Absolute Pull Range Definition

Introduction

Vectron Technologies uses Absolute Pull Range to define the amount of deviation a VCXO can be adjusted about the device's center frequency, fo. This application note defines APR and compares the advantages with alternative terms such as total pull range.

Definition

APR is the minimum guaranteed amount the VCXO can be varied, about the center frequency (fo). It accounts for degradation's including temperature (0 to 70 or -40 to 85°C), aging (20 years, 40°C), power supply variations (10%) and load variations.

APR = (Pull range) - (degradations due to temperature+aging+power supply+load)

For a VCXO specified in terms of APR, there is no guess work regarding how much frequency deviation is available, over all conditions, to track your incoming signal.

For example, one of the most popular APR options is 50 ppm, which is defined by "G" in the fourth position of the letter code. A 16.384 MHz VI VCXO would have no more than 20 ppm of temperature drift, 5 ppm of aging (20 years, 40C), 5 ppm due to power supply variation and 4 ppm due to load variations. A device specified in terms of Total Pull would need to have at least 84 ppm of Total Pull to meet specifications.

In order to offer the APR guarantee, devices are well characterized for temperature, aging and power supply variations. Every VCXO is tested over temperature for pull range. This is a fully automated process where devices are continuously tested throughout a 0 to 70, or -40 to 85°C temperature cycle, including a soak at the extreme temperatures. Data is automatically stored for analysis. Aging characterization has been performed and correlated. Variations due to power supply and load are also well understood.

Devices specified with Total Pull Range can falsely seem superior due to what seems like a higher pull capability. However, in order to ensure that a VCXO specified in terms of Total Pull meets your design needs, the manufacturer must be contacted to define drifts due to temperature, aging, power supply and load variations, which must then be subtracted from their TPR. It can not be assumed that the VCXO performance is equal to Total Pull Range minus the "stability" unless the stability is clearly defined - this is seldom the case. APR reduces time spent defining and understanding VCXO specifications.

Example

In a digital communications network, the source clock has a defined maximum error from the center frequency over temperature, aging and power supply variations. This error is defined by a variety of factors dictated by the application. The receiver incorporates a VCXO which must be capable of tracking the source error to recover the clock and/or translate to a higher frequency. For example, a Stratum 4 level clock dictates a worse case error of 32 ppm over all environmental conditions. The VCXO must also be able to pull or track this 32 ppm over temperature, aging and power supply variations.

A VCXO specified in terms of APR with a 32 ppm APR would be the correct choice and will always be capable of locking to the source clock under the most adverse conditions - specmanship has been eliminated.

Again using a Stratum 4, definition the VCXO can be selected by;

VI's APR Method	**Other's TPR Method**
F= 32ppm APR	Total Pull Range
Done!	Minus temperature stability
	Minus aging
	Minus supply variations
	Minus output load variations

Conclusion

APR is a superior method for specifying the deviation capability of a VCXO and is rapidly being adopted by other suppliers in the industry. In addition to testing to a minimum APR, every device is automatically tested for rise and fall time, duty cycle, current consumption and start-up time with test data stored for SPC analysis. As well as offering superior performance and packaging technology, VCXO's supplied by VI are the most thoroughly tested and have the best guaranteed specifications in the industry.

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