Report on the Radio Testing

For

Centrical Connected Home Limited

on

Hive Hub 360

Report no. TRA-034282-02-47-01D

15th January 2018

Element Materials Technology Warwick Ltd.
Registered in England and Wales. Registered Office: 5 Fleet Place, London, EC4M 7RD
Company Reg No. 02536659

Report Number: TRA-034282-02-47-01D
Issue: D

REPORT ON THE RADIO TESTING OF A
Centrical Connected Home Limited
Hive Hub 360
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 19th September-27th September 2017

Written by:	Digitally signed by Daniel Moncayola DN: cn=Daniel Moncayola, o=Element Materials Technology, ou, email=Daniel.Moncayola@Element.com, c=GB Reason: I am the author of this document Date: 2018.02.26 16:57:28 Z	Daniel Moncayola Radio Test Engineer
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Date:	15th January 2018	

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1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	22nd November 2017	Original
B	23rd November 2017	Original
C	28th November 2017	Update to model number
D	15th January 2018	TBC update

2 Summary

TEST REPORT NUMBER:	TRA-034282-02-47-01D
WORKS ORDER NUMBER	TRA-034282-02
PURPOSE OF TEST:	Class 2 permissive change
TEST SPECIFICATION(S):	47CFR15.247 & RSS-247
EQUIPMENT UNDER TEST (EUT):	Hive Hub 360
FCC IDENTIFIER: ISED IDENTIFIER:	WJHHUB450 21719-HUB450
EUT SERIAL NUMBER:	UFD-637
MANUFACTURER/AGENT: ADDRESS:	Centrical Connected Home Limited Millstream Madenhead Road Windsor, Berkshire SL4 SCO United Kingdom
CLIENT CONTACT:	Darrell Harris ☎ 01223 222150 ✉ darrell.harris@hivehome.com
ORDER NUMBER:	6500467481
TEST DATE:	19th September-27th September 2017
TESTED BY:	Daniel Moncayola S Hodgkinson S Garwell Paul Shaw Element

2.1 Test Summary

Test Method and Description		*Requirement Clause*		*Applicable to this equipment*	*Result / Note*
		RSS	*47CFR15*		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		Gen, 8.10	15.205	☒	*Pass*
AC power line conducted emissions		Gen, 8.8	15.207	☐	*N/A (Note 1)*
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☐	*N/A (Note 1)*
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☒	*Pass*
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☐	*N/A (Note 1)*
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☐	*N/A (Note 1)*
Calculation of duty correction		-	15.35(c)	☐	*N/A (Note 1)*

Notes:

[1] Testing carried out for a class II permissive change and therefore this test is not applicable

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-034282-02-47-01D presents the results of the Radio testing on a Centrical Connected Home Limited, Hive Hub 360 to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

Testing is carried out in support of a class II permissive change only, therefore limited tests are applied to establish if any performance changes have occurred.

The testing was carried out for Centrical Connected Home Limited by Element, at the address detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element Skelmersdale
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):

Element Hull	3483A
Element North West	3930B

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- 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.
- Industry Canada RSS-247, Issue 2, February 2017 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment Under Test

7.1 EUT Identification

- Name: Hive Hub 360
- Serial Number: UFD-637
- Model Number: Hub 450
- Software Revision: Not Stated
- Build Level / Revision Number: Production

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Test laptop (Dell Latitude E6440)
USB Programming cable

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for transmit tests was as follows:

The selection of channels and output powers and modulation was selected using client software. The equipment under test was tested on the bottom, middle, and top channels.

7.3.2 Reception

Not applicable

This test report covers radiated spurious emissions and carrier power for Bluetooth low energy and WiFi only.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	2400 MHz - 2483.5 MHz
Modulation type(s):	DSSS
Occupied channel bandwidth(s):	1MHz / 5 MHz / 20 MHz
Declared output power(s):	20dBm
Nominal Supply Voltage:	110 Vac
Duty cycle:	27% (Max transmit time 27ms per 100ms)

7.4.2 Antennas

Type:	6dBi printed antenna on flexi

7.5 EUT Description

The EUT is a smart home device with Wi-Fi, Zigbee, Bluetooth, and Z wave connection capabilities. The unit also has a function to detect specific sounds in the environment.

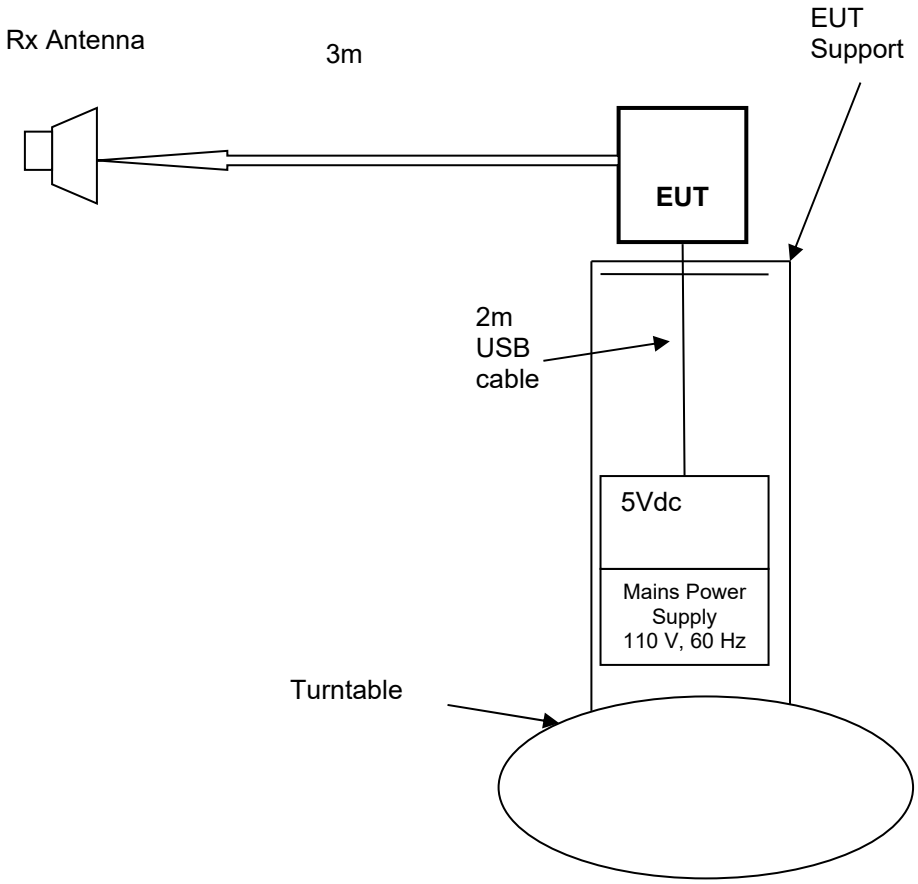
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

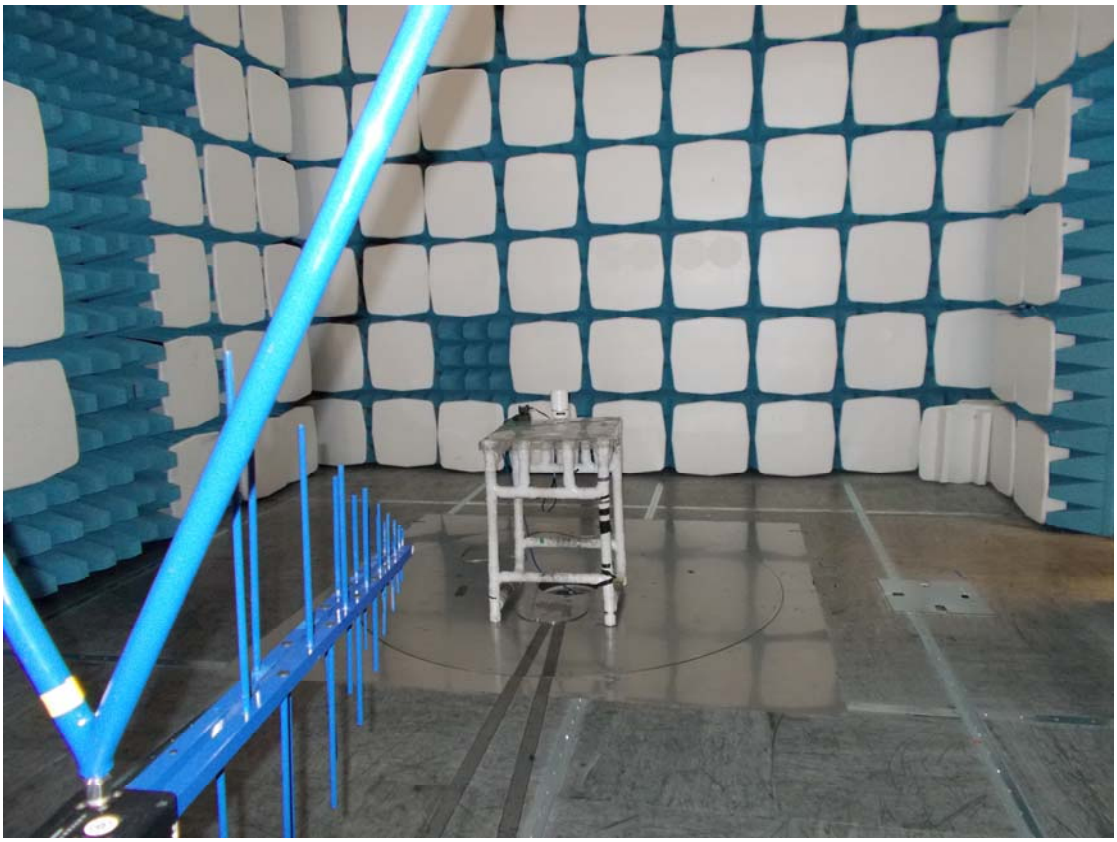
9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



9.2 General Setup Photograph

The following photograph shows basic EUT setup:



10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 110V ac from the mains

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

	Category	***Nominal***	***Variation***
☒	Mains	110 V ac +/-2 %	85 % and 115 %
☐	Battery	New battery	N/A

11 Radiated emissions

11.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz; 5 MHz; 20 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	110 V ac ±10 % (as declared)

11.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

Frequency (MHz)	*Field Strength (µV/m at 3 m)*
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

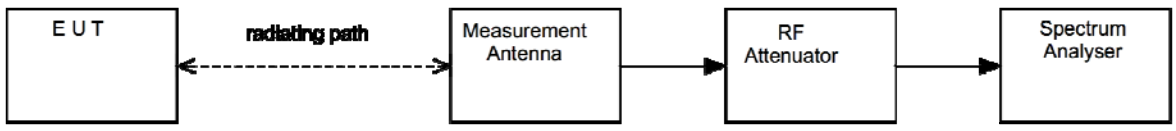
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

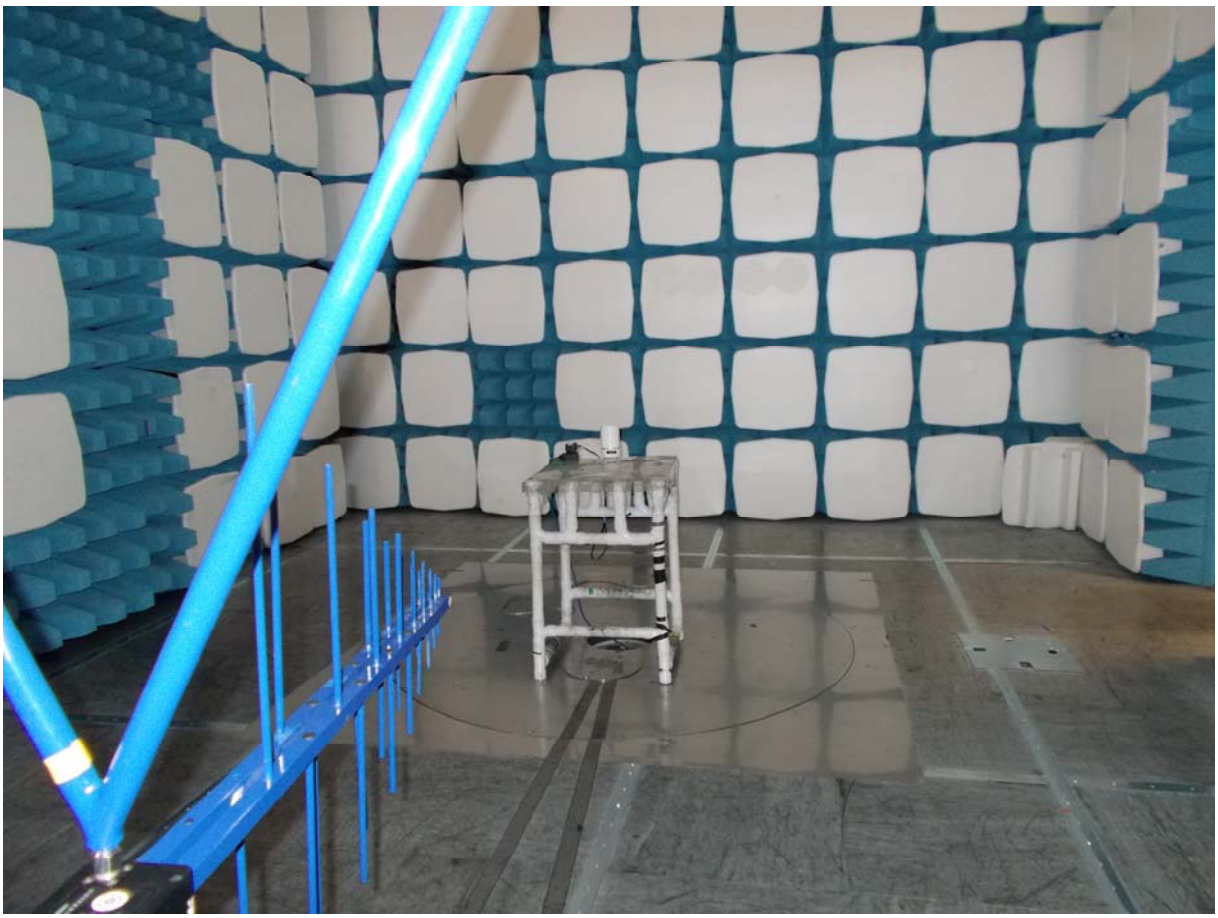
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

Figure i Test Setup



11.5 Test Set-up Photograph

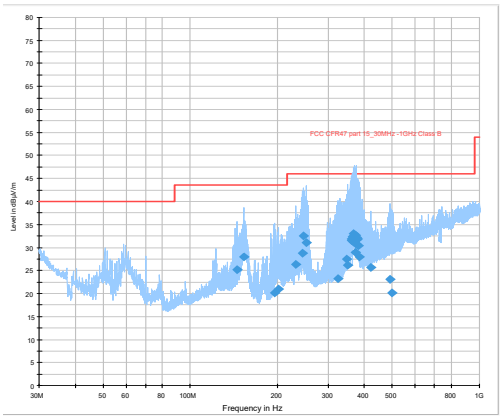


11.6 Test Equipment

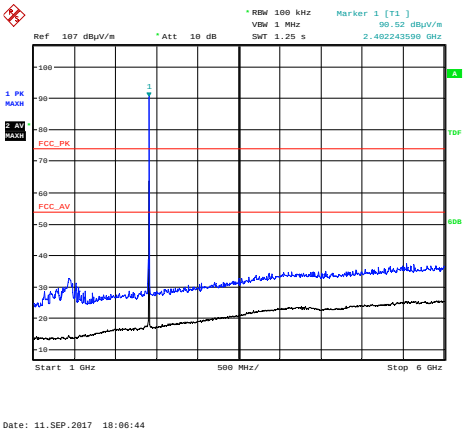
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESVS10	R&S	Receiver	L317	22/03/2018
FSU46	R&S	Spectrum Analyser	U281	19/06/2018
CBL611/A	Chase	Bilog	U191	23/02/2019
3115	EMCO	1-18GHz Horn	L138	13/04/2018
8449B	Agilent	Pre Amp	L572	07/02/2018
20240-20	Flann	Horn 18-26GHz (&U330)	L300	07/04/2018

11.7 Test Results

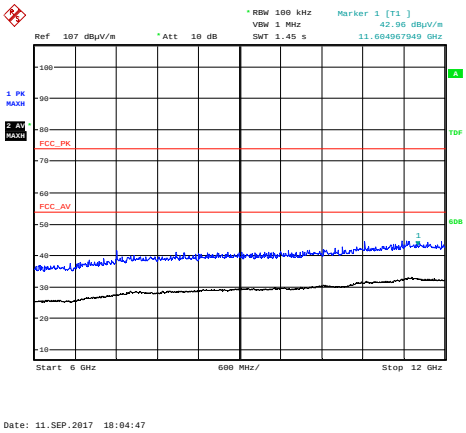
BLE Bottom Channel



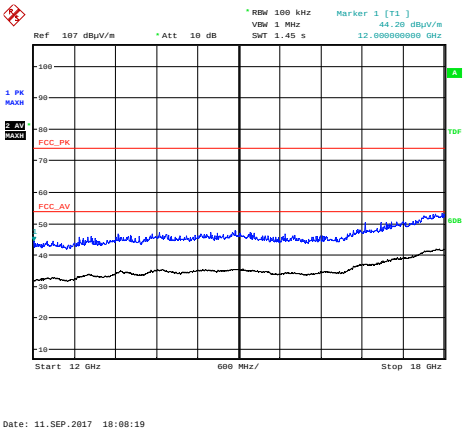
BLE 30 MHz to 1 GHz



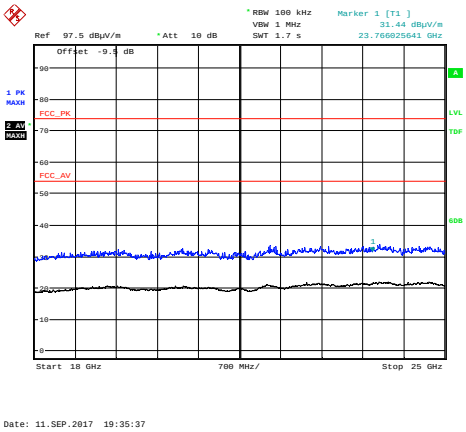
BLE 1 GHz to 6 GHz



BLE 6 GHz to 12 GHz



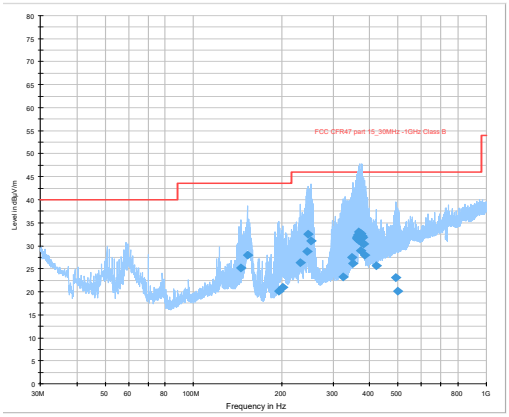
BLE 12 GHz to 18 GHz



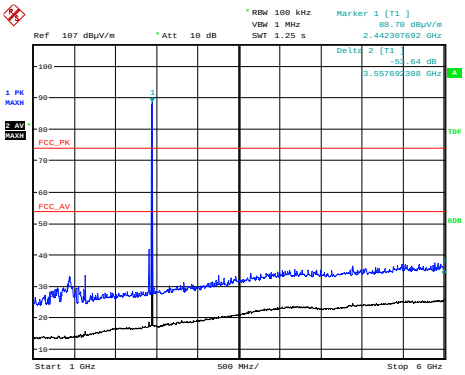
BLE 18 GHz to 25 GHz

High Power: 7 dBm ; Modulation: GFSK; Channel: 2402 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4804.00	43.95	4.60	33.10	35.88	0.00	0.00	45.77	194.31	5000
Av	4804.00	38.51	4.60	33.10	35.88	0.00	0.00	40.33	103.87	500
Pk	12010.00	40.66	8.20	39.30	36.19	0.00	0.00	51.97	396.73	5000
Av	12010.00	29.47	8.20	39.30	36.19	0.00	0.00	40.78	109.40	500

BLE Middle Channel



BLE 30 GHz to 1 GHz



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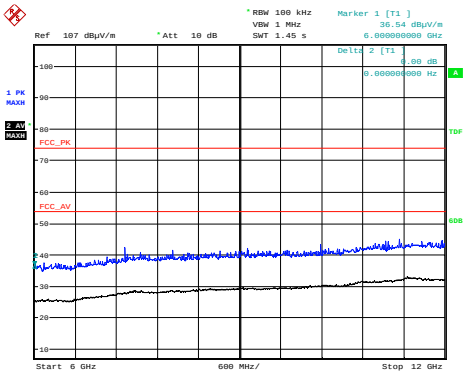
BLE 1 GHz to 6 GHz



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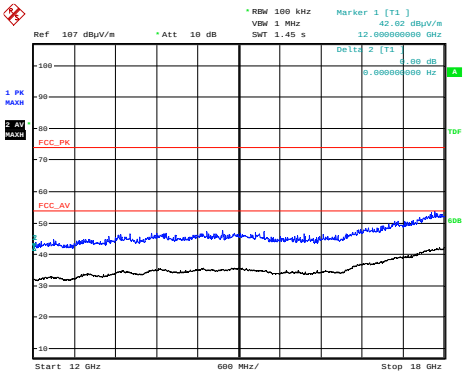
BLE 6 GHz to 12 GHz



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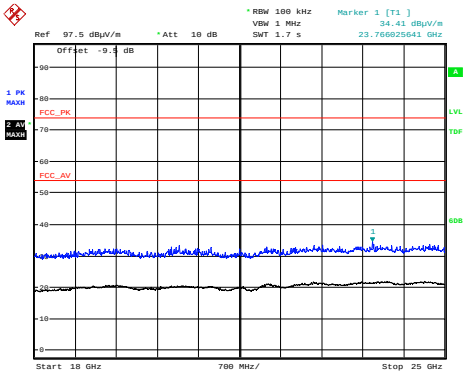
BLE 12 GHz to 18 GHz



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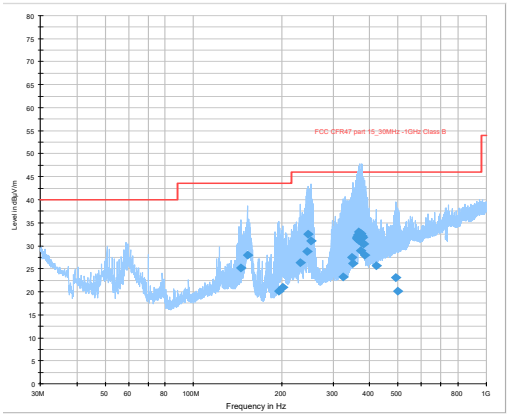
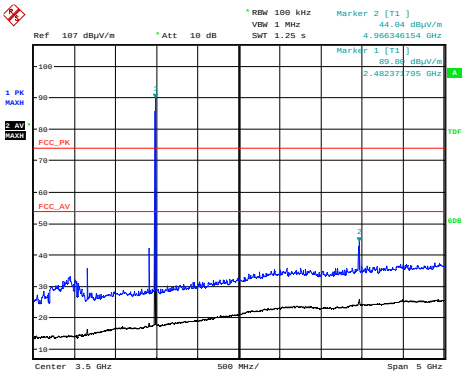
BLE 18 GHz to 25 GHz

High Power: 7 dBm ; Modulation: GFSK; Channel: 2441 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4882.00	52.08	4.60	33.30	35.91	0.00	0.00	54.07	505.24	5000
Av	4882.00	49.03	4.60	33.30	35.91	0.00	0.00	51.02	355.63	500
Pk	7323.00	47.77	6.60	36.40	36.22	0.00	0.00	54.55	533.95	5000
Av	7323.00	42.26	6.60	36.40	36.22	0.00	0.00	49.04	283.14	500
Pk	12205.00	41.08	7.70	39.10	35.98	0.00	0.00	51.90	393.55	5000
Av	12205.00	29.25	7.70	39.10	35.98	0.00	0.00	40.07	100.81	500

BLE Top Channel



BLE 30 MHz to 1 GHz



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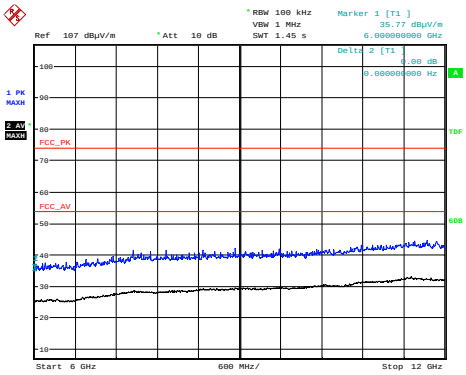

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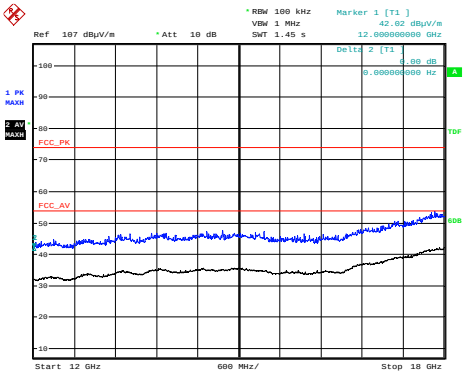
BLE 1 GHz to 6 GHz

BLE 6 GHz to 12 GHZ



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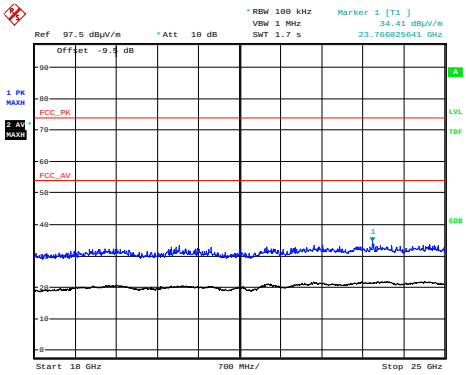

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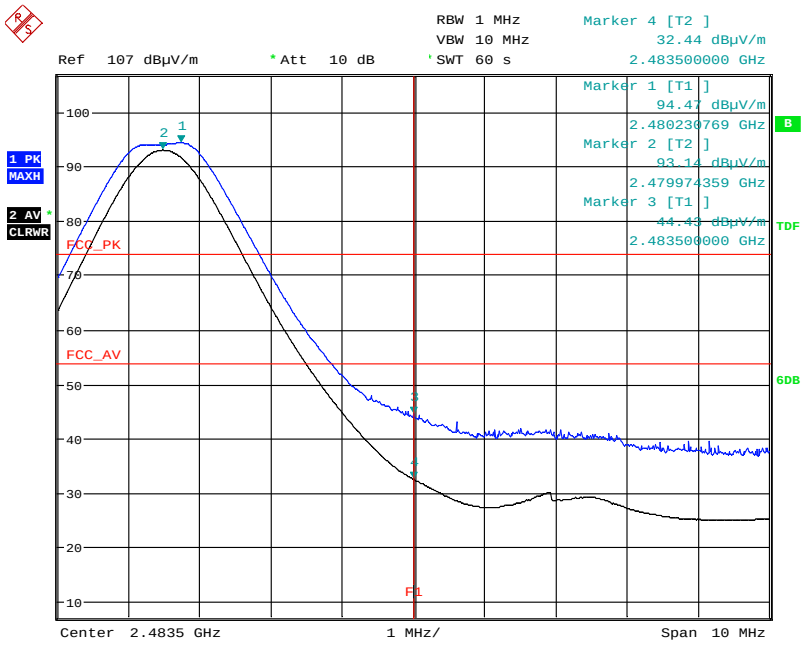
BLE 12 GHz to 18 GHz

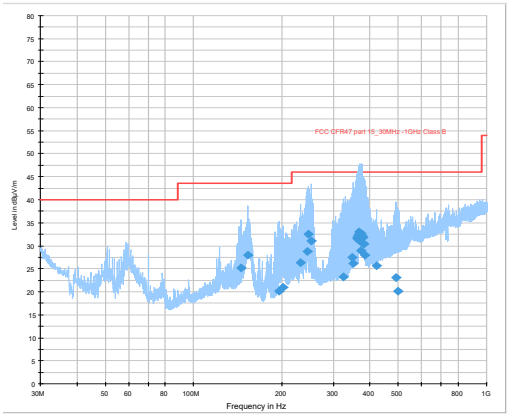
BLE 18 GHz to 25 GHz

High Power: 7 dBm ; Modulation: GFSK; Channel: 2441 MHz										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4960.00	53.98	4.60	33.50	35.94	0.00	0.00	56.14	641.21	5000
Av	4960.00	51.20	4.60	33.50	35.94	0.00	0.00	53.36	465.59	500
Pk	7440.00	48.90	6.20	36.70	36.25	0.00	0.00	55.55	599.10	5000
Av	7440.00	41.63	6.20	36.70	36.25	0.00	0.00	48.28	259.42	500
Pk	12400.00	43.78	7.90	38.80	35.77	0.00	0.00	54.71	543.88	5000
Av	12400.00	33.61	7.90	38.80	35.77	0.00	0.00	44.54	168.66	500

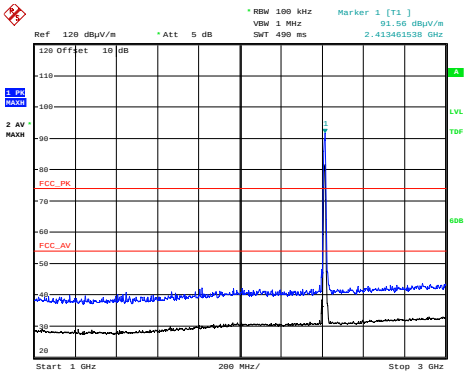


Upper Band Edge Compliance

802.11.b Bottom Channel

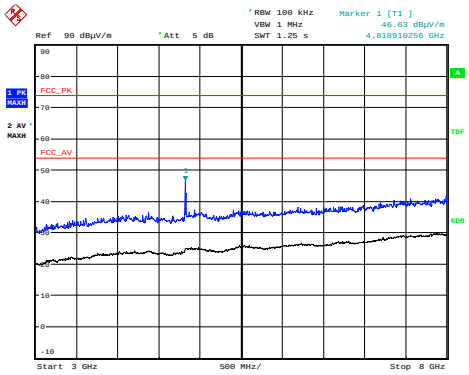


802.11.b 30 MHz to 1 GHz



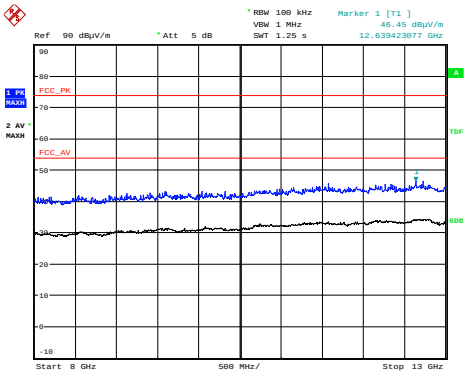
Date: 12.SEP.2017 14:27:30

802.11.b 1 GHz to 3 GHz



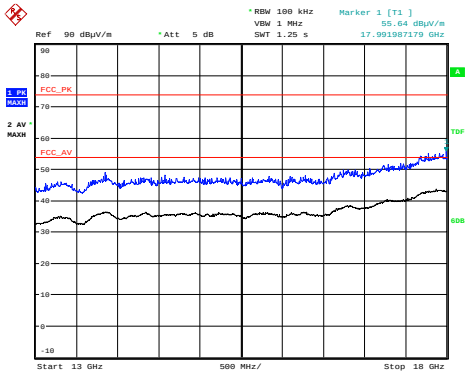
Date: 12.SEP.2017 17:19:04

802.11.b 3 GHz to 8 GHz



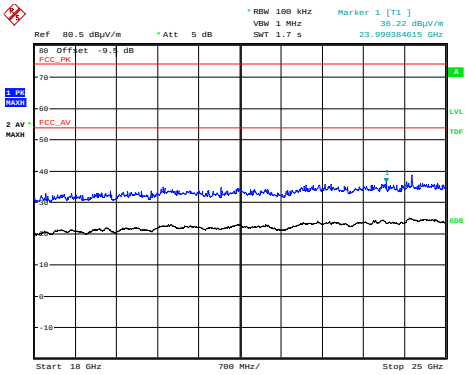
Date: 12.SEP.2017 18:44:02

802.11.b 8 GHz to 13 GHz



Date: 12.SEP.2017 19:26:38

802.11.b 13 GHz to 18 GHz

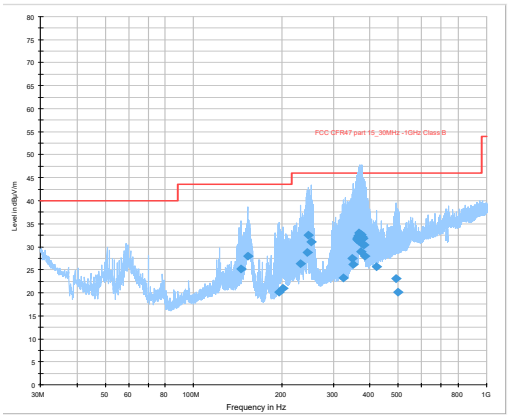


Date: 12.SEP.2017 20:38:21

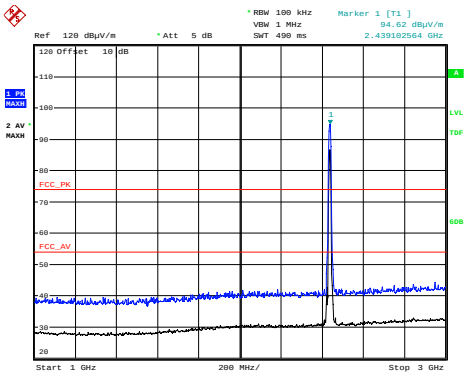
802.11.b 18 GHZ to 25 GHz

802.11 b; Data rate: 1 Mbps; High Power: 18000 ; Channel: 2412 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4824.00	50.81	4.70	33.10	35.88	0.00	0.00	52.73	433.01	5000
Av	4824.00	44.87	4.70	33.10	35.88	0.00	0.00	46.79	218.52	500

802.11.b Middle Channel

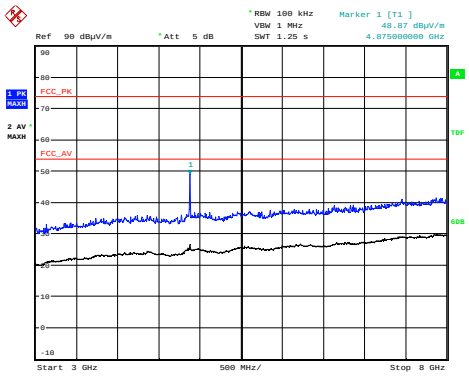


802.11.b 30 MHz to 1 GHz



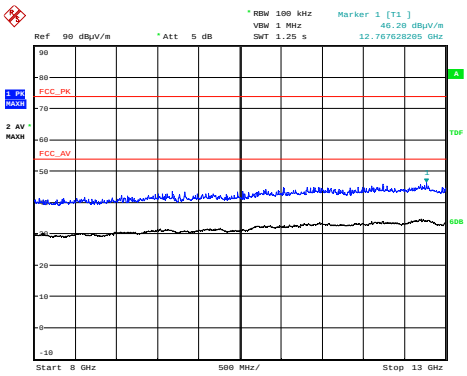
Date: 12.SEP.2017 15:47:02

802.11.b 1 GHz to 3 GHz



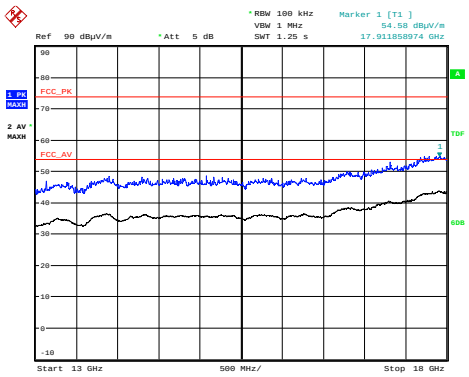
Date: 12.SEP.2017 17:25:34

802.11.b 3 GHz to 8 GHz



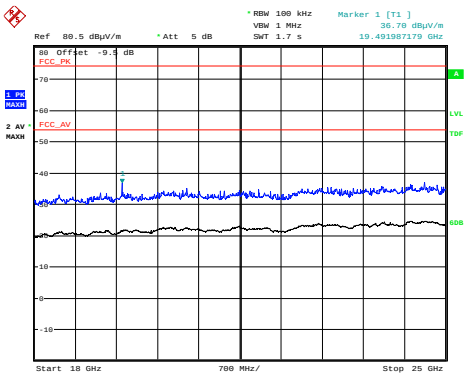
Date: 12.SEP.2017 18:46:49

802.11.b 8 GHz to 13 GHz



Date: 12.SEP.2017 19:33:05

802.11.b 13 GHz to 18 GHz

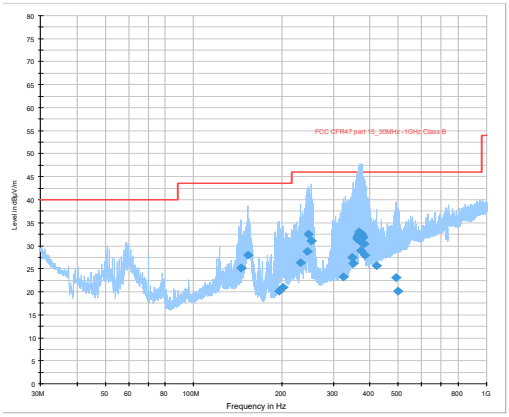


Date: 12.SEP.2017 20:46:44

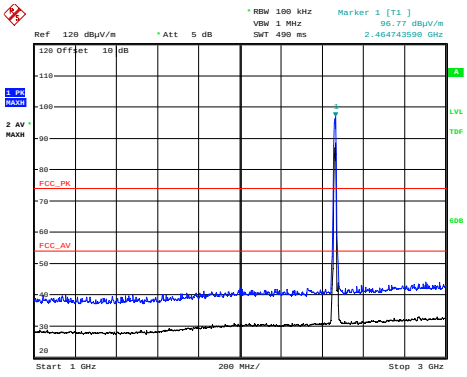
802.11.b 18 GHZ to 25 GHz

802.11 b; Data rate: 1 Mbps; High Power: 18000 ; Channel: 2437 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4874.00	51.96	4.60	33.30	35.91	0.00	0.00	53.95	498.31	5000
Av	4874.00	47.05	4.60	33.30	35.91	0.00	0.00	49.04	283.14	500

802.11.b Top Channel

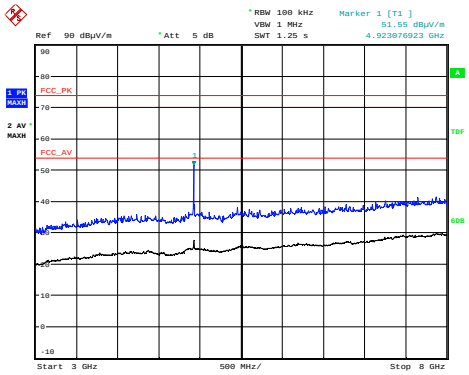


802.11.b 30 MHz to 1 GHz



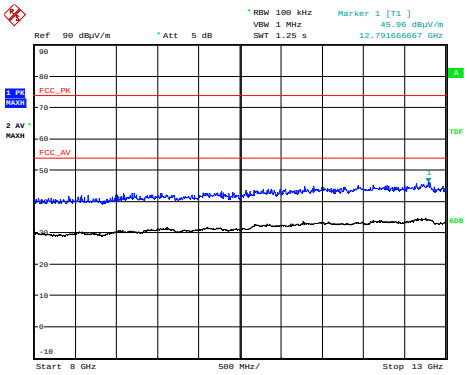
Date: 12.SEP.2017 15:38:59

802.11.b 1 GHz to 3 GHz



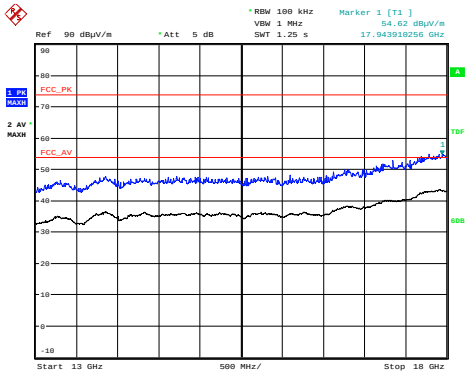
Date: 12.SEP.2017 17:34:28

802.11.b 3 GHz to 8 GHz



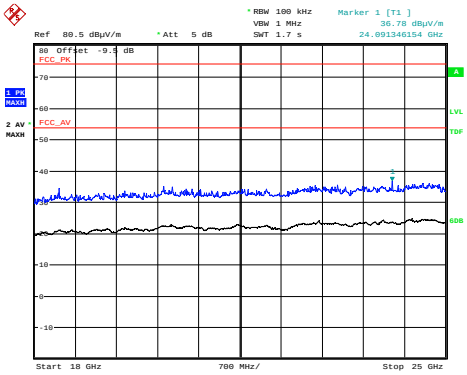
Date: 12.SEP.2017 18:52:51

802.11.b 8 GHz to 13 GHz



Date: 12.SEP.2017 19:41:26

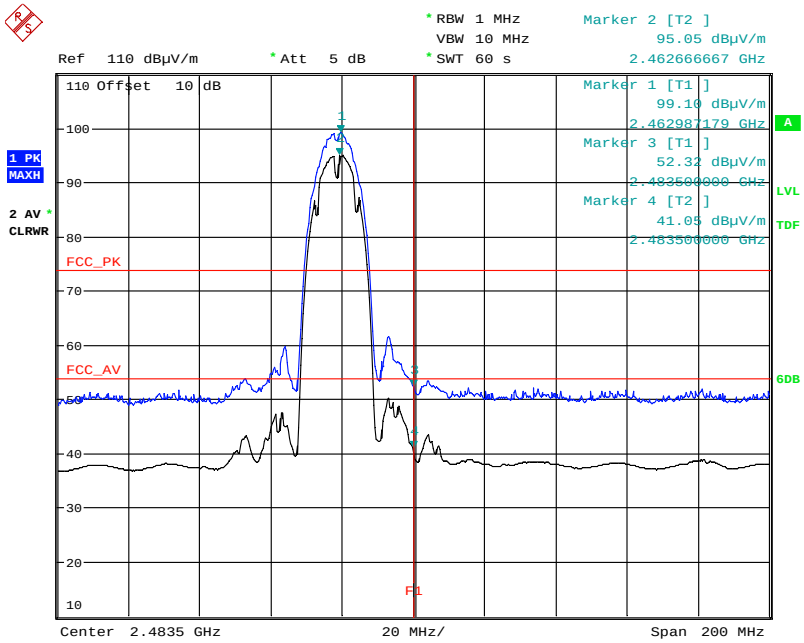
802.11.b 13 GHz to 18 GHz



Date: 12.SEP.2017 20:52:05

802.11.b 18 GHZ to 25 GHz

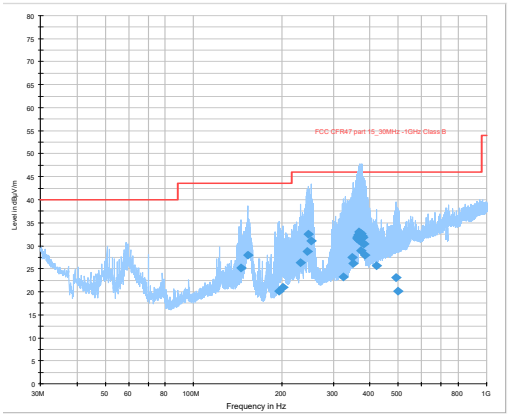
802.11 b; Data rate: 1 Mbps; High Power: 18000 ; Channel: 2462 MHz										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4924.00	50.87	4.50	33.40	35.93	0.00	0.00	52.84	438.53	5000
Av	4924.00	45.50	4.50	33.40	35.93	0.00	0.00	47.47	236.32	500



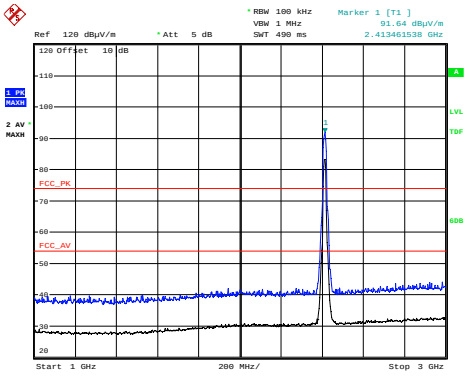
Date: 13.SEP.2017 10:57:11

Upper Band Edge Compliance

802.11.n Bottom Channel

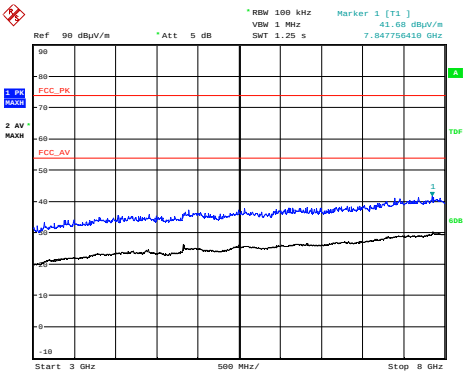


802.11.n 30 MHz to 1 GHz



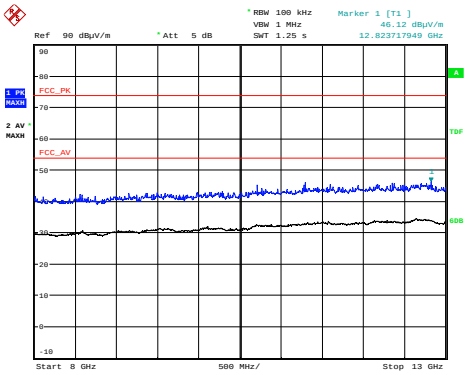
Date: 12.SEP.2017 16:11:35

802.11.n 1 GHz to 3 GHz



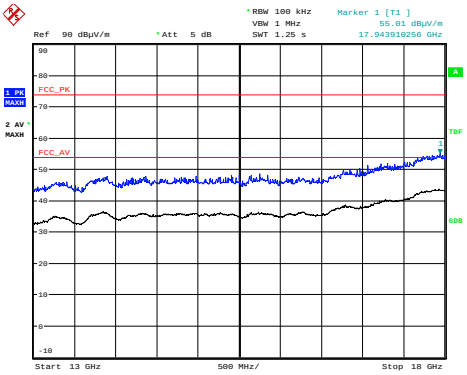
Date: 12.SEP.2017 18:03:20

802.11.n 3 GHz to 8 GHz



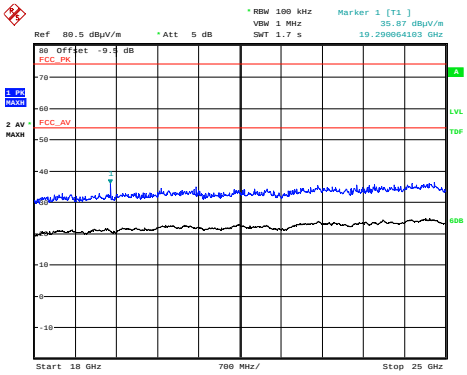
Date: 12.SEP.2017 19:11:26

802.11.n 8 GHz to 13 GHz



Date: 12.SEP.2017 19:58:46

802.11.n 13 GHz to 18 GHz

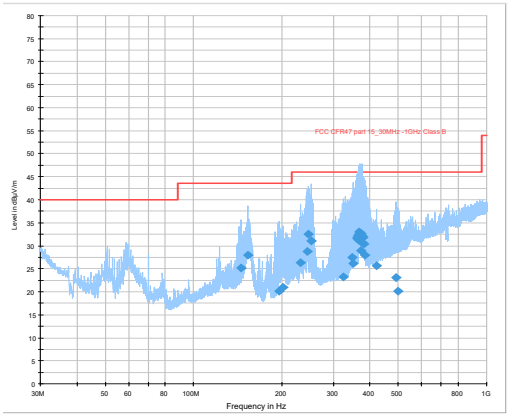


Date: 12.SEP.2017 21:08:48

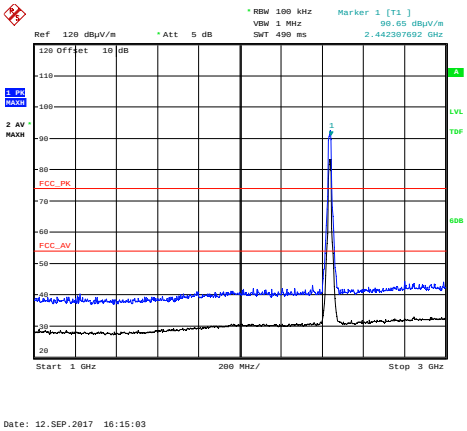
802.11.n 18 GHZ to 25 GHz

802.11 n; Data rate: MCS0; High Power: 18000 ; Channel: 2412 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4824.00	48.42	4.70	33.10	35.88	0.00	0.00	50.34	328.85	5000
Av	4824.00	34.55	4.70	33.10	35.88	0.00	0.00	36.47	66.60	500

802.11.n Middle Channel

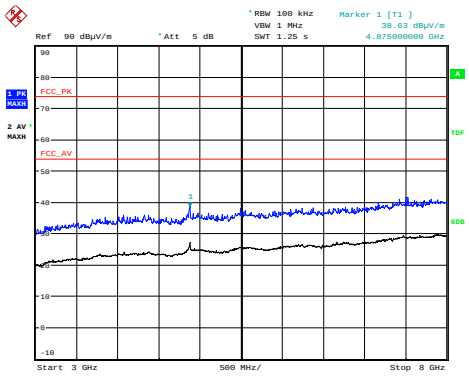


802.11.n 30 MHz to 1 GHz



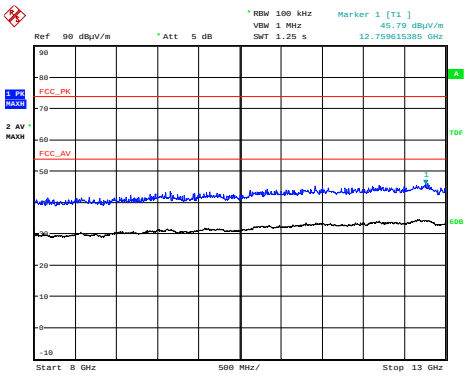
Date: 12.SEP.2017 16:15:03

802.11.n 1 GHz to 3 GHz



Date: 12.SEP.2017 18:09:34

802.11.n 3 GHz to 8 GHz



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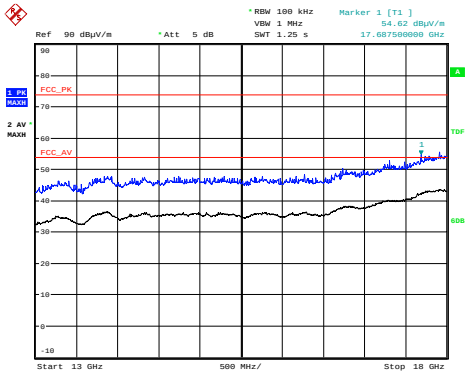
802.11.n 8 GHz to 13 GHz



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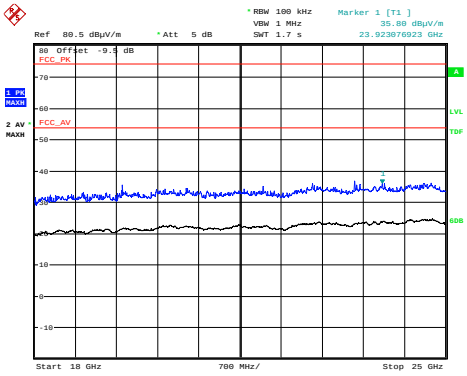
802.11.n 13 GHz to 18 GHz

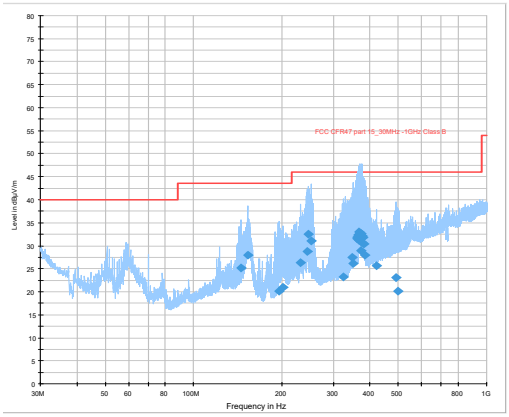


Date: 12.SEP.2017 21:13:49

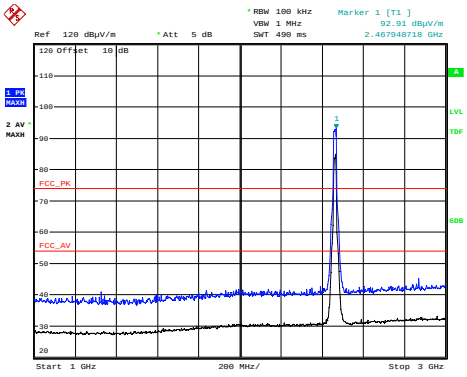
802.11.n 18 GHZ to 25 GHz

802.11 n; Data rate: MCS0; High Power: 18000 ; Channel: 2442 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4874.00	49.21	4.60	33.30	35.91	0.00	0.00	51.20	363.08	5000
Av	4874.00	35.02	4.60	33.30	35.91	0.00	0.00	37.01	70.88	500

802.11.n Top Channel



802.11.n 30 MHz to 1 GHz



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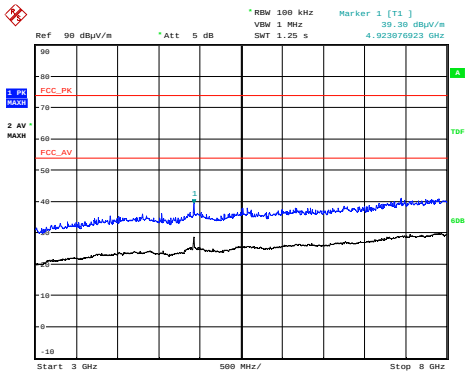
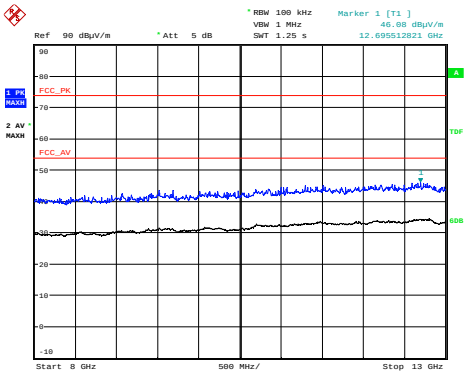
802.11.n 1 GHz to 3 GHz



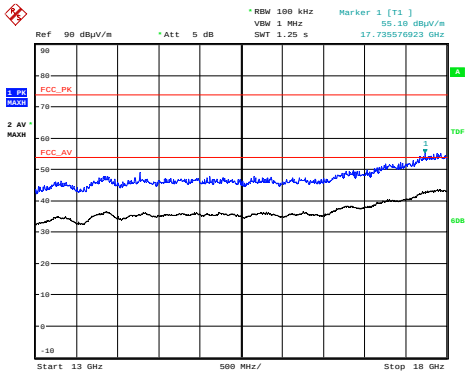
Date: 12.SEP.2017 18:12:26

802.11.n 3 GHz to 8 GHz



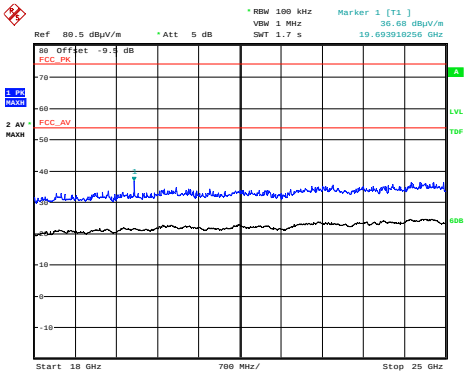
Date: 12.SEP.2017 19:22:43

802.11.n 8 GHz to 13 GHz



Date: 12.SEP.2017 20:07:05

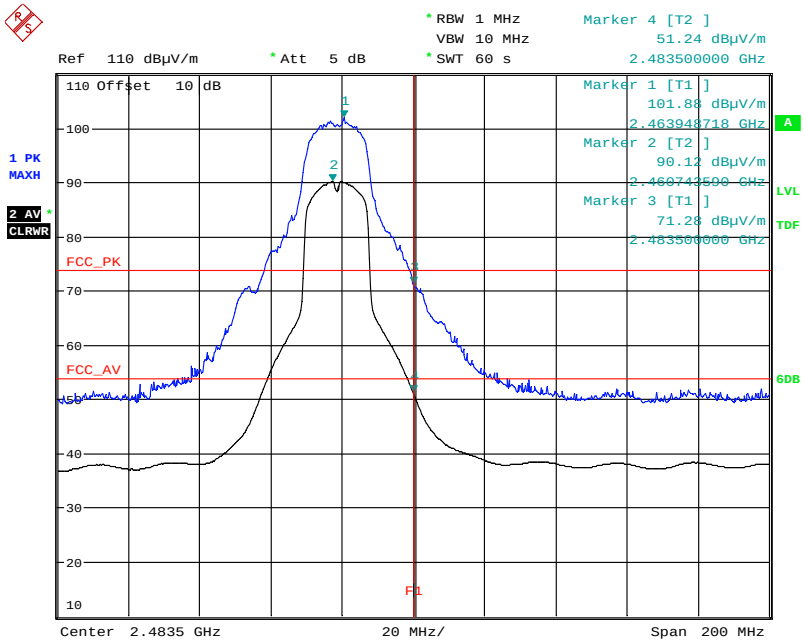
802.11.n 13 GHz to 18 GHz



Date: 12.SEP.2017 21:16:23

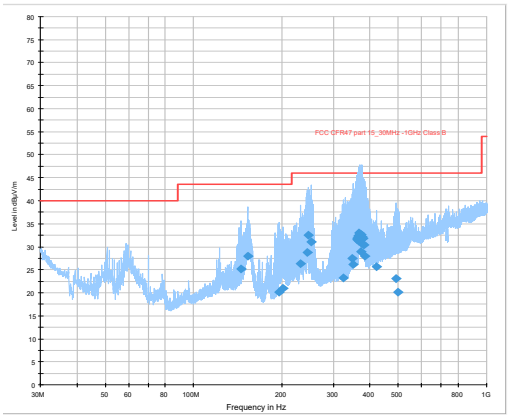
802.11.n 18 GHZ to 25 GHz

802.11 n; Data rate: MCS0; High Power: 18000 ; Channel: 2462 MHz										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4924.00	48.47	4.50	33.40	35.93	0.00	0.00	50.44	332.66	5000
Av	4924.00	34.19	4.50	33.40	35.93	0.00	0.00	36.16	64.27	500

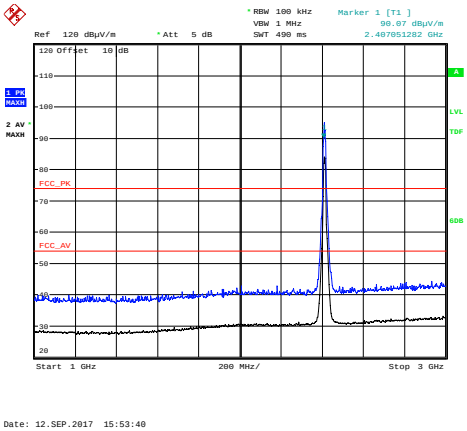


Upper Band Edge Compliance

802.11.g Bottom Channel

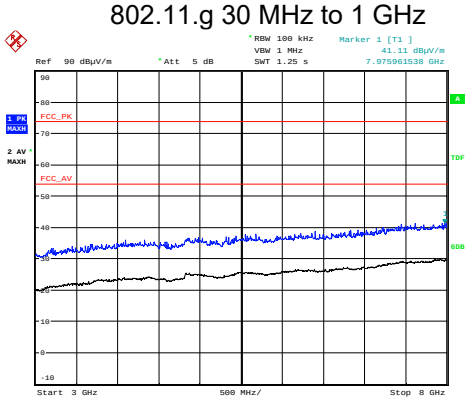


802.11.g 30 MHz to 1 GHz



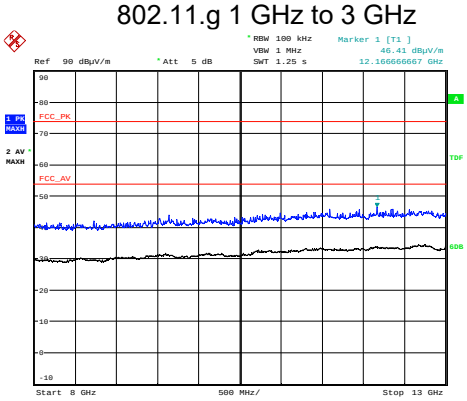
Date: 12.SEP.2017 15:53:40

802.11.g 1 GHz to 3 GHz



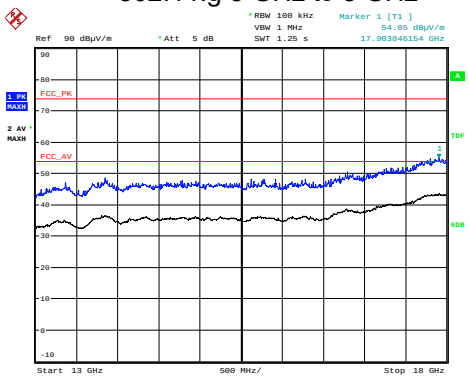
Date: 12.SEP.2017 17:42:42

802.11.g 3 GHz to 8 GHz



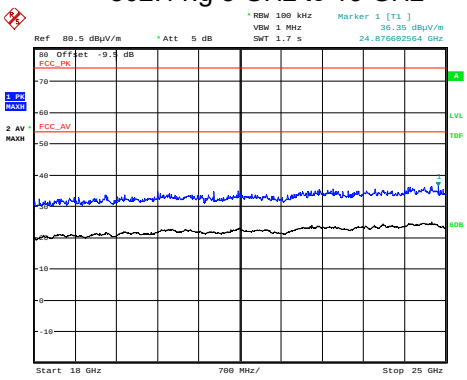
Date: 12.SEP.2017 18:56:01

802.11.g 8 GHz to 13 GHz



Date: 12.SEP.2017 19:44:36

802.11.g 13 GHz to 18 GHz

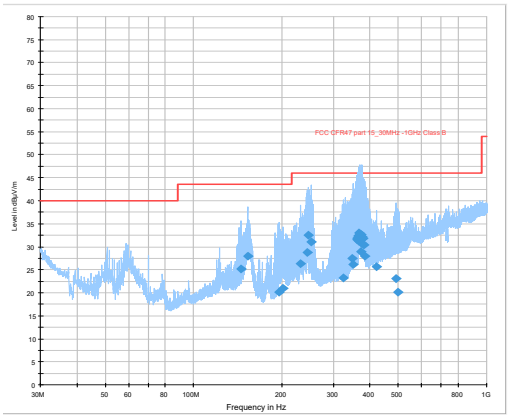


Date: 12.SEP.2017 20:58:48

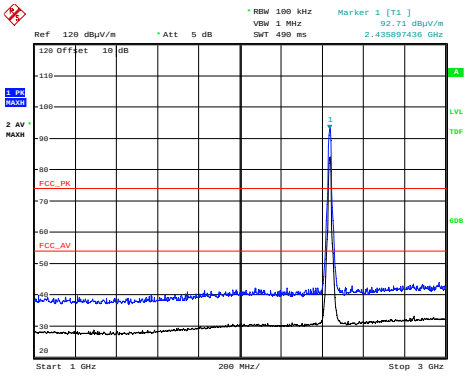
802.11.g 18 GHZ to 25 GHz

802.11 g; Data rate: 6 Mbps; High Power: 18000 ; Channel: 2412 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4824.00	48.26	4.70	33.10	35.88	0.00	0.00	50.18	322.85	5000
Av	4824.00	33.87	4.70	33.10	35.88	0.00	0.00	35.79	61.59	500

802.11.g Middle Channel

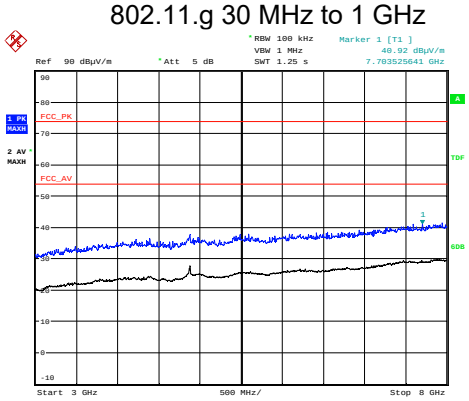


802.11.g 30 MHz to 1 GHz



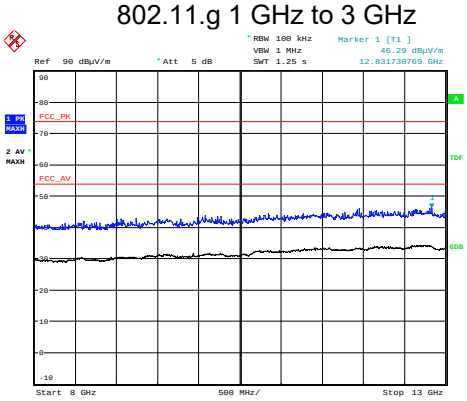
Date: 12.SEP.2017 16:01:22

802.11.g 1 GHz to 3 GHz



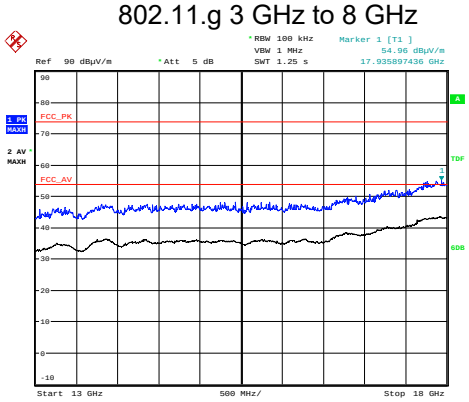
Date: 12.SEP.2017 17:46:36

802.11.g 3 GHz to 8 GHz



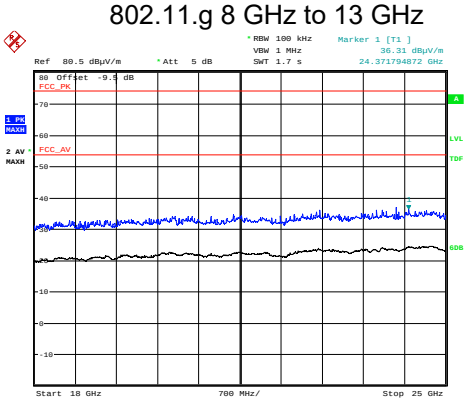
Date: 12.SEP.2017 19:02:22

802.11.g 8 GHz to 13 GHz



Date: 12.SEP.2017 19:49:57

802.11.g 13 GHz to 18 GHz

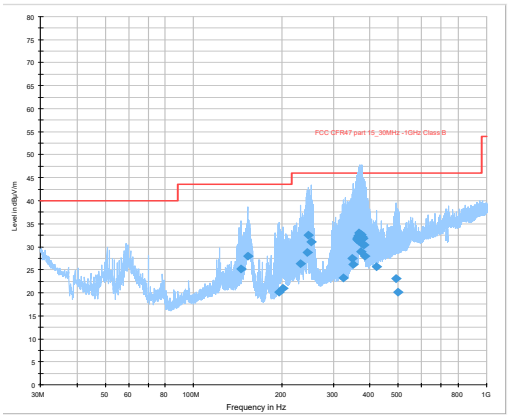


Date: 12.SEP.2017 21:01:14

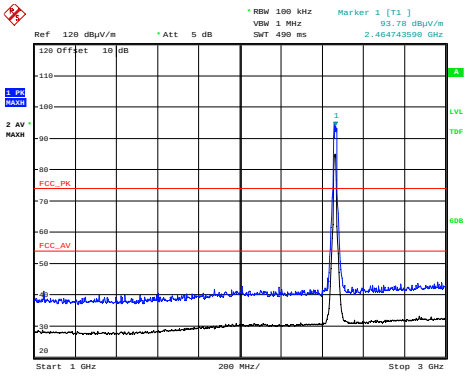
802.11.g 18 GHZ to 25 GHz

802.11 g; Data rate: 6 Mbps; High Power: 18000 ; Channel: 2442 MHz										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	4874.00	49.70	4.60	33.30	35.91	0.00	0.00	51.69	384.15	5000
Av	4874.00	34.55	4.60	33.30	35.91	0.00	0.00	36.54	67.14	500

802.11.g Top Channel

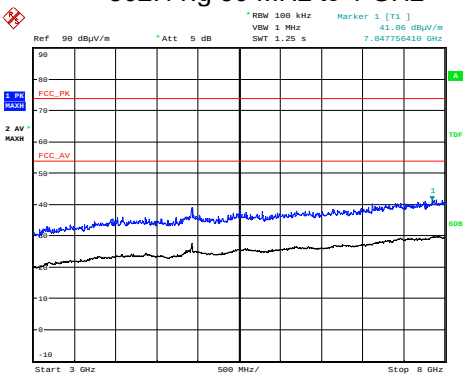


802.11.g 30 MHz to 1 GHz



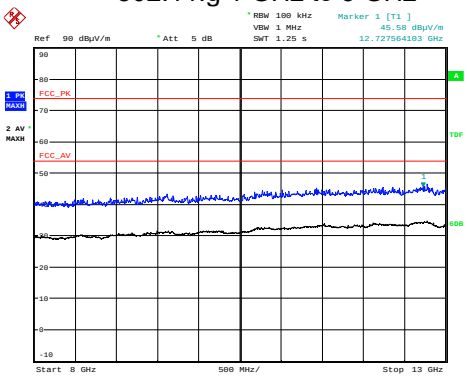
Date: 12.SEP.2017 16:04:39

802.11.g 1 GHz to 3 GHz



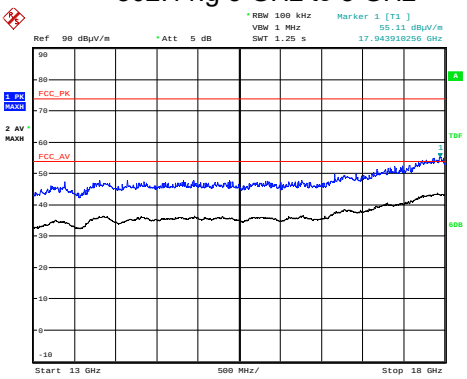
Date: 12.SEP.2017 17:53:29

802.11.g 3 GHz to 8 GHz



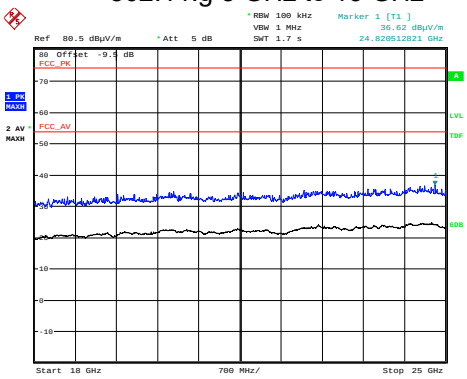
Date: 12.SEP.2017 19:05:32

802.11.g 8 GHz to 13 GHz



Date: 12.SEP.2017 19:52:50

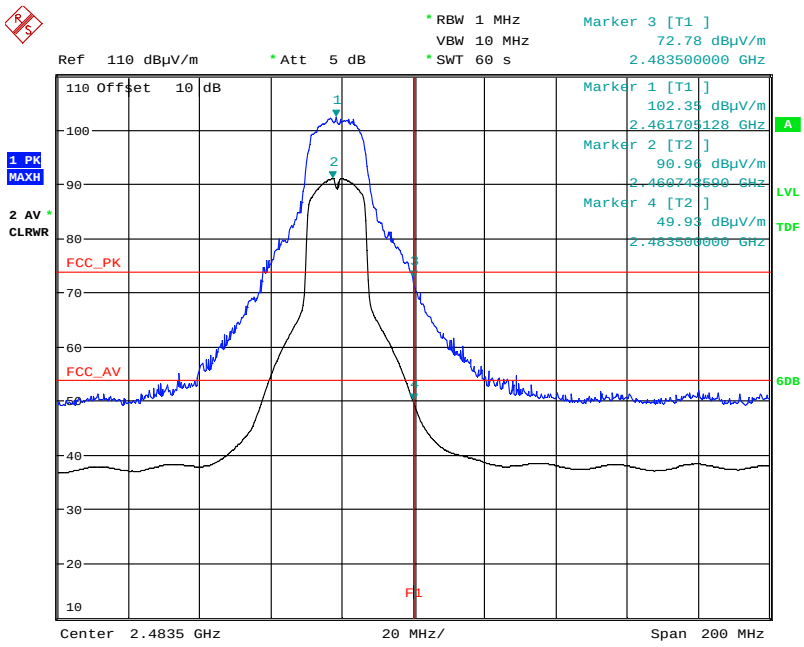
802.11.g 13 GHz to 18 GHz



Date: 12.SEP.2017 21:06:23

802.11.g 18 GHZ to 25 GHz

802.11 g; Data rate: 6 Mbps; High Power: 18000 ; Channel: 2462 MHz										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4924.00	47.96	4.50	33.40	35.93	0.00	0.00	49.93	313.69	5000
Av	4924.00	34.28	4.50	33.40	35.93	0.00	0.00	36.25	64.94	500



Upper Band Edge Compliance

12 Maximum peak conducted output power

12.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz/ 20MHz
Deviations From Standard:	None
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement)

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 42 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

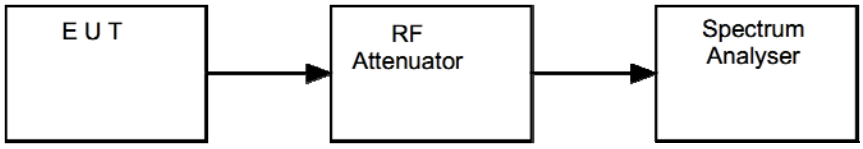
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iv Test Setup



12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
RPR3006W	Dare	Power Meter	REF2111	03/03/2018

12.6 Test Results

BLE; Modulation: GFSK; Power setting: 7 dBm					
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Power (mW)***	***Result***
2402	-3.10	11.4	8.30	6.76	PASS
2441	-2.80	11.3	8.50	7.08	PASS
2480	-2.50	11.4	8.90	7.76	PASS

802.11 b; Data rate 1 Mbps; Power setting: 18000					
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Power (mW)***	***Result***
2412	-6.20	21.80	15.60	36.31	PASS
2437	-6.10	21.80	15.70	37.15	PASS
2462	-6.00	21.80	15.80	38.02	PASS

802.11 g; Data rate: 6 Mbps; Power setting: 18000					
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Power (mW)***	***Result***
2412	-4.50	21.80	17.30	53.70	PASS
2437	-4.20	21.80	17.60	57.54	PASS
2462	-4.10	21.80	17.70	58.88	PASS

802.11 n; Data rate: MCS0 Power setting: 18000					
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Power (mW)***	***Result***
2412	-4.10	21.80	17.70	58.88	PASS
2437	-4.20	21.80	17.60	57.54	PASS
2462	-4.00	21.80	17.80	60.26	PASS

13 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

[1] Radiated spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**

[5] Conducted / radiated RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**
Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**
Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[6] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**