TRANSMITTAL

To: **Tim Johnson of US Tech Lab**
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From: Lee M. Williams for ITERO Technologies

Date: Friday, April 27, 2001

Pages Four (4) plus this cover

Re: Info about Process Gain testing

Attached please find the process gain procedure and results from our AX-570 receiver (mentioned in the earlier e-mail of today). This is a receiver of similar design and function to the NU906250200 receiver. The difference is that this receiver was tuned for the center frequency of 917.78 MHz for this testing. The AX-570 can be tuned for 923.58 MHz just as the NU906250200 is a fixed tune receiver for this same frequency. Both receivers are of similar RF design and both can be used to receive the signal and data sent, or transmitted by, the Robertshaw Propane monitor transmitter (NU9 TX0669-0100). Both the transmitter and the receivers use the same BPSK spreading code. The transmitter uses this code to spread the signal across the ISM spectrum and the receiver uses the identical code to correlate and de-spread the received signal. The transmitter (NU9 TX0669-0100) and the receiver (NU906250200) have the same fixed chipping rate and data rate.

Best Regards,

Lee M. Williams
27 APRIL 2001

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Test Name: **Processing Gain** **Test #:** **3.B.1**
Test Summary: Verifies compliance to receiver processing gain specification at +25°C with an input signal level of -104 dBm.
Applies to Specification 3.2.2.7

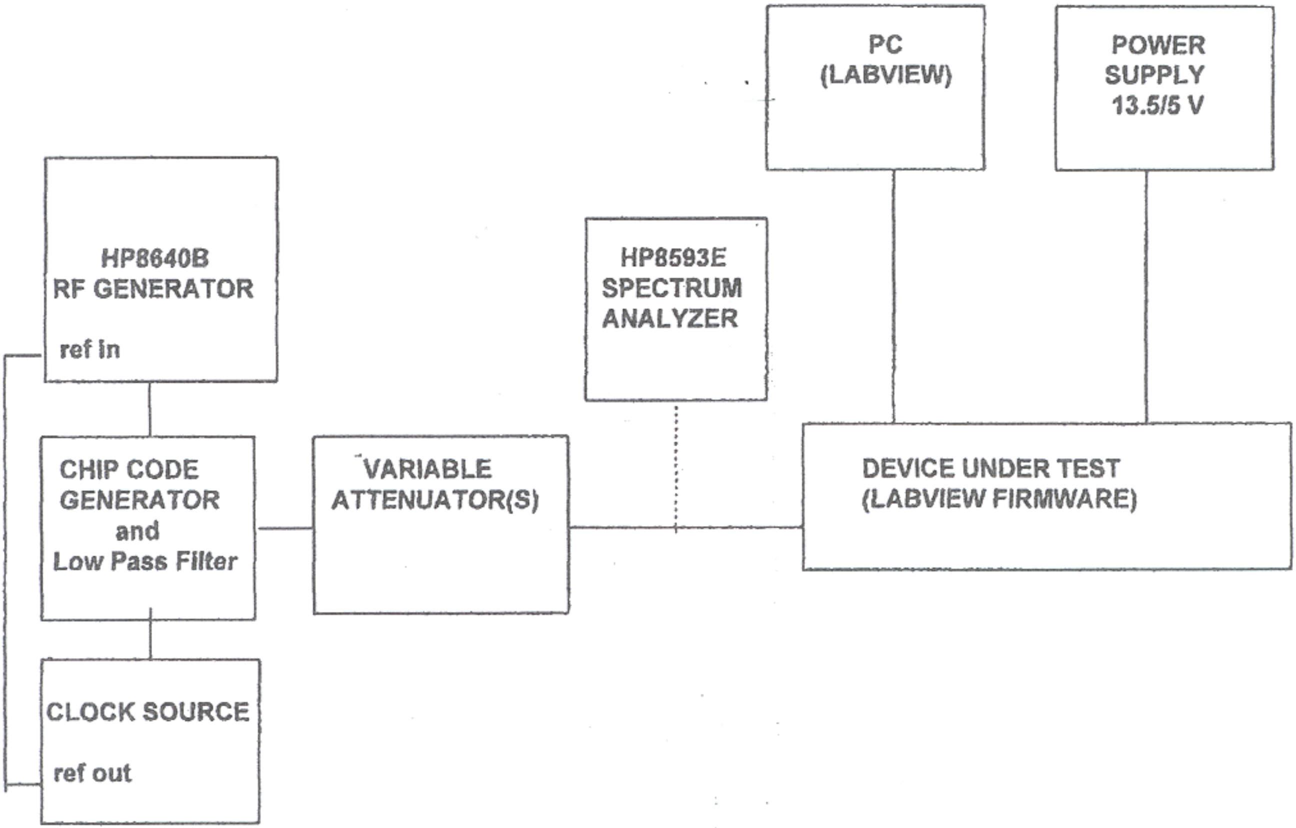
Pass / Fail Criteria:
Every point must exhibit => 12 dB process gain.
The average of every point must be => 15 dB process gain.
The minimum process gain at fc must be => 17 dB.

Required Test Equipment:
HP8640B Signal Generator (two)
Variable attenuator(s)
Power supply
Boonton Power Meter
HP8593E Spectrum Analyzer
Chip Code Generator
IBM PC compatible computer with serial interface and manual channelized test code (LABVIEW)
LABVIEW Firmware
Transceiver power cable, twisted pair, extended length
Transceiver serial cable, RJ45 to DB25, extended length

Equipment Set Up:
The processing gain of the DSSS DSP receiver is measured by the spread signal to unspread signal method whereby a CW signal is injected in 50 kHz intervals from 917.3800 to 917.7800 MHz. The difference (in dB) of the correlated spread signal level (in the channel from which data is extracted) to the level of the CW signal in the same channel is the system process gain.

1. Ensure that the Chip Code Generator is connected to its power source and that the power switch is OFF.
2. Each transceiver receive section will be programmed with default parameters using appropriate software/firmware. Select a receive frequency of 917.58 MHz for all tests.
3. HP8640B Signal Generator:
   Center Frequency = 917.38000 MHz
   Signal Level = -30 dBm
4. HP8593E Spectrum Analyzer
   Resolution Bandwidth = 3 MHz
   Video Bandwidth = 1 MHz
   Sweep = 50 mSec
   Span = 0 MHz
   Attenuation = 10 dB
5. Variable Attenuators
   Attenuation = 74 dB

Note: Ensure that all test equipment has been warmed up for 30 minutes and self-calibrated before measurements are taken.



3.B.1 Test Configuration

Procedure:

1. Place the transceiver to be tested flange side down in the temperature chamber.
2. Label and route each wire and cable described below outside the temperature chamber.
3. Use the transceiver power cable to connect the unit under test to the DC supply. Set the DC supply to provide 13.5 VDC to the unit under test.
4. Determine the amount of power difference between the injected spread signal and the injected CW signal.

   a. Measure and record the power of the spread signal present at the input to the variable attenuators by connecting the spread RF signal to the spectrum analyzer. Measure power during preamble

   b. Measure and record the power of the CW signal present at the input to the variable attenuators by disconnecting the RF and connecting it to the spectrum analyzer.

   c. Determine a calibration factor based on the difference between the measurements made in steps a. and b. This amount of attenuation shall be added or removed (as appropriate) from the circuit when configured for CW input measurements.

5. Apply a spread signal located in the center of channel 5 to the receiver. Record the averaged channel 6 amplitude of this signal after correlation.
6. Reconfigure the set-up to apply a CW signal to the DSSS DSP input.
7. Apply (or remove) the appropriate amount of attenuation, as determined in step 4 above, such that the CW signal is at the same input power level as the spread signal.
8. With the CW signal power at -104 dBm and a frequency beginning at 917.3800 MHz, and incrementing in 50 kHz steps to 917.7800, record the averaged channel 6 amplitude of this CW signal for each signal frequency.
9. Calculate the margin which is defined to be the number in dB between the level of the interferer and that point which is 12 dB (required for specified BER) below the level of the correlated signal.
10. Calculate process gain

    Reference: Dixon, R Spread Spectrum Systems 2nd edition (New York, John Wiley and Sons)
    Gp = S/N + Mi + Lsys (Lsys = 1.2dB saw + 0.4dB DSP = 1.6dB)

11. Determine average process gain by averaging the linear equivalent of the values in the grey boxes of the table below and then converting back to dB's.

TEST# 3.B.1

PROCESS GAIN TEST

+25C	Frequency Offset (kHz)								
UNIT #	-200	-150	-100	-50	0	50	100	150	200
1	14	16	19	16	26	16	20	16	16
2	12	12	16	13	34	14	17	14	12
3	14	16	19	16	37	16	19	16	14
4	12	13	16	14	34	13	17	14	13
5	15	17	18	17	37	13	20	17	16
6	14	16	19	17	36	16	20	17	16
Pass/Fail Criteria	≥ 12 dB	≥ 12 dB	≥ 12 dB	≥ 12 dB	> 17 dB	≥ 12 dB	≥ 12 dB	≥ 12 dB	≥ 12 dB

UNIT # 1 Average Process Gain = 19.498 dB (Pass/Fail criteria: must be => 15 dB)
UNIT # 2 Average Process Gain = 24.8 dB (Pass/Fail criteria: must be => 15 dB)
UNIT # 3 Average Process Gain = 27.8 dB (Pass/Fail criteria: must be => 15 dB)
UNIT # 4 Average Process Gain = 24.8 dB (Pass/Fail criteria: must be => 15 dB)
UNIT # 5 Average Process Gain = 27.8 dB (Pass/Fail criteria: must be => 15 dB)
UNIT # 6 Average Process Gain = 26.9 dB (Pass/Fail criteria: must be => 15 dB)