SAGE
Millimeter, Inc.

STANDARD AND CUSTOM SOLUTIONS
FROM 18 to 170 GHz

2018 MAIN PRODUCT CATALOG

MICROWAVE & MILLIMETERWAVE | COMPONENTS & SUBASSEMBLIES

□ About SAGE Millimeter

SAGE Millimeter, Inc. was founded in 2011 and is a woman-owned, ITAR-registered technology company with a focus on developing high performance microwave and millimeterwave components and subassemblies for commercial and military system applications. SAGE Millimeter's product offerings range from standard catalog products to custom designed, application, performance and/or function specific products in the primary frequency range of 18 to 170 GHz.

SAGE Millimeter's standard product offerings are organized into two product catalogs: the **main catalog** and the **sensor catalog**. The main catalog includes SAGE Millimeter's standard components and modules and is divided into ten product families according to their functionalities. The sensor catalog details the product offerings for speed and distance detection applications and is offered primarily for Radar system integrators. While these two catalogs offer standard models to cover most microwave and millimeterwave general application product categories, SAGE Millimeter is also committed to designing and manufacturing **custom** products according to customers' specifications and helping customers define their system products by using the most available microwave and millimeterwave technologies. New products are periodically added on SAGE Millimeter's website at www.sagemillimeter.com.

SAGE Millimeter's principals have many years of experience in microwave and millimeterwave component and subassembly industry. The company is led with comprehensive knowledge about the engineering and manufacturing process and the quality requirements of the industry. SAGE Millimeter maintains a strong commitment to quality and has been operating according to ISO 9001:2015 and AS9100 Rev. D standards. Quality and operation processes are in place to ensure that customers' requirements and specifications are met and exceeded. In the tradition of its founders, SAGE Millimeter is committed to satisfying customers by providing well-engineered, cost-effective, high quality and on-time delivered products.

Located in Torrance, California, SAGE Millimeter benefits from the proximity of leading aerospace, defense and telecommunication companies, research laboratories and universities by taking advantage of skilled professionals and experienced vendors while working closely with industry leaders to design, develop, and produce many state-of-the-art performance and specific application oriented products.

□ Vision Statement

To become a leading microwave and millimeterwave technology company that delivers well-engineered, high-quality, cost-effective, and superior-performance, products to the industry.

□ Mission Statement

To satisfy our customers by providing timely and effective products and solutions without compromising quality, performance, cost, or delivery.

To empower our employees with respect, opportunity, and a rewarding working environment.

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Pyramidal Horn Antennas, SAR Series

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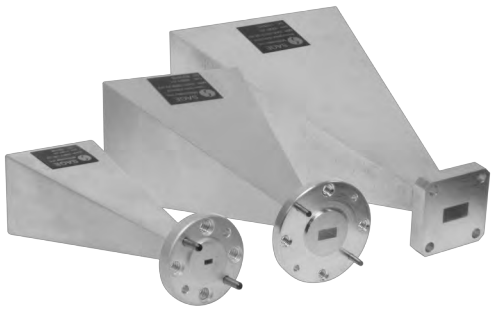
FEATURES:

- Frequency coverage: 8.2 to 170 GHz
- Rectangular waveguide interface
- Precisely machined and gold plated
- Low Voltage Standing Wave Ratio (VSWR)



APPLICATIONS:

- Antenna ranges
- Antenna gain measurements
- Rapid system setups
- Engineering setups

DESCRIPTION:

SAR series pyramidal gain horns or rectangular gain horns are offered as both standard and custom models with a rectangular waveguide interface. The pyramidal gain horns only support linear polarization. With a calibrated gain chart, these horns can be used to measure the gain of other antennas by comparing the generated signal levels of both. For this reason, these horns are also referred to as standard gain horns.

The listed models offer 23 dB nominal gain, 10/11 degrees typical half power beamwidth and 14 dB/30 dB typical side lobe levels at the center frequency of the band. These horns cover full waveguide bandwidths within the frequency range of 8.2 to 170 GHz. In addition to the models listed below, models with 10, 15, 20 and 25 dB gain and other frequency bands are also available. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Gain (dB)	3 dB Beamwidth (°)	Side Lobes (dB)	VSWR	Outline
X	SAR-2309-90-S2	8.2 to 12.4	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-X2
Ku	SAR-2309-62-S2	12.4 to 18.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-62
K	SAR-2309-42-S2	18.0 to 26.5	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-K2
N/A	SAR-2309-34-S2	22.0 to 33.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-32
Ka	SAR-2309-28-S2	26.5 to 40.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-A2
Q	SAR-2309-22-S2	33.0 to 50.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-Q2
U	SAR-2309-19-S2	40.0 to 60.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-U2
V	SAR-2309-15-S2	50.0 to 75.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-V2
E	SAR-2309-12-S2	60.0 to 90.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-E2
W	SAR-2309-10-S2	75.0 to 110.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-W2
F	SAR-2309-08-S2	90.0 to 140.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-F2
D	SAR-2309-06-S2	110.0 to 170.0	23	10.0/11.0 (E/H)	-14.0/-30.0 (E/H)	1.15:1	AR-D2

CUSTOM MODELS:

SAGE Millimeter's pyramidal gain horn model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAR - GG BW - WG - XY

GG is the linear gain in dB. For example: 25 dB = 25
BW is for internal reference.
WG is the rectangular waveguide size of the input connector.
X is the antenna type. “S” is for a standard package and finish and “C” is for a custom design.
Y is for factory reserve.

Example: SAR-1050-12-S2 is a pyramidal gain horn with a frequency range of 60 to 90 GHz, a nominal gain of 10 dB and a 3 dB beamwidth of 50 degrees. The horn has a WR-12 waveguide at the input port and a standard package and finish. “2” is a factory assigned number.

Conical Horn Antennas, SAC Series

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FEATURES:

- Frequency coverage: 8.5 to 170 GHz
- Rectangular and circular WG interfaces
- Precisely machined and gold plated
- Low VSWR

APPLICATIONS:

- Antenna ranges
- Feed horns
- Rapid system setups
- Engineering setups

DESCRIPTION:

SAC series conical gain horns are offered as both standard and custom models with either a circular or rectangular waveguide interface. While conical gain horns with a rectangular waveguide interface can only support linear polarization, models with a circular waveguide interface can support various polarization types including horizontal, vertical, left-handed circular and right-handed circular polarization for broader applications.

The listed models operate across the full waveguide band and offer 23 dB nominal gain, 12 degrees typical half power beamwidth, a 24 dB typical side lobe level and 1.15:1 VSWR at center frequency. The below standard offering covers the frequency range of 8.5 to 140 GHz. However, other frequencies and standard models with 10, 15, 20 and 25 dB gain are also available. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Gain (dB)	Outline
X	SAC-2309-938-S2	8.5 to 11.6	23	AC-CX2
Ku	SAC-2309-594-S2	13.4 to 18.0	23	AC-C62
K	SAC-2309-396-S2	20.0 to 24.5	23	AC-CK2
Ka	SAC-2309-250-S2	33.0 to 38.5	23	AC-CA2
Q	SAC-2309-219-S2	38.5 to 43.0	23	AC-CQ2
U	SAC-2309-188-S2	43.0 to 50.0	23	AC-CU2
V	SAC-2309-141-S2	58.0 to 68.0	23	AC-CV2
E	SAC-2309-125-S2	68.0 to 77.0	23	AC-CE2
W	SAC-2309-094-S2	87.0 to 100.0	23	AC-CW2
F	SAC-2309-082-S2	100.0 to 112.0	23	AC-CF2
D	SAC-2309-075-S2	115.0 to 140.0	23	AC-CD2

Band	Model Number	Frequency Range (GHz)	Gain (dB)	Outline
X	SAC-2309-90-S2	8.5 to 11.6	23	AC-RX2
Ku	SAC-2309-62-S2	13.4 to 18.0	23	AC-R62
K	SAC-2309-42-S2	20.0 to 24.5	23	AC-RK2
Ka	SAC-2309-28-S2	33.0 to 38.5	23	AC-RA2
Q	SAC-2309-22-S2	38.5 to 43.0	23	AC-RQ2
U	SAC-2309-19-S2	43.0 to 50.0	23	AC-RU2
V	SAC-2309-15-S2	58.0 to 68.0	23	AC-RV2
E	SAC-2309-12-S2	68.0 to 77.0	23	AC-RE2
W	SAC-2309-10-S2	87.0 to 100.0	23	AC-RW2
F	SAC-2309-08-S2	100.0 to 112.0	23	AC-RF2
D	SAC-2309-06-S2	115.0 to 140.0	23	AC-RD2

Note: For certain models, the operating frequency can be stretched to cover the full rectangular waveguide bandwidth if the dominant mode is maintained.

CUSTOM MODELS:

SAGE Millimeter's conical gain horn model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAC - GG BW - DDD - XY OR SAC - GG BW - WG - XY

GG is the linear gain in dB. For example: 25 dB = 25
BW is the for internal reference.
DDD is the diameter of the input connector, in mils, for circular waveguides or **WG** is the waveguide size for rectangular waveguides.
X is the antenna type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SAC-1050-12-S2 is a conical gain horn with a frequency range of 68 to 77 GHz, a nominal gain of 10 dB and a 3 dB beamwidth of 50 degrees. The horn has a WR -12 waveguide at the input port and a standard package and finish. "2" is a factory assigned number.

Probe Antennas, SAP Series

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FEATURES:

- Frequency coverage: 8.2 to 170 GHz
- Rectangular waveguide interface
- Tapered end to minimize diffraction effects
- Low loss and high efficiency

APPLICATIONS:

- Antenna ranges
- Antenna gain measurements
- Rapid system setups
- Engineering setups

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DESCRIPTION:

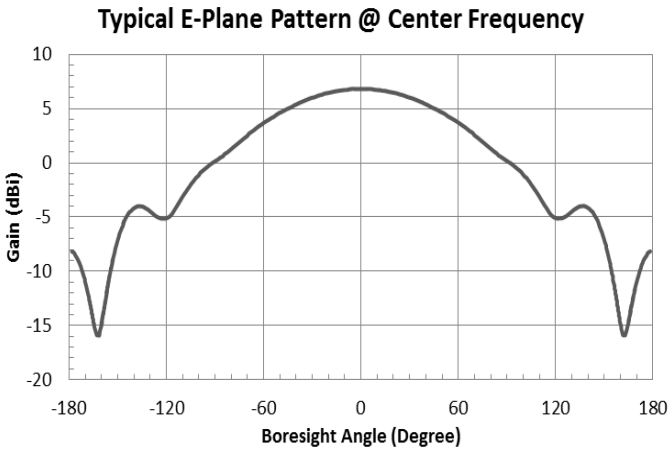
SAP series probe antennas are offered as both standard and custom models with a rectangular waveguide interface. Probe antennas can only support linear polarization. These antennas are often used to measure the gain of other antennas by comparing the signal levels of the probe antenna and antenna under testing.

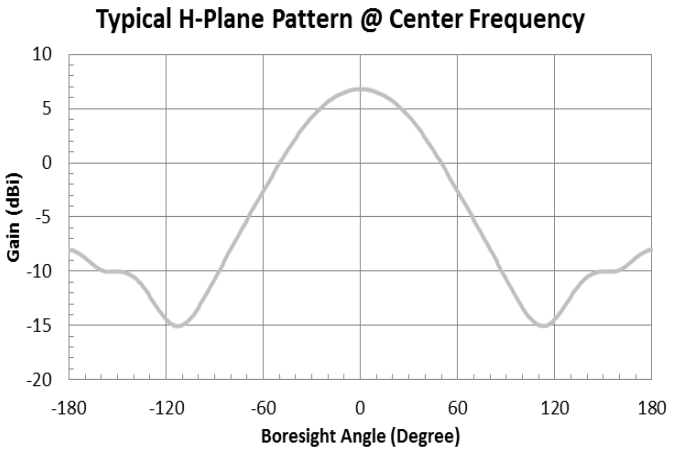
The standard models operate across the full waveguide band and offer 6.5 dB nominal gain and 115 and 60 degrees half power beamwidth at center frequency. The below standard offering covers the frequency range of 8.2 to 170 GHz.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Gain (dB)	E-plane 3 dB BW (°)	H-plane 3 dB BW (°)	VSWR	Outline
X	SAP-90-S2	8.2 to 12.4	6.5	115.0	60.0	2:1	AP-X
Ku	SAP-62-S2	12.4 to 18.0	6.5	115.0	60.0	2:1	AP-6
K	SAP-42-S2	18.0 to 26.5	6.5	115.0	60.0	2:1	AP-K
Ka	SAP-28-S2	26.5 to 40.0	6.5	115.0	60.0	2:1	AP-A
Q	SAP-22-S2	33.0 to 50.0	6.5	115.0	60.0	2:1	AP-Q
U	SAP-19-S2	40.0 to 60.0	6.5	115.0	60.0	2:1	AP-U
V	SAP-15-S2	50.0 to 75.0	6.5	115.0	60.0	2:1	AP-V
E	SAP-12-S2	60.0 to 90.0	6.5	115.0	60.0	2:1	AP-E
W	SAP-10-S2	75.0 to 110.0	6.5	115.0	60.0	2:1	AP-W
F	SAP-08-S2	90.0 to 140.0	6.5	115.0	60.0	2:1	AP-F
D	SAP-06-S2	110.0 to 170.0	6.5	115.0	60.0	2:1	AP-D

TYPICAL E AND H PLANE PATTERNS:





Scalar Feed Horn Antennas, SAF Series

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FEATURES:

- Frequency coverage: 8.5 to 170 GHz
- Rectangular and circular WG interfaces
- 35% typical operating bandwidth
- Polarization insensitive
- Low side lobe levels
- Low VSWR

APPLICATIONS:

- Feeds for lens and reflector antennas
- Rapid system setups
- Engineering setups

DESCRIPTION:

SAF series scalar feed horns are offered as both standard and custom build models with either a circular or rectangular waveguide interface. While scalar feed horns with a rectangular waveguide interface can only support linear polarization, models with a circular waveguide interface can support various polarization types including horizontal, vertical, left-handed circular, and right-handed circular polarization for broader applications.

The standard models operate across the full waveguide band and offer 17 dBi nominal gain, 25 degrees half power beamwidth and a -28 dB side lobe level at center frequency. The below standard offering covers the frequency range of 8.5 to 140 GHz. However, other frequencies or gain values are also available. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Gain (dB)	Beamwidth (°)	Model Number	Frequency Range (GHz)	Gain (dB)	Beamwidth (°)
X	SAF-0931231725-938-S1	8.5 to 11.6	17	25	SAF-0931231725-90-S1	8.5 to 11.6	17	25
Ku	SAF-1331831725-594-S1	13.4 to 18.0	17	25	SAF-1331831725-62-S1	13.4 to 18.0	17	25
K	SAF-2032531725-396-S1	20.0 to 24.5	17	25	SAF-2032531725-42-S1	20.0 to 24.5	17	25
Ka	SAF-3333931725-250-S1	33.0 to 38.5	17	25	SAF-3333931725-28-S1	33.0 to 38.5	17	25
Q	SAF-3934331725-219-S1	38.5 to 43.0	17	25	SAF-3934331725-22-S1	38.5 to 43.0	17	25
U	SAF-4335031725-188-S1	43.0 to 50.0	17	25	SAF-4335031725-19-S1	43.0 to 50.0	17	25
V	SAF-5836831725-141-S1	58.0 to 68.0	17	25	SAF-5836831725-15-S1	58.0 to 68.0	17	25
E	SAF-6837731725-125-S1	68.0 to 77.0	17	25	SAF-6837731725-12-S1	68.0 to 77.0	17	25
W	SAF-8731041725-094-S1	87.0 to 100.0	17	25	SAF-8731041725-10-S1	87.0 to 100.0	17	25
F	SAF-1041141725-082-S1	100.0 to 112.0	17	25	SAF-1041141725-08-S1	100.0 to 112.0	17	25
D	SAF-1141441725-075-S1	115.0 to 140.0	17	25	SAF-1141441725-06-S1	115.0 to 140.0	17	25

CUSTOM MODELS:

SAGE Millimeter's scalar feed horn model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAF - F1N F2N GG BW - DDD - XY OR SAF - F1N F2N GG BW - WG - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
BW is the 3 dB beamwidth in degrees. For example: 12 degrees = 12
DDD is the diameter of the input connector, in mils, for circular waveguides or **WG** is the waveguide size for rectangular waveguides.
X is the antenna type. “S” is for a standard package and finish and “C” is for a custom design.
Y is for factory reserve.

Example: SAF-2833232309-28-S1 is a scalar feed horn with a frequency range of 28 to 32 GHz, a nominal gain of 23 dB and a 3 dB beamwidth of 9 degrees. The horn has a WR-28 waveguide at the input port and a standard package and finish. “1” is a factory assigned number.

Gaussian Optics Lens Antennas, SAG Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Rectangular or circular WG interfaces
- Ridged mechanical configurations
- High efficiency and low loss
- Corrugated feed horn for low side lobe levels
- Low VSWR

APPLICATIONS:

- Communication systems
- Radar systems
- Sensor heads
- Plasma diagnostics systems
- Material science

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DESCRIPTION:

SAG series Gaussian optics lens antennas are offered with either a circular or rectangular waveguide interface. While Gaussian optics lens antennas with a rectangular waveguide interface can only support linear polarization, models with a circular waveguide interface can support various polarization types including horizontal, vertical, left-handed circular, and right-handed circular polarization for broader applications. Gaussian optics lens antennas are designed and constructed to offer high efficiency, low side lobes and a rugged mechanical configuration. A corrugated feed horn and dielectric lens allow these antennas to form well-defined Gaussian beams. Additionally, the dielectric lens provides phase error corrections and serves as a radome to protect from environmental conditions. Check the website for models and details.

ELECTRICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 170.0 GHz	Other frequency ranges are available upon request.
Interface	Circular or Rectangular	Specify when ordering.
Antenna Diameter	3, 6, 9, and 12 Inches	Related to the operation frequency and gain.
Operating Bandwidth (Typical)	Up to 100% of Operation Frequency Range of Waveguide Band	Most Gaussian antennas can operate at a wider bandwidth with minor performance degradation.
3 dB Beamwidth	0.5 to 5.0 Degrees	Related to the operation frequency and diameter.
Antenna Gain Range	30 to 48 dB	Related to the operation frequency and diameter.
Side Lobe Level	23 to 30 dB	Related to the diameter and feed structure.
Cross Polarization	23 to 30 dB	Only relevant to circular waveguide interfaces.
Return Loss (Typical)	17 dB	Related to the operating bandwidth.

MODEL NUMBERS:

SAGE Millimeter's lens corrected antenna model numbers are configured per the following format. Customers may refer to the format and specify the model numbers accordingly when placing an order.

SAG - F1N F2N GG BW - DDD - XY OR SAG - F1N F2N GG BW - WG - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 35 dB = 35
BW is the 3 dB beamwidth in degrees. For example: 12 degrees = 12
DDD is the diameter of the input connector, in mils, for circular waveguides or **WG** is the waveguide size for rectangular waveguides.
X is the antenna type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SAG-3034033602-28-S1 is a Gaussian optics lens antenna with a frequency range of 30 to 40 GHz, a gain of 36 dB and a 3 dB beamwidth of 2 degrees. The antenna has a WR-28 waveguide at the input port and a standard package and finish. "1" is a factory assigned number.

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Lens Corrected Antennas, SAL Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Rectangular and circular WG interfaces
- Ridged mechanical configurations
- High efficiency and low loss
- Low side lobe levels
- Low VSWR

APPLICATIONS:

- Communication systems
- Radar systems
- Sensor heads
- Plasma diagnostics systems

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DESCRIPTION:

SAL series lens corrected antennas are offered with either a circular or rectangular waveguide interface. While lens corrected antennas with a rectangular waveguide interface can only support linear polarization, models with a circular waveguide interface can support various polarization types including horizontal, vertical, left-handed circular, and right-handed circular polarization for broader applications. These antennas are designed and constructed to offer high efficiency, low side lobes and a rugged mechanical configuration. In general, lens corrected antennas are ideal for achieving gain levels of up to 30 dB with moderate side lobe rejections. Additionally, its dielectric lens provides phase error corrections and serves as a radome to protect from environmental conditions. Check the website for models and details.

ELECTRICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 170.0 GHz	Other frequency ranges are available upon request.
Interface	Circular or Rectangular	Specify when ordering.
Antenna Diameter	0.5 to 5.0 Inches	Related to the operation frequency and gain.
Operating Bandwidth (Typical)	50% of Operation Frequency Range of Waveguide Band	Lens antennas can operate up to the full waveguide bandwidth with minor performance degradation.
3 dB Beamwidth	5 to 12 Degree	Related to the operation frequency and diameter.
Antenna Gain Range	22 to 30 dB	Related to the operation frequency and diameter.
Side Lobe Level	17 to 25 dB	Related to the diameter and feed structure.
Cross Polarization	20 dB	Only relevant to circular waveguide interfaces.
Return Loss (Typical)	17 dB	Related to the operating bandwidth.

MODEL NUMBERS:

SAGE Millimeter's lens corrected antenna model numbers are configured per the following format. Customers may refer to the format and specify the model numbers accordingly when placing an order.

SAL - F1N F2N GG BW - DDD - XY OR SAL - F1N F2N GG BW - WG - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
BW is the 3 dB beamwidth in degrees. For example: 12 degrees = 12
DDD is the diameter of the input connector, in mils, for circular waveguides or **WG** is the waveguide size for rectangular waveguides.
X is the antenna type. “S” is for a standard package and finish and “C” is for a custom design.
Y is for factory reserve.

Example: SAL-3034032112-28-S1 is a lens corrected antenna with a frequency range of 30 to 40 GHz, a gain of 21 dB and a 3 dB beamwidth of 12 degrees. The antenna has a WR-28 waveguide at the input port and a standard package and finish. “1” is a factory assigned number.

Omnidirectional Antennas, SAO Series

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FEATURES:

- Frequency coverage: 23 to 100 GHz
- Coaxial and rectangular WG interfaces
- 360° azimuth coverage
- Vertically polarized
- Various vertical beamwidth

APPLICATIONS:

- Communication links
- Electronic Warfare (EW) systems
- Indoor local area networks
- Monitoring and surveillance systems

DESCRIPTION:

SAO series omnidirectional antennas are offered with either a coaxial or rectangular waveguide interface. Omnidirectional antennas provide a complete azimuth coverage of 360° with ±1.0 dB angular gain flatness. These omnidirectional antennas cover a bandwidth of 10% and up to full waveguide band with unnoticeable performance degradation towards the higher and lower ends of the frequency range. They are also constructed with precisely machined housings and a protective radome to ensure a rugged mechanical configuration.

The below standard offering covers the frequency range of 23 to 100 GHz, but custom frequencies can be requested. The listed models are only offered with a waveguide interface. While most models offer a fixed vertical beamwidth of 30° typical, custom models with a vertical beamwidth from 10 to 30° are also available. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range	Vertical Beamwidth	Gain	VSWR	Note
K	SAO-2332530330-42-S1	23.0 to 25.0 GHz	30°	3.0 dB	2:1	Coax Connector Interface Available
Ka	SAO-2734030810-28-S1	26.5 to 40.0 GHz	10°	8.0 dB	2:1	Coax Connector Interface Available
Ka	SAO-3034030330-28-S1	30.0 to 40.0 GHz	30°	3.0 dB	2:1	Coax Connector Interface Available
Q	SAO-3834630330-22-S1	38.0 to 46.0 GHz	30°	2.5 dB	2:1	Coax Connector Interface Available
U	SAO-4034430330-19-S1	40.0 to 44.0 GHz	30°	2.5 dB	2:1	Coax Connector Interface Available
V	SAO-5836230230-15-S1	58.0 to 62.0 GHz	30°	2.0 dB	2:1	Coax Connector Interface Available
E	SAO-7138630230-12-S1	71.0 to 86.0 GHz	30°	2.0 dB	2:1	Coax Connector Interface Available
W	SAO-9031040230-10-S1	90.0 to 100.0 GHz	30°	2.0 dB	2:1	Coax Connector Interface Available

CUSTOM MODELS:

SAGE Millimeter's omnidirectional antenna model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAO - F1N F2N GG BW - CO - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 5 dB = 05
BW is the 3 dB beamwidth in degrees. For example: 18 degrees = 18
CO is the input connector type.
X is for antenna type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SAO-2833030610-28-S1 is an omnidirectional antenna with a frequency range of 28 to 30 GHz, a gain of 6 dB and a 3 dB vertical beamwidth of 10 degrees. The antenna has a WR-28 waveguide at the input port and a standard package and finish. "1" is a factory assigned number.

Cassegrain Antennas, SAY Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Rugged configuration and low profile
- Low loss and high gain
- Low VSWR

APPLICATIONS:

- Communication systems
- Radar systems
- EW systems

DESCRIPTION:

SAY series Cassegrain antennas are offered with a 6", 12", 18", 24", 36" and 48" diameter main reflector dish. These antennas are designed and manufactured with the highest performance and quality. The main advantages of the Cassegrain antenna are its low loss, low profile and light weight compared to other high gain antennas, such as prime focus and lens corrected antennas. As a downside, this antenna has relatively high side lobe levels compared to other antennas due to the interference of the sub-reflector's supporting structure. To ensure good performance, the supporting structures are specially designed to keep side lobe levels under 18 dB for narrow band operations and under 16 dB for broadband operation.

The standard offering covers the frequency range of 18 to 110 GHz, but custom frequencies can be requested. The operating bandwidth of these antennas is mainly limited by the circular waveguide's dominant mode operation. While standard models are equipped with a circular waveguide interface, a rectangular waveguide interface is also available. Check the website for detailed models.

ELECTRICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 110.0 GHz	Other frequency ranges are available upon request.
Interface	Circular or Rectangular	Specify when ordering.
Main Reflector Diameter	6", 12", 18", 24", 36" and 48"	Other diameters are available upon request.
3 dB Beamwidth	0.3 to 8.0 Degrees	Related to the dish diameter.
Antenna Gain Range	25 to 50 dB	Related to the operation frequency and dish diameter.
Operating Bandwidth	Up to Full Circular Waveguide Bandwidth	Performance degradation is expected for broadband operation.
Side Lobe Level	16 dB	Related to the diameter and feed structure.
Return Loss (Typical)	20 dB	Dependent on the operating bandwidth.

MODEL NUMBERS:

SAGE Millimeter's Cassegrain antenna model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAY - F1N F2N GG BW - DDD - XY OR SAY - F1N F2N GG BW - WG - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 30.0 GHz = 303
GG is the linear gain in dB. For example: 40 dB = 40
BW is the 3 dB beamwidth in 1/10 degrees. For example: 0.7 degree = 07
DDD is the diameter of the input connector, in mils, for circular waveguides or **WG** is the waveguide size for rectangular waveguides.
X is the antenna type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SAY-3433634020-28-C1 is a custom Cassegrain antenna with a frequency range of 34 to 36 GHz, a gain of 40 dB and a 3 dB beamwidth of 2 degrees. The antenna has a WR-28 waveguide at the input port. "1" is a factory assigned number.

Microstrip Patch Array Antennas, SAM Series

A

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Coaxial and rectangular WG interfaces
- Compact size and center fed
- Various beamwidth and low side lobe levels
- Low cost with volume

APPLICATIONS:

- Communication systems
- Radar systems
- Sensor heads

A

DESCRIPTION:

SAM series microstrip patch array antennas are offered with either a coaxial interface that can support linear and circular polarization or a rectangular waveguide interface that can support linear polarization. These antennas are constructed with high performing, low loss soft microwave substrates. Various power distributions, such as corporate-fed or series-fed, are implemented to achieve the best aperture efficiency and antenna performance. These patch array antennas offer high gain and low side lobes. While weather resistant designs that incorporate a radome are available, the standard microstrip patch arrays are offered without a radome to allow users to integrate them into their own enclosures. Check the website for models and details.

ELECTRICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 110.0 GHz	Other frequency ranges are available upon request.
Interface	Coax or Rectangular	Specify when ordering.
Number of Elements, Horizontal	4 to 16	Determines beamwidth.
Number of Elements, Vertical	4 to 16	Determines beamwidth.
Operating Bandwidth (Typical)	2% of the Center Operation Frequency	Most microstrip patch array antennas can operate at a wider bandwidth with minor performance degradation.
3 dB Beamwidth, Horizontal	4 to 30 Degrees	Related to the number of elements.
3 dB Beamwidth, Vertical	4 to 30 Degrees	Related to the number of elements.
Antenna Gain Range	14 to 30 dB	Related to the number of elements.
Side Lobe Level (Typical)	20 dB	Related to the number of elements and feed structure.
Cross Polarization (Typical)	20 dB	Related to the feed structure.
Return Loss (Typical)	15 dB	Dependent on the operating bandwidth.

MODEL NUMBERS:

SAGE Millimeter's microstrip patch array antenna model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAM - F1N F2N GG BW - CO - XY OR SAM - F1N F2N GG BW - WG - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
BW is the 3 dB beamwidth in degrees. For example: 12 degrees = 12
CO is the input coaxial connector type or **WG** is the waveguide size for rectangular waveguides.
X is the polarization type. "L" is for linear polarized and "C" is for circular polarized.
Y is for factory reserve.

Example: SAM-3433632012-28-L1 is a linear polarized microstrip patch array antenna with a frequency range of 34 to 36 GHz, a gain of 20 dB and a 3 dB beamwidth of 12 degrees. The antenna has a WR-28 waveguide at the input port.. "1" is a factory assigned number.

Linear to Circular Polarizers, SAS Series

A

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Circular waveguide interface
- Low insertion loss and good axial ratio
- Fixed and switchable options

APPLICATIONS:

- Antenna ranges
- Waveform polarization selection
- Radar systems

DESCRIPTION:

SAS series linear to circular polarizers are offered as either fixed or switchable with a circular waveguide interface. The fixed polarizers are used to convert a linearly polarized waveform into a circularly polarized waveform or vice versa. The direction of the circularly polarized waveform (left-handed or right-handed) is dependent on the orientation of the input signal. The switchable polarizers can be manually switched to convert a linearly polarized waveform into a circularly polarized waveform or to allow the signal through without changing the polarization of the input waveform.

When used with circular to rectangular waveguide mode transitions (SWT series) and orthomode transducers (SAT series), these polarizers can enhance the application of various antennas. The standard offering covers the frequency range of 18 to 110 GHz, and the typical bandwidth of the polarizers is 15% of the full waveguide band with a 1.0 dB axial ratio degradation. Models with a broader bandwidth, up to the full waveguide band, are available as custom designs. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Center Frequency	Bandwidth	Insertion Loss	Axial Ratio	VSWR	Waveguide Flange
K	SAS-243-39642-F1	24.0 GHz	±1.8 GHz	0.25 dB	1.0 dB	1.3:1	UG-595/U Square
Ka	SAS-353-25028-F1	35.0 GHz	±2.6 GHz	0.30 dB	1.0 dB	1.3:1	UG-599/U Square
Q	SAS-403-21922-F1	40.0 GHz	±3.0 GHz	0.40 dB	1.0 dB	1.3:1	UG-383/U Round
U	SAS-443-18819-F1	44.0 GHz	±3.3 GHz	0.40 dB	1.0 dB	1.3:1	UG-383/U-M Round
V	SAS-603-14115-F1	60.0 GHz	±4.5 GHz	0.50 dB	1.0 dB	1.3:1	UG-385/U Round
E	SAS-773-12512-F1	77.0 GHz	±5.5 GHz	0.55 dB	1.0 dB	1.3:1	UG-387/U Round
W	SAS-943-09410-F1	94.0 GHz	±7.0 GHz	0.60 dB	1.0 dB	1.3:1	UG-387/U-M Round

Note: The electrical performance of the switchable polarizers is similar to the fixed models. However, the model number would be SAS-243-39642-S1 instead of SAS-243-39642-F1.

CUSTOM MODELS:

SAGE Millimeter's linear to circular polarizer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAS - F0N - DDD WG - XY

F0N is the center frequency in MHz x 10N. For example: 26.0 GHz = 263
DDD is the diameter of the circular waveguide in mils.
WG is the waveguide band designator.
X is the polarizer type. “F” is for fixed and “S” is for switchable.
Y is for factory reserve.

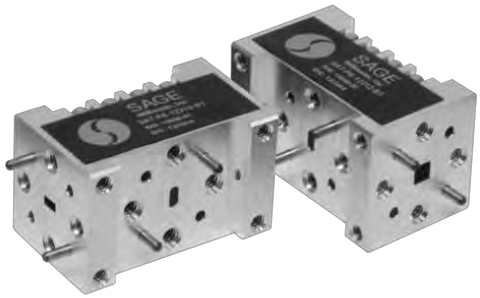
Example: SAS-383-21922-S1 is a switchable polarizer with a center frequency of 38 GHz. The polarizer has a 0.219” diameter circular waveguide and the waveguide band designator is WR-22. “1” is a factory assigned number.

Orthomode Transducers, SAT Series

A

FEATURES:

- Frequency coverage: 8.2 to 140 GHz
- High isolation
- Low insertion loss
- Up to full waveguide bandwidth



APPLICATIONS:

- Waveform polarization separation and combination
- Antenna ranges
- Radar systems

DESCRIPTION:

SAT series orthomode transducers, or OMTs, are used to either separate a waveform that is input through the circular waveguide into two orthogonal waveforms or to combine two orthogonal waveforms into one waveform at the circular waveguide output. Orthomode transducers can support circular, elliptical and linear polarized waveforms.

By adding a compact square to circular waveguide mode transition to the A-port (antenna-port), these orthomode transducers can be utilized for applications requiring a circular waveguide interface. The standard offering covers the frequency range of 8.2 to 140 GHz and features rectangular waveguides at the H- and V-port and a square or circular waveguide at the A-port (antenna port). While full waveguide band models are available for X through W band, narrow band models with enhanced cross polarization and port isolation are offered as custom models. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range	Insertion Loss	Cross Polarization	Isolation	VSWR	V/H-port Waveguide
X	SAT-FX-90090-S1	8.2 to 12.4 GHz	0.30 dB	35 dB	30 dB	1.3:1	WR-90
Ku	SAT-KU-62262-S1	12.0 to 18.0 GHz	0.40 dB	30 dB	30 dB	1.3:1	WR-62
K	SAT-FK-42042-S1	18.0 to 26.5 GHz	0.50 dB	35 dB	40 dB	1.3:1	WR-42
N/A	SAT-F3-34034-S1	22.0 to 33.0 GHz	0.50 dB	35 dB	40 dB	1.3:1	WR-34
Ka	SAT-FA-28028-S1	26.5 to 40.0 GHz	0.60 dB	35 dB	40 dB	1.4:1	WR-28
Q	SAT-FQ-22422-S1	33.0 to 50.0 GHz	0.70 dB	35 dB	40 dB	1.3:1	WR-22
U	SAT-FU-18819-S1	40.0 to 60.0 GHz	0.80 dB	35 dB	40 dB	1.3:1	WR-19
V	SAT-FV-14115-S1	50.0 to 75.0 GHz	0.90 dB	35 dB	40 dB	1.3:1	WR-15
E	SAT-FE-12212-S1	60.0 to 90.0 GHz	1.00 dB	35 dB	40 dB	1.3:1	WR-12
W	SAT-FW-10010-S1	75.0 to 110.0 GHz	1.20 dB	35 dB	40 dB	1.3:1	WR-10
F	SAT-114-07508-S1	110.0 to 118.0 GHz	1.50 dB	25 dB	35 dB	1.3:1	WR-08

Note: Full band models are equipped with a square waveguide at the A-port, and narrow band models are equipped with a circular waveguide.

CUSTOM MODELS:

SAGE Millimeter's orthomode transducer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAT - F0N - DDD WG - XY OR SAT - FB - DDD WG - XY

F0N is the center frequency in MHz x 10N. For example: 26.0 GHz = 263 or **FB** is the waveguide band designator for full band operation.
DDD is the diameter of the circular waveguide or the dimensions of the square waveguide at the antenna port in mils.
WG is the waveguide band designator for the V- and H-port.
X is the V-port configuration type. “T” is with a rectangular to circular waveguide transition and “S” is without a transition.
Y is for factory reserve.

Example: SAT-383-21922-S1 is an orthomode transducer with a center frequency of 38 GHz. The orthomode transducer has a 0.219” diameter circular waveguide, and the waveguide band designator for the V- and H-port is WR-22. 1” is a factory assigned number.

Dual Polarized Horn Antennas, SAR-DP Series

FEATURES:

- Frequency coverage: 8.2 to 110 GHz
- Rectangular waveguide interface
- Full waveguide band coverage
- High port isolation
- High cross-pol rejection
- Low VSWR

APPLICATIONS:

- Antenna ranges
- Waveform polarization separation and combination
- Rapid system setups

A

DESCRIPTION:

SAR-DP series dual polarized horn antennas are offered as both standard and custom models with rectangular waveguide interfaces for both horizontal and vertical ports. These dual polarized horn antennas support both linear and elliptical polarized waveforms. When the antenna receives a circular polarized waveform, equal amplitude linear polarized waveforms are output at both horizontal and vertical ports. When two equal amplitude linear polarized waveforms are input into the vertical and horizontal ports, the antenna will transmit a circular polarized waveform.

The listed models offer 15 dB nominal gain and 33/28 degrees typical half power beamwidth at the center frequency of the band. They also exhibit 40 dB typical port isolation and 35 dB nominal cross polarization. These antennas cover full waveguide bandwidths within the frequency range of 8.2 to 110 GHz. In addition to the models listed below, models with 10, 20, 23 and 25 dB gain and other frequency bands are also available. Check the website for details and models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Gain (dB)	3 dB Beamwidth (°)	Port Isolation (dB)	VSWR	Outline
X	SAR-8221231530-90-S1-DP	8.2 to 12.4	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-X15-DP
Ku	SAR-1231831530-62-S1-DP	12.4 to 18.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-615-DP
K	SAR-1832731530-42-S1-DP	18.0 to 26.5	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-K15-DP
N/A	SAR-2233331530-34-S1-DP	22.0 to 33.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-315-DP
Ka	SAR-2734031530-28-S1-DP	26.5 to 40.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-A15-DP
Q	SAR-3335031530-22-S1-DP	33.0 to 50.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-Q15-DP
U	SAR-4036031530-19-S1-DP	40.0 to 60.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-U15-DP
V	SAR-5037531530-15-S1-DP	50.0 to 75.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-V15-DP
E	SAR-6039031530-12-S1-DP	60.0 to 90.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-E15-DP
W	SAR-7531141530-10-S1-DP	75.0 to 110.0	15	33.0/28.0 (E/H)	40 dB	1.4:1	AR-W15-DP

CUSTOM MODELS:

SAGE Millimeter's dual polarized horn antenna model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SAR - F1N F2N GG BW - WG - XY - DP

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
BW is for internal reference.
WG is the rectangular waveguide size of the vertical and horizontal ports. For example: WR-15 = 15
X is the antenna type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.
DP is for dual polarized.

Example: SAR-5037531725-15-S1-DP is a dual polarized horn antenna with a frequency range of 50 to 75 GHz, a nominal gain of 17 dB and a 3 dB beamwidth of 25 degrees. The antenna has a WR-15 waveguide at the input port and a standard package and finish. "1" is a factory assigned number.

Antenna Application Notes

A

Antennas are a key device in any microwave and millimeterwave system. They are designed to increase the quality of transmitting and receiving radio wave signals. The following are concepts, terms and definitions related to the antennas offered by SAGE Millimeter, which are widely used and accepted in the industry.

A

Antenna Boresight:

An **antenna boresight**, which is also referred to as an electrical boresight, is the optical axis or the direction of maximum gain of a directional antenna.

Antenna Pattern (Radiation Pattern):

An **antenna pattern**, which is also referred to as a radiation pattern, is the antenna's desired performance as a function of the azimuth and elevation directions. It is an angular graphic display of the radiation properties or a field distribution of the antenna and is plotted with either Cartesian or polar coordinates.

Aperture Antenna:

An **aperture antenna** features an opening in a surface that is designed to radiate. Most microwave and millimeterwave antennas are aperture antennas. Examples of aperture antennas are slot antennas, horn antennas, lens antennas, array antennas and reflector antennas.

Aperture Efficiency:

Aperture efficiency is the ratio of the effective radiating area of an antenna to its physical aperture area. Several elements of the antenna can affect its aperture efficiency. In a feed-and-reflector combination antenna, 5 separate components, 1) the illumination efficiency, 2) the spillover, 3) the phase efficiency, 4) the cross-polar efficiency and 5) the surface error efficiency, contribute to the aperture efficiency.

Array Antenna:

An **array antenna** is an antenna that is comprised of multiple radiation elements, which are configured and connected to produce a directional radiation pattern.

Axial Ratio:

Axial ratio is a measure of the circularly polarized field of an antenna or the ratio of two orthogonal components of an E-field. A perfectly circularly polarized antenna has an axial ratio of 1 or 0 dB.

Front to Back Ratio:

Front to back ratio refers to the ratio of directivity of an antenna to its rear directive gain.

Beamwidth:

Beamwidth refers to the width of the antenna's main lobe. The terms "3 dB beamwidth" and "half power beamwidth" are often used to define an antenna's main lobe beamwidth and are often simply referred to as "beamwidth" for short.

Cross Polarization:

Cross polarization is the radiation orthogonal to the desired polarization.

Directive Gain:

Directive gain, which is also referred to as antenna gain, is directly related to the antenna's directivity and efficiency. It is the ratio of the radiation intensity in one intended direction to the total power input into the antenna and is measured in dB.

E-Plane and H-Plane:

E-Plane is any plane that contains the electrical field and the direction of maximum radiation from a linearly polarized antenna. **H-Plane** is any plane that contains the magnetic field and the direction of maximum radiation from a linearly polarized antenna.

Far Field and Near Field:

Far field is the point where the angular field distribution or the antenna pattern is independent of the distance from the antenna. On the other hand, **near field** is the point where the angular field distribution or the antenna pattern is dependent on the distance from the antenna.

Side Lobes and Side Lobe Level:

Side lobes are radiation lobes that occur in addition to the main lobe. The **side lobe level** is the relative power level of any side lobe carrying to its main lobe and is measured in dBc.

Broadband General Purpose Amplifiers, SBB Series

FEATURES:

- Frequency coverage: 0.01 to 110 GHz
- High output power
- Superior gain flatness
- Single positive DC power supply

APPLICATIONS:

- Engineering prototypes
- EW systems
- Test instrumentation
- Power boosters

B

DESCRIPTION:

SBB series broadband, general purpose amplifiers are designed and manufactured by utilizing the most advanced PHEMT or MMIC devices, thin film technologies, and an improved DC power supply to deliver a high power output, superior gain flatness and low noise performance. While standard models focus on general purpose applications, additional models with differing frequency ranges, gains and power levels are listed on the website. Custom designs are also offered to meet any user's specific needs.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Gain (dB)	Gain Flat-ness (±dB)	P_{1dB} (dBm)	VSWR (Typ)	Power Supply (V/mA)	Outlines
SBB-0521832018-KFKF-S1	0.5 to 18.0	20	3.0	18	2.5:1	+8.0/450	BG-SC-1
SBB-0524034210-KFKF-S1	0.5 to 40.0	42	5.0	10	2.0:1	+8.0/550	BB-SA-3
SBB-0524032010-KFKF-S1	0.5 to 40.0	20	5.0	10	2.0:1	+8.0/200	BG-SC-1
SBB-0524032515-KFKF-S1	0.5 to 40.0	25	5.0	15	2.0:1	+8.0/350	BG-SC-1
SBB-0115034020-2F2F-D1	0.01 to 50.0	40	2.5	20	2.8:1	+12.0/550	BB-DC-1
SBB-0631833514-KFKF-S1	6.0 to 18.0	35	3.0	14	2.5:1	+4.0/300	BG-SC-1
SBB-1834033218-KFKF-D1	18.0 to 40.0	32	2.0	18	2.0:1	+12.0/500	BB-DC-1
SBB-1834033627-KFKF-D1-H	18.0 to 40.0	36	4.5	27	2.3:1	+10.0/900	BB-DC-2-H
SBB-2034531820-2F2F-S1	20.0 to 45.0	18	3.0	20	2.0:1	+8.0/250	BG-SC-1
SBB-2034533520-2F2F-S1	20.0 to 45.0	35	3.0	20	2.0:1	+8.0/450	BG-SC-1
SBB-3636531818-VFVF-S1	36.0 to 65.0	18	3.0	18	2.0:1	+8.0/350	BG-SC-1
SBB-3636833518-VFVF-S1	36.0 to 68.0	35	3.0	18	2.0:1	+8.0/650	BG-SC-1
SBB-5038032010-1515-E1	50.0 to 80.0	20	3.0	10	2.5:1	+8.0/150	BG-SV-2
SBB-7031142513-1010-E1	70.0 to 110.0	25	3.0	13	3.0:1	+15.0/300	BG-SW-2

CUSTOM MODELS:

SAGE Millimeter's broadband general purpose amplifiers model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SBB - F1N F2N GG PP - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
PP is the output P_{1dB} in dBm. For example: 20 dBm = 20
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: WR-28 = 28
X is the configuration type. "S" is standard for coax and right angle for WG, "E" is end launch (in-line) for WG and "C" is a custom design.
Y is for factory reserve.

Example: SBB-2035034020-2F2F-S1 is a broadband amplifier with a frequency range of 20 to 50 GHz, a linear gain of 40 dB and P_{1dB} of 20 dBm. The broadband amplifier has female 2.4 mm connectors for the input and output RF port and a standard coax configuration. "1" is a factory assigned number.

Low Noise Amplifiers, SBL Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Low noise figure
- Broad operating bandwidth
- Single positive DC power supply

APPLICATIONS:

- Engineering prototypes
- Low noise receivers
- Communication systems
- Radiometry systems
- Radar systems

DESCRIPTION:

SBL series low noise amplifiers, or LNAs, are designed and manufactured by utilizing the most advanced PHEMT or MMIC devices, thin film technologies, and an improved DC power supply to deliver a low noise performance with broad operating bandwidths and good gain flatness. While standard models focus on general purpose applications, additional models with differing frequency ranges, gains and noise figures are listed on the website. Custom designs are also offered to meet any user's specific needs.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Gain (dB)	Noise Figure (dB)	VSWR (Typ)	Bias (V_{DC}/mA)	Max P_{in} (dBm)	Outlines
SBL-1832732025-KFKF-S1	18.0 to 26.5	20	2.5	2.0:1	+8.0/130	+10	BG-SC-1
SBL-1832733025-KFKF-S1	18.0 to 26.5	30	2.5	2.0:1	+8.0/200	-15	BG-SC-1
SBL-1832734825-KFKF-S1	18.0 to 26.5	48	2.5	2.0:1	+8.0/350	-15	BG-SC-1
SBL-2634032030-KFKF-S1	26.5 to 40.0	20	3.0	2.0:1	+8.0/120	+5	BG-SC-1
SBL-2634033030-KFKF-S1	26.5 to 40.0	30	3.0	2.0:1	+8.0/150	-15	BG-SC-1
SBL-3335032565-2222-S1	33.0 to 50.0	25	6.5	3.0:1	+8.0/350	-17	BG-SQ-1
SBL-4036033080-1919-S1	40.0 to 60.0	30	8.0	3.0:1	+8.0/450	-10	BG-SU-1
SBL-5037533550-1515-S1	50.0 to 75.0	35	5.0	2.5:1	+8.0/150	-20	BG-SV-1
SBL-6039032550-1212-S1	60.0 to 90.0	25	5.0	3.5:1	+8.0/30	-24	BG-SE-1
SBL-7138632040-1212-E1	71.0 to 86.0	20	4.0	3.5:1	+8.0/30	-17	BG-SE-2
SBL-8031042540-1010-E1	80.0 to 100.0	25	4.0	3.5:1	+8.0/30	-23	BG-SW-2
SBL-7531142040-1010-E1	75.0 to 110.0	20	4.0	3.0:1	+8.0/30	-23	BG-SW-2

CUSTOM MODELS:

SAGE Millimeter's low noise amplifier model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SBL - F1N F2N GG NF - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
NF is the noise figure in dB. For example: 3.0 dB = 30
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: WR-28 = 28
X is the configuration type. "S" is standard for coax and right angle for WG, "E" is end launch (in-line) for WG and "C" is a custom design.
Y is for factory reserve.

Example: SBL-7531143060-1010-S1 is a low noise amplifier with a frequency range of 75 to 110 GHz, a linear gain of 30 dB and a noise figure of 6.0 dB. The low noise amplifier has WR-10 waveguides for the input and output RF connectors and a right angle configuration. "1" is a factory assigned number.

Power Amplifiers, SBP Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- High output power and P_{1dB}
- High power added efficiency
- Single positive DC power supply

APPLICATIONS:

- Engineering prototypes
- Radar systems
- Communication systems
- Test instrumentation
- Power boosters

B

DESCRIPTION:

SBP series power amplifiers are designed and manufactured by utilizing the most advanced PHEMT or MMIC devices, thin film technologies, and an improved DC power supply to deliver a high output power with superior power added efficiency (PAE) and high linearity. While standard models focus on general purpose applications, additional models with differing frequency ranges, gains and power levels are listed on the website. Custom designs are also offered to meet any user's specific needs.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Gain (dB)	P_{1dB} (dBm)	VSWR (Typ)	Bias (V_{DC}/mA)	Max P_{in} (dBm)	Outlines
SBP-1834033020-KFKF-S1	18.0 to 40.0	30	+20	2.0:1	+8.0/280	+8	BG-SC-1
SBP-1832733028-KFKF-S1	18.0 to 26.5	30	+28	2.5:1	+8.0/800	-2	BG-SC-1
SBP-2734033020-KFKF-S1	26.5 to 40.0	30	+20	2.0:1	+8.0/280	+5	BG-SC-1
SBP-3333734030-2828-S1	33.0 to 37.0	40	+30	3.0:1	+8.0/1,300	+18	BG-SA-1
SBP-3334033525-KF22-S1	33.0 to 40.0	35	+25	2.0:1	+8.0/650	+20	FA-SQ-1
SBP-3335033018-2F2F-S1	33.0 to 50.0	30	+18	2.0:1	+8.0/640	-1	BG-SC-1
SBP-4034833529-2F2F-S1	40.0 to 48.0	35	+29	2.5:1	+8.0/2,500	+5	BG-SC-1
SBP-4334633029-2F2F-S1	43.0 to 46.0	30	+29	2.0:1	+8.0/2,500	+5	BG-SC-1
SBP-5037032815-1515-S1	50.0 to 70.0	28	+15	1.5:1	+8.0/420	-10	BG-SV-1
SBP-5536533022-1515-E1	55.0 to 65.0	30	+22	2.0:1	+8.0/800	-5	BG-SV-2
SBP-7137633223-1212-E1	71.0 to 76.0	32	+23	2.0:1	+8.0/1,000	-5	BG-SE-2
SBP-7638131610-1212-E1	76.0 to 81.0	16	+10	3.0:1	+8.0/150	-2	BG-SE-2
SBP-8138632520-1212-S1	81.0 to 86.0	25	+20	2.0:1	+8.0/1,000	-5	BG-SE-1
SBP-9239633516-1010-S1	92.0 to 96.0	35	+16	3.0:1	+8.0/250	-14	BG-SW-1
SBP-9239633020-1010-E1	92.0 to 96.0	30	+20	3.0:1	+8.0/650	-7	BG-SW-2

CUSTOM MODELS:

SAGE Millimeter's power amplifier model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SBP - F1N F2N GG PP - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 60 GHz = 603
F2N is the stop frequency in MHz x 10N. For example: 65 GHz = 653
GG is the linear gain in dB. For example: 25 dB = 25
PP is the output P_{1dB} in dBm. For example: 20 dBm = 20
CI is the input connector type. For example: V(F) = VF
CO is the output connector type. For example: WR-15 = 15
X is the configuration type. "S" is standard for coax and right angle for WG, "E" is end launch (in-line) for WG and "C" is a custom design.
Y is for factory reserve.

Example: SBP-8531043015-1010-E1 is a power amplifier with a frequency range of 85 to 100 GHz, a linear gain of 30 dB and P_{1dB} of 15 dBm. The power amplifier has WR-10 waveguides for the input and output RF connectors and an end launch configuration. "1" is a factory assigned number.

Amplifier Application Notes

Microwave and millimeterwave amplifiers are key components in radar, communication and test systems. They are mainly offered as low noise amplifiers, gain block or general purpose amplifiers and power amplifiers. The following are concepts, terms and definitions that are widely used and accepted in the industry.

Class A:

Most microwave and millimeterwave amplifiers are **Class A** amplifiers. Class A amplifiers have a fixed forward bias. When Class A amplifiers operate below the compression point, the RF signal swing is uniformly above and below the quiescent DC bias set point and well within the linear region of the transistor. Therefore, Class A amplifiers have high linearity and low efficiency.

Class C:

Class C amplifiers are not DC forward biased. The current of the drain flows over less than 50% of the RF input cycle. Class C amplifiers have a very limited dynamic range and poor linearity. However, they have high efficiency and are widely used in extremely high power applications.

Gain:

Gain is the ratio of the output power to input power. When using G=10log(G), gain is measured in decibels. **Small signal gain** is the gain in the linear region of an amplifier's operation, often simply referred to as "gain" in the microwave and millimeterwave industry for simplicity.

Gain Flatness:

Gain flatness is the gain variation over a defined frequency range at a fixed temperature, often specified as ±x.x dB.

Harmonic Distortion:

Harmonic distortion is the presence of harmonics that change the voltage waveform from a simple sinusoidal to complex waveform. Harmonic distortion is mainly caused by non-linear device operation or feedback in the amplifier circuits. It is generally given as the relative value of harmonic components to its fundamental power level and often specified as –xx dBc.

Intercept Point:

The **intercept point (IP)** is an imaginary point where the slopes of the fundamental, 2nd order intermodulation (IMD) and 3rd order IMD meet. The IP is used to quantify the linearity of power amplifiers. The 3rd order distortion, i.e. the third order intercept (IP3), is widely used to quantify the linearity of microwave and millimeterwave amplifiers.

Noise Figure:

Noise figure is defined as: NF = ((So/No) Signal To Noise Ratio at Output) / ((Si/Ni) Signal To Noise Ratio at Input). When using NF=10log (NF), noise figure is measured in decibels. Noise figure indicates how much the signal is "contaminated" throughout a component or system.

P_{1dB}:

P_{1dB} is defined as the output power level of an amplifier when it loses tracking with the input power increase by 1 dB. As a rule of thumb, the IP3 should be 8 to 12 dB higher than the P_{1dB} for carefully designed and fabricated microwave and millimeterwave linear power amplifiers.

Power Added Efficiency:

Power-added efficiency (PAE) is used to rate the efficiency of a power amplifier. It is defined as: $PAE = 100*\{[P_{OUT}]_{RF} - [P_{IN}]_{RF}\} / [P_{DC}]$
It differs from power efficiency, which is defined as: $\eta = 100*[P_{OUT}]_{RF} / [P_{IN}]_{DC}$. However, PAE is very similar to power efficiency when the gain of a power amplifier is sufficiently high.

Return Loss and VSWR:

Return loss (RL) is the ratio of reflected power to incident power at the amplifier's input and output ports and widely used in the industry to define the degree of a device's port mismatch. Return loss is measured in decibels. The higher the return loss value, the better the port matching.

VSWR stands for Voltage Standing Wave Ratio, which is another way to characterize port mismatch. The relationship between VSWR and return loss is RL = -20*Log[(VSWR-1)/(VSWR+1)] dB.

Temperature Characteristics:

Gain Stability is the gain variation versus temperature, often specified as ±x.xx dB/˚C.
Power Stability is the output power variation versus temperature, often specified as ±x.xx dBm/˚C.

Unconditionally Stable:

An **unconditionally stable** amplifier refers to an amplifier that has no signal output when an input signal is absent regardless of the load, source impedance and operating temperature. As a contrast, conditionally stable amplifiers may oscillate under certain conditions.

Coaxial Adapters, SCT Series

FEATURES:

- Frequency coverage: DC to 110 GHz
- Various connector types
- Low insertion loss
- Rugged construction

APPLICATIONS:

- Test labs
- Instrumentation
- System integration

C

DESCRIPTION:

SCT series coaxial adapters are constructed with either passivated stainless steel or gold plated beryllium copper for durable use in both engineering labs and production line environments. These coaxial adapters are designed and manufactured for low VSWR and low insertion loss. The standard offering covers the frequency range from DC to 110 GHz and includes various interface options from 2.92 mm (K) to 1 mm connector types and male and female interfaces. Coaxial adapters with connector types other than those listed can also available. Visit the website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Descriptions	Insertion Loss (dB)	VSWR (Typ)
SCT-KFKF-S1	DC to 40.0	K(F) to K(F) Adapter	0.30	1.20:1
SCT-KFKM-S1	DC to 40.0	K(F) to K(M) Adapter	0.30	1.20:1
SCT-KMKM-S1	DC to 40.0	K(M) to K(M) Adapter	0.30	1.20:1
SCT-KF2F-S1	DC to 40.0	K(F) to 2.4 mm (F) Adapter	0.35	1.20:1
SCT-KF2M-S1	DC to 40.0	K(F) to 2.4 mm (M) Adapter	0.35	1.20:1
SCT-KM2F-S1	DC to 40.0	K(M) to 2.4 mm (F) Adapter	0.35	1.20:1
SCT-KM2M-S1	DC to 40.0	K(M) to 2.4 mm (M) Adapter	0.35	1.20:1
SCT-2F2F-S1	DC to 50.0	2.4 mm (F) to 2.4 mm (F) Adapter	0.35	1.25:1
SCT-2F2M-S1	DC to 50.0	2.4 mm (F) to 2.4 mm (M) Adapter	0.35	1.25:1
SCT-2M2M-S1	DC to 50.0	2.4 mm (M) to 2.4 mm (M) Adapter	0.35	1.25:1
SCT-2FVF-S1	DC to 50.0	2.4 mm (F) to V(F) Adapter	0.40	1.30:1
SCT-2FVM-S1	DC to 50.0	2.4 mm (F) to V(M) Adapter	0.40	1.30:1
SCT-2MVF-S1	DC to 50.0	2.4 mm (M) to V(F) Adapter	0.40	1.30:1
SCT-2MVM-S1	DC to 50.0	2.4 mm (M) to V(M) Adapter	0.40	1.30:1
SCT-VFVF-S1	DC to 67.0	V(F) to V(F) Adapter	0.40	1.30:1
SCT-VFVM-S1	DC to 67.0	V(F) to V(M) Adapter	0.40	1.30:1
SCT-VMVM-S1	DC to 67.0	V(M) to V(M) Adapter	0.40	1.30:1
SCT-VF1F-S1	DC to 67.0	V (F) to 1 mm (F) Adapter	1.00	1.30:1
SCT-VF1M-S1	DC to 67.0	V (F) to 1 mm (M) Adapter	1.00	1.30:1
SCT-VM1F-S1	DC to 67.0	V (M) to 1 mm (F) Adapter	1.00	1.30:1
SCT-VM1M-S1	DC to 67.0	V (M) to 1 mm (M) Adapter	1.00	1.30:1
SCT-1F1F-S1	DC to 110.0	1 mm (F) to 1 mm (F) Adapter	0.60	1.40:1
SCT-1F1M-S1	DC to 110.0	1 mm (F) to 1 mm (M) Adapter	0.60	1.40:1
SCT-1M1M-S1	DC to 110.0	1 mm (M) to 1 mm (M) Adapter	0.60	1.40:1

Coaxial Attenuators, SCA Series

FEATURES:

- Frequency coverage: DC to 110 GHz
- Various attenuation values
- Low insertion loss
- Rugged stainless steel construction

APPLICATIONS:

- Test labs
- Instrumentation
- System integration

C

C

DESCRIPTION:

SCA series coaxial attenuators are constructed with passivated stainless steel for durable use in both engineering labs and production line environments. These coaxial attenuators are designed and manufactured for low VSWR, low insertion loss and high attenuation value accuracy. The standard offering covers the frequency range of DC to 110 GHz and includes various interface options from 2.4 mm to 1 mm connector types as well as both male and female interfaces. The power handling of standard models is 0.5 to 1 watt continuous wave (CW). Higher power handling levels and different attenuation values and connector types from those listed below can also be requested. Visit the website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Attenuation (dB)	VSWR (Typ)	Power Handling (W), CW
SCA-03-2M2F-S1	DC to 50.0	3.0	1.70:1	1.0
SCA-06-2M2F-S1	DC to 50.0	6.0	1.70:1	1.0
SCA-10-2M2F-S1	DC to 50.0	10.0	1.70:1	1.0
SCA-20-2M2F-S1	DC to 50.0	20.0	1.70:1	1.0
SCA-30-2M2F-S1	DC to 50.0	30.0	1.70:1	1.0
SCA-03-VMVF-S1	DC to 67.0	3.0	1.60:1	1.0
SCA-06-VMVF-S1	DC to 67.0	6.0	1.60:1	1.0
SCA-10-VMVF-S1	DC to 67.0	10.0	1.60:1	1.0
SCA-20-VMVF-S1	DC to 67.0	20.0	1.60:1	1.0
SCA-30-VMVF-S1	DC to 67.0	30.0	1.60:1	1.0
SCA-03-1M1F-S1	DC to 110.0	3.0	2.00:1	0.5
SCA-06-1M1F-S1	DC to 110.0	6.0	2.00:1	0.5
SCA-10-1M1F-S1	DC to 110.0	10.0	2.00:1	0.5
SCA-20-1M1F-S1	DC to 110.0	20.0	2.00:1	0.5
SCA-30-1M1F-S1	DC to 110.0	30.0	2.00:1	0.5

CUSTOM MODELS:

SAGE Millimeter's coaxial attenuator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCA - AT - CI CO - XY

AT is the attenuation value in dB. For example: 06 dB = 06
CI is the input connector type. For example: 1 mm (F) = 1F
CO is the output connector type. For example: 1 mm (M) = 1M
X is the coaxial attenuator type. “S” is for standard and “C” is for custom.
Y is for factory reserve.

Example 1: SCA-06-VFVF-S1 is a standard, coaxial attenuator with a frequency range of DC to 67 GHz and an attenuation value of 6 dB. The coaxial attenuator has 1.85 mm (V) female connectors at the input and output. “1” is a factory assigned number.

Coaxial Matched Loads, SCM Series

FEATURES:

- Frequency coverage: DC to 67 GHz
- Various power handling
- Low VSWR
- Broad bandwidth

APPLICATIONS:

- Test labs
- Instrumentation
- System integration

C

DESCRIPTION:

SCM series coaxial matched loads are designed and manufactured for low VSWR and offer a moderate performance that is suitable for test instrumentation, system integration, and test lab applications. The below standard offering covers the frequency range of DC to 67 GHz and features various coaxial interfaces, such as SMA, K, and 2.4 mm connectors, to cover different frequency ranges. The below models have a CW power handling of 0.5 to 2 watt. Higher power ratings and a lower VSWR than the values listed are also available. Visit the website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Power Handling (dBm)	Connector Type	VSWR (Typical)
SCM-SF27-S1	DC to 18.0	27.0	SMA(F)	1.05 + 0.008 F (GHz)
SCM-SM27-S1	DC to 18.0	27.0	SMA(M)	1.05 + 0.008 F (GHz)
SCM-SF33-S1	DC to 18.0	33.0	SMA(F)	1.05 + 0.008 F (GHz)
SCM-SM33-S1	DC to 18.0	33.0	SMA(M)	1.05 + 0.008 F (GHz)
SCM-3F27-S1	DC to 26.5	27.0	3.5 mm (F)	1.12:1 (DC to 18 GHz) & 1.18:1 (18 to 26.5 GHz)
SCM-3M27-S1	DC to 26.5	27.0	3.5 mm (M)	1.12:1 (DC to 18 GHz) & 1.18:1 (18 to 26.5 GHz)
SCM-3F33-S1	DC to 26.5	33.0	3.5 mm (F)	1.12:1 (DC to 18 GHz) & 1.18:1 (18 to 26.5 GHz)
SCM-3M33-S1	DC to 26.5	33.0	3.5 mm (M)	1.12:1 (DC to 18 GHz) & 1.18:1 (18 to 26.5 GHz)
SCM-KF27-S1	DC to 40.0	27.0	K(F)	1.15:1 (DC to 26.5 GHz) & 1.20:1 (26.5 to 40.0 GHz)
SCM-KM27-S1	DC to 40.0	27.0	K(M)	1.15:1 (DC to 26.5 GHz) & 1.20:1 (26.5 to 40.0 GHz)
SCM-KF30-S1	DC to 40.0	30.0	K(F)	1.15:1 (DC to 26.5 GHz) & 1.20:1 (26.5 to 40.0 GHz)
SCM-KM30-S1	DC to 40.0	30.0	K(M)	1.15:1 (DC to 26.5 GHz) & 1.20:1 (26.5 to 40.0 GHz)
SCM-2F27-S1	DC to 50.0	27.0	2.4 mm (F)	1.18:1 (DC to 40.0 GHz) & 1.25:1 (40.0 to 50.0 GHz)
SCM-2M27-S1	DC to 50.0	27.0	2.4 mm (M)	1.18:1 (DC to 40.0 GHz) & 1.25:1 (40.0 to 50.0 GHz)
SCM-VF27-S1	DC to 67.0	27.0	V(F)	1.20:1 (DC to 50.0 GHz) & 1.30:1 (50.0 to 67.0 GHz)
SCM-VM27-S1	DC to 67.0	27.0	V(M)	1.20:1 (DC to 50.0 GHz) & 1.30:1 (50.0 to 67.0 GHz)

CUSTOM MODELS:

SAGE Millimeter's coaxial matched load model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCM - CO WW - XY

CO is the connector type. For example: SMA(M) = SM
WW is the power handling in dBm. For example: 1 Watt = 30 dBm = 30
X is the matched load type. "S" is standard and "C" is custom design.
Y is for factory reserve.

Example 1: SCM-SM37-S1 is a standard coaxial matched load with a 5 watt power handling capacity and male SMA connector. "1" is a factory assigned number.

Coaxial Power Splitters, SCS Series

FEATURES:

- Frequency coverage: 1 to 40 GHz
- Broad bandwidth
- Good amplitude balance
- Low VSWR

APPLICATIONS:

- Test labs
- Instrumentation
- System integration

DESCRIPTION:

SCS series coaxial power splitters, also known as power combiners, are in-phase power splitters with an accurate amplitude balance. The below standard offering covers the frequency range of 1 to 40 GHz and features 2-, 3-, 4-, and 8-way power splitters, which can be combined to achieve an even higher number of power splits. While standard models offer a broad bandwidth, higher performance narrowband models are also available as custom models. Visit the website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Number of Splits	Insertion Loss (dB)	Amplitude Balance (dB)	Isolation (dB)	VSWR	Power Handing (W)	Outline
SCS-0131831616-SFSF-21	1.0 to 18.0	2	1.6	±0.25	16	1.5:1	30.0	CS-62
SCS-0231831216-SFSF-21	2.0 to 18.0	2	1.2	±0.20	16	1.5:1	30.0	CS-62
SCS-0132732515-KFKF-21	1.0 to 27.0	2	2.5	±0.25	15	1.8:1	10.0	CS-K2
SCS-0134032810-KFKF-21	1.0 to 40.0	2	2.8	±0.30	10	1.9:1	10.0	CS-A2
SCS-0234032513-KFKF-21	2.0 to 40.0	2	2.5	±0.30	13	1.9:1	10.0	CS-A2
SCS-0434032013-KFKF-21	4.0 to 40.0	2	2.0	±0.50	13	1.9:1	10.0	CS-A2
SCS-1534031813-KFKF-21	15.0 to 40.0	2	1.8	±0.40	13	1.8:1	10.0	CS-A2
SCS-0131832716-SFSF-31	1.0 to 18.0	3	2.7	±0.40	16	1.6:1	30.0	CS-63
SCS-0231832218-SFSF-31	2.0 to 18.0	3	2.2	±0.20	18	1.6:1	30.0	CS-63
SCS-0521834015-SFSF-41	0.5 to 18.0	4	4.0	±0.40	15	1.7:1	30.0	CS-64
SCS-0131832715-SFSF-41	1.0 to 18.0	4	2.7	±0.40	15	1.7:1	30.0	CS-64
SCS-0532732015-KFKF-41	5.0 to 26.5	4	2.0	±0.25	15	1.6:1	10.0	CS-K4
SCS-1534032012-KFKF-41	15.0 to 40.0	4	2.0	±0.30	12	2.0:1	10.0	CS-A4
SCS-1034032512-KFKF-81	10.0 to 40.0	8	2.5	±0.40	12	2.0:1	10.0	CS-A8

CUSTOM MODELS:

SAGE Millimeter's coaxial power splitter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCS - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 18.0 GHz = 183
F2N is the stop frequency in MHz x 10N. For example: 40.0 GHz = 403
IL is the insertion loss in 1/10 dB. For example: 2.5 dB = 25
IS is the isolation in dB. For example: 20 dB = 20
CI is the input connector type and **CO** is the output connector type. For example: K(F) = KF
X is the number of power splitting. “2” is for 2-way, “3” is for 3-way, “4” is for 4-way, etc.
Y is for factory reserve.

Example: SCS-3333731820-KFKF-21 is a 2-way coaxial power splitter with a frequency range of 33 to 37 GHz, an insertion loss of 1.8 dB and a port isolation of 20 dB. The power splitter has female K connectors as the input and output port. “1” is a factory assigned number.

Coaxial Filters, SCF Series

FEATURES:

- Frequency coverage: 1.0 to 50 GHz
- Bandpass, highpass and lowpass types
- Low insertion loss and high rejection

APPLICATIONS:

- Communication systems
- Radar systems
- System integration

C

DESCRIPTION:

SCF series coaxial filters are offered as either bandpass, highpass, or lowpass filters. The standard offering covers the frequency range of 1.0 to 50 GHz and features a female (jack) connector at the input port and a male (plug) connector at the output port. Various coaxial interfaces are offered, such as SMA, K, and 2.4 mm connectors, to cover different frequency ranges. These coaxial filters are designed and manufactured for low VSWR, low insertion loss, and a steep rejection. Visit the website for models not listed.

ELECTRICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	1.0 to 50.0 GHz	Other frequency ranges are available upon request.
Passband Bandwidth (Typical)	100 MHz to 2 GHz	Specify when ordering.
Passband Loss (Typical)	1.0 to 3.0 dB	Related to the passband bandwidth and slope steepness.
Passband Ripple (Typical)	±0.2 to ±0.5 dB	Related to the passband bandwidth and slope steepness.
Rejection (Typical)	25.0 to 40.0 dB	Related to the passband bandwidth and slope steepness.
Return Loss (Typical)	15 dB	Dependent on the operating bandwidth.
Interface	Coaxial Connector	SMA(F), SMA(M), K(F), K(M), 2.4 mm (F), 2.4 mm (M), etc.
Outline	CF-B1, CF-H1, CF-L1	Other outlines are available. Specify when ordering.

CUSTOM MODELS:

SAGE Millimeter's coaxial filter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCF - F0N NNN RJ - CI CO - XY

F0N: For highpass or lowpass filters, F0N is the passband corner frequency in MHz x 10N. For example: 15.0 GHz = 153
F0N: For bandpass filters, F0N is the center frequency of the passband in MHz x 10N. For example: 18.0 GHz = 183
NNN: For highpass or lowpass filters, NNN is the rejection frequency at which rejection is specified in MHz x 10N. For example: 40 GHz = 403
NNN: For bandpass filters, NNN is the passband bandwidth in MHz x 10N. For example: 500 MHz = 052
RJ is the rejection value in dB. For example: 30 dB = 30
CI is the input connector type. For example: SMA(F) = SF
CO is the output connector type. For example: SMA(M) = SM
X is for filter type. "B" is bandpass, "H" is highpass and "L" is lowpass.
Y is for factory reserve.

Example 1: SCF-20318330-SFSM-H1 is a highpass filter with a passband starting at 20 GHz and a rejection of 30 dB at 18 GHz and lower. The filter has a female and male SMA connector at the input and output, respectively. "1" is a factory assigned number.

Example 2: SCF-18320330-SFSM-L1 is a lowpass filter with a passband stopping at 18 GHz and a rejection of 30 dB at 20 GHz and higher. The filter has a female and male SMA connector at the input and output, respectively. "1" is a factory assigned number.

Example 3: SCF-18305230-SFSM-B1 is a bandpass filter with a passband center frequency of 18 GHz, a passband bandwidth of 500 MHz, and a rejection of 30 dB. The filter has a female and male SMA connector at the input and output, respectively. "1" is a factory assigned number.

Coaxial Directional Couplers, SCD Series

FEATURES:

- Frequency coverage: 1.0 to 40 GHz
- 10, 20, and 30 dB coupling levels
- Low insertion loss and VSWR
- Broad bandwidth

APPLICATIONS:

- Test labs
- Instrumentation
- System integration

DESCRIPTION:

SCD series coaxial directional couplers are designed and manufactured for low VSWR, low insertion loss, high directivity, and a flat coupling level. The below standard offering covers the frequency range of 1 to 40 GHz and features three-port directional couplers with a fourth port that is internally terminated with a matched coaxial load. The coupling level of these models are 10, 20, and 30 dB typically and the connector type is female (jack) for all three ports. In addition to the standard offering, various coupling levels and coaxial interfaces, such as SMA, K, and 2.4 mm connectors, are available. Visit the website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Coupling Level (dB)	Coupling Flatness (dB)	Directivity (dB)	VSWR	Average Power (W)
SCD-0231831012-SF-S1	2.0 to 18.0	1.0	10	±1.0	12	1.6:1	30
SCD-0231832012-SF-S1	2.0 to 18.0	1.0	20	±1.0	12	1.6:1	30
SCD-0231833010-SF-S1	2.0 to 18.0	1.0	30	±1.0	10	1.6:1	30
SCD-0632731013-KF-S1	6.0 to 26.5	0.7	10	±1.5	13	1.6:1	10
SCD-0632732013-KF-S1	6.0 to 26.5	0.8	20	±1.5	13	1.6:1	10
SCD-0634031010-KF-S1	6.0 to 40.0	1.2	10	±1.5	10	1.7:1	10
SCD-0634032010-KF-S1	6.0 to 40.0	1.2	20	±1.5	10	1.7:1	10
SCD-0234031010-KF-S1	2.0 to 40.0	1.8	10	±1.5	10	1.7:1	10
SCD-0234032010-KF-S1	2.0 to 40.0	1.6	20	±1.5	10	1.7:1	10
SCD-0134031010-KF-S1	1.0 to 40.0	2.0	10	±1.5	10	1.7:1	10
SCD-0134032010-KF-S1	1.0 to 40.0	1.6	20	±1.5	10	1.7:1	10

Note: Insertion loss does not include the loss due to coupling.

CUSTOM MODELS:

SAGE Millimeter's coaxial directional coupler model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCD - F1N F2N CC DD - CO - XY

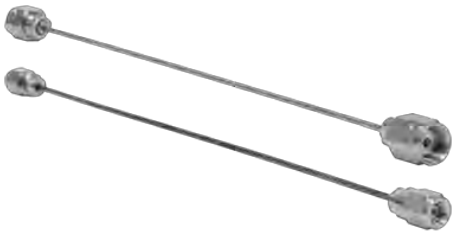
F1N is the start frequency in MHz x 10N. For example: 18.0 GHz = 183
F2N is the stop frequency in MHz x 10N. For example: 40.0 GHz = 403
CC is the coupling level in dB. For example: 10 dB = 10
DD is the directivity in dB. For example: 15 dB = 15
CO is the connector type. For example: SMA(F) = SF
X is for coupler type. “S” is for standard 3-port coupler, “B” is for bi-directional and “D” is for dual directional.
Y is for factory reserve.

Example: SCD-1835031013-2F-D1 is a dual-directional coupler with a frequency range of 18 to 50 GHz, a coupling level of 10 dB and a directivity of 13 dB. The coupler has female 2.4 mm connectors. “1” is a factory assigned number.

Coaxial Cables, SCW Series

FEATURES:

- Frequency coverage: DC to 110 GHz
- Low insertion loss and VSWR
- Semi-ridged cable
- Custom length



APPLICATIONS:

- System integration
- Instrumentation

C

C

DESCRIPTION:

SCW series millimeterwave coaxial cables are offered with a semi-rigid cable and have either male (plug) connectors or male and female (jack) connectors at the ends. The semi-rigid cable is polytetrafluoroethylene based and designed and manufactured for low insertion loss and VSWR. Various interfaces are offered including 1.85 mm and 1 mm connector types to cover frequencies up to 110 GHz. Although the semi-rigid cables are offered as standard lengths of 3, 6, and 9 inches, custom lengths can also be requested. Visit the website for models not listed.

ELECTRICAL SPECIFICATIONS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	VSWR (typ)	Cable Outer Diameter (in)	Length (in)
SCW-VMVM003-S1	DC to 67.0	$0.08F^{0.54}$	1.20:1	0.047	3
SCW-VMVM006-S1	DC to 67.0	$0.16F^{0.54}$	1.20:1	0.047	6
SCW-VMVM009-S1	DC to 67.0	$0.23F^{0.54}$	1.20:1	0.047	9
SCW-VMVF003-S1	DC to 67.0	$0.08F^{0.54}$	1.20:1	0.047	3
SCW-VMVF006-S1	DC to 67.0	$0.16F^{0.54}$	1.20:1	0.047	6
SCW-VMVF009-S1	DC to 67.0	$0.23F^{0.54}$	1.20:1	0.047	9
SCW-VMVM003-S2	DC to 62.0	$0.05F^{0.55}$	1.20:1	0.085	3
SCW-VMVM006-S2	DC to 62.0	$0.09F^{0.55}$	1.20:1	0.085	6
SCW-VMVM009-S2	DC to 62.0	$0.14F^{0.55}$	1.20:1	0.085	9
SCW-VMVF003-S2	DC to 62.0	$0.05F^{0.55}$	1.20:1	0.085	3
SCW-VMVF006-S2	DC to 62.0	$0.09F^{0.55}$	1.20:1	0.085	6
SCW-VMVF009-S2	DC to 62.0	$0.14F^{0.55}$	1.20:1	0.085	9
SCW-1M1M003-S1	DC to 110.0	$0.08F^{0.54}$	1.40:1	0.047	3
SCW-1M1M006-S1	DC to 110.0	$0.16F^{0.54}$	1.40:1	0.047	6
SCW-1M1M009-S1	DC to 110.0	$0.23F^{0.54}$	1.40:1	0.047	9

Note: “F” under Insertion Loss is the frequency.

CUSTOM MODELS:

SAGE Millimeter’s coaxial cable model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SCW - CI CO LLL - XY

CI is the input connector type. For example: 1 mm (F) = 1F
CO is the output connector type. For example: 1 mm (M) = 1M
LLL is the cable length in inches. For example: 3” = 003
X is for the coaxial cable type. “S” is for the standard semi-rigid cable.
Y is for factory reserve.

Example 1: SCW-1M1M008-S1 is a semi-rigid coaxial cable with a frequency range of DC to 110 GHz and a length of 8 inches. The coaxial cable has 1 mm male connectors for the input and output. “1” is a factory assigned number.

Coaxial Connector Torque Wrenches, SCH Series

FEATURES:

- Preset Torque of 4.0 ± 0.15 inch-pounds or 8.0 ± 0.4 in-pounds
- 5/16” or 15/64” Hex Size

APPLICATIONS:

- 1 mm Male Coax Connector Use
- SMA, 2.92 mm, 2.4 mm, 1.85 mm Male Coax Connector Use

C

C

DESCRIPTION:

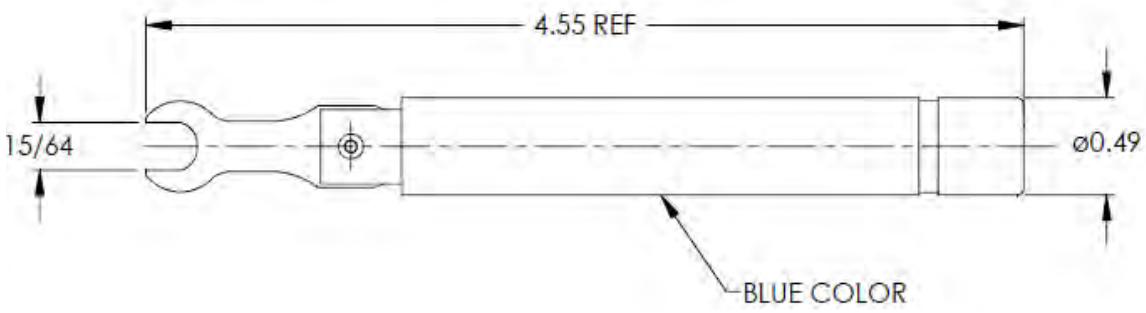
SCH series coaxial connector torque wrenches are designed to properly tighten or loosen coaxial connectors without causing damage. The below standard offering is compatible with 1 mm, 1.85 mm (V), 2.4 mm, 2.92 mm (K), and SMA male coaxial connectors.

For 1 mm male coaxial connectors, a hex size of 15/64” and a torque of 4.0 ± 0.15 inch-pounds or 0.45 ± 0.02 Nm is required.
For 1.85 mm (V), 2.4 mm, 2.92 mm (K), and SMA male coaxial connectors, a hex size of 5/16” and a torque of 8.0 ± 0.4 in-pounds or 0.92 ± 0.05 Nm is required.

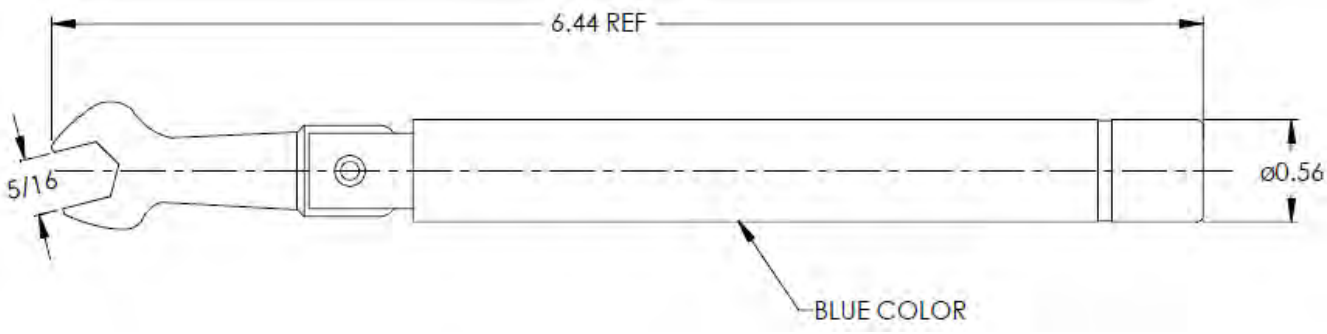
MECHANICAL SPECIFICATIONS:

Model Number	Hex Size (In)	Preset Torque (inch-pounds)	Coaxial Connector Fit	Length (in)	Outline
SCH-06004-S1	15/64	4.0 ± 0.15	1 mm (M)	4.55	CH-06004-S1 (See Below)
SCH-08008-S1	5/16	8.0 ± 0.4	V, 2.4 mm, K, SMA (M)	6.44	CH-08008-S1 (See Below)

CH-06004-S1:



CH-08008-S1:



Amplitude Detectors, SFD Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Broad or narrow band operation
- High sensitivity without tuning
- High stability over a broad temperature range

APPLICATIONS:

- Radar systems
- Communication systems
- Test instrumentation

F

DESCRIPTION:

SFD series amplitude detectors are GaAs beam lead Schottky diode-based detectors with various RF and DC connector options to suit many different applications. With a distinct circuitry design and careful diode selection, these zero-biased detectors exhibit high sensitivity and extremely flat output characteristics.

The below standard offering covers the frequency range of 18 to 170 GHz and is designed to have a 10 MHz video bandwidth, 1 MΩ video output impedance, and an RF input power handling of up to +20 dBm. The relationship of the input power and detected output voltage is square root. A typical input power versus detected output voltage curve of a Ka band detector is shown below. The typical tangential sensitivity of the detector is –45 dBm. Check the website for more models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Sensitivity (mV/mW)	Video Bandwidth (MHz)	Sensitivity Flat-ness (dB)	Output Voltage Polarity	Outline
K	SFD-183273-42SF-N1	18.0 to 26.5	1,300	10	±1.5	Negative	FD-K1
Ka	SFD-273403-28SF-N1	26.5 to 40.0	1,300	10	±1.5	Negative	FD-A1
Q	SFD-333503-22SF-N1	33.0 to 50.0	1,200	10	±1.5	Negative	FD-Q1
U	SFD-403603-19SF-N1	40.0 to 60.0	1,100	10	±1.5	Negative	FD-U1
V	SFD-503753-15SF-N1	50.0 to 75.0	1,000	10	±1.5	Negative	FD-V1
E	SFD-603903-12SF-N1	60.0 to 90.0	900	10	±2.0	Negative	FD-E1
W	SFD-753114-10SF-N1	75.0 to 110.0	800	10	±2.0	Negative	FD-W1
F	SFD-903144-08SF-N1	90.0 to 140.0	300	10	±2.0	Negative	FD-F1
D	SFD-114174-06SF-N1	110.0 to 170.0	300	10	±2.0	Negative	FD-D1

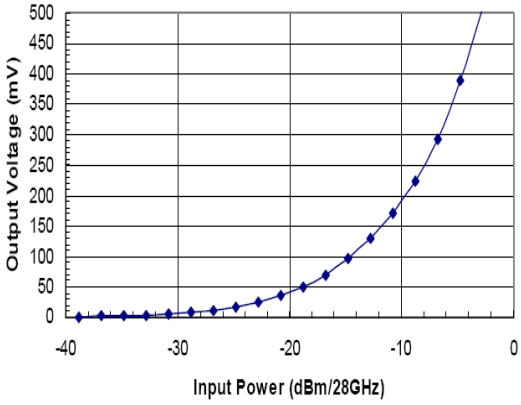
CUSTOM MODELS:

SAGE Millimeter's amplitude detector model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFD - F1N F2N - CR CD - XY

F1N is the RF start frequency in MHz x 10N. For example: 40.0 GHz = 403
F2N is the RF stop frequency in MHz x 10N. For example: 55.0 GHz = 553
CR is the RF connector type. For example: WR-15 = 15
CD is the DC connector type. For example: SMA (F) = SF
X is the detector type. "N" is for a negative output and "P" is for a positive output.
Y is for factory reserve.

Example: SFD-203503-2MSF-P1 is an amplitude detector with a RF frequency range from 20 to 50 GHz. The amplitude detector has a male 2.4 mm connector as the RF connector, a female SMA connector as the DC connector, and a positive voltage output. "1" is a factory assigned number.



Passive Frequency Multipliers, SFP Series

FEATURES:

- Frequency coverage: 26.5 to 110 GHz
- Balanced configuration for high efficiency
- Full waveguide operation
- Low harmonic components
- No external bias required

APPLICATIONS:

- Frequency extenders
- Source modules
- Communication systems
- Radar systems

DESCRIPTION:

SFP series passive frequency multipliers are GaAs beam lead Schottky diode- or MMIC device-based multipliers. The multipliers employ a broadband circuitry and balanced structure to offer higher conversion efficiency and continuous frequency coverage for up to full waveguide band operations. The balanced design enhances the desired harmonic output and suppresses unwanted components. The waveguide output filters out the fundamental frequency naturally, which guarantees an excellent input and output signal isolation. Based on the large-signal, nonlinear characteristics of the resistive device, rich harmonics are generated once the RF power is applied. Hence, no external bias is required. The below standard offering covers the frequency range from 26.5 to 110 GHz. While full band models offer moderate output power, higher output powers with narrow bandwidths are available as custom models. Check the website for more models.

F

CATALOG MODELS:

Band	Model Number	Output Frequency Range (GHz)	M	Input Frequency Range (GHz)	Output Power (dBm)	Input Power (dBm)	Input/Output Connectors	Outline
Ka	SFP-282SF-S1	26.5 to 40.0	2	13.25 to 20.00	+5.0	+19.0	SMA(F)/WR-28	FP-AS2
Ka	SFP-283SF-S1	26.5 to 40.0	3	8.83 to 13.33	+4.0	+23.0	SMA(F)/WR-28	FP-AS3
Q	SFP-222SF-S1	33.0 to 50.0	2	16.50 to 25.00	+7.0	+20.0	K(F)/WR-22	FP-QK3
Q	SFP-223SF-S1	33.0 to 50.0	3	11.00 to 16.67	+3.0	+22.0	SMA(F)/WR-22	FP-QS3
U	SFP-192KF-S1	40.0 to 60.0	2	20.00 to 30.00	+5.0	+20.0	K(F)/WR-19	FP-UK2
U	SFP-193SF-S1	40.0 to 60.0	3	13.33 to 20.00	+2.0	+20.0	SMA(F)/WR-19	FP-UK3
V	SFP-152KF-S1	50.0 to 75.0	2	25.00 to 37.50	+5.0	+20.0	K(F)/WR-15	FP-VK2
V	SFP-15228-S1	50.0 to 75.0	2	25.00 to 37.50	+4.0	+20.0	WR-28/WR-15	FP-VA2
V	SFP-153KF-S1	50.0 to 75.0	3	16.67 to 25.00	+1.0	+20.0	K(F)/WR-15	FP-VK3
E	SFP-1222F-S1	60.0 to 90.0	2	30.00 to 45.00	+5.0	+17.0	2.4 mm(F)/WR-12	FP-E22
E	SFP-123KF-S1	60.0 to 90.0	3	20.00 to 30.00	+3.0	+20.0	K(F)/WR-12	FP-EK3
W	SFP-1022F-S1	75.0 to 110.0	2	37.50 to 55.00	+3.0	+16.0	2.4 mm(F)/WR-10	FP-W22
W	SFP-10328-S1	75.0 to 110.0	3	25.00 to 36.67	+0.0	+20.0	WR-28/WR-10	FP-WA3

CUSTOM MODELS:

SAGE Millimeter's passive frequency multiplier model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFP - F1N F2N M PO - CO CI - XY

F1N is the output start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the output stop frequency in MHz x 10N. For example: 40.0 GHz = 403
M is the multiplying factor. For example: X3 = 3
PO is the output power in dBm. For example: 2 dBm = 02
CO is the output connector type and **CI** is the input connector type. For example: WR-15 = 15
X is the package type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SFP-703903305-12KF-S1 is a X3 passive frequency multiplier with an output frequency range of 70 to 90 GHz and output power of +5 dBm. The passive multiplier has a WR-12 waveguide at the output, a female K connector at the input and a standard package and finish. "1" is a factory assigned number.

Active Frequency Multipliers, SFA Series

FEATURES:

- Frequency coverage: 26.5 to 98 GHz
- High efficiency and higher output power
- Up to full waveguide operation
- Low harmonic components

APPLICATIONS:

- Frequency extenders
- Source modules
- Communication systems
- Radar systems

DESCRIPTION:

F

SFA series active frequency multipliers are GaAs beam lead Schottky diode- or MMIC device-based multipliers. The multipliers employ a broadband circuitry design to offer continuous frequency coverage for up to full waveguide band operations. These multipliers are designed and constructed to enhance the desired harmonic output and suppress unwanted components. The waveguide output filters out the fundamental and lower frequency components naturally, which guarantees an excellent input and output signal isolation. The below standard offering covers the frequency range of 26.5 to 98 GHz and requires a bias voltage of +8.0 Volts. While full band or broadband models offer moderate output power, models with a higher output power or narrow bandwidth are available as custom designs. Check the website for more models.

F

CATALOG MODELS:

Band	Model Number	Output Frequency Range (GHz)	M	Input Frequency Range (GHz)	Output Power (dBm)	Input Power (dBm)	Input/Output Connectors	Outline
Ka	SFA-282SF-S1	26.5 to 40.0	2	13.25 to 20.00	20.0	+0.0	SMA(F)/WR-28	FA-SC-4
Ka	SFA-283SF-S1	26.5 to 40.0	3	8.67 to 13.33	20.0	+5.0	SMA(F)/WR-28	FA-SC-4
Ka	SFA-284SF-S1	26.5 to 40.0	4	6.63 to 10.00	20.0	+5.0	SMA(F)/WR-28	FA-SC-4
Q	SFA-222KF-S1	37.0 to 45.0	2	18.50 to 22.25	20.0	+5.0	K(F)/WR-22	FA-SQ-1
Q	SFA-224SF-S1	37.0 to 45.0	4	9.25 to 11.25	20.0	+5.0	SMA(F)/WR-22	FA-SQ-1
U	SFA-192KF-S1	45.0 to 55.0	2	22.50 to 27.50	18.0	+5.0	K(F)/WR-19	FA-SU-4
U	SFA-194SF-S1	45.0 to 55.0	4	11.25 to 13.75	18.0	+5.0	SMA(F)/WR-19	FA-SU-4
V	SFA-152KF-S1	50.0 to 66.0	2	25.00 to 33.00	16.0	+5.0	K(F)/WR-15	FA-SV-1-1.8
V	SFA-154KF-S1	50.0 to 66.0	4	12.50 to 16.50	16.0	+0.0	K(F)/WR-15	FA-SV-1-1.8
E	SFA-123KF-S1	72.0 to 90.0	3	24.00 to 30.00	8.0	+5.0	K(F)/WR-12	FA-SE-1-1.8
E	SFA-126SF-S1	72.0 to 90.0	6	12.00 to 15.00	9.0	+0.0	SMA(F)/WR-12	FA-SE-1-1.8
W	SFA-104KF-S1	90.0 to 98.0	4	22.50 to 24.50	18.0	+5.0	K(F)/WR-10	FA-SW-1-1.8
W	SFA-106SF-S1	90.0 to 98.0	6	15.00 to 16.33	18.0	+5.0	SMA(F)/WR-10	FA-SW-1-1.8

CUSTOM MODELS:

SAGE Millimeter's active frequency multiplier model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFA - F1N F2N M PO - CO CI - XY

F1N is the output start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the output stop frequency in MHz x 10N. For example: 40.0 GHz = 403
M is the multiplying factor. For example: X3 = 3
PO is the output power in dBm. For example: 20 dBm = 20
CO is the output connector type and **CI** is the input connector type. For example: WR-15 = 15
X is the package type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SFA-503603420-15SF-S1 is a X4 active frequency with an output frequency range of 50 to 60 GHz and output power of 20 dBm. The active multiplier has a WR-15 waveguide at the output, female SMA connector at the input port, and a standard package and finish. "1" is a factory assigned number.

Balanced Harmonic Mixers, SFH Series

FEATURES:

- Frequency coverage: 26.5 to 140 GHz
- Balanced configuration for low conversion loss
- Broadband operation
- Separate RF, LO and IF ports

APPLICATIONS:

- Phase lock loops
- Spectrum analyzers without built-in diplexer

F

F

DESCRIPTION:

SFH series balanced harmonic mixers are GaAs beam lead Schottky diode-based mixers. The harmonic mixers employ a broadband circuitry and balanced structure to offer low conversion loss and continuous frequency coverage for up to full waveguide band operations. These harmonic mixers are used to extend the frequency of spectrum analyzers and frequency counters. Unlike waveguide harmonic mixers (STH series), these mixers possess an internally integrated frequency diplexer so that the RF, LO and IF ports are configured separately. This feature allows for a convenient connection when used with spectrum analyzer models that do not have built-in diplexers, such as the models offered by Keysight (Agilent) Technologies. The below offering covers the frequency range of 26.5 to 140 GHz and is specially designed and manufactured for Keysight equipment.

CATALOG MODELS:

Band	Model Number	RF Frequency Range (GHz)	Harmonic Number	IF Frequency Range (GHz)	LO Frequency Range (GHz)	LO Power Range (dBm)	Conversion Loss (dB)	Outline
Ka	SFH-28SFSF-A1	26.5 to 40.0	8	DC to 1.3	3.0 to 6.1	+14 to +16	25.0	FH-A2
Q	SFH-22SFSF-A1	33.0 to 50.0	10	DC to 1.3	3.0 to 6.1	+14 to +16	28.0	FH-Q2
U	SFH-19SFSF-A1	40.0 to 60.0	12	DC to 1.3	3.0 to 6.1	+14 to +16	30.0	FH-U2
V	SFH-15SFSF-A1	50.0 to 75.0	14	DC to 1.3	3.0 to 6.1	+14 to +16	40.0	FH-V2
E	SFH-12SFSF-A1	60.0 to 90.0	16	DC to 1.3	3.0 to 6.1	+14 to +16	45.0	FH-E2
W	SFH-10SFSF-A1	75.0 to 110.0	18	DC to 1.3	3.0 to 6.1	+14 to +16	47.0	FH-W2
F	SFH-08SFSF-A1	90.0 to 140.0	24	DC to 1.3	3.0 to 6.1	+14 to +16	50.0	FH-F2

CUSTOM MODELS:

SAGE Millimeter's balanced harmonic mixer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFH - F1N F2N MM CL - CR CO CI - XY

F1N is the RF start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the RF stop frequency in MHz x 10N. For example: 40.0 GHz = 403
MM is the harmonic number. For example: 4th harmonic = 04
CL is the small signal conversion loss in dB. For example: 20 dB = 20
CR is the RF port connector type. For example: WR-15 = 15
CO is the LO port connector type. For example: SMA (F) = SF
CI is the IF port connector type. For example: SMA (F) = SF
X is the mixer type. "S" is for a standard package and finish with an external bias, "N" is for no external bias and "C" is for a custom design.
Y is for factory reserve.

Example: SFH-2434030420-28SFSF-S1 is a harmonic mixer with an RF frequency range of 24 to 40 GHz, a harmonic number of 4 and a conversion loss of 20 dB. The mixer has a WR-28 waveguide at the RF port and female SMA connectors at the LO and IF, and a standard package and finish. "1" is a factory assigned number.

Balanced Mixers, SFB Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Balanced configuration for low conversion loss
- Full waveguide band operation
- External bias option for low LO operation

APPLICATIONS:

- Radar systems
- Communication systems
- Test instrumentation

DESCRIPTION:

F

SFB series balanced mixers are GaAs beam lead Schottky diode-based mixers. The balanced mixers employ a broadband circuitry and balanced structure to offer low conversion loss and harmonics for full waveguide band and broad IF bandwidth operations. An externally biased mixer option can be offered when the available LO power is low, particularly in the higher waveguide bands. The below standard offering covers the frequency range of 18 to 170 GHz. While these models focus on full bandwidth operations for most applications, custom models are available to meet specific application needs. Check the website for more models.

F

CATALOG MODELS:

Band	Model Number	RF & LO Frequency Range (GHz)	IF Frequency Range (GHz)	Conversion Loss (dB)	LO Power (dBm)	Port Isolation (dB)	Bias (V/mA)	Outline
K	SFB-42-N1	18.0 to 26.5	DC to 8.5	6.0	+10 to +13	15.0	N/A	FB-NK
Ka	SFB-28-N1	26.5 to 40.0	DC to 13.5	7.5	+10 to +13	15.0	N/A	FB-NA
Q	SFB-22-N1	33.0 to 50.0	DC to 17.0	7.0	+10 to +13	15.0	N/A	FB-NQ
Q	SFB-22-E2	33.0 to 50.0	DC to 17.0	9.0	+0 to +3	15.0	+5.0/1.0	FB-EQ-2
U	SFB-19-N1	40.0 to 60.0	DC to 20.0	8.0	+10 to +13	15.0	N/A	FB-NU
U	SFB-19-E2	40.0 to 60.0	DC to 20.0	9.0	+0 to +3	15.0	+5.0/1.0	FB-EU-2
V	SFB-15-N1	50.0 to 75.0	DC to 25.0	8.5	+10 to +13	15.0	N/A	FB-NV
V	SFB-15-E2	50.0 to 75.0	DC to 25.0	9.5	+0 to +3	15.0	+5.0/1.0	FB-EV-2
E	SFB-12-N1	60.0 to 90.0	DC to 30.0	9.0	+10 to +13	15.0	N/A	FB-NE
E	SFB-12-E2	60.0 to 90.0	DC to 30.0	10.0	+0 to +3	15.0	+5.0/1.0	FB-EE-2
W	SFB-10-N1	75.0 to 110.0	DC to 35.0	9.5	+10 to +13	15.0	N/A	FB-NW
W	SFB-10-E2	75.0 to 110.0	DC to 35.0	12.0	+0 to +3	15.0	+5.0/1.0	FB-EW-2
F	SFB-08-N1	90.0 to 140.0	DC to 40.0	11.0	+10 to +13	15.0	N/A	FB-NF
F	SFB-08-E2	90.0 to 140.0	DC to 20.0	13.0	+0 to +3	15.0	+5.0/2.0	FB-EF-2
D	SFB-06-N1	110.0 to 170.0	DC to 40.0	12.0	+10 to +13	15.0	N/A	FB-ND
D	SFB-06-E2	110.0 to 170.0	DC to 20.0	14.0	+0 to +3	15.0	+5.0/2.0	FB-ED-2

CUSTOM MODELS:

SAGE Millimeter's balanced mixer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFB - RFN LON CL - CR CO CI - XY

RFN is the RF center frequency in MHz x 10N. For example: 26.0 GHz = 263
LON is the LO center frequency in MHz x 10N. For example: 28.0 GHz = 283
CL is the small signal conversion loss in dB. For example: 8.5 dB = 09
CR is the RF port connector type. For example: WR-28 = 28
CO is the LO port connector type. For example: WR-22 = 22
CI is the IF port connector type. For example: SMA (F) = SF
X is the mixer type. "N" is for non-externally biased and "E" is for externally-biased.
Y is for factory reserve.

Example: SFB-33339309-2822SF-E2 is an externally biased balanced mixer with an RF center frequency of 33 GHz, an LO center frequency of 38.5 GHz and a conversion loss of 9 dB. The mixer has a WR-28 waveguide at the RF port, a WR-22 waveguide at the LO and a female SMA connector at the IF. "2" is a factory assigned number.

Subharmonically Pumped Mixers, SFS Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Balanced configuration for low conversion loss
- Up to full waveguide band operation
- LO frequency at half the RF frequency

APPLICATIONS:

- Communication systems
- Radar systems
- Test instrumentation

F

F

DESCRIPTION:

SFS series subharmonically pumped mixers are GaAs beam lead Schottky diode- or MMIC device-based mixers. The subharmonically pumped mixers employ a broadband circuitry and balanced structure to offer low conversion loss and harmonics and are widely used in many communication systems where a superior harmonic and spurious performance is critical. In addition, these mixers have an extremely low LO signal leakage at the RF port. Furthermore, an LO frequency at half the RF frequency reduces the system cost tremendously.

The below standard offering covers the frequency range of 18 to 110 GHz with a typical RF bandwidth that is up to the full waveguide band. Although the non-biased version is the baseline design, externally-biased options are available. Additionally, the standard models focus on full bandwidth operations for most applications, but custom models can be offered to meet specific application needs. Check the website for more models.

CATALOG MODELS:

Band	Model Number	RF Freq. Range (GHz)	LO Freq. Range (GHz)	IF Freq. Range (GHz)	C. L. (dB)	LO Power (dBm)	Port Isolation (dB)	RF/LO Connectors
Ka	SFS-27340312-28KFSF-N1	26.5 to 40.0	13.3 to 20.0	DC to 5.0	12.0	10 to 15	15.0	WR-28/K(F)
Q	SFS-32342312-22KFSF-N1	32.0 to 42.0	16.0 to 21.0	DC to 3.0	12.0	10 to 15	30.0	WR-22/K(F)
U	SFS-44325413-19KFSF-N1	44.0 to 54.0	22.0 to 27.0	DC to 5.0	13.0	10 to 15	15.0	WR-19/K(F)
V	SFS-54364313-15KFSF-N1	54.0 to 64.0	27.0 to 32.0	DC to 6.0	13.0	10 to 15	15.0	WR-15/K(F)
E	SFS-71378314-122FSF-N1	71.0 to 86.0	29.0 to 43.0	DC to 12.0	14.0	10 to 15	20.0	WR-12/2.4(F)
W	SFS-75311415-10VFSF-N1	75.0 to 110.0	37.5 to 55.0	DC to 5.0	15.0	10 to 15	15.0	WR-10/V(F)

CUSTOM MODELS:

SAGE Millimeter's subharmonically pumped mixer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFS - RFL RFH CL - CR CO CI - XY

RFL is the RF low frequency in MHz x 10N. For example: 44.0 GHz = 443
RFH is the RF high frequency in MHz x 10N. For example: 54.0 GHz = 543
CL is the small signal conversion loss in dB. For example: 13 dB = 13
CR is the RF port connector type. For example: WR-19= 19
CO is the LO port connector type. For example: K(F) = KF
CI is the IF port connector type. For example: SMA (F) = SF
X is the mixer type. "N" is for non-externally biased and "E" is for externally-biased.
Y is for factory reserve.

Example: SFS-50360314-15KFSF-N1 is a non-externally biased, subharmonically pumped mixer with an RF frequency range of 50 GHz to 60 GHz and a conversion loss of 14 dB. The mixer has a WR-15 waveguide at the RF port, a female K connector at the LO port and a female SMA connector at the IF port. "1" is a factory assigned number.

Balanced Upconverters, SFU Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Balanced configuration for low conversion loss
- Full waveguide band operation
- External bias option for low LO operation

APPLICATIONS:

- Radar systems
- Communication systems
- Test instrumentation

DESCRIPTION:

SFU series balanced upconverters are GaAs beam lead Schottky diode-based mixers. The upconverters employ a broadband circuitry and balanced structure to offer low conversion loss and harmonics for full waveguide band and broad IF bandwidth operations. An externally biased mixer option can be offered when the available LO power is low, particularly in the higher waveguide bands. The below standard offering covers the frequency range of 18 to 170 GHz. While these models focus on full bandwidth operations for most applications, custom models are available to meet specific application needs. Check the website for more models.

F

CATALOG MODELS:

Band	Model Number	RF & LO Frequency Range (GHz)	IF Frequency Range (GHz)	Conversion Loss (dB)	LO Power (dBm)	Port Isolation (dB)	Bias (V/mA)	Outline
K	SFU-42-N1	18.0 to 26.5	DC to 8.5	6.0	+10 to +13	15.0	N/A	FB-NK
Ka	SFU-28-N1	26.5 to 40.0	DC to 13.5	7.5	+10 to +13	15.0	N/A	FB-NA
Q	SFU-22-N1	33.0 to 50.0	DC to 17.0	7.0	+10 to +13	15.0	N/A	FB-NQ
Q	SFU-22-E2	33.0 to 50.0	DC to 17.0	9.0	+0 to +3	15.0	+5.0/1.0	FB-EQ-2
U	SFU-19-N1	40.0 to 60.0	DC to 20.0	8.0	+10 to +13	15.0	N/A	FB-NU
U	SFU-19-E2	40.0 to 60.0	DC to 20.0	9.0	+0 to +3	15.0	+5.0/1.0	FB-EU-2
V	SFU-15-N1	50.0 to 75.0	DC to 25.0	8.5	+10 to +13	15.0	N/A	FB-NV
V	SFU-15-E2	50.0 to 75.0	DC to 25.0	9.5	+0 to +3	15.0	+5.0/1.0	FB-EV-2
E	SFU-12-N1	60.0 to 90.0	DC to 30.0	9.0	+10 to +13	15.0	N/A	FB-NE
E	SFU-12-E2	60.0 to 90.0	DC to 30.0	10.0	+0 to +3	15.0	+5.0/1.0	FB-EE-2
W	SFU-10-N1	75.0 to 110.0	DC to 35.0	9.5	+10 to +13	15.0	N/A	FB-NW
W	SFU-10-E2	75.0 to 110.0	DC to 35.0	12.0	+0 to +3	15.0	+5.0/1.0	FB-EW-2
F	SFU-08-N1	90.0 to 140.0	DC to 40.0	11.0	+10 to +13	15.0	N/A	FB-NF
F	SFU-08-E2	90.0 to 140.0	DC to 20.0	13.0	+0 to +3	15.0	+5.0/2.0	FB-EF-2
D	SFU-06-N1	110.0 to 170.0	DC to 40.0	12.0	+10 to +13	15.0	N/A	FB-ND
D	SFU-06-E2	110.0 to 170.0	DC to 20.0	14.0	+0 to +3	15.0	+5.0/2.0	FB-ED-2

CUSTOM MODELS:

SAGE Millimeter's balanced upconverter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFU - RFN LON CL - CR CO CI - XY

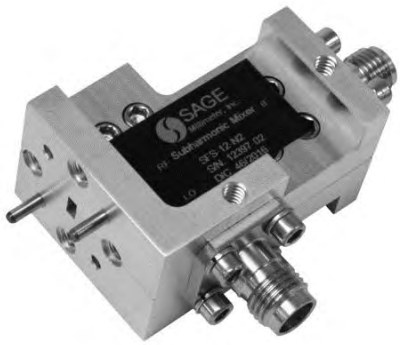
RFN is the RF center frequency in MHz x 10N. For example: 26.0 GHz = 263
LON is the LO center frequency in MHz x 10N. For example: 28.0 GHz = 283
CL is the small signal conversion loss in dB. For example: 8.5 dB = 09
CR is the RF port connector type. For example: WR-28 = 28
CO is the LO port connector type. For example: K(F) = KF
CI is the IF port connector type. For example: SMA (F) = SF
X is the upconverter type. “N” is for non-externally biased and “E” is for externally-biased.
Y is for factory reserve.

Example: SFU-33339309-2822SF-E2 is an externally biased balanced upconverter with an RF center frequency of 33 GHz, an LO center frequency of 38.5 GHz and a conversion loss of 9 dB. The upconverter has a WR-28 waveguide at the RF port, a WR-22 waveguide at the LO port and a female SMA connector at the IF port. “2” is a factory assigned number.

Subharmonically Pumped Upconverters, SFV Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Balanced configuration for low conversion loss
- Up to full waveguide band operation
- LO frequency at half of RF frequency



APPLICATIONS:

- Communication systems
- Radar systems
- Test instrumentation

DESCRIPTION:

SFV series subharmonically pumped upconverters are GaAs beam lead Schottky diode- or MMIC device-based mixers. The subharmonically pumped upconverters employ a broadband circuitry and balanced structure to offer low conversion loss and harmonics and are widely used in many communication systems where superior harmonic and spurious performance is critical. In addition, these upconverters have an extremely low LO signal leakage at the RF port. Furthermore, an LO frequency at half the RF frequency reduces the system cost tremendously.

The below standard offering covers the frequency range of 18 to 110 GHz with a typical RF bandwidth that is up to the full waveguide band. Although the non-biased version is the baseline design, externally-biased options are available. Additionally, the standard models focus on full bandwidth operations for most applications, but custom models can be offered to meet specific application needs. Check the website for more models.

CATALOG MODELS:

Band	Model Number	RF Frequency Range (GHz)	LO Frequency Range (GHz)	IF Frequency Range (GHz)	C. L. (dB)	LO Power (dBm)	Port Isolation (dB)	RF/LO Connectors	Outline
K	SFV-42-N1	18.0 to 26.5	9.0 to 13.3	DC to 5.0	10.0	10 to 15	15.0	WR-42/SMA(F)	FS-K1
Ka	SFV-28-N1	26.5 to 40.0	13.3 to 20.0	DC to 5.0	12.0	10 to 15	15.0	WR-28/K(F)	FS-A1
Q	SFV-22-N1	33.0 to 50.0	16.5 to 25.0	DC to 5.0	13.0	10 to 15	15.0	WR-22/K(F)	FS-Q1
U	SFV-19-N1	40.0 to 60.0	20.0 to 30.0	DC to 5.0	13.0	10 to 15	15.0	WR-19/K(F)	FS-U1
V	SFV-15-N1	50.0 to 75.0	25.0 to 37.5	DC to 5.0	14.0	10 to 15	15.0	WR-15/K(F)	FS-V1
E	SFV-12-N1	60.0 to 90.0	30.0 to 45.0	DC to 5.0	14.0	10 to 15	15.0	WR-12/2.4 mm(F)	FS-E1
W	SFV-10-N1	75.0 to 110.0	37.5 to 55.0	DC to 5.0	15.0	10 to 15	15.0	WR-10/V(F)	FS-W1

CUSTOM MODELS:

SAGE Millimeter's subharmonically pumped upconverter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFV - RFN LON CL - CR CO CI - XY

RFN is the RF center frequency in MHz x 10N. For example: 26.0 GHz = 263
LON is the LO center frequency in MHz x 10N. For example: 28.0 GHz = 283
CL is the small signal conversion loss in dB. For example: 14 dB = 14
CR is the RF port connector type. For example: WR-28 = 28
CO is the LO port connector type. For example: K(F) = KF
CI is the IF port connector type. For example: SMA (F) = SF
X is the upconverter type. “N” is for non-externally biased and “E” is for externally-biased.
Y is for factory reserve.

Example: SFV-58329314-15KFSF-N1 is a non-externally biased, subharmonically pumped upconverter with an RF center frequency of 58 GHz, an LO center frequency of 29 GHz and a conversion loss of 14 dB. The upconverter has a WR-15 waveguide at the RF port, a female K connector at the LO port and a female SMA connector at the IF port. “1” is a factory assigned number.

Quadrature Mixers and Phase Detectors, SFQ Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Balanced configuration for low conversion loss
- Readily to be configured as image rejection mixers
- IF port DC coupling for phase detection

APPLICATIONS:

- Phase detector
- Ranging radar systems
- Communication systems
- Test instrumentation

F

DESCRIPTION:

SFQ series quadrature mixers, or I/Q mixers, are GaAs beam lead Schottky diode- or MMIC device-based mixers. Since the IF port of the quadrature mixer is DC coupled, the mixer can also be used as a phase detector. In addition, these mixers can readily be configured into image rejection mixers or single sideband modulators by adding an IF quadrature coupler.

The below offering covers the frequency range of 18 to 100 GHz, however, additional models can be offered to cover 18 to 110 GHz. The typical LO to RF port isolation of these standard models is 30 dB, which is high enough for most applications without the need for additional port filtering. The below standard models are designed for narrow bandwidth operations with specific package designs to address common industry requirements. However, custom models can be offered to meet differing application needs. Furthermore, subharmonically pumped quadrature mixers are also available. Check the website for more models.

CATALOG MODELS:

Band	Model Number	RF & LO Freq. Range (GHz)	IF Freq. Range (GHz)	Conversion Loss (dB)	LO Power (dBm)	Port Isola-tion (dB)	RF & LO Ports	Outline
K	SFQ-18327313-KFKFSF-F2	18.0 to 26.5	DC to 5.0	13	+17	25.0	K(F)	FM-AC
N/A	SFQ-22333313-KFKFSF-F2	22.0 to 33.0	DC to 5.0	13	+17	25.0	K(F)	FM-AC
Ka	SFQ-30340313-KFKFSF-F2	30.0 to 40.0	DC to 5.0	13	+17	25.0	K(F)	FM-AC
Q	SFQ-33350313-2222SF-F2	33.0 to 50.0	DC to 5.0	13	+17	25.0	WR-22	FQ-Q1
Q	SFQ-33350313-2F2FSF-F2	33.0 to 50.0	DC to 5.0	13	+17	25.0	2.4 (F)	FM-AC
U	SFQ-40350313-1919SF-F2	40.0 to 50.0	DC to 5.0	13	+17	25.0	WR-19	FQ-U1
V	SFQ-57366312-1515SF-F2	57.0 to 66.0	DC to 12.0	12	+12	30.0	WR-15	FQ-V1
E	SFQ-70390313-1212SF-F2	70.0 to 90.0	DC to 12.0	13	+10	30.0	WR-12	FQ-EE
W	SFQ-75310413-1010SF-F2	75.0 to 100.0	DC to 12.0	13	+10	30.0	WR-10	FQ-WE

CUSTOM MODELS:

SAGE Millimeter's quadrature mixer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFQ - RFL RFH CL - CR CO CI - XY

RFL is the RF low frequency in MHz x 10N. For example: 38.0 GHz = 383
RFH is the RF high frequency in MHz x 10N. For example: 46.0 GHz = 463
CL is the small signal conversion loss in dB. For example: 14 dB = 14
CR is the RF port connector type. For example: WR-28 = 28
CO is the LO port connector type. For example: K(F) = KF
CI is the IF port connector type. For example: SMA (F) = SF
X is the mixer type. "F" is for fundamental LO and "E" is for externally-biased.
Y is for factory reserve.

Example: SFQ-38346314-22KFSF-E1 is an externally-biased I/Q mixer with an RF center frequency of 38 GHz to 46 GHz, and a conversion loss of 14 dB. The mixer has a WR-22 waveguide at the RF port, a female K connector at the LO port and a female SMA connector at the IF port. "1" is a factory assigned number.

Single Sideband Modulators, SFM Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Balanced configuration for low conversion loss
- Possible use as image rejection mixers
- IF port DC coupling for phase detection

APPLICATIONS:

- Phase detector
- Ranging radar systems
- Communication systems
- Test instrumentation

F

DESCRIPTION:

F

SFM series single sideband modulators are GaAs beam lead Schottky diode- or MMIC device-based frequency converters that use the IF frequency as a pumping source. The IF quadrature hybrid is not included in these modulators. Instead, separate I and Q ports are provided. Thus, either an external IF quadrature hybrid or two IF orthogonal, equal amplitude signals are required in order to produce a single sideband signal.

The below offering covers the frequency range of 18 to 100 GHz with a typical image rejection of 20 dB, however, additional models can be offered to cover 18 to 110 GHz. The below standard models are designed for narrow bandwidth operations with specific package designs to address common industry requirements. However, custom models can be offered to meet differing application needs. Check the website for more models.

CATALOG MODELS:

Band	Model Number	RF Freq. Range (GHz)	IF Freq. Range (GHz)	Conversion Loss (dB)	IF Power* (dBm)/(V)	Image Rej. (dB)	RF Connectors	Outline
K	SFM-18327313-KFKFSF-N1	18.0 to 26.5	DC to 5.0	13	16 or ±10	20.0	K(F)	FM-AC
Ka	SFM-22333313-KFKFSF-N1	22.0 to 33.0	DC to 5.0	13	16 or ±10	20.0	K(F)	FM-AC
K	SFM-30340313-KFKFSF-N1	30.0 to 40.0	DC to 5.0	13	16 or ±10	20.0	K(F)	FM-AC
Ka	SFM-33350313-2222SF-N1	33.0 to 50.0	DC to 5.0	13	16 or ±10	20.0	WR-22	FQ-Q1
Q	SFM-33350313-2F2FSF-N1	33.0 to 50.0	DC to 5.0	13	16 or ±10	20.0	2.4 (F)	FM-AC
U	SFM-40350313-1919SF-N1	40.0 to 50.0	DC to 5.0	13	16 or ±10	20.0	WR-19	FQ-U1
V	SFM-57366312-1515SF-N1	57.0 to 66.0	DC to 12.0	12	16 or ±10	20.0	WR-15	FQ-V1
E	SFM-70390313-1212SF-N1	70.0 to 90.0	DC to 12.0	13	16 or ±10	20.0	WR-12	FQ-EE
W	SFM-90310413-1010SF-N1	90.0 to 100.0	DC to 12.0	13	16 or ±10	20.0	WR-10	FQ-WE

*Note: ±10 Vp-p driving voltage is equivalent to +16 dBm power.

CUSTOM MODELS:

SAGE Millimeter's single sideband modulator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SFM - RFL RFH CL - C1 C2 CI - XY

RFL is the RF low frequency in MHz x 10N. For example: 38.0 GHz = 383
RFH is the RF high frequency in MHz x 10N. For example: 46.0 GHz = 463
CL is the small signal conversion loss in dB. For example: 14 dB = 14
C1 is input RF port connector type. For example: WR-28 = 28
C2 is output RF port connector type. For example: WR-28 = 28
CI is the IF port connector type. For example: SMA (F) = SF
X is the modulator type. "N" is for non-externally biased and "E" is for externally-biased.
Y is for factory reserve.

Example: SFM-38346314-2222SF-N1 is a non-externally biased single sideband modulator with an RF frequency range of 38 GHz to 46 GHz, and a conversion loss of 14 dB. The modulator has a WR-22 waveguide at the RF input port, a WR-22 waveguide output port and a female SMA connector at the IF port. "1" is a factory assigned number.

Frequency Converter Application Notes

Microwave and millimeterwave frequency converters are key components in radar, communication and test systems. In this catalog, SAGE Millimeter defines a frequency converter as a component that outputs a different frequency or signal from its input. The following are concepts, terms and definitions that are widely used and accepted in the industry.

Amplitude Detector:

An **amplitude detector** is used to convert an RF signal to a DC signal. The relationship of the input power and detected output voltage is square root.

Detection Sensitivity:

Detection sensitivity is the output level of the detected signal versus the input level of the RF power, measured in mV/mW.

Frequency Multiplier:

There are two types of **frequency multipliers**: active and passive multipliers. Active multipliers involve three terminal devices and require an external DC bias. On the other hand, **passive multipliers** employ resistive or capacitive devices, such as Schottky diodes or Varactor diodes, eliminating the need for an external bias. Frequency multipliers utilize the nonlinear characteristics of semiconductors to generate and extract the desired harmonic of an input frequency, such as 2x, 3x, etc.

Harmonic Suppression:

Harmonic suppression is the power of undesired harmonics versus the desired harmonic, measured in dBc.

Mixer:

A **mixer** is a frequency down-converter that uses the nonlinear characteristics of semiconductor devices, such as Schottky diodes or transistors, to convert high radio frequencies into intermediate frequencies. Three frequency components are generally involved: a local oscillator (F_{LO}), a radio frequency (F_{RF}), and an intermediate frequency (F_{IF}). The relationship of these three frequencies is $F_{IF} = F_{RF} \pm F_{LO}$. Since the local oscillator is used to pump semiconductor devices into a nonlinear region for harmonic generation, the required LO power is relatively high. For an unbiased mixer, the required LO power is generally around +13 dBm.

Single-Ended Mixer:

Single-ended mixers are mixers that share a single port for the RF and LO frequency. These mixers are rich in harmonics and produce every possible mixing product or 100% of $nF_{RF} \pm mF_{LO}$, where n and m are integers. SAGE Millimeter does not offer this type of mixer.

Balanced mixer:

Balanced mixers are mixers that use two or more nonlinear devices and phase-correlating power dividers to reduce the number of mixing products. The number of nonlinear devices alone does not determine whether a mixer is single-balanced or double-balanced. As mentioned, single-ended mixers will produce every possible mixing product. A balanced mixer will reduce mixing products by 50%, and a double-balanced mixer will reduce them by 25%.

Harmonic Mixer:

Harmonic mixers are mixers that utilize a relatively low local oscillator frequency to convert high radio frequencies to intermediate frequencies. Therefore, the higher order harmonics of the local oscillator frequency is used. The resultant IF is shown as $F_{IF} = F_{RF} \pm nF_{LO}$, where n = 2, 3, 4... These mixers have a relatively high conversion loss due to the higher order harmonics used. These mixers are mainly used with phase locked loops and spectrum analyzers.

Subharmonically Pumped Mixer:

Subharmonically pumped mixers are harmonic mixers that use a local oscillator frequency at half its radio frequency. Due to their unique features, subharmonically pumped mixers are widely used in communication and radar systems.

Upconverter:

An **upconverter** uses the nonlinear characteristics of semiconductor devices to convert intermediate frequencies to higher radio frequencies for transmitting, shown as $F_{RF} = F_{LO} \pm F_{IF}$. Upconverters are based on principles that are similar to the mixers mentioned above.

Conversion Loss:

Conversion loss is the ratio of output signal power to input signal power. Conversion loss is measured in decibels when using the formula: Conversion Loss =10log(G).

Mixing Products:

Due to the nonlinear characteristics of semiconductors, many frequency components are generated in mixer circuits as $F_{IF} = nF_{RF} \pm mF_{LO}$ and up-converter circuits as $F_{RF} = nF_{LO} \pm mF_{IF}$, where n and m are integers. These frequency components are called **mixing products**.

Electrical Attenuators, SKA Series

FEATURES:

- Frequency coverage: 2 to 110 GHz
- Digital and analog control
- High dynamic range
- Wide bandwidth

APPLICATIONS:

- Automatic level controls
- Amplitude modulations
- System integrations
- Test instrumentation

DESCRIPTION:

K

SKA series electrical attenuators are PIN diode-based attenuators that can be broken down into two main groups: digital and analog control types. Within the digitally controlled attenuators are further classifications: general purpose, high phase stable and high speed versions. The below standard offering features analog attenuators that cover the frequency range of 8 to 96 GHz. However, operation frequencies between 2 and 110 GHz and digital attenuators can be offered to meet specific application needs. Check the website for additional models.

K

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Attenuation (dB)	Control Speed (ns)	VSWR	Power Handling (W)	Outline
SKA-0831833030-SFSF-A1	8.0 to 18.0	3.0	30	100	1.5:1	0.5	KA-AC
SKA-0831833060-SFSF-A1	8.0 to 18.0	3.0	60	100	2.0:1	0.5	KA-AC
SKA-1832731830-4242-A1	18.0 to 26.5	1.8	30	100	2.0:1	0.2	KA-AK
SKA-3034032530-2828-A1	30.0 to 40.0	2.5	30	100	2.0:1	0.2	KA-AA
SKA-3534532530-2222-A1	35.0 to 45.0	2.5	30	100	2.0:1	0.2	KA-AQ
SKA-4535532830-1919-A1	45.0 to 55.0	2.8	30	100	2.0:1	0.2	KA-AU
SKA-5037533030-1515-A1	50.0 to 75.0	3.0	30	100	2.0:1	0.2	KA-AV
SKA-6039033030-1212-A1	60.0 to 90.0	3.0	30	100	2.0:1	0.2	KA-AE
SKA-7539032520-1010-A1	75.0 to 90.0	2.5	20	100	2.0:1	0.2	KA-AW
SKA-9239633030-1010-A1	92.0 to 96.0	3.0	30	100	2.0:1	0.2	KA-AW

CUSTOM MODELS:

SAGE Millimeter's electrical attenuator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SKA - F1N F2N IL AT - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 60 GHz = 603
F2N is the stop frequency in MHz x 10N. For example: 65 GHz = 653
IL is the insertion loss in 1/10 dB. For example: 2.5 dB = 25
AT is the attenuation value in dB. For example: 20 dB = 20
CI is the input connector type. For example: V(F) = VF
CO is the output connector type. For example: WR-15 = 15
X is the electrical attenuator type. “A” is for analog attenuator, “G” is for general purpose digital attenuator, “P” is for phase stable digital attenuator and “S” is for high speed digital attenuator.
Y is for factory reserve.

Example: SKA-5836832220-1515-A1 is an analog attenuator with an RF frequency range of 58 GHz to 68 GHz, an insertion loss of 2.2 dB and an attenuation value of 20 dB. The electrical attenuator has WR-15 waveguides at the input and output port. “1” is a factory assigned number.

Electrical Phase Shifters, SKP Series

FEATURES:

- Frequency coverage: 2.5 to 18 GHz
- Digital and analog control
- Wide bandwidth

APPLICATIONS:

- Radar systems
- System integrations
- Test instrumentation

DESCRIPTION:

SKP series electrical phase shifters are GaAs PIN diode-based and offered as either digital or analog control types. Analog controlled phase shifters can control the signal's phase continuously to cover up to 360°, while digitally controlled phase shifter can only offer discrete phase shifts, such as 180°, 90°, 45°, 22.5° and 11.25° etc. according to the control bit settings.

The below standard offering covers the frequency range of 2.5 to 18 GHz and addresses specific operation frequencies and package styles. However, custom models can be offered to meet different application needs. Check the website for additional models.

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CATALOG MODELS (Digitally Controlled):

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Minimum Phase Shifting	RMS Phase Error (°)	Control Bits	Bias V/I (V/mA)	VSWR	Outline
SKP-0330430836-SFSF-D1	2.5 to 4.0	8.0	360°	±7	6	+5/10	2.0:1	KP-DC
SKP-0430630836-SFSF-D1	4.0 to 6.0	8.0	360°	±8	6	±5/10	2.0:1	KP-DC
SKP-0831231036-SFSF-D1	8.0 to 12.0	10.0	360°	±5	6	+5/10	2.0:1	KP-DC
SKP-0931030836-SFSF-D1	9.0 to 10.0	8.0	360°	±5	6	+5/10	1.5:1	KP-DC
SKP-0631831436-SFSF-D1	6.0 to 18.0	14.0	360°	±12	6	+5/10	2.8:1	KP-DC
SKP-0631830936-SFSF-D1	6.0 to 18.0	9.0	360°	±11	6	+5/10	2.0:1	KP-DC

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CATALOG MODELS (Analog Controlled):

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Phase Shifting Range (Typ)	Control Voltage Range (V)	VSWR	Outline
SKP-0430830836-SFSF-A1	4.0 to 8.0	8.0	0 to 360°	0 to 10.0	2.0:1	KP-AC
SKP-0831230618-SFSF-A1	8.0 to 12.0	6.0	0 to 180°	0 to 10.0	2.3:1	KP-AC
SKP-0631830818-SFSF-A1	6.0 to 18.0	8.0	0 to 180°	0 to 10.0	2.5:1	KP-AC

CUSTOM MODELS:

SAGE Millimeter's electrical phase shifter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SKP - F1N F2N IL DD - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 6.8 GHz = 682
F2N is the stop frequency in MHz x 10N. For example: 9.8 GHz = 982
IL is the insertion loss in dB. For example: 10 dB = 10
DD is the minimum phase shifting in 10 degrees. For example: 360 degrees = 36
CI is the input connector type. For example: SMA (F) = SF
CO is the output connector type. For example: SMA (M) = SM
X is the phase shifter control type. "A" is for analog controlled and "D" is for digitally controlled.
Y is for factory reserve.

Example: SKP-6829820618-SFSF-D1 is a digitally controlled electrical phase shifter with an RF frequency range of 6.8 to 9.8 GHz, an insertion loss of 6.0 dB and a minimum phase shifting range of up to 180°. The electrical phase shifter has female SMA connectors at the input and output. "1" is a factory assigned number.

Single Pole, Single Throw (SPST) Switches, SKS Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Reflective and absorptive
- Low insertion loss and high isolation
- Control: TTL High

APPLICATIONS:

- Amplitude modulations
- Radar systems
- Communication systems
- System integration

DESCRIPTION:

SKS series single pole, single throw (SPST) switches are discrete or MMIC-based PIN diode switches. The operating frequency of these switches is from 18 to 110 GHz. The switches are reflective. While the TTL driver is internally integrated for switches with a coax configuration, an external TTL driver is provided for switches with a waveguide configuration.

While the below standard models address specific operation frequencies and package styles, custom models, as well as absorptive switches, can be offered to meet different application needs. Check the website for additional models.

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CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	Switching Time (ns)	Power Handling (W)	Bias V/I (V/mA)	VSWR (On State)	Outline
SKS-1832731830-KFKF-R1	18.0 to 26.5	1.8	30	100	0.25	±5.0/20	1.5:1	KS-RC
SKS-2734032030-KFKF-R1	26.5 to 40.0	2.0	30	100	0.25	±5.0/20	1.5:1	KS-RC
SKS-2734032030-2828-R1	26.5 to 40.0	2.0	30	100	0.25	±5.0/20	1.5:1	KS-RA
SKS-1834032030-KFKF-R1	18.0 to 40.0	2.0	30	100	0.25	±5.0/20	1.5:1	KS-RC
SKS-3534532535-2F2F-R1	35.0 to 45.0	2.5	35	100	0.25	±5.0/20	1.5:1	KS-RC
SKS-3534532535-2222-R1	35.0 to 45.0	2.5	35	100	0.25	±5.0/20	1.5:1	KS-RQ
SKS-1835032330-2F2F-R1	18.0 to 50.0	2.3	30	100	0.25	±5.0/20	1.5:1	KS-RC
SKS-4535532525-1919-R1	45.0 to 55.0	2.5	25	100	0.25	±5.0/30	1.5:1	KS-RU
SKS-5037533025-1515-R1	50.0 to 75.0	3.0	25	100	0.25	±5.0/10	1.5:1	KS-RV
SKS-6039033030-1212-R1	60.0 to 90.0	3.0	30	100	0.25	±5.0/10	1.5:1	KS-RE
SKS-9031042825-1010-R1	90.0 to 100.0	2.8	25	100	0.25	±5.0/10	1.5:1	KS-RW

CUSTOM MODELS:

SAGE Millimeter's SPST switch model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SKS - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 10 GHz = 103
F2N is the stop frequency in MHz x 10N. For example: 40 GHz = 403
IL is the insertion loss in 1/10 dB. For example: 2.0 dB = 20
IS is the isolation in dB. For example: 35 dB = 35
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: K(M) = KM
X is the switch type. "A" is absorptive and "R" is reflective.
Y is for factory reserve.

Example: SKS-1034032035-KFKM-R1 is a reflective SPST switch with an RF frequency range of 10 to 40 GHz, an insertion loss of 2.0 dB and an isolation of 35 dB. The SPST has a female and male K connector at the input and output port, respectively. "1" is a factory assigned number.

Single Pole, Double Throw (SPDT) Switches, SKD Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Reflective and absorptive
- Low insertion loss and high isolation
- Control: TTL High

APPLICATIONS:

- Radar systems
- Communication systems
- System integration
- Test instrumentation

DESCRIPTION:

SKD series single pole, double throw (SPDT) switches are discrete or MMIC-based PIN diode switches. The operating frequency of these switches is from 18 to 110 GHz. The switches are reflective. While the TTL driver is internally integrated for switches with a coax configuration, an external TTL driver is provided for switches with a waveguide configuration.

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While the below standard models address specific operation frequencies and package styles, custom models, as well as absorptive switches, can be offered to meet different application needs. Check the website for additional models.

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CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	Switching Time (ns)	Power Handling (W)	Bias V/I (V/mA)	VSWR	Outline
SKD-1832732540-KFKF-R1	18.0 to 26.5	2.5	40	100	0.25	±5.0/20	1.5:1	KD-RC
SKD-2734032735-KFKF-R1	26.5 to 40.0	2.7	35	100	0.25	±5.0/20	1.5:1	KD-RC
SKD-1834034040-KFKF-R1	18.0 to 40.0	4.0	40	100	0.25	±5.0/20	1.5:1	KD-RC
SKD-3335033530-2F2F-R1	33.0 to 50.0	3.5	30	100	0.25	±5.0/20	1.5:1	KD-RC
SKD-1835033530-2F2F-R1	18.0 to 50.0	3.5	30	100	0.25	±5.0/20	1.5:1	KD-RC
SKD-4535532525-1919-R1	45.0 to 55.0	2.5	25	100	0.25	±5.0/30	1.5:1	KD-RU
SKD-5536532725-1515-R1	55.0 to 65.0	2.7	25	100	0.25	±5.0/30	1.5:1	KD-RV
SKD-7538533025-1212-R1	75.0 to 85.0	3.0	25	100	0.25	±5.0/30	1.5:1	KD-RE
SKD-9031045030-1010-R1	90.0 to 100.0	5.0	30	100	0.25	±5.0/10	1.5:1	KD-RWM

CUSTOM MODELS:

SAGE Millimeter's SPDT switch model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SKD - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 10 GHz = 103
F2N is the stop frequency in MHz x 10N. For example: 40 GHz = 403
IL is the insertion loss in 1/10 dB. For example: 2.0 dB = 20
IS is the isolation in dB. For example: 35 dB = 35
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: K(M) = KM
X is for switch type. "A" is absorptive and "R" is reflective.
Y is for factory reserve.

Example: SKD-1034032235-KFKM-R1 is a reflective SPDT switch with an RF frequency range of 10 to 40 GHz, an insertion loss of 2.2 dB and an isolation of 35 dB. The SPST has a female and male K connector at the input and output port, respectively. "1" is a factory assigned number.

Single Pole, Four Throw (SP4T) Switches, SK4 Series

FEATURES:

- Frequency coverage: 18 to 81 GHz
- Reflective and absorptive
- Low insertion loss and high isolation
- Control: TTL High

APPLICATIONS:

- Radar systems
- Communication systems
- System integration
- Test instrumentation

DESCRIPTION:

SK4 series single pole, four throw (SP4T) switches are discrete or MMIC-based PIN diode switches. The operating frequency of these switches is from 18 to 110 GHz. The switches are reflective. While the TTL driver is internally integrated for switches with a coax configuration, an external TTL driver is provided for switches with a waveguide configuration.

While the below standard models address specific operation frequencies and package styles, custom models, as well as absorptive switches, can be offered to meet different application needs. Check the website for additional models.

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CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	Switching Time (ns)	Power Handling (W)	Bias V/I (V/mA)	VSWR	Outline
SK4-1832734035-KFKF-R1	18.0 to 26.5	4.0	35	100	0.25	±5.0/20	2.0:1	K4-RC
SK4-2734035540-KFKF-R1	26.5 to 40.0	5.5	40	100	0.25	±5.0/20	2.0:1	K4-RC
SK4-1834034530-KFKF-R1	18.0 to 40.0	4.5	30	100	0.25	±5.0/20	2.0:1	K4-RC
SK4-3335035030-2F2F-R1	33.0 to 50.0	5.0	30	100	0.25	±5.0/20	2.0:1	K4-RC
SK4-1835035030-2F2F-R1	18.0 to 50.0	5.0	30	100	0.25	±5.0/20	2.0:1	K4-RC
SK4-4535535530-1919-R1	45.0 to 55.0	5.5	30	100	0.25	±5.0/30	2.0:1	K4-RU
SK4-5536536530-1515-R1	55.0 to 65.0	6.5	30	100	0.25	±5.0/30	2.0:1	K4-RV-2
SK4-5037536530-1515-R1	50.0 to 75.0	6.5	30	100	0.25	±5.0/30	2.0:1	K4-RV-2
SK4-7238139030-1212-R1	72.0 to 81.0	8.0	30	100	0.25	±5.0/75	2.0:1	K4-RE-2

CUSTOM MODELS:

SAGE Millimeter's SP4T switch model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SK4 - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 10 GHz = 103
F2N is the stop frequency in MHz x 10N. For example: 40 GHz = 403
IL is the insertion loss in 1/10 dB. For example: 3.0 dB = 30
IS is the isolation in dB. For example: 30 dB = 30
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: K(M) = KM
X is for switch type. "A" is absorptive and "R" is reflective.
Y is for factory reserve.

Example: SK4-1034033230-KFKM-R1 is a reflective SP4T switch with an RF frequency range of 10 to 40 GHz, an insertion loss of 3.2 dB and an isolation of 30 dB. The SP4T has a female and male K connector at the input and output port, respectively. "1" is a factory assigned number.

Control Devices Application Notes

Microwave and millimeterwave control devices are key components in radar, communication and test systems. In general, control devices include electrical attenuators, power limiters, phase shifters and switches. The control devices offered in this catalog are PIN-diode or MMIC based. The followings are concepts, terms and definitions that are widely used and accepted in the industry.

Electrical Attenuator:

Electrical attenuators are used to control signal levels and are offered with either analog or digital controls.

Analog Controlled Attenuator:

Analog controlled attenuators have attenuation values that are continuously controlled by the applied current.

Digitally Controlled Attenuator:

Digitally controlled attenuators have attenuation values that are digitally controlled by the bits. For example, if the attenuation range is 64 dB and the bit size is 6, the attenuation step size is 1 dB.

Phase Stability:

Phase stability is used to measure the phase variation of an electrical attenuator while the attenuation values are adjusted. High phase stablility attenuators are designed to achieve a near constant phase during attenuation adjustments.

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Electrical Limiter:

An **electrical limiter** has a negligible insertion loss when the applied power level is below the threshold. However, its insertion loss will increase dramatically once the applied power level exceeds the threshold. In other words, the limiter's output power level is independent from the input power once "triggered". This feature is desirable when over power protection is required, such as for low noise amplifiers or mixers in a communication or radar system.

Leaking Power:

Leaking power is the output power after an electrical limiter is "triggered", which is when the input power exceeds the desired value.

Power handling:

Power handling is the maximum input power that a device can sustain without being damaged.

Recovery time:

Recovery time is the time it takes for the insertion loss of an electrical limiter to return from the "triggered" stage to 3 dB higher than the normal insertion loss. The shorter the recovery time, the better. The recovery time can range from 100 ns to 2 µs. During the recovery time, the system is "blind".

Electrical Phase Shifter:

An **electrical phase shifter** is a device that can cause a signal phase change when an external voltage is applied. Phase shifters are offered with either analog or digital controls.

Analog Controlled Phase Shifter

Analog controlled phase shifters have phase shifting values that are continuously controlled by the applied voltage.

Digital Controlled Phase Shifter:

Digital controlled phase shifters have phase shifting values that are digitally controlled by the bits. For example, if the phase shifting range is 360° and the bit size is 5, the phase shifting step size is 11.25°.

PIN Diode Switch:

PIN diode switches are used to electrically direct signals through an applied voltage/current. Various types of switches, such as single pole, single throw (SPST), single pole, double throw (SPDT), etc. are offered. Both absorptive and reflective switches are widely used in the industry.

Absorptive Switch:

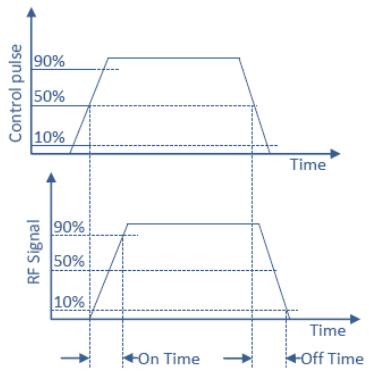
Absorptive switches exhibit low VSWR in both "on" and "off" states. In general, these switches offer lower insertion loss and cost less than reflective switches.

Reflective Switch:

Reflective switches only exhibit low VSWR in the "on" state since the "off" state is achieved by shortening the RF signal's transmission path.

Switching Time:

Switching time refers to the "on" time and "off" time. As illustrated on the right, the "on" time begins when a 50% control pulse is applied and ends when 90% of the RF signal is achieved. On the other hand, the "off" time begins when the control pulse drops below 50% and ends when 90% of the RF signal disappears. The switching time is related to the PIN diode and TTL driver.



Iso-adapters, SNA Series

FEATURES:

- Frequency coverage: 8.2 to 110.0 GHz
- Up to full waveguide operations
- Low insertion loss and high isolation
- Common radar and communication bands

APPLICATIONS:

- Module integration
- Instrumentation
- System integration

DESCRIPTION:

SNA series coaxial to waveguide or waveguide to coaxial iso-adapters are designed and manufactured to provide low insertion loss and high isolation for system integrations where a transition from a coaxial to waveguide or waveguide to coaxial interface is required. Various coaxial connector types, such as SMA, K, 2.4 mm, V and 1 mm can be configured. The below standard offering covers the frequency range of 8.2 to 110 GHz and focuses on full band or common radar and communication applications. The input and output ports can be easily switched by reversing the isolator's direction. Search SAGE Millimeter's website for models not listed.

CATALOG MODELS:

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Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR	Forward Power Handling (W)	Input Connector	Output Connector
SNA-8221230518-90SF-S1	8.2 to 12.4	0.5	18	1.3:1	10	WR-90	SMA(F)
SNA-1231830518-62SF-S1	12.0 to 18.0	0.5	18	1.3:1	10	WR-62	SMA(F)
SNA-1832730516-42KF-S1	18.0 to 26.5	0.5	16	1.4:1	2	WR-42	K(F)
SNA-2734030616-28KF-S1	26.5 to 40.0	0.6	16	1.4:1	2	WR-28	K(F)
SNA-2833230520-28KF-S1	28.0 to 32.0	0.5	20	1.2:1	2	WR-28	K(F)
SNA-3333730620-28KF-S1	33.0 to 37.0	0.6	20	1.2:1	2	WR-28	K(F)
SNA-3734030620-28KF-S1	37.0 to 40.0	0.6	20	1.2:1	2	WR-28	K(F)
SNA-4034430718-222F-S1	40.0 to 44.0	0.7	18	1.3:1	2	WR-22	2.4 mm (F)
SNA-4935130818-19VF-S1	49.0 to 51.0	0.8	18	1.3:1	2	WR-19	V (F)
SNA-5936131018-15VF-S1	59.0 to 61.0	1.0	18	1.3:1	2	WR-15	V (F)
SNA-7137631218-121F-S1	71.0 to 76.0	1.2	18	1.3:1	2	WR-12	1.0 mm (F)
SNA-7638131218-121F-S1	76.0 to 81.0	1.2	18	1.3:1	2	WR-12	1.0 mm (F)
SNA-8138631218-121F-S1	81.0 to 86.0	1.2	18	1.3:1	2	WR-12	1.0 mm (F)
SNA-9339531518-101F-S1	93.0 to 95.0	1.5	18	1.3:1	2	WR-10	1.0 mm (F)

CUSTOM MODELS:

SAGE Millimeter's iso-adapter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SNA - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 37.0 GHz = 373
F2N is the stop frequency in MHz x 10N. For example: 40.0 GHz = 403
IL is the insertion loss in 1/10 dB. For example: 0.3 dB = 03
IS is the isolation in dB. For example: 18 dB = 18
CI is the input connector type. For example: WR-28 = 28
CO is the output connector type. For example: SMA(F) = SF
X is the isolator type. "S" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SNA-4234630716-222F-C1 is a custom iso-adapter with a frequency range of 42 to 46 GHz, an insertion loss of 0.7 dB and an isolation of 16 dB. The iso-adapter has a WR-22 waveguide at the input port and a female 2.4 mm connector at the output port. "1" is a factory assigned number.

Coaxial Isolators and Circulators, SNC Series

FEATURES:

- Frequency coverage: 8.0 to 40.0 GHz
- Broad bandwidth
- Low insertion loss and high isolation

APPLICATIONS:

- Port isolation
- Module integration
- Instrumentation

DESCRIPTION:

SNC series coaxial isolators and circulators are designed and manufactured to provide low insertion loss and high isolation for system integration applications. While the isolator is an important device where port isolation and VSWR are concerned, the circulator offers duplexing functions in many radar and communication systems. The below standard offering addresses specific operation frequencies and package styles. Search SAGE Millimeter's website for models not listed.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR	Forward Power Handling (W)	Type
SNC-0831230520-SFSF-I1	8.0 to 12.0	0.5	20	1.35:1	10	Isolator
SNC-0631831512-SFSF-I1	6.0 to 18.0	1.5	12	1.80:1	10	Isolator
SNC-0831831015-SFSF-I1	8.0 to 18.0	1.0	15	1.40:1	10	Isolator
SNC-1031530520-SFSF-I1	10.0 to 15.0	0.5	20	1.25:1	10	Isolator
SNC-1231830520-SFSF-I1	12.0 to 18.0	0.5	20	1.35:1	10	Isolator
SNC-1832731512-SFSF-I1	18.0 to 26.5	1.5	12	1.50:1	10	Isolator
SNC-2233331615-KFKF-I1	22.0 to 33.0	1.6	15	1.50:1	10	Isolator
SNC-2734031614-KFKF-I1	26.5 to 40.0	1.6	14	1.60:1	10	Isolator
SNC-0831230517-SFSF-C1	8.0 to 12.0	0.5	17	1.35:1	10	Circulator
SNC-0831831015-SFSF-C1	8.0 to 18.0	1.0	15	1.40:1	10	Circulator
SNC-1231830521-SFSF-C1	12.0 to 18.0	0.5	21	1.40:1	10	Circulator
SNC-1832731512-SFSF-C1	18.0 to 26.5	1.5	12	1.50:1	10	Circulator
SNC-2233331615-KFKF-C1	22.0 to 33.0	1.6	15	1.50:1	10	Circulator
SNC-2734031614-KFKF-C1	26.5 to 40.0	1.6	14	1.60:1	10	Circulator

CUSTOM MODELS:

SAGE Millimeter's coaxial isolator and circulator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SNC - F1N F2N IL IS - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 14.0 GHz = 143
F2N is the stop frequency in MHz x 10N. For example: 15.0 GHz = 153
IL is the insertion loss in 1/10 dB. For example: 0.3 dB = 03
IS is the isolation in dB. For example: 23 dB = 23
CI is the input connector type. For example: SMA(F) = SF
CO is the output connector type. For example: SMA(M) = SM. For circulators, CO is the port 2 and 3 connector type.
X: "I" is for isolator and "C" is for circulator.
Y is for factory reserve.

Example: SNC-1431830323-SFSM-I1 is a coaxial isolator with a frequency range of 14 to 18 GHz, an insertion loss of 0.3 dB and an isolation of 23 dB. The isolator has a female SMA connector at the input port and a male SMA connector at the output port. "1" is a factory assigned number.

Full Waveguide Band Isolators and Circulators, SNF Series

FEATURES:

- Frequency coverage: 8.2 to 40.0 GHz
- Full waveguide band operation
- Low insertion loss and high isolation
- Rugged configuration and compact design

APPLICATIONS:

- Instrumentation
- Module integration
- Lab test setups

DESCRIPTION:

SNF series full waveguide band isolators and circulators are offered to cover the frequency range of 8.2 to 40 GHz. These isolators and circulators are designed and manufactured to provide low insertion loss and high isolation across full waveguide bands. Compared with Faraday isolators, these full waveguide band isolators offer lower insertion loss and a shorter insertion length. While these isolators are an important device when port isolation or VSWR are critical, the full waveguide band circulators offer unique duplexing functions for radar and communication systems. Search SAGE Millimeter's website for models not listed.

CATALOG MODELS:

N

Band	WG	Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)[1]	VSWR	Forward Power Handling (W)	Load Power Handling (W)[2]	Type
X	WR-90	SNF-90-I1	8.2 to 12.4	0.5	17	1.35:1	10	0.5	Isolator
X	WR-90	SNF-90-I2	8.2 to 12.4	0.5	17	1.35:1	10	2.0	Isolator
WR-75	WR-75	SNF-75-I1	10.0 to 15.0	0.5	18	1.35:1	5	0.5	Isolator
WR-75	WR-75	SNF-75-I2	10.0 to 15.0	0.5	18	1.35:1	5	2.0	Isolator
Ku	WR-62	SNF-62-I1	12.4 to 18.0	0.5	17	1.35:1	5	0.5	Isolator
K	WR-42	SNF-42-I1	18.0 to 26.5	0.5	16	1.40:1	2	0.5	Isolator
WR-34	WR-34	SNF-34-I1	22.0 to 33.0	0.5	16	1.40:1	2	0.5	Isolator
Ka	WR-28	SNF-28-I1	26.5 to 40.0	0.5	16	1.40:1	2	0.5	Isolator
X	WR-90	SNF-90-C1	8.2 to 12.4	0.5	17	1.35:1	10	N/A	Circulator
WR-75	WR-75	SNF-75-C1	10.0 to 15.0	0.5	18	1.35:1	10	N/A	Circulator
Ku	WR-62	SNF-62-C1	12.4 to 18.0	0.5	17	1.35:1	5	N/A	Circulator
K	WR-42	SNF-42-C1	18.0 to 26.5	0.5	16	1.40:1	5	N/A	Circulator
WR-34	WR-34	SNF-34-C1	22.0 to 33.0	0.5	16	1.40:1	2	N/A	Circulator
Ka	WR-28	SNF-28-C1	26.5 to 40.0	0.5	16	1.40:1	2	N/A	Circulator

N

Note: 1) For higher isolation, see the STF Series, Full Band Faraday Isolators.
2) Load power handling is only applicable to circulators.
3) For higher power handling, contact the factory.

CUSTOM MODELS:

SAGE Millimeter's full band isolators and circulators model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SNF - WG - XY

WG is the waveguide size. For example: WR-19 = 19
X: "I" is for isolator and "C" is for circulator.
Y is for factory reserve.

Example: SNF-22-I1 is an isolator with a frequency range of 33 to 50 GHz, an insertion loss of 0.5 dB and an isolation of 16 dB. The isolator has WR-22 waveguides. "1" is a factory assigned number.

Waveguide Junction Isolators and Circulators, SNW Series

FEATURES:

- Frequency coverage: 8.2 to 110.0 GHz
- Broad bandwidth
- Low insertion loss and high isolation
- Compact configuration

APPLICATIONS:

- Port isolation
- Module integration

DESCRIPTION:

SNW series waveguide junction isolators and circulators are designed and manufactured to provide low insertion loss and high isolation for waveguide based module integrations. While the isolator is an important device where port isolation and VSWR are concerned, the circulator offers duplexing functions for radar and communication systems. The below standard offering addresses specific operation frequencies and package styles. Search SAGE Millimeter's website for models not listed.

CATALOG MODELS (Isolators):

Band	WG Size	Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR	Forward Power (W)	Load Power (W)	Outline
X	WR-90	SNW-8529620320-90-I1	8.5 to 9.6	0.3	20	1.25:1	10	0.5	NW-IX
X	WR-90	SNW-0931030320-90-I1	9.0 to 10.0	0.3	20	1.25:1	10	0.5	NW-IX
X	WR-90	SNW-1031130320-90-I1	10.0 to 11.0	0.3	20	1.25:1	10	0.5	NW-IX
WR-75	WR-75	SNW-1231330320-75-I1	11.5 to 12.5	0.3	20	1.25:1	10	0.5	NW-I7
WR-75	WR-75	SNW-1331430320-75-I1	12.5 to 13.5	0.3	20	1.25:1	10	0.5	NW-I7
Ku	WR-62	SNW-1331530418-62-I1	12.7 to 15.2	0.4	18	1.30:1	5	0.5	NW-I6
Ku	WR-62	SNW-1631730320-62-I1	16.0 to 17.0	0.3	20	1.25:1	5	0.5	NW-I6
WR-51	WR-51	SNW-1832130318-51-I1	18.0 to 21.0	0.3	18	1.25:1	5	0.5	NW-I5
K	WR-42	SNW-1831930320-42-I1	17.7 to 19.2	0.3	20	1.25:1	5	0.5	NW-IK
K	WR-42	SNW-2132430418-42-I1	21.2 to 23.6	0.3	18	1.30:1	5	0.5	NW-IK
K	WR-42	SNW-2332530320-42-I1	23.0 to 25.0	0.3	20	1.25:1	5	0.5	NW-IK
WR-34	WR-34	SNW-2532830320-34-I1	25.0 to 27.5	0.3	20	1.25:1	2	0.5	NW-I3
WR-34	WR-34	SNW-2733130318-34-I1	27.3 to 31.3	0.3	18	1.35:1	2	0.5	NW-I3
Ka	WR-28	SNW-2733230318-28-I1	27.0 to 32.0	0.3	18	1.35:1	2	0.5	NW-IA
Ka	WR-28	SNW-3233430320-28-I1	32.0 to 34.0	0.3	20	1.25:1	2	0.5	NW-IA
Ka	WR-28	SNW-3433630320-28-I1	34.0 to 36.0	0.3	20	1.25:1	2	0.5	NW-IA
Ka	WR-28	SNW-3734030320-28-I1	37.0 to 40.0	0.3	20	1.25:1	2	0.5	NW-IA
Q	WR-22	SNW-3834030420-22-I1	38.0 to 40.0	0.4	20	1.25:1	1	0.5	NW-IQ
Q	WR-22	SNW-4034430418-22-I1	40.0 to 44.0	0.4	18	1.30:1	1	0.5	NW-IQ
Q	WR-22	SNW-4234630418-22-I1	42.0 to 46.0	0.4	18	1.30:1	1	0.5	NW-IQ
U	WR-19	SNW-4935130520-19-I1	49.0 to 51.0	0.5	20	1.30:1	1	0.5	NW-IU
V	WR-15	SNW-5435630818-15-I1	54.0 to 56.0	0.8	18	1.30:1	1	0.5	NW-IV
V	WR-15	SNW-5936130818-15-I1	59.0 to 61.0	0.8	18	1.30:1	1	0.5	NW-IV
E	WR-12	SNW-7137630818-12-I1	71.0 to 76.0	0.8	18	1.30:1	1	0.5	NW-IE
E	WR-12	SNW-7638130818-12-I1	76.0 to 81.0	0.8	18	1.30:1	1	0.5	NW-IE
E	WR-12	SNW-8138630818-12-I1	81.0 to 86.0	0.8	18	1.30:1	1	0.5	NW-IE
W	WR-10	SNW-8338531018-10-I1	83.0 to 85.0	1.0	18	1.40:1	1	0.5	NW-IW
W	WR-10	SNW-9339531018-10-I1	93.0 to 95.0	1.0	18	1.40:1	1	0.5	NW-IW

CATALOG MODELS (Circulators):

Band	WG Size	Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR	Forward Power (W)	Load Power (W)	Outline
X	WR-90	SNW-8529620320-90-C1	8.5 to 9.6	0.3	20	1.25:1	10	0.5	NW-CX
X	WR-90	SNW-0931030320-90-C1	9.0 to 10.0	0.3	20	1.25:1	10	0.5	NW-CX
X	WR-90	SNW-1031130320-90-C1	10.0 to 11.0	0.3	20	1.25:1	10	0.5	NW-CX
WR-75	WR-75	SNW-1231330320-75-C1	11.5 to 12.5	0.3	20	1.25:1	10	0.5	NW-C7
WR-75	WR-75	SNW-1331430320-75-C1	12.5 to 13.5	0.3	20	1.25:1	10	0.5	NW-C7
Ku	WR-62	SNW-1331530418-62-C1	12.7 to 15.2	0.4	18	1.30:1	5	0.5	NW-C6
Ku	WR-62	SNW-1631730320-62-C1	16.0 to 17.0	0.3	20	1.25:1	5	0.5	NW-C6
WR-51	WR-51	SNW-1832130318-51-C1	17.7 to 21.2	0.3	18	1.25:1	5	0.5	NW-C5
K	WR-42	SNW-1831930320-42-C1	17.7 to 19.2	0.3	20	1.25:1	5	0.5	NW-CK
K	WR-42	SNW-2132430318-42-C1	21.2 to 23.6	0.3	18	1.30:1	5	0.5	NW-CK
K	WR-42	SNW-2332530320-42-C1	23.0 to 25.0	0.3	20	1.25:1	5	0.5	NW-CK
WR-34	WR-34	SNW-2532830320-34-C1	25.0 to 27.5	0.3	20	1.25:1	2	0.5	NW-C3
WR-34	WR-34	SNW-2733130318-34-C1	27.3 to 31.3	0.3	18	1.35:1	2	0.5	NW-C3
Ka	WR-28	SNW-2733230318-28-C1	27.0 to 32.0	0.3	18	1.35:1	2	0.5	NW-CA
Ka	WR-28	SNW-3233430320-28-C1	32.0 to 34.0	0.3	20	1.25:1	2	0.5	NW-CA
Ka	WR-28	SNW-3433630320-28-C1	34.0 to 36.0	0.3	20	1.25:1	2	0.5	NW-CA
Ka	WR-28	SNW-3734030320-28-C1	37.0 to 40.0	0.3	20	1.25:1	2	0.5	NW-CA
Q	WR-22	SNW-3834030420-22-C1	38.0 to 40.0	0.4	20	1.25:1	1	0.5	NW-CQ
Q	WR-22	SNW-4034430418-22-C1	40.0 to 44.0	0.4	18	1.30:1	1	0.5	NW-CQ
Q	WR-22	SNW-4234630418-22-C1	42.0 to 46.0	0.4	18	1.30:1	1	0.5	NW-CQ
U	WR-19	SNW-4935130520-19-C1	49.0 to 51.0	0.5	20	1.30:1	1	0.5	NW-CU
V	WR-15	SNW-5435630818-15-C1	54.0 to 56.0	0.8	18	1.30:1	1	0.5	NW-CV
V	WR-15	SNW-5936130818-15-C1	59.0 to 61.0	0.8	18	1.30:1	1	0.5	NW-CV
E	WR-12	SNW-7137630818-12-C1	71.0 to 76.0	0.8	18	1.30:1	1	0.5	NW-CE
E	WR-12	SNW-7638130818-12-C1	76.0 to 81.0	0.8	18	1.30:1	1	0.5	NW-CE
E	WR-12	SNW-8138630818-12-C1	81.0 to 86.0	0.8	18	1.30:1	1	0.5	NW-CE
W	WR-10	SNW-8338531018-10-C1	83.0 to 85.0	1.0	18	1.40:1	1	0.5	NW-CW
W	WR-10	SNW-9339531018-10-C1	93.0 to 95.0	1.0	18	1.40:1	1	0.5	NW-CW

Note: Contact factory for specifications other than those listed.

CUSTOM MODELS:

SAGE Millimeter's waveguide junction isolator and circulator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SNW - F1N F2N IL IS - WG - XY

F1N is the start frequency in MHz x 10N. For example: 96.0 GHz = 963
F2N is the stop frequency in MHz x 10N. For example: 97.0 GHz = 973
IL is the insertion loss in 1/10 dB. For example: 0.8 dB = 08
IS is the isolation in dB. For example: 20 dB = 20
WG is the waveguide size. For example: WR-10 = 10
X: "I" is for isolator and "C" is for circulator.
Y is for factory reserve.

Example: SNW-9639730820-10-I1 is a waveguide junction isolator with a frequency range of 96 to 97 GHz, an insertion loss of 0.8 dB and an isolation of 20 dB. The isolator has a WR-10 waveguide. "1" is a factory assigned number.

Ferrite Device Application Notes

Microwave and millimeterwave ferrite devices are important components in radar, communication and test systems. In general, ferrite devices include isolators and circulators. The following are concepts, terms and definitions that are widely used and accepted in the industry.

Ferrite Device:

Ferrite devices generally refer to non-reciprocal devices, such as isolators and circulators. These devices use ferrite magnets that cause electrical signals to travel in one direction with minimal loss.

Circulator:

A **circulator**, in principle, can have many ports, but the three-port Y junction circulator is the most commonly used in the industry. Circulators have low insertion loss in the forward direction (port 1 → port 2 → port 3) and high isolation in the reverse direction (port 3 → port 2 → port 1). Circulators are mainly used as a duplexer in radar and communication systems where a single antenna is shared for both transmitter and receiver channels.

Isolator:

An **isolator** is a two-port device. Isolators have low insertion loss in the forward direction (port 1 → port 2) and high isolation in the reverse direction (port 2 → port 1). Isolators are mainly used for port isolation to prevent signals from being reflected.

Iso-adapter:

An **iso-adapter** is a device that provides an interface transition, such as from coaxial to waveguide, as well as port isolation.

Faraday Isolator:

A **Faraday isolator** is constructed based on the Faraday EM field rotation principle. Faraday isolators offer high isolation across full wave guide bands with a superior phase performance. Faraday isolators are offered under the test equipment section of this catalog.

Full Waveguide Band Isolator and Circulator:

Full waveguide band isolators and circulators are cavity-type, non-reciprocal devices. They have the same mechanical configuration as wave guide junction isolators and circulators but cover full waveguide bands. For example, a Ka-band full waveguide isolator or circulator has an operating bandwidth of 26.5 to 40 GHz, which covers the full WR-28 frequency range.

Microstrip Line Isolator and Circulator:

Microstrip line isolators and circulators are non-reciprocal devices that have a thin film circuit printed on a ferrite substrate and a magnet placed on the junction to move the signal in a forward direction. The devices have two mechanical configurations: substrate only and substrate on carrier. The characteristic impedance of these isolators and circulators is 50 Ω.

Drop-in Isolator and Circulator:

Drop-in isolators and circulators are non-reciprocal devices with tabs as input and output ports for easy subassembly and module circuit inte gration. The characteristic impedance of these isolators and circulators is 50 Ω.

Waveguide Junction Isolator and Circulator:

Waveguide junction isolators and circulators are cavity-type devices. The signal circulation occurs in the center of the “Y” junction, where a ferrite puck is placed and a uniform magnetic field is formed by a pair of magnets. These devices have a waveguide interface.

Insertion Loss:

Insertion loss is the circuit loss that occurs when signals travel in a forward direction. It is caused by the resistive and dielectric losses of the path.

Isolation:

Isolation is the measure of an isolator’s ability to behave non-reciprocally when signals move in a reverse direction.

Forward Power Handling:

Forward power handling is the power handling capacity of a device when signals travel in a forward direction.

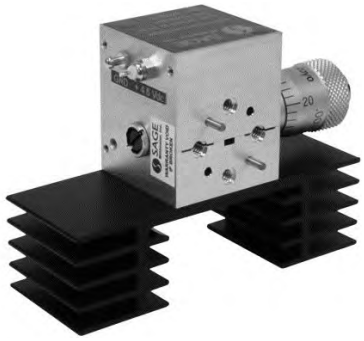
Load Power Handling:

Load power handling is the power handling capacity of a device when signals travel in a reverse direction.

Mechanically Tuned Gunn Oscillators, SOM Series

FEATURES:

- Frequency coverage: 8.2 to 140.0 GHz
- Tuning bandwidth up to full waveguide band
- Low AM/FM noise and harmonics
- Bias tunable



APPLICATIONS:

- Test sources
- Signal generation
- Lab test setups

DESCRIPTION:

SOM series mechanically tuned Gunn oscillators utilize high performance GaAs Gunn diodes and various cavity designs to deliver moderate output power with low AM/FM noise and harmonic emissions. Compared to their counterparts, such as multiplier based sources, Gunn oscillators offer a broader mechanical tuning capability and lower cost solution. The standard offering covers the frequency range of 8.2 to 140 GHz. While standard models are equipped with a micrometer for bench test purpose, models with a self-locking set screw are also available for system integration. The performance of the oscillator can be further enhanced by adding an optional isolator, Gunn oscillator modulator/regulator and temperature heater.

ELECTRICAL SPECIFICATIONS:

Frequency Band	X	Ku	K	Ka	Q	U	V	E	W	F
Waveguide Size	WR-90	WR-62	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
Frequency Range (GHz)	8.2 to 12.4	12.0 to 18.0	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Output Power Range (dBm)	10 to 27	10 to 27	10 to 27	10 to 23	10 to 23	10 to 20	5 to 20	3 to 19	3 to 19	0 to 17
Mechanical Tuning Bandwidth (GHz)	0.5 to 2.0	0.5 to 3.0	0.5 to 4.0	0.5 to 10.0	0.5 to 10.0	0.5 to 10.0	0.5 to 20.0	0.5 to 20.0	0.5 to 20.0	0.5 to 20.0
Bias Tuning Bandwidth (MHz/V)	5 to 25	10 to 25	10 to 50	10 to 50	25 to 100	25 to 100	50 to 250	50 to 500	50 to 750	50 to 750
Harmonics (dBc)	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20
Phase Noise (dBc/Hz @ 100 KHz offset)	-90	-90	-90	-90	-85	-82	-80	-78	-75	-70
Frequency Stability (MHz/°C)	-0.5	-0.8	-1.0	-2.0	-3.0	-3.5	-4.0	-4.5	-5.0	-6.0
Power Stability (dB/°C)	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03
Bias Voltage Range (Volts)	8 to 10	6 to 8	5 to 8	4 to 6	4 to 8	4 to 10	4 to 10	4 to 10	4 to 10	4 to 10
Bias Current Range (Amps)	0.3 to 2.0	0.3 to 2.0	0.3 to 2.0	0.3 to 2.0	0.3 to 1.5	0.3 to 1.5	0.3 to 1.0	0.3 to 1.0	0.3 to 1.0	0.3 to 1.0
Outline	OM-MX	OM-M6	OM-MK	OM-MA	OM-MQ	OM-MU	OM-MV	OM-ME	OM-MW	OM-MF

CUSTOM MODELS:

SAGE Millimeter's mechanically tuned Gunn oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOM - F0N BWN PP - CO - XY

F0N is the center frequency in MHz x 10N. For example: 37.0 GHz = 373
BWN is the tuning bandwidth in MHz x 10N. For example: 4.0 GHz = 043
PP is the output power in dBm. For example: 23 dBm = 23
CO is the RF output connector type. For example: WR-28 = 28
X is the tuning type. "M" is for micrometer tuned and "S" is for screw tuned.
Y is for factory reserve.

Example: SOM-37304320-28-M1 is a mechanically tuned Gunn oscillator with a center frequency of 37 GHz, a mechanical tuning bandwidth of 4 GHz and an output power of 20 dBm. The oscillator has a WR-28 waveguide at the RF output port and is micrometer tuned. "1" is a factory assigned number.

Wide Mechanical Tuning Bandwidth Gunn Oscillators, SOF Series

FEATURES:

- Frequency coverage: Ka to W Band
- Tuning bandwidth near full waveguide band
- Low AM/FM noise and harmonics
- Bias tuning ability

APPLICATIONS:

- Test sources
- Lab test setups
- Broad band systems

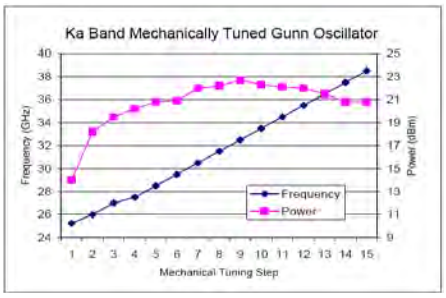
DESCRIPTION:

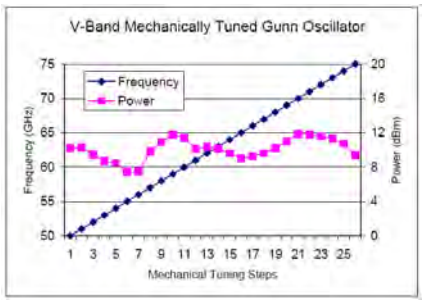
SOF series wide mechanical tuning bandwidth Gunn oscillators utilize high performance GaAs Gunn diodes and various cavity designs to yield near full band frequency coverage. Unlike dual-tuner oscillators, frequency and power optimization are accomplished by a single micrometer. Furthermore, these oscillators can be modified into electrically tunable oscillators by replacing the micrometer with an electrical actuator. The wide tuning bandwidth of these oscillators offers a low cost, high performance means of signal generation, making them ideal test sources for labs and antenna ranges. While standard models offer a waveguide interface, a coaxial interface is also available. When used with a Gunn oscillator regulator/modulator (SOR series), these oscillators can produce AM or FM modulated signals for many test applications.

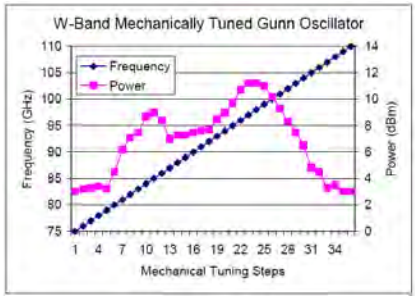
CATALOG MODELS:

Model Numbers	SOF-2820-M1	SOF-2220-M1	SOF-1917-M1	SOF-1507-M1	SOF-1205-M1	SOF-1003-M1
Frequency Band	Ka	Q	U	V	E	W
Waveguide Size	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Coverage (GHz), Typical	27 to 37	33 to 43	44 to 56	56 to 72	65 to 85	80 to 110
Output Power Range (dBm), Typical	18 to 20	18 to 20	17 to 20	3 to 7	0 to 5	0 to 3
Harmonics (dBc), Typical	-20	-20	-20	-20	-20	-20
Phase Noise (dBc/Hz @ 100 KHz offset)	-90	-90	-90	-90	-90	-90
Bias Voltage (Volts), Typical	5.0	5.0	5.0	5.0	5.0	5.0
Bias Current (Amps), Typical	0.8	0.7	0.7	1.0	1.0	1.0
Outline	OF-MA	OF-MQ	OF-MU	OF-MV	OF-ME	OF-MW

TYPICAL TUNING CURVES:







CUSTOM MODELS:

SAGE Millimeter's wide mechanical tuning bandwidth Gunn oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOF - CO PP - XY

CO is the RF output connector type. For example: WR-28 = 28
PP is the output power in dBm. For example: 23 dBm = 23
X is the tuning type. "M" is for micrometer tuned and "S" is for screw tuned.
Y is for factory reserve.

Example: SOF-2813-M1 is a wide mechanical tuning bandwidth Gunn oscillator with an output power of 13 dBm. The oscillator has a WR-28 waveguide at the RF output port and is micrometer tuned. "1" is a factory assigned number.

Gunn Oscillator Regulator SOR Series

FEATURES:

- Highly regulated and precise output voltage
- Low ripple to reduce AM modulation

APPLICATIONS:

- Lab test setups
- Gunn oscillator protection
- Gunn oscillator enhancement

DESCRIPTION:

SOR series Gunn oscillator regulators are offered to either protect or enhance the characteristics and functionalities of Gunn oscillators. The well-regulated, low ripple bias voltage supplied by the regulator prevents damage from overvoltage and reduces the signal amplitude and frequency modulations caused by the ripples of the bias.

CATALOG MODEL:

Product Name	Gunn Oscillator Regulator
Model Number	SOR-R3
Input Voltage (V_{DC}), Typical	+15 V_{DC}
Output Voltage Range (V_{DC})	+3.0 to +12.0 V_{DC}
Output Current Capacity (A)	2.5 A
Ripple and noise (20 Hz to 20 MHz), Typical	350 µV rms, 2 mVp-p
Internal Modulation Waveform	N/A
Internal Modulation Rate (KHz)	N/A
External Modulation Waveform	N/A
External Modulation Rate (KHz), Maximum	N/A
External Modulation Amplitude (Volts)	N/A
Input Connectors	Banana Jack
Output Connector	SMA (F)
External Modulation Input Connector	BNC (F)
Outline	OR-R3

Note: The regulator is designed for biasing Gunn diodes only.

Varactor Tuned Gunn Oscillators, SOV Series

FEATURES:

- Frequency coverage: 8.2 to 110.0 GHz
- Low AM/FM noise and harmonics
- High tuning rate
- Mechanical tuning ability

APPLICATIONS:

- FMCW radar systems
- Communication systems
- Phase locked loops

DESCRIPTION:

SOV series Varactor tuned Gunn oscillators utilize high performance GaAs Gunn diodes and various cavity configurations to deliver moderate output power with low AM/FM noise and harmonic emissions. The oscillators are specially designed for a broader tuning bandwidth and an electrical tuning capability. The standard offering covers the frequency range of 8.2 to 110 GHz and features a self-locking set screw for fine frequency setting. While standard models offer a waveguide interface, a coaxial interface is also available. The performance of the oscillator can be further enhanced by adding an isolator, Gunn oscillator modulator/regulator and temperature heater.

Frequency Band	X	Ku	K	Ka	Q	U	V	E	W
Waveguide Size	WR-90	WR-62	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	8.2 to 12.4	12.0 to 18.0	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0
Output Power Range (dBm)	10 to 27	10 to 27	10 to 27	10 to 23	10 to 23	10 to 20	5 to 20	3 to 19	3 to 19
Varactor Tuning Bandwidth (GHz)	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.7	0.1 to 0.7	0.1 to 0.7	0.1 to 1.0	0.1 to 1.0	0.1 to 1.0
Tuning Voltage Range (Volts)	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20
Frequency Stability (MHz/°C)	-0.5	-0.8	-1.0	-2.0	-3.0	-3.5	-4.0	-4.5	-5.0
Power Stability (dB/°C)	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03
Harmonics (dBc)	-20	-20	-20	-20	-20	-20	-20	-20	-20
Phase Noise (dBc/Hz @ 100 KHz offset)	-85	-85	-85	-85	-80	-78	-75	-73	-70
Bias Voltage Range (Volts)	8 to 10	6 to 8	5 to 8	4 to 6	4 to 8	4 to 10	4 to 10	4 to 10	4 to 10
Bias Current Range (Amps)	0.3 to 2.0	0.3 to 2.0	0.3 to 2.0	0.3 to 2.0	0.3 to 1.5	0.3 to 1.5	0.3 to 1.0	0.3 to 1.0	0.3 to 1.0
Outline	OV-SX	OV-S6	OV-SK	OV-SA	OV-SQ	OV-SU	OV-SV	OV-SE	OV-SW

ELECTRICAL SPECIFICATIONS:

CUSTOM MODELS:

SAGE Millimeter's Varactor tuned Gunn oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOV - F0N BWN PP - CO - XY

F0N is the center frequency in MHz x 10N. For example: 37.0 GHz = 373
BWN is the tuning bandwidth in MHz x 10N. For example: 0.5 GHz = 052
PP is the output power in dBm. For example: 23 dBm = 23
CO is the RF output connector type. For example: WR-28 = 28
X is the oscillator type. "G" is for a standard package and finish and "C" is for a custom design.
Y is for factory reserve.

Example: SOV-37305220-28-G1 is a Varactor tuned Gunn oscillator with center frequency of 37 GHz, a varactor tuning bandwidth of 0.5 GHz and an output power of 20 dBm. The oscillator has a WR-28 waveguide at the RF output port and a standard package and finish. "1" is a factory assigned number.

Volume Production Oscillators, SOL Series

FEATURES:

- Low cost and production ready
- Mechanical tuning ability
- Low AM/FM noise and harmonics
- High frequency and power stability

APPLICATIONS:

- Traffic control systems
- Communication systems
- Radar systems

DESCRIPTION:

SOL series volume production oscillators utilize either high performance GaAs Gunn diodes with high Q cavity designs or state-of-the-art FET devices with dielectric resonators to yield excellent phase noise and stability. These oscillators are free running with extremely high frequency and power stability. The oscillators are generally designed and manufactured for fixed frequency applications. However, fine frequency adjustments can be achieved by mechanically tuning the provided self-locking screw. While the below standard models are offered for immediate production release, custom models are also available.

CATALOG MODELS:

Model Numbers	SOL-94210-90-G1	SOL-94210-SF-D1	SOL-24310-42-G1	SOL-35310-28-G1	SOL-35320-28-G1
Frequency Band	X	X	K	Ka	Ka
Connector Type	WR-90	SMA (F)	WR-42	WR-28	WR-28
Frequency (GHz)	9.375	9.375	24.150	35.000	35.000
Output Power (dBm), Min	10	10	10	10	20
Frequency Tuning (MHz)	±100	±25	±500	±500	±500
Harmonics (dBc), Typical	-20	-20	-20	-20	-20
Phase Noise (dBc/Hz @ 100 KHz offset)	-105	-110	-98	-95	-95
Frequency Stability (MHz/°C)	-0.1	-0.1	-0.2	-0.3	-0.3
Power Stability (dB/°C)	-0.01	-0.01	-0.02	-0.03	-0.03
Bias Voltage (Volts), Typical	+10.0	+12.0	+5.0	+5.5	+5.5
Bias Current (mA), Typical	150	50	250	250	850
Outline	OL-X1	OL-X2	OL-K1	OL-A1	OL-A1

CUSTOM MODELS:

SAGE Millimeter's volume production oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOL - F0N PP - CO - XY

F0N is the center frequency in MHz x 10N. For example: 37.0 GHz = 373
PP is the output power in dBm. For example: 23 dBm = 23
CO is the RF output connector type. For example: WR-28 = 28
X is the oscillator type. "D" is for dielectric resonator oscillator and "G" is for Gunn oscillator.
Y is for factory reserve.

Example: SOL-37320-28-G1 is a Gunn diode-based volume production oscillator with a center frequency of 37 GHz and an output power of 20 dBm. The oscillator has a WR-28 waveguide at the RF output port. "1" is a factory assigned number.

Dielectric Resonator Oscillators, SOD Series

FEATURES:

- Frequency coverage: 2 to 40 GHz
- Mechanically and electrically tunable
- Low phase noise and harmonics
- High frequency stability

APPLICATIONS:

- Communication links
- Radar systems
- Transmitters and receivers

DESCRIPTION:

SOD series dielectric resonator oscillators (DRO) are free running oscillators that utilize state-of-the-art planar circuits, three-terminal devices and dielectric resonator technology to generate high-quality microwave signals with excellent frequency stability. In addition, these oscillators are equipped with an internal voltage regulator that further improves the frequency stability by isolating the external bias pushing and modulation. In general, these oscillators are fixed. However, a small mechanical or electrical tuning range can be achieved by use of a self-locking screw or an integrated Varactor diode.

The standard offering covers the frequency range of 2 to 40 GHz. While standard models are equipped with female SMA and K connectors at the RF port, other RF interface options are also available.

ELECTRICAL SPECIFICATIONS:

Frequency Range (GHz)	2.0 to 8.0	8.0 to 12.0	12.0 to 18.0	18.0 to 26.5	26.5 to 40.0
Output Power Range (dBm)	10 to 27	10 to 25	10 to 23	10 to 23	10 to 23
Harmonics (dBc)	-25	-20	-20	-20	-20
Spurious (dBc)	-80	-75	-70	-65	-65
Phase Noise (dBc/Hz @ 10 KHz Offset)	-90	-85	-80	-75	-70
Mechanical Tuning Range (MHz)	±5.0	±5.0	±10.0	±15.0	±25.0
Optional Electrical Tuning Range (MHz)	±2.0	±4.0	±6.0	±8.0	±10.0
Optional Electrical Tuning Voltage (Volts)	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10
Frequency Stability (ppm/°C)	±2.0	±2.0	±3.0	±3.0	±3.0
Power Stability (dB/°C)	-0.01	-0.01	-0.02	-0.02	-0.02
Bias Voltage/Current Range (Volts/Amps)	+12/50 -100	+12/50 - 150	+12/50 - 200	+12/50 - 200	+12/100 - 200
Outline	OD-FC, OD-VC	OD-FX, OD-VX	OD-F6, OD-V6	OD-FK, OD-VK	OD-FA, OD-VA

Note: Standard DROs do not feature an electrically tunable component. Electrically tunable DROs are offered as dielectric resonator Varactor controlled oscillators (DRVCO).

CUSTOM MODELS:

SAGE Millimeter's dielectric resonator oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOD - F0N BWN PP - CO - XY

F0N is the center frequency in MHz x 10N. For example: 37.0 GHz = 373
BWN is the mechanical tuning bandwidth in MHz x 10N. For example: 10 MHz = 011
PP is the output power in dBm. For example: 23 dBm = 23
CO is the RF output connector type. For example: WR-28 = 28
X is the oscillator type. "S" is for standard, "V" is for Varactor tuned and "C" is for custom.
Y is for factory reserve.

Example: SOD-37302120-28-V1 is a dielectric resonator, Varactor tuned oscillator with a center frequency of 37 GHz, a tuning bandwidth of ±10 MHz and an output power of 20 dBm. The oscillator has a WR-28 waveguide at the RF output port. "1" is a factory assigned number.

Phase Locked Oscillators, SOP Series

FEATURES:

- Frequency coverage: 2 to 110 GHz
- Internal or external reference
- Low phase noise and harmonics

APPLICATIONS:

- Communication links
- Radar systems
- Transmitter and receivers

DESCRIPTION:

SOP series phase locked oscillators (PLO) utilize state-of-the-art planar circuits, three-terminal devices and dielectric resonator technology to generate high-quality microwave signals at lower frequencies. Frequency multipliers, amplifiers and filters are used to extend the low frequencies for higher frequency requirements. The standard offering covers the frequency range of 2 to 110 GHz and provides both internal and external reference options. The frequency stability and phase noise are dependent on the oscillator reference type. The data given below are typical and for reference only.

Frequency Range (GHz)	2.0 to 8.0	8.0 to 12.0	12.0 to 18.0	18.0 to 26.5	26.5 to 40.0	40.0 to 110.0
Output Power Range (dBm)	10 to 27	10 to 25	10 to 23	10 to 23	10 to 23	10 to 23
Harmonics (dBc)	-25	-20	-20	-20	-20	-20
Spurious (dBc)	-80	-75	-70	-65	-65	-65
Phase Noise (dBc/Hz @ 10 KHz Offset)[1]	-110	-105	-100	-95	-90	-85
Phase Noise (dBc/Hz @ 10 KHz Offset)[2]	Phase Noise of Reference Source + 20*Log(N) + 3 dB, where N is an integer = F_o/F_{ref}					
External Reference Frequency/Power[3]	100 to 500 MHz, -3.0 to +10 dBm					
Locking Indicator	TTL High = Locked and TTL Low = Unlocked					
Frequency Stability (ppm/°C)[4]	±5.0	±5.0	±5.0	±5.0	±5.0	±5.0
Power Stability (dB/°C)	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
Bias Voltage (Volts)	+12	+12	+12	+12	+12	+12
Bias Current Range (mA)	250 to 500	250 to 650	250 to 750	250 to 900	350 to 1,000	500 to 1,500
Outline	OP-IC, OP-EC	OP-IX, OP-EX	OP-I6, OP-E6	OP-IK, OP-EK	OP-IA, OP-EA	OP-IM, OP-EM

ELECTRICAL SPECIFICATIONS:

Note:
1) The phase noise given is for internally referenced PLOs only.
2) The phase noise at <100 KHz offset of an externally referenced PLO is dependent on the phase noise of the reference source as shown in the formula above. However, the phase noise at >100 KHz offset is independent of the reference source.
3) The frequency of standard internally referenced PLOs is 100 MHz.
4) The frequency stability given is for internally referenced PLOs only.

CUSTOM MODELS:

SAGE Millimeter's phase locked oscillator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SOP - F0N R0N PP - CO - XY

F0N is the highest fixed frequency in MHz x 10N. For example: 37.0 GHz = 373
R0N is the reference frequency in MHz x 10N. For example: 100 MHz = 101
PP is the output power in dBm. For example: 23 dBm = 23
CO is the RF output connector type. For example: WR-28 = 28
X is the reference type. "E" is externally referenced and "I" is internally referenced.
Y is for factory reserve.

Example: SOP-37310120-28-I1 is an internally referenced, phase locked oscillator with a center frequency of 37 GHz, a reference frequency of 100 MHz and an output power of 20 dBm. The oscillator has a WR-28 waveguide at the RF output port. "1" is a factory assigned number.

Oscillator Application Notes

Microwave and millimeterwave oscillators are large signal devices. Therefore, the semiconductor devices used to generate the signal in oscillators operate in a nonlinear mode. An oscillator is such a key component in any electronics system that its quality determines the system's performance. While three terminal device-based oscillators have recently become advanced in microwave frequencies, Gunn diode, two terminal device-based oscillators are still common in higher microwave and millimeterwave frequencies. The followings are concepts, terms and definitions that are widely used and accepted in the industry.

Fundamental Oscillator:

A **fundamental oscillator** is an oscillator with an output frequency that is the same as the oscillating frequency, such that there is no frequency dividing and multiplying within the circuits.

Second Harmonic Oscillator:

A **second harmonic oscillator** suppresses its fundamental oscillating frequency for output and extracts and optimizes the second harmonic of its oscillating frequency for output. Second harmonic oscillators are mainly used at higher microwave and millimeterwave frequencies to expand the device's operating frequency range.

Frequency Tuning Rate:

Frequency tuning rate is also referred to as frequency tuning speed or frequency hopping rate. This is used to characterize the frequency changing speed of the oscillator.

Frequency Tuning Sensitivity:

Frequency tuning sensitivity is used to characterize the frequency tuning slope of an electrically tuned oscillator.

Frequency Modulation Deviation Stability:

Frequency modulation deviation stability is used to characterize an electrically tuned oscillator's frequency tuning sensitivity stability over temperature, which is important for any communication and radar system.

Frequency Pushing:

Frequency pushing is the change in output frequency caused by bias voltage variation or $\Delta F/\Delta V$. It is also referred to as bias tuning.

Frequency Pulling:

Frequency pulling is used to characterize the load capacity of an oscillator. It is often specified as a frequency change caused by the 360° phase change of a given VSWR load. In general, the smaller the change, the better the oscillator.

Frequency Stability:

Frequency stability is the output frequency stability of the oscillator versus temperature or $\Delta F/\Delta T$. It is generally specified in KHz/°C or ppm/°C.

Power Stability:

Power stability is the output power stability of the oscillator versus temperature or $\Delta P/\Delta T$. It is generally specified in dBm/°C.

AM Noise:

AM noise is the signal's amplitude fluctuation or jitter due to amplitude modulation.

Phase Noise:

Phase noise is the signal's phase fluctuation or instability due to phase modulation. It is widely used to describe the characteristic randomness of an oscillator's frequency stability.

Spectral Purity:

Spectral purity refers to the ratio of signal power to phase-noise sideband power.

Short term and Long-term Frequency Stabilities:

Short-term frequency stability characterizes frequency changes from the nominal frequency that occur over a duration of less than a few seconds, while **long-term frequency stability** characterizes the aging process of circuit elements and materials and is usually expressed in terms of parts per million (PPM) per hour, day, week, month or year.

Harmonics:

Due to the nonlinear characteristics of semiconductor devices, oscillators will generate the desired frequency as well as other undesired frequency components. The **harmonics** of an oscillator are the integer frequency components of the desired frequency, generally specified in dBc.

Spurious:

Spurious are frequency components other than harmonics and the desired frequency, generally specified in dBc.

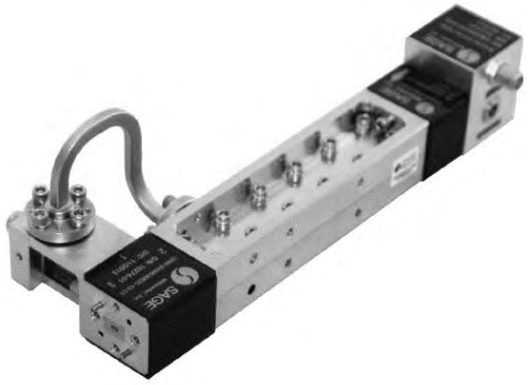
Microphonics:

Microphonics is a phenomenon where the oscillator transforms mechanical impacts or vibrations into an undesired output frequency or power variation. It is mainly caused by the instability of the oscillator's mechanical configuration. Microphonics is one of the biggest issues with Gunn and dielectric resonator oscillators, but SAGE has been able to greatly reduced this problem with its improved mechanical designs.

Doppler Sensor Modules, SSM Series

FEATURES:

- CW mode operation
- Low RF power output
- Low harmonic emissions
- Production ready for K Band
- Low cost



APPLICATIONS:

- Traffic radar systems
- Automatic door openers
- Dual mode security systems
- Automatic production lines

DESCRIPTION:

SSM series Doppler sensor modules are speed sensors that are designed and manufactured to measure the speed and direction of moving objects. The operating frequency for these sensors is at 24, 76.5 and 95 GHz; the RF interface is a standard WR-42, WR-12 and WR-10 waveguide, respectively. The sensor modules support a TE10 mode operation and are configured with a T/R diplexer, a single or I/Q receiver and a transmitter/receiver oscillator in an integrated package. Models with an I/Q receiver can detect the speed and direction of moving targets simultaneously. While three catalog models with a single receiver are listed below, additional models, such as those with an I/Q receiver can be found on the website. In addition, custom models are available to meet unique application needs.

CATALOG MODELS:

Model Number	SSM-24307-S1-1	SSM-77310-S1	SSM-94310-S1
RF Connector	WR-12	WR-12	WR-10
TX Frequency (GHz)	24.125	76.500	94.000
TX Power (dBm, Typ)	7.0	13.0	13.0
Receiver I/Q Phase Δ (Max)	N/A	N/A	N/A
Receiver I/Q Amplitude Δ (Max)	N.A	N.A	N.A
Detection Range (Typ)	Up to 1,000 meters for radar cross section 2 meter^2 (IF amplifier, antenna type and radar DSP scheme dependent)		
IF Frequency Range (Min)	DC to 100 MHz	DC to 100 MHz	DC to 100 MHz
IF Offset Voltage (Typ)	±0.5 V_{DC}	±0.1 V_{DC}	±0.1 V_{DC}
Frequency Stability (Max)	-0.8 MHz/°C	-4.0 MHz/°C	-5.0 MHz/°C
Power Stability (Max)	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC}, Typ)	+4.5 to +6.0	+4.5 to +5.0	+4.5 to +5.0
Bias Current (mA, Typ)	150 to 250	650 to 850	650 to 850
Temperature Range (°C)	-40 to +85	-0 to +50	-0 to +50
Outline	SM-DK-S1-M	SM-NMEV-S1	SM-NMEV-S1

S

S

CUSTOM MODELS:

SAGE Millimeter's Doppler sensor module model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSM - F0N PP - XY

F0N is the center frequency in MHz x 10N. For example: 24.0 GHz = 243
PP is the output power in dBm. For example: 5 dBm = 05
X is the sensor type. "S" is for non-directional single channel and "D" is for directional dual channel, i.e., I/Q receiver.
Y is for factory reserve.

Example: SSM-24303-D1 is a dual channel Doppler sensor module with a center frequency at 24.15 GHz and an output power of 3 dBm. The sensor module is equipped with an I/Q receiver. "1" is a factory assigned number.

Ranging Sensor Modules, SSP Series

FEATURES:

- FMCW mode operation
- Low RF power output
- Low harmonic emissions
- Production ready for K Band
- Low cost

APPLICATIONS:

- Traffic radar systems
- Automatic door openers
- Dual mode security systems
- Automatic production lines

DESCRIPTION:

SSP series ranging sensor modules are designed and manufactured to measure the distance and direction of moving targets. The operating frequency for these sensors is at 24, 76.5 and 95 GHz; the RF interface is a standard WR-42, WR-12 and WR-10 waveguide, respectively. The sensor modules support a TE10 mode operation and are configured with a T/R diplexer, a single or I/Q receiver and a transmitter/receiver oscillator in an integrated package. Models with an I/Q receiver can detect the distance and direction of moving targets simultaneously. While three catalog models with single receiver are listed below, additional models, such as those with an I/Q receiver can be found on the website. In addition, custom models are available to meet unique application needs.

CATALOG MODELS:

Model Number	SSP-24307-S1-1	SSP-77310-S1	SSP-94310-S1
RF Connector	WR-12	WR-12	WR-10
TX Frequency (GHz)	24.125	76.500	94.000
TX Power (dBm, Typ)	7.0	13.0	13.0
FM Bandwidth (MHz, Typ)	±150	±250	±250
FM Tuning Voltage Range (Volts)	0 to +20	0 to +20	0 to +20
Detection Range (Typ)	Up to 1,000 meters for radar cross section 2 meter^2 (IF amplifier, antenna type and radar DSP scheme dependent)		
IF Frequency Range (Min)	DC to 100 MHz	DC to 100 MHz	DC to 100 MHz
IF Offset Voltage (Typ)	±0.5 V_{DC}	±0.1 V_{DC}	±0.1 V_{DC}
Frequency Stability (Max)	-0.8 MHz/°C	-4.0 MHz/°C	-5.0 MHz/°C
Power Stability (Max)	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC}, Typ)	+4.5 to +6.0	+4.5 to +5.0	+4.5 to +5.0
Bias Current (mA, Typ)	150 to 250	650 to 850	650 to 850
Temperature Range (°C)	-40 to +85	-0 to +50	-0 to +50
Outline	SM-PK-S1-M	SP-NMEV-S1	SP-NMEV-S1

CUSTOM MODELS:

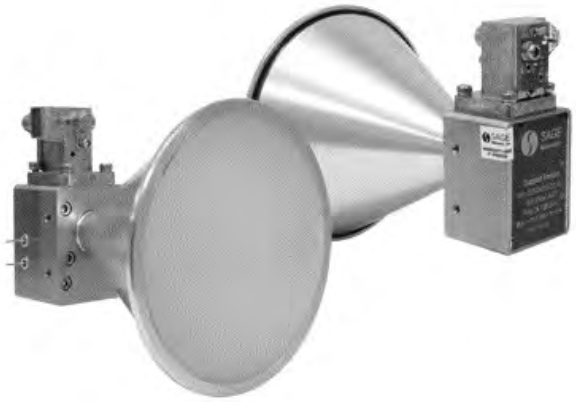
SAGE Millimeter's ranging sensor module model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSP - F0N PP - XY

F0N is the center frequency in MHz x 10N. For example: 24.0 GHz = 243
PP is the output power in dBm. For example: 5 dBm = 05
X is the sensor type. "S" is for non-directional single channel and "D" is for directional dual channel, i.e., I/Q receiver.
Y is for factory reserve.

Example: SSP-24303-D1 is a dual channel ranging sensor module with a center frequency at 24.15 GHz and an output power of 3 dBm. The sensor module is equipped with an I/Q receiver. "1" is a factory assigned number.

Speed Sensor Heads, SSS Series



FEATURES:

- CW and pulse mode operation
- Various antenna types
- Low flick noise and high sensitivity
- Low harmonic emission
- FCC Part 15 compliant

APPLICATIONS:

- Police radar systems
- Traffic monitoring systems
- Microwave fence
- Military surveillance systems

DESCRIPTION:

SSS series speed sensor heads are based on Doppler principles. These sensor heads are designed and manufactured for long range motion, speed and direction detection. The speed sensor heads below and on the next page have an operation frequency of 24.125 GHz and 35 GHz, respectively. The antenna and sensor module are the two major parts in a sensor head assembly. Various antenna types, such as horn, lens corrected and microstrip array, are offered for integration with sensor modules to offer various configuration options for different applications. The sensor modules are configured with a T/R diplexer, a single or I/Q receiver and a transmitter/receiver oscillator in an integrated package. Models with an I/Q receiver can detect the speed and direction of moving targets simultaneously. While catalog models are offered with specific configurations and specifications, custom models are available to meet unique application needs.

CATALOG MODELS (K Band):

Model Number	SSS-24310-22L-S1	SSS-24310-22L-D1	SSS-24307-27M-S1	SSS-24307-27M-D1	SSS-24307-25M-S1	SSS-24307-25M-D1
Antenna Type	Lens Corrected	Lens Corrected	Microstrip Array	Microstrip Array	Microstrip Array	Microstrip Array
Antenna Polarization	Circular	Circular	Linear	Linear	Linear	Linear
Antenna 3 dB Beamwidth	12°(H) x 12°(V)	12°(H) x 12°(V)	4.6°(H) x 6.8°(V)	4.6°(H) x 6.8°(V)	4.6°(H) x 15°(V)	4.6°(H) x 15°(V)
Antenna Gain (dBi)	22	22	27	27	25	25
Antenna Side Lobes (dBc)	20	20	18	18	18	18
TX Frequency (GHz)	24.125	24.125	24.125	24.125	24.125	24.125
TX Power (dBm, Typ)	10.0	10.0	7.0	7.0	7.0	7.0
Receiver I/Q Phase Δ	N/A	80 to 100°	N/A	60 to 120°	N/A	60 to 120°
Receiver I/Q Amplitude Δ	N/A	0 to 2 dB	N/A	0 to 2 dB	N/A	0 to 2 dB
Detection Range	Up to 4,000 meters for radar cross section 2 meter^2 (IF amplifier performance and radar DSP scheme dependent)					
IF Frequency (MHz, Min)	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz
IF Offset Voltage (V_{DC})	-0.2 to +0.2	-0.2 to +0.2	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0
Frequency Stability	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C
Power Stability	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC}, Typ)	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0
Bias Current (mA, Typ)	150 to 250	150 to 250	150 to 250	150 to 250	150 to 250	150 to 250
Temperature Range (°C)	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80
Outline	SS-LK	SS-LK-D	SS-MK-1	SS-MK-1	SS-MK-2	SS-MK-2

Note: Ka Band models are listed on the next page.

CATALOG MODELS (Ka Band):

Model Number	SSS-35310-22L-S1	SSS-35310-22L-D1	SSS-35307-20M-S1	SSS-35307-20M-D1	SSS-35307-19M-S1	SSS-35307-19M-D1
Antenna Type	Lens Corrected	Lens Corrected	Microstrip Array	Microstrip Array	Microstrip Array	Microstrip Array
Antenna Polarization	Circular	Circular	Linear	Linear	Linear	Linear
Antenna 3 dB Beamwidth	12°(H) x 12°(V)	12°(H) x 12°(V)	12°(H) x 12°(V)	12°(H) x 12°(V)	4.6°(H) x 15°(V)	4.6°(H) x 15°(V)
Antenna Gain (dBi)	22	22	20	20	19	19
Antenna Side Lobes (dBc)	20	20	18	18	18	18
TX Frequency (GHz)	35.0	35.0	35.0	35.0	35.0	35.0
TX Power (dBm, Typ)	10.0	10.0	7.0	7.0	7.0	7.0
Receiver I/Q Phase Δ	N/A	80 to 100°	N/A	60 to 120°	N/A	60 to 120°
Receiver I/Q Amplitude Δ	N/A	0 to 2 dB	N/A	0 to 2 dB	N/A	0 to 2 dB
Detection Range	Up to 4,000 meters for radar cross section 2 meter^2 (IF amplifier performance and radar DSP scheme dependent)					
IF Frequency (MHz, Min)	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz
IF Offset Voltage (V_{DC})	-0.2 to +0.2	-0.2 to +0.2	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0
Frequency Stability	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C
Power Stability	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC}, Typ)	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5
Bias Current (mA, Typ)	250 to 350	250 to 350	250 to 350	250 to 350	250 to 350	250 to 350
Temperature Range (°C)	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80
Outline	SS-LA	SS-LA-D	SS-MA-20	SS-MA-20D	SS-MA-25	SS-MA-25D

S

CUSTOM MODELS:

S

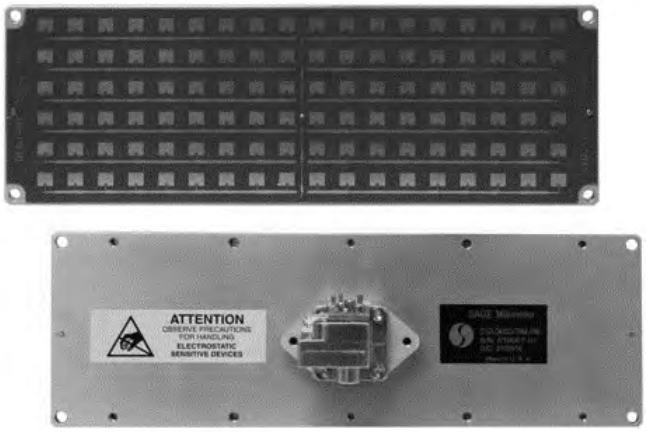
SAGE Millimeter's speed sensor head model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSS - F0N PP - AGA - XY

F0N is the center frequency in MHz x 10N. For example: 77.0 GHz = 773
PP is the output power in dBm. For example: 10 dBm = 10
AG is the antenna gain in dBi. For example: 25 dBi = 25
A is the antenna type. “R” is for rectangular interface, “C” is for circular interface, “L” is for lens corrected and “M” is for microstrip array.
X is the sensor type. "S" is for non-directional single channel and "D" is for directional dual channel, i.e., I/Q receiver.
Y is for factory reserve.

Example: SSS-77310-25L-D1 is a dual channel speed sensor head with a center frequency of 76.5 GHz and an output power of 10 dBm. The speed sensor head is equipped with a 25 dBi gain lens corrected antenna and an I/Q receiver. “1” is a factory assigned number.

Ranging Sensor Heads, SSD Series



FEATURES:

- FMCW mode operation
- High sensitivity
- Various antenna types
- Low flick noise and high sensitivity
- Low harmonic emission

APPLICATIONS:

- Traffic monitoring systems
- True ranging radar systems
- Automotive radar systems
- Automatic production lines

DESCRIPTION:

SSD series ranging sensor heads are based on FMCW radar principles. These sensor heads are designed and manufactured for long range moving or stationary target measurement. The ranging sensor heads below and on the next page have an operation frequency of 24.125 GHz and 35 GHz, respectively. The antenna and sensor module are the two major parts in a sensor head assembly. Various antenna types, such as horn, lens corrected and microstrip array, are offered for integration with sensor modules to offer various configuration options for different applications. The sensor modules are configured with a T/R diplexer, a single or I/Q receiver and a transmitter/receiver oscillator in an integrated package. Models with an I/Q receiver can detect the speed, range and direction of moving targets. While catalog models are offered with specific configurations and specifications, custom models are available to meet unique application needs.

CATALOG MODELS (K Band):

S

Model Number	SSD-24307-22L-S1	SSD-24307-22L-D1	SSD-24303-27M-S1	SSD-24303-27M-D1	SSD-24303-25M-S1	SSD-24303-25M-D1
Antenna Type	Lens Corrected	Lens Corrected	Microstrip Array	Microstrip Array	Microstrip Array	Microstrip Array
Antenna Polarization	Circular	Circular	Linear	Linear	Linear	Linear
Antenna 3 dB Beamwidth	12°(H) x 12°(V)	12°(H) x 12°(V)	4.6°(H) x 6.8°(V)	4.6°(H) x 6.8°(V)	4.6°(H) x 15°(V)	4.6°(H) x 15°(V)
Antenna Gain (dBi)	22	22	27	27	25	25
Antenna Side Lobes (dBc)	20	20	18	18	18	18
TX Frequency (GHz)	24.125	24.125	24.125	24.125	24.125	24.125
TX Power (dBm)	7.0	7.0	3.0	3.0	3.0	3.0
FM Bandwidth (MHz)	50 to 100	50 to 100	50 to 100	50 to 100	50 to 100	50 to 100
FM Tuning Voltage (V)	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20
Receiver I/Q Phase Δ	N/A	80 to 100°	N/A	60 to 120°	N/A	60 to 120°
Receiver I/Q Amplitude Δ	N/A	0 to 2 dB	N/A	0 to 2 dB	N/A	0 to 2 dB
Detection Range	Up to 4,000 meters for radar cross section 2 meter^2 (IF amplifier performance and radar DSP scheme dependent)					
IF Frequency (MHz, Min)	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz
IF Offset Voltage (V_{DC})	-0.1 to 0.1	-0.1 to 0.1	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0
Frequency Stability	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C	-0.8 MHz/°C
Power Stability	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC})	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0	+4.5 to 6.0
Bias Current (mA)	150 to 250	150 to 250	150 to 250	150 to 250	150 to 250	150 to 250
Outline	SD-LK	SD-LK-22D	SD-MK-27	SD-MK-27	SD-MK-25	SD-MK-25

S

CATALOG MODELS (Ka Band):

Model Number	SSD-35310-22L-S1	SSD-35310-22L-D1	SSD-35307-20M-S1	SSD-35307-20M-D1	SSD-35307-19M-S1	SSD-35307-19M-D1
Antenna Type	Lens Corrected	Lens Corrected	Microstrip Array	Microstrip Array	Microstrip Array	Microstrip Array
Antenna Polarization	Circular	Circular	Linear	Linear	Linear	Linear
Antenna 3 dB Beamwidth	12°(H) x 12°(V)	12°(H) x 12°(V)	12°(H) x 12°(V)	12°(H) x 12°(V)	4.6°(H) x 15°(V)	4.6°(H) x 15°(V)
Antenna Gain (dBi)	22	22	20	20	19	19
Antenna Side Lobes (dBc)	20	20	18	18	18	18
TX Frequency (GHz)	35.0	35.0	35.0	35.0	35.0	35.0
TX Power (dBm)	10.0	10.0	7.0	7.0	7.0	7.0
FM Bandwidth (MHz)	50 to 100	50 to 100	50 to 100	50 to 100	50 to 100	50 to 100
FM Tuning Voltage (V)	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20
Receiver I/Q Phase Δ	N/A	80 to 100°	N/A	60 to 120°	N/A	60 to 120°
Receiver I/Q Amplitude Δ	N/A	0 to 2 dB	N/A	0 to 2 dB	N/A	0 to 2 dB
Detection Range	Up to 4,000 meters for radar cross section 2 meter^2 (IF amplifier performance and radar DSP scheme dependent)					
IF Frequency (MHz, Min)	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz
IF Offset Voltage (V_{DC})	-0.1 to 0.1	-0.1 to 0.1	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0	-0.5 to -1.0
Frequency Stability	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C	-0.4 MHz/°C
Power Stability	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C	-0.03 dB/°C
Bias Voltage (V_{DC})	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5	+5.0 to +5.5
Bias Current (mA)	250 to 350	250 to 350	250 to 350	250 to 350	250 to 350	250 to 350
Outline	SD-LA	SD-LA-D	SD-MA-20	SD-MA-20D	SD-MA-25	SD-MA-25D

S

CUSTOM MODELS:

S

SAGE Millimeter's ranging sensor head model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSD - F0N PP - AG A - XY

F0N is the center frequency in MHz x 10N. For example: 35.0 GHz = 353
PP is the output power in dBm. For example: 10 dBm = 10
AG is the antenna gain in dBi. For example: 25 dBi = 25
A is the antenna type. “R” is for rectangular interface, “C” is for circular interface, “L” is for lens corrected and “M” is for microstrip array.
X is the sensor type. "S" is for non-directional single channel and "D" is for directional dual channel, i.e., I/Q receiver.
Y is for factory reserve.

Example: SSD-35320-22L-D1 is a dual channel ranging sensor head with a center frequency of 35 GHz and an output power of 20 dBm. The ranging sensor head is equipped with a 22 dBi gain lens corrected antenna and an I/Q receiver. “1” is a factory assigned number.

Receiver Subassemblies and Modules, SSR Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Custom design
- High performance

APPLICATIONS:

- Communication systems
- Radio systems
- Radar systems

DESCRIPTION:

SSR series receiver subassemblies and modules are offered within the frequency range of 18 to 110 GHz. Due to differing requirements for each system application, most receiver subassemblies and modules are custom models. Since SAGE Millimeter has an extensive in-house design and manufacturing capability for passive and active components, various receiver assemblies and modules can be offered to meet unique requirements. Common frequency bands are K, Ka, Q, V, E and W bands. Typical specifications are listed below.

TYPICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 110.0 GHz	Other frequency ranges are available. Specify when ordering.
Noise Figure Range	2.0 to 6.0 dB	Dependent on the frequency. Specify when ordering.
Linear Gain Range	20 to 60 dB	Other gain ranges are available. Specify when ordering.
Gain Flatness	±1.0 to ±3.0 dB	Specify when ordering.
Output P_{1dB} (Typ)	0 dBm	Specify when ordering.
Local Oscillator Type	Free running or PLO	Dependent on the system.
Local Oscillator Frequency Range	9.0 to 110.0 GHz	Dependent on the down-converter type.
Local Oscillator Power Range	0 to 16 dBm	Dependent on the down-converter type.
Local Oscillator Rejection	20 to 40 dB	Other rejection values are available. Specify when ordering.
Harmonics Rejection (Typ)	-60 dBc	Specify when ordering.
Spurious (Typ)	-60 dBc	Specify when ordering.
Port Return Loss (Typ)	10 dB	Specify when ordering.
Temperature Performance	Such as ΔG/ΔT and ΔNF/ΔT	Gain and noise figure versus temperature. Specify when ordering.
Power Supply	Various	Specify when ordering.
Connector Type	Various	Specify when ordering.
Mechanical Dimensions	Various	Specify when ordering.
Environmental	Various	Specify when ordering.

MODEL NUMBERS:

SAGE Millimeter's receiver subassembly and module model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSR - F0N BWN NF GG - CR - XY

F0N is the center frequency in MHz x 10N. For example: 26.0 GHz = 263
BWN is the operating bandwidth in MHz x 10N. For example: 100 MHz = 012
NF is the noise figure in 1/10 dB. For example: 3.0 dB = 30
GG is the linear gain in dB. For example: 45 dB = 45
CR is the receiver port connector type. For example: WR-42 = 42
X is the receiver type. “S” is for standard, “B” is for breadboard and “M” is for integrated module.
Y is for factory reserve.

Example: SSR-2630123045-42-M1 is an integrated receiver module with a center frequency of 26 GHz, a bandwidth of 100 MHz, a noise figure of 3 dB and a gain of 45 dB. The module has a WR-42 waveguide for the receiver port. “1” is a factory assigned number.

Transmitter Subassemblies and Modules, SST Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Custom design
- High performance

APPLICATIONS:

- Communication systems
- Radio systems
- Radar systems

DESCRIPTION:

SST series transmitter subassemblies and modules are offered within the frequency range of 18 to 110 GHz. Due to differing requirements for each system application, most transmitter subassemblies and modules are custom models. Since SAGE Millimeter has an extensive in-house design and manufacturing capability for passive and active components, various transmitter assemblies and modules can be offered to meet unique requirements. Common frequency bands are K, Ka, Q, V, E and W bands. Typical specifications are listed below.

TYPICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 110.0 GHz	Other frequency ranges are available. Specify when ordering.
Output P_{1dB} Range	20 to 40 dBm	Other P_{1dB} ranges are available. Specify when ordering.
Linear Gain Range	20 to 60 dB	Other gain ranges are available. Specify when ordering.
Gain Flatness	±1.0 to ±3.0 dB	Specify when ordering.
Gain Control (Typ)	30 dB	Specify when ordering.
Local Oscillator Type	Free running or PLO	Dependent on the system.
Local Oscillator Frequency Range	9.0 to 110.0 GHz	Dependent on the upconverter type.
Local Oscillator Power Range	0 to 16 dBm	Dependent on the upconverter type.
Local Oscillator Rejection	20 to 40 dB	Other rejection values are available. Specify when ordering.
IF Input	I/Q	QPSK or higher is available.
Harmonics Rejection (Typ)	-60 dBc	Specify when ordering.
Spurious (Typ)	-60 dBc	Specify when ordering.
Port Return Loss (Typ)	10 dB	Specify when ordering.
Temperature Performance	Such as $\Delta G/\Delta T$ and $\Delta P_{1dB}/\Delta T$	Gain and P_{1dB} versus temperature. Specify when ordering.
Power Supply	Various	Specify when ordering.
Connector Type	Various	Specify when ordering.
Mechanical Dimensions	Various	Specify when ordering.
Environmental	Various	Specify when ordering.

S

S

MODEL NUMBERS:

SAGE Millimeter's transmitter subassembly and module model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SST - F0N BWN P1 GG - CT - XY

F0N is the center frequency in MHz x 10N. For example: 38.0 GHz = 383
BWN is the operating bandwidth in MHz x 10N. For example: 200 MHz = 022
P1 is the output P_{1dB} in dBm. For example: 30 dBm = 30
GG is the linear gain in dB. For example: 45 dB = 45
CT is the transmitter port connector type. For example: WR-28 = 28
X is the transmitter type. "S" is for standard, "B" is for breadboard and "M" is for integrated module.
Y is for factory reserve.

Example: SST-3830223045-28-M1 is an integrated transmitter module with a center frequency of 38 GHz, a bandwidth of 200 MHz, an output P_{1dB} of 30 dBm, and a gain of 45 dB. The module has a WR-28 waveguide for the transmitter port. "1" is a factory assigned number.

Transceiver Subassemblies and Modules, SSC Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Custom design
- High performance

APPLICATIONS:

- Communication systems
- Radio systems
- Radar systems

DESCRIPTION:

SSC series transceiver subassemblies and modules are offered within the frequency range of 18 to 110 GHz. Due to differing requirements for each system application, most transceiver subassemblies and modules are custom models. Since SAGE Millimeter has an extensive in-house design and manufacturing capability for passive and active components, various transceiver assemblies and modules can be offered to meet unique requirements. Common frequency bands are K, Ka, Q, V, E and W bands. Typical specifications are listed below.

TYPICAL SPECIFICATIONS:

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 110.0 GHz	Other frequency ranges are available. Specify when ordering.
Noise Figure Range, RX	2.0 to 6.0 dB	Dependent on the frequency. Specify when ordering.
Output P_{1dB} Range, TX	20 to 40 dBm	Other P_{1dB} ranges are available. Specify when ordering.
Linear Gain, TX & RX	20 to 60 dB	Other gain ranges are available. Specify when ordering.
Gain Flatness	±1.0 to ±3.0 dB	Specify when ordering.
Gain Control (Typ)	30 dB	Specify when ordering.
Local Oscillator Type	Free running or PLO	Dependent on the system.
Local Oscillator Frequency Range	9.0 to 110.0 GHz	Dependent on the upconverter type.
Local Oscillator Power Range	0 to 16 dBm	Dependent on the upconverter type.
Local Oscillator Rejection	20 to 40 dB	Other rejection values are available. Specify when ordering.
IF Input, TX	Single-ended input	QPSK or higher is available.
Harmonics Rejection (Typ)	-20 to -60 dBc	Specify when ordering.
Spurious (Typ)	-60 dBc	Specify when ordering.
Port Return Loss (Typ)	10 dB	Specify when ordering.
Temperature Performance	Such as $\Delta G/\Delta T$, $\Delta NF/\Delta T$ and $\Delta P_{1dB}/\Delta T$	Gain, NF and P_{1dB} versus temperature. Specify when ordering.
Power Supply	Various	Specify when ordering.
Connector Type	Various	Specify when ordering.
Mechanical Dimensions	Various	Specify when ordering.
Environmental	Various	Specify when ordering.

MODEL NUMBERS:

SAGE Millimeter's transceiver subassembly and module model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SSC - FRN FTN NF P1 - CR CT - XY

FRN is the receiver center frequency in MHz x 10N. For example: 21.0 GHz = 213
FTN is the transmitter center frequency in MHz x 10N. For example: 30.0 GHz = 303
NF is the receiver noise figure in 1/10 dB. For example: 4.5 dB = 45
P1 is the transmitter output P_{1dB} in dBm. For example: 30 dBm = 30
CR is the receiver port connector type. For example: WR-42 = 42
CT is the transmitter port connector type. For example: WR-28 = 28
X is the transceiver type. “S” is for standard, “B” is for breadboard and “M” is for integrated module.
Y is for factory reserve.

Example: SSC-2133034530-4228-M1 is an integrated transceiver module with an RX center frequency of 21 GHz, a TX center frequency of 30 GHz, an RX noise figure of 4.5 dB and a TX output P_{1dB} of 30 dBm. The RX connector is a WR-42 waveguide and the TX connector is a WR-28 waveguide. “1” is a factory assigned number.

Subassemblies and Modules Application Notes

Microwave and millimeterwave subassemblies and modules are divided into two main categories: radar sensors and communication transceiver modules. Since a lot of information pertaining to communication systems has become public knowledge, the application notes in this section will only focus on radar sensors.

The word "RADAR" stood for **RA**dio **D**etection **A**nd **R**anging and now refers to a system that uses radio waves to detect and evaluate objects. Radar systems were initially invented for military applications but are now being used in a variety of commercial and industrial applications.

Radar Basis:

The radar equation is expressed as the following: $$Pr = \frac{P_t G_t A_r \sigma F^4}{(4\pi)^2 R_t^2 R_r^2}$$

Where: **Pr** is the power returning to the receiving antenna
Pt is the transmitting power
Gt is the gain of the transmitting antenna
Ar is the effective aperture (area) of the receiving antenna
б is the radar cross section of the target
F is the pattern propagation factor
Rt is the distance from the transmitter to the target
Rr is the distance from the target to the receiver

In the common case where the transmitter and receiver share an antenna and are at the same point, the radar equation can be simplified to the following equation if the effective aperture is "1":

$$Pr = \frac{P_t G_t^2 \sigma}{(4\pi)^2 R_t^4}$$

From the above, one can see that the relationship between the receiving power and distance is $1/R^4$, i.e., every 12 dB increase will double the range.

S

Doppler Radar:

S

Doppler radar is based on the Doppler effect, which is the change in frequency of a moving target's reflected signal. The shift in frequency or Doppler shift is expressed by the equation:

$$F_d = \frac{2VF_{RF}}{C} \cos \Theta$$

Where: F_{RF} is the transmitted frequency in Hz
C is the speed of light (3×10^8 meter/sec)
V is the target's speed in meters/sec
ɵ is the angle between the moving target and radar beam. Two extremes are 1) no Doppler shift when the moving target's direction and radar beam are perpendicular (ɵ=90°) and 2) **Fd = 2 V F_{RF} / C**, when the moving target's direction and radar beam are parallel or ɵ is really small (0 to 10°).

Some Doppler Shifts (Intermediate Frequency) in common microwave bands are listed in the table below.

Transmitting Frequency	9.375 (GHz)	24.150 (GHz)	35.500 (GHz)
Target Speed (Km/hr)	5/100/300/1,000	5/100/300/1,000	5/100/300/1,000
Doppler Shift or IF (Hz)	87/1736/5,208/17,361	224/4,472/13,416/44,722	328/6,574/19,722/65,740

Doppler Directional Radar:

Doppler directional radar is used to measure a moving target's speed and direction. There are various ways to detect a moving target's direction. The directional sensors offered in this catalog are based on a phase detector or I/Q mixer approach.

FMCW Ranging Radar:

Ranging radar is used to measure the distance between a radar and the target. There are several ways to measure a target's distance. The ranging sensors offered in this catalog are based on a continuous frequency modulation (FMCW) approach.

Fixed and Level Setting Full Band Attenuators, STA Series

FEATURES:

- Frequency coverage: 18 to 140 GHz
- Full band operations
- High attenuation accuracy
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

STA series full band attenuators are waveguide based attenuators of four types: fixed, level setting, direct reading and programmable. These attenuators are offered to cover the frequency range of 18 to 140 GHz.

Fixed and level setting attenuators are constructed with an E-plane resistive insert in the rectangular waveguide. The insertion loss of these attenuators is dependent on the frequency. The standard attenuation values for fixed attenuators are 3, 6, 10, 20 and 30 dB, and the attenuation range of level setting attenuators is adjustable from 0 to 30 dB via a micrometer. Fixed and level setting attenuators are typically used for signal attenuation when accuracy is not a focus.

CATALOG MODELS (Fixed Attenuator):

Model Number	STA-AT-42-F2	STA-AT-28-F2	STA-AT-22-F2	STA-AT-19-F2	STA-AT-15-F2	STA-AT-12-F2	STA-AT-10-F2	STA-AT-08-F2
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
Frequency (GHz)	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Attenuation (dB)	3, 6, 10, 20 and 30 dB, Full Waveguide Band							
Insertion Loss (dB)	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6
VSWR	1.15:1	1.15:1	1.15:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1
Power Handling (W)	0.75	0.75	0.50	0.50	0.50	0.50	0.50	0.50
Insertion Length (")	4.0	3.5	3.5	3.5	2.5	2.5	2.5	2.5
Outline	TA-FK	TA-FA	TA-FQ	TA-FU	TA-FV	TA-FE	TA-FW	TA-FF

Note: The "AT" in the model numbers is for the attenuation value. For example, STA-06-10-F2 is a WR-10 fixed waveguide attenuator with a 6 dB attenuation value.

CATALOG MODELS (Level Setting Attenuator):

Model Number	STA-30-42-M2	STA-30-28-M2	STA-30-22-M2	STA-30-19-M2	STA-30-15-M2	STA-30-12-M2	STA-30-10-M2	STA-30-08-M2
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
Frequency (GHz)	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Attenuation (dB)	0 to 30 dB, Full Waveguide Band							
Insertion Loss (dB)	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6
VSWR	1.15:1	1.15:1	1.15:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1
Power Handling (W)	1.00	1.00	0.75	0.50	0.50	0.50	0.50	0.50
Insertion Length (")	4.0	3.5	3.5	3.5	2.5	2.5	2.5	2.5
Outline	TA-MK	TA-MA	TA-MQ	TA-MU	TA-MV	TA-ME	TA-MW	TA-MF

Note: The standard level setting attenuators are equipped with a micrometer.

Direct Reading and Programmable Full Band Attenuators, STA Series

FEATURES:

- Frequency coverage: 18 to 140 GHz
- Full band operations
- High attenuation accuracy
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

Direct reading and programmable attenuators are constructed with a precision, resistive rotary vane in a circular waveguide. The operating mode of the attenuators is the circular waveguide, TE11 mode. Unlike fixed and level setting attenuators, the attenuation value and phase shift of these attenuators are independent of the frequency.

The direct reading attenuator uses a large scale dial to indicate the attenuation value, making this attenuator ideal in waveguide systems when a broadband direct reading of attenuation or a standard for system calibration and instrumentation is required.

The programmable attenuator is designed for both manual and computerized operations. While the toggle switch and LED indicator on the front panel are used for manual operations, an IEEE-488 or RS-232 interface on the back panel is used for automatic controls. The programmable attenuator is ideal in ATE systems where the attenuation is controlled remotely via a computer interface.

CATALOG MODELS (Direct Reading Attenuator):

Model Number	STA-60-42-D1	STA-60-28-D1	STA-60-22-D1	STA-60-19-D1	STA-60-15-D1	STA-60-12-D1	STA-60-10-D1	STA-60-08-D1
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
Frequency (GHz)	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Attenuation Range	0 to 60 dB, Full Waveguide Band							
Attenuation Accuracy	0.1 dB or 3% of reading, whichever is larger, up to 40 dB.							
Insertion Loss (dB)	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9
VSWR	1.2:1	1.2:1	1.2:1	1.3:1	1.3:1	1.3:1	1.3:1	1.3:1
Power Handling (W)	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
Insertion Length (")	8.48	6.87	6.25	5.97	4.36	3.86	3.79	3.78
Outline	TA-DK	TA-DA	TA-DQ	TA-DU	TA-DV	TA-DE	TA-DW	TA-DF

CATALOG MODELS (Programmable Attenuator):

Model Number	STA-60-42-P1	STA-60-28-P1	STA-60-22-P1	STA-60-19-P1	STA-60-15-P1	STA-60-12-P1	STA-60-10-P1	STA-60-08-P1
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
Frequency (GHz)	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Attenuation Range	0 to 60 dB, Full Waveguide Band							
Attenuation Step Size	0.05 dB from 0 to 20 dB and 0.10 dB from 20 to 60 dB							
Insertion Loss (dB)	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9
Operating Voltage	+24 V_{DC} (100 to 240 VAC Adapter is Supplied)							
Control Port	IEEE-488							
VSWR	1.2:1	1.2:1	1.2:1	1.3:1	1.3:1	1.3:1	1.3:1	1.3:1
Power Handling (W)	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
Insertion Length (")	8.54	6.50	6.15	5.94	5.78	5.78	5.78	5.78
Outline	TA-PK	TA-PA	TA-PQ	TA-PU	TA-PV	TA-PE	TA-PW	TA-PF

Note: Contact the factory for other frequency bands.

Full Band Phase Shifters, STP Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Full band operations
- Low VSWR and low insertion loss
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

STP series full band phase shifters are micrometer-driven, waveguide-based phase shifters. The configuration of the micrometer-driven phase shifters is similar to that of level setting attenuators, where the phase shifting is caused by an E-plane dielectric insert in the rectangular waveguide. The amount of phase shifting is directly dependent on the volume of the insert. The VSWR and the insertion loss of these phase shifters are dependent on the frequency.

The below standard offering covers the frequency range of 18 to 110 GHz and a phase shifting range of 180 degrees. These micrometer-driven phase shifters are typically used to introduce a certain amount of phase shifting when the absolute number is not a focus.

CATALOG MODELS:

Model Number	STP-18-42-M2	STP-18-28-M2	STP-18-22-M2	STP-18-19-M2	STP-18-15-M2	STP-18-12-M2	STP-18-10-M2
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	18.0 to 26.5	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0
Phase Shifting Range	0 to 180 Degrees, Full Waveguide Band						
Insertion Loss (dB)	0.3	0.3	0.5	0.5	0.5	0.5	0.5
VSWR	1.20:1	1.20:1	1.25:1	1.25:1	1.25:1	1.25:1	1.25:1
Power Handling (W)	20	10	5	5	3	3	3
Outline	TP-MK	TP-MA	TP-MQ	TP-MU	TP-MV	TP-ME	TP-MW

Note: Contact factory for other frequency bands.

CUSTOM MODELS:

SAGE Millimeter's full band phase shifter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STP - DD - CO - XY

DD is the phase shifting range in 10 degrees. For example: 180 degrees = 18
CO is the connector type. For example: WR-28 = 28
X is the phase shifter type. “M” is micrometer-driven and “D” is direct reading.
Y is for factory reserve.

Example: STP-36-10-M1 is a micrometer-driven phase shifter with a frequency range of 75 to 110 GHz and a phase shifting range of 180 degrees. The phase shifter has a WR-10 waveguide. “1” is a factory assigned number.

Full Band Waveguide Detectors, STD Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Full waveguide band operation
- High sensitivity without tuning
- Integrated Faraday isolator
- Instrumentation grade

APPLICATIONS:

- Network analyzer systems
- Test instrumentation

DESCRIPTION:

STD series full band waveguide detectors are GaAs beam lead Schottky diode-based detectors that are specially designed for millimeterwave network analyzer applications. With a proprietary circuitry design and careful diode selection, these zero-biased detectors exhibit high sensitivity and extremely flat output characteristics.

The below standard offering covers the frequency range of 18 to 170 GHz and offers a 1 MHz video bandwidth and 1 MΩ video output impedance. The standard models also have the capacity to handle a maximum RF input power of up to +17 dBm. The RF interface of these detectors is a standard waveguide with an integrated Faraday isolator to improve the port VSWR. The output voltage polarity is negative and the connector type is a female SMA. Other configurations are offered as custom models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Sensitivity (mV/mW)	Sensitivity Flatness (dB)	VSWR	Max Power (dBm)	Outline
K	STD-42SF-NI	18.0 to 26.5	1,300	±1.5	1.4:1	+17	TD-K1
Ka	STD-28SF-NI	26.5 to 40.0	1,300	±1.5	1.4:1	+17	TD-A1
Q	STD-22SF-NI	33.0 to 50.0	1,200	±1.5	1.4:1	+17	TD-Q1
U	STD-19SF-NI	40.0 to 60.0	1,200	±1.5	1.4:1	+17	TD-U1
V	STD-15SF-NI	50.0 to 75.0	1,000	±2.0	1.4:1	+17	TD-V1
E	STD-12SF-NI	60.0 to 90.0	900	±2.0	1.4:1	+17	TD-E1
W	STD-10SF-NI	75.0 to 110.0	800	±2.0	1.4:1	+17	TD-W1
F	STD-08SF-NI	90.0 to 140.0	300	±2.0	1.4:1	+17	TD-F1
D	STD-06SF-NI	110.0 to 170.0	300	±2.0	1.4:1	+17	TD-D1

CUSTOM MODELS:

SAGE Millimeter's full band waveguide detector model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STD - WG CO - XY

WG is the RF input waveguide size. For example: WR-10 = 10
CO is the DC output connector type. For example: SMA(F) = SF
X is the detector type. “N” is for negative output and “P” is for positive output.
Y is for integration options. “I” is with integrated Faraday isolator and “N” is without isolator.

Example: STD-10SM-PI is an amplitude detector with a frequency range of 75 to 110 GHz. The RF connector is a WR-10 waveguide and the DC connector is a male SMA connector. The detector has a positive voltage output and an integrated Faraday isolator.

Full Band Spectrum Analyzer Harmonic Mixers, STH Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Balanced configuration for low conversion loss
- Broad band operation
- Combined LO and IF port
- Instrumentation grade

APPLICATIONS:

- Phase lock loops
- Spectrum analyzers with built-in diplexer
- Frequency counters with built-in diplexer

DESCRIPTION:

STH series spectrum analyzer harmonic mixers are GaAs beam lead Schottky diode-based mixers. These harmonic mixers employ a single diode and broadband circuitry to extend the operation frequency of test instruments, such as spectrum analyzers and frequency counters, from 18 GHz or below to higher millimeterwave frequencies of up to 170 GHz. These harmonic mixers also provide low conversion loss and continuous frequency coverage across full waveguide band operations. Unlike the balanced harmonic mixers (SFH series), these harmonic mixers do not have a built-in frequency diplexer. Therefore, their LO and IF ports are combined into a single coaxial port, which LO and IF signals share. This feature provides for a convenient connection when used with spectrum analyzers or frequency counters that have a built-in diplexer, such as models offered by Advantest, Anritsu, Rohde & Schwarz, Tektronix and Phase Matrix (EIP).

CATALOG MODELS:

Band	Model Number	Waveguide	RF Frequency Range (GHz)	IF Frequency Range (GHz)	LO Power (dBm)	Sensitivity (dB) @1 KHz RBW	Flange Type	Outline
K	STH-42SF-S1	WR-42	18.0 to 26.5	DC to 4.0	10 to 16	-100	UG595/U	TH-WK
Ka	STH-28SF-S1	WR-28	26.5 to 40.0	DC to 4.0	10 to 16	-95	UG599/U	TH-WA
Q	STH-22SF-S1	WR-22	33.0 to 50.0	DC to 4.0	10 to 16	-90	UG383/U	TH-WQ
U	STH-19SF-S1	WR-19	40.0 to 60.0	DC to 4.0	10 to 16	-90	UG383/U-M	TH-WU
V	STH-15SF-S1	WR-15	50.0 to 75.0	DC to 4.0	10 to 16	-85	UG385/U	TH-WV
E	STH-12SF-S1	WR-12	60.0 to 90.0	DC to 4.0	10 to 16	-80	UG387/U	TH-WE
W	STH-10SF-S1	WR-10	75.0 to 110.0	DC to 4.0	10 to 16	-75	UG387/U-M	TH-WW
F	STH-08SF-S1	WR-08	90.0 to 140.0	DC to 4.0	10 to 16	-70	UG387/U-M	TH-WF
D	STH-06SF-S1	WR-06	110.0 to 170.0	DC to 4.0	10 to 16	-65	UG387/U-M	TH-WD

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CUSTOM MODELS:

SAGE Millimeter's full band spectrum analyzer harmonic mixer model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STH - WG LI - XY

WG is the RF input waveguide size. For example: WR-10 = 10
LI is the IF/LO connector type. For example: SMA(F) = SF
X is for harmonic mixer type. "S" is for standard and "C" is for custom design.
Y is for factory reserve.

Example: STH-10SM-S1 is a standard, full band spectrum analyzer harmonic mixer with a frequency range of 75 to 110 GHz. The RF input is a WR-10 waveguide and the IF/LO connector is a male SMA connector. "1" is a factory assigned number.

Full Band Noise Sources, STZ Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full waveguide band operations
- +28 V_{DC}/60 mA bias requirement
- CW or pulsed AM operation modes
- Precision calibrated ENR
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Radiometric systems

DESCRIPTION:

STZ series full band noise sources are silicon IMPATT diode-based, solid-state noise sources. These noise sources implement a high performance diode and propriety circuit design to offer high ENR with extreme flatness across the entire waveguide bandwidth. The below standard models cover the frequency range of 26.5 to 170 GHz and feature an integrated Faraday isolator to improve the port VSWR for a more reliable noise figure measurement. The operating voltage of the standard models is +28 V_{DC} via a female BNC connector, which is compatible with industry standard noise meters, such as Keysight models. In addition, these noise sources can work in either a CW or pulse AM operation mode. The AM modulation mode is triggered by a TTL control signal via a female SMA connector. While standard models are equipped with a waveguide interface, other interfaces are available as custom models.

CATALOG MODELS:

Model Number	STZ-28-I1	STZ-22-I1	STZ-19-I1	STZ-15-I1	STZ-12-I1	STZ-10-I1	STZ-08-I1	STZ-06-I1
Waveguide Size	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08	WR-10
Frequency Range (GHz)	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110	90 to 140	110 to 170
ENR (dB, Typical)	15.0	13.0	13.0	13.5	13.0	12.0	12.0	12.0
ENR Variation (dB)	±1.0	±1.5	±1.5	±1.5	±1.5	±1.5	±2.0	±2.0
VSWR (Max)	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1
Temperature Stability (dB/°C)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Long Term Stability (dB/Day)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Bias (V_{DC}/mA, Typical)	+28/60	+28/60	+28/60	+28/60	+28/60	+28/60	+28/60	+28/60
Bias Port Connector Type	BNC(F)	BNC(F)	BNC(F)	BNC(F)	BNC(F)	BNC(F)	BNC(F)	BNC(F)
AM Modulation Trigger	TTL	TTL	TTL	TTL	TTL	TTL	TTL	TTL
AM Modulation Rate (KHz, Max)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
AM Modulation Connector Type	SMA(F)	SMA(F)	SMA(F)	SMA(F)	SMA(F)	SMA(F)	SMA(F)	SMA(F)
Outlines	TZ-WA	TZ-WQ	TZ-WU	TZ-WV	TZ-WE	TZ-WW	TZ-WF	TZ-WD

Note: Narrow band models with a high ENR are available as custom models.

CUSTOM MODELS:

SAGE Millimeter's noise source model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STZ - F1N F2N ER - WG - XY

F1N is the start frequency in MHz x 10N. For example: 90.0 GHz = 903
F2N is the stop frequency in MHz x 10N. For example: 100.0 GHz = 104
ER is the ENR in dB. For example: 15 dB = 15
WG is the waveguide size. For example: WR-10 = 10
X is for integration options. "I" is with integrated Faraday isolator and "0" is without isolator.
Y is for factory reserve.

Example: STZ-90310415-10-I1 is a noise source with a frequency range of 90 to 100 GHz and an ENR of 15 dB. The noise source has a WR-10 waveguide and an integrated Faraday isolator. "1" is a factory assigned number.

Full Band Faraday Isolators, STF Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Full waveguide band operation
- Moderate insertion loss
- High isolation
- Instrumentation grade

APPLICATIONS:

- Port isolation
- Test setups
- Test instrumentation

DESCRIPTION:

STF series full band Faraday isolators are constructed with a longitudinal, magnetized ferrite rod that causes a Faraday rotation of the incoming RF signal. Although the typical insertion loss of Faraday isolators is slightly higher than its waveguide junction isolator (SNF series) counterpart, their isolation is at least 10 dB higher. In addition, Faraday isolators cover a broader frequency range and possess less insertion phase variation across the entire waveguide band. These characteristics make them ideal for broadband applications, especially in test labs and instrumentations.

The below standard offering covers the frequency range of 18 to 170 GHz with 28 dB isolation. For higher isolation, narrowband versions of standard models can be requested.

CATALOG MODELS:

Band	Model Number	Waveguide	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR (Max)	Power Handling (W, Max)	Flange Type	Outline
K	STF-42-S1	WR-42	18.0 to 26.5	1.2	28	1.4:1	2.0	UG595/U	TF-K1
Ka	STF-28-S1	WR-28	26.5 to 40.0	1.2	28	1.4:1	1.8	UG599/U	TF-A1
Q	STF-22-S1	WR-22	33.0 to 50.0	1.4	28	1.4:1	1.5	UG383/U	TF-Q1
U	STF-19-S1	WR-19	40.0 to 60.0	1.5	28	1.4:1	1.5	UG383/U-M	TF-U1
V	STF-15-S1	WR-15	50.0 to 75.0	1.7	28	1.4:1	1.2	UG385/U	TF-V1
E	STF-12-S1	WR-12	60.0 to 90.0	1.9	28	1.4:1	1.2	UG387/U	TF-E1
W	STF-10-S1	WR-10	75.0 to 110.0	2.2	28	1.4:1	1.0	UG387/U-M	TF-W1
F	STF-08-S1	WR-08	90.0 to 140.0	2.6	28	1.4:1	1.0	UG387/U-M	TF-F1
D	STF-06-S1	WR-06	110.0 to 170.0	3.0	28	1.4:1	1.0	UG387/U-M	TF-D1

CUSTOM MODELS:

SAGE Millimeter's Faraday isolator model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STF - F1N F2N IS - WG - XY

F1N is the start frequency in MHz x 10N. For example: 90.0 GHz = 903
F2N is the stop frequency in MHz x 10N. For example: 100.0 GHz = 104
IS is the isolation in dB. For example: 35 dB = 35
WG is the waveguide size. For example: WR-10 = 10
X is the configuration type. "S" is for a standard package and "9" is for a 90˚ twist input.
Y is for factory reserve.

Example: STF-90310435-10-S1 is a Faraday isolator with a frequency range of 90 to 100 GHz and an isolation of 35 dB. The isolator has a WR-10 waveguide and a standard package. "1" is a factory assigned number.

Full Band Frequency Extenders, STE Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full waveguide band operation
- High output power
- Low harmonics and spurious emission
- Low cost
- Instrumentation grade

APPLICATIONS:

- Network analyzer systems
- Frequency sources
- Test instrumentation

DESCRIPTION:

STE series full band frequency extenders are designed to extend low frequency signal sources or generators to higher millimeterwave frequency ranges. These extenders offer a low cost means of producing millimeterwave signal sources while preserving the functionality and features that industry standard models offer. These extenders deliver a superior performance since they are assembled with SAGE Millimeter's instrumentation grade components, such as multipliers, amplifiers, filters, isolators, and more. The below standard offering covers the frequency range of 26.5 to 170 GHz and requires a typical input power of +5 dBm to deliver up to +20 dBm output power. Specifications other than those listed below are available upon request.

CATALOG MODELS:

Band	Model Number	Input Frequency (GHz)	Input Power (dBm)	Output Frequency (GHz)	Output Power (dBm)	Harmonics	Spurious	Bias (V_{DC}/mA)
Ka	STE-SF228-08-S1	13.25 to 20.00	+5.0	26.5 to 40.0	+8.0	-20 dBc	-60 dBc	+12.0/180
Q	STE-SF322-05-S1	11.00 to 16.67	+5.0	33.0 to 50.0	+5.0	-20 dBc	-60 dBc	+12.0/180
U	STE-SF319-05-S1	13.33 to 20.00	+5.0	40.0 to 60.0	+5.0	-20 dBc	-60 dBc	+12.0/200
V	STE-SF415-04-S1	12.50 to 18.75	+5.0	50.0 to 75.0	+4.0	-20 dBc	-60 dBc	+12.0/450
E	STE-SF612-03-S1	10.00 to 15.00	+5.0	60.0 to 90.0	+3.0	-20 dBc	-60 dBc	+12.0/450
W	STE-SF610-00-S1	12.50 to 18.33	+5.0	75.0 to 110.0	+0.0	-20 dBc	-60 dBc	+12.0/450
F	STE-SF908-00-S1	10.00 to 15.56	+5.0	90.0 to 140.0	-3.0	-20 dBc	-60 dBc	+12.0/450
D	STE-SF906-00-S1	12.22 to 18.89	+5.0	110.0 to 170.0	-3.0	-20 dBc	-60 dBc	+12.0/450

CUSTOM MODELS:

SAGE Millimeter's frequency extender model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STE - CI M CO - PP - XY

CI is the RF input connector type. For example: SMA(F) = SF
M is the multiplying factor. For example: X2 = 2
CO is the RF output connector type. For example: WR-10 = 10
PP is the RF output power in dB. For example: 20 dBm = 20
X is the extender type. "S" is for a standard model and "C" is for a custom design.
Y is for factory reserve.

Example: STE-SF612-10-S1 is a standard X6 frequency extender with an RF output frequency of 60 to 90 GHz and an output power of 10 dBm. The extender has a female SMA connector at the input port and a WR-12 waveguide at the output port. "1" is a factory assigned number.

Full Band Vector Network Analyzer Extenders, STO Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full waveguide band operation
- 100 dB dynamic range
- Low cost
- Instrumentation grade
- Compatibility with dual source and four port VNA

APPLICATIONS:

- Vector network analyzer systems
- S-Parameter characterization
- Test instrumentation

DESCRIPTION:

STO series full band vector network analyzer (VNA) frequency extenders are designed to extend low frequency VNAs to achieve full 2-port, S-parameter testing at higher millimeterwave frequency ranges. These extenders offer a low cost means of carrying out S-parameter measurements at millimeterwave frequencies while preserving the functionality and features that industry standard models offer. These extenders deliver a superior performance since they are assembled with SAGE Millimeter's instrumentation grade components, such as multipliers, amplifiers, mixers, isolators, and more. The below standard offering covers the frequency range of 26.5 to 170 GHz and operate with an RF and LO input power of +10 dBm. Specifications other than those listed below are available upon request.

CATALOG MODELS:

Band	Model Number	Operating Freq. (GHz)	Output Power (dBm)	Dynamic Range @ 10 Hz (dB)	Magnitude Stability (dB)	Phase Stability (°)	Input Freq. (GHz, RF)	Input Freq. (GHz, LO)
Ka	STO-28203-S1	26.5 to 40.0	+5.0	100	±0.2	±2	8.83 to 13.33	13.25 to 20.00
Q	STO-22203-S1	33.0 to 50.0	+5.0	100	±0.2	±2	11.00 to 16.67	8.25 to 12.50
U	STO-19203-S1	40.0 to 60.0	+5.0	100	±0.2	±2	13.33 to 20.00	10.00 to 15.00
V	STO-15203-S1	50.0 to 75.0	+1.0	100	±0.2	±2	12.50 to 18.75	8.33 to 12.50
E	STO-12203-S1	60.0 to 90.0	+0.0	100	±0.2	±2	10.00 to 15.00	7.50 to 11.25
W	STO-10203-S1	75.0 to 110.0	-1.0	100	±0.2	±2	12.50 to 18.33	9.37 to 13.75
F	STO-08203-S1	90.0 to 140.0	-5.0	90	±0.4	±4	7.50 to 11.67	11.25 to 17.50
D	STO-06203-S1	110.0 to 170.0	-10.0	90	±0.4	±4	9.17 to 14.17	9.17 to 14.17

CUSTOM MODELS:

SAGE Millimeter's VNA frequency extender model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STO - WG IFN - XY

WG is the waveguide size. For example: WR-10 = 10
IFN is the maximum RF input frequency in MHz x 10N. For example: 20 GHz = 203
X is the extender type. "S" is standard for transmit and receive and "R" is for receive only.
Y is for factory reserve.

Example: STO-06303-S1 is a WR-06 VNA frequency extender with an input RF frequency of 18.33 to 28.34 GHz and an output RF frequency of 110 to 170 GHz. The extender only functions as a receiver. "1" is a factory assigned number.

Full Band Scalar Network Analyzer Extenders, STN Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full waveguide band operation
- Low harmonics and spurious
- Low cost
- Instrumentation grade

APPLICATIONS:

- Extend microwave scalar network analyzers to millimeterwave bands

DESCRIPTION:

STN series full band scalar network analyzer extenders are designed to extend low frequency scalar network analyzers to higher millimeterwave frequency ranges. These extenders offer a low cost means of producing millimeterwave scalar network analyzers while preserving the functionality and features that industry standard models offer. These extenders deliver a superior performance since they are assembled with SAGE Millimeter's instrumentation grade frequency extenders (STE series), Faraday isolators (STF series), direct or programmable attenuators (STA series), directional couplers (SWD series) and waveguide detectors (STD series). The below standard offering covers the frequency range of 26.5 to 170 GHz. Specifications other than those listed below are available upon request.

CATALOG MODELS (2-Port):

Band	Model Number	Input Freq. (GHz)	Input Power (dBm)	Output Freq. (GHz)	IL Dynamic Range (dB)	RL Dynamic Range (dB)	Bias (V_{DC}/mA)	Attenuation Method
Ka	STN-SF228-08-D2	13.25 to 20.00	+5.0	26.5 to 40.0	40	30	+12.0/180	Manual
Q	STN-SF322-05-D2	11.00 to 16.67	+5.0	33.0 to 50.0	35	25	+12.0/180	Manual
U	STN-SF319-05-D2	13.33 to 20.00	+5.0	40.0 to 60.0	35	25	+12.0/200	Manual
V	STN-SF415-04-D2	12.50 to 18.75	+5.0	50.0 to 75.0	35	25	+12.0/500	Manual
E	STN-SF612-03-D2	10.00 to 15.00	+5.0	60.0 to 90.0	30	20	+12.0/550	Manual
W	STN-SF610-00-D2	12.50 to 18.33	+5.0	75.0 to 110.0	30	20	+12.0/550	Manual
F	STN-SF908-00-D2	10.00 to 15.56	+5.0	90.0 to 140.0	25	15	+12.0/650	Manual
D	STN-SF906-00-D2	12.22 to 18.89	+5.0	110.0 to 170.0	20	10	+12.0/650	Manual
Ka	STN-SF228-08-P2	13.25 to 20.00	+5.0	26.5 to 40.0	40	30	+12.0/180	Programmable
Q	STN-SF322-05-P2	11.00 to 16.67	+5.0	33.0 to 50.0	35	25	+12.0/180	Programmable
U	STN-SF319-05-P2	13.33 to 20.00	+5.0	40.0 to 60.0	35	25	+12.0/200	Programmable
V	STN-SF415-04-P2	12.50 to 18.75	+5.0	50.0 to 75.0	35	25	+12.0/500	Programmable
E	STN-SF612-03-P2	10.00 to 15.00	+5.0	60.0 to 90.0	30	20	+12.0/550	Programmable
W	STN-SF610-00-P2	12.50 to 18.33	+5.0	75.0 to 110.0	30	20	+12.0/550	Programmable
F	STN-SF908-00-P2	10.00 to 15.56	+5.0	90.0 to 140.0	25	15	+12.0/650	Programmable
D	STN-SF906-00-P2	12.22 to 18.89	+5.0	110.0 to 170.0	20	10	+12.0/650	Programmable

Note: For programmable attenuator specifications, refer to the STA series in this catalog.

CATALOG MODELS (3-Port):

Band	Model Number	Input Freq. (GHz)	Input Power (dBm)	Output Freq. (GHz)	IL Dynamic Range (dB)	RL Dynamic Range (dB)	Bias (V_{DC}/mA)	Attenuation Method
Ka	STN-SF228-08-D3	13.25 to 20.00	+5.0	26.5 to 40.0	40	30	+12.0/180	Manual
Q	STN-SF322-05-D3	11.00 to 16.67	+5.0	33.0 to 50.0	35	25	+12.0/180	Manual
U	STN-SF319-05-D3	13.33 to 20.00	+5.0	40.0 to 60.0	35	25	+12.0/200	Manual
V	STN-SF415-04-D3	12.50 to 18.75	+5.0	50.0 to 75.0	35	25	+12.0/500	Manual
E	STN-SF612-03-D3	10.00 to 15.00	+5.0	60.0 to 90.0	30	20	+12.0/550	Manual
W	STN-SF610-00-D3	12.50 to 18.33	+5.0	75.0 to 110.0	30	20	+12.0/550	Manual
F	STN-SF908-00-D3	10.00 to 15.56	+5.0	90.0 to 140.0	25	15	+12.0/650	Manual
D	STN-SF906-00-D3	12.22 to 18.89	+5.0	110.0 to 170.0	20	10	+12.0/650	Manual
Ka	STN-SF228-08-P3	13.25 to 20.00	+5.0	26.5 to 40.0	40	30	+12.0/180	Programmable
Q	STN-SF322-05-P3	11.00 to 16.67	+5.0	33.0 to 50.0	35	25	+12.0/180	Programmable
U	STN-SF319-05-P3	13.33 to 20.00	+5.0	40.0 to 60.0	35	25	+12.0/200	Programmable
V	STN-SF415-04-P3	12.50 to 18.75	+5.0	50.0 to 75.0	35	25	+12.0/500	Programmable
E	STN-SF612-03-P3	10.00 to 15.00	+5.0	60.0 to 90.0	30	20	+12.0/550	Programmable
W	STN-SF610-00-P3	12.50 to 18.33	+5.0	75.0 to 110.0	30	20	+12.0/550	Programmable
F	STN-SF908-00-P3	10.00 to 15.56	+5.0	90.0 to 140.0	25	15	+12.0/650	Programmable
D	STN-SF906-00-P3	12.22 to 18.89	+5.0	110.0 to 170.0	20	10	+12.0/650	Programmable

Note: For programmable attenuator specifications, refer to the STA series in this catalog.

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BLOCK DIAGRAM:

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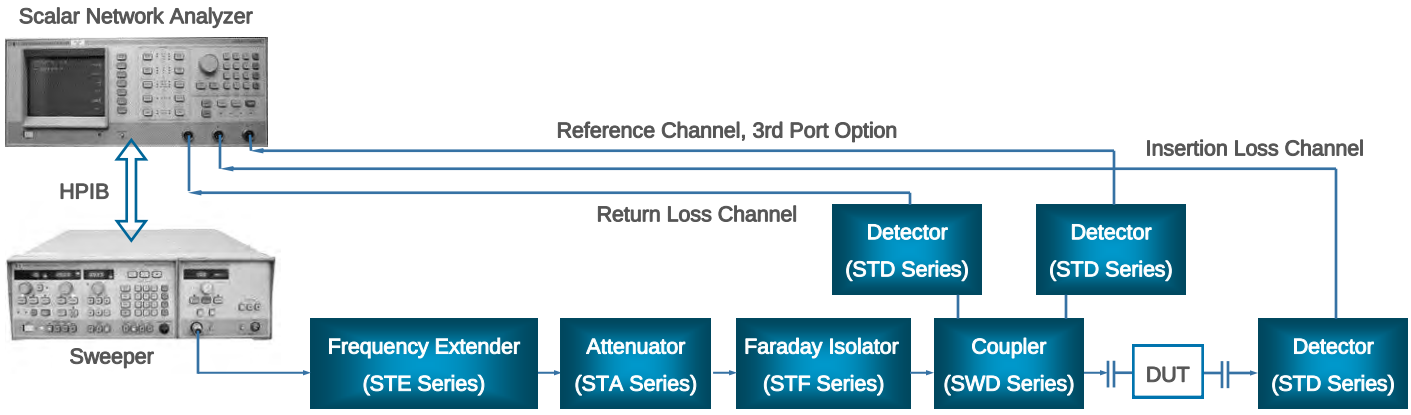


Note:
1) The STN series scalar network analyzers consist of the components shown in blue.
2) The two-port version only includes two detectors. The reference channel shown is for three-port versions.
3) The sweeper and scalar network analyzer shown are for illustration purposes only. Other models will work as long as they meet the specified interface criteria.

Full Band Down-converter, STC Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full waveguide band operation
- Low harmonics and spurious emission
- Low cost
- Instrumentation grade

APPLICATIONS:

- Test labs
- Test instrumentation

DESCRIPTION:

STC series full band down-converters are designed to convert high frequency millimeterwave signals down to the baseband at 10 MHz to 1.6 GHz. These down-converters deliver a superior performance since they are assembled with SAGE Millimeter's instrumentation grade components, such as multipliers, amplifiers, filters, isolators, and more. The below standard offering covers the frequency range of 26.5 to 170 GHz and delivers a typical LO power of 3 dBm and conversion gain of 20 dB. The down-converters provide low harmonic levels and excellent gain flatness, making them ideal for test instrumentation applications. Specifications other than those listed below are available upon request.

CATALOG MODELS:

Band	Model Number	Input Freq. (GHz, RF)	Output Freq. (GHz, IF)	Input Freq. (GHz, LO)	LO Power (dBm)	Conversion Gain (dB)	Harmonics	Bias (V_{DC}/mA)
Ka	STC-20-28-S1	26.5 to 40.0	0.01 to 1.60	13.25 to 20.00	+5.0	20 dB	-20 dBc	+12.0/200
Q	STC-20-22-S1	33.0 to 50.0	0.01 to 1.60	11.00 to 16.67	+5.0	20 dB	-20 dBc	+12.0/250
U	STC-20-19-S1	40.0 to 60.0	0.01 to 1.60	13.33 to 20.00	+5.0	20 dB	-20 dBc	+12.0/250
V	STC-20-15-S1	50.0 to 75.0	0.01 to 1.60	12.50 to 18.75	+5.0	20 dB	-20 dBc	+12.0/300
E	STC-20-12-S1	60.0 to 90.0	0.01 to 1.60	10.00 to 15.00	+5.0	20 dB	-20 dBc	+12.0/450
W	STC-20-10-S1	75.0 to 110.0	0.01 to 1.60	12.50 to 18.33	+5.0	20 dB	-20 dBc	+12.0/450
F	STC-20-08-S1	90.0 to 140.0	0.01 to 1.60	10.00 to 15.56	+5.0	20 dB	-20 dBc	+12.0/450
D	STC-20-06-S1	110.0 to 170.0	0.01 to 1.60	12.22 to 18.89	+5.0	20 dB	-20 dBc	+12.0/450

CUSTOM MODELS:

SAGE Millimeter's down-converter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STC - F1N F2N GG - CO - XY

F1N is the start RF frequency in MHz x 10N. For example: 90.0 GHz = 903
F2N is the stop RF frequency in MHz x 10N. For example: 100.0 GHz = 104
GG is the conversion gain in dB. For example: 20 dB = 20
CO is the connector type. For example: WR-10 = 10
X is the down-converter type. "S" is standard.
Y is for factory reserve.

Example: STC-75385325-10-S1 is a standard down-converter with an RF frequency range of 75 to 85 GHz and a conversion gain of 25 dB. The down-converter features a WR-10 waveguide. "1" is a factory assigned number.

Full Band Noise Figure and Gain Test Extenders, STG Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Full band operations
- Noise source included
- Instrumentation grade

APPLICATIONS:

- mmW amplifier testing
- mmW receiver testing
- Wafer probe station
- Test labs

DESCRIPTION:

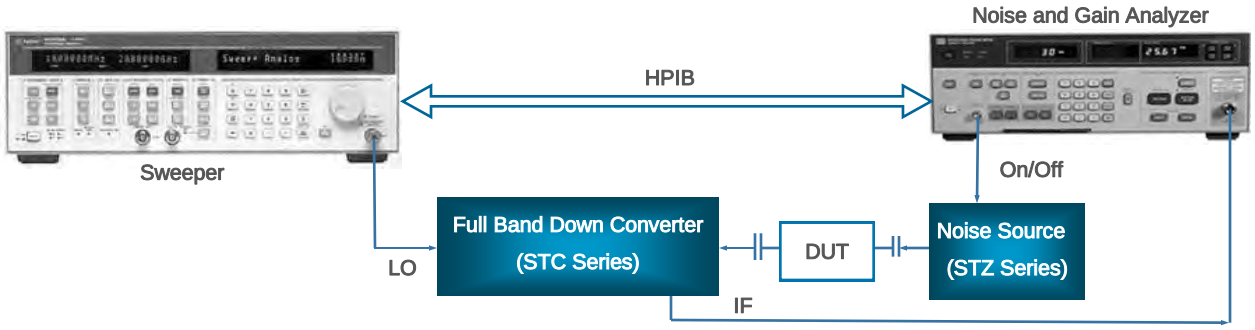
STG series full band noise figure and gain test extenders are offered to extend noise and gain measuring capabilities up to higher millimeterwave frequency ranges. These extenders are designed to interface with noise and gain test systems that have an input IF of 10 MHz to 1.6 GHz, such as the industry standard Keysight 8970A/B, N8975A and Maury MT 2075B.

The noise figure and gain test extenders include a high-performance, solid-state noise source (STZ series) and a full waveguide down converter (STC series), which consists of a Faraday isolator (STF series), full band mixer (SFB series), frequency multiplier and IF amplifier. A frequency source with an output signal in the frequency range of 10 to 20 GHz is required as a local oscillator for the down converter. The noise source is automatically powered on and off by the noise figure meter. A test set arrangement of a noise and gain analyzer being used with an extender is shown in the block diagram below.

CATALOG MODELS:

Model Number	STG-28-S1	STG-22-S1	STG-19-S1	STG-15-S1	STG-12-S1	STG-10-S1	STG-08-S1
Waveguide Size	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08
RF Frequency Range (GHz)	26.5 to 40.0	33.0 to 50.0	40.0 to 60.0	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0
Noise Source: ENR (dB)	15.0	14.0	13.5	13.0	13.0	12.0	12.0
Noise Source: Bias (V_{DC})	+28						
IF Frequency Range (MHz)	10 to 1,600						
LO Frequency Range (GHz)	13.25 to 20.0	11.0 to 16.67	13.33 to 20.0	12.5 to 18.75	10.0 to 15.0	12.5 to 18.33	10.0 to 15.56
LO Power (dBm), Typ	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Noise Figure (dB), Typ	16.5	17.0	18.0	18.5	19.5	20.0	22.0
Conversion Gain (dB), Min	20.0	20.0	20.0	20.0	20.0	20.0	20.0
RF Connector	UG599/U	UG383/U	UG383/U-M	UG385/U	UG387/U	UG387/U-M	UG387/U-M
IF and LO Connectors	SMA (F)	SMA (F)	SMA (F)	SMA (F)	SMA (F)	SMA (F)	SMA (F)
Extender Bias (V_{DC}/mA)	+12/200	+12/250	+12/250	+12/300	+12/450	+12/450	+12/450

TEST SET ARRANGEMENT:



Note: The featured sweeper and noise and gain analyzer are for illustration purposes only. Other models will work as long as they meet the specified interface criteria.

Benchtop, Broadband Driver Amplifiers, STB Series

FEATURES:

- Frequency coverage: 1 to 110 GHz
- High output power
- Superior gain flatness
- Single positive DC power supply

APPLICATIONS:

- Engineering prototypes
- EW systems
- Test instrumentation
- Power boosters

DESCRIPTION:

STB series benchtop, broadband driver amplifiers are designed and manufactured by utilizing the most advanced PHEMT or MMIC devices, thin film technologies, and an improved DC power supply to deliver a high output power and a superior gain flatness and low noise performance. The standard offering focuses on general purpose applications and covers the frequency range of 1 to 110 GHz. However, custom designs are also offered to meet any user's specific needs.

CATALOG MODELS:

Model Number	Frequency Range (GHz)	Gain (dB)	Gain Flatness (±dB)	P_{1dB} (dBm)	VSWR (Typ)	Power Supply (VAC)	Outlines
STB-0131833020-SFSF-S1	1.0 to 18.0	30	2.0	20	2:1	100 to 240	TB-SC
STB-0132732526-KFKF-S1	1.0 to 26.5	25	3.0	26	2:1	100 to 240	TB-SC
STB-0134033020-KFKF-S1	1.0 to 40.0	30	3.0	20	2:1	100 to 240	TB-SC
STB-0135032020-2F2F-S1	1.0 to 50.0	20	2.5	20	2:1	100 to 240	TB-SC
STB-1832732528-KFKF-S1	18.0 to 26.5	25	2.0	28	2:1	100 to 240	TB-SC
STB-1834032515-KFKF-S1	18.0 to 40.0	25	2.0	15	2:1	100 to 240	TB-SC
STB-2734033023-KFKF-S1	26.5 to 40.0	30	2.0	23	2:1	100 to 240	TB-SC
STB-2735033015-2F2F-S1	26.5 to 50.0	30	4.0	15	2:1	100 to 240	TB-SC
STB-3335033518-2F2F-S1	33.0 to 50.0	35	4.0	18	2:1	100 to 240	TB-SC
STB-4036033018-VFVF-S1	40.0 to 60.0	30	4.0	18	2:1	100 to 240	TB-SC
STB-5037032815-VFVF-S1	50.0 to 70.0	28	5.0	15	2:1	100 to 240	TB-SC
STB-5037032815-1515-S1	50.0 to 70.0	28	5.0	15	2:1	100 to 240	TB-SV
STB-7039033018-1212-S1	70.0 to 90.0	30	5.0	18	2:1	100 to 240	TB-SE
STB-7531143015-1010-S1	75.0 to 110.0	30	5.0	15	2:1	100 to 240	TB-SW

CUSTOM MODELS:

SAGE Millimeter's benchtop amplifiers model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

STB - F1N F2N GG PP - CI CO - XY

F1N is the start frequency in MHz x 10N. For example: 26.0 GHz = 263
F2N is the stop frequency in MHz x 10N. For example: 28.0 GHz = 283
GG is the linear gain in dB. For example: 25 dB = 25
PP is the output P_{1dB} in dBm. For example: 20 dBm = 20
CI is the input connector type. For example: K(F) = KF
CO is the output connector type. For example: WR-28 = 28
X is for amplifier type. "S" is a standard package and "C" is a custom design.
Y is for factory reserve.

Example: STB-0136732013-VFVF-S1 is a benchtop amplifier with a frequency range of 1 to 67 GHz, a linear gain of 20 dB and a P_{1dB} of 13 dBm. The benchtop amplifier has female 1.85 mm connectors for the input and output port and a standard package . "1" is a factory assigned number.

Doppler Radar Target Simulators, STR Series

FEATURES:

- Frequencies: 24, 35, 76.5 and 94 GHz
- Single sideband output
- Simulated target speed and size adjustable
- Simulated target moving direction switchable
- Instrumentation grade

APPLICATIONS:

- Doppler target simulation
- Radar systems

DESCRIPTION:

STR series Doppler radar simulators are single-sideband-modulator-based radar simulators with the following working mechanism: a signal emitted by the radar under testing is received through the antenna port and fed into a single sideband modulator through a diplexer. The single sideband modulator modulates the incoming signal and sends either a higher or lower band signal back to the diplexer. The frequency-shifted signal is transmitted back to the antenna as a Doppler signal that is received by the radar under testing. The amount of frequency shifted equals the input modulation frequency, i.e., the intermediate frequency (IF). By adjusting the IF, the phase of the IF's "I" and "Q" channels and the routing attenuation, speed, direction and radar cross-section of the target can be simulated.

Doppler radar simulators offer Doppler radar manufacturers an economic means of evaluating their products by replacing the need for expensive and time-consuming field tests. The below standard models with level setting and direct reading attenuators are offered for common Doppler radar frequencies. However, models with different operation frequencies are also available.

CATALOG MODELS (Level Setting Version):

Model Number	STR-243-42-L1	STR-353-28-L1	STR-773-12-L1	STR-943-10-L1
Waveguide Size	WR-42	WR-28	WR-12	WR-10
Frequency (GHz)	24.125	35.000	76.500	94.000
Operating Bandwidth (MHz)	±100	±150	±250	±250
Carrier Rejection (dB, Min.)	30	30	30	30
Image Suppression (dB, Min.)	20	20	20	20
Routing Loss (dB, Typ.)	14 to 70	14 to 70	30 to 80	30 to 80
I/Q Band Width (MHz, Min.)	0 to 100	0 to 150	0 to 250	0 to 250
I/Q Driving Level (mA, Max.)	±10	±10	±10	±10
I/Q Phase Error (Degrees)	±5	±5	±5	±5
IF Port Connectors	SMA (F)	SMA (F)	SMA (F)	SMA (F)

CATALOG MODELS (Direct Reading Version):

Model Number	STR-243-42-D1	STR-353-28-D1	STR-773-12-D1	STR-943-10-D1
Waveguide Size	WR-42	WR-28	WR-12	WR-10
Frequency (GHz)	24.125	35.000	76.500	94.000
Operating Bandwidth (MHz)	±100	±150	±250	±250
Carrier Rejection (dB, Min.)	30	30	30	30
Image Suppression (dB, Min.)	20	20	20	20
Routing Loss (dB, Typ.)	25 to 125	28 to 125	30 to 130	30 to 130
I/Q Band Width (MHz, Min.)	0 to 100	0 to 150	0 to 250	0 to 250
I/Q Driving Level (Vp-p Max.)	±10	±10	±10	±10
I/Q Phase Error (Degrees)	±5	±5	±5	±5
IF Port Connectors	SMA (F)	SMA (F)	SMA (F)	SMA (F)

SageMillimeter.com ■ 3043 Kashiwa Street, Torrance, CA 90505 ■ Ph (424)-757-0168 ■ Fax (424)-757-0188 ■ Email: Sales@SageMillimeter.com

Instrument Mini Jacks, STJ Series

FEATURES:

- Rugged configuration
- Stainless steel
- Quick and smooth one-knob adjustment
- Instrumentation grade

APPLICATIONS:

- Lab apparatus support
- Test setup support
- Waveguide system support

DESCRIPTION:

STJ series instrument mini jacks provide an adjustable support solution in laboratory environments. These mini jacks are especially useful when setting up benchtop test sets or module testing system. The mini jacks are constructed with passivated stainless steel and a single knob for making height adjustments. Four table sizes and elevation ranges are offered to meet various application needs as shown below.

CATALOG MODELS:

Model Number	STJ-2024-S1	STJ-3030-S1	STJ-4040-S1	STJ-6060-S1
Table Size (A x B, Inches)	2.0 x 2.4	3.0 x 3.0	4.0 x 4.0	6.0 x 6.0
Height Range (C, Inches)	1.7 to 4.5	1.7 to 5.0	1.7 to 5.8	2.4 to 9.8
Maximum Weight Capacity (lb)	10	15	20	30
Outlines	TJ-S1-1	TJ-S1-2	TJ-S1-3	TJ-S1-4

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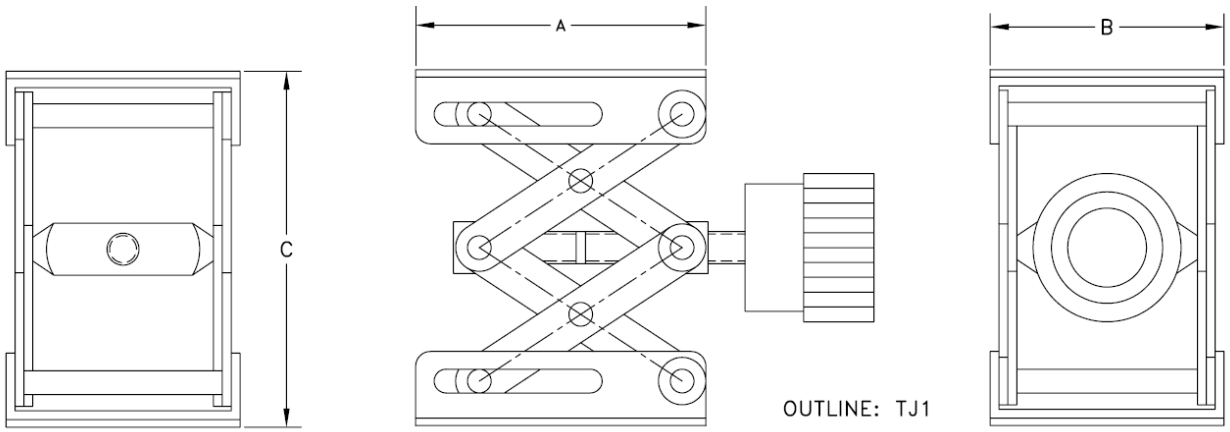
OUTLINES:



Test Equipment & Modules Application Notes

SAGE Millimeter offers a wide range of standard and custom test equipment and modules to meet differing testing requirements in microwave and millimeterwave frequency bands. Customers may use the equipment and modules offered in this section to extend industry-standard test equipment to higher frequency ranges.

Frequency Extenders:

Frequency extenders are designed to extend industry standard, low frequency signal sources or generators to higher millimeterwave frequencies. These extenders offer a low cost means of producing millimeterwave signal sources while preserving the functionality and features that industry standard models offer.

Network Analyzer Extenders:

Network analyzer extenders are designed to extend industry standard, low frequency vector or scalar network analyzers to higher millimeter-wave frequencies. These extenders offer a low cost means of producing millimeterwave network analyzers while preserving the functionality and features that industry standard models offer.

Noise Figure and Gain Test Extenders:

Noise figure and gain test extenders are offered to extend noise and gain measuring capabilities to higher millimeterwave frequencies. These extenders are designed to interface with noise and gain test systems that have an input IF of 10 MHz to 1.6 GHz, such as the industry standard Agilent 8970A/B, N8973A and Maury MT 2075B. An external DC power supply is required to power up the extenders.

Waveguide Test Equipment:

Attenuators: Fixed, level setting, direct reading and programmable waveguide attenuators are offered in this section of the catalog.

Phase Shifters: Waveguide, micrometer-driven phase shifters are offered in this section of the catalog.

Waveguide Detectors: Waveguide detectors are GaAs beam lead Schottky diode-based detectors that are designed for millimeterwave network analyzer applications to offer a high dynamic range and superior port matching. The RF interface of these detectors is a standard waveguide with an integrated Faraday isolator to improve the port VSWR. These detectors are offered in this section of the catalog.

Harmonic Mixers: These harmonic mixers are GaAs beam lead Schottky diode-based mixers. These mixers employ a single diode and broadband circuitry to extend the operation frequency of test instruments, such as spectrum analyzers and frequency counters, to higher millimeterwave frequencies of up to 110 GHz. These harmonic mixers also provide low conversion loss and continuous frequency coverage across full waveguide band operations. Unlike the balanced harmonic mixers (SFH series), these harmonic mixers do not have a built-in frequency diplexer. These mixers are offered in this section of the catalog.

Faraday Isolators: Faraday isolators are constructed with a longitudinal, magnetized ferrite rod that causes a Faraday rotation of the incoming RF signal. Although the typical insertion loss of Faraday isolators is slightly higher than its waveguide junction isolator (SNF series) counterpart, their isolation is at least 10 dB higher. In addition, Faraday isolators cover a broader frequency range and possess less insertion phase variation across the entire waveguide band. These characteristics make them ideal for broadband applications, especially in test labs and instrumentations.

Noise Sources: Noise sources are silicon IMPATT diode-based, solid-state noise sources. These noise sources implement a high performance diode and propriety circuit design to offer high ENR with extreme flatness across the entire waveguide bandwidth. They are offered with and without integrated Faraday isolators.

Waveguide Straight Sections, SWG Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Circular and rectangular
- Various waveguide material options
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWG series waveguide straight sections are offered with either rectangular or circular waveguides. The below models cover the frequency range of 18 to 170 GHz and are offered with 1 and 2" lengths. In addition to the listed models, waveguide straight sections can also be requested for different lengths. While the standard models are commercial grade, instrumentation grade waveguides are also available. Check the website or contact the factory for custom models.

CATALOG MODELS:

Band	WG	Frequency Range (GHz)	Model Number	Outline	Length	Model Number	Outline	Length
K	WR-42	18.0 to 26.5	SWG-42010-FB	WG-FK	1" Long	SWG-42020-FB	WG-FK-L	2" Long
Ka	WR-28	26.5 to 40.0	SWG-28010-FB	WG-FA	1" Long	SWG-28020-FB	WG-FA-L	2" Long
Q	WR-22	33.0 to 50.0	SWG-22010-FB	WG-FQ	1" Long	SWG-22020-FB	WG-FQ-L	2" Long
U	WR-19	40.0 to 60.0	SWG-19010-FB	WG-FU	1" Long	SWG-19020-FB	WG-FU-L	2" Long
V	WR-15	50.0 to 75.0	SWG-15010-FB	WG-FV	1" Long	SWG-15020-FB	WG-FV-L	2" Long
E	WR-12	60.0 to 90.0	SWG-12010-FB	WG-FE	1" Long	SWG-12020-FB	WG-FE-L	2" Long
W	WR-10	75.0 to 110.0	SWG-10010-FB	WG-FW	1" Long	SWG-10020-FB	WG-FW-L	2" Long
F	WR-08	90.0 to 140.0	SWG-08010-FB	WG-FF	1" Long	SWG-08020-FB	WG-FF-L	2" Long
D	WR-06	110.0 to 170.0	SWG-06010-FB	WG-FD	1" Long	SWG-06020-FB	WG-FD-L	2" Long

CUSTOM MODELS:

W

SAGE Millimeter's waveguide straight model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

Rectangular Waveguide: **SWG - WG LLL - XY**

WG is the waveguide size. For example: WR-10 = 10
LLL is the length of the waveguide straight in 1/10". For example: 3.5" = 035
X is the flange designator. "F" is with flanges, and "N" is without flanges.
Y is the grade. "1" is for instrumentation grade, and "B" is for commercial grade.

Example: 1) SWG-10035-F1 is an instrumentation grade, WR-10 waveguide straight section. The waveguide straight is 3.5" long and has flanges.
2) SWG-10060-NB is a commercial grade, WR-10 waveguide straight section. The waveguide straight is 6.0" long and has no flanges.

Circular Waveguide: **SWG - DDD LLL - XY**

DDD is the circular waveguide diameter in mils. For example: 250 mils = 250
LLL is the length of the waveguide straight in 1/10". For example: 3.5" = 035
X is the flange designator. "F" is with flanges, and "N" is without flanges.
Y is the grade. "1" is for instrumentation grade, and "B" is for commercial grade.

Example: 1) SWG-250035-FB is a commercial grade, 0.250" diameter circular waveguide straight section. The waveguide straight is 3.5" long and has flanges.
2) SWG-250035-N1 is an instrumentation grade, 0.250" diameter circular waveguide straight section. The waveguide straight is 3.5" long and has no flanges.

Waveguide Bends and Twists, SWB Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Various waveguide material options
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWB series waveguide bends and twists are offered to cover the frequency range of 18 to 170 GHz. The below standard models offer 90 degree E- and H-plane bends and 90 and 45 degree twists. However, custom angular degrees can be configured as well. While the standard models are commercial grade, instrumentation grade waveguides are also available. Check the website or contact the factory for custom models.

CATALOG MODELS: (E and H Bends)

Band	WG	Frequency Range (GHz)	Model Number	Outline	Orientation	Model Number	Outline	Orientation
K	WR-42	18.0 to 26.5	SWB-42090-EB	WB-EK	90° E Bend	SWB-42090-HB	WB-HK	90° H Bend
Ka	WR-28	26.5 to 40.0	SWB-28090-EB	WB-EA	90° E Bend	SWB-28090-HB	WB-HA	90° H Bend
Q	WR-22	33.0 to 50.0	SWB-22090-EB	WB-EQ	90° E Bend	SWB-22090-HB	WB-HQ	90° H Bend
U	WR-19	40.0 to 60.0	SWB-19090-EB	WB-EU	90° E Bend	SWB-19090-HB	WB-HU	90° H Bend
V	WR-15	50.0 to 75.0	SWB-15090-EB	WB-EV	90° E Bend	SWB-15090-HB	WB-HV	90° H Bend
E	WR-12	60.0 to 90.0	SWB-12090-EB	WB-EE	90° E Bend	SWB-12090-HB	WB-HE	90° H Bend
W	WR-10	75.0 to 110.0	SWB-10090-EB	WB-EW	90° E Bend	SWB-10090-HB	WB-HW	90° H Bend
F	WR-08	90.0 to 140.0	SWB-08090-EB	WB-EF	90° E Bend	SWB-08090-HB	WB-HF	90° H Bend
D	WR-06	110.0 to 170.0	SWB-06090-EB	WB-ED	90° E Bend	SWB-06090-HB	WB-HD	90° H Bend

CATALOG MODELS: (Twists)

Band	WG	Frequency Range (GHz)	Model Number	Outline	Orientation	Model Number	Outline	Orientation
K	WR-42	18.0 to 26.5	SWB-42045-TB	WB-TK-5	45° Twist	SWB-42090-TB	WB-TK	90° Twist
Ka	WR-28	26.5 to 40.0	SWB-28045-TB	WB-TA-5	45° Twist	SWB-28090-TB	WB-TA	90° Twist
Q	WR-22	33.0 to 50.0	SWB-22045-TB	WB-TQ-5	45° Twist	SWB-22090-TB	WB-TQ	90° Twist
U	WR-19	40.0 to 60.0	SWB-19045-TB	WB-TU-5	45° Twist	SWB-19090-TB	WB-TU	90° Twist
V	WR-15	50.0 to 75.0	SWB-15045-TB	WB-TV-5	45° Twist	SWB-15090-TB	WB-TV	90° Twist
E	WR-12	60.0 to 90.0	SWB-12045-TB	WB-TE-5	45° Twist	SWB-12090-TB	WB-TE	90° Twist
W	WR-10	75.0 to 110.0	SWB-10045-TB	WB-TW-5	45° Twist	SWB-10090-TB	WB-TW	90° Twist
F	WR-08	90.0 to 140.0	SWB-08045-TB	WB-TF-5	45° Twist	SWB-08090-TB	WB-TF	90° Twist
D	WR-06	110.0 to 170.0	SWB-06045-TB	WB-TD-5	45° Twist	SWB-06090-TB	WB-TD	90° Twist

W

CUSTOM MODELS:

SAGE Millimeter's waveguide bend and twist model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SWB - WG DDD - XY

WG is the waveguide size. For example: WR-10 = 10
DDD is the degree of the bend or twist. For example: 30° = 030 and 135° = 135
X is the waveguide type. “E” is E-plane bend, “H” is H-plane bend, and “T” is twist.
Y is the grade. “1” is for instrumentation grade, and “B” is for commercial grade.

Example: SWB-10045-EB is a commercial grade, WR-10 waveguide E-plane bend. The bend angle is 45°.

Waveguide Bulkhead Adapters, SWW Series, and Flange Adapters, SWR Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Rugged waveguide configuration
- Low insertion loss
- Instrumentation grade

APPLICATIONS:

- Subassemblies
- Test Instrumentation

DESCRIPTION:

SWW series waveguide bulkhead adapters are offered for applications where panel mount waveguide interfaces are required. These adapters are manufactured through a precision EDM machining technique to ensure high quality and ruggedness. The adapters are offered to cover the frequency range from 18 to 170 GHz. Check the website or contact the factory for additional models.

SWR series flange adapters act as a bridge between different flange patterns with the same waveguide. These adapters are also offered to cover the frequency range from 18 to 170 GHz. Visit the website or contact the factory for custom models.

CATALOG MODELS (SWW Series):

Band	Model Number	Waveguide	I. L. (dB)	Outline	Features
K	SWW-4205-SB	WR-42	0.05	WW-KB	Panel Mount, Brass, 0.50” Thick
Ka	SWW-2805-SB	WR-28	0.05	WW-AB	Panel Mount, Brass, 0.50” Thick
Q	SWW-2205-SB	WR-22	0.05	WW-QB	Panel Mount, Brass, 0.50” Thick
U	SWW-1905-SB	WR-19	0.06	WW-UB	Panel Mount, Brass, 0.50” Thick
V	SWW-1505-SB	WR-15	0.08	WW-VB	Panel Mount, Brass, 0.50” Thick
E	SWW-1205-SB	WR-12	0.10	WW-EB	Panel Mount, Brass, 0.50” Thick
W	SWW-1005-SB	WR-10	0.10	WW-WB	Panel Mount, Brass, 0.50” Thick
F	SWW-0805-SB	WR-08	0.10	WW-FB	Panel Mount, Brass, 0.50” Thick
D	SWW-0605-SB	WR-06	0.10	WW-DB	Panel Mount, Brass, 0.50” Thick

CUSTOM MODELS (SWW Series):

W

SAGE Millimeter’s waveguide bulkhead adapter model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

W

SWW - WG TT - XY

WG is the waveguide size. For example, WR-15 = 15
TT is the thickness of the adapters in 1/10”. For example, 1.0” = 10
X is the adapter type. “S” is standard and “C” is custom.
Y is the material type. “A” is aluminum, “B” is brass and “C” is coin silver.

Example: SWW-1510-SB is a standard, 1.0” thick WR-15 waveguide bulkhead adapter. The material is brass.

CUSTOM MODELS (SWR Series):

SAGE Millimeter’s waveguide flange adapter model numbers are configured per the following format. Customers may refer to the format to specify when placing an order.

SWR - FGC FGS - WG - XY

FGC is the circular or larger waveguide flange designation. For example, UG383/U = 383
FGS is the square or smaller waveguide flange designation. For example, UG599/U = 599
WG is the waveguide size. For example: WR-28 = 28
X is the adapter type. “S” is standard and “C” is custom.
Y is the grade. “1” is for instrumentation grade, and “B” is for commercial grade.

Example: SWR-383599-28-SB is a standard, commercial grade UG383/U to UG599/U flange adapter with a WR-28 waveguide.

Waveguide to Coax Adapters, SWC Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Up to full waveguide band operation
- Right angle and end launch options
- Low insertion loss and VSWR
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWC series waveguide to coax adapters allow for an efficient transition between the rectangular waveguide and coax connector. Two mechanical configurations, a right angle and an end launch (in-line), are offered for various waveguide bands. These adapters are designed and manufactured for instrumentation grade quality, but offered at a commercial price level. These adapters deliver superior RF performance (i.e., low insertion loss and low VSWR). While the adapters are designed and manufactured for full band applications, performance degradation may be observed at the higher end of the frequency range due to the performance limitation of certain coax connector types. Because of the numerous possible combinations of waveguide and coax connector types, always check the website or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	Waveguide	Coaxial Connector Type	Frequency Range (GHz)	Insertion Loss (dB)	Return Loss (dB)	Outline	Configuration
K	SWC-42KF-R1	WR-42	K(F)	18.0 to 26.5	0.20	20	WC-KR	Right Angle
K	SWC-42KM-R1	WR-42	K(M)	18.0 to 26.5	0.20	20	WC-KR	Right Angle
K	SWC-42KF-E1	WR-42	K(F)	18.0 to 26.5	0.20	20	WC-KE	End Launch
K	SWC-42KM-E1	WR-42	K(M)	18.0 to 26.5	0.20	20	WC-KE	End Launch
N/A	SWC-34KF-R1	WR-34	K(F)	22.0 to 33.0	0.20	20	WC-3R	Right Angle
N/A	SWC-34KM-R1	WR-34	K(M)	22.0 to 33.0	0.20	20	WC-3R	Right Angle
Ka	SWC-28KF-R1	WR-28	K(F)	26.5 to 40.0	0.25	20	WC-AR	Right Angle
Ka	SWC-28KM-R1	WR-28	K(M)	26.5 to 40.0	0.25	20	WC-AR	Right Angle
Ka	SWC-28KF-E1	WR-28	K(F)	26.5 to 40.0	0.25	20	WC-AE	End Launch
Ka	SWC-28KM-E1	WR-28	K(M)	26.5 to 40.0	0.25	20	WC-AE	End Launch
Q	SWC-222F-R1	WR-22	2.4 mm (F)	33.0 to 50.0	0.30	18	WC-QR	Right Angle
Q	SWC-222M-R1	WR-22	2.4 mm (M)	33.0 to 50.0	0.30	18	WC-QR	Right Angle
U	SWC-19VF-R1	WR-19	V (F)	40.0 to 60.0	0.40	18	WC-UR	Right Angle
U	SWC-19VM-R1	WR-19	V (M)	40.0 to 60.0	0.40	18	WC-UR	Right Angle
V	SWC-15VF-R1	WR-15	V (F)	50.0 to 70.0	0.50	16	WC-VR	Right Angle
V	SWC-15VM-R1	WR-15	V (M)	50.0 to 70.0	0.50	16	WC-VR	Right Angle
V	SWC-15VF-E1	WR-15	V (F)	50.0 to 70.0	0.40	16	WC-VE	End Launch
V	SWC-15VM-E1	WR-15	V (M)	50.0 to 70.0	0.40	16	WC-VE	End Launch
E	SWC-121F-R1	WR-12	1.0 mm (F)	60.0 to 90.0	1.00	15	WC-ER	Right Angle
E	SWC-121M-R1	WR-12	1.0 mm (M)	60.0 to 90.0	1.00	15	WC-ER	Right Angle
E	SWC-121F-E1	WR-12	1.0 mm (F)	60.0 to 90.0	0.70	16	WC-EE	End Launch
E	SWC-121M-E1	WR-12	1.0 mm (M)	60.0 to 90.0	0.70	16	WC-EE	End Launch
W	SWC-101F-R1	WR-10	1.0 mm (F)	75.0 to 110.0	1.20	14	WC-WR	Right Angle
W	SWC-101M-R1	WR-10	1.0 mm (M)	75.0 to 110.0	1.20	14	WC-WR	Right Angle
W	SWC-101F-E1	WR-10	1.0 mm (F)	75.0 to 110.0	0.80	16	WC-WE	End Launch
W	SWC-101M-E1	WR-10	1.0 mm (M)	75.0 to 110.0	0.80	16	WC-WE	End Launch

W

Waveguide Taper and Mode Transitions, SWT Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Rugged waveguide configuration
- Rectangular taper transition
- Rectangular to circular mode transition
- Low insertion loss
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWT series waveguide transitions are mainly offered as either rectangular waveguide taper transitions or rectangular to circular waveguide mode transitions. While catalog models only list taper transitions between adjacent waveguide sizes, transitions between non-adjacent waveguide sizes are available upon request. Similarly, the catalog models only list mode transitions between standard rectangular waveguides and their corresponding mid-band circular waveguide. However, standard rectangular waveguides to high- and low-band circulator waveguides can also be requested. The taper implemented in the standard models is "linear" type. The below standard models are manufactured by using either EDM machining or electro-forming techniques to ensure high accuracy and a quality surface finish. While the listed models cover 18 to 110 GHz, additional models can be offered for frequencies up to 170 GHz or even higher bands. Typically, these transitions induce a fraction of a dB insertion loss and a VSWR of 1.05:1 or better when operating in the dominant mode. Check the website or contact the factory for additional models.

CATALOG MODELS:

Band	Model Number	Waveguide	I. L. (dB)	VSWR	Outline	Features
K to Ka	SWT-4228-LB	WR-42 to WR-28	0.10	1.05:1	WT-KA	Linear Taper, Brass
Ka to Q	SWT-2822-LB	WR-28 to WR-22	0.12	1.05:1	WT-AQ	Linear Taper, Brass
Q to U	SWT-2219-LB	WR-22 to WR-19	0.15	1.05:1	WT-QU	Linear Taper, Brass
U to V	SWT-1915-LB	WR-19 to WR-15	0.18	1.05:1	WT-UV	Linear Taper, Brass
V to E	SWT-1512-LB	WR-15 to WR-12	0.20	1.05:1	WT-VE	Linear Taper, Brass
E to W	SWT-1210-LB	WR-12 to WR-10	0.22	1.05:1	WT-EW	Linear Taper, Brass

Band	Model Number	Waveguide	I. L. (dB)	VSWR	Outline	Features
K	SWT-42368-SB	WR-42 to 0.368" D	0.10	1.05:1	WT-KC-M	Mode Transition, Brass
Ka	SWT-28250-SB	WR-28 to 0.250" D	0.12	1.05:1	WT-AC-M	Mode Transition, Brass
Q	SWT-22219-SB	WR-22 to 0.219" D	0.15	1.05:1	WT-QC-M	Mode Transition, Brass
U	SWT-19188-SB	WR-19 to 0.188" D	0.18	1.05:1	WT-UC-M	Mode Transition, Brass
V	SWT-15141-SB	WR-15 to 0.141" D	0.20	1.05:1	WT-VC-M	Mode Transition, Brass
E	SWT-12125-SB	WR-12 to 0.125" D	0.22	1.05:1	WT-EC-M	Mode Transition, Brass
W	SWT-10094-SB	WR-12 to 0.094" D	0.25	1.05:1	WT-WC-M	Mode Transition, Brass

W

W

CUSTOM MODELS:

SAGE Millimeter's waveguide transition model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

Rectangular to rectangular: **SWT - WL WS - XY**
Rectangular to circular: **SWT - WG DDD - XY**

WL is the larger waveguide size. For example: WR-15 = 15; **WG** is the rectangular waveguide size. For example, WR–42 = 42
WS is the smaller waveguide size. For example: WR-10 = 10; **DDD** is the diameter of the circular waveguide in inches. For example, 0.396" = 396
X is the transition type. "S" is mode and "L" is linear taper.
Y is the material type. "A" is aluminum, "B" is bronze and "C" is coin silver.

Example: 1) SWT-1510-LB is a WR-15 to WR-10 waveguide linear taper transition. The material is brass.

Waveguide Terminations, SWL Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Low VSWR
- Low and high power
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWL series waveguide terminations are designed to provide a low VSWR and are available in various versions to handle different power applications. The below standard models include low and medium power levels, however, higher power levels of up to several hundred watts are also available. While the listed models cover 18 to 110 GHz, additional models can be offered for frequencies up to 170 GHz. Check the website or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	Waveguide	Frequency Range (GHz)	VSWR (Max)	Power Handling (W, Min)	Flange Type	Outline
K	SWL-4233-S1	WR-42	18.0 o 26.5	1.04:1	2.0	UG595/U	WL-KL
Ka	SWL-2832-S1	WR-28	26.5 to 40.0	1.04:1	1.5	UG599/U	WL-AL
Q	SWL-2230-S1	WR-22	33.0 to 50.0	1.04:1	1.0	UG383/U	WL-QL
U	SWL-1930-S1	WR-19	40.0 to 60.0	1.05:1	1.0	UG383/U-M	WL-UL
V	SWL-1527-S1	WR-15	50.0 to 75.0	1.05:1	0.5	UG385/U	WL-VL
E	SWL-1227-S1	WR-12	60.0 to 90.0	1.05:1	0.5	UG387/U	WL-EL
W	SWL-1027-S1	WR-10	75.0 to 110.0	1.05:1	0.5	UG387/U-M	WL-WL
K	SWL-4240-S1	WR-42	18.0 o 26.5	1.05:1	10.0	UG595/U	WL-KM
Ka	SWL-2840-S1	WR-28	26.5 to 40.0	1.05:1	10.0	UG599/U	WL-AM
Q	SWL-2237-S1	WR-22	33.0 to 50.0	1.05:1	5.0	UG383/U	WL-QM
U	SWL-1937-S1	WR-19	40.0 to 60.0	1.06:1	5.0	UG383/U-M	WL-UM
V	SWL-1537-S1	WR-15	50.0 to 75.0	1.06:1	5.0	UG385/U	WL-VM
E	SWL-1237-S1	WR-12	60.0 to 90.0	1.06:1	5.0	UG387/U	WL-EM
W	SWL-1037-S1	WR-10	75.0 to 110.0	1.06:1	5.0	UG387/U-M	WL-WM

W

CUSTOM MODELS:

SAGE Millimeter's waveguide termination model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SWL - WG PP - XY

WG is the waveguide size. For example: WR-10 = 10
PP is the power level in dBm. For example: 34 dBm = 34
X is the termination type. "S" is standard, "T" is tunable and "C" is custom.
Y is for factory reserve.

Example: 1) SWL-1040-S1 is a standard, WR-10 waveguide termination with a power handling of up to 10 watts. "1" is a factory assigned number.
2) SWL-2843-C1 is a custom, WR-28 waveguide termination with a power handling of up to 20 watts. "1" is a factory assigned number.

Waveguide Magic Tees, SWM Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Waveguide or split block configurations
- Low insertion loss and even port balance
- High isolation
- Up to full waveguide band operations
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWM series magic tees are offered in both waveguide and split block versions. The below models cover 18 to 110 GHz, however, additional models can be offered for frequencies up to 170 GHz. While the waveguide version features flange interfaces for a convenient integration from both directions, the split block version boasts a more compact size for system integrations. Through a detailed design and fabrication process, the catalog models offer up to full waveguide band operations with slight performance degradation at the band edges.

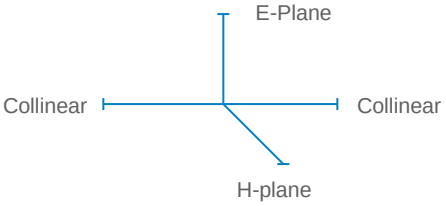
The magic tee is a four-port device. Since its collinear ports are perfectly matched, it is also referred to as a matched hybrid tee. The port relationship of the magic tee is illustrated in the figure below. When two equal-amplitude, in-phase signals are fed into the collinear ports, the resultant output signal appears at the H-plane port only. On the other hand, when two equal-amplitude, 180˚ out-of-phase signals are fed into the collinear ports, the resultant output signal appears at the E-plane port only. Alternatively, signals fed into the H-plane port are split into two equal-amplitude, in-phase signals at the collinear ports and signals fed into the E-plane port are split into two equal-amplitude, 180° out-of-phase signals. The H-plane and E-plane ports are isolated. Because of this feature, the magic tees are widely used in monopulse radar antenna systems and many other systems where phase and port isolation are critical. When either the H-plane or E-plane port is terminated, these magic tees are used as in-phase or out-of-phase power splitters or combiners. Furthermore, the magic tees can be used to construct multi-way power combiners or dividers.

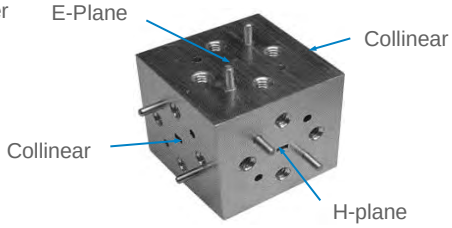
CATALOG MODELS:

Band	Model Number	Waveguide	Frequency Range (GHz)	Insertion Loss (dB)[1]	Isolation (dB)	Amplitude Balance (dB)	VSWR	Outline	Feature
K	SWM-18327320-42-SB	WR-42	18.0 to 26.5	0.15	20.0	±0.10	1.5:1	WM-BK	Block
K	SWM-18327320-42-SW	WR-42	18.0 to 26.5	0.20	20.0	±0.10	1.5:1	WM-WK	Waveguide
Ka	SWM-27340320-28-SB	WR-28	26.5 to 40.0	0.20	20.0	±0.15	1.5:1	WM-BA	Block
Ka	SWM-27340320-28-SW	WR-28	26.5 to 40.0	0.25	20.0	±0.15	1.5:1	WM-WA	Waveguide
Q	SWM-33350320-22-SB	WR-22	33.0 to 50.0	0.25	20.0	±0.15	1.5:1	WM-BQ	Block
Q	SWM-33350320-22-SW	WR-22	33.0 to 50.0	0.30	20.0	±0.15	1.5:1	WM-WQ	Waveguide
U	SWM-40360320-19-SB	WR-19	40.0 to 60.0	0.25	20.0	±0.20	1.5:1	WM-BU	Block
U	SWM-40360320-19-SW	WR-19	40.0 to 60.0	0.30	20.0	±0.20	1.5:1	WM-WU	Waveguide
V	SWM-50375320-15-SB	WR-15	50.0 to 75.0	0.30	20.0	±0.25	1.5:1	WM-BV	Block
V	SWM-50375320-15-SW	WR-15	50.0 to 75.0	0.35	20.0	±0.25	1.5:1	WM-WV	Waveguide
E	SWM-60390320-12-SB	WR-12	60.0 to 90.0	0.30	20.0	±0.30	1.5:1	WM-BE	Block
E	SWM-60390320-12-SW	WR-12	60.0 to 90.0	0.35	20.0	±0.30	1.5:1	WM-WE	Waveguide
W	SWM-75311420-10-SB	WR-10	75.0 to 110.0	0.30	20.0	±0.30	1.5:1	WM-BW	Block
W	SWM-75311420-10-SW	WR-10	75.0 to 110.0	0.35	20.0	±0.30	1.5:1	WM-WW	Waveguide

W

Note: 1) Insertion loss is the power loss on top of the loss due to the power splitting.





Waveguide Power Dividers, SWP Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- 2, 4, and 8 ways
- Low insertion loss and high isolation
- Excellent port balance
- Narrow and broadband operations
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWP series waveguide power dividers (splitters) or combiners are widely used in labs, test instrumentation and radar and communication systems. The below standard models cover 18 to 110 GHz, however, additional models can be offered for frequencies up to 170 GHz. These power dividers are available in in 2^N way power dividing configurations, with a maximum of 32 ways. While the below models list right angle configurations, end launch configurations are also available. Through a detailed design and fabrication process, these power dividers exhibit low insertion loss, high port isolation and well-balanced, in-phase power dividing across a broad frequency range. Always check the website or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	Waveguide	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	Amplitude Balance (dB)	VSWR	Outline	Feature
K	SWP-18327302-42-S1	WR-42	18.0 to 26.5	0.35	20.0	±0.10	1.5:1	WP-K2	2 Way
K	SWP-18327304-42-S1	WR-42	18.0 to 26.5	0.70	20.0	±0.15	1.5:1	WP-K4	4 Way
Ka	SWP-27340302-28-S1	WR-28	26.5 to 40.0	0.40	20.0	±0.15	1.5:1	WP-A2	2 Way
Ka	SWP-27340304-28-S1	WR-28	26.5 to 40.0	0.80	20.0	±0.20	1.5:1	WP-A4	4 Way
Q	SWP-33350302-22-S1	WR-22	33.0 to 50.0	0.40	20.0	±0.20	1.5:1	WP-Q2	2 Way
Q	SWP-33350304-22-S1	WR-22	33.0 to 50.0	0.80	20.0	±0.25	1.5:1	WP-Q4	4 Way
U	SWP-40360302-19-S1	WR-19	40.0 to 60.0	0.40	20.0	±0.20	1.5:1	WP-U2	2 Way
U	SWP-40360304-19-S1	WR-19	40.0 to 60.0	0.80	20.0	±0.25	1.5:1	WP-U4	4 Way
V	SWP-50375302-15-S1	WR-15	50.0 to 75.0	0.50	20.0	±0.20	1.5:1	WP-V2	2 Way
V	SWP-50375304-15-S1	WR-15	50.0 to 75.0	1.00	20.0	±0.25	1.5:1	WP-V4	4 Way
E	SWP-60390302-12-S1	WR-12	60.0 to 90.0	0.50	20.0	±0.20	1.5:1	WP-E2	2 Way
E	SWP-60390304-12-S1	WR-12	60.0 to 90.0	1.00	20.0	±0.30	1.5:1	WP-E4	4 Way
W	SWP-75311402-10-S1	WR-10	75.0 to 110.0	0.50	20.0	±0.20	1.5:1	WP-W2	2 Way
W	SWP-75311404-10-S1	WR-10	75.0 to 110.0	1.00	20.0	±0.30	1.5:1	WP-W4	4 Way

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CUSTOM MODELS:

SAGE Millimeter's waveguide power divider model numbers are configured per the following format. Customers may refer to the format and specify their own model numbers accordingly when placing an order.

SWP - F1N F2N NN - WG - XY

F1N is the start frequency in MHz x 10N. For example: 92 GHz = 923
F2N is the stop frequency in MHz x 10N. For example: 96 GHz = 963
NN is the number of power dividing. For example: 8 ways = 08
WG is the waveguide size. For example: WR-10 = 10
X is the power divider configuration type. “S” is standard coplanar, “E” is end launch and “C” is custom.
Y is for factory reserve.

Example: SWP-92396308-10-E1 is an 8-way waveguide power divider with a frequency range of 92 to 96 GHz. The power divider has WR-10 waveguides at the input and output ports and an end launch configuration. “1” is a factory assigned number.

Waveguide Directional Couplers, SWD Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Waveguide or split block configurations
- Low insertion loss and high directivity
- Directional, bi-directional and dual directional types
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWD series waveguide directional couplers feature low insertion loss, a flat coupling level and high directivity. The below standard models cover 18 to 110 GHz, however, additional models are offered for frequencies up to 170 GHz. Mechanically, they are constructed as either waveguides or split blocks. While the waveguide version offers the advantage being light weight with a flexible coupling arm orientation, the split block version offers a compact size and higher directivity. SAGE Millimeter offers three types of couplers: standard directional (3 ports), bi-directional (4 ports) and dual directional (4 ports). Their schematics are illustrated on the next page. Always check the website or contact the factory for custom models.

CATALOG MODELS (Split Block Version):

Band	Model Number[1, 2, 3]	Waveguide	Frequency Range (GHz)	Coupling (dB)	Insertion Loss (dB)[4]	Directivity (dB)[5]	VSWR	Outline	Feature
K	SWD-CC40H-42-BB	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.50	30	1.1:1	WD-BB-K	4 Ports, HB
K	SWD-CC40H-42-DB	WR-42	18.0 to 26.5	10, 20	0.50	30	1.1:1	WD-DB-K	4 Ports, HB
K	SWD-CC40H-42-SB	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.50	30	1.1:1	WD-SB-K	3 Ports, HB
Ka	SWD-CC40H-28-BB	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.50	35	1.1:1	WD-BB-A	4 Ports, HB
Ka	SWD-CC40H-28-DB	WR-28	26.5 to 40.0	10, 20	0.50	35	1.1:1	WD-DB-A	4 Ports, HB
Ka	SWD-CC40H-28-SB	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.50	35	1.1:1	WD-SB-A	3 Ports, HB
Q	SWD-CC40H-22-BB	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	35	1.1:1	WD-BB-Q	4 Ports, HB
Q	SWD-CC40H-22-DB	WR-22	33.0 to 50.0	10, 20	0.70	35	1.1:1	WD-DB-Q	4 Ports, HB
Q	SWD-CC40H-22-SB	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	35	1.1:1	WD-SB-Q	3 Ports, HB
U	SWD-CC40H-19-BB	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	35	1.1:1	WD-BB-U	4 Ports, HB
U	SWD-CC40H-19-DB	WR-19	40.0 to 60.0	10, 20	0.70	35	1.1:1	WD-DB-U	4 Ports, HB
U	SWD-CC40H-19-SB	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	35	1.1:1	WD-SB-U	3 Ports, HB
V	SWD-CC40H-15-BB	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.70	30	1.1:1	WD-BB-V	4 Ports, HB
V	SWD-CC40H-15-DB	WR-15	50.0 to 75.0	10, 20	0.70	30	1.1:1	WD-DB-V	4 Ports, HB
V	SWD-CC40H-15-SB	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.70	30	1.1:1	WD-SB-V	3 Ports, HB
E	SWD-CC40H-12-BB	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	0.80	30	1.1:1	WD-BB-E	4 Ports, HB
E	SWD-CC40H-12-DB	WR-12	60.0 to 90.0	10, 20	0.80	30	1.1:1	WD-DB-E	4 Ports, HB
E	SWD-CC40H-12-SB	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	0.80	30	1.1:1	WD-SB-E	3 Ports, HB
W	SWD-CC40H-10-BB	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.00	30	1.1:1	WD-BB-W	4 Ports, HB
W	SWD-CC40H-10-DB	WR-10	75.0 to 110.0	10, 20	1.00	30	1.1:1	WD-DB-W	4 Ports, HB
W	SWD-CC40H-10-SB	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.00	30	1.1:1	WD-SB-W	3 Ports, HB

W

Note:
1) “CC” is the coupling factor in dB. For example, SWD-1020H-28-SB is a 10 dB standard directional coupler.
2) “H” is the coupling port bend option. There is no E bend option for the split block configuration.
3) “-BB” is a bi-directional, 4-port coupler, “-DB” is a dual directional, 4-port coupler and “-SB” is a standard 3-port directional coupler.
4) Insertion loss is the power loss on top of the coupling loss. For example, a 3 dB standard directional coupler, model number SWD-0340H-28-SB, has a 4.5 dB total power loss.
5) The directivity of “-BB” models is dependent on the load’s VSWR.

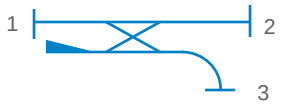
CATALOG MODELS (Waveguide Version):

Band	Model Number[1, 2, 3]	Wave-guide	Frequency (GHz)	Coupling (dB)	Insertion Loss (dB)[4]	Directivi-ty (dB)[5]	VSWR	Outline	Feature
K	SWD-CC30H-42-BW	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-BH-K	4 Ports, HB
K	SWD-CC30H-42-SW	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-SH-K	3 Ports, HB
K	SWD-CC30E-42-BW	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-BE-K	4 Ports, EB
K	SWD-CC30E-42-SW	WR-42	18.0 to 26.5	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-SE-K	3 Ports, EB
Ka	SWD-CC30H-28-BW	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-BH-A	4 Ports, HB
Ka	SWD-CC30H-28-SW	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-SH-A	3 Ports, HB
Ka	SWD-CC30E-28-BW	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-BE-A	4 Ports, EB
Ka	SWD-CC30E-28-SW	WR-28	26.5 to 40.0	3, 6, 10, 20, 30	0.60	30	1.15:1	WD-SE-A	3 Ports, EB
Q	SWD-CC30H-22-BW	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	30	1.15:1	WD-BH-Q	4 Ports, HB
Q	SWD-CC30H-22-SW	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	30	1.15:1	WD-SH-Q	3 Ports, HB
Q	SWD-CC30E-22-BW	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-BE-Q	4 Ports, EB
Q	SWD-CC30E-22-SW	WR-22	33.0 to 50.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-SE-Q	3 Ports, EB
U	SWD-CC30H-19-BW	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-BH-U	4 Ports, HB
U	SWD-CC30H-19-SW	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-SH-U	3 Ports, HB
U	SWD-CC30E-19-BW	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-BE-U	4 Ports, EB
U	SWD-CC30E-19-SW	WR-19	40.0 to 60.0	3, 6, 10, 20, 30	0.70	30	1.18:1	WD-SE-U	3 Ports, EB
V	SWD-CC30H-15-BW	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.80	30	1.20:1	WD-BH-V	4 Ports, HB
V	SWD-CC30H-15-SW	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.80	30	1.20:1	WD-SH-V	3 Ports, HB
V	SWD-CC30E-15-BW	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.80	30	1.20:1	WD-BE-V	4 Ports, EB
V	SWD-CC30E-15-SW	WR-15	50.0 to 75.0	3, 6, 10, 20, 30	0.80	30	1.20:1	WD-SE-V	3 Ports, EB
E	SWD-CC30H-12-BW	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	1.00	30	1.20:1	WD-BH-E	4 Ports, HB
E	SWD-CC30H-12-SW	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	1.00	30	1.20:1	WD-SH-E	3 Ports, HB
E	SWD-CC30E-12-BW	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	1.00	30	1.20:1	WD-BE-E	4 Ports, EB
E	SWD-CC30E-12-SW	WR-12	60.0 to 90.0	3, 6, 10, 20, 30	1.00	30	1.20:1	WD-SE-E	3 Ports, EB
W	SWD-CC30H-10-BW	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.20	30	1.20:1	WD-BH-W	4 Ports, HB
W	SWD-CC30H-10-SW	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.20	30	1.20:1	WD-SH-W	3 Ports, HB
W	SWD-CC30E-10-BW	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.20	30	1.20:1	WD-BE-W	4 Ports, EB
W	SWD-CC30E-10-SW	WR-10	75.0 to 110.0	3, 6, 10, 20, 30	1.20	30	1.20:1	WD-SE-W	3 Ports, EB

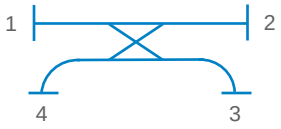
W

Note:
1) "CC" is the coupling factor in dB. For example, SWD-1020H-28-SW is a 10 dB standard directional coupler.
2) "H" OR "E" are the coupling port bend option. There is no E bend option for the split block configuration.
3) "-BW" is a bi-directional, 4-port coupler and "-SW" is a standard, 3-port directional coupler. "-DW" is offered as a non-catalog model.
4) Insertion loss is the power loss on top of the coupling loss. For example, a 3 dB standard directional coupler, model number SWD-0340H-28-SW, has a 4.5 dB total power loss.
5) The directivity of "-BB" models is dependent on the load's VSWR.

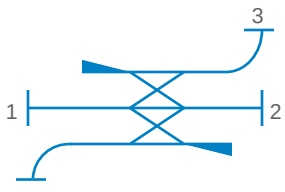
SCHEMATICS:



Standard Directional, 3 Ports



Bi-directional, 4 Ports



Dual directional, 4 Ports

Waveguide Crossguide Couplers, SWX Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Waveguide or split block styles
- Three or four-port configurations
- Various coupling levels
- Low insertion loss and moderate directivity
- Instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWX series waveguide crossguide couplers are offered for power sampling where directivity is a concern. Compared to multi-hole directional couplers, crossguide couplers feature lower insertion loss and a shorter design. These couplers are offered in both waveguide and split block versions. The below standard models cover 18 to 110 GHz, however, additional models can be offered for frequencies up to 170 GHz. While the waveguide version offers a light weight and flange interfaces for a convenient integration from both directions, the block version offers a more compact size. Although both versions can be offered in three and four-port configurations, only four-port configurations are listed below. In addition, full band models and differing coupling levels can be requested. Always check the website or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	WG	Frequency Range (GHz)	Bandwidth (GHz)	Coupling (dB)	Insertion Loss (dB)[1]	Directivity (dB)[2]	VSWR	Outline
K	SWX-F1NF2NCC-42-4B	WR-42	18.0 to 26.5	4.0	20, 30, 40	0.50	15	1.1:1	WX-BK-4
K	SWX-F1NF2NCC-42-4W	WR-42	18.0 to 26.5	4.0	20, 30, 40	0.70	15	1.1:1	WX-WK-4
Ka	SWX-F1NF2NCC-28-4B	WR-28	26.5 to 40.0	6.0	20, 30, 40	0.50	15	1.1:1	WX-BA-4
Ka	SWX-F1NF2NCC-28-4W	WR-28	26.5 to 40.0	6.0	20, 30, 40	0.70	15	1.1:1	WX-WA-4
Q	SWX-F1NF2NCC-22-4B	WR-22	33.0 to 50.0	7.0	20, 30, 40	0.60	15	1.1:1	WX-BQ-4
Q	SWX-F1NF2NCC-22-4W	WR-22	33.0 to 50.0	7.0	20, 30, 40	0.80	15	1.1:1	WX-WQ-4
U	SWX-F1NF2NCC-19-4B	WR-19	40.0 to 60.0	8.0	20, 30, 40	0.60	15	1.1:1	WX-BU-4
U	SWX-F1NF2NCC-19-4W	WR-19	40.0 to 60.0	8.0	20, 30, 40	0.80	15	1.1:1	WX-WU-4
V	SWX-F1NF2NCC-15-4B	WR-15	50.0 to 75.0	10.0	20, 30, 40	0.70	15	1.1:1	WX-BV-4
V	SWX-F1NF2NCC-15-4W	WR-15	50.0 to 75.0	10.0	20, 30, 40	0.90	15	1.1:1	WX-WV-4
E	SWX-F1NF2NCC-12-4B	WR-12	60.0 to 90.0	10.0	20, 30, 40	0.70	15	1.1:1	WX-BE-4
E	SWX-F1NF2NCC12-4W	WR-12	60.0 to 90.0	10.0	20, 30, 40	0.90	15	1.1:1	WX-WE-4
W	SWX-F1NF2NCC10-4B	WR-10	75.0 to 110.0	10.0	20, 30, 40	0.80	15	1.1:1	WX-BW-4
W	SWX-F1NF2NCC-10-4W	WR-10	75.0 to 110.0	10.0	20, 30, 40	1.00	15	1.1:1	WX-WW-4

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Note: 1) Insertion loss is the power loss on top of the coupling loss. For example, 20 dB block type crossguide coupler with model number SWX-30336320-28-4B has 20.5 dB total power loss.
2) The directivity of the four-port coupler is dependent on the load.

CUSTOM MODELS:

SAGE Millimeter's crossguide coupler model numbers are configured per the following format. Customers may refer to the format below and specify their own model numbers accordingly when placing an order.

SWX - F1N F2N CC - WG - XY

F1N is the start frequency in MHz x 10N. For example: 85 GHz = 853
F2N is the stop frequency in MHz x 10N. For example: 95 GHz = 953
CC is the coupling level in dB. For example: 30 dB = 30
WG is the waveguide size. For example: WR-10 = 10
X is for number of ports. "D" is for two ports, "3" is for three ports and "4" is for four ports.
Y is for coupler configuration. "B" is for split block and "W" is for waveguide.

Example: SWX-85395330-10-4B is a 4-port crossguide coupler with a frequency range from 85 to 95 GHz and a coupling level of 30 dB. The coupler has WR-10 waveguides at the input and output ports and a split block configuration.

Waveguide Filters, SWF Series

FEATURES:

- Frequency coverage: 18 to 170 GHz
- Bandpass, highpass and lowpass types
- Low insertion loss and high rejection
- Standard and custom designs
- Commercial and instrumentation grade

APPLICATIONS:

- Test labs
- Instrumentation
- Subassemblies
- Transceivers

DESCRIPTION:

SWF series waveguide filters consist of bandpass, highpass and lowpass types that cover the frequency range of 18 to 170 GHz. While filters are mostly custom designs, catalog models for highpass and lowpass filters are listed as standard models for full waveguide band operations. Always check the website or contact the factory for custom models.

ELECTRICAL SPECIFICATIONS (Bandpass Filters[1]):

Parameters	Specifications	Technical Remarks
Frequency Range	18.0 to 170.0 GHz	Other frequency ranges are available upon request.
Passband Bandwidth[2] (Typical)	100 to 6,000 MHz	Specify when ordering.
Passband Loss (Typical)	1.0 to 3.0 dB	Related to the passband bandwidth and slope steepness.
Passband Ripple[2] (Typical)	±0.2 to ±0.5 dB	Related to the passband bandwidth and slope steepness.
Rejection (Typical)	25.0 to 50.0 dB	Related to the passband bandwidth and slope steepness.
Return Loss (Typical)	15 dB	This is a typical value. Related to the operating bandwidth.
Interface	Waveguides	WR-42, WR-28, WR-22, WR-19, WR-15, WR-12 and WR-10
Outline	WF-BN (N is Band Designator.)	Other outlines available. Specify when ordering.

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Note: 1) SAGE Millimeter's custom bandpass filters are offered in three configurations: iris coupled cavity, corrugated waveguide and E-plane insertion type. In general, iris coupled cavity filters offer a better insertion loss and steeper rejection since they possess higher external Q. Corrugated waveguide filters combine waveguide cutoffs and a lowpass feature to offer broad passbands. E-plane insertion filters offer lower production costs since the configuration does not require tuning.

2) See the definition of passband and passband ripple on the next page.

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CATALOG MODELS (Highpass Filters):

Band	Model Number	Wave-guide	Passband Freq. (GHz)	Passband I. L. (dB)	Passband VSWR	Passband Ripple (dB)	Rejection Band Freq. (GHz)	Rejec-tion (dB)	Outline
K	SWF-18316340-42-H1	WR-42	18.0 & Higher	0.30	1.2:1	±0.10	16.0 & Lower	40	WF-HK
Ka	SWF-27324340-28-H1	WR-28	26.5 & Higher	0.40	1.2:1	±0.15	24.0 & Lower	40	WF-HA
Q	SWF-33330340-22-H1	WR-22	33.0 & Higher	0.40	1.2:1	±0.15	30.0 & Lower	40	WF-HQ
U	SWF-40336340-19-H1	WR-19	40.0 & Higher	0.45	1.2:1	±0.16	36.0 & Lower	40	WF-HU
V	SWF-50346340-15-H1	WR-15	50.0 & Higher	0.50	1.2:1	±0.18	46.0 & Lower	40	WF-HV
E	SWF-60355340-12-H1	WR-12	60.0 & Higher	0.50	1.2:1	±0.20	55.0 & Lower	40	WF-HE
W	SWF-75370340-10-H1	WR-10	75.0 & Higher	0.60	1.2:1	±0.20	70.0 & Lower	40	WF-HW

CATALOG MODELS (Lowpass Filters):

Band	Model Number	Wave-guide	Passband Freq. (GHz)	Passband I. L. (dB)	Passband VSWR	Passband Ripple (dB)	Rejection Band Freq. (GHz)	Rejec-tion (dB)	Outline
K	SWF-27330340-42-L1	WR-42	15.0 to 26.5	0.80	1.3:1	±0.25	30.0 & Higher	40	WF-LK
Ka	SWF-40343340-28-L1	WR-28	23.0 to 40.0	0.80	1.3:1	±0.25	43.0 & Higher	40	WF-LA
Q	SWF-50354340-22-L1	WR-22	28.0 to 50.0	1.00	1.3:1	±0.25	54.0 & Higher	40	WF-LQ
U	SWF-60364340-19-L1	WR-19	33.0 to 60.0	1.20	1.4:1	±0.35	64.0 & Higher	40	WF-LU
V	SWF-75379340-15-L1	WR-15	42.0 to 75.0	1.50	1.4:1	±0.40	79.0 & Higher	40	WF-LV
E	SWF-90395340-12-L1	WR-12	52.0 to 90.0	1.80	1.5:1	±0.40	95.0 & Higher	40	WF-LE
W	SWF-11412440-10-L1	WR-10	65.0 to 110.0	2.00	1.5:1	±0.40	115.0 & Higher	40	WF-LW

CUSTOM MODELS:

SAGE Millimeter's filter model numbers are configured per the following format. Customers may refer to the format below and specify their own model numbers accordingly when placing an order.

SWF - F0N NNN RJ - WG - XY

F0N: For highpass or lowpass filters, F0N is the passband corner frequency in MHz x 10N. For example: 45 GHz = 453
F0N: For bandpass filters, F0N is the center frequency of the passband in MHz x 10N. For example: 48 GHz = 483
NNN: For highpass or lowpass filters, NNN is the rejection frequency at which rejection is specified in MHz x 10N. For example: 60 GHz = 603
NNN: For bandpass filters, NNN is the passband bandwidth in MHz x 10N. For example: 500 MHz = 052
RJ is the rejection value in dB. For example: 30 dB = 30
WG is the waveguide size. For example: WR-10 = 10
X is the filter type. "B" is bandpass, "H" is highpass and "L" is lowpass.
Y is for factory reserve.

Example 1: SWF-29302330-28-B1 is a bandpass filter with a passband center frequency of 29 GHz, a passband bandwidth of 2 GHz, and a rejection of 30 dB. The wave-guide is WR-28. "1" is a factory assigned number.

Example 2: SWF-28325340-28-H1 is a highpass filter with a passband starting at 28 GHz and a rejection of 40 dB at 25 GHz and lower. The waveguide is WR-28. "1" is a factory assigned number.

Example 3: SWF-70374240-15-L1 is a lowpass filter with a passband stopping at 70 GHz and rejection of 40 dB at 74 GHz and higher. The waveguide is WR-15. "1" is a factory assigned number.

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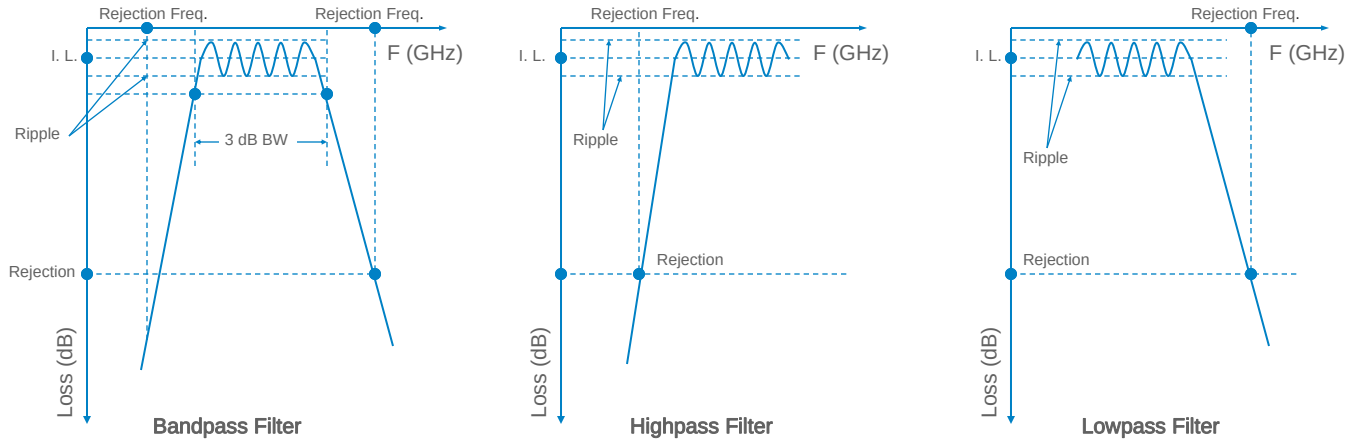
TECHNICAL NOTATIONS:

Definitions of passband, 3 dB bandwidth, passband insertion loss, passband ripple and rejection frequency are illustrated below.



Waveguide Tunable Shorts and Loads, SWS and SWL Series

FEATURES:

- Frequency coverage: 26.5 to 170 GHz
- Linear bearing configuration
- Superior return loss
- Instrumentation grade

APPLICATIONS:

- Instrumentation
- Test setups

DESCRIPTION:

SWS series waveguide tunable shorts and **SWL series** waveguide tunable loads are offered for applications where phase variations are required. These tunable shorts and loads are designed for a smooth and constant phase adjustment by implementing a linear bearing configuration.

The below standard offering covers the frequency range of 26.5 to 170 GHz. Higher frequency bands up to 220 GHz are available per request. The VSWR of the tunable shorts is 20:1 through W band and 15:1 through D band. The average power handling and VSWR of the tunable loads range from 1.0 watts to 0.1 watts and 1.05:1 to 1.1:1, respectively, from low band to high band.

CATALOG MODELS (Tunable Shorts):

Band	Model Number	Waveguide	Frequency Range (GHz)	VSWR	Outline
Ka	SWS-28-T1	WR-28	26.5 to 40.0 GHz	20:1	WS-AT
Q	SWS-22-T1	WR-22	33.0 to 50.0 GHz	20:1	WS-QT
U	SWS-19-T1	WR-19	40.0 to 60.0 GHz	20:1	WS-UT
V	SWS-15-T1	WR-15	50.0 to 75.0 GHz	20:1	WS-VT
E	SWS-12-T1	WR-12	60.0 to 90.0 GHz	20:1	WS-ET
W	SWS-10-T1	WR-10	75.0 to 110.0 GHz	20:1	WS-WT
F	SWS-08-T1	WR-08	90.0 to 140.0 GHz	18:1	WS-FT
D	SWS-06-T1	WR-06	110.0 to 170.0 GHz	15:1	WS-DT

Note: Fixed waveguide shorts are offered under “-F1” instead of “-T1” and are listed on the website.

W

CATALOG MODELS (Tunable Loads):

Band	Model Number	Waveguide	Frequency Range (GHz)	Power (dBm)	VSWR	Outline
Ka	SWL-2830-T1	WR-28	26.5 to 40.0 GHz	30.0	1.05:1	WL-AT
Q	SWL-2227-T1	WR-22	33.0 to 50.0 GHz	27.0	1.05:1	WL-QT
U	SWL-1927-T1	WR-19	40.0 to 60.0 GHz	27.0	1.05:1	WL-UT
V	SWL-1525-T1	WR-15	50.0 to 75.0 GHz	25.0	1.05:1	WL-VT
E	SWL-1223-T1	WR-12	60.0 to 90.0 GHz	23.0	1.05:1	WL-ET
W	SWL-1023-T1	WR-10	75.0 to 110.0 GHz	23.0	1.06:1	WL-WT
F	SWL-0820-T1	WR-08	90.0 to 140.0 GHz	20.0	1.08:1	WL-FT
D	SWL-0620-T1	WR-06	110.0 to 170.0 GHz	20.0	1.10:1	WL-DT

Note: 1) The outline drawings for the tunable shorts and loads are identical.
2) Fixed waveguide loads are offered under “-S1” instead of “-T1” and are listed on the website.

Waveguide Motorized Switches, SWJ Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Low insertion loss
- High isolation
- TTL control
- High reliability and repeatability

APPLICATIONS:

- Communication systems
- Test sets
- Radar systems

DESCRIPTION:

SWJ series waveguide motorized switches are double pole, double throw transfer switches. These motorized switches feature four ports with E-plane switching. The switch is a bi-directional device, which allows each port to be switched on and off between the adjacent ports. The switch offers a low insertion loss and high isolation.

The below standard offering covers the frequency range of 26.5 to 110 GHz and features a TTL driver for signal control. However, latching and manual type switches can also be requested. Always check the website or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR	Switching Speed (mS)	Signal Control
Ka	SWJ-28-TS	26.5 to 40.0	0.15	55.0	1.15:1	125	TTL
Q	SWJ-22-TS	33.0 to 50.0	0.20	50.0	1.15:1	125	TTL
U	SWJ-19-TS	40.0 to 60.0	0.20	50.0	1.15:1	125	TTL
V	SWJ-15-TS	50.0 to 75.0	0.40	50.0	1.20:1	125	TTL
E	SWJ-12-TS	60.0 to 90.0	0.40	50.0	1.20:1	125	TTL
W	SWJ-10-TS	75.0 to 110.0	0.40	50.0	1.20:1	125	TTL

CUSTOM MODELS:

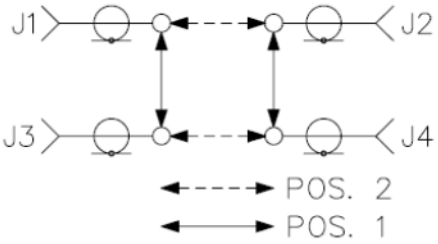
SAGE Millimeter's motorized switch model numbers are configured per the following format. Customers may refer to the format below and specify their own model numbers accordingly when placing an order.

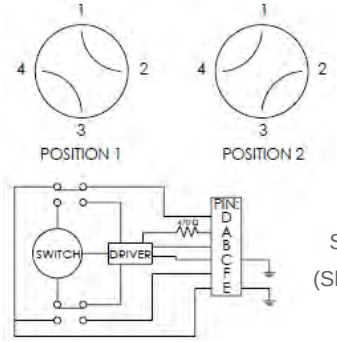
SWJ - WG - XY

WG is the waveguide size. For example: WR-10 = 10
X is the signal control type. "T" is TTL driver, "L" is latching and "M" is manual.
Y is for factory reserve.

Example: SWJ-12-T1 is a motorized switch with WR-12 waveguides and a TTL driver for signal control. "1" is a factory assigned number.

ELECTRICAL SCHEMATICS:





Switch Schematic
(Shown in Position 1)

Waveguide Diplexers, SWY Series

FEATURES:

- Frequency coverage: 18 to 110 GHz
- Low insertion loss
- High channel isolation
- Cavity or E-plane configurations
- Mass production capability

APPLICATIONS:

- Communication systems
- Transceiver modules
- Subassemblies

DESCRIPTION:

SWY series waveguide diplexers are designed and manufactured to meet the requirements of major communication applications worldwide. These diplexers are designed and manufactured for low cost production by implementing either an iris coupled cavity configuration for higher performance or an E-plane structure to further reduce the production cost. The diplexers are available across the frequency range of 18 to 110 GHz. While diplexers are usually custom designs, catalog models reflect SAGE Millimeter's standard product performance, design and production capability. Check the web-site or contact the factory for custom models.

CATALOG MODELS:

Band	Model Number	Antenna Waveguide[1]	Channel 1 (GHz)	Channel 2 (GHz)	Bandwidth (MHz)[2]	Insertion Loss (dB)	Crossover Rejection (dB)[3]	Passband VSWR
K	SWY-23324345-42-I1	WR-42	23.00	24.00	150	1.60	45	1.4:1
N/A	SWY-25326345-34-I1	WR-34	24.60	25.80	180	1.60	45	1.4:1
Ka	SWY-32333345-28-E1	WR-28	31.80	33.00	400	1.50	45	1.4:1
Ka	SWY-38339340-28-E1	WR-28	37.50	38.50	350	1.80	40	1.3:1
Q	SWY-41343345-22-E1	WR-22	41.50	43.50	700	1.50	45	1.4:1
V	SWY-59361350-15-E1	WR-15	58.50	60.50	800	2.50	50	1.5:1
V	SWY-58363350-15-E1	WR-15	58.00	63.00	1,000	1.50	50	1.3:1
E	SWY-74384355-12-I1	WR-12	73.50	83.50	5,000	0.50	55	1.3:1

W

W

Note: 1) The waveguide sizes for the antenna port, RX and TX port may differ. Specify detailed port interfaces when ordering.
2) The passband bandwidth of the RX and TX channel may differ. Specify when ordering.
3) Crossover rejection is the same as channel isolation.

CUSTOM MODELS:

SAGE Millimeter's diplexer model numbers are configured per the following format. Customers may refer to the format below and specify their own model numbers accordingly when placing an order.

SWY - F1N F2N IS - CI - XY

F1N is the center frequency of Channel 1 in MHz x 10N. For example: 45 GHz = 453
F2N is the center frequency of Channel 2 in MHz x 10N. For example: 49 GHz = 493
IS is the crossover rejection or channel isolation in dB. For example: 50 dB = 50
CI is the input connector type. For example: WR-22 = 22
X is the diplexer type. "E" is E-plane type and "I" is iris type.
Y is for factory reserve.

Example: SWY-75380360-12-E1 is a diplexer with a Channel 1 center frequency at 75 GHz, a Channel 2 center frequency at 80 GHz, and a channel isolation of 60 dB. The diplexer is E-plane-based with a WR-12 waveguide at the input. "1" is a factory assigned number.

Waveguide Hardware, SWH Series

FEATURES:

- High quality
- Low cost
- Instrumentation grade

APPLICATIONS:

- Waveguide
- Test labs
- Instrumentation
- Subassemblies

DESCRIPTION:

SWH series waveguide hardware includes waveguide flanges, waveguide screws, waveguide dowel pins and waveguide flange drilling jigs. The standard catalog models are listed in the tables below. Check the website or contact the factory for custom models.

CATALOG MODELS:

Waveguide Flange

Name	Model Number	Band	WG	Descriptions	Outline	Material
Waveguide Flange	SWH-595-FK	K	WR-42	UG595/U Cover flange for WR-42 waveguide	WH-KB	Brass
Waveguide Flange	SWH-599-FA	Ka	WR-28	UG599/U Cover flange for WR-28 waveguide	WH-AB	Brass
Waveguide Flange	SWH-383-FQ	Q	WR-22	UG383/U Cover flange for WR-22 waveguide	WH-QB	Brass
Waveguide Flange	SWH-383-FU	U	WR-19	UG383/U-M Cover flange for WR-19 waveguide	WH-UB	Brass
Waveguide Flange	SWH-385-FV	V	WR-15	UG385/U Cover flange for WR-15 waveguide	WH-VB	Brass
Waveguide Flange	SWH-387-FE	E	WR-12	UG387/U Cover flange for WR-12 waveguide	WH-EB	Brass
Waveguide Flange	SWH-387-FW	W	WR-10	UG387/U-M Cover flange for WR-10 waveguide	WH-WB	Brass

Waveguide Hardware

Name	Model Number	Band	WG	Descriptions	Outline	Material
Waveguide Screw	SWH-332-SS	All	N/A	Standard waveguide screw with 3/32 hex head	WH-332	Stainless Steel
Waveguide Screw	SWH-564-SS	All	N/A	Standard waveguide screw with 5/64 hex head	WH-564	Stainless Steel
Waveguide Pin	SWH-625-PS	All	N/A	Standard waveguide flange dowel pin, 1/16” dia	WH-635	Stainless Steel

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Waveguide Flange Drilling Jigs

Name	Model Number	Band	WG	Descriptions	Outline	Material
WG Flange Drilling Jig	SWH-383-JQ	Q	WR-22	UG383/U Cover flange for WR-22 waveguide	WH-JQ	Steel
WG Flange Drilling Jig	SWH-383-JU	U	WR-19	UG383/U-M Cover flange for WR-19 waveguide	WH-JU	Steel
WG Flange Drilling Jig	SWH-385-JV	V	WR-15	UG385/U Cover flange for WR-15 waveguide	WH-JV	Steel
WG Flange Drilling Jig	SWH-387-JE	E	WR-12	UG387/U Cover flange for WR-12 waveguide	WH-JE	Steel
WG Flange Drilling Jig	SWH-387-JW	W	WR-10	UG387/U-M Cover flange for WR-10 waveguide	WH-JW	Steel
WG Flange Drilling Jig	SWH-387-JF	F	WR-08	UG387/U-M Cover flange for WR-08 waveguide	WH-JF	Steel
WG Flange Drilling Jig	SWH-387-JD	D	WR-06	UG387/U-M Cover flange for WR-06waveguide	WH-JD	Steel

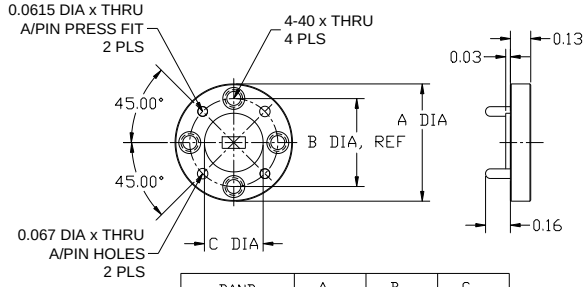
Rectangular Waveguide and Flange Technical References

Band	Waveguide Designator [1]	UK WG I.E.C.	Inner Dimension (Inches)	Frequency Range (GHz)	Wavelength (mm)	Cut-Off Frequency (GHz)	Power Rating (CW, KW)	Attenuation (dB/Feet) [2]	MIL-F-3922/(**) Historic Flange [3,4]
X	WR-90 RG-52/U	WG-16 R100	0.900 x 0.400	8.2 to 12.4	36.6 to 24.2	6.56	3.00 to 2.40	0.030 to 0.065	53-001 UG-39/U
-	WR-75 RG-346/U	WG-17 R120	0.750 x 0.375	10.0 to 15.0	29.9 to 20.0	7.87	2.80 to 2.20	0.036 to 0.077	53-007 -
Ku	WR-62 RG-91/U	WG-18 R140	0.622 x 0.311	12.4 to 18.0	24.2 to 16.6	9.49	1.80 to 1.40	0.047 to 0.097	53-005 UG-419/U
-	WR-51 RG352/U	WG-19 R180	0.510 x 0.255	15.0 to 22.0	20.0 to 13.6	11.54	1.20 to 1.00	0.064 to 0.133	70-010 -
K	WR-42 RG-53/U	WG-20 R220	0.420 x 0.170	18.0 to 26.5	16.6 to 11.3	14.08	0.80 to 0.60	0.101 to 0.207	54-001 UG-595/U
-	WR-34 RG354/U	WG-21 R260	0.340 x 0.170	22.0 to 33.0	13.6 to 9.10	17.28	0.60 to 0.50	0.117 to 0.254	- UG-1530/U
Ka (A)	WR-28 RG-96/U	WG-22 R320	0.280 x 0.140	26.5 to 40.0	11.3 to 7.50	21.10	0.50 to 0.40	0.158 to 0.345	54-003 UG-599/U
Q (B)	WR-22 RG-97/U	WG-23 R400	0.224 x 0.112	33.0 to 50.0	9.10 to 6.00	26.35	0.40 to 0.35	0.221 to 0.376	67-006 UG-383/U
U	WR-19 RG-385/U	WG-24 R500	0.188 x 0.094	40.0 to 60.0	7.50 to 5.00	30.69	0.35 to 0.30	0.286 to 0.398	67-007 UG-383/U-M
V	WR-15 RG-98/U	WG-25 R620	0.148 x 0.074	50.0 to 75.0	6.00 to 4.00	39.86	0.30 to 0.27	0.385 to 0.570	67-008 UG-385/U
E	WR-12 RG-99/U	WG-26 R740	0.122 x 0.061	60.0 to 90.0	5.0 to 3.30	48.35	0.28 to 0.25	0.530 to 0.780	67-009 UG-387/U
W	WR-10 RG-359/U	WG-27 R900	0.100 x 0.050	75.0 to 110	4.00 to 2.70	59.01	0.25 to 0.20	0.710 to 1.020	67-010 UG-387/U-M
F	WR-8 RG-138/U	WG-28 R1200	0.080 x 0.040	90.0 to 140	3.30 to 2.10	73.76	0.15 to 0.12	0.980 to 1.520	74-001 UG-387/U-M
D	WR-6 RG-136/U	WG-29 R1400	0.065 x 0.0325	110 to 170	2.70 to 1.80	90.79	0.13 to 0.11	1.350 to 2.120	74-002 UG-387/U-M
G	WR-5 RG-135/U	WG-30 R1600	0.051 x 0.0225	140 to 220	2.10 to 1.40	115.71	0.12 to 0.10	1.930 to 3.050	74-002 UG-387/U-M

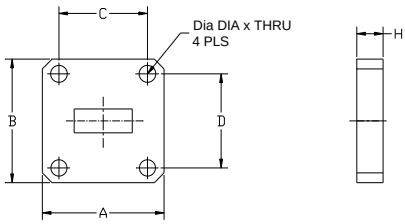
W

Note:

1) The “RG” series waveguide designators are for JAN standard. The “RG” designators shown are for copper material only. If the material is aluminum, the designators differ.
2) The attenuation values shown are for standard copper tubing with a gold plated finish. The attenuation value varies for other types of surface roughness and finishes.
3) The flange designators shown are for brass, cover flange types only. If the flange material is aluminum or non cover type, the designator is different.
4) Flange UG-387/U-M means that only the waveguide size is reduced. All other flange parameters remain the same as UG-387/U.



BAND	A	B	C
Q & U	1.125	0.937	0.500
V, E & W	0.750	0.562	0.375



BAND	WR-90	WR-75	WR-62	WR-51	WR-42/34	WR-28
A, B	1.630	1.500	1.312	1.312	0.880	0.750
C	1.220	1.040	0.994	0.956	0.640	0.500
D	1.280	1.122	0.956	0.994	0.670	0.530
H	0.250	0.250	0.250	0.250	0.190	0.190
Dia	0.172	0.147	0.147	0.147	0.116	0.116

Circular Waveguide and Flange Technical References

The dimensions of the circular waveguide are related to which waveguide mode the waveguide is operating in. Two popular circular waveguide modes are used, namely TE_{11} mode and TE_{01} mode. TE_{11} is the fundamental mode and TE_{01} is a higher order mode. Due to the fact that the electric field is perpendicular to the waveguide wall of TE_{01} mode, there is no conductive loss during the wave propagation. Therefore, TE_{01} mode is widely used in the industry for low loss and high power transmission. Circular waveguide dimensions for both operating modes are given. The EM field distributions of both TE_{11} and TE_{01} modes can be seen in the diagrams below.

TE_{11} Mode Circular Waveguide Parameters

Band	Frequency Range (GHz)		Inner diameter (Inches)	Cut-Off Frequency (GHz)	Historic Flange [1,2]
X	Low Medium High	8.20 to 9.97 8.50 to 11.6 9.97 to 12.4	1.094 0.938 0.797	6.33 7.38 8.68	UG-39/U-M
Ku	Low Medium High	12.4 to 15.9 13.4 to 18.0 15.9 to 18.0	0.688 0.584 0.500	10.06 11.85 13.84	UG-419/U-M
K	Low Medium High	17.5 to 20.5 20.0 to 24.5 24.0 to 26.5	0.470 0.396 0.328	14.73 17.48 21.10	UG-595/U-M
Ka (A)	Low Medium High	26.0 to 33.0 33.0 to 38.5 38.5 to 43.0	0.315 0.250 0.219	21.97 27.69 31.60	UG-599/U-M
Q (B)	Low Medium High	33.0 to 38.5 38.5 to 43.0 43.0 to 50.0	0.250 0.219 0.188	27.69 31.60 36.82	UG-383/U-M
U	Low Medium High	38.5 to 43.0 43.0 to 50.0 50.0 to 60.0	0.219 0.188 0.165	31.60 36.82 41.95	UG-383/U-M
V	Low Medium High	50.0 to 58.0 58.0 to 68.0 68.0 to 77.0	0.165 0.141 0.125	41.95 49.09 55.37	UG-385/U-M
E	Low Medium High	58.0 to 68.0 68.0 to 77.0 77.0 to 87.0	0.141 0.125 0.110	49.09 55.37 62.92	UG-387/U-M
W	Low Medium High	77.0 to 87.0 87.0 to 100 100 to 112	0.110 0.094 0.082	62.92 73.63 84.41	UG-387/U-M
F	Low Medium High	87.0 to 100 100 to 112 115 to 140	0.094 0.082 0.075	73.63 84.41 92.28	UG-387/U-M
D	Low Medium High	100 to 112 115 to 140 140 to 160	0.082 0.075 0.059	84.41 92.28 117.31	UG-387/U-M
G	Low Medium High	115 to 140 140 to 180 180 to 220	0.067 0.059 0.050	103.30 117.31 138.43	UG-387/U-M

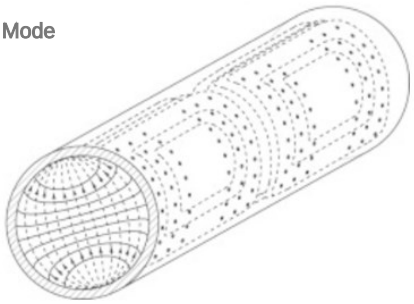
TE_{01} Mode Circular Waveguide Parameters

Frequency Range (GHz)	Inner diameter (Inches)	Cut-Off Frequency (GHz)	Historic Flange [1,2]
11.0 to 16.0	1.500	6.03	-
13.2 to 18.9	1.265	7.15	UG-419/U-M
15.9 to 21.9	1.106	8.18	UG-419/U-M
18.6 to 25.6	0.951	9.51	UG-595/U-M
25.3 to 35.0	0.686	13.18	UG-595/U-M
27.3 to 38.0	0.643	14.06	UG-595/U-M
32.0 to 44.0	0.545	16.59	UG-383/U-M
34.8 to 48.0	0.370	24.44	UG-383/U-M
46.4 to 63.9	0.353	25.61	UG-387/U-M
62.0 to 84.0	0.291	31.07	UG-387/U-M
70.0 to 96.0	0.249	36.31	UG-387/U-M
86.0 to 115.0	0.201	44.98	UG-387/U-M
93.0 to 128.0	0.186	48.6	UG-387/U-M

Note: 1) The flange designators shown are for brass, cover flange types only. If the flange material is aluminum or non cover type, the designator is different.

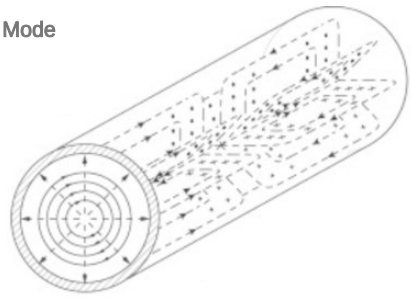
2) Flange UG-387/U-M means that only the waveguide has been modified. All other flange parameters remain the same as UG-387/U.

TE_{11} Mode



E Field
M Field

TE_{01} Mode



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Coaxial Passive Component Technical References

Coaxial devices are widely used in the microwave industry and are increasingly being used at millimeterwave frequencies up to 110 GHz. Since SAGE Millimeter's products and services focus on higher microwave and millimeterwave frequencies, only miniaturized connectors will be discussed here. The following are concepts, terms and definitions that are widely used and accepted in the industry.

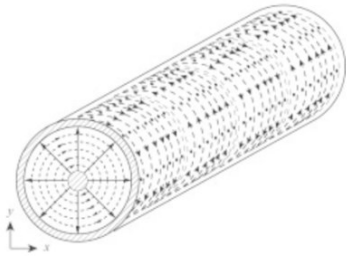
Coaxial Line:

A **coaxial line** is a transmission line that is comprised of an outer conducting metal tube that encloses and insulates an inner central conducting core. Coaxial lines are primarily used to transmit high frequency signals.

Dominant Mode:

The **dominant mode** of a coaxial line is the TEM mode. The electric and magnetic fields of the TEM mode in a coaxial line is shown on the right. Higher order modes tend to cause excessive loss. A coaxial line's dominant mode of operation is governed by the diameters of its outer conductor (D) and inner conductor (d) and the dielectric constant (Ɛr) under the following relationship:

$$D + d \leq \frac{2\lambda o}{\pi\sqrt{\varepsilon r}}$$



Characteristic Impedance:

The **characteristic impedance** of a coaxial component operating within the TEM mode is given by:

$$Zo = \frac{138}{\sqrt{\varepsilon r}} \log\frac{D}{d} \ (\Omega)$$

Coaxial Connector Types:

The main **coaxial connector types** used in higher microwave and millimeterwave frequencies are summarized in the table below. "K" and "V" connectors are trademarks of Anritsu. Their alternative names are 2.92 mm and 1.85 mm connectors, respectively. "SMA" connectors are a trademark of Tyco Electronics, formerly known as Omni Spectra.

The inner diameter of the outer conductor "D", the outer diameter of the inner conductor "d" and the dielectric constant of the connectors are provided below for various connector types. As shown in the table, the inner diameter of the outer conductor is used to name the connector type. For example, the 2.92 mm connector has an outer conductor with a 2.92 mm inner diameter. In addition, the indicated TEM mode operating frequency range for these connectors is wider than industry standard specifications. For example, the K connector's operating frequency range is listed below as DC to 45.58 GHz, while the industry standard specification is DC to 40 GHz.

Name	Alternative Name	SAGE Designator	Descriptions	D (mm)	d (mm)	Ɛr	Z (Ω)	TEM Mode Freq. Range (GHz)
SMA(M)	None	SM	SMA male connector	4.40	1.27	2.20	50	DC to 22.71
SMA(F)	None	SF	SMA female connector	4.40	1.27	2.20	50	DC to 22.71
Super SMA(M)	SSMA(M)	3M	Super SMA male connector	3.50	1.08	2.00	50	DC to 29.49
Super SMA(F)	SSMA(F)	3F	Super SMA female connector	3.50	1.08	1.82	50	DC to 30.91
2.92 mm (M)	K(M)	KM	K male connector	2.92	1.27	1.00	50	DC to 45.58
2.92 mm (F)	K(F)	KF	K female connector	2.92	1.27	1.00	50	DC to 45.58
2.4 mm (M)	None	2M	2.4 mm male connector	2.40	1.04	1.00	50	DC to 55.50
2.4 mm (F)	None	2F	2.4 mm female connector	2.40	1.04	1.00	50	DC to 55.50
1.85 mm (M)	V(M)	VM	V male connector	1.85	0.80	1.00	50	DC to 72.07
1.85 mm (F)	V(F)	VF	V female connector	1.85	0.80	1.00	50	DC to 72.07
1 mm (M)	None	1M	1 mm male connector	1.00	0.43	1.00	50	DC to 133.39
1 mm (F)	None	1F	1 mm female connector	1.00	0.43	1.00	50	DC to 133.39

Appendix A

Return Loss, VSWR, Reflection Coefficient, Mismatch Loss, Power Transmission and Power Reflection

Return Loss (dB)	VSWR	Reflection Coefficient	Mismatch Loss (dB)	Power Transmission, %	Power Reflection, %
1.0	17.391	0.891	6.868	20.567	79.433
2.0	8.724	0.794	4.329	36.904	63.096
3.0	5.848	0.708	3.021	49.881	50.119
4.0	4.419	0.631	2.205	60.189	39.811
5.0	3.570	0.562	1.651	68.377	31.623
6.0	3.010	0.501	1.256	74.881	25.119
7.0	2.615	0.447	0.967	80.047	19.953
8.0	2.323	0.398	0.749	84.151	15.849
9.0	2.100	0.355	0.584	87.411	12.589
10.0	1.925	0.316	0.458	90.000	10.000
11.0	1.785	0.282	0.359	92.057	7.943
12.0	1.671	0.251	0.283	93.690	6.310
13.0	1.577	0.224	0.223	94.988	5.012
14.0	1.499	0.200	0.176	96.019	3.981
15.0	1.433	0.178	0.140	96.838	3.162
16.0	1.377	0.158	0.110	97.488	2.512
17.0	1.329	0.141	0.088	98.005	1.995
18.0	1.288	0.126	0.069	98.415	1.585
19.0	1.253	0.112	0.055	98.741	1.259
20.0	1.222	0.100	0.044	99.000	1.000
21.0	1.196	0.089	0.035	99.206	0.794
22.0	1.173	0.079	0.027	99.369	0.631
23.0	1.152	0.071	0.022	99.499	0.501
24.0	1.135	0.063	0.017	99.602	0.398
25.0	1.119	0.056	0.014	99.684	0.316
26.0	1.106	0.050	0.011	99.749	0.251
27.0	1.094	0.045	0.009	99.800	0.200
28.0	1.083	0.040	0.007	99.842	0.158
29.0	1.074	0.035	0.005	99.874	0.126
30.0	1.065	0.032	0.004	99.900	0.100
31.0	1.058	0.028	0.003	99.921	0.079
32.0	1.052	0.025	0.003	99.937	0.063
33.0	1.046	0.022	0.002	99.950	0.050
34.0	1.041	0.020	0.002	99.960	0.040
35.0	1.036	0.018	0.001	99.968	0.032
36.0	1.032	0.016	0.001	99.975	0.025
37.0	1.029	0.014	0.001	99.980	0.020
38.0	1.025	0.013	0.001	99.984	0.016
39.0	1.023	0.011	0.001	99.987	0.013
40.0	1.020	0.010	0.000	99.990	0.010
41.0	1.018	0.009	0.000	99.992	0.008
42.0	1.016	0.008	0.000	99.994	0.006
43.0	1.014	0.007	0.000	99.995	0.005
44.0	1.013	0.006	0.000	99.996	0.004
45.0	1.011	0.006	0.000	99.997	0.003
46.0	1.010	0.005	0.000	99.997	0.003
47.0	1.009	0.004	0.000	99.998	0.002
48.0	1.008	0.004	0.000	99.998	0.002
49.0	1.007	0.004	0.000	99.999	0.001
50.0	1.006	0.003	0.000	99.999	0.001

Appendix B

µW, mW and Watt to dBm Conversion

µW to dBm

µW	dBm
1.0	-30.0
2.0	-27.0
3.0	-25.2
4.0	-24.0
5.0	-23.0
6.0	-22.2
7.0	-21.5
8.0	-21.0
9.0	-20.5
10.0	-20.0
20.0	-17.0
30.0	-15.2
40.0	-14.0
50.0	-13.0
60.0	-12.2
70.0	-11.5
80.0	-11.0
90.0	-10.5
100	-10.0
200	-7.0
300	-5.2
400	-4.0
500	-3.0
600	-2.2
700	-1.5
800	-1.0
900	-0.5
1000	0.0

mW to dBm

mW	dBm
1.0	0.0
2.0	3.0
3.0	4.8
4.0	6.0
5.0	7.0
6.0	7.8
7.0	8.5
8.0	9.0
9.0	9.5
10.0	10.0
20.0	13.0
30.0	14.8
40.0	16.0
50.0	17.0
60.0	17.8
70.0	18.5
80.0	19.0
90.0	19.5
100	20.0
200	23.0
300	24.8
400	26.0
500	27.0
600	27.8
700	28.5
800	29.0
900	29.5
1000	30.0

Watt to dBm

Watt	dBm
1.0	30.0
2.0	33.0
3.0	34.8
4.0	36.0
5.0	37.0
6.0	37.8
7.0	38.5
8.0	39.0
9.0	39.5
10.0	40.0
20.0	43.0
30.0	44.8
40.0	46.0
50.0	47.0
60.0	47.8
70.0	48.5
80.0	49.0
90.0	49.5
100	50.0
200	53.0
300	54.8
400	56.0
500	57.0
600	57.8
700	58.5
800	59.0
900	59.5
1000	60.0

SAGE Millimeter, Inc. Model Number Index

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NOTES

TERMS AND CONDITIONS

Terms

All sales are governed by SAGE Millimeter's Terms and Conditions of Sale, which can be accessed online. A copy is provided at time of order acceptance and may be requested anytime. Highlights from the Terms and Conditions are Sale are reproduced below for buyer's convenience:

Order Placing

Customer may place orders through the website, to sales representatives or distributors, and to the SAGE Millimeter sales department directly in writing. All accepted orders shall be formally acknowledged. Buyer has a responsibility to verify that material terms like quantity, price, technical specification, shipping and billing addresses, and shipment method are accurately described on the acknowledgement. Discrepancies, questions, and concerns should be brought to the attention of the SAGE Millimeter sales department immediately.

Pricing and Minimum Order

Due to the continuing changes in technology, prices and specifications are subject to change without notice. Always confirm the price and specifications before placing order and again at time of order acceptance. The minimum combined order amount is US Dollars 250.00.

Technical Support

SAGE Millimeter maintains an experienced technical team to offer an optimized solution for your application. Always contact the SAGE Millimeter application department for any technical questions or assistance.

Warranty and Non-Warranty

SAGE Millimeter warrants its products to be free from defects in materials and workmanship for a period of twelve months from the date of delivery. This warranty obligates SAGE Millimeter to perform repair or replacement after the product is returned freight prepaid to factory. SAGE Millimeter will not accept or repair any returned material without a Return Material Authorization (RMA) number. The RMA number can be obtained by contacting the SAGE Millimeter customer service department.

This warranty policy does not cover the low value products or accessories, such as waveguide hardware, such as waveguide screws, dowel pins etc. The warranty period for these products is limited to three months from the date of delivery.

Warranty repairs will be made at no cost to the customer. Out of warranty repair requires a purchase order from the customer before the repairs can be accomplished. SAGE Millimeter. will provide an estimate for the cost and delivery of the repair once such request from the customer is received. An evaluation fee will apply for products which are evaluated for defect and found to be out of warranty.

Limited Liability

In no event shall SAGE Millimeter, Inc. be liable for incidental, indirect, or consequential damages or for any amount in excess of the net price of the products found to be defective or not in conformance with applicable specifications.

SPACE SATELLITE RADAR COMMUNICATION AVIATION

TEST INSTRUMENTS INTERNET OF THINGS TRAFFIC CONTROL COLLISION AVOIDANCE LEVEL SENSING

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