Doublers Drive YIG Sources To 44 GHz

This series of low-phase-noise oscillators provides the spectral purity needed for high-capacity digital radios.

DON KELLER
Senior Editor

YTTRIUM-IRON-GARNET (YIG)-TUNED oscillators can be susceptible to microphonics and residual frequency modulation (FM) from shock and vibration. But a line of YIG-tuned oscillators from Micro Lambda, Inc. (Freemont, CA) achieves low phase noise with virtual immunity to microphonics and residual FM effects. By adding frequency doublers to these oscillators, the company has created an additional line of oscillators that covers frequencies to 44 GHz (see figure). The fundamental-frequency MLPW oscillators and the frequency-doubled MLPX oscillators are ideal for digital microwave radios using high-capacity modulation formats such as phase-shift keying (PSK), quadrature PSK (QPSK), and quadrature amplitude modulation (QAM). The MLPX line is also ideal for higher-frequency applications such as local multichannel distribution system (LMDS). In both product lines, the frequency range covered by each model is incorporated into its part number (see table). For example, model MLPX-2836 is a doubled YIG that operates from 28 to 36 GHz.

Most of the reduction in phase noise in these oscillators can be credited to the use of silicon (Si) bipolar transistors instead of gallium-arsenide field-effect transistors (GaAs FETs). Typical bipolar phase noise is approximately 8 to 12 dB lower than that of GaAs FET circuits. And although frequency doubling adds approximately 6 dB of phase noise, the MLPX models still enjoy 2 to 6 dB less phase noise than comparable fundamental GaAs FET oscillators.

The oscillators' extremely low susceptibility to microphonics and FM effects is due to the structure of the magnetic circuit and the materials used in it. A YIG-based oscillator is essentially a small YIG sphere placed in the air gap of a variable magnetic field. Any change in the gap size, which can be caused by vibration or temperature changes, can disrupt the stability of the magnetic field and create microphonics, phase hits, and FM effects. To overcome these effects, the MLPW and MLPX oscillators use proprietary magnetic materials in a magnetic structure that is miniaturized, ridged, and shock mounted. In addition, surface-mount components are used in the oscillators to minimize the effects of vibration and temperature changes.

The advantages of the design innovations employed in these oscillators are borne out in their specifications. In addition to low phase noise, the oscillators provide substantial output-power levels that remain relatively flat over their respective frequency ranges. As expected, specifications for phase noise, power output, and power flatness are best for oscillators operating at lower frequency ranges. Minimum spurious noise is –70 dBc for all models, and minimum third-harmonic distortion is –20 dBc for all

MLPW and MLPX YIG-based oscillators at a glance

Model	Frequency range (GHz)	Phase noise (dBc/Hz)		Minimum power output (dBm)	Maximum power output variation (dB)
		10-kHz offset	100-kHz offset		
MLPW-0812	8 to 12	–98	–120	+13	±1.5
MLPW-1014	10 to 14	–85	–110	+13	±1.5
MLPW-1418	14 to 18	–85	–105	+13	±1.5
MLPW-1822	18 to 22	–80	–100	+10	±2.0
MLPX-1624	16 to 24	–92	–114	+10	±3.0
MLPX-2028	20 to 28	–79	–104	+8	±3.0
MLPX-2836	28 to 36	–79	–99	+8	±3.5
MLPX-3644	36 to 44	–74	–94	+8	±4.0

The MLPX models consist of a fundamental oscillator and a frequency doubler.

models. Minimum second-harmonic distortion is –12 dBc for all MLPW models and –20 dBc for all MLPX models. The tuning response (sensitivity) of the main coil is 14 MHz/mA for all MLPW models and 28 MHz/mA for all MLPX models. All of the models operate from a +12-VDC power supply at 100 mA, and all of them operate over a temperature range of –20 to +70°C. The MLPW models measure 1.25 × 1.25 × 0.75 in. (3.75 × 3.75 × 1.905 cm) while those with frequency doublers measure 2.84 × 1.25 × 1.0 in. (7.2136 × 3.75 × 2.54 cm).

The low-phase-noise characteristics of these oscillators makes them ideal for applications involving modern phase-based modulation formats, such as PSK and QPSK. And the integral frequency doubler used in the MLPX models is especially helpful to designers of high-frequency systems such as LMDS who might otherwise have to endure the rigors of matching a frequency doubler to a YIG oscillator. **Micro Lambda, Inc., 48041 Fremont Blvd., Fremont, CA 94538; (510) 770-9221, FAX: (510) 770-9213, Internet: http://www.micro-lambda.com.**

CIRCLE NO. 62