

# IWRL6432BOOST/AWRL6432BOOST EVM: FR4-Based Low Power 60 GHz mm-Wave Sensor EVM User Guide



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## 1 Abstract

The xWRL6432BOOST from Texas Instruments is an easy-to-use low cost FR4-based evaluation board for the xWRL6432 mmWave sensing device, with standalone operation and direct connectivity to the DCA1000EVM for raw ADC capture and signal processing development. This EVM contains everything required to start developing software for on-chip Hardware accelerator and low power ARM Cortex® M4F controllers.

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## Trademarks

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## 2 Getting Started

### 2.1 Key Features

- FR4-based PCB substrate
- Wide field of view antenna, targeted for wall mount applications
- Industrial: Building automation, Presence / motion detection, Displacement sensing, Robotics, Security and Surveillance, Vital sign detection, Gesture, Factory automation applications
- Automotive: In cabin sensing, Occupancy detection, Child presence detection, Intruder detection, Seat belt reminder, Gesture applications
- XDS110 JTAG interface with USB connectivity for code development and debugging
- Power optimized discrete DCDC power management solution
- Relaxed PCB rules: lower manufacturing cost
  - No micro vias, only through via
  - No vias on the BGA pads
- Serial port for onboard QSPI flash programming
- 60-pin, high-density (HD) connectors for raw analog-to-digital converter (ADC) data
- Onboard CAN-FD transceiver
- On board LIN PHY transceiver for automotive variant.
- USB powered standalone mode of operation
- EVM is designed as booster pack to connect with other LaunchPad EVMs
- On board 16Mbit QSPI flash

### 2.2 Kit Contents

xWRL6432BOOST includes the following:

- XWRL6432BOOST Evaluation board
- Micro USB cable
- Quick Start Guide

### 2.3 mmWave Out of Box Demo

TI® provides sample demo codes to easily get started with the XWRL6432BOOST evaluation module (EVM) and to experience the functionality of the XWRL6432 mmWave sensor. For details on getting started with these demos visit mmWave SDK on ti.com page.

### 3 Hardware

#### Note



CAUTION HOT SURFACE  
CONTACT MAY CAUSE BURN  
DO NOT TOUCH

The XWRL6432BOOST includes three receivers and two transmitters with a wide field of view sitting on an FR4 PCB substrate.

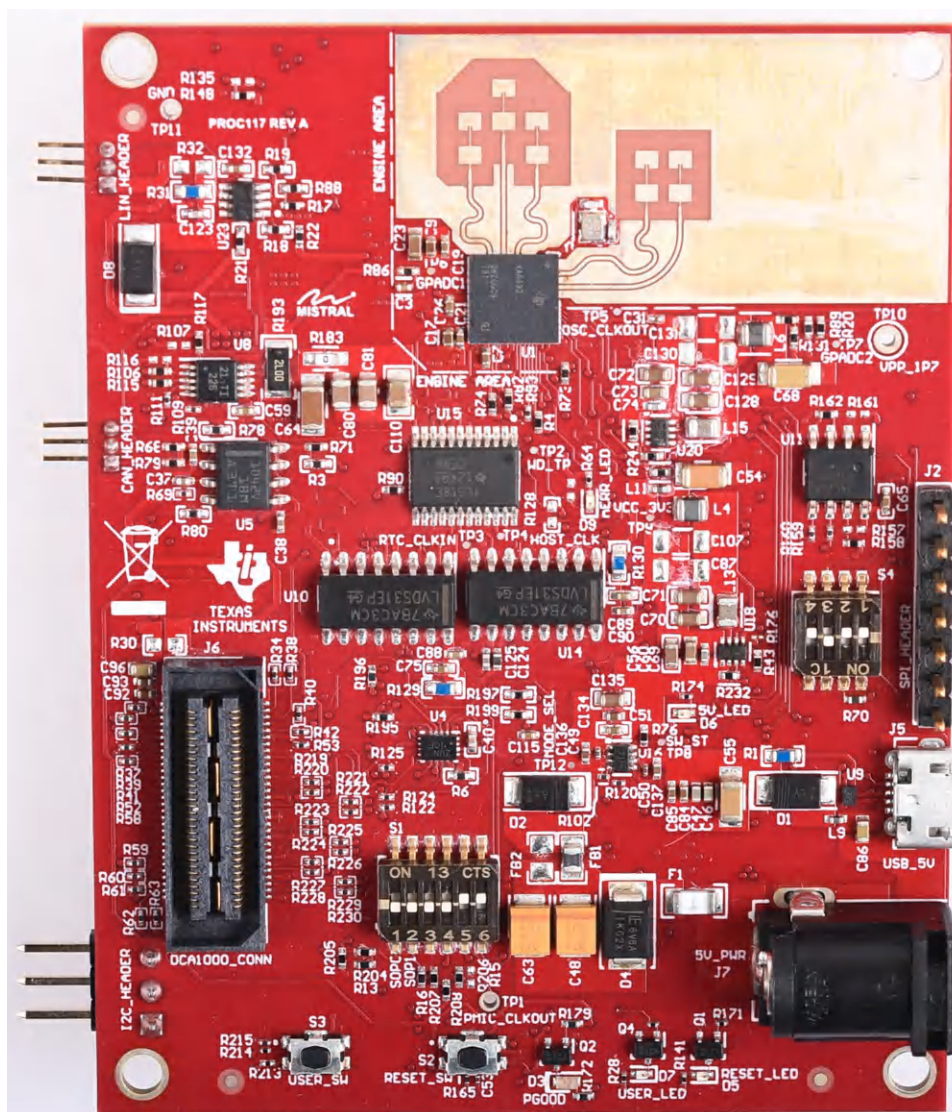


Figure 3-1. XWRL6432BOOST Top View



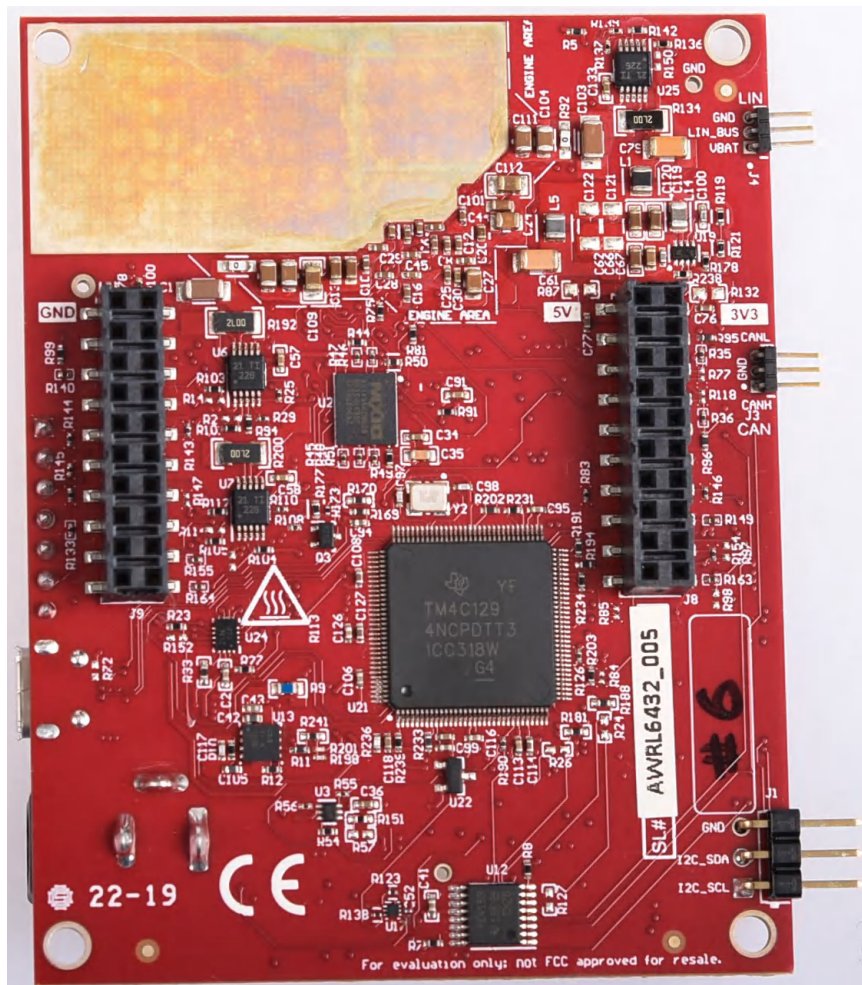


Figure 3-2. XWRL6432BOOST Bottom View

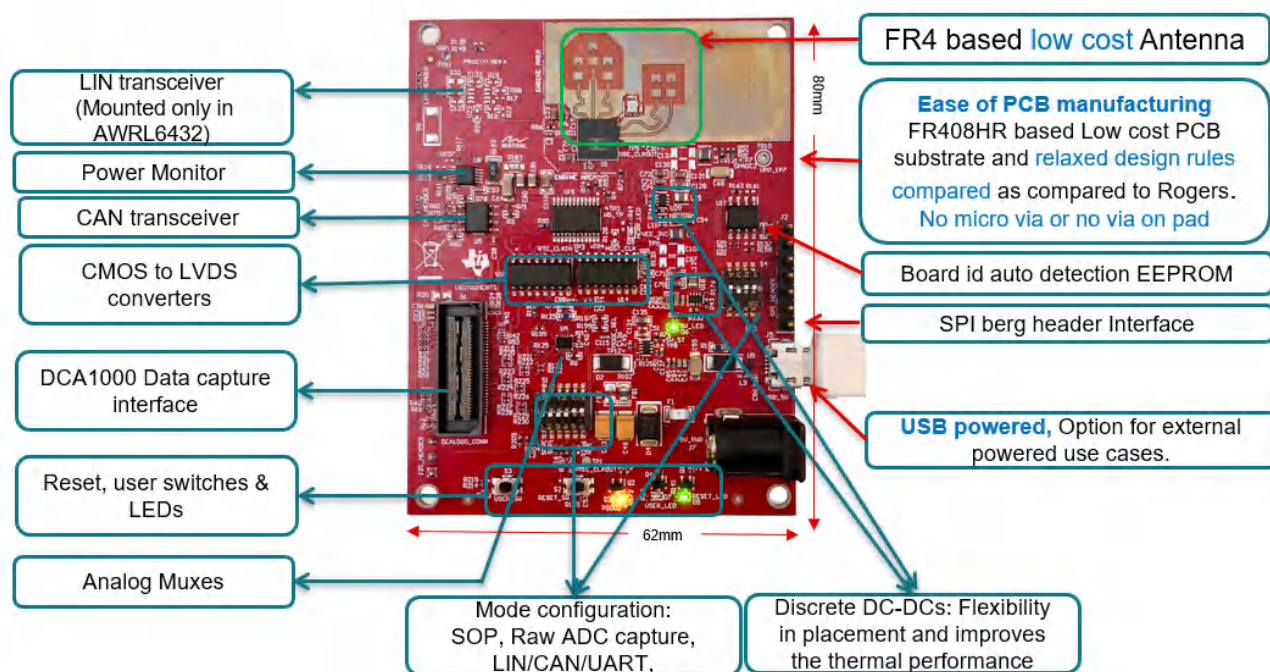


Figure 3-3. Salient Features of EVM (Top side)



**Figure 3-5. Functional block diagram**

Figure 3-5 shows the functional block diagram. The EVM contains the essential components for the TI mm-Wave radar system: DCDC, SFLASH, SOP configuration, Filter, TI mmWave Radar chip, a USB to UART converter, and a 60-pin Samtec connector for interfacing with the DCA1000. The board also hosts a booster pack connector which can be connected to TI's LaunchPad boards.

## 4 EVM Mux Block Diagram

Muxing options for the EVM shows different muxing options for the digital signals. The device is pin limited to support different features simultaneously; hence various internal IPs and signals are pin multiplexed. EVM provides de-muxing options using various analog mux and sliding switch options. Figure 4-1 shows different muxing switch positions to enable different muxing options to connect to different peripherals.

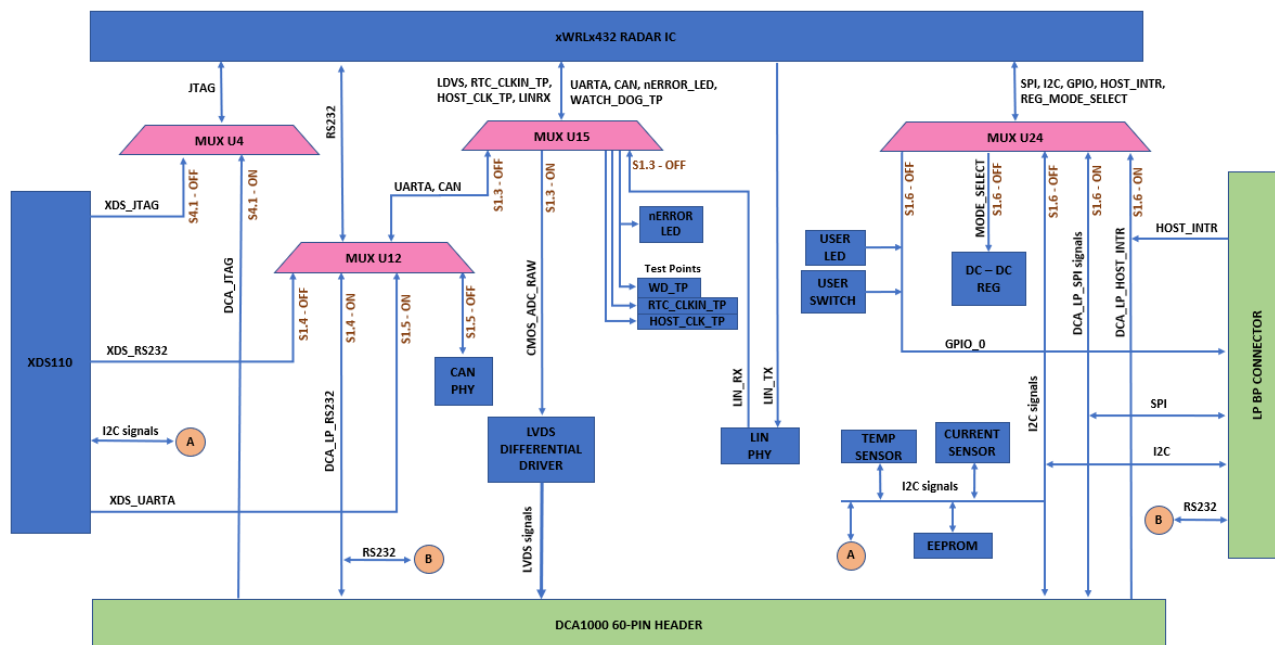


Figure 4-1. Muxing options for the EVM

## 5 PCB Storage and Handling Recommendations:

This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband and operate on an antistatic work surface. For more information on proper handling, refer to SSYA010A.

### 5.1 PCB Storage and Handling Recommendations:

The immersion silver finish of the PCB provides a better high-frequency performance, but is also prone to oxidation in open environment. This oxidation causes the surface around the antenna region to blacken however mmWave Radar performance would remain intact. To avoid oxidation, the PCB should be stored in an ESD cover and kept at a controlled room temperature with low humidity conditions. All ESD precautions must be taken while using and handling the EVM.

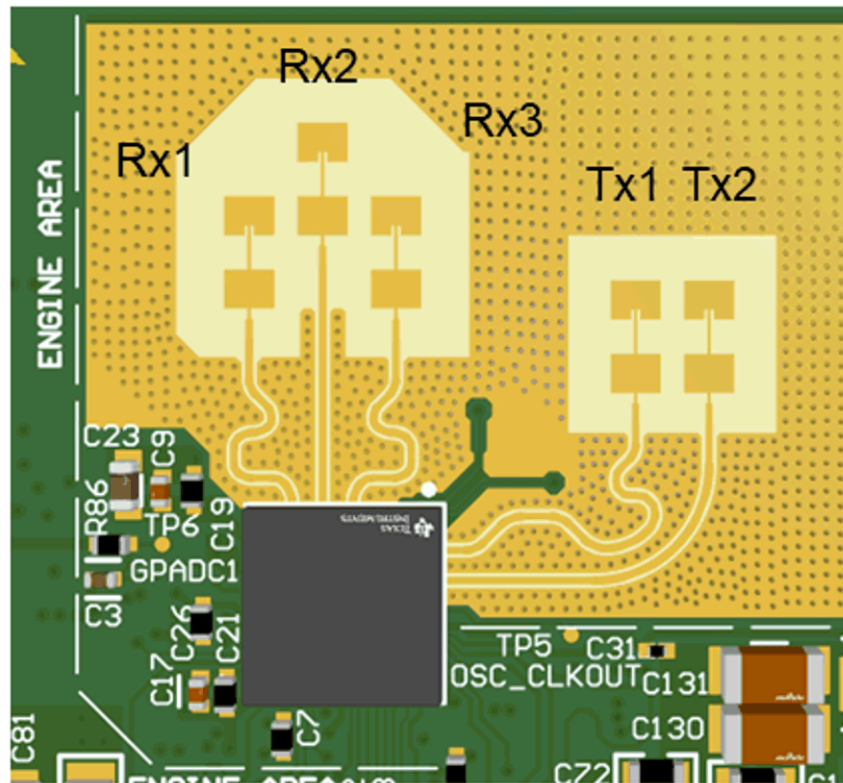
### 5.2 Higher Power Demanding Applications:

Most of the EVM could be operated with a single USB cable itself. For higher power consumption applications where a single USB-port cannot supply power needed, use an external 5V / 2A or higher power adaptor.



## 6 XWRL6432BOOST Antenna

The XWRL6432BOOST includes 3 receivers and 2 transmitters FR4 based antennas on the PCB. [Figure 6-1](#) shows the Antenna configuration.



**Figure 6-1. TX and Rx Antennas of the EVM**

### Note

The XWRL6432BOOST has an antenna gain of ~5-6 dBi across different antenna pairs

### 6.1 PCB material

Material used for this PCB is FR408HR ½ oz dual ply 2x1067 spread glass construction for the Antenna and transmission lines and 370HR is used for the rest of the layers.

Layer	Cu Thick. (mils)	Cu Foil wt (oz)	DK	Lam. Thick. (mils)	Description
1	1.60	0.5 oz	3.30	5.00	0.5oz + Plating Core FR408HR 5.00mils 2x1067 0.5 oz / 1 oz RTF
2	1.20	1 oz	3.90	5.85	Prepreg 370HR 1080(68)/1080(68)
3	1.20	1 oz	4.25	10.00	Core 370HR 10.00mils 2x2116 1 oz / 1 oz RTF
4	1.20	1 oz	3.90	5.65	Prepreg 370HR 1080(68)/1080(68)
5	1.20	1 oz	4.25	10.00	Core 370HR 10.00mils 2x2116 1 oz / 1 oz RTF
6	1.20	1 oz	3.90	6.05	Prepreg 370HR 1080(68)/1080(68)
7	1.20	1 oz	4.25	5.00	Core 370HR 5.00mils 1x2116 1 oz / 0.5 oz RTF 0.5oz + Plating
8	1.60	0.5 oz			

\* The outer finished copper thickness showed on the stack-up is nominal thickness instead of minimum value. The nominal value is used to simulate stack-up. The minimum value will follow the spec or IPC 6012 which specified.

Layer	Drill Type
1 - 8	PTH

58.95 Thickness over Soldermask

### 6.1.1 Transmitter and receiver virtual array

Transmitter and receiver antennas positions in Figure 6-2 form a virtual array of 6 transmitter and receiver pairs. This allows object detections finer azimuthal angular resolution ( $29^\circ$ ) and coarse elevation angular resolution ( $58^\circ$ ). Receiver antennas are spaced at distance  $D$  ( $\lambda/2$ ) and Transmitter antenna Tx1 and Tx2 spaced at  $2D$  ( $\lambda$ ) in azimuthal plane and  $D$  ( $\lambda/2$ ) in elevation plane. Tx1 and Tx2 are placed at  $D$  ( $\lambda/2$ ) in the elevation and  $2D$  ( $\lambda$ ) in azimuth plane.

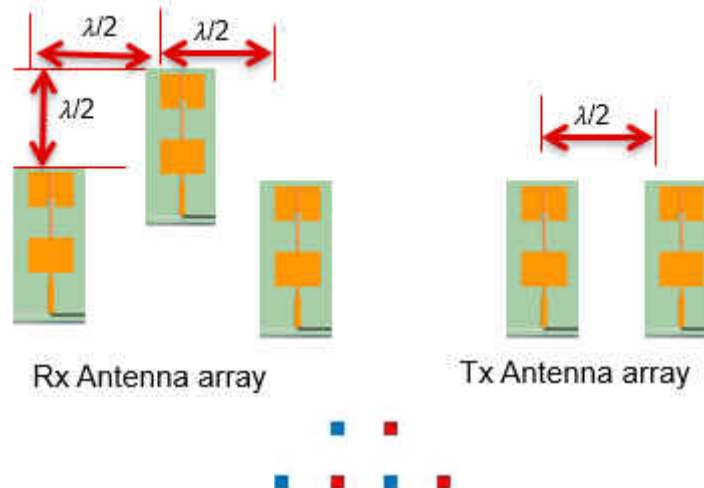


Figure 6-2. Virtual antenna array

Figure 6-2 shows the antenna radiation pattern with regard to azimuth and Figure 6-3 shows the antenna radiation pattern with regard to elevation for TX1 and TX2. Both show the radiation pattern for TX1 and TX2 and RX1, RX2 and RX3 together. All of the measurements were done with a Tx and Rx combination together. Thus, for the -6dB beam width, you must see a -12db (Tx (-6dB) + Rx(-6dB)) number from the boresight.

#### Note

Wavelength ( $\lambda$ ) is computed based on a frequency of 62GHz. Antenna placements are according to this frequency.

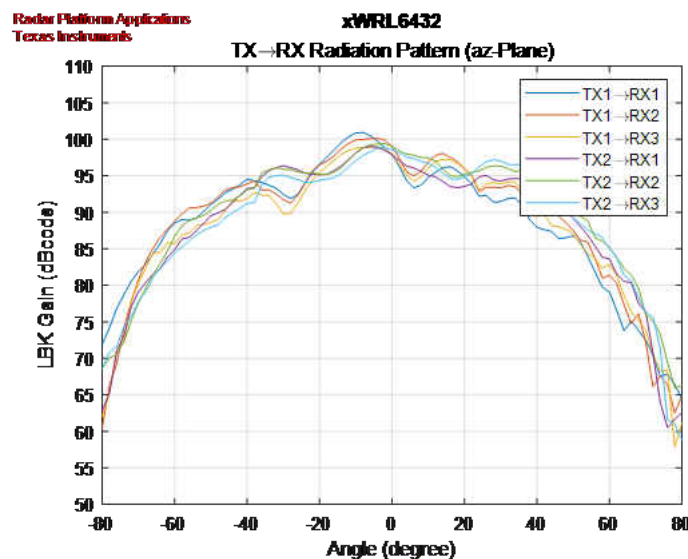
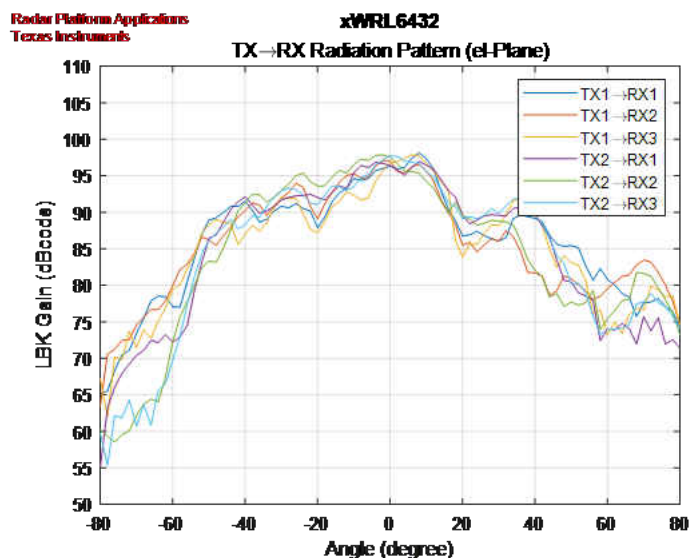


Figure 6-3. Azimuth Antenna Radiation Patterns

Measured azimuthal radiation pattern for all Tx to Rx pairs (Corner reflector placed at ~5 meters with a 4- GHz bandwidth chirp starting at 59GHz)



**Figure 6-4. Elevation Antenna Radiation Patterns**

Measured elevation radiation pattern for all TX to RX pairs (Corner reflector placed at ~5 meters with a 4-GHz bandwidth chirp starting at 59GHz)

#### Note

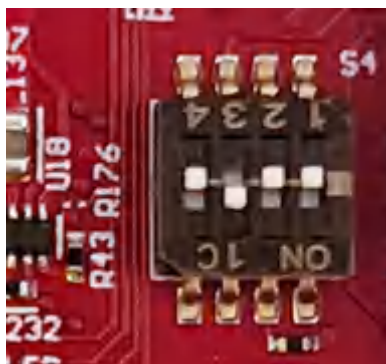
In accordance to the EN 62311 RF exposure test, a minimum separation distance of 20 centimeters should be maintained between the user and the EVM during operation.

## 6.2 Switch Settings

Figure 6-5 shows the part designators and positions of the switches (S1 and S4) on the XWRL6432BOOST.



**Figure 6-5. S1 Switch for Various Mode Settings**



**Figure 6-6. S4 Switch for Various mode Settings**

Figure 6-7 provides the different boot mode configurations to the device. Device supports application mode, QSPI flashing mode (Device management mode), and debug modes. This mode (SOP) configuration shown below in Figure 6-7 must be exercised first. After the SOP settings nRESET need to be issued to register the SOP settings. Figure 6-7 also provides the switch position for different modes of operation supported by the device and EVM.

	OFF	On	Flashing	Functional	Debug Mode (w/ DCA1000)
S1.1			Off	On	On
S1.2			Off	Off	On
S1.3	LVDS	LIN_RX, XDS_UARTA/Can, NERROR_LED, WATCH_DOG_TP, RTC_CLK_IN_TP, HOST_CLK_TPA	Off	Off	Off
S1.4	XDS_RS232	DCA_LP_RS232	Off	Off	Off
S1.5	CAN	XDS_UARTA	On	On	On
S1.6	I2C, REG_MODE, LED_SW_GPIO	SPI	On	On	On
S4.1	XDS_JTAG	DCA_JTAG	Off	Off	Off
S4.2	CAN PHY: Stand by Mode Disable	CAN PHY: Stand by Mode Enable	Off	Off	Off
S4.3	LIN PHY: Enable	LIN PHY: Disable	On	On	On
S4.4	-	-	-	-	-

**Figure 6-7. SOP Switches**

## 6.3 LEDs

Table 6-1 contains the list of LEDs on the XWRL6432BOOST.

**Table 6-1. List of LEDs**

LED reference designators	Description
D6	5V Power indication
D5	Reset LED.
D9	NERROR LED Note: There is switch settings are needed to enable this.
D7	User LED: Customer programmable. Note: There is switch settings are needed to enable this.
D3	Power good indication



## 6.4 Connectors

Higher current support: When using the EVM with the external power adaptor, the 5-V supply is provided by the external power adaptor. For most of the use-cases this external power supply option is not used, power is derived from the USB interface.



### Note

After the 5-V power supply is provided to the EVM, TI recommends pressing the NRST switch one time to ensure a reliable boot-up state.

### Note

All digital IO pins of the device (except NRESET) are non-failsafe; hence, care needs to be taken that they are not driven externally without the VIO supply being present to the device.

## 6.5 USB Connector

The USB connector provides a 5-V supply input to power the device; additionally the PC interface is brought out on this connector:

- UART for flashing the onboard serial flash, downloading FW through Radar Studio, and getting application data sent through the UART



Figure 6-8. USB Connector (J5)

## 6.6 DCA1000 HD Connector

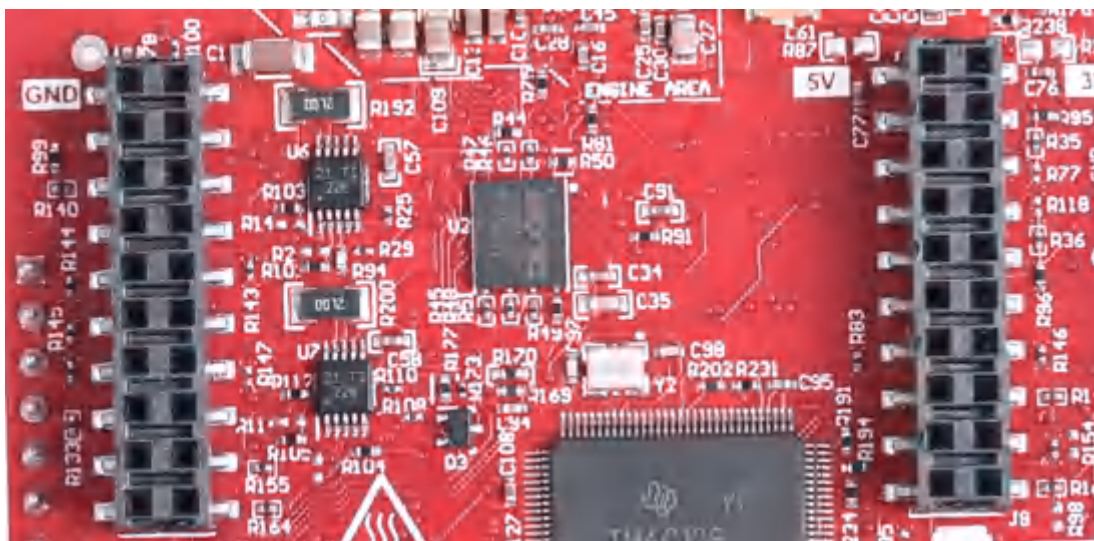
The 60-pin HD connector shown in [Figure 6-9](#) provides the high-speed data and controls signals (SPI, UART, I2C, NRST, NERROR, and SOPs) to the DCA1000.



**Figure 6-9. DCA1000 HD Connector**

### 6.7 Booster Pack Connector for the LaunchPad Connectivity

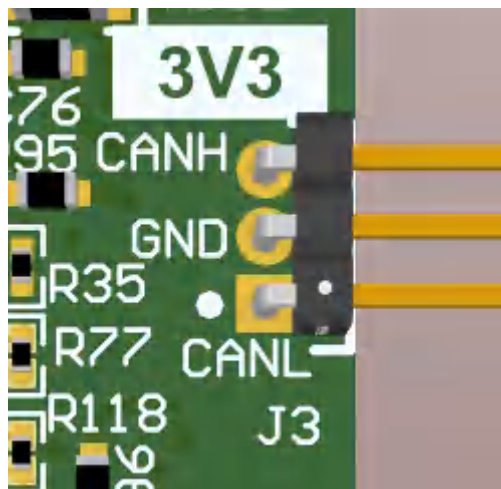
J8/J9 are the booster pack connectors provided for the connectivity option with the other TI LaunchPad ecosystem.



**Figure 6-10. Booster pack connector**

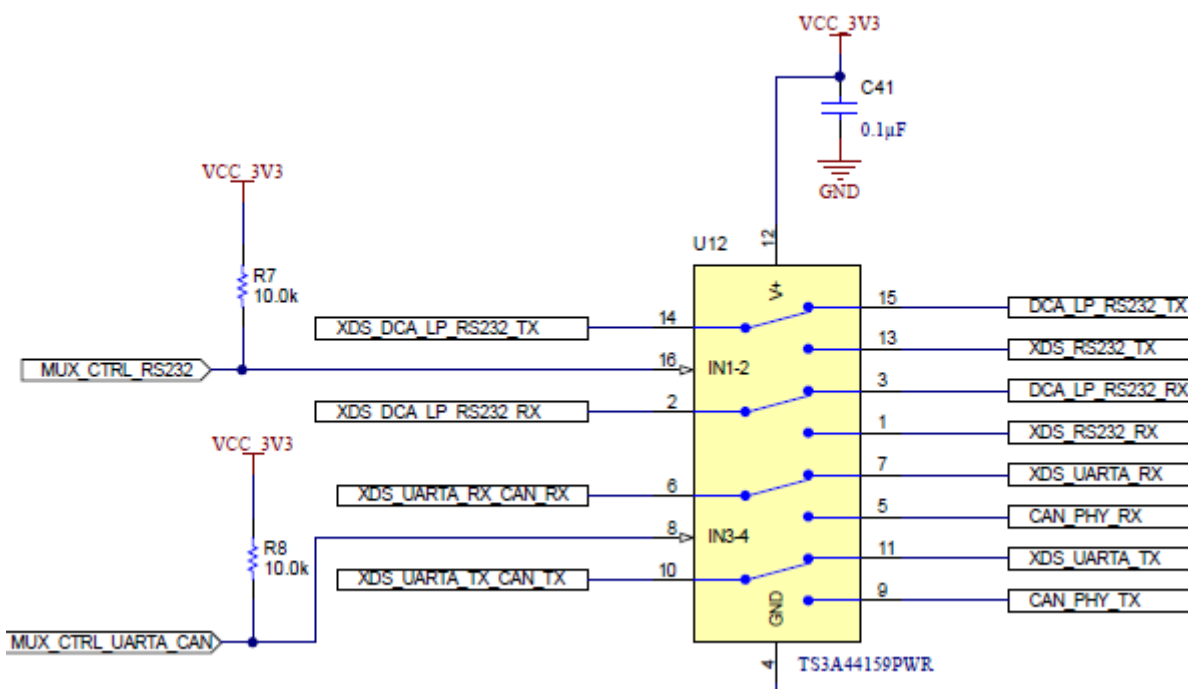
### 6.8 CANFD Connector

The CAN connector provides access to the CAN\_FD interfaces (CAN\_L and CAN\_H signals) from the onboard CAND-FD transceivers. These signals can be directly wired to the CAN bus.



**Figure 6-11. CANFD Connector**

The J3 connector shown in [Figure 6-11](#) provides the CAN\_L and CAN\_H signals from the onboard CAND-FD transceivers (TCAN1042HGVDRQ1). These signals are wired to the CAN bus after muxing with the SPI interface signals; one of the two paths must be selected. CAN signals are selected to PHY by changing the switch S1.5 to off position.



**Figure 6-12. Analog Mux for the CAN PHY Switch**

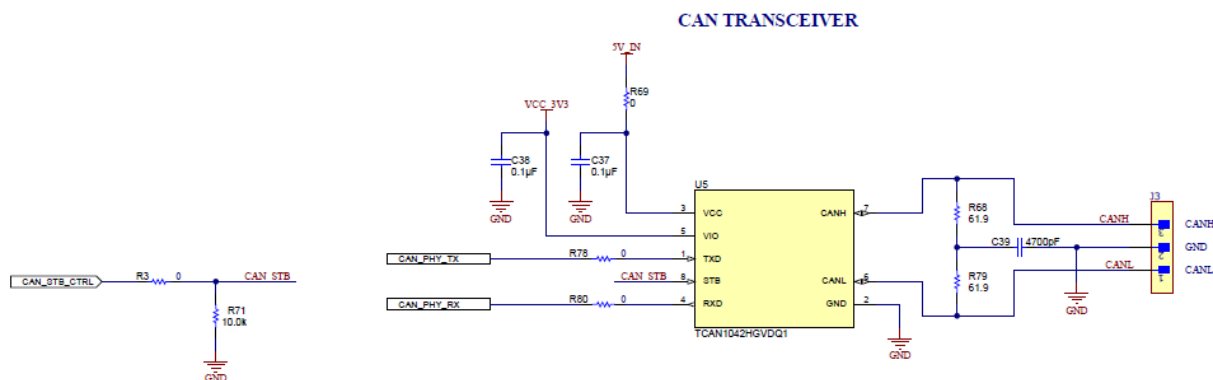


Figure 6-13. CAN FD PHY used in the EVM

## 6.9 LIN PHY connection

Figure 6-14 shows the LIN PHY (TLIN1039DDFRQ1) interface to the device. There are no switches for the LIN PHY interface. LIN PHY could operate with different supply voltage than the mmWave sensor, hence external VBAT option is provided for the LIN VDD supply, by default 5V\_IN supply is provided. To enable external VBAT supply, R32 resistor need to be mounted and R31 resistor need to be removed.



Figure 6-14. LIN header and PHY interface

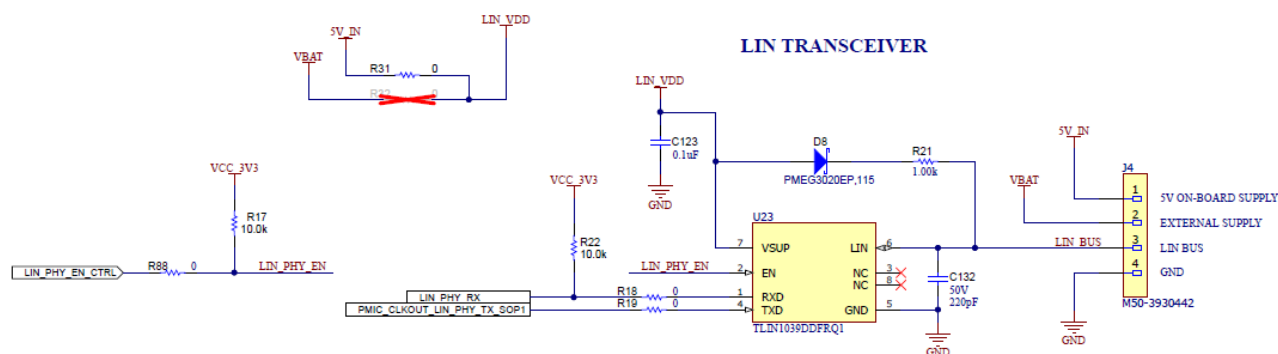


Figure 6-15. LIN PHY interface



## 6.10 I2C Connections

The board features an EEPROM, current sensors, and temperature sensor for measuring on-board temperature. These are connected to the I2C bus and can be isolated using the zero  $\Omega$  provided on the hardware. External I2C headers also provided for easy interface to I2C bus.

### 6.10.1 EEPROM

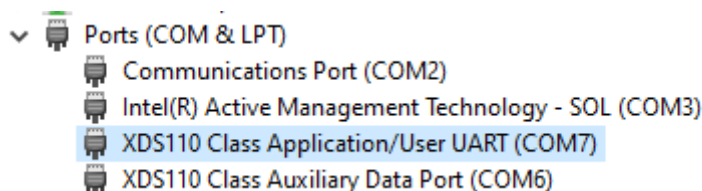
The board features an EEPROM for storing the board specific IDs (for the identification of the EVM through the XDS110 interface). Please refer to device schematics for the I2C addresses.

## 6.11 XDS110 Interface

J5 provides access to the onboard XDS110 (TM4C1294NCPDT) emulator. This connection provides the following interfaces to the PC:

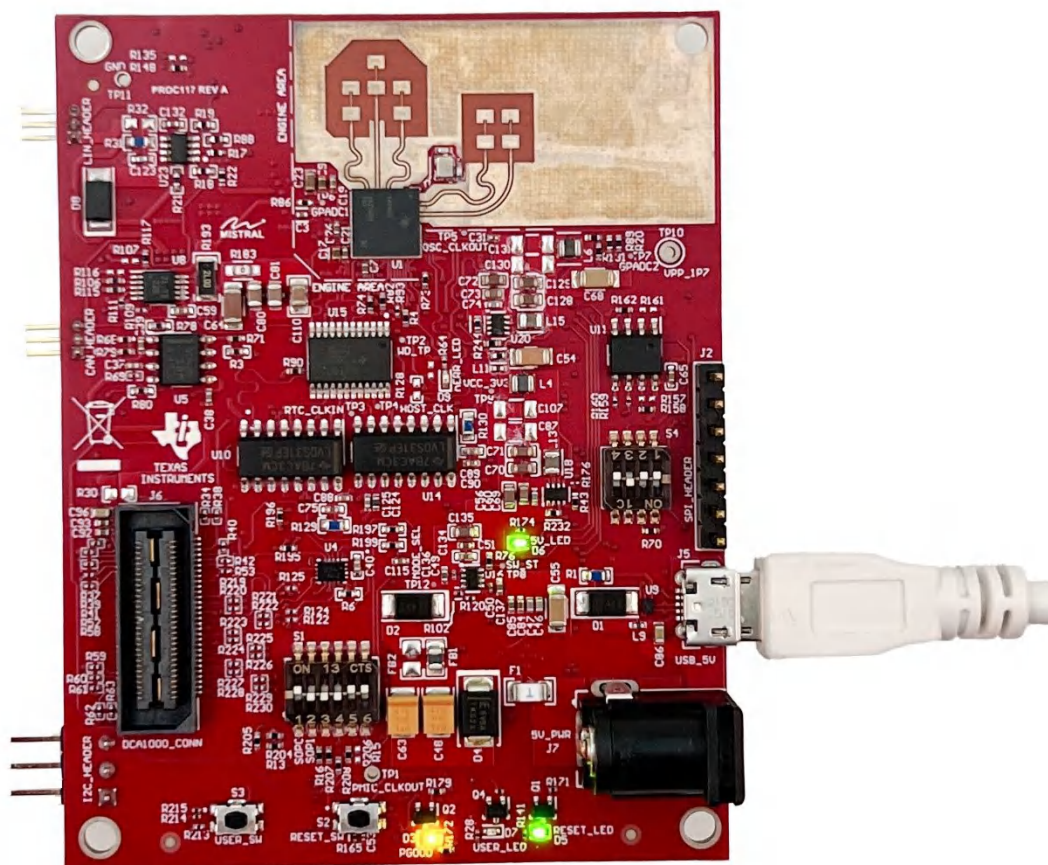
- JTAG for CCS connectivity
- Application/user UART (Configuration and data communication to PC)

When used in standalone mode of operation as shown in [Figure 6-16](#), the power is supplied through a single USB connector; the same USB connector J5 is also used for configuration and data transfer through the XDS110 USB to UART converter. When enumerated correctly, the 2 UART ports from the XDS110 are displayed on the device manager as a virtual COM Port, similar to that shown in [Figure 6-16](#).



**Figure 6-16. Virtual COM port**

If the PC is unable to recognize the above COM ports, install the latest [EMUpack](#).



**Figure 6-17. EVM in functional mode using standalone operation**

EVM uses single UART port for both device configuration and processed data communication to PC.

## 6.12 Flashing the Board

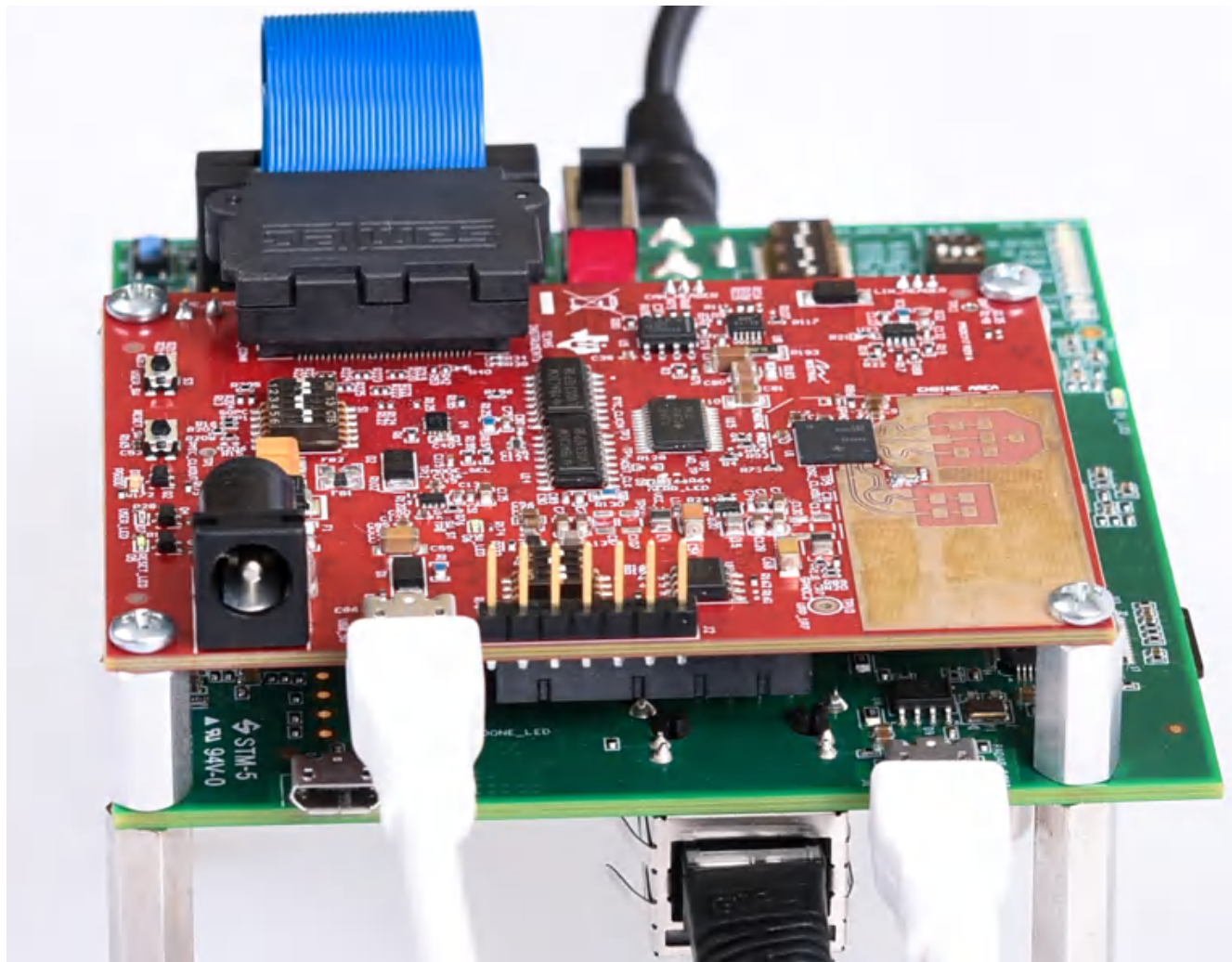
1. Ensure the drivers have been successfully installed and COM ports enumerated.
2. Configure the SOP to flashing mode.
3. Press the reset switch to ensure that the board boots up in the right mode.
4. Run the visualizer and use the flashing tab and follow the instruction or use Uniflash tool.
5. Enter the application port number for the flashing interface.
6. Load image to serial flash. Please refer mmWave SDK for the flash binary for running out of box demos.

## 6.13 DCA1000EVM Mode

The setup for raw data capture using DCA1000EVM is shown in [Figure 6-18](#).







**Figure 6-19. DCA1000EVM mode side view**

Please refer to [Figure 6-7](#) shown in the beginning of this document for the switch settings for the DCA1000 raw ADC capture card.

### 6.13.1 RDIF interface for Raw ADC capture

XWRL6432 doesn't have LVDS I/Os, mainly to reduce the overall power consumption of the SOC. However, DCA1000 board needs LVDS signals on the clock and data interface for raw ADC capture so CMOS to LVDS converters are used on the board as shown below. Data capture interface uses RDIF (Radar Data interface) for transferring the data between mmWave device and DCA1000 capture card. There is no change needed in the DCA1000 capture card for this purpose, however a new low power mmWave studio need to be used for this purpose. Low power mmWave studio interpret the RDIF interface and provides the raw ADC data visualization platform for further signal processing.



## DIFFERENTIAL LVDS DRIVER

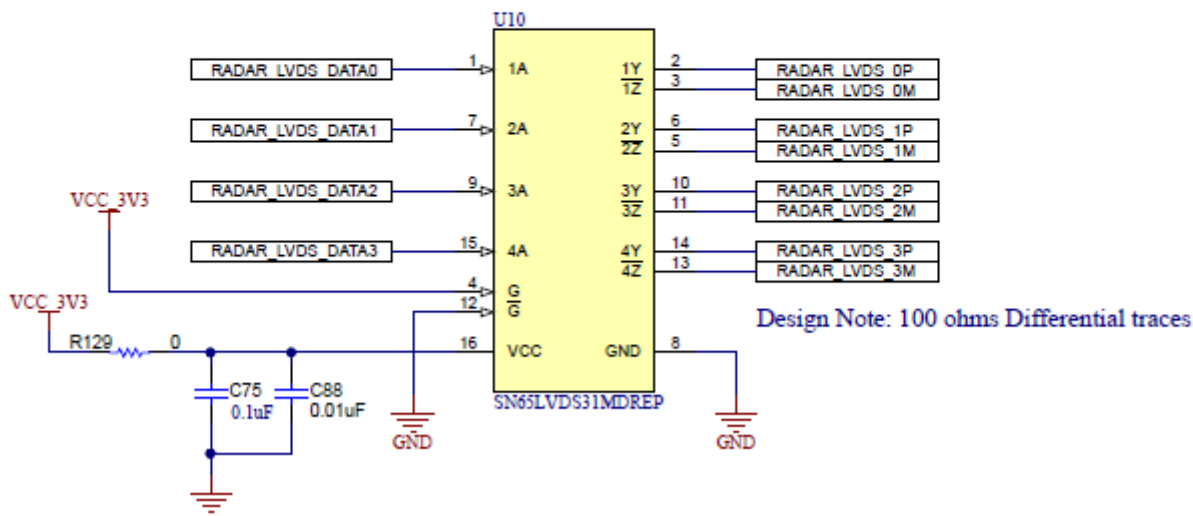


Figure 6-20. DCA1000 CMOS TO LVDS Conversion for Data Lines

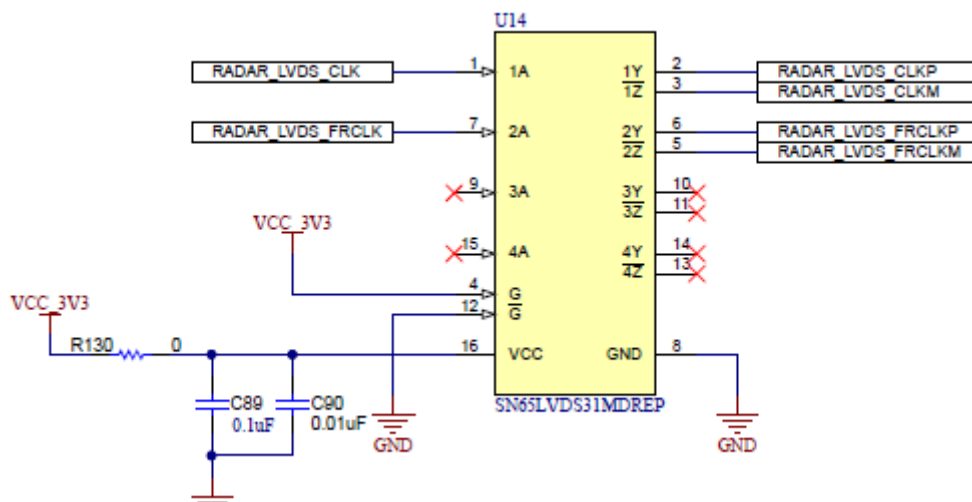


Figure 6-21. DCA1000 CMOS TO LVDS Conversion for Clock and Control Lines

## 7 Software, Development Tools, and Example Code

To enable quick development of end applications on the ARM® Cortex® M4F core in the XWRL6432, TI provides a software development kit (SDK) that includes demo codes, software drivers, emulation packages for debug, and more.

For more information, please refer to mmWave low power SDK user guide.

Below are the steps to running the demo visualizer using the EVM.

### 7.1 XWRL6432 Demo Visualization Getting Started

1. Step 1 : Connect the EVM to the PC via USB
2. Step 2 : Select the Device on the Visualizer. Check the SOP settings for “Functional mode”
3. Step 3 : “AUTO Detect” COM ports
4. Step 4 : In “System Config” tab of the visualizer perform “Scene Selection”
5. Step 5 : “Send Config to Device”
6. Step 6 : “Plots” tab should display point cloud information

## 8 TI E2E Community

Search the forums at [e2e.ti.com](http://e2e.ti.com). If you cannot find your answer, post your question to the community!

## 9 References

1. [DCA1000EVM Data Capture Card User's Guide](#)
2. [mmwave-sdk](#).

## Revision History

DATE	REVISION	NOTES
December 2022	*	Initial Release

## STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

**Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.**

**User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

### 3 Regulatory Notices:

#### 3.1 United States

##### 3.1.1 Notice applicable to EVMs not FCC-Approved:

**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

##### 3.1.2 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**

*NOTE: 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**

*NOTE: 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.*

#### 3.2 Canada

##### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

#### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSSs. 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.

#### **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.

#### **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.



### 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.

#### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/sds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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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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3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/sds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_02.page)

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#### 3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

#### 4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

##### 4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

#### 6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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