Empowering global connectivity:
Designing satellite communications antennas with affordable technologies

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Communication is the linchpin of today's fast-paced global society, facilitating seamless interaction and the flow of information at unprecedented speeds. At CT, we recognize the crucial role of satellite communications in shaping our world. From global connectivity to emergency response and beyond, these technologies permeate every aspect of our daily lives. By leveraging cost-effective technologies, we aim to democratize access to reliable communication tools, ensuring that everyone can benefit from the boundless possibilities of satellite-based connectivity.

Revolutionizing connectivity with our cost-effective antenna for enhanced satellite communications.

As technology evolves, the optimization of existing technologies becomes paramount to enhance their performance, reduce costs, and broaden accessibility. Our innovative approach to satellite communications focuses on the design of a cost-effective H-plane horn antenna with a dielectric lens using Substrate Integrated Waveguide (SIW) technology. By harnessing affordable technologies, we strive to ensure that everyone can benefit from the limitless possibilities of satellite-based communication.

This antenna has been designed for SATCOM applications, operating in Ka-band, within the 26.5 GHz to 40 GHz frequency range. It enables high-speed data, voice, and video transmission, catering to a wide range of applications, from broadband communications and video streaming to mobile communications in remote areas and government/military services. Furthermore, the antenna's compatibility with satellite navigation systems, earth observation, and meteorology applications underscores its significance in scientific research and environmental monitoring.

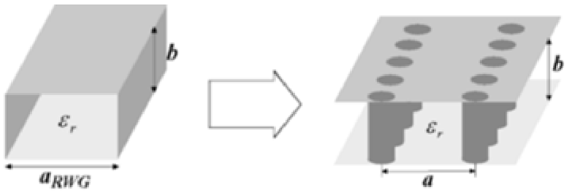
Tools used

- CST Studio Suite
- MATLAB
- Simulink

Design and simulation

The antenna design process involves integrating conventional and SIW rectangular waveguides, sectoral horn antennas, and dielectric lenses on a single substrate using SIW technology. The following paragraphs provide details regarding the phases of the design process.

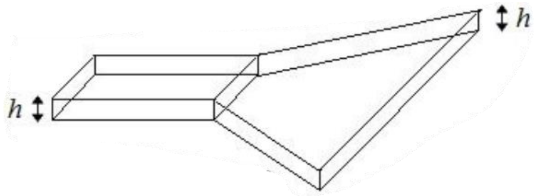
Substrate Integrated Waveguide (SIW) technology to design rectangular waveguides was employed using printed technology, a cost-effective alternative. It employs a structure consisting of two parallel transverse metallic plates and two parallel arrays of metallic vias on a dielectric substrate. These vias simulate the walls of a conventional rectangular waveguide.



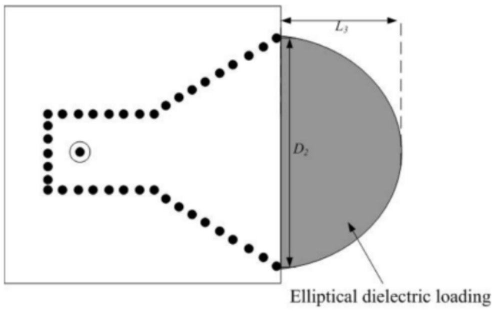
The significant advantage of SIW over traditional designs is its considerably lower manufacturing costs. Furthermore, this technology has emerged as an alternative to planar technology for achieving low losses in very high frequency bands (SATCOM).

H-Plane horn antenna. Its main characteristic is their constant height while modifying the width in the H-plane, resulting in cylindrical wavefronts.

Key components in microwave systems, known for their ability to efficiently transmit signals with high gain and low losses. They work by flaring the signal at the end of a waveguide, ensuring effective communication with receiving antennas.

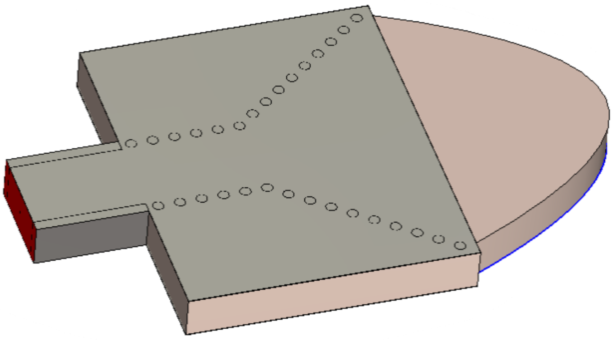


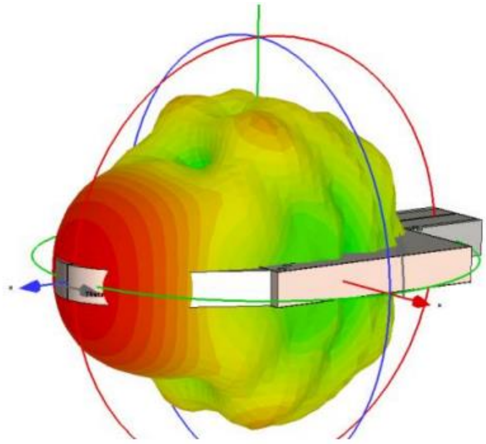
Dielectric lens. Horn antennas face challenges in evenly distributing signals across their aperture, which affects negatively their performance. To tackle this issue, a solution involves adding a dielectric lens at the antenna's opening. This lens, placed in front of the aperture, modifies the way electromagnetic waves pass through, thereby improving the antenna's radiation pattern. The benefits include increased signal strength, controlled beam direction, reduced unwanted radiation, and the ability to operate in specific frequency bands.



Coaxial feeding. It employs a connector with two conductors separated by Teflon insulation, allowing smooth signal transmission to the antenna.

Design, optimization, and simulation of the unitary element. Results show good reflection coefficients and radiation patterns. The dimensions of the SIW H-plane horn has been optimized, considering factors like directivity and aperture efficiency. The addition of a dielectric lens improves phase uniformity and radiation efficiency. Overall, the design process aims to optimize antenna performance through careful integration and optimization of the components.





The development of a new antenna enhances global satellite communications with promising features and opens avenues for further advancements in technology.

In the intricate landscape of satellite communications, the development of this antenna offers a cost-effective and innovative solution for enhancing global connectivity. The results of this prototype have been impressive, providing high directivity and improved field uniformity, making it suitable for various applications.

Future efforts could focus on refining the feeding mechanism, potentially transitioning to waveguide technology for better performance at higher frequencies. Additionally, manufacturing a functional prototype and exploring the feasibility of multi-horn arrays opens exciting avenues for further research and development in SATCOM systems.

References

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