UM10044

XenP202TE Series User Manual

Rev.1.0 User Manual

Introduction

This document introduces the basic functions, hardware specifications, software usage, and installation conditions of the ICLEGEND MICRO (ICL) high-precision multi-target detection mmWave sensor series, XenP202TE and CSP202TE (XenP202TE series). It aims to assist users in quickly getting started with the XenP202TE series multi-target detection solution.

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1. XenP202TE Series Overview

Target tracking refers to the real-time tracking of a target's location within a specific area, and accurately measuring the target's distance, angle, and speed.

XenP202TE series reference/customized designs refer to the high-precision multi-target detection mmWave sensor series of ICL EZ Sensor series, incorporating minimalist 24 GHz mmWave sensor hardware Xen202_E and CS202_E, and intelligent algorithm firmware. This solution is primarily applied in common indoor scenarios such as homes, offices, and hotels, enabling precise positioning and tracking of individual or multiple people.

The sensor hardware series consists of the AIoT mmWave sensor SoC ICL1122, high-performance one-transmit-two-receive(1T2R) microstrip antennas, a low-cost MCU, and peripheral auxiliary circuits. The intelligent algorithmic firmware utilizes Frequency Modulated Continuous Wave (FMCW) waveforms and the advanced signal processing technology specified by the ICL1122.

The key features of XenP202TE series sensors include:

- 24 GHz ISM frequency band
- Integrated mmWave single-chip SoC ICL1122 and intelligent algorithmic firmware
- Precise target positioning and tracking
- Compact module size:

  Xen202_E: 15 mm × 40 mm

  CS202_E: 15 mm × 44 mm
- Operating temperature range: -40°C to 85°C
- Default power supply of 5 V
- Maximum detection distance of 8 m
- Detection azimuth angle of ±60°, elevation angle of ±30°
- Wall-mounted

The XenP202TE series multi-target detection mmWave sensor can accurately position and track targets, with applications in various AIoT scenarios, including the following types:

- **Smart Homes**

  Sensing human position and reporting detection results to enable the main control module to intelligently control the operation of appliances such as air conditioners and fans.
- **Smart Business**

  Human position sensing for screen activation and deactivation, enhancing user experience.
- **Smart Bathroom**

  For example, smart toilets that automatically open and close the toilet lid based on human proximity and distance.
- **Smart Lighting**

  Precisely sensing human position to intelligently control lighting devices.

2. System Characteristics

The XenP202TE series are high-precision multi-target detection mmWave sensors developed based on ICL1122. Utilizing FMCW, combined with the MCU's proprietary radar signal processing and built-in intelligent positioning and tracking algorithms, the sensors can detect multiple targets within a specified area and report the results in real-time. Based on this series design, users can rapidly develop corresponding target positioning and tracking products.

2.1 XenP202TE Characteristics

The systematic characteristics of XenP202TE are shown in Table 2-1.

Table 2-1 XenP202TE characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
Hardware Xen202_E Characteristics					
Supporting Frequency	-	24	-	24.25	GHz
Max. Sweep Bandwidth	-	-	0.25	-	GHz
Operating Voltage	-	-	5	-	V
Size	-	-	15 × 40	-	mm × mm
Environment Temperature	-	-40	-	85	°C
XenP202TE System Characteristics					
Max. Detection Range (in normal direction)	-	-	8	-	m
Angular Detection Range	-	-60	-	60	°
Range Measurement Accuracy (detected with corner reflector in normal direction)	-	-	0.15	-	m
Angle Measurement Accuracy (detected with corner reflector in normal direction)	-	-	2	-	°
Operating Frequency	FCC, CE and SRRC compliant.	24	-	24.25	GHz
Sweep Bandwidth		-	0.23	-	GHz
Data Refresh Rate	The sensor's data reporting frequency.	-	10	-	Hz
Average Operating Current	-	-	97	-	mA

2.2 CSP202TE Characteristics

The systematic characteristics of CSP202TE are shown in Table 2-2.

Table 2-2 XenP202TE characteristics

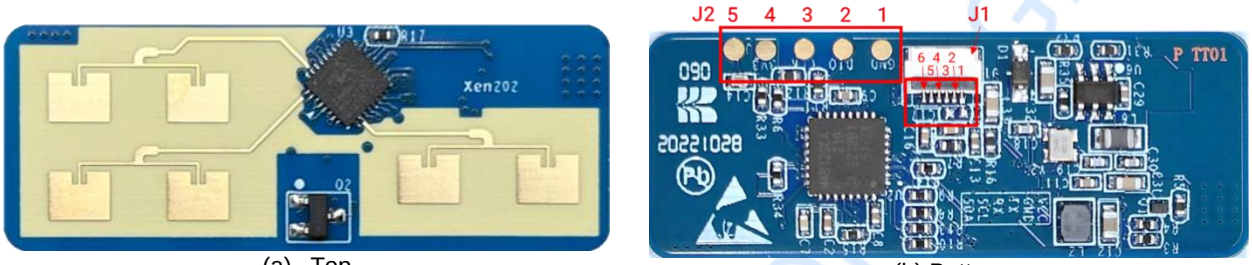
Parameter	Description	Min.	Typ.	Max.	Unit
Hardware CS202_E Characteristics					
Supporting Frequency	-	24	-	24.25	GHz
Max. Sweep Bandwidth	-	-	0.25	-	GHz
Operating Voltage	-	-	5	-	V
Size	-	-	15 × 44	-	mm × mm
Environment Temperature	-	-40	-	85	°C
CSP202TE System Characteristics					
Max. Detection Range (in normal direction)	-	-	8	-	m
Angular Detection Range	-	-60	-	60	°
Range Measurement Accuracy (detected with corner reflector in normal direction)	-	-	0.15	-	m
Angle Measurement Accuracy (detected with corner reflector in normal direction)	-	-	2	-	°
Operating Frequency	FCC, CE and SRRC compliant.	24	-	24.25	GHz
Sweep Bandwidth		-	0.23	-	GHz
Data Refresh Rate	The sensor's data reporting frequency.	-	10	-	Hz
Average Operating Current	-	-	83	-	mA

3. Hardware Overview

This chapter introduces the hardware photos and interface information for the high-precision multi-target detection sensor reference design, XenP202TE, and its customized design, CSP202TE.

3.1 Hardware Xen202_E

Figure 3-1 (a) and (b) depict the top and bottom views of the Xen202_E hardware respectively. The Xen202_E hardware features a reserved FPC slot J1 for power and communication interfaces. The five pins constitute the MCU programming port J2. When programming the hardware, please connect to the serial port according to the pin names.



(a) Top (b) Bottom

Figure 3-1 Hardware Xen202_E device map

Details of the J1 are listed in Table 3-1.

Table 3-1 Xen202_E J1 pin description

J#PIN#	Name	Function	Description
J1Pin1	VCC	Power input	5 V or 3.3 V
J1Pin2	GND	Ground	-
J1Pin3	TX	UART_TX	Connect to USB serial tool's RXD
J1Pin4	RX	UART_RX	Connect to USB serial tool's TXD
J1Pin5	SCL	IIC clock signal	Reserved
J1Pin6	SDA	IIC data signal	Reserved

Note: The power supply design of the Xen202_E hardware is shown in Figure 3-2. The default power supply is 5 V, in this case only the R36 is normally closed; this series hardware also supports 3.3 V power supply, in this case the R36 should be a 0 Ω resistor, and all the other DCDC peripheral circuit devices should be normally closed.

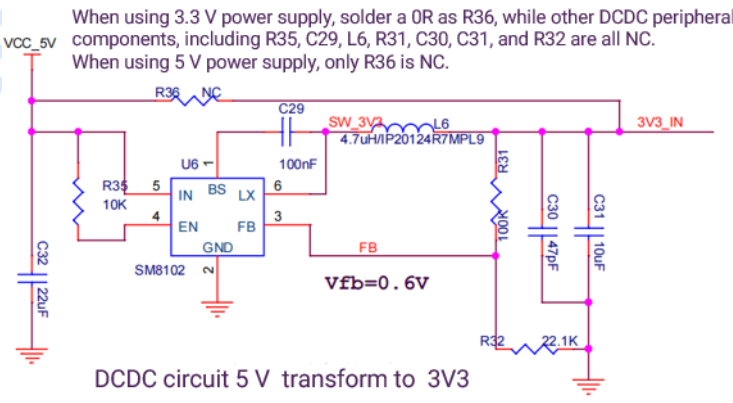


Figure 3-2 Xen202_E series hardware power supply mode

When connecting the hardware to the USB serial port, it is recommended to use an FPC soft cable to connect the Xen202_E J1 slot with an FCP interposer board, then connect the interposer board with the USB serial port. The recommended FPC interposer board and soft cable are shown in Figure 3-3.

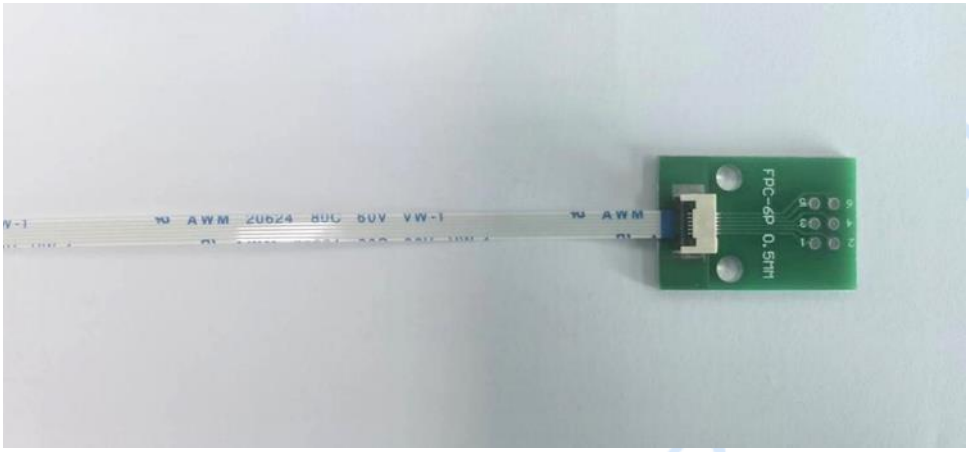


Figure 3-3 FPC interposer board and soft cable

The silkscreen number 1 ~ 6 on the interposer board is corresponded to the respective pin of the Xen202_E J1 slot. The specific correspondence depends on the connection method of the FPC cable and the circuit routing on the adapter board. Therefore, before use, please ensure the pins are connected correctly.

Details of the Xen202_E J2 pins are listed in Table 3-2.

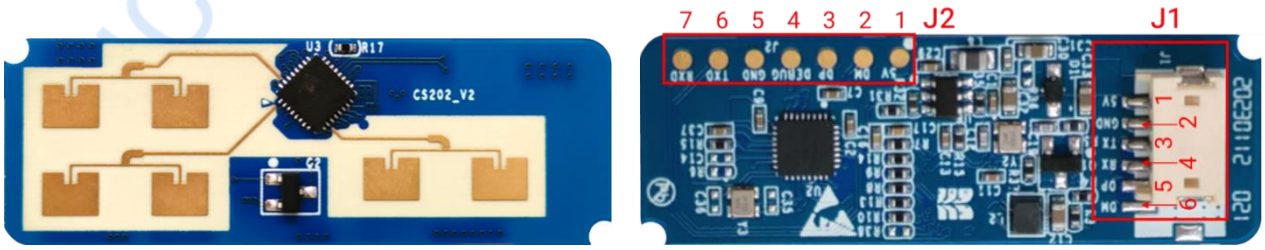
Table 3-2 Xen202_E J2 pin description

J# Pin#	Name	Function	Description
J2 Pin1	GND	Ground	-
J2 Pin2	DIO	Data port	Connect to the DIO pin of the programmer
J2 Pin3	CLK	Clock signal	Connect to the CLK pin of the programmer
J2 Pin4	3V3	Power input	3.3 V
J2 Pin5	reset	Reset signal	-

The Xen202_E hardware supports flashing the program by Keil5 IDE, or flashing hex files by tools such as J-link and CMSIS-DAP. Before the programming, make sure relevant packs such as Nuvoton.NuMicro_DFP.1.3.12.pack and ARM.CMSIS.5.7.0.pack or later versions are installed.

3.2 Hardware CS202_E

Figure 3-4(a) and (b) show the top and bottom views of the CS202_E hardware respectively. The CS202_E hardware reserves connector J1 of model FWF15004 by TXGA as the power and communication interface. J2 serves as the programming and testing contact pins. Some of J2 pins share the functions with some of the pins on J1.



(a) Top (b) Bottom

Figure 3-4 Hardware CS202_E device map

Pin descriptions of J1 and J2 refer to Table 3-3 and Table 3-4 respectively.

Table 3-3 CS202_E J1 pin description

J#PIN#	Name	Function	Description
J1Pin1	5V	Power input	Connects to 5 V of the serial port adapter board
J1Pin2	GND	Ground	Connects to GND of the serial port adapter board
J1Pin3	TX	UART TXD	Connects to RXD of the serial port adapter board
J1Pin4	RX	UART RXD	Connects to TXD of the serial port adapter board
J1Pin5	DP	Programming data positive signal	Not used if a 4-pin connector is used
J1Pin6	DM	Programming data negative signal	Not used if a 4-pin connector is used

Table 3-4 CS202_E J2 pin description

J#PIN#	Name	Function	Description
J2Pin1	5V	Power input	-
J2Pin2	DM	Programming data negative signal	-
J2Pin3	DP	Programming data positive signal	-
J2Pin4	DEBUG	Debug UART TXD	For firmware debugging
J2Pin5	GND	Ground	-
J2Pin6	TXD	UART TXD	Connects to RXD of the serial port adapter board
J2Pin7	RXD	UART RXD	Connects to TXD of the serial port adapter board

The CS202_E hardware requires the use of Jieli's JL USB Updater tool for image programming. Detailed steps on the use of the programming tool and the setup of the Jieli MCU development environment are provided by the official, which can be referenced at the following URL: https://doc.zh-jieli.com/Tools/zh-cn/dev_tools/dev_env/index.html.

4. Software Overview

Both Xen202_E and CS202_E hardware are released with the system firmware programmed. ICL provides visualization tools for the XenP202TE series mmWave sensors, which allows users to intuitively experience the positioning and tracking capabilities of the sensors.

4.1 Software Description

ICL_MTT.exe is a green software specially developed for XenP202TE and CSP202TE. It displays and records detection data after connecting the sensor with a host PC.

Steps for connecting the software with the sensor are as follows:

Step 1: Download the software pack from ICL website, unzip it and enter the directory.

Step 2: Connect the sensor to the USB serial port tool using the appropriate cable, and then connect the serial port tool to the host computer. The connection methods for each module are as follows:

a) Connect XenP202TE to a USB serial port tool using an FPC interposer board and FPC soft cable, as shown in Figure 4-1.

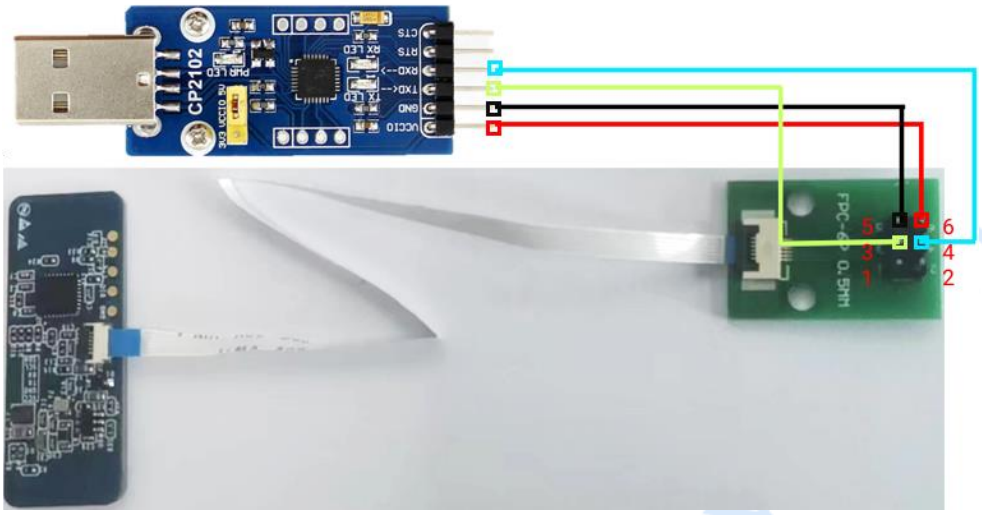


Figure 4-1 Example of connecting Xen202_E with interposer board and USB serial port tool

b) Connect CSP202TE to a USB serial port using cables, as shown in Figure 4-2.

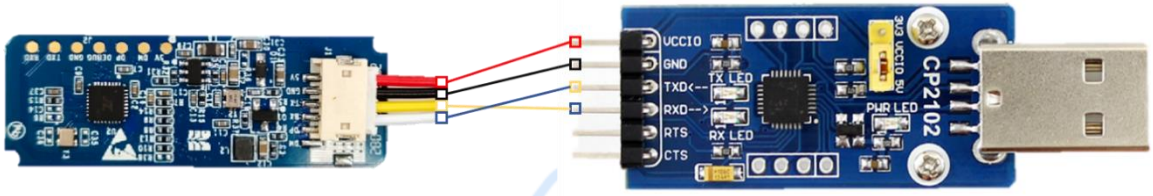


Figure 4-2 Example of connecting CS202_E to USB serial port

Step 3: Double click the **ICL_MTT.exe** in the software directory, and the graphic user interface (GUI) will appear as shown in Figure 4-3.

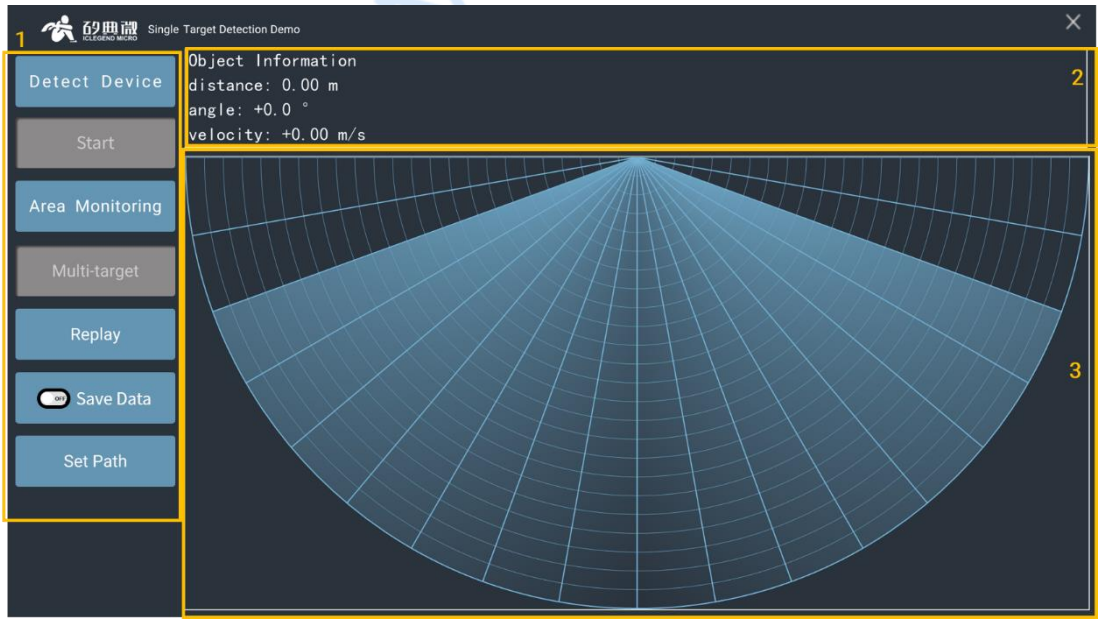


Figure 4-3 ICL_MTT GUI

The GUI mainly consists of three zones, they are Functional Button Zone 1, Data Display Zone 2, and Target Demonstration Zone 3. Descriptions of their functions are as follows:

- **Functional Button Zone**:

- The Detect Device button is to check whether a sensor is successfully connected;
- The Start/Stop toggle button is to start or stop receiving radar data;
- The Area Monitoring button is to define monitoring area and blind area;
- The Multi-/Single-target toggle button is to switch the working mode between single-target and multiple-target detection;
- The Replay/Stop toggle button is to play back recorded radar data;
- The Save Data button is to turn on or off the save radar data mode;
- The Set Path button is to select directory path for saving recorded radar data.

- **Data Display Zone**: to display the distance, angle, and velocity of detected target;
- **Target Demonstration Zone**: to explicitly display the position of the tracked target in detection range.

4.2 Software Guide

The software features single and multiple targets tracking demonstration, and allows users to define one or more interested areas on the GUI to monitor that area, as well as set one or more blind area. The software also support recording, saving and replaying radar data. This section introduces how to use the software.

4.2.1 Single-target/Multi-target Detection

Steps for using the software for single or multiple targets detection are as follows:

Step 1: Connect the sensor with a host PC, and open the software following the steps in section 4.1;

Step 2: Click the **Detect Device** button: if the module successfully connected to the host PC, a window writing Serial Port Device Detected will appear, as shown in Figure 4-4, click the **OK** button to continue;

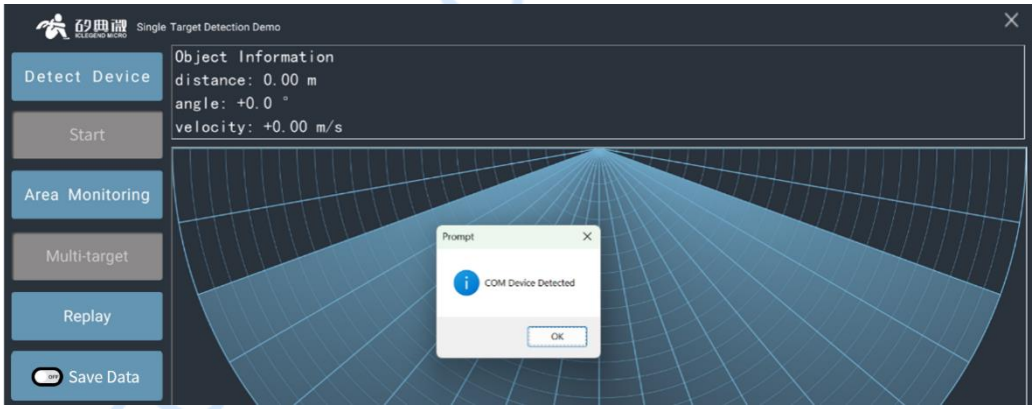


Figure 4-4 Device successfully detected

Step 3: Click the **Start/Stop** toggle button, the GUI will display the position of the detected target referring to the radar, an example is shown in Figure 4-5;

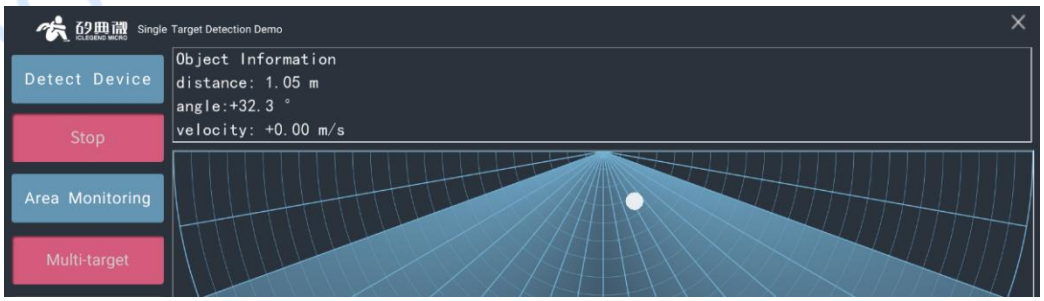


Figure 4-5 Example of single target detection demonstration

Step 4: By default, the software works in Single Target Detection mode, to switch to Multiple Target Detection mode, click the **Multi-target /Single-target** toggle button, the Triple Targets Detection Demo[1] will appear, as shown in Figure 4-6; to switch back to Single Target Detection Mode[2], click the **Multi-target /Single-target** toggle button again.

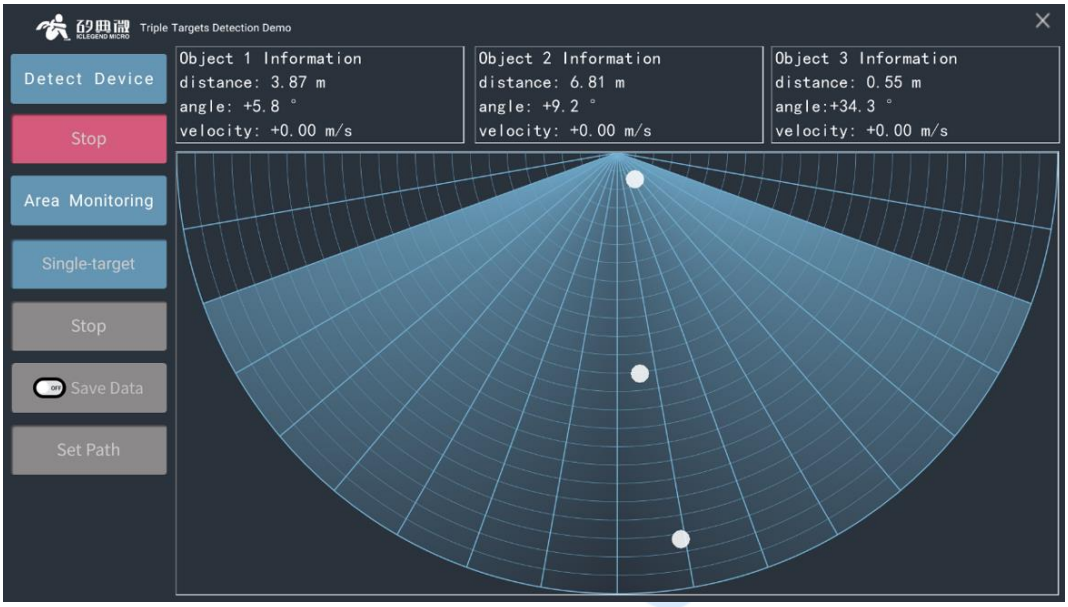


Figure 4-6 Example of triple-target detection demonstration

4.2.2 Area Monitoring

The software provides Area Monitoring and Blind Area Setting functions.

Area Monitoring function allows users to set up one or more monitoring areas inside the detection range so that whenever the human target(s) enters the area, the color of the area changes immediately. This function enables the software to selectively present the radar data according to users' interests.

Blind Area Setting function allows users to define the interested detection and tracking area, and turn off the detection and display of certain range gates. This function enables the software to block certain detection areas according to the parameters that the users set.

Steps for setting up a monitoring area on the GUI are as follows:

Step 1: Connect the sensor with a host PC, and open the software following the steps in section 4.2.1;

Step 2: Click the **Area Monitoring** button, a new window will appear, as shown in Figure 4-7, descriptions of the window are as follows:

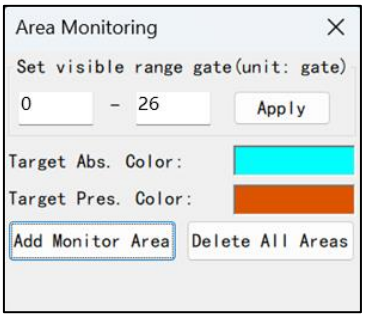


Figure 4-7 Area Monitoring window

[1] The Triple Targets Detection Demo shows at most 3 detected targets that with the highest moving energy.

[2] The Single Target Detection Mode is not suitable for positioning and tracking multiple targets.

Set visible range gate: Default as 0~26, meaning there is no blind area; Users can customize a near-end and a far-end blind area, for example: if users set the visible range gate as 1 ~ 24, there is one range gate blind area in the near-end, and two range gates(26 - 24) of blind area in the far-end (each range gate represents 33 cm), then click the **Apply** button, the new detection range is as shown in Figure 4-8 where the red areas represent blind areas.

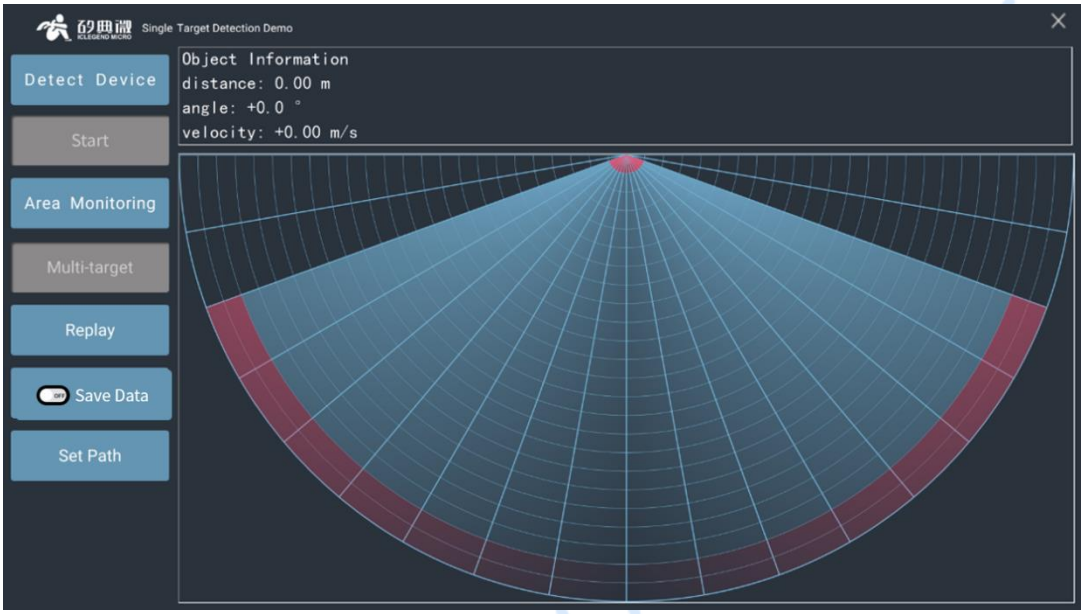


Figure 4-8 Example of blind area setting

Target Abs. Color: to set the color of the monitoring area when there is no target.

Target Pres. Color: to set the color of the monitoring area when there is a target.

Add Monitor Area: to start defining a monitoring area, once this button is clicked, users click in the radar chart to add vertex of the monitoring area, and right click to finish this process.

Delete All Areas: to delete all the pre-defined monitoring areas.

Step 3: Click the **Add Monitor Area** button to start defining a monitoring area, click in the radar chart to define the vertexes of the desired monitoring area in clockwise or anti clockwise direction, right-click to finish the process, and the GUI will display the defined monitoring area, an example is shown in Figure 4-9; After setting the monitoring area, if a human target is detected in this area, the background color of this area changes immediately, as shown in Figure 4-10 and Figure 4-11.

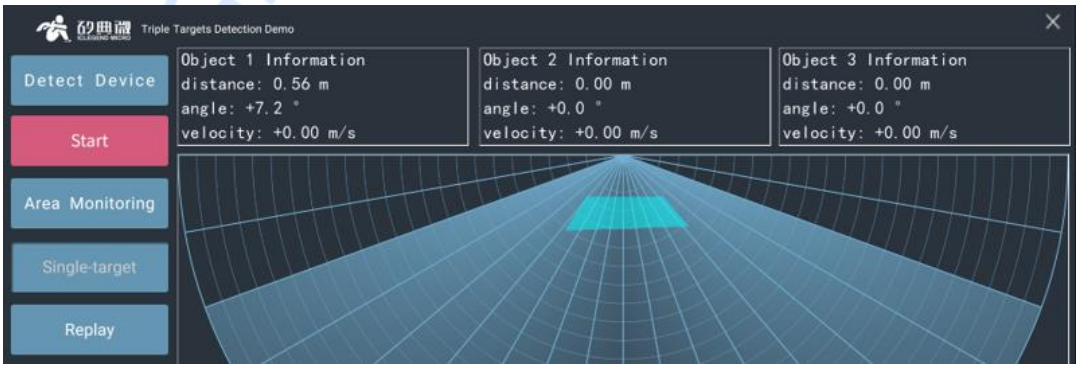


Figure 4-9 Example of a defined monitoring area

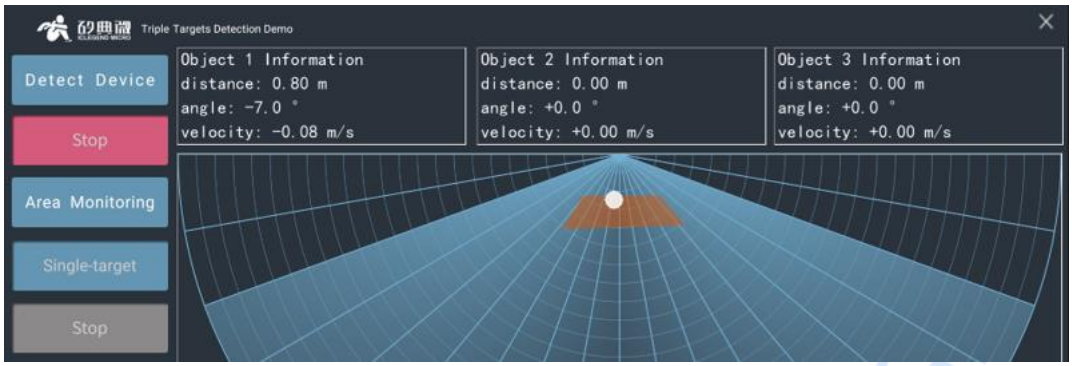


Figure 4-10 Target exists in monitoring area

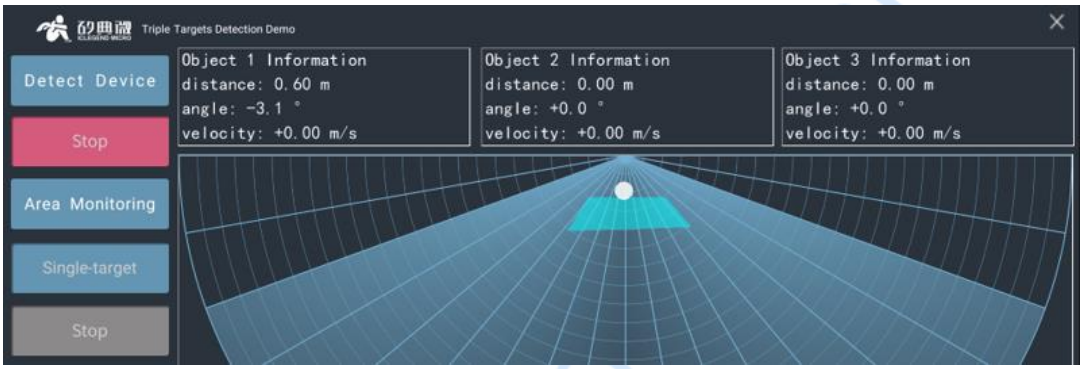


Figure 4-11 No target in monitoring area

Step 4(Optional): Repeat Step 3 to set multiple monitoring areas;

Step 5(Optional): If users want to delete all existed monitoring area, click the **Area Monitoring** button, on the Area Monitoring window, click the **Delete All Areas** button to remove all the monitoring areas defined previously.

Record, Save, and Replay Radar Data

The software supports recording, saving, and replaying the radar data. For the communication protocol of the radar data please refer to 5. Communication Protocol. The steps are as follows:

Step 1: Connect the sensor with the host PC, and open the software following the steps in section 4.1;

Step 2: When the Start/Stop toggle button shows Start, as shown in Figure 4-12 (b), click the **Save Data**[3] button, select the saving path of radar data, by default the folder is named SaveData under the software directory;

[3] When the **Start/Stop** toggle button displays **Stop**, the **Replay**, **Save Data**, and **Set Path** buttons are all unclickable.

(a) Buttons unclickable (b) Buttons clickable

Figure 4-12 Radar data replay/save related buttons

Step 3: By default, the Save Data working mode is off. If users want to turn on the Save Data mode, click the **Save Data** button when the button is clickable (as shown in Figure 4-13(a)); and to turn off the mode, click the **Save Data** button again;

(a) Save Data mode off (b) Save Data mode on (c) Button unclickable

Figure 4-13 Three states of the Save Data button

Step 4: When the Save Data working mode is on, click the **Start/Stop** toggle button to detect human target, the software will display the human target information and demonstration in Zone 2 and Zone 3;

Step 5: Click the **Start/Stop** toggle button to stop detection, and users can find the radar data file folder under the directory set in Step 2, the file folder is named after the time stamp of yyyy_mm_dd_hh_mm_ss;

Step 6: Click the **Replay/Stop** toggle button, choose a radar data file folder, then Zone 2 and Zone 3 will start replaying the radar data;

Step 7: Click the **Replay/Stop** toggle button to stop replaying.

4.3 IAP Tool Guide

4.3.1 XenP202TE Firmware Upgrade

ICL provides an IAP tool for XenP202TE to update the firmware. Steps of using this IAP tool are as follows:

Step 1: Download the *XenP202 IAP Tool* pack from ICL website, unzip the pack and enter the directory;

Step 2: Connect XenP202TE module with a host PC following the Step 2 in section 4.1;

Step 3: On the GUI of the IAP Tool, click the **Refresh Device** button, select the COM number of XenP202TE module, set the baud rate to 256000, as shown in Figure 4-14;

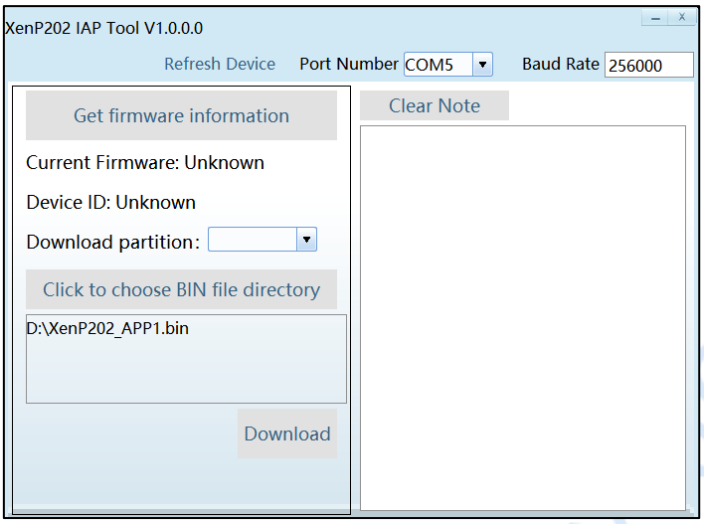


Figure 4-14 XenP202 IAP Tool

Step 4: Click the **Get firmware information** button, the GUI will read and display the device ID and the current firmware information of the module. XenP202TE firmware can run in either partition APP0 or APP1, while it is running in partition APP0, the download partition should be APP1, and vice versa, an example is shown in Figure 4-15;

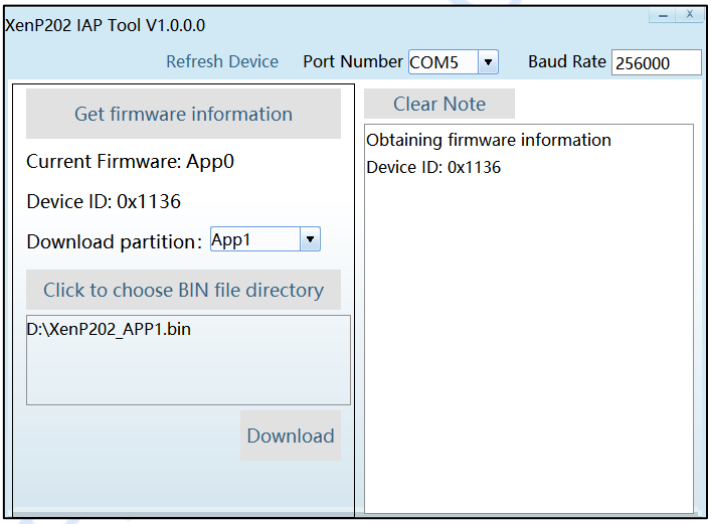


Figure 4-15 Firmware information

Step 5: Choose the corresponding download partition, click the **Click to choose BIN file directory** button to select the new firmware bin file. When the download partition is APP0, users should choose the XenP202_APP0.bin file, otherwise choose XenP202_APP1.bin file. Click the **Download** button to start the update, meanwhile the text box on the right starts printing the downloading states.

After successfully updating the firmware, the text box on the right will print "Download successful!", as shown in Figure 4-16. Otherwise, the text box will print the error message.

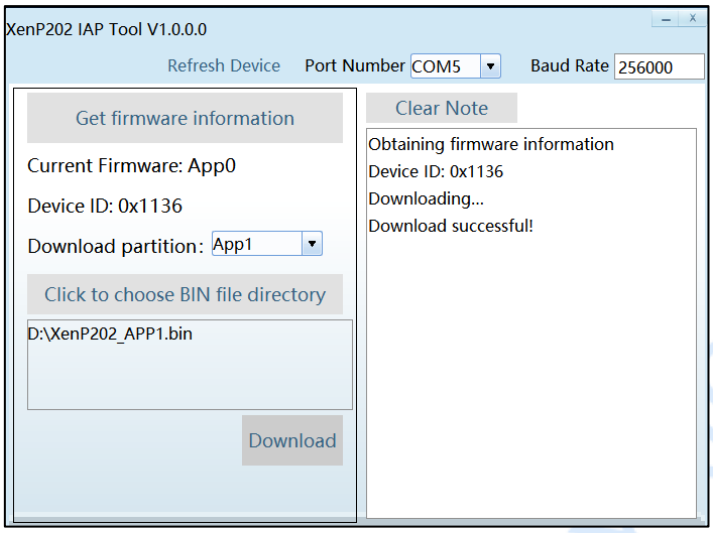


Figure 4-16 Download Successful

4.3.2 CSP202TE Firmware Upgrade

ICL also provides an IAP tool for CSP202TE to update the firmware. Steps of using this IAP tool are as follows:

Step 1: Download the *CSP202 IAP Tool* pack from ICL website, unzip the pack and enter the directory;

Step 2: Connect CSP202TE module with a host PC following the Step 2 in section 4.1;

Step 3: On the GUI of the IAP Tool, click the **Refresh Device** button, select the COM number of CSP202TE module, set the baud rate to 256000, as shown in Figure 4-17;

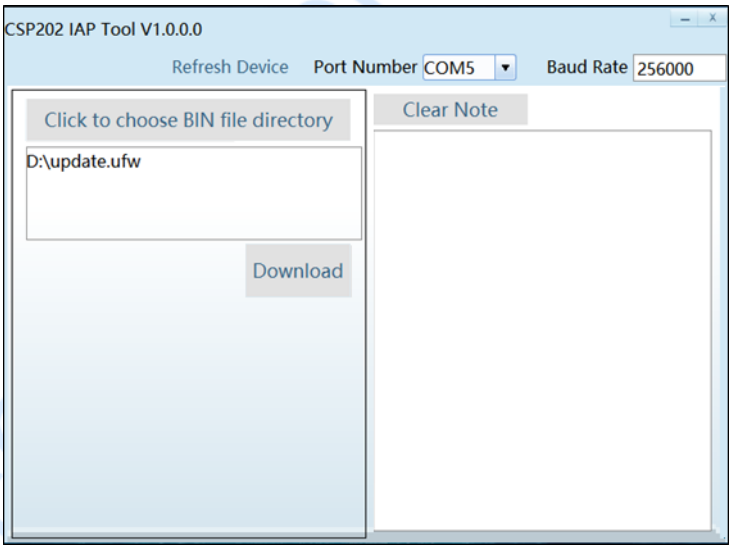


Figure 4-17 CSP202 IAP Tool

Step 4: Click the **Click to choose BIN file directory** button to choose the desired ufw file. Then click the **Download** button to start the upgrade. The text box on the right will display the download results, and meanwhile the downloading progress will be shown below in real-time, as shown in Figure 4-18;

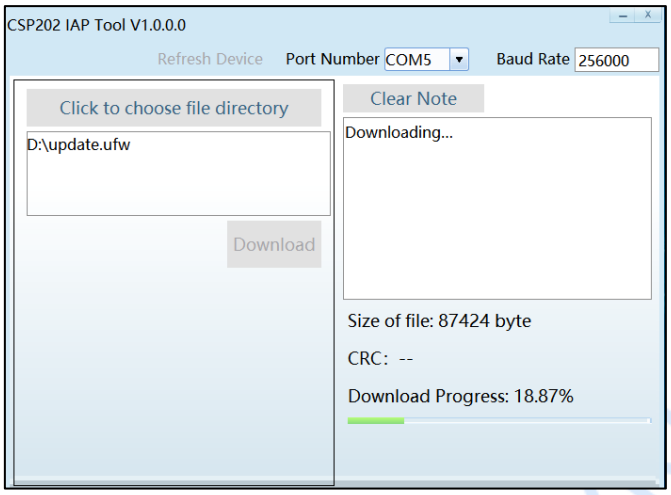


Figure 4-18 Downloading progress

After successfully updating the firmware, the text box on the right will print "Download successful!", as shown in Figure 4-19. Otherwise, the text box will print the error message.

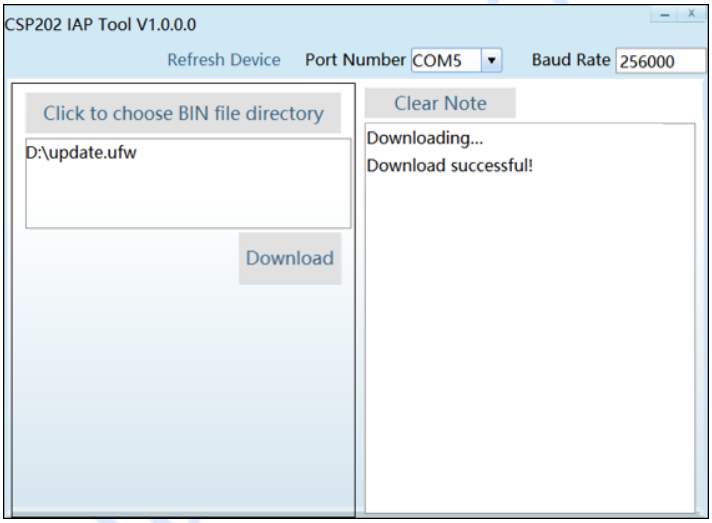


Figure 4-19 Download Successful

5. Communication Protocol

The communication protocols introduced in this chapter are mainly for users who needs to develop products without the software.

XenP202TE and CSP202TE communicate with the host PC via the serial port (TTL electrical level). The baud rate of the radar serial port is 256000 by default with 1 stop bit and no parity check digit.

Sensor outputs the detected target information, including x and y coordinates with the radar as the original point (the definitions of x and y axis are shown in Figure 5-1 and Figure 5-2, with the arrows pointing towards the positive direction), and velocity. The radar data frame format is presented in Table 5-1.

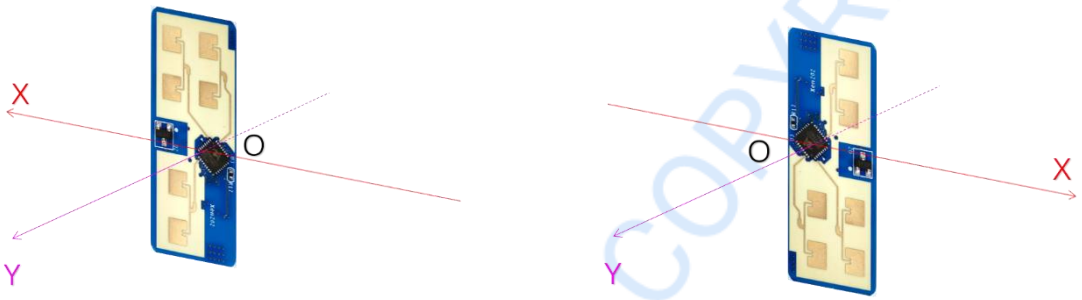
Table 5-1 Format of radar report data frame

Head	Data			Tail
AA FF 03 00	Data of Target 1	Data of Target 2	Data of Target 3	55 CC

Data format of each target information is presented in Table 5-2.

Table 5-2 Target information within the frame

Position x	Position y	Velocity	Range Resolution
signed int16; the highest bit value 1 represents positive of x axis, and 0 represents negative of x axis; the rest 15 bits represents the value of the target on X axis, unit mm	signed int16; the highest bit value 1 represents positive of y axis, and 0 represents negative of y axis; the rest 15 bits represents the value of the target on y axis, unit mm	signed int16; the highest bit value 1 represents positive velocity (leaving the radar), 0 represents negative velocity (approaching the radar); the rest 15 bits represents the value of the velocity, unit cm/s	uint16; represents the value of single range resolution, unit mm



(a) (b)

Figure 5-1 Illustration of the coordination system of XenP202TE in recommended poses

(a) (b)

Figure 5-2 Illustration of the coordination system of CSP202TE in recommended poses

For example: AA FF 03 00 0E 03 B1 86 10 00 68 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 55 CC

The data above contains target 1 information (blue digits), target 2 and target 3 (correspond to red and black digits) do not exist so the digits are all 0s. The sensor processes this data in a way that described as follows:

Position X of target 1: 0x0E + 0x03 * 256 = 782

0 - 782 = -782 mm;

Position Y of target 1: 0xB1 + 0x86 * 256 = 34481

34481 - 2^15 = 1713 mm;

Velocity of target 1: 0x10 + 0x00 * 256 = 16

0 - 6 = -16 cm/s;

Range sampling length of target 1: 0x68 + 0x01 * 256 = 360 mm.

6. Firmware Parameter Configuration

6.1 Modifying Radar Data Report Interval

To modify the data report interval, find the Set_AlgoPara function under the engineering directory \App\algo\src\algopara.c. This function calls the Set_ReportIntervalTime function whose parameter is the radar data report interval, unit is second (s). The default report interval is 0.052 s, which is the valid minimum value of this parameter.

6.2 Setting Target Hold Time

In some application scenarios, it requires the radar to maintain detecting and tracking a human target when the target stays motionless, instead of losing the target. The duration of keeping detecting and tracking a motionless target is called Target Hold Time. To set this time, find the Set_AlgoPara function under the engineering directory \App\algo\src\algopara.c. This function calls the Set_HoldCntTime function whose parameter is the target hold time, unit is second (s). The default target hold time is 37 s.

6.3 Setting Detection Range

Users can set the human target detection and tracking range. First, find the Set_AlgoPara function under the engineering directory \App\algo\src\algopara.c. This function calls two functions, Set_RectRange and Set_SectorArea, which are used for defining the human target detection and tracking range of the radar.

Set_RectRange(int16_t xn, int16_t xp, int16_t y): this function defines a rectangle detection and tracking area, an illustration of this function is shown in Figure 6-1. The unit of both parameters is centimeter (cm).

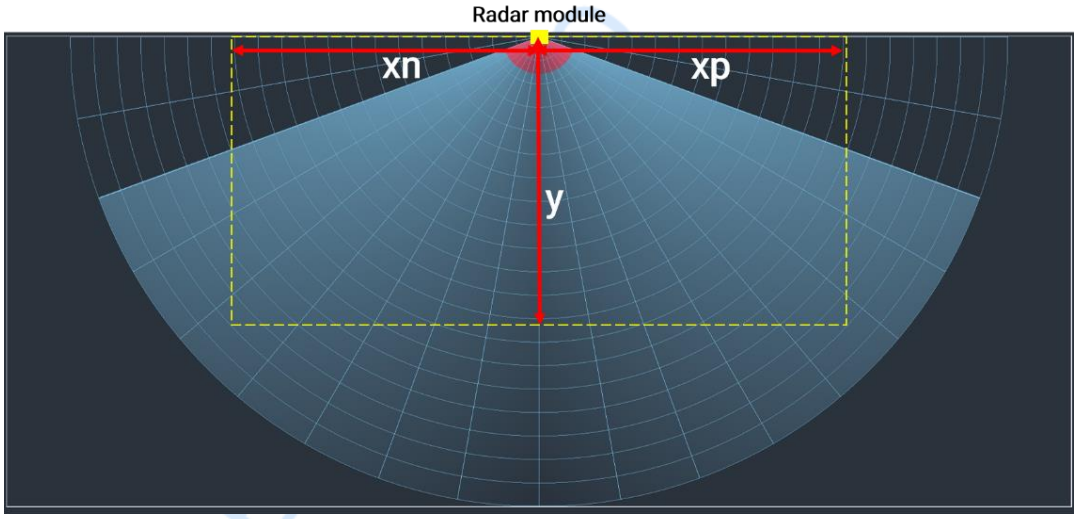


Figure 6-1 Rectangle detection and tracking range defined by Set_RectRange

Set_SectorArea (uint16_t distance, uint8_t angle): this function defines a fan-shaped detection and tracking area, an illustration of this function is shown in Figure 6-2. The units of the two parameters are centimeter (cm) and degree (°) respectively.

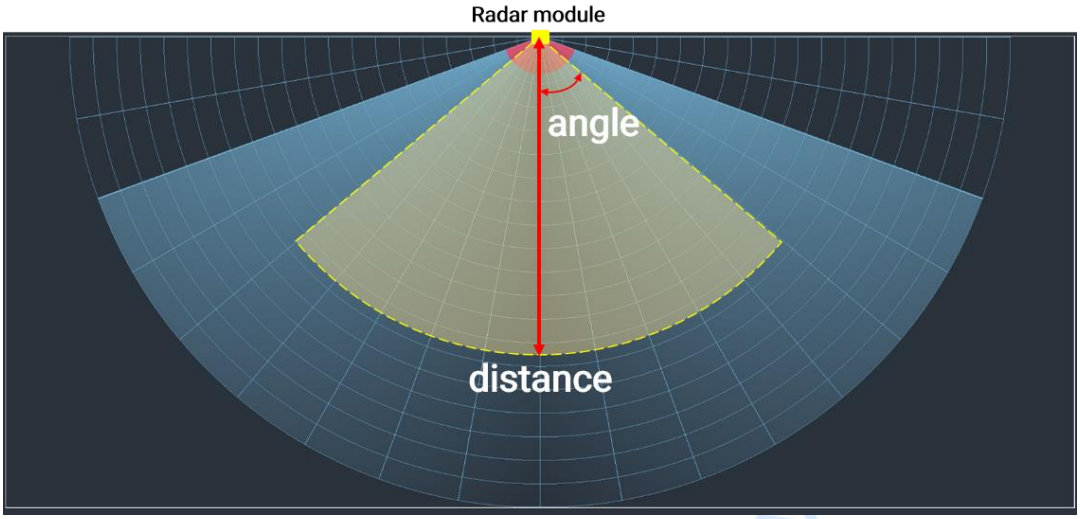


Figure 6-2 Fan-shaped detection and tracking range defined by Set_SectorArea

7. Installation and Detection Range

The XenP202TE is typically wall-mounted, as shown in Figure 7-1. The maximum positioning and tracking range is 8 m. The recommended installation height is 1.4 ~ 1.7 m, and attention should be paid to objects in the detection range or on top of the ceiling, since they may interfere or disturb the radar.

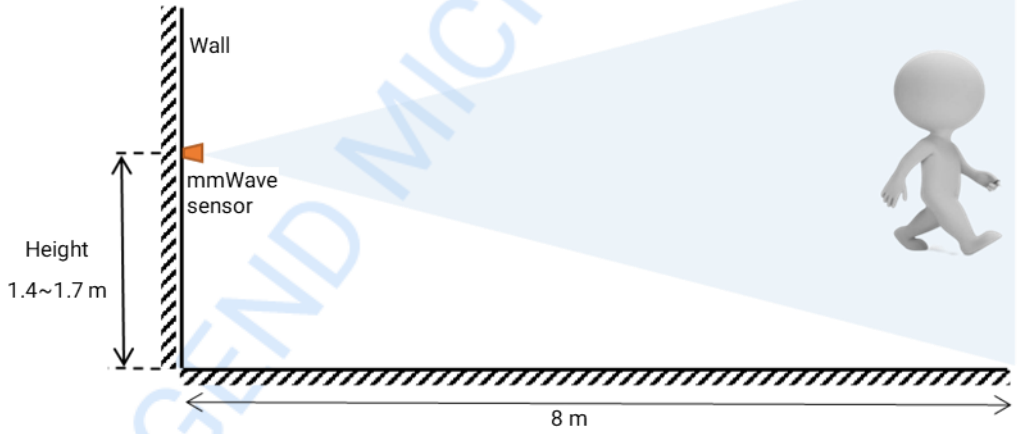


Figure 7-1 Illustration of wall mounted installation

When wall mounted, the recommended installation poses are shown in Figure 7-2 and Figure 7-3. The normal direction of the radar antennas is defined as 0°.

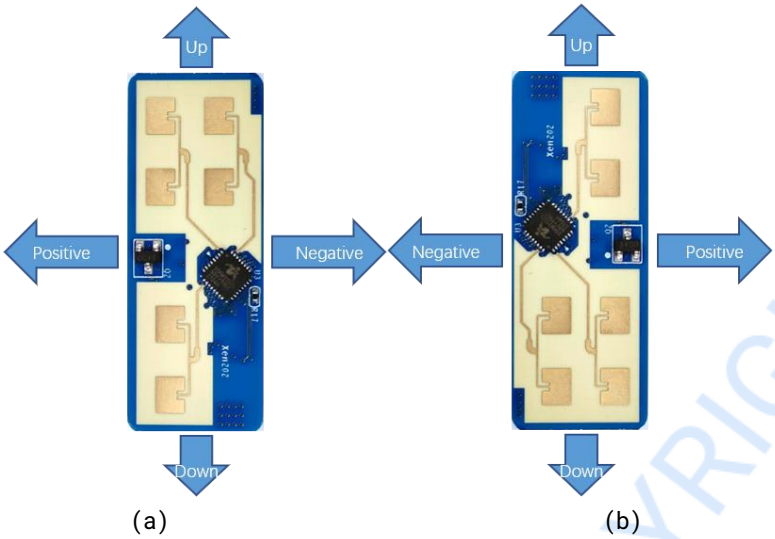


Figure 7-2 Directions of XenP202TE when wall mounted

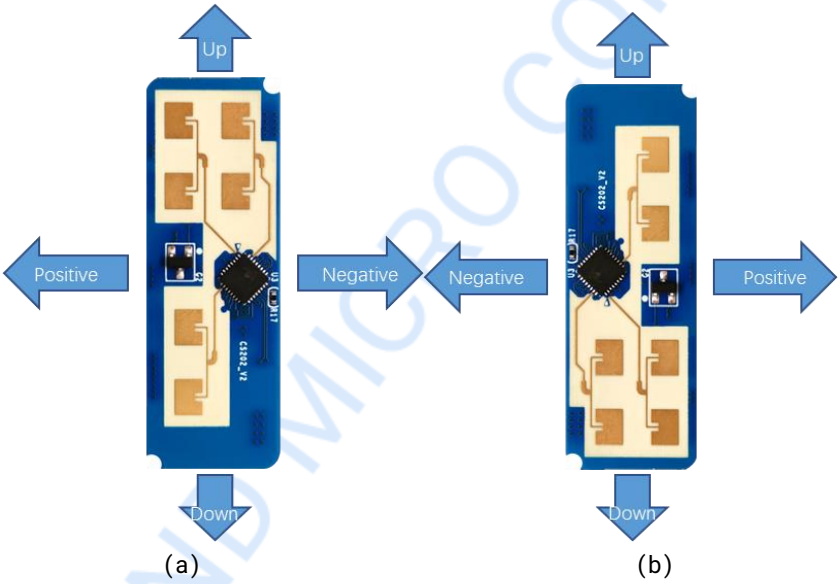


Figure 7-3 Directions of CSP202TE when wall mounted

Figure 7-4 shows the detection range of XenP202TE series sensor when it is wall mounted at 1.5 m height. The tester is 1.75 m tall and medium sized. The detection angle range is ±60° relative to radar normal direction, and the maximum detection range is 8 m in radar normal direction.

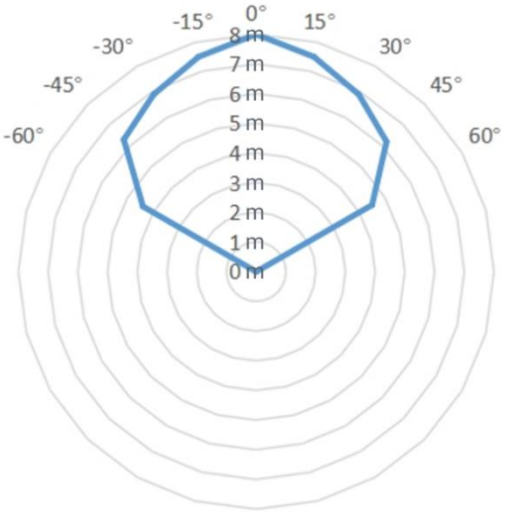


Figure 7-4 Detection and tracking range of wall-mounted radar

8. Mechanical Size

8.1 Xen202_E Mechanical Size

Figure 8-1 presents the mechanical size of Xen202_E hardware PCB. The hardware is 40 mm × 15 mm, the board thickness is 1.3 mm with a tolerance of ±10%.

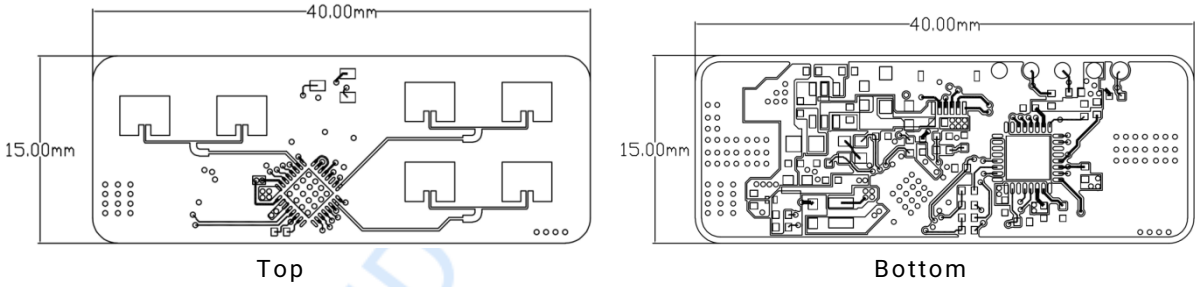


Figure 8-1 Mechanic size of Xen202_E

8.2 CS202_E Mechanical Size

Figure 8-2 presents the mechanical size of CS202_E hardware PCB. The hardware is 44 mm × 15 mm, the board thickness is 1.3 mm with a tolerance of ±10%.

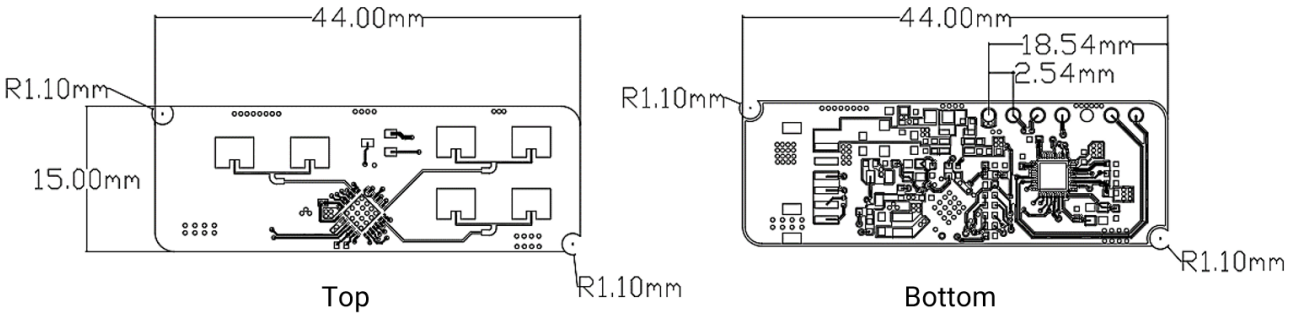


Figure 8-2 Mechanic size of CS202_E

9. Installation Requirements

Radome Requirements

If there is a need to install a radome, the material selected must have good transparency for 24 GHz wave, and do not contain any material that may block electromagnetic wave such as metal. More details please refer to mmWave Sensor Radome Design Guide.

Installation Environment

When installing the product, certain requirements should be taken into consideration in case the detection performance is interfered. Features of unsuitable environment are listed below.

- Continuous moving non-human objects in detection area, such as moving animals, swinging curtains, big shaking plants in front of an active vent etc.
- Large strong reflectors will interfere with detection performance when put in front of the antennas.
- Interferences of on-ceiling home appliances such as air-conditioners, fans, etc. should be taken into consideration while top mounted.

Important Requirements

- Ensure the radar antennas are facing squarely to desired detection area with a clear field of view.
- Ensure the installation position of the sensor is solid and stable. Motion of the radar itself can hugely impact signal processing.
- Ensure there is no object moving or vibrating behind the radar. Motion behind antennas can also be detected due to the penetrability of radar RF wave, thus interferes detection accuracy. It is recommended to use a radome or a backplane to reduce the interference.
- When there are multiple 24 GHz radar installed in close areas, make sure their beamforms do not face to each other, try to separate them as far as possible to avoid interference.

10. Important Tips

Maximum Detection Range, Range Accuracy, and Angle Accuracy

Maximum detection range, range accuracy, and angle accuracy may slightly fluctuate due to the size, motion state, and RCS of the target.

Power Supply

The Xen202 series hardware supports both 3.3 V and 5 V power supply, which method is applied depends on whether certain resistors and conductors are soldered on the board, for more details please refer to Chapter 3 Hardware Overview. Additionally, developers should take the EMC design such as ESD and lightning surge of the power supply into consideration.

11. Revision History

Revision	Date	Modification
1.0	2024/11/27	Initial release.

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