

Wideband VCOs Combine Low Phase Noise and High Output Power in Rugged, RoHS Compliant Modules

by Mark Fallica, Hittite Microwave

Reliable frequency generation subsystems are critical in virtually all RF and Microwave communication and test systems. At the heart of the frequency generation section is the Local Oscillator (LO). The quality of the LO signal source is directly related to the amount of data which can be carried by a modulated RF signal of fixed bandwidth. There are many different LO architectures in use, but one of the more common methods of generating a tunable local oscillator source

is to phase lock the sampled and divided output of a Voltage Controlled Oscillator (VCO) with the output of a stable, low phase noise reference oscillator. The output signal of the phase locked VCO can then be multiplied and amplified as required in order to drive all of the RF conversion elements such as mixers, modulators, and demodulators within the system. Frequency generation sections which require a narrow tuning bandwidth can utilize high Q components in order

to achieve good phase noise performance; however, other applications such as Industrial/Medical Test and Measurement Equipment, Military Communications, Electronic Warfare (EW), and Electronic Countermeasures (ECM) usually require a source which provides up to and beyond one octave bandwidth. Microwave equipment designers seeking to produce a wideband, low noise LO source are sometimes

forced to use complicated electro-mechanical architectures which can be difficult and costly to manufacture. Hittite Microwave has developed an innovative technique for producing VCOs which offer wide tuning bandwidth, high output power, low single sideband (SSB) phase noise and fast modulation bandwidths. This new line of connectorized Wideband VCO Modules is based on a proprietary inte-



Figure 1: Photograph of the HMC-C028, HMC-C029 and HMC-C030 Wideband VCO Modules

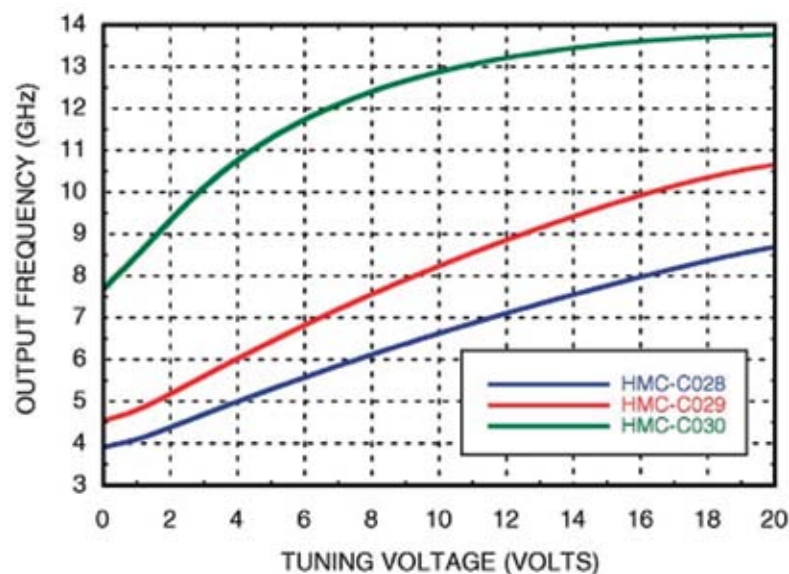


Figure 2: Output Frequency vs. Tuning Voltage for the HMC-C028, HMC-C029 and HMC-C030 Wideband VCO Modules

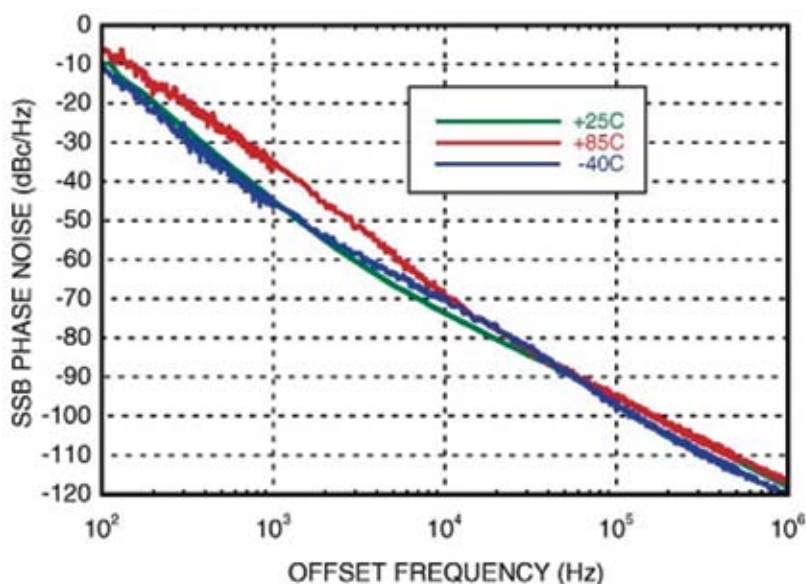


Figure 3: SSB Phase Noise vs. Temperature for the HMC-C028 Wideband VCO Module (Vtune = +12V)

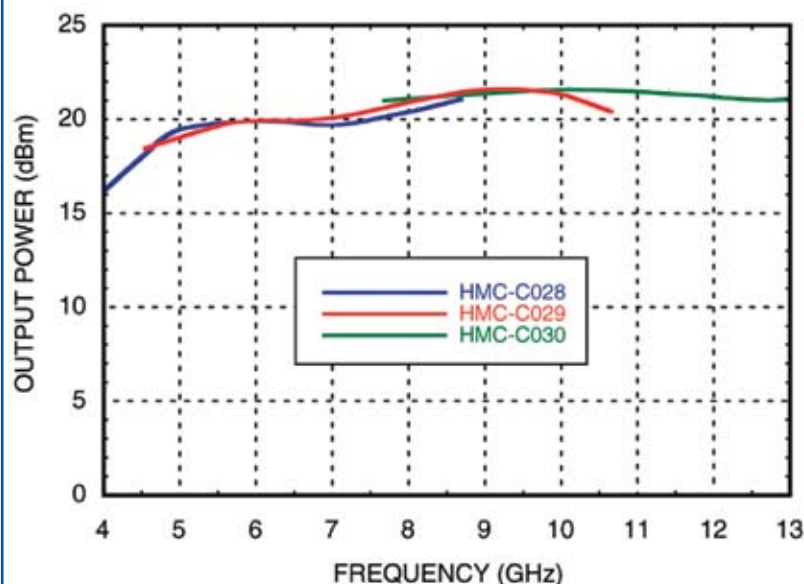


Figure 4: Output Power vs. Frequency for the HMC-C028, HMC-C029 and HMC-C030 Wideband VCO Modules

Figure 5: Performance Summary Table for HMC-C028, HMC-C029, HMC-C030 Wideband VCO Modules

Hittite Wideband Connectorized VCO Typical Performance								
Part Number	Frequency (GHz)	Tuning Voltage (V)	Output Power (dbm)	10 kHz SSB Phase Noise (dBc/Hz)	100 kHz SSB Phase Noise (dBc/Hz)	Frequency Pushing (MHz/V)	Pulling Into 2:1 VSWR (MHz PP)	Base Supply
HMC-C028	4 - 8	0 to +18	+20	-75	-95	0.2	1	+8V to +15V @ 185mA
HMC-C029	5 - 10	0 to +20	+20	-64	-93	0.2	1	+8V to +15V @ 195mA
HMC-C030	8 - 12.5	0 to +13	+21	-59	-83	0.2	2	+8V to +15V @ 195mA

grated oscillator structure, and complements Hittite's broad line of SiGe and InGaP HBT based LO generation, LO distribution, and phase locked oscillator (PLO) components.

As shown in [Figures 2 and 3](#), the HMC-C028, HMC-C029 and HMC-C030 Wideband VCO Modules provide output frequency coverage from 4 to

8 GHz, 5 to 10 GHz, and 8 to 12.5 GHz respectively, and SSB phase noise performance as low as -95 dBc/Hz at 100 kHz offset. These fully integrated wide tuning bandwidth VCOs utilize InGaP GaAs HBT technology and incorporate the resonator, negative resistance device, and the varactor diode in a single hermetic

package. The single-ended RF outputs are matched to 50 Ohms, while the Vtune port of these wideband VCOs accepts a single positive analog tuning voltage between 0V and +20V and can accommodate very fast modulation bandwidths.

As shown in [Figure 4](#), integrated output buffer amplifiers enable these Wideband VCO Modules to deliver significant output power across their rated bandwidth. With output power levels as high as +21 dBm, microwave equipment designers can use these modules to directly drive high level mixers, even after applying power dividers, couplers or filters to their outputs. The integrated buffer amplifier also allows these VCOs to achieve an extremely tight frequency pulling characteristic of only 1 to 2 MHz peak to peak, while driving a 2:1 mismatch at any phase angle.

Integrated voltage regulators allow for flexible biasing of the DC supply input, which accepts a single supply between +8V and +15V, and consumes less than 200 mA of current. Outstanding frequency pushing performance of 0.2 MHz/V makes these VCOs easy to implement by placing less demand on the loop filter in PLO applications.

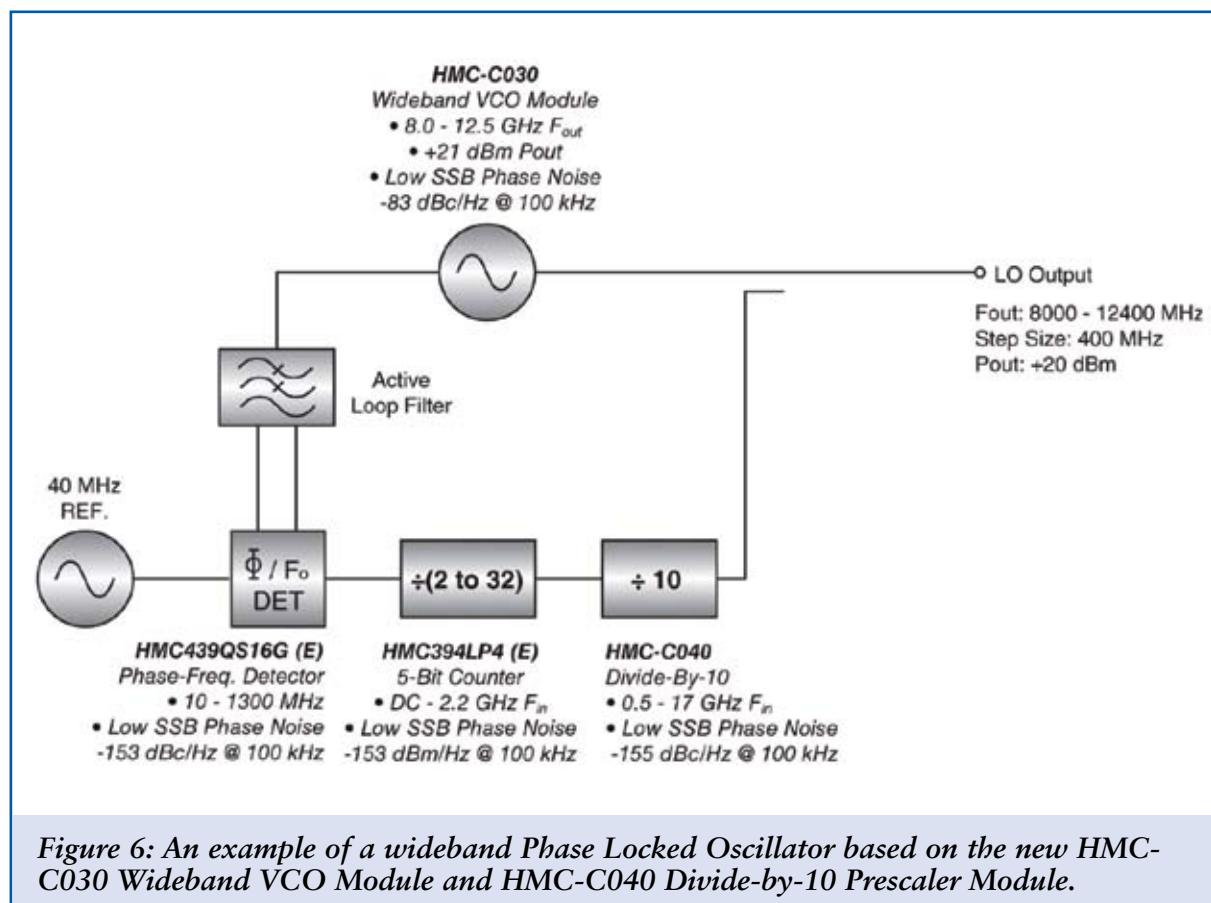
Hittite's Wideband VCO Modules uniquely combine the attributes of high output power, low phase noise, and compact size, making them ideal for numerous small form factor applications, including general Laboratory Instrumentation, Industrial/Medical Test

and Measurement Equipment, Military Communications, Electronic Warfare (EW), and Electronic Countermeasures (ECM). Hittite's Wideband VCO Modules help designers achieve their goals for high reliability and consistent performance, and are rated for operation over the full commercial operating temperature range of -40 to +85°C. The HMC-C028, HMC-C029 and HMC-C030 share a common footprint, and are housed in rugged, hermetically sealed RoHS compliant modules, which also meet stringent military and space solder material requirements.

Also recently introduced are the HMC-C039 and the HMC-C040 Prescaler Modules. The HMC-C039 is a Divide-by-5 Prescaler Module which operates from 0.5 to 8 GHz, and the HMC-C040 is a Divide-by-10 Prescaler Module which operates from 0.5 to 17 GHz. These static, low noise frequency dividers utilize InGaP GaAs HBT technology and exhibit additive single sideband phase noise as low as -155 dBc/Hz at 100 kHz offset. The HMC-C039 and the HMC-C040 accept a wide input power range of -15 dBm to +10 dBm, deliver consistent output power of -1 dBm, and consume only 80 mA and 150 mA respectively, from a single +5V supply. The HMC-C039 and the HMC-C040 are housed in identical ruggedized RoHS compliant hermetic modules, and are footprint compatible with the previously released HMC-C005, HMC-C006 and HMC-C007 prescaler modules, which offer divide ratios of 2, 4 and 8 respectively.

[Figure 6](#) illustrates an example of how some of Hittite's standard frequency

Hittite, Con't on pg 79



Hittite, Con't from pg 77

generation components can be used to quickly fabricate a wideband PLO with +20 dBm of output power, very low SSB phase noise, and a 400 MHz step size.

As shown in the example, the output of the HMC-C030 Wideband VCO Module is coupled into the input of the HMC-C040 Divide-by-10 prescaler, and then further divided in the HMC394LP4(E) GaAs HBT Programmable 5-Bit Counter. The HMC439QS16G(E) Phase Frequency Detector is used to phase lock the output of the HMC394LP4(E) with that of an external 40 MHz reference oscillator. In the example shown, the HMC394LP4(E) 5-Bit Counter is stepped through integer values from 20 to 31, in order to achieve the 400 MHz PLL step size. The HMC439QS16G Phase Frequency Detector and the HMC394LP4 5-Bit Counter are available from stock on connectorized evaluation PCBs. These products can also be provided in hermetic connectorized modules on a customer order basis.

Hittite Microwave is well known for providing high performance frequency generation and distribution prod-

ucts, including dividers, multipliers, dynamic prescalers, VCOs, phase locked oscillators (PLOs) and complete synthesizers. More than 100 standard products are available from Hittite which can be utilized in signal generation applications. In addition, Hittite has developed hundreds of custom VCOs to meet application-specific

requirements from DC to 80 GHz. Custom test screening is available for wider operating temperatures, as well as customer-specific min/max specification requirements.

Designers can choose from more than 480 standard products offered by Hittite, including modulators, demodulators, phase

shifters, attenuators, power amplifiers and switches. Data sheets and supporting information for all of Hittite's products are available online at www.hittite.com.

HITTITE MICROWAVE

WWW.TXTLINX.COM ➤ X