Bluetooth (Basic rate/EDR)

FCC/IC Test Report

FOR:

Verizon Telematics

Model Number: AT-255

Product Description:
GPS Navigation Device with 3G and Bluetooth

FCC ID: ZOQAT-255
IC Certification Number: 9734A-AT255

47 CFR Part 15.247 for DSS

IC RSS-210 Issue 8 & RSS-Gen Issue 3

TEST REPORT #: EMC_VERIT-005-14001_AT_255_FCC_15_247_BT

DATE: 2014-11-22

FCC: Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
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TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant IC standard RSS-210 issue 8, Annex 8. No deviations were ascertained.

Company	Description	Model #
Verizon Telematics	GPS Navigation Device with 3G and Bluetooth	AT-255

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2014-11-22	Compliance	Franz Engert (Compliance Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2014-11-22	Compliance	James Donnellan (Sr. EMC Engineer)	James Donnellan Digitally signed by James Donnellan DN: cn=James Donnellan, c=US, o=Cetecom Inc., ou=Compliance, email=james.donnellan@cetecom.com Date: 2014.11.25 17:48:42 -08'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Franz Engert
Test Engineer:	James Donnellan

2.2 Identification of the Client

Applicant's Name:	Verizon Telematics, Inc.
Street Address:	2002 Summit Blvd., Suite 1800
City/Zip Code	Atlanta, GA / 30319
Country	USA
Contact Person:	Bryant Elliot
Phone No.	404-573-5848
Fax:	---
e-mail:	Bryant.elliot@verizon.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as above.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Details of the Equipment under Test

Marketing Name:	In-Drive Communicator
Model Number	AT-255
HW Version	01 A0
FCC-ID :	9734A-AT255
IC Certification Number:	9734A-AT255
Product Description:	GPS Navigation Device with 3G and Bluetooth
Technology / Type(s) of Modulation:	Bluetooth v 2.1+EDR Class 2, using Frequency Hopping Spread Spectrum with DQPSK, 8DPSK modulation derived from Integrated BlueCore® CSR8811 Dual-mode Bluetooth/Bluetooth LE radio.
Frequency Range / number of channels:	Bluetooth: 2402-2480 MHz / 79
Antenna Information:	BT Ceramic Chip Antenna; Internal antenna Max (Peak) Gain = 0.4 dBi
Max. Output Powers:	**Measured Conducted Output Power:** GFSK/DH1: 0.9 dBm π/4-DQPSK: -0.17 dBm 8DPSK: -0.48 dBm **Calculated Radiated Output Power (EIRP):** GFSK/DH1: 1.3 dBm π/4-DQPSK: 0.23 dBm 8DPSK: -0.08 dBm
Rated Operating Voltage Range:	+6 to +24Vdc
Rated Operating Temperature Range:	-40 °C to +85 °C
Test Sample Status:	Production.
Other Radios included:	1. 2G/3G cellular transceiver module from Sierra Wireless SL8080 2. GPS Receiver

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes
1	352083060000007	A0	1.0.0	Radiated Unit
2	352083060375250	A0	1.0.0	Conducted Unit

3.3 Identification of Support Test Equipment

STE #	Type	Manufacturer	Model	Serial Number
1	N/A	---	---	---

3.4 Other EUT Notes

The EUT was set in Bluetooth Test mode using the Bluetooth Tester (R&S CBT) to control different modulation schemes and channels as required for testing.

4 Subject of Investigation

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 Issue 8 of Industry Canada.

This test report is to support a request for new equipment authorization under the FCC ID **.ZOQAT-255** All testing was performed on the product referred to in Section 3 as EUT.

According to Public Notice "DA 00-705: March 30, 2000" testing of FHSS systems shall consider modulation and packet type of the signal:

An evaluation of comparing the packet schemes offered in the test software was executed and the packet schemes offering highest conducted power were used for GFSK , π/4-DQPSK and 8-DPSK modulations as in DH1 for GFSK, 2DH5 for π/4 DQPSK and 3DH5 for 8-DPSK as per Section 7.1.

Power and emission measurements have been carried out with the worst case configuration.

For Bandwidth and timing measurements all packet types and modulations have been tested according to DA 00-705: March 30, 2000.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(b)(1) RSS210 A8.4(2)	Maximum Peak Conducted Output Power / EIRP	Nominal	GFSK π/4-DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(a)(1) RSS210 A8.1(d)	Number of Hopping Channels	Nominal	GFSK	■	☐	☐	☐	Complies
§15.247(a)(1)(iii) RSS210 A8.3(1)	Time of occupancy	Nominal	GFSK π/4-DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(a)(1) RSS210 A8.1(b)	Carrier Frequency Separation	Nominal	GFSK	■	☐	☐	☐	Complies
15.247 (a) (1), RSS-210 A8.1 (d)	20 dB Channel Bandwidth	Nominal	GFSK π/4-DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Conducted	Nominal	8-DPSK	☐	☐	☐	■	Note 1
§15.247(d) RSS210 A8.5	Band edge compliance-	Nominal	GFSK π/4-DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(d) §15.209 (a) RSS210 A8.5 RSS-Gen 7.2.2	TX Spurious emissions-Radiated	Nominal	8-DFSK	■	☐	☐	☐	Complies
§15.207(a) RSS Gen 7.2.4	AC Conducted Emissions <30MHz	Nominal	8-DPSK	☐	☐	☐	■	Note 2

Note: NA= Not Applicable; NP= Not Performed.

1. Conducted spurious emissions test against non-restricted band limits is NOT PERFORMED since radiated spurious emissions against more stringent restricted band limits over the complete measurement range (9kHz to 26GHz) passed.
2. The EUT's power supply is a 12V DC Supply so AC Power Line Test was not performed.

6 Measurement Information

6.1 Radiated Measurement Procedure

ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beamwidth, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the "cone of radiation" from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT's size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

NOTES

1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

6.2 Sample Calculations for Radiated Measurements

Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dBµV/m) = Measured Value on SA (dBµV)+ Cable Loss (dB)+ Antenna Factor (dB/m)
Eg:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

Measurement Uncertainty: ±3.0 dB

6.3 Conducted Emissions Procedure

ANSI C63.10 (2009) Section 6.2.5: Final AC Power-Line Conducted Emission Measurements

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Section 6.2.5: Measurement requirements

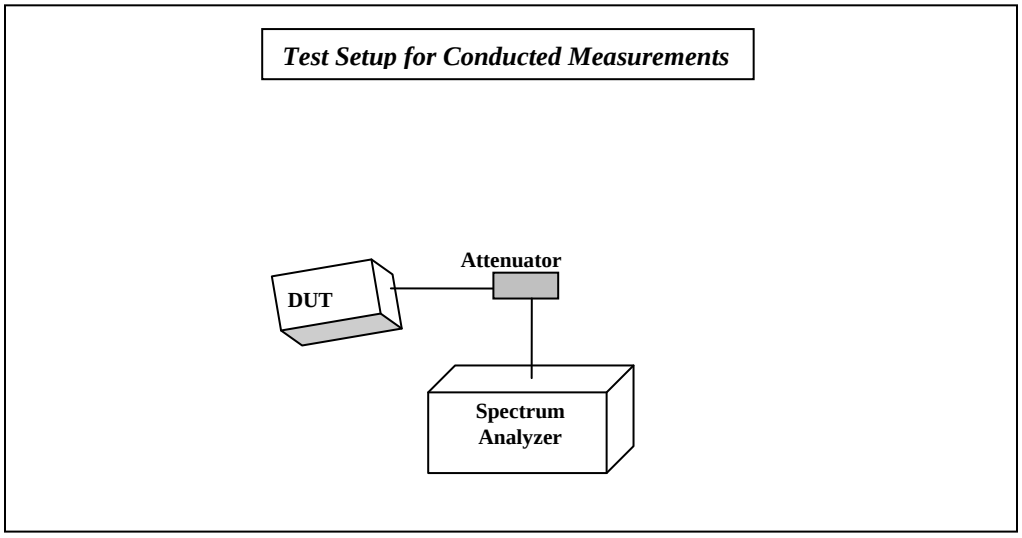
The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Measurement Uncertainty: ±3.0dB

6.4 RF Conducted Measurement Procedure

Reference: FCC Public Notice DA 00-705:2000 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
3. Measurements are to be performed with the EUT set to the low, middle and high channels and for GFSK, π/4DQPSK and 8-DPSK modulation schemes.

Measurement Uncertainty: ±0.5 dB

6.5 Other Testing Notes:

The EUT was tested on low, mid and high channels in GFSK, π/4-DQPSK and 8DPSK modes, unless otherwise stated.

7 Measurement Results

7.1 Maximum Peak Conducted Output Power and EIRP.

7.1.1 Limits:

Maximum Peak Output Power:
FCC §15.247 (b)(1): 1W
IC RSS-210 issue 8, annex 8.4(2): 1W
EIRP: IC RSS-210 issue 8, annex 8.4(2): 4W

7.1.2 Test Conditions

Tnom: 22°C; Vnom: 12 V

7.1.3 Test Procedure

Refer to DA 00-705:2000
Hopping OFF
Spectrum Analyzer settings:
Span = approximately 5 times the 20 dB bandwidth
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW Sweep = auto
Detector function = peak. Trace = max hold
Use the marker-peak function to set the marker to the peak of the emission.

Specified Antenna Gain (dBi):
2.40 GHz – 2.48 GHz: is +0.4 dBi

Testing Notes
Radiated EIRP is calculated as *Radiated EIRP = Conducted Measurement + Antenna Gain*

7.1.4 Test Results

Maximum Peak Conducted Output Power			
Modulation	**Frequency (MHz)**		
	2402	**2441**	**2480**
DH1 / GFSK	-0.44	0.9	0.74
2DH5 / π/4 DQPSK	-1.77	-0.17	-0.88
3DH5 / 8-DPSK	-1.38	-0.6	-0.48

EIRP = Calculated Maximum Peak Output Power + 0.4dBi			
Modulation	**Frequency (MHz)**		
	2402	**2441**	**2480**
DH1 / GFSK	-0.04	1.3	1.14
2DH5 / π/4-DQPSK	-1.37	0.23	-0.48
3DH5 / 8-DPSK	-0.98	-0.2	-0.08

Measurement Verdict

Pass. See Plots in section 11.1

7.2 Band Edge Compliance at Restricted and Non-restricted Band Edge

7.2.1 References

§15.247 (d)
RSS-210 A8.5
Radiated emissions which fall in the restricted bands, as defined in §15.205 (a) and RSS-Gen 7.2.2 (c), must also comply with the radiated emission limits specified in §15.209 (a) and RSS-Gen 7.2.5.

§15.205 (a)
RSS-Gen 7.2.2 (c)
Only spurious emissions are permitted in any of the frequency bands listed in the tables in §15.205 (a) and RSS-Gen 7.2.2 (c).

§15.209
RSS-Gen 7.2.5
The emissions from an intentional radiator shall not exceed the limits in the tables in §15.205 (a) and RSS-Gen 7.2.2 (c).

§15.35 (b)
When average radiated emissions measurements are specified, the limit on the peak level of the radio frequency emissions is 20 dB above the maximum permitted average emission limit.

7.2.2 Spectrum Analyzer Settings

	Low Band Edge – Peak	Low Band Edge – Average	High Band Edge – Peak	High Band Edge - Average
Start Frequency	2.31 GHz	2.31 GHz	2.46 GHz	2.46 GHz
Stop Frequency	2.42 GHz	2.42 GHz	2.51 GHz	2.51 GHz
Resolution Bandwidth	1 MHz	1 MHz	1 MHz	1 MHz
Video Bandwidth	1 MHz	10 Hz	1 MHz	10 Hz
Detector	Peak	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto	Auto

7.2.3 Measurement Procedure:

Peak measurements are made using a peak detector and RBW=1MHz.
Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.
*PEAK LIMIT= 74dBµV/m
*AVG. LIMIT= 54dBµV/m
Measurement Uncertainty: ±3.0dB

7.2.4 Measurement Result

Pass. See Plots in 11.2

7.3 20 dB Bandwidth

7.3.1 Relevant Information.

7.3.1.1 §15.247 (a) (1), RSS-210 A8.1 (d)
Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.3.2 Test Conditions:

Tnom: 21°C; Vnom: 12 V
Hopping OFF

Testing was done on all 3 modulations with different packet types as described in the table below.

Modulation	Packet Type
GFSK	DH1
π/4-DQPSK	2-DH5
8 DPSK	3-DH5

7.3.3 Test Procedure
Measurement according to DA 00-705:2000

Spectrum Analyzer settings:
Span: approximately 2 to 3 times the 20 dB bandwidth, centered on the hopping channel
RBW ≥ 1% of the 20 dB bandwidth
Sweep Time: Auto
Detector = peak
Trace = max. hold

7.3.4 Test Data:

20dB Bandwidth in KHz.			
Modulation (Packet Type)	**Channel Frequency (MHz)**		
	2402	**2440**	**2480**
GFSK (DH1)	922	933	923
π/4 DQPSK (2-DH5)	1312	1323	1294
8-DPSK (3-DH5)	1293	1297	1296
Measurement Uncertainty: ±10 kHz			

2/3 (Max Measured 20 dB BW in KHz)	874.6666667	882	864

7.3.4.1 Measurement Summary

The 2/3 portion of the maximum measured 20dB Bandwidth for the BT channels is ~875 Khz. See -20dB Plots in Section 11.3.

7.4 Carrier Frequency Separation

7.4.1 Limits:

§ 15.247 (a) (1) & RSS-210 (A8.1) (b)
Minimum 25 kHz or 2/3 of the 20dB bandwidth of the hopping system.
2/3 of the 20dB channel BW of the hopping system was measured as ~875 KHz.
The Carrier frequency separation shall be greater than 875 KHz

7.4.2 Test Conditions:

Tnom: 23°C; Vnom: 12 V
Hopping ON

7.4.3 Test Procedure:

Measurement according to DA 00-705:2000

Hopping function: enabled
Spectrum Analyzer settings:
Span = Wide enough to capture the peaks of the two adjacent channels
RBW ≥ 1% of the span
VBW ≥ RBW or 3X
Sweep = auto
Detector function = peak
Trace = max hold
Use marker-delta function to determine the separation between the peak of the two adjacent channels.

7.4.4 Test result:

Channel Separation: 1.01 MHz which is compliant with the minimum limit of section 7.4.1.
Pass. See Plot Section 11.4

7.5 Number of hopping channels

7.5.1 Limits:

§ 15.247 (a) (1) (ii) (iii) & RSS-210 A8.1 (d) (e)
At least 15 non-overlapping channels

7.5.2 Test Conditions:

Tnom: 21°C; Vnom: 12 V

7.5.3 Test Procedure:

Measurement according to DA 00-705

Hopping function: enabled
Spectrum Analyzer settings:
Span = the entire frequency band of operation
RBW ≥ 50 KHz
VBW ≥ RBW or 3X
Sweep = auto
Detector function = peak
Trace = max hold.

7.5.4 Test Result:

Number of hopping channels: 79
See Plot in Section 11.4

7.6 Time of occupancy (Dwell time)

7.6.1 Limits:

§ 15.247 (a) (1) (iii) & RSS-210 A8.1 (d) (e)

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 number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

7.6.2 Time occupancy calculation

For Bluetooth devices

The dwell time of 0.4 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels *31.6 s

Example for a DH1 packet (with a maximum length of one time slot)
Dwell time = 625 µs * 1600 1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.
Example for a DH5 packet (with a maximum length of five time slots)
Dwell time = 5 * 625 µs * 1600 * 1/5 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

This is according to Bluetooth Core Specification for all Bluetooth devices. Therefore all qualified Bluetooth devices satisfy the FCC requirement on time of occupancy (dwell time).

7.6.3 Test Result

Pass.

7.7 Transmitter Spurious Emissions & Restricted Bands- Radiated

7.7.1 Limits:

§15.247/15.205 & RSS-210 A8.5/RSS-Gen 7.2.2

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74dBµV/m
*AVG. LIMIT= 54dBµV/m

Table 1:

Frequency of emission (MHz)	Field strength @ 3m (µV/m)	Field strength @ 3m (dBµV/m)
30–88	100	40dBµV/m
88–216	150	43.5 dBµV/m
216–960	200	46 dBµV/m
Above 960	500	54 dBµV/m

Table 2:

Frequency of emission (MHz)	Field strength (µV/m) / (dBuV/m)	Measurement Distance (m)
0.009–0.490	2400/F(kHz) / ---------	300
0.490–1.705	24000/F(kHz) / --------	30
1.705–30.0	30 / (29.5)	30

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.

When testing at other than specified distance in the standard limits in dBuV/m and in dBm are converted as follows:

For frequencies at and above 30MHz:
Conversion factor (CF) = 20 log (D/d) = 20 log (3m / 30 m) = -20dB
Therefore, 20 dB shall be added to the specified limit @ 30 m to convert to actual test limit @ 3m or shall be subtracted from the actual readings if the specified limit @ 30 m remains the same.
For frequencies below 30MHz according to fcc 15.31(f)(2) :
Conversion factor (CF) = 40 log (D/d) = 20 log (3m / 30 m) = -40dB
Therefore, 40 dB shall be added to the specified limit @ 30 m to convert to actual test limit @ 3m or shall be subtracted from the actual readings if the specified limit @ 30 m remains the same.

7.7.2 Test Procedure

Measurement according to ANSI C63.4:2009

Analyzer Settings:
From 9 KHz – 30 MHz
RBW = 9 KHz
Detector: Peak

From 30 MHz – 1 GHz
Detector = Peak / Quasi-Peak
RBW=120 KHz (<1GHz)

Above 1 GHz
Detector = Peak / Average
RBW= 1MHz

7.7.3 Testing Notes

The measurement distance is 3 m.

DH1 packets with GFSK modulation were used because GFSK has the highest output power and the number of channels is the same for all modulations.

For the measurement range up to 30 MHz in the following plots the field strength results from 3m distance measurement are extrapolated to 300m and 30m distance respectively, by 40dB/decade, according to part 15.31(f)(2), per antenna factor scaling. The red limit line shows the 300 m limit up to 490 kHz, the 30m limit up to 30 MHz and 3m limit above 30MHz.

Measurements below 1000 MHz are performed with a peak detector and compared to quasi-peak limits. Measurements performed with a quasi-peak detector are only performed when the peak measurement is within 6dB of the quasi-peak limit.

Measurements between 9 kHz – 30 MHz and between 18 GHz – 26 GHz are performed at one channel because the emissions in these frequency ranges are the same for all channels.

Peaks over the limit are the carrier frequencies.

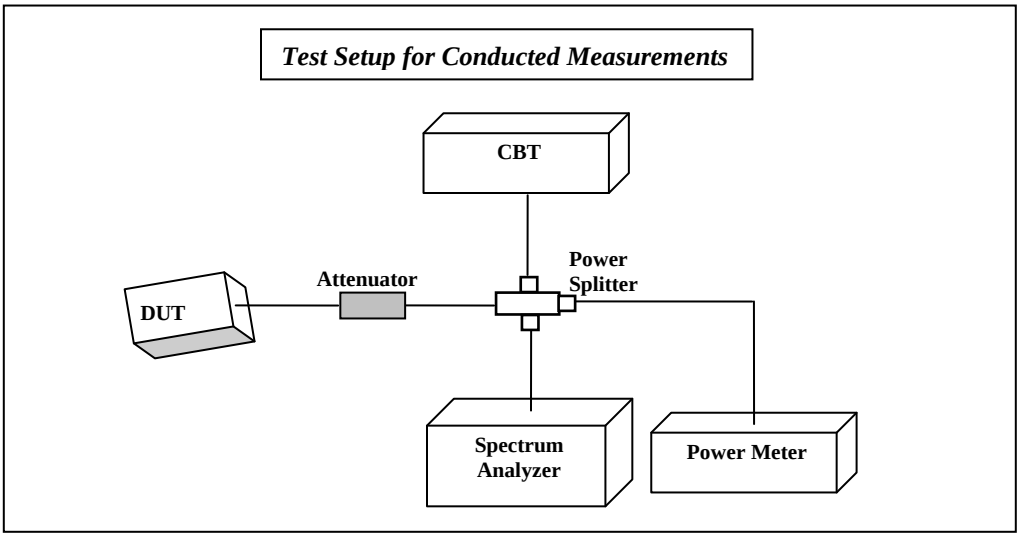
7.7.4 Measurement Verdict

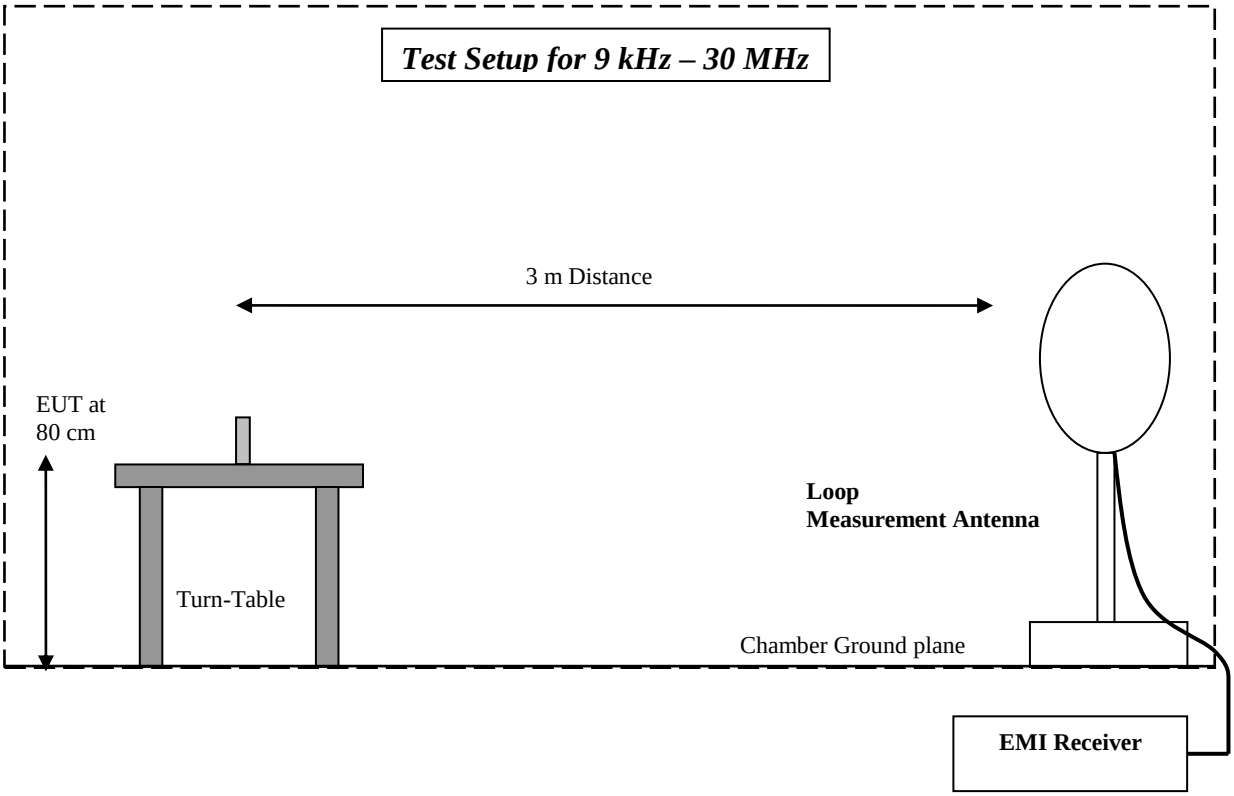
Pass. Plots in section 11.5

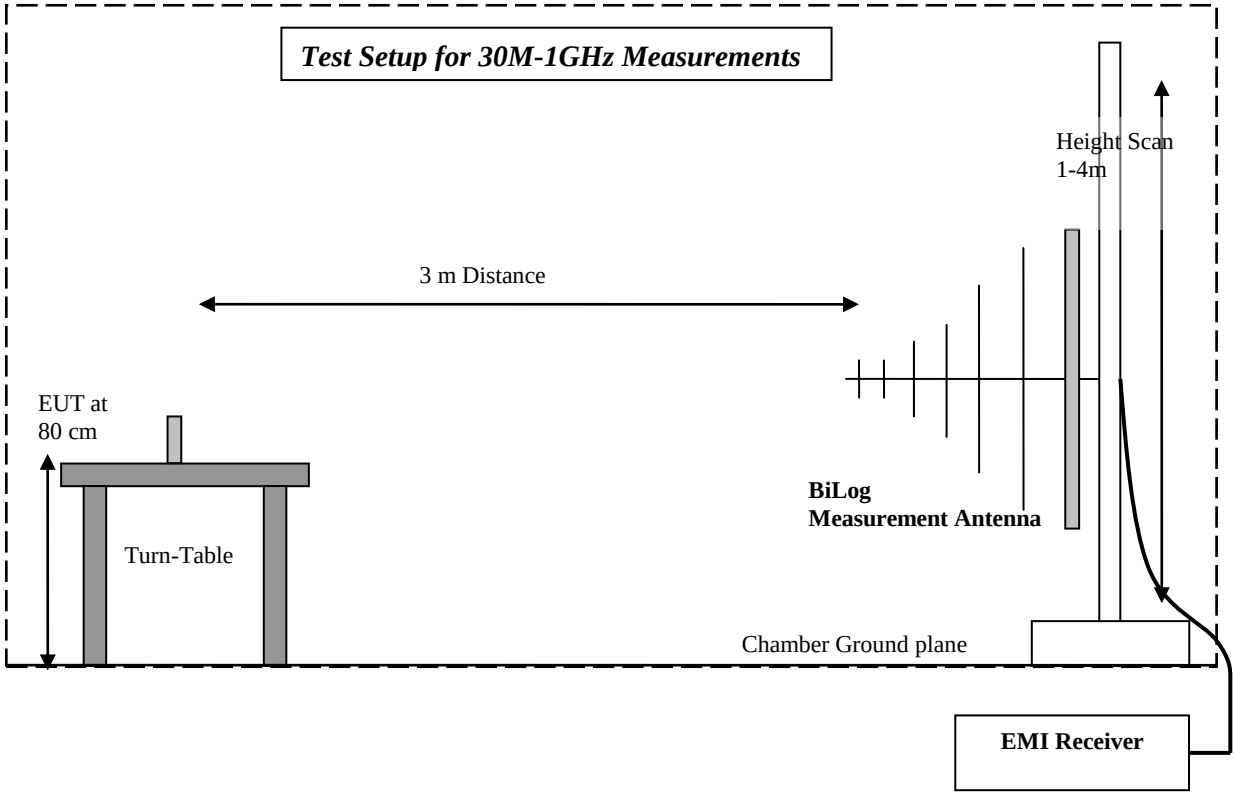
8 Test Equipment and Ancillaries used for tests

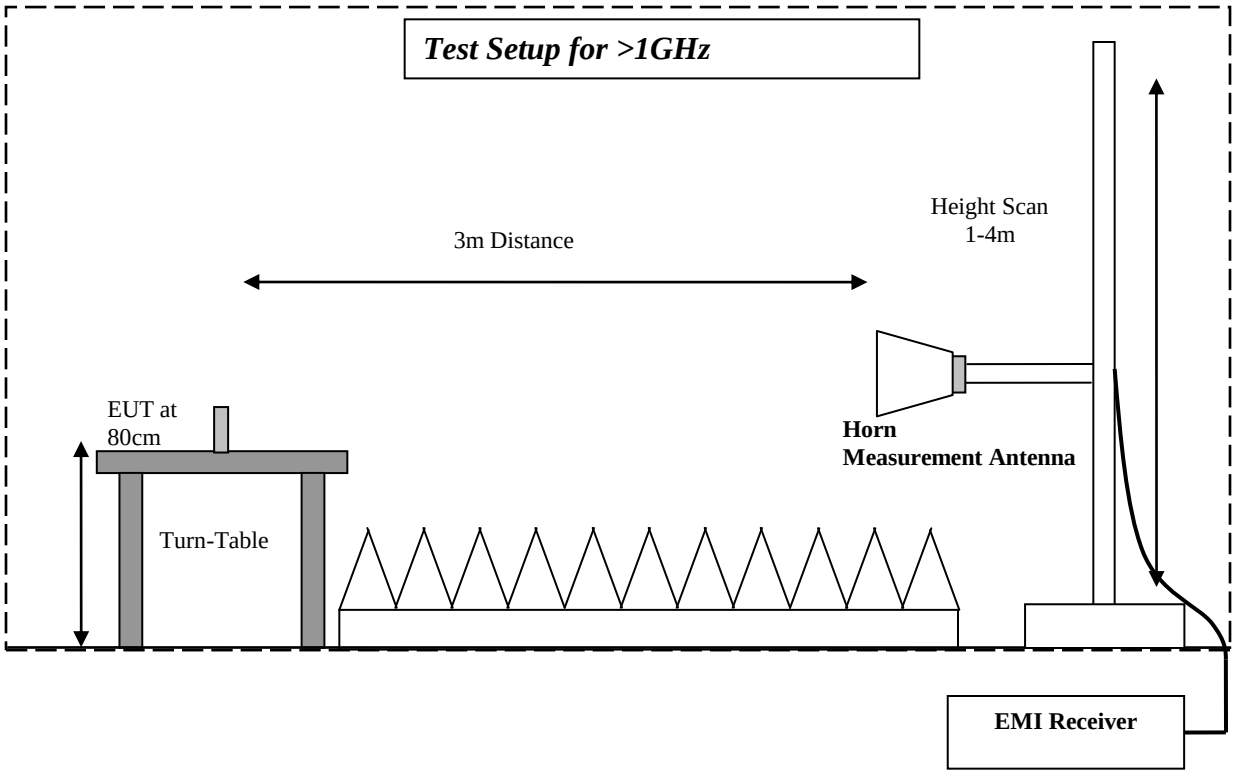
No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Sept 2013	2 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHZ HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	Rohde and Schwarz	ESV 216	101129	Mar 2013	2 years
Ancillary equipment						
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A
	Signal Generator	Agilent	83712B	US37101255	N/A	N/A
	Power Splitter	Agilent	11667B	52565	N/A	N/A
	Temp Hum Logger	TM325	Dickson	5285354	Apr 2014	1 Year

9 Block Diagrams






Test Setup for 30M-1GHz Measurements
Height Scan
1-4m
3 m Distance
EUT at
80 cm
BiLog
Measurement Antenna
Turn-Table
Chamber Ground plane
EMI Receiver


Test Setup for >1GHz
Height Scan
1-4m
3m Distance
EUT at
80cm
Horn
Measurement Antenna
Turn-Table
EMI Receiver

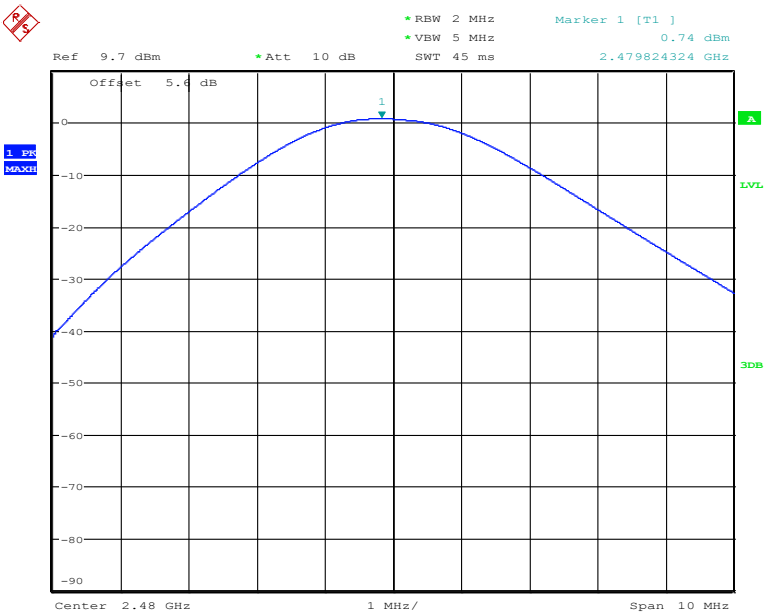
10 Revision History

Date	Report Name	Comments	Report by
2014-9-26	EMC_VERIT-005-14001_AT_255_FCC_15_247	Initial Version	James Donnellan
2014-11-22	EMC_VERIT-005-14001_AT_255_FCC_15_247_BT	1st official Version	James Donnellan

11 Measurement Plots

11.1 Conducted Power

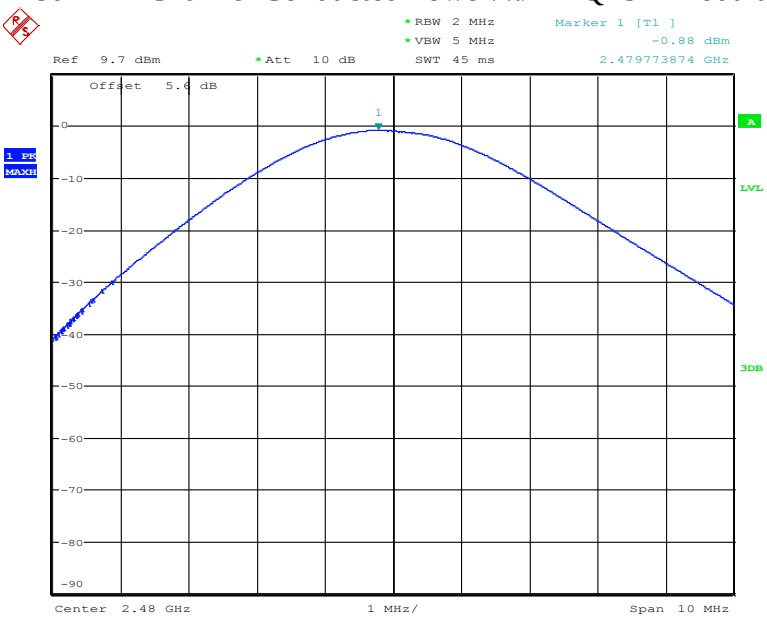
2480 MHz Channel Conducted Power. GFSK Modulation



low

Date: 16.SEP.2014 17:28:41

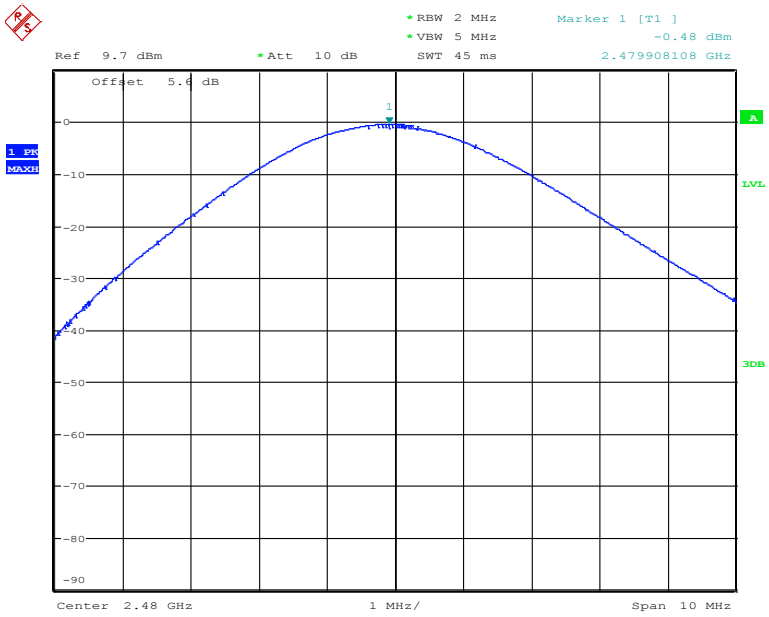
2480 MHz Channel Conducted Power. π/4-DQPSK Modulation.



low

Date: 16.SEP.2014 17:30:29

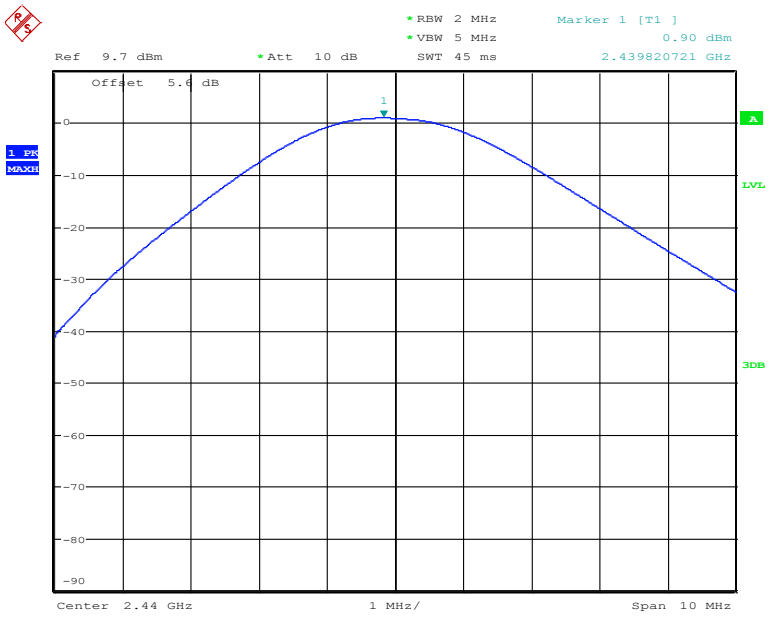
2480 MHz Channel Conducted Power. 8DPSK Modulation.



low

Date: 16.SEP.2014 17:33:18

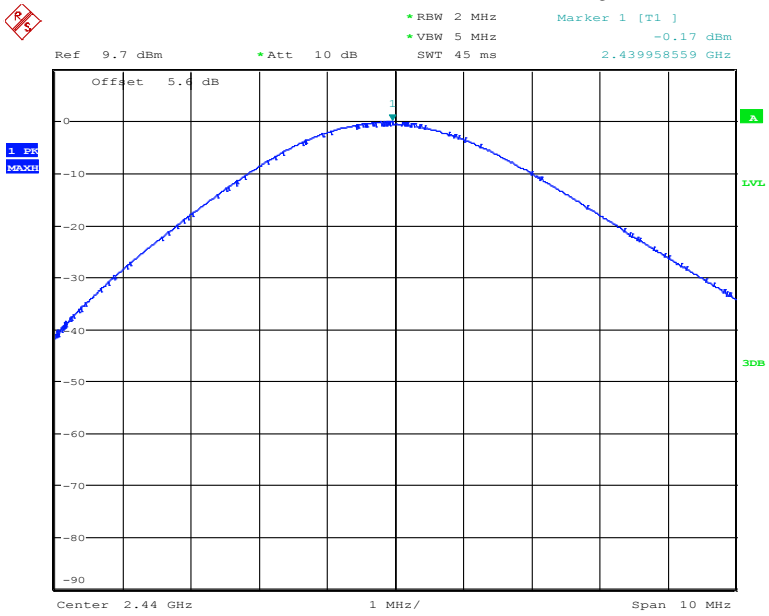
2440 MHz Channel Conducted Power. GFSK Modulation



low

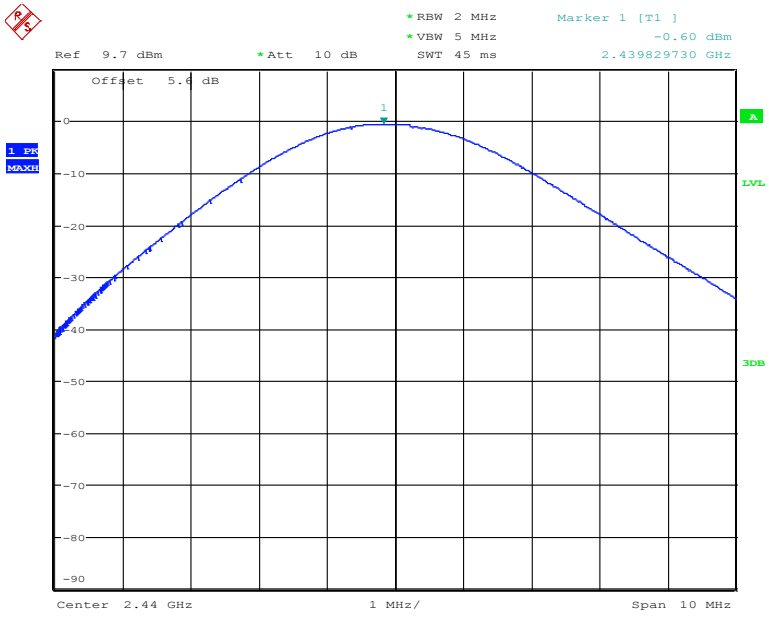
Date: 16.SEP.2014 16:55:12

2440 MHz Channel Conducted Power. π/4-DQPSK Modulation.



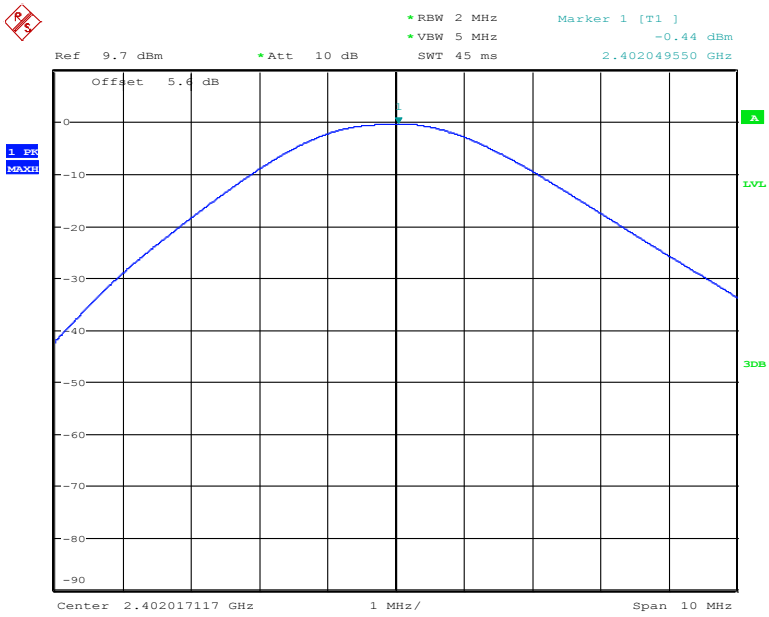
low
Date: 16.SEP.2014 16:59:08

2440 MHz Channel Conducted Power. 8DPSK Modulation.



low
Date: 16.SEP.2014 16:58:07

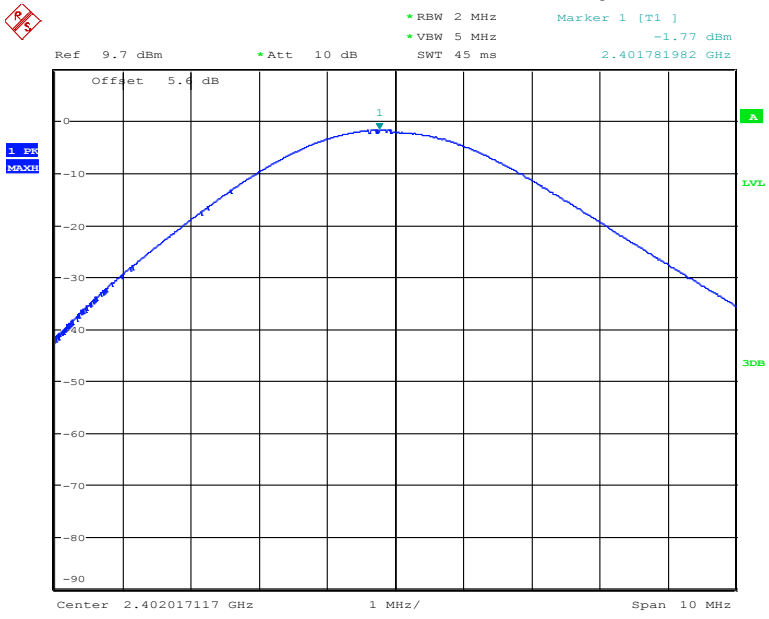
2402 MHz Channel Conducted Power. GFSK Modulation.



low

Date: 16.SEP.2014 16:47:39

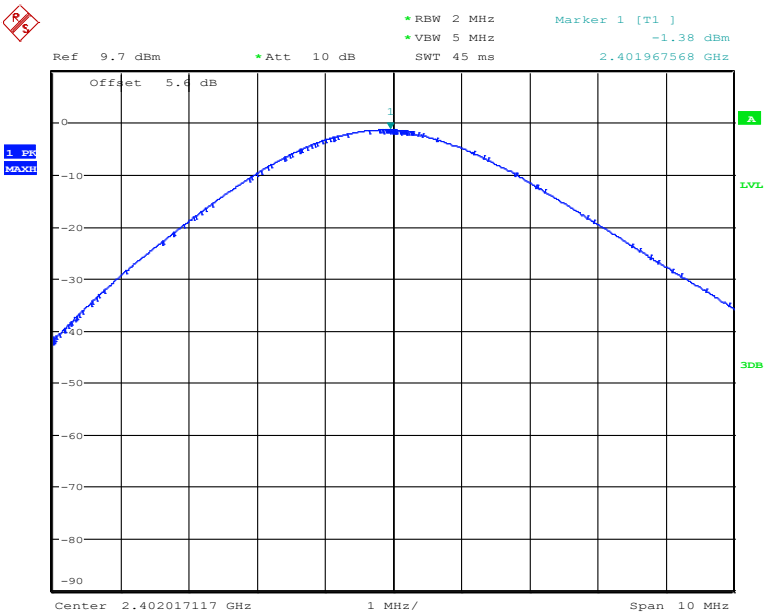
2402 MHz Channel Conducted Power. π/4-DQPSK Modulation.



low

Date: 16.SEP.2014 16:50:40

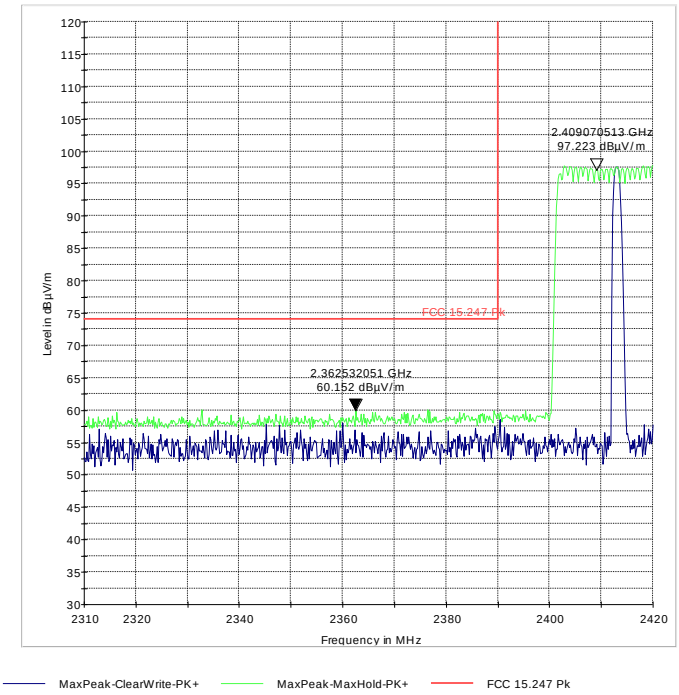
2402 MHz Channel Conducted Power. 8DPSK Modulation.



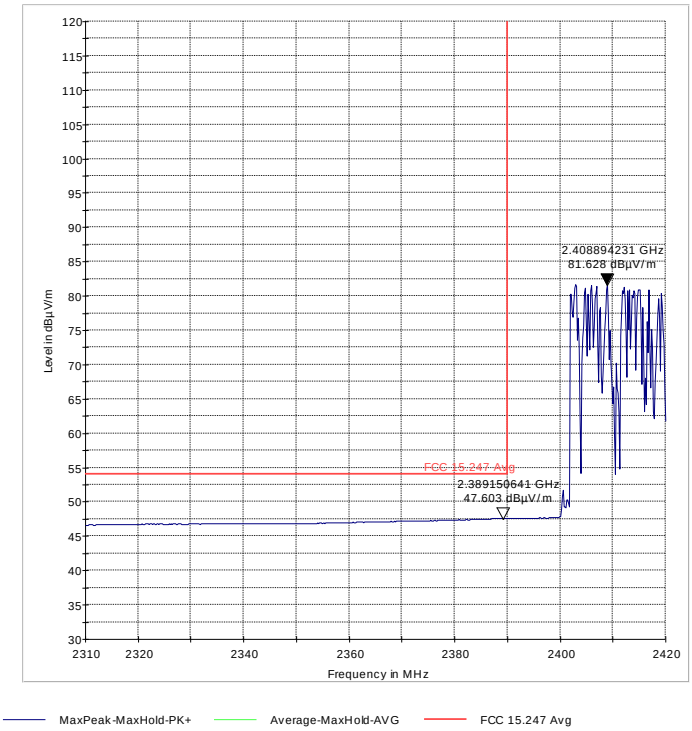
low
Date: 16.SEP.2014 16:51:46

11.2 BAND EDGE Radiated Plots

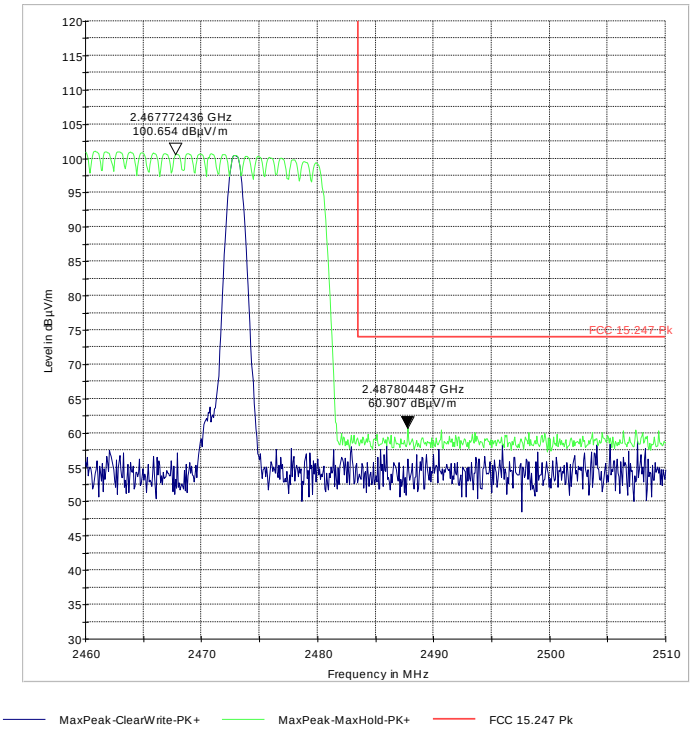
Lower Band Edge Peak – DH5



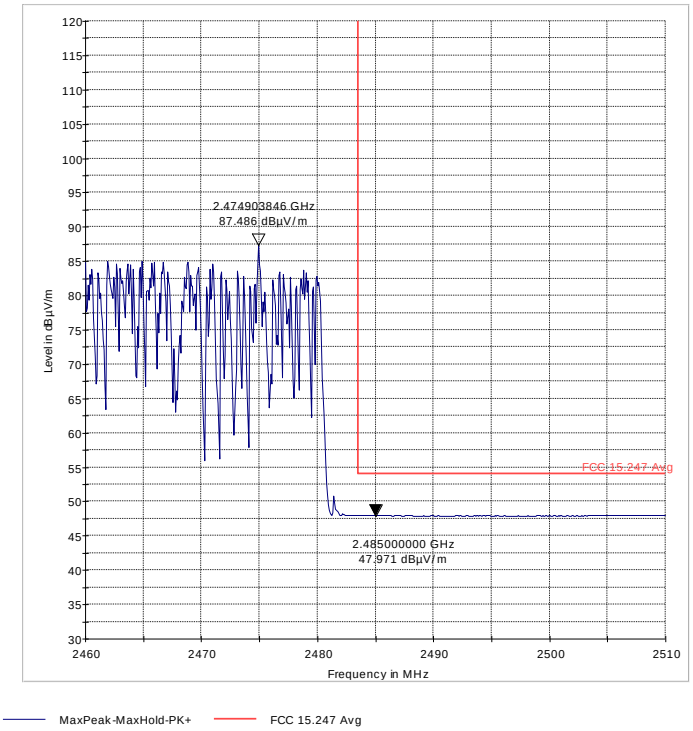
Lower Band Edge Average – DH5



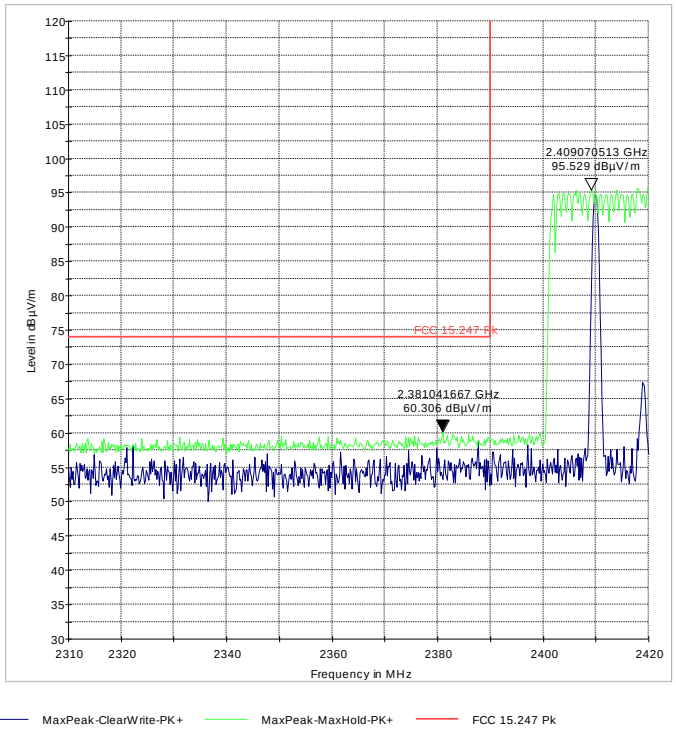
Higher Band Edge Peak – DH5



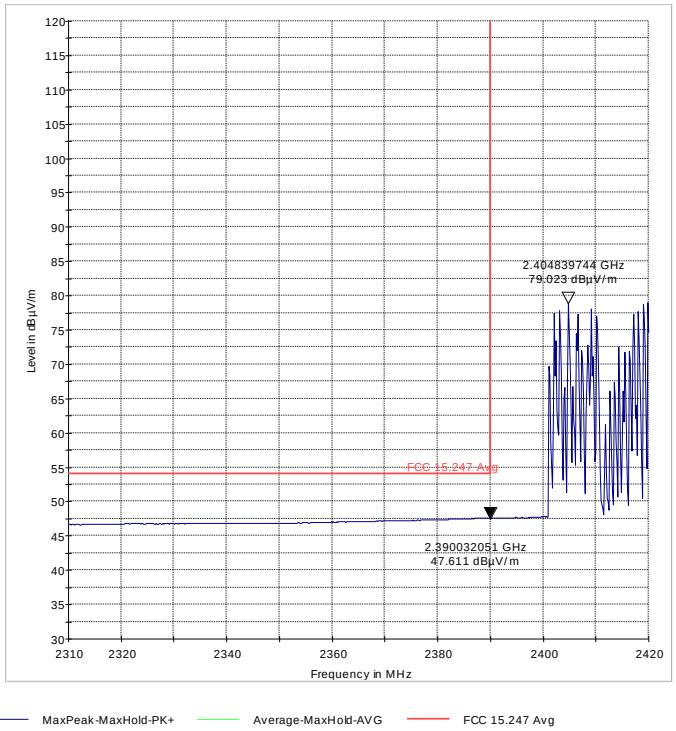
Higher Band Edge Average – DH5



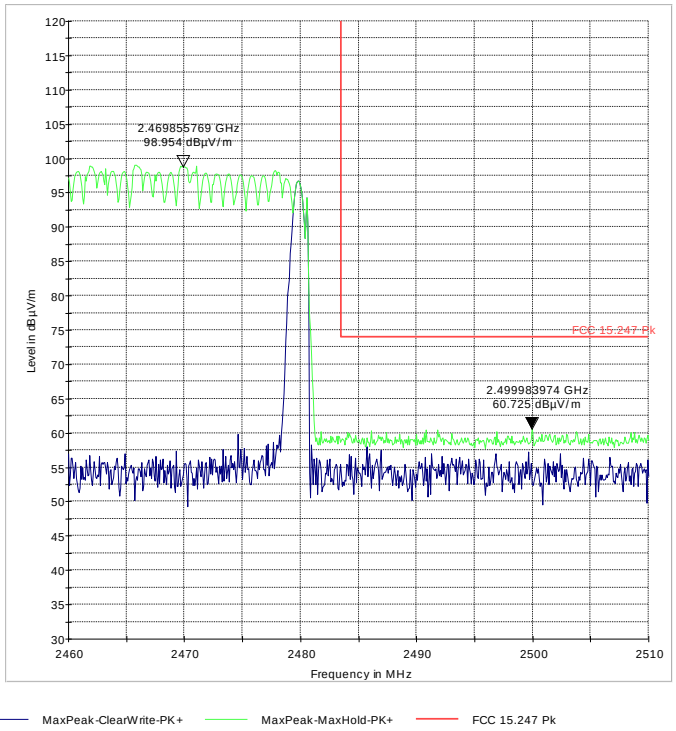
Lower Band Edge Peak – 2DH5



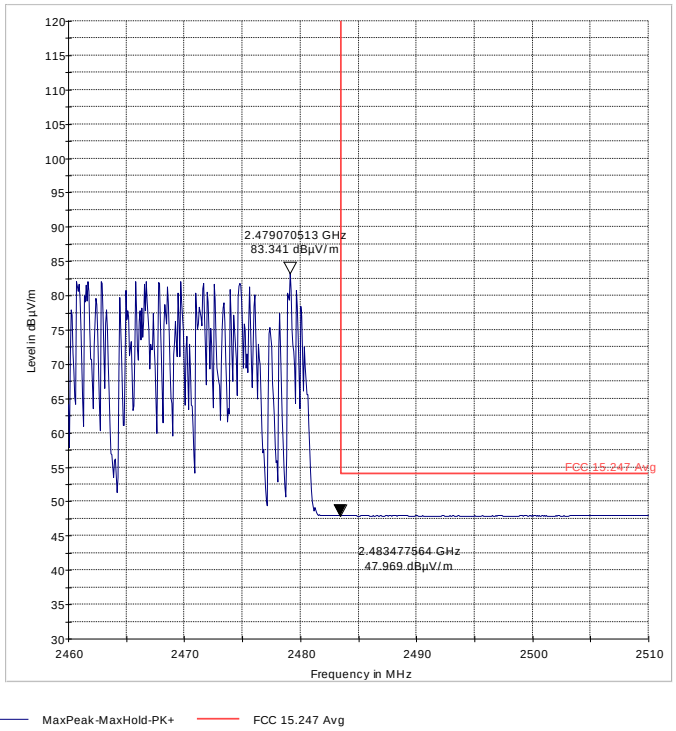
Lower Band Edge Average – 2DH5



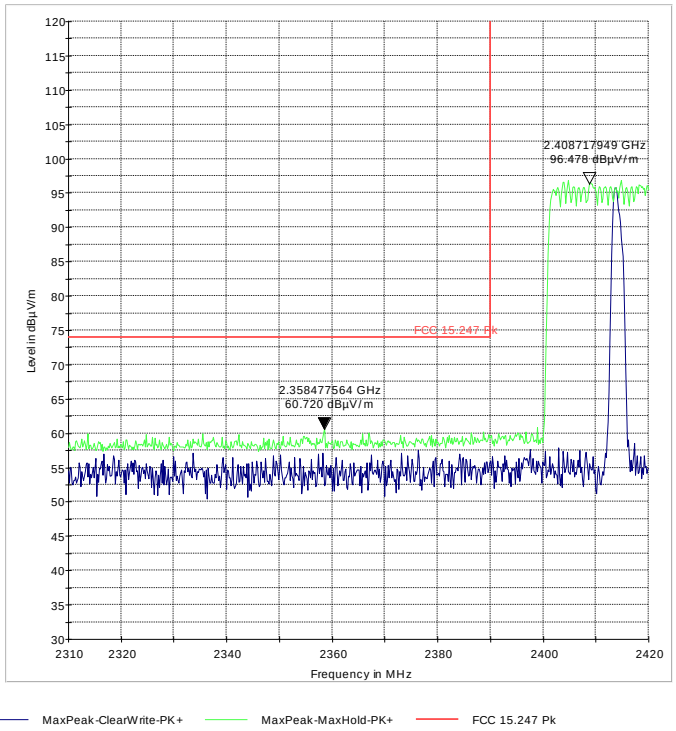
Higher Band Edge Peak – 2DH5



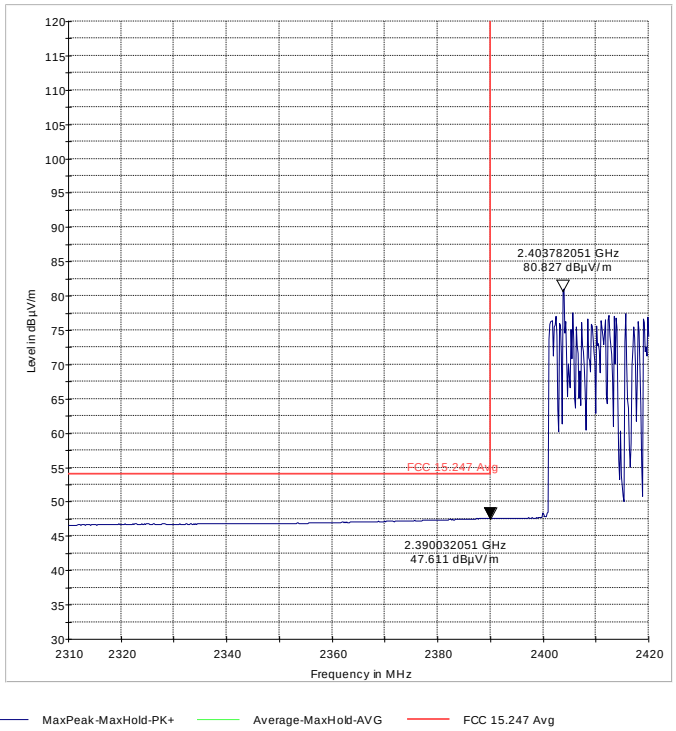
Higher Band Edge Average – 2DH5



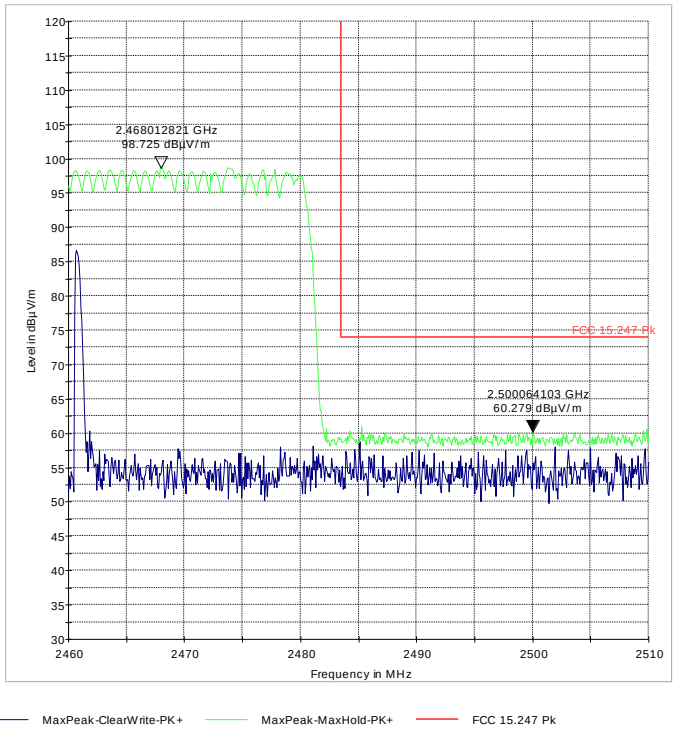
Lower Band Edge Peak – 3DH5



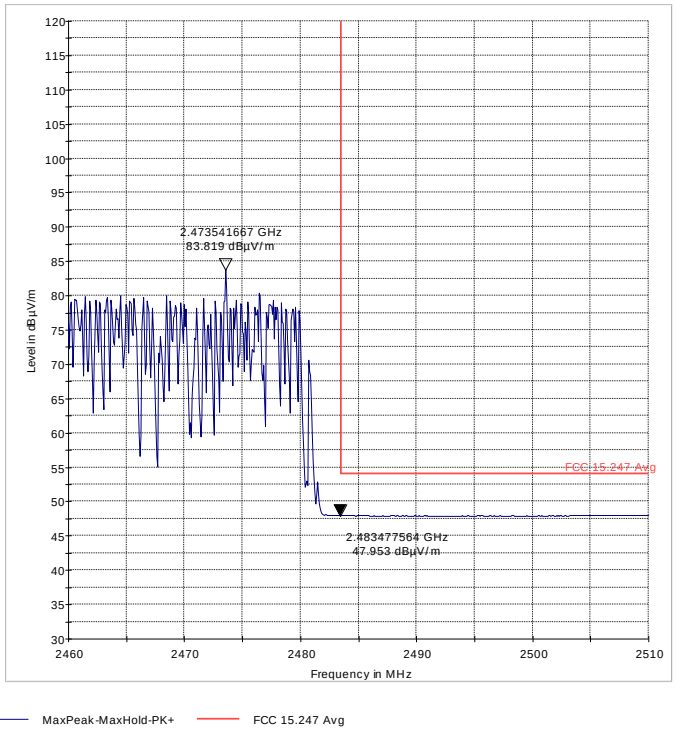
Lower Band Edge Average – 3DH5



Higher Band Edge Peak – 3DH5

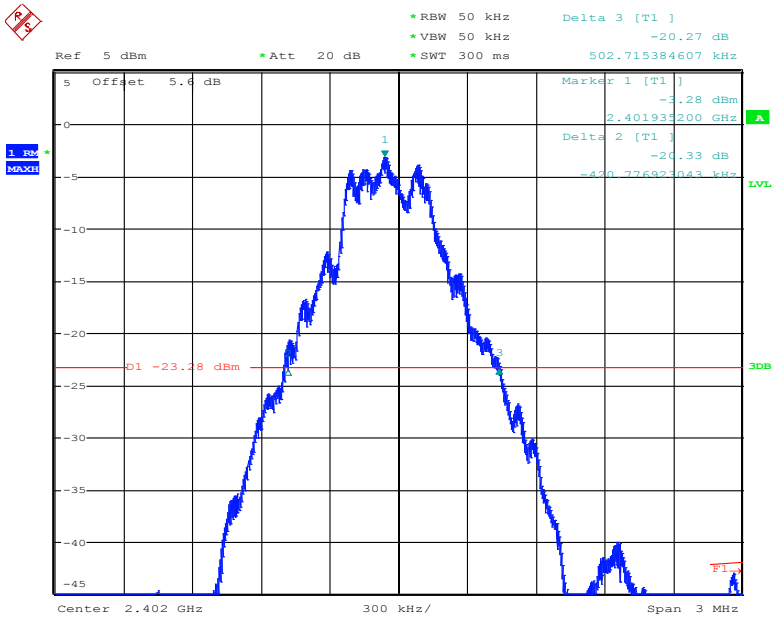


Higher Band Edge Average – 3DH5



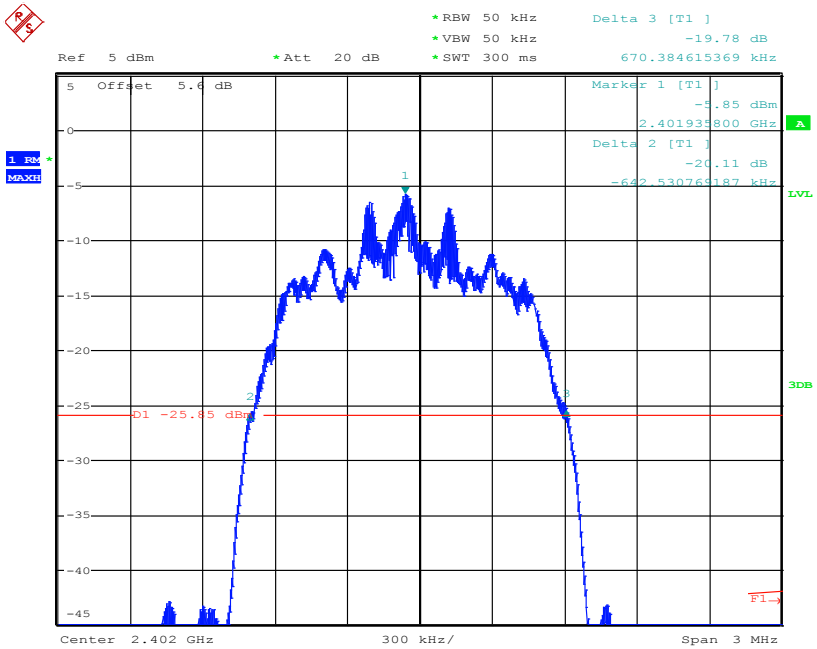
11.3 OBW 20dB plots.

20dB Bandwidth 2402 DH1 Packets



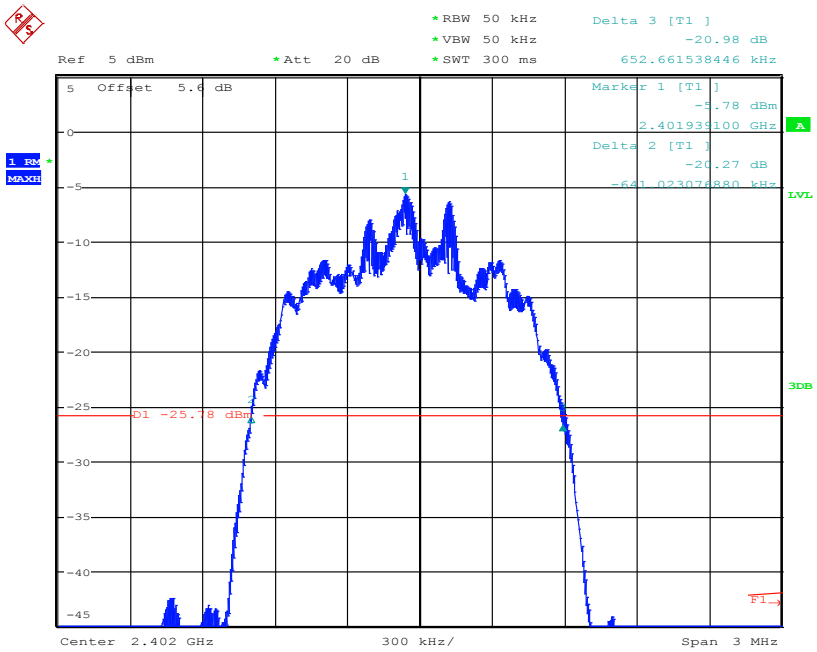
Date: 17.SEP.2014 19:47:30

20dB Bandwidth 2402 2DH5 Packets



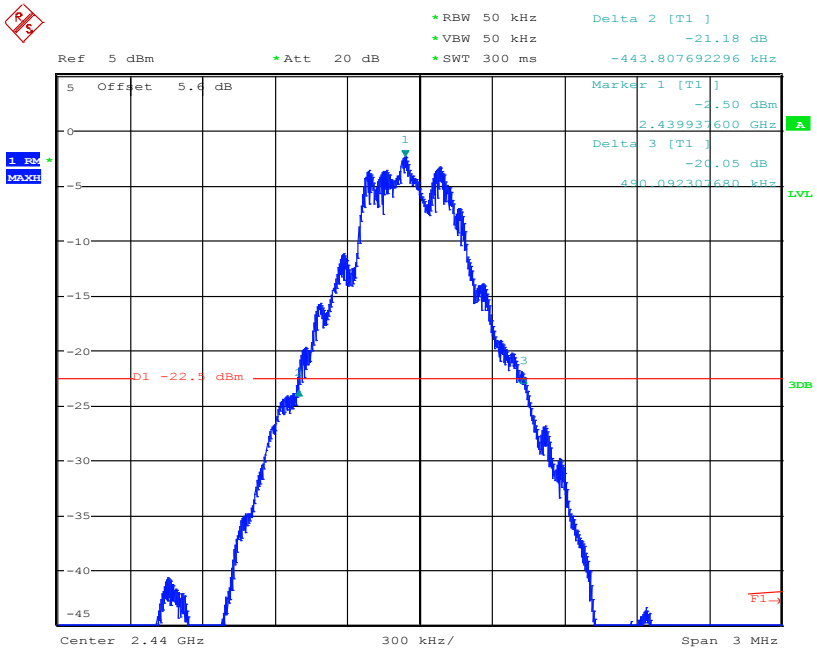
Date: 17.SEP.2014 19:45:03

20dB Bandwidth 2402 3DH5 Packets



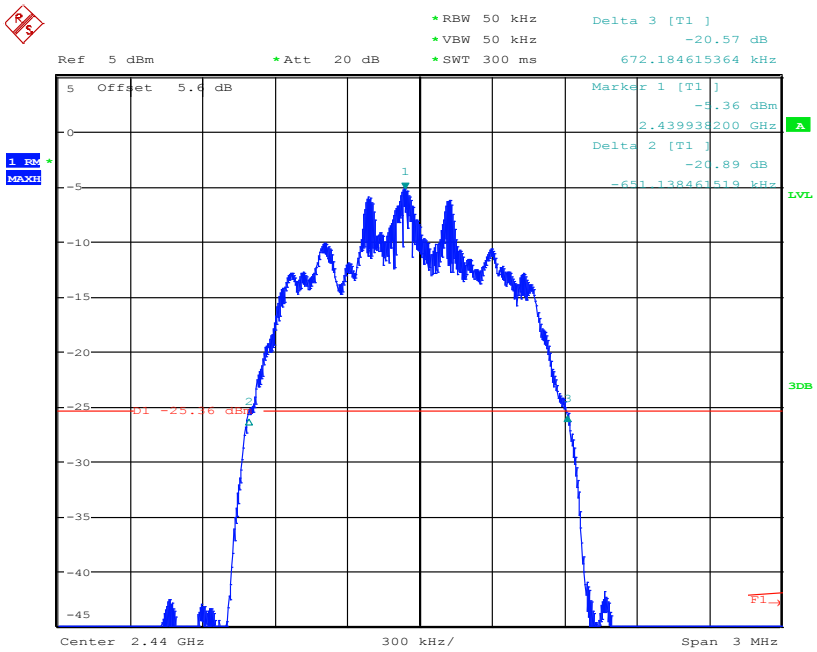
Date: 17.SEP.2014 19:42:26

20dB Bandwidth 2440 DH1 Packets



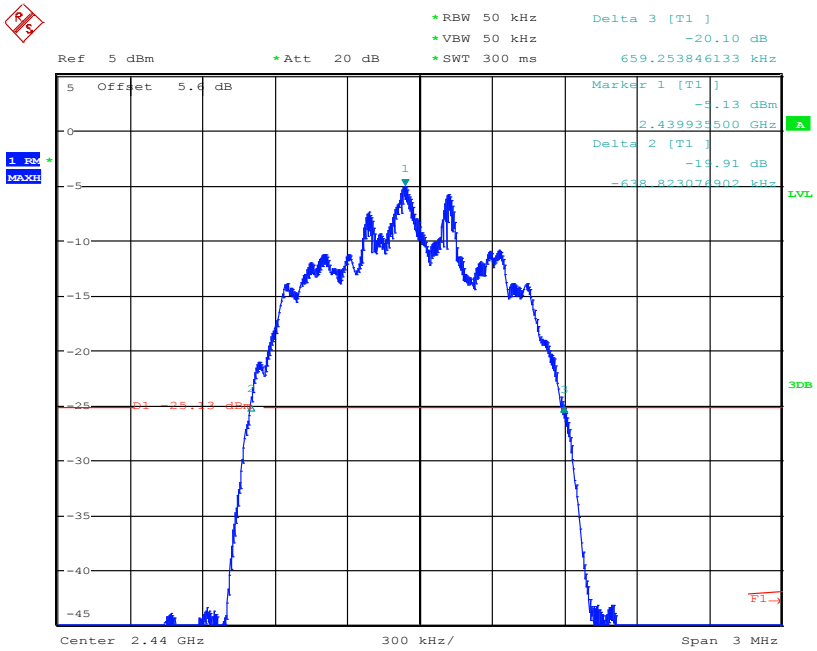
Date: 17.SEP.2014 19:35:09

20dB Bandwidth 2440 2DH5 Packets



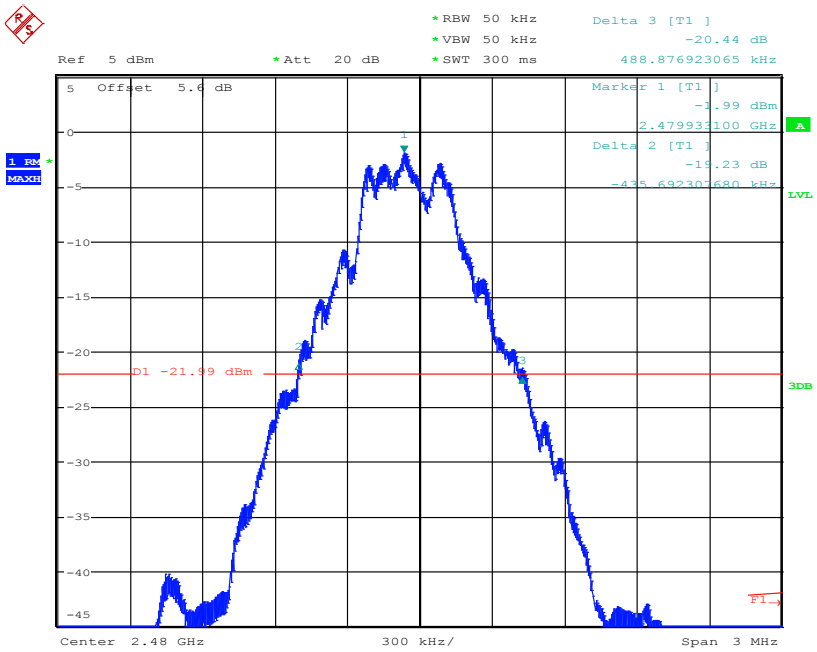
Date: 17.SEP.2014 19:37:47

20dB Bandwidth 2440 3DH5 Packets



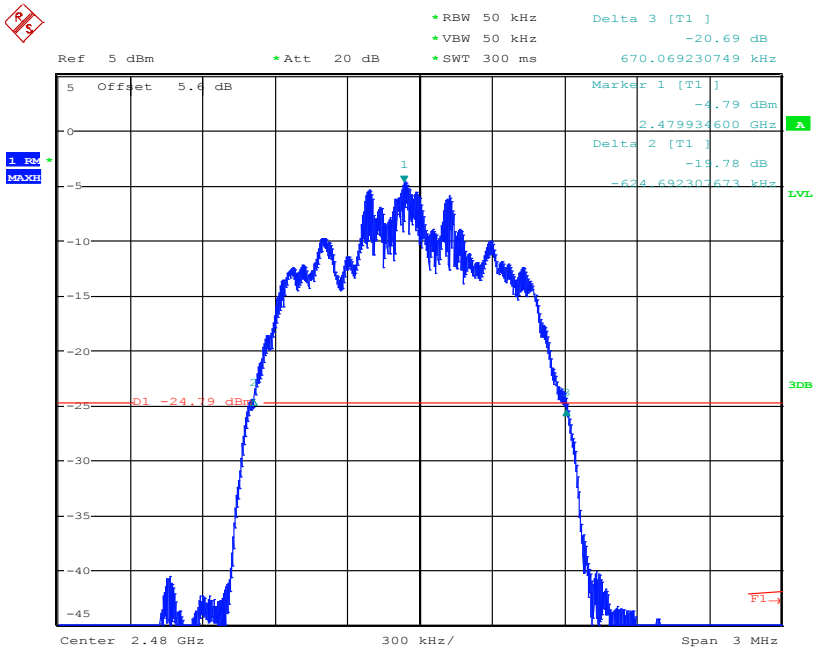
Date: 17.SEP.2014 19:25:07

20dB Bandwidth 2480 DH1 Packets



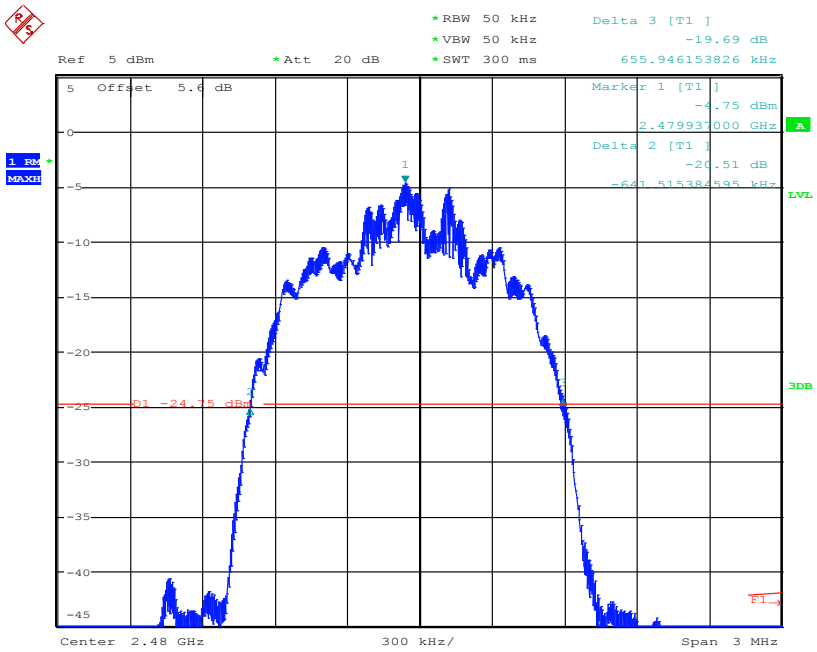
Date: 17.SEP.2014 19:11:19

20dB Bandwidth 2480 2DH5 Packets



Date: 17.SEP.2014 19:16:49

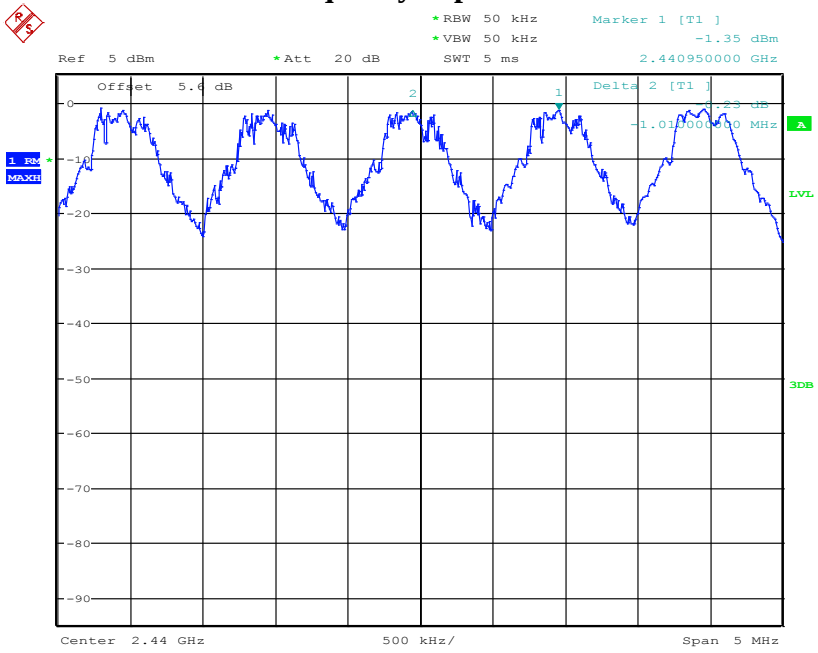
20dB Bandwidth 2440 3DH5 Packets



Date: 17.SEP.2014 19:20:26

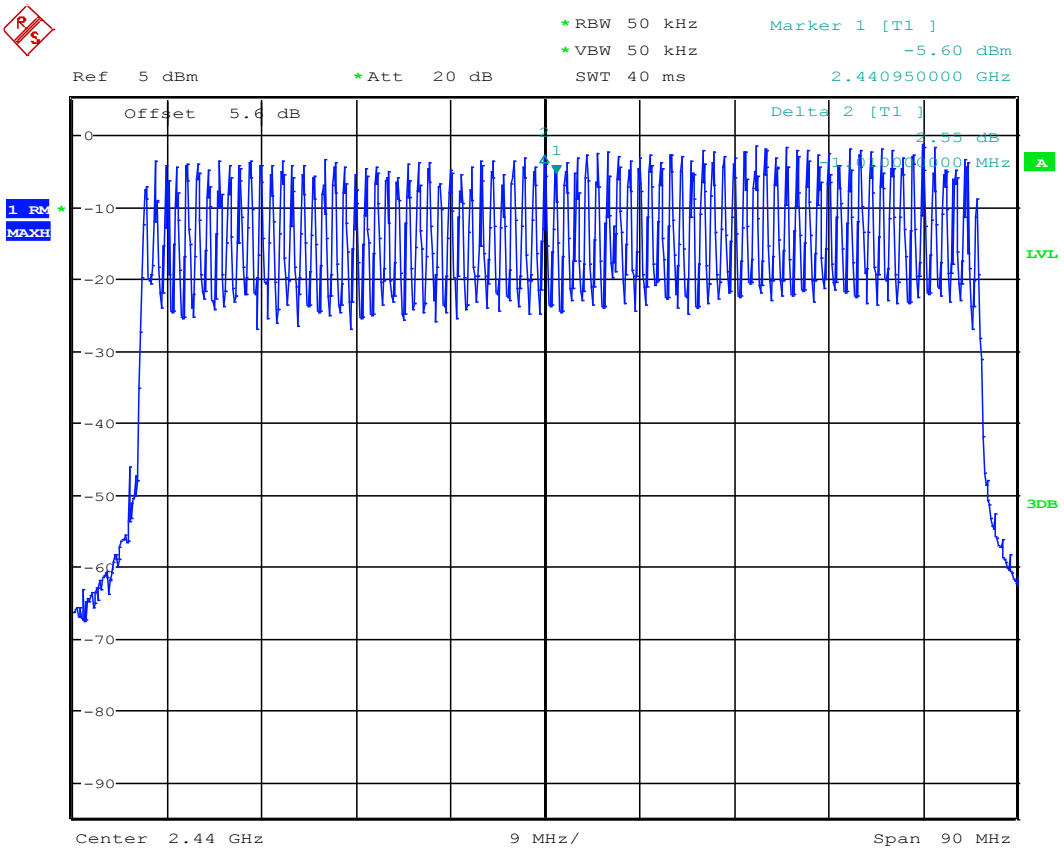
11.4 Bluetooth Channels and Carrier Frequency Plot

Bluetooth Channel Frequency Separation Plot



Date: 18.SEP.2014 19:50:43

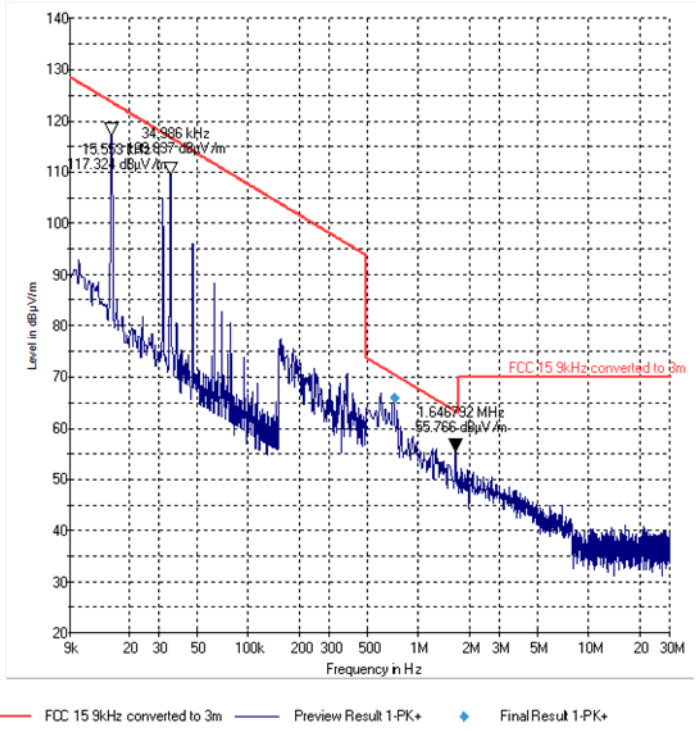
Spectrum of Bluetooth Channels Available on Device .



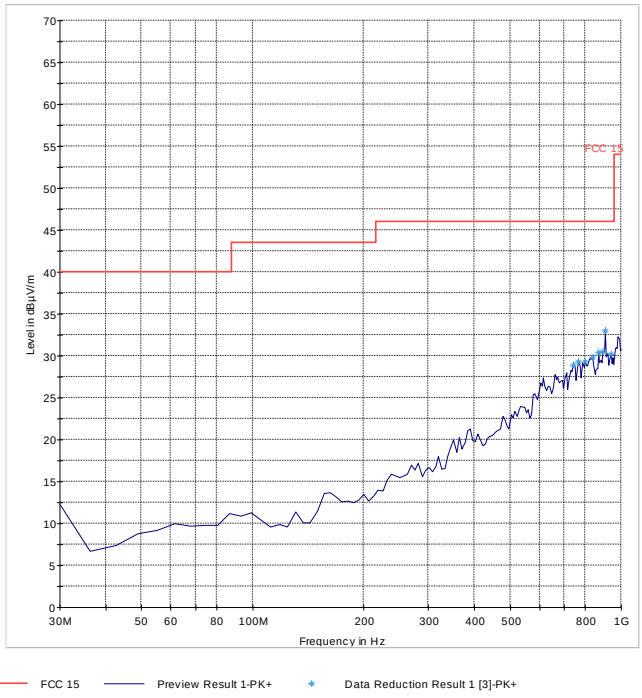
Date: 18.SEP.2014 20:00:00

11.5 Radiated Emission Plots

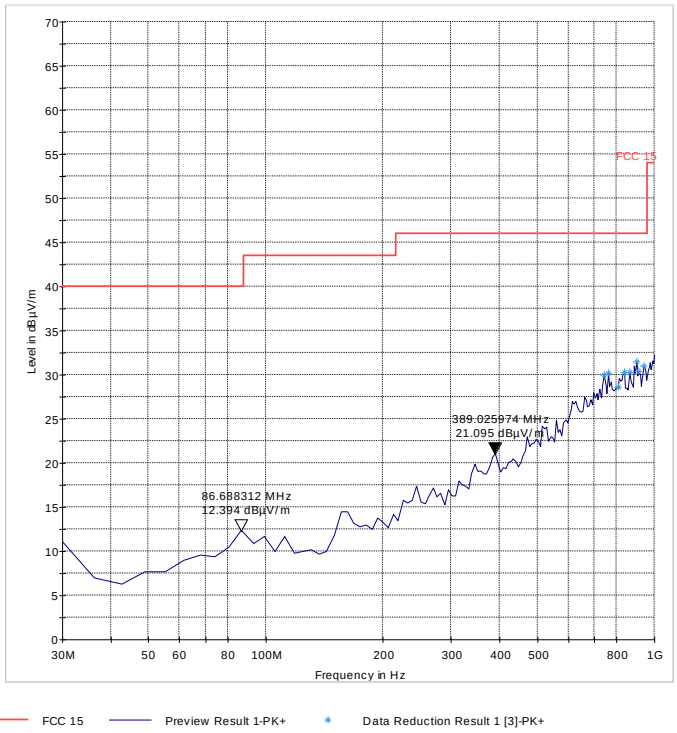
Emission Plot 9 KHz – 30 MHz



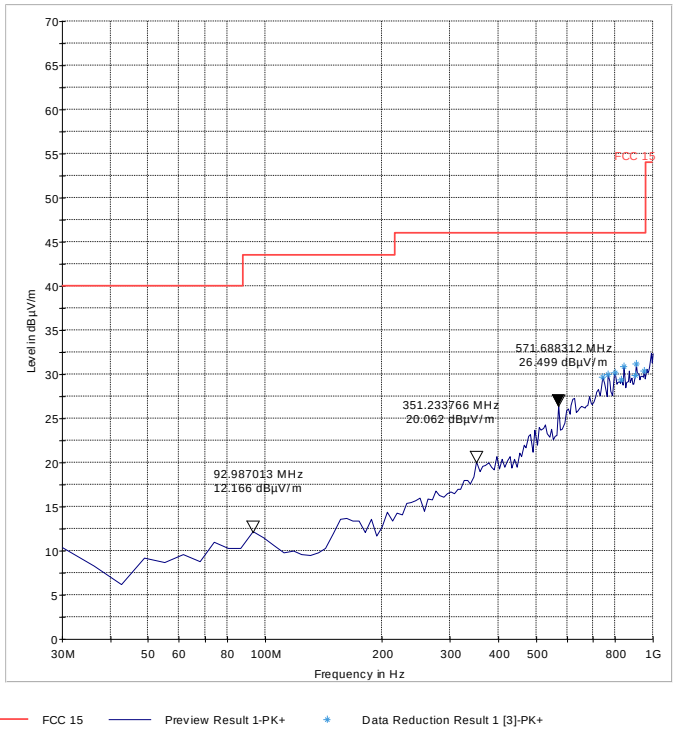
TX Radiated Spurious Emission 30 MHz – 1 GHz Ch0



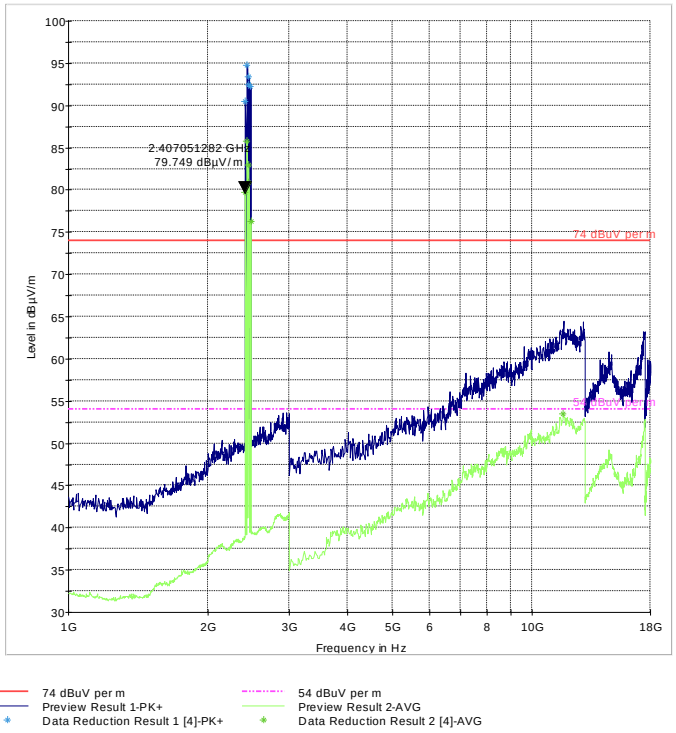
TX Radiated Spurious Emission 30 MHz – 1 GHz Ch39



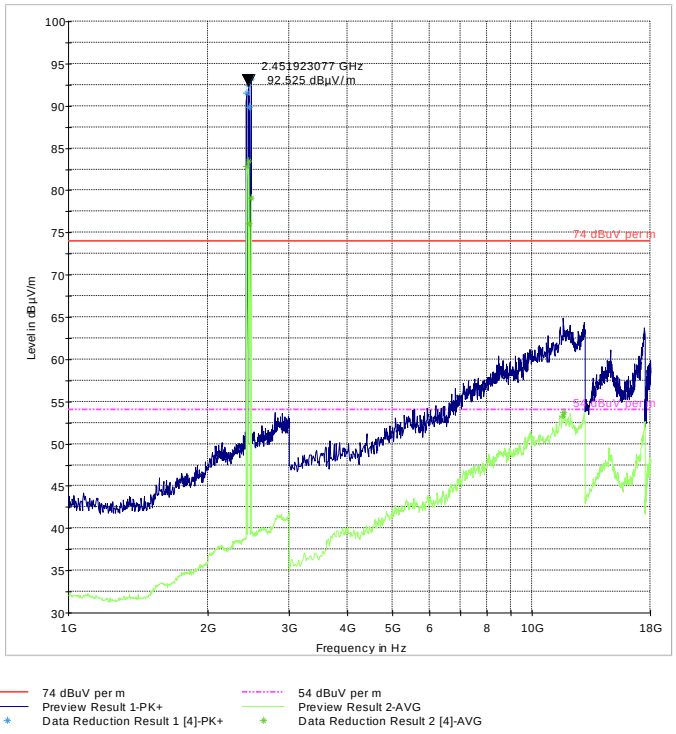
TX Radiated Spurious Emission 30 MHz – 1 GHz CH 78



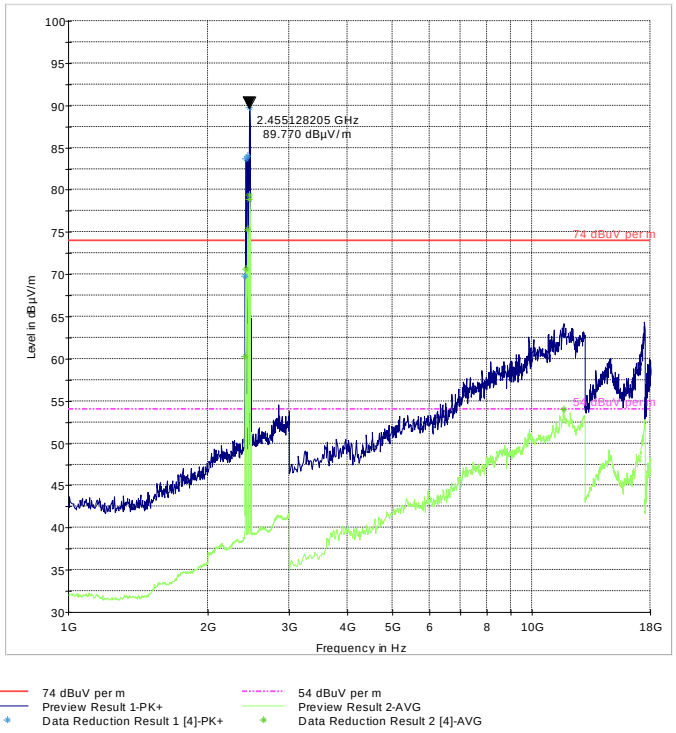
TX Radiated Spurious Emission 1 GHz – 18 GHz CH0



TX Radiated Spurious Emission 1 GHz – 18 GHz CH39



TX Radiated Spurious Emission 1 GHz – 18 GHz CH78



TX Radiated Spurious Emission– 18GHz - 26GHz channel 39