

TPS62113EVM-465

This user's guide describes the characteristics, operation, and use of the TPS62113EVM-465 WLED Drive and Voltage Regulator evaluation module (EVM). The EVM features two independent circuits – one demonstrates the device as a typical voltage regulator, and a second demonstrates the circuit as a current regulator driving a white LED (WLED). This user's guide includes setup instructions for the hardware, a schematic diagram, a bill of materials, and printed-circuit board layout drawings for the evaluation module. The TPS62113 device features an adjustable undervoltage shutdown feature using the LBI input. See the data sheet for additional information.

Contents

1	Introduction	2
2	Setup	3
3	Design Procedure Divider Network.....	4
4	Test Results	5
5	Printed-Circuit Board Layout	7
6	Schematic and Bill of Materials.....	10
7	Related Documentation From Texas Instruments	12

List of Figures

1	WLED Section Efficiency at I _{out} of 500 mA.....	5
2	Voltage Regulator Section Efficiency Versus V _{in} at I _{out} of 1 A	5
3	Voltage Regulator Section Efficiency Versus I _{out} for V _{in} 6 V and 12 V	6
4	Assembly Layer	7
5	Top Layer Routing	8
6	Bottom Layer Routing	9
7	TPS62113EVM-465 Schematic, WLED Section	10
8	TPS62113EVM-465 Schematic, Voltage Regulator Section	11

List of Tables

1	Performance Specification Summary	2
2	TPS62113EVM-465 Bill of Materials.....	12

1 Introduction

The Texas Instruments TPS62113 is a synchronous, step-down converter. With a high-switching, operating frequency of 1 MHz, external components are small; the typical inductor size is 6.8 μ H, and the overall solutions area is 20 mm $\times$ 15 mm. The power switch current limit of 2.4 A provides a typical output current of 1.5 A across a wide input voltage range of 5 V to 17 V.

1.1 Background

The TPS62113EVM-465 uses the TPS62113 in two independent circuits. The U1 circuit is configured as a current regulator driving a WLED at 500 mA. The U2 circuit is the traditional voltage regulator circuit set to a 3.3-V output. To demonstrate the Enhanced LBI (low-battery input) feature of the TPS62113, the shutdown point for WLED (U1) has been set to 6 V; for 3.3 V (U2), the shutdown point has been set to 10.5 V. But the converters can operate at input voltages down to 5 V with the LBI correctly configured for a lower input voltage. As part of the Enhanced LBI function, an additional resistor has been added between the LBI input and the LBO output, R20 for U1 and R19 for U2. This resistor provides additional hysteresis for the LBI comparator; see the data sheet ([SLVS585](#)) for additional information.

1.2 Performance Specification

[Table 1](#) provides a summary of the TPS62113EVM-465 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
U1 Input Voltage		5		17	V
U1 WLED Current		450	500	550	mA
U1 LBI/Low-Battery Shutdown			6		V
U2 Input Voltage		5		17	V
U2 Output Voltage	I _{out} = 10 mA to 1500 mA	3.267	3.3	3.333	V
U2 Output Current		0		1500	mA
U2 LBI/Low-Battery Shutdown			10.5		V
U2 Power Good (PG)	V _{OUT}		3.25		V

1.3 WLED U1 Section

The upper EVM section with integrated circuit (IC) U1 is configured as a WLED driver. The TPS62113 regulates the current through the OSRAM Golden DRAGON™ WLED at 500 mA from an input voltage range of 5 V to 17 V. To reduce power dissipation on the current sense resistor, an external voltage reference is used to sum a higher voltage into the FB node reducing sense voltage, V_{sense} , from 1.153 mV to 255 mV.

The LBI circuit is configured to shut the WLED section down at a 6-V input voltage. This is adjustable using resistors R5 and R6; see the data sheet for additional information.

This summing network combined with the control topology reduces the current regulator's accuracy. This can be seen following a load transient as a change in the current regulation point. The EVM with a V_{sense} voltage of 255 mV varies approximately 10%. As V_{sense} voltage increases, the accuracy improves, and 500 mV is approximately 5% and 1 V is approximately 2%.

The TPS62113 can supply a wide range of current from 100 mA to 1500 mA by adjusting the sense resistor, R10, or the reference voltage network, R1 and R2.

The equations for calculating WLED current appear in [Section 3](#).

1.3.1 Additional WLED Section Options

External control of the WLED section is possible using the EZ430-RF2500 EVM. This module plugs into connector J6. See the TPS62113 product folder on the TI Web site for additional information on this option.

Optional LED Lens: To focus the LED in a tighter beam, lens are available that mount on the board, such as the Titanium-SS from Ledil or OPGD-1-002 from Dialight.

1.3.2 Modifications to 3.3-V Regulator Section, U2

The U2 is configured for evaluation of the adjustable output version. This unit is set to 3.3 V by R17 and R4. Resistors R17 and R4 can be changed to reset the output voltage between 1.2 V and 16 V; see the TPS62113 data sheet ([SLVS585](#)) for recommended values. If the output voltage is increased, verify that the output capacitors C7 and C6 voltage rating is appropriate. Also, two extra output capacitor positions are available if needed, C12 and C13.

U2 can be replaced with the fixed output version, TPS62111 or TPS62112. For this configuration, replace R17 with a 0-Ω resistor, and remove R4 and C9.

The LBI circuit is configured to shut the 3.3-V section down at a 10.5-V input voltage. This is adjustable using resistors R14 and R13; see the data sheet for additional information.

2 Setup

This section describes how to properly use the TPS62113EVM-465.

2.1 Input/Output Connector Descriptions

U1 – WLED Section:

J1 – LED VIN and LED GND	WLED input voltage source connection.
J2 – LED+ and LED–	WLED output voltage connection
JP1 – LED – RTN	WLED header for monitoring LED current or disconnecting onboard LED

U2 – 3.3-V Regulator Section:

J3 – VIN and GND	3.3-V regulator input voltage source connection. Positive connects to bottom three Vin pins, and negative connects to upper three GND pins.
J4 – VOUT and GND	3.3-V regulator output voltage connection. Positive connects to bottom three VOUT pins, and negative connects to upper three GND pins.
JP3 – SYNC PFM/PWM	3.3-V regulator high forces low-noise PWM mode, low enables power save PFM/PWM mode. Also input for synchronization, if used.
JP2 – EN	3.3-V regulator Enable pin, low = off and high = on. Also open = on.
J5 – LBO/PG	Low-battery output (LBO) pulled up to Vout; low indicates LBI is below its threshold. Power good (PG), low indicates output voltage is less than 98.4% of the normal value.

2.2 Configuration Selection

The WLED (U1) section of the EVM is configured to operate with an input voltage from 6 V to 17 V. EN is hard wired to the ON position; it begins operating when power is applied. SYNC input is hard wired to the nonpower save mode. Because the WLED is very bright, appropriate precautions must be taken.

The 3.3-V (U2) section of the EVM is configured to operate with an input voltage from 10.5 V to 17 V. EN jumper JP2 must be installed in the desired ON or OFF position. The unit operates with the SYNC jumper PWM or PWM/PFM position; this impacts efficiency. See the data sheet for additional information

3 Design Procedure Divider Network

The TPS62113 feedback voltage (FB) is set to 1.153 V. If this is used for current regulation, the power dissipation of the sense resistor is high. To reduce the power dissipation on the current sense resistor R_{10} , a reference voltage of 3.3 V is summed resulting in the reduction of the V_{sense} voltage from 1.153 V to 0.255 V.

The first step is to choose the LED operating current and V_{sense} voltage which will determine the value for R_{10} . A tradeoff occurs, however, between the power dissipation on R_{10} and the accuracy of the regulation point. As V_{sense} is increased, the current regulation accuracy improves; the maximum voltage is 1.153 V. As V_{sense} is decreased, the power dissipation is reduced, but error due to V_{ref} , resistors R_1 and R_2 increases.

The EVM I_{LED} is set to 500 mA with a V_{sense} voltage of 0.225 V.

$$V_{\text{sense}} = I_{\text{LED}} \times R_{10} = 500 \text{ mA} \times 510 \text{ m}\Omega = 0.255 \text{ V}$$

$$V_{R1} = V_{\text{FB}} - V_{\text{sense}} = 1.153 \text{ V} - 0.255 \text{ V} = 0.898 \text{ V}$$

$$V_{R2} = V_{\text{REF}} - V_{\text{FB}} = 3.3 \text{ V} - 1.153 \text{ V} = 2.147 \text{ V}$$

Choose divider current of 0.1 mA:

$$R_1 = \frac{V_{R1}}{0.1 \text{ mA}} = \frac{0.898 \text{ V}}{0.1 \text{ mA}} = 898 \Omega$$

Standard value 8.87 k Ω :

$$R_2 = \frac{V_{R2}}{0.1 \text{ mA}} = \frac{2.147 \text{ V}}{0.1 \text{ mA}} = 21.47 \Omega$$

Standard value 21.5 k Ω .

4 Test Results

Test results using the TPS62113EVM-465 evaluation module are presented in [Figure 1](#), [Figure 2](#), and [Figure 3](#).

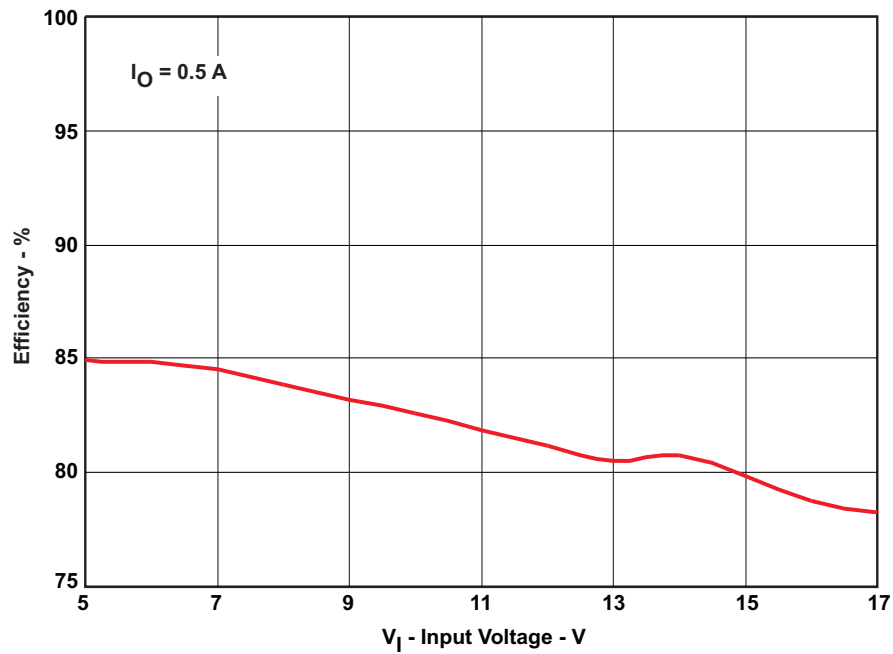


Figure 1. WLED Section Efficiency at Iout of 500 mA

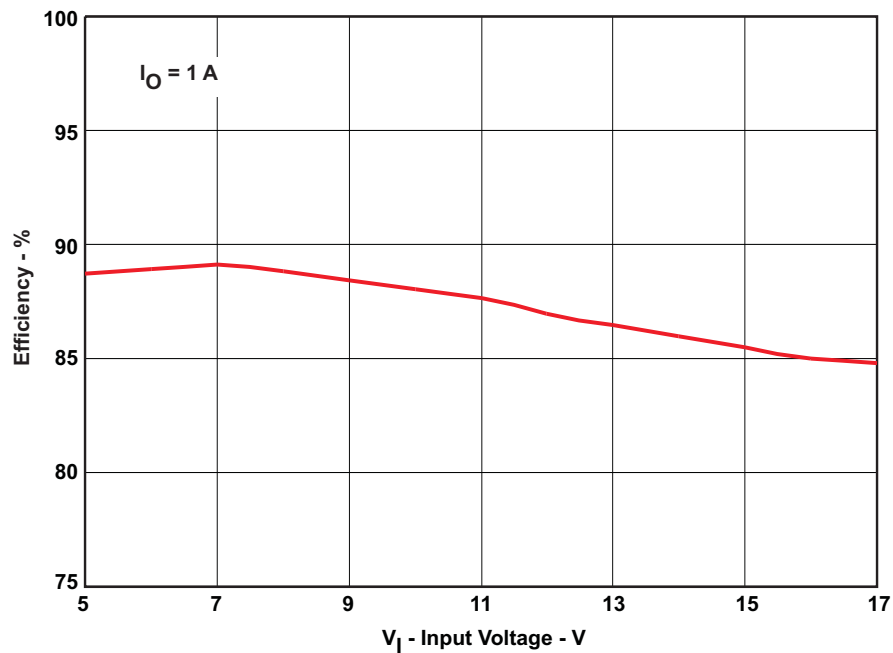


Figure 2. Voltage Regulator Section Efficiency Versus V_{in} at Iout of 1 A

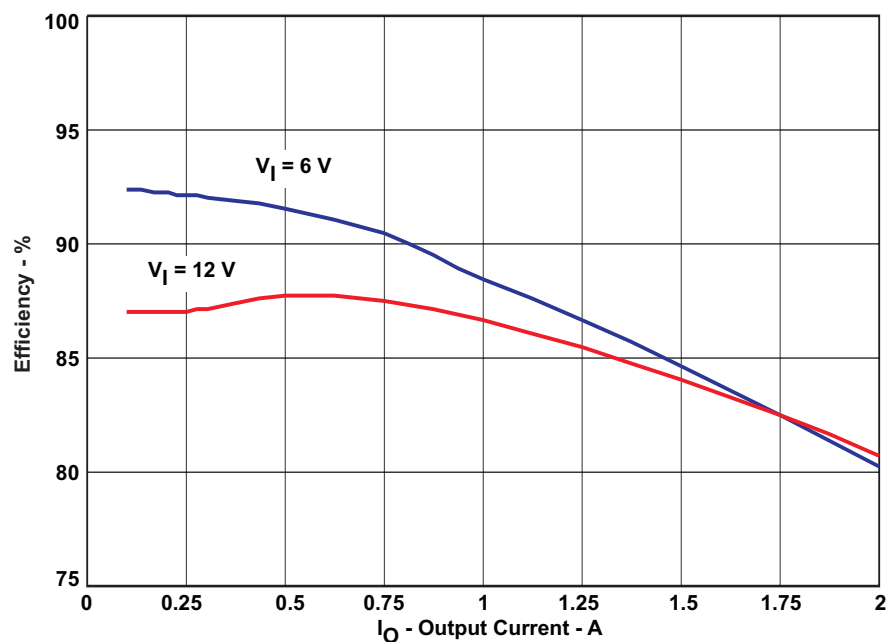


Figure 3. Voltage Regulator Section Efficiency Versus I_{out} for V_{in} 6 V and 12 V

5 Printed-Circuit Board Layout

This section provides the TPS62113EVM-465 printed-circuit board layout and illustrations (Figure 4, Figure 5, and Figure 6).

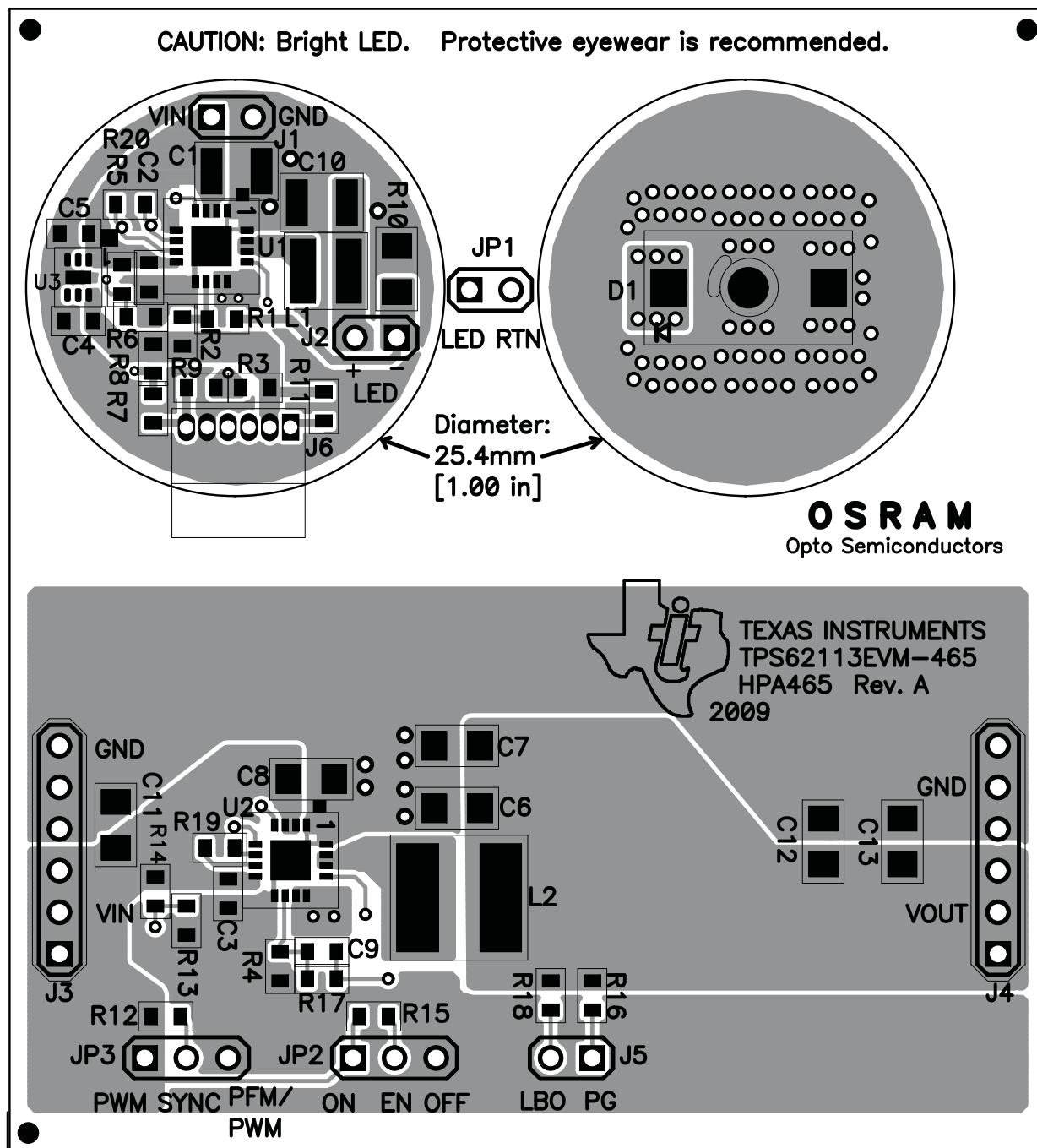


Figure 4. Assembly Layer

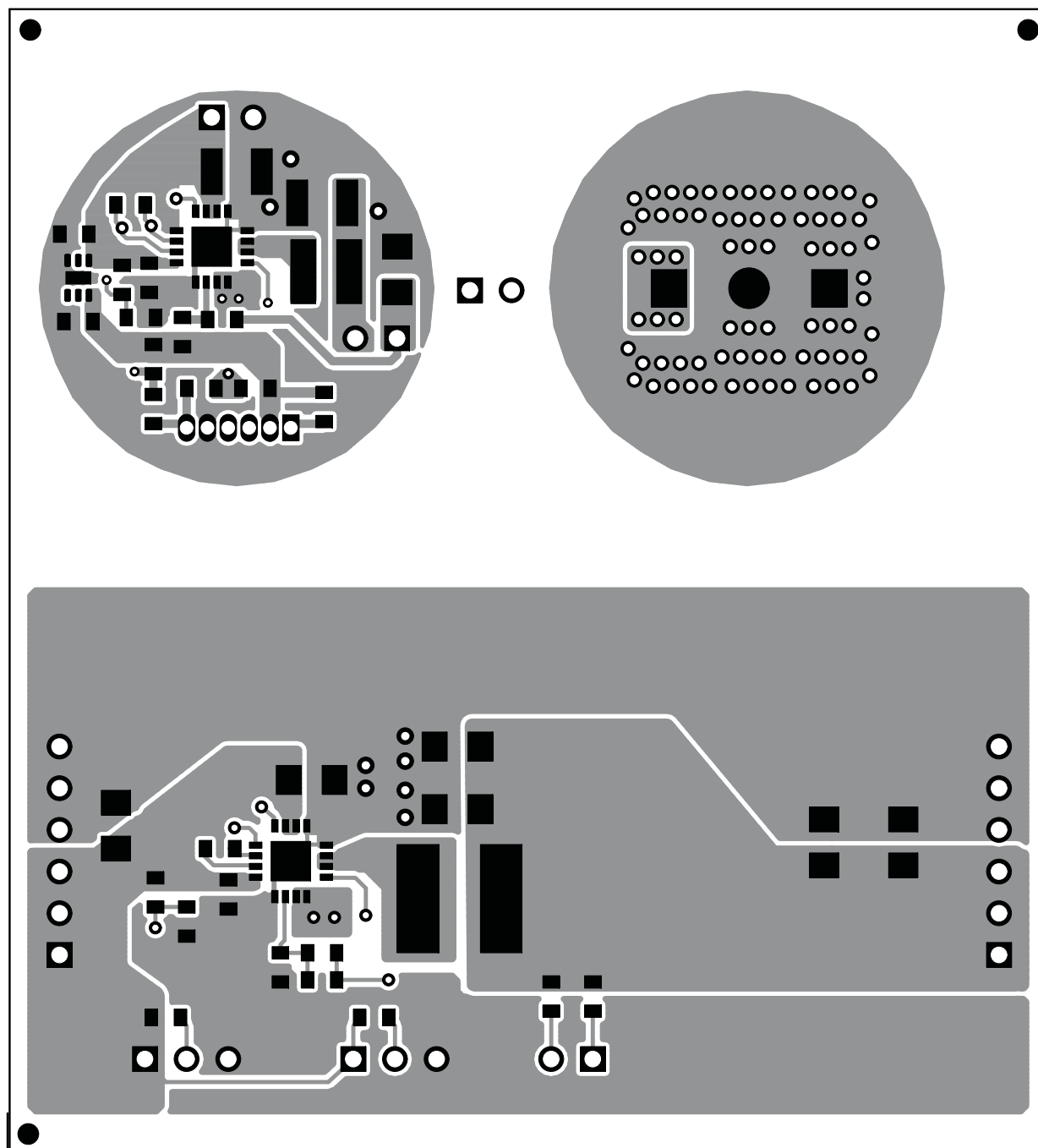


Figure 5. Top Layer Routing

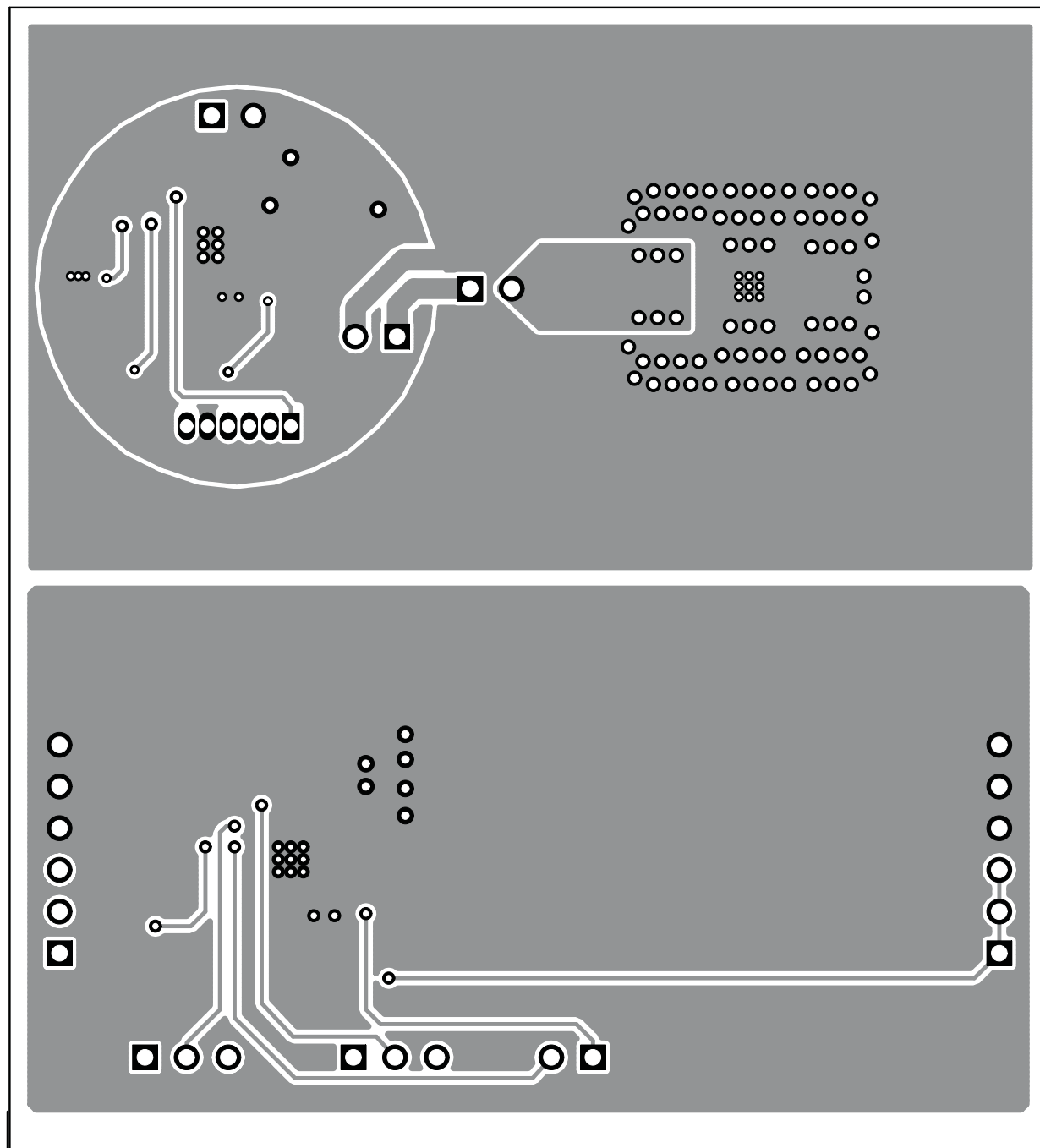


Figure 6. Bottom Layer Routing

6 Schematic and Bill of Materials

This section provides the TPS62113EVM-465 schematic and bill of materials.

6.1 Schematic

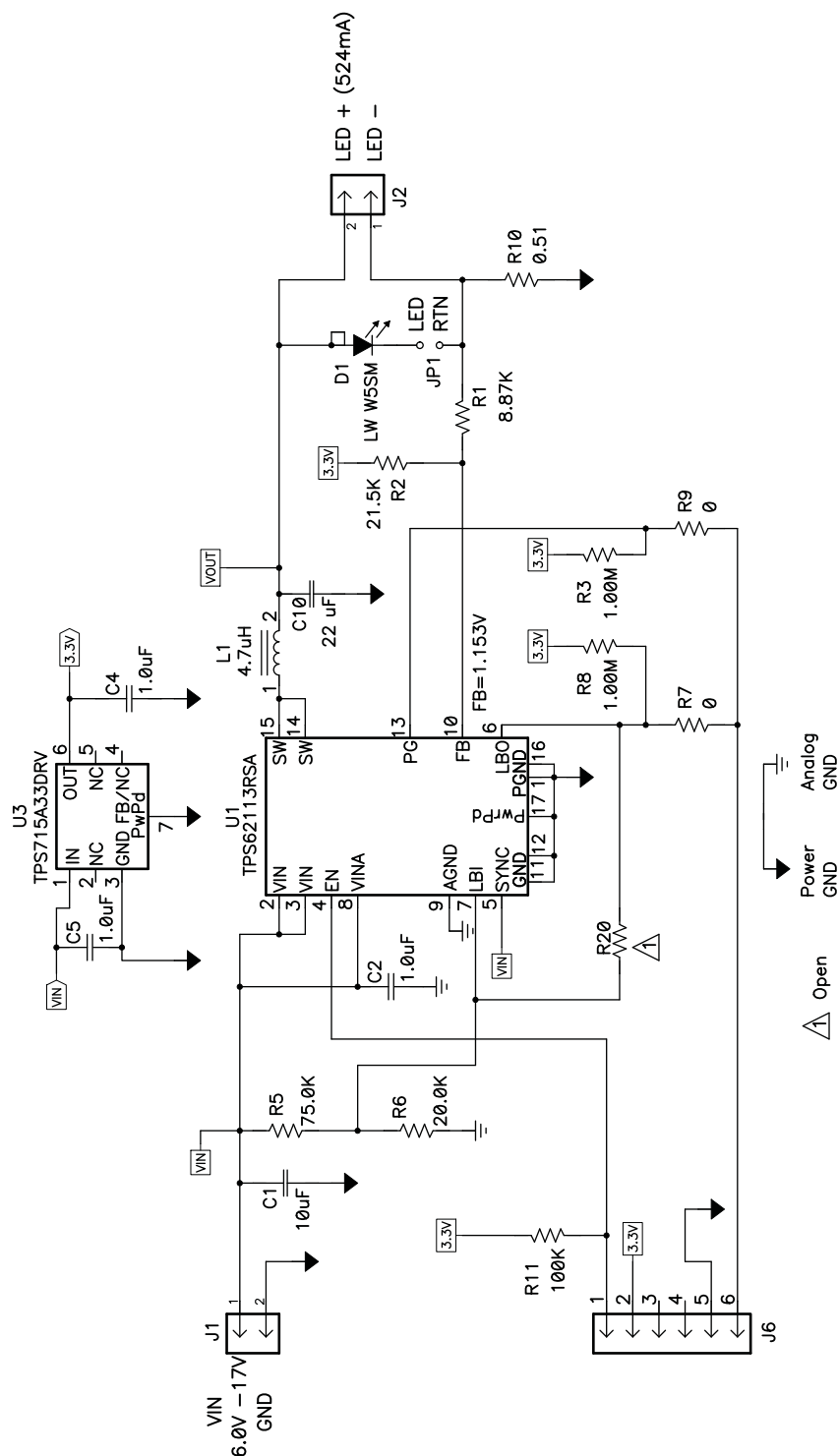


Figure 7. TPS62113EVM-465 Schematic, WLED Section

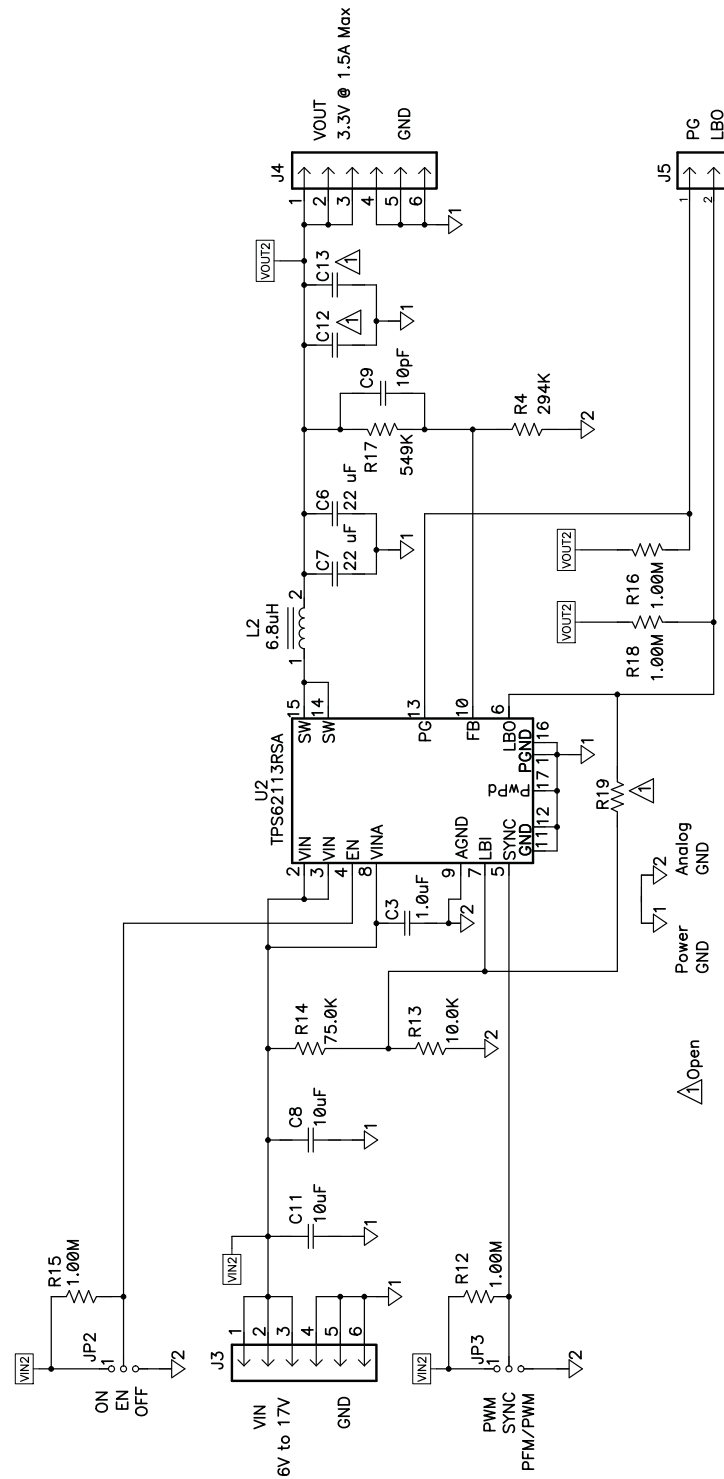


Figure 8. TPS62113EVM-465 Schematic, Voltage Regulator Section

6.2 Bill of Materials

Table 2. TPS62113EVM-465 Bill of Materials

Count	Ref Des	Value	Description	Size	Part Number	Manufacturer
1	C1	10 F	Capacitor, Ceramic, 25V, X5R, 20%	1210	Std	Std
1	C10	22 μ F	Capacitor, Ceramic, 10V, X5R, 20%	1210	Std	Std
0	C12, C13	Open	Capacitor, Ceramic, 10V, X5R, 20%	1206	Std	Std
4	C2–C5	1 F	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
2	C6, C7	22 μ F	Capacitor, Ceramic, 10V, X5R, 20%	1206	Std	Std
2	C8, C11	10 F	Capacitor, Ceramic, 25V, X5R, 20%	1206	Std	Std
1	C9	10 pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	Std	Std
1	D1	LUW W5AM-KXKZ-Z LUW W5AM-KXKZ-5FG-Z	Diode, LED White, 500-mA, 17000-mcd	0.244 $\times$ 0.441 inch	LUW W5AM-KXKZ-4C8E-Z LUW W5AM-KXKZ-5FG-Z	Osram
1	L1	4.7 H	Inductor, SMT, 1.9A, 135 m Ω	0.157 $\times$ 0.157 inch	XPL4020-472ML	Coilcraft
1	L2	6.8 μ H	Inductor, SMT, 4.4A, 99 m Ω	0.276 $\times$ 0.276 inch	HA3808-AL	Coilcraft
1	R1	8.87K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
1	R10	0.51	Resistor, Chip, 1/2W, 1%	1206	CRCW1206R510FKEA	Vishay
1	R11	100K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
1	R13	10.0K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
1	R17	549K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
2	R17, R20	Open	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R2	21.5K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
6	R3, R8, R12, R15, R16, R18	1.00M	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
1	R4	294K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
2	R5, R14	75.0K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
1	R6	20.0K	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
2	R7, R9	0	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
2	U1, U2	TPS62113RSA	IC, Synchronous Step-Down Converter, 17V, 1.5A	QFN-16	TPS62113RSA	TI
1	U3	TPS715A33DRV	IC, High Input Voltage, Micropower, 3.2 A @ 80 mA LDO, 3.3V	QFN-6	TPS715A33DRV	TI

7 Related Documentation From Texas Instruments

1. *TPS62113, 17-V, 1.5-A, Synchronous Step-Down Converter* data sheet ([SLVS585](#))

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3.6 V to 17 V and the output voltage range of 3 V to 16 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 50°C. The EVM is designed to operate properly with certain components above 50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А