



InterLab®

Final Report on

WD-H      FCC ID: NH9WDH-V1

**Report Reference:**

MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

**Date:**

January 27, 2012

**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.

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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:* Patrick Lomax  
*Date Of Test Report:* 2012/01/27  
*Date of first test:* 2011/08/25  
*Date of last test:* 2011/11/15

### 1.2 Applicant Data

*Company Name:* Softing Industrial Automation GmbH  
*Street:* Richard-Reitzner-Allee 6  
*City:* 85540 Haar  
*Country:* Germany  
*Contact Person:* Mr. Thomas Hilz  
*Function:* Product Manager Wireless  
*Phone:* +49 (89) 456 56-238  
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*E-Mail:* thomas.hilz@softing.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

Lab ID	Identification	Responsible	Accreditation Info
Lab 1	Conducted Emissions	Mr. Robert Machulec Mr. Andreas Petz	DAkkS-Registration no. D-PL-12140-01-01
Lab 2	Radiated Emissions	Mr. Robert Machulec Mr. Andreas Petz	DAkkS-Registration no. D-PL-12140-01-01
Lab 3	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



Carsten Steinröder  
responsible for tests performed in: Lab 1, Lab 2, Lab 3

#### 1.5 Signature of the Accreditation Responsible



Accreditation scope responsible person  
responsible for Lab 1, Lab 2, Lab 3

[A. Petz]



7 layers AG, Borsigstr. 12  
40880 Ratingen, Germany  
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## 2 Test Object Data

### 2.1 General OUT Description

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

#### OUT: WD-H

Product Category: Module

#### Parameter List:

Parameter name	Value
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### 2.2 Detailed Description of OUT Samples

#### Sample : G02

OUT Identifier	WD-H		
Sample Description	WD-H WirelessHART		
Serial No.	112800100		
HW Status	1.04		
SW Status	1.0		
Low Voltage	2.7 V		
High Voltage	3.3 V		
Nominal Voltage	3 V	Normal Temp.	23 °C

## 2.3 OUT Features

### Features for OUT: WD-H

Designation	Description	Allowed Values	Supported Value(s)
<b>Features for scope: FCC_v2</b>			
AC	The OUT is powered by or connected to AC Mains		
Dant	removable antenna supplied and type tested with the radio equipment, designed as an example part of the equipment		
DC	The OUT is powered by or connected to DC Mains		
PantC	permanent fixed antenna connector, which may be built-in, designed as an indispensable part of the equipment		

## 2.4 Auxiliary Equipment

AE No.	Type Designation	Serial No.	HW Status	SW Status	Description
AE 05	CHERRY RS 6000 USB ON	G 0000273 2P28			Keyboard 1
AE 01	LG Flatron L1740BQ	509WANF1W607			TFT 1
AE 04	Logitech M-BB48	LZC90505478			Mouse 1
AE 03	Toshiba	PA3378-3AC3			AC Adapter 1
AE 02	Toshiba Tecra M9	87060248H			Laptop 1

## 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.

Setup No.	List of OUT samples	List of auxiliary equipment
Sample No.	Sample Description	AE No. AE Description

### PC\_G02

Sample: G02	WD-H WirelessHART	AE 05	Keyboard 1
		AE 01	TFT 1
		AE 04	Mouse 1
		AE 03	AC Adapter 1
		AE 02	Laptop 1

### S01\_G02

Sample: G02	WD-H WirelessHART
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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:**

The laboratory environmental conditions are recorded and available in the Interlab system.

This report replaces the report referenced by report MDE\_SOFT\_1002\_FCCc

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



### 3.4 Summary

Test Case Identifier / Name Test (condition)	Result	Date of Test	Lab Ref.	Setup
<b>15c.1 Conducted emissions (AC power line) §15.207</b>				
15c.1; Mode = transmit	Passed	2011/08/25	Lab 1	PC_G02
<b>15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209</b>				
15c.2; Frequency = Highest	Passed	2011/10/05	Lab 2	S01_G02
15c.2; Frequency = Lowest	Passed	2011/10/05	Lab 2	S01_G02
15c.2; Frequency = Middle	Passed	2011/10/05	Lab 2	S01_G02
<b>15c.3 Occupied bandwidth §15.247 (a) (1)</b>				
15c.3; Frequency = Highest	Passed	2011/09/16	Lab 3	S01_G02
15c.3; Frequency = Lowest	Passed	2011/09/16	Lab 3	S01_G02
15c.3; Frequency = Middle	Passed	2011/09/16	Lab 3	S01_G02
<b>15c.4 Peak power output §15.247 (b) (1)</b>				
15c.4; Frequency = Highest	Passed	2011/09/16	Lab 3	S01_G02
15c.4; Frequency = Lowest	Passed	2011/09/16	Lab 3	S01_G02
15c.4; Frequency = Middle	Passed	2011/09/16	Lab 3	S01_G02
<b>15c.5 Spurious RF conducted emissions §15.247 (d)</b>				
15c.5; Frequency = Highest	Passed	2011/09/16	Lab 3	S01_G02
15c.5; Frequency = Lowest	Passed	2011/09/16	Lab 3	S01_G02
15c.5; Frequency = Middle	Passed	2011/09/16	Lab 3	S01_G02
<b>15c.6 Band edge compliance §15.247 (d)</b>				
15c.6; Frequency = Highest	Passed	2011/09/16	Lab 3	S01_G02
15c.6; Frequency = Lowest	Passed	2011/09/16	Lab 3	S01_G02
<b>15c.7 Dwell time §15.247 (a) (1) (iii)</b>				
15c.7; Frequency = Middle	Passed	2011/11/15	Lab 3	S01_G02
<b>15c.8 Channel separation §15.247 (a) (1)</b>				
15c.8; Frequency = Middle	Passed	2011/09/16	Lab 3	S01_G02
<b>15c.9 Number of hopping frequencies §15.247 (a) (1) (iii)</b>				
15c.9; Frequency = Middle	Passed	2011/09/16	Lab 3	S01_G02



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### 3.5 Detailed Results

#### 3.5.1 15c.1 Conducted emissions (AC power line) §15.207

**Test: 15c.1; Mode = transmit**

<i>Result:</i>	Passed
<i>Setup No.:</i>	PC_G02
<i>Date of Test:</i>	2011/08/25 11:22
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

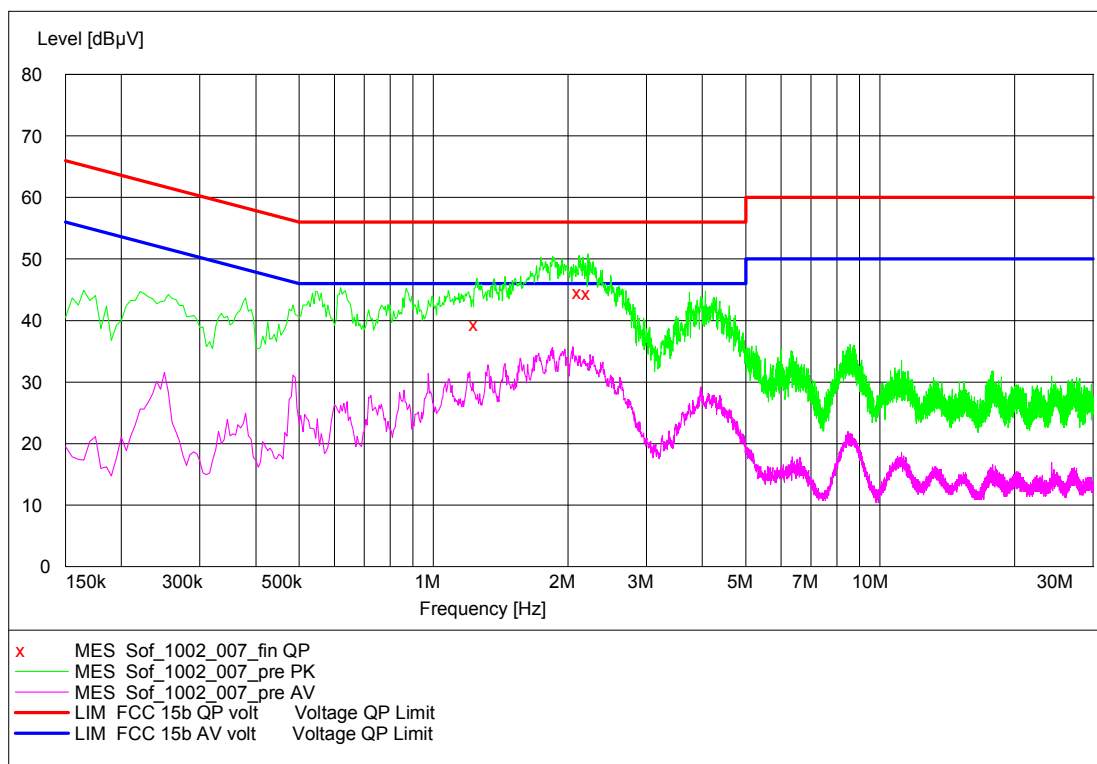
## Detailed Results:

### AC MAINS CONDUCTED

EUT: (CY020g02)  
Manufacturer:  
Operating Condition: Tx on Ch 18  
Test Site: 7 layers Ratingen  
Operator: Gal  
Test Specification: ANSI C63.4; FCC 15.107 / 15.207  
Comment: AC Port Laptop Power Supply  
Start of Test: 25.08.2011 / 13:56:22

### SCAN TABLE: "FCC Voltage"

Short Description:	FCC Voltage					
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak	20.0 ms	9 kHz	ESH3-Z5
			Average			



### MEASUREMENT RESULT: "Sof\_1002\_007\_fin QP"

Frequency	Level	Transd	Limit	Margin	Line	PE
MHz	dBµV	dB	dBµV	dB		
1.245000	39.40	10.0	56	16.6	L1	GND
2.120000	44.50	10.1	56	11.5	N	GND
2.220000	44.40	10.1	56	11.6	N	GND





### 3.5.2 15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209

**Test: 15c.2; Frequency = Highest**

**Result:** Passed

**Setup No.:** S01\_G02

**Date of Test:** 2011/10/05 10:54

**Body:** FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

**Test Specification:** FCC part 2 and 15

#### Detailed Results:

Script	Traffic Mode FCC 15.247 (15.35b,15.209)										1-Mbps	
	Frequency range 30 MHz - 1 GHz											
	Diagram No.	TX on	Ant. Polar.	EUT Pos.	Limit QPK [dBµV]		Frequency [MHz]	QPK [dBµV]		Margin QPK [dB]	Result	
FCC_15.247c_003-1GHz	Sof_1002_004	2405 MHz	Ver + Hor	Ver							Passed	
FCC_15.247c_003-1GHz	xxx_yyyy_002	2440 MHz	Ver + Hor	Ver							Passed	
FCC_15.247c_003-1GHz	xxx_yyyy_003	2475 MHz	Ver + Hor	Ver							Passed	
	Frequency range 1 GHz - 3 GHz											
	Diagram No.	TX on	Ant. Polar.	EUT Pos.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	PK [dBµV]	AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
FCC_15.247c_1-3GHz	Sof_1002_004	2405 MHz	Ver + Hor	Ver	74.00	54.00	2357	54.48	46.46	19.52	7.54	Passed
							2831	60.41	53.95			
FCC_15.247c_1-3GHz	Sof_1002_005	2440 MHz	Ver + Hor	Ver	74.00	54.00	2488	54.68	46.28	19.32	7.72	Passed
FCC_15.247c_1-3GHz	Sof_1002_006	2475 MHz	Ver + Hor	Ver	74.00	54.00	2499	60.11	52.24	13.89	1.76	Passed
	Frequency range 3 GHz - 18 GHz											
	Diagram No.	TX on	Ant. Polar.	EUT Pos.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	PK [dBµV]	AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
FCC_15.247c_3-18GHz	Sof_1002_004	2405 MHz	Ver + Hor	Ver	74.00	54.00	4811	55.03	49.69	18.97	4.31	Passed
FCC_15.247c_3-18GHz	Sof_1002_005	2440 MHz	Ver + Hor	Ver	74.00	54.00	4811	53.14	47.75	20.86	6.25	Passed
FCC_15.247c_3-18GHz	Sof_1002_006	2475 MHz	Ver + Hor	Ver								Passed
	Frequency range 18 GHz - 25 GHz											
	Diagram No.	TX on	Ant. Polar.	EUT Pos.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	PK [dBµV]	AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
FCC_15.247c_18-25GHz	Sof_1002_007	2405 MHz	Ver + Hor	Ver	74.00	54.00						Passed
FCC_15.247c_18-25GHz	Sof_1002_008	2440 MHz	Ver + Hor	Ver	74.00	54.00						Passed
FCC_15.247c_18-25GHz	Sof_1002_009	2475 MHz	Ver + Hor	Ver	74.00	54.00						Passed

**Test: 15c.2; Frequency = Lowest**

**Result:** Passed

**Setup No.:** S01\_G02

**Date of Test:** 2011/10/05 10:56

**Body:** FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

**Test Specification:** FCC part 2 and 15



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

**Test: 15c.2; Frequency = Middle**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/10/05 10:56
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15



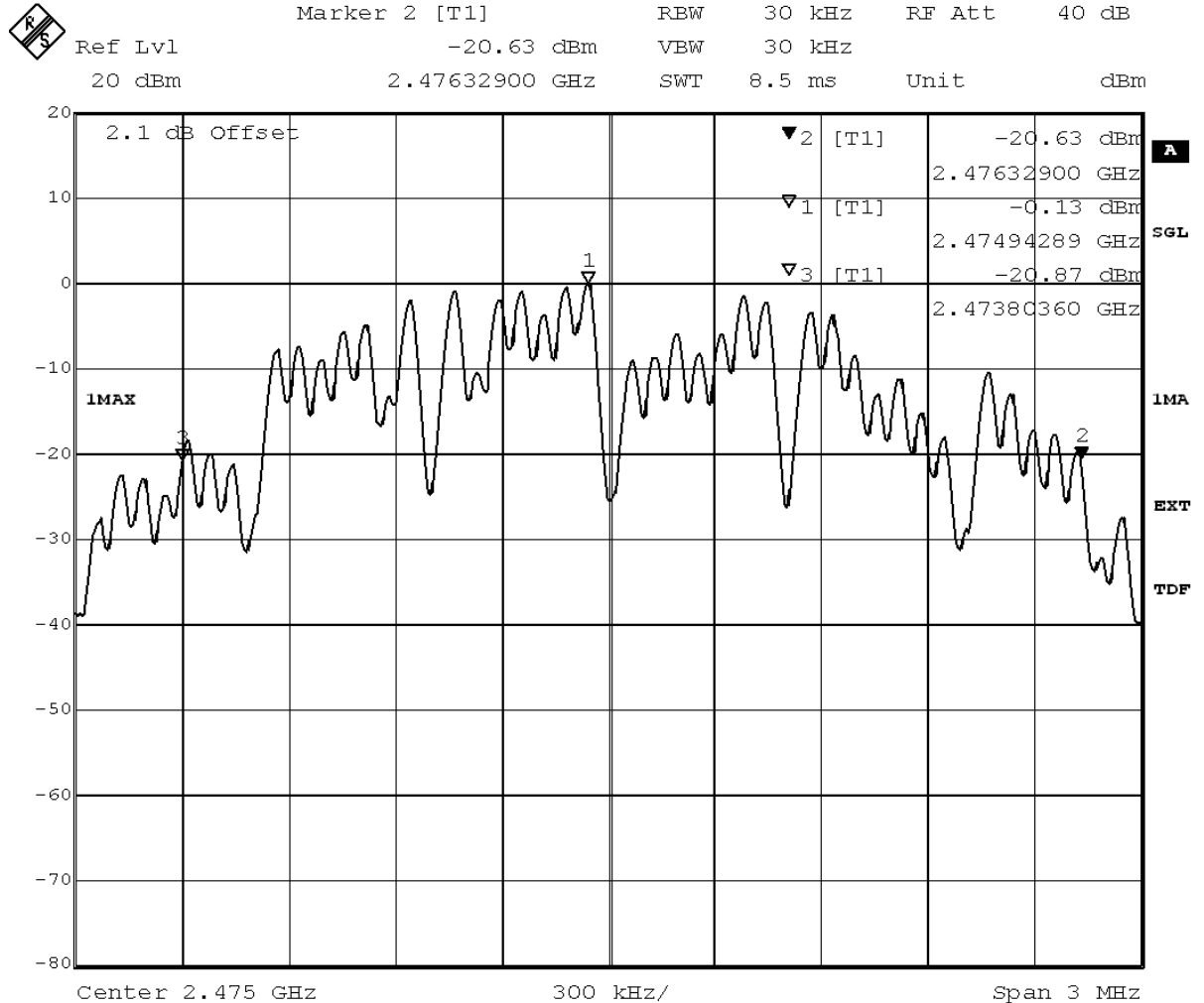
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.3      15c.3    Occupied bandwidth §15.247 (a) (1)**

#### **Test: 15c.3; Frequency = Highest**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/09/16 14:51
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Title: 20dB Bandwidth  
Comment A: CH T: 2475 MHz; 20dB bandwidth (kHz):2525.4  
Date: 16.SEP.2011 15:13:52



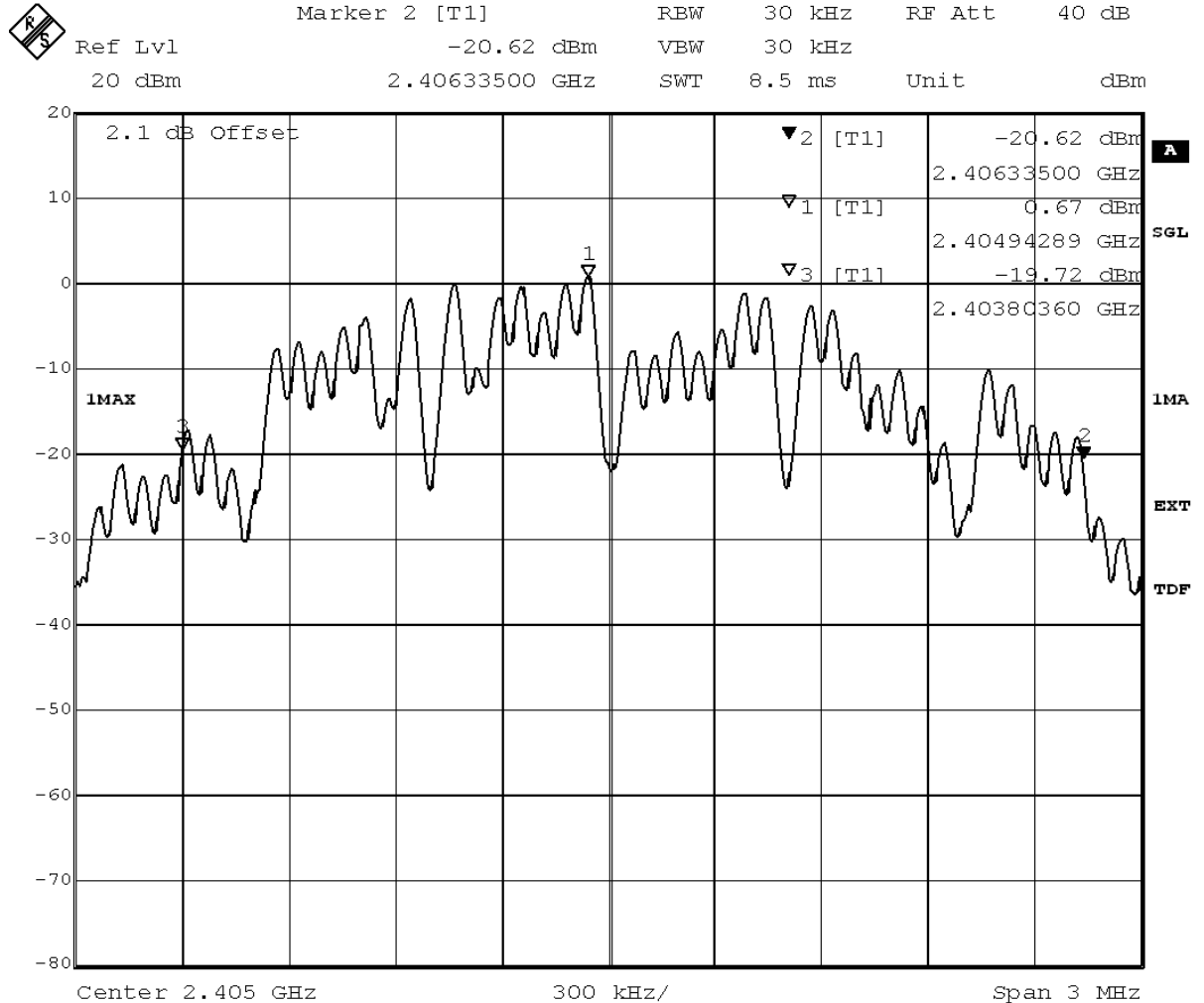
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

20 dB bandwidth Hz
2525400.00

**Test: 15c.3; Frequency = Lowest**

Result:	Passed
Setup No.:	S01_G02
Date of Test:	2011/09/16 14:52
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

## Detailed Results:



Title: 20dB Bandwidth  
Comment A: CH B: 2405 MHz; 20dB bandwidth (kHz):2531.4  
Date: 16.SEP.2011 14:39:30



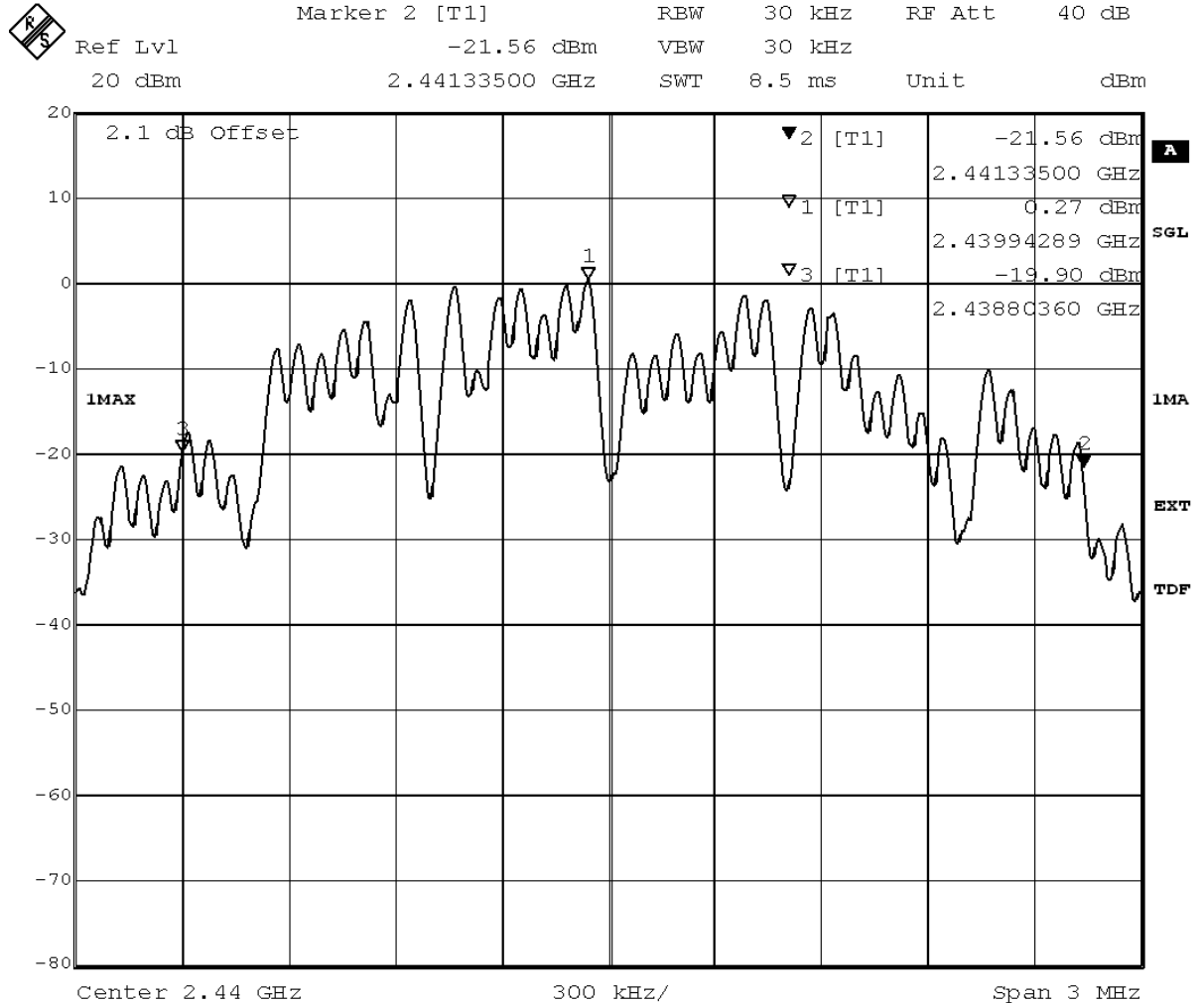
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

20 dB bandwidth Hz
2531400.00

**Test: 15c.3; Frequency = Middle**

Result:	Passed
Setup No.:	S01_G02
Date of Test:	2011/09/16 14:53
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

## Detailed Results:



Title: 20dB Bandwidth  
Comment A: CH M: 2440 MHz; 20dB bandwidth (kHz):2531.4  
Date: 16.SEP.2011 14:57:21





Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

20 dB bandwidth Hz
2531400.00



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.4      15c.4   Peak power output §15.247 (b) (1)**

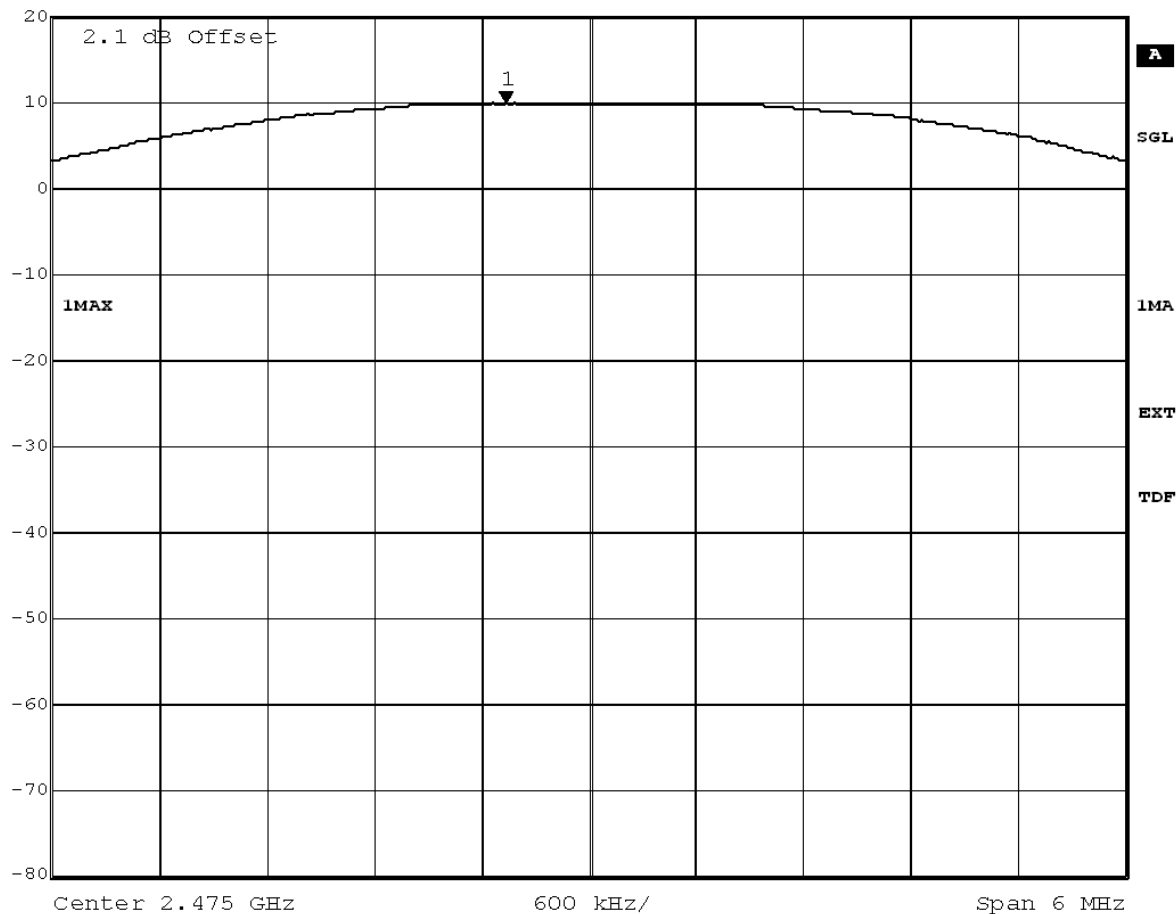
#### **Test: 15c.4; Frequency = Highest**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/09/16 14:53
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Marker 1 [T1]	RBW	3 MHz	RF Att	40 dB
Ref Lvl	9.79 dBm	VBW	3 MHz	
20 dBm	2.47453707 GHz	SWT	5 ms	Unit dBm



Title: Peak outputpower Power  
Comment A: CH T: 2475 MHz  
Date: 16.SEP.2011 15:14:36



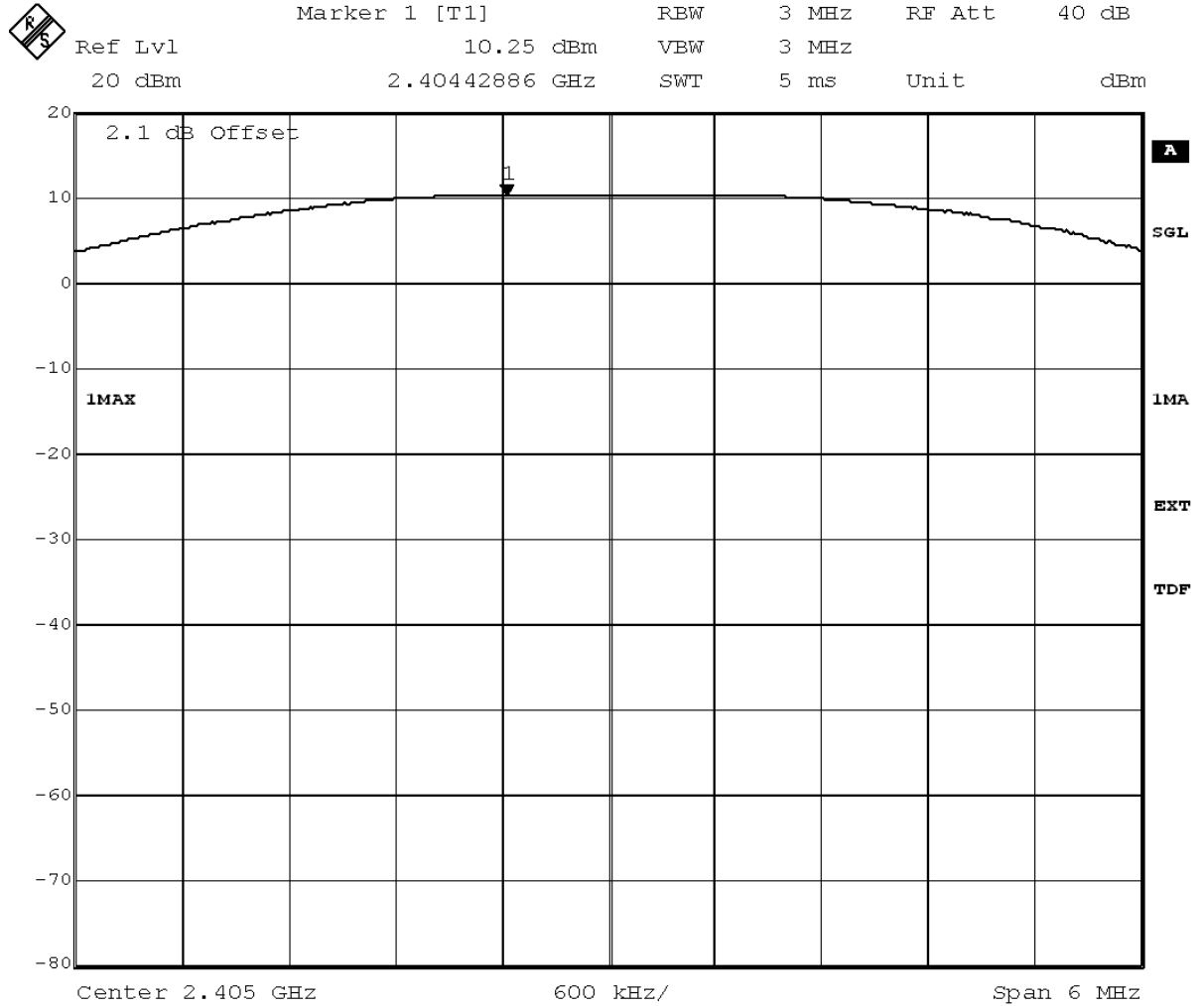
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

conducted peak output power value /dBm	Antena gain	peak value EIRP /dBm	verdict
9.79	0.00	9.79	pass

**Test: 15c.4; Frequency = Lowest**

Result:	Passed
Setup No.:	S01_G02
Date of Test:	2011/09/16 14:54
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

## Detailed Results:



Title: Peak outputpower Power  
Comment A: CH B: 2405 MHz  
Date: 16.SEP.2011 14:40:08



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C


conducted peak output power value /dBm	Antena gain	peak value EIRP /dBm	verdict
10.25	0.00	10.25	pass

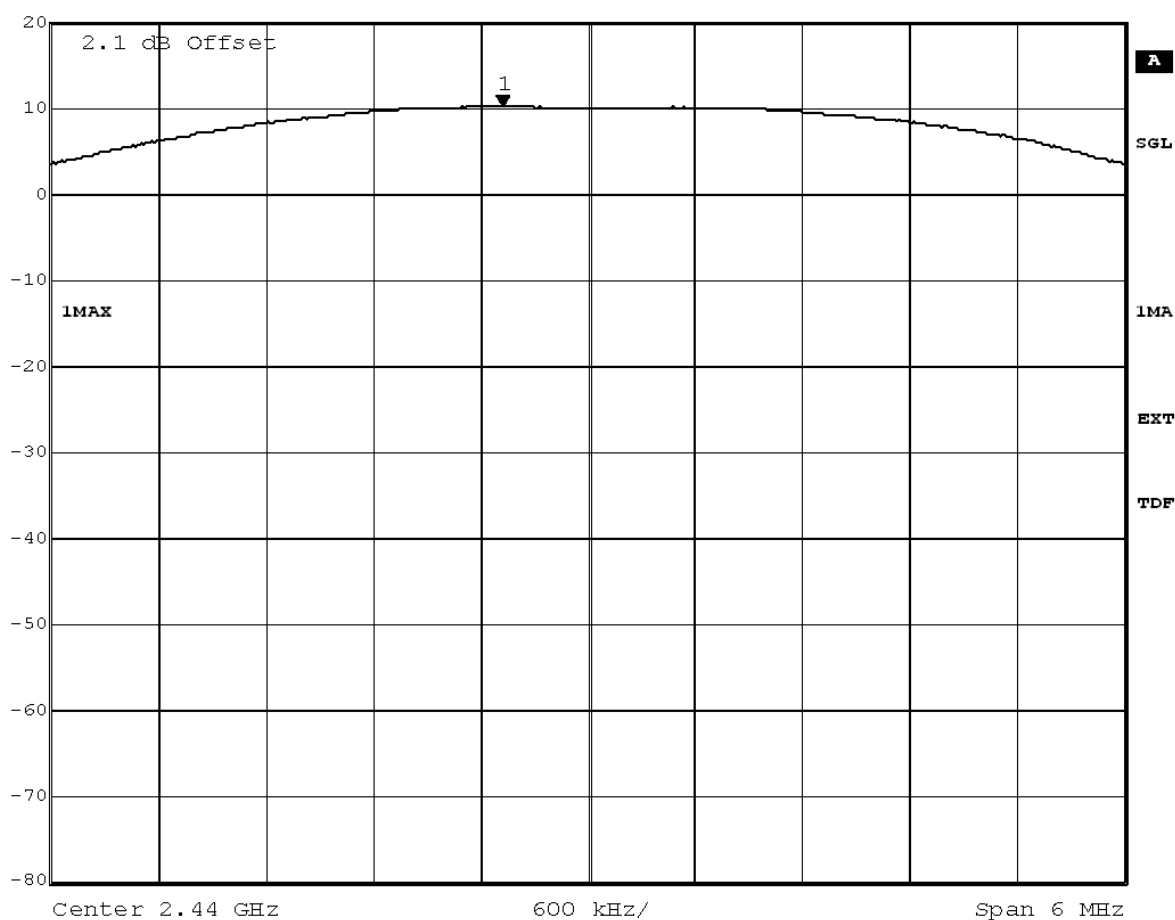
**Test: 15c.4; Frequency = Middle**

Result:	Passed
Setup No.:	S01_G02
Date of Test:	2011/09/16 14:55
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

## Detailed Results:

conducted peak output power value /dBm	Antena gain	peak value EIRP /dBm	verdict
10.06	0.00	10.06	pass

 Marker 1 [T1] RBW 3 MHz RF Att 40 dB  
 Ref Lvl 10.06 dBm VBW 3 MHz  
 20 dBm 2.43952505 GHz SWT 5 ms Unit dBm



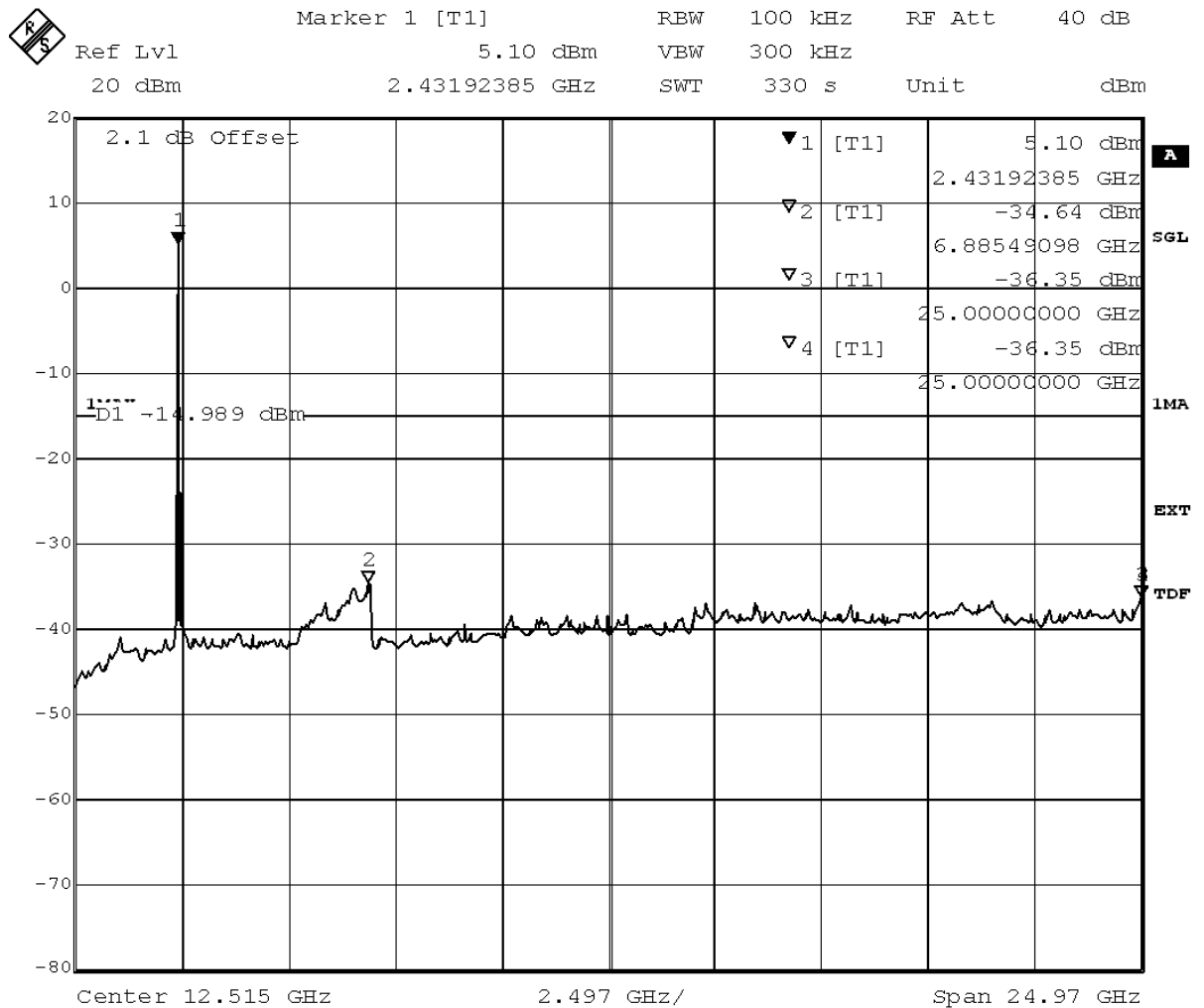
Title: Peak outputpower Power  
 Comment A: CH M: 2440 MHz  
 Date: 16.SEP.2011 14:58:02

### 3.5.5 15c.5 Spurious RF conducted emissions §15.247 (d)

Test: 15c.5; Frequency = Highest

Result: Passed  
Setup No.: S01\_G02  
Date of Test: 2011/09/16 14:55  
Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES  
Test Specification: FCC part 2 and 15

#### Detailed Results:



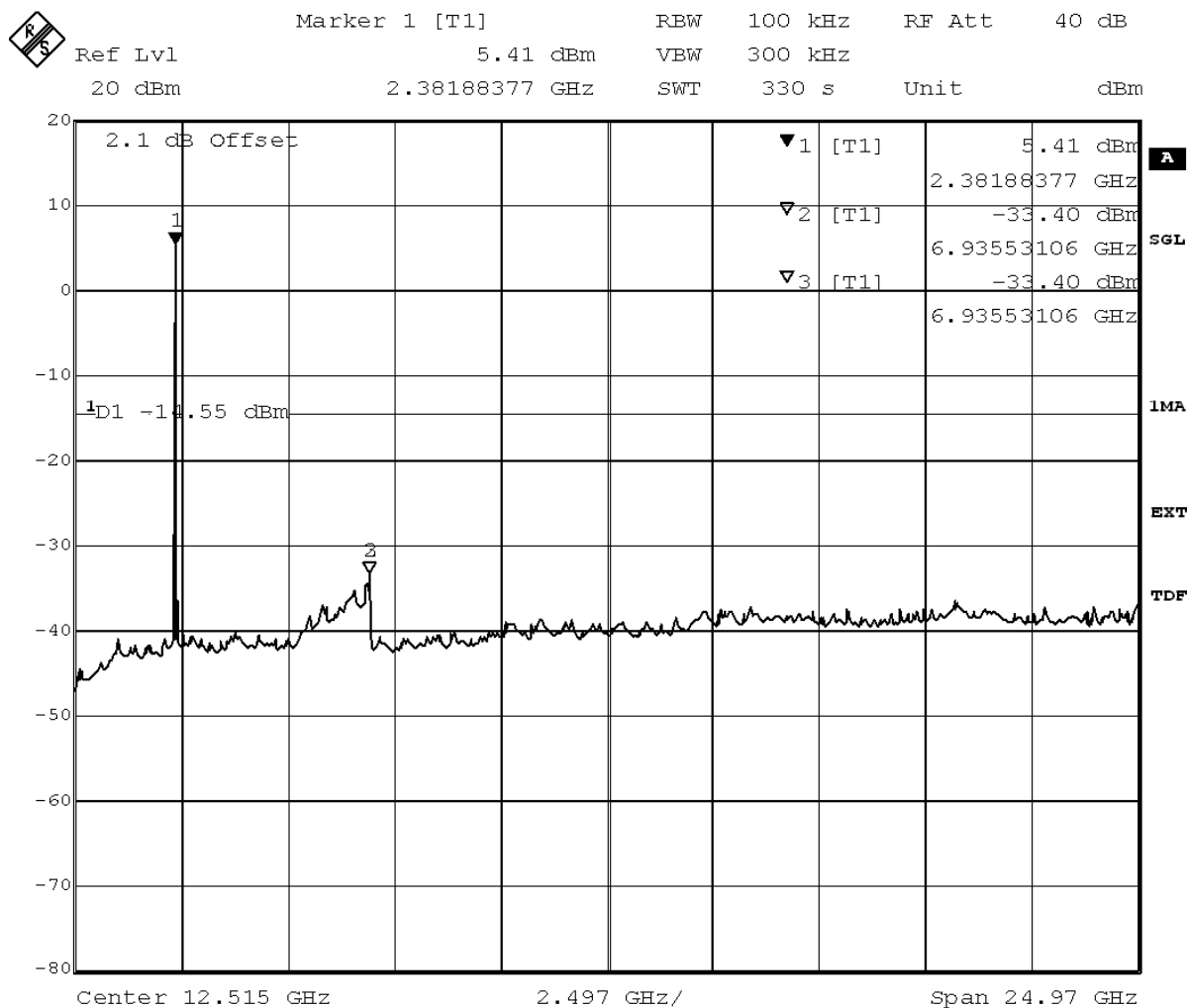
Title: spurious emissions  
Comment A: CH T: 2475 MHz  
Date: 16.SEP.2011 15:11:50



## Test: 15c.5; Frequency = Lowest

Result: Passed  
Setup No.: S01\_G02  
Date of Test: 2011/09/16 14:56  
Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES  
Test Specification: FCC part 2 and 15

## Detailed Results:

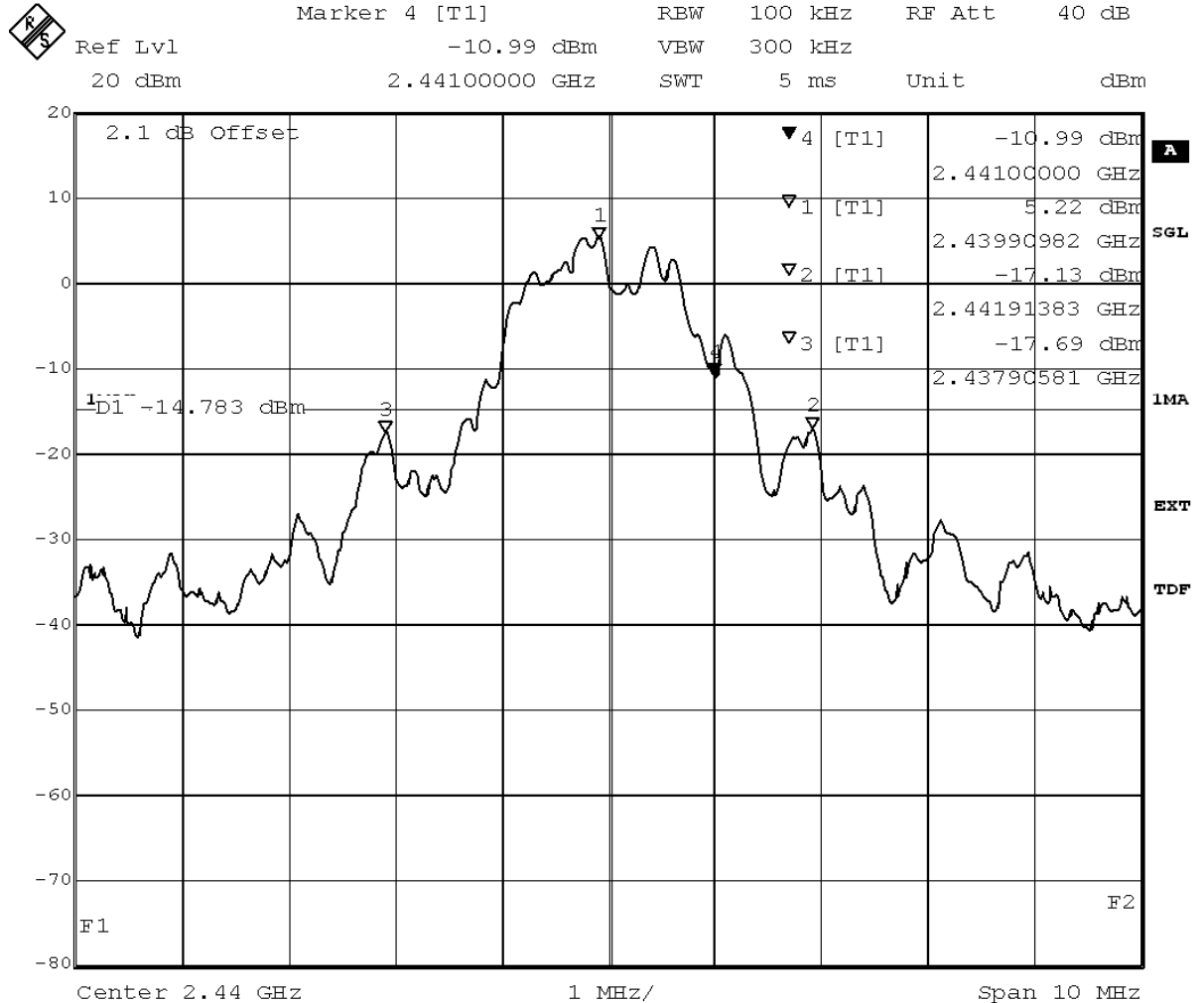


Title: spurious emissions  
Comment A: CH B: 2405 MHz  
Date: 16.SEP.2011 14:37:28

## Test: 15c.5; Frequency = Middle

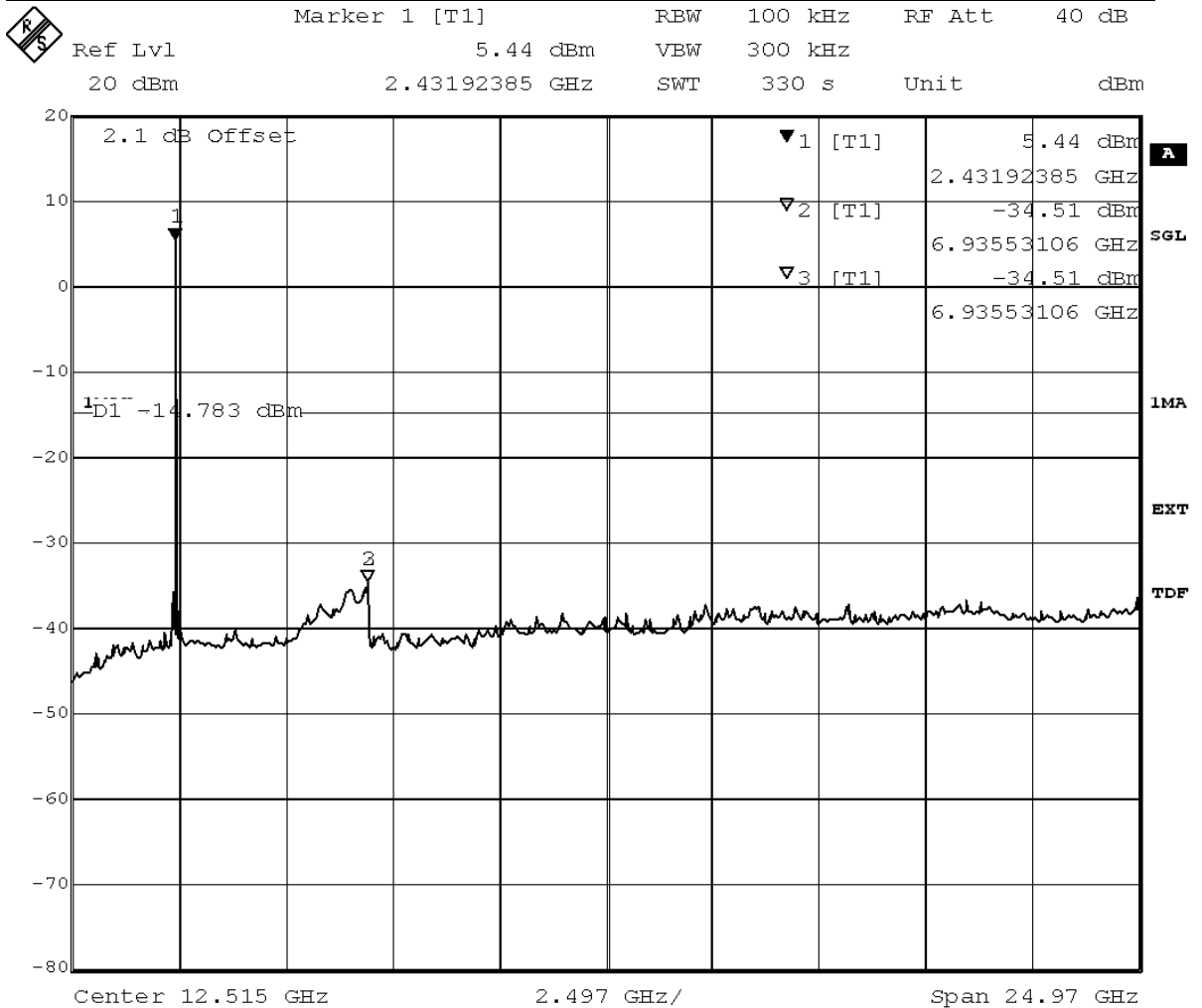
Result: Passed  
Setup No.: S01\_G02  
Date of Test: 2011/09/16 14:56  
Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES  
Test Specification: FCC part 2 and 15

## Detailed Results:



Title: Band Edge Compliance  
Comment A: CH M: 2440 MHz  
Date: 16.SEP.2011 14:43:16

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2441	-10.99	5.22	-14.78	-3.79



Title: spurious emissions  
Comment A: CH M: 2440 MHz  
Date: 16.SEP.2011 14:55:18



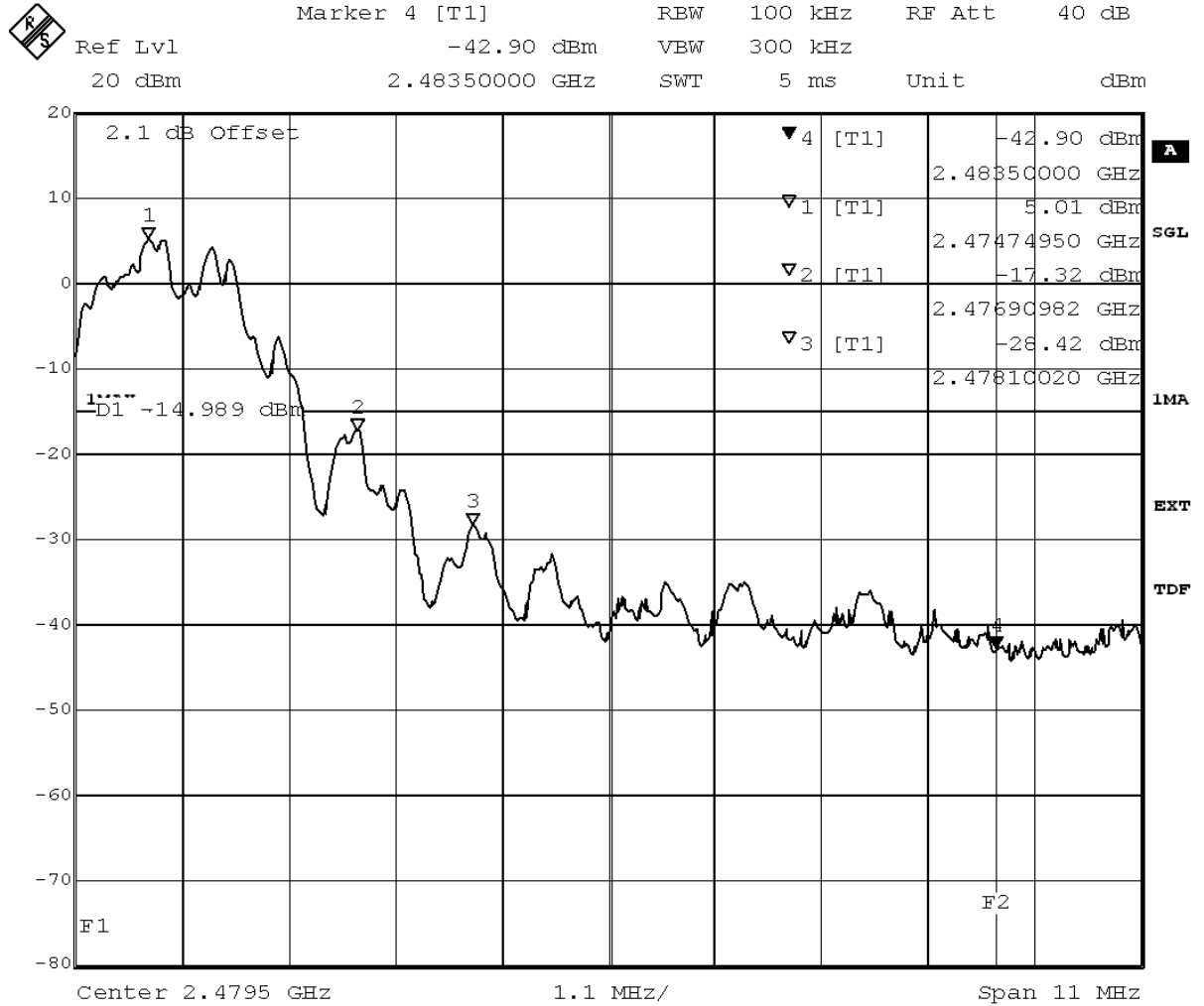
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.6      15c.6    Band edge compliance §15.247 (d)**

#### **Test: 15c.6; Frequency = Highest**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/09/16 14:57
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Title: Band Edge Compliance  
Comment A: CH T: 2475 MHz  
Date: 16.SEP.2011 14:59:47



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2484	-42.90	5.01	-14.99	27.91

**Test: 15c.6; Frequency = Lowest**

*Result:* Passed

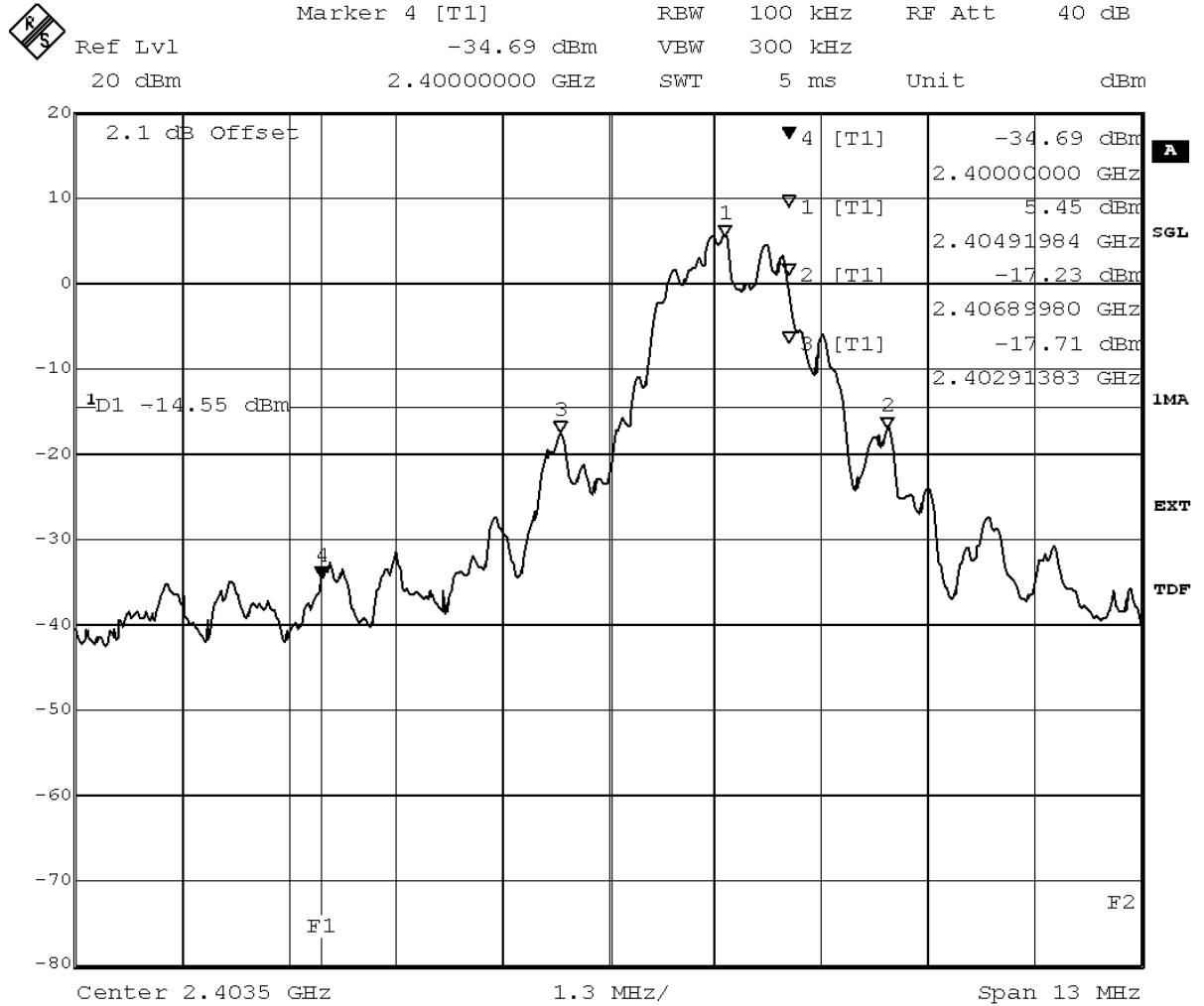
*Setup No.:* S01\_G02

*Date of Test:* 2011/09/16 14:58

*Body:* FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

*Test Specification:* FCC part 2 and 15

## Detailed Results:



Title: Band Edge Compliance  
Comment A: CH B: 2405 MHz  
Date: 16.SEP.2011 14:25:26

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2400	-34.69	5.45	-14.55	20.14





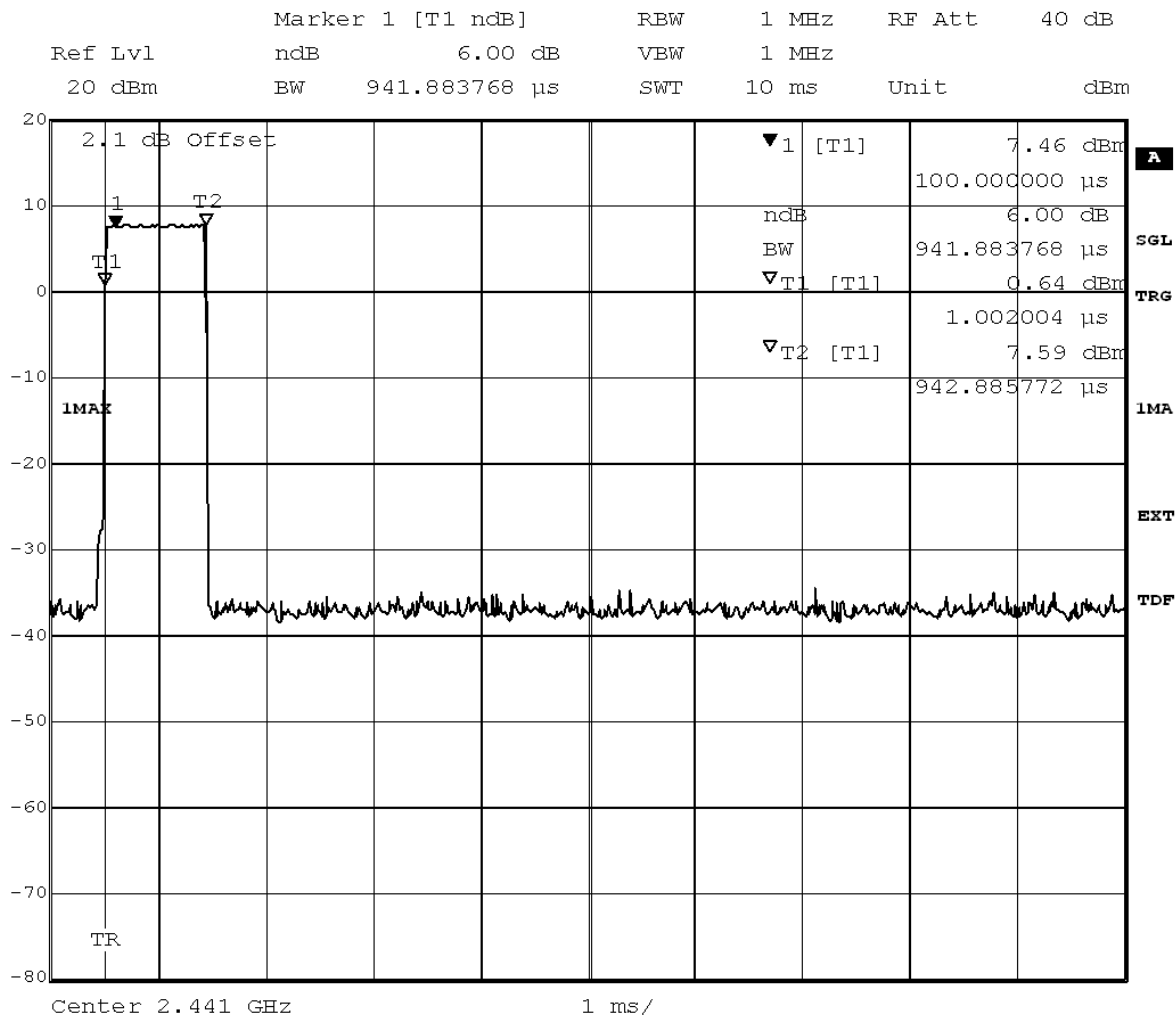
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.7      15c.7   Dwell time §15.247 (a) (1) (iii)**

**Test: 15c.7; Frequency = Middle**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/11/15 10:44
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Title: Dwell time  
Comment A: CH M: 2440 MHz  
Date: 30.SEP.2011 11:01:36

Time slot length	Dwell time	Dwell time ms
0.94	time slot length * 100/15 *6	37.68



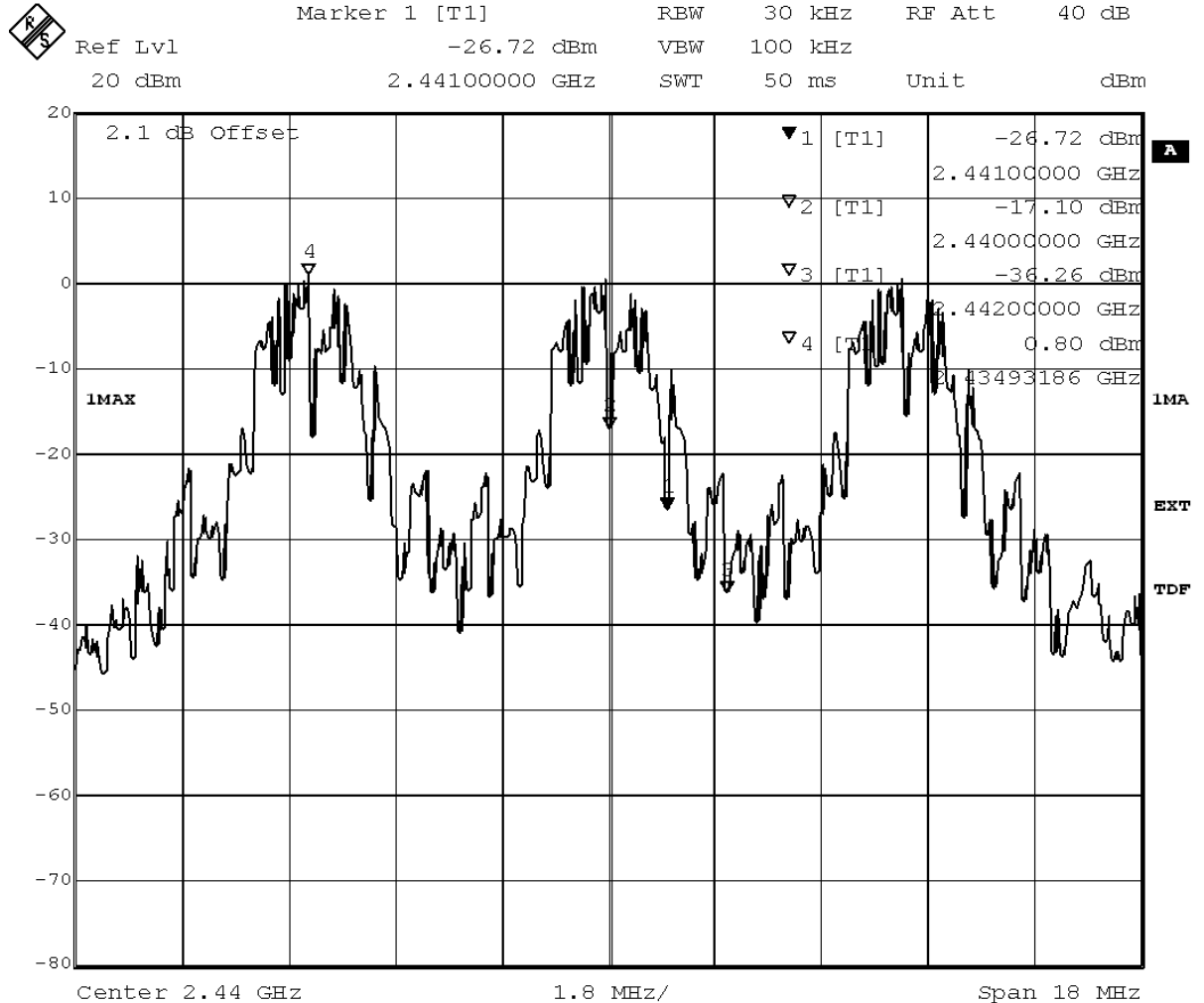
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.8      15c.8   Channel separation §15.247 (a) (1)**

#### **Test: 15c.8; Frequency = Middle**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/09/16 14:59
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Title: Number of hopping frequencies  
Comment A: CH M: 2440 MHz  
Date: 16.SEP.2011 15:50:26



Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

Channel Separation
5.068 MHz



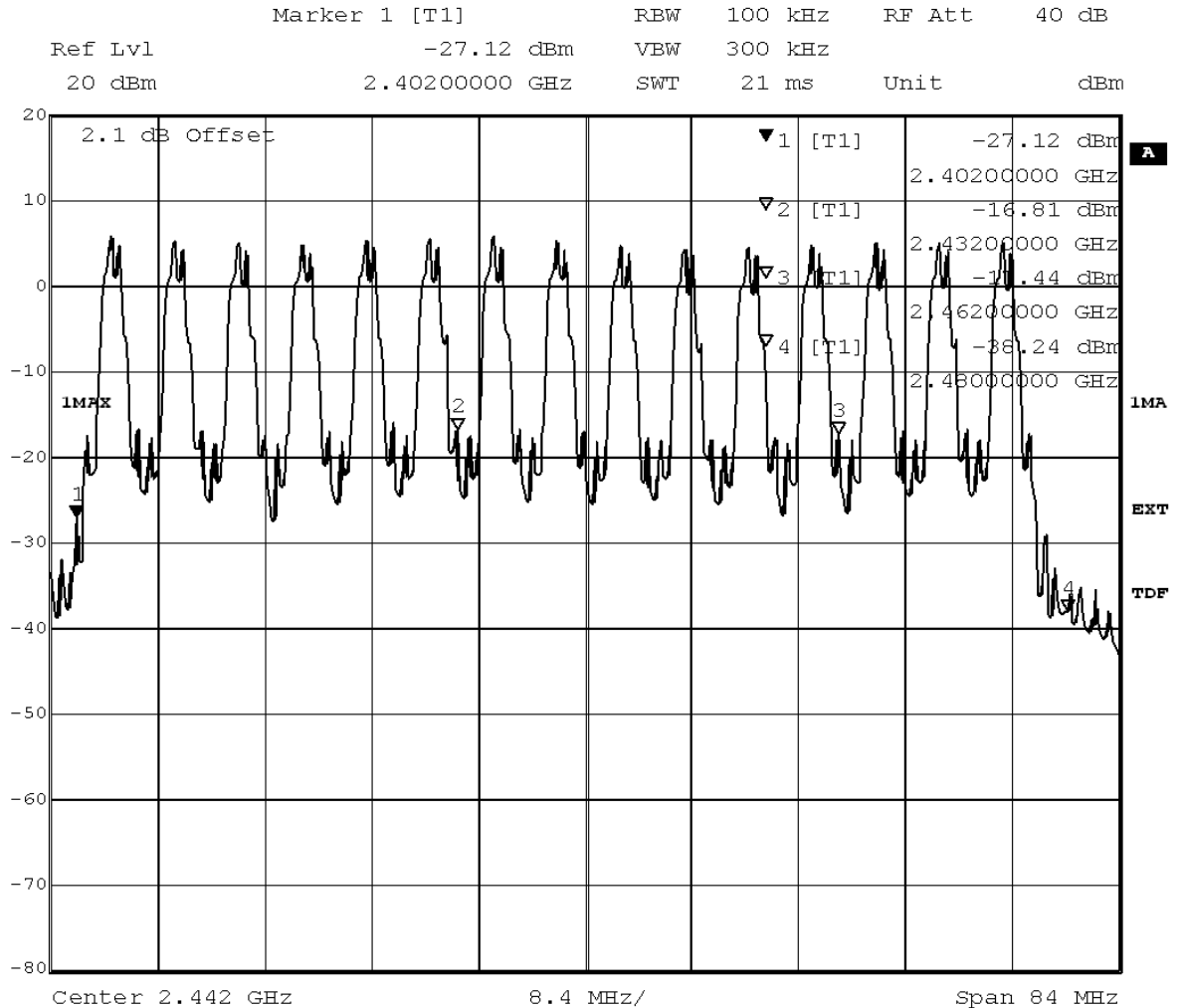
Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

### **3.5.9      15c.9    Number of hopping frequencies §15.247 (a) (1) (iii)**

**Test: 15c.9; Frequency = Middle**

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_G02
<i>Date of Test:</i>	2011/09/16 14:59
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

## Detailed Results:



Title: Number of hopping frequencies  
Comment A: CH H: Hopping  
Date: 30.SEP.2011 11:04:08





Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

Number of Hopping Frequencies
15

## 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 Anechoic Chamber

<b>Lab ID:</b>	<b>Lab 2</b>
<b>Manufacturer:</b>	Frankonia
<b>Description:</b>	Anechoic Chamber for radiated testing
<b>Type:</b>	10.58x6.38x6.00 m <sup>3</sup>

#### Single Devices for Anechoic Chamber

Single Device Name	Type	Serial Number	Manufacturer	
Air compressor	none	-	Atlas Copco	
Anechoic Chamber	10.58 x 6.38 x 6.00 m <sup>3</sup>	none	Frankonia	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	FCC listing 96716 3m Part15/18		2011/01/11	2014/01/10
	IC listing 3699A-1 3m		2011/02/07	2014/02/06
Controller Maturo	MCU	961208	Maturo GmbH	
EMC camera	CE-CAM/1	-	CE-SYS	
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi	
Filter ISDN	B84312-C110-E1		Siemens&Matsushita	
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita	

#### Test Equipment Auxiliary Equipment for Conducted emissions

<b>Lab ID:</b>	<b>Lab 1</b>
<b>Manufacturer:</b>	Rohde & Schwarz GmbH & Co.KG
<b>Description:</b>	EMI Conducted Auxiliary Equipment

#### Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	Type	Serial Number	Manufacturer	
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/11/06	2011/11/05
	Path Calibration		2011/11/11	2012/11/10
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	DKD calibration		2008/10/13	2011/10/12
	DKD calibration		2011/01/20	2013/01/19

## Test Equipment Auxiliary Equipment for Radiated emissions

**Lab ID:** **Lab 2**  
**Description:** Equipment for emission measurements  
**Serial Number:** see single devices

### Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer		
Antenna mast	AS 620 P	620/37	HD GmbH		
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		2008/10/27	2013/10/26	
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01- 2+W38.01-2	Kabel Kusch		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02- 2+W38.02-2	Rosenberger Micro-Coax		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		2009/04/16	2012/04/15	
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		2009/04/28	2012/04/27	
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Path Calibration		2011/05/11	2011/11/10	

### Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2009/05/27    2012/05/26
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	DKD calibration		2008/10/07    2011/10/06
	Standard calibration		2011/10/27    2014/10/26
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

### Test Equipment Auxiliary Test Equipment

<b>Lab ID:</b>	<b>Lab 2</b>
<b>Manufacturer:</b>	see single devices
<b>Description:</b>	Single Devices for various Test Equipment
<b>Type:</b>	various
<b>Serial Number:</b>	none

### Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2009/10/07    2011/10/06
	Customized calibration		2011/10/19    2013/10/18
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

## Test Equipment Digital Signalling Devices

### Lab ID:

Lab 1, Lab 2

### Description:

Signalling equipment for various wireless technologies.

### Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2011/05/26	2013/05/25
	HW/SW Status		Date of Start	Date of End
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2008/12/01	2011/11/30
	HW/SW Status		Date of Start	Date of End
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 --- SW: K62, K69		2007/01/02	
			2008/11/03	



### Test Equipment Emission measurement devices

**Lab ID:** Lab 1, Lab 2  
**Description:** Equipment for emission measurements  
**Serial Number:** see single devices

#### Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer	
Personal Computer	Dell	30304832059	Dell	
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2009/10/20	2011/10/19
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2009/10/15	2011/10/14
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	standard calibration		2011/05/12	2014/05/11
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2009/12/03	2011/12/02
	HW/SW Status		Date of Start	Date of End
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03	

### Test Equipment Multimeter 12

**Lab ID:** Lab 3  
**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.	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2009/10/07	2011/10/06
	Customized calibration		2011/10/18	2013/10/17

### Test Equipment Regulatory Bluetooth RF Test Solution

**Lab ID:** **Lab 3**  
**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	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2011/08/17	2012/08/16
Power Meter NRVD	NRVD	832025/059		
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2011/06/14	2012/06/13
Power Sensor NRV Z1 A	PROBE	832279/013		
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2011/06/14	2012/06/13
Power Supply	NGSM 32/10	2725		
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2011/06/15	2013/06/14
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2011/08/17	2012/08/16
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017		
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2010/06/23	2013/06/20

### Test Equipment Shielded Room 02

**Lab ID:** **Lab 1**  
**Manufacturer:** Frankonia  
**Description:** Shielded Room for conducted testing  
**Type:** 12 qm  
**Serial Number:** none

### Test Equipment Shielded Room 07

**Lab ID:** **Lab 3**  
**Description:** Shielded Room 4m x 6m

#### Test Equipment T/H Logger 04

**Lab ID:** Lab 3  
**Description:** Lufft Opus10  
**Serial Number:** 7481

#### Single Devices for T/H Logger 04

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

#### Test Equipment Temperature Chamber 01

**Lab ID:** Lab 3  
**Manufacturer:** see single devices  
**Description:** Temperature Chamber KWP 120/70  
**Type:** Weiss  
**Serial Number:** see single devices

#### Single Devices for Temperature Chamber 01

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
<b>Calibration Details</b>		<b>Last Execution</b>	<b>Next Exec.</b>
Specific calibration		2010/03/16	2012/03/15





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Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

## **5 Annex**

### **5.1 Additional Information for Report**



#### Summary of Test Results

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

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#### Technical Report Summary

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#### 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

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#### Conducted emissions (AC power line)

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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 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 $\mu$ 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 $\mu$ V)		AV Limit (dB $\mu$ 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 $\mu$ V) = 20 log (Limit ( $\mu$ V)/1 $\mu$ V).

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Occupied bandwidth

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Standard      FCC Part 15, 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 produces the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 30 kHz.

The EUT was connected to the spectrum analyzer via a short coax cable.

#### Test Requirements / Limits

##### FCC Part 15, Subpart C, §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

##### Implication by the test laboratory:

Since the Bluetooth technology defines a fixed channel separation of 1 MHz this design parameter defines the maximum allowed occupied bandwidth depending on the EUT's output power:

1. Under the provision that the system operates with an output power not greater than 125 mW (21.0 dBm) : Implicit Limit: Max. 20 dB BW =  $1.0 \text{ MHz} / 2/3 = 1.5 \text{ MHz}$
2. If the system output power exceeds 125 mW (21.0 dBm): Implicit Limit: Max. 20 dB BW = 1.0 MHz

Used conversion factor: Output power (dBm) =  $10 \log (\text{Output power (W)} / 1\text{mW})$

The measured output power of the system is below 125 mW (21.0 dBm). For the results, please refer to the related chapter of this report. Therefore the limit is determined as 1.5 MHz.

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#### Peak power output

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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 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

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#### Spurious RF conducted emissions

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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

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#### Spurious radiated emissions

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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

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 µs (BT Timing 1.25 ms)
- Turntable angle range: –180 to +180°

- 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°
- 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  $\pm 25$  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:  $-22.5^\circ$  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:  $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$

#### 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)".

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#### Dwell time

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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 dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

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

with:

- hop rate =  $100 \text{ s}^{-1}$  for WirelessHART packets      =  $100 \text{ s}^{-1}$
- number of hopping channels = 15
- $6 \text{ s} = 0.4 \text{ seconds multiplied by the number of hopping channels} = 0.4 \text{ s} * 15$

The highest value of the dwell time is reported.

#### Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.

---

#### Channel separation

---

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 channel separation measurements. The channel separation is independent from the modulation pattern.

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

Analyzer settings:

- Detector: Peak-Maxhold
- Span: 18 MHz
- Centre Frequency: a mid frequency of the 2.4 GHz ISM band
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

#### Test Requirements / Limits

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



Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Number of hopping frequencies

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 number of hopping frequencies measurement. The number of hopping frequencies is independent from the modulation pattern. The EUT was connected to spectrum analyzer via a short coax cable.

Analyzer settings:

- Detector: Peak-Maxhold
- Centre frequency: 2442 MHz
- Frequency span: 84 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

#### Test Requirements / Limits

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

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

\*\*\*\*\*

#### 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.

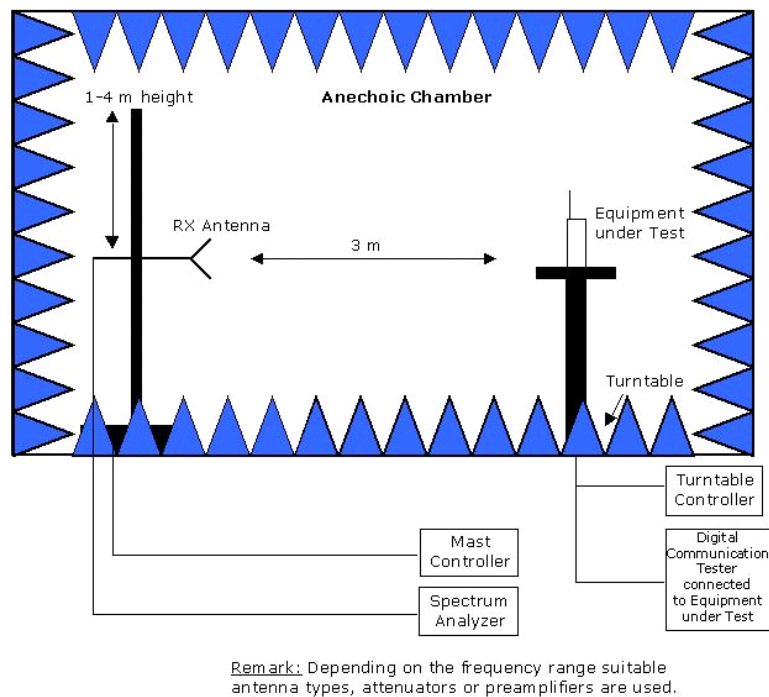
#### Bluetooth® equipment:

Measurement	FCC reference	IC reference
Conducted emissions on AC mains	§ 15.207	RSS-Gen: 7.2.4
Occupied bandwidth	§ 15.247 (a) (1)	RSS-210: A8.1
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
Dwell time	§ 15.247 (a) (1) (iii)	RSS-210: A8.1
Channel separation	§ 15.247 (a) (1)	RSS-210: A8.1
No. of hopping frequencies	§ 15.247 (a) (1) (iii)	RSS-210: A8.1
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



**Drawing 1:** 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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Reference: MDE\_SOFT\_1002\_FCCd  
According to  
Title 47 CFR chapter I part 15 subpart C

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