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COMPONENTS

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- **Magic Tees**
- **Mixers and Multipliers**
- **Terminations**
- **Tools**
- **Waveguide Detectors**
- **Waveguide Sections (Bends, Twists, Straights)**

- **Cable Selector Guide**
- **Littlebend Selector Guide**
- **Handling High-Performance Cables**
- **Glossary of Terms**

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HASCO, Inc. is a global distributor of quality on-demand RF and Microwave components based in Southern California. As an AS9120:B and ISO 9001:2015 certified supplier, the HASCO team takes pride in offering quality and personalized customer service and a large selection of high-performance adapters, amplifiers, attenuators, connectors, cable assemblies, launch accessories, millimeter wave and waveguide components, and more.

Since 1986, HASCO's forward-thinking leadership team has been successful in year-over-year product growth, customer reach, and manufacturer partnerships. From a robust line of quality test and measurement components to a growing selection of millimeter wave active and passive components that are in stock and ready to ship daily, HASCO is an industry leader for "just in time" components designed for systems with higher frequencies, performance and flexibility.

In addition to providing easy and convenient access to highly sought-after RF and Microwave components, HASCO supports its customers through every aspect of the buying experience with an easy-to-use, highly optimized web store and technical sales support, both online and through area sales representatives. From product selection and education to an easy and seamless reordering process, HASCO is committed to its mission of being a convenient and quality source for RF and Microwave engineers.

HASCO offers these value propositions:

- AS9120:B and ISO 9001:2015 certified
- Same-Day Shipping
- Expert In-house Technical Product Support
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- Global Distribution

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RF COAXIAL and WAVEGUIDE ADAPTERS

HASCO offers In-Series Adapters and Between Series Adapters in Precision, Low PIM and Coax-to-Waveguide Adapter options. Our Coax Adapters come in N, TNC, SMB, SMA, 3.5mm, 2.92mm, 2.4mm, 1.85mm and 1.0mm connector configurations, operating up to 110 GHz. HASCO's Coax to Waveguide Adapters interface to WR-10 through WR-430 waveguides, operating from 1.7 GHz to 110 GHz in both right angle and end launch designs.

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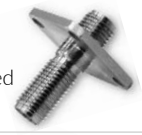
IN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
1.0mm	Male to Male	**2431-00SF** 	**Freq:** DC-110 GHz **VSWR**: 1.28:1 Max **Temp**: -55° to 165°C
	Male to Female	**2430-00SF** 	**Freq:** DC-110 GHz **VSWR**: 1.28:1 Max **Temp:** -55° to 165°C
	Female to Female	**2432-00SF** 	**Freq:** DC-110 GHz **VSWR:** 1.28:1 Max **Temp:** -55° to 165°C
		2432-01SF Bulkhead 	**Freq:** DC-110 GHz **VSWR**: 1.28:1 Max **Temp:** -55° to 165°C
1.85mm	Male to Male	**1831-00SF** 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
		185P-185P-RA Right Angle 	**Freq:** DC-67 GHz **VSWR**: 1.35:1 Max **Temp:** -55° to 165°C
	Male to Female	**1830-00SF** 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
		185P-185J-RA Right Angle 	**Freq:** DC-67 GHz **VSWR**: 1.35:1 Max **Temp:** -55° to 165°C
	Female to Female	**1832-00SF** 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
		185J-185J-RA Right Angle 	**Freq:** DC-67 GHz **VSWR**: 1.35:1 Max **Temp:** -55° to 165°C
2.40mm	Male to Male	**1431-00SF** 	**Freq:** DC-50 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 135°C
		24P-24P-RA Right Angle 	**Freq:** DC-50 GHz **VSWR**: 1.30:1 Max **Temp:** -55° to 125°C
	Male to Female	**1430-00SF** 	**Freq:** DC-50 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 135°C
		24J-24P-RA-01 Right Angle 	**Freq:** DC-50 GHz **VSWR**: 1.30:1 Max **Temp:** -55° to 125°C
	Female to Female	**1432-00SF** 	**Freq:** DC-50 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 135°C
		24J-24J-RA Right Angle 	**Freq:** DC-50 GHz **VSWR**: 1.30:1 Max **Temp:** -55° to 125°C

Type	Config.	Part #/Type	Specifications
2.92mm	Male to Male	**1031-00SF** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29P-29P-MM 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
		29P-29P-RA Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.25:1 Max **Temp**: -55° to 100°C
	Male to Female	**1030-00SF** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		1030-10SF Bulkhead 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29P-29J-MF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
		29P-29J-RA-01 Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
	Female to Female	**1032-00SF** 	**Freq:** DC-40 GHz **VSWR:** 1.15:1 Max **Temp:** -55° to 165°C
		1032-10SF Bulkhead 	**Freq:** DC-40 GHz **VSWR:** 1.15:1 Max **Temp:** -55° to 165°C
		1032-13SF Bulkhead 4-Hole Flange 	**Freq:** DC-40 GHz **VSWR:** 1.15:1 Max **Temp:** -55° to 165°C
		29J-29J-FF 	**Freq:** DC-40 GHz **VSWR:** 1.15:1 Max **Temp:** -55° to 105°C
		29J-29J-FF-BH Bulkhead 	**Freq:** DC-40 GHz **VSWR:** 1.15:1 Max **Temp:** -10° to 165°C
		29J-29J-RA-01 Right Angle 	**Freq:** DC-110 GHz **VSWR**: 1.28:1 Max **Temp:** -55° to 165°C
3.5mm	Male to Male	**35P-35P-MM-01** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp**: -65° to 165°C
	Male to Female	**35P-35J-MF-01** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp**: -65° to 165°C
	Female to Female	**35J-35J-FF-01** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp**: -65° to 165°C

IN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
SSMA	Male to Male	**HAD-SSMAP-SSMAP** 	**Freq:** DC-27 GHz **VSWR**: 1.20:1 Max
	Male to Female	**HAD-SSMAP-SSMAJ** 	**Freq:** DC-27 GHz **VSWR**: 1.20:1 Max
	Female to Female	**HAD-SSMAJ-SSMAJ** 	**Freq:** DC-27 GHz **VSWR**: 1.20:1 Max
BNC	Male to Male	**HAD-BNCP-BNCP** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	Female to Female	**HAD-BNCJ-BNCJ** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
		HAD-BNCJ-BNCJ-BH Bulkhead 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
		HAD-BNCJ-BNCJ-T "T" 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
N	Male to Male	**NP-NP-18** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		NP-NP-18 -01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 105°C
	Male to Female	**NP-NJ-18** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		NP-NJ-18-01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 105°C
		NP-NJ-PO-MF Push-On 	**Freq:** DC-18 GHz **VSWR**: 1.10:1 Max
	Female to Female	**NJ-NJ-18-01** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 105°C

Type	Config.	Part #/Type	Specifications
SMA	Male to Male	**231-502SF** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		SMAP-SMAP-MM-01 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp**: -65° to 165°C
		SMAP-SMAP-MM-RA Right Angle 	**Freq:** DC-27 GHz **VSWR**: 1.35:1 Max **Temp**: -65° to 165°C
	Male to Female	**230-506SF** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		2082-PJ-SMA 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp**: -65° to 125°C
		1312-33-50-QC3 Push-On 	**Freq:** DC-18 GHz
		SMAP-SMAJ-MF-RA Right Angle 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max
	Female to Female	**232-502SF** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		232-510SF Bulkhead 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		232-512SF Panel Mount 4-Hole Threaded 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		232-514SF Panel Mount 4-Hole Un-Threaded 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		1212-33-50-004 	**Freq:** DC-18 GHz **VSWR**: 1.20:1 Max **Temp**: -65° to 125°C
		SMAJ-SMAJ-FF-RA 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max

IN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
SMB	Male to Male	**HAD-SMBP-SMBP** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
		SMBP-SMBP-FF Push-On 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max **Temp**: -55° to 125°C
	Male to Female	**HAD-SMBP-SMBJ** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	Female to Female	**HAD-SMBJ-SMBJ** 	**Freq:** DC-4 GHz **VSWR:** 1.20:1 Max
		HAD-SMBJ-SMBJ-BH Bulkhead 	**Freq:** DC-4 GHz **VSWR:** 1.20:1 Max
		SMBJ-SMBJ-MM Bulkhead Push-On 	**Freq:** DC-4 GHz **VSWR:** 1.20:1 Max **Temp:** -55° to 125°C
TNC	Male to Male	**HAD-TNCP-TNCP** 	**Freq:** DC-11 GHz **VSWR**: 1.20:1 Max **Temp**: -65° to 165°C
		TNCP-TNCP-58 5/8" Hex 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		TNCP-TNCP-916 9/16" Hex 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
	Male to Female	**TNCP-TNCJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		HAD-TNCP-TNCJ 	**Freq:** DC-11 GHz **VSWR**: 1.20:1 Max
	Female to Female	**TNCJ-TNCJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		HAD-TNCJ-TNCJ 	**Freq:** DC-11 GHz **VSWR**: 1.20:1 Max
		HAD-TNCJ-TNCJ-BH Bulkhead 	**Freq:** DC-11 GHz **VSWR**: 1.20:1 Max
		HAD-TNCJ-TNCJ-4H 4-Hole Flange 	**Freq:** DC-11 GHz **VSWR**: 1.20:1 Max

Why Use an Adapter?

In-Series, Between-Series, Millimeter Wave and Low PIM RF and Microwave adapters are used to enable connections between two connector types that would otherwise not mate.

In this case, a low-loss or low-VSWR male to female adapter is placed on the more expensive components and equipment when they are put through many connect/disconnect cycles. This is to prevent damage to the connectors on the equipment.

Any damage caused by repeated connections will be born by the adapter, which is less expensive to replace. This is why male-to-female configured adapters are also known as "connector savers."

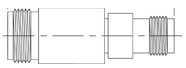
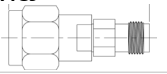
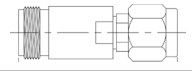
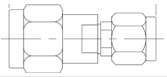
BETWEEN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
1.85mm to 1.0mm	1.85mm Female to 1.0mm Female	182410-00SF 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
	1.85mm Female to 1.0mm Male	182420-00SF 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
	1.85mm Male to 1.0mm Female	182430-00SF 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
	1.85mm Male to 1.0mm Male	182440-00SF 	**Freq:** DC-67 GHz **VSWR**: 1.25:1 Max **Temp:** -55° to 165°C
2.92mm to 1.85mm	2.92mm Female to 1.85mm Female	101810-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29J-185J-FF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
	2.92mm Female to 1.85mm Male	101820-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29J-185P-FM 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
	2.92mm Male to 1.85mm Female	101830-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29P-185J-MF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
	2.92mm Male to 1.85mm Male	101840-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 165°C
		29P-185P-MM 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp**: -55° to 105°C
2.4mm to N	2.4mm Female to N Female	24J-NJ-FF 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	2.4mm Female to N Male	24J-NP-FM 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	2.4mm Male to N Female	24P-NJ-MF 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	2.4mm Male to N Male	24P-NP-MM 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C

Type	Config.	Part #/Type	Specifications
2.92mm to 2.4mm	2.92mm Female to 2.4mm Female	101410-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		HAD-24J29J 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max
		24J-29J-FF-RA Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.33:1 Max **Temp:** -55° to 100°C
	2.92mm Female to 2.4mm Male	101420-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		HAD-24P29J 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max
		24P-29J-MF-RA Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.33:1 Max **Temp:** -55° to 100°C
	2.92mm Male to 2.4mm Female	101430-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		HAD-24J29P 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max
		24J-29P-FM-RA Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.33:1 Max **Temp:** -55° to 100°C
	2.92mm Male to 2.4mm Male	101440-00SF 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		HAD-24P29P 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max
		24P-29P-MM-RA Right Angle 	**Freq:** DC-40 GHz **VSWR**: 1.33:1 Max **Temp:** -55° to 100°C
BNC to N	BNC Female to N Female	HAD-BNCJ-NJ 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	BNC Male to N Female	HAD-BNCP-NJ 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
BNC to SMA	BNC Female to SMA Male	HAD-SMAP-BNCJ 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	BNC Male to SMA Female	HAD-SMAJ-BNCP 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max

BETWEEN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
BNC to TNC	BNC Female to TNC Female	**HAD-BNCJ-TNCJ** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	BNC Female to TNC Male	**HAD-BNCJ-TNCP** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
	BNC Male to TNC Female	**HAD-BNCP-TNCJ** 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
3.5mm to 2.4mm	3.5mm Female to 2.4mm Female	**61410-00SF** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		24J-35J-FF 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	3.5mm Female to 2.4mm Male	**61420-00SF** 	**Freq:** DC-338 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		24P-35J-MF 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	3.5mm Male to 2.4mm Female	**61430-00SF** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		24J-35P-FM 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
		24J-35P 	**Freq:** DC-34 GHz **VSWR**: 1.25:1 Max **Temp:** -60° to 100°C
	3.5mm Male to 2.4mm Male	**61440-00SF** 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
		24P-35P-MM 	**Freq:** DC-33 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
		24P-35P 	**Freq:** DC-34 GHz **VSWR**: 1.25:1 Max **Temp:** -60° to 100°C
3.5mm to 2.92mm	3.5mm Female to 2.92mm Female	**29J-35J** 	**Freq:** DC-34 GHz **VSWR**: 1.25:1 Max **Temp:** -60° to 100°C
	3.5mm Female to 2.92mm Male	**29P-35J** 	**Freq:** DC-34 GHz **VSWR**: 1.25:1 Max **Temp:** -60° to 100°C
	3.5mm Male to 2.92mm Female	**29J-35P** 	**Freq:** DC-34 GHz **VSWR**: 1.25:1 Max **Temp:** -60° to 100°C

Type	Config.	Part #/Type	Specifications
3.5mm to N	N Female to 3.5mm Female	**NJ-35J-FF** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	N Female to 3.5mm Male	**NJ-35P-FM** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	N Male to 3.5mm Female	**NP-35J-MF** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	N Male to 3.5mm Male	**NP-35P-MM** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -40° to 165°C
2.4mm to SSMA	SSMA Female to 2.4mm Female	**11410-00SF** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
	SSMA Female to 2.4mm Male	**11420-00F** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
	SSMA Male to 2.4mm Female	**11430-00F** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
	SSMA Male to 2.4mm Male	**11440-00F** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 135°C
2.92mm to SSMA	SSMA Female to 2.92mm Female	**HAD-29J-SSMAJ** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -40° to 165°C
	SSMA Female to 2.92mm Male	**HAD-29P-SSMAJ** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -40° to 165°C
	SSMA Male to 2.92mm Female	**HAD-29J-SSMAP** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -40° to 165°C
	SSMA Male to 2.92mm Male	**HAD-29P-SSMAP** 	**Freq:** DC-40 GHz **VSWR**: 1.15:1 Max **Temp:** -40° to 165°C
TNC to 7mm	TNC Female to 7mm Male	**7MM-TNCJ** 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
	TNC Male to 7mm Male	**7MM-TNCP** 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
TNC to N	TNC Female to N Female	**NJ-TNCJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
	TNC Female to N Male	**NP-TNCJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
	TNC Male to N Female	**NJ-TNCP** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
	TNC Male to N Male	**NP-TNCP** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max

BETWEEN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
SMA to BMA	SMA Female to BMA Female	**HAD-SMAJ-BMAJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		HAD-SMAJ-BMAJ-2H 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		HAD-SMAJ-BMAJ-BH 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
	SMA Female to BMA Male	**HAD-SMAJ-BMAP** 	**Freq:** DC-18 GHz **VSWR**: 1.20:1 Max
	SMA Male to BMA Female	**HAD-SMAP-BMAP** 	**Freq:** DC-18 GHz **VSWR**: 1.20:1 Max
SMA to SSMA	SMA Female to SSMA Female	**HAD-SMAJ-SSMAJ** 	**Freq:** DC-18 GHz **VSWR**: 1.20:1 Max
	SMA Female to SSMA Male	**HAD-SMAJ-SSMAP** 	**Freq:** DC-18 GHz **VSWR**: 1.20:1 Max
SMA to SMP	SMA Female to SMP Female	**HAD-SMAJ-SMPJ** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max
	SMA Male to SMP Female	**HAD-SMAP-SMPJ** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max
SMA to SMPM	SMA Female to SMPM Male	**HAD-SMAJ-SMPMJ** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max
	SMA Male to SMPM Female	**HAD-SMAP-SMPMJ** 	**Freq:** DC-27 GHz **VSWR**: 1.15:1 Max
SMA to TNC	SMA Female to TNC Female	**TNCJ-SMAJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 100°C
	SMA Female to TNC Male	**TNCJ-SMAP** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 100°C
	SMA Male to TNC Female	**TNCP-SMAJ** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 100°C
	SMA Male to TNC Male	**TNCP-SMAP** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 100°C

Type	Config.	Part #/Type	Specifications
SMA to HUMC	SMA Female to HUMC Female	**HAD-SMAJ-HUMCJ** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
	SMA Female to HUMC Male	**HAD-SMAJ-HUMCP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
	SMA Male to HUMC Female	**HAD-SMAP-HUMCJ** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
SMA to N	SMA Female to N Female	**2310SF** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 165°C
		NJ-SMAJ-FF 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 125°C
		NJ-SMAJ-FF-01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
		NJ-SMAJ-BH Bulkhead 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max
		2312SF 4-Hole Flange 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 165°C
	SMA Female to N Male	**2320SF** 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
		NP-SMAJ-MF 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 125°C
		NP-SMAJ-MF-01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
	SMA Male to N Female	**2330SF** 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 165°C
		NJ-SMAP-FM 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 125°C
		NJ-SMAP-FM-01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C
		2311SF 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 165°C
	SMA Male to N Male	**2340SF** 4-Hole Flange 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -55° to 165°C
		NP-SMAP-MM 	**Freq:** DC-18 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 125°C
		NP-SMAP-MM-01 	**Freq:** DC-18 GHz **VSWR**: 1.15:1 Max **Temp:** -65° to 165°C

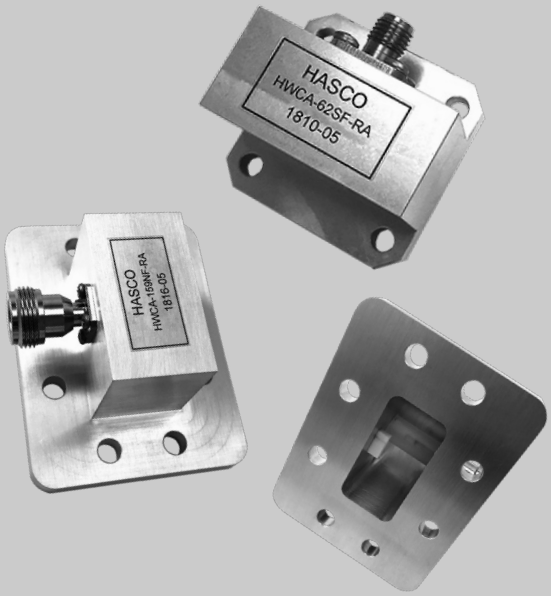
BETWEEN-SERIES ADAPTERS

Type	Config.	Part #/Type	Specifications
SMA to 2.4mm	SMA Female to 2.4mm Female	24J-SMAJ-FF 	**Freq:** DC-26.5 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
	SMA Female to 2.4mm Male	24P-SMAJ-MF 	**Freq:** DC-26.5 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
	SMA Male to 2.4mm Female	24J-SMAP-FM 	**Freq:** DC-26.5 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°C
	SMA Male to 2.4mm Male	24P-SMAP-MM 	**Freq:** DC-26.5 GHz **VSWR**: 1.25:1 Max **Temp:** -65° to 165°Cx
SMA to MCX	SMA Female to MCX Male	HAD-SMAJ-MCXP 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
	SMA Male to MCX Male	HAD-SMAP-MCXP 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
SMA to MMCX	SMA Female to MMCX Male	HAD-SMAJ-MMCXP 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
	SMA Male to MMCX Male	HAD-SMAP-MMCXP 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max
SMB to N	SMB Female to N Female	SMBJ-NJ-MF 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C
	SMB Female to N Male	SMBJ-NP-FM 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C
	SMB Male to N Female	SMBP-NJ-FF 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C
SMB to SMA	SMB Female to SMA Male	HAD-SMAP-SMBJ 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
		SMBJ-SMAP-MM 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C
	SMB Male to SMA Female	HAD-SMAJ-SMBP 	**Freq:** DC-4 GHz **VSWR**: 1.20:1 Max
		SMBP-SMAJ-FF 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C
	SMB Male to SMA Male	SMBP-SMAP-FM 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **Temp:** -55° to 125°C

Waveguide to Coax Adapters

HASCO's offerings of Waveguide to Coax dapters are known for their superior performance as well as low-loss and low VSWR characteristics.

Available in WR-10 to WR-430.



WAVEGUIDE TO COAX ADAPTERS

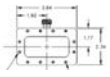
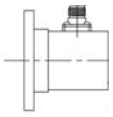
PHOTO	CONFIG.	PART #/TYPE	SPECIFICATIONS
	WR-10 to 1.0mm (F) Straight End-Launch	**HWCA-101F-EL**	**Freq:** 75-110 GHz **VSWR**: √1.7:1 (17dB RL) Typ. **Flange:** UG387/UM **Temp:** -20° to +50°C
	WR-10 to 1.0mm (F) Right Angle	**HWCA-101F-RA**	**Freq:** 75-110 GHz **VSWR**: 1.4:1 Max **Flange:** UG387/UM **Max Power:** 10W (CW)
	WR-10 to 1.0mm (F) Right Angle	**HWCA-101F-RAR**	**Freq:** 75-110 GHz **VSWR**: 1.4:1 Max **Flange:** UG387/UM **Max Power:** 10W (CW)
	WR-112 to SMA (F) Right Angle	**HWCA-112SF-RA**	**Freq:** 7.05-10.0 GHz **VSWR**: 1.25:1 Max **Flange:** UG138/U **IL:** 0.15 dB Typ.
	WR-12 to 1.0mm (F) Straight End-Launch	**HWCA-121F-EL**	**Freq:** 60-90 GHz **VSWR**: √1.7:1 (17dB RL) Typ **Flange:** UG387/U **Temp:** -20° to +50°C
	WR-12 to 1.0mm (F) Right Angle	**HWCA-121F-RA**	**Freq:** 60-90 GHz **VSWR**: 1.4:1 Max **Flange:** UG387/U **Max Power:** 10W (CW)
	WR-12 to 1.0mm (F) Right Angle	**HWCA-121F-RAR**	**Freq:** 60-90 GHz **VSWR**: 1.4:1 Max **Flange:** UG387/U **Max Power:** 10W (CW)
	WR-15 to 1.0mm (F) Straight End-Launch	**HWCA-151F-EL**	**Freq:** 50-75 GHz **VSWR**: √1.7:1 (17dB RL) Typ **Flange:** UG385/U **Temp:** -20° to +50°C
	WR-15 to 1.0mm (F) Right Angle	**HWCA-151F-RA**	**Freq:** 50-75 GHz **VSWR**: 1.4:1 Max **Flange:** UG385/U **Max Power:** 10W (CW)
	WR-15 to 1.0mm (F) Right Angle	**HWCA-151F-RAR**	**Freq:** 50-75 GHz **VSWR**: 1.4:1 Max **Flange:** UG385/U **Max Power:** 10W (CW)
	WR-15 to 1.85mm (F) Right Angle	**HWCA-1518F-RAR**	**Freq:** 50-67 GHz **VSWR**: 1.4:1 Max **Flange:** UG385/U **Max Power:** 30W (CW)
	WR-15 to 1.85mm (F) Straight End-Launch	**HWCA-15VF-EL**	**Freq:** 50-70 GHz **VSWR**: √1.7:1 (17dB RL) Typ **Flange:** UG385/U **Temp:** -20° to +50°C
	WR-159 to N (F) Right Angle	**HWCA-159NF-RA**	**Freq:** 4.90-7.05 GHz **VSWR**: 1.25:1 Max **Flange:** CPR159F
	WR-187 to N (F) Right Angle	**HWCA-187NF-RA**	**Freq:** 3.95-5.85 GHz **VSWR**: 1.25:1 Max **Flange:** CMR187
	WR-229 to N (F) Right Angle	**HWCA-229NF-RA**	**Freq:** 3.30-4.90 GHz **VSWR**: 1.25:1 Max **Flange:** CMR229
	WR-284 to N (F) Right Angle	**HWCA-284NF-RA**	**Freq:** 3.30-4.90 GHz **VSWR**: 1.25:1 Max **Flange:** UG1484/U
	WR-28 to 2.92mm (F) Right Angle	**HWCA-2829F-RA**	**Freq:** 2.6-3.95 GHz **VSWR**: 1.20:1 Max **Flange:** UG599/U **IL:** 0.010 dB Typ.

PHOTO	CONFIG.	PART #/TYPE	SPECIFICATIONS
	WR-34 to 2.92mm (F) Straight End-Launch	**ADP-W-27500-11000-34-2F-E**	**Freq:** 22-33 GHz **IL**: <0.4 dB Typ **Flange:** UG1530/U **Temp:** -25° to +65°C
	WR-34 to 2.92mm (F) Right Angle	**HWCA-3429F-RA**	**Freq:** 22-33 GHz **VSWR**: 1.25:1 Max **Flange:** UG1530/U **IL:** 0.30 dB Typ.
	WR-34 to N (F) Right Angle	**HWCA-340NF-RA**	**Freq:** 2.1 - 3.0 GHz **VSWR**: 1.25:1 Max **Flange:** UG554F/U **Temp:** -40° to +85°C
	WR-42 to SMA (F) Right Angle	**HWCA-42SF-RA**	**Freq:** 18-26.5 GHz **VSWR**: 1.30:1 Max **Flange:** UG595/U & UG597/U **Temp:** -55° to +120°C
	WR-430 to N (F) Right Angle	**HWCA-430NF-RA**	**Freq:** 1.7-2.6 GHz **VSWR**: 1.20:1 Max **Flange:** UG437F **IL:** 0.15 dB Typ.
	WR-51 to SMA (F) Right Angle	**HWCA-515SF-RA**	**Freq:** 15-22 GHz **VSWR**: 1.20:1 Max **Flange:** WR51 **IL:** 0.10 dB Typ.
	WR-62 to SMA (F) Right Angle	**HWCA-62SF-RA**	**Freq:** 12.4-18.0 GHz **VSWR**: 1.25:1 Max **Flange:** UG1665/U **IL:** 0.30 dB Typ.
	WR-75 to SMA (F) Right Angle	**ADP-W-12500-5000-75-E**	**Freq:** 10-15 GHz **IL**: 0.15 dB Typ **Flange:** UBR120 **Temp:** -50° to +85°C
	WR-75 to SMA (F) Right Angle	**HWCA-75SF-RA**	**Freq:** 10-15 GHz **VSWR**: 1.25:1 Max **Flange:** WR-75 Cover **IL:** 0.30 dB Typ.
	WR-75 to SMA (F) Right Angle	**HWCA-75SF-RA-01**	**Freq:** 10-15 GHz **VSWR**: 1.25:1 Max **Flange:** WR-75 Cover **IL:** 0.30 dB Typ.
	WR-90 to SMA (F) Right Angle	**HWCA-90SF-RA**	**Freq:** 8.2-12.4 GHz **VSWR**: 1.25:1 Max **Flange:** UG135/U **IL:** 0.30 dB Typ.
	WR-90 to N (F) Right Angle	**HWCA-90NF-RA**	**Freq:** 8.2-12.4 GHz **VSWR**: 1.25:1 Max **Flange:** UG135/U

Ask us about your specific requirement.

HASCO can provide engineering assistance to fulfill many specialized requirements.

LOW PIM ADAPTERS

IN-SERIES LOW PIM ADAPTERS

Type	Config.	Part #/Type	Specifications
4.3-10	4.3-10 Male to 4.3-10 Female	**4310P-4310J-RA-SLP** Right Angle 	**Freq:** DC-6 GHz **VSWR**: 1.45:1 Max **PIM:** <-165 dBc
7/16 DIN	716 DIN Female to 716 DIN Female	**716J-716J-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to 716 DIN Female	**716P-716J-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to 716 DIN Male	**716P-716P-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
N	N Female to N Female	**NJ-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
	N Male to N Female	**NP-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
	N Male to N Male	**NP-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
SMA	SMA Female to SMA Female	**1212-35-50-LPIM** 	**Freq:** DC-18 GHz **VSWR**: 1.35:1 Max **PIM:** <-150 dBc **Temp:** -65° to 125°C

BETWEEN-SERIES LOW PIM ADAPTERS

Type	Config.	Part #/Type	Specifications
N to Mini DIN	N Male to Mini DIN Female	**MDP-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	N Male to Mini DIN Male	**MDP-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
4.3-10 to SMA	4.3-10 Female to SMA Female	**4310J-SMAJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.30:1 Max **PIM:** <-165 dBc
	4.3-10 Male to SMA Male	**4310P-SMAP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.25:1 Max **PIM:** <-165 dBc

Type	Config.	Part #/Type	Specifications
4.3-10 to N	4.3-10 Female to N Female	**4310J-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.25:1 Max **PIM:** <-168 dBc
	4.3-10 Female to N Male	**4310J-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	4.3-10 Male to N Female	**4310P-NJ-RA-SLP** Right Angle 	**Freq:** DC-6 GHz **VSWR**: 1.45:1 Max **PIM:** <-160 dBc
	4.3-10 Male to N Male	**4310P-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.25:1 Max **PIM:** <-168 dBc
4.3-10 to 7/16 DIN	4.3-10 Female to 7/16 DIN Female	**4310J-716J-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.30:1 Max **PIM:** <-168 dBc
	4.3-10 Female to 7/16 DIN Male	**4310J-716P-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
7/16 DIN to SMA	716 DIN Female to SMA Female	**716J-SMJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
	716 DIN Female to SMA Male	**716J-SMP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
	716 DIN Male to SMA Female	**716P-SMJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
	716 DIN Male to SMA Male	**716P-SMP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-160 dBc
7/16 DIN to N	716 DIN Female to N Female	**716J-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Female to N Male	**716J-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to N Female	**716P-NJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to N Male	**716P-NP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
7/16 DIN to Mini DIN	716 DIN Female to Mini DIN Male	**716J-MDP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to Mini DIN Female	**716P-MDP-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc
	716 DIN Male to Mini DIN Male	**716P-MDJ-SLP** 	**Freq:** DC-6 GHz **VSWR**: 1.20:1 Max **PIM:** <-168 dBc

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BROADBAND AMPLIFIERS

An amplifier boosts the loss experienced by a microwave signal.

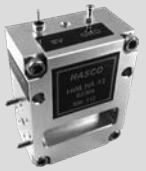
A Low Noise Amplifier is placed near the input of a receiver. The noise figure measures how much the LNA degrades the signal-to-noise ratio of the received signal. The other important characterstics of the LNA is its linearity, survivable power and DC dissipation.

Power Amplifiers are used to boost a small signal to a large signal based on the frequency.

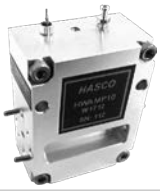
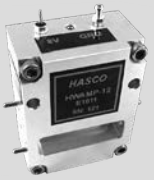
HASCO's line of amplifiers are high performance LNA (Low Noise Amplifiers) and power amplifier designs with extremely low noise and broadband performance in Waveguide Amplifier and MMIC Amplifier options.

Our amplifiers operate from 17 GHz up to 110 GHz with up to 32 dB of gain or a Psat of 27 dBm, depending on the design. The LNA designs can achieve a noise figure down to 3.5 dB in the mmWave bands.

LOW NOISE AMPLIFIERS

PHOTO	TYPE/PART #	OUTPUT FREQUENCY	GAIN	NOISE FACTOR	DC	MATERIALS
	**W-Band, WR-10 HWLNA10-W10045**	75-110 GHz	• 75-105 GHz: 20 dB Typ • 106-110 GHz: Gain may drop slightly • 110- GHz: 10 dB Typ	4.5 dB Typ.	+8V @ 100 mA Typ. or +7V to +12V	• **Waveguide:** Gold Plated Aluminum • WR-10, UG-387/U-M
	**E-Band, WR-12 HWLNA12-E2304**	67-90 GHz	23 dB Typ.	4.5 dB Typ.	+7.5V to 12V @ 75 mA Typ.	• **Waveguide:** Gold Plated Aluminum • WR-12, UG-3387/U
	**V-Band, WR-15 HWLNA15-V2004**	53-65 GHz	-10° - +65°C	4 dB Typ.	+8V @ 100 mA Typ. or +7V to +12V	• **Waveguide:** Gold Plated Aluminum • WR-15, UG-385U

POWER AMPLIFIERS

PHOTO	TYPE/PART #	OUTPUT FREQUENCY	GAIN	PSAT	DC	MATERIALS
	**W-Band, WR-10 HWAMP10-W1712**	75-110 GHz	17 dB Typ	75-105 GHz: +12 dBm Typ. 110 GHz: +8 dBm Typ.	+8V @ 300 mA Typ. or +7V to +12V	• **Waveguide:** Gold Plated Aluminum • WR-10, UG-387/U-M
	**E-Band, WR-12 HWAMP12-E1011**	71-860 GHz	25 dB Typ.	+11 dBm to +13 dBm	+7.5V to 12V @ 150 mA Typ.	• **Waveguide:** Gold Plated Aluminum • WR-12, UG-3387/U
	**V-Band, WR-15 HWAMP15-V2012**	50-75 GHz	20 dB Typ.	12 dBm Typ.	+8V @ 300 mA Typ. or +7V to +12V	• **Waveguide:** Gold Plated Aluminum • WR-15, UG-385U
	**U-Band, WR-19 HWAMP19-U1820**	40-60 GHz	18 dB Typ.	20 dBm Typ.	+8V @ 300 mA Typ.	• **Waveguide:** Gold Plated Aluminum • WR-19, UG-383/U
	**Q-Band, WR-22 HWAMP22-Q1821**	33-48 GHz	18 dB Typ.	21 dBm Typ	+8V @ 450 mA Typ.	• **Waveguide:** Gold Plated Aluminum • WR-22, UG-383/U
	**Ka-Band, WR-28 HWAMP28-KA2222**	26.5-40 GHz	22 dB Typ.	22 dBm Typ	+8V @ 200 mA Typ.	• **Waveguide:** Gold Plated Aluminum • WR-28, UG-599/U

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RF COAXIAL and WAVEGUIDE ATTENUATORS

RF Coaxial Attenuators are used to reduce signal levels and improve the match between components.

A Millimeter Waveguide Attenuator is a passive RF device specifically designed to reduce the power of a signal without affecting or reducing the waveform of the signal. Millimeter Waveguide Fixed Attenuators have a fixed level of attenuation - any signal input in to the system will be attenuated by the waveguide.

HASCO stocks thousands of RF and Microwave attenuators and can support most requirements, such as Type N, SMA, 2.92mm, 2.4mm, and 1.85mm in addition to many other RF Coaxial and Waveguide Attenuators.

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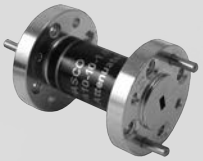
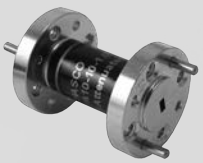
RF COAXIAL ATTENUATORS

XX = dB Value

PHOTO	TYPE/PART #	FREQUENCY	POWER	TEMP RANGE	ATTENUATION	VSWR	MATERIALS
	**Type N** **HA18N5W-XX**	DC-18 GHz	5 Watts Peak: 500 W	-65° - +125°C	• 1-6 dB = ± 0.30 dB • 7-20 dB = ± 0.50 dB • 30 dB = ± 0.75 dB • 40 dB = ± 1.25 dB	1:15:1 to 1.35:1	• **Heat Sink:** Black Anodized Aluminum • **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**Type N** **HA18N10W-XX**	DC-18 GHz	10 Watts Peak: 500 W	-65° - +125°C	• 1-6 dB = ± 0.50 dB • 7-20 dB = ± 0.75 dB • 30-40 dB = ± 1.00 dB	1:15:1 to 1.40:1	• **Heat Sink:** Black Anodized Aluminum • **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA3A2-XX**	DC-3 GHz	2 Watts Peak: 100 W	-10° - +65°C	• 1-2 dB = ± 0.40 dB • 3-9 dB = ± 0.50 dB • 10 dB = ± 0.60 dB • 15-20 dB = ± 0.70 dB • 30 dB = ± 0.80 dB	1:20:1	• **Housing:** Gold Plated Brass • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA6A-XX**	DC-6 GHz	2 Watts Peak: 200 W	-65° - +125°C	• 1-20 dB = ± 0.50 dB • 30 dB = ± 0.75 dB	1:15:1 to 1.20:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead
	**SMA** **HA6A2-XX**	DC-6 GHz	2 Watts Peak: 200 W	-65° - +125°C	• 1-20 dB = ± 0.50 dB • 30 dB = ± 0.75 dB	1:15:1 to 1.35:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA18A-XX**	DC-18 GHz	2 Watts Peak: 250 W	-55° - +85°C	• 0.5-9 dB = ± 0.30 dB • 10-20 dB = ± 0.50 dB • 25-30 dB = ± 0.75 dB	1:15:1 to 1.35:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA18A5W-XX**	DC-18 GHz	5 Watts Peak: 500 W	-65° - +125°C	• 0.5-6 dB = ± 0.30 dB • 7-20 dB = ± 0.50 dB • 30 dB = ± 0.75 dB • 40 dB = ± 1.25 dB	1:15:1 to 1.35:1	• **Heat Sink:** Black Anodized Aluminum • **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA18A10W-XX**	DC-18 GHz	10 Watts Peak: 500 W	-65° - +125°C	• 1-6 dB = ± 0.50 dB • 10-20 dB = ± 0.75 dB • 30 dB = ± 1.00 dB	1:15:1 to 1.40:1	• **Heat Sink:** Black Anodized Aluminum • **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA** **HA26A-XX**	DC-26 GHz	2 Watts Peak: 500 W	-65° - +125°C	• 1-12 dB = ± 0.50 dB • 15-20 dB = ± 0.75 dB • 30 dB = ± 1.25 dB	1:15:1 to 1.35:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**2.92mm** **HA40A-XX**	DC-40 GHz	1/2 (.5) Watt Peak: 500 W	-55° - +125°C	• 1-30 dB = ± 0.75 dB	1:30:1 to 1.40:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead
	**2.92mm** **HA40A2-XX**	DC-40 GHz	2 Watts Peak: 500 W	-55° - +125°C	• 1-9 dB = ± 0.80 dB • 10-30 dB = ± 1.00 dB	1:30:1 to 1.40:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead
	**2.4mm** **HA50A-XX**	DC-50 GHz	1/2 (.5) Watt	-55° - +100°C	• 1-10 dB = ± 1.50 dB • 20-30 dB = ± 2.00 dB	1:35:1 to 1.75:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead
	**2.4mm** **HA50A1-XX**	DC-50 GHz	1 Watt	-55° - +100°C	• 1-10 dB = ± 1.50 dB • 20-30 dB = ± 2.00 dB	1:35:1 to 1.75:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead
	**1.85mm** **HA65A-XX**	DC-65 GHz	1 Watt	-55° - +100°C	• 1-9 dB = ± 1.50 dB • 10 dB = ± 1.75 dB • 20 dB = ± 2.5 dB • 30 dB = ± 5.5 dB	1:35:1 to 1.65:1	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** High Temp. Plastic Bead

FIXED WAVEGUIDE ATTENUATORS

PHOTO	TYPE/PART #	FREQUENCY	POWER	TEMP RANGE	ATTENUATION ACCURACY	VSWR	MATERIALS
	**W Band HWFA10-03-1.0 (1 Inch)**	75 to 110 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 3 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U-M
	**W Band HWFA10-06-1.0 (1 Inch)**	75 to 110 GH	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 6 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U-M
	**W Band HWFA10-10-1.0 (1 Inch)**	75 to 110 GH	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 10 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U-M
	**E Band HWFA12-03-1.0 (1 Inch)**	60 to 90 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 3 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U
	**E Band HWFA12-06-1.0 (1 Inch)**	60 to 90 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 6 dB Typ	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U
	**E Band HWFA12-10-1.0 (1 Inch)**	60 to 90 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 10 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-387/U
	**V Band HWFA15-03-1.0 (1 Inch)**	50 to 75 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 3 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-385/U
	**V Band HWFA15-06-1.0 (1 Inch)**	50 to 75 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 6 dB Typ	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-385/U
	**V Band HWFA15-10-1.0 (1 Inch)**	50 to 75 GHz	0.3 Watts	-0° - +100°C	Accuracy: (0.7 dB @ 4%) 10 dB Typ.	1:15:1	• **Waveguide:** 075-T6 Aluminum • **Finish:** Gold Over Electroless Nickel • **Flange** UG-385/U

LEVEL-SET WAVEGUIDE ATTENUATORS

PHOTO	TYPE/PART #	FREQUENCY	VARIABLE ATTENUATION	VSWR	MATERIALS
	**WR-06** **D Band** **HWLSA06-0330-ER**	110 to 170 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-387/M
	**WR-08** **F Band** **HWLSA08-0330-ER**	90 to 140 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-387/M
	**WR-10** **W Band** **HWLSA10-0330-ER**	75 to 110 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-387/M
	**WR-12** **E Band** **HWLSA12-0330-ER**	60 to 90 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-387
	**WR-15** **V Band** **HWLSA15-0330-ER**	50 to 75 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-385
	**WR-19** **U Band** **HWLSA19-0330-ER**	40 to 60 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-383/M
	**WR-22** **Q Band** **HWLSA22-0330-ER**	33 to 50 GHz	0 to 30dB	1:30:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-383/U-M
	**WR-28** **Ka Band** **HWLSA28-0330-ES**	26.5 to 40 GHz	0 to 30dB	1:25:1	• **Waveguide:** OFHC Copper • **Flange:** OFHC Copper • **Finish:** Gold Plate • **Flange** UG-599

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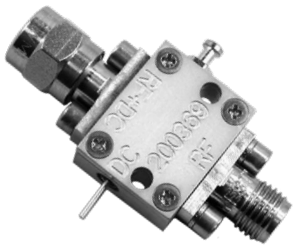
BIAS TEES
MAGIC TEES

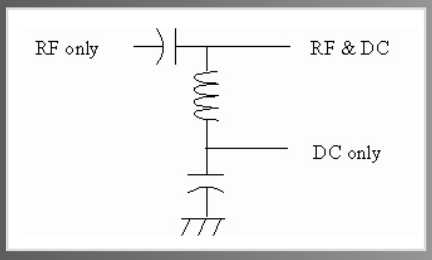
A **Bias Tee** is a diplexer, which splits incoming signals from a common port into two paths (sometimes called “channels”), dependent on frequency. It is a three-port network used to supply DC currents or voltages to RF devices, and for setting the DC bias point, without disturbing other components. The DC port injects a bias onto the RF path by adding a DC bias level to a radio-frequency signal from the RF port onto the RF-DC port. The biased RF signal can be sent to a remote device to provide both an RF signal and a DC supply.

A **Waveguide Magic Tee** is a four-port hybrid coupler and/or power divider with two collinear arms, an E-plane (difference) arm and an H-plane (sum) arm. HASCO Magic Tees offer a nominal insertion loss and high isolation between the two collinear arms and between the sum and difference arms.

BIAS TEES

PHOTO	PART #	CONNECTOR	TYPE	SPECIFICATIONS
	**HBT4-20040-MF**	2.92mm Male to 2.92mm Female	Coaxial	**Freq:** 200 MHz - 40 GHz **VSWR**: 2.0:1 Max. **IL:** 1.5dB Typ. **RL:** -15dB Typ **Voltag**e: 225mA **Temp:** -55° to 125°C

In this figure, an RF signal is introduced to the RF & DC port and a DC bias is added from the DC Only port. A **Bias Tee** can also work in reverse order to remove a DC bias that is received from the RF & DC port, while allowing only the RF signal to pass to the RF port. In the reverse scenario, the DC Only port can be c onnected to a VDC port of an active device, such as an amplifier, to power it.



Properties that are important to a bias tee are RF bandwidth, insertion loss and mismatch at the two RF ports, the maximum DC current, and video bandwidth of the DC port.

WAVEGUIDE MAGIC TEES

PHOTO	PART #	WAGEGUIDE BAND	FLANGE	SPECIFICATIONS
	**HWMT10-9030T-ER**	W-Band	WR-10 UG-387/UM	**Freq:** 75 - 105 GHz **IL:** 1.0dB Typ. **RL:** 14dB MIN (H Port) 12.5 dB Min (E Port) **Isolation:** 30 dB Min E-H Ports 20 dB Min Colinear Points **Balance:** 0.5 dB Max
	**HWMT12-7330T-ER**	E-Band	WR-12 UG-387/U	**Freq:** 60 - 86 GHz **IL:** .35dB Typ. **RL:** 14dB MIN (H Port) 12.5 dB Min (E Port) **Isolation:** 30 dB Min E-H Ports 20 dB Min Colinear Points **Balance:** 0.5 dB Max
	**HWMT15-6130T-ER**	V-Band	WR-15 UG-385/U	**Freq:** 50 - 72 GHz **IL:** 1.0dB Typ. **RL:** 14dB MIN (H Port) 12.5 dB Min (E Port) **Isolation:** 30 dB Min E-H Ports 20 dB Min Colinear Points **Balance:** 0.5 dB Max

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CIRCULATORS and ISOLATORS

A circulator is sometimes called a “duplexer,” because it duplexes two signals into one channel.

Circulators make a great antenna interface for a transmit/receive system. Energy can be made to flow from the transmitter (port 1) to the antenna (port 2) during transmit, and from the antenna (port 2) to the receiver (port 3) during receive. Circulators have low electrical losses and can be made to handle huge power loads, well into kilowatts. They usually operate over no more than an octave bandwidth, and are purely an RF component.

Waveguide circulators and isolators have by far the best electrical characteristics. You can specify insertion loss down to less than 0.2 dB in some cases! Coax circulators and isolators might have losses between 0.5 and 1.0 dB.

By terminating one port, a circulator becomes an isolator, which has the property that energy flows on one direction only. They isolate components in a chain, so that bad VSWRs don’t contribute to gain ripple, or lead to instabilities. An isolator is a non-reciprocal, passive network.

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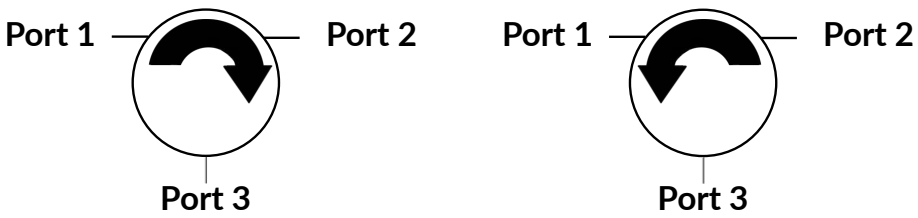
COAXIAL CIRCULATORS

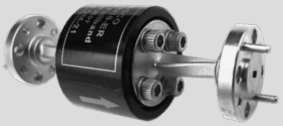
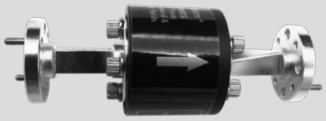
PHOTO	TYPE PART #	FREQUENCY RANGE	ISOLATION (MIN.)	IL (MAX)	VSWR (MAX)	POWER	POWER (MAX)
	**SMA HSC0810S**	800 MHz to 1.0 GHz	20 dB	0.50 dB	1.30:1	250 WATTS	750 WATTS
	**N HSC0810N**	800 MHz to 1.0 GHz	20 dB	0.40 dB.	1.25:1	250 WATTS	750 WATTS
	**SMA HSC0102S**	1.0 to 2.0 GHz	18 dB	0.50 dB	1.30:1	50 WATTS	75 WATTS
	**SMA HSC1722S**	1.70 to 2.20 GHz	20 dB	0.40 dB	1.25:1	150 WATTS	500 WATTS
	**N HSC1722N**	1.70 to 2.20 GHz	20 dB	0.40 dB	1.25:1	150 WATTS	500 WATTS
	**SMA HSC2040**	2.0 to 4.0 GHz	18 dB	0.50 dB	1.30:1	20 WATTS	30 WATTS
	**SMA HSC2060**	2.0 to 6.0 GHz	14 dB	0.80 dB	1.50:1	20 WATTS	30 WATTS
	**SMA HSC4080**	4.0 to 8.0 GHz	20 dB	0.40 dB	1.25:1	20 WATTS	30 WATTS
	**SMA HSC6018**	6.0 to 18.0 GHz	14 dB	1.00 dB	1.50:1	10 WATTS	30 WATTS
	**SMA HSC8012**	8.0 to 12.4 GHz	20 dB	0.50 dB	1.25:1	25 WATTS	500 WATTS
	**SMA HSC1218**	12.0 to 18.0 GHz	20 dB	0.50 dB	1.25:1	10 WATTS	30 WATTS
	**SMA HSC1826**	18.0 to 26.5 GHz	18 dB	0.80 dB	1.40:1	10 WATTS	30 WATTS

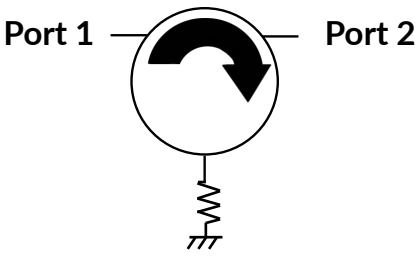


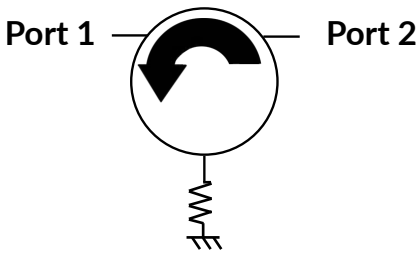
COAXIAL ISOLATORS

PHOTO	TYPE PART #	FREQUENCY RANGE	ISOLATION (MIN.)	IL (MAX)	VSWR (MAX)	REFLECTIVE POWER	POWER	POWER (MAX)
	**SMA HSI0810S**	800 MHz to 1.0 GHz	20 dB	0.50 dB	1.25:1	10 WATTS	250 WATTS	750 WATTS
	**N HSI0810N**	800 MHz to 1.0 GHz	20 dB	0.40 dB.	1.25:1	10 WATTS	250 WATTS	750 WATTS
	**SMA HSI0102S**	1.0 to 2.0 GHz	18 dB	0.50 dB	1.30:1	10 WATTS	50 WATTS	75 WATTS
	**SMA HSI1722S**	1.70 to 2.20 GHz	20 dB	0.40 dB	1.25:1	10 WATTS	150 WATTS	500 WATTS
	**N HSI1722N**	1.70 to 2.20 GHz	20 dB	0.40 dB	1.25:1	10 WATTS	200 WATTS	500 WATTS
	**SMA HSI2040S**	2.0 to 4.0 GHz	18 dB	0.40 dB	1.30:1	2 WATTS	20 WATTS	30 WATTS
	**SMA HSI2060**	2.0 to 6.0 GHz	14 dB	0.80 dB	1.50:1	2 WATTS	20 WATTS	30 WATTS
	**SMA HSI4080**	4.0 to 8.0 GHz	20 dB	0.40 dB	1.25:1	2 WATTS	20 WATTS	30 WATTS
	**SMA HSI6018**	6.0 to 18.0 GHz	14 dB	1.00 dB	1.50:1	2 WATTS	10 WATTS	30 WATTS
	**SMA HSI8012**	8.0 to 12.4 GHz	20 dB	0.40 dB	1.25:1	2 WATTS	25 WATTS	500 WATTS
	**SMA HSI1218**	12.0 to 18.0 GHz	20 dB	0.50 dB	1.25:1	2 WATTS	10 WATTS	30 WATTS
	**SMA HSI1826**	18.0 to 26.5 GHz	18 dB	0.80 dB	1.40:1	2 WATTS	10 WATTS	30 WATTS
	**SMA HSI2640**	26.0 to 40.0 GHz	14 dB	1.00 dB	1.50:1	2 WATTS	5 WATTS	30 WATTS
	**SMA HSI2731**	27.0 to 31.0 GHz	20 dB	0.60 dB	1.25:1	2 WATTS	5 WATTS	30 WATTS

WAVEGUIDE FULL BAND ISOLATORS

PHOTO	TYPE PART #	FREQUENCY RANGE	ISOLATION (MIN.)	IL (MAX)	POWER (MAX)	FLANGE MATERIAL
	**WR-08 HWFBI08-ER**	90 to 140 GHz	20 dB	3..2 dB	0.75 WATTS	UG-387/U-M Round Gold Plated Brass
	**WR-10 HWFBI10-ER**	75 to 110 GHz	27 dB	2.5 dB	1.0 WATTS	UG-387/U-M Round Gold Plated Brass
	**WR-12 HWFBI12-ER**	60 to 90 GHz	27 dB	2.0 dB	1.0 WATTS	UG-387/U Round Gold Plated Brass
	**WR-15 HWFBI15-ER**	50 to 75 GHz	27 dB	1.8 dB	1.5 WATTS	UG-385/U Round Gold Plated Brass
	**WR-19 HWFBI19-ER**	40 to 60 GHz	27 dB	1.8 dB	1.5 WATTS	UG-383/U Round Gold Plated Brass
	**WR-22 HWFBI22-ER**	33 to 50 GHz	27 dB	1.8 dB	1.5 WATTS	UG-383/U Round Gold Plated Brass
	**WR-28 HWFBI28-ES**	26.5 to 40 GHz	25 dB	1.8 dB	1.5 WATTS	UG-599/U Square Gold Plated Brass





CONNECTORS

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HASCO is the exclusive distributor of Southwest Microwave connectors. We specialize in high performance end launch, vertical launch, field-replaceable, blind-mate and cable connectors that operate up to 110 GHz. They are available in N, TNC, SMA, SSMA, 2.92mm, 2.4mm, 1.85mm, and 1.0mm. These connector lines offer precision-design options for when performance and quality are key to system performance.

Further information can be found at https://www.hasco-inc.com/southwest-microwave-connectors/

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SOUTHWEST CONNECTORS

Type	Series	Typical Specifications
1.0mm	**2400 Series**	• **Freq:** DC-110 GHz • **VSWR**: **DC - 50 GHz**: 1.18:1 Max **50 - 110 GHz**: 1.25:1 Max • **RF Leakage:** < -100 dB • **Temp:** -55° to +165°C
1.85mm	**1800 Series**	• **Freq:** DC-67 GHz • **VSWR**: **DC - 27 GHz**: 1.10:1 Max **27 - 40 GHz**: 1.15:1 Max **40 - 50 GHz**: 1.18 :1 Max **50 - 67 GHz**: 1.25:1 Max • **RF Leakage:** < -100 dB • **Temp:** -55° to +165°C
2.4mm	**1400 Series**	• **Freq:** DC-50 GHz • **VSWR**: **DC - 18 GHz**: 1.10:1 Max **18 - 40 GHz**: 1.15:1 Max **40 - 50 GHz**: 1.18 :1 Max • **RF Leakage:** < -120 dB • **Temp:** -55° to +135°C
2.92mm	**1000 Series**	• **Freq:** DC-27 GHz • **VSWR**: **DC - 18 GHz**: 1.10:1 Max **18 - 40 GHz**: 1.15:1 Max • **RF Leakage:** < -120 dB • **Temp:** -55° to +135°C
SSMA	**100 Series**	• **Freq:** DC-36 GHz • **VSWR**: **DC - 18 GHz**: 1.10:1 Max **18 - 27 GHz**: 1.15:1 Max **27 - 36 GHz**: 1.25:1 Max • **RF Leakage:** < -120 dB • **Temp:** -55° to +165°C
SMA	**200 Series**	• **Freq:** DC-27 GHz • **VSWR**: **DC - 18 GHz**: 1.10:1 Max **18 - 27 GHz**: 1.15:1 Max • **RF Leakage:** < -120 dB • **Temp:** -55° to +165°C
N	**300 Series**	• **Freq:** DC-18 GHz • **VSWR**: **DC - 18 GHz**: 1.15:1 Max **RF Leakage:** < -120 dB • **Temp:** -55° to +165°C
TNC	**400 Series**	• **Freq:** DC-18 GHz • **VSWR**: **DC - 18 GHz**: 1.15:1 Max **RF Leakage:** < -120 dB • **Temp:** -55° to +165°C

End-launch connectors are commonly used for test boards. Vertical launch connectors are typically used for input, output, and control ports on circuit boards. Field replaceable connectors provide the ability to design a housing with interchangeable connectors that is hermetically sealed using hermetic seals. Blind mate connectors are installed on bulkhead, gang-block and single test-point applications where connections are "blind" and thus require an alignment structure. Cable connectors are compatible with flexible coax, conformable coax and semi-rigid coax, depending on the design.

SOUTHWEST MICROWAVE

Type	Series	Features
End Launch Connectors	**1.0mm** **1.85mm** **2.40mm** **2.92mm** **SMA**	• **DC to 110 GHz** • **Low VSWR** • **Low Insertion Loss** • **Low RF Leakage** • **High Temperature** • **Rugged & Durable** • **Excellent Repeatability**
Vertical Launch Connectors	**1.0mm** **1.85mm** **2.40mm** **2.92mm**	• **DC to 110 GHz** • **Low VSWR** • **Low Insertion Loss** • **Low RF Leakage** • **High Temperature** • **Rugged & Durable** • **Excellent Repeatability**
Cable Connectors	**1.0mm** **1.85mm** **2.40mm** **2.92mm** **SMA**	• **DC to 67 GHz** • **Direct Solder** • **Field Replaceable**

Product specifications subject to change without notification. Full specifications can be found at www.hasco-inc.com.

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DC BLOCKS

HASCO offers a selection of Inner-Only and Inner / Outer DC Blocks with 1.85mm, 2.4mm, 2.92mm, SMA, or Type N Male to Female connectors. Depending on the model, they operate down to 7 KHz and up to 65 GHz.

Several of the Inner-Only DC Blocks and the Inner/ Outer DC Blocks will handle maximum DC voltages up to 200 VDC. All of our DC Blocks are precision designs that are constructed using Passivated Stainless Steel bodies.

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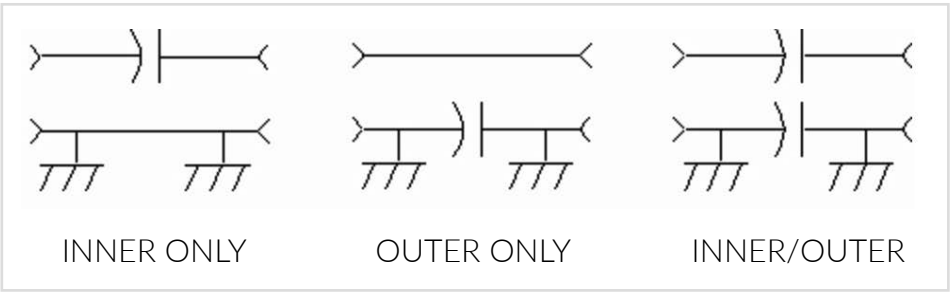
DC BLOCKS

PHOTO	TYPE/PART #	FREQUENCY	INSERTION LOSS	TEMP RANGE	VSWR	POWER	MATERIALS
	**SMA INNER/OUTER HDC18IO**	10MHz-18 GHz	0.75dB	-65° - +125°C	1.35:1	5 WATT AVG. 200V	• **Housing:** High Temp. Plastic • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**SMA INNER ONLY HDC23I**	7KHz-23 GHz	0.75dB	-65° - +125°C	1.35:1	2 WATT AVG. 100V	• **Housing:** Passivated SS • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**N INNER/OUTER HDC18NI0**	10MHz-18 GHz	0.85dB	-65° - +125°C	1.35:1	20V	• **Housing:** High Temp. Plastic • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**N INNER ONLY HDC18NI**	10MHz-18 GHz	0.60dB	-65° - +125°C	1.35:1	100V	• **Housing:** Passivated SS • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**2.92mm INNER ONLY HDC40I**	10MHz-40 GHz	0.75dB	-65° - +125°C	1.45:1	200V	• **Housing:** Passivated SS • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**2.4mm INNER ONLY HDC50I**	10MHz-40 GHz	1.25dB	-35° - +85°C	1.65:1	100V	• **Housing:** Passivated SS • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu
	**1.85mm INNER ONLY HDC65I**	DC-65 GHz	1.25dB	-40° - +85°C	1.60:1	1 WATT 16V	• **Housing:** Passivated SS • **Connector:** Passivated SS • **Contact:** Gold Plated BeCu



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WAVEGUIDE GAIN HORN ANTENNAS

HASCO's Stand Rectangular Gain Horns are used in a wide variety of applications, such as antenna testing and RF radiation pattern measurement. Our Gain Horns function as a calibration standard or as reference for antenna gain measurement. They are also used as feed horns for lens and reflector antennas or stand-alone antennas in subsystems.

The HASCO standard gain horn antenna is used for antenna range calibration and general-purpose system setups.

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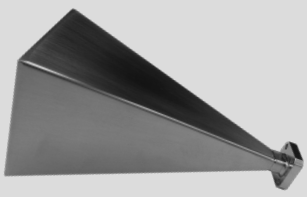
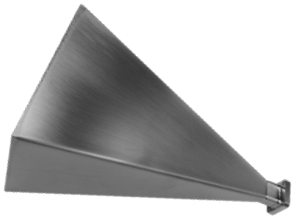
WAVEGUIDE GAIN HORN ANTENNAS

PHOTO	PART #	INPUT WAVEGUIDE	GAIN	SPECIFICATIONS
	**HWSGH10-23-ER**	WR-10 Waveguide **Flange:** UG-387/UM W Band	23 dBi	**Frequency:** 75 - 110 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWSGH12-23-ER**	WR-12 Waveguide **Flange:** UG-387/U E Band	23 dBi	**Frequency:** 60 - 90 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWSGH15-23-ER**	WR-15 Waveguide **Flange:** UG-385/U V Band	23 dBi	**Frequency:** 50 - 75 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWSGH19-23-ER**	WR-19 Waveguide **Flange:** UG-383/UM U Band	23 dBi	**Frequency:** 40 - 60 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWSGH22-23-ER**	WR-22 Waveguide **Flange:** UG-383/UM Q Band	23 dBi	**Frequency:** 33 - 50 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWPSD28-23-ES**	WR-28 Waveguide **Flange:** UG-599/U Ka Band	23 dBi	**Frequency:** 26.5 - 40 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C
	**HWPSD42-23-ES**	WR-42 Waveguide **Flange:** UG-599/U K Band	23 dBi	**Frequency:** 18 - 26.5 GHz **VSWR**: 1.10:1 Max **Series:** Directional **Polarity**: Vertical **Temp:** -55° to 85°C

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LAUNCH ACCESSORIES

HASCO provides an extensive selection of Hermetic Seals, Feed Thrus and Launch Pins from Southwest Microwave and HASCO, Inc.

The end launch accessories are designed to interface with Southwest Microwave's and other manufacturer's end launch connectors that use common end launch .005 pin, .007 pin, .009 pin, .010 pin, .012 pin, .015 pin, .020 pin, .0290 pin, /0390 pin, .0480 pin and .0635 pin connectors.

To view all Southwest Microwave connectors, launch accessories and test boards, please visit HASCO's website at www.hasco-inc.com

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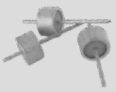
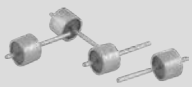
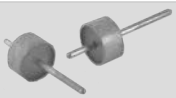
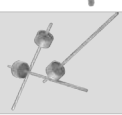
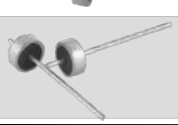
FEEDTHRUS/HERMETIC SEALS

PHOTO	PART #	PIN A	BODY LTH	PIN B	BODY DIA	PIN DIA	OP FREQ	GLASS
	**HA-V01**	0.026 ±0.005	0.055 ±0.002	0.031 ±0.005	0.068 ±0.002	0.009 ±0.001	65 GHz	CORNING 7070
	**HA-V100/ V100B**	0.025 ±0.003	0.055 ±0.002	0.032 ±0.003	0.068 ±0.001	0.009 ±0.001	65 GHz	CORNING 7070
	**HA-3180**	0.031 ±0.005	0.055 ±0.002	0.0180 ±0.005	0.068 ±0.001	0.009 ±0.001	65 GHz	CORNING 7070
	**HA-089**	0.072 ±0.007	0.0625 ±0.0025	0.180 ±0.0010	0.099 ±0.0015	0.012 ±0.001	42 GHz	CORNING 7052
	**HA-095**	0.040 ±0.005	0.055 ±0.002	0.080 ±0.005	0.076 ±0.002	0.012 ±0.005	42 GHz	CORNING 7070
	**HA-1361**	0.040 ±0.005	0.055 ±0.002	0.125 ±0.003	0.076 ±0.002	0.012 ±0.001	42 GHz	CORNING 7070
	**HA-1869**	0.055 0.005	0.069 ±0.002	0.180 ±0.001	0.076 ±0.001	0.012 ±0.001	42 GHz	CORNING 7070
	**HA-2940**	0.029 ±0.005	0.055 ±0.002	0.041 ±0.005	0.076 ±0.002	0.012 ±0.001	42 GHz	CORNING 7070
	**HA-4040**	0.040 ±0.005	0.055 ±0.002	0.040 ±0.005	0.076 ±0.002	0.012 ±0.001	42 GHz	CORNING 7070
	**HA-074**	0.050 ±0.005	0.062 ±0.002	0.125 ±0.005	0.098 ±0.002	0.015 ±0.001	28 GHz	CORNING 7070
	**HA-075**	0.060 ±0.005	0.062 ±0.002	0.190 ±0.005	0.098 ±0.002	0.015 ±0.001	28 GHz	CORNING 7070
	**HA-079**	0.072 ±0.007	0.060 ±0.002	0.018 ±0.010	0.110 ±0.002	0.018 ±0.001	18 GHz	CORNING 7070
	**HA-459**	0.072 ±0.005	0.060 ±0.002	0.250 ±0.010	0.110 ±0.015	0.018 ±0.001	18 GHz	CORNING 7070
	**HA-1071**	0.180 ±0.007	0.060 ±0.002	0.180 ±0.007	0.110 ±0.002	0.018 ±0.005	18 GHz	CORNING 7070
	**HA-1397-06**	0.100 ±0.005	0.060 ±0.002	0.250 ±0.005	0.110 ±0.002	0.018 ±0.001	18 GHz	CORNING 7070
	**HA-247**	0.100 ±0.005	0.060 ±0.002	0.600 ±0.002	0.110 ±0.002	0.018 ±0.001	18 GHz	CORNING 7070
	**HA-084**	0.095 ±0.005	0.060 ±0.002	0.125	0.158	0.020 ±0.001	8 GHz	CORNING 7052
	**HA-184**	0.095 ±0.005	0.060 ±0.002	0.500 ±0.005	0.158 ±0.0015	0.020 ±0.005	8 GHz	CORNING 7052

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MIXERS and FREQUENCY MULTIPLIERS

HASCO offers a selection of microwave and millimeter-wave Mixers and Frequency Multipliers in packaged and MMIC designs. Connectorized Mixers and Multipliers operate as low as 2 GHz and up to 110 GHz. MMIC Mixers operate between the 57 through 170 GHz band, while MMIC Multipliers have an input frequency as low as 9.5 GHz, with an output up to 106 GHz. MMIc's are available in die form and come in gelpacks.

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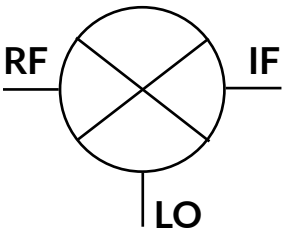
COAXIAL MIXERS

PHOTO	TYPE/PART #	FREQUENCY	CONVERSION LOSS	TEMP RANGE	ISOLATION	LO DRIVE LEVEL	INPUT P1 dB	MATERIALS
	**SMA Multi-Octive HM3001**	RF/LO 4-20 GHz IF DC-3 GHz	5-8.5 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 17-25 dB • L/R - 25-30 dB	+7 dBm to +12 dBm	+4 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Multi-Octive HM3005**	RF/LO 5.5-24 GHz IF DC-4 GHz	6.5-11 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 18-25 dB • L/R - 22-28 dB	+7 dBm to +10 dBm	+4 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Triple Bal. Multi-Octive, HM3006**	RF/LO 2-24 GHz IF 0.6-8 GHz	7-12 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 16-25 dB • L/R - 16-21 dB	+10 dBm to +16 dBm	+7 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Multi-Octive HM3014**	RF/LO 2-18 GHz IF DC-1.5 GHz	6-8 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 18-25 dB • L/R - 18-30 dB	+7 dBm to +12 dBm	+4 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Double Balanced HM3208**	RF/LO 18-32 GHz IF DC-8 GHz	9 - 11 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 18-23 dB • L/R - 27-32 dB	+14 dBm to +17 dBm	+10 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Double Balanced HM3508**	RF/LO 25-40 GHz IF DC-8 GHz	10 - 13 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 24-30 dB • L/R - 27-32 dB	+14 dBm to +17 dBm	+8 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Double Balanced HM3708**	RF/LO 23-41 GHz IF DC-18 GHz	10 - 15 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 18-25 dB • L/R - 24-35 dB	+14 dBm to +17 dBm	+10 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA Double Balanced HM3808**	RF: 18-38 GHz LO: 20-24 GHz IF: DC-20 GHz	10 - 15 dB Noise Figure +0.5 dB	-40° - +85°C	• L/I - 20-30 dB • L/R - 20-26 dB	+15 dBm to +18 dBm	+10 dBm	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA IQ Mixer/Modulator HM3531**	RF/LO 8-18 GHz IF DC-1 GHz	7-9 dB	-40° - +85°C	• L/I - 25-30 dB • L/R - 28-35 dB	+10 dBm to +16 dBm	Amp. Balance ±0.6 dB	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE
	**SMA- IQ Mixer Modulator/ Demodulator HM3833**	RF/LO 18-32 GHz IF DC-3 GH	9-12 dB	-40° - +85°C	• L/I - 20-26 dB • L/R - 27-32 dB	+15 dBm to +19 dBmo	Amp. Balance ±0.9 dB	• **Housing:** Passivated SS • **Contact:** Gold Plated BeCu • **Dielectric:** PTFE

WAVEGUIDE MIXERS

PHOTO	TYPE/PART #	FREQUENCY	CONVERSION LOSS	LO INPUT POWER	ISOLATION	MATERIALS
	**W-Band, WR-10 Waveguide, Balanced HWMX10-SFW**	RF: 75-110 GHz LO: 75-110 GHz IF: 0.1-18 GHz	9.5 dB Typical	+10 to +13 dBm	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-10, UG-387/UM • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**E-Band, WR-12 Waveguide, Balanced HWMX12-SFE**	RF: 60-90 GHz LO: 60-90 GHz IF: 0.1-18 GHz	9 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-12, UG-387/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**V-Band, WR-15 Waveguide, Balanced HWMX15-SFV**	RF: 50-75 GHz LO: 50-75 GHz IF: 1-18 GHz	8.5 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-15, UG-385/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**U-Band, WR-19 Waveguide, Balanced HWMX19-SFU**	RF: 40-60 GHz LO: 40-60 GHz IF: 0.1-18 GHz	7.5 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-19, UG-383/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**Q-Band, WR-22 Waveguide, Balanced HWMX22-SFQ**	RF: 33-50 GHz LO: 33-50 GHz IF: 0.1-18 GHz	7 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-22, UG-383/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**Ka-Band, WR-28 Waveguide, Balanced HWMX28-SFKA**	RF: 26.5-40 GHz LO: 26.5-40 GHz IF: 0.1-18 GHz	7 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	• **Waveguide:** Gold Plated Aluminum • WR-28, UG-599/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu



A mixer is a device that performs the task of frequency conversion, by multiplying two signals. Mixers are needed in most microwave systems because the RF signal is way too high to process its information.

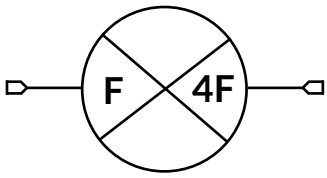
You can use a mixer to convert a signal down in frequency (as in a receiver) or up in frequency (as in an transmitter or exciter) because it is a reciprocal device.

A mixer can be as simple as one that uses a single diode, or it can get far more complicated for improved performance. Two broad categories of mixers commonly used in microwave applications are switching mixers and nonlinear mixers. Switching mixers include single-balanced and double-balanced mixers and are the most prevalent and have the most predictable performance, but nonlinear mixers allow you to go to much higher frequencies (well into the millimeterwave spectrum).

Even in switching mixers you still need a nonlinear device. The nonlinear device within a mixer is most often a Schottky diode, but can also be a FET or other transistor. PIN diodes are never used for mixers, they switch too slowly.

FREQUENCY MULTIPLIERS

PHOTO	TYPE/PART #	FREQUENCY	POWER	DC	SIGNAL PURITY	MULTIPLICATION POWER	MATERIALS
	**WR-10 Full Band Active Multiplier HWFM10-SF6X10**	Output 75-110 GHz Input 12.5-18.33 GHz	Output 10-12 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X6	• **Waveguide:** Gold Plated Aluminum • WR-10, UG-387/UM • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-12 Full Band Active Multiplier HWFM12-SF4X13**	Output 60-90 GHz Input 15-22 GHz	Output 10-12 dBm Input 6-10 dBm	+8V @ 500mA	-20 dBc	X4	• **Waveguide:** Gold Plated Aluminum • WR-12, UG-387/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-12 Full Band Active Multiplier HWFM12-SF6X12**	Output 71-86 GHz Input 11.83-14.33 GHz	Output 12-13 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X6	• **Waveguide:** Gold Plated Aluminum • WR-12, UG-387/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-15 Full Band Active Multiplier HWFM15-SF4X13**	Output 50-75 GHz Input 12.5-18.75 GHz	Output 13-15 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X4	• **Waveguide:** Gold Plated Aluminum • WR-15, UG-385/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-19 Full Band Active Multiplier HWFM19-SF4X15**	Output 40-60 GHz Input 10-15 GHz	Output 14-16 dBm Input 3-8 dBm	+8V @ 400mA	-20 dBc	X4	• **Waveguide:** Gold Plated Aluminum • WR-19, UG-383/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-22 Full Band Active Multiplier HWFM22-SF4X15**	Output 33-50 GHz Input 8.25-12 GHz	Output 15-17 dBm Input 3-8 dBm	+8V @ 600mA	-20 dBc	X4	• **Waveguide:** Gold Plated Aluminum • WR-22, UG-383/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu
	**WR-28 Full Band Active Multiplier HWFM28-SF2X23**	Output 26-40 GHz Input 13-20 GHz	Output 0-3 dBm Input 23 dBm	+8V @ 400mA	-20 dBc	X2	• **Waveguide:** Gold Plated Aluminum • WR-28, UG-599/U • **SMA Housing:** Passivated SS • **Contact:** Gold Plated BeCu



Frequency Multipliers are nonlinear, two-port devices where an input signal is used to create an output signal that is at a higher harmonic.

Passive multipliers

Passive multipliers are usually an arrangement of diodes that rectify a signal. For a doubler, you can expect 8-10 dB loss.

Passive doublers are usually not reciprocal, meaning one port will be defined as the input and the other defined as the output. In some cases the ports will be obvious, as the input will be coax and the output will be waveguide.

Active multipliers

Active multipliers combine a multiplier with an amplifier on the output.

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TERMINATIONS LOADS

RF Terminations or loads are components that are used to absorb energy and prevent RF signals from reflecting back from an open-ended or unused port. The ports are usually terminated with a load that has the same characteristic impedance as the transmission line.

Any multi-port RF system, whose ports are not all being used should be terminated so that any signal incident on these ports will be absorbed. If a port is left un-terminated, then the signals can reflect back into the system which can introduce distortions and other undesirable effects. These are used in couplers, hybrids, isolators, test equipment and in systems where a port needs to be terminated. There are three main types of RF terminations: coaxial, waveguide, and chip. Coaxial terminations terminate coaxial ports, and waveguide terminations terminate waveguide ports.

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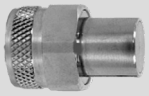
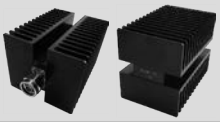
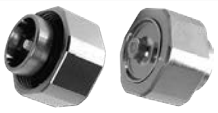
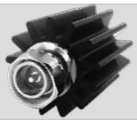
COAXIAL TERMINATIONS

PHOTO(S)	TYPE PART #	FREQUENCY RANGE	MAX. VSWR	POWER	FLANGE MATERIAL
	1.85mm • **HT65M (Male)** • **HT65F (Female)**	DC to 65 GHz	1.45:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE
	2.4mm • **HT50M (Male)** • **HT50F (Female)**	DC to 50 GHz	1.45:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: High Temperature Plastic Bead
	2.9mm • **HT40M (Male)** • **HT40F (Female)**	DC to 40 GHz	1.25:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: High Temperature Plastic Bead
	2.9mm • **HT40F-1 (Female)**	DC to 40 GHz	1.25:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PEI, Natural
	2.9mm • **HT40M-2 (Male)**	DC to 40 GHz	1.25:1	2.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: High Temperature Plastic Bead
	3.5mm • **HT35M-1 (Male)**	DC to 34.5 GHz	1.15:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: Silicone
	N • **221-34-50-001 (Female)**	DC to 18 GHz	1.43:1	2.0 WATTS	• Housing: Tri-Metal over Brass • Contact: Gold Plated BeCu • Dielectric: PTFE
	N • **231-34-50-001 (Male)** **Knurled Head**	DC to 18 GHz	1.43:1	2.0 WATTS	• Housing: Ternary Alloy Plated Brass • Contact: Gold Plated Brass • Dielectric: PTFE
	N • **231-34-50-002 (Male)** **Hex Head**	DC to 18 GHz	1.43:1	2.0 WATTS	• Housing: Ternary Alloy Plated Brass • Contact: Gold Plated Brass • Dielectric: PTFE
	N • **HT18NM-10 (Male)**	DC to 18 GHz	1.05:1	10.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE • Heat Sink: Black Annodized Aluminum
	N • **HT18NM-25 (Male)**	DC to 18 GHz	1.40:1	25.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE • Heat Sink: Black Annodized Aluminum
	N • **HT4NM-100 (Male)**	DC to 4 GHz	1.25:1	100.0 WATT	• Housing: Albaloy Plated Brass • Contact: Silver Plated Phosphor Bronze • Dielectric: PTFE • Heat Sink: Black Annodized Aluminum
	TNC • **HT4310M-2 (Male)**	DC to 4 GHz	1.25:1	2.0 WATT	• Housing: Brass • Contact: Brass • Dielectric: PSeries Resin
	TNC • **HT4310M-5 (Male)**	DC to 8.5 GHz	1.25:1	5.0 WATT	• Housing: Albaloy Plated Brass • Contact: Silver Plated Phosphor Bronze • Dielectric: PTFE • Heat Sink: Black Anodized Aluminum
	TNC • **HT4310M-10 (Male)**	DC to 8.5 GHz	1.25:1	10.0 WATT	• Housing: Albaloy/Al Plated Brass • Contact: Silver Plated Phosphor Bronze • Dielectric: PTFE • Heat Sink: Black Anodized Aluminum
	TNC • **HT4310M-25 (Male)**	DC to 7 GHz	1.25:1	25.0 WATT	• Housing: Albaloy/Al Plated Brass • Contact: Silver Plated Phosphor Bronze • Dielectric: PTFE • Heat Sink: Black Anodized Aluminum

COAXIAL TERMINATIONS

PHOTO(S)	TYPE PART #	FREQUENCY RANGE	MAX. VSWR	POWER	FLANGE MATERIAL
	SMA • **HT20M (Male)** • **HT20M-1C** (with Chain)	DC to 20 GHz	1.22:1	1.0 WATTS	• Housing: Gold Plated Brass • Hex Nut: Ternary Alloy Plated Brass • Contact: Gold Plated Brass • Dielectric: PTFE
	SMA • **HT18M-S (Male)**	DC to 18 GHz	1.20:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE
	SMA • **HT18M-1FX (Male)**	DC to 18 GHz	1.20:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated Brass • Dielectric: PTFE
	SMA • **HT18QMM (Male)** Quick Mate	DC to 18 GHz	1.15:1	1.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE
	SMA • **HT18EMS (Male)**	DC to 18 GHz	1.30:1	2.0 WATTS	• Housing: Nickel Plated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE
	SMA • **HT18M2-02 (Male)** • **HT18M2-02C** (with Chain)	DC to 18 GHz	1.20:1	2.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE & PEI
	SMA • **HT26M-2 (Male)**	DC to 26.5 GHz	1.25:1	2.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu • Dielectric: PTFE & PEI
	SMA • **HT18F-2 (Female)**	DC to 18 GHz	1.20:1	2.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu Alloy • Dielectric: PTFE & PEI • Heat Sink: Albaloy Plated Brass
	SMA • **HT18F-2G (Female)**	DC to 18 GHz	1.20:1	2.0 WATTS	• Housing: Gold Plated Brass • Contact: Gold Plated BeCu Alloy • Dielectric: PTFE & PEI • Heat Sink: Albaloy Plated Brass
	SMA • **HT18F-2G-1 (Female)**	DC to 18 GHz	1.20:1	2.0 WATTS	• Housing: Gold Plated Brass • Contact: Gold Plated BeCu Alloy • Dielectric: PTFE & PEI
	SMA • **HT18M-5 (Male)** • **HT18F-5 (Female)**	DC to 18 GHz	1.20:1	5.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu Alloy • Dielectric: PTFE & PEI • Heat Sink: Black Anodized Aluminum
	SMA • **HT18M-10 (Male)**	DC to 18 GHz	1.350:1	10.0 WATTS	• Housing: Passivated Stainless Steel • Contact: Gold Plated BeCu Alloy • Dielectric: PTFE & PEI • Heat Sink: Black Anodized Aluminum
	**SMPM** • **HT6SMPMF (Female)** • **HT6SMPMF-1 (Female)**	DC to 6 GHz	1.20:1	.25 WATT 1 WATT	• Housing and Contact: Gold Plated BeCu • Ferrule & Cover: Gold Plated Brass • Dielectric: PPO
	**7/16** • **HT716M-25 (Male)**	DC to 6 GHz	1.25:1	25.0 WATT	• Housing: Albaloy Plated Brass • Contact: Silver Plated Phosphor Bronze • Dielectric: PTFE • Heat Sink: Black Anodized Aluminum

WAVEGUIDE TERMINATIONS

PHOTO	TYPE PART #	FREQUENCY RANGE	MAX. VSWR	POWER	FLANGE MATERIAL
	WR-08 (0.9" length) **HWLPT08-02-ER**	90 to 140 GHz	1.10:1	0..2 WATTS	• WG: Gold Plated Copper • Flange: UG-387/U-M Round Gold Plated Brass
	WR-10 (2.0" length) **HWLPT10-ER**	75 to 110 GHz	1.50:1	0.3 WATTS	• WG: Gold Plated Aluminum • Flange: UG-387/U-M Round Gold Plated Aluminum
	WR-10 (1.5" length) **HWLPT10-03-ER**	75 to 110 GHz	1.05:1	0.3 WATTS	• WG: Gold Plated Copper • Flange: UG-387/U-M Round Gold Plated Brass
	WR-12 (2.0" length) **HWLPT12-ER**	60 to 90 GHz	1.05:1	0.3 WATTS	• WG: Gold Plated Aluminum • Flange: UG-387/U Round Gold Plated Aluminum
	WR-12 (1.5" length) **HWLPT12-03-ER**	60 to 90 GHz	1.05:1	0.3 WATTS	• WG: Gold Plated Copper • Flange: UG-387/U Round Gold Plated Brass
	WR-15 (2.0" length) **HWLPT15-ER**	50 to 75 GHz	1.05:1	0.3 WATTS	• WG: Gold Plated Aluminum • Flange: UG-385/U Round Gold Plated Aluminum
	WR-15 (1.5" length) **HWFBI15-03-ER**	50 to 75 GHz	1.05:1	0.3 WATTS	• WG: Gold Plated Aluminum • Flange: UG-385/U Round Gold Plated Aluminum
	WR-19 (1.75" length) **HWLPT19-2-ER**	40 to 60 GHz	1.05:1	2.0 WATTS	• WG: Gold Plated Copper • Flange: UG-383/U-M Round Gold Plated Brass
	WR-22 (2.0" length) **HWLPT22-2-ER**	33 to 50 GHz	1.05:1	4.0 WATTS	• WG: Gold Plated Copper • Flange: UG-383/U Round Gold Plated Brass
	WR-28 (0.56" length) **HWLPT28-1-ES**	26.5 to 40 GHz	1.30:1	1.0 WATTS	• WG: Gold Plated Copper • Flange: UG-599/U Square
	WR-34 (0.69" length) **HWLPT34-2-ES**	22 to 33 GHz	1.25:1	1.0 WATTS	• WG: Gold Plated Copper • Flange: UG-1530/U Square
	WR-42 (1.0" length) **HWLPT42-2-ES**	18 to 26.5 GHz	1.25:1	1.0 WATTS	• WG: Gold Plated Copper • Flange: UG-1530/U Square
	WR-51 (1.0" length) **HWLPT51-1-ES** **HWLPT51-2-ES**	15 to 22 GHz	1.20:1	1.0 WATTS 2.0 WATTS	• WG: Gold Plated Copper • Flange: UBR180 Square
	WR-62 (1.0" length) **HWLPT62-2-ES**	12.4 to 18 GHz	1.20:1	2.0 WATTS	• WG: Gold Plated Copper • Flange: UG-1665/U Square
	WR-75 (1.0" length) **HWLPT75-2-ES**	10 to 15 GHz	1.20:1	2.0 WATTS	• WG: Gold Plated Copper • Flange: UG-138/U Square
	WR-90 (1.0" length) **HWLPT90-1-ES** **HWLPT90-2-ES**	8.2 to 12.4 GHz	1.20:1	1.0 WATTS 2.0 WATTS	• WG: Gold Plated Copper • Flange: UG-135/U Square
	WR-112 (1.13" length) **HWLPT112-2-ES**	7.05 to 10 GHz	1.20:1	2.0 WATTS	• WG: Gold Plated Copper • Flange: UG-138/U Square

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TOOLS
Wrenches

HASCO has an extensive list of tools and accessories for preparing and installing RF components, such as end launch counterbore tools, insertion tools, torque wrenches and miscellaneous hardware. The tools and accessories will prepare and install most Southwest Microwave connectors, while the torque wrenches are available in several wrench sizes and torque values.

To view all Southwest connector preparation and installation tools, visit us at www.hasco-inc.com.

It is very important to protect your sensitive and expensive components, such as RF Connectors, Adapters and Coaxial Cables by not over- or under-tightening them during assembly. In this way, using the proper torque wrench will provide you with that protection.

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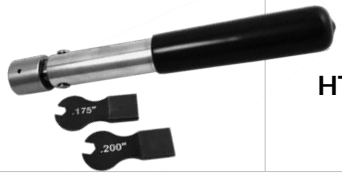
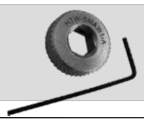
TORQUE WRENCHES

PHOTO	PART #	CONNECTOR TYPE	WRENCH TYPE	HEAD SIZE	TORQUE VALUE
	**HTW-NC100-08**	Wrench Only	Click Type	N/A Wrench Only	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-NC100-14**	Wrench Only	Click Type	N/A Wrench Only	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-516-BIT**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	N/A (Bit Only)	5/16”	N/A
	**HTW-34-BIT**	N, 7mm	N/A (Bit Only)	3/4”	N/A
	**HTW-1316-BIT**	N, SC	N/A (Bit Only)	13/16”	N/A
	**HTW-516-05**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	Break Over	5/16”	5.0 ± 0.2 In. lbs (0.56 ±0.02 Nm)
	**HTW-516-08**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	Break Over	5/16”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-516-18**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	Break Over	5/16”	18.0 ± 0.72 In. lbs (2.03±0.08 Nm)
	**HTW-NC100-516-08**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	Click Type	5/16”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-NC100-516-14**	SMA, 3.5mm 2.92mm, 2.4mm, 1.85mm	Click Type	5/16”	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-34-08**	N, 7mm	Break Over	3/4”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-34-14**	N, 7mm	Break Over	3/4”	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-34-23**	N, 7mm	Break Over	3/4”	23.0 ± 0.92 In.lbs (2.598 ±0.10 Nm)
	**HTW-NC100-34-08**	N, 7mm	Click Type	3/4”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-NC100-34-14**	N, 7mm	Click Type	3/4”	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-1316-14**	N, SC	Break Over	13/16”	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-NC100-1316-08**	N, SC	Click Type	13/16”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)

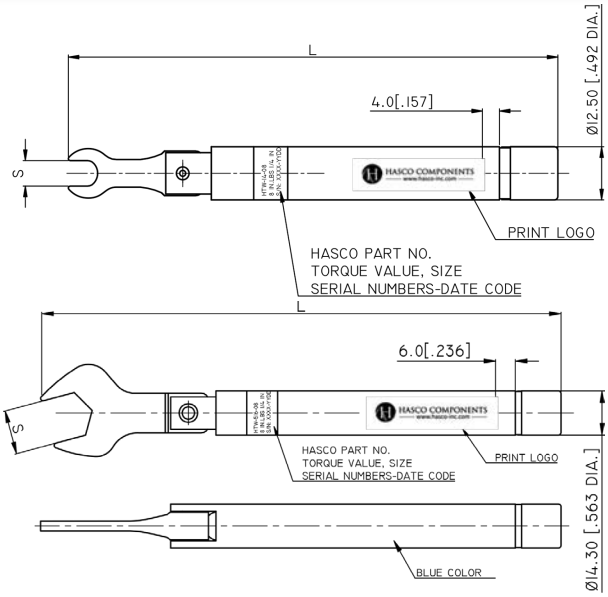
TORQUE WRENCHES

PHOTO	PART #	CONNECTOR TYPE	WRENCH TYPE	HEAD SIZE	TORQUE VALUE
	**HTW-NC100-1316-14**	N, SC	Click Type	13/16”	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-2532-14**	N, SC	Break Over	25/32	14.0 ± 0.8 In. lbs (1.60 ±0.09 Nm)
	**HTW-58-12**	TNC	Break Over	5/8”	12.0 ± 0.6 In. lbs (1.36 ±0.09 Nm)
	**HTW-916-12**	TNC	Break Over	9/16”	12.0 ± 0.6 In. lbs (1.36 ±0.09 Nm)
	**HTW-14-2.5**	SSMA	Break Over	1/4”	2.5 ± 0.10 In. lbs (0.282±0.011 Nm)
	**HTW-14-03**	SSMA	Break Over	1/4”	3.0 ± 0.12 In. lbs (0.34 ±0.01 Nm)
	**HTW-14-05**	SSMA	Break Over	1/4”	5.0 ± 0.2 In. lbs (0.57 ±0.02 Nm)
	**HTW-14-08**	SSMA	Break Over	1/4”	8.0 ± 0.4 In. lbs (0.92 ±0.05 Nm)
	**HTW-14-10**	SSMA	Break Over	1/4”	10.0 ± 0.4 In. lbs (1.13 ±0.05 Nm)
	**HTW-532-02**	SSMC, SMC	Break Over	5/32”	2.0 ± 0.1 In. lbs (0.23 ±0.01 Nm)
	**HTW-38-80**	3/8 Hex	Break Over	3/8”	80 ± 3.2 In. lbs (9.04 ±0.36 Nm)
	**HTW-1564-04**	1.0mm	Break Over	15/64”	4.0 ± 0.15 In. lbs (0.45 ±0.02 Nm)
	**HTW-1.0mm-KIT**	1.0mm	Click Type	15/64”	8.0 ± 0.4 In. lbs (3 pc Kit)

FINGER WRENCHES

PHOTO	PART #	CONNECTOR TYPE	WRENCH TYPE	HEAD SIZE	MATERIAL
	**HTW-516-BL**	SMA, 3.5mm 2.92mm, 2.4mm,	FINGER	5/16”	NON-MARKING BLUE PLASTIC
	**HTW-SMA1-A**	SMA, 3.5mm 2.92mm, 2.4mm,	FINGER	5/16”	BRASS

HASCO TORQUE WRENCHES



Description:

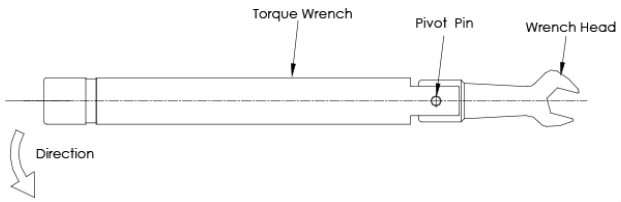
HASCO RF break-over torque wrenches are designed to guarantee an accurate mating torque when joining two components together. When the proper force has been achieved, these wrenches will become ineffective by "breaking" and making them unusable until reset.

- Anodized aluminum handles
- Nickel-plated steel wrench heads
- ANSI/NCSLZ540-3 and ISO-10011 calibration certification
- Packaged in a wooden box
- Labeled and serial numbered

RoHS compliant

HASCO RF break-over torque wrenches are RoHS Compliant

Important User Instructions:



1. HASCO torque wrenches are unidirectional and preset torque can only be achieved when you use the wrench according to the force orientation as illustrated in Drawing 1 above.
2. Fit the wrench around the connector hex nut and apply force on the torque wrench. Caution: Do not apply force by holding any other part of the wrench other than the handle. Do not use any other lever aid on the wrench. Apply force with a smooth, steady action.
3. Automatic release: When the set torque is reached, the torque wrench will move through a small arc about the pivot pin. At this point the set torque has been achieved and force on the handle must be released.
4. If a wrench has not been used recently, actuate the wrench by clicking the wrench head back and forth several times before use. Clicking the wrench head back and forth spreads lubricant throughout the internal mechanism to improve wrench performance.
5. Torque wrenches are precision instruments and should be carefully handled. Do no use as a hammer. If a wrench is dropped accidentally, it should be checked on a Torque Tester before using again.

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WAVEGUIDE DETECTORS

A detector is a two-terminal device that is used to rectify an RF signal (like a diode rectifies an alternating current signal in a power supply). Detectors are used as the receiving element in amplitude modulation schemes among other uses.

HASCO Waveguide Detectors offer full waveguide band operation with high sensitivity without tuning and high sensitivity stability over a broad temperature range.

WAVEGUIDE DETECTORS

PHOTO	PART #	INPUT WAVEGUIDE	OUTPUT CONNECTOR	SPECIFICATIONS
	**HWPSD08-90140-S2**	WR-08 Waveguide **Flange:** UG-387/UM F Band	SMA Female	**Frequency:** 90 - 140 GHz **Sensitivity**: 700 mV/mW Typ. **Flatness:** +/- 1.7 dB Max **Polarity:** Positive **Tangential Sensitivity**: -40 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD10-75110-S2**	WR-10 Waveguide **Flange:** UG-387/UM W Band	SMA Female	**Frequency:** 75 - 110 GHz **Sensitivity**: 800 mV/mW Typical **Flatness:** +/- 1.5 dB Max **Polarity:** Positive **Tangential Sensitivity**: -45 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD12-6090-S2**	WR-12 Waveguide **Flange:** UG-387/U E Band	SMA Female	**Frequency:** 60 - 90 GHz **Sensitivity**: 1000 mV/mW Typical **Flatness:** +/- 1.5 dB Max **Polarity:** Positive **Tangential Sensitivity**: -45 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD15-5075-S2**	WR-15 Waveguide **Flange:** UG-385/U V Band	SMA Female	**Frequency** 50 - 75 GHz **Sensitivity**: 1000 mV/mW Typical **Flatness:** +/- 1.5 dB Max **Polarity:** Positive **Tangential Sensitivity**: -45 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD19-4060-S2**	WR-19 Waveguide **Flange:** UG-383/U U Band	SMA Female	**Frequency:** 40 - 60 GHz **Sensitivity**: 750 mV/mW Typ. **Flatness:** +/- 2 dB Max **Polarity:** Positive **Tangential Sensitivity**: -50 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD22-3350-S2**	WR-22 Waveguide **Flange:** UG-383/U Q Band	SMA Female	**Frequency:** 33 - 50 GHz **Sensitivity**: 1500 mV/mW Typ. **Flatness:** +/- 1.5 dB Max **Polarity:** Positive **Tangential Sensitivity**: -55 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C
	**HWPSD28-2640-S2**	WR-28 Waveguide **Flange:** UG-599/U Ka Band	SMA Female	**Frequency:** 26.5 - 40 GHz **Sensitivity**: 1300 mV/mW Typ. **Flatness:** +/- 2 dB Max **Polarity:** Positive **Tangential Sensitivity**: -55 dBm (BW 40 Hz, dBm) **CW Power**: +16 dBm **Absolute Max Input Power**: +20 dBm **Temp:** -55° to 85°C

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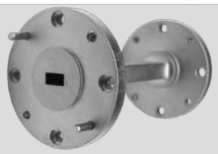
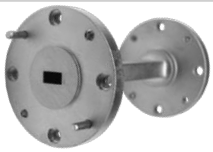
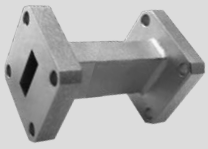
WAVEGUIDE SECTIONS

HASCO waveguide sections provide different configurations to route waveguide signals between devices using Straight Waveguides, Twist Waveguides, E-Bend Waveguides, H-Bend Waveguides in common 1 inch, 1.5 inch, 2 inch and 2.5 inch lengths.

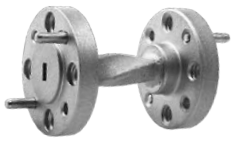
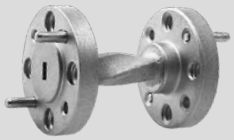
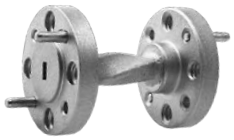
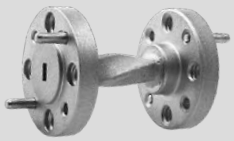
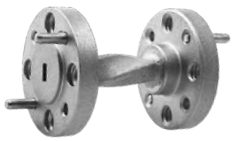
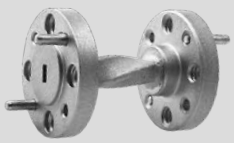
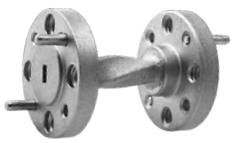
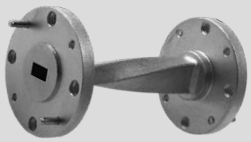
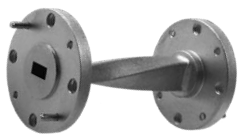
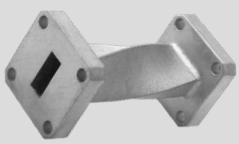
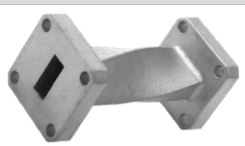
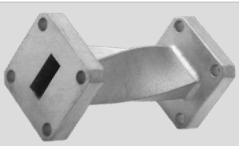
HASCO's waveguides come in standard WR designs and operate across the full waveguide band from 18 GHz to 325 GHz. Whether it is WR-42, WR12, WR-03 or WR sizes in between, HASCO has them in stock.

WAVEGUIDE STRAIGHT SECTIONS

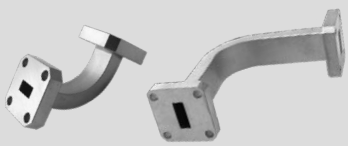
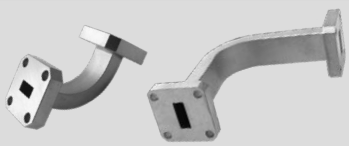
XX = LENGTH

PHOTO	TYPE/PART #	FREQUENCY	TEMP RANGE	VSWR	MATERIALS
	WR-3 **HWSS03-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	220 to 325 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** Silver • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	G-Band, WR-5 **HWSS05-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	140 to 220 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	D-Band, WR-6 **HWSS06-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	110 to 175 GH	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	F Band, WR-8 **HWSS08-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	90 to 1400 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	W Band, WR-10 **HWSS10-XX-ER** **HWSS10-XX-ER-1** (Available in 1.0 & 2.0 Inch)	75 to 110 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	E Band, WR-12 **HWSS12-XX-ER** **HWSS12-XX-ER-1** (Available in 1.0 & 2.0 Inch)	60 to 90 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U • **Finish**: Gold Plated
	V Band, WR-15 **HWSS15-XX-ER** **HWSS15-XX-ER-1** (Available in 1.0 & 2.0 Inch)	50 to 75 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-385/U • **Finish**: Gold Plated
	U Band, WR-19 **HWSS19-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	40 to 60 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-22 **HWSS22-XX-ER** (Available in 1.0, 1.5 & 2.0 Inch)	33 to 50 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-28 **HWSS28-XX-ES** (Available in 1.0, 1.5 & 2.0 Inch)	26.5 to 40 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-599/U • **Finish**: Gold Plated
	WR-34 **HWSS34-XX-ES** (Available in 1.0, 1.5 & 2.0 Inch)	22 to 33 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U-M • **Finish**: Gold Plated
	WR-42 **HWSS42-XX-ES** (Available in 1.0, 1.5 & 2.0 Inch)	18 to 26.5 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U • **Finish**: Gold Plated

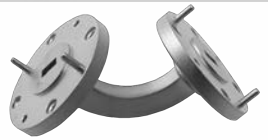
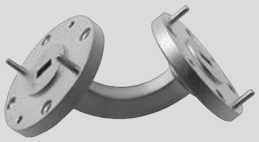
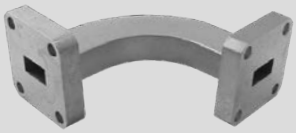
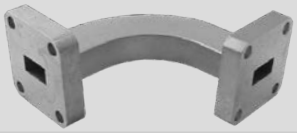
WAVEGUIDE 90° TWISTS

PHOTO	TYPE/PART #	FREQUENCY	TEMP RANGE	VSWR	MATERIALS
	WR-3 **HWTW03-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	220 to 325 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** Silver • **Flange:** Brass , UG-387/U-M • **Finish:** Gold Plated
	G-Band, WR-5 **HWTW05-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	140 to 220 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish:** Gold Plated
	D-Band, WR-6 **HWTW06-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	110 to 175 GH	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish:** Gold Plated
	F Band, WR-8 **HWTW08-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	90 to 1400 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish:** Gold Plated
	W Band, WR-10 **HWTW10-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	75 to 110 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish:** Gold Plated
	E Band, WR-12 **HWTW12-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	60 to 90 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U • **Finish:** Gold Plated
	V Band, WR-15 **HWTW15-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	50 to 75 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-385/U • **Finish:** Gold Plated
	U Band, WR-19 **HWTW19-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	40 to 60 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383 /U-M • **Finish:** Gold Plated
	Q Band, WR-22 **HWTW22-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	33 to 50 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish:** Gold Plated
	Q Band, WR-28 **HWTW28-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	26.5 to 40 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-599/U • **Finish:** Gold Plated
	WR-34 **HWTW34-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	22 to 33 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U-M • **Finish:** Gold Plated
	WR-42 **HWTW42-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	18 to 26.5 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U • **Finish:** Gold Plated

WAVEGUIDE E BENDS

PHOTO	TYPE/PART #	FREQUENCY	TEMP RANGE	VSWR	MATERIALS
	WR-3 **HWEB03-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	220 to 325 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** Silver • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	G-Band, WR-5 **HWEB05-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	140 to 220 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	D-Band, WR-6 **HWEB06-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	110 to 175 GH	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	F Band, WR-8 **HWEB08-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	90 to 1400 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	W Band, WR-10 **HWEB10-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	75 to 110 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	E Band, WR-12 **HWEB12-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	60 to 90 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U • **Finish**: Gold Plated
	V Band, WR-15 **HWEB15-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	50 to 75 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-385/U • **Finish**: Gold Plated
	U Band, WR-19 **HWEB19-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	40 to 60 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-22 **HWEB22-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	33 to 50 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-28 **HWEB28-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	26.5 to 40 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-599/U • **Finish**: Gold Plated
	WR-34 **HWEB34-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	22 to 33 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U-M • **Finish**: Gold Plated
	WR-42 **HWEB42-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	18 to 26.5 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U • **Finish**: Gold Plated

WAVEGUIDE H BENDS

PHOTO	TYPE/PART #	FREQUENCY	TEMP RANGE	VSWR	MATERIALS
	WR-3 **HWHB03-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	220 to 325 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** Silver • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	G-Band, WR-5 **HWHB05-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	140 to 220 GHz	+220°C Max	1:04:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	D-Band, WR-6 **HWHB06-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	110 to 175 GH	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	F Band, WR-8 **HWHB08-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	90 to 1400 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	W Band, WR-10 **HWHB10-XX-ER** (Available in 1.0, 2.05 & 2.5 Inch)	75 to 110 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U-M • **Finish**: Gold Plated
	E Band, WR-12 **HWHB12-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	60 to 90 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-387/U • **Finish**: Gold Plated
	V Band, WR-15 **HWHB15-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	50 to 75 GHz	+220°C Max	1:03:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-385/U • **Finish**: Gold Plated
	U Band, WR-19 **HWHB19-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	40 to 60 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-22 **HWHB22-XX-ER** (Available in 1.0, 2.0 & 2.5 Inch)	33 to 50 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-383/U-M • **Finish**: Gold Plated
	Q Band, WR-28 **HWHB28-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	26.5 to 40 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-599/U • **Finish**: Gold Plated
	WR-34 **HWHB34-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	22 to 33 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U-M • **Finish**: Gold Plated
	WR-42 **HWHB42-XX-ES** (Available in 1.0, 2.0 & 2.5 Inch)	18 to 26.5 GHz	+220°C Max	1:02:1 Typ.	• **Waveguide:** OFHC Copper • **Flange:** Brass, UG-595/U • **Finish**: Gold Plated

Low-Loss, Phase-Stable RF Cable Selection Guide

FEATURES:

- **Low loss to 110 GHz**
- **Phase Stable over Flexure**
- **High VoP up to 85%**
- **Armored and Ruggedized Options**
- **Temperature Range from -55°C to +200°C**

HASCO carries a large selection of test cables to meet low-loss, phase-stable and temperature-stable requirements to 110 GHz. In addition to standard low-loss test cables, we offer ruggedized and armored versions to suit every application. The standard connectors offered are 1.0mm, 1.85mm, 2.4mm, 2.92mm, 3.5mm, SMA, TNC, N, and SMP. HASCO stocks popular connector configurations, with additional connector configurations available in less than 4 weeks.

This selector guide offers critical parameters to identify the best test cable for your specific application. The table also provides information at 18 GHz for comparison purposes.

CABLE PARAMETERS (TABLE 1)

Cable Series	Arm. Rugg.	Cable Max. Frequency	Attenuation @ 18 GHz	Phase Stability @ 18 GHz	Max CW Power @ 18 GHz	VoP	Temp. Phase Stability (PPM)	Cable Dia.	Min. Bend Radius	Temperature Range
HULL320		18 GHz	0.19 dB/ft	±2.0°	425W	85%	500	0.319"	2.00"	-55°C to +85°C
HLL142		26.5 GHz	0.36 dB/ft	±3.6°	165W	80%		0.142"	1.00"	-55°C to +200°C
HLL142A	Y	26.5 GHz	0.36 dB/ft	±6.4°	165W	83%		0.195"	2.50"	-55°C to +200°C
HLL283R	Y	26.5 GHz	0.50 dB/ft	±2.2°	115W	76%		0.283"	0.70"	-55°C to +125°C
HSB42		26.5 GHz	0.59 dB/ft	±2.0°	125W	70%		0.195"	1.00"	-55°C to +105°C
HULL190		30 GHz	0.32 dB/ft	±2.0°	197W	83%	500	0.189"	1.00"	-65°C to +200°C
HSS45A	Y	40 GHz		±1.86°	21W	70%		0.256"	1.00"	-55°C to +200°C
HULL140		40 GHz	0.51 dB/ft	±2.0°	150W	85%	500	0.142"	0.70"	-55°C to +85°C
HULL140A	Y	40 GHz	0.51 dB/ft	±2.0°	150W	85%	500	0.322"	0.50"	-55°C to +85°C
HLL141TS		40 GHz	0.55 dB/ft	±2.0°	120W	85%	500	0.142"	1.00"	-65°C to +165°C
HLL150		45 GHz	0.49 dB/ft	±4.0°	120W	83%	630	0.091"	0.32"	-55°C to +85°C
HLL150A	Y	45 GHz	0.49 dB/ft	±4.0°	120W	83%	630	0.322"	1.50"	-55°C to +85°C
HBTC		46 GHz	1.10 dB/ft		125W	78%		0.305"	2.00"	-65°C to +200°C
HLL140M		50 GHz	2.00 dB/ft	±1.4°	80W	74%	2,000	0.140"	0.56"	-55°C to +165°C
HLL228R	Y	50 GHz	0.59 dB/ft	±2.5°	72W	76%		0.228"	0.57"	-55°C to +165°C
HLL185R	Y	67 GHz	0.88 dB/ft	±2.5°	21W	82%		0.185"	0.35"	-55°C to +125°C
HLB098		67 GHz	0.69 dB/ft	±4.0°	23W	76%		0.098"	0.20"	-65°C to +165°C
HLL125		70 GHz	0.96 dB/ft		50W	75%		0.110"	0.20"	-65°C to +200°C
SW192		110 GHz	1.8 dB/ft		8W	70%		0.056"	0.20"	-65°C to +165°C
HLB055	Y	110 GHz	0.69 dB/ft	±4.0°	23W	78.7%		0.055"	0.20"	-55°C to +85°C

STANDARD CABLE CONFIGURATION AVAILABILITY (TABLE 2)

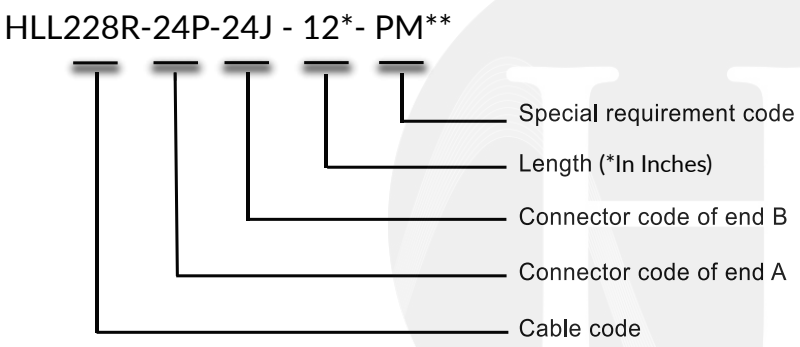
(Marked with * available upon request)
Additional configurations and cables also available upon request

Connector → ↓ Cable Type/Code	1.0mm 110 GHz	1.85mm 67 GHz	2.4mm 50 GHz	2.92mm 40 GHz	3.5mm 26.5 GHz	SMA 26.5 & 18 GHz	TNC 18 GHz	N 18 GHz
HULL320						S1	TNCP*	NP*, NJ*
HLL142				29P*	35P*, 35J*	S1, S2*, S1RA*	TNCP*	NP, NJ, NPRA*
HLL142A						S1		NP
HLL283R						S1, S2		
HSB42						S1, S2		NP*, NJ*
HULL190					35P*, 35J	S1, S2*, S1RA*	TNCP*, TNCJ*	NP*
HSS45A			24P*	29P				
HULL140			24P*	29P, 29J*	35P*	S1*, S2*, S1Z*		
HULL140A			24P*	29P, 29J*		S1*, S2*, S1Z*		
HLL141TS			24P*	29P, 29J*		S1*, S2*		
HLL150			24P*	29P	35P*, 35J*	S1*		
HLL150A			24P*	29P	35P*, 35J*			
HBTC				29P, 29J				
HLL140M			24P, 24J*					
HLL228R			24P					
HLL185R		185P						
HLL125		185P						
SW192	192							
HLB098		VP, VJ	24P	29P		S1, S2BH		
HLB055	WP, WJ							

Selecting the Right Cable for Your Project:

1. Refer to the **CABLE PARAMETERS (TABLE 1)** on page 1 to select the parameters that are important to your application, such as armoring, maximum frequency, temperature range, insertion loss, and CW power handling.
   Note: Loss is linear, so the lowest loss cable at 18 GHz will remain the lowest loss at its max frequency.
2. Look for that **Cable Type/Code** from **TABLE 2** above and choose a **Connector** that is compatible with that Cable Type.
   Note: HASCO also has between-series coax adapters that can adapt to other connectors, but the max frequency will be limited by the lowest frequency connector.
   • SMA. 3.5mm, and 2.92mm will mate with one another. • 2.4mm and 1.85mm will mate with one another.
3. Use **TABLE 3** below to create the desired part number.
4. Feel free to call HASCO Customer Service at (888) 492-3242 if the desired cable does not show a compatible connector on the table, or if you have any questions about cables and cable assemblies. HASCO continually builds new configurations and we may already have what you need.

HOW TO CONFIGURE RF CABLES (TABLE 3)



*NOTE: Maximum frequency of final cable configuration will be limited to the maximum frequency of the lowest frequency connector.
**SPECIAL REQUIREMENTS: If you have a special requirement, such as Phase Matched or Right Angle Clocking, we will be happy to assist you with the configuration process.

STANDARD CONNECTOR CODES

Connector	Male	Female	Right Angle Male
N	NP	NJ	NPRA
TNC	TNCP	TNCJ	N/A
SMA	S1	S2	S1RA
3.5mm	35P	35J	N/A
2.92mm	29P	29J	N/A
2.4mm	24P	24J	N/A
1.85mm	185P/VP	185J/VJ	N/A
1.0mm	192/WP	WJ	N/A
SMP	SMPP	SMPJ	N/A

Additional Connectors and Configurations Available (ie. Right-Angle, Bulkhead, etc.)

Littlebend™

Ultra-Flexible High-Performance Cables

CABLE FEATURES:

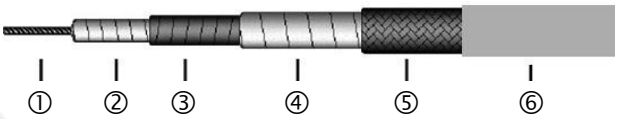
- **Super Flexible with Really Tight Bend Radius** (see chart)
- **High Shielding Effectiveness of >90dB**
- **High Retention Force of >90N**
- **Eliminates the Need for Right Angle Connectors**
- **Phase and Amplitude Stable**

The HLB098 Littlebend Flexible Cable is an 0.098" and HLB055 is 0.055" cable design with a steel braid that are capable of a very tight minimum bend radius. It is well suited for demanding microwave interconnect requirements, such as dense microwave packaging. The Littlebend cable can replace Right Angle connectors with minimal performance degradation due to its tight bend radius.

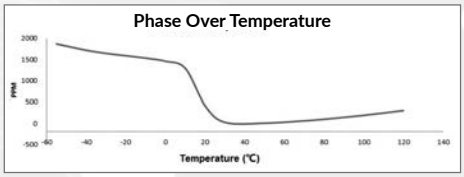
This selector guide offers critical parameters to identify the best Littlebend cable for your specific application.

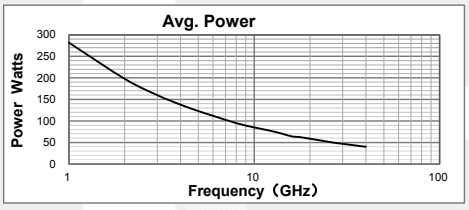
CABLE SPECS	HLB098	HLB055/055A
IMPEDANCE	50 Ω	50 Ω
VELOCITY OF PROPAGATION	76%	78.7%
TIME DELAY	1.31 ns/ft (4.39 ns/m)	1.27 ns/ft 4.24 ns/m
CAPACITANCE	27.4 pF/ft (90 pF/m)	25.9 pF/ft (85 pF/m)
WITHSTANDING VOLTAGE	900V	500V
INSULATION RESISTANCE	1,000 MΩ	1,000 MΩ
SHIELDING EFFECTIVENESS	<-90dB	>100dB
PHASE STABILITY VS FLEXURE	±4° @ 40 GHz	± 8° @ 110GHz
AMPLITUDE STABILITY	<±0.05dBm @ 18 GHz	<± 0.1dB @ 110GHz
DURABILITY	1,000 Cycles Min.	1,000 Cycles Min.
OPERATING TEMP. RANGE	-65° C to +165 ° C	-55° C to +85 ° C
MIN. BEND RADIUS	Static: 0.2" (5mm) Repeated: 0.4in (10mm)	Armored: .79" (20mm) Non-Armored: 0.2" (5mm)
DURABILITY	1,000 Cycles Min.	1,000 Cycles Min
RoHS COMPLIANT	RoHS compliant	RoHS compliant

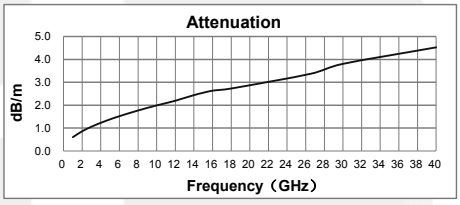
HLB098 CABLE CONSTRUCTION

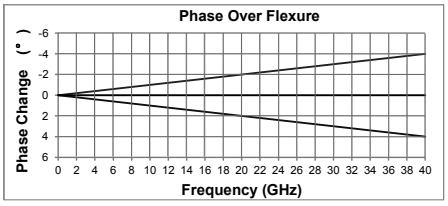


① CABLE CENTER CONDUCTOR	Silver Plated Solid Copper	Silver Plated Solid Copper
② CABLE DIELECTRIC	Low Denisty PTFE	Foamed PTFE
③ CABLE OUTER CONDUCTOR	Silver Plated Copper Strip	Silver Plated Copper Strip
④ CABLE INTERLAYER	Aluminum Foil	--
⑤ CABLE OUTER SHIELD	Stainless Steel Braid	Silver Plated Copper Braid
⑥ CABLE JACKET	FEP	FEP









HLB098 CABLE ATTENUATION (Typical @ 25°C) & Power (40°C, Sea Level)

Frequency GHz	1	2	3	4	5	6	8	10	12	14	16	18	26.5	30	40
Attenuation dB/m	0.60	0.86	1.06	1.23	1.38	1.52	1.77	1.99	2.19	2.44	2.64	2.73	3.37	3.81	4.53
Avg. Power W	103	72	59	50	45	41	35	31	28	27	25	23	18	16	14

HLB055 CABLE TYPICAL PERFORMANCE DATA

Frequency GHz	1	2	3	4	5	6	8	10	12	14	16	18	26.5	30	40	50	60	67	110
VSWR	1.05	1.07	1.09	1.06	1.13	1.09	1.16	1.11	1.15	1.17	1.23	1.20	1.25	1.21	1.26	1.31	1.25	1.37	1.41
Insertion Loss (dB)	0.34	0.52	0.68	0.77	0.86	0.99	1.13	1.31	1.42	1.58	1.67	1.78	2.12	2.25	2.54	2.83	3.27	3.54	5.07

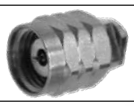
HOW TO CONFIGURE LITTLEBEND CABLES

HLB098-S1-SMPJ -12*

- Length (*In Inches)
- Connector code of end B
- Connector code of end A
- Cable code

*NOTE: Maximum frequency of final cable configuration will be limited to the maximum frequency of the lowest frequency connector.

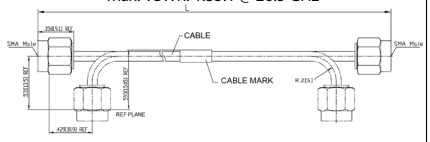
CONNECTOR CODES	
S1	SMA Male
KP	2.92mm Male
24P	2.4mm Male
SMPJ	SMP Female
SMPJRA	SMP Female Right Angle
S2BH	SMA Female Bulkhead
SMPPBH	SMP Male Bulkhead
VJ	1.85mm Female
VP	1.85mm Male
WJ	1.0mm Female
WP	1.0mm Male

CONNECTOR TYPE	CONNECTOR CODE	FREQUENCY*	MATERIAL	MAX VSWR
	SMA Male = **S1**	26.5 GHZ	Stainless Steel	1.30:1
	2.92mm Male = **KP**	40 GHz	Stainless Steel	1.35:1
	2.4mm Male = **24P**	50 GHz	Stainless Steel	1.35:1
	SMP Female = **SMPJ**	40 GHz	Brass	1.35:1
	SMP Female Right Angle = **SMPJRA**	18 GHz	Brass	1.30:1
	SMA Female Bulkhead = **S2BH**	26.5 GHz	Stainless Steel	1.30:1
	SMP Male Bulkhead = **SMPPBH**	18 GHz	Stainless Steel	1.30:1
	1.85mm Male = **VP**	67 GHz	Stainless Steel	1.40:1
	1.85mm Female = **VJ**	67 GHz	Stainless Steel	1.40:1
	1.0mm Male = **WP**	110 GHz	Stainless Steel	1.50:1
	1.0mm Female = **WJ**	110 GHz	Stainless Steel	1.50:1

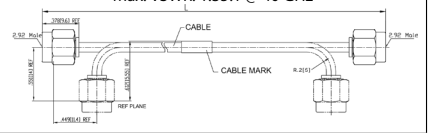
SAMPLE CONFIGURATIONS

Additional Configurations Available Upon Request

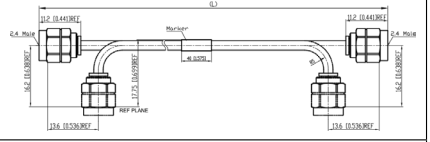
Part # HLB098-S1-S1-L (L=Length)
SMA Male to SMA Male: 26.5 GHz
Max. VSWR: 1.35:1 @ 26.5 GHz



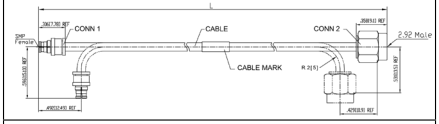
Part # HLB098-KP-KP-L (L=Length)
2.92mm Male to 2.92mm Male: 40 GHz
Max. VSWR: 1.35:1 @ 40 GHz



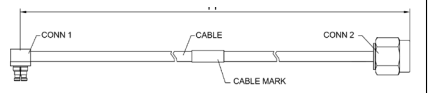
Part # HLB098-24P-24P-L (L=Length)
2.4mm Male to 2.4mm Male: 50 GHz
Max. VSWR: 1.35:1 @ 50 GHz



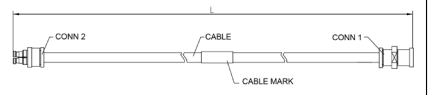
Part # HLB098-S1-SMPJ-L (L=Length)
SMA Male to SMP Female: 26.5 GHz
Max. VSWR: 1.35:1 @ 26.5 GHz



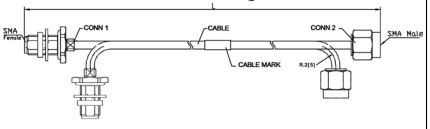
Part # HLB098-S1-SMPJRA-L (L=Length)
SMA Male to SMP Female Right Angle: 18 GHz
Max. VSWR: 1.35:1 @ 18 GHz



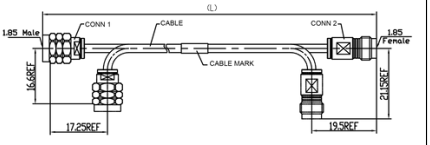
Part # HLB098-SMPJ-SMPPBH-L (L=Length)
SMP Female to SMP Male Bulkhead: 18 GHz
Max. VSWR: 1.35:1 @ 18 GHz



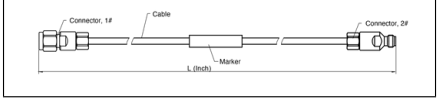
Part # HLB098-S1-S2BH-L (L=Length)
SMA Male to SMA Female Bulkhead: 18 GHz
Max. VSWR: 1.35:1 @ 18 GHz



Part # HLB098-VP-VJ-L (L=Length)
1.85mm Male to 1.85mm Female: 67 GHz
Max. VSWR: 1.40:1 @ 67 GHz



Part # HLB055-WP-WJ-L (L=Length)
1.0mm Male to 1.0mm Female Bulkhead: 110 GHz
Max. VSWR: 1.50:1 @ 110 GHz

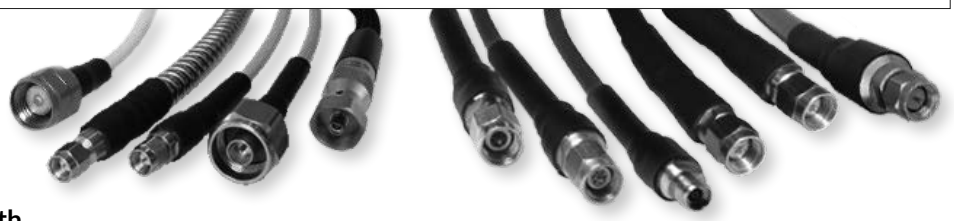


HANDLING HIGH-PERFORMANCE COAXIAL CABLES

High performance cables require special handling procedures to ensure optimum electrical performance. Many of these handling procedures are outlined here in detail. Taking just a few, basic preventative measures during handling could significantly extend the life of the assembly. Always take care to prevent anything from being placed on an assembly, as this could result in internal damage caused by compression. Also, try to prevent cable from bending below its minimum bend radius as this will cause the cable to kink which results in internal damage.

Limit bend radius whenever possible

It is recommend to use the widest possible bend radius to fit the application. This will help to keep mechanical stresses low through the bend and prolong the life of the assembly.



Avoid torquing down connector ends until both connectors are mated in position

It is important to tighten both connectors into position before any torque is applied. If a connector is torqued down before the assembly is routed into position, excessive torsion could be applied at the torqued connector's termination during the routing. These torsion forces could cause the dielectric to change its mechanical position at the connector termination, and ultimately lead to an electrical failure.

Avoid twisting assembly to orient connectors

When installing assemblies with right angle connectors, do not twist the cable or connectors to orient it with the mating connectors. Twisting the assembly could result in mechanically changing the dielectric position at the termination and ultimately lead to an electrical failure. Assemblies should be purchased with a specific connector offset angle to match the proper mating connector.

Avoid bending the assembly at the connector termination

A cable assembly should never be bent at the back of the connector. Applying a bend prematurely at the end of an assembly and allowing the bend to encompass the connector could lead to the build up of excessive cable forces against the connector and through the bend area. The applied forces will cause the cable to kink, resulting in electrical degradation and possible failure.

Avoid pulling an assembly through channeling by the connector end

Never pull an assembly by its connector when routing it through a frame work, channeling or building. Doing this could mechanically damage the connector termination. The assembly should always be pulled by the cable itself. Furthermore, the installation should be assisted by pushing the assembly through the channeling while the cable is pulled. Additionally, it is less stressful to the assembly if it is installed in phases (through individual sections) rather than a single run across the entire routing length.

Never allow an assembly to support its own weight when routed in a vertical installation

Never allow an assembly to hang freely by its own weight. Clamp down the cable at equal intervals along its length. Cable hangers can be used when it is not possible to clamp down the assembly in a vertical installation, provided the assembly has been reinforced for such an installation. Using multiple hangers whenever possible is also recommended to help evenly distribute the assembly's weight along the run.

Avoid the use of cable ties

Most high performance cables use an air-filled dielectric core. This makes the cable very soft. Therefore, any compressive load applied to the cable has the potential of collapsing the dielectric core within the cable. Cable ties and tie wraps are not recommended for this reason. They offer virtually no load distribution and consequently focus very high compressive forces through the tied down area. A concentrated force such as this almost always deforms the cable and significantly degrades assembly performance. For best holding results with minimal clamping forces, we recommend rubberized clamps. Be sure to select a clamp that will apply a minimum amount of compression force while still offering the desired holding strength. Selecting a clamp that is too small can do as much damage to an assembly as a cable tie.

Avoid subjecting the connector ends to cable axial loads

Cable assembly life can be increased by clamping down the cable a few inches from the connector ends in applications where the cable will be moving (such as a moving antenna) or where a high vibration condition exists. Clamping the cable down at the cable ends reduces mechanical loads applied to the connector when the cable is moved.

Always wrap connectors in weather proofing when installing outside

All cable connections that will be subjected to rain and snow should be wrapped in a weather proofing material. A self-fusing silicone tape is recommended to create a weather tight seal over the connection. If weather precautions are not taken, water will eventually work its way into the connector assembly causing high insertion losses.

Always provide adequate drip loops

Always allow for a drip loop in outside applications to prevent water from flowing down the cable and onto the connector. Over time the water could work its way into the connector assembly causing high insertion losses.

Take extra care with short assemblies

Always bend assemblies around mandrels whenever possible

The use of mandrels or wheels will help to evenly distribute bending loads applied to the cable. This is the preferred method for bending cables.

Take caution when bending cables by hand

Sometimes bending a cable by hand is the only option. In this case the following method should be used;

- Start at bending point keeping hands close together.
- Bend the cable a little at a time working in an outward direction along the bend.
- Return to the center point of the bend and work in an outward direction making the bend a little tighter.
- Continue to return to the center of the bend, and working outward until the desired bend is reached.

Take caution bending cables under 12" in length

An assembly that is 12" in length and smaller can be very rigid depending on the cable type. The cable becomes rigid because its inner and outer conductors are fully (mechanically) terminated to the cable connectors. The cable is terminated this way to yield maximum electrical performance. Unfortunately, it minimizes the bending characteristics of the assembly because the cable is too short to accommodate the total material volume displacement needed for a typical bend. Often, the minimum bend radius cannot be achieved without damaging the assembly. Therefore, short cables should only be used in applications where slight jogging bends will be used. A longer assembly that uses a service loop should be considered as a replacement for a short cable in situation where a tight or sharp bend is needed.

COAXIAL CABLE TERMINOLOGY

Phase Stability over Flexure for Low Loss Coaxial Cable

Phase stability over flexure can be significantly affected by the cable assembly technique, cable bend radius, and the length of the cable assembly

Phase Stability over Temperature for Low Loss Coaxial Cable

The electrical length for a given frequency will “shift” as a result of environmental changes. The degree of change is based on mechanical stresses, connector to torque and thermal conditions.

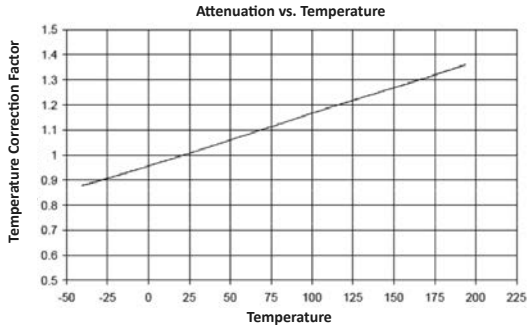
Power Handling Capability of Coaxial Cable

The power handling capabiltiy of coaxial cable is dependent either on its maximum voltage-withstanding capability for the transmission of peak power or on its thermal dissipation ability for average power transmission, which is the more common problem for RF applications. The thermal dissipation of cable depends upon its thermal resistance. For a cable in air, the thermal resistance of the surrounding air is related to the condition and radiation losses and dependent upon the surface area of the cable, the temperature of the surfaces, the ambient temperature, emissivity of the surface, and the flow of air.

The amount of heat which flows radially from the line will depend upon the composite thermal resistivity of the dielectric and insulating material of the cable, and the temperature gradients therein. The heat generated within a cable is given by the ratio of temperature rise between the inner conductor and the ambient temperature to its thermal resistance, which is equal to the difference of the input power and the output power in a matched system. The ratio of these powers is a function of the attenuation per unit length, which is directly proportional to the heat generated in the cable. For any particular cable construction, the average power rating will depend on the permissible temperature rise above a stated ambient which is limited by the maximum operating temperature that the dielectric can withstand. The generally accepted maximum operating temperature for polyethylene is 80°C and for PTFE is 250°C. Simply stated, power handling of a coaxial cable is a function of attenuation and the temperature of the dielectric. The higher the operating frequency, the lower the power handling capability.

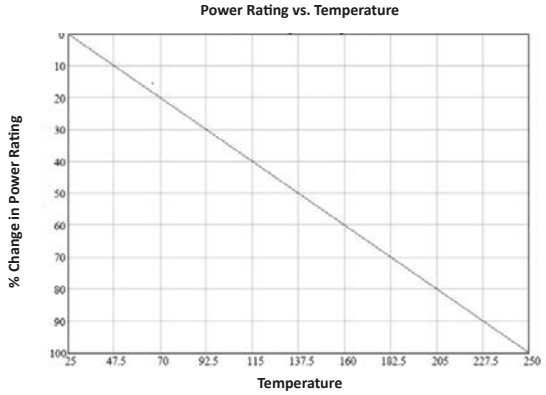
Attenuation vs. Temperature Correction Factor for Coaxial Cable

Recalculates the attenuation of a coax cable at various temperatures



Power vs. Temperature Derating Factors

Recalculates the power handling capabilities of a coax cable at various temperatures



VSWR and Return Loss of Coaxial Cables

Voltage Standing Wave Ratio (VSWR) and Structural Return Loss (SRL) are basically the same - only different. Both terms are used to characterize the uniformity of a cable’s impedance along its length as it relates to reflected energy. VSWR is essentially the ratio of the Input Impedance to the average Characteristic Impedance as a result of signal losses due to reflections and is expressed as a ratio (1.xxxx:1). SRL is the measurement of reflected energy expressed in decibels (-dB). Connectors and termination techniques are major sources of reflected energy and can significantly deteriorate system VSWR or SRL. The difference between VSWR and SRL is no more than how reflected energy is measured.

Structural Return loss (SRL) is expressed as VSWR (Voltage Standing Wave Ratio) by the following formula:

$$VSWR = \frac{1 + 10^{RL/20}}{1 - 10^{RL/20}}$$

SRL	VSWR	SRL	VSWR	SRL	VSWR
40dB	1.0202:1	29dB	1.0736:1	18dB	1.2880:1
39dB	1.0227:1	28dB	1.0829:1	17dB	1.3290:1
38dB	1.0255:1	27dB	1.0935:1	16dB	1.3767:1
37dB	1.0287:1	26dB	1.1055:1	15dB	1.4326:1
36dB	1.0322:1	25dB	1.1192:1	14dB	1.4985:1
35dB	1.0362:1	24dB	1.1347:1	13dB	1.5769:1
34dB	1.0407:1	23dB	1.1524:1	12dB	1.6709:1
33dB	1.0458:1	22dB	1.1726:1	11dB	1.7849:1
32dB	1.0515:1	21dB	1.1957:1	10dB	1.9250:1
31dB	1.0580:1	20dB	1.2222:1		
30dB	1.0653:1	19dB	1.2528:1		

GLOSSARY OF TERMS

Albaloy: A plating finish comprised primarily of copper, tin and zinc which provides good electrical performance, but unlike silver, albaloy is highly resistant to tarnish. Being non-magnetic, it also provides excellent passive intermodulation (PIM) performance comparable to silver.

Amplitude Balance: The maximum peak-to-peak amplitude difference (in dB) between the output ports of a power divider or hybrid coupler over the specified frequency range.

Attenuation Accuracy: The amount of variation in magnitude from the nominal value across the entire frequency band.

Attenuator: A passive device or network that absorbs part of the input signal and transmits the remainder with minimal distortion. Attenuators are used to extend the dynamic range of devices such as power meters and amplifiers, reduce signal levels to detectors, match circuits and are used daily in lab applications to aid in product design. Attenuators are also used to balance out transmission lines that otherwise would have unequal signal levels.

Base Station: A fixed transmitter/receiver with which a mobile radio transceiver establishes a connection link to gain access to the public-switched telephone network.

Bias Tees: A passive device used in applications to inject/remove DC voltages in RF circuits without affecting the RF signal through the main transmission path. Ideal for remote powering of bi-directional amplifiers (BDAs), repeaters and tower top amplifiers (TTAs) by BTS control modules.

Circulator: A three-port ferromagnetic passive device used to control the direction of signal flow in an RF circuit.

Coaxial: A transmission line in which one conductor completely surrounds the other, the two being coaxial and separated by a continuous dielectric such as air or PTFE.

CW – (Continuous Wave): Signal of constant amplitude. Used to differentiate between the performance of a microwave component for continuous power level vs. pulsed signals.

dB – (Decibel): A unit of gain equal to ten times the common logarithm of the ratio of two power levels or 20 times the common logarithm of the ratio between two voltages.

dBc: Decibel related to the signal of a carrier. Passive intermodulation distortion is typically stated in dBc which takes into consideration the 43 dBm carrier tones.

dBm: Decibels related to 1mW – the standard unit of power level used in the microwave industry. Example: 0 dBm = 1mw, +10 dBm = 10mw, +20dBm = 100mw, etc.

DC Block: An in-line device primarily used in applications to block DC voltages in RF circuits without affecting the RF signal through the main transmission path. The three basic types are:

1. Inner – Blocks DC voltages on inner conductor only
2. Outer – Blocks DC voltages on outer conductor only
3. Inner/Outer – Blocks DC voltages on both conductors

Directional Coupler: A passive device used for sampling incident and reflected microwave power conveniently and accurately with minimal disturbance to the transmission line. Some general applications for directional couplers include line monitoring, power measurements and load source isolators.

Directivity: A measurement of the desired signal strength to the undesired signal strength. Determined by taking the value of isolation and subtracting the specified coupling (including all variations). Directivity is a measure of how good the couplers performance is (similar to the Q factor of a coil).

EMI – (Electromagnetic Interference): Unintentional interfering signals generated within or external to electronic equipment. Typical sources could be power line transients and electromechanical switching equipment.

Frequency Range: The minimum and maximum frequencies between which the specified component will meet all guaranteed specification.

Frequency Sensitivity: The maximum peak-to-peak variation in coupling (in dB) of a directional or hybrid coupler over the specified frequency range. Also referred to as "flatness."

GHz - (Gigahertz): A unit of frequency measure equal to 1000 MHz (Megahertz) or a billion hertz.

Hybrid Coupler: A passive four-port device that is used either to equally split an input signal with a resultant 90° phase shift between output signals or to combine two signals while maintaining high isolation between them.

Impedance: Resistance to alternating current. Most RF and microwave systems are designed to operate with a characteristic impedance of 50 ohms.

Input VSWR: Minimum voltage standing wave ratio of a power divider at the input (sum) port over the specified frequency range with all other ports terminated in 50 ohm loads.

Insertion Loss: The change in load power due to the insertion of a particular device into a transmission system.

Iridite: A chemical film (typically clear or yellow in color) which provides a barrier medium to prevent corrosion on aluminum surfaces and enhance adhesion of subsequent coatings such as paints and primers.

Isolation: A unit of measure (in dB) that states the separation of signal levels on adjacent ports of a device. The greater the isolation value, less interference from a signal on one port is present at the other.

Isolator: A two-port ferromagnetic passive device which is used to control the direction of signal flow and utilizes an internal resistor. Typically used to protect other RF components from excessive signal reflection.

MHz - (Megahertz): A unit of frequency measure equal to 1000 kHz (Kilohertz) or a million hertz.

Microstrip – (Microstripline): A transmission line consisting of a metalized strip and solid ground plane metallization separated by a thin, solid dielectric. Microstrip is a popular material above 400 MHz and below 6 GHz because it permits accurate fabrication of transmission lines on ceramic or PC board substrates. Higher frequencies or broadband devices tend to favor stripline technology.

MTBF – (Mean Time Between Failure): The mean (average) time between failures of a component and is often attributed to the "useful life" of the materials used to assemble the device. MTBF assumes that the component can be "renewed" or fixed after each failure and returned to service immediately after failure.

Non-Coherent Signals: The limiting factor for most Wilkinson power dividers used as combiners is power dissipation. When input signals are out of phase, non-coherent or have amplitude unbalance this causes a cancellation across the isolation resistors resulting in power dissipation. Since these devices are most commonly used as dividers, typical industry designs utilize low power alumina surface mount resistor chips on a thermally insulative circuit board. However, maximum input for combining non-coherent signals on adjacent ports is: (Rated input power of divider * 5%) / "N" # of input channel. If the rated power is exceeded, the chip resistors will heat up and degrade resulting in loss of port-to-port isolation and VSWR.

Output VSWR: Minimum voltage standing wave ratio of a power divider at any output port over the specified frequency range with all other ports terminated in 50 ohm loads.

GLOSSARY OF TERMS

Passivation: The formation of an insulated layer directly over a metal to protect the surface from contaminants, moisture or particles.

Phase Balance: The maximum peak-to-peak phase difference (in degrees) between the output ports of a power divider over the specified frequency range.

PIM (Passive Intermodulation): Passive Intermodulation (PIM) occurs when two or more signals are present in a passive device (cable, connector, coupler, etc.) that exhibits a nonlinear response. The nonlinearity is typically caused by dissimilar metals or dirty/loose interconnects. Nonlinearity is typically not troublesome at low input signal levels, but if PIM is generated from a high power transmitter path to an adjacent receiver channel, desensitization will occur. A common PIM specification is typically -110 dBc or greater.

Power (Average): The maximum amount of mean (average) power of a modulated/pulsed signal a given component can dissipate at ambient temperature without degradation in performance.

Power (Peak): Instantaneous power a given component can dissipate for a percentage of the duty cycle (typically 2%) without degradation in performance.

PTFE (PolyTetraFluoroEthylene): Used as an insulator in RF and microwave coaxial connectors because of its low & stable dielectric constant and loss factor over a wide temperature and frequency range.

Reactive Splitter: A broadband passive network that equally divides power applied to the input ports between any particular number of output ports without substantially affecting the phase relationship or causing distortion. Reactive splitters differ from Wilkinson power dividers as they provide no isolation between adjacent ports. Therefore, power entering any output of a reactive splitter will divide evenly between the adjacent and input ports.

Return Loss: When expressed in dB is the ratio of reflected power to incident power. It is a measure of the amount of reflected power on a transmission line when it is terminated or connected to any passive or active device. Once it is measured, it can be converted by equation to reflection coefficient which can be converted to VSWR.

RF – (Radio Frequency): Generally referring to any frequency at which the radiation of electromagnetic energy is possible typically above 50 MHz. Above 1000 MHz and up is considered microwave.

RF Leakage: The amount of energy which “leaks” or radiates from a connector and/or device. Typically tested at one frequency and expressed in dB. Very large negative values indicate that the device does not radiate much energy.

RoHS: (Restriction of Hazardous Substances) Directive adopted by the European Union in February 2003 with the specified limits for the following elements in the manufacture of various types of electronic and electrical equipment:

1. Lead (Pb) < 0.1%
2. Mercury (Hg) < 0.1%
3. Cadmium (Cd) < 0.01%
4. Hexavalent Chromium (CrVI) < 0.1%
5. Polybrominated Biphenyls (PBB) < 0.1%
6. Polybrominated Diphenyl Esters (PBDE) < 0.1%

Stripline: A transmission line consisting of a conductor above or between extended conducting surfaces. Higher frequencies or broadband devices tend to favor stripline technology.

Temperature: The minimum and maximum ambient temperatures a given component can operate at and still meet all guaranteed specifications unless otherwise noted.

Termination (RF Loads): Used at the end of a transmission line designed to absorb RF power with very little reflection, effectively terminating the line or port in its characteristic impedance. Terminations are used in a wide variety of measurement systems; any port of a multi-port microwave device that is not involved in the measurement should be terminated in its characteristic impedance in order to ensure an accurate measurement.

Torque: Recommended mating torque for industry standard connectors:

1. SMA - 7 to 10 in-lbs
2. Type-N – 12 to 15 in-lbs
3. TNC – 12 to 15 in-lbs
4. 7/16 DIN – 220 to 300 in-lbs

Transmission Line: The conductive connections between circuit elements which carry signal power. Wire, coaxial cable, microstrip and stripline traces and waveguide are common examples.

VSWR – (Voltage Standing Wave Ratio): The ratio of the incident signal compared to the reflected signal in a transmission line. VSWR cannot be
directly measured, so a return loss measurement (expressed in dB) is taken of reflected power to incident power. Once it is measured, it can be converted by equation to reflection coefficient which can be converted to VSWR.

Wilkinson Power Divider: A passive device that equally splits an input signal to each output or combines signals to a common port. Wilkinson power divider differ from reactive splitters as the output ports are isolated, so signals entering one of the output ports will not interfere with signals on the adjacent port. The limiting factor for Wilkinson power dividers used as combiners is power dissipation. When input signals are out of phase, non-coherent or have amplitude unbalance this causes a cancellation across the isolation resistors resulting in power dissipation.

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