InterLab®

# FCC Measurement/Technical Report on

# Bluetooth® transceiver
# iFrog Keyboard

**Report Reference:** 4_Gennu_0104_BTT_FCCa

**Test Laboratory:**

7 layers AG
Borsigstrasse 11
40880 Ratingen
Germany
email: info@7Layers.de

Deutscher Akkreditierungs Rat
DAR
TTI-P-G 178/99

CTIA Authorized Test Lab
LAB CODE 20011121-00

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



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# 0 Summary

## 0.1 Technical Report Summary

**Type of Authorization**
Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum).

**Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (2001-10-01 Edition) and 15 (2004-07-12 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 2 | Setup_c01 | AC Port (power line) | passed |

| **FCC Part 15, Subpart C** | | **§ 15.247 (a) (1)** | |
|---|---|---|---|
| Occupied bandwidth | | | |
| The measurement was performed according to FCC § 15.31 | | | 2004 |
| **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 |

| **FCC Part 15, Subpart C** | | **§ 15.247 (b) (1)** | |
|---|---|---|---|
| Peak power output | | | |
| The measurement was performed according to FCC § 15.31 | | | 2004 |
| **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 |

| **FCC Part 15, Subpart C** | | **§ 15.247 (d)** | |
|---|---|---|---|
| Spurious RF conducted emissions | | | |
| The measurement was performed according to FCC § 15.31 | | | 2004 |
| **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 |

| **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 |

| **FCC Part 15, Subpart C** | | **§ 15.247 (d)** | |
|---|---|---|---|
| Band edge compliance | | | |
| The measurement was performed according to FCC § 15.31 (2004) / ANSI C63.4 (2003) | | | 2004 / 2003 |
| **OP-Mode** | **Setup** | **Port** | **Final Result** |
| op-mode 1 | Setup_b01 | Temp.ant.connector | passed |
| op-mode 3 | 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 | | | 2004 |
| **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 | | | 2004 |
| **OP-Mode** | **Setup** | **Port** | **Final Result** |
| op-mode 4 | Setup_b01 | Temp.ant.connector | passed |

| FCC Part 15, Subpart C | | § 15.247 (a) | |
|---|---|---|---|
| Number of hopping frequencies | | | |
| The measurement was performed according to FCC § 15.31 | | | 2004 |
| **OP-Mode** | **Setup** | **Port** | **Final Result** |
| op-mode 4 | Setup_b01 | Temp.ant.connector | passed |

Responsible for Accreditation Scope: T. Hall

Responsible for Test Report: Machulec

7 layers AG, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

# 1 Administrative Data

## 1.1 Testing Laboratory

| | |
|---|---|
| Company Name: | 7 Layers AG |
| Address | Borsigstr. 11<br>40880 Ratingen<br>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. TTI-P-G 178/99

| | |
|---|---|
| Responsible for Accreditation Scope: | Dipl.-Ing. Bernhard Retka<br>Dipl.-Ing. Arndt Stöcker<br>Dipl.-Ing. Thomas Hoell |
| Report Template Version: | 2005-02-01 |

## 1.2 Project Data

| | |
|---|---|
| Responsible for testing and report: | Dipl.-Ing. Robert Machulec |
| Date of Test(s): | 2004-07-10 to 2005-04-22 |
| Date of Report: | 2005-04-25 |

## 1.3 Applicant Data

| | |
|---|---|
| Company Name: | Gennum Corporation |
| Address: | 970 Fraser Drive<br>Burlington, Ontario, L7L 5P5<br>Canada |
| Contact Person: | Kamal Ali |

## 1.4 Manufacturer Data

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

# 2 Product labeling

## 2.1 FCC ID label

At the time of the report there was no FCC label available.

## 2.2 Location of the label on the EUT

see above

# 3 Test object Data

## 3.1 General EUT Description

| | |
|---|---|
| **Equipment under Test** | Bluetooth® transceiver |
| **Type Designation:** | iFrog Keyboard |
| **Kind of Device:** | Wireless Keyboard |
| **(optional)** | |
| **Voltage Type:** | AC (charger) / DC (keyboard) |
| **Voltage level:** | 115 V / 5.0 V |

**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 µs. The maximum dwell time 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 EUT provides the following ports:**

**Ports**
Temporary antenna connector
Enclosure
AC Port (power line, charger)
DC port

**The main components of the EUT are listed and described in Chapter 3.2**

## 3.2 EUT Main components

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

| Short Description | Equipment under Test | Type Designation | Serial No. | HW Status | SW Status | Date of Receipt |
|---|---|---|---|---|---|---|
| EUT A (Code: 1P030a01) | Bluetooth® transceiver | iFrog Keyboard | Test sample A01 | Rev 0 | Rev 0 | 2004-07-10 |
| Remark: EUT A is equipped with an integral antenna (gain= 4,0 dBi). | | | | | | |
| EUT B (Code: 1P030h01) | Bluetooth® transceiver | iFrog Keyboard | Test sample H01 | Rev 0 | Rev 0 | 2004-07-10 |
| Remark: EUT B is equipped with an integral antenna (gain= 4,0 dBi). | | | | | | |
| EUT C (Code: 1P030L02) | Bluetooth® transceiver | iFrog Keyboard | Test sample L02 | Rev 0 | Rev 0 | 2004-07-10 |
| Remark: EUT C is equipped with a temporary antenna connector. | | | | | | |

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

## 3.3 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 | HW Status | SW Status | Serial no. | FCC ID |
|---|---|---|---|---|---|---|
| | | | | | | |

## 3.4 EUT Setups

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

| Setup No. | Combination of EUT's | Description |
|---|---|---|
| Setup_a01 | EUT B + EUT D | setup for radiated measurements |
| Setup_b01 | EUT C | setup for conducted measurements |
| Setup_c01 | EUT A + EUT D | setup for test "conducted emissions" |

## 3.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing.

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

# 4 Test Results

## 4.1 Conducted emissions (AC power line)

**Standard** FCC Part 15, 2004-07-12
Subpart C

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

### 4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

**Step 1: Preliminary scan**
Preliminary test to identify the highest amplitudes relative to the limit.
EMI receiver settings:
- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF–Bandwidth: 10 kHz
- Measuring time / Frequency step: 1 ms
- Measurement on phase + neutral lines of the power cords

Intention of this step is, to determine the conducted EMI-profile of the EUT. With this data, the test system performs (to reduce the number of final measurements) a data reduction with the following parameters:
- Offset for acceptance analysis: Limit line – 6 dB
- Maximum number of final measurements: 6

**Step 2: Final measurement**
With the frequencies determined in step 1, the final measurement will be performed.
EMI receiver settings:
- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1s / frequency

### 4.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

| Frequency Range (MHz) | QP Limit (dBµV) | AV Limit (dBµV) |
|---|---|---|
| 0.15 – 0.5 | 66 to 56 | 56 to 46 |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

Used conversion factor: Limit (dBµV) = 20 log (Limit (µV)/1µV).

### 4.1.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1018 hPa
Humidity: 41 %

| Op. Mode | Setup | Port |
|---|---|---|
| op-mode 2 | Setup_c01 | AC Port (power line, charger) |

| Power line | Frequency MHz | Measured value dBµV | Delta to limit dBµV | Remarks |
|---|---|---|---|---|
| L1 | 0.190000 | 60.00 | 4.1 | Final measurement with QP detector |
| L1 | 0.280000 | 53.10 | 7.8 | Final measurement with QP detector |
| N | 0.375000 | 51.00 | 7.4 | Final measurement with QP detector |
| L1 | 0.555000 | 46.70 | 9.3 | Final measurement with QP detector |
| N | 0.565000 | 48.60 | 7.4 | Final measurement with QP detector |
| L1 | 0.660000 | 48.50 | 7.5 | Final measurement with QP detector |
| L1 | 0.845000 | 49.70 | 6.3 | Final measurement with QP detector |
| L1 | 0.945000 | 48.40 | 7.6 | Final measurement with QP detector |
| L1 | 1.000000 | 45.90 | 10.1 | Final measurement with QP detector |
| N | 1.135000 | 50.00 | 6.0 | Final measurement with QP detector |
| N | 1.875000 | 49.30 | 6.7 | Final measurement with QP detector |
| L1 | 2.180000 | 47.60 | 8.4 | Final measurement with QP detector |
| L1 | 0.185000 | 48.40 | 5.9 | Final measurement with AV detector |
| L1 | 0.375000 | 40.30 | 8.1 | Final measurement with AV detector |
| N | 0.565000 | 37.70 | 8.3 | Final measurement with AV detector |
| N | 0.660000 | 38.00 | 8.0 | Final measurement with AV detector |
| N | 0.850000 | 37.80 | 8.2 | Final measurement with AV detector |
| N | 1.135000 | 36.50 | 9.5 | Final measurement with AV detector |

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

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

## 4.2 Occupied bandwidth

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.2.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room 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 10 kHz.
The EUT was connected to the spectrum analyzer via a short coax cable.

### 4.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### 4.2.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| 20 dB bandwidth MHz | Remarks |
|---|---|
| 0.874 | - |

Remark: Please see annex for the measurement plot.

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

| 20 dB bandwidth MHz | Remarks |
|---|---|
| 0.826 | - |

Remark: Please see annex for the measurement plot.

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

| 20 dB bandwidth MHz | Remarks |
|---|---|
| 0.842 | - |

Remark: Please see annex for the measurement plot.

### 4.2.4 Test result: Occupied bandwidth

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

## 4.3 Peak power output

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements.
The results recorded were measured with the modulation which produces the worst-case (highest) output power.
The resolution bandwidth for measuring the output power was 1 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.

### 4.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (1)
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

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

### 4.3.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| Output power dBm | Remarks |
|---|---|
| -2.04 | The EIRP including antenna gain (4.0 dBi) is 1.96 dBm |

Remark: Please see annex for the measurement plot.

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

| Output power dBm | Remarks |
|---|---|
| -1.26 | The EIRP including antenna gain (4.0 dBi) is 2.74 dBm |

Remark: Please see annex for the measurement plot.

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

| Output power dBm | Remarks |
|---|---|
| -0.87 | The EIRP including antenna gain (4.0 dBi) is 3.13 dBm |

Remark: Please see annex for the measurement plot.

### 4.3.4 Test result: Peak power output

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

## 4.4 Spurious RF conducted emissions

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.4.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room 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 4.6). This value is used to calculate the 20 dBc limit.

### 4.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

### 4.4.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

| 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 |
|---|---|---|---|---|
| 1181 | -57.05 | -2.09 | -22.09 | 34.96 |
| 4784 | -53.69 | -2.09 | -22.09 | 31.60 |
| 6835 | -55.34 | -2.09 | -22.09 | 33.25 |

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 |
|---|---|---|---|---|
| 880 | -54.39 | -1.34 | -21.34 | 33.05 |
| 4884 | -55.26 | -1.34 | -21.34 | 33.92 |
| 6885 | -55.34 | -1.34 | -21.34 | 34.00 |

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 |
|---|---|---|---|---|
| 880 | -56.36 | -0.87 | -20.87 | 35.49 |
| 6885 | -55.18 | -0.87 | -20.87 | 34.31 |

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

### 4.4.4 Test result: Spurious RF conducted emissions

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

## 4.5 Spurious radiated emissions

**Standard** FCC Part 15, 2004-07-12
Subpart C

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

### 4.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.
The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

**Measurement up to 1GHz**

Step 1: Preliminary scan
Preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs
- Turntable angle range: –180 to 180 °
- Turntable step size: 90°
- Height variation range: 1 – 3m
- Height variation step size: 2m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. With this data, the test system performs (to reduce the number of final measurements) a data reduction with the following parameters:

- Offset for acceptance analysis: Limit line – 10 dB
- Maximum number of final measurements: 12

Step 2:
With the frequencies 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.

Settings for step 2:
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: –180 to 180 °
- Turntable step size: 45°
- Height variation range: 1 – 4m
- Height variation step size: 0,5m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):
- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:
- Azimuth value (of turntable): 45°
- Antenna height: 0,5m

Step 3:
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 the turntable azimuth and antenna height, which was determined in step 3, will be adjusted. The turntable azimuth will be slowly varied by +/- 22,5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/- 25 cm around the antenna height determined in step 3. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

Settings for step 3:
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: –22,5° to + 22,5 ° around the value determined in step 2
- Height variation range: -0,25m to + 0,25m around the value determined in step 2

Step 4:
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak(< 1GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1s

**Measurement above 1GHz**

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
The measurement distance was reduced to 1m. 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.

### 4.5.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)
... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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

| Frequency Range (MHz) | Class B Limit (dBµV/m) |
|---|---|
| 30 – 88 | 40,0 |
| 88 – 216 | 43,5 |
| 216 – 960 | 46,0 |
| above 960 | 54,0 |

§15.35(b)
..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....
Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

### 4.5.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1023 hPa
Humidity: 38 %

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

| Polari-sation | 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 | 4804,0 | | 46,25 | 35,72 | | 74,0 | 54,0 | 27,48 | 18,28 |
| | | | | | | | | | |

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

| Op. Mode | Setup | Port |
|---|---|---|
| op-mode 2 | Setup_a01 | Enclosure |

| Polari-sation | 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 | 4882,0 | | 41,66 | 30,77 | | 74,0 | 54,0 | 32,34 | 23,23 |
| | | | | | | | | | |

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

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

| Polari-sation | 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 | 4960,0 | | 41,57 | 30,12 | | 74,0 | 54,0 | 32,43 | 23,88 |
| | | | | | | | | | |

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

### 4.5.4 Test result: Spurious radiated emissions

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

## 4.6 Band edge compliance

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** ANSI C 63.4, 2003
FCC §15.31, 2004-07-12

### 4.6.1 Test Description

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

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge is 2400 MHz.
Analyzer settings:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

For the second measurement the EUT is set to transmit on the highest channel (2480 MHz). The higher band edge is 2483,5 MHz.
Analyzer settings for conducted measurement:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

Analyzer settings for radiated measurement:
- Detector: Peak, Average
- RBW = VBW = 100 kHz

### 4.6.2 Test Requirements / Limits

FCC Part 15.247 (d)
"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
...
Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

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

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

### 4.6.3 Test Protocol

4.6.3.1 Lower band edge

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---|---|---|---|---|
| 2400,00 | -50.63 | -2.09 | -22.09 | 28.54 |

Remark: Please see annex for the measurement plot.

4.6.3.2 Higher band edge

Conducted measurement

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---|---|---|---|---|
| 2483,50 | -54.34 | -0.87 | -20.87 | 33.47 |

Radiated measurement

Temperature: 23 °C
Air Pressure: 1023 hPa
Humidity: 38 %

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

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---|---|---|---|---|---|---|---|
| | | Peak | AV | | | | |
| 2483,50 | Vertical + horizontal | 46.35 | 34.78 | 74.00 | 54.00 | 27.65 | 19.22 |

Remark: Please see annex for the measurement plot.

### 4.6.4 Test result: Band edge compliance

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

## 4.7 Dwell time

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.7.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the dwell time measurements.
The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.
The time slot length is measured of three different packet types which are available in the Bluetooth technology. Those are DH1, DH3 and DH5 packets. The dwell time is calculated by:

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

with:
- hop rate=1600 * 1/s for DH1 packets =1600
- hop rate=1600/3 * 1/s for DH3 packets =533.33
- hop rate=1600/5 * 1/s for DH5 packets =320
- number of hopping channels=79
- 31.6 s=0.4 seconds multiplied by the number of hopping channels=0.4s * 79

### 4.7.2 Test Requirements / Limits

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

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.

### 4.7.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| Packet type | Time slot length ms | Dwell time calculation | Dwell time ms |
|---|---|---|---|
| DH1 | 0.44088 | time slot length * 1600 /79 * 31.6 | 282 |
| DH3 | 1.70341 | time slot length * 1600/3 /79 * 31.6 | 363 |
| DH5 | 2.94589 | time slot length * 1600/5 /79 * 31.6 | 377 |

Remark: Please see annex for the measurement plots.

### 4.7.4 Test result: Dwell time

| FCC Part 15, Subpart C | Op. Mode | | Result |
|---|---|---|---|
| | op-mode 2 | DH1 | passed |
| | op-mode 2 | DH3 | passed |
| | op-mode 2 | DH5 | passed |

## 4.8 Channel separation

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.8.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the channel separation measurements.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Detector: Peak-Maxhold
- Span: 3 MHz
- Centre Frequency: 2441 MHz
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

### 4.8.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### 4.8.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

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

| Channel separation MHz | Remarks |
|---|---|
| 1 | - |

Remark: Please see annex for the measurement plot.

### 4.8.4 Test result: Channel separation

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

## 4.9 Number of hopping frequencies

**Standard** FCC Part 15, 2004-07-12
Subpart C

**The test was performed according to:** FCC §15.31, 2004-07-12

### 4.9.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the channel separation measurements.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Detector: Peak-Maxhold
- Start frequency: 2402 MHz
- Stop frequency: 2483.5 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

### 4.9.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a)

### 4.9.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1018 hPa
Humidity: 32 %

| 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.

### 4.9.4 Test result: Number of hopping frequencies

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

# 5 Test Equipment

## *EUT Digital Signalling System*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Digital Radio Communication Tester | CMD 55 | 831050/020 | Rohde & Schwarz |
| Signalling Unit for Bluetooth Spurious Emissions | PTW60 | 100004 | Rohde & Schwarz |
| Universal Radio Communication Tester | CMU 200 | 102366 | Rohde & Schwarz |

## *EMI Test System*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Comparison Noise Emitter | CNE III | 99/016 | York |
| EMI Analyzer | ESI 26 | 830482/004 | Rohde & Schwarz |
| Signal Generator | SMR 20 | 846834/008 | Rohde & Schwarz |

## *EMI Radiated Auxiliary Equipment*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Antenna mast 4m | MA 240 | 240/492 | HD GmbH H. Deisel |
| Biconical dipole | VUBA 9117 | 9117108 | Schwarzbeck |
| Broadband Amplifier 18MHz-26GHz | JS4-18002600-32 | 849785 | Miteq |
| Broadband Amplifier 30MHz-18GHz | JS4-00101800-35 | 896037 | Miteq |
| Broadband Amplifier 45MHz-27GHz | JS4-00102600-42 | 619368 | Miteq |
| Cable "ESI to EMI Antenna" | EcoFlex10 | W18.01-2 + W38.01-2 | Kabel Kusch |
| Cable "ESI to Horn Antenna" | UFB311A + UFB293C | W18.02-2 + W38.02-2 | Rosenberger-Microcoax |
| Double-ridged horn | HF 906 | 357357/002 | Rohde & Schwarz |
| Double-ridged horn | HF 906 | 357357/001 | Rohde & Schwarz |
| High Pass Filter | 5HC3500/12750-1.2-KK | 200035008 | Trilithic |
| High Pass Filter | 5HC2700/12750-1.5-KK | 9942012 | Trilithic |
| High Pass Filter | 4HC1600/12750-1.5-KK | 9942011 | Trilithic |
| KUEP pre amplifier | Kuep 00304000 | 001 | 7layers |
| Log.-per. Antenna | HL 562 Ultralog | 830547/003 | Rohde & Schwarz |
| Loop Antenna | HFH2-Z2 | 829324/006 | Rohde & Schwarz |
| Pyramidal Horn Antenna 26,5 GHz | Model 3160-09 | 9910-1184 | EMCO |

## *EMI Conducted Auxiliary Equipment*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Cable "LISN to ESI" | RG214 | W18.03+W48.03 | Huber+Suhner |
| Two-Line V-Network | ESH 3-Z5 | 828304/029 | Rohde & Schwarz |
| Two-Line V-Network | ESH 3-Z5 | 829996/002 | Rohde & Schwarz |

## *Auxiliary Test Equipment*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Broadband Resist. Power Divider N | 1506A / 93459 | LM390 | Weinschel |
| Broadband Resist. Power Divider SMA | 1515 / 93459 | LN673 | Weinschel |
| Digital Multimeter 01 | Voltcraft M-3860M | IJ096055 | Conrad |
| Digital Multimeter 02 | Voltcraft M-3860M | IJ095955 | Conrad |
| Digital Oscilloscope | TDS 784C | B021311 | Tektronix |
| Fibre optic link Satellite | FO RS232 Link | 181-018 | Pontis |
| Fibre optic link Transceiver | FO RS232 Link | 182-018 | Pontis |
| I/Q Modulation Generator | AMIQ-B1 | 832085/018 | Rohde & Schwarz |
| Notch Filter ultra stable | WRCA800/960-6E | 24 | Wainwright |
| Spectrum Analyzer 9 kHz to 3 GHz | FSP3 | 838164/004 | Rohde & Schwarz |
| Temperature Chamber | VT 4002 | 58566002150010 | Vötsch |
| Temperature Chamber | KWP 120/70 | 59226012190010 | Weiss |
| ThermoHygro Datalogger 03 | Opus10 THI (8152.00) | 7482 | Lufft Mess- und Regeltechnik GmbH |

## *Anechoic Chamber*

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| Air Compressor (pneumatic) | | | Atlas Copco |
| Controller | HD 100 | 100/603 | HD GmbH H. Deisel |
| EMC Camera | CE-CAM/1 | | CE-SYS |
| EMC Camera for observation of EUT | CCD-400E | 0005033 | Mitsubishi |
| Filter ISDN | B84312-C110-E1 | | Siemens&Matsushita |
| Filter telephone systems / modem | B84312-C40-B1 | | Siemens&Matsushita |
| Filter Universal 1A | B84312-C30-H3 | | Siemens&Matsushita |
| Fully/Semi AE Chamber | 10.58x6.38x6 | | Frankonia |
| Turntable | DS 420S | 420/573/99 | HD GmbH, H. Deisel |
| Valve Control Unit (pneum.) | VE 615P | 615/348/99 | HD GmbH, H. Deisel |

| Equipment | Type | Serial No. | Manufacturer |
|---|---|---|---|
| 10 MHz Reference | MFS | 5489/001 | Efratom |
| Power Meter 832025/059 | NRVD | 832025/059 | Rohde & Schwarz |
| Power Sensor A 832279/013 | NRV-Z1 | 832279/013 | Rohde & Schwarz |
| Power Sensor B 832279/015 | NRV-Z1 | 832279/015 | Rohde & Schwarz |
| Power Supply | E3632A | MY40003776 | Agilent |
| Power Supply | PS-2403D | - | Conrad |
| RF Step Attenuator 833695/001 | RSP | 833695/001 | Rohde & Schwarz |
| Rubidium Frequency Normal | MFS | 002 | Efratom |
| Signal Analyzer FSIQ26 832695/007 | FSIQ26 | 832695/007 | Rohde & Schwarz |
| Signal Generator 833680/003 | SMP 03 | 833680/003 | Rohde & Schwarz |
| Signal Generator A 834344/002 | SMIQ03B | 834344/002 | Rohde & Schwarz |
| Signal Generator B 832870/017 | SMIQ03B | 832870/017 | Rohde & Schwarz |
| Signal Switching and Conditioning Unit | SSCU | 338826/005 | Rohde & Schwarz |
| Signalling Unit PTW60 838312/014 | PTW60 for TS8960 | 838312/014 | Rohde & Schwarz |
| System Controller 829323/008 | PSM12 | 829323/008 | Rohde & Schwarz |

# 6 Photo Report

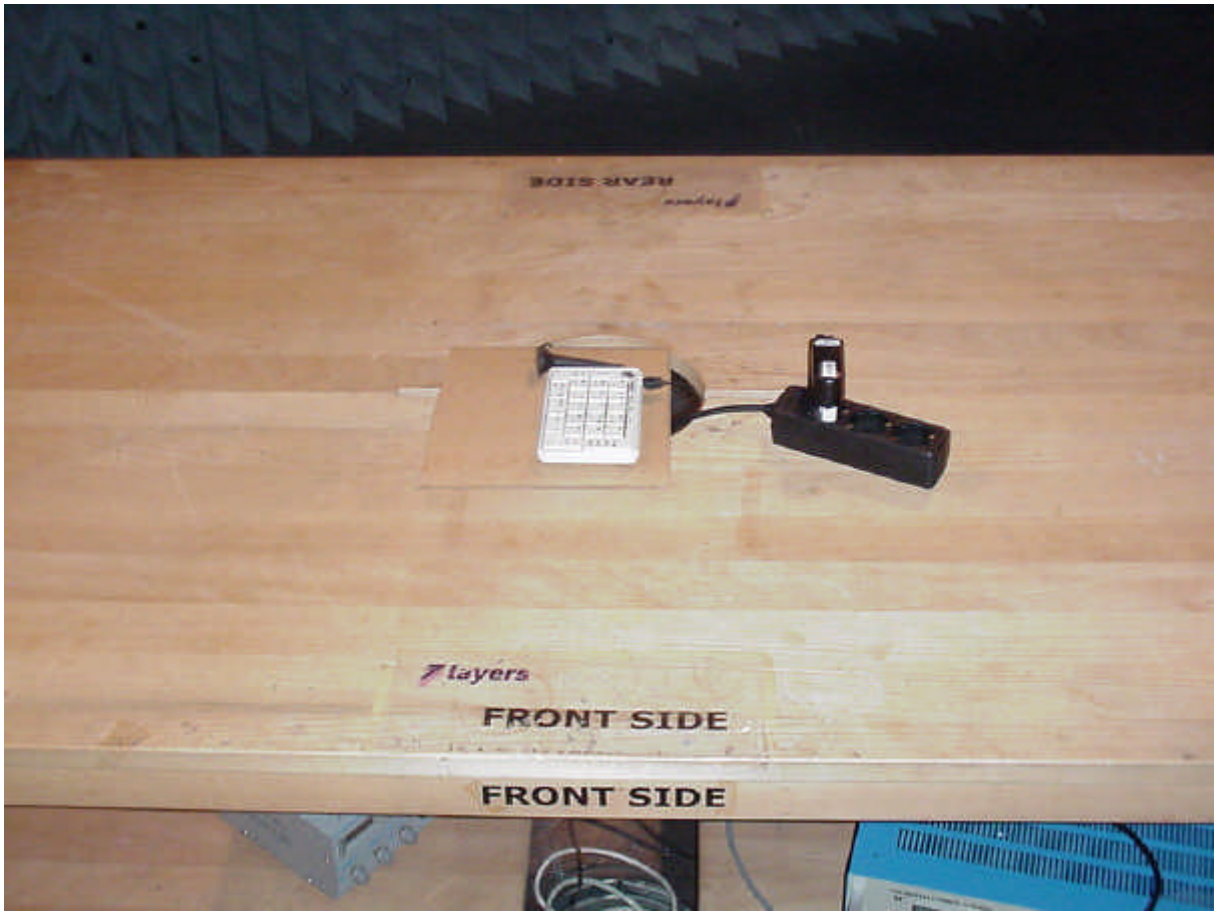
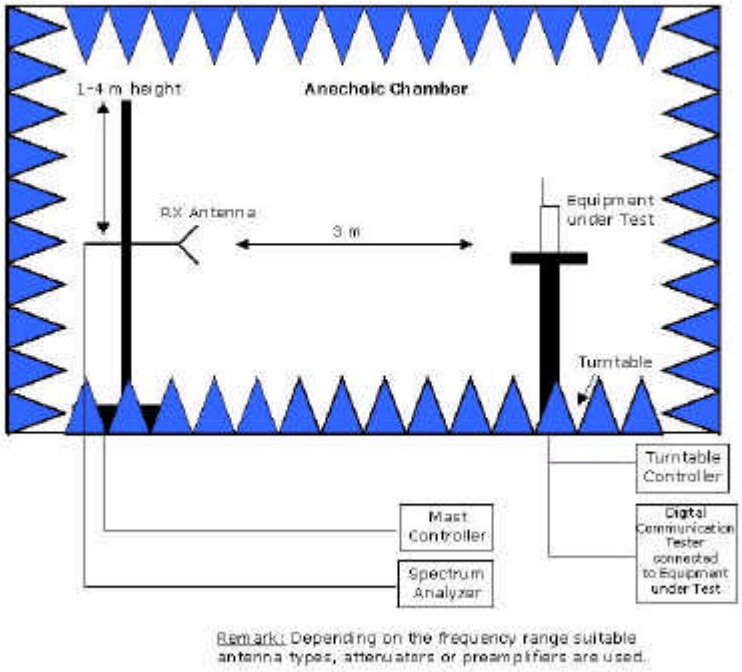



**Photo 1:** Test setup for radiated measurements

**Photo 2:** EUT (top side)

## Setup Drawings




**Drawing 1:** Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.

# 7 Annex

Measurement plots

***AC MAINS CONDUCTED***

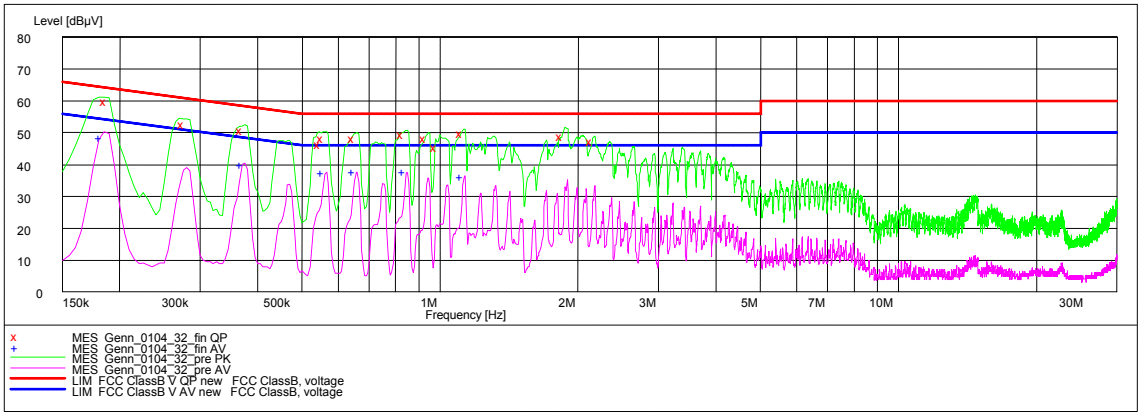
***Diagram No.: 1.01***

| | |
|---|---|
| EUT: | ifrog Keyboard + AC Charger (1Ps30a01) |
| Manufacturer: | Gennum |
| Operating Condition: | TX on 2441 MHz, loopback mode |
| Test Site: | 7 layers Ratingen |
| Operator: | PAv / Groe |
| Test Specification: | ANSI C63.4; FCC 15.107 / 15.207 |
| Comment: | |
| Start of Test: | 07.10.04 / 17:54:23 |

***SCAN TABLE: "FCC Voltage"***

Short Description: FCC Voltage

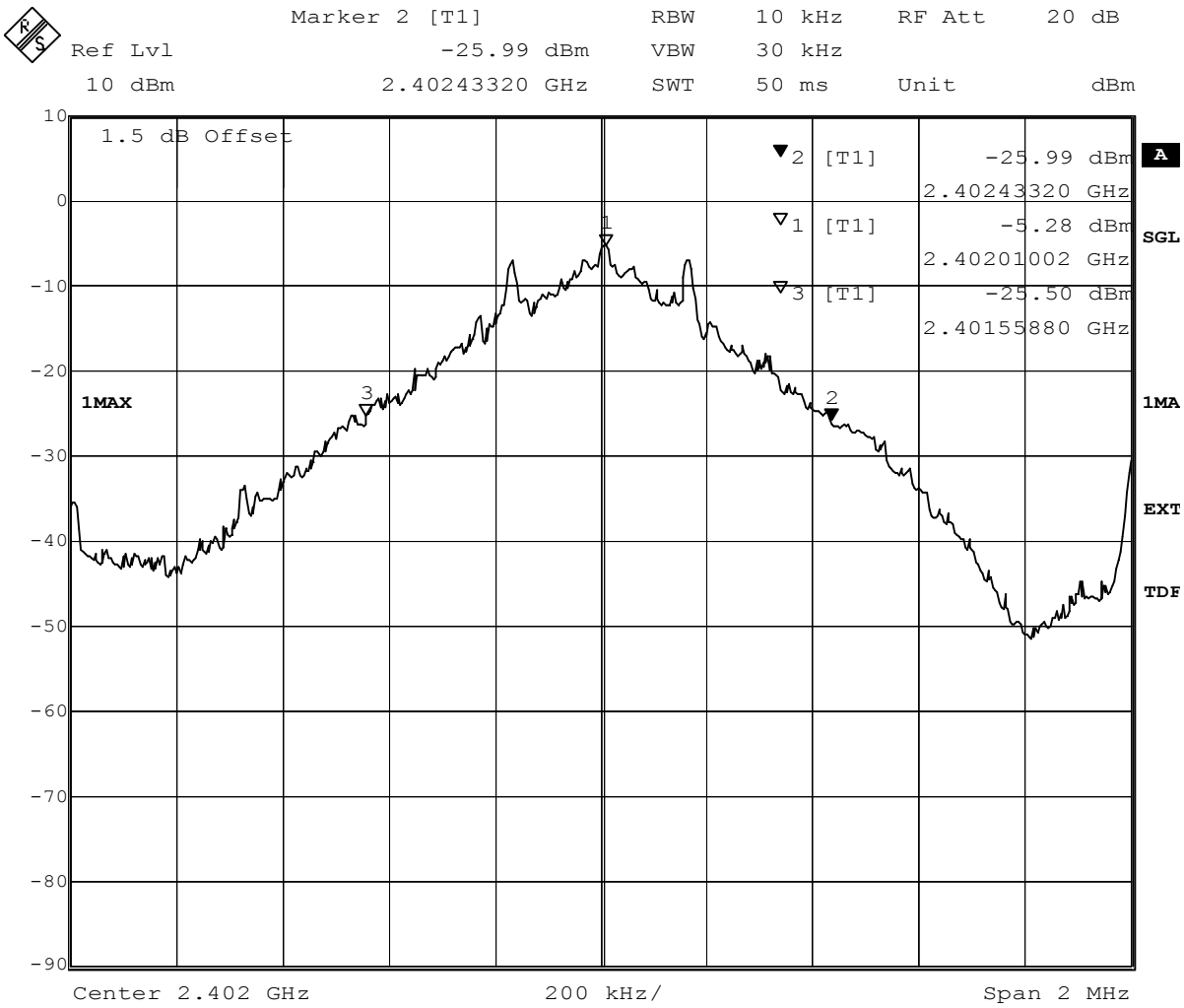
| Start Frequency | Stop Frequency | Step Width | Detector | Meas. Time | IF Bandw. | Transducer |
|---|---|---|---|---|---|---|
| 150.0 kHz 3 | 0.0 MHz | 5.0 kHz | MaxPeak<br>Average | 20.0 ms | 9 kHz | ESH3-Z5 |



## Occupied bandwidth

## Op. Mode

op-mode 1

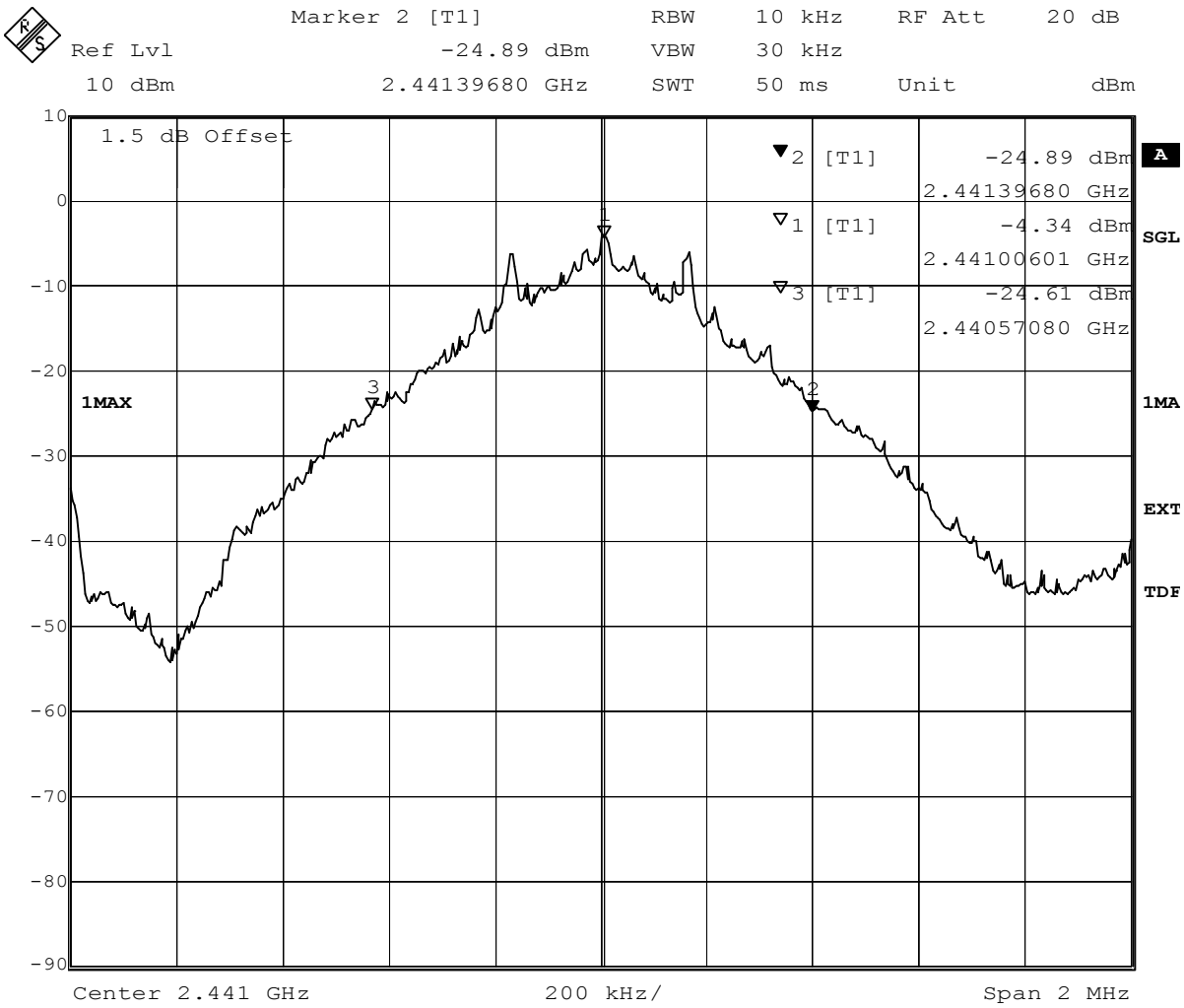



Title: 20dB Bandwidth
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):874.4
Date: 22.APR.2005 15:01:40

## Occupied bandwidth

### Op. Mode

op-mode 2

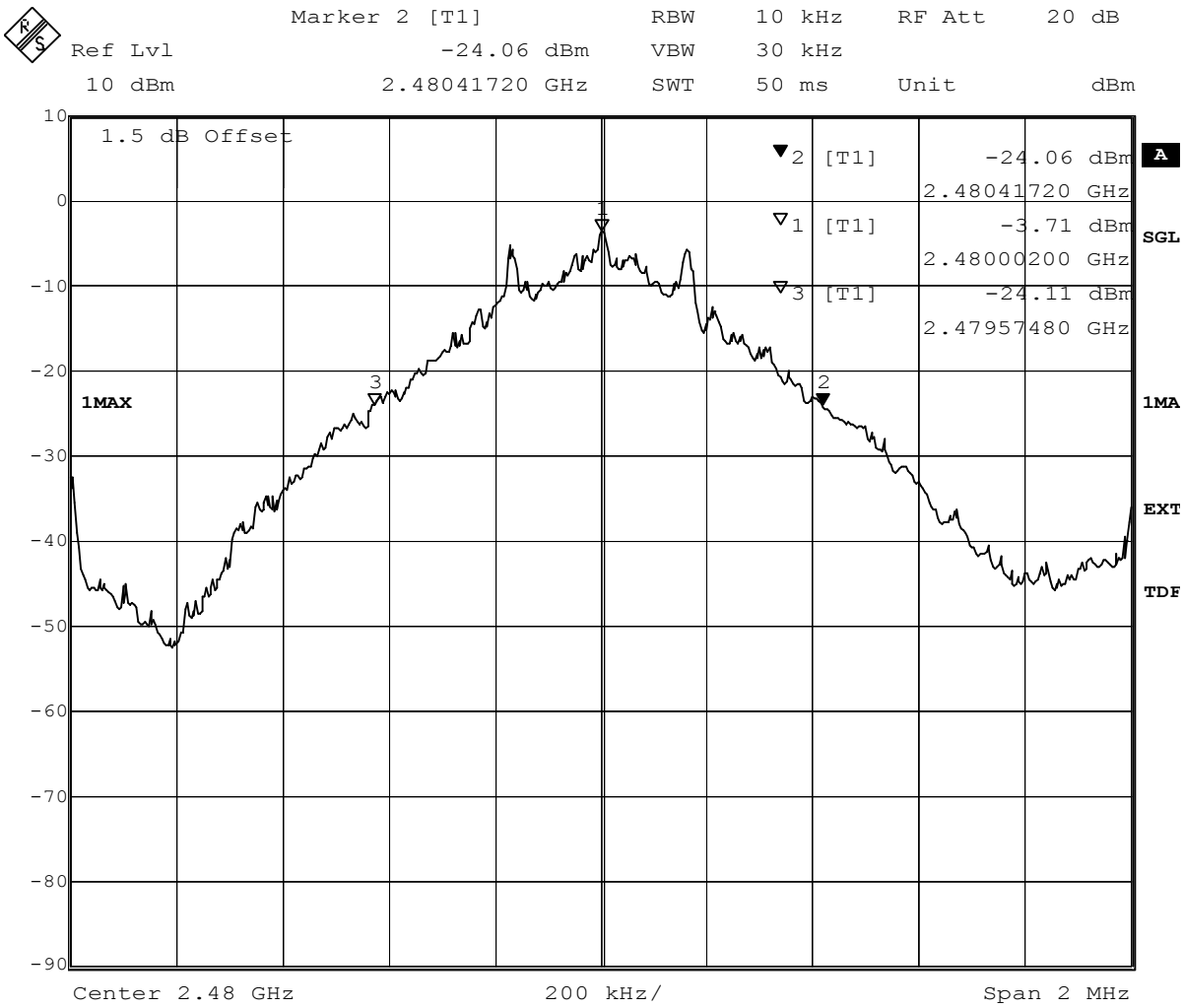



Title: 20dB Bandwidth
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):826
Date: 22.APR.2005 15:20:39

## Occupied bandwidth

## Op. Mode

op-mode 3

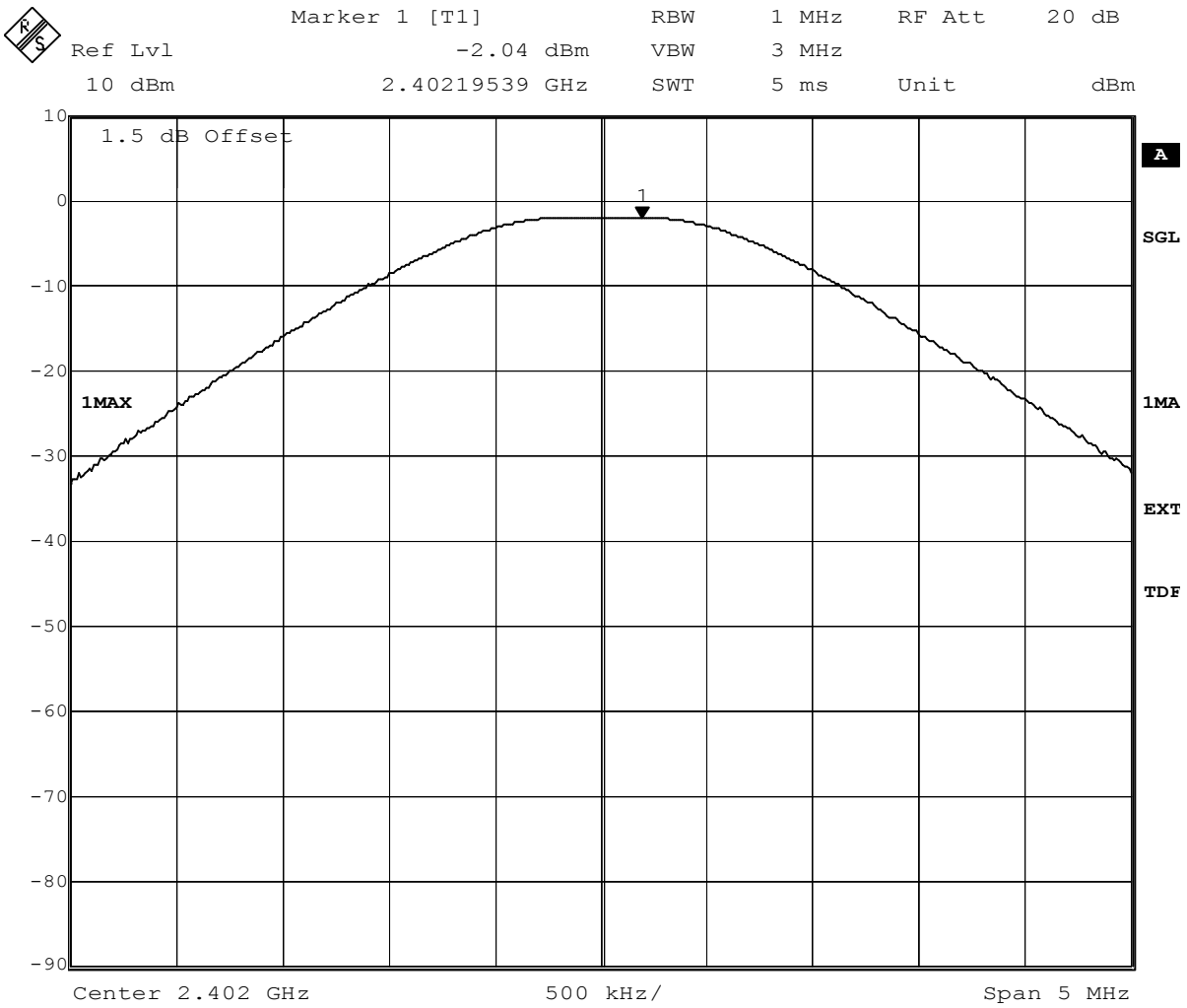



Title: 20dB Bandwidth
Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):842.4
Date: 22.APR.2005 15:38:46

## Peak power output

### Op. Mode

op-mode 1

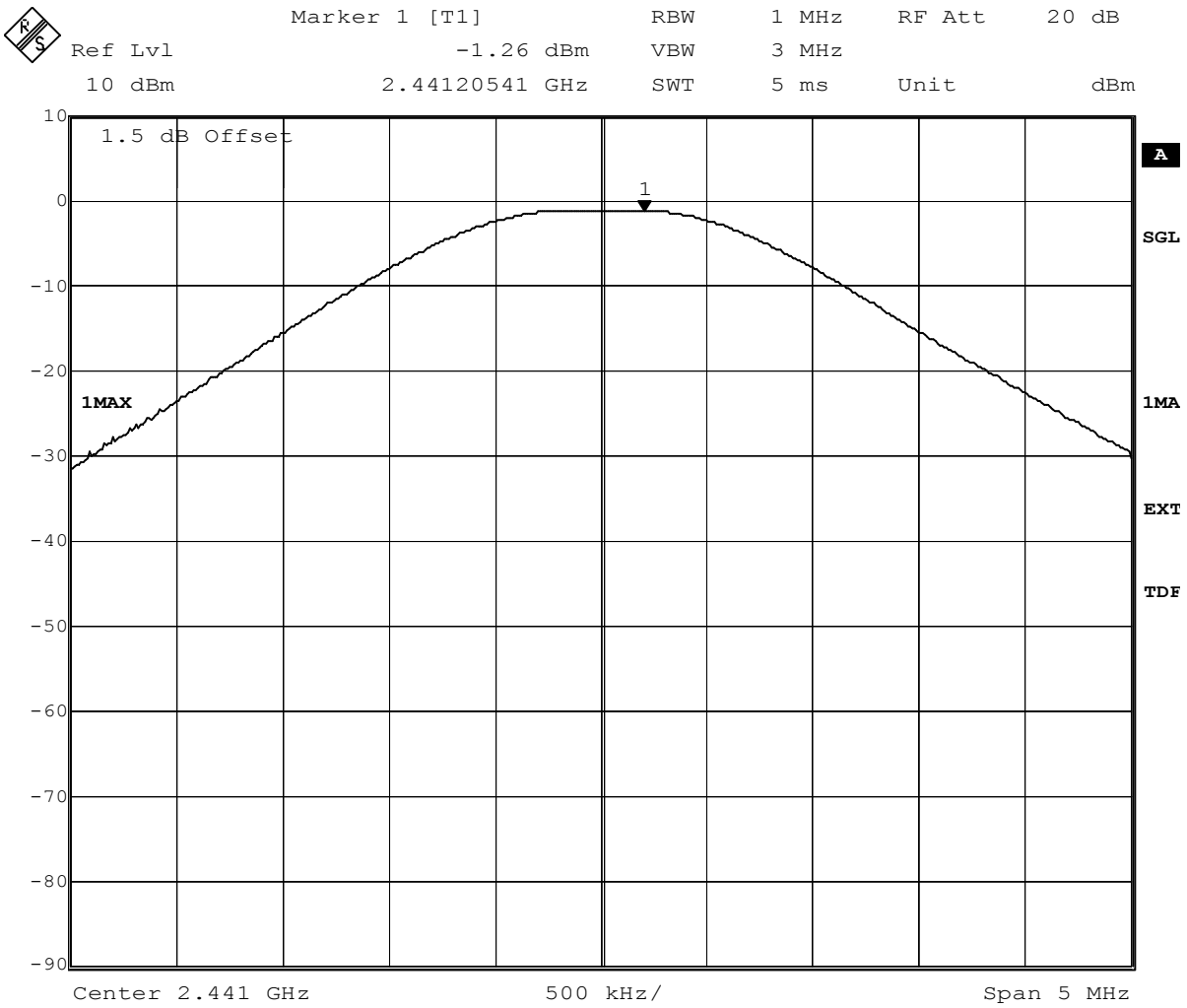



Title: Peak outputpower Power
Comment A: CH B: 2402 MHz
Date: 22.APR.2005 15:02:07

**Peak power output**

**Op. Mode**

op-mode 2

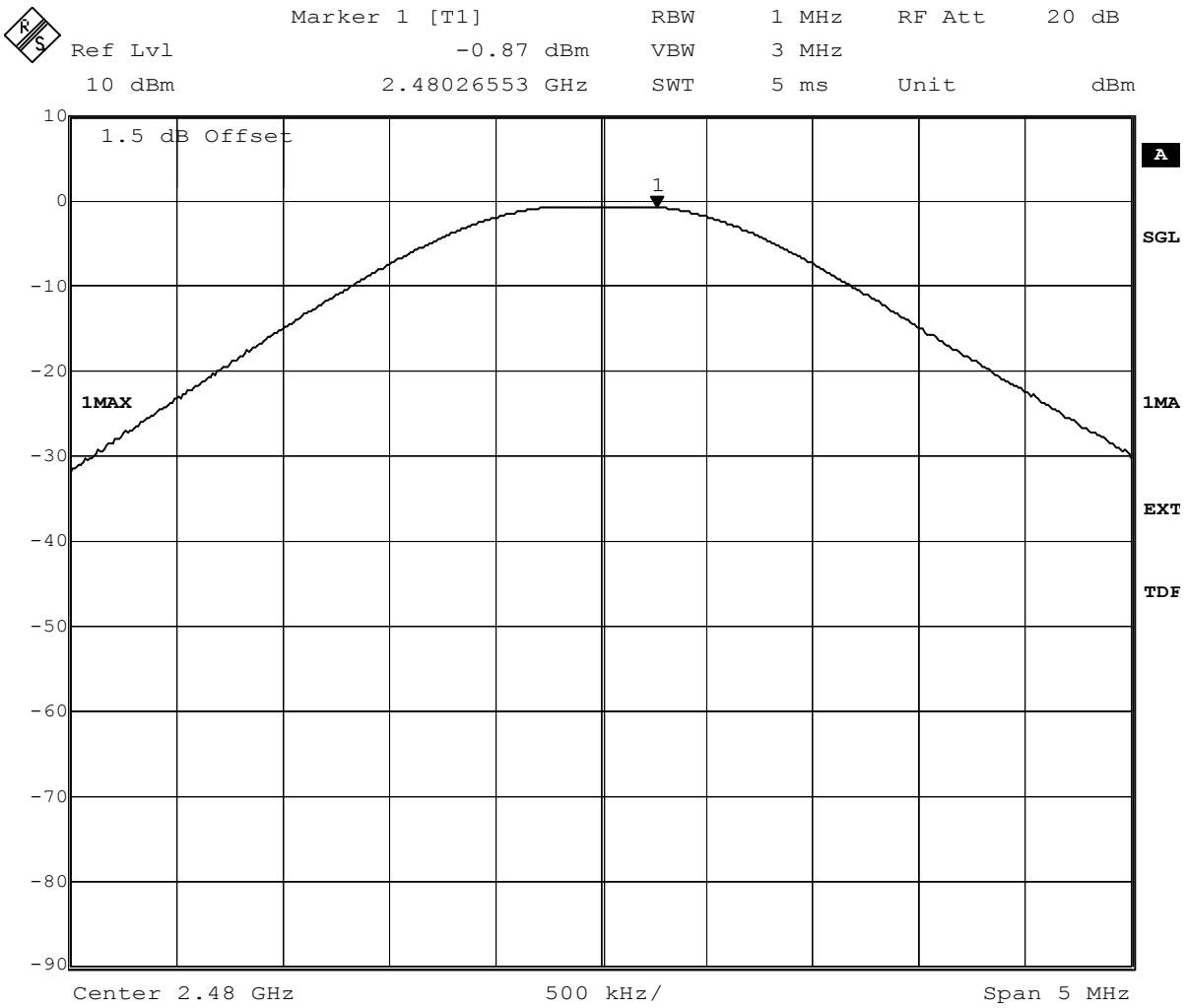



Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 15:21:05

**Peak power output**

**Op. Mode**

op-mode 3

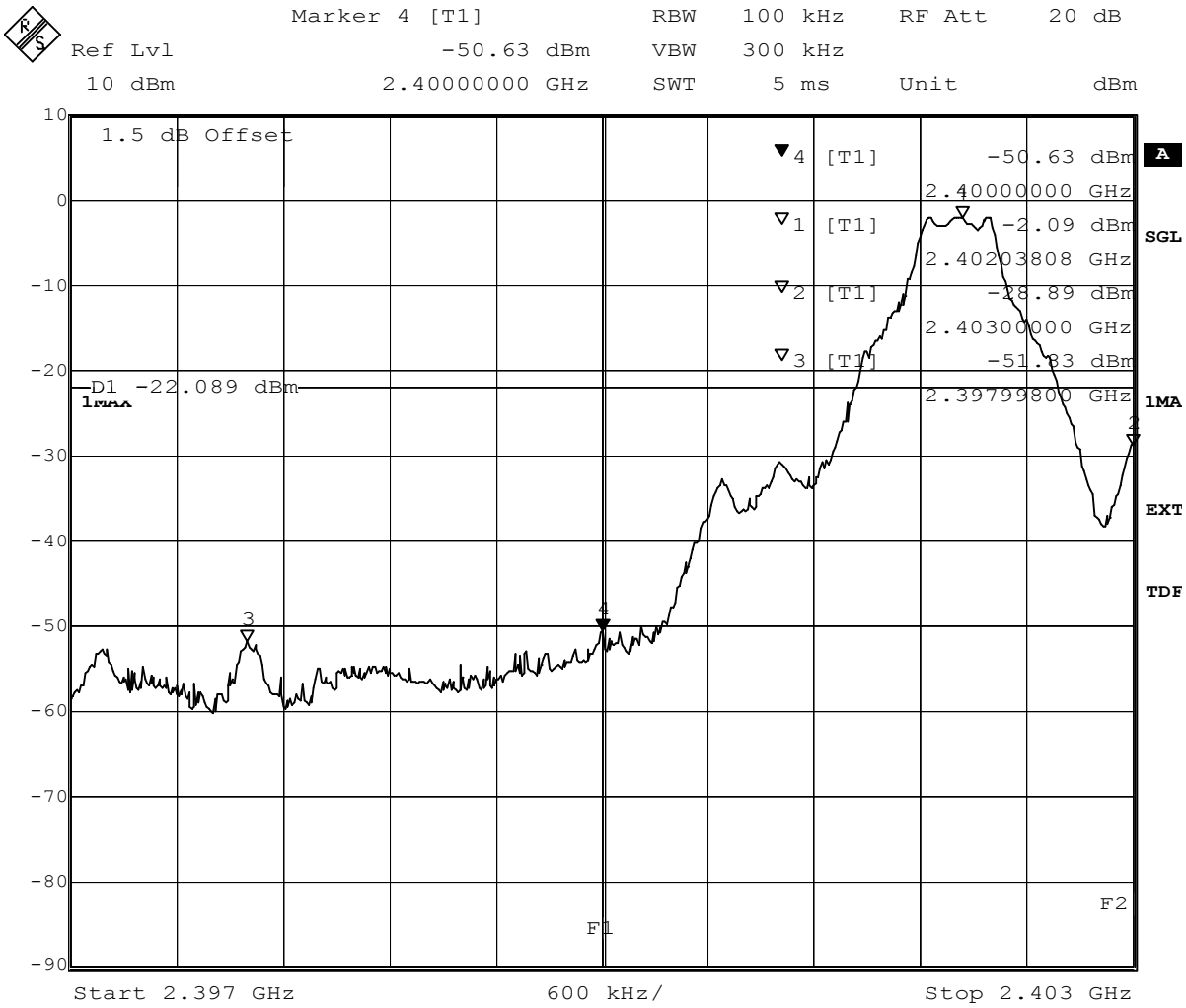



Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 22.APR.2005 15:39:12

## Band edge compliance conducted and Spurious RF conducted emission

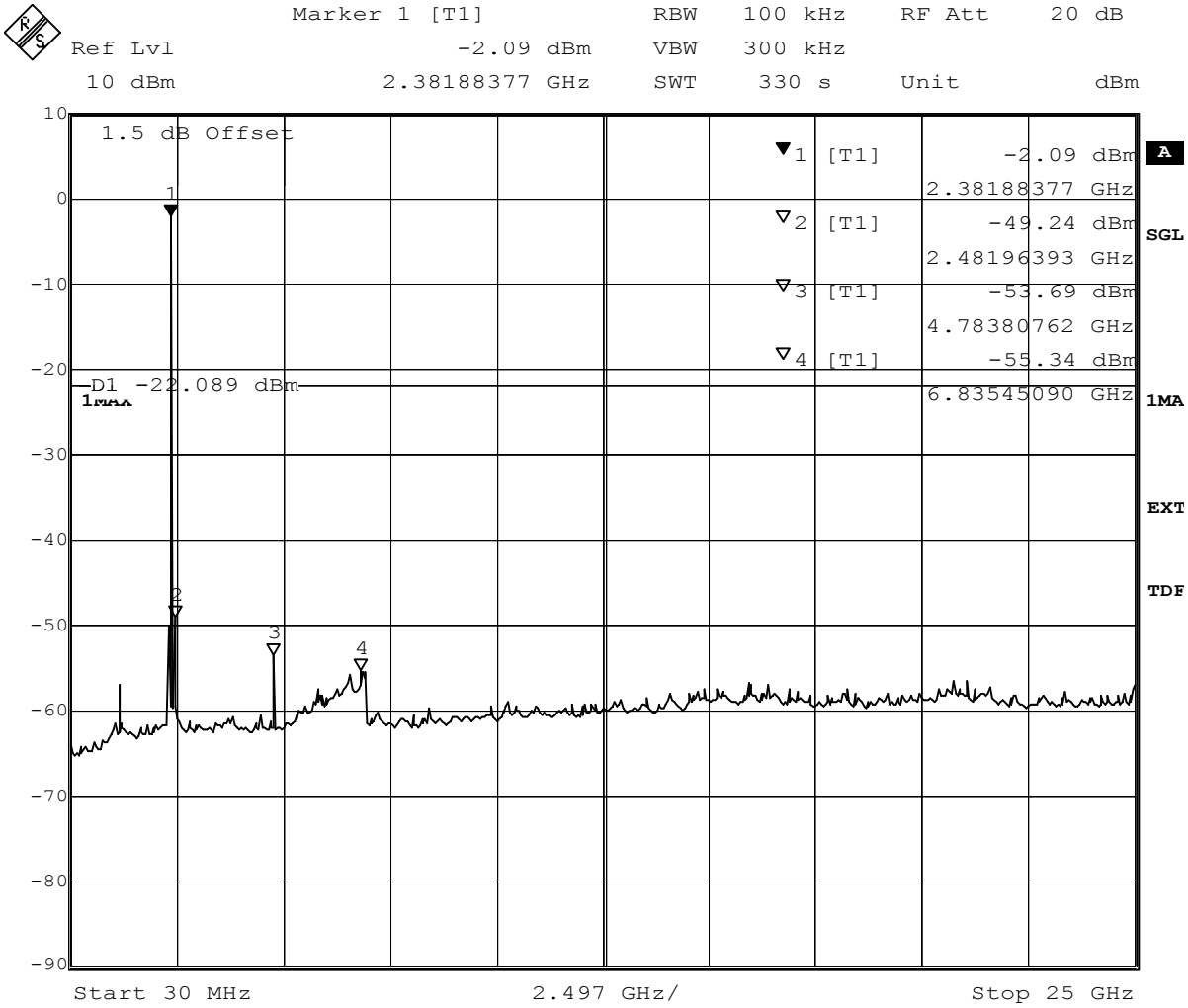
### Op. Mode

op-mode 1




Title: Band Edge Compliance
Comment A: CH B: 2402 MHz
Date: 22.APR.2005 14:46:22

(determination of reference value)



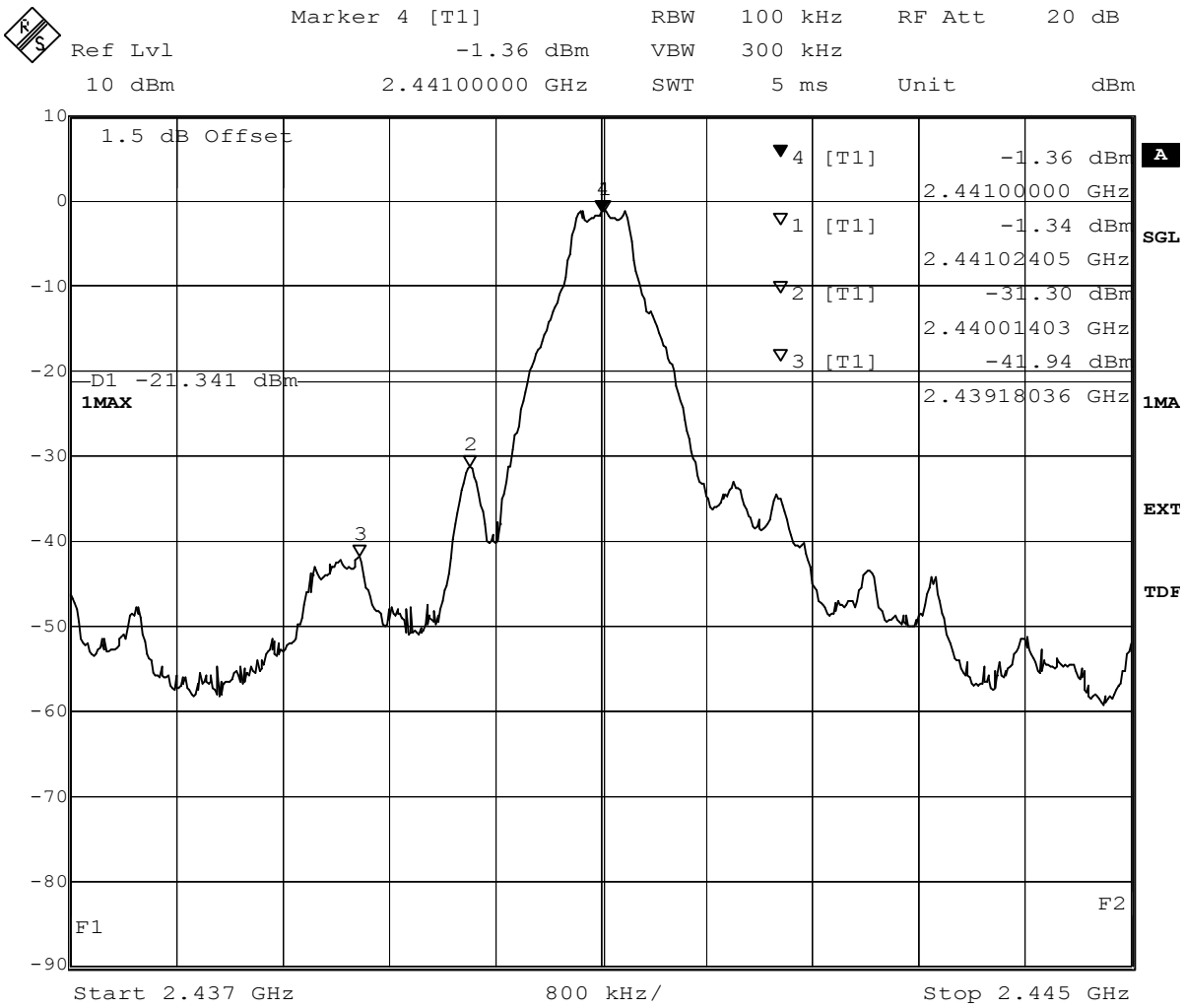

Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 22.APR.2005 14:58:00

(spurious emissions measurement)

**Band edge compliance conducted and Spurious RF conducted emission**

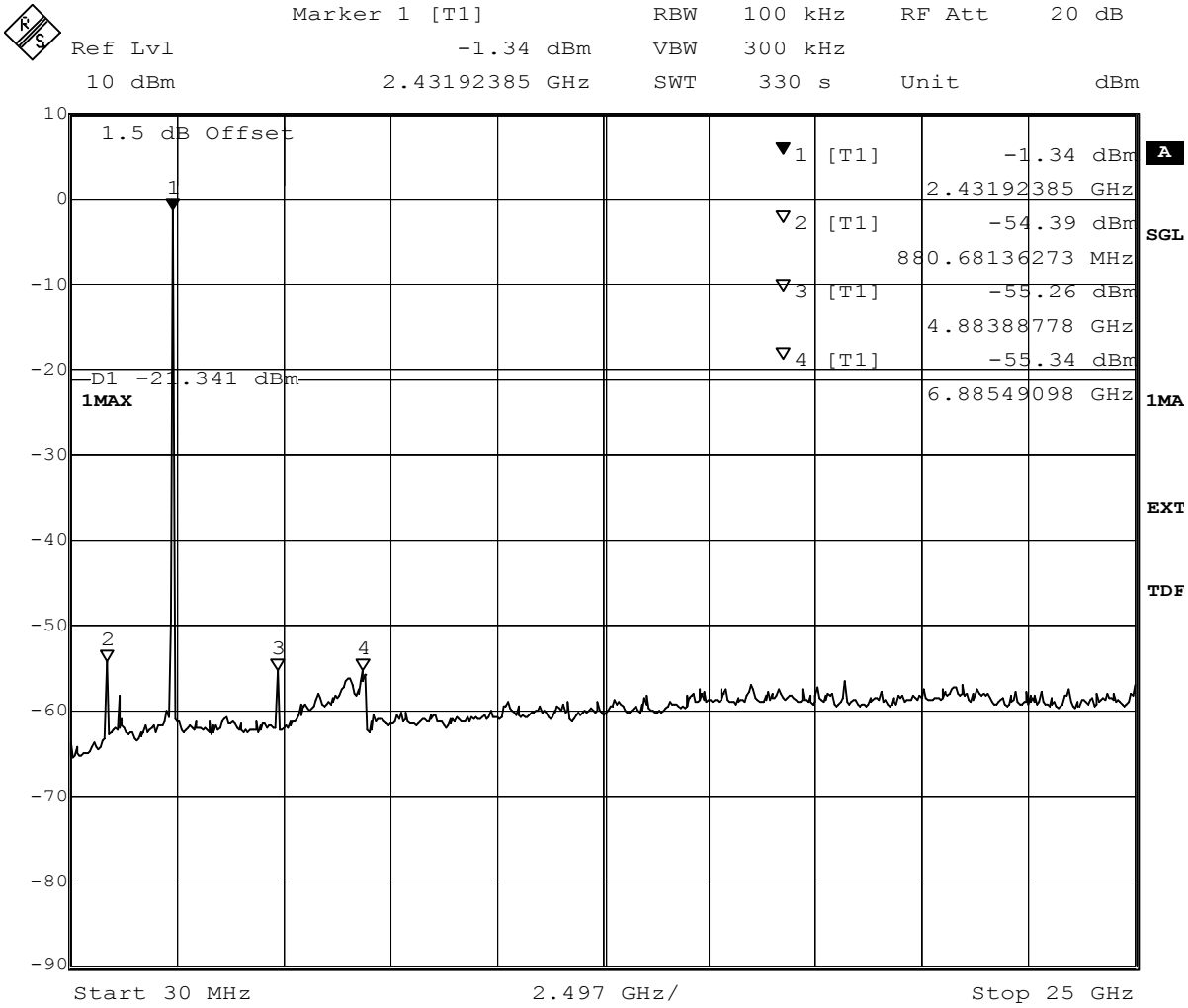
**Op. Mode**

op-mode 2




Title: Band Edge Compliance
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 15:05:26

(determination of reference value)



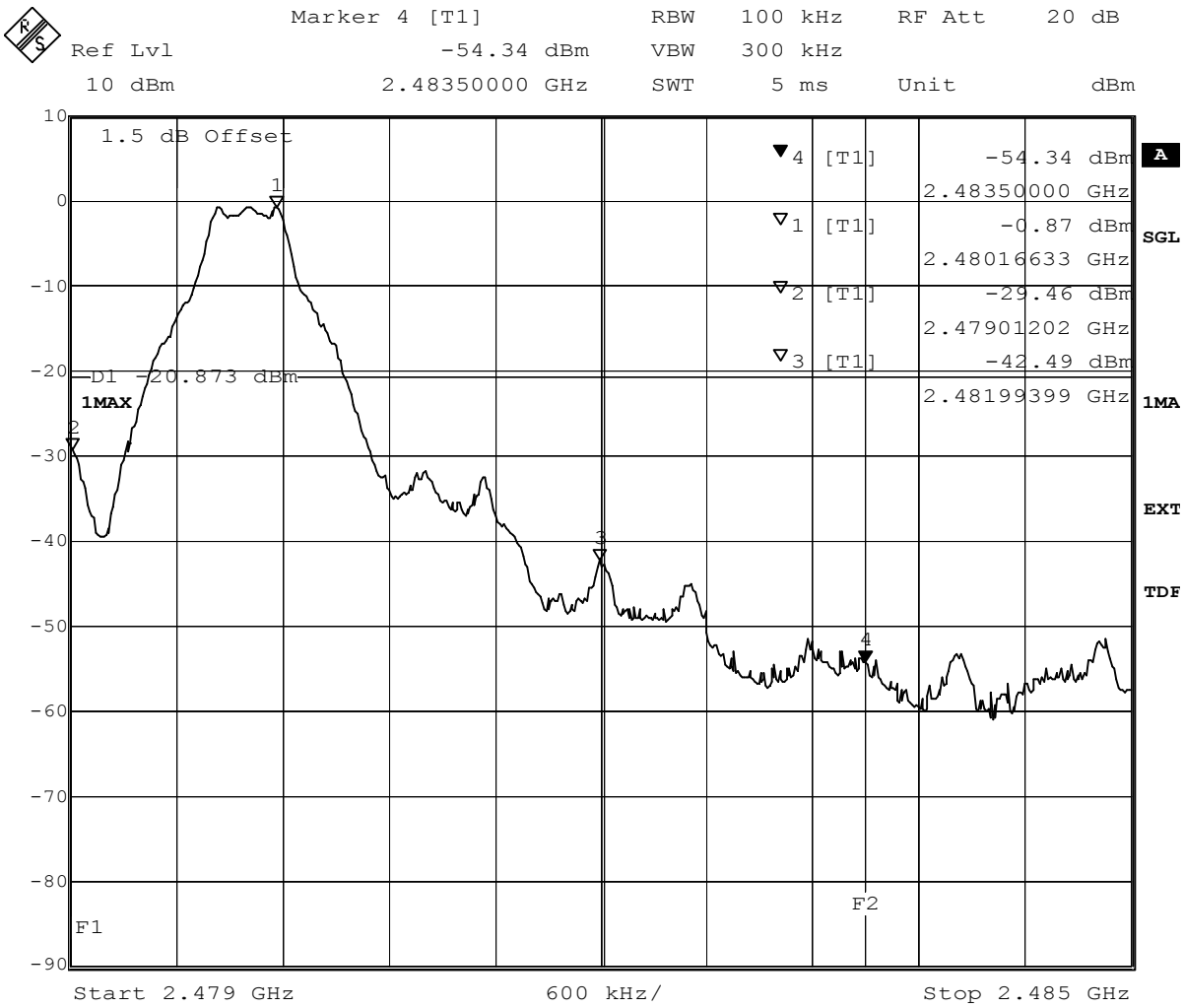

Title: spurious emissions
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 15:17:03

(spurious emissions measurement)

**Band edge compliance conducted and Spurious RF conducted emission**

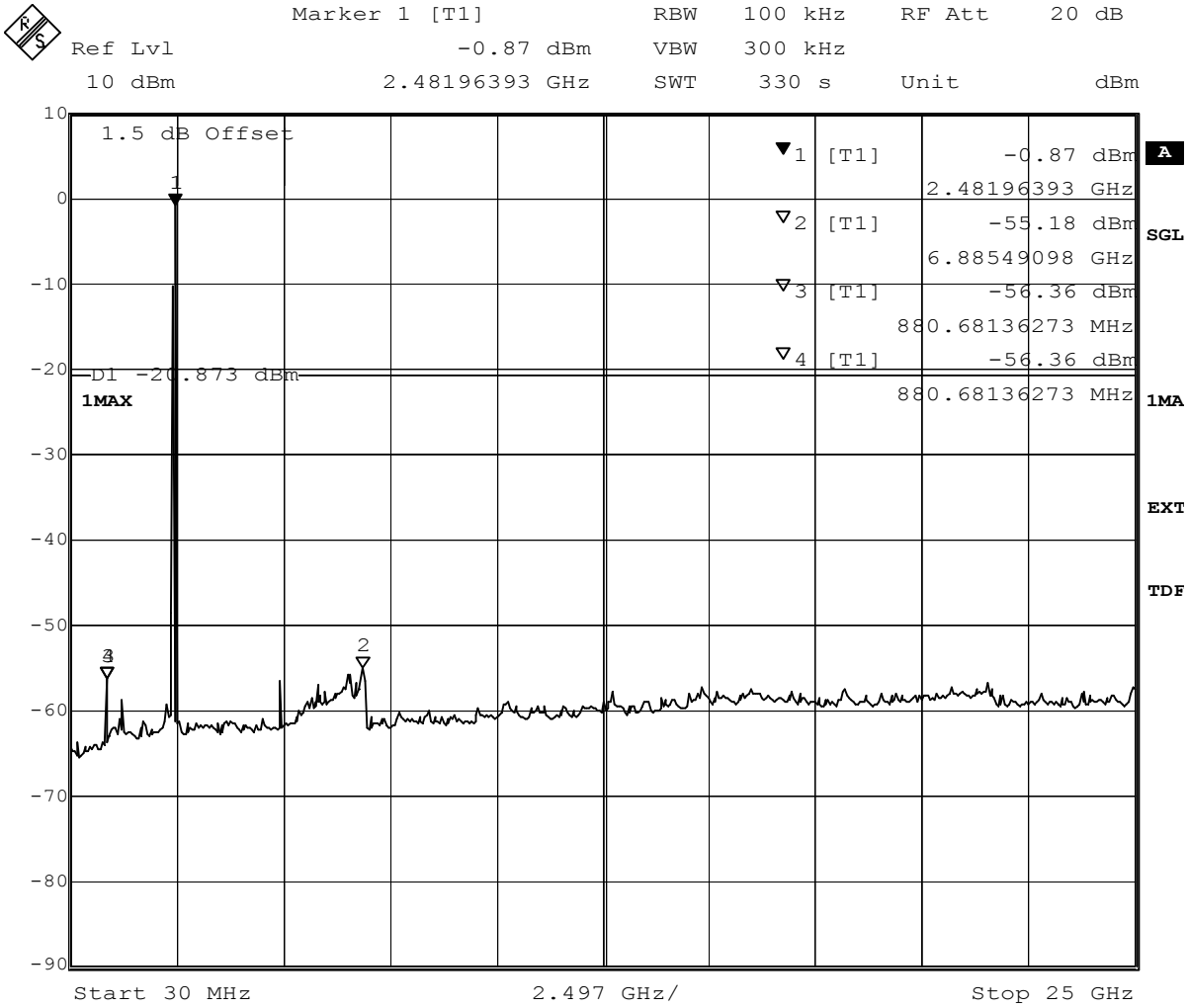
**Op. Mode**

op-mode 3




Title: Band Edge Compliance
Comment A: CH T: 2480 MHz
Date: 22.APR.2005 15:23:26

(determination of reference value)



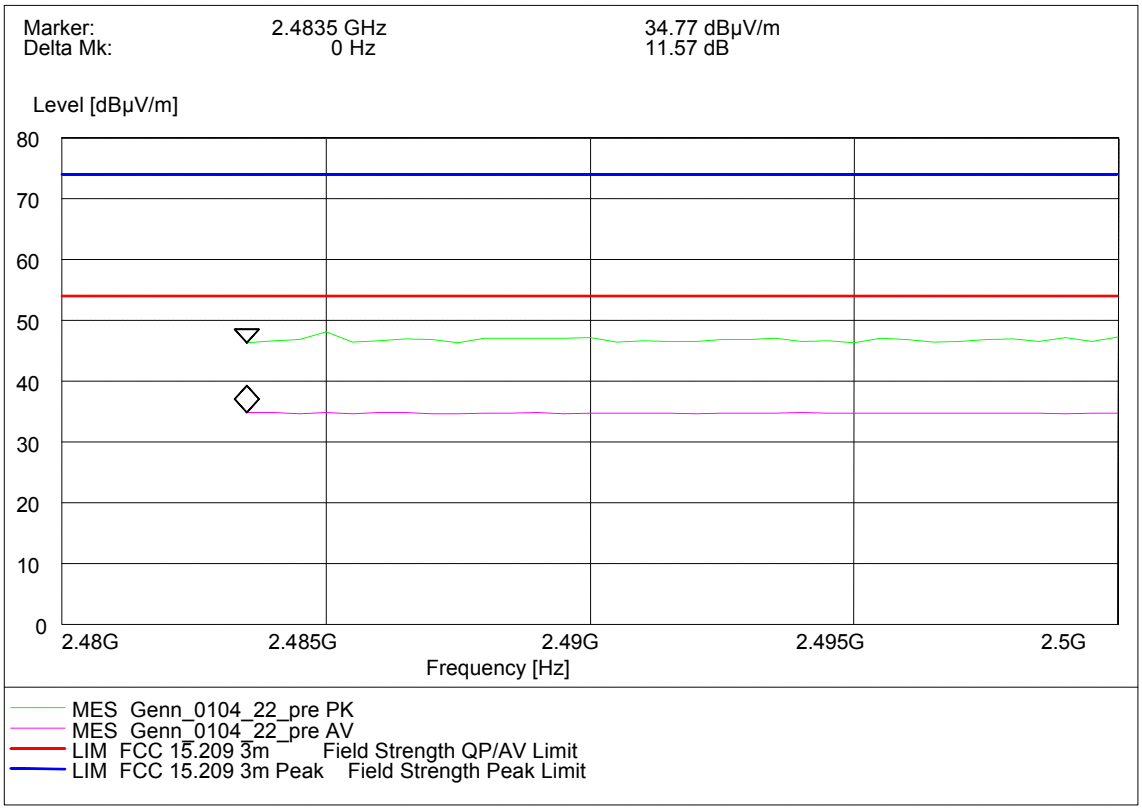

Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 22.APR.2005 15:35:03

(spurious emissions measurement)

**Band edge compliance radiated**

| **Op. Mode** | **higher band edge** |
|---|---|
| op-mode 3 | **TX on 2480 MHz** |

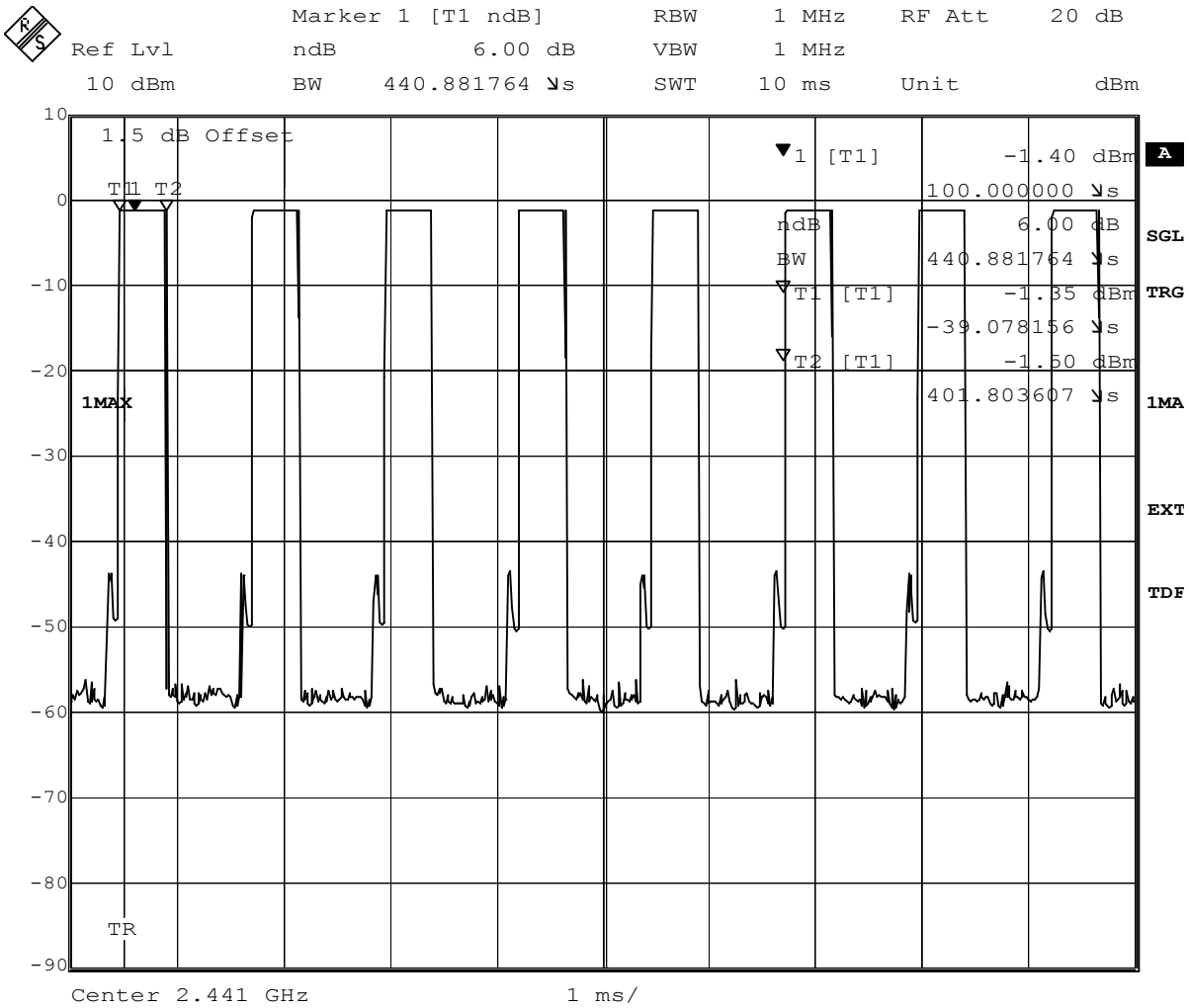
Radiated measurement



**Dwell time**

**Op. Mode**

op-mode 2 Time slot measurement of a DH1 packet

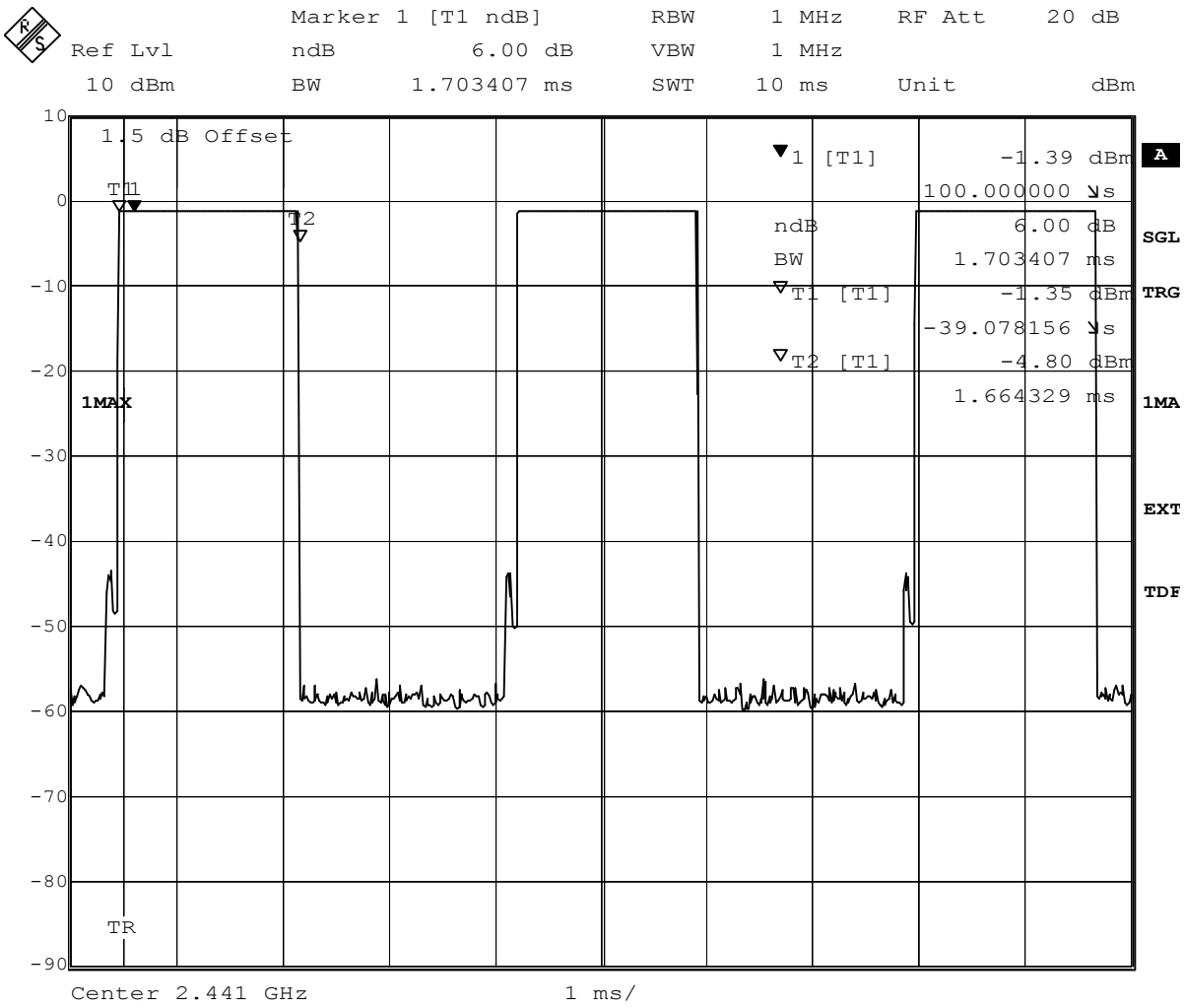



Title: Dwell time
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 14:34:08

## Dwell time

## Op. Mode

op-mode 2 Time slot measurement of a DH3 packet

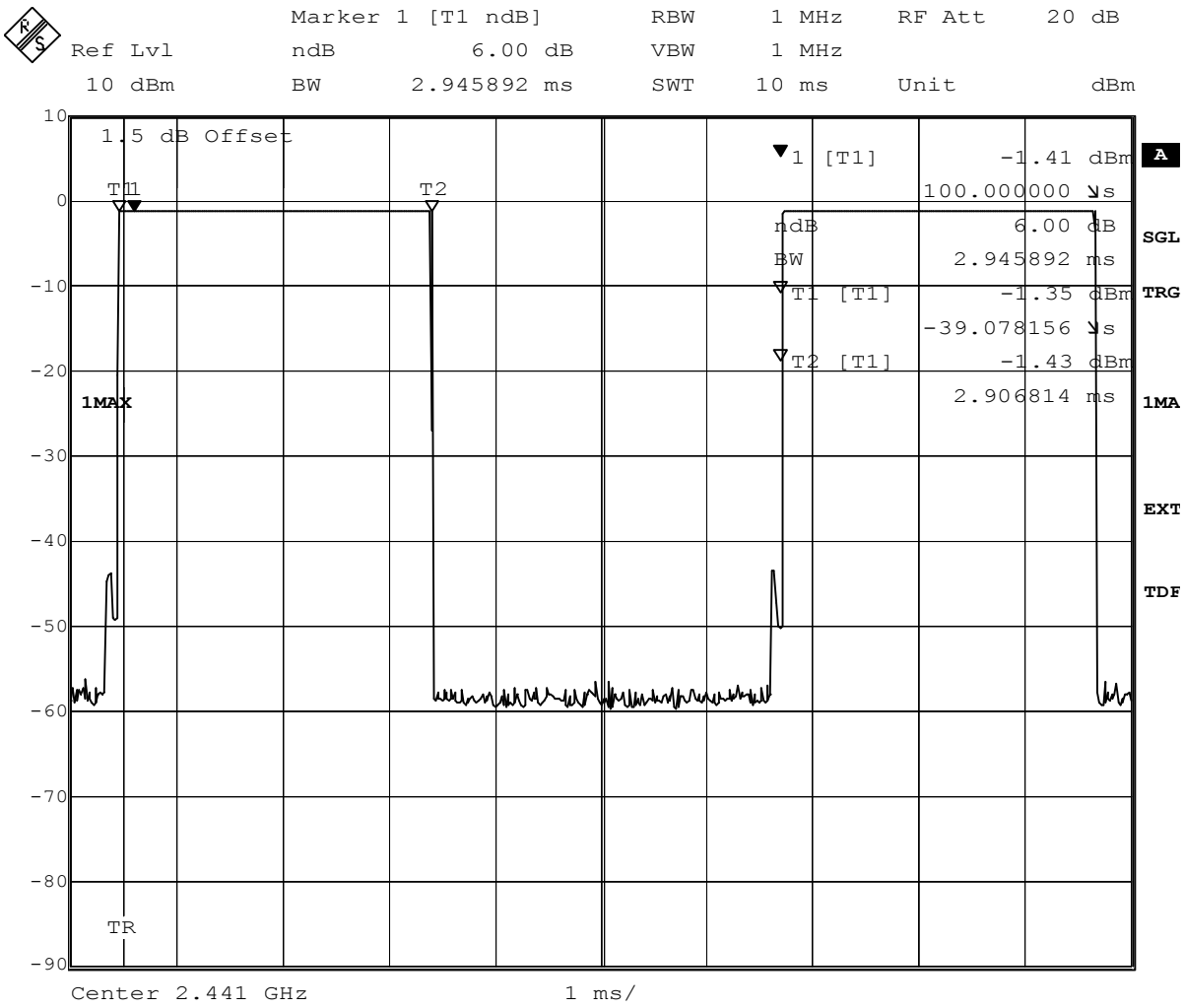



Title: Dwell time
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 14:34:33

**Dwell time**

**Op. Mode**

op-mode 2 Time slot measurement of a DH5 packet

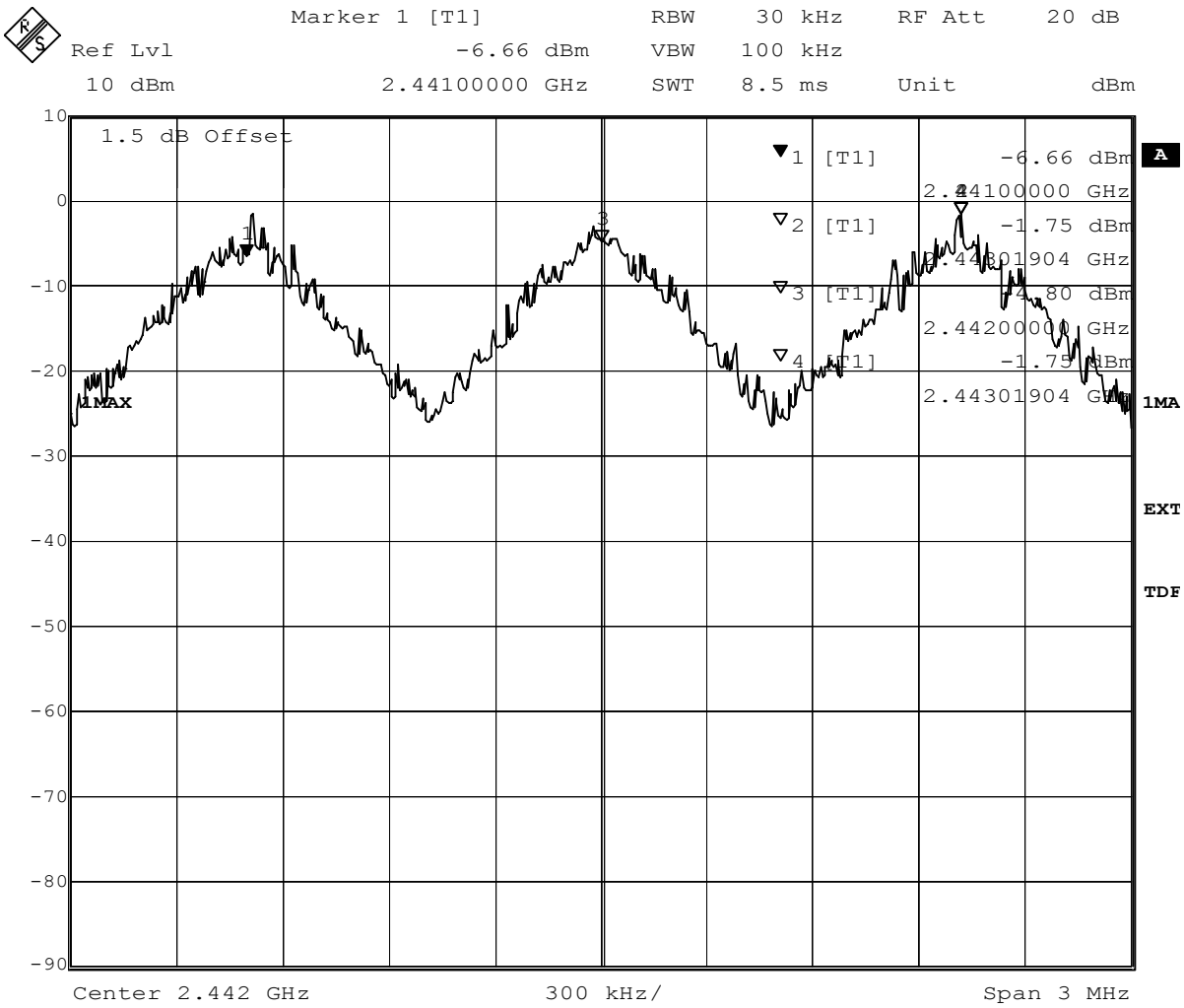



Title: Dwell time
Comment A: CH M: 2441 MHz
Date: 22.APR.2005 14:34:54

## Channel separation

## Op. Mode

op-mode 4

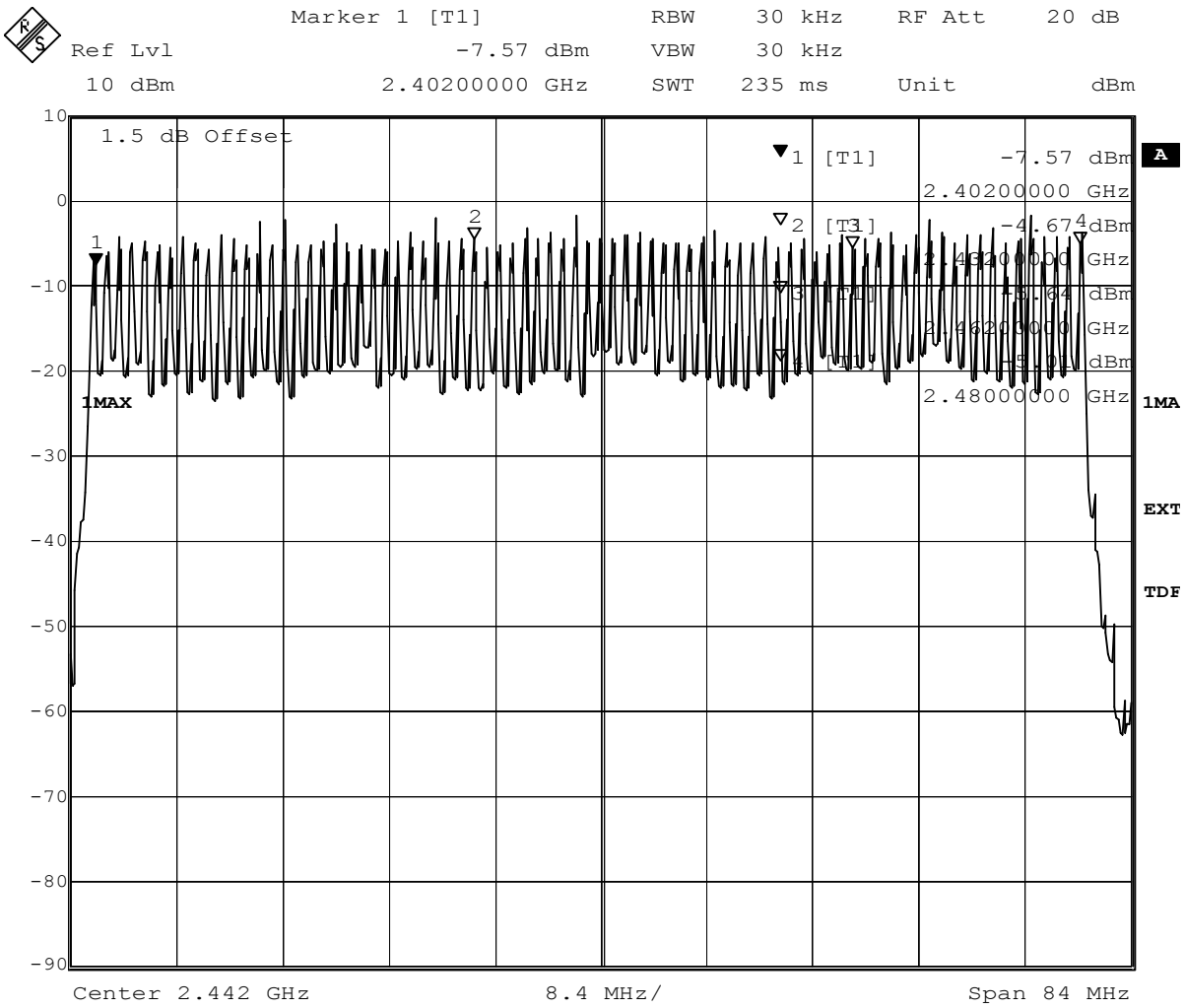



Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 22.APR.2005 14:37:38

## Number of hopping frequencies

### Op. Mode

op-mode 4




Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 22.APR.2005 14:42:08

## Annex 1 – test modes (power supply)

The device can be charged by a AC charger or a USB interface. After performing a pre-scan it could be seen that the AC power supply can be considered as the worst case so only this mode was tested.