



## ABSTRACT

This user's guide describes the schematic, layout, bill of materials (BOM), and setup of the evaluation module (EVM) for the TPS61094EVM-066. It can supply the Vout to programmed target from 2.7 V~5.4 V with Vin low to 1.8 V. The TPS61094EVM-066 supports four operating modes with different jumpers configuration, including force bypass, true shutdown, force buck, and auto buck or Boost.

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## Trademarks

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## 1 Introduction

### 1.1 Performance Specification

Table 1-1 and Table 1-2 provide a summary of the TPS61094EVM performance specifications. All specification are given for an ambient temperature of 25°C.

**Table 1-1. Performance Specification Summary(Boost converter with bypass)**

Parameter	Test Condition	MIN	TYP	MAX	Unit
Vin		0.7	3.3	5.5	V
Vout		2.7	3.6	5.4	V
Default Switching Frequency			1		MHz
Iout	Vin=3.3 V		500		mA

**Table 1-2. Performance Specification Summary (Boost converter with Automatic Buck or Boost)**

Parameter	Test Condition	MIN	TYP	MAX	Unit
Vin		0.7	5	5.5	V
Vout			3.3		V
Vsup target		1.7	2.6	5.4	V
Iout	IC Enabled, Vin=5 V, Vsup=2.6 V		250		mA

### 1.2 Modification

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

## 2 Connector, Test Point and Jumper Descriptions

This section describes how to properly connect, set up, and use the TPS61094EVM-066.

### 2.1 Connector and Test Point Descriptions

This EVM includes I/O connectors and test points as shown in [Table 2-1](#).

**Table 2-1. Connectors and test Points**

Reference Designator	Description
J1	Input voltage positive connection
J2	Input voltage positive and negative sense connection
J3	Vout positive connection
J4	Output voltage positive and negative sense connection
J5, J6, J9, J10	GND connection
J7	SUP port positive connection
J8	Sup port positive and negative sense connection

### 2.2 Jumper Configuration

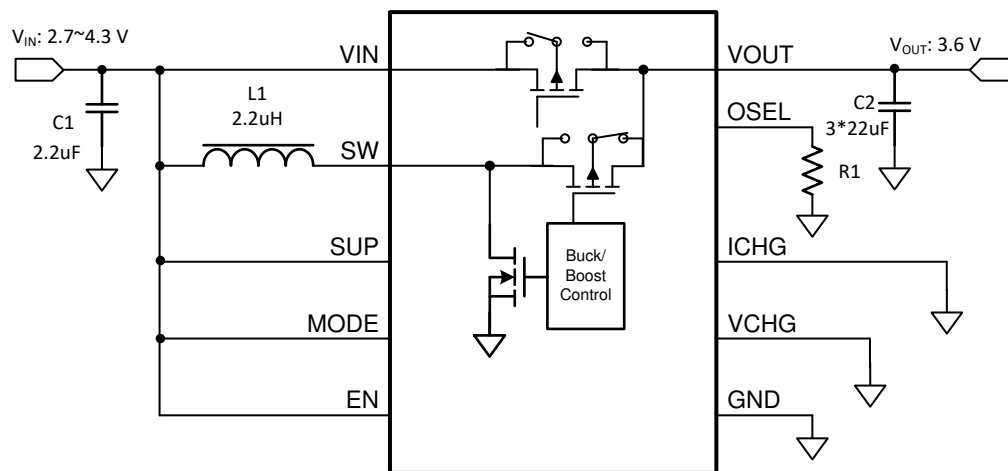
The TPS61094EVM-066 can support different operating modes by the varied jumper combinations. And in this paper, it will show two typical application circuits.

One typical application circuit is the pure boost with bypass function, as shown in [Figure 2-1](#), which connects the SUP pin and VIN pin together. The jumper configuration for this application is shown in [Table 2-2](#).

The other typical application circuit is the supercap backup application, which separates the SUP pin and VIN pin, as shown in [Figure 2-2](#), which can charge supercap or boost supercap to power the output. The jumper configuration for this application is shown in [Table 2-3](#)

#### 2.2.1 Boost Converter with Bypass

In this section, it shows how to set the EVM to support *Boost converter with bypass* application. The sketch schematic is shown in [Figure 2-1](#), while the jumper configuration is shown in [Table 2-2](#)



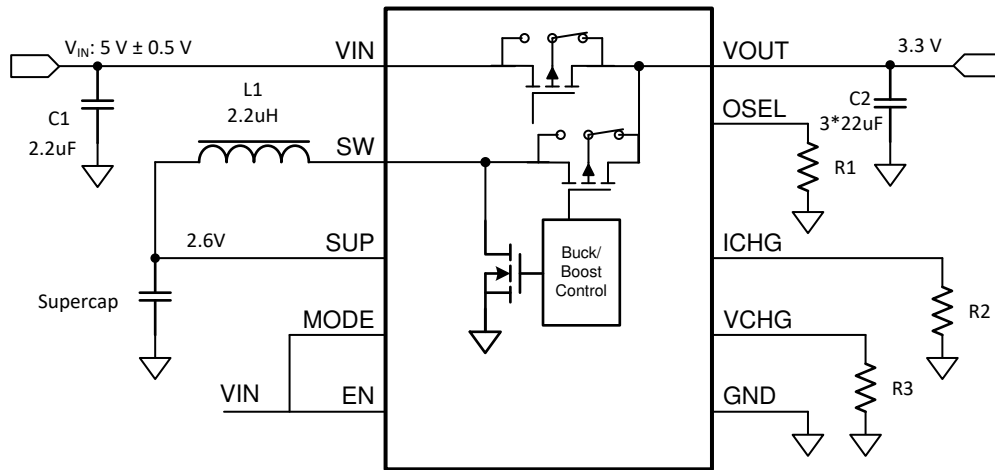
**Figure 2-1. Boost Converter with Bypass**

**Table 2-2. Jumpers Configuration for Boost Converter with Bypass**

Reference Designator	Description	Configuration
JP1 , JP2	Short 1-2 :connect the SUP pin to the Vin port Short 2-3: connect the SUP pin to the SUP port	Short 1-2
JP3	Sup termination voltage selection	-
JP4	Changing current selection	-
JP5	Output voltage target selection	At mark 3.6 V
J11, J12	Operating mode selection pin. The MODE pin and EN pin work together to set device operation mode.	Set High to select auto Buck or boost mode

### 2.2.2 Boost Converter with Automatic Buck or Boost Function

In this section, it shows the how to set the EVM support *Boost converter with automatic buck or boost* application. The sketch schematic is shown in [Figure 2-2](#), while the jumper configuration is shown in [Table 2-3](#)


**Figure 2-2. Boost Converter with Automatic Buck or Boost**
**Table 2-3. Jumpers Configuration for Boost Converter with Automatic Buck or Boost**

Reference Designator	Description	Configuration
JP1 , JP2	Short 1-2: connect the SUP pin to the Vin port Short 2-3: connect the SUP pin to the SUP port	Short 2-3
JP3	Sup termination voltage selection	At the mark 2.6 V
JP4	Changing current selection	At the mark 250 mA
JP5	Output voltage target selection	At mark 3.6 V
J11, J12	Operating mode selection pin. The MODE pin and EN pin work together to set device operation mode.	Set High to select auto Buck or boost mode

### 3 Schematic, Bill of Materials, and Board Layout

This section provides the TPS61094EVM-066 schematic, bill of materials (BOM), and board layout.

#### 3.1 Schematics

Figure 3-1 shows the TPS61094EVM-066 schematic.

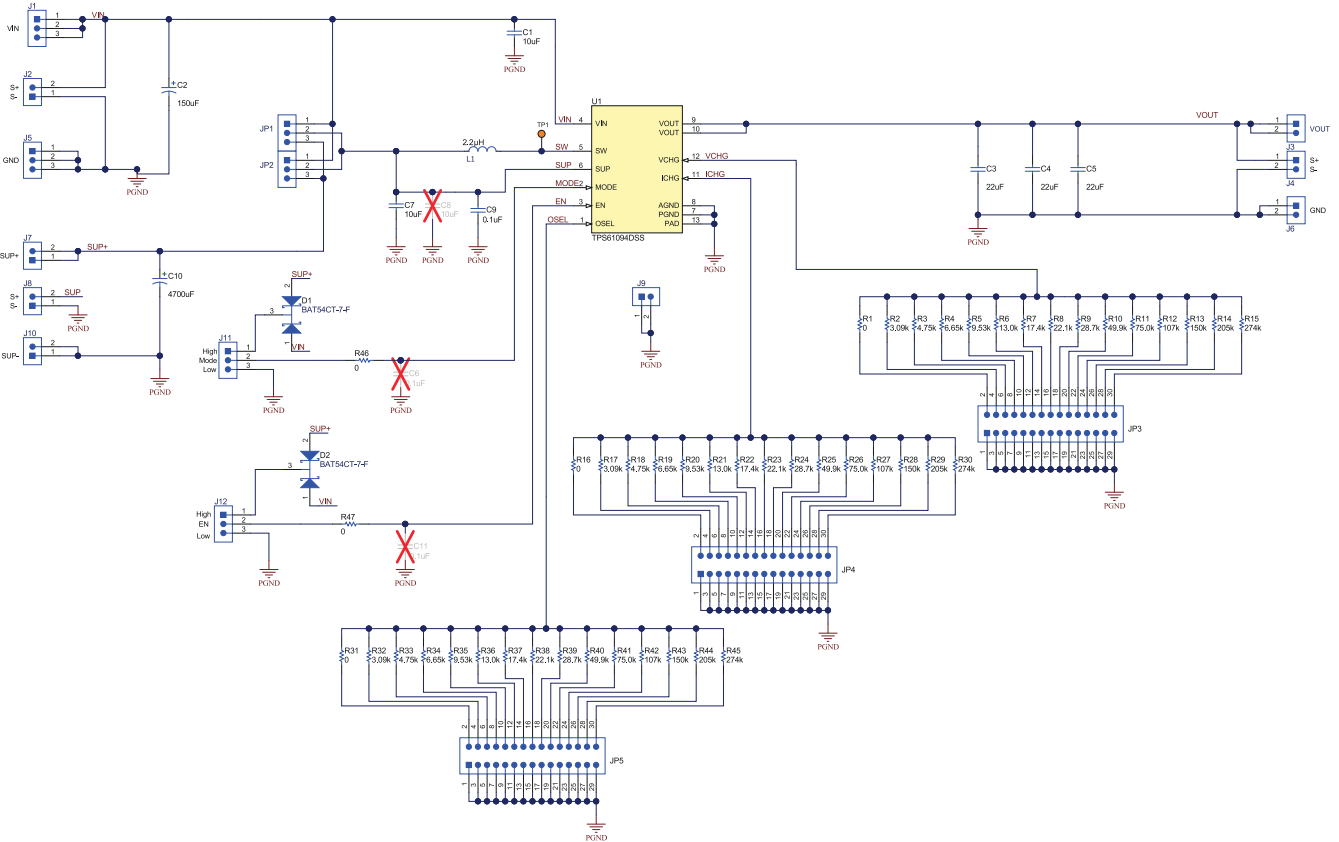


Figure 3-1. TPS61094EVM-066 Schematic

### 3.2 Bill of Materials

Table 3-1 lists the BOM of the TPS61094EVM-066.

**Table 3-1. Bill of Materials**

Designator	Qty	Value	Description	Package Reference	PartNumber	Manufacturer
C1, C7	2	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	GRM188R61A106ME6 9D	MuRata
C2	1	150uF	CAP, TA, 150 uF, 10 V, +/- 10%, 0.1 ohm, SMD	7343-31	T495D157K010ATE10 0	Kemet
C3, C4, C5	3	22uF	CAP, CERM, 22 uF, 10 V, +/- 20%, X5R, 0805	0805	GRM21BR61A226ME4 4L	MuRata
C9	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K0 50BB	TDK
C10	1	4700uF	CAP, AL, 4700 uF, 6.3 V, +/- 20%, 0.015 ohm, TH	12.5x25mm	EEUFR0J472	Panasonic
D1, D2	2	30 V	Diode, Schottky, 30 V, 0.2 A, SOT-523	SOT-523	BAT54CT-7-F	Diodes Inc.
J1, J5, J11, J12	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J2, J3, J4, J6, J7, J8, J9, J10	8		Header, 100mil, 2x1, Gold, TH	Header, 100mil, 2x1, TH	HTSW-102-07-G-S	Samtec
JP1, JP2	2		Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH	HTSW-103-07-G-S	Samtec
JP3, JP4, JP5	3		Conn Unshrouded Header HDR 30 POS 2.54mm Solder ST Thru-Hole	HDR30	HMTSW-115-07-G-D-240	Samtec
L1	1		Shielded Power Inductors	SMT_4MM0_4MM0	XGL4020-222MEC	Coilcraft
R1, R16, R31, R46, R47	5	0	RES, 0, 5%, 0.063 W, 0402	0402	RC0402JR-070RL	Yageo America
R2, R17, R32	3	3.09k	RES, 3.09 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04023K09FKED	Vishay-Dale
R3, R18, R33	3	4.75k	RES, 4.75 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04024K75FKED	Vishay-Dale
R4, R19, R34	3	6.65k	RES, 6.65 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04026K65FKED	Vishay-Dale
R5, R20, R35	3	9.53k	RES, 9.53 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04029K53FKED	Vishay-Dale
R6, R21, R36	3	13.0k	RES, 13.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040213K0FKED	Vishay-Dale
R7, R22, R37	3	17.4k	RES, 17.4 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040217K4FKED	Vishay-Dale
R8, R23, R38	3	22.1k	RES, 22.1 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040222K1FKED	Vishay-Dale
R9, R24, R39	3	28.7k	RES, 28.7 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040228K7FKED	Vishay-Dale
R10, R25, R40	3	49.9k	RES, 49.9 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040249K9FKED	Vishay-Dale
R11, R26, R41	3	75.0k	RES, 75.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040275K0FKED	Vishay-Dale
R12, R27, R42	3	107k	RES, 107 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402107KFKED	Vishay-Dale
R13, R28, R43	3	150k	RES, 150 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402150KFKED	Vishay-Dale
R14, R29, R44	3	205k	RES, 205 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402205KFKED	Vishay-Dale

Table 3-1. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	PartNumber	Manufacturer
R15, R30, R45	3	274k	RES, 274 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402274KFKED	Vishay-Dale
TP1	1		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
U1	1		100-nA QUIESCENT CURRENT BI-DIRECTIONAL BUCK/BOOST CONVERTER WITH BYPASS MODE, DSS0012B (WSON-12)	DSS0012B	TPS61094DSS	Texas Instruments
C6, C11	0	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K050BB	TDK
C8	0	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	GRM188R61A106ME69D	MuRata

### 3.3 PCB Layouts

The TPS61094EVM board is a 4-layer PCB. The top and bottom layers copper thickness is 2-oz. The two inner layers copper thickness is 1-oz. Figure 3-2 and Figure 3-5 show the top view and bottom view, respectively. Figure 3-3 and Figure 3-4 show the inner layer 1 and inner layer 2, respectively.

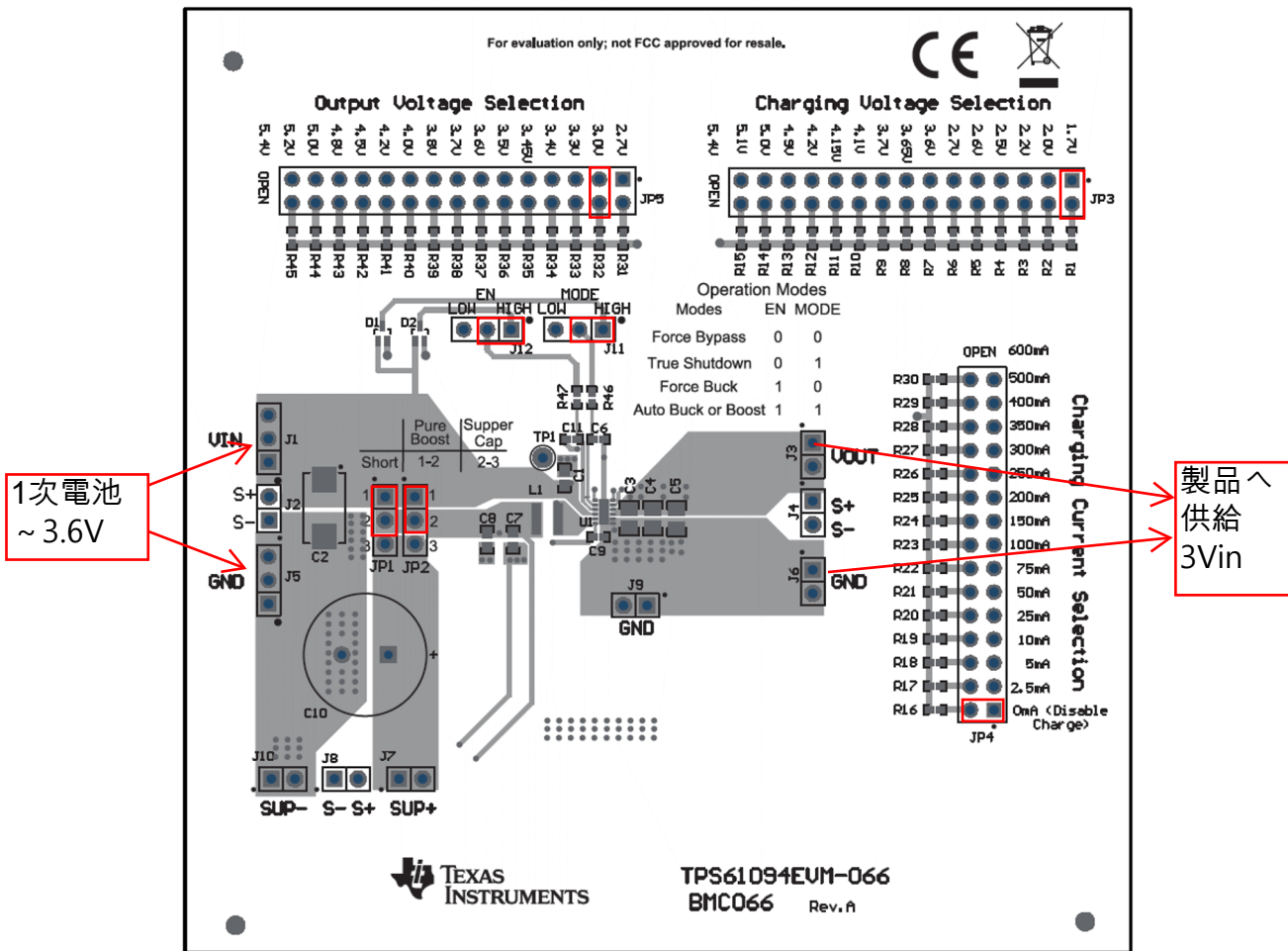
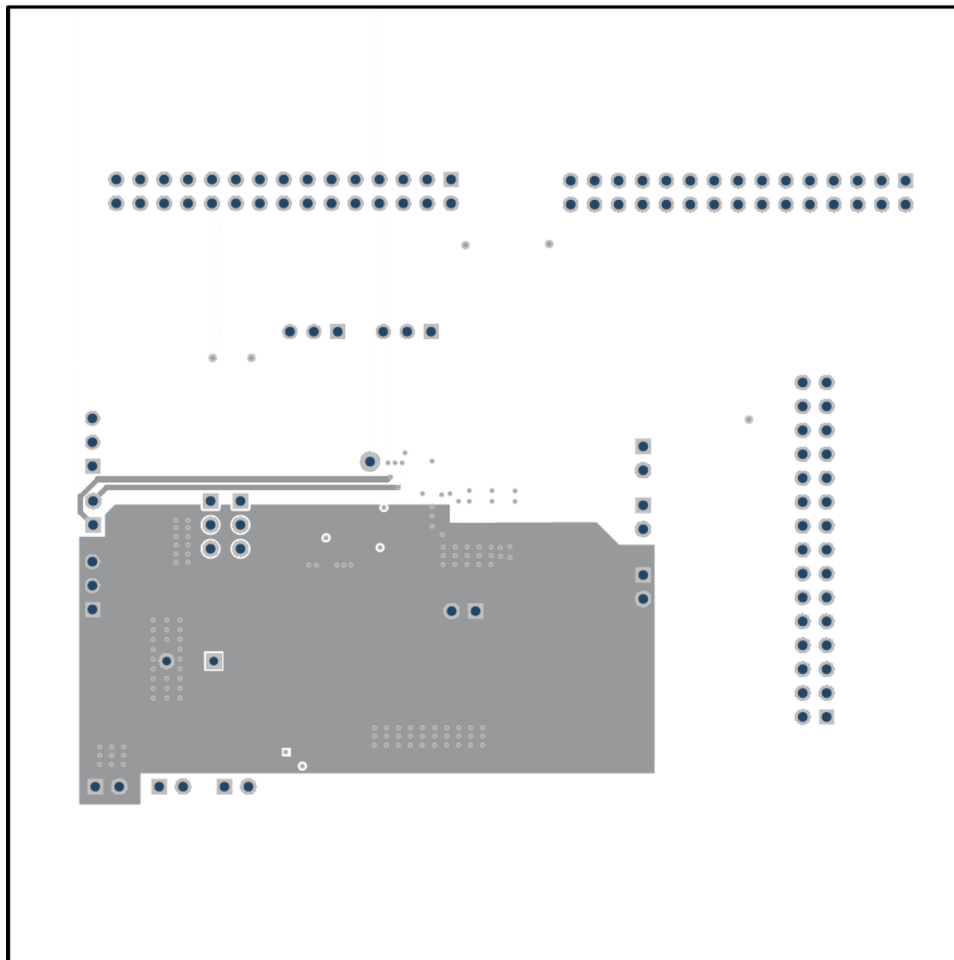
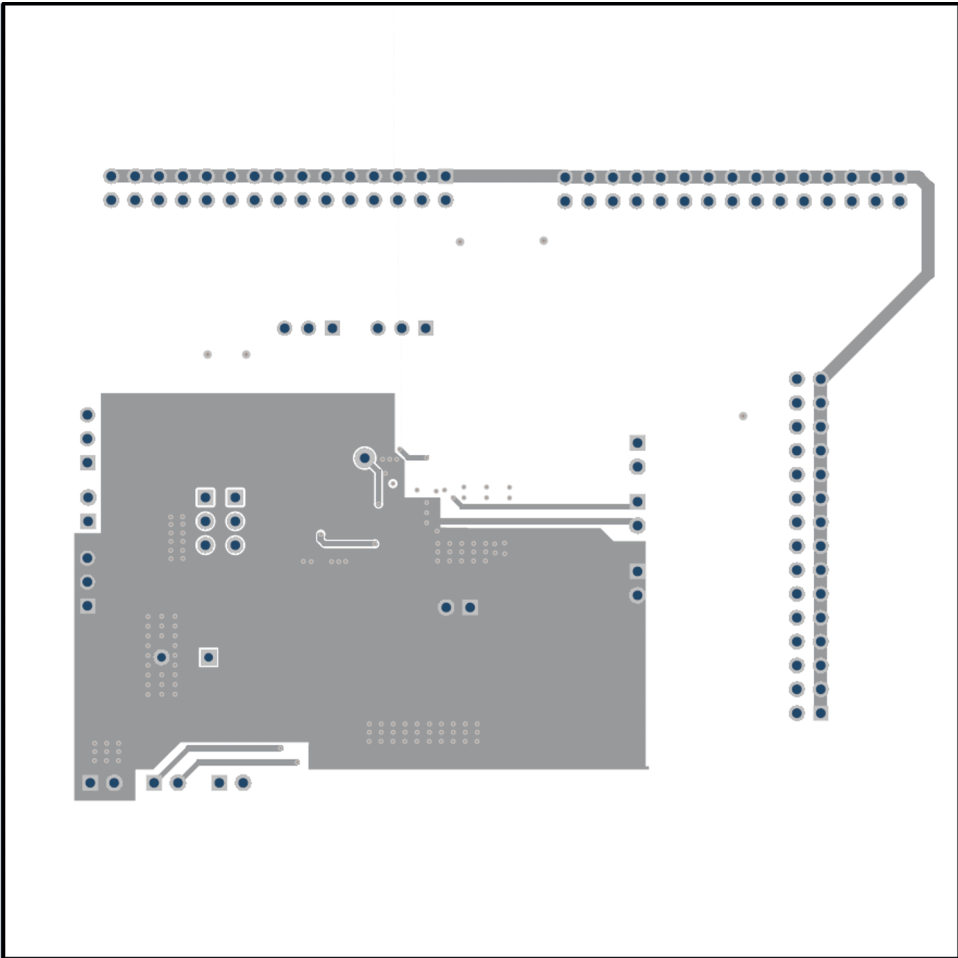


Figure 3-2. TPS61094EVM-066 Top-Side Layout

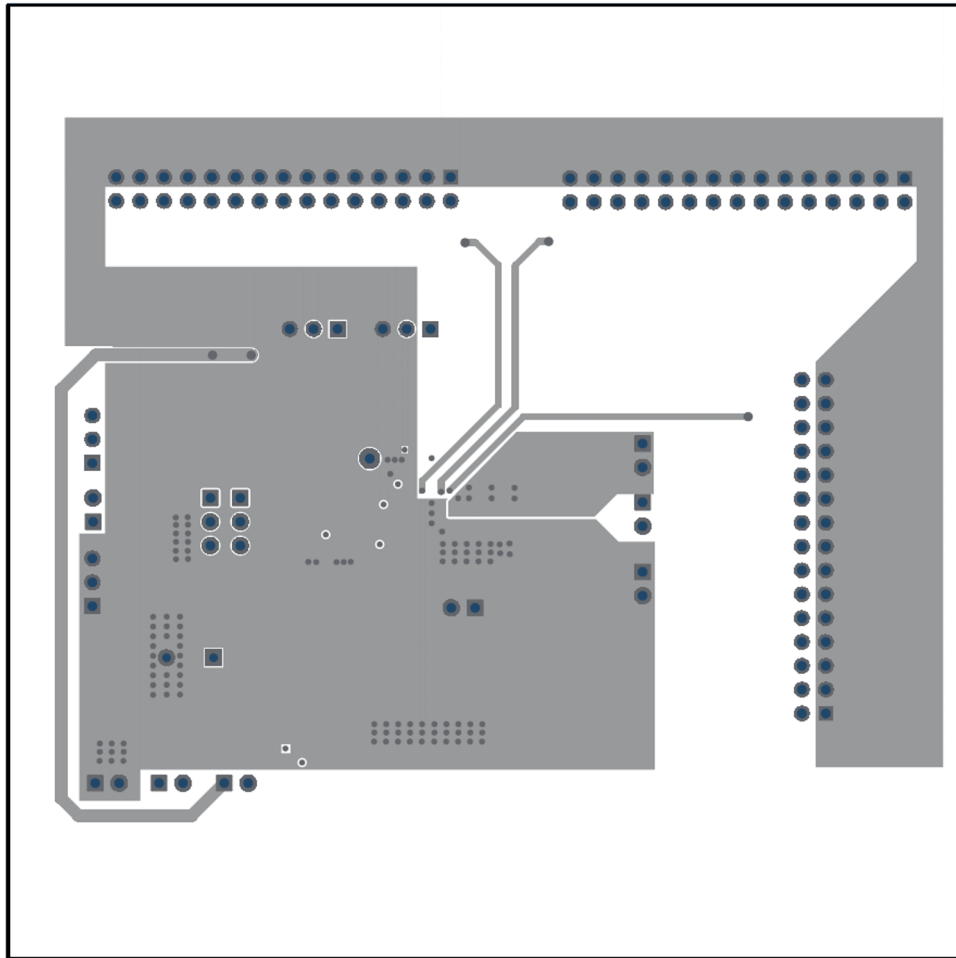


**Figure 3-3. TPS61094EVM-066 Inner Layer1 Layout**





**Figure 3-4. TPS61094EVM-066 Inner Layer2 Layout**



**Figure 3-5. TPS61094EVM-066 Bottom Side Layout**

## STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
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  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
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  - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

**Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.**

**User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

**EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.**

### 3 Regulatory Notices:

#### 3.1 United States

##### 3.1.1 Notice applicable to EVMs not FCC-Approved:

**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

##### 3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

#### **CAUTION**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### **FCC Interference Statement for Class A EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

#### **FCC Interference Statement for Class B EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- 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.

#### 3.2 Canada

##### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

#### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### **Concernant les EVMs avec appareils radio:**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### **Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

### Concernant les EVMs avec antennes détachables

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.

#### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)  
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#### 3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

- 
4. *EVM Use Restrictions and Warnings:*
    - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
    - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
    - 4.3 *Safety-Related Warnings and Restrictions:*
      - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
      - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
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