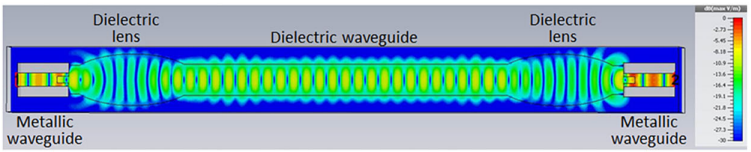
National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Optics

Lens-Coupled Dielectric Waveguides

Small, lightweight, low-power interconnect solution with improved reliability and reduced packaging complexity

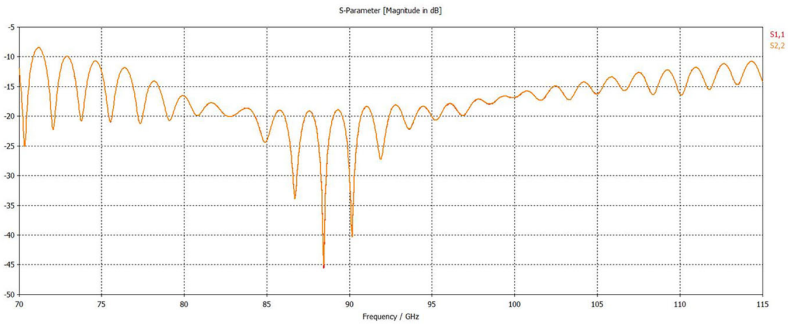
NASA's Jet Propulsion Laboratory has developed a low-loss dielectric waveguide that provides a simple, versatile, and flexible transmission medium. Dielectric waveguides—long, solid pieces of dielectric that confine electromagnetic waves—offer high bandwidth and low transmission loss compared to conventional metallic waveguides. Despite these advantages, practical use of these waveguides has been limited because a large fraction of signal power is lost at the state-of-the-art interconnects joining conventional metallic waveguides and dielectric waveguides. JPL's interconnect solution uses lens coupling to reduce these losses by a factor of 10 or more, yielding a reliable, cost-effective alternative to conventional waveguides.

BENEFITS

- Dielectric waveguides are a simple, versatile, and flexible transmission medium
- Dielectric waveguides provide high bandwidth and low transmission losses
- Lens coupling reduces overall loss due to coupling into a dielectric waveguide by a factor of 10 or more
- Lens-coupled dielectric waveguides do not depend on physical contact, which allows for added vibration/stress immunity

THE TECHNOLOGY

Conventional interconnects consist of tapering the extremities of the dielectric waveguide that are inserted directly in the metallic waveguides, using long waveguide transition to reduce coupling loss (radiation at the dielectric-metallic interface). With JPL's novel interconnect solution, a lens couples the power from the metallic waveguide to the dielectric waveguide. (This lens can be fabricated inexpensively from the same dielectric material as the dielectric waveguide.) The ellipsoid geometry of the lens is designed to maximize the coupled power into the dielectric waveguide, resulting in only a small fraction of the coupled power radiating at the interface (14 to 20 dB). A small stepped impedance at the input of the lens and inserted in the waveguide provides a better matching impedance network at the discontinuity. Unlike conventional interconnects, the lens-coupled dielectric waveguide does not depend on physics contact; this improves reliability, reduces packaging complexity, and allows for added vibration/stress immunity.



Simulated transmission coefficients of the dielectric waveguide shown in Figure 1.

APPLICATIONS

The technology has several potential applications:

- Data transmission media - applications where low transmission/coupling losses are critical
- Data links with added vibration/stress immunity - communication links between modules on spacecraft, landers, and rovers

PUBLICATIONS

Patent No: 9,478,842

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

NPO-49481-1, NPO-TOPS-46

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Jet Propulsion Laboratory

4800 Oak Grove Drive, M/S 180-800C
Pasadena, CA 91109
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2015-04-1579-HQ