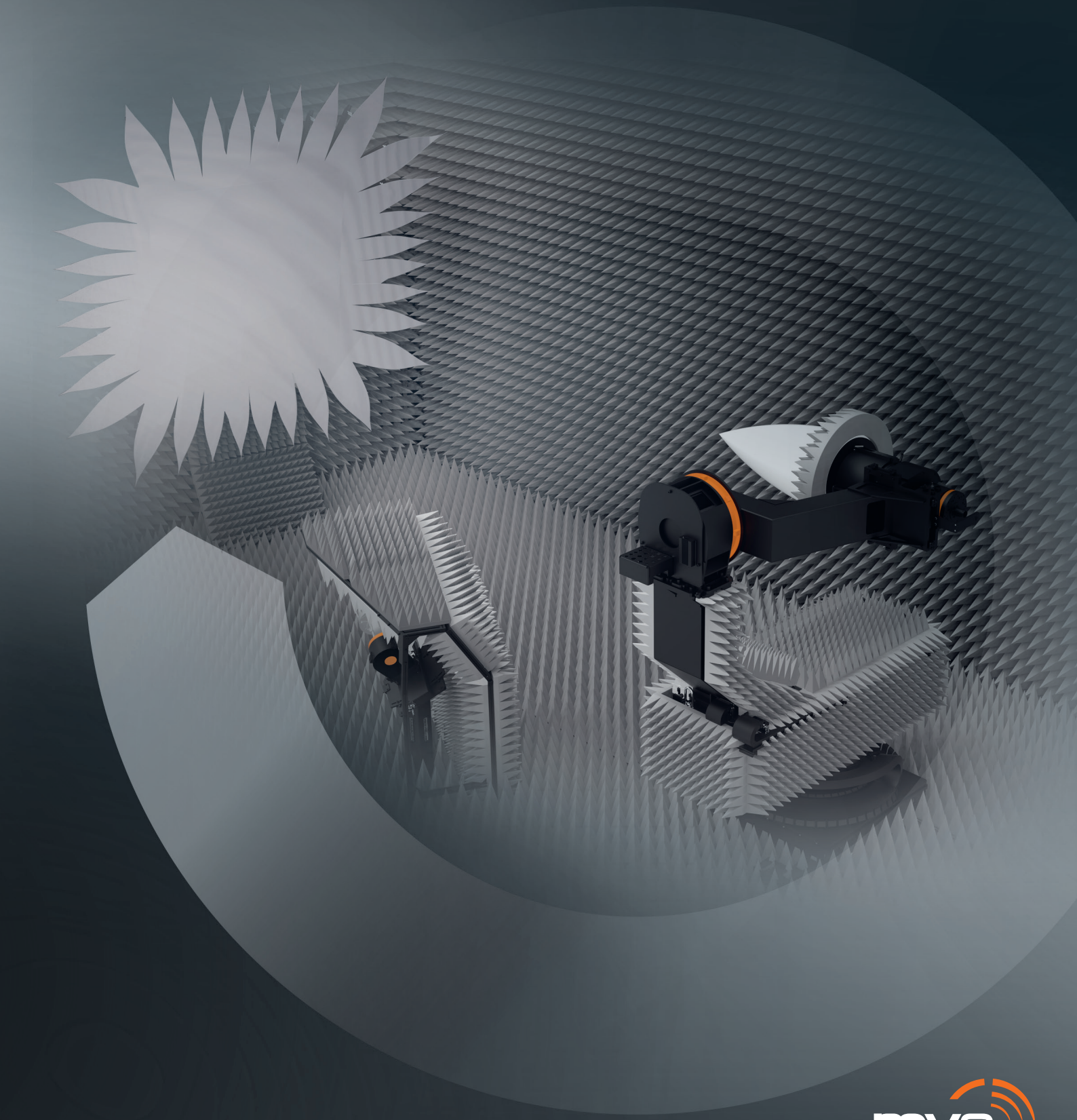
Radome Measurement Systems



Microwave Vision Group

Introduction

Overcoming measurement challenges with innovative solutions

Radome measurement systems require exceptional repeatability and accuracy to detect small shifts in an antenna radiation pattern caused by the introduction of a radome. The load of the radome must not cause mechanical deflection, and the entire radome must be considered the Device Under Test (DUT) within the quiet zone to accurately detect potential distortions.

MVG's Radome Measurement Systems address these critical challenges by offering fast, reliable, and highly accurate measurement facilities.

With over 35 years of engineering expertise, MVG designs and manufactures state-of-the-art systems that integrate precision mechanical positioning, advanced RF technologies, and industry-leading software, ensuring superior accuracy under demanding conditions and providing confidence in radome performance across various applications.

MVG is vertically integrated with full in-house control of all main sub-systems of a radome test facility, including shielded chambers, absorbers and precision antennas.

Radome Measurement Systems by MVG

Purpose

Radome measurement systems characterize radiation pattern deviations caused by the introduction of a radome over an antenna, typically a radar antenna.

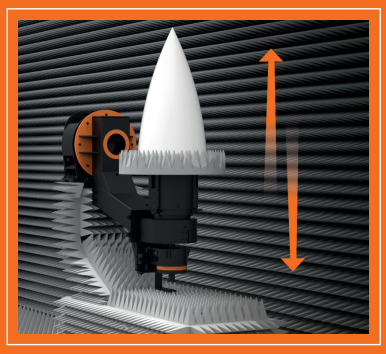
To ensure accurate performance assessment, both the radome and antenna aperture have to be illuminated by a uniform plane wave. This is best achieved in a compact antenna test range, designed to evaluate a wide range of beam angles while keeping the radome within the quiet zone.

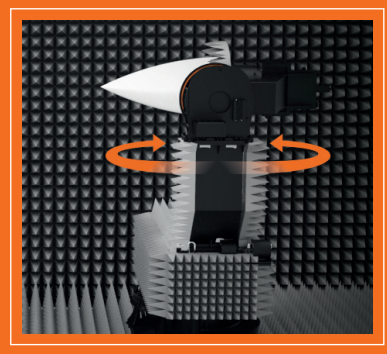
Evaluating conical sector influence in radome measurement:

Full conical evaluation

In complex cases, the complete conical sector influence should be evaluated. In this scenario, the Active Electronically Scanned Array (AESA), or a fixed beam antenna is installed on a gimbal and is moved through a conical angle sector within the space enclosed by the radome while continuously maintaining the Antenna Electrical Boresight (AEB).

By having excellent system repeatability, measurement with and without the radome can be made to directly see different influences to enable accurate characterization of both antenna and radome.





MVG addresses this challenge through innovation, with its Radome Measurement Systems designed for precision and adaptability.

+ Advantages

A turnkey solution including:

- Anechoic chamber
- Compact range
- Positioning system
- RF capabilities
- Software integration

Supports a variety of antenna types:

- Monopulse
- Multi-port magnitude
- Phase comparison antenna
- AESA

With over 35 years of experience in delivering radome measurement systems, MVG's advanced mechanical design provides:

High repeatability

Mechanical positioning system featuring MVG's cutting edge zero backlash drive system

High accuracy

Direct drive encoder readout ensuring high position accuracy and active positioning correction

6DoF alignment

Mechanical design high alignment flexibility ensures highly accurate point of intersection, for both elevation and azimuth measurement axes

Insertion depth solution

Allows to adjust radome vs antenna aperture position for the evaluation of different points of interest

Operator friendly

Ergonomic design allowing safe mounting of large and heavy radomes

Rugged and reliable design

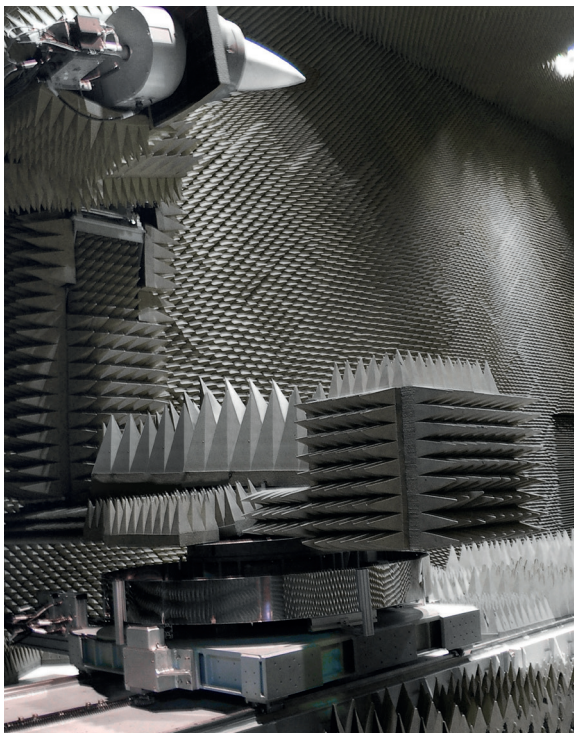
Built for long and trouble-free operation

Fast data processing

Real-time "on-the-fly" data processing and visualization

Flexible measurement

- Setup suitable for both large and small diameter radomes within the same mechanical configuration
- Wide frequency range of operation



Example of an MVG solution for radome measurements

Main Features

The MVG Radome Measurement System integrates cutting-edge compact range technology, precision alignment, and dynamic positioning to evaluate radome effects on signal transmission and reception.

- Ultra-fast test process – results in minutes
- High measurement accuracy
- High reliability
- Flexible and compact

SOLUTION FOR

- Electromagnetic quality evaluation
- Serial production and R&D applications

Radome measurement outputs

- Antenna Electrical Boresight (AEB)
- Boresight Shift Error and Slope (BSES)
- Transmission loss / efficiency
- Transmission phase
- Pattern degradation: sidelobes levels and beamwidth
- Image lobe level and location
- Cable loss and port balancing calibration

Frequency bands

- Up to 110 GHz

Measurement with gimbal

- Gimbal based conical coverage scan of ± 60 deg, both in azimuth and elevation

Position accuracy

- ± 0.1 mrad

Software

- Customized Tracking Error Processors (TEP)
- Real-time computation engine for tracking boresight errors
- Real-time collection of measured data and Relative Boresight Shift (RBS) presentation
- Built-in interface with active and digital antennas
- Automatic post-processing report generation
- 2D and 3D plot generation

Proposed configuration

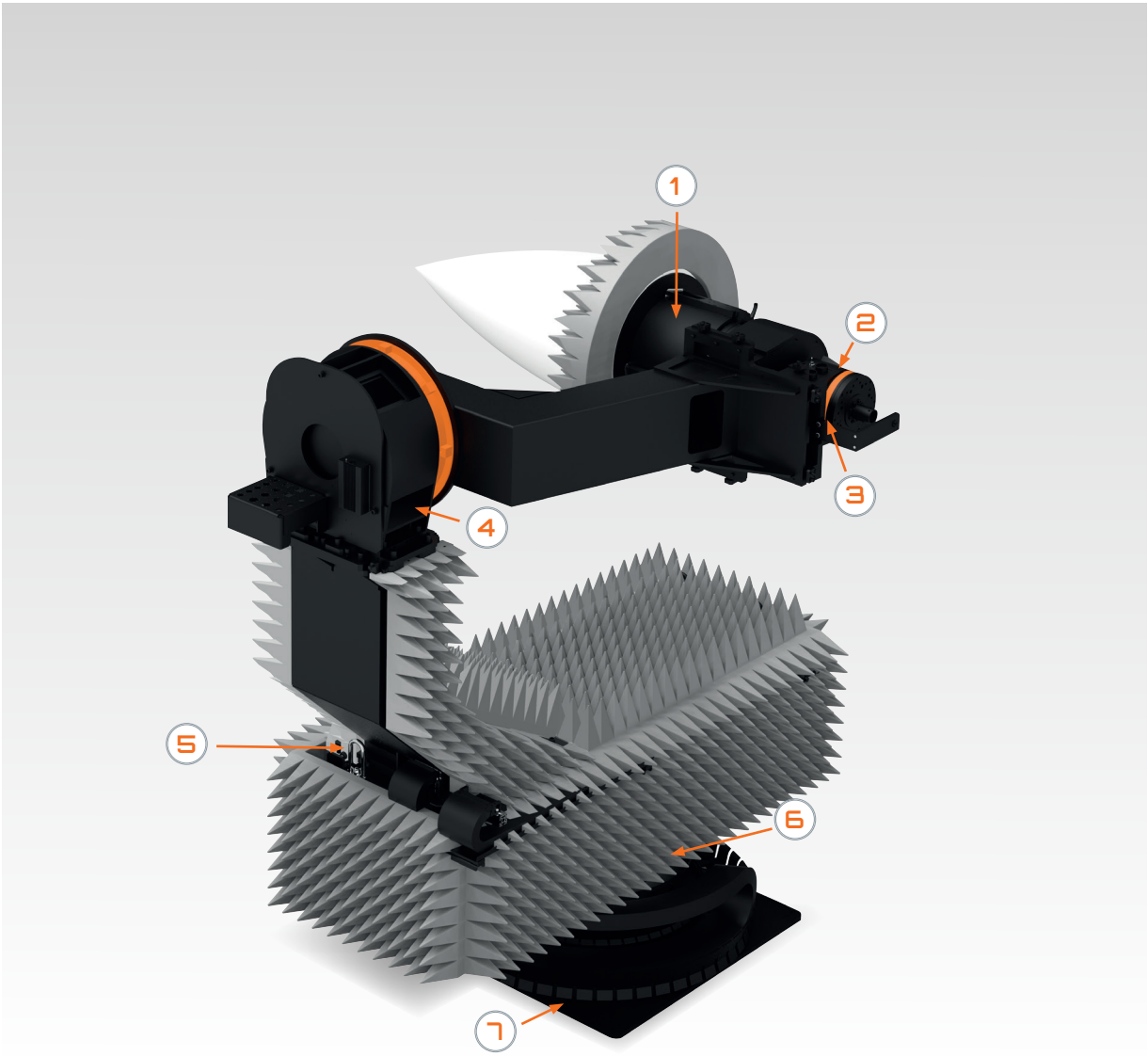
- Motorized downrange slide
- Radome azimuth / elevation positioner
- Upper slide
- Roll positioner
- Gimbal roll positioner
- Gimbal to radome insertion depth adjustment
- Gimbal azimuth / elevation positioner
- Scissor lift
- Overhead crane

Services

- Installation
- Performance validation
- Training
- Warranty
- Post warranty service plans

* MVG provides and supports other types of Radome measurement positioning configurations and Gimbals.

Product Overview



1. Radome / gimbal insertion depth linear slide adjustment
2. Radome roll positioner
3. Gimbal roll positioner
4. Radome Elevation (EL) positioner
5. Upper slide for gimbal / radome axes intersection alignment
6. Radome Azimuth (AZ) positioner
7. Floor slide

Radome Measurement Software

The MVG Radome Measurement System has a dedicated software setup to enhance data collection and analysis

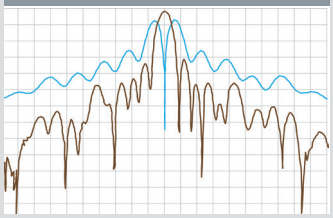
Main Features	Key Benefits
Modes of operation: Calibration, RF and position-slave tracking, null cross over and image lobe	✔ Flexibility in supporting diverse measurement needs and ensuring comprehensive data acquisition
Data acquisition capabilities: Supports multiple tracking error processors (sum/diff monopulse, multi-port phase comparison, twisted reflector antenna); null tracking methods	✔ High accuracy and versatility for tracking errors in different antenna configurations
Calibration support: Fully automated radome measurement calibration, and linked-axis support	✔ Reduces manual setup, enhancing ease-of-use and minimizing error during calibration
Measurement analysis: Boresight analysis and shift, transmission loss and repeatability analysis	✔ Precise analysis of key parameters, ensuring accurate measurement results
Handling & monitoring error slopes: Automatically extracted from the far-field pattern	✔ Prevents errors from impacting data quality, allowing corrective actions during measurement
Scanning: Limited raster scan capability	✔ Can define an ellipse of any other user defined raster scan shape

STANDARD

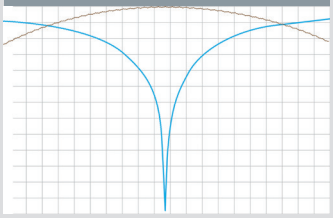
Monopulse antenna real-time plot representation:

a ± 50° measurement (0.1° steps)
b ± 3° overlay of 2 measurements repeatability (0.02° steps)

FF Pattern - AZ Cut



FF Pattern - EL Cut

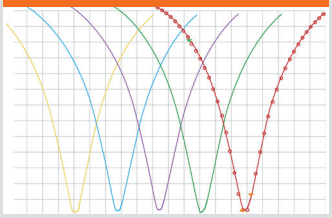


AESA

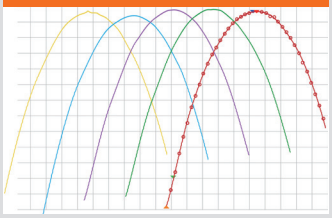
AESA real time plot representation:

a ± 60°measurement (0.1° sample in continuous movement)
b Simultaneous presentation of SUM and DELTA patterns

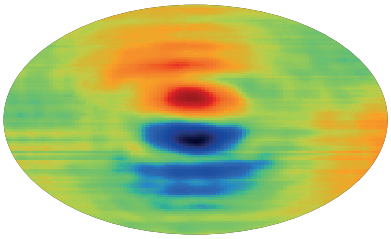
DELTA Patterns (multiple beams)



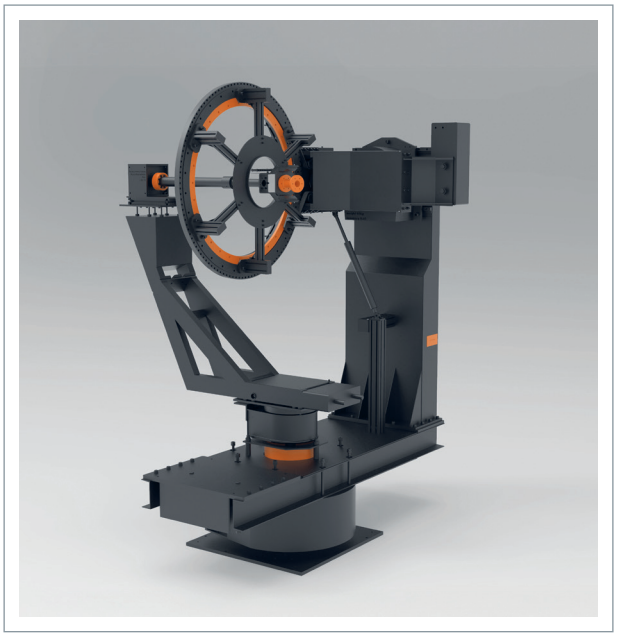
SUM Patterns (multiple beams)

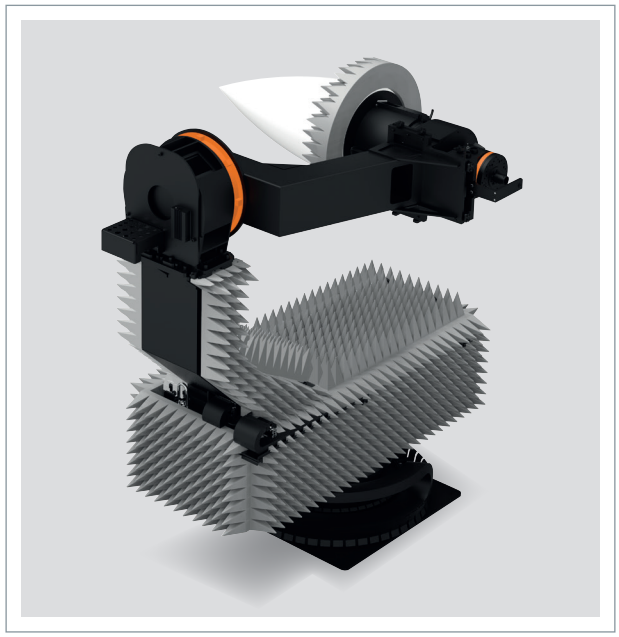


EXAMPLE OF RADOME RBS MEASUREMENT



A selection of MVG positioning solutions for radome measurements





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