

TPS2291xxEVM-656

This user's guide describes the characteristics, operation, and use of the TPS2291xxEVM-656 evaluation module (EVM). This EVM demonstrates the Texas Instruments TPS2291xx load switch with controlled turn on. The device contains a P-channel MOSFET that can operate over an input voltage of 1.4V to 5.5V. The switch is controlled by an on/off input (ON), which is capable of interfacing directly with low-voltage control signals. This user's guide includes setup instructions, schematic diagram, bill of materials, and printed-circuit board layout drawings for the EVM.

1 Introduction

The TPS2291xxEVM-656 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS2291xx load switches. The board features the small 4-pin CSP package for a small solution size.

Table 1. TPS22910, TPS22912, TPS22913 Vout Rise Time, Enable, and Discharge Options

EVM	Device	Rise Time (μS) Typ.	VIN(V)	Enable (ON Pin)	Quick Output Discharge
HPA656-001	TPS22910A	0.5	5	Active Low	No
HPA656-0011	TPS22912C	1000	5	Active High	No
HPA656-0014	TPS22913B	100	5	Active High	Yes
HPA656-0015	TPS22913C	1000	5	Active High	Yes

1.1 Related Documentation From Texas Instruments

TPS2291xx, ULTRA-SMALL, LOW r_{ON} LOAD SWITCH data sheet

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS2291xxEVM-656.

2.1 J1/J3 – Input Connections

This is the connection for the leads from the input source. Connect the positive connection to the VIN J1 and the negative connection to the GND J3.

2.2 J4/J6 – Output Connections

This is the connection for the output of the TPS2291xxEVM. Connect the positive connection of the load to the VOUT J4 and the negative connection to the GND J6.

2.3 JP3 – ON

This is the enable input for the device. A shorting jumper must be installed on JP3 in either the HI or LO positions. The TPS2291xx family contains products that are active high and active low (refer to [Table 1](#)). ON must not be left unconnected. An external enable source can be applied to the EVM by removing the shunt and connecting a signal to the center pin of JP3. Refer to the Datasheet for proper ON and OFF voltage level settings. A switching signal may also be used and connected at this point.

2.4 J2/J5 – V_{IN} Sense and V_{OUT} Sense

These two connectors are used when very accurate measurements of input or output voltage are required. Ron measurements should be made using these sense connections and measuring the voltage drop from VIN to VOUT and then calculating the resistance.

2.5 JP1/JP2 – Input Capacitors

During normal operation a shorting jumper is placed on JP2 and connects C2 capacitor from the input of the device to ground. JP1 and C1 may be used to connect a user selected capacitor value from the input of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the input capacitors.

2.6 JP4/JP5 – Output Capacitors

During normal operation a shorting jumper is placed on JP4 and connects C3 capacitor from the output of the device to ground. JP5 and C4 may be used to connect a user selected capacitor value from the output of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the output capacitors.

2.7 JP6/JP7/JP8 – Output Resistors

During normal operation no shorting jumpers are placed on JP6, JP7, or JP8. A shorting jumper may be used on JP6 to connect R1 load resistor from the output of the device to ground. JP7 and JP8 may be used to connect R2 and R3 user selected load resistors from the output of the device to ground. R1, R2, and R3 are intended for light loads of the output; observe the 1/8W power rating for these parts.

NOTE: R2 is populated on some EVM's with a 14Ω 1/8W resistor, the maximum power rating for this part can be easily exceeded, observe the power rating for R2 if it is populated and used on your EVM.

3 Operation

Connect the positive input of the power supply to the VIN J1 and the negative lead of the power supply to GND J3. The input voltage range of the TPS2291xx is 1.4 V to 5.5 V.

Output load can be applied by connecting between J4 VOUT and J6 GND. The TPS2291xx is rated for a maximum continuous current of 2A. Configure jumper JP3 as required. JP3 must be installed for proper operation. When the ON pin is asserted, the TPS2291xx will control the slew rate of VOUT. The slew rate of the device is internally controlled to avoid inrush current. When ON is deasserted, the TPS2291xx will open the P-Channel MOSFET. Devices equipped with the Quick Output Discharge (QOD) option will connect a 150Ω on-chip load resistor to the output for quick discharge. Devices equipped with the QOD function are noted in [Table 1](#).

4 Test Results

See the *Typical Characteristics* section of the TPS2291xx data sheet.

5 Board Layout, Schematic, and Bill of Materials

This section provides the TPS2291xxEVM-656 board layout, schematic, and bill of materials.

5.1 Board Layout

For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. Using wide traces for V_{IN} , V_{OUT} , and GND helps minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance [Figure 1](#), [Figure 2](#), and [Figure 3](#) show the board layout for the TPS2291xxEVM-656 PCB.

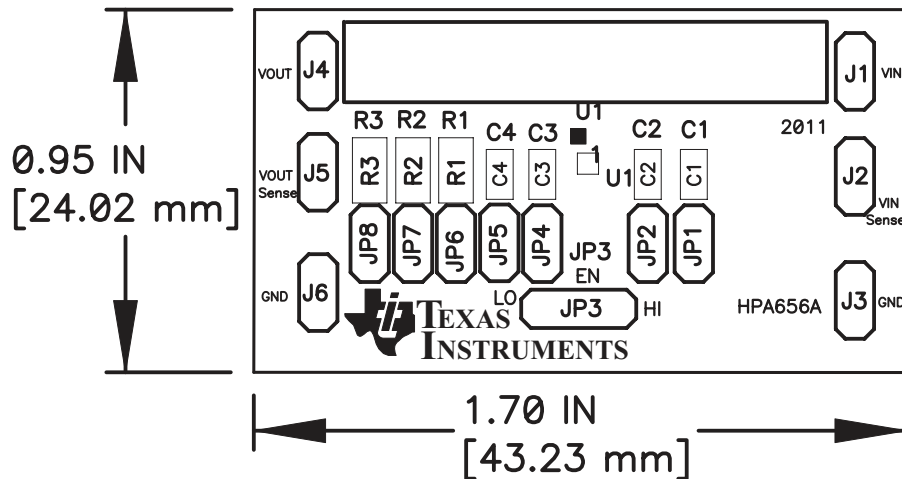


Figure 1. Top Assembly Layer

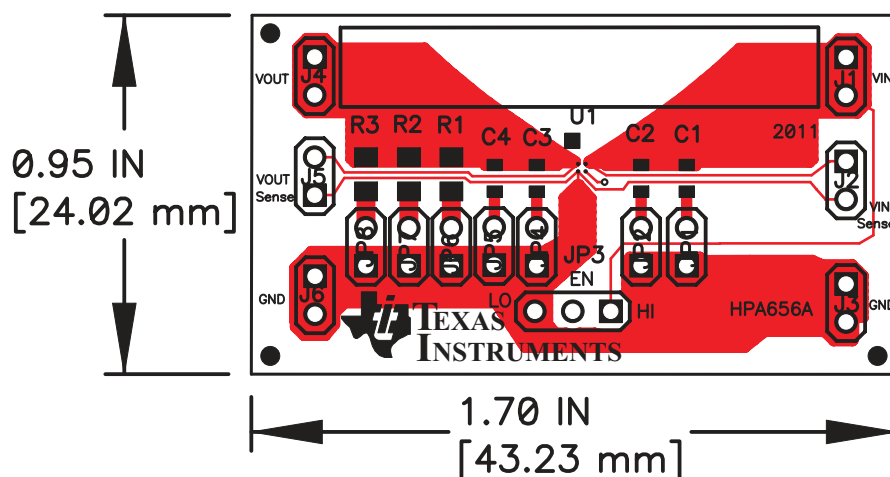


Figure 2. Top Layer

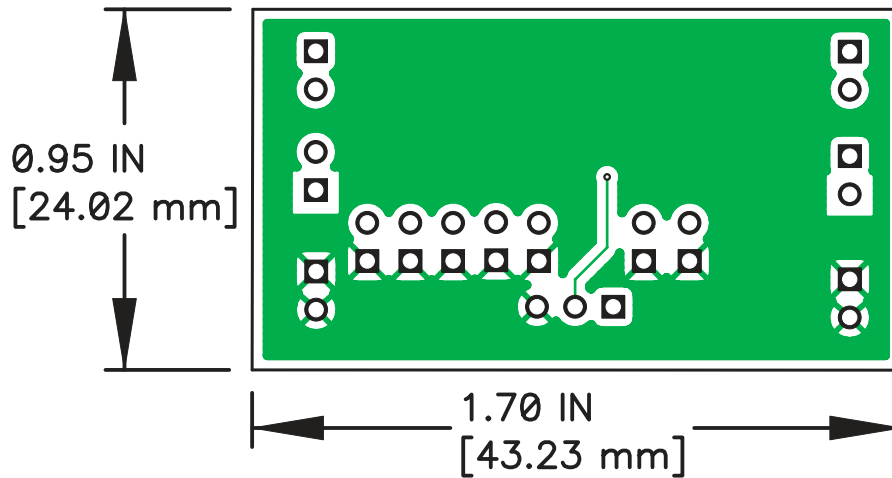


Figure 3. Bottom Layer

5.2 Schematic and Bill of Materials

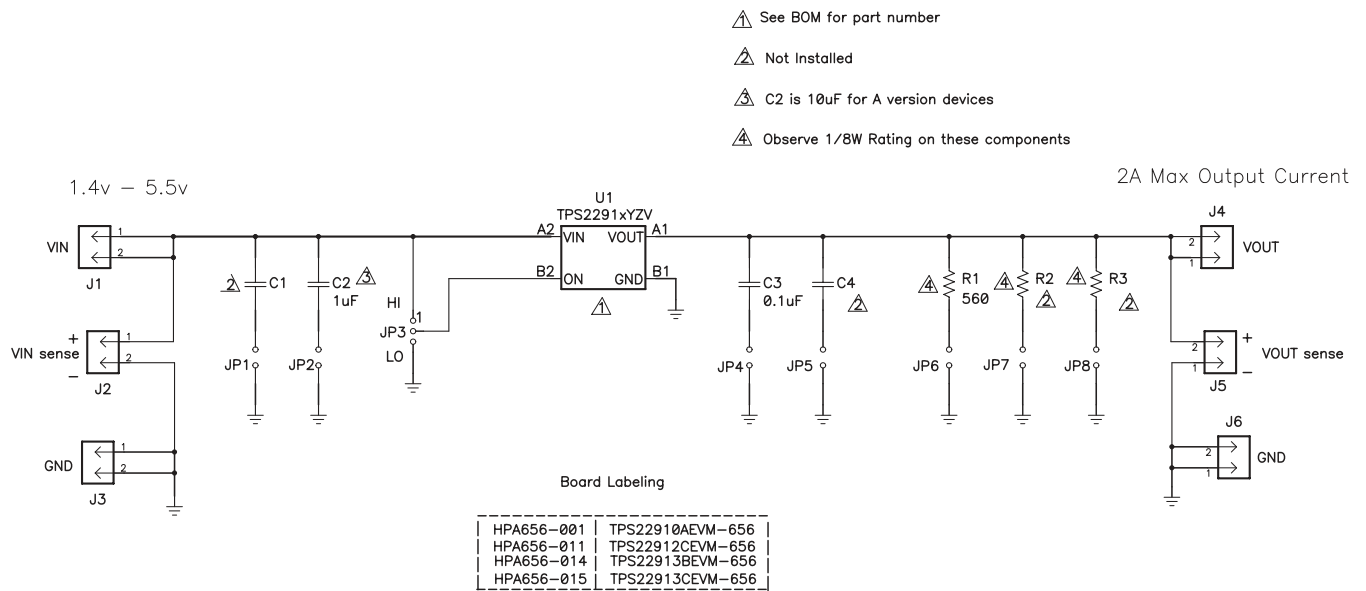


Figure 4. TPS2291xxEVM-656 Schematic

Table 2. Bill of Materials ⁽¹⁾ ⁽²⁾ ⁽³⁾ ⁽⁴⁾

Count	RefDes	Value	Description	Size	Part Number	MFR
1	–		PCB, 0.9 In x 1.7 In x 0.062 In		HPA656	Any
1	C3	0.1 μ F	Capacitor, Ceramic,16-V, X7R, 10%	603	Std	Std
1	C2	1 μ F, use 10 μ F for A type devices	Capacitor, Ceramic,6.3-V, X5R, 10%	603	Std	Std
0	C1, C4	OPEN	Capacitor, Ceramic	603	Std	Std
1	R1	560 Ω	Resistor, 5% 1/8W	805	Std	Std
1	R2	OPEN	Resistor, 5% 1/8W	805	Std	Std
0	R3	OPEN	Resistor, 5% 1/8W	805	Std	Std
13	J1 – J6, JP1–2, JP4–8	PEC02SAAN	Header,2pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	JP3	PEC03SAAN	Header,3pin, 100mil spacing IC,	0.100 inch x 3	PEC03SAAN	Sullins
1	U1	TPS2291xxYZP V	Single Chip, Low Input Voltage Current-Limited Load Switch with Shut Off Auto-Restart	YZV	TPS2291xxYZV	TI
3	N/A	N/A	Shunt, 100-mil, Black	0.100	929950-00	3M

- (1) These assemblies are ESD sensitive, ESD precautions shall be observed.
- (2) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
- (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
- (4) Ref designators marked with an asterisk (**) cannot be substituted. All other components can be substituted with equivalent components.

Table 3.

Assembly number	Text
HPA656-001	TPS22910AEVM-656
HPA656-011	TPS22912CEVM-656
HPA656-014	TPS22913BEVM-656
HPA656-015	TPS22913CEVM-656

5.3 VOUT Rise Time Examples

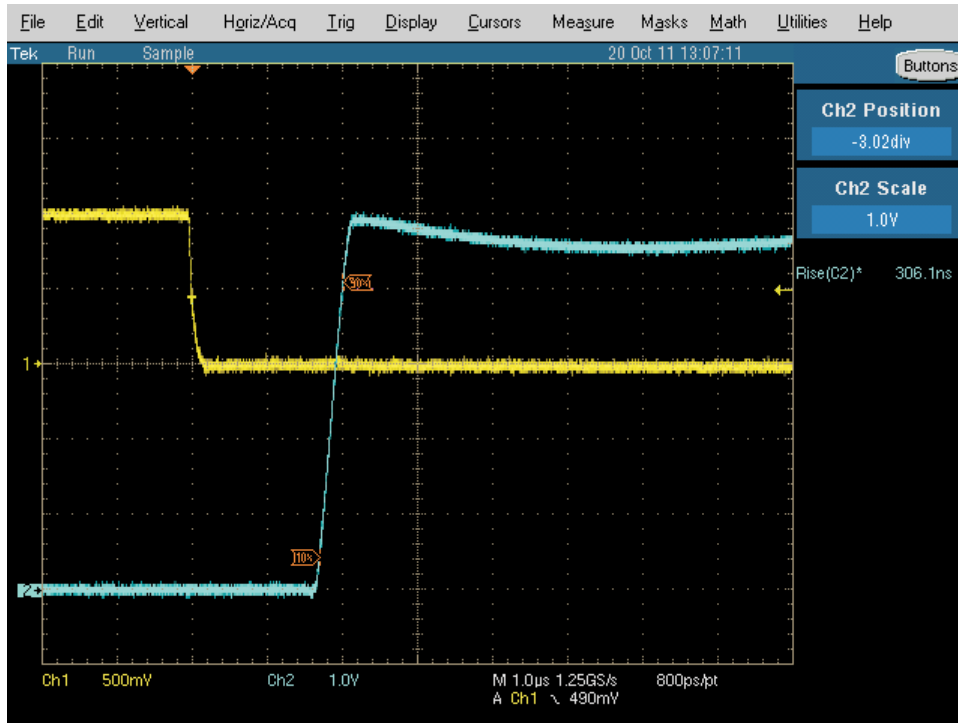


Figure 5. TPS22910A Trise Example

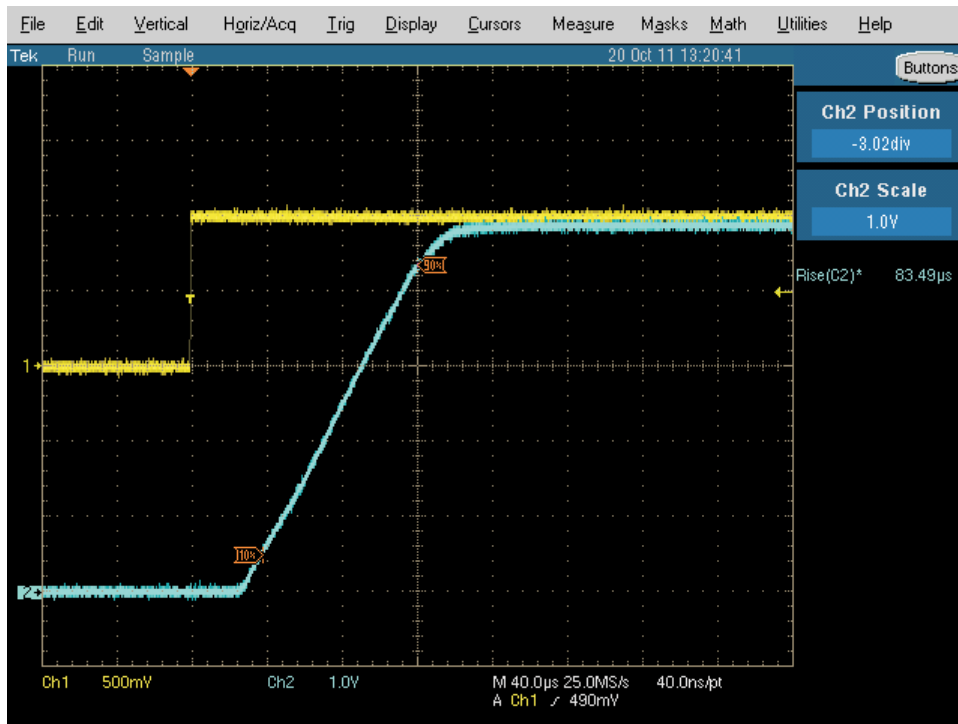


Figure 6. TPS22913B Trise Example

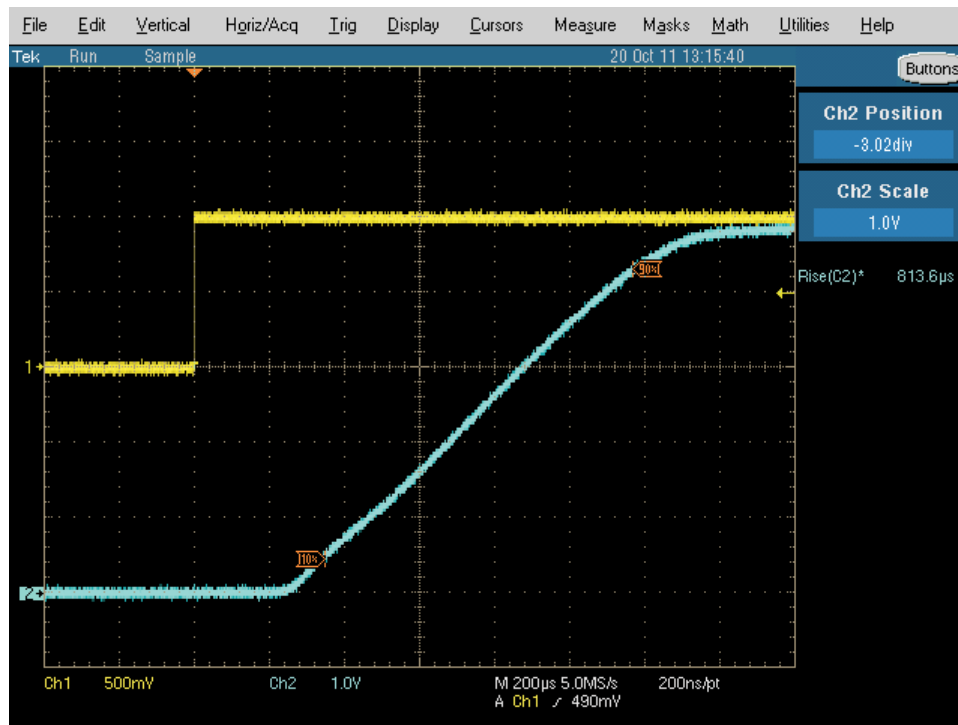


Figure 7. TPS22913C Trise Example

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 1.4 V to 5.5 V and the output voltage range of unspecified.

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 60°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 © 2012, 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

Audio	www.ti.com/audio
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
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated