



InterLab[®]

Final Report on FC6000TN (BT4.0)

Report Reference: MDE_PARRO_1311_FCCb
acc. Title 47 CFR chapter I part 15 subpart C

Date: November 08, 2013

Test Laboratory:

7Layers AG
Borsigstr. 11
40880 Ratingen
Germany



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

7Layers AG
Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
www.7Layers.com

Aufsichtsratsvorsitzender •
Chairman of the Supervisory Board:
Ralf Mertens
Vorstand • Board:
Dr. H.-J. Meckelburg

Registergericht • registered in:
Düsseldorf, HRB 44096
USt-IdNr • VAT No.:
DE 203159652
TAX No. 147/5869/0385

1 Administrative Data

1.1 Project Data

Project Responsible: Imad Hjije
Date Of Test Report: 2013/11/08
Date of first test: 2013/10/10
Date of last test: 2013/10/11

1.2 Applicant Data

Company Name: Parrot S.A.
Street: 174 quai de Jemmapes
City: 75010 Paris
Country: France
Contact Person: Mr. Bruno Pellet
Function: Qualification
Phone: +33 (0) 1 48 03 60 60
Mobile: +33 (0) 1 48 03 61 13
E-Mail: bruno.pellet.ext@parrot.com

1.3 Test Laboratory Data

The following list shows all places and laboratories involved for test result generation:

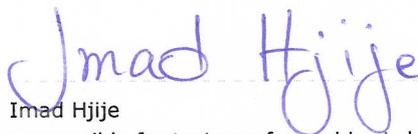
7 layers DE

Company Name : 7 layers AG
Street : Borsigstrasse 11
City : 40880 Ratingen
Country : Germany
Contact Person : Mr. Michael Albert
Phone : +49 2102 749 201
Fax : +49 2102 749 444
E Mail : michael.albert@7Layers.de

Laboratory Details

<i>Lab ID</i>	<i>Identification</i>	<i>Responsible</i>	<i>Accreditation Info</i>
Lab 1	Regulatory Bluetooth RF Test Solution	Mr. Jimmy Chatheril Mr. Sören Berentzen	DAkkS-Registration no. D-PL-12140-01-01

1.4 Signature of the Testing Responsible


Imad Hjije
responsible for tests performed in: Lab 1

1.5 Signature of the Accreditation Responsible



Accreditation scope responsible person
responsible for Lab 1

2 Test Object Data

2.1 General OUT Description

The following section lists all OUTs (Object's Under Test) involved during testing.

OUT: FC6000TN (BT4.0)



2.2 Detailed Description of OUT Samples

Sample : c01

<i>OUT Identifier</i>	FC6000TN (BT4.0)		
<i>Sample Description</i>	LE sample with external antenna		
<i>Serial No.</i>	PF817001AA2M000200		
<i>HW Status</i>	02		
<i>SW Status</i>	03.16.00		
<i>Low Voltage</i>	3.1 V	<i>Low Temp.</i>	-40 °C
<i>High Voltage</i>	3.6 V	<i>High Temp.</i>	+85 °C
<i>Nominal Voltage</i>	3.3 V	<i>Normal Temp.</i>	+20 °C

Parameter List:

<i>Parameter Description</i>	<i>Value</i>
Parameter for Scope FCC_v2	
Antenna Gain	2.18 (dBi)
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2440 (MHz)

Sample : d01

<i>OUT Identifier</i>	FC6000TN (BT4.0)		
<i>Sample Description</i>	LE sample with internal antenna		
<i>Serial No.</i>	PF817003AA3D000273		
<i>HW Status</i>	02		
<i>SW Status</i>	03.16.00		
<i>Low Voltage</i>	3.1 V	<i>Low Temp.</i>	-40 °C
<i>High Voltage</i>	3.6 V	<i>High Temp.</i>	+85 °C
<i>Nominal Voltage</i>	3.3 V	<i>Normal Temp.</i>	+20 °C

Parameter List:

<i>Parameter Description</i>	<i>Value</i>
Parameter for Scope FCC_v2	
Antenna Gain	1.7 (dBi)
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2440 (MHz)

2.3 OUT Features

Features for OUT: FC600TN (BT4.0)

<i>Designation</i>	<i>Description</i>	<i>Allowed Values</i>	<i>Supported Value(s)</i>
Features for scope: FCC_v2			
AC	The OUT is powered by or connected to AC Mains		
BT	EUT supports Bluetooth data rate of 1 Mbps with GFSK modulation in the band 2400 MHz - 2483.5 MHz		
BTLE	Support of Bluetooth Low Energy		
Eant	removable antenna supplied and type tested with the radio equipment, designed as an indispensable part of the equipment		
Iant	Integral Antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment		

2.4 Auxiliary Equipment

<i>AE No.</i>	<i>Type Designation</i>	<i>Serial No.</i>	<i>HW Status</i>	<i>SW Status</i>	<i>Description</i>
AE AUX1	WB_FC6XXX_CEM_01				Test Board

2.5 Setups used for Testing

For each setup a relation is given to determine if and which samples and auxiliary equipment is used. The left side list all OUT samples and the right side lists all auxiliary equipment for the given setup.

<i>Setup No.</i>	<i>List of OUT samples</i>		<i>List of auxiliary equipment</i>	
	<i>Sample No.</i>	<i>Sample Description</i>	<i>AE No.</i>	<i>AE Description</i>

C01 (Conducted measurement setup)

<i>Sample:</i> c01	LE sample with external antenna	AE AUX1	Test Board
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D01 (Conducted measurement setup)

<i>Sample:</i> d01	LE sample with internal antenna	AE AUX1	Test Board
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3 Results

3.1 General

Documentation of tested devices:

Available at the test laboratory.

Interpretation of the test results:

The results of the inspection are described on the following pages, where 'Conformity' or 'Passed' means that the certification criteria were verified and that the tested device is conform to the applied standard.

In cases where 'Declaration' is printed, the required documents are available in the manufacturers product documentation.

In cases where 'not applicable' is printed, the test case requirements are not relevant to the specific equipment implementation.

Note:

1) The laboratory environmental conditions are available and recorded in the Interlab System.

2) This test report focuses on the Bluetooth low energy part of the device. Only the applicable conducted measurements were performed. The radiated tests are covered by the 3.0 Bluetooth part of the module.

3) The tests were selected and performed with reference to the FCC measurement guide line "Measurement of Digital Transmission Systems Operating under Section 15.247 March 23, 2005" (KDB 558074 D01 DTS Meas Guidance v03r01) Instead of applying ANSI C63.4-1992 which is referenced in the FCC Public Note, the newer ANSI C63.4-2009 is applied.

3.2 List of the Applicable Body

(Body for Scope: FCC_v2)

<i>Designation</i>	<i>Description</i>
FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES	Subpart C - Intentional Radiators; 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

3.3 List of Test Specification

<i>Test Specification:</i>	FCC part 2 and 15
<i>Version</i>	10-1-12 Edition
<i>Title:</i>	PART 2 - GENERAL RULES AND REGULATIONS PART 15 - RADIO FREQUENCY DEVICES



3.4 Summary

<i>Test Case Identifier / Name Test (condition)</i>	<i>Result</i>	<i>Date of Test</i>	<i>Lab Ref.</i>	<i>Setup</i>
15c.10 Power density §15.247 (e)				
15c.10; Frequency = Highest	Passed	2013/10/11	Lab 1	C01
15c.10; Frequency = Lowest	Passed	2013/10/11	Lab 1	C01
15c.10; Frequency = Middle	Passed	2013/10/11	Lab 1	C01
15c.11 6dB Bandwidth §15.247 (a) (2)				
15c.11; Frequency = Highest	Passed	2013/10/11	Lab 1	C01
15c.11; Frequency = Lowest	Passed	2013/10/11	Lab 1	C01
15c.11; Frequency = Middle	Passed	2013/10/11	Lab 1	C01
15c.4 Peak power output §15.247 (b) (1)				
15c.4; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
	Passed	2013/10/10	Lab 1	D01
15c.4; Frequency = 2440, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
	Passed	2013/10/10	Lab 1	D01
15c.4; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
	Passed	2013/10/10	Lab 1	D01
15c.5 Spurious RF conducted emissions §15.247 (d)				
15c.5; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
15c.5; Frequency = 2440, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
15c.5; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2013/10/11	Lab 1	C01
15c.6 Band edge compliance §15.247 (d)				
15c.6; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted	Passed	2013/10/11	Lab 1	C01
15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted	Passed	2013/10/11	Lab 1	C01



3.5 Detailed Results

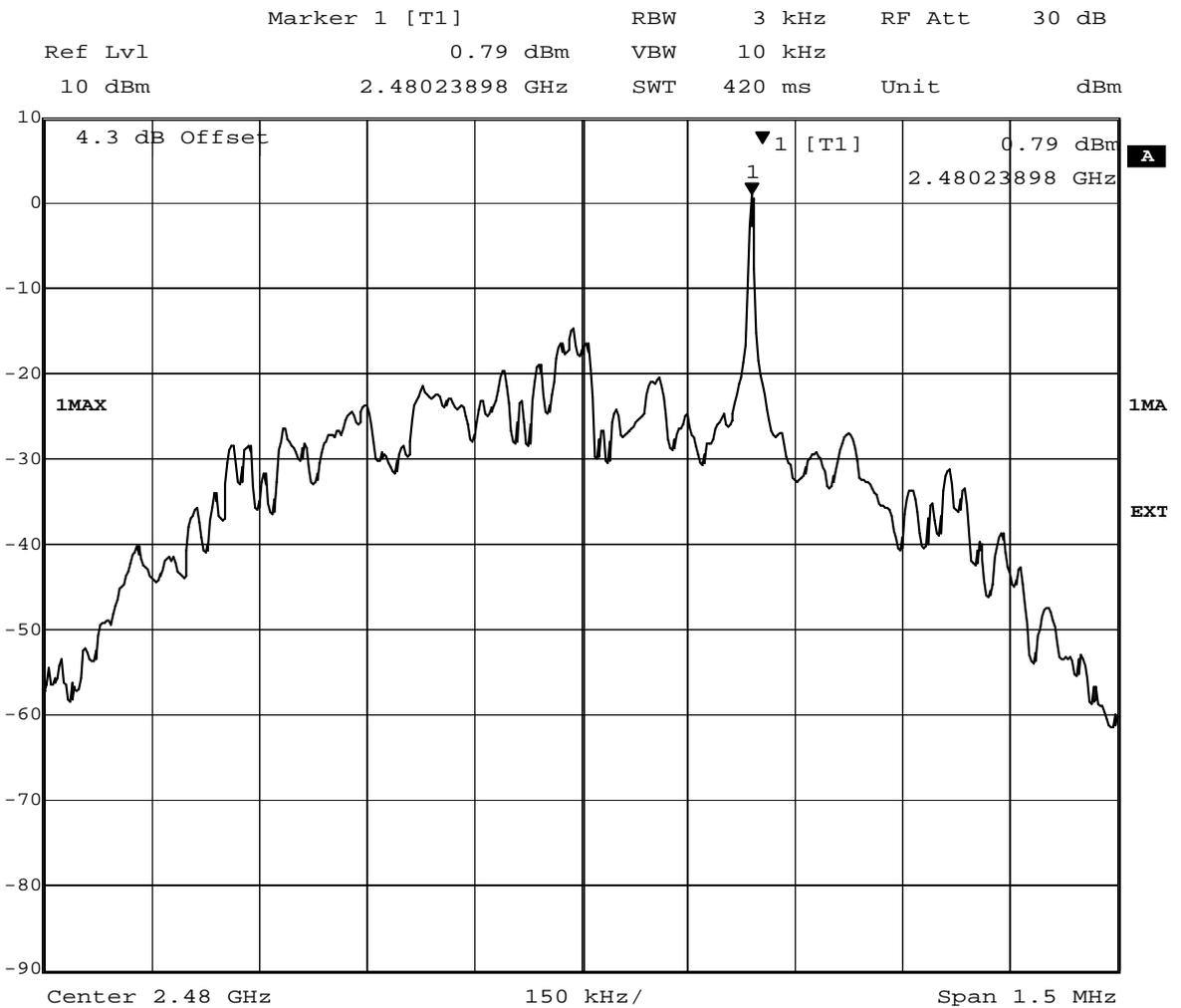
3.5.1 15c.10 Power density §15.247 (e)

Test: 15c.10; Frequency = Highest

<i>Result:</i>	Passed
<i>Setup No.:</i>	C01
<i>Date of Test:</i>	2013/10/11 13:01
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

Detailed Results:

Power Density dBm / 3 KHz
0.790



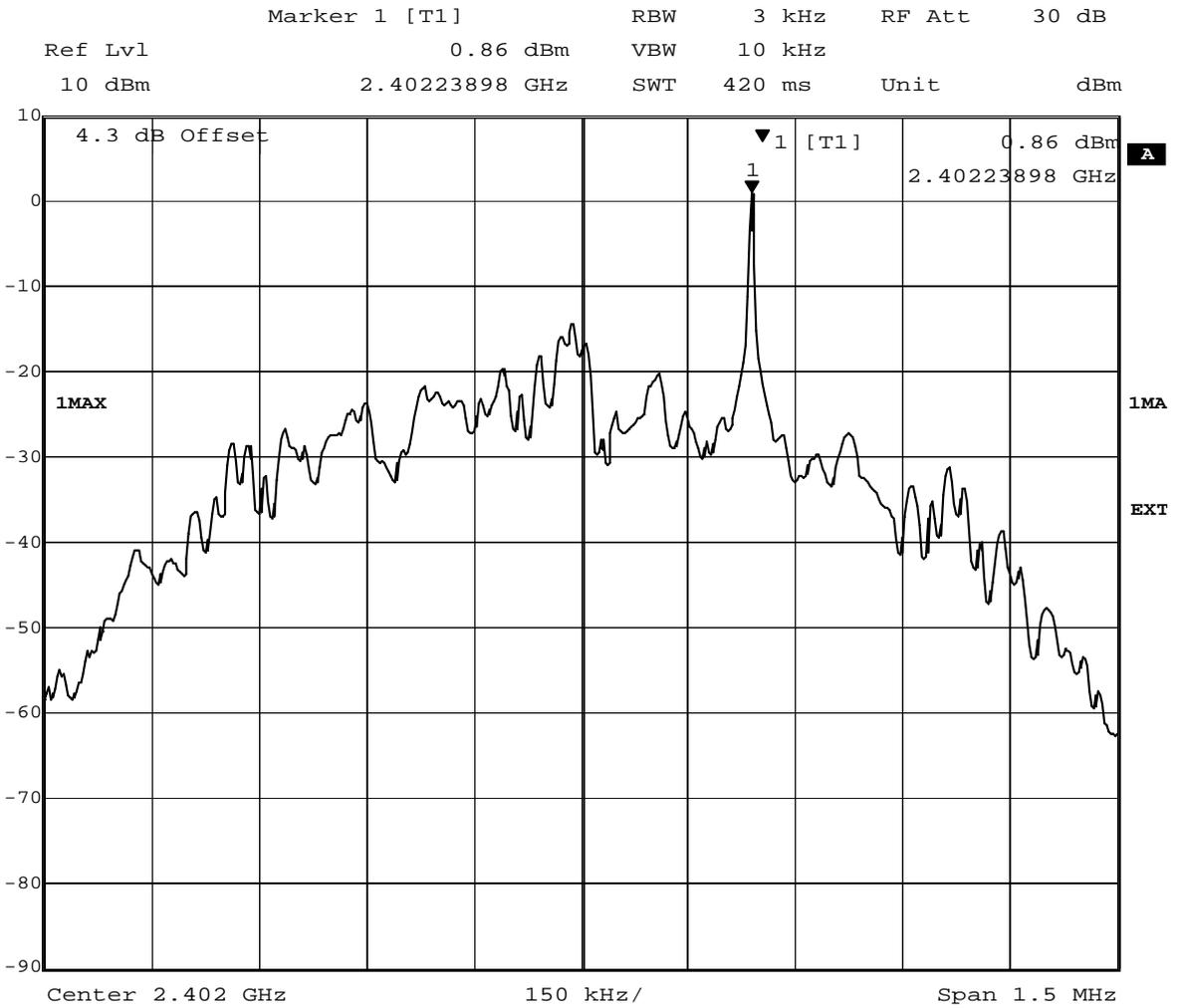
Date: 11.OCT.2013 10:04:28

Test: 15c.10; Frequency = Lowest

Result:	Passed
Setup No.:	C01
Date of Test:	2013/10/11 13:37
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Power Density dBm / 3 KHz
0.860



Date: 11.OCT.2013 10:05:59

Test: 15c.10; Frequency = Middle

Result: Passed

Setup No.: C01

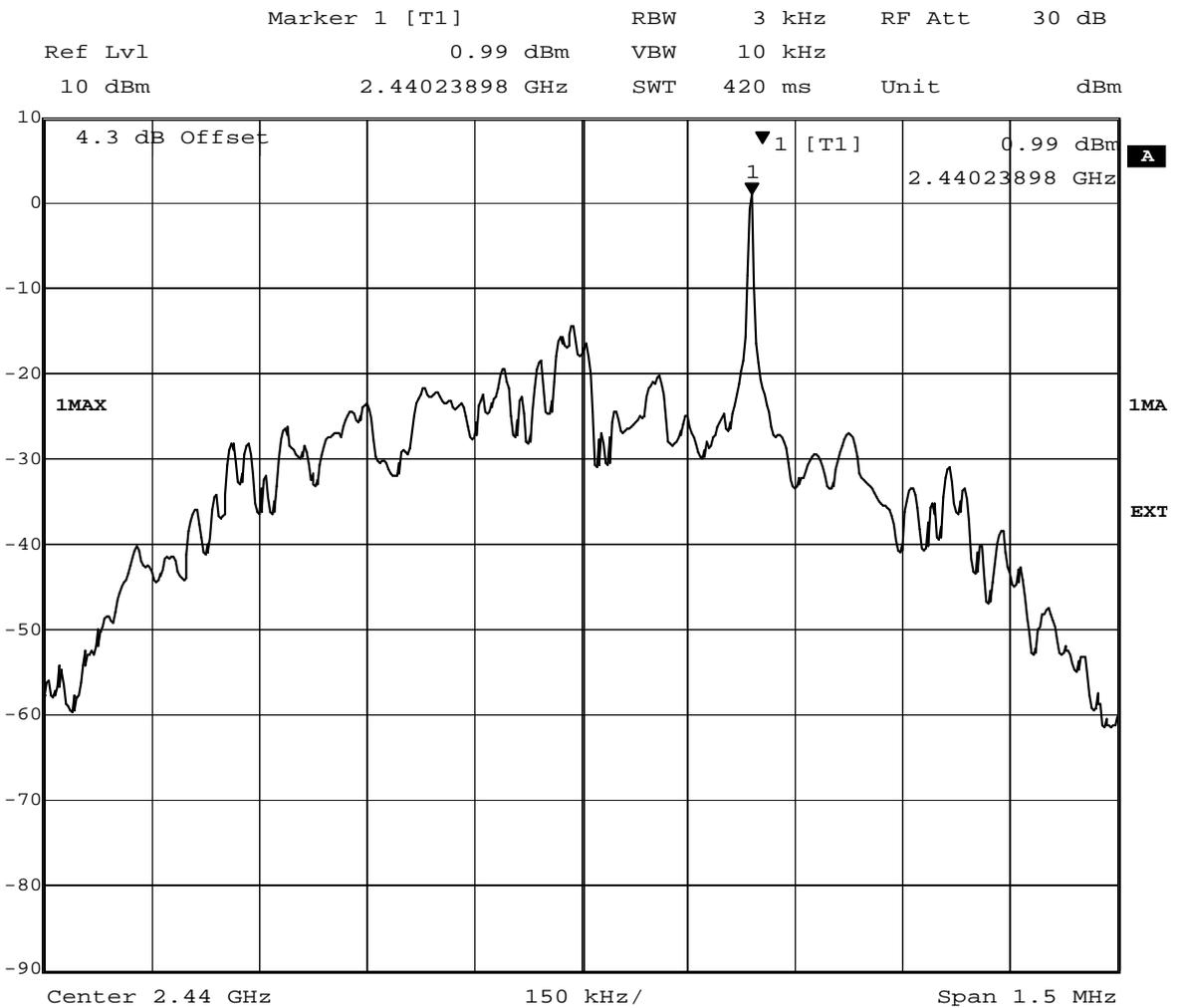
Date of Test: 2013/10/11 13:50

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Power Density dBm / 3 KHz
0.990



Date: 11.OCT.2013 10:05:20



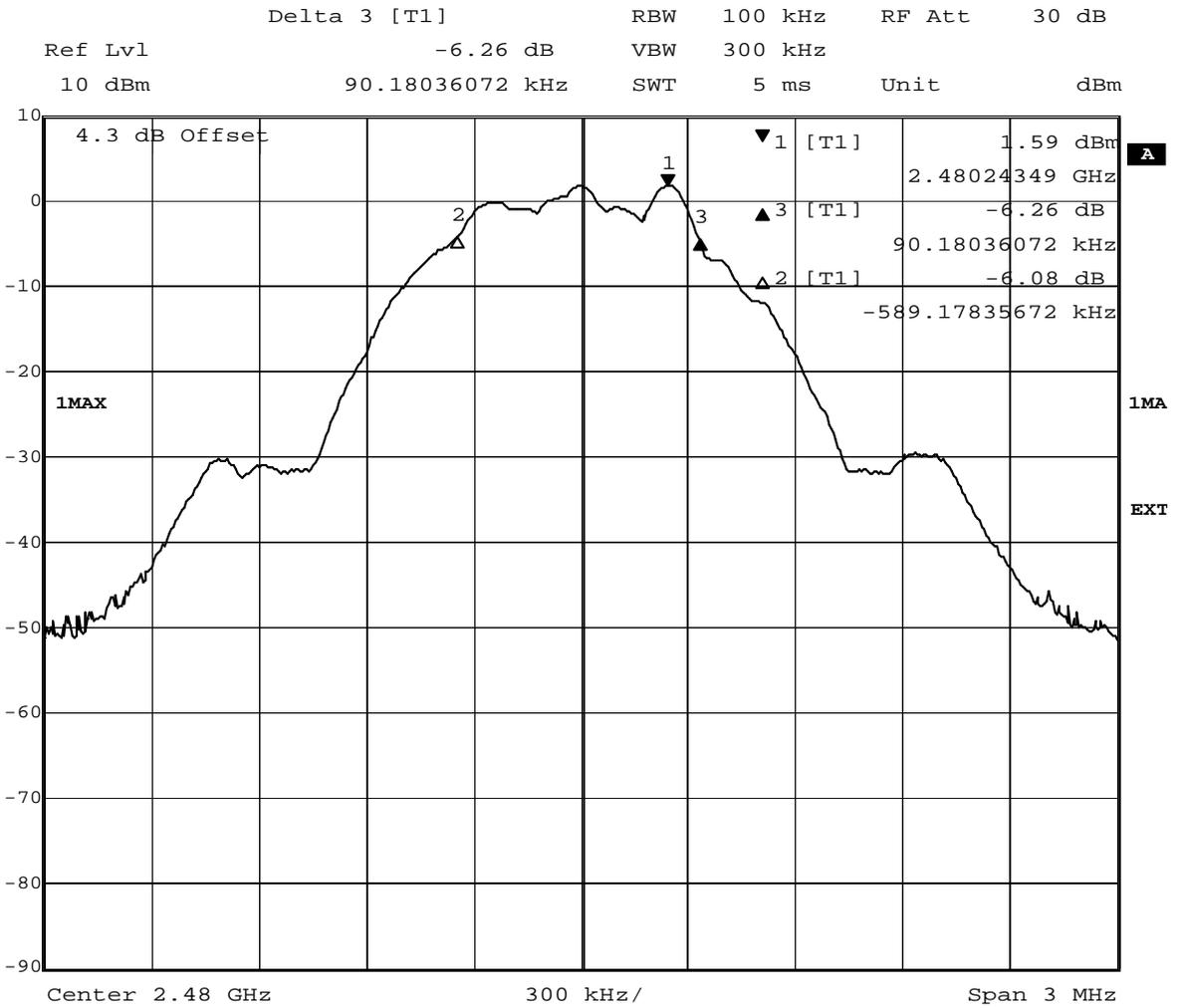
3.5.2 15c.11 6dB Bandwidth §15.247 (a) (2)

Test: 15c.11; Frequency = Highest

<i>Result:</i>	Passed
<i>Setup No.:</i>	C01
<i>Date of Test:</i>	2013/10/11 14:00
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

Detailed Results:

6 dB bandwidth KHz
679.358



Date: 11.OCT.2013 10:03:02

Test: 15c.11; Frequency = Lowest

Result: Passed

Setup No.: C01

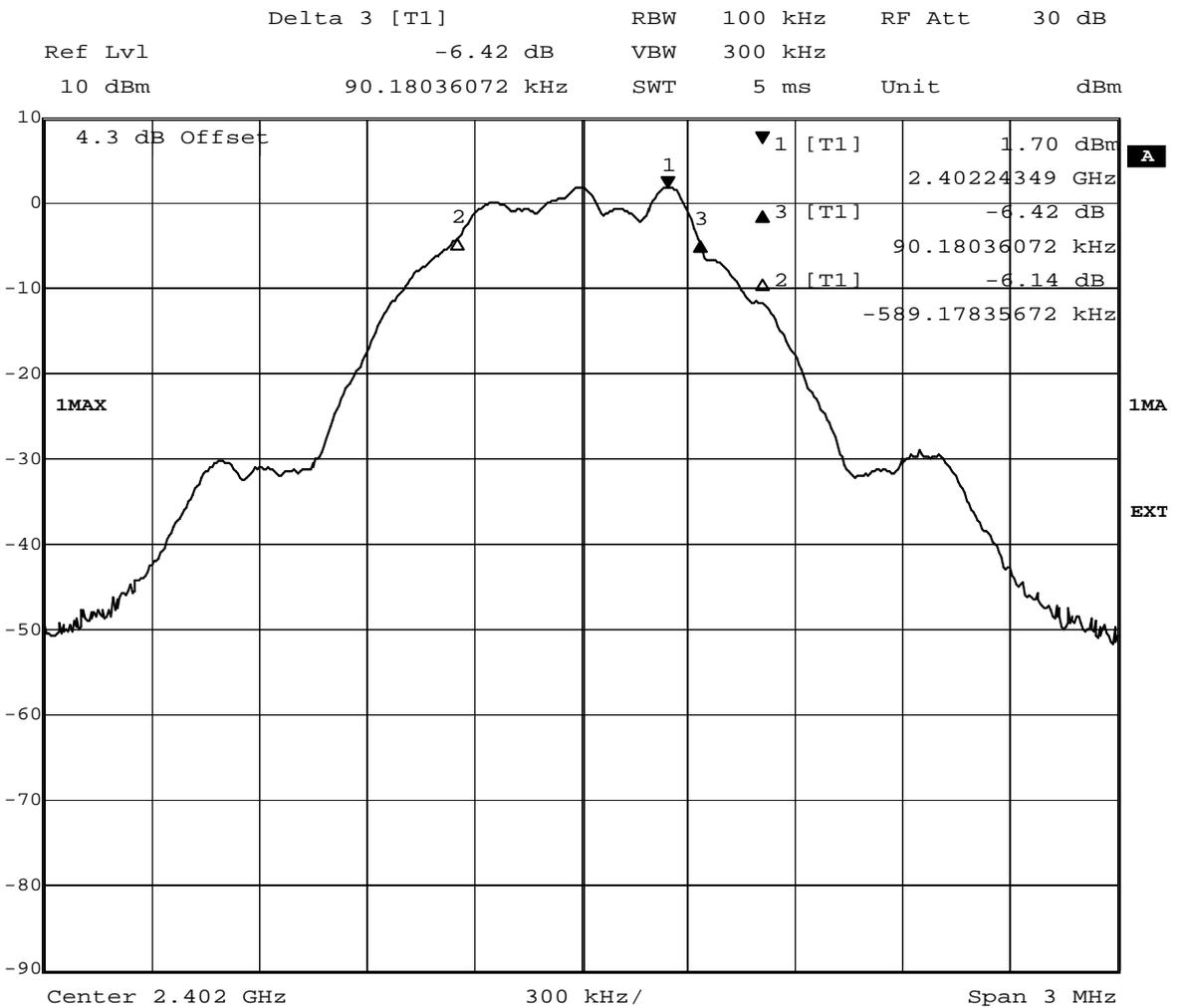
Date of Test: 2013/10/11 13:46

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

6 dB bandwidth KHz
679.358



Date: 11.OCT.2013 10:00:46

Test: 15c.11; Frequency = Middle

Result: Passed

Setup No.: C01

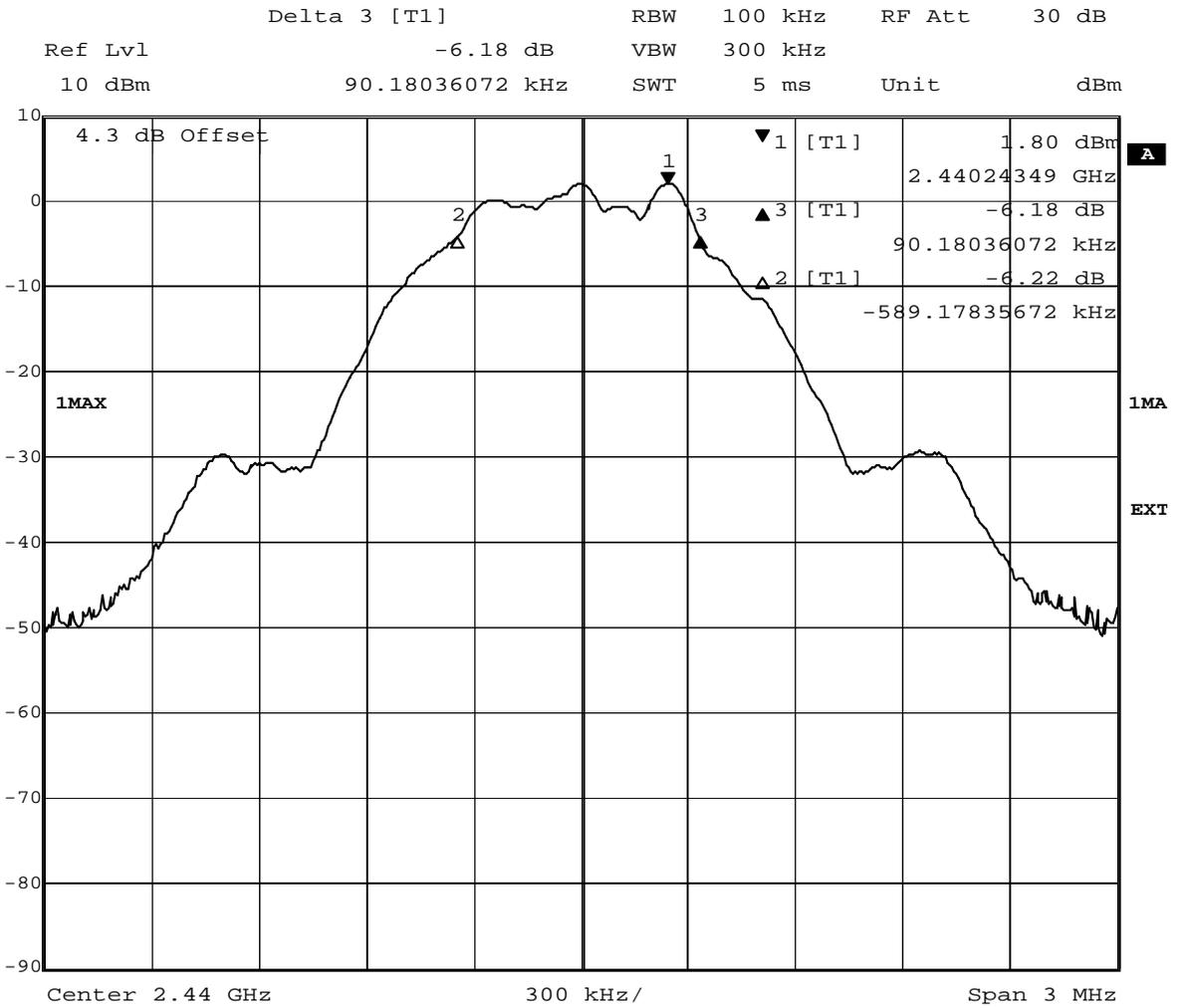
Date of Test: 2013/10/11 14:49

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

6 dB bandwidth KHz
679.358



Date: 11.OCT.2013 10:02:01



3.5.3 15c.4 Peak power output §15.247 (b) (1)

Test1: 15c.4; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed

Setup No.: D01

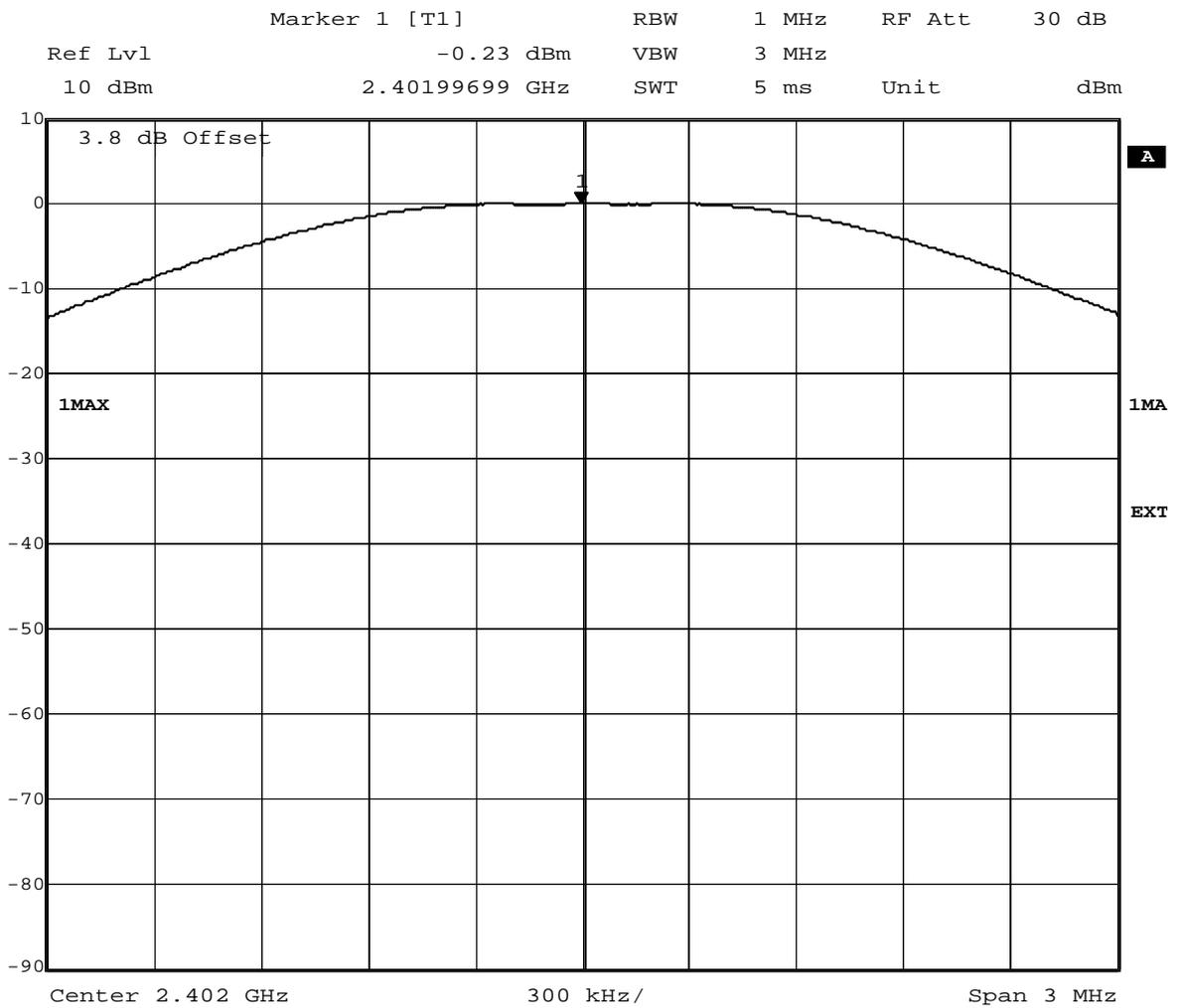
Date of Test: 2013/10/10 15:02

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
-0.23	1.70	1.47



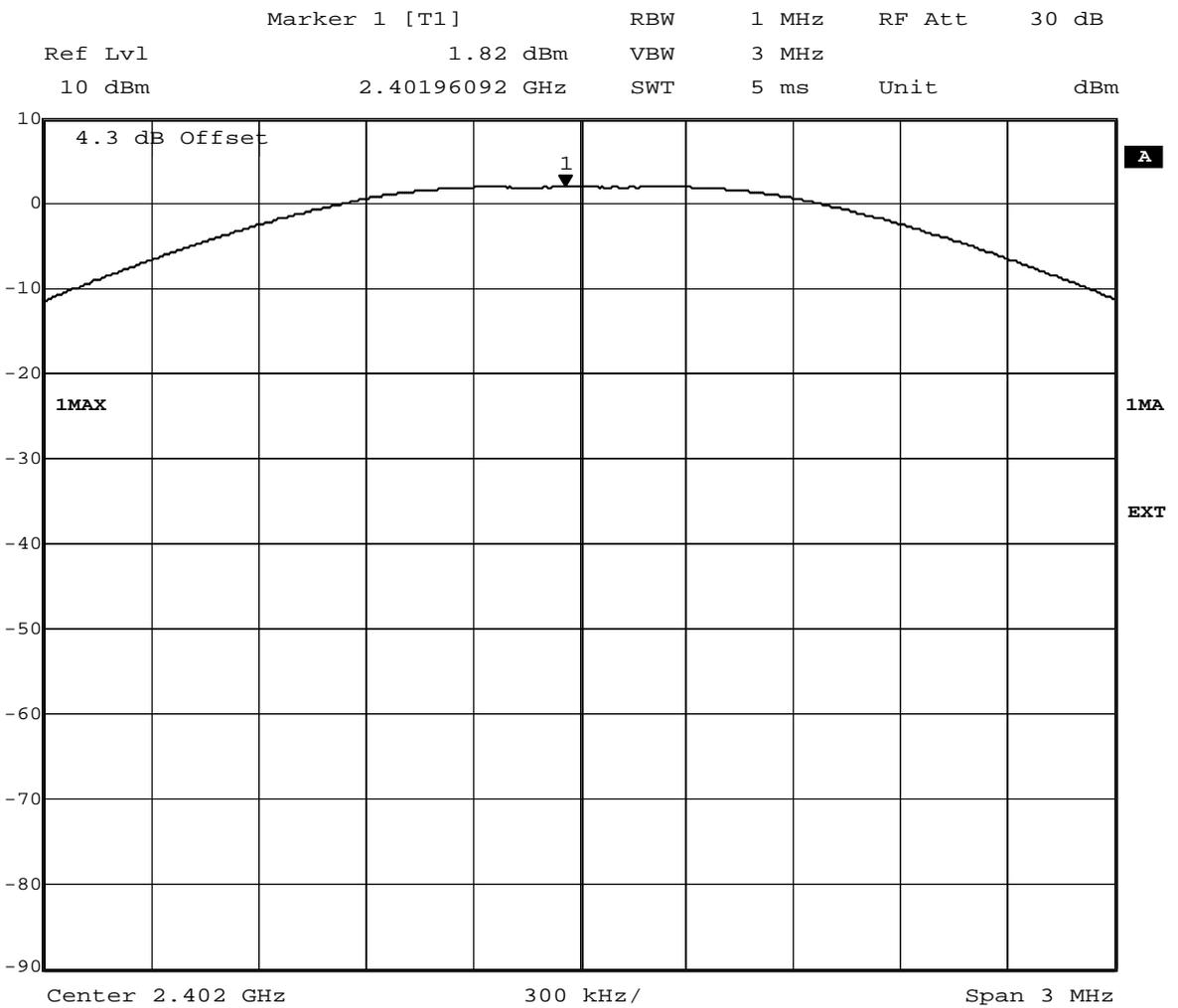
Date: 10.OCT.2013 13:52:43

Test2: 15c.4; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed
 Setup No.: C01
 Date of Test: 2013/10/11 10:19
 Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
 Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
1.82	2.18	4.00



Date: 11.OCT.2013 09:59:02

Test1: 15c.4; Frequency = 2440, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed

Setup No.: D01

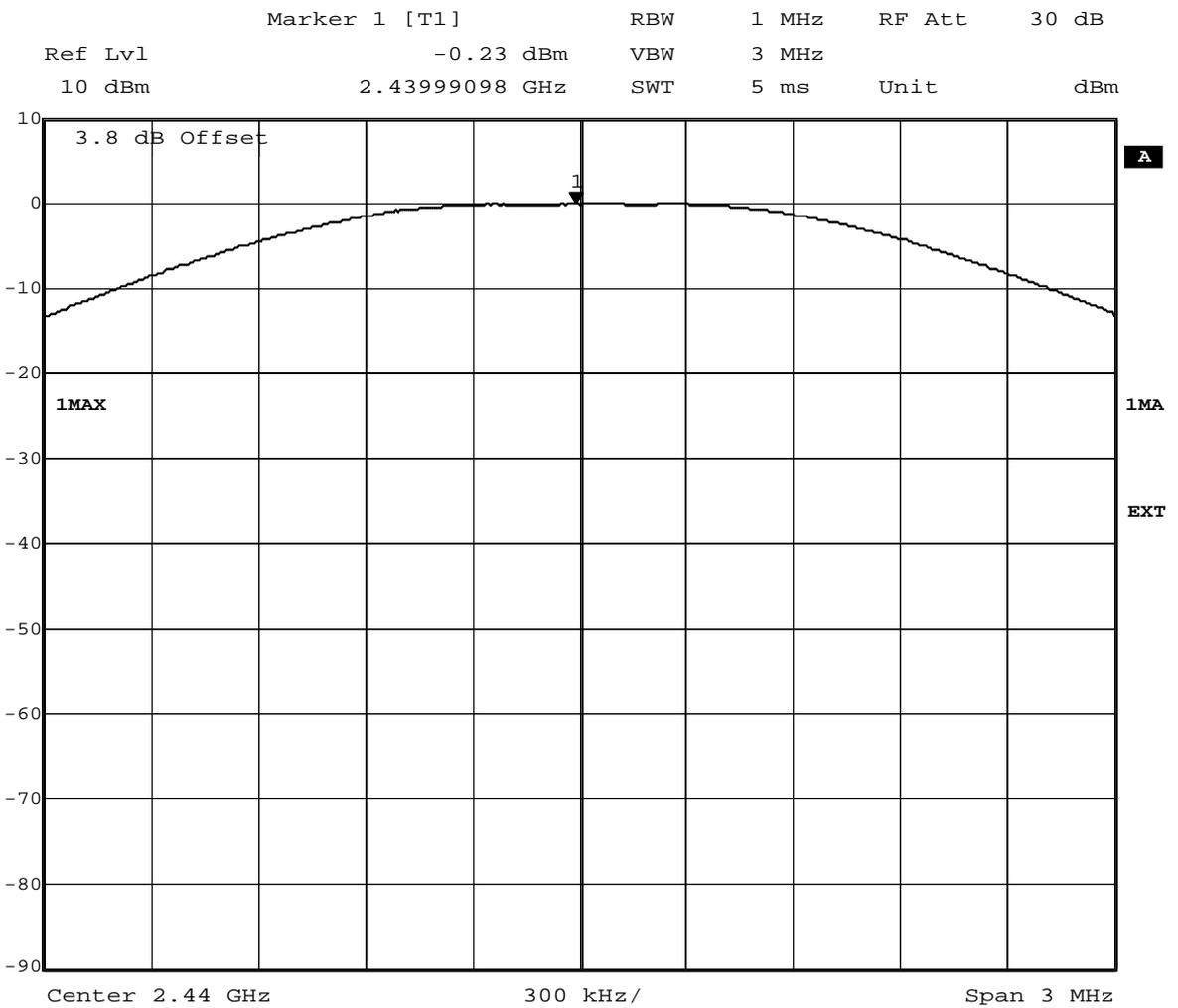
Date of Test: 2013/10/10 15:30

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
-0.23	1.70	1.47



Date: 10.OCT.2013 13:54:52

Test2: 15c.4; Frequency = 2440, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed

Setup No.: C01

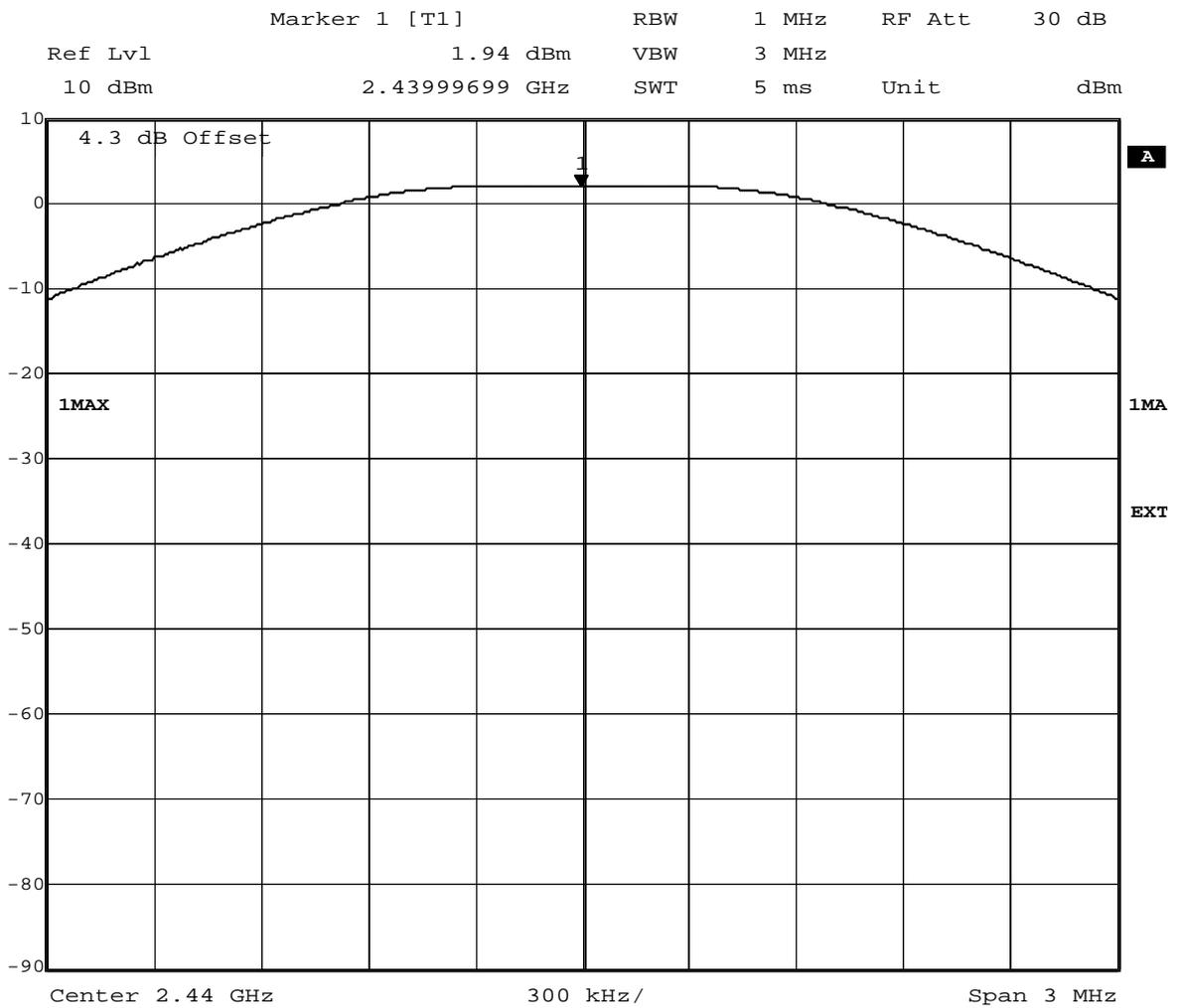
Date of Test: 2013/10/11 10:45

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
1.94	2.18	4.12



Date: 11.OCT.2013 09:58:14

Test1: 15c.4; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed

Setup No.: D01

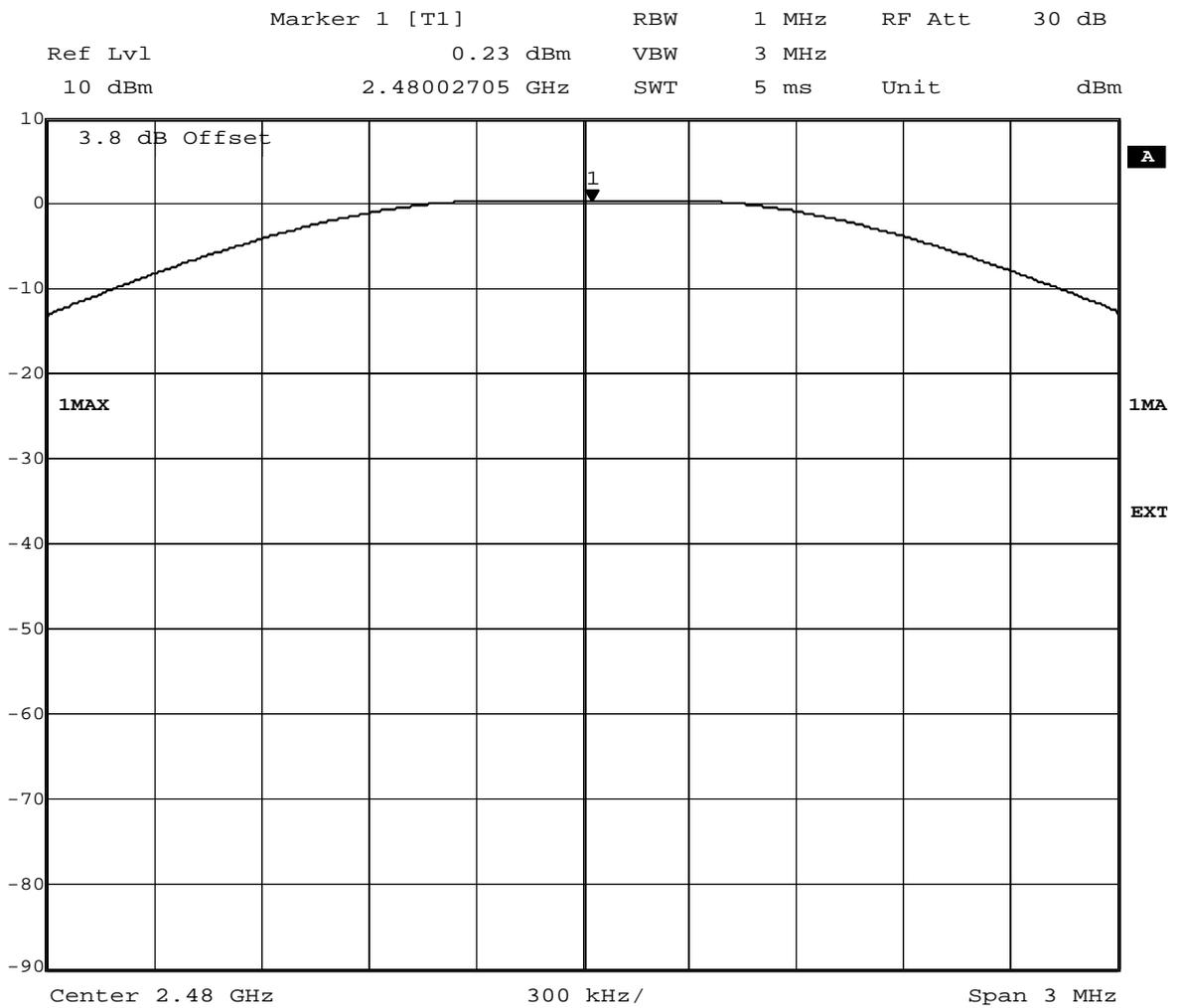
Date of Test: 2013/10/10 16:04

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
0.23	1.70	1.93



Date: 10.OCT.2013 13:55:56

Test2: 15c.4; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed

Setup No.: C01

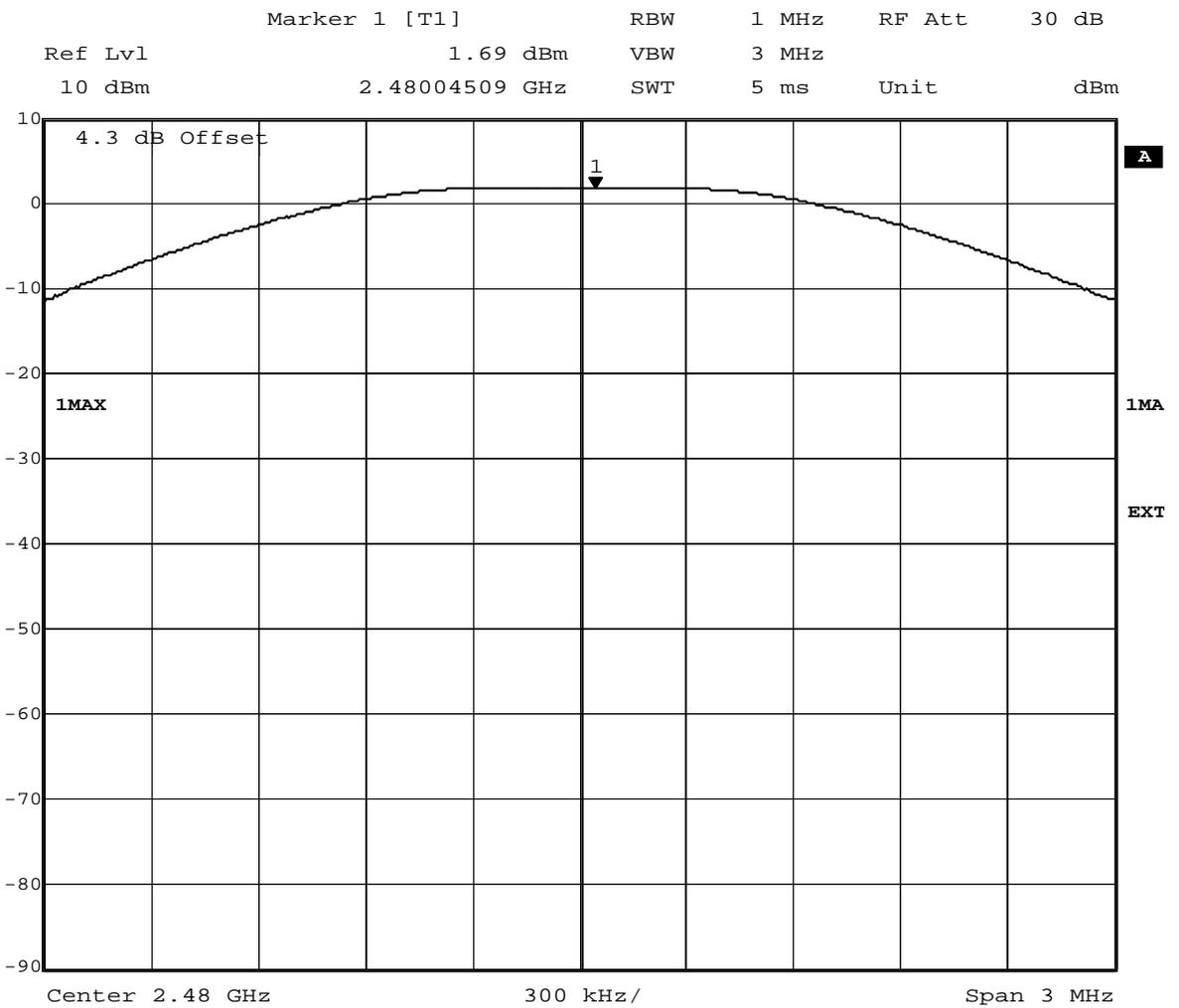
Date of Test: 2013/10/11 11:05

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
1.69	2.18	3.87



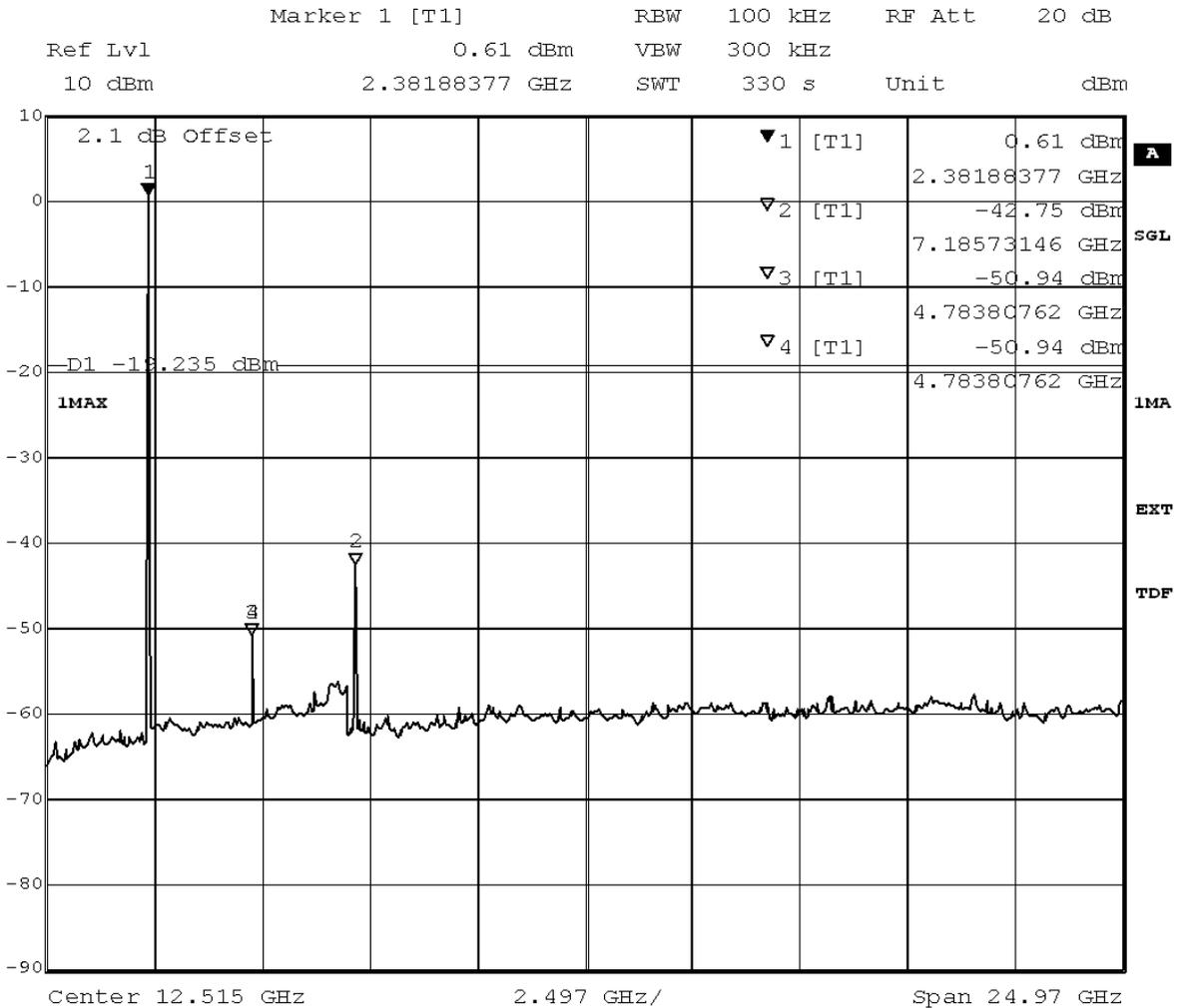
Date: 11.OCT.2013 09:57:39

3.5.4 15c.5 Spurious RF conducted emissions §15.247 (d)

Test: 15c.5; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed
 Setup No.: C01
 Date of Test: 2013/10/11 11:23
 Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
 Test Specification: FCC part 2 and 15

Detailed Results:



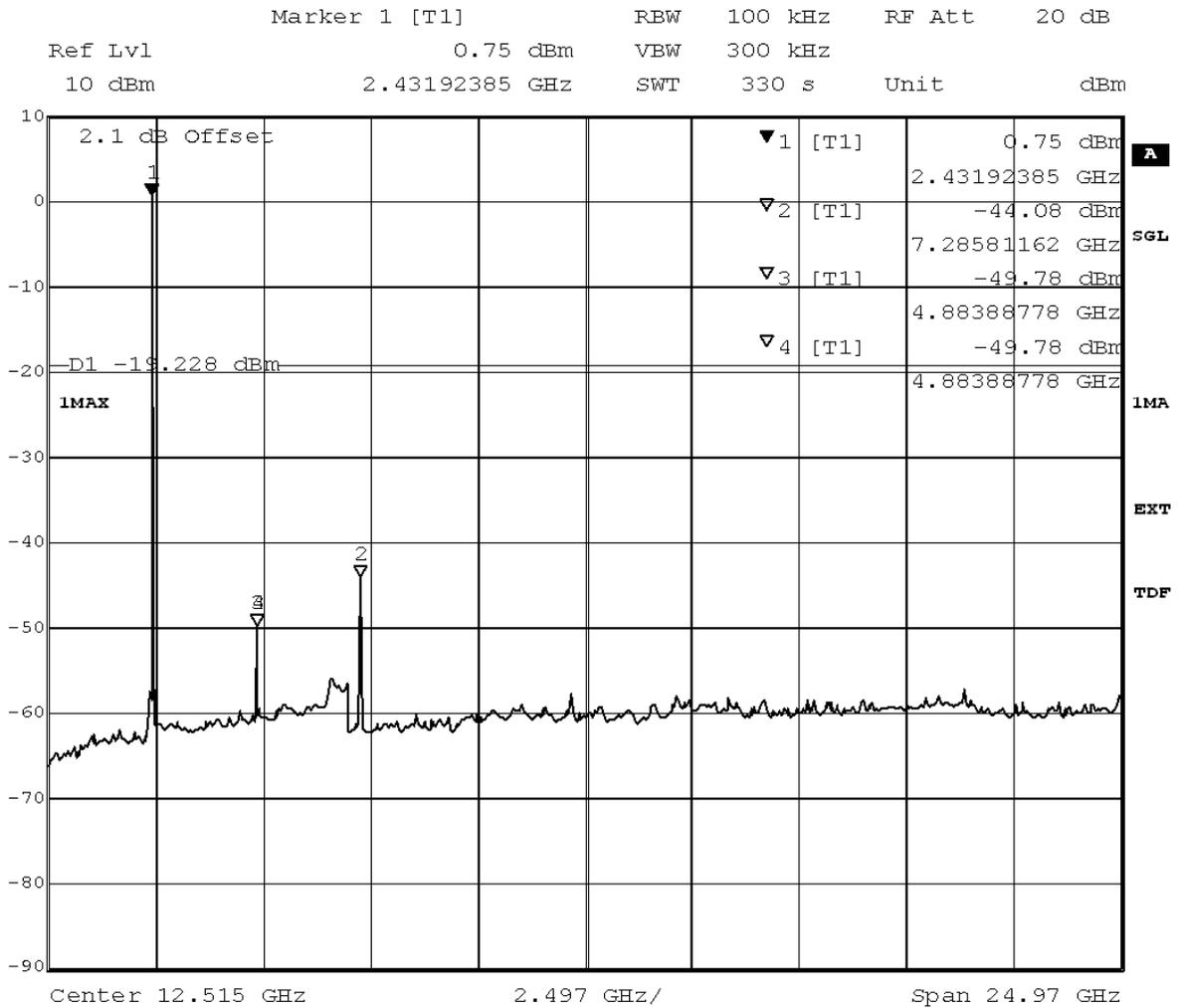
Title: spurious emissions
 Comment A: CH B: 2402 MHz
 Date: 11.OCT.2013 09:22:18

Test: 15c.5; Frequency = 2440, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed
 Setup No.: C01
 Date of Test: 2013/10/11 11:45
 Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
 Test Specification: FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2440		0.77		

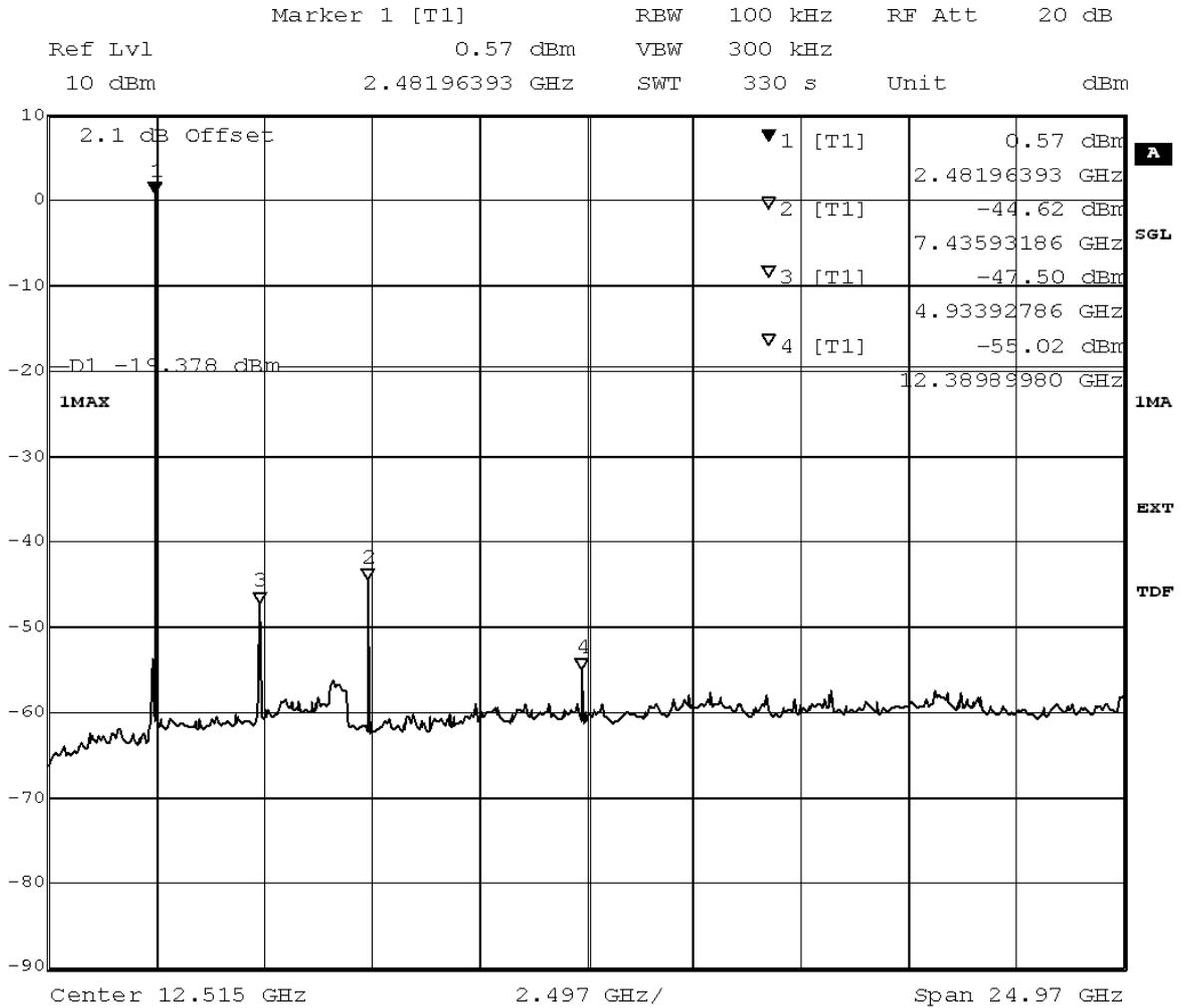


Title: spurious emissions
 Comment A: CH M2: 2440 MHz
 Date: 11.OCT.2013 09:36:26

Test: 15c.5; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result: Passed
Setup No.: C01
Date of Test: 2013/10/11 12:15
Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification: FCC part 2 and 15

Detailed Results:



Title: spurious emissions
Comment A: CH T:2480 MHz
Date: 11.OCT.2013 09:52:26



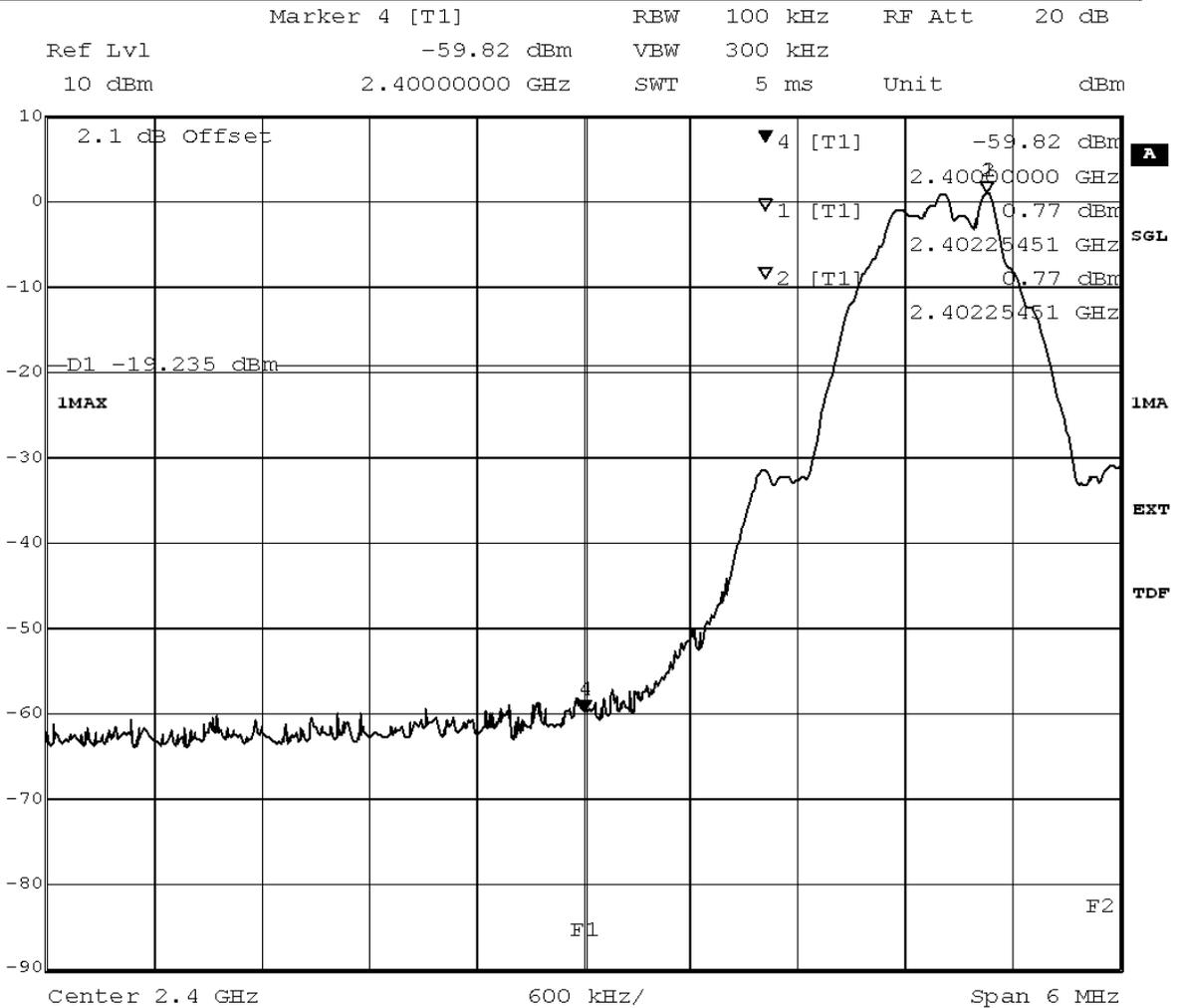
3.5.5 15c.6 Band edge compliance §15.247 (d)

Test: 15c.6; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted

Result: Passed
 Setup No.: C01
 Date of Test: 2013/10/11 9:10
 Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
 Test Specification: FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2400	-59.82	0.77	-19.23	40.59



Title: Band Edge Compliance
 Comment A: CH B: 2402 MHz
 Date: 11.OCT.2013 09:10:21

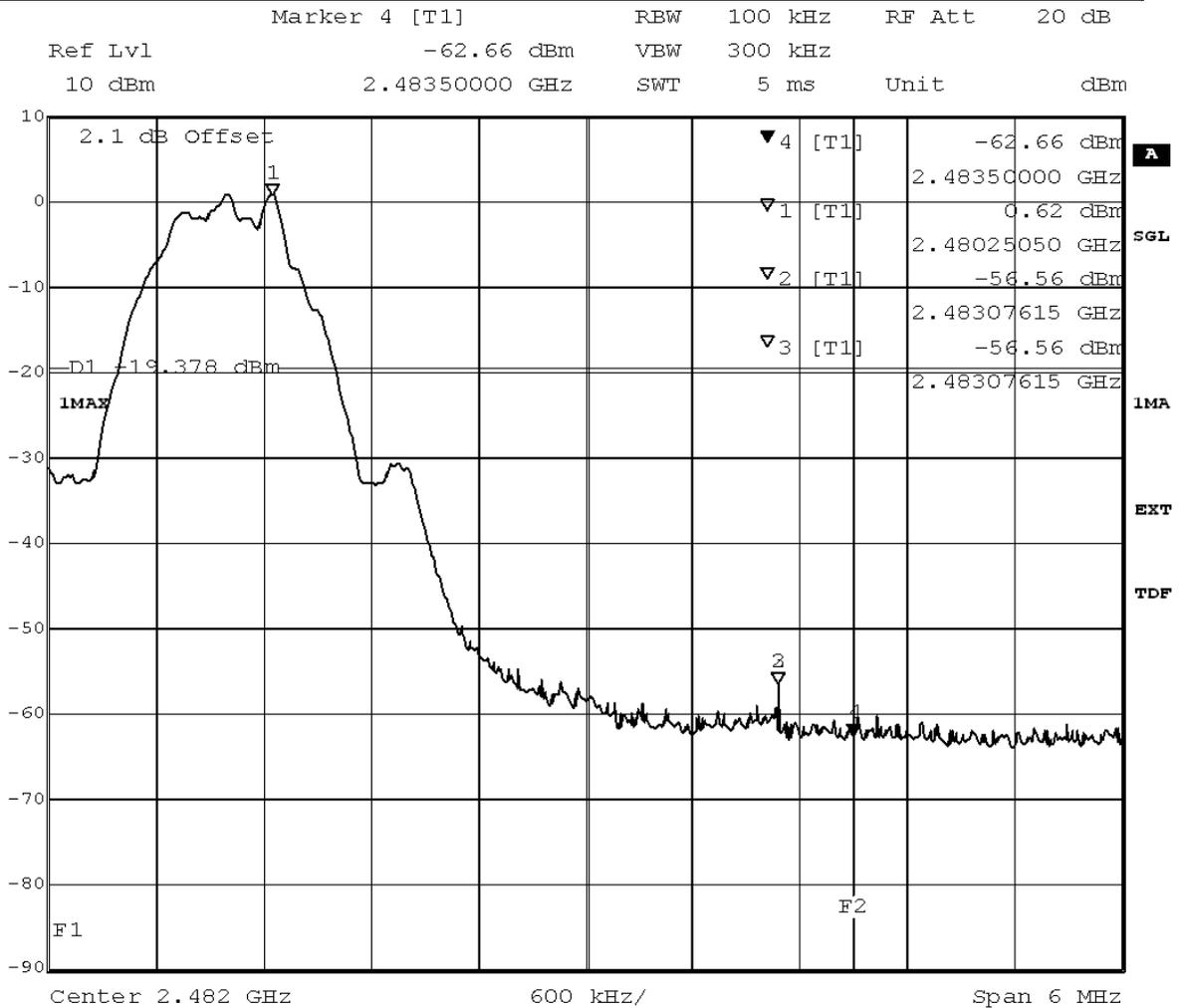


Test: 15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted

Result: Passed
 Setup No.: C01
 Date of Test: 2013/10/11 9:28
 Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
 Test Specification: FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2484	-62.66	0.62	-19.38	43.29



Title: Band Edge Compliance
 Comment A: CH T:2480 MHz
 Date: 11.OCT.2013 09:40:28

4 Test Equipment Details

4.1 List of Used Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Multimeter 12

Lab ID: Lab 1
Description: Ex-Tech 520
Serial Number: 05157876

Single Devices for Multimeter 12

Single Device Name	Type	Serial Number	Manufacturer
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Customized calibration			2011/10/18 2013/10/17

Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID: Lab 1
Description: Regulatory Bluetooth RF Tests
Type: Bluetooth RF
Serial Number: 001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.
Bluetooth Signalling Unit CBT	CBT	100302	Rohde & Schwarz GmbH & Co.KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/08/28 2014/08/27
Power Meter NRVD	NRVD	832025/059	
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/08/26 2014/08/25
Power Sensor NRV Z1 A	PROBE	832279/013	
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/08/28 2014/08/27
Power Supply	NGSM 32/10	2725	
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/06/14 2015/06/13
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/08/27 2014/08/26
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017	
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2013/06/22 2014/06/20

Test Equipment Shielded Room 07

Lab ID: Lab 1
Description: Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID: Lab 1
Description: Lufft Opus10
Serial Number: 7481

Single Devices for T/H Logger 04

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
ThermoHygro Datalogger 04 (Environ)	Opus10 THI (8152.00)	7481	Lufft Mess- und Regeltechnik GmbH

Test Equipment Temperature Chamber 01

Lab ID: Lab 1
Manufacturer: see single devices
Description: Temperature Chamber KWP 120/70
Type: Weiss
Serial Number: see single devices

Single Devices for Temperature Chamber 01

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Customized calibration			2012/03/12 2014/03/11



Reference: MDE_PARRO_1311_FCCb

acc. Title 47 CFR chapter I part 15 subpart C

5 Annex

5.1 Additional Information for Report



Summary of Test Results

The EUT complied with all performed tests as listed in the summary section of this report.

Technical Report Summary

Type of Authorization :

Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15. The following subparts are applicable to the results in this test report

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

additional documents

The tests were selected and performed with reference to the FCC Public Notice DA 00-705, released March 30, 2000. Instead of applying ANSI C63.4-1992 which is referenced in the FCC Public Note, the newer ANSI C63.4-2009 is applied.

Description of Methods of Measurements

Conducted emissions (AC power line)

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4,

Test Description

acc. Title 47 CFR chapter I part 15 subpart C

The test set-up was made in accordance to the general provisions of ANSI C 63.4. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads. The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dB μ V)	AV Limit (dB μ V)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dB μ V) = 20 log (Limit (μ V)/1 μ V).

Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the output power measurements. The resolution bandwidth for measuring the output power was set to 3 MHz. The reference level of the spectrum analyzer was set higher than the output power of the EUT. The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (1)

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping

acc. Title 47 CFR chapter I part 15 subpart C

channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

Used conversion factor: Limit (dBm) = $10 \log (\text{Limit (W)}/1\text{mW})$
==> Maximum Output Power: 30 dBm

Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements. The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Detector: Peak-Maxhold
- Frequency range: 30 – 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: 330 s

The reference value for the measurement of the spurious RF conducted emissions is determined during the test "band edge compliance" (cf. chapter 3.6). This value is used to calculate the 20 dBc limit.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4,

Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-2009.

The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30-1000 MHz was evaluated.

The test was performed at the distance of 3 m between the EUT and the receiving antenna. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The radiated emissions measurements were made in a typical installation configuration. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition.

1. Measurement up to 30 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4.

The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

The radiated emissions measurements were made in a typical installation configuration.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

The Loop antenna HFH2-Z2 is used.

Step 1: pre-measurement

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

acc. Title 47 CFR chapter I part 15 subpart C

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
 - Antenna distance: according to the Standard
 - Detector: Quasi-Peak
 - Frequency range: 0.009 – 30 MHz
 - Frequency steps: measurement at frequencies detected in step 1
 - IF-Bandwidth: 200 Hz – 10 kHz
 - Measuring time / Frequency step: 100 ms
2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s (BT Timing 1.25 ms)
- Turntable angle range: -180 to $+180^\circ$
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -180 to $+180^\circ$
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by $\pm 22.5^\circ$ around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -22.5° to $+22.5^\circ$ around the determined value
- Height variation range: -0.25 m to $+0.25$ m around the determined value

Step 4: final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies

- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz: The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2–4 are omitted. Step 1 was performed with one height of the receiving antenna only.

- EMI receiver settings:
- Detector: Peak, Average
 - IF Bandwidth = 1 MHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement. For the enhanced data rate packets the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at basic data rate. Typically, the measurement for these packets is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the basic data rate. Please refer to the results for the used frequency range.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

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

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m)+30dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m)+10dB
1.705 - 30	30	30	Limit (dBµV/m)+10dB

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 - 88	100	3	40.0
88 - 216	150	3	43.5
216 - 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: $Limit (dBµV/m) = 20 \log (Limit (\mu V/m)/1\mu V/m)$

Band edge compliance

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4, FCC §15.31

Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements: 1. Show compliance of the lower band edge by a conducted measurement and 2. show compliance of the higher band edge by a radiated and conducted measurement.

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge

is 2400 MHz.

Analyzer settings:

- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

For the second measurement the EUT is set to transmit on the highest channel (2480 MHz). The higher band edge is 2483.5 MHz.

Analyzer settings for conducted measurement:

- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

EMI receiver settings:

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Test Requirements / Limits

FCC Part 15.247 (d)

"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

...

Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

For the measurement of the lower band edge the RF power at the band edge shall be "at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power..."

For the measurement of the higher band edge the limit is "specified in Section 15.209(a)".

Power density

Standard FCC Part 15, 10-1-11 Subpart C

The test was performed according to: FCC §15.31

Test Description

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Detector: Peak-Maxhold
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: Coupled

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

...

The same method of determining the conducted output power shall be used to determine the power spectral density.

6-dB bandwidth



Standard FCC Part 15, 10-1-11 Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was setup to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. The results recorded were measured with the modulation which produce the worst-case (widest) occupied bandwidth.

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 30 MHz

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Used conversion factor: Output power (dBm) = 10 log (Output power (W) / 1mW)

FCC and IC Correlation of measurement requirements

The following tables show the correlation of measurement requirements for Bluetooth equipment and Digital Apparatus from FCC and IC standards.

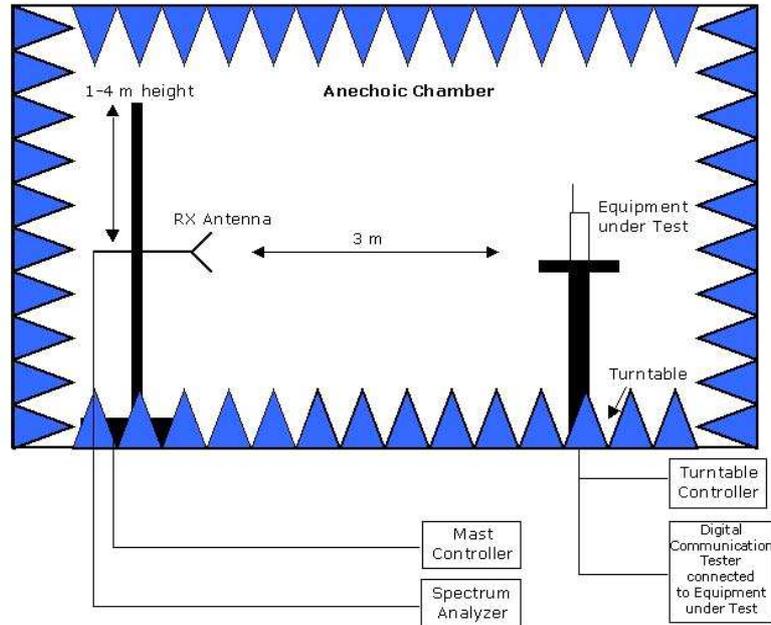
Bluetooth® equipment:

Measurement	FCC reference	IC reference
Conducted emissions on AC mains	§ 15.207	RSS-Gen: 7.2.4
6-dB bandwidth	§ 15.247 (a) (1)	RSS-210: A8.2
Peak power output	§ 15.247 (b) (1)	RSS-210: A8.4
Spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen: 6;RSS-210: A8.5
Spurious radiated emissions	§ 15.247 (d)	RSS-Gen: 6;RSS-210: A8.5
Band edge compliance	§ 15.247 (d)	RSS-210: A8.5
Antenna requirement	§ 15.203 / 15.204	RSS-Gen: 7.1.2

Digital Apparatus:

Measurement	FCC reference	IC reference
Conducted Emissions(AC Power Line)	§15.107	ICES-003
Spurious Radiated Emissions	§15.109	ICES-003

Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Setup in the Anechoic chamber:

Measurements below 1 GHz: Semi-anechoic, conducting ground plane.

Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces



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