a module solution provider

MM5D91-00

Presence Detection Sensor

Installation Guide

Draft 0.1

http://www.jorjin.com.tw

Index

1. INTRODUCTION

Floor plan planning strategy is a methodology for radar installation in presence detection device. Planning steps are shown as below.

1.1. Flow Chart of planning strategy

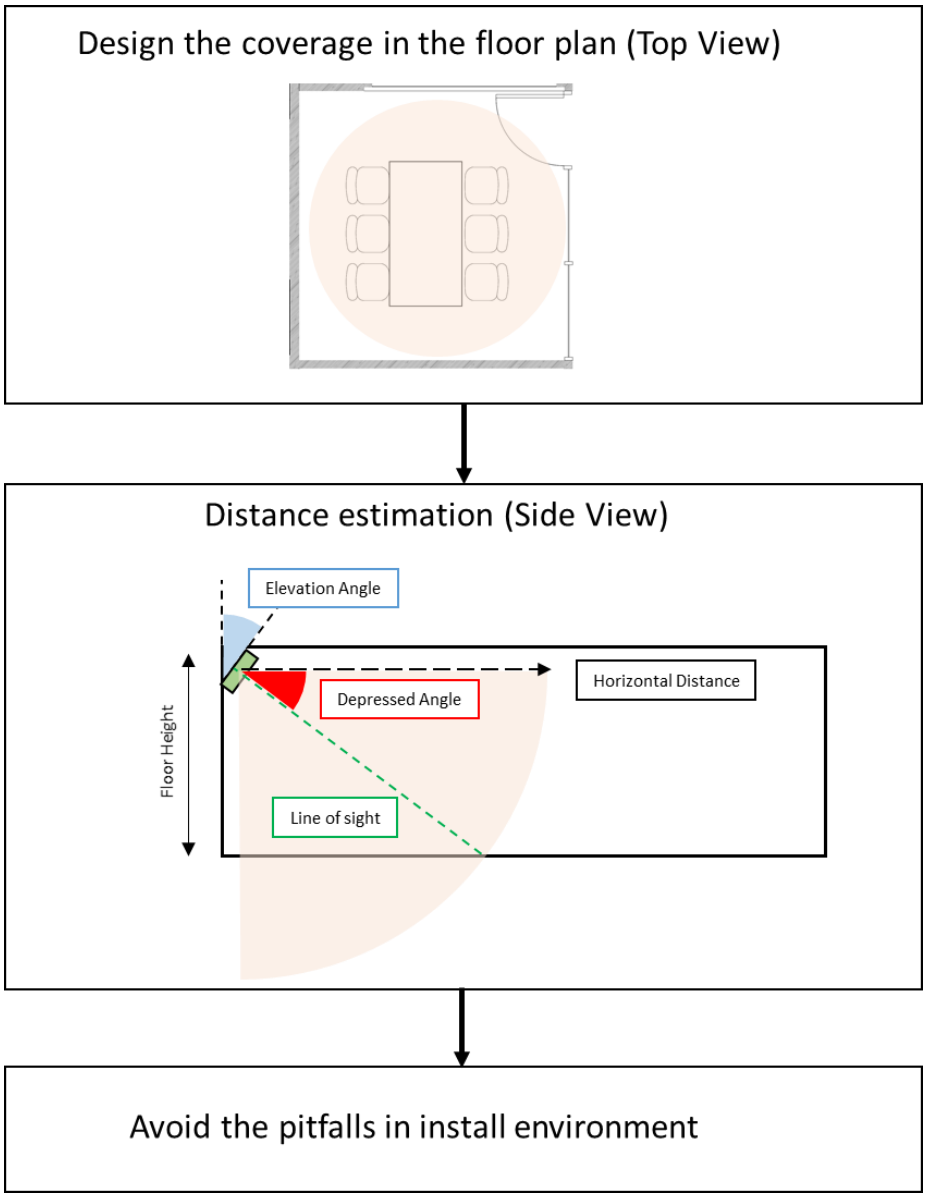


Figure 1-1. Flow chart of planning strategy

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

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

Pitfalls in installation environment is the unstable effect for presence detection. Small vibration of different objects will easily trigger false alarm. The small vibration can be quantified by the micro value in calibration mode. Special precaution should be made to avoid the pitfalls.

2. DESIGN THE COVERAGE IN FLOOR PARCLAN

2.1. Radar Setup and Mounting

Install the radar device on the wall with 45-degree elevation angle, as shown in **Figure 2-1**. The coverage of the radar device is around 90-degree on E-plane and H-plane respectively.

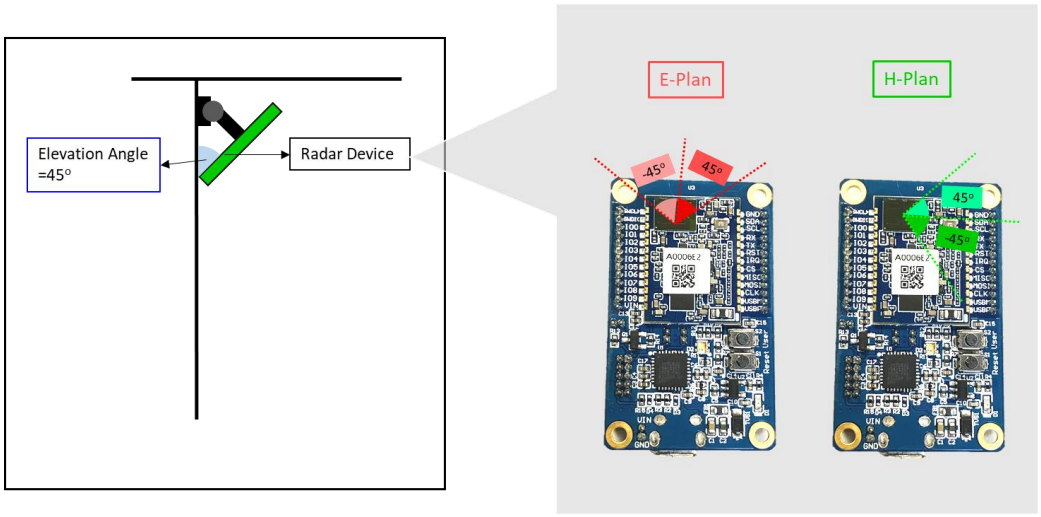


Figure 2-1. Elevation angle Setup and Radar position

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

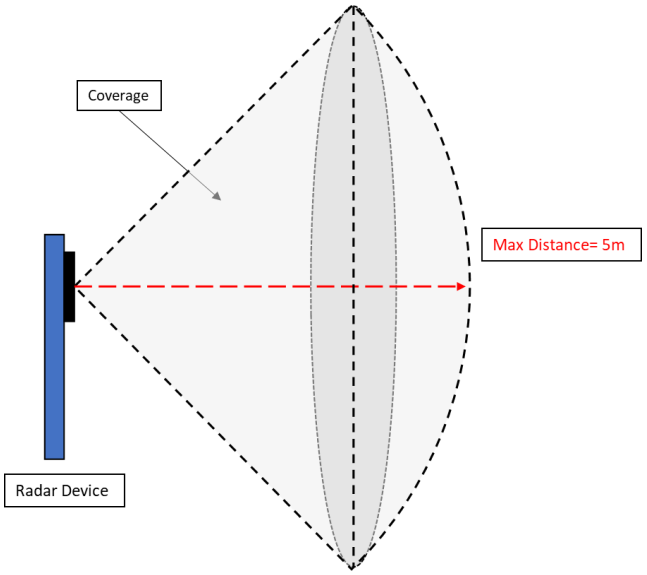


Figure 2-2. Radar coverage in side view

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

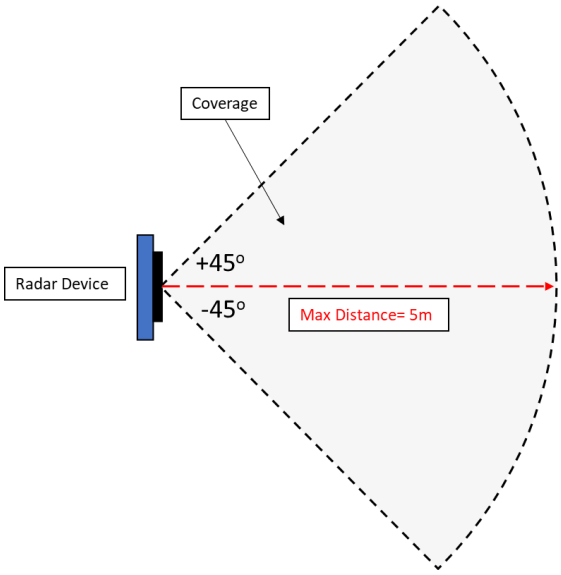


Figure 2-3. Radar coverage in top view

2.2. Example of radar installation in a room

Number of radars required to cover the floor plan is depending on the room size. 2 types of room are illustrated in this example.

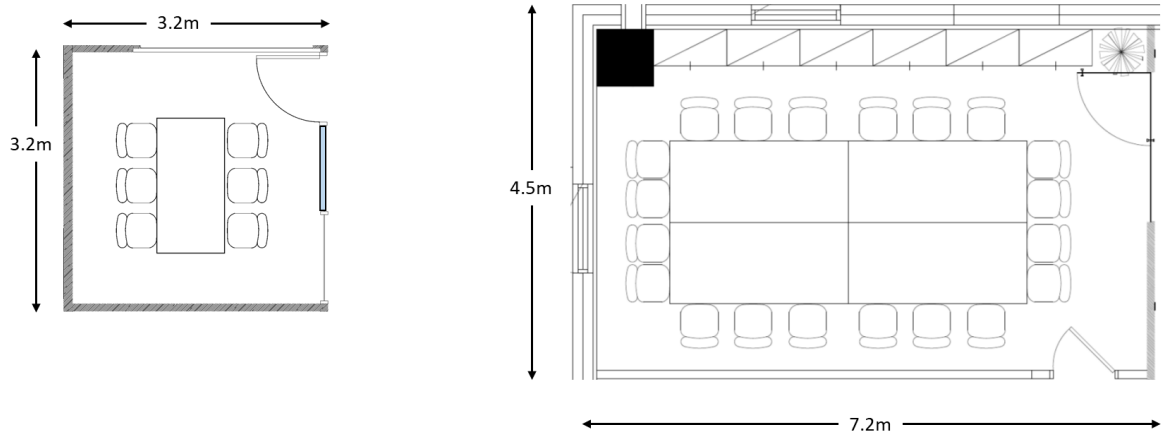


Figure 2-4. Analyze the floor plan

2.2.1. Example of radar installation in small room

Figure 2-5. shows a small room of size 3.2m x 3.2m, and height 2.8m. As the width and length are both smaller than the maximum cover distance (5m), 1 radar is enough to cover the room area. In this example, the radar is installed at corner with maximum range set to 3m. Some margins are left to avoid the disturbance coming from curtain.

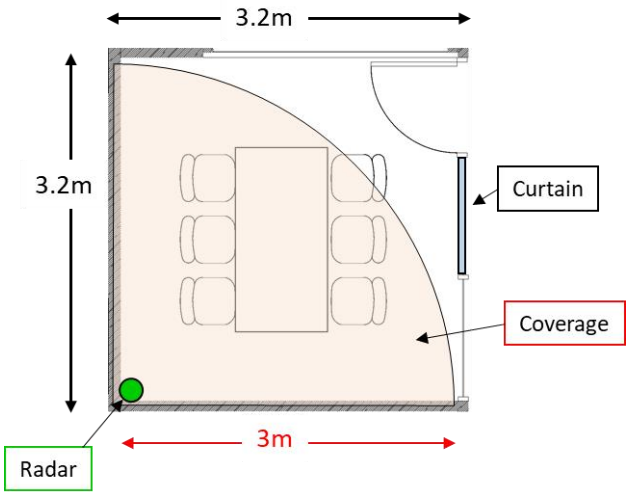


Figure 2-5. Radar setup in small room (Top view)

The radar is mounted on the wall at 2.6m height with 45-degree elevation angle. A 0.2~0.5m gap between curtain and coverage area is to prevent false alarm caused by curtain.

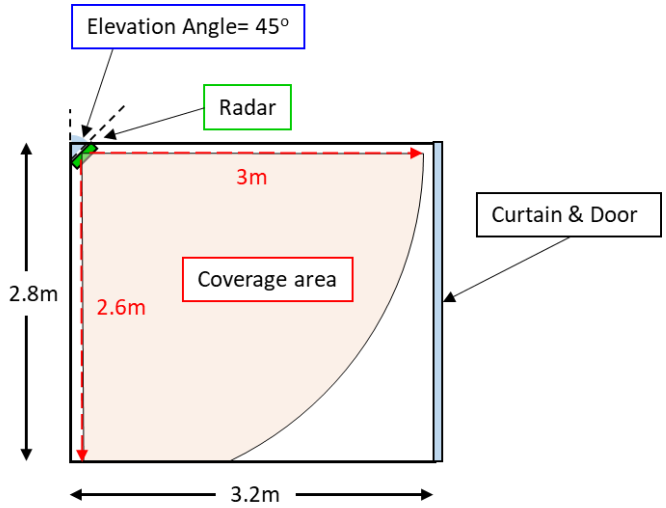


Figure 2-6. Radar setup in small room (Side view)

2.2.1. Example of radar installation in big room

Figure 2-7. shows a big meeting room of 7.2m x 4.5m, and height 2.8m. As the length of room is exceeding maximum cover distance (5m), 3 radars are used to cover the room. The radars are installed at opposite side of the curtain to avoid the disturbance from curtain movement. Maximum setting of the 3 radars are set to 4m.

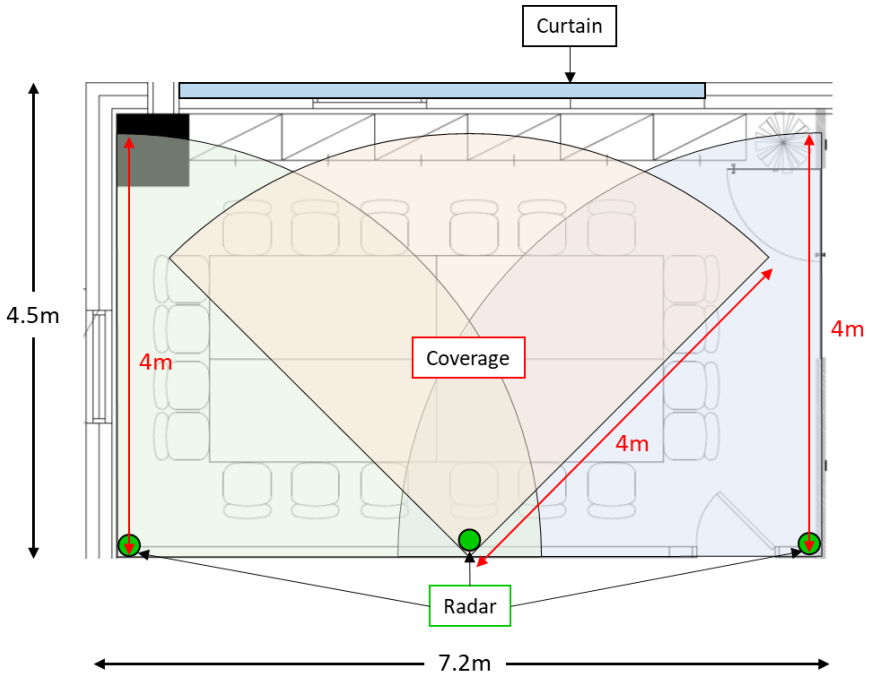


Figure 2-7. Radar setup in big room (Top view)

The 3 radars are mounted on the wall at 2.6m heght with 45-degree elevation angle. A 0.5m gap between curtain and coverage area is to prevent false alarm caused by curtain movement.

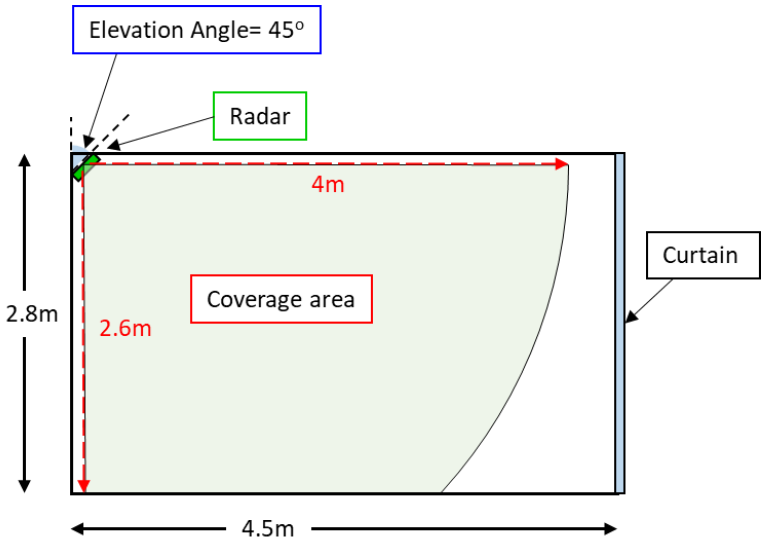


Figure 2-8. Radar setup in big room (Side view)

2.3. Steps to design coverage in floor plan

This section provides detailed procedures to design the radar configuration for covered range. Microsoft PowerPoint is used as the tool for doing the estimation. An example design flow is provided as below. The scale using is 1:50, which means 2cm represent 1m.

1. Draw a 1:50 scale block and place the floor plan in the block

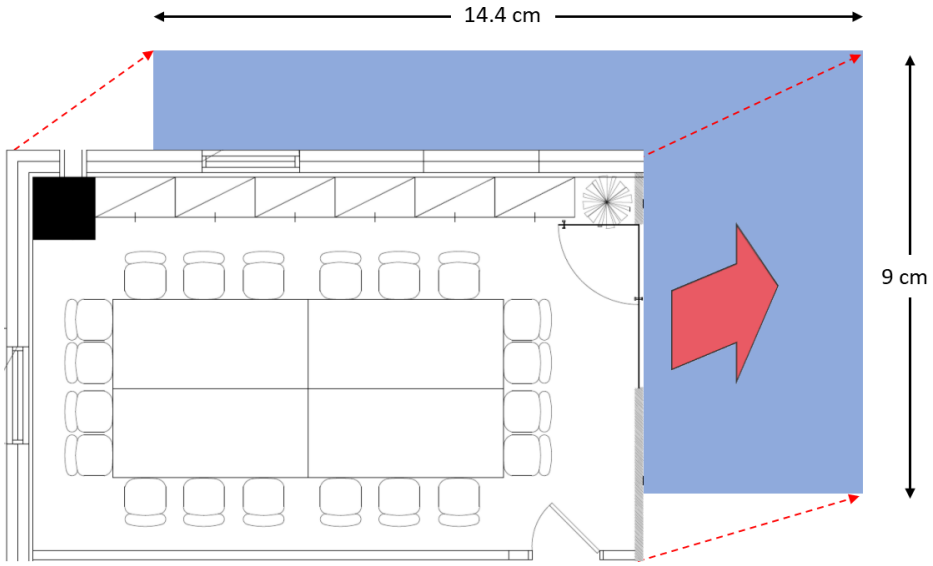


Figure 2-9. Floor plan measurement

2. Select **Shapes** and choose **Partial Circle** to create the radar detected area. Set angle of the partial circle from to 90 degree.

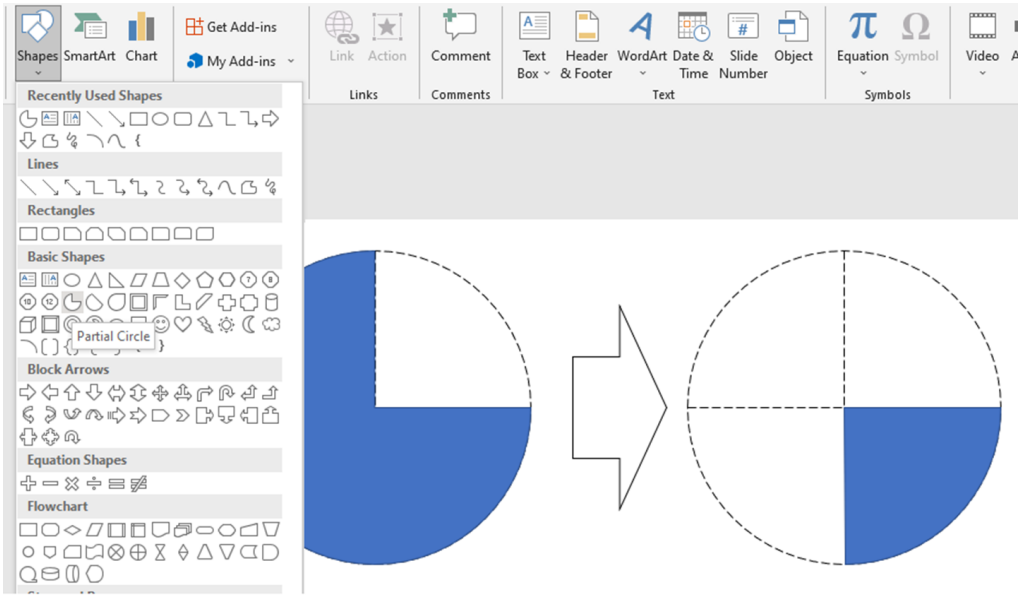


Figure 2-10. Radar coverage shape creation

3. Right click the **Partial Circle** and press **Size and Position**. Set height and width (diameter) to 16cm. It represents the required detected distance of the radar is 4m in real space.

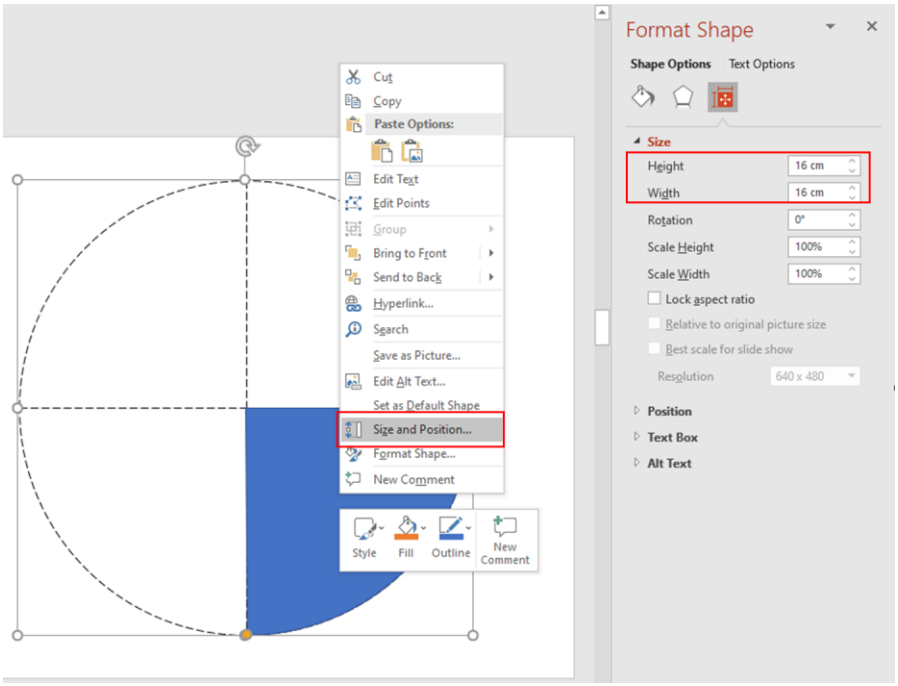


Figure 2-11. Radar coverage shape size

4. Right click the **Partial Circle** and select shape fill. Choose a color to fill the partial circle and set 50% in transparency. The partial circle area represents the coverage area of radar.

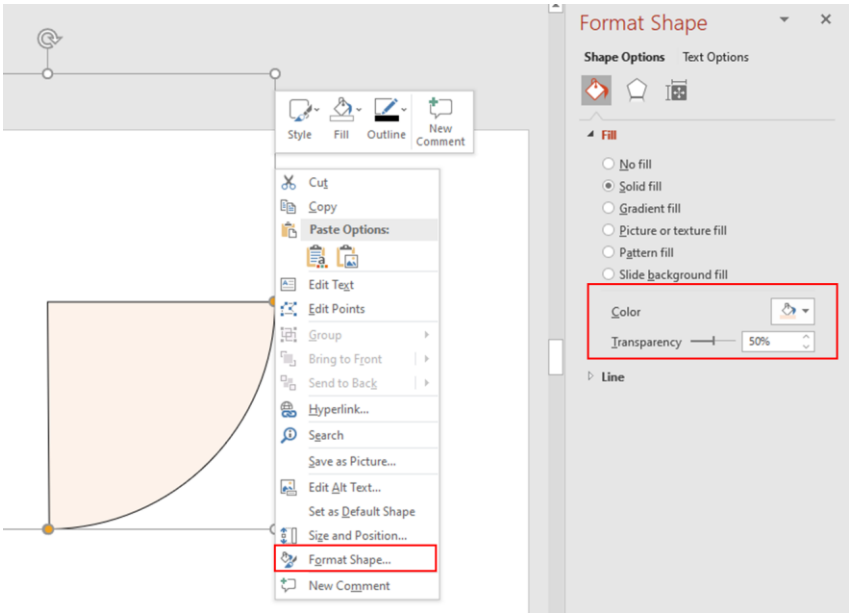


Figure 2-12. Radar coverage shape setting

5. Place the partial circle area on the target position.

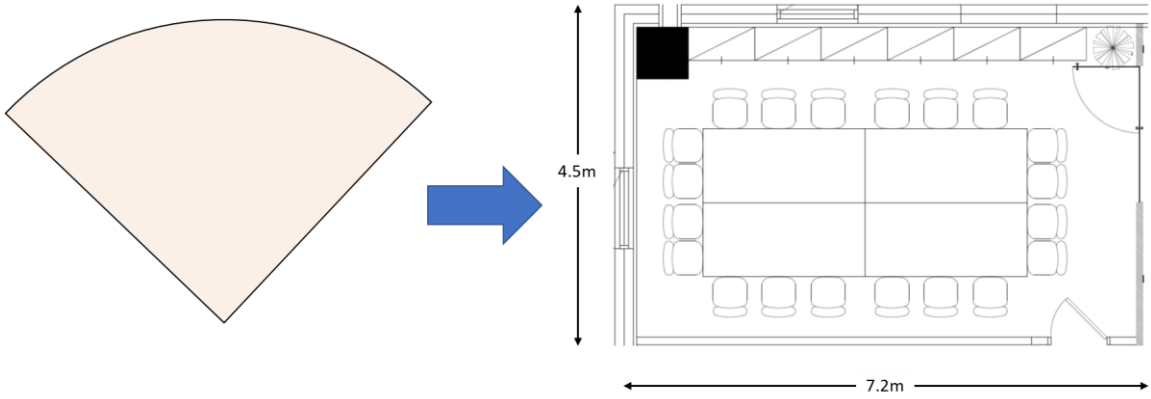


Figure 2-13. Radar coverage in floor plan

6. Repeat Step-5 again to complete the setup.

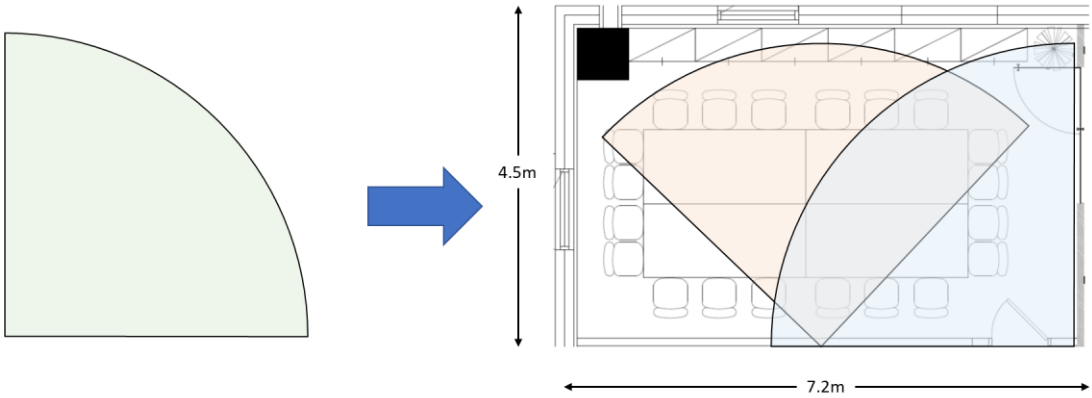


Figure 2-14. Multiple radars coverage in floor plan

2.4. Distance estimation in Side View

This section provides detailed procedures to estimate the covered distance at side view. Microsoft PowerPoint is used as the tool for doing the estimation. The example setup and estimation are the same as 2.3. Area of the shape is in scale of 1:50.

1. Draw a 1:50 scale block to simulate the space of the side view. The height and length of the space is 2.8m and is 7.2m respectively. Place the radar block on the left corner. The Elevation angle of the radar is set as 45 degree.

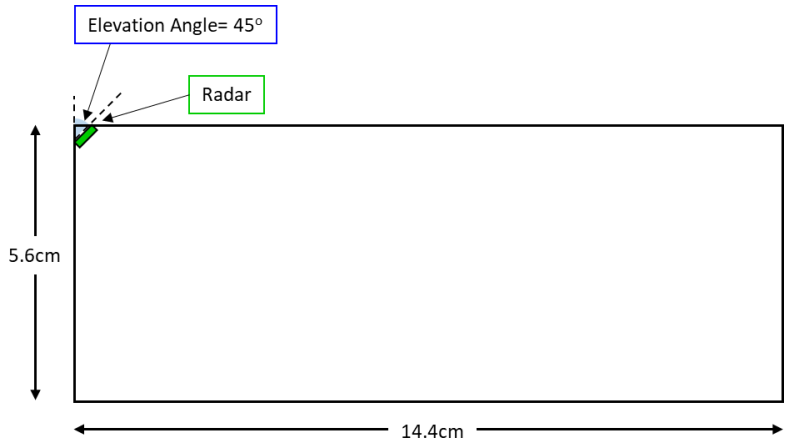


Figure 2-15. Floor plan creation

2. Create a partial circle shape of 90 degree to represent the radar coverage area. Set the height and width (diameter) to 8cm

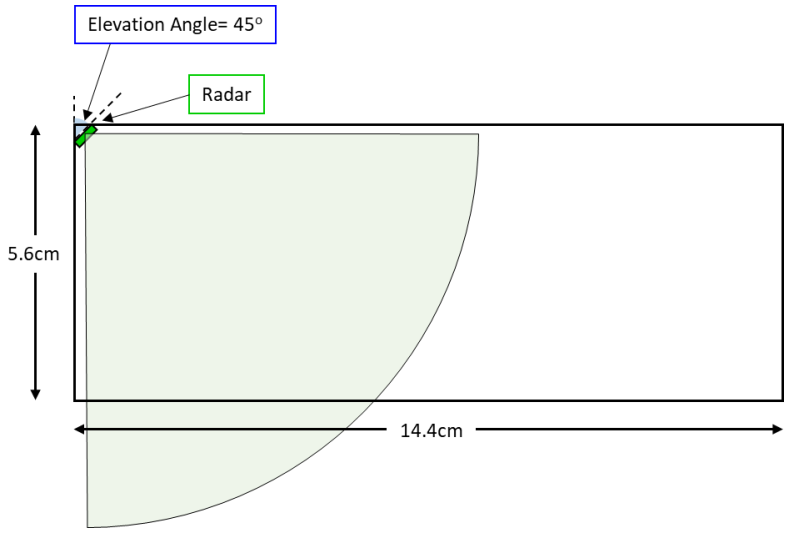


Figure 2-16. Add radar coverage

3. Draw a rectangular with 0.5cm height to place on the coverage area. Extend the length of the rectangle until it touches the arc edge **Figure 2-17.** shows that the rectangular labeled A and B are examples of the rectangle.

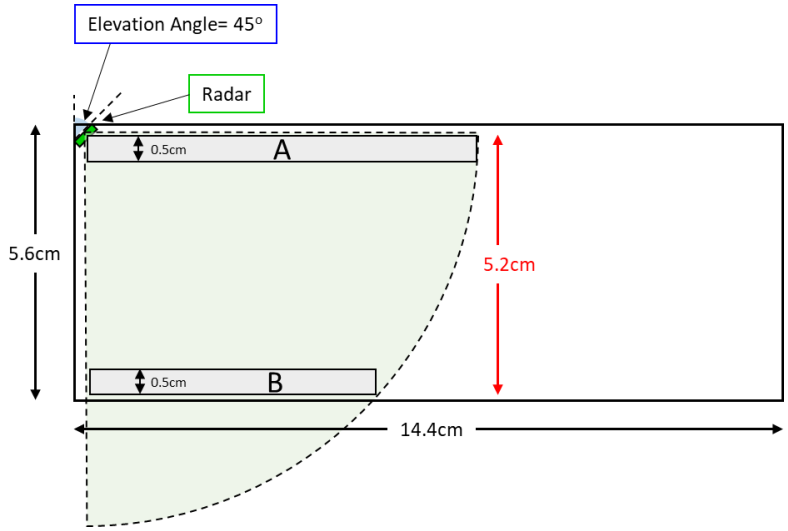


Figure 2-17. Coverage measurement

4. Right click the rectangle and select **Size and Position** to see the scaled distance.

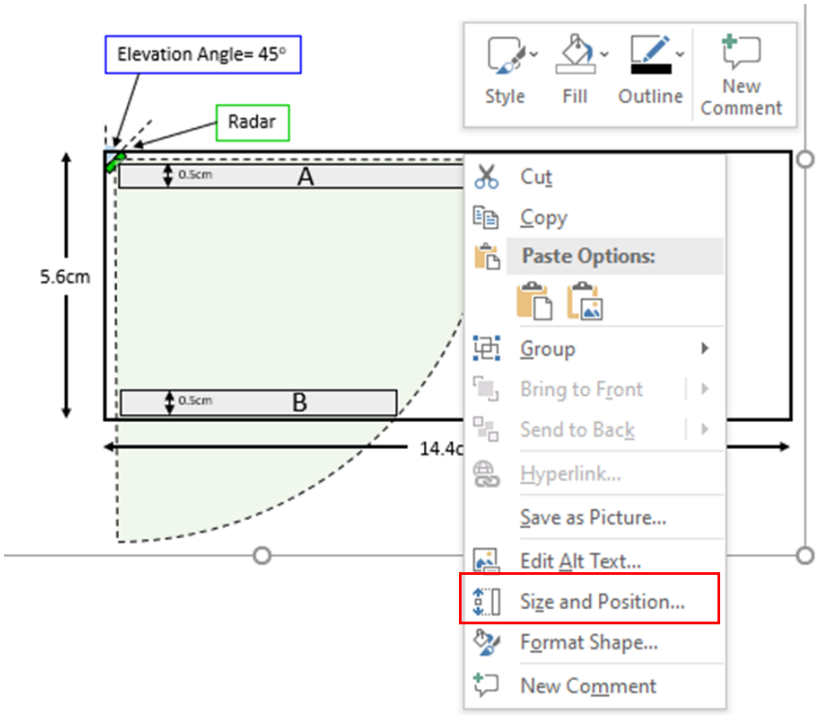


Figure 2-18. Read the width of rectangle

5. Read the width value under Format Shape Bar. The cover length is 5.8cm, in this example. Which represents 2.9m

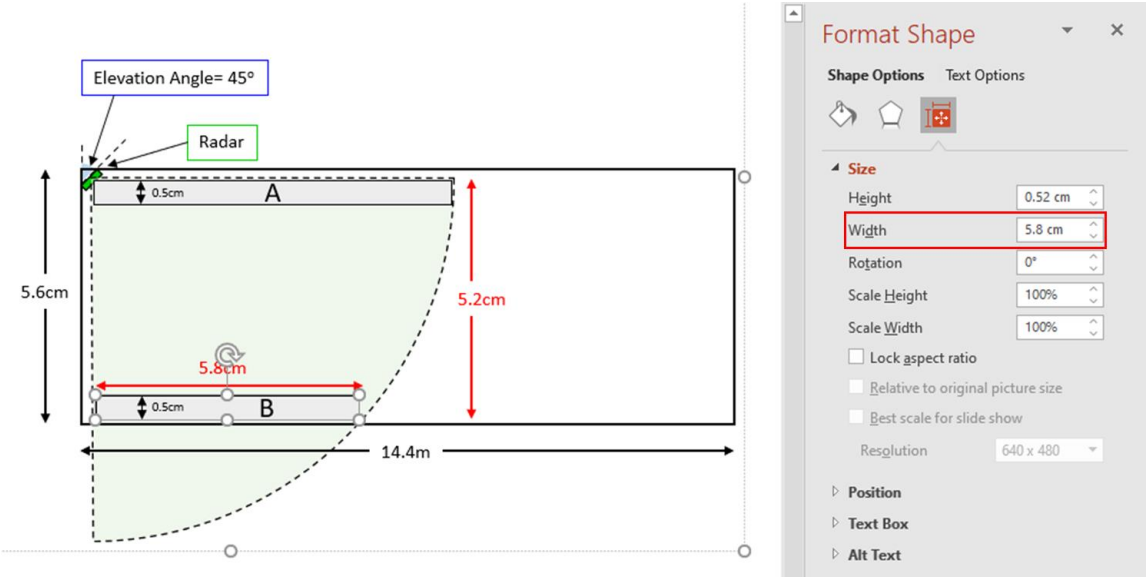


Figure 2-19. Length of rectangle

3. MICRO AND MACRO DETECTION AND SETUP

As the radar is sensitive to small motion, other vibration objects such as air conditioner and curtain will easily affect the detection performance. User needs to take special precaution when doing radar installation.

In the presence detection solution, there is a macro and micro detection mode.

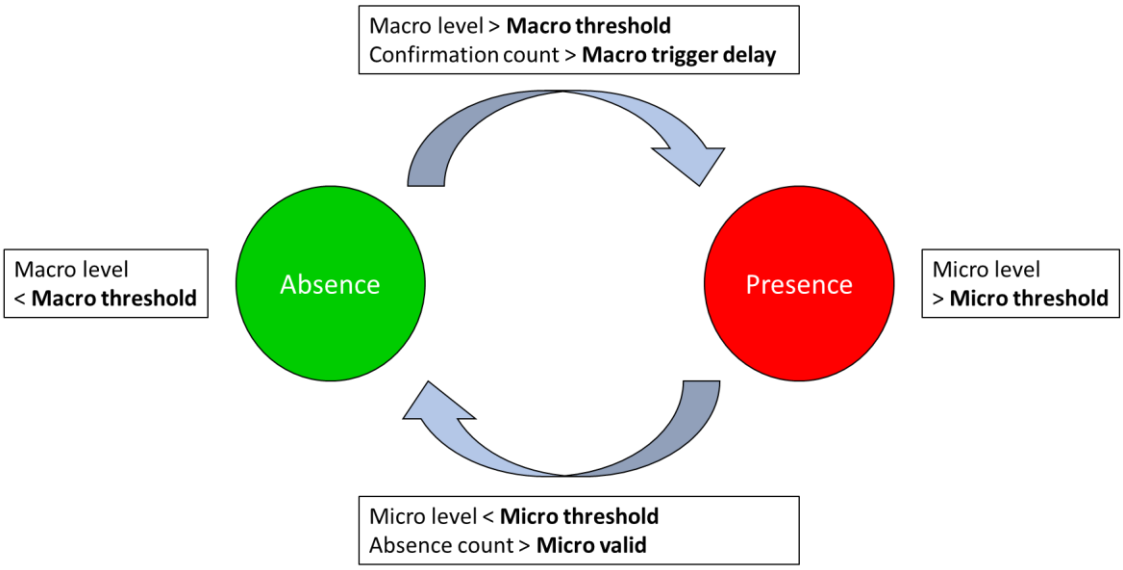


Figure 3-1. Presence Detect state diagram

When the detection is in absence state, it would check the marco level. If marco level is higher than marco threshold, macro trigger confirmation count will increase by 1. If confirmation count exceeds macro trigger delay, state would transit from absence to presence.

For presence state, state remains in presence when micro level is higher than the micro threshold. When the micro level is lower than the micro threshold, absence count will increase by 1. If absence count exceeds micro valid, the state would go back to absence.

If there are vibration objects inside the detection area, the micro value will keep at high level. Resulting in not able to switch to absence state when no one is in the detection area anymore

3.1. Procedures of marco and micro level recording

Calibration mode provide the feature to print out and save the micro detection value over time. Following procedures show the steps to do recording.

1. Open BGT60TR13C_Radar_Config_Tool. Select radar **COM port** and press **Connect**.

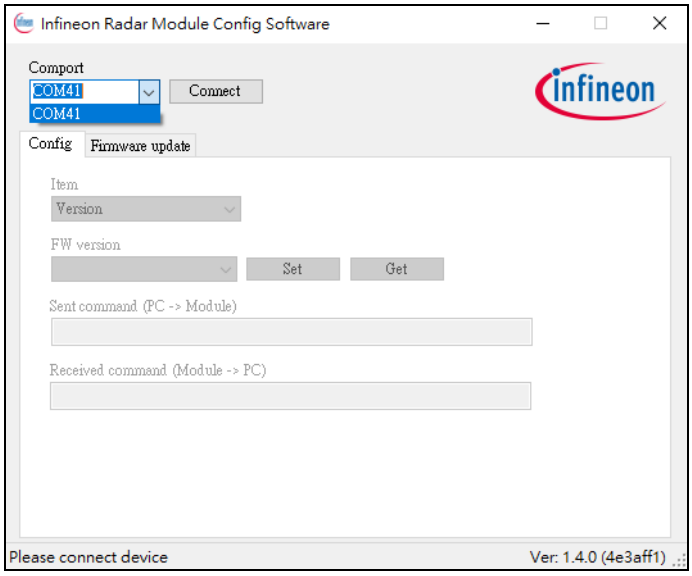


Figure 3-2. Radar config tool

2. Select **Reset config** in item and press **Set**.

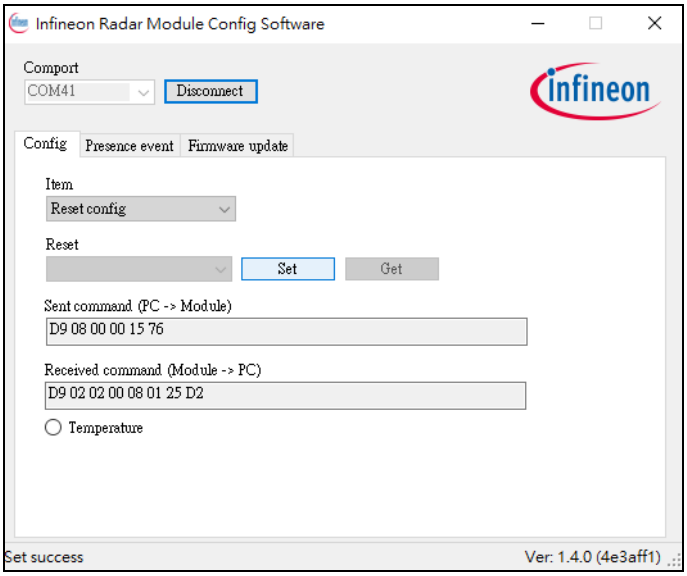


Figure 3-3. Reset radar config

3. Select **Calibration mode** in item. Select **Enable** in select bar and press **Set**.

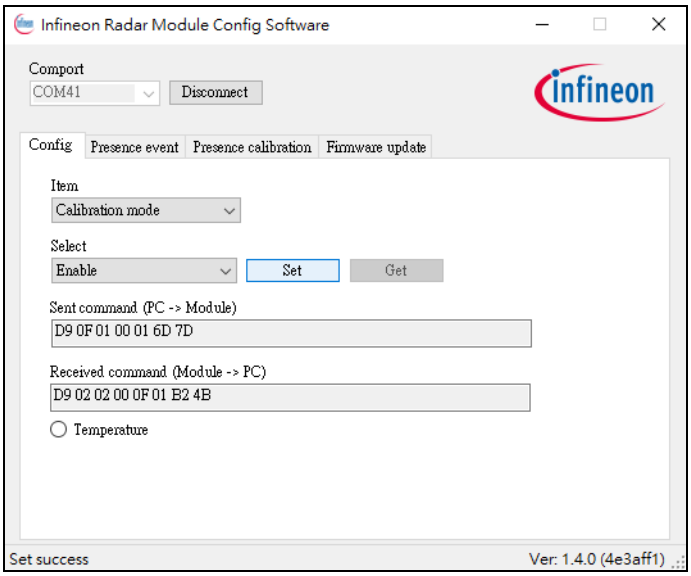


Figure 3-4. Enable Calibration mode

4. Select **Calibration rate** in item. Select **4** in select bar and press **Set**.

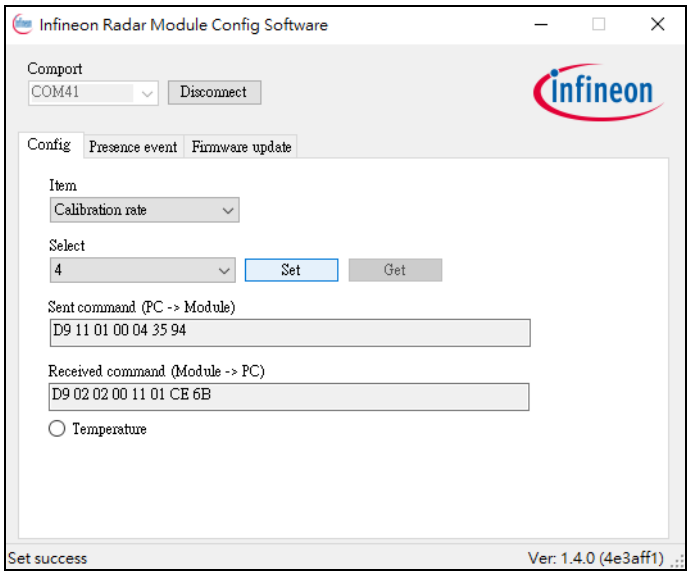


Figure 3-5. Set Calibration rate

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

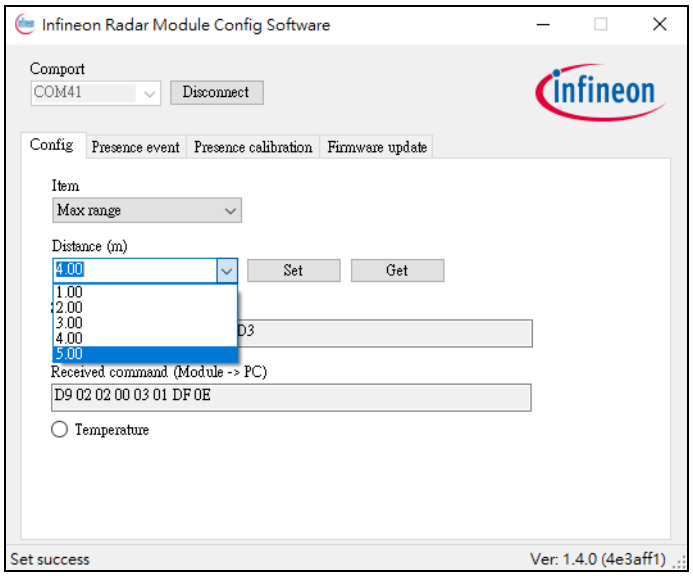


Figure 3-6. Set maximum range

6. Select **Detect mode** in item. Select **Macro and micro** in Select and press **Set**.

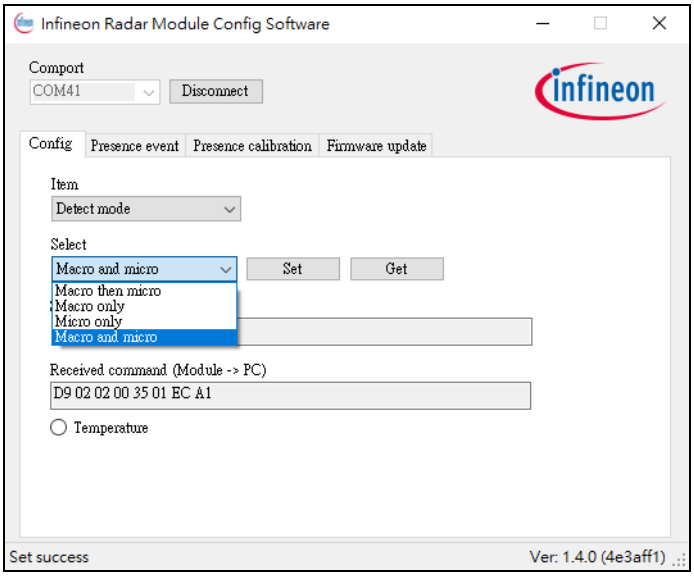


Figure 3-7. Set the Detect mode

7. Select **Presence calibration** tab page. Select **save to file** checkbox at bottom right side.

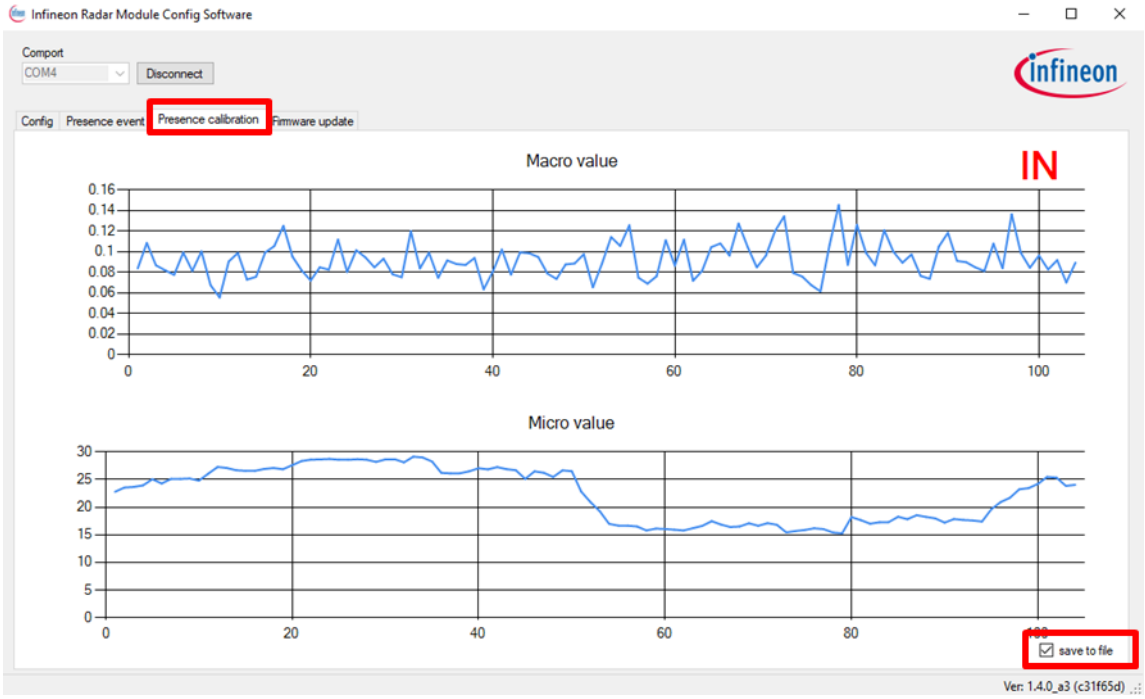


Figure 3-8. Save marco and micro to a file

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

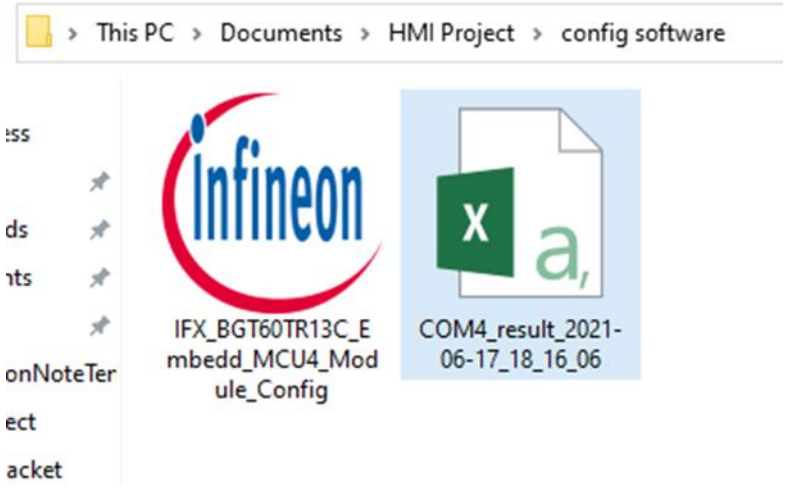
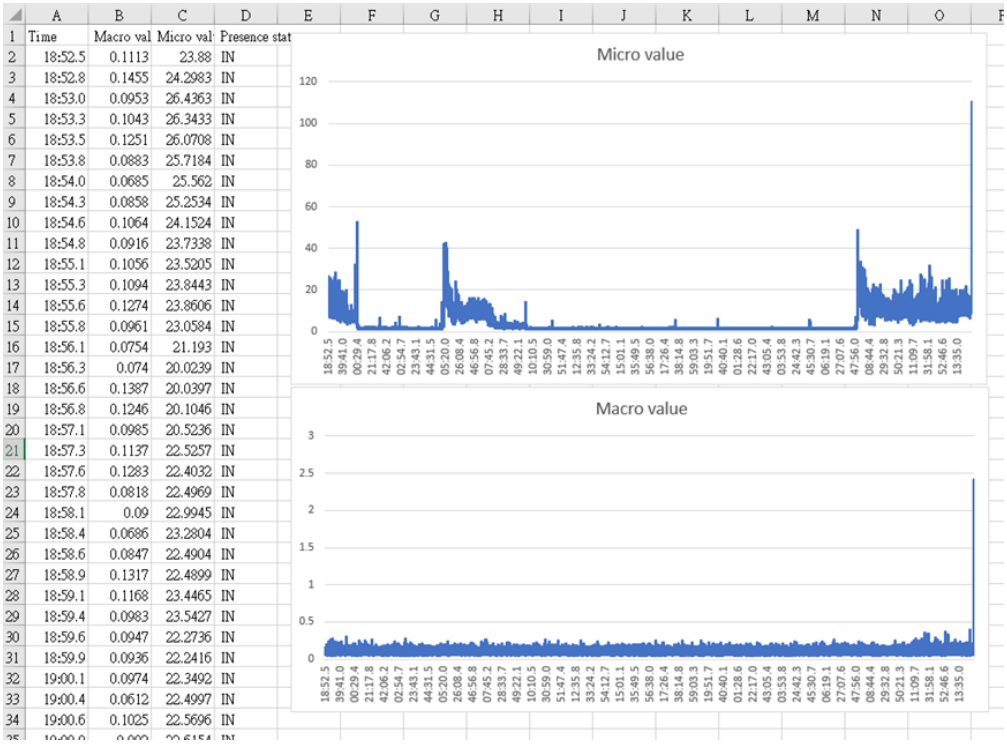


Figure 3-9. Recording file

9. Open the recording file in excel and plot graphs for marco value and micro value against time.



Time	Macro val	Micro val	Presence stat
18:52.5	0.1113	23.88	IN
18:52.8	0.1455	24.2983	IN
18:53.0	0.0953	26.4363	IN
18:53.3	0.1043	26.3433	IN
18:53.5	0.1251	26.0708	IN
18:53.8	0.0883	25.7184	IN
18:54.0	0.0685	25.562	IN
18:54.3	0.0858	25.2534	IN
18:54.6	0.1064	24.1524	IN
18:54.8	0.0916	23.7338	IN
18:55.1	0.1056	23.5205	IN
18:55.3	0.1094	23.8443	IN
18:55.6	0.1274	23.8606	IN
18:55.8	0.0961	23.0584	IN
18:56.1	0.0754	21.193	IN
18:56.3	0.074	20.0239	IN
18:56.6	0.1387	20.0397	IN
18:56.8	0.1246	20.1046	IN
18:57.1	0.0985	20.5236	IN
18:57.3	0.1137	22.5257	IN
18:57.6	0.1283	22.4032	IN
18:57.8	0.0818	22.4969	IN
18:58.1	0.09	22.9945	IN
18:58.4	0.0686	23.2804	IN
18:58.6	0.0847	22.4904	IN
18:58.9	0.1317	22.4899	IN
18:59.1	0.1168	23.4465	IN
18:59.4	0.0983	23.5427	IN
18:59.6	0.0947	22.2736	IN
18:59.9	0.0936	22.2416	IN
19:00.1	0.0974	22.3492	IN
19:00.4	0.0612	22.4997	IN
19:00.6	0.1025	22.5696	IN

Figure 3-10. Plot the graph in excel file

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

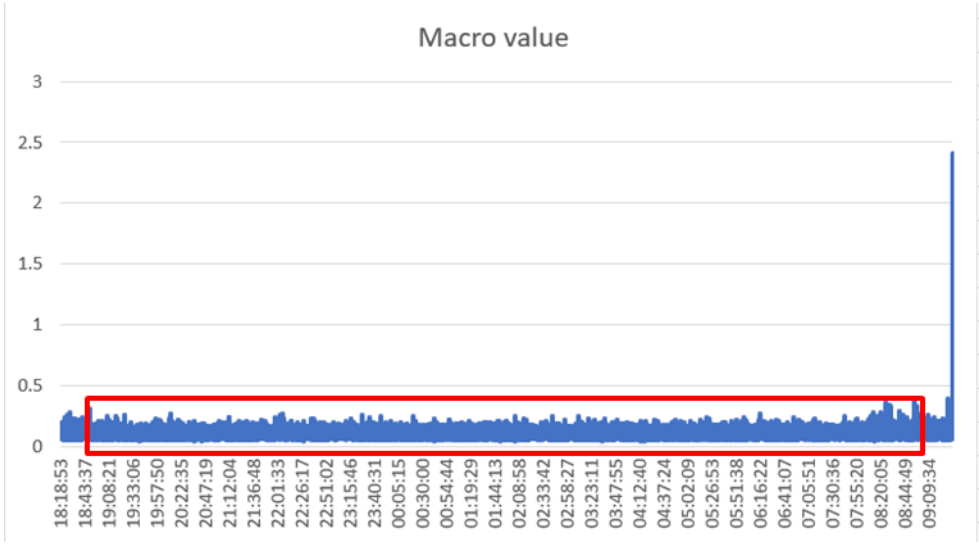


Figure 3-11. Analyze the Macro graph

11. Select **Marco threshold** in item. Input **0.5** in the Value and press **Set**.

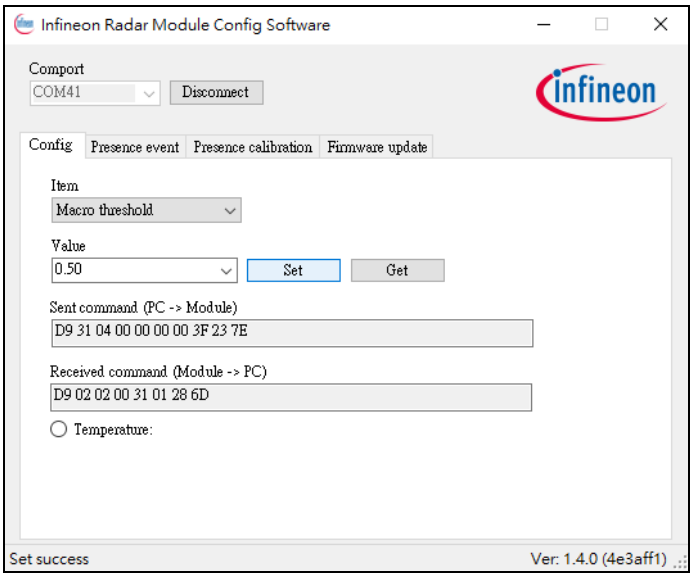


Figure 3-12. Set marco threshold

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

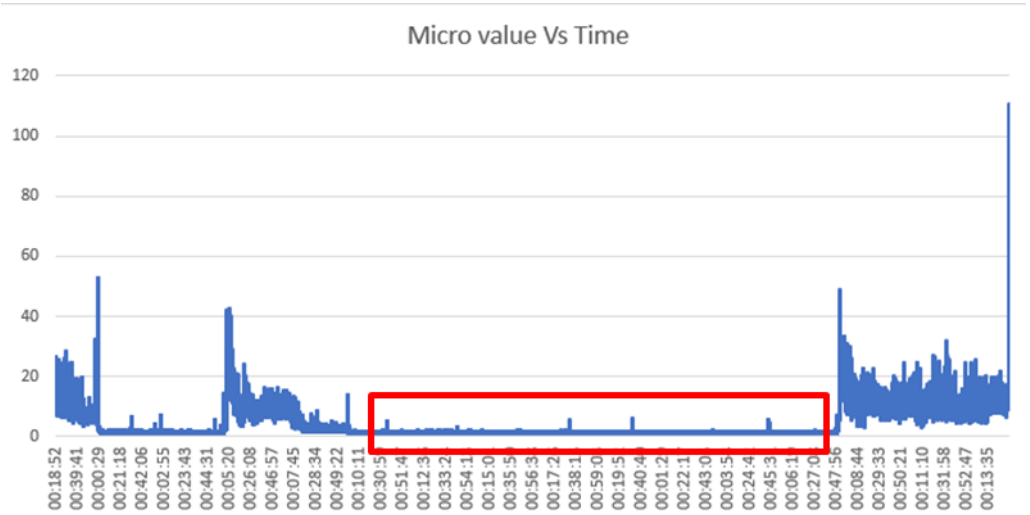


Figure 3-13. Analyze the Micro graph

13. Select **Micro threshold** in item. Input **10** in the Value and press **Set**.

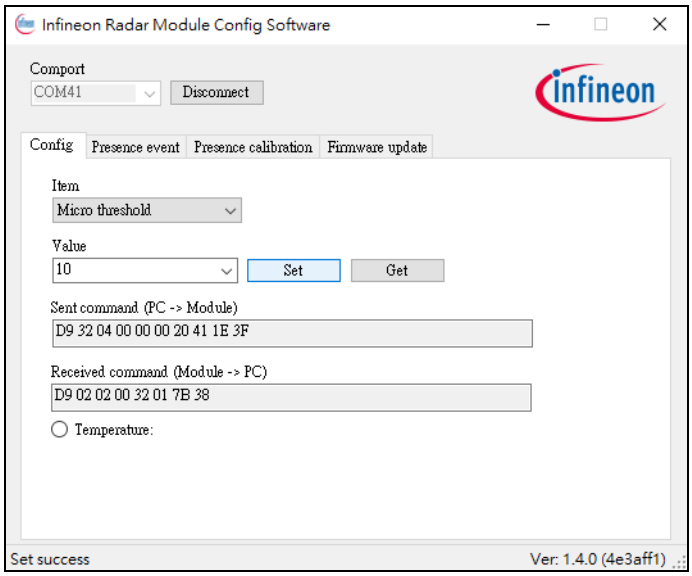


Figure 3-14. Set micro threshold

3.2. Abnormal Situation

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

Figure 3-15. shows an example of situation with air conditioner disturbing the detection. Area highlighted in black is the timing which air conitioner is turned on. Area highlighted in blue is the timing which air conitioner is turned off.

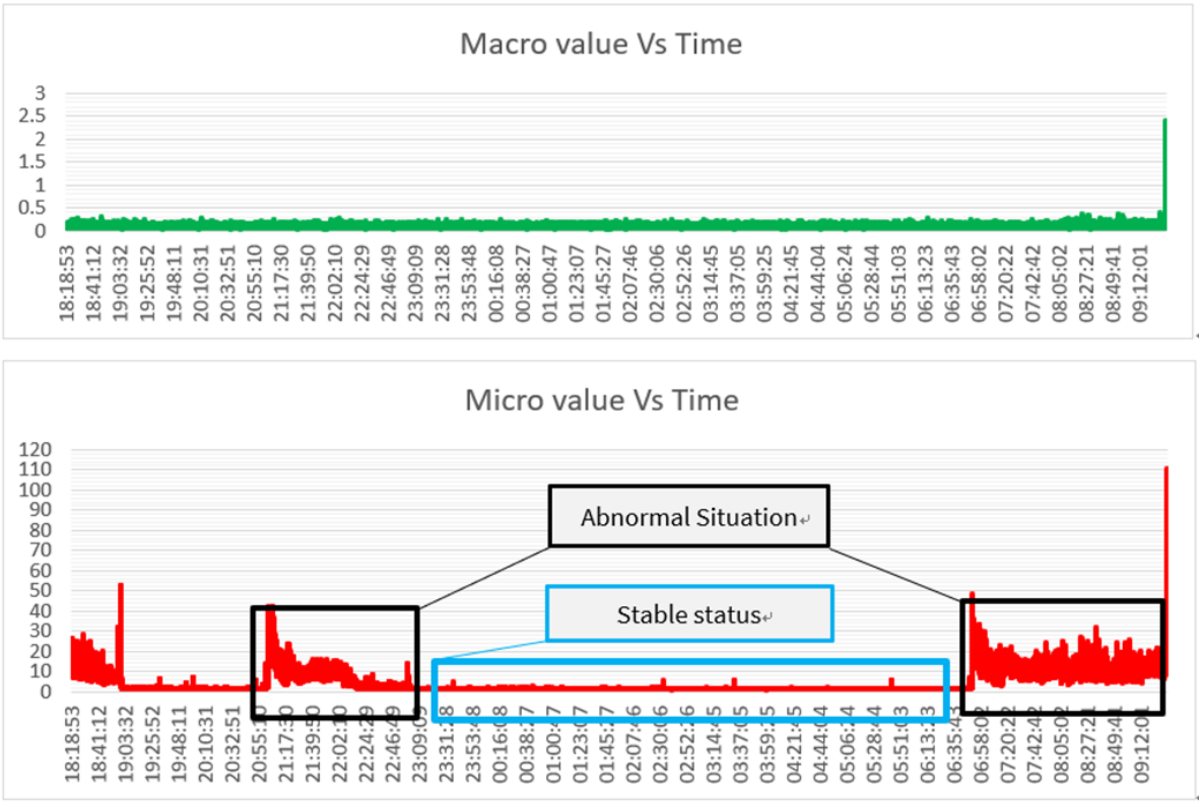


Figure 3-15. Mirco value and Marco value when small vibration exits

4. PITFALLS IN INSTALLATION ENVIRONMENT

As mentioned in Chapter 3, some objects like air conditioner will easily generate vibration and affect the radar detection performance. This chapter list out some vibration objects that need to take care of.

- Hanging Light / Tube
- Curtain
- Radar installed near the air conditioner
- IP Camera/ CCTV Camera

Figure 4-1. to Figure 4-3. are the examples of pitfalls. It is recommended to keep the radar away from these objects. Avoid putting them in the detection area of the radar.

Figure 4-1. Hanging light and Curtain

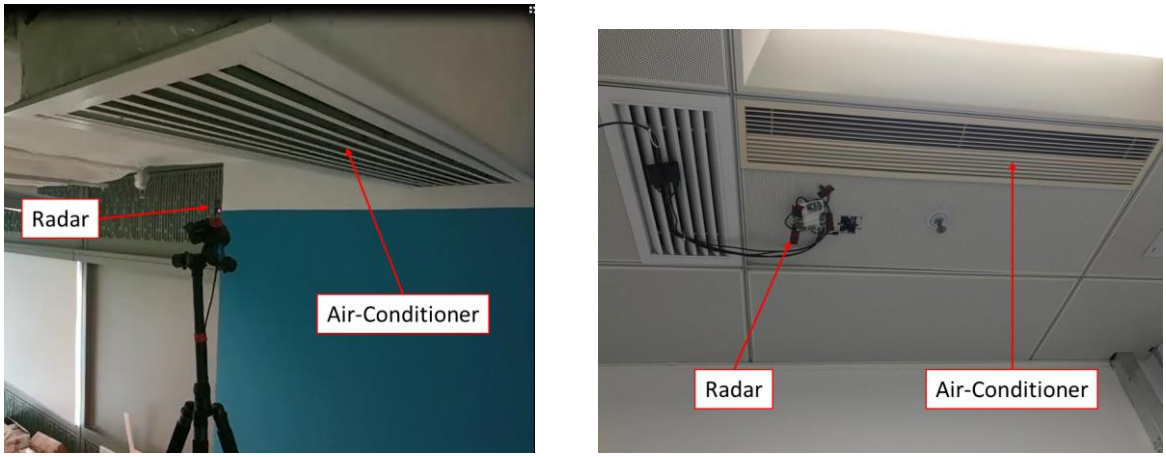


Figure 4-2. Air conditioner

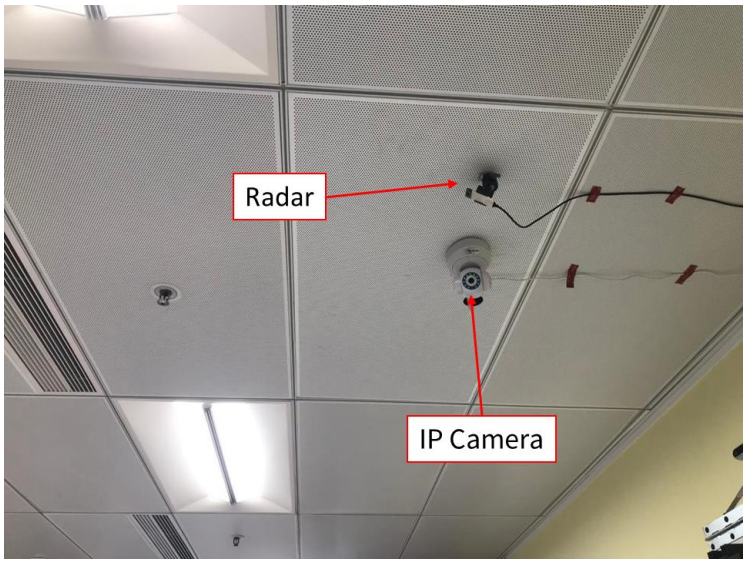


Figure 4-3. IP camera/CCTV

5. HISTORY CHANGE

Revision	Date	Description
Draft 0.1	2021-09-08	Draft version.