

## ***TPS2480 and TPS2481 Evaluation Module***

This user's guide describes the evaluation modules (EVM) for the TPS2480 and TPS2481. TPS2480 and TPS2481 are positive-voltage, power-limiting, hot-swap controllers with a built-in I2C™ current monitor. The TPS2480 operates in a latched fault manner whereas the TPS2481 operates in an automatic retry manner.

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## 1 Description

The EVM design allows for several common application designs: a 12-V system with latched or automatic retry and a 48-V system with latched or automatic retry. The 12-V versions feature Texas Instruments new line of high-performance power MOSFETs. The EVM also provides a USB interface for the I2C™ current monitor when using the TPS2480/1 GUI on a PC.

### 1.1 Features

- General TPS2480/1 Device Features
  - Programmable current limiting and power limiting for complete SOA protection
  - Programmable fault timer to eliminate nuisance shutdowns
  - Programmable undervoltage lockout
  - Power good
  - Latched operation mode (TPS2480)
  - Automatic retry mode (TPS2481)
- EVM Configurable Options
  - TPS2481EVM-001 (12 V, 480 W, auto retry)
  - TPS2480EVM-002 (12 V, 480 W, latched)
  - High-voltage applications (48 V, 400 W, auto retry or latched)

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**NOTE:** The high-voltage version is not orderable. For details, see the schematic and bill of materials.

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### 1.2 Applications

- Any live backplane insertion application
  - Servers
  - Telecommunications

### 1.3 Electrical Specifications

**Table 1. TPS2480/1EVM Electrical and Performance Specifications at 25°C**

| Characteristic                          | TPS2481EVM-001<br>TPS2480EVM-002 | High-Voltage Application |
|-----------------------------------------|----------------------------------|--------------------------|
| Maximum input voltage                   | 15 V                             | 57 V                     |
| Input voltage (operating)               | 10 V 14 V                        | 42 V to 54 V             |
| Turnon voltage (maximum)                | 9 V                              | 35.8 V                   |
| Turnoff voltage (minimum)               | 7.9 V                            | 31.6 V                   |
| Nominal current                         | 40 A                             | 8.3 A                    |
| Trip point current                      | 45 A to 55 A                     | 9 A to 11 A              |
| Operating temperature                   | –40°C to 85°C                    | –40°C to 85°C            |
| TPS2480 fault timer trip time (nominal) | 528 µs                           | 240 µs                   |
| TPS2481 fault timer period (nominal)    | 4.4 ms                           | 2.0 ms                   |
| Program power limit (Vprog/2*R1)        | 200 W                            | 400 W                    |

## 2 General Configuration and Description

### 2.1 Physical Access

Table 2 lists the TPS2480/1EVM connector functionality, and Table 3 describes the test point availability.

**Table 2. Connector Functionality**

| Connector | Label     | Description                                                                                                                                                                                         |
|-----------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J1/J6     | +IN/–IN   | Power bus input (high-current, screw-down lugs). J1 is +IN and J6 is –IN. Apply bus input voltage between either J1/J6 or between J3/J8.                                                            |
| J3/J8     | +IN/–IN   | Power bus input (banana jack). J3 is +IN and J8 is –IN. Apply bus input voltage between either J1/J6 or between J3/J8.                                                                              |
| J2/J5     | +OUT/–OUT | Switched bus output (high-current, screw-down lugs). J2 is +OUT and J5 is –OUT. Apply the load between either J2/J5 or between J4/J7.                                                               |
| J4/J7     | +OUT/–OUT | Switched bus output (banana jack). J4 is +OUT and J7 is –OUT. Apply the load between either J2/J5 or between J4/J7.                                                                                 |
| J13       | USB       | USB port. Connect furnished USB cable to PC when using the TPS2480/1 GUI                                                                                                                            |
| J9        | A1        | Allows selection of the A1 I2C address bit. The EVM default is set to address 1000000 by R13/R14. For other address options, remove R13/R14 and see the table on the schematic.                     |
| J10       | A0        | Allows selection of the A0 I2C address bit. The EVM default is set to address 1000000 by R13/R14. For other address options remove R13/R14 and see the table on the schematic.                      |
| S1        | EN        | Selecting the S1 EN position (toward TP15) allows the TPS2480/1 to enable the MOSFET if the power bus input is above the turn on voltage. Setting S1 away from the EN position disables the MOSFET. |
| J11, J12  |           | For manufacturing use only. Shunts must remain installed in J11 and J12.                                                                                                                            |

**Table 3. Test Points**

| Test Point | Color | Label    | Description                                                                                                                                             |
|------------|-------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| TP2        | RED   | +IN      | Power bus input high.                                                                                                                                   |
| TP5        | BLK   | –IN      | Power bus input low.                                                                                                                                    |
| TP3        | ORG   | +OUT     | Switched bus output high.                                                                                                                               |
| TP4        | BLK   | –OUT     | Switched bus output low.                                                                                                                                |
| TP1        | WHT   | SNS      | SNS pin test point.                                                                                                                                     |
| TP6        | WHT   | GATE     | GATE pin test point.                                                                                                                                    |
| TP10       | WHT   | PG       | PG pin (power good) test point.                                                                                                                         |
| TP16       | WHT   | TMR      | TMR pin (timer) test point.                                                                                                                             |
| TP18       | WHT   | PRG      | PROG pin (power program) test point.                                                                                                                    |
| TP15       | WHT   | EN       | EN pin (enable) test point.                                                                                                                             |
| TP14       | WHT   | SCL      | SCL pin (serial clock) test point.                                                                                                                      |
| TP13       | WHT   | SDA      | SDA pin (serial data) test point.                                                                                                                       |
| TP12       | WHT   | A1       | A1 pin (upper address bit) test point. Level set by R14 and J9.                                                                                         |
| TP11       | WHT   | A0       | A0 pin (lower address bit) test point. Level set by R13 and J10.                                                                                        |
| TP17       | RED   | 3P3V_USB | VS pin (current monitor supply voltage) test point. The USB source applied at J13 powers the current monitor.                                           |
| TP19       | BLK   | GND      | GNDB pin (current monitor ground) test point. The USB source applied at J13 powers the current monitor.                                                 |
| TP7        | WHT   | HSNS     | High-voltage (HV) sense test point. TPS2480/1EVM-001 provides a circuit to shift the current monitor input. This test point mirrors the voltage at TP1. |
| TP9        | WHT   | LSNS     | Low-voltage (LV) sense test point. This test point represents the HV to LV mirrored current sense voltage.                                              |
| TP8        | RED   | V–       | Sense voltage mirror negative supply voltage. Normally –5 V below the power bus high-input voltage.                                                     |
| D6         | GRN   | USB      | USB active indicator LED. When a USB power source is presently connected to a PC, this LED illuminates.                                                 |

### 3 Test Setup

Figure 1 shows a typical test setup for TPS2480/1EVM. Input voltage can be applied as described in Table 2.

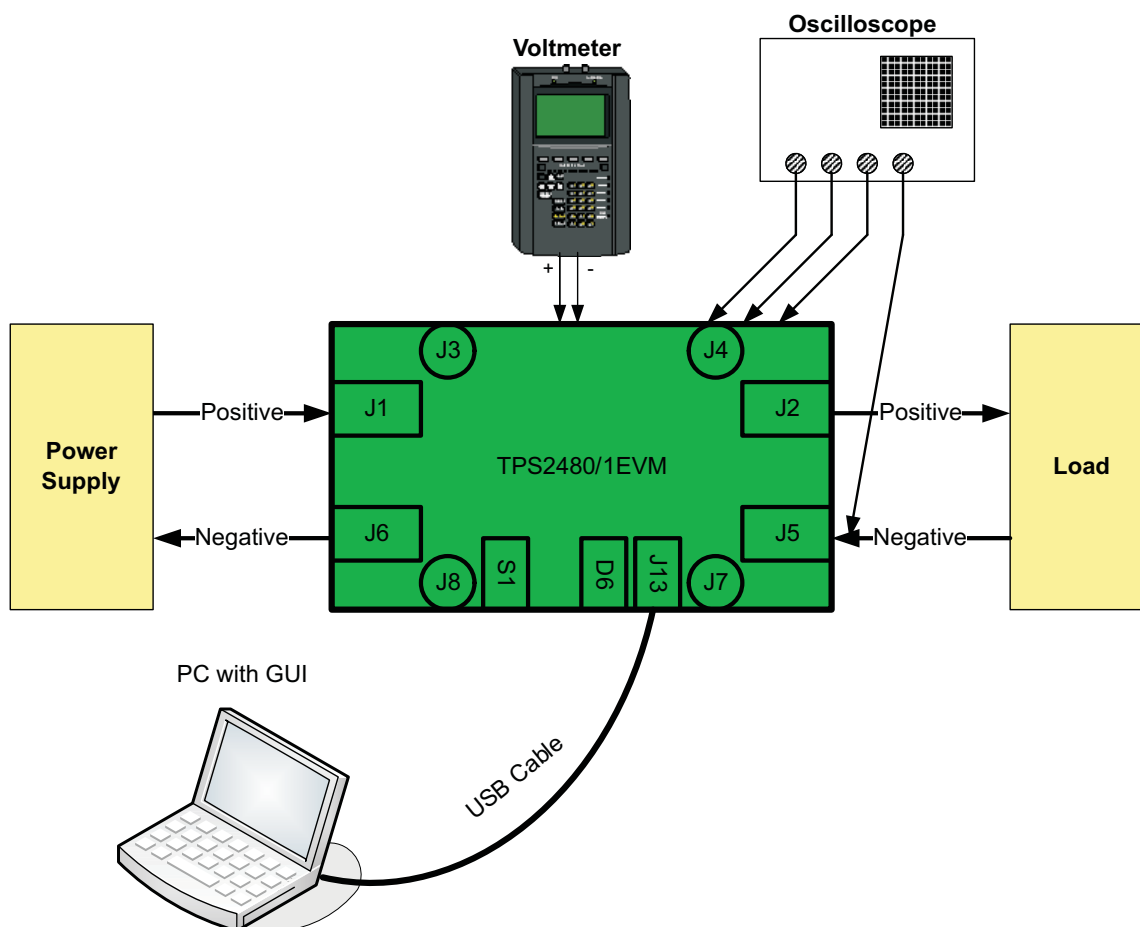


Figure 1. Typical TPS2480/1EVM Test Setup

## 4 TPS2480/1EVM GUI Setup

### 4.1 TPS2480/1EVM GUI Installation

If not already performed on the PC/laptop to be used for test, open the TPS2480/1 GUI ([SLUC167](#)) file, and extract it to a known folder.

### 4.2 TPS2480/1EVM GUI Operation

- Navigate to the TPS2480\_1EVM.exe file, and double-click it. A GUI as shown in [Figure 2](#) or [Figure 4](#) appears. For a detailed example of the equations running behind the GUI, see the TPS2480/81 data sheet ([SLUS939](#)).
- Click the Calibrate tab of the GUI. A GUI form as shown in [Figure 3](#) or [Figure 5](#) appears.
- Type the appropriate Rshunt value into the text box (0.001 for TPS2480EVM-002/TPS2481EVM-001 or 0.005 for the High Voltage Application). Press the Enter Shunt Resistance GUI button.
- Type a value of 60 into Max Expected Current  $\pm$  text box. Press the Enter Max Expected Current GUI button.
- Type a value of 0.002 into Enter LSB text box. Press the Enter Current LSB GUI button.
- At this time, the Read Initial Cal Current pushbutton activates (right side of Calibrate form under Second Calibration). Press the Read Initial Cal Current GUI button.
- Type the appropriate Measured Shunt Current value into the text box. Press the *Compute New Full Scale and Read Post Second Cal Current* GUI button.
- Press the Write all Edited and then the Read all Reg buttons in sequence.

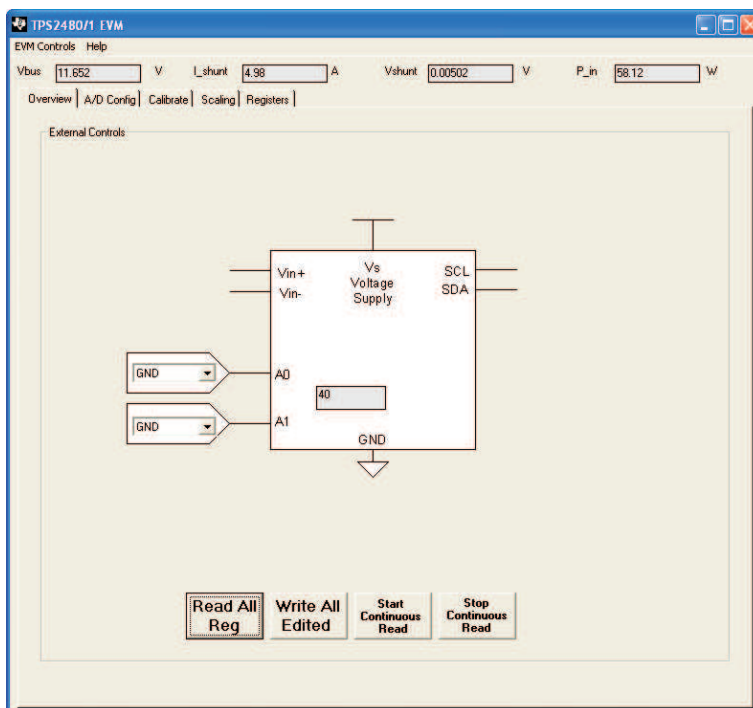


Figure 2. TPS2481EVM-001 and TPS2480EVM-002 GUI Overview Form

Figure 3. TPS2481EVM-001 and TPS2480EVM-002 GUI Calibrate Form

Figure 4. High-Voltage Application GUI Overview Form

**Figure 5. High-Voltage Application GUI Calibrate Form**

## 5 TPS2480/1EVM Typical Performance Data

### 5.1 TPS2481EVM-001 and TPS2480EVM-002 Power Limit Curves

Figure 6 illustrates the current limit versus output voltage curve for TPS2481EVM-001 and TPS2480EVM-002.

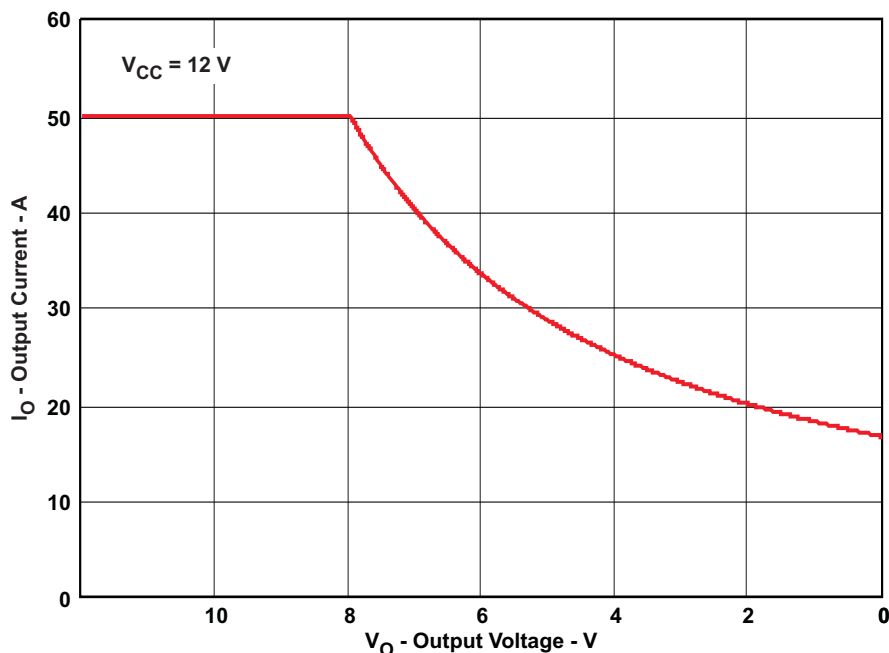


Figure 6. TPS2481EVM-001 and TPS2480EVM-002 Current and Power Limit Curve

### 5.2 High-Voltage Application Power Limit Curves

Figure 7 illustrates the current limit versus output voltage curve for the high-voltage application.

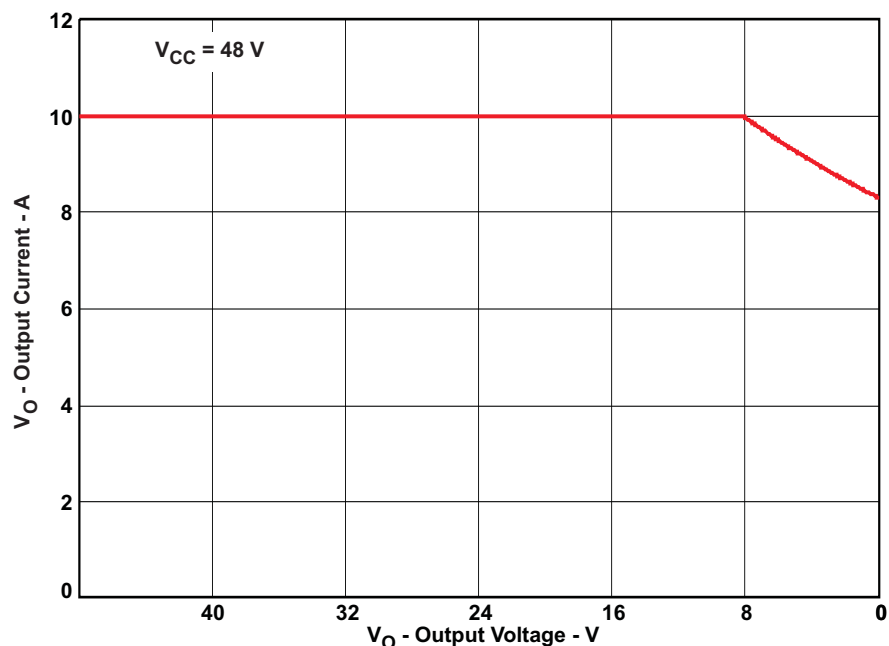
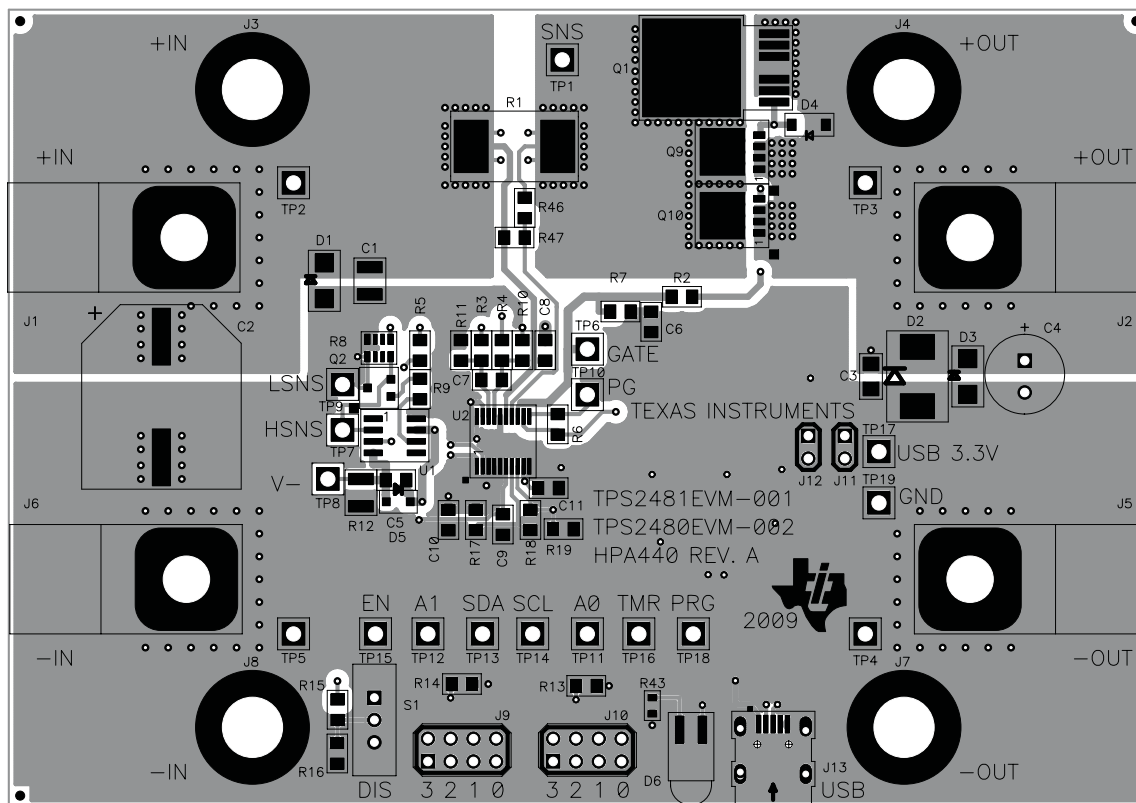


Figure 7. High-Voltage Application Current and Power Limit Curve

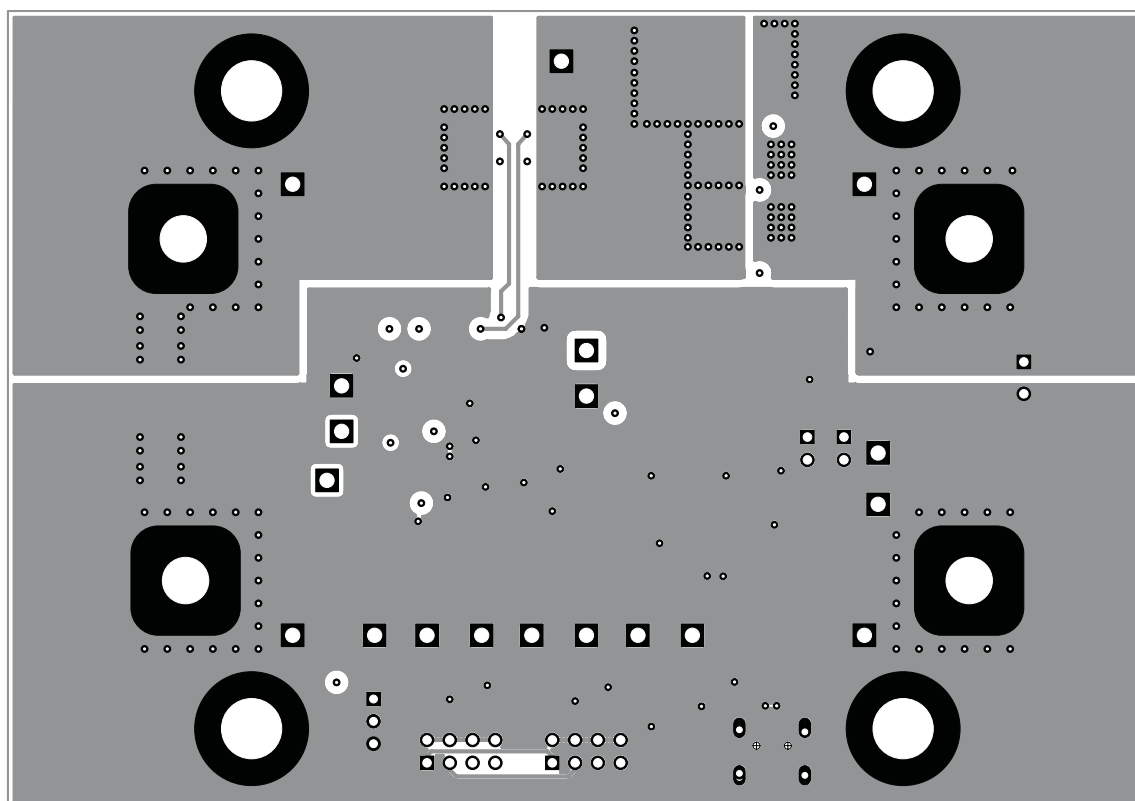
## 6 EVM Assembly Drawing and Layout Guidelines

### 6.1 PCB Drawings

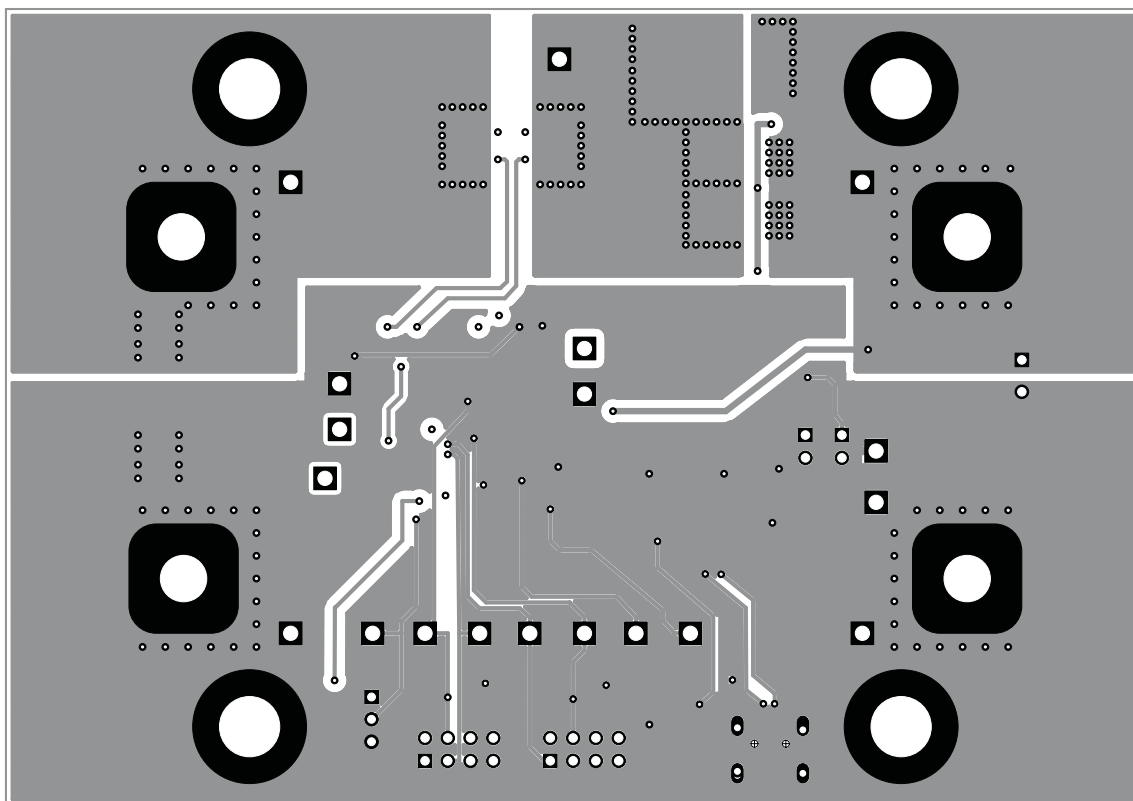
Figure 8 through Figure 11 show component placement and layout of the EVM.



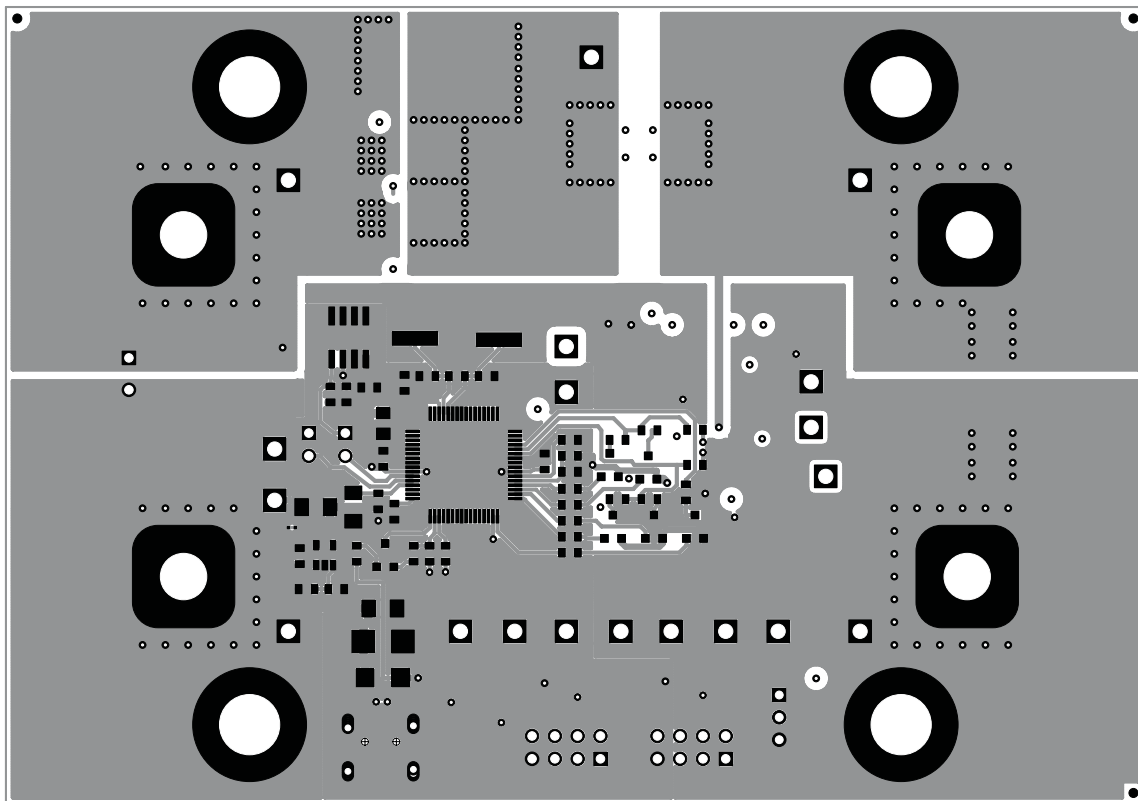
**Figure 8. Top Side Layout/Routing**



**Figure 9. Layer Two Routing**



**Figure 10. Layer Three Routing**



**Figure 11. Bottom Side Placement/Routing**

## 6.2 Layout Guidelines

The TPS2480/1 circuit layout must follow power and EMI/ESD best-practice guidelines. A basic set of recommendations include:

- Arrange the high-power devices so that current flows in a sequential, linear fashion.
- Place a good ground plane under the power planes and TPS2480/1.
- The TPS2480/81 must be placed close to the sense resistor and MOSFET using a Kelvin type connection to achieve accurate current sensing.
- A low-impedance GND connection is required because the TPS2480/81 can momentarily sink upwards of 100 mA from the gate of the MOSFET. The GATE amplifier has high bandwidth while active, so keep the GATE trace length short.
- Spacing consistent with safety standards like IEC60950 must be observed between the 48-V input voltage rails and between the input and an isolated converter output.
- Large copper fills and traces must be used on SMT power-dissipating devices, and wide traces or overlay copper fills must be used in the power path.
- The PROG, TIMER, and EN pins have high input impedances; therefore, their input lead length must be minimized.
- Oversize power traces and power device connections assuring low voltage drop and good thermal performance.

## 7 Bill of Materials and Schematics

### 7.1 Bill of Materials

**Table 4. Bill of Materials**

| High Voltage Count |         | Count          |                | RefDes                 | Value          | Description                                                    | Size                | Part Number     | Supplier                |
|--------------------|---------|----------------|----------------|------------------------|----------------|----------------------------------------------------------------|---------------------|-----------------|-------------------------|
| TPS2480            | TPS2481 | TPS2480EVM-002 | TPS2481EVM-001 |                        |                |                                                                |                     |                 |                         |
| 1                  | 1       | 1              | 1              | C1                     | 1μF            | Capacitor, Ceramic, 100V, X7R, 10%                             | 1210                | Std             | Std                     |
| 1                  | 1       | 0              | 0              | C11                    | 1.5nF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 0805                | Std             | Std                     |
| 0                  | 0       | 1              | 1              | C11                    | 3.3nF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 0805                | Std             | Std                     |
| 6                  | 6       | 6              | 6              | C12, C16–C18, C21, C23 | 0.1μF          | Capacitor, Ceramic, X7R, 16V, 10%                              | 0603                | Std             | Std                     |
| 2                  | 2       | 2              | 2              | C13, C14               | 22pF           | Capacitor, Ceramic, 50V, C0G, 10%                              | 0603                | Std.            | Std.                    |
| 1                  | 1       | 1              | 1              | C15                    | 1000pF         | Capacitor, Ceramic, 100V, C0G, 5%                              | 0805                | Std.            | Std.                    |
| 1                  | 1       | 1              | 1              | C19                    | 1μF            | Capacitor, Tantalum, 16V, 20%                                  | 3216                | 293D105X0016A2T | Vishay                  |
| 1                  | 1       | 0              | 0              | C2                     | 47μF           | Capacitor, Aluminum, SM, 100V, 20%                             | 0.670 × 0.750       | EEVFK2A470Q     | Panasonic               |
| 0                  | 0       | 1              | 1              | C2                     | 1000μF         | Capacitor, Aluminum, SM, 25V, 20%                              | 0.670 × 0.750       | EEVFK1E102Q     | Panasonic               |
| 2                  | 2       | 2              | 2              | C20, C22               | 10μF           | Capacitor, Tantalum, 10V, 20%                                  | 3216                | 293D106X0010A2T | Vishay                  |
| 1                  | 1       | 1              | 1              | C3                     | 0.1μF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 1206                | Std             | Std                     |
| 1                  | 1       | 0              | 0              | C4                     | 47μF           | Capacitor, Panasonic, 100V, 20%                                | 0.315               | ECA-2AM470      | Panasonic               |
| 0                  | 0       | 1              | 1              | C4                     | 330μF          | Capacitor, Panasonic, 25-V, 20%                                | 0.315               | ECA-1EM331      | Panasonic               |
| 1                  | 1       | 0              | 0              | C5                     | 0.1μF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 0805                | Std             | Std                     |
| 3                  | 3       | 3              | 3              | C8, C9, C10            | 0.1μF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 0805                | Std             | Std                     |
| 0                  | 0       | 0              | 0              | C6, C7                 | 0.1μF          | Capacitor, Ceramic, 100V, X7R, 10%                             | 0805                | Std             | Std                     |
| 2                  | 2       | 0              | 0              | D1, D3                 | SMAJ58A        | Diode, TVS, 58V, 1W                                            | SMA                 | SMAJ58A         | Diodes Inc.             |
| 0                  | 0       | 2              | 2              | D1, D3                 | SMAJ16A        | Diode, TVS, 16V, 1W                                            | SMA                 | SMAJ16A         | Diodes Inc.             |
| 1                  | 1       | 1              | 1              | D2                     | MBRS3100T3     | Diode, Schottky 3-A 100-V                                      | SMC                 | MBRS3100T3      | On Semi                 |
| 0                  | 0       | 0              | 0              | D4                     | BZT52C8V2      | Diode, Zener, Planar Power, 500mW, 8.2V                        | SOD-123             | BZT52C8V2-7     | Diodes Inc.             |
| 1                  | 1       | 0              | 0              | D5                     | BZT52C5V1      | Diode, Zener, 200mW, 5.1V                                      | SOD-323             | BZT52C5V1S      | Diodes Inc.             |
| 1                  | 1       | 1              | 1              | D7                     | MBRA130        | Diode, Schottky, 1A, 30V                                       | SMA                 | MBRA130         | IR                      |
| 1                  | 1       | 1              | 1              | D8                     | 7.5V           | Diode, Zener, 7.5V, 3W                                         | SMB                 | 1SMB5922BT3     | On Semi                 |
| 4                  | 4       | 4              | 4              | J1, J2, J5, J6         | CX35-36-CY     | Lug, Copper, 35A,                                              | 0.380 × 1.020 inch  | CX35-36-CY      | Panduit                 |
| 2                  | 2       | 2              | 2              | J11, J12               | PEC02SAAN      | Header, Male 2pin, 100mil spacing,                             | 0.100 inch × 2      | PEC02SAAN       | Sullins                 |
| 1                  | 1       | 1              | 1              | J13                    | UX60-MB-5ST    | Connector, Recpt, USB-B, Mini, 5pins, SMT                      | 0.354in. × 0.303in. | UX60-MB-5S8     | Hirose                  |
| 4                  | 4       | 4              | 4              | J3, J4, J7, J8         | 3267           | Connector, Banana Jack, Uninsulated                            | 0.500 dia. inch     | 3267            | Pomona                  |
| 2                  | 2       | 2              | 2              | J9, J10                | PEC04DAAN      | Header, Male 2×4-pin, 100mil spacing                           | 0.20 × 0.40 inch    | PEC04DAAN       | Sullins                 |
| 1                  | 1       | 0              | 0              | Q1                     | IRFS3107-7PPBF | Transistor, MOSFET, 75V, 190A, 2.1 mΩ                          | TO-263-7            | IRFS3107-7PPBF  | International Rectifier |
| 1                  | 1       | 0              | 0              | Q2                     | Si2325DS       | MOSFET, P-ch, -150 V, 690-mA, 1.2 Ω                            | SOT-23              | Si2325DS        | Vishay                  |
| 5                  | 5       | 5              | 5              | Q3–Q7                  | BSS84          | Transistor, PFET, -50 V, 130 mA, Rds(ON) < 10 Ω at V(gs) = 5 V | SOT-23              | BSS84           | Fairchild               |
| 1                  | 1       | 1              | 1              | Q8                     | MMBT2222A      | Transistor, NPN, 40 V, 500 mA                                  | SOT-23              | MMBT2222A       | Fairchild               |
| 0                  | 0       | 2              | 2              | Q9, Q10                | CSD16401Q5A-R  | MOSFET, NChan, 25V, 37A, 1.3milliOhm                           | QFN5×6mm            | CSD16401Q5A-R   | TI                      |
| 1                  | 1       | 0              | 0              | R1                     | 0.005          | Res, Power Metal Strip, 5W, ±1%                                | 4527                | WSR55L000FEA    | Vishay Dale             |

Table 4. Bill of Materials (continued)

| High Voltage Count |         | Count          |                | RefDes                     | Value          | Description                                                         | Size                      | Part Number         | Supplier          |
|--------------------|---------|----------------|----------------|----------------------------|----------------|---------------------------------------------------------------------|---------------------------|---------------------|-------------------|
| TPS2480            | TPS2481 | TPS2480EVM-002 | TPS2481EVM-001 |                            |                |                                                                     |                           |                     |                   |
| 0                  | 0       | 1              | 1              | R1                         | 0.001          | Res, Power Metal Strip, 5W, $\pm 1\%$                               | 4527                      | WSR51L000FEA        | Vishay Dale       |
| 1                  | 1       | 0              | 0              | R12                        | 24.0K          | Resistor, Chip, 1/2W, 5%                                            | 1210                      | STD                 | STD               |
| 1                  | 1       | 0              | 0              | R15                        | 249K           | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 0                  | 0       | 1              | 1              | R15                        | 54.9K          | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 0              | 0              | R18                        | 47.5k          | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 0                  | 0       | 1              | 1              | R18                        | 178k           | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 0                  | 0       | 1              | 1              | R19                        | 20K            | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R2                         | 10             | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R20                        | 1.00M          | Resistor, Chip, 1/16 W, 1%                                          | 0603                      | Std.                | Std.              |
| 3                  | 3       | 3              | 3              | R21, R22, R39              | 1.5K           | Resistor, Chip, 1/16 W, 5%                                          | 0603                      | Std                 | Std               |
| 9                  | 9       | 9              | 9              | R23, R24, R35–R38, R40–R42 | 33             | Resistor, Chip, 1/16W, 5%                                           | 0603                      | Std                 | Std               |
| 5                  | 5       | 5              | 5              | R25, R27, R28, R29, R45    | 100K           | Resistor, Chip, 1/16W, 1%                                           | 0603                      | Std                 | Std               |
| 2                  | 2       | 2              | 2              | R26, R44                   | 15K            | Resistor, Chip, 1/16 W, 5%                                          | 0603                      | Std.                | Std               |
| 0                  | 0       | 2              | 2              | R3, R4                     | 0              | Resistor, Chip, 1/10W, 5%                                           | 0805                      | Std                 | Std               |
| 2                  | 2       | 0              | 0              | R10, R11                   | 0              | Resistor, Chip, 1/10W, 5%                                           | 0805                      | Std                 | Std               |
| 0                  | 0       | 0              | 0              | R17                        | 0              | Resistor, Chip, 1/10W, 5%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R46                        | 0              | Resistor, Chip, 1/10W, 5%                                           | 0805                      | Std                 | Std               |
| 3                  | 3       | 3              | 3              | R30, R31, R33              | 2.2K           | Resistor, Chip, 1/16 W, 5%                                          | 0603                      | Std.                | Std.              |
| 2                  | 2       | 2              | 2              | R32, R34                   | 1K             | Resistor, Chip, 1/16W, 1%                                           | 0603                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R43                        | 200            | Resistor, Chip, 1/16W, 5%                                           | 0603                      | Std                 | Std               |
| 0                  | 0       | 0              | 0              | R47                        | 100            | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 0              | 0              | R5                         | 10K            | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R16                        | 10K            | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | R6                         | 100K           | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 2                  | 2       | 2              | 2              | R13, R14                   | 1K             | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 0                  | 0       | 0              | 0              | R7                         | 1K             | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 0              | 0              | R8                         | 100 $\times$ 4 | Resistor, Chip Array, 100mW $\pm$ 0.1%                              | 612                       | ACASA1000E100 0P100 | Vishay            |
| 1                  | 1       | 0              | 0              | R9                         | 100            | Resistor, Chip, 1/10W, 1%                                           | 0805                      | Std                 | Std               |
| 1                  | 1       | 1              | 1              | S1                         | EG1218         | Switch, SPDT, Slide, PC-mount,                                      | 0.457 $\times$ 0.157 inch | EG1218              | E_Switch          |
| 10                 | 10      | 10             | 10             | TP1, TP6, TP10–TP16, TP18  | 5012           | Test Point, White, Thru Hole                                        | 0.125 $\times$ 0.125 inch | 5012                | Keystone          |
| 2                  | 2       | 0              | 0              | TP7, TP9                   | 5012           | Test Point, White, Thru Hole                                        | 0.125 $\times$ 0.125 inch | 5012                | Keystone          |
| 2                  | 2       | 2              | 2              | TP2, TP17                  | 5010           | Test Point, Red, Thru Hole                                          | 0.125 $\times$ 0.125 inch | 5010                | Keystone          |
| 1                  | 1       | 0              | 0              | TP8                        | 5010           | Test Point, Red, Thru Hole                                          | 0.125 $\times$ 0.125 inch | 5010                | Keystone          |
| 1                  | 1       | 1              | 1              | TP3                        | 5013           | Test Point, Orange, Thru Hole                                       | 0.125 $\times$ 0.125 inch | 5013                | Keystone          |
| 3                  | 3       | 3              | 3              | TP4, TP5, TP19             | 5011           | Test Point, Black, Thru Hole                                        | 0.125 $\times$ 0.125 inch | 5011                | Keystone          |
| 1                  | 1       | 0              | 0              | U1                         | OPA333AID      | IC, CMOS Op Amp, 1.8V micro-Power, Zero-Drift Series                | SO-8                      | OPA333AID           | TI                |
| 1                  | 0       | 1              | 0              | U2                         | TPS2480PW      | IC, Positive Latching Hot Swap Controller and I2C Current Monitor   | TSSOP-20                  | TPS2480PW           | TI                |
| 0                  | 1       | 0              | 1              | U2                         | TPS2481PW      | IC, Positive Auto-retry Hot Swap Controller and I2C Current Monitor | TSSOP-20                  | TPS2481PW           | TI                |
| 1                  | 1       | 1              | 1              | U3                         | 24LC64-I/SN    | IC, Serial EEPROM, 64K, 2.5-5.5V, 400 kHz Max.                      | SO-8                      | 24LC64I-SN          | Microchip         |
| 1                  | 1       | 1              | 1              | U4                         | TUSB3210PM     | IC, USB, General Purpose Device Controller                          | PQFP-64                   | TUSB3210PM**        | Texas Instruments |

**Table 4. Bill of Materials (continued)**

| High Voltage Count |         | Count          |                | RefDes | Value       | Description                                      | Size          | Part Number     | Supplier           |
|--------------------|---------|----------------|----------------|--------|-------------|--------------------------------------------------|---------------|-----------------|--------------------|
| TPS2480            | TPS2481 | TPS2480EVM-002 | TPS2481EVM-001 |        |             |                                                  |               |                 |                    |
| 1                  | 1       | 1              | 1              | U5     | TPS76333DBV | IC, Micro-Power 100 mA LDO Regulator             | SOT23-5       | TPS76333DBV     | TI                 |
| 1                  | 1       | 1              | 1              | Y1     | 12MHZ       | Crystal, 12-MHz, 20 pF, ±50 PPM at 25°C          | 0.185 × 0.532 | CY12BPSMD       | Crystek            |
| 4                  | 4       | 4              | 4              |        |             | Screw, panhead, #10-32, 0.500 inch               |               | PMS 102 0050 PH | Building Fasteners |
| 4                  | 4       | 4              | 4              |        |             | Washer, flat, #10                                |               | #10FWZ          | Building Fasteners |
| 4                  | 4       | 4              | 4              |        |             | Washer, split, M5                                |               | MLWZ 005        | Building Fasteners |
| 4                  | 4       | 4              | 4              |        |             | Nut, hex, #10-32                                 |               | HNZ102          | Building Fasteners |
| 2                  | 2       | 2              | 2              | —      |             | Shunt, Black                                     | 100-mil       | 929950-00       | 3M                 |
| 4                  | 4       | 4              | 4              |        | SJ5514-0    | Bumpers, cylindrical, black                      |               | SJ5514-0        | 3M                 |
| 1                  | 1       | 1              | 1              | —      |             | PCB, 5 in × 3.5 in × 0.062 in                    |               | HPA440          | Any                |
| 1                  | 1       | 1              | 1              | N/A    |             | USB Cable, 5-pin, B-Mini Male to Type A Male, 2m |               | AK672M/2-2-R    | Assman             |

## 7.2 Schematics

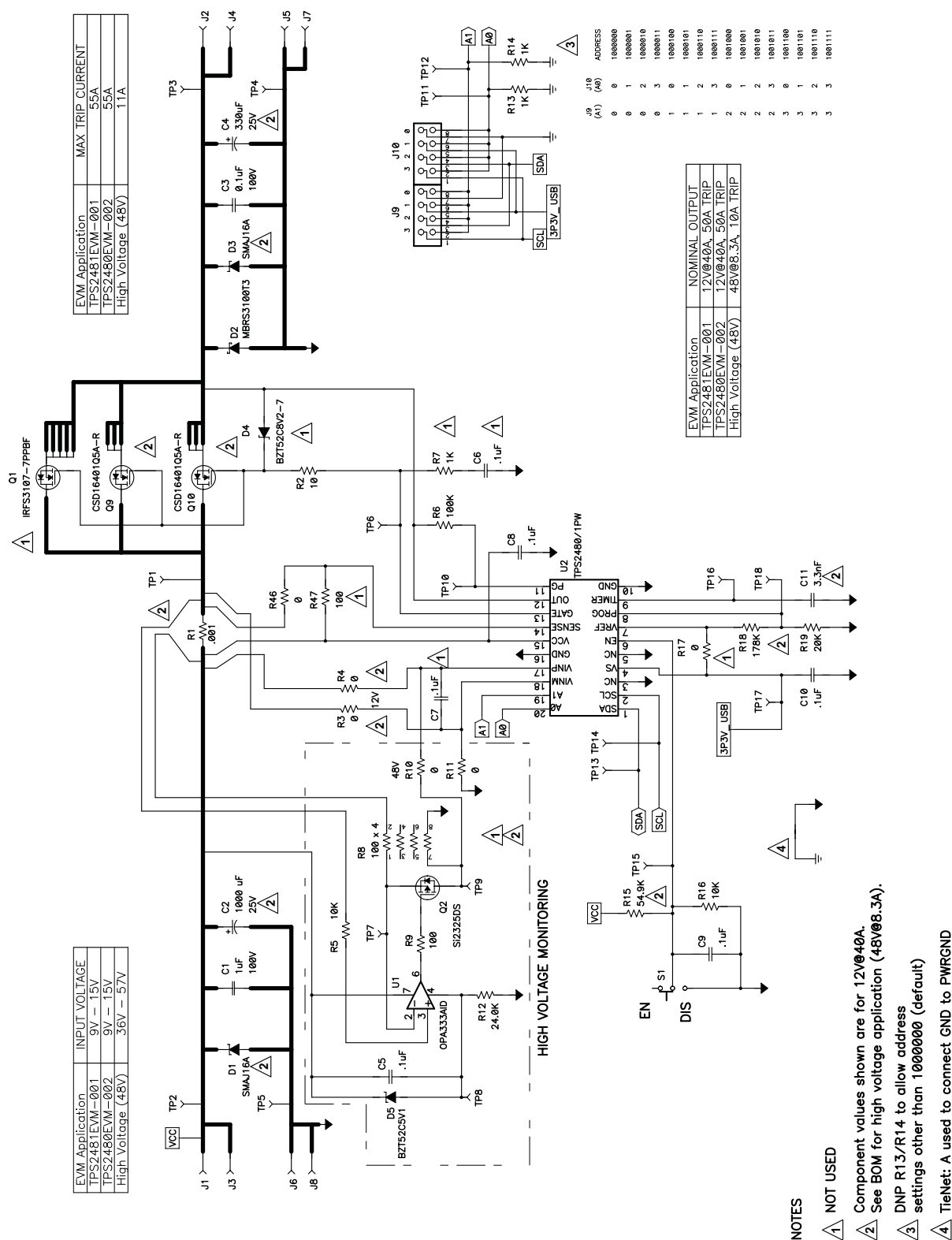


Figure 12. TPS2480/1 EVM Schematic

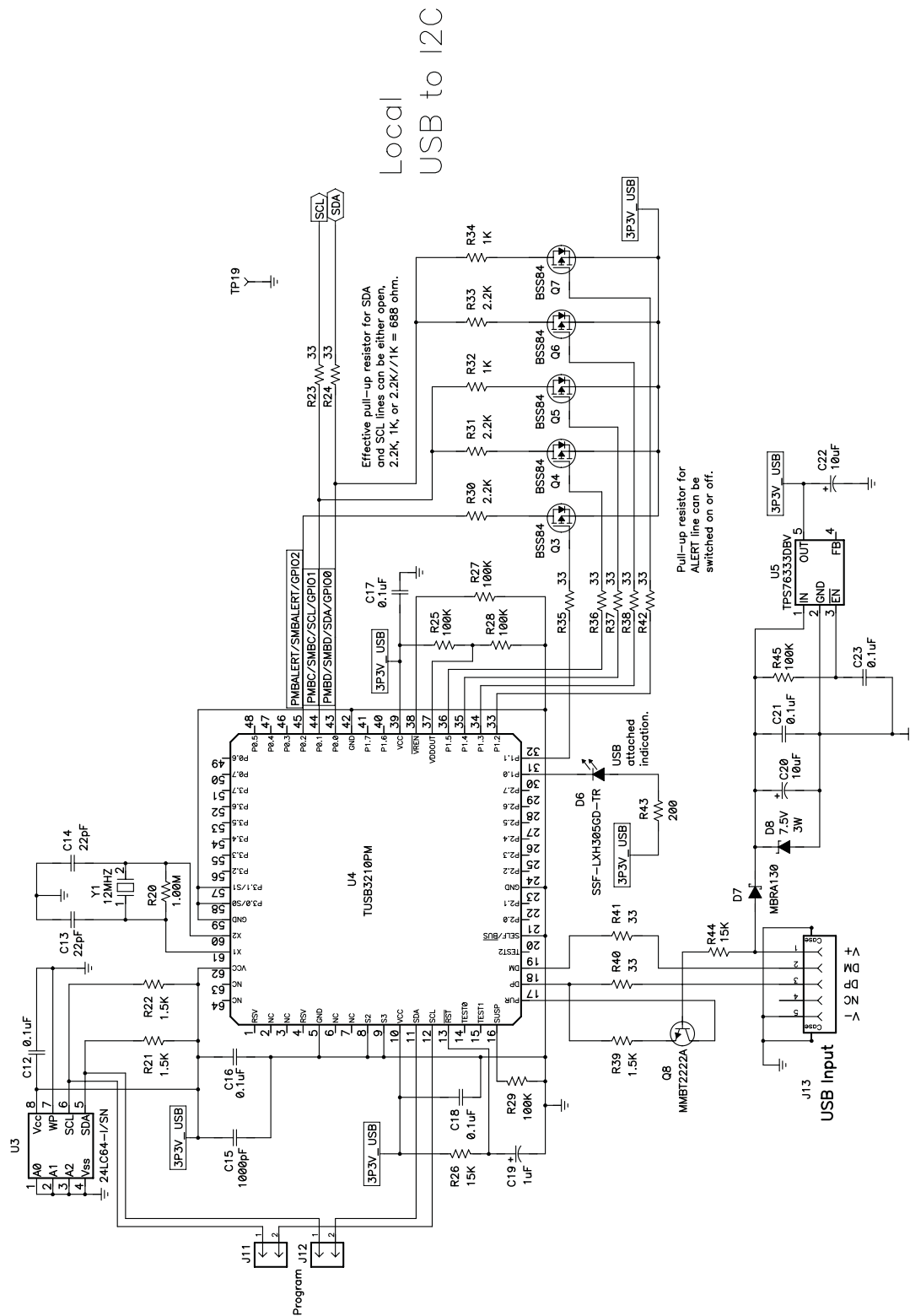


Figure 13. TPS2480/1 EVM Schematic – USB-I2C

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## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 15 V and the output voltage range of 0 V to 15 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85° C. The EVM is designed to operate properly with certain components above 85° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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