UltraTech
Group of Labs

Sep.03, 2001

CLEARWIRE TECHNOLOGIES INC.
485 Cayuga Road, P.O. Box 222
Buffalo, New York
USA, 14225-0222

Attn.: **Mr. David Chauncey**

Subject: **FCC Certification Application Testing under FCC PART 15, Subpart C, Sec. 15.247 - Direct Sequence Spread Spectrum Transmitters operating in the frequency band 2408.040 - 2465.328 MHz.**

Product: **Clearwire G2 Access Server**
(Fixed, Point-to-Point 2.4 GHz DSSS Transceiver)
Model No.: **G2IDU-SE1**
FCC ID: **NUXG2CPE-SE1**

Dear Mr. Chauncey,

The product sample, as provided by you, has been tested and found to comply with **FCC PART 15, Subpart C, Sec. 15.247 - Direct Sequence Spread Spectrum Transmitters operating in the frequency band 2408.040 - 2465.328 MHz.**

- Compliance with RF Exposure Requirements:
  - The transmitter complies with FCC 2.1091 with the minimum RF safety distance of 2 meters. Please refer to Chapters 0, 2 & 3 of the Users Manual for details of the antenna installation instruction for details.
  - The antenna is required to be professionally installed by the manufacturer or parties who are trained to install the antenna for ensuring compliance with the RF exposure requirements.

Enclosed you will find copies of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

Encl

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ENGINEERING TEST REPORT

Clearwire G2 Access Server
(Fixed, Point-to-Point 2.4 GHz DSSS Transceiver)
Model No.: G2IDU-SE1

FCC ID: NUXG2CPE-SE1

Applicant: **CLEARWIRE TECHNOLOGIES INC.**
485 Cayuga Road, P.O. Box 222
Buffalo, New York
USA, 14225-0222

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.247
Direct Sequence Spread Spectrum Transmitters operating in the frequency band 2408.040 - 2465.328 MHz

UltraTech's File No.: IAW-019FCC15C

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: Sep.03, 2001

Report Prepared by: Tri M. Luu . Issued Date: Sep.03, 2001	Tested by: Hung Trinh, RFI/EMI Technician Test Dates: Aug. 28 - Sep. 04, 2001

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
	Test Report	• Exhibit 1: Submittal check lists • Exhibit 2: Introduction • Exhibit 3: Performance Assessment • Exhibit 4: EUT Operation and Configuration during Tests • Exhibit 5: Summary of test Results • Exhibit 6: Measurement Data • Exhibit 7: Measurement Uncertainty • Exhibit 8: Measurement Methods	
1	Test Report - Plots of Measurement Data	Plots # 1 to 72	
2	Test Setup Photos	Photos # 1 to 6	
3	External Photos of EUT	Photos # 1 to 8	
4	Internal Photos of EUT	Photos of 1 to 6	
5	Cover Letters	• Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing	Yes Yes Yes
6	Attestation Statements	•	N/A
7	ID Label/Location Info	• ID Label • Location of ID Label	OK OK
8	Block Diagrams	• Block diagrams # 1 to 2	OK
9	Schematic Diagrams	• Schematic diagrams # 1 to 18 (Indoor Unit) & 1 to 8 (Outdoor Unit)	
10	Parts List/Tune Up Info	• Details show in schematics	N/A
11	Operational Description		Yes
12	RF Exposure Info	Chapters 0, 2 & 3 of the User Manual	Yes
13	Users Manual	Chapter 0 to Chapter 5	Yes

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247:1998
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Direct Sequence Spread Spectrum Transmitters operating in the Frequency Band 2408.040 - 2465.328 MHz .
Test Procedures	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Light-industry, Commercial

2.2. RELATED SUBMITAL(S)/GRANT(S)

None

2.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	1999	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT:	
Name:	CLEARWIRE TECHNOLOGIES INC.
Address:	485 Cayuga Road, P.O. Box 222 Buffalo, New York USA, 14225-0222
Contact Person:	Mr. David Chauncey Phone #: 716-631-4545 Fax #: 716-631-6080 Email Address: e Chauncey@clearwire.com

MANUFACTURER:	
Name:	CLEARWIRE TECHNOLOGIES INC.
Address:	485 Cayuga, P.O. Box 222 Buffalo, New York USA, 14225-0222
Contact Person:	Mr. David Chauncey Phone #: 716-631-4545 Fax #: 716-631-6080 Email Address: e Chauncey@clearwire.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name	CLEARWIRE TECHNOLOGIES INC.
Product Name	Clearwire G2 Access Server (Fixed, Point-to-Point 2.4 GHz DSSS Transceiver)
Model Name or Number	G2IDU-SE1
Serial Number	Preproduction
Type of Equipment	Direct Sequence Spread Spectrum Transmitters
Input Power Supply Type	Alternative Power Supplies provided with the EUT: 1. Power Supply #1: Regal Electronics External Switching Power Supply, Model No: SPA25N-10545, P/N:0112 2. Power Supply #2: I.T.E Power Supply, Model No.: UP02521050 3. Power Supply #3: UMEC AC-DC Adapter, Model No.: UP0251A-05P
Primary User Functions of EUT:	Provide data communication link through air for Point-to-Point application

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Base station (fixed use)
Intended Operating Environment:	▪ Commercial, light industry
Power Supply Requirement:	AC 120V 60Hz
RF Output Power Rating:	0.174 Watts total peak conducted power at the antenna port or 39.81 Watts total peak EIRP
Operating Frequency Range:	▪ Narrow band: 2408.040 – 2465.328 MHz ▪ Medium band: 2408.040 – 2463.282 MHz ▪ Wide band: 2420.316 – 2453.052 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	▪ Narrow band: 2.045 MHz ▪ Medium band: 2.045 MHz ▪ Wide band: 4.092 MHz
Duty Cycle:	45%
6 dB Bandwidth:	▪ Narrow band: 4.09 MHz ▪ Medium band: 5.40 MHz ▪ Wide band: 10.63 MHz
Modulation Type:	DQPSK (for all bands)
Chip Rate/Symbol Rate:	11 Chips/Symbol (for all bands)
Data Rate:	▪ Narrow band: 0.818 Mbps ▪ Medium band: 1.023 Mbps ▪ Wide band: 2.045 Mbps
Measured Process Gain:	▪ Narrow band: 11.8 dB ▪ Medium band: 11.2 dB ▪ Wide band: 11.0 dB
Emission Designation:	Direct Sequence Spread Spectrum
Oscillator Frequencies:	IF = 382.5 MHz, Tx Loc. Osc. Freq. = Tx Freq. - IF
Spectral Density	▪ Narrow band: 6.9 Watts/MHz peak EIRP ▪ Medium band: 6.2 Watts/MHz peak EIRP ▪ Wide band: 3.5 Watts/MHz peak EIRP
Antenna Connector Type:	▪ TNC connector (Professional Installation). Please refer to the User's manual for detailed instruction of antenna installation and RF Exposure Warning.
Antenna Description:	1. Mag Grid (Conifer) Antenna • Manufacturer: Andrew • Model: 26T-2400 • Gain: 24 dBi Directional • Operating Frequency: 2.4 - 2.5 GHz • Connector Type: Female N 2. 3"x3" Patch Monoband Antenna • Manufacturer: Huber & Suhner • Model: SPA 2400/27/17 • Gain: 16.5 dBi Directional • Operating Frequency: 2.3 - 2.5 GHz • Connector Type: SMA

3.4. LIST OF EUT'S PORTS

INDOOR UNIT				
Port Number	**EUT's Port Description**	**Number of Identical Ports**	**Connector Type**	**Cable Type (Shielded/Non-shielded)**
1	Ethernet Port	1	RJ-45	Shielded
2	Power Port	1	Plug-in jack	Non-shielded
3	RF Line Signal Port	1	Female F	Shielded

OUTDOOR UNIT				
Port Number	**EUT's Port Description**	**Number of Identical Ports**	**Connector Type**	**Cable Type (Shielded/Non-shielded)**
1	RF IN/OUT Port	1	TNC (Note 1)	Shielded
3	RF Line Signal Port	1	Female F	Shielded

Note (1): The equipment and antenna is required Professional Installation.

3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop Computer
Brand name:	Toshiba
Model Name or Number:	PAS401U
FCC Approval	FCC Class B DoC
Serial Number:	Z8300185A
Connected to EUT's Port:	RF-45 shielded ethernet
Notes:	This laptop computer is used for technical services only; therefore, and it is used for control purpose only but not for testing.

3.6. GENERAL TEST SETUP

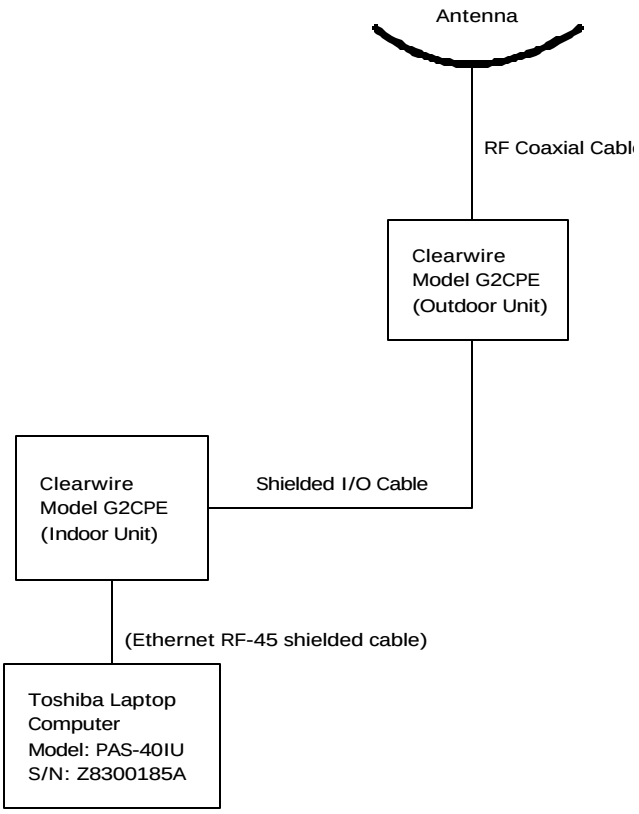


EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	AC 120V 60Hz

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest and highest channel frequencies of the operating bands transmits continuously for emissions measurements. ▪ The EUT operates in normal Direct Sequence mode for occupancy duration, and frequency separation.
Special Test Software:	▪ Special software is provided by the Applicant to select and operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of lowest and highest frequencies individually continuously during testing.
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as a non-integral antenna equipment.

Transmitter Test Signals:	
Frequencies: ▪ 2408.040-2465.328 (Narrowband) ▪ 2408.040-2463.282 MHz (Medium band) ▪ 2420.316-2453.052 MHz (Wideband)	Lowest and highest channel frequencies tested: ▪ 2408.040 and 2465.328 MHz ▪ 2408.040 and 2463.282 MHz ▪ 2420.316 and 2453.052 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 0.174 Watts ▪ DSSS with different data rate. ▪ Internal

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

  The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Aug. 08, 2001.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
Public Notice DA 00-1407	Part 15 Unlicensed Modular Transmitter Approval	Yes
15.107, 15.109	AC Power Conducted Emissions & Radiated Emissions for Receiver and Digital Circuit Portions	Yes
15.247(a)(2)	Spectrum Bandwidth of a Direct Sequence Spread Spectrum System	Yes
15.247(b) & 1.1310	Maximum Peak Power and RF Exposure Limits	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
15.247(d)	Transmitted Power Density of a Direct Sequence Spread Spectrum System	Yes
15.247(e)	Processing Gain of Direct Sequence Spread Spectrum System	Yes

Note 1: The digital circuits portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class A Digital Devices and Radio Receivers. The engineering test report can be provided upon FCC requests.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report and ANSI C63-4:1992

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3:1992, FCC 15.247 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. AC POWERLINE CONDUCTED EMISSIONS @ FCC PART 15, SUBPART B, PARA.15.107(A)

6.5.1. LIMITS

The equipment shall meet the limits of the following table:

Test Frequency Range	Test Limits	EMI Detector Used	Measuring Bandwidth
0.45 to 30 MHz	48 dBµV 51 dBµV	Quasi-Peak (Narrow band) Quasi-Peak (Broad band)	B = 10 kHz B = 10 kHz

6.5.2. METHOD OF MEASUREMENTS

Refer to Exhibit 8, Sec. 8.2 of this test report & ANSI C63-4:1992

6.5.3. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 µH
12'x16'x12' RF Shielded Chamber	RF Shielding	…	..	…

6.5.4. PLOTS

The following plots graphically represent the test results recorded in the above Test Data Table.

Refer to Plots # 1 & 6 in Annex 1 for actual measurement plots

6.5.5. PHOTOGRAPHS OF TEST SETUP

Refer to the Photographs #1 & #6 in Annex 2 for setup and arrangement of equipment under tests and its ancillary equipment.

6.5.6. TEST DATA

6.5.6.1. TEST CONFIGURATION #1: ALTERNATIVE POWER SUPPLY UMEC MODEL CB063801

FREQUENCY (MHz)	RF LEVEL (dBuV)	RECEIVER DETECTOR (P/QP/AVG)	QP/NB LIMIT (dBuV)	QP/BB LIMIT (DbuV)	MARGIN (dB)	PASS/ FAIL	LINE TESTED (L1/L2)
7.880	37.5	Peak	48.0	61.0	-10.5	PASS	L1
20.710	37.0	Peak	48.0	61.0	-11.0	PASS	L1
9.820	37.8	Peak	48.0	61.0	-10.2	PASS	L2
20.330	37.6	Peak	48.0	61.0	-10.5	PASS	L2
• The emissions from 450 kHz to 30 MHz were scanned and all emissions less than 20 dB below the FCC Limits were recorded.							

6.5.6.2. TEST CONFIGURATION #2: ALTERNATIVE POWER SUPPLY I.T.E. MODEL UP02521050

FREQUENCY (MHz)	RF LEVEL (dBuV)	RECEIVER DETECTOR (P/QP/AVG)	QP/NB LIMIT (dBuV)	QP/BB LIMIT (dBuV)	MARGIN (dB)	PASS/ FAIL	LINE TESTED (L1/L2)
10.070	36.6	Peak	48.0	61.0	-11.4	PASS	L1
23.250	37.2	Peak	48.0	61.0	-10.8	PASS	L1
9.440	36.6	Peak	48.0	61.0	-11.4	PASS	L2
23.250	37.7	Peak	48.0	61.0	-10.3	PASS	L2
• The emissions from 450 kHz to 30 MHz were scanned and all emissions less than 20 dB below the FCC Limits were recorded.							

6.5.6.3. TEST CONFIGURATION #3: ALTERNATIVE POWER SUPPLY REGAL ELECTRONICS MODEL SPA25N-10545 BY UMEC

FREQUENCY (MHz)	RF LEVEL (dBuV)	RECEIVER DETECTOR (P/QP/AVG)	QP/NB LIMIT (dBuV)	QP/BB LIMIT (dBuV)	MARGIN (dB)	PASS/ FAIL	LINE TESTED (L1/L2)
3.780	50.2	Peak	48.0	61.0	+2.2	PASS See Note 1	L1
11.340	43.8	Peak	48.0	61.0	-4.2	PASS	L1
3.740	50.2	Peak	48.0	61.0	+2.2	PASS See Note 1	L2
11.890	43.2	Peak	48.0	61.0	-4.8	PASS	L2

- The emissions from 450 kHz to 30 MHz were scanned and all emissions less than 20 dB below the FCC Limits were recorded.
- Note 1: The emissions in the above table was found to be from the Class A Unintentional Radiators only and it comply with the FCC Class A Limit (69.5 dBµV). Therefore, the FCC Limit of 48 dBµV for the intentional radiators does not apply to this emission at 3.78 MHz.

6.6. 6 DB BANDWIDTH @ FCC 15.247(A)(2)

6.6.1. LIMITS

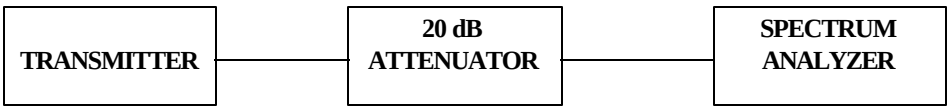
For a direct sequence spread spectrum system, the minimum 6 dB bandwidth shall be at least 500 KHz.

6.6.2. METHOD OF MEASUREMENTS

Refer to FCC 15.247(c) & ANSI C63-4:1992

The transmitter output was connected to the spectrum analyzer through an attenuator. the bandwidth of the fundamental frequency was measured with the spectrum analyzer using 30 KHz RBW, VBW = 100 KHz,. The 6 dB bandwidth was measured and recorded.

6.6.3. TEST ARRANGEMENT



6.6.4. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

6.6.5. PLOTS

Please refer to Plots # 7 & 12 in Annex 1 for Measurements data

6.6.6. TEST DATA

EMISSION TYPE	CHANNEL FREQUENCY (MHz)	6 dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS/FAIL
Narrow band: DQPSK, 11 Chip/symbol, 0.818 Mbps	2408.040	4.1	0.5	PASS
	2465.328	3.5	0.5	PASS
Medium band: DQPSK, 11 Chip/symbol, 1.023 Mbps	2408.040	5.4	0.5	PASS
	2465.282	5.0	0.5	PASS
Wideband: DQPSK, 11 Chip/symbol, 2.045 Mbps	2420.316	10.6	0.5	PASS
	2453.051	10.1	0.5	PASS

6.7. PEAK OUTPUT POWER & EFFECTIVE RADIATED POWER (EIRP) @ FCC 15.247(B)

6.7.1. LIMITS

- **FCC 15.247(b)(1):** Maximum peak output power of the transmitter shall not exceed 1 Watt.
- **FCC 15.247(b)(3):** If the antenna of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
- **FCC 15.247(b)(3)(i):** Systems operating in the 2408.040 - 2465.328 MHz band that are used exclusively for fixed, **point-to-point operations** may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduce by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi..

De Facto EIRP Limit:

Describe how the EUT complies with the de facto EIRP limit for every antenna proposes for use with the EUT. This includes those devices that will be used in point-to-point applications. If the peak power, as measured above, must be reduced so that the de facto EIRP limit may be met for a particular antenna, described exactly how much it will be reduced for that antenna. If the minimum length of cable which will always be used, the type of cable, and its loss, in dB per unit length, for the frequency of the emission. The limit is specified in one of the subparagraphs of this section. Also, specify who will be responsible for ensuring that compliant operation is maintained for every antenna that will be used with EUT.

Point-to-Point Operation:

- If the EIRP relaxation for point-to-point operation is proposed for any particular antenna, describe who will be responsible for ensuring that the EUT is only used in such an application.
- Fixed, point-to-point operation, as used in 2400-2483.5 MHz and 5725-5850 MHz bands, excludes the use of the following:
  - Point-to-multipoint systems
  - Omnidirectional applications
  - Multiple co-located intentional radiators transmitting the same information.
- The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that *the system is used exclusively for fixed, point-to-point operations*. The instruction manual furnished with the intentional radiators shall contain language in the installation instructions informing the operator and the installer of this responsibility.

6.7.2. METHOD OF MEASUREMENTS & TEST ARRANGEMENT

Refer to Exhibit 8, Sec. 8.3 of this test report, FCC 15.247(b)(1)&(3), ANSI C63-4:1992 & ETSI 300 328

Note: The conducted peak power measurement method was performed in accordance with ETSI 300 328 since it was proven to be independent with the peak power meter characteristics.

6.7.3. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz
67297 RF Detector (Diode Detector)	Herotex	DZ122-553	63400	..
Storage Oscilloscope	Philips	PM3320A	ST9907959	--

6.7.4. TEST DATA

6.7.4.1. CONDUCTED PEAK POWER AT THE RF OUTPUT PORT (ANTENNA PORT):

EMISSION TYPE	CHANNEL FREQUENCY (MHz)	(full bandwidth) PEAK POWER (conducted) (dBm)	MAXIMUM POWER LIMIT (1) (dBm)	PASS/FAIL
Narrow band: DQPSK,	2408.040	22.4	24.0	PASS
11 Chip/symbol, 0.818 Mbps	2465.328	22.4	24.0	PASS
Medium band: DQPSK,	2408.040	22.4	24.0	PASS
11 Chip/symbol, 1.023 Mbps	2465.282	22.4	24.0	PASS
Wideband: DQPSK,	2420.316	22.4	24.0	PASS
11 Chip/symbol, 2.045 Mbps	2453.051	22.4	24.0	PASS

Note (1):

- **FCC 15.247(b)(3)(i):** Systems operating in the 2408.040 - 2465.328 MHz band that are used exclusively for fixed, **point-to-point operations** may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduce by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi..
- Since maximum antenna gain specified is 24 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (24 dBi Directional –6 dBi)/3 = 24 dBm or 0.251 Watts, Peak EIRP Limit = 24 dBm +24 dBi Directional = 48 dBm or 63.1 Watts

6.7.4.2. PEAK EIRP POWER USING SUBSTITUTION METHOD:

6.7.4.2.1. Using Andrew Model 26T-2400 Mag Grid (Conifer) Antenna, Antenna Gain: 24 dBi Directional maximum

6.7.4.2.1.1. Narrow Band: DQPSK, 11 Chip/Symbol, 0.818 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2408.040	134.4	V	30.4	8.0	38.4	**44.5**	48.0
2408.040	112.9	H	7.1	7.6	14.7	20.8	48.0
2465.328	135.2	V	30.8	8.1	38.9	41.5	48.0
2465.328	115.2	H	8.6	7.7	16.3	18.9	48.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 16.3 dBm =+6.1 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 19.8 dBm = +2.6 dB

2. Since maximum antenna gain specified is 24 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (24 dBi Directional – 6 dBi)/3 = 24 dBm or 0.251 Watts, Peak EIRP Limit = 24 dBm +24 dBi Directional = 48 dBm or 63.1 Watts.

6.7.4.2.1.2. Medium Band: DQPSK, 11 Chip/Symbol, 1.023 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2408.040	133.9	V	29.9	8.0	37.9	**46.0**	48.0
2408.040	114.7	H	8.8	7.6	17.4	25.5	48.0
2463.282	133.6	V	29.0	8.1	37.1	43.8	48.0
2463.282	115.3	H	8.6	7.7	16.3	22.7	48.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 14.3 dBm =+8.1 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 15.7 dBm = +6.7 dB

2. Since maximum antenna gain specified is 24 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (24 dBi Directional – 6 dBi)/3 = 24 dBm or 0.251 Watts, Peak EIRP Limit = 24 dBm +24 dBi Directional = 48 dBm or 63.1 Watts.

6.7.4.2.1.3. Wide Band: DQPSK, 11 Chip/Symbol, 2.045 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2420.316	131.9	V	27.4	8.0	35.4	**46.0**	48.0
2420.316	115.2	H	8.7	7.6	16.3	26.9	48.0
2453.052	130.4	V	25.1	8.0	33.1	43.8	48.0
2453.052	111.8	H	4.4	7.7	12.1	22.8	48.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 11.8 dBm =+10.6 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 13.1 dBm = +10.7 dB

2. Since maximum antenna gain specified is 24 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (24 dBi Directional – 6 dBi)/3 = 24 dBm or 0.251 Watts, Peak EIRP Limit = 24 dBm +24 dBi Directional = 48 dBm or 63.1 Watts.

6.7.4.2.2. Using Huber & Suhner 3"x3" Patch Monoband Antenna, Model SPA 2400/27/17, Antenna Gain: 16.5 dBi Directional

6.7.4.2.2.1. Narrow Band: DQPSK, 11 Chip/Symbol, 0.818 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2408.040	126.2	V	22.2	8.0	30.2	**36.3**	43.0
2408.040	108.1	H	2.5	7.6	10.1	16.2	43.0
2465.328	126.2	V	21.8	8.1	29.9	32.5	43.0
2465.328	105.5	H	-0.4	7.7	7.3	9.9	43.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 16.3 dBm =+6.1 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 19.8 dBm = +2.6 dB

2. Since maximum antenna gain specified is 16.5 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (16.5 dBi Directional – 6 dBi)/3 = 26.5 dBm or 0.447 Watts, Peak EIRP Limit = 26.5 dBm + 16.5 dBi Directional = 43 dBm or 20 Watts.

6.7.4.2.2.2. Medium Band: DQPSK, 11 Chip/Symbol, 1.023 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2408.040	126.2	V	22.2	8.0	30.2	**38.3**	43.0
2408.040	102.9	H	-1.9	7.6	5.7	13.8	43.0
2463.282	125.1	V	20.6	8.1	28.7	35.4	43.0
2463.282	103.8	H	-1.8	7.7	5.9	12.6	43.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 14.3 dBm =+8.1 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 15.7 dBm = +6.7 dB

2. Since maximum antenna gain specified is 16.5 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (16.5 dBi Directional – 6 dBi)/3 = 26.5 dBm or 0.447 Watts, Peak EIRP Limit = 26.5 dBm + 16.5 dBi Directional = 43 dBm or 20 Watts.

6.7.4.2.2.3. Wide Band: DQPSK, 11 Chip/Symbol, 2.045 Mbps

Frequency (MHz)	E-Field E1 in 1 MHz BW @ 3m (dBuV/m)	Antenna Polarization (V/H)	Peak Power from Signal GEN. Ps (dBm)	Substitution Antenna Gain Gd (dBi)	Measured Peak EIRP in 1 MHz BW (Ps + Gd) (dBm/MHz)	Measured Total Peak EIRP (Note 1) (dBm)	EIRP LIMIT (Note 2) (dBm)
2420.316	123.0	V	18.5	8.0	26.5	**37.1**	43.0
2420.316	100.4	H	-4.1	7.6	3.5	14.1	43.0
2453.052	123.3	V	18.0	8.0	26.0	36.7	43.0
2453.052	105.2	H	-1.4	7.7	6.3	17.0	43.0

Notes:

1. The peak EIRP power in 1 MHz BW was measured, and the total peak EIRP was calculated using the equivalent difference factor (Kp) between the conducted peak power in 1 MHz and total conducted power.

   TOTAL PEAK EIRP = $EIRP_{IN\ 1\ MHz\ BW}$ + Kp

   @ 2408.040 MHz, Kp = 22.4 dBm – 11.8 dBm =+10.6 dB
   @ 2465.328 MHz, Kp = Kp = 22.4 dBm – 13.1 dBm = +10.7 dB

2. Since maximum antenna gain specified is 16.5 dBi Directional, the Conducted Peak Power Limit for Point-to-Point Transmitter is = 30 dBm – (16.5 dBi Directional – 6 dBi)/3 = 26.5 dBm or 0.447 Watts, Peak EIRP Limit = 26.5 dBm + 16.5 dBi Directional = 43 dBm or 20 Watts.

6.8. RF EXPOSURE REQUIRMENTS @ FCC 15.247(B)(4), 1.1310 & 2.1091

6.8.1. LIMITS

- **FCC 15.247(b)(4):** Systems operating under provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See @ 1.1307(b)(1).
- **FCC 1.1310:**- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
1500-100,000	...	...	5	6
(B) Limits for General Population/Uncontrolled Exposure				
1500-100,000	...	...	1.0	30

F = Frequency in MHz

6.8.2. METHOD OF MEASUREMENTS

Refer to FCC @ 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000)

- Spread spectrum transmitters operating under section 15.247 are categorically from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$r = \sqrt{PG/4\Pi S}$

FCC radio frequency exposure limits may not be exceeded at distances closer than r cm from the antenna of this device

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones., an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that a SAR evaluation be performed, as provided for in Section 1.1307(d)

6.8.3. TEST DATA

Highest EIRP from Sec. 6.8 of this Test Report is as follows

Frequency (MHz)	Measured Total EIRP (dBm)	Laboratory's Recommended Minimum RF Safety Distance r (cm)
2408.040	46	
2420.316	46	

Note 1: RF EXPOSURE DISTANCE LIMITS : $r = (PG/4\pi S)^{1/2} = (EIRP/4\pi S)^{1/2}$
$S = 1.0\ mW/cm^2$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: 56 cm	Manufacturer' instruction for separation distance between antenna and persons required: 2 m. Please refer to the Users/ Manual Chapter 0, 2 & 3 for compliance with RF Exposure Requirements per Industry Canada RSS-102.
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	The antenna is required to be professionally installed by the manufacturer or parties who are trained to install the antenna for ensuring compliance with the RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Please refer to the Users/ Manual and FCC RF Exposure folder
Any other RF exposure related issues that may affect MPE compliance	N/A

6.9. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS (CONDUCTED), FCC CFR 47, PARA. 15.247(C)

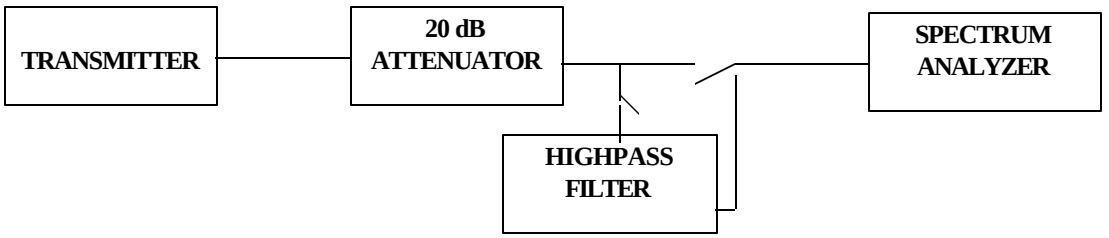
6.9.1. LIMITS

In any 100 KHz bandwidth outside the operating frequency band, the radio frequency power that is produced by modulation products of the spreading sequence, the information sequence and the carrier frequency shall be at least 20 dB below that in any 100 KHz bandwidth within the band that contains the highest level of the desired power.

6.9.2. METHOD OF MEASUREMENTS

Refer to Exhibit 8, Sec. 8.4 of this test report, FCC 15.247(c) & ANSI C63-4:1992

6.9.3. TEST ARRANGEMENT



6.9.4. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

6.9.5. PLOTS

Please refer to Plots # 13 through 30 in Annex 1 for Measurements data

6.9.6. TEST DATA

6.9.6.1. TEST CONFIGURATION #1: DQPSK, DATA RATE: 0.818 MBPS, PEAK OUTPUT POWER: 22.4 DBM (CONDUCTED)

6.9.6.1.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2408.04	12.3	PEAK	--	--	--
2025.55	-37.9	PEAK	-7.7	-30.2	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Refer to Plots # 13 through 15 in Annex 1

6.9.6.1.2. Highest Frequency (2465.328 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2465.33	13.2	PEAK	--	--	--
2082.86	-37.2	PEAK	-6.8	-30.4	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Plots # 16 through 18 in Annex 1

6.9.6.2. TEST CONFIGURATION #2: DQPSK, DATA RATE: 1.023 MBPS, PEAK OUTPUT POWER: 22.4 DBM (CONDUCTED)

6.9.6.2.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2408.04	6.8	PEAK	--	--	--
209.00	-49.1	PEAK	-13.2	-35.9	PASS
1550.00	-51.7	PEAK	-13.2	-38.5	PASS
2025.55	-36.1	PEAK	-13.2	-22.9	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Plots # 19 through 21 in Annex 1

6.9.6.2.2. Highest Frequency (2463.282 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2463.28	8.6	PEAK	--	--	--
209.00	-49.6	PEAK	-11.4	-38.2	PASS
1867.00	-38.8	PEAK	-11.4	-27.4	PASS
2080.78	-36.1	PEAK	-11.4	-24.7	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Plots # 22 through 24 in Annex 1

6.9.6.3. TEST CONFIGURATION #3: DQPSK, DATA RATE: 2.045 MBPS, PEAK OUTPUT POWER: 22.4 DBM (CONDUCTED)

6.9.6.3.1. Lowest Frequency (2420.316 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2420.32	5.3	PEAK	--	--	--
209.00	-48.8	PEAK	-14.7	-34.1	PASS
2037.82	-40.2	PEAK	-14.7	-25.5	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Plots # 25 through 27 in Annex 1

6.9.6.3.2. Highest Frequency (2453.052 MHz)

FREQUENCY (MHz)	RF LEVEL IN 100 kHz BW (dBm)	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2451.90	6.6	PEAK	--	--	--
209.00	-48.8	PEAK	-13.4	-35.4	PASS
2070.55	-38.5	PEAK	-13.4	-25.1	PASS

The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.

Plots # 28 through 30 in Annex 1

6.10. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS (RADIATED @ 3 METERS), FCC CFR 47, PARA. 15.247(C), 15.209 & 15.205

6.10.1.LIMITS

In any 100 KHz bandwidth outside the operating frequency band, the radio frequency power that is produced by modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 KHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in @ 15.209(a), which lesser attenuation.

All other emissions inside restricted bands specified in @ 15.205(a) shall not exceed the general radiated emission limits specified in @ 15.209(a)

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- **@ FCC CFR 47, Para. 15.237(c)** - The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in **@15.35** for limiting peak emissions apply.

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

6.10.2.METHOD OF MEASUREMENTS

Refer to Exhibit 8, Sec. 8.4 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.
- For measurement below 1 GHz, set RBW = 100 KHz, VBW $\geq$ 100 KHz, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak) & VBW = 10 Hz (Average), SWEEP=AUTO.
- If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

6.10.3.TEST ARRANGEMENT

Please refer to Test Arrangement in Sec. 5.5.3 for details of test setup for emission measurements.

6.10.4.TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3160-09	..	18 GHz – 26.5 GHz
Horn Antenna	EMCO	3160-10	..	26.5 GHz – 40 GHz
Mixer	Tektronix	118-0098-00	..	18 GHz – 26.5 GHz
Mixer	Tektronix	119-0098-00	..	26.5 GHz – 40 GHz

6.10.5.PLOTS

Refer to Plots # 31 to 54 for radiated Band-Edges and the following plots graphically represent the spurious/harmonic radiated emissions.

6.10.6.PHOTOGRAPHS OF TEST SETUP

Refer to the Photographs #3 & #6 in Annex 2 for setup and arrangement of equipment under tests and its ancillary equipment.

6.10.7.TEST DATA

DUTY CYCLE FACTOR = $20LOG_{10}(0.45)$ = -6.9 dB

6.10.7.1. USING ANDREW MODEL 26T-2400 MAG GRID (CONIFER) ANTENNA, ANTENNA GAIN: 24 DBI DIRECTIONAL MAXIMUM

6.10.7.1.1. Test Configuration #1: Narrowband DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm (conducted)

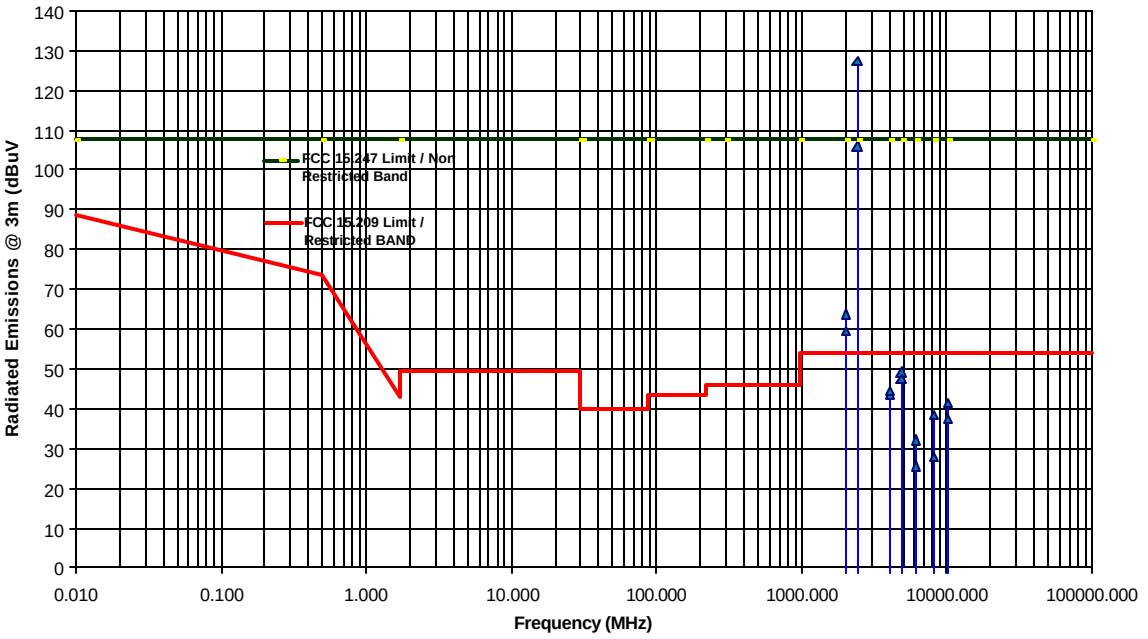
6.10.7.1.1.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2025.55	80.6	63.8	V	54.0	107.5	-43.7	PASS
2025.55	66.8	59.5	H	54.0	107.5	-48.0	PASS
2408.04	134.4	127.5	V	--	--	--	--
2408.04	112.9	106.0	H	--	--	--	--
4051.10	54.1	43.7	V	54.0	107.5	-10.3	*PASS
4051.10	55.7	44.3	H	54.0	107.5	-9.7	*PASS
4816.08	65.0	49.2	V	54.0	107.5	-4.8	*PASS
4816.08	63.4	47.6	H	54.0	107.5	-6.4	*PASS
6076.65	45.5	32.1	V	54.0	107.5	-75.4	PASS
6076.65	39.2	25.6	H	54.0	107.5	-81.9	PASS
8102.20	43.9	28.0	V	54.0	107.5	-26.0	*PASS
8102.20	50.0	38.5	H	54.0	107.5	-15.5	*PASS
10127.75	53.4	41.5	V	54.0	107.5	-66.0	PASS
10127.75	51.7	37.3	H	54.0	107.5	-70.2	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 31 & 32 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Narrowband DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm
2408.040 MHz



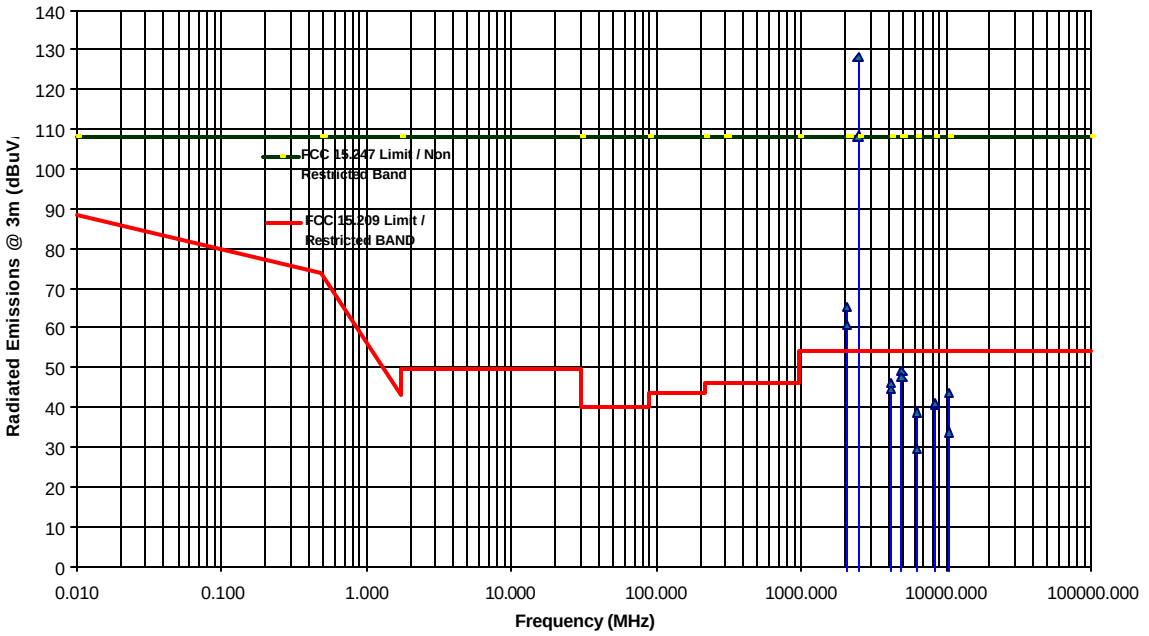
6.10.7.1.1.2. Highest Frequency (2465.328 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2082.86	77.6	60.9	V	54.0	108.3	-47.4	PASS
2082.86	72.3	65.1	H	54.0	108.3	-43.2	PASS
2465.33	135.2	128.3	V	--	--	--	--
2465.33	115.2	108.3	H	--	--	--	--
4165.72	56.6	44.6	V	54.0	108.3	-9.4	*PASS
4165.72	56.6	46.2	H	54.0	108.3	-7.8	*PASS
4930.76	68.3	49.2	V	54.0	108.3	-4.8	*PASS
4930.76	69.2	47.6	H	54.0	108.3	-6.4	*PASS
6248.58	51.2	38.8	V	54.0	108.3	-69.5	PASS
6248.58	41.4	29.6	H	54.0	108.3	-78.7	PASS
8331.44	53.2	40.7	V	54.0	108.3	-13.3	*PASS
8331.44	51.6	41.2	H	54.0	108.3	-12.8	*PASS
10414.30	56.0	43.7	V	54.0	108.3	-64.6	PASS
10414.30	52.2	33.8	H	54.0	108.3	-74.5	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 33 & 34 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Narrowband DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm
2465.328 MHz



6.10.7.1.2. Test Configuration #2: Medium-Band DQPSK, Data Rate: 1.023 Mbps, Peak Output Power: 22.4 dBm (conducted)

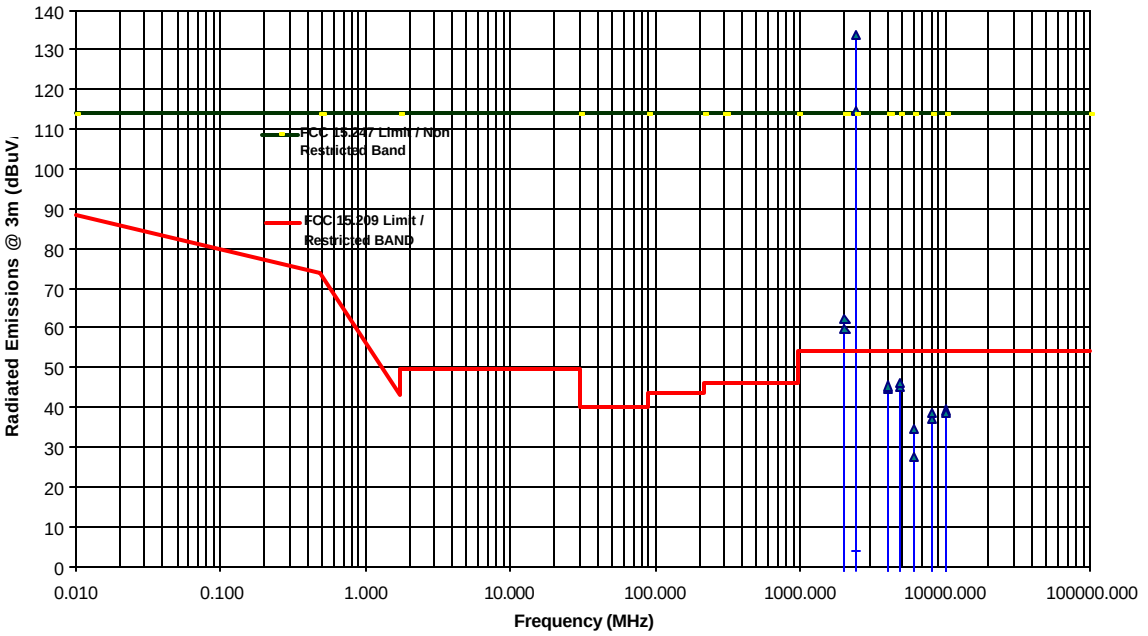
6.10.7.1.2.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2025.55	81.4	62.3	V	54.0	113.9	-51.6	PASS
2025.55	68.0	59.8	H	54.0	113.9	-54.1	PASS
2408.04	133.9	133.9	V	--	--	--	--
2408.04	114.7	114.7	H	--	--	--	--
4051.10	55.3	44.6	V	54.0	113.9	-9.4	*PASS
4051.10	56.0	45.3	H	54.0	113.9	-8.7	*PASS
4816.08	61.7	45.1	V	54.0	113.9	-8.9	*PASS
4816.08	63.6	46.1	H	54.0	113.9	-7.9	*PASS
6076.65	47.5	34.6	V	54.0	113.9	-79.3	PASS
6076.65	41.3	27.6	H	54.0	113.9	-86.3	PASS
8102.20	49.9	37.2	V	54.0	113.9	-16.8	*PASS
8102.20	50.4	38.6	H	54.0	113.9	-15.4	*PASS
10127.75	52.7	39.4	V	54.0	113.9	-74.5	PASS
10127.75	52.1	38.7	H	54.0	113.9	-75.2	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 35 & 36 in Annex 1 for band-edges
-

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Medium Band DQPSK, Data Rate: 1.023 Mbps, Peak Output Power: 22.4 dBm
2408.040 MHz



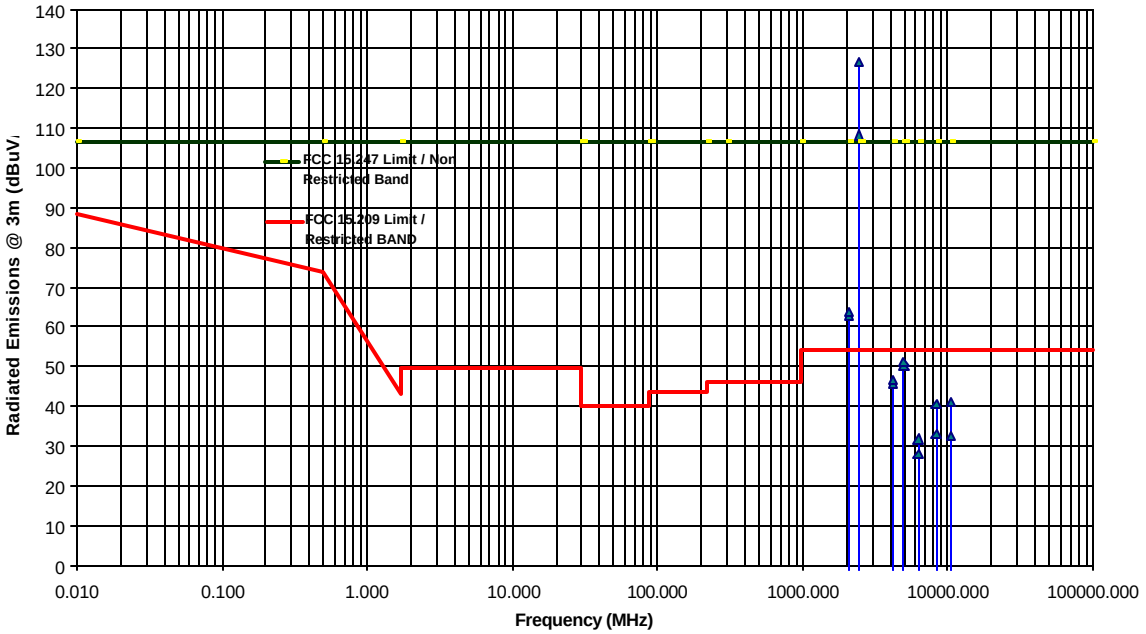
6.10.7.1.2.2. Highest Frequency (2463.282 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2082.86	80.7	62.9	V	54.0	106.8	-43.9	PASS
2082.86	71.6	63.8	H	54.0	106.8	-43.0	PASS
2463.28	133.7	126.8	V	--	--	--	--
2463.28	115.3	108.4	H	--	--	--	--
4161.54	55.5	45.9	V	54.0	106.8	-8.1	*PASS
4161.54	57.4	46.6	H	54.0	106.8	-7.4	*PASS
4966.56	67.3	50.2	V	54.0	106.8	-3.8	*PASS
4966.56	68.2	51.3	H	54.0	106.8	-2.7	*PASS
6242.31	43.6	31.7	V	54.0	106.8	-75.1	PASS
6242.31	42.6	28.1	H	54.0	106.8	-78.7	PASS
8323.08	51.6	40.6	V	54.0	106.8	-13.4	*PASS
8323.08	47.1	33.0	H	54.0	106.8	-21.0	*PASS
10403.82	53.1	41.0	V	54.0	106.8	-65.8	PASS
10403.82	49.3	32.4	H	54.0	106.8	-74.4	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 37 & 38 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Medium-Band DQPSK, Data Rate: 1.023 Mbps, Peak Output Power: 22.4 dBm (conducted)
@ 2463.282 MHz



6.10.7.1.3. Test Configuration #3: Wideband DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm (conducted)

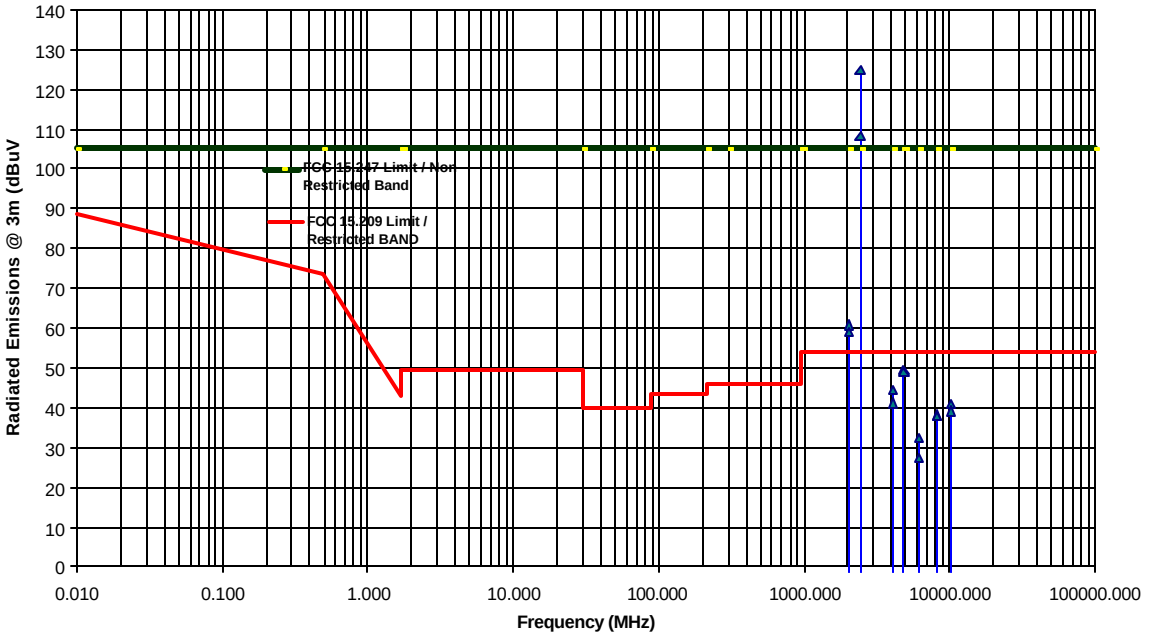
6.10.7.1.3.1. Lowest Frequency (2420.316 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2037.84	82.7	60.8	V	54.0	105.0	-44.2	PASS
2037.84	66.3	58.9	H	54.0	105.0	-46.1	PASS
2420.32	131.9	125.0	V	--	--	--	--
2420.32	115.2	108.3	H	--	--	--	--
4075.68	52.8	41.2	V	54.0	105.0	-12.8	*PASS
4075.68	55.2	44.3	H	54.0	105.0	-9.7	*PASS
4840.63	65.7	49.4	V	54.0	105.0	-4.6	*PASS
4840.63	65.0	49.1	H	54.0	105.0	-4.9	*PASS
6113.51	45.6	32.3	V	54.0	105.0	-72.7	PAS+S
6113.51	40.0	27.3	H	54.0	105.0	-77.7	PASS
8151.35	49.5	38.1	V	54.0	105.0	-15.9	*PASS
8151.35	49.0	37.8	H	54.0	105.0	-16.2	*PASS
10189.19	53.4	40.9	V	54.0	105.0	-64.1	PASS
10189.19	51.8	39.1	H	54.0	105.0	-65.9	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 39 & 40 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Wideband DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm
2420..316 MHz



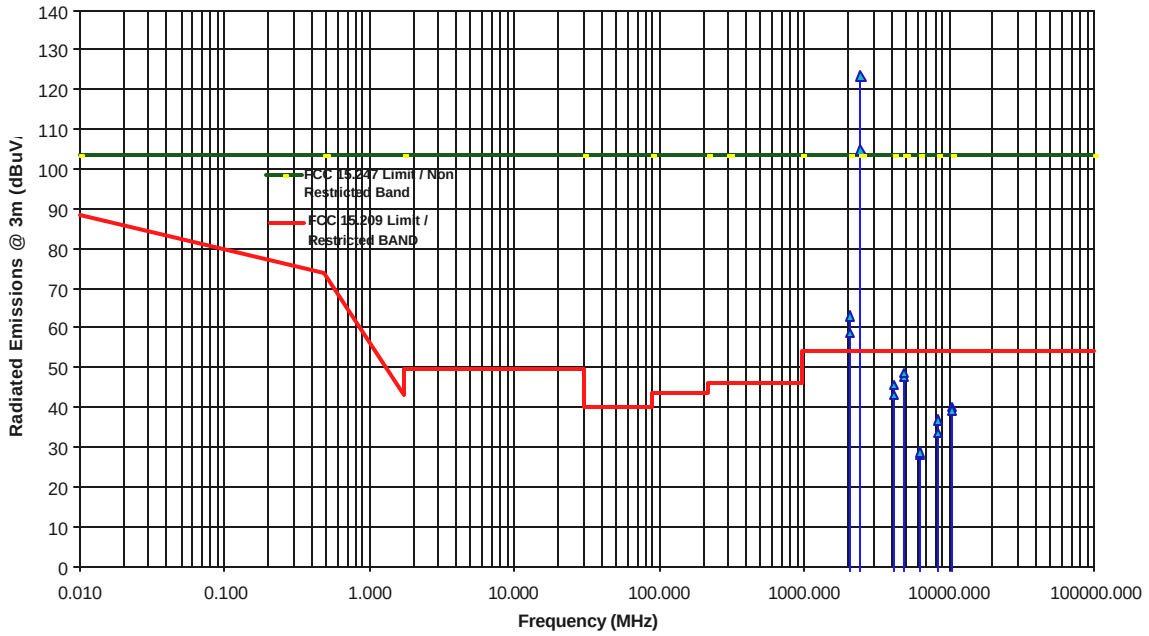
6.10.7.1.3.2. Highest Frequency (2453.052 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2070.51	81.8	62.9	V	54.0	103.5	-40.6	PASS
2070.51	80.6	58.7	H	54.0	103.5	-44.8	PASS
2453.05	130.4	123.5	V	--	--	--	--
2453.05	111.8	104.9	H	--	--	--	--
4141.02	55.4	45.5	V	54.0	103.5	-8.5	*PASS
4141.02	54.6	43.1	H	54.0	103.5	-10.9	*PASS
4906.10	64.3	47.7	V	54.0	103.5	-6.3	*PASS
4906.10	66.2	48.8	H	54.0	103.5	-5.2	*PASS
6211.54	40.7	27.8	V	54.0	103.5	-75.7	PASS
6211.54	43.9	28.7	H	54.0	103.5	-74.8	PASS
8282.05	47.6	33.6	V	54.0	103.5	-20.4	*PASS
8282.05	49.8	36.7	H	54.0	103.5	-17.3	*PASS
10352.56	53.1	40.1	V	54.0	103.5	-63.4	PASS
10352.56	52.5	39.3	H	54.0	103.5	-64.2	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 41 & 42 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Wideband DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm
2453.052 MHz



6.10.7.2. USING HUBER & SUHNER 3"X3" PATCH MONOBAND ANTENNA, MODEL SPA 2400/27/17, ANTENNA GAIN: 16.5 DBI DIRECTIONAL

6.10.7.2.1. Test Configuration #1: DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm (conducted)

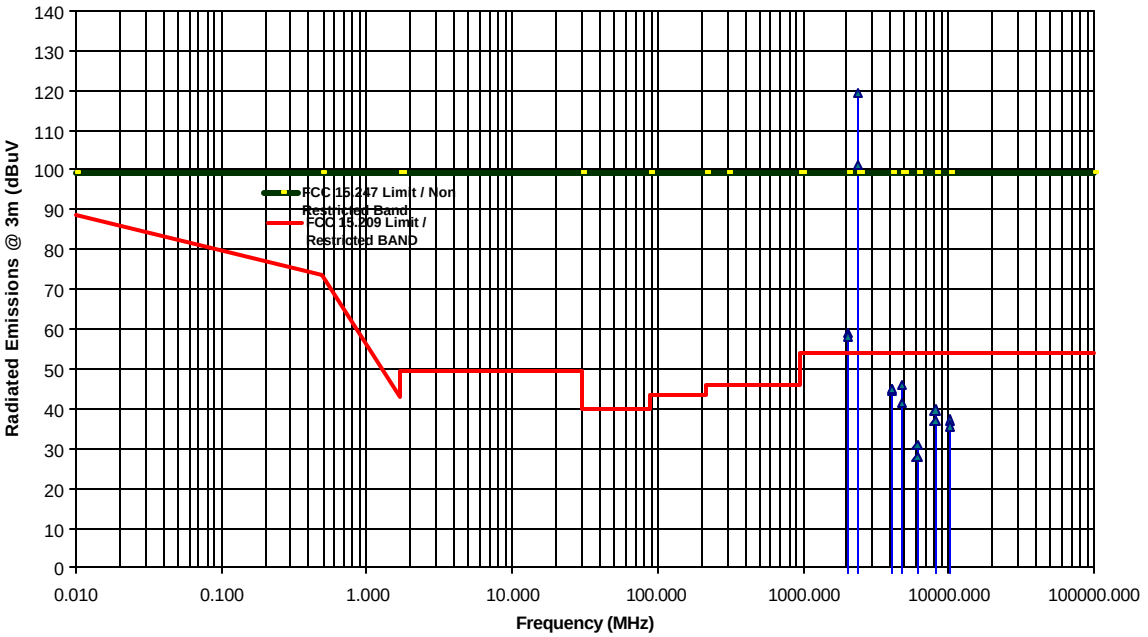
6.10.7.2.1.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2025.55	75.6	59.0	V	54.0	99.3	-40.3	PASS
2025.55	66.2	58.3	H	54.0	99.3	-41.0	PASS
2408.04	126.2	119.3	V	--	--	--	--
2408.04	108.1	101.2	H	--	--	--	--
4051.10	55.7	44.7	V	54.0	99.3	-9.3	*PASS
4051.10	56.2	45.1	H	54.0	99.3	-8.9	*PASS
4816.08	57.6	41.4	V	54.0	99.3	-12.6	*PASS
4816.08	62.9	45.9	H	54.0	99.3	-8.1	*PASS
6076.65	43.3	30.9	V	54.0	99.3	-68.4	PASS
6076.65	41.6	27.9	H	54.0	99.3	-71.4	PASS
8102.20	51.2	36.8	V	54.0	99.3	-17.2	*PASS
8102.20	51.7	39.6	H	54.0	99.3	-14.4	*PASS
10127.75	55.4	37.2	V	54.0	99.3	-62.1	PASS
10127.75	50.3	35.7	H	54.0	99.3	-63.6	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 43 & 44 in Annex 1 for band-edges
-

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Narrowband DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm
2408.040 MHz



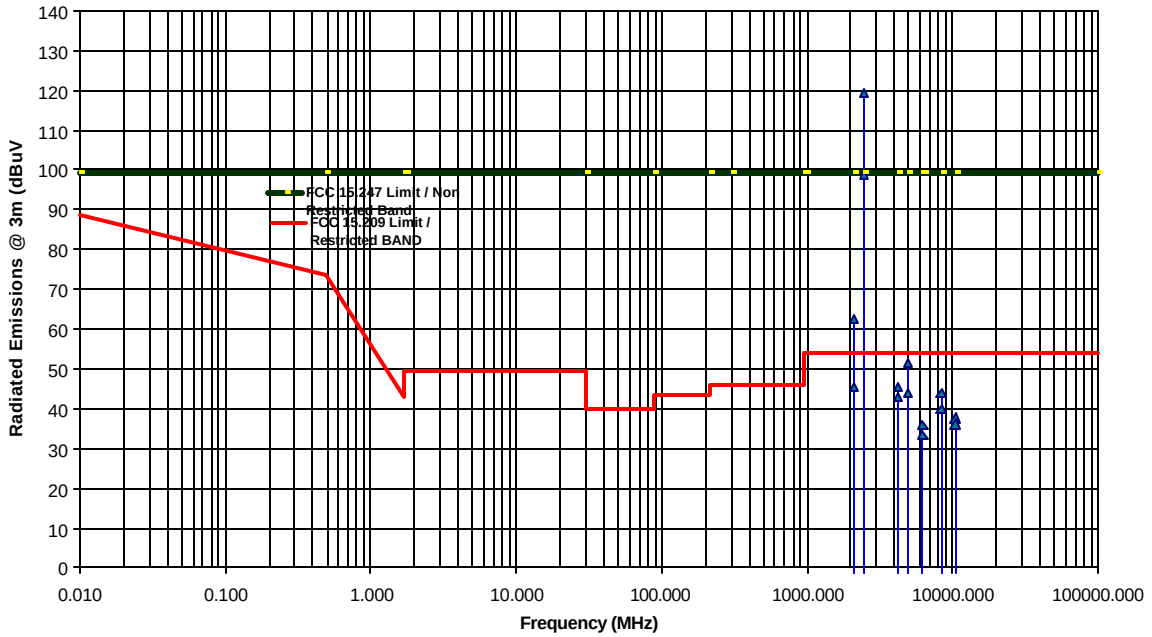
6.10.7.2.1.2. Highest Frequency (2465.328 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2082.86	80.4	62.4	V	54.0	99.3	-36.9	PASS
2082.86	67.7	45.5	H	54.0	99.3	-53.8	PASS
2465.33	126.2	119.3	V	--	--	--	--
2465.33	105.5	98.6	H	--	--	--	--
4165.72	54.8	43.0	V	54.0	99.3	-11.0	*PASS
4165.72	56.1	45.5	H	54.0	99.3	-8.5	*PASS
4930.76	61.0	44.1	V	54.0	99.3	-9.9	*PASS
4930.76	66.2	51.4	H	54.0	99.3	-2.6	*PASS
6248.58	43.7	33.3	V	54.0	99.3	-66.0	PASS
6248.58	45.8	35.9	H	54.0	99.3	-63.4	PASS
8331.44	52.8	39.9	V	54.0	99.3	-14.1	*PASS
8331.44	54.3	43.8	H	54.0	99.3	-10.2	*PASS
10414.30	56.4	37.7	V	54.0	99.3	-61.6	PASS
10414.30	51.5	36.2	H	54.0	99.3	-63.1	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 45 & 46 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Narrowband DQPSK, Data Rate: 0.818 Mbps, Peak Output Power: 22.4 dBm
2465.328 MHz



6.10.7.2.2. Test Configuration #2: DQPSK, Data Rate: 1.023 Mbps, Peak Output Power: 22.4 dBm (conducted)

6.10.7.2.2.1. Lowest Frequency (2408.040 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2025.55	80.1	59.0	V	54.0	106.2	-47.2	PASS
2025.55	66.0	58.3	H	54.0	106.2	-47.9	PASS
2408.04	126.2	126.2	V	--	--	--	--
2408.04	102.9	102.9	H	--	--	--	--
4051.10	54.8	43.3	V	54.0	106.2	-10.7	*PASS
4051.10	56.3	44.5	H	54.0	106.2	-9.5	*PASS
4816.08	57.4	40.2	V	54.0	106.2	-13.8	*PASS
4816.08	61.8	44.8	H	54.0	106.2	-9.2	*PASS
6076.65	39.8	25.1	V	54.0	106.2	-81.1	PASS
6076.65	39.8	22.9	H	54.0	106.2	-83.3	PASS
8102.20	52.0	30.9	V	54.0	106.2	-23.1	*PASS
8102.20	52.0	40.8	H	54.0	106.2	-13.2	*PASS
10127.75	56.6	36.9	V	54.0	106.2	-69.3	PASS
10127.75	51.1	36.6	H	54.0	106.2	-69.6	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 47 & 48 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

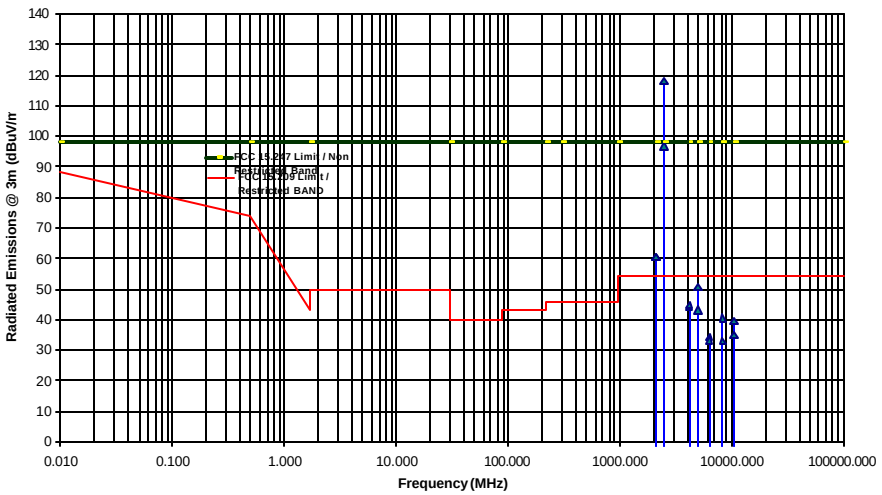
6.10.7.2.2.2. Highest Frequency (2463.282 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2082.86	79.9	60.5	V	54.0	98.2	-37.7	PASS
2082.86	67.7	60.4	H	54.0	98.2	-37.8	PASS
2463.28	125.1	118.2	V	--	--	--	--
2463.28	103.8	96.9	H	--	--	--	--
4161.54	55.7	44.0	V	54.0	98.2	-10.0	*PASS
4161.54	56.7	44.7	H	54.0	98.2	-9.3	*PASS
4966.56	60.1	43.3	V	54.0	98.2	-10.7	*PASS
4966.56	65.3	50.5	H	54.0	98.2	-3.5	*PASS
6242.31	45.1	34.2	V	54.0	98.2	-64.0	PASS
6242.31	45.1	33.3	H	54.0	98.2	-64.9	PASS
8323.08	52.9	33.2	V	54.0	98.2	-20.8	*PASS
8323.08	51.5	40.5	H	54.0	98.2	-13.5	*PASS
10403.82	57.0	35.1	V	54.0	98.2	-63.1	PASS
10403.82	53.1	39.5	H	54.0	98.2	-58.7	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 49 & 50 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Medium-Band DQPSK, Data Rate: 1.023 Mbps, Peak Output Power: 22.4 dBm (conducted)
@ 2463.282 MHz



6.10.7.2.3. Test Configuration #3: DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm (conducted)

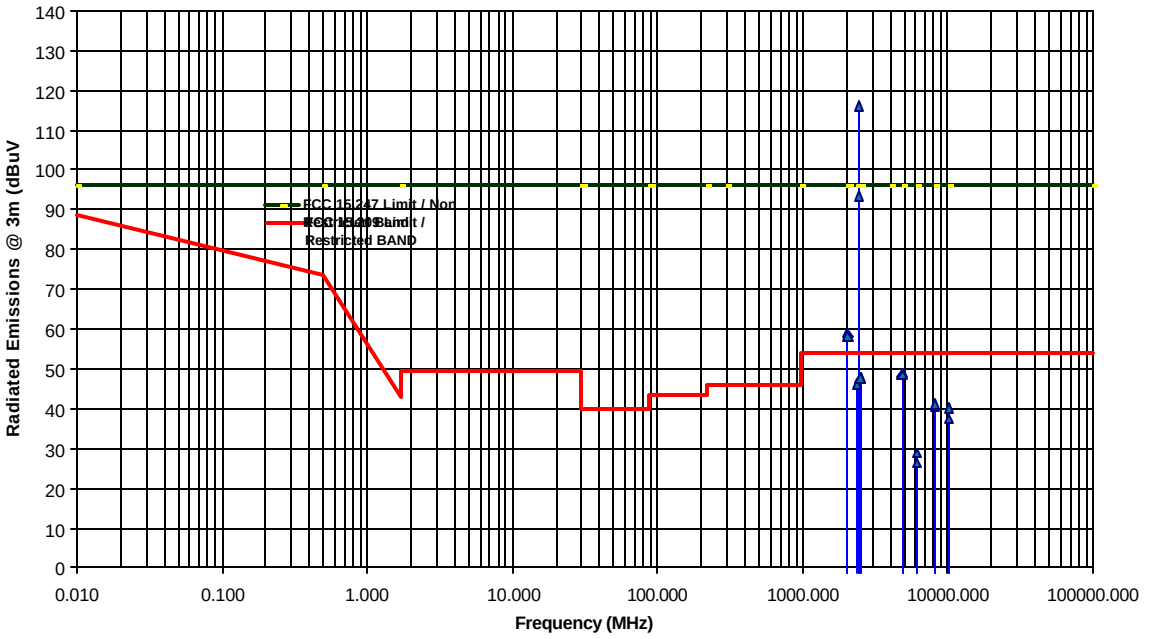
6.10.7.2.3.1. Lowest Frequency (2420.316 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2037.84	81.1	59.0	V	54.0	96.1	-37.1	PASS
2037.84	67.7	58.3	H	54.0	96.1	-37.8	PASS
2368.10	64.3	46.3	V	54.0	96.1	-7.7	*PASS
2483.50	66.9	47.7	V	54.0	96.1	-6.3	*PASS
2420.32	123.0	116.1	V	--	--	--	--
2420.32	100.4	93.5	H	--	--	--	--
2483.50	66.9	47.7	V	54.0	96.1	-6.3	*PASS
4075.68	56.4	-6.9	V	54.0	96.1	-60.9	*PASS
4075.68	54.6	-6.9	H	54.0	96.1	-60.9	*PASS
4840.63	65.2	48.9	V	54.0	96.1	-5.1	*PASS
4840.63	65.8	48.6	H	54.0	96.1	-5.4	*PASS
6113.51	41.7	28.8	V	54.0	96.1	-67.3	PASS
6113.51	40.5	26.2	H	54.0	96.1	-69.9	PASS
8151.35	51.7	40.3	V	54.0	96.1	-13.7	*PASS
8151.35	52.0	41.2	H	54.0	96.1	-12.8	*PASS
10189.19	56.2	37.3	V	54.0	96.1	-58.8	PASS
10189.19	52.9	40.1	H	54.0	96.1	-56.0	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 51 & 52 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Wideband DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm
2420.316 MHz



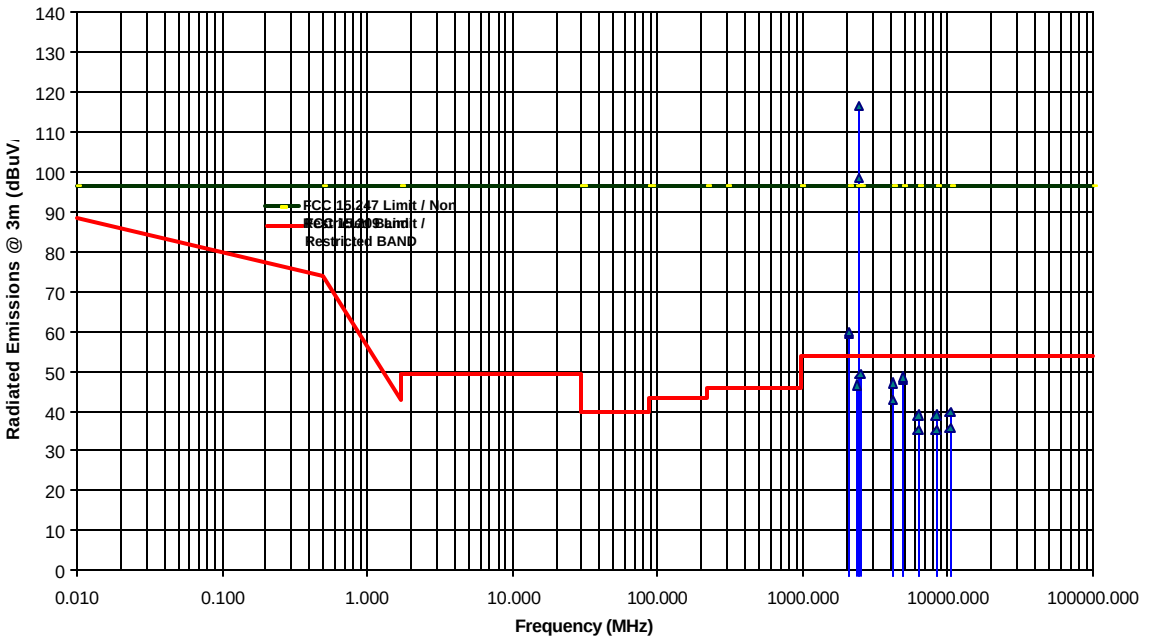
6.10.7.2.3.2. Highest Frequency (2453.052 MHz)

FREQUENCY (MHz)	RF PEAK LEVEL IN 1MHz BW (dBuV/m)	RF AVERAGE LEVEL IN 1MHz BW (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2070.51	80.1	59.3	V	54.0	96.4	-37.1	PASS
2070.51	67.0	59.7	H	54.0	96.4	-36.7	PASS
2383.00	66.8	46.5	V	54.0	96.4	-49.9	PASS
2453.05	123.3	116.4	V	--	--	--	--
2453.05	105.2	98.3	H	--	--	--	--
2483.00	66.3	49.3	V	54.0	96.4	-4.7	*PASS
4141.02	57.4	47.0	V	54.0	96.4	-7.0	*PASS
4141.02	54.9	42.9	H	54.0	96.4	-11.1	*PASS
4906.10	64.5	48.0	V	54.0	96.4	-6.0	*PASS
4906.10	65.8	48.5	H	54.0	96.4	-5.5	*PASS
6211.54	43.8	35.3	V	54.0	96.4	-61.1	PASS
6211.54	42.7	39.0	H	54.0	96.4	-57.4	PASS
8282.05	49.9	35.3	V	54.0	96.4	-18.7	*PASS
8282.05	50.9	39.0	H	54.0	96.4	-15.0	*PASS
10352.56	52.9	39.7	V	54.0	96.4	-56.7	PASS
10352.56	50.4	35.8	H	54.0	96.4	-60.6	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 40 dB below the limits were recorded.
- Refer to Plots # 53 & 54 in Annex 1 for band-edges

* Emissions fall in the restricted band FCC 15.205 shall meet the limit in FCC 15.209

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
ClearWire Model G2CPE Transmitter
Test Mode: Wideband DQPSK, Data Rate: 2.045 Mbps, Peak Output Power: 22.4 dBm
2453.052 MHz



6.11. TRANSMITTED POWER DENSITY OF A DSSS SYSTEM, FCC CFR 47, PARA. 15.247(D)

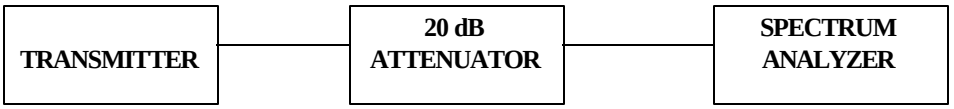
6.11.1.LIMITS

For a direct sequence system, the transmitted power density average over any 1 second interval shall not be greater than 8 dBm in any 3 KHz bandwidth within this band.

6.11.2.METHOD OF MEASUREMENTS

Refer to Exhibit 8, Sec. 8.5 of this test report for detailed measurement procedures

6.11.3.TEST ARRANGEMENT



6.11.4.TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

6.11.5.PLOTS

Refer to Plots # 55 to 66 in Annex 1 for Measurement Plots

6.11.6.TEST DATA

CHANNEL FREQUENCY (MHz)	MODULATION DATA RATE	RF POWER LEVEL IN 3 KHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	COMMENTS (PASS/FAIL)
2408.040	DQPSK 0.818 Mps	-0.2	8.0	-8.2	PASS
2465.328	DQPSK 0.818 Mps	+1.2	8.0	-6.8	PASS
2408.040	DQPSK 1.023 Mps	-3.3	8.0	-11.3	PASS
2463.282	DQPSK 1.023 Mps	+0.5	8.0	-7.5	PASS
2420.316	DQPSK 2.045 Mps	-1.8	8.0	-9.8	PASS
2453.052	DQPSK 2.045 Mps	-1.6	8.0	-9.6	PASS

6.12. PROCESSING GAIN OF A DIRECT SEQUENCE SPREAD SPECTRUM, FCC CFR 47, PARA. 15.247(E)

6.12.1.LIMITS

The processing gain of a direct sequence system shall be at least 10 dB. The processing gain shall be determined from the ratio in dB of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver.

6.12.2.METHOD OF MEASUREMENTS

Detailed of the Measurement Procedures are described in Sec. 8.7 of Exhibit 8

6.12.3.TEST EQUIPMENT LIST

- Anritsu Power Meter ML2437A
- HP ESG-D Series Signal Generator E4433B
- HP Negative Detector Diode 3330C
- Minicircuits Power Am ZHL-42W
- Tektronics Digital Phosphor Oscilloscope TP57054

6.12.4.METHOD OF MEASUREMENTS – JAMMING MARGIN

The signal to noise ratio for an ideal differentially coherent detection of a differentially encoded BPSK receiver can be derived from the Bit Error Probability (Pb) versus Signal-to-Noise ratio. See attached plot for detailed information.

For measurement of the $(S/N)_o$ we use the Pb of $1.0x10^{-5}$ minimum.

Ref.: Viterbi, A.J. Principles of Coherent Communications (New York: McGraw-HILL 1966), Pg. 207

Using equation (1) shown above, calculate the signal to noise ratio required for your chosen BER. This value and the measured J/S ratio are used in the following equation to calculate the Process Gain (Gp) of the system.

$$Gp = (S/N)o+Mj+Lsys$$

Where:

(S/N)o: Theoretical signal to noise ratio required to maintain the normal operation just before the BER appears. In real measurements the maximum error of 0.00001 is allowed in an ideal system using their modulation scheme with all codes turned off (i.e. no spreading or processing gain).

Mj: Maximum jammer to Signal Ratio that recorded at the detected BER.

Lsys: System losses such as non-ideal synchronization, tracking circuitry, non-optimal baseband receiver filtering and etc... These losses can be in excess of 3 dB for each transmitter and receiver pair. For the purpose of this processing gain calculation we assume a Lsys at its minimum value of 2 dB.

Ref.: Dixon, R, Spread Spectrum Systems . (New York: Wiley, 1984), Chapter 1.

- (S/N)o: Refer to attached curves, BER versus (S/N)o for Differential Coherent Detection of Differentially Encoded SK
- Processing gain Gp = (S/N)o + Lsys + Mj = (S/N)o + 2 + Mj

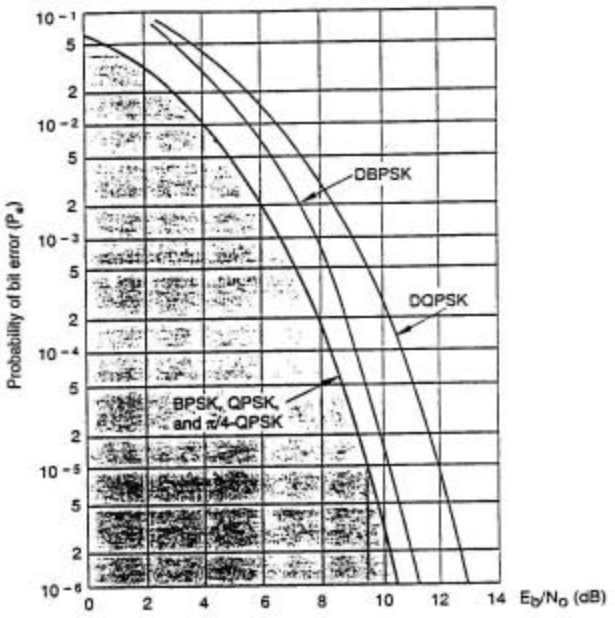


Figure 4.5.1 Theoretical $P_e = f(E_b/N_o)$ performance in a stationary additive white Gaussian noise (AWGN) environment. Ideal, linearly amplified coherent BPSK, QPSK, and differentially demodulated DBPSK systems are illustrated. The performance of non-linearly amplified FQPSK and GMSK is compared to ideal linearly amplified QPSK in Figures 4.3.33 and 4.3.34. (From Proakis, 1989.) See Appendix A.3.

tically equivalent term bit-error rate (BER) is used in applied references and specifications.

Power efficiency of modulated systems is defined as being inversely proportional to the

$$\text{BER} = f(C/N)$$

and/or

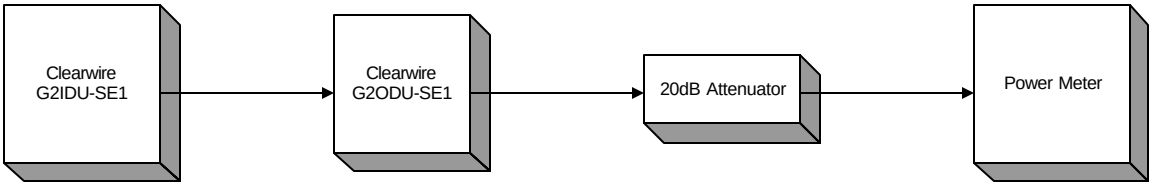
$$\text{BER} = f(E_b/N_o)$$

equations and performance curves, where E_b is the average energy of a modulated bit and N_o is the noise power spectral density (the noise power in a normalized 1-Hz bandwidth) at the demodulator input. The higher the probability of error, the lower the power efficiency, since transmitted power is "wasted" on more bad data.

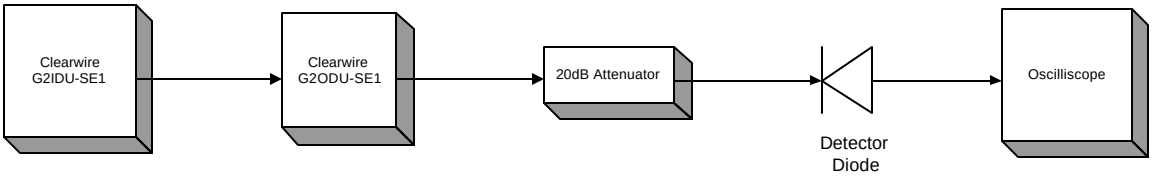
PEAK POWER MEASUREMENT:

Method:

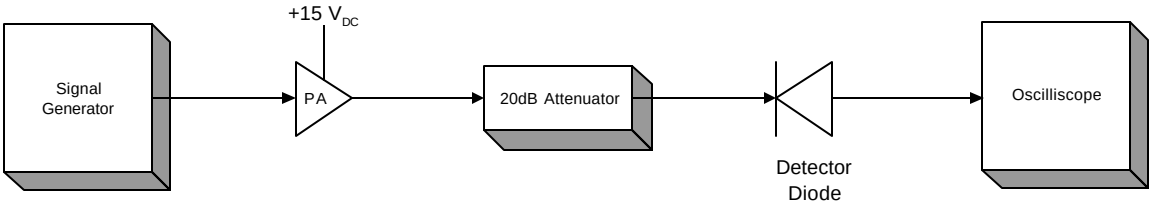
1. Measure Peak Power from ODU using Anritsu Model ML2437A (Peak Power Mode). This determines the power level used during the test.



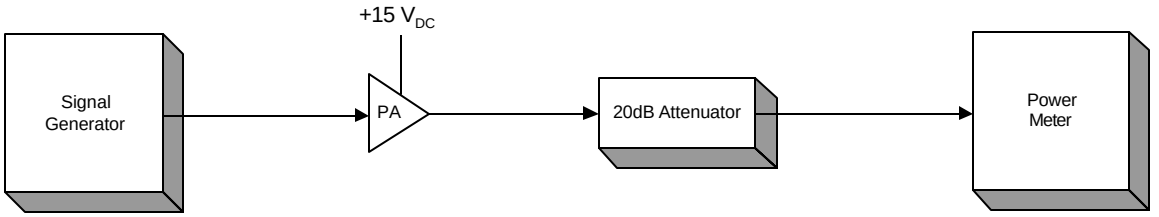
2. Substitute a HP Negative Detector diode 3330C for the peak power meter and using an O'scope measure the voltage level of the detected RF.



3. Substitue a Signal Generator with Power amplifier, HP Model E4433B and Minicircuits ZHL-42W, for the ODU. Output a CW Signal into the HP detector or such that the detector reads the Negative Voltage described in the previous step.



4. Measure the Power of this CW Signal using Anritsu Model ML2437A (Average Power Mode Calculation). This determines the actual Peak Power measured in Step 1.



Using the results of Step 1 and Step 4, a calibration factor can be determined for the Anritsu Model ML2437A.

Using the results of Step 1 and Step 4, a calibration factor can be determined for the Anritsu Model ML2437A.

TEST RESULTS: Conforms.

TEST PERSONNEL: Joseph Longo Microwave Engineer

DATE: 9/17/2001

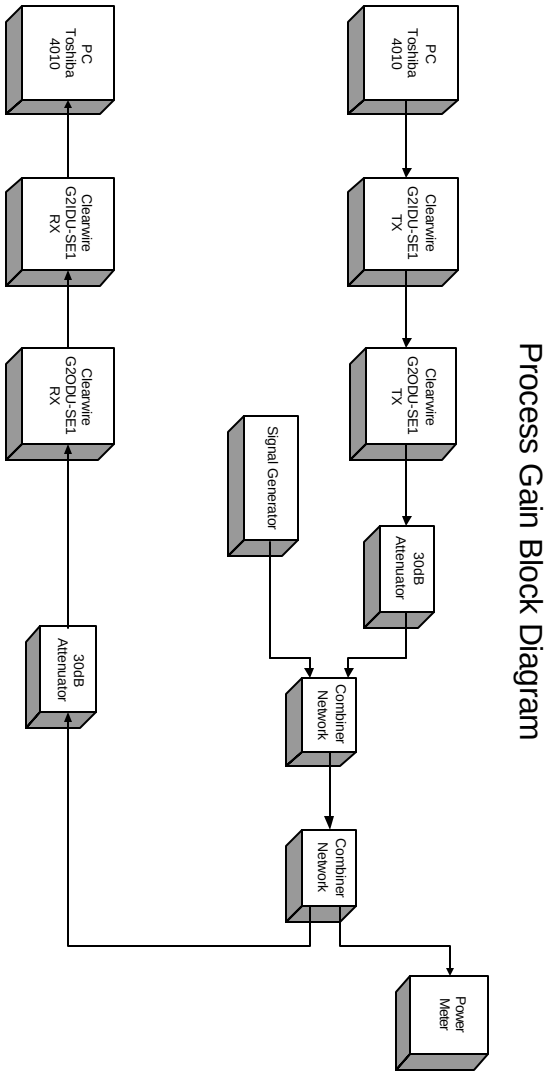


Figure 1 :- **SETUP FOR PROCESSING GAIN MEASUREMENT JAMMING MARGIN METHOD**

6.12.5.TEST DATA

6.12.5.1. TEST CONFIGURATION #1 – WIDEBAND

Fc = 2420.316 MHz
Data Rate = 2.045 Mbps (DQPSK), Wideband
Chip Rate = 11.25 MHz
PN Code Length = 11 chips/symbol
6 dB BW = 10.6 MHz

(S/N)o = 12 dB per attached Figure 4.5.1
Measured Processing Gain Gp = (S/N)o + Lsys + Mj = 13.7 +2 + Mj = 15.7+Mj (dB)

Theoretical Calculated Processing Gain = Chip Rate/Data rate = $\frac{11.25\ \text{MHz}}{(2.045\ \text{Mb/s})/(2\ \text{bits/symbol})}$ = 11.0 or 10.4 dB

SUMMARY OF TEST RESULTS	
Theoretical Process Gain:	10.4 dB
Minimum Measured Process Gain with discard of 19.9% of the worst measurements:	11.8 dB

Note:

- Total Peak Power from the EUT's Tx measured at the EUT's Rx Input: P_t = -46.7 dBm
- Jamming signal level at measured at the EUT's receiver input: Mj = J - P_t
- The following shaded boxes are discarded worst measurements (19.1% of total measurement points)

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
1	-5.00	0.00001	12.0	2	-3.4	10.6	12
2	-4.95	0.00001	12.0	2	-3.15	10.9	13
3	-4.90	0.00001	12.0	2	-2.93	11.1	15
4	-4.85	0.00001	12.0	2	-2.7	11.3	18
5	-4.80	0.00001	12.0	2	-2.8	11.2	16
6	-4.75	0.00001	12.0	2	-3.13	10.9	14
7	-4.70	0.00001	12.0	2	-2.5	11.5	23
8	-4.65	0.00001	12.0	2	-1.5	12.5	
9	-4.60	0.00001	12.0	2	-1.2	12.8	
10	-4.55	0.00001	12.0	2	-1.2	12.8	
11	-4.50	0.00001	12.0	2	-0.9	13.1	
12	-4.45	0.00001	12.0	2	-0.81	13.2	
13	-4.40	0.00001	12.0	2	-0.6	13.4	
14	-4.35	0.00001	12.0	2	-0.4	13.6	
15	-4.30	0.00001	12.0	2	-0.6	13.4	
16	-4.25	0.00001	12.0	2	-0.9	13.1	
17	-4.20	0.00001	12.0	2	-0.7	13.3	
18	-4.15	0.00001	12.0	2	-0.75	13.3	
19	-4.10	0.00001	12.0	2	-0.9	13.1	
20	-4.05	0.00001	12.0	2	-1.25	12.8	
21	-4.00	0.00001	12.0	2	-1.5	12.5	
22	-3.95	0.00001	12.0	2	-1.6	12.4	
23	-3.90	0.00001	12.0	2	-1.7	12.3	
24	-3.85	0.00001	12.0	2	-1.6	12.4	
25	-3.80	0.00001	12.0	2	-1.4	12.6	
26	-3.75	0.00001	12.0	2	-1.3	12.7	
27	-3.70	0.00001	12.0	2	-1.35	12.7	
28	-3.65	0.00001	12.0	2	-1.2	12.8	
29	-3.60	0.00001	12.0	2	-0.75	13.3	
30	-3.55	0.00001	12.0	2	-0.55	13.5	
31	-3.50	0.00001	12.0	2	-0.2	13.8	
32	-3.45	0.00001	12.0	2	-0.5	13.5	
33	-3.40	0.00001	12.0	2	-0.2	13.8	
34	-3.35	0.00001	12.0	2	-0.4	13.6	
35	-3.30	0.00001	12.0	2	-0.3	13.7	
36	-3.25	0.00001	12.0	2	-0.5	13.5	
37	-3.20	0.00001	12.0	2	-0.6	13.4	
38	-3.15	0.00001	12.0	2	-0.6	13.4	
39	-3.10	0.00001	12.0	2	-0.6	13.4	
40	-3.05	0.00001	12.0	2	-0.6	13.4	
41	-3.00	0.00001	12.0	2	-0.6	13.4	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
42	-2.95	0.00001	12.0	2	-0.85	13.2	
43	-2.90	0.00001	12.0	2	-1.15	12.9	
44	-2.85	0.00001	12.0	2	-1.4	12.6	
45	-2.80	0.00001	12.0	2	-1.55	12.5	
46	-2.75	0.00001	12.0	2	-1.65	12.4	
47	-2.70	0.00001	12.0	2	-1.45	12.6	
48	-2.65	0.00001	12.0	2	-1.6	12.4	
49	-2.60	0.00001	12.0	2	-1.6	12.4	
50	-2.55	0.00001	12.0	2	-0.9	13.1	
51	-2.50	0.00001	12.0	2	-0.8	13.2	
52	-2.45	0.00001	12.0	2	-1.1	12.9	
53	-2.40	0.00001	12.0	2	-0.7	13.3	
54	-2.35	0.00001	12.0	2	-0.65	13.4	
55	-2.30	0.00001	12.0	2	-0.6	13.4	
56	-2.25	0.00001	12.0	2	-0.3	13.7	
57	-2.20	0.00001	12.0	2	-0.2	13.8	
58	-2.15	0.00001	12.0	2	-0.2	13.8	
59	-2.10	0.00001	12.0	2	-0.3	13.7	
60	-2.05	0.00001	12.0	2	-0.3	13.7	
61	-2.00	0.00001	12.0	2	-0.2	13.8	
62	-1.95	0.00001	12.0	2	-0.1	13.9	
63	-1.90	0.00001	12.0	2	-0.1	13.9	
64	-1.85	0.00001	12.0	2	-0.4	13.6	
65	-1.80	0.00001	12.0	2	-0.4	13.6	
66	-1.75	0.00001	12.0	2	-0.5	13.5	
67	-1.70	0.00001	12.0	2	-0.5	13.5	
68	-1.65	0.00001	12.0	2	-0.41	13.6	
69	-1.60	0.00001	12.0	2	-0.3	13.7	
70	-1.55	0.00001	12.0	2	-0.25	13.8	
71	-1.50	0.00001	12.0	2	-0.25	13.8	
72	-1.45	0.00001	12.0	2	-0.35	13.7	
73	-1.40	0.00001	12.0	2	-0.5	13.5	
74	-1.35	0.00001	12.0	2	-0.6	13.4	
75	-1.30	0.00001	12.0	2	-0.5	13.5	
76	-1.25	0.00001	12.0	2	-0.2	13.8	
77	-1.20	0.00001	12.0	2	-0.4	13.6	
78	-1.15	0.00001	12.0	2	-0.5	13.5	
79	-1.10	0.00001	12.0	2	-0.6	13.4	
80	-1.05	0.00001	12.0	2	-0.6	13.4	
81	-1.00	0.00001	12.0	2	-0.6	13.4	
82	-0.95	0.00001	12.0	2	-0.4	13.6	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
83	-0.90	0.00001	12.0	2	-0.6	13.4	
84	-0.85	0.00001	12.0	2	-1	13.0	
85	-0.80	0.00001	12.0	2	-0.75	13.3	
86	-0.75	0.00001	12.0	2	-1.1	12.9	
87	-0.70	0.00001	12.0	2	-0.9	13.1	
88	-0.65	0.00001	12.0	2	-0.9	13.1	
89	-0.60	0.00001	12.0	2	-0.8	13.2	
90	-0.55	0.00001	12.0	2	-0.7	13.3	
91	-0.50	0.00001	12.0	2	-0.5	13.5	
92	-0.45	0.00001	12.0	2	-0.5	13.5	
93	-0.40	0.00001	12.0	2	0	14.0	
94	-0.35	0.00001	12.0	2	0.5	14.5	
95	-0.30	0.00001	12.0	2	1.1	15.1	
96	-0.25	0.00001	12.0	2	2.1	16.1	
97	-0.20	0.00001	12.0	2	3.1	17.1	
98	-0.15	0.00001	12.0	2	3.8	17.8	
99	-0.10	0.00001	12.0	2	4.5	18.5	
100	-0.05	0.00001	12.0	2	4.7	18.7	
101	0.00	0.00001	12.0	2	4.8	18.8	
102	0.05	0.00001	12.0	2	4.8	18.8	
103	0.10	0.00001	12.0	2	5.1	19.1	
104	0.15	0.00001	12.0	2	4.9	18.9	
105	0.20	0.00001	12.0	2	4.2	18.2	
106	0.25	0.00001	12.0	2	3.4	17.4	
107	0.30	0.00001	12.0	2	2.7	16.7	
108	0.35	0.00001	12.0	2	1.8	15.8	
109	0.40	0.00001	12.0	2	1.2	15.2	
110	0.45	0.00001	12.0	2	0.5	14.5	
111	0.50	0.00001	12.0	2	0.2	14.2	
112	0.55	0.00001	12.0	2	-0.4	13.6	
113	0.60	0.00001	12.0	2	-0.9	13.1	
114	0.65	0.00001	12.0	2	-1.3	12.7	
115	0.70	0.00001	12.0	2	-1.4	12.6	
116	0.75	0.00001	12.0	2	-1.8	12.2	
117	0.80	0.00001	12.0	2	-1.9	12.1	
118	0.85	0.00001	12.0	2	-1.8	12.2	
119	0.90	0.00001	12.0	2	-1.9	12.1	
120	0.95	0.00001	12.0	2	-1.9	12.1	
121	1.00	0.00001	12.0	2	-1.7	12.3	
122	1.05	0.00001	12.0	2	-1.5	12.5	
123	1.10	0.00001	12.0	2	-1.3	12.7	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
124	1.15	0.00001	12.0	2	-1.1	12.9	
125	1.20	0.00001	12.0	2	-0.8	13.2	
126	1.25	0.00001	12.0	2	-0.5	13.5	
127	1.30	0.00001	12.0	2	-0.3	13.7	
128	1.35	0.00001	12.0	2	-0.2	13.8	
129	1.40	0.00001	12.0	2	-0.3	13.7	
130	1.45	0.00001	12.0	2	-0.5	13.5	
131	1.50	0.00001	12.0	2	-0.4	13.6	
132	1.55	0.00001	12.0	2	-0.8	13.2	
133	1.60	0.00001	12.0	2	-1.1	12.9	
134	1.65	0.00001	12.0	2	-1.1	12.9	
135	1.70	0.00001	12.0	2	-1.3	12.7	
136	1.75	0.00001	12.0	2	-1.6	12.4	
137	1.80	0.00001	12.0	2	-1.9	12.1	
138	1.85	0.00001	12.0	2	-2.3	11.7	32
139	1.90	0.00001	12.0	2	-2.3	11.7	33
140	1.95	0.00001	12.0	2	-2.3	11.7	34
141	2.00	0.00001	12.0	2	-2.4	11.6	25
142	2.05	0.00001	12.0	2	-2.4	11.6	26
143	2.10	0.00001	12.0	2	-2.6	11.4	21
144	2.15	0.00001	12.0	2	-2.4	11.6	27
145	2.20	0.00001	12.0	2	-1.9	12.1	
146	2.25	0.00001	12.0	2	-2	12.0	
147	2.30	0.00001	12.0	2	-1.5	12.5	
148	2.35	0.00001	12.0	2	-1.4	12.6	
149	2.40	0.00001	12.0	2	-1.5	12.5	
150	2.45	0.00001	12.0	2	-1.7	12.3	
151	2.50	0.00001	12.0	2	-1.3	12.7	
152	2.55	0.00001	12.0	2	-1.6	12.4	
153	2.60	0.00001	12.0	2	-1.4	12.6	
154	2.65	0.00001	12.0	2	-1.4	12.6	
155	2.70	0.00001	12.0	2	-1.5	12.5	
156	2.75	0.00001	12.0	2	-1.6	12.4	
157	2.80	0.00001	12.0	2	-1.65	12.4	
158	2.85	0.00001	12.0	2	-1.5	12.5	
159	2.90	0.00001	12.0	2	-1.4	12.6	
160	2.95	0.00001	12.0	2	-1.4	12.6	
161	3.00	0.00001	12.0	2	-1.5	12.5	
162	3.05	0.00001	12.0	2	-1.5	12.5	
163	3.10	0.00001	12.0	2	-1.7	12.3	
164	3.15	0.00001	12.0	2	-1.7	12.3	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
165	3.20	0.00001	12.0	2	-1.8	12.2	
166	3.25	0.00001	12.0	2	-1.7	12.3	
167	3.30	0.00001	12.0	2	-1.7	12.3	
168	3.35	0.00001	12.0	2	-1.7	12.3	
169	3.40	0.00001	12.0	2	-1.6	12.4	
170	3.45	0.00001	12.0	2	-1.6	12.4	
171	3.50	0.00001	12.0	2	-1.8	12.2	
172	3.55	0.00001	12.0	2	-2	12.0	
173	3.60	0.00001	12.0	2	-2.3	11.7	35
174	3.65	0.00001	12.0	2	-2.8	11.2	17
175	3.70	0.00001	12.0	2	-2.5	11.5	24
176	3.75	0.00001	12.0	2	-2.4	11.6	28
177	3.80	0.00001	12.0	2	-2.65	11.4	20
178	3.85	0.00001	12.0	2	-2.6	11.4	22
179	3.90	0.00001	12.0	2	-2.2	11.8	40
180	3.95	0.00001	12.0	2	-2.3	11.7	36
181	4.00	0.00001	12.0	2	-2.3	11.7	37
182	4.05	0.00001	12.0	2	-2.4	11.6	29
183	4.10	0.00001	12.0	2	-1.9	12.1	
184	4.15	0.00001	12.0	2	-1.8	12.2	
185	4.20	0.00001	12.0	2	-2.2	11.8	
186	4.25	0.00001	12.0	2	-2.4	11.6	30
187	4.30	0.00001	12.0	2	-2.4	11.6	31
188	4.35	0.00001	12.0	2	-2.3	11.7	38
189	4.40	0.00001	12.0	2	-2.3	11.7	39
190	4.45	0.00001	12.0	2	-2.65	11.4	19
191	4.50	0.00001	12.0	2	-3.6	10.4	9
192	4.55	0.00001	12.0	2	-3.5	10.5	11
193	4.60	0.00001	12.0	2	-3.65	10.4	8
194	4.65	0.00001	12.0	2	-3.7	10.3	7
195	4.70	0.00001	12.0	2	-4.6	9.4	3
196	4.75	0.00001	12.0	2	-5.2	8.8	1
197	4.80	0.00001	12.0	2	-5.1	8.9	2
198	4.85	0.00001	12.0	2	-3.9	10.1	5
199	4.90	0.00001	12.0	2	-3.6	10.4	10
200	4.95	0.00001	12.0	2	-3.7	10.3	6
201	5.00	0.00001	12.0	2	-4.1	9.9	4

6.12.5.2. TEST CONFIGURATION #2 – MEDIUM BAND

Fc = 2465.282 MHz
Data Rate = 1.023 Mbps (DQPSK), Medium
Chip Rate = 5.625 MHz
PN Code Length = 11 chips/symbol
6 dB BW = 5.4 MHz

(S/N)o = 12 dB per attached Figure 4.5.1
Measured Processing Gain Gp = (S/N)o + Lsys + Mj = 13.7 +2 + Mj = 15.7+Mj (dB)

Theoretical Calculated Processing Gain = Chip Rate/Data rate = $\frac{5.625\ \text{MHz}}{(1.023\ \text{Mb/s})/(2\ \text{bits/symbol})}$ = 11.0 or 10.4 dB

SUMMARY OF TEST RESULTS	
Theoretical Process Gain:	10.4 dB
Minimum Measured Process Gain with discard of 19.1% of the worst measurements:	11.2 dB

Note:
- Total Peak Power from the EUT's Tx measured at the EUT's Rx Input: P_t = -46.7 dBm
- Jamming signal level at measured at the EUT's receiver input: Mj = J - P_t
- The following shaded boxes are discarded worst measurements (19.1% of total measurement points)

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
1	-3.50	0.00001	12.0	2	-2.8	11.2	
2	-3.45	0.00001	12.0	2	-1.1	12.9	
3	-3.40	0.00001	12.0	2	0.1	14.1	
4	-3.35	0.00001	12.0	2	1.4	15.4	
5	-3.30	0.00001	12.0	2	2.4	16.4	
6	-3.25	0.00001	12.0	2	2.3	16.3	
7	-3.20	0.00001	12.0	2	3.3	17.3	
8	-3.15	0.00001	12.0	2	3.2	17.2	
9	-3.10	0.00001	12.0	2	2.7	16.7	
10	-3.05	0.00001	12.0	2	2.9	16.9	
11	-3.00	0.00001	12.0	2	2.7	16.7	
12	-2.95	0.00001	12.0	2	3.5	17.5	
13	-2.90	0.00001	12.0	2	4.7	18.7	
14	-2.85	0.00001	12.0	2	4.8	18.8	
15	-2.80	0.00001	12.0	2	4.2	18.2	
16	-2.75	0.00001	12.0	2	2.5	16.5	
17	-2.70	0.00001	12.0	2	1.0	15.0	
18	-2.65	0.00001	12.0	2	-0.5	13.5	
19	-2.60	0.00001	12.0	2	-1.6	12.4	
20	-2.55	0.00001	12.0	2	-2.8	11.2	
21	-2.50	0.00001	12.0	2	-3.5	10.5	14
22	-2.45	0.00001	12.0	2	-3.5	10.5	15
23	-2.40	0.00001	12.0	2	-2.9	11.1	25
24	-2.35	0.00001	12.0	2	-2.2	11.8	
25	-2.30	0.00001	12.0	2	-1.3	12.7	
26	-2.25	0.00001	12.0	2	-0.7	13.3	
27	-2.20	0.00001	12.0	2	-1.3	12.7	
28	-2.15	0.00001	12.0	2	0.6	14.6	
29	-2.10	0.00001	12.0	2	1.7	15.7	
30	-2.05	0.00001	12.0	2	3.1	17.1	
31	-2.00	0.00001	12.0	2	3.0	17.0	
32	-1.95	0.00001	12.0	2	2.2	16.2	
33	-1.90	0.00001	12.0	2	2.0	16.0	
34	-1.85	0.00001	12.0	2	1.3	15.3	
35	-1.80	0.00001	12.0	2	0.3	14.3	
36	-1.75	0.00001	12.0	2	0.6	14.6	
37	-1.70	0.00001	12.0	2	0.1	14.1	
38	-1.65	0.00001	12.0	2	-0.2	13.8	
39	-1.60	0.00001	12.0	2	-0.4	13.6	
40	-1.55	0.00001	12.0	2	-1.2	12.8	
41	-1.50	0.00001	12.0	2	-1.3	12.7	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
42	-1.45	0.00001	12.0	2	-2.0	12.0	
43	-1.40	0.00001	12.0	2	-1.8	12.2	
44	-1.35	0.00001	12.0	2	-1.6	12.4	
45	-1.30	0.00001	12.0	2	-1.1	12.9	
46	-1.25	0.00001	12.0	2	-1.0	13.0	
47	-1.20	0.00001	12.0	2	-0.9	13.1	
48	-1.15	0.00001	12.0	2	-0.4	13.6	
49	-1.10	0.00001	12.0	2	-0.1	13.9	
50	-1.05	0.00001	12.0	2	0.3	14.3	
51	-1.00	0.00001	12.0	2	1.2	15.2	
52	-0.95	0.00001	12.0	2	0.6	14.6	
53	-0.90	0.00001	12.0	2	0.5	14.5	
54	-0.85	0.00001	12.0	2	0.3	14.3	
55	-0.80	0.00001	12.0	2	1.5	15.5	
56	-0.75	0.00001	12.0	2	1.5	15.5	
57	-0.70	0.00001	12.0	2	1.9	15.9	
58	-0.65	0.00001	12.0	2	1.6	15.6	
59	-0.60	0.00001	12.0	2	1.5	15.5	
60	-0.55	0.00001	12.0	2	1.2	15.2	
61	-0.50	0.00001	12.0	2	0.5	14.5	
62	-0.45	0.00001	12.0	2	-0.3	13.7	
63	-0.40	0.00001	12.0	2	-1.0	13.0	
64	-0.35	0.00001	12.0	2	-1.5	12.5	
65	-0.30	0.00001	12.0	2	-0.7	13.3	
66	-0.25	0.00001	12.0	2	-0.3	13.7	
67	-0.20	0.00001	12.0	2	0.5	14.5	
68	-0.15	0.00001	12.0	2	2.0	16.0	
69	-0.10	0.00001	12.0	2	3.5	17.5	
70	-0.05	0.00001	12.0	2	4.5	18.5	
71	0.00	0.00001	12.0	2	4.6	18.6	
72	0.05	0.00001	12.0	2	2.8	16.8	
73	0.10	0.00001	12.0	2	2.4	16.4	
74	0.15	0.00001	12.0	2	1.2	15.2	
75	0.20	0.00001	12.0	2	0.2	14.2	
76	0.25	0.00001	12.0	2	-0.4	13.6	
77	0.30	0.00001	12.0	2	-1.7	12.3	
78	0.35	0.00001	12.0	2	-2.0	12.0	
79	0.40	0.00001	12.0	2	-2.0	12.0	
80	0.45	0.00001	12.0	2	-2.1	11.9	
81	0.50	0.00001	12.0	2	-1.9	12.1	
82	0.55	0.00001	12.0	2	-1.3	12.7	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
83	0.60	0.00001	12.0	2	-0.8	13.2	
84	0.65	0.00001	12.0	2	-0.3	13.7	
85	0.70	0.00001	12.0	2	-0.4	13.6	
86	0.75	0.00001	12.0	2	-0.5	13.5	
87	0.80	0.00001	12.0	2	-0.8	13.2	
88	0.85	0.00001	12.0	2	-0.8	13.2	
89	0.90	0.00001	12.0	2	-1.6	12.4	
90	0.95	0.00001	12.0	2	-1.6	12.4	
91	1.00	0.00001	12.0	2	-1.9	12.1	
92	1.05	0.00001	12.0	2	-2.1	11.9	
93	1.10	0.00001	12.0	2	-2.0	12.0	
94	1.15	0.00001	12.0	2	-2.3	11.7	
95	1.20	0.00001	12.0	2	-2.5	11.5	
96	1.25	0.00001	12.0	2	-3.2	10.8	21
97	1.30	0.00001	12.0	2	-3.4	10.6	16
98	1.35	0.00001	12.0	2	-3.7	10.3	11
99	1.40	0.00001	12.0	2	-3.4	10.6	17
100	1.45	0.00001	12.0	2	-3.7	10.3	13
101	1.50	0.00001	12.0	2	-3.7	10.3	12
102	1.55	0.00001	12.0	2	-3.8	10.2	10
103	1.60	0.00001	12.0	2	-3.4	10.6	18
104	1.65	0.00001	12.0	2	-3.3	10.7	19
105	1.70	0.00001	12.0	2	-3.1	10.9	22
106	1.75	0.00001	12.0	2	-3.0	11.0	24
107	1.80	0.00001	12.0	2	-2.7	11.3	
108	1.85	0.00001	12.0	2	-2.5	11.5	
109	1.90	0.00001	12.0	2	-1.3	12.7	
110	1.95	0.00001	12.0	2	-0.6	13.4	
111	2.00	0.00001	12.0	2	-0.9	13.1	
112	2.05	0.00001	12.0	2	-1.0	13.0	
113	2.10	0.00001	12.0	2	-1.1	12.9	
114	2.15	0.00001	12.0	2	-1.7	12.3	
115	2.20	0.00001	12.0	2	-2.6	11.4	
116	2.25	0.00001	12.0	2	-3.1	10.9	23
117	2.30	0.00001	12.0	2	-4.4	9.6	8
118	2.35	0.00001	12.0	2	-5.3	8.7	4
119	2.40	0.00001	12.0	2	-5.5	8.5	2
120	2.45	0.00001	12.0	2	-5.3	8.7	5
121	2.50	0.00001	12.0	2	-5.1	8.9	6
122	2.55	0.00001	12.0	2	-4.1	9.9	9
123	2.60	0.00001	12.0	2	-2.9	11.1	26

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
124	2.65	0.00001	12.0	2	-1.9	12.1	
125	2.70	0.00001	12.0	2	-0.4	13.6	
126	2.75	0.00001	12.0	2	0.9	14.9	
127	2.80	0.00001	12.0	2	2.4	16.4	
128	2.85	0.00001	12.0	2	3.1	17.1	
129	2.90	0.00001	12.0	2	2.8	16.8	
130	2.95	0.00001	12.0	2	2.3	16.3	
131	3.00	0.00001	12.0	2	-0.9	13.1	
132	3.05	0.00001	12.0	2	-1.1	12.9	
133	3.10	0.00001	12.0	2	-1.2	12.8	
134	3.15	0.00001	12.0	2	-1.5	12.5	
135	3.20	0.00001	12.0	2	-2.0	12.0	
136	3.25	0.00001	12.0	2	-2.7	11.3	
137	3.30	0.00001	12.0	2	-2.9	11.1	27
138	3.35	0.00001	12.0	2	-3.3	10.7	20
139	3.40	0.00001	12.0	2	-5.0	9.0	7
140	3.45	0.00001	12.0	2	-5.5	8.5	3
141	3.50	0.00001	12.0	2	-7.2	6.8	1

6.12.5.3. TEST CONFIGURATION #3 - NARROWBAND

Fc = 2436.755319 MHz
Data Rate = 0.818 Mbps (DQPSK), Narrowband
Chip Rate = 4.5 MHz
PN Code Length = 11 chips/symbol
6 dB BW = 4.1 MHz

(S/N)o = 11.7 dB per attached Figure 4.5.1
Measured Processing Gain Gp = (S/N)o + Lsys + Mj = 13.7 +2 + Mj = 15.7+Mj (dB)

Theoretical Calculated Processing Gain = Chip Rate/Data rate = $\frac{4.5\ \text{MHz}}{(0.818\ \text{Mb/s})/(2\ \text{bits/symbol})}$ = 11.0 or 10.4 dB

SUMMARY OF TEST RESULTS	
Theoretical Process Gain:	10.4 dB
Minimum Measured Process Gain with discard of 17.8% of the worst measurements:	11.0 dB

Note:

- Total Peak Power from the EUT's Tx measured at the EUT's Rx Input: P_t = -46.7 dBm
- Jamming signal level at measured at the EUT's receiver input: Mj = J - P_t
- The following shaded boxes are discarded worst measurements (19.1% of total measurement points)

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
1	-2.50	0.00001	12.0	2	0.5	14.5	
2	-2.45	0.00001	12.0	2	0.6	14.6	
3	-2.40	0.00001	12.0	2	0.9	14.9	
4	-2.35	0.00001	12.0	2	2.5	16.5	
5	-2.30	0.00001	12.0	2	3.7	17.7	
6	-2.25	0.00001	12.0	2	3.5	17.5	
7	-2.20	0.00001	12.0	2	1.6	15.6	
8	-2.15	0.00001	12.0	2	-0.9	13.1	
9	-2.10	0.00001	12.0	2	-2.1	11.9	
10	-2.05	0.00001	12.0	2	-3.1	10.9	17
11	-2.00	0.00001	12.0	2	-4.6	9.4	3
12	-1.95	0.00001	12.0	2	-4.3	9.7	5
13	-1.90	0.00001	12.0	2	-3.8	10.2	7
14	-1.85	0.00001	12.0	2	-2.9	11.1	
15	-1.80	0.00001	12.0	2	-2.1	11.9	
16	-1.75	0.00001	12.0	2	-0.6	13.4	
17	-1.70	0.00001	12.0	2	0.9	14.9	
18	-1.65	0.00001	12.0	2	1.0	15.0	
19	-1.60	0.00001	12.0	2	0.3	14.3	
20	-1.55	0.00001	12.0	2	0.3	14.3	
21	-1.50	0.00001	12.0	2	-1.1	12.9	
22	-1.45	0.00001	12.0	2	-1.8	12.2	
23	-1.40	0.00001	12.0	2	-2.4	11.6	
24	-1.35	0.00001	12.0	2	-2.2	11.8	
25	-1.30	0.00001	12.0	2	-2.7	11.3	
26	-1.25	0.00001	12.0	2	-2.8	11.2	
27	-1.20	0.00001	12.0	2	-3.0	11.0	
28	-1.15	0.00001	12.0	2	-3.0	11.0	
29	-1.10	0.00001	12.0	2	-3.2	10.8	14
30	-1.05	0.00001	12.0	2	-2.8	11.2	
31	-1.00	0.00001	12.0	2	-2.0	12.0	
32	-0.95	0.00001	12.0	2	-1.6	12.4	
33	-0.90	0.00001	12.0	2	-1.8	12.2	
34	-0.85	0.00001	12.0	2	-1.1	12.9	
35	-0.80	0.00001	12.0	2	-0.5	13.5	
36	-0.75	0.00001	12.0	2	-0.7	13.3	
37	-0.70	0.00001	12.0	2	-0.8	13.2	
38	-0.65	0.00001	12.0	2	-0.9	13.1	
40	-0.55	0.00001	12.0	2	-0.9	13.1	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
41	-0.50	0.00001	12.0	2	-1.7	12.3	
42	-0.45	0.00001	12.0	2	-1.8	12.2	
43	-0.40	0.00001	12.0	2	-3.2	10.8	15
44	-0.35	0.00001	12.0	2	-3.2	10.8	16
45	-0.30	0.00001	12.0	2	-3.4	10.6	11
46	-0.25	0.00001	12.0	2	-3.1	10.9	18
47	-0.20	0.00001	12.0	2	-3.0	11.0	
48	-0.15	0.00001	12.0	2	-3.0	11.0	
49	-0.10	0.00001	12.0	2	0.8	14.8	
50	-0.05	0.00001	12.0	2	2.4	16.4	
51	0.00	0.00001	12.0	2	3.0	17.0	
52	0.05	0.00001	12.0	2	3.1	17.1	
53	0.10	0.00001	12.0	2	1.6	15.6	
54	0.15	0.00001	12.0	2	-0.3	13.7	
55	0.20	0.00001	12.0	2	-1.5	12.5	
56	0.25	0.00001	12.0	2	-2.4	11.6	
57	0.30	0.00001	12.0	2	-2.5	11.5	
58	0.35	0.00001	12.0	2	-2.1	11.9	
59	0.40	0.00001	12.0	2	-1.3	12.7	
60	0.45	0.00001	12.0	2	-0.5	13.5	
61	0.50	0.00001	12.0	2	-0.1	13.9	
62	0.55	0.00001	12.0	2	0.1	14.1	
63	0.60	0.00001	12.0	2	-0.1	13.9	
64	0.65	0.00001	12.0	2	-0.2	13.8	
65	0.70	0.00001	12.0	2	-0.4	13.6	
66	0.75	0.00001	12.0	2	-1.1	12.9	
67	0.80	0.00001	12.0	2	-1.5	12.5	
68	0.85	0.00001	12.0	2	-1.7	12.3	
69	0.90	0.00001	12.0	2	-2.1	11.9	
70	0.95	0.00001	12.0	2	-2.6	11.4	
71	1.00	0.00001	12.0	2	-3.5	10.5	9
72	1.05	0.00001	12.0	2	-3.4	10.6	12
73	1.10	0.00001	12.0	2	-3.5	10.5	8
74	1.15	0.00001	12.0	2	-3.2	10.8	17
75	1.20	0.00001	12.0	2	-3.3	10.7	13
76	1.25	0.00001	12.0	2	-3.1	10.9	16
77	1.30	0.00001	12.0	2	-2.7	11.3	
78	1.35	0.00001	12.0	2	-2.4	11.6	
79	1.40	0.00001	12.0	2	-1.6	12.4	
80	1.45	0.00001	12.0	2	-1.2	12.8	
81	1.50	0.00001	12.0	2	-0.1	13.9	

Continued …

Test Point	Jammer Singal Freq +/- Fc (MHz)	(BER) (DQPSK)	(S/N)o (dB)	System Loss Lsys (dB)	Jammer to Signal Ratio Mj (dB)	Measured Processing Gain (dB)	Discarded Readings
82	1.55	0.00001	12.0	2	0.6	14.6	
83	1.60	0.00001	12.0	2	1.3	15.3	
84	1.65	0.00001	12.0	2	1.3	15.3	
85	1.70	0.00001	12.0	2	0.5	14.5	
86	1.75	0.00001	12.0	2	-0.1	13.9	
87	1.80	0.00001	12.0	2	-2.5	11.5	
88	1.85	0.00001	12.0	2	-3.5	10.5	10
89	1.90	0.00001	12.0	2	-4.5	9.5	4
90	1.95	0.00001	12.0	2	-4.7	9.3	1
91	2.00	0.00001	12.0	2	-4.7	9.3	2
92	2.05	0.00001	12.0	2	-3.9	10.1	6
93	2.10	0.00001	12.0	2	-2.7	11.3	
94	2.15	0.00001	12.0	2	-1.2	12.8	
95	2.20	0.00001	12.0	2	0.9	14.9	
96	2.25	0.00001	12.0	2	2.9	16.9	
97	2.30	0.00001	12.0	2	2.6	16.6	
98	2.35	0.00001	12.0	2	2.9	16.9	
99	2.40	0.00001	12.0	2	1.1	15.1	
100	2.45	0.00001	12.0	2	0.8	14.8	
101	2.50	0.00001	12.0	2	-0.2	13.8	

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

8.1.1. NORMAL TEMPERATURE AND HUMIDITY

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

8.1.2. NORMAL POWER SOURCE

8.1.2.1. MAINS VOLTAGE

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

8.1.2.2. BATTERY POWER SOURCE.

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

8.1.3. OPERATING CONDITION OF EQUIPMENT UNDER TEST

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

8.2. METHOD OF MEASUREMENTS - AC MAINS CONDUCTED EMISSIONS

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 450 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlet. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 450 kHz to 30 MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1. Monitor the frequency range of interest at a fixed EUT azimuth.

  Step2. Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.

  Step4. After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 10 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (10 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

- ***Broad-band ac Powerline conducted emissions***:- If the EUT exhibits ac Powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.

8.3. PEAK CONDUCTED POWER & PEAK EIRP

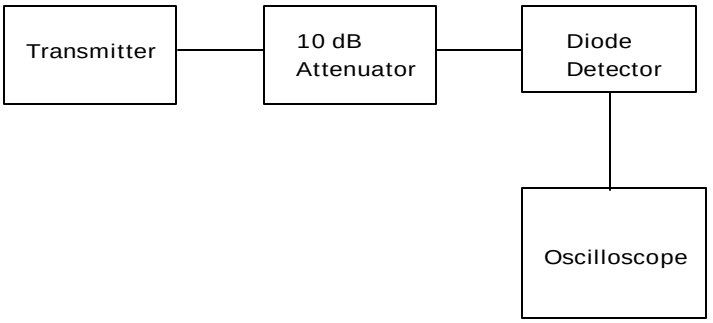
8.3.1. MEASUREMENTS OF TRANSMITTER PARAMETERS (DUTY CYCLE & PEAK POWER)

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

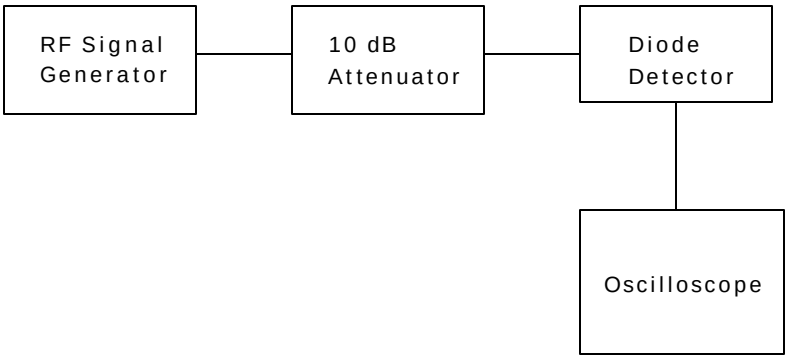
Step 1: Duty Cycle (x) and Peak Power (y) parameters measurements

- Connect the transmitter output to a diode detector through an attenuator
- Connect the diode detector to the vertical channel of an oscilloscope.
- The observed duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with $0<x<1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.
- Observe and record the y parameter of the DC level on the oscilloscope.



Step 2: Peak Power Measurements

- Replace the transmitter by a RF signal generator
- Set the signal generator frequency be the same as the transmitter frequency
- Adjust the rf output level of the RF signal generator until the DC level on the oscilloscope is same as that (y) recorded in step 1.
- Measure the RF signal generator output level using a power meter
- Calculate the total peak power (Pp) by adding the signal generator level with the attenuator value and the cable loss.



Step 3: Total Peak EIRP Substitution Method. See Figure 2

(a) The setting of the spectrum analyzer shall be:

Center Frequency:	equal to the signal source
Resolution BW:	100 kHz for FSS, 1 MHz for DSSS
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Connect the transmitter output to the spectrum analyzer and measure the peak power in 1 MHz bandwidth for reference.
(c) Calculate the difference (Kp) between the total peak power and 1 MHz BW peak power. This value will be used to add onto the 1MHz BW peak EIRP to obtain the TOTAL peak EIRP.
(d) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(e) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(f) The horn test antenna was used and tuned to the transmitter carrier frequency.
(g) The spectrum analyzer was tuned to transmitter carrier frequency. The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The substitution horn antenna and the signal generator replaced the transmitter and antenna under test in the same position, and the substitution horn antenna was placed in vertical polarization. The test horn antenna was lowered or raised as necessary to ensure that the maximum signal is stilled received.

(k) The input signal to the substitution antenna was adjusted in level until an equal or a known related level to that detected from the transmitter was obtained in the test receiver. The maximum carrier radiated power is equal to the power supply by the generator.

(l) The substitution antenna gain and cable loss were added to the signal generator level for the corrected 1MHz BW peak EIRP level. The total peak EIRP can be calculated by adding its value with the Kp

(m) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization. Measured in step (c).

(n) Actual gain of the EUT's antenna is the difference of the measured ERP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

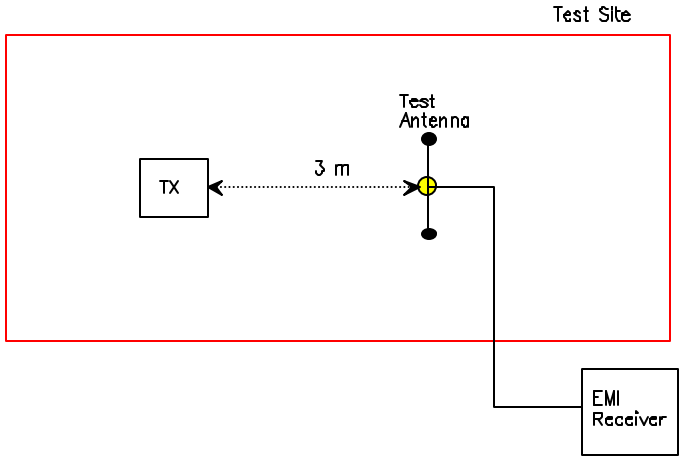
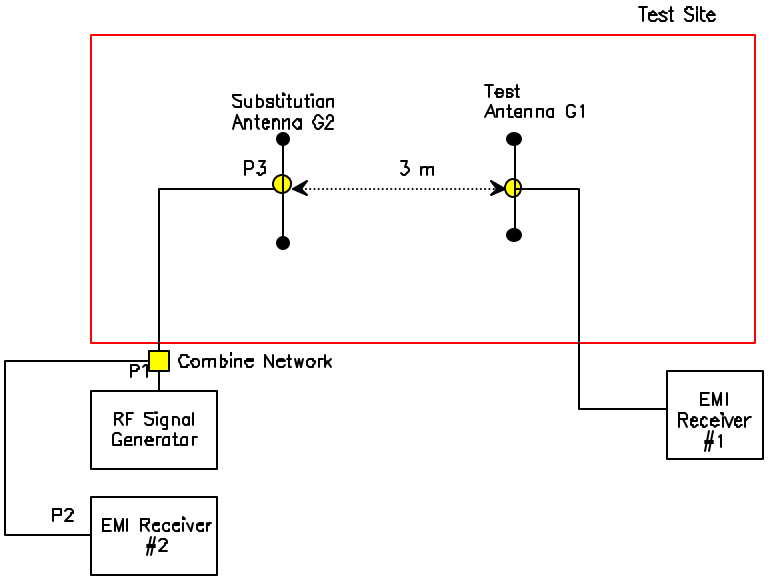


Figure 3



8.4. SPURIOUS EMISSIONS (CONDUCTED & RADIATED)

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

8.4.1. BAND-EDGE AND SPURIOUS EMISSIONS (CONDUCTED)

Band-edge Compliance of RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Submit this plot

Spurious RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the in-band-emission and all spurious emissions (e.g. harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, sevral plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
- Submit this plot

8.4.2. SPURIOUS EMISSIONS (RADIATED)

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

   - RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
   - Allow the trace to stabilize.
   - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

   Calculation of Field Strength:

   The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

   FS = RA + AF + CF - AG

Where FS = Field Strength
RA = Receiver/Analyzer Reading
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:
Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.
Field Level = $10^{(38/20)}$ = 79.43 uV/m.

   - Submit this test data
   - Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time of the each channel is less than 100ms, then the reading obtained may be further adjusted by a “duty cycle correction factor”, derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
   - Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.

- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

  The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

  Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

  Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

  Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

  Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

  Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

8.5. ALTERNATIVE TEST PROCEDURES

If the antenna conducted tests cannot be performed on this device, radiated tests show compliance with the peak output power limit specified in Section 15.247(b) and the spurious RF conducted emission limit specified in Section 15.247(c) are acceptable. As stated previously, a pre-amp, and, in the later case, a high pass filter, are required for the following measurements:

8.5.1. PEAK POWER MEASUREMENTS

Calculate the transmitter's peak power using the following equation:

$E = 30PG/d$
$P = (Ed)^2/30G$

Where:

- E: measured maximum fundamental field strength in V/m. Utilizing a RBW, the 20 dB bandwidth of the emission VBW >RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission
- G is numeric gain of the transmitting antenna with reference to an isotropic radiator
- D is the distance in meters from which the field strength was measured
- P is the distance in meters from which the field strength was measured

8.5.2. SPURIOUS RF CONDUCTED EMISSIONS

The demonstrate compliance with the spurious RF conducted emission requirement of Section 15.247©, use the following spectrum analyzer settings:

- Span = wide enough to fully capture the emission being measured
- RBW = 100 kHz
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Measure the field strength of both the fundamental and all spurious emissions with these settings.
- Follow the procedures C62-4:1994 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental emission by the amount specified in Section 15.247©. Note that if the emission falls in a Restricted Band, as defined in Section 15.205, the procedure for measuring spurious radiated emissions listed above must be followed

8.6. TRANSMITTED POWER DENSITY OF A DSSS SYSTEM

- The radio was connected to the measuring equipment via a suitable attenuator.
- Locate and zoom in on emission peak(s) within the passband
- The spectrum analyzer were used and set as follows:

  - Resolution BW: 3 kHz
  - Video BW: same or greater
  - Detector Mode: Normal
  - Averaging: Off
  - Span: 3 MHz
  - Amplitude: Adjust for middle of the instrument's range
  - Sweep Time: 1000 seconds

- Locate and zoom in on emission peak(s) within the passband. Set RBW = 3 KHz, VBW $\geq$ RBW, Sweep = SPAN/3 KHz. For example, a span of 1.5 MHz, the sweep should be $1.6x10^6/3.0x10^3$= 500 seconds. The measured peak level must be no greater than +8 dBm.
- For devices with spectrum line spacing greater than 3 KHz no change is required.
- For devices with spectrum line spacing equal to or less than 3 KHz, the resolution bandwidth must be reduced below 3 KHz until the individual lines in the spectrum are resolved. The measurement data must then be normalized to 3 KHz by summing the power of all the individual spectral lines within 3 KHz band (in linear power units) to determine compliance.
- If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzer will directly measure the noise power density normalized to 1 Hz noise power bandwidth. Add 30 dB for correction to 3 KHz.
- Should all the above fail or any controversy develop regarding accuracy of measurement, the Laboratory will use HP 89440A Vector Signal Analyzer for final measurement unless a clear showing can be made for a further alternate.