

TEST REPORT:

**TTI Wireless
(WaveRider Communications, Inc.)**

FCC 15.247(e) Jamming Margin Test

prepared for

Dragan Zivkovic

May 13, 1998

PROJECT INFORMATION

PROJECT: TTI Wireless Jamming Margin Test

COMPANY CONTACTS: Pete Bonk , President
Dragan Zivkovic, Director of Engineering
17830 Englewood Dr. #1
Cleveland, OH 44130
Phone (440)-243-9033
FAX: (440)-243-9045

L.S. RESEARCH CONTACTS: Brian Petted, Vice President,.Engineering
Bill Steinike, Business Manager
Phone: (414) 375-4400
FAX: (414) 375-4248
R&D FAX: (414)-375-6731

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Signature Page:

Prepared By: *Brian Petted*



Technical Approval By: _____

1.0 Scope

This report presents the test procedure, test configuration and test data associated with a FCC Part 15.247 (e) Jamming Margin test for the indirect measurement of processing gain.

2.0 Applicable Reference Documents.

- [1] “Operation within the bands 902-928 MHz, 2400-2483.5, and 5725-5850 MHz” **Title 47 Part 15 section 247 (e) Code of Federal Regulations. (47 CFR 15.247).**
- [2] “Report and Order: Amendment of Parts 2 and 15 of the Commission’s Rules Regarding Spread Spectrum Transmitters. Appendix C: ‘Guidance on Measurements for Direct Sequence Spread Spectrum Systems” **FCC 97-114. ET Docket No. 96-8, RM-8435, RM-8608, RM-8609.**
- [3] “The Treatment of Uncertainty in EMC Measurements” **NAMAS, NIS 81 Edition 1, May 1994. NAMAS Executive, National Physical Laboratory, Teddington Middlesex, TW11 0LW, England.**
- [4] “ HFA3860 Direct Sequence Spread Spectrum Baseband Processor” **Harris Corporation Semiconductor Sector Preliminary Data Sheet**, Melbourne FL, June 1997.
- [5] “ M-ary Orthogonal Keying BER Curve”, **Communication from Harris Corporation to L.S. Research, Inc.**

3.0 Test Background and Procedure.

According to FCC regulations [1], a direct sequence spread spectrum system must have a processing gain, G_p of at least 10 dB. Compliance to this requirement can be shown by demonstrating a relative bit-error-ratio (BER) performance improvement (and corresponding signal to noise ratio per symbol improvement of at least 10 dB) between the case where spread spectrum processes (coding, modulation) are engaged relative to the processes being bypassed. In some practical systems, the spread spectrum processing cannot simply be bypassed. In these cases, the processing gain can be indirectly measured by a jamming margin test [2].

The processing gain is related to the jamming margin as follows [2]:

$$G_p = BER_{REFERENCE} \leftrightarrow \left| \frac{S}{N} \right|_{output} + \left(\frac{J}{S} \right) + L_{system}$$

Where $BER_{REFERENCE}$ is the reference bit error ratio with its corresponding, theoretical output signal to noise ratio per symbol, $(S/N)_{output}$, (J/S) is the jamming margin (jamming signal power relative to desired signal power), and L_{system} are the system implementation losses.

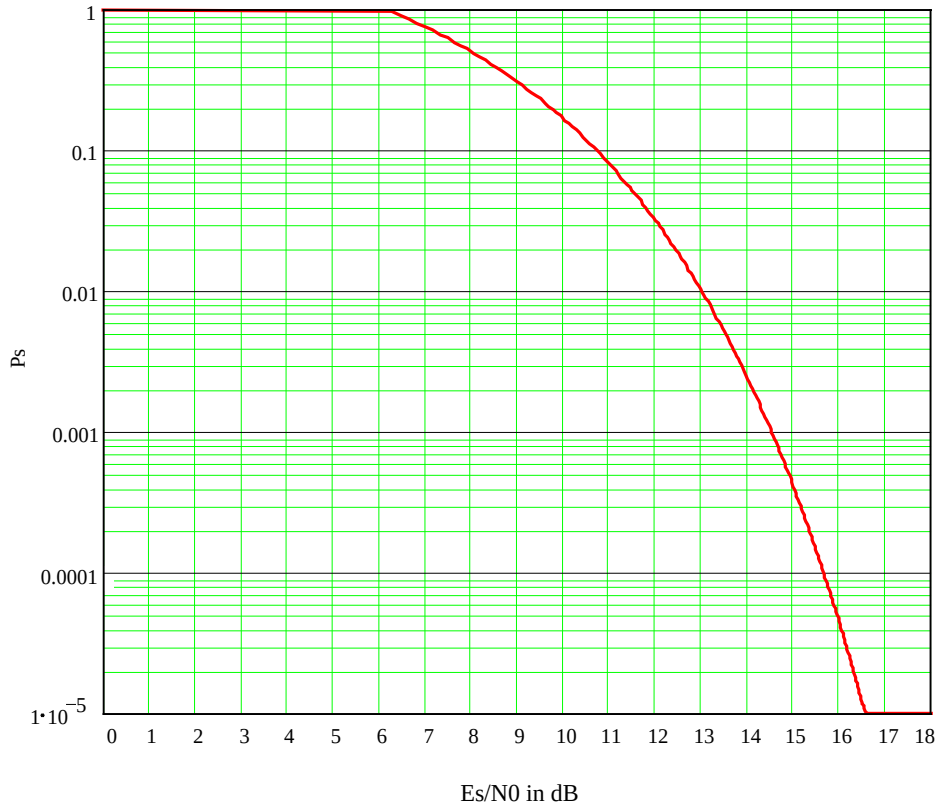
The maximum allowable system implementation loss is 2 dB.

The HFA3860 direct sequence spread spectrum baseband processor uses M-ary Bi-Orthogonal Keying. The BER performance curve is given by [5]:

“ The probability of error for generalized M-ary Orthogonal signaling using coherent demodulation is given by:

$$P_e = 1 - P_{c1} = 1 - \frac{1}{\sqrt{2\pi}} \int_{-\frac{S_{01}}{N_0}}^{\infty} \left[2(1 - Q\left(z + \sqrt{2 \frac{E_b}{\eta}}\right) \right]^{\frac{M}{2}-1} \exp\left\{-\frac{z^2}{2}\right\} dz$$

This integral cannot be solved in closed form, and numerical integration must be used. This is done in a MATHCAD environment and is displayed in graphical format for M=2, 4, 8, and 16.” (Shown on next page for M=16).



M=16 QMBOK Es/No

The reference BER is specified as $1 \cdot 10^{-5}$. The corresponding Es/No (signal to noise ratio per symbol) is 16.6 dB. The Es/No required to achieve the desired BER with maximum system implementation losses is 18.6 dB. The minimum processing gain is again, 10 dB, therefore:

$$G_p = \left| \frac{E_s}{N_o} \right|_{\text{output}} + \left(\frac{J}{S} \right) + L_{\text{system}} = 16.6 \text{ dB} + 2.0 \text{ dB} + \left(\frac{J}{S} \right) \geq 10 \text{ dB}$$

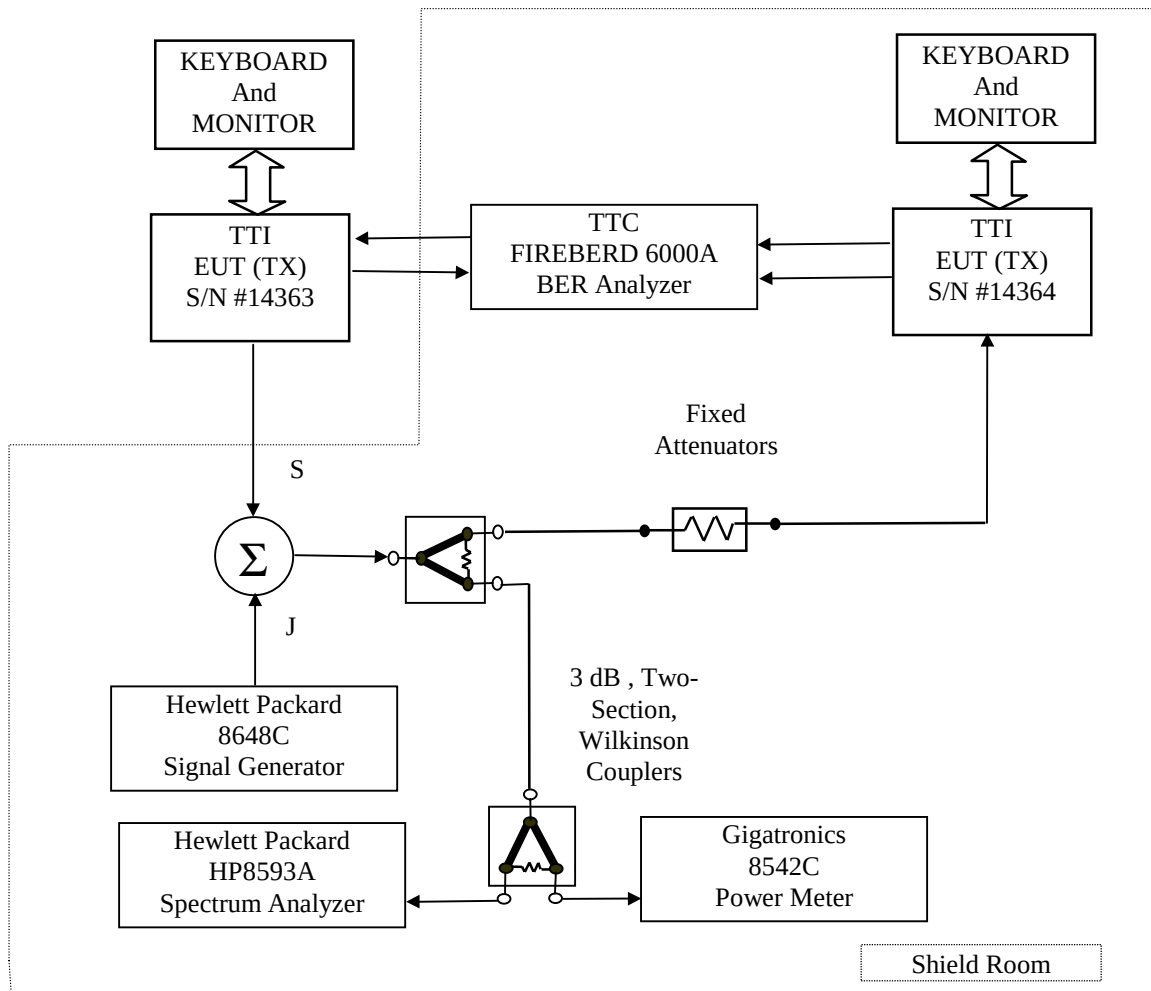
$$G_p = 18.6 \text{ dB} + \left| \frac{J}{S} \right| \geq 10 \text{ dB}$$

The minimum jammer to signal ratio is as follows:

$$\left| \frac{J}{S} \right| \geq -8.6 \text{ dB}$$

4.0 Test Configuration: CW Jamming Margin (15.247) (e)

4.1 Basic Test Block Diagram



4.2 Test Procedure

4.2.1 Obtain the simplex link shown. Perform all independent instrumentation calibrations prior to this procedure. Set operating power levels using fixed and variable attenuators in system to meet the following objectives:

1. Signal Power at receiver approximately -60 dBm (above thermal sensitivity such that thermal noise does not cause bit errors).
2. Signal Power at power meter between -20 and -40 dBm for optimal linearity.
3. Use spectrum analyzer to monitor test.
4. Ensure that CW Jammer generator RF output is disabled and measure the power at the power meter port using the power meter. This is the relative signal power, S_r .
5. Disable Transmitter, and set CW Jammer generator RF output frequency equal to the carrier frequency and enable generator output. Set reference CW Jammer power level at power meter port equal to S_r (0 dB J/S reference level). Note the power level setting on the generator, this is the reference CW Jammer power setting, J_r .
6. Disable CW Jammer, re-establish link. BER test set should be operating error-free.
7. Enable CW Jammer at a low power level and gradually increase the CW Jammer power until the BER test set indicates the reference BER level ($1 \bullet 10^{-5}$) or greater. Note nominal Jammer power setting, J_n .
8. The maximum Jamming signal level is limited such that the link is not degraded to the point where re-acquisition is necessary. This was necessary to allow the test to be automated and to be independent of the E.U.T. If the jammer power level were allowed to exceed the threshold in which the link is lost in the equipment, the test would be interrupted. The maximum jamming level is above the level necessary to detect the minimum processing gain.

4.2.2 This test is repeated for a fixed signal carrier frequency and for uniform steps in frequency increments of 50 kHz across the receiver passband with the CW Jammer. In this case, the receiver passband is ± 9.5 MHz. The procedure can be illustrated as follows:

For offset frequency - 9.5 MHz to carrier frequency + 9.5 MHz , Step 50 kHz.

Begin at minimum Jammer Power

Do:

Increase Jammer Power Setting by 1dB.

Until:

Average BER is greater or equal to reference BER.

Record Indicated Nominal Jammer Level setting.

Next offset frequency.

4.2.3 The nominal Jammer Level settings are tabulated versus offset frequency. The J/S ratio and the processing gain are then calculated as follows:

$$\left(\frac{J}{S} \right) = [(J_r - J_n)]$$

If $J_n = J_r$ then:

$$\left(\frac{J}{S} \right) = 0dB$$

is the reference Jammer Power Level.

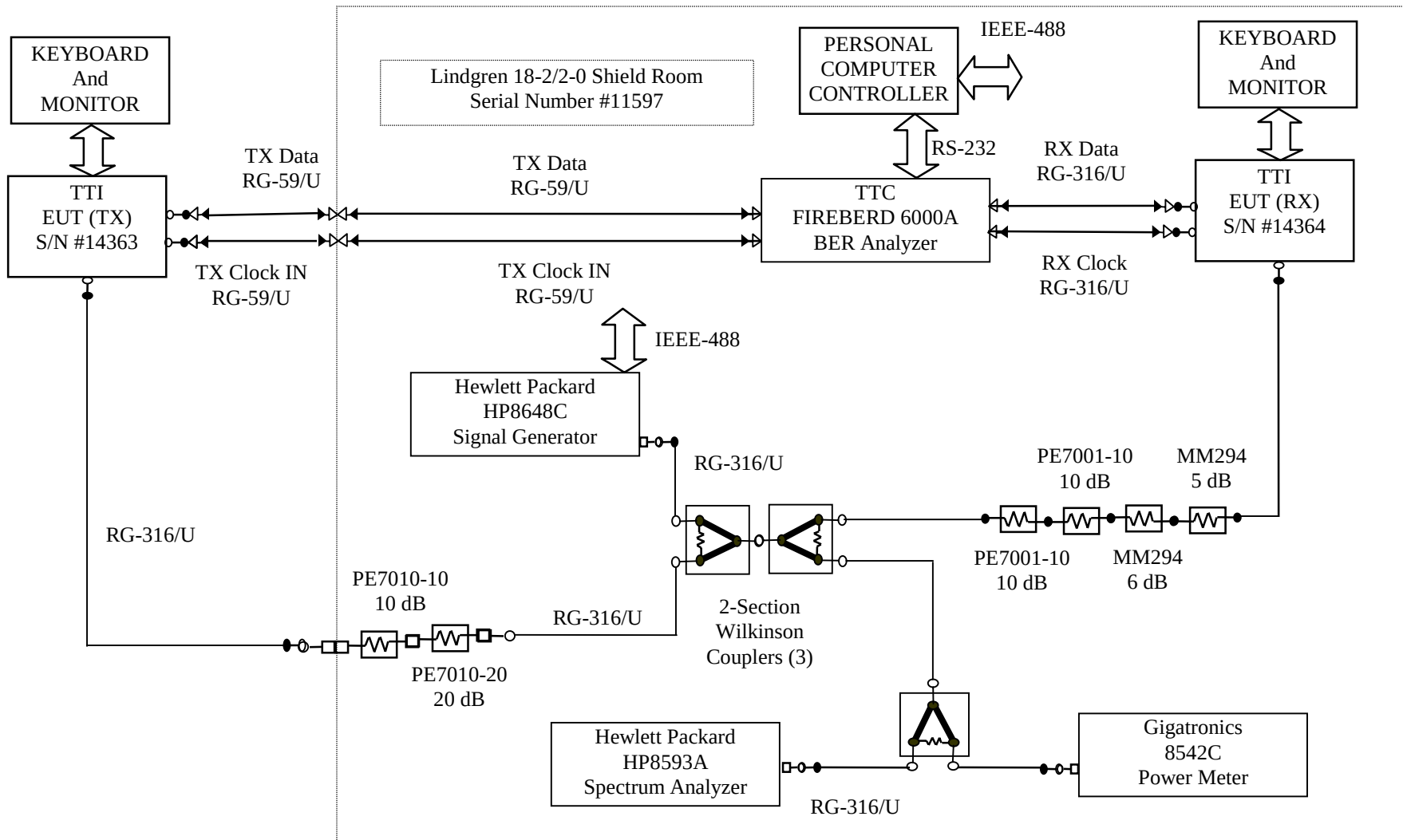
4.2.4 The processing gain then is determined using the J/S ratio:

$$G_p = 18.6 \text{ dB} + \left| \frac{J}{S} \right|$$

4.2.4 The numerical data associated with the following radio channels is tabulated and presented in Appendix A:

Sorted Data: Channels 1,3,6 Table entries:f,Gp for each Channel.

4.3 Test Electrical Configuration:



4.4 Measurement Equipment List

Equipment	LSR Serial No.	Serial Number	Calibration
HP8596E Spectrum Analyzer	CC00130C	3205A00103	Initial Only
Gigatronics 8542C Power Meter	EE960005	1831450	2/14/97
Gigatronics 86301A Sensor	-	1830164	3/5/98
TTC Fireberd 6000 BER Test Set Test Interval 10 ⁷ Pattern: 2 ²³ -1 External TX input	CC00164C	10016	11/29/96
HP 8648C Signal Generator.	CC00129C	34119400344	6/16/94
Wilkinson Power Couplers (3)	-	2400-1,-2,-3	HP8753E

4.5 Measurement Uncertainties for Absolute Measurements

The measurement uncertainties are determined by the methods specified in NAMAS NIS 81, Edition 1, May 1994, "The Treatment of Uncertainty in EMC Measurements". Relevant equipment specifications found in Appendix B.

Equipment	Specified Characteristic	Probability Density	Specified Uncertainty
HP8596E Spectrum Analyzer	Reference Level	Uniform	±0.3 dB +0.01 • dB from -20 dBm
HP8596E Spectrum Analyzer	Calibrator Output	Uniform	±0.4 dB
HP8596E Spectrum Analyzer	Absolute Amplitude Calibration Uncertainty	Uniform	±0.15 dB
Gigatronics 86301A Sensor	Power Calibration Factor	Uniform	1.33 %
Wilkinson Couplers 2400-2500 MHz	Amplitude Imbalance	Uniform	±0.1 dB
HP 8648C	Output Power	Uniform	±2.0 dB

HP Spectrum Analyzer Total Uncertainty (-60 dBm level):

Perform Root-Sum-Square of three uncertainties to find total uncertainty for a 95% confidence level:

Uniform uncertainties specify the probability density interval $\pm a$. The variance of the uniform density is $a^2/3$.

Sum the uncorrelated variances to find the total variance:

$$\text{Total variance} = [(0.3 \text{ dB} + 0.01 \bullet 40 \text{ dB})/3 + (0.4)/3 + (0.15)/3] = 1.25/3 = 0.416$$

The uncertainty for a 95% confidence interval is 1.96 times the standard deviation:

$$\text{Total Uncertainty} = \pm 1.96 \bullet \sqrt{0.416} = 1.96 \bullet 0.644 = \pm 1.26 \text{ dB}$$

Gigatronics Power Sensor Power Calibration Factor Uncertainty:

Probable error in Power sensor: $\pm 1.33\%$, $\pm 10 \log_{10} (1.0133) = \pm 0.0574 \text{ dB}$

$$\text{Variance} = 0.0574^2/3 = 0.00109$$

$$\text{Total uncertainty} = \pm 1.96 \bullet \sqrt{0.00109} = \pm 0.27 \text{ dB}$$

Signal Generator Output Power Uncertainty:

$$\text{Level Accuracy} = \pm 2.0 \text{ dB}$$

$$\text{Variance} = 2.0^2/3 = 0.667$$

$$\text{Total uncertainty} = \pm 1.96 \bullet \sqrt{0.667} = \pm 1.6 \text{ dB}$$

To check the power setting accuracy, the output of the HP8648 C was varied at 2432 MHz over expected power level range and the power was measured at the output of the summing coupler. The power was measured with the Gigatronics Power meter.

Power Setting (dBm)	Coupler Output Power (dBm)	Ideal Output Power (dBm)	Error (dB)
-17.5	-30.3	-30.3	0
-18.5	-31.3	-31.3	0
-19.5	-32.3	-32.3	0
-20.5	-33.2	-33.3	-0.1
-21.5	-34.2	-34.3	-0.1
-22.5	-35.2	-35.3	-0.1
-23.5	-36.1	-36.3	-0.2
-24.5	-37.1	-37.3	-0.2
-25.5	-38	-38.3	-0.3
-26.5	-39.4	-39.3	0.1
-27.5	-40.4	-40.3	0.1
-28.5	-41.5	-41.3	0.2
-29.5	-42.5	-42.3	0.2
-30.5	-43.5	-43.3	0.2
-31.5	-44.6	-44.3	0.3
-32.5	-45.6	-45.3	0.3
-33.5	-46.7	-46.3	0.4
-34.5	-47.8	-47.3	0.5
-35.5	-48.9	-48.3	0.6
-36.5	-49.9	-49.3	0.6
-37.5	-50.5	-50.3	0.2
-38.5	-50.9	-51.3	-0.4
-39.5	-51.4	-52.3	-0.9

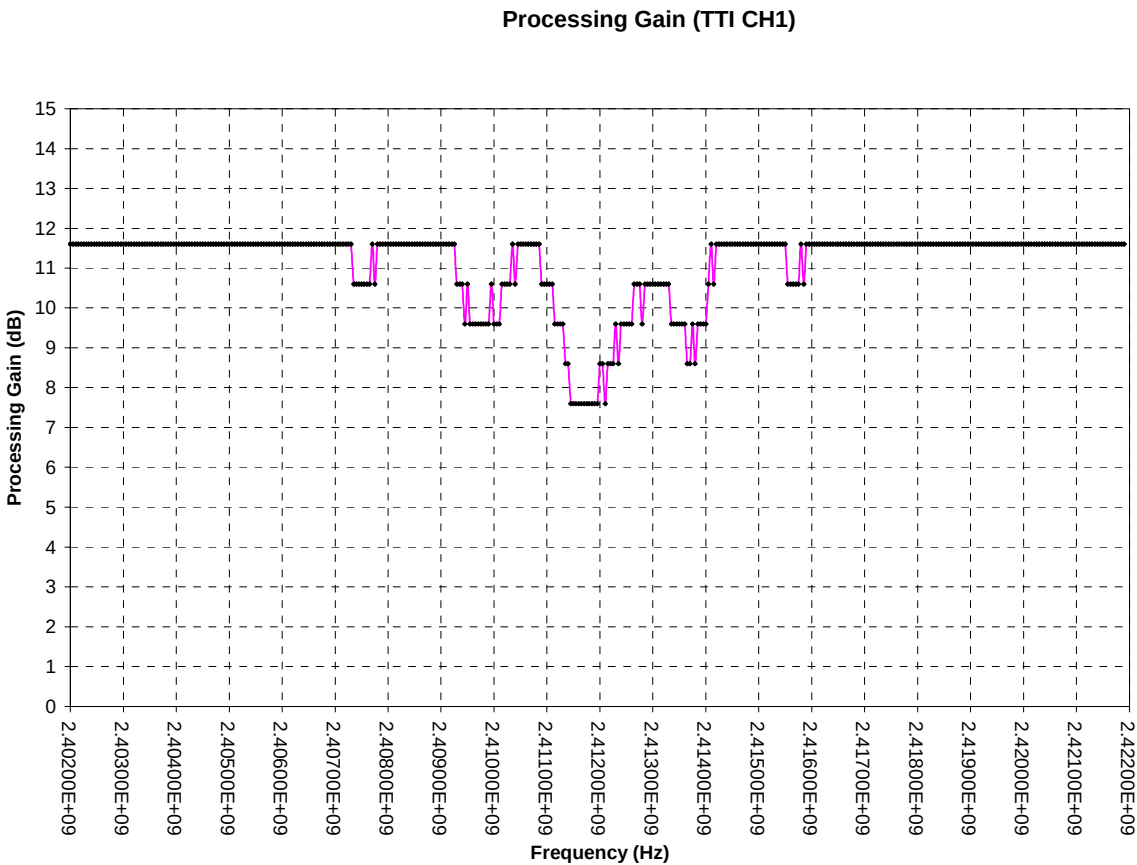
5.0 CW Jamming Margin Test Data

The tabulated numerical test data is presented in Appendix A. The numerical data is presented in graphical form here. Processing gain versus CW frequency for Channels 1,3, and 6 are presented. The measured relative signal power, reference jamming level, and reference jamming level setting are shown below for each channel:

	Channel 1 2412 MHz	Channel 3 2432 MHz	Channel 6 2462 MHz
Relative Signal Power , Sr	-33.7 dBm	-29.5 dBm	-32.5 dBm
Reference Jamming Level	-33.9 dBm	-29.8 dBm	-32.6 dBm
Reference Jamming Level Setting, Jr	-21 dBm	-17.5 dBm	-20 dBm

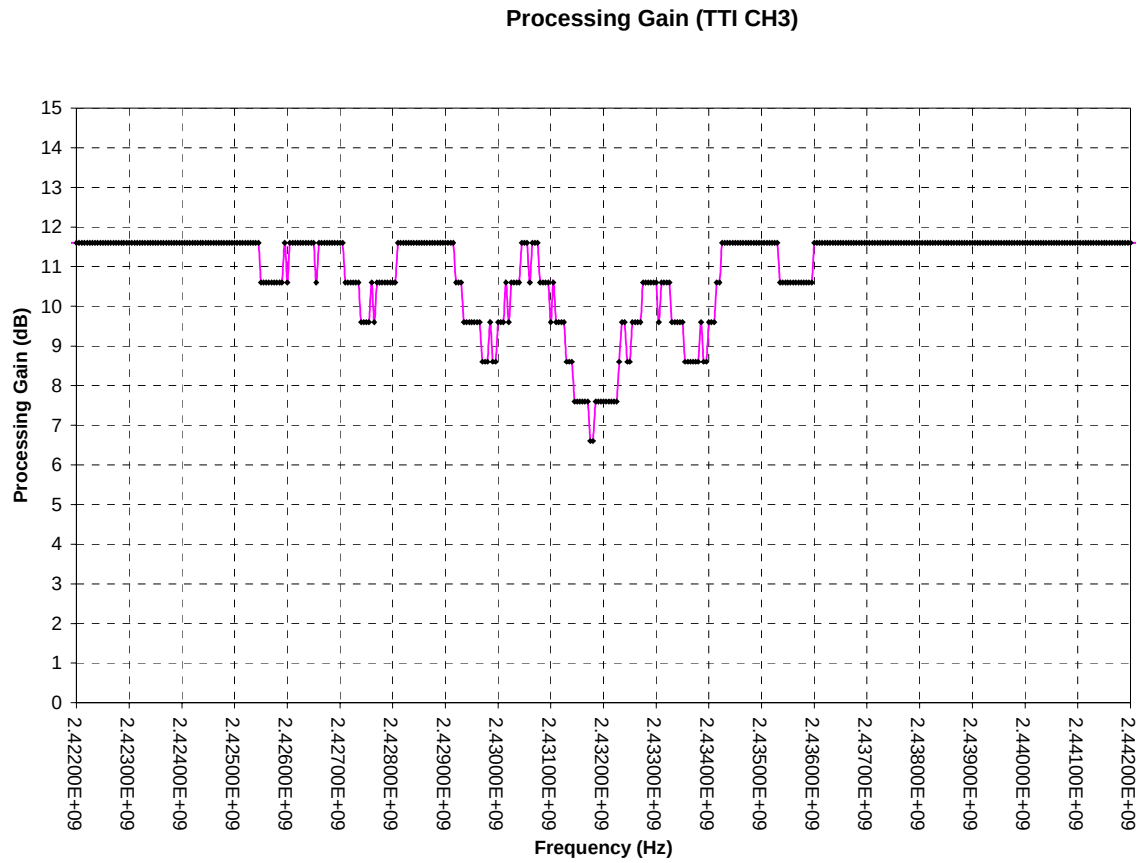
5.1 CW Jamming Test Data for Channel 1

The processing gain versus frequency offset from the carrier is presented below. The Jamming Margin test procedure [3] allows the worst 20% of the points to be discarded. The minimum processing gain is the minimum of the remaining points. The minimum of remaining points can be determined by calculating the upper bound of the 20th percentile of processing gain data. This number will be listed with the data and it represents the final compliance quantity.



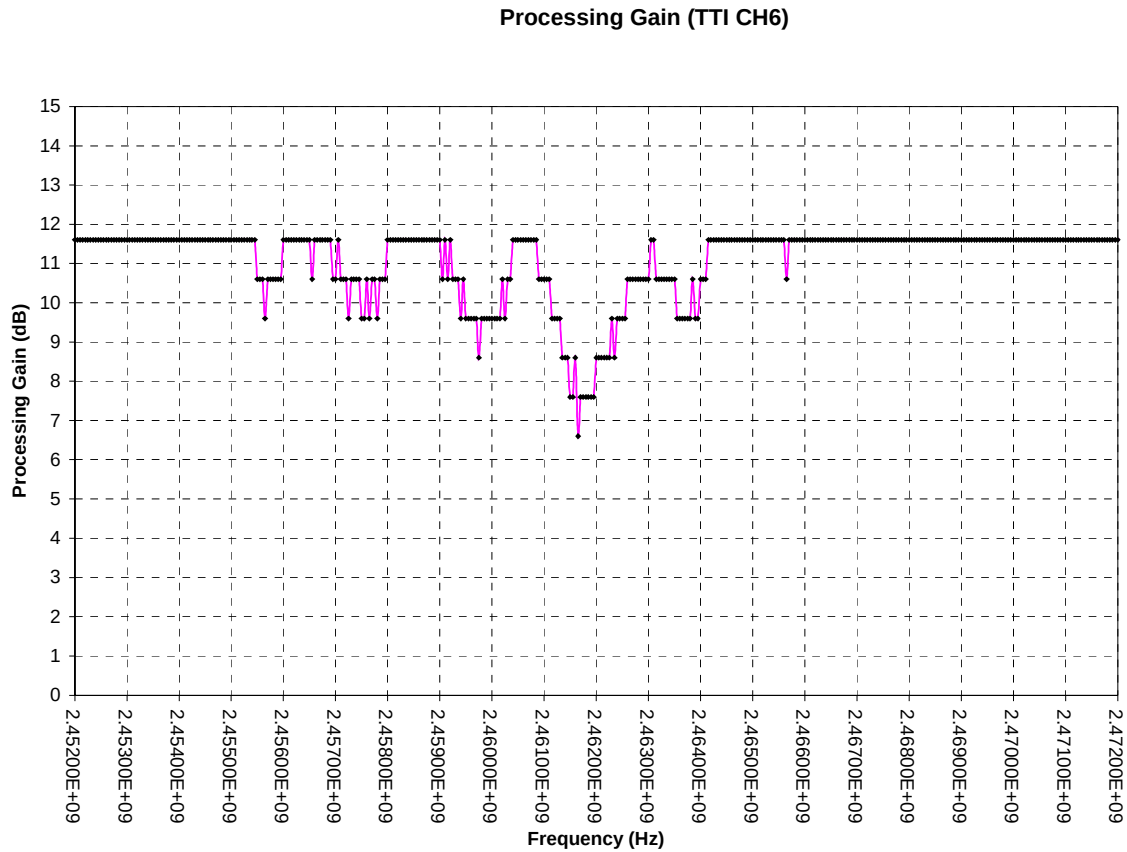
The minimum processing gain with 20% worst points removed is 10.6 dB.

5.2 CW Jamming Test Data for Channel 3



The minimum processing gain with 20% worst points removed is 10.6 dB.

5.3 CW Jamming Test Data for Channel 6:



The minimum processing gain with 20% worst points removed is 10.6 dB.

6.0 Analysis of Test Data

The main conclusions associated with this set of tests are as follows:

1. The system passes the CW jamming margin test on Channel 1.
2. The system passes the CW jamming margin test on Channel 3.
3. The system passes the CW jamming margin test on Channel 6.

APPENDIX A: TABULATED DATA.

APPENDIX A: PROCEEDS ON NEXT PAGE

APPENDIX B: HP VEE PROGRAM USED FOR TEST.

APPENDIX B is presented as an attachment.

APPENDIX C: MEASURING EQUIPMENT SPECIFICATIONS

APPENDIX C is presented as attachments

Appendix A: Tabulated Data for Channel 1

Frequency (Hz) Processing Gain (dB)

2401000000	11.6
2401050000	11.6
2401100000	11.6
2401150000	11.6
2401200000	11.6
2401250000	11.6
2401300000	11.6
2401350000	11.6
2401400000	11.6
2401450000	11.6
2401500000	11.6
2401550000	11.6
2401600000	11.6
2401650000	11.6
2401700000	11.6
2401750000	11.6
2401800000	11.6
2401850000	11.6
2401900000	11.6
2401950000	11.6
2402000000	11.6
2402050000	11.6
2402100000	11.6
2402150000	11.6
2402200000	11.6
2402250000	11.6
2402300000	11.6
2402350000	11.6
2402400000	11.6
2402450000	11.6
2402500000	11.6
2402550000	11.6
2402600000	11.6
2402650000	11.6
2402700000	11.6
2402750000	11.6
2402800000	11.6
2402850000	11.6
2402900000	11.6
2402950000	11.6
2403000000	11.6
2403050000	11.6
2403100000	11.6
2403150000	11.6
2403200000	11.6
2403250000	11.6

2403300000	11.6
2403350000	11.6
2403400000	11.6
2403450000	11.6
2403500000	11.6
2403550000	11.6
2403600000	11.6
2403650000	11.6
2403700000	11.6
2403750000	11.6
2403800000	11.6
2403850000	11.6
2403900000	11.6
2403950000	11.6
2404000000	11.6
2404050000	11.6
2404100000	11.6
2404150000	11.6
2404200000	11.6
2404250000	11.6
2404300000	11.6
2404350000	11.6
2404400000	11.6
2404450000	11.6
2404500000	11.6
2404550000	11.6
2404600000	11.6
2404650000	11.6
2404700000	11.6
2404750000	11.6
2404800000	11.6
2404850000	11.6
2404900000	11.6
2404950000	11.6
2405000000	11.6
2405050000	11.6
2405100000	11.6
2405150000	11.6
2405200000	11.6
2405250000	11.6
2405300000	11.6
2405350000	11.6
2405400000	11.6
2405450000	11.6
2405500000	11.6
2405550000	11.6
2405600000	11.6
2405650000	11.6
2405700000	11.6
2405750000	11.6

2405800000	11.6
2405850000	11.6
2405900000	11.6
2405950000	11.6
2406000000	11.6
2406050000	11.6
2406100000	11.6
2406150000	11.6
2406200000	11.6
2406250000	11.6
2406300000	11.6
2406350000	11.6
2406400000	11.6
2406450000	11.6
2406500000	11.6
2406550000	11.6
2406600000	11.6
2406650000	11.6
2406700000	11.6
2406750000	11.6
2406800000	11.6
2406850000	11.6
2406900000	11.6
2406950000	11.6
2407000000	11.6
2407050000	11.6
2407100000	11.6
2407150000	11.6
2407200000	11.6
2407250000	11.6
2407300000	11.6
2407350000	10.6
2407400000	10.6
2407450000	10.6
2407500000	10.6
2407550000	10.6
2407600000	10.6
2407650000	10.6
2407700000	11.6
2407750000	10.6
2407800000	11.6
2407850000	11.6
2407900000	11.6
2407950000	11.6
2408000000	11.6
2408050000	11.6
2408100000	11.6
2408150000	11.6
2408200000	11.6
2408250000	11.6

2408300000	11.6
2408350000	11.6
2408400000	11.6
2408450000	11.6
2408500000	11.6
2408550000	11.6
2408600000	11.6
2408650000	11.6
2408700000	11.6
2408750000	11.6
2408800000	11.6
2408850000	11.6
2408900000	11.6
2408950000	11.6
2409000000	11.6
2409050000	11.6
2409100000	11.6
2409150000	11.6
2409200000	11.6
2409250000	11.6
2409300000	10.6
2409350000	10.6
2409400000	10.6
2409450000	9.6
2409500000	10.6
2409550000	9.6
2409600000	9.6
2409650000	9.6
2409700000	9.6
2409750000	9.6
2409800000	9.6
2409850000	9.6
2409900000	9.6
2409950000	10.6
2410000000	9.6
2410050000	9.6
2410100000	9.6
2410150000	10.6
2410200000	10.6
2410250000	10.6
2410300000	10.6
2410350000	11.6
2410400000	10.6
2410450000	11.6
2410500000	11.6
2410550000	11.6
2410600000	11.6
2410650000	11.6
2410700000	11.6
2410750000	11.6

2410800000	11.6
2410850000	11.6
2410900000	10.6
2410950000	10.6
2411000000	10.6
2411050000	10.6
2411100000	10.6
2411150000	9.6
2411200000	9.6
2411250000	9.6
2411300000	9.6
2411350000	8.6
2411400000	8.6
2411450000	7.6
2411500000	7.6
2411550000	7.6
2411600000	7.6
2411650000	7.6
2411700000	7.6
2411750000	7.6
2411800000	7.6
2411850000	7.6
2411900000	7.6
2411950000	7.6
2412000000	8.6
2412050000	8.6
2412100000	7.6
2412150000	8.6
2412200000	8.6
2412250000	8.6
2412300000	9.6
2412350000	8.6
2412400000	9.6
2412450000	9.6
2412500000	9.6
2412550000	9.6
2412600000	9.6
2412650000	10.6
2412700000	10.6
2412750000	10.6
2412800000	9.6
2412850000	10.6
2412900000	10.6
2412950000	10.6
2413000000	10.6
2413050000	10.6
2413100000	10.6
2413150000	10.6
2413200000	10.6
2413250000	10.6

2413300000	10.6
2413350000	9.6
2413400000	9.6
2413450000	9.6
2413500000	9.6
2413550000	9.6
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2413900000	9.6
2413950000	9.6
2414000000	9.6
2414050000	10.6
2414100000	11.6
2414150000	10.6
2414200000	11.6
2414250000	11.6
2414300000	11.6
2414350000	11.6
2414400000	11.6
2414450000	11.6
2414500000	11.6
2414550000	11.6
2414600000	11.6
2414650000	11.6
2414700000	11.6
2414750000	11.6
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2414850000	11.6
2414900000	11.6
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2415450000	11.6
2415500000	11.6
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2415650000	10.6
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2415750000	10.6

2415800000	11.6
2415850000	10.6
2415900000	11.6
2415950000	11.6
2416000000	11.6
2416050000	11.6
2416100000	11.6
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2416400000	11.6
2416450000	11.6
2416500000	11.6
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2416650000	11.6
2416700000	11.6
2416750000	11.6
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2416850000	11.6
2416900000	11.6
2416950000	11.6
2417000000	11.6
2417050000	11.6
2417100000	11.6
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2417450000	11.6
2417500000	11.6
2417550000	11.6
2417600000	11.6
2417650000	11.6
2417700000	11.6
2417750000	11.6
2417800000	11.6
2417850000	11.6
2417900000	11.6
2417950000	11.6
2418000000	11.6
2418050000	11.6
2418100000	11.6
2418150000	11.6
2418200000	11.6
2418250000	11.6

2418300000	11.6
2418350000	11.6
2418400000	11.6
2418450000	11.6
2418500000	11.6
2418550000	11.6
2418600000	11.6
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2418700000	11.6
2418750000	11.6
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2418850000	11.6
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2419150000	11.6
2419200000	11.6
2419250000	11.6
2419300000	11.6
2419350000	11.6
2419400000	11.6
2419450000	11.6
2419500000	11.6
2419550000	11.6
2419600000	11.6
2419650000	11.6
2419700000	11.6
2419750000	11.6
2419800000	11.6
2419850000	11.6
2419900000	11.6
2419950000	11.6
2420000000	11.6
2420050000	11.6
2420100000	11.6
2420150000	11.6
2420200000	11.6
2420250000	11.6
2420300000	11.6
2420350000	11.6
2420400000	11.6
2420450000	11.6
2420500000	11.6
2420550000	11.6
2420600000	11.6
2420650000	11.6
2420700000	11.6
2420750000	11.6

2420800000	11.6
2420850000	11.6
2420900000	11.6
2420950000	11.6
2421000000	11.6
2421050000	11.6
2421100000	11.6
2421150000	11.6
2421200000	11.6
2421250000	11.6
2421300000	11.6
2421350000	11.6
2421400000	11.6
2421450000	11.6
2421500000	11.6
2421550000	11.6
2421600000	11.6
2421650000	11.6
2421700000	11.6
2421750000	11.6
2421800000	11.6
2421850000	11.6
2421900000	11.6

Tabulated Data for Channel 3.

Frequency (Hz) Processing Gain (dB)

2421000000	11.6
2421050000	11.6
2421100000	11.6
2421150000	11.6
2421200000	11.6
2421250000	11.6
2421300000	11.6
2421350000	11.6
2421400000	11.6
2421450000	11.6
2421500000	11.6
2421550000	11.6
2421600000	11.6
2421650000	11.6
2421700000	11.6
2421750000	11.6
2421800000	11.6
2421850000	11.6
2421900000	11.6
2421950000	11.6
2422000000	11.6
2422050000	11.6
2422100000	11.6
2422150000	11.6
2422200000	11.6
2422250000	11.6
2422300000	11.6
2422350000	11.6
2422400000	11.6
2422450000	11.6
2422500000	11.6
2422550000	11.6
2422600000	11.6
2422650000	11.6
2422700000	11.6
2422750000	11.6
2422800000	11.6
2422850000	11.6
2422900000	11.6
2422950000	11.6
2423000000	11.6
2423050000	11.6
2423100000	11.6
2423150000	11.6
2423200000	11.6
2423250000	11.6

2423300000	11.6
2423350000	11.6
2423400000	11.6
2423450000	11.6
2423500000	11.6
2423550000	11.6
2423600000	11.6
2423650000	11.6
2423700000	11.6
2423750000	11.6
2423800000	11.6
2423850000	11.6
2423900000	11.6
2423950000	11.6
2424000000	11.6
2424050000	11.6
2424100000	11.6
2424150000	11.6
2424200000	11.6
2424250000	11.6
2424300000	11.6
2424350000	11.6
2424400000	11.6
2424450000	11.6
2424500000	11.6
2424550000	11.6
2424600000	11.6
2424650000	11.6
2424700000	11.6
2424750000	11.6
2424800000	11.6
2424850000	11.6
2424900000	11.6
2424950000	11.6
2425000000	11.6
2425050000	11.6
2425100000	11.6
2425150000	11.6
2425200000	11.6
2425250000	11.6
2425300000	11.6
2425350000	11.6
2425400000	11.6
2425450000	11.6
2425500000	10.6
2425550000	10.6
2425600000	10.6
2425650000	10.6
2425700000	10.6
2425750000	10.6

2425800000	10.6
2425850000	10.6
2425900000	10.6
2425950000	11.6
2426000000	10.6
2426050000	11.6
2426100000	11.6
2426150000	11.6
2426200000	11.6
2426250000	11.6
2426300000	11.6
2426350000	11.6
2426400000	11.6
2426450000	11.6
2426500000	11.6
2426550000	10.6
2426600000	11.6
2426650000	11.6
2426700000	11.6
2426750000	11.6
2426800000	11.6
2426850000	11.6
2426900000	11.6
2426950000	11.6
2427000000	11.6
2427050000	11.6
2427100000	10.6
2427150000	10.6
2427200000	10.6
2427250000	10.6
2427300000	10.6
2427350000	10.6
2427400000	9.6
2427450000	9.6
2427500000	9.6
2427550000	9.6
2427600000	10.6
2427650000	9.6
2427700000	10.6
2427750000	10.6
2427800000	10.6
2427850000	10.6
2427900000	10.6
2427950000	10.6
2428000000	10.6
2428050000	10.6
2428100000	11.6
2428150000	11.6
2428200000	11.6
2428250000	11.6

2428300000	11.6
2428350000	11.6
2428400000	11.6
2428450000	11.6
2428500000	11.6
2428550000	11.6
2428600000	11.6
2428650000	11.6
2428700000	11.6
2428750000	11.6
2428800000	11.6
2428850000	11.6
2428900000	11.6
2428950000	11.6
2429000000	11.6
2429050000	11.6
2429100000	11.6
2429150000	11.6
2429200000	10.6
2429250000	10.6
2429300000	10.6
2429350000	9.6
2429400000	9.6
2429450000	9.6
2429500000	9.6
2429550000	9.6
2429600000	9.6
2429650000	9.6
2429700000	8.6
2429750000	8.6
2429800000	8.6
2429850000	9.6
2429900000	8.6
2429950000	8.6
2430000000	9.6
2430050000	9.6
2430100000	9.6
2430150000	10.6
2430200000	9.6
2430250000	10.6
2430300000	10.6
2430350000	10.6
2430400000	10.6
2430450000	11.6
2430500000	11.6
2430550000	11.6
2430600000	10.6
2430650000	11.6
2430700000	11.6
2430750000	11.6

2430800000	10.6
2430850000	10.6
2430900000	10.6
2430950000	10.6
2431000000	9.6
2431050000	10.6
2431100000	9.6
2431150000	9.6
2431200000	9.6
2431250000	9.6
2431300000	8.6
2431350000	8.6
2431400000	8.6
2431450000	7.6
2431500000	7.6
2431550000	7.6
2431600000	7.6
2431650000	7.6
2431700000	7.6
2431750000	6.6
2431800000	6.6
2431850000	7.6
2431900000	7.6
2431950000	7.6
2432000000	7.6
2432050000	7.6
2432100000	7.6
2432150000	7.6
2432200000	7.6
2432250000	7.6
2432300000	8.6
2432350000	9.6
2432400000	9.6
2432450000	8.6
2432500000	8.6
2432550000	9.6
2432600000	9.6
2432650000	9.6
2432700000	9.6
2432750000	10.6
2432800000	10.6
2432850000	10.6
2432900000	10.6
2432950000	10.6
2433000000	10.6
2433050000	9.6
2433100000	10.6
2433150000	10.6
2433200000	10.6
2433250000	10.6

2433300000	9.6
2433350000	9.6
2433400000	9.6
2433450000	9.6
2433500000	9.6
2433550000	8.6
2433600000	8.6
2433650000	8.6
2433700000	8.6
2433750000	8.6
2433800000	8.6
2433850000	9.6
2433900000	8.6
2433950000	8.6
2434000000	9.6
2434050000	9.6
2434100000	9.6
2434150000	10.6
2434200000	10.6
2434250000	11.6
2434300000	11.6
2434350000	11.6
2434400000	11.6
2434450000	11.6
2434500000	11.6
2434550000	11.6
2434600000	11.6
2434650000	11.6
2434700000	11.6
2434750000	11.6
2434800000	11.6
2434850000	11.6
2434900000	11.6
2434950000	11.6
2435000000	11.6
2435050000	11.6
2435100000	11.6
2435150000	11.6
2435200000	11.6
2435250000	11.6
2435300000	11.6
2435350000	10.6
2435400000	10.6
2435450000	10.6
2435500000	10.6
2435550000	10.6
2435600000	10.6
2435650000	10.6
2435700000	10.6
2435750000	10.6

2435800000	10.6
2435850000	10.6
2435900000	10.6
2435950000	10.6
2436000000	11.6
2436050000	11.6
2436100000	11.6
2436150000	11.6
2436200000	11.6
2436250000	11.6
2436300000	11.6
2436350000	11.6
2436400000	11.6
2436450000	11.6
2436500000	11.6
2436550000	11.6
2436600000	11.6
2436650000	11.6
2436700000	11.6
2436750000	11.6
2436800000	11.6
2436850000	11.6
2436900000	11.6
2436950000	11.6
2437000000	11.6
2437050000	11.6
2437100000	11.6
2437150000	11.6
2437200000	11.6
2437250000	11.6
2437300000	11.6
2437350000	11.6
2437400000	11.6
2437450000	11.6
2437500000	11.6
2437550000	11.6
2437600000	11.6
2437650000	11.6
2437700000	11.6
2437750000	11.6
2437800000	11.6
2437850000	11.6
2437900000	11.6
2437950000	11.6
2438000000	11.6
2438050000	11.6
2438100000	11.6
2438150000	11.6
2438200000	11.6
2438250000	11.6

2438300000	11.6
2438350000	11.6
2438400000	11.6
2438450000	11.6
2438500000	11.6
2438550000	11.6
2438600000	11.6
2438650000	11.6
2438700000	11.6
2438750000	11.6
2438800000	11.6
2438850000	11.6
2438900000	11.6
2438950000	11.6
2439000000	11.6
2439050000	11.6
2439100000	11.6
2439150000	11.6
2439200000	11.6
2439250000	11.6
2439300000	11.6
2439350000	11.6
2439400000	11.6
2439450000	11.6
2439500000	11.6
2439550000	11.6
2439600000	11.6
2439650000	11.6
2439700000	11.6
2439750000	11.6
2439800000	11.6
2439850000	11.6
2439900000	11.6
2439950000	11.6
2440000000	11.6
2440050000	11.6
2440100000	11.6
2440150000	11.6
2440200000	11.6
2440250000	11.6
2440300000	11.6
2440350000	11.6
2440400000	11.6
2440450000	11.6
2440500000	11.6
2440550000	11.6
2440600000	11.6
2440650000	11.6
2440700000	11.6
2440750000	11.6

2440800000	11.6
2440850000	11.6
2440900000	11.6
2440950000	11.6
2441000000	11.6
2441050000	11.6
2441100000	11.6
2441150000	11.6
2441200000	11.6
2441250000	11.6
2441300000	11.6
2441350000	11.6
2441400000	11.6
2441450000	11.6
2441500000	11.6
2441550000	11.6
2441600000	11.6
2441650000	11.6
2441700000	11.6
2441750000	11.6
2441800000	11.6
2441850000	11.6
2441900000	11.6
2441950000	11.6
2442000000	11.6
2442050000	11.6
2442100000	11.6
2442150000	11.6
2442200000	11.6
2442250000	11.6
2442300000	11.6
2442350000	11.6
2442400000	11.6
2442450000	11.6
2442500000	11.6
2442550000	11.6
2442600000	11.6
2442650000	11.6
2442700000	11.6
2442750000	11.6
2442800000	11.6
2442850000	11.6
2442900000	11.6
2442950000	11.6
2443000000	11.6

Tabulated Data for Channel 6

Frequency (Hz) Processing Gain (dB)

2451000000	11.6
2451050000	11.6
2451100000	11.6
2451150000	11.6
2451200000	11.6
2451250000	11.6
2451300000	11.6
2451350000	11.6
2451400000	11.6
2451450000	11.6
2451500000	11.6
2451550000	11.6
2451600000	11.6
2451650000	11.6
2451700000	11.6
2451750000	11.6
2451800000	11.6
2451850000	11.6
2451900000	11.6
2451950000	11.6
2452000000	11.6
2452050000	11.6
2452100000	11.6
2452150000	11.6
2452200000	11.6
2452250000	11.6
2452300000	11.6
2452350000	11.6
2452400000	11.6

2452450000	11.6
2452500000	11.6
2452550000	11.6
2452600000	11.6
2452650000	11.6
2452700000	11.6
2452750000	11.6
2452800000	11.6
2452850000	11.6
2452900000	11.6
2452950000	11.6
2453000000	11.6
2453050000	11.6
2453100000	11.6
2453150000	11.6
2453200000	11.6
2453250000	11.6
2453300000	11.6
2453350000	11.6
2453400000	11.6
2453450000	11.6
2453500000	11.6
2453550000	11.6
2453600000	11.6
2453650000	11.6
2453700000	11.6
2453750000	11.6
2453800000	11.6
2453850000	11.6
2453900000	11.6
2453950000	11.6
2454000000	11.6
2454050000	11.6
2454100000	11.6
2454150000	11.6
2454200000	11.6
2454250000	11.6
2454300000	11.6
2454350000	11.6
2454400000	11.6
2454450000	11.6
2454500000	11.6
2454550000	11.6
2454600000	11.6
2454650000	11.6
2454700000	11.6
2454750000	11.6
2454800000	11.6
2454850000	11.6
2454900000	11.6

2454950000	11.6
2455000000	11.6
2455050000	11.6
2455100000	11.6
2455150000	11.6
2455200000	11.6
2455250000	11.6
2455300000	11.6
2455350000	11.6
2455400000	11.6
2455450000	11.6
2455500000	10.6
2455550000	10.6
2455600000	10.6
2455650000	9.6
2455700000	10.6
2455750000	10.6
2455800000	10.6
2455850000	10.6
2455900000	10.6
2455950000	10.6
2456000000	11.6
2456050000	11.6
2456100000	11.6
2456150000	11.6
2456200000	11.6
2456250000	11.6
2456300000	11.6
2456350000	11.6
2456400000	11.6
2456450000	11.6
2456500000	11.6
2456550000	10.6
2456600000	11.6
2456650000	11.6
2456700000	11.6
2456750000	11.6
2456800000	11.6
2456850000	11.6
2456900000	11.6
2456950000	10.6
2457000000	10.6
2457050000	11.6
2457100000	10.6
2457150000	10.6
2457200000	10.6
2457250000	9.6
2457300000	10.6
2457350000	10.6
2457400000	10.6

2457450000	10.6
2457500000	9.6
2457550000	9.6
2457600000	10.6
2457650000	9.6
2457700000	10.6
2457750000	10.6
2457800000	9.6
2457850000	10.6
2457900000	10.6
2457950000	10.6
2458000000	11.6
2458050000	11.6
2458100000	11.6
2458150000	11.6
2458200000	11.6
2458250000	11.6
2458300000	11.6
2458350000	11.6
2458400000	11.6
2458450000	11.6
2458500000	11.6
2458550000	11.6
2458600000	11.6
2458650000	11.6
2458700000	11.6
2458750000	11.6
2458800000	11.6
2458850000	11.6
2458900000	11.6
2458950000	11.6
2459000000	11.6
2459050000	10.6
2459100000	11.6
2459150000	10.6
2459200000	11.6
2459250000	10.6
2459300000	10.6
2459350000	10.6
2459400000	9.6
2459450000	10.6
2459500000	9.6
2459550000	9.6
2459600000	9.6
2459650000	9.6
2459700000	9.6
2459750000	8.6
2459800000	9.6
2459850000	9.6
2459900000	9.6

2459950000	9.6
2460000000	9.6
2460050000	9.6
2460100000	9.6
2460150000	9.6
2460200000	10.6
2460250000	9.6
2460300000	10.6
2460350000	10.6
2460400000	11.6
2460450000	11.6
2460500000	11.6
2460550000	11.6
2460600000	11.6
2460650000	11.6
2460700000	11.6
2460750000	11.6
2460800000	11.6
2460850000	11.6
2460900000	10.6
2460950000	10.6
2461000000	10.6
2461050000	10.6
2461100000	10.6
2461150000	9.6
2461200000	9.6
2461250000	9.6
2461300000	9.6
2461350000	8.6
2461400000	8.6
2461450000	8.6
2461500000	7.6
2461550000	7.6
2461600000	8.6
2461650000	6.6
2461700000	7.6
2461750000	7.6
2461800000	7.6
2461850000	7.6
2461900000	7.6
2461950000	7.6
2462000000	8.6
2462050000	8.6
2462100000	8.6
2462150000	8.6
2462200000	8.6
2462250000	8.6
2462300000	9.6
2462350000	8.6
2462400000	9.6

2462450000	9.6
2462500000	9.6
2462550000	9.6
2462600000	10.6
2462650000	10.6
2462700000	10.6
2462750000	10.6
2462800000	10.6
2462850000	10.6
2462900000	10.6
2462950000	10.6
2463000000	10.6
2463050000	11.6
2463100000	11.6
2463150000	10.6
2463200000	10.6
2463250000	10.6
2463300000	10.6
2463350000	10.6
2463400000	10.6
2463450000	10.6
2463500000	10.6
2463550000	9.6
2463600000	9.6
2463650000	9.6
2463700000	9.6
2463750000	9.6
2463800000	9.6
2463850000	10.6
2463900000	9.6
2463950000	9.6
2464000000	10.6
2464050000	10.6
2464100000	10.6
2464150000	11.6
2464200000	11.6
2464250000	11.6
2464300000	11.6
2464350000	11.6
2464400000	11.6
2464450000	11.6
2464500000	11.6
2464550000	11.6
2464600000	11.6
2464650000	11.6
2464700000	11.6
2464750000	11.6
2464800000	11.6
2464850000	11.6
2464900000	11.6

2464950000	11.6
2465000000	11.6
2465050000	11.6
2465100000	11.6
2465150000	11.6
2465200000	11.6
2465250000	11.6
2465300000	11.6
2465350000	11.6
2465400000	11.6
2465450000	11.6
2465500000	11.6
2465550000	11.6
2465600000	11.6
2465650000	10.6
2465700000	11.6
2465750000	11.6
2465800000	11.6
2465850000	11.6
2465900000	11.6
2465950000	11.6
2466000000	11.6
2466050000	11.6
2466100000	11.6
2466150000	11.6
2466200000	11.6
2466250000	11.6
2466300000	11.6
2466350000	11.6
2466400000	11.6
2466450000	11.6
2466500000	11.6
2466550000	11.6
2466600000	11.6
2466650000	11.6
2466700000	11.6
2466750000	11.6
2466800000	11.6
2466850000	11.6
2466900000	11.6
2466950000	11.6
2467000000	11.6
2467050000	11.6
2467100000	11.6
2467150000	11.6
2467200000	11.6
2467250000	11.6
2467300000	11.6
2467350000	11.6
2467400000	11.6

2467450000	11.6
2467500000	11.6
2467550000	11.6
2467600000	11.6
2467650000	11.6
2467700000	11.6
2467750000	11.6
2467800000	11.6
2467850000	11.6
2467900000	11.6
2467950000	11.6
2468000000	11.6
2468050000	11.6
2468100000	11.6
2468150000	11.6
2468200000	11.6
2468250000	11.6
2468300000	11.6
2468350000	11.6
2468400000	11.6
2468450000	11.6
2468500000	11.6
2468550000	11.6
2468600000	11.6
2468650000	11.6
2468700000	11.6
2468750000	11.6
2468800000	11.6
2468850000	11.6
2468900000	11.6
2468950000	11.6
2469000000	11.6
2469050000	11.6
2469100000	11.6
2469150000	11.6
2469200000	11.6
2469250000	11.6
2469300000	11.6
2469350000	11.6
2469400000	11.6
2469450000	11.6
2469500000	11.6
2469550000	11.6
2469600000	11.6
2469650000	11.6
2469700000	11.6
2469750000	11.6
2469800000	11.6
2469850000	11.6
2469900000	11.6

2469950000	11.6
2470000000	11.6
2470050000	11.6
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