FCC
Electromagnetic Compatibility
Test Report

For

XT-1B Base Station

FCC ID: DGFBCSDXT1B
IC: 458A-BCSDXT1B

Security Systems Division

St. Paul, MN

September 20, 2012

Report Number: RE1207020F

Prepared By:
3M Regulatory Engineering and Quality
EMC Laboratory
410 Fillmore Avenue, Building 76
St. Paul, Minnesota 55144-1000

CERTIFICATE OF COMPLIANCE

MANUFACTURER'S NAME:	3M™ Company
NAME OF EQUIPMENT:	XT-1B Base Station
DESIGNATION:	Short Range Device
MODEL NUMBER:	XT-1B
TEST REPORT NUMBER:	RE1207020F
DATE:	September 20, 2012

USA (FCC) - Title 47, Code of Federal Regulations (2011)
Industry Canada (IC) – ICES, RSS

EMISSIONS:

Radiated / Conducted	**(FCC Part 15, Subpart B, Class A)** **(IC, ICES-003)**
Radiated / Conducted	**(FCC Part 15, Subpart C)** **(IC, RSS-210, RSS-GEN)**
RF Exposure	**(FCC - Exempt)** **(IC - Complies with RSS-102)**

FCC ID: DGFBCSDXT1B
IC ID: 458A-DCSDXT1B

As the responsible EMC Project Engineer, I hereby declare that the equipment tested, as specified in the test report, at the 3M Product Safety EMC Laboratory is in compliance with 47 CFR, Part 15, Subpart B and Subpart C, and Industry Canada RSS & ICES Standards. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

Robert E. Heller

Digitally signed by Robert E. Heller
DN: cn=Robert E. Heller, c=US, o=EMC Lab, ou=SEMS, email=reheller@mmm.com
Date: 2012.10.31 03:55:15 -05'00'

Robert E. Heller
Senior EMC Engineer

NVLAP®
Lab Code 200033

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1.0 TEST SUMMARY

Test Report Number:	RE1207020F
Requester:	Michael Campbell
Company:	3M Company Building & Commercial Services Division 3M Center St Paul, Minnesota 55144
Telephone Number:	651-733-8629
Equipment Under Test:	XT-1B Wireless Communication System
Condition upon receipt	Device was in good working condition
Test Environment:	See individual test sheets.
Test Results:	Passed the following tests: Conducted Emissions: FCC Part 15 Subpart B, ICES-003 Radiated Emissions: FCC Part 15 Subpart B, ICES-003 Conducted Emissions: FCC Part 15 Subpart C, IC RSS-210, RSS-Gen Radiated Emissions: FCC Part 15 Subpart C, IC RSS-210, RSS-Gen IC RSS-102
Modifications:	Modifications were required. See section 3.0
Test Location:	3M Product Safety EMC Laboratory Building 76-1-01 410 Fillmore Ave. St. Paul, MN 55144-1000

2.0 INTRODUCTION

2.1 Scope

This report contains results describing the conformance of the Equipment Under Test (EUT) to FCC Part 15, Subpart B and IC ICES-003 rules for unintentional radiators and FCC Part 15, Subpart C and IC RSS rules for intentional radiators.

This report is the confidential property of the client and applies only to the specific item tested under the stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. This report shall not be reproduced except in full without the written approval of the testing laboratory. The appropriate testing standards and references that were used are contained in Section 3.0. Worse case test data, test configuration, and photographs (worst case configuration) are provided in Sections 4.0 and 5.0. Equipment information is contained in Section 6.0. Documentation labeling information is contained in Section 7.0.

Subsequent tests are necessary from time to time on equipment taken at random from production. Retesting of the EUT is also required when the EMC profile has been changed or is suspected of being changed.

The 3M Regulatory Engineering and Quality EMC Laboratory is recognized under the United States Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 17025 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of test results. Accreditation by the National Voluntary Laboratory Accreditation Program is awarded for specific services, listed on the Scope of Accreditation for: Electromagnetic Compatibility and Telecommunications FCC under Lab Code 200033. A complete copy of the Scope of Accreditation is available upon request.

The FCC Site Registration Number is 790245. The Industry Canada (IC) Site Registration Number is 458A-1.

The NVLAP accreditation or this test report does not in any way constitute or imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

2.2 EUT Description and Operation

The Equipment Under Test (EUT) was the 3M™ Wireless Communication System Model XT-1. The XT-1 B is the Base Station portion of the 3M™ Wireless Communication System Model XT-1 and its intended use is to provide 2-way radio-frequency audio communication in quick service drive through restaurants and convenience stores. The system must be professionally installed as specified in the 3M™ Wireless Communication System Model XT-1 Installation Instructions and operated as specified in 3M™ Wireless Communication System Model XT-1 Operating Instructions. It has not been evaluated for other uses or locations. The EUT was tested while exercising all functions and at an input power of 120 VAC, 60 Hz.

XT-1 B Base Station

EUT operating frequency range: 2401.92 MHz to 2479.68 MHz

Number of channels: 75

The system hops to channel frequencies from a pseudo randomly ordered list of hopping frequencies. Each frequency is used equally on average by the transmitter, and separated by a minimum of 20 dB channel bandwidth.

Modulation Type: GFSK FHSS (Frequency Hopping Spread Spectrum), TDD (Time Division Duplex) & TDMA (Time Division Multiple Access). Data Rate of 576Kbits/s

Maximum Conducted Power Output: 21.69 dBm 147.57mw
Power level, frequency range and channel characteristics are not user adjustable.

2.3 Modifications to EUT

1 Turn Steward # 28B2025 ferrite on power cable to digital display at Base Station main board end.

2.4 Measurement Uncertainty

The data and test results referenced in this report are true and accurate. However, there may be deviations within the calibration limits of the test equipment and facilities that can account for deviations. The following table lists the measurement uncertainty for the emissions testing. Furthermore, EUT component and manufacturing process variables may result in additional deviation.

Emission test	Confidence (95%)	Measurement Uncertainty	CISPR Limit
Radiated Emissions (30 MHz – 5 GHz)	k=2.0	4.11 dB	5.20 dB
Conducted Emissions (150 kHz – 30 MHz)	k=2.0	3.29 dB	3.60 dB

3.0 APPLICABLE DOCUMENTS

The following documents were used as references. The dates that are referenced are the dates of the latest amendments. All 3M Test Procedures can be found in the Document Center of the SEMS QDS System.

CFR 47: 2011	Part 15 Radio Frequency Devices, Subpart B Unintentional Radiators and Subpart C, Intentional Radiators.	
FCC DA 00-705	Filing & Measurement Guidelines for Frequency Hopping Spread Spectrum Systems - Released March 30, 2000	
FCC OET Bulletin 65	Evaluating Compliance with FCC Guidelines for Human Exposure to RF Electromagnetic Fields	
CISPR 16-1	Specification for radio disturbance and immunity measuring apparatus and methods	
	-1 Measuring Apparatus	2006
	-2 Ancillary Equipment – Conducted Disturbance	2004
	-3 Ancillary Equipment – Disturbance Power	2004
	-4 Ancillary Equipment – Radiated Disturbance	2004
CISPR 16-2	Specification for radio disturbance and immunity measuring apparatus and methods	
	-1 Conducted Disturbance Measurements	2003
	-2 Measurements of Disturbance Power	2004
	-3 Radiated Disturbance Measurements	2003
CISPR 16-4	-1 Uncertainties in Standardized EMC Tests	2005
ANSI C63.4:2009	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.	
ANSI C63.10:2009	American National Standard for Testing Unlicensed Wireless Devices	
ICES-003	Industry Canada, Interference-Causing Equipment Standard, 2004 Issue 4	
RSS-GEN	Industry Canada, Radio Standards Specification Issue 3 2010	
RSS-210	Industry Canada, Radio Standards Specification Issue 8 2010	
RSS-102	Industry Canada, Radio Frequency Exposure Compliance, Issue 4, 2010	
3M Test Procedure:	Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2	
3M Test Procedure:	Radiated Emissions Test (1 GHz – 5 GHz), PBLI-6SNHFY	
3M Test Procedure:	Conducted Emissions Test (150 kHz – 30 MHz), PBLI-S8LR2	
3M Test Procedure:	Frequency Hopping Spread Spectrum Intentional Radiator Test Procedure, PBLI-87ZLW7	
3M Test Procedure:	99% Power Bandwidth Test, PBLI-7C9JVN	

4.0 CONDUCTED EMISSIONS TESTING - DIGITAL

Conducted emissions testing was performed in accordance with ANSI C63.4, FCC Part 15 and 3M Test Procedures: Conducted Emissions Test (150 kHz – 30 MHz), PBLI-6S8LR2. Conducted emissions tests were made to determine the level of electromagnetic noise that is conducted onto the power mains from the EUT.

4.1 Test Procedure:

A Line Impedance Stabilization Network (LISN) with 50Ω /50μH characteristic was used to isolate the EUT and give accurate and repeatable readings. An EMI test receiver was used for the emissions measurements in the range from 150 KHz to 30 MHz. Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Initial results were measured at discrete frequencies utilizing quasi-peak detection. Measurement results were automatically calculated via software running the EMI receiver. The final quasi-peak and average measurements recorded were determined by the following: Result (dBμV) = receiver reading (μV) + LISN (dB) + cable loss (dB)

4.2 Test Criteria:

The FCC Part 15 Subpart B 15.107 and Subpart C 15.207 conducted limits are given below. The lower limit shall apply at the transition frequency.

Mains Terminal Disturbance Limits		
Frequency (MHz)	Quasi-Peak (dBμV)	Average (dBμV)
0.15 to 0.50	66 to 56 (decreasing with log of frequency)	56 to 46 (decreasing with log of frequency)
0.5 to 5.0	56	46
5.0 to 30.0	60	50

4.3 Test Results

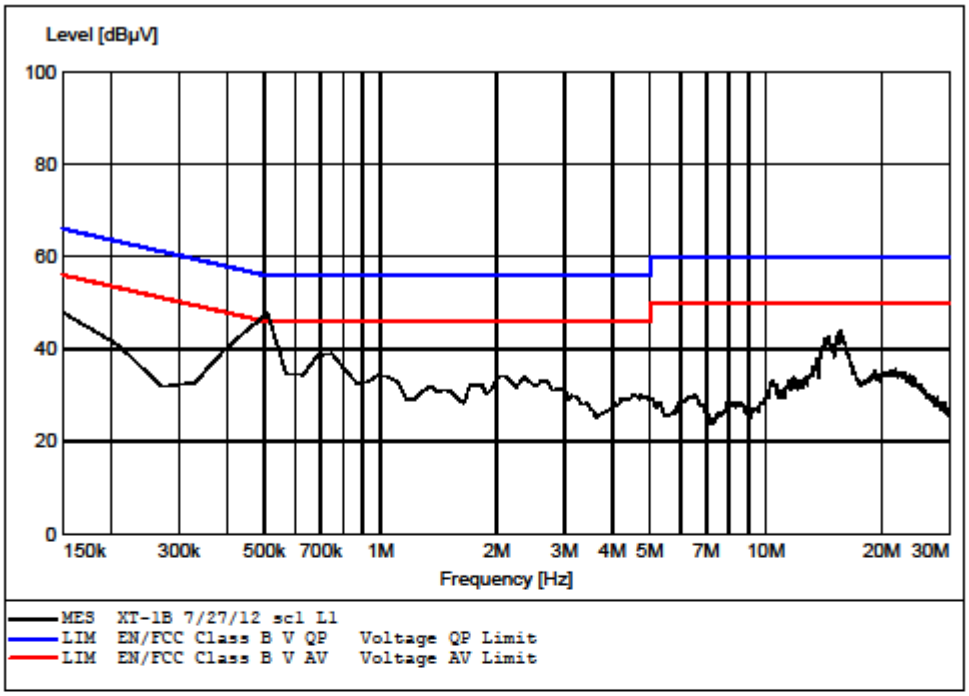
The EUT met the conducted emission and discontinuous requirements.

Report Number	RE1207020	**Date**	27 July 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 VAC / 60 Hz
EUT Model	XT-1B Base Station	**Test Std**	FCC 15.207
EUT Serial #		**Temperature (°C)**	23
EUT Description	XT-1 Wireless Communication System	**Humidity (%)**	38
		Air Pressure (kPa)	100.9

MAXIMIZED FILES SEE BELOW

	PEAK (dBµV)		QUASI-PEAK (dBµV)				AVERAGE (dBµV)			
FREQUENCY (MHz)	L1 Line	L2 N	L1 Line	L2 N	Limit	Passing Margin	L1 Line	L2 N	Limit	Passing Margin
XT-1B 7/27/12 L1 L2 120 VAC / 60 Hz Class B limits										
.158			40.8	40.8	65.5	24.7	19.5	18.4	55.5	36.0
.189			38.3	38.6	64.1	25.5	21.2	18.5	54.1	32.9
.210			38.0	39.1	63.2	24.1	27.4	24.2	53.2	25.8
.525			47.3	46.3	56.0	8.7	40.9	40.0	46.0	5.1
.738			37.5	34.1	56.0	18.5	29.2	24.8	46.0	43.8
15.640			39.3	38.9	60.0	20.7	33.2	32.2	50.0	28.2
XT-1B 7/27/12 ISN CAT 5										
.257				55.3	79	23.7		55.2	66	10.8
.512				50.5	73	22.5		45.3	60	14.7
.770				47.5	73	25.5		45.4	60	14.6
1.025				38.4	73	34.6		34.7	60	25.4
16.229				50.0	73	23.0		47.1	60	12.9
18.243				48.7	73	24.3		45.7	60	14.3

Test Engineer: Mike Schultz	Date:27 July 2012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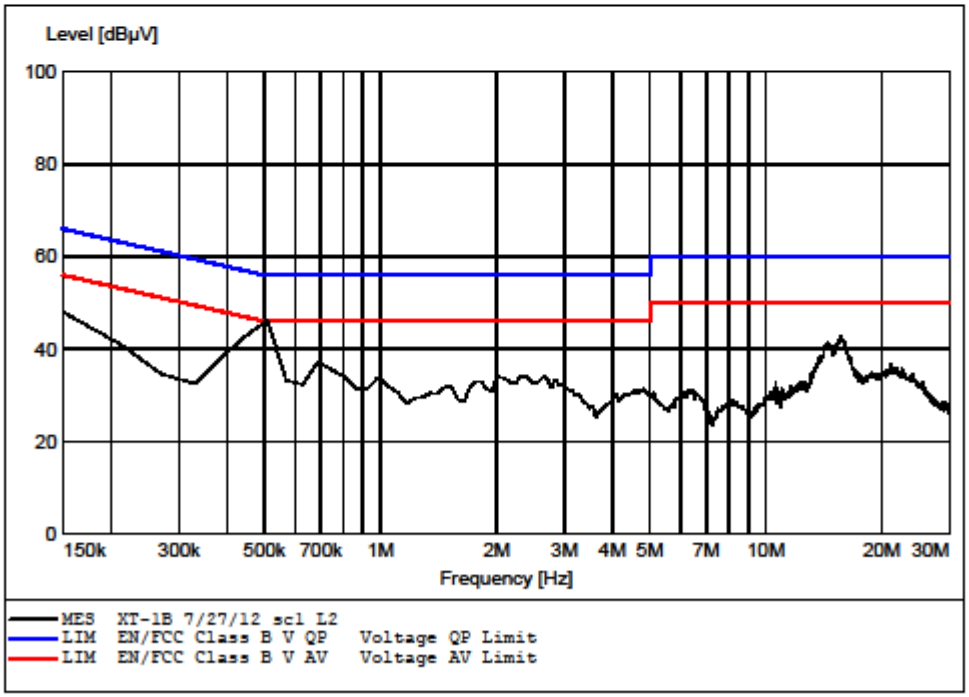
300k
500k
700k
1M
2M
3M
4M
5M
7M
10M
20M
30M
Frequency [Hz]
MES XT-1B 7/27/12 scl L1
LIM EN/FCC Class B V QP Voltage QP Limit
LIM EN/FCC Class B V AV Voltage AV Limit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40
20
0
150k
300k
500k
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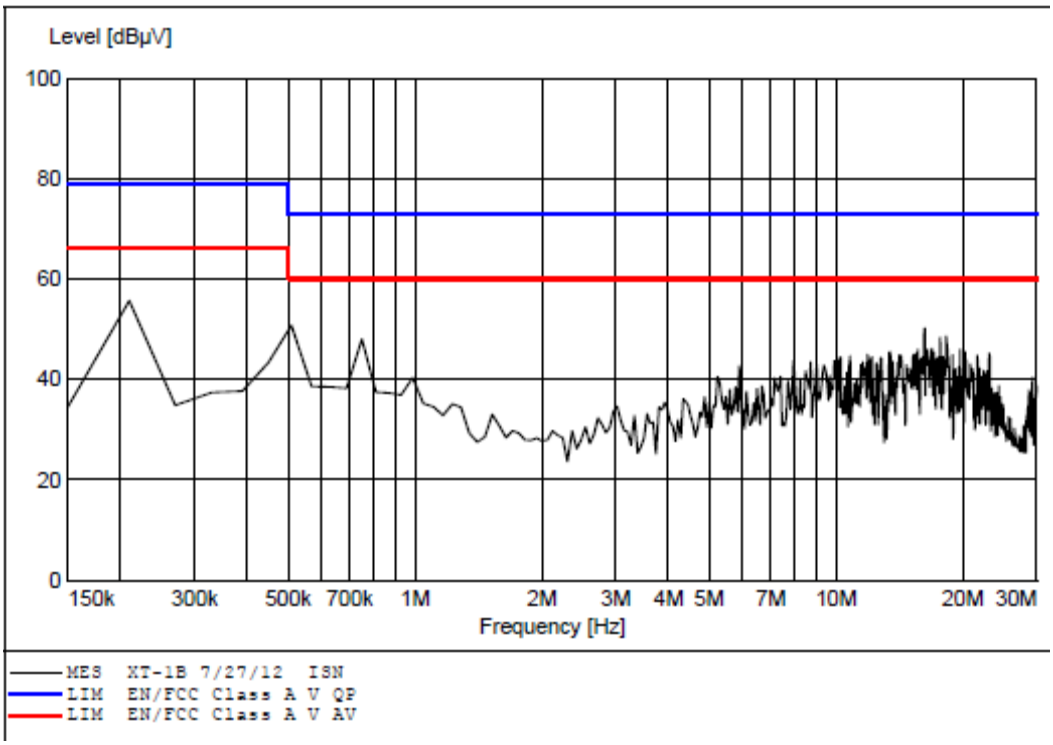
1M
2M
3M
4M
5M
7M
10M
20M
30M
Frequency [Hz]
MES XT-1B 7/27/12 scl L2
LIM EN/FCC Class B V QP Voltage QP Limit
LIM EN/FCC Class B V AV Voltage AV Limit



4.4 Test Setup Photo

Conducted Emissions (120V 60 Hz)

Conducted Emissions CAT 5

5.0 Digital Radiated Emissions (30 MHz - 18000 MHz)

The EUT was placed in an anechoic chamber and radiated emissions testing was performed in accordance with ANSI C63.4, FCC Part 15 and 3M Test Procedures: Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2, and Radiated Emissions Test (1 GHz – 18 GHz), PBLI-6SNHFY. Radiated emissions measurements were made to determine the level of electromagnetic energy radiating from the EUT.

5.0.1 Test Procedure

The EUT was placed in the center of a turntable. An EMI receiver was used for the emissions measurements in the range of 30MHz to 40GHz (the upper limit of measurement is determined by the 5^{th} harmonic of the highest frequency generated in the device or 40 GHz whichever is lower). Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Peak results were maximized at discrete frequencies utilizing quasi-peak detection. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling every 4 degrees) and varying the antenna height between 1 and 4 meters at the angles of the highest emissions levels found. Measurements were taken in both vertical and horizontal antenna polarization. The final quasi-peak measurements recorded were determined by the following (the detector used above 1000 MHz is both average and peak):

Result (dBμV /m) = receiver level (μV) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB)

5.0.2 Test Criteria

The FCC Class ‘A’ radiated limits are given below. The lower limit shall apply at the transition frequency.

Frequency (MHz)	Distance (Meters)	Field Strength (dBμV/m)
30 - 88	10	39.08
88 - 216	10	43.52
216 - 960	10	46.44
960 - 1000	10	49.54
1000 – 40000	10	49.54 AVG 69.54 PEAK

5.0.3 Test Results

The EUT met the FCC Class 'A' radiated emission requirements. The upper Limit of testing was 15000 MHz. All maximized quasi-peak measurements for the EUT were below the quasi-peak limit. No Digital Emissions were detected above 1000 MHz

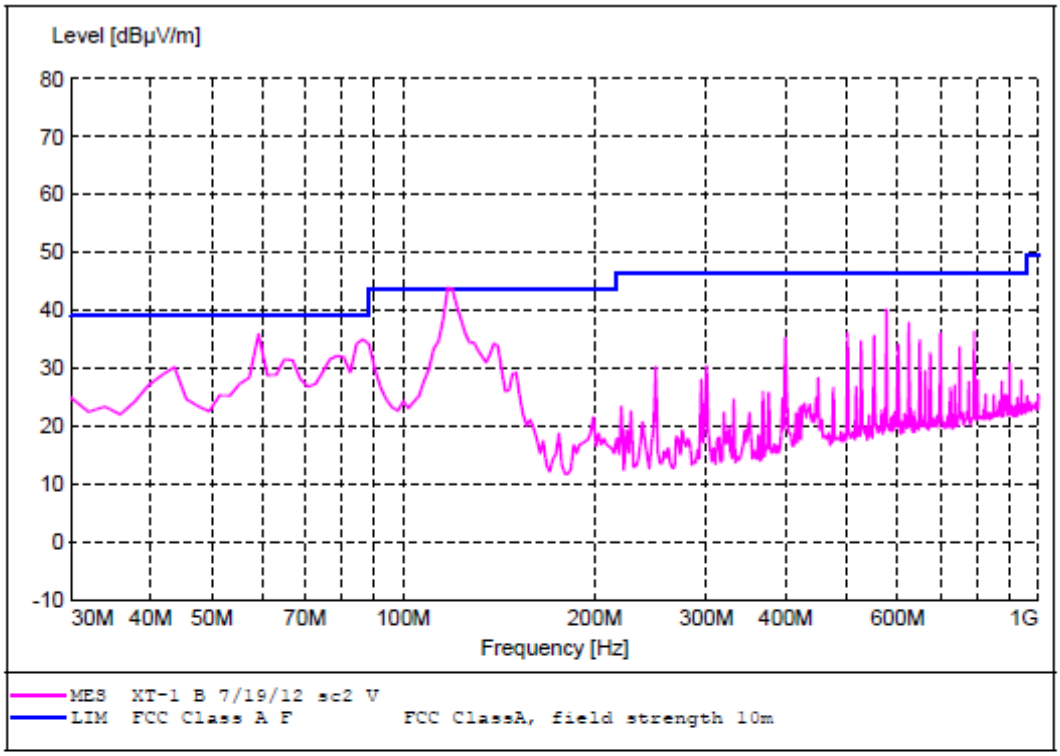
Report Number	RE1207020	**Date**	19 July 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 VAC / 60 Hz
EUT Model	XT-1B Base Station	**Test Std**	FCC 15.109
EUT Serial #		**Temperature (°C)**	23
EUT Description	XT-1 Wireless Communication System	**Humidity (%)**	35
		Air Pressure (kPa)	100.8

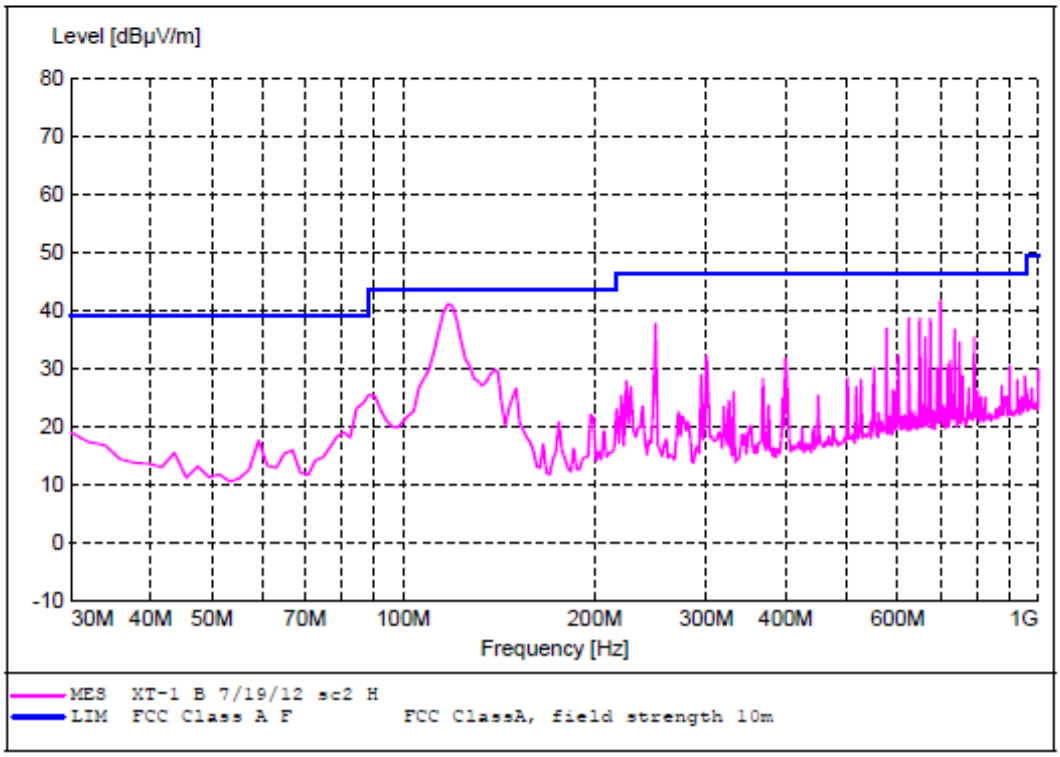
MAXIMIZED FILES XT-1 B 7/19/12 sc2 V-H

	MAXIMIZED QP SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED POSITION		
FREQ. (MHz)	H/V	dBµV	dBµV	dBµV	TURNTABLE (°)	ANTENNA (M)	REMARKS
43.807	V	29.40	39.08	9.68	92	1.0	
60.000	V	35.61	39.08	3.47	165	1.0	
86.292	V	33.54	39.08	5.54	285	1.0	
119.500	V	41.74	43.52	1.78	140	1.0	
250.000	H	37.41	46.44	9.03	34	1.0	
575.032	V	40.72	46.44	5.72	323	1.0	
700.028	H	42.09	46.44	4.35	95	1.0	

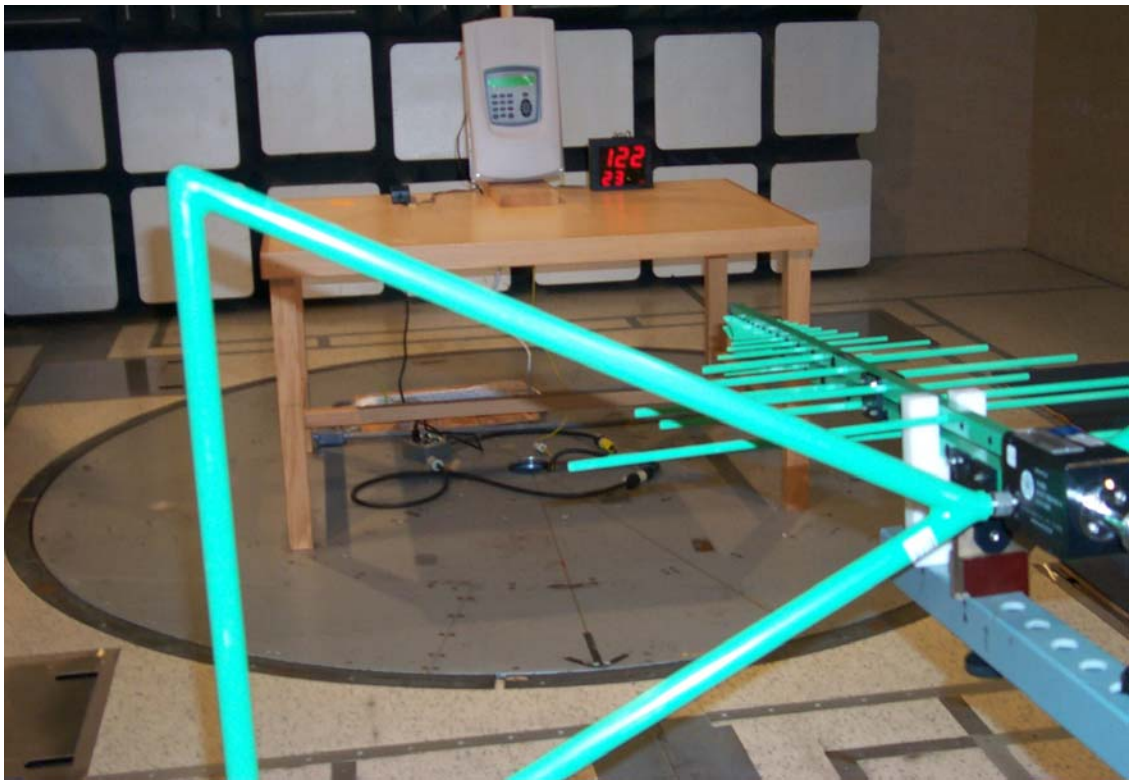
* - All readings have the correction factors applied.

Test Engineer: Mike Schultz	Date: 19 July 2012


Level [dBµV/m]
80
70
60
50
40
30
20
10
0
-10
30M 40M 50M 70M 100M 200M 300M 400M 600M 1G
Frequency [Hz]
MES XT-1 B 7/19/12 sc2 V
LIM FCC Class A F FCC ClassA, field strength 10m


Level [dBµV/m]
80
70
60
50
40
30
20
10
0
-10
30M 40M 50M 70M 100M 200M 300M 400M 600M 1G
Frequency [Hz]
MES XT-1 B 7/19/12 sc2 H
LIM FCC Class A F FCC ClassA, field strength 10m

5.0.4 Digital Emissions Setup Photos



Radiated Emissions 30 to 1000 MHz

Radiated Emissions 1 to 15 GHz

5.1 47 CFR Part 15 Subpart C – Intentional Radiators

5.2 15.203 Antenna Requirement

The XT-1B complies with this section. Professional installation is required to insure compliance with this section and local building codes. See Intended Use Statement as printed in section 2.2 **EUT Description and Operation.** The manufacturer markets the product through approved professional installation companies only, which in turn market the product with installation to the end user. Consult Installation Guide for instructions.

5.2.1 15.204 (c) Antenna Modifications

The following antennas have been tested with the XT-1B, and found to comply with the requirements of Subpart C.

Giga-Concept RUB09A-2400SMA	0dBi Gain	Omni Antenna
HyperLink Technologies HG2408P	8dBi Gain	Patch Antenna
HyperLink Technologies HGV-2409U	8dBi Gain	Omni Antenna

External Patch and Omni antennas are connected to EUT via 100 ft of type LMR400 coax (3M # 78-8117-4337-2), 2 ft of RG58A/U (SMA Male to N Female 3M # 78-8117-4334-9), & Lightning Arrester (3M # 78-8117-4335-6)

5.3 15.247 (a)

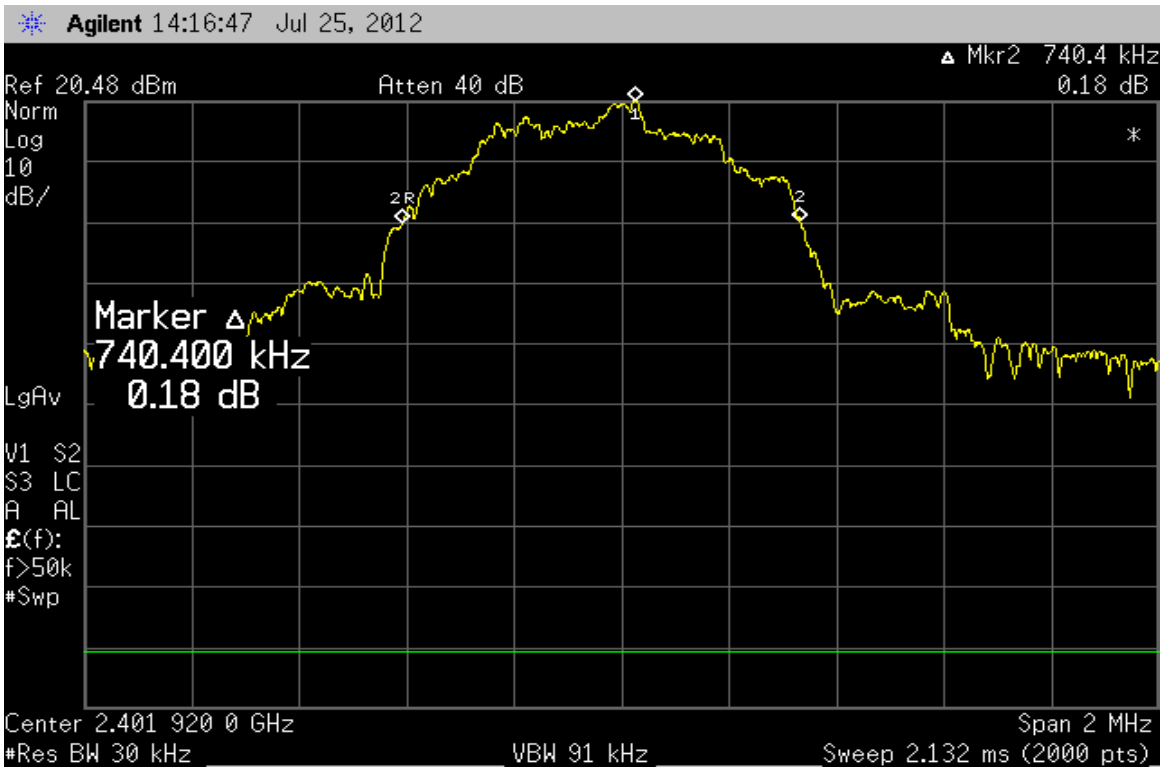
Unless otherwise specified, the following measurements were made in an RF conducted manner, with a direct connection between the antenna port of the EUT and the measuring instrument. If any attenuation was required between the EUT and the measuring instrument, this value, in addition to the measured cable loss, was added to the measured levels. If a direct connection could not be made to the antenna port, then one of the alternative procedures as outlined at the end of document DA 00-705 was used.

5.3.1 20 dB Bandwidth

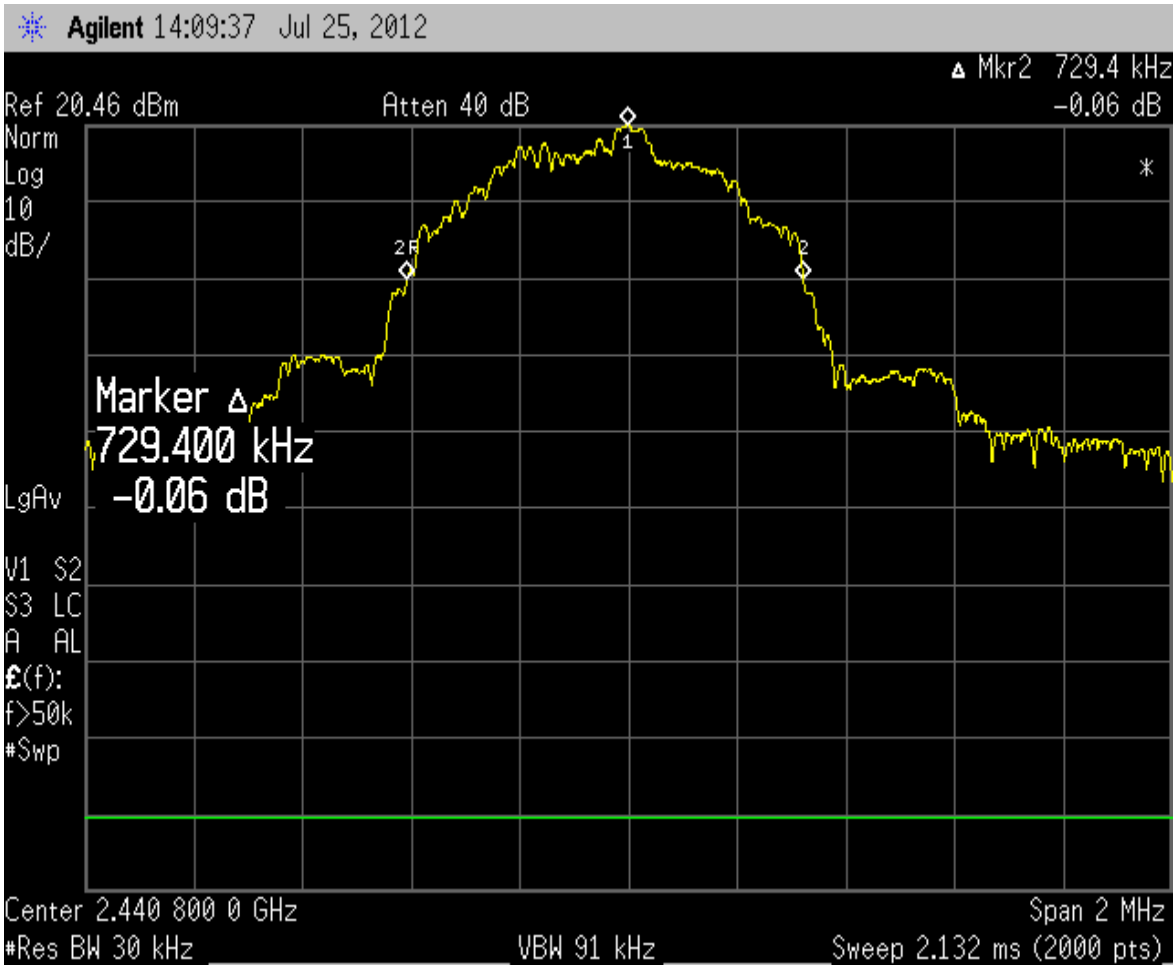
The measurement was made on a Low, Mid & High channel. The EUT was cabled to a spectrum analyzer with the span centered on the transmit channel. A marker was set on the peak of the emission. Using the marker-delta function, markers were set 20 dB down on each side of peak, and the bandwidth was recorder at each channel frequency.

5.3.1.1 Results

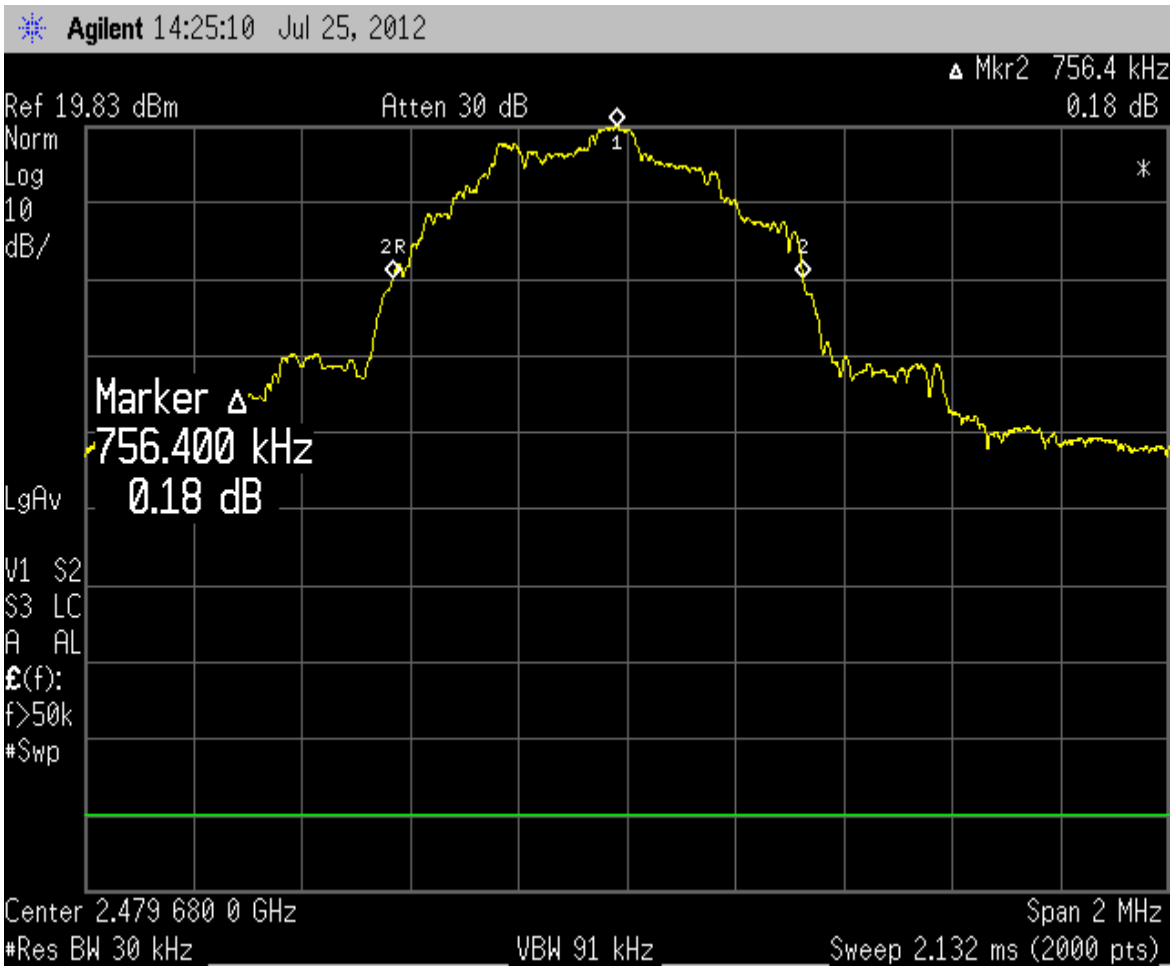
20 dB Bandwidth	Low channel	740.4 KHz
	Mid Channel	729.4 KHz
	High Channel	756.4 KHz



Low Channel Bandwidth



Mid Channel Bandwidth



High Channel Bandwidth

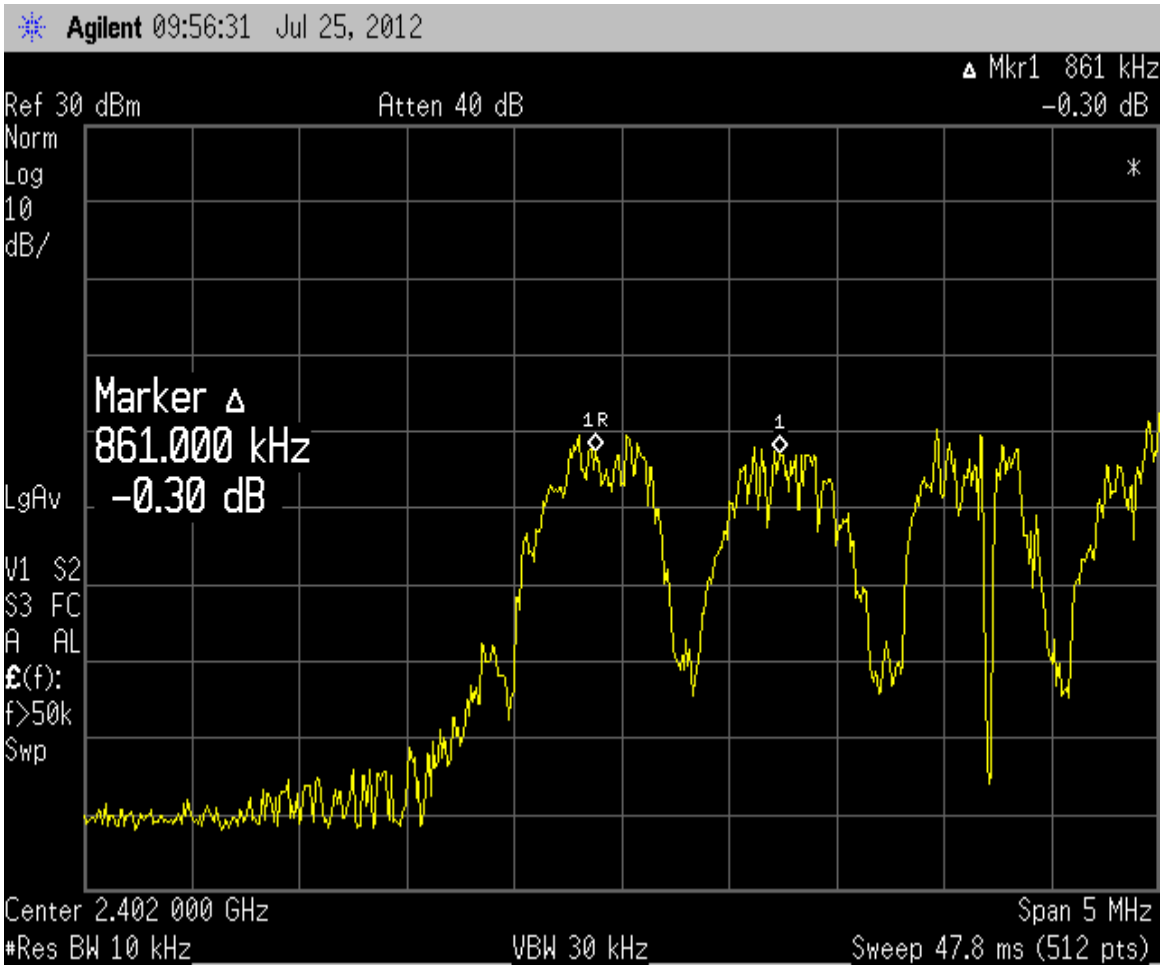
5.3.2 Carrier Frequency Separation

The EUT was placed in the hopping mode. The spectrum analyzer span was set to capture the peaks of two adjacent channels. The marker-delta function was used to measure the separation between the peaks of the adjacent channels.

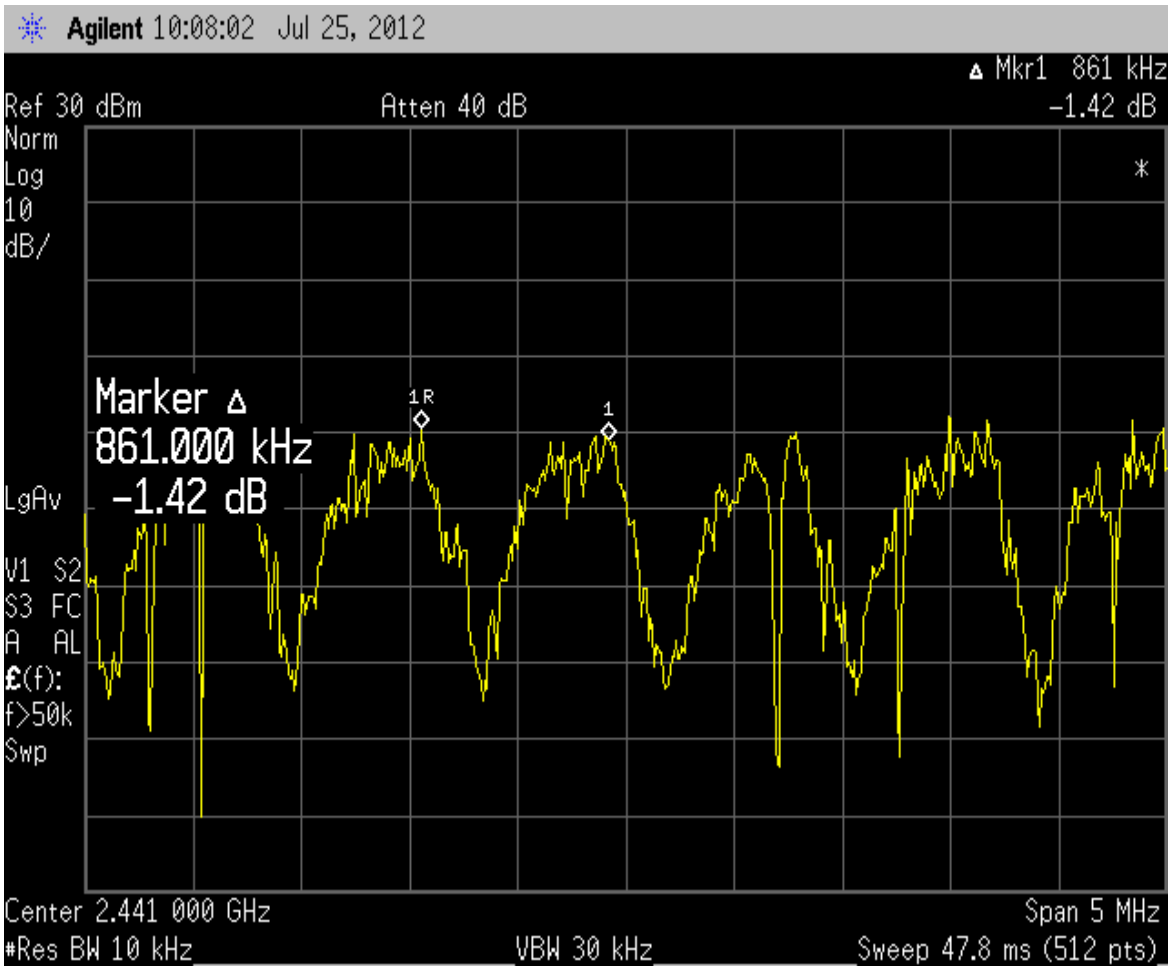
Limit: Minimum 25 KHz or the 20 dB bandwidth of the hopping channel which ever is greater.

5.3.2.1 Results

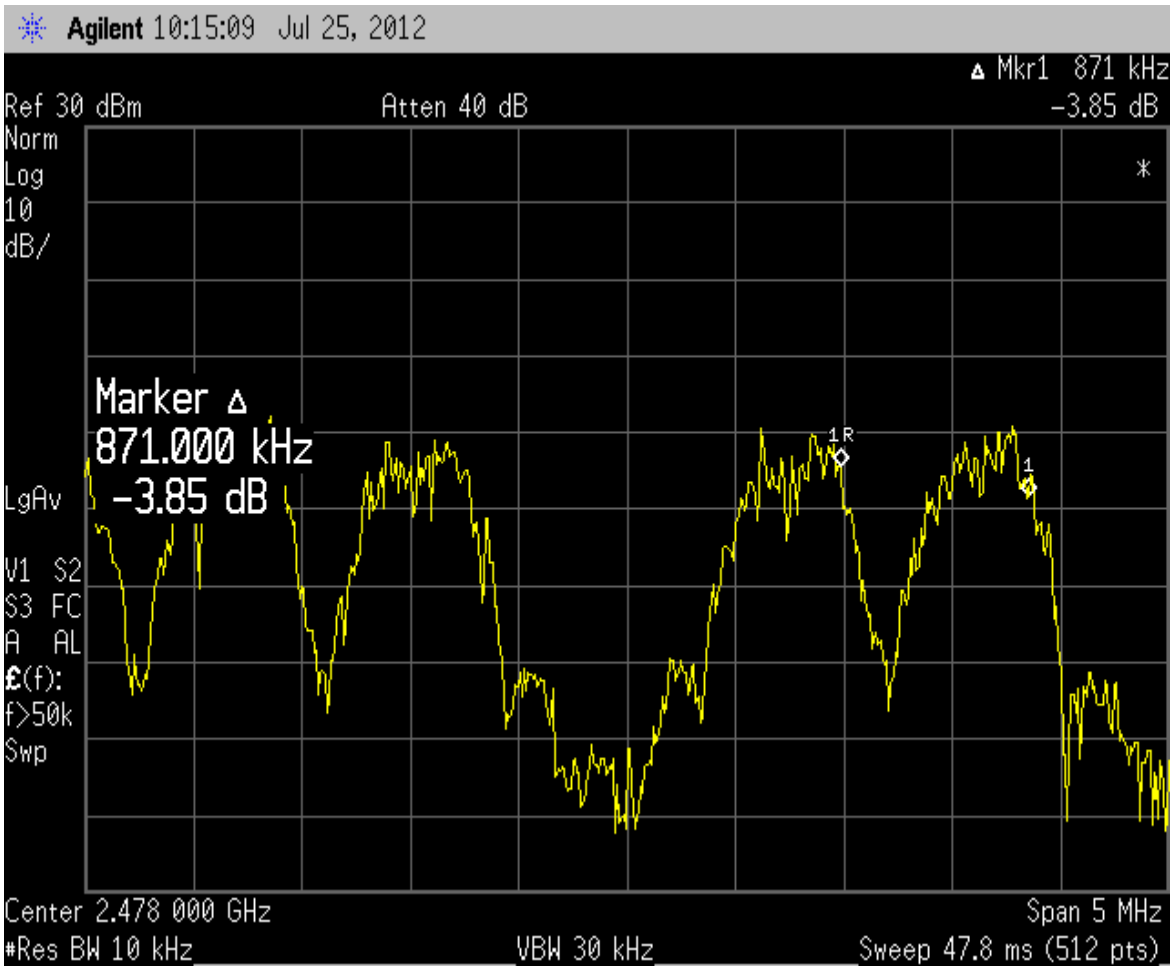
Channel separation	Low	861 KHz
	Mid	861 KHz
	High	871 KHz



Channel Separation Low



Channel Separation Mid



Channel Separation High

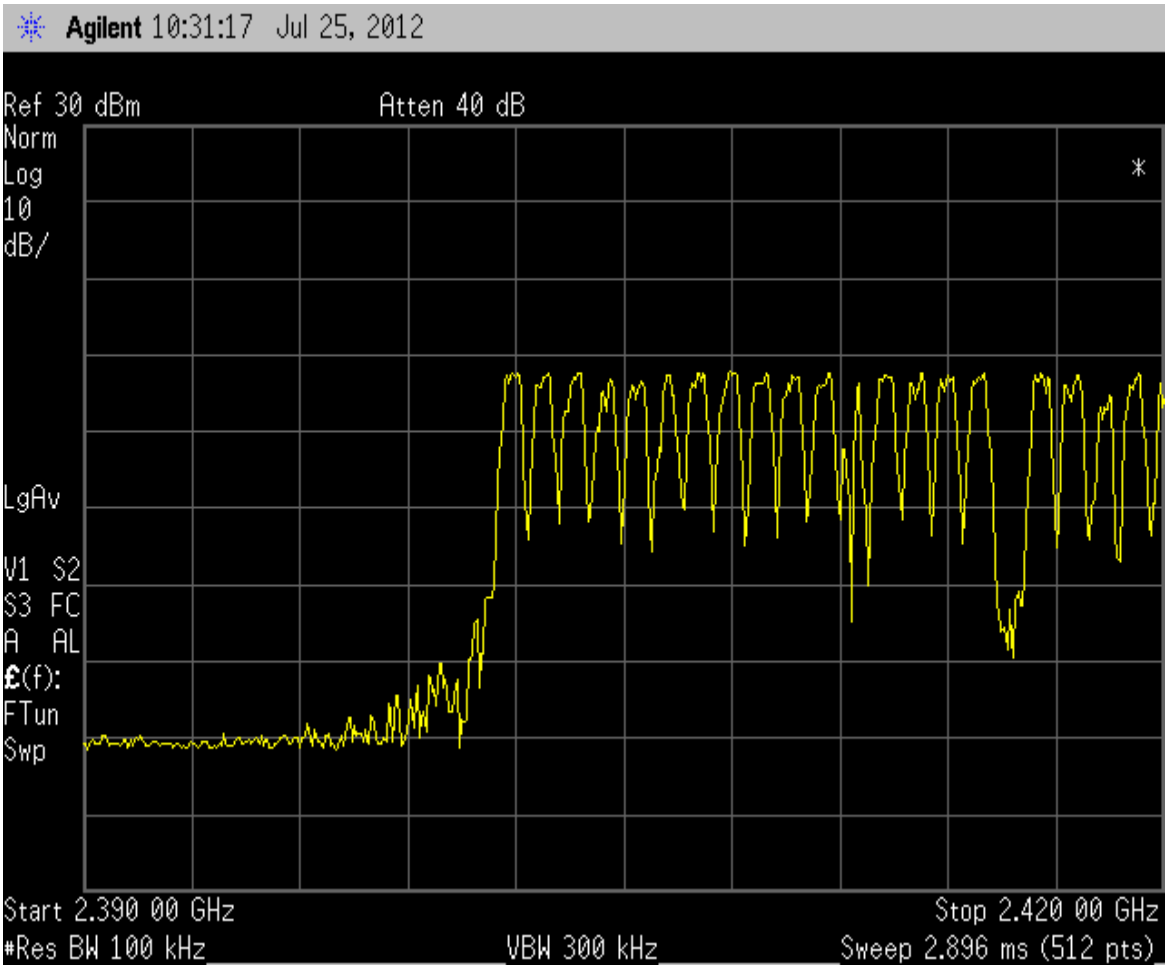
5.3.3 Number of Hopping Frequencies

The EUT was placed in the hopping mode. The spectrum analyzer span was broken into sections in order to clearly show all of the hopping channels.

Limit: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. Frequency hopping systems may avoid or suppress transmission on a particular frequency provided a minimum of 15 channels are used.

5.3.3.1 Results

The EUT met the limit. The EUT uses 75 hopping channels.


Agilent 10:31:17 Jul 25, 2012
Ref 30 dBm
Atten 40 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
A AL
£(f):
FTun
Swp
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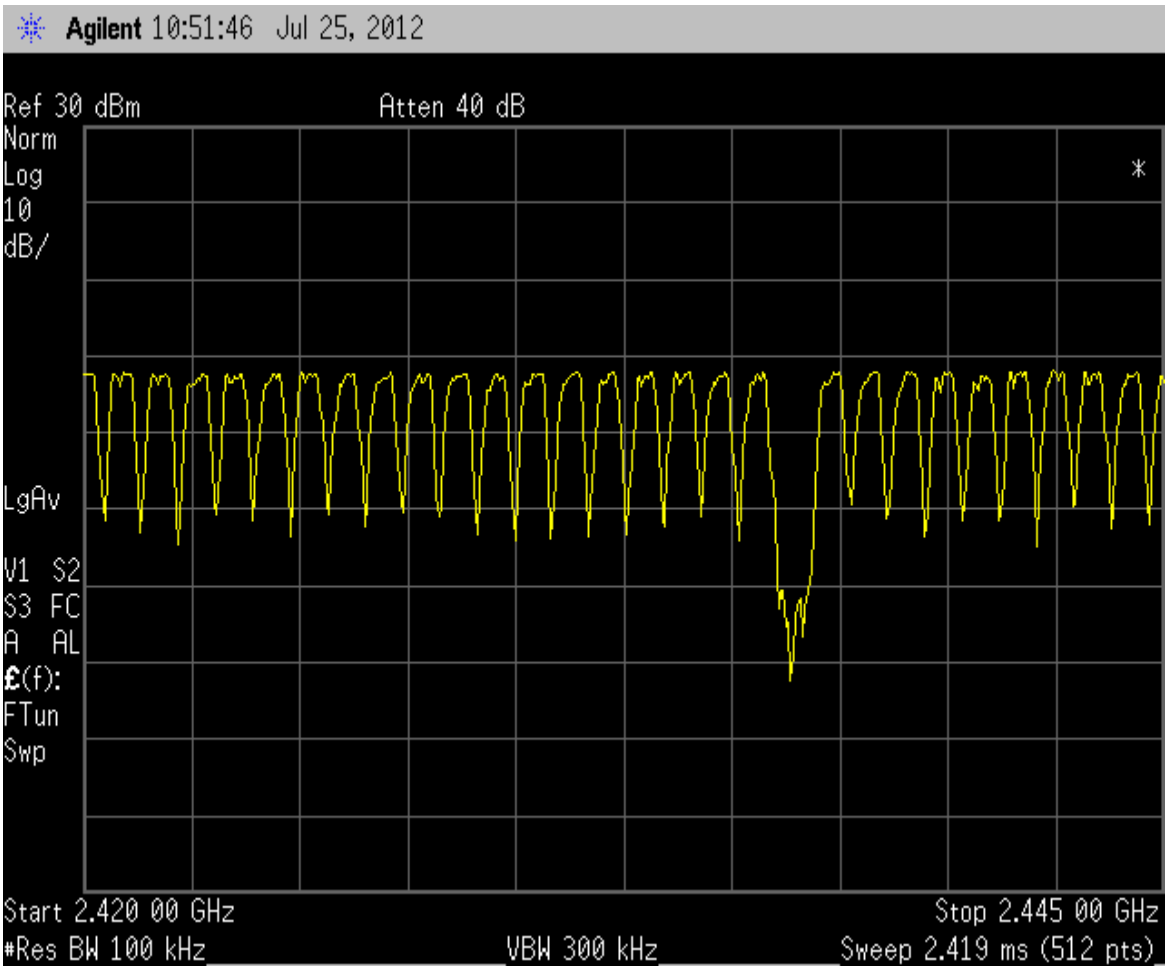
Stop 2.420 00 GHz
#Res BW 100 kHz
VBW 300 kHz
Sweep 2.896 ms (512 pts)

Low Section


Agilent 10:51:46 Jul 25, 2012
Ref 30 dBm
Atten 40 dB
Norm
Log
10
dB/
LgAv
V1 S2
S3 FC
A AL
£(f):
FTun
Swp
Start 2.420 00 GHz
Stop 2.445 00 GHz
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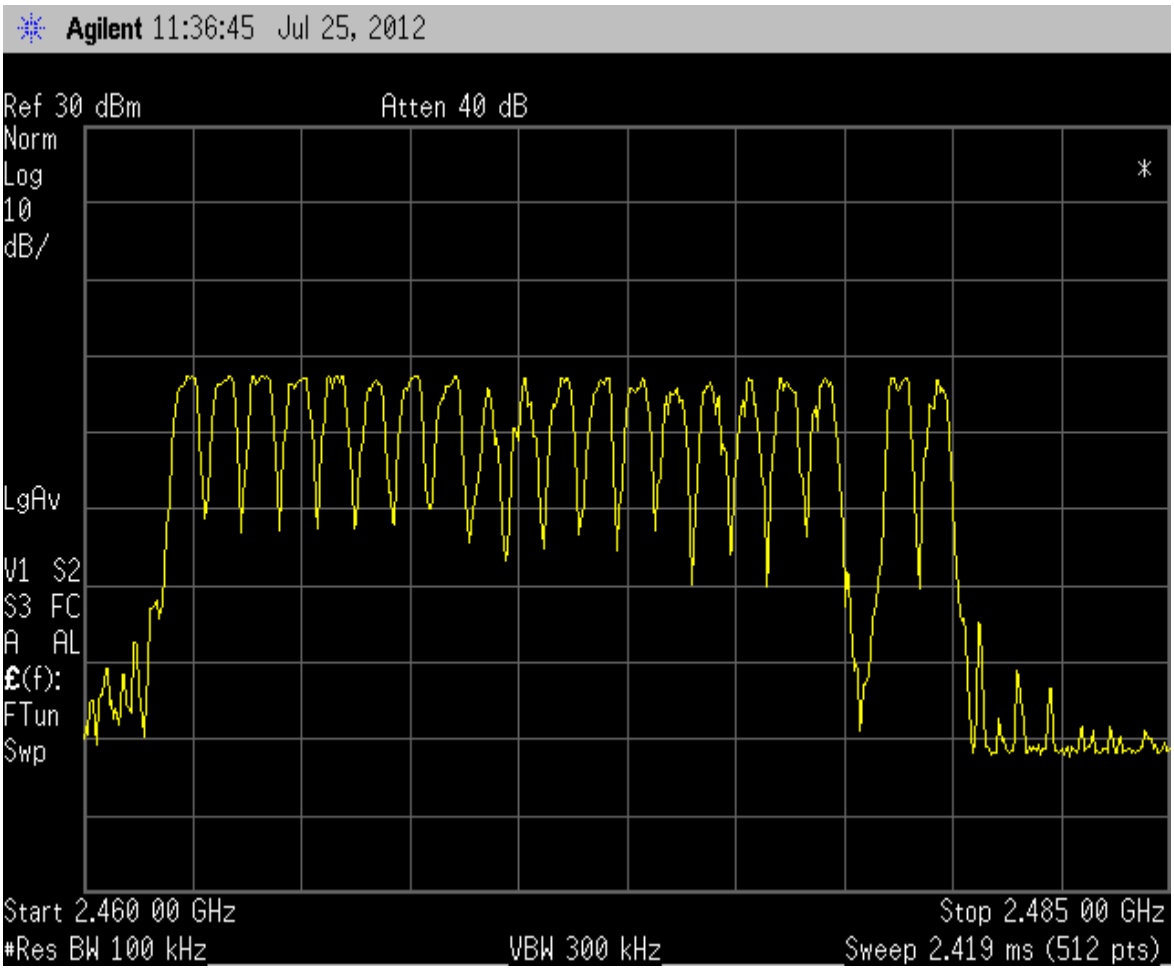
VBW 300 kHz
Sweep 2.419 ms (512 pts)

Mid Section



High Section

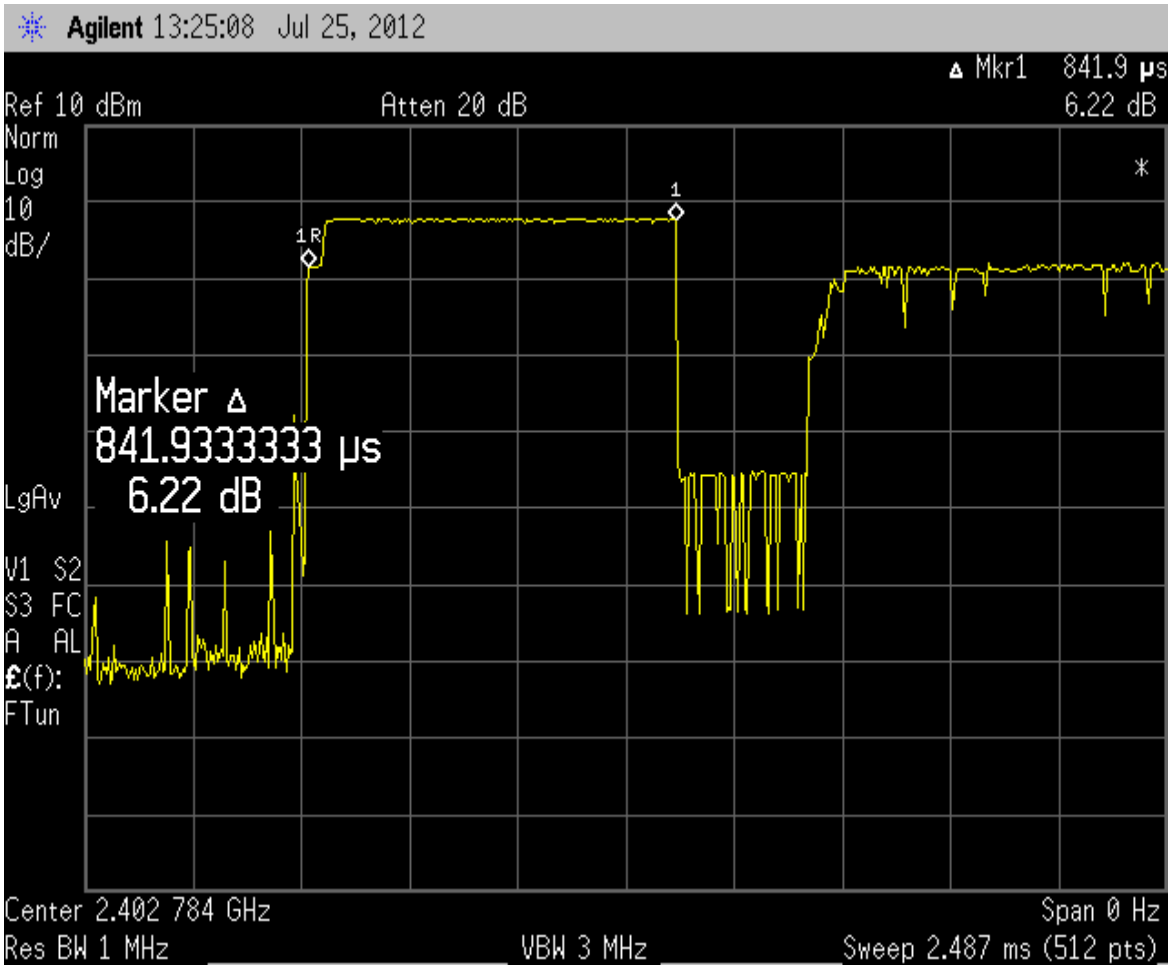
5.3.4 Time of Occupancy (Dwell Time)

The EUT was placed in the hopping mode. The spectrum analyzer span was set to zero span, centered on a hopping channel. The marker-delta function was used to determine the dwell time of each channel, (Low, Mid, High).

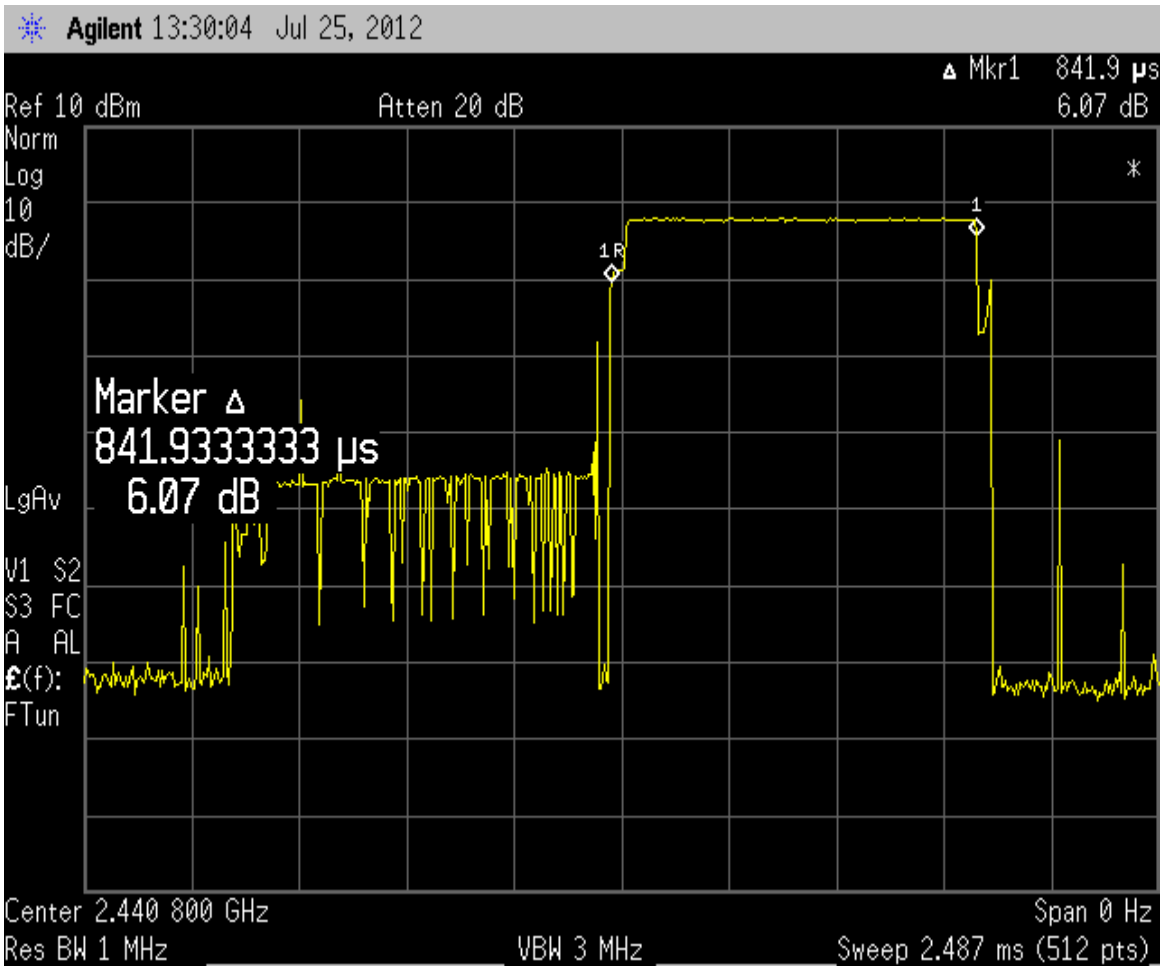
Limit: The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the on hopping channels employed. The number of channels used by the EUT is provided by the manufacturer. The EUT employs 75 channels, therefore the period is 30 seconds, and occupancy must not be greater than 400 ms. The EUT met the limit.

5.3.4.1 Results

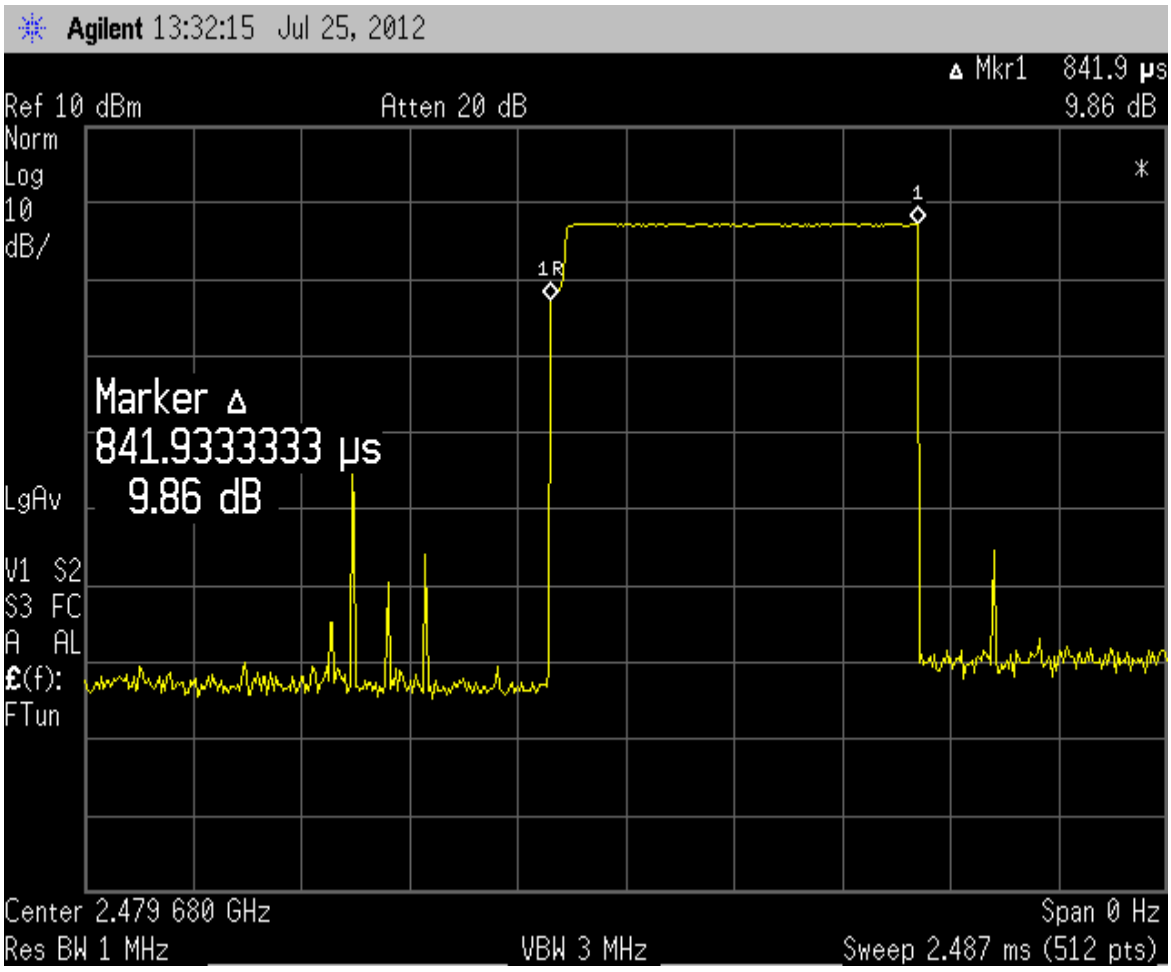
The dwell time of any channel is 841.93 micro sec. During any 30 second period the EUT will occupy a given channel 40 times. 40 X 841.93 µs = 33.67 ms



Dwell Time Low Channel



Dwell Time Mid Channel



Dwell Time High Channel

5.3.5 Pseudorandom Hopping Sequence and Equal Hopping Usage

This is explained in the Transmit Circuit Description Document. Confidentiality has been requested for this document.

5.4 15.247 (b)

5.4.1 Peak Output Power

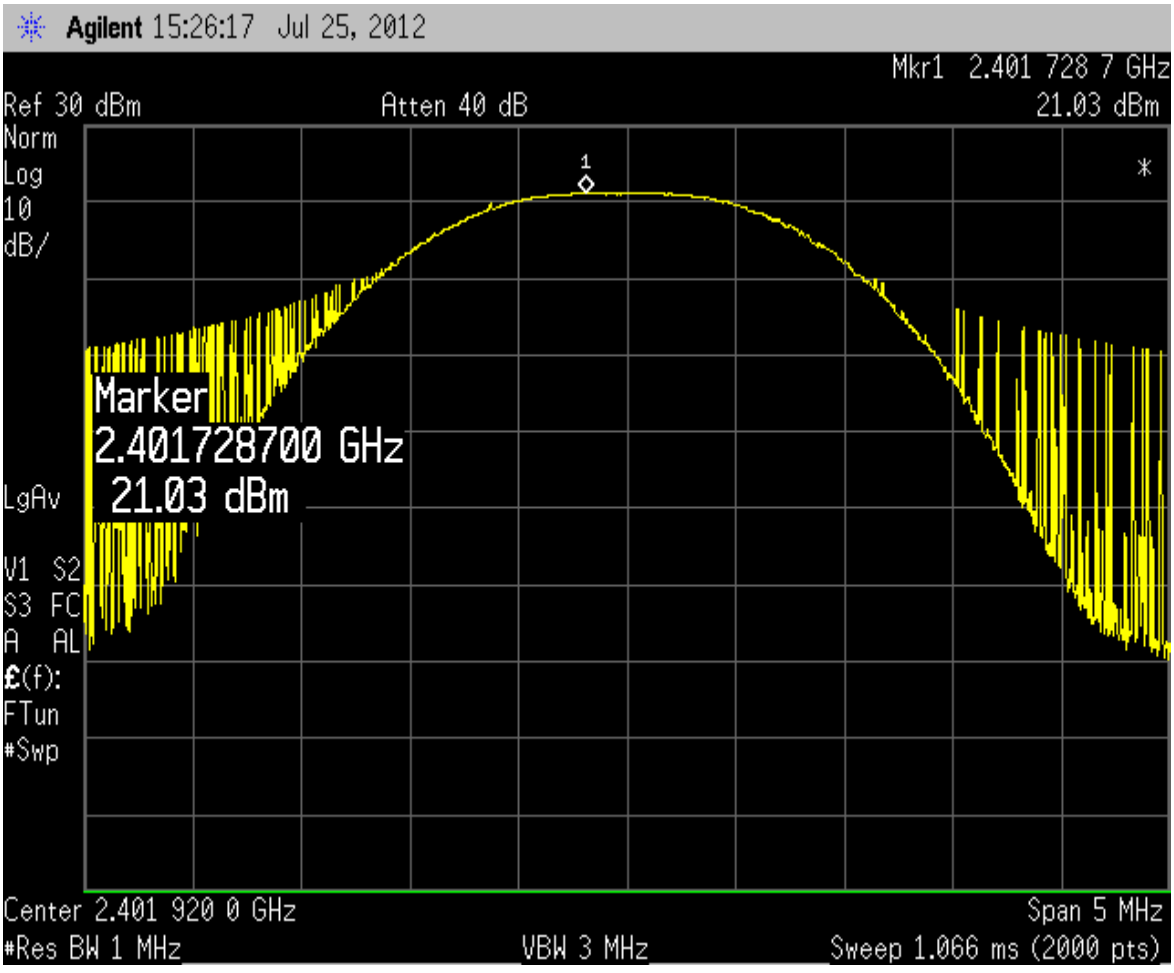
The EUT was operating in a single frequency mode and cabled to the spectrum analyzer. Analyzer was centered on transmit frequency. Detector was Peak. Trace was max hold. Measurement was made using marker-to-peak function. Actual power output is equal to peak indicated level plus cable loss.

Limit: 1 Watt EUT met conducted output power limit.

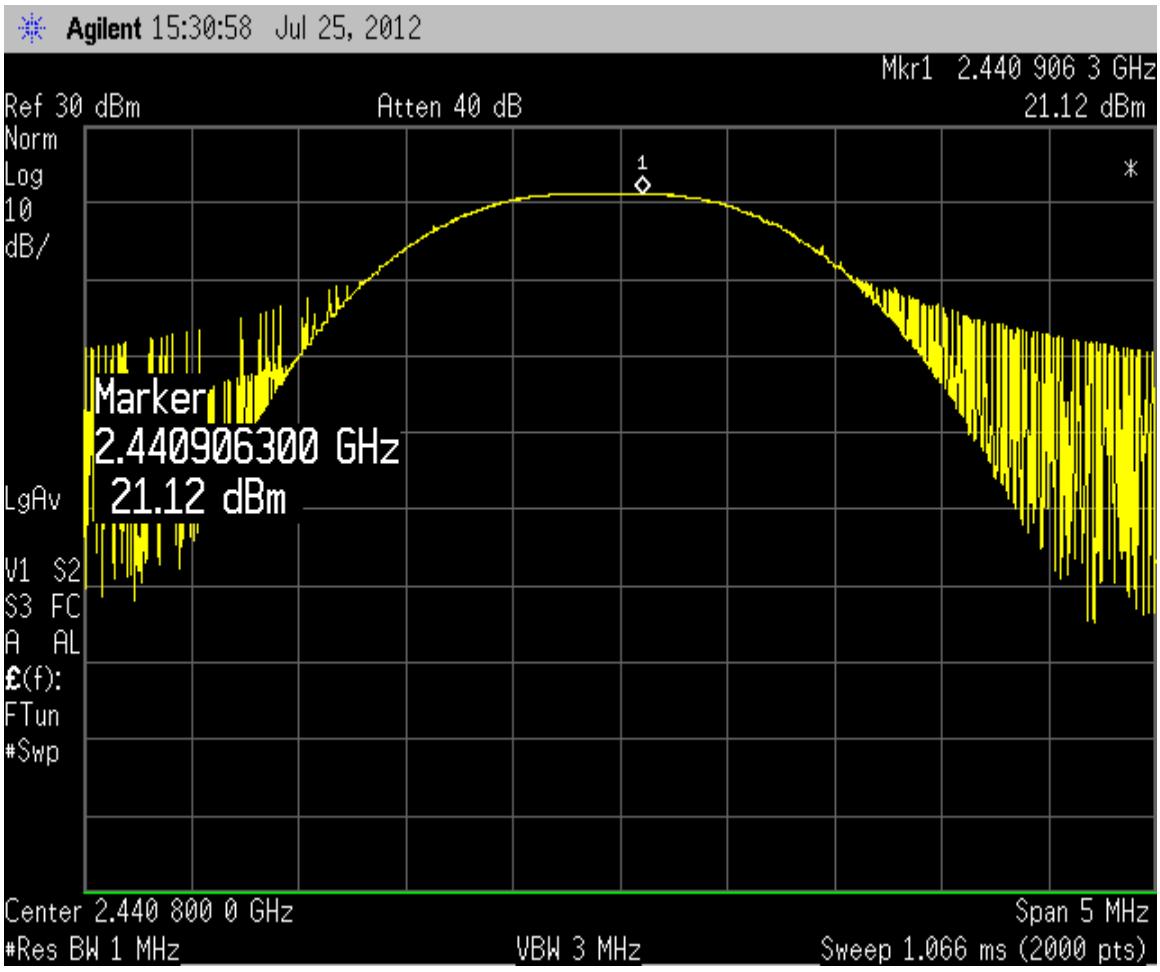
5.4.1.1 Results

Corrected output = Measured level + Cable loss

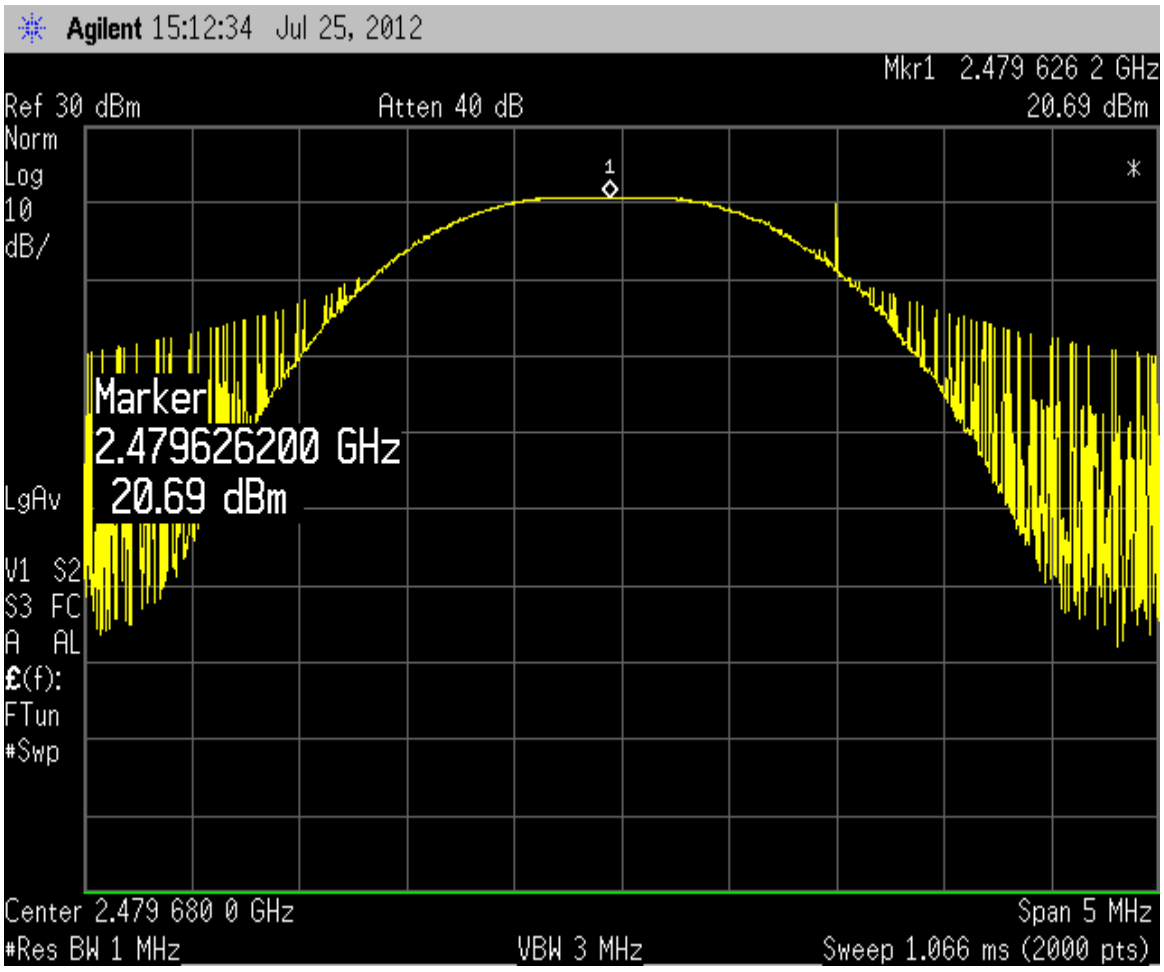
Channel Number	Frequency MHz	Measured Level dBm	Cable Loss dB	Corrected Output dBm	Corrected Output mw
1	2401.92	21.03	0.57	21.60	144.54
46	2440.8	21.12	0.57	21.69	147.57
91	2479.68	20.69	0.57	21.26	133.66



Output Power Channen1



Output Power Channel 46



Output Power Channel 91

5.4.2 EIRP (DeFacto EIRP Limit)

Limit: 4 Watts EIRP

EIRP = Measured power at antenna + Antenna gain (dBi)

Internal antenna Giga-Concept RUB09A-2400SMA 0 dBi gain

LO Channel 1	21.60 + 0 = 21.60 dBm = 144.54 mw EIRP
Mid Channel 46	21.69 + 0 = 21.69 dBm = 147.57 mw EIRP
Hi Channel 91	21.26 + 0 + 21.26 dBm = 133.66 mw EIRP

External Patch Antenna HyperLink Technologies Model HG2408P 8 dBi gain

LO Channel 1	12.65 + 8 = 20.65 dBm = 116.14 mw EIRP
Mid Channel 46	12.68 +8 = 20.68 dBm = 116.95 mw EIRP
Hi Channel 91	12.28 + 8 + 20.28 dBm = 106.65 mw EIRP

External Omni Antenna HyperLink Technologies Model HGV2409U 8 dBi gain

LO Channel 1	12.65 + 8 = 20.65 dBm = 116.14 mw EIRP
Mid Channel 46	12.68 +8 = 20.68 dBm = 116.95 mw EIRP
Hi Channel 91	12.28 + 8 + 20.28 dBm = 106.65 mw EIRP

External Patch and Omni antennas are connected to EUT via 100 ft of type LMR400 coax (3M # 78-8117-4337-2), 2 ft of RG58A/U (SMA Male to N Female 3M # 78-8117-4334-9), & Lightning Arrester (3M # 78-8117-4335-6)

Internal Antenna

External Patch Antenna

External Omni Antenna

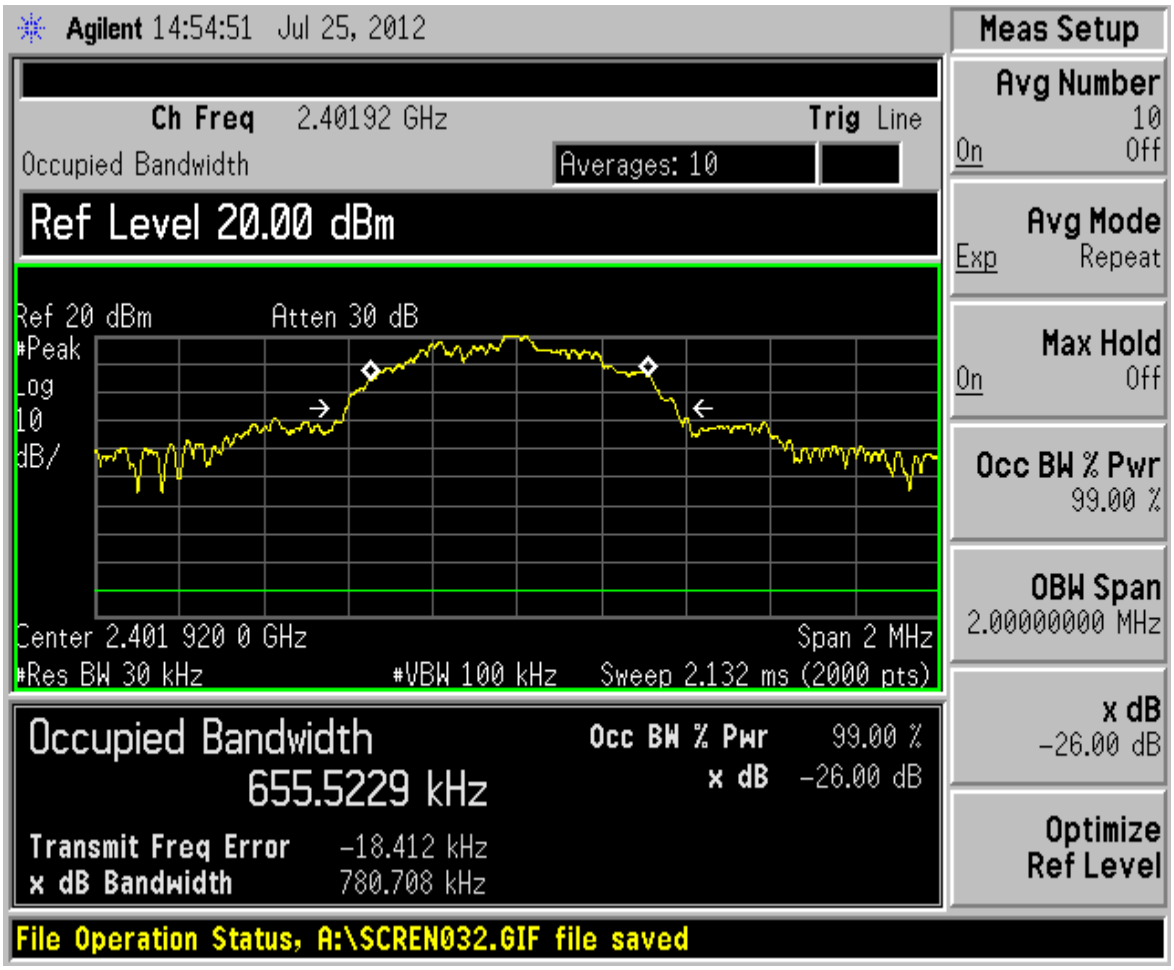
External Antennas with Range Extender Components

5.4.3 99 % Power Bandwidth

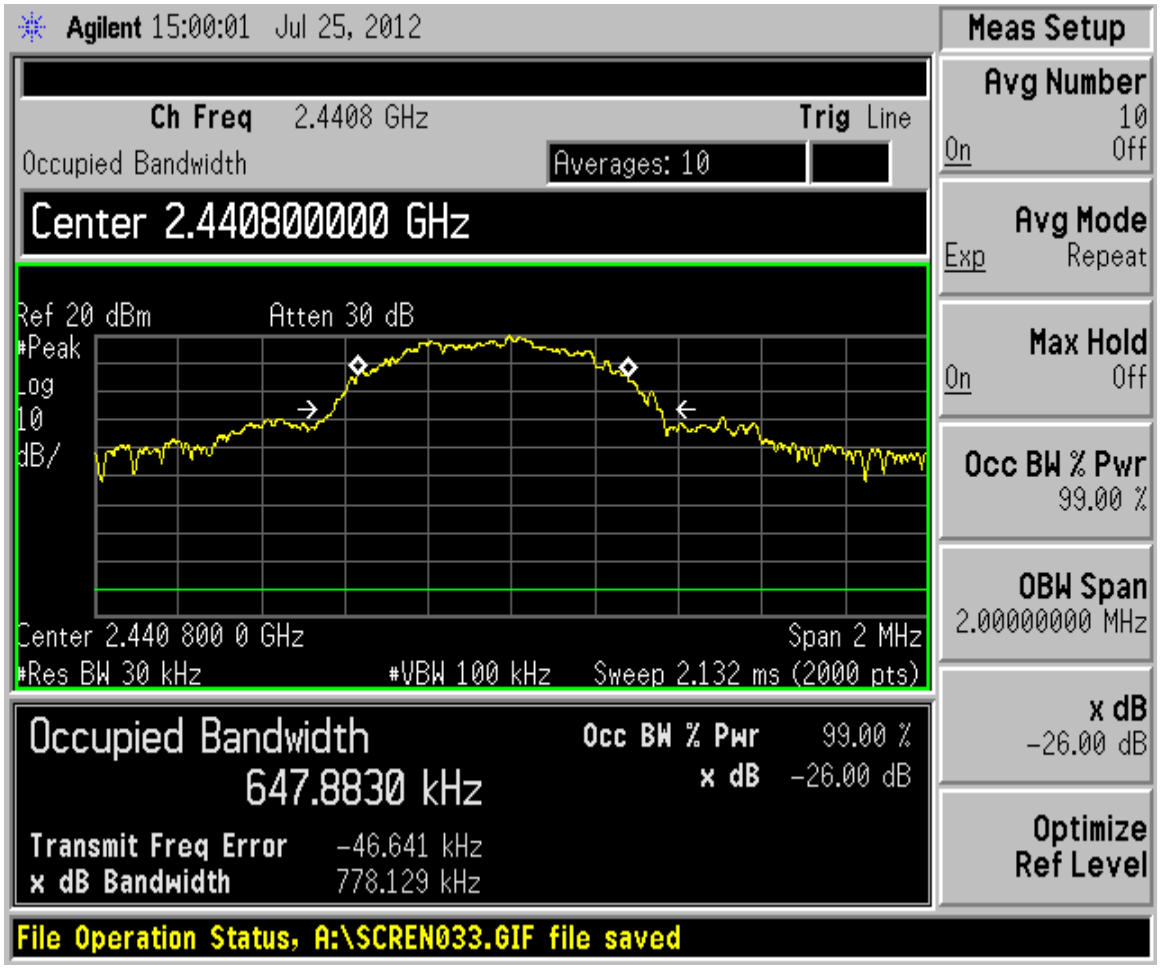
The EUT was operating in a single frequency mode and cabled to the spectrum analyzer. The EUT was placed in a shielded room and connected directly to the input of a Spectrum Analyzer. The analyzer was centered on the transmit frequency with a span of 2 MHz. The transmitter was operated at its maximum carrier output under normal test conditions. The analyzer's span and bandwidths were set in accordance with Industry Canada RSS-GEN (section 4.6.1). The analyzer has an internal function that can be selected for the measurement of the 99% Bandwidth, and automatic placement of the markers. 3M Test Procedure: PBLI-6WHLEM contains the procedure for selecting the Bandwidth function and output of the result plot.

5.4.3.1 Results

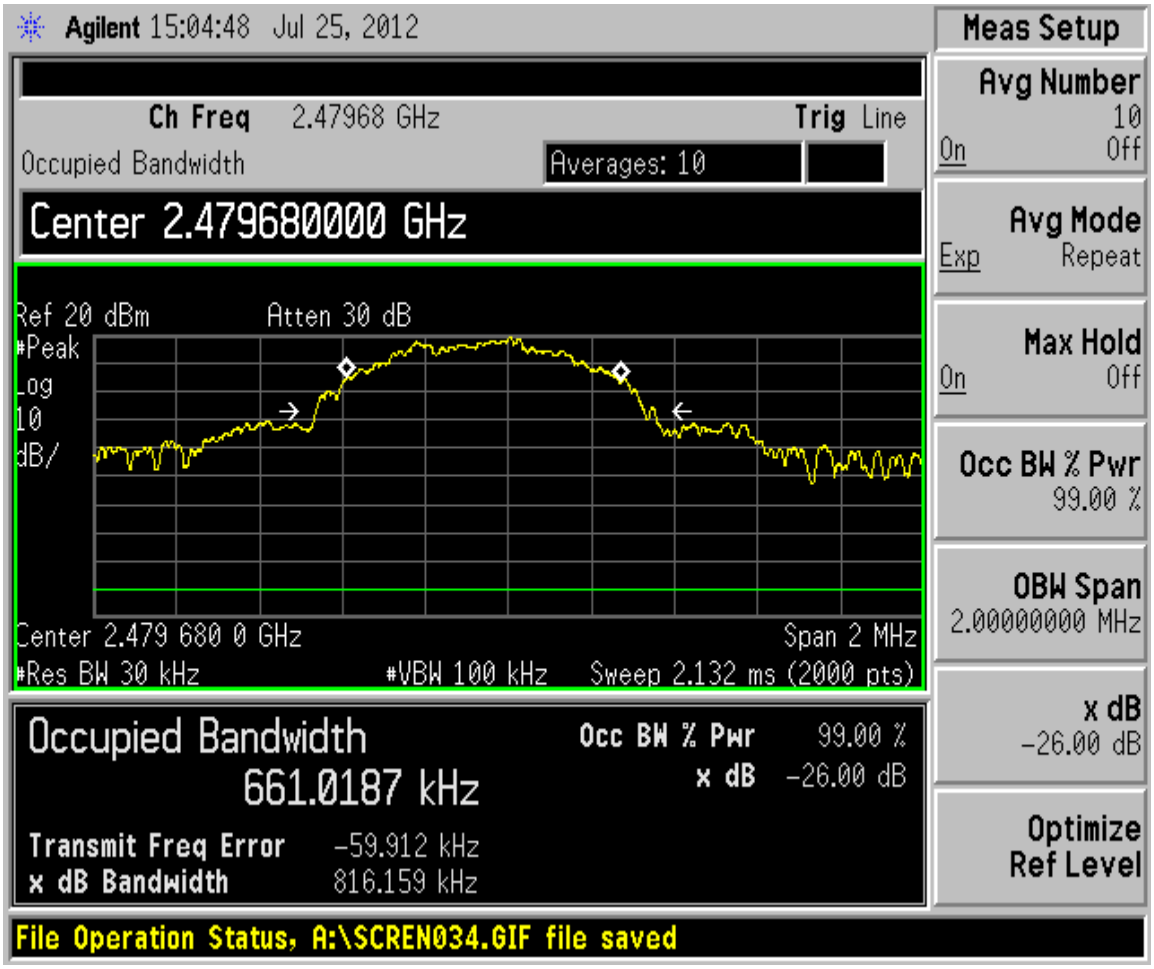
Channel 1	Bandwidth	655.523 KHz
Channel 46	Bandwidth	647.883 KHz
Channel 91	Bandwidth	661.019 KHz



Occupied Bandwidth Channel 1



Occupied Bandwidth channel 46



Occupied Bandwidth Channel 91

5.5 15.247 (c)

5.5.1 Band-edge Compliance of Conducted Emission

EUT is operated in single frequency mode on the channel closet to the band edge to be measured. (Channel 1 for lower edge & channel 91 for upper edge) Span is set to capture channel peak emission as well as any modulation product outside the band authorized for operation. Using marker-delta function, place a marker at the band edge or the highest modulation product outside the band edge as well as on the peak channel emission. The marker-delta value displayed must comply with the limit.

Repeat measurement with EUT operating in hopping mode.

Limit: 20 dB below Peak in band emission on channel closest to band edge.
Use RBW of 100 KHz per 15.247.

EUT met Limit requirements.

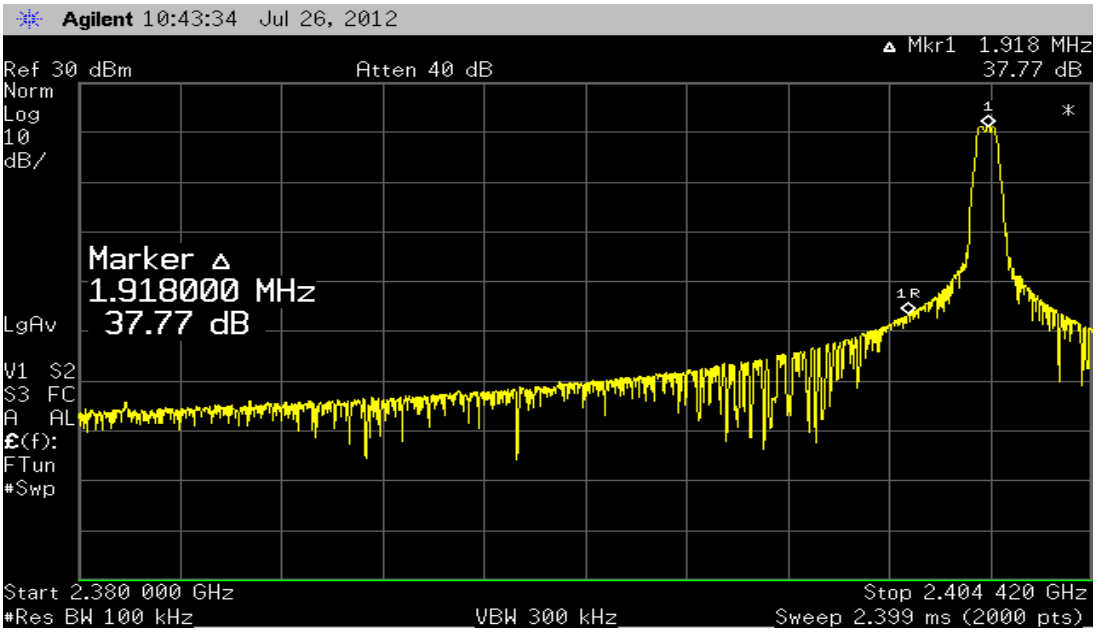
5.5.1.1 Results

Single channel operation

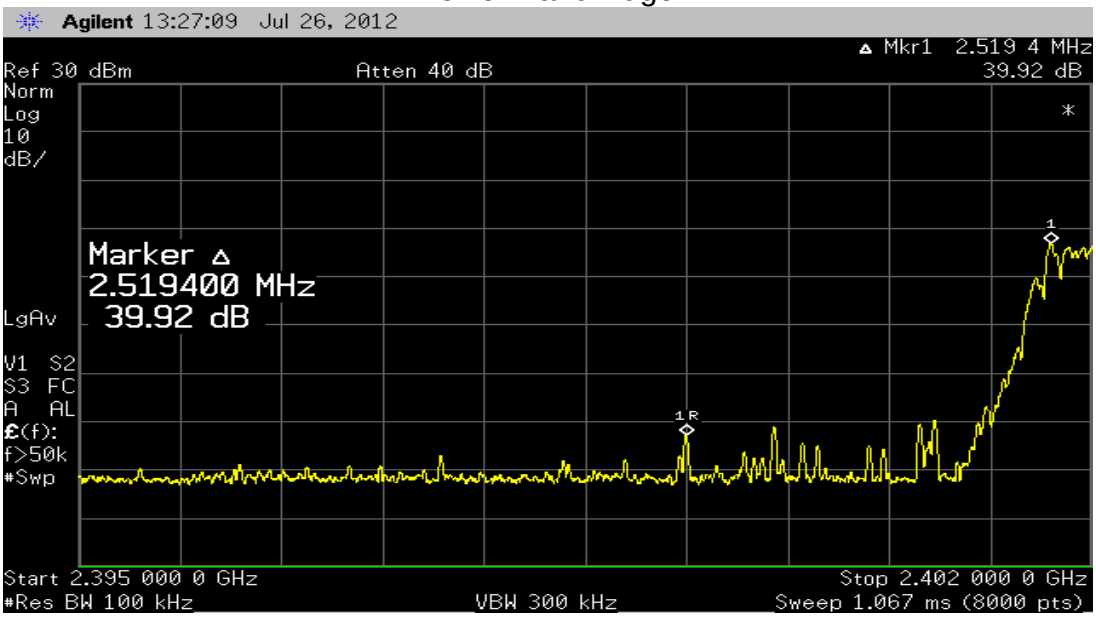
Lower Band edge -37.77 dBc
Upper Band edge -44.47 dBc

Hopping mode activated

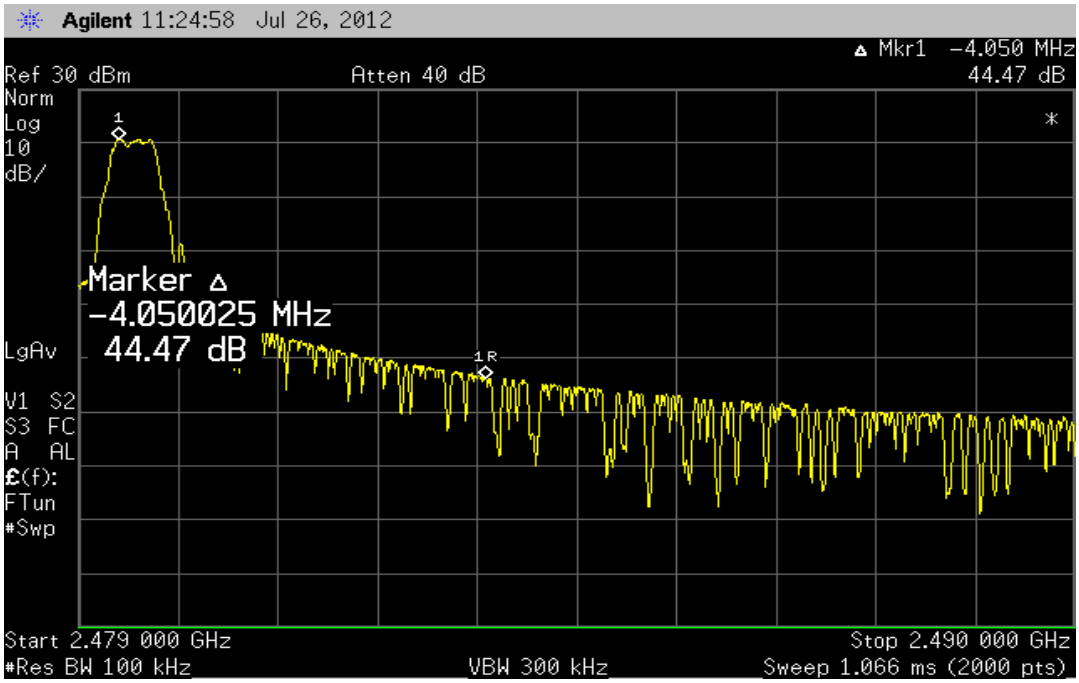
Lower Band edge -39.92 dBc
Upper Band edge -44.55 dBc



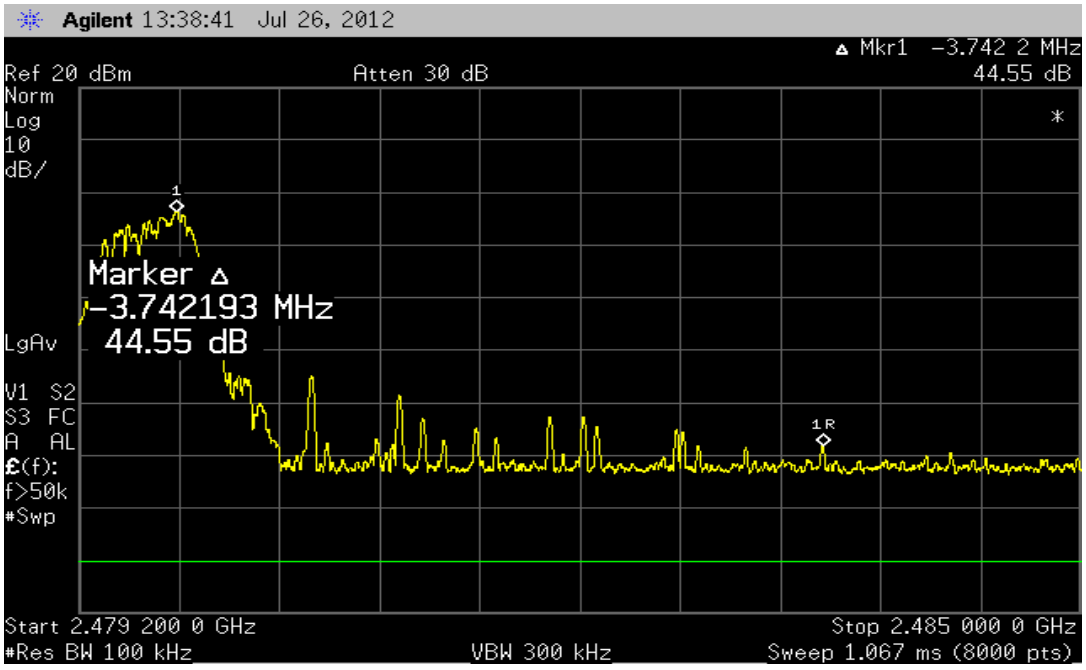
Lower Band Edge



Lower Band Edge with Hopping



Upper Band Edge



Upper Band Edge with Hopping

5.5.2 Spurious Radiated Emissions

The EUT was placed in a semi-anechoic chamber for spurious emissions testing in accordance with ANSI C63.4, FCC Part 15, Subpart C and 3M Test Procedures: 13.56 MHz RFID Emissions Test, PBLI-6WHLEM and Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2 and Radiated Emissions Test (1 GHz – 5 GHz), PBLI-6SNHFY. The Spurious Emission measurements were made to determine the level of spurious electromagnetic energy radiated from the EUT while in the transmit mode. Spurious emissions were measured using each antenna approved for use with the EUT.

5.5.2.1 Test Procedure

The EUT was placed in the center of a turntable. An EMI receiver was used for the emissions measurements in the range of 30MHz to 18000 MHz. Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Peak results were maximized at discrete frequencies utilizing quasi-peak detection. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling every 4 degrees) and varying the antenna height between 1 and 4 meters at the angles of the highest emissions levels found. Measurements were taken in both vertical and horizontal antenna polarization. The final measurements recorded were determined by the following formula:

Result (dBμV /m) = receiver level (μV) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB)

5.5.2.2 Test Criteria

The FCC Part 15, Subpart C radiated limits are given below for all spurious emissions within restricted bands (15.205)

Frequency (MHz)	Distance (Meters)	Field Strength (dBμV/m)
30 - 88	3	40.0
88 - 216	3	43.52
216 - 960	3	46.0
960 and higher	3	53.98

Limit outside restricted bands: 20dB below highest in band emission.
RBW 100 KHz

5.5.2.3 Test Results

The EUT met the FCC Part 15, Subpart C Spurious Emissions (30 to 18000 MHz.) requirements. No spurious emissions were detected in the range of 30 to 1000 MHz.

Report Number	RE1207020	**Date**	31 July 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	23
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 01Internal Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
3.6029	V	53.11	73.98*	20.87	PK	1 MHz	185	1.0
3.6029	V	33.50	53.98*	20.48	Ave	1MHz	185	1.0
4.8038	V	66.14	73.98*	7.84	PK	1 MHz	347	1.51
4.8038	V	43.77	53.98*	10.21	Ave	1 MHz	347	1.51
7.2057	V	73.96	98.68	24.72	PK	100 KHz	27	1.22
9.6076	V	58.05	98.68	40.63	PK	100 KHz	348	1.0
12.0096	H	69.74	73.98*	4.24	PK	1 MHz	150	1.0
12.0096	H	46.67	53.98*	7.31	Ave	1 MHz	150	1.0

* Restricted Band Limit 15.209

Test Engineer: Bruce Jungwirtrh	Date: 31July 2012

Report Number	RE1207020	**Date**	31 July 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	24
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 46 Internal Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
3.6610	V	58.57	73.98	15.41	PK	1 MHz	144	1.0
3.6610	V	37.33	53.98	16.65	Ave	1 MHz	144	1.0
4.8816	V	65.13	73.98	8.85	PK	1 MHz	0	1.74
4.8816	V	43.15	53.98	10.83	Ave	1 MHz	0	1.74
7.3224	V	69.01	73.98	4.97	PK	1 MHz	313	1.0
7.3224	V	52.69	53.98	1.29	Ave	1 MHz	313	1.0
9.7632	V	65.34	98.68	33.34	PK	100 KHz	348	1071
12.204	V	64.88	73.98	9.10	PK	1 MHz	305	1.0
12.204	V	46.34	53.98	7.64	Ave	1 MHz	305	1.0

* Restricted Band Limit 15.209

Test Engineer: Mike Schultz	Date: 31 July 2012

Report Number	RE1207020	**Date**	31 July 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	23
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 91 Internal Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
3.7195	V	57.98	73.68*	16.0	PK	1 MHz	154	1.33
3.7195	V	36.60	53.68*	17.38	Ave	1MHz	154	1.33
4.9593	V	62.92	73.68*	11.06	PK	1 MHz	17	1.49
4.9593	V	41.98	53.68*	12.0	Ave	1 MHz	17	1.49
6.1990	V	57.24	98.68	41.44	PK	100 KHz	9	1.29
7.4390	V	68.34	73.68*	5.64	PK	1 MHZ	133	1.0
7.4390	V	45.15	53.68*	8.83	Ave	1MHz	133	1.0
9.9187	V	57.03	98.68	41.65	PK	100 KHz	133	1.0
12.3984	V	61.47	73.68*	12.51	PK	1 MHz	0	2.26
12.3984	V	45.96	53.68*	8.02	Ave	1 MHz	0	2.26

* Restricted Band Limit 15.209

Test Engineer: Bruce Jungwirth	Date: 31 July 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	23
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 01Patchl Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
4.8038	V	56.93	73.98*	17.05	PK	1 MHz	137	1.12
4.8038	V	37.12	53.98*	16.86	Ave	1 MHz	137	1.12
7.2057	V	68.75	98.68	29.93	PK	100 KHz	227	1.71
9.6076	V	62.65	98.68	36.03	PK	100 KHz	95	1.66
12.0096	H	66.16	73.98*	7.82	PK	1 MHz	111	1.8
12.0096	H	46.38	53.98*	7.60	Ave	1 MHz	111	1.8

*Restricted Band Limit 15.209

Test Engineer: Bruce Jungwirtrh	Date: 1 Aug 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	24
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 46 Patch Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
4.8816	V	54.40	73.98*	19.58	PK	1 MHz	165	1.74
4.8816	V	36.21	53.98*	17.77	Ave	1 MHz	165	1.74
7.3224	V	73.85	73.98*	0.13	PK	1 MHz	176	1.74
7.3224	V	48.77	53.98*	5.21	Ave	1 MHz	176	1.74
9.7632	V	60.95	98.68	37.73	PK	100 KHz	172	1.0
12.204	H	62.47	73.98*	11.51	PK	1 MHz	155	1.0
12.204	H	45.59	53.98*	8.39	Ave	1 MHz	155	1.0

* Restricted Band Limit 15.209

Test Engineer: Mike Schultz	Date: 1 Aug 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	24
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 91 Patch Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
7.4390	V	62.49	73.68*	11.19	PK	1 MHZ	235	1.80
7.4390	V	41.64	53.68*	12.34	Ave	1MHz	235	1.80

* Restricted Band Limit 15.209

Test Engineer: Bruce Jungwirth	Date: 1 Aug 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	24
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 01 Omni Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
4.8038	V	56.67	73.98*	17.31	PK	1 MHz	140	1.0
4.8038	V	36.62	53.98*	17.36	Ave	1 MHz	140	1.0
7.2057	V	66.89	98.68	31.79	PK	100 KHz	230	1.65
9.6076	V	46.73	98.68	51.95	PK	100 KHz	0	1.0
12.0096	V	68.01	73.98*	5.97	PK	1 MHz	160	1.75
12.0096	V	45.86	53.98*	8.12	Ave	1 MHz	160	1.75

*Restricted Band Limit 15.209

Test Engineer: Mike Schultz	Date:1 Aug 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	24
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

Transmit channel 46 Omni Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
7.3224	V	73.20	73.98*	0.78	PK	1 MHz	230	1.65
7.3224	V	48.36	53.98*	5.62	Ave	1 MHz	230	1.65
9.7632	V	60.94	98.68	37.74	PK	100 KHz	103	1.55
12.204	V	63.02	73.98*	10.96	PK	1 MHz	135	1.0
12.204	V	45.80	53.98*	8.18	Ave	1 MHz	135	1.0

* Restricted Band Limit 15.209

Test Engineer: Mike Schultz	Date: 1 Aug 2012

Report Number	RE1207020	**Date**	1 Aug 2012
EUT Name	XT-1 Wireless Communication System	**EUT Power**	120 / 60
EUT Model	XT-1 Base Station	**Test Std**	15.247
EUT Serial #		**Temperature (°C)**	25
EUT Description	XT-1 Base Station	**Humidity (%)**	29
		Air Pressure (kPa)	100.1

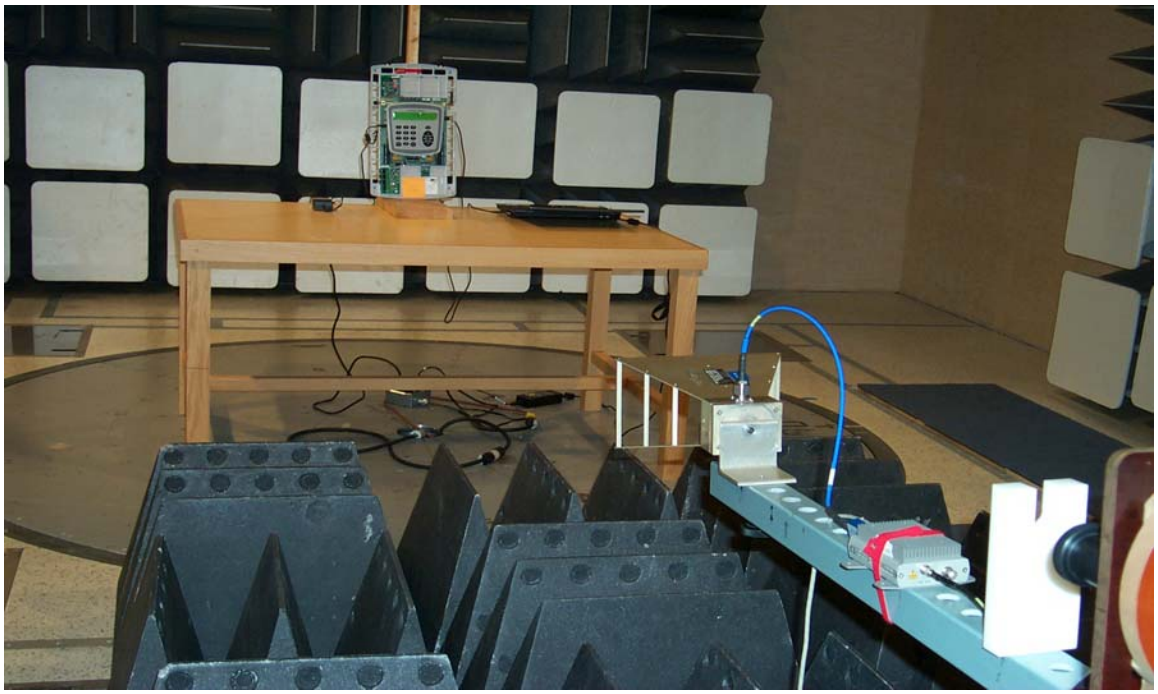
Transmit channel 91 Omni Antenna

FREQ. (GHz)	MAXIMIZED SIGNAL		LIMIT LINE	PASSING MARGIN	MAXIMIZED SIGNAL		TURN TABLE	ANTENNA HEIGHT
	H/V	(dBµV/m)	(dBµV/m)	(dB)	Detector	RBW	(degrees)	(m)
7.4390	V	65.19	73.68*	8.79	PK	1 MHZ	234	1.70
7.4390	V	43.32	53.68*	10.66	Ave	1MHz	234	1.70

* Restricted Band Limit 15.209

Test Engineer: Mike Schultz	Date: 1 Aug 2012

5.5.2.4 Setup Photos



Spurious Emissions 1 to 18 GHz
Internal Antenna

Spurious Emissions 1 to 18 GHz
External Omni Antenna

Spurious Emissions 1 to 18 GHz
External Patch Antenna

5.6 Human Exposure (EMF)

Spread Spectrum transmitters operating under Section 15.247 are categorically excluded from routine environmental evaluation for demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempt from compliance per 15.247 (b) (4).

5.6.1 Test Criteria

Limit per FCC OET 65 Table 1.

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	**--**	**--**	**1.0**	**30**

f = frequency in MHz *Plane-wave equivalent power density

5.6.2 Test Procedure

Calculate Power Density (mW/cm^2) based on EIRP using equation (4) in OET 65.

$$S = \frac{EIRP}{12.566\ R^2}$$

S= power density
EIRP= equivalent isotropic radiated power
R= distance to center of radiation of the antenna

5.6.3 Results

Assume the minimum separation distance from antenna is 20cm
Maximum EIRP per section 5.4.2 is 147.57 mw EIRP

$R^2 = 400$

$$S = \frac{147.57}{5026.4} \qquad S = 0.029\ mW/cm^2$$

The EUT met the general public exposure criteria.

6.0 LIST OF TEST EQUIPMENT

The following test equipment was used to perform the indicated tests. All test equipment was calibrated by an accredited calibration laboratory or by the manufacturer. All calibration intervals are one year. All equipment calibrations, test procedures, and test facility are traceable to the standards of the National Institute of Standards and Technology (NIST). The test facility site attenuation verification results fall within the normalized site attenuation (NSA) criteria for open area test sites using volumetric measurements.

RADIATED EMISSIONS
Schaffner Biconilog Antenna, Model CBL6112B, Serial No. 27491 (cal due date: 21 Oct 12)
A. H Systems Horn Antenna, Model SAS_200/571 Serial No: 234 (cal due date: 22 Oct 12)
HP Pre-Amplifier, Model 8447D, Serial No. 1937A03090 (cal due date: 21Oct 12)
HP Pre-Amplifier, Model 83017A, Serial No. 3123A00259 (cal due date: 20 Oct 12)
Rohde & Schwarz EMI Receiver, Model ESIB 40, S/N 100235 (cal due date: 23 Oct 12)
Rohde & Schwarz ESIB 40 Firmware Version 4.34.3

CONDUCTED EMISSIONS
EMCO LISN, Model 3825-2, Serial No. 1039 (cal due date: 20 Oct 12)
Solar High Pass Filter, Model 8130 - 5.0 (cal due date: 6 Jul 13)
Rohde & Schwarz EMI Receiver, Model ESIB 40, S/N 100235 (cal due date: 23 Oct 12)
Rohde & Schwarz ESIB 40 Firmware Version 4.34.3

CONDUCTED RF EMISSIONS / POWER OUTPUT
Agilent, Model E4448A Spectrum Analyzer, Serial No.MY50180107 (cal due date:14 Oct 12)

OCCUPIED BANDWIDTH
Agilent, Model E4448A Spectrum Analyzer, Serial No.MY50180107 (cal due date:14 Oct 12)

TEST FACILITY
Lindgren Semi-Anechoic Chamber, (verification due date: 30 Nov 12)
FCC Site Registration Number: 790245
Canadian Site Registration Number: 458A-1

SOFTWARE
EMI Measurement Software, Rohde & Schwarz ESIB-K1 Vers. 1.20

7.0 LABELING INFORMATION

The following labeling information is required by the FCC (Federal Communications Commission) and IC (Industry Canada) for Class A digital devices. Since the equipment contains both intentional and unintentional radiators, it must be labeled as a digital device and as an intentional radiator.

Labels on the Product

The following statements shall be placed in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC ID: DGFBCSDXT1B
IC: 458A-BCSDXT1B

"This Class A digital apparatus complies with Canadian ICES-003."

"Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada."

Statements in the Manuals

The following statement shall be placed in a prominent location in the text of the user manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

FCC ID: DGFBCSDXT1B

NO MODIFICATIONS. Modifications to this device shall not be made without the written consent of 3M, Company. Unauthorized modifications may void the authority granted under Federal Communications Commission and Industry Canada Rules permitting the operation of this device.

"This Class A digital apparatus complies with Canadian ICES-003."

"Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada."

IC: 458A-BCSDXT1B

This is the last page of the Test Report