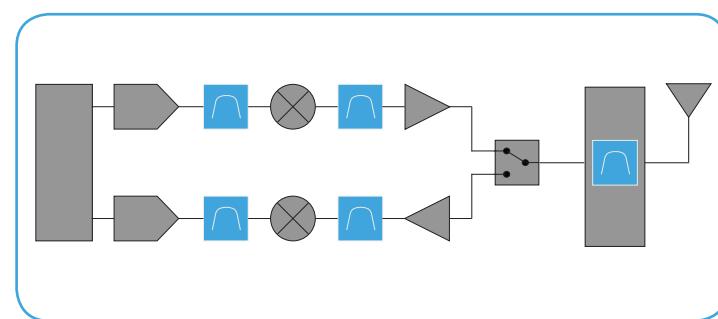


700MHz  
(43cm)

 Sub 6GHz  
6GHz (50mm)

## MOVING TO MMWAVE BRINGS ABOUT NEW FILTERING CHALLENGES



Technology  
Frequency  
Close To Antenna  
RF Section  
IF Section

LTE Macro RRH  
2.6GHz  
Cavity Filter  
SMT RF Filters  
SMT IF Filters

 24GHz  
(12.5mm)

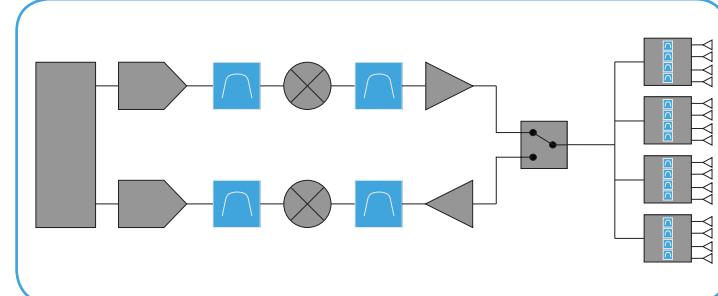
mmWave

 38GHz  
(7.7mm)

 70GHz  
(4.3mm)

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 and at 2.6GHz wavelengths are 11.5cm. Yet at 39GHz wavelengths are only 7.7mm.
- **Reduced Size of the RF Front End**  
As wavelength shrinks so do antenna sizes. And for arrays to avoid diffraction effects antenna spacing needs to be similarly shrunk. Filters in RF Front Ends need to be compact.
- **Increase in number of RF paths RF Front End**  
The enabling technologies for mmWave, Beam Steering and MIMO, rely on arrays of antennas, which in turn rely on arrays of RF paths further necessitating compact filtering components.
- **Increased Temperature**  
In dense board environments temperatures rise, and front ends will need to operate at increased temperature and with inherent temperature stability.
- **Increased Need For Performance Repeatability**  
High frequency circuits are sensitive to variations in performance from part to part. Repeatability in filter component performance is key to avoid costly 'set at test' scenarios.
- **Ever present need to perform**  
Filter Components for the mmWave RF Front End need to encompass all of these factors, and they still need to perform to ensure the best spectral efficiency and rejection possible.



Technology  
Frequency  
Close To Antenna  
RF Section  
IF Section

5G mmWave Beamforming  
28 & 39 GHz  
SMT RF Filters  
SMT RF Filters  
SMT IF Filters

## KNOWLES PRECISION DEVICES DLI FILTER TECHNOLOGY ADDRESSES THESE CHALLENGES

## Small Size

Filter size reduction of up to 20x  
Actual Size:



## Temperature Stable

Stable operation  
From: -55°C  
To: +125 °C

## High Repeatability

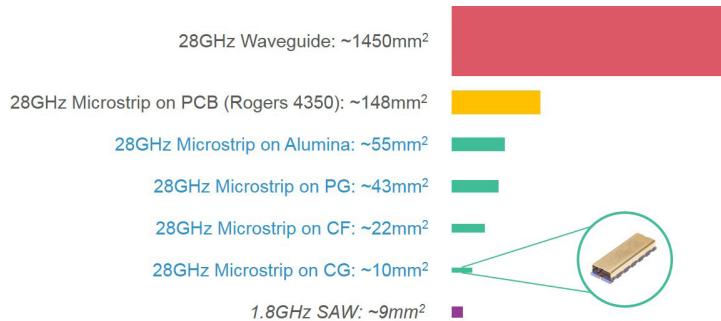
Precise Manufacturing = No Tuning

## High Performance

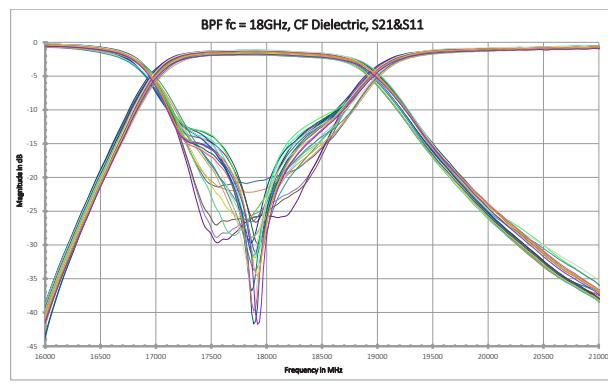
Very Broad Band  
High Rejection  
Low Insertion Loss

## MEETING THE 5G MMWAVE FILTER CHALLENGE

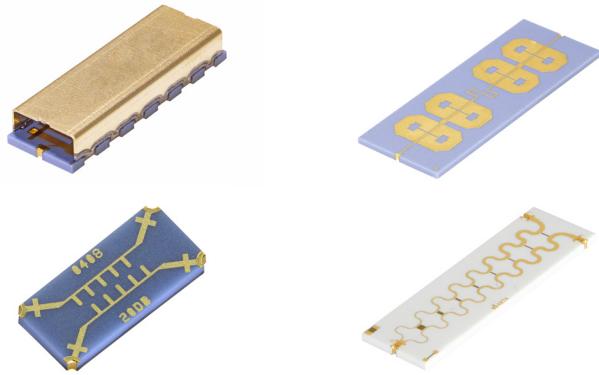
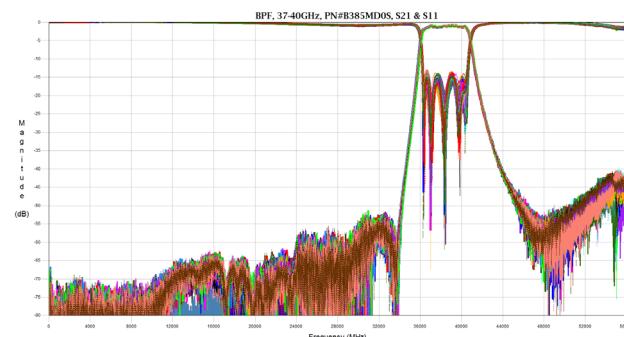
## Small Size



## Temp Stable from -55°C to +125°C



## High Performance with High Repeatability



REQUEST A SAMPLE KIT TO GET YOUR 5G PROJECT OFF THE GROUND

## 26/28GHz 5G Sample Kit Contents

Part Number	Frequency	Description
B274MB1S	28GHz	SMD Bandpass Filters
B280LB0S	28GHz	SMD Bandpass Filters
B280LA0S	28GHz	SMD Bandpass Filters
FPC07182	20.0 to 40.0	Couplers
FPC07181	20.0 to 40.0	Couplers
PDW07069	25.0 to 32.0 4 output ports (4:1)	Power Dividers
PDW07630	25.0 to 32.0 2 output ports (2:1)	Power Dividers

## 39GHz 5G Sample Kit Contents

Part Number	Frequency	Description
B385MD0S	38.5GHz	SMD Bandpass Filters
FPC07182	20.0 to 40.0	Couplers
FPC07181	20.0 to 40.0	Couplers
TBD	TBD	Power Dividers
TBD	TBD	Power Dividers