Frequency Stability Calculation

A digital phase-lock loop (PLL) provides the frequency stability of the transmitter. The PLL consists of a high-stability crystal reference oscillator, a digital synthesizer, a voltage controlled oscillator and a passive loop filter. The frequency synthesizer used for this transmitter is a Zarlink 2.7 GHz SP5655S synthesizer. The frequency synthesizer includes a phase detector, current mode charge pump, and programmable frequency dividers.

The reference oscillator for the synthesizer is a 4.0000 MHz crystal oscillator. The frequency tolerance is ± 30 ppm. The frequency temperature characteristic is ± 50 ppm over a temperature range of -40° C to +85° C. The reference oscillator provides the main error factor in the frequency stability of the transmitter over temperature.

The transmitter is specified for a maximum drift of ±0.010% over temperature. This calculates to a maximum of ±0.247 MHz deviation of the carrier. Using a worst case of ± 80 ppm frequency drift in the reference oscillator, this calculates to an error of only ±0.197 MHz in offset.

An analysis of the PLL design is provided using the GENESYS PLL ver. 6.0 simulation program by Eagleware Corporation.

The synthesizer divides the 4.00 MHz reference frequency by 512 for an internal reference frequency of 7812.5 Hz. The synthesizer first divides the VCO frequency by 16 then by 19,760 for a total division of 316,160. Dividing 2470 MHz by 316,160 equals 7812.5 Hz. The phase detector in the synthesizer generates a phase error signal that the charge pump uses to correct the VCO for any errors in frequency.

The analysis by the GENESYS PLL software calculates an error of only 1.94564 Hz RMS in frequency. This calculation does not take into account the stability of the reference oscillator. This demonstrates that the reference oscillator will generate the most significant error since the synthesizer generates less than a 2.0 Hz error.

Based on these calculations the transmitter will provide excellent frequency stability over temperature.