

## **SN65LVCP1414 Evaluation Module (EVM)**

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The Texas Instruments SN65LVCP1414 Evaluation Module (EVM) board is used to evaluate the SN65LVCP1414, 14.2-Gbps quad-channel, dual mode linear-redriver with signal conditioning. This document provides guidance on the devices proper use by showing some operating configurations and test modes. In addition, the EVM board schematic and layout information are provided. Information in this guide assists in choosing the optimal design methods and materials for designing a complete system.

### **Contents**

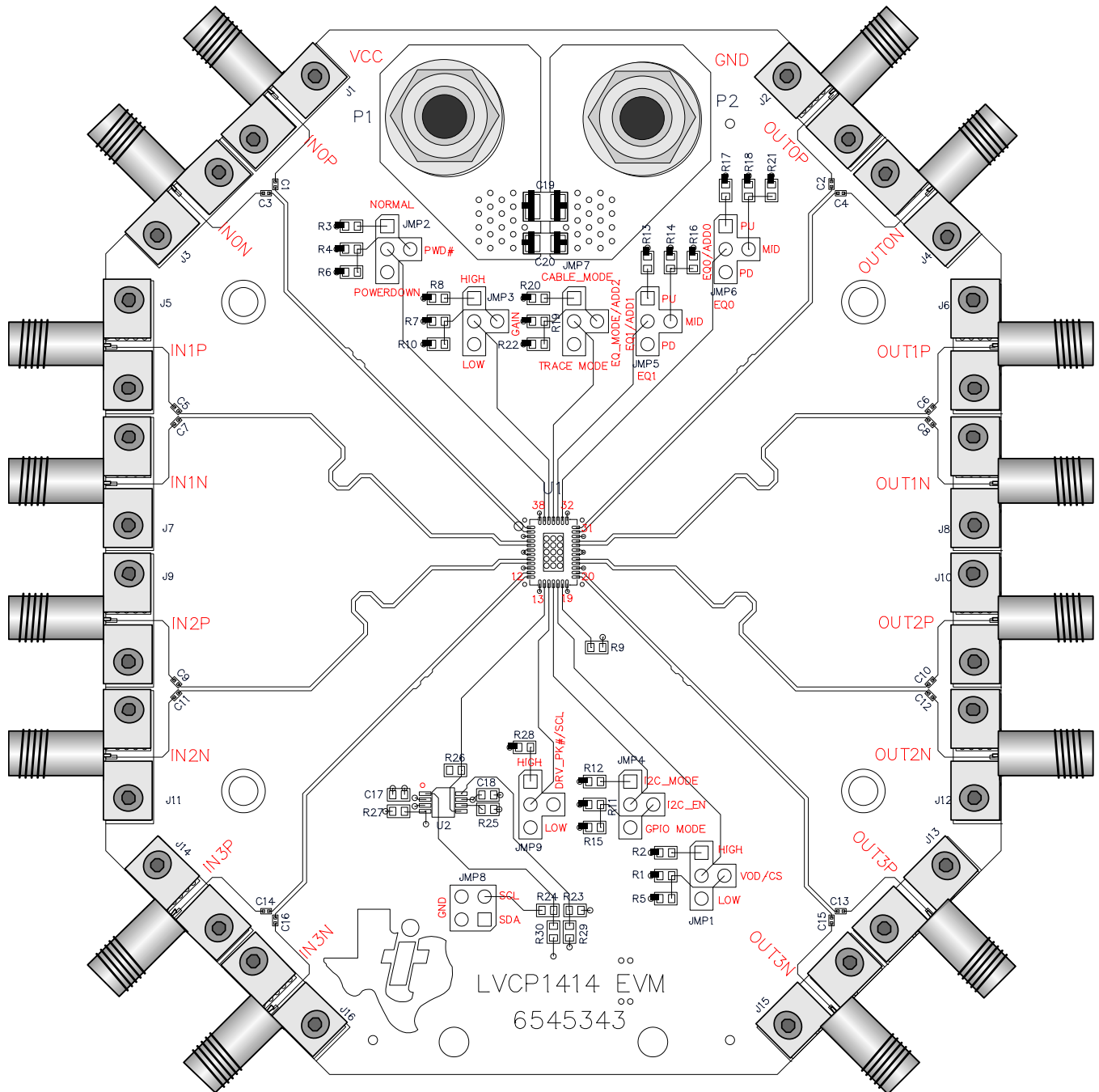
1	Introduction .....	4
2	EVM PCB and High-Speed Design Considerations .....	4
3	SN65LVCP1414 EVM Kit Contents .....	4
4	SN65LVCP1414 EVM Board Configuration .....	4
5	Test Setup .....	7
6	I <sup>2</sup> C Mode .....	8
7	GPIO Mode .....	9
8	Schematics .....	10
9	Bill of Materials .....	15
10	Board Layout .....	16
Appendix A	Jumper Shunt Settings .....	21

### **List of Figures**

1	SN65LVCP1414 EVM .....	5
2	USB Dongle Board.....	6
3	SN65LVCP1414 EVM Jumper Description .....	7
4	SN65LVCP1414 EVM Schematic, Sheet 1 Inputs and Outputs .....	10
5	SN65LVCP1414 EVM Schematic, Sheet 2 GPIO Controls.....	11
6	SN65LVCP1414 EVM Schematic, Sheet 3 I <sup>2</sup> C Controls .....	12
7	SN65LVCP1414 EVM Schematic, Sheet 4 I <sup>2</sup> C Communications .....	13
8	SN65LVCP1414 EVM Schematic, Sheet 5 Power.....	14
9	SN65LVCP1414 Board Layout: Top Signal (Layer 1) .....	17
10	SN65LVCP1414 Board Layout: Internal Ground (Layer 2) .....	18
11	SN65LVCP1414 Board Layout: Internal Power (Layer 3) .....	19
12	SN65LVCP1414 Board Layout: Bottom Signal (Layer 4) .....	20

### **List of Tables**

1	SN65LVCP1414 EVM Pin and Jumper Functionality Description .....	8
2	SN65LVCP1414 EVM I <sup>2</sup> C Mode Settings.....	8
3	SN65LVCP1414 EVM Jumper and EQ Settings.....	9
4	SN65LVCP1414 EVM GPIO Mode Settings .....	9
5	SN65LVCP1414 EVM Bill of Materials .....	15
6	SN65LVCP1414 EVM PCB Layer Construction.....	16



### **WARNING**

**This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of 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 their own expense, is required to take whatever measures are required to correct this interference.**

## 1 Introduction

The Texas Instruments (TI) SN65LVCP1414 is a 14.2-Gbps quad channel dual mode linear-redriver with signal conditioning. The device linearly compensates for channel loss in backplane and active-cable applications. The architecture of SN65LVCP1414 linear-redriver is designed to work effectively with ASIC or FPGA products implementing digital equalization using decision feedback equalizer (DFE) technology. SN65LVCP1414 preserves the integrity (composition) of the received signal ensuring optimum DFE and system performance. SN65LVCP1414 provides a low power linear-redriver solution while at the same time extending the effectiveness of DFE.

## 2 EVM PCB and High-Speed Design Considerations

Use the EVM and the contents of this guide to evaluate device parameters in addition to helping with high-speed board layout. As the frequency of operation increases, special care is required to ensure that the highest signal integrity is maintained. Achieve this by controlling the board's impedance to 50  $\Omega$  single-ended or 100- $\Omega$  differential. The use of vias is minimized and, when necessary, are designed to minimize impedance discontinuities along the transmission line. Care was taken to control trace length mismatch (board skew) to less than  $\pm 0.001$  in.

Overall, the board layout is designed and optimized for high-speed operation. Thus, understanding impedance control and transmission line effects are crucial when designing high-speed boards. Some of the advanced features offered by this board include:

- SN65LVCP1414 PCB (printed-circuit board), designed for optimal high-speed signal integrity using Rogers Material for the outer signal layers and FR-4 for the inner layers. All Gigabit signals are routed over the Rogers Material for minimal signal loss.
- SMA and header fixtures are easily connected to test equipment
- All input and output signals are accessible for rapid prototyping
- On-board capacitors provide AC coupling of high-speed transmit and receive signals

## 3 SN65LVCP1414 EVM Kit Contents

The SN65LVCP1414 EVM Kit contains the following:

- SN65LVCP1414 EVM Board
- SN65LVCP1414 EVM User's Guide (this document)
- USB Dongle Board
- CD-ROM containing GUI (Graphical User Interface) software

## 4 SN65LVCP1414 EVM Board Configuration

The SN65LVCP1414 operates from a single 2.5-V or a 3.3-V power supply with a 0.5 A or greater current rating. The EVM provides SMA connections for all input and output channels for device evaluation with full configuration control of the device through I<sup>2</sup>C™, using the provided SN65LVCP1414 EVM GUI, or GPIO, using the on-board jumpers.

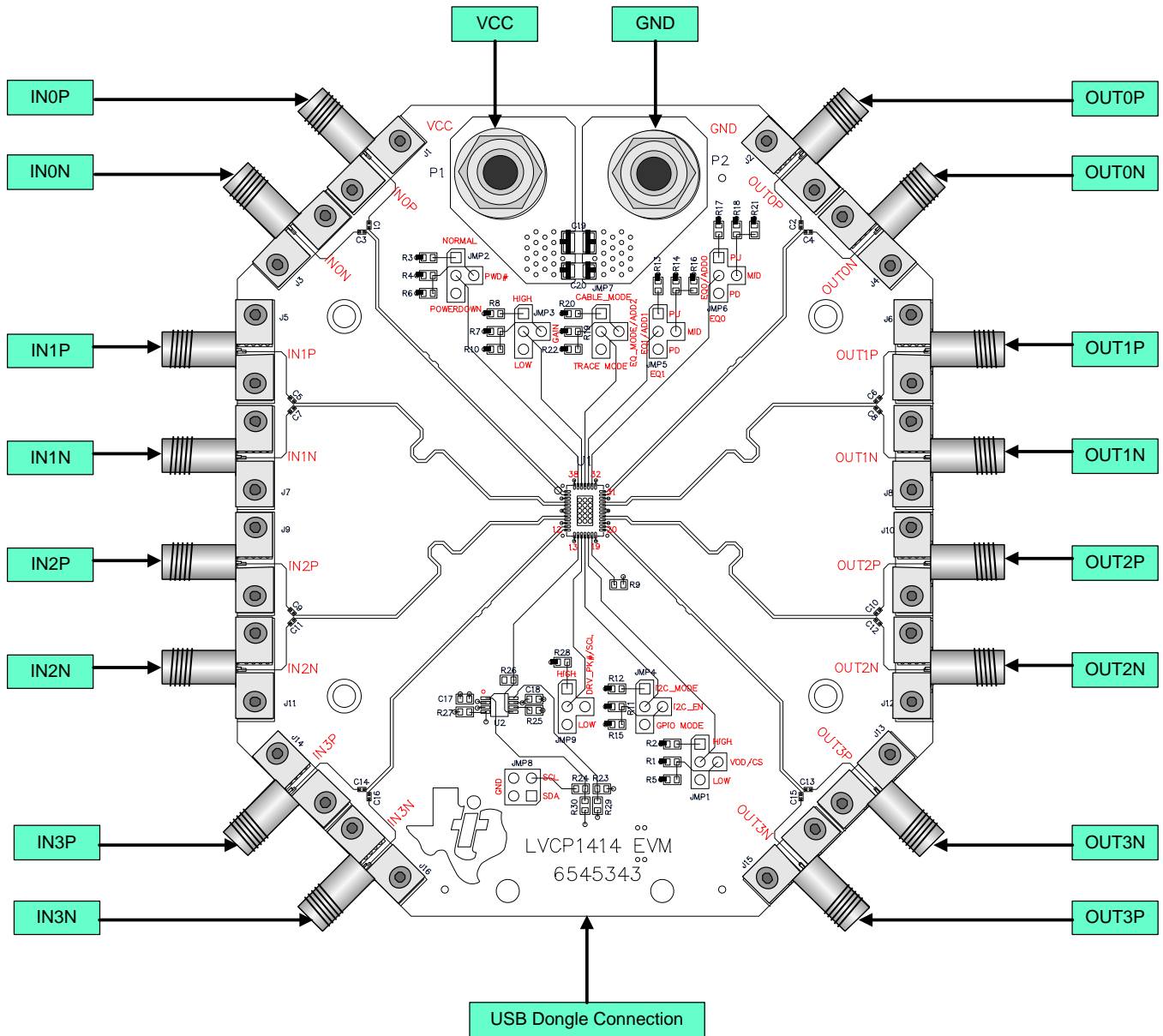


Figure 1. SN65LVCP1414 EVM

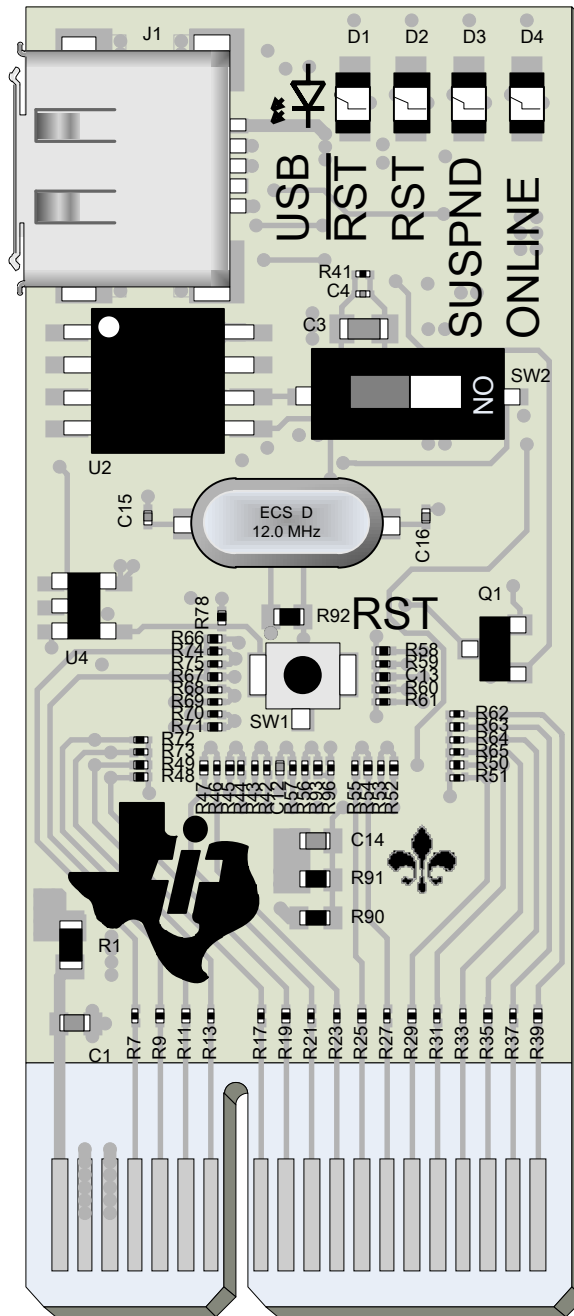


Figure 2. USB Dongle Board

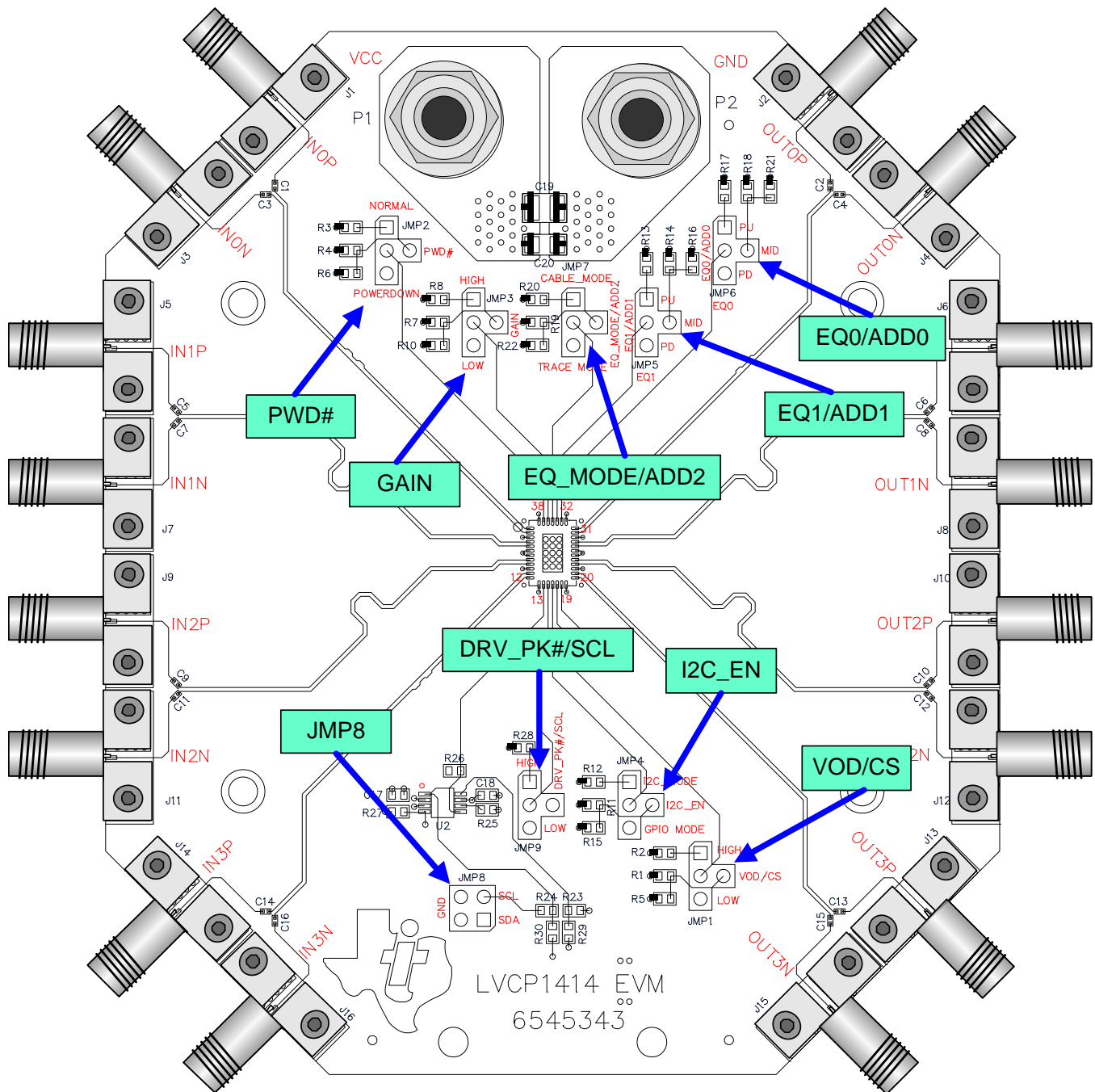


Figure 3. SN65LVCP1414 EVM Jumper Description

## 5 Test Setup

The EVM gives the developer two control interface options for operation, I<sup>2</sup>C or GPIO mode. Input and output differential pairs are available through edge-launch SMAs with approximately 2.5 inches of trace with Rogers Low-Dielectric material with 0.1- $\mu$ F AC coupling capacitors. Apply power to the device, VCC, using banana jacks (P1, P2).

**Table 1. SN65LVCP1414 EVM Pin and Jumper Functionality Description**

Ref Des	Symbol	Description	
		GPIO mode	I <sup>2</sup> C mode
J1, J3	In0+, In0–	Differential input, channel 0	
J5, J7	In1+, In1–	Differential input, channel 1	
J9, J11	In2+, In2–	Differential input, channel 2	
J14, J16	In3+, In3–	Differential input, channel 3	
J2, J4	Out0+, Out0–	Differential output, channel 0	
J6, J8	Out1+, Out1–	Differential output, channel 1	
J10, J12	Out2+, Out2–	Differential output, channel 2	
J13, J15	Out3+, Out3–	Differential output, channel 3	
P1	VCC	Banana jack, positive power-supply connection	
P2	GND	Banana jack, ground power-supply connection	
J17	USB	USB dongle connection	
JMP1	VOD/CS	High, sets the high VOD range Low, sets the low VOD range	High, acts as chip select Low, disables the I <sup>2</sup> C interface
JMP2	PD#	High, normal operation Low, power downs the device, inputs off and outputs disabled, resets the I <sup>2</sup> C	
JMP3	GAIN	High, sets the high DC gain Low, sets the low DC gain	Don't care
JMP4	I2C_EN	Configures the device in I <sup>2</sup> C or GPIO mode of operation High, enables I <sup>2</sup> C mode Low, enables GPIO mode	
JMP5	EQ1/ADD1	3-level control for EQ gain	I <sup>2</sup> C address
JMP6	EQ0/ADD0	3-level control for EQ gain	I <sup>2</sup> C address
JMP7	EQ_MODE/ADD2	3-level control for EQ gain	I <sup>2</sup> C address
JMP9	DRV_PK#/SCL	High, disables driver peaking Low, enables driver 6 dB AC peaking	I <sup>2</sup> C SCL pin

## 6 I<sup>2</sup>C Mode

Implement I<sup>2</sup>C mode by using the SN65LVCP1414 GUI software provided in the CD-ROM with the EVM. See the SN65LVCP1414 EVM GUI User's Guide ([SLLU170](#)) for details on using the GUI. [Table 2](#) shows the appropriate jumpers settings on the EVM for configuring the device in I<sup>2</sup>C mode. Refer to [Appendix A](#) for jumper shunt settings.

The USB dongle implementing TI's TUSB3210 microcontroller, connected to the EVM board through the Samtec MEC1 connector, is the preferred method of controlling the SN65LVCP1414 register stack and is the *only* way to interface the GUI with the board.

See the SN65LVCP1414 datasheet ([SLLSEC5](#)) for a detailed description of the register map.

**Table 2. SN65LVCP1414 EVM I<sup>2</sup>C Mode Settings**

Ref Des	Symbol	I <sup>2</sup> C Mode Pin Settings
JMP1	VOD/CS	High, acts as chip select
JMP2	PD#	High, normal operation Low, powers down the device, inputs off and outputs disabled, resets the I <sup>2</sup> C
JMP4	I2C_EN	High, enables I <sup>2</sup> C mode
JMP5	EQ1/ADD1	Low
JMP6	EQ0/ADD0	Low
JMP7	EQ_MODE/ADD2	Low
JMP9	DRV_PK#/SCL	Set in Mid position for SCL flow through from the USB card



## 7 GPIO Mode

The SN65LVCP1414 is fully controllable in GPIO. Refer to [Table 3](#) for the different jumper and EQ settings. [Table 4](#) shows the appropriate jumper and default settings on the EVM to configure and control the device in GPIO mode. Refer to Appendix A for jumper shunt settings.

See the SN65LVCP1414 datasheet ([SLLSEC5](#)) for a detailed description of the control signals.

**Table 3. SN65LVCP1414 EVM Jumper and EQ Settings**

EQ1	EQ0	EQ Gain	
GND	GND	000	
GND	Hi-Z	000	
GND	VCC	001	
Hi-Z	GND	010	
Hi-Z	Hi-Z	011	
Hi-Z	VCC	100	
VCC	GND	101	
VCC	Hi-Z	110	
VCC	VCC	111	
EQ1/EQ0	Gain	DC Gain (dB)	EQ Gain (dB)
000 ~ 111	LOW	-6	1 ~ 9
000 ~ 111	Hi-Z	-6	7 ~ 17
000 ~ 111	HIGH	0	1 ~ 9

**Table 4. SN65LVCP1414 EVM GPIO Mode Settings**

Ref Des	Symbol	GPIO Mode Pin Description
JMP1	VOD/CS	High, sets the high VOD range Low, sets the low VOD range
JMP2	PD#	High, normal operation Low, power downs the device, inputs off and outputs disabled, resets the I <sup>2</sup> C
JMP3	GAIN	High, sets the high DC gain Low, sets the low DC gain
JMP4	I2C_EN	Configures the device in I <sup>2</sup> C or GPIO mode of operation High, enables I <sup>2</sup> C mode Low, enables GPIO mode
JMP5	EQ1/ADD1	3 level control for EQ gain
JMP6	EQ0/ADD0	3 level control for EQ gain
JMP7	EQ_MODE/ADD2	3 level control for EQ gain
JMP9	DRV_PK#/SCL	High, disables driver peaking Low, enables driver 6 dB AC peaking

8 Schematics

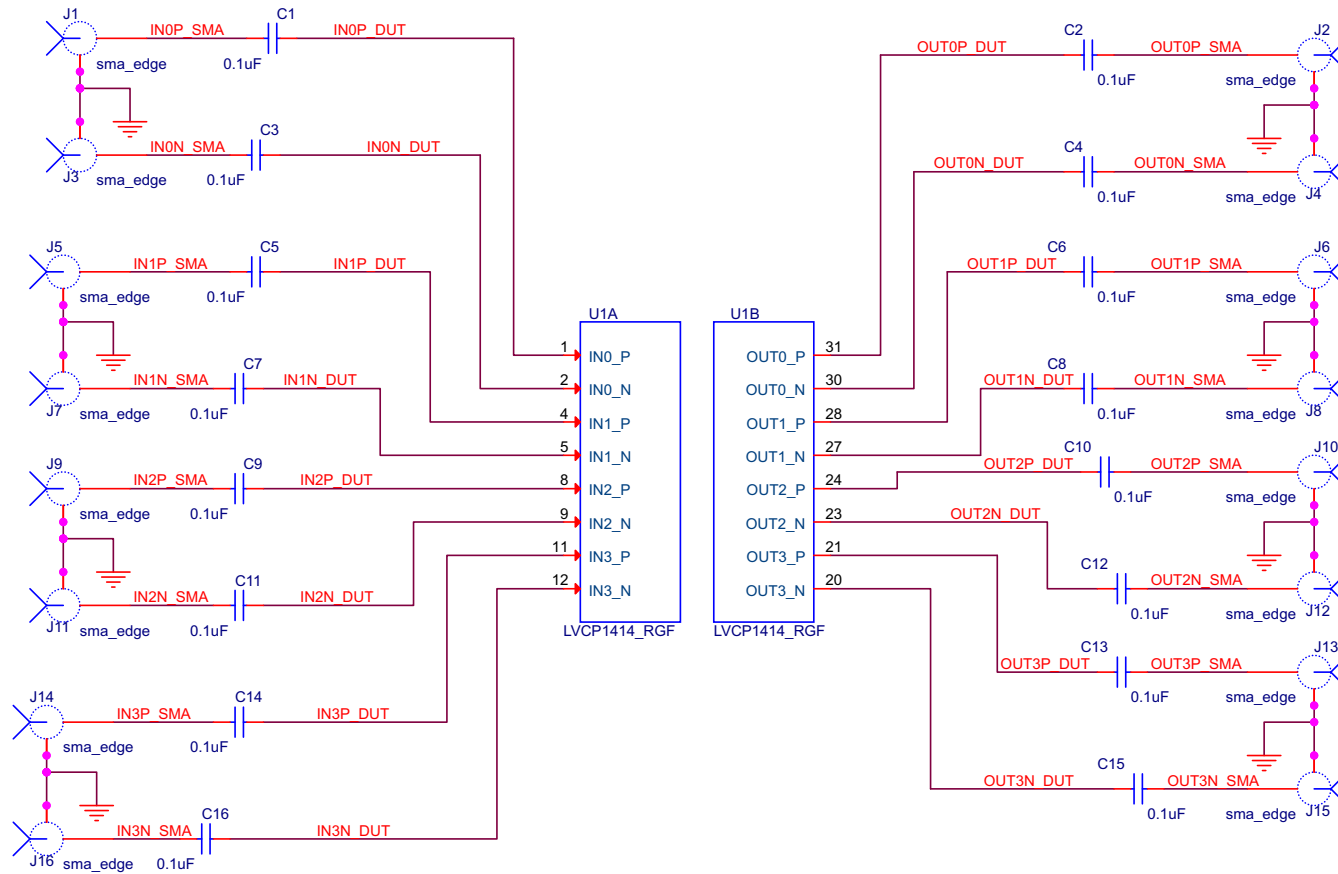


Figure 4. SN65LVCP1414 EVM Schematic, Sheet 1 Inputs and Outputs

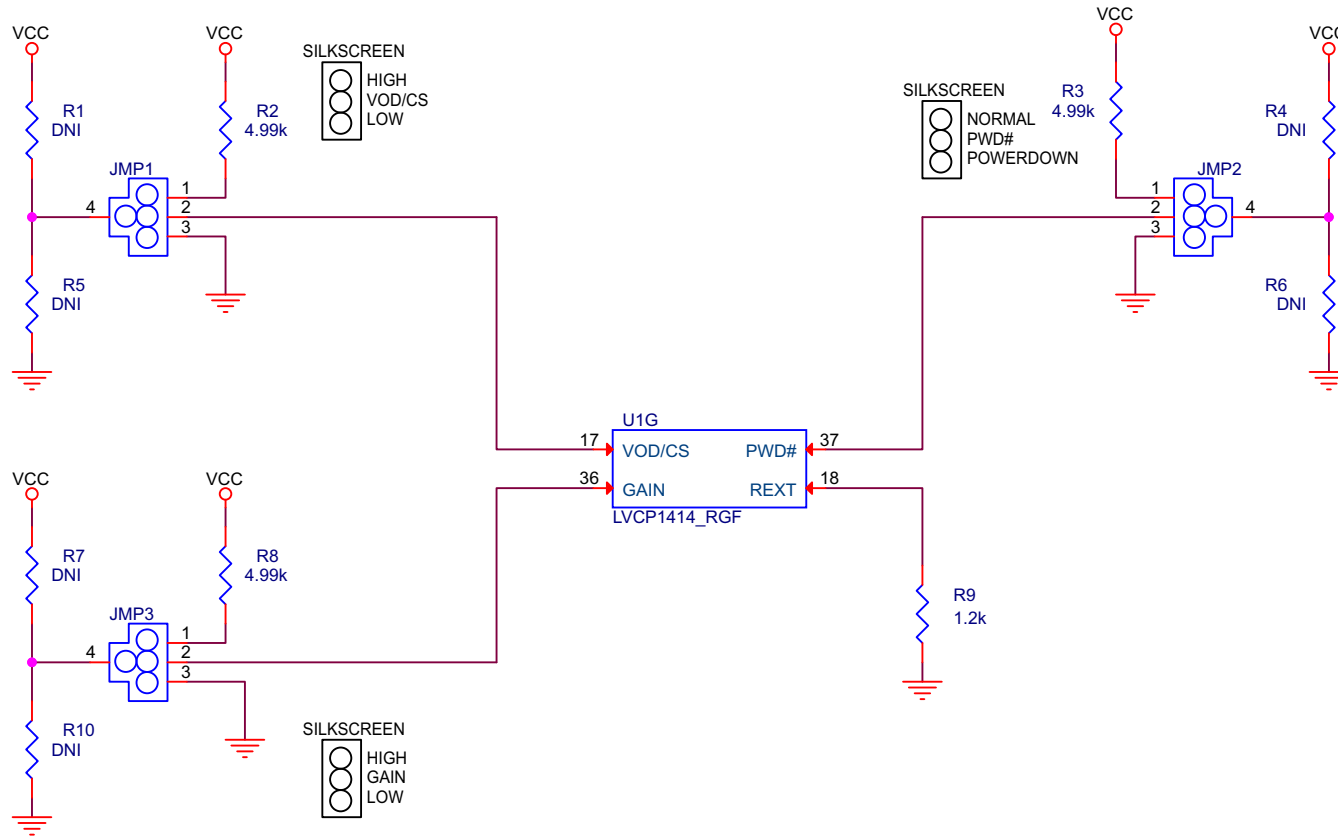


Figure 5. SN65LVCP1414 EVM Schematic, Sheet 2 GPIO Controls

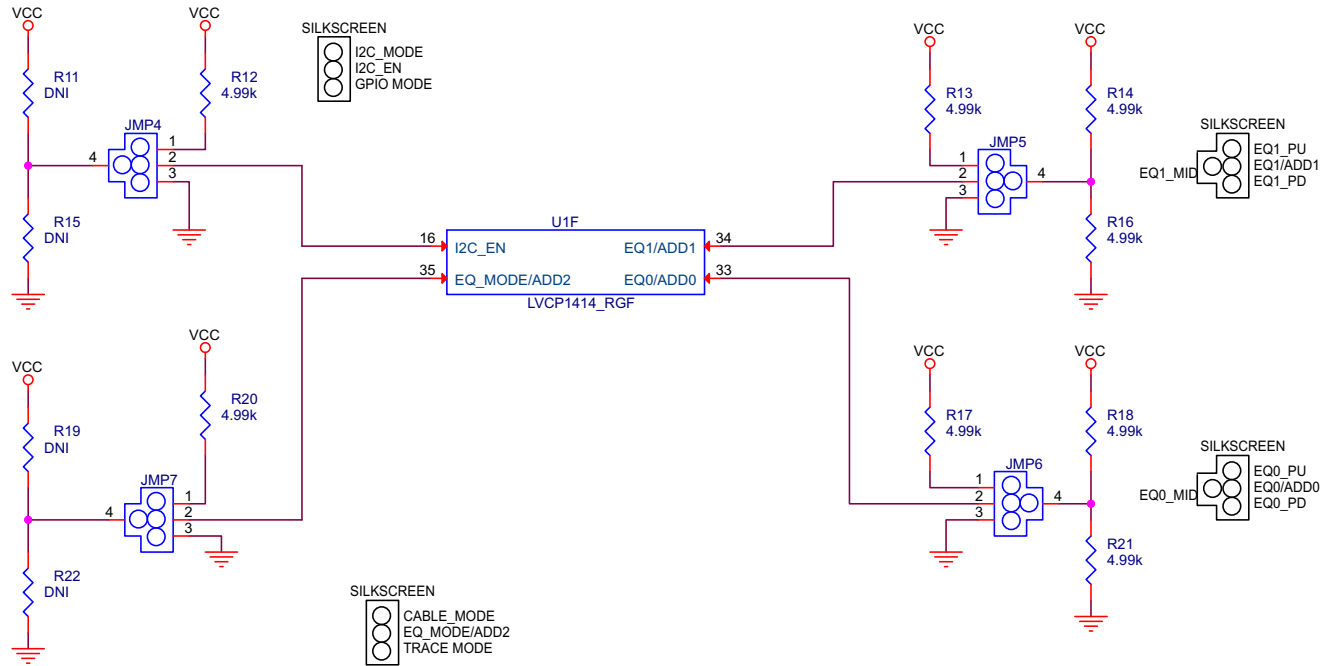


Figure 6. SN65LVCP1414 EVM Schematic, Sheet 3 I<sup>2</sup>C Controls

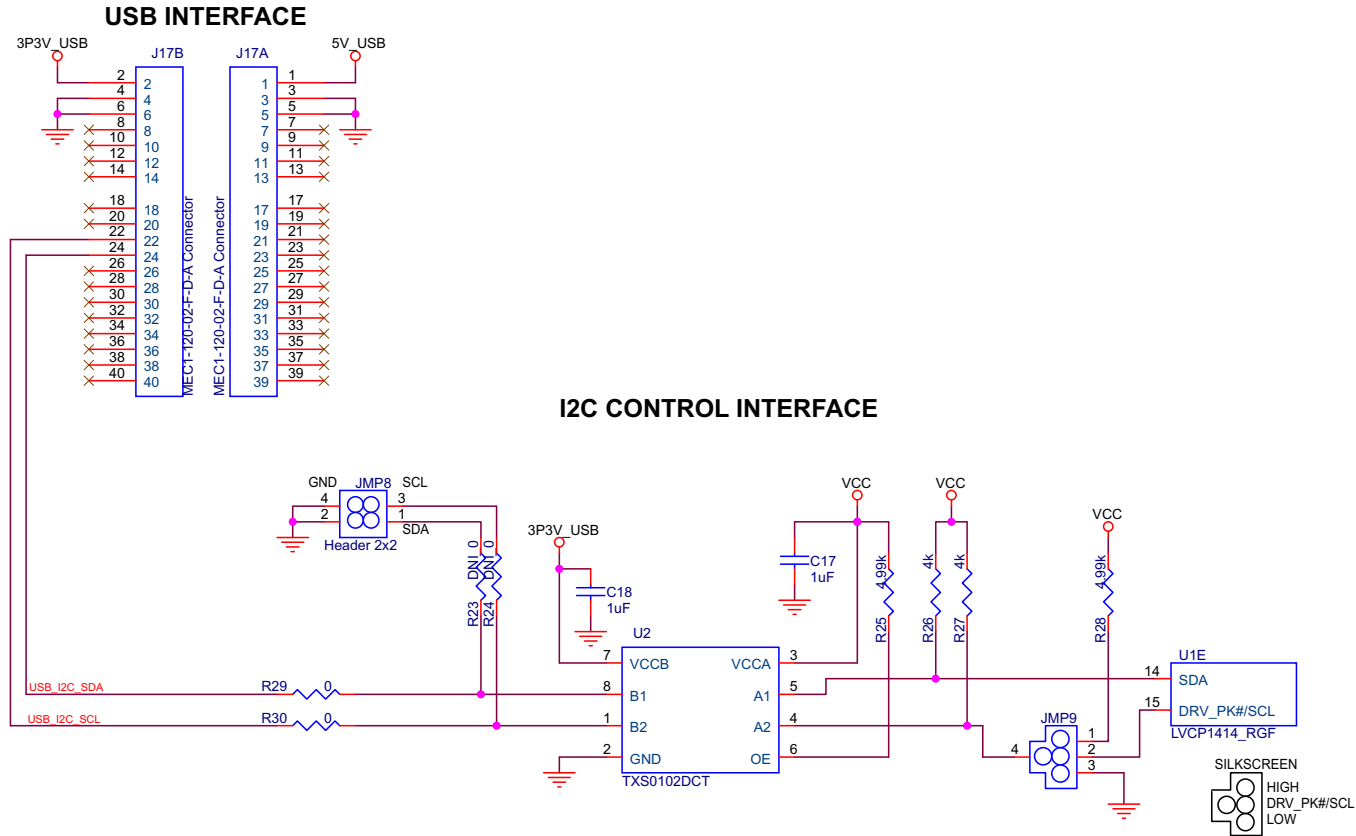


Figure 7. SN65LVCP1414 EVM Schematic, Sheet 4 I<sup>2</sup>C Communications

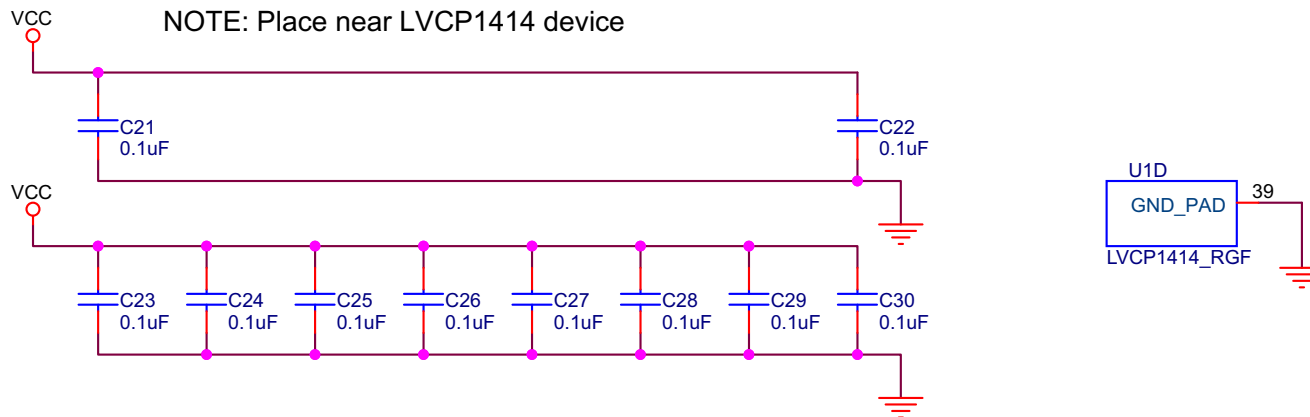
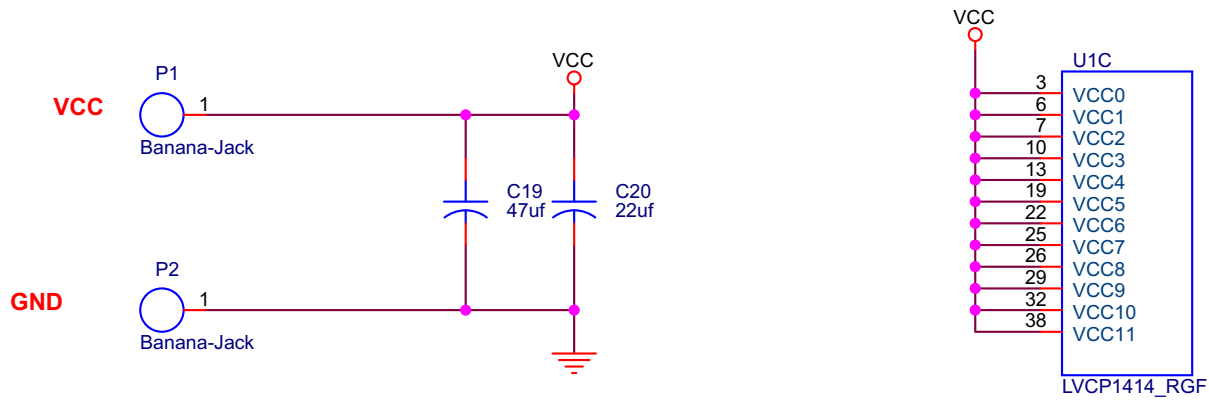


Figure 8. SN65LVCP1414 EVM Schematic, Sheet 5 Power

## 9 Bill of Materials

**Table 5. SN65LVCP1414 EVM Bill of Materials**

Reference	Value	Part	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30	0.1 $\mu$ F	0201	LMK063BJ104KP-F	Taiyo Yuden
C17, C18	1.0 $\mu$ F	0402	LMK105BJ105KV-F	Taiyo Yuden
C20	22 $\mu$ F	1206	GCM31CR70J226KE23L	Murata Electronics North America
C19	47 $\mu$ F	1210	LMK325BJ476MM-T	Taiyo Yuden
R29, R30	0.0 (Zero Ohm)	0402	ERJ-2GE0R00X	Panasonic - Ecg
R9	1.21 k $\Omega$	0402	CR0402-16W-1211FT	Venkel
R26, R27, R28	4.02 k $\Omega$	0402	CRCW04024K02FKED	Vishay/Dale
R2, R3, R8, R12, R13, R14, R16, R17, R18, R20, R21	4.99 k $\Omega$	0402	RG1005P-4991-B-T5	Susumu (VA)
U1	SN65LVCP1414RLJ	38-VQFN	SN65LVCP1414RLJ	Texas Instruments
U2	TXS0102DCTR	SM8	TXS0102DCT	Texas Instruments
JMP1, JMP2, JMP3, JMP4, JMP5, JMP6, JMP7, JMP9	1 X 4 T	0.1 in	HTSW-150-07-G-S	Samtec
JMP8	2 X 2	0.1 x 0.1 in	HTSW-150-07-G-D	Samtec
J17	SMT R/A	1.00 mm	MEC1-120-02-F-D-RA1-SL	Samtec
P1, P2	Banana Plug - Metal	4 mm	108-0740-001	Emerson Network Pwr Connectivity
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16	32K243-40ML5	RF screw type	32K243-40ML5	Rosenberger
screws	0.25 in- Stainless Steel	4-40 Phillips panhead	PMSSS 440 0025 PH	Building Fasteners
standoff	0.75 in - Aluminum	4-40 Round - F/F	2029	Keystone Electronics
R1, R4, R5, R6, R7, R10, R11, R15, R19, R22, R23, R24, R25	DNI	DNI	DNI	DNI

**10 Board Layout**
**Table 6. SN65LVCP1414 EVM PCB Layer Construction**

Layer	Type	CU Weight	CU %	Material Description	Via Structure	Segment	Glass Style	Material Family	Dielectric constant	Thickness After lamination [mil]
Soldermask										0.80
I1comp	Signal	H	100	6.6 mil H/1		Core		RO4350B	3.7	2.00
L2	Plane	1.0	60	Press thk = 7.52 mil		Prepreg	1080(65)	PCL-370HR	3.9	1.20
							106(75)	PCL-370HR	3.9	7.52
							1080(65)	PCL-370HR	3.9	
	Filler			28.0 mil -/-		Core		PCL-370HR	3.9	28.00
				Press thk = 7.52 mil		Prepreg	1080(65)	PCL-370HR	3.9	7.52
							106(75)	PCL-370HR	3.9	
							1080(65)	PCL-370HR	3.9	
L3	Plane	1.0	60							1.20
L4	Signal	H	100	6.6 mil 1/H		Core		RO4350B	3.7	6.60
Soldermask										2.00
										0.80

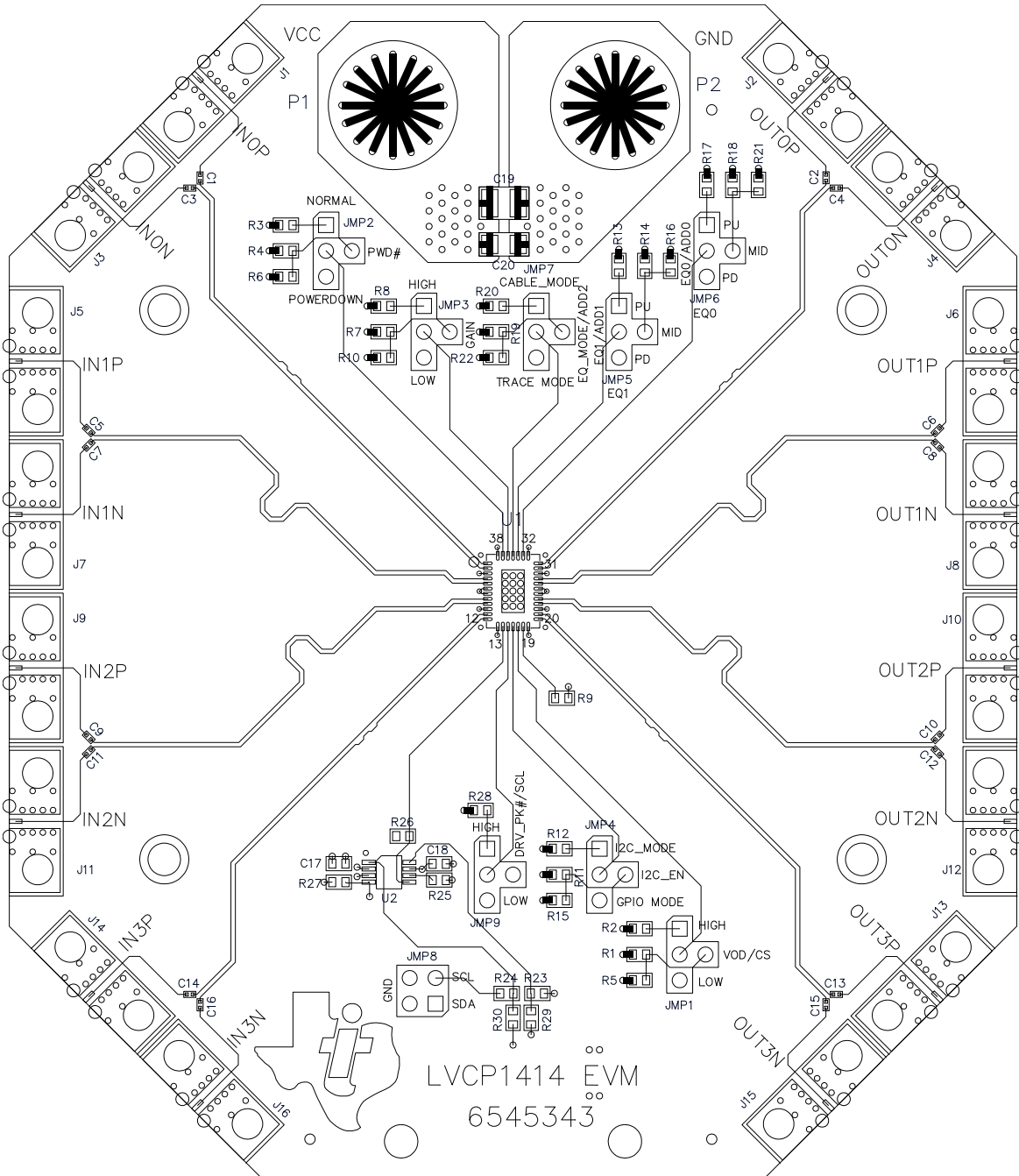
Specification (Over mask on plated copper):	mil
Overall Board Thickness:	64.0
Tolerance:	+6.4/-6.4
Min-Max Board Thickness:	57.6 - 70.4

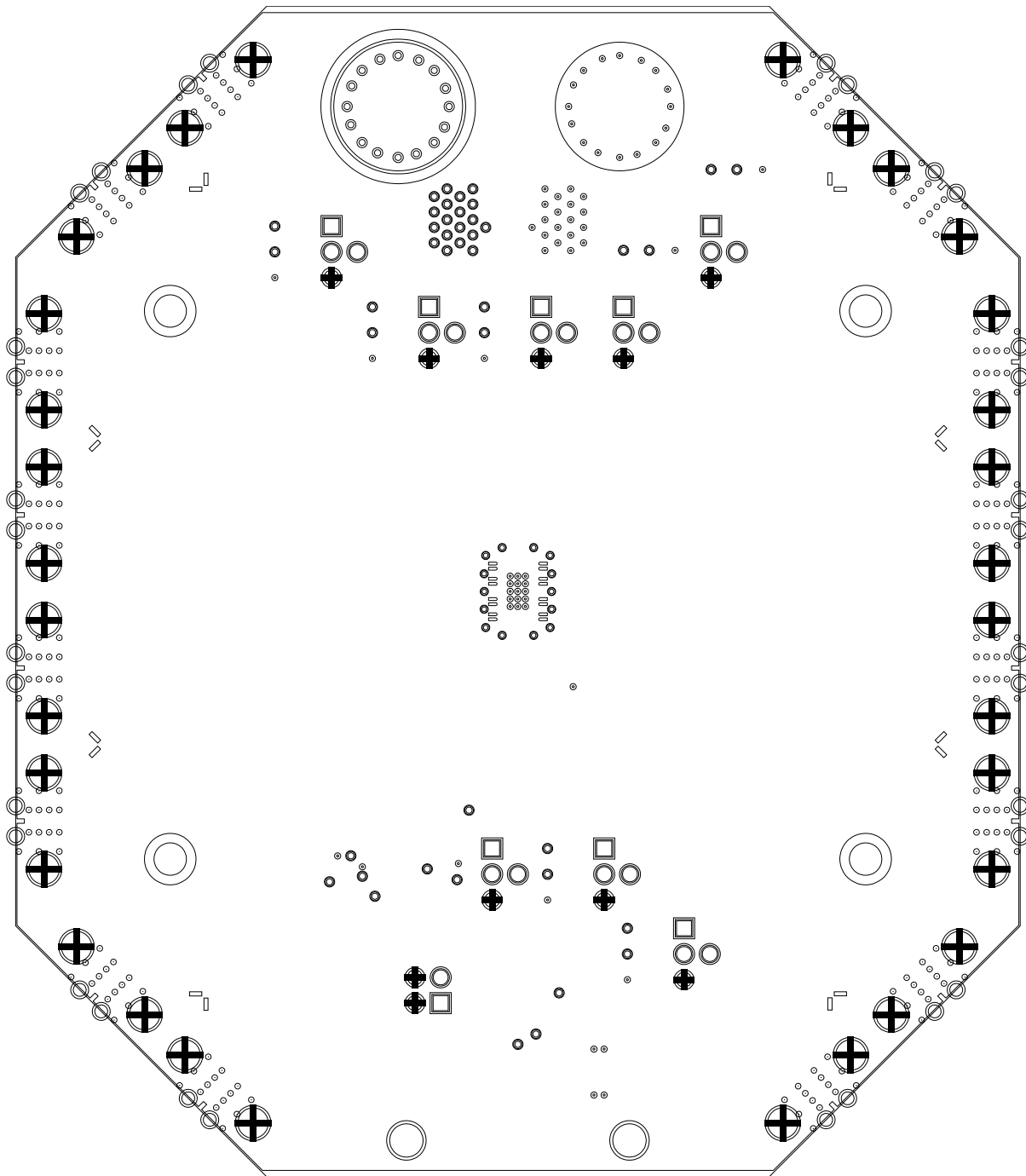
Anticipated Board Thickness:	mil
After lamination:	59.8
Over mask on plated copper:	64.2

**NOTE:** Always consult the board manufacturer for their process and design requirements ensuring the desired impedance is achieved.

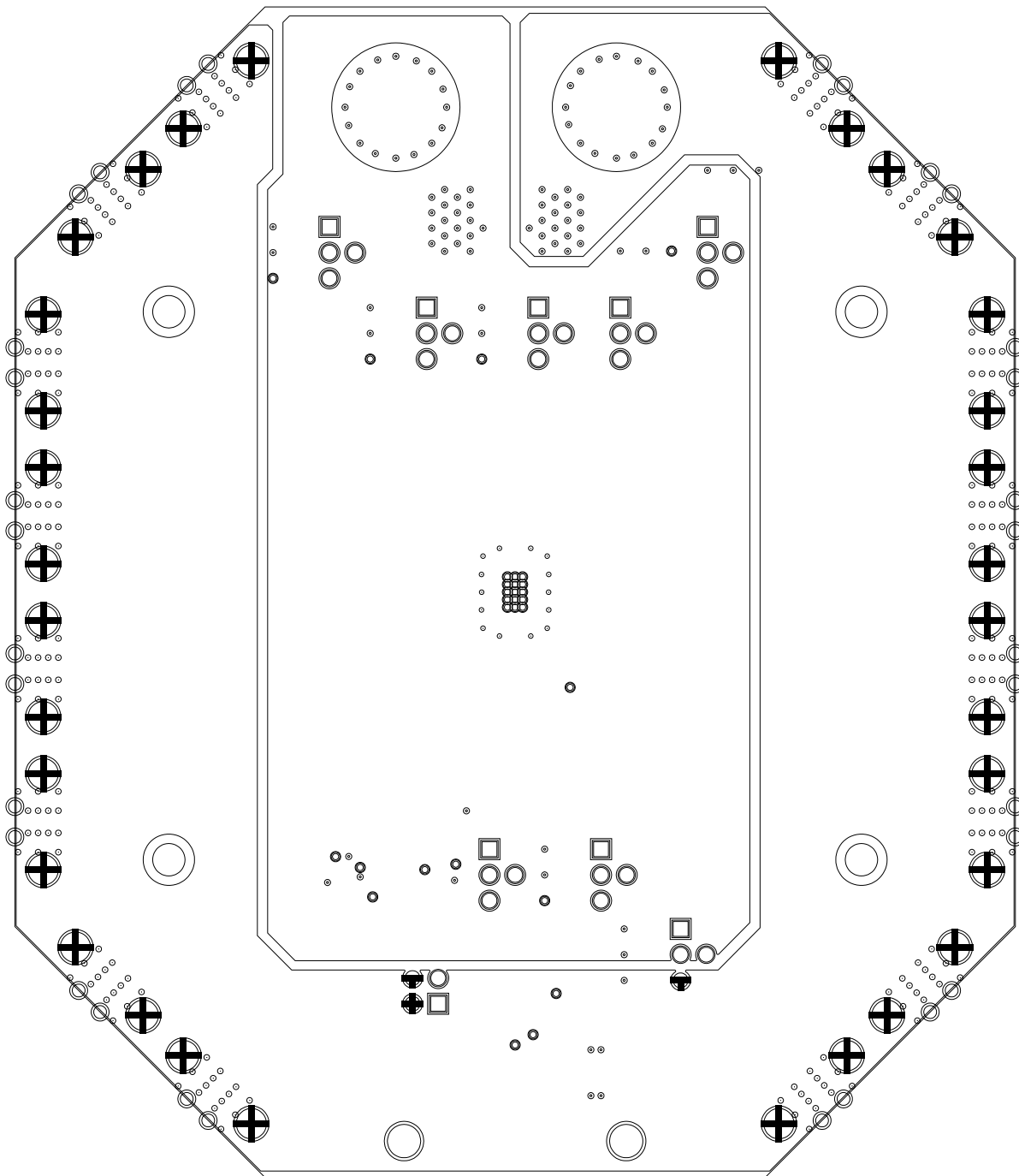




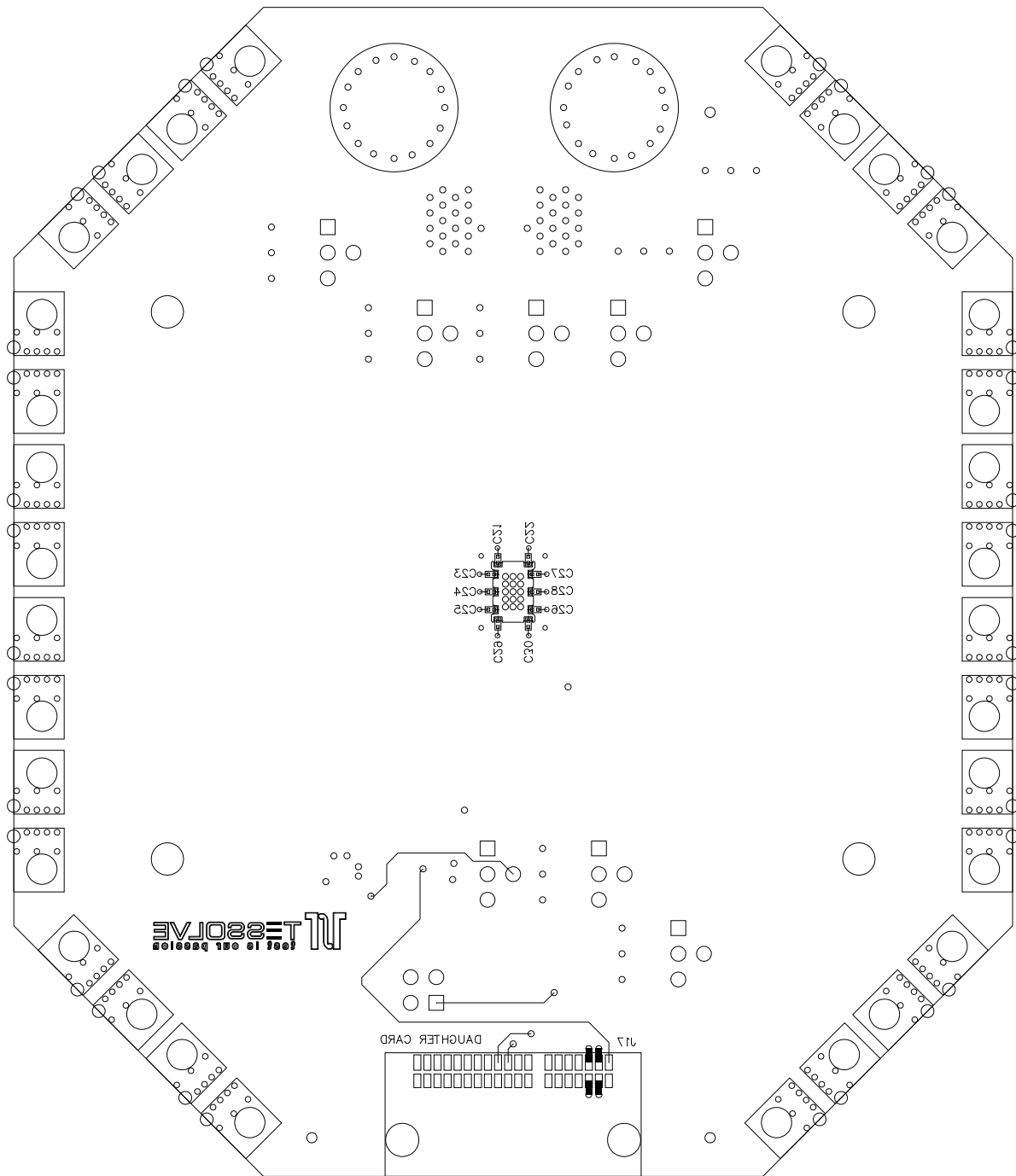
**Figure 9. SN65LVCP1414 Board Layout: Top Signal (Layer 1)**



**Figure 10. SN65LVCP1414 Board Layout: Internal Ground (Layer 2)**



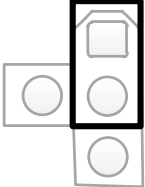
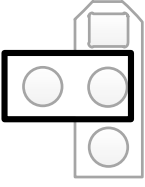
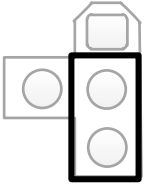

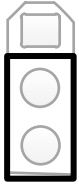
**Figure 11. SN65LVDS1414 EVM Board Layout: Internal Power (Layer 3)**



**Figure 12. SN65LVCP1414 Board Layout: Bottom Signal (Layer 4)**

## Appendix A Jumper Shunt Settings

The table below shows the different shunt settings of the 3 and 4 pin jumpers on the EVM.

Shunt Setting	Description
	High
	HiZ
	Low
	High
	Low

## 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](http://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**  
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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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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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## 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](http://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.

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

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In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

### Products

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Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
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