TPS61046EVM-682 Evaluation Module

This user's guide describes the schematic, layout, and operation of the TPS61046EVM-682 evaluation module.

There are two TPS61046 power circuits in the EVM. U1 is for the adjustable output voltage version, where the FB pin is connected to the feedback network, so the VOUT can be set from 5 V to 28 V; U2 is for the fixed 12-V VOUT version as the FB pin is connected to the VIN pin directly. A 1.6 mm × 0.8 mm inductor is used in this circuit, limiting the input current no higher than 100 mA.

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1 Introduction

This section contains the electrical performance and components selection of TPS61046EVM-682.

1.1 Performance Specification

Table 1 provides a summary of the TPS61046EVM-682 performance specifications. All specifications are given at an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification	Test Condition	MIN	Typ	MAX	Unit
Input Voltage		1.8		5.5	V
Output Voltage	V_{IN} = 3.6V, I_{IN} < 600 mA (U1 circuit)	5		28	V
	V_{IN} = 3.6V, I_{IN} < 100 mA (U2 circuit)		12.0		
Output Current	V_{IN} = 3.6 V, V_{OUT} = 12 V (U1 circuit)	0	100		mA
	V_{IN} = 3.6V, V_{OUT} = 12 V (U2 circuit)	0	20		mA

1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by the user. The external component can be changed according the real application.

1.2.1 Input Capacitor and Output Capacitor

A 150-µF tantalum capacitor is added as the input capacitor in the EVM. The ESR of the tantalum capacitor is 0.1 Ω which helps to damp the ringing in the input voltage when the EVM is powered by a power supply with long cable. The capacitor is not required for proper operation and can be removed in a real application.

C5, C6, C7, and C8 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response.

1.2.2 Feedforward Resistor and Capacitor

Feedforward capacitor C3 is used to speed up the device's respond when the output capacitor is much larger than the value in the EVM. When C3 is selected, a resistor with a value not lower than 100 Ω must be used to avoid switching noise coupling into the FB pin. This resistor, R2, also helps to stabilize the system because the frequency of the pole introduced by this feedforward capacitor decreases.

2 Input/output Connector Descriptions

This section describes how to properly use the TPS61046EVM-682.

2.1 Connection and Jumper for U1

J1 – VIN	Positive input connection from the input supply for the EVM
J2 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J3 – GND	Return connection from the input supply for the EVM
J4 – GND	GND
J5 – VOUT	Positive output connection
J6 – S+/S–	Output voltage sense connections
J7 – GND	GND for the output
JP-1	Enable/disable the device U1

2.2 Connection and Jumper for U2

J8 – VIN	Positive input connection from the input supply for the EVM
J9 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J10 – GND	Return connection from the input supply for the EVM
J11 – VOUT	Positive output connection
J12 – S+/S–	Output voltage sense connections
J13 – GND	GND for the output
JP-2	Enable/disable the device U2

3 Test Results

Refer to the datasheet (SLVSCQ7), *Application Performance Curves* section for the test result of the U1 circuit. The following measurements in this section are done on the U2 circuit.

3.1 Startup Waveform

The startup waveform is shown in Figure 1. The test condition: V_{IN} = 3.6 V, V_{OUT} = 12 V, R_{LOAD} = 1 kΩ, T_a = 25°C. (CH2 V_{OUT}, CH3 EN)

Figure 1. Startup at R_{LOAD} = 1 kΩ

3.2 Output Ripple

The output ripple waveforms at different loads are shown Figure 2 and Figure 3, respectively. The test condition: V_{IN} = 3.6 V, V_{OUT} = 12 V, I_{OUT} = 1 mA, 20 mA, T_a = 25°C. (CH2 V_{OUT}, CH3 SW)

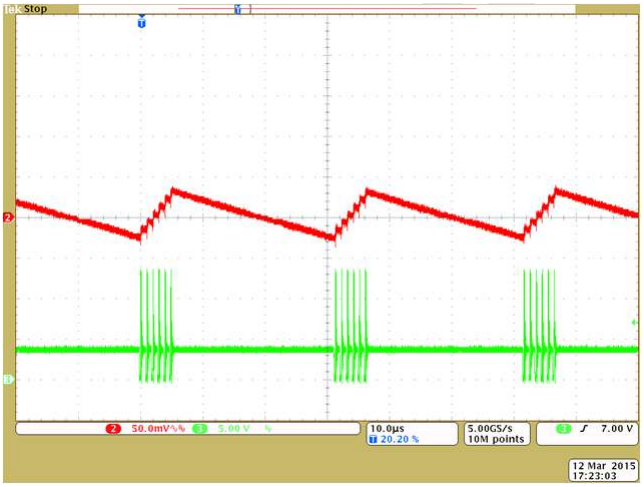

Figure 2. Output Ripple at I_{OUT} = 1 mA

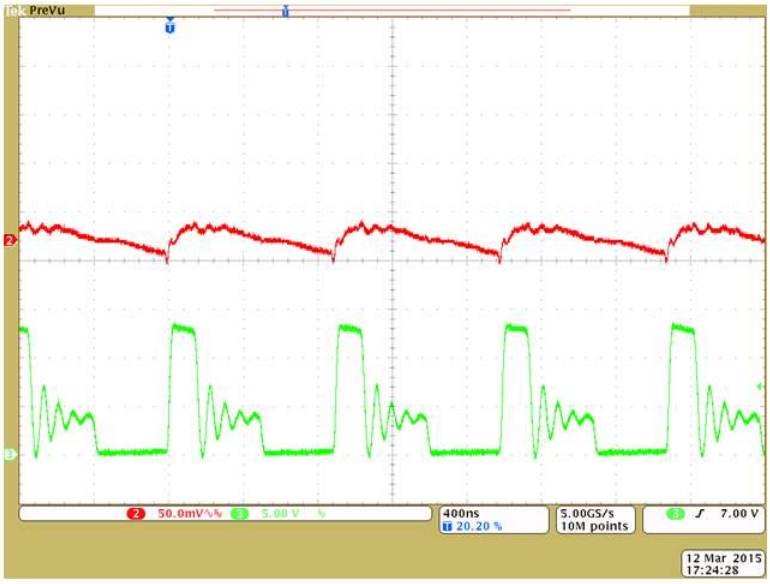

Figure 3. Output Ripple at I_{OUT} = 20 mA

3.3 Load Transient

The load transient waveform is shown in Figure 4. The test condition: V_{IN} = 3.6 V, V_{OUT} = 12 V, I_{OUT} = 5 mA–15 mA, T_a = 25°C. (CH2 V_{OUT}(AC), CH4 I_{LOAD}). Please note that the effective output capacitance is only about 0.47 µF because of the ceramic capacitor characteristics, although a 2.2 µF is used in the EVM. Larger effective capacitance will help to improve the load transient performance.

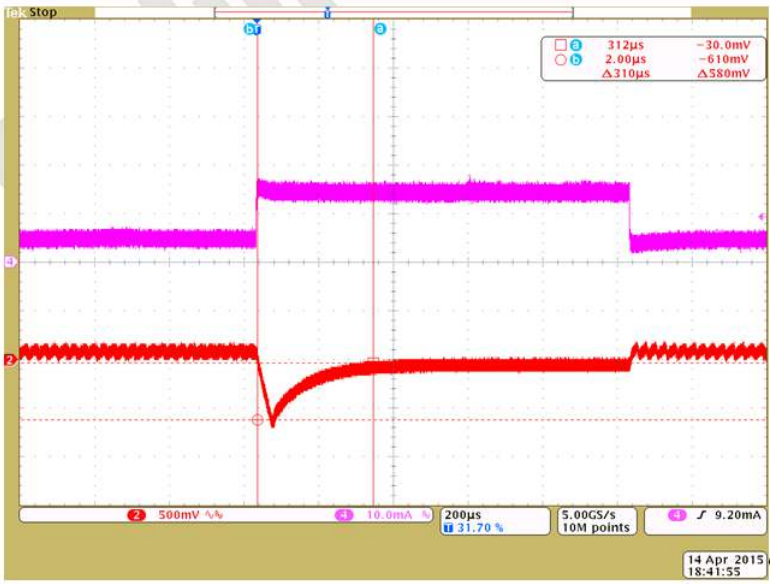

Figure 4. Load Transient with I_{OUT} from 5 mA to 15 mA

4 Schematic and Bill of Materials

This section provides the TPS61046EVM-682 schematics and the bill of materials

4.1 Schematic

The schematics for U1, U2 circuit are shown in Figure 5 and Figure 6, respectively.

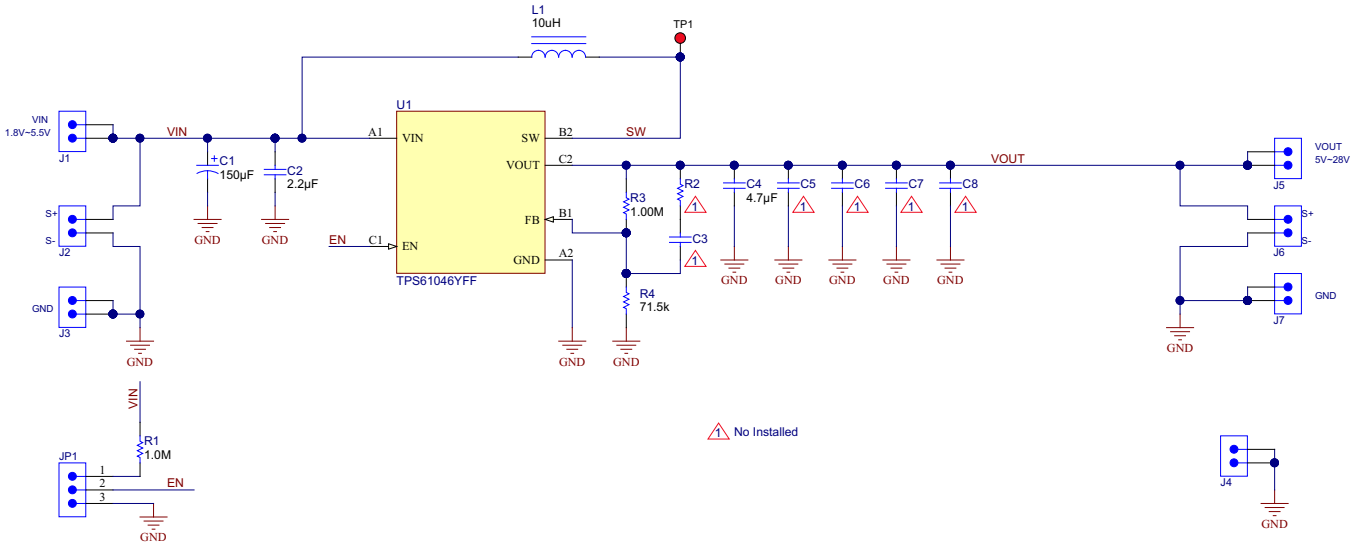

Figure 5. TPS61046EVM-682 Schematic – U1 Circuit Configuration

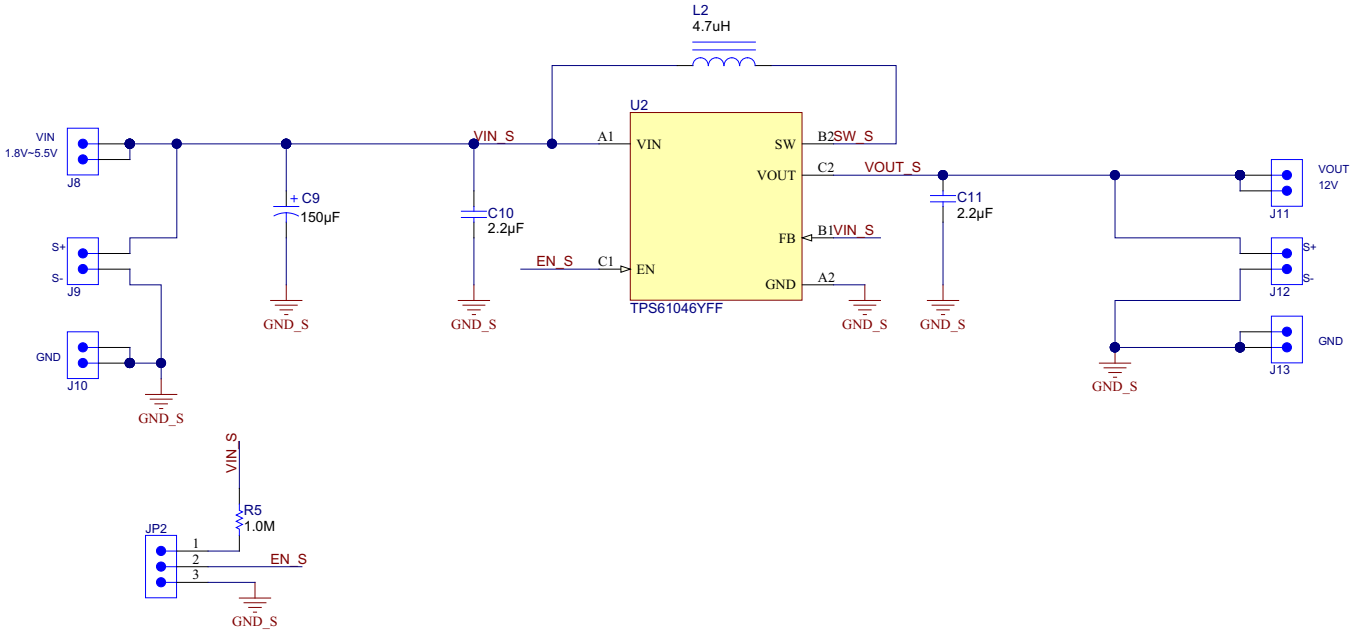

Figure 6. TPS61046EVM-682 Schematic – U2 Circuit Configuration

4.2 Bill of Materials

Table 2 provides the bill of the materials of the EVM board.

Table 2. TPS61046 Bill of Materials

Designator	QTY	Value	Description	Package	Part Number	MFG
C1, C9	2	150uF	CAP, TA, 150uF, 10V, +/-10%, 0.1 ohm, SMD	7343-31	T495D157K010ATE100	Kemet
C2	1	2.2uF	CAP, CERM, 2.2 µF, 10 V, +/- 10%, X5R, 0603	0603	GRM188R61A225KE34D	Murata
C4	1	4.7uF	CAP, CERM, 4.7 µF, 35 V, +/- 10%, X5R, 0603	0603	GRM188R6YA475KE15D	Murata
C10, C11	2	2.2uF	CAP, CERM, 2.2 µF, 25 V, +/- 10%, X5R, 0402	0402	GRM155R61E225KE11D	Murata
L1	1	10uH	Inductor, Shielded, Powdered Iron, 10 µH, 2 A, 0.2 ohm, SMD	4.2x4.2mm	FDSD0420-H-100M	Toko
L2	1	4.7uH	Inductor, Wirewound, Metal Composite, 4.7 µH, 0.37 A, 0.73 ohm, SMD	0603	MBKK1608T4R7M	Taiyo Yuden
R1, R5	2	1.0Meg	RES, 1.0 M, 5%, 0.1 W, 0603	0603	CRCW06031M00JNEA	Vishay-Dale
R3	1	1.00Meg	RES, 1.00 M, 1%, 0.1 W, 0603	0603	RC0603FR-071ML	Yageo America
R4	1	71.5k	RES, 71.5 k, 1%, 0.1 W, 0603	0603	RC0603FR-0771K5L	Yageo America
U1, U2	2		28-V Output Voltage Boost Converter, YFF0006AAAA	YFF0006AAAA	TPS61046YFF	Texas Instruments
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13	13		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
JP1, JP2	2		Header, 100mil, 3x1, Tin plated, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
TP1	1	Red	Test Point, TH, Multipurpose, Red	Keystone5010	5010	Keystone
C3, C5, C6, C7, C8, R2	open					

5 Board Layout

This section provides the TPS61046EVM-682 board layout and illustrations, Figure 7 is the top layer and Figure 8 is the bottom layer.

The output capacitor should be as close to the IC as possible and be connected to VOUT and the GND pin with short, width track. If the bulk capacitor is too large to place close the IC, a small capacitor should be placed close to the IC.

Make sure the track and inductor node connected to the SW pin is far from the FB pin which is sensitive to noise.

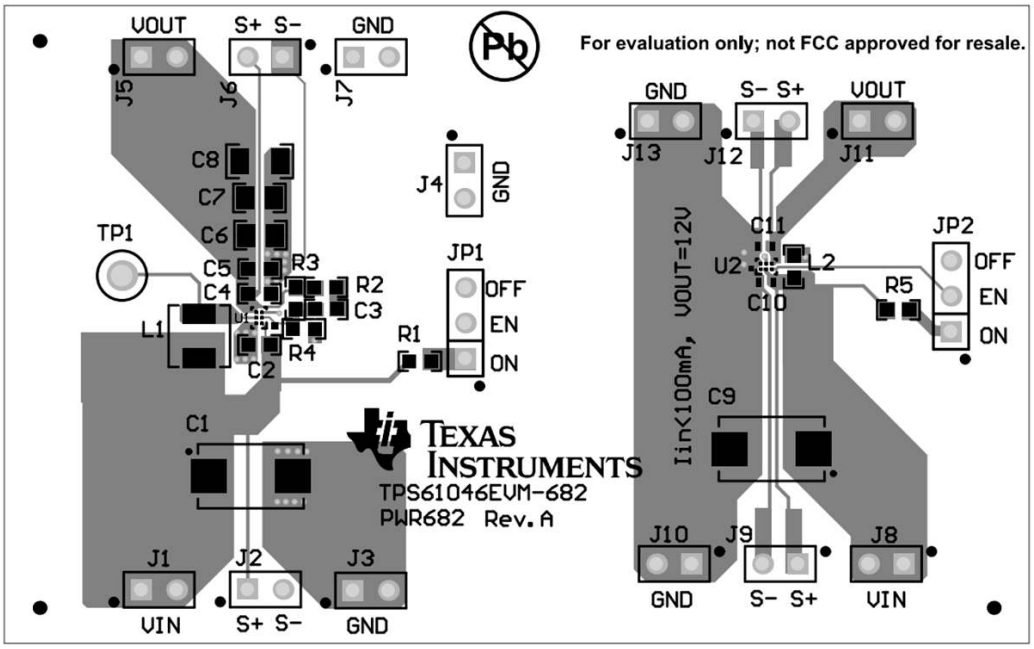

Figure 7. Silkscreen and Top Layer

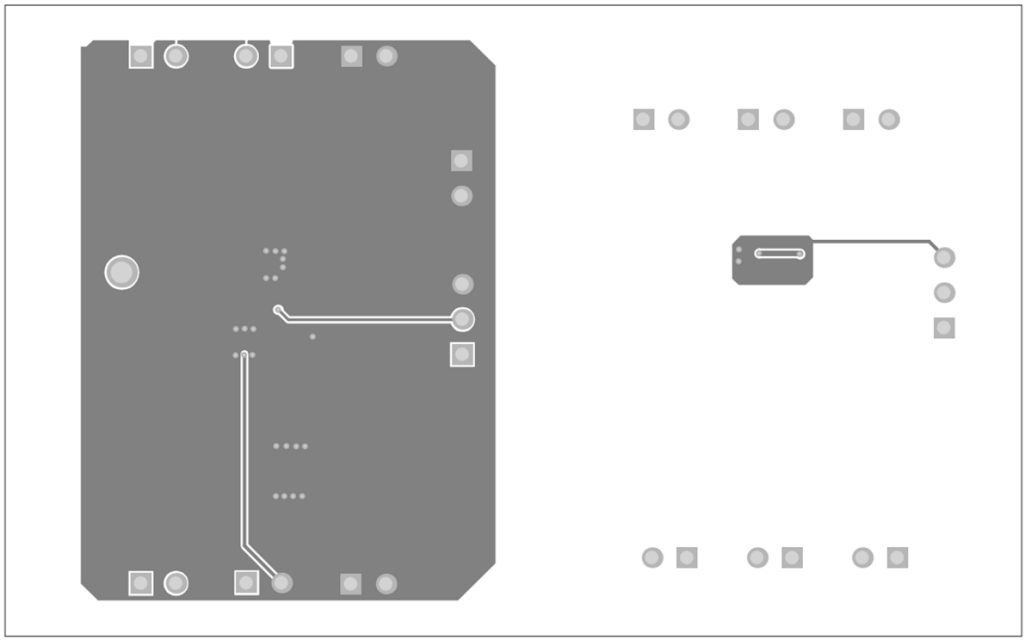

Figure 8. Bottom Layer

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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