RF/Microwave Products for Space Applications

When launching expensive mission-critical equipment into space there is no room for failure.

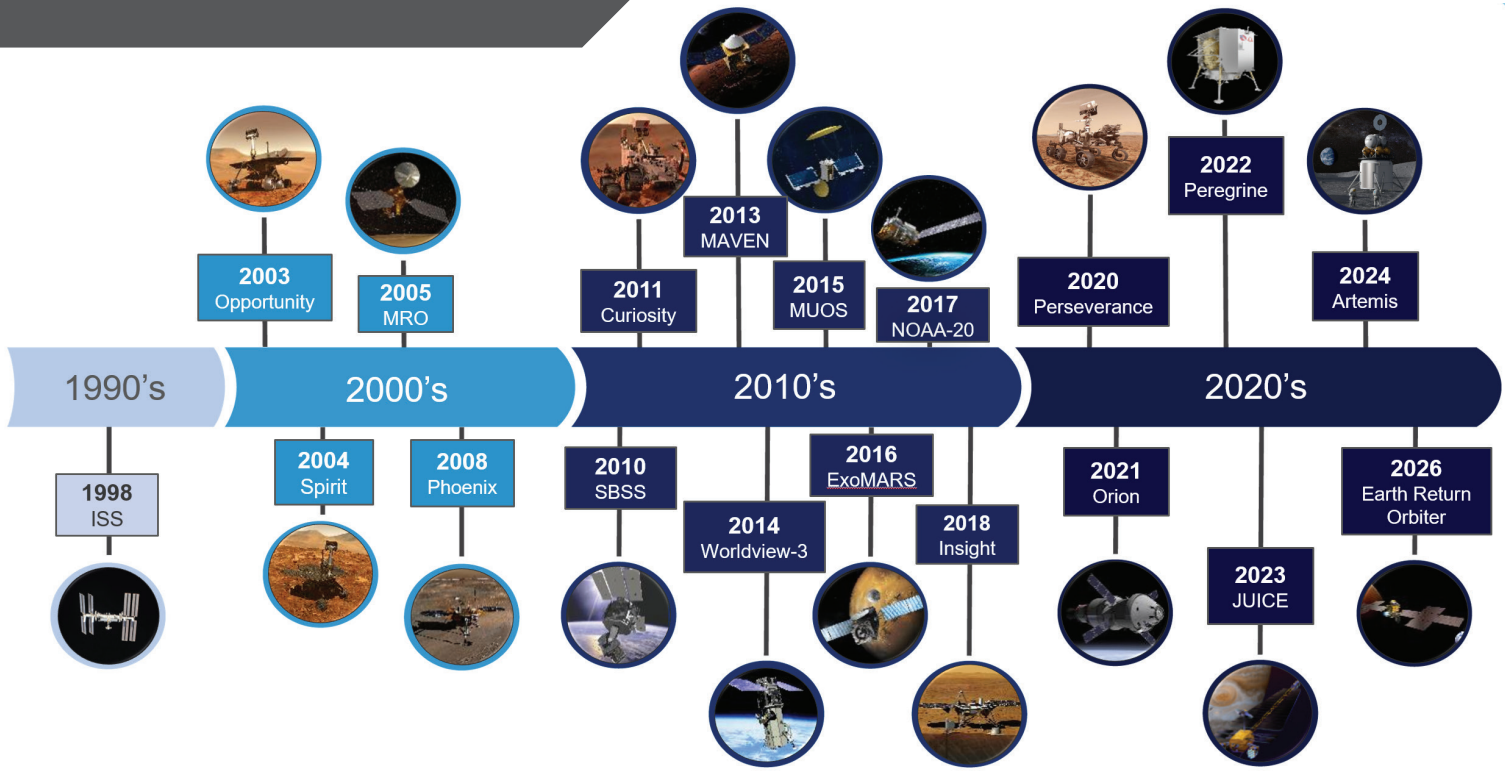
knowles PRECISION DEVICES

We Know Space Applications

At Knowles Precision Devices, sending our components into space is something we've been doing for over 40 years.

Knowles is already recognized as a supplier for many space applications, and our long space heritage includes developing innovative, mission-critical space-qualified components for use on the International Space Station (ISS), MARS rovers, MARs orbiters, launch vehicles and many more.

Space Systems Heritage at Knowles

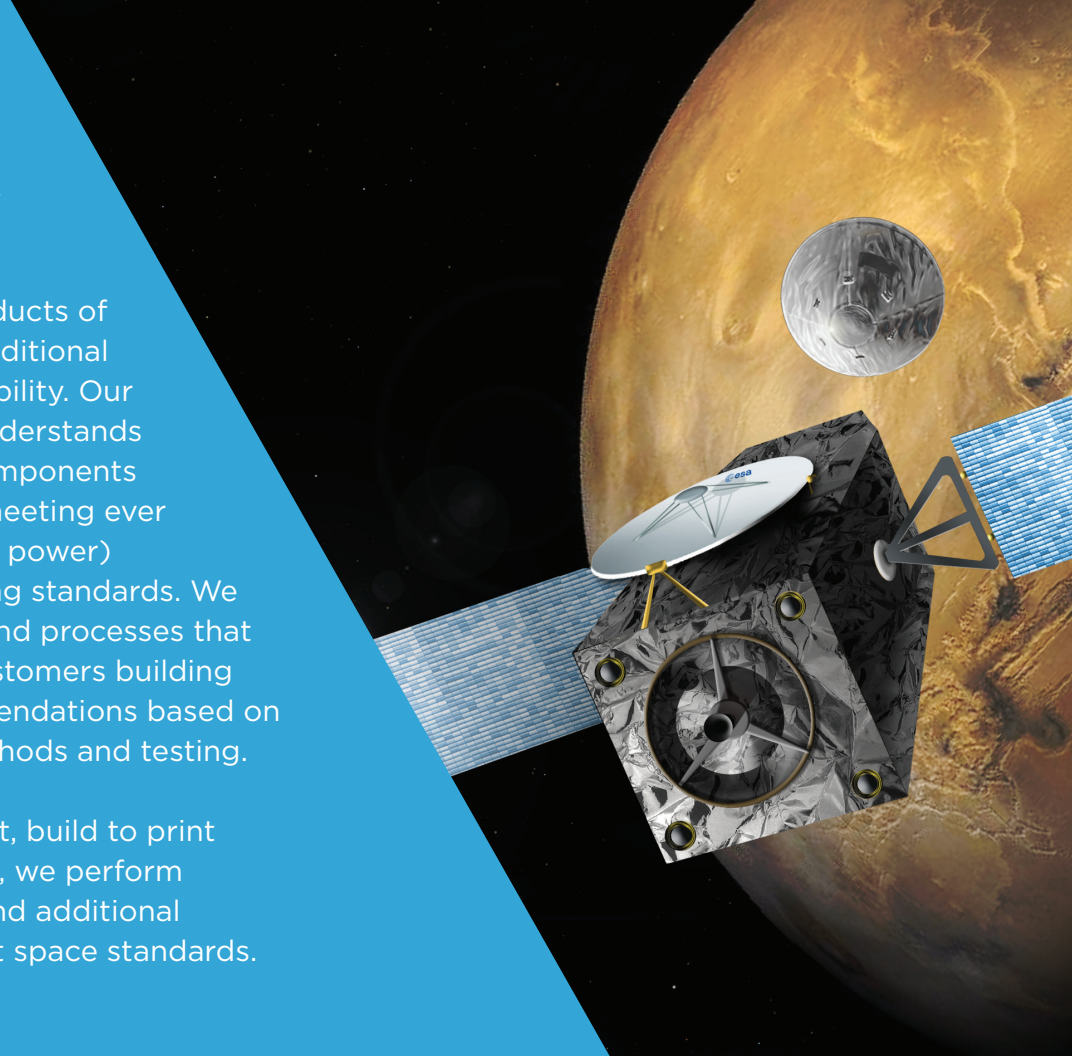


Knowles Precision Devices provides components for aerospace, low Earth orbit (LEO), geostationary (GEO), and deep space platforms and missions.

High Quality, High Reliability

Space applications demand products of high quality, with appropriate additional testing to ensure long term reliability. Our world class engineering team understands the challenges of developing components optimized for space, including meeting ever evolving SWaP (size, weight and power) requirements and rigorous testing standards. We have space-qualified materials and processes that allow us to work closely with customers building new designs to provide recommendations based on tried-and-true components, methods and testing.

Whether you need a catalog part, build to print services, or custom components, we perform special life testing, sectioning, and additional electrical measurements to meet space standards.



Testing Capabilities

Electric Testing

Capacitance	MIL-STD-202, Method 305
Insulation Resistance	MIL-STD-202, Method 302
Dielectric Withstanding Voltage	MIL-STD-202, Method 301
Quality Factor	MIL-STD-202, Method 306
DC Resistance	MIL-STD-202, Method 303A
RF performance over Temperature	-55 to +125°C

Mechanical Testing

Constant Acceleration	MIL-STD-883, Method 2001
Mechanical Shock	MIL-STD-883, Method 2002
Solderability	MIL-STD-883, Method 2003
Visual	MIL-STD-883, Method 2008
External Visual	MIL-STD-883, Method 2009
Bond Strength	MIL-STD-883, Method 2011
Die Shear	MIL-STD-883, Method 2019
Ball Shear	ASTM 1269
Tape Test	ASTM 3339

Physical Testing

Vibration	MIL-STD-202, Method 201
Resistance to Soldering Heat	MIL-STD-202, Method 210
Acceleration	MIL-STD-202, Method 212
DPA	EIA-469

Environmental Testing

Humidity	MIL-STD-202, Method 103
Immersion	MIL-STD-202, Method 104
Moisture Resistance	MIL-STD-202, Method 106
Thermal Shock	MIL-STD-202, Method 107
Temperature Cycling	MIL-STD-883, Method 1010
Burn-In	MIL-STD-883, Method 1010

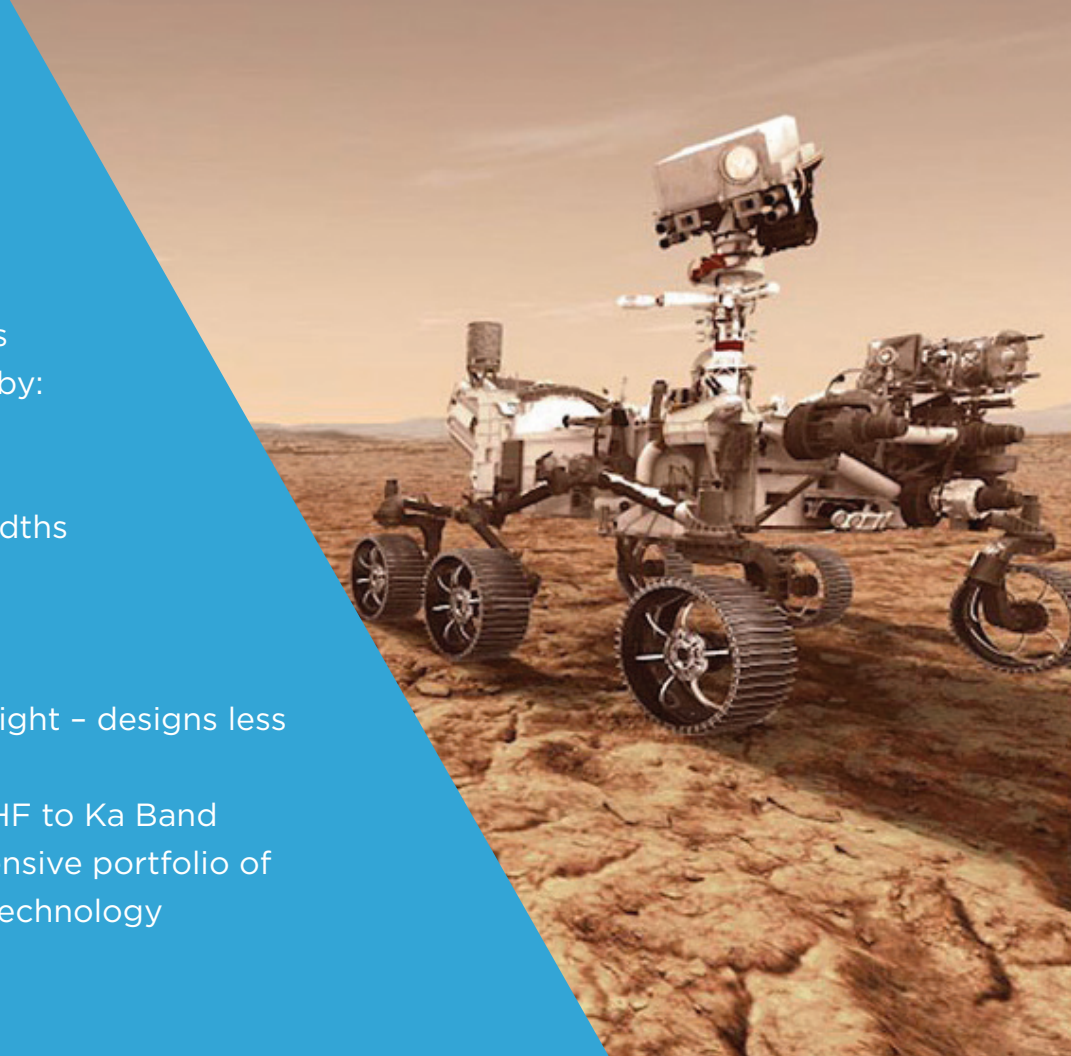
- C, DF, IR, DWV
- TCC, TVC
- ESR
- Power
- Hot IR
- Cross Section
- Visual Appearance
- Scanning Acoustic Imaging
- Plating Thickness
- Terminal Strength
- Resistance to Soldering Heat
- Life
- Shock & Vibration
- Pulse
- Group B & C

Through a combination of our space heritage, proven thin film manufacturing process, and ability to seamlessly integrate multiple passive component into a single circuit, we constantly have new and innovate ways to improve SWaP while meeting the harsh requirements of operating in space.

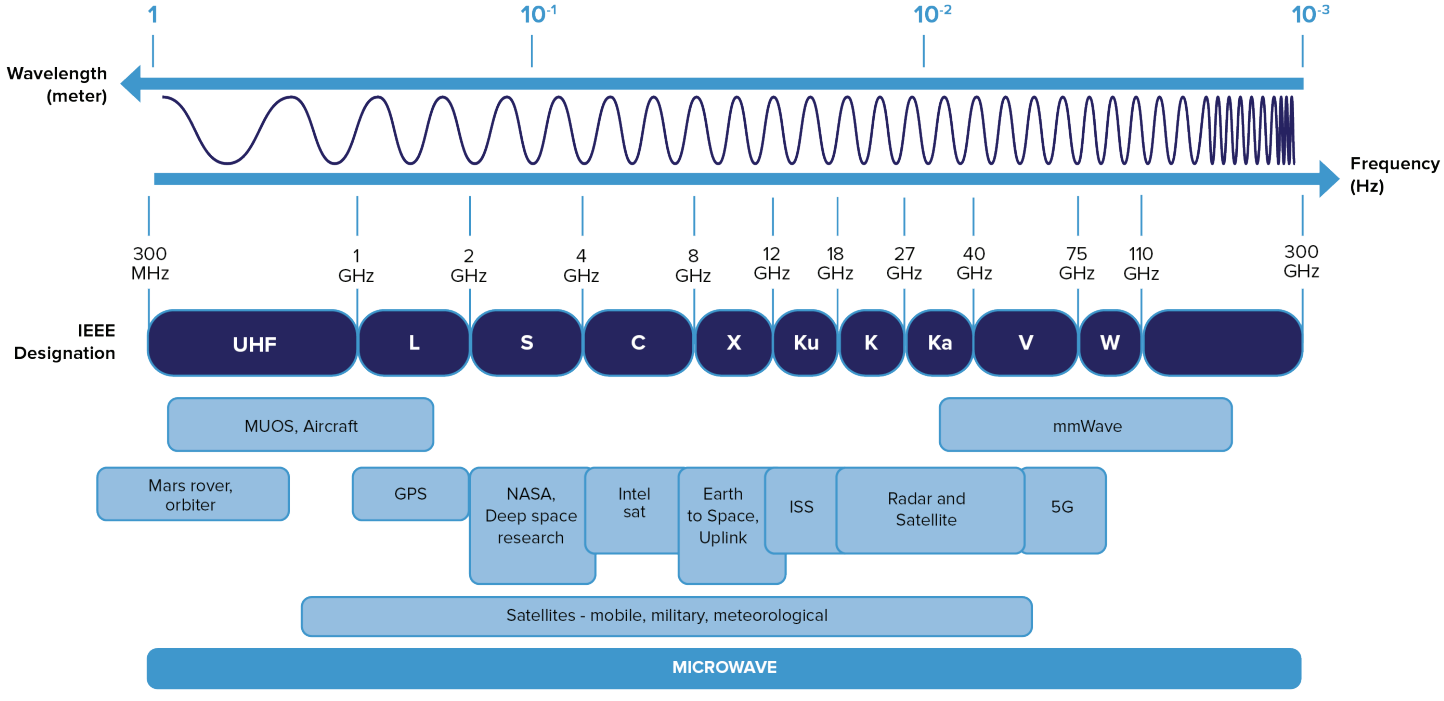
RF Filter Capabilities

Our space-qualified RF Filters are commonly characterized by:

- Surface mount packaging
- Narrow and broad bandwidths
- Low loss
- Low insertion loss
- High power capability
- Optimized for size and weight – designs less than 3.75mm wide
- Frequency ranges from UHF to Ka Band
- Complemented by an extensive portfolio of microwave and mmwave technology



Frequency & Applications

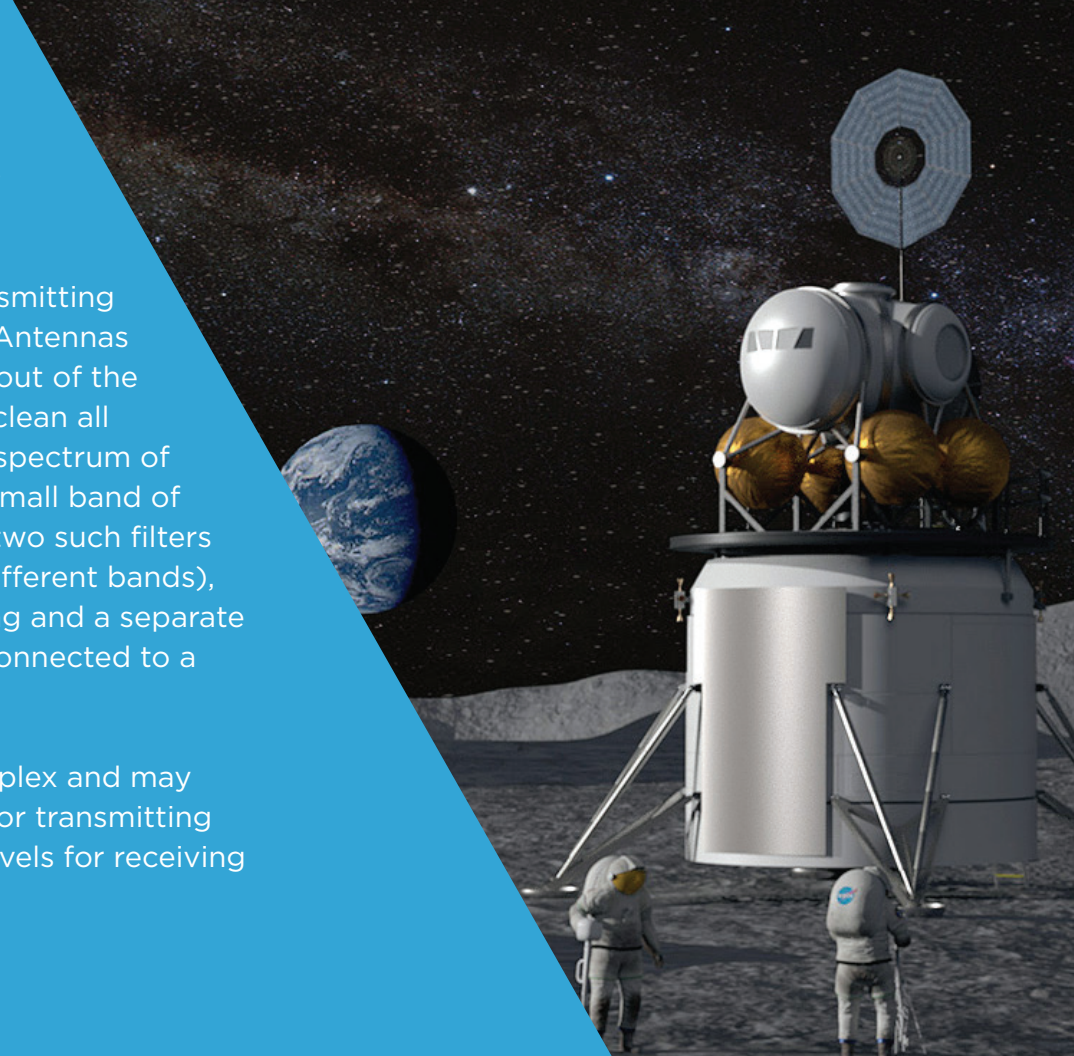


From rovers and landers to orbiters and satellites, we have been a proud long-term supplier for interplanetary and lunar missions. We know it takes high-quality and high-reliability electronic components to meet the rigorous standards required for space applications.

Filters in Space

RF filters are responsible for transmitting and receiving wave frequencies. Antennas grab signals of a large spectrum out of the air. The filter's job is to strip and clean all unwanted frequencies from that spectrum of signals except a specific critical small band of needed information. A diplexer (two such filters each striping and cleaning two different bands), filters both a band for transmitting and a separate band for receiving signals both connected to a common node, the Antenna.

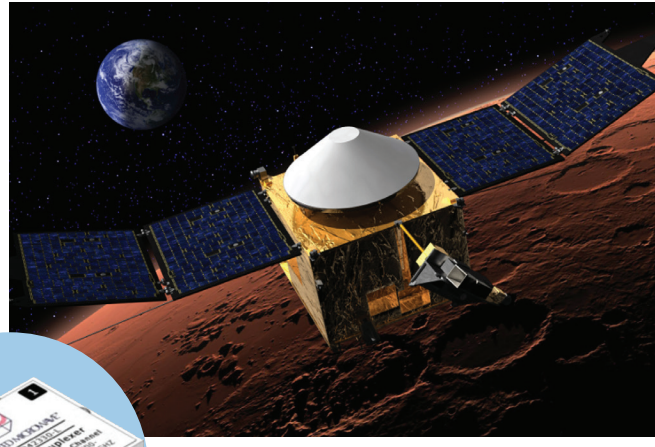
Filters in space can be quite complex and may have to handle very high power for transmitting while operating at small power levels for receiving very weak signals.

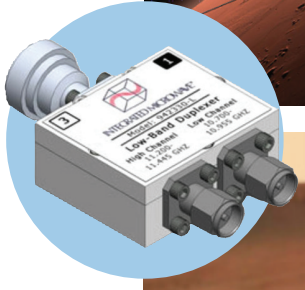


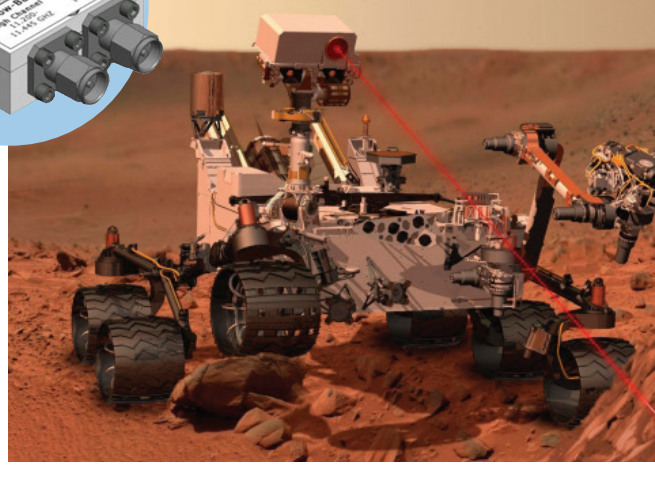
Application Highlight

Front-End Duplexer:
Our Front-End Duplexers come from the UHF Antenna to a main radio. Integral for earth-to-space and space-to-rover-to-earth communications, the Front-End Duplexer set the stage for stable, rapid download/upload transmissions. Over the years, transceiver radio duplexers have become mission-critical for commercial and military applications.

- Superior performance
- Compact sizing; suitable for space craft from the UHF to X band
- Mitigates extreme temperature cycling; tested with both Corona and Multipactor testing
- Long-term reliability



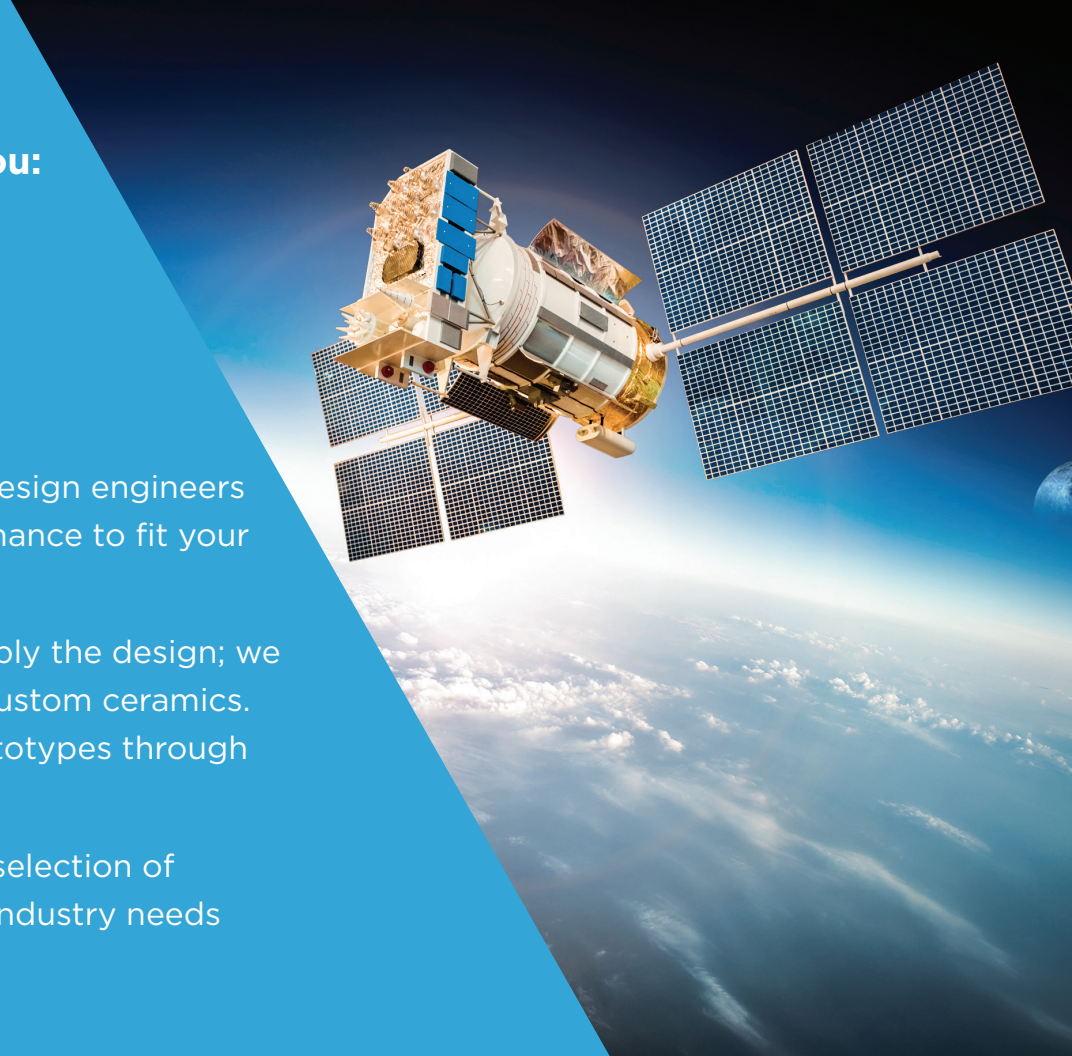




Choose what's best for you:

Custom, Build-to-Print, Catalog

- **CUSTOM** – work with our design engineers to achieve size and performance to fit your application
- **BUILT-TO-PRINT** – you supply the design; we manufacture utilizing our custom ceramics. This option is great for prototypes through high volume production
- **CATALOG** – we offer a full selection of passive components fit to industry needs



Custom is Standard For Us!

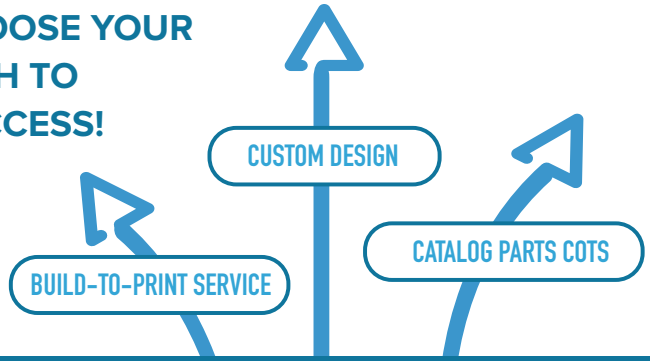
About our materials:

Our custom ceramics offer significantly better thermal performance than the majority of industry standard ceramics and have an added benefit of a sufficiently higher dielectric constant (K) allowing miniaturization opportunities and temperature stable performance. We also offer services across a wide range of other materials to suit your application.

Why Customize?

- Collaboration is the key to top performance!
- Leverage our expertise to achieve your performance goals with low cost of ownership and optimized SWAP-C
- Utilize ceramics to achieve stable performance over wide temperature ranges
- Achieve the best manufacturing outcomes with our precision processing and testing capabilities

CHOOSE YOUR PATH TO SUCCESS!



Not sure which is right for you?

Reach out to discuss your requirements with our engineers: **DLIengineering@Knowles.com**

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