Tiva™ C Series EK-TM4C123GXL LaunchPad: BoosterPack Development Guide

The Texas Instruments' Tiva™ C Series TM4C123G LaunchPad concept is an extremely low-cost, expandable evaluation system for TI microcontrollers. This concept began with the tremendously successful MSP430™ LaunchPad which introduced a large number of engineers to the TI MSP430 family of microcontrollers (MCUs). The Tiva Series of 32-bit ARM® Cortex™-M4 MCU family expands that success by introducing the Tiva C Series TM4C123G LaunchPad featuring the Tiva C Series TM4C123GH6PM microcontroller.

Build your own BoosterPack and take advantage of Texas Instruments' website to help promote it! From sharing a new idea or project, to designing, manufacturing, and selling your own BoosterPack kit, TI offers a variety of avenues for you to reach potential customers with your solutions.

This document briefly discusses the design and architecture of the LaunchPad platform and presents practical guidelines for application developers to build their own BoosterPacks for use with any of the available TI MCU LaunchPad kits. For more information about the LaunchPad, or about the BoosterPacks currently available for each LaunchPad kit, visit the LaunchPad site at www.ti.com.

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1 LaunchPad and BoosterPack Expansion Concept and Overview

The Texas Instruments' Tiva C Series TM4C123G LaunchPad concept is an extremely low-cost, expandable evaluation system for TI's Tiva C Series of ARM microcontrollers. This concept began with the tremendously successful MSP430™ LaunchPad which introduced a large number of engineers to the TI MSP430 family of microcontrollers. The TI Stellaris® LM4F120 LaunchPad expanded on that success. Now, the LaunchPad evaluation kit platform introduces the Tiva C Series EK-TM4C123GXL LaunchPad, featuring the Tiva C Series TM4C123GH6PM MCU.

A Tiva C Series LaunchPad consists of a target microcontroller, an in-circuit debug interface (ICDI) such as JTAG, a regulated power supply, a minimal microcontroller support circuit, a user interface, and a set of expansion headers. These expansion headers are referred to as the *BoosterPack Interface*. A BoosterPack is an expansion card designed for this interface. The BoosterPack interface provides a mechanism for developers to easily extend the Tiva C Series LaunchPad with application- and user-specific functions.

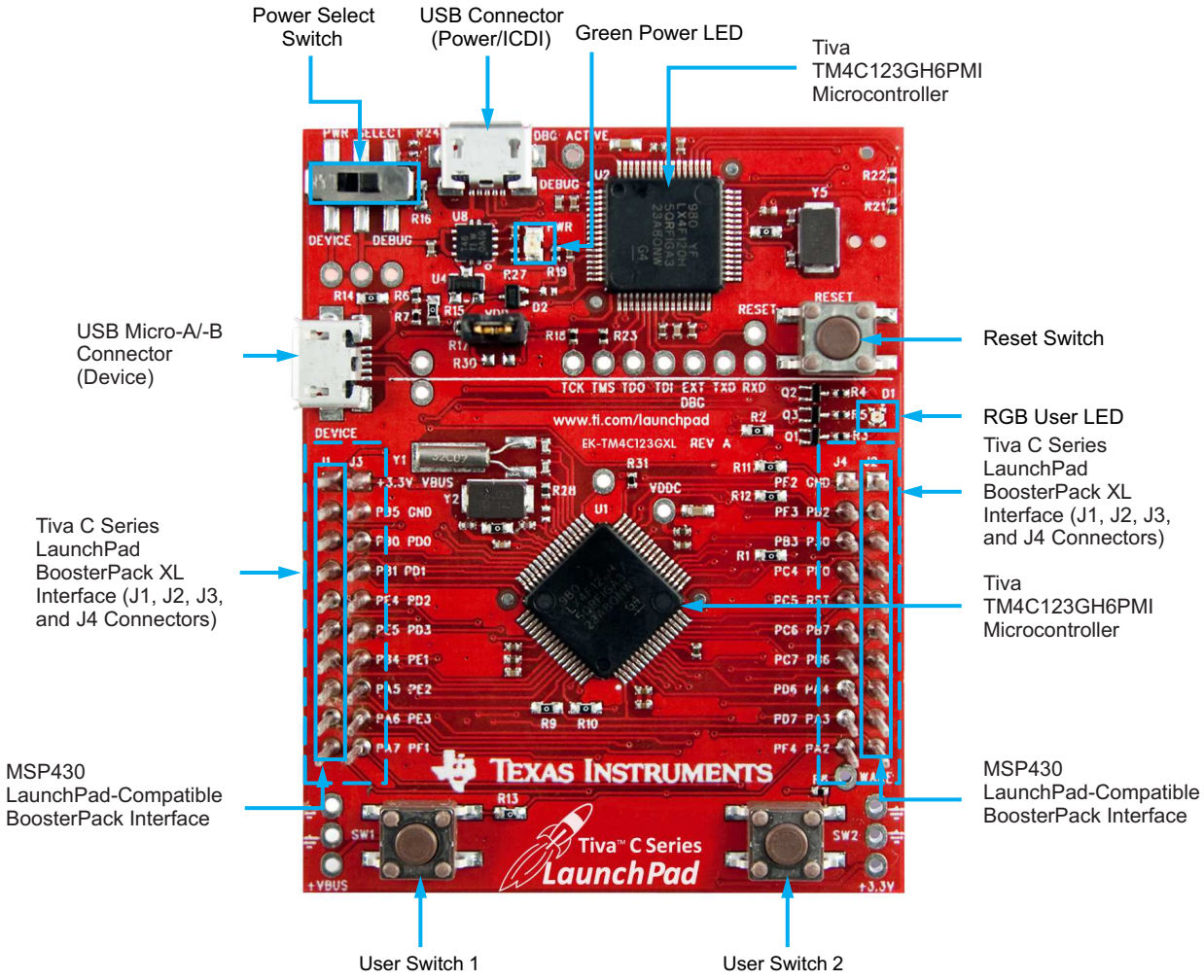
The EK-TM4C123GXL LaunchPad provides a BoosterPack interface that is compatible with the MSP430 LaunchPad. In addition, the TM4C123 LaunchPad provides access to additional Tiva C Series functionality through an extended BoosterPack interface called the *BoosterPack XL Interface*. BoosterPack interfaces with highly similar functionality for expansion will be available for the Tiva C Series LaunchPad, in addition to microcontroller-family-specific functionality available on a BoosterPack XL Interface for additional options. Table 1 provides a summary of current BoosterPack interface compatibility.

Table 1. LaunchPad BoosterPack Compatibility Summary

LaunchPad Kit	Compatible with:	
	BoosterPack Interface	BoosterPack XL Interface
Stellaris LaunchPad	Yes	Yes
MSP430 LaunchPads	Yes	No
Tiva C Series LaunchPad	Yes	Yes
Other TI LaunchPads	Yes	No

This development guide provides necessary design information for developers who want to create BoosterPacks that extend the functionality of the Tiva C Series or Stellaris LaunchPads using either the original BoosterPack Interface or the BoosterPack XL Interface. Figure 1 shows a photo of the Tiva C Series LaunchPad.

Figure 1. Tiva C Series TM4C123G LaunchPad Evaluation Board



2 BoosterPack Functional Interface

The Tiva C Series LaunchPad BoosterPack Interface provides compatibility with the original MSP430 LaunchPad BoosterPack interface. This interface consists of the outer 10-pin headers. The pins are spaced 0.10 in (2,54 mm) apart with the two headers located 1.8 in (4,572 cm) apart.

Table 2 and Table 3 both provide information about which Tiva C Series MCU peripherals are routed to each of the interface pins. The J1 connector is located on the far left side of the Tiva C Series LaunchPad. The J2 connector is located on the far right side of the TM4C123G LaunchPad. Software is used to configure the TM4C123GH6PM pin for one of the functions found in the tables. Highlighted functions indicate configuration for compatibility with the MSP430 LaunchPad.

Table 2. J1 Connector[(1)]

J1 Pin	GPIO	Analog Function	On-board Function	Tiva C Series MCU Pin	GPIOPCTL Register Setting										
		GPIO AMSEL			1	2	3	4	5	6	7	8	9	14	15
1.01	3.3 V														
1.02	PB5	AIN11	–	57	–	SSI2Fss	–	M0PWM3	–	–	T1CCP1	CAN0Tx	–	–	–
1.03	PB0	USB0ID	–	45	U1Rx	–	–	–	–	–	T2CCP0	–	–	–	–
1.04	PB1	USB0VBUS	–	46	U1Tx	–	–	–	–	–	T2CCP1	–	–	–	–
1.05	PE4	AIN9	–	59	U5Rx	–	I2C2SCL	M0PWM4	M1PWM2	–	–	CAN0Rx	–	–	–
1.06	PE5	AIN8	–	60	U5Tx	–	I2C2SDA	M0PWM5	M1PWM3	–	–	CAN0Tx	–	–	–
1.07	PB4	AIN10	–	58	–	SSI2Clk	–	M0PWM2	–	–	T1CCP0	CAN0Rx	–	–	–
1.08	PA5	–	–	22	–	SSI0Tx	–	–	–	–	–	–	–	–	–
1.09	PA6	–	–	23	–	–	I2C1SCL	–	M1PWM2	–	–	–	–	–	–
1.10	PA7	–	–	24	–	–	I2C1SDA	–	M1PWM3	–	–	–	–	–	–

(1) Shaded cells indicate configuration for compatibility with the MSP430 LaunchPad.

Table 3. J2 Connector[(1)]

J2 Pin	GPIO	Analog Function	On-board Function	Tiva C Series MCU Pin	GPIOPCTL Register Setting										
		GPIO AMSEL			1	2	3	4	5	6	7	8	9	14	15
2.01	GND														
2.02	PB2	–	–	47	–	–	I2C0SCL	–	–	–	T3CCP0	–	–	–	–
2.03	PE0	AIN3	–	9	U7Rx	–	–	–	–	–	–	–	–	–	–
2.04[(2)]	PF0	–	USR_SW2/ WAKE (R1)	28	U1RTS	SSI1Rx	CAN0Rx	–	M1PWM4	PhA0	T0CCP0	NMI	C0o	–	–
2.05	RESET														
2.06	PB7	–	Connected for MSP430 Compatibility (R10)	4	–	SSI2Tx	–	M0PWM1	–	–	T0CCP1	–	–	–	–
	PD1	AIN6		62	SSI3Fss	SSI1Fss	I2C3SDA	M0PWM7	M1PWM1	–	WT2CCP1	–	–	–	–
2.07	PB6	–	Connected for MSP430 Compatibility (R9)	1	–	SSI2Rx	–	M0PWM0	–	–	T0CCP0	–	–	–	–
	PD0	AIN7		61	SSI3Clk	SSI1Clk	I2C3SCL	M0PWM6	M1PWM0	–	WT2CCP0	–	–	–	–
2.08	PA4	–	–	21	–	SSI0Rx	–	–	–	–	–	–	–	–	–
2.09	PA3	–	–	20	–	SSI0Fss	–	–	–	–	–	–	–	–	–
2.10	PA2	–	–	19	–	SSI0Clk	–	–	–	–	–	–	–	–	–

(1) Shaded cells indicate configuration for compatibility with the MSP430 LaunchPad.

(2) Not recommended for BoosterPack use. J2.04 is a TEST pin on the MSP430 LaunchPad. This signal tied to on-board function via 0-Ω resistor.

3 BoosterPack XL Functional Interface

The BoosterPack XL Interface consists of the J1 and J2 connectors as well as the inner 10-pin headers spaced 1.6 in (4,064 cm) apart directly inside of the MSP430 LaunchPad-compatible BoosterPack interface headers. The pins are spaced on 0.10-inch (2,54-mm) centers. These inner 10-pin headers (connectors J3 and J4) are not intended to be compatible with other TI LaunchPads or LaunchPad XL kits. This feature is a Tiva C Series-only interface. TI recommends that LaunchPads provide analog functions on the left side of the BoosterPack XL interface and timer or PWM functions on the right side of the BoosterPack XL interface. The Tiva C Series board conforms to these recommendations. No effort has been made to make this interface compatible with any other LaunchPad.

Table 4 and Table 5 show the Tiva C Series peripherals that are routed to each pin of the Tiva C Series-only BoosterPack XL Interface pins. J3 is the inner left BoosterPack XL Interface header. J4 is the inner right BoosterPack XL Interface header. Software is used to configure the TM4C123GH6PM pin for one of the functions found in the tables.

Table 4. J3 Connector[1]

J3 Pin	GPIO	Analog Function	On-board Function	Tiva C Series MCU Pin	GPIOPCTL Register Setting										
		GPIO AMSEL			1	2	3	4	5	6	7	8	9	14	15
3.01	5.0 V														
3.02	GND														
3.03	PD0	AIN7	Connected for MSP430 Compatibility (R9)	61	SSI3Clk	SSI1Clk	I2C3SCL	M0PWM6	M1PWM0	–	WT2CCP0	–	–	–	–
	PB6	–		1	–	SSI2Rx	–	M0PWM0		–	T0CCP0	–	–	–	–
3.04	PD1	AIN6	Connected for MSP430 Compatibility (R10)	92	SSI3Fss	SSI1Fss	I2C3SDA	M0PWM7	M1PWM1	–	WT2CCP1	–	–	–	–
	PB7	–		4	–	SSI2Tx	–	M0PWM1	–	–	T0CCP1	–	–	–	–
3.05	PD2	AIN5		63	SSI3Rx	SSI1Rx	–	M0FAULT0	–	–	WT3CCP0	USB0EPEN			
3.06	PD3	AIN4	–	64	SSI3Tx	SSI1Tx	–	–	–	–	WT3CCP1	USB0PFLT	–	–	–
3.07	PE1	AIN2	–	8	U7Tx	–	–	–	–	–		–	–	–	–
3.08	PE2	AIN1	–	7	–	–	–	–	–	–	–	–	–	–	–
3.09	PE3	AIN0	–	6	–	–	–	–	–	–	–	–	–	–	–
3.10[2]	PF1	–	–	29	U1CTS	SSI1Tx	–	–	M1PWM5	–	T0CCP1	–	C1o	TRD1	–

(1) Shaded cells indicate configuration for compatibility with the MSP430 LaunchPad.
(2) Not recommended for BoosterPack use. This signal tied to on-board function via 0-Ω resistor.

Table 5. J4 Connector

J4 Pin	GPIO	Analog Function	On-board Function	Tiva C Series MCU Pin	GPIOPCTL Register Setting										
		GPIO AMSEL			1	2	3	4	5	6	7	8	9	14	15
4.01	PF2	–	Blue LED (R11)	30	–	SSI1Clk	–	M0FAULT0	M1PWM6	–	T1CCP0	–	–	–	TRD0
4.02	PF3	–	Green LED (R12)	31	–	SSI1Fss	CAN0Tx	–	M1PWM7	–	T1CCP1	–	–	–	TRCLK
4.03	PB3	–	–	48	–	–	I2C0SDA	–	–	–	T3CCP1	–	–	–	–
4.04	PC4	C1–	–	16	U4Rx	U1Rx	–	M0PWM6	–	IDX1	WT0CCP0	U1RTS	–	–	–
4.05	PC5	C1+	–	15	U4Tx	U1Tx	–	M0PWM7	–	PhA1	WT0CCP1	U1CTS	–	–	–
4.06	PC6	C0+	–	14	U3Rx	–	–	–	–	PhB1	WT1CCP0	USB0EPEN	–	–	–
4.07	PC7	C0–	–	13	U3Tx	–	–	–	–	–	WT1CCP1	USB0PFLT	–	–	–
4.08	PD6	–	–	53	U2Rx	–	–	–	–	PhA0	WT5CCP0	–	–	–	–
4.09	PD7	–	–	10	U2Tx	–	–	–	–	PhB0	WT5CCP1	NMI	–	–	–
4.10[1]	PF4	–	USR_SW1 (R13)	5	–	–	–	–	M1FAULT0	IDX0	T2CCP0	USB0EPEN	–	–	–

(1) Not recommended for BoosterPack use. This signal tied to on-board function via 0-Ω resistor.

4 LaunchPad Power Interface

The Tiva C Series LaunchPad has provisions to provide power to a BoosterPack through either the BoosterPack Interface or the BoosterPack XL Interface. The configuration of power and ground pins on both of these interfaces must be consistent across LaunchPads from all TI microcontroller families.

The TM4C123G LaunchPad draws power from either of the on-board USB interfaces as selected by the power switch in the top left corner of the board. Typically, the USB connection provides 500 mA at 5 V to the Tiva C Series LaunchPad. The selected USB power source is made directly available to the BoosterPack XL Interface on the J3.01 pin. This pin is a direct connection with only small decoupling capacitors provided on the Tiva C Series LaunchPad.

All LaunchPads, including the TM4C123G LaunchPad, also provide a 3.3-V supply on pin J1.01 of the BoosterPack Interface. On the Tiva C Series LaunchPad, this supply is sourced by a TPS73633 LDO voltage regulator which converts the selected 5-V USB power to 3.3 V. The regulator is capable of sourcing 400 mA at 3.3 V. This 3.3-V supply is shared between the BoosterPack Interface, the in-circuit debug interface (ICDI), and the target microcontroller. Therefore, under normal circumstances, approximately 300 mA to 350 mA are available to the BoosterPack Interface. Detailed power management is the responsibility of the BoosterPack developer who must also manage the application to be run on the target microcontroller.

The TM4C123G LaunchPad can be powered through an external supply on a BoosterPack. If providing power to the Tiva C Series LaunchPad from a BoosterPack, move the power select switch to select an unused USB connection to prevent power bus contention between the BoosterPack and the USB connection. Power may be supplied to either the 3.3-V or the 5.0-V system, but not both. Providing external power to both 5 V and 3.3 V would result in a contention between the external power supplies and the TM4C123G LaunchPad voltage regulator. Providing only 3.3 V results in some lost functionality (for example, the on-board LEDs may not illuminate). It may also result in reverse current leakage through the on-board voltage regulator. Therefore, if providing power externally, it is recommended to use either the existing USB connections or an external 5-V supply from a BoosterPack.

Ground connections are available on pins J2.01 and J3.02. These pins provide a ground connection for both the BoosterPack Interface and the BoosterPack XL Interface, respectively.

Additional power and ground pins are available through labeled pins located in the extreme lower corners of the Tiva C Series LaunchPad. These pins are connected to the same 3.3 V, 5 V, and ground connections as the pins on the BoosterPack Interface and the BoosterPack XL Interface.

5 Special Consideration for Shared Pins

To provide compatibility with the MSP430 LaunchPad's BoosterPack interface as well as to provide a maximum number of signals to the BoosterPack Interface and BoosterPack XL Interface, it was necessary to route some signals to more than one pin. In addition, certain on-board functions such as the button and LED signals are available on the BoosterPack Interface and BoosterPack XL Interface. A 0-Ω jumper resistor was installed for signals that are used for more than one purpose or routed to more than one GPIO. Removal of this jumper disconnects the functions. All jumpers are installed by default. A listing of these jumpers and the respective use of each is provided in Table 6.

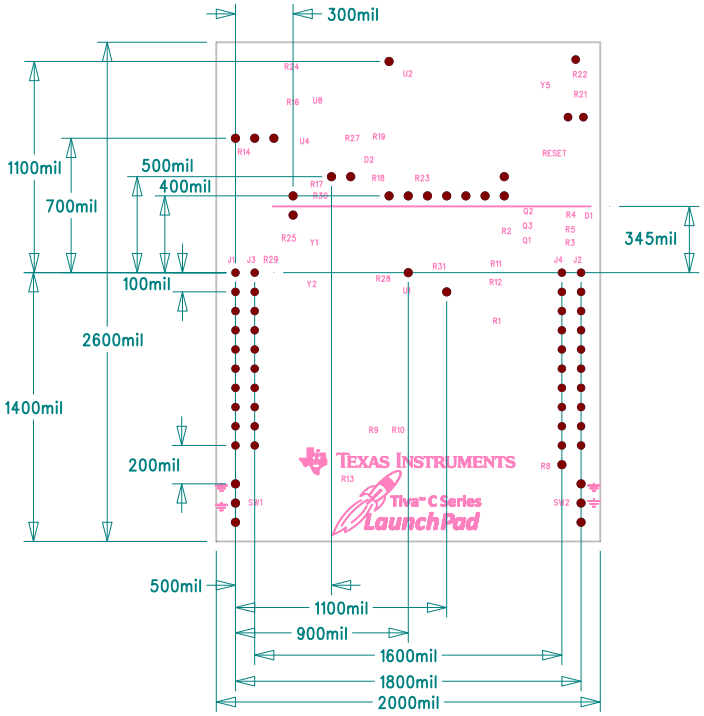
Table 6. Tiva C Series LaunchPad Jumper List

Resistor	Primary Function	Alternate Function	Comments
R1	Right User Switch	J2.04	Test pin on MSP430 LaunchPad. This connection along with R13 provides Hibernate wake to BoosterPack Interface
R2	Red LED	To PF1 and J3.10	If removed: allows extra GPIO to the BoosterPack XL Interface. If installed (default): allows BoosterPack to drive LED or sense LED state. Also provides Embedded Trace signal TRD1.
R8	Hibernate Wake	To PF0 and J2.04 via R1	Allows user switch 2 to wake device from hibernate. Also ties wake to J2.04 to allow BoosterPack to wake Stellaris LaunchPad from Hibernate.
R9	PB6 SSI2 TX on J2.07	PD0 I2C SCL on J2.07	Routes I^2C from PD0 to J2.07 for MSP430-Tiva C Series LaunchPad compatibility. If using PD0 or PB6, the unused GPIO must be configured as an input or R9 removed.
R10	PB7 SSI2 RX on J2.06	PD1 I2C SDA on J2.06	Routes I^2C from PD1 to J2.06 for MSP430-Tiva C Series LaunchPad compatibility. If using PD1 or PB7, the unused GPIO must be configured as an input or R9 removed.
R11	Blue LED	To PF2 and J4.01	If removed: allows extra GPIO to the BoosterPack XL Interface. If installed (default): allows BoosterPack to drive LED or sense LED state Also provides Embedded Trace signal TRD0.
R12	Green LED	To PF3 and J4.02	If removed: allows extra GPIO to the BoosterPack XL Interface. If installed (default): allows BoosterPack to drive LED or sense LED state. Also provides Embedded Trace signal TRDCLK.
R13	Left User Switch	To PF4 and J4.10	If removed: allows extra GPIO to the BoosterPack XL Interface. If installed (default): allows BoosterPack to simulate switch press or sense switch state.

6 Tiva C Series LaunchPad Dimensions and Mating

See Figure 2 for a dimensional drawing of the Stellaris LaunchPad. J1 and J2 are 1.8 in (4,572 cm) apart and constitute the BoosterPack interface. J3 and J4 are 1.6 in (4,064 cm) apart and constitute the BoosterPack XL Interface. Other major board signals are available on unpopulated headers on a 0.1-in (2,54-mm) grid. Dimensions to these signals are provided for convenience. These signals are subject to change or move across revisions of the Tiva C Series LaunchPad or future LaunchPads. It is recommended that BoosterPacks use only the BoosterPack Interface and BoosterPack XL Interface. Use of other pins and signals is acceptable, but these pins and signals can change at any time.

Figure 2. Tiva C Series LaunchPad Dimensions



NOTE: Units are in mils (one thousandth of an inch): 1 mil = 0.001 inch (0.0254 mm).

7 BoosterPack Design Guidelines

Follow these guidelines when designing your BoosterPack:

- BoosterPacks should not extend more than 0.350 in (8,89 mm) above the center of the top BoosterPack Interface pin.
- BoosterPacks should not extend more than 0.150 in (3,81 mm) below the center of the bottom pin of the BoosterPack Interface.

NOTE: BoosterPacks that extend more than 0.150 in (3,81 mm) below the center of the bottom pin will partially cover the Tiva C Series LaunchPad user switches, which can result in lost user access to those user inputs.

- BoosterPacks are not restricted in width and may extend as much as desired left and right of the Tiva C Series LaunchPad.
- For BoosterPacks with RF antennas, place the antenna to the left or right of the Tiva C Series LaunchPad for minimal interference and signal attenuation.
- The BoosterPack interface does not provide any means of keying or alignment guidance. It is recommended that visual cues be provided on the BoosterPack to assist user in proper orientation of the BoosterPack.
- If possible, design the BoosterPack so that incorrect mating to a Tiva C Series LaunchPad does not damage the BoosterPack.

8 References and Schematics

8.1 References

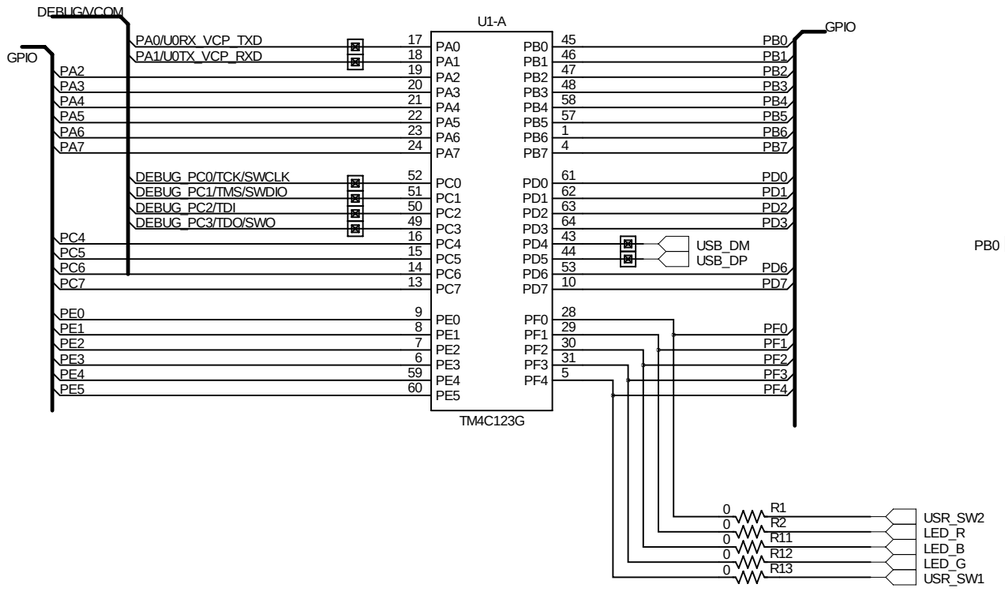
In addition to this document, the following references are available for download at www.ti.com:

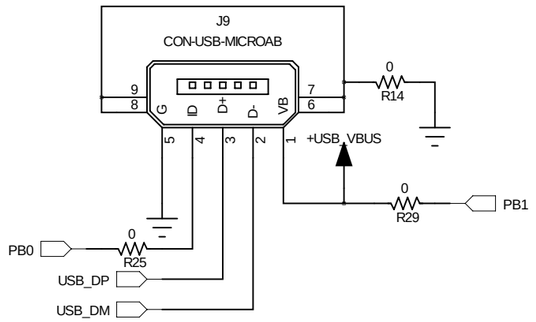
- Tiva C Series TM4C123GH6PM Microcontroller Data Sheet (literature number SPMS376).
- Tiva C Series LaunchPad (EK-TM4C123GXL) User Guide. Available for download at www.ti.com/tool/ek-tm4c123gxl
- TivaWare for C Series Driver Library. Available for download at www.ti.com/tool/sw-tm4c-drl.
- TivaWare for C Series Driver Library User's Manual (literature number SPMU298).
- TPS73633 Low-Dropout Regulator with Reverse Current Protection Data Sheet (literature number SBVS038)

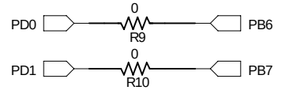
8.2 Schematics

This section contains the complete schematics for the Tiva C Series LaunchPad board.

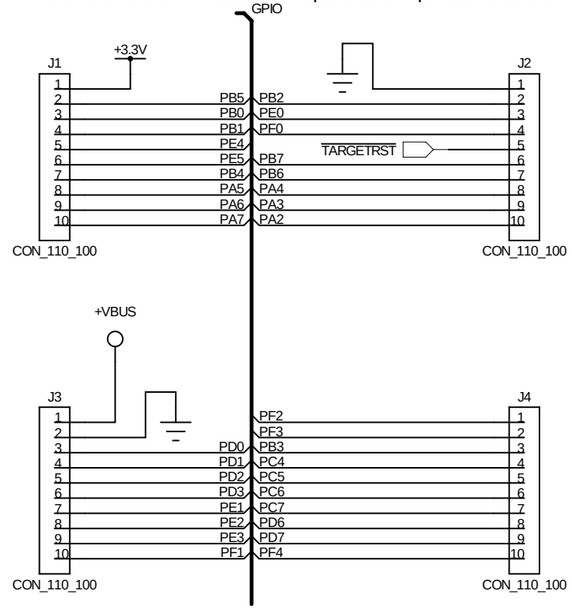
- Microcontroller, USB, Expansion, Buttons, and LED
- Power Management
- In-Circuit Debug Interface

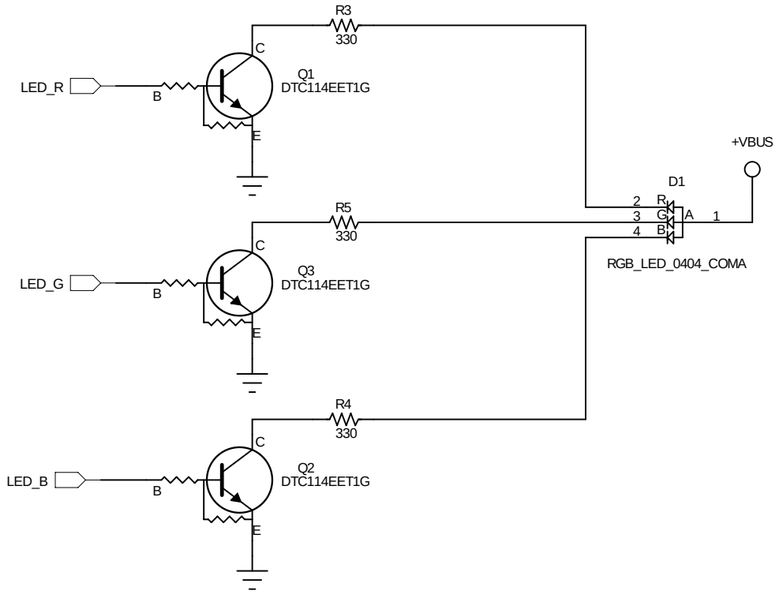


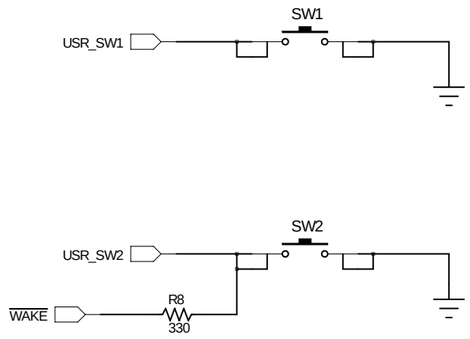




J1 and J2 provide compatability with
Booster Packs designed for MSP430 Launchpad
J3 and J4 sit 100 mils inside J1 and J2 to provide
extended functions specific to this board.
See the board user manual for complete table of pin mux functions







DESIGNER	REVISION	DATE
DGT	0.3	2/20/2013

PROJECT
Tiva TM4C123G LaunchPad

DESCRIPTION
Microcontroller, USB, Expansion, Buttons and LED

FILENAME
EK-TM4C123GXL Rev A.sch

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TIVA MICROCONTROLLERS
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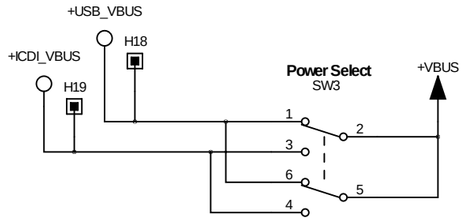
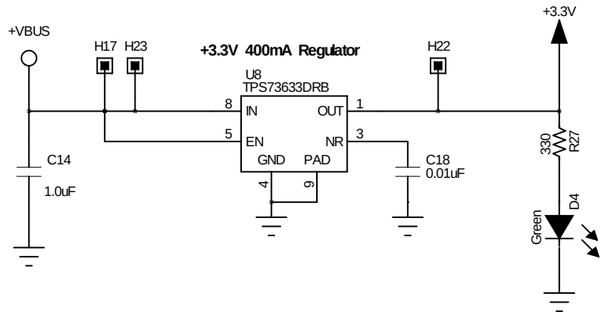
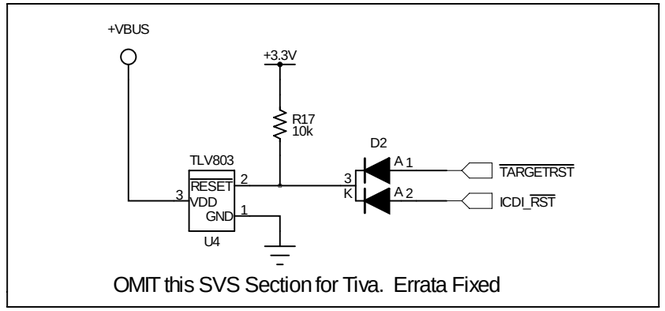
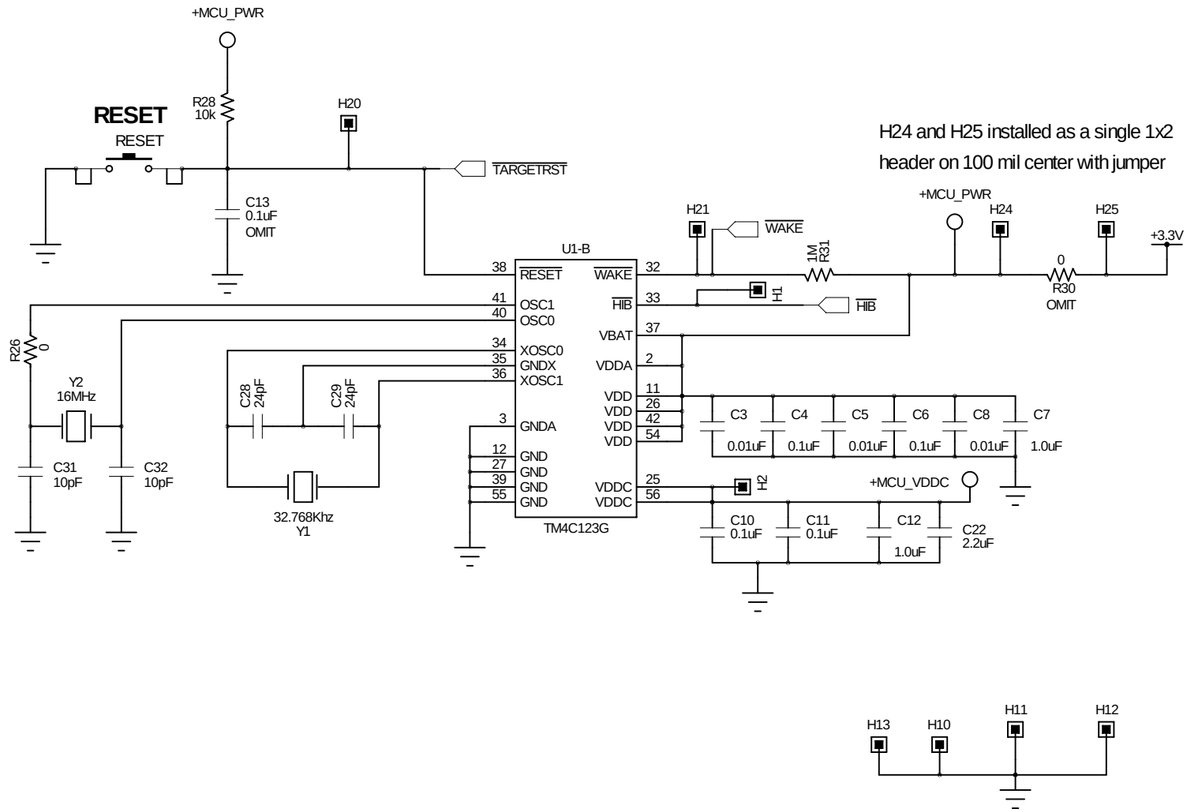
AUSTIN TX, 78746
www.ti.com

PART NO.	SHEET
EK-TM4C123GXL	1 OF 3









H24 and H25 installed as a single 1x2 header on 100 mil center with jumper

DESIGNER	REVISION	DATE
DGT	0.3	2/20/2013

PROJECT: Tiva Launchpad

DESCRIPTION: Power Management

FILENAME: EK-TM4C123GXL Rev A.sch

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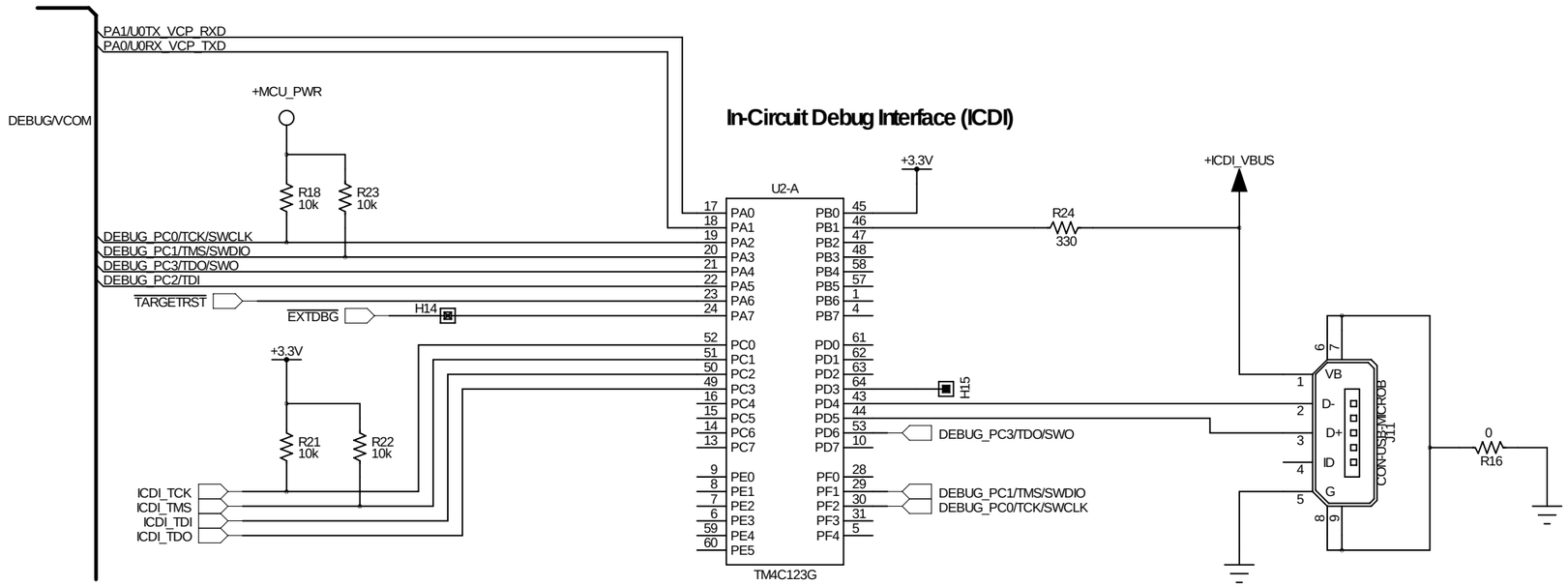
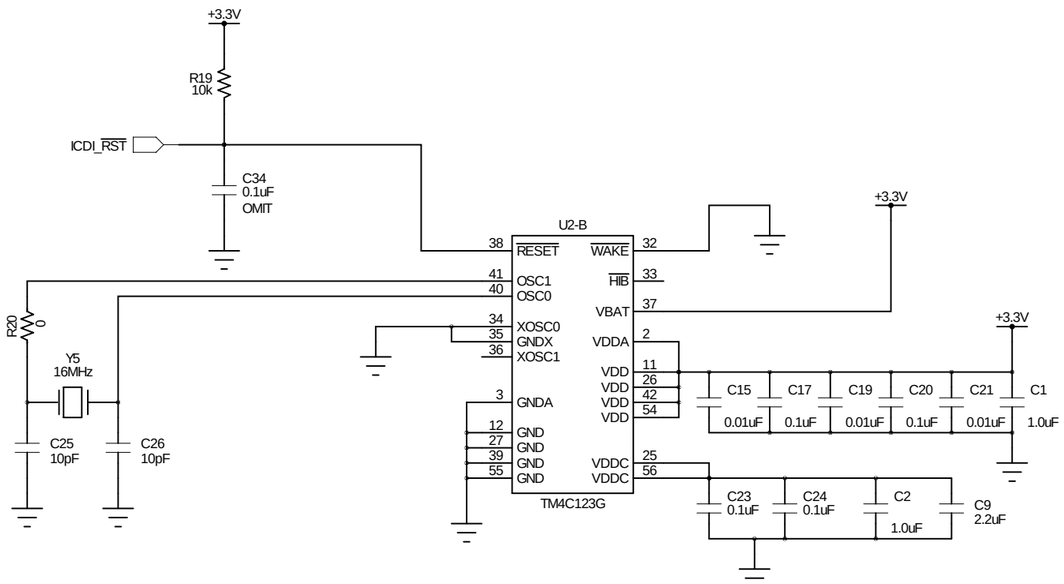
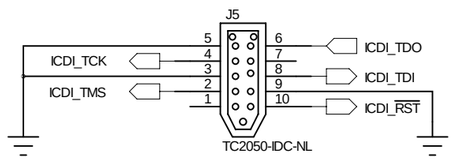
PART NO. EK-TM4C123GXL

In-Circuit Debug Interface (ICDI)





ICDI JTAG



DESIGNER	REVISION	DATE
DGT	0.3	2/20/2013

PROJECT
Tiva TM4C123G LaunchPad

DESCRIPTION
In Circuit Debug Interface

FILENAME
EK-TM4C123GXL Rev A.sch

TEXAS INSTRUMENTS
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TIVA MICROCONTROLLERS
108 WILD BASIN ROAD, SUITE 350
AUSTIN TX, 78746
www.ti.com

PART NO.	SHEET
EK-TM4C123GXL	3 OF 3

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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.

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 LIMITED 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. 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.

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 visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module 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 or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible 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, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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