

Compact Multi-Beam Antenna for Satellites & Aircraft

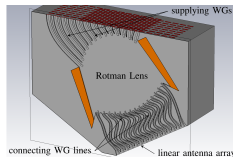
This modular antenna architecture addresses a critical unmet need by enabling simultaneous multi-directional beamforming of up to eight simultaneous beams while reducing complexity and thermal stress. Current multi-beam antenna systems for aircraft and satellites are bulky, heavy, and directionally limited. Satellite and airborne platforms require compact, robust solutions that maintain signal coverage over wide angular ranges during motion. This invention addresses all these needs.



Wide beam range in robust and lightweight architecture

The system stacks multiple plate-shaped modules, each containing hollow waveguides and a Rotman lens beam-forming network, such that different module types face different directions. This configuration creates antenna arrays on opposing or adjacent surfaces. This setup enables the device to transmit and receive across a wide angle range simultaneously.

- 01 Compact and lightweight: Stacked modules reduce footprint and mass by 40–60 percent
- 02 Wide angular coverage: Simultaneous transmission and reception over multiple directions
- 03 Scalable multi-beam sectioning: Dynamic control of multiple independent beams or combined beams via variable phase-shift
- 04 Superior thermal design: Full-metal block with no moving parts



Interior design of an antenna module showing the waveguides and Rotman lens by means of which beam steering takes place in the plane of the module.



Antenna prototype stacked from 33 modules, compactly forming two 2D antenna arrays. Beams are steered perpendicularly to the modules by feeding them different signals.

IP RIGHTS

EP, CN, US
Application filed

2022

CHALLENGE

Satellites and aircraft in motion require continuous coverage as their orientation changes relative to ground. Conventional phased array antennas are inherently directional, requiring multiple systems to cover different angles. This increases weight and volume. Current solutions are bulky and limited to opposing transmitters and receivers directly facing the array. Existing multi-beam systems compromise on compactness, thermal performance and/or angular coverage.

INNOVATION

This invention introduces a modular stacking architecture where multiple antenna module types are arranged with transmission surfaces facing different directions of the base. By integrating Rotman lens beamforming networks and hollow waveguide-arrays within each module, the system achieves wide-angle beam coverage in a compact design. The modular approach allows scaling from two to multiple module types, covering additional directions. Active phase control between modules enables sectioning into multiple independent beams—all with no moving parts and a high mechanical and thermal robustness.

01 Basic principles observed · 02 Technology concept formulated · 03 Experimental proof of concept · 04 Technology validated in lab · 05 Technology validated in relevant environment · 06 Technology demonstrated in relevant environment · 07 System prototype demonstrated in operational environment · 08 System complete and qualified

TRL 08
TRL 07
TRL 06
TRL 05
TRL 04
TRL 03
TRL 02
TRL 01

Technology Readiness Level (TRL)



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