User's Guide
SLVUB41–July 2017

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.

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1.3.1 TPS92830EVM Board

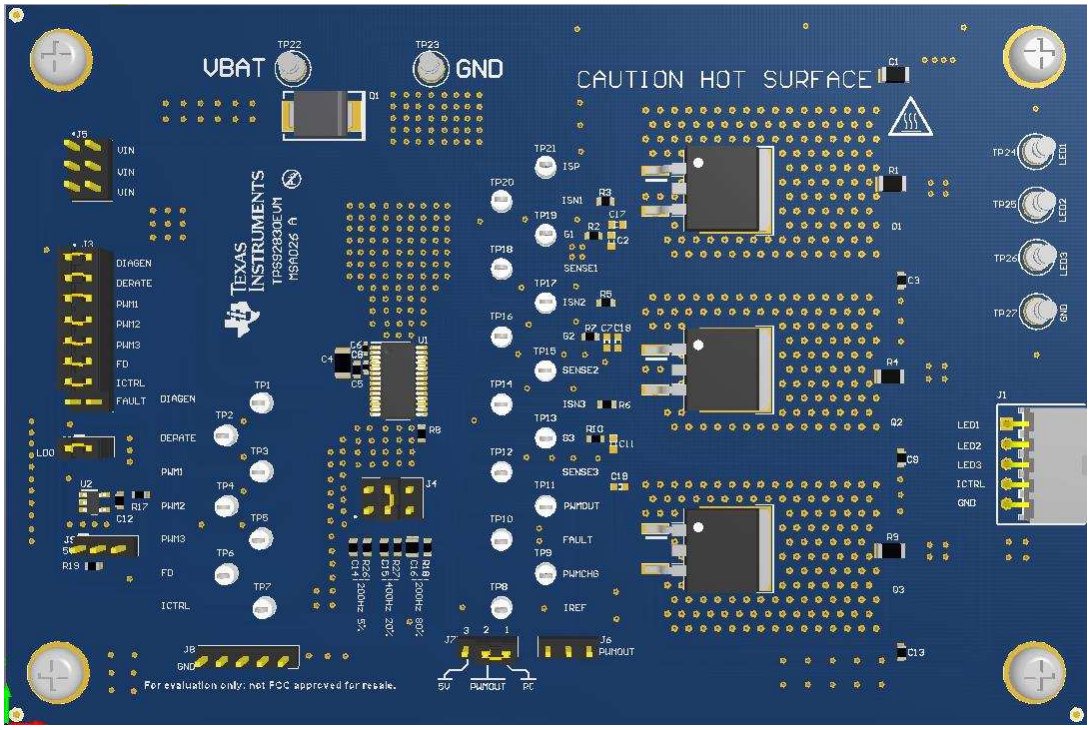


Figure 1. TPS92830EVM Board

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

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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 With Shunt – 1 Without Shunt – 0			Description
	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%

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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

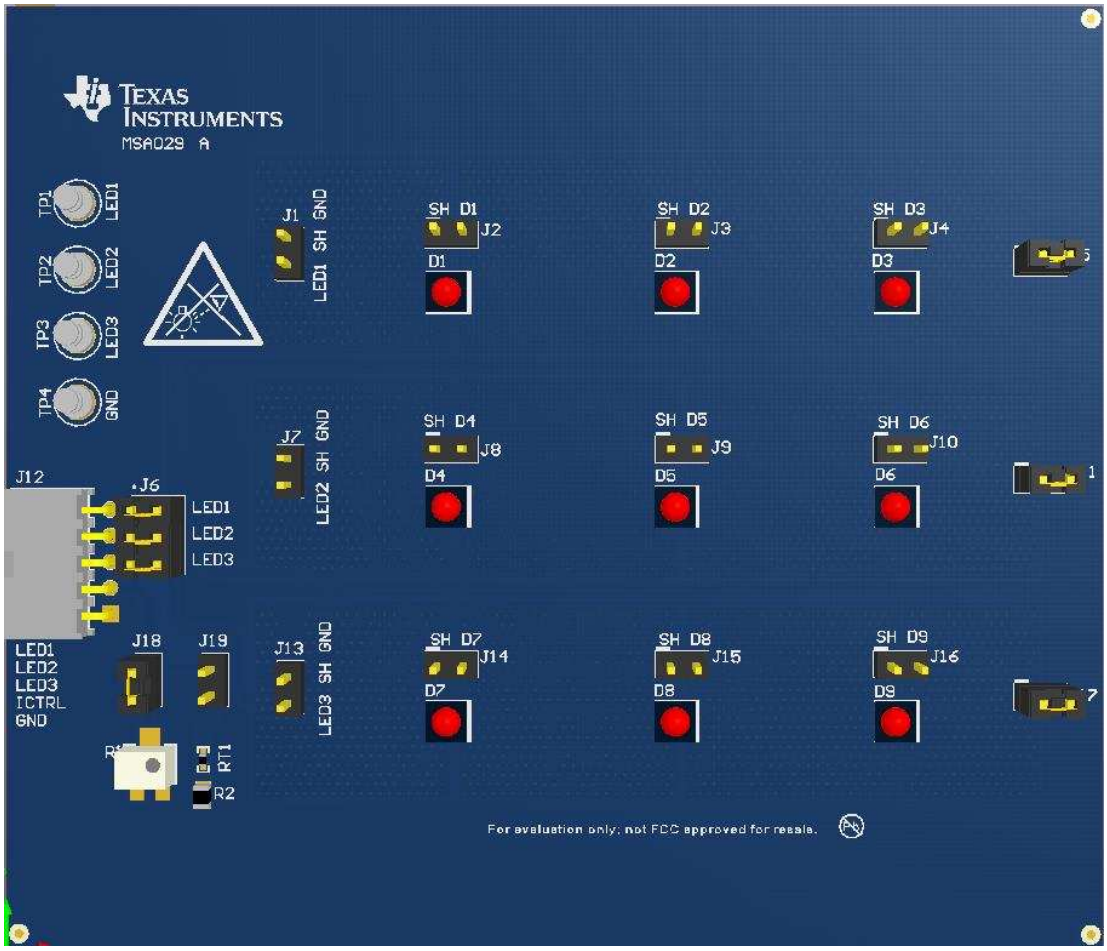


Figure 2. LED Board

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

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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

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1.3.2.2.6 ICTRL Jumper

Table 9. ICTRL Jumper

Label	Jumper	With Shunt – 1 Without Shunt – 0		Description
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.

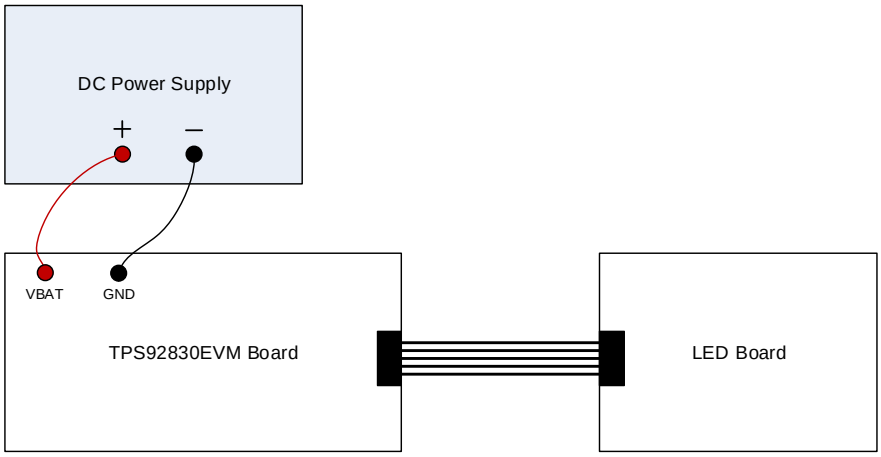


Figure 3. TPS92830EVM Setup

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.

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3 Board Layout

WARNING

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

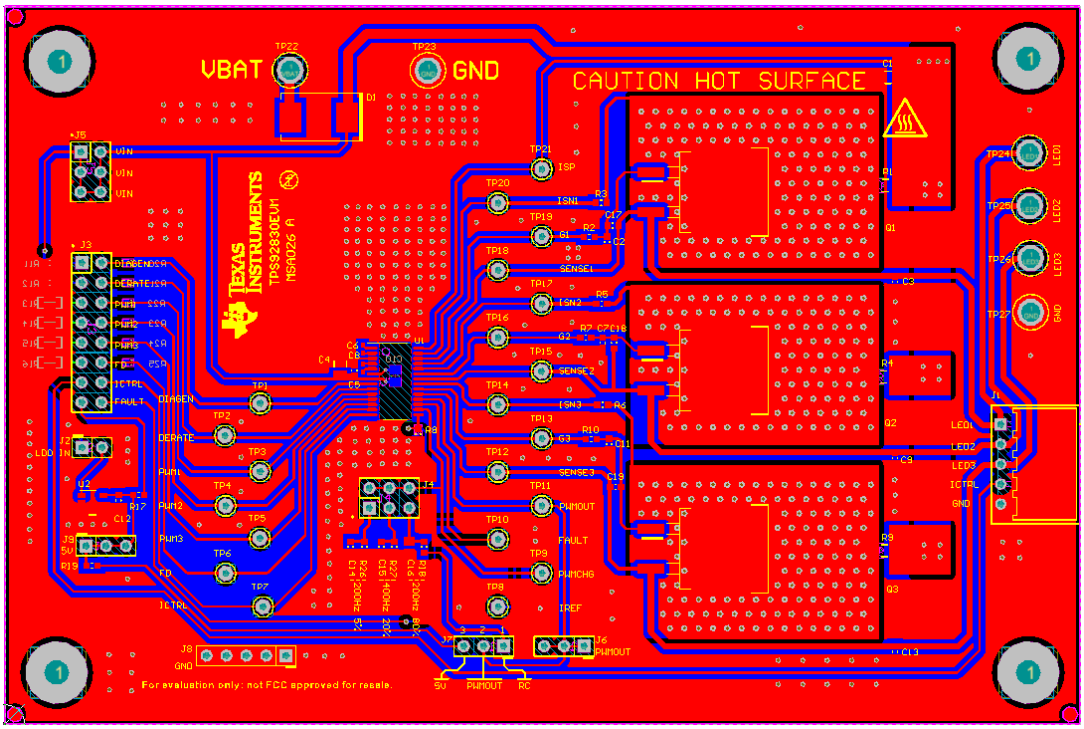


Figure 4. TPS92830EVM Board Layout

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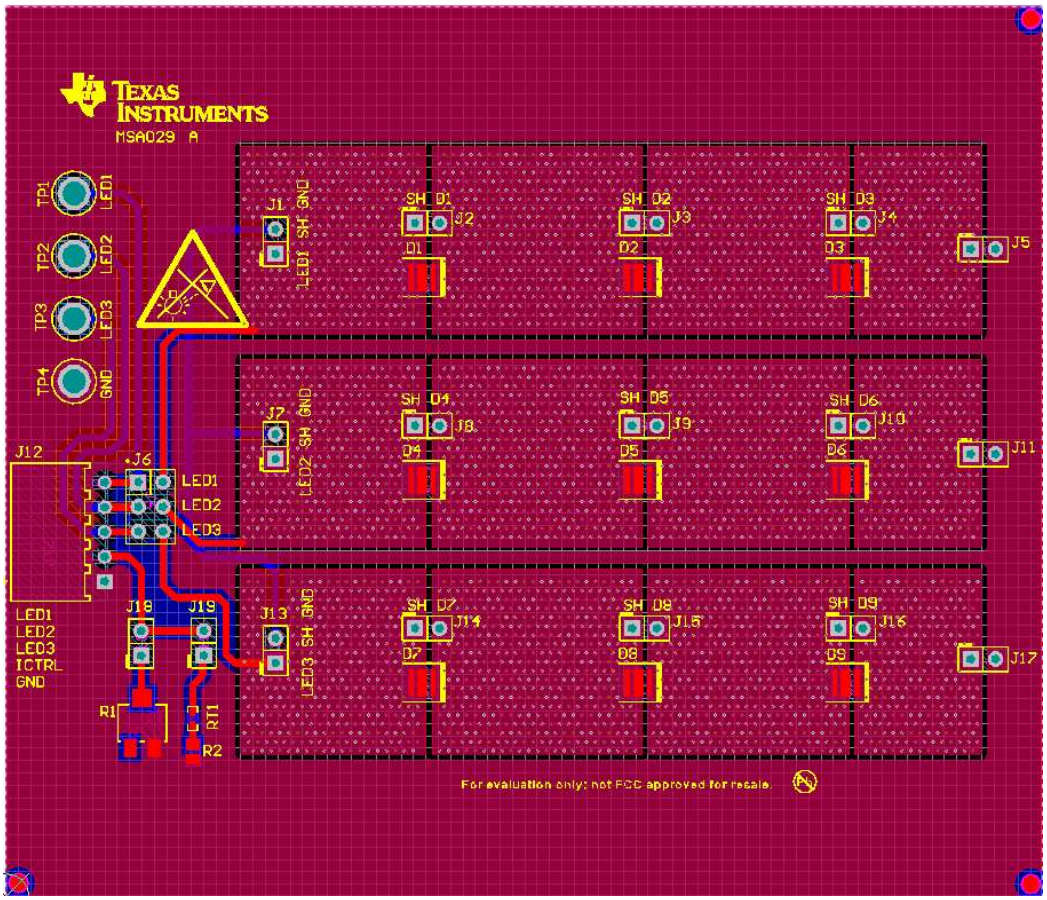


Figure 5. LED Board Layout

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4 Schematic and Bill of Materials

4.1 Schematics

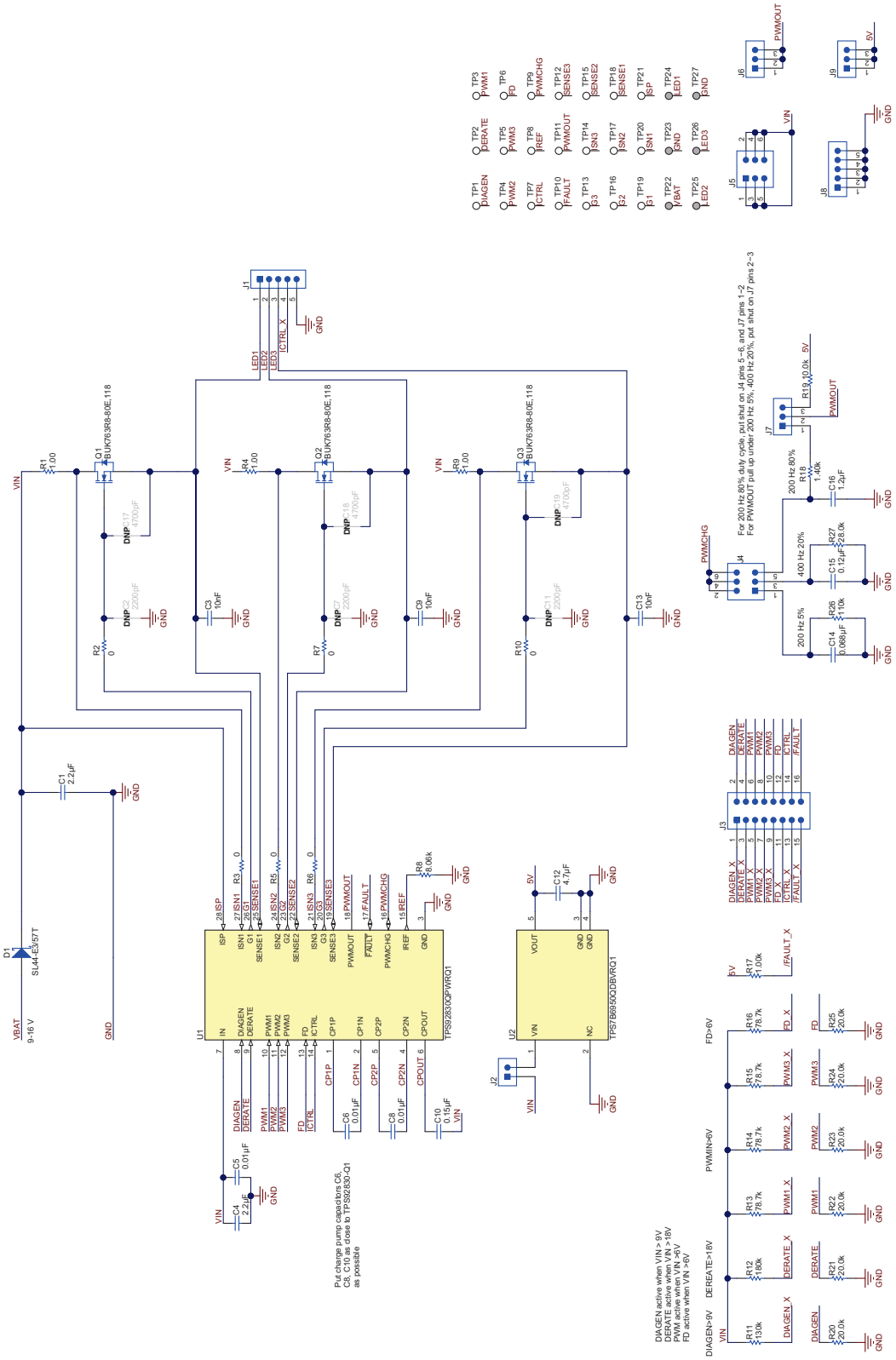


Figure 6. TPS92830EVM Board Schematic

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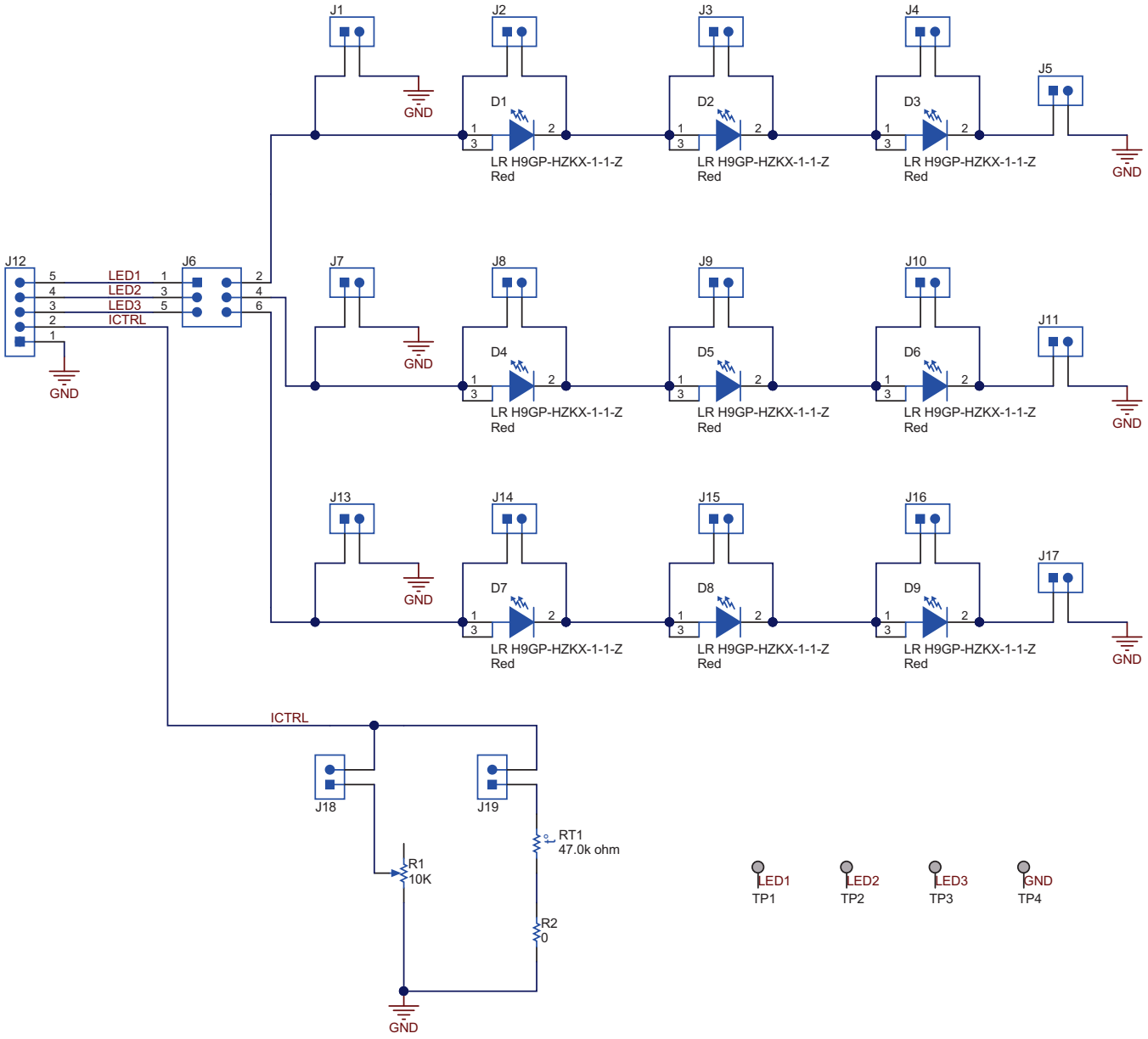


Figure 7. LED Board Schematic

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 µF	UMK316B7225KL-T	Taiyo Yuden	Capacitor, ceramic, 2.2 µF, 50 V, ±10%, X7R, 1206	1206
3	C3, C5, C9, C13	4	0.01 µF	06031C103JAT2A	AVX	Capacitor, ceramic, 0.01 µF, 100 V, ±5%, X7R, 0603	0603

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Table 11. TPS92830EVM Board BOM (continued)

Item No.	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
4	C6, C8	2	0.01 µF	GCM155R71H103KA55D	MuRata	Capacitor, ceramic, 0.01 µF, 50 V, ±10%, C0G/NP0, 0402	0402
5	C10	1	0.15 µF	C0805C154K5RACTU	Kemet	Capacitor, ceramic, 0.15 µF, 50 V, ±10%, X7R, 0805	0805
6	C12	1	4.7 µF	0603ZD475KAT2A	AVX	Capacitor, ceramic, 4.7 µF, 10 V, ±10%, X5R, 0603	0603
7	C14	1	0.068 µF	CGA3E3X7S2A683K080AB	TDK	Capacitor, ceramic, 0.068 µF, 100 V, ±10%, X7S, AEC-Q200 Grade 1, 0603	0603
8	C15	1	0.12 µF	GRM188R61A124KA01D	MuRata	Capacitor, ceramic, 0.12 µF, 10 V, ±10%, X5R, 0603	0603
9	C16	1	1.2 µF	C0805C125K8RACTU	Kemet	Capacitor, ceramic, 1.2 µF, 10 V, ±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 × 1/4, nylon, Philips 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, 5x1, gold, R/A, TH	Header (Shrouded), 2.54 mm, 5×1, R/A, TH
14	J2	1		TSW-102-07-G-S	Samtec	Header, 100 mil, 2×1, gold, TH	2×1 header
15	J3	1		TSW-108-07-G-D	Samtec	Header, 100 mil, 8×2, gold, TH	8×2 header
16	J4, J5	2		TSW-103-07-G-D	Samtec	Header, 100 mil, 8×2, gold, TH	3×2 header
17	J6, J7, J9	3		TSW-103-07-G-S	Samtec	Header, 100 mil, 3×1, gold, TH	3×1 header
18	J8	1		TSW-105-07-G-S	Samtec	Header, 100 mil, 5×1, gold, TH	5×1 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 kΩ	RT0603BRD078K06L	Yageo America	Resistor, 8.06 kΩ, 0.1%, 0.1 W, 0603	0603
23	R11	1	130 kΩ	CRCW0603130KFKEA	Vishay-Dale	Resistor, 130 kΩ, 1%, 0.1 W, 0603	0603
24	R12	1	180 kΩ	CRCW0603180KJNEA	Vishay-Dale	Resistor, 180 kΩ, 5%, 0.1 W, 0603	0603
25	R13, R14, R15, R16	4	78.7 kΩ	RC0603FR-0778K7L	Yageo America	Resistor, 78.7 kΩ, 1%, 0.1 W, 0603	0603

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Table 11. TPS92830EVM Board BOM (continued)

Item No.	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
26	R17	1	1 kΩ	CRCW06031K00FKEA	Vishay-Dale	Resistor, 1 kΩ, 1%, 0.1 W, 0603	0603
27	R18	1	1.4 kΩ	CRCW06031K40FKEA	Vishay-Dale	Resistor, 1.4 kΩ, 1%, 0.1 W, 0603	0603
28	R19	1	10 kΩ	CRCW060310K0FKEA	Vishay-Dale	Resistor, 10 kΩ, 1%, 0.1 W, 0603	0603
29	R20, R21, R22, R23, R24, R25	6	20 kΩ	CRCW060320K0FKEA	Vishay-Dale	Resistor, 20 kΩ, 1%, 0.1 W, 0603	0603
30	R26	1	110 kΩ	CRCW0603110KFKEA	Vishay-Dale	Resistor, 110 kΩ, 1%, 0.1 W, 0603	0603
31	R27	1	28 kΩ	CRCW060328K0FKEA	Vishay-Dale	Resistor, 28 kΩ, 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, ±10%, X7R, 0603	0603
38	C17, C18, C19	0	4700 pF	GRM188R71E472KA01D	MuRata	Capacitor, ceramic, 4700 pF, 25 V, ±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

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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, 100il, 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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