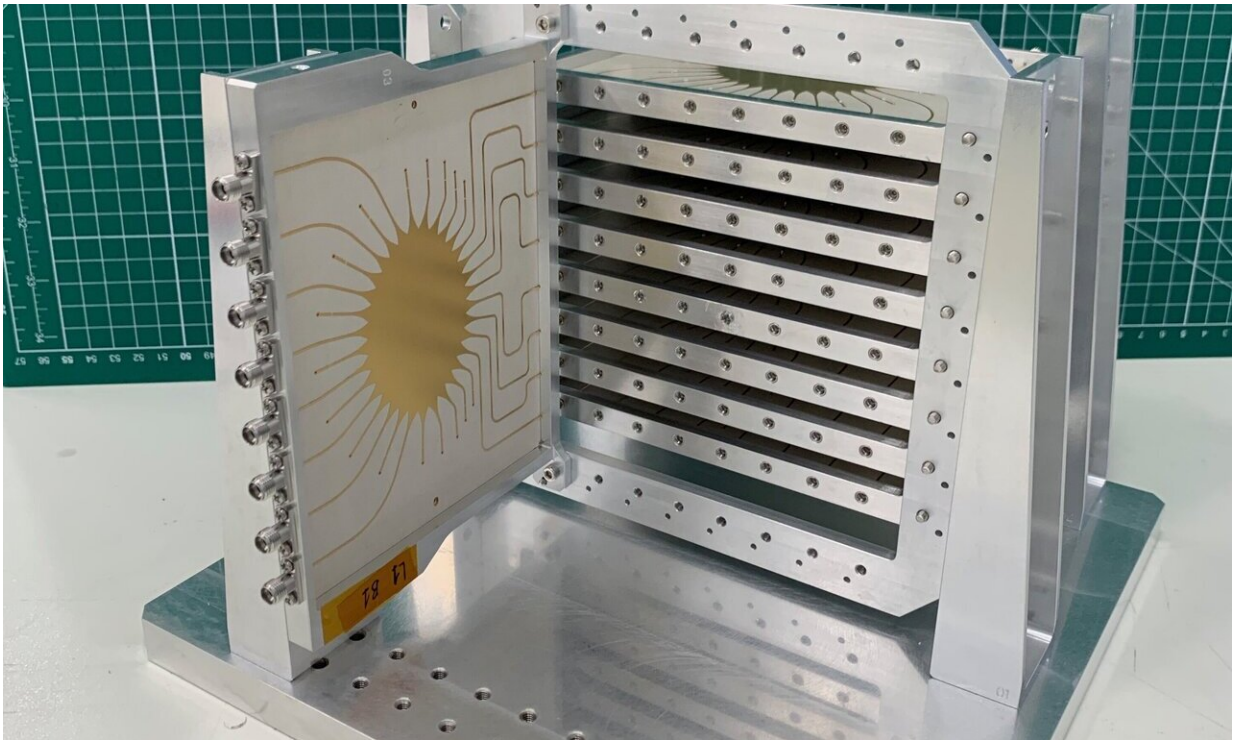


Microwave lenses harnessed for multi-beam forming

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Credit: ESA-P. Jankovic

This highly compact beam forming network has been designed for multi-beam satellite payload antennas. Generating a total of 64 signal beams outputted from a single antenna, this novel design could cover the entire Earth with multiple spot beams from geostationary orbit.

"The traditional solution for a multibeam telecommunications satellite payload would be a single feed per signal [beam](#), but only a limited number of feeds are able to be accommodated in front of the satellite antenna, with each feed requiring a dedicated amplifier," explains Petar Jankovic of ESA's Radio Frequency Equipment and Technology section.

"This is a highly integrated, lower mass alternative, developed with Airbus in Italy."

What looks like a sunburst design is actually a Rotman [lens](#), laid down on a printed circuit board, used to direct and focus microwaves. These are commonly employed in terrestrial radar systems, for instance aboard high-end drones or in-car radar, and are also being looked at for future 5G base stations.

A single flat Rotman lens allows beam scanning along a single axis. For this design, eight of these Rotman lenses are stacked horizontally, and eight more are arranged vertically. The result is a two-dimensional array of 64 pencil-shaped signal beams—and this architecture can be leveraged up as desired.

"Testing of our prototype demonstrator shows [high performance](#), demonstrating low insertion loss and with the measured worst-case return loss for the beam ports and array ports always better than 15 decibels throughout the full Ka- operative band," adds Petar. "For all our measured beams very regular pointing has been achieved."

Almost perfect alignment between simulation and measurement results have been achieved, guided by ESA in-house software that converts mathematical models of the lenses into geometric structures, combined with [commercial software](#) used to simulate the prototype in advance of its manufacture and testing.

Developed through ESA's long-running Advanced Research in Telecommunications Systems (ARTES) program, this beam forming network demonstrator was designed and built using space-qualified solutions, materials and processes. The next step would be to manufacture a qualification model to qualify the design at equipment level for flight.

Provided by European Space Agency

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