TPS62230EVM-370 User's Guide

This user's guide describes the characteristics, operation, and use of the TPS62230EVM-370 evaluation module (EVM). This EVM demonstrates three individual configurations of the Texas Instruments TPS62230 3-MHz, synchronous step-down converter capable of supplying up to 500 mA of output current. This user's guide includes setup instructions, a schematic diagram, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

Contents

1 Introduction 2
2 Setup 2
3 Board Layout 4
4 Schematic and Bill of Materials 6
5 Related Documentation From Texas Instruments 10

List of Figures

1 Assembly Layer 4
2 Top Layer Routing 5
3 Bottom Layer Routing 6
4 TPS62230EVM-370 Schematic, U11 Section 7
5 TPS62230EVM-370 Schematic, U21 Section 8
6 TPS62230EVM-370 Schematic, U31 Section 9

List of Tables

1 Device and Output Voltage Configurations 2
2 Input and Output Connections 3
3 TPS62230EVM-370 Bill of Materials 10

1 Introduction

The Texas Instruments TPS62230EVM-370 evaluation module helps designers evaluate the operation and performance of the TPS62230 family of devices. These devices are high-efficiency, ultra-small size, buck converters that switch at 3 MHz.

The EVM contains three independent dc/dc converters. Table 1 lists the default output voltages of the converters.

Table 1. Device and Output Voltage Configurations

Converter	Integrated Circuit	Output Voltage
U11	TPS62230DRY	2.5 V
U21	TPS62231DRY	1.8 V
U31	TPS62232DRY	1.2 V

See the data sheet (SLVS941) for the various fixed output voltage options available in the TPS62230 device family.

2 Setup

This section describes the jumpers and connectors on the EVM and how to properly connect, set up, and use the TPS62230EVM-370.

2.1 Input/Output Connector Descriptions

2.1.1 J11 , J21, and J31 – VIN

This is the positive input connection to the corresponding converter. Twist the leads to the input supply, and keep as short as possible to minimize EMI transmission.

2.1.2 J13 , J23, and J33 – GND

This is the return connection for the input power supply for the corresponding converter.

2.1.3 J12, J22, and J32 – Input Sense

This connection provides monitoring for input voltage using independent traces to the input capacitor.

2.1.4 J14, J24, and J34 – VOUT

This is the positive connection from the output of the corresponding buck power supply.

2.1.5 J16 , J26, and J36 – GND

This is the negative connection from the output of the corresponding buck power supply.

2.1.6 J15, J25, and J35 – Output Sense

This connection provides monitoring for output voltage using independent traces to the output capacitor.

2.1.7 JP11, JP21, JP31 – ENABLE

This jumper enables or disables the converter through the IC EN pin. Connect the shorting jumper from the center (EN) pin to either the ON or OFF position. Never leave EN floating.

2.1.8 JP12, JP22, and JP32 – Mode

This jumper is used to select the operating mode of the converter. The converter operates in a fixed-frequency, low-noise, PWM mode when a jumper is used to short the MODE pin to the ON pin. Shorting the MODE pin and OFF pin together allows the controller to use the power-saving (PFM) mode for high efficiency at low output currents.

2.2 Converter Configurations

All converters are designed to use an input voltage between 2.05 V and 6 V. But the input voltage must be higher than the output voltage in order to maintain voltage regulation, and U11 requires 2.5-V minimum input. Connect the input voltage power supply and output according to Table 2.

Table 2. Input and Output Connections

Converter No.	Output Voltage	Signal	Connection
U11	2.5 Vdc Fixed	Positive Input Voltage	J11
		Input Voltage Return	J13
		Positive Output Voltage	J14
		Output Voltage Return	J16
U21	1.8 Vdc Fixed	Positive Input Voltage	J21
		Input Voltage Return	J23
		Positive Output Voltage	J24
		Output Voltage Return	J26
U31	1.2 Vdc Fixed	Positive Input Voltage	J31
		Input Voltage Return	J33
		Positive Output Voltage	J34
		Output Voltage Return	J36

2.3 Operation

The ENABLE jumper and the MODE jumper must be configured for proper operation of the converter.

For ENABLE, the converter enable uses a shorting block to set the JPX1 header to the desired configurations. Each converter has its own header: JP11 for U11, JP21 for U21, and JP31 for U31. The converters are shut down when the EN pin is pulled low; this is the ENABLE-to-OFF connection. The converters are in operate mode when the EN pin is pulled high; this is the ENABLE-to-ON connection. Do not leave the EN pin floating.

The MODE header, JPX2, controls the device power-save mode option. This mode changes the operation at light loads; it has no impact at mid-to-high loads . The device can operate in the low-noise, fixed-frequency PWM mode or high-efficiency, power-saving PFM mode at low power. Each converter has its own mode header: JP12 for U11, JP22 for U21, and JP32 for U31. The converters are in PWM mode when the MODE pin is pulled high; this is the MODE-to-ON connection. The converters operate in PFM mode when the MODE pin is pulled low; this is the MODE-to-OFF connection. Do not leave the MODE pin floating.

2.4 Test Results

See the Typical Characteristics section of the TPS62230 data sheet. This EVM uses the same inductors and similar capacitors as those used for characterization in the data sheet. Performance is consistent with that shown in the data sheet.

3 Board Layout

This section provides the TPS62230EVM-370 board layout and illustrations.

Board layout is critical for all high-frequency, switch-mode power supplies. Figure 1, Figure 2, and Figure 3 show the board layout for the TPS62230EVM-370 printed-circuit board. The nodes with high-switching frequencies and currents are kept as short as possible to minimize trace inductance. High-impedance inputs to the TPS62230, such as the Vout pin, have traces that are shielded by ground traces and planes. Careful attention has been given to the routing of high-frequency current loops, and a single-point grounding scheme is used. See the data sheet for specific layout guidelines. Input and output capacitors must be kept as close as possible to the device. A large bulk input capacitor (C13, C23, and C33) is provided to compensate for impedance in long input leads.

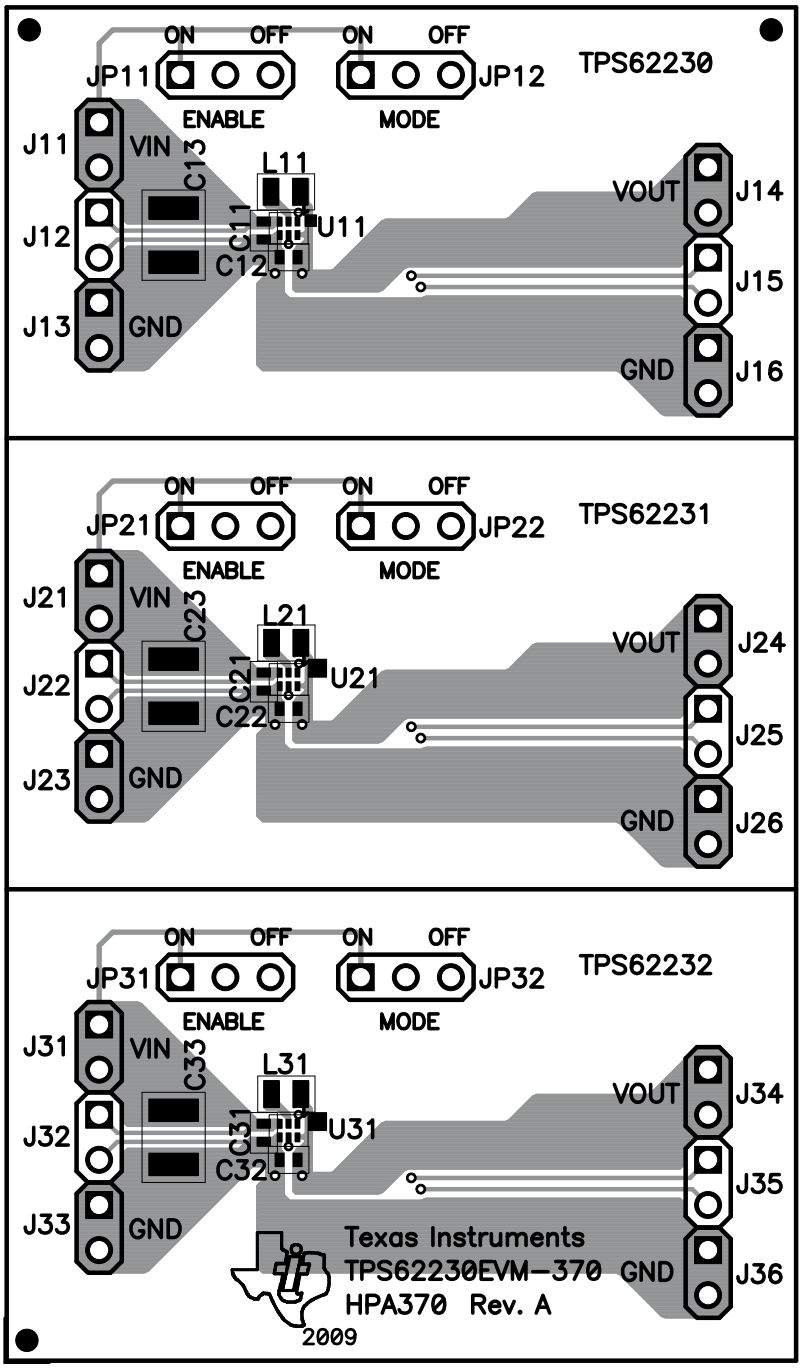

Figure 1. Assembly Layer

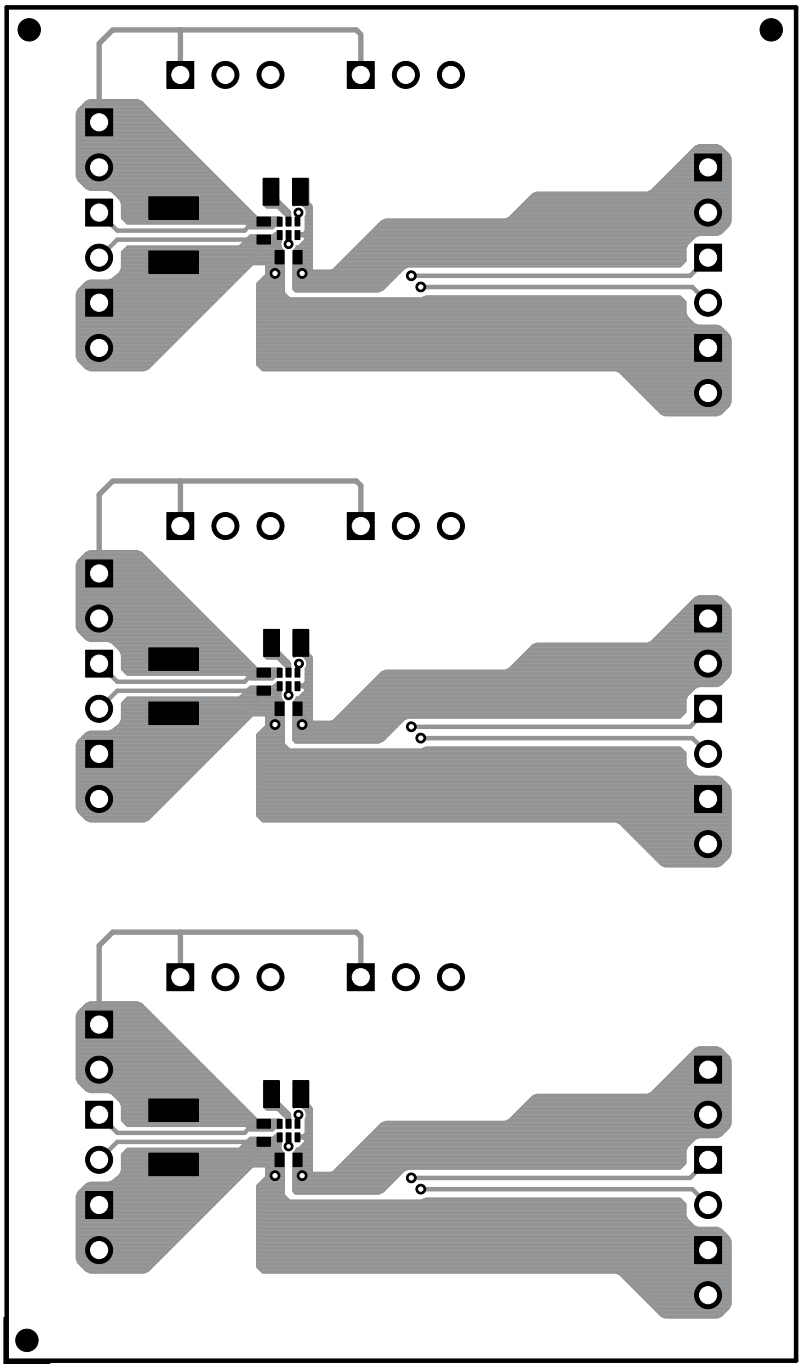

Figure 2. Top Layer Routing

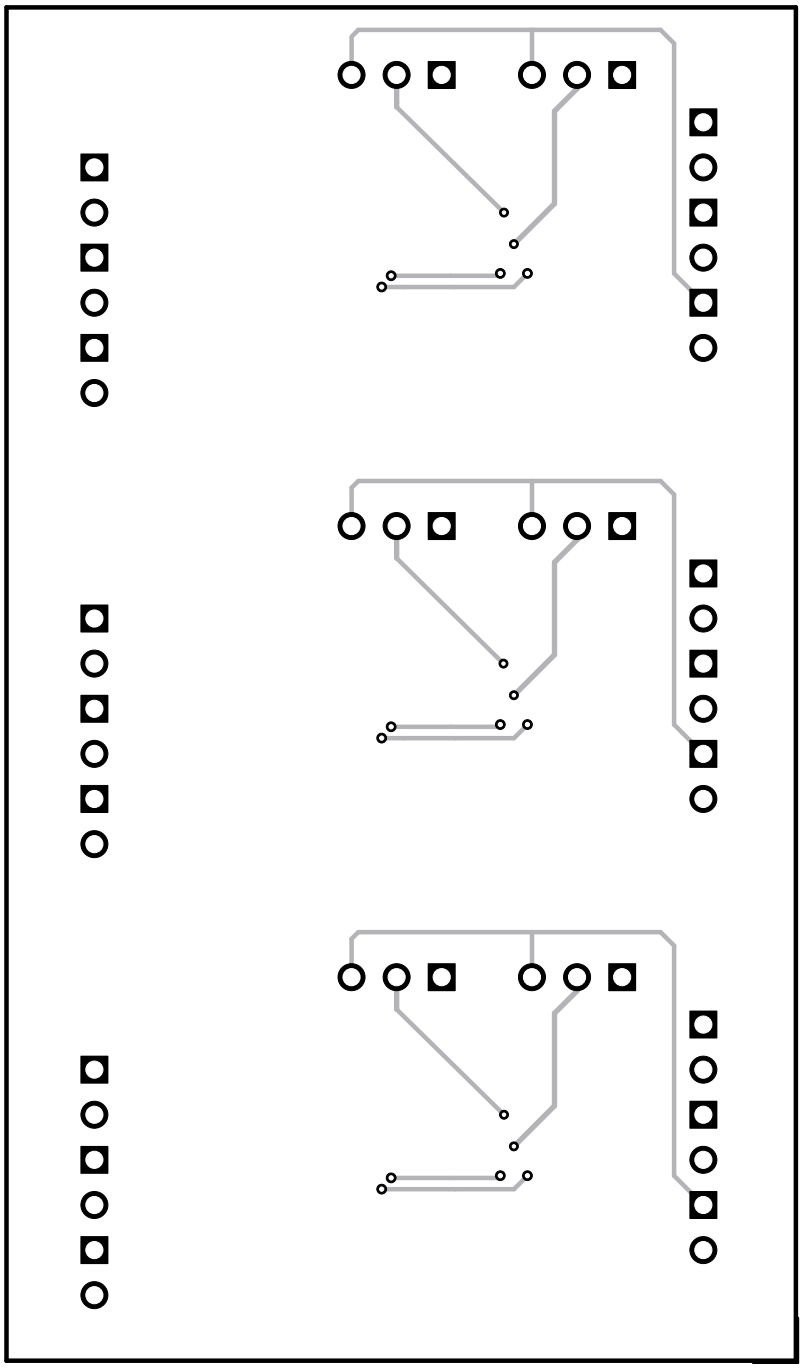

Figure 3. Bottom Layer Routing

4 Schematic and Bill of Materials

This section provides the TPS62230EVM-370 schematic and bill of materials.

4.1 Schematic

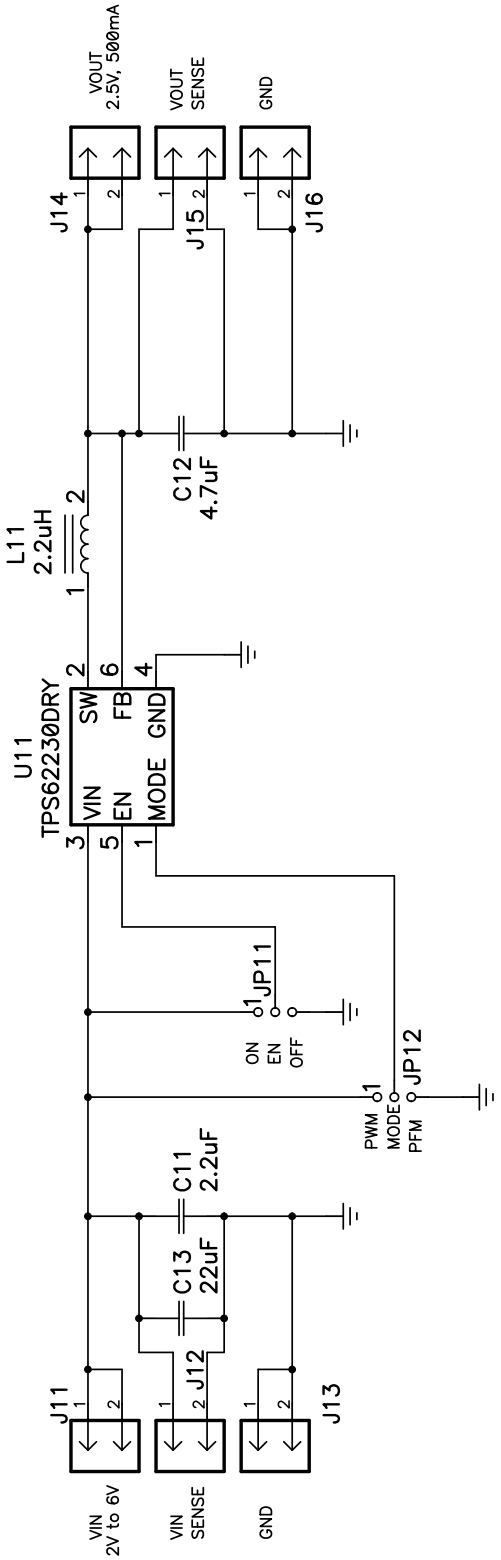

Figure 4. TPS62230EVM-370 Schematic, U11 Section

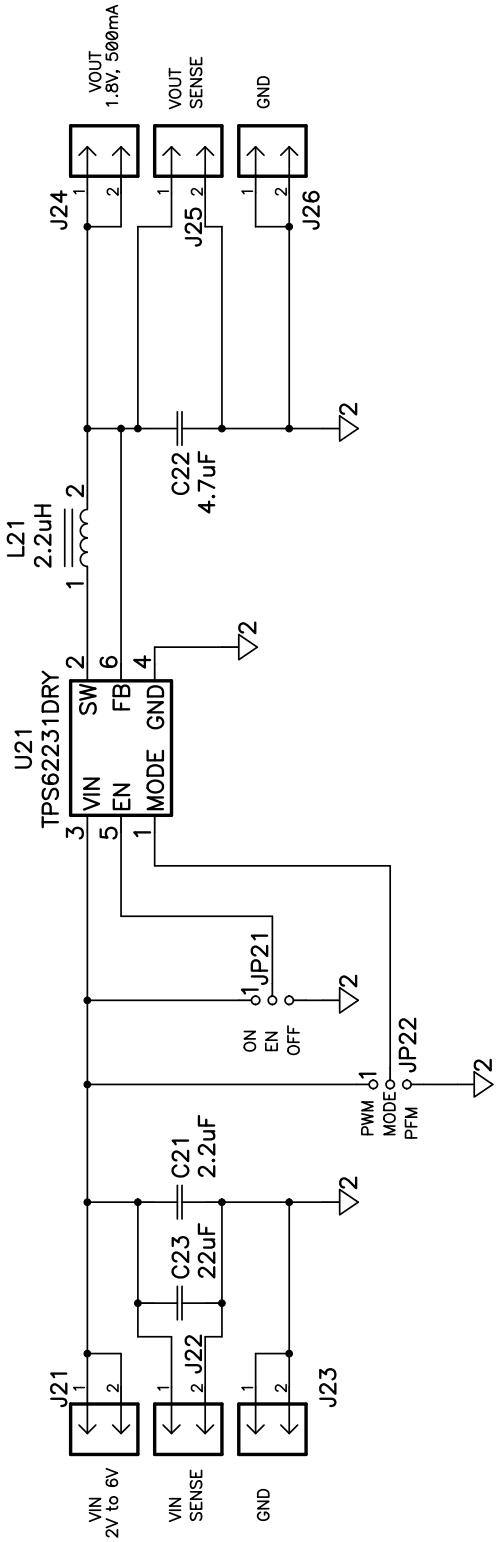

Figure 5. TPS62230EVM-370 Schematic, U21 Section

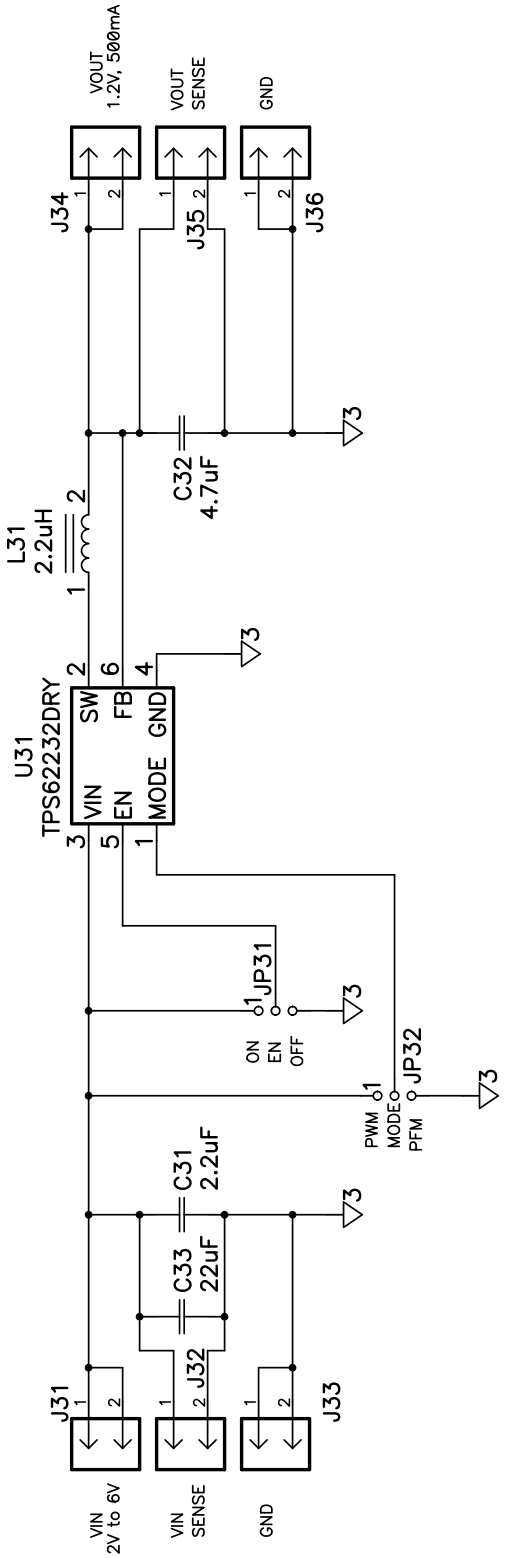

Figure 6. TPS62230EVM-370 Schematic, U31 Section

4.2 Bill of Materials

Table 3. TPS62230EVM-370 Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
3	C11,C21,C31	2.2µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	CL05A225MQ5NNNC	Samsung
3	C12,C22,C32	4.7µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	CL05A475MQ5NRNC	Samsung
3	C13, C23, C33	22µF	Capacitor, Ceramic, 10V, X5R, 20%	1210	Std	Vishay
18	J11, J12, J13, J14, J15, J16, J21, J22, J23, J24, J25, J26, J31, J32, J33, J34, J35, J36	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
6	JP11, JP12, JP21, JP22, JP31, JP32	PEC03SAAN	Header, 3 pin, 100mil spacing	0.100 x 3	PEC03AAN	Sullins
3	L11,L21,L31	2.2µH	Inductor, SMT, 0.7A, 230-milliohm	0805	MIPSZ20120D2R2	FDK
1	U11	TPS62230DRY	IC, 3MHz Ultra Small Step Down Converter, 2.5 V	QFN	TPS62230DRY	TI
1	U21	TPS62231DRY	IC, 3MHz Ultra Small Step Down Converter, 1.8 V	QFN	TPS62231DRY	TI
1	U31	TPS62232DRY	IC, 3MHz Ultra Small Step Down Converter, 1.2 V	QFN	TPS62232DRY	TI
6	--		Shunt, 100-mil, Black	0.100	929950-00	3M
1			PCB	1.75x3.0x0.062"	HPA370	Any

5 Related Documentation From Texas Instruments

TPS62230, TPS62231, TPS62232, 3 MHz Ultra Small Step Down Converter in 1x1.5 SON Package data sheet (SLVS941)

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 customer 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.

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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.05 V to 6 V and the output voltage range of 1.2 V to 2.5 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 25°C. The EVM is designed to operate properly with certain components above 25°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		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

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