UM10035

EVB1122 Wave Config and Demo GUI

Rev.1.0   **User Manual**

Introduction

The EVB1122 Wave Config and Demo GUI (Graphic User Interface) provides easy and friendly methods and interfaces to use the EVB1122 development kit. It enables users to quickly evaluate the performance of the ICL1122 through two incorporated demonstrations.

Table of Contents

1. Environment Setup

This chapter introduces the environment setup of EVB1122, including the OS of the host PC, the drivers, and the hardware requirements of the evaluation board.

1.1 Operation Environment

- OS: Windows10-64 bit;

- Hardware: EVB1122 board programmed with data-transfer firmware.

1.2 Driver Installation

Download the zip file _Virtual Serial Driver of STSW_STM32102_STM32_ from STMicroelectronics official website. Unzip the file, double click the _VCP_V1.5.0_Setup_W7_x64_64bits.exe_, and install the driver by following the default steps.

After installing the driver, connect the EVB1122 board with a host PC using a USB Type-C cable. After connecting the board with the host PC, the board's device information will show up in the device Manager list of the host PC, as shown in Figure 1-1.

Figure 1-1 The device information in the Device Manager list

2. Main Interface Instruction

This chapter introduces the outlook and function of the main window of the _EVB1122 Wave Config and Demo GUI_.

As shown in Figure 2-1, the main window of _EVB1122 Wave Config and Demo GUI_ consists of the following zones.

- Main Menu

- Toolbar

- Basic Configuration Tabs

- Configuration File Operating Zone

- Waveform Window

- Fan-shaped Window

- Target Information Window

- Status Bar

Figure 2-1 Main window of the EVB1122 Waveform Config and Demo GUI

2.1 Main Menu

The Main Menu provides the following sub-menus: Device, File, Record, Replay, Window, Demo, and Help.

2.1.1 Device Menu

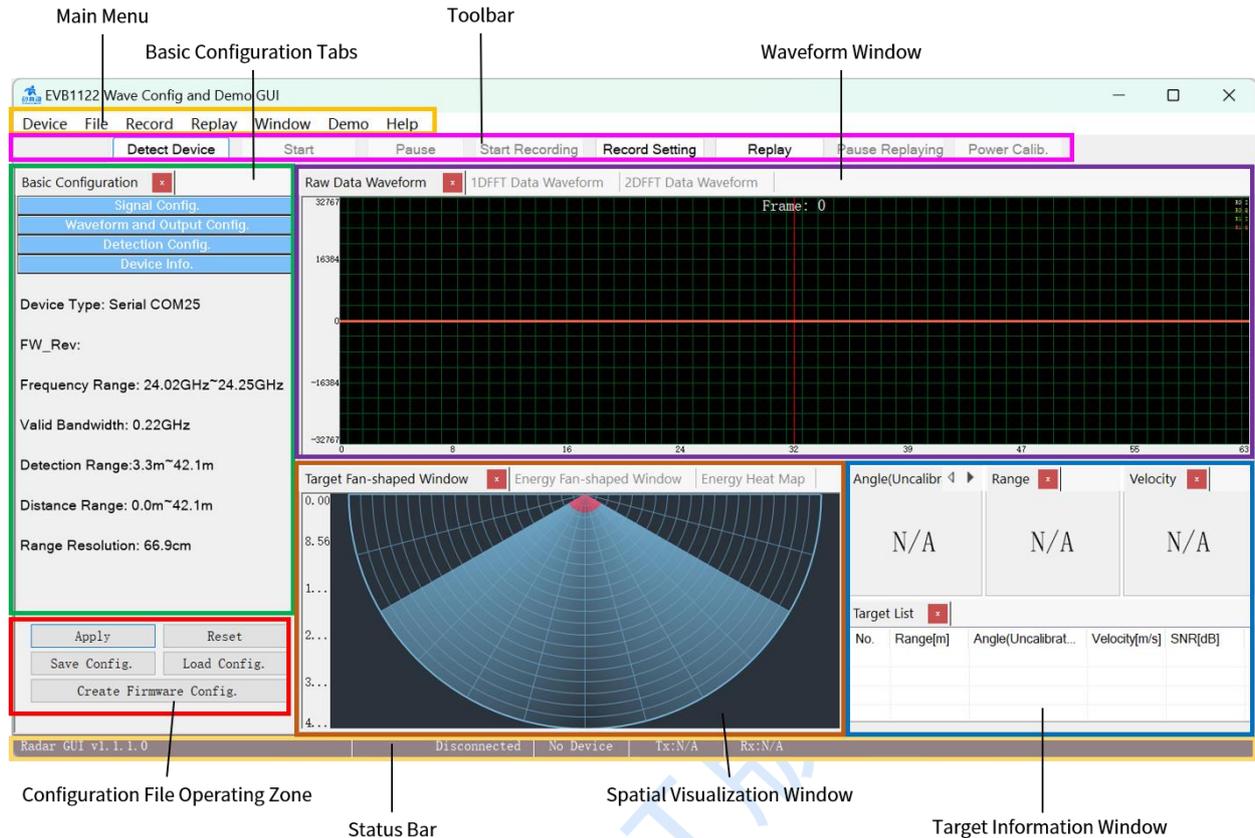The Device Menu provides Detect Device, Start/Stop, Pause/Resume, Update Firmware, and IC Total Radiated Power Display Configuration functions, as shown in Figure 2-2.

Detect Device: Detect the connection status between the EVB1122 board and the host PC according to the configuration file. If they are connected successfully, the GUI will display the board's port number and firmware information.

Start/Stop:	This is a Start/Stop toggle switch. It becomes clickable once the board is detected. By clicking Start/Stop button users can Start or Stop transferring data.

Pause/Resume: This is a Pause/Resume toggle switch. It becomes clickable once the system starts transferring data. By clicking the Pause/Resume button users can Pause or Resume transferring data.

Update Firmware: This submenu opens the Update Firmware Window, which allows users to update the firmware for the EVB1122 board.

IC Total Radiated Power Display Config.: This submenu opens the IC Total Radiated Power Display Config. window, which allows users to turn on or off the IC total radiated power display on the bottom status bar.

Figure 2-2 Device menu

2.1.2 File Menu

The File Menu provides Save Config., Load Config., Config. Overview, and Create Firmware Config. functions, as shown in Figure 2-3.

Save Config.: Save the register configuration to a specified directory.

Load Config.: Load register configuration from a specified directory.

Config. Overview: Display all the configurations in a window called Config. Overview.

Create Firmware Config.: Output the firmware's register value list to a .txt file and save to a specified directory.

Figure 2-3 File menu

2.1.3 Record Menu

The Record Menu provides Start/Stop Recording and Record Setting functions.

Start/Stop Recording: This is a Start/Stop Recording toggle switch. It becomes clickable once the system starts transferring data. By clicking the Start Recording button users can save the data that received from the board to a binary file.

Record Setting: This submenu enables users to configure recording-related information, including the saving directory, recording mode, the size of the recording file, etc.

2.1.4 Replay Menu

The Replay Menu provides Start/Stop Replay and Pause/Resume Replay functions.

Start/Stop Replay: This is a Start/Stop Replay toggle switch. By clicking this button users can choose a file to display on the GUI.

Pause/Resume Replay: This is a Start/Stop Replay toggle switch. It becomes clickable once GUI starts replaying data. By clicking the Pause/Resume Replay button users can Pause or Resume replaying data.

2.1.5 Window Menu

The Window Menu provides Display Window and Restore Window functions, as shown in Figure 2-4.

Display Window: This submenu displays the unfolded view of a selected tab. Users can click on a tab bar to select it.

Restore Window: This submenu restores the unfolded tabs back to the default layout.
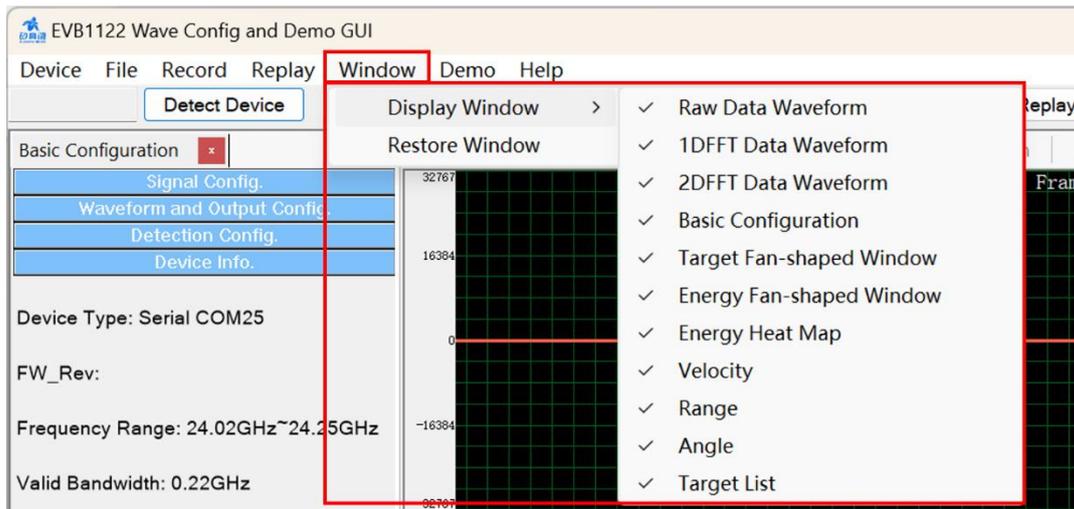
Figure 2-4 The Display Window options of the Window menu

2.1.6 Demo Menu

The Demo Menu provides two demonstration modes, as shown in Figure 2-5.

Indoor Multi-Human Tracking: Open the Indoor Multi-Human Tracking demonstration program.

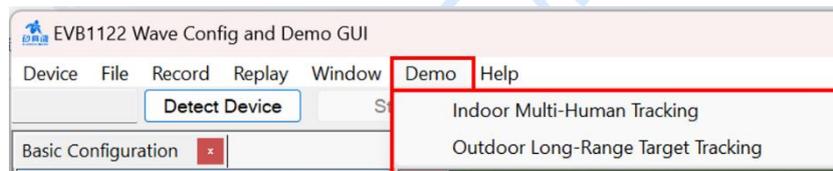Outdoor Long-Range Target Tracking: Open the Outdoor Long-Range Target Tracking demonstration program.

Figure 2-5 The demonstration programs of the Demo menu

2.1.7 Help Menu

The Help Menu provides User Manual and About information.

User Manual: Provide the guide of EVB1122 Wave Config and Demo GUI.

About: Display the copyright information of this software.

2.2 Toolbar

The Toolbar integrates the main functions of Device, Record, and Replay menus, as shown in Figure 2-6.

Device Port No. textbox: Display the port number of the first detected EVB1122 board.

Detect Device: Load the configuration file and detect the device port number.

Start/Stop: Start/Stop transferring data.

Pause/Resume: Pause/Resume transferring data.

Start Recording: Record evaluation board data and save them to a binary file. This function is active only after the evaluation board starts transferring data normally.

Record Setting: Let users set recording-related information, including saving directory, recording mode, the number and size limit of the recording file, etc.

Replay: Replay specified evaluation board data file.

Pause Replaying: Pause replaying evaluation board data file. This function is active only after GUI starts replaying evaluation board data.

Power Calib.: Open the Power Calibration Setting window.

Detect Device	Start	Pause	Start Recording	Record Setting	Replay	Pause Replaying	Power Calib.

Figure 2-6 Top Toolbar

2.3 Basic Configuration Tabs

The Basic Configuration Tabs support Signal Config., Waveform and Output Config., Detection Config. and Device Info. functions. These tabs support operations such as dragging, zooming, and closing. When clicking a tab, it will unfold and all the other tabs will fold like drawers. To display a tab after closing it, just click the Window menu on the main menu bar, and choose the tab's name in the Display Window list.

2.3.1 Signal Configuration

The Signal Configuration tab enables users to configure signal-related parameters, as shown in Figure 2-7.

WaveStatic: The modulation signal type of the chip.

Chirp Start (Frequency): The chirp start frequency, unit MHz.

Chirp Cutoff (Frequency): The chirp cutoff frequency[1], unit MHz.

CW Freq.(MHz): The CW frequency, only valid when WaveStatic is set as Continuous Wave, unit MHz.

SPI Merge: To turn on/off the SPI Merge mode.

Tx Config: Transmitting antenna configuration.

Rx Config: Receiving antenna configuration[2].

Tx: The Tx power of the chip.
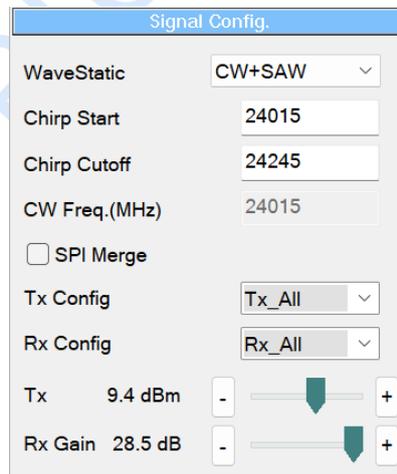
Rx Gain: The Rx gain of the chip.

Figure 2-7 Signal Configuration Tab

2.3.2 Waveform and Output Config.

The Waveform and Output Config. tab enables users to configure waveform-related parameters, as shown in

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[1] Chirp bandwidth = Chirp Cutoff Frequency - Chirp Start Frequency.

[2] Receiver1 is antenna 1, Receiver 2 is antenna 2, Rx_All means both antennas are selected.
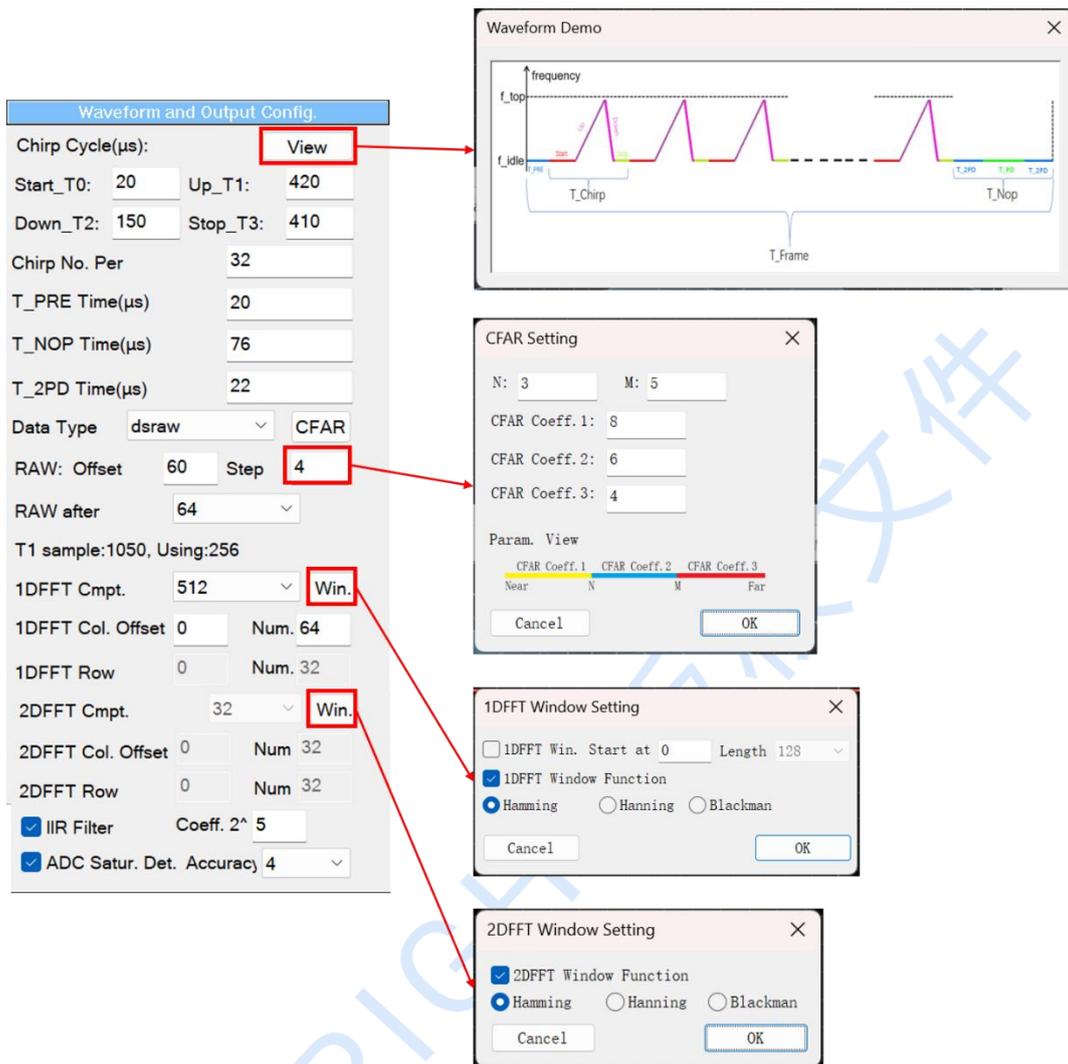
Figure 2-8.

Figure 2-8 Waveform and Output Config.

For details of the parameters in the Waveform and Output Config. tab, and those of CFAR Setting, 1DFFT Window Setting, and 2DFFT Window Setting windows, please refer to Table 4-1 and Table 4-2.

2.3.3 Detection Config.

The Detection Config. tab supports configuring detection related parameters, as shown in Figure 2-9.

Range Gate: Set the maximum number of range gate of the detection area; should be less than the length of outputted 1DFFT data.

Gate Range: Set the detection range, i.e. targets within this range will be detected; The Ranging zone appears blue in this zone, and red elsewhere.

Angle[3]:

Scale: Scale the target angle to specified ratio;

Offset: Compensate the target's angle, ranges from -180° ~ 180°.

ACC Remove: When ticked, the algorithm will apply an accumulative average cluster remove process,

EVB1122 Wave Config and Demo GUI

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[3] This function is generally for micro-adjusting the display on host PC: Reverse function is aimed to solve the left-right reverse display caused by the position of the sensor.

where the larger this parameter is, the longer it will take to remove the background noise; This value MUST be greater than 31.

Min. Target Energy: Display the energy threshold of the target; Only when the target's energy exceeds this threshold will its value be displayed on the GUI.
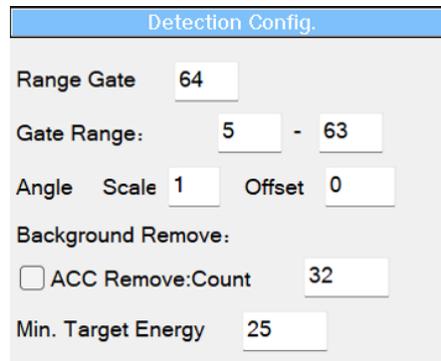

Figure 2-9 Target Detection Configuration

2.3.4 Device Information

The Device Information tab displays the hardware and firmware information, as well as several critical detecting parameters, as shown in Figure 2-10.

Device Type: Display the port number of the detected device.

FW_Rev: Display the firmware revision of the detected evaluation board.

Frequency Range: The chirp frequency range of the chip.

Valid Bandwidth: The effective bandwidth computed according to the chirp frequency range and chirp cycle.

Detection Range: The evaluation board's range for detecting target.

Distance Range: The range of the detection area displayed on the GUI.

Range Resolution: The resolution of evaluation board's range measurement, which is computed according to the sweeping bandwidth.
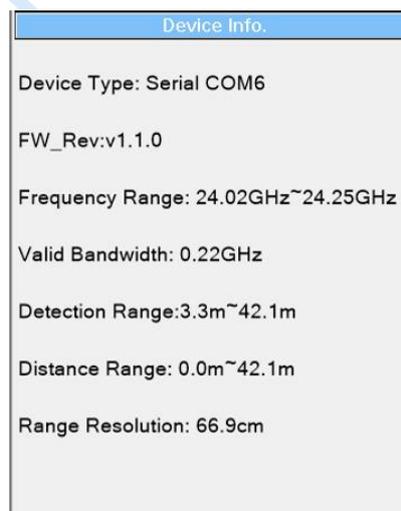

Figure 2-10 Device Information

2.4 Configuration File Operating Zone

Configuration File Operating Zone provides buttons for operating the configuration file, they are Apply, Reset,

Save Config., Load Config, and Create Firmware Config, as shown in Figure 2-11.

Apply: Enable the modifications made in the Basic Configuration tab, and save them to the *Evaluation board_Config.ini* file in the working directory.

Reset: Reset the parameters in the Basic Configuration tab to default settings, and save them to the *Evaluation board_Config.ini* file in the working directory.

Save Config.: Wave the modifications in the Basic Configuration tab to a specified directory.

Load Config.: Load a configuration file from a specified directory.

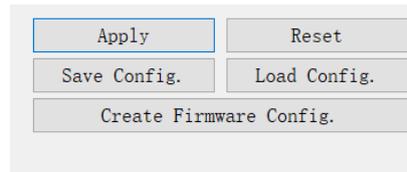Create Firmware Config.: Output the firmware's register value list to a .txt file.

Figure 2-11 Configuration File Operating Zone

2.5   Data Display View

The Data Display View visualizes the evaluation board data received from the evaluation board. Visualized views include Waveform Window, Fan-shaped Window, and Target Information Window.

2.5.1   Waveform Window

The Waveform Window has three sub-tabs, they are Raw Data Waveform, 1DFFT Waveform, and 2DFFT Waveform.

Raw Data Waveform: Display the data received from the evaluation board directly to the view (the GUI displays RAW data by default), as shown in Figure 2-12, and support zooming in or out. The data types outputted by the board include RAW data, 1DFFT data, and 2DFFT data. Therefore, The Waveform Window supports switching displays among different data types.

Figure 2-12 Reference waveform of RAW data

1DFFT Waveform: Display 1DFFT waveform (To display 1DFFT data, users can choose 1dfft as the data type on the Waveform and Output Config. Tab, and then click the Apply button in the Configuration File Operating Zone). Different types of data that received directly from the board will be processed accordingly, as shown in Figure 2-13. When RAW data are received, they will be processed to 1DFFT data before being displayed; when 1DFFT data are received, they will be displayed directly; when 2DFFT data are received, they will not be displayed. There is a Drop-down List at the top right corner of the window, it provides options to visualize specified part of the evaluation board data, including Real, Imaginary, Modulus, Energy, and SNR, as shown in Figure 2-14.

Figure 2-13 Reference waveform of 1DFFT data

Figure 2-14 Drop-down List of display options

2DFFT Waveform: Display 2DFFT data waveform (To display 2DFFT data, users can choose 2dfft as the data type on the Waveform and Output Config. Tab, and then click the Apply button in the Configuration File Operating Zone). Different types of data received directly will be processed accordingly, as shown in Figure 2-15. When RAW or 1DFFT data are received, they will be processed to 2DFFTdata before being displayed; when 2DFFT data are received, they will be displayed directly. This view also provides a Drop-down List as introduced in 1DFFT view.

Figure 2-15 Reference waveform of 2DFFT data

2.5.2 Fan-shaped Window

Fan-shaped Window has three sub-tabs, they are Target Fan-shaped Window, Energy Fan-shaped Window, and Energy Heat Map.

Target Fan-shaped Window: Display the position of the strongest target detected within detection range (as shown in Figure 2-16). Y axis stands for the distance of the target from the evaluation board in its normal direction (unit: meter). The detection range can be configured in the Detection Config. Tab of Basic Configuration Tabs.

Figure 2-16 Target Fan-shaped Window

Energy Fan-shaped Window: Display the energy distribution within detection range. In this window, the green pixels represent low energy, and the red ones represent high energy (as shown in Figure 2-17). Y axis stands for the distance of the target from the evaluation board in its normal direction (unit: m).

Figure 2-17 Energy Fan-shaped Window

Energy Heat Map: Display the energy distribution within the detection range (as shown in Figure 2-18). The heat map supports data types including raw, 1dfft, and rdmap.

Click the Setting button on the right bottom of this view, a Colorbar Setting window will appear, allowing users to set the channel of data to be displayed, as well as set the energy range of the heatmap.

The horizontal dimension represents range gate (range gate 0 lies at the far left of the map); and the vertical represents velocity dimension (velocity at the center of the green strip in Figure 2-18 is 0, upward represents the increase of speed towards the evaluation board, and downward represents the increase of speed away from the evaluation board); the color stands for energy level in that the cold color represents low energy, and warm represents high.

Figure 2-18 Energy Heat Map

2.5.3 Target Information Window

Target Information Window displays key information of the strongest target detected by the evaluation board, such as Angle, Range, and Velocity, as shown in Figure 2-19.

Figure 2-19 Target Information

2.6 Bottom Status Bar

The Bottom Status Bar lies at the bottom of the GUI, and displays key information about the program and evaluation board, as shown in Figure 2-20.

- GUI and Firmware Revision
- ID of the evaluation board
- Connection status
- Tx/Rx status
- SoC junction temperature
- IC Total Radiated Power

| Radar GUI v1.1.1.0(FW_Rev: v1.1.0) | Connected | EVB1122 | Tx: Normal | Rx: 540.37 KB/s | T:40.9℃ | IC TRP:9.0dBm |

Figure 2-20 Bottom Status Bar

3. Sub-interface Introduction

This chapter introduces functions of the main windows of EVB1122 Wave Config. and Demo GUI.

3.1 Configuration Overview

The Configuration Overview incorporates all the configurations in a single window, as shown in Figure 3-1. To access this window, first click **File** on the menu, then click **Config. Overview** submenu.

Figure 3-1 Configuration Overview

3.2 Record Setting

The Record Setting function is for configuring data saving parameters and methods, as shown in Figure 3-2. To access this tab, either click the Record Setting on the Menu, or click the Record Setting button in the Top toolbar.

Figure 3-2 Record Configuration

Save to: Click the "…" button and choose a saving directory.

Overwrite: If this box is ticked, only the latest data will be saved.

Compress: If this box is ticked, the real-time data received from the evaluation board will be compressed.

Number Limit: The maximum number of data files.

Size Limit (MB): The maximum size of a data file.

3.3 Update Firmware

The Update Firmware window allows users to update the EVB1122 board's firmware online, instead of using programming tools. To apply this function, click **Device** option on the main menu, and choose the **Update Firmware** submenu, the window will appear as shown in Figure 3-3.

Figure 3-3 Update Firmware

3.4 IC Total Radiated Power Display Config.

The IC Total Radiated Power Display Config. window is for switching on/off the real-time IC radiated power report. To open this window, users need to click the Device menu, then click the IC Total Radiated Power Display Config. submenu. The window is shown as Figure 3-4.

Figure 3-4 The IC Total Radiated Power Display Config. window

3.5 Power Calibration Setting

The Power Calibration Setting window is for calibrating the power detector of the SoC. After clicking this button, a Power Calibration Setting window will appear, as shown in Figure 3-5. There are two types of calibration methods: the default one, and the one using a spectrometer. The latter requires installing the Visa library, otherwise the power detector can only be calibrated using the default Tx value.

If a spectrometer is used to calibrate the power detection, users should type in the address of the spectrometer.

(a) Default mode

(b) Spectrometer mode

Figure 3-5 Power Calibration Setting window

4. Parameter Configuration

This chapter introduces the parameters provided by EVB1122 Wave Config. and Demo. GUI, and their value ranges, as well as the requirements they need to meet.

4.1 Bandwidth Configuration

Chirp Frequency Configuration

Chirp Frequency refers to a type of transmission where the frequency varies dynamically within a certain range. Chirp Frequency bandwidth is determined by Chirp Start Frequency and Chirp Cutoff Frequency.

For example, if the waveform is configured as *CW + Saw Wave Mode* with 230 MHz bandwidth, it is suggested to set the Chirp Start Frequency as 24,015 MHz, and the Chirp Cutoff Frequency as 24,245 MHz.

Continuous Wave Frequency

Continuous Wave refers to a type of transmission whose frequency maintains unchanged. This parameter is not configurable when the waveform is configured as CW + Saw Wave or CW + Triangular Wave.

4.2   Link Gain Configuration

Parameter Description

Transmission Configuration: It can be configured as either Off, or On.

Receiving Configuration: It can be configured as Off[4], RX1, RX2, or All On.

Receiving Antenna

EVB1122 has two receiving antennas, with RX1 corresponds to Antenna 1, and RX2 to Antenna 2.

Transmission Gain: Range from 0 to 11 dBm, with 30 gears in total.

Receiving Gain: It has three levels, with level 1 be 23.0 dB, level 2 be 25.5 dB, and level 3 be 28.5 dB.

4.3   Waveform Configuration

Parameter Description

Waveform Mode: EVB1122 supports three waveform modes, they are Continuous Wave Mode (CW), CW + Saw Wave Mode (CW + SAW), and CW + Triangular Wave Mode (CW + TRI).

Total Chirp Time: Equal to（T0+T1+T2+T3）.

Start-up Time (T0): Chirp start-up time, also known as Chirp build-up time.

Up Time (T1): When configured as CW + SAW or CW + TRI, T1 equals to Chirp up time.

Down Time (T2): When configured as CW + SAW or CW + TRI, T2 equals to Chirp down time.

Note: When set to CW + SAW, T2 must be greater than T1 × 1/4.

Stop Time (T3): Chirp stop time.

Chirp No. per Frame: The number of Chirps in a single frame.

T_PRE: The start delay of each frame.

T_NOP: The end delay of each frame.

T_2PD: The preparation time duration of entering or exiting Low Power Mode, which must be no less than 22 μs.

4.4   Data Output Configuration

EVB1122 outputs the following data types: 1DFFT, 2DFFT, 2DFFT_PEAK, and DSRAW, which are all processed from RAW data. Parameters involved in data processing are listed in Table 4-1. The Column mentioned in the table refers to range unit, and the Row refers to the number of chirps.

Table 4-1 EVB1122 data processing related parameter description

Parameter	Description
RAW Sample Offset	Offset when sampling RAW data
RAW Sample Step	Raw data sample step, can be set to 1, 2, 4, or 8.
RAW Sample Size	The size of RAW data that is sampled, can be 64, 128, 256, 512 or 1,024
1DFFT Computation Size	1DFFT computation size of the chip; can be set to 64, 128, or 256; Default 256.

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[4] Close a certain channel refers to close the ADC of that channel, the data in that channel can still be acquired, but all are 0 s.

1DFFT Output Column Offset	The range unit offset of the 1DFFT data.
1DFFT Output Column Num.	The FFT data size after 1DFFT data offset, default 64; 1DFFT output column + 1DFFT output column offset must ≤ 1DFFT computation size
1DFFT Output Row Offset	The starting chirp of the 1DFFT output
1DFFT Output Row Num.	The chirp number of the 1DFFT output after the computation; 1DFFT Output Row Offset + 1DFFT Output Row Num. must ≤ the chirp number per frame
2DFFT Computation Size (Row)	Chirp number in the 2DFFT process, should satisfy the following requirements: 1. must be no bigger than the Chirp number in a frame, it is suggested to be equal to Chirp No. per Frame; 2. must be a certain power of 2; 3. 2DFFT Line Number × 1DFFT Output Size = 1,024.
2DFFT Output Column Offset	Starting column of the output 2DFFT after the computation
2DFFT Output Column Num.	The number of columns of the output 2DFFT after the computation; 2DFFT Output Column Offset + 2DFFT Output Column Num. must ≤ 1DFFT Output Column Num.
2DFFT Output Row Offset	Starting row of the output 2DFFT after the computation
2DFFT Output Row Num.	The number of rows of the output 2DFFT after the computation; 2DFFT Output Row Offset + 2DFFT Output Row Num. must ≤ 2DFFT Computation Size (Row)

The sample rate of EVB1122 is fixed to 2.5 MSPS (sample per second). Therefore, during a Chirp cycle, the Total Number of Sample = 2.5 M × Total Chirp Time. The interactions of each parameter when processing data is shown in Figure 4-1.

It is highly recommended that:

T0 × 2.5 M < RAW Sample Offset;
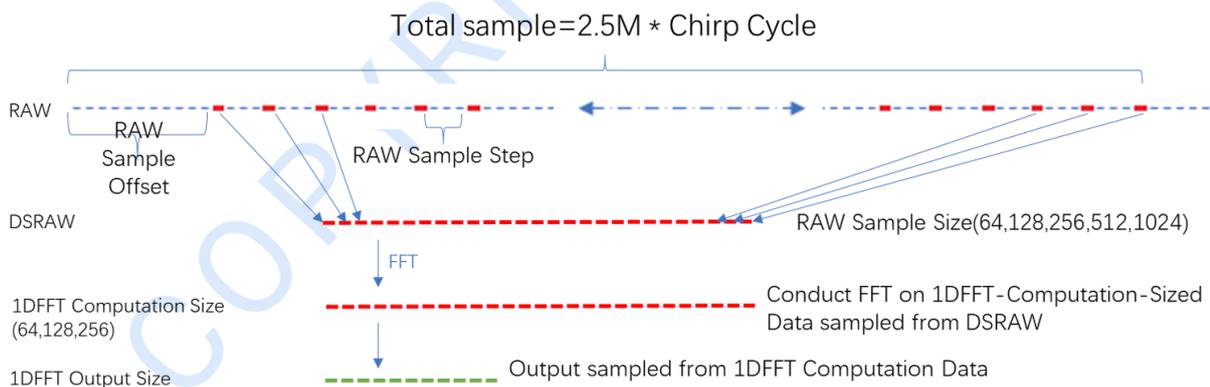
T1 × 2.5 M > RAW Sample Step × RAW Sample Size.

Figure 4-1 Data processing diagram

4.5   Parameter Table

Table 4-2 EVB1122 waveform GUI output parameter description

Parameter	Default	Range	Description
Output Waveform	CW + SAW	CW CW + SAW CW +TRI	Type of waveform

Start Frequency (MHz)	24,015	Recommended: 24,000~25,000 Supported: 22,500~27,500	Start frequency of Triangular Wave or Saw Wave
Cutoff Frequency (MHz)	24,245		Cutoff frequency of Triangular Wave or Saw Wave
Continuous Wave Frequency (MHz)	24,015		Continuous wave frequency
Tx Power	9.4 dBm	0~11 dBm	Transmission power
Rx Gain	28.5 dB	23.0 dB 25.5 dB 28.5 dB	Receiving gain
Start_T0 (µs)	20	< 1,000,000	Chirp build-up time
Up_T1 (µs)	420	< 1,000,000	Frequency rise time in a single Chirp
Down_T2 (µs)	150	< 1,000,000	Frequency down time in a single Chirp; It is suggested that: For 1 GHz bandwidth, T2 ≥ 100 µs In Saw Wave mode, T2 ≥ 1/4 × T1 must be satisfied
Stop_T3 (µs)	410	< 1,000,000	Chirp stop time
Chirp No. per Frame	32	≥1	Number of Chirps in a frame
T_PRE Time(µs)	20	≥1 < 1,000,000	Start delay of each frame
T_NOP Time(µs)	76	≥1	End delay of each frame; when in Low Power Mode, must be no less than (2 × T_2PD + 1)
T_2PD Time(µs)	22	≥22 <T_NOP/2	The preparation time duration of entering or exiting Low Power Mode
Data Type	1DFFT	DSRAW 1DFFT 2DFFT 2DFFT_PEAK	DSRAW: down sampling RAW data, mainly used for debugging serial data 1DFFT: slave board outputs 1DFFT data 2DFFT: slave board outputs 2DFFT data 2DFFT_PEAK: slave board outputs the maximum values of 2DFFT
CFAR coefficient	N: 3 M: 5 CFAR coefficient1: 8 CFAR coefficient2: 6 CFAR coefficient3: 4	N< M M < 32 CFAR coefficient1, coefficient2, coefficient3: 0 ~ 255	Range gate 0~N: applies CFAR coefficient1; Range gate N~M: applies CFAR coefficient2; Range gate M~Max: applies CFAR coefficient3;
RAW Sample Offset	60	1~1024	Sampling offset of RAW data
RAW Sample Step	4	1, 2, 3, 4	Sampling step of RAW data
RAW Size after Sampling	256	64, 128, 256, 512, 1,024	RAW data size after sampling
1DFFT Computation Size	256	64, 128, 256	The size of data in a 1DFFT

1DFFT Output Column Offset	0	0~255	1DFFT sample offset.
1DFFT Output Column Size	64	1 ~1DFFT computation size	The length of 1DFFT output data
1DFFT window	Start: 0 Length: 128 Function: Hamming	Start: 0 ~ (Raw after sampling – Window length -1); Length: 64, 128; Window Function: Hamming, Hanning, Blackman	Start: the starting point for conducting the window function Length: the length of the window function Function: the name of the window function
1DFFT Output Row Offset	0	0~255	1DFFT output row offset
1DFFT Output Row Size	32	1~Chirp Num. per Frame	1DFFT output row number
2DFFT Computation Size (Row)	32	8, 16, 32, 64, 128	Chirp number for computing 2DFFT
2DFFT Output Column Offset	0	< 1DFFT Output Column Num.	Column offset of the output data after 2DFFT computation
2DFFT Line Number	32	< 1DFFT Output Column Num.	Column number of the output data after 2DFFT computation
2DFFT Output Row Offset	0	< 2DFFT Computation Size	Row offset of the output data after 2DFFT computation
2DFFT Output Row Num.	32	< 2DFFT Computation Size	Row number of the output data after 2DFFT computation
2DFFT window	Function: Hamming	Hamming, Hanning, Blackman	Window function of 2DFFT windowing
IIR Filter Coefficient	5	1~6	The larger this coefficient, the more sensitive to slow target the evaluation board becomes
ADC Saturation Detection Accuracy	4	4, 8, 16, 32, 64 128, 256, 512	The larger the value, the more frequent the detection
Num. of Range Gate	64	1 ~ 64	The number of the evaluation board detection zones that separated equivalently
Range gate scope	5~63	0~Range gate Num. - 1	-
Accumulative Average Cluster Remove	128	≥32	The larger the number, the longer it will take to remove the cluster
Target Energy Threshold	30	≥0	The threshold of displaying target on the GUI

5. Example of Main Interface Operation

This chapter introduces how to start up with the EVB1122 Waveform Config. and Demo. GUI through two examples.

5.1 Connect and Run

The steps for connecting the evaluation board with the host PC, and running the EVB1122 Waveform Config. and Demo. GUI are as follows:

Step 1: Connect the EVB1122 evaluation board with a host PC using a USB Type-C cable;

Step 2: Open the EVB1122 *Wave Config and Demo GUI* on the host PC; Click **Device** menu to unfold the submenu before click the **Detect Device** submenu, or just click the **Detect Device** button on the toolbar, a prompt window writing *Serial Device Detected!* will appear if the device is successfully connected to the host PC, as shown in Figure 5-1;

Figure 5-1 The prompt window when a device is detected

Step 3: Configure the evaluation board; Take outputting 1DFFT waveform as an example, unfold **Waveform and Output Data Config.** in *Basic Configuration* by clicking on the tab, and select 1DFFT for *Data Type*; Click the **Apply** button to let the configuration take effect, as shown in Figure 5-2;

Figure 5-2 Configure the Data Type in the Waveform and Output Config. tab

Step 4: Click the *Start* button on the top bar, the evaluation board starts detecting and reporting data to the host PC; Meanwhile, the GUI will change in the following aspects:

- As shown in Figure 5-3, Waveform Window(1), Fan-shaped Window(2), and Target Information Window(3) start displaying data curves, data, and target information in real time;

- The text on *Start* button changes to *Stop*, the *Pause* and *Start Recording* button become clickable; the *Record Setting* and *Replay* button become unclickable, as shown in Figure 5-4.

- The bottom status bar starts displaying the temperature of the IC, as shown in Figure 5-5.

Figure 5-3 The Waveform Window, Fan-shaped Window, and Target Information Window during detecting

a Before

b After

Figure 5-4 Top toolbar status before and after the evaluation board starts detecting

Figure 5-5 The bottom status bar displaying IC information

5.2 Update Firmware

Steps of using the IAP function of the EVB1122 are as follows:

Step 1:   Ensure that the EVB1122 has programmed the bootloader firmware; connect the evaluation board and the host PC using a USB cable; Start the *EVB1122 Wave Configuration and Demonstration GUI*; Click the **Device** menu and the **Update Firmware** submenu in turn to open the Update Firmware window, as shown in Figure 5-6;

Figure 5-6 Update Firmware interface

Step 2:   Click the Refresh Device button, choose the COM port number of the EVB1122 board, an example is shown in Figure 5-7;

Figure 5-7 Obtain port number on Update Firmware interface

Step 3:   Click the Get firmware information button, then GUI will display the firmware information that is running in the MCU and the device ID, as shown in Figure 5-8;

Figure 5-8 Obtain firmware information

Step 4:   Since the target firmware that can be updated can only be the three-in-one merged firmware (i.e. EVB1122_USBHS_Function_Firmware) regardless of whether the current running firmware is BootLoader or other demo, users should select the App_Merge download partition from the drop-down box in the " Download partition" section; Subsequently, click the Click to choose bin file directory button to load the bin file; Finally, click the Download button to start downloading.

When the download process finishes, the sensor's firmware will jump to the latest application and start running.

6. Example of Demonstration Program

This chapter introduces the two demonstration programs provided in EVB1122 Wave Config. and Demo. GUI. Click *Demo* on the Main Menu, a drop-down list will show up with options *Indoor Multi-Human Tracking* and *Outdoor Long-Range Target Tracking*. Details of these demonstration programs are presented as follows.

6.1 Indoor Multi-Human Tracking Demonstration

6.1.1 Introduction

As shown in Figure 6-1, Indoor Multi-Human Tracking GUI can be partitioned into 3 zones: Operation Zone (1), Results Display Zone (2) and Position Display Zone (3). Functions of each zone are explained in Table 6-1.

Figure 6-1 Indoor Multi-Human Tracking GUI

Table 6-1 Indoor Multi-Human Tracking GUI Description

Number	Zone	Function
1	Operation Zone	Detect Device, Area Monitor, Start or Stop detecting
2	Results Display Zone	Display the distance, angle, and velocity information of detected target(s); In Single Target Detection mode, it displays the information of the target with the largest energy value; In Triple Target Detection mode, it displays the information of at most three targets with the largest energy values
3	Position Display Zone	Display moving target's position in detection range

Functions of the buttons in Operation Zone are explained in detail as follows:

Detect Device: Detect whether EVB1122 is connected to the host HOST PC; if the connection is failed, a notice window writing *No device detected!* will appear;

Start(/Stop): Start (or stop) receiving data from the evaluation board and display the target's position in the detection range in real-time.

Area Monitoring: Set up monitoring area(s) and blind area(s): for monitoring area, when a target enters this area the color of this area will change immediately; for blind area, the sensor will automatically ignore the signals from the blind area;

Single/Multi- Target: Switch the working mode of the program;

Replay: Replay the previously recorded detection data;

Save Data: After being clicked, the ON/OFF icon will swich its status so that when it displays ON, the program will save the detection data collected afterwards to the directory that the users set;

Set Path: Let users choose a directory for saving recorded detection data.

6.1.2 Single-/Triple- Target Detection

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

Step 1: Connect the EVB1122 board with a host PC, and open the EVB1122 Wave Config and Demo GUI, click the **Demo, Indoor Multi-Human Tracking** in turn to open the demonstration program;

Step 2: Click the **Detect Device** button: if the board is successfully connected to the host PC, a window writing Serial Port Device Detected will appear, as shown in Figure 6-2, click the **OK** button to continue;

Figure 6-2 Device successfully detected

Step 3: Click the **Start/Stop** toggle button, the GUI will display the position of the detected target referring to the evaluation board, an example is shown in Figure 6-3;

Figure 6-3 Example of single target detection demonstration

Step 4: (Optional) 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[5] will appear, as shown in Figure 6-4; to switch back to Single Target Detection Mode[6], click the **Multi-target /Single-target** toggle button again.

EVB1122 Wave Config and Demo GUI

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

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

Figure 6-4 Example of triple-target detection demonstration

6.1.3 Area Monitoring and Blind Area Setting

The software provides Area Monitoring and Blind Area Setting functions.

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

• Blind Area setting 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 EVB1122 board with a host PC, and open the EVB1122 Wave Config and Demo GUI, click the **Demo, Indoor Multi-Human Tracking** in turn to open the demonstration program;

Step 2: Click the **Area Monitoring** button, a new window will appear, as shown in Figure 6-5, descriptions of the window are as follows:

Figure 6-5 Area Monitoring window

Set visible range gate: Default as 0~23, 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 ~ 21, there is one range gate blind area in the near-end, and two range gates(22 and 23) of blind area in the far-end (each range gate represents 36 cm), then click the **Apply** button, the new detection range is as shown in Figure 6-6 where the red areas represent blind areas.

Figure 6-6 Example of blind area setting

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

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

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

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

Step 3: Click the **Add Monitor Area** button to start defining a monitoring area, click in the evaluation board 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 6-7; 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 6-8 and Figure 6-9.

Figure 6-7 Example of a defined monitoring area

Figure 6-8 Target exists in monitoring area

Figure 6-9 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.

6.1.4 Save and Replay Detection Data

Steps for saving and replaying the detection data are as follows:

Step 1:   Connect the EVB1122 board with the host PC, open the EVB1122 Wave Config and Demo GUI, click the **Demo**, **Indoor Multi-Human Tracking** in turn to open the demonstration program;

Step 2:   When the Start/Stop toggle button shows Start, as shown in Figure 6-10 (b), click the **Save Data**[7] button, select a directory for the detection data, by default the folder is named SaveData in the MTT folder under the software directory;

(a) Buttons unclickable   (b) Buttons clickable

Figure 6-10 Evaluation board data replay/save related buttons

Step 3:   If users want to turn on the Save Data mode, and the ON/OFF icon on the Save Data button shows OFF, click the **Save Data** button when the button is clickable (as shown in Figure 6-10(b));

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 evaluation board data file

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

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 an evaluation board data file folder, then Zone 2 and Zone 3 will start replaying the evaluation board data;

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

6.1.5 Evaluation board Data Format

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

The evaluation board data frame format is shown in Table 6-2.

<center>Table 6-2 Format of evaluation board report data frame</center>

Head	Data			Trailer
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 6-3.

<center>Table 6-3 Target information within the frame</center>

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 evaluation board), 0 represents negative velocity (approaching the evaluation board); The rest 15 bits represents the value of the velocity, unit cm/s	Uint16; Represents the value of single range resolution, unit mm

For example: AA FF 03 00 0E 03 B1 86 10 00 40 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 EVB1122 board 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 resolution of target 1:   0x40 + 0x01 * 256 = 320 mm.

6.2 Outdoor Long-Range Target Tracking Demonstration

6.2.1 Introduction

The GUI of Outdoor Long-Range Target Tracking demonstration is shown in Figure 6-11. It can be partitioned into 5 zones:

1   Operational button zone;
3   Sector chart zone;

2   Target information configuration zone;
4   Target information table zone;
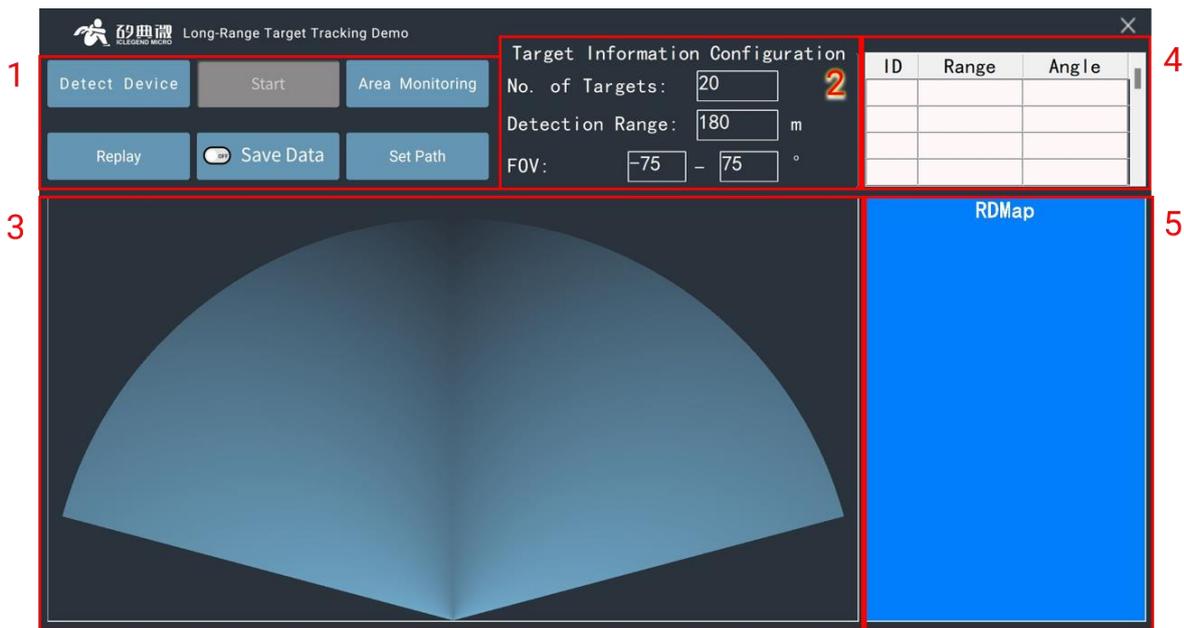
5   RD Map Zone.

Figure 6-11 Outdoor Long-Range Target Tracking Demo GUI

Descriptions of each zone are listed in Table 6-4.

Table 6-4 Descriptions of each zone on Outdoor Long-Range Target Tracking demo

Number	Zone	Function
1	Operation Button	Detect device, start or stop detecting, area monitoring, replay detecting data, turn on/off save data mode, and set save directory
2	Target Information Configuration	Configure the maximum number (≤20) of targets that are going to be displayed on the GUI, the maximum detection range (≤180 m), and the sensor's field of view (up to ±75°)
3	Sector Map	Display the detected targets' real-time position in the sector map
4	Detected Results	Display the distance and angle information of detected targets
5	Range-Doppler Plane Zone	Display the energy distribution of targets and base noise on the Range-Doppler plane, the warmer the color, the higher the energy; The horizontal axis represents Doppler dimension, and the vertical axis represents Range.

6.2.2   Outdoor Long-Range Target Tracking

Steps for applying the Outdoor Long-Range Target Tracking demonstration program are as follow:

Step 1: Connect the EVB1122 board with the host PC using a USB Type-C cable;

Step 2: Open the EVB1122 Wave Config and Demo GUI, click the **Demo** menu, choose the **Outdoor Long-Range Target Tracking** submenu, the Long-Range Target Tracking window will appear, as shown in Figure 6-11;

Step 3: Click the **Detect Device** button to connect the program with the EVB1122 board via the USB serial port;

Step 4: (Optional) Type in the target information parameters in Zone 2;

Step 5: Click the **Start/Pause** toggle button, the program starts reading the detection results, including the range and angle information of detected targets, from the EVB1122 board, real-time presenting the target using car-like icon with the speed tagged above (positive means it is away from the board, and negative means it is moving towards the board) in the sector chart, and displaying the range and angle information in the Target Information Table, as shown in Figure 6-12;

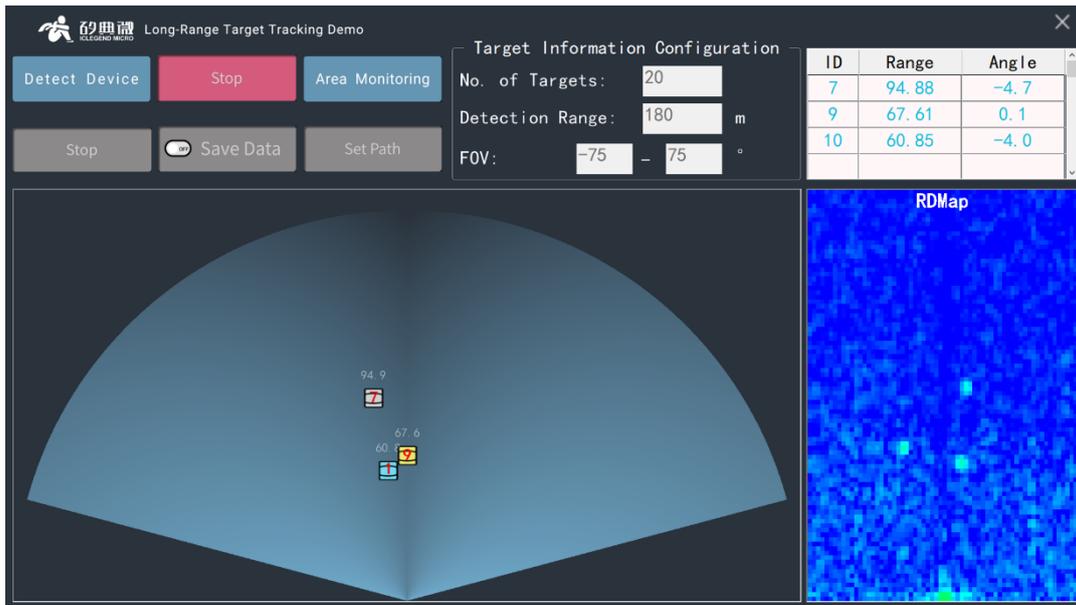Step 6: (Optional) Click the **Start/Pause** toggle button to stop the demonstration program.

Figure 6-12 Example of multiple targets detected on Outdoor Long-Range Target Tracking demo

6.2.3 Area Monitoring

Steps for applying the Area Monitoring function are as follow:

Step 1: Connect the EVB1122 board with the host PC using a USB Type-C cable;

Step 2: Open the EVB1122 Wave Config and Demo GUI, click the **Demo** menu, choose the **Outdoor Long-Range Target Tracking** submenu, the Long-Range Target Tracking window will appear;

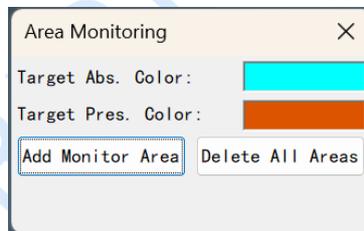Step 3: Click the **Area Monitoring** button, the Area Monitoring window will appear, as shown in Figure 6-13;

Figure 6-13 Area Monitoring window

Step 4: Click the **Add Monitor Area** button on the Area Monitoring window, then in the sector area, click the vertexes of the desired monitoring area in turn (clockwise or anticlockwise, please stick to one method when defining a monitoring area), then right click to finish the process, and all the vertexes will be connected to form a polygon, as shown in Figure 6-14;
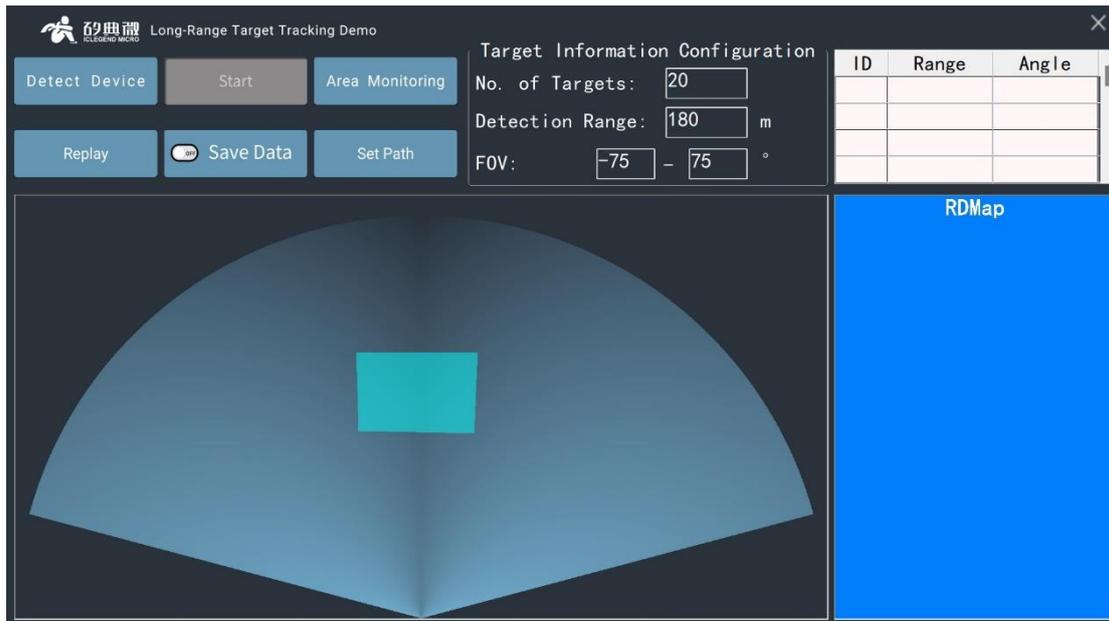
Figure 6-14 Example of a monitoring area

Step 5: (Optional) If users need to define more than on monitoring area, repeat Step 3;

Step 6: (Optional) If users need to delete all the monitoring area, click the **Area Monitoring** button, the Area Monitoring window will appear, then click the **Delete All Areas**.

6.2.4   Data Saving

Steps for saving detection data on Outdoor Long-Range Target Tracking Demo are as follow:

Step 1: Connect the EVB1122 board with the host PC using a USB Type-C cable;

Step 2: Open the EVB1122 Wave Config and Demo GUI, click the **Demo** menu, choose the **Outdoor Long-Range Target Tracking** submenu, the Long-Range Target Tracking window will appear;

Step 3: Ensure the ON/OFF icon on the Save Data button displays ON; If not, users need to click the **Save Data** button when it is clickable;

Step 4: (Optional) The default saving path is /LRT/SaveData/ under the same directory with the EVB1122 Wave Config and Demo GUI tool; If users need to alter the save path, click the **Set Path** button and select a specified directory.

6.2.5   Data Replaying

Steps for recording and saving the detection data on Outdoor Long-Range Target Tracking Demo are as follow:

Step 1:   Connect the EVB1122 board with the host PC using a USB Type-C cable;

Step 2: Open the EVB1122 Wave Config and Demo GUI, click the **Demo** menu, choose the **Outdoor Long-Range Target Tracking** submenu, the Long-Range Target Tracking window will appear;

Step 3: Click the **Replay/Stop** toggle button, select the directory that saves recorded detection data and click OK, the program starts displaying the detected data on the GUI, as shown in Figure 6-9;

Step 4: (Optional) Click the **Replay/Stop** toggle button to end the replay in advance.
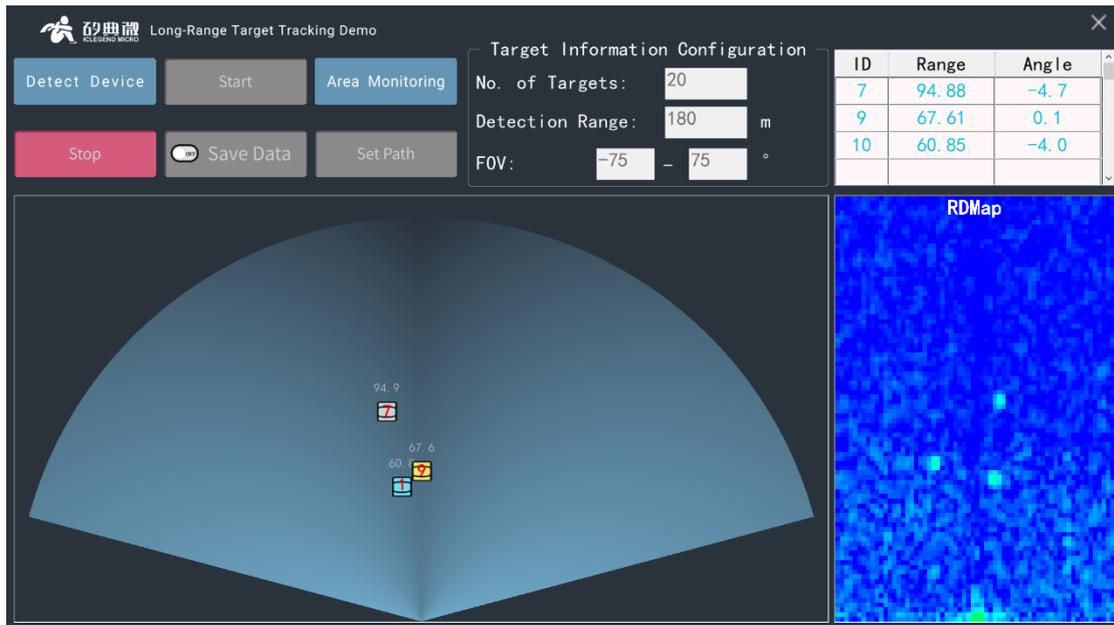
Figure 6-15 Example of data replaying

7. Revision History

Revision	Date	Modification
1.0	2024/2/28	Initial release.

UM10035P_Rev.1.0_20240228 EVB1122 Wave Config and Demo GUI

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