An Axonn spread spectrum receiver and the Axonn Artist tool was used to acquire the data for this file. The AX551 transceiver was connected to the serial port of a PC, and Artist acquires messages from the transceiver and formats the message data. AX551 transceivers are capable of measuring multiple RF signal level parameters. These include transmitter correlation processing gain, key-off signal level, Power correlation signal level, Post correlation noise signal level, and calculated Signal to Noise Ratio.

The associated Excel file (process gain.xls) has a lot of data and calculations spread among 11 workbooks. The first 3 workbooks are collected data, and the remaining 8 workbooks are calculations base upon the first three workbooks.

Explanations of the columns in the first three workbooks (SS, CW, Idle):

The first column (COM) shows which com port of the PC is attached to the AX551 transceiver. COM port 2 was used in collecting all of the data for this file.

The second column (Time) shows the time when the message was received.

The third column (Ty) indicates the status of the received message. "D" indicates that a good message was received. "S" is one of the debug flags that indicates that there was an error in the received message. "I" indicates that the AX551 transceiver was idle (no messages were received).

The fourth and fifth columns (PC and ID) are the Property Code and Identification number of the received transmitter.

The sixth column (Tx) indicates the type of message transmitted by the transmitter.

The "Alarms" field is several characters wide and indicates the status of various alarm bits in the transmitter.

The eight column is unmarked but contains additional alarm information.

The ninth column (SN) contains sequence number information. Axonn transmitters embed an incrementing sequence count value into every sent message. This gives the receiver the ability to tell if a messages was lost.

A note about the remaining columns. The remaining columns show signal data that is measured by the AX551 transceiver. The values 0-255 span a dynamic range of 100 dB. To convert the displayed value (referred to as "Hex counts") to power in dB, divide the displayed Hex count value by 2.56

The tenth column (KO) indicates the Key-Off value. Axonn transmitters incorporate OOK (on-off keying) to modulate data. The KO value indicates the difference between a key-on value and a key-off value. These values are not used in the processing gain calculations.

The next column (Cr) shows the increase in signal level due to spread spectrum correlation. These values are not used in the processing gain calculations.

The next column (Sg) displays the signal level at its peak correlated signal level. These values are used in the processing gain calculations.

The next column (Ns) is the background noise level that is present to the receiver when it is not acquiring a data message. These values are used in the processing gain calculations.

The next column (SNR) is the calculated difference of the Sn and Ns columns. These values are used in the processing gain calculations.

Explanations of the data recorded in the first three workbooks (SS, CW, Idle):

In the SS (Spread Spectrum) workbook, all data messages were received when the Axonn transmitter was operating normally. All data columns had entries because the AX551 transceiver detected valid messages throughout the data acquisition.

In the CW (Carrier Wave) workbook, the spreading code was disabled in the Axonn transmitter. The difference in the SS received messages and the CW received messages therefore indicates the amount of processing gain achieved by the AX551 transceiver. The received message status (Ty) shows that errors were detected in the received signal. No Transmitter ID, Property Code, message type (Tx), alarm information, or Sequence Number could be detected in the received message. The AX551 was able to extract the signal level information from the signal, as indicated by the five rightmost columns.

In the Idle workbook, no messages were transmitted. The receiver provided noise samples to the PC running the Axonn Artist program.

Explanations of the next seven workbooks (SS SNR, CW SNR, SS Noise, CW Noise, Idle Noise, SS Signal, CW Signal):

The purpose of the next seven workbooks is to extract a particular column from one of the first three workbooks and calculate an average value from that particular column. For example, the first column of the "SS SNR" workbook is comprised of the SNR column (as measured in Hex counts) of the SS workbook. The Hex counts of the first column are converted into their dB equivalents in the second column. The third column converts the dB values into milliwatt values. The final value takes the average of all milliwatt values, and converts it back into dB for an average SNR value measured in dB.

The last workbook (Summary):

The average values of the SS SNR, CW SNR, SS Noise, CW Noise, Idle Noise, SS Signal, and CW Signal are used in the upper most box of the summary sheet. The Idle Noise value is used as the noise floor value for both the SS and CW columns in the bottom box. The delta column is calculated by subtracting the CW values from the SS values. One can see that the processing gain as measured by the AX551 is 10.02864 dB.