INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

Sheroz Khan, International Islamic University Malaysia

AHM Zahirul Alam, International Islamic University Malaysia

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Taman Perindustrian Batu Caves
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68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

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Chapter 25

ULTRA-WIDE BAND TECHNOLOGY

MOKHALED M., MOHAMMED, SHEROZ KHAN, JALEL CHEBIL, KHALED A. S. AL-KHATEEB, IMRAN MOEZ KHAN

Communication technologies and applications have developed rapidly during the past half century. Most communication technologies utilize the Radio Frequency spectrum. However, given the vast number of technologies utilizing a limited spectrum standardization bodies had to be formed to regulate the usage of the RF spectrum by the various technologies. Therefore, each technology is allocated a band or a certain number of frequency bands to operate at. With the rise of new technologies every day the RF spectrum has become very crowded. UWB offers a solution to this problem by providing an RF technology that would coexist with current RF technologies with little or no interference. This chapter provides an overview of the concept of UWB, historical development, and applications.

25.1. UWB CONCEPTS

Ultra-wideband technology provides the solution to the spectrum problems by performing the communication task through a concept different to that of the common communications systems. The UWB communications relies on sending sub-nanosecond pulse with a corresponding Ultra-wide band in the frequency domain while other technologies communicate through continuous signals with a narrow frequency band. To illustrate the concept of UWB in comparison to that of narrow band technologies the scaling property of the Fourier transform has to be examined. The scaling property is given by:

$$x(at) \leftrightarrow \frac{1}{|a|} X\left(\frac{f}{a}\right) \qquad (1)$$

Where a is the scaling factor, x(t) is the function in the time domain, and X(f) is the function in the frequency domain. The scaling equation means that if the signal is narrower in the time domain, the corresponding signal in the frequency domain would be wider, and vice versa. To further illustrate the concept the following graphs has been generated using MATLAB.