



Inter**Lab**<sup>®</sup>

FCC Measurement/Technical Report on

Bluetooth transceiver

Insulin pump, ACCU-CHEK Spirit Combo

**Report Reference:** MDE\_DISET\_0901\_FCCa

**Test Laboratory:**

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**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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## Table of Contents

|          |                                                                    |           |
|----------|--------------------------------------------------------------------|-----------|
| <b>0</b> | <b>Summary</b>                                                     | <b>3</b>  |
| 0.1      | Technical Report Summary                                           | 3         |
| 0.2      | Measurement Summary                                                | 4         |
| <b>1</b> | <b>Administrative Data</b>                                         | <b>7</b>  |
| 1.1      | Testing Laboratory                                                 | 7         |
| 1.2      | Project Data                                                       | 7         |
| 1.3      | Applicant Data                                                     | 7         |
| 1.4      | Manufacturer Data                                                  | 7         |
| <b>2</b> | <b>Test object Data</b>                                            | <b>8</b>  |
| 2.1      | General EUT Description                                            | 8         |
| 2.2      | EUT Main components                                                | 9         |
| 2.3      | Ancillary Equipment                                                | 9         |
| 2.4      | EUT Setups                                                         | 10        |
| 2.5      | Operating Modes                                                    | 10        |
| 2.6      | Product labelling                                                  | 10        |
| <b>3</b> | <b>Test Results</b>                                                | <b>11</b> |
| 3.1      | Occupied bandwidth                                                 | 11        |
| 3.2      | Peak power output                                                  | 14        |
| 3.3      | Spurious RF conducted emissions                                    | 17        |
| 3.4      | Spurious radiated emissions                                        | 20        |
| 3.5      | Band edge compliance                                               | 26        |
| 3.6      | Dwell time                                                         | 30        |
| 3.7      | Channel separation                                                 | 32        |
| 3.8      | Number of hopping frequencies                                      | 34        |
| <b>4</b> | <b>Test Equipment</b>                                              | <b>35</b> |
| <b>5</b> | <b>Photo Report</b>                                                | <b>38</b> |
| <b>6</b> | <b>Setup Drawings</b>                                              | <b>41</b> |
| <b>7</b> | <b>Annex measurement plots</b>                                     | <b>42</b> |
| 7.1      | Occupied bandwidth                                                 | 42        |
| 7.2      | Peak power output                                                  | 51        |
| 7.3      | Band edge compliance conducted and Spurious RF conducted emissions | 60        |
| 7.4      | Band edge compliance radiated                                      | 78        |
| 7.5      | Radiated emissions ( $f < 30$ MHz)                                 | 81        |
| 7.6      | Dwell time                                                         | 83        |
| 7.7      | Channel separation                                                 | 84        |
| 7.8      | Number of hopping frequencies                                      | 85        |



## **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 (10-1-08 Edition) and 15 (10-1-08 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

| FCC Part 15, Subpart C                                 |           | § 15.207             |              |
|--------------------------------------------------------|-----------|----------------------|--------------|
| Conducted emissions (AC power line)                    |           |                      |              |
| The measurement was performed according to ANSI C63.4  |           |                      | 2003         |
| OP-Mode                                                | Setup     | Port                 | Final Result |
| op-mode 5                                              | Setup_a01 | AC Port (power line) | N/A          |
| FCC Part 15, Subpart C                                 |           | § 15.247 (a) (1)     |              |
| Occupied bandwidth                                     |           |                      |              |
| The measurement was performed according to FCC § 15.31 |           |                      | 10-1-08      |
| OP-Mode                                                | Setup     | Port                 | Final Result |
| 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       |
| op-mode 6                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 7                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 8                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 10                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 11                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 12                                             | Setup_b01 | Temp ant.connector   | passed       |
| FCC Part 15, Subpart C                                 |           | § 15.247 (b) (1)     |              |
| Peak power output                                      |           |                      |              |
| The measurement was performed according to FCC § 15.31 |           |                      | 10-1-08      |
| OP-Mode                                                | Setup     | Port                 | Final Result |
| 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       |
| op-mode 6                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 7                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 8                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 10                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 11                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 12                                             | Setup_b01 | Temp ant.connector   | passed       |
| FCC Part 15, Subpart C                                 |           | § 15.247 (d)         |              |
| Spurious RF conducted emissions                        |           |                      |              |
| The measurement was performed according to FCC § 15.31 |           |                      | 10-1-08      |
| OP-Mode                                                | Setup     | Port                 | Final Result |
| 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       |
| op-mode 6                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 7                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 8                                              | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 10                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 11                                             | Setup_b01 | Temp ant.connector   | passed       |
| op-mode 12                                             | Setup_b01 | Temp ant.connector   | passed       |

**FCC Part 15, Subpart C****§ 15.247 (d), § 15.35 (b), § 15.209**

Spurious radiated emissions

The measurement was performed according to ANSI C63.4

2003

| OP-Mode    | Setup     | Port      | Final Result |
|------------|-----------|-----------|--------------|
| op-mode 1  | Setup_a01 | Enclosure | passed       |
| op-mode 2  | Setup_a01 | Enclosure | passed       |
| op-mode 3  | Setup_a01 | Enclosure | passed       |
| op-mode 6  | Setup_a01 | Enclosure | passed       |
| op-mode 7  | Setup_a01 | Enclosure | passed       |
| op-mode 8  | Setup_a01 | Enclosure | passed       |
| op-mode 10 | Setup_a01 | Enclosure | passed       |
| op-mode 11 | Setup_a01 | Enclosure | passed       |
| op-mode 12 | Setup_a01 | Enclosure | passed       |

**FCC Part 15, Subpart C****§ 15.247 (d)**

Band edge compliance

The measurement was performed according to FCC § 15.31  
(10-1-08) / ANSI C63.4 (2003)

10-1-08 / 2003

| OP-Mode    | Setup     | Port               | Final Result |
|------------|-----------|--------------------|--------------|
| 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       |
| op-mode 6  | Setup_b01 | Temp ant.connector | passed       |
| op-mode 8  | Setup_b01 | Temp ant.connector | passed       |
| op-mode 8  | Setup_a01 | Enclosure          | passed       |
| op-mode 10 | Setup_b01 | Temp ant.connector | passed       |
| op-mode 12 | Setup_b01 | Temp ant.connector | passed       |
| op-mode 12 | Setup_a01 | Enclosure          | passed       |

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

Dwell time

The measurement was performed according to FCC § 15.31

10-1-08

**OP-Mode**
**Setup**
**Port**
**Final Result**

op-mode 2

Setup\_b01

Temp ant.connector

passed

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

Channel separation

The measurement was performed according to FCC § 15.31

10-1-08

**OP-Mode**
**Setup**
**Port**
**Final Result**

op-mode 4

Setup\_b01

Temp ant.connector

passed

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

Number of hopping frequencies

The measurement was performed according to FCC § 15.31

10-1-08

**OP-Mode**
**Setup**
**Port**
**Final Result**

op-mode 4

Setup\_b01

Temp ant.connector

passed

N/A not applicable (the EUT is powered by DC)



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Responsible for  
Accreditation Scope:



Responsible  
for Test Report:





## **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. DAT-P-192/99-01

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

Report Template Version: 2009-01-27

### **1.2 Project Data**

Responsible for testing and report: Dipl.-Ing. Robert Machulec

Date of Test(s): 2009-07-09 to 2009-07-21  
Date of Report: 2009-07-24

### **1.3 Applicant Data**

Company Name: Disetronic Medical Systems AG

Address: Kirchbergstr. 190  
3401 Burgdorf  
Switzerland

Contact Person: Mr. Markus Jungen

### **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 transceiver      |
| <b>Type Designation:</b>                    | ACCU-CHEK Spirit Combo     |
| <b>Kind of Device:</b><br><b>(optional)</b> | Insulin pump               |
| <b>Voltage Type:</b>                        | DC (internal battery)      |
| <b>Voltage level:</b>                       | 1.5V                       |
| <b>Modulation Type:</b>                     | GFSK, 8DPSK, $\pi/4$ DQPSK |

#### 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, 1.875 ms for DH3 and 3.125 ms for DH5. The nominal hop rate is 1600 hops/s for DH1, 1600/3 for DH3 and 1600/5 for DH5. 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 and the enhanced data rate uses PSK modulation. For the enhanced data rate of 3 Mbps 8DPSK modulation and of 2 Mbps  $\pi/4$  DQPSK modulation is used.

#### The EUT provides the following ports:

##### Ports

Temp antenna connector  
Enclosure

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<br>(Code: 4O001h06)                                          | Bluetooth transceiver | ACCU-CHEK Spirit Combo | 02261620   | 0502725000<br>1 Spirit<br>Combo Rev.<br>F, CM | V1.03, BT<br>V1.01, CM<br>200041668 | 2009-06-29      |
| Remark: EUT A is equipped with an integral antenna (gain = 0 dBi). |                       |                        |            |                                               |                                     |                 |
| EUT B<br>(Code: 4O001e06)                                          | Bluetooth transceiver | ACCU-CHEK Spirit Combo | 10074502   | 0502725000<br>1 Spirit<br>Combo Rev.<br>F, CM | V1.03, BT<br>V1.01, CM<br>200041668 | 2009-06-29      |
| 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 |
|-------------------|----------------------|------------------|------------|-----------|-----------|--------|
|-------------------|----------------------|------------------|------------|-----------|-----------|--------|



## 2.4 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               | setup for radiated measurements  |
| Setup_b01 | EUT B               | setup for conducted measurements |

## 2.5 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 5  | Bluetooth "standby", EUT powered | BT scan mode                              |
| op-mode 6  | The EUT transmits on 2402 MHz    | Loopback mode, enhanced data rate 3 Mbps  |
| op-mode 7  | The EUT transmits on 2441 MHz    | Loopback mode, enhanced data rate 3 Mbps  |
| op-mode 8  | The EUT transmits on 2480 MHz    | Loopback mode, enhanced data rate 3 Mbps  |
| op-mode 10 | The EUT transmits on 2402 MHz    | Loopback mode, enhanced data rate, 2 Mbps |
| op-mode 11 | The EUT transmits on 2441 MHz    | Loopback mode, enhanced data rate, 2 Mbps |
| op-mode 12 | The EUT transmits on 2480 MHz    | Loopback mode, enhanced data rate, 2 Mbps |

## 2.6 Product labelling

### 2.6.1 FCC ID label

Please refer to the documentation of the applicant.

### 2.6.2 Location of the label on the EUT

Please refer to the documentation of the applicant.



## 3 Test Results

### 3.1 Occupied bandwidth

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### 3.1.1 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.

#### 3.1.2 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 systems operates with an output power no 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 systems 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.

### 3.1.3 Test Protocol

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

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

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 0.950                  | –       |

Remark: Please see annex for the measurement plot.

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

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 0.950                  | –       |

Remark: Please see annex for the measurement plot.

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

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 0.944                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 6 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.276                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 7 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.276                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 8 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.282                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 10 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.234                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 11 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.270                  | –       |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 12 | Setup_b01 | Temp ant.connector |

| 20 dB bandwidth<br>MHz | Remarks |
|------------------------|---------|
| 1.246                  | –       |

Remark: Please see annex for the measurement plot.

### 3.1.4 Test result: Occupied bandwidth

| FCC Part 15, Subpart C | Op. Mode   | Result |
|------------------------|------------|--------|
|                        | op-mode 1  | passed |
|                        | op-mode 2  | passed |
|                        | op-mode 3  | passed |
|                        | op-mode 6  | passed |
|                        | op-mode 7  | passed |
|                        | op-mode 8  | passed |
|                        | op-mode 10 | passed |
|                        | op-mode 11 | passed |
|                        | op-mode 12 | passed |



### **3.2 Peak power output**

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### **3.2.1 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.

#### **3.2.2 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:  $\text{Limit (dBm)} = 10 \log (\text{Limit (W)}/1\text{mW})$   
==> Maximum Output Power: 30 dBm

### 3.2.3 Test Protocol

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

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

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 6.29                | The EIRP including antenna gain (0 dBi) is 6.29 dBm |

Remark: Please see annex for the measurement plot.

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

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 6.62                | The EIRP including antenna gain (0 dBi) is 6.62 dBm |

Remark: Please see annex for the measurement plot.

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

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 6.39                | The EIRP including antenna gain (0 dBi) is 6.39 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 6 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 5.19                | The EIRP including antenna gain (0 dBi) is 5.19 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 7 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 5.20                | The EIRP including antenna gain (0 dBi) is 5.20 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 8 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 4.73                | The EIRP including antenna gain (0 dBi) is 4.73 dBm |

Remark: Please see annex for the measurement plot.



| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 10 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 5.05                | The EIRP including antenna gain (0 dBi) is 5.05 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 11 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 5.02                | The EIRP including antenna gain (0 dBi) is 5.02 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 12 | Setup_b01 | Temp.ant.connector |

| Output power<br>dBm | Remarks                                             |
|---------------------|-----------------------------------------------------|
| 4.54                | The EIRP including antenna gain (0 dBi) is 4.54 dBm |

Remark: Please see annex for the measurement plot.

### 3.2.4 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 |
|                        | op-mode 6  | passed |
|                        | op-mode 7  | passed |
|                        | op-mode 8  | passed |
|                        | op-mode 10 | passed |
|                        | op-mode 11 | passed |
|                        | op-mode 12 | passed |

### **3.3 Spurious RF conducted emissions**

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### **3.3.1 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 3.5). This value is used to calculate the 20 dBc limit.

#### **3.3.2 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.

### 3.3.3 Test Protocol

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

| 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 |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 6.39                | -13.61    | -                 |

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 |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 6.66                | -13.42    | -                 |

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 |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 6.50                | -13.50    | -                 |

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 6 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 4.45                | -15.55    | -                 |

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 7 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 4.04                | -15.96    | -                 |

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 8 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 3.59                | -16.41    | -                 |

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 10 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 4.38                | -15.62    | -                 |

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 11 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 3.95                | -16.05    | -                 |

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 12 | Setup_b01 | Temp ant.connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| -             | -                               | 3.71                | -16.29    | -                 |

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

### 3.3.4 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 |
|                        | op-mode 6  | passed |
|                        | op-mode 7  | passed |
|                        | op-mode 8  | passed |
|                        | op-mode 10 | passed |
|                        | op-mode 11 | passed |
|                        | op-mode 12 | passed |

### 3.4 Spurious radiated emissions

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

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

#### 3.4.1 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  $\mu$ s (BT Timing 1.25 ms)
- Turntable angle range:  $-180$  to  $180^\circ$
- Turntable step size:  $90^\circ$
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

**Step 2: second measurement**

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

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $-180$  to  $180^\circ$
- Turntable step size:  $45^\circ$
- 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):  $45^\circ$
- 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
- RBW = VBW = 100 kHz

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.

#### 3.4.2 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 (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:  $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit (}\mu\text{V/m)}/1\mu\text{V/m)}$

### 3.4.3 Test Protocol

Temperature: 27 °C  
Air Pressure: 1010 hPa  
Humidity: 37 %

#### 3.4.3.1 Measurement up to 30 MHz

| Op. Mode  | Setup     | Port      |
|-----------|-----------|-----------|
| op-mode 1 | Setup_a01 | Enclosure |

| Polarisation | Frequency MHz | Corrected value dBµV / m |      |    | Limit dBµV / m | Limit dBµV / m | Limit dBµV / 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.

#### 3.4.3.2 Measurement above 30 MHz

| Op. Mode  | Setup     | Port      |
|-----------|-----------|-----------|
| op-mode 1 | Setup_a01 | Enclosure |

| Polarisation          | Frequency MHz | Corrected value dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 1602          | -                        | 51.34 | 41.98 | -              | 74             | 54             | 22.66             | 12.02             |
| Vertical + horizontal | 4804          | -                        | 55.67 | 38.03 | -              | 74             | 54             | 18.33             | 15.97             |

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 dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 1627          | -                        | 48.28 | 35.75 | -              | 74             | 54             | 25.72             | 18.25             |
| Vertical + horizontal | 4882          | -                        | 56.36 | 33.11 | -              | 74             | 54             | 17.64             | 20.89             |
| Vertical + horizontal | 7323          | -                        | 48.82 | 35.46 | -              | 74             | 54             | 25.18             | 18.54             |

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 dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 1601          | -                        | 49.55 | 40.35 | -              | 74             | 54             | 24.45             | 13.65             |
| Vertical + horizontal | 2484          | -                        | 54.62 | 39.93 | -              | 74             | 54             | 19.38             | 14.07             |
| Vertical + horizontal | 4960          | -                        | 57.50 | 39.92 | -              | 74             | 54             | 16.50             | 14.08             |
| Vertical + horizontal | 7440          | -                        | 33.37 | 46.78 | -              | 74             | 54             | 40.63             | 7.22              |

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

**Op. Mode**      **Setup**      **Port**  
op-mode 6      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 1602          | -                        | 52.24 | 42.67 | -              | 74             | 54             | 21.76             | 11.33             |
| Vertical + horizontal | 4804          | -                        | 50.46 | 27.86 | -              | 74             | 54             | 23.54             | 26.14             |

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

The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

**Op. Mode**      **Setup**      **Port**  
op-mode 7      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 4882          | -                        | 50.26 | 29.12 | -              | 74             | 54             | 23.74             | 24.88             |

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

The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

**Op. Mode**      **Setup**      **Port**  
op-mode 8      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV / m |       |       | Limit dBµV / m | Limit dBµV / m | Limit dBµV / m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|--------------------------|-------|-------|----------------|----------------|----------------|-------------------|-------------------|
|                       |               | QP                       | Peak  | AV    | QP             | Peak           | AV             | QP / Peak         | AV                |
| Vertical + horizontal | 1601          | -                        | 50.04 | 40.65 | -              | 74             | 54             | 23.96             | 13.35             |
| Vertical + horizontal | 2484          | -                        | 54.88 | 39.42 | -              | 74             | 54             | 19.12             | 14.58             |
| Vertical + horizontal | 4960          | -                        | 51.17 | 31.90 | -              | 74             | 54             | 22.83             | 22.10             |

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

The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

**Op. Mode**      **Setup**      **Port**  
op-mode 10      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV/m |       |       | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
|                       |               | QP                     | Peak  | AV    | QP           | Peak         | AV           | QP/Peak           | AV                |
| Vertical + horizontal | 1602          | -                      | 51.72 | 42.63 | -            | 74           | 54           | 22.28             | 11.37             |
| Vertical + horizontal | 4804          | -                      | 50.09 | 27.97 | -            | 74           | 54           | 23.91             | 26.03             |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

**Op. Mode**      **Setup**      **Port**  
op-mode 11      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV/m |       |       | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
|                       |               | QP                     | Peak  | AV    | QP           | Peak         | AV           | QP/Peak           | AV                |
| Vertical + horizontal | 4882          | -                      | 48.77 | 29.92 | -            | 74           | 54           | 25.23             | 24.08             |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

**Op. Mode**      **Setup**      **Port**  
op-mode 12      Setup\_a01      Enclosure

| Polarisation          | Frequency MHz | Corrected value dBµV/m |       |       | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
|                       |               | QP                     | Peak  | AV    | QP           | Peak         | AV           | QP/Peak           | AV                |
| Vertical + horizontal | 1600          | -                      | 50.29 | 40.84 | -            | 74           | 54           | 23.71             | 13.16             |
| Vertical + horizontal | 2484          | -                      | 54.88 | 39.42 | -            | 74           | 54           | 19.12             | 14.58             |
| Vertical + horizontal | 4960          | -                      | 52.86 | 32.79 | -            | 74           | 54           | 21.14             | 21.21             |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.  
The measurement was performed from 1 GHz up to 8 GHz because no significant spurious emissions were found outside this range this frequency in op-mode 1, 2 and 3.

### 3.4.4 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 |
|                        |  | op-mode 6  | passed |
|                        |  | op-mode 7  | passed |
|                        |  | op-mode 8  | passed |
|                        |  | op-mode 10 | passed |
|                        |  | op-mode 11 | passed |
|                        |  | op-mode 12 | passed |



### 3.5 Band edge compliance

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** ANSI C 63.4, 2003  
                                                         FCC §15.31, 10-1-08

#### 3.5.1 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

Analyzer settings for radiated measurement:

- Detector: Peak, Average
- RBW = VBW = 100 kHz

#### 3.5.2 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)”.

### 3.5.3 Test Protocol

#### 3.5.3.1 Lower band edge

##### Conducted measurement

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

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

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2400.00          | -36.44                | 6.39                   | -13.61       | 22.83                |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 6 | Setup_b01 | Temp ant.connector |

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2400.00          | -41.69                | 4.45                   | -15.55       | 26.14                |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 10 | Setup_b01 | Temp ant.connector |

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2400.00          | -42.94                | 4.38                   | -15.62       | 27.32                |

Remark: Please see annex for the measurement plot.

### 3.5.3.2 Higher band edge

#### Conducted measurement

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

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

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2483.50          | -39.77                | 6.50                   | -13.50       | 26.27                |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 8 | Setup_b01 | Temp ant.connector |

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2483.50          | -38.01                | 3.59                   | -16.41       | 21.60                |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port               |
|------------|-----------|--------------------|
| op-mode 12 | Setup_b01 | Temp ant.connector |

| Frequency<br>MHz | Measured value<br>dBm | Reference value<br>dBm | Limit<br>dBm | Delta to limit<br>dB |
|------------------|-----------------------|------------------------|--------------|----------------------|
| 2483.50          | -39.30                | 3.71                   | -16.29       | 23.01                |

Remark: Please see annex for the measurement plot.

## Radiated measurement

Temperature: 27 °C  
Air Pressure: 1010 hPa  
Humidity: 37 %

| Op. Mode  | Setup     | Port      |
|-----------|-----------|-----------|
| op-mode 3 | Setup_a01 | Enclosure |

| Frequency<br>MHz | Polarisation             | Corrected value<br>dBµV/m |       | Limit<br>Peak<br>dBµV/m | Limit<br>AV<br>dBµV/m | Delta to<br>Peak<br>limit/dB | Delta to AV<br>limit<br>dB |
|------------------|--------------------------|---------------------------|-------|-------------------------|-----------------------|------------------------------|----------------------------|
|                  |                          | Peak                      | AV    |                         |                       |                              |                            |
| 2483.50          | Vertical +<br>horizontal | 54.62                     | 39.93 | 74.00                   | 54.00                 | 19.38                        | 17.07                      |

Remark: Please see annex for the measurement plot.

| Op. Mode  | Setup     | Port      |
|-----------|-----------|-----------|
| op-mode 8 | Setup_a01 | Enclosure |

| Frequency<br>MHz | Polarisation             | Corrected value<br>dBµV/m |       | Limit<br>Peak<br>dBµV/m | Limit<br>AV<br>dBµV/m | Delta to<br>Peak<br>limit/dB | Delta to AV<br>limit<br>dB |
|------------------|--------------------------|---------------------------|-------|-------------------------|-----------------------|------------------------------|----------------------------|
|                  |                          | Peak                      | AV    |                         |                       |                              |                            |
| 2483.50          | Vertical +<br>horizontal | 54.88                     | 39.42 | 74.00                   | 54.00                 | 19.12                        | 14.58                      |

Remark: Please see annex for the measurement plot.

| Op. Mode   | Setup     | Port      |
|------------|-----------|-----------|
| op-mode 12 | Setup_a01 | Enclosure |

| Frequency<br>MHz | Polarisation             | Corrected value<br>dBµV/m |       | Limit<br>Peak<br>dBµV/m | Limit<br>AV<br>dBµV/m | Delta to<br>Peak<br>limit/dB | Delta to AV<br>limit<br>dB |
|------------------|--------------------------|---------------------------|-------|-------------------------|-----------------------|------------------------------|----------------------------|
|                  |                          | Peak                      | AV    |                         |                       |                              |                            |
| 2483.50          | Vertical +<br>horizontal | 54.88                     | 39.42 | 74.00                   | 54.00                 | 19.12                        | 14.58                      |

Remark: Please see annex for the measurement plot.

### 3.5.4 Test result: Band edge compliance

| FCC Part 15, Subpart C | Op. Mode   | Result |
|------------------------|------------|--------|
|                        | op-mode 1  | passed |
|                        | op-mode 3  | passed |
|                        | op-mode 6  | passed |
|                        | op-mode 8  | passed |
|                        | op-mode 10 | passed |
|                        | op-mode 12 | passed |

### 3.6 Dwell time

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### 3.6.1 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 following shortcuts are used for the different packet types:

- Basic data rate, 1 Mbps:            DH1, DH3, DH5
- Enhanced data rate, 3 Mbps:      3-DH1, 3-DH3, 3-DH5
- Enhanced data rate, 2 Mbps:      2-DH1, 2-DH3, 2-DH5

The worst case value is reported.

#### 3.6.2 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.

### 3.6.3 Test Protocol

Temperature: 27 °C  
 Air Pressure: 1005 hPa  
 Humidity: 38 %

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

| Packet type | Time slot length<br>ms | Dwell time                              | Dwell time<br>ms |
|-------------|------------------------|-----------------------------------------|------------------|
| DH5         | 2.946                  | time slot length *<br>1600/5 /79 * 31.6 | 377.09           |

Remark: Please see annex for the measurement plots.

### 3.6.4 Test result: Dwell time

| FCC Part 15, Subpart C |  | Op. Mode      | Result |
|------------------------|--|---------------|--------|
|                        |  | op-mode 2 DH5 | passed |



### 3.7 Channel separation

**Standard**      FCC Part 15, 10-1-08  
                     Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### 3.7.1 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: 2442 MHz
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

#### 3.7.2 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.

### 3.7.3 Test Protocol

Temperature: 27 °C  
 Air Pressure: 1005 hPa  
 Humidity: 38 %

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 4 | Setup_b01 | Temp ant.connector |

| Channel separation<br>MHz | Remarks |
|---------------------------|---------|
| 1.000                     | -       |

Remark: Please see annex for the measurement plot.

### 3.7.4 Test result: Channel separation

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

### 3.8 Number of hopping frequencies

**Standard** FCC Part 15, 10-1-08  
Subpart C

**The test was performed according to:** FCC §15.31, 10-1-08

#### 3.8.1 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

#### 3.8.2 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.

#### 3.8.3 Test Protocol

Temperature: 27 °C  
Air Pressure: 1005 hPa  
Humidity: 38 %

| Op. Mode  | Setup     | Port               |
|-----------|-----------|--------------------|
| op-mode 4 | Setup_b01 | Temp ant.connector |

| Number of hopping channels | Remarks |
|----------------------------|---------|
| 79                         | -       |

Remark: Please see annex for the measurement plot.

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

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

## 4 Test Equipment

### *EUT Digital Signalling System*

| Equipment                            | Type   | Serial No. | Manufacturer    | Cal. data | Next cal. |
|--------------------------------------|--------|------------|-----------------|-----------|-----------|
| Digital Radio Communication Tester   | CMD 55 | 831050/020 | Rohde & Schwarz | 07.10.08  | 06.10.11  |
| Universal Radio Communication Tester | CMU200 | 102366     | Rohde & Schwarz | 16.02.09  | 15.02.11  |
| Universal Radio Communication Tester | CMU200 | 837983/052 | Rohde & Schwarz | 01.12.08  | 30.11.11  |
| Signalling Unit for Bluetooth        | CBT    | 100589     | Rohde & Schwarz | 14.08.08  | N/A *)    |
| Signalling Unit for GPS              | SMU200 | 100912     | Rohde & Schwarz | 28.10.08  | 27.10.11  |

### *EMI Test System*

| Equipment        | Type   | Serial No.  | Manufacturer    | Cal. data | Next cal. |
|------------------|--------|-------------|-----------------|-----------|-----------|
| EMI Analyzer     | ESI 26 | 830482/004  | Rohde & Schwarz | 06.12.07  | 05.12.09  |
| Signal Generator | SMR 20 | 846834/008  | Rohde & Schwarz | 05.12.07  | 04.12.09  |
| AC Power Source  | 6404   | 64040000B04 | Croma ATE INC.  | 01.06.08  | 31.05.11  |

### *EMI Radiated Auxiliary Equipment*

| Equipment                       | Type                     | Serial No.           | Manufacturer          | Cal. data | Next cal.              |
|---------------------------------|--------------------------|----------------------|-----------------------|-----------|------------------------|
| Antenna mast 4m                 | MA 240                   | 240/492              | HD GmbH H. Deisel     | -         | -                      |
| Biconical dipole                | VUBA 9117                | 9117108              | Schwarzbeck           | 27.10.08  | 26.10.13               |
| Broadband Amplifier 18MHz-26GHz | JS4-18002600-32          | 849785               | Miteq                 | 19.05.09  | 18.11.09               |
| Broadband Amplifier 30MHz-18GHz | JS4-00101800-35          | 896037               | Miteq                 | 19.05.09  | 18.11.09               |
| Broadband Amplifier 45MHz-27GHz | JS4-00102600-42          | 619368               | Miteq                 | 19.05.09  | 18.11.09               |
| Cable "ESI to EMI Antenna"      | EcoFlex10                | W18.01-2<br>W38.01-2 | Kabel Kusch           | 19.05.09  | 18.11.09               |
| Cable "ESI to Horn Antenna"     | UFB311A<br>UFB293C       | W18.02-2<br>W38.02-2 | Rosenberger-Microcoax | 19.05.09  | 18.11.09               |
| Double-ridged horn              | HF 906                   | 357357/002           | Rohde & Schwarz       | 28.04.09  | 27.04.12               |
| Double-ridged horn              | HF 906                   | 357357/001           | Rohde & Schwarz       | 16.04.09  | 15.04.12               |
| High Pass Filter                | 5HC3500/127<br>50-1.2-KK | 200035008            | Trilithic             | 19.05.09  | 18.11.09               |
| High Pass Filter                | 5HC2700/127<br>50-1.5-KK | 9942012              | Trilithic             | 19.05.09  | 18.11.09               |
| High Pass Filter                | 4HC1600/127<br>50-1.5-KK | 9942011              | Trilithic             | 19.05.09  | 18.11.09               |
| High Pass Filter                | WHKX<br>7.0/18G-8SS      | 9                    | Wainwright            | 19.05.09  | 18.11.09               |
| KUEP pre amplifier              | Kuep<br>00304000         | 001                  | 7 layers AG           | -         | N/A – spare part       |
| Log.-per. Antenna               | HL 562<br>Ultralog       | 830547/003           | Rohde & Schwarz       | 22.05.09  | 21.05.12               |
| Loop Antenna                    | HFH2-Z2                  | 829324/006           | Rohde & Schwarz       | 07.10.08  | 06.10.11               |
| Pyramidal Horn Antenna 26.5 GHz | Model 3160-09            | 9910-1184            | EMCO                  | 28.02.08  | N/A (Stand. Gain Horn) |
| Pyramidal Horn Antenna 40 GHz   | Model 3160-10            | 00086675             | EMCO                  | 18.12.07  | N/A (Stand. Gain Horn) |

### EMI Conducted Auxiliary Equipment

| Equipment           | Type     | Serial No.    | Manufacturer    | Cal. data | Next cal. |
|---------------------|----------|---------------|-----------------|-----------|-----------|
| Cable "LISN to ESI" | RG214    | W18.03+W48.03 | Huber+Suhner    | 19.05.09  | 18.11.09  |
| Two-Line V-Network  | ESH 3-Z5 | 828304/029    | Rohde & Schwarz | 13.10.08  | 12.10.11  |
| Two-Line V-Network  | ESH 3-Z5 | 829996/002    | Rohde & Schwarz | -         | -         |
| Four-Line Network   | ENY41    | 838119/004    | Rohde & Schwarz | 06.03.08  | 05.03.11  |

### Auxiliary Test Equipment

| Equipment                              | Type                    | Serial No.     | Manufacturer                            | Cal. data | Next cal. |
|----------------------------------------|-------------------------|----------------|-----------------------------------------|-----------|-----------|
| Broadband Resist.<br>Power Divider N   | 1506A /<br>93459        | LM390          | Weinschel                               | -         | -         |
| Broadband Resist.<br>Power Divider SMA | 1515 / 93459            | LN673          | Weinschel                               | -         | -         |
| Digital Multimeter                     | 177                     | 86670383       | Fluke                                   | 01.08.08  | 31.07.09  |
| Digital Oscilloscope                   | TDS 784C                | B021311        | Tektronix                               | -         | -         |
| Fibre optic link Satellite             | FO RS232 Link           | 181-018        | Pontis                                  | -         | -         |
| Fibre optic link<br>Transceiver        | FO RS232 Link           | 182-018        | Pontis                                  | -         | -         |
| Notch Filter ultra stable              | WRCA800/960<br>-6E      | 24             | Wainwright                              | -         | -         |
| Temperature Chamber                    | VT 4002                 | 58566080550010 | Vötsch                                  | 12.03.09  | 11.03.10  |
| Temperature Chamber                    | KWP 120/70              | 59226012190010 | Weiss                                   | 12.03.09  | 11.03.10  |
| ThermoHygro<br>Datalogger 03           | Opus10 THI<br>(8152.00) | 7482           | Lufft Mess- und<br>Regeltechnik<br>GmbH | 22.01.09  | 21.01.10  |
| Spectrum Analyzer<br>9 kHz to 3 GHz    | FSP3                    | 836722/011     | Rohde & Schwarz                         | 06.10.08  | 05.10.11  |
| Signal Analyzer<br>20 Hz to 26.5 GHz   | FSIQ26                  | 840061/005     | Rohde & Schwarz                         | 02.10.08  | 01.10.11  |

### Anechoic Chamber

| Equipment                            | Type                    | Serial No. | Manufacturer                            | Cal. data | Next cal. |
|--------------------------------------|-------------------------|------------|-----------------------------------------|-----------|-----------|
| EMC Camera                           | CE-CAM/1                |            | CE-SYS                                  | -         | -         |
| EMC Camera for<br>observation of EUT | CCD-400E                | 0005033    | Mitsubishi                              | -         | -         |
| Filter ISDN                          | B84312-C110-<br>E1      |            | Siemens &<br>Matsushita                 | -         | -         |
| Filter telephone<br>systems / modem  | B84312-C40-<br>B1       |            | Siemens &<br>Matsushita                 | -         | -         |
| Filter Universal 1A                  | B84312-C30-<br>H3       |            | Siemens &<br>Matsushita                 | -         | -         |
| Fully/Semi AE Chamber                | 10.58x6.38x6            |            | Frankonia                               | -         | -         |
| Turntable                            | DS 420S                 | 420/573/99 | HD GmbH,<br>H.Deisel                    | -         | -         |
| ThermoHygro<br>Datalogger 12         | Opus10 THI<br>(8152.00) | 12482      | Lufft Mess- und<br>Regeltechnik<br>GmbH | 05.08.08  | 04.08.09  |
| ThermoAirpressure<br>Datalogger 13   | Opus10 TPR<br>(8253.00) | 13936      | Lufft Mess- und<br>Regeltechnik<br>GmbH | 22.01.09  | 21.01.10  |



## 7 layers InterLab Bluetooth RF Test Solution – Setup C Bluetooth BDR and EDR RF Conformance Test System

| Equipment                 | Type                 | Serial No.     | Manufacturer                      | Cal. data | Next cal. |
|---------------------------|----------------------|----------------|-----------------------------------|-----------|-----------|
| Power Meter               | NRVD                 | 832025/059     | Rohde & Schwarz                   | 23.06.09  | 22.06.10  |
| Power Sensor A            | NRV-Z1               | 832279/013     | Rohde & Schwarz                   | 23.06.09  | 22.06.10  |
| Power Supply              | E3632A               | MY40003776     | Agilent                           | -         | -         |
| Power Supply              | PS-2403D             | -              | Conrad                            | -         | -         |
| Power Supply              | NGSM 32/10           | 2725           | Rohde & Schwarz                   | 28.04.09  | 27.04.10  |
| Rubidium Frequency Normal | MFS                  | 002            | Datum GmbH                        | 23.06.09  | 22.06.10  |
| Signal Analyzer FSIQ26    | FSIQ26               | 832695/007     | Rohde & Schwarz                   | 23.08.07  | 22.08.09  |
| Signal Generator          | SMP 03               | 833680/003     | Rohde & Schwarz                   | 23.06.09  | 22.06.12  |
| Signal Generator          | SMI03B               | 832870/017     | Rohde & Schwarz                   | 24.05.07  | 23.05.10  |
| Signal Switching Unit     | TOCT                 | 030106         | 7 layers Inc.                     | -         | -         |
| Signalling Unit           | CBT                  | 100302         | Rohde & Schwarz                   | 28.04.09  | 27.04.10  |
| ThermoHygro Datalogger 04 | Opus10 THI (8152.00) | 7481           | Lufft Mess- und Regeltechnik GmbH | 22.01.09  | 21.01.10  |
| Temperature Chamber       | KWP 120/70           | 59226012190010 | Weiss                             | 12.03.09  | 11.03.10  |

### Radio Lab

| Equipment                           | Type                 | Serial No.     | Manufacturer                      | Cal. data | Next cal. |
|-------------------------------------|----------------------|----------------|-----------------------------------|-----------|-----------|
| Broadband Resist. Power Divider SMA | 1515 / 93459         | LN673          | Weinschel                         | -         | -         |
| Digital Oscilloscope                | TDS 784C             | B021311        | Tektronix                         | -         | -         |
| Temperature Chamber                 | VT 4002              | 58566080550010 | Vötsch                            | 12.03.09  | 11.03.10  |
| Temperature Chamber                 | KWP 120/70           | 59226012190010 | Weiss                             | 12.03.09  | 11.03.10  |
| Spectrum Analyzer 9 kHz to 3 GHz    | FSP3                 | 836722/011     | Rohde & Schwarz                   | 06.10.08  | 05.10.11  |
| Signal Analyzer 20 Hz to 26.5 GHz   | FSIQ26               | 840061/005     | Rohde & Schwarz                   | 02.10.08  | 01.10.11  |
| ThermoHygro Datalogger 11           | Opus10 THI (8152.00) | 12472          | Lufft Mess- und Regeltechnik GmbH | 22.01.09  | 21.01.10  |

### OTA RF Performance

| Equipment                            | Type                        | Serial No. | Manufacturer                      | Cal. data                      | Next cal. |
|--------------------------------------|-----------------------------|------------|-----------------------------------|--------------------------------|-----------|
| Power Meter                          | 8652A                       | 861836     | Giga-Tronics                      | 21.10.08                       | 20.10.09  |
| Power Sensor                         | 80701A                      | 1837015    | Giga-Tronics                      | 21.10.08                       | 20.10.09  |
| Power Sensor                         | 80701A                      | 1837017    | Giga-Tronics                      | 21.10.08                       | 20.10.09  |
| Universal Radio Communication Tester | CMU200                      | 107459     | Rohde & Schwarz                   | 07.11.08                       | 06.11.09  |
| Spectrum Analyzer 9 kHz to 3 GHz     | FSP3                        | 838164/004 | Rohde & Schwarz                   | 06.10.08                       | 05.10.11  |
| Antenna                              | Dual polarized horn 3164-03 | 00052619   | ETS Lindgreen                     | accredited factory calibration | - *)      |
| Fully Anechoic Room                  | 6.7x 3.4x3.0 m              | -          | Albatross                         | -                              | -         |
| ThermoHygro Datalogger 11            | Opus10 THI (8152.00)        | 7482       | Lufft Mess- und Regeltechnik GmbH | 22.01.09                       | 21.01.10  |

\*) N/A – only used for relative measurements

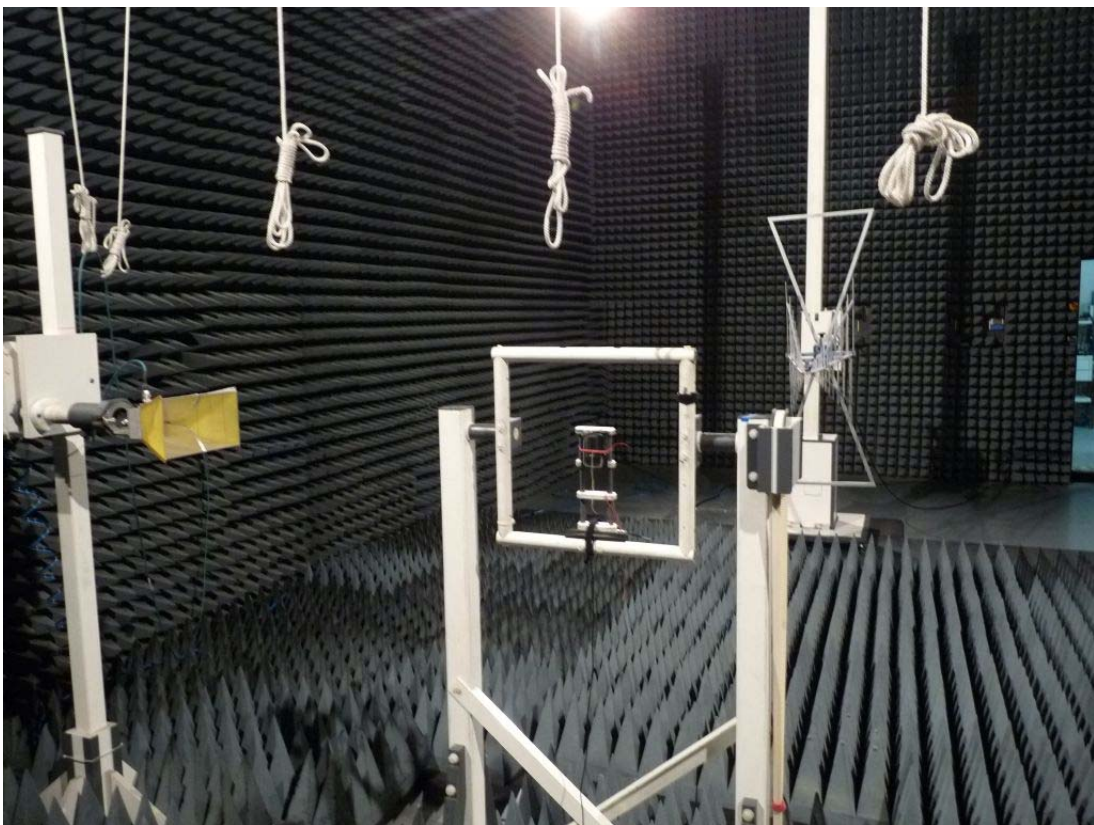
## 5 Photo Report



**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)

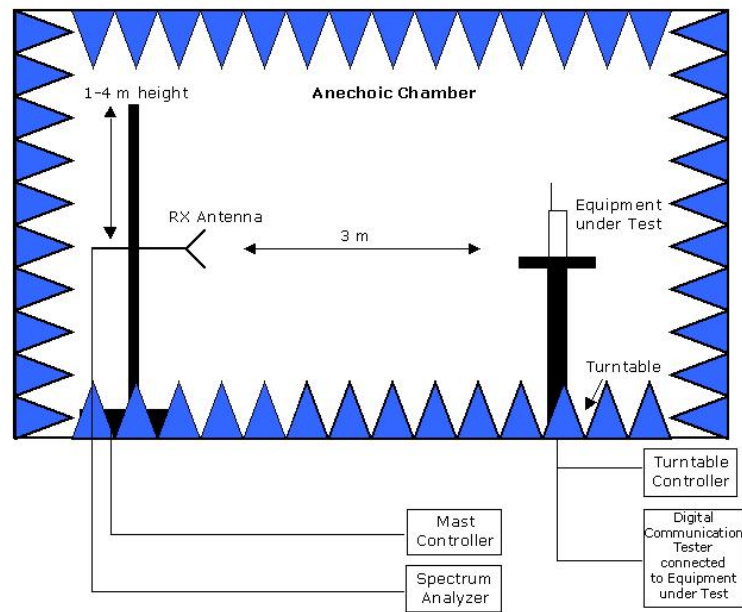


**Photo 4:** EUT (front side)



**Photo 5:** EUT (rear side)

## 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

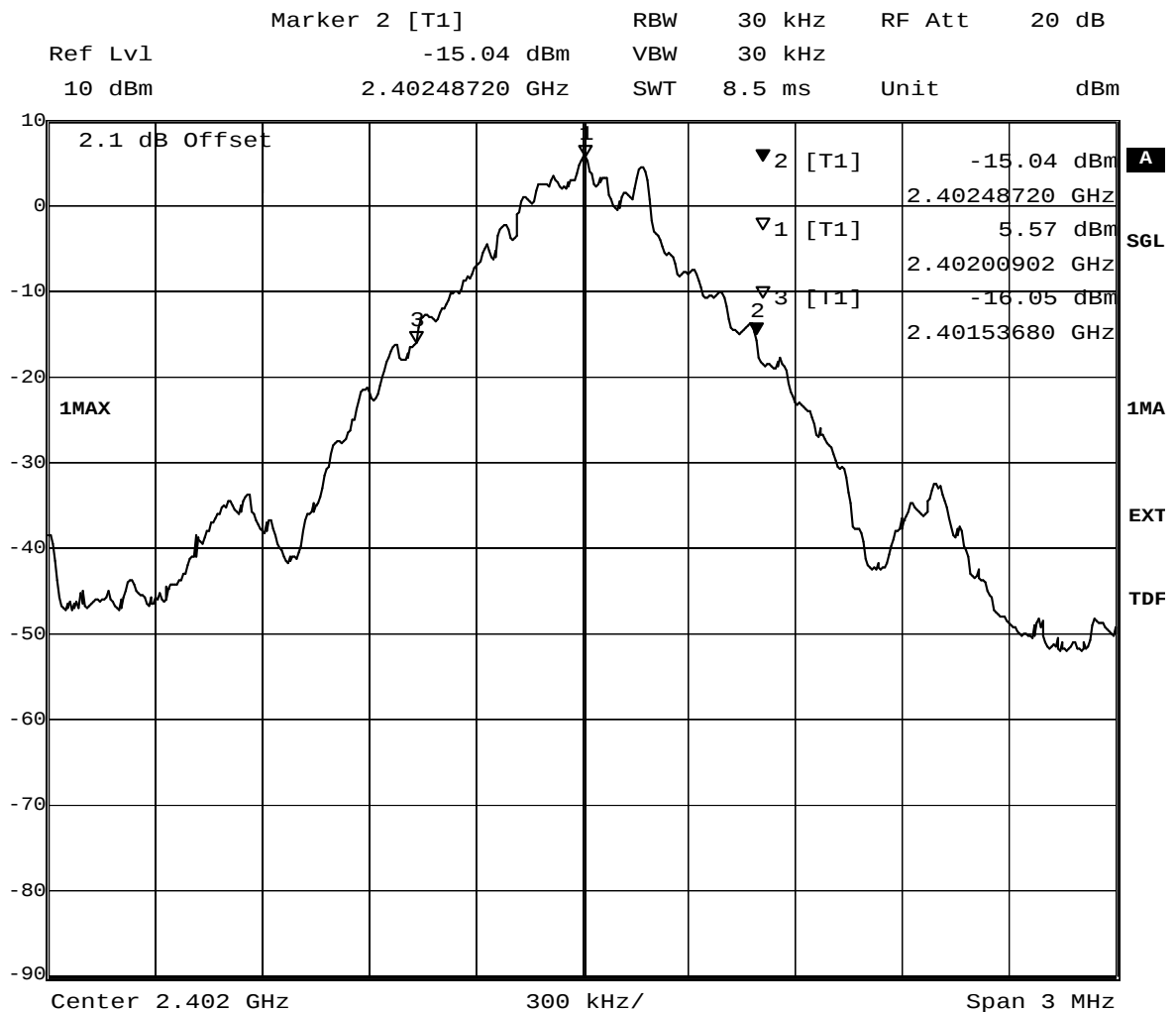
## 7 Annex measurement plots

### 7.1 Occupied bandwidth

#### 7.1.1 Occupied bandwidth operating mode 1

##### Op. Mode

op-mode 1



Title: 20dB Bandwidth

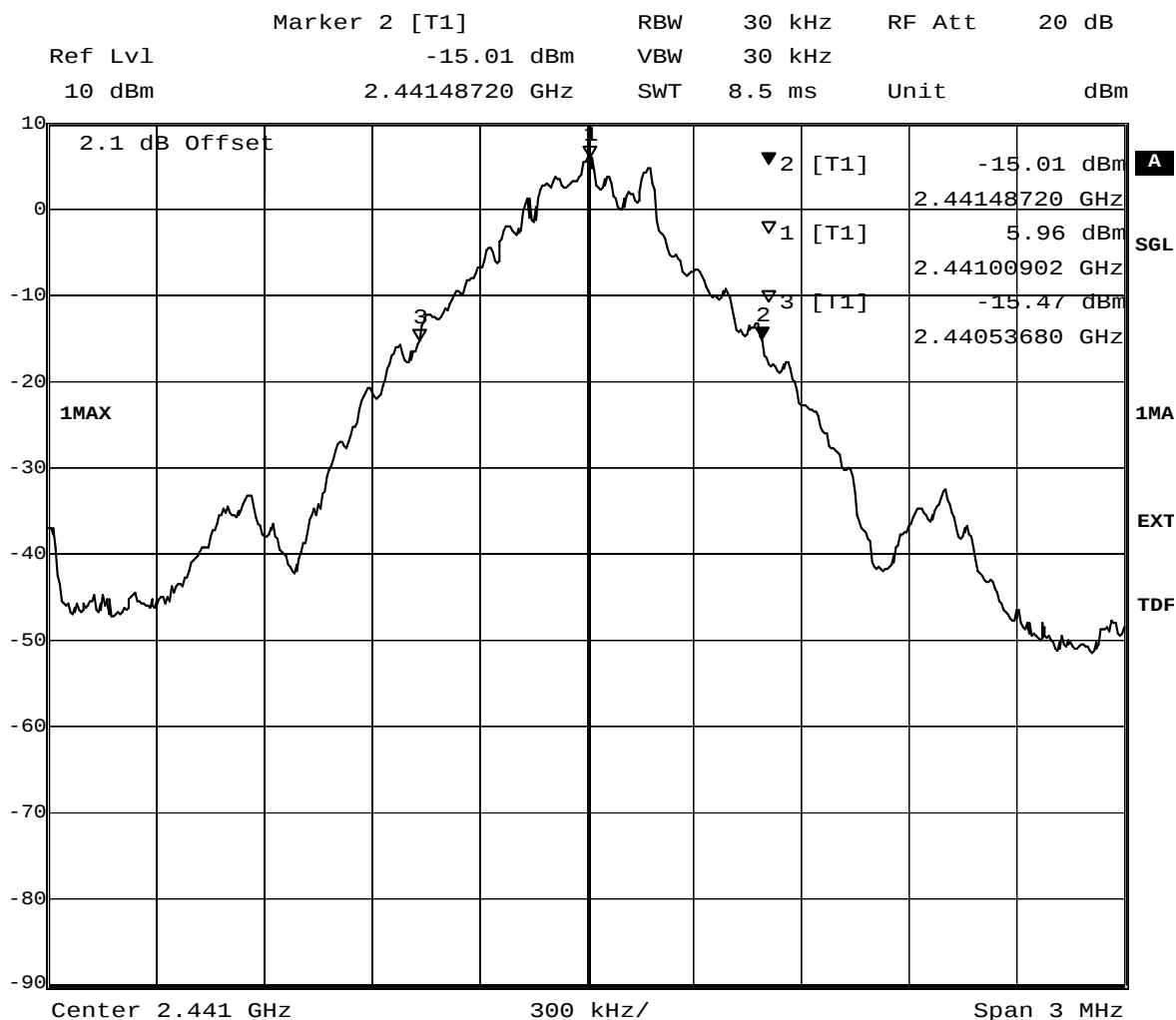
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):950.4

Date: 21.JUL.2009 09:16:03

## 7.1.2 Occupied bandwidth operating mode 2

### Op. Mode

op-mode 2



Title: 20dB Bandwidth

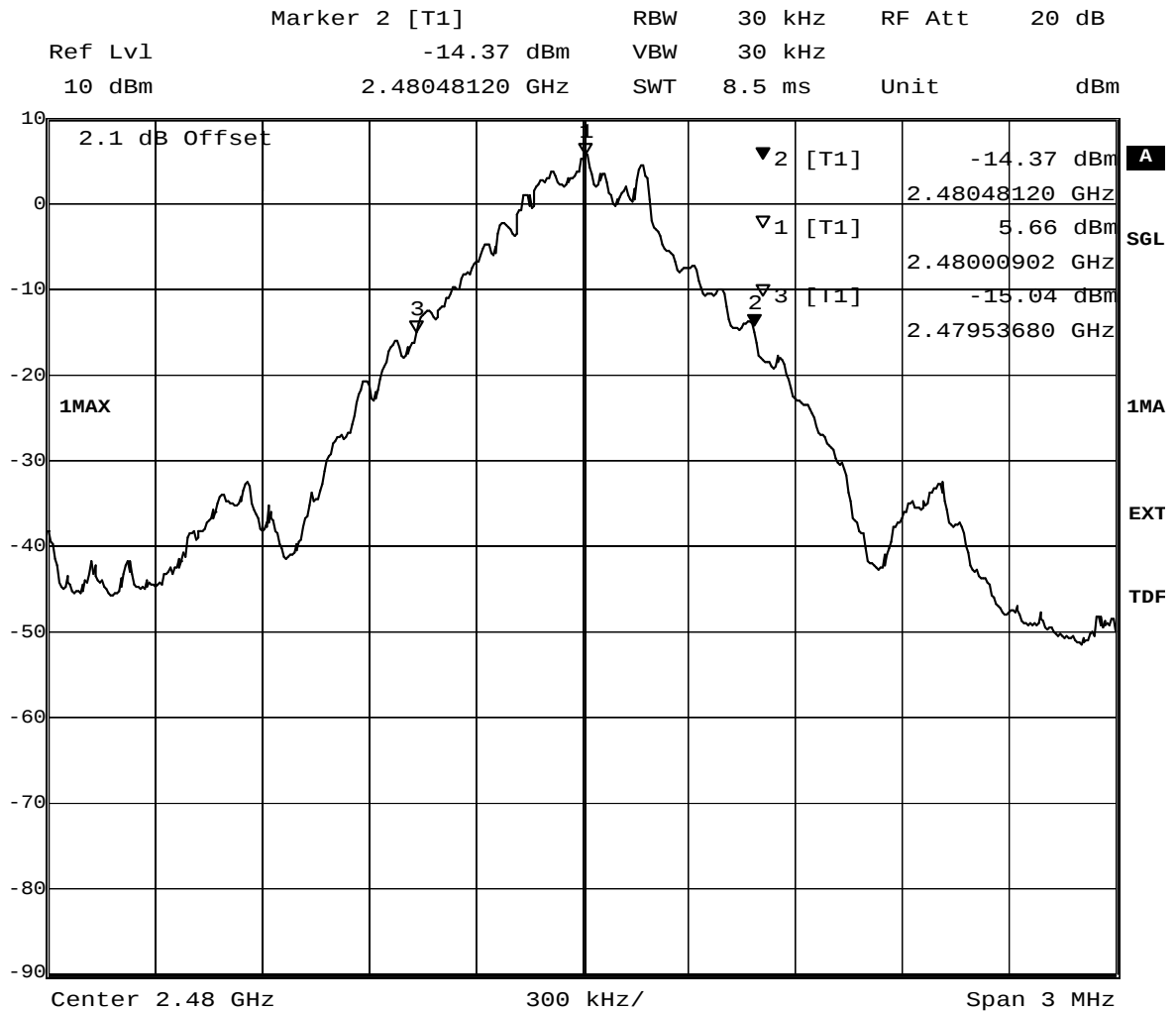
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):950.4

Date: 21.JUL.2009 10:32:13

### 7.1.3 Occupied bandwidth operating mode 3

#### Op. Mode

op-mode 3

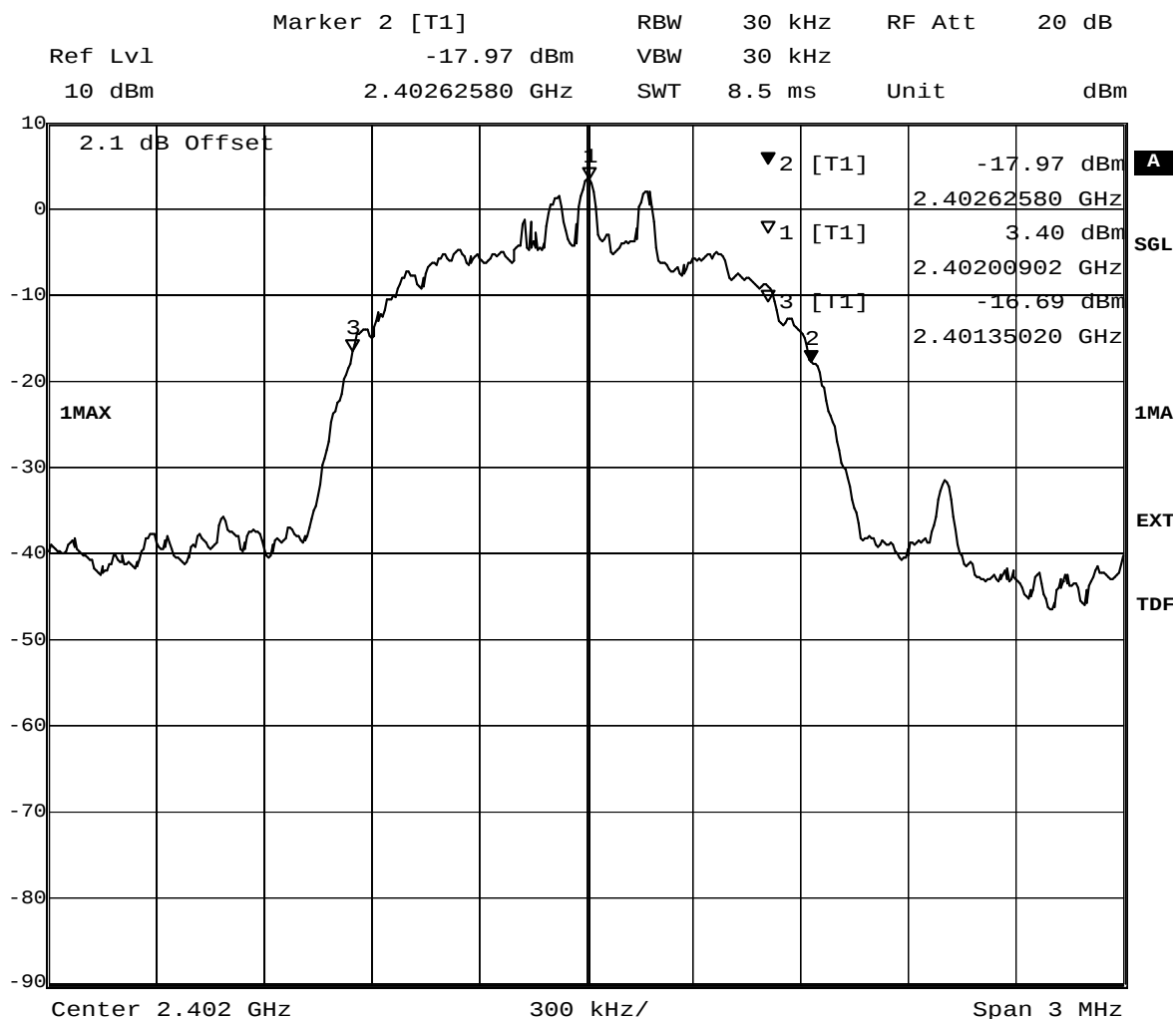


Title: 20dB Bandwidth  
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):944.4  
 Date: 21.JUL.2009 10:04:53

## 7.1.4 Occupied bandwidth operating mode 6

### Op. Mode

op-mode 6



Title: 20dB Bandwidth

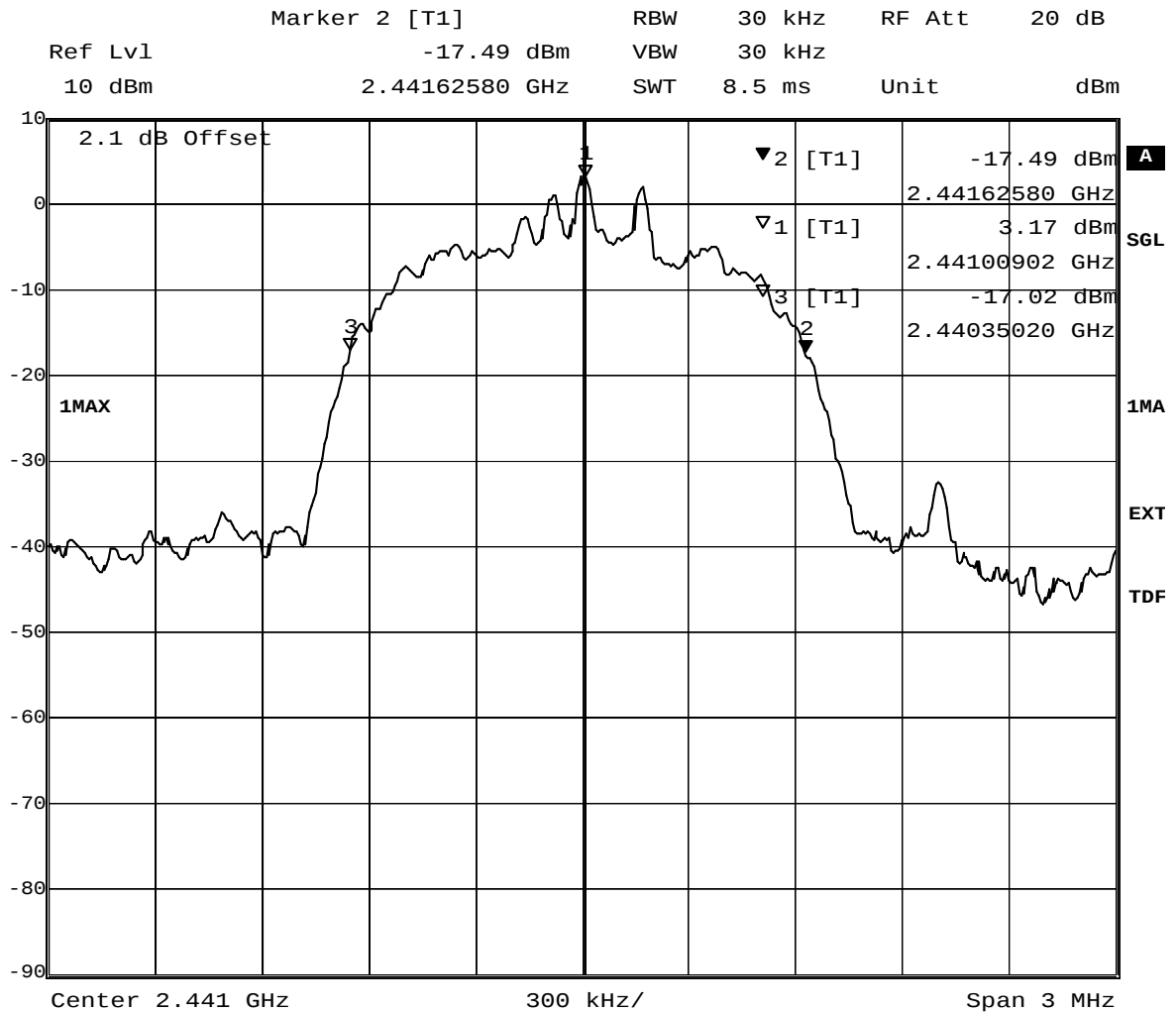
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1275.6

Date: 21.JUL.2009 12:44:05

## 7.1.5 Occupied bandwidth operating mode 7

### Op. Mode

op-mode 7



Title: 20dB Bandwidth

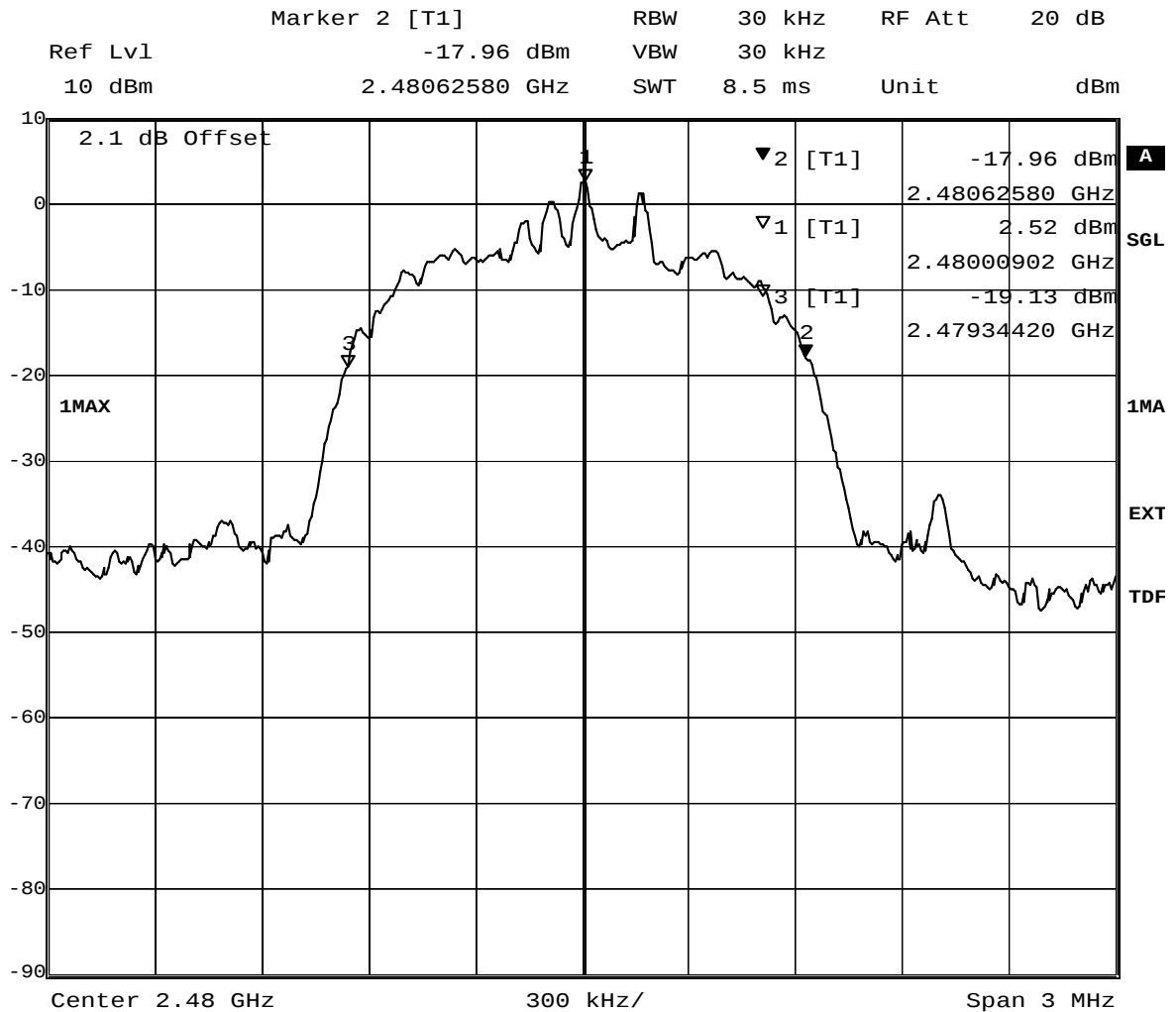
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1275.6

Date: 21.JUL.2009 13:16:23

## 7.1.6 Occupied bandwidth operating mode 8

### Op. Mode

op-mode 8



Title: 20dB Bandwidth

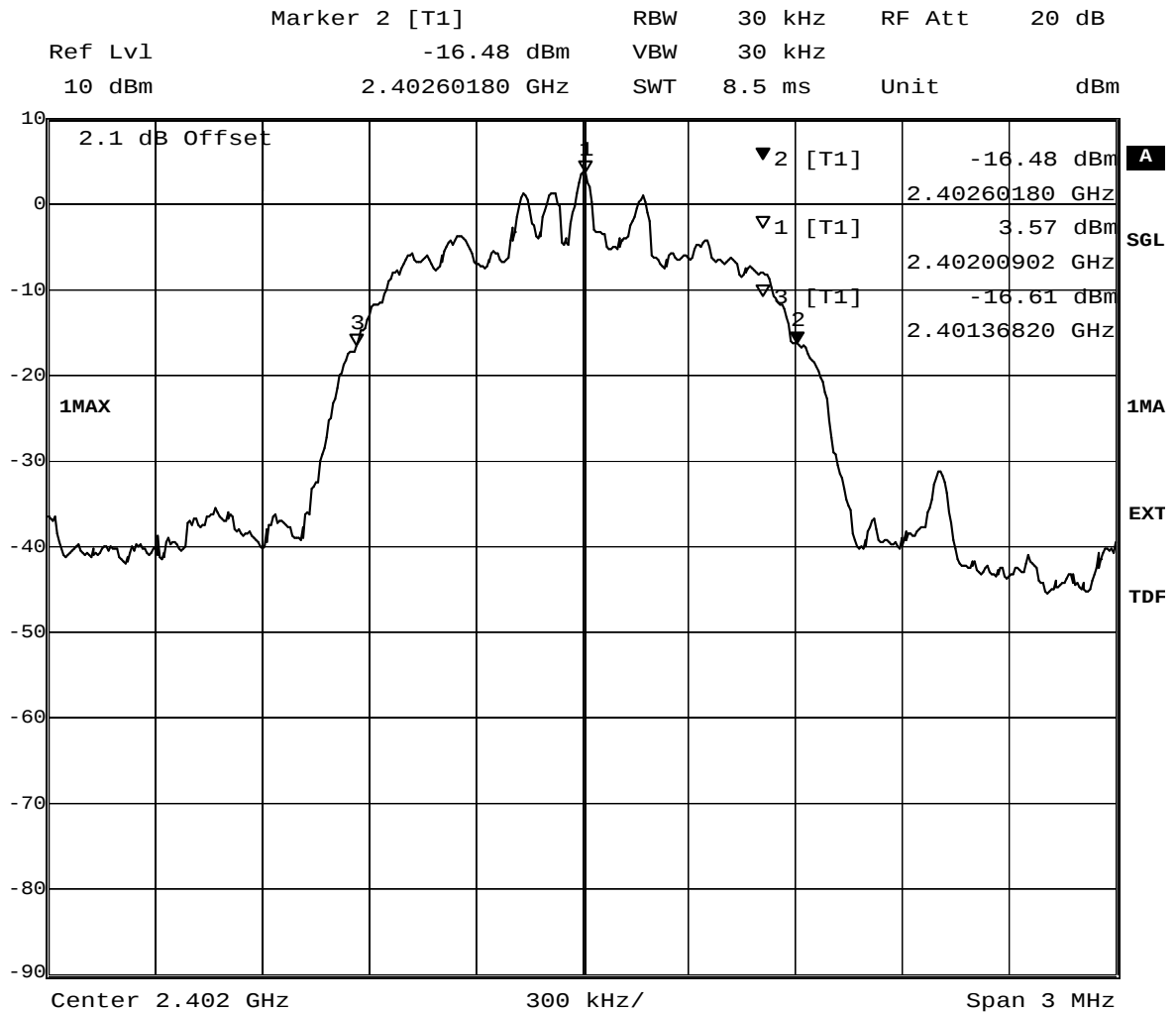
Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1281.6

Date: 21.JUL.2009 13:21:24

## 7.1.7 Occupied bandwidth operating mode 10

### Op. Mode

op-mode 10



Title: 20dB Bandwidth

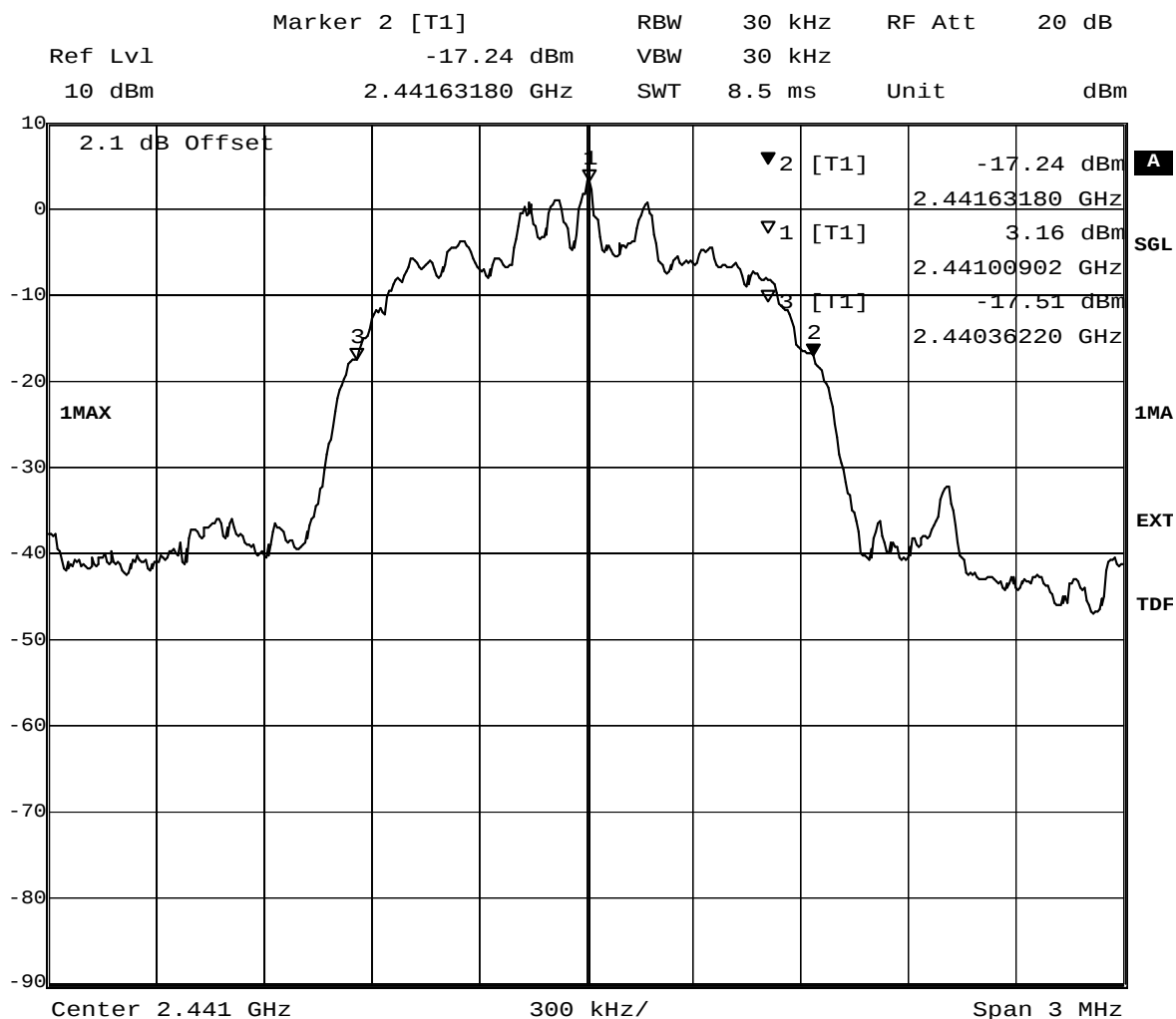
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1233.6

Date: 21.JUL.2009 12:33:01

## 7.1.8 Occupied bandwidth operating mode 11

### Op. Mode

op-mode 11



Title: 20dB Bandwidth

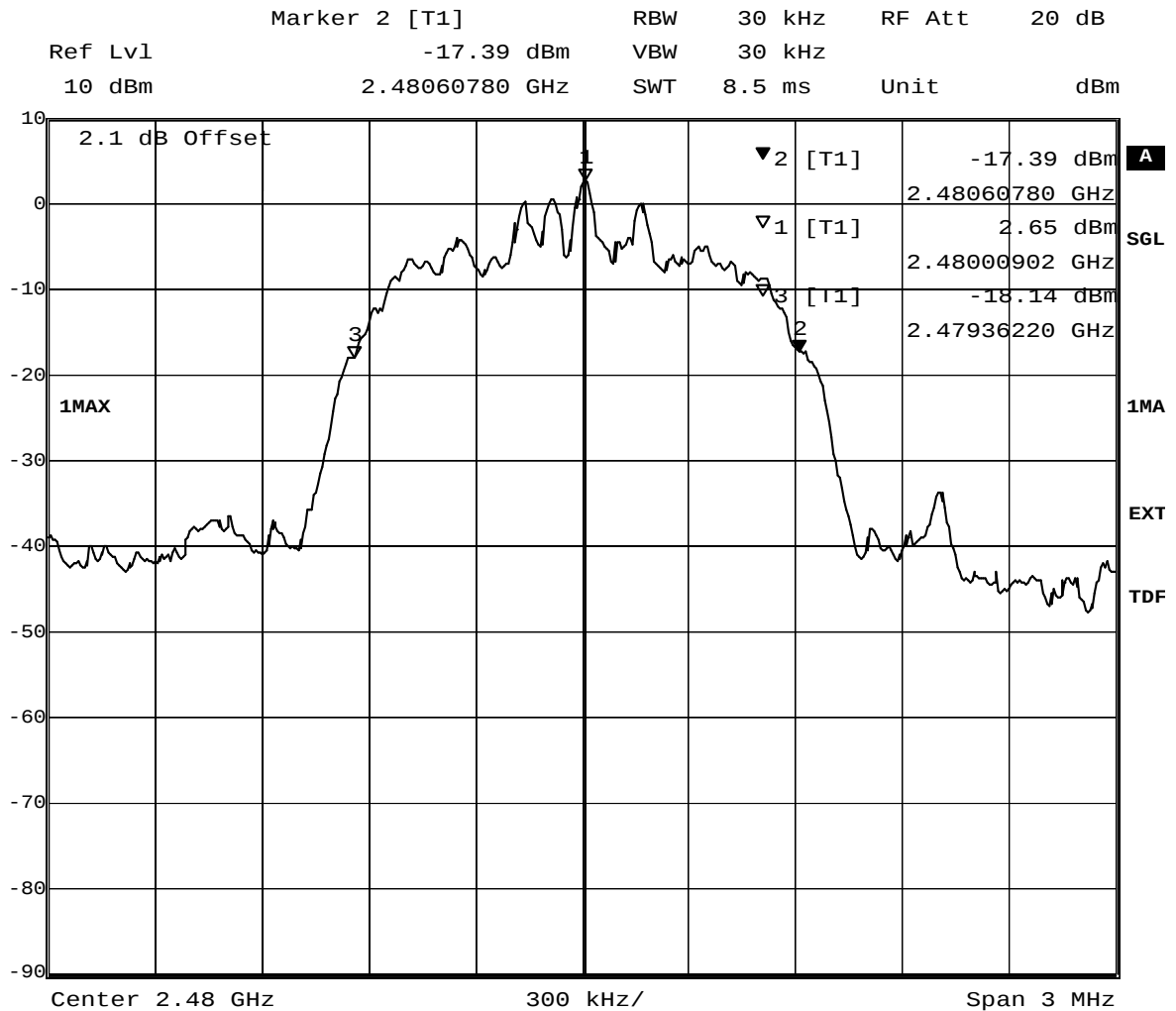
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1269.6

Date: 21.JUL.2009 11:49:22

## 7.1.9 Occupied bandwidth operating mode 12

### Op. Mode

op-mode 12



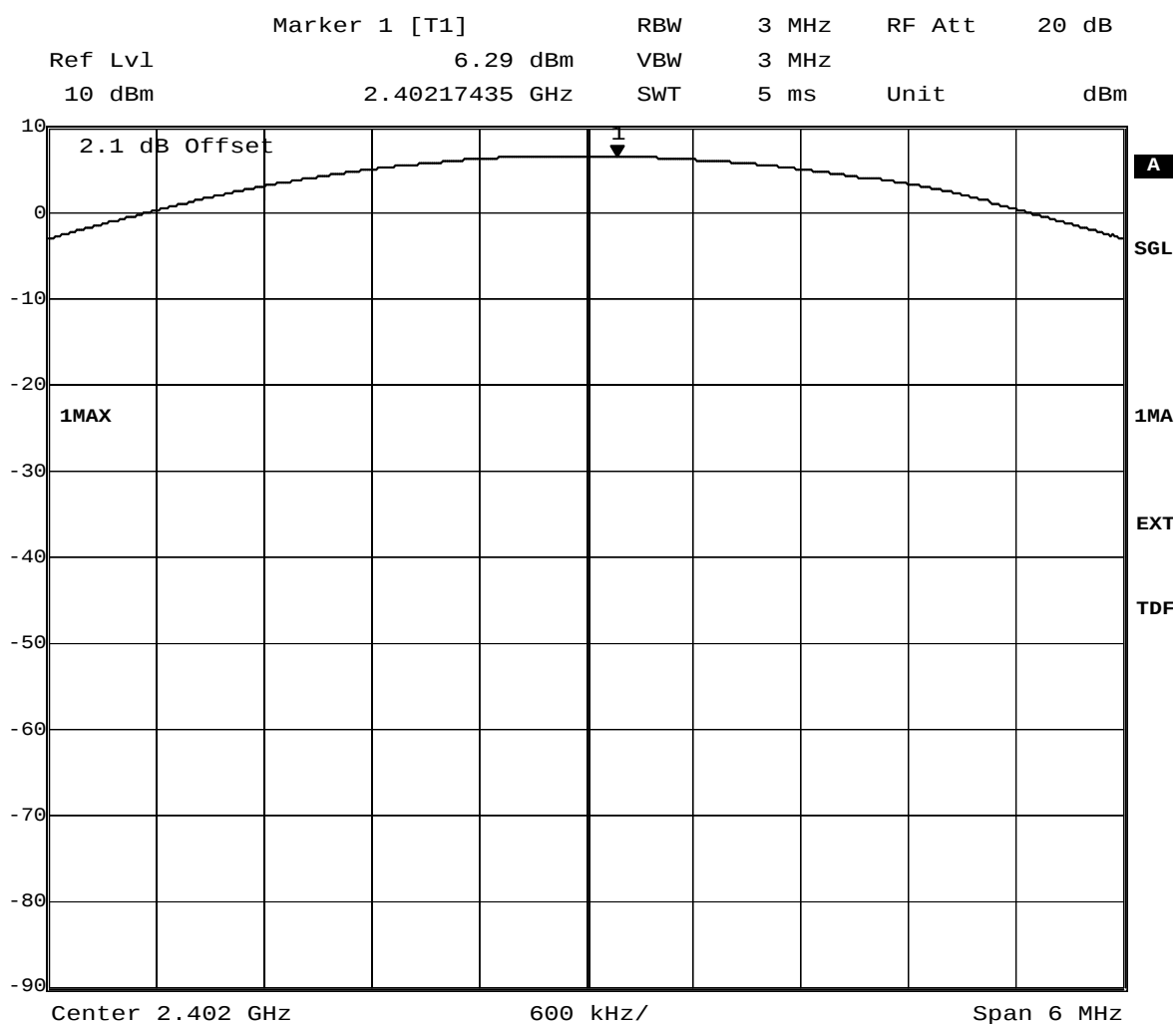
Title: 20dB Bandwidth  
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1245.6  
 Date: 21.JUL.2009 11:54:58

## 7.2 Peak power output

### 7.2.1 Peak power output operating mode 1

#### Op. Mode

op-mode 1



Title: Peak outputpower Power

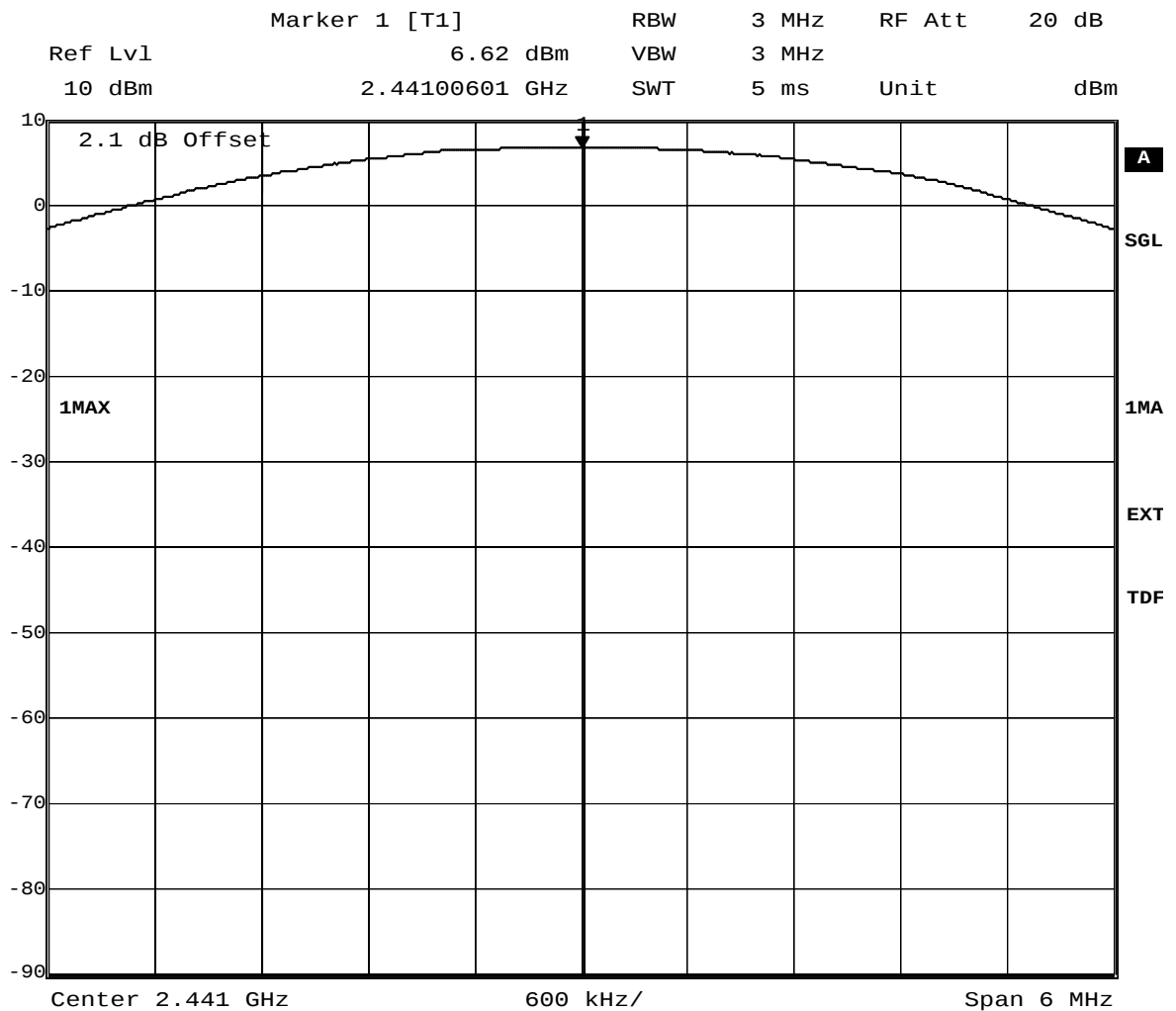
Comment A: CH B: 2402 MHz

Date: 21.JUL.2009 09:16:29

## 7.2.2 Peak power output operating mode 2

### Op. Mode

op-mode 2



Title: Peak outputpower Power

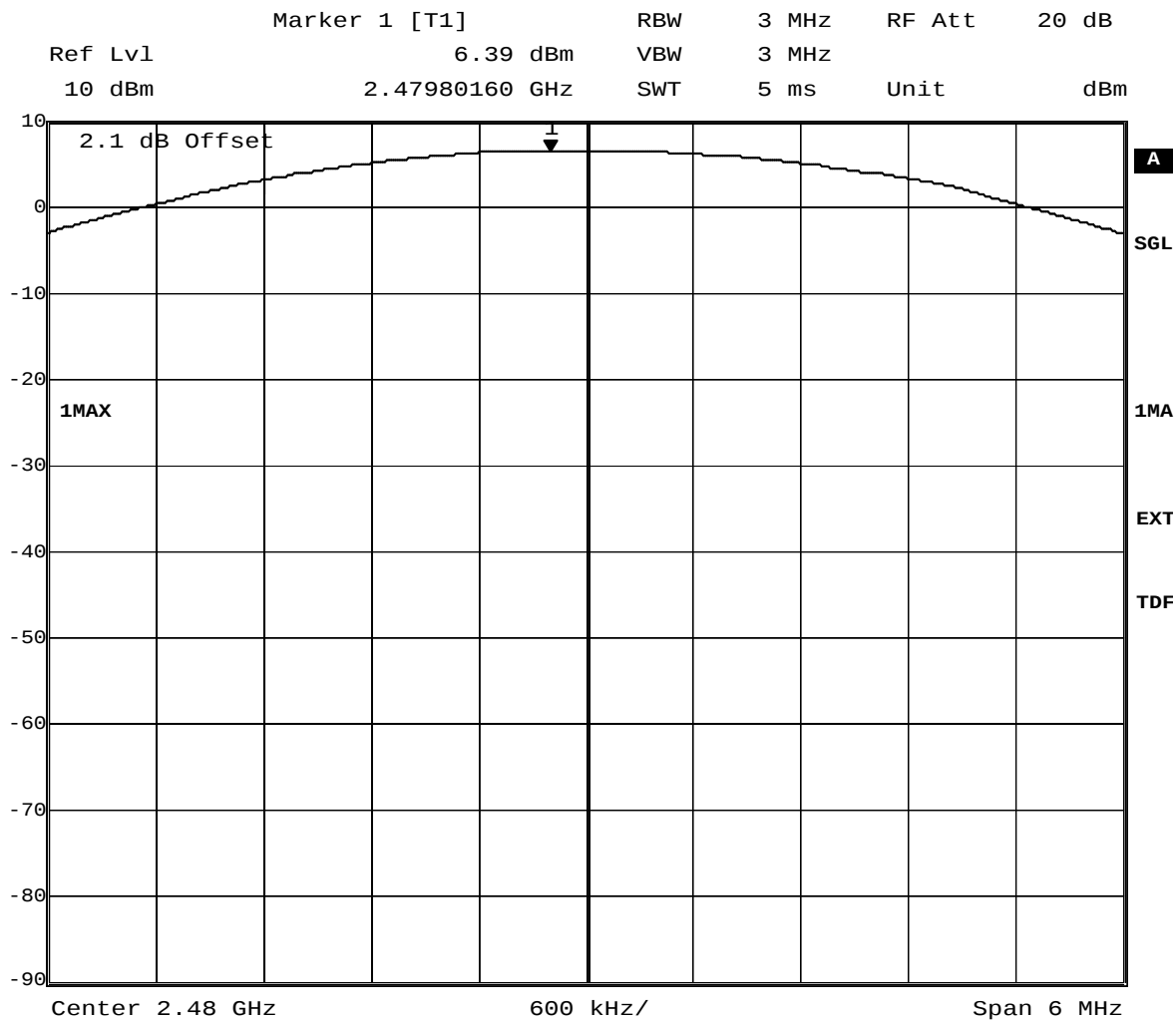
Comment A: CH M: 2441 MHz

Date: 21.JUL.2009 10:32:42

### 7.2.3 Peak power output operating mode 3

#### Op. Mode

op-mode 3

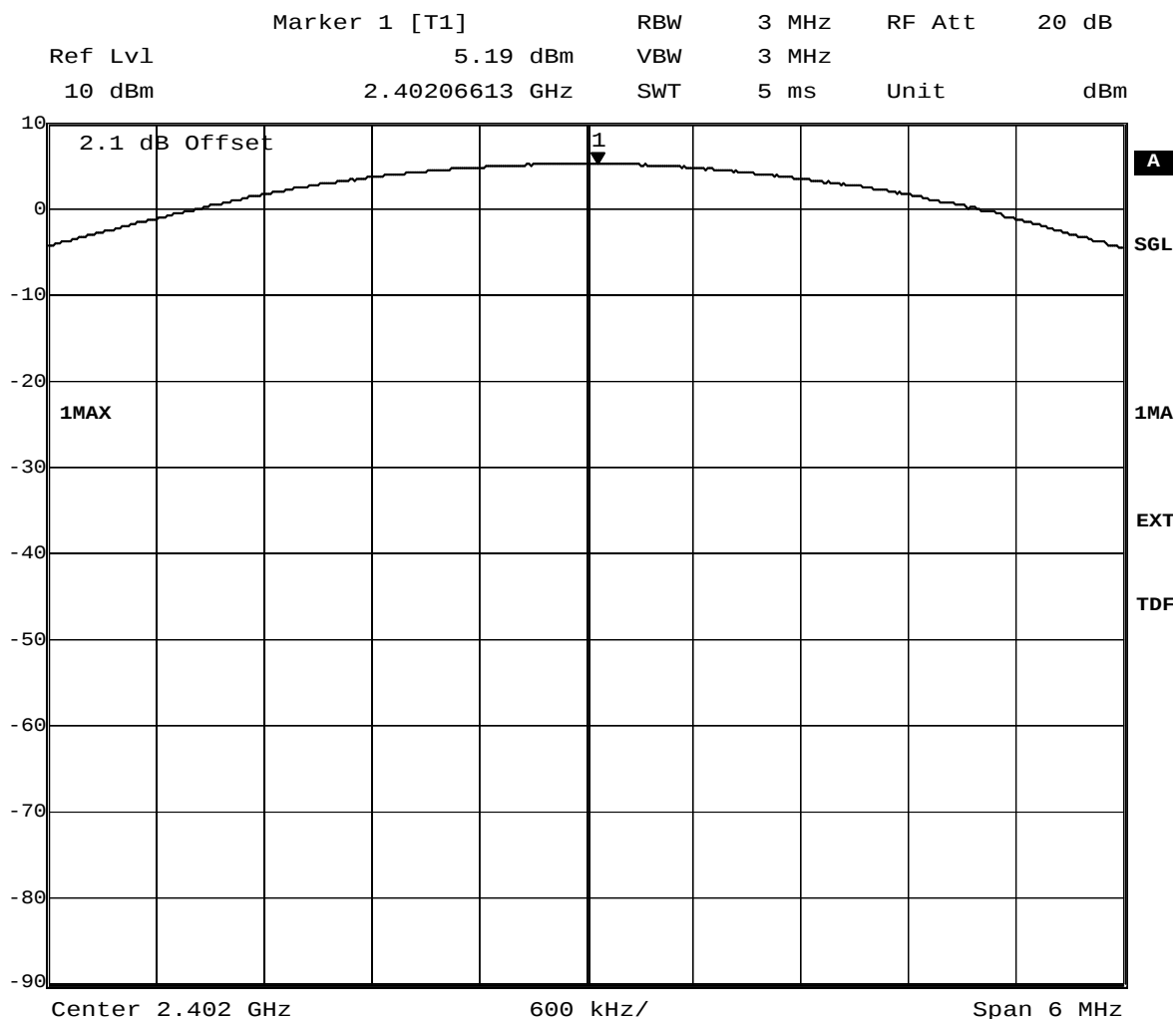


Title: Peak outputpower Power  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 10:05:20

## 7.2.4 Peak power output operating mode 6

### Op. Mode

op-mode 6

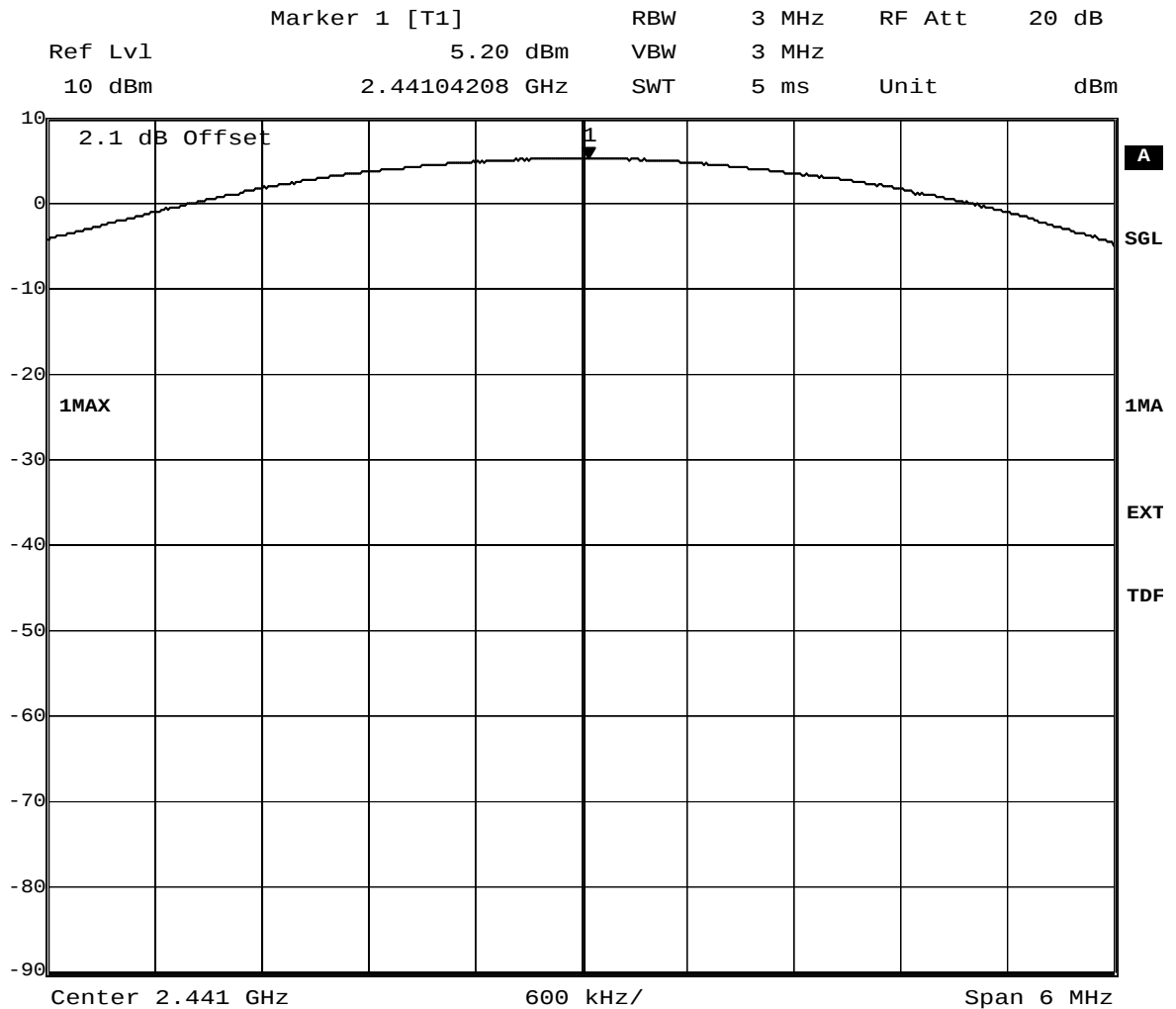


Title: Peak outputpower Power  
 Comment A: CH B: 2402 MHz  
 Date: 21.JUL.2009 12:44:32

## 7.2.5 Peak power output operating mode 7

### Op. Mode

op-mode 7

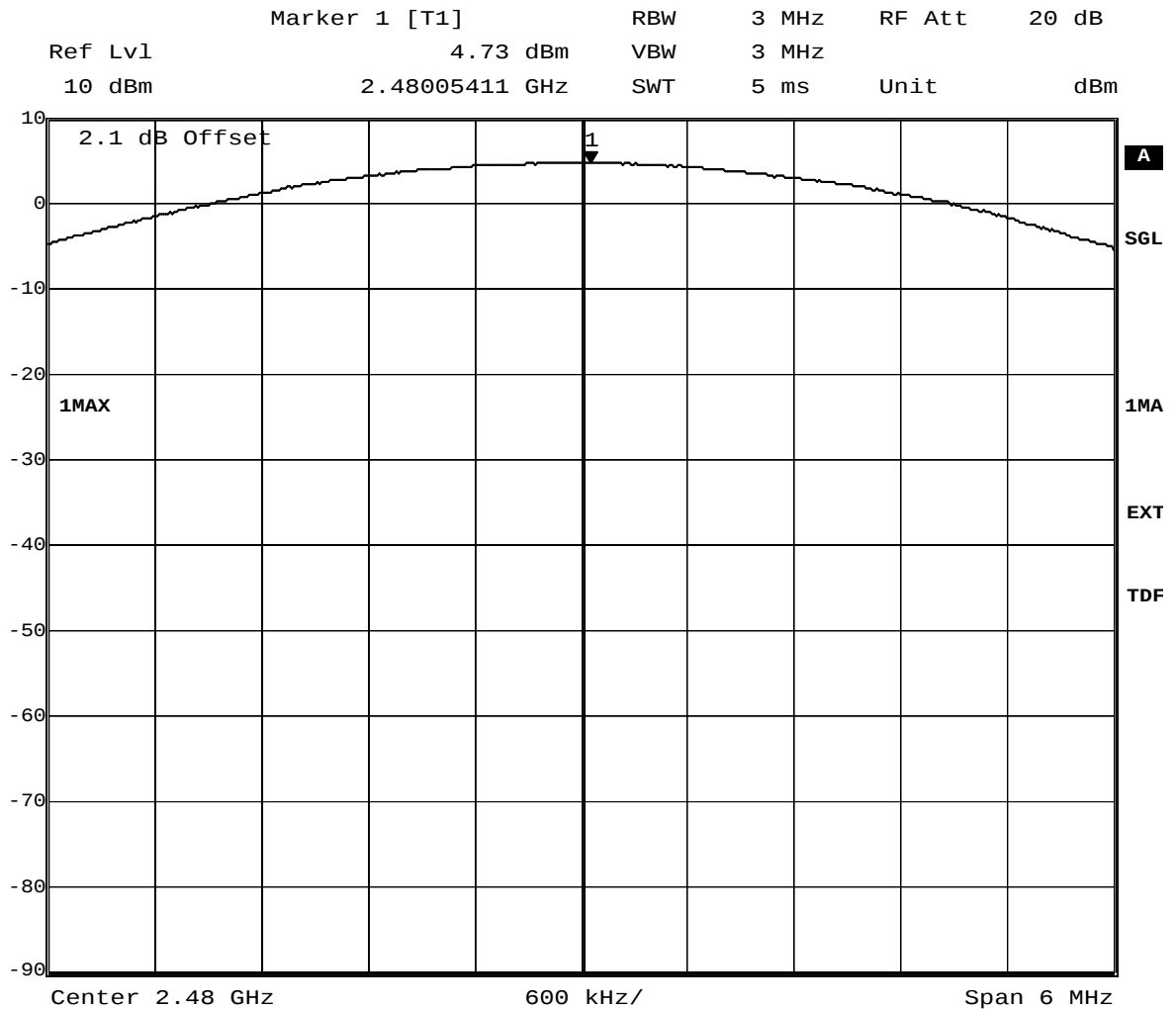


Title: Peak outputpower Power  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 13:16:48

## 7.2.6 Peak power output operating mode 8

### Op. Mode

op-mode 8

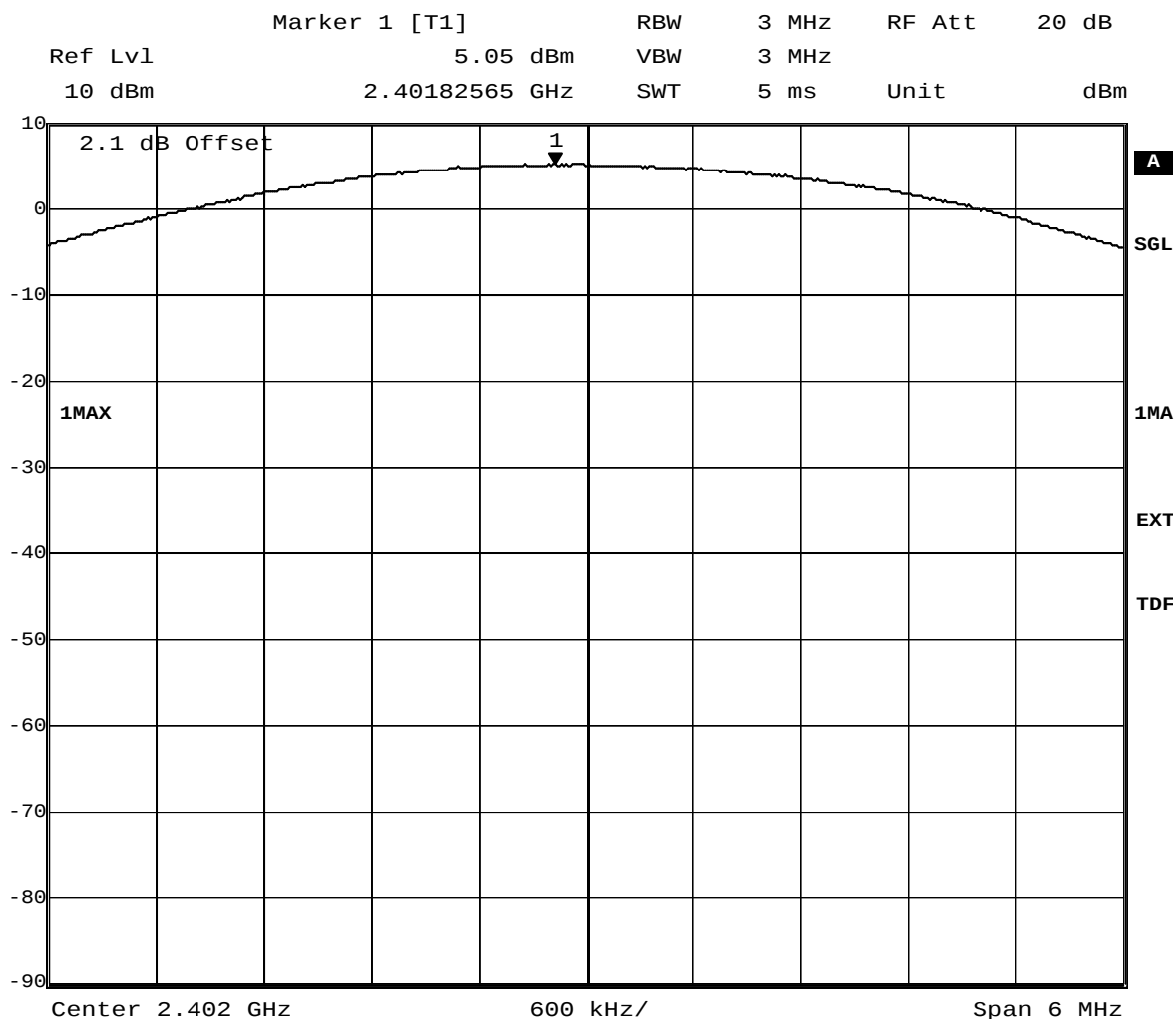


Title: Peak outputpower Power  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 13:21:50

## 7.2.7 Peak power output operating mode 10

### Op. Mode

op-mode 10

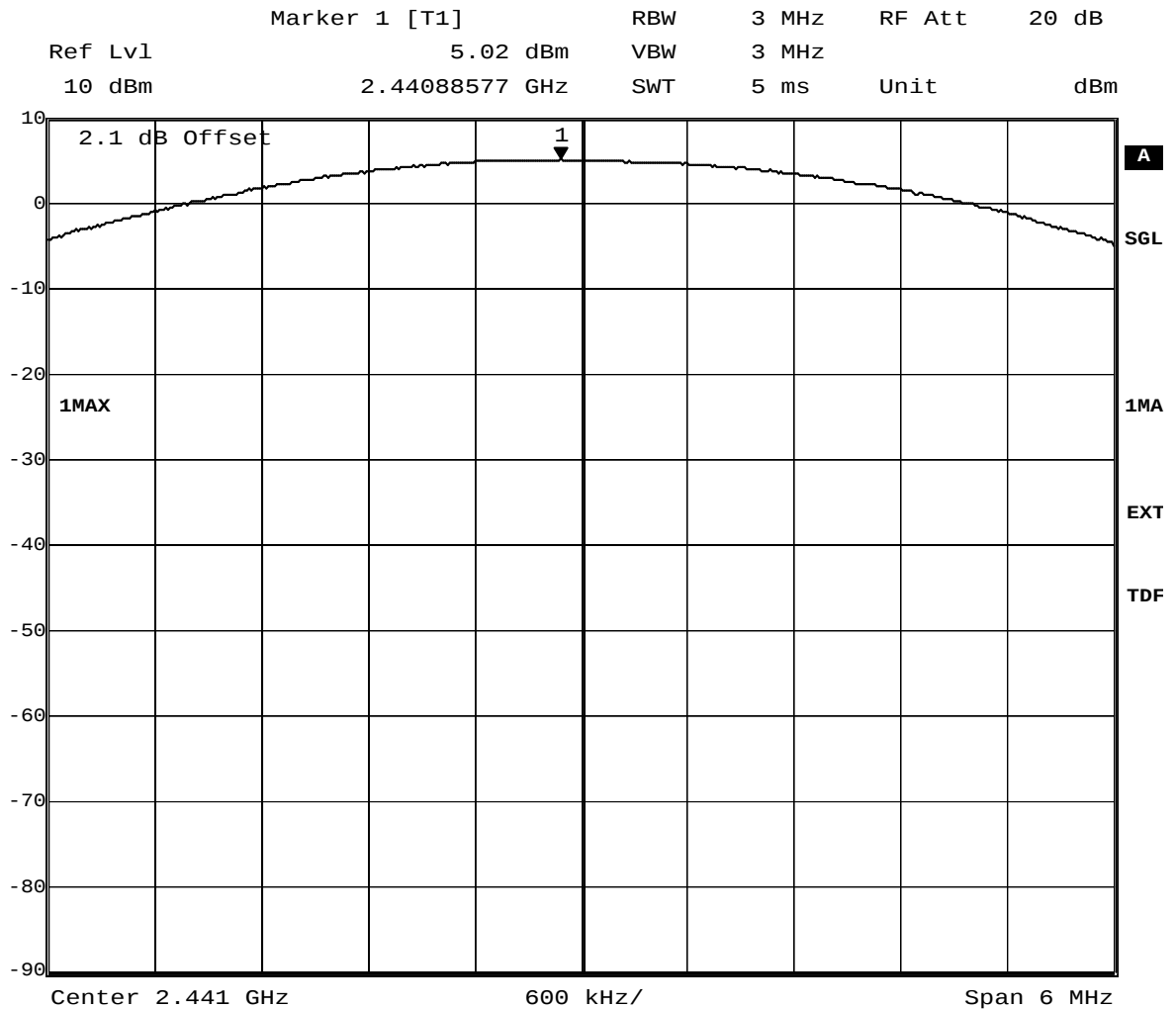


Title: Peak outputpower Power  
 Comment A: CH B: 2402 MHz  
 Date: 21.JUL.2009 12:33:28

## 7.2.8 Peak power output operating mode 11

### Op. Mode

op-mode 11

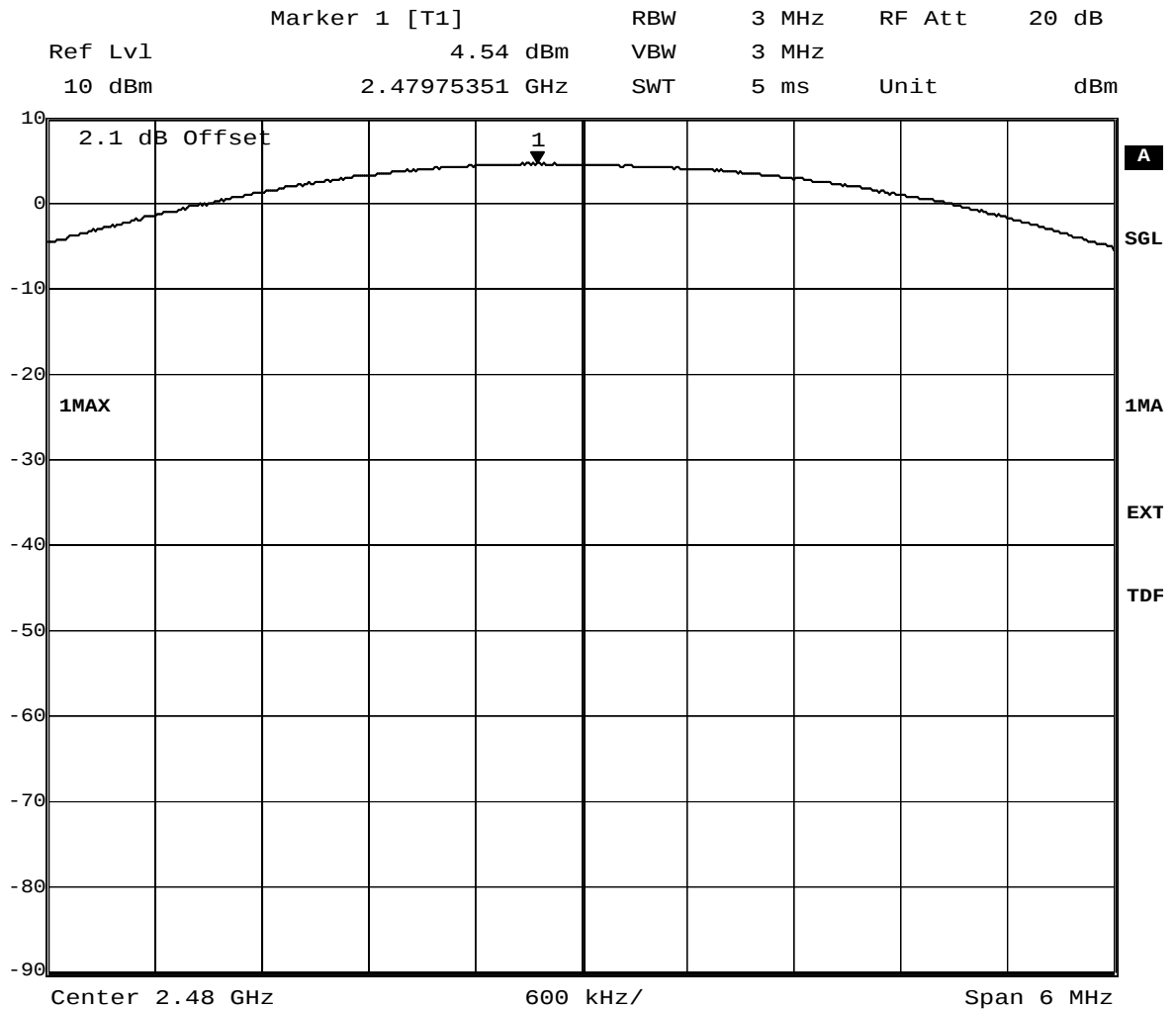


Title: Peak outputpower Power  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 11:49:50

## 7.2.9 Peak power output operating mode 12

### Op. Mode

op-mode 12



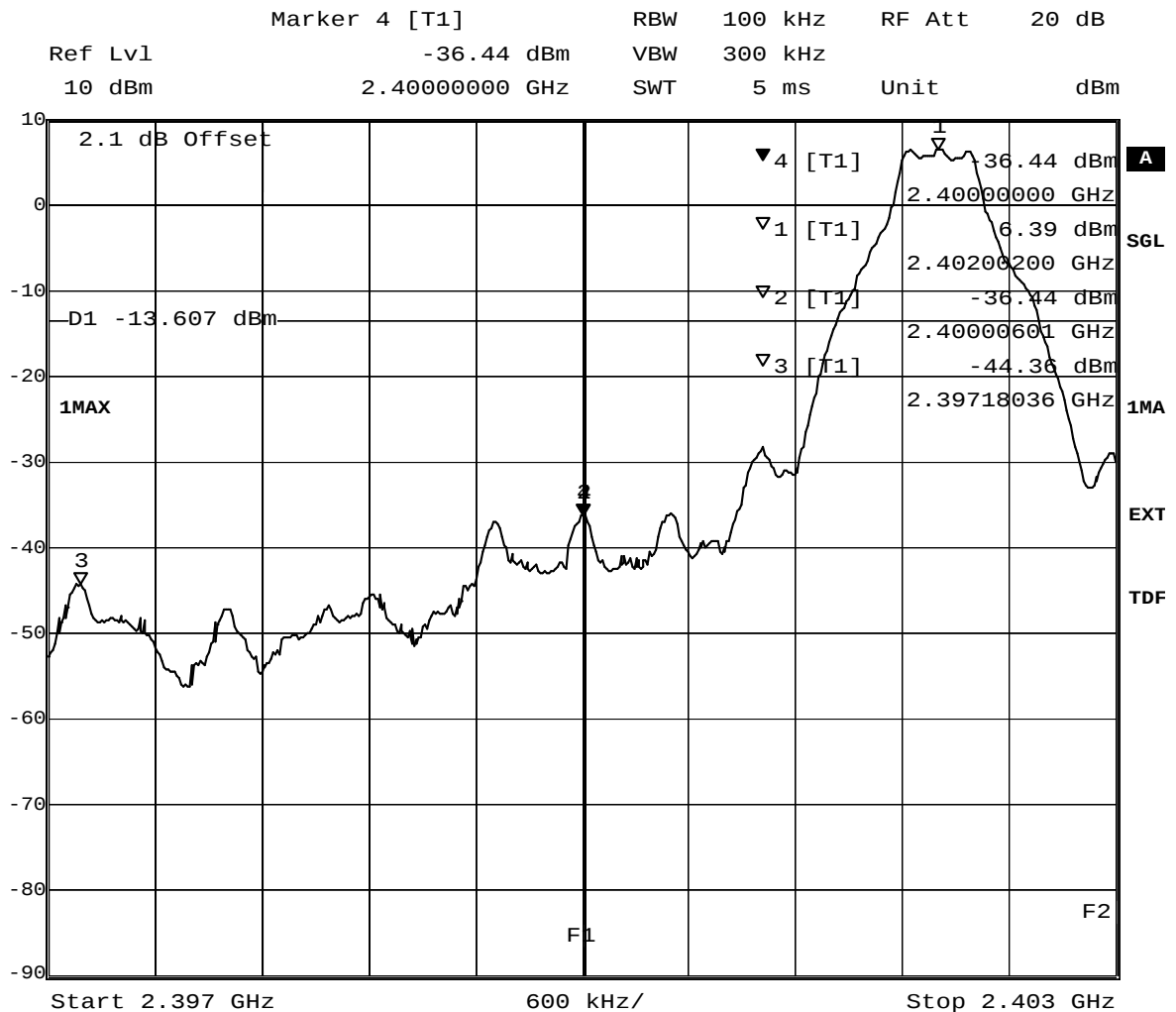
Title: Peak outputpower Power  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 11:55:25

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

### 7.3.1 Band edge compliance conducted operating mode 1

#### Op. Mode

op-mode 1



Title: Band Edge Compliance

Comment A: CH B: 2402 MHz

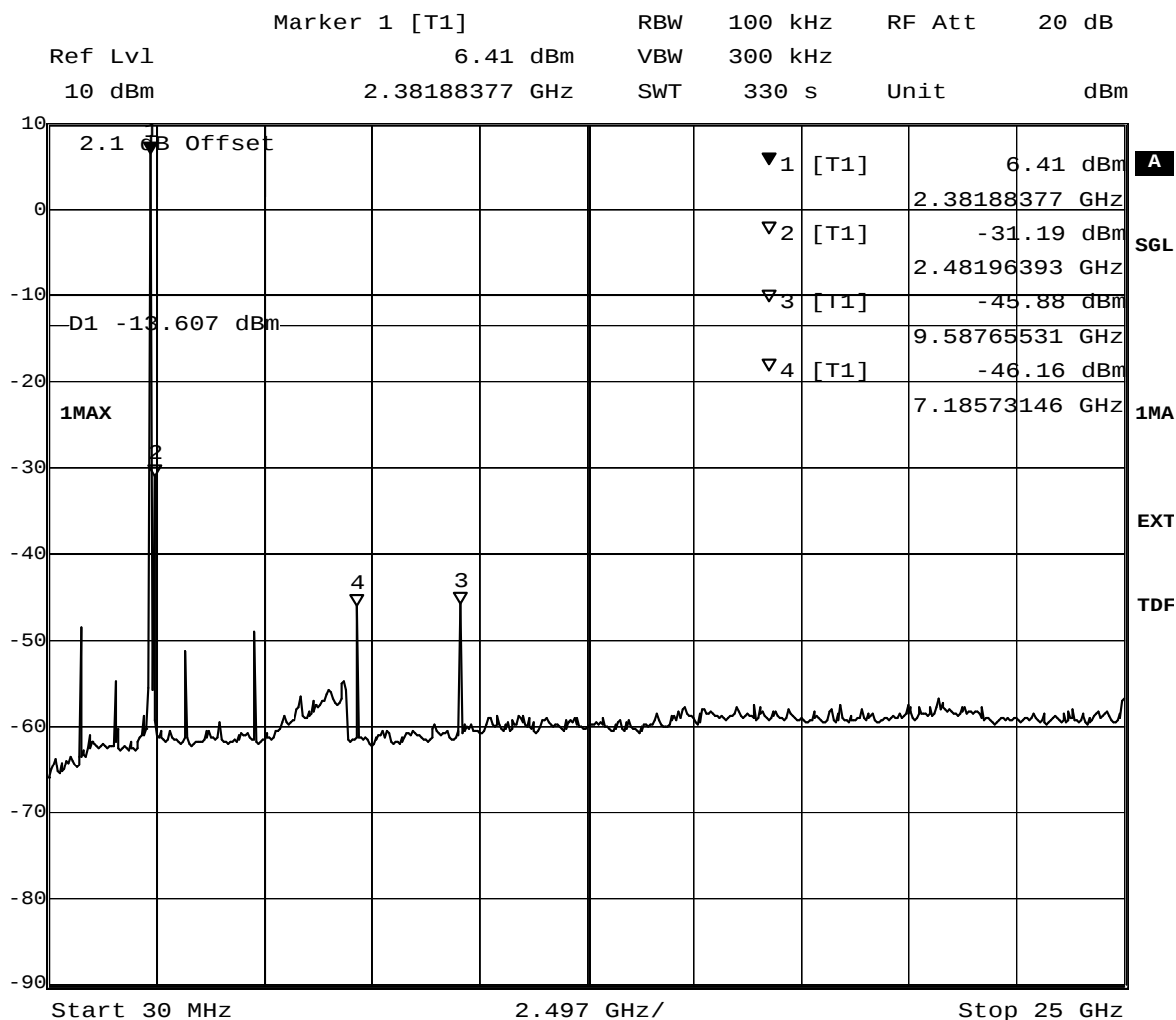
Date: 21.JUL.2009 08:49:31

(determination of reference value for spurious emissions measurement)

### 7.3.2 Spurious RF conducted emissions operating mode 1

#### Op. Mode

op-mode 1



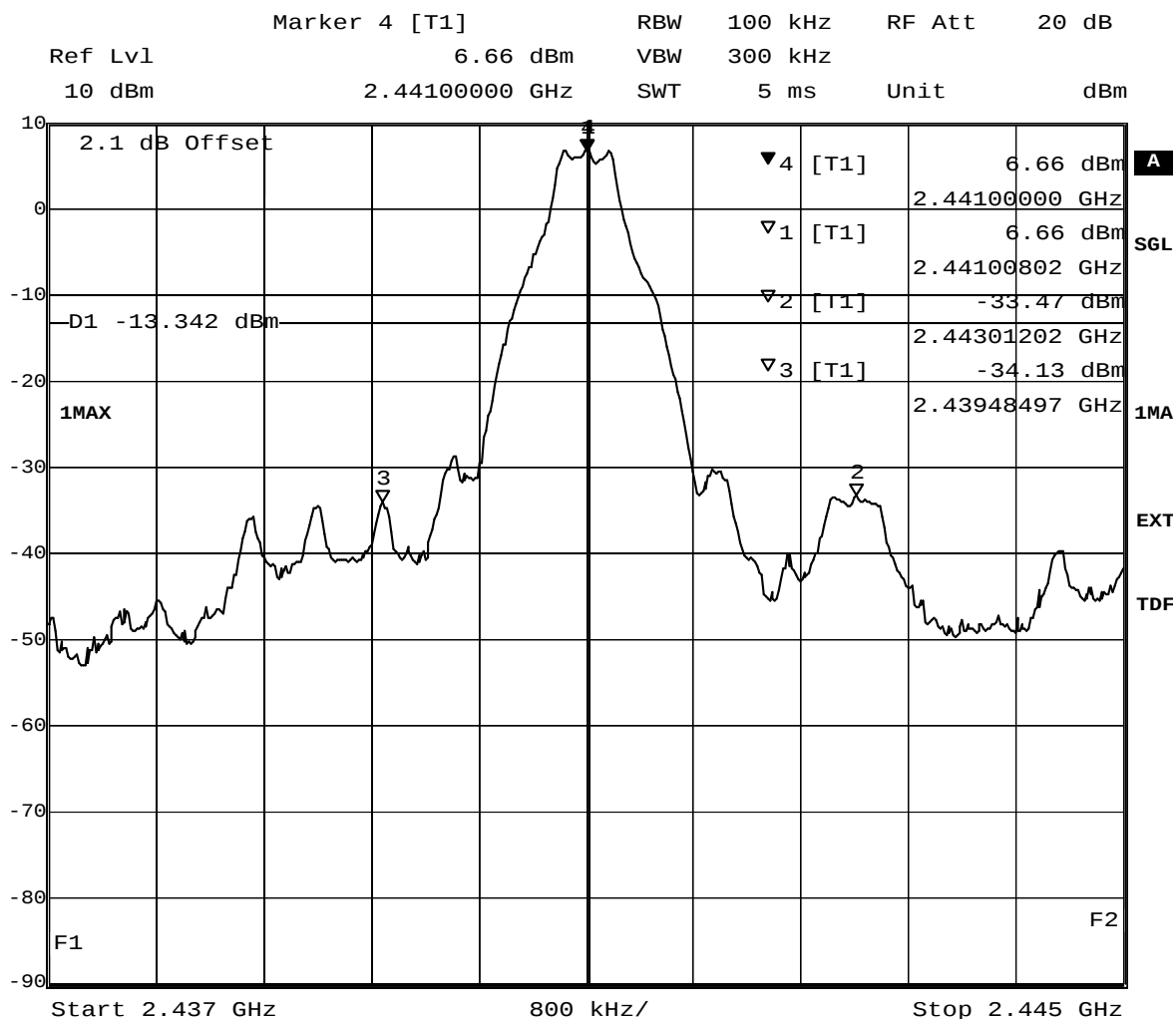
Title: spurious emissions  
 Comment A: CH B: 2402 MHz  
 Date: 21.JUL.2009 09:01:09

(spurious emissions measurement)

### 7.3.3 Spurious RF conducted emissions operating mode 2

#### Op. Mode

op-mode 2

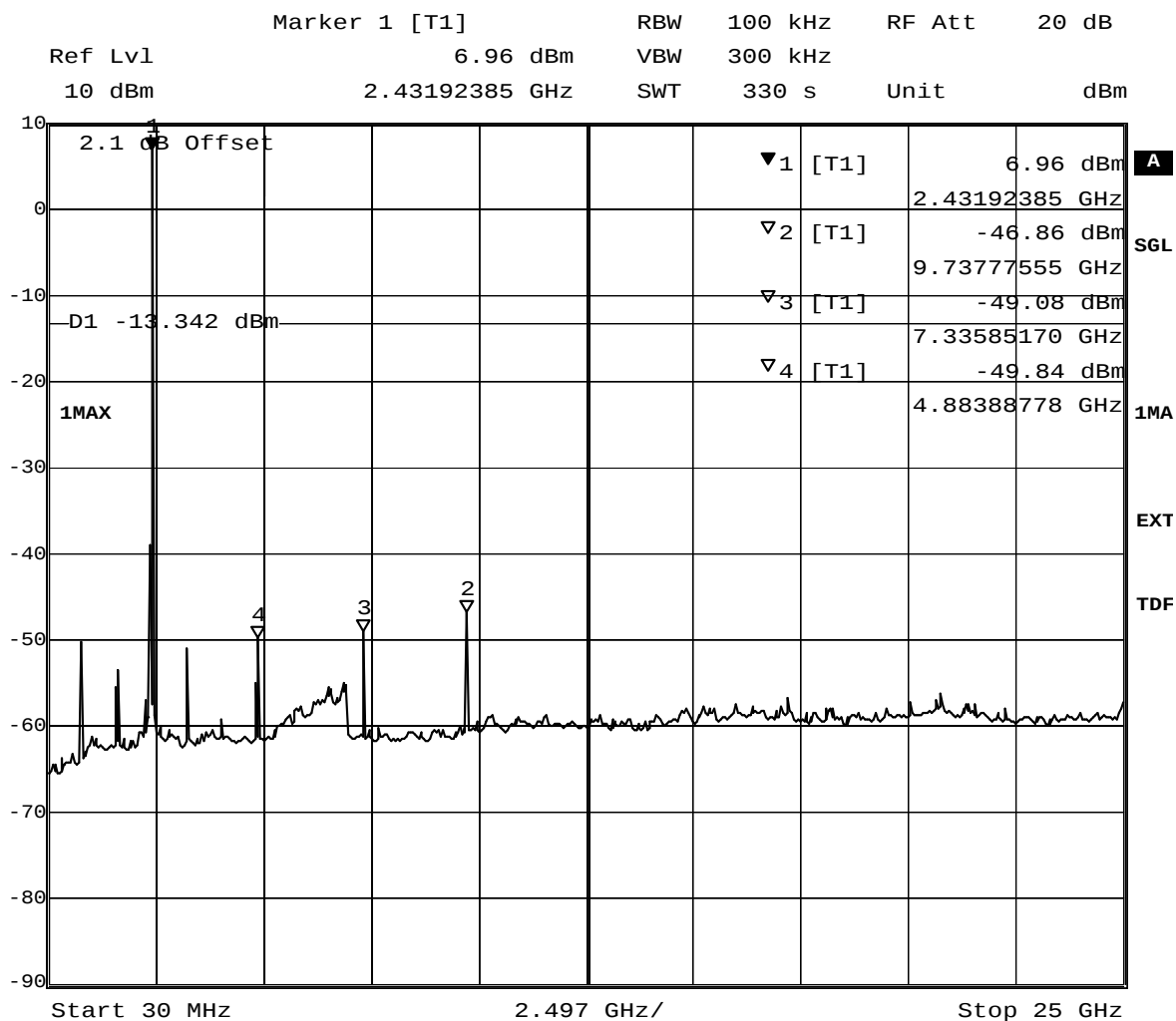


Title: Band Edge Compliance

Comment A: CH M: 2441 MHz

Date: 21.JUL.2009 10:16:32

(determination of reference value for spurious emissions measurement)



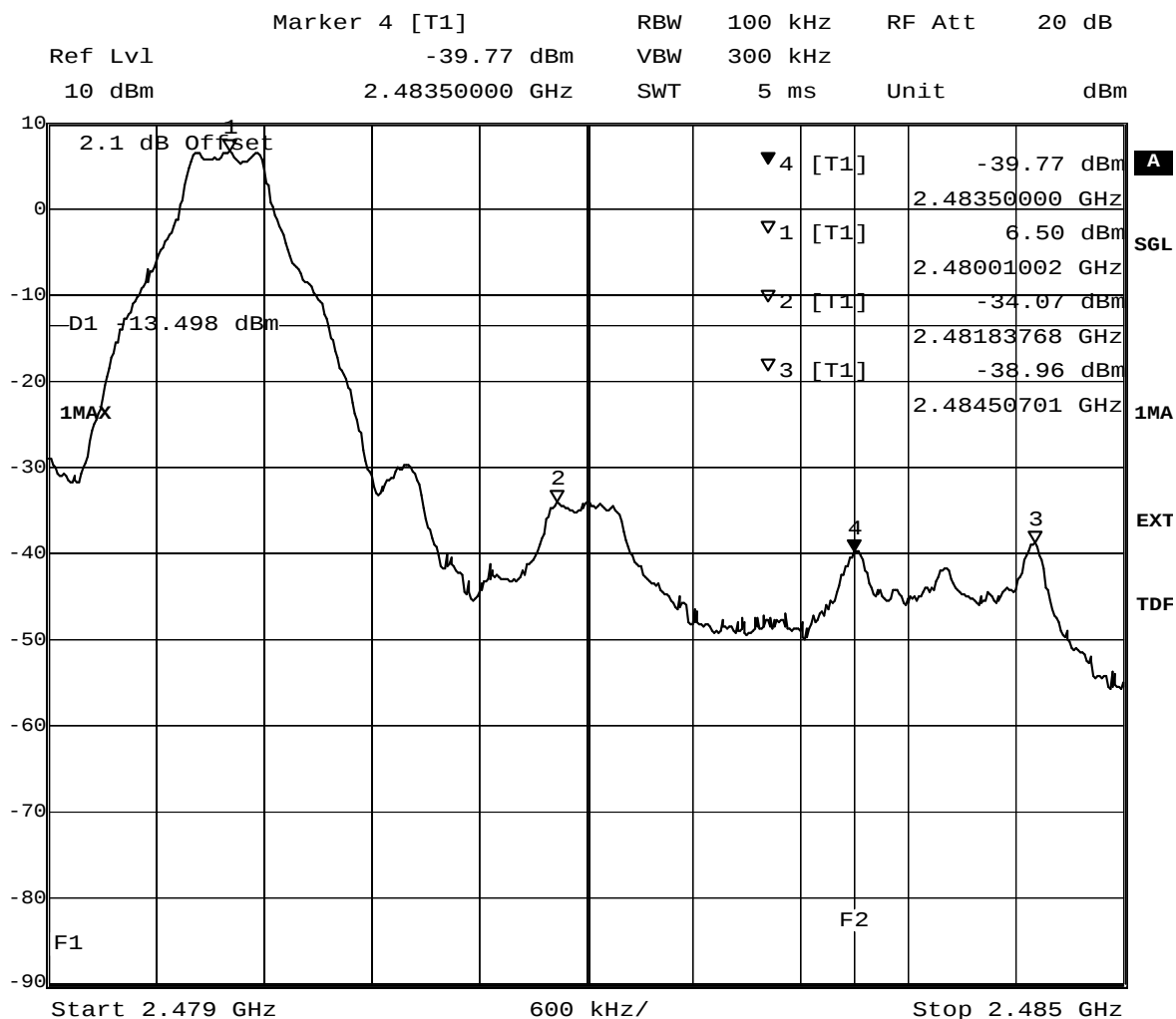
Title: spurious emissions  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 10:28:09

(spurious emissions measurement)

### 7.3.4 Band edge compliance conducted operating mode 3

#### Op. Mode

op-mode 3



Title: Band Edge Compliance

Comment A: CH T: 2480 MHz

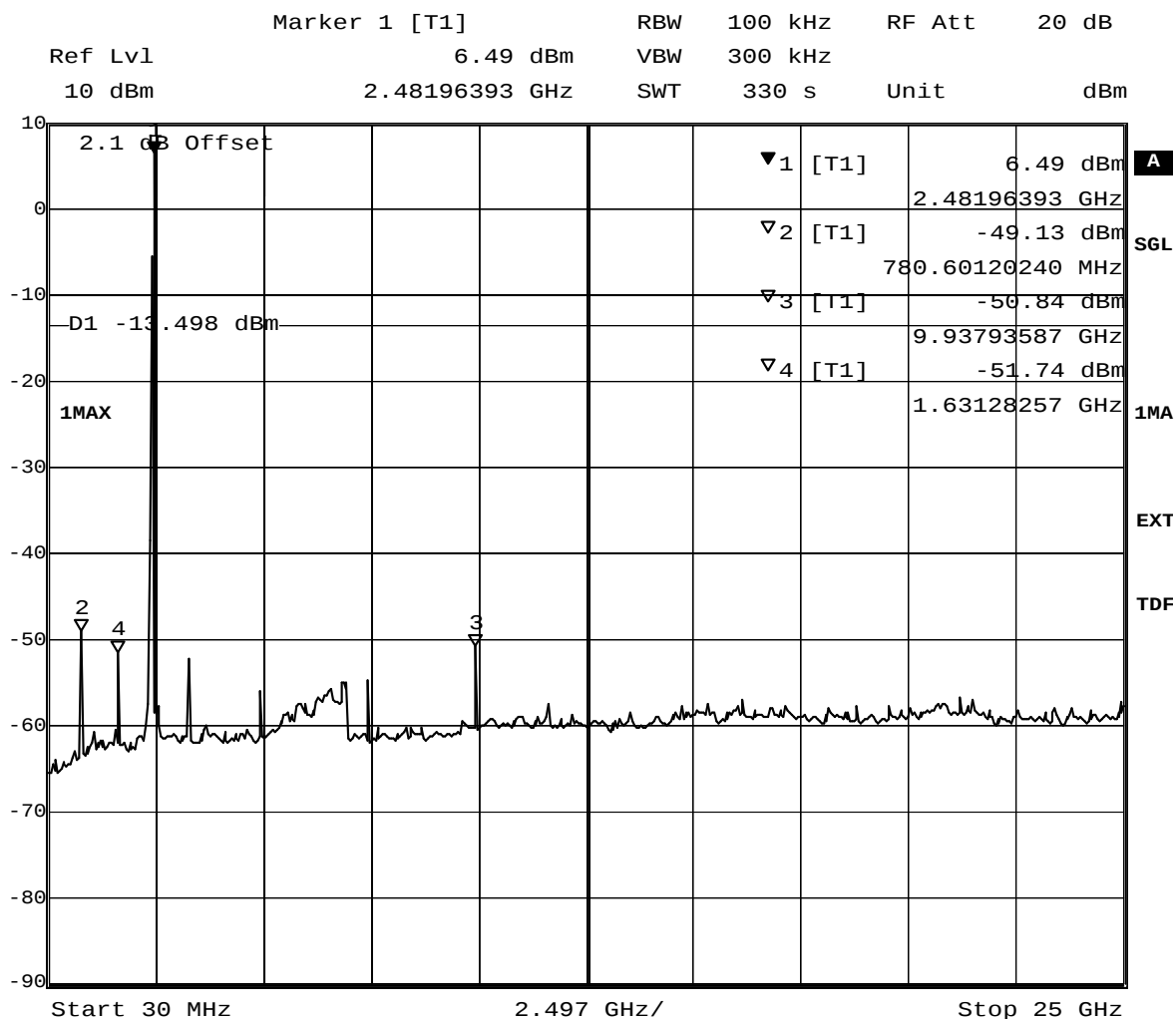
Date: 21.JUL.2009 09:47:39

(determination of reference value for spurious emissions measurement)

### 7.3.5 Spurious RF conducted emissions operating mode 3

#### Op. Mode

op-mode 3



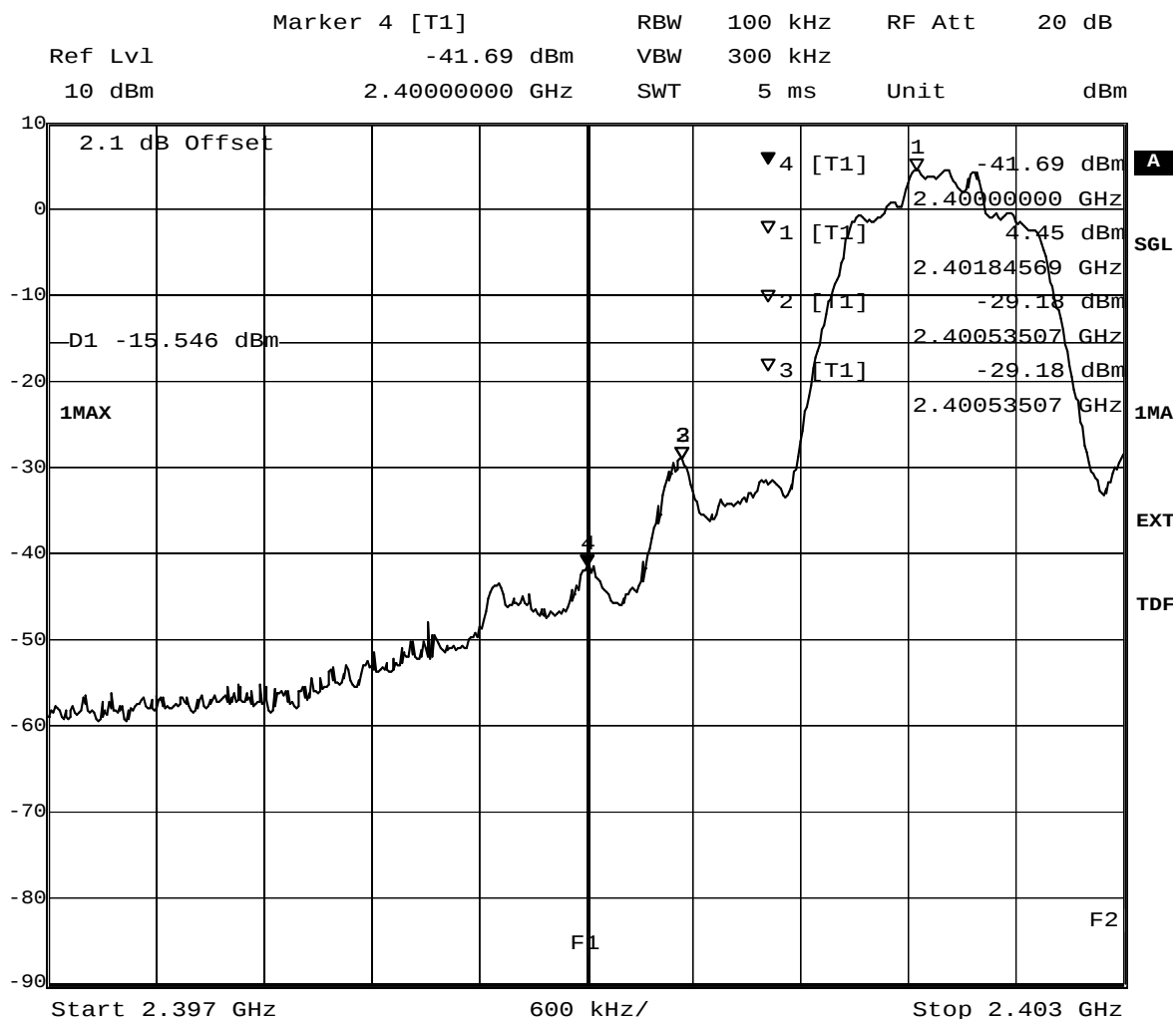
Title: spurious emissions  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 09:59:18

(spurious emissions measurement)

### 7.3.6 Band edge compliance conducted operating mode 6

#### Op. Mode

op-mode 6



Title: Band Edge Compliance

Comment A: CH B: 2402 MHz

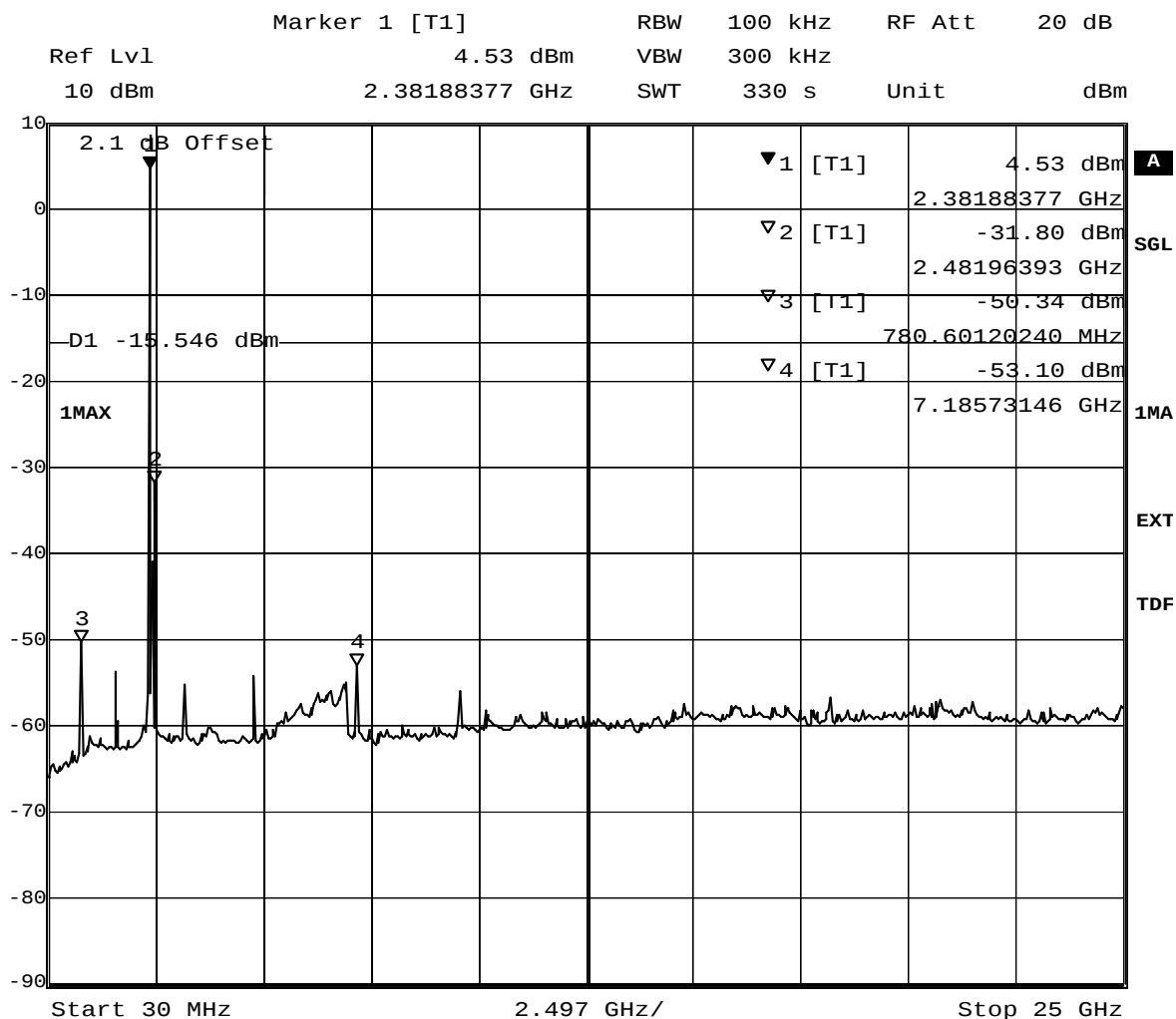
Date: 21.JUL.2009 12:46:33

(determination of reference value for spurious emissions measurement)

### 7.3.7 Spurious RF conducted emissions operating mode 6

#### Op. Mode

op-mode 6



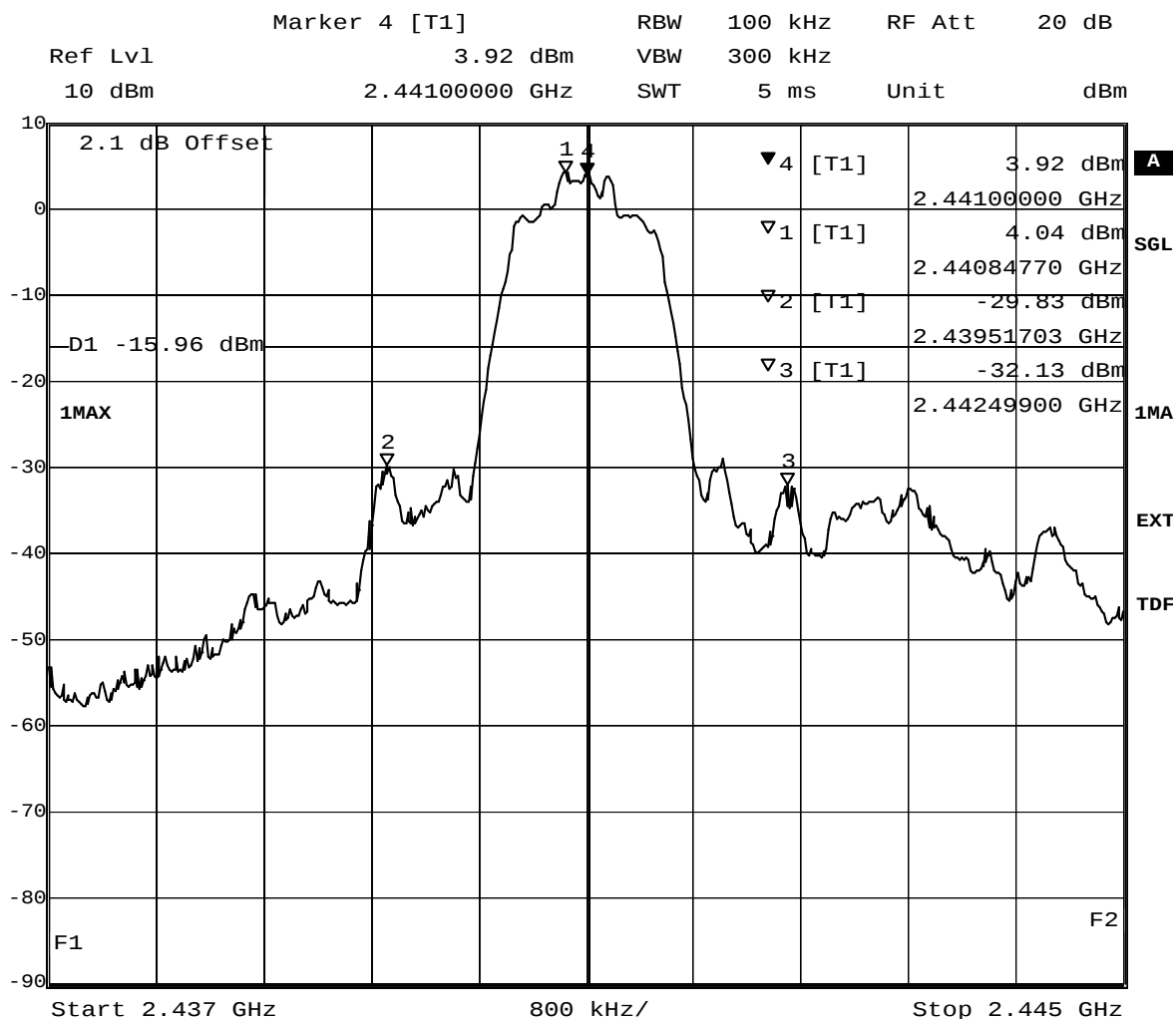
Title: spurious emissions  
 Comment A: CH B: 2402 MHz  
 Date: 21.JUL.2009 12:58:10

(spurious emissions measurement)

### 7.3.8 Spurious RF conducted emissions operating mode 7

#### Op. Mode

op-mode 7

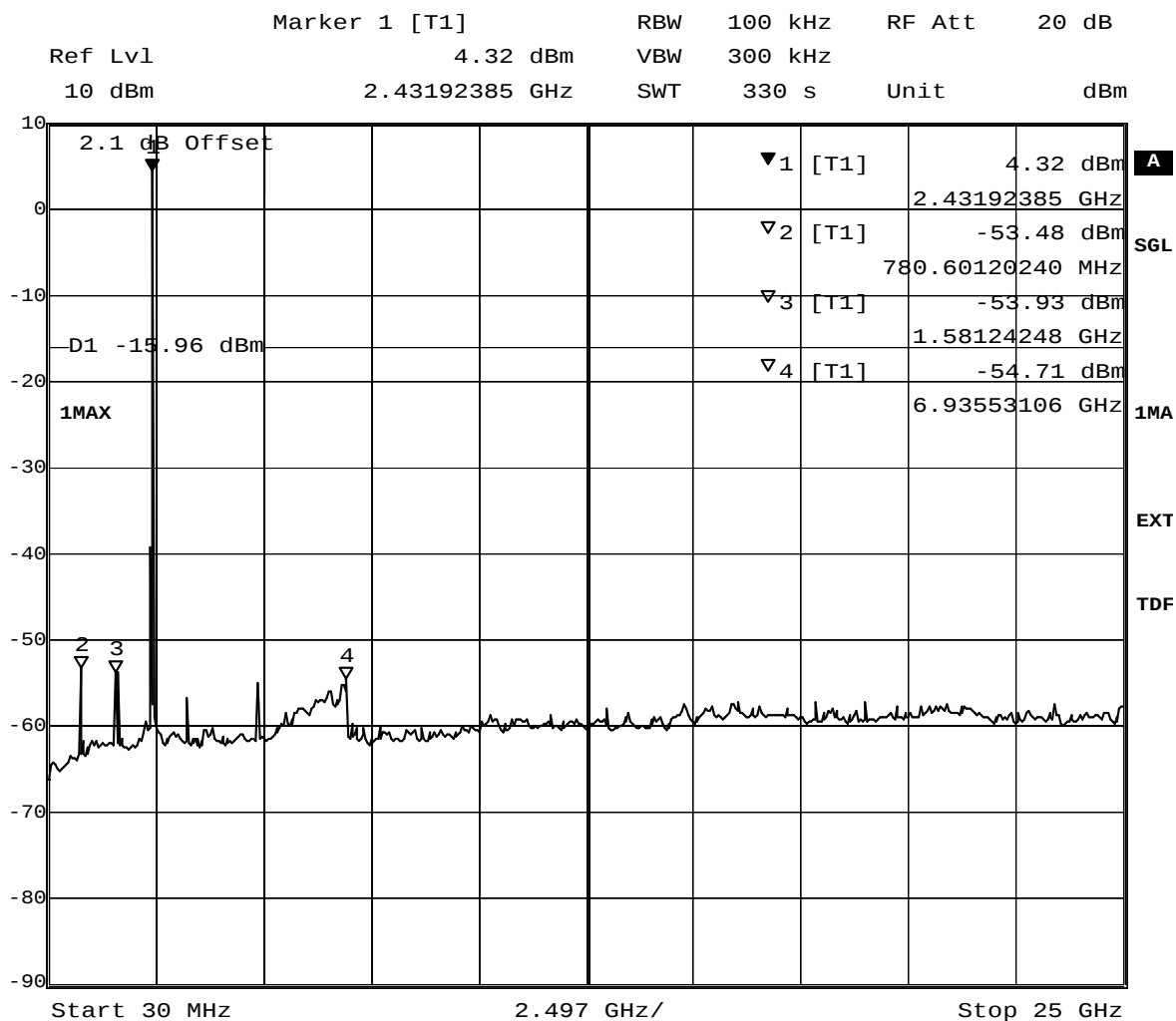


Title: Band Edge Compliance

Comment A: CH M: 2441 MHz

Date: 21.JUL.2009 13:00:37

(determination of reference value for spurious emissions measurement)



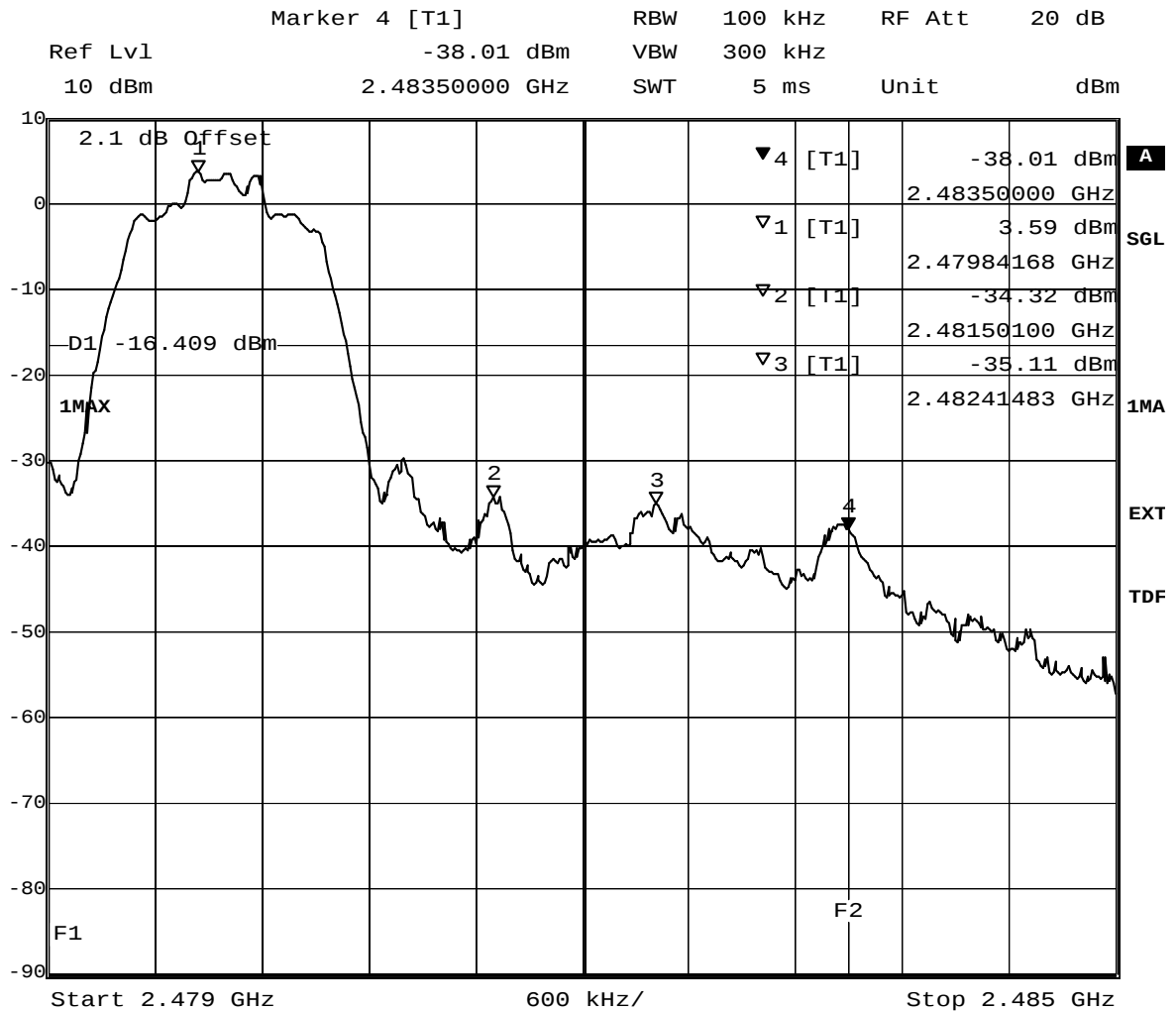
Title: spurious emissions  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 13:12:14

(spurious emissions measurement)

### 7.3.9 Band edge compliance conducted operating mode 8

#### Op. Mode

op-mode 8



Title: Band Edge Compliance

Comment A: CH T: 2480 MHz

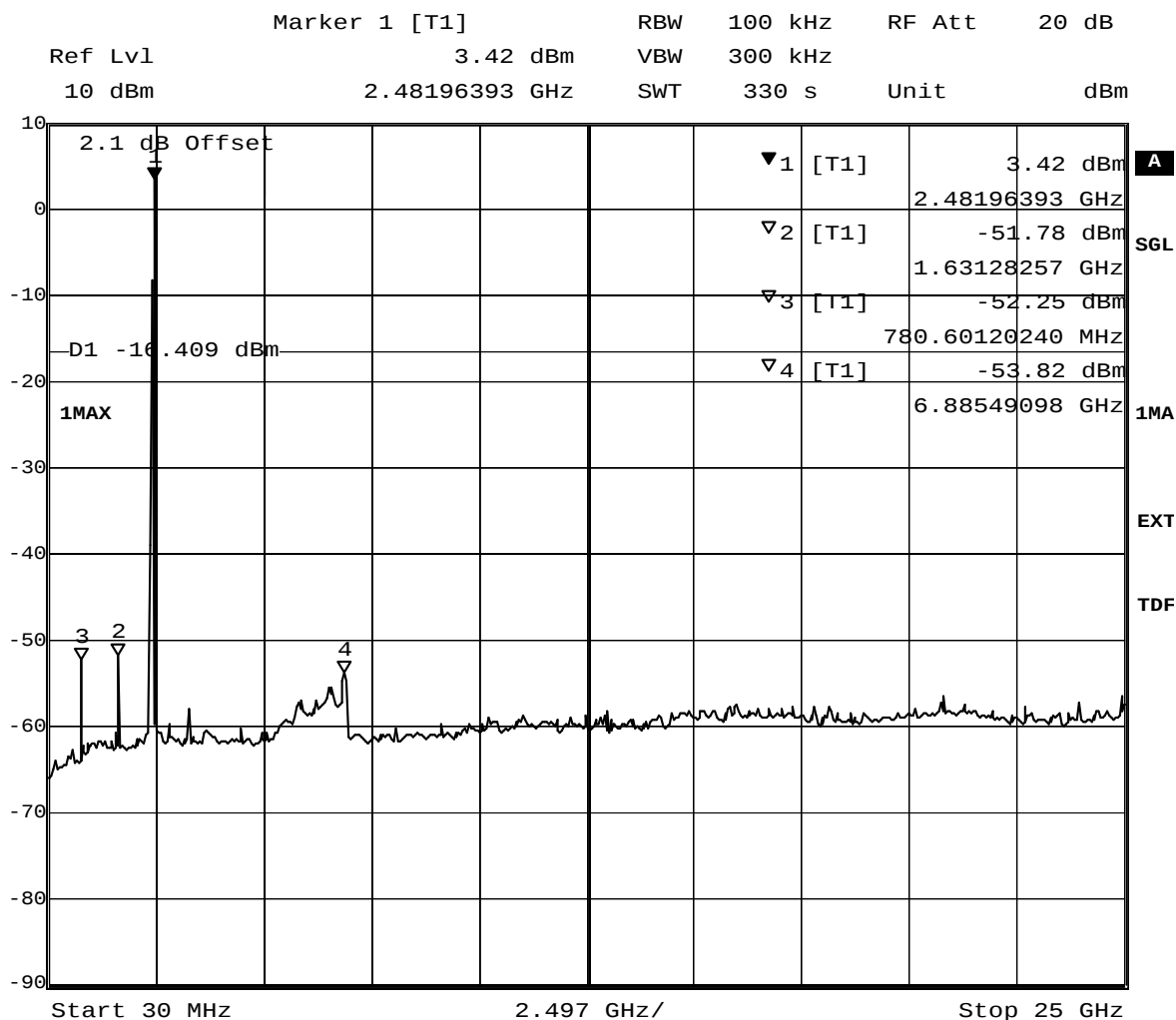
Date: 21.JUL.2009 13:23:46

(determination of reference value for spurious emissions measurement)

### 7.3.10 Spurious RF conducted emissions operating mode 8

#### Op. Mode

op-mode 8



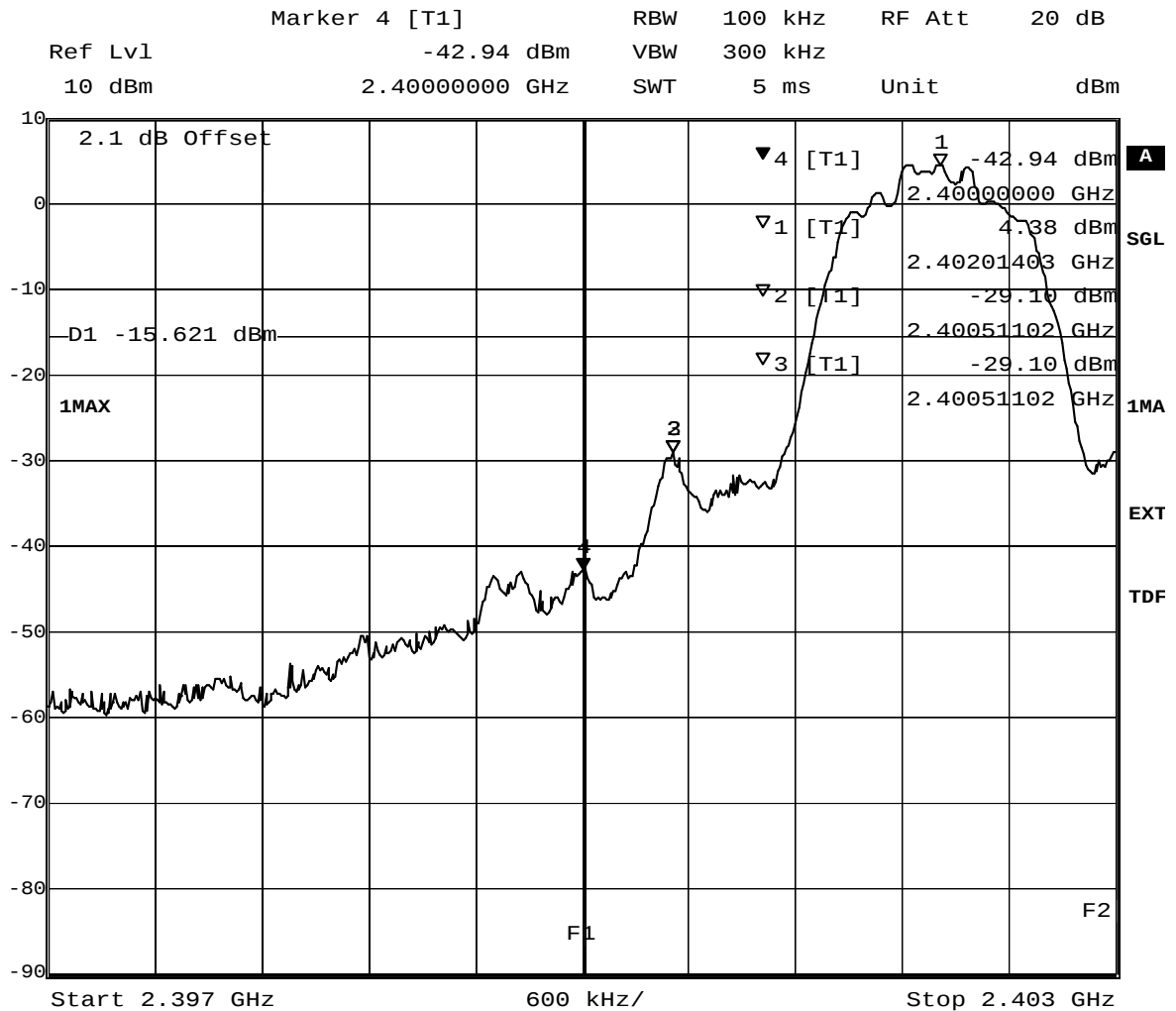
Title: spurious emissions  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 13:35:24

(spurious emissions measurement)

### 7.3.11 Band edge compliance conducted operating mode 10

#### Op. Mode

op-mode 10



Title: Band Edge Compliance

Comment A: CH B: 2402 MHz

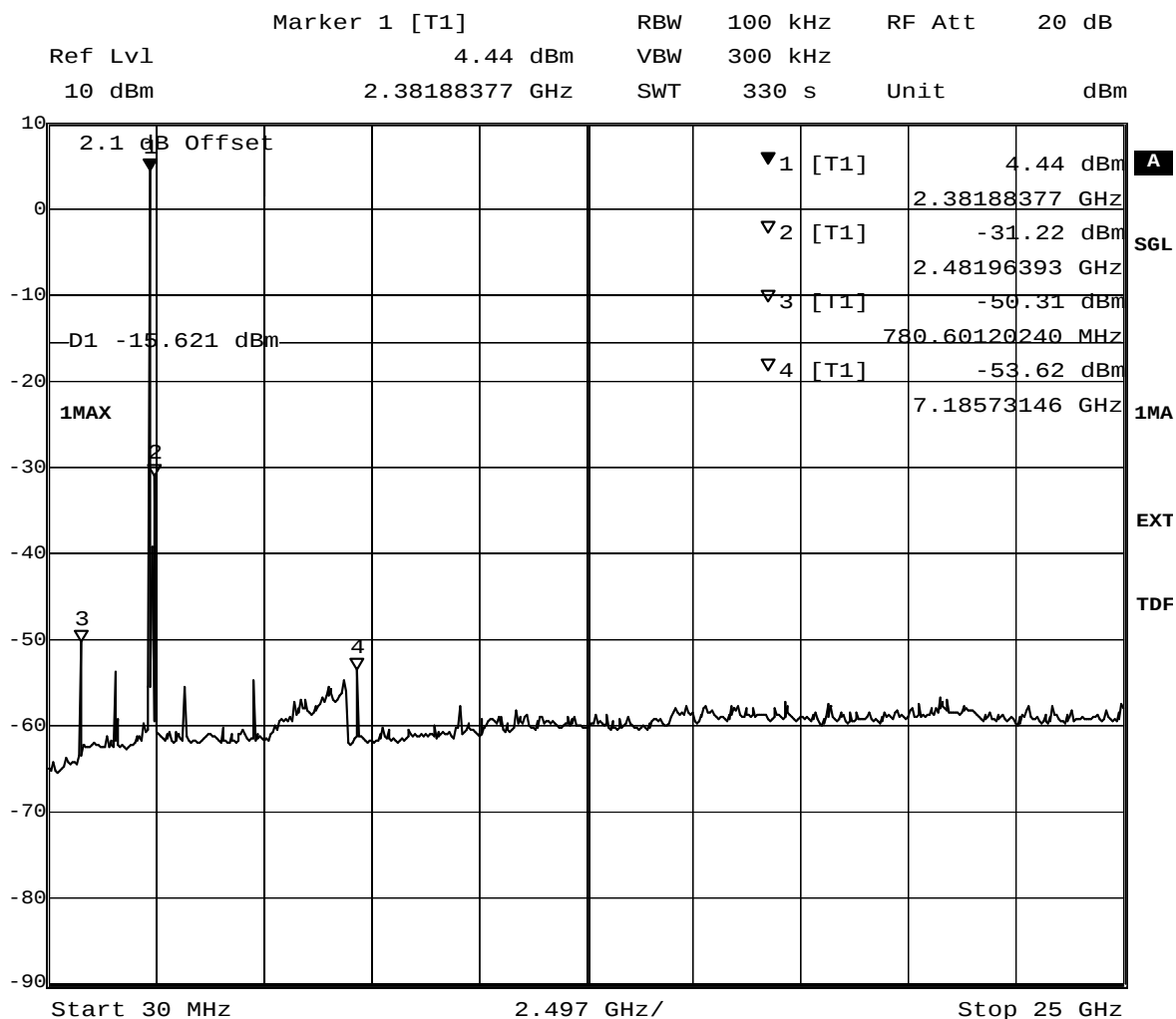
Date: 21.JUL.2009 12:16:59

(determination of reference value for spurious emissions measurement)

### 7.3.12 Spurious RF conducted emissions operating mode 10

#### Op. Mode

op-mode 10



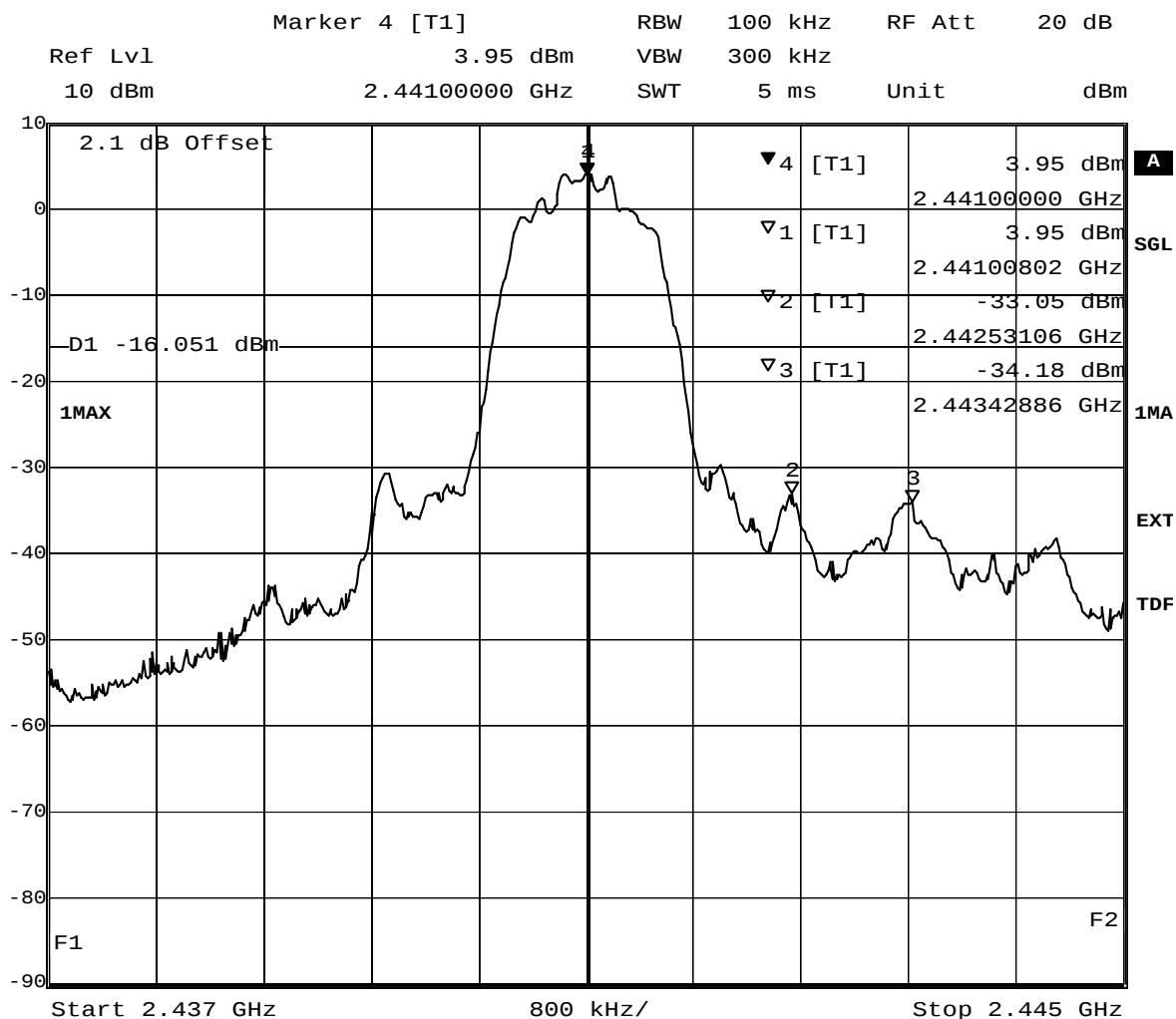
Title: spurious emissions  
 Comment A: CH B: 2402 MHz  
 Date: 21.JUL.2009 12:28:38

(spurious emissions measurement)

### 7.3.13 Band edge compliance conducted operating mode 11

#### Op. Mode

op-mode 11



Title: Band Edge Compliance

Comment A: CH M: 2441 MHz

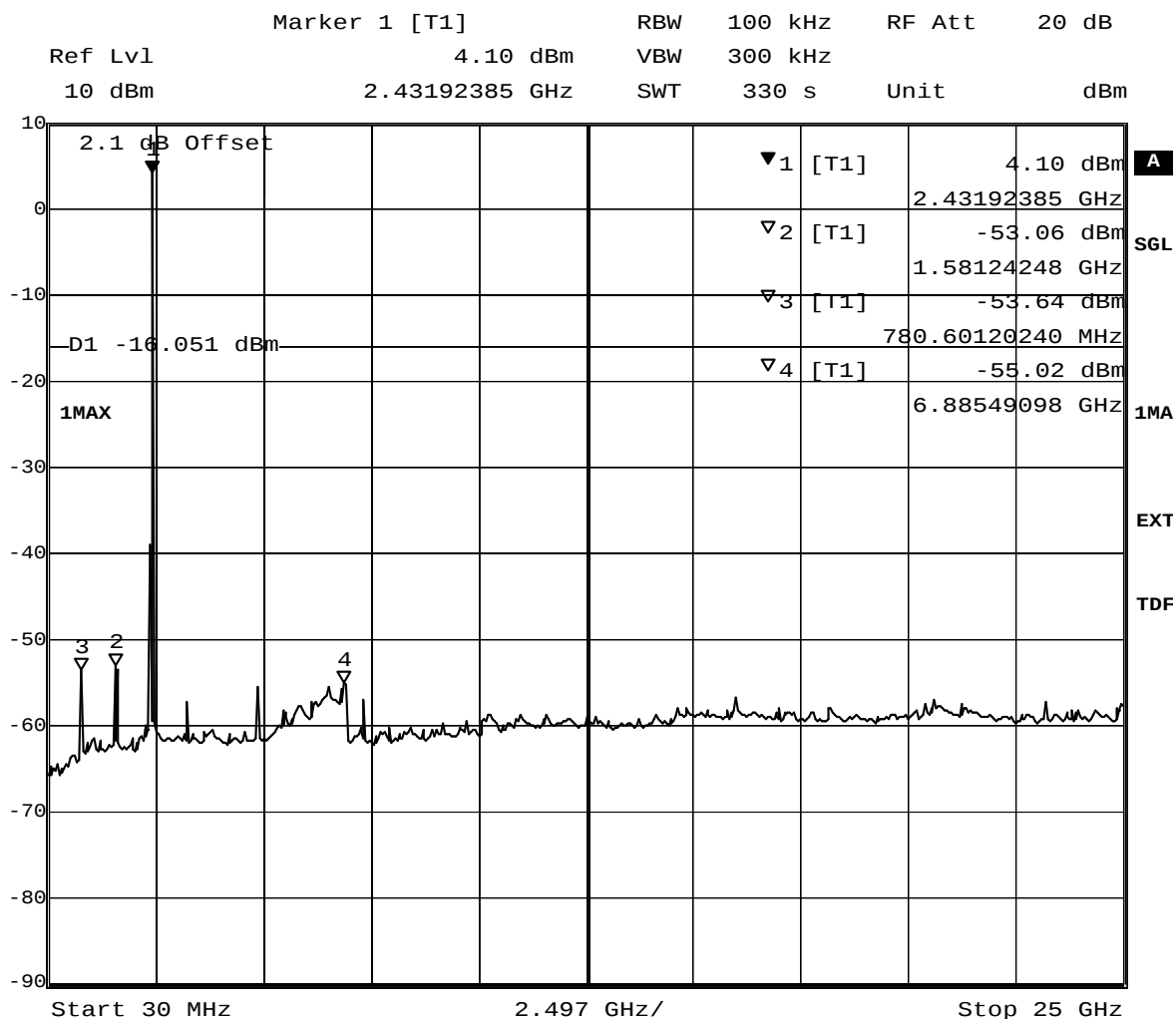
Date: 21.JUL.2009 11:32:08

(determination of reference value for spurious emissions measurement)

### 7.3.14 Spurious RF conducted emissions operating mode 11

#### Op. Mode

op-mode 11



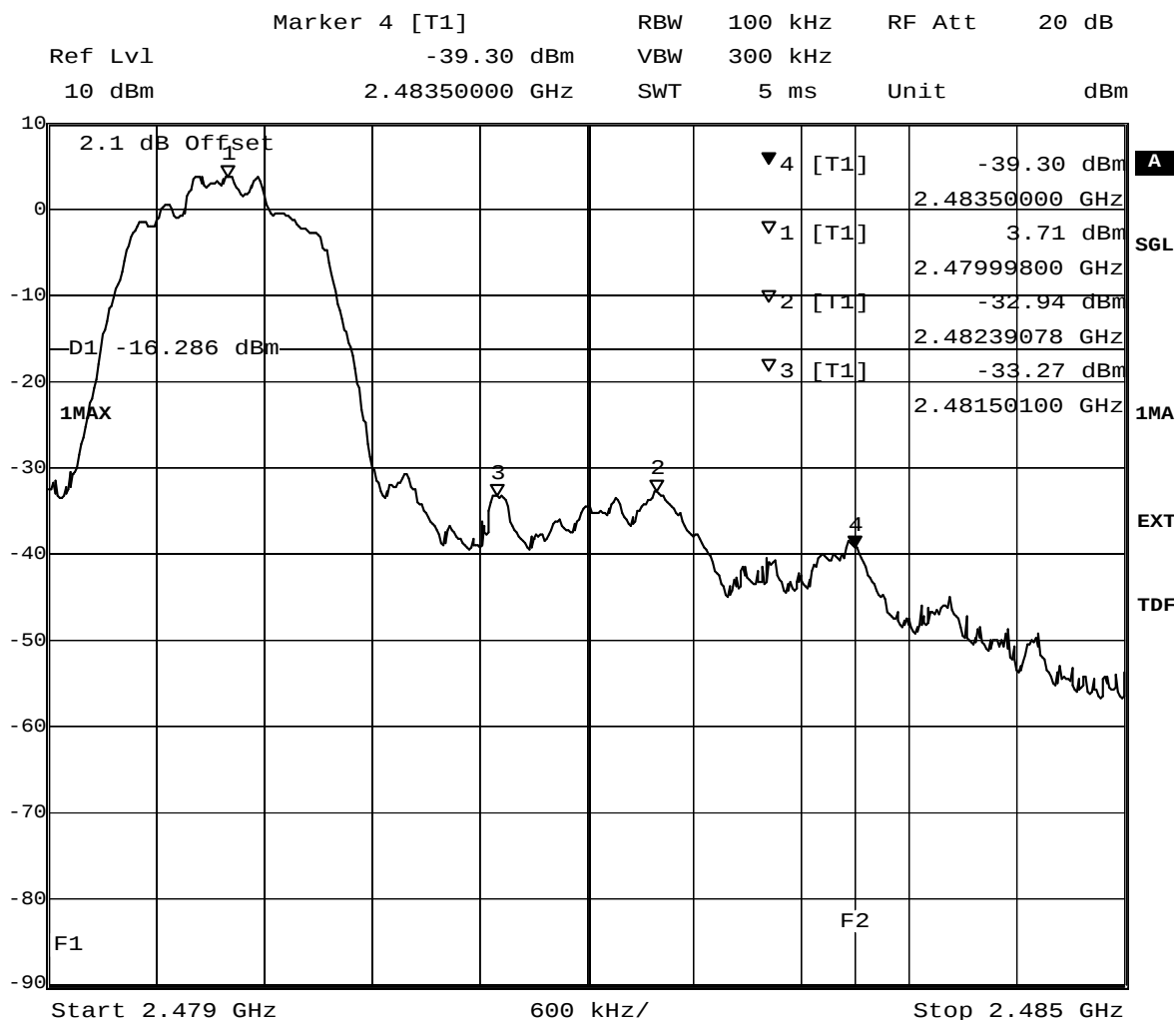
Title: spurious emissions  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 11:43:46

(spurious emissions measurement)

### 7.3.15 Band edge compliance conducted operating mode 12

#### Op. Mode

op-mode 12



Title: Band Edge Compliance

Comment A: CH T: 2480 MHz

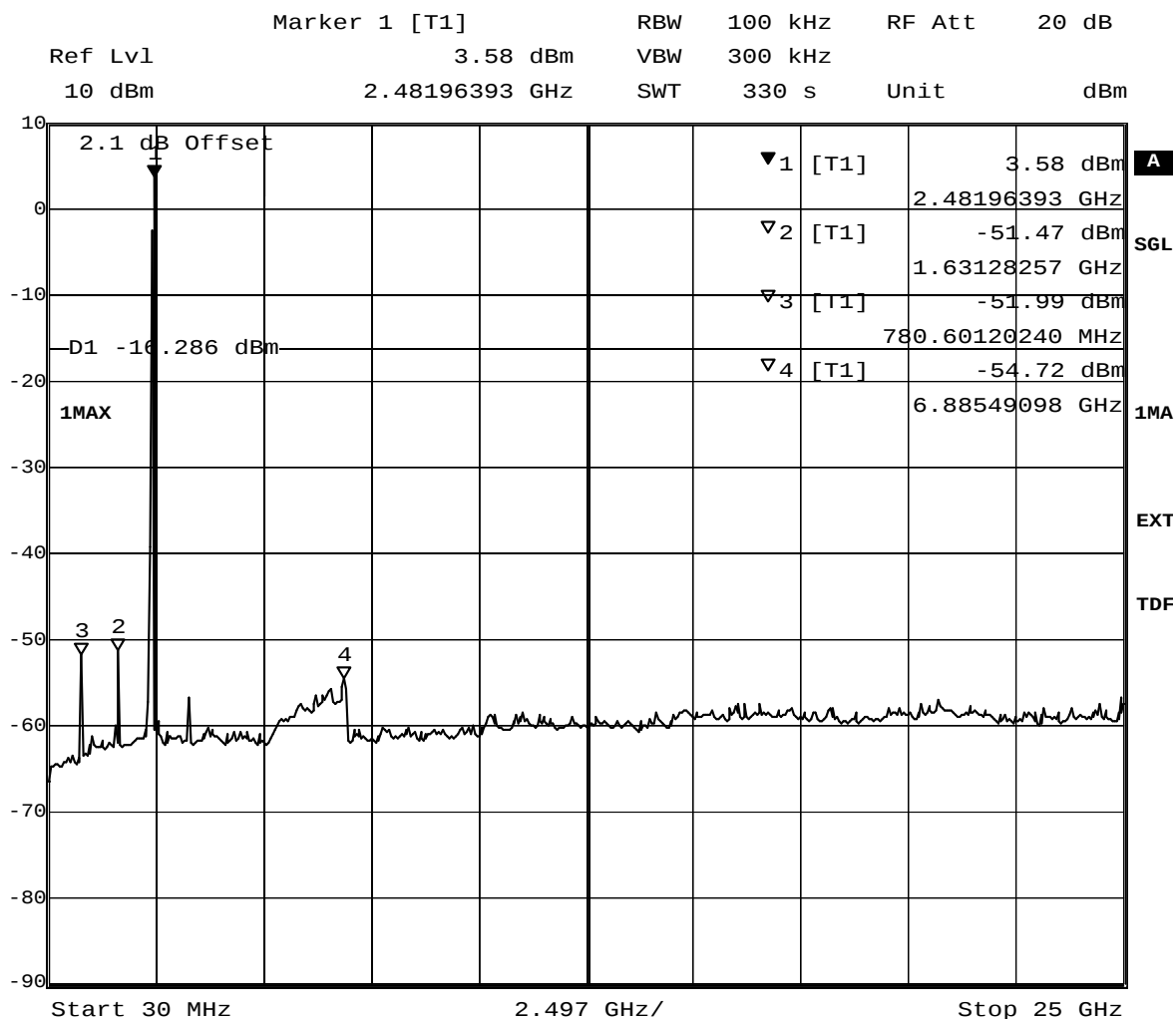
Date: 21.JUL.2009 11:58:35

(determination of reference value for spurious emissions measurement)

### 7.3.16 Spurious RF conducted emissions operating mode 12

#### Op. Mode

op-mode 12



Title: spurious emissions  
 Comment A: CH T: 2480 MHz  
 Date: 21.JUL.2009 12:10:14

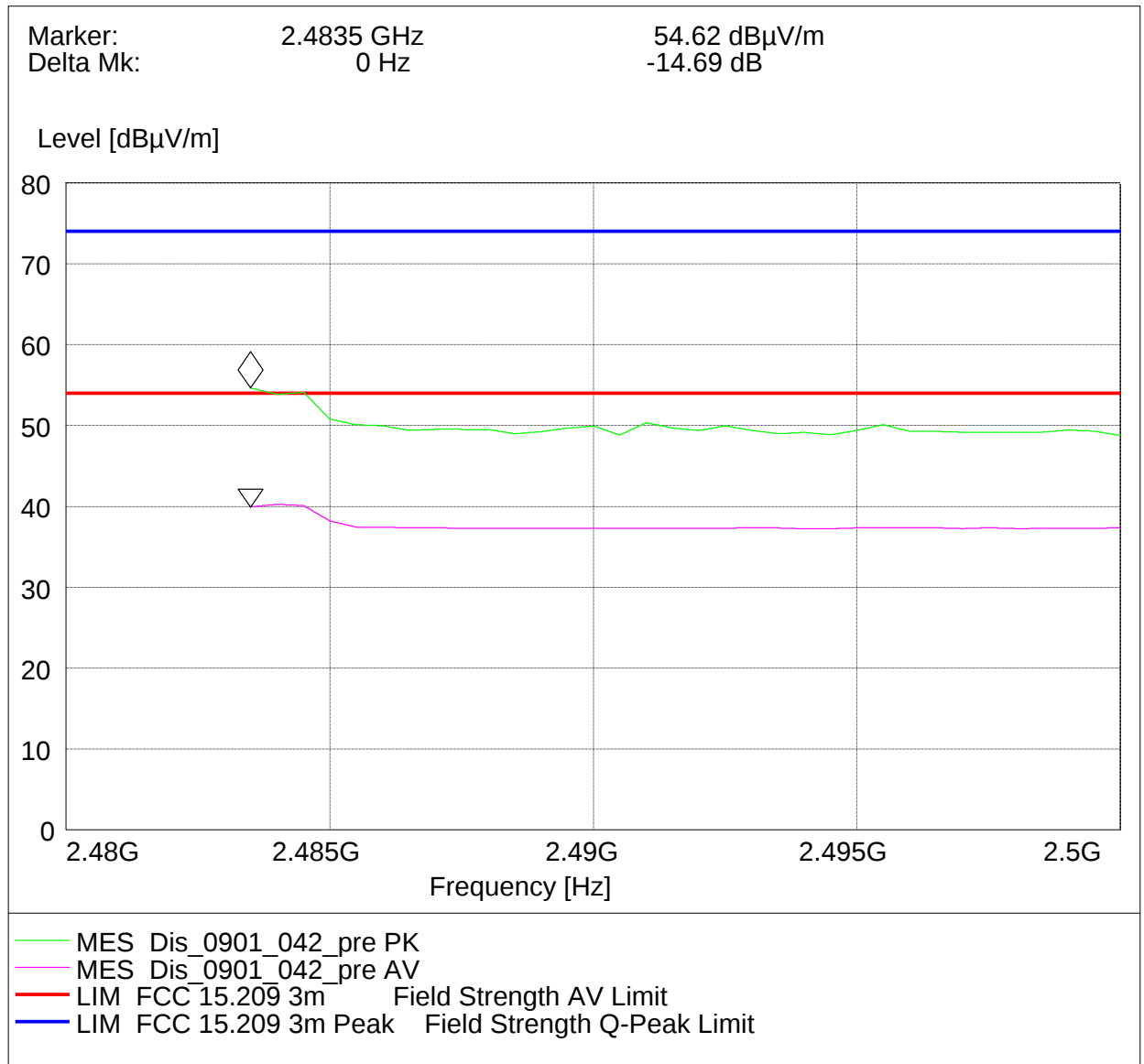
(spurious emissions measurement)

## 7.4 Band edge compliance radiated

### 7.4.1 Band edge compliance radiated operating mode 3

#### Op. Mode

op-mode 3

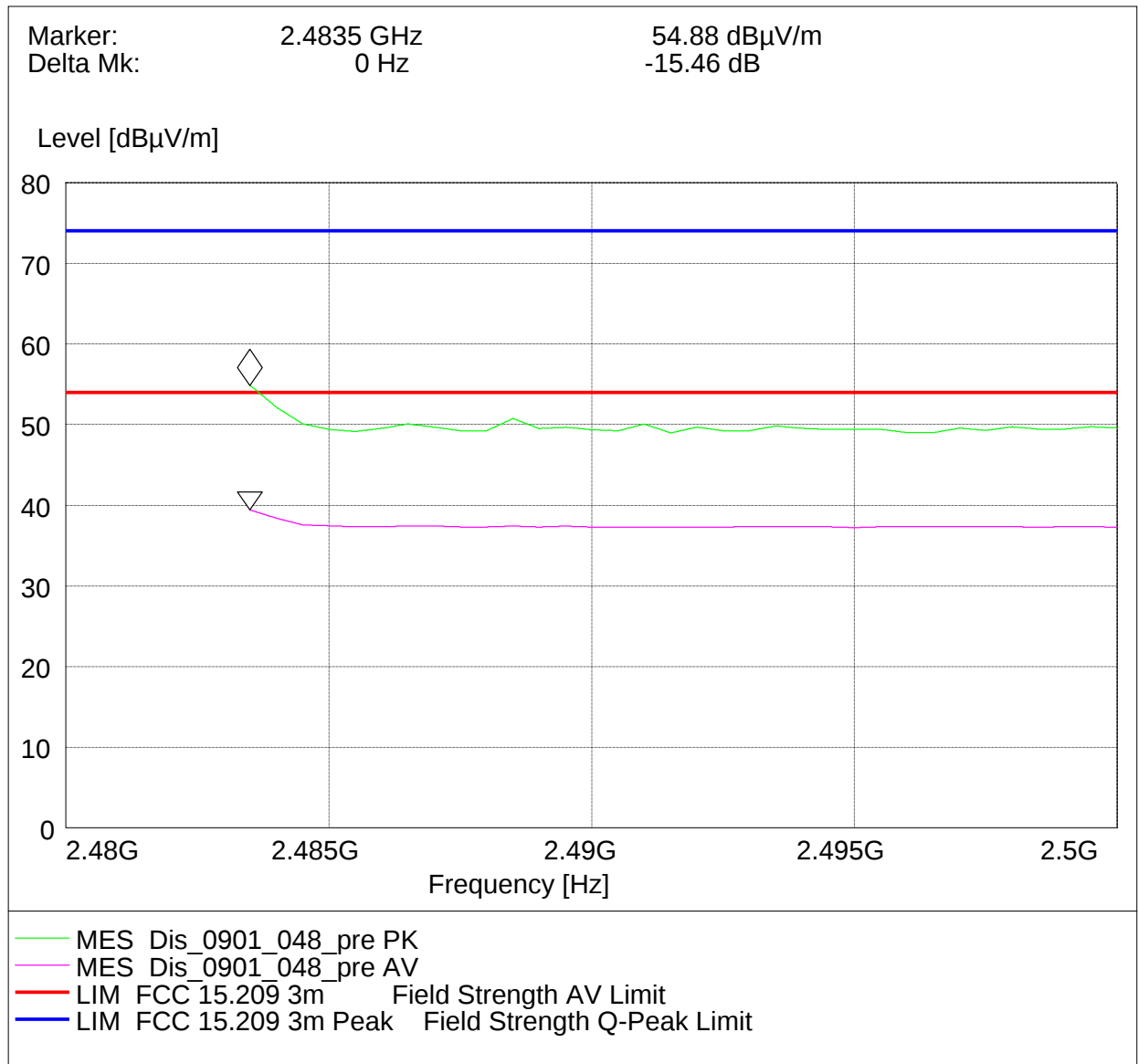


Radiated measurement (higher band edge)

## 7.4.2 Band edge compliance radiated operating mode 8

### Op. Mode

op-mode 8

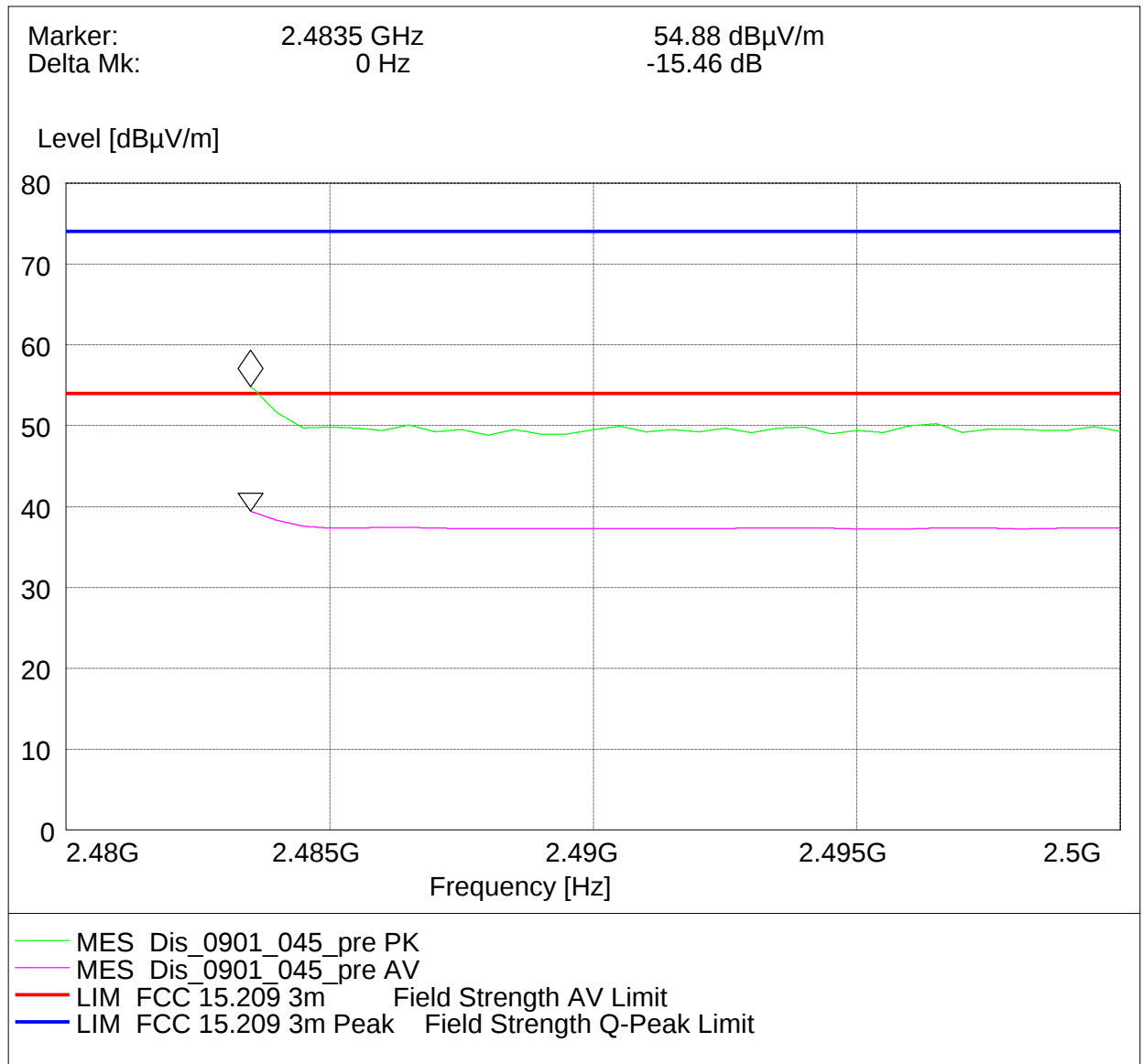


Radiated measurement (higher band edge)

### 7.4.3 Band edge compliance radiated operating mode 12

#### Op. Mode

op-mode 12



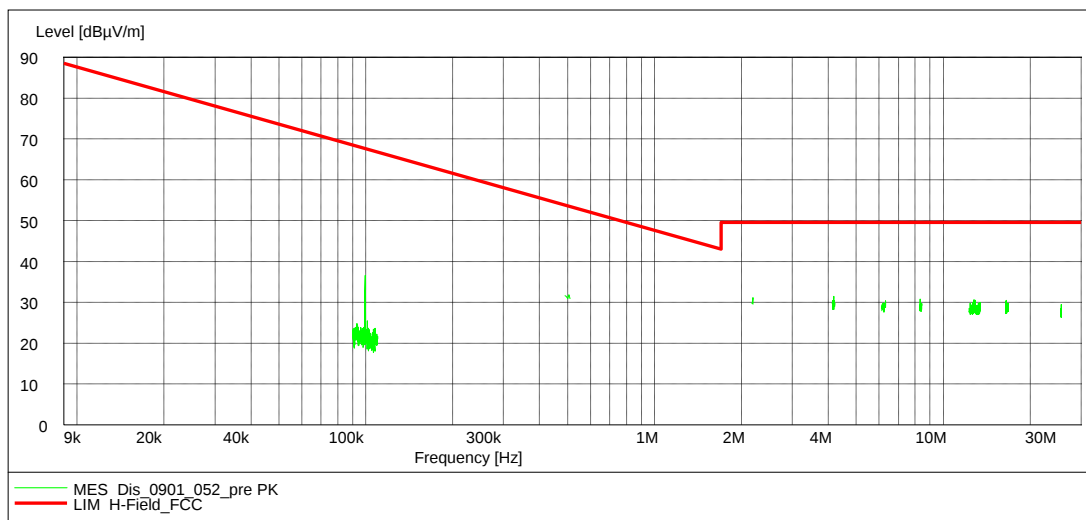
Radiated measurement (higher band edge)

## 7.5 Radiated emissions ( $f < 30$ MHz)

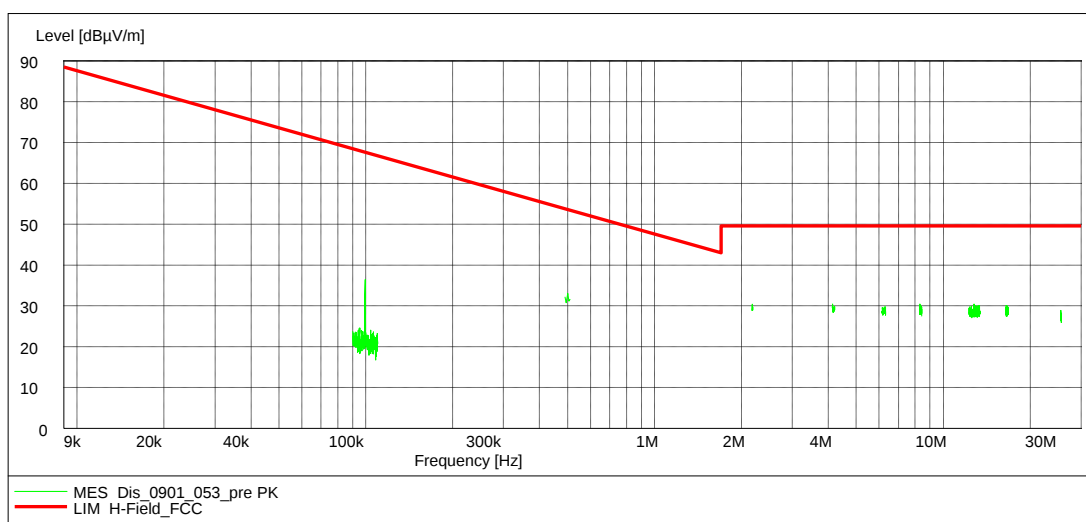
### Op. Mode

op-mode 1

Antenna position 90°  
EUT position front side



Antenna position 90°  
EUT position right side

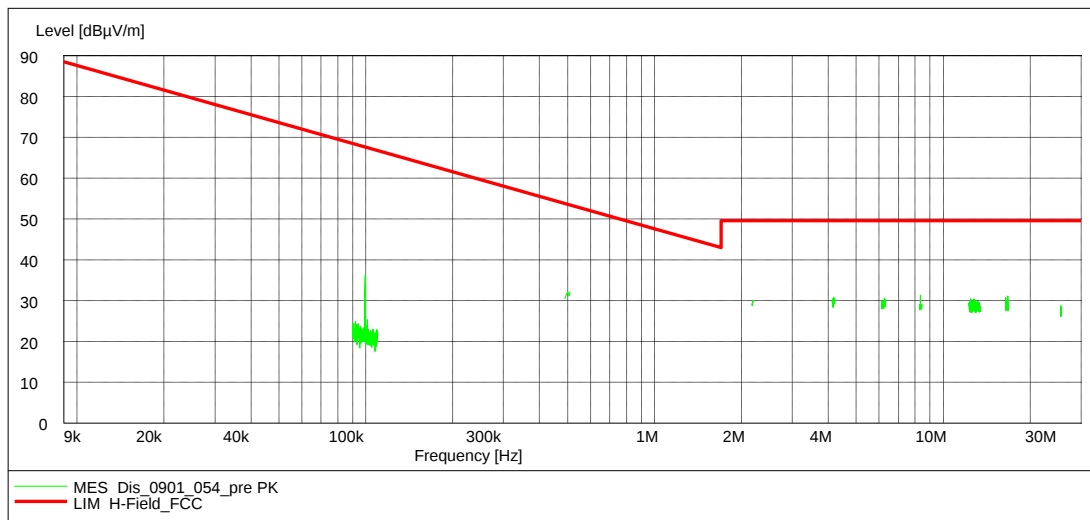


## Op. Mode

op-mode 1

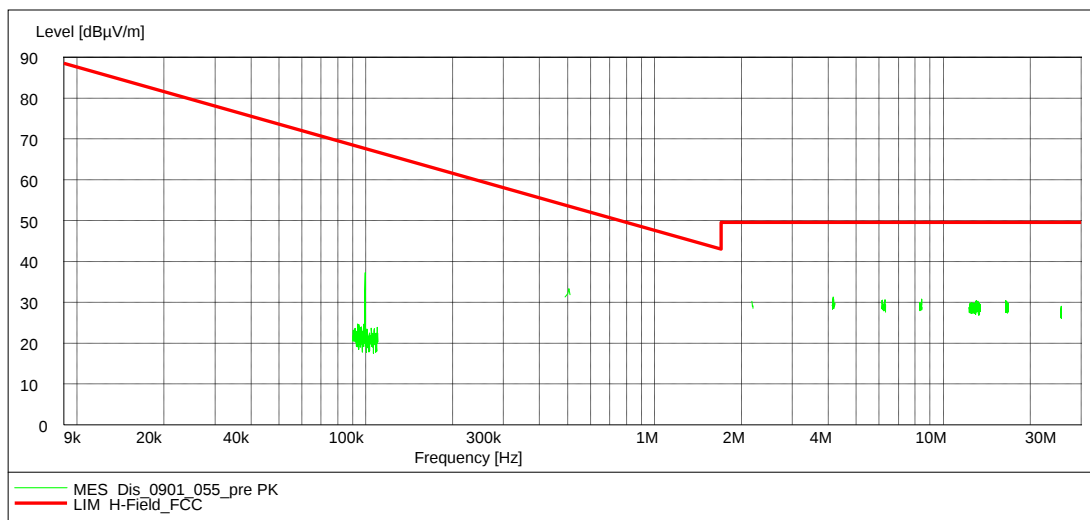
Antenna position 0°

EUT position front side



Antenna position 0°

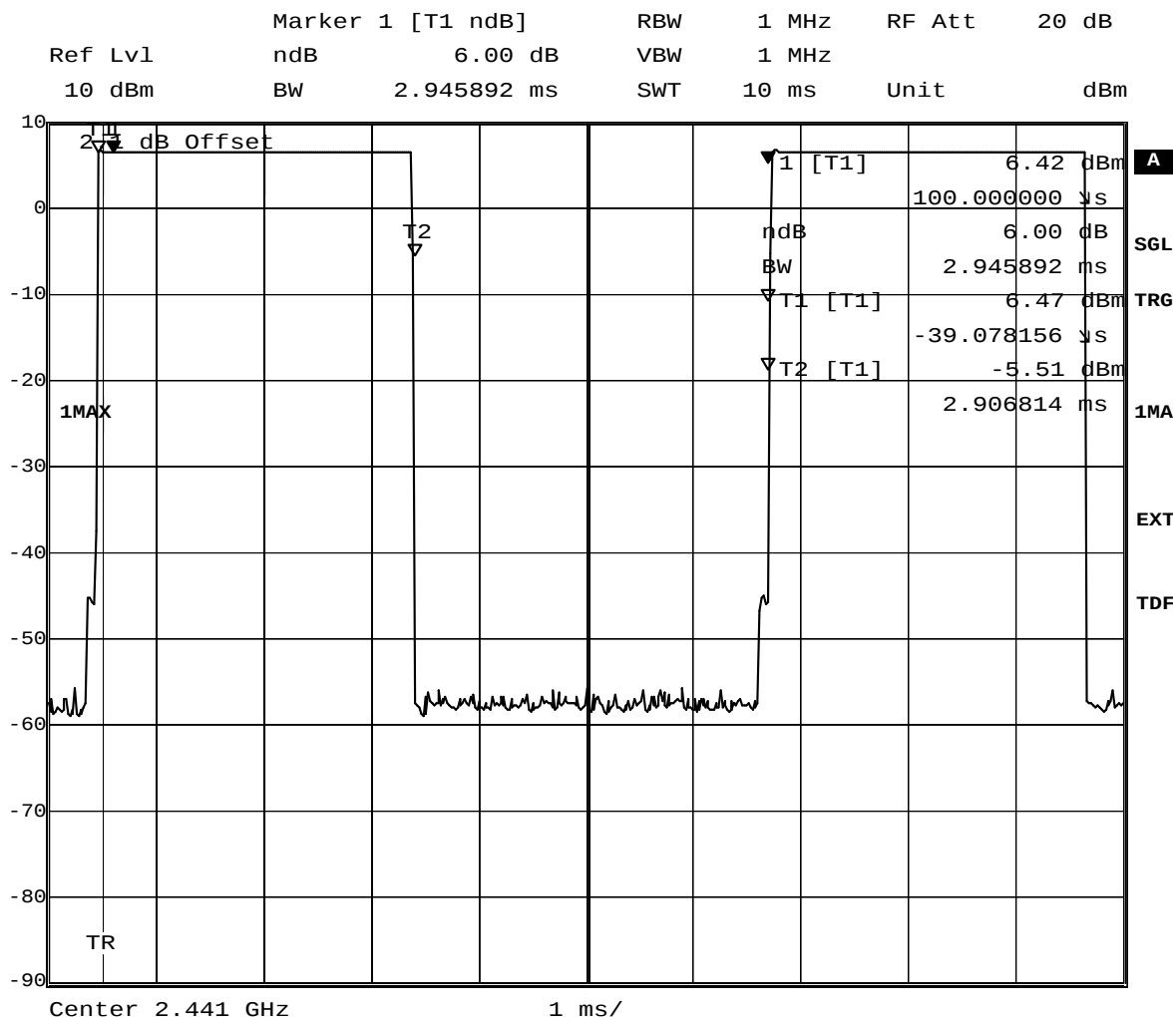
EUT position right side



## 7.6 Dwell time

### Op. Mode

op-mode 2 Time slot measurement of a DH5 packet

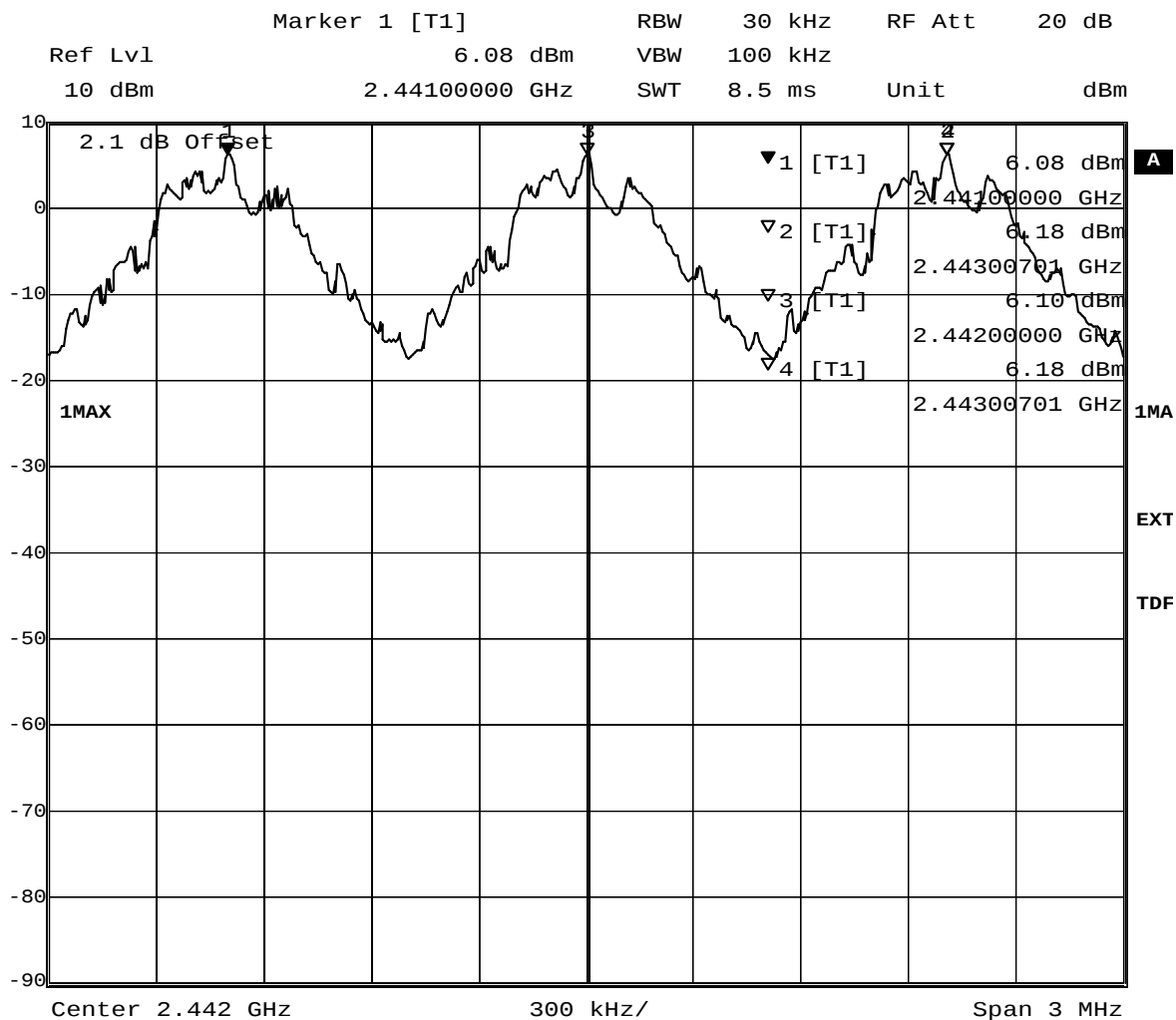


Title: Dwell time  
 Comment A: CH M: 2441 MHz  
 Date: 21.JUL.2009 10:14:15

## 7.7 Channel separation

### Op. Mode

op-mode 4



Title: Number of hopping frequencies

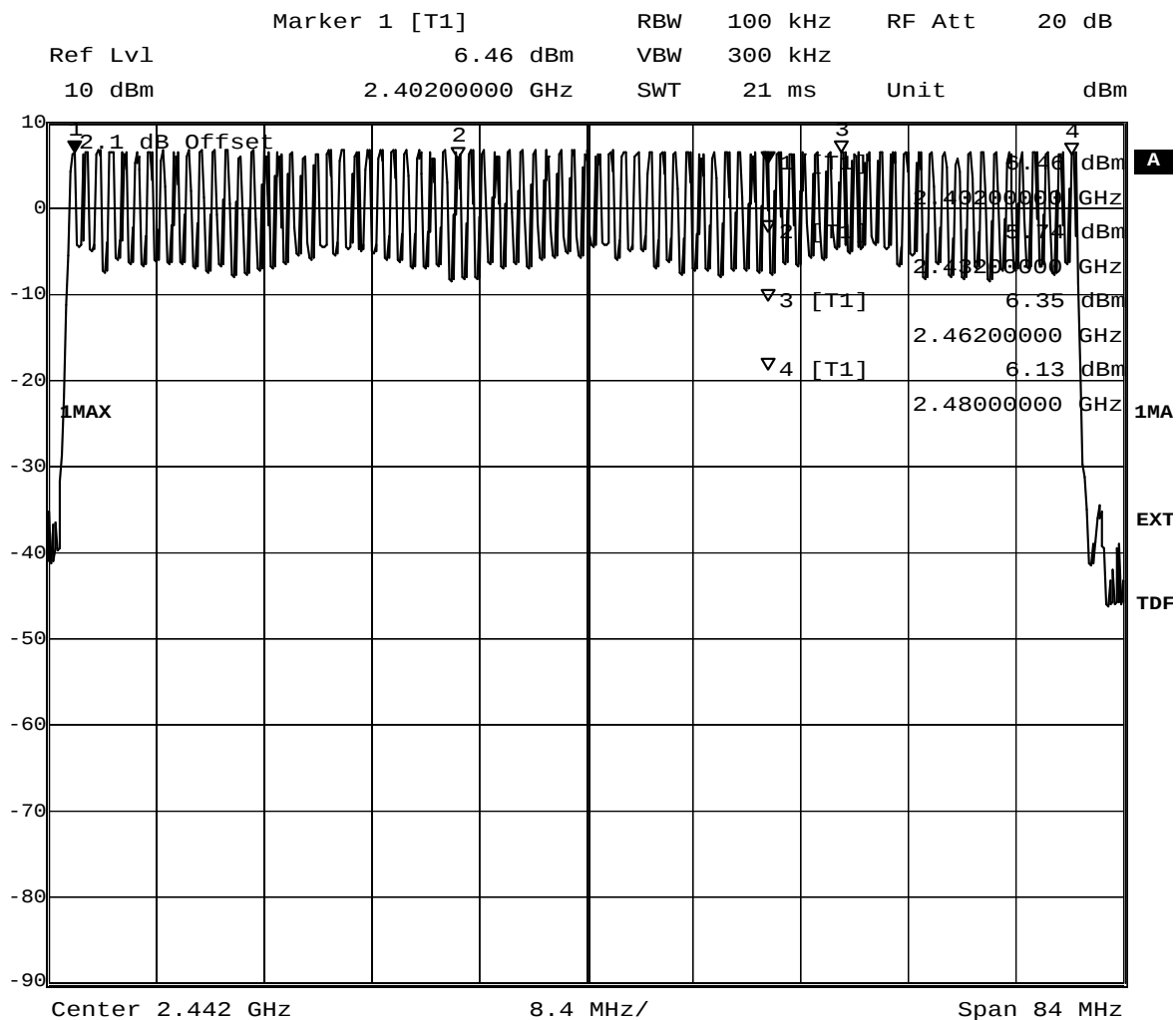
Comment A: CH H: Hopping

Date: 21.JUL.2009 10:45:05

## 7.8 Number of hopping frequencies

### Op. Mode

op-mode 4



Title: Number of hopping frequencies

Comment A: CH H: Hopping

Date: 21.JUL.2009 10:49:40