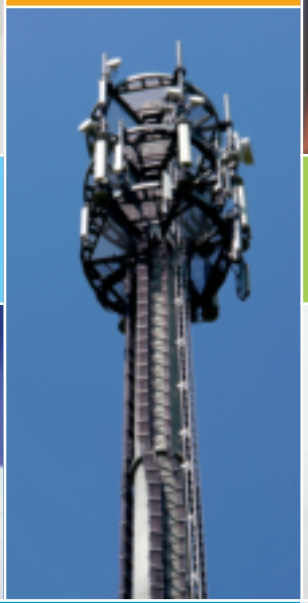
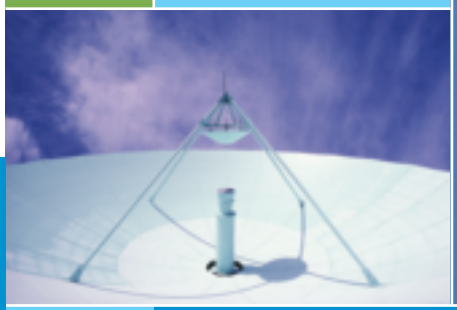
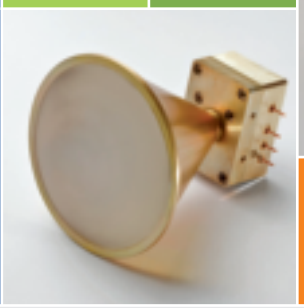
Ducommun

Millimeter Wave Catalog

RF / MILLIMETERWAVE


- Amplifiers
- Antennas
- Control Devices
- Doppler Transceivers
- Ferrite Devices
- Frequency Converters
- Oscillators
- Passive Components
- Ranging Transceivers
- Subsystems

About Ducommun

Founded in 1849, Ducommun Incorporated is a global provider of manufacturing and engineering solutions for customers in the defense, aerospace and industrial markets. The company draws on its broad-based capabilities to develop innovative electronic, engineered and structural solutions to meet customers' complex requirements. Ducommun's capabilities are organized into nine strategic business units, each focused on a distinct area of expertise: Circuit Board Solutions, Interconnect Solutions, Aerospace Integrated Solutions, Industrial Integrated Solutions, Systems Development and Integration, Engineered Solutions, Structural Assembly Solutions, Structural Systems Solutions, and Bonded Component Solutions. Customers have access to the company's full spectrum of capabilities through common, companywide processes that create value for the customer and facilitate ease of doing business. Ducommun operates with a one-team approach called the Ducommun Way, which drives the company's vision, core values, operating performance, and customer satisfaction through a combined focus on operational excellence, organizational development and profitable growth. The company employs 3,300 talented individuals at 21 operations in the USA and abroad.

In 2006, Ducommun acquired Torrance, California-based WiseWave Technologies, Inc. WiseWave is a manufacturer of custom microwave and millimeterwave products for both aerospace and non-aerospace applications.

The integration of WiseWave broadened Ducommun's existing microwave product line, added millimeterwave products, and continued WiseWave's commitment to providing customers with well-engineered, high-quality, and cost-effective microwave and millimeterwave components and sub-assemblies up to 140 GHz.

This catalog of millimeterwave products is divided into eight categories to offer total microwave and millimeterwave solutions: amplifiers, antennas, control devices, ferrite devices, frequency converters, oscillators, passive components, and sub-assemblies. Ducommun also designs to customers' specifications, or assists customers in developing their own products for their unique applications.

Ducommun maintains a strong commitment to quality and has established processes that ensure customer requirements and specifications are met and exceeded. Ducommun's customer list includes industry leaders, research institutions, government agencies, and universities.

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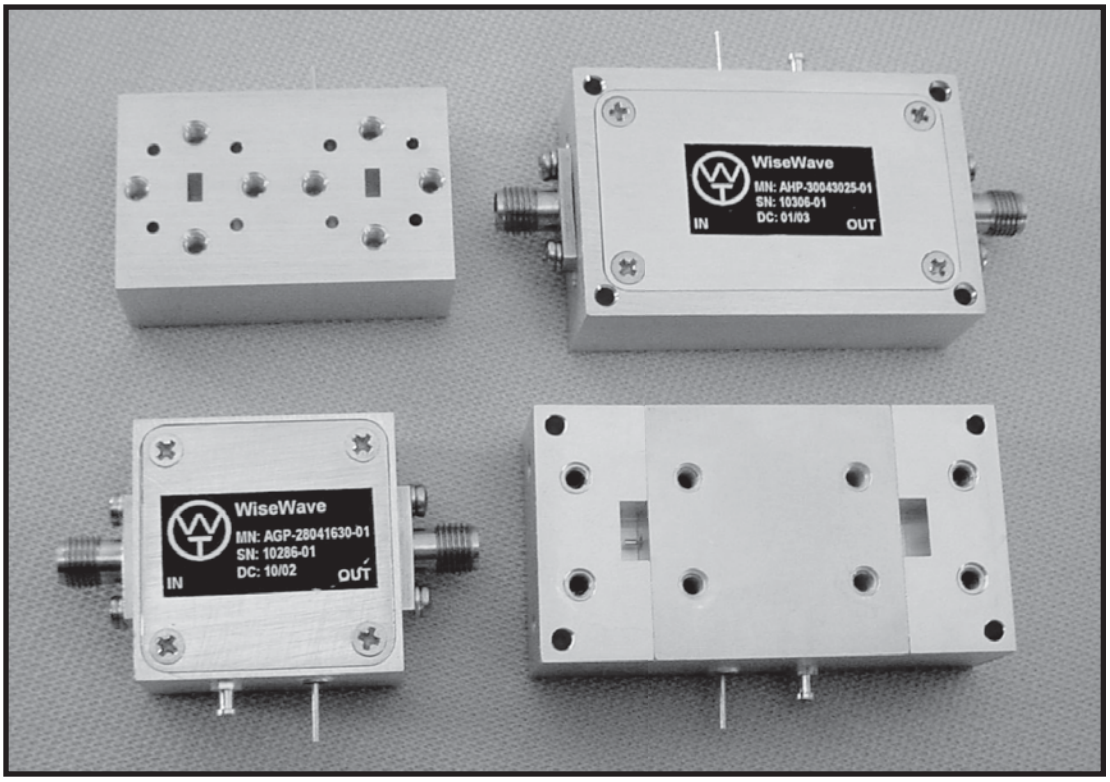
Terms and Conditions of Sale
can be found at www.ducommun.com

1. Amplifiers

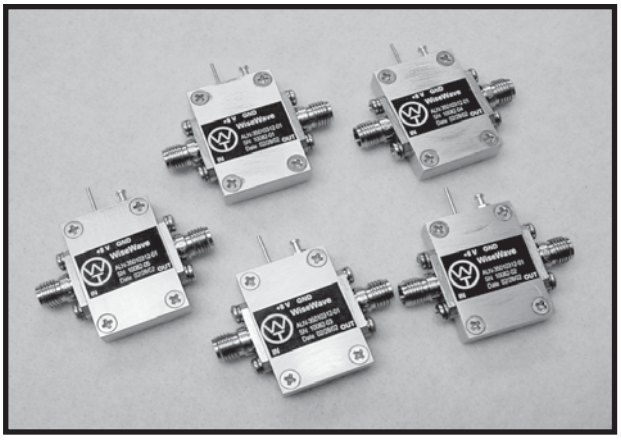


FEATURES

- Low noise figure
- Up to full waveguide bandwidth
- Single power supply
- Compact size, light weight
- Wide operation temperature range

APPLICATIONS

- Communication receivers
- Radar front ends
- Wideband radiometry
- Transceiver sub-assemblies



ALN Series

DESCRIPTION

ALN series low noise amplifiers are constructed with discrete or MMIC PHEMT devices that operate at the frequency range from 18 to 100 GHz. These amplifiers are especially designed for low noise applications. The amplifiers are offered in two categories, namely, standard and custom built. The custom built amplifiers are offered in various RF interfaces, including standard waveguide or coax connectors, for convenient system integration. The optional input and output integrated isolators are available to further improve the port return loss.

STANDARD AMPLIFIER SPECIFICATIONS

Model Number	Freq. (GHz)	BW (GHz)	NF (dB, Max)	Gain (dB)	V/I (V / mA)	VSWR (Typ)	Outline
ALN-22093515-01	18.0 - 26.5	8.5	3.5	15	8/100	2:1	WT-A-1, 3
ALN-22093530-01	18.0 - 26.5	8.5	3.5	30	8/200	2:1	WT-A-1, 3
ALN-33144020-01	26.5 - 40.0	13.5	4.5	20	8/100	2:1	WT-A-1, 3
ALN-33144030-01	26.5 - 40.0	13.5	4.5	30	8/200	2:1	WT-A-1, 3
ALN-61086015-01	57.0 - 65.0	8.0	6.0	15	8/100	2:1	WT-A-5
ALN-61086030-01	57.0 - 65.0	8.0	6.0	30	8/150	2:1	WT-A-5
ALN-94046015-01	92.0 - 96.0	4.0	6.0	15	8/50	2:1	WT-A-5
ALN-94046030-01	92.0 - 96.0	4.0	6.0	30	8/100	2:1	WT-A-5
Temperature Range	0 to +50°C						

CUSTOM BUILT AMPLIFIERS

The amplifiers with the performance other than listed above are available per customer's request. You may submit your specifications along with the model number per following instruction.

Specify Model Number: ALN - CF BW NF GG -XX ← Factory Reserve

Center Frequency in GHz

Bandwidth in GHz

Gain in dB

Noise Figure in 1/10 of dB

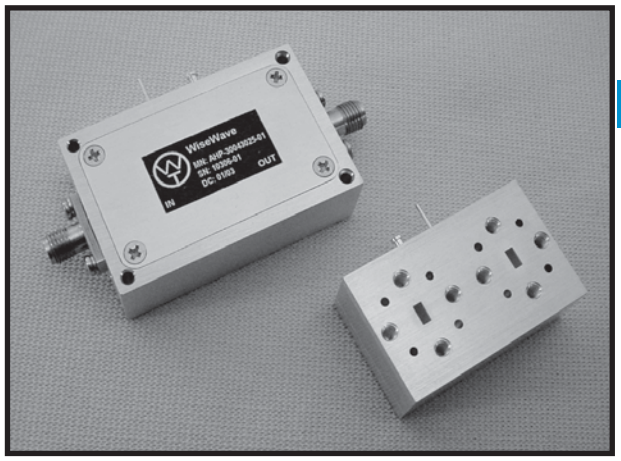
Example: To order a low noise amplifier with center frequency 42 GHz, 2 GHz bandwidth, 5.5 dB noise figure and 24 dB gain, specify ALN-42025524-XX.

FEATURES

- High output power and IP3
- Up to full waveguide bandwidth
- Single power supply
- Compact size, light weight
- Wide operation temperature range

APPLICATIONS

- Communication transmitters
- Radar front ends
- Power block for multiplier chains
- Transceiver sub-assemblies



AHP Series

DESCRIPTION

AHP series high power amplifiers are discrete and/or MMIC PHEMT devices based amplifiers that operate at the frequency range between 18 to 98 GHz for high output power applications. The amplifiers are offered in two categories, namely, standard and custom built. The custom built amplifiers are offered in various RF interfaces, including standard waveguide or coax connectors, for convenient system integration. The optional input and output integrated isolators are available to further improve the port return loss.

STANDARD AMPLIFIER SPECIFICATIONS

Model Number	Freq. (GHz)	BW (GHz)	P-1 (dBm, Min)	Gain (dB)	V/I (V / mA)	VSWR (Typ)	Outline
AHP-22092825-01	18.0 - 26.5	8.5	28	25	8/550	2:1	WT-A-2
AHP-30052925-01	27.0 - 32.0	5.0	29	25	8/650	2:1	WT-A-2
AHP-34043025-01	32.0 - 36.0	4.0	30	25	8/1,100	2:1	WT-A-2
AHP-38043025-01	36.0 - 40.0	4.0	30	25	8/900	2:1	WT-A-2
AHP-41082220-01	37.0 - 45.0	8.0	22	20	8/500	2:1	WT-A-2
AHP-42042625-01	40.0 - 44.0	4.0	26	25	8/1,500	2:1	WT-A-2
AHP-61101625-01	55.0 - 65.0	10.0	16	25	8/200	2:1	WT-A-5
AHP-61181628-01	52.0 - 70.0	18.0	16	28	8/200	2:1	WT-A-5
AHP-94021818-01	93.0 - 95.0	2.0	18	18	8/500	2:1	WT-A-5
AHP-94022424-01	93.0 - 95.0	2.0	26 (Psat)	24	8/2,000	2:1	WT-A-12
Temperature Range	0 to +50°C						

CUSTOM BUILT AMPLIFIERS

The amplifiers with the performance other than listed above are available per customer's request. You may submit your specifications along with the model number per following instruction.

Specify Model Number: AHP - CF BW PP GG -XX ← Factory Reserve

Center Frequency in GHz

Bandwidth in GHz

Gain in dB

P-1 dB in dBm

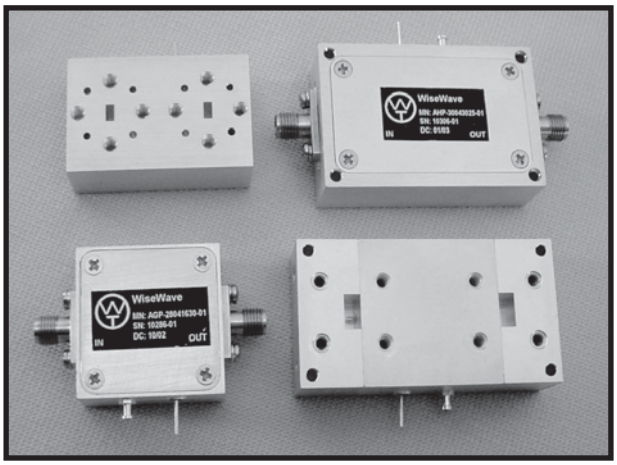
Example: To order a high power amplifier with center frequency of 38 GHz, 2 GHz bandwidth, 33 dBm P-1 power and 25 dB gain, specify AHP-38023325-XX.

FEATURES

- High gain and wide bandwidth
- Low DC power consumption
- Single power supply
- Compact size, light weight
- Wide operation temperature range

APPLICATIONS

- Gain blocks
- High power transmitter driving stage
- Gain block for multiplier chains
- Transceiver sub-assemblies



AGP Series

DESCRIPTION

AGP series general purpose amplifiers are discrete and/or MMIC PHEMT devices based amplifiers that operate at the frequency range between 18 to 96 GHz for gain added applications. The amplifiers are offered in two categories, namely, standard and custom built. The custom built amplifiers are offered in various RF interfaces, including standard waveguide or coax connectors, for convenient system integration. The optional input and output integrated isolators are available to further improve the port return loss.

STANDARD AMPLIFIER SPECIFICATIONS

Model Number	Freq. (GHz)	BW (GHz)	P-1 (dBm, Min)	Gain (dB)	V/I (V / mA)	VSWR (Typ)	Outline
AGP-22091515-01	18.0 - 26.5	8.5	15	15	8/100	2:1	WT-A-1
AGP-22091530-01	18.0 - 26.5	8.5	15	30	8/200	2:1	WT-A-1
AGP-22092520-01	18.0 - 26.5	8.5	25	20	8/600	2:1	WT-A-1
AGP-33141515-01	26.5 - 40.0	13.5	15	15	8/100	2:1	WT-A-1
AGP-33141530-01	26.5 - 40.0	13.5	15	30	8/120	2:1	WT-A-1
AGP-33142025-01	26.5 - 40.0	13.5	20	25	8/800	2:1	WT-A-1
AGP-29221015-01	18.0 - 40.0	22.0	10	15	8/50	2:1	WT-A-1
AGP-29221615-01	18.0 - 40.0	22.0	16	15	8/200	2:1	WT-A-1
Temperature Range	0 to +50°C						

CUSTOM BUILT AMPLIFIERS

The amplifiers with the performance other than listed above are available per customer's request. You may submit your specifications along with the model number per following instruction.

Specify Model Number: AGP - CF BW PP GG -XX ← Factory Reserve

Center Frequency in GHz

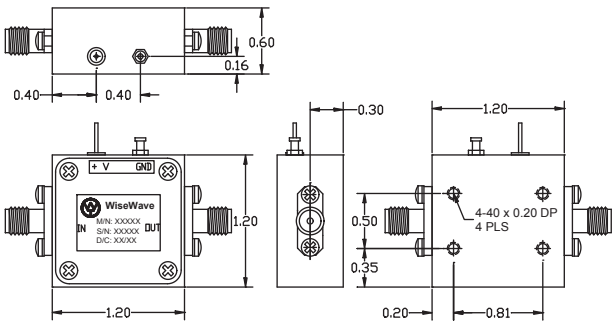
Bandwidth in GHz

Gain in dB

P-1 in dBm

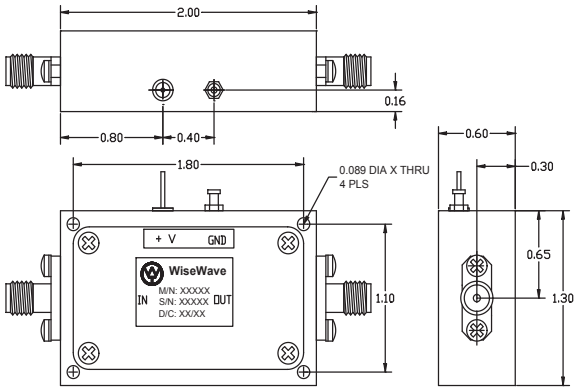
Example: To order general purpose amplifier with center frequency 37 GHz, 10 GHz bandwidth, 18 dBm P-1 power and 20 dB gain, specify AGP-37101820-XX.

WT-A-1



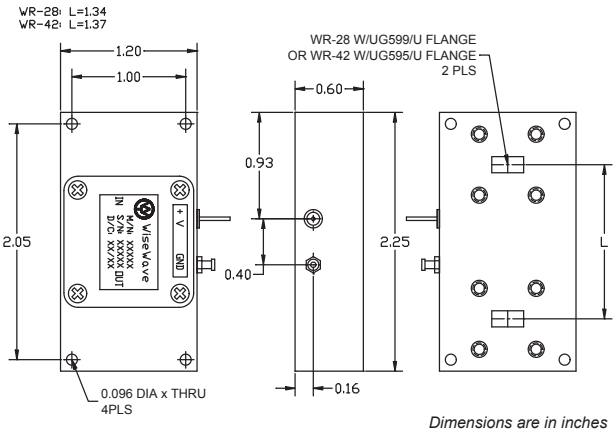
Dimensions are in inches

WT-A-2



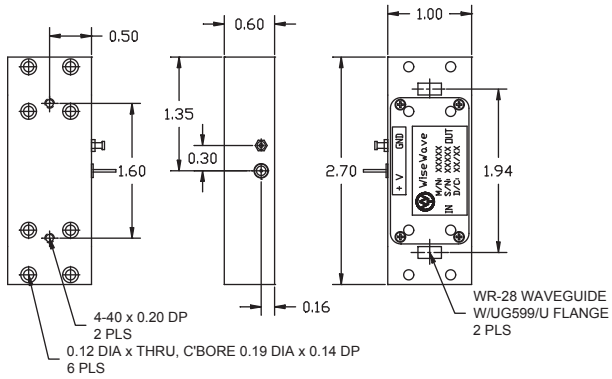
Dimensions are in inches

WT-A-3



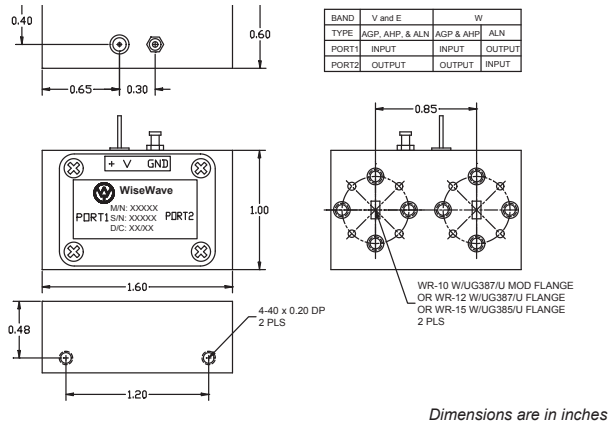
Dimensions are in inches

WT-A-4



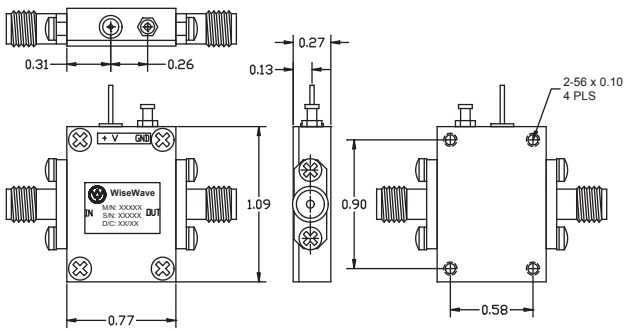
Dimensions are in inches

WT-A-5



Dimensions are in inches

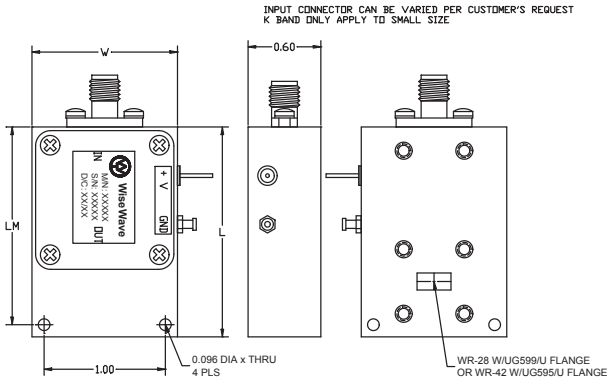
WT-A-6



Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

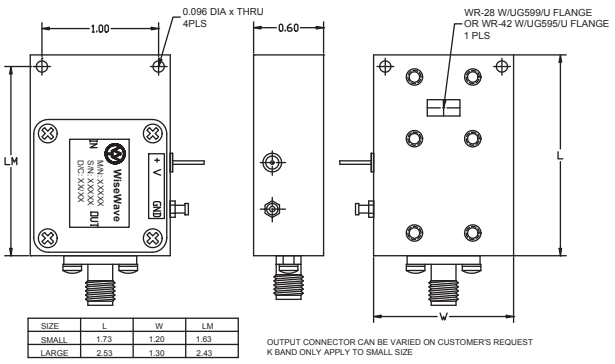
WT-A-7



SIZE	L	W	LM
SMALL	1.73	1.20	1.63
LARGE	2.53	1.30	2.43

Dimensions are in inches

WT-A-8

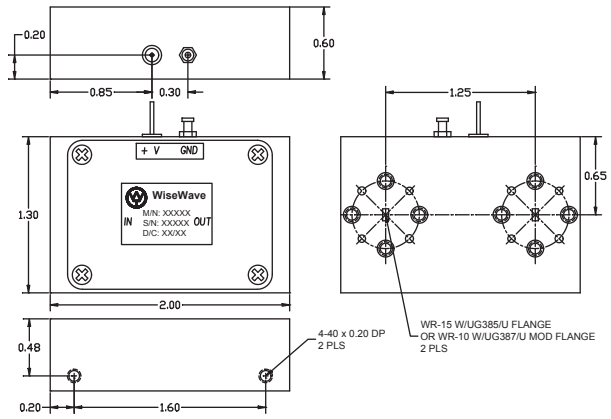


SIZE	L	W	LM
SMALL	1.73	1.20	1.63
LARGE	2.53	1.30	2.43

OUTPUT CONNECTOR CAN BE VARIED ON CUSTOMER'S REQUEST
K BAND ONLY APPLY TO SMALL SIZE

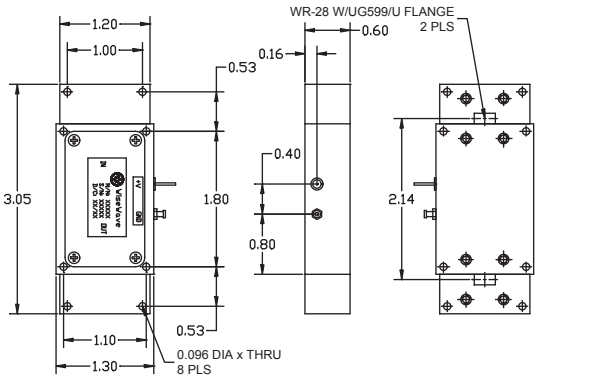
Dimensions are in inches

WT-A-9



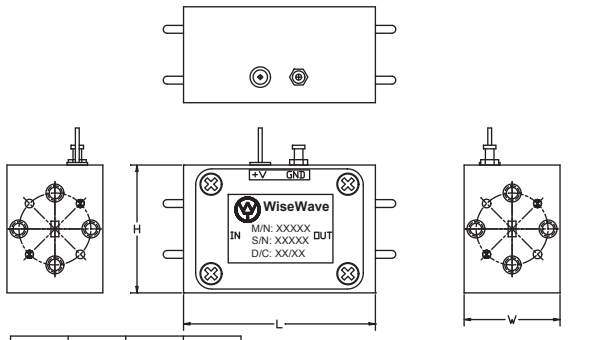
Dimensions are in inches

WT-A-10



Dimensions are in inches

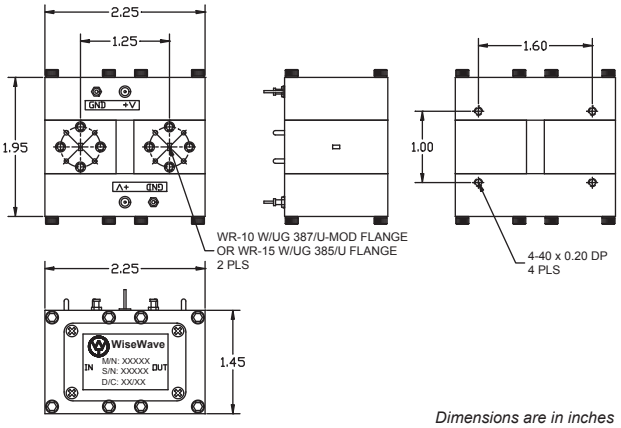
WT-A-11



BAND	L	H	W
V,E, & W	1.50	1.00	0.75
Q & U	1.80	1.13	1.13

Dimensions are in inches

WT-A-12



Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

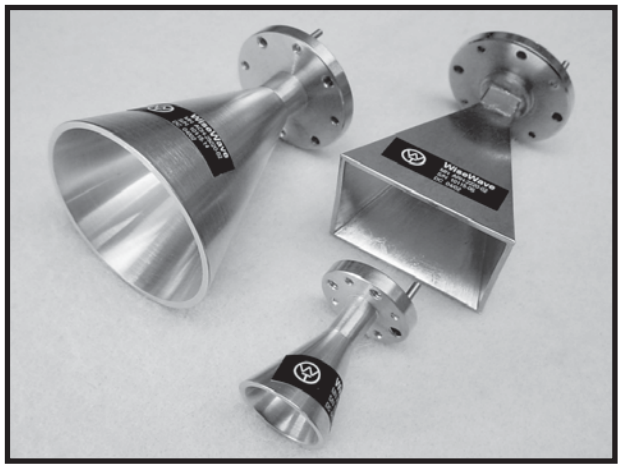
2. Antennas

FEATURES

- Standard gain
- Low side lobes
- Ridged configuration
- Gold plated finishing
- Low cost

APPLICATIONS

- Antenna range reference
- Radiation element for sub-systems



ACH & ARH Series

DESCRIPTION

ACH and ARH series circular and rectangular gain horns are offered for the frequency range of 18 to 110 GHz. The standard gain value and corresponding half power beamwidth at mid-frequency point of each waveguide band are 15, 20, 23, 25 dBi and 24, 13, 9, 7 degrees, respectively. Other gain values are available as custom order. The standard circular gain horns are equipped with circular waveguide interface, while rectangular waveguide interface are available. Other circular waveguide size is available per request. The rectangular gain horns are offered with standard waveguide interface.

STANDARD GAIN HORN SPECIFICATIONS

Circular Horn	K	Ka	Q	U	V	E	W
Model Numbers[1]	ACH - DDD GG - 02 (Where DDD is the diameter in mils and GG is the gain in dB)						
Frequency Range (GHz)	20 to 24.5	33 to 38.5	38.5 to 43	43 to 50	58 to 68	66 to 88	88 to 110
Circular Waveguide Size (Dia, Inch)	0.356	0.250	0.219	0.188	0.141	0.125	0.094
Gain (dBi @ Fo, Typical)	15.0, 20.0, 23.0, 25.0						
3 dB Beamwidth (°@ Fo, Typical)	24.0, 13.0, 9.0, 7.0						
Sidelobe Level (dB, Typical)	-18.0						
Outline Drawing	WT-B-2						

Rectangular Horn	K	Ka	Q	U	V	E	W
Model Numbers[2]	ARH - WG GG - 02 (Where WG is the waveguide size and GG is the gain in dB)						
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33.0 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Circular Wave guide Size (Dia, Inch)	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Gain (dBi @ Fo, Typical)	15.0, 20.0, 23.0, 25.0						
3 dB Beamwidth, E (°@ Fo, Typical)	22.0, 12.0, 9.0, 7.0						
3 dB Beamwidth, H (°@ Fo, Typical)	22.0, 12.0, 9.0, 7.0						
Sidelobe Level (dB, Typical)	-18.0						
Outline Drawing	WT-B-1						

Note: 1. To order a Ka band circular gain horn with 0.250” diameter interface, 20 dBi gain, specify ACH-25020-02.
2. To order a W band rectangular gain horn with 20 dBi gain, specify ARH-1020-02.
3. The model number for a horn antenna with non-standard gain or different circular waveguide size may be specified in the similar manner mentioned above.
4. The model number for circular gain horn with rectangular waveguide is specified as ACH-WG GG-01, where WG is the waveguide size and GG is the gain in dB. For example, specify ACH-22 20-01 for a 20dBi gain circular gain horn with WR-22 waveguide interface.

FEATURES

- Linear and circular polarization applicable
- Low side lobes
- High performance
- High gain

ALC Series

APPLICATIONS

- Radar systems
- Communication systems
- Sensor sub-assemblies

DESCRIPTION

ALC series lens corrected horn antennas are offered to cover the frequency range of 18 to 110 GHz. These antennas offer high gain, phase error corrected beam form and low side lobes. The dielectric lens provides not only the phase error correction, but also rugged waterproof structure. The interface of these lens corrected horn antennas are offered in standard circular and rectangular waveguide, respectively. These antennas are widely used in Radar, communication systems and sensor sub-assemblies.

TYPICAL SPECIFICATIONS

Parameters	Typical Range
Frequency Range (Typical)	18 to 110 GHz
Lens Diameter (Typical)	1 to 12 Inches
Gain (Typical)	20 to 40 dB
3 dB Beamwidth (Typical)	3 to 20 Degrees
Sidelobe Level (Typical)	-18 to -25 dB
VSWR (Typical)	1.3:1
Cross Polarization (Typical)*	-25 dB

* Only for Rectangular interface version.

HOW TO ORDER

Specify Model Number:

ALC - DDD CF BW GG -XX ← Factory Reserve

- DDD: Circular Waveguide Diameter in Mils
- CF: in GHz
- BW: in Degrees
- GG: Gain in dB

OR

ALC - WG CF BW GG -XX ← Factory Reserve

- WG: Rectangular waveguide size
- CF: in GHz
- BW: in Degrees
- GG: Gain in dB

Example: To order a lens corrected horn antenna with input circular waveguide 0.250" diameter and 22 dBi gain, specify ALC-25022-XX.

FEATURES

- Low noise figure
- High gain
- Ceramic patch antenna
- Water-tight housing
- Temperature and vibration qualified
- Compact size
- Low cost

APPLICATIONS

- GPS systems

AGA Series

DESCRIPTION

AGA Series GPS antenna is a standard product for the GPS system. The antenna is constructed with machined housing, ceramic patch array, low noise amplifier, filter and high performance Radome material. The circular polarization improves reception ability. The built-in low noise amplifier with very low DC power consumption enhances an already high performance patch array. The integrated design and pre-installed cable offers compact size and ease system connection.

SPECIFICATIONS

Performance				
Model Number	AGA-G501	AGA-G502	AGA-G503	AGA-G504
Connector Type	SMA (M)	TNC (M)	MMCX (M)	SMC(M)
Frequency (MHz)	1575			
Bandwidth (MHz)	± 5			
Polarization	Right Hand Circular			
Gain (dB)	27 (Typical)			
Noise Figure (dB)	1.5 (Typical)			
Interference Rejection (dB)	20 dB at fo ± 140 MHz (Typical)			
Power Consumption	+ 3 to +5 Vdc @ 12 mA (Typical)			
Operation Temperature (°C)	-45 to + 85 °C			
Storage Temperature (°C)	-50 to + 90 °C			
Humidity	100%, Water Tight			
Size (mm)	46 x 34 x 14 (Typ)			
Weight (g)	75 (Typ)			
Mounting	Magnet or Double Sided Tape			

Note: The standard products are equipped with a 3 meters cable and a magnet mounting mechanism.

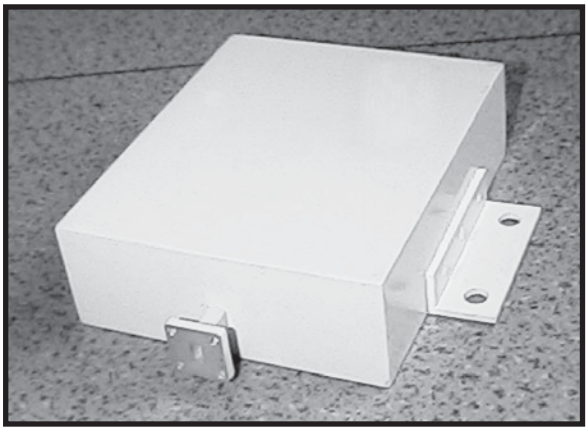
FEATURES

- Custom designed
- Various antenna configurations
- High performance
- Quick delivery
- Cost effective

APPLICATIONS

- Communication Systems
- Radar Systems
- Modules
- Sensors

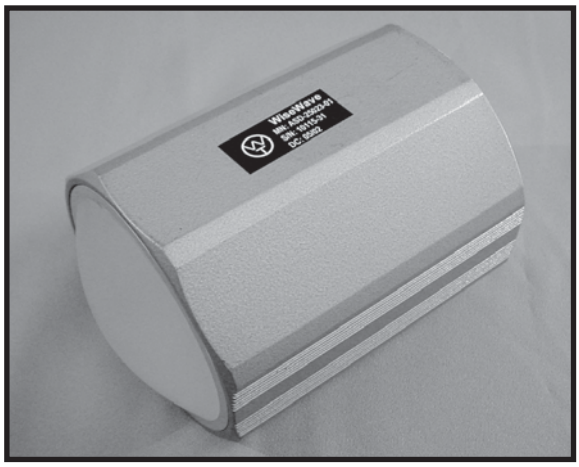
DESCRIPTION



26 GHz Sector Antenna

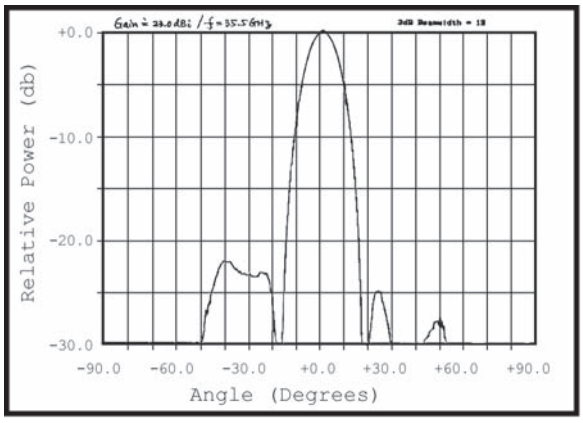
Ducommun not only supplies the standard gain horn antennas, but also has the ability to design and manufacture other antenna products include, but not limited to

- **Corrugated Horn Antennas**
- **Gassegrain Antennas**
- **Gaussian Optical Antennas**
- **Parabolic Antennas**
- **Reflector Antennas**
- **Omni Directional Antennas**
- **Sector Antennas**
- **Printed Array Antennas**



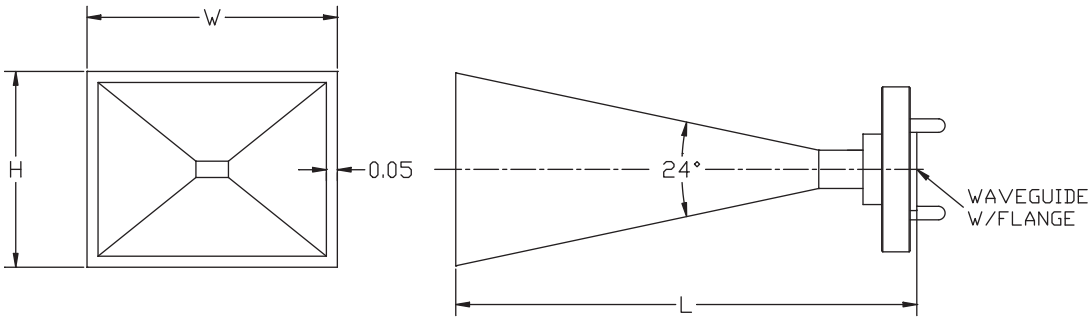
Ka Band 6” Lens Corrected Antenna

Ducommun also understands customer needs and is ready to provide the engineering design and service to its customers for their unique applications.
Ducommun’s self-contained, in-house design and fabrication capacities ensured the breath of antenna products offer from rapid prototyping and proof of concept to full production.
Ducommun is approved to be a company who can not only supply high performance catalog products, but also realize a concept into the hardware with state-of-the-art performance prototypes and cost effective volume production.



Ka Band Phase Array E Plane Pattern

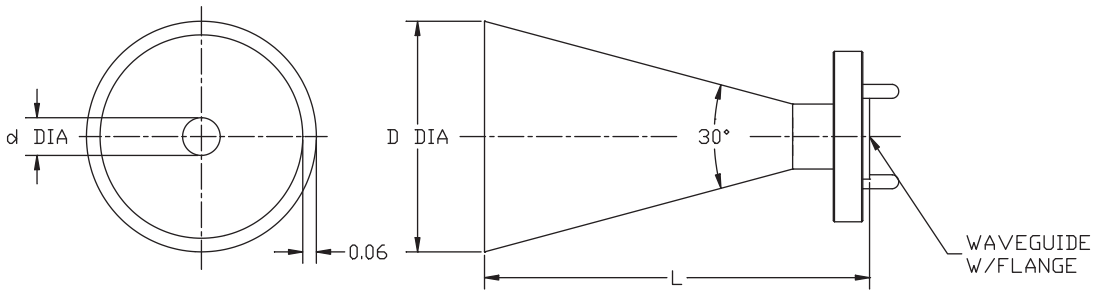
WT-B-1



Band	Frequency	Flange	W x H x L			
			Gain=15dB, BW=22°	Gain=20dB, BW=12°	Gain=23dB, BW=9°	Gain=25dB, BW=7°
K	24GHz	UG595/U	1.56 x 1.21 x 2.80	2.69 x 2.08 x 4.80	3.76 x 2.89 x 6.80	4.71 x 3.62 x 8.40
Ka	35GHz	UG599/U	1.10 x 0.86 x 2.10	1.88 x 1.46 x 3.40	2.61 x 2.02 x 4.80	3.26 x 2.51 x 6.00
Q	42GHz	UG383/U	0.93 x 0.74 x 1.70	1.58 x 1.23 x 2.80	2.19 x 1.70 x 3.90	2.73 x 2.11 x 4.90
U	50GHz	UG383/U-M	0.80 x 0.63 x 1.50	1.34 x 1.05 x 2.50	1.86 x 1.44 x 3.40	2.31 x 1.79 x 4.30
V	60GHz	UG385/U	0.68 x 0.54 x 1.40	1.14 x 0.89 x 2.20	1.56 x 1.22 x 3.00	1.94 x 1.51 x 3.60
E	77GHz	UG387/U	0.55 x 0.45 x 1.20	0.91 x 0.72 x 1.80	1.24 x 0.97 x 2.40	1.54 x 1.20 x 3.00
W	94GHz	UG387/U-M	0.47 x 0.38 x 1.00	0.76 x 0.60 x 1.50	1.03 x 0.81 x 2.10	1.28 x 1.00 x 2.50

Dimensions are in inches

WT-B-2

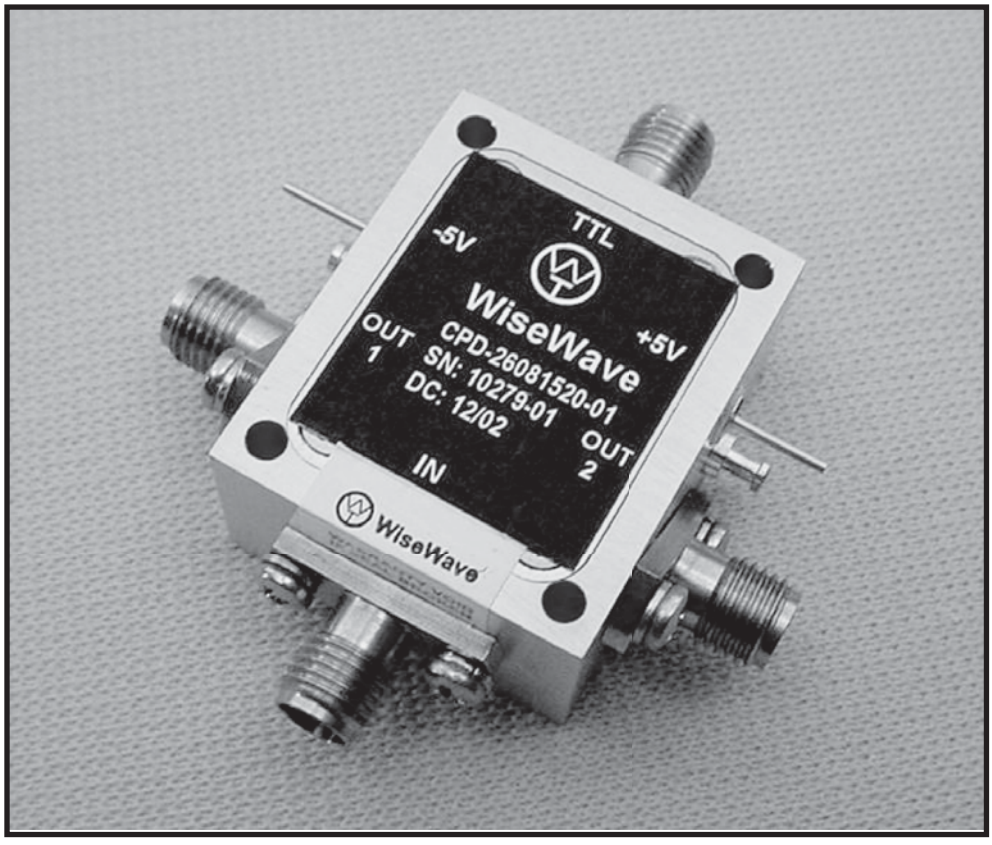


Band	Frequency	Flange	D x d x L			
			Gain=15dB, BW=24°	Gain=20dB, BW=13°	Gain=23dB, BW=9°	Gain=25dB, BW=7°
K	24GHz	UG595/U	1.31 x 0.368 x 2.30	2.36 x 0.368 x 4.40	3.39 x 0.368 x 6.30	4.34 x 0.368 x 8.00
Ka	35GHz	UG599/U	0.93 x 0.250 x 1.70	1.65 x 0.250 x 3.00	2.36 x 0.250 x 4.30	3.01 x 0.250 x 5.50
Q	42GHz	UG383/U	0.80 x 0.219 x 1.30	1.40 x 0.219 x 2.50	1.99 x 0.219 x 3.60	2.53 x 0.219 x 4.60
U	50GHz	UG383/U-M	0.69 x 0.188 x 1.20	1.19 x 0.188 x 2.10	1.69 x 0.188 x 3.10	2.14 x 0.188 x 3.90
V	60GHz	UG385/U	0.60 x 0.141 x 1.10	1.02 x 0.141 x 1.80	1.43 x 0.141 x 2.60	1.81 x 0.141 x 3.30
E	77GHz	UG387/U	0.49 x 0.125 x 0.90	0.82 x 0.125 x 1.50	1.14 x 0.125 x 2.10	1.43 x 0.125 x 2.70
W	94GHz	UG387/U-M	0.42 x 0.094 x 0.70	0.69 x 0.094 x 1.20	0.96 x 0.094 x 1.80	1.20 x 0.094 x 2.30

Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

3. Control Devices

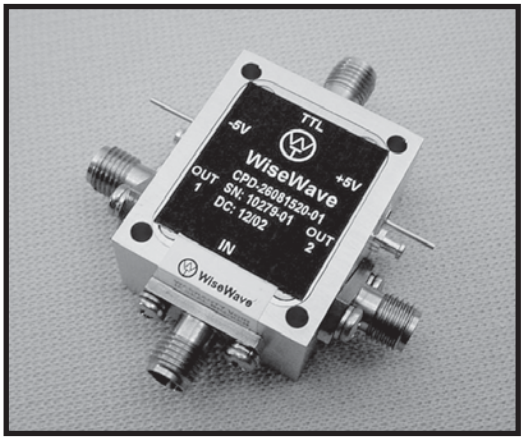


FEATURES

- Low insertion loss
- High isolation
- High speed available
- TTL control available
- Single, double and multi-throw

APPLICATIONS

- Pulse modulation
- Radar duplexing
- Receiver protection
- Antenna beam switching



CPS, CPD & CPM Series

DESCRIPTION

CPS, CPD and CPM series are discrete or MMIC based PIN diode switches that operate at the frequency range from 18 to 110 GHz. These switches are especially designed for low insertion loss and high isolation applications. While these switches are designed for broadband operation, lower insertion loss and higher isolation can be achieved by optimizing design for specific narrower frequency range. These PIN diode switches are reflective type and can be tailored to absorptive type by integrating input and output isolators. Furthermore, the internal TTL driver is offered as an option for ease TTL control.

SPECIFICATIONS

Frequency Range (GHz)	Maximum Available Bandwidth (GHz)	Insertion Loss (dB, Typ)* SPST	SPDT	SPMT	Isolation (dB, Min)*	VSWR (Typ)	Switch Speed (nS, Min)
18 - 26.5	Full	1.2	1.8	Consult Factory	20	2:1	250
26.5 - 40	Full	1.5	2.0		20	2:1	250
33 to 50	10	1.8	2.2		20	2:1	250
40 to 60	10	2.0	2.4		20	2:1	250
50 to 75	10	2.2	2.6		20	2:1	250
60 to 90	10	2.3	2.8		20	2:1	250
75 to 110	10	2.5	3.0		20	2:1	250
Temperature Range	0 to +50°C						

* Insertion Loss & Isolation are for waveguide version.

** Consult factory for the switches with the outlines and specifications other than listed above.

HOW TO ORDER

The switches with the performance other than listed above are available per customer's request. You may submit your specifications along with the model number per following instruction.

Specify Model Number: CPX - CF BW IL IS -XX ← Factory Reserve

- S — Single Throw
- D — Double Throw
- M — Multi-Throw

→ Center Frequency in GHz

→ Bandwidth in GHz

→ Insertion Loss in 1/10 of dB

→ Isolation in dB

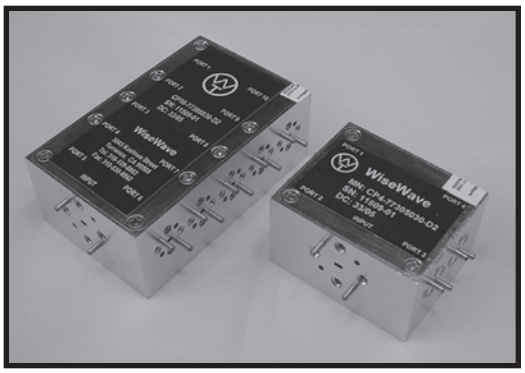
Example: To order a SPDT switch with center frequency of 60 GHz, 4 GHz bandwidth, 2.2 dB insertion loss and 20 dB isolation, specify CPS-60042220-XX.

FEATURES

- High power handling
- High isolation
- Low insertion loss
- Compact size
- TTL Controlled

APPLICATIONS

- Antenna beam switching
- Channel selection



SP4T & SP10T Series

DESCRIPTION

Model **CP4T-77303030-D2 and CP10T-77308030-D2** are PIN diode based SP10T and SP4T switches that operate at the RF frequency range from 75 to 78 GHz. These switches are offered with a built-in TTL driver to simplify the channel switching and to reduce the switching time. The DC and logic control ports are accessed via a single Molex miniature connector. The RF interface of the switches WR-10 waveguide with standard UG387/U-M flange on the input and a miniature flange at the outputs. Operational frequency ranges other than 75 to 78 GHz or number of switching channels other than 4 or 10 are available on request.

SPECIFICATIONS

Description	SP4T (CP4-77305030-D2)	SP10T (CP10-77308030-D2)
RF Frequency	75 to 78 GHz	75 to 78 GHz
Insertion Loss	6.5 dB (Max)	10.0 dB (Max)
Isolation	30 dB (Min)	30 dB (Min)
Switching Speed	150 ns (Max)	150 ns (Max)
DC Bias	+5 Vdc / 50 mA; -5 Vdc / 0 mA (Typ)	+5 Vdc / 160 mA; -5 Vdc / 0 mA (Typ)
Waveguide	Input: WR-12 with UG387/U Flange; Outputs: WR-12 with Miniature Flange	
DC Connector/TTL Control	MOLEX 87833-1020	

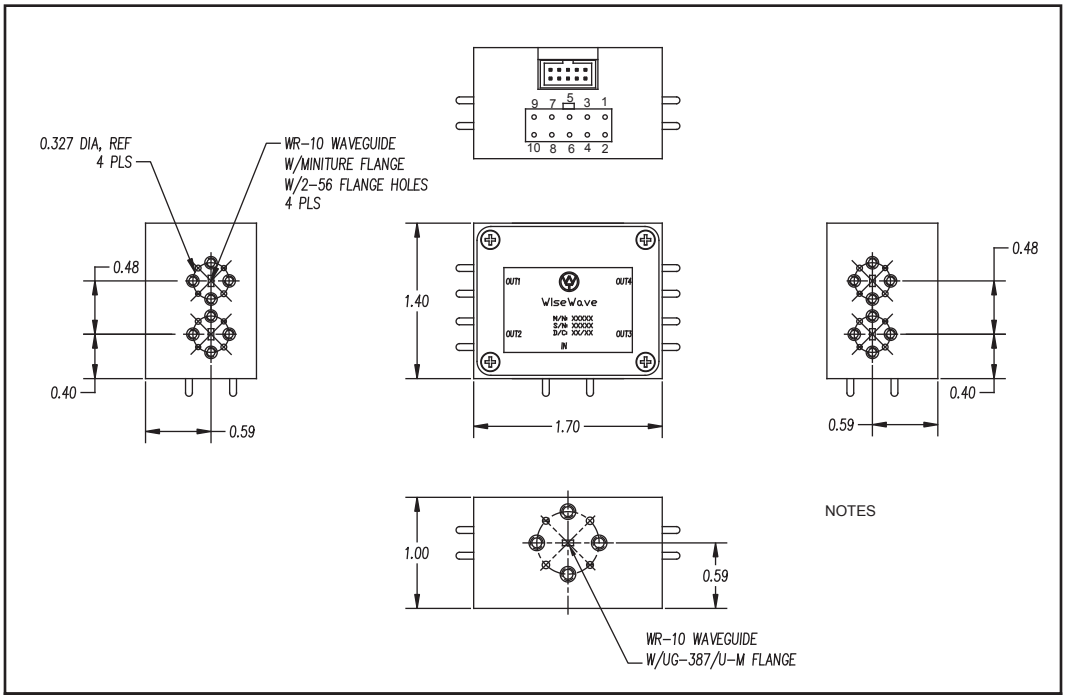
SP4T TRUTH TABLE

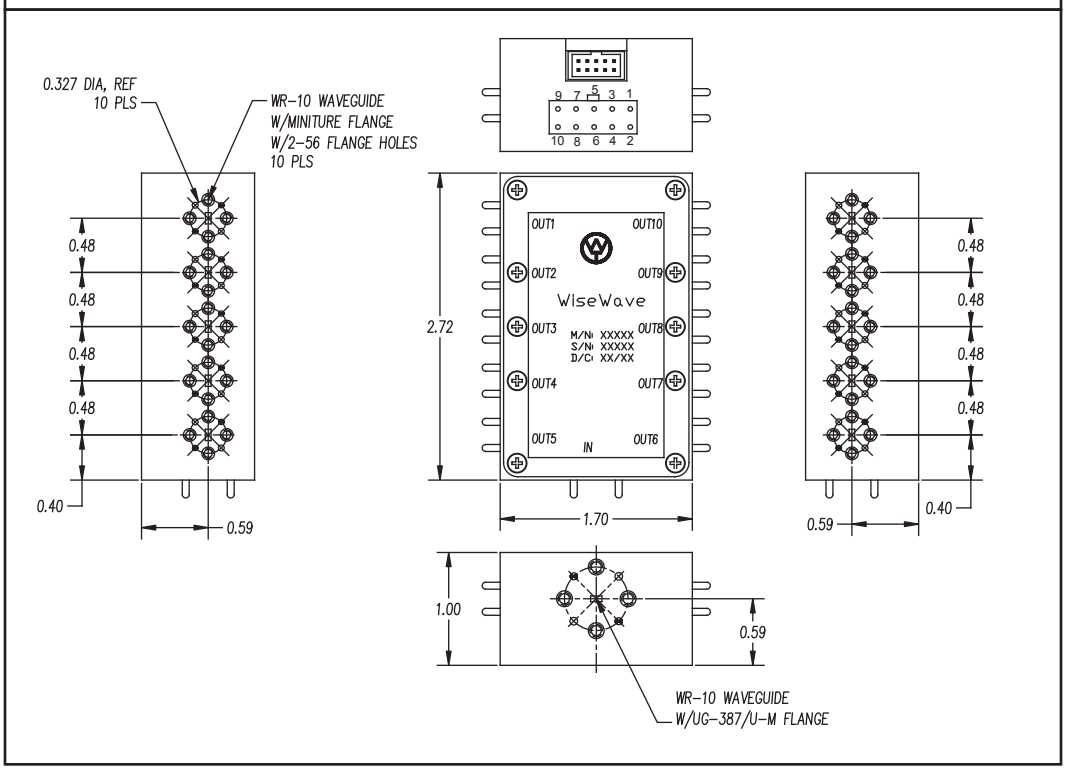
C1	C0	Port "On"
0	0	Port 1
0	1	Port 2
1	0	Port 3

SP10T TRUTH TABLE

C3	C2	C1	C0	Port "On"	C3	C2	C1	C0	Port "On"
0	0	0	0	Port 1	0	1	0	1	Port 6
0	0	0	1	Port 2	0	1	1	0	Port 7
0	0	1	0	Port 3	0	1	1	1	Port 8
0	0	1	1	Port 4	1	0	0	0	Port 9
0	1	0	0	Port 5	1	0	0	1	Port 10

OUTLINE DRAWINGS



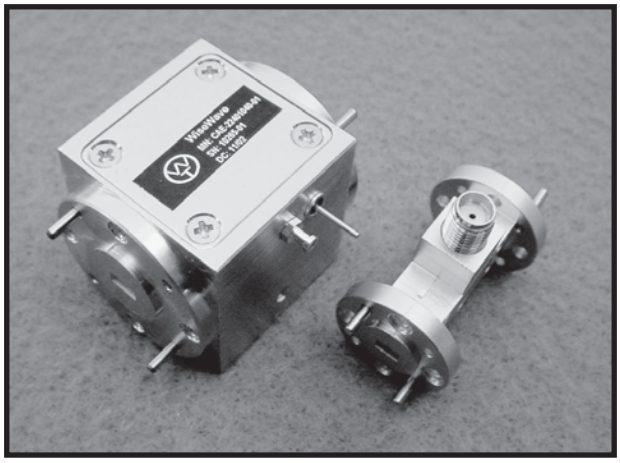


FEATURES

- High dynamic range
- Low insertion loss
- Broad operating bandwidth
- Pin diode or MMIC based circuitry
- Current or voltage controlled

APPLICATIONS

- Automatic level control
- Amplitude modulation
- Instrumentation



CAE Series

DESCRIPTION

CAE series are discrete or MMIC PIN diode based current or voltage controlled electrical attenuators that operate at the frequency range from DC to 110 GHz. These attenuators are especially designed for low insertion loss and high attenuation applications. While PIN diode based attenuators are designed for waveguide bandwidth operation from 18 to 110 GHz, the MMIC based attenuators are designed for broadband operation from DC up to 50 GHz. The maximum attenuation value up to 100 dB is available.

WAVEGUIDE INTERFACE ATTENUATOR SPECIFICATIONS

Frequency Range (GHz)	Maximum Available Bandwidth (GHz)	Insertion Loss (dB, Typ)*	Attenuation (dB, Min)	VSWR (Typ)	Tuning Speed (nS)	Outline* Drawing
18 to 26.5	Full	1.2	20	2:1	10 to 250	WT-H-3
26.5 to 40	Full	1.5	20	2:1	10 to 250	WT-H-3
33 to 50	10	1.8	20	2:1	10 to 250	WT-H-3, WT-H-4
40 to 60	10	2.0	20	2:1	10 to 250	WT-H-3, WT-H-4
50 to 75	10	2.2	20	2:1	10 to 250	WT-H-3
60 to 90	10	2.3	20	2:1	10 to 250	WT-H-3
75 to 110	10	2.5	20	2:1	10 to 250	WT-H-3
Temperature Range	0 to +50°C					

* Insertion Loss & Isolation are for waveguide version.
** Consult factory for the attenuators with the outline and specifications other than listed above.

HOW TO ORDER

The attenuators with the performance other than listed above are available per customer's request. You may submit your specifications along with the model number per following instruction.

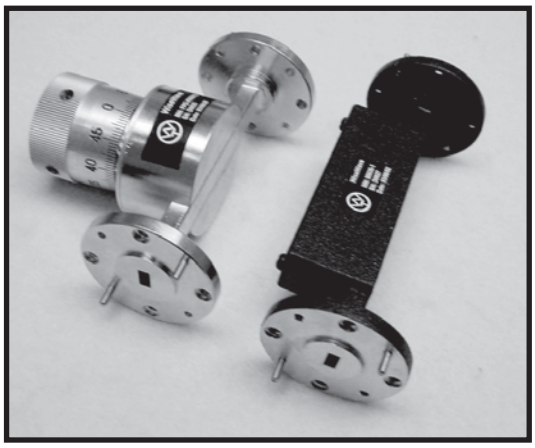
Specify Model Number: CAE - CO CF BW AT -XX ← Factory Reserve

- CO: RF Connector Type
- CF: Center Frequency in GHz
- BW: Bandwidth in GHz
- AT: Attenuation in dB

Example: To order an electrical attenuator with center frequency of 35 GHz, +/- 5 GHz bandwidth, 35 dB minimum attenuation and WR-28 waveguide interface, specify CAE-28351035-XX.

FEATURES

- Rugged waveguide configuration
- Full band operation
- Up to 30 dB attenuation
- Low cost



CAF & CAL Series

APPLICATIONS

- Test benches
- Subsystems
- Prototypes

DESCRIPTION

CAF and CAL series fixed and level setting attenuators are offered for the frequency range of 18 to 110 GHz in seven waveguide bands. The standard attenuation level for fixed attenuators are 3, 6, 10, 20 and 30 dB, while level setting attenuators are from 0 to 30 dB with full waveguide operational bandwidth. The level setting attenuators are equipped with a micrometer, which enables rapid re-setting. With calibrated charts, the level setting attenuators can be used as direct reading attenuator for bench top test set use. The fixed and level setting attenuators are typically used in the test setups and prototype assemblies where certain attenuation is required.

SPECIFICATIONS

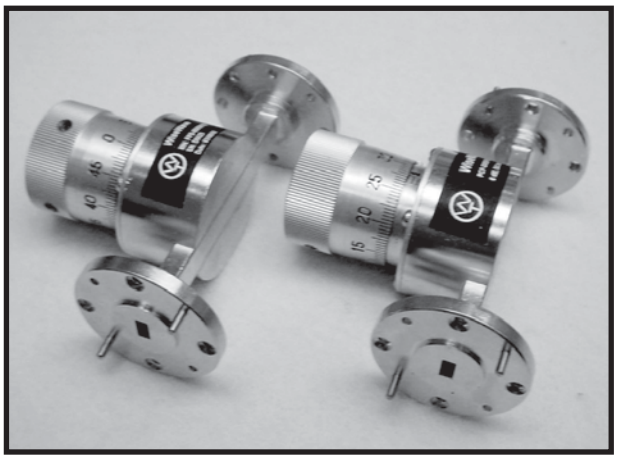
Fixed Attenuator	K	Ka	Q	U	V	E	W
Model Number	CAF-WG AT-02 (Where WG is the waveguide size and AT is the attenuation value in dB.)**						
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Fixed Attenuation Value (dB, Typ.)*	3, 6, 10, 20 and 30						
VSWR (Typical)	1.15:1						
Outline Drawing	WT-H-1	WT-H-1	WT-H-1	WT-H-1	WT-H-1	WT-H-1	WT-H-1

Level Setting Attenuator	K	Ka	Q	U	V	E	W
Model Number*	CAL-42-02	CAL-28-02	CAL-22-02	CAL-19-02	CAL-15-02	CAL-12-02	CAL-10-02
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Level Setting Value (dB, Minimum)	0 to 25						
VSWR (Typical)	1.30:1						
Outline Drawing	WT-H-II	WT-H-II	WT-H-II	WT-H-2	WT-H-2	WT-H-2	WT-H-2
Power Rating (Maximum)	0.6	0.6	0.5	0.5	0.4	0.3	0.3

* Consult factory for other attenuation values, waveguide bands and specifications.
** To order a WR-15 fixed attenuator with 20 dB attenuation level, specify CAF-1520-02

FEATURES

- Rugged waveguide configuration
- Full band operation
- 0 to 180 ° minimum phase shifting
- Low cost



CPL Series

APPLICATIONS

- Test benches
- Subsystems
- Prototypes

DESCRIPTION

CPL series variable phase shifters are offered for the frequency range of 18 to 110 GHz in seven waveguide bands. The phase shifters utilize low loss dielectric material, which offers minimum insertion loss. The standard phase shifters are equipped with micrometer, which allows fine accurate and repeatable phase settings. The variable phase shifters are typically used in the test setups and prototype assemblies where certain phase shifting is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Model Number	CPL-42-02	CPL-28-02	CPL-22-02	CPL-19-02	CPL-15-02	CPL-12-02	CPL-10-02
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Variable Phase Shifting Range (Min)	0 to 180 degrees						
VSWR (Typical)	1.4:1						
Insertion Loss (dB, Typical)	0.4	0.4	0.5	0.6	0.7	0.8	1.0
Power Rating (Maximum)	0.6	0.6	0.5	0.5	0.4	0.3	0.3
Insertion Length (Inches, Typ)	3.94	3.46	3.46	2.46	2.46	2.46	2.46
Outline Drawing	WT-H-II	WT-H-II	WT-H-II	WT-H-2	WT-H-2	WT-H-2	WT-H-2

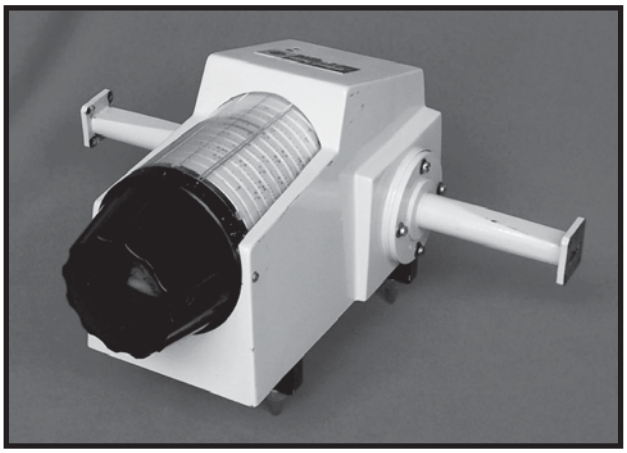
Note: Contact factory for other waveguide bands and specifications.

FEATURES

- Rugged waveguide configuration
- Full band operation
- 0 to 50 dB attenuation range
- High accuracy

APPLICATIONS

- Test benches
- Instrumentation
- Calibration



CAR Series

DESCRIPTION

CAR series direct reading attenuators are offered for the frequency range of 18 to 110 GHz in seven waveguide bands. The attenuators are constructed with a precision rotary resistive vane in a circular waveguide. Therefore, they are frequency independent. The attenuators offer a high degree of repeatability and accuracy over whole attenuation range for the full waveguide band operation. The attenuation value is read directly from the helical drum scale. These attenuators are the ideal devices when precision measurement, such as output power, gain, insertion loss, isolation, coupling and return loss is required.

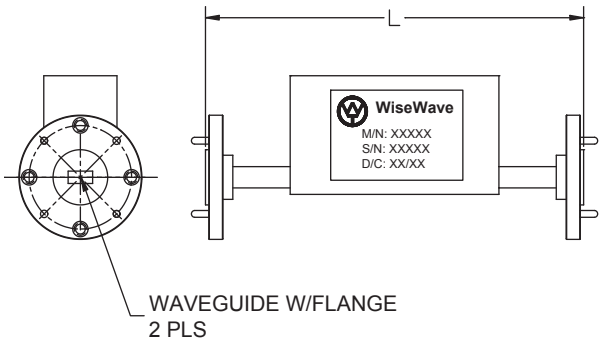
SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Model Number	CAR-4250	CAR-2850	CAR-2250	CAR-1950	CAR-1550	CAR-1250	CAR-1050
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Insertion Loss (dB)[2]	0.5	0.5	0.6	0.6	0.8	0.8	1.0
Attenuation (dB)	0 to 50	0 to 50	0 to 50	0 to 50	0 to 50	0 to 50	0 to 50
Accuracy (Max)	0.1 dB or 2% which ever is greater.						
Return Loss (dB)	20	23	23	23	20	20	20
Power Handling (W)	1.0	0.5	0.5	0.5	0.4	0.3	0.3
Power Rating (Maximum)	0.6	0.6	0.5	0.5	0.4	0.3	0.3
Insertion Length (Inches)	8.5	6.9	6.3	5.8	4.5	4.5	4.5

Note:

1. The attenuation range is above the insertion loss value;
2. The maximum attenuation setting is up to 60 dB;
3. Other waveguide bands are available upon request.

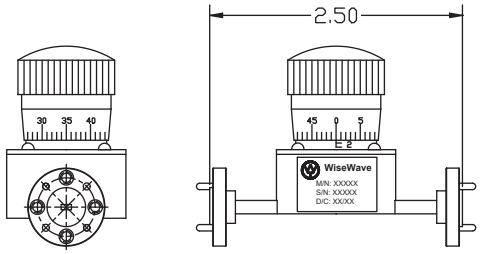
WT-H-1



BAND	W,E & V	U, Q & Ka	K
L	2.50	3.50	4.00

Dimensions are in inches

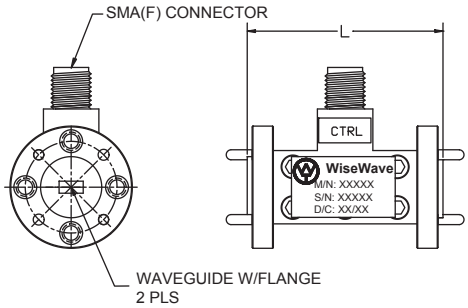
WT-H-2



W, E, V & U BAND

Dimensions are in inches

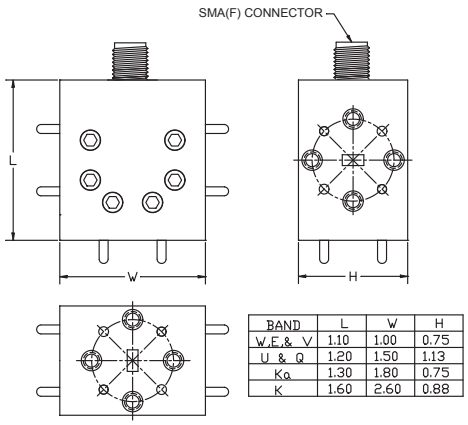
WT-H-3



BAND	W,E & V	U & Q	Ka & K
L	1.20	1.50	2.00

Dimensions are in inches

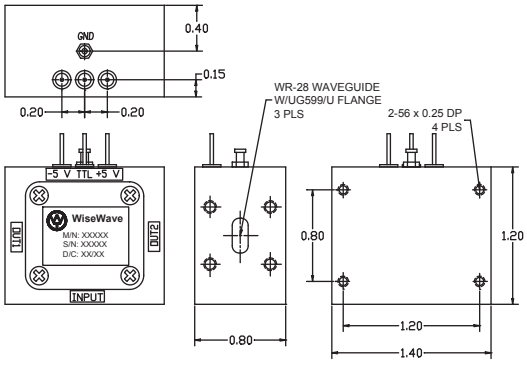
WT-H-4



BAND	L	W	H
W,E & V	1.10	1.00	0.75
U & Q	1.20	1.50	1.13
Ka	1.30	1.80	0.75
K	1.60	2.60	0.88

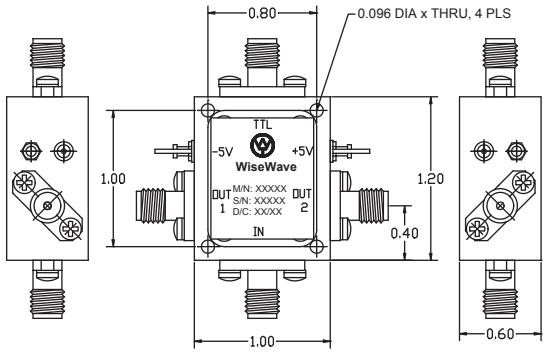
Dimensions are in inches

WT-H-5



Dimensions are in inches

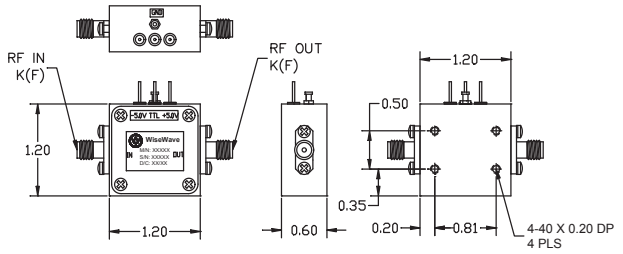
WT-H-6



Dimensions are in inches

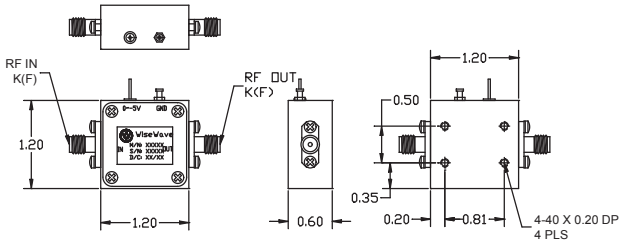
The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

WT-H-7



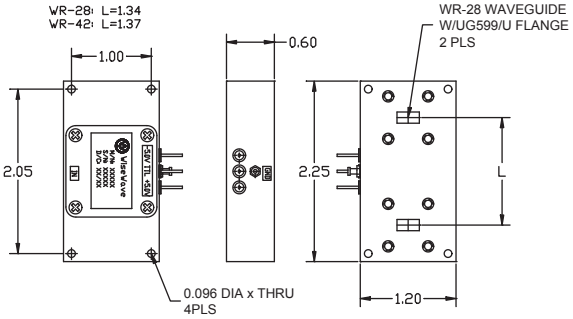
Dimensions are in inches

WT-H-8



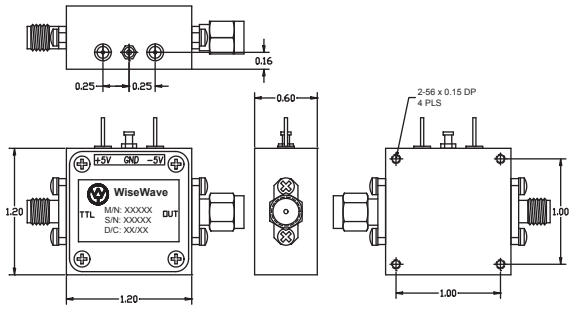
Dimensions are in inches

WT-H-9



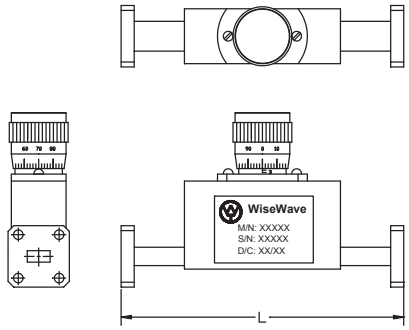
Dimensions are in inches

WT-H-10



Dimensions are in inches

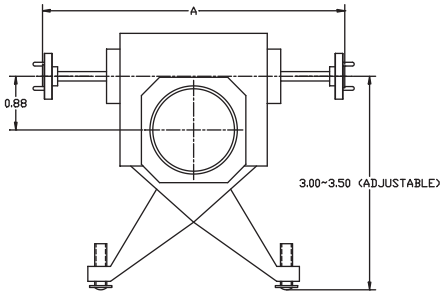
WT-H-11



BAND	Q & Ka	K
L	3.50	4.00

Dimensions are in inches

WT-H-12

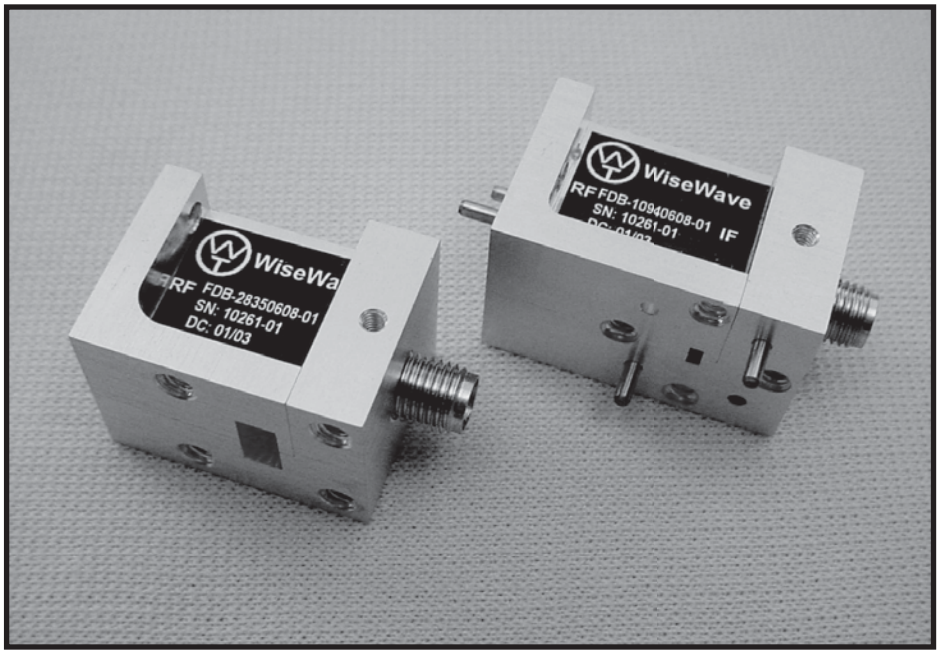


BAND	K	Ka	Q	U	V	E	W	F
A	8.48	6.87	6.25	5.76	4.50	4.50	4.50	3.53

Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

4. Frequency Converters

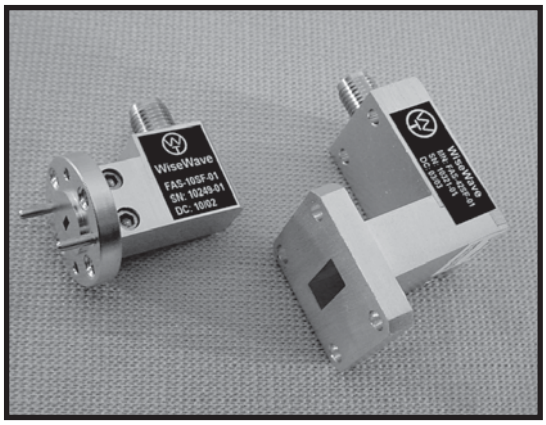


FEATURES

- Full waveguide bandwidth
- High sensitivity
- Zero biased
- No mechanical tuning
- Compact size

APPLICATIONS

- Instrumentation
- Power detection
- Direct detection receiver



FAS Series

DESCRIPTION

FAS series broadband waveguide detectors are offered in seven waveguide bands to cover frequency spectrums from 18 to 110 GHz. These detectors employ high performance GaAs Schottky beamlead diodes and a proprietary circuit design to produce high sensitivity and broad bandwidth without external DC bias or mechanical tuning. The standard detectors are equipped with SMA(F) connector for video output and offered negative output voltage polarity for various applications. The matched pairs with similar sensitivity response cross the entire bandwidth are available. These detectors are idea devices where power detection or power monitoring is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Model Number[1]	FAS-42SF-01	FAS-28SF-01	FAS-22SF-01	FAS-19SF-01	FAS-15SF-01	FAS-12SF-01	FAS-10SF-01
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Sensitivity (mV/mW, Min)	1000	1000	800	800	700	600	500
Video Bandwidth (MHz, Min)	1	1	1	1	1	1	1
Output Video Imp. (M ohm, Typ)	1	1	1	1	1	1	1
Outlines	WT-F-1	WT-F-1	WT-F-2	WT-F-2	WT-F-2	WT-F-2	WT-F-2
Voltage Output Polarity[2]	Negative						
Input RF Power (dBm, Max)	+ 20						
Temperature Range	0 to +50°C						

Note:

1. SMA(F) output connector is offered as standard model while SMA(M) is available per customer request. For example, the model number for a WR-22 detector with SMA(M) connector is specified as FAS-22SM-01;
2. Positive polarity is available per request. Specify model number with –P1. For example: FAS-10SF-P1.

FEATURES

- Low conversion loss
- Low LO drive power
- I/Q IF outputs
- LO/RF in-line configuration
- Compact size

APPLICATIONS

- Distance detection
- Plasma analysis system
- Communication system

FPB Series

DESCRIPTION

FPB series I/Q mixers are offered in seven waveguide bands to cover frequency spectrums from 18 to 110 GHz with 5 % minimum bandwidth. These mixers employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with moderate LO pumping level. The mixers are constructed with fully integrated 2 balanced mixers, 2 3-dB power splitters and phase shifters. These mixers offer high port to port isolation for most application without the requirement of additional filtering. These mixers are ideal candidates for critical distance measurement and specific modulation scheme in certain communication systems where phase information is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
RF & LO Bandwidth (Min.)	5%	5%	5%	5%	5%	5%	5%
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
RF & LO Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
RF & LO Bandwidth	5%	5%	5%	5%	5%	5%	5%
IF Frequency Range (GHz)	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0
LO Pumping Level (dBm)	15	15	16	16	16	16	16
Conversion Loss (dB, Typical)	9.5	10.0	11.0	11.0	11.0	12.0	12.0
IF I/Q Phase Error (Degree)	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Outline Drawing	Consult Factory	Consult Factory	WT-F-4	WT-F-4	WT-F-4	WT-F-4	WT-F-4
Port Isolation (dB, Typical)	30	30	30	30	30	30	30
Maximum Input Signal Level	+ 23 dBm						
Temperature Range	0 to +50°C						

HOW TO ORDER

Specify Model Number:

FPB – CO RF IF CL - XX ← Factory Reserve

RF Connector Type

RF Frequency in GHz

Conversion Loss in dB

IF Bandwidth in GHz

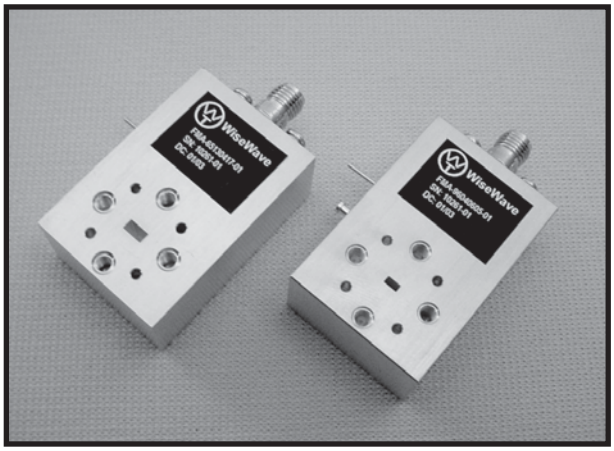
Example: To order a V band, 60 GHz I/Q mixer with 1 GHz IF frequency and 11.0 dB conversion loss, specify FPB-15600111-XX.

FEATURES

- High output power
- Up to full waveguide operation
- Moderate conversion gain
- Frequency up to 96 GHz
- Single power supply

APPLICATIONS

- Frequency extenders
- Test set
- Local oscillators
- Subsystems



FMA Series

DESCRIPTION

FMA series active multipliers utilize high performance GaAs Schottky beamlead diodes or discrete PHEMT devices and/or MMIC chips for frequency multiplication and amplification. The multipliers offer moderate conversion gain with output frequency covering 18 to 96 GHz in six waveguide bands. The X2, X3 and X4 are offered as standard multiplication factors. The input power requirement for these multipliers is +10 to +20 dBm. While SMA or K female coaxial connector is equipped for input and waveguide for output interface, WR-28 waveguide input is available as an option for V band doubler and W band tripler design.

SPECIFICATIONS

Output Freq. (GHz)	Multiplying Factor	Input Freq. (GHz)	Output Power (dBm, Typ)	Bandwidth (GHz)	Output Waveguide	Input Connector
18.0-26.5	X 2	9.0-13.25	10 to 30	± 2 to Full	WR-42	SMA(F)
26.5-40.0	X 2	13.25-20.0	10 to 25	± 2 to Full	WR-28	SMA(F)
	X 4	6.625-10.0	10 to 25	± 2 to Full	WR-28	SMA(F)
33.0-42.0	X 2	16.5-21.0	10 to 23	± 2 to ± 4	WR-22	SMA(F)
	X 4	8.25-10.5	7 to 23	± 2 to ± 4	WR-22	SMA(F)
54.0-65.0	X 2	27.0-32.5	7 to 16	± 2 to ± 6	WR-15	K(F)
	X 4	13.5-16.25	7 to 16	± 2 to ± 6	WR-15	K(F)
92.0-96.0	X 2	46.0-48.0	7 to 20	± 2	WR-10	2.4mm(F)
	X 6	15.3-16.0	5 to 20	± 2	WR-10	SMA(F)
Temperature Range		0 to +50°C				

* Consult factory for other active multiplier and outline requirements.

HOW TO ORDER

Specify Model Number: FMA - EF BW MM PP - XX ← Factory Reserve

- EF: Output High End Frequency in GHz
- BW: Output Bandwidth in GHz
- MM: Multiplying Factor
- PP: Output Power in dBm

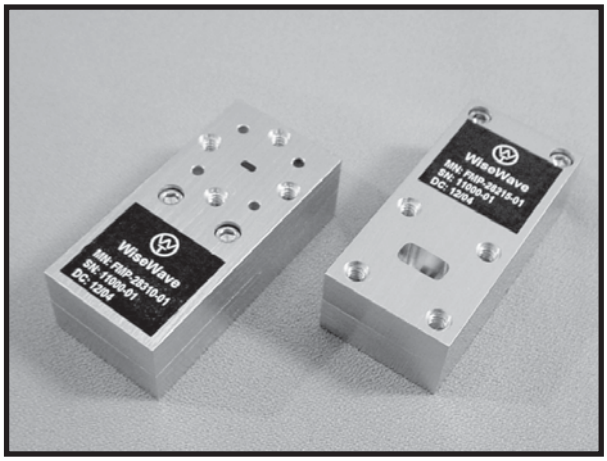
Example: To order an active doubler with output end frequency 65 GHz, bandwidth 10 GHz and power 16 dBm, specify FMA-65100216-XX.

FEATURES

- High output power
- Full waveguide bandwidth
- Or narrow band with higher output power
- Low conversion loss
- Frequency up to 110 GHz

APPLICATIONS

- Frequency extenders
- Test set
- Local oscillators
- Subsystems



FMP Series

DESCRIPTION

FMP series of passive frequency multipliers utilize high performance GaAs Schottky beamlead diodes and balanced configuration to produce an extremely broad bandwidth performance. The multipliers cover the output frequency range of 18 to 110 GHz with seven waveguide bands. The balanced design enhances either even or odd harmonics while suppressing unwanted odd or even harmonics. External bias is not required for ease system integration. The maximum input power for these standard units are rated at +23 dBm. While SMA or K female coaxial connector is equipped for input and waveguide for output interface, WR-28 waveguide input is available as an option for V band doubler and W band tripler design.

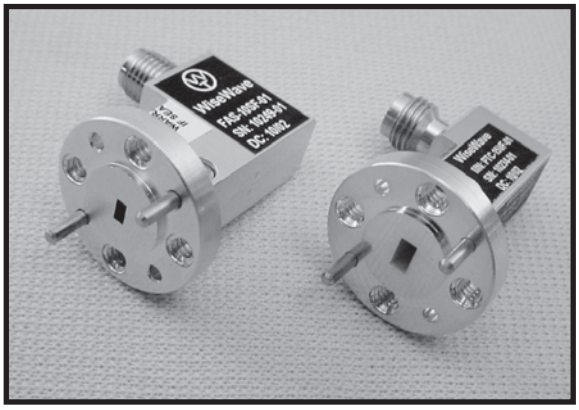
Ducommun also offers passive frequency multipliers with higher output power and narrower bandwidth by utilizing high performance varactor diodes. These multipliers offer several GHz bandwidth with 10 dB typical conversion loss. Contact factory for your detailed requirements.

STANDARD PASSIVE MULTIPLER SPECIFICATIONS (Input Power: 20 dBm)

Model Number	Output Freq. (GHz)	Multiplying Factor	Input Freq. (GHz)	Output Power (dBm, Min)	Output Waveguide	Input Connector	Outline Drawings
FMP-SF242-01	18.0-26.5	X 2	9.00-13.25	6.0	WR-42	SMA(F)	WT-F-7
FMP-SF228-01	26.5-40.0	X 2	13.25-20.00	5.0	WR-28	SMA(F)	WT-F-7
FMP-SF328-01		X 3	8.67-13.33	3.0	WR-28	SMA(F)	WT-F-7
FMP-SF322-01	33.0-50.0	X 3	11.00-16.67	3.0	WR-22	SMA(F)	WT-F-7
FMP-SF319-01	40.0-60.0	X 3	13.33-20.00	2.0	WR-19	SMA(F)	WT-F-7
FMP-KF215-01	50.0-75.0	X 2	25.00-37.50	3.0	WR-15	K(F)	WT-F-7
FMP-28215-01		X 2	25.00-37.50	3.0	WR-15	WR-28	WT-F-6
FMP-KF315-01		X 3	16.67-25.00	0.0	WR-15	K(F)	WT-F-7
FMP-KF312-01	60.0-90.0	X 3	20.00-30.00	-1.0	WR-12	K(F)	WT-F-7
FMP-KF310-01	75.0-110.0	X 3	25.00-36.67	-3.0	WR-10	K(F)	WT-F-7
FMP-28310-01		X 3	25.00-36.67	-3.0	WR-10	WR-28	WT-F-6
Temperature Range		0 to +50°C					

FEATURES

- Low conversion loss
- High Sensitivity
- Full waveguide band operation
- Compact and rugged package



FDH Series

APPLICATIONS

- Spectrum analyzer
- Frequency counter
- Phase lock loop

DESCRIPTION

FDH series harmonic mixers are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz. These mixers employ high performance GaAs Schottky beamlead diode to produce superior performance with a moderate LO pumping level. The mixers are designed for full RF waveguide band operation with wide IF bandwidth. The LO and IF frequency range for standard models are 2 to 15 GHz and DC to 4 GHz, respectively. These harmonic mixers are designed for use with spectrum analyzers and frequency counters with built-in frequency diplexer. When used with external diplexer, these mixers can be used to phase lock the high frequency sources. The standard model equipped with SMA(F) connector for LO/IF port connection.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
RF Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
RF Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
LO Frequency Range (GHz)	2 to 4 GHz, 4 to 8 GHz and 8 to 15 GHz						
IF Frequency Range (GHz)	DC to 1 GHz, DC to 2.5 GHz and DC to 4.0 GHz						
LO Pumping Level (dBm)	15	15	15	15	15	15	15
Conversion Loss (dB, Typ)*	20	22	24	26	28	30	32
Maximum Input Signal Level	+ 20 dBm						
Temperature Range	0 to +50°C						

* The conversion loss is a typical value with harmonic mixing number 8 or lower.

HOW TO ORDER

Specify Model Number:

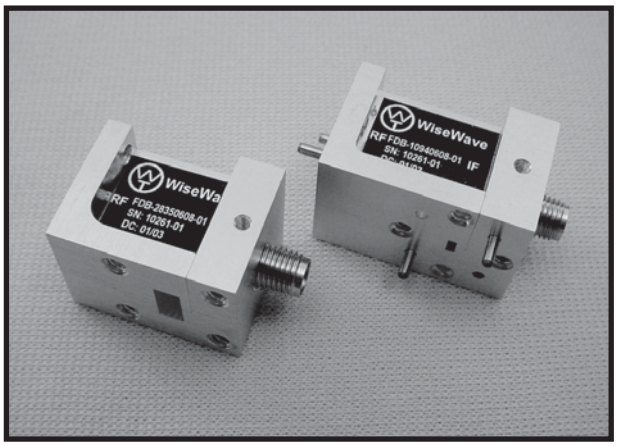
FDH - CO NN IF CL - XX ← Factory Reserve

- CO: Output Connector Type
- NN: Harmonic Number
- IF: IF in GHz
- CL: Conversion Loss in dB

Example: To order a 6th harmonic mixer with 1 GHz 1F Bandwidth and 20 dB Conversion Loss and WR-22 waveguide RF port and SMA(F) LO/IF port, specify FDH-22060120-XX.

FEATURES

- Low conversion loss
- Low LO drive power
- Full waveguide band operation
- Compact and rugged package



FDB Series

APPLICATIONS

- Test equipment
- Communication systems
- Radar receivers

DESCRIPTION

FDB series balanced mixers are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz. These mixers employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a moderate LO pumping level. The mixers are designed for full RF waveguide band operation with extremely wide IF bandwidth. Better performance can be obtained by operating the mixers in narrower bandwidth. These mixers are ideal candidates for test equipment, communication systems and Radar receivers where frequency down conversion is required.

FULL BAND MODEL SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Model Number	FDB-42-01	FDB-28-01	FDB-22-01	FDB-19-01	FDB-15-01	FDB-12-01	FDB-10-01
RF & LO Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
IF Frequency Range (GHz)	DC to 8	DC to 14	DC to 17	DC to 18	DC to 18	DC to 18	DC to 18
LO Pumping Level (dBm)	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13
Conversion Loss (dB, Typical)	6.0	6.5	7.0	7.5	8.0	8.5	9.0
Port Isolation (dB, Typical)	20	20	20	20	20	20	20
Input Signal Level (max)	+17.0 dBm						
Outline	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3
Temperature Range	0 to +50°C						

NARROW BAND MODELS

The lower cost model with narrow operating bandwidth. Customer may submit the specifications along with the model number per following instruction.

Specify Model Number: FDB – CO LO IF CL - XX ← Factory Reserve

RF Port Connector Type
LO Center Frequency in GHz
Conversion Loss in dB
IF Bandwidth in GHz

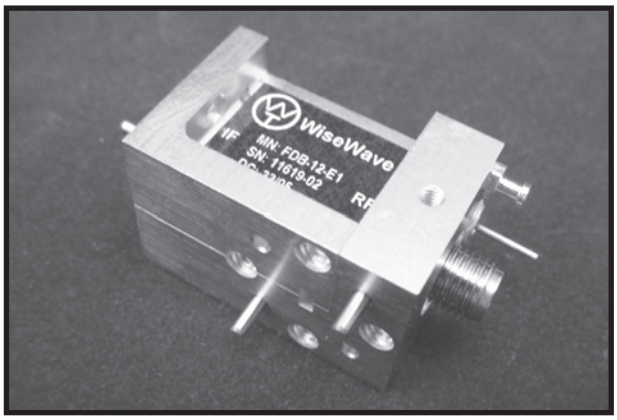
Example: To order a V band balanced mixer with 60 GHz LO frequency, 2 GHz IF bandwidth and 7 dB conversion loss, specify FDB-15600207-XX.

FEATURES

- Low conversion loss
- Low LO drive power
- Single external bias
- Full waveguide band operation
- Compact and rugged package

APPLICATIONS

- Test equipment
- Communication systems
- EW systems



FDB-XX-E1 Series

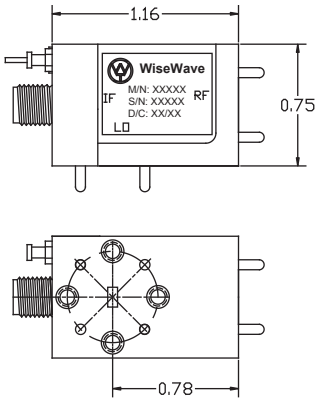
DESCRIPTION

It is always a concern at high millimeterwave band that there is not enough power to drive the mixer, especially full waveguide band. Model **FDB-XX-E1** series externally biased, balanced mixers is especially developed for this purpose. The mixers are offered in 4 waveguide bands to cover frequency spectra from 50 to 140 GHz. These mixers employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a very low LO pumping level. The mixers are designed for full RF waveguide band operation with extremely wide IF bandwidth. Better performance can be obtained by operating the mixers in narrower bandwidth. These mixers are ideal candidates for test equipment, communication systems and EW receivers where frequency down conversion is required.

SPECIFICATIONS

Waveguide Band	V	E	W	F
Waveguide Size	WR-15	WR-12	WR-10	WR-8
Model Number	FDB-15-E1	FDB-12-E1	FDB-10-E1	FDB-08-E1
RF & LO Frequency Range (GHz)	50 to 75	60 to 90	75 to 110	90 to 140
IF Frequency Range (GHz)	DC-18	DC-18	DC-18	DC-18
LO Pumping Level (dBm)	0 to 3	0 to 3	0 to 3	0 to 3
Conversion Loss (dB, Typ)	11.0	12.0	13.0	15.0
LO/RF Isolation (dB, Typ)	20	20	20	20
External Bias (V/mA, Typ)	+5.0/1.0	+5.0/1.0	+5.0/1.0	+5.0/1.0
RF & LO Flange	UG385/U	UG387/U	UG387/U-M	UG387/U-M
IF Connector	SMA(F)	SMA(F)	SMA(F)	SMA(F)
DC Connector	Pin	Pin	Pin	Pin

Outline Drawing



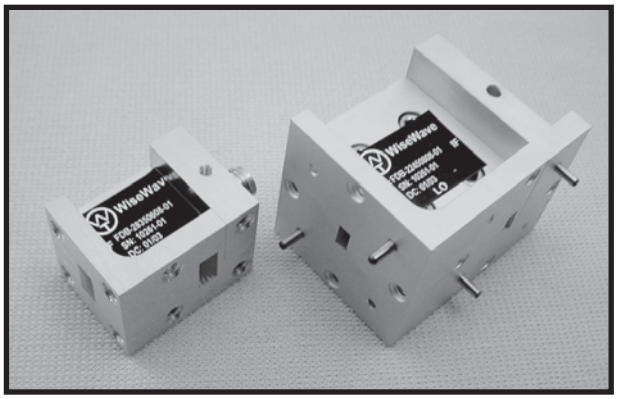
Note: Consult factory for the frequencies and performance other than listed.

FEATURES

- Low conversion loss
- Low LO drive power
- Full waveguide band operation
- Compact and rugged package

APPLICATIONS

- Test equipment
- Communication systems
- Radar receivers



FUB Series

DESCRIPTION

FUB series balanced up-converters are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz. These converters employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a moderate LO pumping level. The converters are designed for full RF waveguide band operation with extremely wide IF bandwidth. Better performance can be obtained by operating the converters in narrower bandwidth. These converters offer moderate port to port isolation, which is high enough for most applications to eliminate additional filtering requirement. The standard converters are offered as double sideband operation and signal sideband version can be realized by adding an optional low pass or band pass filter. These converters are ideal candidates for test equipment, communication systems, frequency extenders and radar transmitters where frequency up conversion is desired.

FULL BAND MODEL SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Model Number	FUB-42-01	FUB-28-01	FUB-22-01	FUB-19-01	FUB-15-01	FUB-12-01	FUB-10-01
RF & LO Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
IF Frequency Range (GHz)	DC to 8	DC to 14	DC to 17	DC to 18	DC to 18	DC to 18	DC to 18
LO Pumping Level (dBm)	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13	10 to 13
Conversion Loss (dB, Typical)	6.0	6.5	7.0	7.5	8.0	8.5	9.0
Port Isolation (dB, Typical)	20	20	20	20	20	20	20
Input Signal Level (max)	+17 dBm						
Outline Drawing	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3	WT-F-3
Temperature Range	0 to +50°C						

NARROW BAND MODELS

The lower cost model with narrow operating bandwidth. Customer may submit the specifications along with the model number per following instruction.

Specify Model Number: FUB – CO LO IF CL - XX ← Factory Reserve

RF Port Connector Type

LO Center Frequency in GHz

Conversion Loss in dB

IF Bandwidth in GHz

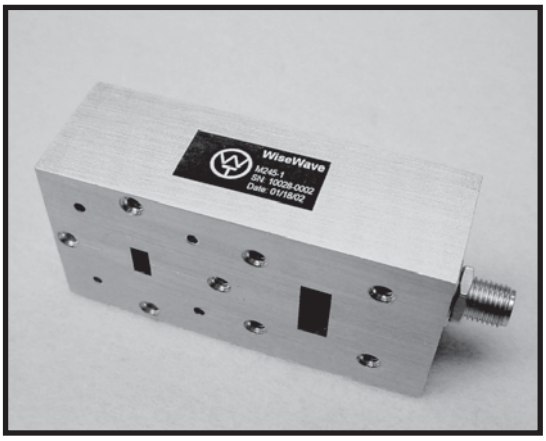
Example: To order a W band balanced up-converter with 94 GHz LO frequency, 8 GHz IF bandwidth and 8 dB conversion loss, specify FUB-10940808-XX.

FEATURES

- Low conversion loss
- LO frequency = ½ RF frequency
- Up to full waveguide band operation
- Compact and rugged package

APPLICATIONS

- Test equipment
- Communication systems
- Receivers



FDS Series

DESCRIPTION

FDS series balanced subharmonically pumped mixers are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz. These mixers employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a moderate LO pumping level. The mixers are designed for up to full RF waveguide band operation with wide IF bandwidth. Better performance can be obtained by operating the mixers in narrower bandwidth. The advantage to use subharmonically pumped mixers is their low LO frequency (½ RF frequency) characteristic, therefore, LO/RF frequency separation and their products treatment can be easily realized. In addition, lower LO frequency requirement will reduce system integration cost dramatically, especially, at higher millimeterwave frequency range. These mixers are ideal candidates for test equipment, communication systems and receivers where frequency down conversion is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
RF Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
LO Connector	SMA	SMA or K	WG or K	WG or K	WG or K	WG or K	WG or V
RF Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
LO Frequency Range (GHz)	9 to 13.25	13.25 to 20	16.5 to 25	20 to 30	25 to 37.5	30 to 45	37.5 to 55
IF Frequency Range (GHz)	DC to 4	DC to 6	DC to 8	DC to 10	DC to 12	DC to 15	DC to 18
LO Pumping Level (dBm)	10 to 15	10 to 15	12 to 15	12 to 15	12 to 15	12 to 15	12 to 15
Conversion Loss (dB, Typ)	10	11	12	13	14	15	16
Input Signal Level (max)	+ 20 dBm				+ 18 dBm		
Temperature Range	0 to +50°C						

HOW TO ORDER

Specify Model Number:

FDS – CO LO IF CL - XX ← Factory Reserve

RF Port Connector Type

LO Center Frequency in GHz

Conversion Loss in dB

IF Bandwidth in GHz

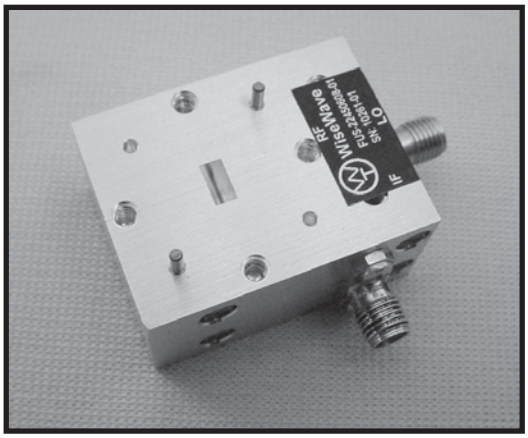
Example: To order a subharmonically pumped mixer with WR-22 waveguide, 21 GHz LO frequency, DC to 8 GHz IF bandwidth and 12 dB conversion loss, specify FDS-22210812-XX.

FEATURES

- Low conversion loss
- LO frequency = ½ RF frequency
- Up to full waveguide band operation
- Compact and rugged package

APPLICATIONS

- Test equipment
- Communication systems
- Receivers



FUS Series

DESCRIPTION

FUS series balanced subharmonically pumped up-converters are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz. These up-converters employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a moderate LO pumping level. The up-converters are designed for up to full RF waveguide band operation with wide IF bandwidth. Better performance can be obtained by operating the up-converters in a narrower bandwidth. The advantage to use subharmonically pumped up-converters is their low LO frequency (½ RF frequency) characteristic, therefore, LO/RF frequency separation and their products treatment can be easily realized. In addition, lower LO frequency requirement will reduce system integration cost dramatically, especially, at higher millimeterwave frequency range. These up-converters are ideal candidates for test equipment, communication systems and receivers where frequency up conversion is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
RF Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
LO Connector	SMA	SMA or K	WG or K	WG or K	WG or K	WG or K	WG or V
RF Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
LO Frequency Range (GHz)	9 to 13.25	13.25 to 20	16.5 to 25	20 to 30	25 to 37.5	30 to 45	37.5 to 55
IF Frequency Range (GHz)	DC to 4	DC to 6	DC to 8	DC to 10	DC to 12	DC to 15	DC to 18
LO Pumping Level (dBm)	10 to 15	10 to 15	12 to 15	12 to 15	12 to 15	12 to 15	12 to 15
Conversion Loss (dB, Typ)	10	11	12	13	14	15	16
Input Signal Level (max)	+ 20 dBm				+ 18 dBm		
Temperature Range	0 to +50°C						

HOW TO ORDER

Specify Model Number:

FUS – CO LO IF CL - XX ← Factory Reserve

RF Port Connector Type

LO Center Frequency in GHz

Conversion Loss in dB

IF Bandwidth in GHz

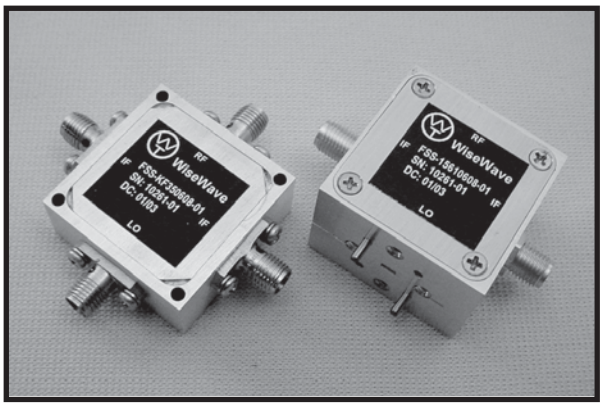
Example: To order a subharmonically pumped up-converter with WR-10 waveguide, 47 GHz LO frequency, DC to 8 GHz IF bandwidth and 12 dB conversion loss, specify FUS-10470812-XX.

FEATURES

- Low conversion loss
- High image rejection
- Separate I/Q IF inputs
- LO/RF in-line configuration
- Compact size

APPLICATIONS

- Single sideband modulation
- Communication system
- Radar system



FSS Series

DESCRIPTION

FSS series single sideband modulators are offered in seven waveguide bands to cover frequency spectra from 18 to 110 GHz with 5 % minimum bandwidth. These modulators employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with moderate LO pumping level. The modulators are constructed with fully integrated two balanced mixers, two 3-dB power splitters and phase shifters. The modulators are internally phase matched and often be used as single sideband up-converters without adding external filter. The modulators are ideal candidates for test equipment, communication and Radar systems where the single sideband modulation is required.

SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
RF Bandwidth (Min)	5%	5%	5%	5%	5%	5%	5%
LO Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
IF Frequency Range (GHz)	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0	DC to 1.0
LO Pumping Level (dBm)	15	15	16	16	16	16	16
Conversion Loss (dB, Typical)	9.5	10.0	11.0	11.0	11.0	12.0	12.0
Image Rejection (dB, Min)	20	20	20	20	20	20	20
Outline Drawing	WT-F-10	WT-F-10	WT-F-4	WT-F-4	WT-F-4	WT-F-4	WT-F-4
Port Isolation (dB, Typical)	30	30	30	30	30	30	30
RF Bandwidth (Min)	5%	5%	5%	5%	5%	5%	5%
Maximum Input Signal Level	+ 23 dBm				+ 20 dBm		
Temperature Range	0 to +50°C						

HOW TO ORDER

Specify Model Number: FSS – CO LO IF CL - XX ← Factory Reserve

RF Port Connector Type

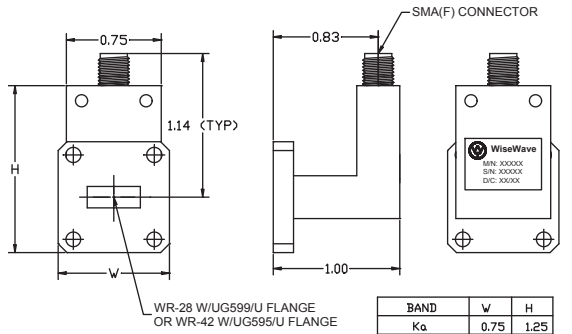
LO Center Frequency in GHz

Conversion Loss in dB

IF Bandwidth in 1/10 GHz

Example: To order a V band, 60 GHz single sideband modulator with 0.5 GHz IF frequency and 11.0 dB conversion loss, specify FSS-15600511-XX.

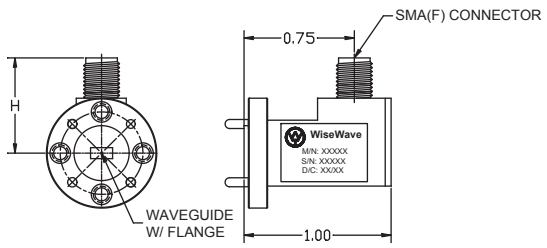
WT-F-1



BAND	W	H
Ka	0.75	1.25
K	0.88	1.33

Dimensions are in inches

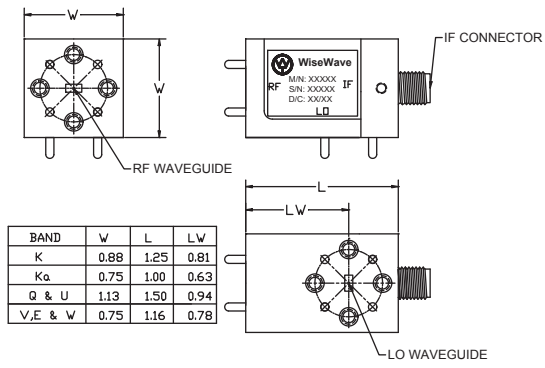
WT-F-2



BAND	Q & U	V,E & W
H	0.72	0.65

Dimensions are in inches

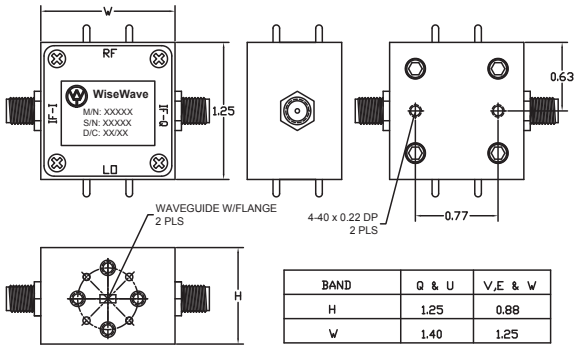
WT-F-3



BAND	W	L	LW
K	0.88	1.25	0.81
Ka	0.75	1.00	0.63
Q & U	1.13	1.50	0.94
V,E & W	0.75	1.16	0.78

Dimensions are in inches

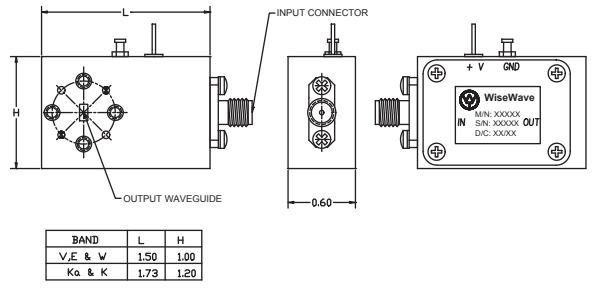
WT-F-4



BAND	Q & U	V,E & W
H	1.25	0.88
W	1.40	1.25

Dimensions are in inches

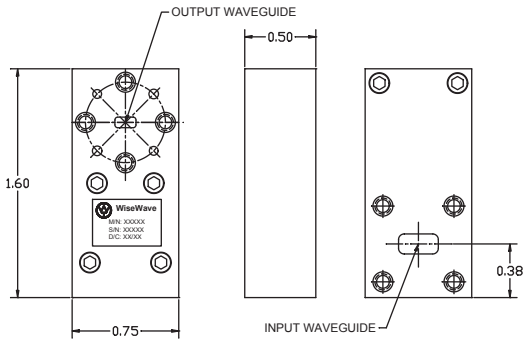
WT-F-5



BAND	L	H
V,E & W	1.50	1.00
Ka & K	1.73	1.20

Dimensions are in inches

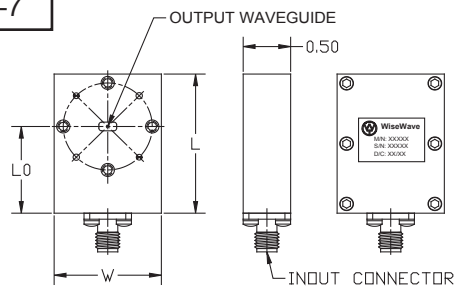
WT-F-6



Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

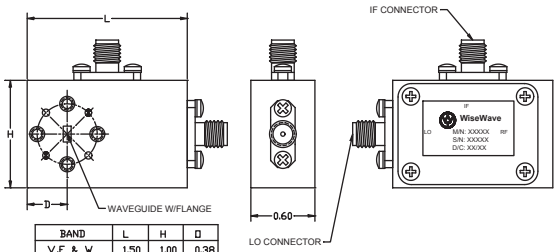
WT-F-7



BAND	K	Ka	Q & U	V, E, & W
L	1.70	1.40	1.50	1.20
LO	1.26	1.03	0.94	0.83
W	0.88	0.75	1.13	0.75

Dimensions are in inches

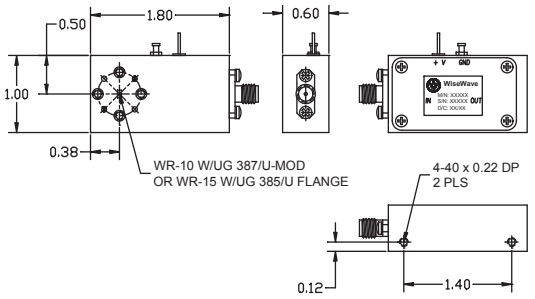
WT-F-8



BAND	L	H	D
V,E & W	1.50	1.00	0.38
U & Q	1.80	1.13	0.56
Ka & K	1.73	1.20	0.60

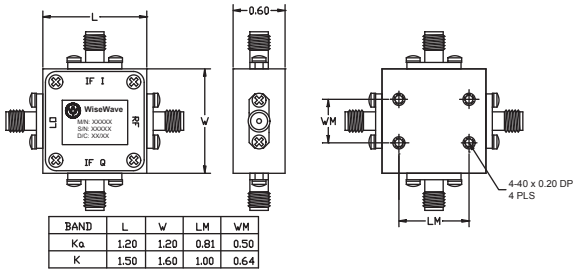
Dimensions are in inches

WT-F-9



Dimensions are in inches

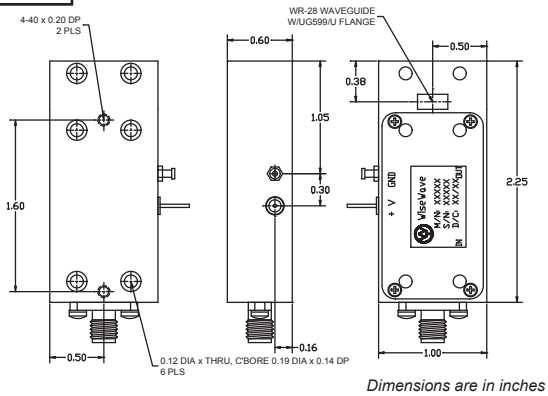
WT-F-10



BAND	L	W	LM	WM
Ka	1.20	1.20	0.81	0.50
K	1.50	1.60	1.00	0.64

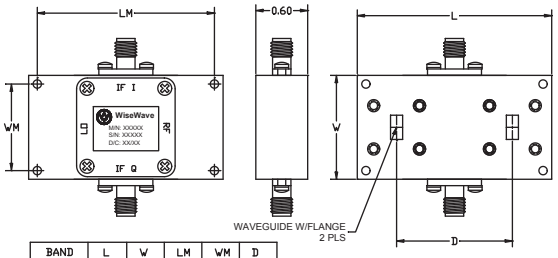
Dimensions are in inches

WT-F-11



Dimensions are in inches

WT-F-12

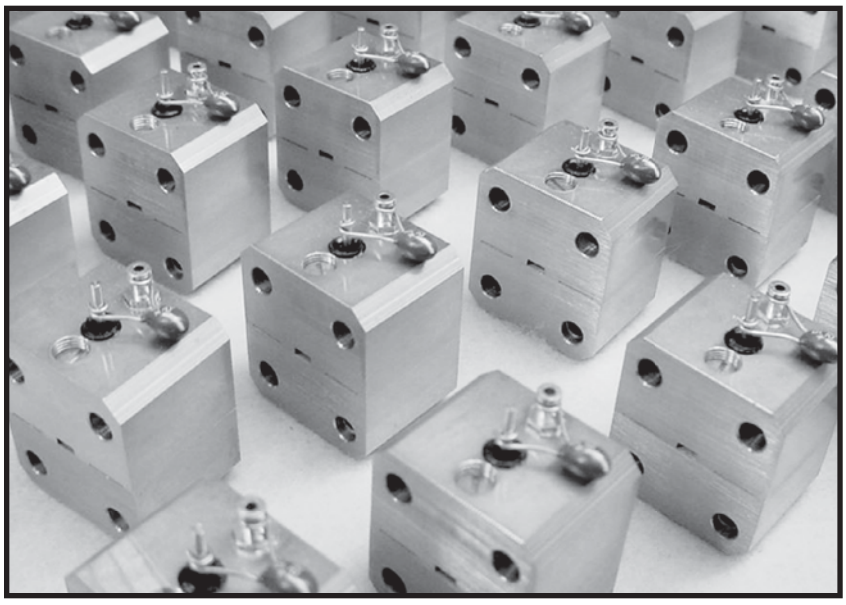


BAND	L	W	LM	WM	D
Ka	2.25	1.20	2.05	1.00	1.34
K	2.55	1.60	2.35	1.00	1.67

Dimensions are in inches

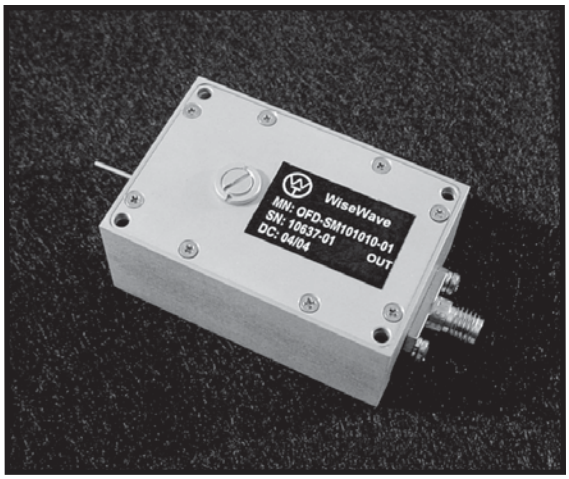
The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

5. Oscillators



FEATURES

- Internal voltage regulated
- Excellent frequency stability
- Low phase noise
- Low cost and reliable construction



OFD Series

APPLICATIONS

- Communication systems
- Radar systems
- Frequency reference
- Local oscillators

DESCRIPTION

OFD series dielectric resonator stabilized oscillators cover the frequency range of 5 to 26.5 GHz. The oscillators utilize state of the art MIC and FET devices technology to provide highly stable, reliable and clean signal sources. Each oscillator has an internal voltage regulator to provide regulated bias and over-voltage protection. An internal isolator may be integrated in to improve the anti-load pulling ability. Standard products incorporate a screw tuner with a reliable self-locking feature to provide small mechanical frequency tuning. SMA or K female coaxial connector is equipped for standard RF interface. The electrical tunable dielectric resonator oscillators are offered as non-standard units. Consult factory for technical information regarding this choice.

SPECIFICATIONS

Frequency Range	8.0 to 13.0 GHz	13.0 to 18.0 GHz	18.0 to 26.5 GHz
Output Power	13 to 23 dBm	13 to 23 dBm	13 to 23 dBm
Frequency Stability	+/-3 ppm/°C	+/-3 ppm/°C	+/-3 ppm/°C
Phase Noise (Typ)	-70 dBc/Hz @ 1KHz offset -80 dBc/Hz @ 10KHz offset -113 dBc/Hz @ 100KHz offset	-65dBc/Hz at 1KHz offset -75dBc/Hz at 10KHz offset -107dBc/Hz at 100KHz offset	-60dBc/Hz at 1KHz offset -70dBc/Hz at 10KHz offset -102dBc/Hz at 100KHz offset
Harmonic (Max)	-20 dBc	-20 dBc	-20 dBc
Spurious (Max)	-70 dBc	-60 dBc	-60 dBc
Bias (V/mA)	+12 Vdc / 50 to 150 mA	+12 Vdc / 100 to 200 mA	+12 Vdc / 100 to 200 mA
Outline Drawing	Consult Factory	Consult Factory	Consult Factory
Temperature	0 to +50 °C		

HOW TO ORDER

Specify Model Number

OFD - CO CF BW PP - XX ← Factory Reserve

RF Connector Type
Center Frequency in GHz
Output Power in dBm
Mechanical Tuning Range in MHz

Example: To order an DRO with SMA female connector, frequency output 18 GHz, mechanical tuning bandwidth 10 MHz and power output 16 dBm, specify OFD-SF181016-XX.

Low Cost K and Ka Band Gunn Diode Oscillators

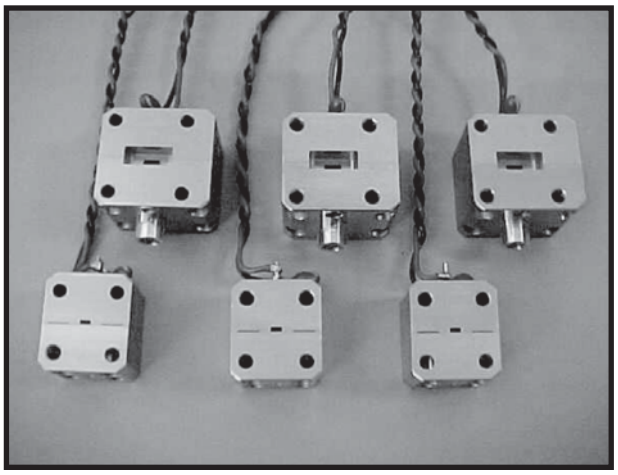
Bulletin No. OGL

FEATURES

- Fix or mechanically tuned
- Excellent frequency and power stability
- Extremely high external Q
- Very low phase noise
- Self locking tuning mechanism

APPLICATIONS

- Police speed radar guns
- Doppler sensors
- Transceivers



OGL Series

DESCRIPTION

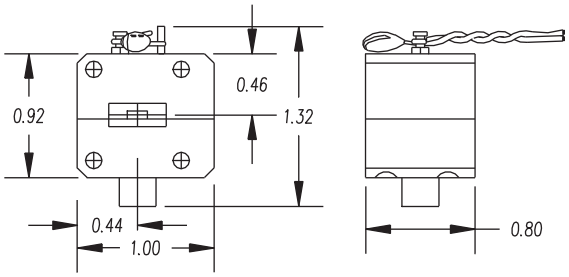
OGL series K and Ka band Gunn diode oscillators are especially designed for low cost commercial applications. Unlike most manufacturers' products, these oscillators are made of high performance devices and machined aluminum cavities. Due to extremely high external Q and temperature compensation mechanism, these oscillators exhibit higher frequency and power stability, lower phase noise and higher anti-load-pulling abilities. The oscillators are ideal candidates for the applications such as Police Speed Radar Gun and Doppler Sensors, where low close-in phase noise and high frequency stability are required.

SPECIFICATIONS

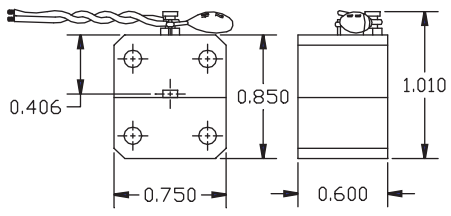
Typical Specifications	
K Band (Model No.: OGL-42240110-31)	Ka Band (Model No.: OGL-28350110-32)
Center frequency: 24.125 GHz Power Output: +10 dBm (minimum) Mechanical tuning range: ± 500 MHz (minimum) ΔF/ΔT: -0.20 MHz/°C (maximum, -40 to +85°C) ΔP/ΔT: -0.03 dB/°C (maximum, -40 to +85°C) Phase noise: -98 dBc/Hz @ 100 KHz offset Bias: 5.5V/250 mA (Typical) Flange: UG595/U (through holes, 4-40) Temperature Range: -40 to +85°C	Center frequency: 35.000 GHz Power Output: +10 dBm (minimum) Mechanical tuning range: ± 500 MHz (minimum) ΔF/ΔT: -0.40 MHz/°C (maximum, -40 to +85°C) ΔP/ΔT: -0.04 dB/°C (maximum, -40 to +85°C) Phase noise: -95 dBc/Hz @ 100 KHz offset Bias: 5.5V/350 mA (Typical) Flange: UG599/U (through holes, 4-40) Temperature Range: -40 to +85°C

OUTLINE

K Band (Outline: WT-G-A1)



Ka Band (Outline: WT-G-A2)

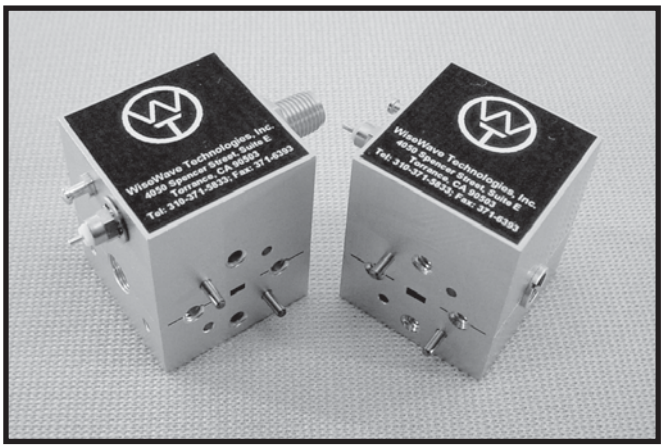


FEATURES

- High output power
- Wide bias tuning range
- Up to 2 MHz tuning rate
- Excellent frequency stability
- Low AM and FM noise

APPLICATIONS

- Test benches
- Local oscillators
- Multiplier drivers
- Subsystems



OGB Series

DESCRIPTION

OGB series bias tuned Gunn oscillators combine proprietary circuit design capability and experience with either GaAs or InP Gunn diode to cover the frequency range of 18 to 150 GHz in nine waveguide bands. The oscillators are especially designed for high output power, fast bias tuning ability and low AM/FM noise characteristics. The standard models are equipped with feedthru pin for bias port, while a SMA(F) connector can be specified at the time of order for better EM shielding. The oscillators can be supplied with optional integrated isolator, **OMR** Gunn oscillator modulator/regulator and temperature heater. Combined with the **OMR** Gunn oscillator modulator/regulator, the bias-tuning characteristic of the oscillator can be enhanced without additional circuitry. The benefit of utilizing bias tuned Gunn oscillator includes better linearity and higher power output compared with its counter part, Varactor Tuned Gunn oscillator (**OGV**). While waveguide is the standard interface, the oscillators are available with coaxial interface as an option. The operating temperature range of the standard unit is 0 to +50°C.

SPECIFICATIONS

Range (GHz)	Output Power (dBm)	Bias Tuning Bandwidth (MHz/V)	Bias Voltage Range (Volts)	Bias Current Range (A)	Waveguide size	Frequency Stability (MHz/ºC)	Power Stability (dB/ºC)	Outline Drwing
18-26.5	10-27	10-50	4-12	0.2-2.5	WR-42	-2.0	-0.02	WT-G-1
26.5-40	10-26	10-50	4-12	0.3-2.5	WR-28	-2.5	-0.02	WT-G-1
33-50	10-25	10-200	4-11	0.3-2.0	WR-22	-3.0	-0.03	WT-G-1
40-60	10-24	10-200	3-10	0.3-2.0	WR-19	-4.0	-0.03	WT-G-1
50-75	10-23	100-1000	3-10	0.3-1.0	WR-15	-4.5	-0.03	WT-G-1
60-90	10-20	100-1000	3-10	0.25-1.0	WR-12	-5.0	-0.03	WT-G-1
75-110	10-20	100-1000	4-10	0.25-1.0	WR-10	-6.0	-0.03	WT-G-1
90-140	10-15	100-400	4-10	0.25-1.0	WR-8	-7.0	-0.04	WT-G-1
110-150	5-13	100-400	4-10	0.25-1.0	WR-6	-8.0	-0.04	WT-G-1
Temperature Range		0 to +50 °C						

HOW TO ORDER

Specify Model Number

OGB-CO CF BW PP - XX ← Factory Reserve

RF Connector Type

Center Frequency in GHz

Output Power in dBm

Bandwidth in 1/10 GHz

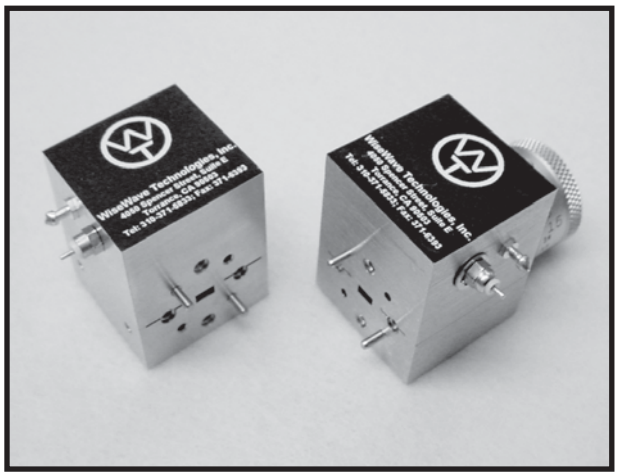
Example: To order a center frequency 94 GHz bias tuned Gunn oscillator with WR-10 waveguide interface, 0.5 GHz tuning bandwidth 17 dBm output power, specify OGM-10940517-XX.

FEATURES

- High output power
- Wide mechanical tuning range
- Bias tuning ability
- Excellent frequency stability
- Low AM and FM noise

APPLICATIONS

- Test benches
- Local oscillators
- Multiplier drivers
- Subsystems



OGM Series

DESCRIPTION

OGM series mechanically tuned Gunn oscillators combine proprietary circuit design capability and experience with either GaAs or InP Gunn diode to cover the frequency range of 18 to 150 GHz in nine waveguide bands. The oscillators are especially designed for high output power, wide mechanical tuning range, bias tuning ability and low AM/FM noise characteristics. The standard oscillators are equipped with a self-locking screw for system integration, while a micrometer driver can be provided instead of a self-locking screw to enhance convenient frequency tuning and reliable frequency resetting. The models with micrometer driver are ideally suited for bench test sources. The oscillators can be supplied with optional integrated isolator, voltage regulator and temperature heater. While waveguide is standard interface, the oscillators are available with coaxial interface as an option. The operating temperature range of the standard unit is 0 to +50°C.

SPECIFICATIONS

Frequency Range (GHz)	Output Power (dBm)	Mechanical Tuning Range (GHz)	Bias Voltage Range (Volts)	Bias Current Range (A)	Waveguide size	Frequency Stability (MHz/°C)	Power Stability (dB/°C)	Outline Drawing
18-26.5	10-27	0.05-6	4-12	0.2-2.5	WR-42	-2.0	-0.02	WT-G-1,2
26.5-40	10-26	0.05-10	4-12	0.3-2.5	WR-28	-2.5	-0.02	WT-G-1,2,4
33-50	10-25	0.0510	4-11	0.3-2.0	WR-22	-3.0	-0.03	WT-G-1,2,3
40-60	10-24	0.05-12	3-10	0.3-2.0	WR-19	-4.0	-0.03	WT-G-1,2,3
50-75	10-23	0.05-20	3-10	0.3-1.5	WR-15	-4.5	-0.03	WT-G-1,2,3,6
60-90	10-20	0.05-20	3-10	0.25-1.5	WR-12	-5.0	-0.03	WT-G-1,2,3,6
75-110	10-19	0.05-20	4-10	0.25-1.5	WR-10	-6.0	-0.03	WT-G-1,2,3,6
90-140	10-15	0.05-20	4-10	0.25-1.5	WR-8	-7.0	-0.04	WT-G-1,2,3,6
110-150	5-13	0.05-4	4-10	0.25-1.5	WR-6	-8.0	-0.04	WT-G-1,2,3
Temperature Range		0 to +50 °C						

HOW TO ORDER

Specify Model Number

OGM-CO CF BW PP - XX ← Factory Reserve

- CO: RF Connector Type
- CF: Center Frequency in GHz
- BW: Bandwidth in GHz
- PP: Output Power in dBm

Example: To order a center frequency 60 GHz mechanically tuned Gunn oscillator with WR-15 waveguide interface, 4 GHz tuning bandwidth 17 dBm output power, specify OGM-15600417-XX.

Full Band Mechanically Tuned Gunn Oscillators

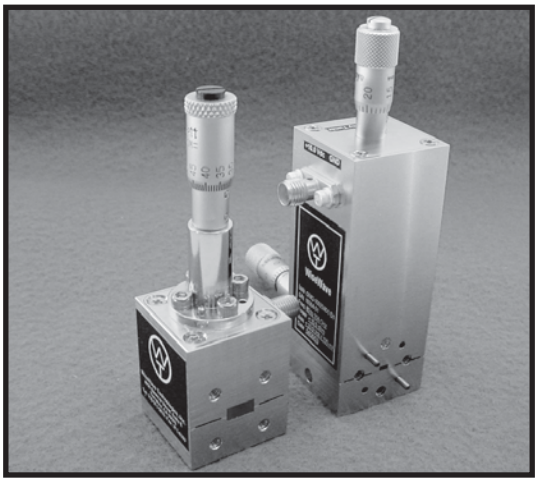
Bulletin No. OGF

FEATURES

- Up to full waveguide band coverage
- Single mechanical tuner
- Bias tuning ability
- High output power
- Excellent frequency and power stability
- Low AM and FM noise

APPLICATIONS

- Test sources
- Local oscillators
- EW systems
- Radio astronomy systems
- Frequency extender drivers



OGF Series

DESCRIPTION

OGF series Gunn oscillators are **near full waveguide band** mechanically tuned Gunn oscillators. The oscillators combine proprietary circuit design capability and experience with either GaAs or InP Gunn diode to cover the frequency range of 18 to 110 GHz in seven waveguide bands. The oscillators are especially designed for high output power, full waveguide band mechanical tuning range, bias tuning ability and low AM/FM noise characteristics. The standard oscillators are equipped with a micrometer driver, which enables convenient frequency tuning and reliable frequency resetting. Unlike many other competitors' products, these oscillators are equipped with a single mechanical tuner, which eases frequency and power control. The oscillator can be converted to an electrical/mechanical-tuned oscillator by replacing micrometer with an electrical driven motor.

The oscillators are ideally suited for test sources, local oscillators of EM and radio astronomy systems and frequency extender drivers. The oscillators can be supplied with optional integrated isolator, voltage regulator and temperature heater. While waveguide is standard interface, the oscillators are available with coaxial interface up to U band as an option.

Combined with **OMR** Gunn modulator/regulator (Bulletin number OMR), **OGF** series Gunn oscillators can produce AM or FM modulated signals with internal or external modulation capability. The operating temperature range of the standard unit is 0 to +50°C.

SPECIFICATIONS

Model Number	Frequency (GHz)	Output Power (dBm, Typ.)	Tuning (GHz, Typ.)	Bias Voltage (Volts, Typ.)	Bias Current (Amp, Typ.)	Waveguide Size	Outline Drawing
OGF-4220-01	18-26.5	+20	6.0	7	1.5	WR-42	1
OGF-2820-01	26.5-40	+20	10.0	5	1.5	WR-28	WT-G-4
OGF-2210-01	33-50	+8	10.0	5	1.5	WR-22	WT-G-2
OGF-1910-01	40-60	+8	12.0	5	1.5	WR-19	WT-G-2
OGF-1507-01	50-75	+7	Full Band	5	1.5	WR-15	1
OGF-1205-01	60-90	+5	Full Band	5	1.5	WR-12	1
OGF-1003-01	75-110	+3	Full Band	5	1.5	WR-10	1
Temperature Range		0 to +50 °C					

Note:

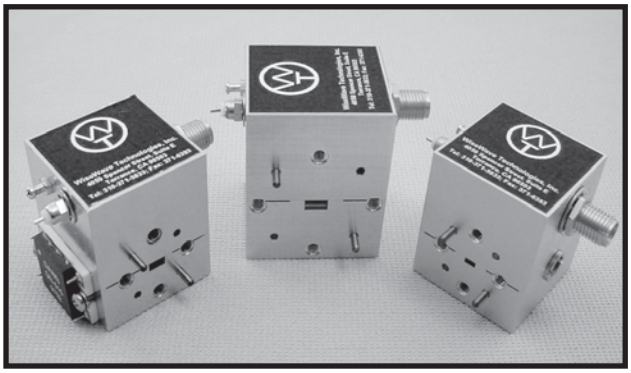
1. Consult factory for outline drawings;
2. Specifications are subject to change without notice.

FEATURES

- High output power
- Wide varactor tuning range
- Mechanical tuning ability
- Excellent frequency stability
- Low AM and FM noise

APPLICATIONS

- FMCW transceivers
- Phase locked oscillators
- AFC loops



OGV Series

DESCRIPTION

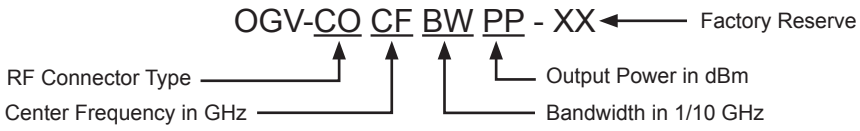
OGV series varactor tuned Gunn oscillators combine proprietary circuit design capability and experience with either GaAs or InP Gunn diode to cover the frequency range of 18 to 110 GHz in seven waveguide bands. The oscillators are especially designed for high output power, wide varactor tuning range, mechanical tuning ability and low AM/FM noise characteristics. The DC power is applied via a low pass EMI filter, while a female SMA connector is utilized for the varactor tuning voltage. The tuning rate can be as high as 50 MHz. The oscillators are ideally suited for FMCW transceivers, AFC loops and phase locked systems. The oscillators can be supplied with an optional integrated isolator, voltage regulator and temperature heater. While waveguide is standard interface, the oscillators are available with coaxial interface as an option. The operating temperature range is 0 to +50°C.

SPECIFICATIONS

Frequency Range (GHz)	Output Power (dBm)	Varactor Tuning Range (GHz)	Bias Voltage Range (Volts)	Bias Current Range (A)	Waveguide size	Frequency Stability (MHz/ºC)	Power Stability (dB/ºC)	Outline Drawing
18-26.5	10-25	0.05-0.25	4-12	0.2-2.5	W R-42	-2.0	-0.03	W T-G-5
26.5-40	10-24	0.05-0.50	4-12	0.3-2.5	W R-28	-2.5	-0.03	W T-G-5
33-50	10-23	0.05-0.50	4-11	0.3-2.0	W R-22	-3.0	-0.03	W T-G-5
40-60	10-22	0.05-0.50	3-10	0.3-2.0	W R-19	-4.0	-0.04	W T-G-5
50-75	10-21	0.05-0.50	3-10	0.3-1.5	W R-15	-4.5	-0.04	W T-G-5
60-90	10-19	0.05-0.50	3-10	0.25-1.5	W R-12	-5.0	-0.04	W T-G-5
75-110	10-17	0.05-0.50	4-10	0.25-1.5	W R-10	-6.0	-0.04	W T-G-5
Temperature Range		0 to +50 °C						

HOW TO ORDER

Specify Model Number



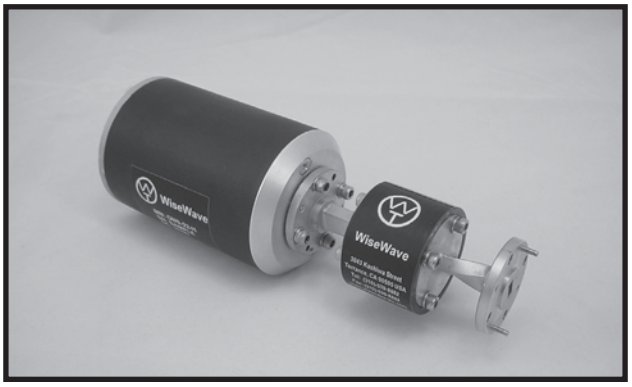
Example: To order a center frequency 35 GHz varactor tuned Gunn oscillator with WR-28 waveguide interface, 0.2 GHz tuning bandwidth and 17 dBm output power, specify OGV-28350217-XX.

FEATURES

- Solid state noise source
- Full waveguide band
- High ENR with good flatness
- High stability
- Compatible with Agilent noise test set
- Compact size

APPLICATIONS

- Calibration source
- Noise figure measurement
- Test instrument



ONS Series

DESCRIPTION

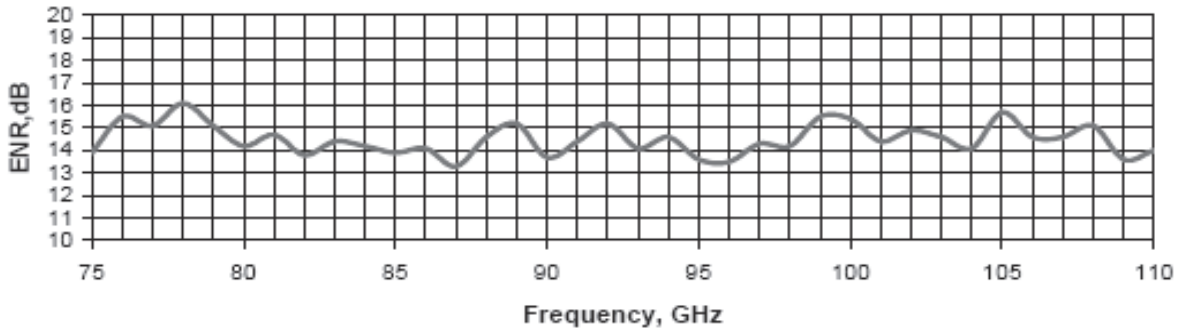
The **ONS** Series of solid state noise sources cover **full waveguide bands**. The noise sources offered cover the frequency range of 26.5 to 170 GHz in eight overlapping waveguide bands. The noise sources utilize a silicon IMPATT diode to provide a stable 15 dB typical ENR. The bias voltage and current for the noise source are +28 Vdc at 60 mA typical, which is compatible with the Agilent 8970A/B noise meters.

The standard noise sources are supplied with a full band Faraday isolator. While waveguide is the standard interface, the noise sources are also available with a coaxial interface by using the appropriate WiseWave PTC series waveguide to coax adapter up to 110 GHz.

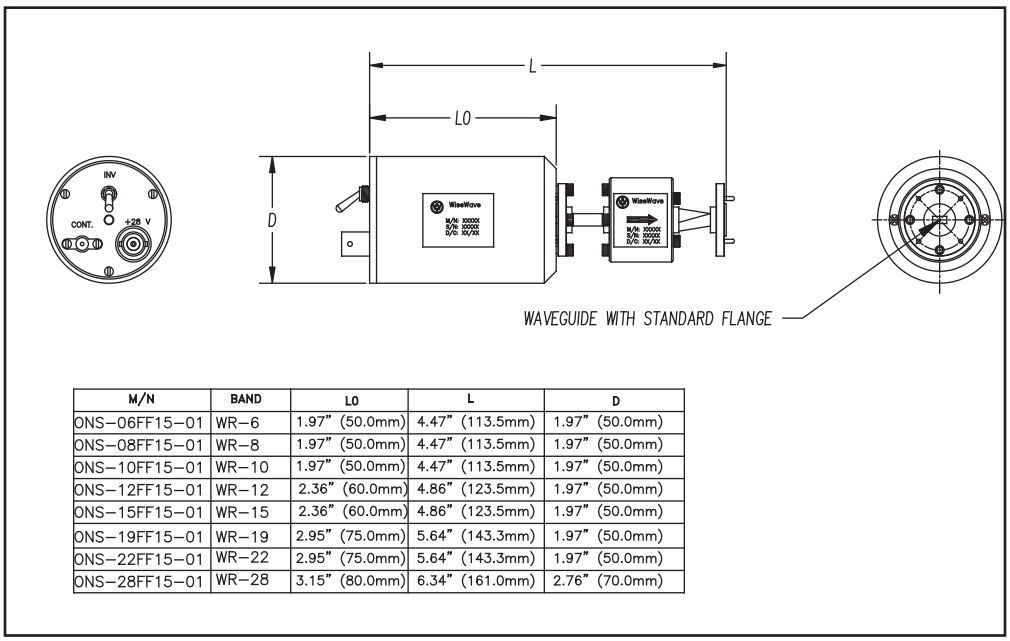
SPECIFICATIONS

Model Number	Frequency (GHz)	ENR (dB, Typ)	Flatness (dB, Typ)	Bias Voltage (volts, Typ)	Bias Current (mA, Typ)	Waveguide Flange
ONS-28FF15-I1	26.5-40	15	±1.0	+28	60	WR-28, UG599/U
ONS-22FF14-I1	33-50	14	±1.5	+28	60	WR-22, UG383/U
ONS-19FF13- I1	40-60	13	±1.5	+28	60	WR-19, UG383/U Mod
ONS-15FF13- I1	50-75	13	±1.5	+28	60	WR-15, UG385/U
ONS-12FF13- I1	60-90	13	±1.5	+28	60	WR-12, UG387/U
ONS-10FF12- I1	75-110	12	±1.5	+28	60	WR-10, UG387/U Mod
ONS-08FF12- I1	90 to 140	12	±1.5	+28	60	WR-08, UG387/U Mod
ONS-06FF12- I1	110- to 170	12	±2.0	+28	60	WR-06, UG387/U Mod

Representative ENR (The ENR shown is without FFF-10-01 isolator)



OUTLINE DRAWING



M/N	BAND	LO	L	D
ONS-06FF15-01	WR-6	1.97" (50.0mm)	4.47" (113.5mm)	1.97" (50.0mm)
ONS-08FF15-01	WR-8	1.97" (50.0mm)	4.47" (113.5mm)	1.97" (50.0mm)
ONS-10FF15-01	WR-10	1.97" (50.0mm)	4.47" (113.5mm)	1.97" (50.0mm)
ONS-12FF15-01	WR-12	2.36" (60.0mm)	4.86" (123.5mm)	1.97" (50.0mm)
ONS-15FF15-01	WR-15	2.36" (60.0mm)	4.86" (123.5mm)	1.97" (50.0mm)
ONS-19FF15-01	WR-19	2.95" (75.0mm)	5.64" (143.3mm)	1.97" (50.0mm)
ONS-22FF15-01	WR-22	2.95" (75.0mm)	5.64" (143.3mm)	1.97" (50.0mm)
ONS-28FF15-01	WR-28	3.15" (80.0mm)	6.34" (161.0mm)	2.76" (70.0mm)

FEATURES

- Low noise
- Internal and external AM/FM modulation
- External modulation rate up to 1 MHz
- Phase locking capability
- Over voltage protection

APPLICATIONS

- Regulator for test bench Gunn oscillators
- Modulator for test bench Gunn oscillators
- Phase lock Gunn oscillator to frequency counters
- Subsystems and instruments

OGR & OMR Series

DESCRIPTION

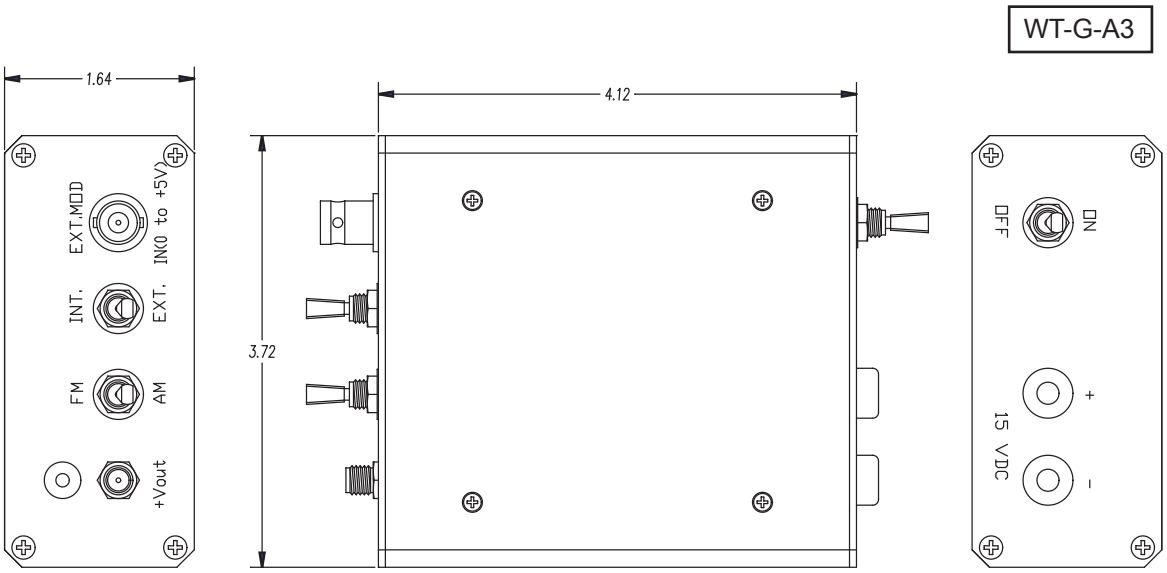
OGR and OMR series Gunn oscillator bias regulator and regulator/modulator are developed as a low noise DC regulator/modulator for Gunn diode oscillators. The **OGR** regulator and **OMR** regulator/modulator supplies well regulated, low noise DC voltage to Gunn oscillators. This feature enhances Gunn oscillator signal purity and also provides protection against destructive over-voltage to the Gunn diode. The **OMR** regulator/modulator features internal or external AM or FM modulation capabilities. The internal modulation rate is 1 KHz and external modulation rate is from DC and up to 1 MHz. This feature allows phase locking the Gunn oscillator to a microwave source-locking counter via bias voltage.

SPECIFICATIONS

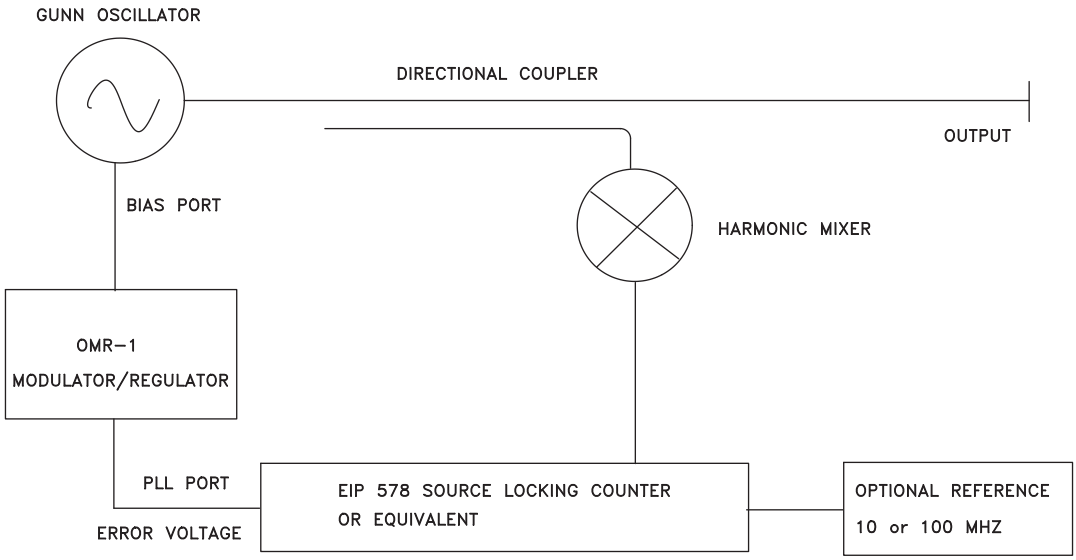
Model Number:	OGR-1
Input Voltage (V)	+15.0 (Typical)
Output Voltage Range (V)	+2.0 to +12.0 (Typical)
Output Current (mA)	0 to 2,000 (Typical)
Noise and Ripple (MV, rms)	100 (Typical)
Dimensions (L" x W" x H")	4.2 X 3.8 X 1.7 (Typical)
Connectors	DC Input: Post; DC Output: SMA(F)

Model Number:	OMR-1
Input Voltage (V)	+15.0 (Typical)
Output Voltage Range (V)	+2.0 to +12.0 (Typical)
Output Current (mA)	0 to 2,000 (Typical)
Noise and Ripple (MV, rms)	1.0 (Typical)
Internal Modulation Rate (KHz)	1.0 (Typical)
External Modulation Rate (KHz)	0 to 1,000 (Max)
External Modulation Amplitude (V)	0 to +5 V
Phase Locking Feature	Yes. Use with EIP Source-Locking Counters, Model # 575 and 578.
Dimensions (L" x W" x H")	4.2 X 3.8 X 1.7 (Typical)
Connectors	DC Input: Post; DC Output: SMA(F); Modulation Input: BNC (F); Phase Locking Input: BNC (F)

OMR Modulator Outline and Port Designation



Phase Lock Application Block Diagram



Injection Locked Gunn Diode Oscillators

Bulletin No. OGI

FEATURES

- High output power
- Moderate gain and bandwidth
- CW operation
- Frequency up to 110 GHz

APPLICATIONS

- Power amplification
- Local oscillators
- Multiplier drivers
- Subsystems

OGI Series

DESCRIPTION

OGI series CW injection-locked Gunn oscillators are alternatives to HEMT device and IMPATT diode based stable amplifiers, especially at high millimeterwave frequencies. The operating frequency and power output of these oscillators are up to 110 GHz and 24 dBm. The spectrum purity of the output signal is injected signal dependent. There is an output free running signal in the absence of an input injection signal. The oscillators are provided with integral circulators and optional DC voltage regulator. An optional heater is provided to achieve better temperature stability. For higher gain, broader locking bandwidth and higher output, multi-stage and multi-diodes configurations are used. The operating temperature range is 0 to +50°C.

SPECIFICATIONS

Frequency Range (GHz)	Input Power (dBm)	Output Power (dBm, Min)	Locking Bandwidth (GHz, Max)	Bias Voltage Range (Volts)	Bias Current Range (A)	Waveguide Size	Outline Drawing
26.5-40	0 to 10	24	1.5	4-12	0.3-2.5	WR-28	*
33-50	0 to 10	23	2.0	4-11	0.3-2.0	WR-22	*
40-60	0 to 10	22	2.0	3-10	0.3-2.0	WR-19	*
50-75	0 to 10	20	2.0	3-10	0.3-1.5	WR-15	*
60-90	0 to 10	19	2.0	3-10	0.25-1.5	WR-12	*
75-110	0 to 10	19	2.0	4-10	0.25-1.5	WR-10	*
Temperature Range		0 to +50 °C					

* Consult factory for outlines.

HOW TO ORDER

Specify Model Number

OGI-CO CF BW PP - XX ← Factory Reserve

RF Connector Type

Center Frequency in GHz

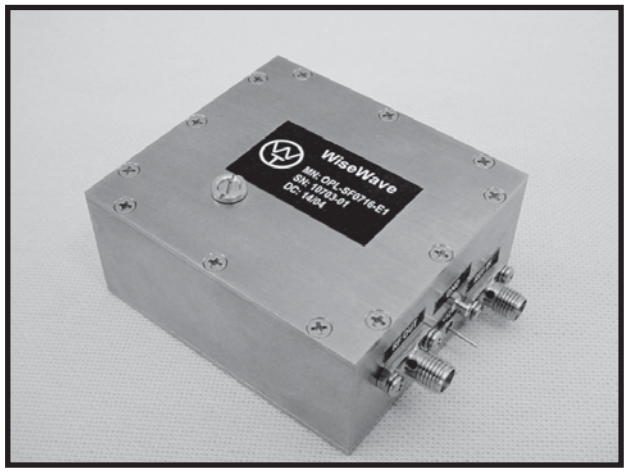
Output Power in dBm

Bandwidth in 1/10 GHz

Example: To order a center frequency 60 GHz injection locked Gunn oscillator with WR-15 waveguide interface, 2 GHz locking bandwidth and 17 dBm output power, specify OGI-15602017-XX.

FEATURES

- High output power
- Low phase noise
- Internal or external reference
- Frequency up to 110 GHz



OPL Series

APPLICATIONS

- Instrumentation
- Local oscillators
- Subsystems

DESCRIPTION

OPL series phase-locked oscillators are offered to cover frequency range up to 110 GHz by utilizing high performance FET oscillators, Gunn oscillators or multiplier/amplifier chain to produce desired frequency and power output. The phase locked oscillators are offered with either internal or external referenced version. The phase noise of an externally referenced phase locked oscillator is depended on the quality of the reference signal.

SPECIFICATIONS

FREQUENCY RANGE[1]	5 to 40 GHz	40 to 60 GHz	60 to 110 GHz
Output Power	10 to 30 dBm	10 to 20 dBm	10 to 20 dBm
Frequency Stability[2]	±5 PPM		
Phase Noise (Typ)	Consult Factory		
Harmonics (Max)	- 20 dBc		
Spurious (Max)	- 60 dBc		
External Reference[3]	100 MHz, - 3 to + 3 dBm		
Lock Alarm	Locked = TTL High; Unlocked = TTL Low		
Temperature Range	0 to +50°C		

Note:

1. Consult factory for the frequency other than listed;
2. Frequency stability is with internal reference;
3. 100 MHz external reference is for standard model. Consult factory for the frequency other than 100 MHz.

HOW TO ORDER

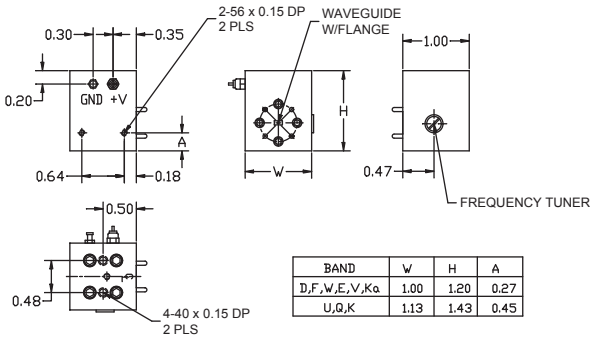
Specify Model Number

OPL-CO CF PP X – Y Z ← Factory Reserve

- CO: RF Port Connector Type
- CF: Center Frequency in GHz
- PP: Output Power in dBm
- X: Factory Reserve
- Y: "E" for External; "I" for Internal Reference
- Z: Factory Reserve

Example: To order an output frequency 94 GHz, 17 dBm output power phase locked oscillator with WR-10 waveguide interface and externally referenced specify OPL-109417X-EZ.

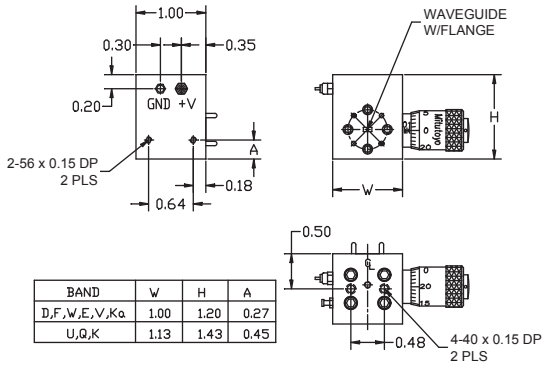
WT-G-1



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

Dimensions are in inches

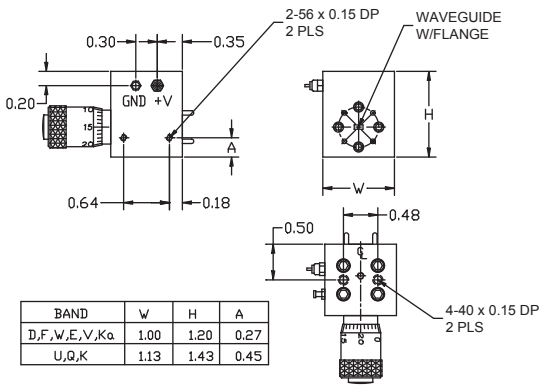
WT-G-2



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

Dimensions are in inches

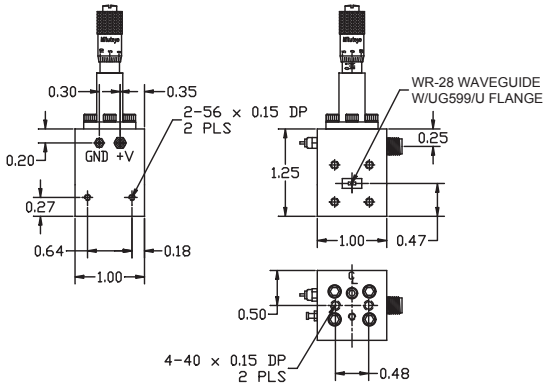
WT-G-3



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

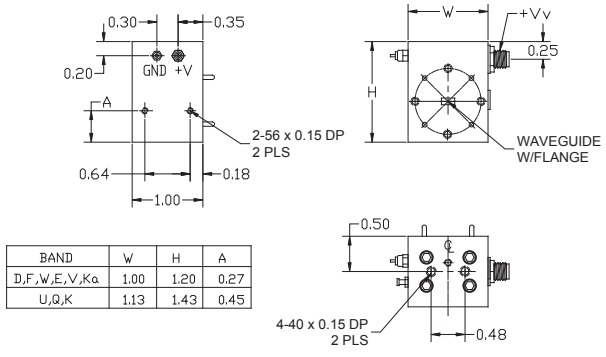
Dimensions are in inches

WT-G-4



Dimensions are in inches

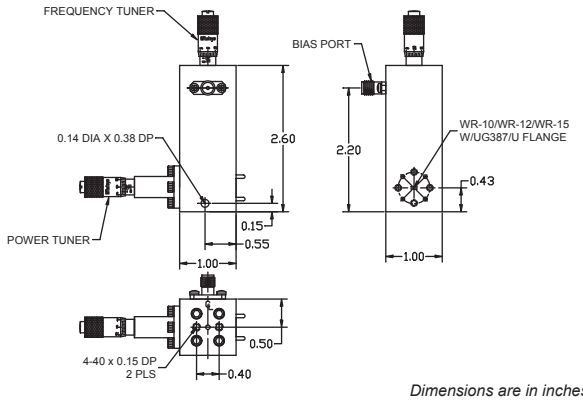
WT-G-5



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

Dimensions are in inches

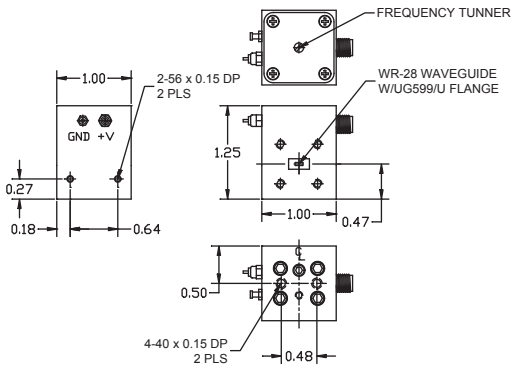
WT-G-6



Dimensions are in inches

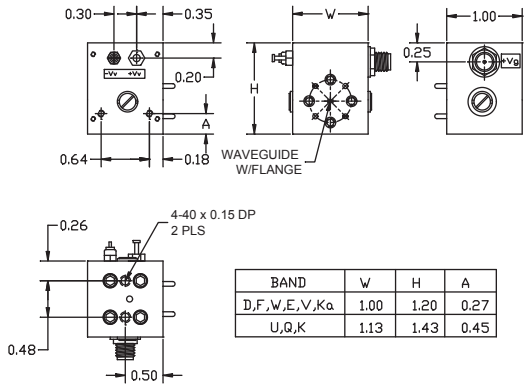
The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

WT-G-7



Dimensions are in inches

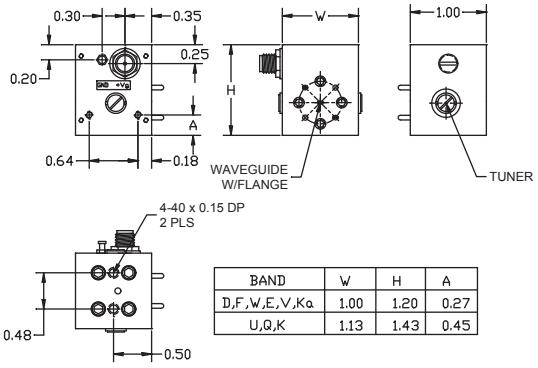
WT-G-8



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

Dimensions are in inches

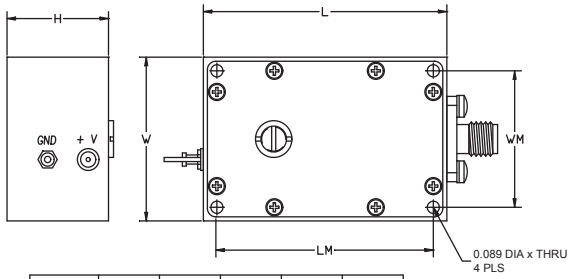
WT-G-9



BAND	W	H	A
D,F,W,E,V,Ka	1.00	1.20	0.27
U,Q,K	1.13	1.43	0.45

Dimensions are in inches

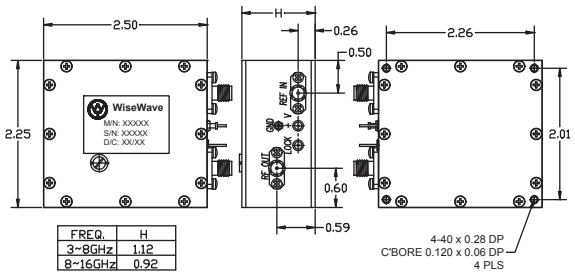
WT-G-10



FREQ.	L	W	LM	WM	H
8~13GHz	1.80	1.20	1.60	1.00	0.75
13~18GHz	1.50	1.00	1.30	0.80	0.60

Dimensions are in inches

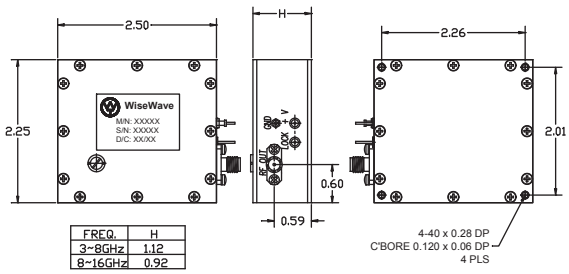
WT-G-11



FREQ.	H
3~8GHz	1.12
8~16GHz	0.92

Dimensions are in inches

WT-G-12

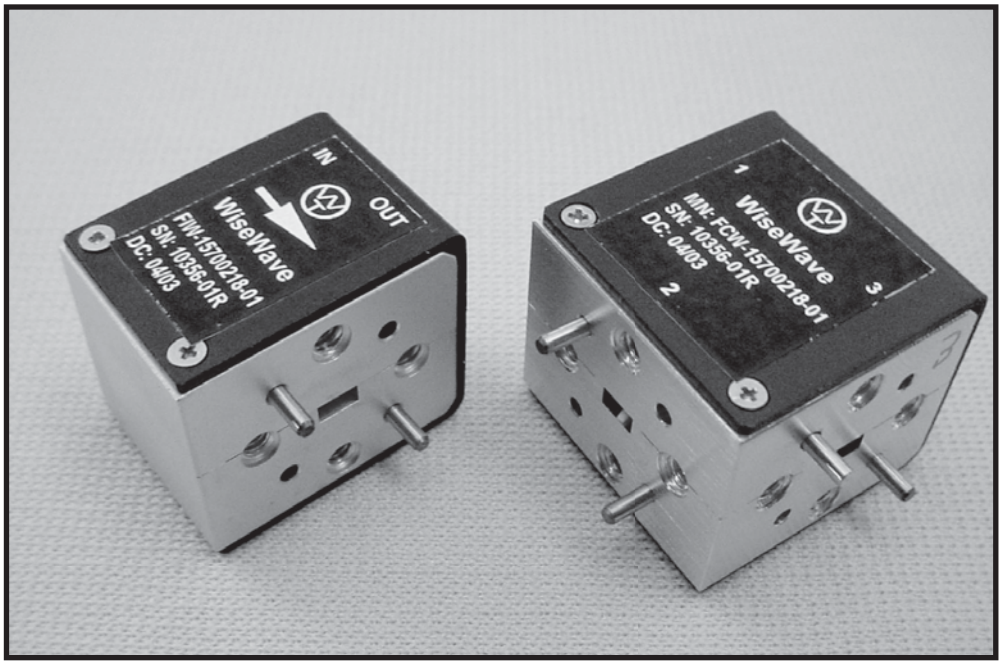


FREQ.	H
3~8GHz	1.12
8~16GHz	0.92

Dimensions are in inches

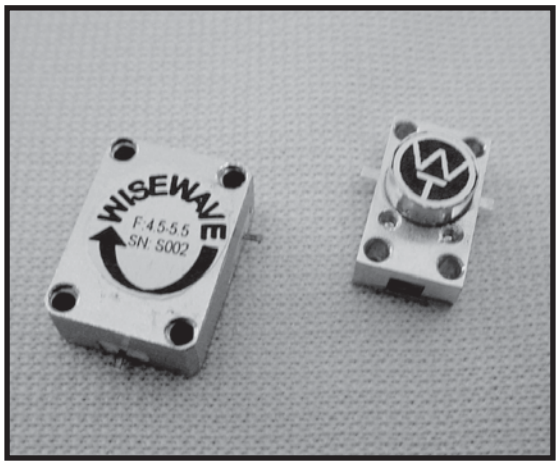
The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

6. Ferrite Devices



FEATURES

- Low cost, high quality
- Compact size, light weight
- High performance
- Wide operation temperature range
- Common Radar and wireless bands



FID & FCD Series

APPLICATIONS

- Ports isolation
- Module integration
- Transceiver subsystems

DESCRIPTION

FID and FCD series narrow band drop-in isolators and circulators cover common Radar and wireless communication frequency bands up to 20 GHz. The isolator is an ideal device where the port isolation is required, while the circulator is commonly used as a duplexer for transceiver subsystems where the transmitter and receiver ports share a single antenna port. They are often used in amplifiers, oscillators, integrated modules and transceiver subsystems. The low cost **FID** and **FCD** series isolators and circulators offer very compact sizes that can be easily inserted into the sub-assembly with minimum size increase. While the standard specifications are shown below, the custom ones with wider bandwidth and higher isolation are available.

SPECIFICATIONS

Frequency Range (GHz)	0.8 to 1.2		1.2 to 2.4		2.0 to 3.5		3.5 to 5.0		5.0 to 8.0		8.0 to 18.0	
Bandwidth (MHz min)	25	70	70	200	200	400	300	500	100	600	300	1000
Isolation (dB min)	23	20	23	20	23	20	23	20	20	20	23	20
Insertion Loss (dB max)	0.3	0.4	0.3	0.4	0.3	0.5	0.3	0.4	0.3	0.4	0.4	0.4
VSWR (max)	1.20	1.25	1.20	1.25	1.20	1.25	1.20	1.25	1.25	1.25	1.20	1.25
Power Handling (W, min)	60		10		10		10		10		10	
Outline Drawings	WT-D-1 and/or WT-D-2											
Temperature Range	0 to +50°C											

HOW TO ORDER

Specify Model Number

FXD - CF BW IL IS - XX ← Factory Reserve

- I = Isolator, C = Circulator → CF
- Center Frequency in GHz → CF
- Bandwidth in 1/10 GHz → BW
- Insertion Loss in 1/10dB → IL
- Isolation in dB → IS

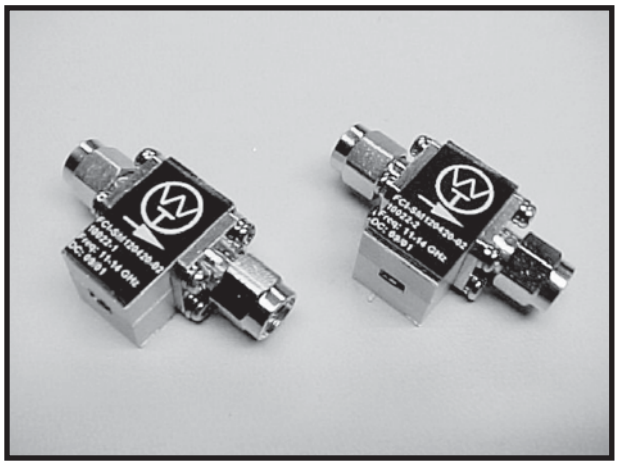
Example: To order a center frequency 4.0 GHz isolator with 0.3 GHz bandwidth, 0.3 dB maximum insertion loss and 30 dBminimum isolation, specify FID-04030330-XX.

FEATURES

- Low cost, high quality
- Compact size, light weight
- High performance
- Wide operation temperature range
- Common Radar and wireless bands

APPLICATIONS

- Ports isolation
- Module integration
- Transceiver subsystems



FIC & FCC Series

DESCRIPTION

FIC and FCC series narrow band connectorized isolators and circulators cover common Radar and wireless communication frequency bands up to 20 GHz. The isolator is an ideal device where the port isolation is required, while the circulator is commonly used as a duplexer for transceiver subsystems where the transmitter and receiver ports share a single antenna port. The connectorized isolators and circulators equipped with either SMA(F) or SMA(M) connectors for ease connections. The low cost **FIC** and **FCC** series isolators and circulators offer very compact sizes that can be easily inserted into the sub-assembly with minimum size increase. While the standard specifications are shown below, the custom ones with wider bandwidth and higher isolation are available.

SPECIFICATIONS

Frequency Range (GHz)	0.8 to 1.2		1.2 to 2.4		2.0 to 3.5		3.5 to 5.0		5.0 to 8.0		8.0 to 18.0	
Bandwidth (MHz min)	25	70	70	200	200	400	300	500	100	600	300	1000
Isolation (dB min)	23	20	23	20	23	20	23	20	20	20	23	20
Insertion Loss (dB max)	0.3	0.4	0.3	0.4	0.3	0.5	0.3	0.4	0.3	0.4	0.4	0.4
VSWR (max)	1.20	1.25	1.20	1.25	1.20	1.25	1.20	1.25	1.25	1.25	1.20	1.25
Power Handling (W, min)	60		10		10		10		10		10	
Outline Drawings	WT-D-3 and/or WT-D-4											
Temperature Range	0 to +50°C											

HOW TO ORDER

Specify Model Number

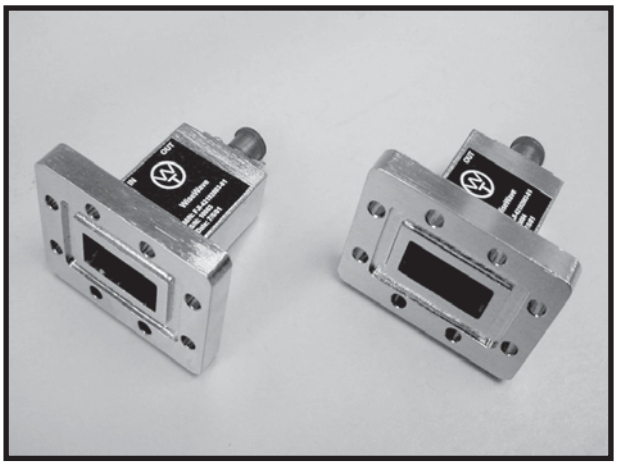
FXC - CF BW IL IS - XX ← Factory Reserve

- I = Isolator, C = Circulator
- Center Frequency in GHz
- Bandwidth in 1/10 GHz
- Insertion Loss in 1/10 dB
- Isolation in dB

Example: To order a center frequency 18 GHz circulator with 1.0 GHz bandwidth, 0.4 dB maximum insertion loss and 20 dB, minimum isolation, specify FCC-18100420-XX.

FEATURES

- Low cost, high quality
- Compact size, light weight
- High performance
- Wide operation temperature range
- Common Radar and wireless bands



FII & FCI Series

APPLICATIONS

- Ports isolation
- Module integration
- Transceiver subsystems

DESCRIPTION

FII and FCI series narrow band iso-adapters provide isolation and circulation functions between waveguide and coaxial interface. These iso-adapters cover common Radar and wireless communication frequency bands up to 65 GHz. The iso-adapters are ideal device where the port isolation and duplexing are required. The iso-adapters can be configured with standard waveguide interface with N-type, SMA, K, 2.4 mm and V coax interface. The low cost **FII** and **FCI** series iso-adapters offer very compact sizes that can be easily inserted into the sub-assembly with minimum size increase. While the standard specifications are shown below, the custom ones with up to full waveguide bandwidth and higher isolation are available.

SPECIFICATIONS

Frequency Band	X	WR-75	KU	K	KA	Q	U	V
Frequency Range (GHz)	8.2 to 12.4	10 to 15	12.4 to 18	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 70
Bandwidth (GHz)	1.0	1.5	1.5	2.0	2.0	2.0	2.0	2.0
Insertion Loss (dB max)	0.4	0.4	0.5	0.5	0.6	0.7	0.8	1.0
Isolation (dB min)	20	20	20	19	18	18	18	18
VSWR (max)	1.25:1	1.25:1	1.25:1	1.25:1	1.25:1	1.3:1	1.3:1	1.4:1
Waveguide Size	WR-90	WR-75	WR-62	WR-42	WR-28	WR-22	WR-19	WR-15
Coax Connector	N, SMA	SMA	SMA	K	K	2.4	V	V
Temperature Range	0 to +50°C							

HOW TO ORDER

Specify Model Number

FXI - CF BW IL IS - XX ← Factory Reserve

I = Isolator
C = Circulator

Center Frequency in GHz

Isolation in dB

Insertion Loss in 1/10dB

Bandwidth in 1/10 GHz

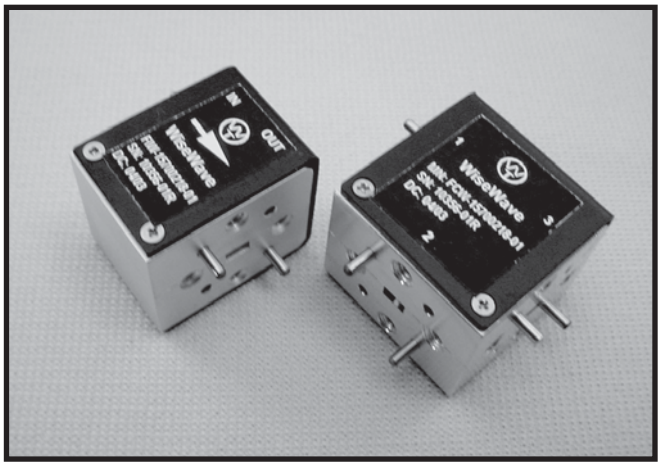
Example: To order a center frequency 18 GHz circulator/iso-adpater with 1.0 GHz bandwidth, 0.5 dB maximum insertion loss and 20 dB minimum isolation, specify FCI-18100520-XX.

FEATURES

- High quality and volume production
- Compact size, light weight
- High performance
- Wide operation temperature range
- Common communication and Radar frequency bands

APPLICATIONS

- Cavity oscillators
- Amplifiers
- Transceiver subsystems



FIW & FCW Series

DESCRIPTION

FIW and **FCW** series narrow band junction isolators and circulators cover common communication and Radar frequency bands from 8.2 to 110 GHz in eleven waveguide bands. The isolator is an ideal device where the port isolation is required, while the circulator is commonly used as a duplexer for transceiver subsystems where the transmitter and receiver ports share a single antenna port. The **FIW** and **FCW** series isolators and circulators offer very compact size that can be easily inserted into the sub-assembly with minimum size increase. While the standard specifications are shown below, the custom ones with up to full waveguide bandwidth and higher isolation are available.

SPECIFICATIONS

Waveguide Band	Frequency (GHz)	Bandwidth (GHz, Min)	Insertion Loss (dB, Max)	Isolation (dB, Min)	VSWR (Typ)	Power (W, Min)	Outline (Isolator)	Outline (Circulator)
X	8.2 to 12.4	1.0	0.3	23.0	1.3:1	5.0	Consult Factory	
WR-75	10.0 to 15.0	1.2	0.3	23.0	1.3:1	4.0	Consult Factory	
Ku	12.4 to 18.0	1.5	0.3	23.0	1.3:1	3.0	Consult Factory	
K	18.0 to 26.5	2.0	0.3	22.0	1.3:1	2.0	WT-D-5	WT-D-6
WR-34	22.0 to 33.0	2.0	0.4	20.0	1.3:1	1.0	WT-D-5	WT-D-6
Ka	26.5 to 40.0	3.0	0.4	20.0	1.3:1	1.0	WT-D-5	WT-D-6
Q	33.0 to 50.0	3.0	0.5	18.0	1.3:1	1.0	WT-D-5	WT-D-6
U	40.0 to 60.0	3.0	0.5	18.0	1.3:1	1.0	WT-D-5	WT-D-6
V	50.0 to 75.0	2.0	0.6	18.0	1.3:1	1.0	WT-D-5	WT-D-6
E	60.0 to 90.0	2.0	0.7	18.0	1.3:1	1.0	WT-D-5	WT-D-6
W	75.0 to 110	2.0	0.8	18.0	1.3:1	1.0	WT-D-5	WT-D-6
Temperature Range		0 to +50°C						

HOW TO ORDER

Specify Model Number

FXW-WG CF BW IS -XX ← Factory Reserve

- "I" or "C" for Isolator or Circulator
- WG Size
- Center Frequency in GHz
- Bandwidth in 1/10 GHz
- Isolation in dB

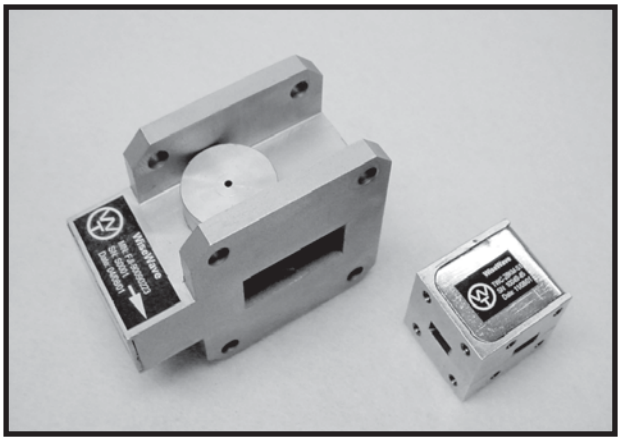
Example: To order a center frequency 24.0 GHz isolator with 2 GHz bandwidth, 20 dB minimum isolation and WR-42 waveguide interface, specify FIW-42242020-XX.

Full Band Junction Circulators and Isolators

Bulletin No. FIF & FCF

FEATURES

- Full waveguide band operation
- Low insertion loss
- High Isolation
- Compact size



FIF & FCF Series

APPLICATIONS

- Test setup
- Instrumentation
- Subsystems
- Transceivers

DESCRIPTION

FIF series full band waveguide junction isolators and **FCF** series full band waveguide junction circulators are available from 8.2 to 40 GHz frequency range in five waveguide bands. The isolators and circulators feature low insertion loss and high isolation for full waveguide bands operation. With H-plane junction configuration, the full band junction isolators offer a lower insertion loss compared to the Faraday-rotation types, while circulators offer unique full band operation features. These devices are ideally suited for broad band communication systems, EW systems and test instrument applications.

SPECIFICATIONS

Frequency Band	X	WR-75	Ku	K	Ka
Model Number (Isolator)	FIF-90-01	FIF-75-01	FIF-62-01	FIF-42-01	FIF-28-01
Model Number (Circulator)	FCF-90-01	FCF-75-01	FCF-62-01	FCF-42-01	FCF-28-01
Frequency Range (GHz)	8.2 to 12.4	10.0 to 15.0	12.4 to 18.0	18 to 26.5	26.5 to 40.0
Waveguide Size	WR-90	WR-75	WR-62	WR-42	WR-28
Insertion Loss (dB max)	0.5	0.5	0.5	0.5	0.5
Isolation (dB min)	18	18	18	16	16
VSWR (max)	1.35:1	1.35:1	1.35:1	1.40:1	1.40:1
Flange Type	UG-39/U	WR-75	UG419/U	UG595/U	UG599/U
Forwarding (W, min)	50	50	50	10	10
Load Power (W, min)*	1	1	0.5	0.5	0.5
Outline Drawings	Consult Factory				
Temperature Range	0 to +50°C				

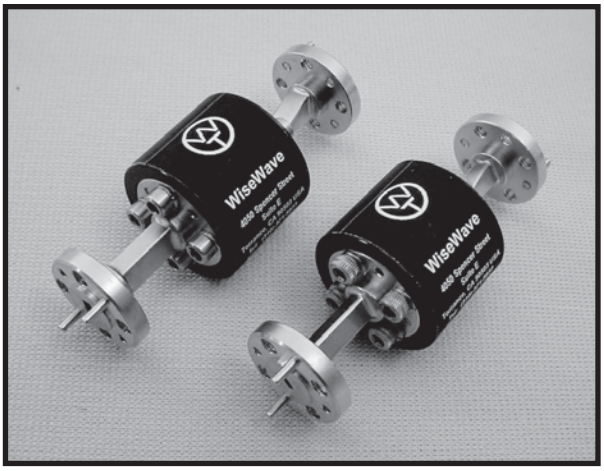
*__Note__: Isolator only

FEATURES

- Full waveguide band operation
- Faraday rotation type
- 18 to 110 GHz frequency range
- High Isolation

APPLICATIONS

- Test setup
- Instrumentation
- Subsystems
- Transceivers



FFF Series

DESCRIPTION

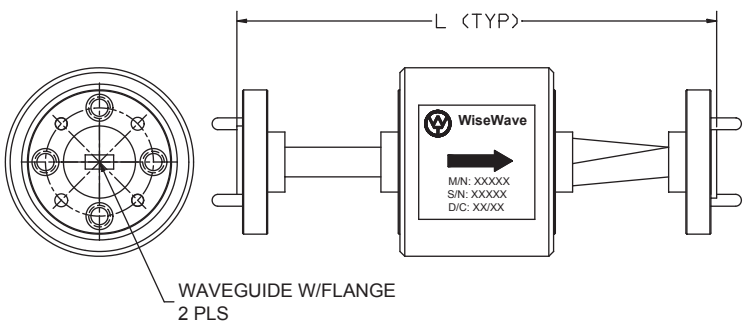
FFF series full band Faraday waveguide are available from 18 to 110 GHz frequency range in seven waveguide bands. The isolators feature moderate insertion loss and high isolation up to 30 dB for full waveguide bands operation. These devices are ideally suited for broadband communication systems or test instrument applications.

SPECIFICATIONS

Frequency Band	K	Ka	Q	U	V	E	W
Model Number	FFF-42-01	FFF-28-01	FFF-22-01	FFF-19-01	FFF-15-01	FFF-12-01	FFF-10-01
Freq. Range (GHz)	18-26.5	26.5-40	33-50	40-60	50-75	60-90	75-110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Insertion Loss (dB max)	1.0	1.2	1.5	1.6	1.8	2.0	2.3
Isolation (dB typ)	30	30	30	30	30	30	30
VSWR (max)	1.4:1	1.4:1	1.4:1	1.4:1	1.4:1	1.5:1	1.5:1
Power Handling (W)	2.0	2.0	1.5	1.5	1.0	1.0	1.0
Flange Type	UG595/U	UG599/U	UG383/U	UG383/U Mod	UG385/U	UG387/U	UG387/U Mod
Temperature Range	0 to +50°C						

OUTLINE DRAWING

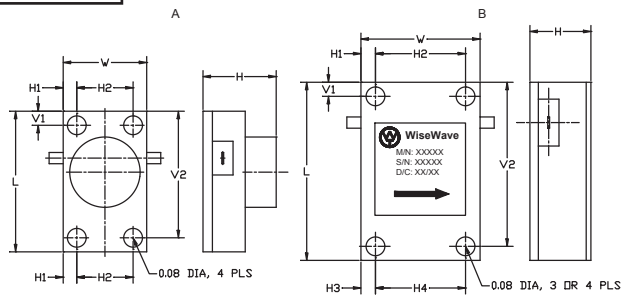
Outline: WT-D-A1



BAND	Ka	Q & U	V,E & W
L	3.18	2.69	2.50

Note: The outline is subject to change without notice. Please confirm with factory if the outline is a critical issue to your design.

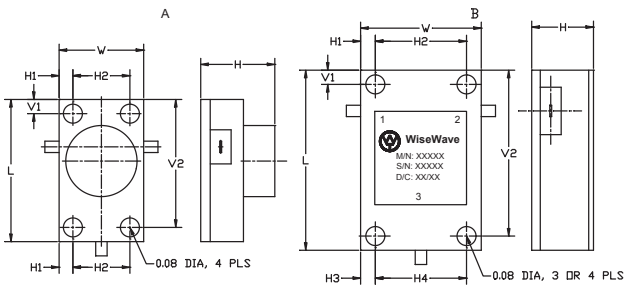
WT-D-1 Drop-in Isolator



Freq. Range	DWG	W	L	H	H1	H2	H3	H4	V1	V2
0.8~1.2 GHz	A	1.00	1.25	0.27	0.09	0.82	NA	NA	0.09	0.82
1.2~2.4 GHz	B	1.00	1.00	0.47	0.09	0.82	0.09	0.82	0.09	0.82
2.0~3.5 GHz	B	0.71	0.98	0.39	0.16	0.39	0.10	NA	0.08	0.83
3.5~5.0 GHz	B	0.63	1.02	0.41	0.31	NA	0.08	0.47	0.09	0.54
5.0~8.0 GHz	B	0.47	0.79	0.37	0.08	0.31	0.08	0.31	0.08	0.63
8.0~18.0 GHz	A	0.35	0.59	0.31	0.06	0.24	NA	NA	0.06	0.47

Dimensions are in inches

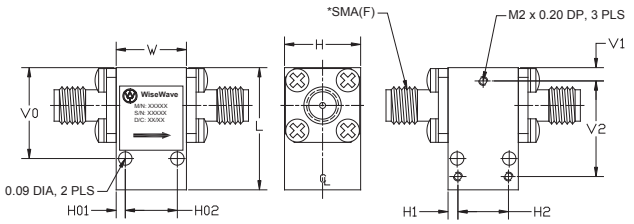
WT-D-2 Drop-in Circulator



Freq. Range	DWG	W	L	H	H1	H2	H3	H4	V1	V2
0.8~1.2 GHz	A	1.00	1.00	0.27	0.09	0.82	NA	NA	0.09	0.82
1.2~2.4 GHz	B	1.00	1.00	0.47	0.09	0.82	0.09	0.82	0.09	0.82
2.0~3.5 GHz	B	0.79	0.98	0.45	0.39	NA	0.14	0.51	0.06	0.83
3.5~5.0 GHz	B	0.63	0.87	0.41	0.31	NA	0.08	0.47	0.09	0.54
5.0~8.0 GHz	B	0.50	0.67	0.24	0.06	0.38	0.06	0.38	0.06	0.55
8.0~18.0 GHz	A	0.35	0.49	0.31	0.06	0.24	NA	NA	0.06	0.37

Dimensions are in inches

WT-D-3 Coaxial Isolator

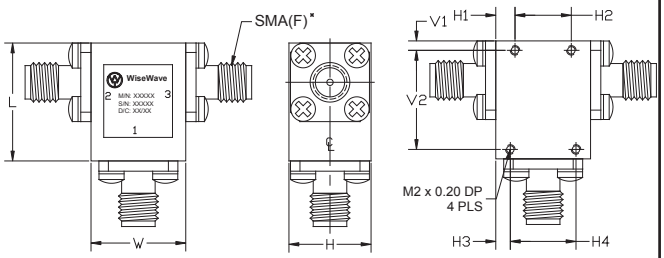


Freq. Range	W	L	H	V0	H01	H02	H1	H2	V1	V2
0.9~2.0 GHz	0.98	1.16	0.59	0.71	0.12	0.75	NA	NA	NA	NA
2.0~3.5 GHz	0.98	1.16	0.59	0.71	0.12	0.75	NA	NA	NA	NA
3.5~6.5 GHz	0.63	1.02	0.55	0.63	0.10	0.43	0.10	0.43	0.09	0.78
6.5~18.0 GHz	0.47	0.79	0.51	0.55	0.08	0.31	NA	NA	NA	NA

*SMA(M) is available per request

Dimensions are in inches

WT-D-4 Coaxial Circulator

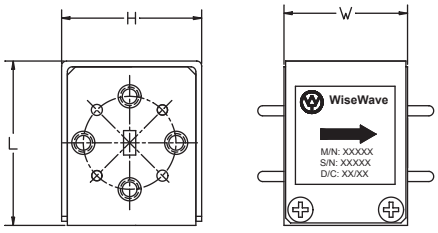


Freq. Range	W	L	H	H1	H2	H3	H4	V1	V2
0.9~2.0 GHz	0.98	0.98	0.59	0.18	0.63	0.12	0.75	0.12	0.75
2.0~3.5 GHz*	0.98	0.98	0.59	0.12	0.75	NA	NA	0.71	NA
3.5~6.5 GHz	0.63	0.83	0.55	NA	NA	NA	NA	NA	NA
6.5~18.0 GHz	0.59	0.75	0.51	0.16	0.28	0.12	0.35	0.12	0.47

* SMA(M) is available per request

Dimensions are in inches

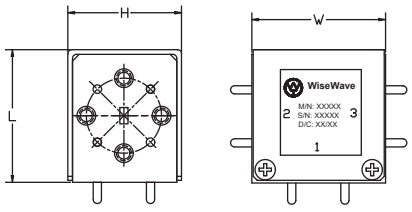
WT-D-5 Junction Isolator



BAND	H	L	W
K	0.88	1.26	0.50
Ka	0.75	1.10	0.39
Q & U	1.18	1.26	0.59
V,E & W	0.85	1.00	0.75

Dimensions are in inches

WT-D-6 Junction Circulator

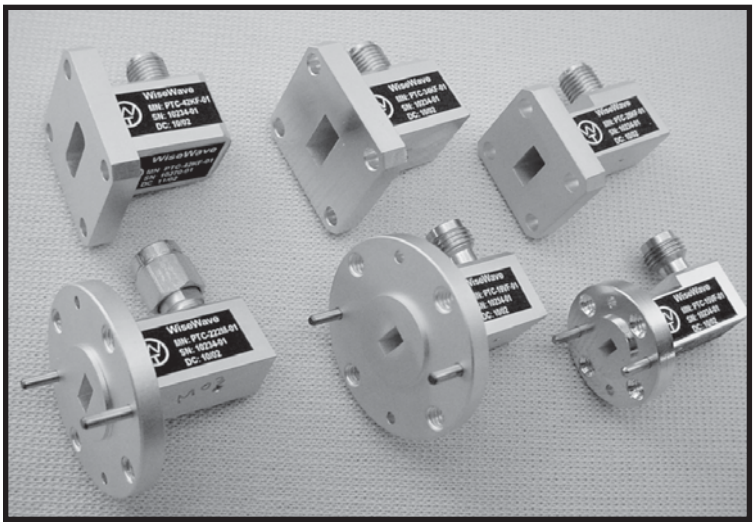


BAND	H	L	W
K	0.88	1.06	0.94
Ka	0.75	0.94	0.83
Q	1.22	1.34	1.22
U	1.22	1.34	1.34
V,E & W	0.85	1.00	1.00

Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

7. Passive Components

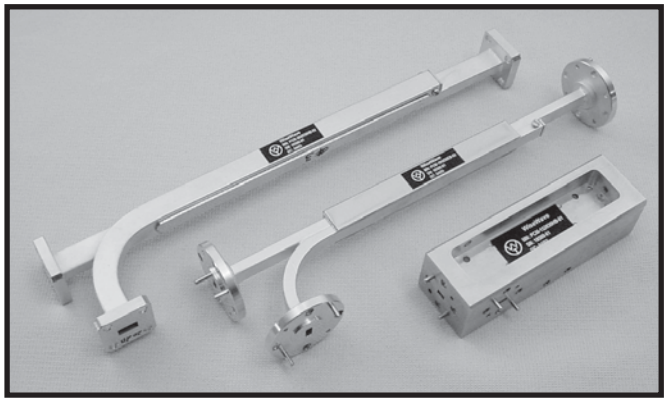


FEATURES

- Waveguide or split block configuration
- Light weight
- High directivity
- Low insertion loss
- Low cost

APPLICATIONS

- Test benches
- Subsystems
- Power sampling



PCM Series

DESCRIPTION

PCM series multi-hole directional couplers are offered for the frequency range of 18 to 110 GHz in seven waveguide bands. The standard coupling levels are 3, 6, 10, 30 and 40 dB with full waveguide operational bandwidth. The high directivity is achieved via low VSWR built-in termination. The couplers are typically used for power sampling or frequency monitoring with minimum signal loss on the main transmitting path. The multi-hole couplers are especially used in the test setups where power reflection measurement is required. The multi-hole couplers are offered in two physical configurations, waveguide and split block.

SPECIFICATIONS

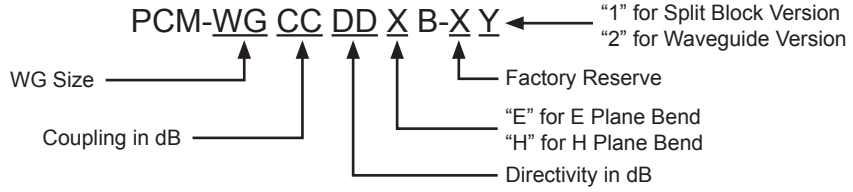
Waveguide Band	K	KA	Q	U	V	E	W
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Coupling Level (dB, Typical)	3, 6, 10, 20, 30 and 40						
Coupling Flatness (dB, Maximum)	± 0.8	± 0.8	± 0.8	± 0.9	± 0.9	± 0.9	± 1.0
Insertion Loss (dB, Typical)[1]	0.7	0.7	0.7	0.8	1.0	1.2	1.5
Directivity (dB, Typical)	30	30	30	30	30	30	30
Main Line VSWR (Typical)	1.1:1	1.1:1	1.1:1	1.2:1	1.2:1	1.2:1	1.2:1
Secondary Line VSWR (Typical)	1.1:1	1.1:1	1.2:1	1.2:1	1.2:1	1.25:1	1.25:1
Outline for Split Block Version[2]	WT-E-9	WT-E-9	WT-E-9	WT-E-9	WT-E-9	WT-E-9	WT-E-9
Outline for Waveguide Version[2]	WT-E-10	WT-E-10	WT-E-10	WT-E-10	WT-E-10	WT-E-10	WT-E-10

Note:

1. Insertion loss is defined as the power loss in addition to the coupling loss. Contact factory for other waveguide size or coupling level needs.
2. Split block version does not have an E plane bend version. Contact factory for outline drawing of waveguide version with E bend coupling port.

HOW TO ORDER

Specify Model Number



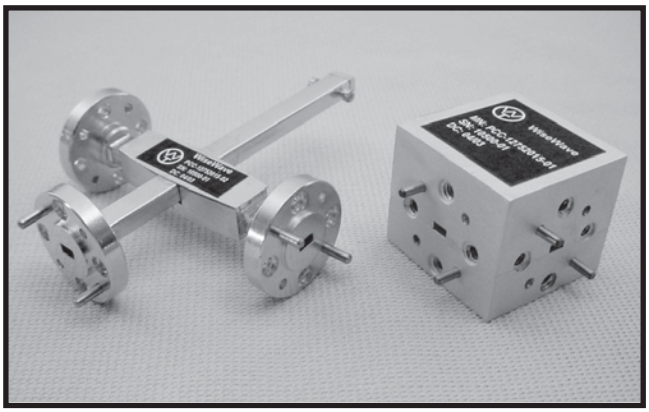
Example: To order a WR-15 waveguide multi-hole directional coupler with 20 dB coupling level, 30 dB minimum directivity E plane bend for coupling port and waveguide version, specify PCM-152030EB-X2.

FEATURES

- Waveguide or split block configurations
- Light weight
- High performance
- Low insertion loss
- Low cost

APPLICATIONS

- Test benches
- Subsystems
- Power sampling



PCC Series

DESCRIPTION

PCC series crossguide directional couplers are offered for the frequency range of 18 to 110 GHz in seven waveguide bands. The standard coupling level is 20 dB with moderate operation bandwidth and directivity. The couplers are typically used for power sampling or frequency monitoring with minimum signal loss on the main transmitting path. The crossguide couplers perform similar system functions while delivering much shorter insertion length and lower insertion loss compared to their counterpart, multi-hole directional couplers. Because of its unique features, these directional couplers are ideal candidates for system integration. The crossguide couplers are offered in two physical configurations, waveguide and split block.

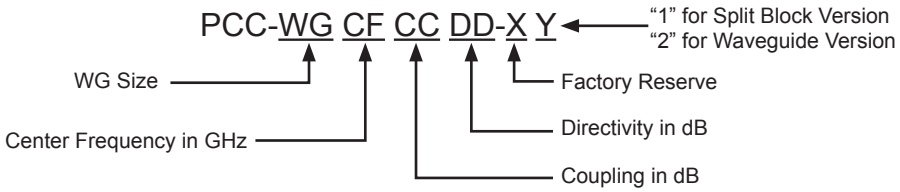
SPECIFICATIONS

Waveguide Band	K	KA	Q	U	V	E	W
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33.0 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Bandwidth (GHz,Typical)	6	8	10	12	15	18	20
Coupling Level (dB @ Fo, Typical)	15 to 30	15 to 30	15 to 30	15 to 30	15 to 30	15 to 30	15 to 30
Coupling Flatness (dB, Maximum)	± 1.5	± 1.5	± 1.6	± 1.6	± 1.6	± 1.8	± 1.8
Insertion Loss (dB, Maximum)[1]	0.5	0.5	0.7	0.7	0.8	1.0	1.0
Directivity (dB, Typical)	16	16	16	15	15	15	15
Main Line VSWR (Maximum)	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.25:1	1.25:1
Secondary Line VSWR (Maximum)	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.25:1	1.3:1
Outline for Split Block Version	WT-E-7	WT-E-7	WT-E-7	WT-E-7	WT-E-7	WT-E-7	WT-E-7
Outline for Waveguide Version	WT-E-8	WT-E-8	WT-E-8	WT-E-8	WT-E-8	WT-E-8	WT-E-8

Note: 1. Insertion loss is defined as the power loss in addition to the coupling loss. Contact factory for other waveguide size or coupling level needs.

HOW TO ORDER

Specify Model Number



Example: To order a center frequency 94 GHz crossguide coupler with 20 dB coupling level, 15 dB minimum directivity and WR-10 waveguide interface and split block version, specify PCC-10942015-X1.

Matched Hybrid Tees (Magic Tees)

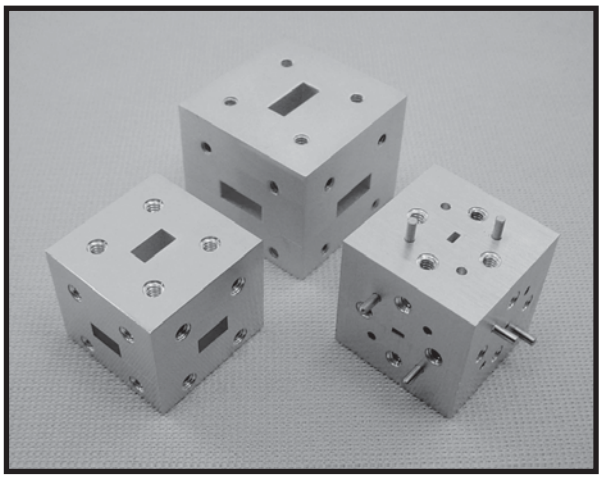
Bulletin No. PCT

FEATURES

- High isolation
- Low insertion loss
- Excellent port balance
- Wide bandwidth
- Rugged mechanical construction

APPLICATIONS

- Power splitting & combining
- Phase & frequency discriminating



PCT Series

DESCRIPTION

PCT series waveguide matched hybrid tees(Magic Tees) are available in microwave and millimeterwave frequency bands up to 110 GHz. These hybrid tees are matched power dividers or combiners for many system applications. These hybrid tees are four port couplers. A signal inputting to H-plane port is equally split into two amplitude balanced, in phase signals at colinear ports (H-arms) and isolated from the E-plane port, while a signal inputting to E-plane port is equally split into two amplitude balanced, 180° out of phase signals at colinear ports (H-arms) and isolated from the E-plane port. The in-phase and equal amplitude signals inputting into two colinear ports can result combined signal at H-plane port and cancelled signal at E-plane port. This feature is widely used in the monopulse antenna feed structure and phase testing setup. The typical operating bandwidth of the matched hybrid tees is up 80 % of waveguide bandwidth while it can cover full waveguide bandwidth with slight performance degradation at band edge. The matched hybrid tees are readily to be used to configure 4, 8 and 16 way power dividers.

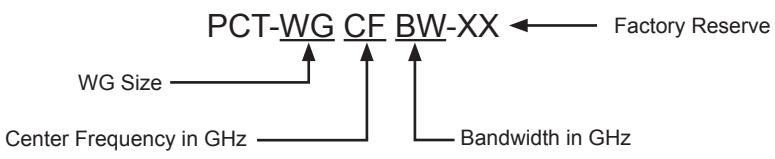
SPECIFICATIONS

Frequency Band	K	KA	Q	U	V	E	W
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Insertion Loss (dB, Typ)*	0.3	0.3	0.4	0.4	0.4	0.5	0.5
Ports Isolation (dB, Min)	20	20	20	20	20	20	20
Amplitude Un-Balance (dB, Max)	± 0.1	± 0.1	± 0.2	± 0.2	± 0.2	± 0.3	± 0.3
VSWR (Typ)	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Outline Drawing	WT-E-1	WT-E-1	WT-E-1	WT-E-1	WT-E-1	WT-E-1	WT-E-1

* Insertion loss is defined as the power loss in addition to the coupling loss. Contact factory for other waveguide size.

HOW TO ORDER

Specify Model Number

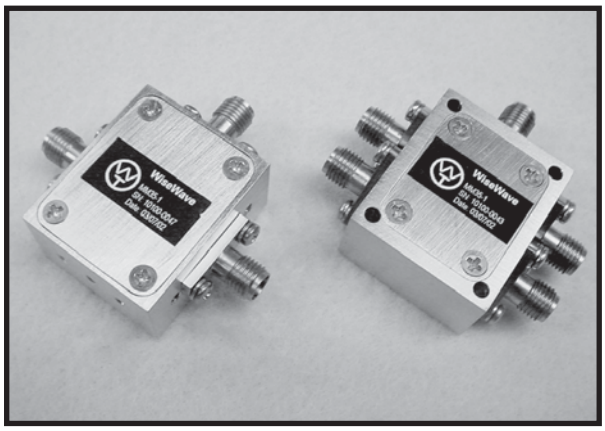


FEATURES

- 12 to 45 GHz
- Even power splitting
- Low insertion loss
- Wide bandwidth
- High port isolation

APPLICATIONS

- Laboratory
- Instrumentation
- Subsystems



PPD Series

DESCRIPTION

PPD series coax standard power dividers are available in 2 way and 4 way power splitting configuration to cover the frequency range of 12 to 45 GHz frequency range. Unlike their resistive counterpart, these power dividers offer extremely low insertion loss and high port to port isolation while having moderate operating bandwidth. The power dividers are ideal choices where the precise power splitting is required. The power dividers can be used as power combiners.

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SPECIFICATIONS

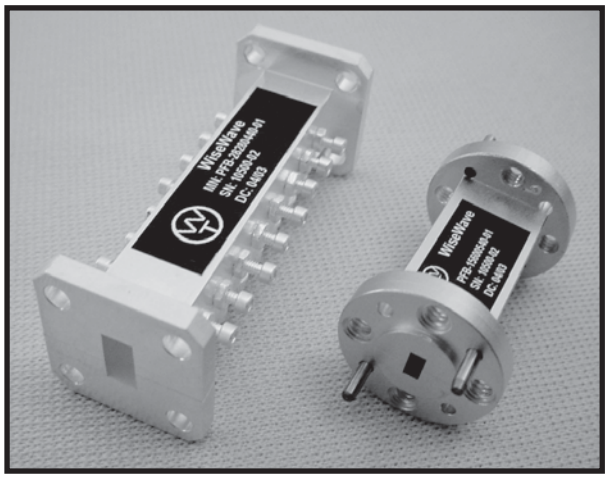
Frequency Range (GHz)	12 to 18	18 to 25	20 to 30	25 to 35	30 to 40	35 TO 45
2 Way Power Dividers						
Model Number	PPD-SF150602	PPD-KF220802	PPD-KF251002	PPD-KF301002	PPD-KF351002	PPD-2F401002
Insertion Loss (dB Typical)	1.4	1.5	1.6	1.7	1.9	2.0
Amplitude Balance (dB Max)	± 0.12	± 0.15	± 0.18	± 0.20	± 0.22	± 0.25
Port Isolation (dB, Min)	20	20	20	20	20	20
VSWR (Typical)	2:1	2:1	2:1	2:1	2:1	2:1
Outline Drawing	WT-E-11	WT-E-11	WT-E-11	WT-E-11	WT-E-11	WT-E-11
4 Way Power Dividers						
Model Number	PPD-SF150604	PPD-KF220804	PPD-KF251004	PPD-KF301004	PPD-KF351004	PPD-2F401004
Insertion Loss (dB Typical)	2.4	2.5	2.6	2.7	2.9	3.0
Amplitude Balance (dB Max)	± 0.22	± 0.25	± 0.28	± 0.30	± 0.32	± 0.35
Port Isolation (dB, Min)	20	20	20	20	20	20
VSWR (Typical)	2:1	2:1	2:1	2:1	2:1	2:1
Outline Drawing	WT-E-12	WT-E-12	WT-E-12	WT-E-12	WT-E-12	WT-E-12

TECHNICAL NOTATION

- These power dividers offer wider operating bandwidth than shown above with moderate performance degradation. For example, PDD-KF301002 can cover 25 to 40 GHz frequency range with slightly higher VSWR (2.5:1) in 35 to 40 GHz frequency band.
- The standard products are equipped with K (2.92 mm) female coax connectors. Different type connectors, such as 2.4 mm or V connectors, both male and female type are available per request.
- To order the product with the specification other than listed, contact factory with your detailed requirement.

FEATURES

- High rejection
- Low insertion loss
- Frequency up to 110 GHz
- Rugged mechanical construction



PFB Series

APPLICATIONS

- Outdoor Units
- Subsystems
- Transceivers

DESCRIPTION

PFB series waveguide bandpass filters are available in millimeterwave frequency bands up to 110 GHz and major communication frequency bands. There are two types of configurations employed in these bandpass filters. The cavity/ tunable version offers best performance and design flexibility, while E-plane version offers low cost and large volume production solution. The typical pass band bandwidth is 2 to 10% and in band ripple is 0.1 to 0.5 dB.

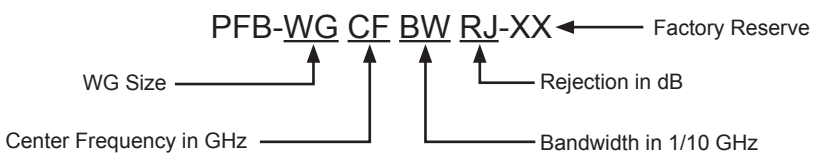
TYPICAL SPECIFICATIONS

Frequency Band	K	KA	Q	U	V	E	W
Waveguide	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Insertion Loss (dB)[1]	0.8 to 1.2	0.8 to 1.2	0.8 to 1.5	1.0 to 1.5	1.0 to 1.8	1.2 to 1.8	1.2 to 2.0
Rejection (dB)[2]	30 to 50	30 to 50	30 to 50	30 to 50	30 to 50	30 to 50	30 to 50
Ripple in Passband	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5
Outline for E Plane Version	WT-E-2	WT-E-2	WT-E-2	WT-E-2	WT-E-2	WT-E-2	WT-E-2

Note: 1. The pass band insertion loss is bandwidth related;
2. The out of band rejection is offset frequency related. Consult factory for you specific bandpass filter requirement.

HOW TO ORDER

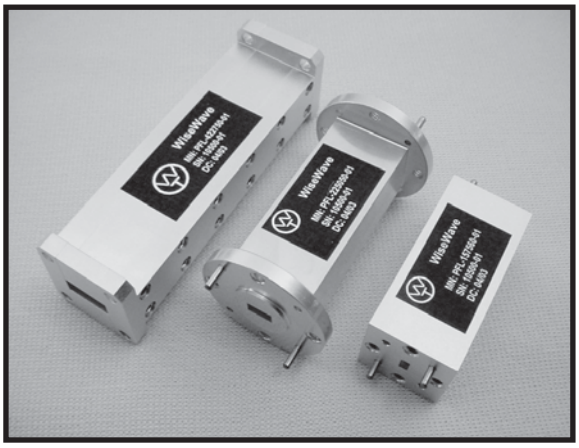
Specify Model Number



Example: To order a WR-28 bandpass filter with 38 GHz center frequency, 2.2GHz bandwidth and 45 dB rejection, specify PFB-28382245-XX.

FEATURES

- High rejection
- Low insertion loss
- Frequency up to 110 GHz
- Rugged mechanical construction



PFL Series

APPLICATIONS

- Test systems
- Subsystems
- Transceivers

DESCRIPTION

PFL series waveguide low pass filters are available in millimeterwave bands to cover the frequency range up to 110 GHz. The high pass nature of waveguide dictates the low end cut off for standard model. Both low end and high end cut off frequencies can be specified as a custom order. In fact, the waveguide low pass filters are the bandpass filters with very broad pass band. They are ideally suited for broad band system applications, such as EW system, instrumentation and harmonic and spurious rejections,etc.

STANDARD PRODUCT SPECIFICATIONS

Frequency Band	K	Ka	Q	U	V	E	W
Model Numbers	PFL-42-01	PFL-28-01	PFL-22-01	PFL-19-01	PFL-15-01	PFL-12-01	PFL-10-01
Waveguide	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Passband (GHz)	16 to 26.5	22 to 40	28 to 50	33 to 60	42 to 75	50 to 90	62 to 110
Insertion Loss (dB)	1.0	1.0	1.0	1.0	1.2	1.5	1.8
Rejection Band (GHz)	< 14 & > 33	< 20 & > 47	< 25 & > 56	< 29 & > 66	< 38 & > 80	< 45 & > 98	< 56 & > 118
Rejection (dB, Min)	40	40	40	40	40	40	40
Outline Drawing	WT-E-4	WT-E-4	WT-E-4	WT-E-4	WT-E-4	WT-E-4	WT-E-4

CUSTOM ORDER

Specify Model Number

PFL-WG EF RJ-XX ← Factory Reserve

WG Size

Rejection in dB

High End Cut Off Frequency in GHz

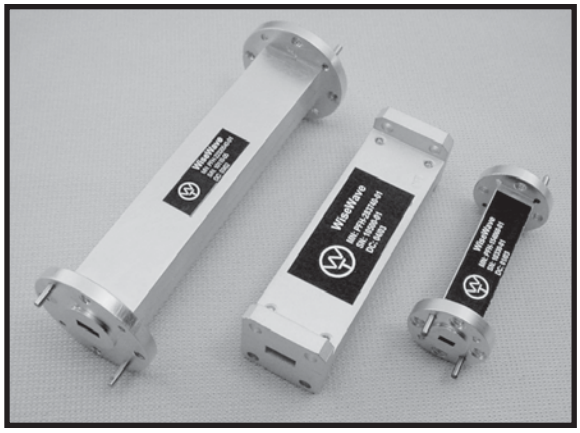
Example: To order a WR-28 bandpass filter with 38 GHz high end cut off frequency, 45 dB rejection, specify PFL-283845-XX.

FEATURES

- High rejection
- Low insertion loss
- Frequency up to 110 GHz
- Rugged mechanical construction

APPLICATIONS

- Lower side band rejection
- Up and down converters
- Transceivers



PFH Series

DESCRIPTION

PFH series waveguide highpass filters are available in major communication frequency and Radar bands. The frequency coverage is up to 110 GHz in seven waveguide bands. These filters are designed to offer sharp cut off and high attenuation in the stop band and low insertion loss in the pass band. The corner frequency is specified at the time of order.

SPECIFICATIONS

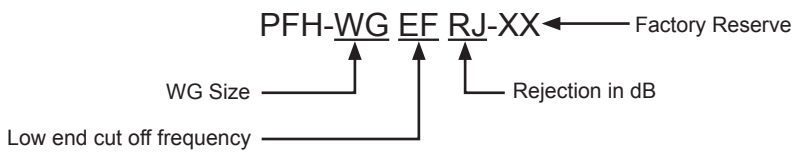
Frequency Band	K	Ka	Q	U	V	E	W
Waveguide	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Cut off Frequency Range (GHz)	14 to 23	21 to 36	26 to 45	31 to 54	40 to 68	48 to 82	59 to 100
Pass band Loss (dB)[1]	0.6	0.7	0.8	0.8	0.9	1.0	1.0
Stop band Rejection (dB)[1]	45	45	45	45	45	45	45
Outline Drawing	WT-E-3	WT-E-3	WT-E-3	WT-E-3	WT-E-3	WT-E-3	WT-E-3

Note:

1. The pass band insertion loss and stop band rejection is cut off frequency and filter physical length related. The longer the length, the higher the rejection in the stop bands.
2. Other waveguide band highpass filters are available upon request.

HOW TO ORDER

Specify Model Number



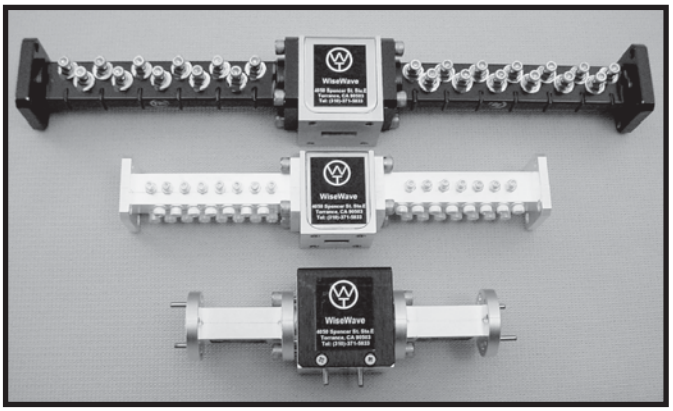
Example: To order a WR-28 highpass filter with 35 GHz cut off frequency and 40 dB minimum rejection, specify PHF-283540-XX.

FEATURES

- High Isolation
- Low insertion loss
- Rugged mechanical construction

APPLICATIONS

- Outdoor Units
- Transceivers
- Subsystems



PDC Series

DESCRIPTION

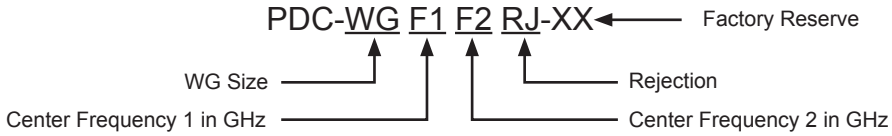
PDC series waveguide diplexers are available in major communication frequency bands. Existing products offer narrow frequency band to cover common North American point-to-point digital radio frequency bands and unlicensed communication bands from 18 to 65 GHz. These diplexers consist of two bandpass filters (BPF) and a circulator. The critical element, BPF, can be constructed with either E plane configuration by using proprietary simulation tool and fabricated by conventional low cost printed circuit techniques or more conventional cavity structure. The diplexers with E-plane configuration require no tuning, which allows low cost, high volume production, while cavity structure offer design flexibility, quick prototyping and higher performance. Typical insertion loss is from 1.0 to 2.0 dB, depending on the channel bandwidth and isolation. The frequency stability is around -0.4 MHz/°C with low cost aluminum housing. Some of products' performance is illustrated as follows. Other frequency bands and performance are available upon request.

SPECIFICATIONS

Item	Model Number	Waveguide Size	Center Freq. (GHz)	Bandwidth (MHz)	Insertion Loss (dB)	Channel Isolation (dB)	VSWR (Typ)
1	PDC-42181940-01	WR-42	17.90/18.90	400	1.5	40	1.25
2	PDC-42181940-11	WR-42	18.20/19.20	400	1.5	40	1.25
3	PDC-42181940-21	WR-42	18.50/19.50	600	1.2	40	1.25
4	PDC-34283140-01	WR-34	27.75/31.15	700	1.2	40	1.25
5	PDC-28373840-01	WR-28	37.00/38.00	350	1.8	40	1.25
6	PDC-28383940-01	WR-28	37.50/38.50	350	1.8	40	1.25
7	PDC-28394040-01	WR-28	38.50/39.50	350	1.8	40	1.25
8	PDC-15586240-01	WR-15	58.00/62.00	500	2.0	40	1.25

HOW TO ORDER

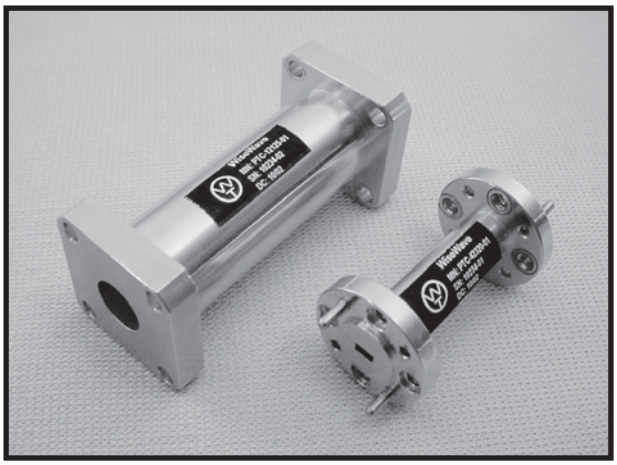
Specify Model Number



Example: To order a WR-22 diplexer with 40GHz for receiver channel and 42 GHz for transmitter channel and rejection 40 dB, specify PDC-22404240-XX.

FEATURES

- Rugged waveguide configuration
- Full band operation
- High performance



PRC & PTW Series

APPLICATIONS

- Test benches
- Subsystems
- Prototypes
- Inter connections

DESCRIPTION

PRC series rectangular to circular waveguide transitions are offered to cover frequency range of 18 to 110 GHz. These transitions are manufactured with electro-forming technique to ensure high mechanical tolerance and surface smoothness. Typical VSWR for these transitions is 1.05:1. The transitions are used for connecting rectangular waveguide to circular waveguide with minimum loss. The outline drawing for these transitions is WT-E-6.

PTW series rectangular waveguide taper transitions are offered to cover frequency range of 18 to 110 GHz. These transitions are manufactured with EDM technique to ensure high mechanical tolerance and ruggedness. Typical VSWR for these transitions is 1.05:1. The transitions are used for smooth transition between different waveguide size with minimum loss. The outline drawing for these transitions is WT-E-6.

HOW TO ORDER

Rectangular to circular waveguide transitions

Specify Model Number

PRC - WG DDD -XX ← Factory Reserve

Rectangular Waveguide Size

Diameter in Mils

Example: To order a WR-15 to 0.141" diameter rectangular to circular waveguide transition, specify PRC-15141-XX.

Rectangular taper transitions

Specify Model Number

PTW - WG WG L - XX ← Factory Reserve

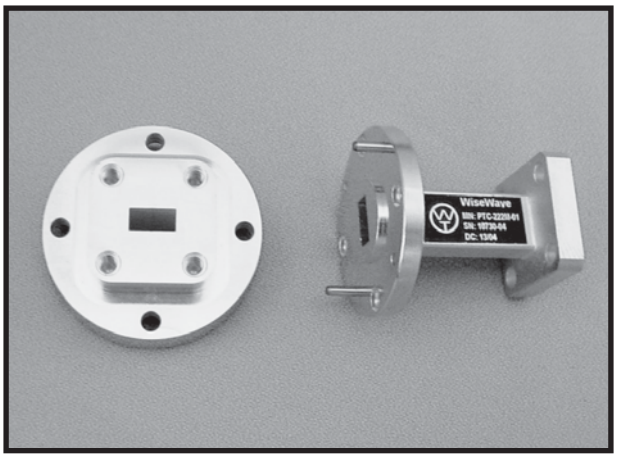
Smaller Waveguide Size

Larger Waveguide Size

Example: To order a WR-10 to WR-28 waveguide taper transition, specify PTW-1028L-XX.

FEATURES

- Rugged waveguide configuration
- Full band operation
- High performance



PWA & PWK Series

APPLICATIONS

- Test benches
- Subsystems
- Prototypes
- Inter connections

DESCRIPTION

PWA series rectangular waveguide flange adapters are offered to cover frequency range of 18 to 110 GHz in seven waveguide bands. These adapters are used for connecting the same size rectangular waveguide with different flange patterns.

PWK series rectangular waveguide bulkhead flange amount adapters are offered to cover frequency range of 18 to 110 GHz in seven waveguide bands. These transitions are manufactured with EDM technique to ensure high mechanical tolerance and ruggedness. The transitions are used for waveguide interface in panel amount equipment.

7

HOW TO ORDER

Waveguide Flange Adapters

Specify Model Number

PWA – FG1 FG2 -XX ← Factory Reserve

Flange Type 1 ↑ ↑ Flange Type 2

Example: To order a UG383/U to UG599/U flange adapter, specify PWA-383599-XX.

Bulkhead Waveguide Adapters

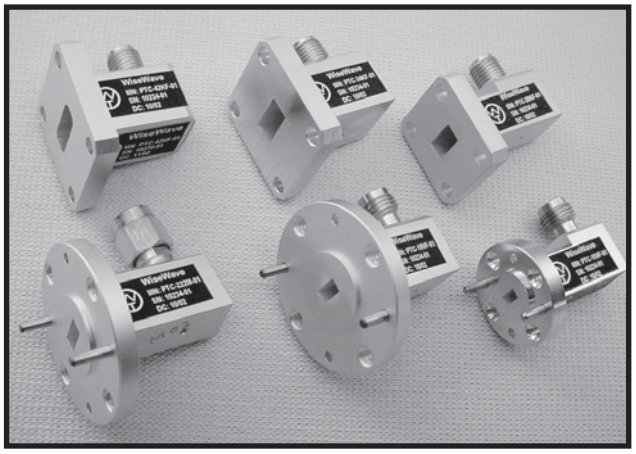
Frequency Band	K	Ka	Q	U	V	E	W
Model Number	PWK-42-01	PWK-28-01	PWK-22-01	PWK-19-01	PWK-15-01	PWK-12-01	PWK-10-01
Freq. Range (GHz)	18-26.5	26.5-40	33-50	40-60	50-75	60-90	75-110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Flange Type	UG595/U	UG599/U	UG383/U	UG383/U Mod	UG385/U	UG387/U	UG387/U Mod

FEATURES

- Full waveguide band operation
- Low insertion loss
- Low VSWR
- Rugged mechanical configuration

APPLICATIONS

- Test setups
- Instrumentation
- Subsystems
- Transceivers



PTC Series

DESCRIPTION

PTC series waveguide to coax adapters are available in nine waveguide bands covering the frequency range of 8.2 to 70 GHz. The adapters covering 8.2 to 60 GHz frequency range are designed for full waveguide band operation, while V band one is for 50 to 70 GHz. These adapters are specially designed with exceptional high performance. SMA male or female connectors are standard coaxial line interfaces for WR-90, WR-75, WR-62 waveguide adapters. 2.92 mm (K) male or female connectors are for WR-42 and WR-28 waveguide adapters, while 2.4 mm male or female connectors are for WR-22 and V male or female connectors are for WR-19 and WR-15 waveguide adapters. The adapters are ideal choices where the waveguide to coaxial transitions are required.

SPECIFICATIONS

Model Number	Frequency (GHz)	Waveguide Size	Coax Connector	Insertion Loss (dB, Max)	Return Loss (dB, Min)	Flange Type	Outline Drawing
PTC-90SF-01	8.2 to 12.4	WR-90	SMA (F)	0.20	20.0	UG39/U	WT-E-5
PTC-90SM-01	8.2 to 12.4	WR-90	SMA (M)	0.20	20.0	UG39/U	WT-E-5
PTC-75SF-01	10.0 to 15.0	WR-75	SMA (F)	0.20	20.0	Square	WT-E-5
PTC-75SM-01	10.0 to 15.0	WR-75	SMA (M)	0.20	20.0	Square	WT-E-5
PTC-62SF-01	12.4 to 18.0	WR-62	SMA (F)	0.25	20.0	UG419/U	WT-E-5
PTC-62SM-01	12.4 to 18.0	WR-62	SMA (M)	0.25	20.0	UG419/U	WT-E-5
PTC-42KF-01	18.0 to 26.5	WR-42	K (F)	0.30	20.0	UG595/U	WT-E-5
PTC-42KM-01	18.0 to 26.5	WR-42	K (M)	0.30	20.0	UG595/U	WT-E-5
PTC-34KF-01	22.0 to 33.0	WR-34	K (F)	0.30	20.0	UG1530/U	WT-E-5
PTC-34KM-01	22.0 to 33.0	WR-34	K (M)	0.30	20.0	UG1530/U	WT-E-5
PTC-28KF-01	26.5 to 40.0	WR-28	K (F)	0.35	20.0	UG599/U	WT-E-5
PTC-28KM-01	26.5 to 40.0	WR-28	K (M)	0.35	20.0	UG599/U	WT-E-5
PTC-222F-01	33.0 to 50.0	WR-22	2.4 mm (F)	0.40	18.0	UG383/U	WT-E-5
PTC-222M-01	33.0 to 50.0	WR-22	2.4 mm (M)	0.40	18.0	UG383/U	WT-E-5
PTC-19VF-01	40.0 to 60.0	WR-19	V (F)	0.40	17.0	UG383/U-M	WT-E-5
PTC-19VM-01	40.0 to 60.0	WR-19	V (M)	0.40	17.0	UG383/U-M	WT-E-5
PTC-15VF-01	50.0 to 70.0	WR-15	V (F)	0.50	16.0	UG385/U	WT-E-5
PTC-15VM-01	50.0 to 70.0	WR-15	V (M)	0.50	16.0	UG385/U	WT-E-5

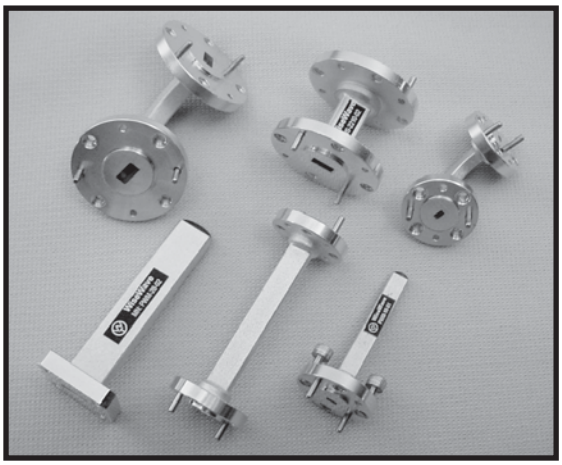
Note: The adapters with different type of coax interface and flange are available per request.

FEATURES

- Rugged waveguide configuration
- Full band operation
- Low cost

APPLICATIONS

- Test benches
- Subsystems
- Prototypes



PWS, PWE, PWH, PWM & PWT Series

DESCRIPTION

PWS, PWE, PWH, PWM and **PWT** series offered various waveguide components to cover frequency range of 18 to 110 GHz in seven waveguide bands. Other frequency bands are available per request.

Straight waveguide sections **(PWS)** offer the inter-connections between the waveguide ports and are available in 1" to 8" standard length in 1" incremental as well as customer-specified lengths.

Waveguide bends **(PWE)** change the E plane direction in the waveguide assembly. While standard version offers 90° bend, the special bend angle up to 180° are available per request.

Waveguide bends **(PWH)** change the H plane direction in the waveguide assembly. While standard version offers 90° bend, the special bend angle up to 180° are available per request.

Waveguide termination loads **(PWM)** are useful when a matched port termination is required. The standard termination loads offer less than 1.10 VSWR and up to 10.0 watts power handling. Higher power handling versions are offered as custom-specified option.

Waveguide twists **(PWT)** allow changing the orientation of the waveguide port and are available with the twisting angle of 45° or 90°.

WAVEGUIDE SPECIFICATIONS

Waveguide Band	K	Ka	Q	U	V	E	W
Frequency Range (GHz)	18 to 26.5	26.5 to 40	33 to 50	40 to 60	50 to 75	60 to 90	75 to 110
Waveguide Size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Flange Pattern	UG595/U	UG599/U	UG383/U	UG383/U	UG385/U	UG387/U	UG387/U
Inner Dimension (A x B, Inches)	0.420 x 0.170	0.280 x 0.140	0.224 x 0.112	0.188 x 0.094	0.148 x 0.074	0.122 x 0.061	0.100 x 0.050

Note: Contact factory for other waveguide band needs.

HOW TO ORDER

Straight waveguide sections

Specify Model Number

PWS - WG LL -XX ← Factory Reserve

Waveguide Size — Length in Inches

Example: To order a 2" long, WR-15 straight waveguide section, specify PWS-1502-XX.

Waveguide E plane bends

Specify Model Number

PWE - WG DD - XX ← Factory Reserve

Waveguide Size — Degrees

Example: To order a WR-28, E-plane, 30° waveguide bend, specify PWE-2830-XX.

Waveguide H plane bends

Specify Model Number

PWH - WG DD - XX ← Factory Reserve

Waveguide Size — Degrees

Example: To order a WR-28, E-plane, 30° waveguide bend, specify PWE-2830-XX.

Waveguide twists

Specify Model Number

PWT - WG DD -XX ← Factory Reserve

Waveguide Size — Degrees

Example: To order a 45°, 1" long, WR-12 waveguide twist, specify PWT-120145-XX.

Waveguide termination loads

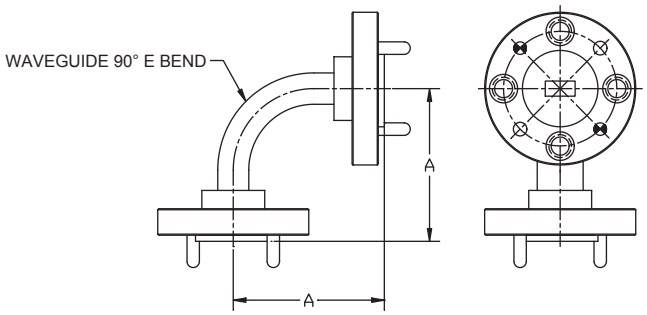
Specify Model Number

PWM – WG WW -XX ← Factory Reserve

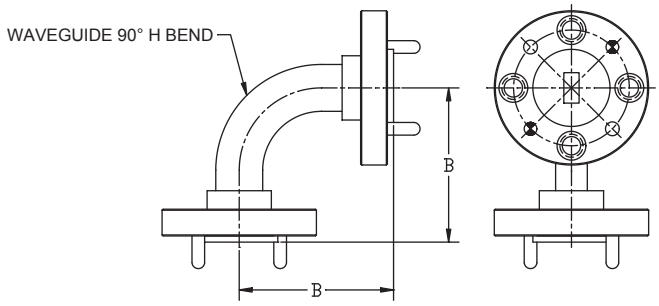
Waveguide Size — Power in Watts

Example: To order a WR-42 waveguide, 2 Watts termination load, specify PWM-4202-XX.

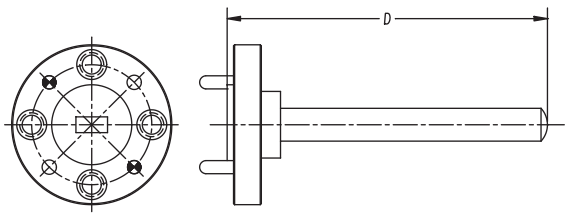
Outline: WT-E-A1



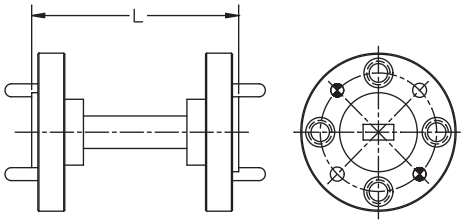
Outline: WT-E-A2



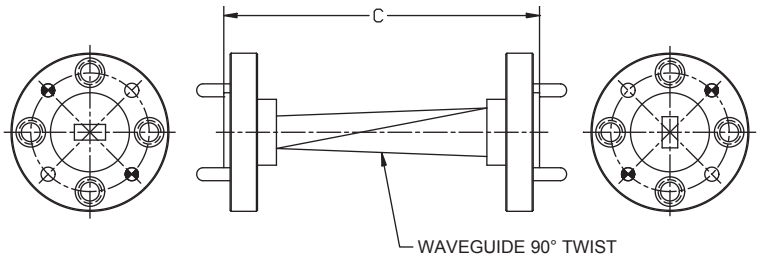
Outline: WT-E-A3



Outline: WT-E-A4



Outline: WT-E-A5



Waveguide Band	Frequency Range (GHz)	Waveguide Size	Flange Pat-tern	E-Bends A(Inch)	H-Bends B(Inch)	Twist C(Inch)	Loads D(Inch)	Section L(Inch)*
X	8-12.4	WR-90	UG39/U	2.00	2.00	3.00	3.00	2.0
WR-75	10-15	WR-75	Square	1.75	1.75	2.75	2.75	2.0
Ku	12-18	WR-62	UG419/U	1.50	1.50	2.50	2.50	2.0
K	18-26.5	WR-42	UG595/U	1.25	1.25	2.50	2.50	1.0
Ka	26.5-40	WR-28	UG599/U	1.00	1.00	2.00	2.00	1.0
Q	33-50	WR-22	UG383/U	1.00	1.00	2.00	2.00	1.0
U	40-60	WR-19	UG383/U-M	1.00	1.00	1.50	2.00	1.0
V	50-75	WR-15	UG385/U	0.75	0.75	1.50	1.50	1.0
E	60-90	WR-12	UG387/U	0.75	0.75	1.25	1.50	1.0
W	75-110	WR-10	UG387/U-M	0.75	0.75	1.25	1.50	1.0
Outline Drawing				WT-E-A1	WT-E-A2	WT-E-A5	WT-E-A3	WT-E-A4

* The length shown is for standard model. Customer may specify the length at time of inquiry.

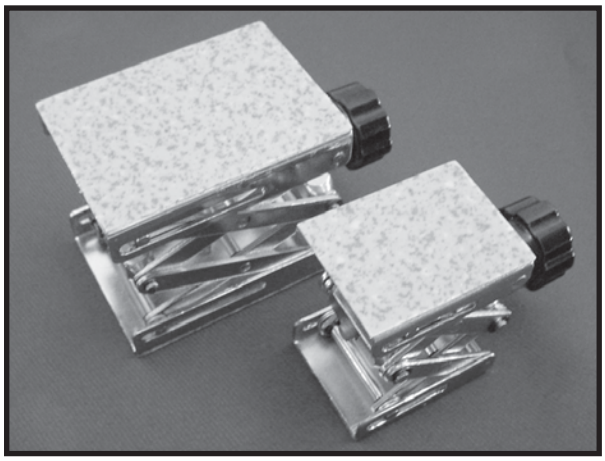
The flange pattern shown is for illustration purpose. Refer to standard waveguide flange pattern for details.

FEATURES

- Rugged configuration
- Smooth adjustment
- Top and bottom plate skid pads
- Four size selections

APPLICATIONS

- Laboratory setup supporting
- Waveguide system supporting



WTJ Series

DESCRIPTION

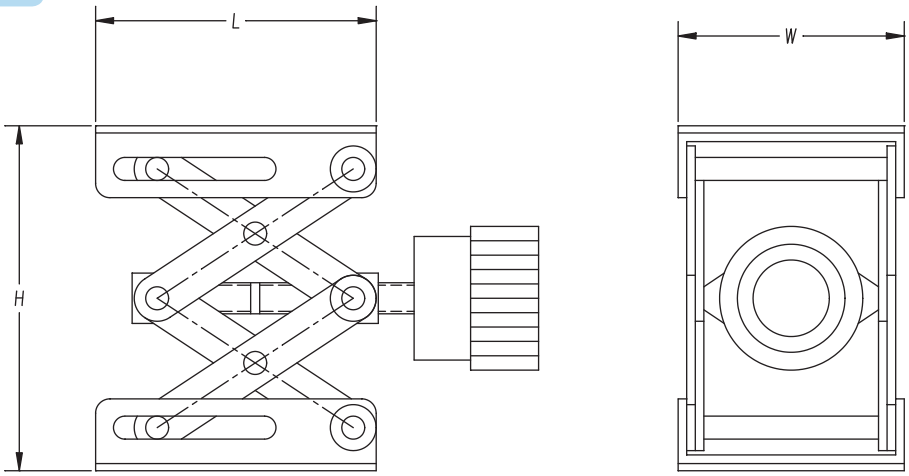
WTJ series jacks are offered in four table size to provide total flexibility of waveguide or module supporting or positioning requirements in the laboratory environment. These jacks are engineered for smooth and continuous height adjustment through their height range. They are constructed with chromed steel and anti-skid pads to offer stable, slipping and scratch free support.

SPECIFICATIONS

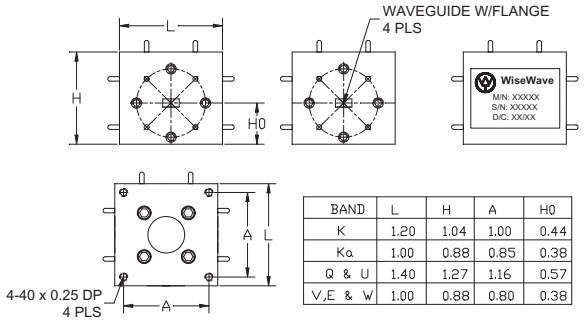
Model Number	WTJ-050040-02	WTJ-075055-02	WTJ-100075-02	WTJ-140100-02
Table Size (L x W)	50 x 40 mm	75 x 55 mm	100 x 75 mm	140 x 100 mm
Elevation Height (H)	37 - 93 mm	37 - 138 mm	43 - 182 mm	52 - 255 mm

OUTLINE DRAWING

Outline: WT-E-A6



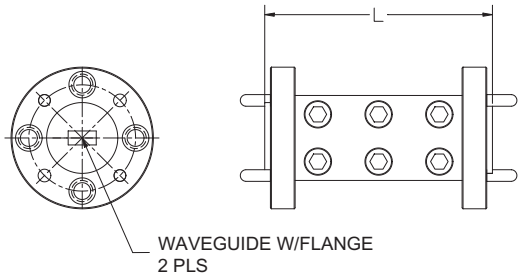
WT-E-1



BAND	L	H	A	H0
K	1.20	1.04	1.00	0.44
Ka	1.00	0.88	0.85	0.38
Q & U	1.40	1.27	1.16	0.57
V,E & W	1.00	0.88	0.80	0.38

Dimensions are in inches

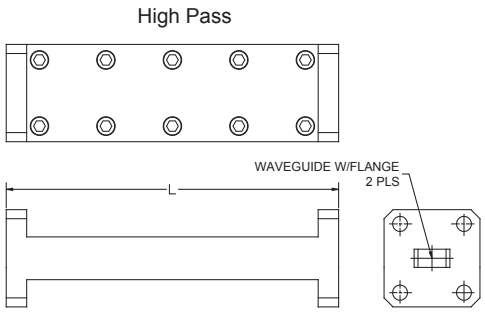
WT-E-2



BAND	K	Ka	Q & U	V,E & W
L	Vary per Specifications			

Dimensions are in inches

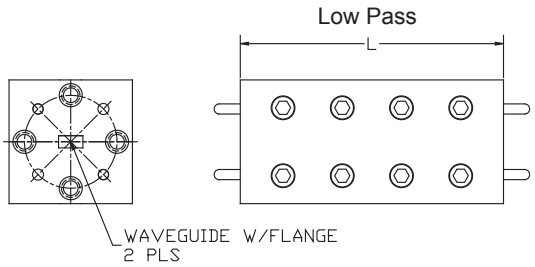
WT-E-3



BAND	K	Ka	Q & U	V,E & W
L	3.00	2.60	2.20	1.80

Dimensions are in inches

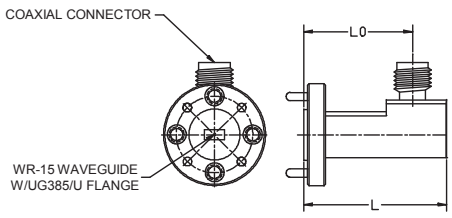
WT-E-4



BAND	K	Ka	Q & U	V,E & W
L	3.00	2.50	2.00	1.60

Dimensions are in inches

WT-E-5

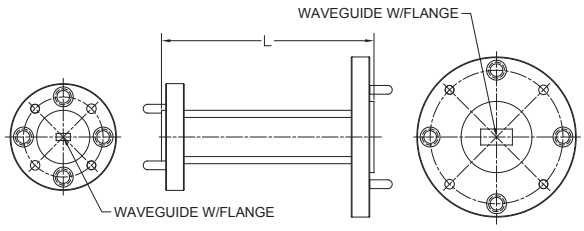


BAND	X	WR-75	WR-62	K/WR-34	Ka,Q & U	V
L	1.40	1.25	1.20	0.85	1.00	1.05
L0	1.00	0.90	0.95	0.60	0.75	0.80

NOTES:
BOTH MALE AND FEMALE COAXIAL CONNECTORS ARE AVAILABLE FOR ALL BANDS

Dimensions are in inches

WT-E-6



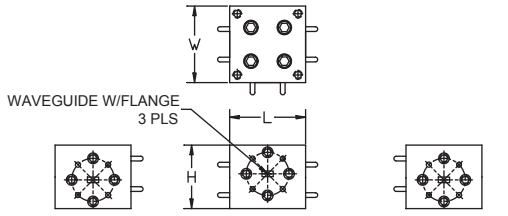
PTW	BIGGER WAVEGUIDE BAND	K	Ka	Q	U	V	E	
	L	2.00	2.00	1.50	1.50	1.00	1.00	

PRC	RECTANGULAR WG BAND	K	Ka	Q	U	V	E	W
	L	2.00	1.50	1.30	1.30	1.10	1.10	1.10

Dimensions are in inches

The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

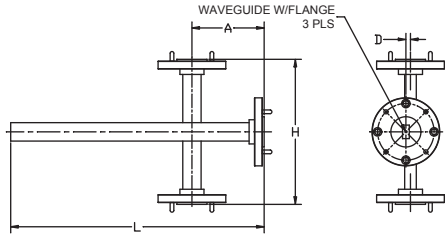
WT-E-7



BAND	K	Ka	Q	U	V	E	W
L	1.20	1.00	1.30	1.30	1.00	1.00	1.00
W	1.20	1.00	1.30	1.30	1.00	1.00	1.00
H	1.06	0.90	1.25	1.23	0.83	0.82	0.81

Dimensions are in inches

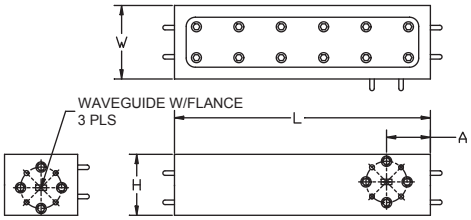
WT-E-8



Band	X	WR-75	Ku	K	Ka	Q	U	V	E	W
L	5.46	4.80	4.66	4.24	3.46	3.26	2.66	2.56	2.56	2.46
A	1.73	1.65	1.58	1.52	1.23	1.23	0.98	0.98	0.98	0.98
D	0.45	0.43	0.35	0.21	0.18	0.15	0.13	0.11	0.10	0.09
H	3.46	3.30	3.16	3.04	2.46	2.46	1.96	1.96	1.96	1.96

Dimensions are in inches

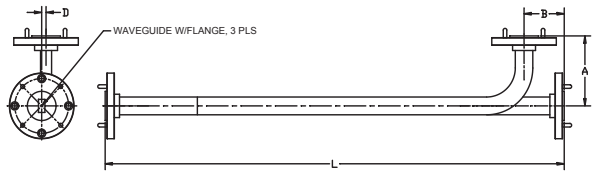
WT-E-9



BAND	Q	U	V	E	W
L	5.50	5.50	3.50	3.50	3.50
W	1.30	1.30	1.00	1.00	1.00
H	1.25	1.23	0.83	0.82	0.81
A	0.80	0.80	0.60	0.60	0.60

Dimensions are in inches

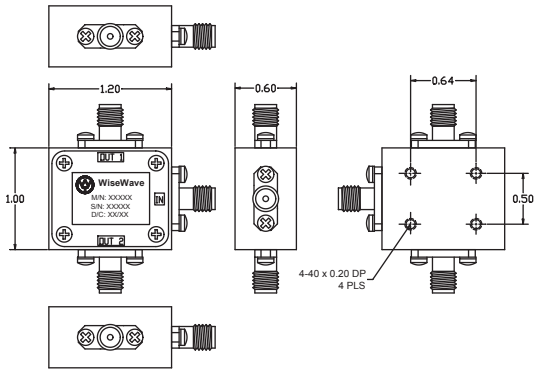
WT-E-10



Band	X	WR-75	Ku	K	Ka	Q	U	V	E	W
L	19.50	16.50	13.00	11.00	10.00	8.00	6.50	6.00	5.50	5.00
A	1.90	1.85	1.75	1.50	1.40	1.20	1.20	1.00	1.00	1.00
B	0.95	0.95	0.90	0.70	0.60	0.70	0.70	0.60	0.60	0.60
D	0.45	0.43	0.35	0.21	0.18	0.15	0.13	0.11	0.10	0.09

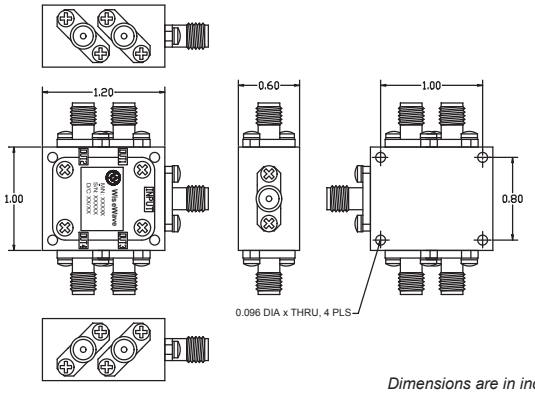
Dimensions are in inches

WT-E-11



Dimensions are in inches

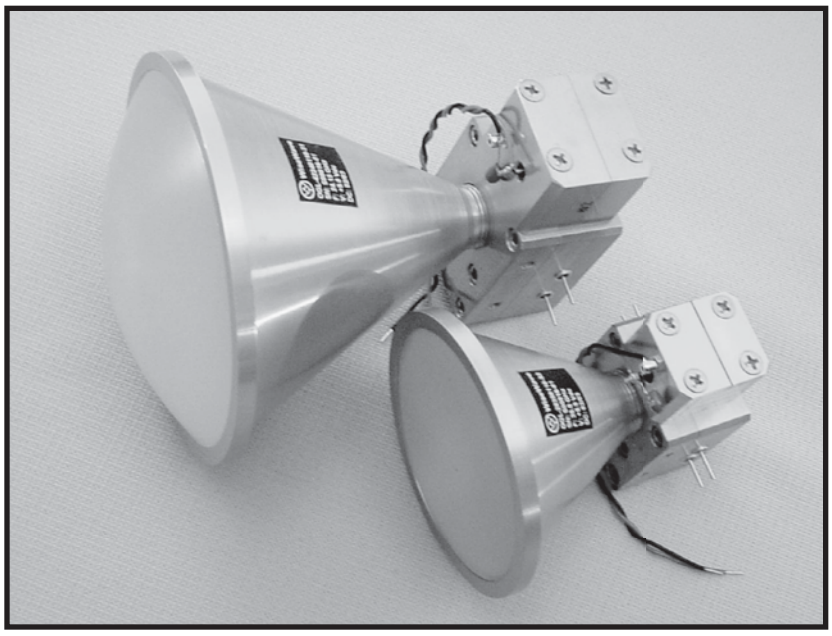
WT-E-12



Dimensions are in inches

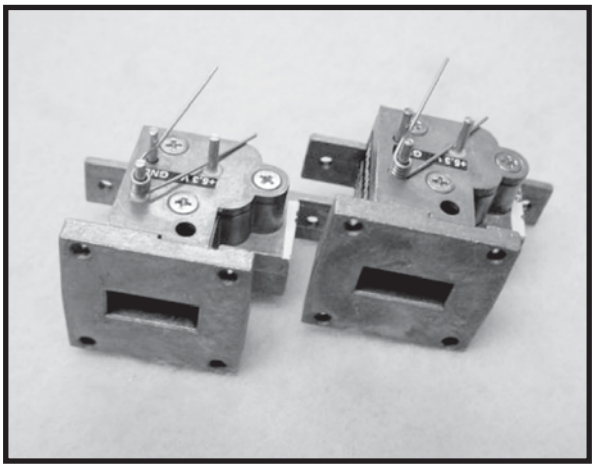
The flange pattern shown is for illustration purpose. Refer to Technical Reference Section for flange pattern details. The outline drawings shown are standard versions. Contact factory for your specific package requirements.

8. Subsystems



FEATURES

- High reliability
- High sensitivity
- CW and pulse operation
- Low harmonic emission
- Compact size
- Low cost and volume production
- Meet FCC, PTT, FTZ and DTI regulations



SMD Series

APPLICATIONS

- Intrusion alarm
- Automatic door opener
- Speed measurement
- Contact less vibration measurement
- Traffic signal actuator
- Automatic illumination system

DESCRIPTION

SMD series K band **Motion Detector Modules** are designed for **short-range** motion/speed detection where the cost is essential. The modules are constructed with a T/R diplexer, a single ended mixer and a frequency and power adjustable Gunn diode oscillator. The module uses the low cost die-cast housing to further reduce the manufacturing cost while maintain a ridged mechanical configuration. The integrated design offers compact size and ease system integration. The dual channel version is available per request.

SPECIFICATIONS

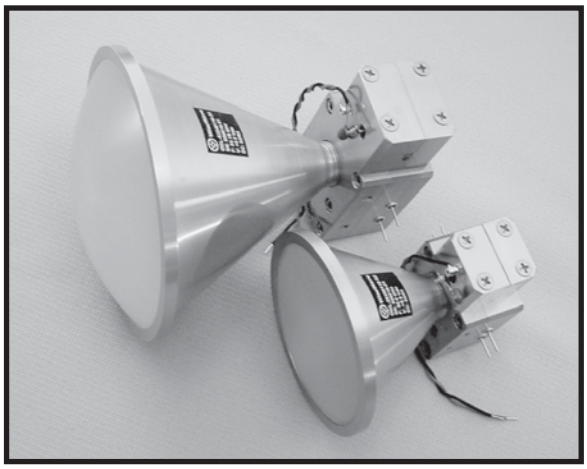
Typical Specifications		
Parameters	CW (Model No.: SMD-240912CW-02)	Pulse (Model No.: SMD-240912PS-02)
RF frequency	24.150 GHz	24.150 GHz
Transmitter output power	+8.5 dBm (typical)	+8.5 dBm (typical)
Receiver conversion loss	12 dB (typical)	12 dB (typical)
IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Operation Voltage	4.5 to 5.5 Vdc	6 to 8.5 Vdc, 2% Duty Cycle
Operating Current	90 to 160 mA	N/A
Detector Voltage	0.3 (Volts) into 2 K-ohm Load	0.3 (Volts) into 2 K-ohm Load
$\Delta F/\Delta T$	-0.50 MHz/°C (maximum)	-0.50 MHz/°C (maximum)
$\Delta P/\Delta T$	-0.04 dB/°C (maximum)	-0.04 dB/°C (maximum)
Operation temperature	-40 to +85 °C	-40 to +85 °C
Storage temperature	-50 to + 90 °C	-50 to + 90 °C

FEATURES

- High sensitivity
- Low 1/f noise
- Circular polarized waveform
- Low harmonic and spurious emission
- Temperature and vibration qualified
- Compact size
- Low cost and volume production

APPLICATIONS

- Automotive Radar
- Doppler Radar
- Directional sensor
- Long range motion detector



SRF Series

DESCRIPTION

SRF series Single and Dual Channel Doppler Sensor Heads are designed for **long range** motion/speed/directional detection where the sensitivity is essential. The sensors are constructed with a high performance horn antenna or horn-lens antenna, a linear to circular polarizer and T/R diplexer, a balanced mixer (I/Q mixer for dual channel version) and a high performance Gunn diode oscillator or dielectric resonator oscillator/multiplier chain. The low 1/f noise mixer diodes and high performance oscillator enhance Doppler detection at low IF frequency and circular polarization waveform improves reception ability for various Radar targets. The sensors are offered with single or dual channel version. The dual channel version provides target moving direction (approaching or receding) information of the target while detecting speed.

Standard products are offered at 24.15 GHz, 35 GHz and 76.5 GHz, while other frequency bands are available upon request.

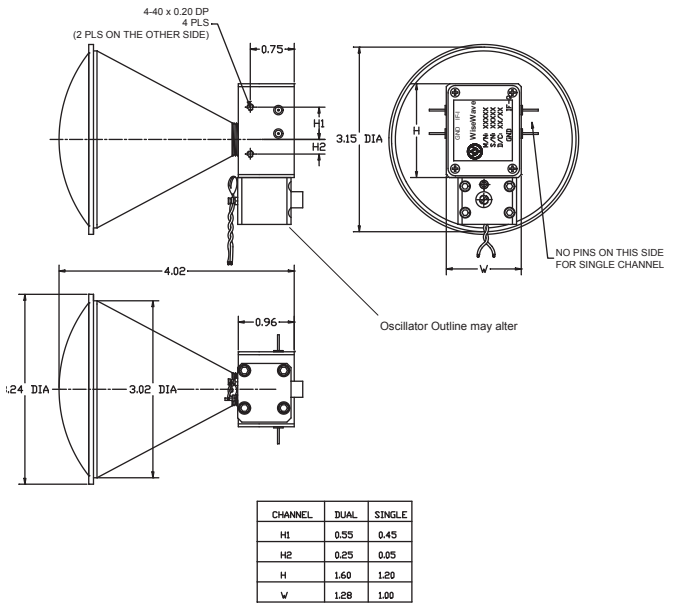
SPECIFICATIONS

Typical Specifications (Single Channel)			
Parameters / Model #	SRF-24120610-01	SRF-35120610-01	SRF-77120910-01
RF frequency	24.150 GHz	35.500 GHz	76.500 GHz
Transmitter output power	+10 dBm (typical)	+10 dBm (typical)	+10 dBm (typical)
Receiver conversion loss	6 dB (typical)	6 dB (typical)	9 dB (typical)
IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Antenna 3 dB beamwidth	12 degrees (typical)	12 degrees (typical)	12 degrees (typical)
Antenna side lob level	-20 dB (maximum)	-20 dB (maximum)	-20 dB (maximum)
Polarization	right hand circular	right hand circular	right hand circular
Spurious and harmonics	-16 dBc (maximum)	-16 dBc (maximum)	-16 dBc (maximum)
$\Delta F/\Delta T$	-0.20 MHz/°C (maximum)	-0.40 MHz/°C (maximum)	-4.0 MHz/°C (typical)
$\Delta P/\Delta T$	-0.03 dB/°C (maximum)	-0.04 dB/°C (maximum)	-0.04 dB/°C (typical)
DC bias	+5.5 V / 250 mA (typical)	+5.5 V / 350 mA (typical)	+5.5 V / 650 mA (typical)
Operation temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Outline drawing	WT-C-A1	WT-C-A2	Consult factory

Typical Specifications (Dual Channel)			
Parameters / Model #	**SRF-24120910-D1**	**SRF-35121010-D1**	**SRF-77121210-D1**
RF frequency	24.150 GHz	35.500 GHz	76.500 GHz
Transmitter output power	+10 dBm (typical)	+10 dBm (typical)	+10 dBm (typical)
Receiver conversion loss	9 dB (typical)	10 dB (typical)	12 dB (typical)
IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
I/Q Channel Phase	90 °± 10 °	90 °± 10 °	90 °± 20 °
Antenna 3 dB beamwidth	12 degrees (typical)	12 degrees (typical)	12 degrees (typical)
Antenna side lob level	-20 dB (maximum)	-20 dB (maximum)	-20 dB (typical)
Polarization	right hand circular	right hand circular	right hand circular
Spurious and harmonics	-16 dBc (maximum)	-16 dBc (maximum)	-16 dBc (maximum)
ΔF/ΔT	-0.20 MHz/°C (maximum)	-0.40 MHz/°C (maximum)	-4.0 MHz/°C (typical)
ΔP/ΔT	-0.03 dB/°C (maximum)	-0.04 dB/°C (maximum)	-0.04 dB/°C (typical)
DC bias	+5.5 V / 250 mA (typical)	+5.5 V / 350 mA (typical)	+5.5 V / 650 mA (typical)
Operation temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Outline drawing	WT-C-A1	WT-C-A2	Consult factory

OUTLINES

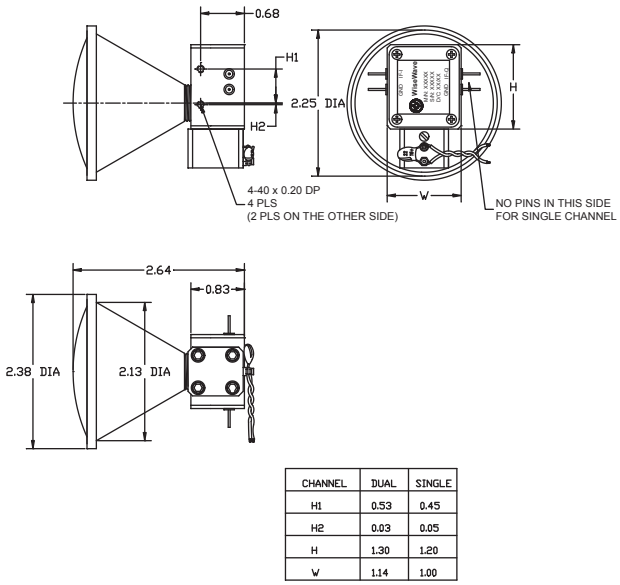
WT-C-A1



CHANNEL	DUAL	SINGLE
H1	0.55	0.45
H2	0.25	0.05
H	1.60	1.20
W	1.28	1.00

K Band Doppler Sensor Heads

WT-C-A2



CHANNEL	DUAL	SINGLE
H1	0.53	0.45
H2	0.03	0.05
H	1.30	1.20
W	1.14	1.00

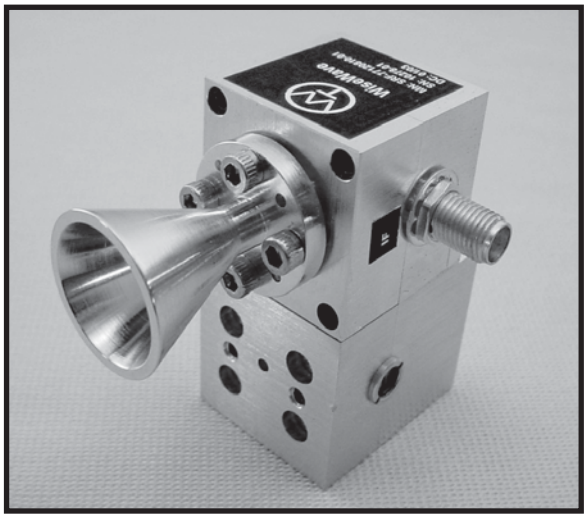
Ka Band Doppler Sensor Heads

FEATURES

- High sensitivity
- Low 1/f noise
- Circular polarized waveform
- Low harmonic and spurious emission
- Temperature and vibration qualified
- Compact size
- Low cost and volume production

APPLICATIONS

- Automotive Radar
- Ranging Radar



SRR Series

DESCRIPTION

SRR series ranging sensor heads are designed for **long range** distance detection where the sensitivity is essential. The sensors are constructed with a high performance horn antenna or horn-lens antenna, a linear to circular polarizer and T/R diplexer, a balanced mixer and a high performance varactor tuned Gunn oscillator or dielectric resonator VCO/multiplier chain. The low 1/f noise mixer diodes and high performance oscillator enhance the detection sensitivity at low IF frequency and circular polarization waveform improves reception ability for various Radar targets. The standard models are offered with single channel output and the dual channel version are available per request.

Standard products are offered at 24.15 GHz, 35.0 GHz and 76.5 GHz, while other frequency bands are available upon request.

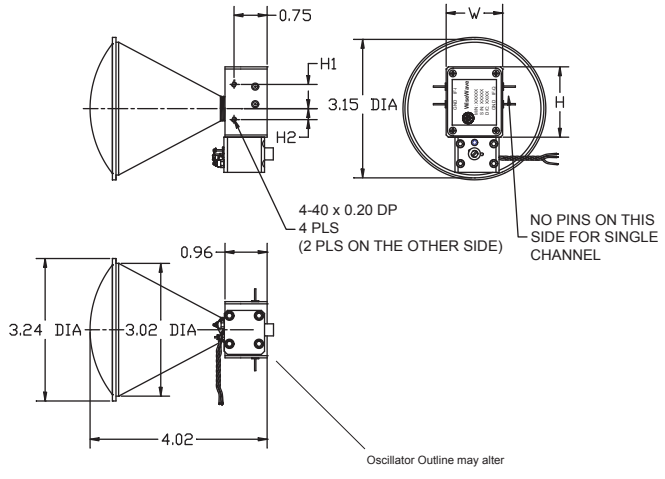
SPECIFICATIONS

Parameters / Model #	SRR-24120610-01	SRR-35120610-01	SRR-77120910-01
RF frequency	24.150 GHz	35.500 GHz	76.500 GHz
Varactor Tuning Range	50 MHz (Min) / 0 to +20 V (Typ.)	100 MHz (Min) / 0 to +20 V (Typ.)	250 MHz (Min) / 0 to +20 V (Typ.)
Transmitter output power	+10 dBm (typical)	+10 dBm (typical)	+10 dBm (typical)
Receiver conversion loss	6 dB (typical)	6 dB (typical)	9 dB (typical)
IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Antenna 3 dB beamwidth	12 degrees (typical)	12 degrees (typical)	12 degrees (typical)
Antenna side lob level	-20 dB (maximum)	-20 dB (maximum)	-20 dB (maximum)
Polarization	right hand circular	right hand circular	right hand circular
Spurious and harmonics	-16 dBc (maximum)	-16 dBc (maximum)	-16 dBc (maximum)
ΔF/ΔT	-0.20 MHz/°C (maximum)	-0.40 MHz/°C (maximum)	-4.0 MHz/°C (typical)
ΔP/ΔT	-0.03 dB/°C (maximum)	-0.04 dB/°C (maximum)	-0.04 dB/°C (typical)
DC bias	+5.5 V / 250 mA (typical)	+5.5 V / 350 mA (typical)	+5.5 V / 650 mA (typical)
Operation temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Outline drawing	WT-C-A3	WT-C-A4	Consult factory

Typical Specifications (Dual Channel)			
Parameters / Model #	**SRR-24120910-D1**	**SRR-35121010-D1**	**SRR-77121210-D1**
RF frequency	24.150 GHz	35.500 GHz	76.500 GHz
Varactor tuning range	50 MHz (Min) 0 to +20 V (Typ.)	100 MHz (Min) 0 to +20 V (Typ.)	250 MHz (Min) 0 to +20 V (Typ.)
Transmitter output power	+10 dBm (typical)	+10 dBm (typical)	+10 dBm (typical)
Receiver conversion loss	9 dB (typical)	9 dB (typical)	12 dB (typical)
IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Antenna 3 dB beamwidth	12 degrees (typical)	12 degrees (typical)	12 degrees (typical)
Antenna side lob level	-20 dB (maximum)	-20 dB (maximum)	-20 dB (maximum)
Polarization	right hand circular	right hand circular	right hand circular
Spurious and harmonics	-16 dBc (maximum)	-16 dBc (maximum)	-16 dBc (maximum)
ΔF/ΔT	-0.20 MHz/°C (maximum)	-0.40 MHz/°C (maximum)	-4.0 MHz/°C (typical)
ΔP/ΔT	-0.03 dB/°C (maximum)	-0.04 dB/°C (maximum)	-0.04 dB/°C (typical)
DC bias	+5.5 V / 250 mA (typical)	+5.5 V / 350 mA (typical)	+5.5 V / 650 mA (typical)
Operation temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Outline drawing	WT-C-A3	WT-C-A4	Consult factory

OUTLINES

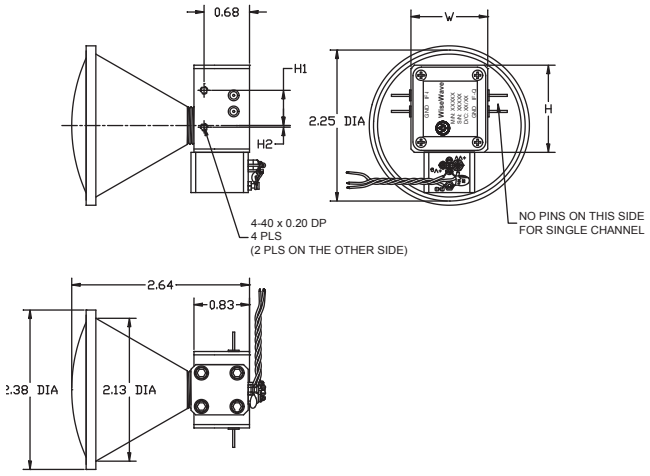
WT-C-A3



CHANNEL	DUAL	SINGLE
H1	0.55	0.45
H2	0.25	0.05
H	1.60	1.20
W	1.28	1.00

K Band Ranging Sensor Heads

WT-C-A4



CHANNEL	DUAL	SINGLE
H1	0.53	0.45
H2	0.03	0.05
H	1.30	1.20
W	1.14	1.00

Ka Band Ranging Sensor Heads

Ducommun offers three types of microwave and millimeterwave sensor heads. They are **Doppler Sensor Heads**, **Directional Doppler Sensor Heads (SRF Series)** and **Ranging Sensor Heads (SRR Series).** The main objectives of the application notes are to explain the basic principles of Doppler Radar and Ranging (Distance) Radar and how Ducommun's sensor heads should be implemented to configure such Radar systems.

Doppler Radar

It is well known that **Doppler Radar** is widely used for speed measurement. The principle behind the Doppler Radar is the frequency shift of a microwave signal bounced back by a moving object. The resultant frequency shift is known as **Doppler Frequency Shift**, which is given by the following equation

F_d = 2V (Fo/C) Cos (θ)

Where:

Fo is the transmitter frequency (Hertz).
C is the speed of light, which is 3 x 10^8 (meter/sec).
V is the speed of the target (meter/sec).
θ is the angle between the radar beam and the moving target (in degrees) as shown in Fig. 1.

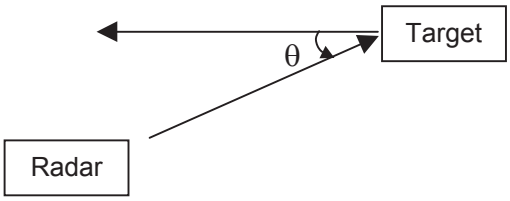


Figure 1. Doppler Shift

When moving target moves perpendicular to the radar beam, the Fd equals 0, which indicates no Doppler shift. On the other hand, the F_d is equal to 2V(Fo/C) when the target moves parallel to the radar beam or if **q** is real small (0 to 10 degrees).

SRF series single channel Doppler sensor heads offered by Ducommun are designed for **long range** Doppler Radar application where detection sensitivity is essential.

The simplified block diagram of a Doppler Radar formed by using Ducommun's single channel sensor head is shown in Fig. 2. A high quality DC power supply for Gunn oscillator bias, a low noise IF amplifier and DSP circuitry are the minimum requirements for a system designer to realize such a radar system. In addition, the moving target radar cross section, detection distance and target speed are the main factors in consideration when specifying the transmitting power, antenna gain and IF frequency bandwidth of the sensor head. The example of the IF frequency range of a 24.15 GHz and 76.5 GHz Doppler radar at various speeds is shown in the following table.

Transmitting Freq. (GHz)	24.15		
Speed (Km/Hr.)	10	80	200
IF (Hz)	224	1,790	4,475
Transmitting Freq. (GHz)	**76.50**		
Speed (Km/Hr.)	10	80	200
IF (Hz)	709	5,670	14,176

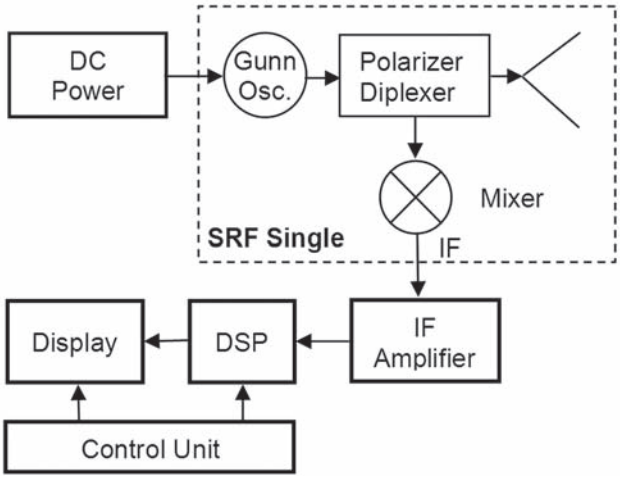


Figure 2. Simplied Doppler Radar

Doppler Directional Radar

In certain applications, one not only has to know the target speed, but also the target moving directions, i.e., whether the target is approaching to the radar or receding from the Radar. The examples for such applications are the law enforcement radar systems used by police officer or door openers in the building entrance. Also, such radar systems are often used for distinguishing vibrating targets, fan rotations or curtain movements caused by the wind from a real intrusion in the security system.

The implement of the directional information is realized by adding an additional mixer to the single channel sensor head with a 90 degrees phase difference. The mixer used in the directional sensor is sometimes known as phase detector or I/Q mixer. The phase relationship between two mixers is that the first mixer will lead the second, or the phase shift is positive if the target is approaching the radar, while the phase will lag if the target is receding from the radar.

SRF series dual channel Doppler sensor heads offered by Ducommun are designed for **long range** Directional Doppler Radar applications where detection sensitivity is essential.

The simplified block diagram of a Directional Doppler Radar achieved by using Ducommun's dual channel sensor head is shown in the Fig. 3. In a similar manner, a high quality DC power supply for Gunn oscillator bias, a low noise IF amplifier and DSP circuitry are the minimum requirements for a system designer to realize such a radar system.

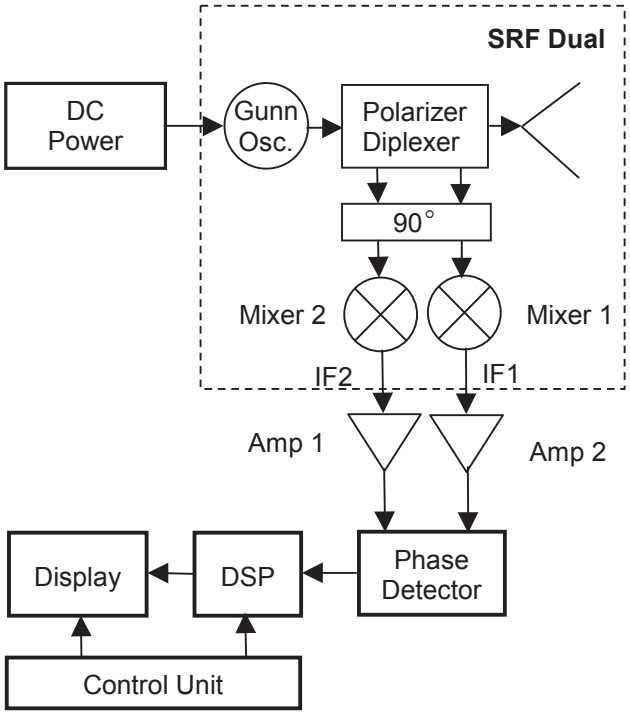


Figure 3. Simplied Directional Doppler Radar

SRR series dual channel Doppler sensor heads offered by Ducommun are designed for **long range** FMCW Radar application.

Ranging (Distance) Radar

In many applications, one has to know not only the speed of a moving target, but also the range or distance between the moving or stationary target and the radar. In this case, a Frequency Modulation Continuos Waveform (FMCW) technique may be used in the sensor head to realize the ranging radar.

Implementing the FMCW technique in the sensor head is to replace the fixed tuned oscillator with a Varactor or voltage tuned one.

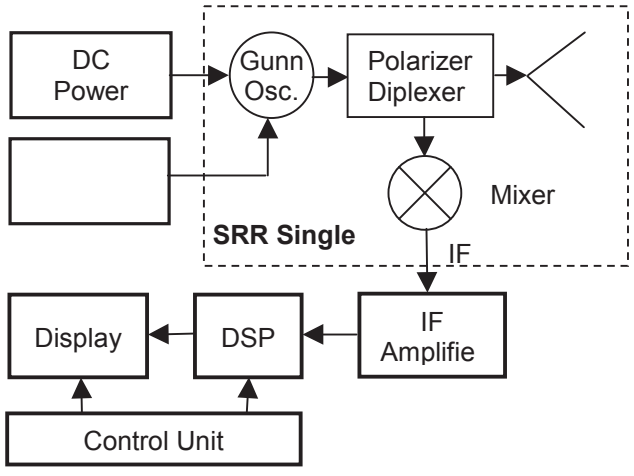


Figure 4. Simplied FMCW Ranging Radar

The simplified block diagram of an FMCW Radar formed by using Ducommun's single channel sensor head is shown in the Fig. 4. In a similar manner, a high quality DC power supply for Gunn oscillator bias, a voltage modulator, a low noise IF amplifier and DSP circuitry are the minimum requirements for a system designer to realize such a radar system. The range information can be extracted from the frequency difference between the transmitted and returned signal at distance R, the signal transit time (ΔT) and the frequency modulation rate (N). The idea is briefly illustrated in the Fig. 5. The detail is explained as follow. At time T1, the signal is transmitted and fed to the mixer at frequency F1. The F1 returned from the target at distance R is received at T2, while the transmitting and LO frequency is F2. With known ramping rate (N), one can find the transit time by using

$\Delta T = (Ft-Fr)/N$,

where **Ft** and **Fr** are the IF frequency at mixer IF port in Hz and **N** is Hz/sec.

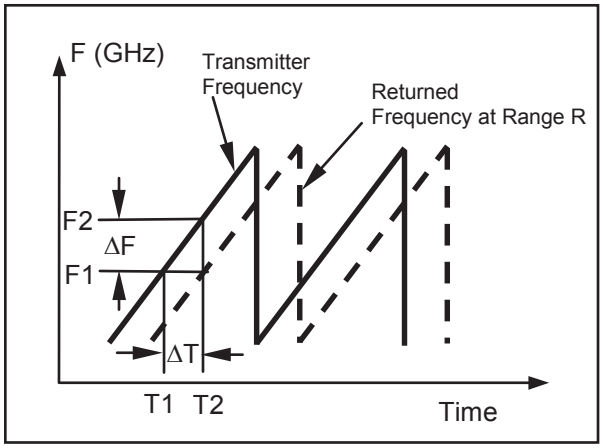


Figure 5. FMCW Radar Frequency vs. Time

Therefore, the range (distance) is given by

R = (ΔT x C)/2

Where **C** is the speed of light, which is 3 x 10^8 (meter/sec).

The range accuracy is governed by the ramp linearity.

From the description above, an FMCW ranging radar can detect not only the stationary target, but also the moving target. Therefore, an FMCW radar is a Doppler Ranging Radar.

Ranging (Distance) Radar with Directional Doppler Feature

With a similar idea, Ducommun's **SRR series** Dual channel sensor head offers ranging capacity with directional features. The simplified block diagram is shown in Fig. 6.

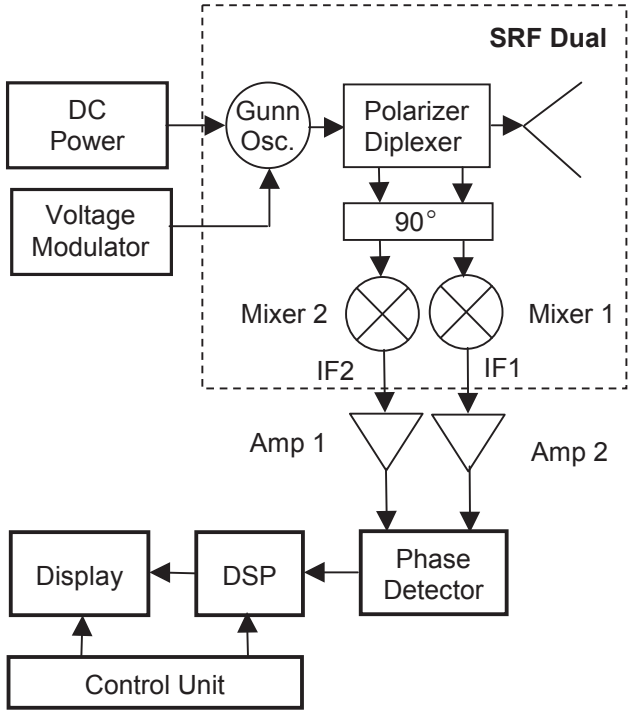


Figure 6. Simplied FMCW Ranging Radar with Directional Doppler Feature

Conclusions

1. Ducommun's **SRF and SRR series** sensor heads offer total solutions for **Long Range** Radar system requirements.

2. Ducommun's **SRF and SRR series** sensor heads can be tailored to various transmitting power levels and antenna gains.

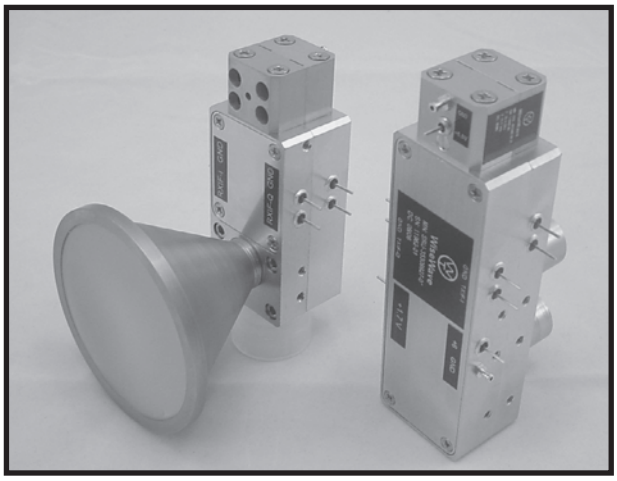
8

FEATURES

- High sensitivity
- Low 1/f noise
- Circular polarized waveform
- Low harmonic and spurious emission
- Temperature and vibration qualified
- Compact size
- Low cost and volume production

APPLICATIONS

- Automotive Radar
- Doppler Ranging Radar



SRU Series

DESCRIPTION

SSRU series ranging sensor heads are designed for **long range** distance detection where the sensitivity is essential. The **SRU series** ranging sensors are used for **moving target** (where Doppler shift is presented) distance detection. The technology key is to utilize a single side band up-converter (modulator) to generate a second frequency in addition to its master frequency. By comparing the returned signals from the target caused by these two frequencies, the ranging (distance) information of the target can be extracted.

Four configurations are offered for special applications. The single channel versions are used for **speed** and **distance** sensing only while dual channel versions are offered for **speed**, **distance** and **direction** sensing. In addition, dual antenna versions are offered for high power version to eliminate the limited TX/RX isolation problems due to the diplexer. The single antenna versions are constructed with a high performance horn antenna or lens corrected antenna, a linear to circular polarizer and T/R diplexer, a single side band up-converter or modulator, a balanced mixer or an I-Q mixer and an amplifier and a high performance Gunn oscillator. The deviation of the dual antenna versions is that an additional antenna is used and no diplexer is required. The low 1/f noise mixer diodes and high performance oscillator enhance the detection sensitivity at low IF frequency and circular polarization waveform improves reception ability for various Radar targets.

Standard products are offered at 35.0 GHz, while other frequency bands are available upon request.

Specify Model Number:

SRU – CF BW IF PP - XY

- CF: Center Frequency in GHz
- BW: Antenna 3 dB Beamwidth Use “NA” for NO Antenna
- IF: TX IF Frequency in MHz
- PP: TX Output Power in dBm
- XY: “0” for Single Channel, “D” for Dual Channel; “1” for Single Antenna, “D” for Dual Antenna

Example: A dual channel, dual antenna sensor with center frequency 35 GHz, antenna beamwidth 12 degrees, TX input frequency 2 MHz and output power 30 dBm, the model number is SRU-35120230-DD.

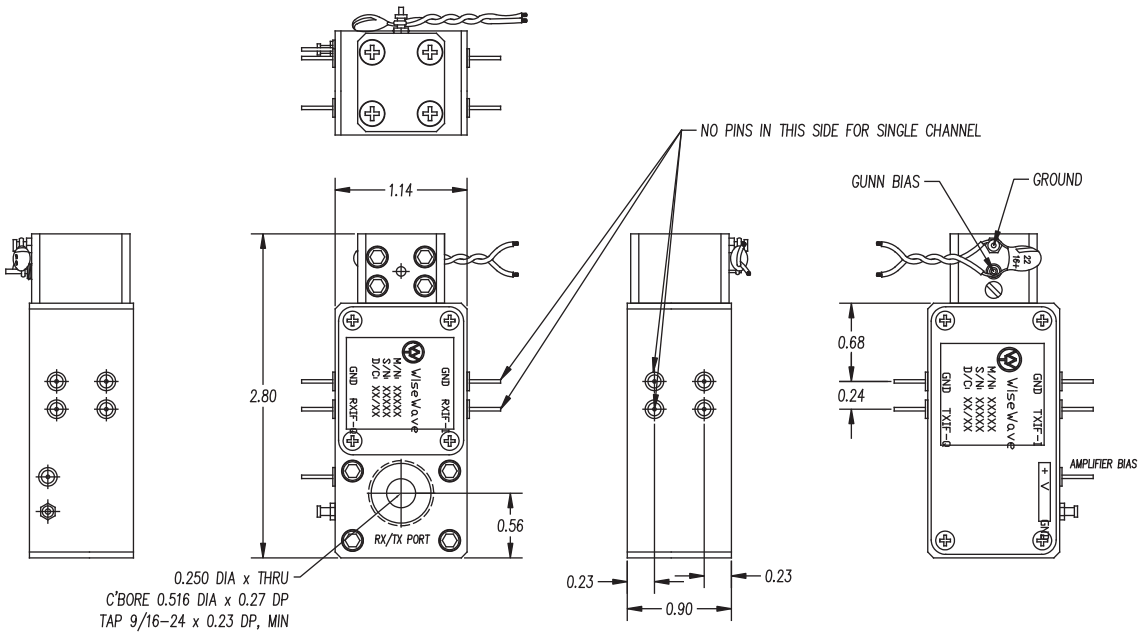
STANDARD MODELS

Typical Specifications (Single Channel)		
Parameters	SRU-35NA9910-01	SRU-35NA9927-0D
RF Frequency	35.000 GHz	35.000 GHz
Transmitter output power	+10 dBm (typical)	0 to 100 MHz (Min)
Transmitter IF Bandwidth	0 to 100 MHz (Min)	12 dB
Receiver conversion loss	6 dB (typical)	6 dB (typical)
RX IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Antenna 3 dB beamwidth	To be specified by customer	To be specified by customer (30 Degrees or wider)
Antenna side lob level	To be specified by customer	To be specified by customer
Polarization	Right hand circular	Right hand circular
TX and RX isolation	20 dB (minimum)	80 dB (minimum)
ΔF/ΔT	-0.40 MHz/ΔC (maximum)	-0.40 MHz/ΔC (maximum)
ΔP/ΔT	-0.04 dB/ΔC (maximum)	-0.04 dB/ΔC (maximum)
Oscillator DC bias	+5.0 V / 250 mA (typical)	+5.0 V / 250 mA (typical)
Amplifier DC bias	+8.0 V / 250 mA (typical)	+8.0 V / 650 mA (typical)
Operation temperature	-40 to +85 ΔC	-40 to +85 ΔC

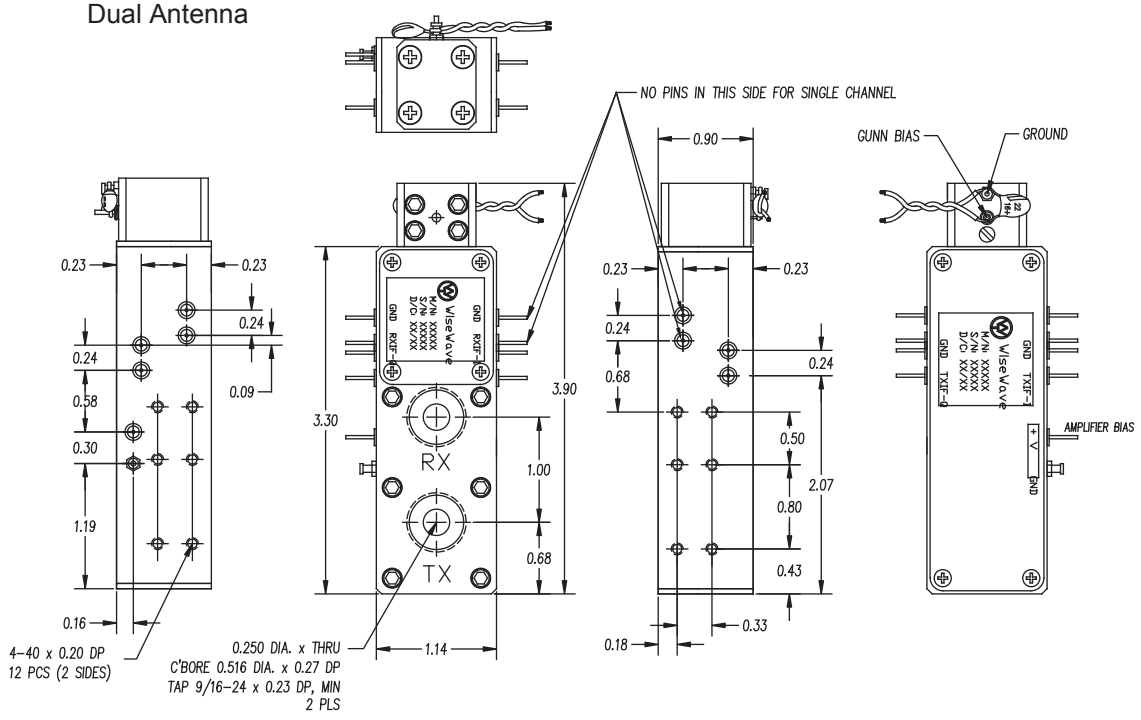
Typical Specifications (Dual Channel)		
Parameters	SRU-35NA9910-D1	SRU-35NA9927-DD
RF Frequency	35.000 GHz	35.000 GHz
Transmitter output power	+10 dBm (typical)	+27 dBm (typical)
Transmitter IF Bandwidth	0 to 100 MHz (Min)	0 to 100 MHz (Min)
Receiver conversion loss	10 dB (typical)	10 dB (typical)
RX IF bandwidth	DC to 100 MHz (minimum)	DC to 100 MHz (minimum)
Antenna 3 dB beamwidth	To be specified by customer	To be specified by customer (30 Degrees or wider)
Antenna side lob level	To be specified by customer	To be specified by customer
Polarization	Right hand circular	Right hand circular
TX and RX isolation	20 dB (minimum)	80 dB (minimum)
ΔF/ΔT	-0.40 MHz/ΔC (maximum)	-0.40 MHz/ΔC (maximum)
ΔP/ΔT	-0.04 dB/ΔC (maximum)	-0.04 dB/ΔC (maximum)
Oscillator DC bias	+5.0 V / 250 mA (typical)	+5.0 V / 250 mA (typical)
Amplifier DC bias	+8.0 V / 250 mA (typical)	+8.0 V / 650 mA (typical)
Operation temperature	-40 to +85 ΔC	-40 to +85 ΔC

Note: The standard model is offered with out antenna. Specify the antenna by type, 3 dB beamwidth and gain. The output power other than shown is available. Consult factory for your detailed requirements.

Single Antenna



Dual Antenna

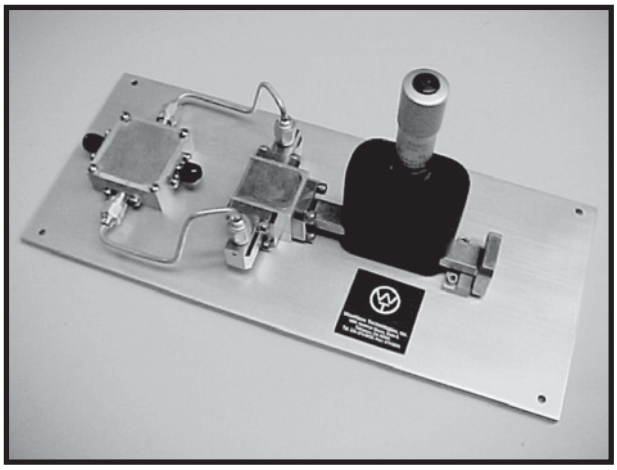


FEATURES

- Low routing loss
- High image rejection
- Separate I/Q input ports
- Low harmonic and spurious emission
- Circular or rectangular waveguide interface

APPLICATIONS

- Radar target simulator
- Single side band modulation
- Forward and backward moving object simulator



SSA Series

DESCRIPTION

SSA series Radar target simulators is a single side band (SSB) modulators, which can simulate the moving Radar target for Doppler Radar system testing. The simulator can eliminate expensive and time consuming field test for most Doppler/ speed Radar manufacturers. The modulators are available in major Doppler Radar frequency bands, such as K band (24.15 GHz), Ka band (35 GHz), V band (60 GHz), and W band (77 GHz and 94 GHz).

The simulators are capable of simulating the approching and receding moving target by varying the relative phase of I and Q channel audio input signals, the speed of the target by adjusting the audio input frequency and the size and/or distance of the target by adjusting the attenuator value.

The existing product specifications are illustrated as following. Other frequency bands are available up request.

SPECIFICATIONS

Typical Specifications (Single Channel)					
Parameters	SSA-4212-XX	SSA-2812-XX	SSA-1513-XX	SSA-1214-XX	SSA-1015-XX
Frequency (GHz)	24.150	35.50	60.00	76.50	94.00
Bandwidth (MHz)	+/- 50	+/- 75	+/- 100	+/- 100	+/- 100
Routing Loss (dB)	12 dB	12 dB	13 dB	14 dB	15 dB
Image Rejection (dBc)	-20	-20	-20	-20	-20
Attenuation Level (dB)*	30	30	30	30	30
I/Q Driven Current (mA)	10	10	10	10	10
RF Connector	WR-42 or Circular	WR-28 or Circular	WR-15 or Circular	WR-10 or Circular	WR-10 or Circular
I/Q Connectors	SMA (F)	SMA (F)	SMA (F)	SMA (F)	SMA (F)
Temperature Range	0 to +50°C				

* **Note:** 60-dB round trip.

FEATURES

- High output power
- Full waveguide bandwidth
- Extends MW frequencies to MMW bands
- Output frequency up to 110 GHz

SFE Series

APPLICATIONS

- Automatic test set
- Bench top test set
- Local oscillators
- Swept frequency sources

DESCRIPTION

SFE series of frequency extenders combine high performance millimeterwave amplifiers, passive or active multipliers and filters to extend the low frequency sweepers, such as HP 83550B or Agilent 83751B, to extreme clean and low cost millimeterwave sources. The frequency extenders cover the output frequency range of 26.5 to 110 GHz in six waveguide bands. The typical input power for these standard units are rated at + 10.0 dBm while the output power up to 20 dBm is available. The SMA (F) coaxial connector is equipped for input and standard waveguide for output interface. The dimension of the standard products is measured as 4.20” (W) x 6.15” (L) x 2.68” (H).

STANDARD PRODUCT SPECIFICATIONS

Model Number	Output Freq. (GHz)	Multiplying Factor	Input Freq. (GHz)	Output Power (dBm, Min)	Input Power (dBm, Typ.)	Output Waveguide	Bias (V/mA)
SFE-280208-01	26.5 - 40.0	X 2	13.25 - 20.0	8.0	+3.0	WR-28	+8 / 200
SFE-280220-01	26.5 - 40.0	X 2	13.25 - 20.0	20.0	+3.0	WR-28	+8 / 600
SFE-220305-01	33.0 - 50.0	X 3	11.00-16.67	5.0	+3.0	WR-22	+8 / 200
SFE-190305-01	40.0 - 60.0	X 3	13.33 - 20.0	5.0	+3.0	WR-19	+8 / 200
SFE-150405-01	50.0 - 75.0	X 4	12.5 - 18.75	3.0	+3.0	WR-15	+8 / 600
SFE-120600-01	60.0 - 90.0	X 6	10.00 - 15.00	0.0	+3.0	WR-12	+8 / 600
SFE-100600-01	75.0- 110.0	X 6	12.50 - 18.33	-3.0	+3.0	WR-10	+8 / 600
Temperature Range		0 to +50°C					

CUSTOM ORDER

Specify Model Number:

SFE-WG NN PO-XX ← Factory Reserve

WG Size

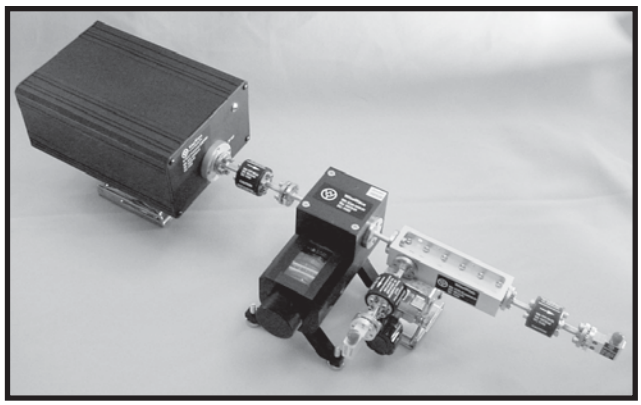
Output Power in dBm

Multiplication Factor

Example: To order a Quadriplier with WR-15 waveguide with 15 dBm output power, specify SFE-150415-XX.

FEATURES

- High output power
- Full waveguide bandwidth
- Extend MW SNA to MMW bands
- Output frequency up to 110 GHz



SNA Series

APPLICATIONS

- Bench top test set

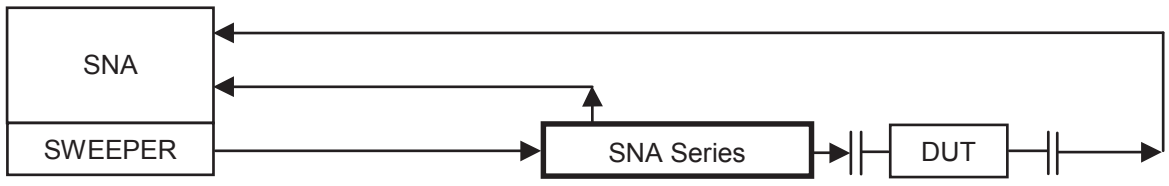
DESCRIPTION

SNA series of scalar network extenders combine high performance millimeterwave amplifiers, passive or active multipliers, filters, Faraday isolators, direct reading attenuator, high directivity directional couplers and high sensitive detectors to extend the low frequency scalar network analyzers, such as HP 8756A or HP 8757A to low cost millimeterwave scalar network analyzers. The scalar network analyzers cover the output frequency range of 26.5 to 110 GHz in six waveguide bands. The typical input power required for these standard units are + 10.0 dBm while the dynamic ranges of these extenders for insertion loss are 30 to 50 dB and return loss is 20 dB to 40 dB. The SMA (F) coaxial connector is equipped for input and standard waveguide for output interface.

STANDARD PRODUCT SPECIFICATIONS

Model Number	Output Freq. (GHz)	Multiplying Factor	Input Freq. (GHz)	Dynamic Range (IL, dB)	Dynamic Range (RL, dB)	Output Waveguide	Bias (V/mA)
SNA-280208-01	26.5 - 40.0	X 2	13.25 - 20.0	40.0	30.0	WR-28	+8 / 200
SNA-280220-01	26.5 - 40.0	X 2	13.25 - 20.0	50.0	40.0	WR-28	+8 / 600
SNA-220305-01	33.0 - 50.0	X 3	11.00-16.67	35.0	25.0	WR-22	+8 / 200
SNA-190305-01	40.0 - 60.0	X 3	13.33 - 20.0	35.0	25.0	WR-19	+8 / 200
SNA-150405-01	50.0 - 75.0	X 4	12.5 - 18.75	35.0	25.0	WR-15	+8 / 600
SNA-120600-01	60.0 - 90.0	X 6	10.0 - 15.00	30.0	20.0	WR-12	+8 / 600
SNA-100600-01	75.0- 110.0	X 6	12.5 - 18.33	30.0	20.0	WR-10	+8 / 600
Temperature Range		0 to +50°C					

APPLICATION BLOCK DIAGRAM

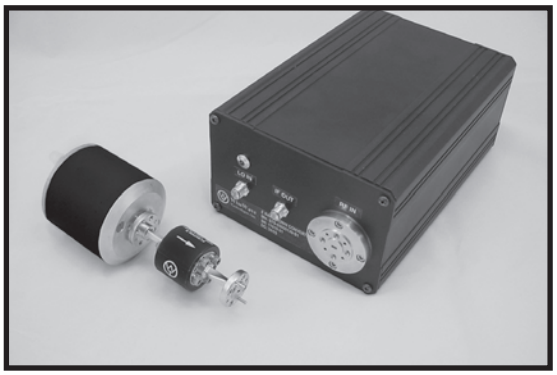


FEATURES

- Full waveguide band operation
- Compatible with various noise figure meters
- Swept measurement capacity
- Solid-state noise sources offered
- Compact and rugged package

APPLICATIONS

- Laboratory test set
- Wafer probe station
- Receivers



SNG Series

DESCRIPTION

The **SNG** Series of noise figure and gain test sets are configured to provide automatic noise and gain measurement of amplifiers or receivers in the frequency range of 26.5 to 140 GHz in seven overlapping waveguide bands. These test sets combine high performance broadband solid state noise sources with full waveguide band down converters (**STS** Series) extending the Agilent 8970A/B noise figure meters to the millimeterwave frequency range. A signal generator with output frequencies from 8 to 20 GHz, such as an Agilent 8350B/83550A or 83751B is required by the down converter unit as an LO. A complete system block diagram is shown. The standard models have SMA (F) coaxial connectors for the LO input and IF output ports of the down converters with a standard waveguide for the DUT (Device Under Test) RF input port.

SPECIFICATIONS

Model Number	Freq. Range (GHz)	Input Freq. (GHz)	Input Power (dBm)	ENR (dB)	Dynamic Range (NF/ Gain, dB0	Output Waveguide	Bias (V/mA)
SNG-28-01	26.5 – 40.0	13.25 - 20.0	10.0	15.0	NF: 0 to 20 Gain: -20 to +30	WR-28	+8 / 250
SNG-22-01	33.0 - 50.0	11.00-16.67	10.0	14.0		WR-22	+8 / 250
SNG-19-01	40.0 – 60.0	13.33 – 20.0	10.0	13.0		WR-19	+8 / 350
SNG-15-01	50.0 – 75.0	12.5 – 18.75	10.0	13.0		WR-15	+8 / 350
SNG-12-01	60.0 - 90.0	10.0 - 15.00	10.0	13.0		WR-12	+8 / 500
SNG-10-01	75.0- 110.0	12.5 – 18.33	10.0	12.0		WR-10	+8 / 500
SNG-08-01	90.0 to 140.0	10.0 – 15.56	10.0	12.0		WR-8	+8 / 500

Note: Consult factory for other noise/gain test set configurations.

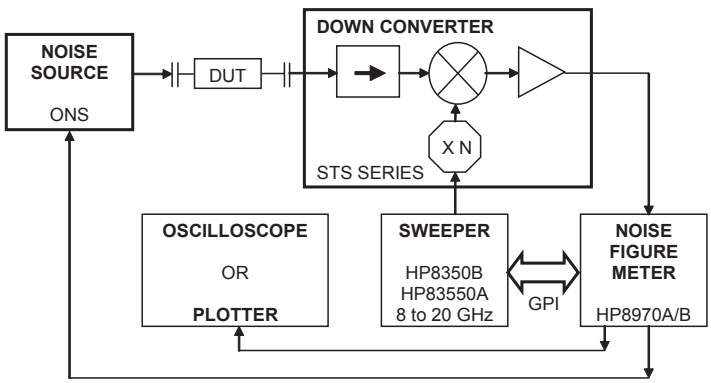
TECHNICAL NOTATION

The oscilloscope, sweeper and noise figure meter are not part of the standard noise/gain test set offered. The OEM model numbers shown in the block diagram are for reference only. Models other than those shown that have similar functionality, or are from other manufacturers, can also be used.

OUTLINE

Refer to ONS data sheet for noise sources outline.

BLOCK DIAGRAM



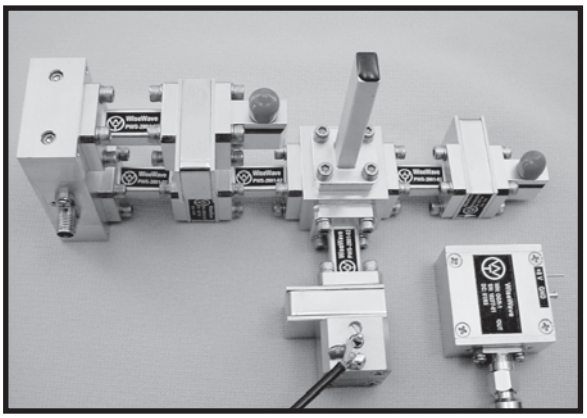
FEATURES

- Custom designed
- Integrated module or bolt together solution
- High performance
- Quick delivery
- Cost effective

APPLICATIONS

- Radar
- Sensors
- Modules
- Test set

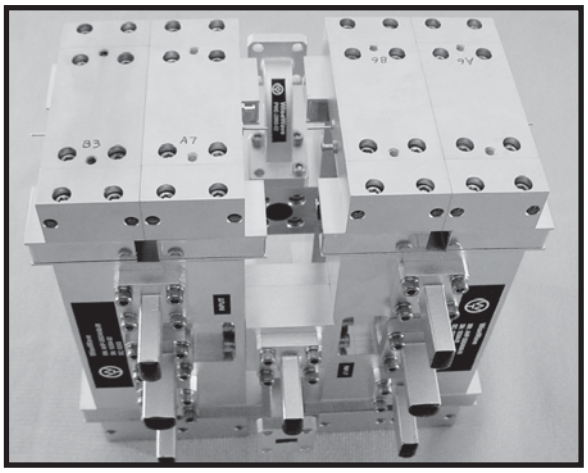
DESCRIPTION



30 GHz Plasma Detection Sensor Assembly

Ducommun understands customers' needs. Ducommun not only supplies the standard and custom made components and modules, but also understands the importance of providing engineering design and service to its customers.

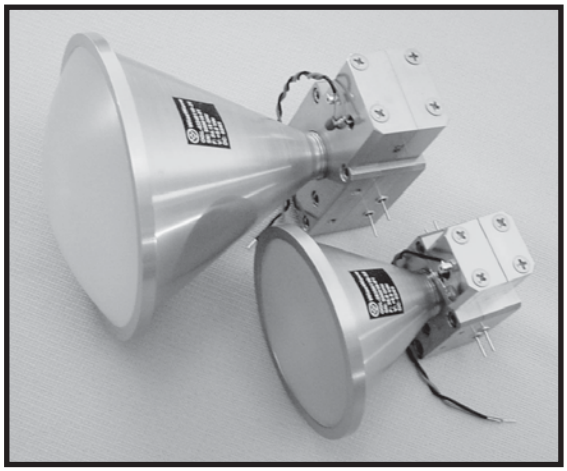
Ducommun's self-contained, in-house components design and fabrication capacities ensured the breath of sub-assemblies offer from rapid prototyping and proof of concept to full production. **Ducommun** has produced many high performance millimeterwave band sub-assemblies for specific commercial and military system applications.



35 GHz 10 W PA Assembly

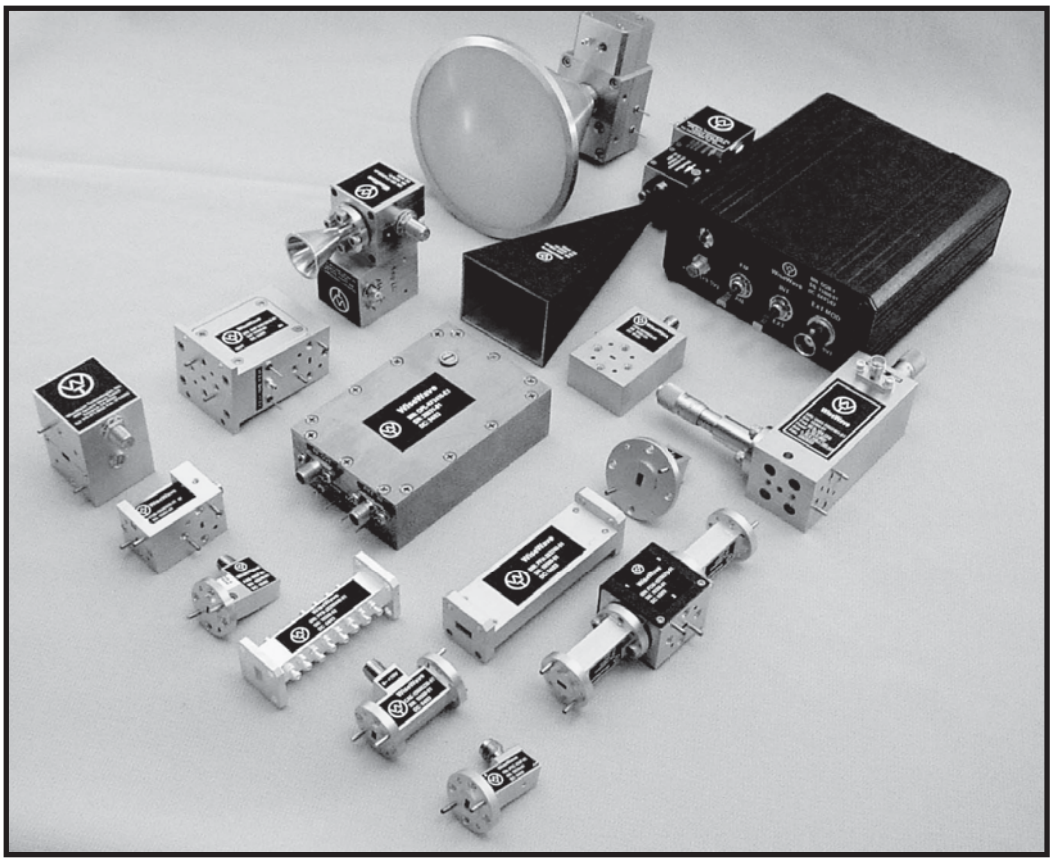
Among them, the K and Ka band directional Doppler Radar front ends are in production. More than one thousand sets have been delivered. In addition, Ducommun has delivered Ka through W band engineering prototypes for plasma detection system, automotive Radar, speed Radar, automatic test set, Radio Telescope, Missile terminal guidance, telecommunication system, etc. applications.

Ducommun is approved to be a company who can not only supply high performance catalog products, but also realize a concept into the hardware with state-of-the-art performance prototypes and cost effective volume production.



K and Ka Band Doppler Sensor Assemblies

9. Technical Reference



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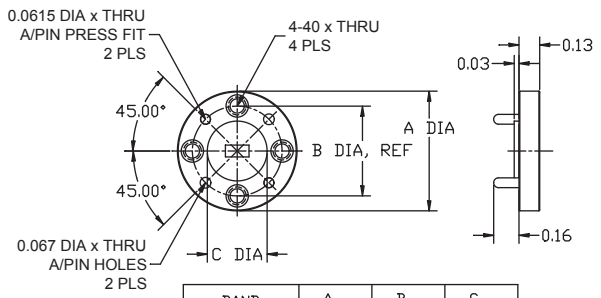
Rectangular Waveguide and Flange Designations

Bands	U.S.A. (EIA) (JAN)	U.K. WG I.E.C.	Operating Frequency Range (GHz)	Cut-off Frequncy (GHz)	Waveguide Inner Size (Inches)	Cover Flange* MIL-F-3922/ UG	Flange Type
X	WR-90 RG-52/ U	WG-16 R100	8.2 to 12.4	6.56	0.900 x 0.400	53-001 UG-39/ U	Square
	WR-75 RG-346/ U	WG-17 R120	10.0 to 15.0	7.87	0.750 x 0.375	53-007 -	Square
Ku	WR-62 RG-91/ U	WG-18 R140	12.4 to 18.0	9.48	0.622 x 0.311	53-005 UG-419/ U	Square
	WR-51 RG-352/ U	WG-19 R180	15.0 to 22.0	11.57	0.510 x 0.255	70-010 -	Square
K	WR-42 RG-53/ U	WG-20 R220	18.0 to 26.5	14.05	0.420 x 0.170	54-001 UG-595/ U	Square
	WR-34 RG-53/ U	WG-21 R260	22.0 to 33.0	17.33	0.340 x 0.170	- UG-1530/ U	Square
Ka	WR-28 RG-96/ U	WG-22 R320	26.5 to 40.0	21.08	0.280 x 0.140	54-003 UG-599/ U	Square
Q (B)	WR-22 RG-97/ U	WG-23 R400	33.0 to 50.0	26.34	0.224 x 0.112	67B-006 UG-383/ U	Round
U	WR-19 RG-358/ U	WG-24 R500	40.0 to 60.0	31.36	0.188 x 0.094	67B-007 UG-383/ U-M	Round
V	WR-15 RG-98/ U	WG-25 R620	50.0 to 75.0	39.86	0.148 x 0.074	67B-008 UG-385/ U	Round
E	WR-12 RG-99/ U	WG-26 R740	60.0 to 90.0	48.35	0.122 x 0.061	67B-009 UG-387/ U	Round
W	WR-10 RG-359/ U	WG-27 R900	75.0 to 110.0	59.01	0.100 x 0.050	67B-010 UG-387/ U-M	Round
F	WR-8 RG-138/ U	WG-28 R1200	90.0 to 140.0	73.84	0.080 x 0.040	- UG-387/ U-M	Round
D	WR-6 RG-276/ U	WG-29 R1400	110.0 to170.0	90.84	0.065 x 0.0325	- UG-387/ U-M	Round

***Note**: The flange material is brass. The flange number is different if the material is aluminum.

Round

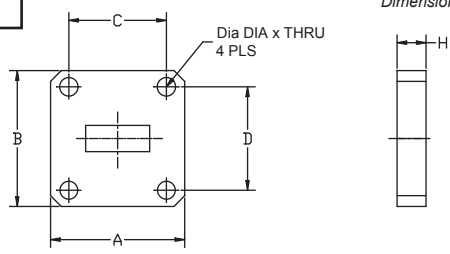
Dimensions are in inches



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

Square

Dimensions are in inches



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 Designations

Bands		Frequency Range (GHz)	Circular Waveguide Diameter (Inches)	Cover Flange* MIL-F-3922 UG	Flange Type
X	Low	8.2 to 9.97	1.094	53-001 UG-39/ U	Square
	Medium	8.5 to 11.6	0.938		
	High	9.97 to 12.4	0.797		
Ku	Low	12.4 to 15.9	0.688	53-005 WG-419/U	Square
	Medium	13.4 to 18.0	0.594		
	High	15.9 to 18.0	0.500		
K	Low	18.0 to 20.5	0.455	54-001 UG-595/U	Square
	Medium	20.0 to 24.5	0.396		
	High	24.0 to 26.5	0.328		
Ka	Low	26.5 to 33.0	0.315	54-003 UG-599/U	Square
	Medium	33.0 to 38.5	0.250		
	High	38.5 to 40.0	0.219		
Q (B)	Low	33.0 to 38.5	0.250	67B-008 UG-383/ U	Round
	Medium	38.5 to 43.0	0.219		
	High	43.0 to 50.0	0.188		
U	Low	40.0 to 43.0	0.210	67B-007 UG-383/U-M	Round
	Medium	43.0 to 50.0	0.188		
	High	50.0 to 60.0	0.165		
V	Low	50.0 to 58.0	0.165	67B-008 UG-385/U	Round
	Medium	58.0 to 68.0	0.141		
	High	68.0 to 75.0	0.125		
E	Low	68.0 to 75.0	0.136	67B-009 UG-387/U	Round
	Medium	66.0 to 88.0	0.125		
	High	88.0 to 90.0	0.094		
W	Low	75.0 to 88.0	0.112	67B-010 UG-387/U-M	Round
	High	88.0 to 110.0	0.094		
F	Low	90.0 to 115.0	0.089	- UG-387/U-M	Round
	High	115.0 to 140.0	0.075		
D	Low	110.0 to 140.0	0.073	- UG-387/U-M	Round
	High	140.0 to 160.0	0.059		

***Note**: The flange material is brass. The flange number is different if the material is aluminum.

Coax Connectors

Connector Type	Frequency Range (GHz)	Ducommun Technologies' Designations	
N	DC to 18.0	**NF** - Female Connector	**NM** - Male Connector
7 mm or APC-7	DC to 18.0	**7F** - Female Connector	**7M** - Male Connector
SMA	DC to 18.0	**SF** - Female Connector	**SM** - Male Connector
Super SMA	DC to 27.0	**SF** - Female Connector	**SM** - Male Connector
3.5 mm	DC to 26.5	**3F** - Female Connector	**3M** - Male Connector
2.92 mm or K	DC to 40.0	**KF** - Female Connector	**KM** - Male Connector
2.4 mm	DC to 50.0	**2F** - Female Connector	**2M** - Male Connector
1.85 mm or V	DC to 65.0	**VF** - Female Connector	**VM** - Male Connector
1 mm	DC to 110.0	**1F** - Female Connector	**1M** - Male Connector

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Return Loss, VSWR, Reflection Coefficient and Mis-match Loss

Return Loss (dB)	VSWR	Reflection Coef-ficient	Mismatch Loss (dB)	Return Loss (dB)	VSWR	Reflection Coefficient	Mismatch Loss (dB)
1	17.39	0.89	6.87	21	1.20	0.09	0.03
2	8.72	0.79	4.33	22	1.17	0.08	0.03
3	5.85	0.71	3.02	23	1.15	0.07	0.02
4	4.42	0.63	2.20	24	1.13	0.06	0.02
5	3.57	0.56	1.65	25	1.12	0.06	0.01
6	3.01	0.50	1.26	26	1.11	0.05	0.01
7	2.61	0.45	0.97	27	1.09	0.04	0.01
8	2.32	0.40	0.75	28	1.08	0.04	0.01
9	2.10	0.35	0.58	29	1.07	0.04	0.01
10	1.92	0.32	0.46	30	1.07	0.03	0.00
11	1.78	0.28	0.36	31	1.06	0.03	0.00
12	1.67	0.25	0.28	32	1.05	0.03	0.00
13	1.58	0.22	0.22	33	1.05	0.02	0.00
14	1.50	0.20	0.18	34	1.04	0.02	0.00
15	1.43	0.18	0.14	35	1.04	0.02	0.00
16	1.38	0.16	0.11	36	1.03	0.02	0.00
17	1.33	0.14	0.09	37	1.03	0.01	0.00
18	1.29	0.13	0.07	38	1.03	0.01	0.00
19	1.25	0.11	0.06	39	1.02	0.01	0.00
20	1.22	0.10	0.04	40	1.02	0.01	0.00

mW and dBm

mW	dBm	mW	dBm	mW	dBm
0.001	-30.0	1	0.0	30	14.8
0.005	-23.0	2	3.0	40	16.0
0.01	-20.0	3	4.8	50	17.0
0.02	-17.0	4	6.0	60	17.8
0.03	-15.2	5	7.0	70	18.5
0.04	-14.0	6	7.8	80	19.0
0.05	-13.0	7	8.5	90	19.5
0.06	-12.2	8	9.0	100	20.0
0.07	-11.5	9	9.5	200	23.0
0.08	-11.0	10	10.0	300	24.8
0.09	-10.5	11	10.4	400	26.0
0.1	-10.0	12	10.8	500	27.0
0.2	-7.0	13	11.1	600	27.8
0.3	-5.2	14	11.5	700	28.5
0.4	-4.0	15	11.8	800	29.0
0.5	-3.0	16	12.0	900	29.5
0.6	-2.2	17	12.3	1,000	30.0
0.7	-1.5	18	12.6	10,000	40.0
0.8	-1.0	19	12.8	100,000	50.0
0.9	-0.5	20	13.0	1,000,000	60.0

Ducommun

Model Number Index

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