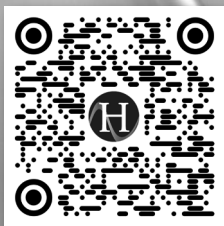




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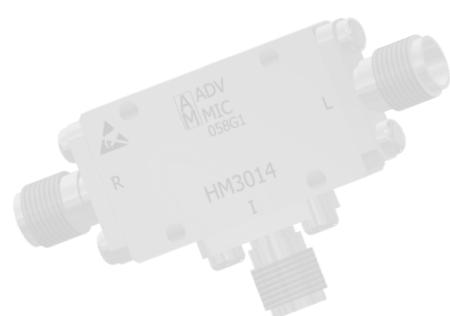
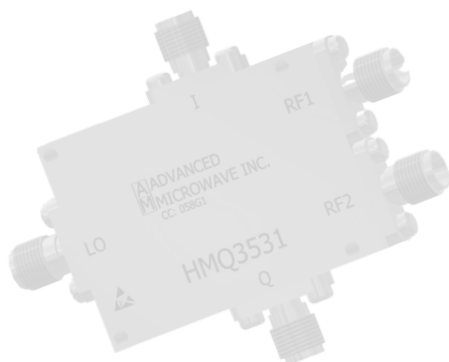
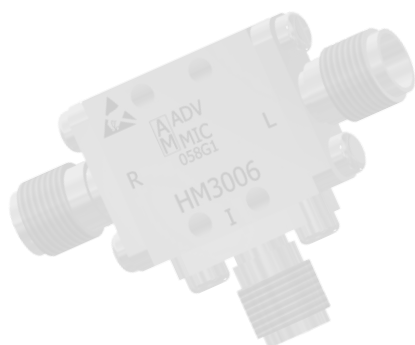
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# MIXERS and FREQUENCY MULTIPLIERS


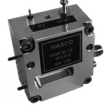




HASCO offers a selection of microwave and millimeter-wave Mixers and Frequency Multipliers in packaged and MMIC designs. Connectorized Mixers and Multipliers operate as low as 2 GHz and up to 110 GHz. MMIC Mixers operate between the 57 through 170 GHz band, while MMIC Multipliers have an input frequency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

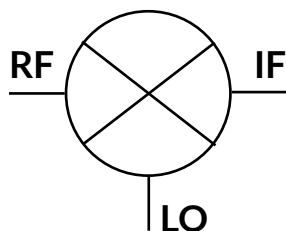
# COAXIAL MIXERS

PHOTO	TYPE/PART #	FREQUENCY	CONVERSION LOSS	TEMP RANGE	ISOLATION	LO DRIVE LEVEL	INPUT P1 dB	MATERIALS
	<b>SMA Multi-Octave</b> <b>HM3001</b>	RF/LO 4-20 GHz IF DC-3 GHz	5-8.5 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 17-25 dB</li> <li>L/R - 25-30 dB</li> </ul>	+7 dBm to +12 dBm	+4 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Multi-Octave</b> <b>HM3005</b>	RF/LO 5.5-24 GHz IF DC-4 GHz	6.5-11 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 18-25 dB</li> <li>L/R - 22-28 dB</li> </ul>	+7 dBm to +10 dBm	+4 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Triple Bal. Multi-Octave,</b> <b>HM3006</b>	RF/LO 2-24 GHz IF 0.6-8 GHz	7-12 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 16-25 dB</li> <li>L/R - 16-21 dB</li> </ul>	+10 dBm to +16 dBm	+7 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Multi-Octave</b> <b>HM3014</b>	RF/LO 2-18 GHz IF DC-1.5 GHz	6-8 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 18-25 dB</li> <li>L/R - 18-30 dB</li> </ul>	+7 dBm to +12 dBm	+4 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Double Balanced</b> <b>HM3208</b>	RF/LO 18-32 GHz IF DC-8 GHz	9 - 11 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 18-23 dB</li> <li>L/R - 27-32 dB</li> </ul>	+14 dBm to +17 dBm	+10 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Double Balanced</b> <b>HM3508</b>	RF/LO 25-40 GHz IF DC-8 GHz	10 - 13 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 24-30 dB</li> <li>L/R - 27-32 dB</li> </ul>	+14 dBm to +17 dBm	+8 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Double Balanced</b> <b>HM3708</b>	RF/LO 23-41 GHz IF DC-18 GHz	10 - 15 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 18-25 dB</li> <li>L/R - 24-35 dB</li> </ul>	+14 dBm to +17 dBm	+10 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA Double Balanced</b> <b>HM3808</b>	RF: 18-38 GHz LO: 20-24 GHz IF: DC-20 GHz	10 - 15 dB Noise Figure +0.5 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 20-30 dB</li> <li>L/R - 20-26 dB</li> </ul>	+15 dBm to +18 dBm	+10 dBm	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA IQ Mixer/Modulator</b> <b>HM3531</b>	RF/LO 8-18 GHz IF DC-1 GHz	7-9 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 25-30 dB</li> <li>L/R - 28-35 dB</li> </ul>	+10 dBm to +16 dBm	Amp. Balance ±0.6 dB	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>
	<b>SMA- IQ Mixer Modulator/ Demodulator</b> <b>HM3833</b>	RF/LO 18-32 GHz IF DC-3 GHz	9-12 dB	-40° - +85°C	<ul style="list-style-type: none"> <li>L/I - 20-26 dB</li> <li>L/R - 27-32 dB</li> </ul>	+15 dBm to +19 dBm	Amp. Balance ±0.9 dB	<ul style="list-style-type: none"> <li><b>Housing:</b> Passivated SS</li> <li><b>Contact:</b> Gold Plated BeCu</li> <li><b>Dielectric:</b> PTFE</li> </ul>



# WAVEGUIDE MIXERS

PHOTO	TYPE/PART #	FREQUENCY	CONVERSION LOSS	LO INPUT POWER	ISOLATION	MATERIALS
	W-Band, WR-10 Waveguide, Balanced HWMX10-SFW	RF: 75-110 GHz LO: 75-110 GHz IF: 0.1-18 GHz	9.5 dB Typical	+10 to +13 dBm	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-10, UG-387/UM</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	E-Band, WR-12 Waveguide, Balanced HWMX12-SFE	RF: 60-90 GHz LO: 60-90 GHz IF: 0.1-18 GHz	9 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-12, UG-387/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	V-Band, WR-15 Waveguide, Balanced HWMX15-SFV	RF: 50-75 GHz LO: 50-75 GHz IF: 1-18 GHz	8.5 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-15, UG-385/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	U-Band, WR-19 Waveguide, Balanced HWMX19-SFU	RF: 40-60 GHz LO: 40-60 GHz IF: 0.1-18 GHz	7.5 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-19, UG-383/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	Q-Band, WR-22 Waveguide, Balanced HWMX22-SFQ	RF: 33-50 GHz LO: 33-50 GHz IF: 0.1-18 GHz	7 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-22, UG-383/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	Ka-Band, WR-28 Waveguide, Balanced HWMX28-SFKA	RF: 26.5-40 GHz LO: 26.5-40 GHz IF: 0.1-18 GHz	7 dB Typical	+10 to +13 dBm Typ.	LO/RF: +20dB Typ.	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-28, UG-599/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>



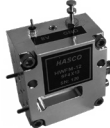
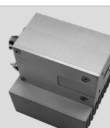
A mixer is a device that performs the task of frequency conversion, by multiplying two signals. Mixers are needed in most microwave systems because the RF signal is way too high to process its information.

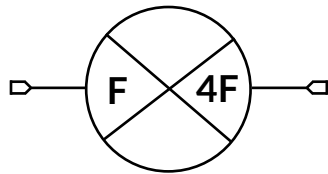
You can use a mixer to convert a signal down in frequency (as in a receiver) or up in frequency (as in an transmitter or exciter) because it is a reciprocal device.

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

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

# FREQUENCY MULTIPLIERS

PHOTO	TYPE/PART #	FREQUENCY	POWER	DC	SIGNAL PURITY	MULTIPLICATION POWER	MATERIALS
	<b>WR-10 Full Band Active Multiplier</b> HWFM10-SF6X10	Output 75-110 GHz Input 12.5-18.33 GHz	Output 10-12 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X6	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-10, UG-387/UM</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-12 Full Band Active Multiplier</b> HWFM12-SF4X13	Output 60-90 GHz Input 15-22 GHz	Output 10-12 dBm Input 6-10 dBm	+8V @ 500mA	-20 dBc	X4	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-12, UG-387/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-12 Full Band Active Multiplier</b> HWFM12-SF6X12	Output 71-86 GHz Input 11.83-14.33 GHz	Output 12-13 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X6	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-12, UG-387/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-15 Full Band Active Multiplier</b> HWFM15-SF4X13	Output 50-75 GHz Input 12.5-18.75 GHz	Output 13-15 dBm Input 6-15 dBm	+8V @ 600mA	-20 dBc	X4	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-15, UG-385/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-19 Full Band Active Multiplier</b> HWFM19-SF4X15	Output 40-60 GHz Input 10-15 GHz	Output 14-16 dBm Input 3-8 dBm	+8V @ 400mA	-20 dBc	X4	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-19, UG-383/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-22 Full Band Active Multiplier</b> HWFM22-SF4X15	Output 33-50 GHz Input 8.25-12 GHz	Output 15-17 dBm Input 3-8 dBm	+8V @ 600mA	-20 dBc	X4	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-22, UG-383/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>
	<b>WR-28 Full Band Active Multiplier</b> HWFM28-SF2X23	Output 26-40 GHz Input 13-20 GHz	Output 0-3 dBm Input 23 dBm	+8V @ 400mA	-20 dBc	X2	<ul style="list-style-type: none"> <li>● <b>Waveguide:</b> Gold Plated Aluminum</li> <li>● WR-28, UG-599/U</li> <li>● <b>SMA Housing:</b> Passivated SS</li> <li>● <b>Contact:</b> Gold Plated BeCu</li> </ul>



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

## Passive multipliers

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

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

## Active multipliers

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