

# **XENSIV™ 60GHz BGT60TR13C system-on-module (SoM) installation guide**

## **User guide**

### **About this document**

#### **Scope and purpose**

This document is a user guide for the installation of the XENSIV™ 60GHz BGT60TR13C system-on-module (SoM) for presence detection. It shows how to install the radar correctly.

#### **Intended audience**

The intended audience are manufacturers who use XENSIV™ 60GHz BGT60TR13C SoM for presence detection.

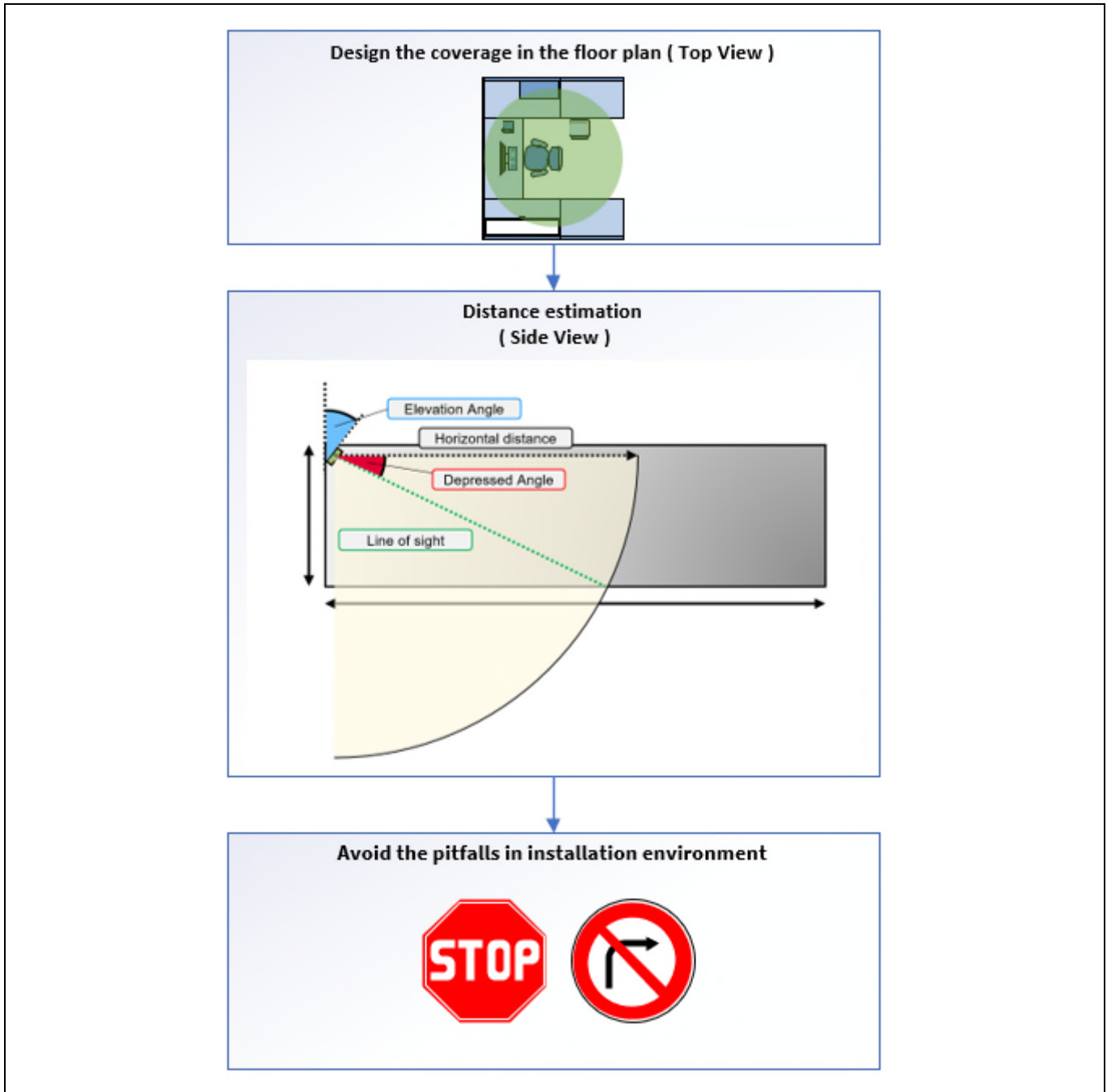
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### 1 Introduction

A floor plan design strategy is one way of approaching radar installation for presence detection. The planning steps are shown as below.

#### 1.1 Planning strategy



**Figure 1** Planning strategy flowchart

## Introduction

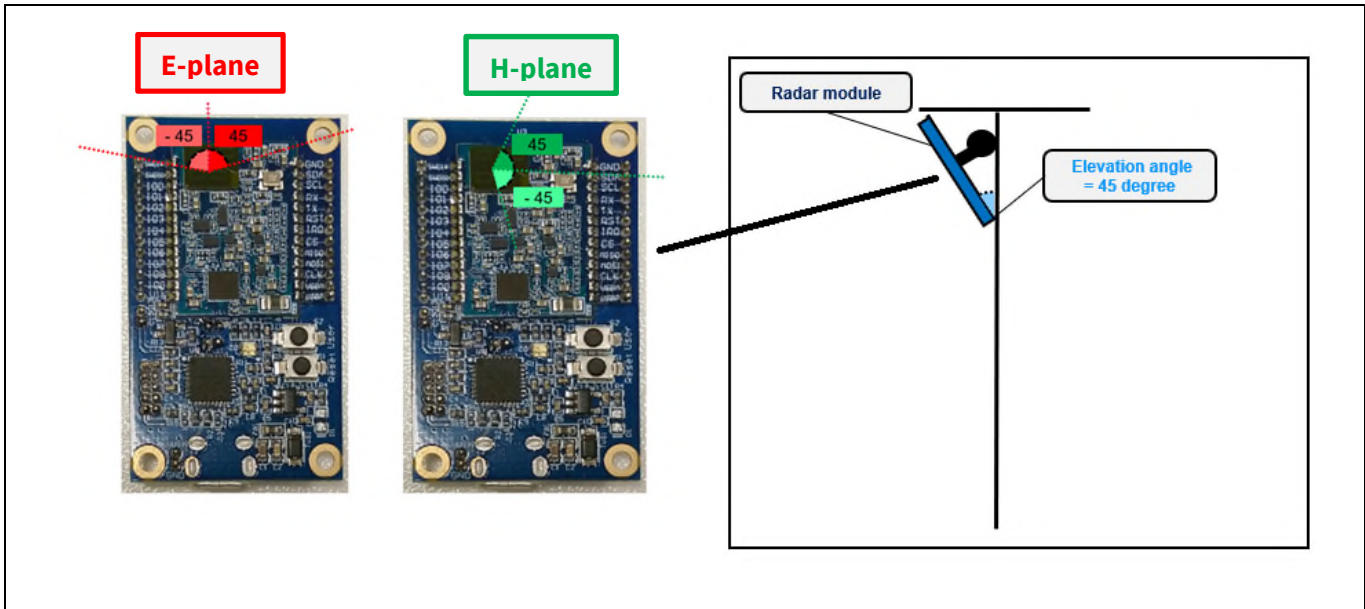
**Design the floor plan coverage** to decide the number of radars required for the area. The radar configuration, placement and mounting position are the parameters to determine.

**Use a side view** to analyze the estimated distance covered. The elevation angle of each radar is set to 45 degrees in order to achieve better the best sensitivity. Based on the tilted is angle, the line of sight from the radar to the ground floor is shorter than the horizontal distance. Distance estimation in using a side view can help the manufacturer to predefine the suitable detected best detection distance.

**Check for problems in the installation environment** which could make presence detection unstable. Small vibrations of objects will easily trigger a false alarm. These small vibrations can be quantified by the micro value in calibration mode. Take care to avoid these problems.

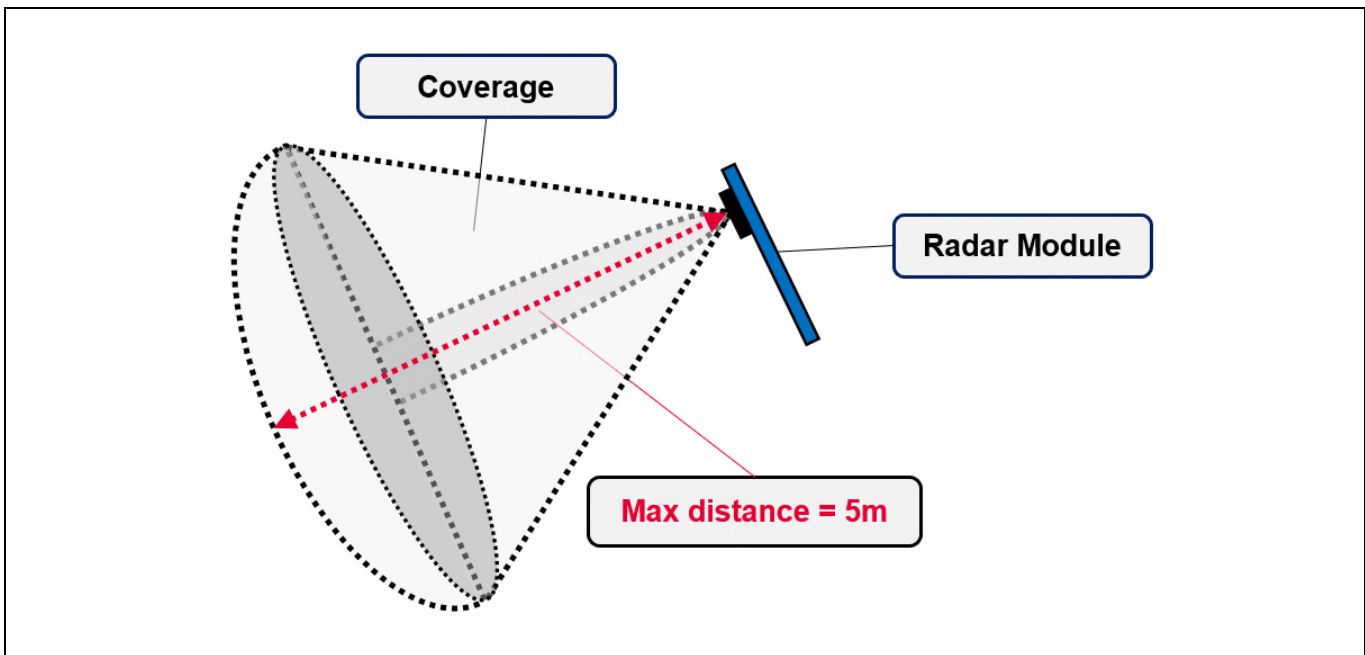
## 2 Design the coverage using a floor plan

### 2.1 Radar setup and mounting



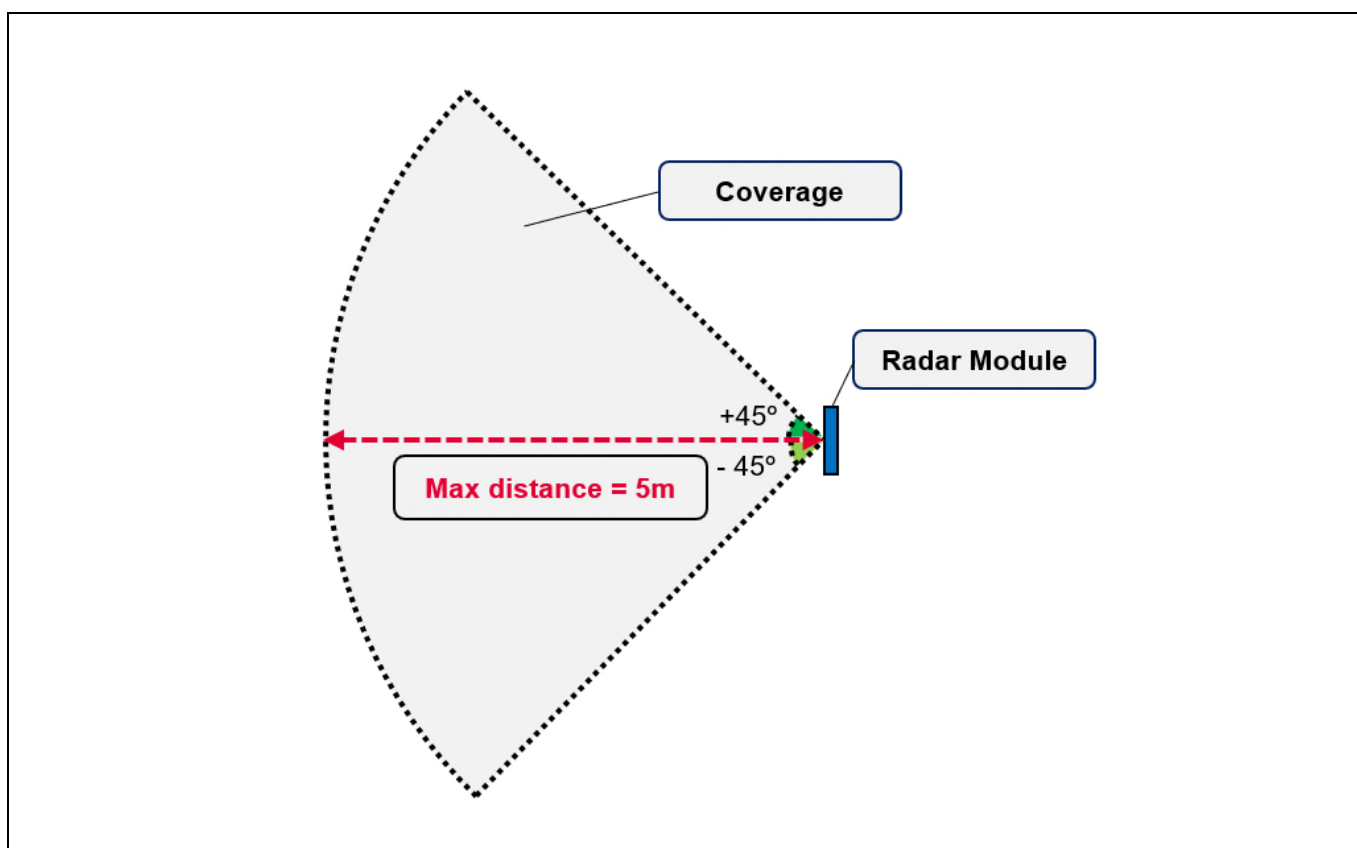
**Figure 2** Elevation angle setup and radar position

Install the radar module on the wall with a 45 degree elevation angle, as shown in **Figure 2**. The coverage of the radar module is around 90 degrees on the E-plane and H-plane, respectively.



**Figure 3** Radar coverage - inside view

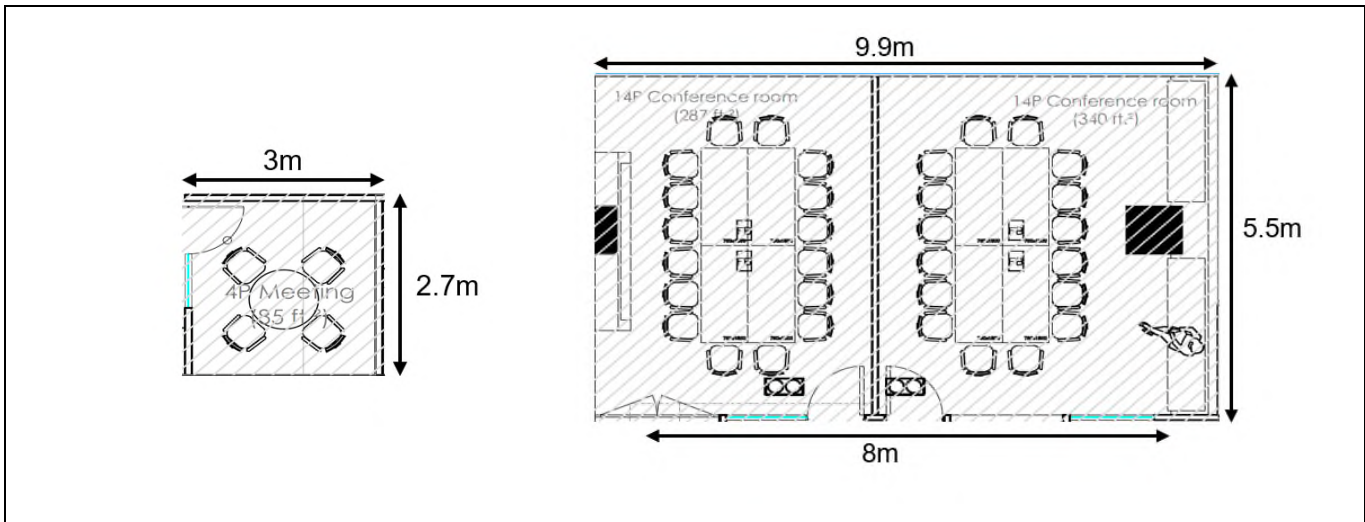
The shape of the coverage is similar to a cone with a hemisphere added at the end. The height of the cone depends on the maximum detection range setting, which could be set from 1 m to 5 m.



**Figure 4 Radar coverage - top view**

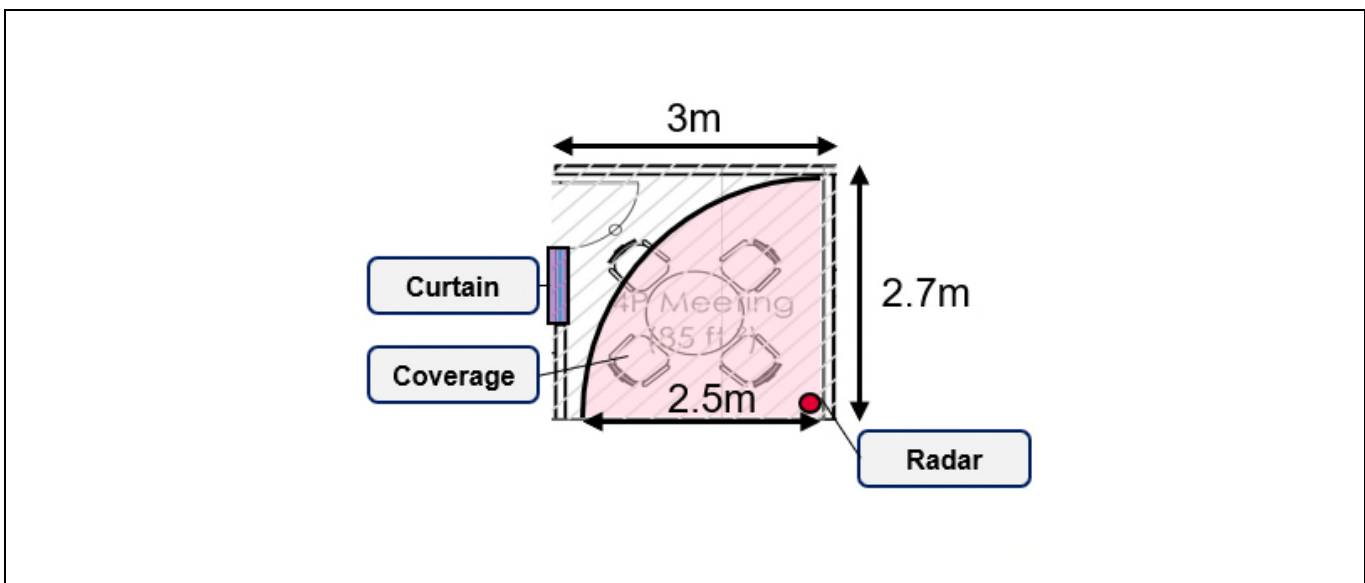
The top view of the coverage shows a 90 degree arc. The radius of the arc depends on the maximum detection range setting (5 m in this example).

### 2.2 Example of radar installation in a room



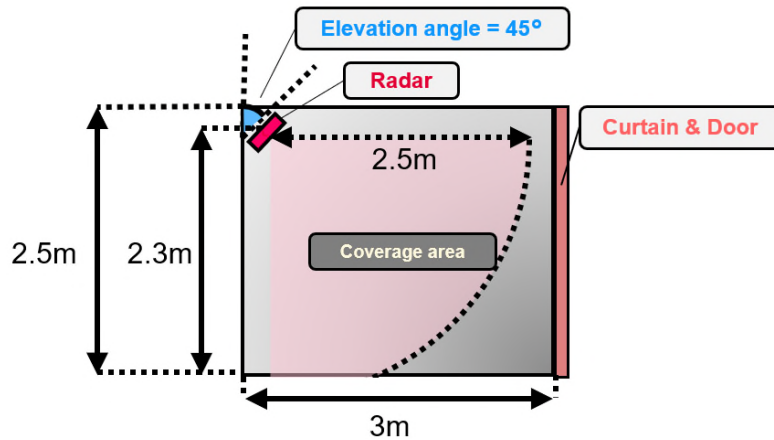
**Figure 5** Analyze the floor plan

The number of radars required to cover the floor plan depends on the room size. Two types of room are illustrated in this example.



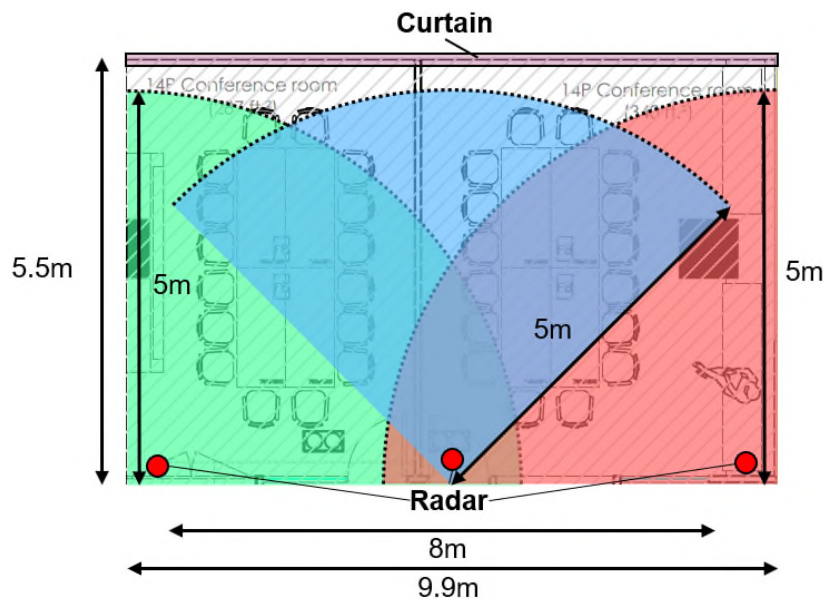
**Figure 6** Radar setup in a small room

**Figure 6** shows a small room of 3 m x 2.7 m, and height 2.5 m. As the width and length are both smaller than the maximum coverage distance (5 m), one radar is enough to cover the room area. In this example, the radar is installed in the corner, with a maximum range set to 2.5 m. Some margins are left to avoid the disturbance coming from the curtain.



**Figure 7 Radar setup in a small room (side view)**

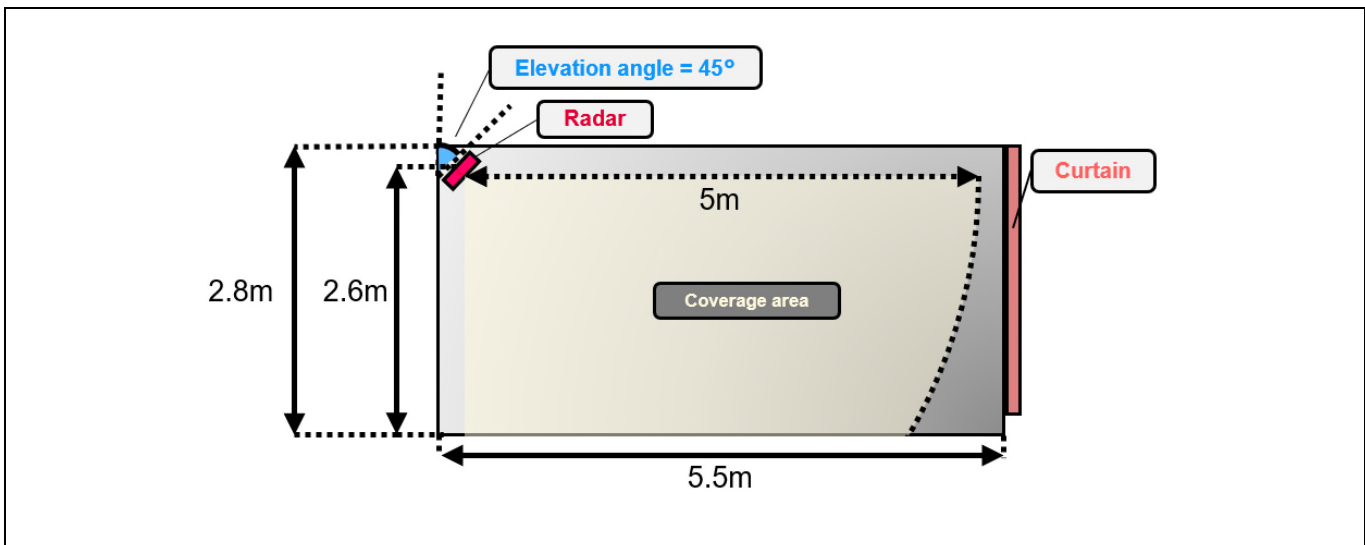
The radar is mounted on the wall at 2.3 m height with a 45 degree elevation angle. A 0.5 m gap between the curtain and the coverage area is to prevent false alarms caused by the curtain.



**Figure 8 Radars setup in a large room**

**Figure 8** shows a large meeting room of 9.9 m x 5.5 m, and height 2.8 m. As the length of the room exceeds the maximum coverage distance (5 m), three radars are used to cover the room. The radars are installed at opposite sides of the curtain to avoid disturbance from the curtain movement. The three radars are set to the maximum setting of 5 m.



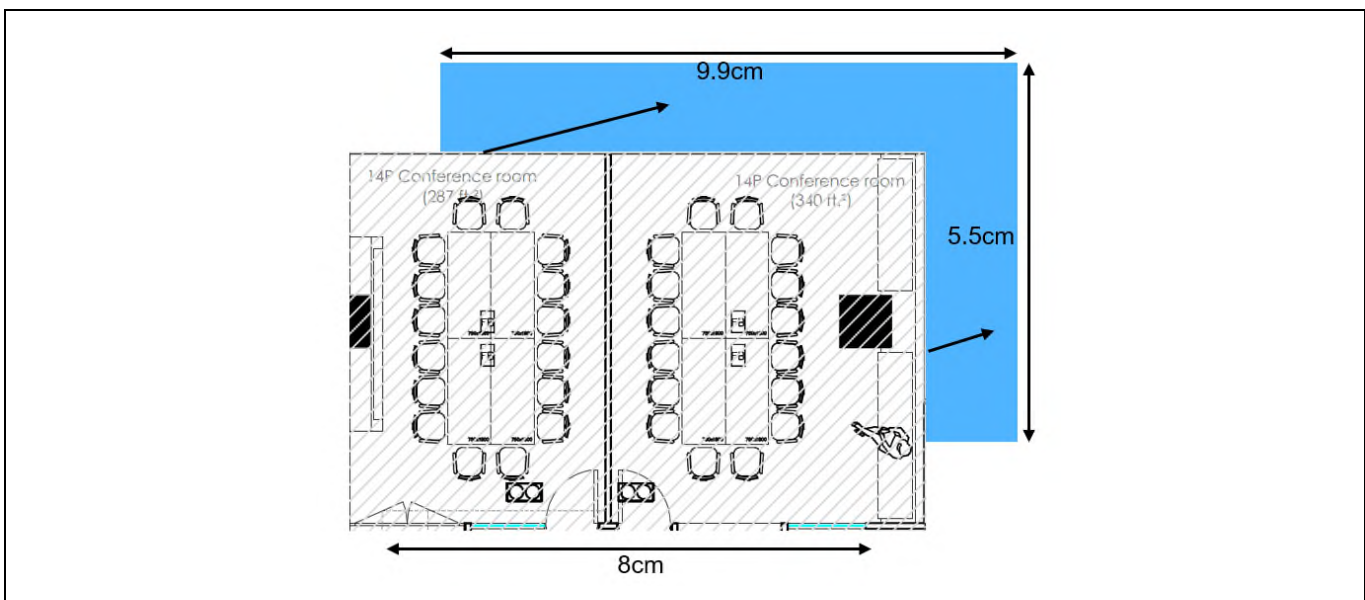


**Figure 9 Radars setup in a large room (side view)**

The three radars are mounted on the wall at 2.6 m height with a 45 degree elevation angle. A 0.5 m gap between the curtain and the coverage area is to prevent false alarms caused by curtain movement.

### 2.3 Steps to design floor plan coverage

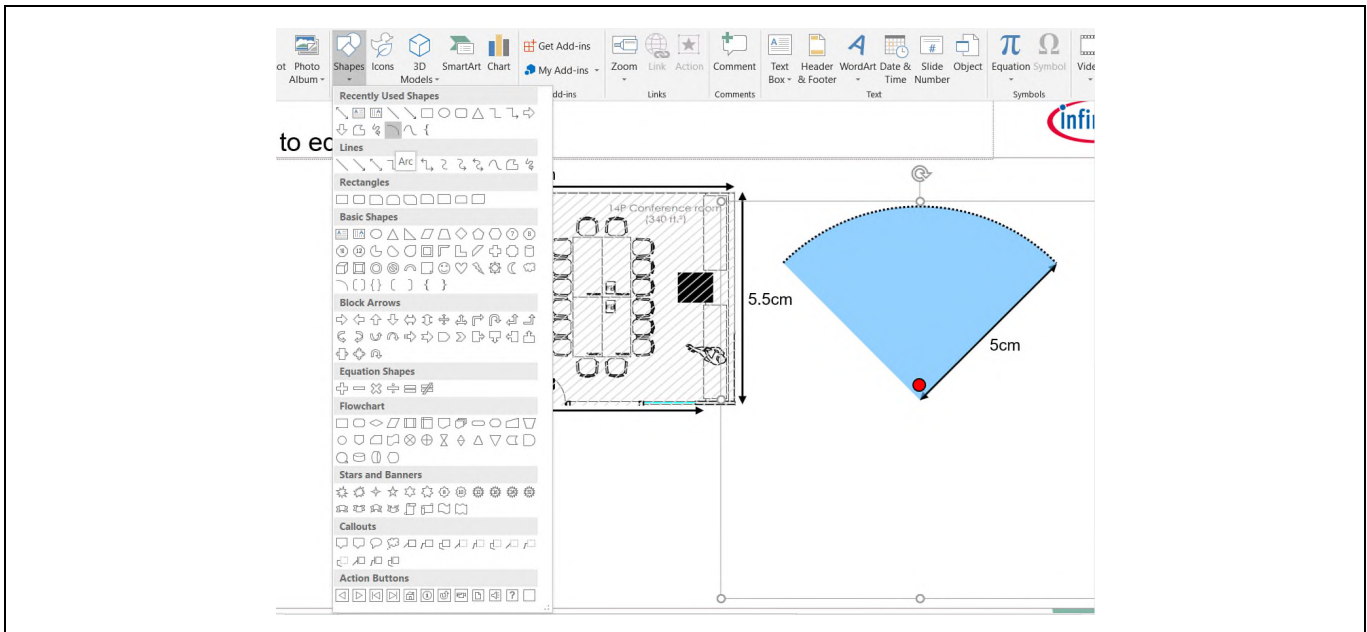
This section provides detailed procedures to design the radar configuration for the covered range. Microsoft PowerPoint is used as the tool for the estimation. An example design flow is provided below. The scale used is 1:100, which means 1 cm represents 1 m.



**Figure 10 Floor plan measurement**

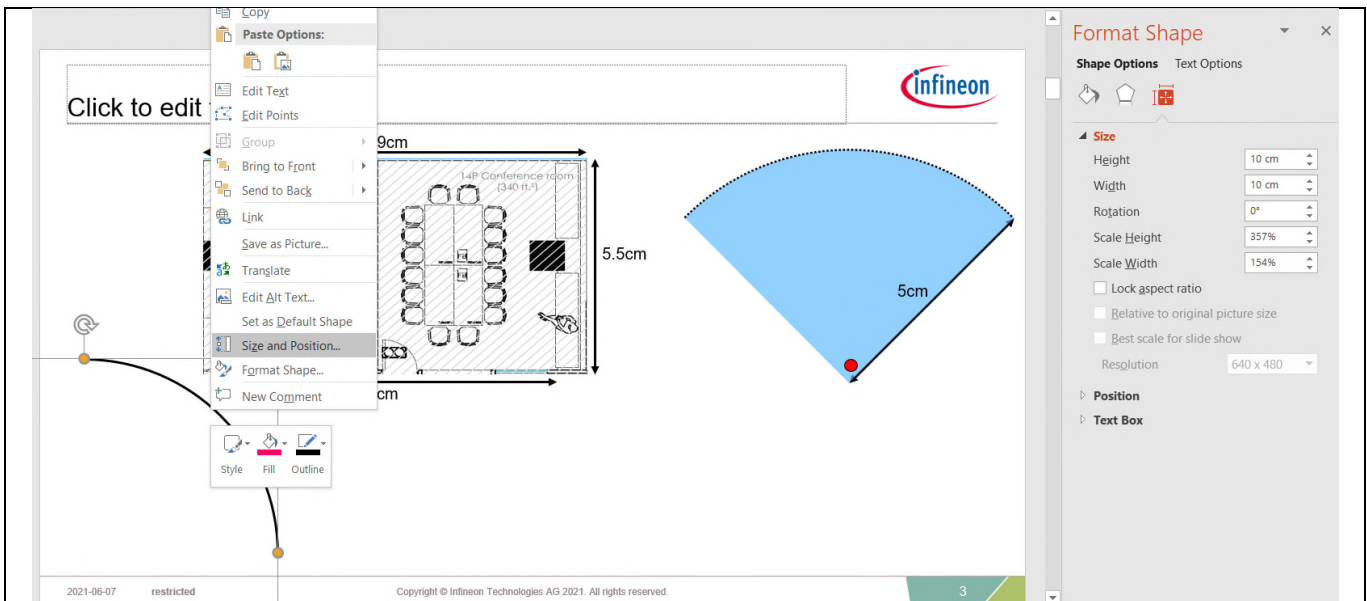
1. Draw a 1:100 scale block, and place the floor plan in the block.

## Design the coverage using a floor plan



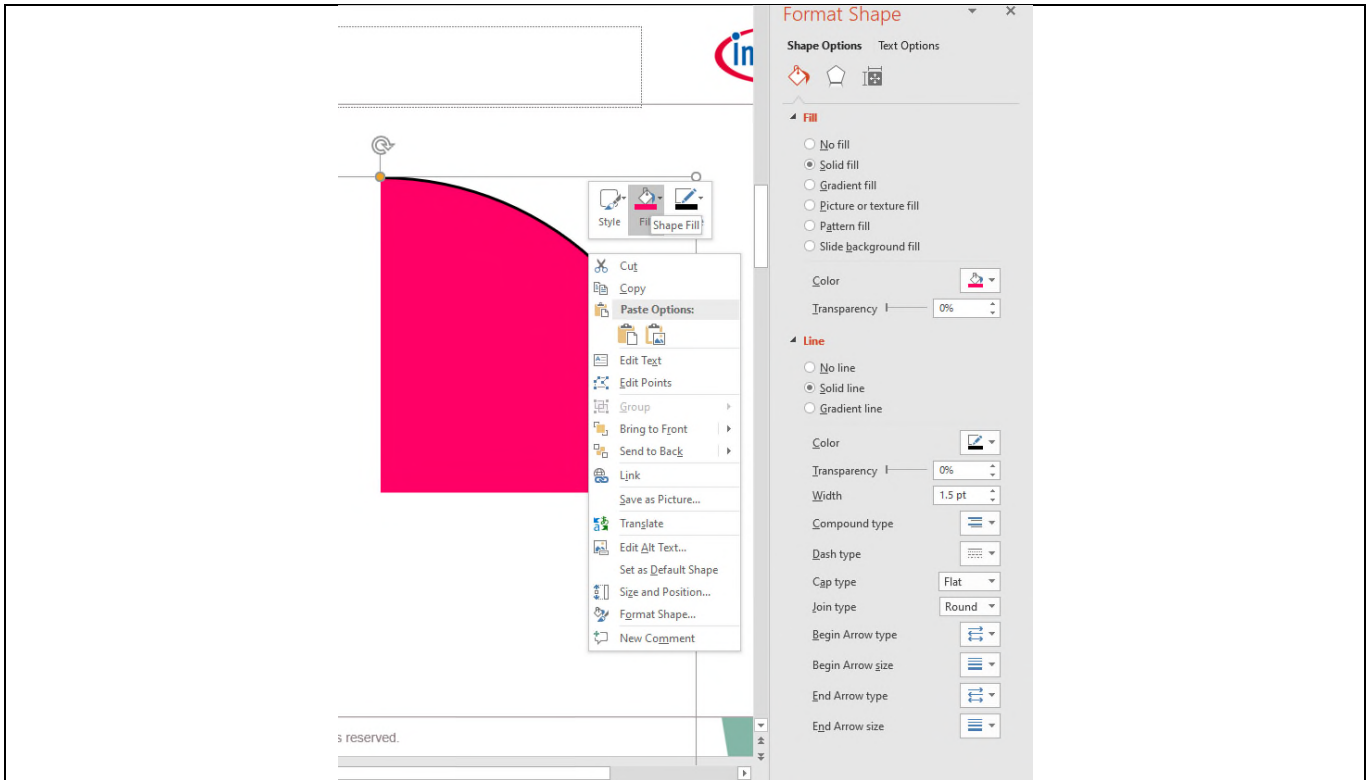
**Figure 11 Radar coverage shape creation**

2. Select “Shapes” and choose “Arc” to create the radar detect area. Set the angle of the arc to 90 degrees.



**Figure 12 Radar coverage shape size**

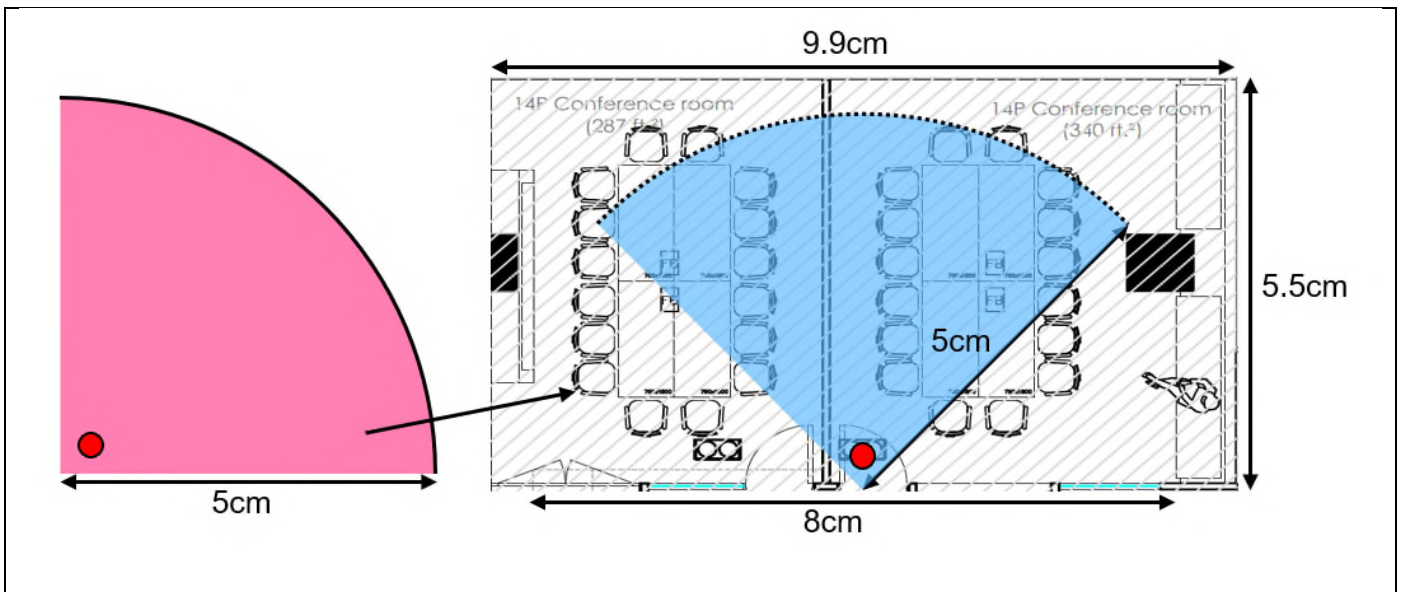
3. Right-click the arc and select “Size and Position”. Set the height and width (diameter) to 10 cm. This represents the required detect distance of the radar as 5 m in real space.



**Figure 13 Radar coverage shape setting**

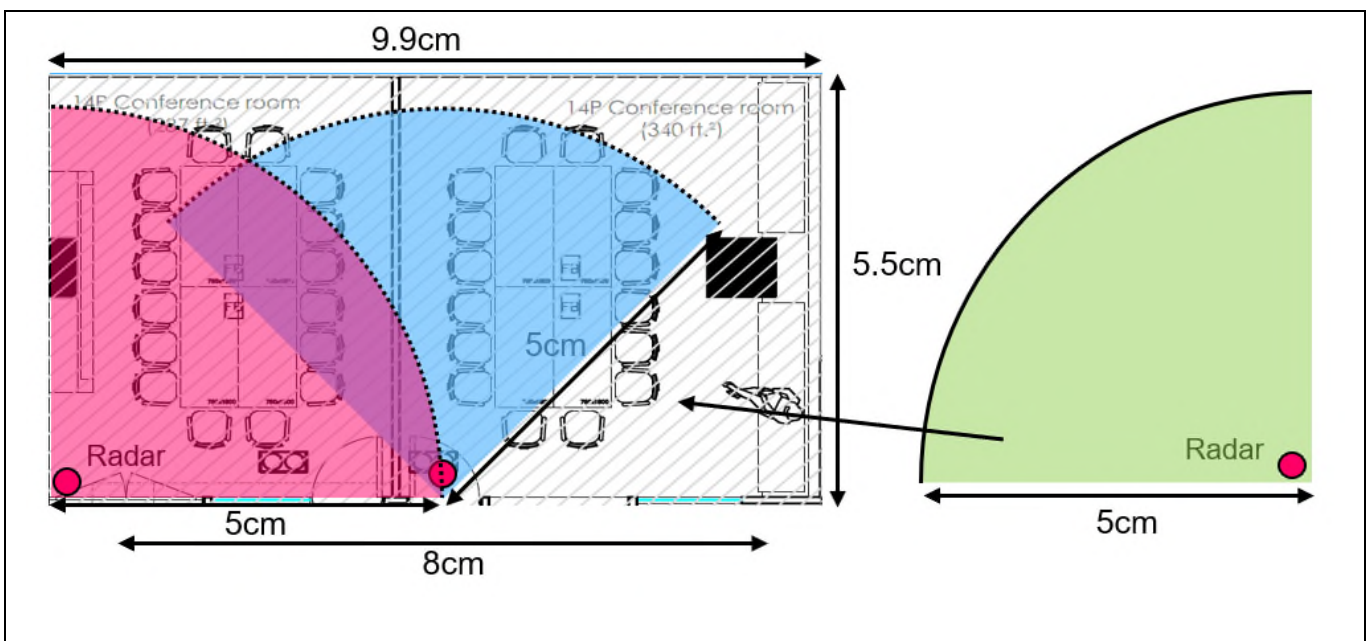
4. Right-click the arc and select “Solid fill”. Choose a color to fill the arc and set the transparency at 50 percent. The arc area represents the coverage area of the radar.

## Design the coverage using a floor plan



**Figure 14** Radar coverage in floor plan

5. Place the arc area on the target position.

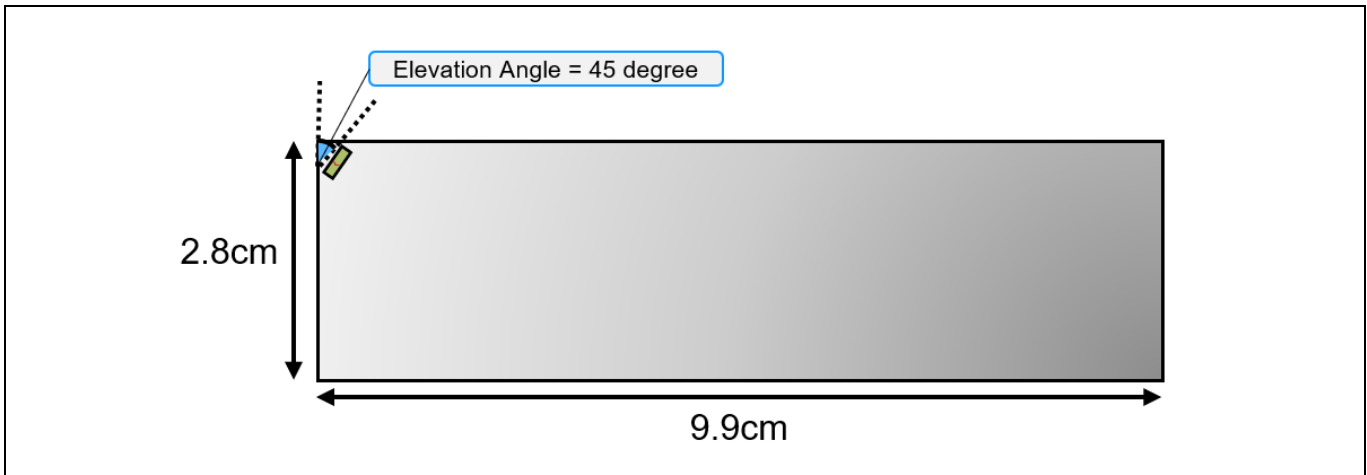


**Figure 15** Multiple radar coverage in floor plan

6. Repeat Step 5 to complete the setup.

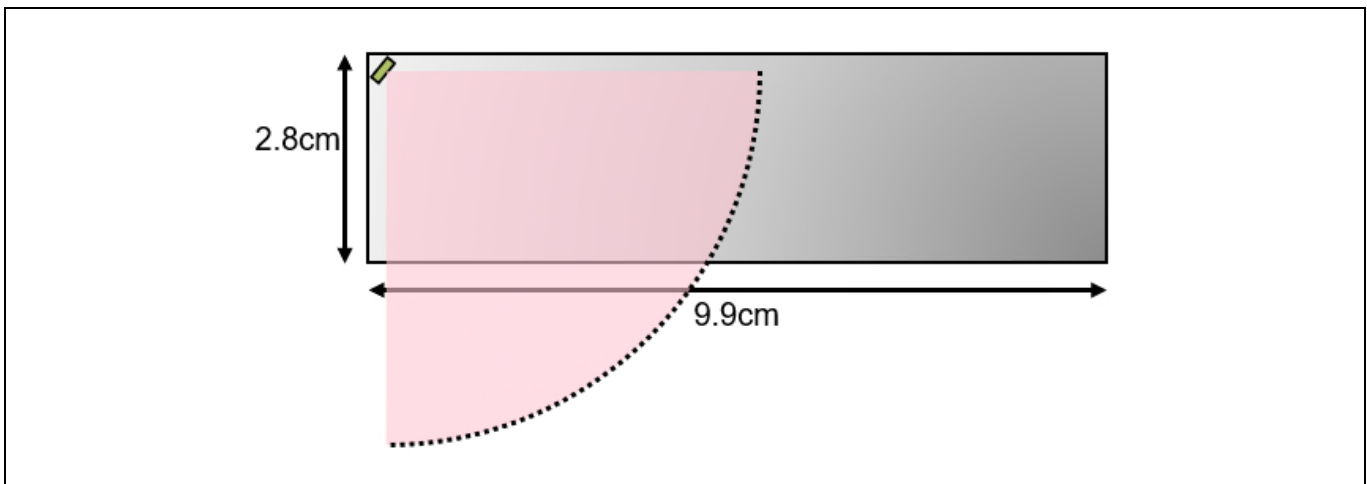
### 2.4 Distance estimation – side view

This section shows how to estimate the covered distance using a side view. Microsoft PowerPoint is used as the tool for the estimation. The example setup and estimation are the same as in Section 2.3. The area of the shape is at a scale of 1:100.



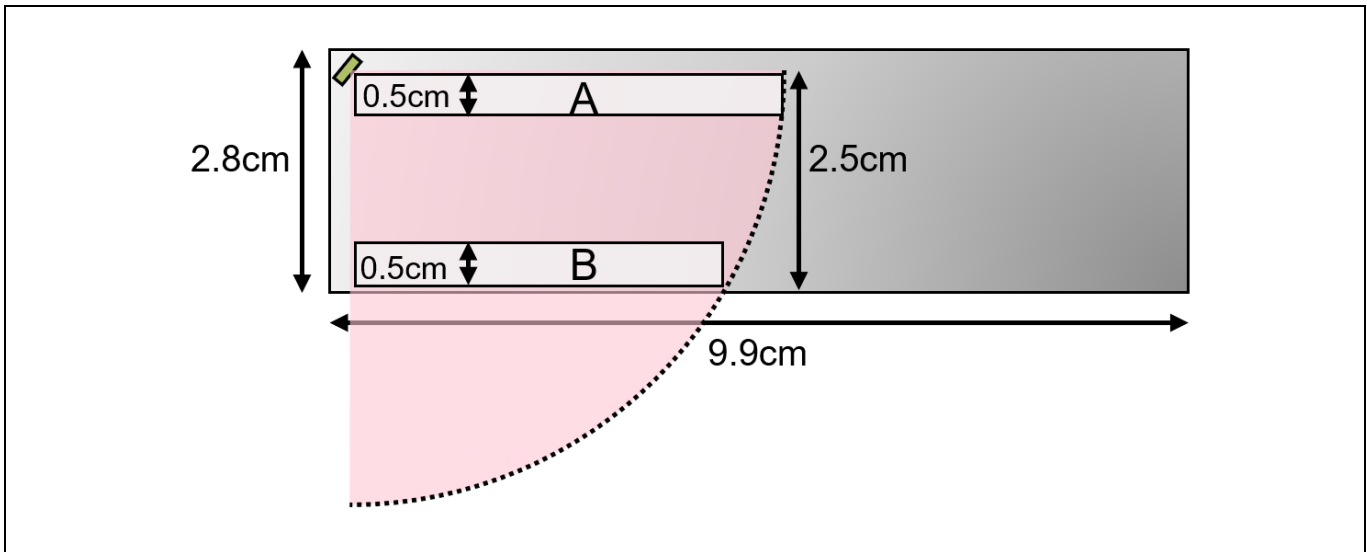
**Figure 16** Floor plan creation

1. Draw a 1:100 scale block to simulate the space of the side view. The height and length of the space are 2.8 m and 9.9 m, respectively. Place the radar block in the top left corner. The elevation angle of the radar is set as 45 degrees.



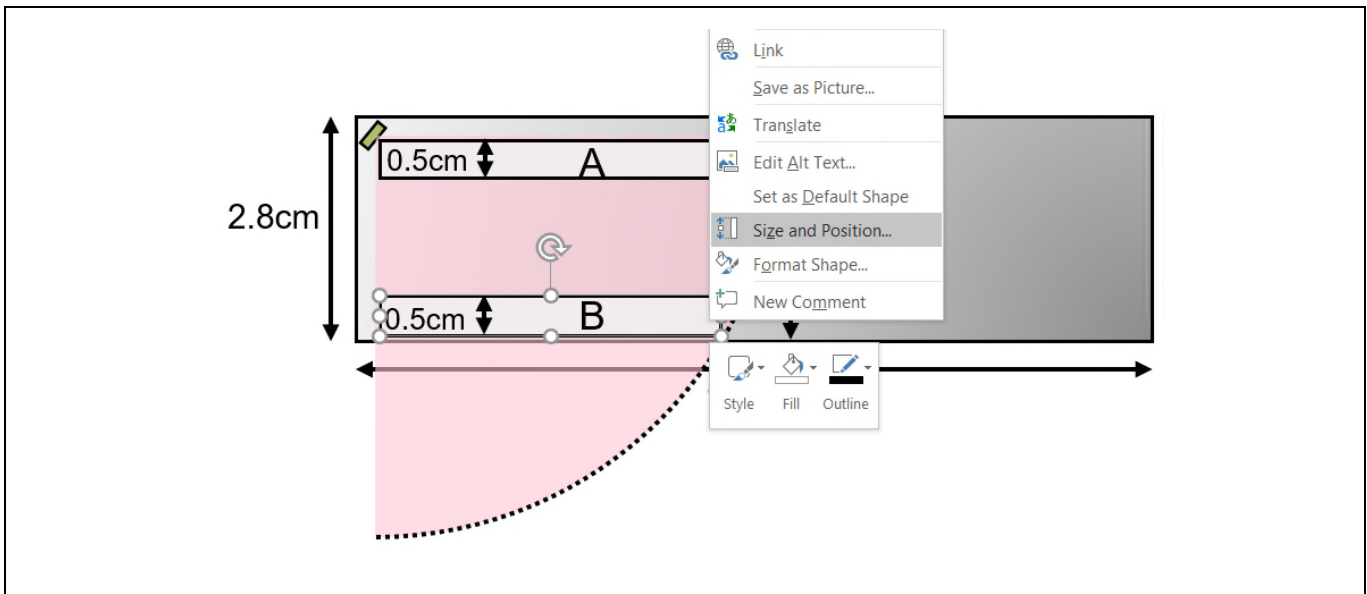
**Figure 17** Add radar coverage

2. Create a 90 degree arc to represent the radar coverage area. Set the height and width (diameter) to 10 cm.



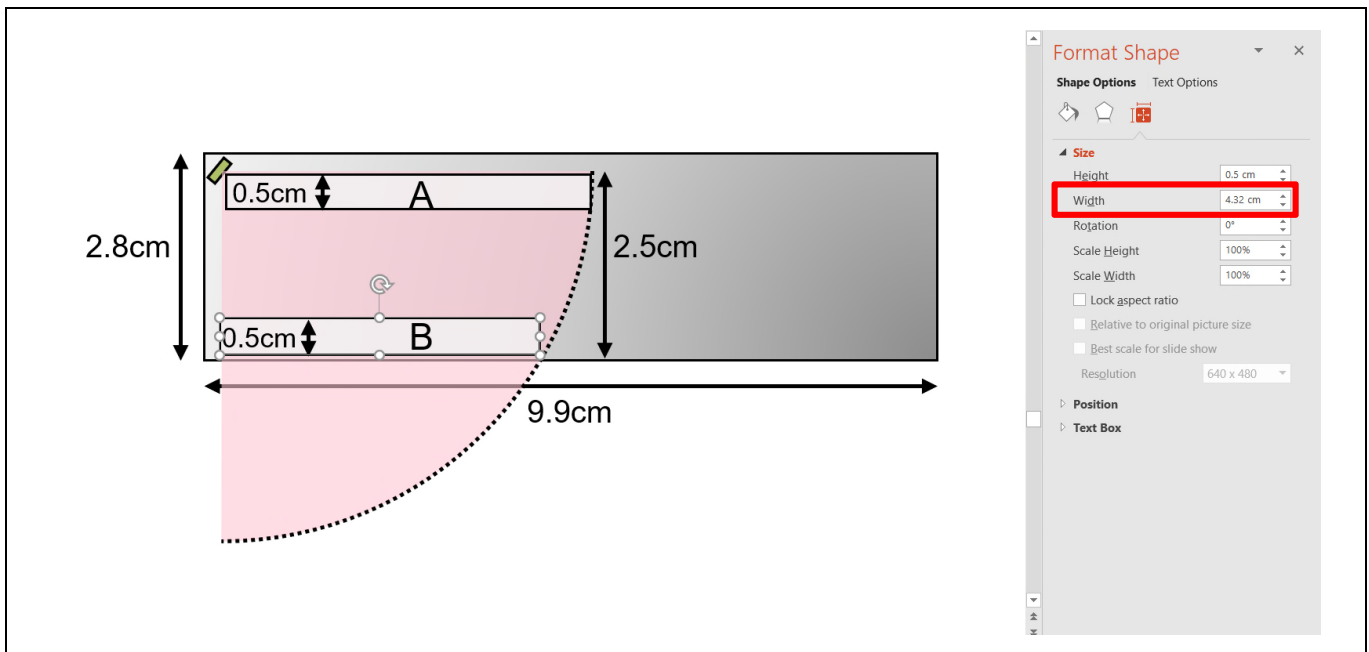
**Figure 18 Coverage measurement**

3. Draw a rectangle with 0.5 cm height to place on the coverage area. Extend the length of the rectangle until it touches the arc edge. **Figure 18** shows examples of the rectangle, labeled A and B.



**Figure 19 Read the width of the rectangle**

4. Right-click the rectangle and select “Size and Position” to see the scaled distance.



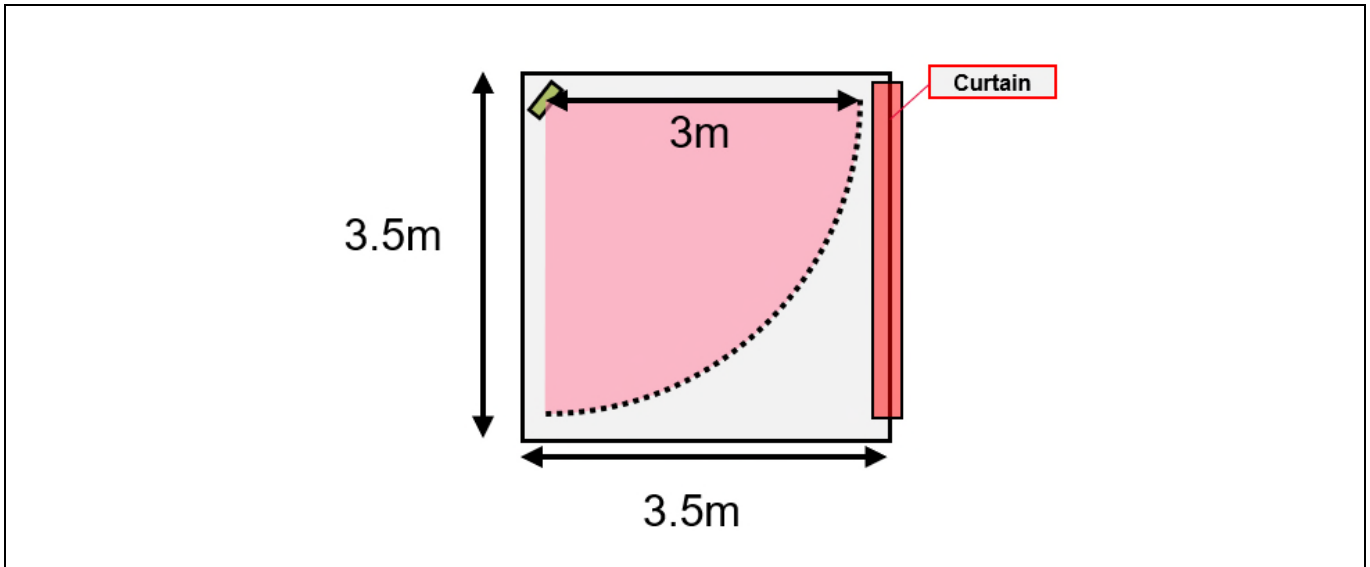
**Figure 20 Length of rectangle**

5. Read the width value under “Format Shape”. The cover length is 4.32 cm, in this example, which represents 4.32 m.



### 2.5 Example setup – small room

This example considers a small room of 3.5 m x 3.5 m x 3.5 m, with a curtain on one side. To avoid detecting vibration from the curtain, the maximum range setting should not exceed 3 m, such that there is at least a 0.5 m buffer between the maximum coverage area and the curtain. As the coverage area is an arc, part of the room will not be covered.



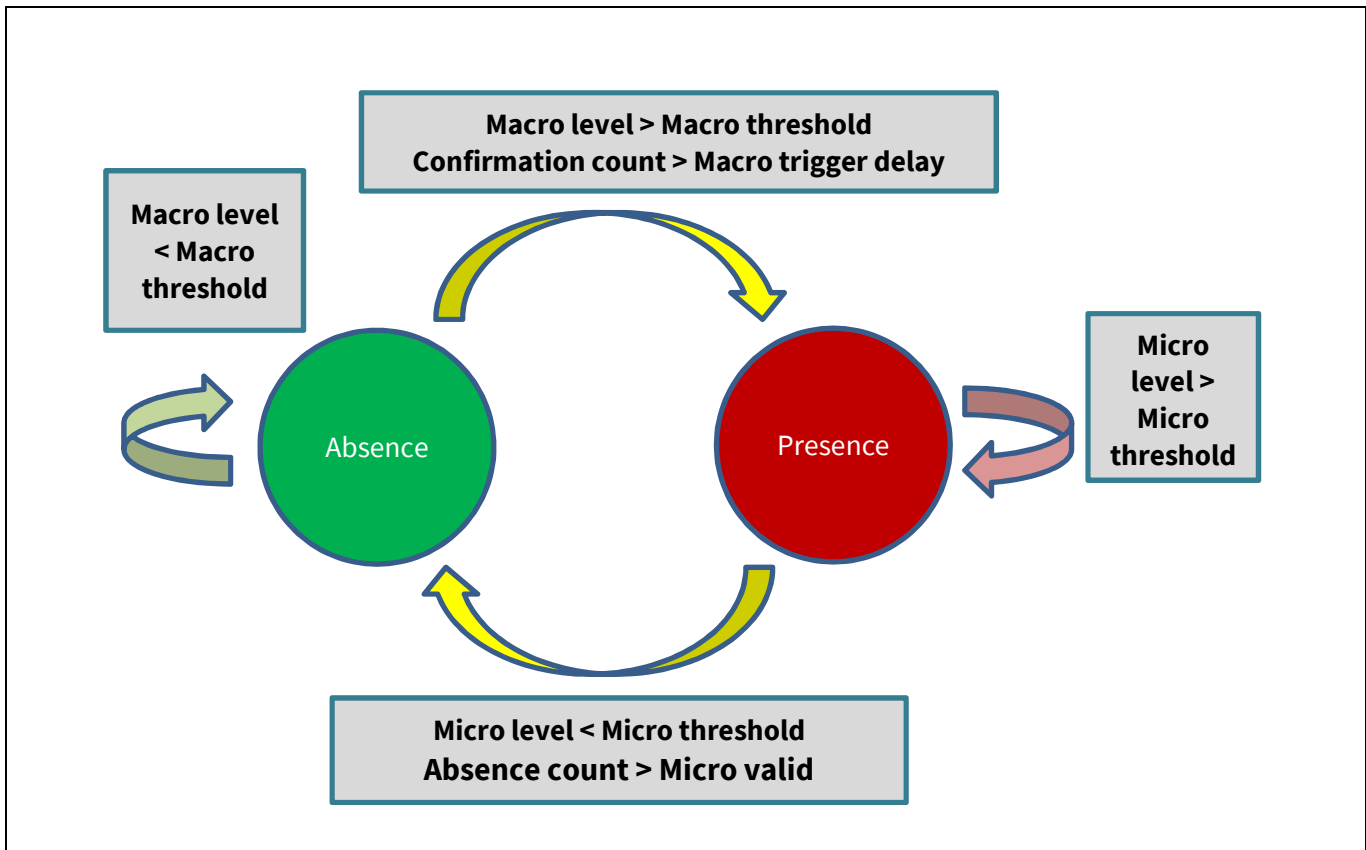
**Figure 21** Side view of – small room



### 3 Micro and macro detection and setup

As the radar is sensitive to small movements, vibrating objects such as air-conditioners and curtains can easily affect detection performance. The user must take special precautions when installing radar in this case.

In presence detection solutions, there can be macro and micro detection modes.



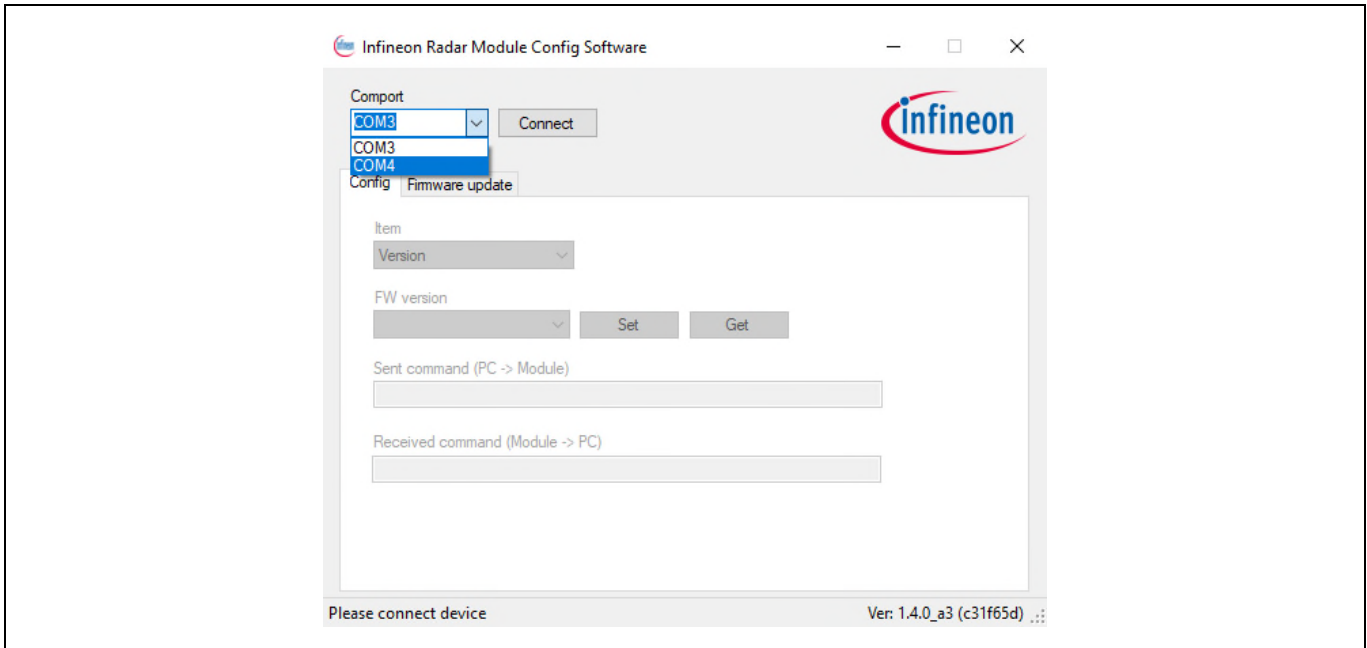
**Figure 22 Presence detect state diagram**

When the detection is in the absence state, it will check the macro level. If the macro level is higher than the macro threshold, the state will transit from absence to presence. The state remains in presence when the micro level is higher than the micro threshold. When the micro level is lower than the micro threshold, the state will return to absence.

If there are vibrating objects inside the detection area, the micro value will remain at a high level, resulting in it not being able to switch to the absence state when no one is in the detection area anymore.

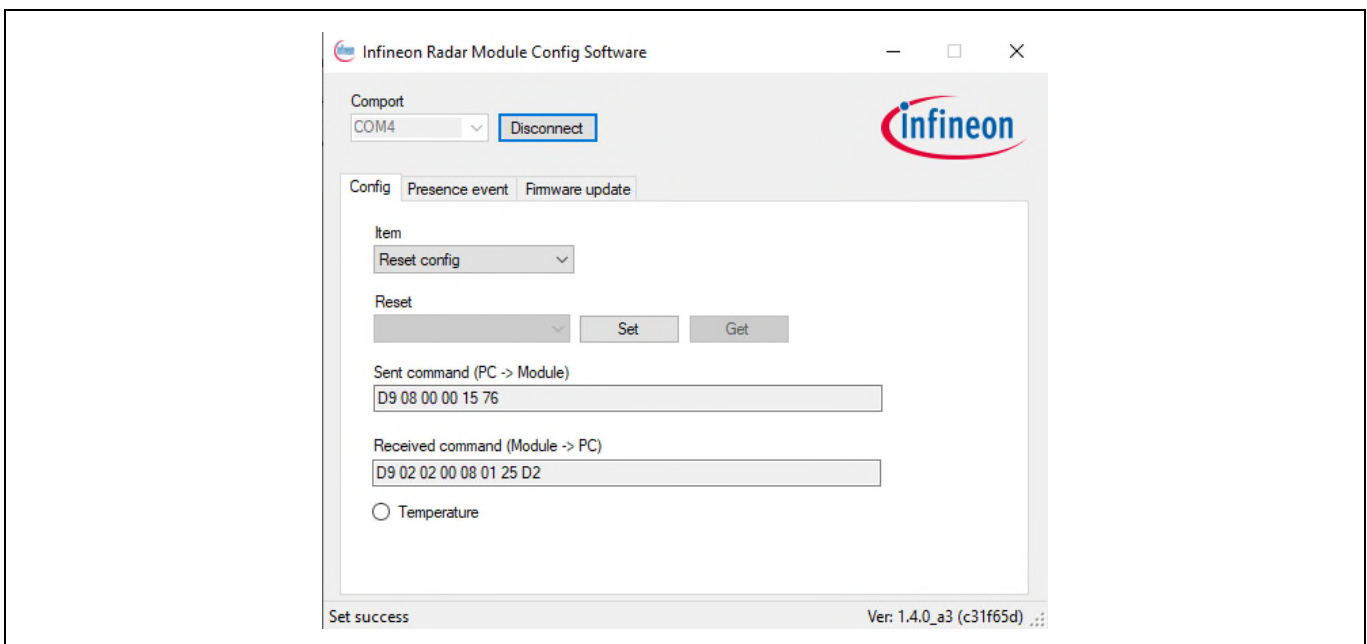
### 3.1 Procedures of macro and micro-level recording

Calibration mode enables printing out and saving the micro detection value over time. Below are the steps for doing this recording.



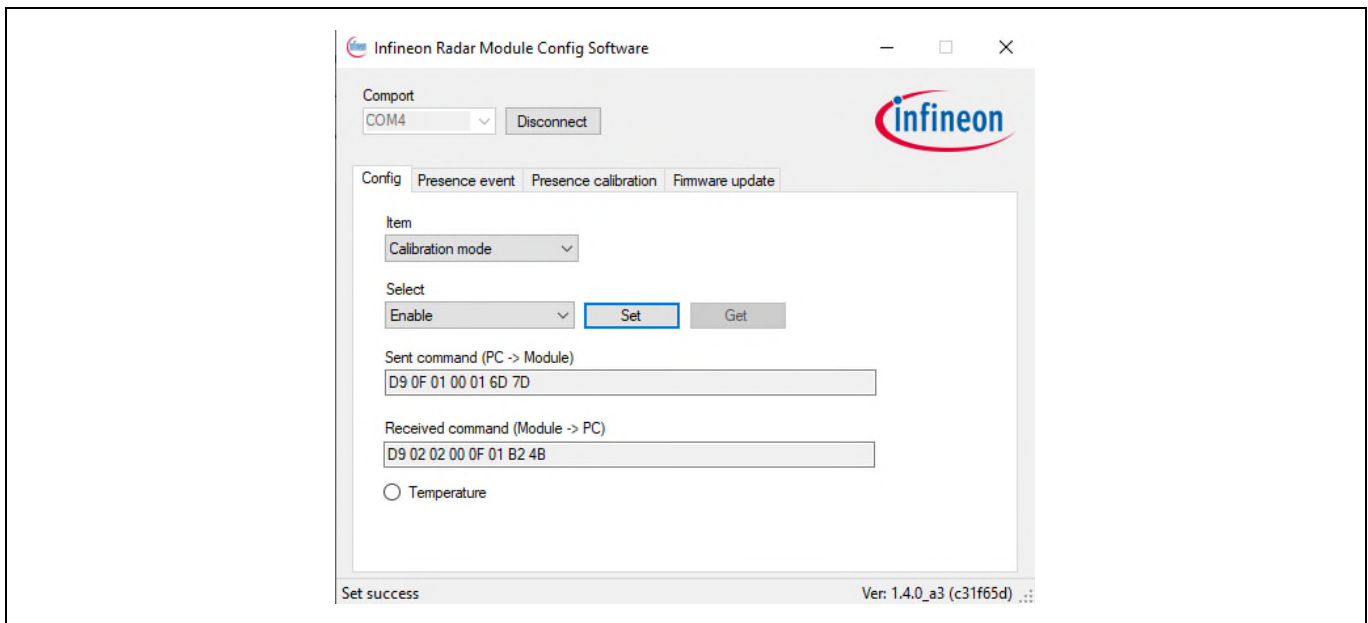
**Figure 23 Radar Config tool**

1. Open BGT60TR13C\_Radar\_Config\_Tool. Select the radar COM port and press “Connect”.



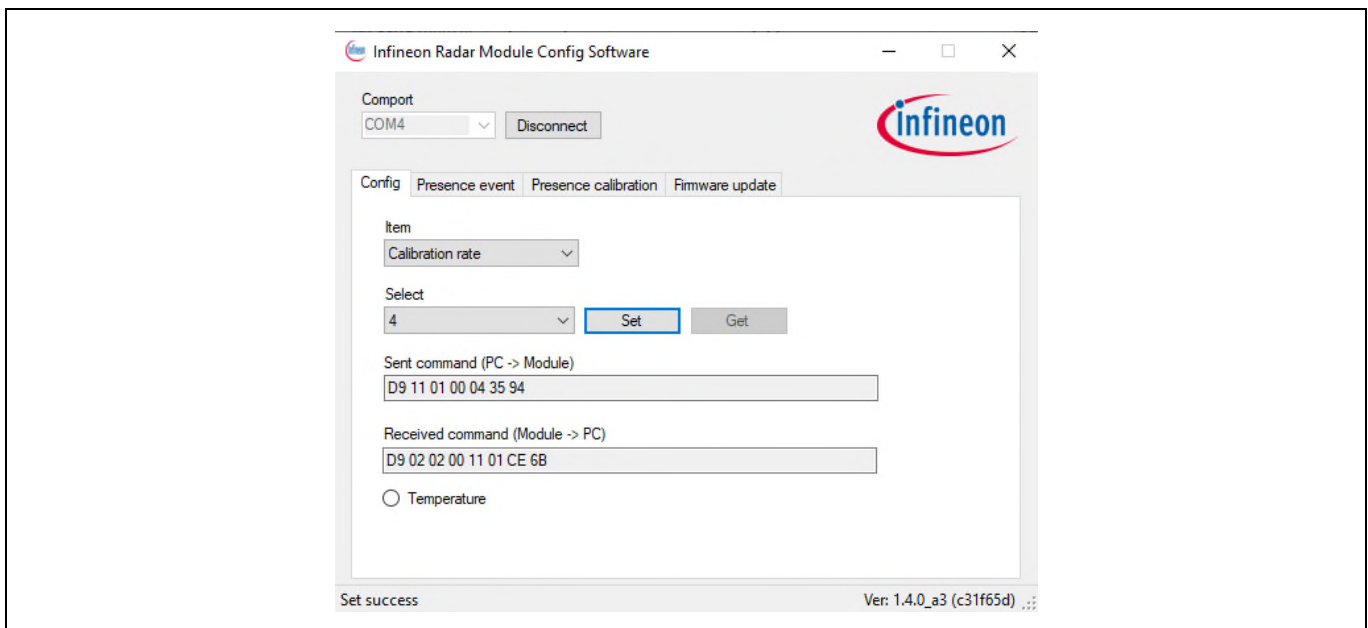
**Figure 24 Reset radar Config**

2. Select “Reset config” and press “Set”.



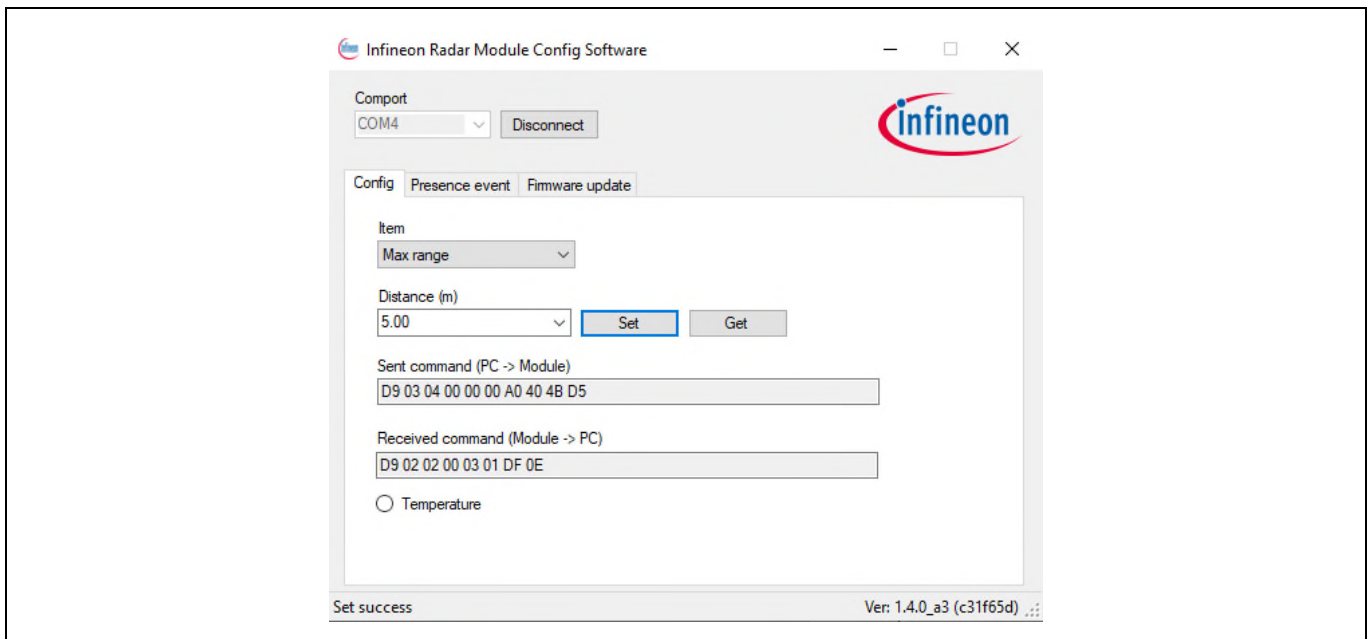
**Figure 25 Enable calibration mode**

3. Select "Calibration mode". Select "Enable" and press "Set".



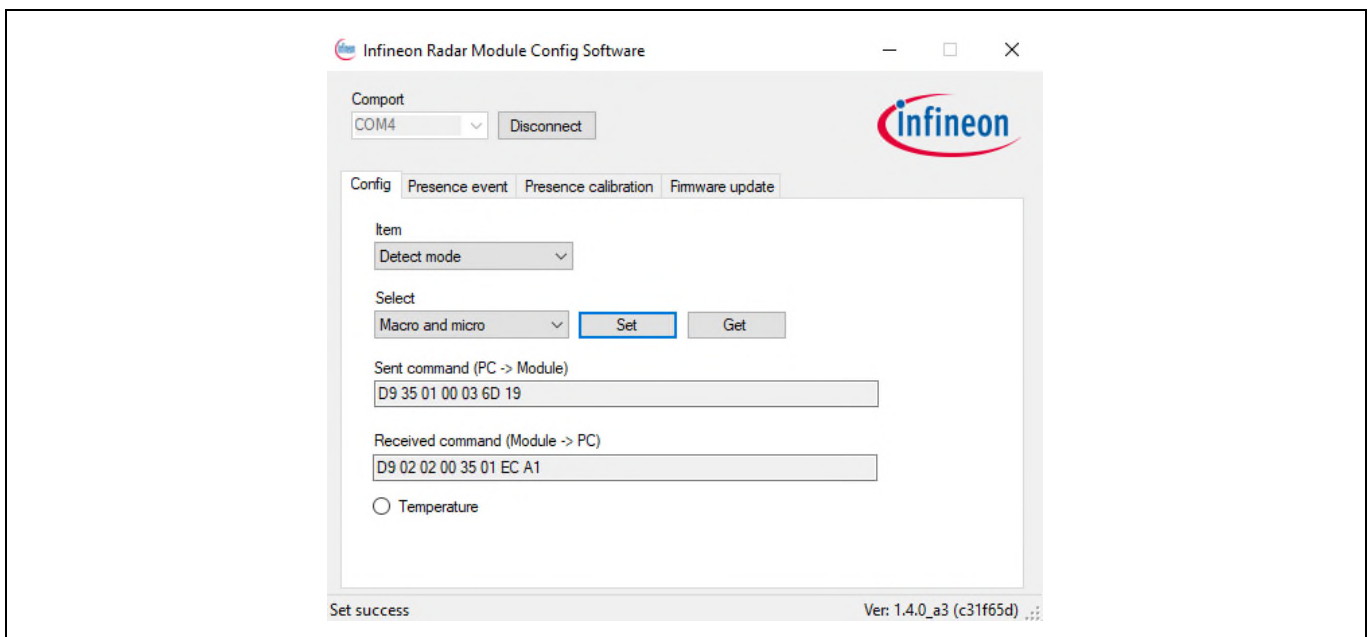
**Figure 26 Set calibration rate**

4. Select "Calibration rate". Select "4" and press "Set".



**Figure 27 Set maximum range**

5. Select "Max range". Input 5.0 in "Distance (m)" and press "Set".

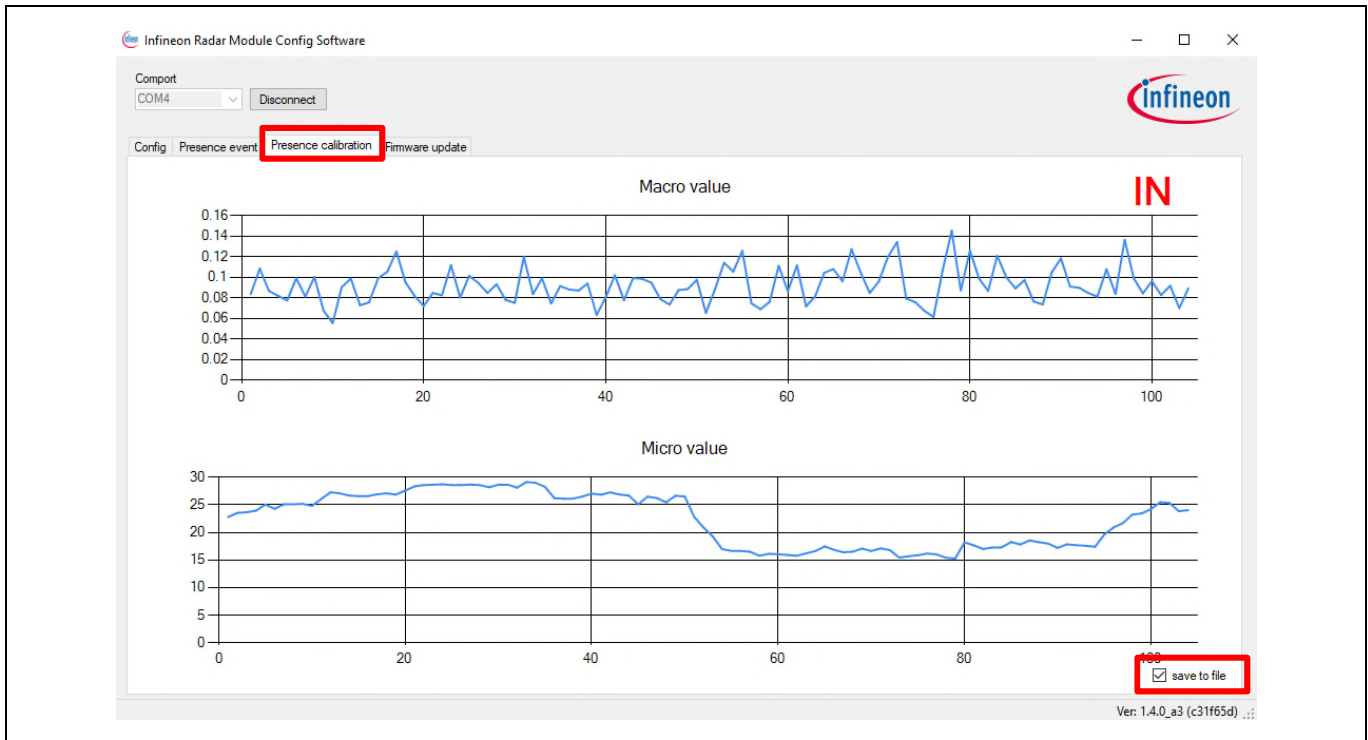


**Figure 28 Set detect mode**

6. Select "Detect mode". Select "Macro and micro" and press "Set".

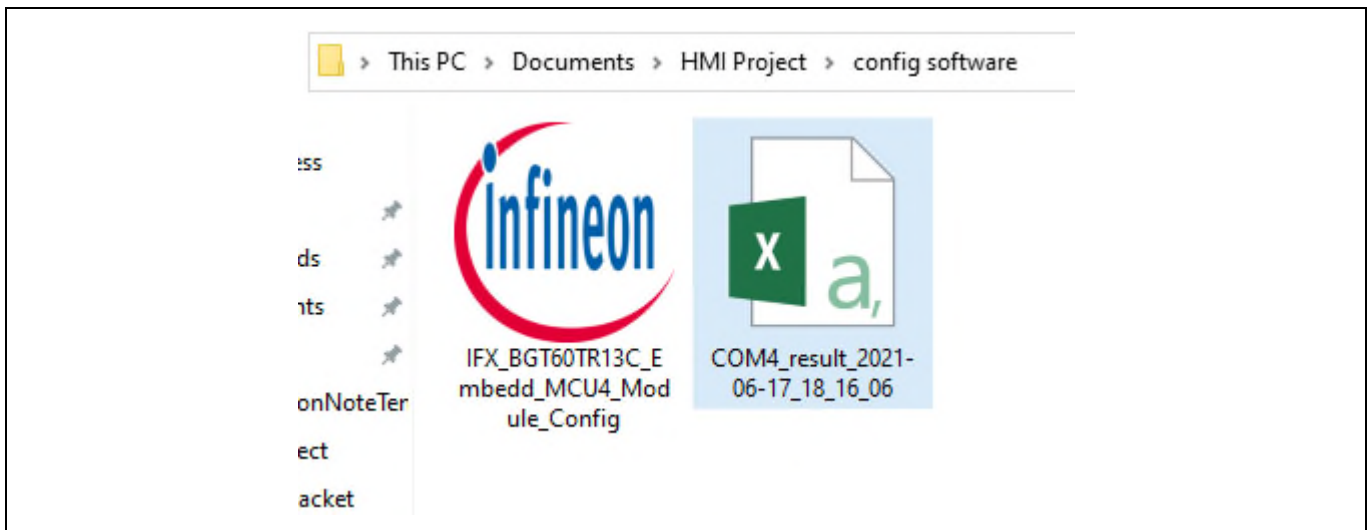
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## Micro and macro detection and setup



**Figure 29 Save macro and micro to a file**

7. Select the “Presence calibration” tab. Check “save to file” at bottom right.



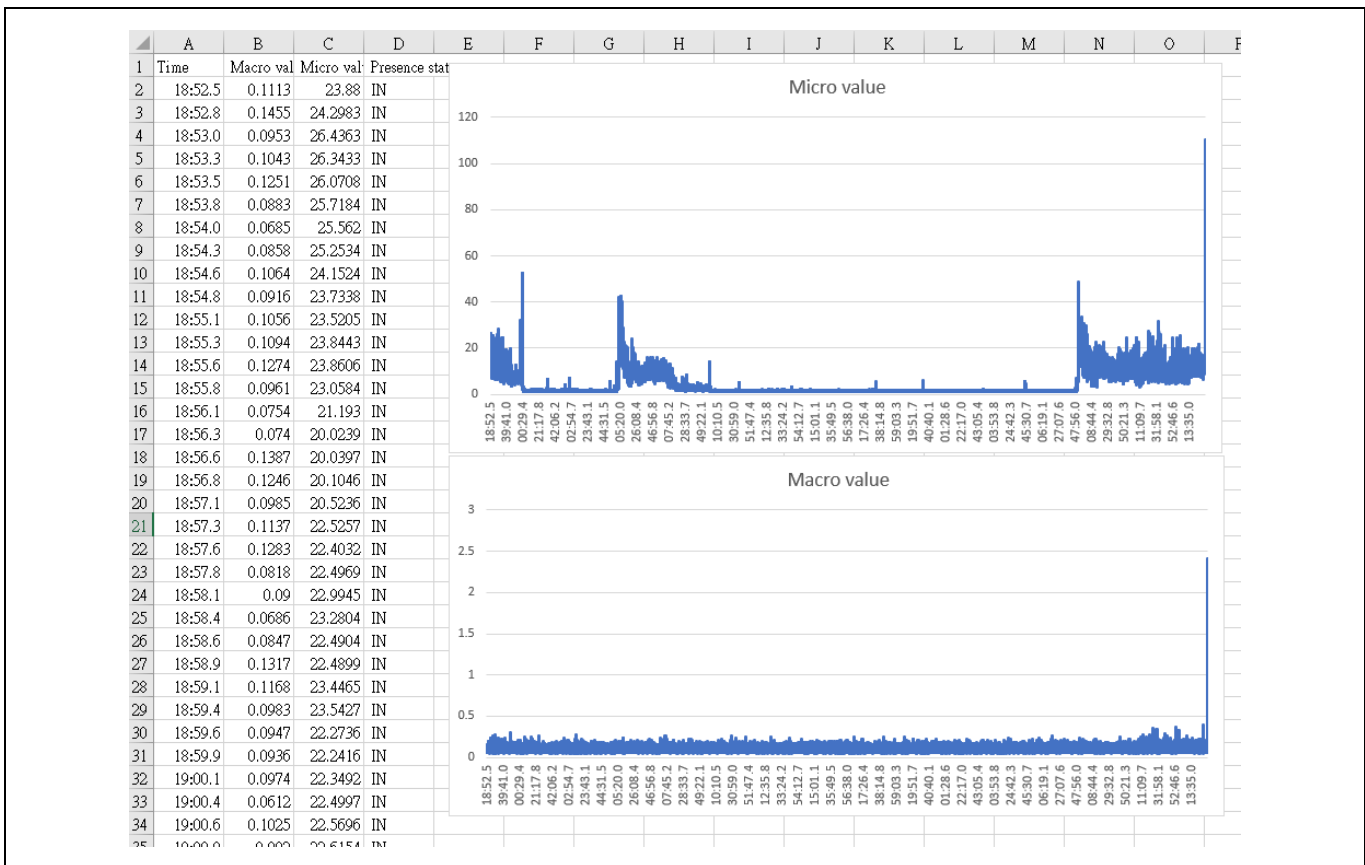
**Figure 30 Recording file**

8. A .csv file will be created in the same directory.

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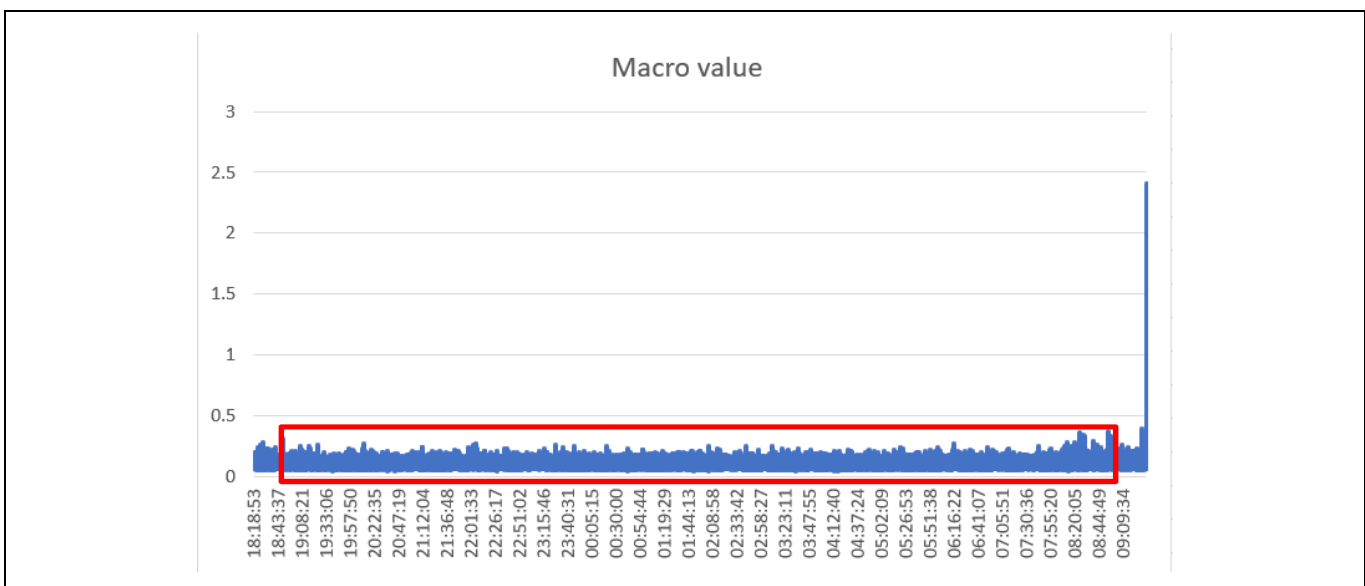


## Micro and macro detection and setup



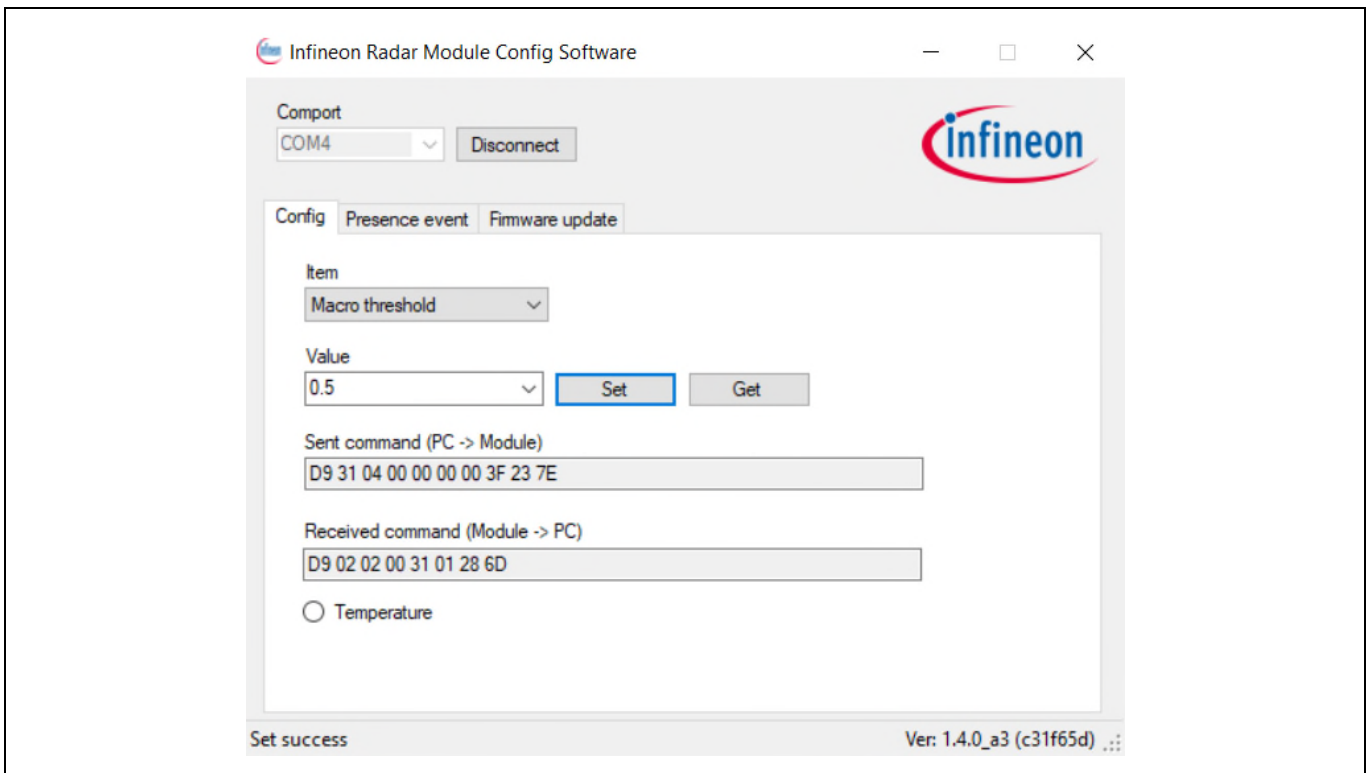
**Figure 31** Plot the graph an Excel file

- Open the recording file in Excel and plot graphs for macro and micro values against time.



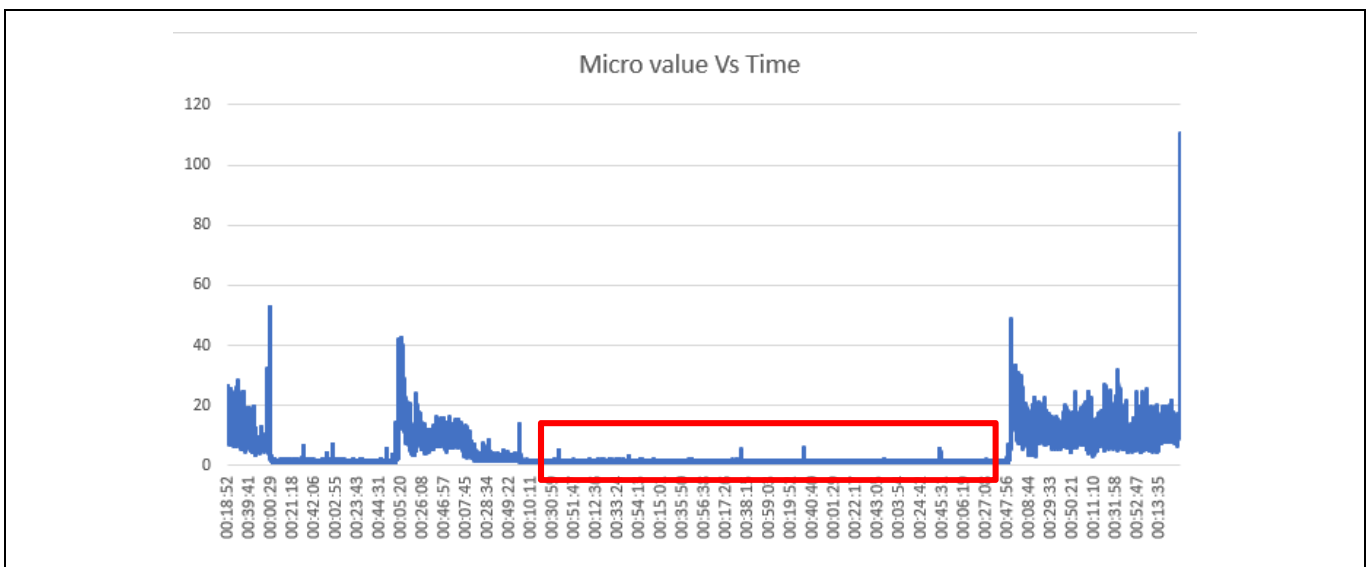
**Figure 32** Analyze macro graph

- For an empty environment with no moving objects, the macro value will stay relatively low. In this example, 0.5 can be selected as the macro threshold.



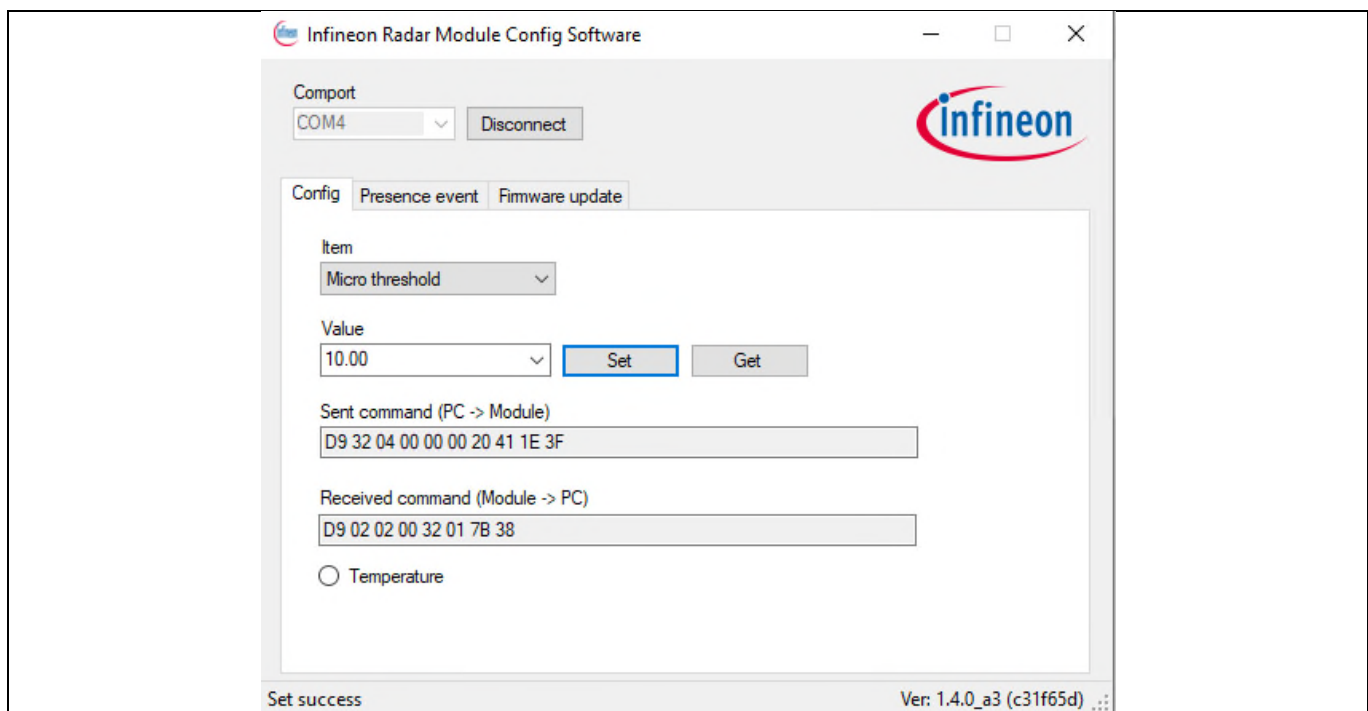
**Figure 33 Set macro threshold**

11. Select “Macro threshold”. Input “0.5” as the “Value” and press “Set”.



**Figure 34 Analyze micro graph**

12. Similar to the macro value, the micro value will stay at a low level when no moving object is in the environment. In this example, the region highlighted in red is the timing for an empty environment. Select the maximum value in that range as the micro threshold, which is 10.



**Figure 35 Set micro threshold**

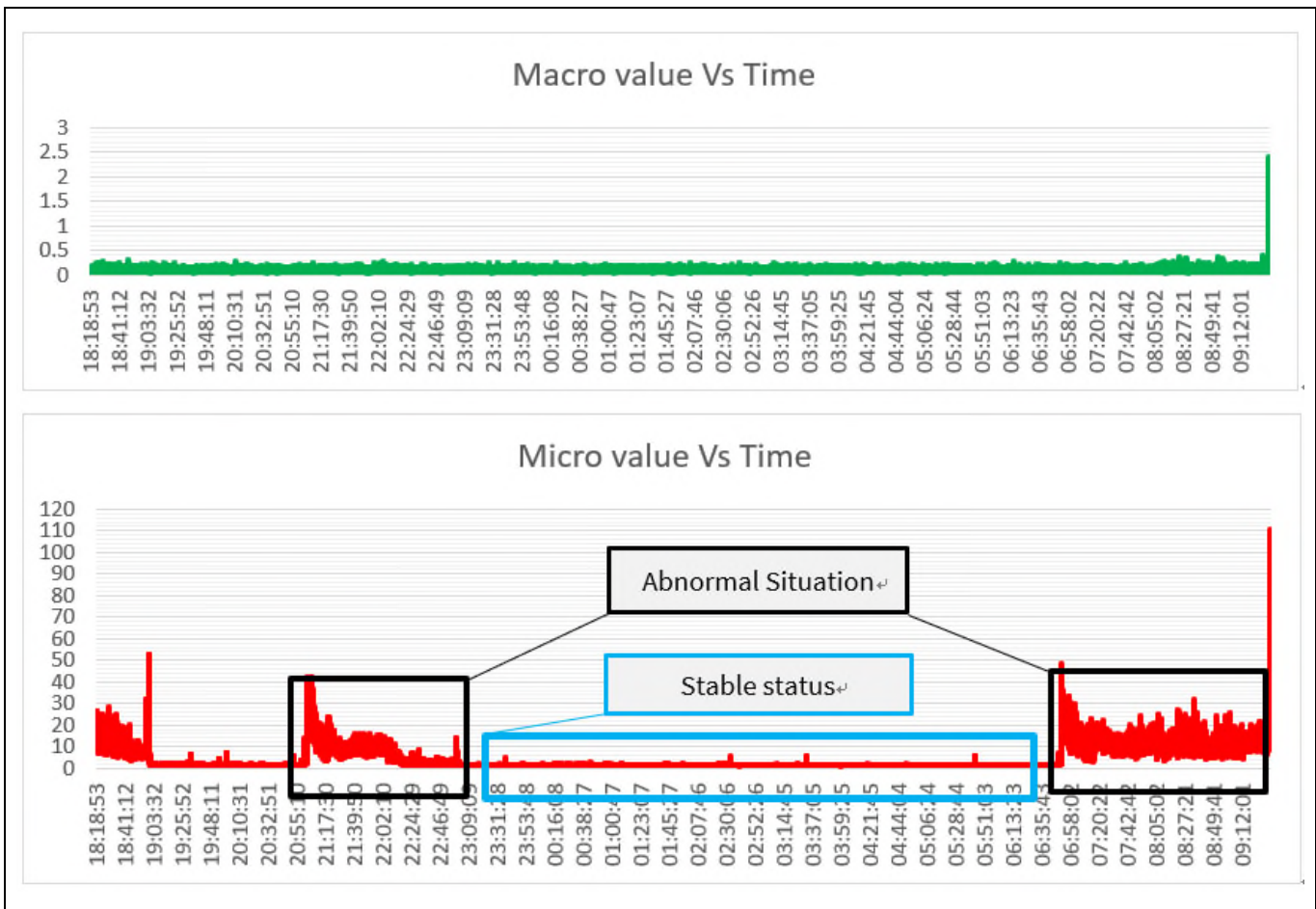
13. Select "Micro threshold". Input "10" as the "Value" and press "Set".



### 3.2 Abnormal situations

Assume the macro threshold and micro threshold are set to 0.5 and 10, respectively. When there is a vibrating object, the micro value will remain at a higher level than the micro threshold. This will make the radar incorrectly stay in the presence state, even when no one is in the room.

**Figure 36** shows an example of a situation with an air-conditioner disturbing the detection. The area highlighted in black is the time at which the air-conditioner is turned on. The area highlighted in blue is the time at which the air-conditioner is turned off.



**Figure 36** Micro and macro values with small vibrations

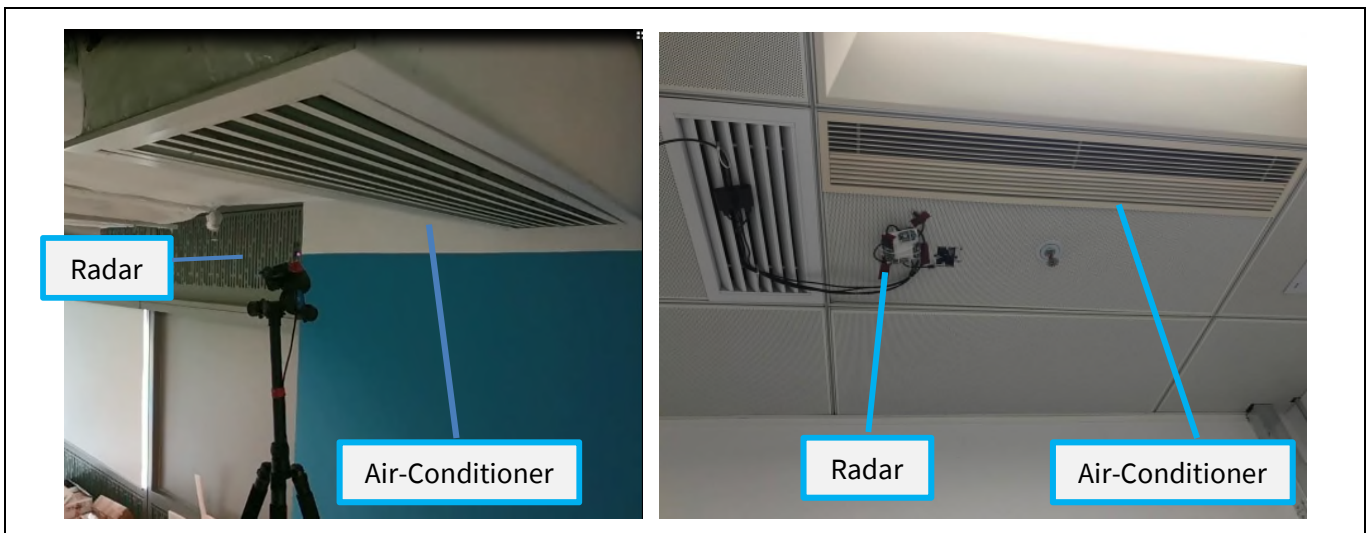
### 4 Potential problems in the installation environment

As mentioned in Chapter 3, some objects such as air-conditioners will easily generate vibration and affect the radar detection performance. Watch out for the following potential problems:

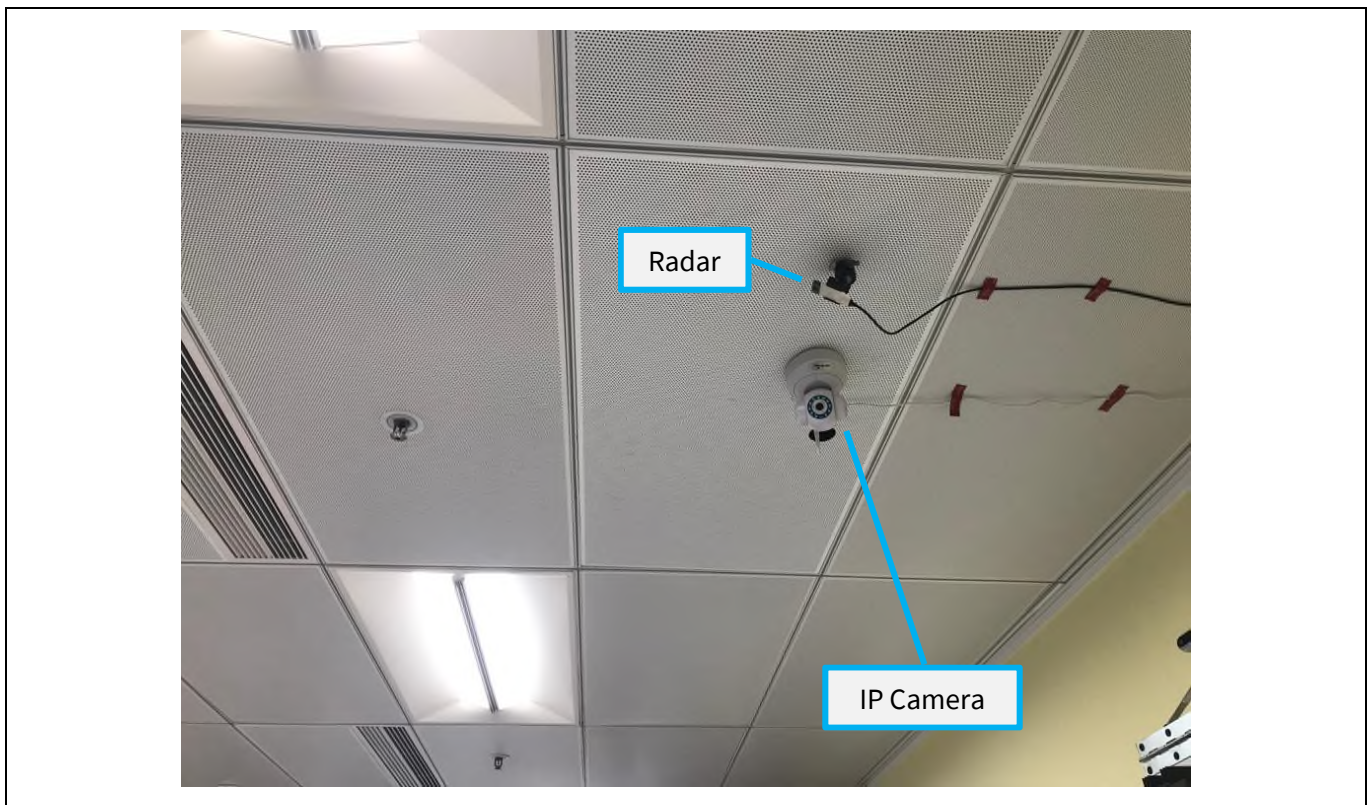
- Hanging light / tube
- Curtain
- Radar installed near air-conditioner
- IP camera/ CCTV camera



**Figure 37** Hanging light and curtain



**Figure 38** Air-conditioner



**Figure 39** IP camera/CCTV camera

**Figure 37, Figure 38 and Figure 39** show examples of potential problems. It is recommended to keep the radar away from these objects. Avoid putting them in the detection area of the radar.

# XENSIV™ 60GHZ BGT60TR13C system-on-module (SoM) installation guide



## Revision history

### Revision history

Document version	Date of release	Description of changes
06/07/2021	1.0	Engineering samples release version
02/03/2022	1.1	Corrections to title and words

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