EXHIBIT 4

EXPOSITORY STATEMENT

Theory of Operation

General Description

The RadioWire Modem (RWM) consists of 6 different Printed Circuit Boards (PCB). The six boards are the Transceiver, I/F Demodulator, Spread Spectrum Controller, Application Processor, Backplane, and Power Supply. The antenna connects directly to the Transceiver Board through a proprietary connector that feeds through the weatherproof housing. Data and power are provided to the RWM from the outside world through a 28 pin AMP CPC connector. Differential baseband digital data connects to the RWM through twisted-pair wires.

Transmit Path

The digital data including payload and control signals is processed by a micro-processor which resides on the Application Processor Board. This payload data is handed off to the Spread Spectrum Controller Board that adds a header, groups the data into packets and spreads the data using a 12.8 MHz chip rate and a 32,768 bit spreading code. The null-to-null bandwidth of this data now occupies 25.6 MHz.

The Spread Spectrum Controller (SSC) also orchestrates the Transmit/Receive (T/R) cycle. The entire cycle takes 2.56 ms, 1.28 ms each for both transmit and receive portions (see figure 1). The transmitter operates on a 44. 5% duty cycle, (114 bytes * 10 us / byte)/2.56 ms, during normal operations. Eight quiet, one preamble, 102 payload and 2 CRC bytes make up the structure of transmit or receive packet (see figure 2). Since the raw data rate is 800,000 bits per second for the RWM, the one-way data handling capability is (102 bytes * 8 bits/byte) / 2.56 ms = 318,750 bits-per-second. During one cycle, both transmit and receive can occur making the aggregate data rate 2 * one-way data rate = 637,500 bits-per-second.

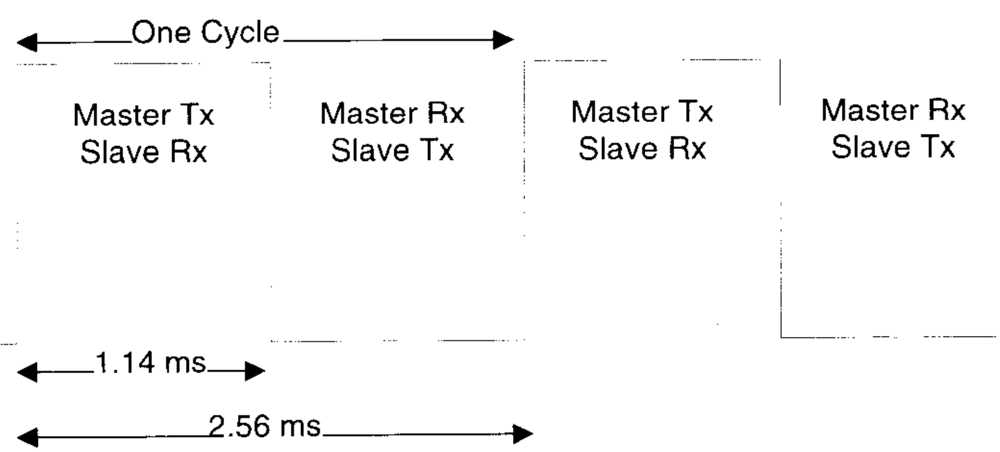

Figure 1 Transmit/Receive Timing

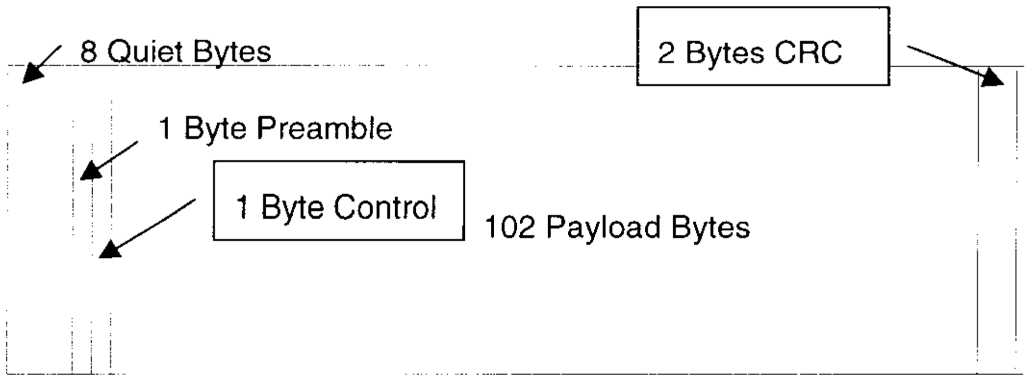

Figure 2 RadioWire Packet Structure

The Spread Spectrum Controller also provides, AGC, Tracking, Mode Control, Timing and Code Generation functions during receive. After the SSC combines the data with the code to the proper In-Phase (I) and Quadrature (Q) channels, it is handed off to the Transceiver Board.

On the Transceiver Board, the I / Q channels are modulated onto a 2.4 GHz carrier by using a Quadrature Phase Shift Keying (QPSK) modulator (see Block Diagram, Transceiver Board, U3). The resulting signal is amplified and filtered before going through a Transmit/Receive (T/R) switch that allows the antenna to be shared by the transmitter and receiver. The transmit level is factory set to a maximum output of +24 dBm using a digitally controlled attenuator. This level ensures compliance with docket 96-8 for all RWM antennas. The Transceiver Board also generates a 280 MHz reference and 2091 MHz Local Oscillator (LO) frequencies that are used to generate the 2.4 GHz carrier frequency. The Phase Locked Loop (PLL) synthesizer enables frequency agility in the 2.4 - 2.483 GHz band. 5 total channels, 3 non-overlapping, covers the entire band (see figure 3).

CH#	Channel 1 - 5.			
	f_{low}	f_{center}	f_{high}	f_{vco}
CH1	2402.8	2415.6	2428.4	2065.6
CH2	2415.6	2428.4	2441.2	2078.4
CH3	2428.4	2441.2	2454.0	2091.2
CH4	2441.2	2454.0	2466.8	2104.0
CH5	2454.0	2466.8	2479.6	2116.8

Figure 3 Frequency Channels

Receive Path

During receive operations, the antenna is switched from the transmitter to the receiver circuitry using a T/R switch (see Block Diagram, Transceiver Board, U16). The received signal is filtered, amplified then mixed (U19) down to 350 MHz. The resulting signal is then fed to the IF Demodulator Board.

The IF Demodulator Board's provides two major functions. The first is to take the 350 MHz spread signal (mixed down from 2.4 GHz) and feed a stream of I / Q data to the Spread Spectrum Controller Board for processing back into digital data. Additionally, the IF Demodulator generates a Received Signal Strength Indication (RSSI) which is used to maintain the signal within the RF path at optimum levels and synchronization.

The Spread Spectrum Controller Board uses the I / Q data and RSSI to generate an Automatic Gain Control (AGC) and tracking function for de-spreading the code. The SSC dynamically adjusts the timing to track and maintain synchronization with the far end RWM ensuring reliable decoding of the received data. This data is assembled into bytes that are sent to the Application Processor Board.

In addition to converting the parallel data received from the SSC to serial differential signals, the Application Processor (AP) Board collects status on the RWM and relays it to the Network Interface Module (NIM). The NIM acts as an intermediary to interface signals from the outside world and convert them into signals that the RWM can use.

Theoretical Process Gain

The process gain can be estimated using a formula below described by Dixon in his book 'Spread Spectrum Systems with Commercial Applications' section 1.3.

$$G_p = 10 \cdot \log\left(\frac{BW_{rf}}{Rdata}\right)$$

where

BW_{rf} = 2 * 12.8 MHz, RF bandwidth used to send the encoded signal

R_{data} = 800,000 , Data rate in bits-per-second

G_p = 15 dB Process Gain