

# OPTIREG™ Switcher TLS4120D0EPVxx Core module

## Synchronous Step-Down Regulator

### About this document

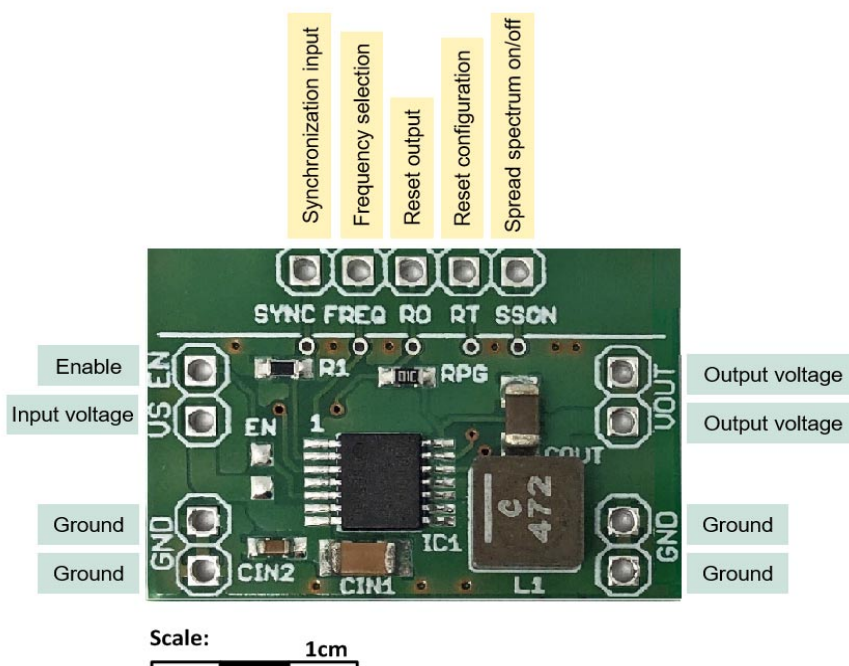
#### Scope and purpose

This user manual provides information about the characteristics and the usage of the TLS4120D0EPVxx Core module. The Core module is designed to help the user in the evaluation of the OPTIREG™ Switcher TLS4120D0EPVxx synchronous standalone step-down DC/DC converter family in PG-TSDSO-14 exposed-pad package from Infineon Technologies AG.

This user manual includes setup instructions, schematic diagram, bill of materials, and printed-circuit board layout drawings for the evaluation module. Please also refer to the corresponding TLS4120D0EPVxx datasheet.

#### Intended audience

This document is as intended for engineers who develop applications.



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**Introduction**

**1 Introduction**

**1.1 General Description**

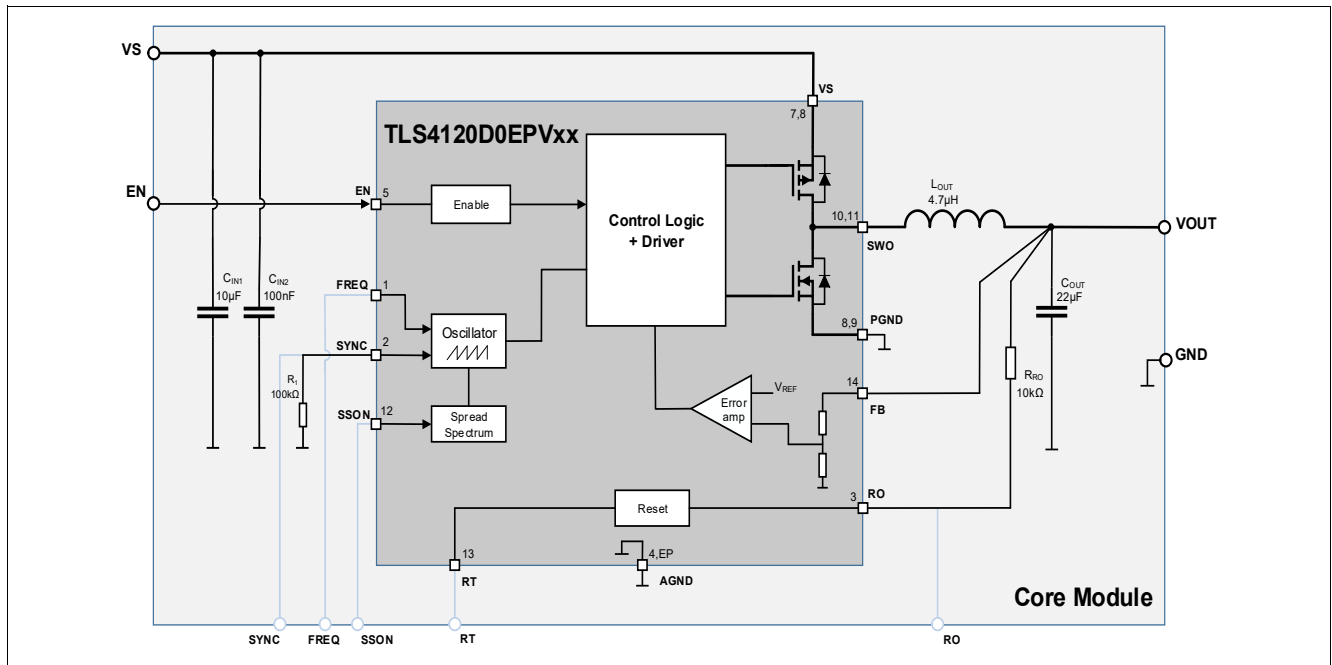
The TLS4120D0EPVxx Core module is a compact design and highly integrated step-down DC-DC converter capable of delivering up to 2 A of output current. It employs the OPTIREG™ Switcher TLS4120D0EPV50 2.8 MHz synchronous buck regulator to achieve high conversion efficiency in a small footprint. The reduced BOM allows the design to use less than 1 square inch of board area.

The wide input voltage range between 3.7 V and 35 V together with 100% duty-cycle operation mode make the device suitable for battery cranking scenarios in automotive applications. The device is offering a low-current consumption in PFM mode at light loads to optimize the efficiency. In disabled mode, the current consumption is reduced to typically 1  $\mu$ A.

The TLS4120D0EPV50 is able to detect undervoltage and overvoltage conditions of the output voltage and indicates this with the reset output (RO) signal. Overcurrent and overload protections avoid excessive currents to protect the device during short circuit conditions at the buck converter output. The integrated thermal shutdown feature additionally protects the device from overheating.

The Core module is configured to operate as 5 V output voltage and up to 2 A output current at a switching frequency of 2.2 MHz.

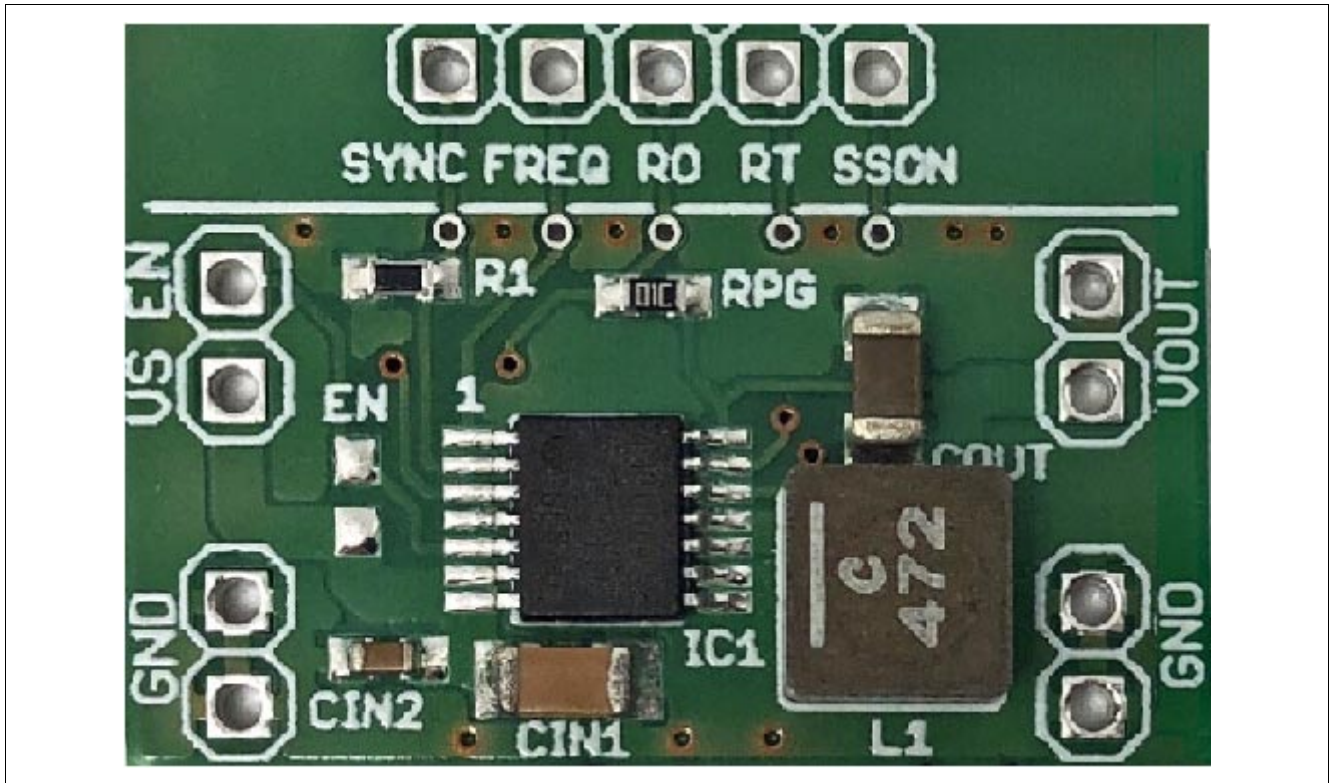
**Figure 1** presents the core module schematic for quick reference.



**Figure 1** TLS4120D0EPVxx Core module schematic.

## 2 Setup and Features

The TLS4120D0EPVxx Core module is equipped with TLS4120D0EPV50 to operate as 5 V output voltage and up to 2 A output current at a switching frequency of 2.2 MHz



**Figure 2** TLS4120D0EPVxx Core module

### 2.1 Feature List

- 5 V output voltage
- Up to 2 A Output current
- Switching frequency of 2.2 MHz
- Small solution size (26 mm x 18 mm)
- Reduced BOM
- Low quiescent current 31  $\mu$ A at no load condition
- 100% duty cycle operation
- Input voltage range from 3.7 V to 35 V
- Integrated high & low side power MOSFETs
- Enable
- Overtemperature Shutdown
- Output Current Limit Protection

**Setup and Features**

**2.2 Operating Conditions**

The typical operating conditions of the demo board are listed in **Table 1**. To avoid any electrical damage of the Demoboard, the maximum operating range defined in must be followed.

**Table 1 Typical operating conditions<sup>1)</sup>**

| Parameter                          | Symbol           | Operating conditions |      |                  | Unit | Note  |
|------------------------------------|------------------|----------------------|------|------------------|------|---|
|                                    |                  | Min.                 | Typ. | Max.             |      |   |
| Board Supply Voltage <sup>2)</sup> | VS               | 6                    | 12   | 35 <sup>3)</sup> | V    | Power supply                                  |
| Enable Signal                      | EN               | 0                    | 5    | 35 <sup>3)</sup> | V    | Enable signal to enable or disable the device |
| Output voltage                     | VOUT             | -                    | 5.0  | -                | V    | Regulated output voltage                      |
| Output current                     | I <sub>CC</sub>  | 0                    | -    | 2.0              | A    | Current capability                            |
| Switching frequency                | f <sub>OSC</sub> | -                    | 2.2  | -                | MHz  | Default switching frequency                   |
| Reset output Signal                | RO               | 0                    | 5.0  | 5.2              | V    | Indicates whether reset conditions are met    |

1) The Demoboard operates at ambient temperature of 25°C.

2) Functional input voltage range starts from 3.7 V to 35 V.

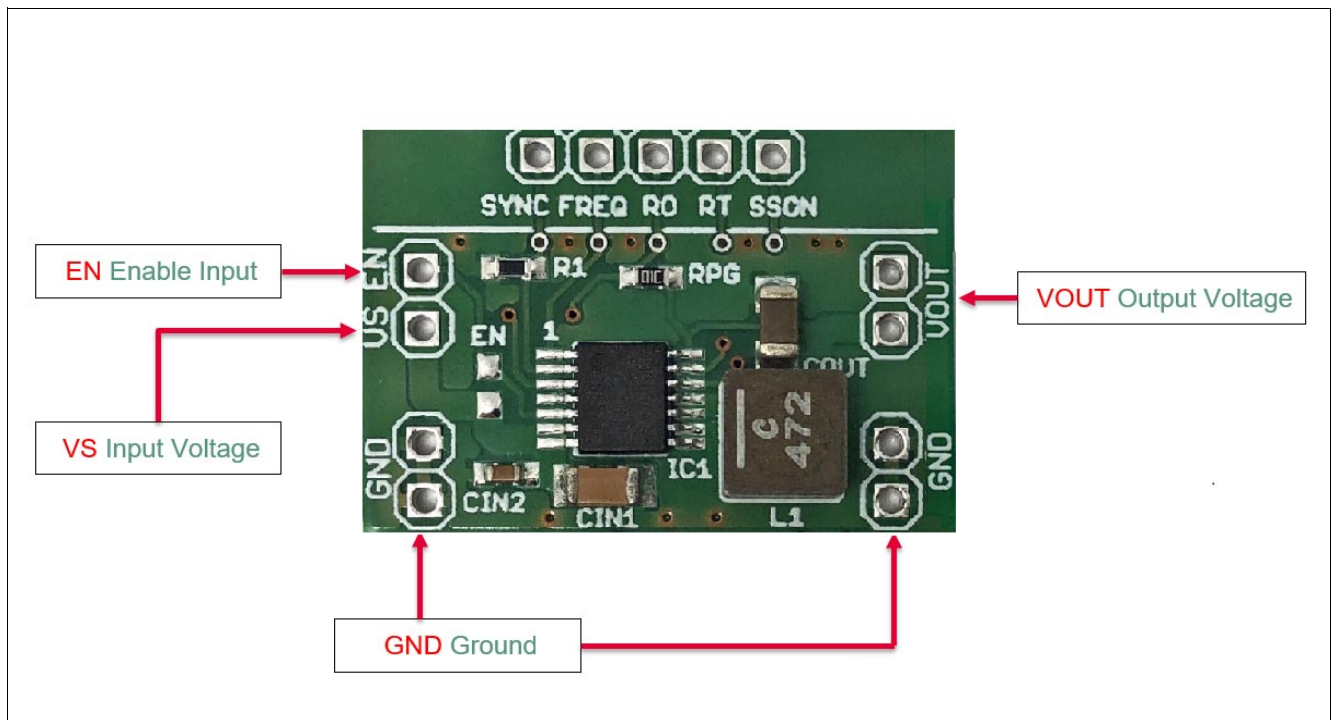
3) Absolute max rating.

**Setup and Features**

**2.3 Board Configuration**

The Core Module demonstrator board is easy to set up to evaluate the performance of the OPTIREG™ Switcher TLS4120D0EPV50

- Connect the input power supply to the VS and GND terminals on the left-side of the board.
- Connect the load between the VOUT and GND terminals on the right-side of the board.
- Connect the enable signal to the EN and GND terminals on the right-side of the board to enable and disable the circuit.



**Figure 3 Quick Start - How to connect the TLS4120D0EPVxx Core module**

**2.3.1 Enable Function**

The solder pad EN can be used to connect the EN pin of the device to one of the following:

- Connecting enable signal EN with the supply voltage VS.
- Leave the solder pad open, the EN input pin is supplied from the EN connector.

**Table 2 Solder pad EN setting for enable function**

| Solder pad EN | Function  |
|---------------|---|
| short         | EN is connected to the supply voltage VS; the regulator is enabled while it is supplied |
| open          | EN is supplied from the EN connector <sup>1)</sup>                                      |

1) Without supplying a signal to EN, the device is disabled because of an internal pull down resistor.

**Setup and Features**

**2.3.2 Signal Adaption**

For easy signal adaption e.g. connecting probes for an oscilloscope, connectors VS, EN, VOUT, PG, PG\_EXT and GND can be used.

**Table 3 Signals on connector**

| <b>Connector</b> | <b>Accessible Signals</b> |
|------------------|---------------------------|
| VS               | Input voltage             |
| EN               | Enable input signal       |
| VOUT             | Output voltage            |
| RO               | Reset output signal       |
| SYNC             | Synchronization input     |
| FREQ             | Frequency selection       |
| RT               | Reset configuration       |
| SSON             | Spread spectrum on/off    |
| GND              | System GND                |

**Setup and Features**

**2.4 Setup and Results**

This section describes how to properly use the TLS4120D0EPVxx Core module

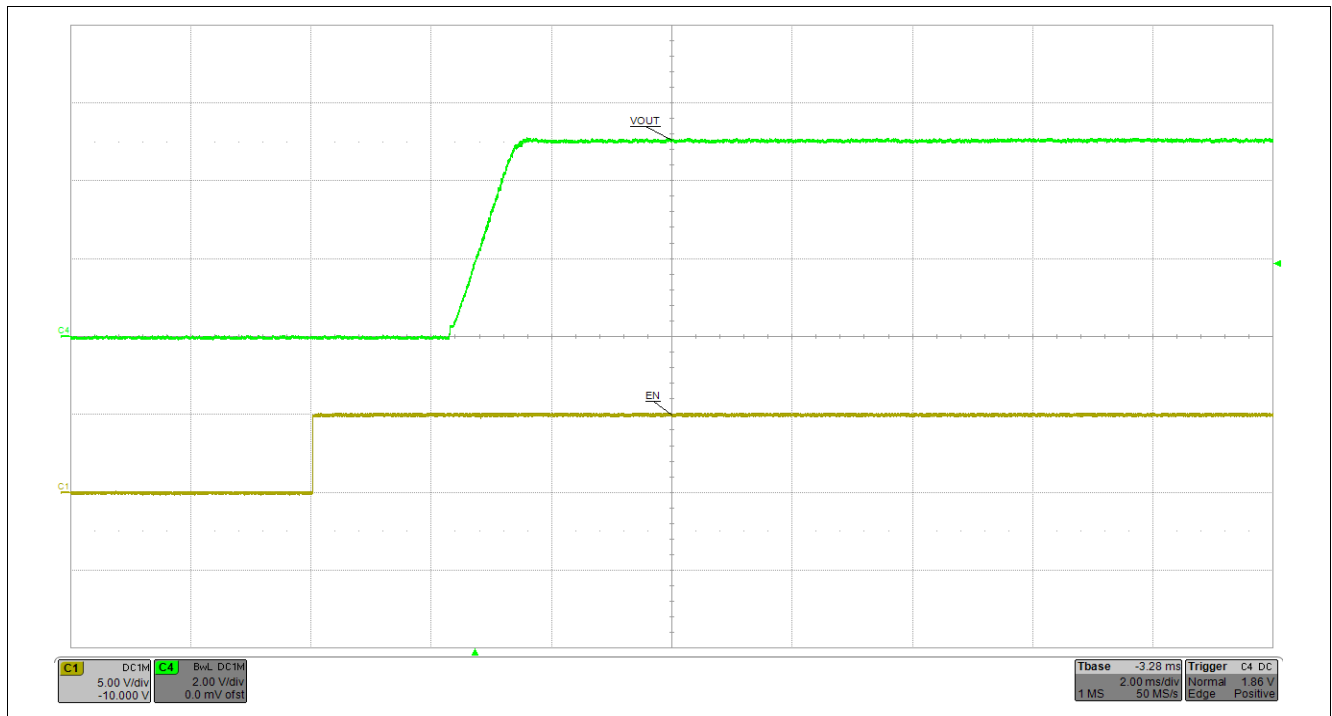
The Core module is configured to operate as 5 V output voltage and up to 2 A output current at a switching frequency of 2.2 MHz.

To operate the TLS4120D0EPVxx Core module, connect an input supply to the appropriate pins, and connect a load to the appropriate pins as described in the section [Board Configuration](#).

All the presented measures were performed for a 12V input voltage

**2.4.1 Power-up**

The OPTIREG™ Switcher TLS4120D0EPV50 provides a soft start function in order to control the ramp up of the output voltage with defined timing during start up. A valid high signal at pin EN will initiate the start up procedure.



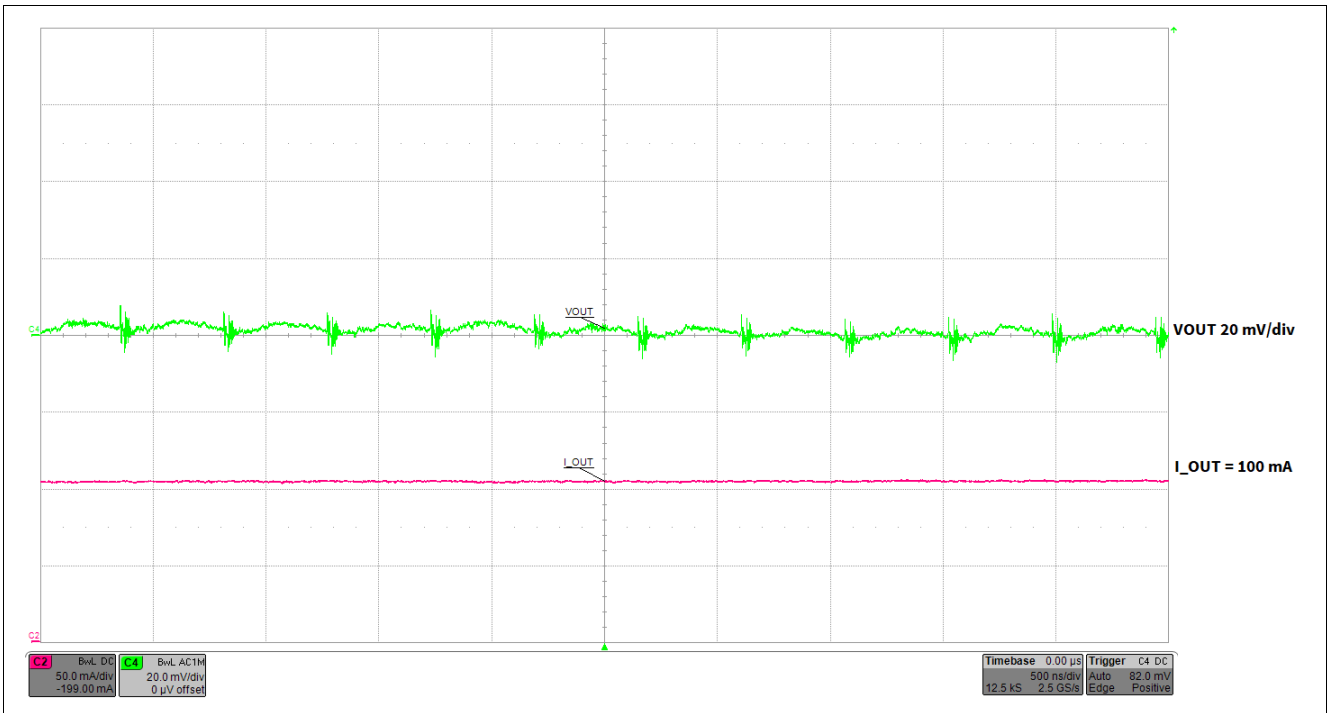
**Figure 4** TLS4120D0EPVxx Core module power-up.

**2.4.2 Output Ripple**

The amplitude of the output voltage ripple is dependent on load current and input voltage and it occurs at the switching frequency of 2.2 MHz. For accurate results, when measuring output voltage ripple, always consider to minimize the loop area connecting the oscilloscope probe as close as possible to the output capacitor and with a short ground lead. Resistance of traces also affect the output ripple and ground loop length increases the amplitude of switching spikes.



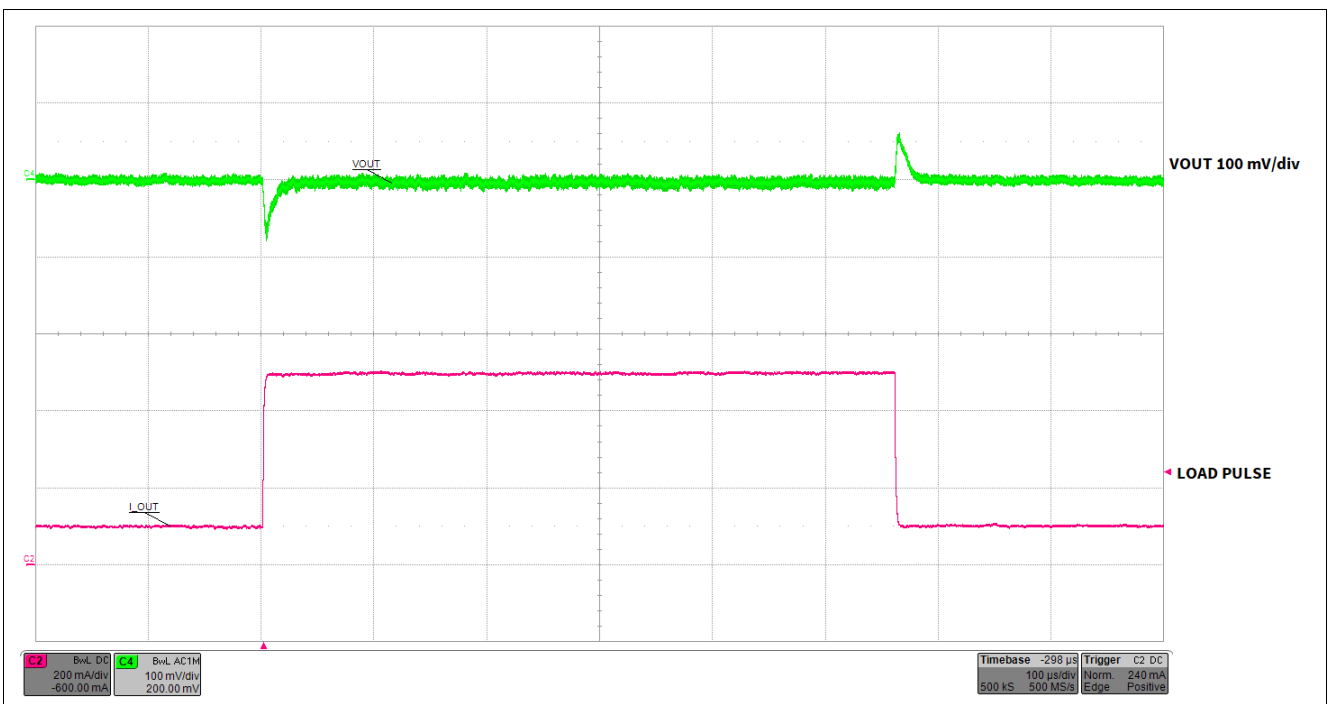
**Setup and Features**



**Figure 5** TLS4120D0EPVxx Core module output ripple for 100mA output current.

**2.4.3 Load transients**

Load transient measurements illustrate the OPTIREG™ Switcher TLS4120D0EPV50 ability to respond to abrupt changes in load current.



**Figure 6** TLS4120D0EPVxx Core module Load Step 100 mA to 500 mA.

Setup and Features

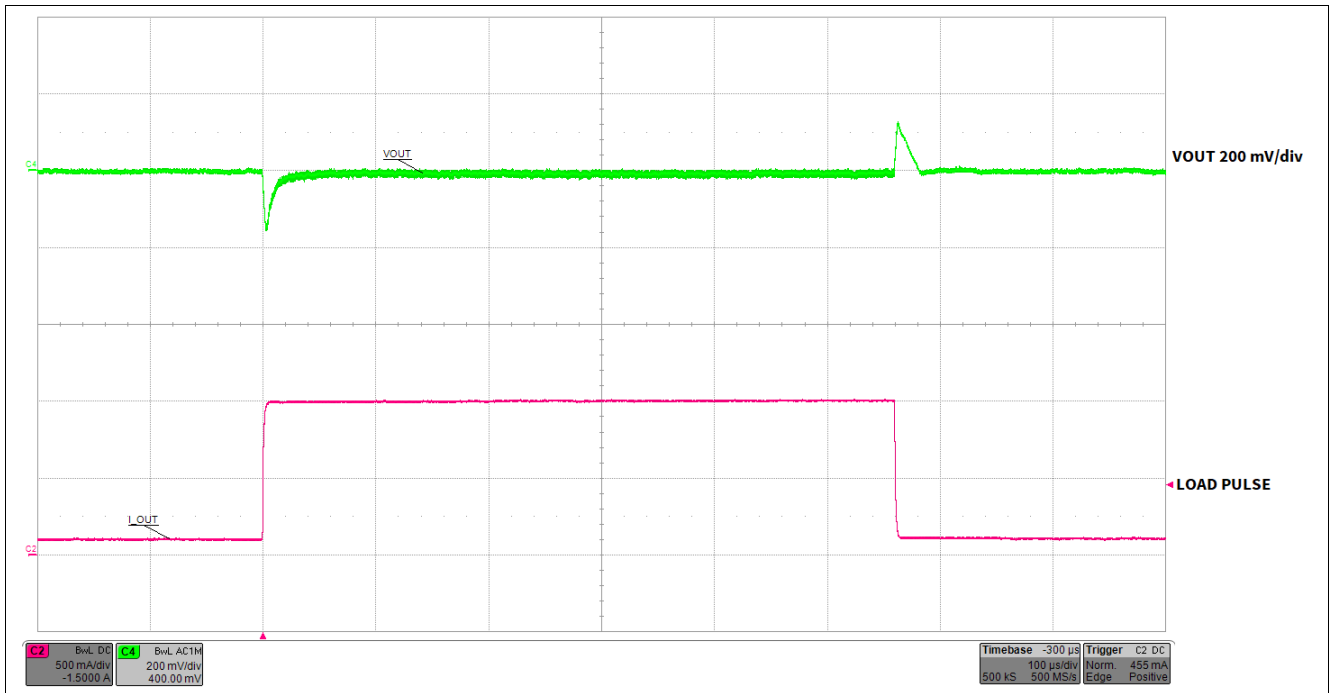
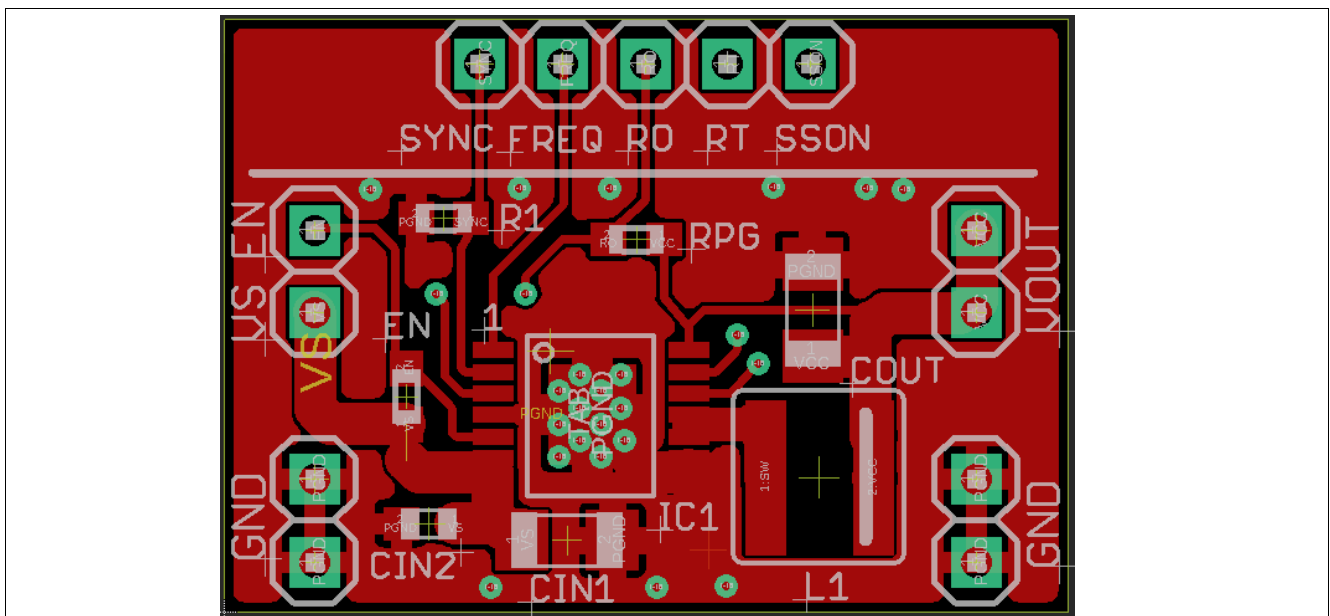


Figure 7 TLS4120D0EPVxx Core module Load Step 100 mA to 1A.

### 3 Layout and Schematic

#### 3.1 Layout TLS4120D0EPVxx Core module

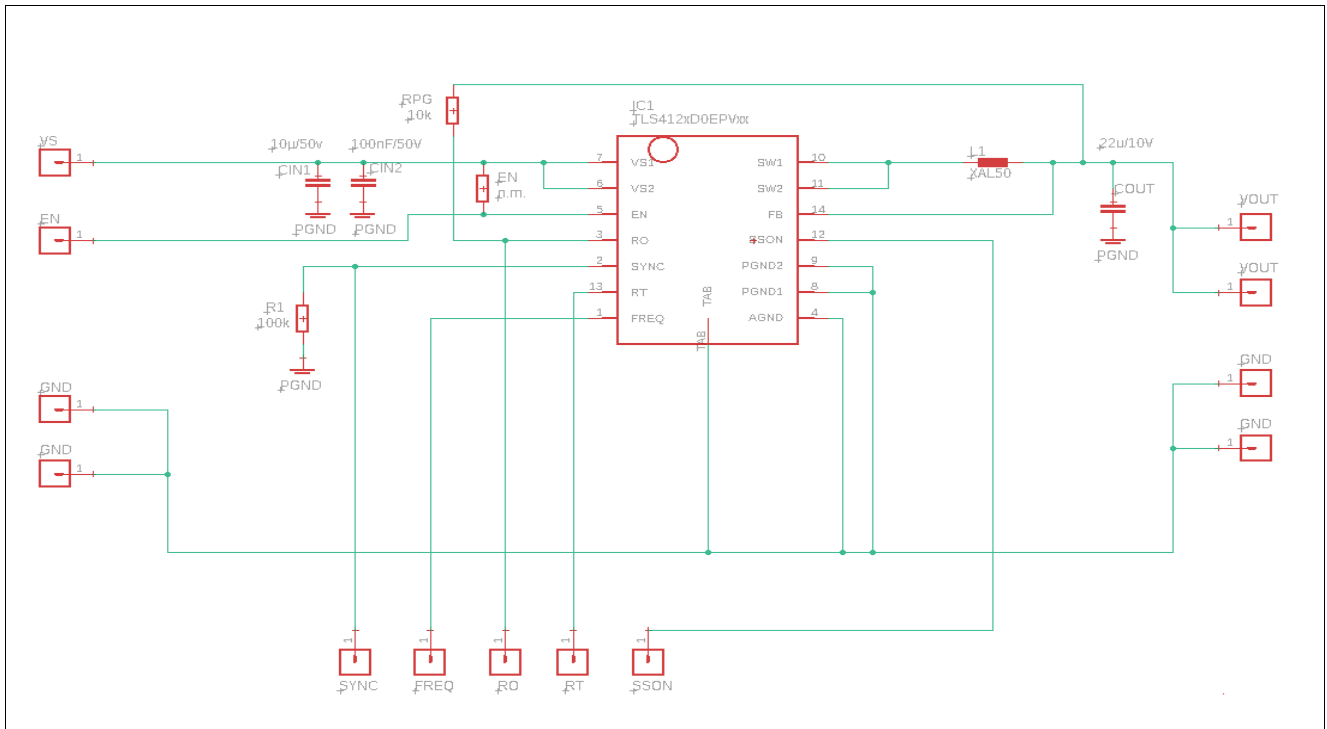
**Figure 8** and **Figure 9** show the board layout and schematic for the Core module. The 14-pin PG-TSDSO-14 package offers an exposed thermal pad, which must be soldered to the copper landing on the PCB for optimal thermal performance. The PCB consists of a 4-layer design. There are 2-oz copper planes on the top and bottom and 1-oz copper mid-layer planes to dissipate heat with an array of thermal vias under the thermal pad to connect to all four layers.



**Figure 8** Top Layer of TLS4120D0EPVxx Core module

**Layout and Schematic**

**3.2 Schematic TLS4120D0EPVxx Core module**



**Figure 9 Schematic of TLS4120D0EPVxx Core module**

**Bill of Material**

## 4 Bill of Material

**Table 4 Bill of Material**

| <b>Part</b> | <b>Value</b>                       | <b>Package</b> |
|-------------|------------------------------------|----------------|
| IC1         | TLS4120D0EPV50 /<br>TLS4120D0EPV33 | PG-TSDSO-14    |
| CIN1        | 10 $\mu$ F/50V                     | C1206          |
| CIN2        | 100nF/50V                          | C0805          |
| COU1        | 22 $\mu$ F/10V                     | C1206          |
| L1          | 4.7 $\mu$ H                        | XAL50          |
| RPG         | 10 k $\Omega$ , 1%                 | R0805          |
| R1          | 100 k $\Omega$ , 1%                | R0805          |

## **5 General Information**

### **5.1 Restrictions**

This Demoboard is intended as a size optimized solution offering limited features allowing to evaluate and test the Infineon products. For better EMC and specification performance please refer to the corresponding recommended solutions.

The Core module is not an end product (or finished appliance), nor is it intended or authorized by Infineon to be integrated into end products. The Core module may not be used in any production system.

### **5.2 Additional Information**

For further information you may contact <http://www.infineon.com/>

**Revision History**

**6 Revision History**

| <b>Revision</b> | <b>Date</b> | <b>Changes</b>  |
|-----------------|-------------|-----------------|
| 1.0             | 2019-10-30  | Initial version |

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**Email: [erratum@infineon.com](mailto:erratum@infineon.com)**

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