



LS RESEARCH, LLC

Wireless Product Development

W66 N220 Commerce Court • Cedarburg, WI 53012 USA • Phone: 262.375.4400 • Fax: 262.375.4248 • www.lsr.com

ENGINEERING TEST REPORT # TR 315103 B

LSR Job #: C-2210

Compliance Testing of:

OneExpert CATV

Test Date(s):

April-June 2015

Prepared For:

JDSU

5808 Churchman Bypass

Indianapolis, IN 46203

This Test Report is issued under the Authority of: Tom Smith, VP EMC Test Services

Signature:

Date: 9-1-15

Test Report Reviewed by:

Tom Smith, VP EMC Test Services

Signature:

Date: 8-7-15

Report by:

Adam Alger, EMC Engineer

Signature:

Date: 8-3-15

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Prepared For: JDSU

Report: TR 315103 B

LSR: C-2210

Name: OneExpert CATV

Model: OneExpert CATV

Serial: Eng. Sample

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LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:



TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation

A2LA Certificate Number: 1255.01



Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948

FCC Registration Number: 90756



Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1

File Number: IC 3088-A

On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1

File Number: IC 3088



U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility – Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).

Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: November 20, 2002

Notified Body Identification Number: 1243

Prepared For: JDSU

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Name: OneExpert CATV

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Serial: Eng. Sample

1.0 Summary of Test Report

In April-June 2015 the EUT, OneExpert CATV, as supplied by JDSU was tested and MEETS the following requirements:

FCC Requirement	IC Requirement	Test Requirements	Measurement Procedure	Compliance (Yes/No)
15.247 (a)(1)	RSS-247 Section 5.1 (1)	Bandwidth of a Frequency Hopping System	ANSI C63.10-2013 Section 6.9	Yes
15.247(b) & 1.1310	RSS-247 Section 5.4 (2)	Maximum Output Power	ANSI C63.10-2013 Section 7.8	Yes
15.247 (a)(1)	RSS-247 Section 5.1 (2)	Carrier Frequency Separation	ANSI C63.10-2013 Section 7.8	Yes
15.247 (a)(1)(iii)	RSS-247 Section 5.1 (4)	Number of Channels and Time of Occupancy	ANSI C63.10-2013 Section 7.8	Yes
15.247(d)	RSS-247 Section 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10-2013 Section 7.8	Yes
15.247(c), 15.209 & 15.205	RSS-GEN Section 8.9, 8.10	Transmitter Radiated Emissions in Restricted Bands	ANSI C63.10-2013 Section (6.3,6.5,6.6)	Yes
2.1055 (d)	RSS-GEN Section 6.11	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.207	RSS-GEN Section 8.8	Power Line Conducted Emissions Measurements	ANSI C63.10-2013 Section 6.2	Yes

2.0 Test Facilities

All testing was performed at:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

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3.0 Client Information

Manufacturer Name:	JDSU
Address:	5808 Churchman Bypass Indianapolis, IN 46203
Contact Person:	Adam Nowotarski

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	OneExpert CATV
Model Number:	OneExpert CATV
Serial Number:	Eng. Sample
FCC ID:	WUW-22100382
IC:	9613A-22100382

3.2 Product Description

Bluetooth device using Basic Rate, EDR-2, EDR-3
Device does not transmit BT and WLAN simultaneously

3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

3.5 Additional Information

Low Channel 0 (2402MHz), Middle Channel 39 (2441 MHz), High Channel 78 (2480 MHz).
EUT programmed for continuous transmit or receive on selectable channel and data rate (modulation) using hyper terminal program connection via Ethernet port on EUT.

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4.0 Conditions of Test

Environmental:

Temperature: 20-25° C
Relative Humidity: 30-60%
Atmospheric Pressure: 86-106 kPa

Mains Voltage: 120 VAC 60 Hz

5.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

Frequency Range	Resolution Bandwidth
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1 MHz

6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.207 as well as Industry Canada RSS-247 Issue 1, RSS-GEN Issue 4.

If some emissions are seen to be within 3 dB of their respective limits:

As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

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Appendix B – Test Data
B.1 – RF Conducted Emissions

Manufacturer	JDSU
Test Location	LS Research, LLC
Rule Part	FCC 15.247 IC RSS-247
General Measurement Procedure	ANSI C63.10 Section 6.7
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

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B.1.1 – RF Conducted – Fundamental Bandwidth

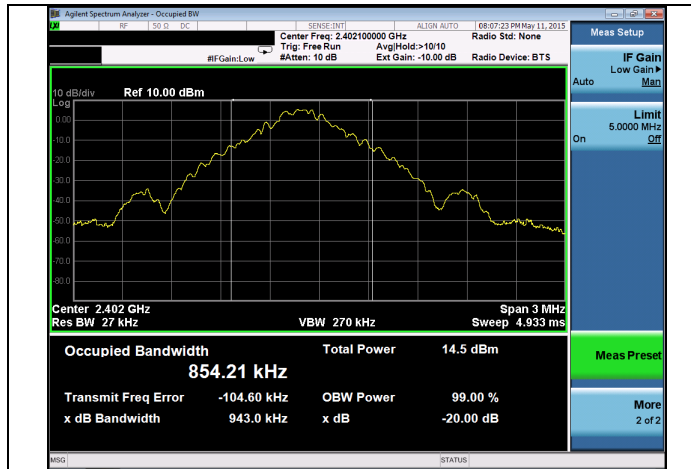
Manufacturer	JDSU
Date	5-11-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1) IC RSS-247 Section 5.1 (1)
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.9
Additional Description of Measurement	Peak detector used
Additional Notes	Continuous transmit modulated used for this test.

Table

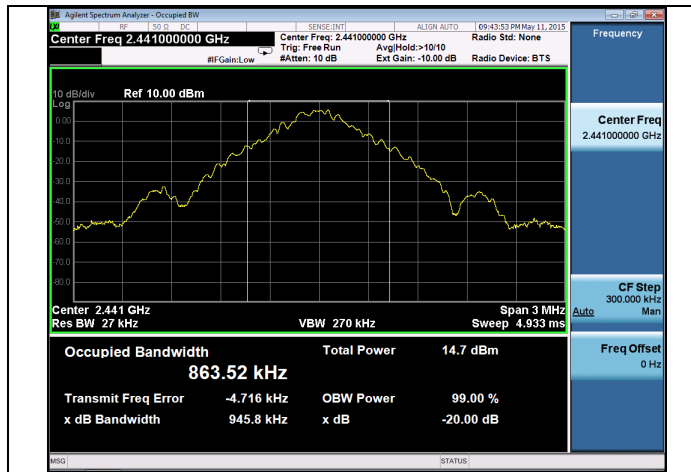
Mode	Frequency (MHz)	20 dB OBW (MHz)	99 % BW (MHz)
BR	2402	0.943	0.854
	2441	0.946	0.864
	2480	0.948	0.871
EDR-2	2402	1.371	1.239
	2441	1.370	1.224
	2480	1.375	1.222
EDR-3	2402	1.356	1.233
	2441	1.356	1.225
	2480	1.356	1.224

Plots – BR

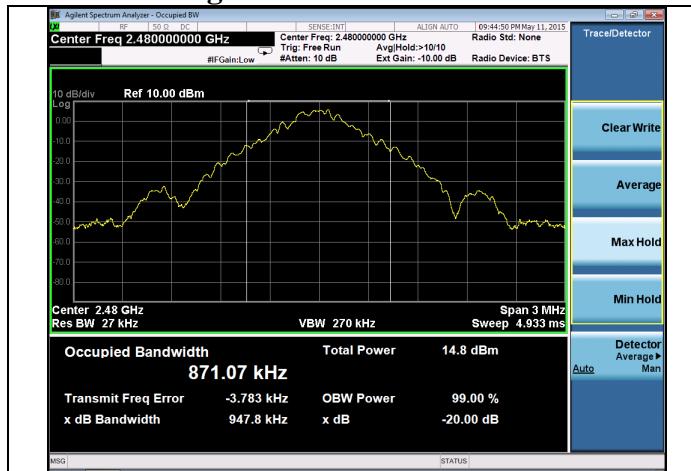
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz

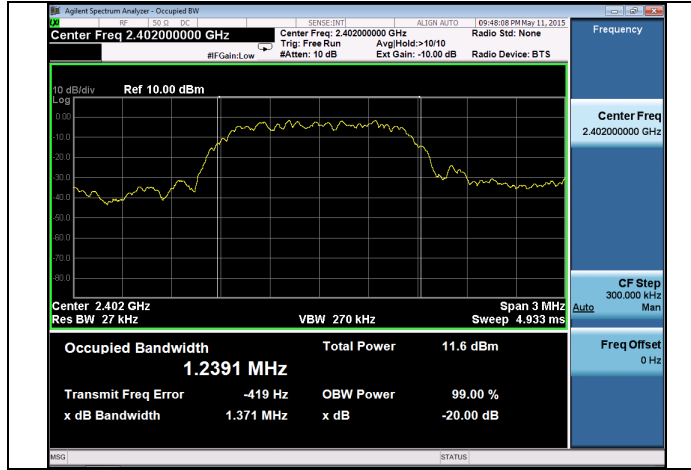


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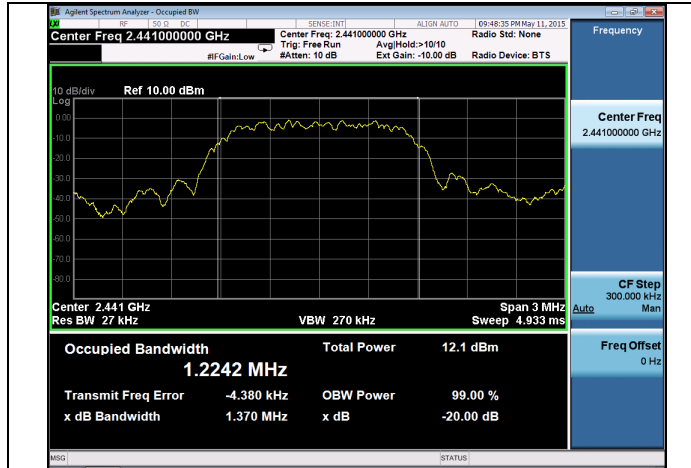
Name: OneExpert CATV
 Model: OneExpert CATV
 Serial: Eng. Sample

Plots – EDR-2

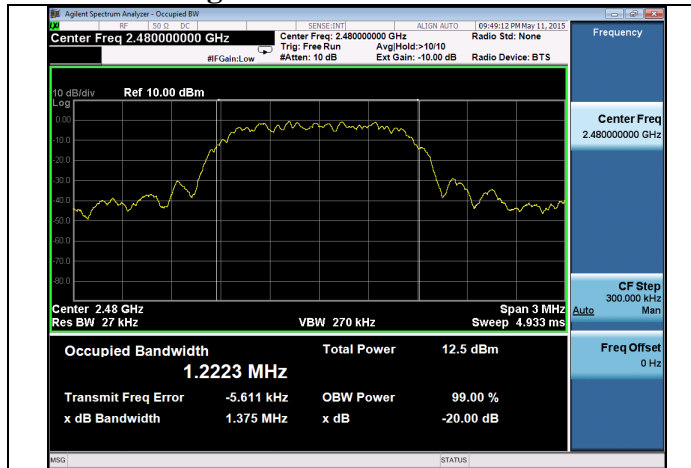
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz

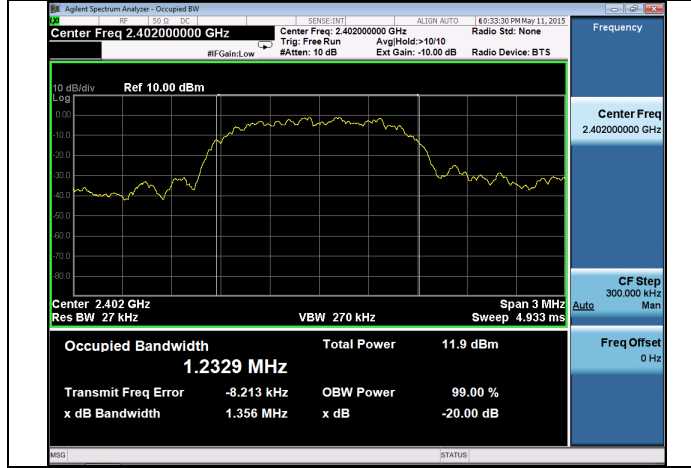


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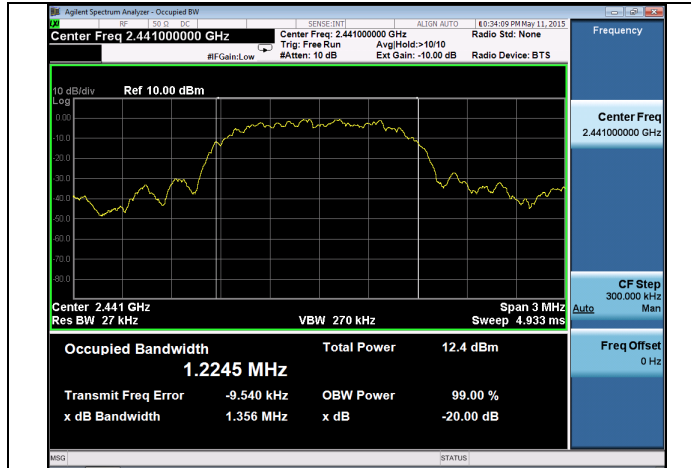
Name: OneExpert CATV
 Model: OneExpert CATV
 Serial: Eng. Sample

Plots – EDR-3

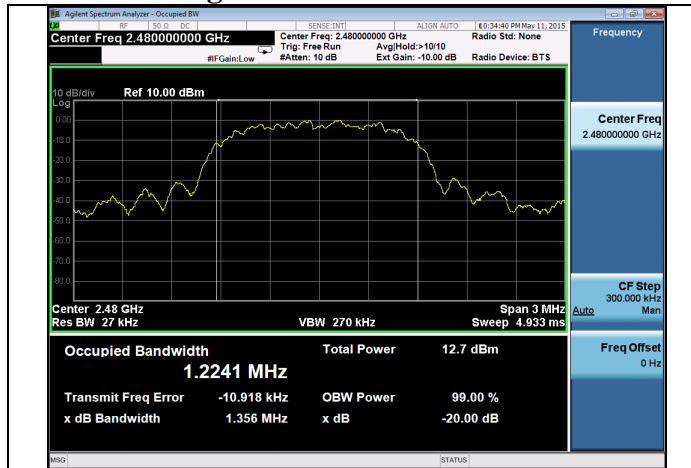
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz



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Name: OneExpert CATV
 Model: OneExpert CATV
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B.1.2 – RF Conducted – Fundamental Power

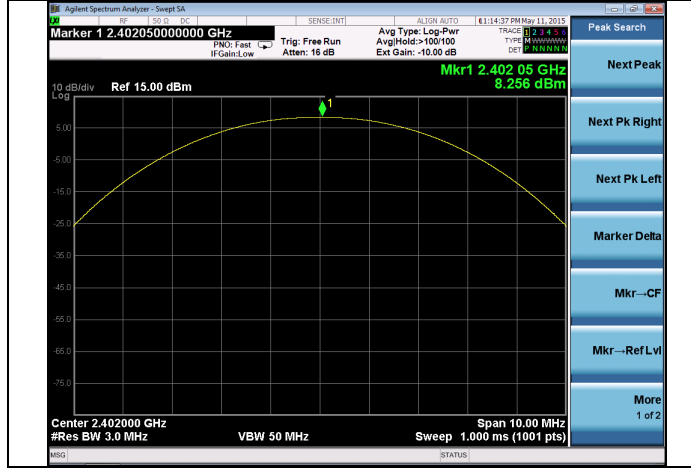
Manufacturer	JDSU
Date	5-11-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 (b) IC RSS-247 Section 5.4 (2)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	Peak detector with Max Hold and RBW greater than 20 dB OBW
Additional Notes	Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured level

Table

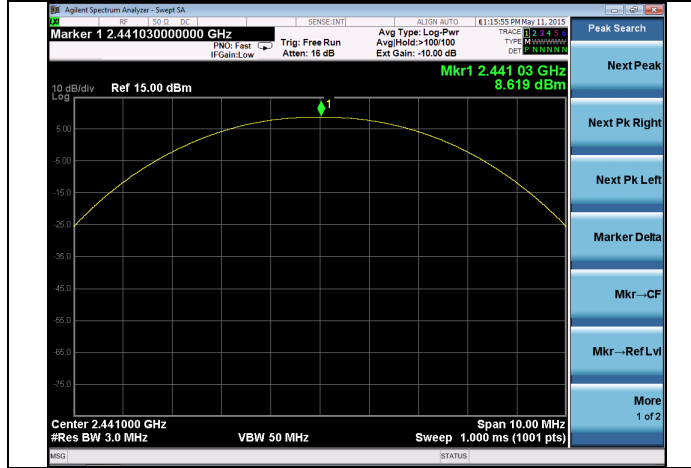
Mode	Frequency (MHz)	20 dB OBW (MHz)	99 % BW (MHz)	Output Power (dBm)
BR	2402	0.943	0.854	8.26
	2441	0.946	0.864	8.62
	2480	0.948	0.871	8.59
EDR-2	2402	1.371	1.239	8.28
	2441	1.370	1.224	8.63
	2480	1.375	1.222	8.72
EDR-3	2402	1.356	1.233	9.13
	2441	1.356	1.225	9.39
	2480	1.356	1.224	9.37

Plots – BR

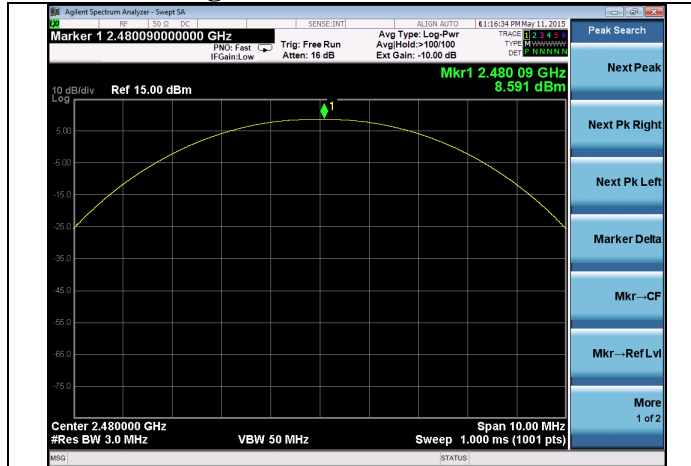
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz

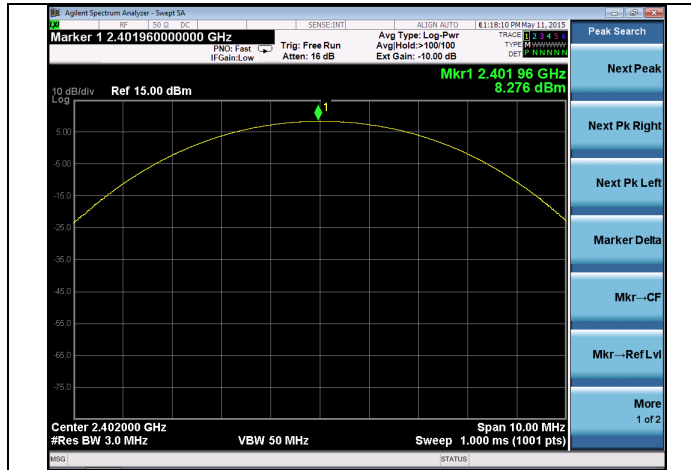


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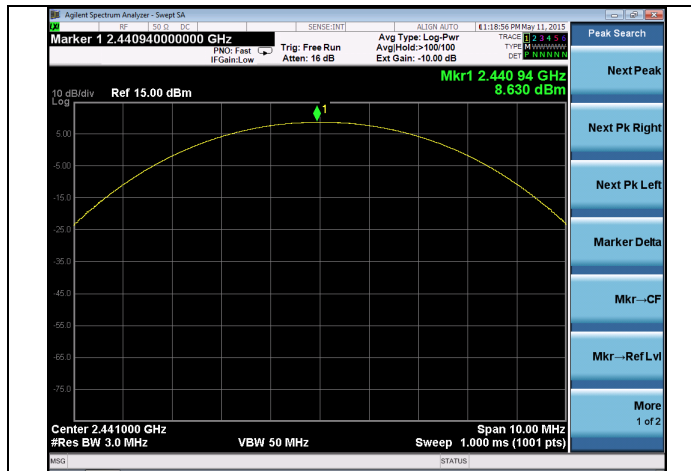
Name: OneExpert CATV
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Plots – EDR-2

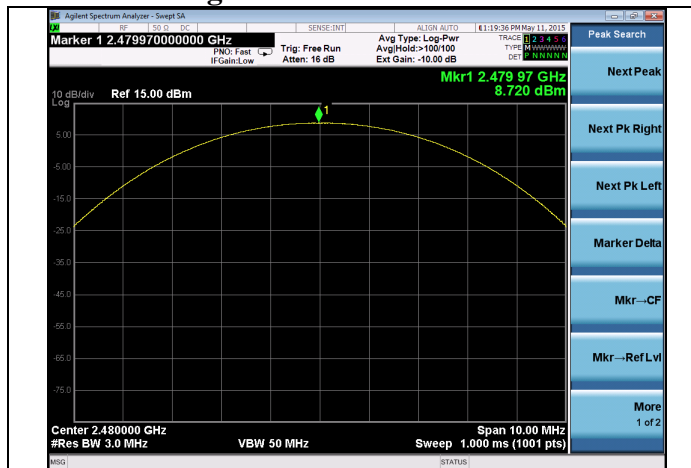
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz

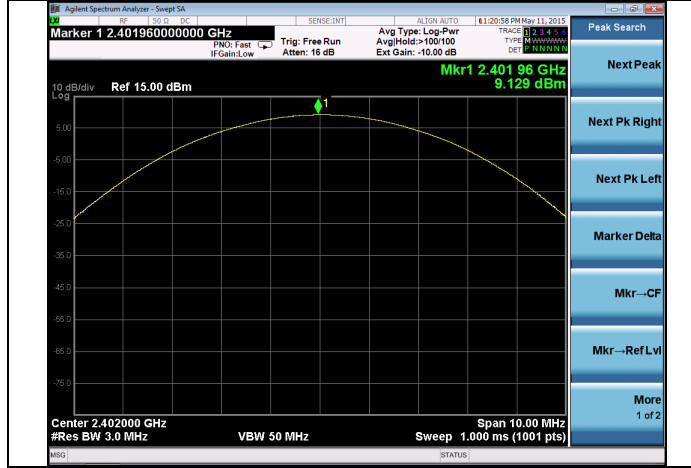


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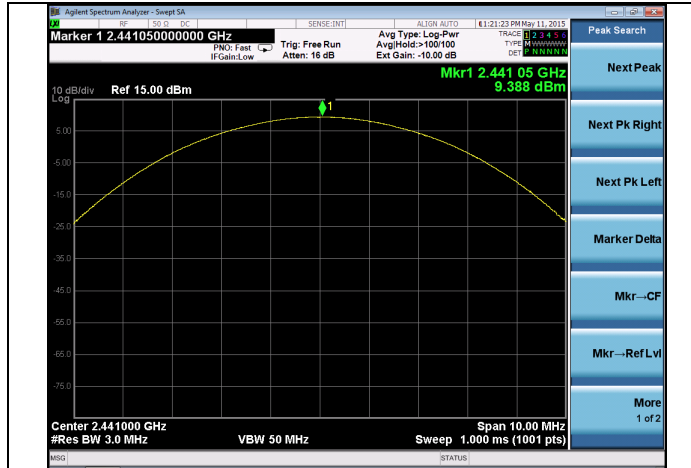
Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

Plots – EDR-3

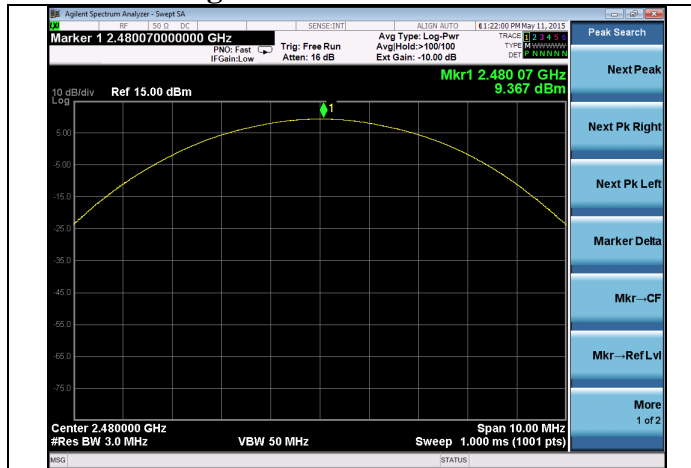
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz

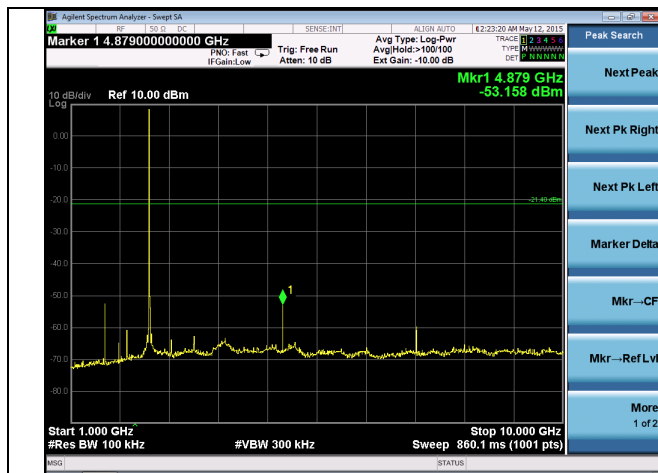


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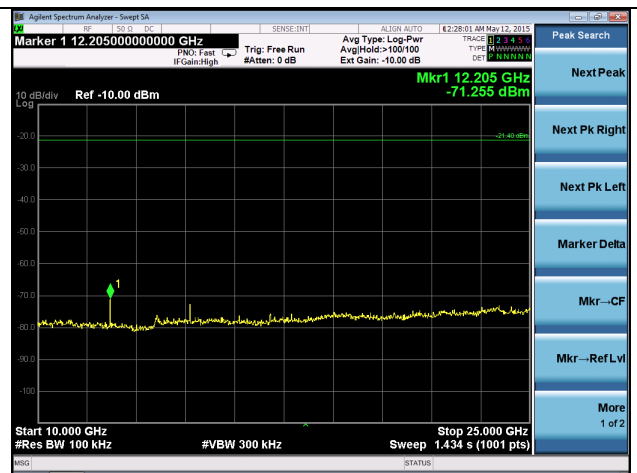
Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

B.1.3 – RF Conducted – Transmitter Spurious Emissions

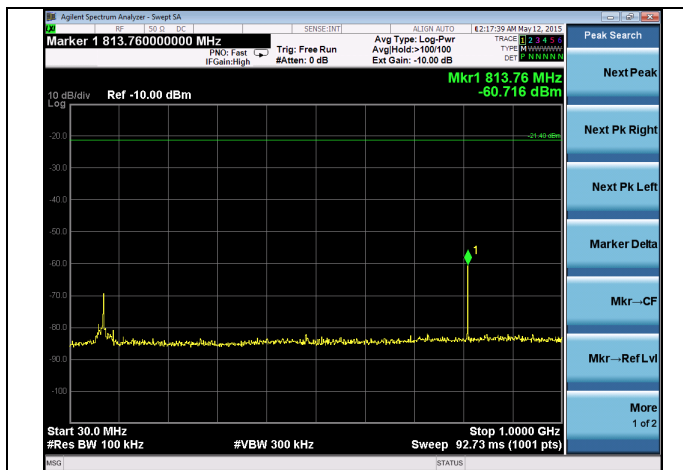
Manufacturer	JDSU
Date	5-12-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 (d) IC RSS-247 Section 5.5
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	Peak detector
Additional Notes	1. BR – Mid channel worst case data shown



1 – 10 GHz



10-25 GHz



30-1000 MHz

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Name: OneExpert CATV
 Model: OneExpert CATV
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B.1.4 – RF Conducted – Frequency Stability

Manufacturer	JDSU
Date	5-15-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 2.1055 RSS-GEN Section 6.11
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	<p>The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied from the nominal.</p> <p>The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.</p> <p>Below is data showing stability of the fundamental frequency.</p> <p>Continuous transmit un-modulated used for this test.</p>

Channel	Supply voltage (DC)		Deviation (Hz)
	Nominal (7.4 VDC)	-15% (6.3 VDC)	
Low (Hz)	2401996039	2401996052	13
Middle (Hz)	2440995977	2440995978	1
High (Hz)	2479995921	2479995905	16

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B.1.5 – RF Conducted – Carrier Frequency Separation, Number of Channels, and Time of Occupancy

Manufacturer	JDSU
Date	Shane R.
Operator	5-11, 12 2015
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1) & (a)(1)(iii) IC RSS-247 Section 5.1 (2) & 5.1 (4)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	Hopping mode enabled – BR found to be worst case mode

Carrier Frequency Separation = 1.0 MHz > two-thirds of the 20 dB BW of the hopping channel when operating with output power less than 125 mW.

Number of Channels = 79

Time of Occupancy = 0.4 seconds with a period of 0.4 seconds multiplied by the number of hopping channels employed.

$$0.4 \text{ s} \times 79 = 31.6 \text{ s}$$

$$\text{Dwell Time} = 395 \text{ } \mu\text{s}$$

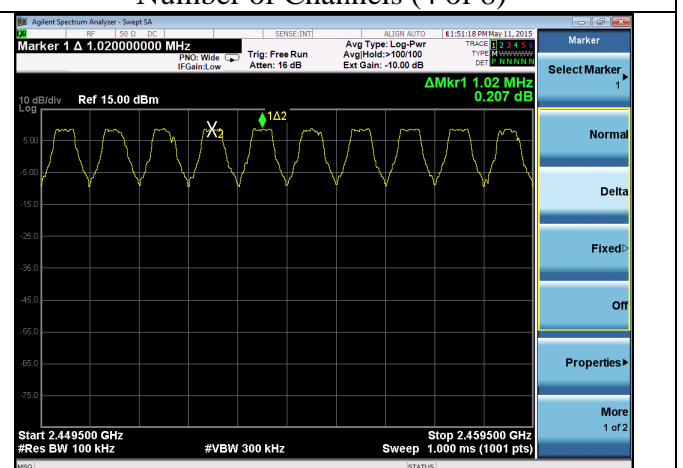
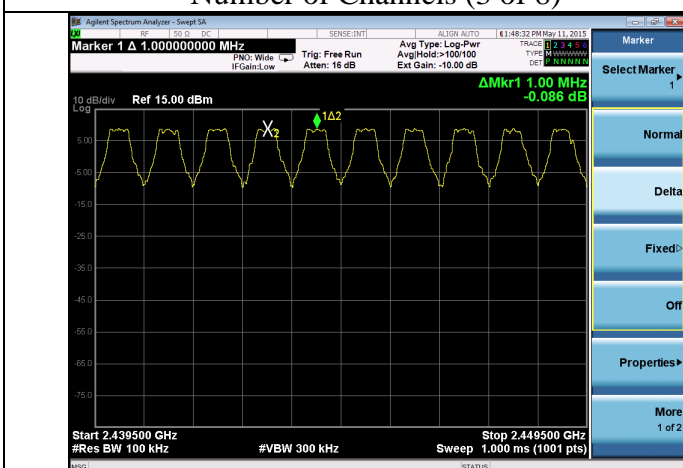
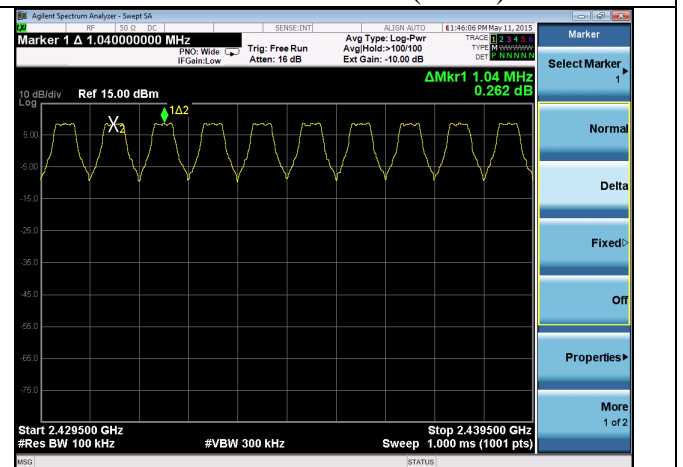
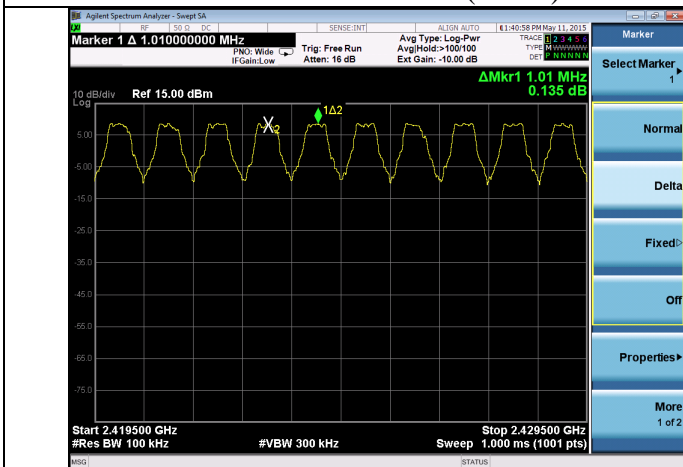
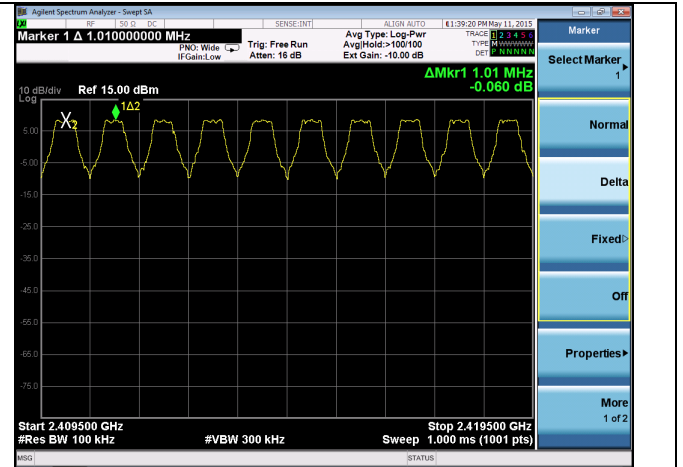
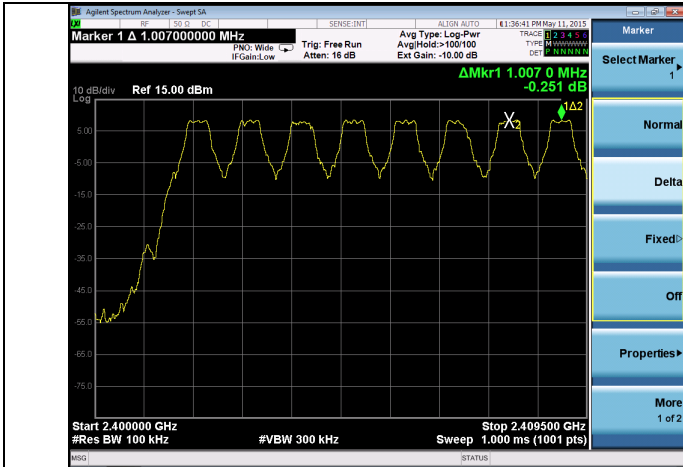
$$\text{Number of Hops in } 20 \text{ s} = 124$$

$$31.6 \text{ s} / 20 \text{ s} = 1.58$$

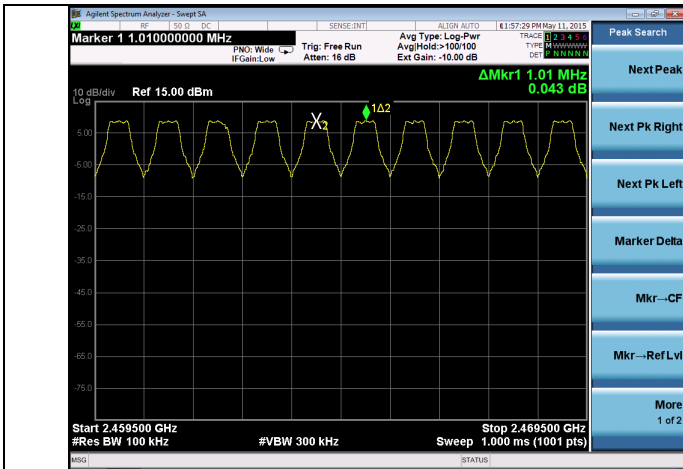
$$395 \text{ } \mu\text{s} \times 124 \times 1.58 = 77.4 \text{ ms} < 0.4 \text{ in } 31.6 \text{ s}$$

Prepared For: JDSU	Name: OneExpert CATV
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LSR: C-2210	Serial: Eng. Sample

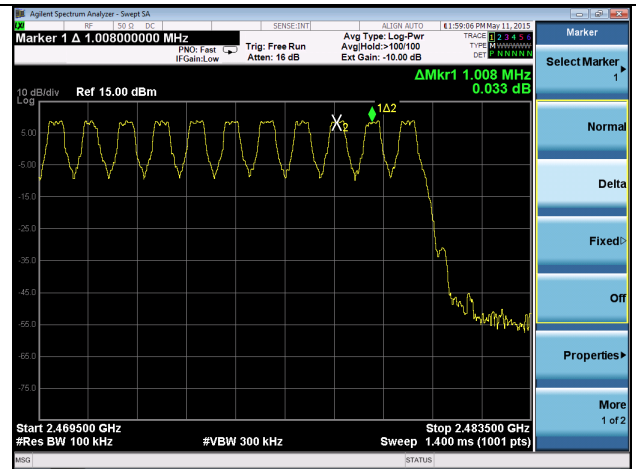
Plots



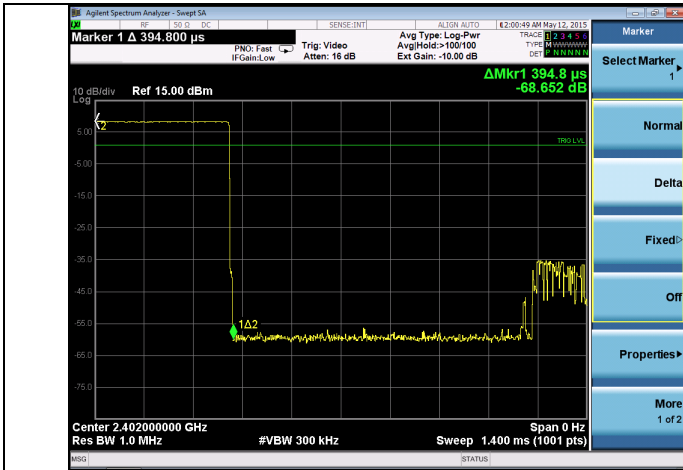
Prepared For: JDSU	Name: OneExpert CATV
Report: TR 315103 B	Model: OneExpert CATV
LSR: C-2210	Serial: Eng. Sample



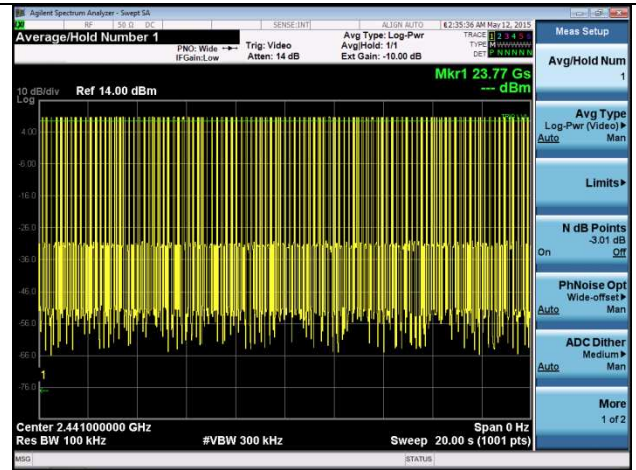
Number of Channels (7 of 8)



Number of Channels (8 of 8)



Dwell Time



Number of Pulses

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Name: OneExpert CATV
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B.2 – Transmitter Radiated Emissions in Restricted Bands

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-GEN Section 8.9,8.10			
Measurement Procedure	ANSI C63.10 – 2013 Section 6.3,6.5,6.6			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: \leq 30 Hz Average	
Description of Measurement	<p>1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values.</p> <p>2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT</p> <p>3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.</p>			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (μ V/m)	3 m Limit (dB μ V/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

Prepared For: JDSU

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LSR: C-2210

Serial: Eng. Sample

B.2.1 – Radiated Band-Edge Restricted Bands

Manufacturer	JDSU
Date	4-28-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 10Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported.

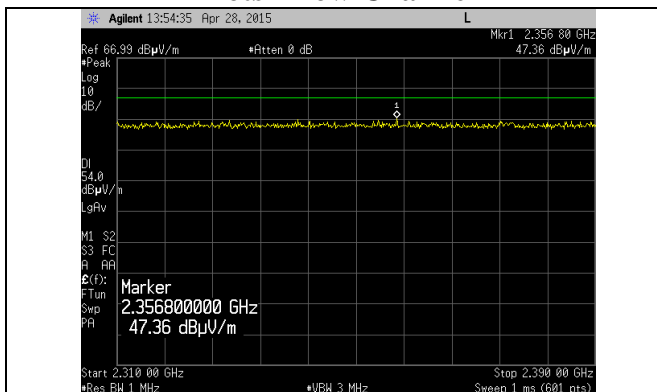
Example Calculation:

$$\text{Limit (dB}\mu\text{V/m)} - \text{Reading (dB}\mu\text{V/m)} = \text{Margin (dB)}$$

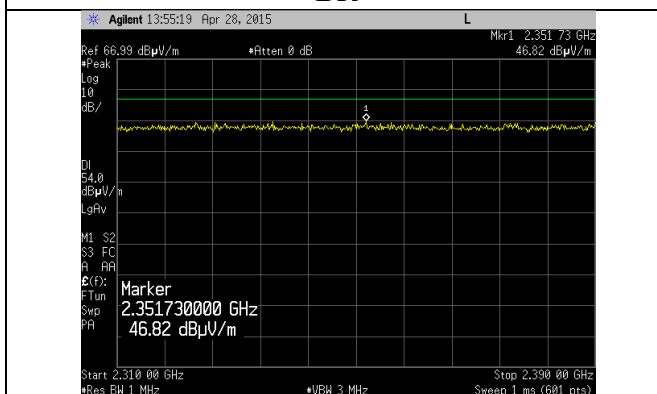
Table

Mode	Channel	Frequency (GHz)	Meas (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas Type	Limit Type
BR	0	2.38680	47.36	54	6.6	Peak	Average
	78	2.48435	48.07	54	5.9	Peak	Average
EDR-2	0	2.35173	46.82	54	7.2	Peak	Average
	78	2.48350	38.30	54	15.7	Average	Average
	78	2.49043	61.25	74	12.8	Peak	Peak
EDR-3	0	2.38853	47.10	54	6.9	Peak	Average
	78	2.48350	38.01	54	16.0	Average	Average
	78	2.48361	62.13	74	11.9	Peak	Peak

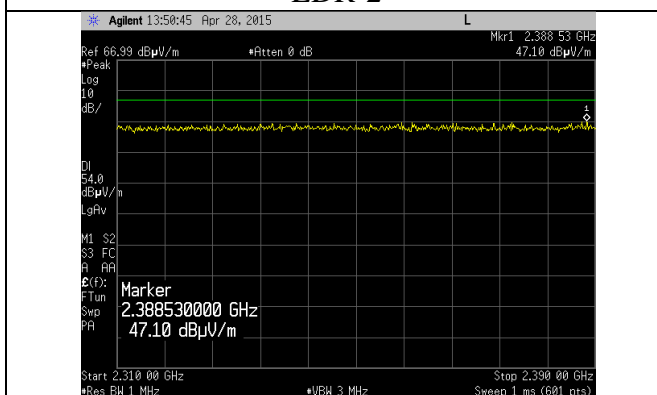
Plots - Low Channel



BR



EDR-2

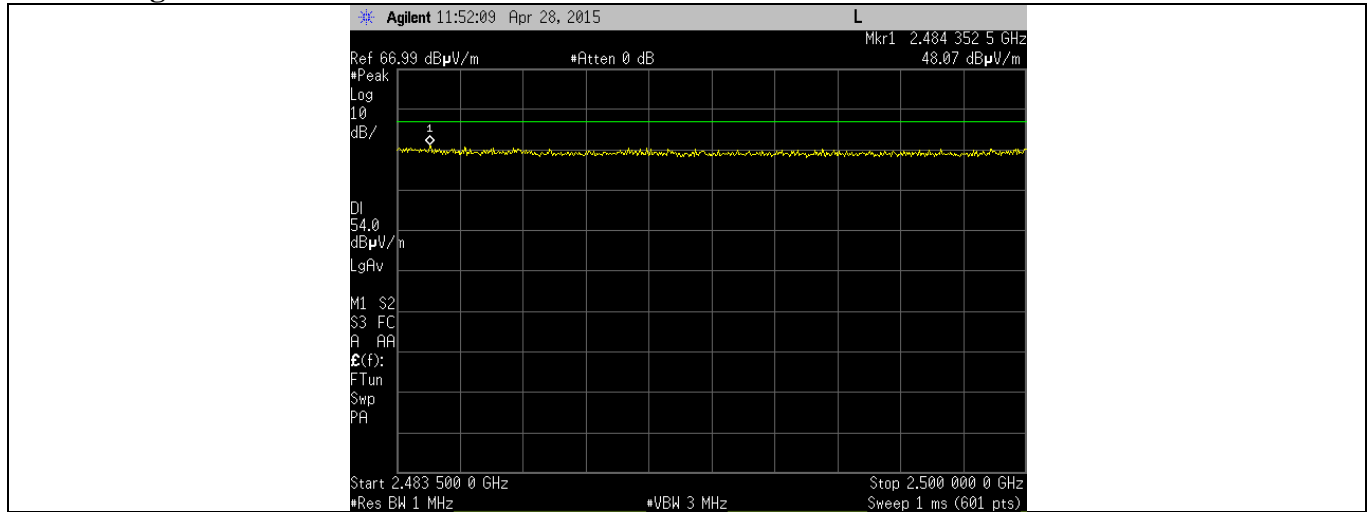


EDR-3

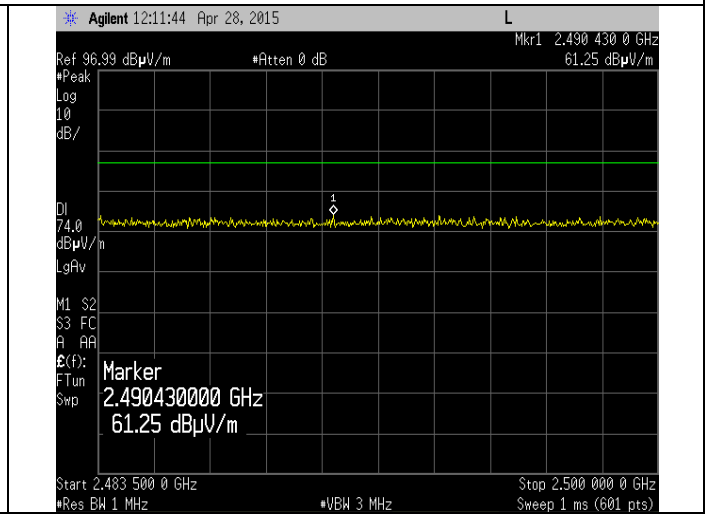
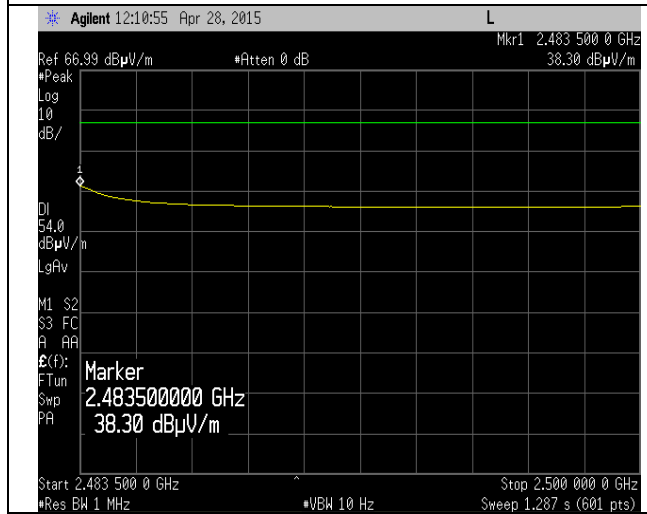
Prepared For: JDSU
Report: TR 315103 B
LSR: C-2210

Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

Plots - High Channel

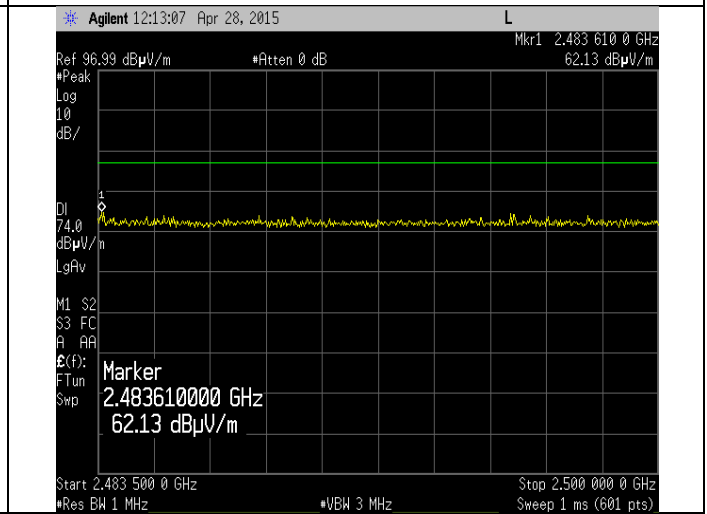
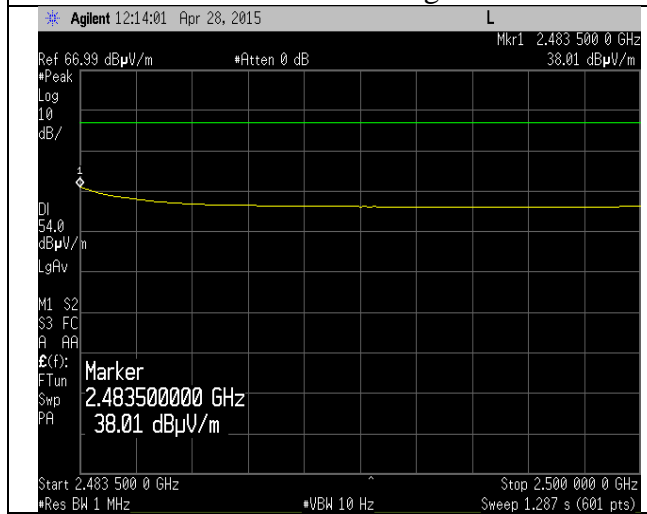


BR – Peak



EDR-2 – Average

EDR-2 – Peak



EDR-3 – Average

EDR-3 – Peak

Prepared For: JDSU
Report: TR 315103 B
LSR: C-2210

Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

B.2.2 – Radiated Harmonics in Restricted Bands

Manufacturer	JDSU
Date	5-6-15
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Peak VBW 3 MHz
Additional Notes	<ol style="list-style-type: none"> 1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) Worst case mode (BR) measured. 3) *Refer to Appendix E for duty cycle correction. (14.9 dB)

Example Calculation:

Peak Limit (74 dB μ V/m @ 3m) – Peak Reading (dB μ V/m) = Peak Margin (dB)

Peak Reading (dB μ V/m) – Duty Cycle* (dB) = Calculated Average (dB μ V/m)

Average Limit (54 dB μ V/m @ 3m) – Calculated Average (dB μ V/m) = Average Margin (dB)

Table

EUT Channel	Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dB μ V/m)	Calculated Average (dB μ V/m)	Peak Margin (dB)	Average Margin (dB)
Low	4804	Vertical	Horizontal	140	195	47.4	32.5	26.6	21.5
			Vertical	105	158	50.6	35.7	23.4	18.3
		Side	Horizontal	125	121	48.1	33.2	25.9	20.8
			Vertical	100	151	48.1	33.2	25.9	20.8
		Flat	Horizontal	160	90	47.6	32.7	26.4	21.3
			Vertical	132	166	49.3	34.4	24.7	19.6
Mid	4882	Vertical	Horizontal	100	157	57.4	42.5	16.6	11.5
			Vertical	128	212	51.0	36.1	23.0	17.9
		Side	Horizontal	108	150	52.8	37.9	21.2	16.1
			Vertical	100	140	55.5	40.6	18.5	13.4
		Flat	Horizontal	144	100	52.1	37.2	21.9	16.8
			Vertical	118	128	54.5	39.6	19.5	14.4
High	4960	Vertical	Horizontal	163	150	58.8	43.9	15.2	10.1
			Vertical	100	204	52.5	37.6	21.5	16.4
		Side	Horizontal	135	151	54.5	39.6	19.5	14.4
			Vertical	118	154	57.1	42.2	16.9	11.8
		Flat	Horizontal	146	95	55.2	40.3	18.8	13.7
			Vertical	164	187	55.4	40.5	18.6	13.5

Prepared For: JDSU

Name: OneExpert CATV

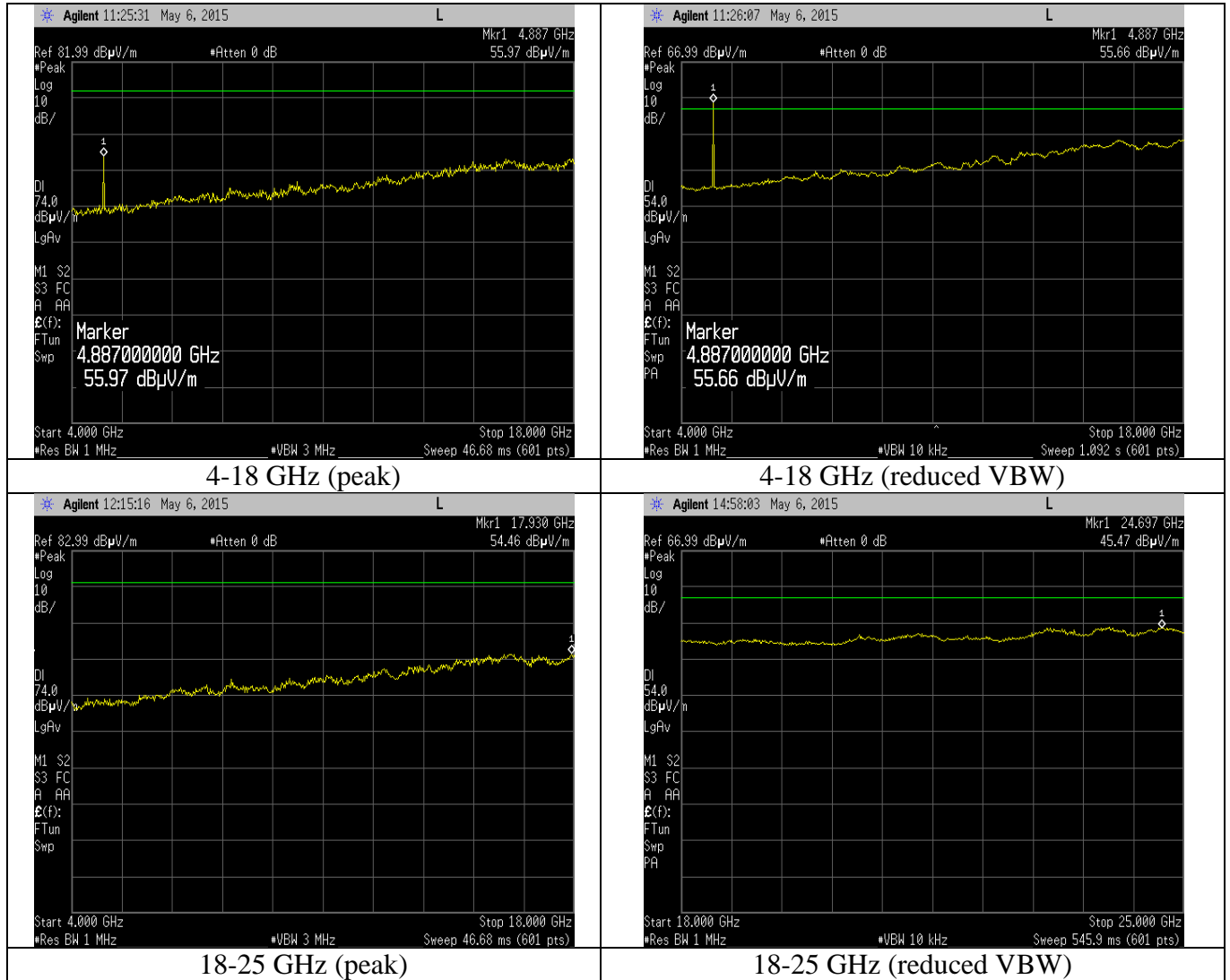
Report: TR 315103 B

Model: OneExpert CATV

LSR: C-2210

Serial: Eng. Sample

Plots



Prepared For: JDSU	Name: OneExpert CATV
Report: TR 315103 B	Model: OneExpert CATV
LSR: C-2210	Serial: Eng. Sample

B.2.3 – Radiated Spurious Emissions Transmit Mode (1-26 GHz)

Manufacturer	JDSU
Date	4-28, 5-6 2015
Operator	Shane R.
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter 1-18 GHz
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Peak; RBW 1 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) No Emissions found above system noise floor 3) Frequency ranges 2310-2390 MHz, 2483.5-2500 MHz, and 4-25 GHz seen in previous sections.

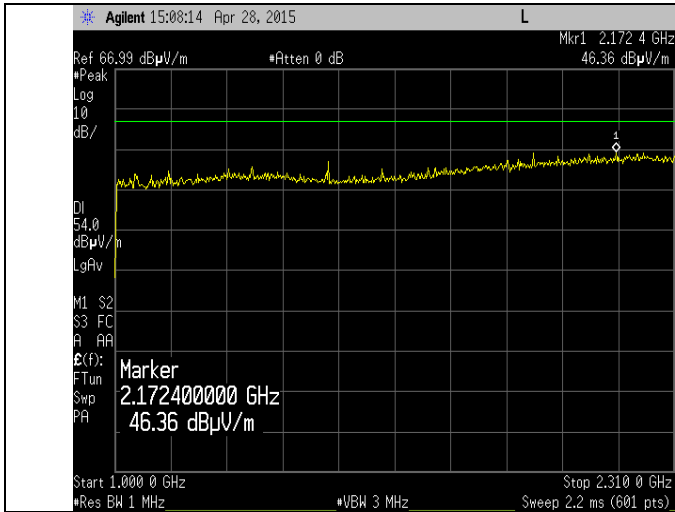
Example Calculation:

$$\text{Limit (dB}\mu\text{V/m)} - \text{Reading (dB}\mu\text{V/m)} = \text{Margin}$$

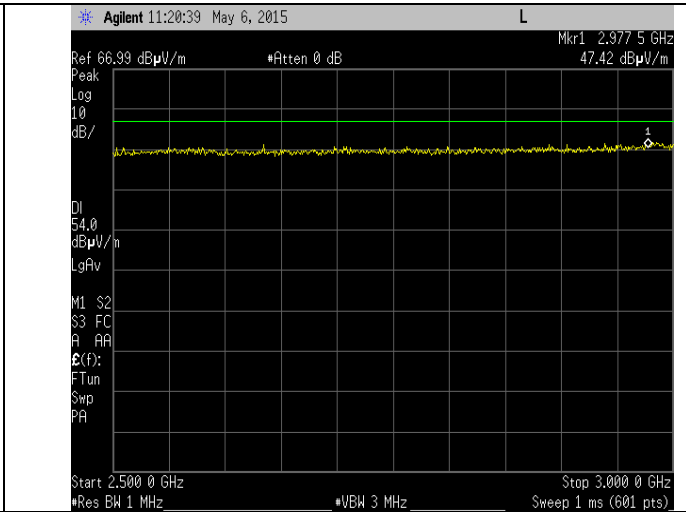
Prepared For: JDSU
Report: TR 315103 B
LSR: C-2210

Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

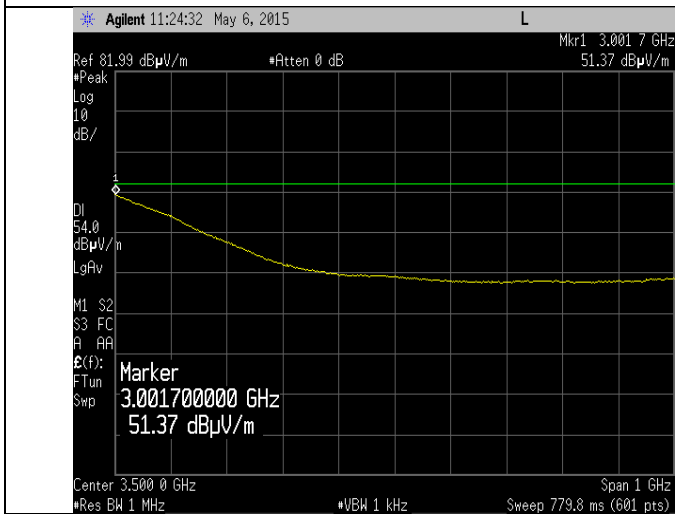
Plots



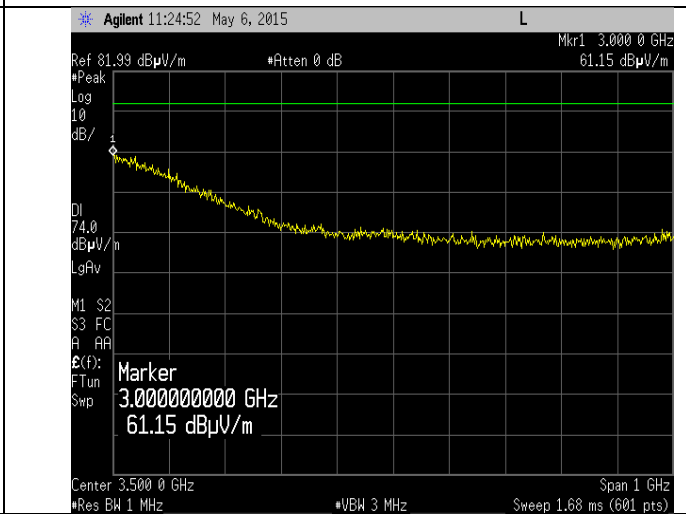
1-2.31 GHz



2.5-3 GHz



3-4 GHz (Reduced VBW)



3-4 GHz Peak

Prepared For: JDSU
Report: TR 315103 B
LSR: C-2210

Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample

B.2.4 – Radiated Spurious Emissions Transmit Mode (30-1000 MHz)

Manufacturer	JDSU
Date	6-19-15
Operator	Adam A
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.5
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous transmit modulated mode with EUT in three orientations at maximum power. 2) Emissions not effected by channel or modulation.

Example Calculation:

$$\text{Limit (dB}\mu\text{V/m)} - \text{Reading (dB}\mu\text{V/m)} = \text{Margin}$$

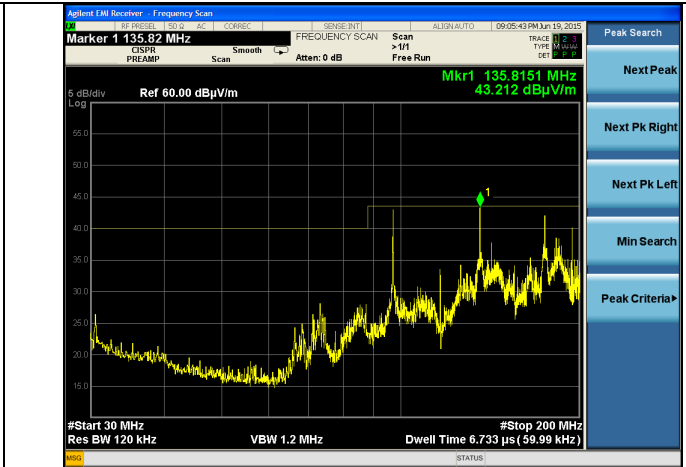
Table

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dB μ V/m)	Quasi-Peak Limit (dB μ V/m)	Margin (dB)
97.0	Vertical	100	0	40.7	43.5	2.8
73.9	Vertical	100	257	38.4	40.0	1.6
31.4	Vertical	100	187	33.5	40.0	6.5
135.8	Horizontal	314	252	39.2	43.5	4.3
97.0	Horizontal	218	90	38.5	43.5	5.0
174.5	Horizontal	179	126	38.1	43.5	5.4
875.0	Vertical	126	16	44.4	46.0	1.6
213.4	Vertical	100	159	34.5	43.5	9.0
625.0	Vertical	100	0	39.0	46.0	7.0
698.2	Horizontal	121	0	39.9	46.0	6.1
504.2	Horizontal	201	300	40.9	46.0	5.1
426.6	Horizontal	195	0	39.3	46.0	6.7

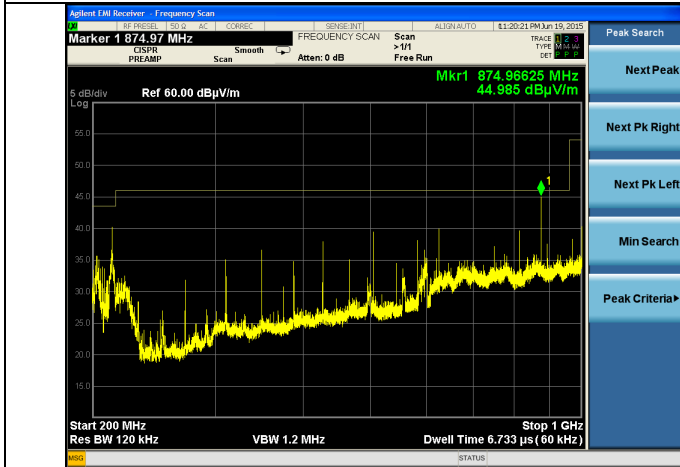
Plots



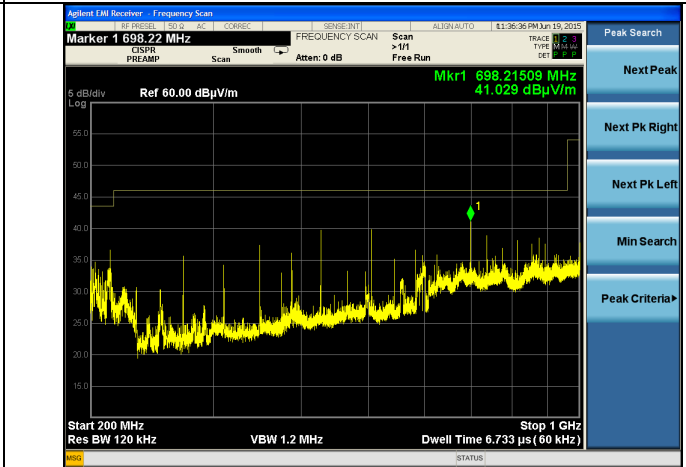
30-200 MHz Vertical



30-200 MHz Horizontal



200-1000 MHz Vertical



200-1000 MHz Horizontal

Prepared For: JDSU
 Report: TR 315103 B
 LSR: C-2210

Name: OneExpert CATV
 Model: OneExpert CATV
 Serial: Eng. Sample

B.3 – AC Mains Conducted Emissions

Rule Part(s)	FCC: 15.207 / 15.107 IC: RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 – 2013
Test Location	LS Research, LLC – Conducted Emissions Area
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table above reference ground plane
Frequency Range of Measurement	150 kHz – 30 MHz
Measurement Detectors	Peak, Quasi-Peak, Average RBW: 9 kHz VBW: At least 27 kHz
Description of Measurement	<p>1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values.</p> <p>2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).</p> <p>3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.</p>
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)

Limits of Conducted Emissions at the AC Mains Ports:

Frequency Range (MHz)	Class B Limits (dBμV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50

* The limit decreases linearly with the logarithm of the frequency in this range.

Prepared For: JDSU	Name: OneExpert CATV
Report: TR 315103 B	Model: OneExpert CATV
LSR: C-2210	Serial: Eng. Sample

B.4.1 – AC Mains Conducted Emissions

Manufacturer	JDSU
Date	6-22-15
Operator	Adam A
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	15.207 / 15.107 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz supplied to AC adapter supplied by applicant for use with EUT
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak; RBW 9 kHz Quasi-Peak and Average
Additional Notes	1) Tested in continuous transmit and receive with no significant difference between operating channels. WLAN Channel 6, 1 MBPS for final data.

Example Calculation:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V)} - \text{Reading (dB}\mu\text{V)}$$

Table

Frequency (MHz)	Line	Peak Reading (dB μ V)	Quasi-Peak Reading (dB μ V)	Average Reading (dB μ V)	Q-Peak Limit (dB μ V)	Quasi-Peak Margin (dB)	Average Limit (dB μ V)	Average Margin (dB)
0.150	1	52.6	47.4	34.7	66.00	18.6	56.00	21.3
0.222	1	47.7	41.0	30.6	62.74	21.7	52.74	22.1
0.469	1	43.3	39.3	30.0	56.53	17.2	46.53	16.5
6.193	1	38.4	34.9	28.6	60.00	25.1	50.00	21.4
6.445	1	38.1	34.4	27.9	60.00	25.6	50.00	22.1
0.177	1	49.3	43.0	32.7	64.63	21.6	54.63	21.9
0.163	2	50.0	45.8	32.2	65.31	19.5	55.31	23.1
0.190	2	46.2	42.4	29.0	64.04	21.6	54.04	25.0
0.469	2	43.2	40.0	29.9	56.53	16.5	46.53	16.6
0.437	2	41.5	37.9	29.2	57.12	19.2	47.12	17.9
6.179	2	38.6	35.9	29.7	60.00	24.1	50.00	20.3
6.449	2	38.5	35.8	29.5	60.00	24.2	50.00	20.5

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Plots



Line 1



Line 2

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 Report: TR 315103 B
 LSR: C-2210

Name: OneExpert CATV
 Model: OneExpert CATV
 Serial: Eng. Sample

Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64°/ 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2015	Code of Federal Regulations – Telecommunications
RSS-247 Issue 1	2015	Digital Transmissions Systems (DTSSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4	2014	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	2013	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices

Appendix E – Duty Cycle Calculation

1.0 Summary

There are directed and undirected advertising events.

The worst case relaxation factor for a directed advertising event is 14.9 dB.

The worst case relaxation factor for an undirected advertising event is 20 dB.

Prepared For: JDSU	Name: OneExpert CATV
Report: TR 315103 B	Model: OneExpert CATV
LSR: C-2210	Serial: Eng. Sample

1.1 Defining Packet Length

2.1 PACKET FORMAT

The Link Layer has only one packet format used for both advertising channel packets and data channel packets.

The packet format is shown in [Figure 2.1](#). Each packet consists of four fields: the preamble, the Access Address, the PDU, and the CRC.

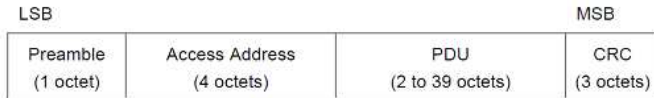


Figure 2.1: Link Layer packet format

The preamble is 1 octet and the Access Address is 4 octets. The PDU range is from 2 to a maximum of 39 octets. The CRC is 3 octets.

The Preamble is transmitted first, followed by the Access Address, followed by the PDU followed by the CRC.

The shortest packet is 80 bits in length. The longest packet is 376 bits in length.

PDU Type $b_3b_2b_1b_0$	Packet Name
0000	ADV_IND
0001	ADV_DIRECT_IND
0010	ADV_NONCONN_IND
0011	SCAN_REQ
0100	SCAN_RSP
0101	CONNECT_REQ
0110	ADV_SCAN_IND
0111-1111	Reserved

Table 2.1: Advertising channel PDU Header's PDU Type field encoding

Octets per Packet

ADV_IND = 37 octets

ADV_DIRECT_IND = 12 octets

ADV_NONCONN_IND = 37 octets

SCAN_REQ = 12 octets

SCAN_RSP = 37 octets

CONNECT_REQ = 34 octets

ADV_SCAN_IND = 37 octets

Preamble (1)	Access Address (4)	PDU Header (2)	Worst Case PDU Type (37)	CRC (3)
-----------------	--------------------------	----------------------	--------------------------------	------------

Stated worst case length packet: 47 octets = 376 bits

Worst Case Packet Duration: 376 bits * 1 μ S / bit = 376 μ S

1.2 Defining Inter Frame Space

4.1 INTER FRAME SPACE

The time interval between two consecutive packets on the same channel index is called the Inter Frame Space. It is defined as the time from the end of the last bit of the previous packet to the start of the first bit of the subsequent packet.

The Inter Frame Space is designated "T_IFS" and shall be 150 μ s.

1.3 Defining Undirected Advertising Event

For all undirected advertising events, the time between the start of two consecutive advertising events ($T_{advEvent}$) is computed as follows for each advertising event:

$$T_{advEvent} = advInterval + advDelay$$

The *advInterval* shall be an integer multiple of 0.625 ms in the range of 20 ms to 10.24 s. If the advertising event type is either a scannable undirected event type or a non-connectable undirected event type, the *advInterval* shall not be less than 100 ms. If the advertising event type is a connectable undirected event type, the *advInterval* can be 20 ms or greater.

The *advDelay* is a pseudo-random value with a range of 0 ms to 10 ms generated by the Link Layer for each advertising event.

As illustrated in Figure 4.1, the advertising events are perturbed in time using the *advDelay*.

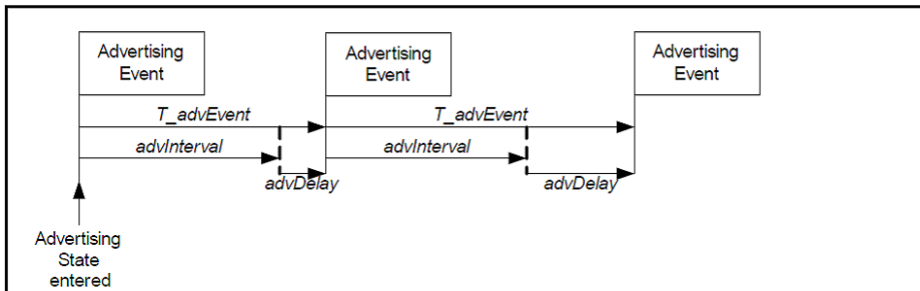


Figure 4.1: Advertising events perturbed in time using *advDelay*

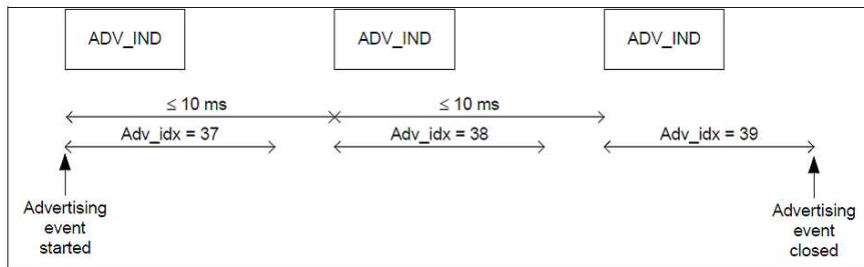


Figure D2: Connectable undirected advertising event with only advertising PDUs

1.3.1 Duty Factor for Connectable Undirected Advertising Event, per advertising channel:

ADV_IND = 376 μ S duration (ON channel 37)

IFS = 150 μ S (OFF)

ADV_IND = 376 μ S duration (OFF channel 38)

IFS = 150 μ S (OFF)

ADV_IND = 376 μ S duration (OFF Channel 39).

advInterval (min) = 20 mS

1.3.1.1 Straight Duty Factor

$$DF = 376 / (376*3+150*2+20000) = 0.0175$$

$$\text{Relaxation factor} = -\min(20*\log_{10}(DF), -20 \text{ dB}) = -\min(-35.119, -20) = 20 \text{ dB}$$

1.3.1.2 Duty Factor in 100mS window:

Packet Repetition Interval is $(376*3) + (2*150) + 20000$ microseconds = 21428 microseconds

Number of Packet Repetitions per 100 mS window = $21428/100000 = 4.667$ Packet Intervals

This will result in 5 packets being transmitted in a 100 mS window.

$$DF(\text{rel } 100 \text{ mS}) = (5*376) / (100000) = 0.0188$$

$$\text{Relaxation Factor Relative to 100 mS} = -\text{Max}(20*\log_{10}(DF(\text{rel } 100\text{mS})), -20 \text{ dB}) = -\text{Max}(-34.51 \text{ dB}, -20) = 20 \text{ dB}$$

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Report: TR 315103 B	Model: OneExpert CATV
LSR: C-2210	Serial: Eng. Sample

1.4 Defining Directed Advertising Event

Duty Factor for Connectable Directed Advertising Event, per advertising channel

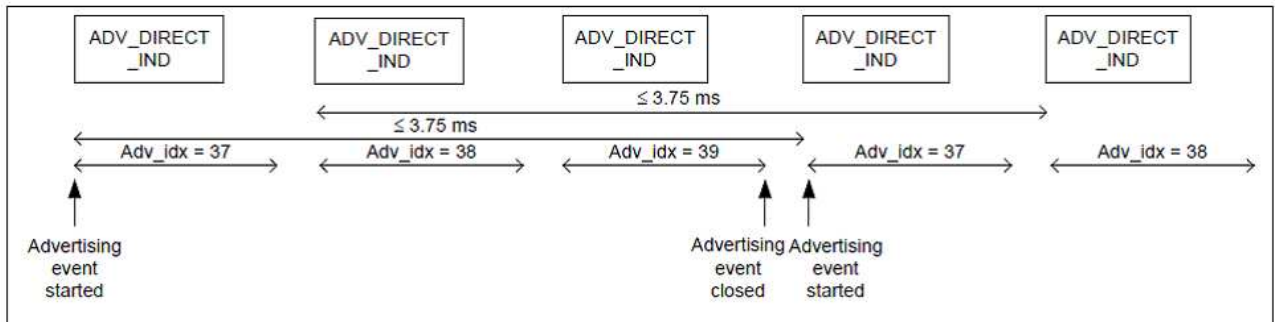


Figure D3: Connectable directed advertising event type with only advertising PDUs

1.4.1 Duty Factor for Connectable Directed Advertising Event, per advertising channel:

ADV_DIRECT_IND = 176 μ S duration. (22 octets) (ON channel 37)

IFS = 150 μ S (OFF)

ADV_IND = 176 μ S duration (OFF channel 38)

IFS = 150 μ S (OFF)

ADV_IND = 176 μ S duration (OFF Channel 39).

IFS = 150 μ S (OFF)

Time from open to close of advertising event = $3 \times 176 + 3 \times 150 = 978 \mu$ S

1.4.1.1 Straight Duty Factor

DF = $176 / (978) = 0.179$

Relaxation factor = $-\min(20 \times \log_{10}(\text{DF}), -20 \text{ dB}) = -\min(-14.9, -20) = 14.9 \text{ dB}$

1.4.1.2 Duty Factor in 100mS window:

Number of Connectable Directed Advertising Packets, per advertising channel, per 100 mS window:

$100000 / 978 = 102.78$ packets.

Therefore, there can be 103 transmissions of packets 176 microseconds in length on one channel within a 100 mS window.

Duty Factor relative to 100 mS window: DF (rel 100 mS) = $(176 \times 103) / (100000) = 0.18128$

Relaxation Factor Relative to 100 mS = $-\text{Max}(20 \times \log_{10}(\text{DF (rel 100mS)}), -20 \text{ dB}) = -\text{Max}(-14.83 \text{ dB}, -20) = 14.83 \text{ dB}$

END OF REPORT

Date	Version	Comments	Person
8-03-15	V0	Initial Draft Release	Adam Alger
8-11-15	V1	Final Release	Tom Smith
9-1-15	V1a	TCB Reviewer Comments Addressed	Adam Alger

Prepared For: JDSU
Report: TR 315103 B
LSR: C-2210

Name: OneExpert CATV
Model: OneExpert CATV
Serial: Eng. Sample