60GHz AoPCB mmWave Industrial Radar on Module
User Guide

TABLE OF CONTENTS

Table of Figure

Table of Table

1. INTRODUCTION

1.1. Purpose and Scope

The purpose of this document is to provide instructions to use Mistral's 60GHz AoPCB mmWave Industrial RADAR on Module (RoM) with Antenna on PCB (AoPCB), RevA.

1.2. Audience

This document is intended for Mistral's 60GHz AoPCB mmWave Industrial RoM users.

1.3. About 60GHz Industrial RADAR on Module (AoPCB)

Mistral's 60GHz AoPCB mmWave Industrial RoM with Antenna on PCB (AoPCB) is an easy to use, compact, light-weight RADAR providing high functionality for Industrial applications. The AoPCB is built around IWR6843 from Texas Instruments assuring long lifecycle and support.

1.3.1. Key Features

- Small, optimized and ready to use module.
- USB Powered
- Standalone boot up and programming support
- Built-in Calibration and Self-test
- On board QSPI flash and PMIC
- Antenna Pattern : Tapered Three Elements
- UART communication over USB for Configuration and RADAR Data
- Flexible Connectivity: CAN, UART,SPI,I2C,GPIOs,JTAG and LVDS
- Supports TI's SDK 3.01
- Supports 60-pin high-speed connector for host-controlling interface
- Supports raw data capture through DCA1000 EVM
- Board Dimension (L x W x H): 54 x 53 x 18 mm
- Industrial Operating Temperature: -40^{o}C to 85^{o}C

1.3.2. Kit Contents

- 60Ghz AoPCB Board
- Mechanical Clamp
- M2x6 Philip Pan Head Screw.
- M2 Hex Nut.

2. GENERAL SAFETY PRECAUTIONS

2.1. ESD Precautions

The boards contain devices, which are sensitive to Electro-Static Discharge. Improper handling may lead to performance degradation of the devices or even permanent damage.

3. Hardware

3.1. 60GHz Industrial RADAR (AoPCB) description

The figure below shows the Top and bottom view of AoPCB

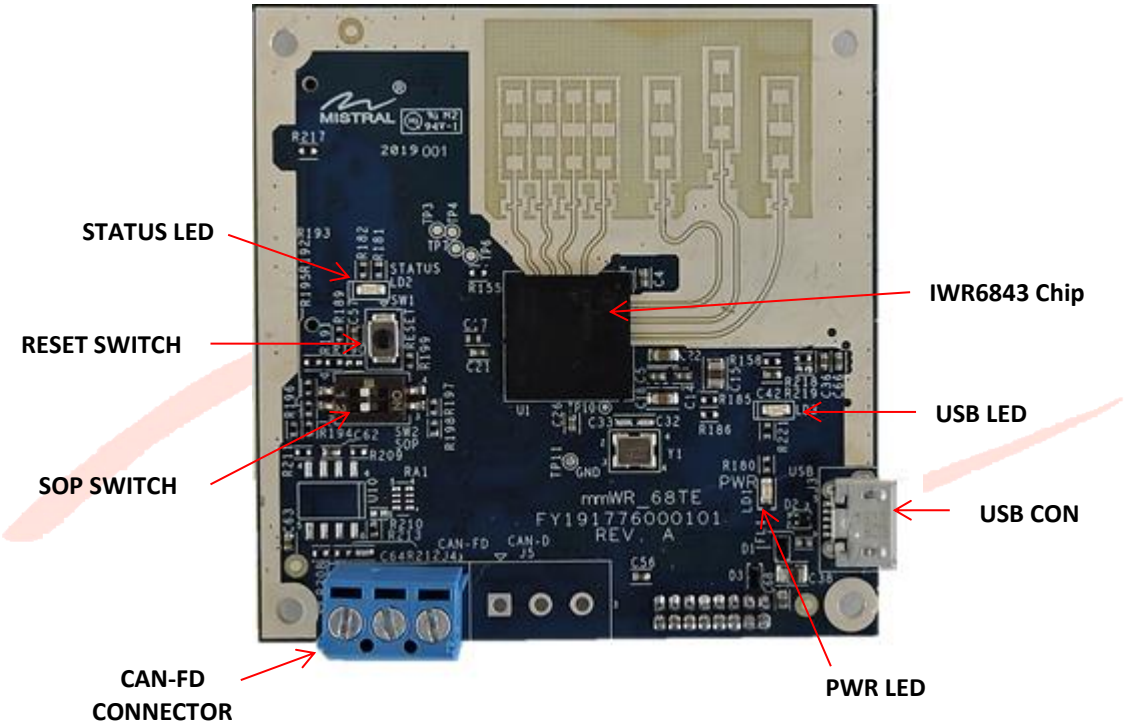


Figure 1 : 60GHz AoPCB Top View

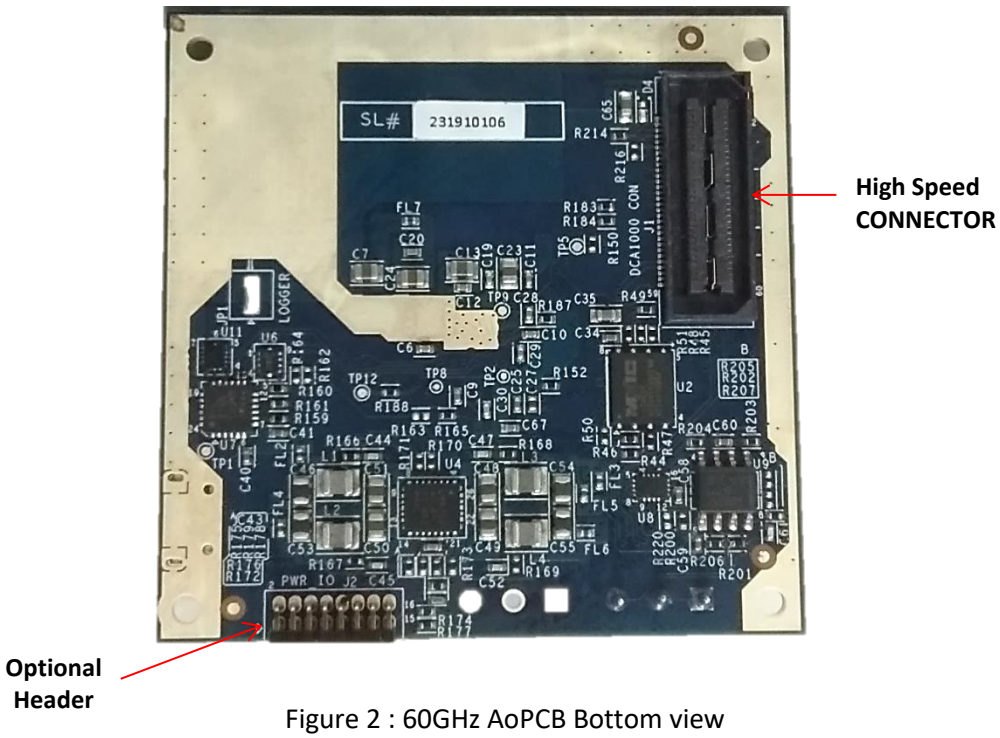


Figure 2 : 60GHz AoPCB Bottom view

The Module requires a USB Type A to micro-B Cable connected to Host PC for power and data.

3.2. AoPCB Mechanical Assembly

For correct functionality of the radar, the orientation of the radar must be as depicted in figure below. AoPCB board fixed with mechanical clamp with the help of M2 Pan Head screw and M2 Hex nut.

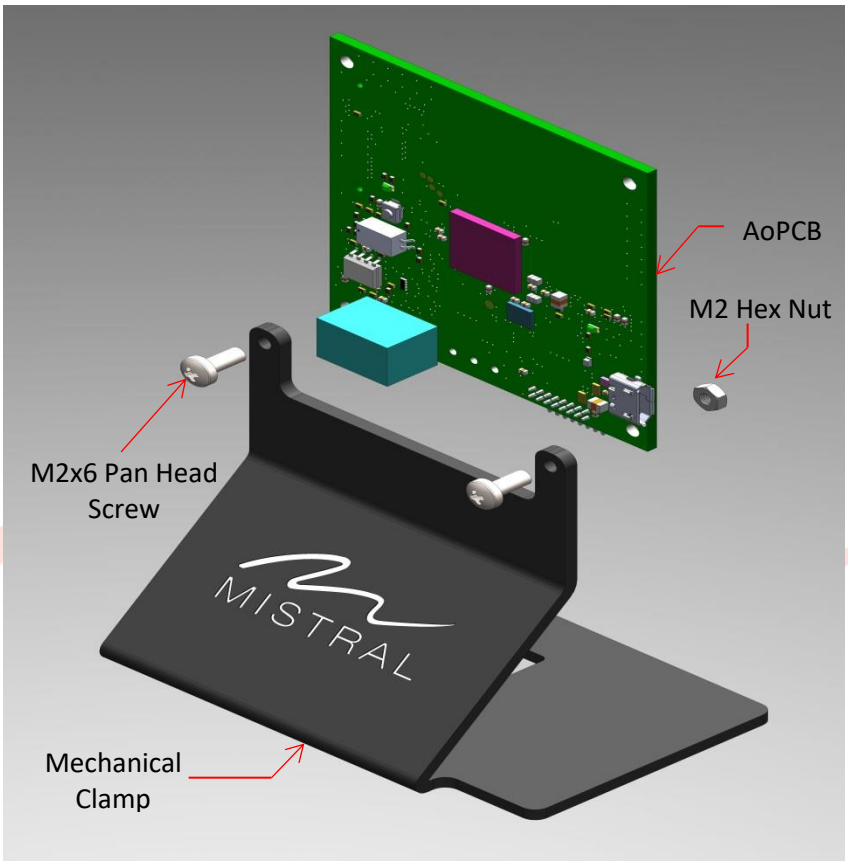


Figure 3 : Mechanical Assembly

Mounting holes are provided on the mechanical fixture. Contact Mistral for any custom mount / heat sink requirements.

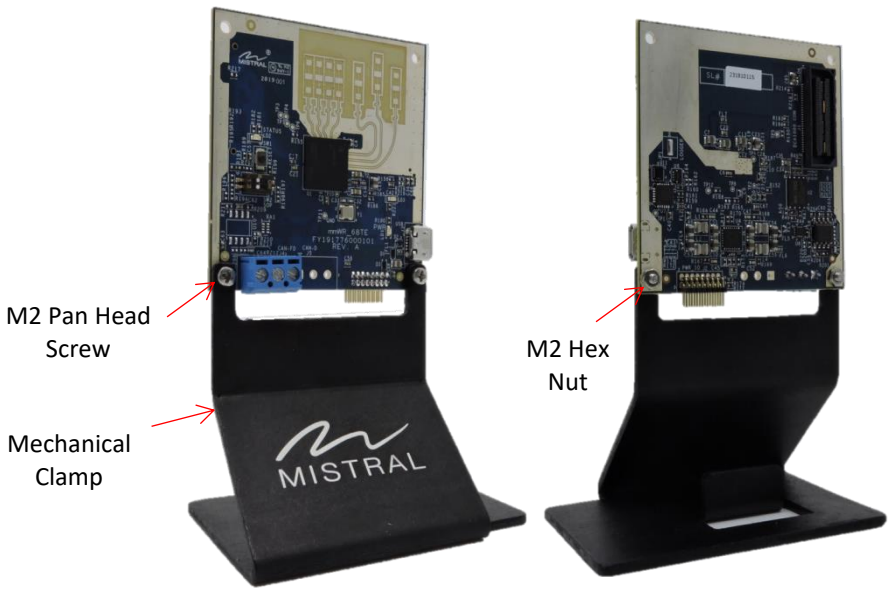


Figure 4: Mounting Orientation

3.3. SOP Switch Setting

The SOP Switch (SW2) setting determines the mode of operation of AoPCB. The following table details its function.

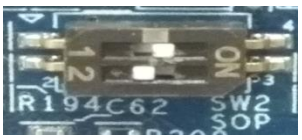
SOP Setting	Mode of Operation	Image
SW2-1 position → OFF SW2-2 position → OFF	Functional Mode	
SW2-1 position → ON SW2-2 position → OFF	Flash Programming Mode	
SW2-1 position → OFF SW2-2 position → ON	Development /Raw Data Capture mode	

Table 1 : SOP Switch setting

3.4. Reset switch and LED's

Reference Designator	Usage	Comments	Image
SW1	RESET	This is used to RESET the mmWave Sensor. This signal is also present as an input in the 60 pin connector so an external processor can control the mmWave sensor Device.	

Reference Designator	Usage	Comments	Image
LD1	Power	This LED indicates the presence of the 5-V supply	
LD2	NERROUT	Glows if there is any HW error in the IWR6843 sensor module	
LD3	USB	Glows if the USB enumerates.	

4. RUNNING THE OUT OF BOX DEMO

4.1. Quick Host PC Setup

1. If a windows Host PC is used, install the CP2105 drivers from https://www.silabs.com/documents/public/software/CP210x_Windows_Drivers.zip
2. Open the mmWave Demo Visualizer from https://dev.ti.com/mmWaveDemoVisualizer. If prompted to install browser extensions, install the extensions.

4.2. Identifying the COM ports

When the 60GHz AoPCB RoM is powered on and connected to a windows PC, the following COM ports appears in the Host PC's Device Manager.

AoPCB Port	Host PC COM Ports	Port Function
CFG_port	Port: CP2105-Enhanced COM Port, Baud Rate:115200	AoPCB Programming & Configuration
DATA_port	Port: CP2105-Standard COM Port, Baud Rate:921600	AoPCB MSS Logger output

Table 2 : UART Port mapping

4.3. Running the demos

For running Out-of-Box demo, follow the procedure given below:

1. Ensure that the SOP switches (SW2) are set to Functional Mode.
2. Connect AoPCB Board to Host PC via USB cable
3. Ensure PWR LED (LD1) glows (it indicates that the module gets correct power).
4. USB LED (LD3) glows and stays off, after successful USB enumeration.
5. Open mmWave Demo Visualizer in a browser (URL is given in **Table 3 : Tool dependency**). In Options->Serial Port, configure the COM ports as mentioned in **Table 2 : UART Port mapping**.
6. Under Plots tab, click 'LOAD CONFIG FROM PC AND SEND'. Select profile_2d.cfg file from the Profiles folder present in zip package provided by Mistral.
7. Demo starts running and detected object plot can be seen. If not, check status in 'Console Messages' under 'Configure' tab.

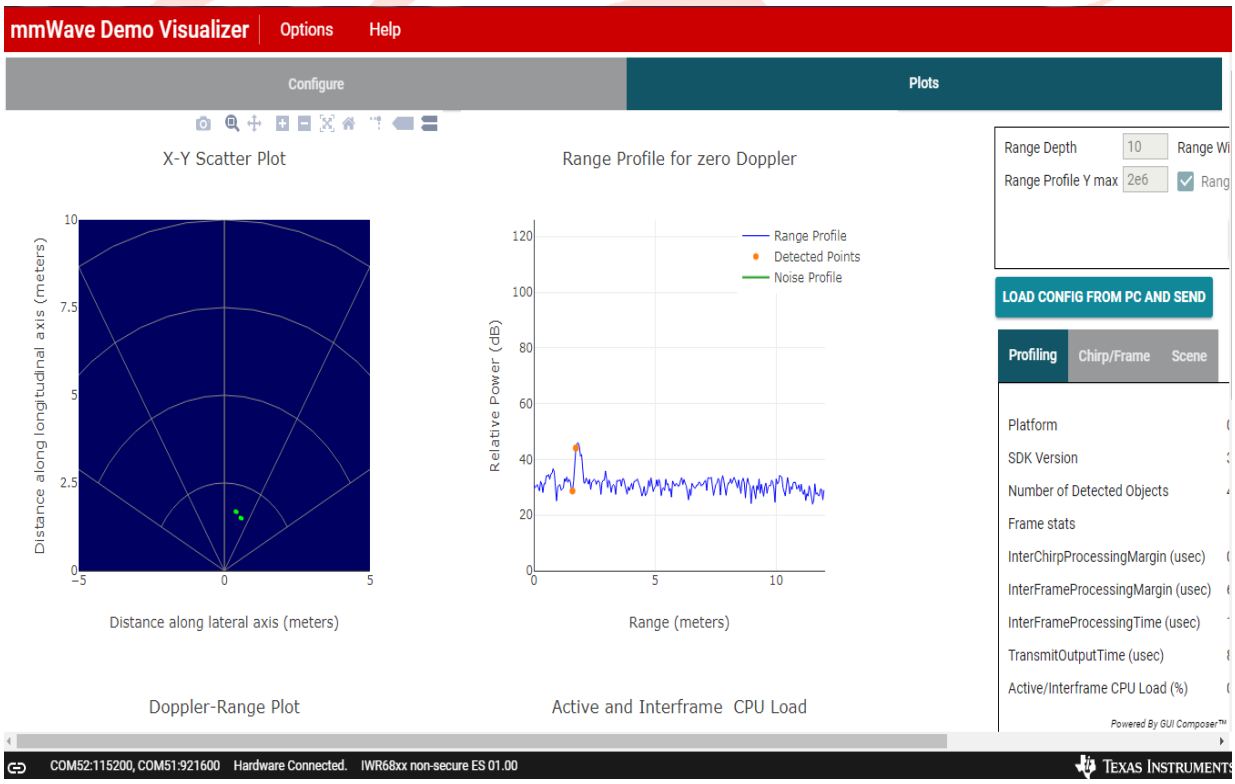


Figure 5 : Out of Box demo output

5. 60GHZ AoPCB FLASH PROGRAMMING

The AoPCB Boards are shipped with the default out of box demo software pre-programmed. To program a custom software, follow the below given procedure.

5.1. Host PC Tool Dependency

For building and using mmWave SDK the following tool versions are to be installed on Windows system.

Tool	Version	Download Link
CCS	7.4 or later	http://processors.wiki.ti.com/index.php/Download_CCS#Code_Composer_Studio_Version_7_Downloads
Uniflash	4.2	http://software-dl.ti.com/ccs/esd/uniflash/uniflash_sl.4.2.1435.exe
mmWave Demo Visualizer(optional)	Latest	TI Gallery APP for configuring mmWave sensors and visualizing the point cloud objects generated by the mmWave SDK demo : https://dev.ti.com/mmWaveDemoVisualizer Refer to http://www.ti.com/lit/ug/swru529b/swru529b.pdf for mmWave Demo Visualizer setup information
CP2105 Windows Driver		https://www.silabs.com/documents/public/software/CP210x_Windows_Drivers.zip

Table 3 : Tool dependency

5.2. Programming 60GHz AoPCB RoM

1. Ensure that the SOP Switches (SW2) are set to Flash Programming Mode
2. Connect AoPCB Board to Host PC via USB cable.
3. Open Uniflash tool, select IWR1642 and click 'Start'.

   Note: We have tested with Uniflash v4.2 by selecting IWR1642 as device. For newer Uniflash versions refer to the Uniflash user guide.
4. Under Settings and Utilities tab, choose CFG_port as the COM port. Refer **Table 2 : UART Port mapping** for correct identification of the COM ports.
5. Under '*Program*' tab, browse to the binary file to be programmed for 'Meta Image 1'. In the release zip package provided by Mistral, the binary file is 'MS_60GhzAoPCB_mmw_demo.bin'.
6. Click 'Load Image'.
7. Check logs in Console window to verify flashing status. After successful flashing, disconnect the board from PC.
8. Power OFF the Board.
9. Set SOP Switches back to Functional Mode for normal Radar Function.

6. 60GHZ AoPCB Raw Data capture with DCA1000 EVM

60 GHz AoPCB can be directly integrated with DCA1000 EVM which enables users to capture High-Speed LVDS data from the radar device and stream it over Ethernet. 60 pin High speed connector J1 of AoPCB is used to connect to the J3 input connector on the DCA1000 EVM. AoPCB supports 2 LVDS data lanes for capturing ADC data.
Follow the below given procedure for AoPCB Data Capture with DCA1000 EVM.

1. Mount AoPCB on DCA1000 EVM as shown in Figure 6.
2. Ensure that the SOP Switches (SW2) are set to Development Mode.
3. Make sure Power Selection switch (SW3) on DCA1000 EVM is closed to Position 1.
4. Connect AoPCB Board to Host PC via USB cable.
5. Power on DCA1000 EVM with 5V adaptor.
6. Refer to DCA1000EVM user guide (Section 8 ADDITTIONAL INFORMATION) for further information on capturing Raw ADC data from mmWave Sensor.

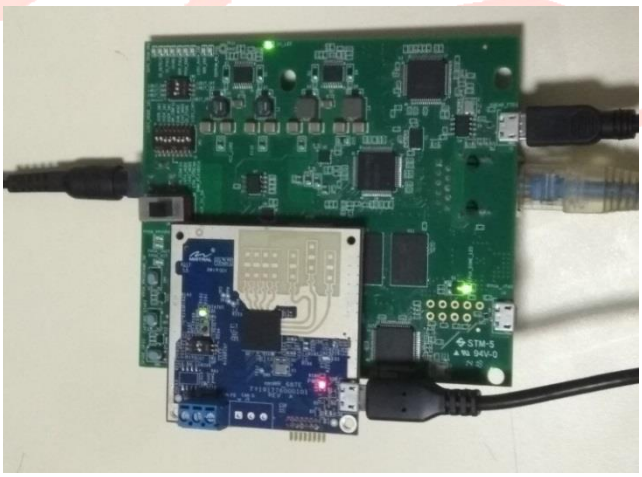


Figure 6 : AoPCB Data capture with DCA1000 EVM demo Setup

7. External Connector Options

The AoPCB RoM has the following connector provisions:

1. CAN-FD Connector Terminal Block (3x1,3.5mm Pitch)
2. Optional Header-double Row 16 pin right angle (8x2, 1.27mm pitch)
3. High Speed Connector (60 POS, 0.5mm pitch)

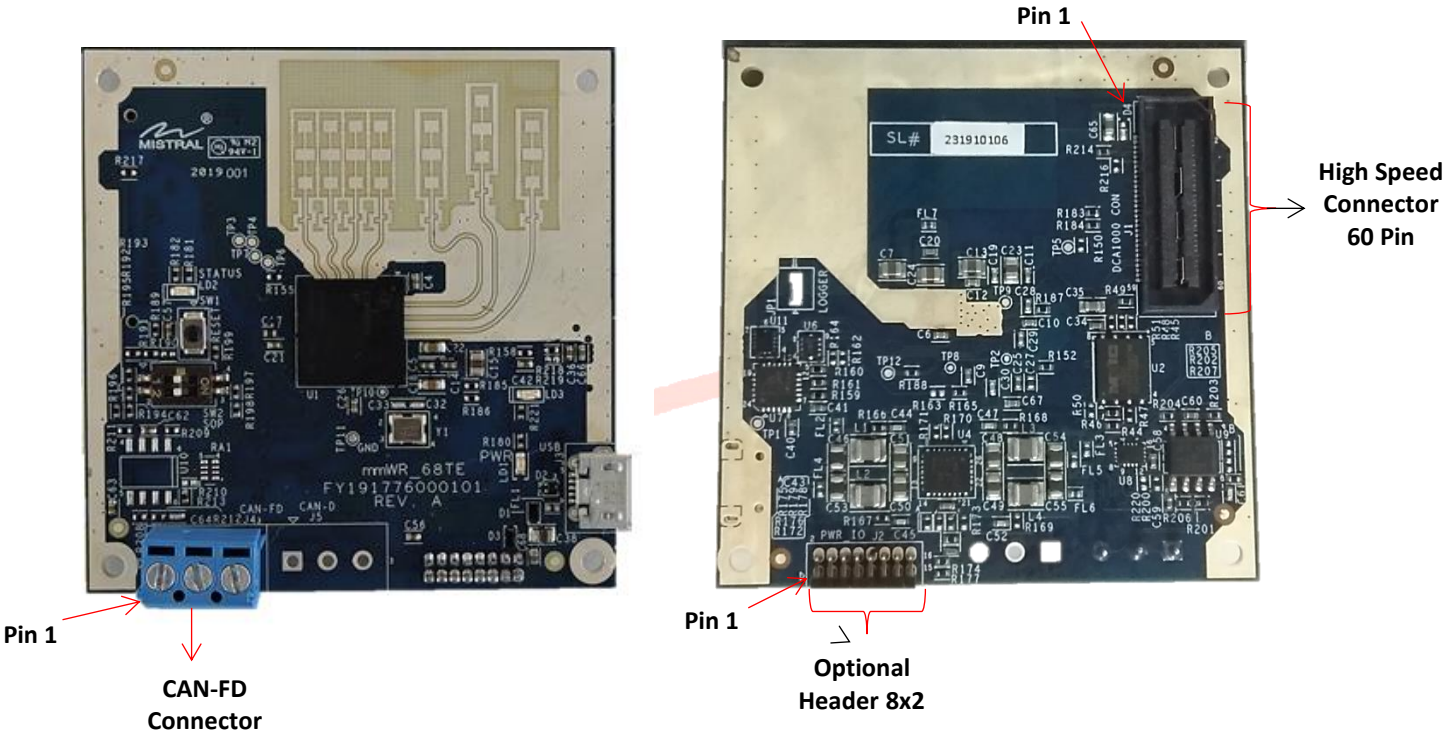


Figure 7 : AoPCB Connector Options

- **CAN-FD Connector 3x1:**

Pin #	Pin Name	Description
1	CAN_FD_H	High level CAN bus input/output line
2	GND	Ground
3	CAN_FD_L	Low level CAN bus input/output line

- **Optional Header 8x2:**

  Mating Part: LPPB082CFFN-RC

Pin #	Pin Name	Description	Requirement
1	GND	Ground	
2	VIN_5V0	External 5V DC input, max of 1A current	
3	GND	Ground	
4	VIN_5V0	External 5V DC input, max of 1A current	
5	GND	Ground	
6	EXT_GPIO0	GPIO_0 can be configurable as Input or Output	
7	GND	Ground	
8	MUX Control 1	MUX control(Default: high) from IWR6843 for SPI/CAN bus select	MUX control 1 - **High** for SPI Interface MUX control 1 - **Low** for CAN Interface
		Can be used as GPIO_1, If SPI/CAN is not used	
9	SPI_CS	SPI interface CS by default/ Can be used as GPIO_30	
10	MUX Control 2	MUX control (Default: high) from IWR6843 for EXT_UART/USB_UART select	MUX control 2 - **High** for UART over USB MUX control 2 - **Low** for EXT_UART via Header
		Can be used as GPIO_2, If UART is not used	
11	SPI_CLK	SPI interface Clock by default/ Can be used as GPIO_30	
12	EXT_LOGGER	UART Data Logger Output from AoPCB	
13	EXT_UART_TXD	UART Command TXD from AoPCB	
14	SPI_MISO	SPI interface MISO by default/ Can be used as GPIO_20	
15	EXT_UART_RXD	UART Command RXD to AoPCB	
16	SPI_MOSI	SPI interface MOSI by default/ Can be used as GPIO_19	

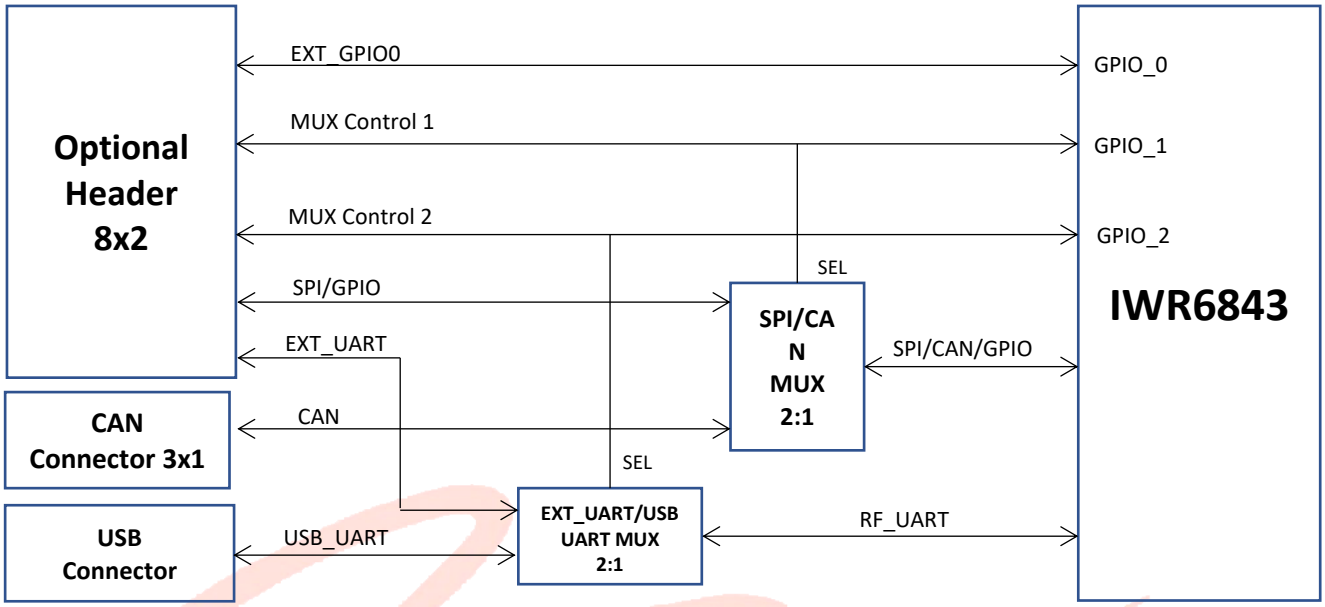


Figure 8 : Optional Header interface Block Diagram

- **High Speed Connector 60 Pin:**

Mating Part: QTH-030-01-L-D-A (5mm Stack Height)
QTH-030-02-L-D-A-K-TR (8mm Stack Height)
QTH-030-03-L-D-A-K-TR (11mm Stack Height)

Pin #	Pin Name	Description	Pin #	Pin Name	Description
1	VCC_FR_5V0	5V Input to AoPCB	2	VCC_FR_5V0	5V Input to AoPCB
3	VCC_FR_5V0	5V Input to AoPCB	4	JTAG_TDO	JTAG TDO Signal
5	JTAG_TDI	JTAG TDI Signal	6	JTAG_TCK	JTAG TCK Signal
7	SPI_CS	SPI interface CS	8	JTAG_TMS	JTAG TMS Signal
9	SPI_CLK	SPI interface Clock	10	SPI_HOST_INT	O/P Interrupt to an Ext- host communicating over SPI
11	SPI_MOSI	SPI interface MOSI	12	SPI_MISO	SPI interface MISO
13	PMIC_PGOOD	PGOOD o/p from AoPCB	14	NERROR_OUT	NERROR output from AWR AoPCB
15	RADAR_DMM_CLK	DMM clock	16	SYNC_IN	Frame Synchronization Input to AoPCB
17	RADAR_DMM_SYNC	DMM sync	18	GND	Ground
19	RADAR_DP0	DMM Data0	20	NC	No Connect
21	RADAR_DP1	DMM Data1	22	NC	No Connect
23	RADAR_DP2	DMM Data2	24	GND	Ground
25	RADAR_DP3	DMM Data3	26	LVDS_FRCLK_P	LVDS Frame Clock +
27	RADAR_DP4	DMM Data4	28	LVDS_FRCLK_N	LVDS Frame Clock -
29	RADAR_DP5	DMM Data5	30	GND	Ground
31	RADAR_DP6	DMM Data6	32	NC	No Connect
33	RADAR_DP7	DMM Data7	34	NC	No Connect
35	NC	No Connect	36	GND	Ground
37	NC	No Connect	38	NC	No Connect
39	NC	No Connect	40	NC	No Connect
41	NC	No Connect	42	GND	Ground
43	NC	No Connect	44	LVDS_CLK_P	LVDS Clock pair +
45	NC	No Connect	46	LVDS_CLK_P	LVDS Clock pair -
47	NC	No Connect	48	GND	Ground
49	NC	No Connect	50	LVDS_TX1_P	LVDS data pair 1 +
51	I2C_SDA	I2C Data	52	LVDS_TX1_N	LVDS data pair 1 +
53	I2C_SCL	I2C Clock	54	GND	Ground
55	UART_RX	UART RXD to AoPCB	56	LVDS_TX0_P	LVDS data pair 0 +
57	UART_TX	UART TXD from AoPCB	58	LVDS_TX0_N	LVDS data pair 0 -
59	NRESET	Reset Input to AoPCB	60	GND	Ground

Note:

Pins #1 & #3 VCC_FR_5V0, power input is not required when mated with DCA1000 board. Hence these lines are internally disconnected via DNI of diode, D4. In case this board is mated with other boards and it is required to be powered through these pins instead of USB input, this diode is to be populated.

8. ADDITTIONAL INFORMATION

Please refer the following links:

1. MMW SDK 03_01_01_02
   http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/03_01_01_02/index_FDS.html

2. MMW SDK release note:
   http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/03_01_01_02/exports/mmwave_sdk_release_notes.pdf

3. MMW SDK user guide:
   http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/03_01_01_02/exports/mmwave_sdk_user_guide.pdf

4. DCA1000 EVM data capture user guide:
   http://www.ti.com/lit/ug/spruij4a/spruij4a.pdf

9. SUPPORT INFORMATION

9.1. Contact

For any queries, contact Mistral Solutions Pvt Ltd.

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