

# FMCW Radar Sensors

## Antennas

The choice of antenna will be highly dependent on the intended application and the transmission medium one is working in. Additionally the antenna choice will have a large impact on the range and field of view of the final sensing system.

In outdoor applications a horn or patch antenna is generally most appropriate. For enclosed or indoor applications such as storage tanks or silos, horn antennas are common; other options may include wave-stick and wave-guide antennas, which provide better performance with certain storage vessel configurations. Installing the antenna or sensor into an existing still-well that was previously used for another measurement system may also be an option but may require more careful antenna selection.

Attention should especially be paid to the dielectric constant of the medium the antenna is interfacing with. For many applications the transmission medium will be air. However, given the inherently-safe nature of the design, use in other mediums, such as liquified natural gas or other explosive environments is also quite suitable.

### Beamwidth

The beamwidth of the antenna will primarily determine the “field of view” of the sensor. A more narrow beamwidth will result in a more directional sensor. This can have advantages or disadvantage. If the beamwidth is too narrow, the intended target may be missed. If it is too wide, clutter may become a problem while trying to take measurements.

### Gain

Beamwidth and gain are closely related. A higher gain antenna will generally have a narrower beamwidth and vice-versa. Higher gain generally results in longer range, at the cost beamwidth. Higher gain horn antennas are also generally larger in physical size. If this is a concern a patch antenna may provide a more compact alternative, however at significantly higher cost.

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## Bandwidth

Given the wide bandwidth available in RS3400 series modules an appropriately high performance antenna with matching bandwidth should be selected to ensure high measurement resolution.

## Location / connections

Another factor to take into account is the intended mounting configuration. The antenna can be located remotely from the FMCW sensor module requiring a connecting coaxial cable. This allows for more flexibility in system packaging or permits accommodation of adverse environmental conditions. There will however be an increase in losses and reflections due to this longer connection. Direct connection from the sensor module to the antenna is also possible, greatly reducing these effects. In extreme locations, such as in a steel mill or chemical plant remote location of the antenna due to temperature or corrosive effects may be an absolute requirement. The possibility of using waveguides instead of cabling also exists in these situations, providing a physically robust connection.

Many of our customers have used standard gain horn antennas in the evaluation FMCW measurement systems. A 20 dB antenna provides a good starting point for evaluation purposes, with a good balance between coverage and range. Based on results using this antenna, a more appropriate antenna may then be identified.

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