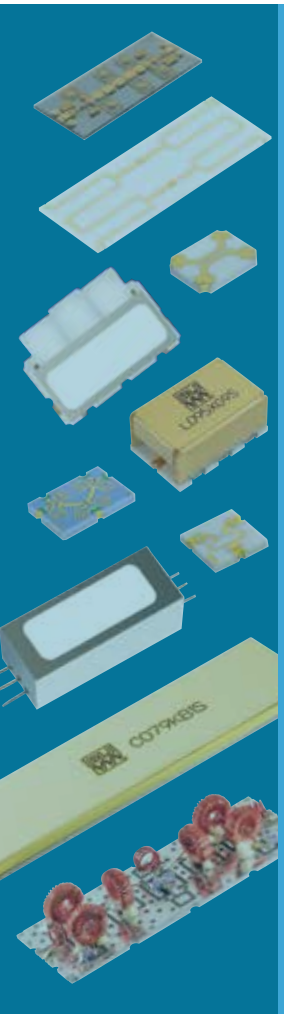
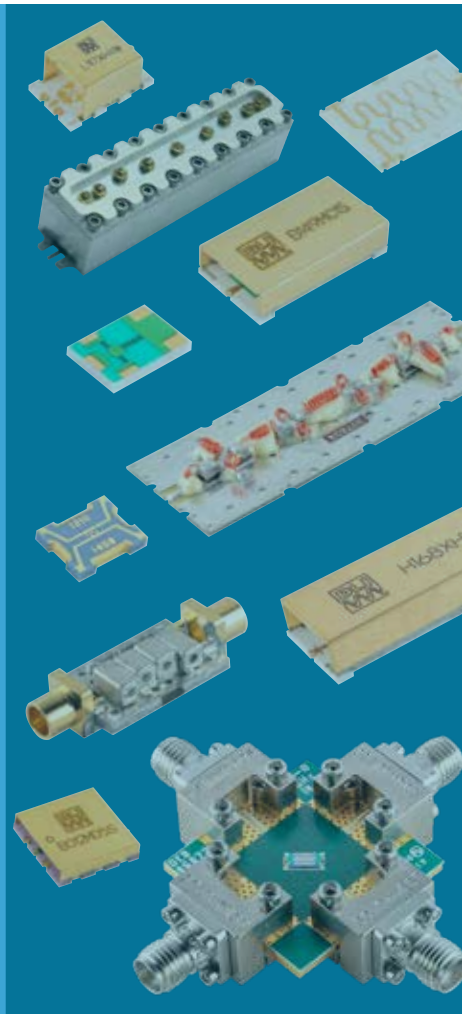
knowles



RF/Microwave Products Catalog

Filters, Multiplexers, Couplers, Power Dividers and Combiners, and Custom Devices



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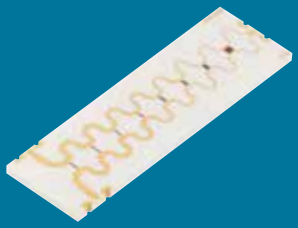
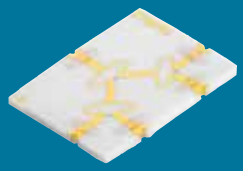


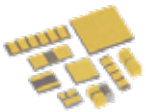


Who We Are

Knowles is a leading manufacturer of specialty electronic components. We design parts that perform unique, critical functions for innovative technologies. Through extreme reliability, custom engineering, and scalable manufacturing, we enable businesses to succeed in the most demanding applications across MedTech, Defense, and Industrial markets.

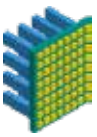
Knowles' DLI brand of technologies addresses the complex challenges of implementing high-performance RF/Microwave products across the widest range of specifications.

The Evolution of Knowles' DLI Brand of RF/MW Product



1974
Dielectric Laboratories (DLI) invents the Single Layer Capacitor.

1985
DLI becomes a part of Dover Corp.

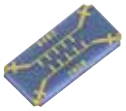


1995
Phased Array Technology:
Plank/Brick Architecture

2011
Ku Band Filters for
Mars Rover Curiosity

2012
DLI SMD Filter @ Ka Band

2015
KPD formed into Knowles



2016
K band Filters, Splitters, Couplers for Satellite Phased Arrays

Phased Array Technology:
Flat Panel/Tile Architecture

2018
3GPP Release 15, SA
DLI 28, 39GHz, SMD Filters

2019
Joint Strike Fighter Lots 12, 13
5G in the US
Auction 101, 28GHz,
Auction 102, 24GHz,
Auction 103, 37GHz, 39GHz, 47GHz
DITF Thin Film Acquisition

2020
5x Filter
Capacity Expansion

2021
Integrated Microwave Corporation joins the Knowles Family.

Custom is Standard for Us

What you see in this catalog is just the tip of the iceberg for the design capability with Knowles!

Collaboration Is the Key to Top Performance!

- Leverage Knowles expertise to achieve your performance goals with low cost of ownership and optimized SWAP-C
- Utilize DLI brand ceramics to achieve stable performance over wide temperature ranges
- Achieve the best manufacturing outcomes with Knowles' precision processing and testing capabilities
- All devices including DLI Catalog, Custom and Build to Print are classified with ECCN EAR99

Knowles' Design

Product spec listing in this document and on website (COTS)

+ Proven DLI performance
+ Availability directly and through distribution
+ Short time frame for delivery
✓ 100% RF Testing Certainty

Trade-off: Specs may not closely fit your needs

DLI Catalog

Custom Devices

Collaborate with our design engineers for devices modified for frequency to fit your needs using Knowles' expertise, high performance materials, and precision manufacturing

+ Optimized RF capabilities and SWAP-C
+ Exclusive modified designs to your RF/electrical specifications
+ Utilize Knowles technologies listed in this document or collaborate to develop something new
✓ 100% RF Testing Certainty
+ Additional testing capability to support applications with unique reliability requirements

Trade-off: Longer time frame for collaboration, design, optimization and manufacturing

Your Design

Custom Substrate

Leverage DLI brand's ceramic performance in your application

Metallized substrates also available

+ Quick turnaround

Build to Print

Knowles precision process capabilities to manufacture your designs, simple to complex

+ Speed of delivery (as little as 4-5 weeks)
+ Your design with substrates as specified or using DLI ceramic technologies

Trade-off: Potential performance and SWAP-C enhancement from Custom DLI Devices

Custom Technology Portfolio

Knowles offers a wide range of devices to meet your application needs.

FILTERS	• Microstrip • Coaxial Ceramic • Ceramic Cavity • Cavity	• Lumped Element • Waveguide • Custom	**0.1 MHz - 67+ GHz**
COUPLERS	• Wilkinson Couplers • Resistive Couplers	• Quadrature Hybrid Couplers	**0.3 - 60 GHz**
DIVIDERS	• Wilkinson Power Dividers (or Combiners) • Resistive Power Dividers		**DC - 67 GHz**
MULTIPLEXERS	• Diplexers • Duplexers	• Triplexers	**0.1 MHz - 67 GHz**
RESONATORS	• Ceramic resonators	• Thin film resonators	**0.3 - 65 GHz**
INTEGRATED PASSIVES	• CRC Networks	• Custom Solutions	**DC - 67+ GHz**

APPLICATIONS

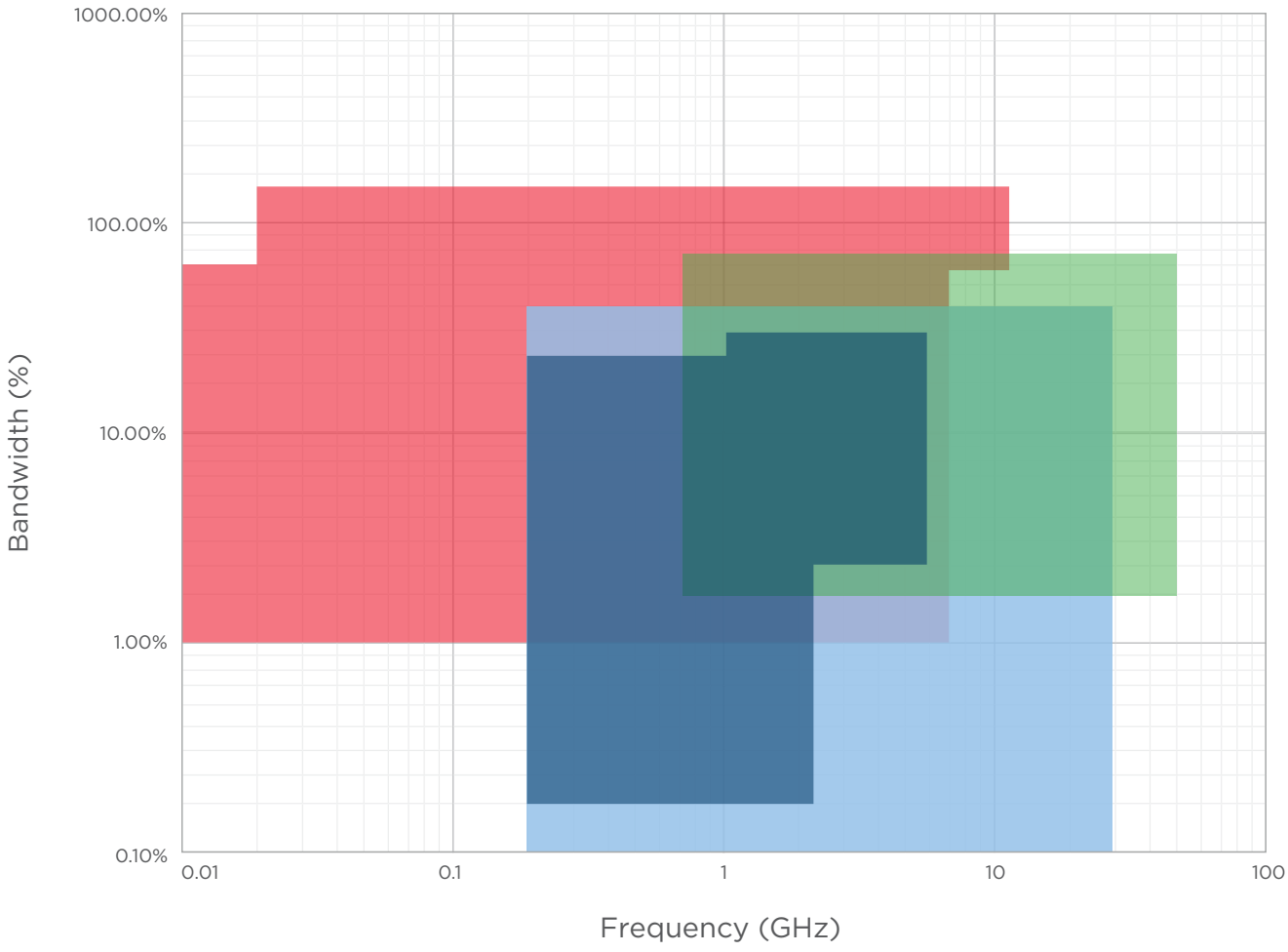
Microwave Radar | Test Equipment | Switch Filter Banks | Satellite Communications | 3GPP & mmWave | Radio Communications | Telecom | 5G Infrastructure | Aerospace | Military

Knowles' Filter Technology

Knowles' expanded portfolio brings together varied approaches to deliver the best performance to meet your requirements. Since different applications require different data rates to successfully transmit signals without introducing noise, different types of filters are necessary as bandwidth and frequency increase.

Filter Technology	Frequency Range (GHz)	Bandpass	Bandreject/Notch	Lowpass	Highpass	Custom Designs	Built to Order	Catalog (COTS) Part Numbers Available
Microstrip	0.8 - 67+	✓	✓	✓	✓	✓	✓	✓
Coaxial Ceramic	0.3 - 6	✓	✓	✓	✓	✓	✓	✓
Cavity	0.3 - 30	✓	✓			✓	✓	
Lumped Element	DC - 15	✓	✓	✓	✓	✓	✓	

FILTER CAPABILITY AND SELECTION BASED ON TECHNOLOGY



Visit www.knowlescapacitors.com/Products/Microwave-Products for COTS Part Numbers, Reference Designs and Datasheets.

Design Support from Knowles

Knowles' provides a full range of engineering expertise and services. When the design team reviews the provided specs, we assess feasibility and which technology category best fits the requirements. These capabilities are fully utilized in providing custom filter solutions to fit your needs.

Your finished design will include custom datasheet specs, outline drawing and recommended PCB layout, reflecting the parameters of simulated performance.

Reach out to our engineers for assistance with custom designs at:
DLIengineering@knowles.com

ASSURING DESIGN COMPLIANCE

- Compliance with design parameters can only occur if all phases from modeling to production are monitored for strict conformance to customer requirements and design standards. Knowles' takes pride in the close and constant attention paid to every aspect of the design process, from the acquisition of raw materials to final inspection and shipping of the finished product.
- Every component is continuously monitored for electrical and physical performance, workmanship and compliance to applicable specifications.

COMPUTER-AIDED CAPABILITIES

- Synthesis/Analysis
- Design
- Engineering
- Manufacturing
- Full MIL Standard Capability for Environmental Testing
- QA Tracking

TRANSFER FUNCTIONS

Frequency Domain

- Chebyshev
- Butterworth
- Elliptic (Cauer)
- Pseudo-Elliptic

Transitional

- Gaussian (6 dB)
- Gaussian (12 dB)

Time Domain

- Gaussian
- Bessel
- Linear Phase (.05°)
- Linear Phase (.5°)

TYPICAL CERAMIC FILTER ENVIRONMENTAL SPECIFICATIONS

- Knowles' custom devices are designed to meet performance specifications after being subjected to the physical and environmental tests of MIL-STD-202 listed below, unless otherwise noted.
- For details of electrical testing associated with DLI devices see page 43.
- Knowles also offers testing beyond what is our standard, based on the needs of an application, see page 12.

	SPEC	MIL-STD-202	METHOD CONDITION
Temperature, Operating	-20 to +70°C (Commercial) -40 to +85°C (Industrial) -55 to +125°C (Military)	-	-
Temperature, Storage	-55 to +125°C	-	-
Altitude	From Lower Earth to Deep Space	105	E
Humidity	90% RH to Full Hermetic*	106	-
Thermal Shock	-55 to +125°C	107	B
Solderability	95% Coverage	208	-
Solvent Resistance*		215	-

*Depending on device and configuration

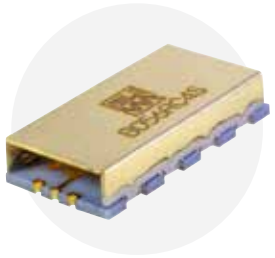
Custom Filter Technologies

MICROSTRIP FILTERS

Using temperature stable, high permittivity dielectrics to offer small size and high selectivity

- Bandwidth: 1 – 100%
- Q Factor: 100 – 400
- Frequency Range: 0.8 – 67 GHz
- Configurations: SMD or Wirebond*
- With or without Integrated RF Shielding

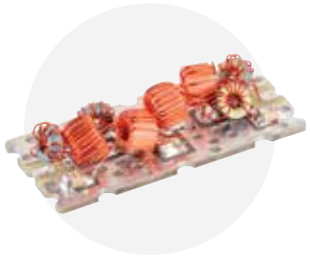
*See page 29 for details



LUMPED ELEMENT FILTERS

Offer small size at low frequencies not achievable by coaxial ceramic, cavity or waveguide implementations

- Bandwidth: 0.01% – 50%
- Q Factor: 50 – 500
- Frequency Range: 300 KHz – 26 GHz
- Packaging: Connector, SMT, Pin



COAXIAL CERAMIC FILTERS

Ideal option for applications with high Q in the UHF and microwave frequency ranges

- Bandwidth: 0.1% – 40%
- Q Factor: 200 – 1100
- Frequency Range: 300 MHz – 12 GHz
- Packaging: Connector, SMT, Pin

CAVITY FILTERS

Available in Combline for high Q, elliptic response, delay equalized and Interdigital for wide band, high Q, symmetric response

- Bandwidth: 0.1% – 50%
- Q Factor: 800 – 7000
- Frequency Range: 300 MHz – 40 GHz
- Packaging: Connector, SMT, Pin

CERAMIC RESONATORS

Quarter wave, half wave and fully metalized resonators made with high performance ceramic dielectric material

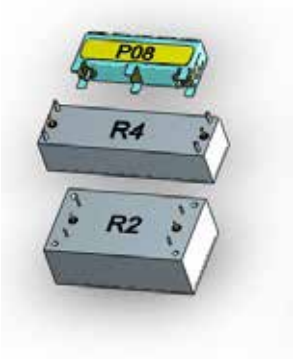
- Size: 2 – 18 mm
- Dielectric Constant: 5 – 98
- Frequency Range: 300 MHz – 10 GHz
- Frequency Tolerance: 0.1 – 1.0%
- Packaging: Tabbed, Tabless

See SLC catalog for additional information

Available Filter Packaging Options

For Lumped Element, Coaxial Ceramic and Cavity Filters (pg 8)

BOARD MOUNT PACKAGES



High Performance RF Filters

- Customized performance, tuned to meet specifications
- Offering tighter bandwidths and selectivity

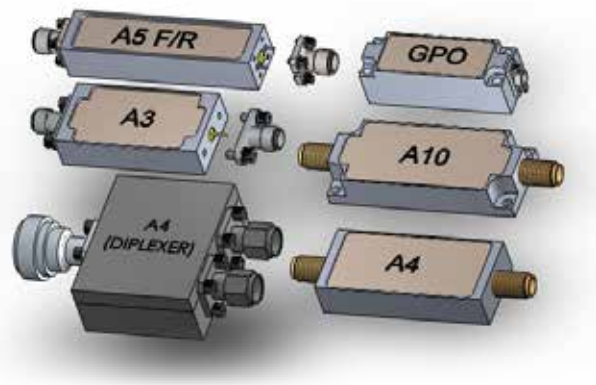
Extensive RF Product Capabilities

- Fully Pb-free shielded devices, high-temperature reflow (>250°C), hermetic and vented packages, tape & reel

On-site Testing and Reliability Lab

- Environmental testing, including thermal vacuum, shock and vibration, and x-ray capability

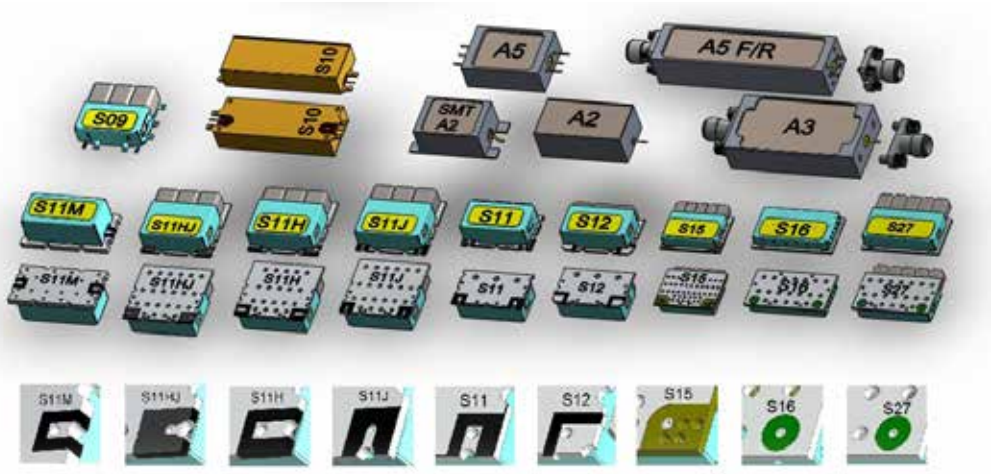
CONNECTORIZED PACKAGES



Custom Package Options

- Copper
- Brass
- Aluminum
- Kovar
- Invar
- Hermetic
- Gold
- Silver
- Nickel Plating

SURFACE MOUNT PACKAGES



Reach out to our engineers for assistance with custom designs at:
DLIengineering@knowles.com

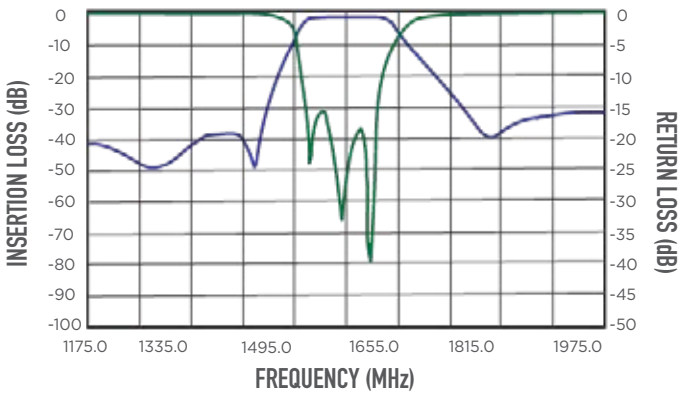
Global Positioning System (GPS) Filters

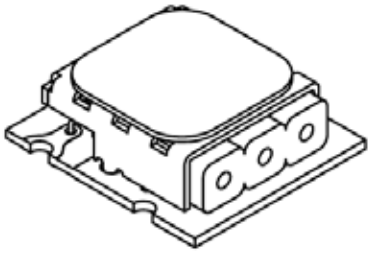
For GPS applications, Knowles offers an extensive line of standard and custom filters with over 50 existing filter designs. Our ceramic resonator technology enables high rejection and selectivity with low insertion loss.

- Single band and dual band / diplexer configurations
  - » L1-band, 1574.4 MHz
  - » L2-band, 1227.6 MHz
  - » Bandwidth (BW) from 10 to 200 MHz
- High Q ceramic with low insertion loss
- Small size, surface mount package

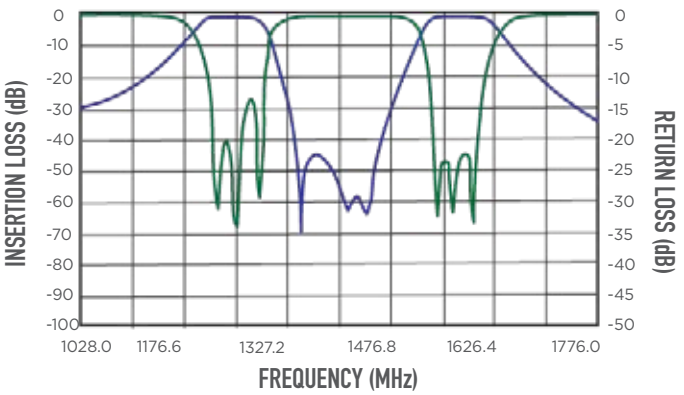
Part Number	GPS Bandpass Filters	Freq. BW (MHz)	L	W	H	
GD4124013S	GPS L1/L2 Ceramic Diplexer	(L1) 1575.4, 16	0.57	0.40	0.12	in
		(L2) 1227.6, 16	14.5	10.2	2.92	mm
GD4124794S	GPS L1/L2 Ceramic Diplexer	(L1) 1575.4, 16	0.53	0.40	0.12	in
		(L2) 1227.6, 16	13.5	10.2	3.05	mm
GD4124014S	GPS L1/L2 Ceramic Dual-Band	(L1) 1575.4, 16	0.33	0.6	0.12	in
		(L2) 1227.6, 16	8.38	15.2	2.92	mm
GD4113370S	GPS L1/L2 Ceramic Diplexer	(L1) 1575.42, 16	0.57	0.28	0.17	in
		(L2) 1227.6, 16	14.5	6.99	4.29	mm
GD4113372S	GPS L1/L2 Ceramic Dual-Band	(L1) 1575.42, 16	0.60	0.35	0.16	in
		(L2) 1227.6, 16	15.2	8.89	4.06	mm
GB1224758S	GPS L1 Ceramic	1575.42, 20	0.33	0.37	0.12	in
			8.38	9.27	3.05	mm
GB2214180S	GPS L2 Ceramic	1227.6, 20	0.57	0.48	0.23	in
			14.5	12.2	5.84	mm

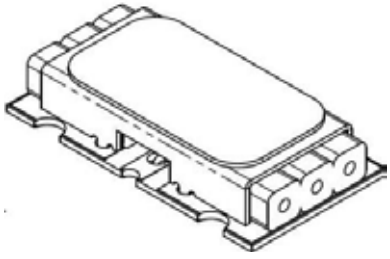
Single Band (L1)





Dual Band (L1/L2)





Targeted 5G Solutions and Specialty Kits

Based on decades of experience working with mmWave filtering solutions, Knowles has a product line of mmWave filter solutions based on DLI filter technology that addresses the challenges outlined below of working with 5G technology.

- Shrinking wavelengths
- Reduced size of RF front end
- Increased operating temperatures
- Increased need for repeatable performance
- Next generation performance
  - » Filter components for mmWave RF front ends need to encompass all these factors, and they still need to perform to ensure the best spectral efficiency and rejection possible. Using specialized topologies and material formulations, Knowles' created off-the-shelf catalog designs available up to 42 GHz that are 20 times smaller than the current alternatives
  - » Order one of these kits for a variety of devices to try or as a resource for testing set-ups

MMWAVE FILTER KEY FEATURES & BENEFITS:

- Filter size reduction of up to 20x
- Stable operation from -55°C to +125°C
- Precise manufacturing means no tuning
- Performance—very broad band, high rejection and low insertion loss

5G Kit 26GHz - B259MC1S

5G Kit, 26GHz, n258

PART NUMBER	TYPE	FC (GHz)	FL (GHz)	FH (GHz)	INSERTION LOSS (@FC, dB 25°C)	L, INCHES (mm)	W, INCHES (mm)	H, INCHES (mm)
B259MC1S	26GHz Bandpass	25.9	24.25	27.5	3.5	0.2165 (5.4991)	0.090 (2.286)	0.070 (1.778)
DEB-B259MC1S	26GHz Bandpass, mounted on eval board	25.9	24.25	27.5	3.5			
B274MB1S	28GHz Bandpass	28	25	29.5	3.25	0.450 (11.43)	0.110 (2.794)	0.089 (2.2606)
B280LB0S	28GHz Bandpass	28	27	29	1.5	0.350 (8.89)	0.120 (3.048)	0.098 (2.4892)
B280LA0S	28GHz Bandpass	28	27.5	28.5	4	0.550 (13.97)	0.140 (3.556)	0.083 (2.1082)
FPC07182	20dB Coupler		20	40	0.3	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)
FPC07181	10dB Coupler		20	40	0.6	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)
PDW07069	4-way Power Divider		25	32	1	0.140 (3.556)	0.170 (4.318)	0.010 (0.254)
PDW07630	2-way Power Divider		25	32	0.25	0.070 (1.778)	0.070 (1.778)	0.010 (0.254)

5G Kit 28GHz - B274MB1S

5G Kit, 28GHz, n257, n261

PART NUMBER	TYPE	FC (GHz)	FL (GHz)	FH (GHz)	INSERTION LOSS (@FC, dB 25°C)	L, INCHES (mm)	W, INCHES (mm)	H, INCHES (mm)
B274MB1S	28GHz Bandpass	28	26.5	29.5	3.25	0.450 (11.43)	0.110 (2.794)	0.089 (2.2606)
DEB-B274MB1S	28GHz Bandpass, mounted on eval board	28	26.5	29.5	3.25			
B280LB0S	28GHz Bandpass	28	27	29	1.5	0.350 (8.89)	0.120 (3.048)	0.098 (2.4892)
B280LA0S	28GHz Bandpass	28	27.5	28.5	4	0.550 (13.97)	0.140 (3.556)	0.083 (2.1082)
PDW07069	4-way Power Divider		25	32	1	0.140 (3.556)	0.170 (4.318)	0.010 (0.254)
PDW07630	2-way Power Divider		25	32	0.25	0.070 (1.778)	0.070 (1.778)	0.010 (0.254)
FPC07182	20dB Coupler		20	40	0.3	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)
FPC07181	10dB Coupler		20	40	0.6	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)

5G Kit 39GHz - B385MD0S

5G Kit, 39GHz, n260

PART NUMBER	TYPE	FC (GHz)	FL (GHz)	FH (GHz)	INSERTION LOSS (@FC, dB 25°C)	L, INCHES (mm)	W, INCHES (mm)	H, INCHES (mm)
B385MD0S	39GHz Bandpass	38.5	37	40	2.5	0.275 (6.985)	0.080 (2.032)	0.075 (1.905)
DEB-B385MD0S	39GHz Bandpass, mounted on eval board	38.5	37	40	2.5			
PDW08323	2-way Power Divider		37	42	0.5	0.070 (1.778)	0.070 (1.778)	0.010 (0.254)
PDW08324	4-way Power Divider		37	42	0.7	0.170 (4.318)	0.140 (3.556)	0.010 (0.254)
FPC07182	20dB Coupler		20	40	0.3	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)
FPC07181	10dB Coupler		20	40	0.6	0.065 (1.651)	0.050 (1.27)	0.010 (0.254)

Space Heritage

Our products are currently used worldwide and in space — in the most advanced military and aerospace instrumentation and communication systems.

SPACE APPLICATIONS

2024	Artemis Lunar Lander
2023	Griffin Lunar Lander
2022	Peregrine Lunar Lander
	NISAR (NASA-ISO Synthetic Aperture Radar)
	NISAR TROPICS
2021	SWOT (Surface Water Ocean Topography)
	JPSS2 (Joint Polar Satellite System 2)
	New Glenn Blue Origin
2019	New Shepard Blue Origin
2017	JPSS1 (Joint Polar Satellite System 1)
2015	OG2 (Orbcomm Generation 2)
	MMS (Magnetosphere Multiscale Mission)
	SMAP (Soil Moisture Active Passive)
2014	WorldView-3
2013	MUOS (Mobile User Objective System)

2011	Suomi NPP (National Polar-orbiting Partnership)
2010	SBSS (Space Based Space Surveillance)
2009	WISE (Wide-field Infrared Survey Explorer)
	WorldView-2
	LM-900
2008	GLAST (Gamma Ray Large Space Telescope)
2008	JEM-PM (Japanese Experimental Module "Kibo" Pressurized Module)
Various 2002 -	ATLAS Launch Vehicle
Ongoing 1998-	ISS (International Space Station)
	C2V2 (Common Communication for Visiting Vehicle)
	CONNECT
	IPP

MARS & JUPITER MISSIONS

2026	Earth Return Orbiter
	Sample Return Lander
2023	Europa JUICE (Jupiter Icy Explorer)
	Europa RIME (Radar for Icy Moon Exploration)
2021	Orion
2020	Perseverance Rover
2018	InSight Lander (Interior exploration using Seismic Investigations, Geodesy and Heat Transport)
2016	ExoMars TGO (Trace Gas Orbiter)
2013	MAVEN (Mars Atmosphere and Volatile Evolution)
2011	Curiosity Sky Crane
	Curiosity Rover
2008	Phoenix Lander
2005	MRO (Mars Reconnaissance Orbiter)
2003	Opportunity Rover
	Spirit Rover

TESTING CAPABILITIES

RF PERFORMANCE TESTING

RF Performance GSG (ground signal ground)	100% or sample
RF Test Over Temperature	
Design Evaluation Boards	
Resistor Testing	100% or sample
TCR (Thermal Coefficient of Resistance)	MIL-STD-202, Method 304

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

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

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

Note: Standard test methods listed as capabilities. For each order, testing is carried out as specified by the customer on the SCD and PO.

SatCom Offerings

C BAND

PART NUMBER	TYPE	FREQUENCY RANGE, GHz	SIZE L X W X H, INCHES (mm)
B056RC4S	Bandpass Filter Octave	4.0-8.0	0.450 (11.43) x 0.230 (5.842) x 0.100 (2.54)
B038NC4S	Bandpass Filter Downlink	3.4-4.2	0.550 (13.97) x 0.220 (5.588) x 0.108 (2.743)
B040RG9S	Bandpass Filter Downlink	2.0-6.0	0.620 (15.75) x 0.280 (7.11) x 0.093 (2.36)
B061MB6S	Bandpass Filter Downlink	5.85-6.425	0.450 (11.43) x 0.200 (5.08) x 0.098 (2.48)
PDW06398	Power Divider 2:1 Splitter	5.0-7.0	0.120 (3.048) x 0.240 (6.096) x 0.015 (0.381)
FPC06700	Branchline Coupler 3 dB	5.9-6.5	0.425 (10.80) x 0.250 (6.35) x 0.020 (0.508)
FPC06073	Directional Coupler 10 dB	4.0-8.0	0.170 (4.318) x 0.080 (2.032) x 0.015 (0.381)
FPC06149	Directional Coupler 10 dB	4.0-8.0	0.180 (4.572) x 0.080 (2.032) x 0.015 (0.381)
FPC06076	Directional Coupler 20 dB	4.0-8.0	0.170 (4.318) x 0.080 (2.032) x 0.015 (0.381)
FPC06152	Directional Coupler 20 dB	4.0-8.0	0.180 (4.572) x 0.080 (2.032) x 0.015 (0.381)

X BAND

PART NUMBER	TYPE	FREQUENCY RANGE, GHz	SIZE L X W X H, INCHES (mm)
B096QC2S	Bandpass Filter Octave	8.0-12.0	0.400 (10.16) x 0.180 (4.572) x 0.100 (2.54)
PDW06399	Power Divider 2:1 Splitter	9.0-11.0	0.150 (3.81) x 0.100 (2.54) x 0.015 (0.381)
FPC06630	Branchline Coupler 3 dB	9.0-11.0	0.286 (7.264) x 0.180 (4.572) x 0.015 (0.381)
FPC06074	Directional Coupler 10 dB	8.0-12.0	0.120 (3.048) x 0.080 (2.032) x 0.015 (0.381)
FPC06150	Directional Coupler 10 dB	8.0-12.0	0.130 (3.302) x 0.090 (2.286) x 0.015 (0.381)
FPC06153	Directional Coupler 20 dB	8.0-12.0	0.130 (3.302) x 0.090 (2.286) x 0.015 (0.381)
FPC06302	Directional Coupler 20 dB	8.0-12.0	0.120 (3.048) x 0.080 (2.032) x 0.015 (0.381)
FPC06701	Branchline Coupler 3 dB	10.7-12.75	0.255 (6.48) x 0.155 (3.94) x 0.015 (0.381)

KU BAND

PART NUMBER	TYPE	FREQUENCY RANGE, GHz	SIZE L X W X H, INCHES (mm)
B119LB1S	Bandpass Filter Downlink	11.7-12.2	0.450 (11.43) x 0.200 (5.08) x 0.098 (2.488)
B119MB1S	Bandpass Filter Downlink	4.0-10.0	0.450 (11.43) x 0.200 (5.08) x 0.098 (2.488)
B142LA2S	Bandpass Filter Downlink	14.0-14.5	0.575 (14.60) x 0.200 (5.08) x 0.093 (2.36)
PDW06400	Power Divider 2:1 Splitter	11.0-13.0	0.130 (3.302) x 0.130 (3.302) x 0.015 (0.381)
PDW06401	Power Divider 2:1 Splitter	15.0-17.0	0.120 (3.048) x 0.120 (3.048) x 0.015 (0.381)
FPC06075	Directional Coupler 10 dB	12.0-18.0	0.100 (2.54) x 0.080 (2.032) x 0.015 (0.381)
FPC06151	Directional Coupler 10 dB	12.0-18.0	0.100 (2.54) x 0.080 (2.032) x 0.015 (0.381)
FPC06078	Directional Coupler 20 dB	12.0-18.0	0.100 (2.54) x 0.080 (2.032) x 0.015 (0.381)
FPC06164	Directional Coupler 20 dB	12.0-18.0	0.100 (2.54) x 0.080 (2.032) x 0.015 (0.381)

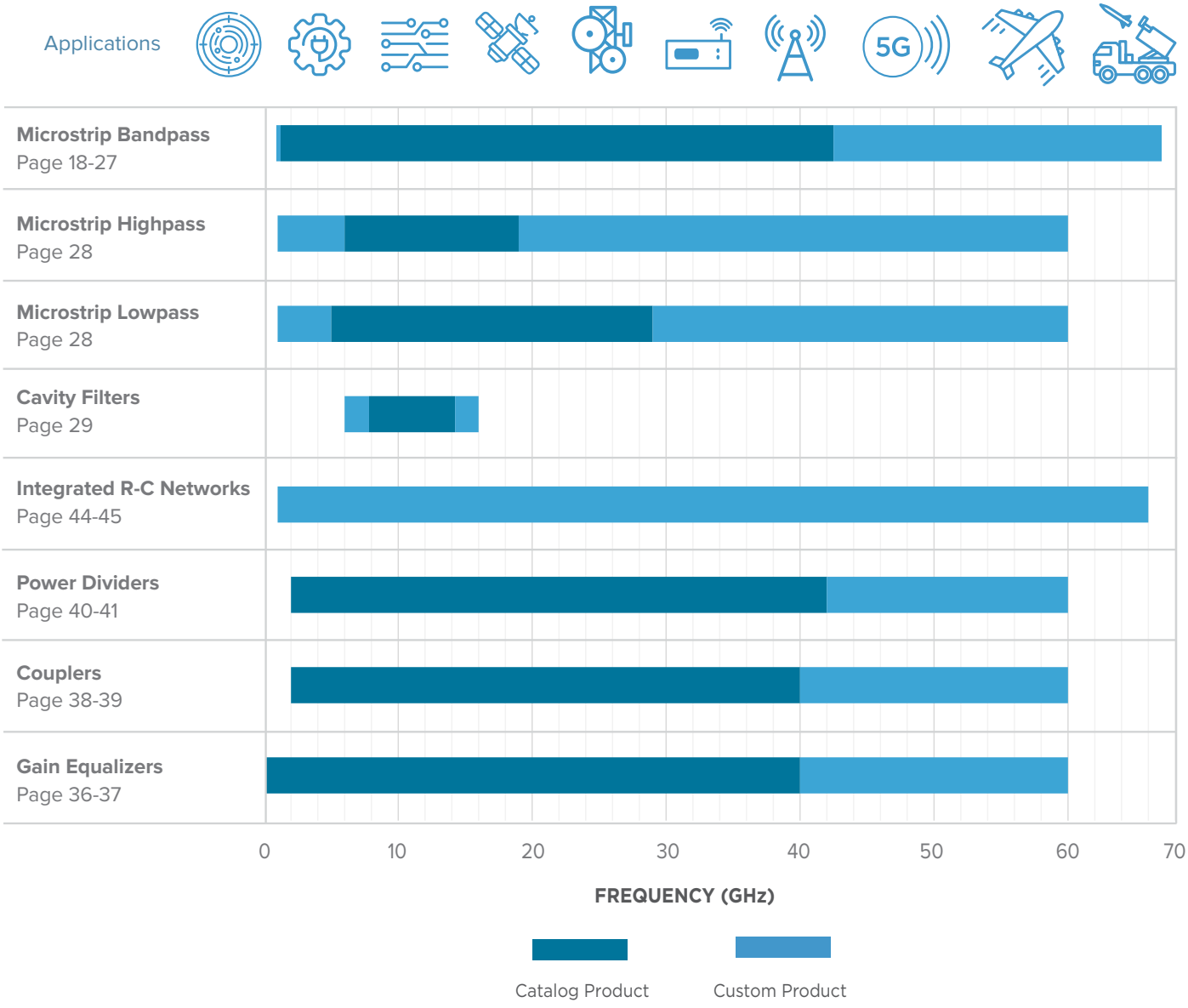
KA BAND

PART NUMBER	TYPE	FREQUENCY RANGE, GHz	SIZE L X W X H, INCHES (mm)
B289KA0S	Bandpass Filter Uplink	28.6-29.1	0.550 (13.97) x 0.140 (3.556) x 0.088 (2.235)
B291MB0S	Bandpass Filter Uplink	3.0-10.0	0.450 (11.43) x 0.140 (3.556) x 0.088 (2.235)
B305LA0S	Bandpass Filter Uplink	3.5-10.0	0.550 (13.97) x 0.140 (3.556) x 0.078 (1.981)
PDW06984	Power Divider 2:1 Splitter	25.0-32.0	0.085 (2.159) x 0.095 (2.413) x 0.010 (0.254)
PDW07069	Power Divider 4:1 Splitter	24.0-32.0	0.140 (3.556) x 0.170 (4.318) x 0.010 (0.254)
PDW07630	Power Divider 2:1 Splitter	25.0-32.0	0.070 (1.778) x 0.070 (1.778) x 0.010 (0.254)
FPC07182	Directional Coupler 10 dB	20.0-40.0	0.065 (1.651) x 0.050 (1.27) x 0.010 (0.254)
FPC07181	Directional Coupler 20 dB	20.0-40.0	0.065 (1.651) x 0.050 (1.27) x 0.010 (0.254)

DLI Brand Device Selection

FREQUENCY 800MHZ TO 67 GHZ

Do you need a custom order or a catalog part? We are here to help, email us **DLIengineering@knowles.com**.



KEY FEATURES AND BENEFITS OF ALL OUR MICROWAVE PRODUCTS

- Small Size
- Frequency Stable Over Temperature
- Operating Temperature: -55˚C to +125˚C
- Excellent Repeatability
- Solder Surface Mount Package

Ceramic Advantages

Why do DLI brand devices have exceptional performance?

The specialized attributes of our ceramic substrate materials

K or ϵ_R
Dielectric Constant Reduced Size 3-20x

Q or TanΔ
Reduced loss from the dielectric

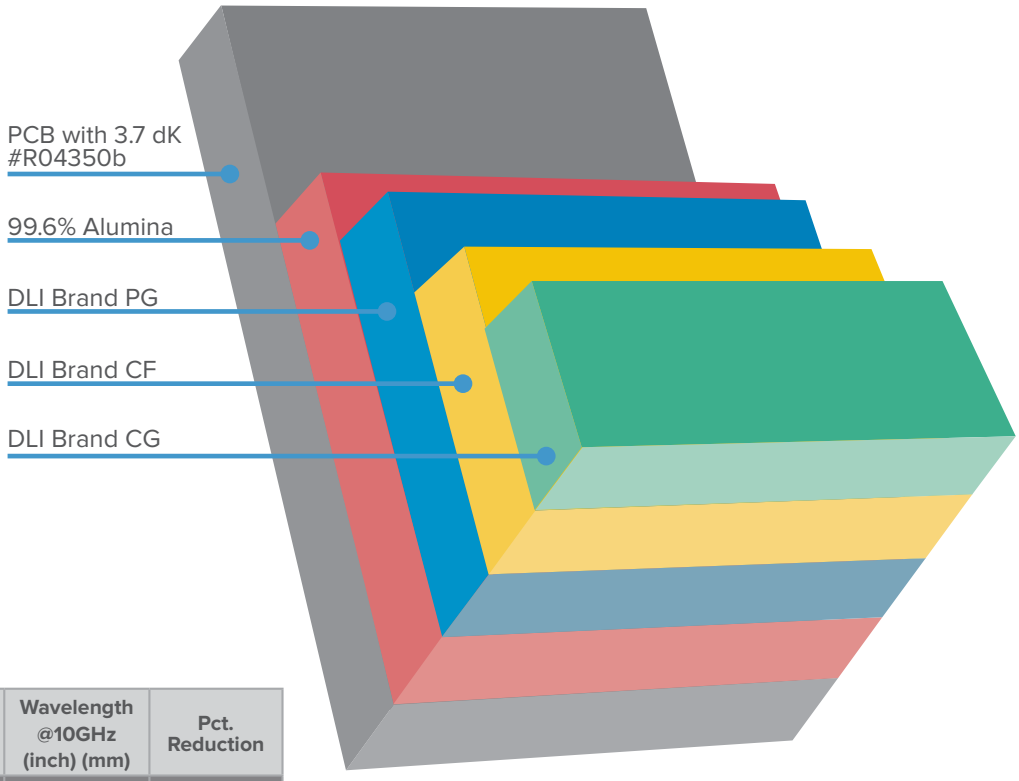
TCC
Performance stability over temperature

CTE
Matched for high reliability

CONSISTENT PERFORMANCE
Excellent part-to-part repeatability based on our expertise in thin film device manufacturing

Relative Filter Size

Compared by Material



Filter Characteristics

Compared by Material

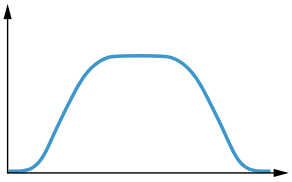
Material	dK	Effective K**	Wavelength @10GHz (inch) (mm)	Pct. Reduction
PCB with Dk #R04350b	3.7	2.8	0.707 [17.96]	----------
99.6% Alumina	9.6	6.5	0.462 [11.73]	34.7%
DLI Brand PG	**12.5**	**8.2**	**0.412 [10.46]**	**41.7%**
DLI Brand CF	**25**	**15.1**	**0.304 [7.72]**	**57.0%**
DLI Brand CG	**67**	**36.8**	**0.194 [4.93]**	**72.6%**

**Values are for Freq. 10GHz on 0.010" Substrate

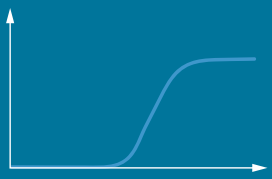
Microstrip Filter Overview

BANDPASS

DLI bandpass filters are designed for high-performance microwave applications in a surface mountable package. Using temperature-stable, high-permittivity dielectrics and thin-film processing, these designs offer high selectivity without sacrificing in-band performance.

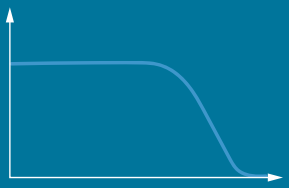


HIGHPASS



DLI's selection of lowpass and highpass filters aims to provide a drop-in solution for high-frequency attenuation. These filters have extreme repeatability, therefore multiple filters can be placed in series for increased rejection.

LOWPASS



DESIGN ADVANTAGES:

- Miniaturization enabled by specialty high-Q ceramics
- Fully shielded component
- Surface mount device configuration available
- Consistent performance
- 100% testing before ship

APPLICATIONS:

5G

Aerospace

Military

Telecom

Satellite Communications

KEY CHARACTERISTICS:

- Low variation over a wide temperature range
- Integrated RF shielding
- Characteristic impedance: 50Ω
- Moisture sensitivity level: MSL1
- No ESD sensitivity

CERTIFICATION:

Certified System SAI GLOBAL ISO 9001 Quality

Certified System SAI GLOBAL AS9100 Aerospace

RoHS 2015/863/EU Exemption-7a

Part Number Decoder

PART NUMBER FORMAT	PRODUCT TYPE
AFL#####	DLI Custom Filters with Integrated Shielding
FFL#####	DLI Custom Filters
FHC#####	DLI Quadrature Hybrid Couplers
FPC#####	DLI Couplers
PDW#####	DLI Wilkinson Power Dividers
PDR#####	DLI Resistive Power Dividers
ADP#####	DLI Diplexers
AEQ#####	DLI Gain Equalizers
DDL#####	DLI Thru-line/Delay line/Crossover

OPTIONAL SUFFIX	MEANING
-T	Tape and Reel Packaging
-E	Space Level Screening per MIL-PRF-38534
-P	Production Level Screening*
-ATP	Acceptance Level Testing*
-QTP	Qualification Testing*
-FLT	Flight Level Testing*
	*Custom testing based on customer supplied testing requirements or source control documentation

Filter Catalog Part Number Structure

L	0	6	0	X	D	9	S
Filter type code	10 GHz Place Value	1 GHz Place Value	0.1 GHz Place Value	% BW Code	30 dB Rejection Level Code	Re-entrance Code	Package Code

FILTER TYPE CODE	
CODE	FILTER TYPE
B	BANDPASS
L	LOWPASS
H	HIGHPASS
C	CAVITY
N	NOTCH

PACKAGE CODE	
CODE	FILTER TYPE
W	WIRE-BOND
S	SMD

% BW CODE	
CODE	3DB% BW
J	0 - 1%
K	> 1 - 5%
L	> 5 - 10%
M	> 10 - 20%
N	> 20 - 30%
O	> 30 - 40%
P	> 40 - 50%
Q	> 50 - 60%
R	> 60%
X	LPF & HPF

30 DB REJECTION LEVEL CODE	
CODE	% OFF 3 DB CORNER
A	0 - 2%
B	> 2 - 4%
C	> 4 - 6%
D	> 6 - 8%
E	> 8 - 10%
F	> 10 - 15%
G	> 15 - 20%
H	> 20%

Notes:

LPF & HPF: Percentage off of 3db corner

BPF: Average percentage off 3dB BW

Notch: Average percentage 3dB BW to 10dB BW

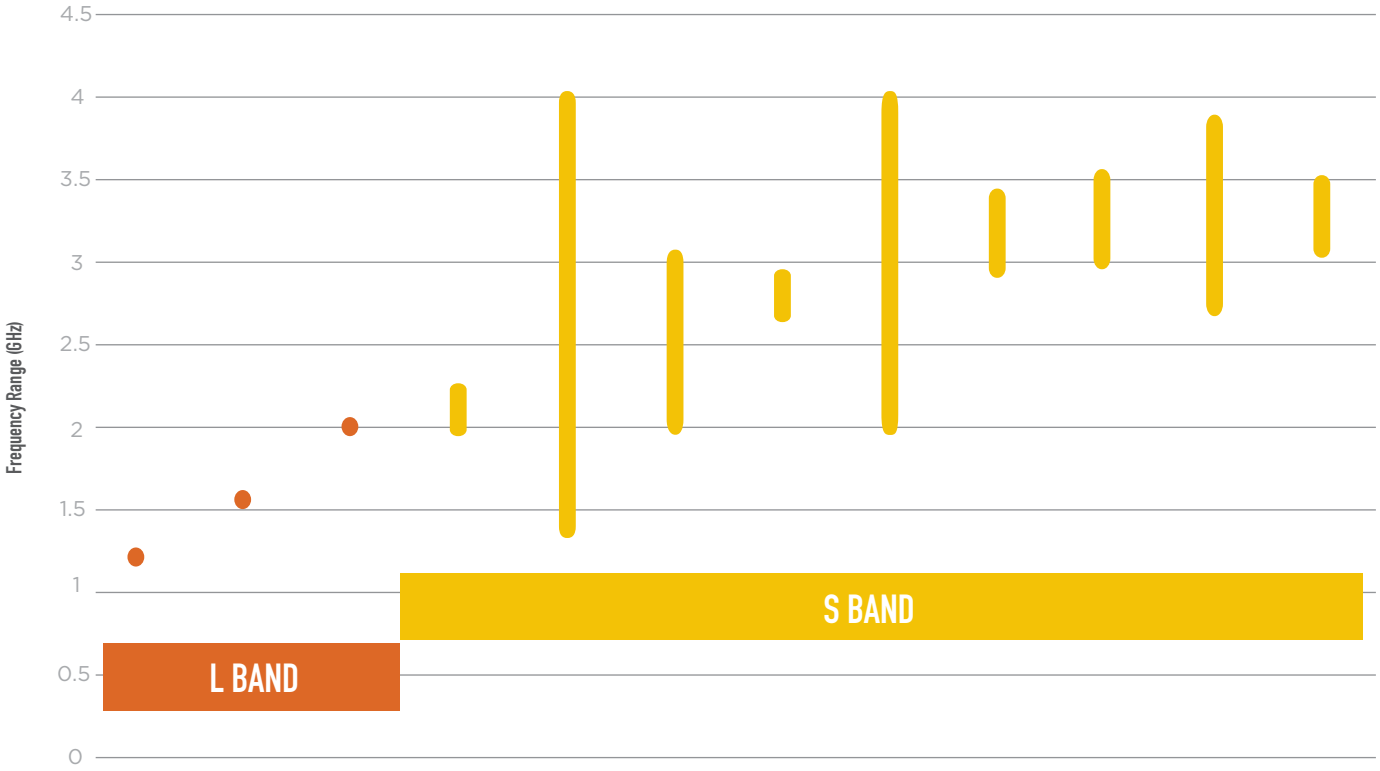
RE-ENTRANCE CODE	
CODE	RE-ENTRANT MULTIPLIED
0	1.2 - 1.4
1	> 1.4 - 1.6
2	> 1.6 - 1.8
3	> 1.8 - 2.0
4	> 2.0 - 2.2
5	> 2.2 - 2.4
6	> 2.4 - 2.6
7	> 2.6 - 2.8
8	> 2.8 - 3.0
9	> 3.0
X	HPF

Notes:

Re-entrance is multiplier past the highside 30dB rejection level.

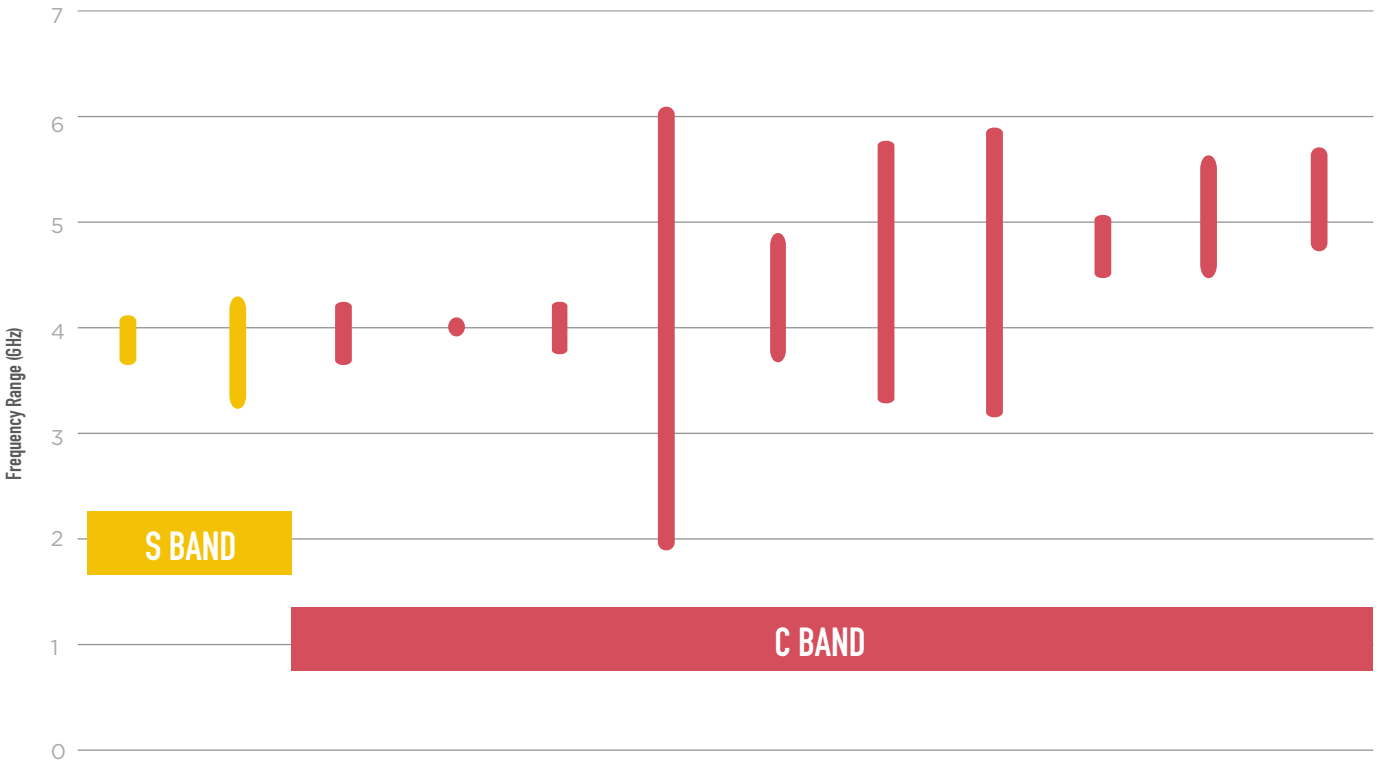
Notch: Multiplier from corner of first notch to center or second notch

Bandpass Filter Ordering Information



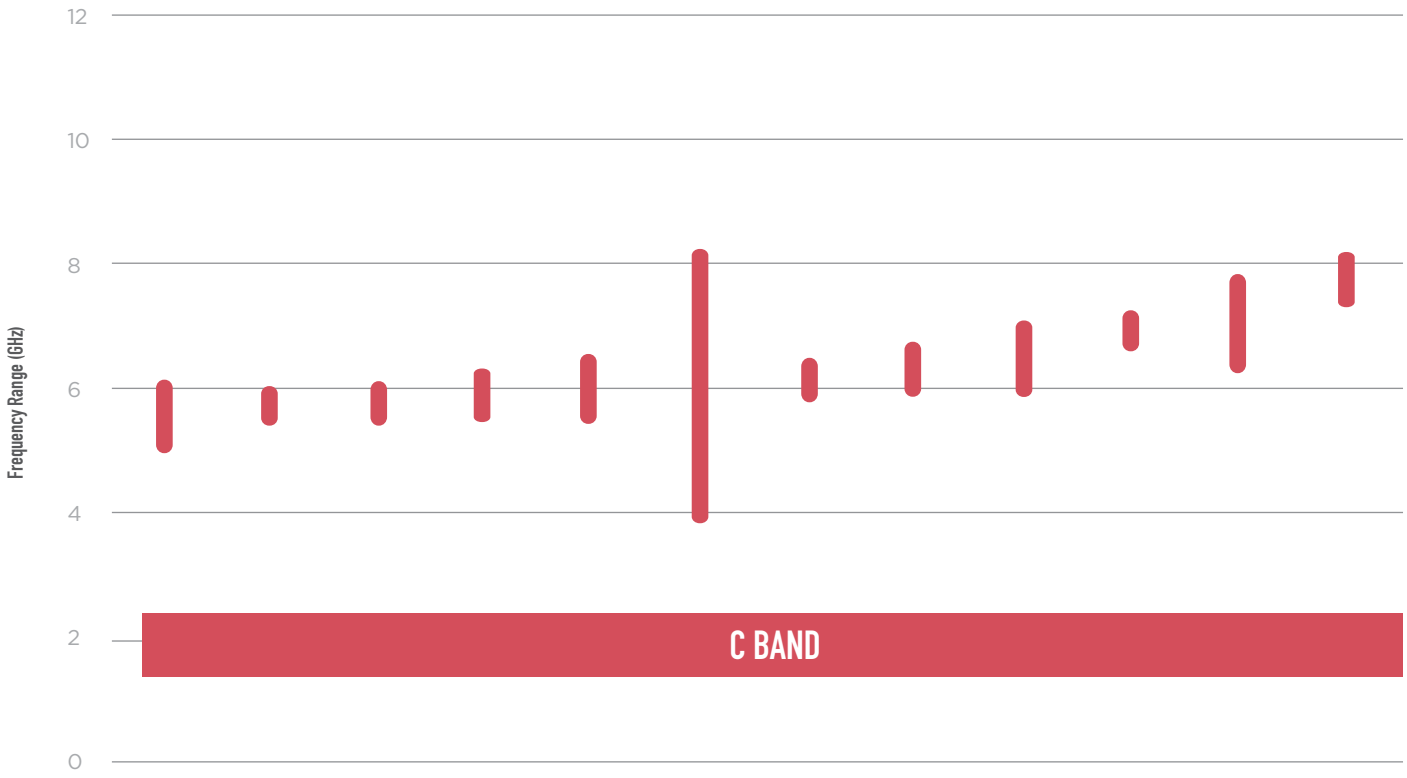
Part Number	B012MD5S	B016MD6S	B020JC6S	B021MC8S	B023RH7S	B024RF2S	B028LB7S	B028RF2S	B031ND5S	B032ND5S	B032OD5S	B033ND5S
Center Frequency (GHz)	1.227	1.575	2	2.1	2.665	2.4	2.8	2.8	3.1	3.24	3.25	3.3
Bandwidth (GHz)	0.01	0.01	0.002	0.01	2.67	1.08	0.2	2	0.43	0.6	1	0.4
Insertion Loss												
@ 25°C (dB)	3.5	3.5	3.5	3	2.5	3	2.5	2	3	3	3	2
-40°C to +85°C (dB)	4.2	4.2	4	3.5	3	3.5	3	3	3.5	3.5	3.5	3.2
VSWR	2.0:1	2.0:1	1.92:1	2.0:1	1.92:1	2.0:1	1.43:1	1.63:1	2.0:1	1.67:1	1.67:1	2.0:1
Rejection												
Amplitude (dB)	40	40	40	40	40	40	35	40	40	40	40	40
LS Range (GHz)	DC - 0.925	DC - 1.175	DC - 1.7	DC - 1.7	DC - 0.25	DC - 1.25	2.4 - 2.54	DC - 1.25	DC - 2.4	DC - 2.3	DC - 1.875	DC - 2.25
HS Range (GHz)	1.45 - 2.5	1.875 - 3.0	2.23 - 5.0	2.5 - 6	4.8 - 11.6	3.8 - 4.75	3.06 - 3.20	4.85 - 6.0	3.85 - 7.0	4.1 - 7.0	4.125 - 6	4.0 - 6.0
Dimensions (inches)												
Length	0.460	0.460	0.350	0.6	0.65	0.500	1.200	0.450	0.500	0.500	0.360	0.393
Width	0.460	0.460	0.210	0.3	0.33	0.250	0.350	0.400	0.250	0.250	0.260	0.353
Height	0.113	0.113	0.098	0.118	0.098	0.110	0.160	0.113	0.100	0.110	0.098	0.128
Dimensions (mm)												
Length	11.68	11.68	8.89	15.24	16.51	12.70	30.48	11.43	12.70	12.70	9.14	9.98
Width	11.68	11.68	5.33	7.62	8.38	6.35	8.89	10.16	6.35	6.35	6.60	8.97
Height	2.87	2.87	2.49	3.00	2.49	2.79	4.06	2.87	2.54	2.79	2.49	3.25

Bandpass Filter Ordering Information



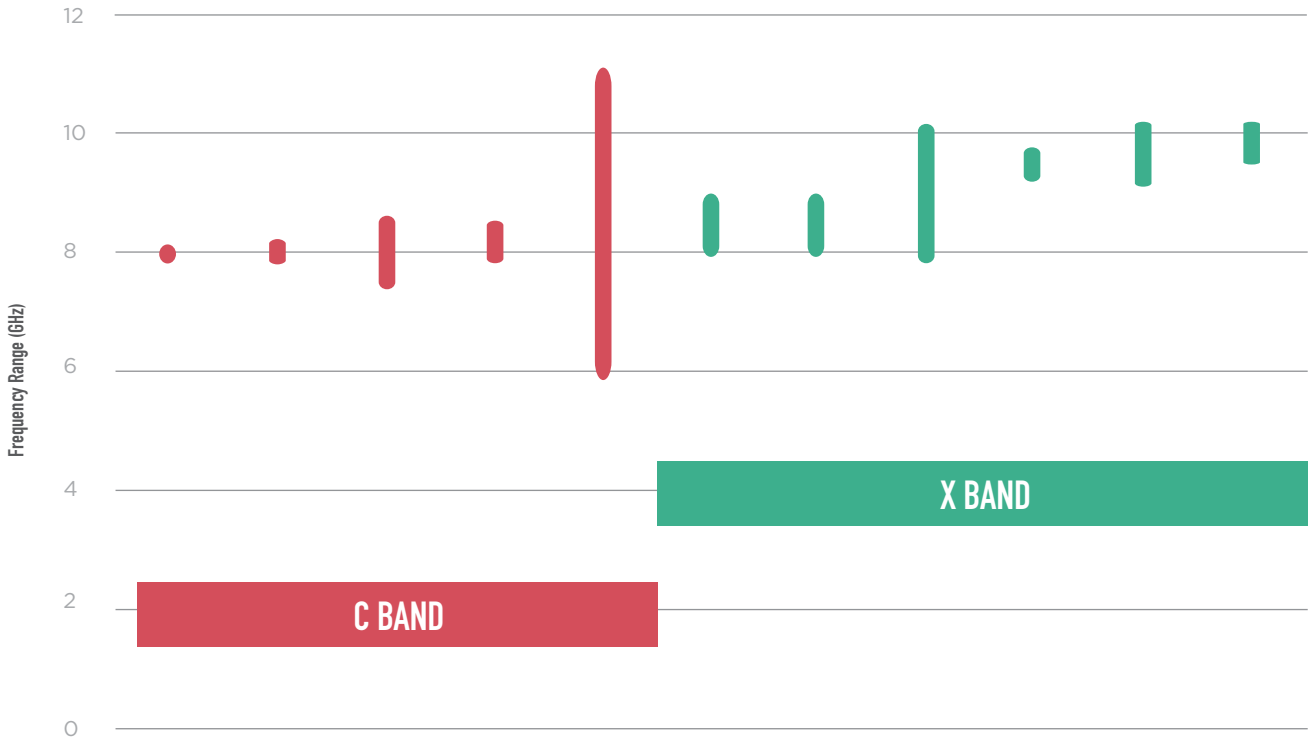
Part Number	B038MC9S	B038NC4S	B039NC5S	B040JC6S	B040MB5S	B040RG9S	B042OD4S	B043QB4S	B042RC3S	B047MC5S	B050ND4S	B052NC5S
Center Frequency (GHz)	3.8	3.8	3.95	4	4	4	4.2	4.5	4.5	4.7	5	5.2
Bandwidth (GHz)	0.38	0.8	0.5	0.004	0.44	4	1	2.2	2.4	0.6	1	0.8
Insertion Loss												
@ 25°C (dB)	4	2.25	2.5	3.5	2.5	2.75	3	6.5	6.5	2	2	2.25
-40°C to +85°C (dB)	4.5	2.5	2.75	4	2.75	3.25	3.5	7	7	2.5	2.5	2.75
VSWR	1.92:1	2.0:1	2.0:1	1.92:1	2.0:7	2.0:1	1.67:1	1.92:1	1.92:1	2.0:1	1.58:1	1.67:1
Rejection												
Amplitude (dB)	40	40	40	40	40	40	40	70	40	40	40	40
LS Range (GHz)	DC - 3.25	DC - 2.8	DC - 3.0	DC - 3.4	DC - 3.4	DC - 0.75	DC - 3.0	DC - 2.6	DC - 2.875	DC - 3.8	DC - 3.65	DC - 3.5
HS Range (GHz)	4.45 - 12	4.7 - 8.9	4.8 - 8.0	4.4 - 10.0	4.6 - 10.0	7.25 - 18.75	5.6 - 10.0	6.4 - 11.0	6.25 - 11.0	5.5 - 11.0	6.15 - 12.0	6.2 - 12.5
Dimensions (inches)												
Length	0.500	0.550	0.500	0.350	0.500	0.590	0.500	0.775	0.900	0.500	0.350	0.350
Width	0.250	0.220	0.250	0.210	0.250	0.280	0.250	0.320	0.320	0.250	0.200	0.200
Height	0.098	0.098	0.110	0.098	0.100	0.093	0.110	0.098	0.158	0.100	0.098	0.095
Dimensions (mm)												
Length	12.70	13.97	12.70	8.89	12.70	14.99	12.70	19.69	22.86	12.70	8.89	8.89
Width	6.35	5.59	6.35	5.33	6.35	7.11	6.35	8.13	8.13	6.35	5.08	5.08
Height	2.49	2.49	2.79	2.49	2.54	2.36	2.79	2.49	4.01	2.54	2.49	2.41

Bandpass Filter Ordering Information



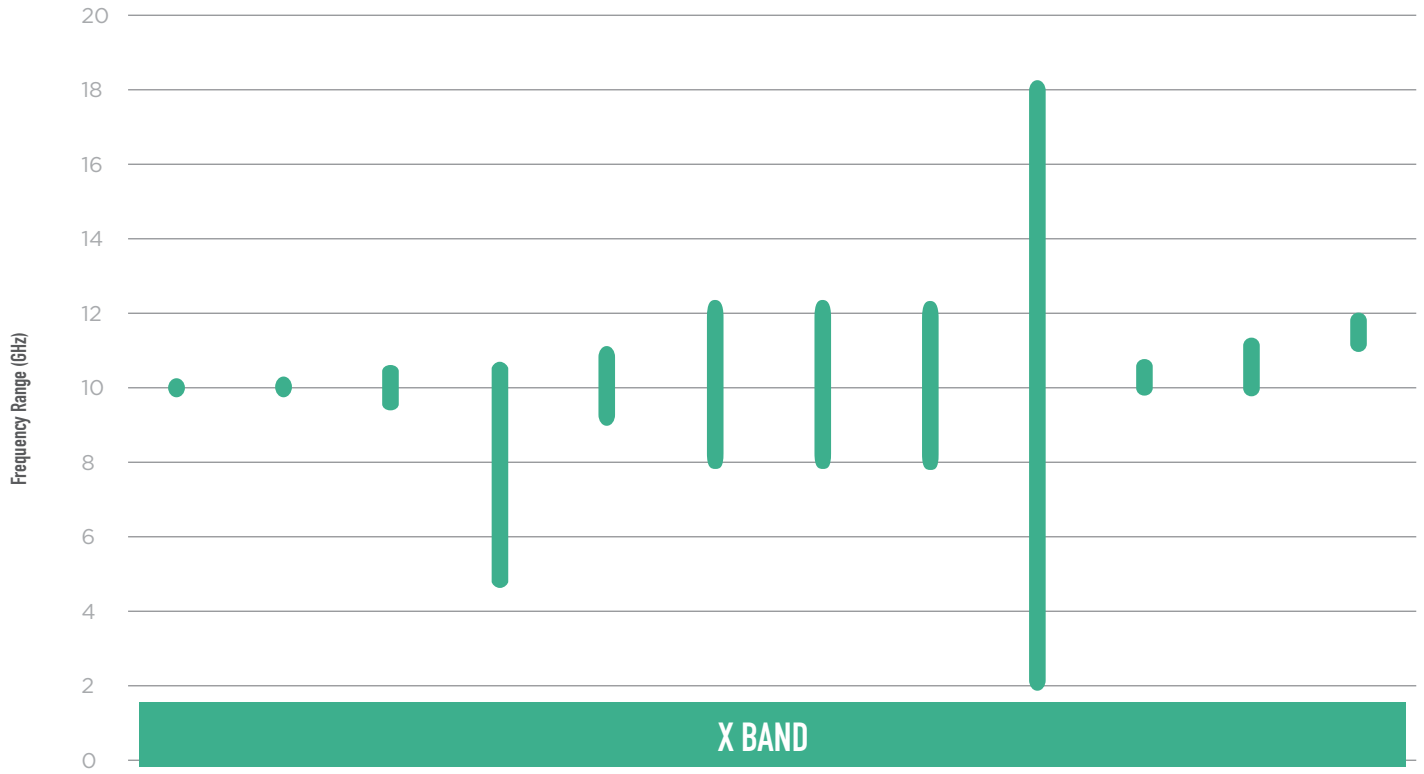
Part Number	B055NC5S	B056MB5S	B057MC5S	B058MD7S	B060NC5S	B056RC4S	B061MB6S	B062MC5S	B065NC5S	B070MB6S	B070NC5S	B076MB6S
Center Frequency (GHz)	5.5	5.6	5.7	5.8	6	5.6	6.1	6.3	6.5	7.1	7	7.6
Bandwidth (GHz)	1	0.05	0.5	0.6	1	4	0.5	0.8	1	0.55	1.26	0.72
Insertion Loss												
@ 25°C (dB)	2	2	2	2.3	2	3	3	2.5	3	2.5	2	2.5
-40°C to +85°C (dB)	2.5	2.5	2.5	2.8	3	3.5	3.5	2.75	3.5	2.75	2.5	2.75
VSWR	2.0:12	2.0:13	1.67:1	1.67:1	1.29:1	1.5:1	2.0:1	1.67:1	1.67:1	2.0:1	2.0:1	2.2:1
Rejection												
Amplitude (dB)	40	40	40	40	40	40	40	40	40	40	40	40
LS Range (GHz)	DC - 4.2	DC - 4.8	DC - 4.7	DC - 4.65	DC - 4.9	DC - 3.0	DC - 5.25	DC - 5.2	DC - 5.2	DC - 6.2	DC - 5.8	DC - 6.69
HS Range (GHz)	6.75 - 12.0	6.75 - 14.0	6.6 - 14.25	7.0 - 16.0	7.1 - 14.0	9.5 - 12.0	7.25 - 16.0	7.5 - 15.0	7.75 - 15.0	7.8 - 15.0	8.5 -17.5	8.52 - 18.25
Dimensions (inches)												
Length	0.350	0.440	0.350	0.048	0.500	0.450	0.450	0.500	0.500	0.500	0.500	0.500
Width	0.200	0.240	0.200	0.275	0.200	0.230	0.200	0.250	0.250	0.200	0.200	0.200
Height	0.095	0.098	0.110	0.103	0.088	0.100	0.098	0.095	0.095	0.100	0.100	0.100
Dimensions (mm)												
Length	8.89	11.18	8.89	1.21	12.70	11.43	11.43	12.70	12.70	12.70	12.70	12.70
Width	5.08	6.10	5.08	6.99	5.08	5.84	5.08	6.35	6.35	5.08	5.08	5.08
Height	2.41	2.49	2.79	2.62	2.24	2.54	2.49	2.41	2.41	2.54	2.54	2.54

Bandpass Filter Ordering Information



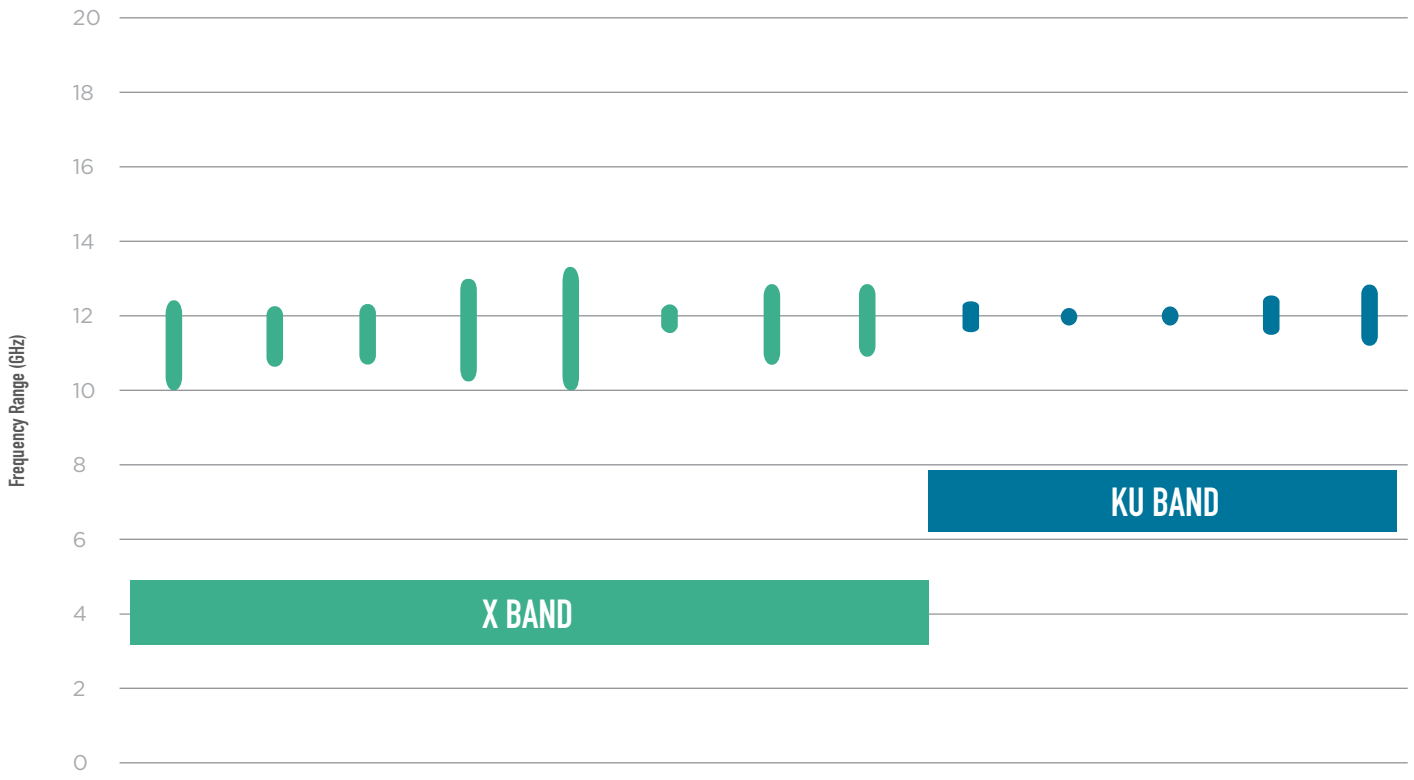
Part Number	B080JB4S	B080KF4S	B080MB5S	B083LB6S	B081RC0S	B084MC6S	B084LF3S	B089NC4S	B094LA2S	B095MB1S	B097MB0S
Center Frequency (GHz)	8	8	8	8.3	8.1	8.4	8.42	8.9	9.4	9.5	9.7
Bandwidth (GHz)	0.008	0.08	1	0.5	5	0.84	0.842	2	0.35	1.1	0.8
Insertion Loss											
@ 25°C (dB)	4	2.5	2	2.5	3.4	4	2	2.5	2.75	1.75	2.5
-40°C to +85°C (dB)	4.5	3	3	2.75	3.9	4.5	2.5	2.75	3	2	2.75
VSWR	1.92:1	1.92:1	1.29:1	1.92:1	2.0:1	1.92:1	1.92:1	1.92:1	1.58:1	1.92:1	1.92:1
Rejection											
Amplitude (dB)	40	40	40	40	40	40	40	40	40	40	40
LS Range (GHz)	DC - 7.4	DC - 5.0	DC - 6.8	DC - 8.825	DC - 3.5	DC - 7.1	DC - 7.0	DC - 6.8	DC - 8.6	DC - 8.0	DC - 8.1
HS Range (GHz)	8.4 - 16.5	9.0 - 16.0	9.25 - 17.0	11.35 - 16.5	14.0 - 19.0	9.75 - 20.0	10.3 - 16.0	11.25 - 20.0	10.25 - 15.0	11.5 - 20.0	11.35 - 23.0
Dimensions (inches)											
Length	0.250	0.250	0.500	0.450	0.190	0.600	0.250	0.400	0.450	0.400	0.400
Width	0.160	0.160	0.180	0.200	0.100	0.300	0.160	0.150	0.200	0.150	0.150
Height	0.098	0.098	0.100	0.103	0.090	0.093	0.098	0.103	0.098	0.103	0.103
Dimensions (mm)											
Length	6.35	6.35	12.70	11.43	4.83	15.24	6.35	10.16	11.43	10.16	10.16
Width	4.06	4.06	4.57	5.08	2.54	7.62	4.06	3.81	5.08	3.81	3.81
Height	2.49	2.49	2.54	2.62	2.29	2.36	2.49	2.62	2.49	2.62	2.62

Bandpass Filter Ordering Information



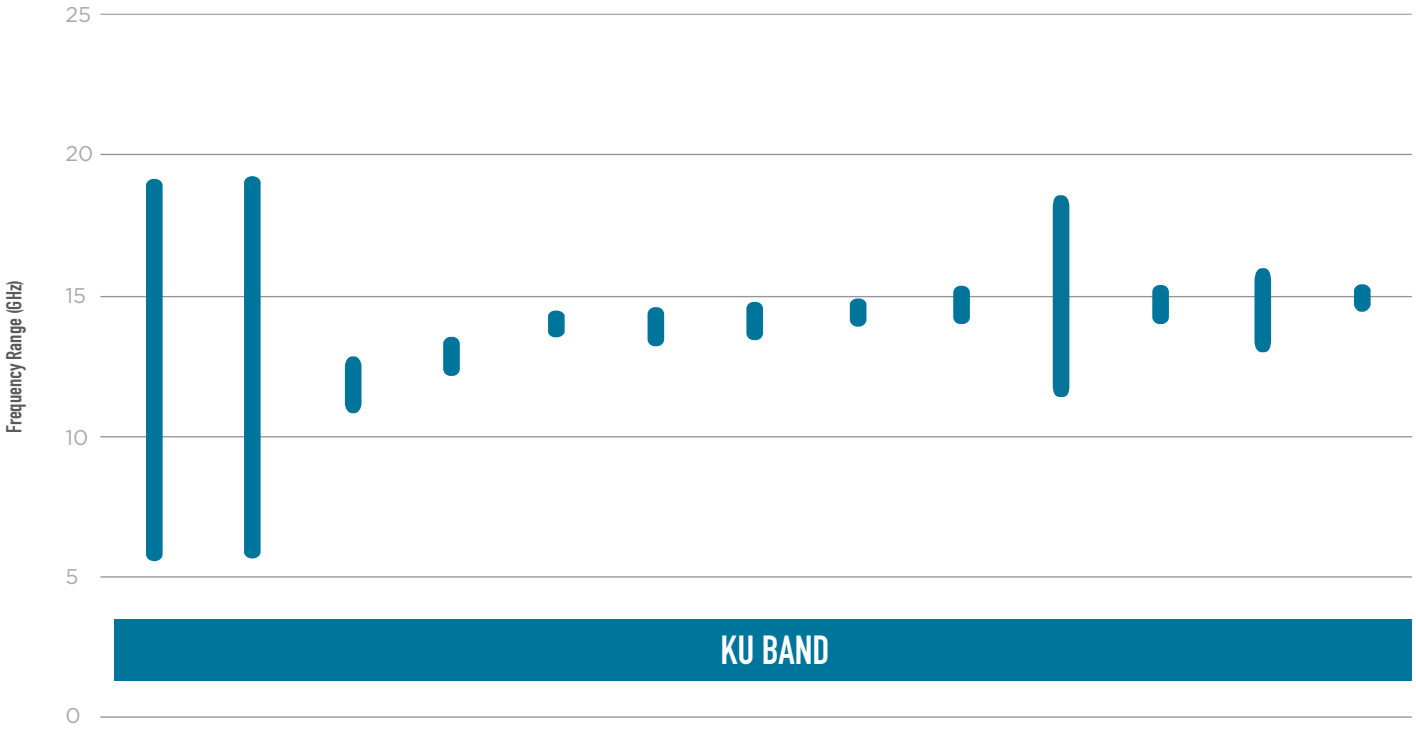
Part Number	B100JB5S	B100KB4S	B100MC5S	B100MD2S	B099NC4S	B096QC2S	B098QC5S	B099QF3S	B100RH4S	B102MC1S	B105MB5S	B112MB1S
Center Frequency (GHz)	10	10	10	10	10.25	10	10	10	10	10.25	10.6	11.2
Bandwidth (GHz)	0.01	0.1	1	1	2.25	4	4	4	16	0.5	1.2	1
Insertion Loss												
@ 25°C (dB)	4	3	2	2	2.25	2.5	3	2	3	2.25	1.75	2.25
-40°C to +85°C (dB)	4.5	3.5	2.5	2.5	2.25	3	3.5	2.5	3.5	2.25	2	2.75
VSWR	1.92:1	1.92:1	1.92:1	1.92:1	1.58:1	2.0:1	1.92:1	1.92:1	1.92:1	1.92:1	1.92:1	1.92:1
Rejection												
Amplitude (dB)	40	40	40		40	40	40	40	20	40	40	40
LS Range (GHz)	DC - 9.45\	DC - 9.3	DC - 8.5	DC - 8.3	DC - 7.5	DC - 6.0	2.0 -6.5	DC - 5.0	DC - 1.0	DC - 9.0	DC - 8.0	DC - 9.4
HS Range (GHz)	10.4 - 18.5	10.55 - 20	11.75 - 20.0	12.5 - 18.5	13.0 - 23.0	14.0 - 18.0	13.5 - 20.0	15.5 - 25.5	21.5 - 30.0	11.35 - 16.5	13.0 - 23.5	13.25 - 20.0
Dimensions (inches)												
Length	0.250	0.250	0.400	0.250	0.400	0.400	0.450	0.170	0.34	0.450	0.450	0.400
Width	0.160	0.160	0.150	0.160	0.150	0.180	0.180	0.140	0.17	0.200	0.200	0.150
Height	0.098	0.098	0.098	0.098	0.090	0.100	0.143	0.093	0.085	0.090	0.103	0.103
Dimensions (mm)												
Length	6.35	6.35	10.16	6.35	10.16	10.16	11.43	4.32	8.64	11.43	11.43	10.16
Width	4.06	4.06	3.81	4.06	3.81	4.57	4.57	3.56	4.32	5.08	5.08	3.81
Height	2.49	2.49	2.49	2.49	2.29	2.54	3.63	2.36	2.16	2.29	2.62	2.62

Bandpass Filter Ordering Information



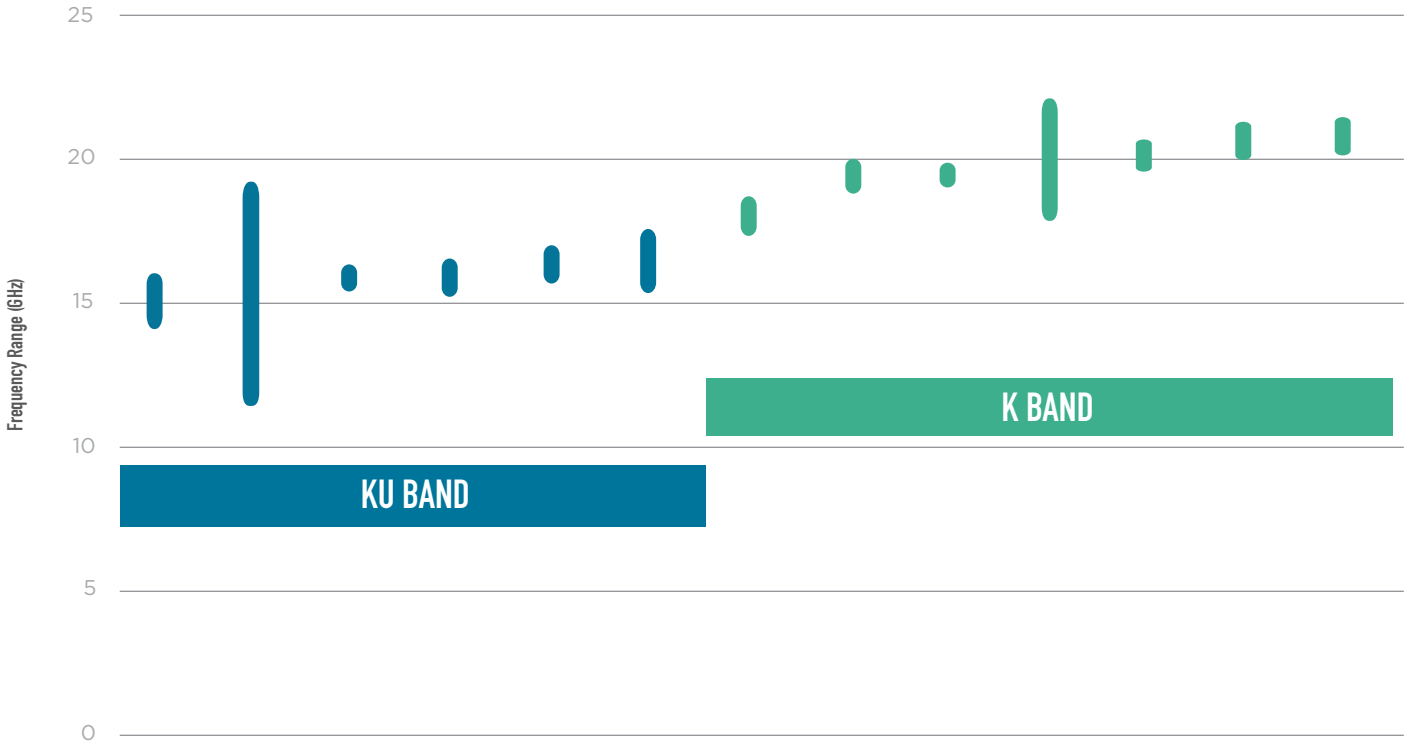
Part Number	B111NC4S	B114MB1S	B114MD2S	B115NB4S	B116NC5S	B118LB4S	B117NB5S	B119MB1S	B119LB1S	B120JA3S	B121KB3S	B120MB1S	B121MB4S
Center Frequency (GHz)	11.2	11.43	11.43	11.6	11.4	11.8	11.75	11.9	11.9	12	12	12	12
Bandwidth (GHz)	2.5	1.14	1.14	2.5	2.25	0.5	2	2.7	2.2	0.012	0.12	1	1.5
Insertion Loss													
@ 25°C (dB)	2.25	3.75	2	2.5	2.25	2.5	3.25	3	3.25	5.25	2.5	2	2.5
-40°C to +85°C (dB)	2.25	4.25	2.5	2.75	2.5	2.75	3.75	3.75	3.75	5.75	3	3	3
VSWR	1.92:1	1.92:1	1.92:1	1.92:1	1.92:1	1.58:1	2:1	1.92:1	2.0:1	1.92:1	1.92:1	1.29:1	1.92:1
Rejection													
Amplitude (dB)	40	40	40	40	40	40	35	40	40	40	40	40	40
LS Range (GHz)	DC - 8.75	DC - 10.0	DC - 9.6	DC - 9.5	DC - 9.0	DC - 10.25	DC - 10	DC - 9.8	DC - 10.75	DC - 11.4	8	DC - 10.6	DC - 9.5
HS Range (GHz)	14.5 -25.0	12.9 - 19.0	14.3 - 20.0	14.5 - 23.0	14.25 - 23.5	13.25 - 18.0	13.5 - 25	13.9 - 20.0	13 - 19.5	12.6 - 20.0	14.0 - 20.0	13.2 - 19.5	14.5 - 24.25
Dimensions (inches)													
Length	0.400	0.400	0.250	0.575	0.400	0.450	0.450	0.450	0.450	0.250	0.250	0.525	0.400
Width	0.150	0.200	0.160	0.200	0.150	0.200	0.175	0.200	0.200	0.160	0.160	0.225	0.150
Height	0.090	0.093	0.098	0.093	0.090	0.103	0.093	0.098	0.098	0.098	0.098	0.090	0.103
Dimensions (mm)													
Length	10.16	10.16	6.35	14.61	10.16	11.43	11.43	11.43	11.43	6.35	6.35	13.34	10.16
Width	3.81	5.08	4.06	5.08	3.81	5.08	4.45	5.08	5.08	4.06	4.06	5.72	3.81
Height	2.29	2.36	2.49	2.36	2.29	2.62	2.36	2.49	2.49	2.49	2.49	2.29	2.62

Bandpass Filter Ordering Information



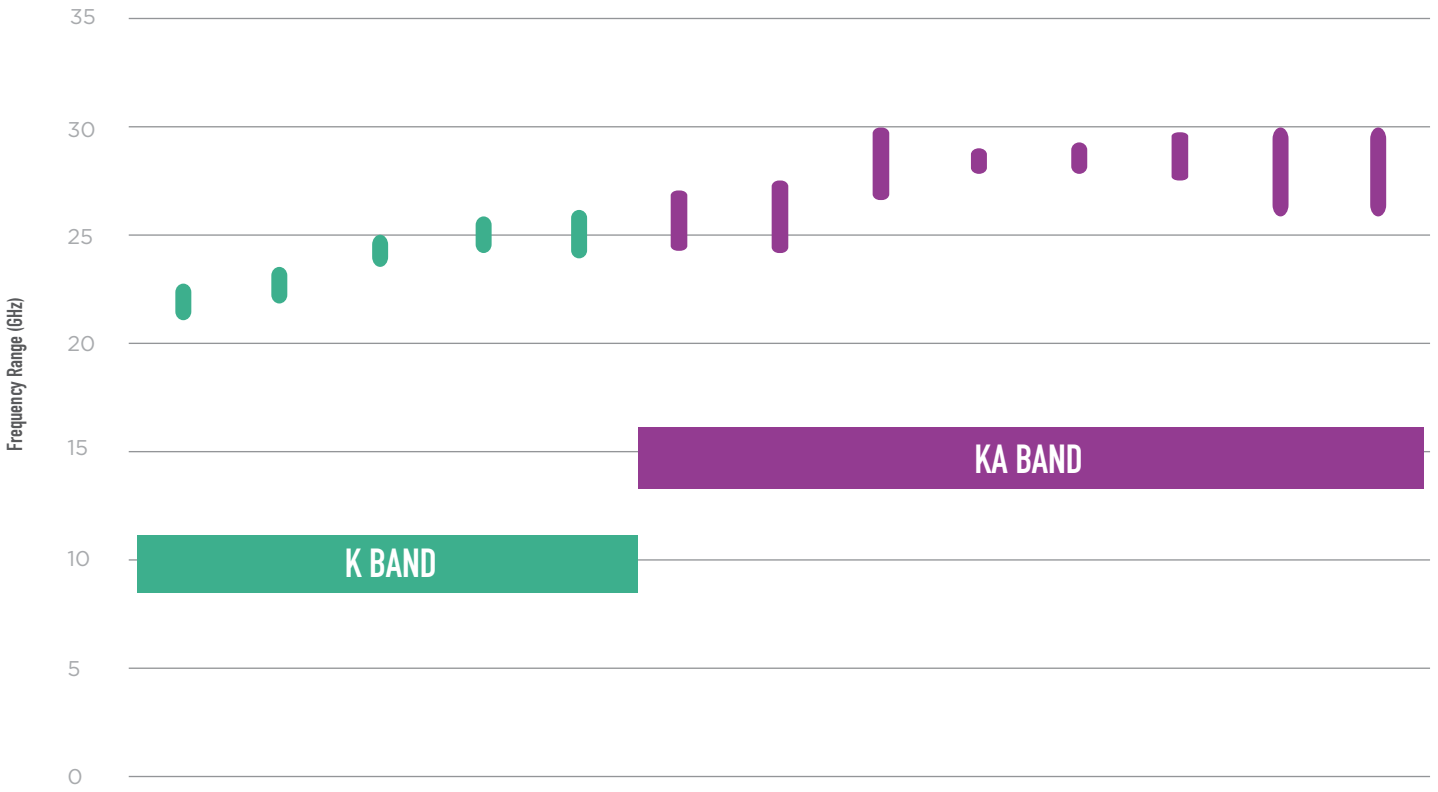
Part Number	B120RF0S	B120RF0W	B121MB4S	B127MB2S	B138LA2S	B138MB1S	B140MB4S	B142LA2S	B145LB1S	B145RE0S	B144MB1S	B150GG0S	B148LA2S
Center Frequency (GHz)	12	12	12.1	12.75	13.75	13.75	14.125	14.2	14.5	15	14.5	14.5	14.75
Bandwidth (GHz)	12	12	1.55	1	0.5	1	0.75	-0.6	0.8	6	1	3	0.5
Insertion Loss													
@ 25°C (dB)	2.5	2.5	1.75	2.75	2.75	2.75	3.75	4.5	3.5	1.75	2.4	2.25	3.25
-40°C to +85°C (dB)	3	3	2.5	3	3.25	3	4.25	5	3.75	2.25	2.5	2.5	3.5
VSWR	2.0:1	2.0:1		1.58:1	1.58:1	1.58:1	2:1	2.0:1	2.0:1	1.92:1	1.58:1	1.58:1	1.58:1
Rejection													
Amplitude (dB)	40	40	40	40	40	40	40	40	40	40	40	40	40
LS Range (GHz)	DC - 3.3	DC - 3.3	DC - 9.5	DC - 10.75	DC - 12.5	DC - 11.75	DC - 12.25	DC - 13.25	DC - 12.5	DC - 8.0	DC - 12.25	DC - 10.5	DC - 13.25
HS Range (GHz)	19.8 - 22.0	19.8 - 22.0	14.5 - 24.0	14.25 - 19.75	14.75 - 22.00	15.25 - 21.00	15.5- 25	15.25 - 25.0	16 - 22.25	22.5 - 26.0	16.25 - 22.0	18.0 - 25.0	16.0 - 20.0
Dimensions (inches)													
Length	0.450	0.450	0.440	0.400	0.450	0.400	0.500	0.575	0.550	0.400	0.400	0.375	0.450
Width	0.200	0.200	0.240	0.200	0.180	0.200	0.180	0.200	0.230	0.180	0.200	0.140	0.180
Height	0.103	0.103	0.098	0.098	0.098	0.098	0.098	0.093	0.093	0.103	0.098	0.093	0.098
Dimensions (mm)													
Length	11.43	11.43	11.18	10.16	11.43	10.16	12.70	14.61	13.97	10.16	10.16	9.53	11.43
Width	5.08	5.08	6.10	5.08	4.57	5.08	4.57	5.08	5.84	4.57	5.08	3.56	4.57
Height	2.62	2.62	2.49	2.49	2.49	2.49	2.49	2.36	2.36	2.62	2.49	2.36	2.49

Bandpass Filter Ordering Information



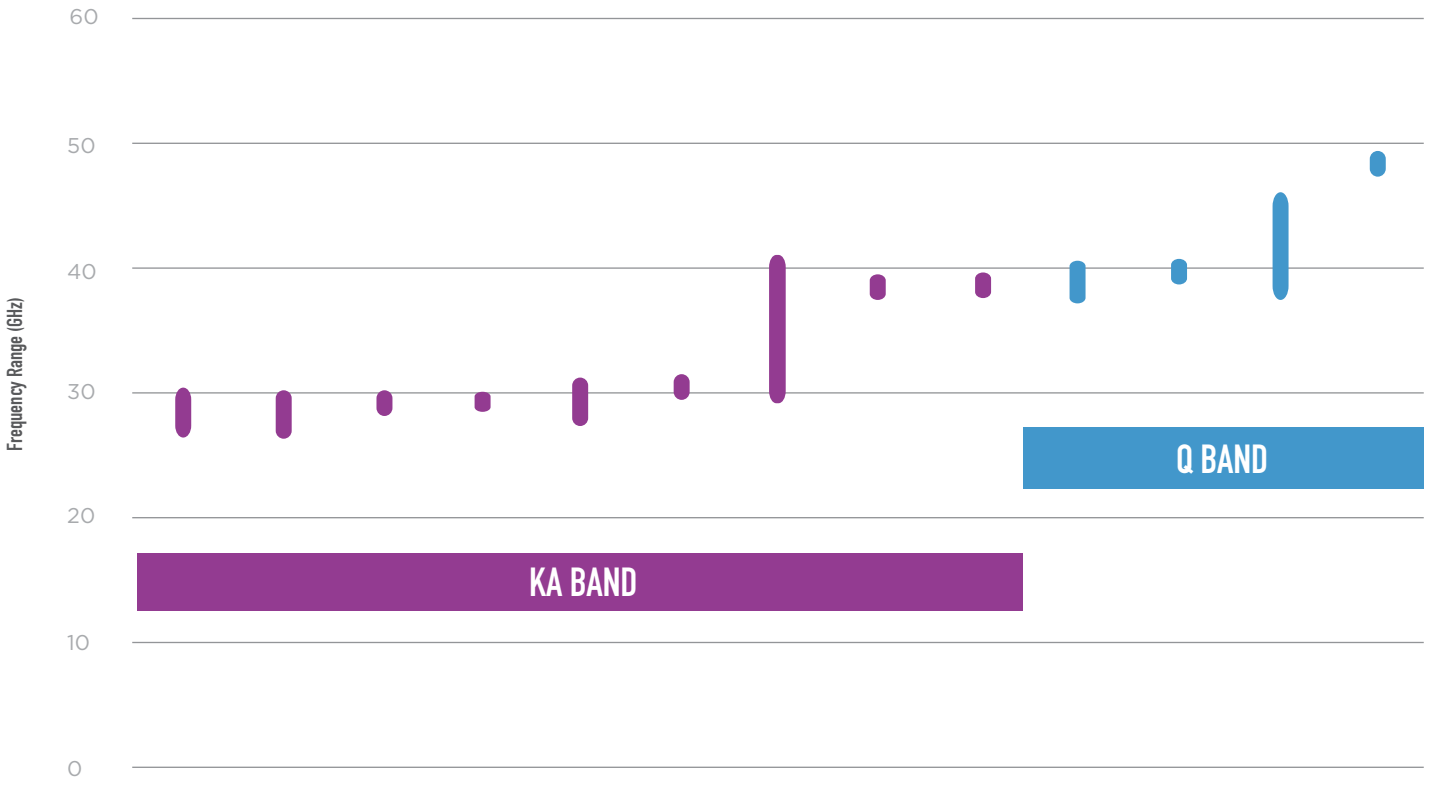
Part Number	B149MC1S	B148QF0S	B160KA1S	B161LA0S	B165LA1S	B168MB1S	B180MA1S	B190MB1S	B191KA1S	B192NB2S	B200LA0S	B207LA0S	B210LA0S
Center Frequency (GHz)	15	15	16	16	16.5	16.75	18	19	19.1	19.2	20	20.7	21
Bandwidth (GHz)	2	6	0.5	1	1	2	1	1	0.5	4	1	1	1
Insertion Loss													
@ 25°C (dB)	2.25	3.6	2.75	4	2.75	2.5	3	3	4.5	3.75	3	3.75	3.25
-40°C to +85°C (dB)	2.5	4.2	3	6	3	2.75	3.25	3.25	5	4.25	3.5	4.25	3.75
VSWR	1.58:1	1.63:1	1.58:1	1.67:1	1.58:1	1.58:1	2.0:1	2.0:1	2.0:1	1.92:1	1.92:1	2.0:1	2.0:1
Rejection													
Amplitude (dB)	40	40	40	40	40	40	40	40	40	40	40	40	40
LS Range (GHz)	DC - 11.0	DC - 7.6	DC - 14.25	DC - 14.7 5	DC - 14.5	DC - 13.4	DC - 16.25	DC - 17.0	DC - 18.0	DC - 15.0	DC - 18.25	DC - 18.7	DC - 19.25
HS Range (GHz)	18.5 - 23.0	23.0 - 25.0	17.75 - 20.5	17.3 - 22.00	18.0 - 25.0	19.25 - 24.00	19.5 - 27.5	20.75 - 27.0	20.0 - 26.0	23.25 - 35.0	21.35 - 28.0	22.4 - 27.0	22.75 - 26.75
Dimensions (inches)													
Length	0.350	0.550	0.400	0.695	0.400	0.350	0.450	0.450	0.575	0.450	0.450	0.450	0.450
Width	0.200	0.150	0.200	0.250	0.200	0.200	0.175	0.175	0.200	0.140	0.175	0.175	0.175
Height	0.098	0.098	0.098	0.093	0.098	0.098	0.093	0.093	0.093	0.088	0.093	0.093	0.093
Dimensions (mm)													
Length	8.89	13.97	10.16	17.65	10.16	8.89	11.43	11.43	14.61	11.43	11.43	11.43	11.43
Width	5.08	3.81	5.08	6.35	5.08	5.08	4.45	4.45	5.08	3.56	4.45	4.45	4.45
Height	2.49	2.49	2.49	2.36	2.49	2.49	2.36	2.36	2.36	2.24	2.36	2.36	2.36

Bandpass Filter Ordering Information



Part Number	B220LA0S	B230LA0S	B240LA0S	B250LA0S	B258MB0S	B260MB2S	B259MC1S	B275MB2S	B279KB1S	B280LA0S	B280LB0S	B274MB1S	B280MC1S
Center Frequency (GHz)	22	23	24	25	25.62	26	26	28	27.9	28	28	28	28
Bandwidth (GHz)	1	1	1	1	2.75	3	3.25	3	0.85	1	2	3	3
Insertion Loss													
@ 25°C (dB)	4	4	4	4	3.5	5	4	3.5	3.75	4.5	2	3.5	3.5
-40°C to +85°C (dB)	4.25	4.5	4.5	4.5	4	5.25	4.25	4	4.25	4.75	2.5	3.75	4
VSWR	2.0:1	2.0:1	2.0:1	2.0:1	1.92:1	1.58:1	1.58:1	1.92:1	1.58:1	1.92:1	1.58:1	1.58:1	1.58:1
Rejection													
Amplitude (dB)	40	40	40	40	35	40	30	40	40	30	40	40	30
LS Range (GHz)	DC - 20.25	DC - 21.25	DC - 22.0	DC - 23.0	DC - 20.0	DC - 22.6	DC - 23.0	DC - 24.0	DC - 25.9	DC - 26.0	DC - 25.0	DC - 24.0	DC - 24.5
HS Range (GHz)	23.75 - 28.6	25.0 - 31.5	25.7 - 30.0	26.75 - 30.0	29.0 - 35.0	28.6 - 35.0	29.5 - 41.0	31.0 - 38.0	30.0 - 40.0	30.0 - 38.0	30.75 - 34.25	31.0 - 39.0	31.0 - 41.0
Dimensions (inches)													
Length	0.450	0.450	0.450	0.450	0.354	0.260	0.217	0.450	0.290	0.550	0.350	0.450	0.217
Width	0.140	0.140	0.140	0.140	0.197	0.120	0.090	0.110	0.080	0.140	0.120	0.110	0.090
Height	0.088	0.088	0.088	0.088	0.088	0.079	0.070	0.088	0.070	0.083	0.098	0.089	0.070
Dimensions (mm)													
Length	11.43	11.43	11.43	11.43	8.99	6.60	5.50	11.43	7.37	13.97	8.89	11.43	5.50
Width	3.56	3.56	3.56	3.56	5.00	3.05	2.29	2.79	2.03	3.56	3.05	2.79	2.29
Height	2.24	2.24	2.24	2.24	2.24	2.01	1.78	2.24	1.78	2.11	2.49	2.26	1.78

Bandpass Filter Ordering Information



Part Number	B280MD1S	B280MF1S	B285LB2S	B289KA0S	B291MB0S	B305LA0S	B350NB2S	B380KA1S	B381KD0S	B385MD0S	B393KD0S	B424MB1S	B479KB0S
Center Frequency (GHz)	28	28	28.5	28.9	29.25	30.5	35	38	38.1	38.5	39.3	42.5	47.9
Bandwidth (GHz)	3	3	2	0.5	3.5	1	10	1	1	3	1.4	4.75	1
Insertion Loss													
@ 25°C (dB)	3	3	3.25	4.3	3	4	4.25	4.5	2.5	2.5	2.5	3	4.25
-40°C to +85°C (dB)	3.5	3.25	3.75	4.8	3.5	4.5	4.75	5	2.75	2.75	2.75	3.5	4.75
VSWR	1.58:1	1.58:1	1.58:1	2.0:1	2.0:1	2.0:1	1.92:1	1.92:1	1.92:1	1.92:1	1.92:1	2.0:1	1.92:1
Rejection													
Amplitude (dB)	35	30	40	40	40	40	40	35	40	40	40	30	40
LS Range (GHz)	DC - 23.5	DC - 23.0	DC - 25.7	DC - 27.2	DC - 25.25	DC - 28.25	DC - 26.0	DC - 36.0	DC - 35	DC - 34.0	DC - 36	DC - 36.5	DC - 40.0
HS Range (GHz)	31.75 - 42.0	32.0 - 42.0	31.0 - 40.0	30.6 - 34.0	32.5 - 35.0	32.7 - 38.0	32.5 - 48.0	39.2 - 45.0	43 - 53	44.0 - 56.0	45 - 53	49 - 64	51.5 - 62.0
Dimensions (inches)													
Length	0.158	0.158	0.330	0.550	0.450	0.550	0.275	0.300	0.275	0.275	0.275	0.236	0.25
Width	0.090	0.090	0.120	0.140	0.140	0.140	0.080	0.080	0.080	0.080	0.080	0.080	0.08
Height	0.070	0.070	0.079	0.078	0.088	0.078	0.070	0.074	0.070	0.070	0.070	0.065	0.085
Dimensions (mm)													
Length	4.01	4.01	8.38	13.97	11.43	13.97	6.99	7.62	6.99	6.99	6.99	5.99	6.35
Width	2.29	2.29	3.05	3.56	3.56	3.56	2.03	2.03	2.03	2.03	2.03	2.03	2.03
Height	1.78	1.78	2.01	1.98	2.24	1.98	1.78	1.88	1.78	1.78	1.78	1.65	2.16

Lowpass Filters - Surface Mount

Part Number	L050XF9S	L065XG9S	L090XE6S	L095XG9S	L117XH4S	L128XH4S	L157XG3S	L185XF4S	L204XF4S	L220XH5S	L254XF3S	L288XC3S
Passband Frequency (GHz)												
3dB Cutoff Frequency	5	6.5	9	9.5	11.7	12.8	15.7	18.5	20.4	22	25.4	28.6
Low	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
High	4	6	9	9	11	12	15	18	20	22.4	25	27.65
Rejection												
Amplitude (dB)	45	40	60	40	40	40	40	30	35	45	35	45
HS Range (GHz)	6-16.0	7.9 - 20.0	11-20.0	11.5 - 32.0	17.6 -27.8	18.8 31.2	19.9 - 32.2	20.5 - 40.0	23 - 42.0	26.75 - 50.0	29. 5 0.0	34 - 50.0
Insertion Loss												
Max @25°C (dB)	1.0	1.3	2	1.3	1.0	1.2	2.2	2.2	1.8	2.5	1.4	2.0
Dimensions (inches)												
Length	0.220	0.220	0.360	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220
Width	0.180	0.180	0.120	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140
Height	0.103	0.103	0.104	0.103	0.103	0.103	0.103	0.098	0.098	0.118	0.098	0.098
Dimensions (mm)												
Length	5.59	5.59	9.14	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59
Width	4.57	4.57	3.05	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56
Height	2.62	2.62	2.64	2.62	2.62	2.62	2.62	2.49	2.49	3.00	2.49	2.49

Lowpass Filters - Chip and Wire

Part Number	L065XG9W	L117XH4W	L157XF3W	L185XF4W
Passband Frequency (GHz)				
3dB Cutoff Frequency	6.5	11.7	17	18.5
Low	DC	DC	DC	DC
High	6	11	16.5	18
Rejection				
Amplitude (dB)	40	40	35	30
HS Range (GHz)	8.0-22.4	17.6-27.8	20.5-29.5	20.5-40.0
Insertion Loss				
Max @25°C (dB)	1.3	2.0	2.0	2.0
Dimensions (inches)				
Length	0.220	0.220	0.220	0.220
Width	0.140	0.140	0.140	0.140
Height	0.118	0.113	0.108	0.113
Dimensions (mm)				
Length	5.59	5.59	5.59	5.59
Width	3.56	3.56	3.56	3.56
Height	3.00	2.87	2.74	2.87

Notch Filters

DLI brand notch filters offer attenuation of signals in a specific band, with a compact footprint and extreme repeatability. These are often used in conjunction with a bandpass filter to further attenuate certain frequencies. Contact us for a custom solution for the frequency range you need.

Part Number	N012ME9S	N016MD9S
Notch Frequency (MHz)	1227	1575
Passbands (MHz)	500-1000 and 1500-2000	DC-1300 and 1800-3000
Passband Insertion Loss (dB)	1.5	1.5
Rejection in Notch (dB)	20	20
Length (in)	0.350	0.250
Width (in)	0.300	0.250
Height (in)	0.103	0.100

Highpass Filters- Surface Mount

Part Number	H060XHXS	H080XHXS	H100XHXS	H120XHXS	H140XHXS	H160XHXS	H168XHXS	H182XHXS	CHIP AND WIRE H026XHXW
Passband Frequency (GHz)									
3dB Cutoff Frequency	6	8	10	12	14	16	16.95	18.2	2.6
Low	6.5	8.5	10.5	12.5	14.5	16.5	18	18.75	3
High	20	22	23	30	28	32.5	30	28	18
Rejection									
Amplitude (dB)	30	30	30	30	30	30	30	30	65
LS Range (GHz)	DC - 3.5	DC - 5	DC - 5.5	DC - 9	DC - 9.5	DC - 12.1	DC - 13.0	DC - 14	DC - 1.4
Insertion Loss									
Max @25°C (dB)	1	1	1	1	1	1	1	1	0.8
Dimensions (inches)									
Length	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.250
Width	0.200	0.200	0.175	0.175	0.175	0.175	0.175	0.175	0.160
Height	0.093	0.093	0.083	0.083	0.083	0.083	0.083	0.083	0.010
Dimensions (mm)									
Length	11.43	11.43	11.43	11.43	11.43	11.43	11.43	11.43	6.35
Width	5.08	5.08	4.45	4.45	4.45	4.45	4.45	4.45	4.00
Height	2.36	2.36	2.11	2.11	2.11	2.11	2.11	2.11	0.25

CERTIFICATION:

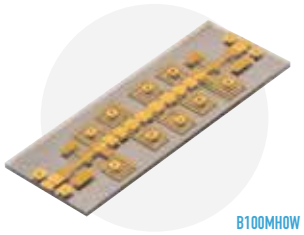
RoHS 2011/65/EU Lead Free

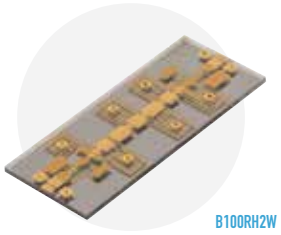
Certified System SAI GLOBAL ISO 9001 Quality

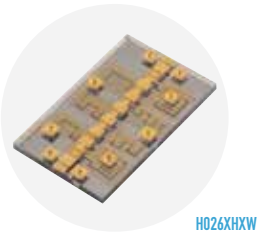
Certified System SAI GLOBAL AS9100 Aerospace

Wideband Filters (2-18GHz) for Chip and Wire Assembly

- Integrated wideband solutions for COTS
- Temperature stability -55 to 125°C
- Integrated Quasi-lumped Planar Custom Designs
  Note: SMD version available B100RH4S


B100MH0W


B100RH2W


H026XHXW

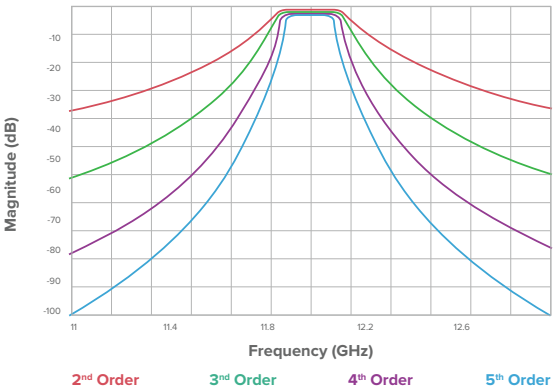
Part Number	B100MH0W		B100RH2W		H026XHXW	
Parameter	**Frequency Range (GHz)**	**Spec (dB)**	**Frequency Range (GHz)**	**Spec (dB)**	**Frequency Range (GHz)**	**Spec (dB)**
Typical Insertion Loss	2.0 - 3.0	2	2.0 - 18.0	0.7	3.0 - 25.0	0.8
	3.0 - 18.0	0.7				
Typical Return Loss	2.0 - 18.0	15	2.0 - 18.0	12	3.0 - 25.0	12
Minimum Low Side Rejection	DC - 1.20	60	DC - 0.80	60	DC - 1.40	60
	1.20 - 1.30	40	0.80 - 0.90	40	1.40 - 1.70	40
Minimum High Side Rejection	23.0 - 25.0	35	22.0 - 29.0	25		
			29.0 - 35.0	15		
Size (inches) L x W x H	0.420 x 0.160 x 0.010		0.370 x 0.160 x 0.010		0.250 x 0.160 x 0.010	
Size (mm) L x W x H	10.67 x 4.06 x 0.25		9.40 x 4.06 x 0.25		6.35 x 4.06 x 0.25	

Ceramic Cavity Filters

Part Number	C079KB1S	C142KB0S
Center Frequency (GHz)	7.85	14.25
Bandwidth (GHz)	0.15	0.5
Insertion Loss		
@ 25°C (dB)	2.25	2.25
-40°C to +85°C (dB)	2.75	2.75
Return Loss		
@ 25°C (dB)	14	14
Rejection		
Amplitude (dB)	50	50
LS Range (GHz)	DC - 7.25	DC - 12.9
HS Range (GHz)	8.5 - 11.0	16.6 - 19
Dimensions (inches)		
Length	0.937	0.636
Width	0.238	0.238
Height	0.064	0.064
Dimensions (mm)		
Length	23.80	16.15
Width	0.60	6.05
Height	1.63	1.63

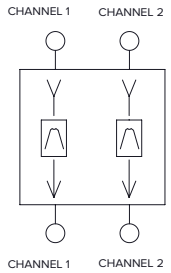
DLI brand cavity filters utilize proprietary high-Q ceramics to enable miniaturized, highly selective low-loss SMD filters. This design dramatically reduces the part's size, compared to traditional air-filled cavity filters, which makes them a perfect choice for applications with SWAP constraints. These cavity filters enable integration with their small size, shielding and surface mount configuration, achieving repeatable performance without the need for mechanical tuning.

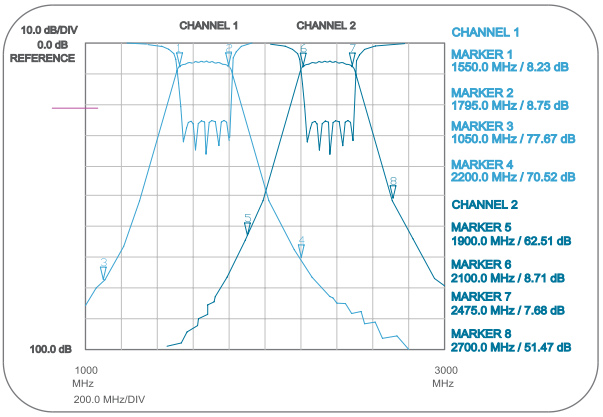
TYPICAL CAVITY FILTER TRANSMISSION COEFFICIENT



Integrated Multi-band Filters

FILTERBANK, DUALBANK OR MULTIBANK





AFL09387 28 and 40GHz Dual Filter (SMD) with 2 Inputs, 2 Outputs

	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)
LOW BAND	Maximum Insertion Loss	26.5 - 29.5	4.5
	Minimum Return Loss	26.5 - 29.5	10
	Minimum Low Side Rejection	DC - 23.5	35
	Minimum High Side Rejection	32. 0 - 43.0	35
HIGH BAND	Maximum Insertion Loss	37.0 - 40.0	4.5
	Minimum Return Loss	37.0 - 40.0	10
	Minimum Low Side Rejection	DC - 33.0	40
	Minimum High Side Rejection	44.0 - 55.0	25
SIZE (nominal)	L x W x H	0.275 x 0.187 x 0.060	inches
	L x W x H	6.99 x 4.75 x 1.52	mm

40GHz Dual Filter (SMD) with 2 Inputs, 2 Outputs

	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)
LOW BAND	Maximum Insertion Loss	26.5 - 29.5	4.5
	Minimum Return Loss	26.5 - 29.5	10
	Minimum Low Side Rejection	DC - 23.5	35
	Minimum High Side Rejection	32. 0 - 43.0	35
HIGH BAND	Maximum Insertion Loss	37.0 - 40.0	4.5
	Minimum Return Loss	37.0 - 40.0	10
	Minimum Low Side Rejection	DC - 33.0	40
	Minimum High Side Rejection	44.0 - 55.0	25
SIZE (nominal)	L x W x H	0.275 x 0.187 x 0.060	inches
	L x W x H	6.99 x 4.75 x 1.52	mm

Knowles' Customized Designs Frequency Range: DC – 40 GHz

Available Technology:

- Microstrip
- Ceramic
- Cavity
- Lumped Element

Available Configurations:

- Surface Mount (SMD)
- Chip and Wire (Wirebond)
- PC Mount
- Connectorized
- Customized
- RoHS
- Hermetic

DIFFERENTIAL FILTERS

L095XG4S Differential Lowpass Filter (SMD) with 2 Inputs, 2 Outputs

	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)
PASSBAND	Maximum Insertion Loss	DC - 9.0	1.5
	Minimum Return Loss	DC - 9.0	10
	Minimum High Side Rejection	11.0 - 20.0	20
SIZE (nominal)	L x W x H	0.200.x 0.174 x 0.103	inches
	L x W x H	5.08 x 4.45 x 2.62	mm

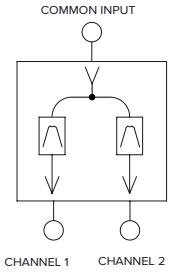
B097QF0S Differential Bandpass Filter (SMD) with 2 Inputs, 2 Outputs

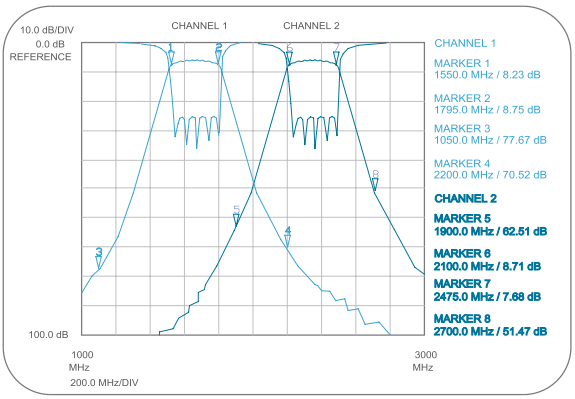
	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)
PASSBAND	Maximum Insertion Loss	8.0 - 12.0	1
	Minimum Return Loss	8.0 - 12.0	10
	Minimum Low Side Rejection	2.0 - 6.0	20
	Minimum High Side Rejection	16.0 - 20.0	20
SIZE (nominal)	L x W x H	0.375.x 0.225 x 0.078	inches
	L x W x H	9.53 x 5.72 x 1.98	mm

Diplexers

Knowles' expertise delivers highly efficient and frequency selective integrated multi-band solutions in a variety of configurations for the most targeted performance (up to 4 bands), including COTS PNs for Telecom Applications. This approach not only saves space but also streamlines design and placement through integration.

DIPLEXER, DUPLEXER OR MULTIPLEXER





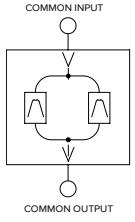
ADP09388 28 and 40GHz Diplexer (SMD) with 1 Input, 2 Outputs

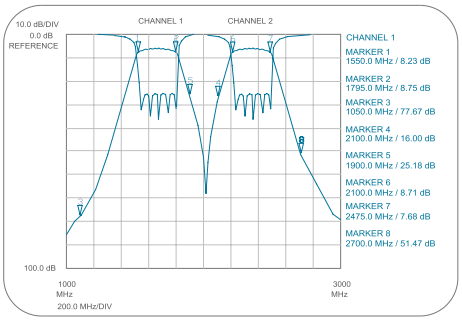
	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)
LOW BAND	Maximum Insertion Loss	26.5 - 29.5	4.5
	Minimum Return Loss	26.5 - 29.5	10
	Minimum Low Side Rejection	DC - 23.5	35
	Minimum High Side Rejection	32. 0 - 43.0	35
HIGH BAND	Maximum Insertion Loss	37.0 - 40.0	4.5
	Minimum Return Loss	37.0 - 40.0	10
	Minimum Low Side Rejection	DC - 33.0	40
	Minimum High Side Rejection	44.0 - 55.0	25
SIZE (nominal)	L x W x H	0.335 x 0.180 x 0.070	inches
	L x W x H	8.51 x 4.57 x 1.52	mm

Ku Band Diplexer (SMD) with 1 Input, 2 Outputs

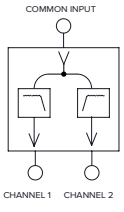
		ADP12055		ADP12054	
	PARAMETER	FREQUENCY RANGE (GHZ)	SPEC (DB)	FREQUENCY RANGE (GHZ)	SPEC (DB)
LOW BAND	Maximum Insertion Loss	10.75 - 12.75	3.5	10.75 - 12.75	4
	Minimum Return Loss	10.75 - 12.75	10	10.75 - 12.75	10
	Minimum Low Side Rejection	DC - 10.0	35	DC - 10.0	40
	Minimum High Side Rejection	13.5 - 23.0	35	13.5 - 30.0	40
HIGH BAND	Maximum Insertion Loss	13.75 - 14.5	3.5	17.25 - 21.25	4
	Minimum Return Loss	13.75 - 14.5	10	17.25 - 21.25	10
	Minimum Low Side Rejection	DC - 12.25	40	DC - 16.0	40
	Minimum High Side Rejection	15.5 - 23.0	40	22.5 - 30.0	40
SIZE (nominal)	L x W x H	0.500 x 0.370 x 0.083	inches	0.450 x 0.310 x 0.088	inches
	L x W x H	12.70 x 9.39 x 2.10	mm	11.43 x 7.87 x 2.24	mm

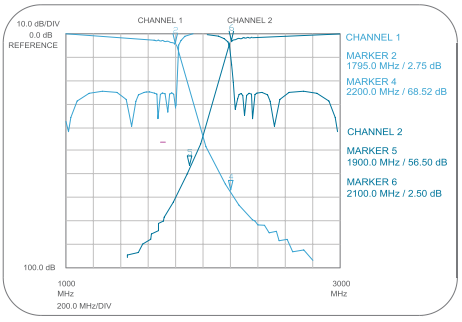
DUALBAND OR MULTIBAND





HI/LO DIPLEXER, DUPLEXER OR MULTIPLEXER





Custom Devices, Testing and Design Evaluation Boards

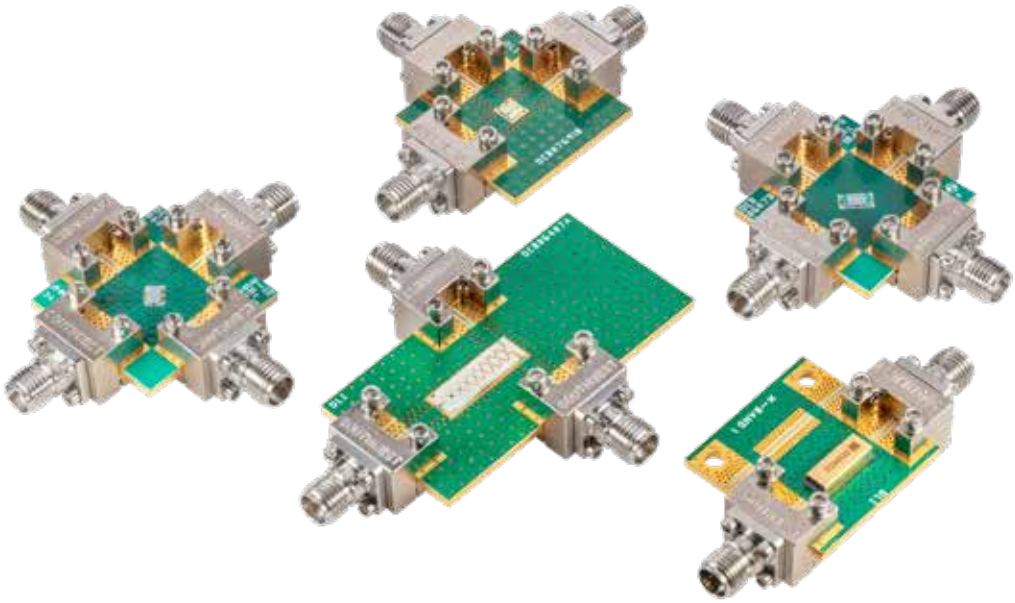
The part numbers in this catalog are available off-the-shelf and through distribution partners. Also, they can serve as a starting point for a customized DLI device. Whether you'd like to adjust the bandwidth, integrate with a passive device, or tweak other aspects of the performance, our RF design engineers are here to work with you.

DLI custom devices deliver repeatable results through design, precision manufacturing, and inspection. The PNs listed in this catalog* are based on space-qualified technology and tested to ensure consistent performance:

- 100% RF Testing* to Specs
- 100% Visual Inspection to MIL-STD-883 Method 2032
- Sample solderability or wire bond testing depending on configuration/termination finish
- Add a -E to the end of any DLI part number listed to add Space Level Screening Tests.
  - » Screening per MIL-PRF-38534 Substrate evaluation (Table C-V)

* Some devices are an exception and will be sample RF tested due to test constraints

Summary of -E Screening Tests		
100%		RF Testing
100%		Visual Inspection
Group A	5 pieces	Physical Dimensions
		Visual Inspection
		Electrical Testing
Group B	3 pieces	Conductor Thickness
		Film Adhesion
		Solderability
Group C	2 pieces	TCR
		10 wire bond test
		Die shear evaluation



- DLI brand Design Evaluation Boards (DEB) are a great way to test the assembled performance of DLI devices in a connectorized module. Inquire for availability for the part numbers listed in this catalog as well as custom designs.
- Each DEB includes a device mounted onto a 10 mil thick Rogers RO4350B circuit board with an aluminum base plate and connectors at each I/O port.
- **DEB FEATURES: Fully assembled test board for evaluation of DLI devices**
- Maximum Temperature for Exposure: 150°C

Note: DEB electrical specifications differ from the performance of the device alone as listed on the datasheet due to losses from the board and connectors. DEBs are not RoHS Compliant due to SnPb solder used to attach the part to the board (and for filters, solder for attaching the integrated shielding, RoHS compliant per exemption 7a)

Integrating RF Passives on a Single Substrate

Knowles' has done a lot of passive integration!

BPF + LPF = **Wideband Harmonic Rejection**

HPF + LPF = **Ultra Wide Passband Performance**

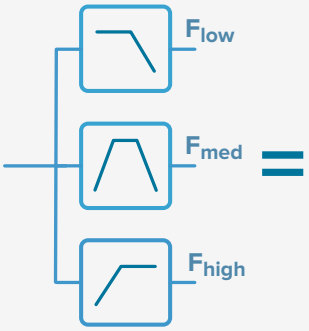
BPF + EQUALIZER = **High Selectivity Filters with Flat Passband**

BPF + PDW = **Filtering with Power Combining / Splitting**

BPF + NOTCH = **Filtering with Additional Attenuation**

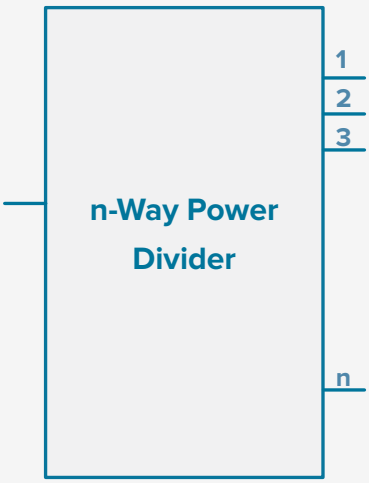
COUPLER + RESISTOR = **Coupler with Built-In Termination**

INTEGRATE MULTIPLE FILTER PATHWAYS



= **Reduced Footprint**
-Multiplexers
-Filter Banks

INTEGRATE COMBINER/SPLITTER UP TO 16-WAYS



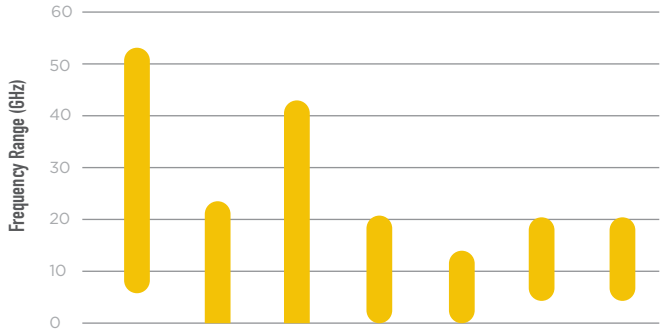
= **Reduced Footprint, Repeatable Performance**

N – Way Power Combiners / Dividers

Wideband Performance Devices

for All Surface Mount Applications

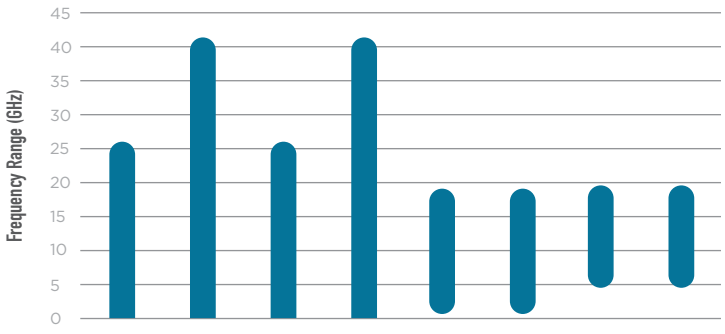
Power Dividers



Part Number	PDW09692	PDR06390	PDR06380	PDW06407	PDW06038	PDW05758	PDW06089
Configuration	2:1	2:1	2:1	2:1	2:1	2:1	4:1
Nominal Power Splitting	3dB	6dB	6dB	3dB	3dB	3dB	6dB
Freq. Low (GHz)	8	0	0	2	2	6	6
Freq. High (GHz)	50	20	40	18	10	18	18
Typical Excess Insertion Loss (dB)	0.5	0.25	0.5	2.5	1.25	2.35	0.8
Typical Return Loss (dB)	17	20	20	18	20	20	15
Typical Isolation (dB)	20	6	6	20	20	25	20
L x W x H (mils)	220x80 x10	75x70 x10	75x65 x10	600x180 x20	400x250 x20	186x160 x20	300x250 x20
Additional Details on	Page 41						

For wirebond configured PNs check out page 42

Couplers



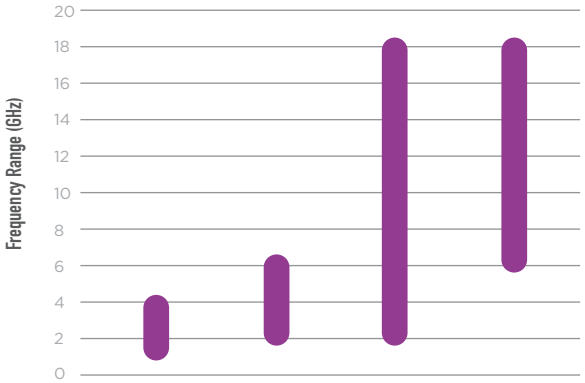
Part Number	FPC06881	FPC07803	FPC06882	FPC07802	FPC07234	FPC07180	FPC06719	FPC06913
Fl (GHz)	DC	DC	DC	DC	2	2	6	6
Fh (GHz)	25	40	25	40	18	18	18	18
Coupler Type	Resistive				Directional			
Nominal Coupling (dB)	20	20	30	30	10	20	10	20
Excess Insertion Loss Typ. (dB)	2.85	3	2	2.5	0.8	1	0.5	0.3
Isolation Typ. (dB)	n/a*	n/a*	n/a*	n/a*	20	25	23	30
L x W x H (mils)	88x60x10				500x150 x30	500x150 x15	255x100 x15	180x110 x15
Additional Details on	Page 39				Page 38			

* 3-port device, isolation does not apply

For wirebond configured PNs check out page 42

See also Quad Hybrid Couplers on page 39

Filters



Part Number	B023RH7S	B040RG9S	B100RH4S	B120RF0S
Center Frequency (GHz)	2.665	4	10	12
Bandwidth (GHz)	100%	160%	100%	100%
Insertion Loss @ 25°C (dB)	2.5	2.75	3	2.5
L x W x H (mils)	650x330x98	590x280x93	340x170x85	450x200x103
Additional Details on	Page 18	Page 19	Page 22	Page 24

For wirebond 2-18GHz Filters check out page 29

Broadband Capacitors – Milli-Cap®

Milli-Cap® capacitors are broadband blocking capacitors with performance over a wide range of frequency from 20 MHz – 50 GHz with Insertion Loss less than 0.6 dB.

Each capacitor has very low series Inductance and matches typical 50Ω transmission lines, available in standard footprints – 0201, 0402 and 0602.

Standard Part Numbers in the table below are available in both Waffle Pack and Tape & Reel Packaging.

Part Number	P21BNL300M5S	P42BNL820M5S	P62BNL820M5S
Voltage Rating	50V		
Temperature Coefficient of Capacitance	±15%		
Dissipation Factor	3.50%		
Min. Insulation Resistance (MΩ)	105		
Frequency Range	20 MHz – 50 GHz		
Part Size	0201	0402	0602

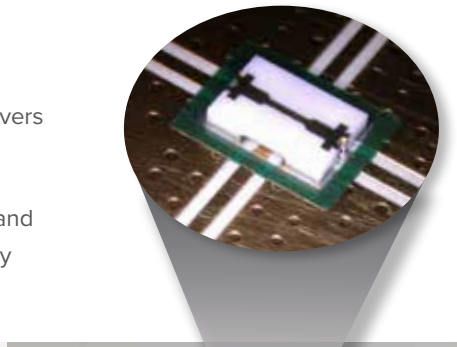
See SLC catalog for additional information

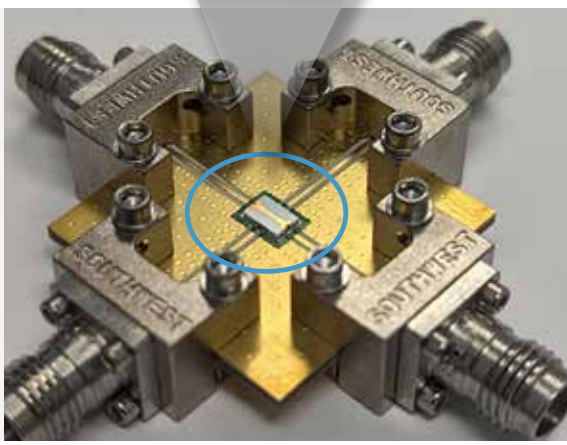
High Frequency RF Crossover

From DC - 40GHz | Knowles Part Number DDL10519

Our crossover enables integration into defense and space applications that operate in higher frequency bands such as X, Ku, K and Ka bands where currently available crossovers cannot operate.

Using Knowles' new crossover at higher frequency bands simplifies PCB signal routing and construction which helps to mitigate VSWR issues from transitioning in and out of loosely controlled multilayer board construction.





FEATURES & BENEFITS

- Wideband performance covering DC-40GHz
- Ease of implementation (compared to multilayer boards)
- Over 40dB isolation from DC-10GHZ and over 30dB isolation from 10-40GHz
- Over 20dB return loss from DC-10GHz and over 12dB return loss from 10-40GHz
- Small size L 0.15" x W 0.10" x H 0.02"

APPLICATIONS

Aerospace

Radar

Telecom

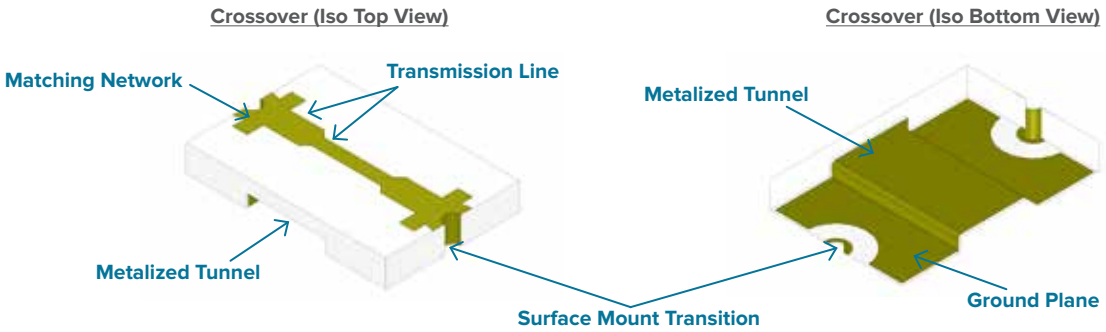
Defense

The use of complex multilayer printed circuit boards (PCBs) has become standard, even for the simplest of RF boards, in order to cross over an RF or digital trace. A less expensive, less complex alternative is the component style crossover device which can even eliminate the need for PCBs in some cases.

Current crossover devices available today in the market only operate up to ~6GHz. Not anymore! Knowles' new, patented surface mount RF crossover component can operate **from DC to 40GHz!**

Our RF Crossover utilizes a new grooved ceramic channel which enables the product to crossover a top layer DC or RF trace, simplifying board routings and construction.

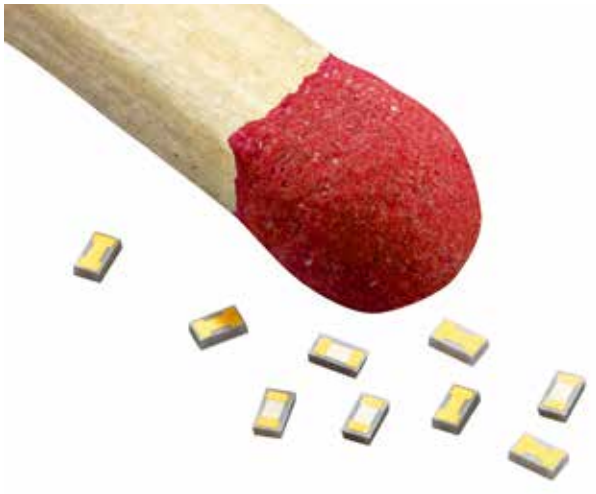
DEVICE CONSTRUCTION



Size Dimensions: L 0.15" x W 0.10" x H 0.02"

Gain Equalizers

The DLI brand of gain equalizers are designed to compensate for module gain slope. Excellent repeatable microwave performance is achieved by application of precision thin-film fabrication and high-permittivity ceramic materials. This unique design solution provides near ideal R-C frequency response that is far superior to “stacked R-C chip” assemblies.



					Dimensions (mil)					
Part Number	Attachment Medium	Nominal Slope	Operating Frequency Range (GHz)	Termination Finish Reference	L	W	T	Lp	Wp	G
AEQ3042	Epoxy or Solder	0.6	DC - 7	3	40 ± 2	20 ± 2	6 ± 1	17.5 ± 1	17.5 ± 1	3 ± 1
AEQ3055	Epoxy or Solder	1.5	DC - 7	3	40 ± 2	20 ± 2	6 ± 1	15.4 ± 1	18.4 ± 1	7.2 ± 1
AEQ2199	Epoxy	3.5	DC - 16	1	28 ± 2	16 ± 2	7 ± 1	7 ± 1	14 ± 1	12 ± 1
AEQ05246	Epoxy or Solder	3.5	DC - 16	2	28 ± 2	16 ± 2	7 ± 1	7 ± 1	14 ± 1	12 ± 1
AEQ05467	Epoxy or Solder	1	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ05468	Epoxy or Solder	1.5	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ05469	Epoxy or Solder	2	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ05470	Epoxy or Solder	2.5	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ05471	Epoxy or Solder	3	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ05472	Epoxy or Solder	3.5	DC - 18	4	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ11388	Epoxy or Solder	4	DC - 22	2	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ2234	Epoxy	3.25	DC - 32	1	32 ± 2	16 ± 2	5 ± 1	8 ± 1	12 ± 1	12 ± 1
AEQ06042	Epoxy or Solder	3.25	DC - 32	2	32 ± 2	16 ± 2	5 ± 1	8 ± 1	12 ± 1	12 ± 1
AEQ2050	Epoxy	2.25	DC - 34	1	30 ± 2	18 ± 2	5 ± 1	9 ± 1	14 ± 1	8 ± 1
AEQ05510	Epoxy or Solder	2.25	DC - 34	2	30 ± 2	18 ± 2	5 ± 1	9 ± 1	14 ± 1	8 ± 1
AEQ11391	Epoxy or Solder	2.5	DC - 45	2	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ11390	Epoxy or Solder	3	DC - 45	2	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10
AEQ11389	Epoxy or Solder	4	DC - 45	2	28 ± 1	16 ± 1	7 ± 1	7min	14 ± 1	10

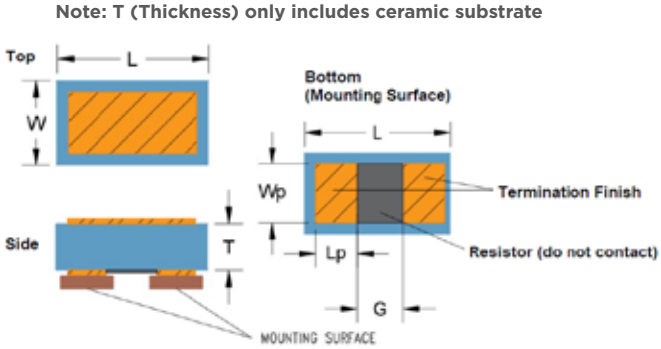
CERTIFICATION:

ISO 9001 Quality

AS9100 Aerospace

PHYSICAL DIMENSION DEFINITIONS

Note: T (Thickness) only includes ceramic substrate

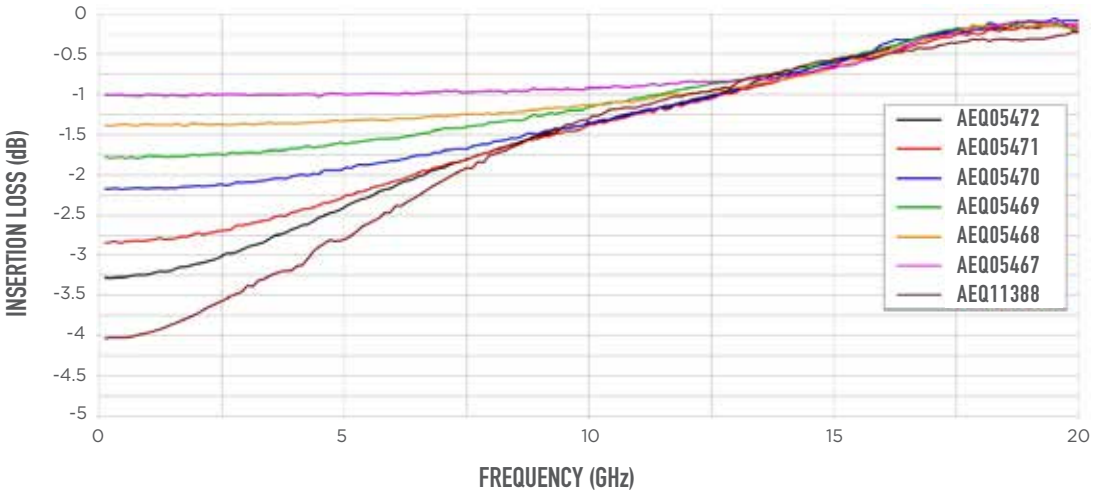


TERMINATION FINISH REFERENCES

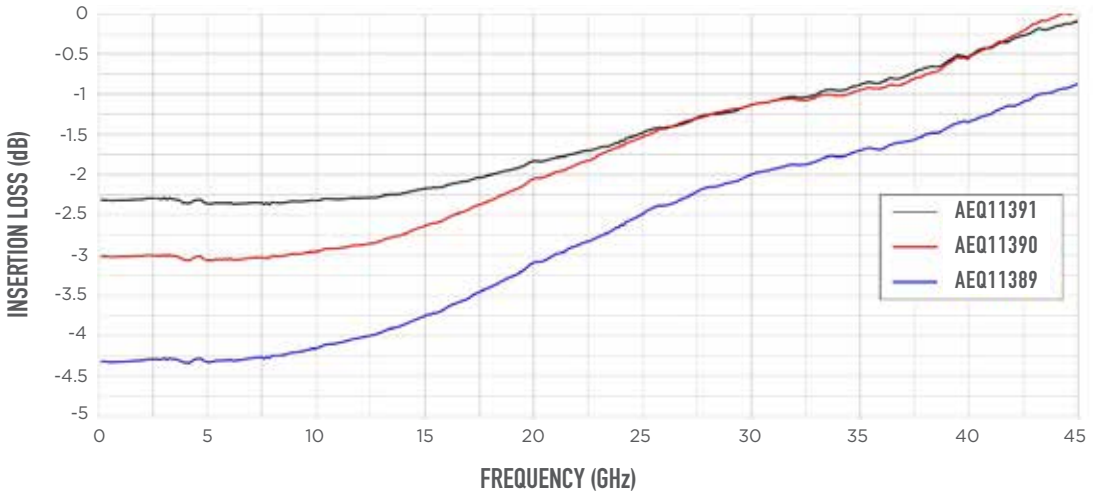
1	• 100 Microinches Min. Au
2	• 25 Microinches Min. Au Over • 50 Microinches Min. NiV
3	• 20 Microinches Max. Au Over • 30 Microinches Min. NiV
4	• 15 Microinches Min. Au Over • 50 Microinches Min. NiV

Gain Equalizers

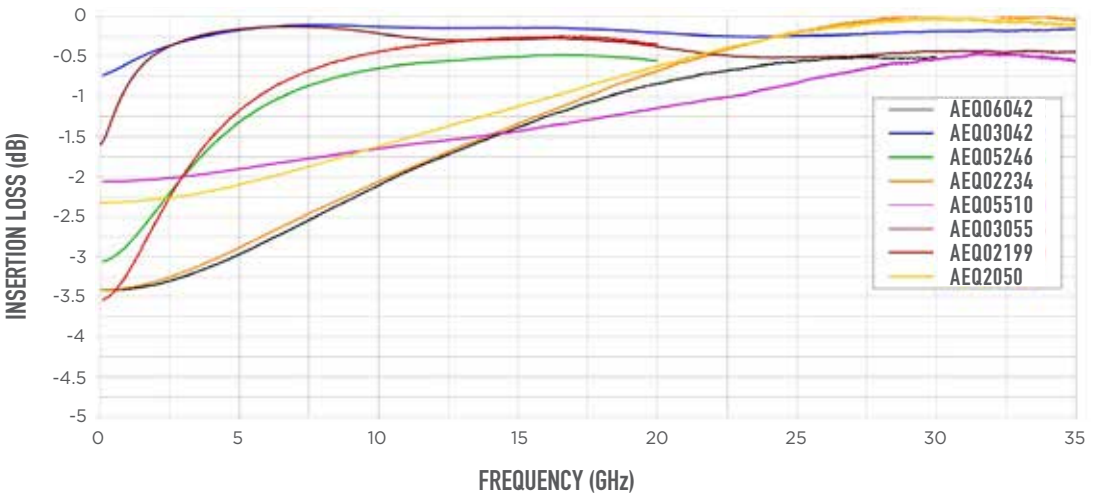
Typical* Measured Performance** up to 20GHz



Typical* Measured Performance** up to 45GHz



Typical* Measured Performance** up to 35GHz

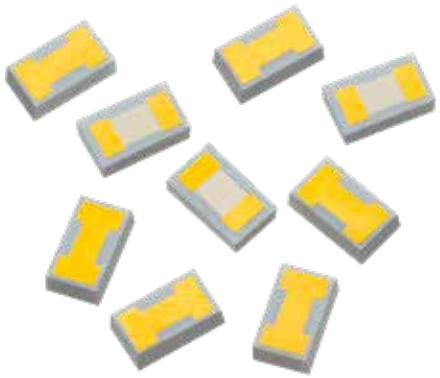


DLI Gain Equalizer Kits include a range of options for attenuation

Gain Equalizer Part Numbers:
AEQ05467, AEQ05468, AEQ05469, AEQ05470, AEQ05471, AEQ05472

Benefits include:

- Designed for 2-18GHz applications



* Typical measured performance mounted on RO4350B test board at 25°C.

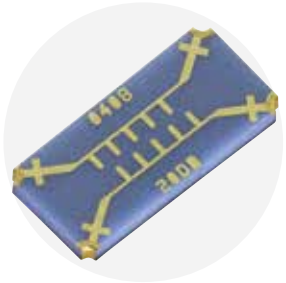
** Electrical specifications based on typical mounted performance at room temperature. Insertion loss shall vary ±0.5dB over temperature.

Gain Equalizer Part Numbers:
AEQ2050, AEQ2199, AEQ2234, AEQ3042, AEQ3055

Benefits include:

- Small size (0402 or smaller)
- Products up through 40GHz

Directional Couplers



- DLI's selection of couplers utilize DLI's high-permittivity ceramic materials to provide small size, 30x smaller than waveguide technology, and minimal performance variation over temperature
- These couplers offer a turnkey solution in surface mount (SMD) and chip and wire formats for high-frequency power monitoring, ideal for wireless communications modules.
- 3, 10 and 20dB offerings are available in these tables with common footprints for maximum flexibility.
- Contact us for couplers with customized coupling values.

Part Number	Fl (GHz)	Fh (GHz)	Nominal Coupling (dB)	Passband Coupling Variation Typ. (dB)	Excess Insertion Loss Typ. (dB)	Return Loss Typ. (dB)	Isolation Typ. (dB)	Directivity Typ. (dB)	Power Handling (W CW*)	Length (in)	Width (in)	Height (in)	Length (mm)	Width (mm)	Height (mm)
FPC07234	2	18	10	±1.5	0.8	12	20	10	10	0.500	0.150	0.030	12.70	3.81	0.76
FPC06073	4	8	10	±0.75	0.3	20	32	22	25	0.170	0.080	0.015	4.32	2.03	0.38
FPC06719	6	18	10	±1.0	0.5	15	23	13	10	0.255	0.100	0.015	6.48	2.54	0.38
FPC06074	8	12	10	±0.2	0.5	20	30	20	25	0.120	0.080	0.015	3.05	2.03	0.38
FPC06075	12	18	10	±1.25	0.3	15	25	14	25	0.100	0.080	0.015	2.54	2.03	0.38
FPC07182	20	40	10	±1.5	0.3	10	23	13	14	0.065	0.050	0.010	1.65	1.27	0.25
FPC07180	2	18	20	±1.0	1	15	25	5	10	0.500	0.150	0.015	12.70	3.81	0.38
FPC06076	4	8	20	±2.5	0.75	20	35	15	25	0.170	0.080	0.015	4.32	2.03	0.38
FPC06913	6	18	20	±1.0	0.3	18	30	10	10	0.180	0.110	0.015	4.57	2.79	0.38
FPC06302	8	12	20	±1.25	0.3	20	35	15	25	0.120	0.080	0.015	3.05	2.03	0.38
FPC06078	12	18	20	±0.75	0.3	23	35	15	25	0.100	0.080	0.015	2.54	2.03	0.38
FPC07181	20	40	20	±1.5	0.3	12	30	10	14	0.065	0.050	0.010	1.65	1.27	0.25
FPC08035	20	40	20	±1.5	0.5	10	30	10	5	0.065	0.050	0.010	1.651	1.27	0.254
FPC06077	8	12	25	±1.0	0.3	18	35	10	25	0.120	0.080	0.015	3.05	2.03	0.38

*Data is based on operating temperatures up to 125°C

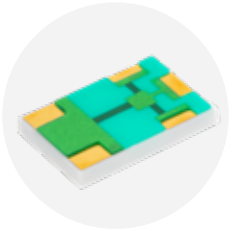
CERTIFICATION:

SAI GLOBAL ISO 9001 Quality

SAI GLOBAL AS9100 Aerospace

RoHS 2011/65/EU Lead Free

Couplers



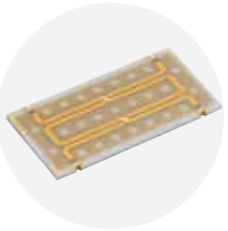
SURFACE MOUNT RESISTIVE COUPLERS

Part Number	Fl (GHz)	Fh (GHz)	Nominal Coupling (dB)	Passband Coupling Variation Typ. (dB)	Excess Insertion Loss Typ. (dB)	Return Loss Typ. (dB)	Power Handling (W CW*)	Length (in)	Width (in)	Height (in)	Length (mm)	Width (mm)	Height (mm)
FPC06881	DC	25	20	±1.5	2.85	12	0.2	0.060	0.088	0.010	1.52	2.24	0.25
FPC07803	DC	40	20	±2	3	12	0.2	0.060	0.088	0.010	1.52	2.24	0.25
FPC06882	DC	25	30	±3	2	12	0.2	0.060	0.088	0.010	1.52	2.24	0.25
FPC07802	DC	40	30	±2	2.5	12	0.2	0.060	0.088	0.010	1.52	2.24	0.25

Couplers with Nominal 90 Degree Phase Balance

FEATURES:

- Small Size
- 90° Phase Delta between Output Ports
- >50W Power Handling as Coupler (single input)
- Frequency Stable over Temperature
- Excellent for Balanced Amplifiers
- Operating & Storage Temp: -55°C to +125°C
- Characteristic Impedance: 50Ω



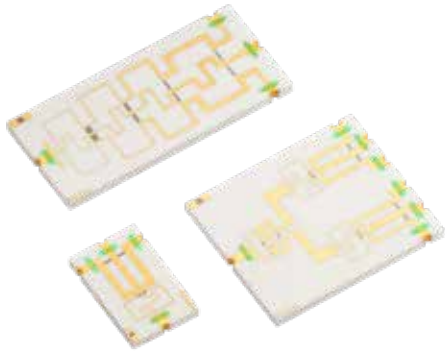
QUADRATURE HYBRID COUPLERS

Part Number	Fl (GHz)	Fh (GHz)	Max. Insertion Loss (dB)	Min. Return Loss (dB)	Min. Isolation (dB)	Amplitude Balance (dB)	Mounting Style	Length (in)	Width (in)	Height (in)	Length (mm)	Width (mm)	Height (mm)
FHC09096	4	8	0.75	15.00	20	±1	SMD	0.300	0.150	0.010	7.62	3.81	0.25
FHC10292	6	18	1.00	15.00	15	±1	SMD	0.350	0.250	0.010	8.89	6.35	0.25
FHC09101	4	8	0.75	15.00	20	±1	Chip and Wire	0.300	0.150	0.010	7.62	3.81	0.25
FHC10293	6	18	1.00	15.00	15	±1	Chip and Wire	0.350	0.250	0.010	8.89	6.35	0.25

SURFACE MOUNT BRANCHLINE COUPLERS

Part Number	Fl (GHz)	Fh (GHz)	Nominal Coupling (dB)	Passband Coupling Variation Typ. (dB)	Excess Insertion Loss Typ. (dB)	Return Loss Typ. (dB)	Isolation Typ. (dB)	Directivity Typ. (dB)	Power Handling (W CW*)	Length (in)	Width (in)	Height (in)	Length (mm)	Width (mm)	Height (mm)
FPC06700	5.9	6.5	3	±1	0.75	17	20	17	5	0.425	0.250	0.020	10.80	6.35	0.51
FPC06630	9	11	3	±1	0.5	20	18	15	15	0.286	0.180	0.015	7.26	4.57	0.38
FPC10207	8	12	3	±1	0.4	20	20	17	14	0.350	0.170	0.015	8.90	4.32	0.38
FPC06701	10.7	12.75	3	±1	0.5	12	15	12	15	0.255	0.155	0.015	6.48	3.94	0.38
FPC07183	24	33	3	±1	1	12	15	12	10	0.180	0.110	0.010	4.57	2.79	0.25

Power Dividers



DLI brand power dividers incorporate low-loss, high-permittivity ceramics, providing miniaturized dimensions and temperature-stable RF performance. The integrated thin film resistors improve phase and amplitude balance over broadband devices. There are two styles: Wilkinson and resistive power dividers, and these designs are configured for attachment with either solder or conductive adhesive.

Due to their compact size and proven performance, DLI brand power dividers are a superior option over integration in a soft board material with discrete resistors.

DESIGN ADVANTAGES:

- Small size
- Excellent repeatability

KEY CHARACTERISTICS:

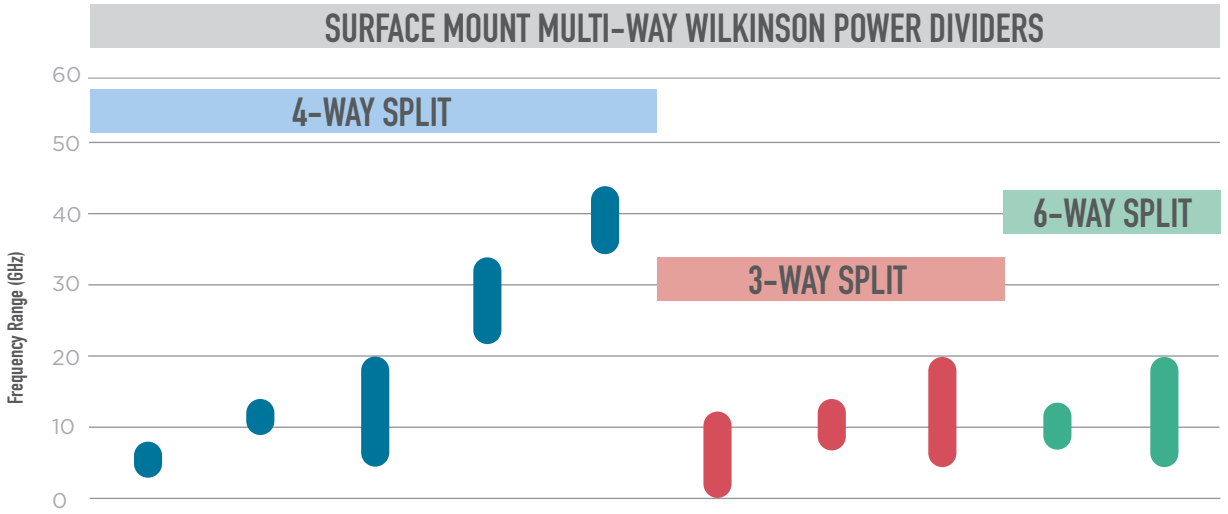
- Low excess insertion loss
- High isolation
- Even splits for 3-way and 6-way dividers without terminated paths
- Excellent phase and amplitude balance for Wilkinson Power Dividers only
- Well-matched on all ports

CERTIFICATION:

SAI GLOBAL ISO 9001 Quality

SAI GLOBAL AS9100 Aerospace

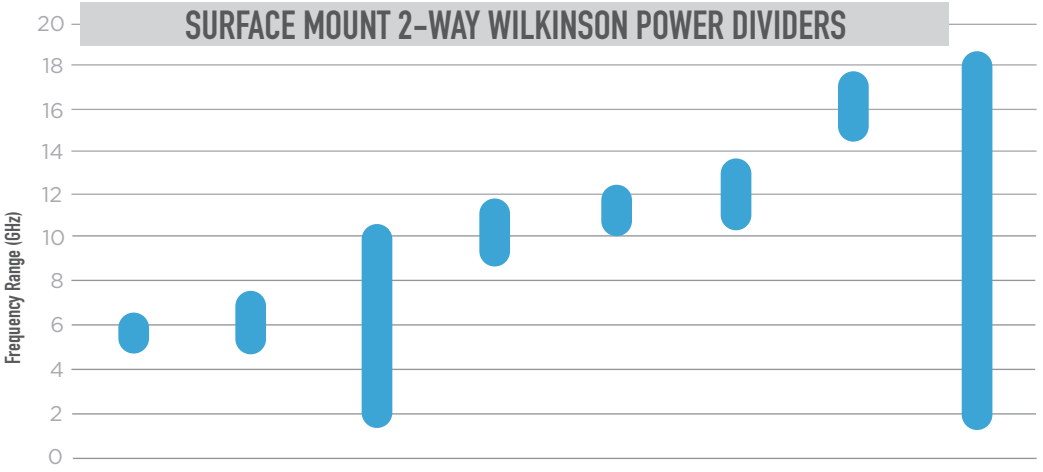
RoHS 2011/65/EU Lead Free



Part Number	PDW08607	PDW08605	PDW06089	PDW07069	PDW08324	PDW11594	PDW11595	PDW11597	PDW11596	PDW11598
Configuration	4:1	4:1	4:1	4:1	4:1	3:1	3:1	3:1	6:1	6:1
Nominal Power Splitting	6dB	6dB	6dB	6dB	6dB	5.5dB	5dB	5.5dB	8.5dB	8.75dB
Freq. Low (GHz)	5.3	10.6	6	24	37	2	8	6	8	6
Freq. High (GHz)	5.9	11.8	18	32	42	10	12	18	12	18
Max. Amplitude Balance (dB)	±0.25	±0.25	±0.75	±0.25	±0.75	±0.75	±0.75	±0.75	±0.75	±0.75
Max. Phase Balance (degrees)	±5.0	±5.0	±9.0	±5.0	±5.0	±6.0	±6.0	±6.0	±6.0	±6.0
Typical Excess Insertion Loss (dB)	0.5	0.4	0.8	1	0.75	0.75	0.25	0.75	0.75	1
Typical Return Loss (dB)	16	20	15	15	15	14	14	14	14	14
Typical Isolation (dB)	20	20	20	20	25	20	20	20	20	20
Mounting	SMD									
Length (inches)	0.260	0.190	0.250	0.140	0.140	0.470	0.210	0.275	0.275	0.350
Width (inches)	0.175	0.125	0.300	0.170	0.170	0.210	0.135	0.150	0.150	0.295
Height (inches)	0.030	0.020	0.020	0.010	0.010	0.020	0.020	0.020	0.020	0.020
Length (mm)	6.60	4.83	6.35	3.56	3.56	11.94	5.33	6.99	6.99	8.89
Width (mm)	4.45	3.18	7.62	4.32	4.32	5.33	3.43	3.81	3.81	7.49
Height (mm)	0.76	0.51	0.51	0.25	0.25	0.51	0.51	0.51	0.51	0.51

Above: Example of a Wilkinson Power Divider PDW

SURFACE MOUNT 2-WAY WILKINSON POWER DIVIDERS



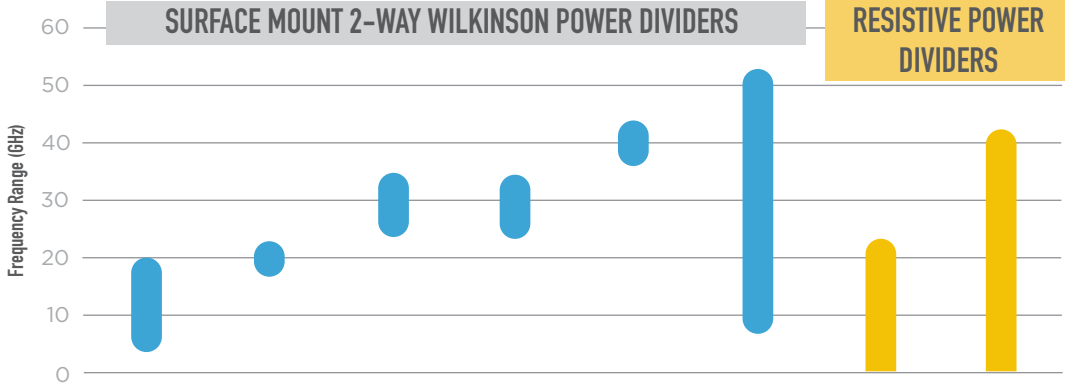
Part Number	PDW08606	PDW06398	PDW06038	PDW06399	PDW08604	PDW06400	PDW06401	PDW06407
Configuration	2:1	2:1	2:1	2:1	2:1	2:1	2:1	2:1
Nominal Power Splitting	3dB	3dB	3dB	3dB	3dB	3dB	3dB	3dB
Freq. Low (GHz)	5.3	5	2	9	10.6	11	15	2
Freq. High (GHz)	5.9	7	10	11	11.8	13	17	18
Max. Amplitude Balance (dB)	+/-0.15	+/-0.20	+/-0.25	+/-0.1	+/-0.25	+/-0.25	±0.1	±0.6
Max. Phase Balance (degrees)	+/-2.5	+/-3.0	+/-5.0	+/-1.0	+/-1.75	+/-4.0	±2.0	±8
Typical Excess Insertion Loss (dB)	0.3	0.25	1.25	0.4	0.4	0.5	0.25	2.5
Typical Return Loss (dB)	20	20	20	20	15	25	20	18
Typical Isolation (dB)	20	18	20	18	15.5	20	20	20
Mounting	SMD							
Length (inches)	0.115	0.120	0.400	0.150	0.085	0.130	0.120	0.600
Width (inches)	0.115	0.240	0.250	0.100	0.085	0.130	0.120	0.180
Height (inches)	0.030	0.015	0.020	0.015	0.020	0.015	0.015	0.020
Length (mm)	2.92	3.05	10.16	3.81	2.16	3.30	3.05	15.24
Width (mm)	2.92	6.10	6.35	2.54	2.16	3.30	3.05	4.57
Height (mm)	0.76	0.38	0.51	0.38	0.51	0.38	0.38	0.51

APPLICATIONS:

- 5G
- Aerospace
- Military
- Telecom

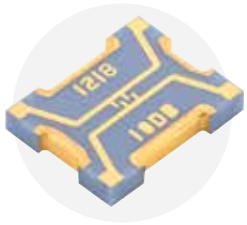
SURFACE MOUNT 2-WAY WILKINSON POWER DIVIDERS

RESISTIVE POWER DIVIDERS



Part Number	PDW05758	PDW07691	PDW06984	PDW07630	PDW08323	PDW09692	PDR06390	PDR06380
Configuration	2:1	2:1	2:1	2:1	2:1	2:1	2:1	2:1
Nominal Power Splitting	3dB	3dB	3dB	3dB	3dB	3dB	6dB	6dB
Freq. Low (GHz)	6	18	25	25	37	8	0	0
Freq. High (GHz)	18	20	32	32	42	50	20	40
Max. Amplitude Balance (dB)	±0.5	±0.25	±0.25	±0.25	±0.5	±0.7	±0.6	±0.6
Max. Phase Balance (degrees)	±1.25	±1.25	±2.5	±5.0	±5.75	±10	±3.0	±3.0
Typical Excess Insertion Loss (dB)	2.35	0.25	0.6	0.25	0.75	0.50	0.25	0.5
Typical Return Loss (dB)	20	20	15	17	15	17	20	20
Typical Isolation (dB)	25	20	15	15	20	20	6	6
Mounting	SMD							
Length (inches)	0.185	0.100	0.085	0.070	0.070	0.220	0.075	0.075
Width (inches)	0.160	0.100	0.095	0.070	0.070	0.080	0.070	0.065
Height (inches)	0.020	0.015	0.010	0.010	0.010	0.010	0.010	0.010
Length (mm)	4.70	2.54	2.16	1.78	1.78	5.59	1.91	1.91
Width (mm)	4.06	2.54	2.41	1.78	1.78	2.03	1.78	1.65
Height (mm)	0.51	0.38	0.25	0.25	0.25	0.25	0.25	0.25

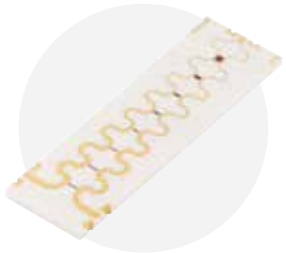
Chip and Wire Devices

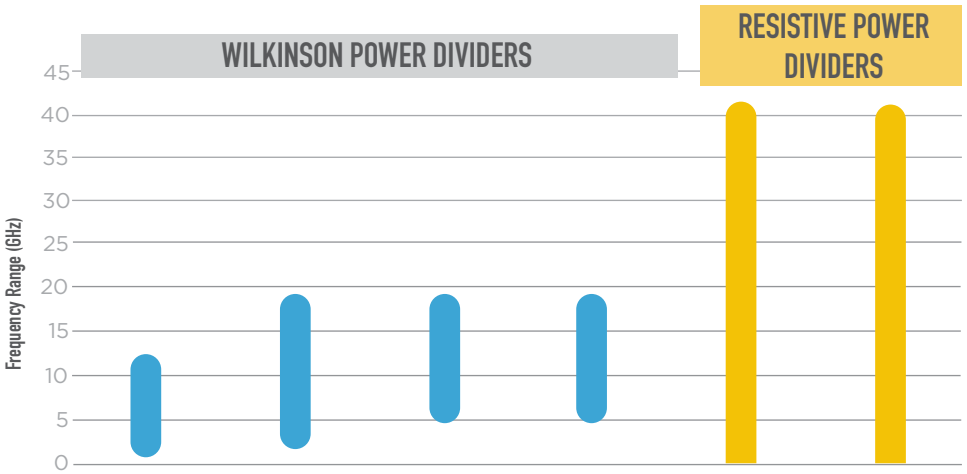


CHIP AND WIRE DIRECTIONAL COUPLERS

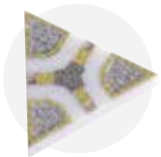
Part Number	Fl (GHz)	Fh (GHz)	Coupling (dB)	Passband Coupling Variation Typ. (dB)	Excess Insertion Loss Typ. (dB)	Return Loss Typ. (dB)	Isolation Typ. (dB)	Directivity Typ. (dB)	Power Handling (W CW*)	Length (in)	Width (in)	Height (in)	Length (mm)	Width (mm)	Height (mm)
FPC09291	2	18	10	±1.5	0.8	12	20	10	10	0.500	0.150	0.030	12.70	3.81	0.76
FPC06149	4	8	10	±0.75	0.5	15	30	20	25	0.180	0.080	0.015	4.57	2.03	0.38
FPC07643	6	18	10	±1.0	0.5	15	23	13	10	0.255	0.100	0.015	6.48	2.54	0.38
FPC06150	8	12	10	±1.5	1	12	24	14	25	0.130	0.090	0.015	3.30	2.29	0.38
FPC06151	12	18	10	±0.75	0.75	15	20	10	25	0.100	0.080	0.015	2.54	2.03	0.38
FPC08057	20	40	10	±1.5	0.5	10	23	13	10	0.065	0.050	0.010	1.65	1.27	0.25
FPC07237	2	18	20	±1.5	0.8	15		10	10	0.500	0.150	0.015	12.70	3.81	0.38
FPC06152	4	8	20	±1.5	0.25	25	40	20	25	0.180	0.080	0.015	4.57	2.03	0.38
FPC07337	6	18	20	±1	0.7	15	25	5	10	0.180	0.100	0.015	4.57	2.54	0.38
FPC06153	8	12	20	±1.25	0.2	20	35	15	25	0.130	0.090	0.015	3.30	2.29	0.38
FPC06154	12	18	20	±1.5	0.3	10	30	10	25	0.100	0.080	0.015	2.54	2.03	0.38
FPC08056	20	40	20	±1.5	0.5	12	30	10	10	0.065	0.050	0.010	1.65	1.27	0.25

CHIP AND WIRE POWER DIVIDERS





Part Number	PDW06041	PDW06933	PDW06011	PDW07948	PDR05848	PDR06120
Configuration	2:1	2:1	2:1	4:1	2:1	2:1
Nominal Power Splitting	3dB	3dB	3dB	6dB	6dB	6dB
Freq. Low (GHz)	2	2	6	6	0	0
Freq. High (GHz)	10	18	18	18	40	40
Max. Amplitude Balance (dB)	+/-0.25	±0.6	±0.5	±0.75	±0.6	±0.6
Max. Phase Balance (degrees)	+/-5.0	±8	±1.25	±9.0	±3.0	±3.0
Typical Excess Insertion Loss (dB)	1.25	2.5	0.9	0.8	0.5	0.5
Typical Return Loss (dB)	20	18	16	15	20	20
Typical Isolation (dB)	20	20	25	20	6	6
Mounting	Chip and Wire	Chip and Wire	Chip and Wire	Chip and Wire	Flip Chip (AuSn)	Epoxy
Length (inches)	0.115	0.120	0.400	0.150	0.085	0.130
Width (inches)	0.115	0.240	0.250	0.100	0.085	0.130
Height (inches)	0.030	0.015	0.020	0.015	0.020	0.015
Length (mm)	2.92	3.05	10.16	3.81	2.16	3.30
Width (mm)	2.92	6.10	6.35	2.54	2.16	3.30
Height (mm)	0.76	0.38	0.51	0.38	0.51	0.38



Above: Example of a Resistive Power Divider PDR (note: shows mounting configuration on bottom side of the part)

DLI Brand Devices: Available Configurations

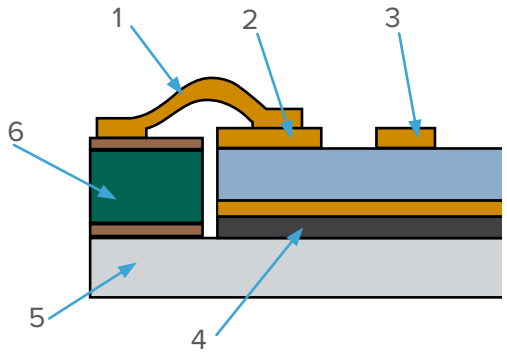
Optimal performance relies on having optimal assembly, especially with increasing frequencies. DLI offers devices with the following configurations, to fit applications focused on the highest rejection (WB), or optimized for volume manufacturing (SMD). See the general descriptions as follows:

WIREBOND TERMINATION

Chip and Wire or Wirebond (WB): For detailed recommendations reference Wire Bond Application Note*

- Typically mounted to board with conductive epoxy for grounding (not solderable finish unless specified)
- IO connections are wire- or ribbon-bonded
- Customer will design necessary RF shielding or channelization into application
- Board and housing materials should be chosen with the aim to minimize CTE mismatch with the ceramic filter
- Termination finish: Gold
- Filter PN designates W for last character

*To view the Wire Bond Application Note, scan the QR Code



WIREBOND (WB) CALLOUTS

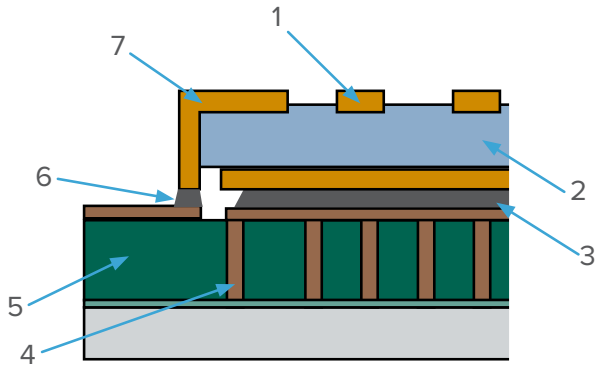
1. Wire/ribbon signal bond
2. Signal pad on part (Au termination)
3. RF pattern
4. Conductive epoxy mount (ground pad)
5. Housing floor
6. PCB with cavity for part

SURFACE MOUNT (SMD) TERMINATION

Surface mount (SMD): For detailed recommendations, reference the Microwave Products Guide

- Typically mounted during reflow soldering with solder paste
- IO connections and ground pad are soldered using solder paste
- Most SMD devices include integrated shielding if needed (unless specified)
- Termination finish: ENIG
- Filter PN designates S for last character

*To view the Microwave Products Guide, scan the QR Code



SURFACE MOUNT (SMD) CALLOUTS

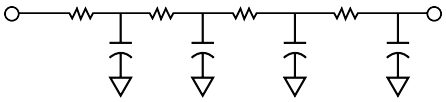
1. RF pattern (non-solderable)
2. Ceramic substrate
3. Solder attachment (ground pad)
4. PCB vias in pad
5. Printed circuit board (PCB)
6. Solder attachment (IO)
7. IO castellation (ENIG)

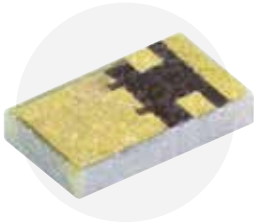
Integrated R-C Networks

BIAS FILTER NETWORK

Knowles takes advantage of the high permittivity ceramics offered by the DLI brand combined with thin film resistors to provide Unique Bias Filter products. Bias Filter Networks provide high attenuation (>40dB, 300 MHz to 40 GHz) of unwanted RF signals on DC Bias lines. They are designed for applications with low current, such as gate bias of an FET or MMIC. RF energy is bypassed to RF ground. Bias Filters are designed for conductive epoxy attachment directly to the Ground plane (module floor) of Chip & wire modules. DC current rating: 10 mA max.

EQUIVALENT SCHEMATIC REPRESENTATION:





PART NUMBERS

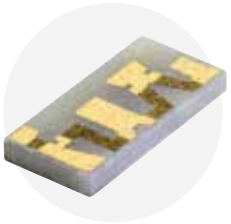
Full PN	Cap Range (pF)	Resist	Width (in)	Length (in)	Thickness (in)
B20BHSBN01	40 to 90	100 ± 20%	.020 ± .001	.034 ± .001	.006 ± .001
B20BLSBN01	40 to 90	100 ± 20%	.020 ± .001	.034 ± .001	.006 ± .001
B28BHBFN01	76 to 171	600 ± 20%	.028 ± .001	.053 ± .001	.007 ± .001

SELF BIAS NETWORK

Knowles takes advantage of the high-permittivity ceramics offered by the DLI brand combined with thin film resistors to provide a device that integrates source decoupling and user-selectable bias resistance.

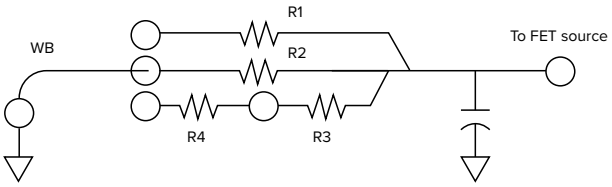
The technique is commonly referred to as a self-bias GaAs FET amplifier – this enables the use of a single DC supply voltage. The gate is at DC ground potential and a negative Vgs is provided by the voltage drop across the selected wire-bond resistors from source to ground — thus setting the desired drain bias current (IDS).

The chip network is designed for epoxy attachment to a ground Ridge, one on either side of an FET chip transistor. This provides symmetric, minimum reactance to ground source bypassing for optimum FET gain. By selectively wire bonding from resistor pads to ground, the pair of networks used for each FET provides a wide range of Resistance combinations. The Self Bias Networks, used as a pair, replace 2 standard Parallel plate capacitors and a separate set of bias resistors, reducing parts count, assembly and size.



EQUIVALENT SCHEMATIC REPRESENTATION:

User wire bond to Ground to select resistance.



Resistor Values:

R1 - 200Ω R3 - 50Ω
R2 - 100Ω R4 - 20Ω

Nominal Capacitance:

50pF

PART NUMBERS

Full PN	Cap Range (pF)	Resist	Width (in)	Length (in)	Thickness (in)
B28BJBFN01	76 to 171	600 ± 20%	.028 ± .001	.053 ± .001	.007 ± .001
B28BTBFN01	112 to 168	600 ± 20%	.028 ± .001	.053 ± .001	.007 ± .001

CUSTOM INTEGRATED PASSIVE DEVICES

Reach our to our team of engineers to inquire about custom designs at:
DLIengineering@knowles.com

TYPICAL APPLICATIONS

- Wireless communication modules
- Ideal varactor decoupling element
- High gain RF/Microwave modules
- Ideal GaAs FET gate biasing device
- MMIC multichip modules
- MIC broadband high gain RF/Microwave modules
- Bias line voltage divider and integrated decoupling capacitor

CERTIFICATION:

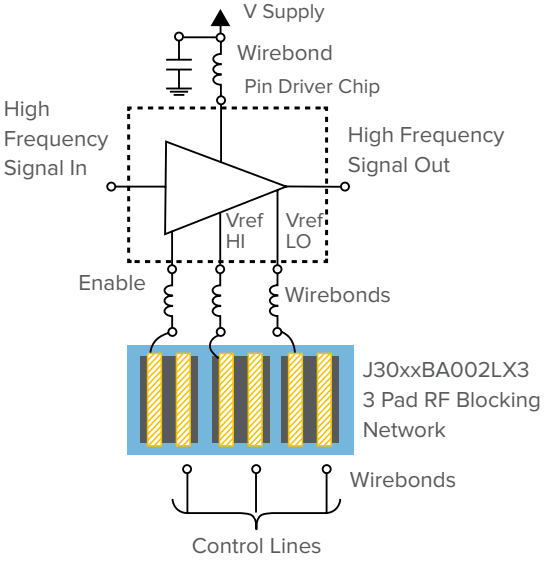
SAI GLOBAL ISO 9001 Quality

SAI GLOBAL AS9100 Aerospace

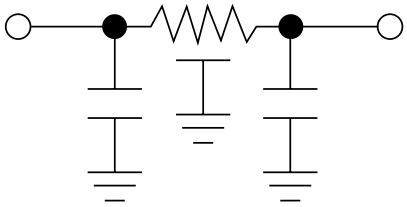
Integrated R-C Networks

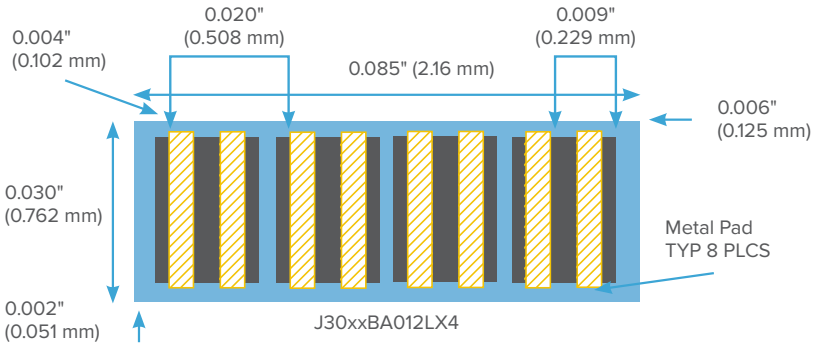
C-R-C DECOUPLING NETWORKS

(aka. RF Blocking Networks)



SEGMENT EQUIVALENT SCHEMATIC REPRESENTATION





Part Number	J30BLBA032LX1	J30BLBA022LX2	J30BLBA002LX3	J30BLBA012LX4	J30BJBA032LX1	J30BJBA022LX2	J30BJBA002LX3	J30BJBA012LX4
Number of RC Segments	1	2	3	4	1	2	3	4
Nominal Resistance (pad to pad) (Ω)	10	10	10	10	10	10	10	10
Capacitance (typical) (pF)	30	30	30	30	45	45	45	45
Maximum DF	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
TCC	X7R	X7R	X7R	X7R	X7R	X7R	X7R	X7R
Rated Voltage (Vdc)	25	25	25	25	25	25	25	25
Attachment Method	All are configured for Chip & Wire attachment							
Termination Finish	100µinches Au, minimum							
Dimensions (inches)								
Length	0.025	0.045	0.065	0.085	0.250	0.045	0.065	0.085
Width	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Dimensions (mm)								
Length	0.64	1.14	1.65	2.16	6.35	1.14	1.65	2.16
Width	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76

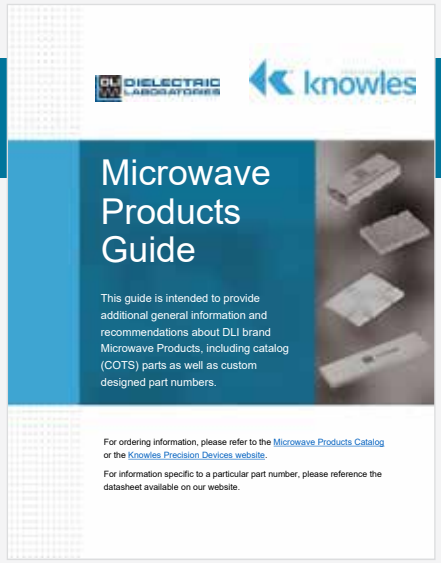
Additional Product Information Right at Your Fingertips

Online product guides and e-Books provide a wealth of knowledge to assist in the ordering process.

Knowles' Microwave Products Guide

This document is the technical complement to the Microwave Products Catalog. It provides detailed information on the configuration of DLI devices and what you need to know about board design, stencil design, assembly and testing to achieve the best outcomes using these devices.

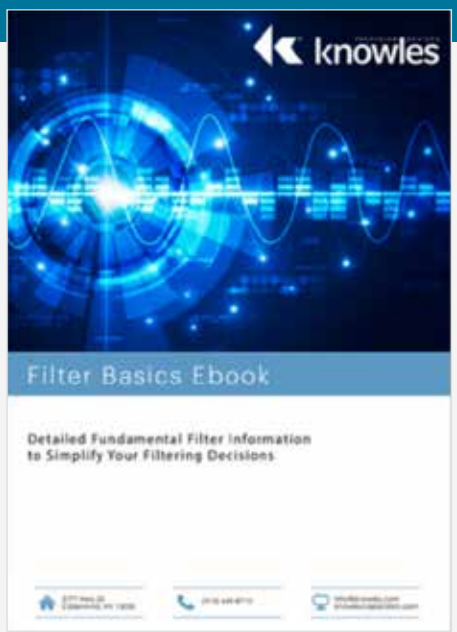
Scan the QR code to view the Microwave Products Guide



Knowles' Build-to-Print e-Book

Visit **info.knowlescapacitors.com/build-to-print-basics** to download the e-Book and with an overview of Knowles' capabilities and options for build-to-print services.

Knowles' RF Filters e-Book



Visit **info.knowlescapacitors.com/filter-basics-ebook** to download the e-Book for an overview of the basics of RF Filters and performance assessment.

DLI Brand Devices

Packaging Types:

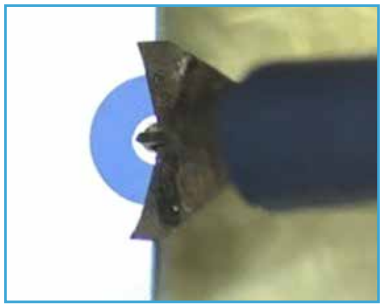
- Tape and Reel
- Bulk Cases (shown above)
- Waffle Packs

STORAGE AND HANDLING FAQS

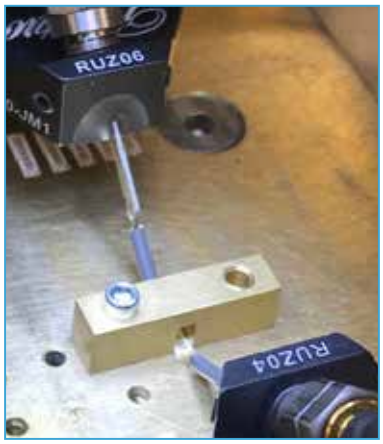
- Materials Declarations, Certifications, Conflict Minerals Statements, RoHS and REACH Statements available online at www.knowlescapacitors.com/Quality
- All DLI brand devices are Moisture Sensitivity Level (MSL)=1
  - Per IPC/JEDEC J-STD-020D
- All DLI brand devices fall under Group 1 – Fungus Inert Materials
  - Per MIL-STD-820; Paragraph 508.8
- All DLI brand devices are not ESD sensitive (passive devices)
  - Note: DLI packaging is ESD sensitive to make sure it is safe for ESD sensitive manufacturing environments, even if the parts themselves are not sensitive.
- Tape and Reel or Bulk Packaged Storage Temperature: up to 40˚C (cool, dry storage is preferred)
- Part Storage (Pre-Assembly): -55 to 125˚C
- Post-assembly Storage and Operating Temperature Range: -55 to 125˚C
- No concern for outgassing, all materials compliant as follows:
  - Ceramic
  - Metallization
  - Cover
  - Solder
  - Solder Dam

RF TESTING AND SHIELDING

- Knowles has precision measurement capability up to 67GHz, utilizing multiple vector network analyzers
- Filters are probed with coplanar RF probes (ground signal ground (GSG)) with 450 or 750 micron pitch, depending on operating frequency and configuration, on the bottom side of the filter
- When using coplanar RF probes, it is critical that all 3 points of the probe are equally in contact with the device for an accurate reading
- When devices do not include integrated shielding, custom fixtures are employed to assure accurate measurements without outside noise
- Shielding and customer housing dimensions are critical to account for during the design phase for continuity between filter modeling, measured data and actual use environments (contact DLIengineering@knowles.com if you are not sure your shielding solution aligns with the device design)



Top: Coplanar RF probe example
Bottom: Example of test fixture



RoHS Compliance Statement

Knowles is a leading supplier to the electronic components market and is fully committed to offering products supporting Restriction of Hazardous Substances (RoHS) directives. All our dielectric formulations are RoHS compliant along with a broad range of capacitors with RoHS compliant terminations. Knowles Precision Devices complies with the requirements of the individual customer and will maintain product offerings that meet industry demands.

Scan to view our Product Compliance

Quality and Environmental Policy

Knowles' reputation for quality and environmental responsibility is based on a commitment not only to meet customer requirements, but to exceed their expectations. The entire organization, beginning with top management, strives to achieve excellence in designing, manufacturing and delivering High Q capacitors and proprietary thin film components for niche high-frequency applications, while maintaining safe and healthy working conditions.

Furthermore, Knowles is committed to achieving these goals in an environmentally responsible manner through a commitment to comply with environmental regulations and pollution prevention initiatives. Knowles strives to continually improve the effectiveness of its quality and environmental management system through the establishment and monitoring of objectives and targets.

Microwave products proudly made in the USA.

SAI GLOBAL ISO 9001 Quality

SAI GLOBAL AS9100 Aerospace

RoHS

knowles

For more information, visit us online at knowlescapacitors.com

0525/R9.2

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