

TPS92830-Q1 EVM User's Guide

The TPS92830-Q1 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS92830-Q1 device, a linear LED controller with external N-channel MOSFETs for automotive lighting applications.

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1 Introduction

1.1 Features of TPS92830EVM KIT

- Channel-Current Setting by Separate High-Side Sensing Resistors
- LED-Short and -Open Protection and Fault Reporting
- Auto-Recovery After Removing Fault State
- One-Fails–All-Fail With Fault Floating or Only-Failed-Channel-Off LED Failure Mode With Fault Pulled Up
- Stand-Alone Operation With Full Duty Cycle or PWM Dimming via TPS92830-Q1 Internal PWM Generator (Useful for Stop or Tail Light and Daytime Running Light (DRL) or Position Light Applications)
- PWM Duty Cycle and Frequency Configurable via Jumper
- PWM Output Optional for Sync Dimming (PWMOUT Must Be Pulled Up to 5 V Through a Resistor)
- Analog Dimming With Potentiometer on LED Board (Can Be Used for Bin Resistor)
- Optional LED Board Thermal Protection via ICTRL
- Current Derating During Overvoltage
- Open-Fault Detection Mask During Dropout Mode
- Compatible With Different Type N-Channel MOSFETs

1.2 Typical Applications

Automotive DRL, position light, stop or tail light, turn indicator, reverse light, fog light, and so forth.

1.3 TPS92830EVM KIT Description

The TPS92830EVM KIT includes two boards: TPS92830EVM board and LED board. This section describes the connectors and jumpers of the two boards.

1.3.1 TPS92830EVM Board

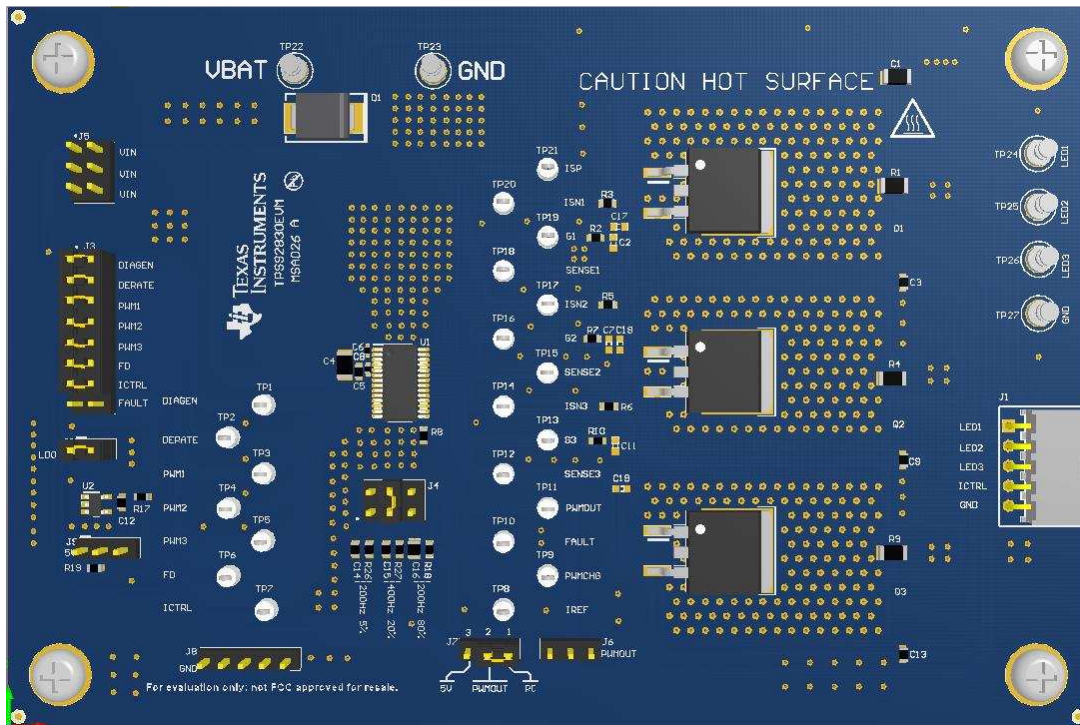


Figure 1. TPS92830EVM Board

1.3.1.1 Connectors

1.3.1.1.1 Power Supply Connector

VBAT (TP22): Input power supply (VBAT) for voltage up to 40 V
 GND (TP23): Supply ground

1.3.1.1.2 LED Connector

LED1 (TP24): CH1 output, connects to LED anode
 LED2 (TP25): CH2 output, connects to LED anode
 LED3 (TP26): CH3 output, connects to LED anode
 GND (TP27): LED output ground

1.3.1.2 Jumpers

1.3.1.2.1 LED Output Jumper – J1

Pin 1: CH1 output, connects to LED anode
 Pin 2: CH2 output, connects to LED anode
 Pin 3: CH3 output, connects to LED anode
 Pin 4: ICTRL function, connects to analog dimming resistor on LED board
 Pin 5: LED output ground

1.3.1.2.2 5V LDO Input Jumper – J2

Allows V_{IN} to connect to a 5-V LDO

1.3.1.2.3 Control Signal Input Jumper – J3

Table 1. Jumper J3

| Label | Jumper J3 | With Shunt | Without Shunt |
|--------|------------|---------------------------------------|---|
| DIAGEN | Pins 1–2 | Connect to VIN via a resistor divider | Use external control signal |
| DERATE | Pins 3–4 | Connect to VIN via a resistor divider | Use external control signal |
| PWM1 | Pins 5–6 | Connect to VIN via a resistor divider | Use external control signal |
| PWM2 | Pins 7–8 | Connect to VIN via a resistor divider | Use external control signal |
| PWM3 | Pins 9–10 | Connect to VIN via a resistor divider | Use external control signal |
| FD | Pins 11–12 | Connect to VIN via a resistor divider | Use external control signal |
| ICTRL | Pins 13–14 | Connect to off-board bin resistor | Use external control signal or leave floating |
| FAULT | Pins 15–16 | Pull up to 5 V | Use external control signal or leave floating |

1.3.1.2.4 PWM Generator Configuration Jumper – J4

To use the TPS92830-Q1 internal PWM dimming function, there are two requirements.

- Keep the FD pin at a low level and remove the shunt on J3 pins 11–12.
- Keep all PWM inputs at a high level by keeping the shunts on J3 pins 5–6, pins 7–8 and pins 9–10.

Table 2. Jumper J4

| Label | Jumper J4 | | | Description |
|-------------|-------------------------------------|----------|----------|---|
| | With Shunt – 1 Without Shunt – 0 | | | |
| | Pins 1–2 | Pins 3–4 | Pins 5–6 | |
| 200 Hz, 5% | 1 | 0 | 0 | PWM generator outputs 200 Hz, 5% duty-cycle PWM |
| 400 Hz, 20% | 0 | 1 | 0 | PWM generator outputs 400 Hz, 20% duty-cycle PWM |
| 200 Hz, 80% | 0 | 0 | 1 | PWM generator outputs 200 Hz, 80% duty-cycle PWM Note: Put a shunt on J7 pins 1–2 to realize 80% duty cycle. |

1.3.1.2.5 PWMOUT Jumper – J7

Table 3. Jumper J7

| Label | With Shunt – 1 Without Shunt – 0 | | Description |
|-------|-------------------------------------|----------|--|
| | Pins 1–2 | Pins 2–3 | |
| RC | 1 | 0 | For 200 Hz, 80% PWM configuration, combine with shunt on J4 pins 5–6 |
| 5 V | 0 | 1 | For PWMOUT pullup under 200 Hz, 5% or 400 Hz, 20% |

1.3.1.3 Test Points

All the pins on the TPS92830-Q1 device except CP1N, CP1P, CP2N, and CP2P have test points on the EVM, which helps users to observe the waveform on the pins.

1.3.2 LED Board

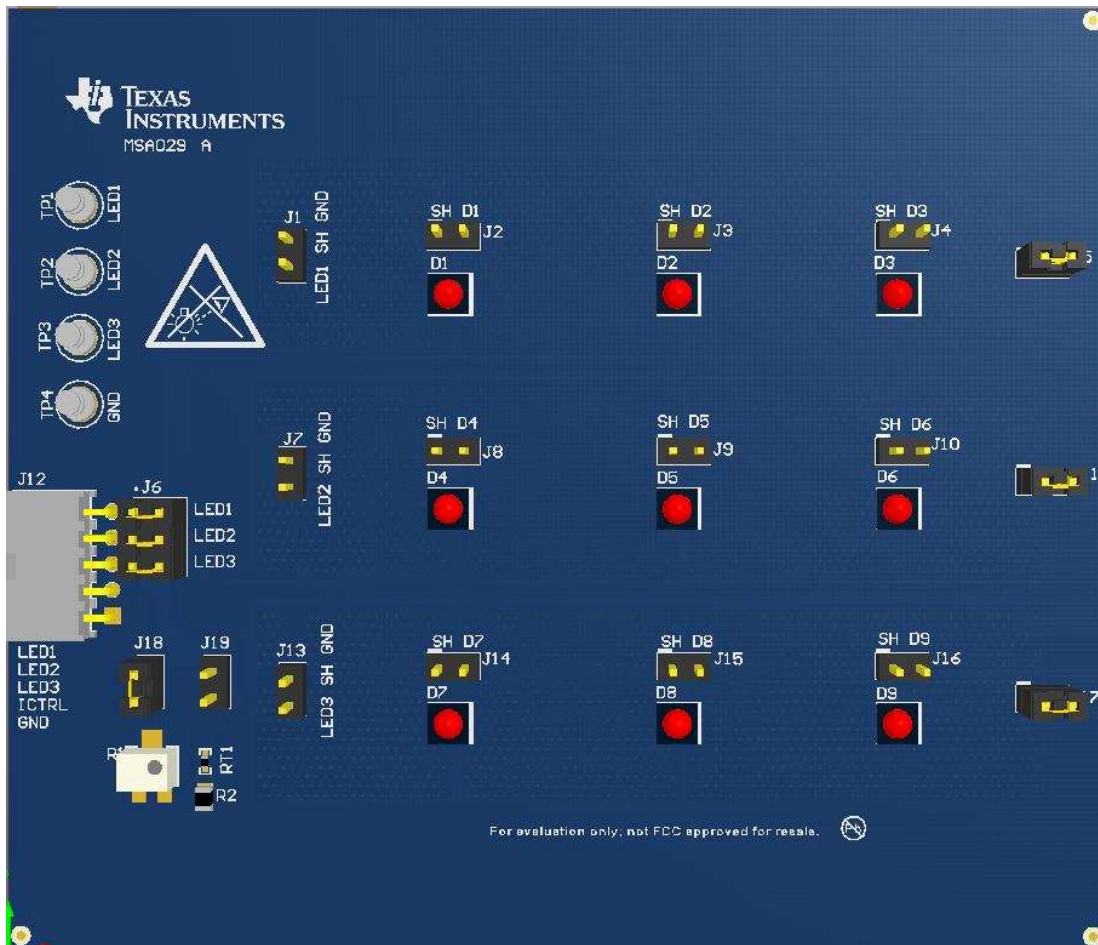


Figure 2. LED Board

1.3.2.1 Connectors

- LED1 (TP1): Positive input of LED board, connects to LED1 on TPS92830EVM
- LED2 (TP2): Positive input of LED board, connects to LED2 on TPS92830EVM
- LED3 (TP3): Positive input of LED board, connects to LED3 on TPS92830EVM
- GND (TP4): LED output ground, connects to GND on TPS92830EVM

1.3.2.2 Jumpers

1.3.2.2.1 LED Outputs – J12

Table 4. Jumper J12

| Label | Jumper J12 | Description |
|-------|------------|--|
| LED1 | Pin 5 | Positive input of LED board, connects to LED1 on TPS92830EVM board |
| LED2 | Pin 4 | Positive input of LED board, connects to LED2 on TPS92830EVM board |
| LED3 | Pin 3 | Positive input of LED board, connects to LED3 on TPS92830EVM board |
| ICTRL | Pin 2 | Analog dimming function, connects to ICTRL on TPS92830EVM board |
| GND | Pin 1 | LED output ground, connects to GND on TPS92830EVM board |

1.3.2.2.2 LED Anode Jumper – J6

Table 5. Jumper J6

| Label | Jumper J6 | With Shunt | Without Shunt |
|-------|-----------|--------------------------------------|---|
| LED1 | Pins 1–2 | Connect LED1 connector to LED string | Disconnect LED1 connector from LED string |
| LED2 | Pins 3–4 | Connect LED2 connector to LED string | Disconnect LED2 connector from LED string |
| LED3 | Pins 5–6 | Connect LED3 connector to LED string | Disconnect LED3 connector from LED string |

1.3.2.2.3 LED String Short-to-GND Jumper

Table 6. LED String Short-to-GND Jumper

| Label | Jumper | With Shunt | Without Shunt |
|-------------|--------|--------------------------|------------------|
| LED1 SH GND | J1 | LED1 string short to GND | Normal operation |
| LED2 SH GND | J7 | LED2 string short to GND | Normal operation |
| LED3 SH GND | J13 | LED3 string short to GND | Normal operation |

1.3.2.2.4 LED String-Open Jumpers

Table 7. LED String-Open Jumper

| Label | Jumper | With Shunt | Without Shunt |
|-------|--------|------------------|------------------|
| — | J5 | Normal operation | LED1 string open |
| — | J11 | Normal operation | LED2 string open |
| — | J17 | Normal operation | LED3 string open |

1.3.2.2.5 Shorted-LED Jumper

Table 8. Shorted-LED Jumper

| Label | Jumper | With Shunt | Without Shunt |
|-------|--------|------------|------------------|
| SH D1 | J2 | Short D1 | Normal operation |
| SH D2 | J3 | Short D2 | Normal operation |
| SH D3 | J4 | Short D3 | Normal operation |
| SH D4 | J8 | Short D4 | Normal operation |
| SH D5 | J9 | Short D5 | Normal operation |
| SH D6 | J10 | Short D6 | Normal operation |
| SH D7 | J14 | Short D7 | Normal operation |
| SH D8 | J15 | Short D8 | Normal operation |
| SH D9 | J16 | Short D9 | Normal operation |

1.3.2.2.6 ICTRL Jumper

Table 9. ICTRL Jumper

| Label | Jumper | With Shunt – 1 Without Shunt – 0 | | Description |
|--------------------|--------|-------------------------------------|---|---|
| | | 1 | 0 | |
| Analog dimming | J18 | 1 | 0 | Connect ICTRL to a potentiometer for analog dimming |
| Thermal protection | J19 | 0 | 1 | Connect ICTRL to an NTC resistor for overtemperature protection |

2 Test Setup

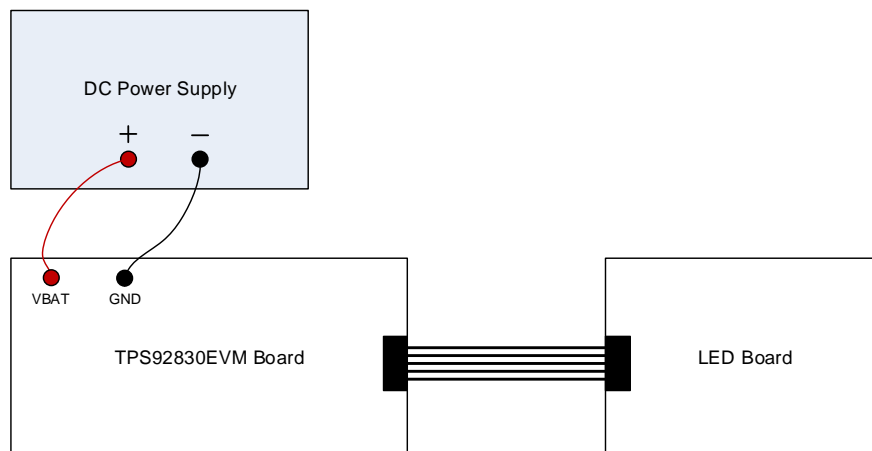
Table 10 shows the typical parameters for the TPS92830EVM. The typical requirement for 3s3p red LED loads is 9 V–16 V, and 85°C is the maximum ambient temperature for the application. The full-scale output current of the TPS92830EVM is 300 mA. Users can adjust the output current by using the analog dimming function or changing the sensing resistors.

Table 10. TPS92830EVM Parameters

| Parameter | Value |
|-----------------------------|----------------------|
| Input voltage | 9 V–16 V Typical |
| Output current | 0–300 mA |
| LED | 3s3p red LED LR H9GP |
| Maximum ambient temperature | 85°C |

The TPS92830EVM can support a minimum 5-V input voltage using one LED. The maximum supported input voltage is 40 V, but the output current must be controlled and/or the number of LEDs be properly selected to limit the temperature on the MOSFETs.

Below is the overview of the setup of the TPS92830EVM. Connect the positive and negative outputs of the dc power supply to TP22 (VBAT) and TP23 (GND) on the TPS92830EVM board. Connect J1 on the TPS92830EVM board and J12 on the LED board together with the 5-wire cable.


Figure 3. TPS92830EVM Setup

With the default jumper connections, the board should begin operating as soon as proper voltage is applied to the input. Modify the jumpers for other operating modes.

3 Board Layout

WARNING



Hot surface. Contact may cause burns. Do not touch.

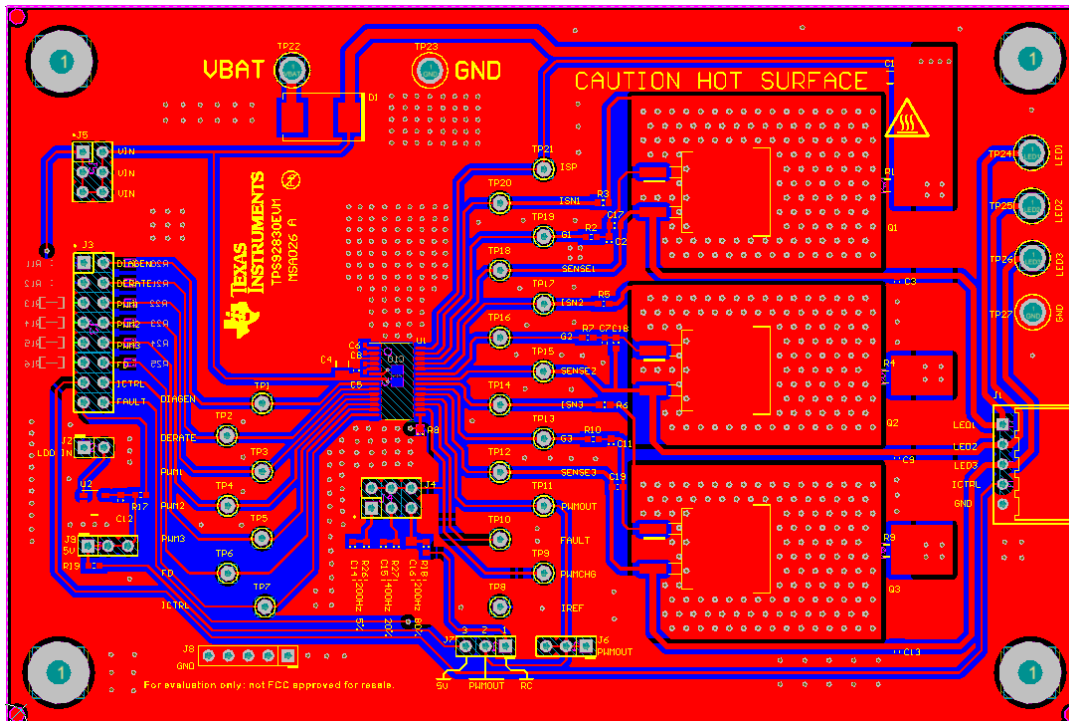


Figure 4. TPS92830EVM Board Layout

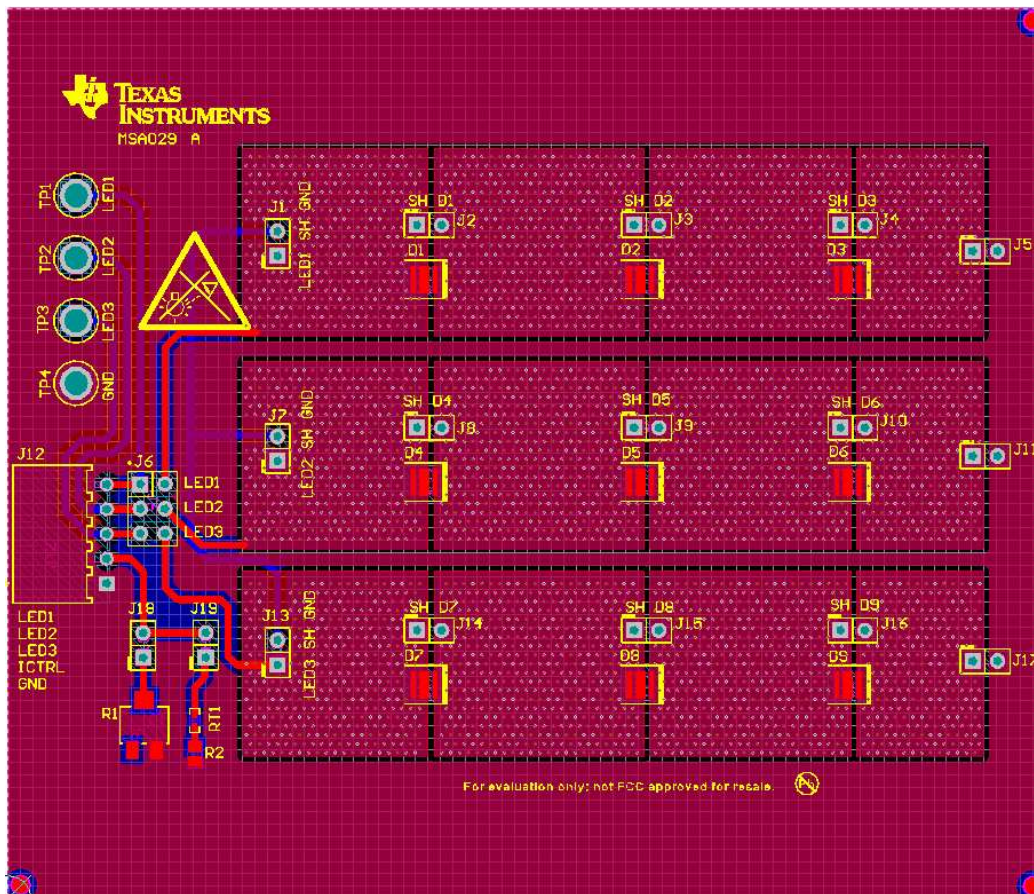


Figure 5. LED Board Layout

4 Schematic and Bill of Materials

4.1 Schematics

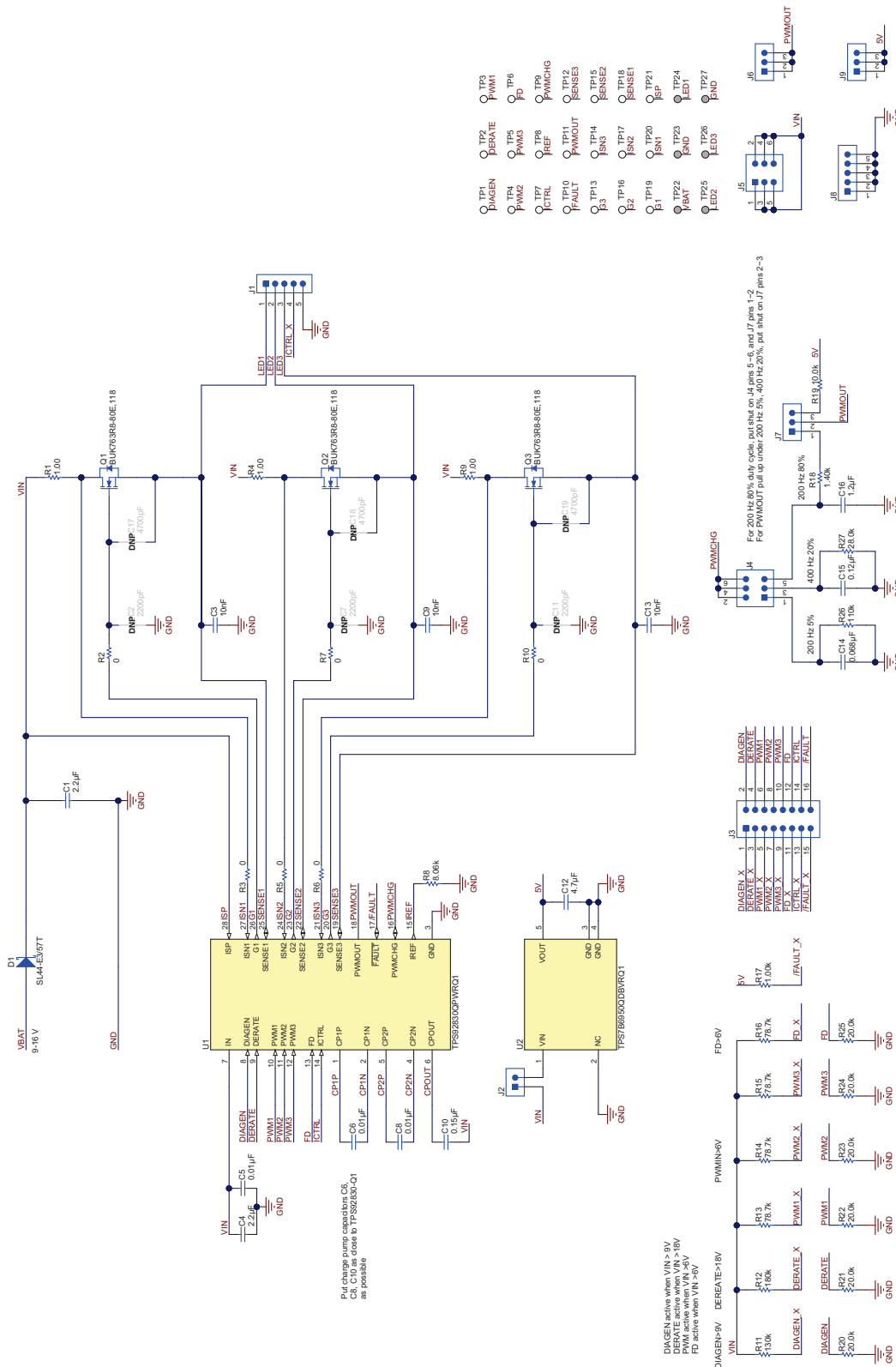


Figure 6. TPS92830EVM Board Schematic

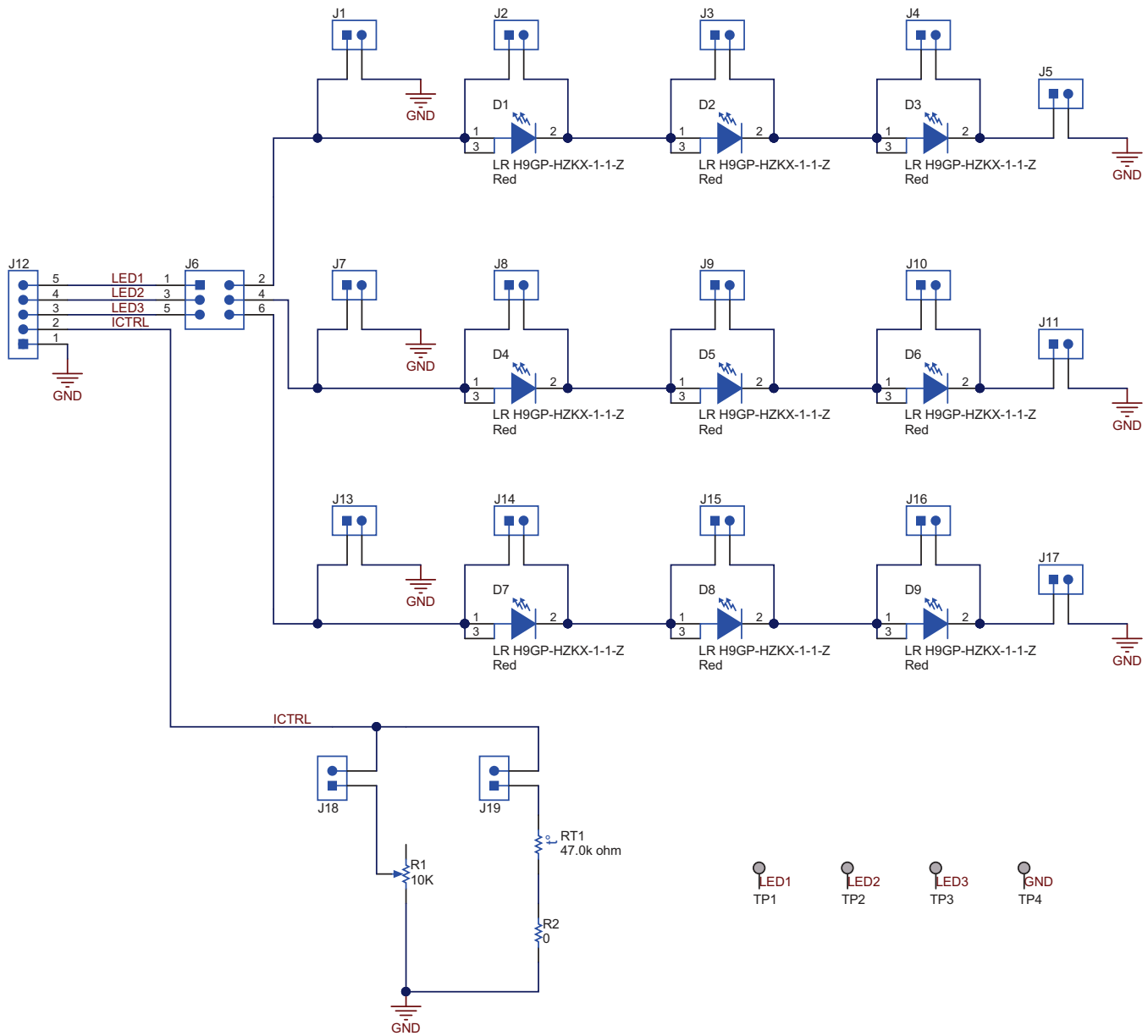


Figure 7. LED Board Schematic

4.2 Bill of Materials

This section provides the TPS92830EVM bill of materials.

Table 11. TPS92830EVM Board BOM

| Item No. | Designator | Quantity | Value | Part Number | Manufacturer | Description | Package Reference |
|----------|-----------------|----------|--------------|-----------------|--------------|--|-------------------|
| 1 | !PCB1 | 1 | | MSA026A | Any | Printed circuit board | |
| 2 | C1, C4 | 2 | 2.2 μ F | UMK316B7225KL-T | Taiyo Yuden | Capacitor, ceramic, 2.2 μ F, 50 V, \pm 10%, X7R, 1206 | 1206 |
| 3 | C3, C5, C9, C13 | 4 | 0.01 μ F | 06031C103JAT2A | AVX | Capacitor, ceramic, 0.01 μ F, 100 V, \pm 5%, X7R, 0603 | 0603 |

Table 11. TPS92830EVM Board BOM (continued)

| Item No. | Designator | Quantity | Value | Part Number | Manufacturer | Description | Package Reference |
|----------|-------------------------|----------|-----------------|----------------------|----------------------|--|---|
| 4 | C6, C8 | 2 | 0.01 μ F | GCM155R71H103KA55D | MuRata | Capacitor, ceramic, 0.01 μ F, 50 V, \pm 10%, COG/NPO, 0402 | 0402 |
| 5 | C10 | 1 | 0.15 μ F | C0805C154K5RACTU | Kemet | Capacitor, ceramic, 0.15 μ F, 50 V, \pm 10%, X7R, 0805 | 0805 |
| 6 | C12 | 1 | 4.7 μ F | 0603ZD475KAT2A | AVX | Capacitor, ceramic, 4.7 μ F, 10 V, \pm 10%, X5R, 0603 | 0603 |
| 7 | C14 | 1 | 0.068 μ F | CGA3E3X7S2A683K080AB | TDK | Capacitor, ceramic, 0.068 μ F, 100 V, \pm 10%, X7S, AEC-Q200 Grade 1, 0603 | 0603 |
| 8 | C15 | 1 | 0.12 μ F | GRM188R61A124KA01D | MuRata | Capacitor, ceramic, 0.12 μ F, 10 V, \pm 10%, X5R, 0603 | 0603 |
| 9 | C16 | 1 | 1.2 μ F | C0805C125K8RACTU | Kemet | Capacitor, ceramic, 1.2 μ F, 10 V, \pm 10%, X7R, 0805 | 0805 |
| 10 | D1 | 1 | 40 V | SL44-E3/57T | Vishay-Semiconductor | Diode, Schottky, 40 V, 4 A, SMC | SMC |
| 11 | H1, H2, H3, H4 | 4 | | NY PMS 440 0025 PH | B&F Fastener Supply | Machine screw, round, 4-40 \times 1/4, nylon, Phillips pan head | Screw |
| 12 | H5, H6, H7, H8 | 4 | | 1902C | Keystone | Standoff, hex, 0.5 in L, 4-40, nylon | Standoff |
| 13 | J1 | 1 | | IPL1-105-01-L-S-RA-K | Samtec | Header (shrouded), 2.54 mm, 5 \times 1, gold, R/A, TH | Header (Shrouded), 2.54 mm, 5 \times 1, R/A, TH |
| 14 | J2 | 1 | | TSW-102-07-G-S | Samtec | Header, 100 mil, 2 \times 1, gold, TH | 2 \times 1 header |
| 15 | J3 | 1 | | TSW-108-07-G-D | Samtec | Header, 100 mil, 8 \times 2, gold, TH | 8 \times 2 header |
| 16 | J4, J5 | 2 | | TSW-103-07-G-D | Samtec | Header, 100 mil, 8 \times 2, gold, TH | 3 \times 2 header |
| 17 | J6, J7, J9 | 3 | | TSW-103-07-G-S | Samtec | Header, 100 mil, 3 \times 1, gold, TH | 3 \times 1 header |
| 18 | J8 | 1 | | TSW-105-07-G-S | Samtec | Header, 100 mil, 5 \times 1, gold, TH | 5 \times 1 header |
| 19 | Q1, Q2, Q3 | 3 | 80 V | BUK763R8-80E,118 | NXP Semiconductor | MOSFET, N-CH, 80 V, 120 A, AEC-Q101, DDPAK | DDPAK |
| 20 | R1, R4, R9 | 3 | 1 Ω | CRCW12061R00FKEA | Vishay-Dale | Resistor, 1, 1%, 0.25 W, 1206 | 1206 |
| 21 | R2, R3, R5, R6, R7, R10 | 6 | 0 | CRCW06030000Z0EA | Vishay-Dale | RES, 0, 5%, 0.1 W, 0603 | 0603 |
| 22 | R8 | 1 | 8.06 k Ω | RT0603BRD078K06L | Yageo America | Resistor, 8.06 k Ω , 0.1%, 0.1 W, 0603 | 0603 |
| 23 | R11 | 1 | 130 k Ω | CRCW0603130KFKEA | Vishay-Dale | Resistor, 130 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 24 | R12 | 1 | 180 k Ω | CRCW0603180KJNEA | Vishay-Dale | Resistor, 180 k Ω , 5%, 0.1 W, 0603 | 0603 |
| 25 | R13, R14, R15, R16 | 4 | 78.7 k Ω | RC0603FR-0778K7L | Yageo America | Resistor, 78.7 k Ω , 1%, 0.1 W, 0603 | 0603 |

Table 11. TPS92830EVM Board BOM (continued)

| Item No. | Designator | Quantity | Value | Part Number | Manufacturer | Description | Package Reference |
|----------|---|----------|----------------|--------------------|-------------------|--|----------------------------|
| 26 | R17 | 1 | 1 k Ω | CRCW06031K00FKEA | Vishay-Dale | Resistor, 1 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 27 | R18 | 1 | 1.4 k Ω | CRCW06031K40FKEA | Vishay-Dale | Resistor, 1.4 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 28 | R19 | 1 | 10 k Ω | CRCW060310K0FKEA | Vishay-Dale | Resistor, 10 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 29 | R20, R21, R22, R23, R24, R25 | 6 | 20 k Ω | CRCW060320K0FKEA | Vishay-Dale | Resistor, 20 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 30 | R26 | 1 | 110 k Ω | CRCW0603110KFKEA | Vishay-Dale | Resistor, 110 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 31 | R27 | 1 | 28 k Ω | CRCW060328K0FKEA | Vishay-Dale | Resistor, 28 k Ω , 1%, 0.1 W, 0603 | 0603 |
| 32 | SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10 | 10 | 1x2 | 969102-0000-DA | 3M | Shunt, 100 mil, gold plated, black | Shunt |
| 33 | TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21 | 21 | | 5002 | Keystone | Test point, miniature, white, TH | White miniature test point |
| 34 | TP22, TP23, TP24, TP25, TP26, TP27 | 6 | | 1502-2 | Keystone | Terminal, turret, TH, double | Keystone1502-2 |
| 35 | U1 | 1 | | TPS92830QPWRQ1 | Texas Instruments | 3-ch high-current linear LED controller with diagnostics and one-fails-all-fail fault bus, PW0028A | PW0028A |
| 36 | U2 | 1 | | TPS7B6950QDBVRQ1 | Texas Instruments | High-voltage ultralow I_q low-dropout regulator, DBV0005A | DBV0005A |
| 37 | C2, C7, C11 | 0 | 2200 pF | GRM188R72A222KA01D | MuRata | Capacitor, ceramic, 2200 pF, 100 V, $\pm 10\%$, X7R, 0603 | 0603 |
| 38 | C17, C18, C19 | 0 | 4700 pF | GRM188R71E472KA01D | MuRata | Capacitor, ceramic, 4700 pF, 25 V, $\pm 10\%$, X7R, 0603 | 0603 |
| 39 | FID1, FID2, FID3, FID4, FID5, FID6 | 0 | | N/A | N/A | Fiducial mark. There is nothing to buy or mount. | Fiducial |

Table 12. LED Board BOM

| Item No. | Designator | Quantity | Value | Part Number | Manufacturer | Description | Package Reference |
|----------|---|----------|-------|----------------------|--------------|--|--|
| 1 | !PCB1 | 1 | | MSA029A | Any | Printed circuit board | |
| 2 | D1, D2, D3, D4, D5, D6, D7, D8, D9 | 9 | Red | LR H9GP-HZKX-1-1-Z | OSRAM | LED, red, SMD | 3.85 mm × 3.85 mm |
| 3 | J1, J2, J3, J4, J5, J7, J8, J9, J10, J11, J13, J14, J15, J16, J17, J18, J19 | 17 | | TSW-102-07-G-S | Samtec | Header, 100mil, 2x1, gold, TH | 2x1 header |
| 4 | J6 | 1 | | TSW-103-07-G-D | Samtec | Header, 100 mil, 3x2, gold, TH | 3x2 header |
| 5 | J12 | 1 | | IPL1-105-01-L-S-RA-K | Samtec | Header (shrouded), 2.54 mm, 5x1, gold, R/A, TH | Header (shrouded), 2.54 mm, 5x1, R/A, TH |
| 6 | R1 | 1 | 10 kΩ | 3224X-1-103E | Bourns | Trimmer, 10 kΩ, 0.25 W, SMD | 3.5x5.3x4.8 mm |
| 7 | R2 | 1 | 0 | ERJ-6GEY0R00V | Panasonic | Resistor, 0.5%, 0.125 W, 0805 | 0805 |
| 8 | RT1 | 1 | 47 kΩ | NCP15WB473J03RC | MuRata | Thermistor NTC, 47 kΩ, 1%, 0402 | 0402 |
| 9 | SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7 | 7 | 1×2 | 969102-0000-DA | 3M | Shunt, 100 mil, gold plated, black | Shunt |
| 10 | TP1, TP2, TP3, TP4 | 4 | | 1502-2 | Keystone | Terminal, turret, TH, double | Keystone1502-2 |
| 11 | FID1, FID2, FID3 | 0 | | N/A | N/A | Fiducial mark. There is nothing to buy or mount. | Fiducial |

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
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