Key Specifications and Definitions

Narda DROs operate in the 3 to 18 GHz frequency range and typically use bipolar and FET active devices, depending on the requirement. These units are designed for MIL-E-5400 and MIL-E-16400 environments. Pertinent specifications are discussed below.

Output Power and DC Current

A typical DRO source will provide a power out of +12 dBm or more at room temperature. This level will vary about ±2dB over the specified temperature range with the power decreasing with increasing temperature. The output power can be increased 5 to 10 dB by the addition of an optional buffer amplifier. These units are regulated to operate from +12 or +15 volts DC and the basic FET or bipolar transistor DRO will typically draw about 100 mA. The amplifier option will draw an additional 100 mA.

Frequency Stability

The frequency stability of the dielectric resonator oscillator is primarily determined by the temperature coefficient of the dielectric resonator. This is approximately 5 ppm per °C which translates to ±5 MHz at 12 GHz over a temperature range of -54 to +85°C. This temperature coefficient will degrade at higher frequency and also when a large range of mechanical tuning is required. In certain instances the package can be designed so that its change in dimension with temperature can accommodate change of the resonator frequency, thereby producing improved temperature performance. Varactor tuning can also be provided for either frequency or phase locking.

Spurious Response

A dielectric resonator oscillator is essentially free of spurious response. Typical specifications for non-harmonic spurious are on the order of 90 dBc which relates more to measurement system dynamic range than the actual presence of spurious signal. Harmonics are typically in the -10 to -20 dBc range and can be improved 20 to 30 dB by the addition of a miniature low pass filter.

Phase Noise

DROs offer excellent phase noise performance. Figure 1 compares typical performance of DROs built with FET, bipolar and Gunn active elements. The level of performance is in the -80 to -100 dBc per Hz range at a 10 kHz offset frequency around 6 GHz. Bipolar transistors offer superior performance; however, their utility is limited to about 6 GHz due to power fall off at higher frequencies. Gunn oscillators offer superior noise performance to FETs. However, this improved performance is normally offset by excessive power drain and the FETs are often preferred.

Figure 2 is an example of excellent phase noise performance in a high frequency (19.6 GHz) Narda DRO. Performance is comparable to that expected on a much lower frequency unit.

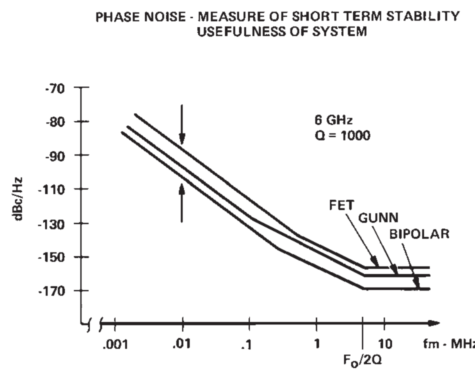

Figure 1. Phase Noise

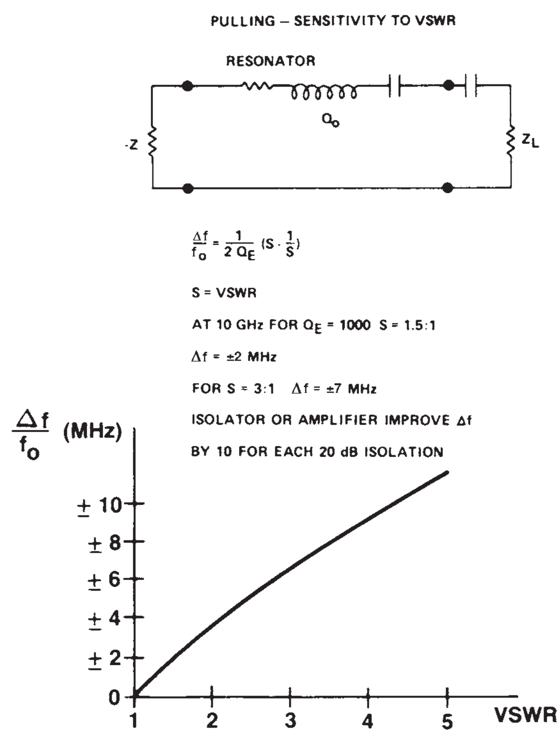

Figure 2. Phase Noise Performance in a High Frequency Narda DRO

Pushing

Pushing is a sensitivity of the oscillator's output frequency to power supply variation. In DRO sources with integrated regulators, pushing effects are small and are typically well below 100 kHz per volt.

Pulling

Pulling is an oscillator's sensitivity to VSWR changes. Unexpected reactive and resistive elements in the oscillator load can tune an oscillator to a different frequency and, in extreme cases, result in the unit ceasing to oscillate. Pulling is reduced by isolating the oscillator from its load. Pulling is improved by a factor of 10 for each 20 dB of isolation added between the oscillator and its external load.

The three isolation techniques frequently employed are:

A buffer amplifier typically adds about 10 dB of isolation and 5 dB to 7 dB of gain. The disadvantages are increased cost and DC power requirements.

An isolator typically adds 18 dB of isolation with an insertion loss of 0.75 dB. Adding an isolator is usually less expensive than adding an amplifier and it doesn't require the additional power. At lower frequencies, however, an isolator is usually much larger than an amplifier and may require a larger overall package size for the oscillator. Isolator use may also be limited at extreme temperatures.

Padding with resistors is the least expensive approach and normally doesn't impact oscillator size. Pads of 2 to 6 dB, which add 4 to 12 dB of isolation, are practical. The major disadvantage is the reduced output power level of the oscillator.

A Comparison of Dielectrically Stabilized Sources with Other Sources

The Table in Figure 3 compares the DRO source with conventional cavity, phase locked and crystal multiplied sources. The DRO is the smallest and has the advantage of being system-component compatible. Cavity sources are awkward and easy to integrate, particularly at lower microwave frequencies. The DRO offers superior temperature stability when compared to the cavity source. Phase locked sources and crystal multiplied sources offer the stability of the reference or multiplied crystal. The DRO and cavity oscillators are virtually spurious-free. Spurious signals of phase lock loops depend on implementation. Crystal multiplier assemblies are usually high in spurious content. The mechanical tuning range for a DRO is less than that for a cavity oscillator if one wishes to maintain the high Q. For cases where Q can be degraded, the tuning range can be greatly increased. DROs can be varactor tuned allowing the option of phase locking for improved performance. As shown in Figure 14 the phase noise of a DRO compared with cavity and crystal multiplied sources is excellent. When the DRO is phase locked, superior noise performance is obtained. The DRO is potentially the most cost effective source.

DIELECTRICALLY STABILIZED SOURCES VS OTHER APPROACHES

	DRO	CAVITY	PLL	CRYSTAL MULT.
SIZE	MIC	AWKWARD	COMPLEX	ASSEMBLY
STABILITY	<5ppm/°C	<50ppm/°C	<10ppm	<10ppm
SPURIOUS	-90 dBc	-90 dBc	DEPENDS	COMPLEX FILTER
MECH. TUNING VARACTOR	<1% VAR.	<10%	<10%	<1%
TUNING	OK FOR PLL	10%	N/A	N/A
PHASE NOISE	EXCELLENT	POORER	DEPENDS	POOR FAR OUT

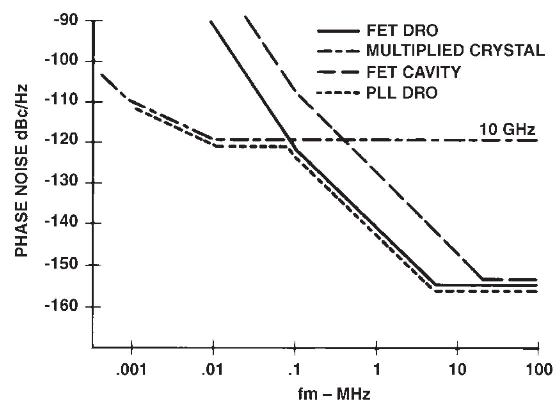

Figure 3. Phase Noise Comparison