



5G Solutions



TELECOMMUNICATIONS

SETTING THE CONTEXT

5G is a broad category of innovative technologies that is transforming wireless communications.



FOR MOBILE USERS: Enhanced Mobile Broadband (eMBB) will enable increased mobile capabilities, with three distinct attributes: higher capacity, enhanced connectivity and higher user mobility.



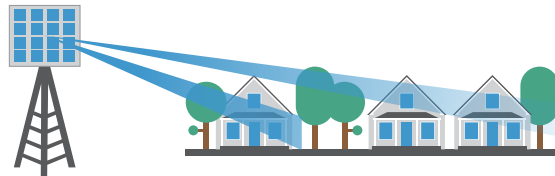
FOR FIXED BROADBAND USERS: Fixed Wireless Access. Distinct from the advantages 5G brings to mobile, Fixed Wireless Access (FWA) is a way to provide high-performance broadband access to homes and offices through wireless.



FOR THE INTERNET OF THINGS: The increased capacity and reduced latency that 5G brings will further fuel the growth of IoT (Internet of Things) applications.

Fifth Generation (5G) communication systems are being planned to enable a hundredfold increase in user data rates – and with this increase comes a need for significant increases in bandwidth over what is currently available.

The high end of the spectrum at mmWave frequencies offers the most dramatic increase in available bandwidths.



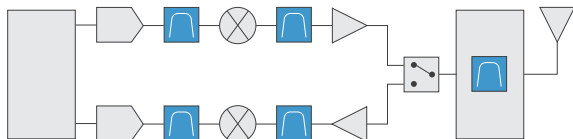
A key enabler in mmWave base station systems is the use of multi-element beamforming antenna arrays in both urban and suburban environments.



DEFINING THE PROBLEM

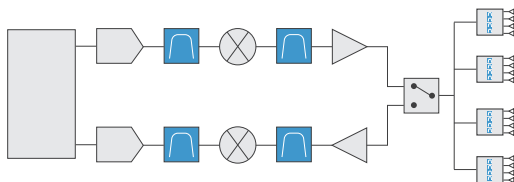
The new beamforming radio architectures being developed to leverage mmWave in 5G bring about new challenges for the designer.

<6GHz (e.g., LTE MACRO)



<i>Technology</i>	LTE Macro RRH
<i>Frequency</i>	2.6GHz
<i>Close to Antenna</i>	Cavity Filter
<i>RF Section</i>	SMT RF Filters
<i>IF Section</i>	SMT IF Filters

5G NR mmWave



<i>Technology</i>	5G mmWave Beamforming
<i>Frequency</i>	28 & 39GHz
<i>Close to Antenna</i>	SMT RF Filters
<i>RF Section</i>	SMT RF Filters
<i>IF Section</i>	SMT IF Filters

In the move from radios operating in the range of 700MHz and 2.6GHz to the mmWave frequencies of interest such as 39GHz, some key factors need to be considered in selecting a filter solution.

SHRINKING WAVELENGTHS

At 700MHz the wavelength in free space is about 43cm. Yet at 39GHz wavelengths are only 7.7mm.

INCREASED TEMPERATURE

In dense board environments temperatures rise.

REDUCED SIZE OF THE RF FRONT END

As wavelength shrinks, so do antenna sizes. Filters in RF front ends need to be compact.

INCREASED NEED FOR PERFORMANCE REPEATABILITY

High frequency circuits are sensitive to variations in performance from part to part.

INCREASE IN NUMBER OF RF PATHS RF FRONT END

Arrays of RF paths necessitate compact filtering components.

EVER-PRESENT NEED TO PERFORM

Filter components need to ensure the best spectral efficiency and rejection possible.

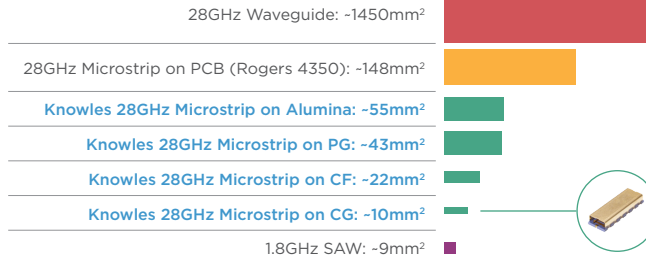


THE SOLUTION

Size and Temperature Stability

SMALL SIZE

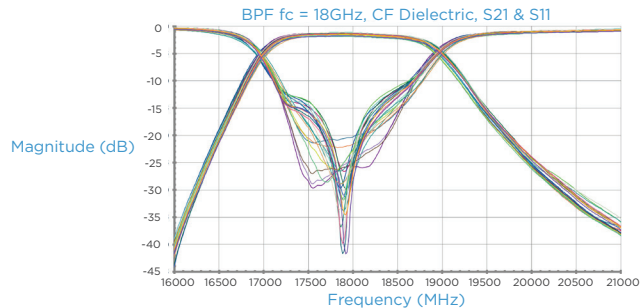
Filter size reduction
of up to 20x



Smart Phone
10000mm²

TEMPERATURE STABLE

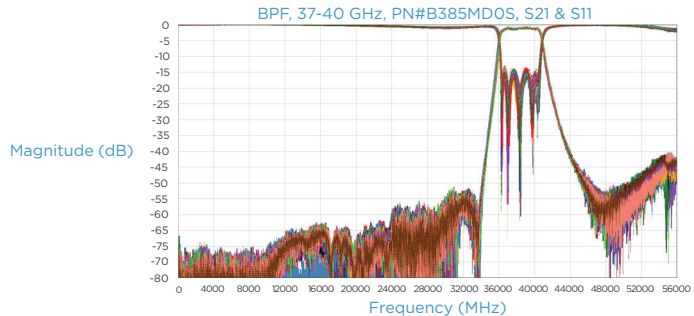
Stable operation
from -55°C to +125°C



High Repeatability with High Performance

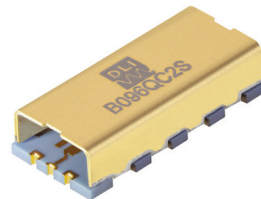
HIGH PERFORMANCE WITH HIGH REPEATABILITY

Precise manufacturing = No tuning



SOLDER SURFACE MOUNT

Easy next-level assembly



To learn more visit www.knowlescapacitors.com/Products/Microwave-Products.aspx



ABOUT KNOWLES

At Knowles Precision Devices we make Multilayer, High Reliability, Single Layer and Precision Variable Capacitors, EMI Filters and Thin Film Devices including RF Filters, splitters and couplers. Our business was formed by combining Compex Corporation, Dielectric Laboratories, Johanson Manufacturing, Novacap, Syfer and Voltronics, each well-established specialty capacitor makers with a combined history of over 200 years, into a single organization.

Our expertise is the design and manufacture of components important to engineers in applications where function and reliability are key. The markets we serve include medical implantable and medical equipment, military, aerospace/avionics, EMI and connector filtering, oil exploration, instrumentation, industrial electronics, optical networks, telecom and automotive.

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