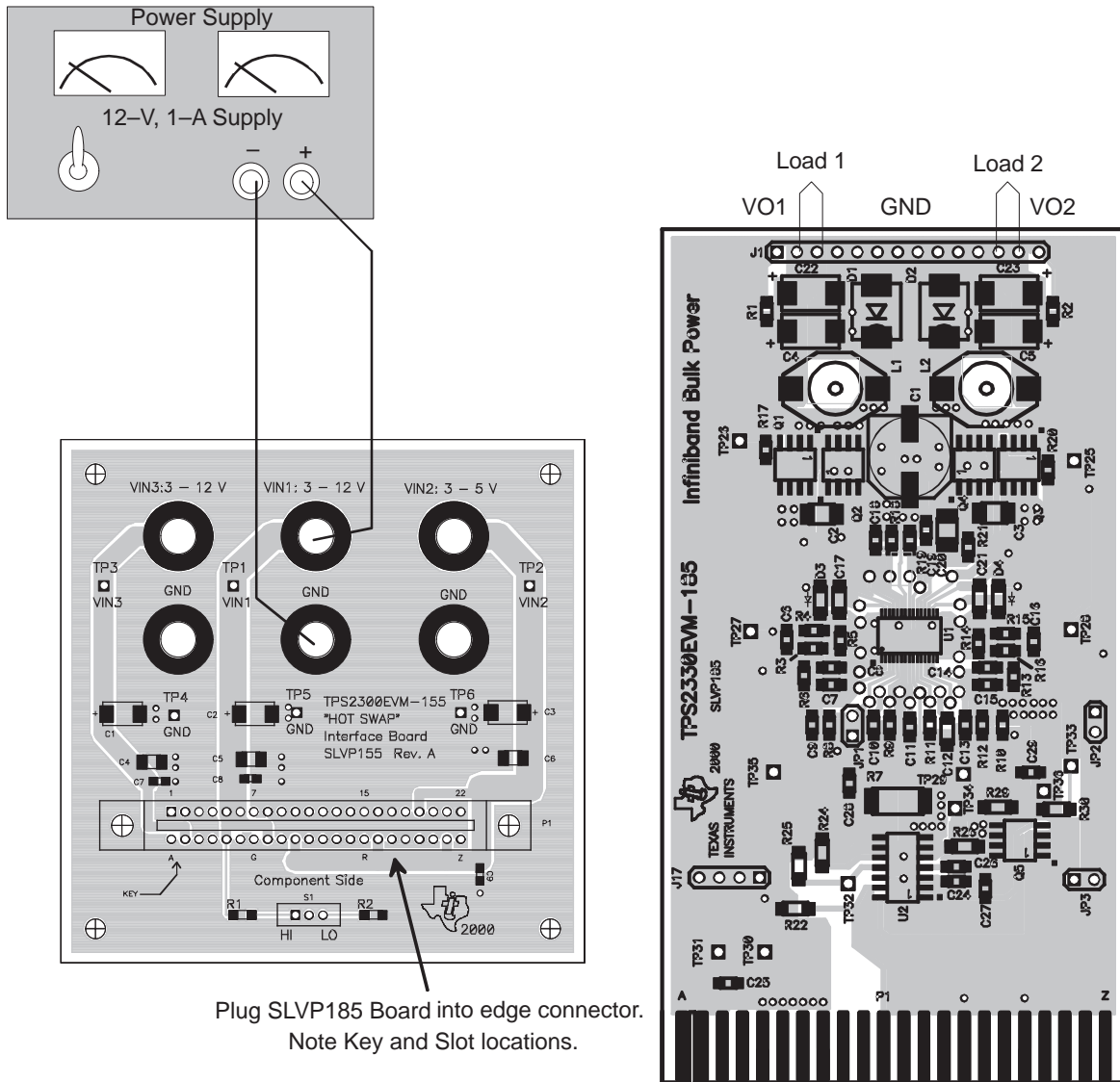
For proper operation of the EVM, one 12-V 1-A power supply, two resistive loads, and a couple of voltage meters are required.

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

- 1) Verify that the power-supply voltage is set at 12 V. Make sure the supply has the capability to provide the current loads need. Turn off the supply.
- 2) Connect the loads to the two output pins—one load connected from VO1 (pin 2 or 3 of J1 on SLVP185) to ground (pin 4 or 5 of J1 on SLVP185), and the other load from VO2 (pin 12 or 13 of J1 on SLVP185) to ground. Monitor the voltages from VO1 and VO2 to ground respectively.
- 3) Plug the supply into the interface card; connect the supply from IN1 to ground. Then turn the power supply on. Check the voltage from VIN1 to GND and it should be about 12 V.
- 4) Slide the switch S1 on the interface board (SLVP155) to HI if the hot-swap controller U2 on SLVP185 is TPS2331 (or to LO if the hot-swap controller U2 on SLVP185 is TPS2330). Otherwise, the supply will not be connected to the loads, because the TPS2331 is an active-high-enabling device and TPS2330 is an active-low-enabling device.
- 5) Short jumpers JP1 and JP3 on the hot-swap board (SLVP185). *Do not* short the jumper JP2.
- 6) Plug the hot-swap board (SLVP185) into the interface board (SLVP155). The key installed between pins 1 and 2 of the edge connector ensures that the board can only be inserted in the correct direction.
- 7) Test points or headers are provided for oscilloscope probes and/or multimeters. Read the voltage from the multimeters connecting from VO1 (pin 2 or 3 of J1 on SLVP185) and VO2 (pin 12 or 13 of J1 on SLVP185) to GND (pin 4 or 5 of J1 on SLVP185). The values on the meter should be about 5 V and 3.3 V respectively. Otherwise, the board may have problems or the testing may not be correct.
- 8) Unplug the SLVP185 board from the interface card.

The current limits for VO1 and VO2 were set to be less than 3 A on the EVM. If higher currents are required, adjust the resistor values as indicated in the TPS5102 and TPS2331 data sheets, and use a supply with a higher current rating.

Figure 5–1. Evaluation Setup of the InfiniBand Bulk Power EVM



Test Points

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

- TP1 – VIN1 (input voltage)
- TP5 – GND (ground)

On the InfiniBand Bulk Power EVM, there are total 36 test points:

- TP1 – Pin 1 (INV1) of TPS5102
- TP2 – Pin 2 (FB1) of TPS5102
- TP3 – Pin 3 (SOFTSTART1) of TPS5102
- TP4 – Pin 4 (PWM/SKIP) of TPS5102
- TP5 – Pin 5 (CT) of TPS5102
- TP6 – Pin 6 (RT) of TPS5102
- TP7 – Pin 7 (GND) of TPS5102
- TP8 – Pin 8 (REF) of TPS5102
- TP9 – Pin 9 (STBY1) of TPS5102
- TP10 – Pin 10 (STBY2) of TPS5102
- TP11 – Pin 11 (VCC) of TPS5102
- TP12 – Pin 12 (COMP) of TPS5102
- TP13 – Pin 13 (SOFTSTART2) of TPS5102
- TP14 – Pin 14 (FB2) of TPS5102
- TP15 – Pin 15 (INV2) of TPS5102
- TP16 – Pin 16 (LH2) of TPS5102
- TP17 – Pin 17 (OUT2U) of TPS5102
- TP18 – Pin 19 (OUT2D) of TPS5102 and gGate of Q4 SI4410DY
- TP19 – Pin 22 (VREF5) of TPS5102
- TP20 – Pin 23 (TRIP2) of TPS5102
- TP21 – Pin 25 (TRIP1) of TPS5102

TP22 – Pin 27 (OUT1D) of TPS5102 and gate of Q2 SI4410DY
TP23 – Pin 29 (OUT1U) of TPS5102
TP24 – Pin 30 (LH1) of TPS5102
TP25 – Gate of Q3 SI4410DY
TP26 – Gate of Q1 SI4410DY
TP27 – Pin1 of J1 (channel 1 control feedback)
TP28 – Pin14 of J1 (channel 2 control feedback)
TP29 – GND
TP30 – Input, pin 1 and 2 of J17
TP31 – GND
TP32 – ENABLE pin of TPS2331
TP33 – PWRGD pin of TPS2331
TP34 – VSENSE pin of TPS2331
TP35 – GND
TP36 – Output of hot-swap stage and input of dc/dc converter

In addition to all the above listed test points, the header J1 on the InfiniBand bulk power EVM can be used as a test point for VO1 and VO2 or connecting loads:

Pins 1 of J1 – same as TP27
Pins 2 and 3 of J1 – VO1
Pins 4 and 5 of J1 – GND
Pins 6 and 7 of J1 – same as TP36
Pins 8 and 9 of J1 – GND
Pins 10 and 11 of J1 – GND
Pins 12 and 13 of J1 – VO2
Pins 14 of J1 – same as TP28