

FOCUS ENHANCEMENTS

TT-6001 DS-OFDM Waveform Generator

Theory of Operations

TT-6001 DS-OFDM WAVEFORM GENERATOR

Theory of Operations

© Focus Enhancements, Inc.
Semiconductor Division
22867 NW Bennett St • Suite 200
Hillsboro, OR 97124 USA
Phone 503.615.7700 • Fax 503.615.4232
Email info@focussemi.com
Web Site <http://www.focussemi.com>

Scope

Focus Enhancements' proprietary modulation and signaling approach is based on a Direct Sequence Spread Spectrum (DS-SS) technique. This approach covers the frequency band from 3.2 to 7.3 GHz with an ensemble of codes instead of a single code per data rate as in other DS-SS solutions already certified. The purpose of this paper is to explain our DS-SS technology as implemented in our Waveform Generator.

The Waveform Generator radio will be placed into a test mode in which all of the normal radio off times, either inter-packet or intra-packet, are removed eliminating all gating on the transmitter.

Description

Focus Enhancement's proprietary DS-SS approach is based on chirp spreading sequences of ternary $\{+1, 0, -1\}$ codes. The ternary chips are complex valued and contain both In-Phase and Quadrature sequences which are output at 5.28 GChips/sec each. This complex pair is then low passed with brick-wall filters to a bandwidth of ± 2 GHz and then modulated to a 5.28 MHz center frequency. The resulting pass band spectrum covers 3.2 to 7.3 GHz. The symbols will support constellations up to 8 PSK. An example is shown following:

I Value	1	0	-1	-1	0	1	1	0	-1	-1	1	1
Q Value	1	1	1	0	-1	-1	-1	1	1	0	-1	-1

Table 1 - Complex 12 Chip Symbol

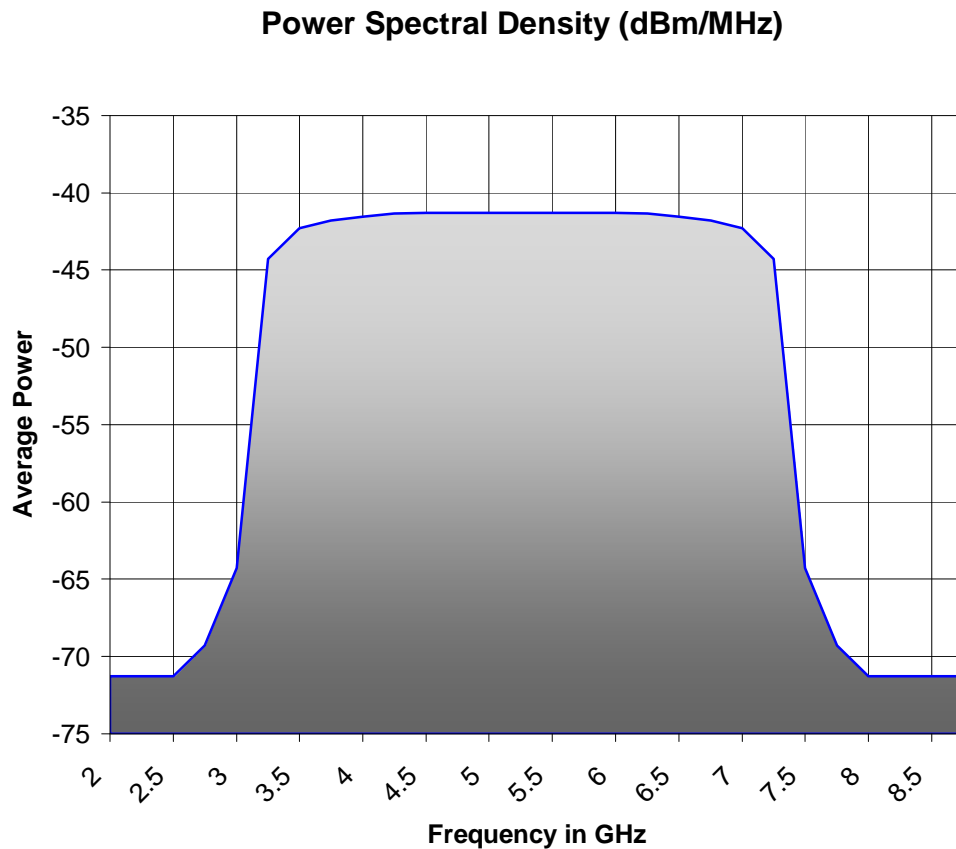
The symbols vary in length according to their purpose. For example, the shortest symbol is 8 complex chips long and is used for synchronization and the longest symbol is 48 chips long and used to transmit data at the lowest data rate. The table below summarizes the properties and use of each symbol.

Symbol Use	Chips per Symbol	Symbol Rate (MSym/sec)	Symbol Modulation
Synchronization	8	660	BPSK
Data 440 to 880 Mb/sec	12	440	8 PSK
Data 220 to 330 Mb/sec	24	220	8 PSK
Data 37 to 110 Mb/sec	48	110	8 PSK

Table 2 - Symbol Properties and Use

The Synchronization Symbol is a single simple code which has autocorrelation properties that make it best for measuring time of arrival of the packet.

The data symbols have multiple orthogonal codes per Long Code set. This allows the receiver to combine the energy associated with one symbol while ignoring the other symbols and their delayed multi-path energy are arriving at the receiver. This tried and true Long Code (or Random Code) sequence approach is used in most CDMA cell phone systems used today.



LEGAL NOTICES

THIS DOCUMENT CONTAINS CONFIDENTIAL AND TRADE SECRET INFORMATION OF FOCUS ENHANCEMENTS AND ITS RECEIPT OR POSSESSION DOES NOT CONVEY ANY RIGHTS TO REPRODUCE OR DISCLOSE ITS CONTENTS, OR TO MANUFACTURE, USE, OR SELL ANYTHING THAT IT MAY DESCRIBE.

REPRODUCTION, DISCLOSURE, OR USE IN WHOLE OR IN PART WITHOUT THE SPECIFIC WRITTEN AUTHORIZATION OF FOCUS ENHANCEMENTS IS STRICTLY FORBIDDEN.

EVERY EFFORT HAS BEEN MADE TO ENSURE THAT THE INFORMATION IN THIS DOCUMENT IS COMPLETE AND ACCURATE AT THE TIME OF PRINTING; HOWEVER, THE INFORMATION CONTAINED IN THIS DOCUMENT IS SUBJECT TO CHANGE.

COPYRIGHT 2006 FOCUS ENHANCEMENTS

ALL RIGHTS RESERVED

THE MATERIAL CONTAINED IN THIS DOCUMENT IS ALSO PROTECTED BY COPYRIGHT LAWS OF THE UNITED STATES OF AMERICA AND OTHER COUNTRIES. IT MAY NOT BE REPRODUCED OR DISTRIBUTED IN ANY FORM BY ANY MEANS, ALTERED IN ANY FASHION, OR STORED IN A DATA BASE OR RETRIEVAL SYSTEM, WITHOUT EXPRESS WRITTEN PERMISSION OF FOCUS ENHANCEMENTS.

FOCUS ENHANCEMENTS CANNOT BE RESPONSIBLE FOR UNAUTHORIZED USE OF EQUIPMENT AND WILL NOT MAKE ALLOWANCE OR CREDIT FOR UNAUTHORIZED USE OR ACCESS.

© Focus Enhancements, Inc.
Semiconductor Division
22867 NW Bennett St • Suite 200
Hillsboro, OR 97124 USA
Phone 503.615.7700 • Fax 503.615.4232
Email info@focussemi.com
Web Site <http://www.focussemi.com>