



# InterLab®

## FCC Measurement/Technical Report on

### Bluetooth Module

### NBM-1

**FCC ID: WJLNBM-1**  
**IC: 7847A-NBM1**

**Report Reference:** MDE\_NOVER\_0912\_FCCa

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DGA-PL-192/99-02

**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 testing laboratory.

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## 0 Summary

### 0.1 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 (10-1-09 Edition) and 15 (10-1-09 Edition). 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

#### Note:

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 C63.4-2003 is applied.

#### Summary Test Results:

**The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.**

## 0.2 Measurement Summary

<b>FCC Part 15, Subpart C</b>		<b>§ 15.207</b>	
Conducted emissions (AC power line)			
The measurement was performed according to ANSI C63.4		2003	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 2	Setup_a01	AC Port (power line)	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (a) (1)</b>	
Occupied bandwidth			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	Setup_b01	Temp ant.connector	passed
op-mode 2	Setup_b01	Temp ant.connector	passed
op-mode 3	Setup_b01	Temp ant.connector	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (b) (1)</b>	
Peak power output			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	Setup_b01	Temp ant.connector	passed
op-mode 2	Setup_b01	Temp ant.connector	passed
op-mode 3	Setup_b01	Temp ant.connector	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (d)</b>	
Spurious RF conducted emissions			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	Setup_b01	Temp ant.connector	passed
op-mode 2	Setup_b01	Temp ant.connector	passed
op-mode 3	Setup_b01	Temp ant.connector	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (d), § 15.35 (b), § 15.209</b>	
Spurious radiated emissions			
The measurement was performed according to ANSI C63.4		2003	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	Setup_a01	Enclosure	passed
op-mode 2	Setup_a01	Enclosure	passed
op-mode 3	Setup_a01	Enclosure	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (d)</b>	
Band edge compliance			
The measurement was performed according to FCC § 15.31 / ANSI C63.4		10-1-09 Edition / 2003	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	Setup_b01	Temp ant.connector	passed
op-mode 3	Setup_b01	Temp ant.connector	passed
op-mode 3	Setup_a01	Enclosure	passed



<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (a) (1) (iii)</b>	
Dwell time			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 2	Setup_b01	Temp ant.connector	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (a) (1)</b>	
Channel separation			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 4	Setup_b01	Temp ant.connector	passed
<b>FCC Part 15, Subpart C</b>		<b>§ 15.247 (a) (iii)</b>	
Number of hopping frequencies			
The measurement was performed according to FCC § 15.31		10-1-09 Edition	
<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 4	Setup_b01	Temp ant.connector	passed



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Responsible for  
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B. Reth

Responsible  
for Test Report:

C. S. [Signature]



## 1 Administrative Data

### 1.1 Testing Laboratory

Company Name: 7 Layers AG  
Address: Borsigstr. 11  
40880 Ratingen  
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:  
- Deutscher Akkreditierungs Rat DAR-Registration no. DGA-PL-192/99-02

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka  
Dipl.-Ing. Robert Machulec  
Dipl.-Ing. Thomas Hoell  
Dipl.-Ing. Andreas Petz

Report Template Version: 2010-05-07

### 1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Carsten Steinröder  
Date of Test(s): 2010-07-12 to 2010-07-15  
Date of Report: 2010-07-22

### 1.3 Applicant Data

Company Name: Novero GmbH  
Address: Meesmannstr. 103  
44807 Bochum  
Germany  
Contact Person: Mr. Robert Müller

### 1.4 Manufacturer Data

Company Name: please see applicant data  
Address:  
Contact Person:



## 2 Test object Data

### 2.1 General EUT Description

<b>Equipment under Test</b>	Bluetooth Module
<b>Type Designation:</b>	NBM-1
<b>Kind of Device: (optional)</b>	Bluetooth Module with Handsfree/Headset applications
<b>Voltage Type:</b>	DC (internal battery)
<b>Voltage level:</b>	3.7 V (internal battery) 120 V (AC/DC Charger)
<b>Modulation Type:</b>	GFSK

#### **General product description:**

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, the Bluetooth technology defines 79 RF channels spaced 1 MHz (2402 - 2480 MHz). The actual RF channel is chosen from a pseudo-random hopping sequence through the 79 channels. A channel is occupied for a defined amount of time slots, with a nominal slot length of 625  $\mu$ s. The maximum time slot length on one channel is defined by the packet type and is 0.625 ms for DH1 packets. The nominal hop rate is 1600 hops/s for DH1. All frequencies are equally used. The maximum nominal average time of occupancy is 0.4 s within a period of 79\*0.4 seconds.

The basic data rate of 1 Mbps uses GFSK modulation.

#### **Specific product description for the EUT:**

The EUT is a Bluetooth module which uses Bluetooth technology to be connected to e.g. a mobile phone to make usage of Hands-Free and Headset application.  
The EUT supports only DH1 packets.

#### **The EUT provides the following ports:**

**Ports**  
Temp antenna connector  
Enclosure  
AC Port (Power Line)

**The main components of the EUT are listed and described in Chapter 2.2.**



## 2.2 EUT Main components

### Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: EI010b01)	Bluetooth transceiver	NBM-1	5908005012 4202029A	R6	D01.01.16	2010-07-12
Remark: EUT A is equipped with an integral antenna (gain = 0.5 dBi).						
EUT B (Code: EI010a01)	Bluetooth transceiver	NBM-1	5908005019 120203A5	R6	D01.01.16	2010-07-12
Remark: EUT B is equipped with a temporary antenna connector.						

**NOTE: The short description is used to simplify the identification of the EUT in this test report.**

## 2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
AE1 (Code: EI010c01)	AC/DC charger	Novero NACM-1	0750845934 23000002	-	-	-
AE2 (Code: EI010d01)	AC/DC charger	Novero NACM-1	0750845934 23000011	-	-	-

## 2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
-	-	-	-	-	-	-

## 2.5 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
Setup_a01	EUT A + AE1	setup for radiated measurements
Setup_b01	EUT B + AE2	setup for conducted measurements

## 2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	The EUT transmits on 2402 MHz	Loopback mode, basic data rate 1 Mbps
op-mode 2	The EUT transmits on 2441 MHz	Loopback mode, basic data rate 1 Mbps
op-mode 3	The EUT transmits on 2480 MHz	Loopback mode, basic data rate 1 Mbps
op-mode 4	The EUT is in Hopping mode	The EUT is hopping on 79 channels, basic data rate 1 Mbps

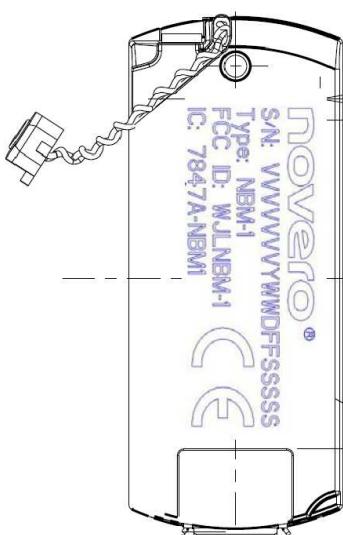
## 2.7 Product labelling

### 2.7.1 FCC ID label



Type label example

### 2.7.2 Location of the label on the EUT



Bottom view of BT module

## 3 Test Results

### 3.1 Conducted emissions (AC power line)

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** ANSI C 63.4, 2003

#### 3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. 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  $50\mu\text{H} \parallel 50 \text{ Ohm}$  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.



### 3.1.2 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).

### 3.1.3 Test Protocol

Temperature: °C  
Air Pressure: hPa  
Humidity: %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	AC Port (power line)

Power line	Frequency MHz	Measured value dB $\mu$ V	Delta to limit dB $\mu$ V	Remarks
-	-	-	-	-

Remark: No final measurement was performed because no frequencies (peaks) were found within the offset for acceptance analysis during the preliminary scan. Please see annex for the measurement plot.

### 3.1.4 Test result: Conducted emissions (AC power line)

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 5	passed



### 3.2 Occupied bandwidth

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.2.1 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.

#### 3.2.2 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:  $\text{Max. } 20 \text{ dB BW} = 1.0 \text{ MHz} / 2/3 = 1.5 \text{ MHz}$
2. If the system output power exceeds 125 mW (21.0 dBm):  
Implicit Limit:  $\text{Max. } 20 \text{ dB BW} = 1.0 \text{ MHz}$

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.



### 3.2.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	Setup_b01	Temp ant.connector
<b>20 dB bandwidth MHz</b>		<b>Remarks</b>
0.848		-

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 2	Setup_b01	Temp ant.connector
<b>20 dB bandwidth MHz</b>		<b>Remarks</b>
0.848		-

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3	Setup_b01	Temp ant.connector
<b>20 dB bandwidth MHz</b>		<b>Remarks</b>
0.848		-

Remark: Please see annex for the measurement plot.

### 3.2.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed



### 3.3 Peak power output

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.3.1 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.

#### 3.3.2 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 (Limit (W)/1mW)

==> Maximum Output Power: 30 dBm



### 3.3.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	Setup_b01	Temp.ant.connector

Output power dBm	Remarks
0.88	The EIRP including antenna gain (0.5 dBi) is 1.38 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 2	Setup_b01	Temp.ant.connector

Output power dBm	Remarks
0.44	The EIRP including antenna gain (0.5 dBi) is 0.94 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3	Setup_b01	Temp.ant.connector

Output power dBm	Remarks
0.35	The EIRP including antenna gain (0.5 dBi) is 0.85 dBm

Remark: Please see annex for the measurement plot.

### 3.3.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed



### 3.4 Spurious RF conducted emissions

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.4.1 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.

#### 3.4.2 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.



### 3.4.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode	Setup	Port		
op-mode 1	Setup_b01	Temp ant.connector		
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	0.71	-19.29	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
Please see annex for the measurement plot.

Op. Mode	Setup	Port		
op-mode 2	Setup_b01	Temp ant.connector		
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	0.23	-19.77	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
Please see annex for the measurement plot.

Op. Mode	Setup	Port		
op-mode 3	Setup_b01	Temp ant.connector		
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	0.12	-19.88	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
Please see annex for the measurement plot.

### 3.4.4 Test result: Spurious RF conducted emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed

### 3.5 Spurious radiated emissions

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** ANSI C 63.4, 2003

#### 3.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. 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 test was performed at the distance of 3 m between the EUT and the receiving antenna.

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.

##### 1. Measurement up to 30 MHz

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. 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 +/- 22.5° 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 ° 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.

#### 3.5.2 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 ( $\mu$ V/m)	Measurement distance (m)	Limit(dB $\mu$ V/m @10m)
0.009 - 0.49	2400/F(kHz)	300	Limit (dB $\mu$ V/m)+30dB
0.49 - 1.705	24000/F(kHz)	30	Limit (dB $\mu$ V/m)+10dB
1.705 - 30	30	30	Limit (dB $\mu$ V/m)+10dB

Frequency in MHz	Limit ( $\mu$ V/m)	Measurement distance (m)	Limit (dB $\mu$ V/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 (dB $\mu$ V/m) = 20 log (Limit ( $\mu$ V/m)/1 $\mu$ V/m)

### 3.5.3 Test Protocol

Temperature: 28 °C  
 Air Pressure: 1007 hPa  
 Humidity: 35 %

#### 3.5.3.1 Measurement up to 30 MHz

Op. Mode		Setup		Port					
op-mode 1		Setup_a01		Enclosure					
Polarisation	Frequency MHz	Corrected value dB $\mu$ V/m			Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
0°	-	-	-	-	-	-	-	-	-
90°	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed. The found peak at 91.2 kHz is emission from loop antenna power supply.

#### 3.5.3.2 Measurement above 30 MHz

Op. Mode		Setup		Port					
op-mode 1		Setup_a01		Enclosure					
Polarisation	Frequency MHz	Corrected value dB $\mu$ V/m			Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical + horizontal	4804	-	49.05	37.63	-	74	54	24.95	16.37

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode		Setup		Port					
op-mode 2		Setup_a01		Enclosure					
Polarisation	Frequency MHz	Corrected value dB $\mu$ V/m			Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical + horizontal	4882	-	52.59	40.89	-	74	54	21.41	13.11

Remark: No (further) spurious emissions in the range 20 dB below the limit found.



Op. Mode	Setup	Port
op-mode 3	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dB $\mu$ V/m			Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Limit dB $\mu$ V/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical + horizontal	4960	-	54.56	42.79	-	74.00	54.00	19.44	11.21

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

### 3.5.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed



### 3.6 Band edge compliance

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** ANSI C 63.4, 2003 FCC §15.31

#### 3.6.1 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

#### 3.6.2 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)".



### 3.6.3 Test Protocol

#### 3.6.3.1 Lower band edge

##### Conducted measurement

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode	Setup	Port		
op-mode 1	Setup_b01	Temp ant.connector		
Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2400.00	-36.76	0.71	-19.29	17.47

Remark: Please see annex for the measurement plot.

#### 3.6.3.2 Higher band edge

##### Conducted measurement

Op. Mode	Setup	Port		
op-mode 3	Setup_b01	Temp ant.connector		
Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2483.50	-57.45	0.12	-19.88	37.57

Remark: Please see annex for the measurement plot.

##### Radiated measurement

Temperature: 28 °C  
Air Pressure: 1007 hPa  
Humidity: 35 %

Op. Mode	Setup	Port				
op-mode 3	Setup_a01	Enclosure				
Frequency MHz	Polarisation	Corrected value dB $\mu$ V/m	Limit Peak dB $\mu$ V/m	Limit AV dB $\mu$ V/m	Delta to Peak limit/dB	Delta to AV limit dB
Peak	AV					
2483.50	Vertical + horizontal	47.87	74.00	54.00	26.13	18.51

Remark: Please see annex for the measurement plot.

### 3.6.4 Test result: Band edge compliance

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 3	passed



### 3.7 Dwell time

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.7.1 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 =  $1600 * 1/s$  for DH1 packets =  $1600 \text{ s}^{-1}$
- hop rate =  $1600/3 * 1/s$  for DH3 packets =  $533.33 \text{ s}^{-1}$
- hop rate =  $1600/5 * 1/s$  for DH5 packets =  $320 \text{ s}^{-1}$
- number of hopping channels = 79
- $31.6 \text{ s} = 0.4 \text{ seconds multiplied by the number of hopping channels} = 0.4 \text{ s} * 79$

The highest value of the dwell time is reported.

#### 3.7.2 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.



### 3.7.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode		Port	
op-mode 2		Setup_b01	
Packet type	Time slot length ms	Dwell time	Dwell time ms
DH1	0.421	time slot length * 1600/79 * 31.6	269.44

Remark: Please see annex for the measurement plots.

### 3.7.4 Test result: Dwell time

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 2	passed



### 3.8 Channel separation

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.8.1 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: 3 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

#### 3.8.2 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.



### 3.8.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1012 hPa  
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 4	Setup_b01	Temp ant.connector
Channel separation MHz	Remarks	
1.000	-	

Remark: Please see annex for the measurement plot.

### 3.8.4 Test result: Channel separation

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 4	passed



### 3.9 Number of hopping frequencies

**Standard** FCC Part 15, 10-1-09 Edition Subpart C

**The test was performed according to:** FCC §15.31

#### 3.9.1 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

#### 3.9.2 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.

#### 3.9.3 Test Protocol

Temperature: 23 °C

Air Pressure: 1012 hPa

Humidity: 40 %

Op. Mode	Setup	Port
op-mode 4	Setup_b01	Temp ant.connector
<b>Number of hopping channels</b>		<b>Remarks</b>
79		-

Remark: Please see annex for the measurement plot.

#### 3.9.4 Test result: Number of hopping frequencies

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 4	passed



## 4 Test Equipment

## Test Equipment Details

## 1.1 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 1</b>		
<b>Manufacturer:</b>	Frankonia		
<b>Description:</b>	Anechoic Chamber for radiated testing		
<b>Type:</b>	10.58x6.38x6		
	<i>Calibration Details</i>	<i>Last Execution</i>	<i>Next Exec.</i>
	IC renewal	2009/01/21	2011/01/20
	FCC renewal	2009/01/07	2011/01/06

## 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	none	Frankonia	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	FCC listing 96716 3m Part15/18		2009/01/07	2011/01/06
	ANSI C64.3 NSA		2009/01/21	2011/01/20
Controller Innco 2000	CO 2000	CO2000/328/12470 406/L	Innco innovative constructions 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 Radiated emissions

**Lab ID:** Lab 1  
**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		HD GmbH	
Biconical dipole	VUBA 9117	9117108	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		2010/05/10	2010/11/09
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01- Kabel Kusch 2		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02- Rosenberger Micro-Coax 2		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
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
Dreheinheit	DE 325		HD GmbH	
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Path Calibration		2010/05/10	2010/11/09
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

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

Single Device Name	Type	Serial Number	Manufacturer
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
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH

### Test Equipment Auxiliary Test Equipment

**Lab ID:** **Lab 1**  
**Manufacturer:** see single devices  
**Description:** Single Devices for various Test Equipment  
**Type:** various  
**Serial Number:** 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 01 (Multimeter)	Voltcraft M-3860M	IJ096055	Conrad Electronics
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
Digital Oscilloscope [SA2] (Aux)	TDS 784C	B021311	Tektronix GmbH
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
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	DKD calibration		2008/10/06   2011/10/05
Vector Signal Generator	SMIQ B3	832492/061	

## Test Equipment Digital Signalling Devices

### Lab ID:

### Lab 1

### 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
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2008/08/14	2011/08/13
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration	2008/10/07	2010/10/06
Digital Radio Test Set	6103E	2359	Racal Instruments, Ltd.
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration	2009/02/16	2012/02/15
	<i>HW/SW Status</i>		<i>Date of Start</i> <i>Date of End</i>
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04	2007/07/16	
	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		
	---		
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration	2008/12/01	2011/11/30
	<i>HW/SW Status</i>		<i>Date of Start</i> <i>Date of End</i>
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02	2007/01/02	
	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	2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration	2008/10/28	2011/10/27

### Test Equipment Emission measurement devices

**Lab ID:** **Lab 1**  
**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
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2007/12/05 2010/12/04
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2009/12/03 2011/12/02

### Test Equipment Multimeter 12

**Lab ID:** **Lab 2**  
**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>
	Standard calibration		2009/10/07 2010/10/06
	Standard calibration		2009/10/07 2011/10/06

## Test Equipment Regulatory Bluetooth RF Test Solution

**Lab ID:** **Lab 2**  
**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 1153.9000.35 CBT		100302	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2009/08/06	2010/08/05
	Standard Calibration	2010/06/23	2011/06/22
Power Meter NRV	857.8008.02	832025/059	
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2010/06/21	2011/06/20
Power Sensor NRV Z1 A	828.3018.03	832279/013	
Power Supply	NGSM 32/10	2725	
Rubidium Frequency Normal MFS	828.3018.03	002	Datum GmbH
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2009/06/24	2011/06/23
Signal Generator	SMP03	833680/003	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2009/06/23	2012/06/22
Vector Signal Generator SMIQ03B B	1125.5555.03	832870/017	
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration	2010/06/23	2013/06/20

## Test Equipment Shielded Room 07

**Lab ID:** **Lab 2**  
**Description:** Shielded Room 4m x 6m

## Test Equipment T/H Logger 04

**Lab ID:** **Lab 2**  
**Description:** Lufft Opus10  
**Serial Number:** 7481

### Single Devices for T/H Logger 04

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 04 (Environ)		7481	Lufft Mess- und Regeltechnik GmbH
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration	2009/01/23	2011/01/22

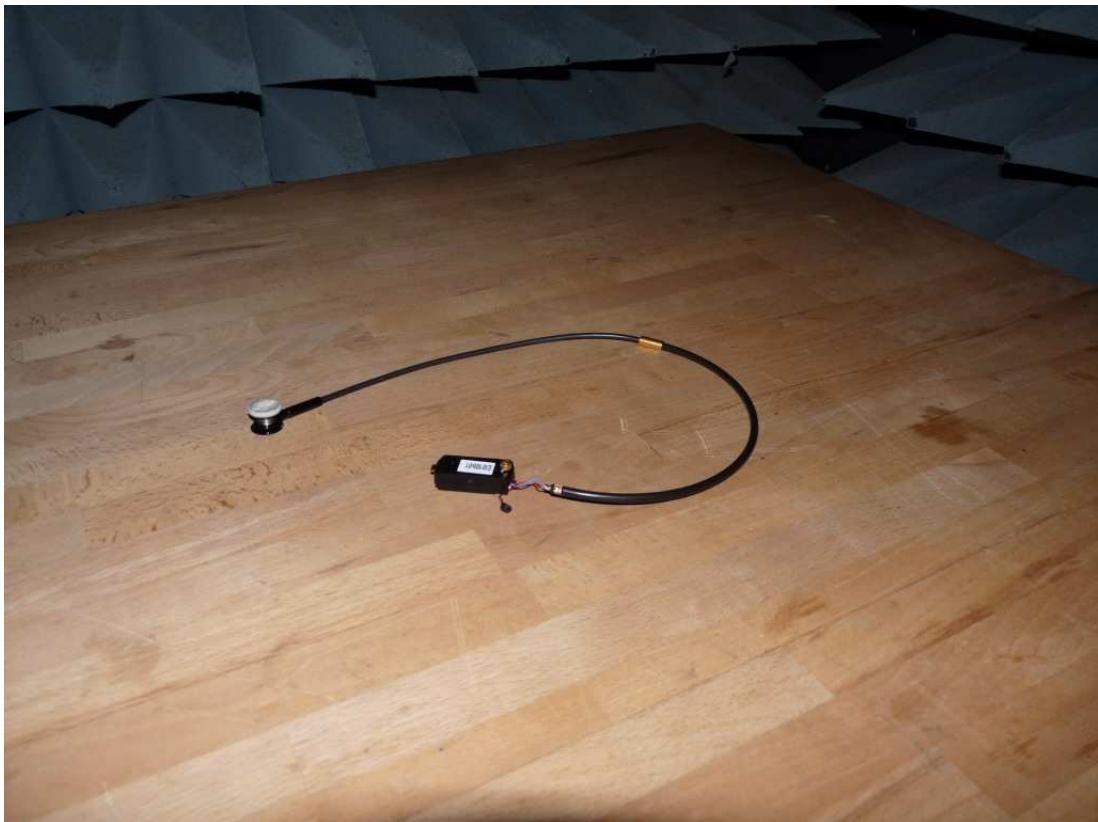
**Test Equipment Temperature Chamber 01**

**Lab ID:** **Lab 2**  
*Manufacturer:* see single devices  
*Description:* Temperature Chamber KWP 120/70  
*Type:* Weiss  
*Serial Number:* see single devices

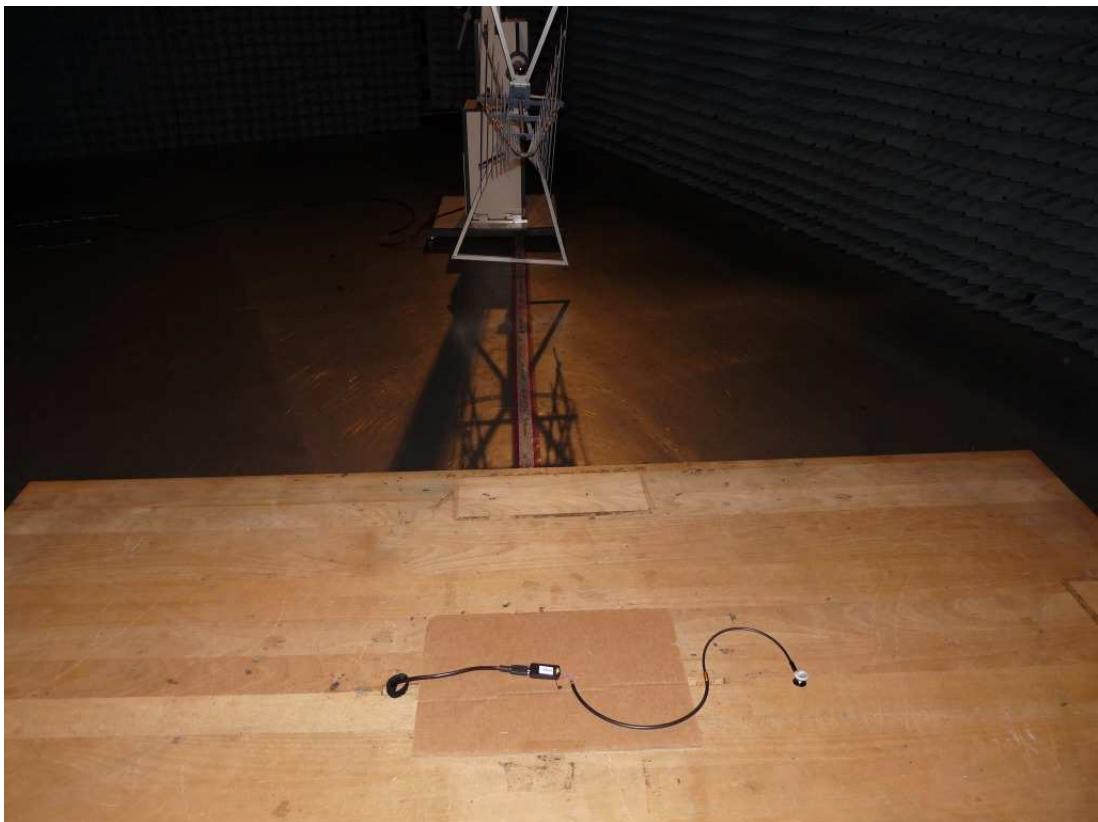
**Single Devices for Temperature Chamber 01**

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
	<i>Calibration Details</i> Specific calibration		<i>Last Execution</i> 2010/03/16 <i>Next Exec.</i> 2011/03/15

## 5 Photo Report



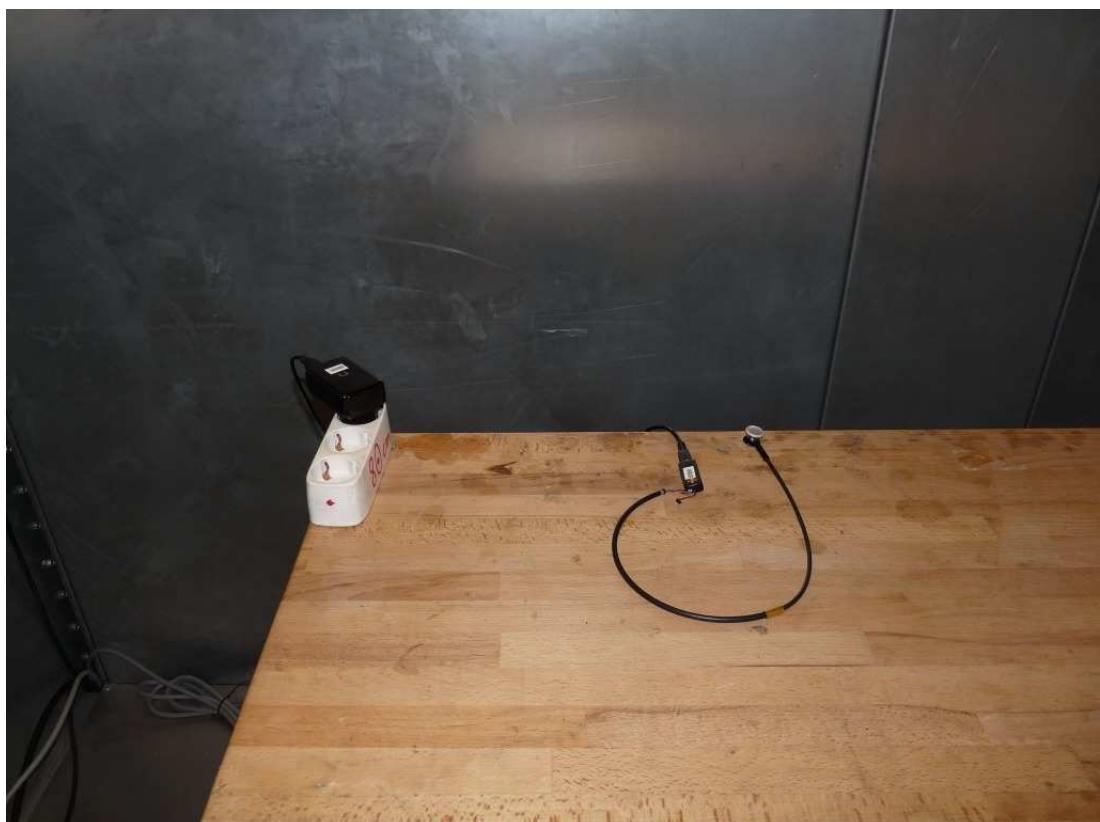
**Photo 1:** Test setup for radiated measurements (Enclosure, below 30 MHz)



**Photo 2:** Test setup for radiated measurements (Enclosure, 30 MHz to 1 GHz)

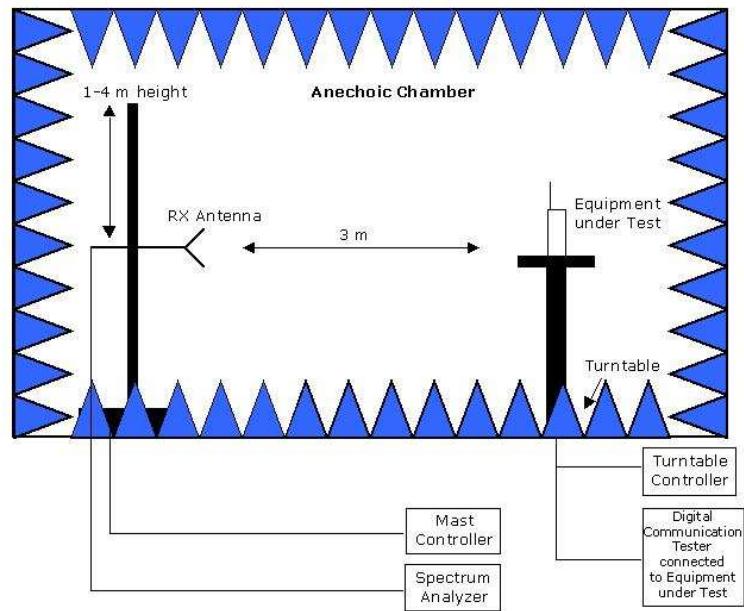


**Photo 3:** Test setup for radiated measurements (Enclosure, above 1 GHz)



**Photo 4:** Test setup for conducted measurements (AC Port (power line))

## 6 Setup Drawings



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

**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

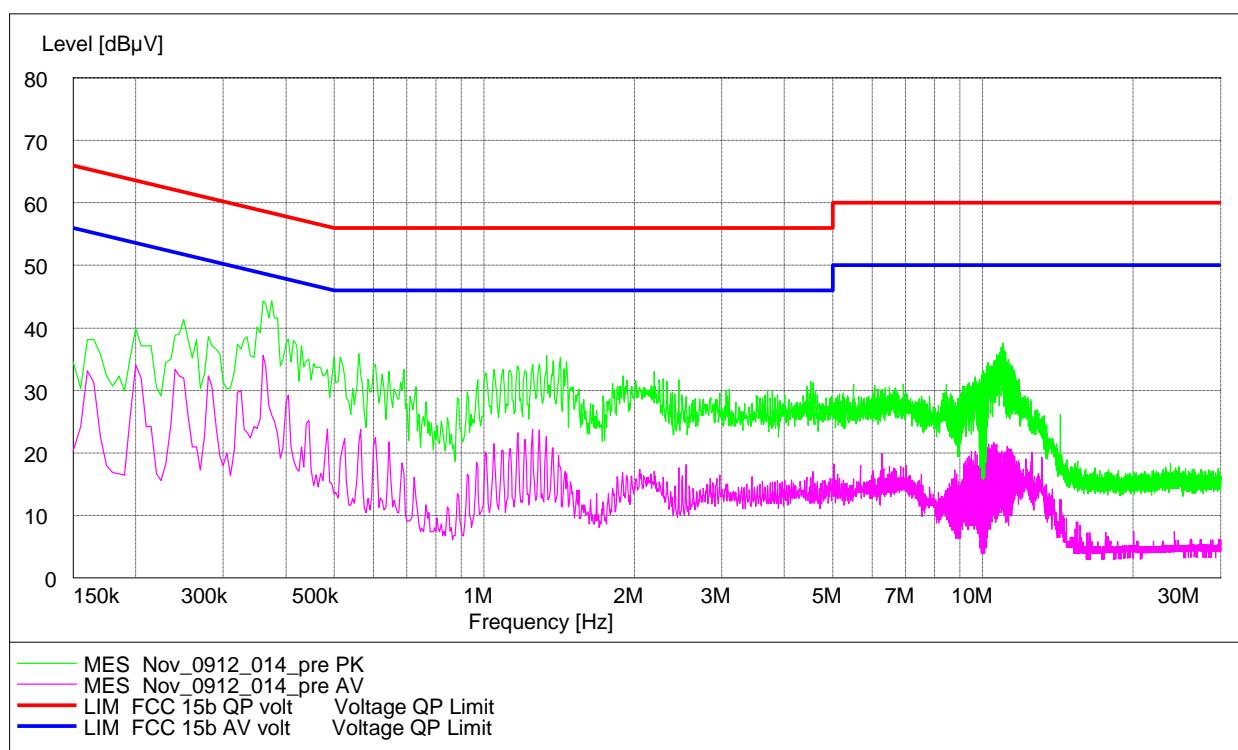
## 7 Annex measurement plots

### 7.1 AC Mains conducted

#### Op. Mode

op-mode 5

Start Frequency	Stop Frequency	Step Width	Detector	Meas.	IF Time	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak	20.0 ms	9 kHz	ESH3-Z5
Average						

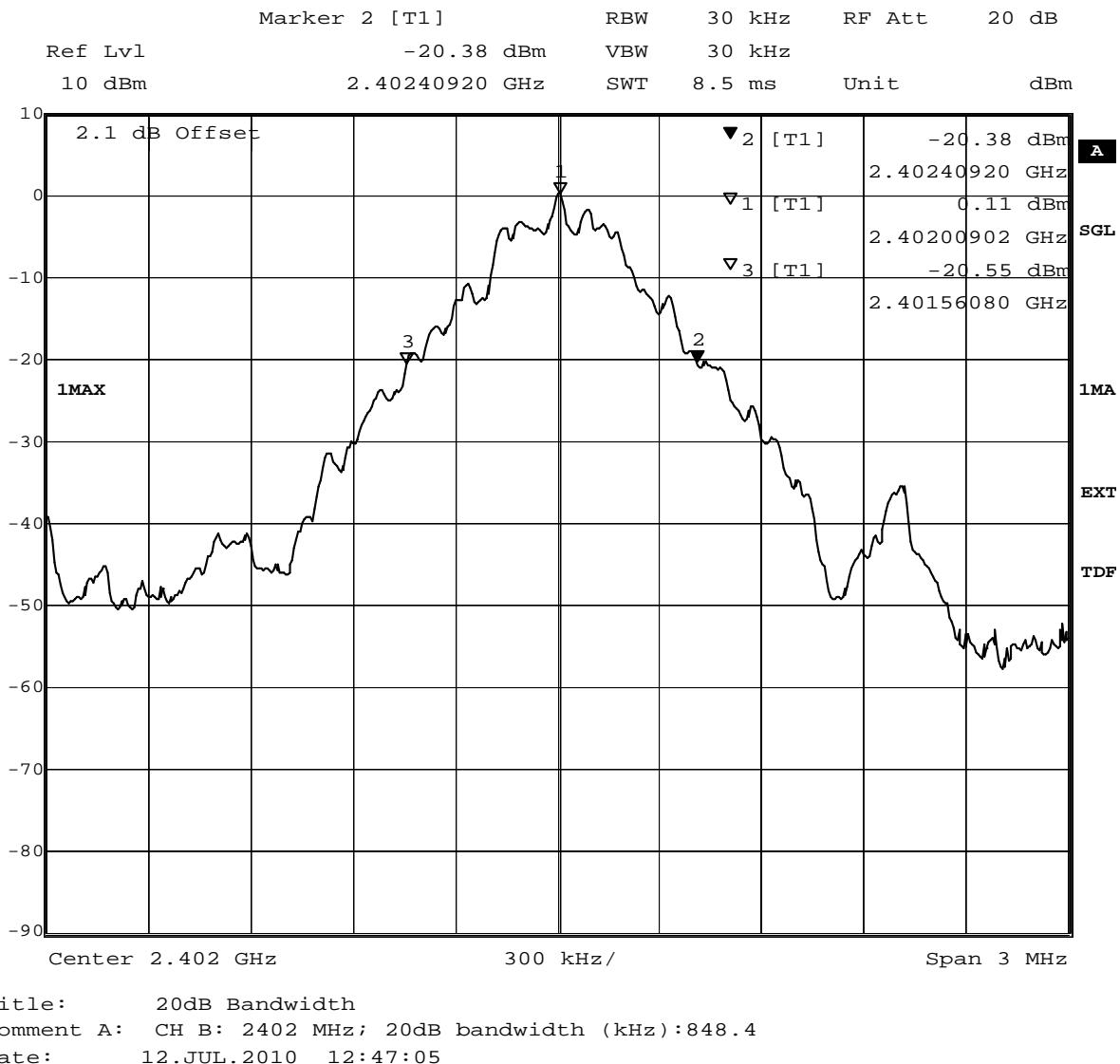


## 7.2 Occupied bandwidth

### 7.2.1 Occupied bandwidth operating mode 1

#### Op. Mode

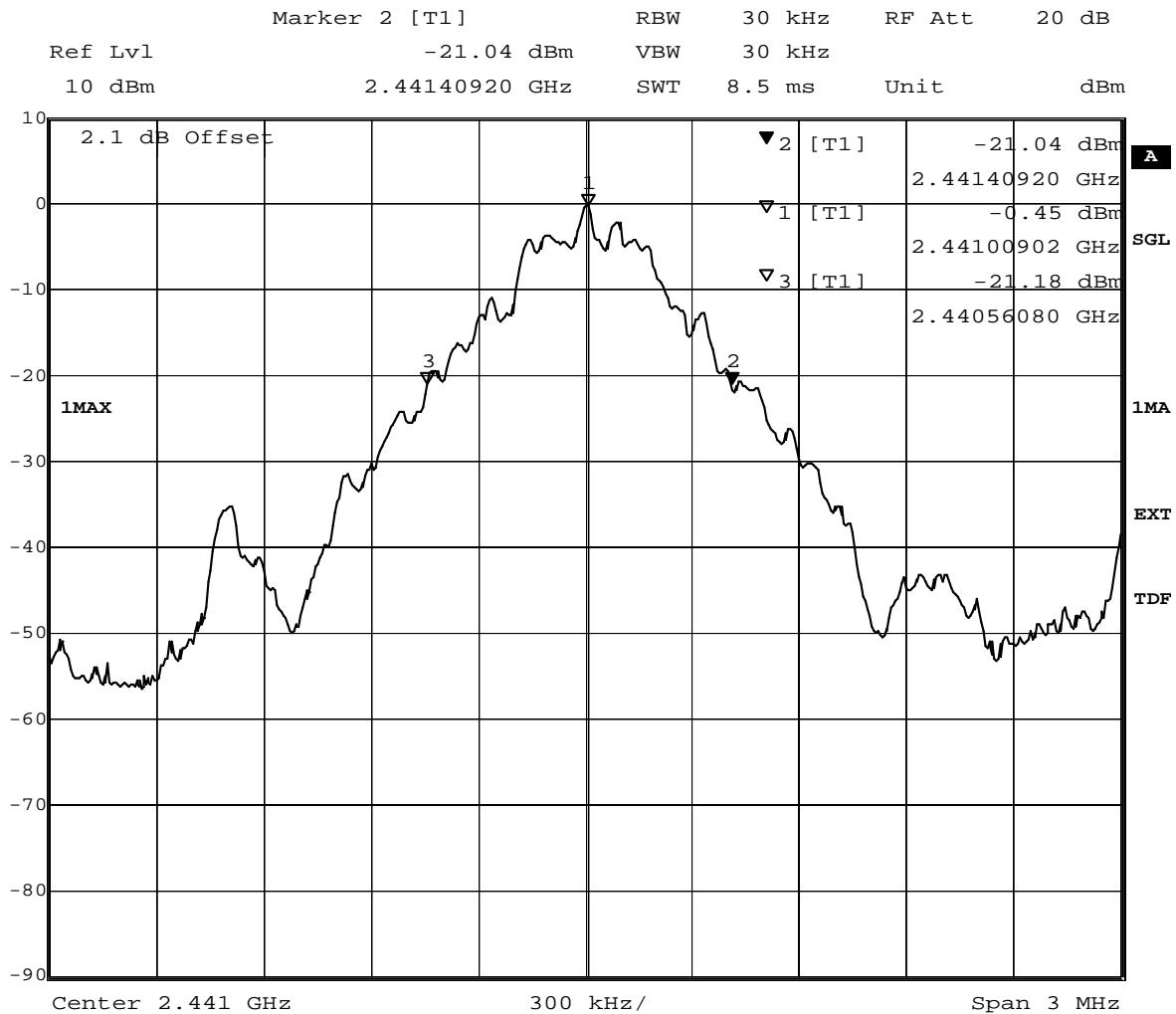
op-mode 1



## 7.2.2 Occupied bandwidth operating mode 2

### Op. Mode

op-mode 2



Title: 20dB Bandwidth

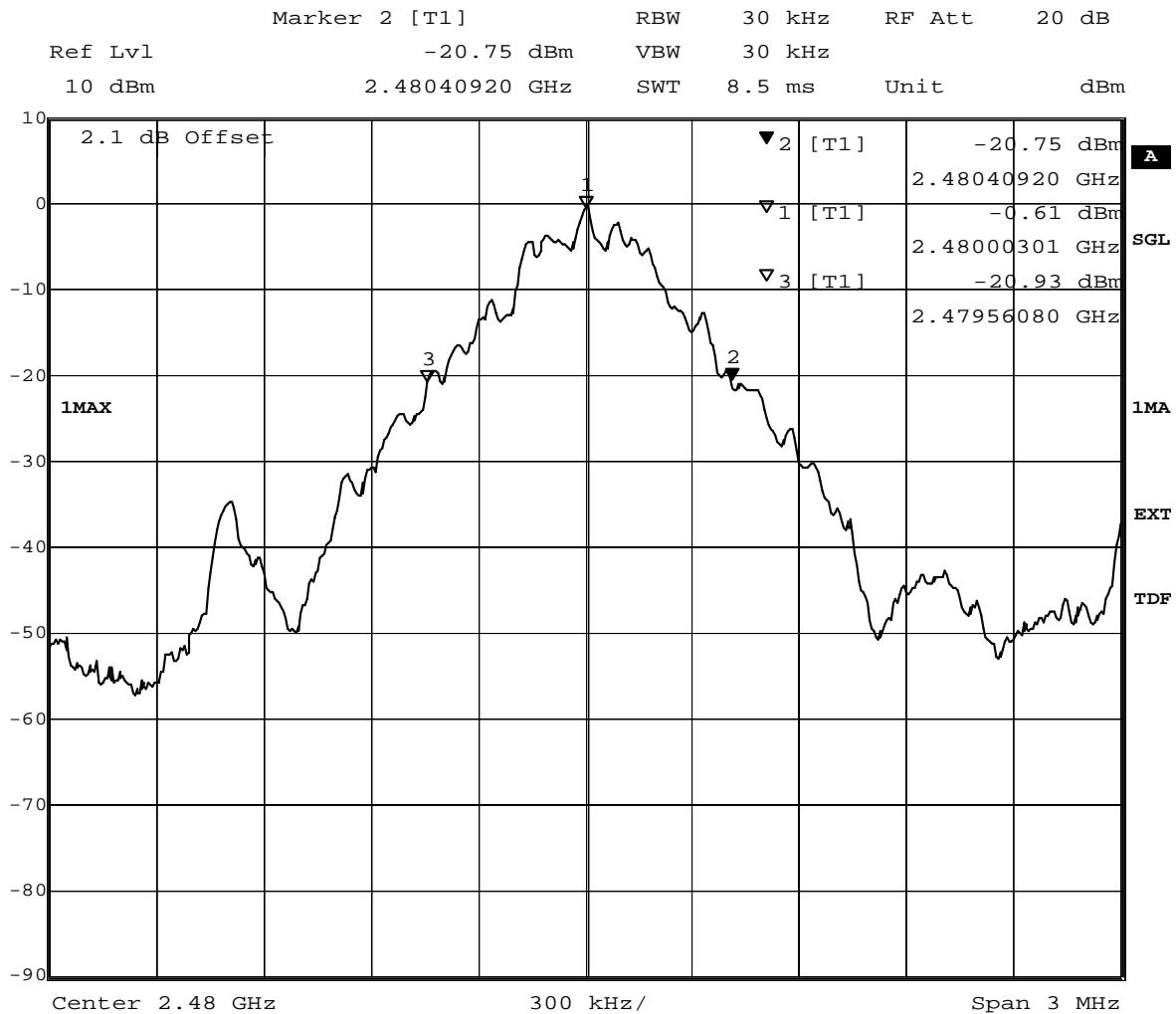
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):848.4

Date: 12.JUL.2010 13:11:07

### 7.2.3 Occupied bandwidth operating mode 3

#### Op. Mode

op-mode 3



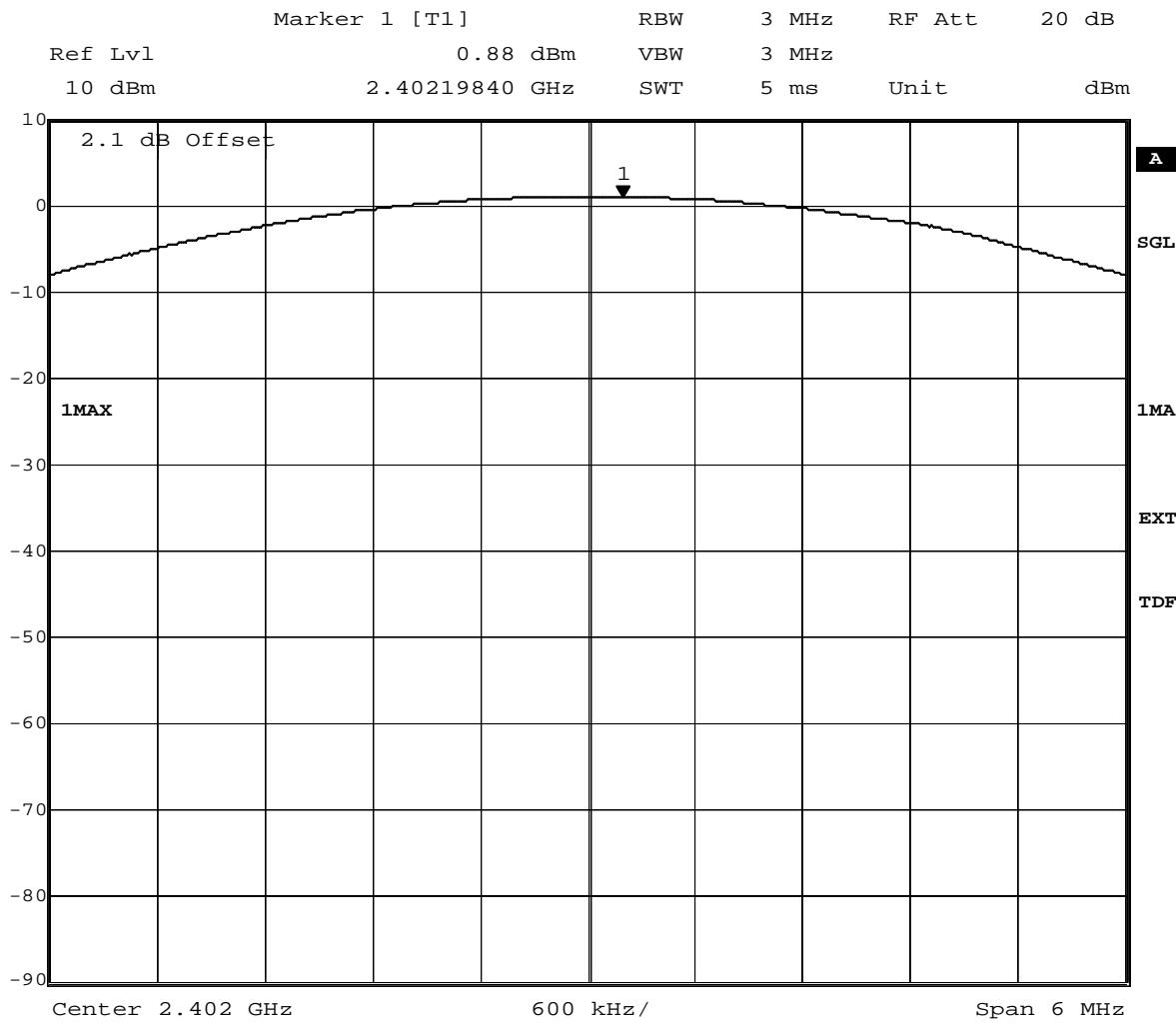
Title: 20dB Bandwidth  
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):848.4  
 Date: 12.JUL.2010 13:35:30

## 7.3 Peak power output

### 7.3.1 Peak power output operating mode 1

#### Op. Mode

op-mode 1

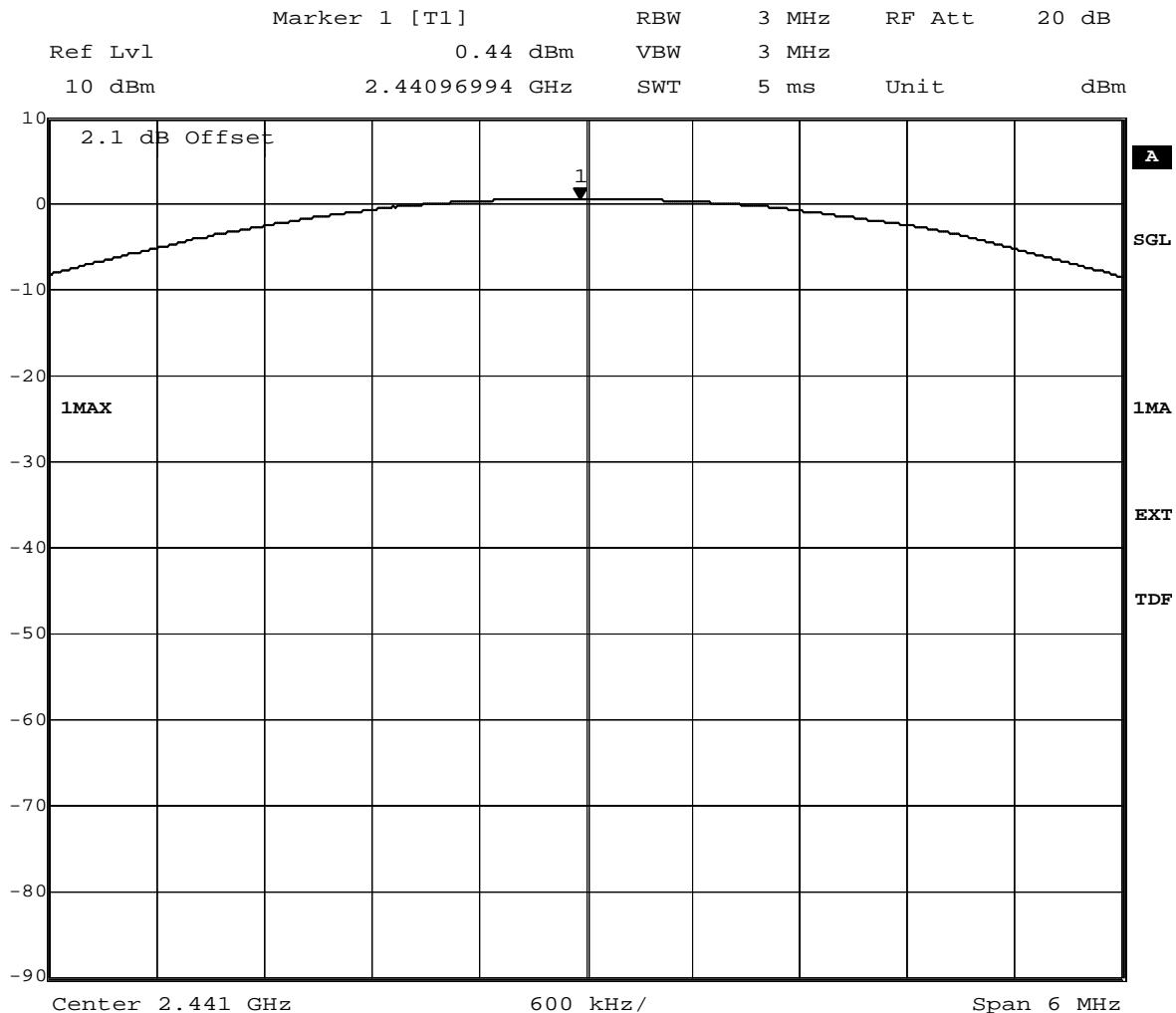


Title: Peak outputpower Power  
 Comment A: CH B: 2402 MHz  
 Date: 12.JUL.2010 12:47:32

### 7.3.2 Peak power output operating mode 2

#### Op. Mode

op-mode 2

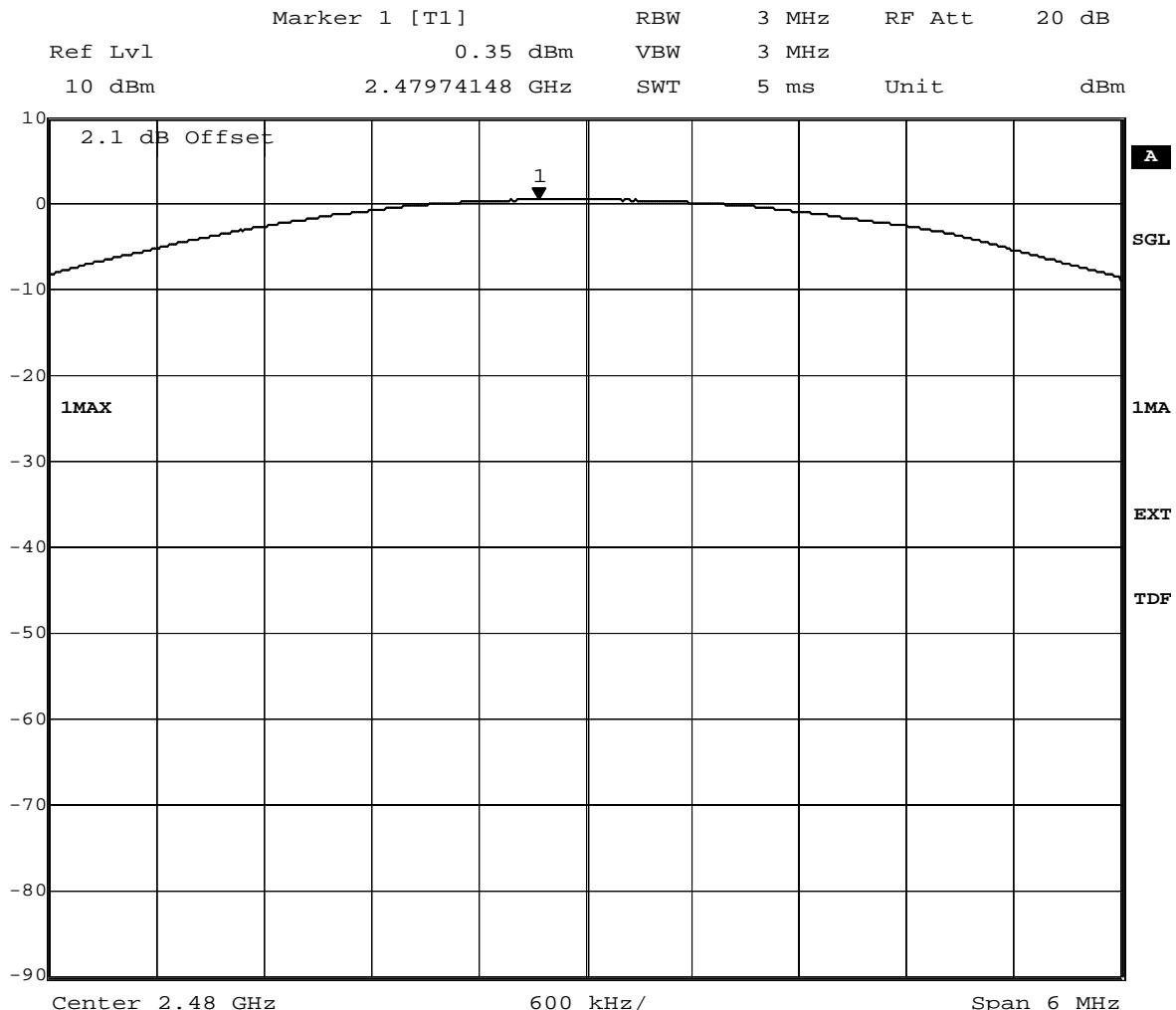


Title: Peak outputpower Power  
 Comment A: CH M: 2441 MHz  
 Date: 12.JUL.2010 13:11:34

### 7.3.3 Peak power output operating mode 3

#### Op. Mode

op-mode 3



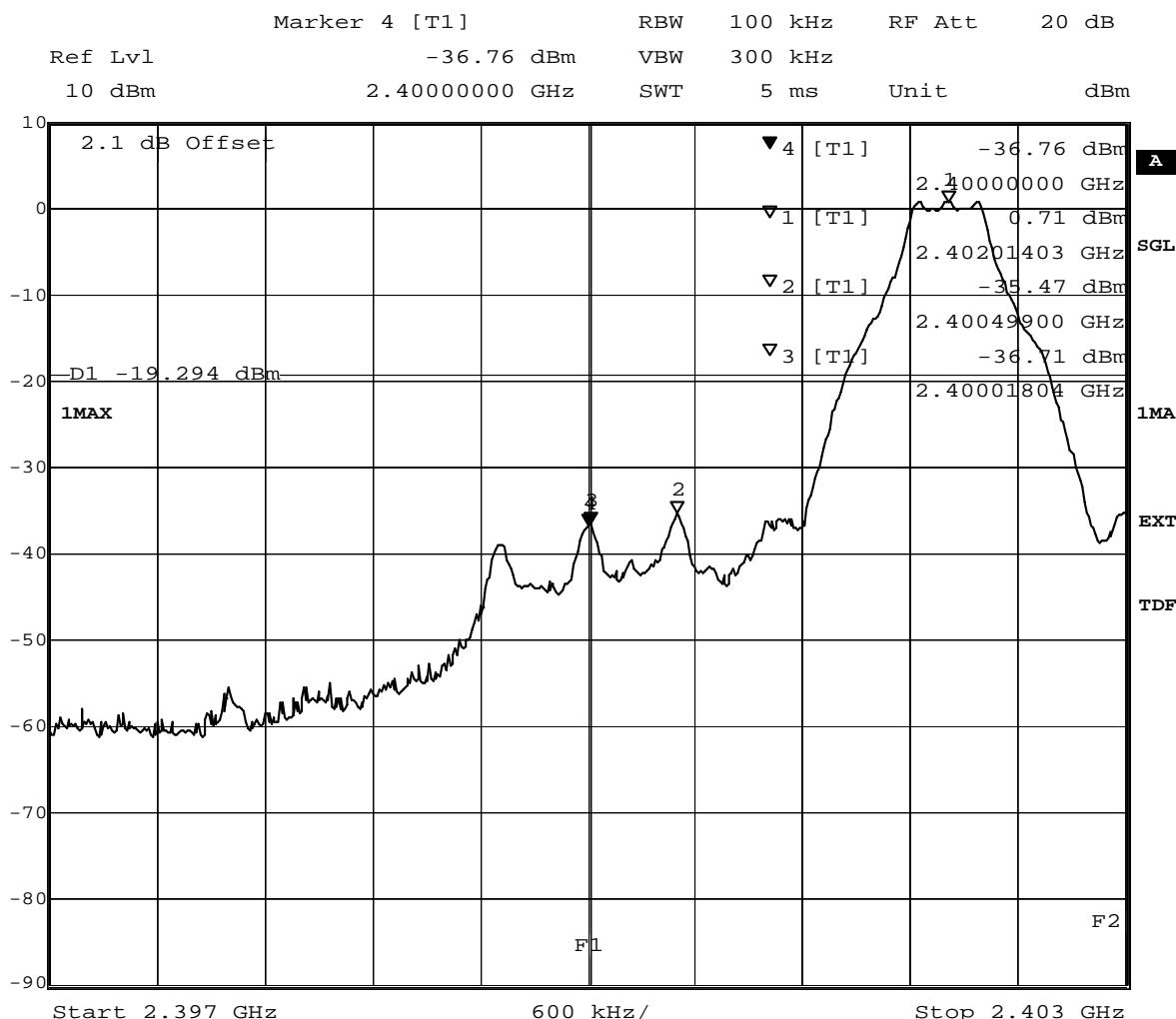
Title: Peak output power Power  
 Comment A: CH T: 2480 MHz  
 Date: 12.JUL.2010 13:35:57

## 7.4 Band edge compliance conducted and Spurious RF conducted emissions

### 7.4.1 Band edge compliance conducted operating mode 1

#### Op. Mode

op-mode 1



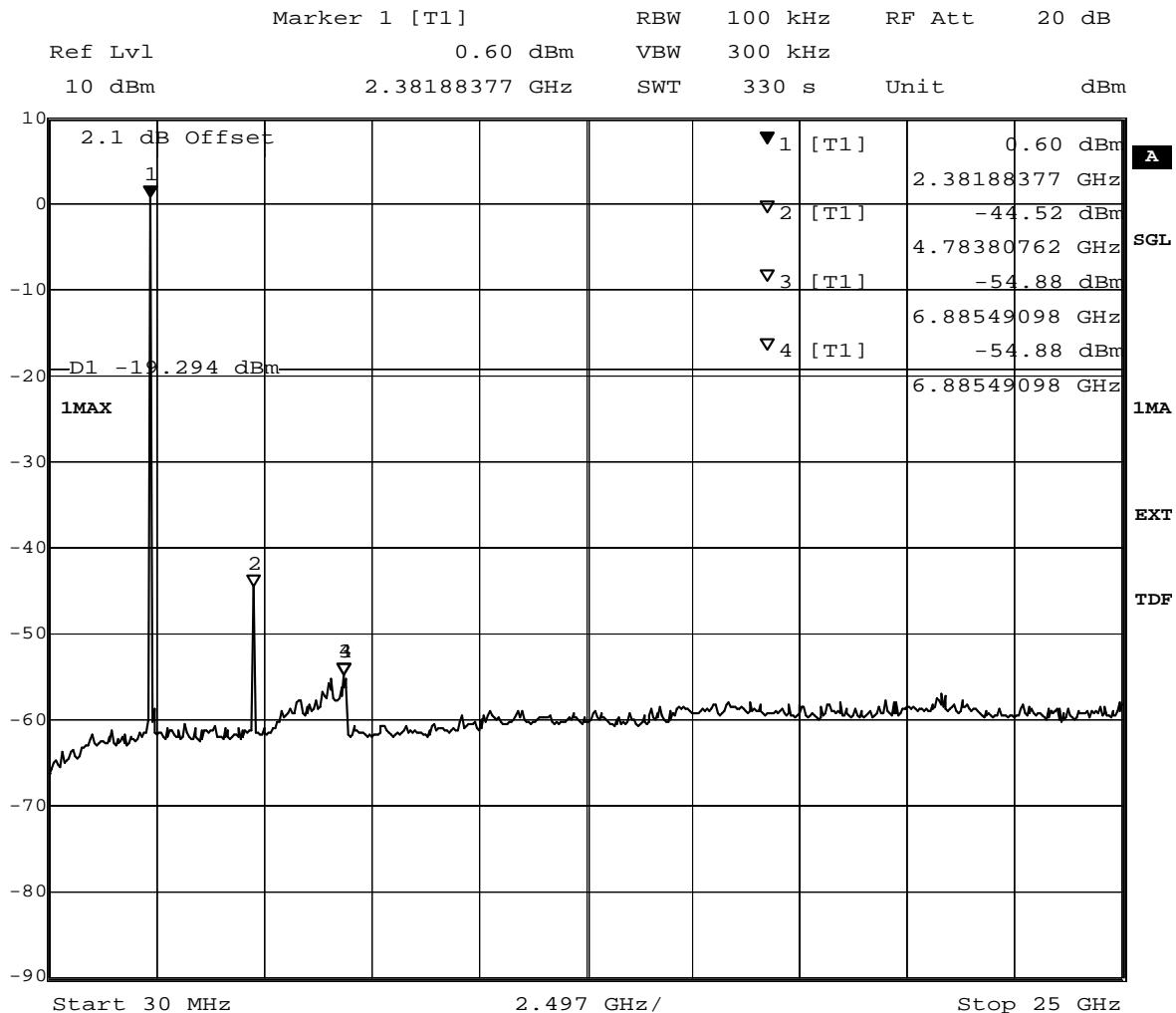
Title: Band Edge Compliance  
 Comment A: CH B: 2402 MHz  
 Date: 12.JUL.2010 12:31:59

(determination of reference value for spurious emissions measurement)

### 7.4.2 Spurious RF conducted emissions operating mode 1

#### Op. Mode

op-mode 1



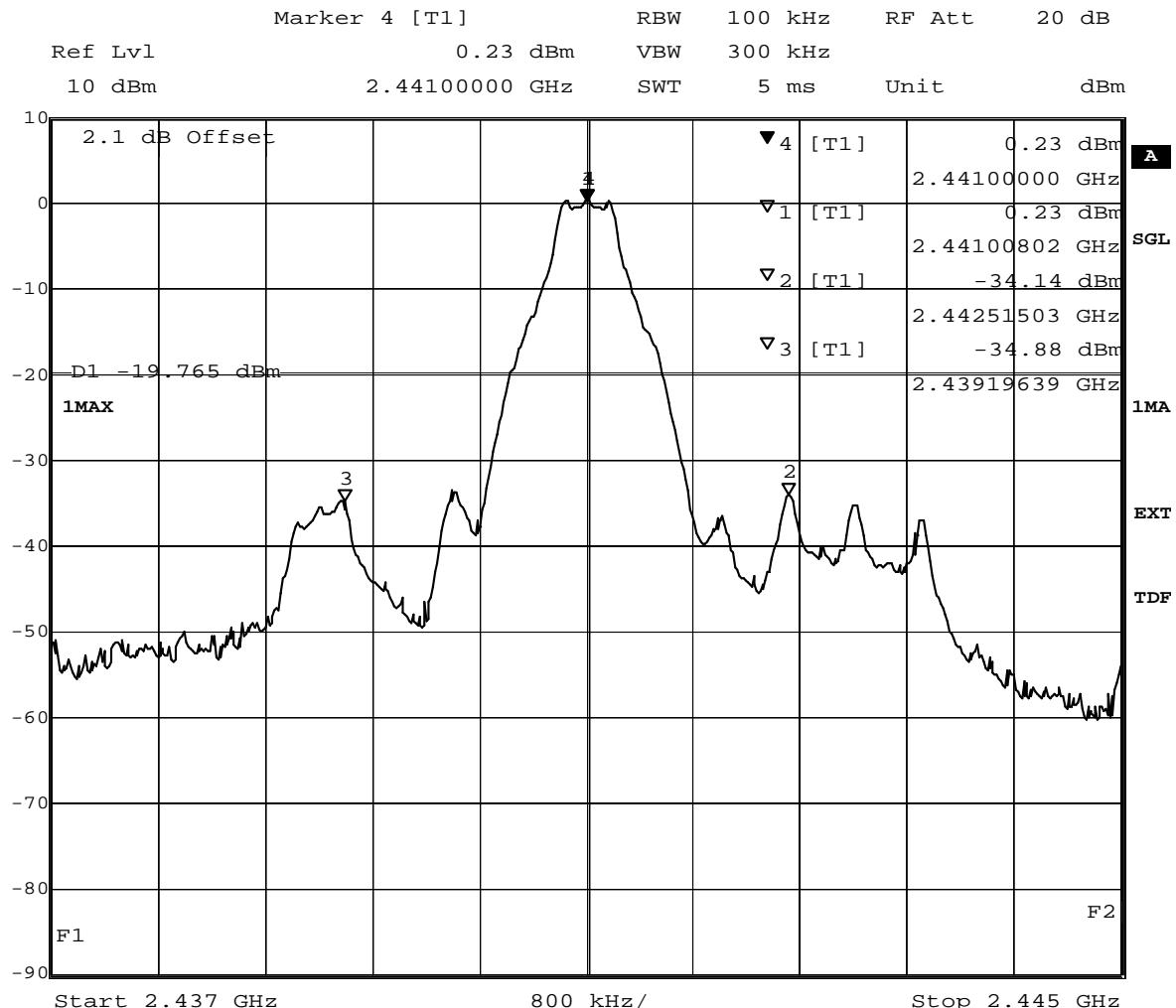
Title: spurious emissions  
 Comment A: CH B: 2402 MHz  
 Date: 12.JUL.2010 12:43:38

(spurious emissions measurement)

### 7.4.3 Spurious RF conducted emissions operating mode 2

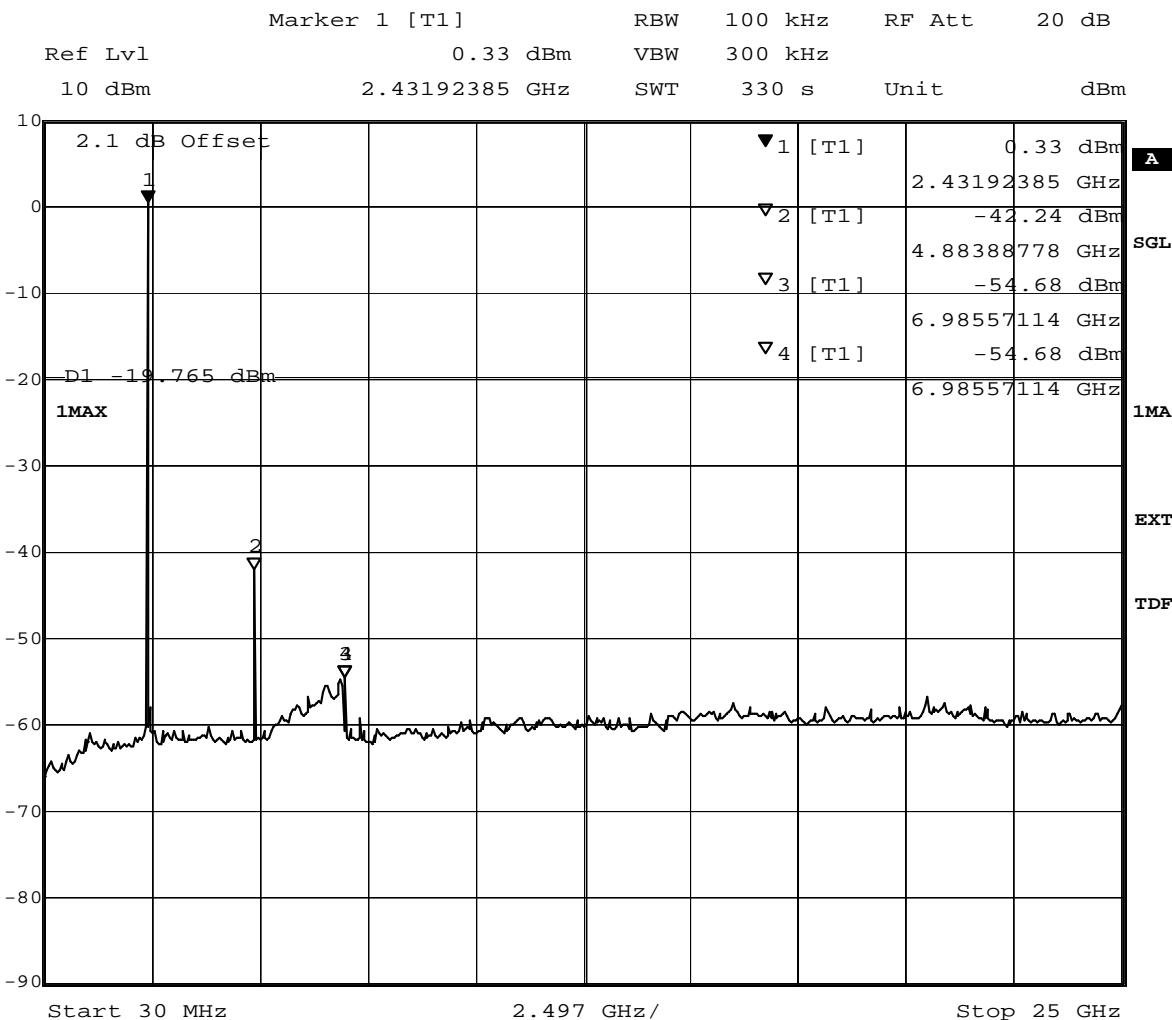
## **Op. Mode**

op-mode 2



Title: Band Edge Compliance  
Comment A: CH M: 2441 MHz  
Date: 12.JUL.2010 12:56:08

(determination of reference value for spurious emissions measurement)



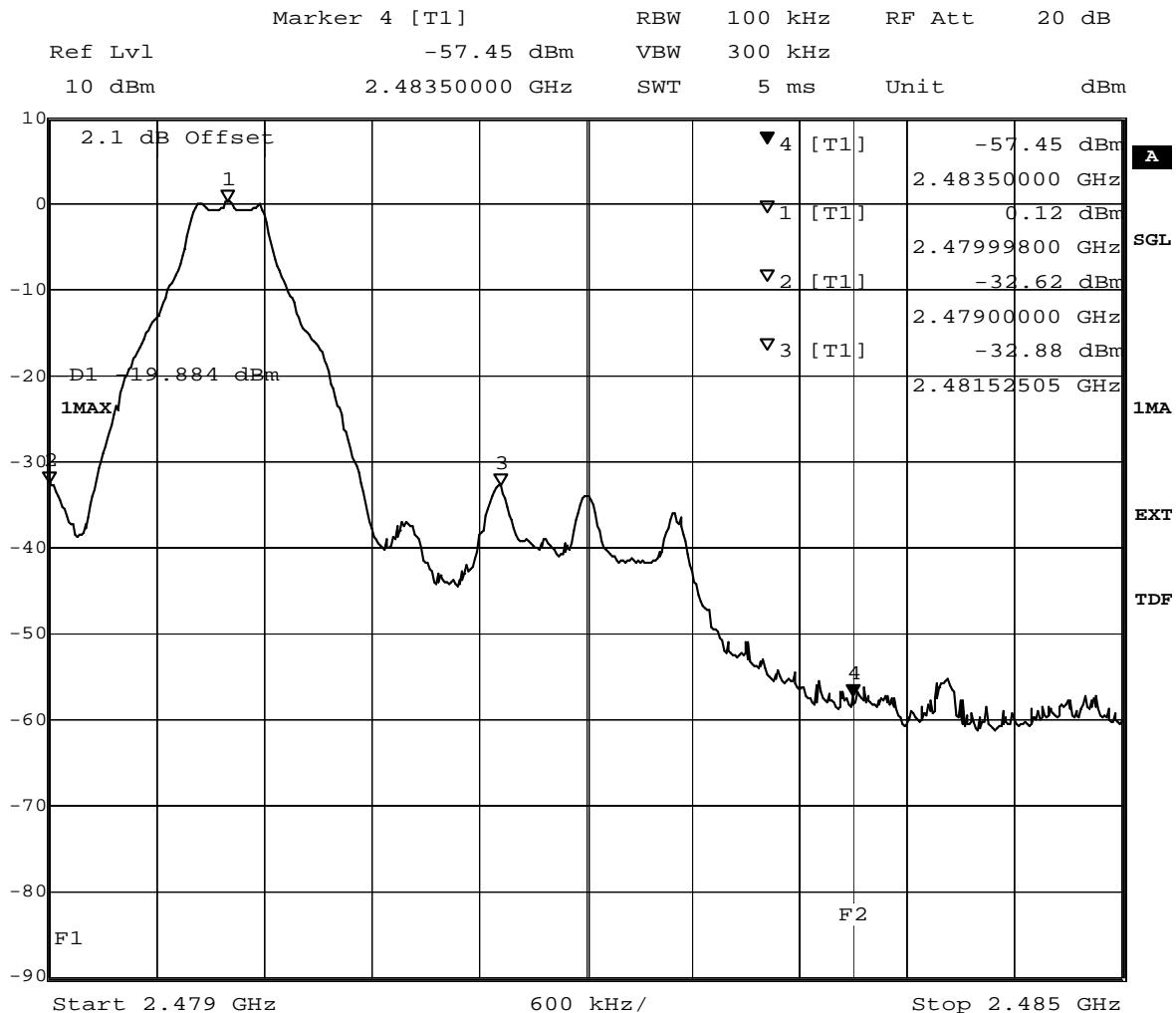
Title: spurious emissions  
 Comment A: CH M: 2441 MHz  
 Date: 12.JUL.2010 13:07:47

(spurious emissions measurement)

#### 7.4.4 Band edge compliance conducted operating mode 3

##### Op. Mode

op-mode 3



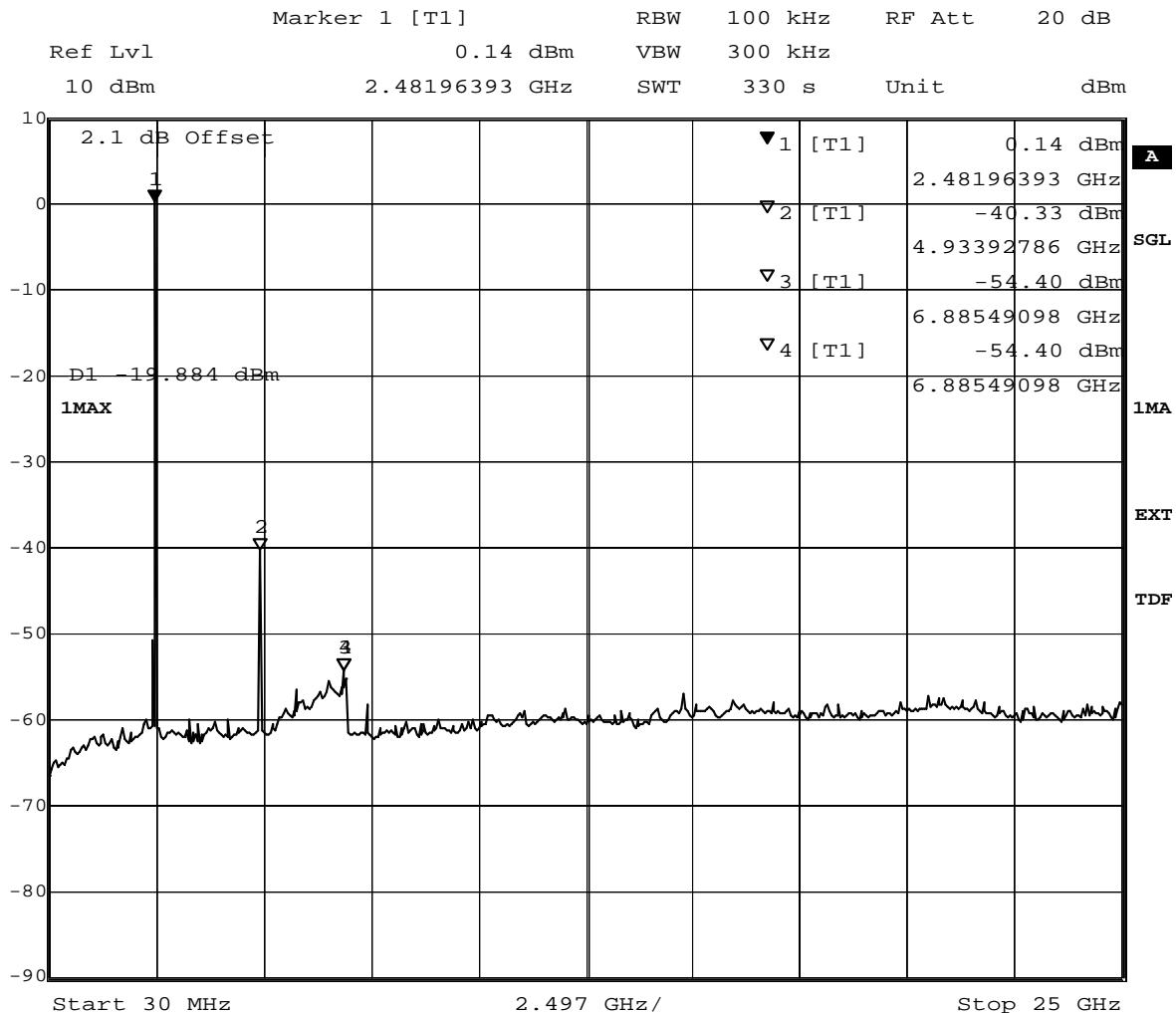
Title: Band Edge Compliance  
 Comment A: CH T: 2480 MHz  
 Date: 12.JUL.2010 13:20:26

(determination of reference value for spurious emissions measurement)

#### 7.4.5 Spurious RF conducted emissions operating mode 3

##### Op. Mode

op-mode 3



Title: spurious emissions  
 Comment A: CH T: 2480 MHz  
 Date: 12.JUL.2010 13:32:05

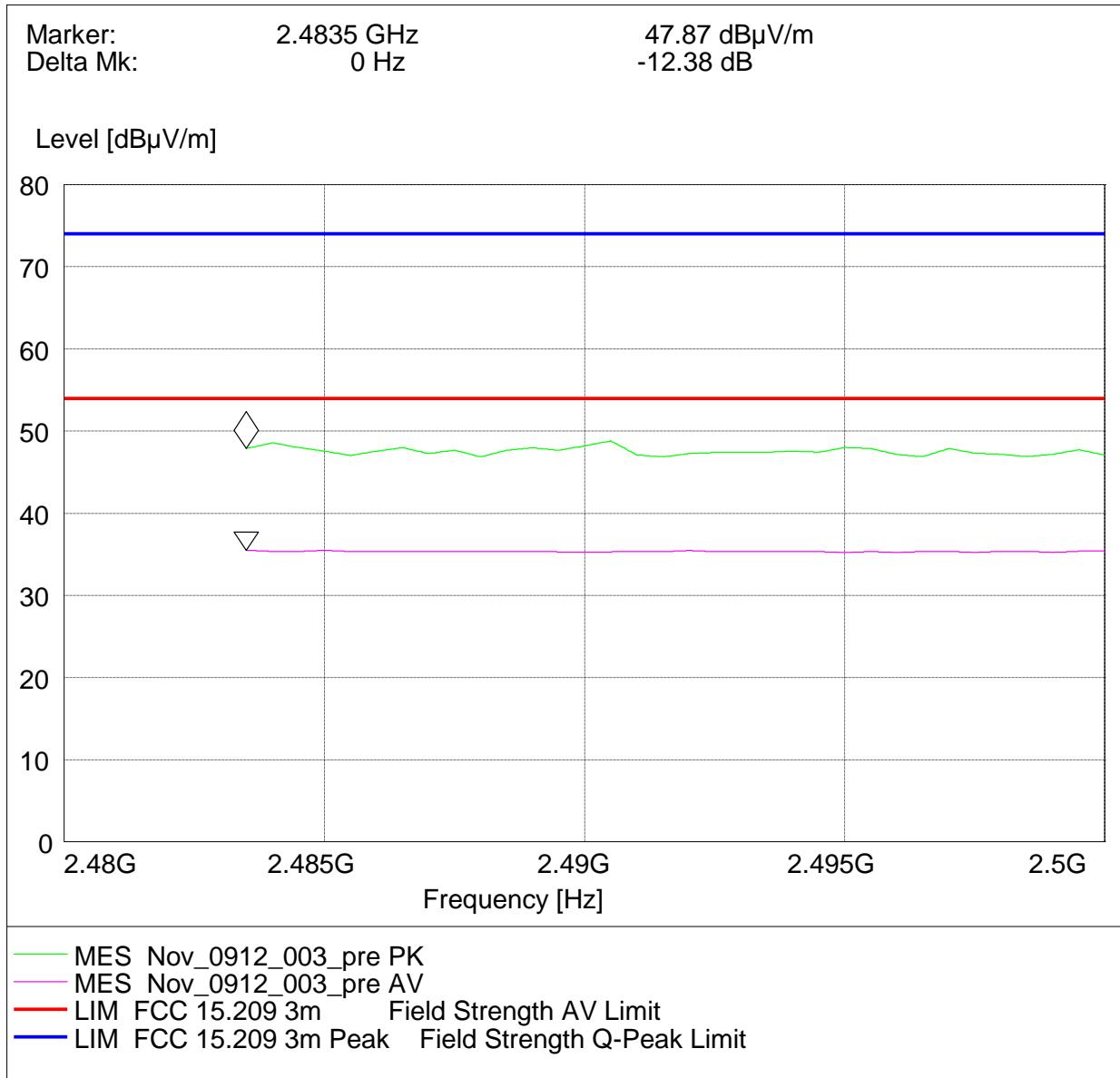
(spurious emissions measurement)

## 7.5 Band edge compliance radiated

### 7.5.1 Band edge compliance radiated operating mode 3

#### Op. Mode

op-mode 3

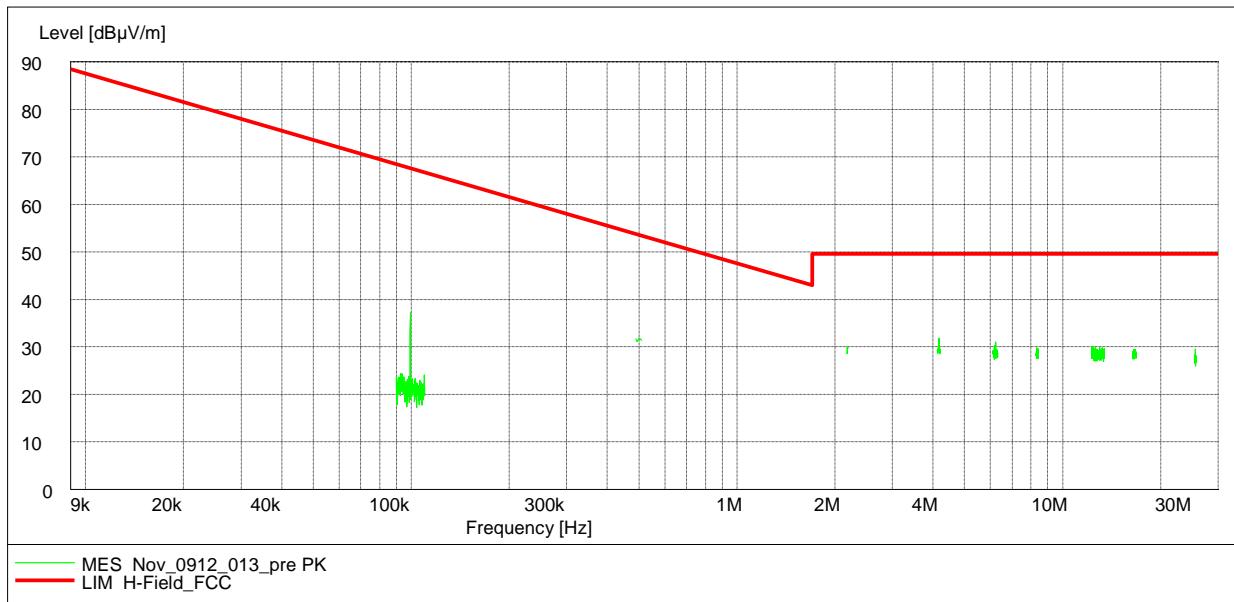


Radiated measurement (higher band edge)

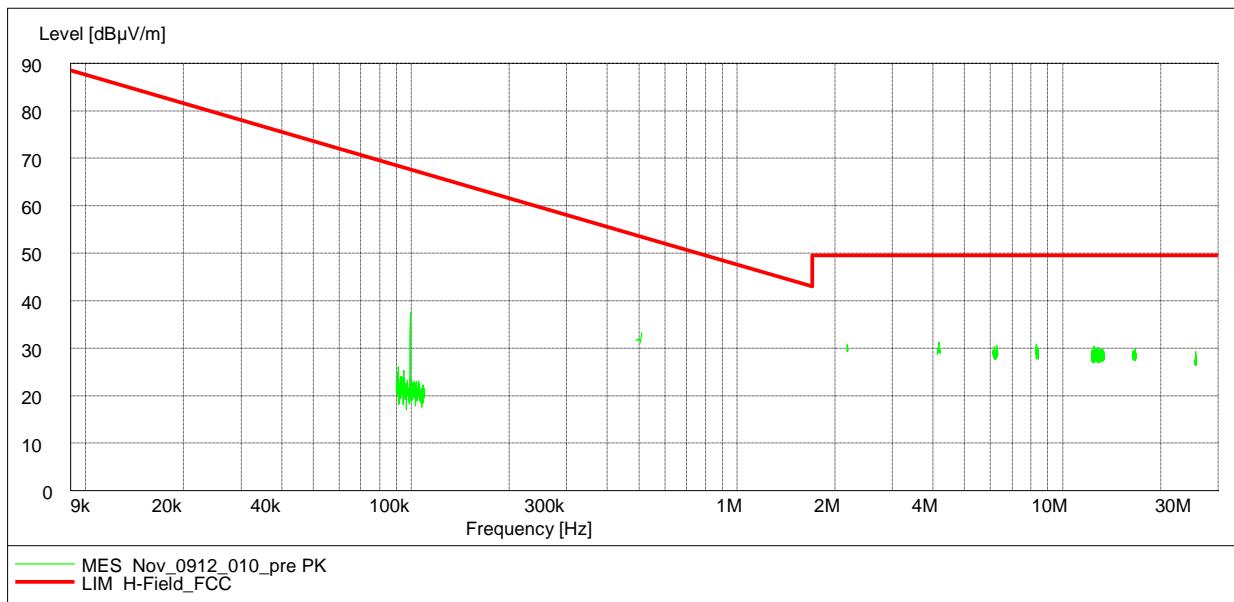
## 7.6 Radiated emissions (f < 30 MHz)

### Op. Mode

op-mode 1



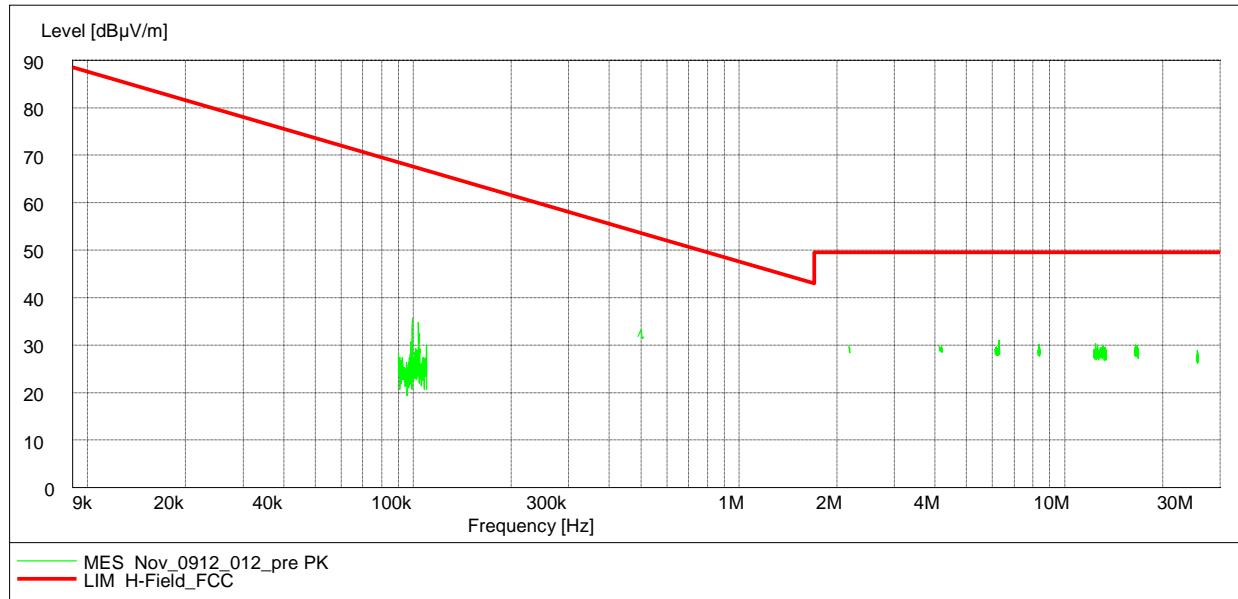
Antenna position 90°  
EUT position top side



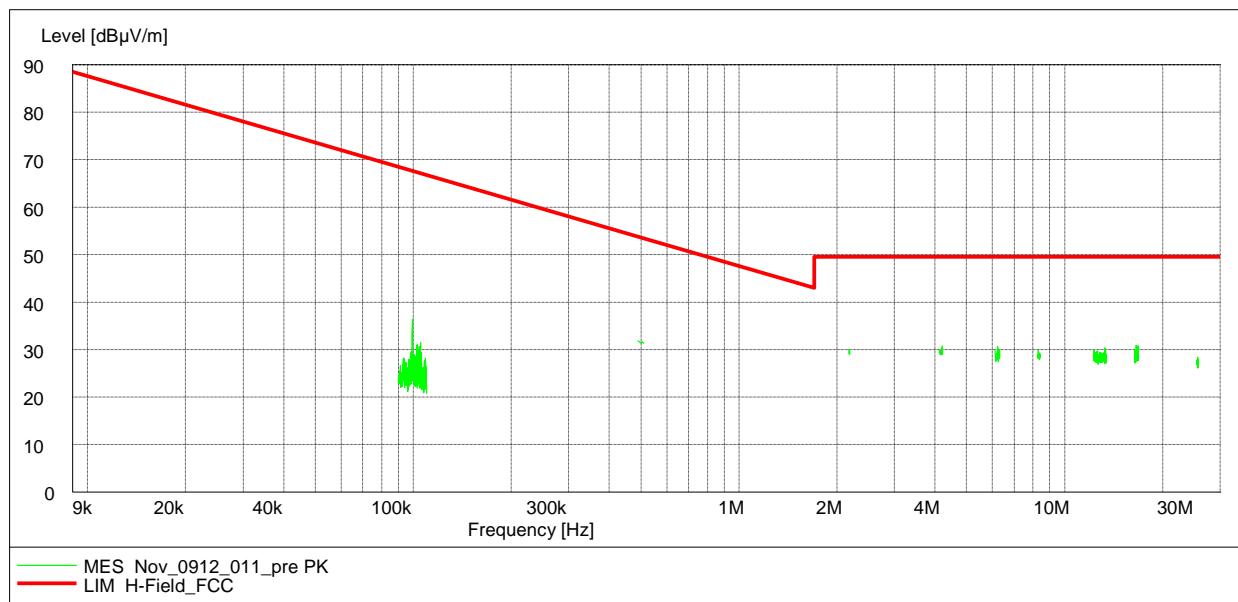
Antenna position 90°  
EUT position left side

## Op. Mode

### op-mode 1



Antenna position 0°  
EUT position top side

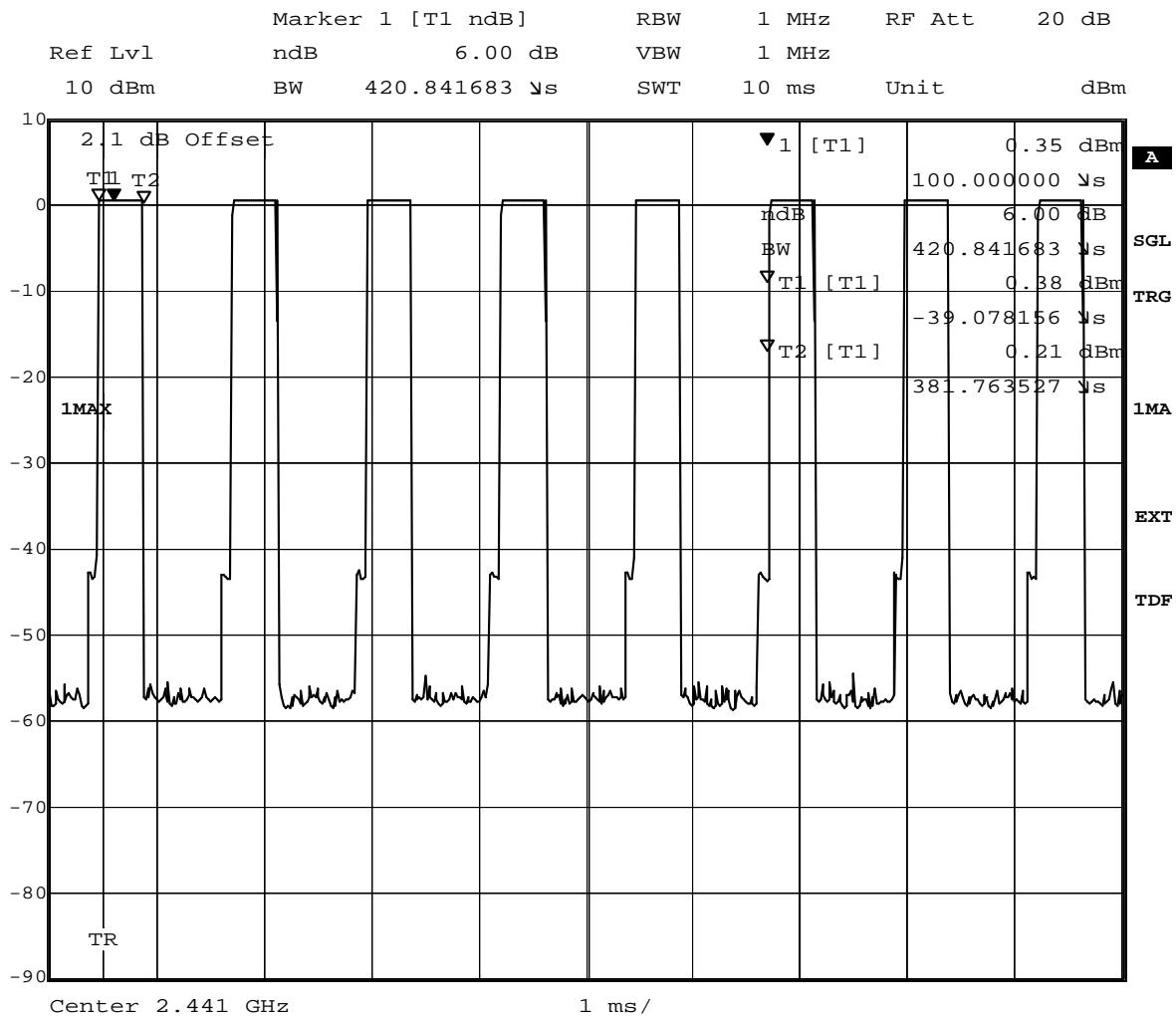


Antenna position 0°  
EUT position left side

## 7.7 Dwell time

### Op. Mode

op-mode 2 Time slot measurement of a DH1 packet

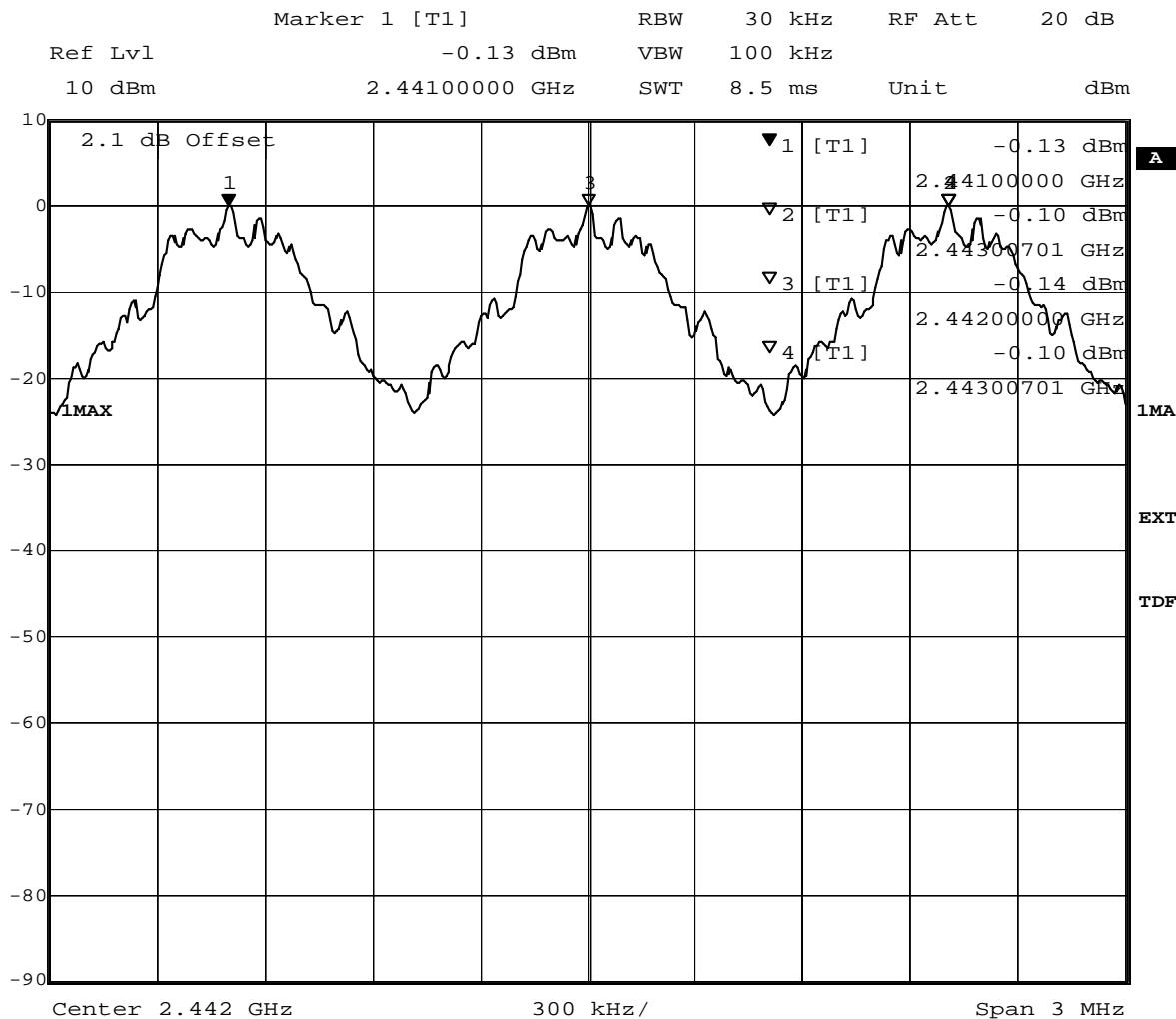


Title: Dwell time  
 Comment A: CH M: 2441 MHz  
 Date: 12.JUL.2010 13:42:24

## 7.8 Channel separation

### Op. Mode

op-mode 4

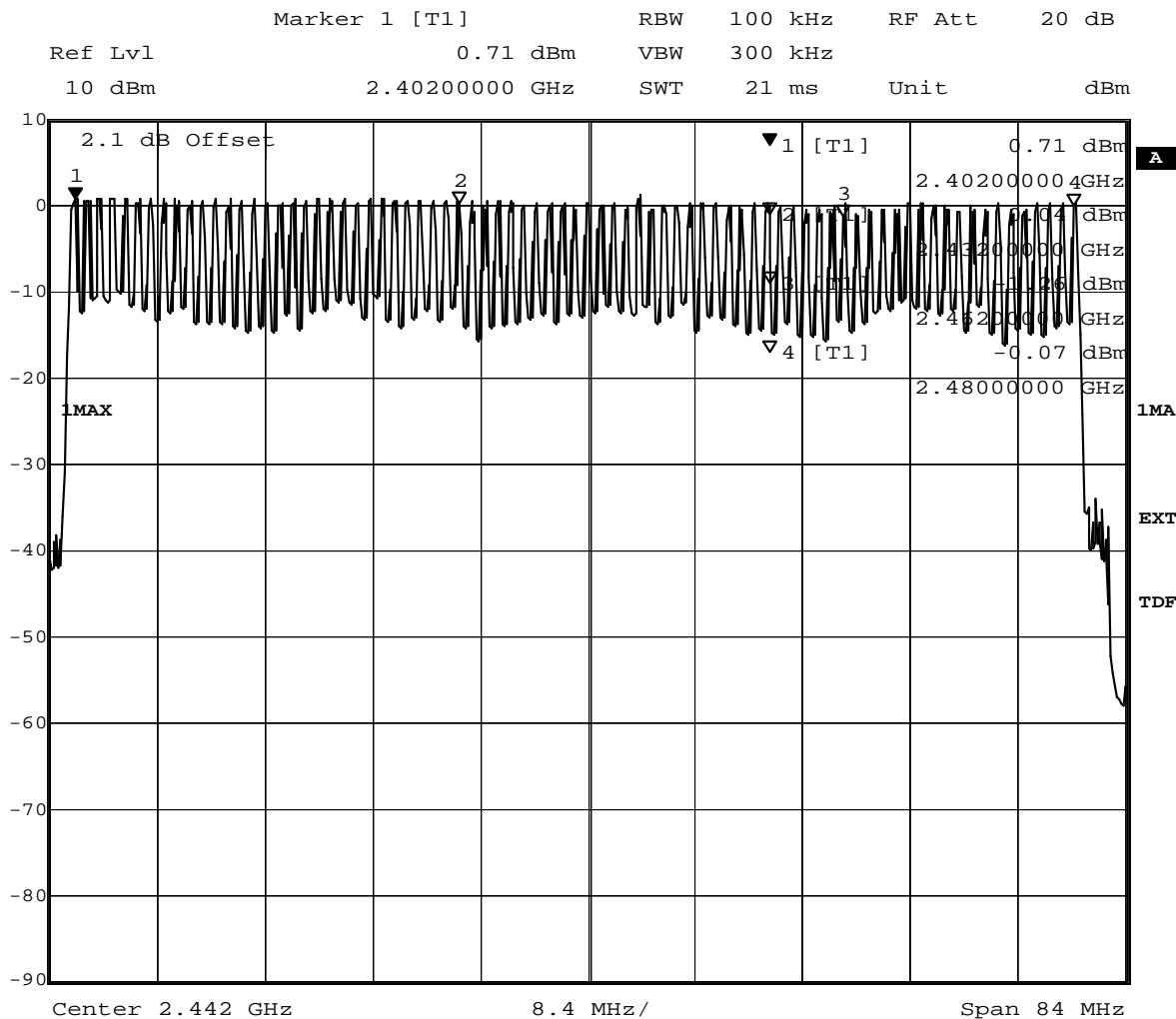


Title: Number of hopping frequencies  
 Comment A: CH H: Hopping  
 Date: 12.JUL.2010 13:46:24

## 7.9 Number of hopping frequencies

### Op. Mode

op-mode 4



Title: Number of hopping frequencies

Comment A: CH H: Hopping

Date: 12.JUL.2010 13:49:03