ENGINEERING TEST REPORT

ISP DIRECT INDOOR & OUTDOOR UNITS
Model No.: 2401-01 (indoor) and 2401-02 (outdoor)

FCC ID: NUX-ISP2401-2

FCC CLASS II PERMISSIVE CHANGES

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 2408.625 - 2464.875 MHz

UltraTech's File No.: IAW8-FTX

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs …… Date: ……	
Report Prepared by: Dan Huynh ……	Tested by: Mr. Hung Trinh, RFI/EMI Technician ……
Issued Date: October 15, 1999	Test Dates: October 6, 1999

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

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TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION 3

1.1. SCOPE 3
1.2. RELATED SUBMITAL(S)/GRANT(S) 3
1.3. NORMATIVE REFERENCES 3

EXHIBIT 2. PERFORMANCE ASSESSMENT 4

2.1. CLIENT INFORMATION 4
2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION 4
2.3. EUT'S TECHNICAL SPECIFICATIONS 5
2.4. LIST OF EUT'S PORTS 5
2.5. ANCILLARY EQUIPMENT 6

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS 7

3.1. CLIMATE TEST CONDITIONS 7
3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS 7

EXHIBIT 4. SUMMARY OF TEST RESULTS 8

4.1. LOCATION OF TESTS 8
4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS 8
4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES 8

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS 9

5.1. TEST PROCEDURES 9
5.2. MEASUREMENT UNCERTAINTIES 9
5.3. MEASUREMENT EQUIPMENT USED: 9
5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER: 9
5.5. TRANSMITTER RADIATED EMISSIONS @ 3 METERS, FCC CFR 47, PARA. 15.247(C), 15.209 & 15.205 10
5.5.1. Limits 10
5.5.2. Method of Measurements 11
5.5.3. Test Arrangement 12
5.5.4. Test Equipment List 12
5.5.5. Test data 13
5.5.6. Plots 21
5.5.7. Photographs of Test Setup 21

EXHIBIT 6. MEASUREMENT UNCERTAINTY 22

6.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY 22

EXHIBIT 7. MEASUREMENT METHODS 23

7.1. GENERAL TEST CONDITIONS 23
7.1.1. Test Conditions 23
7.1.2. Method of Measurements - Electric Field Radiated Disturbance 23

EXHIBIT 8. MEASUREMENT PLOTS FOR RADIATED EMISSIONS 27

EXHIBIT 9. TEST SETUP PHOTOGRAPHS FOR RADIATED EMISSIONS 28

EXHIBIT 1. INTRODUCTION

1.1. 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 Class II Permissive Change Authorization for Direct Sequence Spread Spectrum Transmitters operating in the Frequency Band 2408.625 - 2464.875 MHz .
Test Procedures	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 • Industry

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

None

1.3. 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

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. 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 C. Chauncey Phone #: 716-631-6409 Fax #: 716-631-6080 Email Address: dchauncey@clearwire.com

MANUFACTURER:	
Name:	CLEARWIRE TECHNOLOGIES INC.
Address:	485 Cayuga Road, P.O. Box 222 Buffalo, New York USA, 14225-0222
Contact Person:	Mr. David C. Chauncey Phone #: 716-631-6409 Fax #: 716-631-6080 Email Address: dchauncey@clearwire.com

2.2. 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	ISP DIRECT INDOOR & OUTDOOR UNITS
Model Name or Number	2401-01 (indoor) and 2401-02 (outdoor)
Serial Number	Preproduction
Type of Equipment	Direct Sequence Spread Spectrum Transmitters
External Power Supply	N/A
Transmitting/Receiving Antenna Type	Non-integral
Primary User Functions of EUT:	The essential function of the EUT is to correctly communicate data to and from radios over RF link.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Portable ▪ Mobile ▪ Base station (fixed use)
Intended Operating Environment:	▪ Residential ▪ Commercial, light industry & heavy industry
Power Supply Requirement:	AC 120V 60Hz using alternative external swithing power supply
RF Output Power Rating:	190 mWatts
Operating Frequency Range:	2408.625 - 2464.875 MHz
RF Output Impedance:	50 Ohms
Duty Cycle:	63 % maximum
Emission Designation:	Direct Sequence Spread Spectrum Transmitters
Oscillator Frequencies:	35 MHz (Rx IF), 70 MHz (Rx Lo), 915 MHz (Tx IF), Tx Lo. Osc. = 915 MHz (Tx Freq)
Antenna Connector Type:	TNC

Antenna Description **The following items are alternative antennas, which will be provided with EUT.**			
Manufacturer	**Manufacturer's P/N**	**Description**	**Gain (dBi)**
Conifer	26T2400	Reflector	24
Til-Tek	TPA2324	Dish	21

2.4. LIST OF EUT'S PORTS

INDOOR UNIT:
(1) LAN Port - RJ-45
(2) Event In/Out (Sync) - BNC
(3) Serial Port – DB9 (for factory uses only)
(4) RF OUT - TNC. The RF OUT will not deliver any rf power if the indoor unit is not connected to the outdoor unit.

OUTDOOR UNIT:
(1) RF-IN (TNC)
(2) LAN Port - RJ-45
(3) RF-OUT (TNC). Permanently attached to the antenna as one unique assembly. Heat shrink is used to secured the Outdoor Box's RF –OUT terminal to the Antenna, and the Outdoor Box is mounted on the antenna.

NOTE:
- ***Ports of the EUT which in normal operation*** *were connected to ancillary equipment through interconnecting cables via a representative interconnecting cable to simulate the input/output characteristics. RF input/output was correctly terminated to the associated antenna.*
- ***Ports which are not connected to cables during normal intended operation****: None*

2.5. 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:	Terminal
Brand name:	Hewlett Packard
Model Name or Number:	2392A
Serial Number:	2519A70021

Ancillary Equipment # 2	
Description:	Keyboard
Brand name:	Hewlett Packard
Model Name or Number:	46011A
Serial Number:	2645S10226

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	101 kPa
Power input source:	AC 120V 60Hz using alternative external swithing power supply

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies 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, middle and highest frequencies individually continuously during testing.
Special Hardware Used:	N/A
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: ▪ 2408.625 - 2464.875 MHz band:	Lowest, middle and highest channel frequencies tested:
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	▪ 190mWatts
▪ Normal Test Modulation	▪ Each channel is DQPSK modulated with data @ 0.818, 1.023 or 2.045 Mbps
▪ Modulating signal source:	▪ Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. 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.

- 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 site 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: Sep. 20, 1998.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.247(a)(2)	Spectrum Bandwidth of a Direct Sequence Spread Spectrum System	Note 1
15.247(b) & 1.1310	Maximum Peak Power and RF Exposure Limits	Note 1
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Note 1
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
15.247(d)	Transmitted Power Density of a Direct Sequence Spread Spectrum System	Note 1
15.247(e)	Processing Gain of Direct Sequence Spread Spectrum System	Note 1

Notes:

1. Tests are not required since there are no electrical and mechanical changes in the circuit designs of the radio.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report.

5.2. 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 6 for Measurement Uncertainties.

5.3. 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.

5.4. 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.

5.5. TRANSMITTER RADIATED EMISSIONS @ 3 METERS, FCC CFR 47, PARA. 15.247(C), 15.209 & 15.205

5.5.1. 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

5.5.2. Method of Measurements

Refer to **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

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).

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated

The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

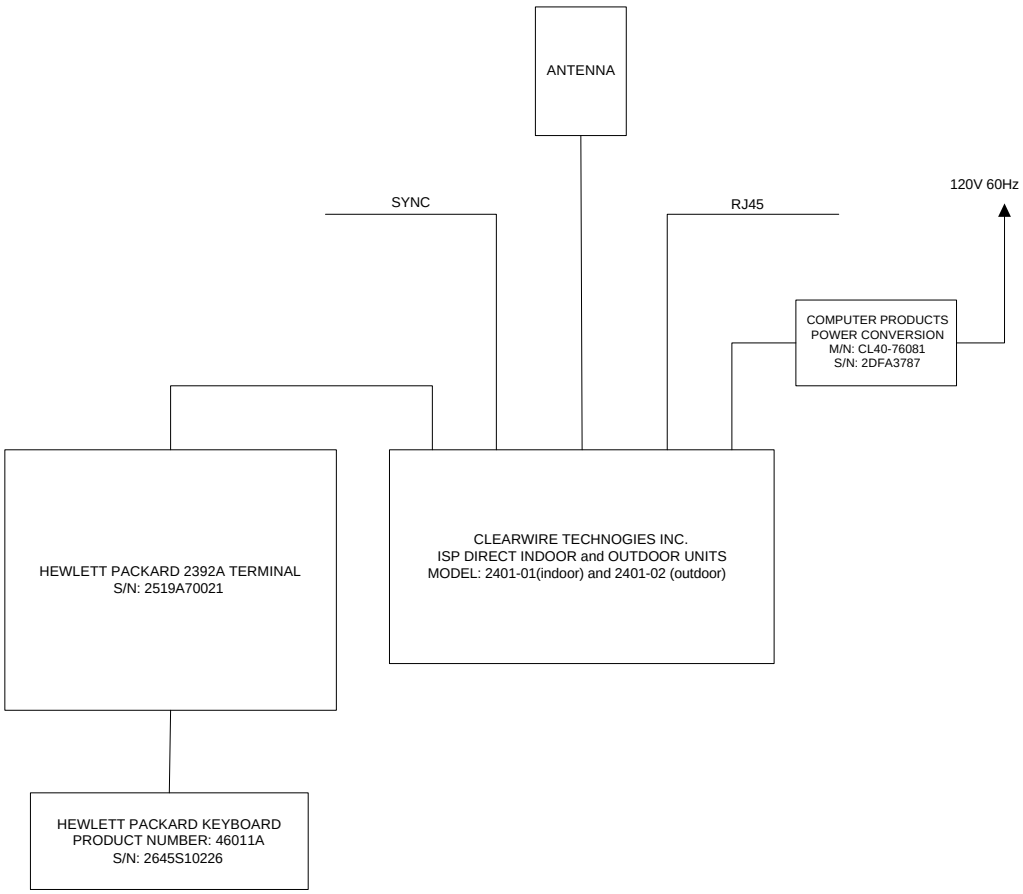
FCC CFR 47, Para. 2.993 - Field Strength Spurious Emissions

(a) Measurements was made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.989(c) as appropriate. For equipment operating on frequencies below 1 GHz, an Open Field Test is normally required, with the measuring instrument antenna located in the far field at all test frequencies. In event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emission are required to be 60 dB or more below he mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the commission.

5.5.3. Test Arrangement



5.5.4. 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

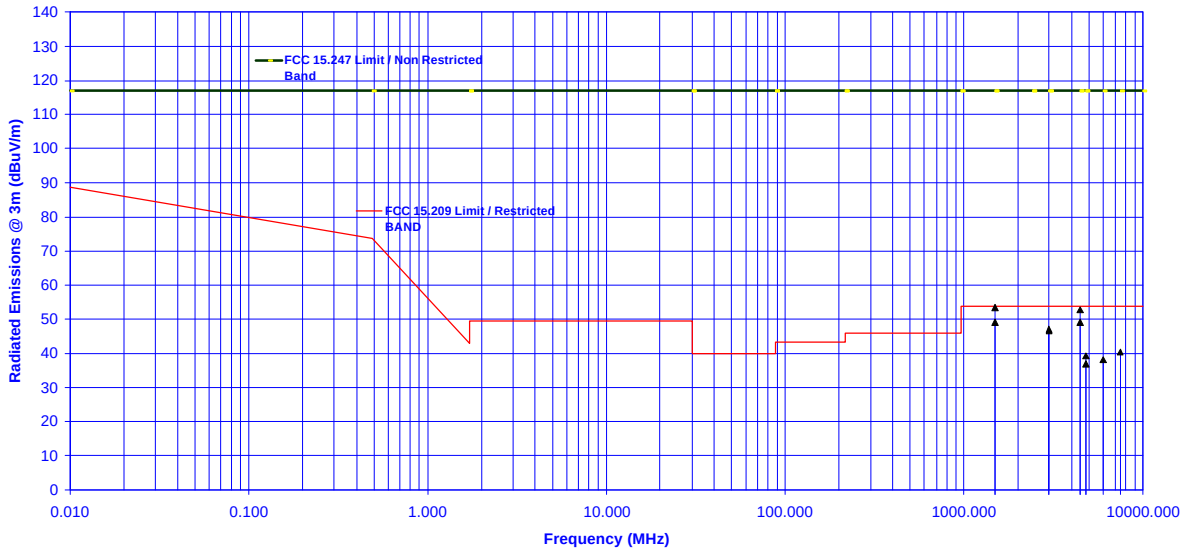
5.5.5. Test data

ISP Direct Indoor & Outdoor Units with Conifer Reflector Antenna (P/N: 26T2400, 24 dBi Gain)

Channel #: 3 Frequency: 2408.63 MHz **Full Rated Peak Power: 190mW** **Modulation:DQPSK, narrow, 11 chips/symbol** **Data Rate: 0.818 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 136.97.3dBμV/m** **Limit = 136.97 - 20dB = 116.97 dBμV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1493.63	69.8	49.1	V	54.0	117.0	-4.9	PASS*
1493.63	59.6	53.5	H	54.0	117.0	-0.5	PASS*
2408.63	137.0	--	V	--	--	--	--
2408.63	118.5	--	H	--	--	--	--
2987.25	55.4	46.6	V	54.0	117.0	-70.4	PASS
2987.25	55.0	47.0	H	54.0	117.0	-70.0	PASS
4480.88	59.5	52.8	V	54.0	117.0	-64.2	PASS
4480.88	58.3	49.2	H	54.0	117.0	-67.8	PASS
4817.26	59.4	39.2	V	54.0	117.0	-14.8	PASS*
4817.26	56.4	37.0	H	54.0	117.0	-17.0	PASS*
5974.50	53.7	38.1	V	54.0	117.0	-78.9	PASS
7468.13	55.8	40.3	V	54.0	117.0	-13.7	PASS*
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

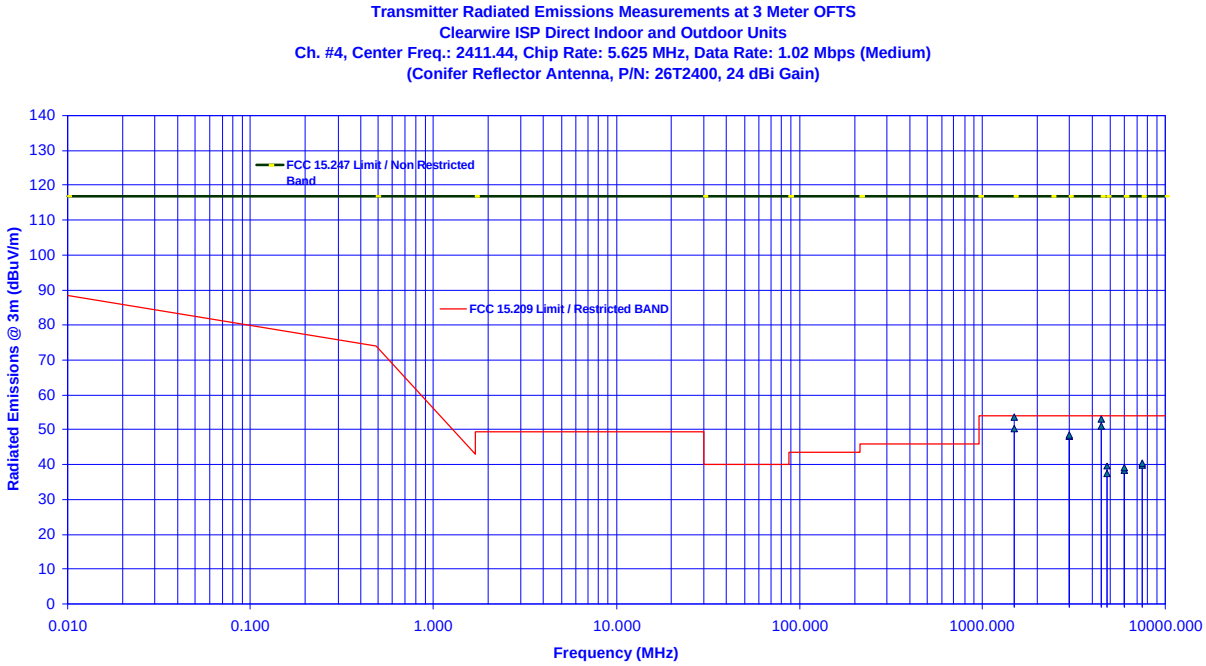
**** Emission within the restricted band specified in @ 15.205(a)***

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Clearwire ISP Direct Indoor and Outdoor Units, Model: 2401-02
Ch. #3, Center Freq.: 2408.63, Chip Rate: 4.5 MHz, Data Rate: 0.818 Mbps (Narrow)
(Conifer Reflector Antenna, P/N: 26T2400)



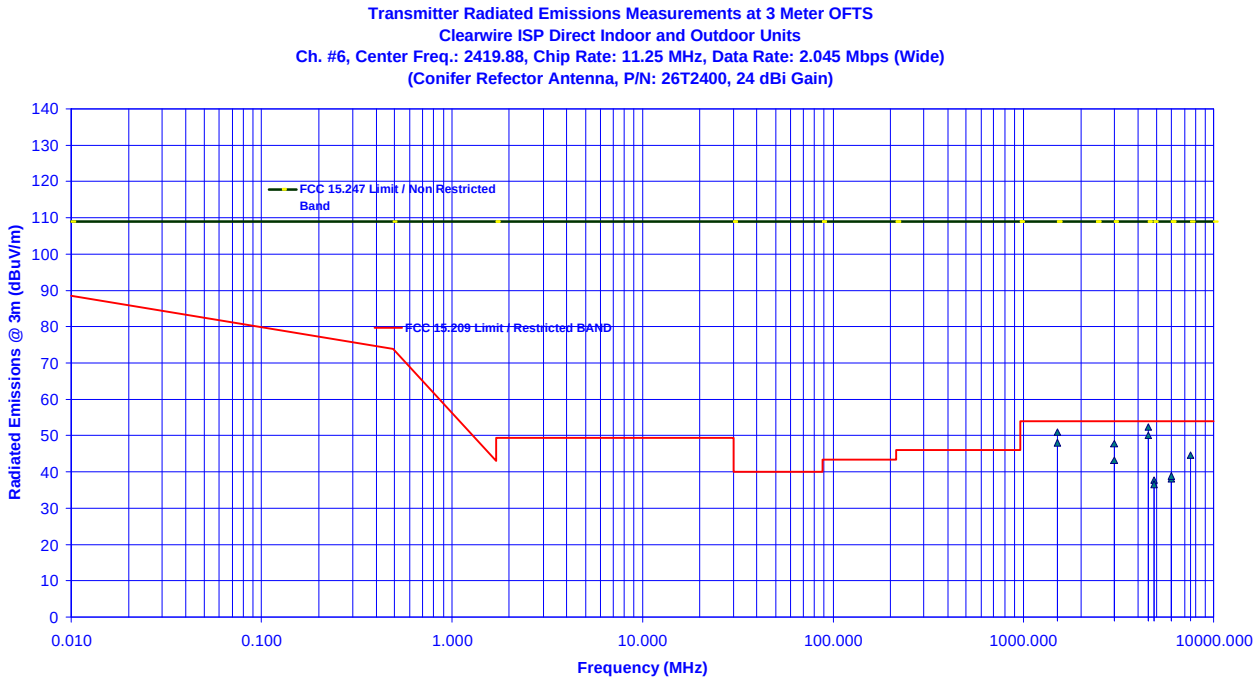
Channel #: 4 Frequency: 2411.44MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, medium, 11 chips/symbol** **Data Rate: 1.023 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 136.91 dBµV/m** **Limit = 136.91 - 20dB = 116.91 dBµV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1496.44	71.7	50.4	V	54.0	116.9	-3.6	PASS*
1496.44	59.4	53.5	H	54.0	116.9	-0.5	PASS*
2411.44	136.9	--	V	--	--	--	--
2411.44	115.8	--	H	--	--	--	--
2992.88	55.5	48.0	V	54.0	116.9	-68.9	PASS
2992.88	55.7	48.4	H	54.0	116.9	-68.5	PASS
4489.31	60.8	53.0	V	54.0	116.9	-63.9	PASS
4489.31	58.9	51.0	H	54.0	116.9	-65.9	PASS
4822.88	60.0	39.6	V	54.0	116.9	-14.4	PASS*
4822.88	56.6	37.4	H	54.0	116.9	-16.6	PASS*
5985.75	53.9	38.5	V	54.0	116.9	-65.4	PASS
5985.75	54.3	39.2	H	54.0	116.9	-64.7	PASS
7482.19	55.3	39.8	V	54.0	116.9	-14.3	PASS*
7482.19	56.7	40.4	H	54.0	116.9	-13.6	PASS*
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

**** Emission within the restricted band specified in @ 15.205(a)***



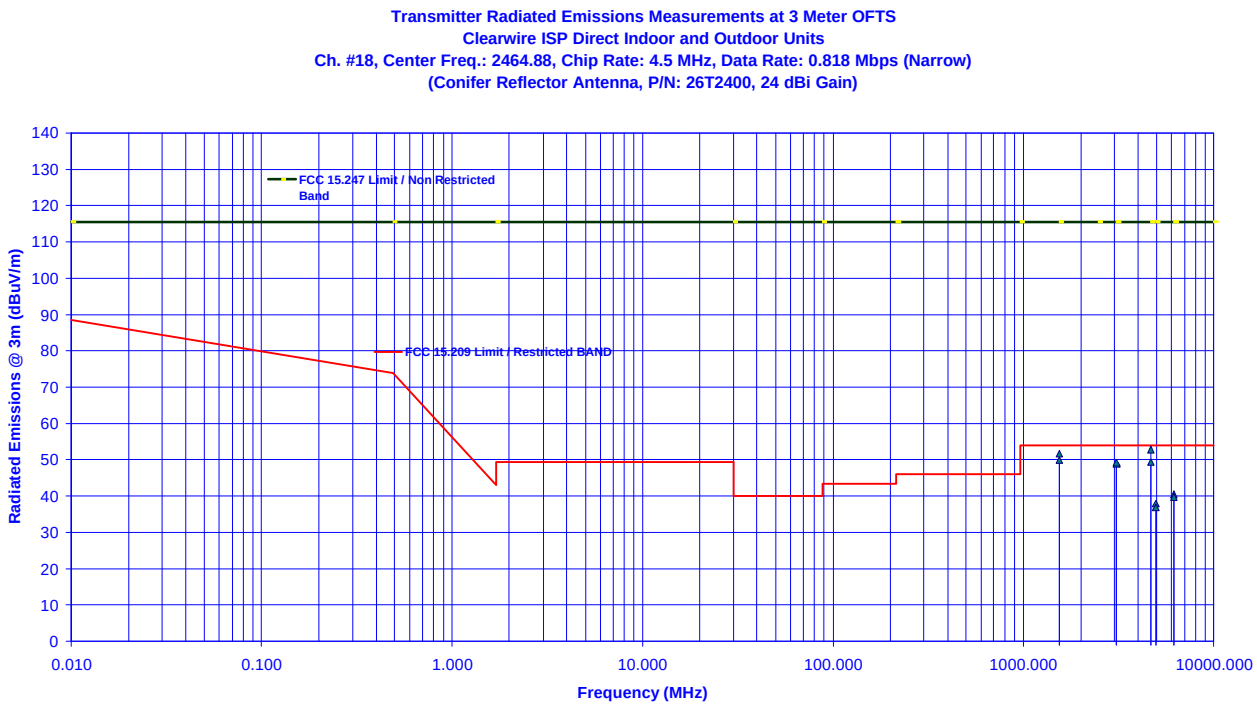
Channel #: 6 Frequency: 2419.88 MHz **Full Rated Peak Power: 190mW** **Modulation:DQPSK, wide, 11 chips/symbol** **Data Rate: 2.045 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 128.8 dBµV/m** **Limit = 128.8 - 20dB = 108.8 dBµV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1504.88	57.1	48.1	V	54.0	108.8	-5.9	PASS*
1504.88	57.2	50.9	H	54.0	108.8	-3.1	PASS*
2419.88	128.8	--	V	--	--	--	--
2419.88	111.5	--	H	--	--	--	--
3009.75	54.2	43.2	V	54.0	108.8	-65.6	PASS
3009.75	55.1	47.7	H	54.0	108.8	-61.1	PASS
4514.63	59.1	52.5	V	54.0	108.8	-1.5	PASS*
4514.63	58.0	50.0	H	54.0	108.8	-4.0	PASS*
4839.75	56.7	37.7	V	54.0	108.8	-71.1	PASS
4839.75	53.5	36.6	H	54.0	108.8	-72.2	PASS
6019.50	54.4	38.2	V	54.0	108.8	-70.6	PASS
6019.50	54.4	38.9	H	54.0	108.8	-69.9	PASS
7524.38	60.4	44.7	H	54.0	108.8	-9.3	PASS*
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

**** Emission within the restricted band specified in @ 15.205(a)***



Channel #: 18 Frequency: 2464.88 MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, narrow, 11 chips/symbol** **Data Rate: 0.818 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 135.5 dBµV/m** **Limit = 135.5 - 20dB = 115.5 dBµV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1549.88	58.9	49.8	V	54.0	115.5	-4.2	PASS*
1549.88	57.7	51.7	H	54.0	115.5	-2.3	PASS*
2464.88	135.5	--	V	--	--	--	--
2464.88	116.8	--	H	--	--	--	--
3099.75	56.8	48.8	V	54.0	115.5	-66.7	PASS
3099.75	56.2	49.2	H	54.0	115.5	-66.3	PASS
4649.63	59.8	52.8	V	54.0	115.5	-1.2	PASS*
4649.63	58.0	49.5	H	54.0	115.5	-4.5	PASS*
4929.75	56.5	37.9	V	54.0	115.5	-16.1	PASS*
4929.75	53.0	36.9	H	54.0	115.5	-17.1	PASS*
6199.50	55.0	40.4	V	54.0	115.5	-75.1	PASS
6199.50	54.2	39.7	H	54.0	115.5	-75.8	PASS
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

**** Emission within the restricted band specified in @ 15.205(a)***



ISP Direct Indoor & Outdoor Units with Til-Tek Disk Antenna (P/N: TPA2324, 21 dBi Gain)

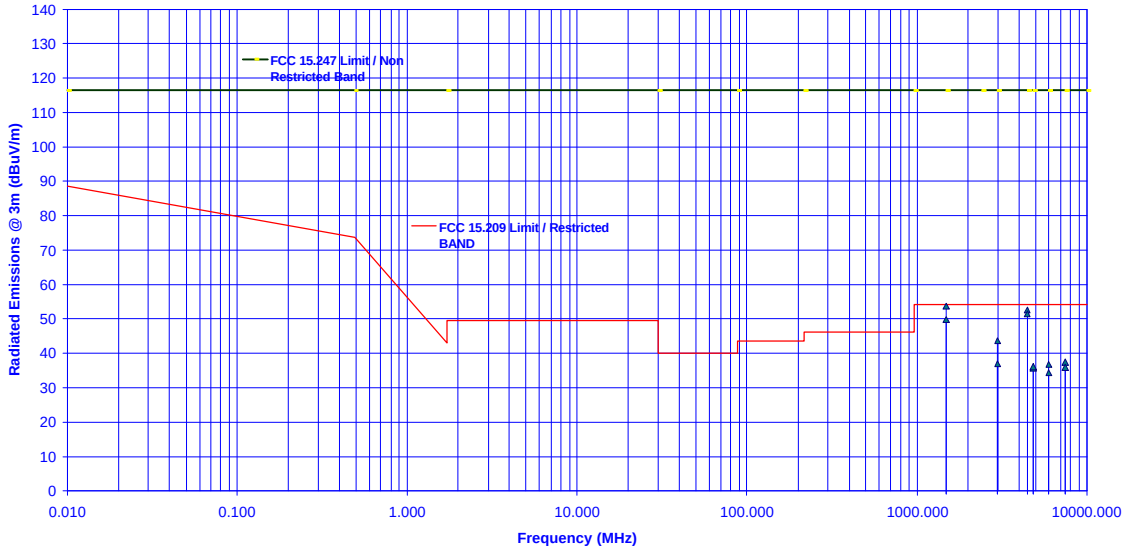
Channel #: 3 Frequency: 2408.63 MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, narrow, 11 chips/symbol** **Data Rate: 0.818 Mbps, 2 bits/symbol**	**Power Level in 1 MHz BW: 136.4 dBµV/m** **Limit = 136.4 - 20dB = 116.4 dBµV/m**

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
1493.63	64.3	53.6	V	54.0	116.4	-0.4	PASS*
1493.63	64.3	49.7	H	54.0	116.4	-4.3	PASS*
2408.63	136.4	--	V	--	--	--	--
2408.63	135.4	--	H	--	--	--	--
2987.25	54.8	37.1	V	54.0	116.4	-79.3	PASS
2987.25	58.8	43.7	H	54.0	116.4	-72.7	PASS
4480.88	60.6	52.7	V	54.0	116.4	-63.7	PASS
4480.88	58.7	51.6	H	54.0	116.4	-64.8	PASS
4817.26	53.8	35.8	V	54.0	116.4	-18.2	PASS*
4817.26	55.3	36.2	H	54.0	116.4	-17.8	PASS*
5974.50	51.9	36.7	V	54.0	116.4	-79.7	PASS
5974.50	51.2	34.3	H	54.0	116.4	-82.1	PASS
7468.13	53.7	37.4	V	54.0	116.4	-16.6	PASS*
7468.13	53.4	35.9	H	54.0	116.4	-18.1	PASS*

No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details

**** Emission within the restricted band specified in @ 15.205(a)***

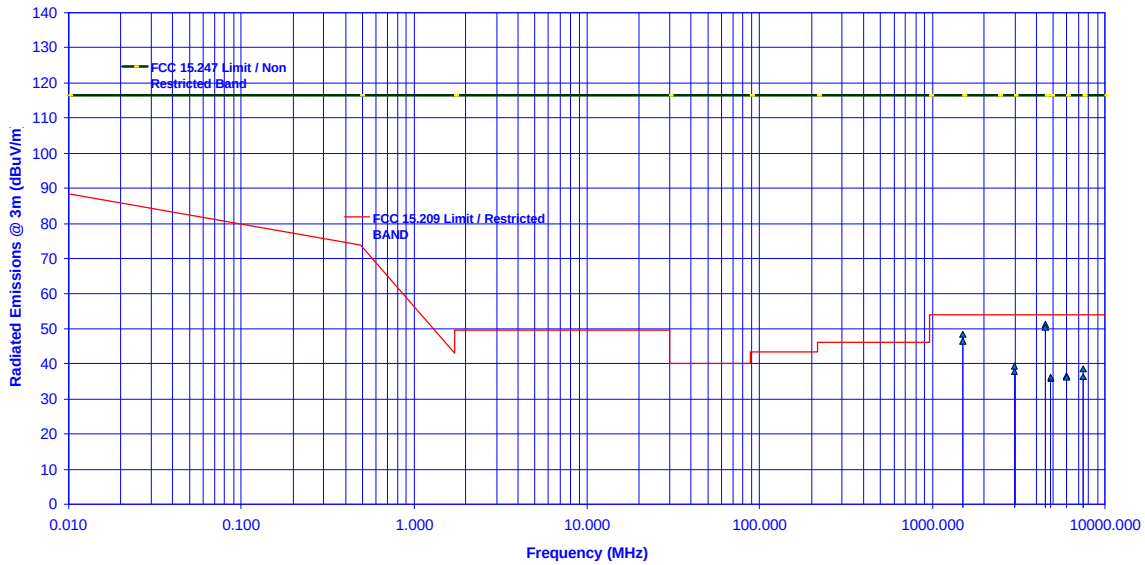
Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Clearwire ISP Direct Indoor and Outdoor Units
Ch. #3, Center Freq.: 2408.63, Chip Rate: 4.5 MHz, Data Rate: 0.818 Mbps (Narrow)
(Til-Tek Dish Antenna, P/N: TPA2324, 21 dBi Gain)



Channel #: 4 Frequency: 2411.44 MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, medium, 11 chips/symbol** **Data Rate: 1.023 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 136.5 dBµV/m** **Limit = 136.5 - 20dB = 116.5 dBµV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1496.44	62.8	46.5	V	54.0	116.5	-70.0	PASS*
1496.44	62.9	48.4	H	54.0	116.5	-68.1	PASS*
2411.44	136.3	--	V	--	--	--	--
2411.44	136.5	--	H	--	--	--	--
2992.88	53.1	37.9	V	54.0	116.5	-78.6	PASS
2992.88	57.2	39.5	H	54.0	116.5	-77.0	PASS
4489.31	58.0	51.3	V	54.0	116.5	-65.2	PASS
4489.31	57.4	50.3	H	54.0	116.5	-66.2	PASS
4822.88	55.1	36.0	V	54.0	116.5	-80.5	PASS*
4822.88	56.4	36.1	H	54.0	116.5	-80.4	PASS*
5985.75	51.8	36.6	V	54.0	116.5	-79.9	PASS
5985.75	50.6	36.2	H	54.0	116.5	-80.3	PASS
7482.19	52.7	36.3	V	54.0	116.5	-80.2	PASS*
7482.19	53.7	38.6	H	54.0	116.5	-77.9	PASS*
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

**** Emission within the restricted band specified in @ 15.205(a)***

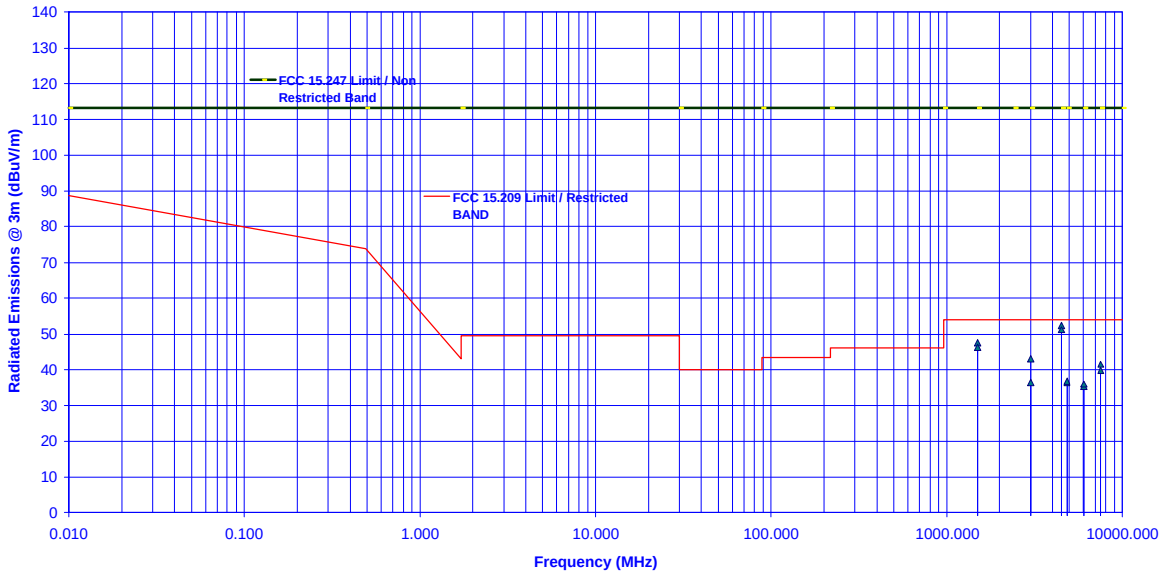
Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Clearwire ISP Direct Indoor and Outdoor Units
Ch. #4, Center Freq.: 2411.44, Chip Rate: 5.625 MHz, Data Rate: 1.023 Mbps (Medium)
(Til-Tek Disk Antenna, P/N: TPA2324, 21 dBi Gain)



Channel #: 6 Frequency: 2419.88 MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, wide, 11 chips/symbol** **Data Rate: 2.045 Mbps, 2 bits/symbol**				**Power Level in 1 MHz BW: 133.0 dBµV/m** **Limit = 133.0 - 20dB = 113.0 dBµV/m**			
FREQUENCY (MHz)	**RF PEAK LEVEL (dBuV/m)**	**RF AVG LEVEL (dBuV/m)**	**ANTENNA PLANE (H/V)**	**LIMIT 15.209 (dBuV/m)**	**LIMIT 15.247 (dBuV/m)**	**MARGIN (dB)**	**PASS/ FAIL**
1504.88	62.2	47.6	V	54.0	113.1	-6.4	PASS*
1504.88	61.7	46.3	H	54.0	113.1	-7.7	PASS*
2419.88	133.0	--	V	--	--	--	--
2419.88	133.1	--	H	--	--	--	--
3009.75	51.4	43.0	V	54.0	113.1	-70.1	PASS
3009.75	48.8	36.3	H	54.0	113.1	-76.8	PASS
4514.63	59.8	52.2	V	54.0	113.1	-1.8	PASS*
4514.63	58.2	51.2	H	54.0	113.1	-2.8	PASS*
4839.75	56.2	36.3	V	54.0	113.1	-17.8	PASS*
4839.75	57.4	36.8	H	54.0	113.1	-17.2	PASS*
6019.50	53.5	35.3	V	54.0	113.1	-77.9	PASS
6019.50	51.5	35.9	H	54.0	113.1	-77.2	PASS
7524.38	54.5	39.7	V	54.0	113.1	-14.3	PASS*
7524.38	56.1	41.4	H	54.0	113.1	-12.6	PASS*
No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details							

**** Emission within the restricted band specified in @ 15.205(a)***

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Clearwire ISP Direct Indoor and Outdoor Units
Ch. #6, Center Freq.: 2419.88, Chip Rate: 11.25 MHz, Data Rate: 2.045 Mbps (wide)
(Til-Tek Disk Antenna, P/N: TPA2324, 21 dBi Gain)

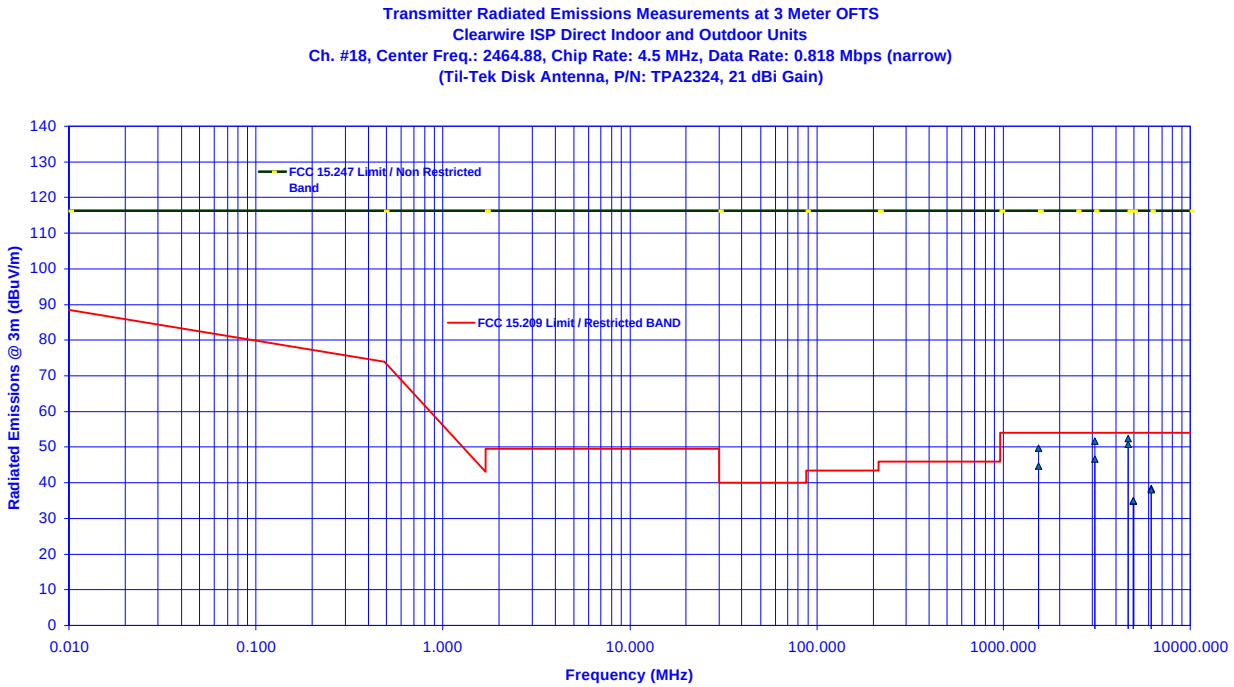


Channel #: 18 Frequency: 2464.88 MHz **Full Rated Peak Power: 190mW** **Modulation: DQPSK, narrow, 11 chips/symbol** **Data Rate: 0.818 Mbps, 2 bits/symbol**	**Power Level in 1 MHz BW: 136.3 dBµV/m** **Limit = 136.3 - 20dB = 116.3 dBµV/m**

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
1549.88	63.6	49.7	V	54.0	116.3	-4.3	PASS*
1549.88	60.6	44.7	H	54.0	116.3	-9.4	PASS*
2464.88	136.3	--	V	--	--	--	--
2464.88	135.7	--	H	--	--	--	--
3099.75	57.4	51.8	V	54.0	116.3	-64.6	PASS
3099.75	53.8	46.8	H	54.0	116.3	-69.5	PASS
4649.63	58.0	50.8	V	54.0	116.3	-3.2	PASS*
4649.63	59.2	52.3	H	54.0	116.3	-1.7	PASS*
4929.75	51.1	34.8	V	54.0	116.3	-19.3	PASS*
4929.75	53.8	35.0	H	54.0	116.3	-19.0	PASS*
6199.50	52.8	38.3	V	54.0	116.3	-78.0	PASS
6199.50	52.6	38.0	H	54.0	116.3	-78.3	PASS

No other significant emissions were found in the frequency range from 10 MHz to 25 GHz. Refer to attached plots for details

**** Emission within the restricted band specified in @ 15.205(a)***



5.5.6. Plots

Please refer to EXHIBIT 8 for measurement plots.

5.5.7. Photographs of Test Setup

Please refer to EXHIBIT 9 for setup and arrangement of equipment under tests and its ancillary equipment.

EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

6.1. 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 $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	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 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

7.1.1. Test Conditions

- The measurement shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications.
- An attempt shall be made to maximize the detected radiated emissions, for example moving cables of the equipment, rotating the equipment by 360^{o} and moving the measuring receiving antenna up and down within 1 to 4 meters high.
- Where appropriate, a single tone or a bit stream shall be used to modulate the receiver. The manufacturer shall define the modulation with the highest emission in transmit mode.

7.1.2. Method of Measurements - Electric Field Radiated Disturbance

- The radiated emission measurements were performed at the UltraTech's 10 or 30 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. 3.Calibrated Advantest spectrum analyzer and pre-selector. In general, the spectrum analyzer would be used as follows:

        – The rf electric field levels were measured with the spectrum analyzer set to PEAK detector (120 KHz VBW and VBW $\geq$ RBW).

        – If any rf emission was observed to be a broadband noise, the spectrum analyzer's CISPR QUASI-PEAK detector (120 KHz RBW and VBW $\geq$ RBW) was then set to measure the signal level.

        – If the signal being measured was narrowband and the ambient field was broadband, the bandwidth of the spectrum analyzer was reduced.

- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- 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 allowed 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.

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:

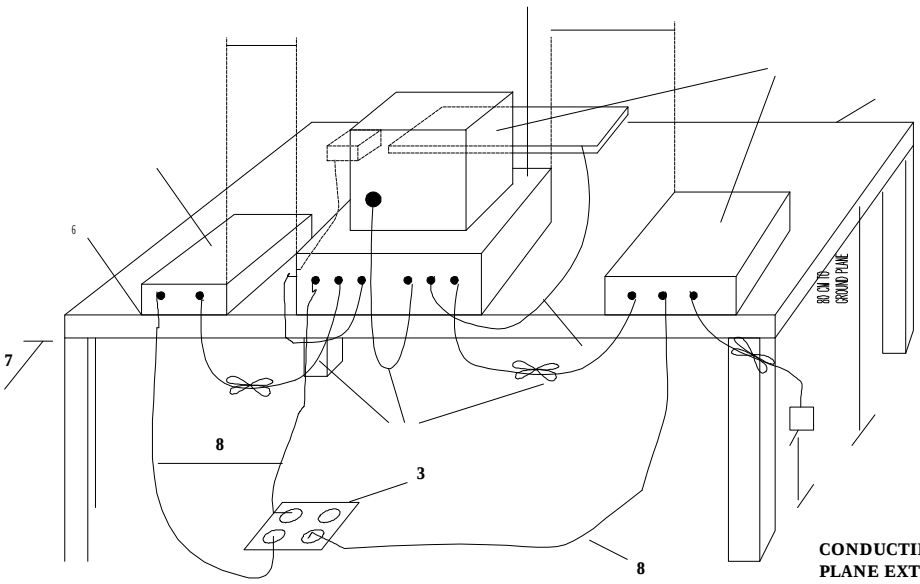
$$FS = RA + AF + CF - AG$$

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.



CONDUCTING GROUND PLANE EXTENDS 0.5 m BEYOND EUT SYSTEM FOOTPRINT

LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.

2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1m.

3. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptable flush with the ground plane.

4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the controller.

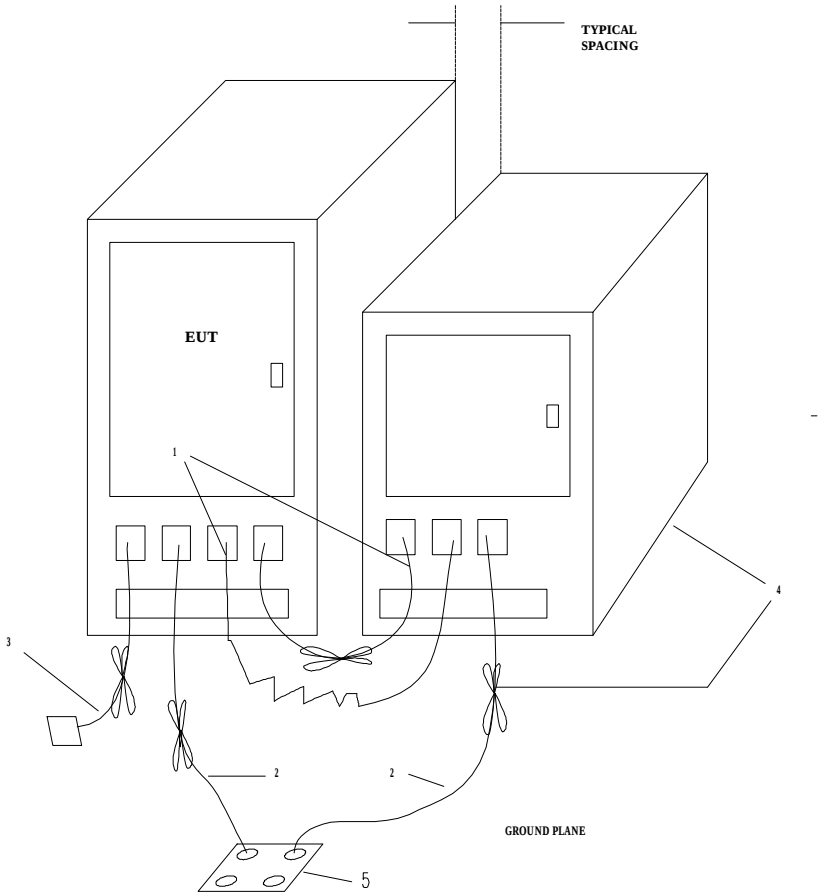
5. Non-EUT components of EUT system being tested.

6. The rear of all components of the system under test shall be located flush with the rear of the table.

7. No vertical conducting wall used.

8. Power cords drape to the floor and are routed over to receptacle.

Tabletop Equipment Radiated Emissions



LEGEND:

1. Excess I/O cables shall be bundled in center. If bundling is not possible, the cables shall be arranged in serpentine fashion.

2. Excess power cords shall be bundled in the center or shortened to appropriated length.

3. I/O cables that are not connected to aperipheral shall be bundled in the center. The end of the cable may be terminated if required using correct terminating impedance. If bundling is not possible, the cable shall be arranged in serpentine fashion.

4. EUT and all cables shall be inslulated from ground plane by 3 to 12 mm of insulating material.

5. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.

Floor-Standing Equipment Radiated Emissions

EXHIBIT 8. MEASUREMENT PLOTS FOR RADIATED EMISSIONS

Refer to attached plots.

EXHIBIT 9. TEST SETUP PHOTOGRAPHS FOR RADIATED EMISSIONS

Refer to attached photographs.