# Rain´s impact on presence detection with radar

Application note

# Versions

| Version | Date | Rationale |
|---|---|---|
| **1.0** | July 8, 2025 | First release. Author: KOA |

# Legal disclaimer

The evaluation board is for testing purposes only and, because it has limited functions and limited resilience, is not suitable for permanent use under real conditions. If the evaluation board is nevertheless used under real conditions, this is done at one's responsibility;
any liability of Rutronik is insofar excluded.

# Table of contents

## Project task

This document describes tests of radar sensors from Infineon, MineW, and Nisshinbo (24GHz and 60GHz). The objective is to determine how rainy weather conditions affect the presence detection function of the radars and to select the optimal sensor.

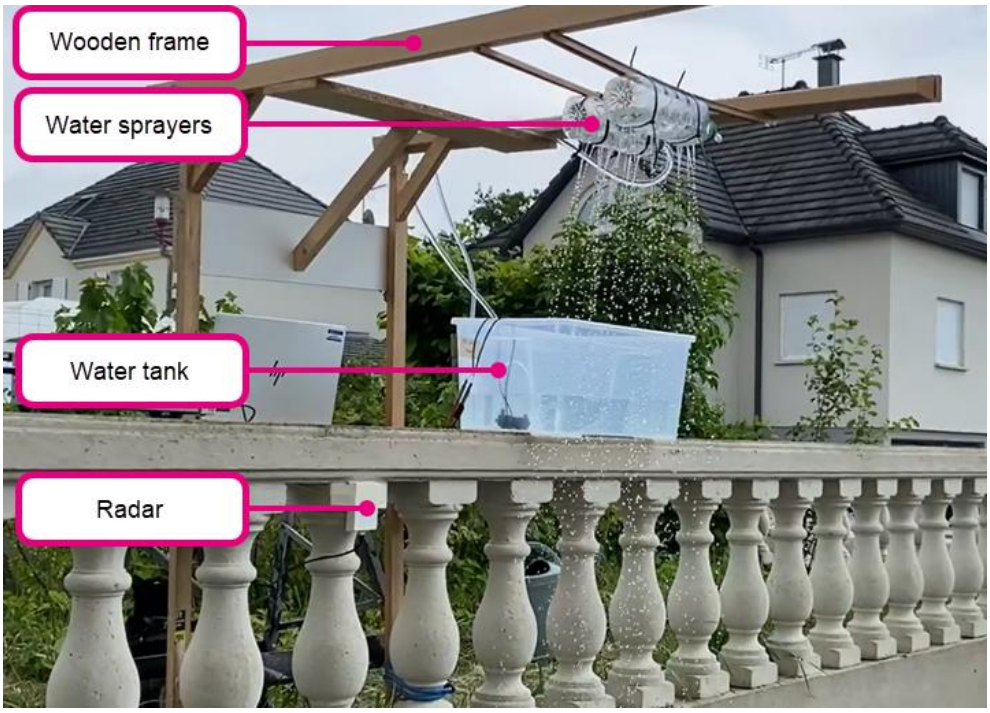
The customer's project involves outdoor mailboxes in the entrance area of a building. When a person is within 1 m of the mailboxes, they should unlock, the light in the entrance area should turn on.

The customer assumed that rain could affect the presence detection function. This refers to a situation where there is a “wall” of rain between the mailboxes and the person. Rutronik System Solutions specialists conducted comparative tests to verify this assumption.

## Test conditions

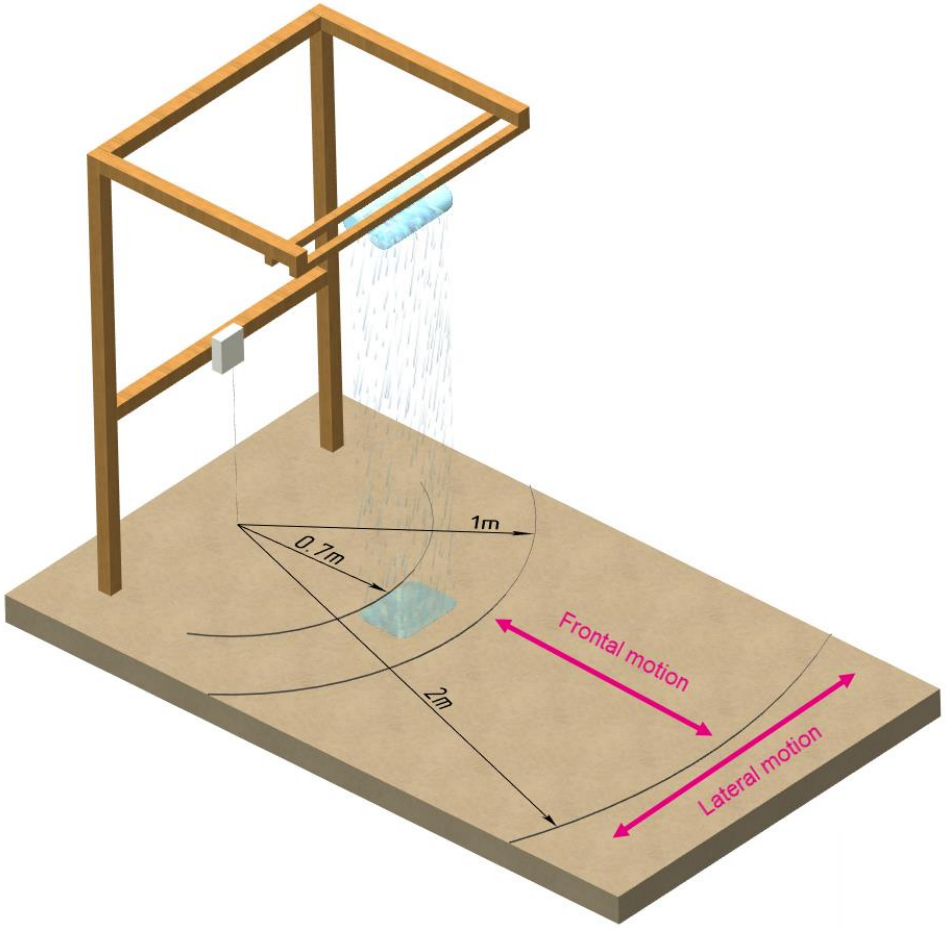
A test bench consisted of:

1. A box with a radar mounted on a vertical surface,
2. Two water sprayers,
3. A water tank, from which water was supplied by two pumps.
4. A wooden frame.




During the tests, the radars were in the box. The water sprayers installed on the frame simulated rain at a distance of 0.7 m from the radar. A stable water flow was created by two

electric pumps (280 L/hour each). A person approached the radar from a distance of 2 m to 1 m in the direction of the radar.




These test conditions correspond to a situation where mailboxes with radar sensor are located under a roof canopy protruding 0.7 m, and a person walks toward them “through the rain,” being outside the canopy at the moment of passing the 1 m mark.

For comparison, the radars were also tested in “no rain” conditions, including when a person moved from left to right at a distance of 2 m.

In total, each radar was tested under five types of conditions:

| Rain | No rain |
|---|---|
| No motion | No motion |
| Frontal motion | Frontal motion |
| | Lateral motion |

## Tested radar sensors

The following radars participated in the tests:

- Infineon BGT60TR13C (60GHz FMCW radar, a part of RAB3-Radar board by System Solutions).
- Infineon BGT60LTR11AIP (60GHz Doppler radar).
- Infineon BGT24LTR11N16 Sense2GoL Pulse (24GHz Doppler radar).
- MineW ME73MS01 (24GHz FMCW radar).

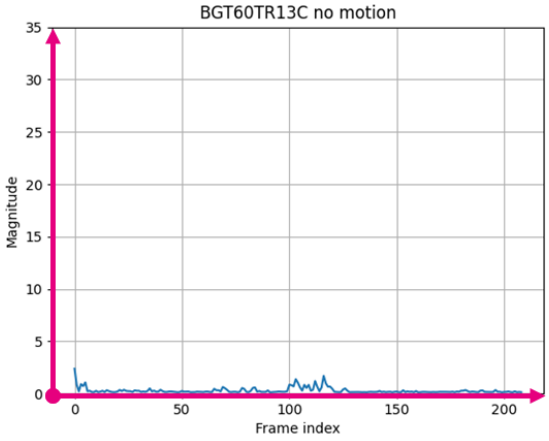
Most of the radars are used in test boards provided by suppliers, see details in the table below. The tests with other radars are coming soon.

Please note that the radars are based on different technologies: FMCW and Doppler. FMCW radar measures the distance to an object and its speed with a high precision, but it requires more calculations. The Doppler radar is only able to measure the object speed.

## Results

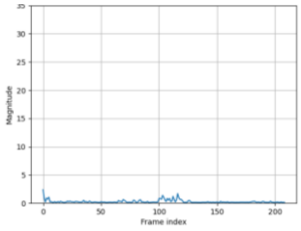
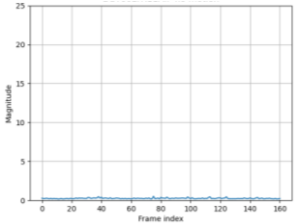
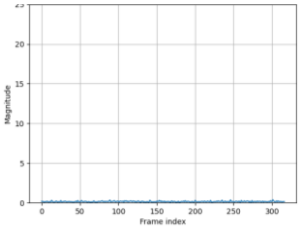
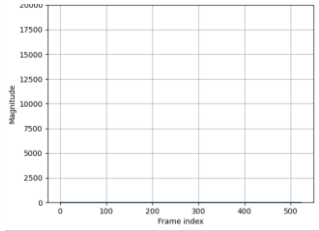
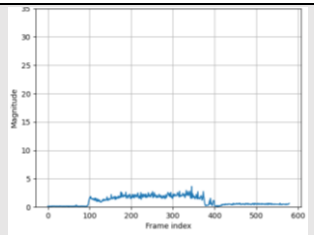
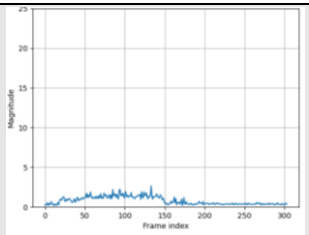
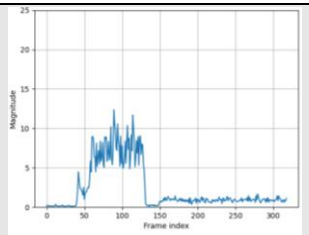
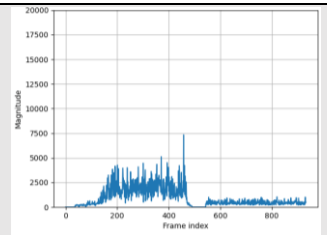
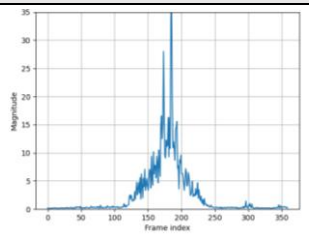
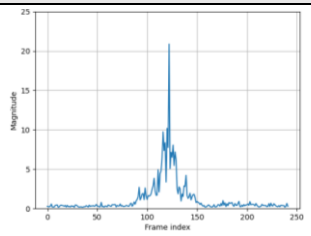
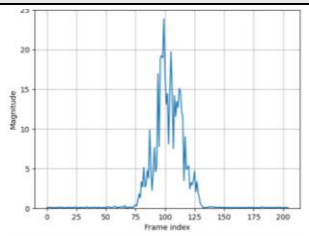
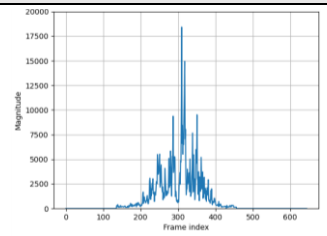
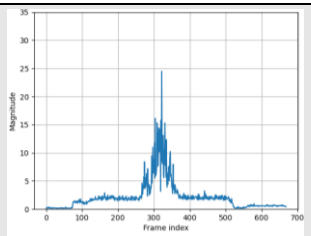
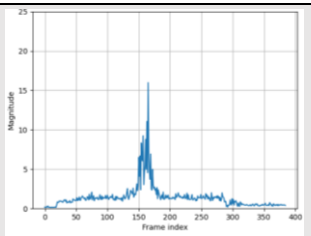
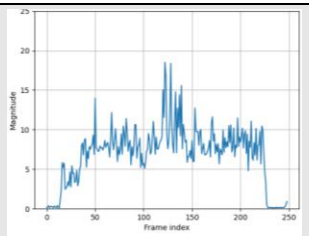
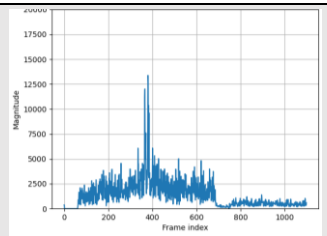
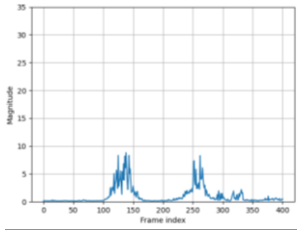
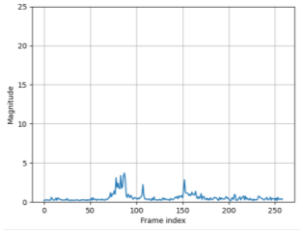
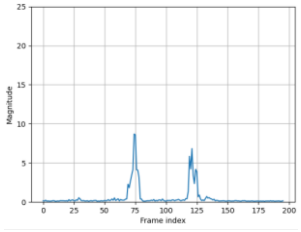
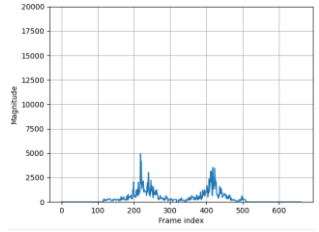
### Data

The table below provides information about radars, test boards they are included in, software for collecting raw data, parameters extracted from them, and test results. All graphs show how the signal magnitude changes over time (time is counted via frames).




The graphs reflecting the test results were obtained after preliminary processing of the raw data in a custom application developed by Rutronik. Processing allows you to extract parameters from the raw data (changes in signal amplitude over time) that can be used to evaluate the radar's performance (e.g., distance to an object). For the MineW ME73MS01 radar, a custom Rutronik application was also used to collect raw data.

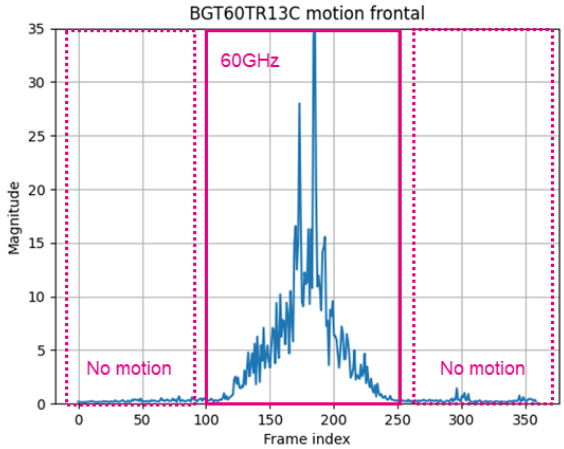
| Radar | Infineon BGT60TR13C | Infineon BGT60LTR11AIP | Infineon BGT24LTR11 | MineW ME73MS01 |
|---|---|---|---|---|
| **Features** | 60GHz FMCW | 60GHz Doppler | 24GHz Doppler | 24GHz FMCW |
| **Demo board** | DEMOBGT60TR13CTOBO1 | DEMOBGT60LTR11AIPTOBO1 | DEMOSENSE2GOLPULSETOBO1 | Custom |
| **Raw data** | Radar Fusion GUI v3.6.5 by Infineon | Radar Fusion GUI v3.6.5 by Infineon | Radar Fusion GUI v3.6.5 by Infineon | Custom software by Rutronik |
| **Pre-processing** | Custom software by Rutronik | Custom software by Rutronik | Custom software by Rutronik | Custom software by Rutronik |
| **Extracted data** | Range FFT<br>Doppler FFT<br>Biggest amplitude per frame | Range FFT<br>Biggest amplitude per frame | Range FFT<br>Biggest amplitude per frame | Magnitude<br>Distance to target |

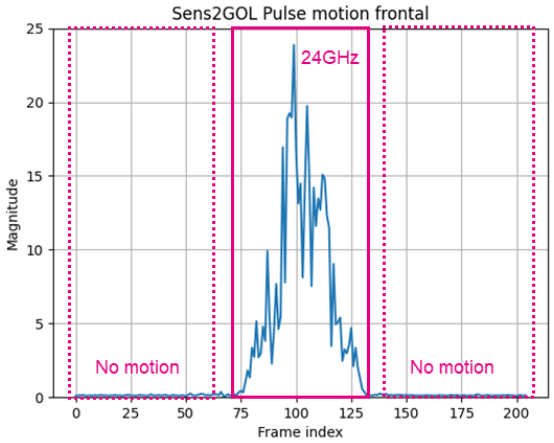
| Radar | | Infineon BGT60TR13C 60GHz FMCW | Infineon BGT60LTR11AIP 60GHz Doppler | Infineon BGT24LTR11 24GHz Doppler | MineW ME73MS01 24GHz FMCW |
|---|---|---|---|---|---|
| No motion | No rain |  |  |  |  |
| | Rain |  |  |  |  |
| Frontal motion | No rain |  |  |  |  |
| | Rain |  |  |  |  |
| Lateral motion | No rain |  |  |  |  |

## Analysis and conclusions

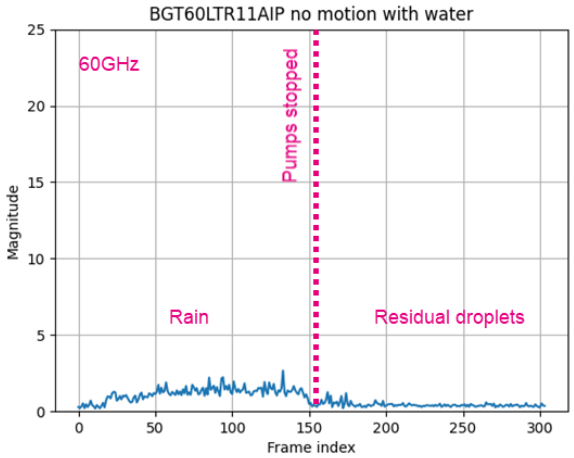
You can find all the graphs in full size on our GitHub. Let's look at them.

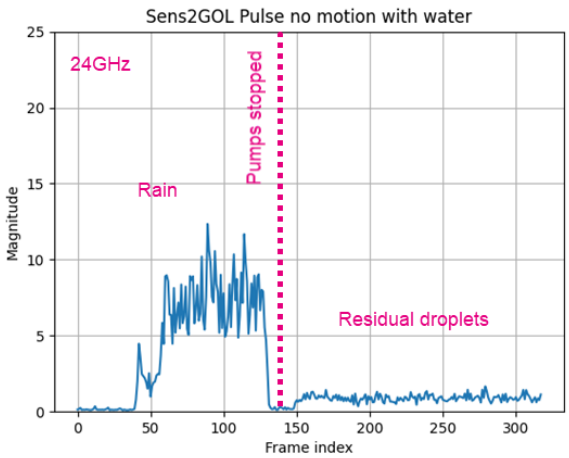
In the absence of “rain” and motion, almost all radars read only a small amount of noise. When a person approaches the radar, the period of no movement is followed by a period of approach and departure (marks 2m – 1m – 2m), after which there is another period of no movement. Movement is clearly detected by both 60GHz and 24GHz radars.



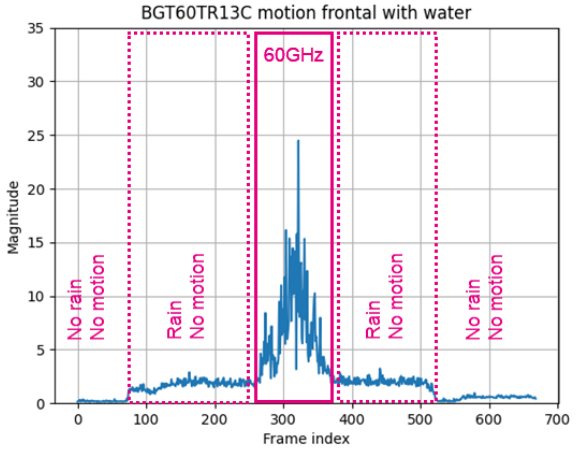



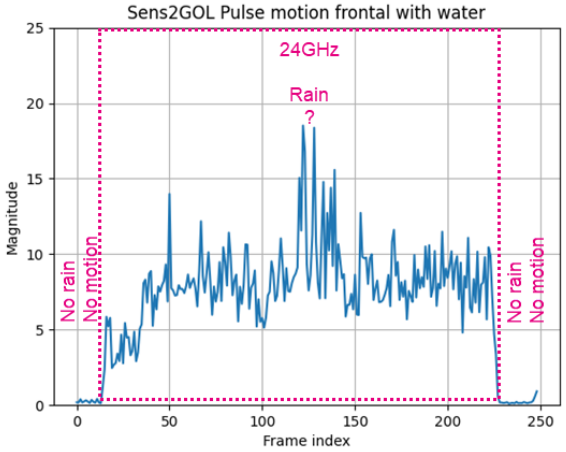

In the absence of movement, “rain” is interpreted as intense noise. We also observe a slight noise caused by water droplets falling from the sprayers after the pumps have stopped. At this stage, we see that 24GHz radars demonstrate higher sensitivity to rain.




A person approaching the radar in simulated rain conditions is detected with high accuracy by 60 GHz radars. The readings of some 24 GHz radars in this case were ambiguous.




## Useful links

| | |
|---|---|
| A Python project to evaluate the impact of the rain on radar measurements. | radar_rain_analysis |
| App notes on RAB3-Radar, including the one explaining the signal processing | App notes |