7. rms Jitter Calculation

rms Jitter Calculation in the 12 kHz to 20 MHz Bandwidth for VI's VCO600A/VS500 @622.08 MHz

For applications requiring a 622.080, or 666.5143, MHz PECL/ECL VCO with the lowest possible jitter in the 50kHz to 80 MHz bandwidth, VI is offering the VCO600A/VS500 Series. These devices utilize SAW technology that resonates at a fundamental frequency eliminating the need for internal multiplication, which is usually required to achieve high frequencies. The net result is no harmonics/subharmonics and low phase noise, or in the time domain, low jitter. The phase noise was measured on several pairs of the VCO600A @ 622.080 MHz using an HP 3048A Phase Noise Measurement System. The typical phase noise was then integrated from 50 kHz to 80 MHz and converted to jitter using the methodology outlined in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com).

The following are the results:

X: = -54.95 dB Equivalent sideband level or the integrated phase noise

Jrms := (360/(2p) 10 $^{\frac{(X)}{20}}$ = 0.1025 rms jitter in degrees

Jrms/360 := 0.0002847 Unit Intervals (UI) rms

(Jrms/360)(1/622.080MHz) = 0.458 ps rms or 3.206 ps peak to peak

The sideband level of -54.95 dBc for the integration of the phase noise over 50 kHz to 80 MHz has an equivalent jitter value of 0.458 ps RMS or 3.206 ps peak to peak.

rms

For applications requiring a 622.080, or 666.5143, MHz PECL/ECL VCO with the lowest possible jitter in the 12kHz to 20 MHz bandwidth, VI is offering the VCO600A/VS500 Series. These devices utilize SAW technology that resonates at a fundamental frequency eliminating the need for internal multiplication, which is usually required to achieve high frequencies. The net result is no harmonics/subharmonics and low phase noise, or in the time domain, low jitter. The phase noise was measured on several pairs of the VCO600A @ 622.080 MHz using an HP 3048A Phase Noise Measurement System. The typical phase noise was then integrated from 12 kHz to 20 MHz and converted to jitter using the methodology outlined in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com).

The following are the results:

X: = -60.98 dB Equivalent sideband level or the integrated phase noise

Jrms := (360/(2p)) 10 $^{\frac{(X)}{20}}$ = 0.0051 rms jitter in degrees

Jrms/360 := 0.0014225 UI rms

(Jrms/360)(1/622.080MHz) = 0.230 ps rms or 1.610 pS peak to peak

The sideband level of -60.98 dBc for the integration of the phase noise over 12 kHz to 20 MHz has an equivalent RMS jitter value of 0.230 ps or 1.610 ps peak to peak.

rms Jitter Calculation in the 12 kHz to 20 MHz Bandwidth for VI's VC-400 Series VCXO

For applications requiring a PECL or ECL VCXO having an RMS jitter of < 1.0 ps within the bandwidth of 12KHz to 20 MHz, VI is offering our CO-400 Series. The phase noise on two VCXO's of VI's model VC-400-CFC-20SG @ 155.52 MHz were measured on the HP 3048A Phase Noise Measurement System. The phase noise was then integrated from 12 kHz to 20 MHz using the Trace Integration function of the 3048A. The equivalent sideband level of the integrated phase noise was -74.76 dBc. Per the methodology outlined in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com) the RMS jitter can be treated as small index phase modulation and can be converted from radians to degrees:

X:=-74.76 dB Equivalent sideband level or the integrated phase noise

Jrms:= (360/2) $^{\frac{(X)}{20}}$ jitter in degrees.

Jrms/360 = 0.0000409 UI rms.

(Jrms/360) (1/155.52 MHz) = 0.187 ps rms or 1.309 ps peak to peak.

The sideband level of -74.76 dBc for the integration of the phase noise over 12KHz to 20 MHz has an equivalent RMS jitter value of 0.187 ps. Therefore, the CO-600V series VCXO can satisfy the performance requirement of < 1ps RMS jitter for 12kHz to 20 MHz.

7. rms Jitter Calculation

rms Jitter Calculation in the 12 kHz to 20 MHz Bandwidth for VI's J-Type Series VCXO

For applications requiring a PECL VCXO having an RMS jitter of <1.0 ps within the bandwidth of 12 kHz to 20 MHz, VI is offering our J type series. The phase noise on two VCXO's of VI's model JDUGLMEP-155.52 MHz were measured on the HP 3048A Phase Noise Measurement System. The phase noise was then integrated from 12 kHz to 20 MHz using the Trace Integration function of the 3048A. The equivalent sideband level of the integrated phase noise was -70./dBc. Per the methodology outline in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com) the RMS jitter can be treated as small index phase modulation and can be converted from radians to degrees:

X = -70.1 dB Equivalent sideband level or the integrated phase noise. (X)

Jrms = (360/2) 10 20 = 0.017911 degrees

Jrms/360 = 0.0000497 IT rms

(Jrms/360) (1/155.52 MHz) = 0.319 ps rms or 2.23

The sideband level of -70.1 dBc for the integration of the phase noise over 12 kHz to 20 MHz has an equivalent RMS jitter value of 0.319 ps. Therefore, the J Type series VCXO can satisfy the performance requirement of <1 ps RMS jitter for 12 kHz to 20 MHz.

rms Jitter Calculation in the 12 kHz to 20 MHz Bandwidth for VI's XO-500 Series XO

For applications requiring a PECL XO having an rms jitter of <1.0 ps within the bandwidth of 12 kHz to 20 MHz, VI is offering our XO-500 series. The phase noise on two VCXO's of VI's model XO-500 Series. The phase noise on two XO's of VI's model XO-500-DFC-20SN - 155.52 MHz were measured on the HP 3048A Phase Noise Measurement System. The phase noise was then integrated from 12 kHz to 20 MHz using the Trace Integration function of the 3048A. The equivalent sideband level of the integrated phase noise was -70.0 dBc. Per the methodology outlined in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com) the RMS jitter can be treated as small index phase modulation and can be converted from radians to degrees.

X = 70.0 dB Equivalent sideband level or the integrated phase noise (X)

Jrms = (360) (2) 10 20 = 0.0181185 degrees

Jrms/360 = 0.0000503 UI rms

(Jrms/360) (1/155.52 MHz) = 0.323 ps rms or 2.26 ps peak to peak

The sideband level of -70.0 dBc for the integration of the phase noise over 12 kHz to 20 MHz has an equivalent RMS jitter value of 0.165 ps. Therefore, the XO-500 series XO can satisfy the performance requirement of <1 ps RMS jitter for 12 kHz to 20 MHz.

rms Jitter Calculation in the 12 kHz to 20 MHz Bandwidth for VI's XO-400 Series VCXO

For applications requiring a PECL XO having an rms jitter of <1.0 ps within the bandwidth of 12 kHz to 20 MHz, VI is offering our XO-400 series. The phase noise on two XO's of VI's model XO-400 Series. The phase noise on two XO's of VI's model XO-400-DFC-20SN - 155.52 MHz were measured on the HP 3048A Phase Noise Measurement System. The phase noise was then integrated from 12 kHz to 20 MHz using the Trace Integration function of the 3048A. The equivalent sideband level of the integrated phase noise was -69.0 dBc. Per the methodology outlined in VI's "Jitter in Clock Sources" by Joe Adler, (available for download at VI's website www.vectron.com) the RMS jitter can be treated as small index phase modulation and can be converted from radians to degrees.

X = 69.0 dB Equivalent sideband level or the integrated phase noise (X)

Jrms = (360) (2) 10 20 = 0.020329 degrees

Jrms/360 = 0.0000564 UI rms

(Jrms/360) (1/155.52 MHz) = 0.363 ps rms or 2.54 ps peak to peak

The sideband level of -69.0 dBc for the integration of the phase noise over 12 kHz to 20 MHz has an equivalent RMS jitter value of 0.363 ps. Therefore, the XO-400 series XO can satisfy the performance requirement of <1 ps RMS jitter for 12 kHz to 20 MHz.