# Contents

1. Introduction .......................................................................................................................... 4
2. Features and Electrical Performance .................................................................................... 4
3. Test Points and Jumper ........................................................................................................... 4
   3.1 MODE Setup – J1 ............................................................................................................... 4
   3.2 Test Points – J2 ................................................................................................................ 5
4. Test Equipment ....................................................................................................................... 5
   4.1 Power Supply .................................................................................................................... 5
   4.2 Electronic Load .................................................................................................................. 5
   4.3 Meters ............................................................................................................................... 5
   4.4 Oscilloscope ...................................................................................................................... 5
5. Test Setup and Procedure ...................................................................................................... 6
   5.1 Precaution & Wire Gauge ................................................................................................. 6
   5.2 Test Setup ......................................................................................................................... 6
   5.3 Quick Test Procedure ....................................................................................................... 6
6. Performance Curves ................................................................................................................ 7
   6.1 Efficiency ......................................................................................................................... 7
   6.2 Load Transient .................................................................................................................. 7
   6.3 Clock Synchronization ....................................................................................................... 8
   6.4 Light Load Operation ....................................................................................................... 8
   6.5 Loop Response ................................................................................................................ 9
   6.6 Start-up ............................................................................................................................. 10
7. Schematic .................................................................................................................................. 11
8. Layout ...................................................................................................................................... 12
10. Single Output Dual Phase Configuration .............................................................................. 14
List of Figures

1. J1 Jumper Setting ........................................................................................................... 5
2. Connection Diagram ...................................................................................................... 6
3. Efficiency (FPWM Mode) .............................................................................................. 7
4. Load Transient ................................................................................................................ 7
5. Clock Synchronization .................................................................................................. 8
6. Forced PWM .................................................................................................................... 8
7. Pulse Skip ....................................................................................................................... 8
8. Skip Cycle ....................................................................................................................... 9
9. Loop Response ............................................................................................................... 9
10. Start-up .......................................................................................................................... 10
11. Schematic ...................................................................................................................... 11
12. Top Silk (Top View) .................................................................................................... 12
13. Bottom Silk (X-Ray View) .......................................................................................... 12
14. Top Copper (Top View) ............................................................................................... 12
15. Bottom Copper (X-Ray View) .................................................................................... 13

List of Tables

1. Electrical Performance Specifications .............................................................................. 4
2. J2 Pin Descriptions ......................................................................................................... 5
3. Bill of Materials ............................................................................................................... 13
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>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td></td>
<td>9</td>
<td>12</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Input current</td>
<td>$V_{\text{SUPPLY}}=12\text{V}, I_{\text{LOAD}}=4.5\text{A}$</td>
<td>9.4</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Output Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>$I_{\text{LOAD}}=4.5\text{A}$</td>
<td>23.16</td>
<td>24</td>
<td>24.84</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>System Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching frequency</td>
<td></td>
<td></td>
<td>250</td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Full load efficiency</td>
<td>$V_{\text{SUPPLY}}=12\text{V}$</td>
<td>96</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>$V_{\text{SUPPLY}}=20\text{V}$</td>
<td>98</td>
<td></td>
<td></td>
<td>%</td>
</tr>
</tbody>
</table>

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.
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

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

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

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)](image)

6.2 Load Transient

![Figure 4. Load Transient](image)

C1: Vout
\[ V_{\text{SUPPLY}} = 12V \text{, 2.25A to 4.5A and 4.5A to 2.25A load transient} \]
6.3 Clock Synchronization

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

6.4 Light Load Operation

C1: SW
V_{SUPPLY}=12V, I_{LOAD}=0A
C1: SW
\( V_{\text{SUPPLY}}=12V, \ I_{\text{LOAD}}=0A \)

6.5 **Loop Response**

C1: SW
\( V_{\text{SUPPLY}}=12V, \ I_{\text{LOAD}}=0A \)

Figure 8. Skip Cycle

Figure 9. Loop Response
6.6 Start-up

Figure 10. Start-up

C1: $V_{\text{SUPPLY}}$, C2: Inductor current, C3: $V_{\text{OUT}}$, C4: SS

$V_{\text{SUPPLY}}=12V$, $I_{\text{LOAD}}=0A$
Figure 11. Schematic
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.
9 Bill of Materials

The EVM components are listed according to the schematic shown in Figure 11.

**Table 3. Bill of Materials**

<table>
<thead>
<tr>
<th>Reference Designator</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2, C3, C4</td>
<td>CAP, CERM, 3.3uF, 50V, +/- 10%, X7R, 1210</td>
<td>MURATA</td>
<td>GRM32DR71H335KA88L</td>
<td>4</td>
</tr>
<tr>
<td>C5, C6, C7, C9</td>
<td>CAP CER 10UF 35V 20% X7R 1210</td>
<td>Taiyo Yuden</td>
<td>GMK325AB7106MM-T</td>
<td>4</td>
</tr>
<tr>
<td>C8</td>
<td>CAP, CERM, 1uF, 50V, +/- 10%, X7R, 0805</td>
<td>MURATA</td>
<td>GRM21BR71H105KA12L</td>
<td>1</td>
</tr>
<tr>
<td>C10, C11, C12</td>
<td>CAP ALUM 330UF 35V 20% SMD</td>
<td>Panasonic</td>
<td>EEE-FP1V331AP</td>
<td>3</td>
</tr>
<tr>
<td>C15</td>
<td>CAP, CERM, 470pF, 100V, +/- 5%, C0G/NP0, 0805</td>
<td>MURATA</td>
<td>GRM2165C2A471JA01D</td>
<td>1</td>
</tr>
<tr>
<td>C16</td>
<td>CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603</td>
<td>KEMET</td>
<td>C0603C104K3RACUT</td>
<td>1</td>
</tr>
<tr>
<td>C17, C19, C20</td>
<td>CAP, CERM, 100pF, 50V, +/- 5%, C0G/NP0, 0603</td>
<td>MURATA</td>
<td>GRM1885C1H101JA01D</td>
<td>3</td>
</tr>
<tr>
<td>C18</td>
<td>CAP, CERM, 4.7uF, 16V, +/- 10%, X7R, 0805</td>
<td>MURATA</td>
<td>GRM21BR71C475KA73L</td>
<td>1</td>
</tr>
<tr>
<td>C22, C23</td>
<td>CAP, CERM, 0.47uF, 25V, +/- 10%, X7R, 0603</td>
<td>MURATA</td>
<td>GRM188R71E474KA12D</td>
<td>2</td>
</tr>
<tr>
<td>C24</td>
<td>CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603</td>
<td>MURATA</td>
<td>GRM188R71E104KA01D</td>
<td>1</td>
</tr>
<tr>
<td>C25</td>
<td>CAP, CERM, 330pF, 50V, +/- 10%, X7R, 0603</td>
<td>KEMET</td>
<td>C0603C331K5RACUT</td>
<td>1</td>
</tr>
<tr>
<td>C26</td>
<td>CAP, CERM, 0.022uF, 50V, +/- 10%, X7R, 0603</td>
<td>KEMET</td>
<td>C0603C223K5RACUT</td>
<td>1</td>
</tr>
<tr>
<td>R2</td>
<td>RES 0.004 Ω 3W 1% 3015 WIDE</td>
<td>Susumu</td>
<td>KRL7638-C-R004-F-T1</td>
<td>1</td>
</tr>
<tr>
<td>R3</td>
<td>RES 8.2 Ω 3/4W 5% 2010 SMD</td>
<td>Vishay Dale</td>
<td>CRCW20108R20JNEF</td>
<td>1</td>
</tr>
<tr>
<td>R5, R6</td>
<td>RES, 100 Ω, 1%, 0.1W, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW0603100RFKEA</td>
<td>2</td>
</tr>
<tr>
<td>R9, R11, R12, R14, R18, R30, R32, R33</td>
<td>RES, 0 Ω, 5%, 0.1W, 0603</td>
<td>Panasonic</td>
<td>ERJ-3GEY0R00V</td>
<td>8</td>
</tr>
<tr>
<td>R16</td>
<td>RES, 49.9k Ω, 1%, 0.1W, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW060349K9FKEA</td>
<td>1</td>
</tr>
<tr>
<td>R17</td>
<td>RES, 3.3 Ω, 5%, 0.1W, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW06033R30JNEA</td>
<td>1</td>
</tr>
<tr>
<td>R21</td>
<td>RES, 8.06k Ω, 1%, 0.1W, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW06038K06FKEA</td>
<td>1</td>
</tr>
</tbody>
</table>
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:

2. Populate 0Ω 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.
IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information from third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have not been so designated is solely at the Buyer’s risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

- **Audio**: [www.ti.com/audio](http://www.ti.com/audio)
- **Amplifiers**: [amplifier.ti.com](http://amplifier.ti.com)
- **Data Converters**: [dataconverter.ti.com](http://dataconverter.ti.com)
- **DLP® Products**: [www.dlp.com](http://www.dlp.com)
- **DSP**: [dsp.ti.com](http://dsp.ti.com)
- **Clocks and Timers**: [www.ti.com/clocks](http://www.ti.com/clocks)
- **Interface**: [interface.ti.com](http://interface.ti.com)
- **Logic**: [logic.ti.com](http://logic.ti.com)
- **Power Mgmt**: [power.ti.com](http://power.ti.com)
- **Microcontrollers**: [microcontroller.ti.com](http://microcontroller.ti.com)
- **RFID**: [www.ti-rfid.com](http://www.ti-rfid.com)
- **OMAP Applications Processors**: [www.ti.com/omap](http://www.ti.com/omap)
- **Wireless Connectivity**: [www.ti.com/wirelessconnectivity](http://www.ti.com/wirelessconnectivity)

### Applications

- **Automotive and Transportation**: [www.ti.com/automotive](http://www.ti.com/automotive)
- **Communications and Telecom**: [www.ti.com/communications](http://www.ti.com/communications)
- **Computers and Peripherals**: [www.ti.com/computers](http://www.ti.com/computers)
- **Consumer Electronics**: [www.ti.com/consumer-apps](http://www.ti.com/consumer-apps)
- **Energy and Lighting**: [www.ti.com/energy](http://www.ti.com/energy)
- **Industrial**: [www.ti.com/industrial](http://www.ti.com/industrial)
- **Medical**: [www.ti.com/medical](http://www.ti.com/medical)
- **Security**: [www.ti.com/security](http://www.ti.com/security)
- **Space, Avionics and Defense**: [www.ti.com/space-avionics-defense](http://www.ti.com/space-avionics-defense)
- **Video and Imaging**: [www.ti.com/video](http://www.ti.com/video)
- **TI E2E Community**: [e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2015, Texas Instruments Incorporated