# User's Guide **TPS53819A Buck Controller Evaluation Module User's** Guide

# **TEXAS INSTRUMENTS**

#### ABSTRACT

The TPS53819AEVM-123 evaluation module (EVM) is designed to evaluate the TPS53819A. The TPS53819A is a small-size single-buck controller with adaptive on-time D-CAP2 mode control. It provides a fixed 1.2-V output at up to 25 A from a nominal 12-V input bus. This controller is an analog PWM controller allowing programming and monitoring via the PMBus interface. The TPS53819AEVM-123 also uses a 5 mm × 6 mm TI power block MOSFET (CSD87350Q5D) for high power density and superior thermal performance.

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### Trademarks

D-CAP2<sup>™</sup> is a trademark of Texas Instruments. All trademarks are the property of their respective owners.

# 1 Description

The TPS53819AEVM-123 is designed to use a regulated 12-V bus to produce a regulated 1.2-V output at up to 25 A of load current. The TPS53819AEVM-123 is designed to demonstrate the TPS53819A in a typical low voltage application while providing a number of test points to evaluate the performance of the TPS53819A.

## **1.1 Typical Applications**

- Point of load systems
- Storage computer
- Server computer
- Multi-function printer
- Embedded computing

### 1.2 Features

• Regulated 1.2-V output, marginable and trimmable through the PMBus interface

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- 25-A DC steady state output current
- D-CAP2<sup>™</sup> mode control supporting all ceramic output capacitors
- Programmable soft start through the PMBus interface
- Programmable enable function through the PMBus interface
- · Fault report through the PMBus interface
- J2 for external enable function
- Supports pre-bias output voltage start-up
- · High efficiency and high-power density by using a TI power block MOSFET
- Convenient test points for probing critical waveforms
- Cycle-by-cycle valley overcurrent limit protection

#### **2 Electrical Performance Specifications**

#### Table 2-1. TPS53819AEVM-123 Electrical Performance Specifications<sup>(1)</sup>

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS			·	·	
Voltage range, V <sub>IN</sub>		8	12	14	V
Maximum input current	V <sub>IN</sub> = 8 V, I <sub>OUT</sub> = 25 A		4.3		А
No load input current	V <sub>IN</sub> = 14 V, I <sub>OUT</sub> = 0 A with auto skip mode		1		mA
OUTPUT CHARACTERISTICS					
Output voltage, V <sub>OUT</sub>			1.2		V
Output load current, I <sub>OUT</sub>		0		25	А
Output voltage regulation	Line regulation: input voltage = 8 V to 14 V		0.5%		
	Load regulation: output current = 0 A to 25 A		0.5%		
Output voltage ripple	V <sub>IN</sub> = 12 V, I <sub>OUT</sub> = 25 A		10		mVpp
Output over current	IOUT_OC fault flag asserted	25			А
SYSTEMS CHARACTERISTICS				·	
Switching frequency			425		kHz
Peak efficiency	V <sub>IN</sub> = 12 V, I <sub>OUT</sub> = 10 A		91.0%		
Full load efficiency	V <sub>IN</sub> = 12 V, I <sub>OUT</sub> = 25 A		87.9%		
Loop bandwidth	V <sub>IN</sub> = 12 V, I <sub>OUT</sub> = 25 A		111		kHz
Phase margin	V <sub>IN</sub> = 12 V, I <sub>OUT</sub> = 25 A		91.4		٥
Operating temperature			25		°C

(1) This design uses TI Default PMBus settings



# **3 Schematic**



Figure 3-1. TPS53819AEVM-123 Schematic



# 4 Test Setup

#### 4.1 Test and Configuration Software

In order to change any of the default configuration parameters on the EVM, it is necessary to obtain the TI Fusion Digital Power Designer software.

#### 4.1.1 Description

Fusion Digital Power Designer is the Graphical User Interface (GUI) used to configure and monitor Texas Instrument's (TI) TPS53819A power controller on this evaluation module (EVM). The application uses the PMBus protocol to communicate with the controller over serial bus by way of a TI USB Interface Adapter EVM included.

#### 4.1.2 Features

Some of the tasks performed with the GUI include:

- Turn on or off the power supply output, either through the hardware control line or the PMBus operation command.
- Configure common operating characteristics such as V<sub>OUT</sub>, switching frequency, soft-start time, and more.
- Monitor status and warnings or fault conditions real-time.

The software is available for download at this location: http://focus.ti.com/docs/toolsw/folders/print/fusion\_digital\_power\_designer.html.

#### 4.2 Test Equipment

**Voltage Source:** The input voltage source  $V_{IN}$  should be a 0-V to 14-V variable DC source capable of supplying 30 ADC. Connect VIN to J4 as shown in Figure 4-2.

#### Multimeters:

- V1: VIN at TP1 (VIN) to TP4 (PGND)
- V2: VOUT at TP7 (VOUT) to TP9 (PGND)
- A1: VIN input current

**Output Load:** The output load should be an electronic constant-resistance mode load capable of 0 ADC to 25 ADC at 1.2 V. An electronic constant-current load is also acceptable.

**Oscilloscope:** A digital or analog oscilloscope can be used to measure the output ripple. The oscilloscope must be set for 1-M $\Omega$  impedance, 20-MHz bandwidth, AC coupling, 2- $\mu$ s per division horizontal resolution, 20-mV per division vertical resolution. As shown in Figure 4-1, test points TP7 and TP9 can be used to measure the output ripple voltage by placing the oscilloscope probe tip through TP7 and holding the ground barrel to TP9. It is not recommended to use a long leaded ground connection because this may induce additional noise due to a large ground loop. Alternatively, the output ripple can be measured directly across C14 with a short ground lead as shown in Figure 4-2. To measure other waveforms, adjust the oscilloscope as needed.



Figure 4-1. Tip and Barrel Measurement for V<sub>OUT</sub> Ripple





Figure 4-2. Probe with Short Ground Lead for V<sub>OUT</sub> Ripple Across C14

**Fan:** Some of the components of this EVM can approach temperatures of 60°C during operation. A small fan capable of 200–400 LFM is recommended to reduce component temperatures while the EVM is operating. Exercise caution when touching the EVM while the fan is not running and always exercise caution when touching any circuits that can be live or energized.

#### **Recommended Wire Gauge:**

- **V**<sub>IN</sub> to J1 (12-V input): The recommended wire size is 1 × AWG #14 per input connection, with the total length of wire less than four feet (two feet input, two feet return).
- **J3 to LOAD:** The minimum recommended wire size is 2 × AWG #14, with the total length of wire less than four feet (two feet input, two feet return).

#### 4.3 Recommended Test Setup

Figure 4-3 is the recommended test set up to evaluate the TPS53819AEVM-123. Working at an ESD workstation, make sure that any wrist straps, bootstraps or mats are connected referencing the user to earth ground before power is applied to the EVM.





Figure 4-3. TPS53819AEVM-123 Recommended Test Setup

#### 4.3.1 Input Connections

- 1. Prior to connecting the DC input source V<sub>IN</sub>, it is advisable to limit the source current from V<sub>IN</sub> to 10-A maximum. Make sure V<sub>IN</sub> is initially set to 0 V and connected to J1 as shown in Figure 4-3.
- 2. Connect a voltmeter V1 at TP1 and TP4 to measure the input voltage.
- 3. Connect a current meter to A1 to measure the input current.

#### 4.3.2 Output Connections

- 1. Connect Load to J3 and set Load to constant resistance mode to sink 0 Adc before V<sub>IN</sub> is applied.
- 2. Connect a voltmeter V2 at TP7 and TP9 to measure the output voltage.

#### 4.3.3 Other Connections

- 1. When using a fan, ensure air is flowing across the EVM.
- 2. Connect the ribbon cable from the USB interface adapter to J4.

#### 4.4 List of Test Points

TEST POINTS	NAME	DESCRIPTION				
TP1	VIN	Input voltage				
TP2	VREG	5-V LDO output				
TP3	PGOOD	Power good				
TP4	PGND	GND reference for V <sub>IN</sub>				
TP5	DRVH	High-side driver output				
TP6	SW	Switching node				
TP7	VOUT	Output voltage				
TP8	DRVL	Low-side driver output				
TP9	PGND	GND reference for VOUT				
TP10	VDD	Controller power-supply input				
TP11	LOOPB	Input B for loop injection				
TP12	GND	GND for sensitive analog circuitry				

#### Table 4-1. The Functions of Each Test Points



#### Table 4-1. The Functions of Each Test Points (continued)

TEST POINTS	NAME	DESCRIPTION
TP13	LOOPA	Input A for loop injection

## 4.5 Jumper Configuration: Enable Selection

The controller can be enabled and disabled by J3.

Default setting: No Jumper shorts on J3 to Enable the controller.

Table 4-2. Enable Selection				
JUMPER POSITION ENABLE SELECTION				
Jumper shorts on J3	Disable the controller			
No jumper shorts on J3	Enable the controller			

# **5 EVM Configuration Using the Fusion GUI**

In order to configure the TPS53819A controller on the EVM from its default values, it is required to use the TI Fusion Digital Power Designer software. It is necessary to have input voltage applied to the EVM prior to launching the software so the TPS53819A can respond to the GUI and the GUI can recognize the TPS53819A. At least 4.25 V must be applied to the V<sub>DD</sub> pin to overcome the default UVLO setting.

### **5.1 Configuration Procedure**

- 1. Adjust the input supply to provide at least 4.25 V.
- 2. Apply the input voltage to the EVM. Refer to Figure 4-3 for connections and test setup.
- Launch the Fusion GUI software. If prompted, select GUI scan mode to DEVICE\_CODE only. Refer to Figure 5-1 for changing device scanning options. The software will recognize the TPS53819A device on the EVM and load the GUI.
- 4. Configure the EVM operating parameters as needed.

Some parameters can be configured, such as switching frequency, to values that can result in erratic or unexpected behavior on this EVM. Consult the *TPS53819A 3-V to 28-V Input, 40-A, Eco-Mode*™, *D-CAP2*™ *Synchrons Buck Controller Data Sheet* for guidance in configuration of parameters and impact on component selection.

CAUTION

49 Device Scan Editor					2
Set All Addresses To: Skip	DEVICE_ID DEVICE_CODE	DEVICE_ID & DEVICE_CODE	UCD3XXX Isolated		
1d 0x01 DEVICE_CODE	23d 0x17 DEVICE_CODE	44d 0x2C DEVICE_CODE	65d 0x41 DEVICE_CODE	86d 0x56 DEVICE_CODE	107d 0x68 DEVICE_CODE
2d 0x02 DEVICE_CODE 🗸	24d 0x18 DEVICE_CODE	45d 0x2D DEVICE_CODE V	66d 0x42 DEVICE_CODE	87d 0x57 DEVICE_CODE	108d 0x6C DEVICE_CODE
3d 0x03 DEVICE_CODE	25d 0x19 DEVICE_CODE V	46d 0x2E DEVICE_CODE V	67d 0x43 DEVICE_CODE	88d 0x58 DEVICE_CODE V	109d 0x6D DEVICE_CODE V
4d 0x04 DEVICE_CODE	26d 0x1A DEVICE_CODE	47d 0x2F DEVICE_CODE	68d 0x44 DEVICE_CODE	89d 0x59 DEVICE_CODE	110d 0x6E DEVICE_CODE
5d 0x05 DEVICE_CODE	27d 0x18 DEVICE_CODE	48d 0x30 DEVICE_CODE	69d 0x45 DEVICE_CODE	90d 0x5A DEVICE_CODE	111d 0x6F DEVICE_CODE

#### Figure 5-1. Selection of Device Scan Options

## 5.2 Default Fusion GUI Screenshots and Description

Figure 5-2 is a screenshot of the *General* tab of the Fusion GUI with default configuration where the general configuration parameters can be set. After modifying a parameter the **Write to Hardware** button must be clicked to apply it. When power cycling all parameters reset to the values stored in flash. To change the values stored in flash, click the **Store RAM to Flash** button. Figure 5-3 is a screenshot of the *All Config* tab where all accessible registers are viewed. Figure 5-4 is a screenshot of the Status screen selected on the bottom-left corner. The USB adapter settings are found in the File menu of the Digital Fusion GUI.

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File Device Tools H	elp			TP553819A/TP553912/TP553913/TP55391	5 @ Ad
Configure	General Al Config				
Write to Hardware	ON_OFF_CONFIG	DELAY_CO	INTROL	MANUFACTURER_INFO	
Auto write on rail or device change Discard Changes	EN Pin Only     The device ignores the on/off portion of the     OPERATION command from serial bus. Power     is converted when the EN pin is active.	Power Good Power-On E	d Delay Time: 1.024 ms V Delay Time: 1.124 ms V		
Store Coofia to MM	O OPERATION Only	VOUT_AD	JUSTMENT		_
Restore NVM Config	The device ignores the EN pin. Power is converted when the on/off portion of the OPERATION command is on.	Vout Adjust	tment: 0.00%	Disable all writes except to the     WRITE_PROTECT command	
Class Dectors Making	O Both EN Pin & OPERATION	VOUT_MA	RGIN	WRITE_PROTECT, OPERATION and PAGE	
Clear Rescore modices	The EN pin must be active and the on/off portion of the OPERATION command on for the device to convert power.	Vout Margin Vout Margin	n High: 5.70% 🗸	Commands  Disable all writes except to the WRITE_PROTECT, OPERATION, PAGE, ON_OFF_CONFIG and VOUT_COMMAND	=
	MODE_SOFT_START_CONFIG	UVLO THE	RESHOLD	commands	
	Soft Start Time: 1 ms	VIN Turn-O	n UNLO Threshold: 4.25 V	Enable writes to all commands	
	Under-Voltage Mode:   Hiccup after UV  Latch-off after UV	FREQUENC	Y_CONFIG: TP553819A (TP5539)		
	Conduction Mode: O DCM (For TP553819A only)  FCCM	Switching F	requency: 425kHz (400kHz) 🗸		
					~
	Tips & Hinks		PMBus Log		5
Configure	WRITE_PROTECT [0x10] Controls writing to the PMBus device. The intent of this command is to provide protection against accidential ch This command is not intended to provide protection ag deliberate or malicious changes to a device's configura operation.	s Anges. anges. tion or			2
8 Status		E.	PMBus Loo		Eh S

Figure 5-2. TPS53819A GUI Configure General Tab

ice Tools Help				TP553819A/TP553912/TP553913/TP553
General Al Config				
Hardware	Code	Value/Edit	Hex/Edit	
te on rail or Configuration				
Changes DELAY_CONTROL [MFR 01]	0xD1	PGD:1.0 🗸	0x12	
DEVICE_CODE [MFR 44]	0×FC	0x0090 🗸	0×0090	
nfig to NVM FREQUENCY_CONFIG [MFR 03]	0xD3	F5:425k 🗸	0::82	
NVM Config MANUFACTURER_INFO [MFR 00]	0xD0	0000000b 🖂	0x00	
tore Notices MODE_SOFT_START_CONFIG [MFR 02]	0xD2	SST:1 m 🗸	0::01	
eters By: UVLO_THRESHOLD [MFR 06]	0xD6	VDDINU 🗸	0x05	
and Name VOUT_ADJUSTMENT [MFR 04]	0×D4	VOA:0.0 🗸	0×10	
and Code VOUT_MARGIN [MFR 05]	0×D5	VOMH:5 🗸	0x65	
VY Category WRITE_PROTECT	0×10	0x00 🗸	0x00	
▼ On/Off Configuration				
ON_OFF_CONFIG	0x02	0x17 🗸	0×17	
OPERATION	0×01	0x00 🗸	0x00	
▼ Status				
STATUS BYTE	0x78	00000000	0x00	
Tips & Hints		PMBus Log		
Gure MODE_SOFT_START_CONFIG [MFR 02,0x07 Custom programmable register to control soft states as hiccup, latch-off and conduction modes. These can be stored in NVM cells, and the contents of N automatically loaded to these register memory log internal 3.3V supply powers up. The rvmSST<1:	2] rt time as we e register bits VM cells are cations after 0> bus has a			
IS		PMBus Log		

Figure 5-3. TPS53819A GUI Configure, All Config Tab

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Fusion Digital Power Designer - TP553819A/TP553912/TP55	i3913/TP553915 @ Address 16d - Техаs Instruments	
File Device Tools Help		TP553819A/TP553912/TP553913/TP553915 @ Ad 🖂
Status Operation & Status Registers		
Stop Poling EN Pin (CONTROL on USB-TO-GPIO)	STATUS_WORD	
Clear Faults	15     YOUT       14     IOUT / POUT       13     INPUT       12     MFR       11     POWER_GOOD#       10     FANS       9     OTHER       8     Unknown       7     Busy       6     Output Off       5     Yout OV Fault	
Fault Ignore Fault	S Yout OV Fault 4 IOUT OC Fault 3 Vin UV Fault 3 Vin UV Fault	
Clear Faults	1     CML       0     More faults in high byte	
Key: Fault Warnin Note: the STATUS_BYTE command return	Bit not set Bit not implemented S the lower byte of STATUS_WORD (bits 0-7)	
Configure		
Status     I New PMBus Log Messages Show PM	IBus Log 🗸 Unique	open/close settings for Configure, Monitor, and Status 📳
Fusion Digital Power Designer v1.8.273 [2012-11-08] TP553819A/TP55	3912/TP553913/TP553915 @ Address 16d USB Adapter v1.0.10 [No PEC;	400 kHz; Aler 🛛 🕸 Texas Instruments   fusion digital power

Figure 5-4. TPS53819A GUI Status

# **6 Test Procedure**

# 6.1 Line and Load Regulation and Efficiency Measurement Procedure

- 1. Set up the EVM as described in Section 4 and Figure 4-3.
- 2. Ensure the load is set to constant resistance mode and to sink 0 ADC.
- 3. Ensure the jumper provided in the EVM shorts on J2 before  $V_{\text{IN}}$  is applied.
- 4. Increase  $V_{IN}$  from 0 V to 12 V, using V1 to measure input voltage.
- 5. Remove the jumper on J3 to enable the controller.
- 6. Use V2 to measure  $V_{OUT}$  voltage.
- 7. Vary Load from 0 ADC to 25 ADC. V<sub>OUT</sub> should remain in load regulation.
- 8. Vary  $V_{\text{IN}}$  from 8 V to 14 V.  $V_{\text{OUT}}$  should remain in line regulation.
- 9. Put the jumper on J3 to disable the controller.
- 10. Decrease the load to 0 A.
- 11. Decrease V<sub>IN</sub> to 0 V.

## 6.2 Control Loop Gain and Phase Measurement Procedure

TPS53819AEVM-123 contains a place holder for a  $10-\Omega$  series resistor in the feedback loop for loop response analysis.

- 1. Replace R16 with a  $10-\Omega$  resistor.
- 2. Set up EVM as described in Section 4 and Figure 4-3.
- 3. Connect isolation transformer to test points marked TP13 and TP11.
- 4. Connect input signal amplitude measurement probe (Loop B) to TP11. Connect output signal amplitude measurement probe (Loop A) to TP13.
- 5. Connect ground lead of Loop A and Loop B to TP12.
- 6. Inject around 10 mV or less signal through the isolation transformer.
- 7. Sweep the frequency from 100 Hz to 1 MHz with 10 Hz or lower post filter. The control loop gain and phase margin can be measured.
- 8. Disconnect isolation transformer from bode plot test points before making other measurements (Signal injection into feedback can interfere with accuracy of other measurements).

### 6.3 Equipment Shutdown

- 1. Shut down the load.
- 2. Shut down V<sub>IN</sub>.
- 3. Shut down fan.





## 7 Performance Data and Typical Characteristic Curves

Figure 7-1 through Figure 7-4 present typical performance curves for TPS53819AEVM-123.

#### 7.1 Efficiency







## 7.2 Load Regulation





# 7.3 Line Regulation







# 7.4 f<sub>SW</sub> Versus Load

Figure 7-4. TPS53819AEVM-123 f<sub>SW</sub> Versus Load



## 7.5 Bode Plot



Figure 7-5. TPS53819AEVM-123 Loop Response Gain and Phase





Figure 7-6. TPS53819AEVM-123 Load Transient, 12 V<sub>IN</sub>, 0-A to 15-A Eco-mode





Figure 7-7. TPS53819AEVM-123 Load Transient, 12 V<sub>IN</sub>, 0-A to 15-A FCCM



7.7 Output Ripple

Figure 7-8. TPS53819AEVM-123 Output Ripple, 12 V<sub>IN</sub>, 25 A





Figure 7-9. TPS53819AEVM-123 Output Ripple, 12 V<sub>IN</sub>, 1-A Load Eco-mode

7.8 Switching Node



Figure 7-10. TPS53819AEVM-123 Switching Node, 12-VIN, 25-A Load Full Bandwidth

## 7.9 Turn-On Waveform



Figure 7-11. TPS53819AEVM-123 Enable Turn-On Waveform, 12-V\_{IN}, 1- $\Omega$  Load



Figure 7-12. TPS53819AEVM-123  $V_{\text{IN}}$  Turn-On Waveform, 12- $V_{\text{IN}},$  1- $\Omega$  Load



## 7.10 Turn-Off Waveform



Figure 7-13. TPS53819AEVM-123 Enable Turn-Off Waveform, 12  $V_{\text{IN}},$  1- $\Omega$  Load



Figure 7-14. TPS53819AEVM-123  $V_{\text{IN}}$  Turn off Waveform, 12  $V_{\text{IN}},$  1- $\Omega$  Load

## 7.11 Pre-bias Turn-On Waveform



Figure 7-15. TPS53819AEVM-123 Enable Turn-On Waveform, 12 V<sub>IN</sub>, 1-Ω Load, 1-V Pre-bias

#### 7.12 Thermal Images



Hottest point is the CSD87350Q5D

![](_page_19_Figure_8.jpeg)

![](_page_20_Picture_1.jpeg)

![](_page_20_Picture_2.jpeg)

Hottest point is below the CSD87350Q5D

![](_page_20_Figure_4.jpeg)

![](_page_21_Picture_1.jpeg)

# 8 EVM Assembly Drawing and PCB layout

Figure 8-1 through Figure 8-8 show the design of the TPS53819AEVM-123 printed-circuit board (PCB). The EVM has been designed using six layers, 2-oz copper circuit board.

![](_page_21_Figure_4.jpeg)

Figure 8-1. TPS53819AEVM-123 Top Layer Assembly Drawing (Top View)

![](_page_21_Figure_6.jpeg)

![](_page_21_Figure_7.jpeg)

![](_page_22_Picture_1.jpeg)

![](_page_22_Figure_2.jpeg)

Figure 8-3. TPS53819AEVM-123 Top Copper (Top View)

![](_page_22_Figure_4.jpeg)

![](_page_22_Figure_5.jpeg)

![](_page_23_Picture_1.jpeg)

![](_page_23_Figure_2.jpeg)

Figure 8-5. TPS53819AEVM-123 Internal Layer 3 (Top View)

![](_page_23_Figure_4.jpeg)

![](_page_23_Figure_5.jpeg)

![](_page_24_Picture_1.jpeg)

![](_page_24_Figure_2.jpeg)

Figure 8-7. TPS53819AEVM-123 Internal Layer 5 (Top View)

![](_page_24_Figure_4.jpeg)

Figure 8-8. TPS53819AEVM-123 Bottom Copper (Top View)

![](_page_25_Picture_1.jpeg)

# 9 Bill of Materials

#### Table 9-1. TPS53819AEVM-123 List of Materials

COUN T	REFDES	DESCRIPTION	PART NUMBER	MFR
4	C1–C4	Capacitor, Ceramic, 22 µF, 16 V, X5R, 10%	GRM31CR61C226ME15L	Murata
2	C5, C7	Capacitor, Ceramic, 0.1 µF, 50 V, X7R, 10%	Std	Std
0	C6	Capacitor, OSCON, 330 μF, 16 V	16SEP330M	Sanyo
1	C8	Capacitor, Ceramic, 1000 pF, 50 V, X7R, 20%	Std	Std
0	C9, C17	Capacitor, Ceramic, 50 V, X7R, 10%	Std	Std
5	C10–C14	Capacitor, Ceramic, 100 µF, 6.3 V, X5R, 20%	GRM32ER60J107ME20L	Murata
0	C15–C16	Capacitor, POSCAP, SMT, 2.5 V, 330 μF, 8 mΩ	2R5TPE330M9 or 6TPE330MIL	Sanyo
2	C18, C19	Capacitor, Ceramic, 1 µF, 16 V, X7R, 10%	Std	Std
2	J1, J3	Terminal Block, 4-pin, 15-A, 5.1 mm	ED120/4DS	OST
1	J2	Header, Male 2-pin, 100-mil spacing	PEC02SAAN	Sullins
1	J4	Connector, Male Straight 2 × 5 pin, 100-mil spacing, 4 Wall	N2510-6002RB	3M
1	L1	Inductor, Toroid, 0.440 μH, 30 A, 0.0032 Ω	PA0513.441NLT or 744309047	Pulse or WE
1	Q1	MOSFET, Dual N-Chan, 30 V 27 A	CSD87350Q5D	TI
4	R1–R2, R14–R15	Resistor, Chip, 100 kΩ, 1/16W, 1%	Std	Std
1	R3	Resistor, Chip, 300 kΩ, 1/16W, 1%	Std	Std
1	R4	Resistor, Chip, 1.00 kΩ, 1/16W, 1%	Std	Std
2	R6	Resistor, Chip, 4.7 Ω, 1/16W, 1%	Std	Std
1	R9	Resistor, Chip, 3 Ω, 1/4W, 1%	Std	Std
0	R7, R13	Resistor, Chip, 1/16W, 1%	Std	Std
1	R10	Resistor, Chip, 39.2 kΩ, 1/16W, 1%	Std	Std
5	R5, R8, R11–R12, R16	Resistor, Chip, 0 Ω, 1/10W, 1%	Std	Std
2	R17–R18	Resistor, Chip, 10.0 kΩ, 1/16W, 1%	Std	Std
10	TP1–TP3, TP5– TP8, TP10–TP11, TP13	Test Point, Red, Thru Hole Color Keyed	5000	Keystone
3	TP4, TP9, TP12	Test Point, Black, Thru Hole Color Keyed	5001	Keystone
1	U1	IC, Single Synchronous Step-Down Controller with PMBus	TPS53819ARGT	TI
1		Shunt, 100-mil, Black	929950-00	3M
1	_	PCB, 2.5 inch × 3.3 inch × 0.062 inch	PWR123	Any
4		STANDOFF HEX .375"L 4-40THR NYL	1902B	Keystone
4	_	STANDOFF M/F HEX 4-40 NYL 1.00"L	4806	Keystone

# **10 Revision History**

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (December 2012) to Revision B (November 2021)		Page
•	Updated the numbering format for tables, figures, and cross-references throughout the document	2
•	Updated the user's guide title	2

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