

New Active x2 Multipliers Extend Output Frequency Coverage to 46 GHz for Microwave Radio Applications

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Various topologies are used to generate high frequency Local Oscillator (LO) signal sources for Military, Space, Microwave Radio and Industrial Sensor applications. The tradeoffs between cost, complexity, and size, must be weighed against system requirements such as power consumption, bandwidth, and phase noise performance. LO signal sources can be created cost effectively by multiplying and amplifying the output of a high quality, narrow band VCO, in order to generate the frequencies necessary to drive the upconverter and downconverter mixers within a transceiver.

Seven new Active x2 Multipliers have been added to Hittite's broad line of active and passive frequency multiplier products. These new active doublers extend the output frequency coverage of the product line to 46 GHz, and provide enough output power capability to drive many of Hittite's mixers directly, without the need for additional LO amplification. These Active x2 Multipliers are fabricated in GaAs pHEMT technology, and are comprised of an input amplifier, a low conversion loss frequency doubler, and an output buffer amplifier stage.

The HMC576, HMC578, and HMC579 Active x2 Frequency

Multiplier Die (Figure 1) provide Microwave Radio designers with continuous output frequency coverage from 18 to 46 GHz. These multipliers are ideal for hybrid and Multi Chip Module (MCM) applications due to their compact size of less than 1.5 mm², and single positive supply of +5V. All three multipliers share an identical bond pad layout to facilitate the use of a common hybrid/MIC circuit, where different components can be populated to address various radio bands. These three MMIC Active x2 Multipliers are offered in bare die form, and each die is wafer probed for RF and DC conformance prior to shipment.

As shown in Figure 2, with an input drive level of +3 dBm, the HMC576, HMC578, and HMC579 x2 Active multipliers provide between +12 and +20 dBm of 2Fo output power, while isolation of the fundamental input frequencies are typically 20 to 25 dBc. These multiplier die require no external matching components, and only a bypass capacitor is recommended on the +5V bias supply input.

For applications where a surface mount (SMT) compatible package is required, the HMC575LP4(E), HMC576LC3B, HMC577LC4B, and the

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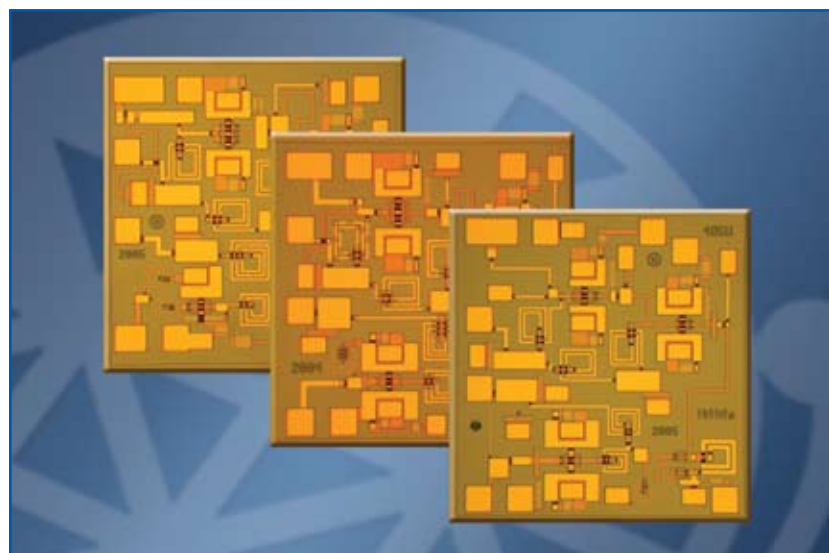


Figure 1: Photograph of Hittite's HMC576, HMC578, and HMC579 Active x2 Multiplier Die

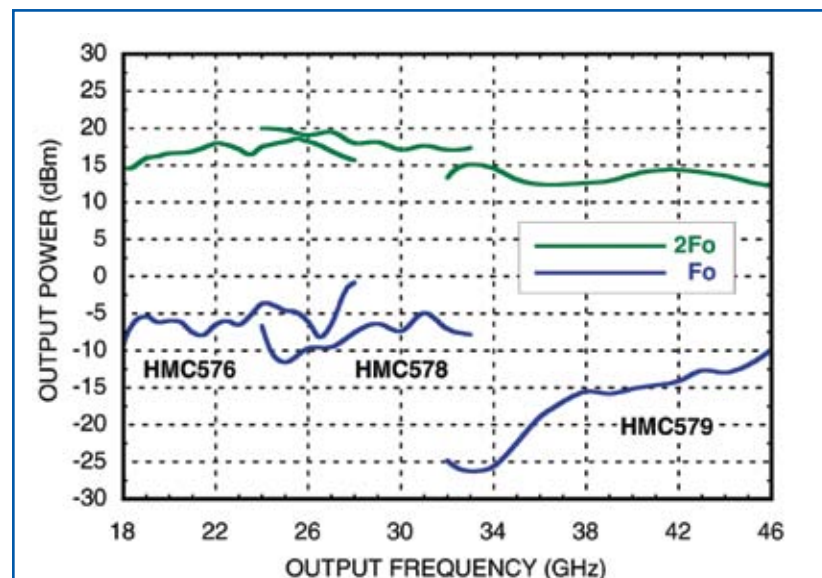


Figure 2: Output Power and Isolation vs. Frequency for the HMC576, HMC578, and HMC579 Active x2 Multiplier Die @ +3dBm Input Power.



Figure 3: Hittite's SMT Packaged Active x2 Multipliers are offered in a variety of RoHS compliant packages.

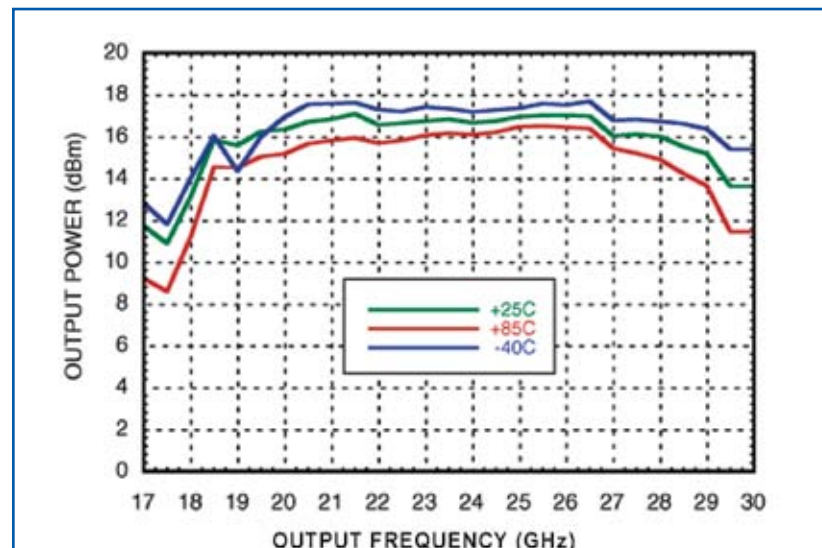


Figure 4: Plot of Output Power vs. Temperature for the HMC576LC3B. (Pin = +3dBm)

HMC578LC3B Active x2 Frequency Multipliers provide output frequencies from 6 to 33 GHz. As shown in Figure 3, each of these new multipliers is furnished in RoHS compliant, surface mount packages. These well behaved doublers are ideal for microwave and millimeter wave point to point, point to multi point, VSAT, and military applications.

As in the die versions, each of these frequency doublers provide excellent fundamental and harmonic suppression, operate from a single +5V supply, and require no external matching components. Designers will welcome the increased output power capability, which ranges from +15 to +20 dBm, and which may allow the designer to eliminate an LO buffer amplifier stage.

As shown in Figure 4, the output power of the HMC576LC3B, 18 to 29 GHz x2 Active multiplier is extremely consistent over temperature. At +3dBm of input drive, the output power variation is generally less than 2 dB over the rated temperature range of -40C to +85C. This small variation in output power is within the allowable input drive range of a typical +15 dBm LO mixer, such that the designer can avoid adding a saturated amplifier stage to drive the mixer.

The output power saturation performance of the HMC576LC3B is shown in Figure 5. With an input power variation of 0 to +6 dBm, the output power of the HMC576LC3B varies by only about 2 dB. In addition, the high midband output power of +17 dBm may provide enough power margin to allow inter-stage filtering between the HMC576LC3B, and the mixer LO port. If additional input drive is made available, then the output power variation over temperature would be reduced further still.

The block diagram shown in Figure 6 is an example of the HMC576LC3B x2 Active Multiplier being used to create a 23 GHz Microwave Radio receiver and LO generation chain.

The HMC515LP5 VCO is used to generate a signal source between 11.5 and 12.5 GHz. The HMC515LP5 features an on-chip divide-by-4 prescaler. This divide-by-4 output of the

HMC515LP5 is routed to the HMC432 Divide-By-2, and then into the HMC440QS16G, Phase Frequency Detector with 5-Bit Counter.

The fundamental output of the HMC515LP5 VCO provides more than enough power (+10dBm) to drive the new HMC576LC3B x2 active Multiplier. The HMC576LC3B in turn, provides the correct amount of output power (+15 dBm) to drive the LO port of the HMC292LC3B Fundamental Mixer. All of the components shown in this example block diagram operate from a single +3V or +5V supply and all components are compatible with high volume Surface Mount

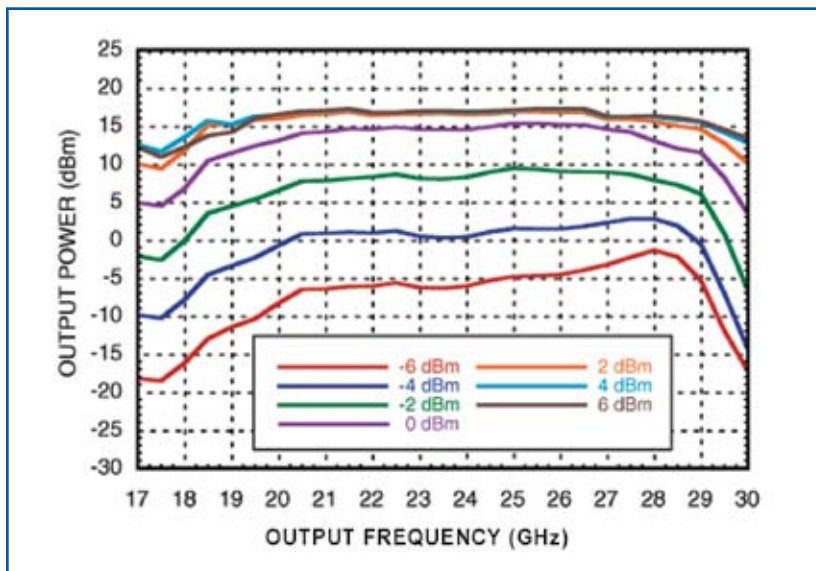


Figure 5: Plot of Output Power vs. Input Drive Level for the HMC576LC3B.

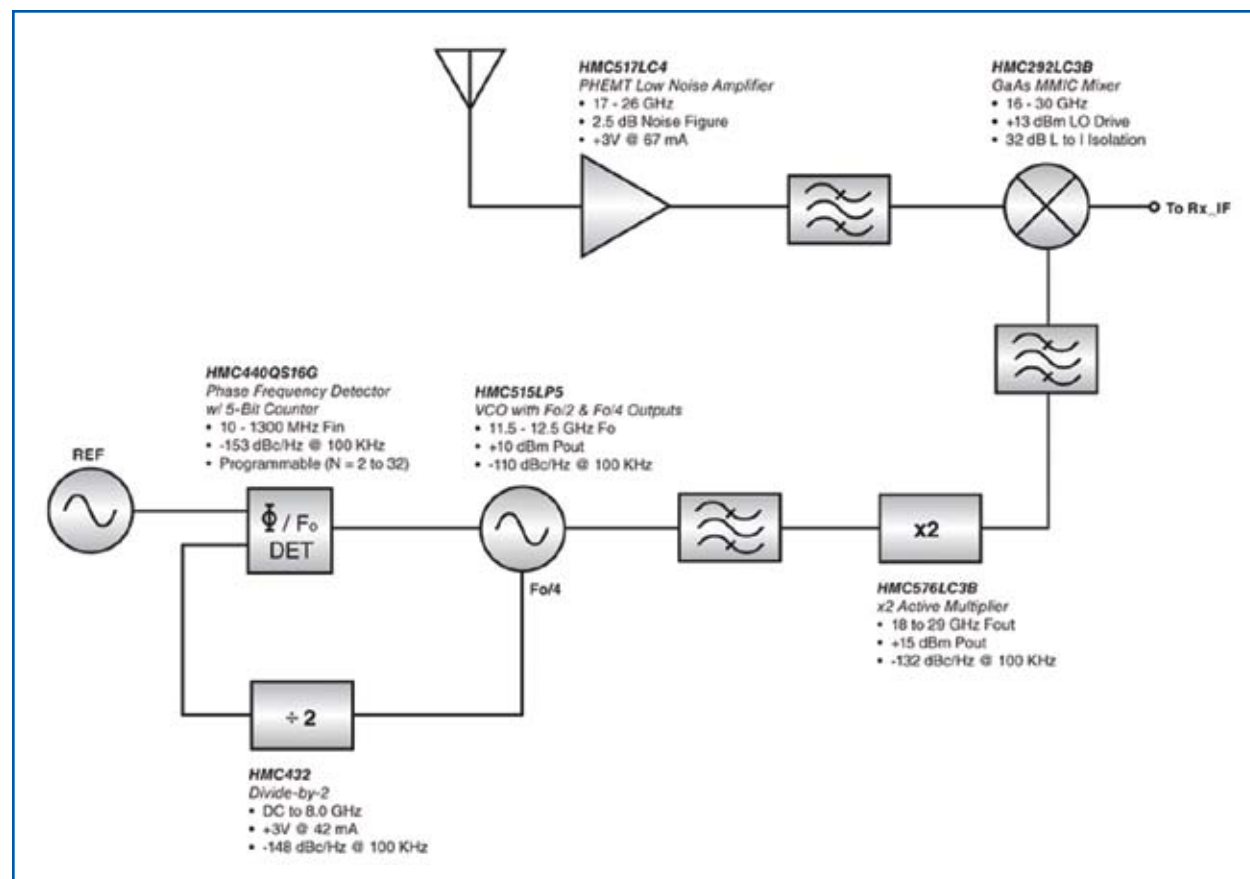


Figure 6: An example application of the HMC576LC3B Active x2 Multiplier in the LO section of a Microwave Radio transceiver.

	Input Freq. (MHz)	Function	Output Freq. (GHz)	Input Power (dBm)	Output Power (dBm)	100kHz SSB Phase Noise (dBc/Hz)	Package	Part Number
NEW!	3000 - 4500	Active x2	6 - 9	0	17	-140	LP4	HMC575LP4 (E)
	4500 - 8000	Active X2	9 - 16	2	15	-140	LP4	HMC368LP4 (E)
	4950 - 8350	Active X2	9.9 - 12.7	0	4	-142	LP3	HMC369LP3 (E)
NEW!	9000 - 14500	Active x2	18 - 29	3	17	-132	Chip	HMC576
NEW!	9000 - 14500	Active x2	18 - 29	3	15	-132	LC3B	HMC576LC3B
	9500 - 12500	Active X2	19 - 25	0	11	-135	Chip	HMC448
	10000 - 12500	Active X2	20 - 25	0	11	-135	LC3B	HMC448LC3B
NEW!	12000 - 16500	Active x2	24 - 33	3	17	-132	Chip	HMC578
NEW!	12000 - 16500	Active x2	24 - 33	3	15	-132	LC3B	HMC578LC3B
	13500 - 16500	Active X2	27 - 33	0	10	-132	Chip	HMC449
	13500 - 15500	Active X2	27 - 31	0	9	-132	LC3B	HMC449LC3B
NEW!	13500 - 15500	Active x2	27 - 31	5	20	-126	LC4B	HMC577LC4B
NEW!	16000 - 23000	Active x2	32 - 46	3	13	-127	Chip	HMC579

Table 1: Summary table for Hittite's Active x2 Multiplier Line.

Technology (SMT) processes. Furthermore, no LO buffer is required, and the output power margin provided by these components allow the designer to insert a bandpass filter between

most stages to minimize any spurious effects.

Table 1 provides a performance summary for the entire line of Hittite Active x2 Multipliers providing output frequency coverage from 6 to 46 GHz. Samples and evaluation PC boards for all SMT

packaged products are available from stock and can be ordered via the company's e-commerce site or via direct purchase order.

Designers can also choose from more than 430 standard products offered by Hittite including Attenuators,

Modulators, Phase Shifters, Power Detectors, and Switches. Data sheets and supporting information for all of Hittite's products are available at www.hittite.com.

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