User's Guide

IWR6843L EVM

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ABSTRACT

The IWR6843LEVM from Texas Instruments is an easy-to-use low cost FR4-based evaluation board for the XWR6843 mmWave sensing device, with direct connectivity to the MMWAVEICBOOST and DCA1000EVM development kits. This EVM contains everything required to start developing software for on-chip C67x DSP core and low power Arm® Cortex®-R4F controllers

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1 Getting Started

1.1 Key Features

- FR4-based PCB substrate
- Wide field of view antenna: Azimuth FOV 120°, Elevation FOV 80°
- 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 over LVDS
- Onboard CAN-FD transceiver
- USB powered standalone mode of operation

1.2 Kit Contents

The following items are included in the IWR6843LEVM:

- IWR6843LEVM Evaluation board
- Micro USB

1.3 mmWave Out of Box Demo

TI provides sample demo codes to easily get started with the IWR6843LEVM evaluation module (EVM) and to experience the functionality of the IWR6843 radar sensor. For details on getting started with these demos, see www.ti.com/tool/mmwave-sdk.

CAUTION

- Caution Hot Surface
- Contact May Cause Burn
- Do Not Touch

2 Hardware

The IWR6843LEVM includes four receivers and three transmitters wide field of antennas on the FR4 PCB substrate.

The IWR6843 operates at a 4-GHz bandwidth from 60 to 64 GHz. The IWR6843LEVM has an antenna gain of ~5-6 dBi across different antenna pairs.

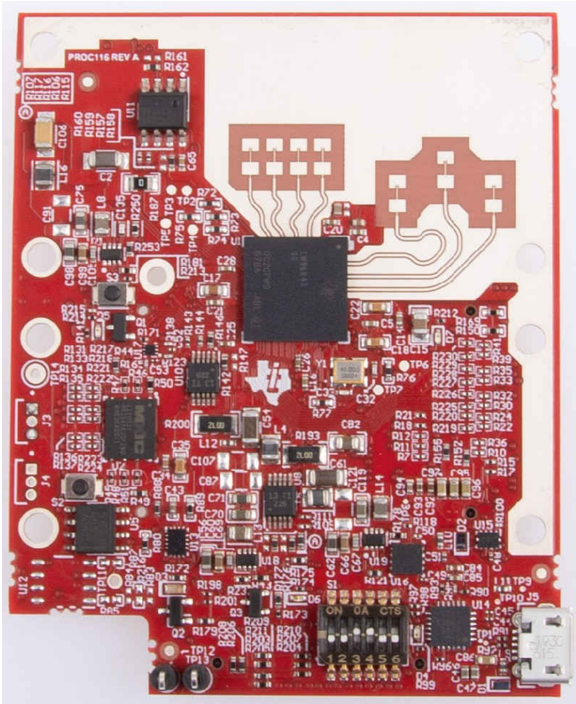

Figure 2-1. IWR6843LEVM Top View

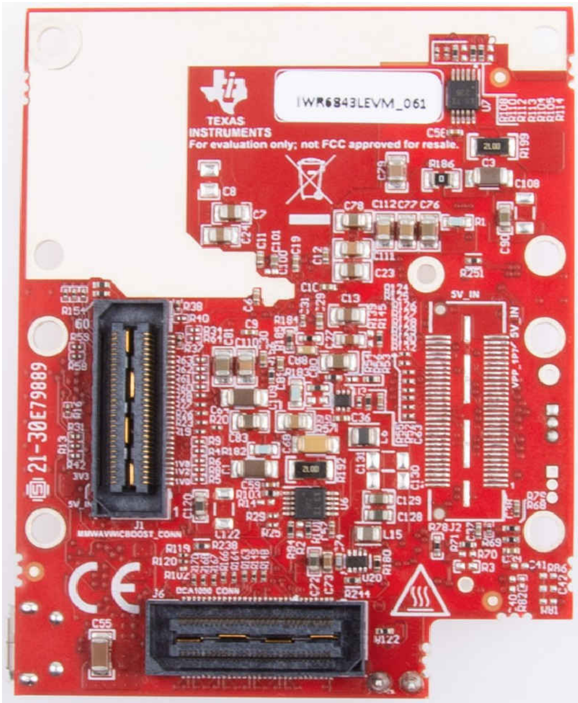

Figure 2-2. IWR6843LEVM Bottom View

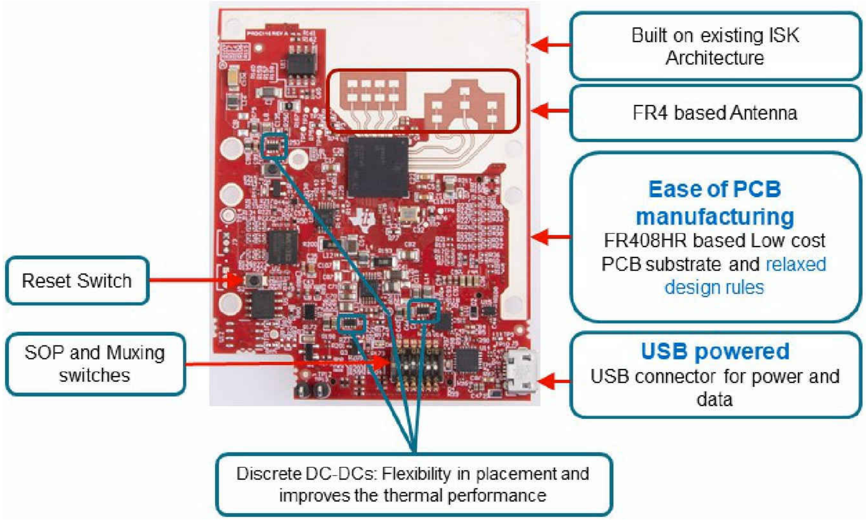

Figure 2-3. Salient features of EVM (top side)

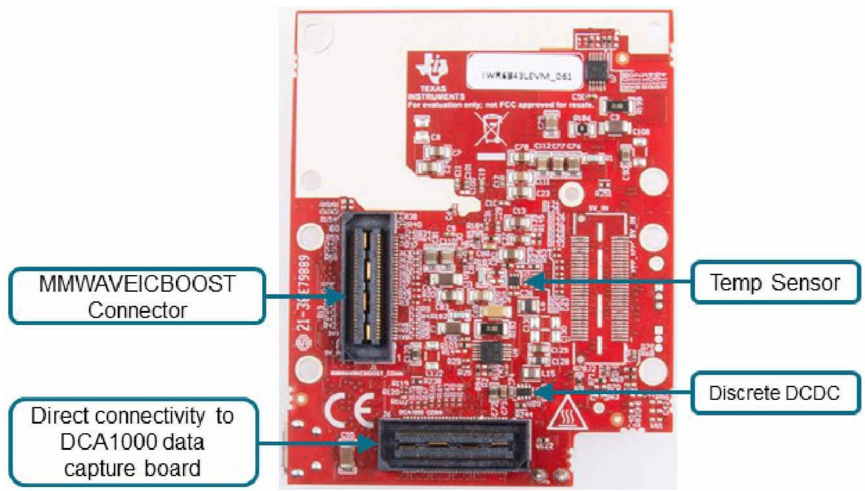

Figure 2-4. Salient features of EVM (bottom side)

2.1 Block Diagram

Figure 2-5 shows the functional block diagram. The EVM contains the essential components for the TI mmWave radar system, DCDC, SFLASH, SOP configuration, Filter, TI mmWave Radar chip, and a USB to universal asynchronous receiver/transmitter (UART) converter, two 60-pin Samtec connectors for interfacing with the DCA1000 and MMWAVEICBOOST.

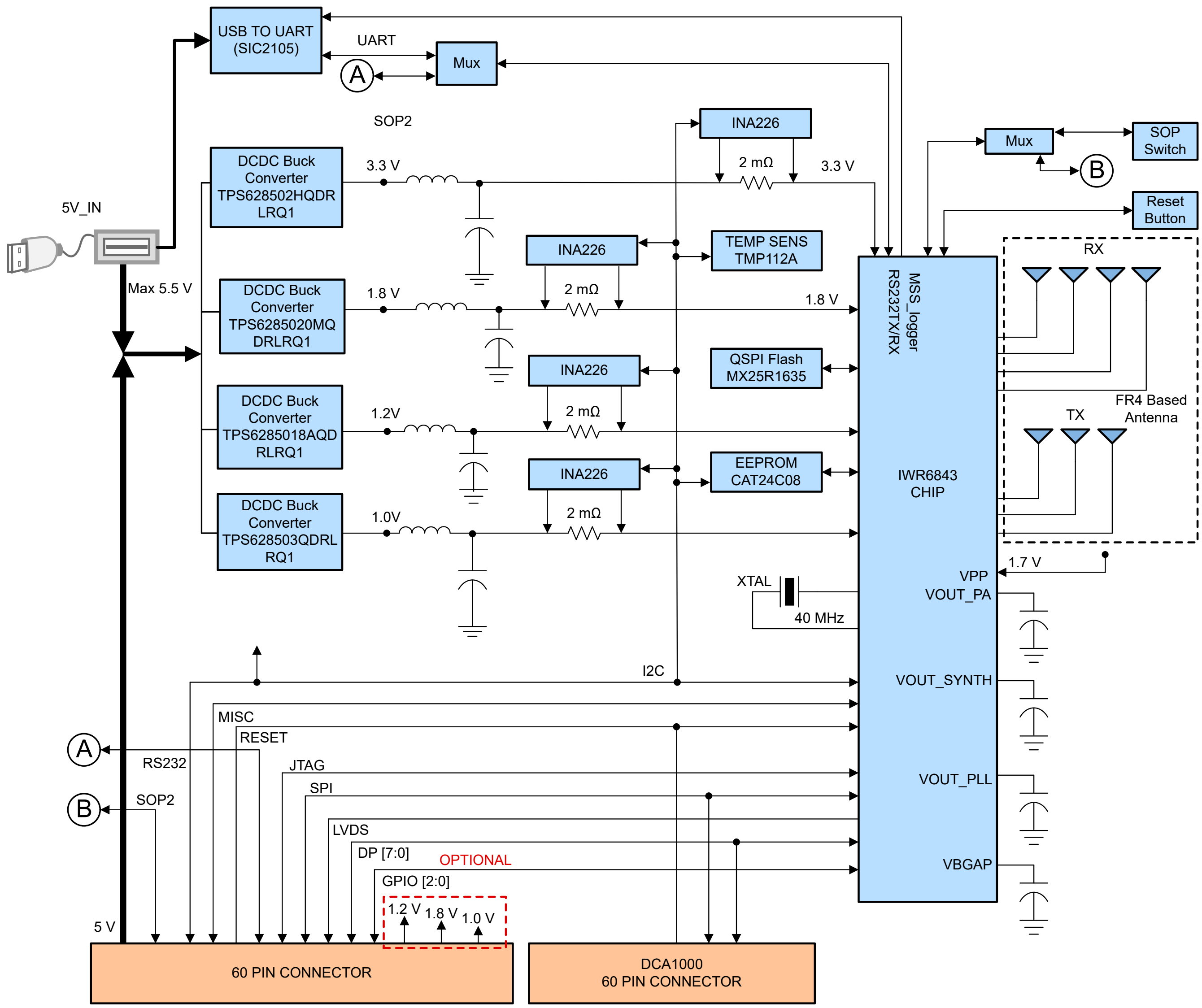

Figure 2-5. Functional Block Diagram

3 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. Operate on an antistatic work surface. For more information on proper handling, see *Electrostatic Discharge (ESD)*.

3.1 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 be 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.

3.2 Higher Power Demanding Applications

For higher power applications, which single USB-port cannot supply, for example simultaneous 3 Tx operation MMWAVEICBOOST board could be used which has external power adapter to power the entire board.

4 IWR6843LEVM Antenna

The IWR6843LEVM includes four receivers and three transmitters FR4 based antennas on the PCB. Figure 4-1 shows the Antenna configuration.

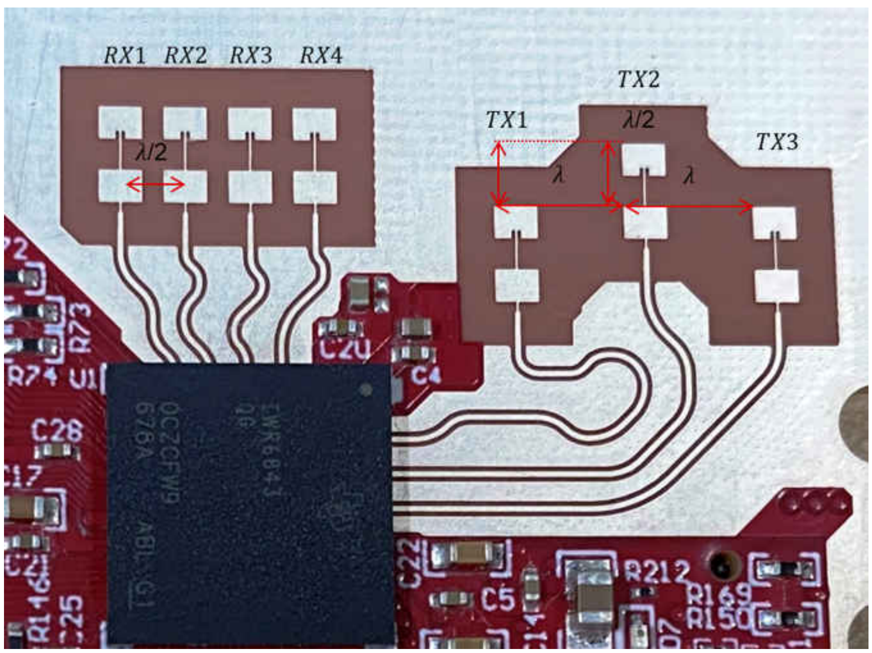

Figure 4-1. TX and Rx Antennas of the EVM

4.1 Transmitter and Receiver Virtual Array

The transmitter and receiver antenna's positions form a virtual array of 12 transmitter and receiver pairs (as shown in Figure 4-2). This allows the object detections finer azimuthal angular resolution (15°) and coarse elevation angular resolution (58°). 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. Tx2 and Tx3 are placed at D (lambda/2) in the elevation and 2D (Lambda) in azimuth plane.

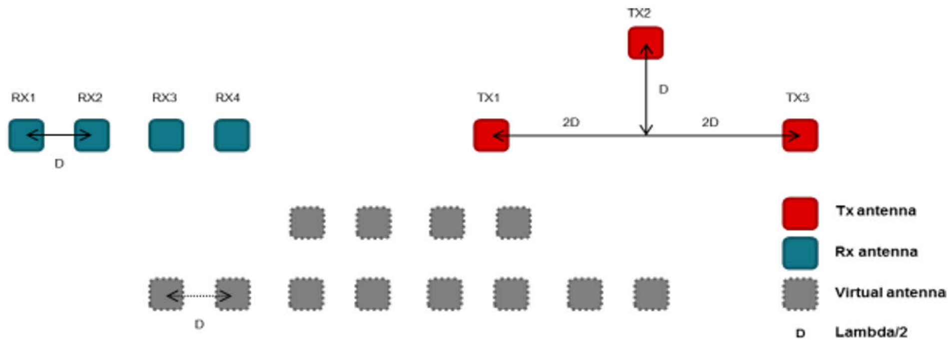

Figure 4-2. Virtual Antenna Array

Figure 4-3 shows the antenna radiation pattern with regard to azimuth. Figure 4-4 shows the antenna radiation pattern with regard to elevation for TX1, TX2, and TX3. Both show the radiation pattern for TX1, TX2, and TX3 and RX1, RX2, RX3, and RX4 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 62 GHz frequency. Antenna placements are done according to this frequency.

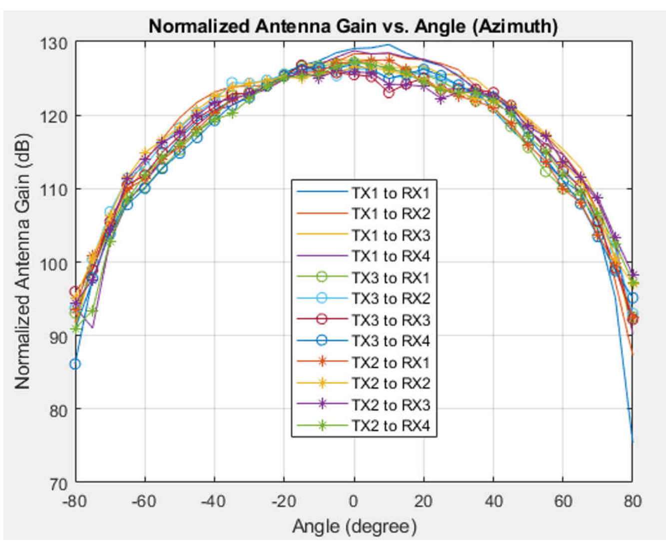

Figure 4-3. Azimuth Antenna Radiation Patterns

Measured azimuthal radiation pattern for all Tx to Rx Pairs (Corner Reflector Placed at approximately 4 meters with a 2- GHz Bandwidth Chirp starting at 62 GHz).

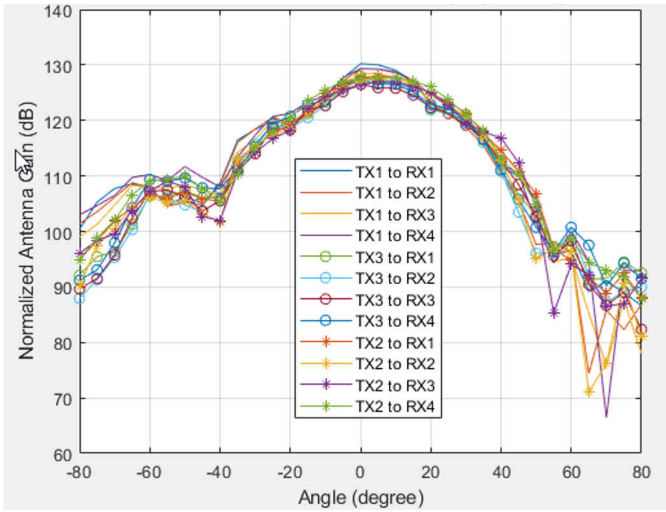

Figure 4-4. Elevation Antenna Radiation Patterns

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.

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5 Hardware Details

5.1 Switch Settings

Figure 5-1 shows the part designators and positions of the switches on the IWR6843LEVM.

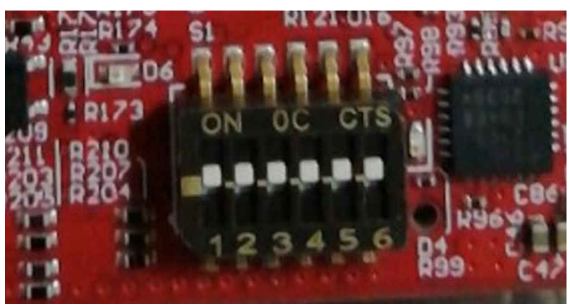

Figure 5-1. Part Designators and Positions of the Switches on the IWR6843LEVM

Table 5-1. Switches, Buttons and Muxes

Reference Designator	Switch On	Switch Off
S1.1	SOP2 pulled up	SOP2 pulled down
S1.2	SOP1 pulled up	SOP1 pulled down
S1.3	SOP0 pulled up	SOP0 pulled down
S1.4	Muxes to CAN connector J3, J4	Muxes to serial peripheral interface (SPI) on 60 pin connector, J1, J6
S1.5	Muxes USER UART to 60 pin header J1	Muxes USER UART to USB connector J5
S1.6	-	-
S2	Reset switch	
S3	GPIO1 toggle switch	

5.2 LEDs

Table 5-2 contains the list of LEDs on the IWR6843LEVM.

Table 5-2. List of LEDs

Reference Designator	Color	Usage	Comment
D3	Orange	Power good	This LED is used to indicate the PGOOD. If this LED is glowing, it means that all of the voltage rails are in limits.
D4	Green	USB enumeration LED	Turns on while enumerating the USB
D5	Green	Reset	Toggles when reset button is depressed
D6	Green	5 V indicator	Indicates the application of 5 V power
D7	Green	GPIO 2	Connected to GPIO2 can be used when GPIO is set as an output.

5.3 Connectors

Higher current support: When using the EVM with the MMWAVEICBOOST, the 5-V supply is provided by the MMWAVEICBOOST board, so power over the USB connector is not required.

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 NERROR IN, NERROR_OUT, and WARM_RESET) are non-failsafe; hence, care needs to be taken that they are not driven externally without the VIO supply being present to the device.

5.4 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
- MSS logger UART (can be used to get MSS code logs on the PC)

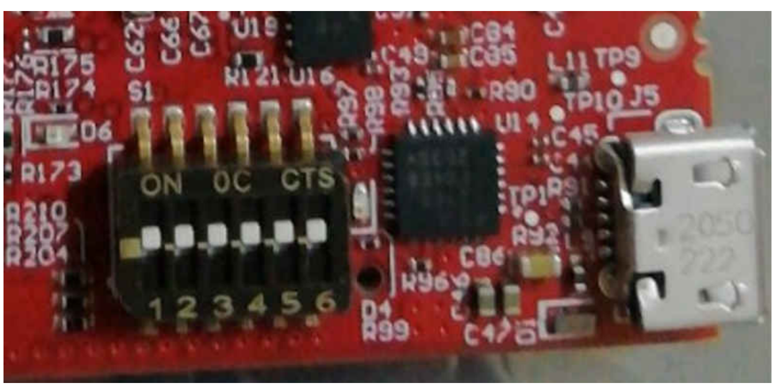

Figure 5-2. USB Connector (J5)

5.5 DCA1000 HD Connector

The 60-pin HD connector shown in Figure 5-3 provides the high-speed LVDS data, and controls signals (SPI, UART, Inter-Integrated Circuit (I2C), NRST, NERROR, and SOPs) to the DCA1000.

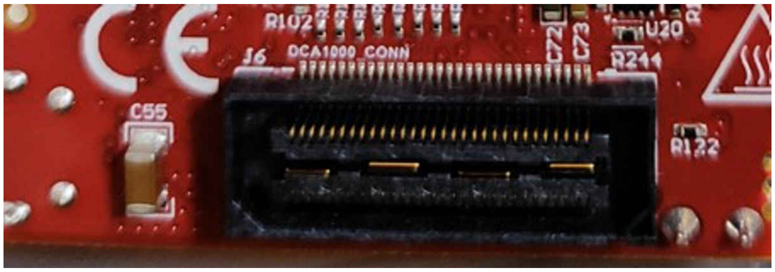

Figure 5-3. DCA1000 HD Connector

5.6 MMWAVEICBOOST HD Connector

The 60-pin HD connector shown in Figure 5-4 provides the high-speed LVDS data, controls signals (SPI, UART, I2C, NRST, NERR, and SOPs) and JTAG debug signals to the MMWAVEICBOOST. The Trace and DMM interface lines are also available through this connector (not connected by default).

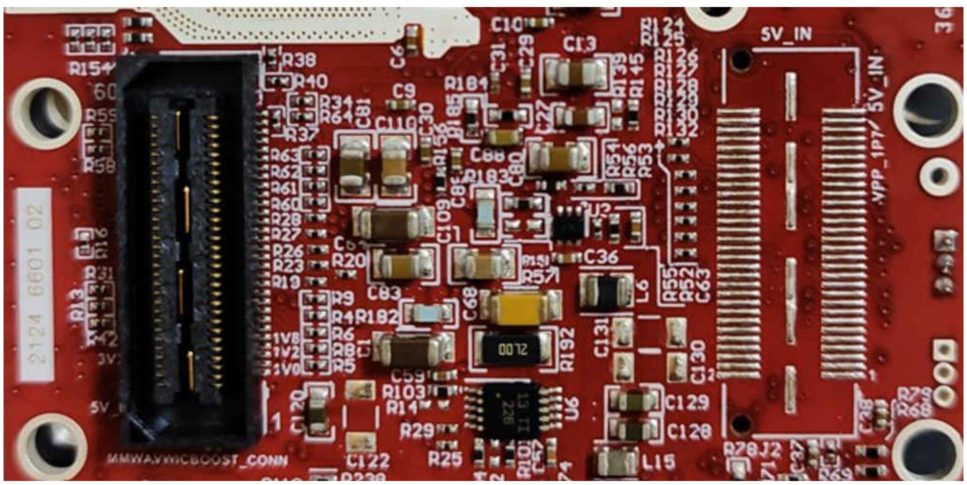

Figure 5-4. MMWAVEICBOOST HD Connector

5.7 CANFD Connector

The CAN connector provides access to the two 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.

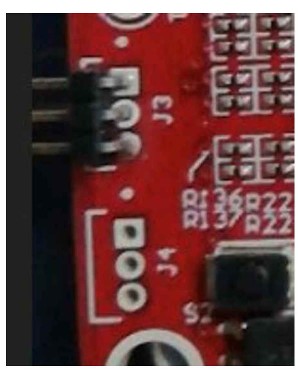

Figure 5-5. CANFD Connector

Table 5-3 shows the J3 and J4 connectors that provide the CAN_L and CAN_H signals from the 2 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. Two CANs are selected by closing the switch S1.4 (1st position of switch to be ON).

Table 5-3. CAN Pin Assignment

Pin Description	Device Interface	Connector on Board
SPI_CS1	CAN2_TX	J4.1 - CANL, J4.2 - GND, J4.3 - CANH
SPI_CLK1	CAN2_RX	
MISO_1	CAN1_TX	J3.1 - CANL, J3.2 - GND, J3.3 - CANH
MOSI_1	CAN1_RX	

5.8 I2C Connections

The board features an EEPROM, current sensor, and temperature sensor for measuring on-board temperature. These are connected to the I2C bus and can be isolated using the zero Ω provided on the hardware.

5.9 EEPROM

The board features an EEPROM for storing the board specific IDs (for the identification of the starter kit connected to the MMWAVEICBOOST).

5.10 Default I2C Address

Table 5-4 provides the list of I2C devices and its address.

Table 5-4. List of I2C Device and Addresses

Sensor Type	Designator	Part Number	Slave Address
Temperature sensor	U3	TMP112AQDRLRQ1	100 1011
EEPROM	J11	CAT24C08W1-GT3	101 00XX (1)
Current sensor 1	U6	INA226AIDGST	100 0000
Current sensor 2	U7	INA226AIDGST	100 0101
Current sensor 3	U8	INA226AIDGST	100 0001
Current sensor 4	U10	INA226AIDGST	100 0100
PMIC	U4	LP87702DRHBRQ1	110 0000

1. XX means 00,01,10,11

5.11 Modular Mode

When used in modular mode as shown in Figure 5-7, the power is supplied through a single USB connector; the same USB connector J5 is also used for data transfer through the CP2015 USB to UART converter. When enumerated correctly, the 2 UART ports are displayed on the device manager as a Virtual COM Port, similar to that shown in Figure 5-6.

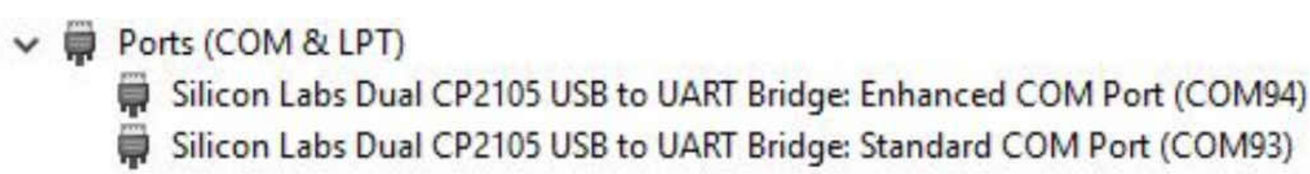

Figure 5-6. Virtual COM Port

The SICP2105 drivers must be installed to access the UART port. Download and install the drivers here.

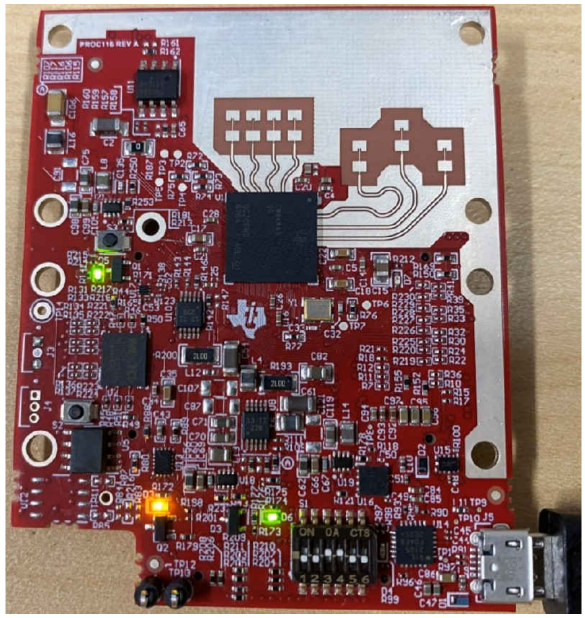

Figure 5-7. EVM in Functional Mode Using Standalone Operation

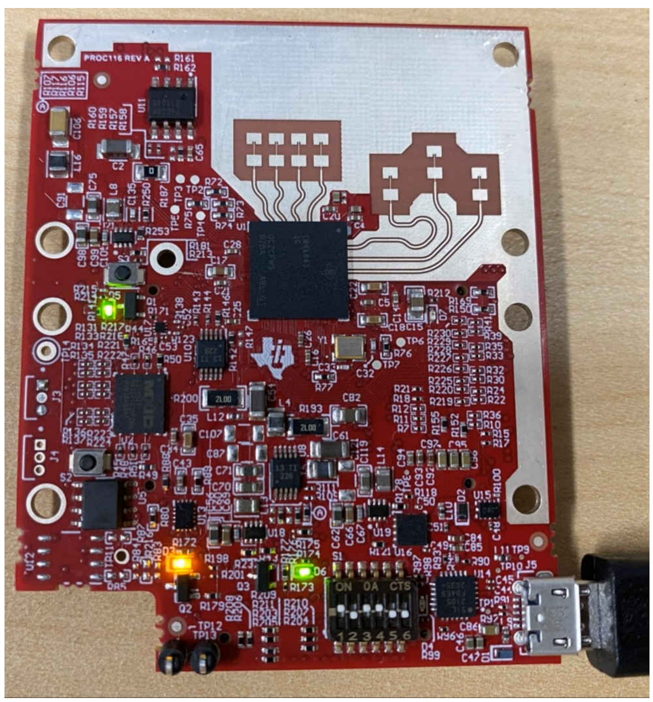

Figure 5-8. EVM in Flashing Mode Using Standalone Operation

The enhanced COM port is the application/user UART and the standard COM port is the data port.

The S1 switch setting for functional and flashing mode is shown in Table 5-5.

Table 5-5. S1 Swtch Setting for Functional and Flashing Mode

	S1.1	S1.2	S1.3	S1.4	S1.5	S1.6
Flashing	On	Off	On	On	Off	-
Functional	Off	Off	On	On	Off	-

5.12 Flashing the Board

1. Ensure the drivers have been successfully installed and COM ports enumerated.
2. Configure the SOP to flashing mode.
3. Run the UniFlash tool.
4. Press the reset switch to ensure that the board boots up in the right mode.
5. Enter the Enhanced COM Port in UniFlash interface.
6. Load image to serial flash. For running out of box demos, see the mmWave SDK for the flash binary.

For running the demo applications please refer training videos from training.ti.com link provided below:

- Hardware Setup for IWR6843ISK and IWR6843ISK-ODS | TI.com Video
- Hardware Setup for MMWAVEICBOOST and antenna module | TI.com Video

5.13 DCA1000EVM Mode

The setup for raw data capture using DCA1000EVM is shown in Figure 5-9.

Figure 5-9. DCA1000EVM Mode

S1 switch settings for this mode is shown in Table 5-6.

Table 5-6. S1 Configuration for DCA1000EVM Mode

	S1.1	S1.2	S1.3	S1.4	S1.5	S1.6
DCA1000EMV mode	Off	On	On	Off	Off	-

5.14 MMWAVEICBOOST Mode

In this mode the boards are setup as shown in Figure 5-10, UART is routed to the 60 pin connector to the XDS110 USB. This mode enables access to debugging tools available on the MMWAVEICBOOST such as the JTAG, RAW ADC capture through MMWAVEICBOOST camera-mount option, CAN, Launchpad connector, and so forth.

Note

In MMWAVEICBOOST mode, the IWR6843LEVM is mounted on the MMWAVEICBOOST and the SOP mode is set by the MMWAVEICBOOST.

More on the mmWAVEICBOOST, setup and features it provides can be found in the *MMWAVEICBOOST* section of MMWAVEICBOOST EVM userguide.

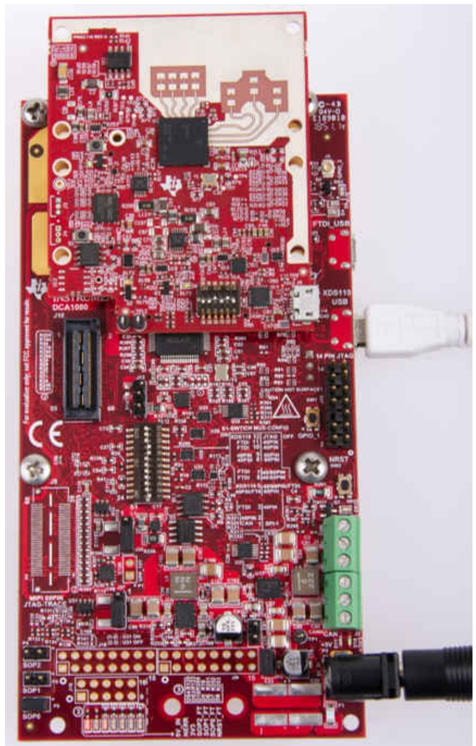

Figure 5-10. MMWAVEICBOOST Mode

5.15 Raw ADC Data Capture Using MMWAVEICBOOST and DCA1000 EVMs

This mode enables raw data capture using the DCA1000 EVM via MMWAVEICBOOST. MMWAVEICBOOST supports higher current and camera mount options.

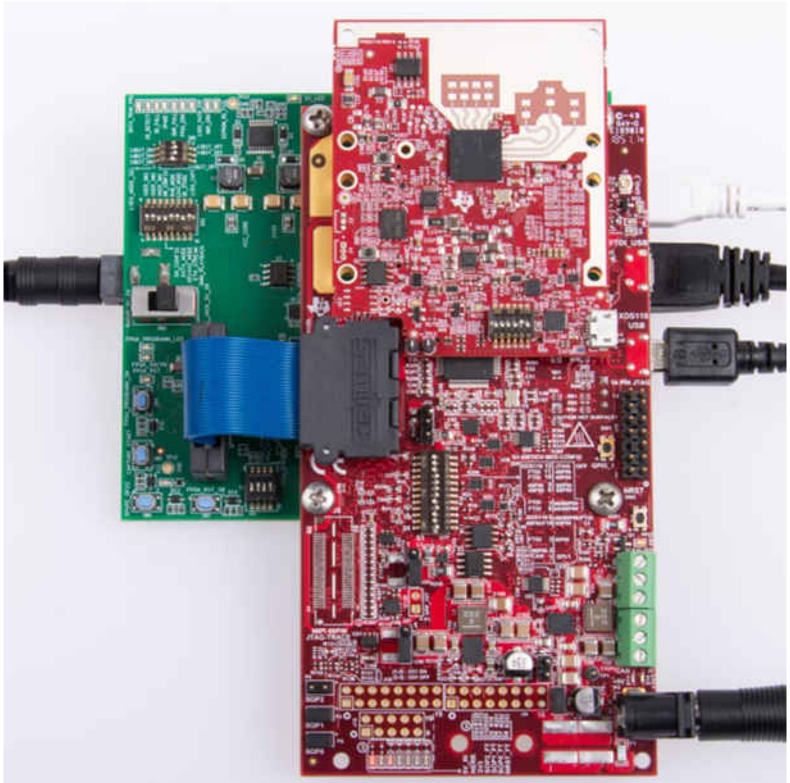

Figure 5-11. mmWAVEICBOOST With DCA1000 Mode

5.16 Muxing Scheme

The IWR6843LEVM UART RX/TX can be routed to the Samtec 60-pin connector, USB to UART (SICP2105) using S1.5 switch.

6 Software, Development Tools, and Example Code

To enable quick development of end applications on the C67x DSP and Arm Cortex R4F core in the IWR6843, TI provides a software development kit (SDK) that includes demo codes, software drivers, emulation packages for debug, and more. These can be found at mmwave-sdk.

You can also visit the TI resource explorer for the mmWave product from here. You will find Toolbox for mmWave Sensors, experiments, labs, and various demo examples.

7 TI E2E Community

Search the forums at e2e.ti.com. If you cannot find your answer, post your question to the community.

8 References

- Texas Instruments: *DCA1000EVM Data Capture Card User's Guide*
- Texas Instruments: *MMWAVEICBOOST & 60GHz EVM User's Guide*
- Hardware Setup for IWR6843ISK and IWR6843ISK-ODS | TI.com Video
- Hardware Setup for MMWAVEICBOOST and antenna module | TI.com Video
- mmwave-sdk
- USB to UART Drivers for the CP2105

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265