9. COMPARISON OF THEORY AND MEASUREMENTS

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It is important to compare theoretical calculations with measurements whenever possible to validate results. Such validation is usually based on comparing salient features of measured results with corresponding features based on theoretical predictions.

Theoretical results given in Section 3 predict that 1) fixed time-base dithering will attenuate spectral lines (relative to the non-dithered periodic signal) and also introduce a continuous spectrum with a shape similar to the pulse spectrum, 2) periodically repeating the dithered signal will introduce spectral lines at the dither signal repetition frequency, and 3) statistics obtained from filtered UWB signals will be approximately Gaussian when the bandwidth is less than the PRR. Note that baseband Gaussian signal statistics yield Rayleigh amplitude statistics.

Device D measurements, summarized in Section 8.3.4, are for a 25% fixed dithered UWB device. Measurements include a 10 MHz PRR mode with 100% gating. These measurement results were compared with theoretical predictions given in Section 3. A synopsis of the comparison is given in this section.

Fixed time-base dithering features

Theoretical results for the 50% fixed time-base dithered, 10 MHz PRR PSD are presented in Section 3.2.1. These results predict that at frequencies of several hundred MHz and higher, spectral lines are only 10-20 dB above the continuous spectrum and hence should not be observable when the receiver bandwidth significantly exceeds 20 dB Hz. In addition, the continuous spectrum should have a shape corresponding to the pulse spectrum.

The pulse shape of Device D was measured with the full bandwidth test described in Section 5.2. The emission spectra was measured with the spectrum analyzer test described in Section 6. The spectrum analyzer test for a 25% fixed dithered, 10 MHz PRR UWB signal is summarized in Figure 8.53. These emission spectra measurements have the same shape as the pulse spectrum measured by the full bandwidth test in Figure 8.49 as predicted. Also, spectral lines at the PRR intervals were not evident in the emission spectra measurements as predicted by theory.

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Dither signal repetition features

Theoretical results presented in Section 3.2.2 show that for repeated fixed dithered signals, spectral lines should be observed at frequencies corresponding to the signal repetition period. Figure 8.59 shows an emission spectrum measurement of a 25 % fixed dither, 10 MHz PRR UWB signal with a dither repetition frequency of 10 kHz. The measurement shows the spectral lines due to the repeating dither signal at 10 kHz intervals as predicted.

Band Limited UWB signal APD features

Theoretical results for the band limited 50% fixed dithered, 10 MHz PRR, UWB signal PSD were presented in Section 3.3. These results show that when the UWB signal passes through a receiver filter that is well below the PRR, the signal statistics are approximately Gaussian. As the filter bandwidth increases, the shape of the density function deviates from Gaussian. This deviation is measured by a statistic called excess which is a function of filter bandwidth as shown in Figure 3.5. Excesses near zero are indicative of an underlying Gaussian process. The excess factor deviates from zero at approximately 3 MHz bandwidth. This trend continues and at 10 MHz the value of the excess is significantly greater than zero.

The APD of for a 25 % fixed dithered, 10 MHz PRR APD shows the same non-Gaussian trend for bandwidths greater than 3 MHz where the statistics become increasingly impulsive. When the UWB signal is passed through filters with bandwidths of 1 MHz or less measurements show that the signal statistics are approximately Gaussian as predicted by theory.