TPS61181EVM-259 / TPS61182EVM-259

This user's guide describes the characteristics, operation, and use of the TPS6118xEVM-259 evaluation module (EVM). This EVM contains either Texas Instruments' TPS61181 (-001 build) or TPS61182 (-002 build)-based WLED power solutions, each of which provides up to six independently regulated current outputs using a single inductor step-up (boost) converter. The current outputs are ideal for driving a WLED backlight in notebook/laptop computers. A separate EVM, WLEDEVM-260, contains eight strings of 10 series WLEDs and connects to the TPS6118xEVM via a 14-pin ribbon cable to simplify evaluation. This user's guide includes EVM specifications, recommended test setup, test results, bill of materials, and a schematic diagram for the TPS61181EVM.

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1 Introduction

This EVM contains either Texas Instruments' TPS61181 (-001 build) or TPS61182 (-002 build) based WLED power solution, each of which provides up to six independently regulated current outputs using a single inductor step-up (boost) converter. The current outputs are ideal for driving a WLED backlight in notebook/laptop computers. A separate EVM, WLEDEVM-260 (SLVU238), contains six strings of 12 series WLEDs and connects to the TPS6118xEVM via a 14-pin ribbon cable to simplify evaluation. The goal of these EVMs is to facilitate evaluation of the TPS6118x integrated circuit (IC) in a typical WLED application.

1.1 Performance Specification Summary

Table 1 provides a summary of the TPS6118xEVM-259 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Typical Performance Specification Summary

	CONDITION	MIN	TYP	MAX	UNITS
V_{BAT} supply		5		24	V
EN logic high		1.2		7	V
V(TP5)	J8 connected to 10 WLED configured WLEDEVM-260, JP13 shorted, JPFBxS open, V_{BAT} supplied, EN=3.3V, DCTRL=VCC		30	35	V
	J8 connected to 10 WLED configured WLEDEVM-260, JP13 open, JPFBxS open, V_{BAT} supplied, EN=3.3V, DCTRL=VCC	38	39	40	
I(JP13) = 6 X IFBx	J8 connected to 10 WLED configured WLEDEVM-260, JP13 shorted, JPFBxS open, V_{BAT} =5.0 V, V_{CC} supplied, EN=3.3V, DCTRL=VCC	116	120	124	mA

1.2 Modifications

To aid user customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space.

Changing components can improve or degrade EVM performance. For example, using inductors with larger dc resistances lowers efficiency of the solution.

Transistor Q1, resistor R3, and diode D2 are optional but are highly recommended components. Transistor Q1 and resistor R3 provide input to output isolation when the IC is disabled and in the event of a fault. Diode D2 clamps inductor L1 to 0.3 V when Q1 opens in order to protect Q1 from overvoltage.

2 Input/Output Connector Descriptions

2.1 Input/Output Connections

The connection points are described in the following paragraphs.

2.1.1 J1 - VIN

This header is the positive connection to the input power supply. Twist the leads to the input supply and keep them as short as possible.

2.1.2 J2 - GND

This header is the return connection to the input power supply.

2.1.3 J3 - EN

This header connects to the IC's EN pin and must be taken logic high (above 1.2 V but no higher than 7 V) to enable the IC. Removing the logic high signal allows the internal pulldown resistor to pull EN to ground, which disables the IC.

2.1.4 J4 - CIN/VCC

For the TPS61181 and TPS61182 IC, this header provides a measurement point for the internal LDO that outputs 3.3 V on the CIN pin. For the TPS61180, an external 3.3-V supply must be applied to this pin in order for the IC to operate.

2.1.5 J5 - GND

This header connects to the board's ground plane.

2.1.6 J6 - GND

This header connects to the board's ground plane.

2.1.7 J7 - GND

This header connects to the board's ground plane.

2.1.8 J8 - 14-pin Connector

This header provides connections to the boost converter output (VOUT) and each of the six current feedback lines (IFBx). With a 14-pin ribbon cable, this header can be connected to WLEDEVM-260, containing six strings of 12 LEDs, to facilitate evaluation.

2.1.9 JP1-DCTRL

Installing this jumper ties the DCTRL dimming control pin to V_{CC}, thereby providing 100% WLED dimming or GND, thereby effectively disabling the internal current regulators. Removing the jumper allows the internal pulldown resistor to pull DCTRL to ground, which also effectively disables the internal current regulators.

2.1.10 JFB1S-JFB6S

Installing any of these jumpers shorts the corresponding internal current regulator to ground. These jumpers are intended to assist in testing the TPS61181 and TPS61182's ability to protect itself from a WLED string accidentally shorting to ground.

2.1.11 JFB1R-JFB6R

These jumpers and the corresponding series resistors are not used in testing the TPS61181 or TPS61182.

2.2 Test Setup

Connect a power supply capable of supplying up to 24 V at 1.5 A is required between the VBAT pin and GND (J1 and J2). Connect a second logic signal or power supply capable of providing 1.2 V - 7 V to the high-impedance EN pin (J3) referenced to the same ground on J2. For normal operation, JP13 should be shorted with a jumper or ammeter and multiple WLEDs connected to one or more of the IFBx lines. J8 provides a convenient connection to WLEDEVM-260 ***(SLVU238)*** via a 14-pin ribbon, which contains six strings of 12 WLEDs each. Alternatively, external WLEDs can be connected to J2 or between jumpers JFB1S - JFB6S. If fewer than six WLEDs are needed, simply leave the unused IFBx line unconnected or short it to ground. By shorting jumpers JFB1S - JFB6S, the user can test the IC's protection against short circuits.

The TPS6118x family implements WLED dimming by replicating the PWM signal applied to DCTRL pin to the IFBx internal current regulators. A function generator capable of providing 1.2-V to 6-V maximum amplitude PWM signal between 100 Hz to 1 kHz is required to implement dimming, avoid screen flickering, and maintain dimming linearity.

2.3 Test Results

Below are the test results at T_A = 25°C using this EVM:

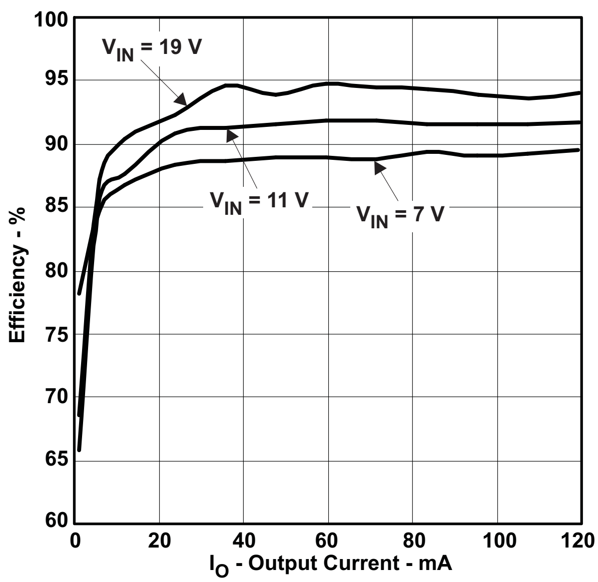

Figure 1. Efficiency vs Total WLED Output Current

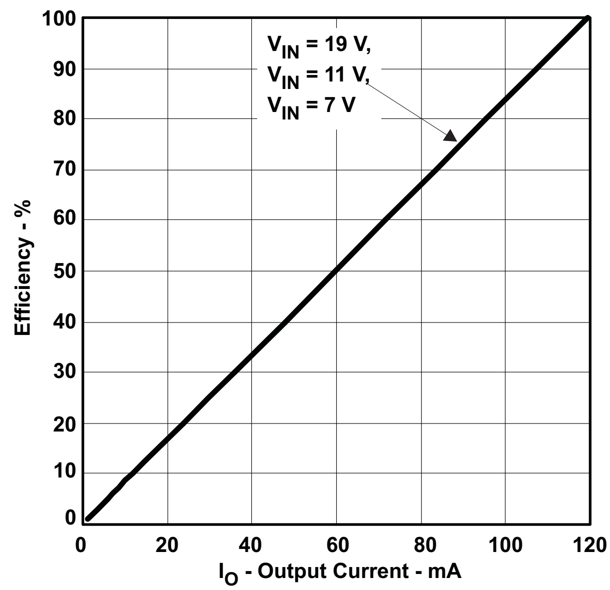

Figure 2. Dimming Linearity

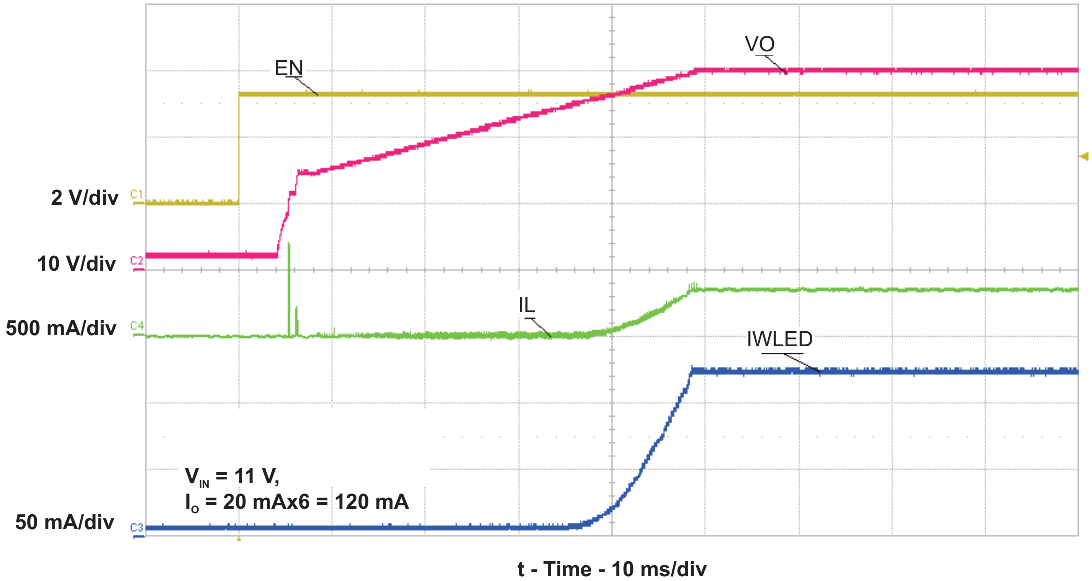

Figure 3. Start-up

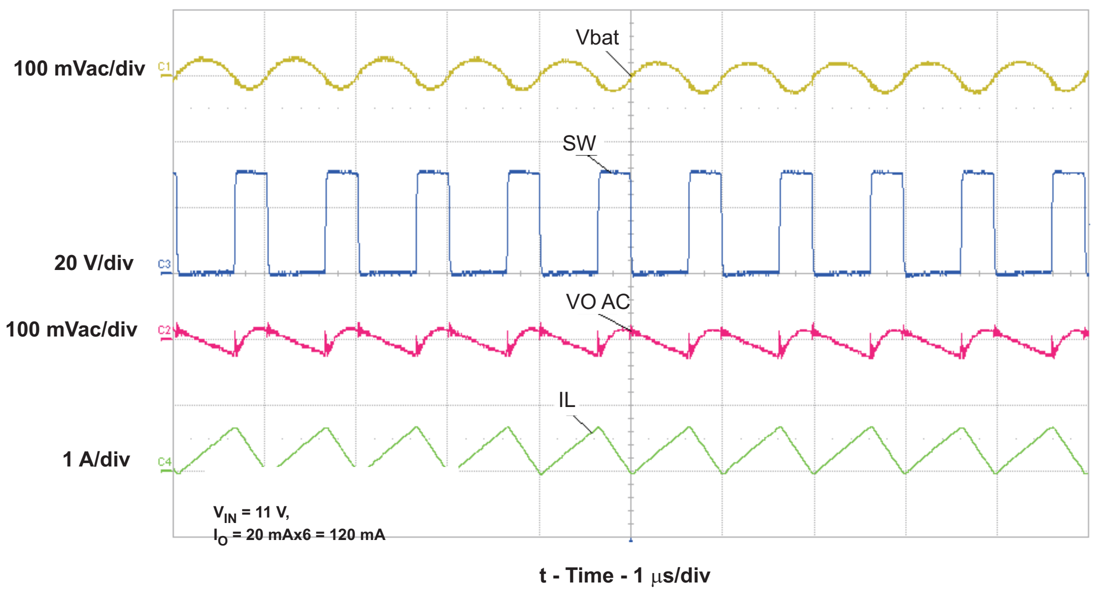

Figure 4. Switching Waveform

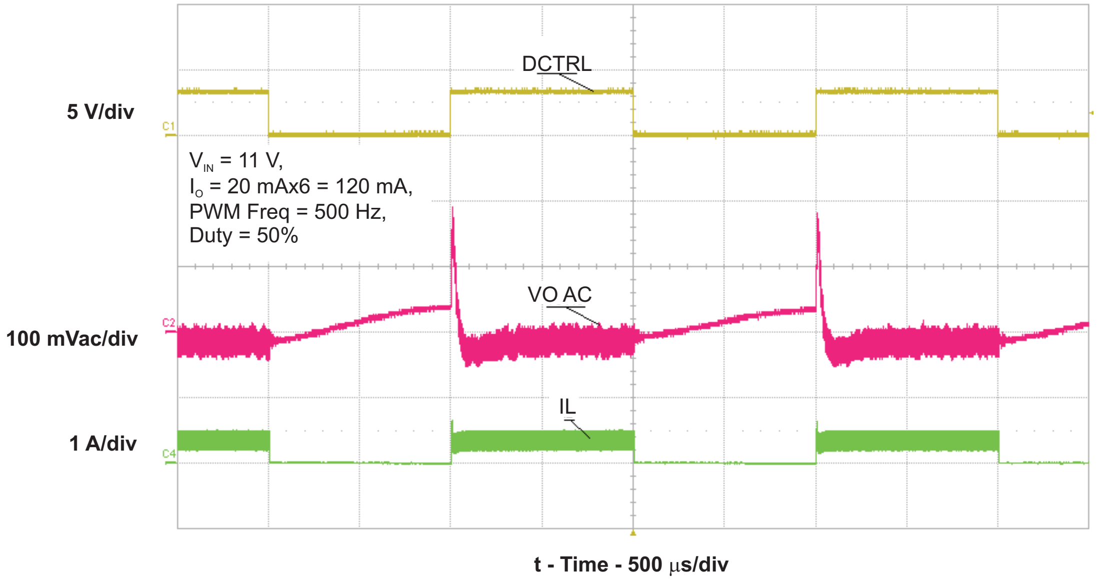

Figure 5. Output Ripple at PWM Dimming with Co=4.7 µF

Note that when measuring the WLED output voltage for the efficiency computation, the output voltage from the IC's I_{OUT} pin to ground was used, which includes the voltage drop across the series ammeter, used to measure the WLED current, as well as the voltage drop across the internal current sink circuit and external current setting resistor.

3 Board Layout

Board layout is critical for all switch mode power supplies. Figure 6, Figure 7, and Figure 8 show the board layout for the HPA283 PCB. The switching nodes with high-frequency noise are isolated from the noise-sensitive feedback circuitry, and careful attention has been given to the routing of high-frequency current loops. See the data sheet for more specific layout guidelines.

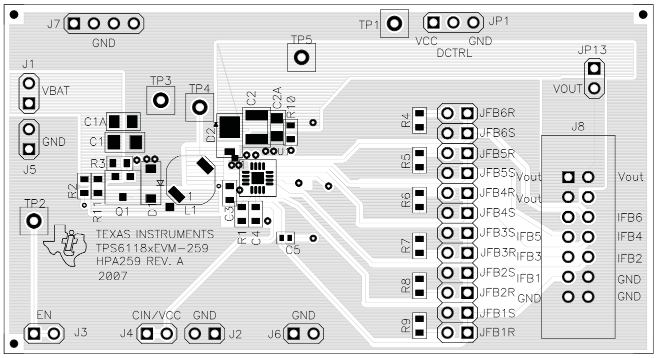

Figure 6. Top Assembly Layer

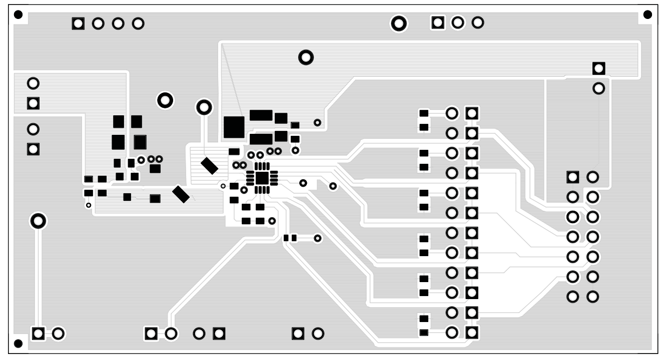

Figure 7. Top Layer

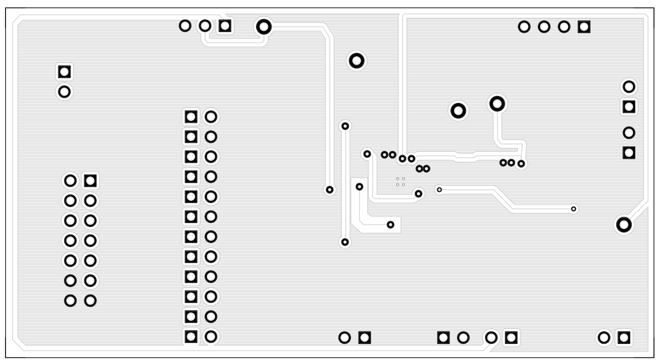

Figure 8. Bottom Layer

4 Schematic and Bill of Materials

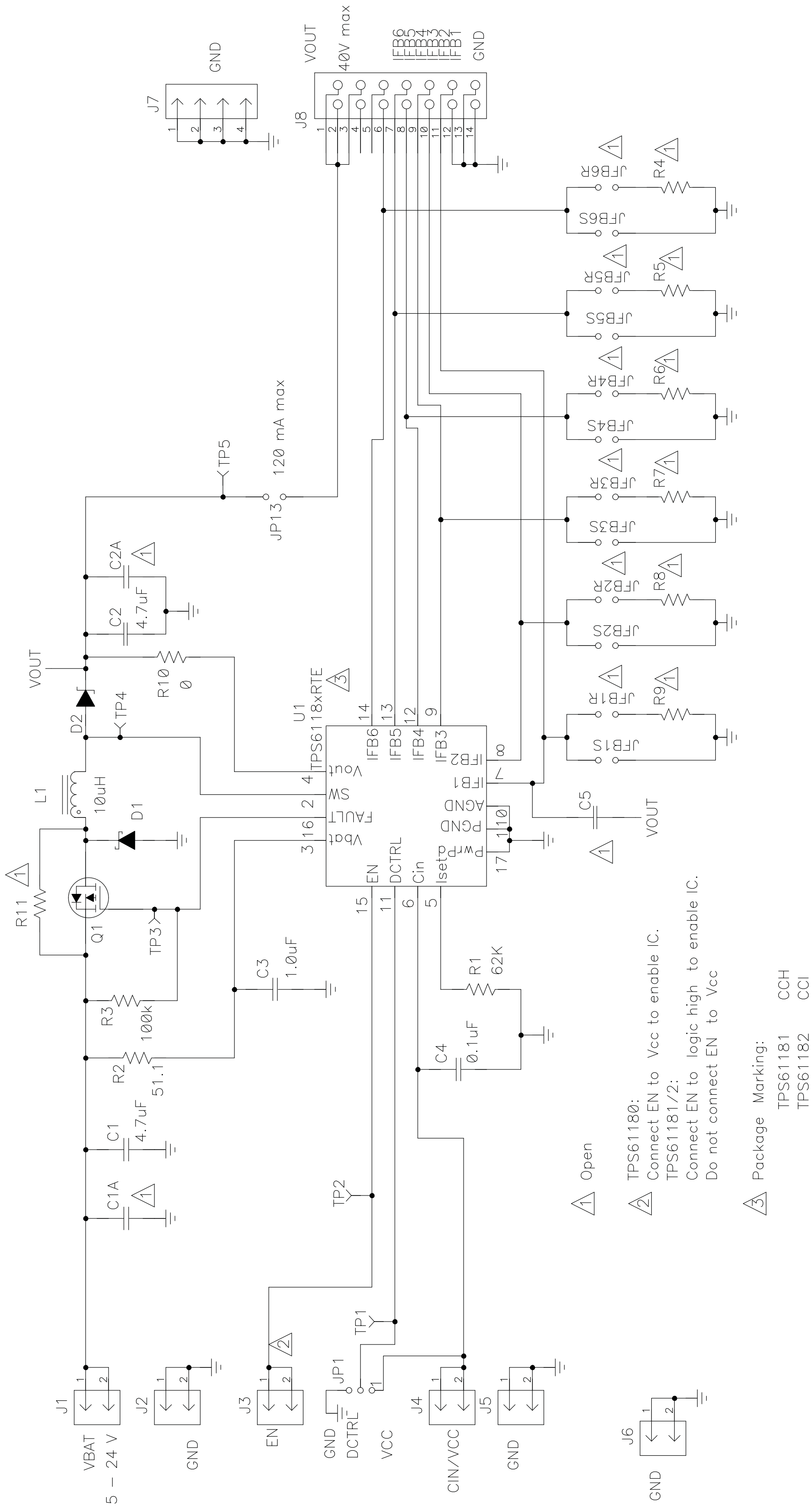

Figure 9. HPA259A Schematic

4.1 Bill of Materials

Table 2. HPA259 Bill of Materials

COUNT		REF DES	VALUE	DESCRIPTION	SIZE	PART NUMBER	MFR
-001	-002						
1	1	C1	4.7 µF	Capacitor, Ceramic, 25V, X5R, 10%	1206	C1206C475K3PAC	Kemet
0	0	C1A	Open	Capacitor, Ceramic, 25V, X5R, 10%	0805	Std	Std
1	1	C2	4.7 µF	Capacitor, Ceramic, 50V, X7R, 10%	1210	GRM32ER71H475KA88L	Murata
0	0	C2A	Open	Capacitor, Ceramic, 50V, X5R, 10%	0805	Std	Std
1	1	C3	1 µF	Capacitor, Ceramic, 25V, X5R, 10%	0603	GRM188R61E105KA12D	Murata
1	1	C4	0.1 µF	Capacitor, Ceramic, 50V, X7R, 10%	0603	C1608X7R1H104K	TDK
0	0	C5	Open	Capacitor, Ceramic, 50V, X7R, ±15%	0402	Std	Std
1	1	D1	BAT54ZFILM	Diode, Schottky, 300-mA, 40-V	SOD123	BAT54ZFILM	ST
1	1	D2	SS2P5-E3/84A	Diode, High Current SMD Schottky Rectifier, 2A, 50VDC	DO-220AA	SS2P5-E3/84A	Vishay
6	6	J1–J6	PTC36SAAN	Header, Male 2 pin, 100mil spacing, (36-pin strip)	0.100 inch × 2	PTC36SAAN	Sullins
1	1	J7	PTC36SAAN	Header, Male 4 pin, 100mil spacing, (36-pin strip)	0.100 inch × 4	PTC36SAAN	Sullins
1	1	J8	2514-6002UB	Connector, Male Straight 2x7 pin, 100mil spacing, 4 Wall	0.100 inch × 2X7	2514-6002UB	3M
0	0	JFB1R1 – JFB6R1	Open	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 inch × 2	PTC36SAAN	Sullins
6	6	JFB1S1–JFB6S1	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 inch × 2	PTC36SAAN	Sullins
1	1	JP1	PTC36SAAN	Header, 3-pin, 100mil spacing, (36-pin strip)	0.100 inch × 3	PTC36SAAN	Sullins
1	1	JP13	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 inch x 2	PTC36SAAN	Sullins
1	1	L1	10 µH	10-µH Inductor, 75 Ω [90 Ω] DC resistance, ±20%	0.205 x 0.205 inch	A915AY-100M	Toko
1	1	Q1	Si2307BDS	MOSFET, P-ch, –30V, –2A, 140 mΩ	SOT23	Si2307BDS	Vishay
1	1	R1	62K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R10	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R2	51.1	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R3	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	0	R4– R11	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	5	TP1–TP5	5000	Test Point, Red, Thru Hole Color Keyed	0.100 × 0.100 inch	5000	Keystone
1	0	U1	TPS61181RTE	IC, WLED Driver	QFN-16	TPS61181RTE	TI
0	1	U1	TPS61182RTE	IC, WLED Driver	QFN-16	TPS61182RTE	TI
7	7	–		Shunt, 100 mil, Black	0.1	929950-00	
1	1	–		PCB, 3.25 In × 1.75 In × 0.062 In		HPA259	Any

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 5 V to 24 V and the output voltage range of VIN to 17.4 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 25°C . The EVM is designed to operate properly with certain components above 25°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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