

# LM5122EVM-1PH Evaluation Module

## User's Guide



Literature Number: SNVU197  
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# LM5122EVM-1PH Evaluation Module

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## 1 Introduction

The LM5122EVM-1PH evaluation module (EVM) provides the design engineer with a fully functional synchronous boost converter to evaluate the Texas Instruments LM5122 synchronous boost controller IC. The EVM provides 24V output at up to 4.5A current from a 9V to 20V input. The EVM is designed to start up from a single power supply without any additional bias voltage.

## 2 Features and Electrical Performance

- 9V to 20V input voltage range
- 24V target output voltage
- Up to 4.5A output current
- 250kHz typical switching frequency
- Configurable light load operation
- Easy access to IC pins including SYNCOUT, RT, SS, UVLO, COMP and RES

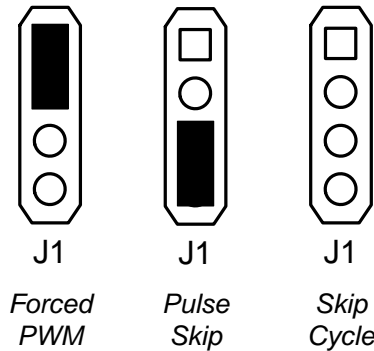
**Table 1. Electrical Performance Specifications**

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>Input Characteristics</b>					
Input voltage		9	12	20	V
Input current	$V_{SUPPLY}=12V, I_{LOAD}=4.5A$		9.4		A
<b>Output Characteristics</b>					
Output voltage	$I_{LOAD}=4.5A$	23.16	24	24.84	V
Output current				4.5	A
<b>System Characteristics</b>					
Switching frequency			250		kHz
Full load efficiency	$V_{SUPPLY}=12V$		96		%
	$V_{SUPPLY}=20V$		98		%

## 3 Test Points and Jumper

### 3.1 MODE Setup – J1

LM5122EVM-1PH's light load operation can be configured as one of Forced PWM, Skip Cycle or Pulse Skip mode by J1 jumper setting. By placing a jumper shunt on pin 1 and 2, the converter operates in Forced FPWM mode. By placing the jumper shunt on pin 3 and 4, the converter operates in Pulse Skip mode. Skip cycle operation is enabled by not placing any jumper on J1.



**Figure 1. J1 Jumper Setting**

### 3.2 Test Points – J2

J2 connector provides convenient access to IC pins which are often required for multi-phase configuration. This connector is left unpopulated to use as test points.

**Table 2. J2 Pin Descriptions**

PIN NUMBER	LABEL	DESCRIPTIONS
2	SYNCOUT	Clock output pin connection. Can be used for multi-phase configuration.
4	NC	Not used.
6	SYNC	AC coupled synchronization clock input.
8	RT	RT pin connection. Can be used for synchronization clock input.
10	SS	Soft-start pin connection.
12	UVLO	Under voltage lockout pin connection.
14	COMP	Internal error amplifier output connection.
16	RES	Restart pin connection.
1, 3, 5, 7, 9, 11, 13, 15, 17, 19	Ground	Ground connections

## 4 Test Equipment

### 4.1 Power Supply

Power Supply should be capable of 20V/25A, current monitoring and remote sensing.

### 4.2 Electronic Load

Electronic load should be capable of 28V/5A. Use Constant Current (CC) mode.

### 4.3 Meters

One current meter is required to measure input current accurately. Maximum current rating of the meter should be carefully considered. Input current can be as high as 14A at full load current and minimum input voltage. .

Output voltage is monitored by a voltage meter which should be capable of monitoring up to 28V

### 4.4 Oscilloscope

Oscilloscope and 10x probe with at least 20MHz bandwidth are required.

## 5 Test Setup and Procedure

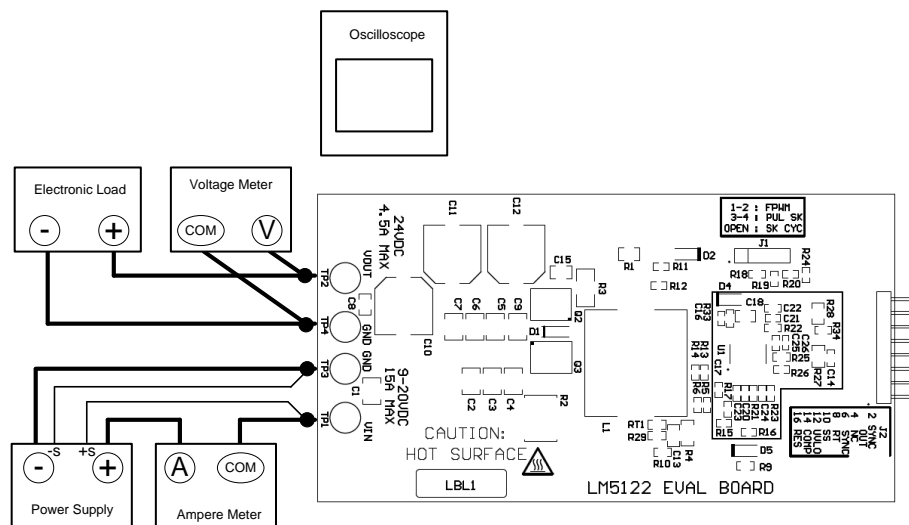


Figure 2. Connection Diagram

### 5.1 Precaution & Wire Gauge

Prolonged operation with low input voltage at full power will cause heating of the MOSFETs. A fan with a minimum of 200LFM should be always provided. Wire gauge for the input power supply should be 10 AWG minimum and no longer than 1 foot each for VIN and GND.

Wire gauge for the output electronic load should be 14 AWG minimum and no longer than 1 foot each for VOUT and GND.

### 5.2 Test Setup

#### 5.2.1 Power Supply

Connect the power supply's positive terminal (+) to 'A' terminal of ampere meter and negative terminal (-) to TP3 GND. Connect the power supply's positive remote sense terminal to TP1 VIN and negative remote sense terminal to TP3 GND.

#### 5.2.2 Meter

Connect 'COM' terminal of ampere meter to TP1 VIN. Double check 'A' terminal is connected to the power supply's positive terminal.

Voltage meter is used to measure output voltage. Connect positive terminal (V) of the voltage meter to TP2 VOUT and negative terminal (COM) of the voltage meter to TP4 GND.

#### 5.2.3 Load

Connect electronic load's positive terminal (+) to TP2 VOUT and negative terminal (-) to TP4 GND.

### 5.3 Quick Test Procedure

#### 5.3.1 Start-Up

- Set load current to 0A and turn the load on
- Set power supply current limit to 25A
- Turn on the power supply and increase voltage slowly up to 20V
- Increase load current slowly up to 4.5A

### 5.3.2 Shutdown

- Turn off the load
- Decrease the input voltage down to 0V
- Turn on the load and discharge output capacitor

## 6 Performance Curves

The following curves are presented for reference, the actual field data may differ from these curves. Actual performance data can be affected by measurement techniques, equipment setting and environmental variables.

### 6.1 Efficiency

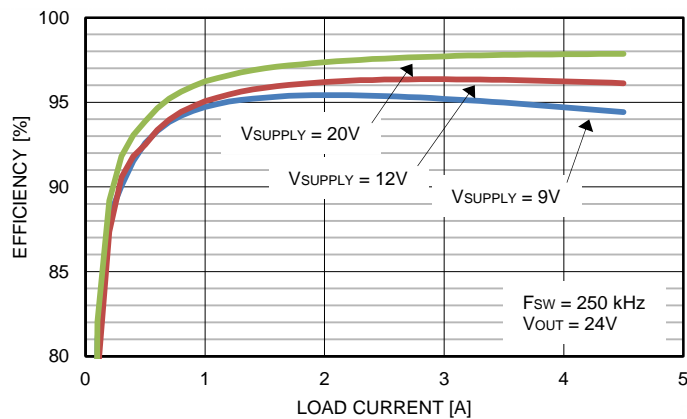


Figure 3. Efficiency (FPWM Mode)

### 6.2 Load Transient

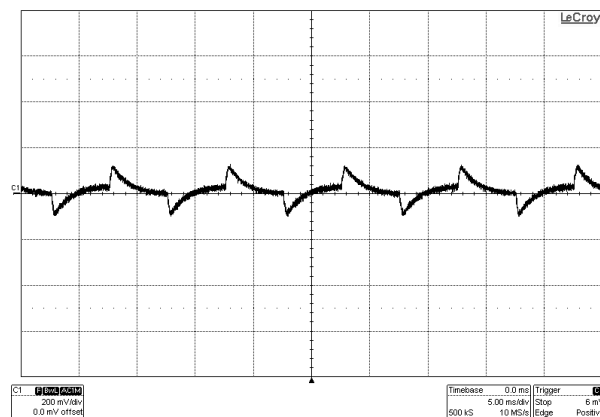


Figure 4. Load Transient

C1: Vout

$V_{supply} = 12 \text{ V}$ , 2.25A to 4.5A and 4.5A to 2.25A load transient

### 6.3 Clock Synchronization

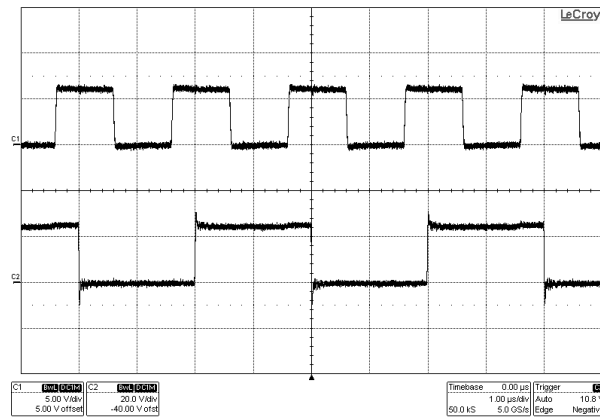


Figure 5. Clock Synchronization

C1:  $F_{SYNC}$ , C2: SW  
 $V_{SUPPLY}=12V$ ,  $F_{SYNC}=500\text{ kHz}$

### 6.4 Light Load Operation

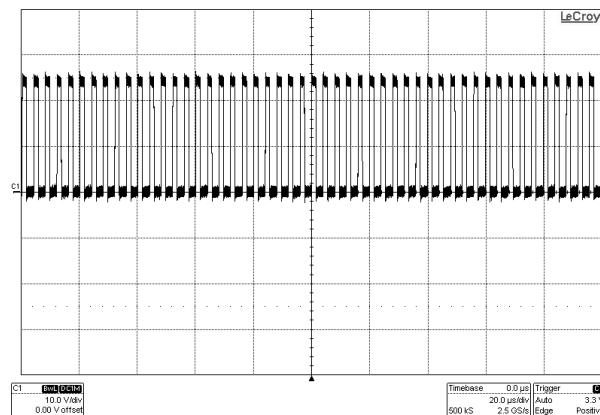


Figure 6. Forced PWM

C1: SW  
 $V_{SUPPLY}=12V$ ,  $I_{LOAD}=0A$

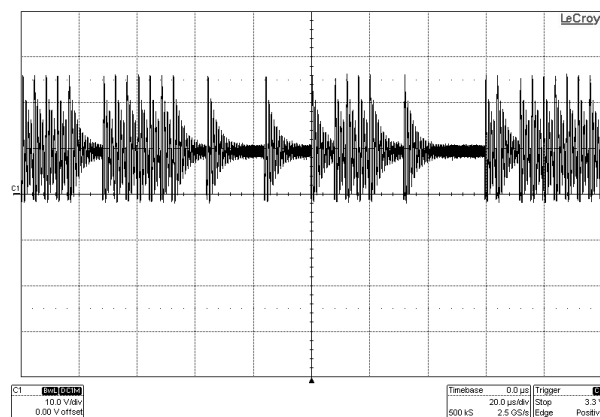


Figure 7. Pulse Skip



C1: SW  
 $V_{SUPPLY}=12V, I_{LOAD}=0A$

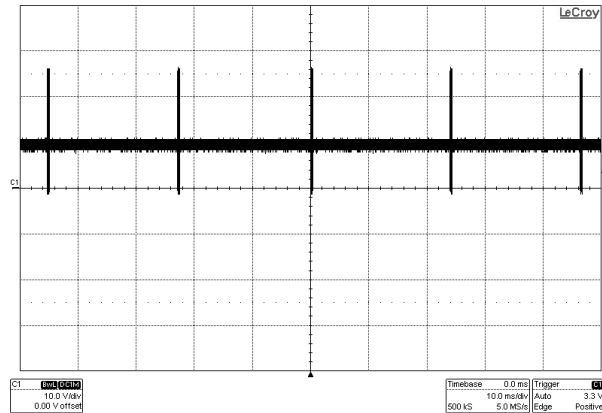


Figure 8. Skip Cycle

C1:SW  
 $V_{SUPPLY}=12V, I_{LOAD}=0A$

6.5 Loop Response

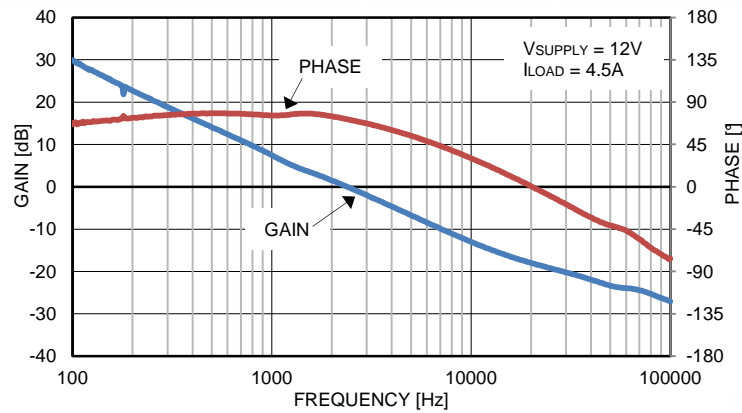


Figure 9. Loop Response

## 6.6 Start-up

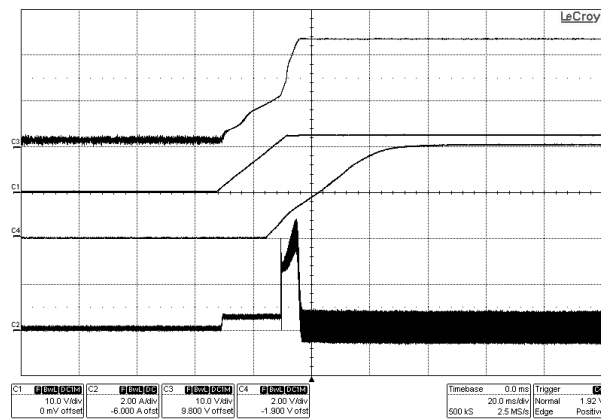


Figure 10. Start-up

C1:  $V_{SUPPLY}$ , C2: Inductor current, C3:  $V_{OUT}$ , C4: SS  
 $V_{SUPPLY}=12V$ ,  $I_{LOAD}=0A$

7 Schematic

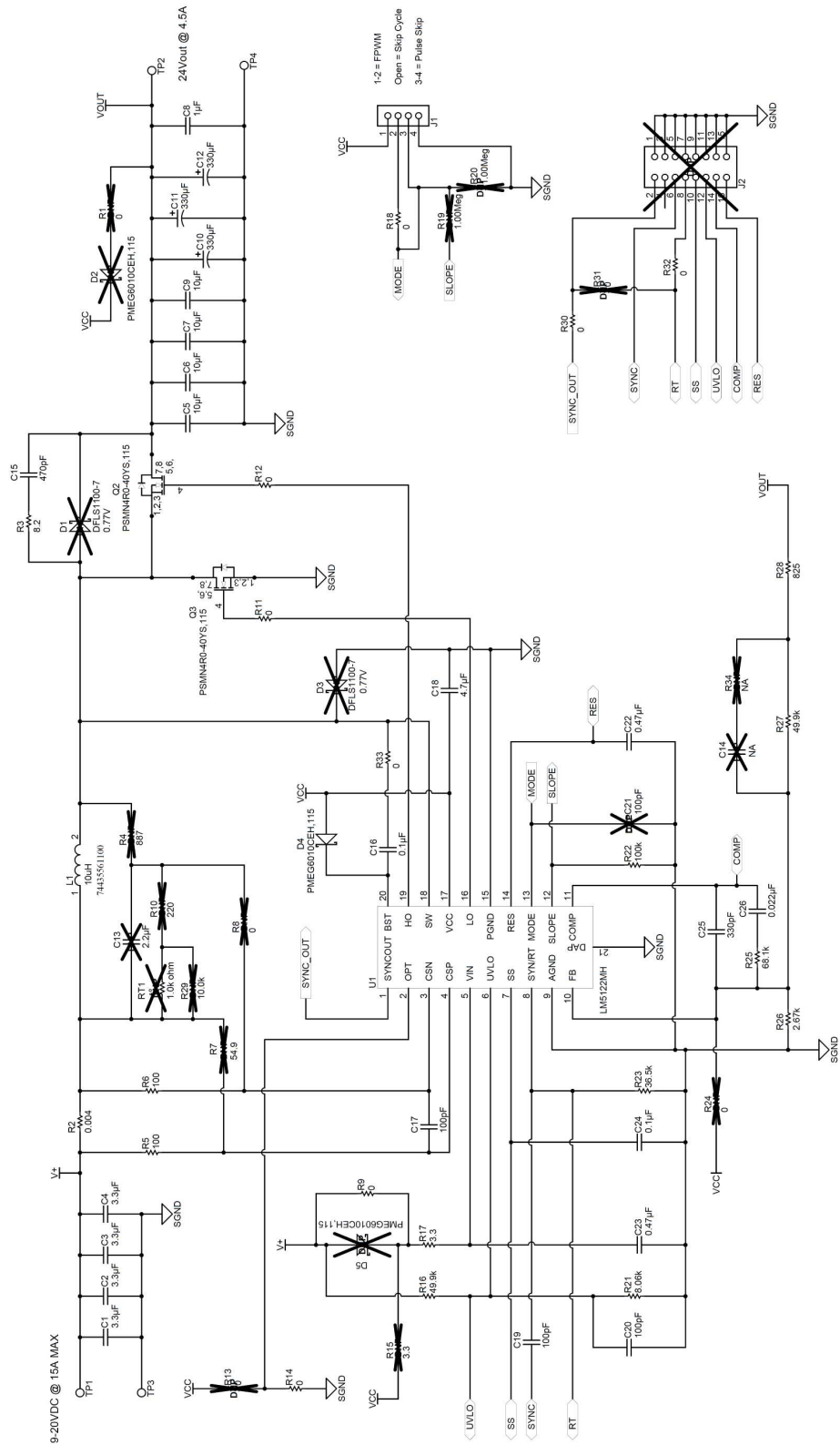


Figure 11. Schematic

## 8 Layout

The LM5122 EVM has been designed using a 2-layer board. Most of components are on the top to allow the user to easily view, probe, and evaluate the LM5122 IC.

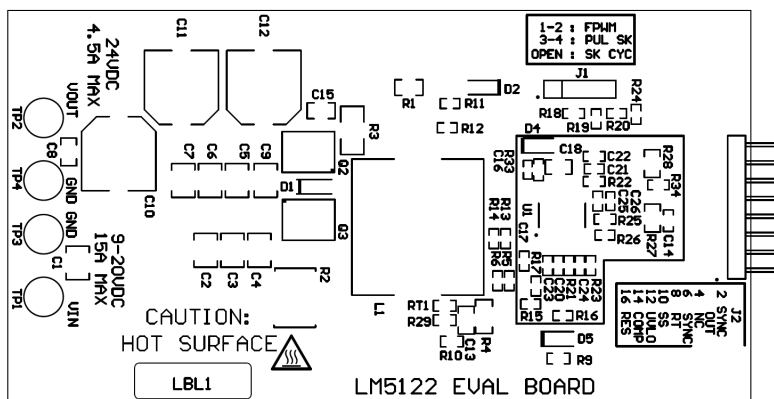


Figure 12. Top Silk (Top View)

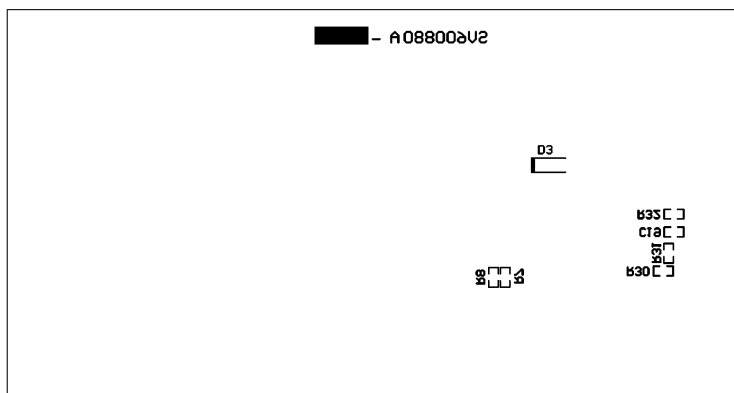


Figure 13. Bottom Silk (X-Ray View)

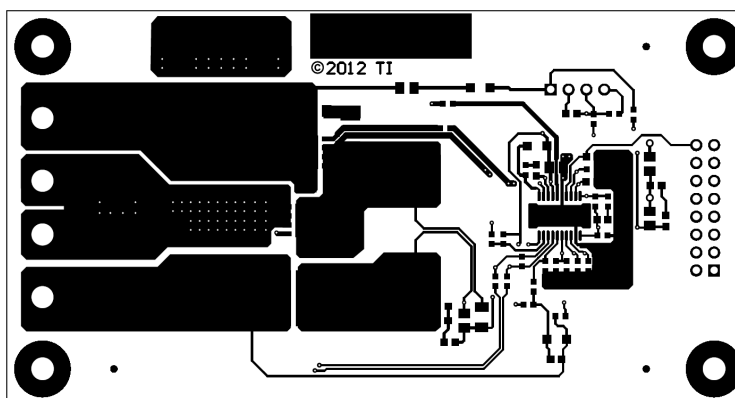
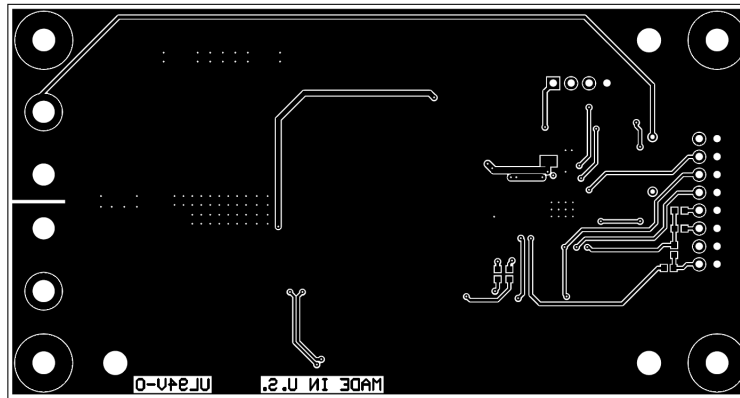


Figure 14. Top Copper (Top View)



**Figure 15. Bottom Copper (X-Ray View)**

## 9 Bill of Materials

The EVM components are list according to the schematic shown in [Figure 11](#).

**Table 3. Bill of Materials**

Reference Designator	Description	Manufacturer	Part Number	Qty.
C1, C2, C3, C4	CAP, CERM, 3.3uF, 50V, +/- 10%, X7R, 1210	MURATA	GRM32DR71H335KA88L	4
C5, C6, C7, C9	CAP CER 10UF 35V 20% X7R 1210	Taiyo Yuden	GMK325AB7106MM-T	4
C8	CAP, CERM, 1uF, 50V, +/- 10%, X7R, 0805	MURATA	GRM21BR71H105KA12L	1
C10, C11, C12	CAP ALUM 330UF 35V 20% SMD	Panasonic	EEE-FP1V331AP	3
C15	CAP, CERM, 470pF, 100V, +/- 5%, C0G/NP0, 0805	MURATA	GRM2165C2A471JA01D	1
C16	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603	KEMET	C0603C104K3RACTU	1
C17, C19, C20	CAP, CERM, 100pF, 50V, +/- 5%, C0G/NP0, 0603	MURATA	GRM1885C1H101JA01D	3
C18	CAP, CERM, 4.7uF, 16V, +/- 10%, X7R, 0805	MURATA	GRM21BR71C475KA73L	1
C22, C23	CAP, CERM, 0.47uF, 25V, +/- 10%, X7R, 0603	MURATA	GRM188R71E474KA12D	2
C24	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603	MURATA	GRM188R71E104KA01D	1
C25	CAP, CERM, 330pF, 50V, +/- 10%, X7R, 0603	KEMET	C0603C331K5RACTU	1
C26	CAP, CERM, 0.022uF, 50V, +/- 10%, X7R, 0603	KEMET	C0603C223K5RACTU	1
R2	RES 0.004 $\Omega$ 3W 1% 3015 WIDE	Susumu	KRL7638-C-R004-F-T1	1
R3	RES 8.2 $\Omega$ 3/4W 5% 2010 SMD	Vishay Dale	CRCW20108R20JNEF	1
R5, R6	RES, 100 $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW0603100RFKEA	2
R9, R11, R12, R14, R18, R30, R32, R33	RES, 0 $\Omega$ , 5%, 0.1W, 0603	Panasonic	ERJ-3GEY0R00V	8
R16	RES, 49.9k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW060349K9FKEA	1
R17	RES, 3.3 $\Omega$ , 5%, 0.1W, 0603	Vishay-Dale	CRCW06033R30JNEA	1
R21	RES, 8.06k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW06038K06FKEA	1

**Table 3. Bill of Materials (continued)**

R22	RES, 100k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW0603100KFKEA	1
R23	RES, 36.5k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW060336K5FKEA	1
R25	RES, 68.1k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW060368K1FKEA	1
R26	RES, 2.67k $\Omega$ , 1%, 0.1W, 0603	Vishay-Dale	CRCW06032K67FKEA	1
R27	RES, 49.9k $\Omega$ , 1%, 0.125W, 0805	Vishay-Dale	CRCW080549K9FKEA	1
R28	RES, 825 $\Omega$ , 1%, 0.125W, 0805	Vishay-Dale	CRCW0805825RFKEA	1
D4	Diode, Schottky, 60V, 1A, SOD-123F	NXP Semiconductor	PMEG6010CEH	1
Q2, Q3	MOSFET N-CH 40V 100A LPAK	NXP Semiconductor	PSMN4R0-40YS	2
	MOSFET N-CH 40V 100A SON 5x6	Texas Instruments	CSD18501Q5A	Alternative
L1	SMD Flat Wire Inductor, L=10.0 $\mu$ H	WURTH	74435561100	1
TP1, TP2, TP3, TP4	Terminal, Turret, TH, Double	Keystone	1503-2	4
H1, H2, H3, H4	Machine Screw, Round, #4-40 x 1/4, Nylon	B&F Fastener Supply	NY PMS 440 0025 PH	4
H5, H6, H7, H8	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C	4
J1	Header, TH, 100mil, 4x1, Gold plated, 230 mil	SAMTEC, Inc.	TSW-104-07-G-S	1
SH-J1	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA	1
U1	Synchronous Boost Controller	TI	LM5122MH	1

## 10 Single Output Dual Phase Configuration

Two LM5122EVM-1PH evaluation boards can be easily configured as a single-output dual-phase interleaved boost converter following the four steps listed below:

1. Remove C19, C25, C26, R25, R26, R27, R28, R30, and R32 on the slave board.
2. Populate 0 $\Omega$  resistors (R24 and R31) on the slave board.
3. Populate J2 on both master and slave boards.
4. Connect J2 on the master board and J2 on the slave board together using a flat cable.

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Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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