

# TPS922152EVM Average-Current Buck LED Driver Evaluation Module



## Description

The Texas Instruments TPS922152EVM evaluation module (EVM) helps designers evaluate the operation and performance of the buck LED (light emitting diode) driver TPS922152. The TPS922152EVM operates from 4.5V to 15V input voltage range, 60V bus voltage and provides default 5A constant current to drive the external LED load.

## Get Started

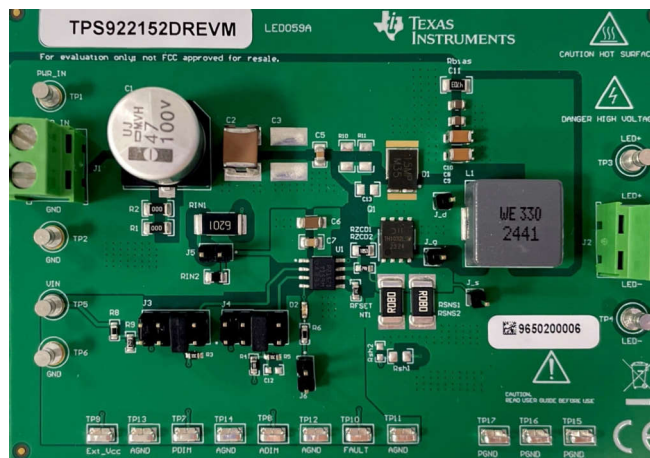
1. Read and study this user's guide completely before evaluating
2. Order the [TPS922152EVM](#) for evaluation if step 1 met
3. Setup and test the [TPS922152EVM](#) per user's guide instructions

## Features

- 4.5V to 15V input voltage range
- Wide application voltage up to 500V
- LED common anode connection
- Adjustable switching frequency: 50kHz to 1MHz
- Adaptive off time mode
- Advanced dimming options:
  - Analog dimming (1000:1)
  - PWM dimming (50ns pulse width)
  - Flexible dimming

## Applications

- Constant illumination:
  - Indoor and Outdoor lighting
  - Stage and Photography lighting
  - Projector, Laser TV, Printer, IP camera
  - High Voltage LED Driver
- Instant illumination:
  - Machine vision and Camera flash
  - Fire alarm and Strobe
- LED Backlight:
  - Flat Panel Display
  - LCD TV and Monitor



TPS922152 Evaluation Module


## 1 Introduction

The TPS922152 EVM evaluation module (EVM) helps designers evaluate the operation and performance of the TPS922152 non-synchronous average-current control Buck LED drivers with wide application voltage range. The TPS922152 is capable of driving external switching FETs at adjustable switching frequency up to 1MHz with Adaptive Off-Time (AOT) mode. The AOT mode allows low LED current ripple and fast transient response with small output capacitor. The device also supports single layer PCB design and common anode connection.

## 2 Warnings and Cautions

Observe the following precautions when using the TPS922152EVM.

**WARNING**



When choosing an LED component (not included with this EVM) the end-user must consult the LED data sheet supplied by the LED manufacturer to identify the EN62471 Risk Group Rating and review any potential eye hazards associated with the LED chosen. Always consider and implement the use of effective light filtering and darkening protective eye wear and be fully aware of surrounding laboratory-type set-ups when viewing intense light sources that can be required to minimize or eliminate such risks to avoid accidents related to temporary blindness.

## 3 Description

The TPS922152EVM provides an LED driver based on the TPS922152 buck switching regulator. The EVM is set up for a default output current of 5A with analog and PWM dimming options. By applying 0-100% duty cycle PWM signal on PDIM pin or analog voltage in the range of 0.2V to 2.4V on ADIM pin, device is able to operate in PWM dimming or analog dimming respectively. For analog dimming, the EVM can provide dimming ratio up to 1000:1. For PWM dimming, the EVM can output pulse with width down to 50ns. To further increase the flexibility of dimming control, flexible dimming mode is also available to independently control LED current value and the on/off behavior. The TPS92215x can provide features like wide voltage range, high current rating and ultra-deep dimming range.

### 3.1 Typical Applications

This design describes an application of the TPS922152 as an LED driver using the following specifications. For applications with a different input voltage range or different output voltage and current, please refer to the TPS922152 datasheet.

[Table 3-1](#) lists the electrical performance specifications.

**Table 3-1. TPS922152EVM Electrical Performance Specifications**

Parameter	Test Conditions	MIN	TYP	MAX	Units
Input bus voltage range, $V_{BUS}$		54	60	66	V
LED forward voltage	Single white LED		3		V
Output voltage, $V_{OUT}$	LED+ to LED-, depends on $V_{IN}$		48		V
Maximum LED current			5		A
Output current ripple	$V_{IN} = 60$ V, 16 white LEDs, 5-A output current		100		mApp
Analog dimming range		0.2		2.4	V
PWM dimming range	3.3-V PWM at PDIM pin	0		100	%
PWM dimming frequency		0.1		50	kHz
Switching frequency			400		kHz

## 4 Test Setup

This section describes the connectors and test points on the EVM and how to properly connect, setup, and use the TPS922152EVM.

### 4.1 Connector Description

**Table 4-1. EVM Connectors and Test Points**

Reference Designator	Function
J1	Connect to $V_{BUS}$ power supply
J2	Connect to LED load
J3	PDIM optional connection to $V_{IN\_div}$ , external $V_{CC}$ , TP7 or GND
J4	ADIM optional connection to $V_{IN\_div}$ , external $V_{CC}$ , TP8 or GND
J5	Option to power supply the device through $V_{BUS}$ directly
J6	Option to pull up FAULT to $V_{IN\_div}$
TP1, TP2	Positive and Negative $V_{BUS}$ input test point
TP3, TP4	LED load anode and cathode test point
TP5, TP6	Connect to $V_{IN}$ power supply
TP7	PDIM signal input
TP8	ADIM signal input
TP9	External $V_{CC}$ signal input
TP10	FAULT test point
TP11, TP12, TP13, TP14	AGND test point
TP15, TP16, TP17	PGND test point

## 4.2 Input/Output Connection

A power supply capable of supplying 10A must be connected to J1 through a pair of 20-AWG wires. The LED load must be connected to J2 through a pair of 20-AWG wires. The positive terminal of the LED load must be connected to the TP3 or J2 terminal beside TP3, and the negative terminal of the LED load must be connected to TP4 or J2 terminal beside TP4. Wires must be twisted and kept as short as possible to minimize voltage drop, inductance, and EMI transmission. TP7 and TP8 are the input terminals for control signals of different dimming modes. Please refer to the data sheet for the dimming mode configuration. As an example, [Figure 4-1](#) shows the connection diagram of TPS922152EVM.

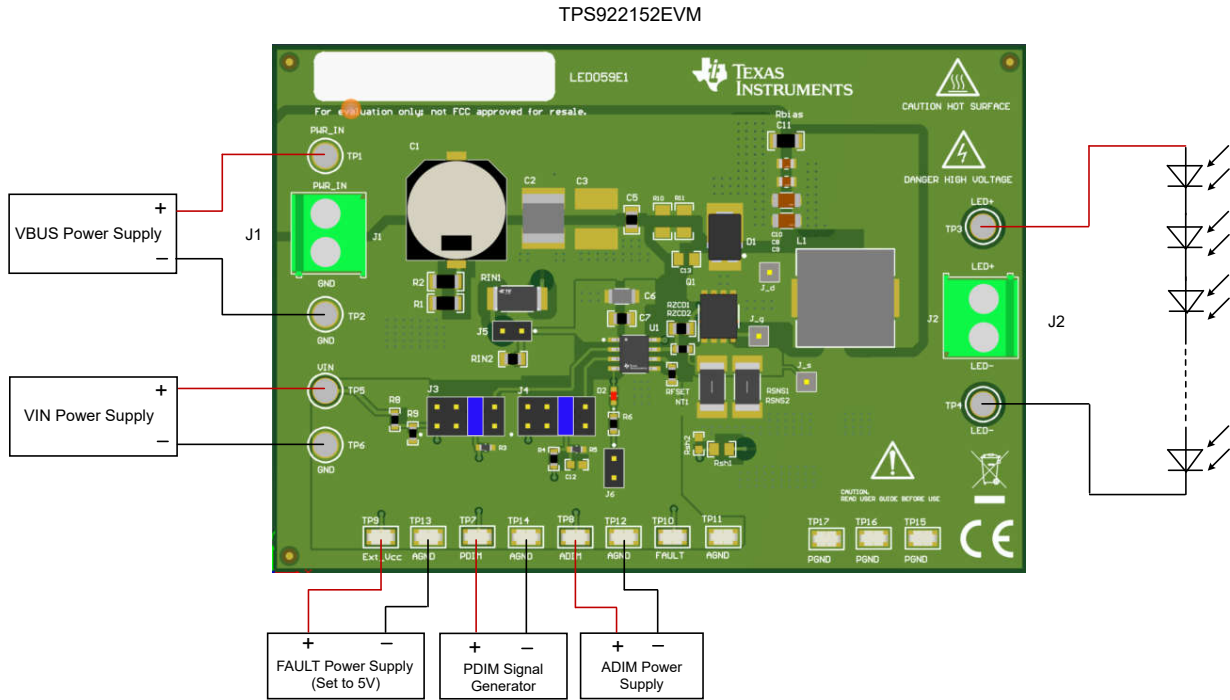


Figure 4-1. Connection Diagram of TPS922152EVM

## 5 Implementation Results

## 5.1 Test Result

Figure 5-1 and Figure 5-2 show the LED current transient waveform for a PWM transition from 1% to 99%, 20kHz and 99% to 1%, 20kHz respectively. Input voltage is 60V, with 16 white LEDs in series used as load. The full-scale LED current is set at 5.0A.

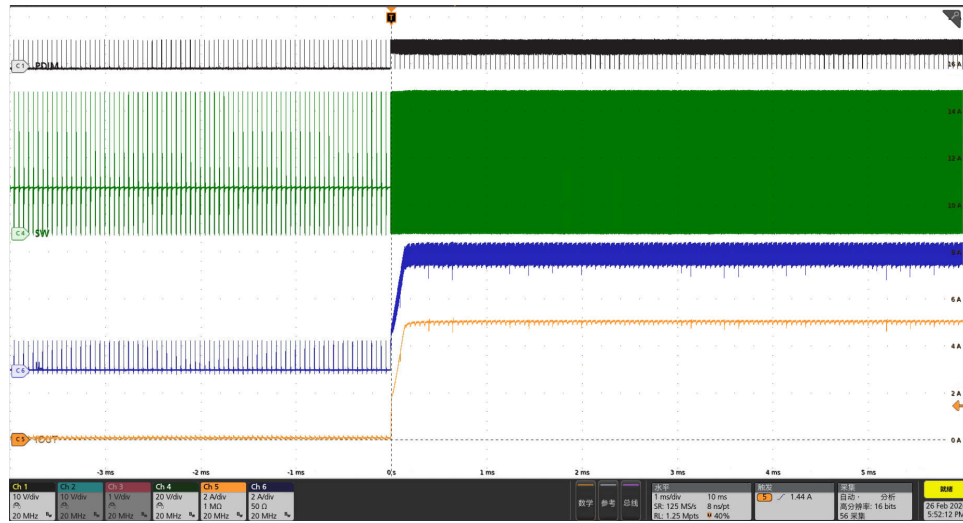


Figure 5-1. LED Current Transient for a PWM Transition from 1% to 99%, 20kHz

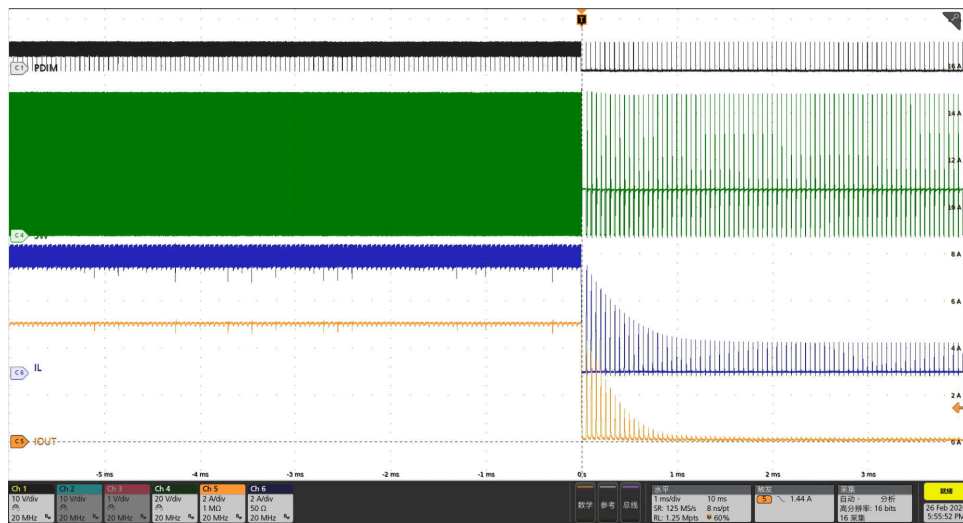


Figure 5-2. LED Current Transient for a PWM Transition from 99% to 1%, 20kHz

## 6 Schematic

Figure 6-1 shows the schematic for TPS922152EVM.

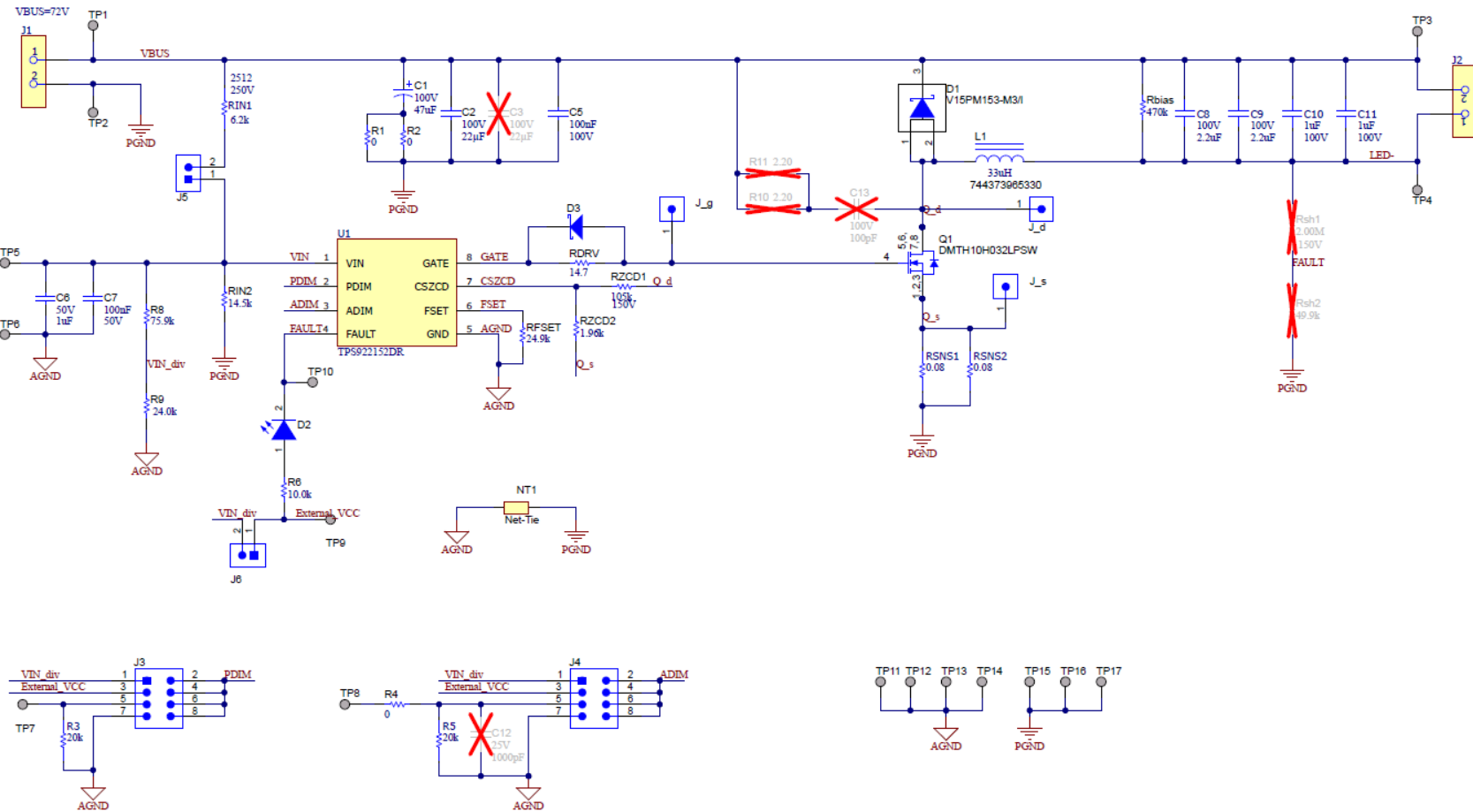


Figure 6-1. TPS922152EVM Schematic

## 7 Layout

Figure 7-1, Figure 7-2, Figure 7-3 and Figure 7-4 show the layout of the TPS922152EVM printed circuit board (PCB).

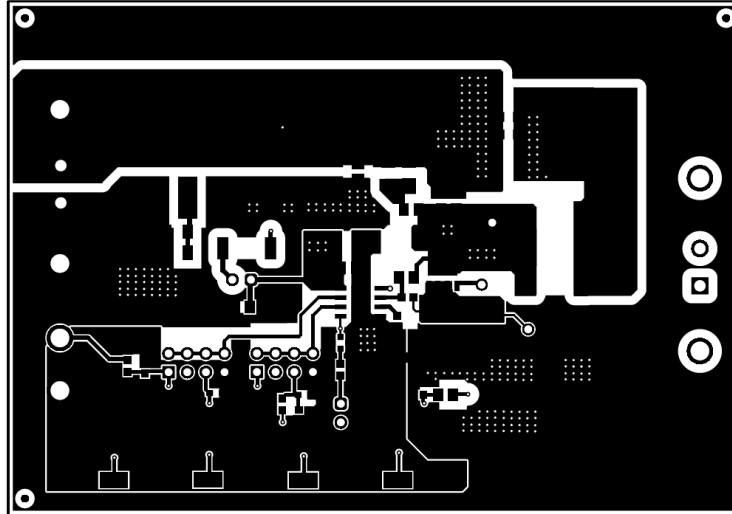


Figure 7-1. TPS922152EVM Top Layer

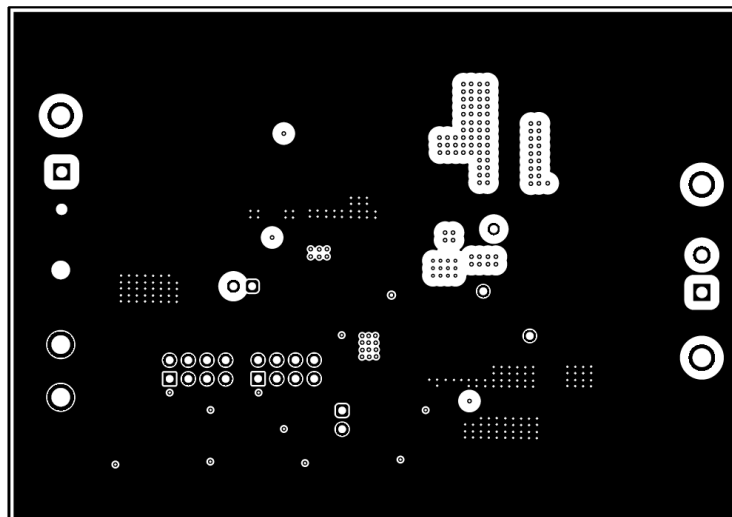
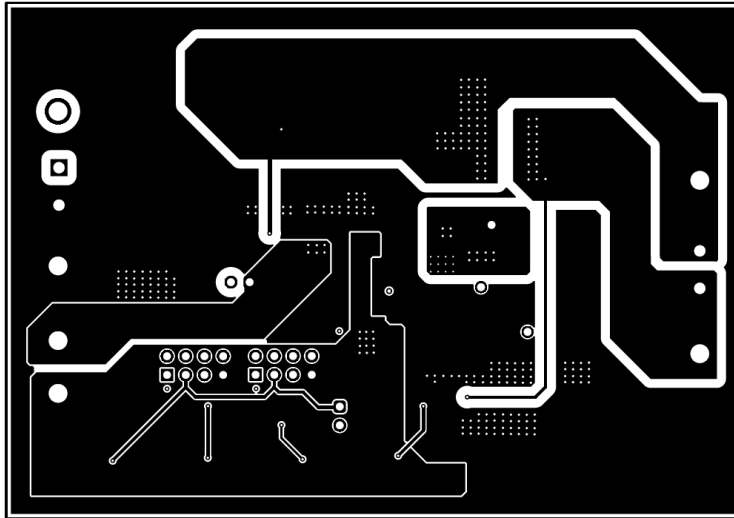
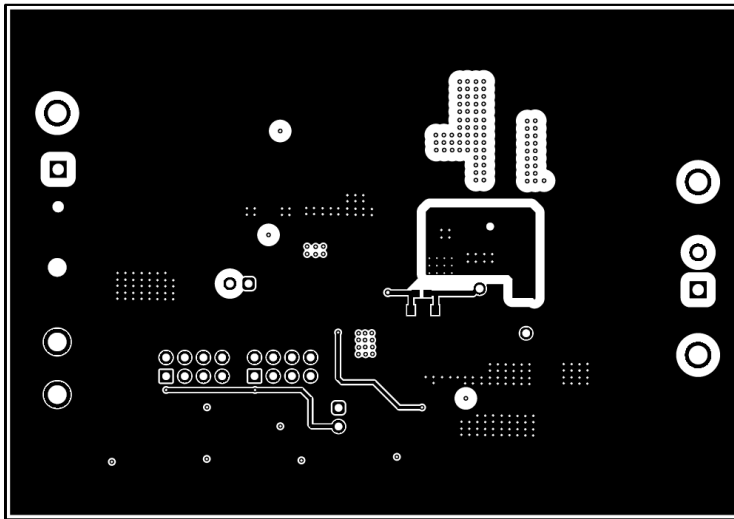


Figure 7-2. TPS922152EVM Inner Layer 1



**Figure 7-3. TPS922152EVM Inner Layer 2**



**Figure 7-4. TPS922152EVM Bottom Layer**

## 8 Bill of Materials

Table 8-1 shows the bill of materials for TPS922152EVM.

**Table 8-1. TPS922152EVM Bill of Materials**

Designator	Quantity	Description	PartNumber	Manufacturer
!PCB1	1	Printed Circuit Board	LED059	Any
C1	1	CAP, AL, 47 uF, 100 V, +/- 20%, 0.33 ohm, SMD	EMVH101ARA470MKE0S	Chemi-Con
C2	1	CAP, CERM, 22 uF, VAC/100 VDC, +/- 20%, X7R, 6.1x6.4x5.3mm	KRM55WR72A226MH01L	MuRata
C5	1	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	GCM21BR72A104KA37L	MuRata
C6	1	CAP, CERM, 1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	CGA5L3X7R1H105K160AB	TDK
C7	1	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0805	GRT21BR71H104KE01L	MuRata
C8, C9	2	2.2uF ±10% 100V Ceramic Capacitor X7R SMD, J-Lead	KRM31KR72A225KH01K	Murata
C10, C11	2	1uF ±10% 100V Ceramic Capacitor X7S 0805 (2012 Metric)	GRM21BC72A105KE01L	Murata
D1	1	Diode, Schottky, 150 V, 15 A, AEC-Q101, TO-277A	V15PM153-M3/I	Vishay-Semiconductor
D2	1	Red 625nm LED Indication - Discrete 2V 0603 (1608 Metric)	150060RS75003	Würth Electronics
D3	1	Diode, Schottky, 30 V, 0.5 A, SOD-123	MBR0530T1G	ON Semiconductor
J1, J2	2	2 Position Wire to Board Terminal Block Horizontal with Board 0.200" (5.08mm) Through Hole	691216510002S	Würth Elektronik
J3, J4	2	Header, 100mil, 4x2, Gold, TH	TSW-104-07-G-D	Samtec
J5, J6	2	Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	Samtec
J_d, J_g, J_s	3	Header, 2.54mm, 1x1, Gold, TH	HTSW-101-07-G-S	Samtec
L1	1	Inductor, Wirewound, Powdered Iron, 33 uH, 5.45 A, 48.7m ohm, SMD	7.44374E+11	Würth Elektronik
LBL1	1	Thermal Transfer Printable Labels, 1.250" W x 0.250" H - 10,000 per roll	THT-13-457-10	Brady
Q1	1	MOSFET, N-CH, 100 V, PowerPAK SO-8	DMTH10H032LPSW	Diodes
R1, R2	2	RES, 0, 5%, 0.25 W, 1206	RC1206JR-070RL	Yageo America
R3, R5	2	Res General Purpose Thick Film 0603 20K Ohm 1% 1/10W ±100ppm/°C Molded SMD Paper T/R	RC0603FR-0720KL	Yageo
R4	1	RES, 0, 5%, 0.1 W, 0603	ERJ-3GEY0R00V	Panasonic
R6	1	RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060310K0FKEA	Vishay-Dale
R8	1	RES, 75.9 k, 0.1%, 0.1 W, 0603	RT0603BRD0775K9L	Yageo America
R9	1	RES, 24.0 k, 0.5%, 0.1 W, 0603	RT0603DRE0724KL	Yageo America
Rbias	1	RES, 470 k, 1%, 0.25 W, 1206	RC1206FR-07470KL	Yageo America
RDRV	1	RES, 14.7, 1%, 0.1 W, 0603	RC0603FR-0714R7L	Yageo
RFSET	1	RES, 24.9 k, 0.5%, 0.1 W, 0603	RT0603DRE0724K9L	Yageo America
RIN1	1	Res Thick Film 2512 6.2K Ohm 1% 3W ±100ppm/°C Molded SMD T/R	35216K2FT	TE Connectivity
RIN2	1	RES, 14.5 k, 0.1%, 0.125 W, 0805	RT0805BRD0714K5L	Yageo America
RSNS1	1	80 mOhms ±1% 3W Chip Resistor 2512 (6332 Metric) Automotive AEC-Q200, Current Sense Metal Element	CRA2512-FZ-R080ELF	Bourns
RSNS2	1	80 mOhms ±1% 1W Chip Resistor 2512 (6332 Metric) Automotive AEC-Q200, Current Sense Metal Element	CRA2512-FZ-R080ELF	Bourns
RZCD1	1	RES, 105k , 1%, 0.125 W, 0805	RC0805FR-07105KL	Vishay-Dale
RZCD2	1	RES, 1.96 k, 0.1%, 0.1 W, 0603	RC0603FR-071K96L	Yageo America
SH-J1, SH-J2	2	Shunt, 2.54mm, Gold, Black	60900213421	Würth Elektronik
TP1, TP2, TP3, TP4, TP5, TP6	6	Terminal, Turret, TH, Double	1502-2	Keystone
TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17	11	Test Point, Miniature, SMT	5019	Keystone
U1	1	TPS922152DR	TPS922152DR	Texas Instruments
C3	0	CAP, CERM, 22 uF, VAC/100 VDC, +/- 20%, X7R, 6.1x6.4x5.3mm	KRM55WR72A226MH01L	MuRata
C12	0	CAP, CERM, 1000 pF, 25 V, +/- 1%, C0G/NP0, 0603	C0603C102F3GACTU	Kemet
C13	0	CAP, CERM, 100 pF, 100 V, +/- 1%, C0G, 0805	C0805C101F1GACTU	Kemet

**Table 8-1. TPS922152EVM Bill of Materials (continued)**

FID1, FID2, FID3	0	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
R10, R11	0	RES, 2.20, 1%, 0.25 W, 1206	RC1206FR-072R2L	Yageo America
Rsh1	0	RES, 2.00 M, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	CRCW08052M00FKEA	Vishay-Dale
Rsh2	0	RES, 49.9 k, 0.5%, 0.1 W, 0603	RT0603DRE0749K9L	Yageo America

## **9 Additional Information**

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