



Inter**Lab**[®]

FCC Measurement/Technical Report on

Bluetooth transceiver
FC6000S

Report Reference: MDE_PARRO_1101_FCCa

Test Laboratory:

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



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.

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

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Aufsichtsratsvorsitzender •
Chairman of the Supervisory Board:
Markus Becker
Vorstand • Board:
Dr. H.-J. Meckelburg
Wilfried Klassmann

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



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0 Summary

0.1 Technical Report Summary

Type of Authorization

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

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-10 Edition) and 15 (10-1-10 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 C63.4-2009 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) ¹⁾

The measurement was performed according to ANSI C63.4

2009

| OP-Mode | Setup | Port | Final Result |
|-----------|----------|----------------------|--------------|
| op-mode 2 | Setup_02 | 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

10-1-10 Edition

| OP-Mode | Setup | Port | Final Result |
|------------|----------|-------------------|--------------|
| op-mode 1 | Setup_01 | Antenna connector | passed |
| op-mode 2 | Setup_01 | Antenna connector | passed |
| op-mode 3 | Setup_01 | Antenna connector | passed |
| op-mode 6 | Setup_01 | Antenna connector | passed |
| op-mode 7 | Setup_01 | Antenna connector | passed |
| op-mode 8 | Setup_01 | Antenna connector | passed |
| op-mode 10 | Setup_01 | Antenna connector | passed |
| op-mode 11 | Setup_01 | Antenna connector | passed |
| op-mode 12 | Setup_01 | Antenna connector | passed |

FCC Part 15, Subpart C

§ 15.247 (b) (1)

Peak power output

The measurement was performed according to FCC § 15.31

10-1-10 Edition

| OP-Mode | Setup | Port | Final Result |
|------------|----------|-------------------|--------------|
| op-mode 1 | Setup_01 | Antenna connector | passed |
| op-mode 2 | Setup_01 | Antenna connector | passed |
| op-mode 3 | Setup_01 | Antenna connector | passed |
| op-mode 6 | Setup_01 | Antenna connector | passed |
| op-mode 7 | Setup_01 | Antenna connector | passed |
| op-mode 8 | Setup_01 | Antenna connector | passed |
| op-mode 10 | Setup_01 | Antenna connector | passed |
| op-mode 11 | Setup_01 | Antenna connector | passed |
| op-mode 12 | Setup_01 | Antenna connector | passed |

FCC Part 15, Subpart C

§ 15.247 (d)

Spurious RF conducted emissions

The measurement was performed according to FCC § 15.31

10-1-10 Edition

| OP-Mode | Setup | Port | Final Result |
|------------|----------|-------------------|--------------|
| op-mode 1 | Setup_01 | Antenna connector | passed |
| op-mode 2 | Setup_01 | Antenna connector | passed |
| op-mode 3 | Setup_01 | Antenna connector | passed |
| op-mode 6 | Setup_01 | Antenna connector | passed |
| op-mode 7 | Setup_01 | Antenna connector | passed |
| op-mode 8 | Setup_01 | Antenna connector | passed |
| op-mode 10 | Setup_01 | Antenna connector | passed |
| op-mode 11 | Setup_01 | Antenna connector | passed |
| op-mode 12 | Setup_01 | Antenna 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

2009

| OP-Mode | Setup | Port | Final Result |
|----------------|--------------|-------------|---------------------|
| op-mode 1 | Setup_01 | Enclosure | passed |
| op-mode 2 | Setup_01 | Enclosure | passed |
| op-mode 3 | Setup_01 | Enclosure | passed |
| op-mode 6 | Setup_01 | Enclosure | passed |
| op-mode 7 | Setup_01 | Enclosure | passed |
| op-mode 8 | Setup_01 | Enclosure | passed |
| op-mode 10 | Setup_01 | Enclosure | passed |
| op-mode 11 | Setup_01 | Enclosure | passed |
| op-mode 12 | Setup_01 | Enclosure | passed |

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

Band edge compliance

The measurement was performed according to FCC § 15.31 / ANSI C63.4

10-1-10 Edition / 2009

| OP-Mode | Setup | Port | Final Result |
|----------------|--------------|-------------------|---------------------|
| op-mode 1 | Setup_01 | Antenna connector | passed |
| op-mode 3 | Setup_01 | Antenna connector | passed |
| op-mode 3 | Setup_01 | Enclosure | passed |
| op-mode 6 | Setup_01 | Antenna connector | passed |
| op-mode 8 | Setup_01 | Antenna connector | passed |
| op-mode 8 | Setup_01 | Enclosure | passed |
| op-mode 10 | Setup_01 | Antenna connector | passed |
| op-mode 12 | Setup_01 | Antenna connector | passed |
| op-mode 12 | Setup_01 | Enclosure | passed |

FCC Part 15, Subpart C

§ 15.247 (a) (1) (iii)

Dwell time

The measurement was performed according to FCC § 15.31 10-1-10 Edition

| OP-Mode | Setup | Port | Final Result |
|-----------|----------|-------------------|--------------|
| op-mode 2 | Setup_01 | Antenna connector | passed |

FCC Part 15, Subpart C

§ 15.247 (a) (1)

Channel separation

The measurement was performed according to FCC § 15.31 10-1-10 Edition

| OP-Mode | Setup | Port | Final Result |
|-----------|----------|-------------------|--------------|
| op-mode 4 | Setup_01 | Antenna connector | passed |

FCC Part 15, Subpart C

§ 15.247 (a) (iii)

Number of hopping frequencies

The measurement was performed according to FCC § 15.31 10-1-10 Edition

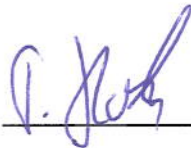
| OP-Mode | Setup | Port | Final Result |
|-----------|----------|-------------------|--------------|
| op-mode 4 | Setup_01 | Antenna connector | passed |

- 1) The EUT is powered by DC, it can indirectly be connected to AC Mains.



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

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. DGA-PL-192/99-02

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

Report Template Version: 2011-05-25

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Andreas Petz
Date of Test(s): 2011-04-21 to 2011-05-04
Date of Report: 2011-06-14

1.3 Applicant Data

Company Name: PARROT S.A.
Address: 174 quai Jemmapes
75010 Paris
France
Contact Person: Mr. Vincent Leblanc

1.4 Manufacturer Data

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



2 Test object Data

2.1 General EUT Description

| | |
|-----------------------------|--|
| Equipment under Test | Bluetooth transceiver |
| Type Designation: | FC6000S |
| Kind of Device: | Bluetooth Module with EDR and Audio Profiles |
| (optional) | |
| Voltage Type: | DC (supplied by 12V host) |
| Voltage level: | 3.4 V |
| Modulation Type: | 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 μ 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.

Specific product description for the EUT:

The EUT is a module which uses Bluetooth technology. The tests are performed using a representative combination of the EUT and a host device. The EUT supports Bluetooth radio links in the 2.4 GHz ISM band.

The module is tested in a representative combination with host devices.

The EUT provides the following ports:

Ports

- Antenna connector
- Enclosure
- DC power supply

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



2.2 EUT Main components

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

| Short Description | Equipment under Test | Type Designation | Serial No. | HW Status | SW Status | Date of Receipt |
|---|-----------------------|------------------|------------|-----------|-----------|-----------------|
| EUT A (Code: CX220b01) | Bluetooth transceiver | FC6000S | – | 05 | 01.01.30 | 2011-04-19 |
| Remark: EUT A is equipped with an integral antenna (gain = –2.34 dBi) and a permanent antenna connector. The integral antenna is switched off when the permanent antenna connector is used. | | | | | | |

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 Auxiliary Equipment

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

| Short Description | Equipment under Test | Type Designation | Serial no. | HW Status | SW Status | FCC ID |
|-------------------|----------------------|---|-----------------|-----------|-----------|--------|
| AUX 1 | Host 1 | Workbench Host Mainboard Parrot WBFC6XXX_CEM_01 | 1106 – 004 FULL | 04/11 | – | – |
| AUX 2 | Host 2 | Workbench Adapter-board Parrot FC6000_MEZ Z_0 30411 | 17 | – | – | – |
| AUX 3 | DC Power Supply | Rohde&Schwarz NGSM 32/10 | 1771 | – | – | – |



2.5 EUT Setups

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

| Setup No. | Combination of EUTs | Description and Rationale |
|-----------|-------------------------------|---|
| Setup_01 | EUT A + AUX 1 + AUX 2 | setup for radiated and conducted measurements, AUX 1 + AUX 2 are used to operate the EUT which can not work stand-alone and to provide a representative configuration how it will be integrated later in other products |
| Setup_02 | EUT A + AUX 1 + AUX 2 + AUX 3 | setup for measurement of AC Mains conducted emissions, same as setup_01 + AUX 3 which provides the connection to the AC Mains networks to be able to perform the conducted emission tests at AC MAINS lines |

The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards, applying long-term experience and good engineering practice.

2.6 Operating Modes

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

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



2.7 Special software used for testing

The EUT can not be operated in all modes listed at sub-clause 2.6. E.g. a special firmware version can be used in the EUT where code is added to the normal operation providing the additional modes required for testing. This is listed at sub-clause 2.2. If a special software to control the EUT is used then it is described below. This software might directly control the EUT.

For Bluetooth technology, the Bluetooth Standards define a test mode that enables the operator during the tests to set the EUT into a mode that it can be externally controlled by the signalling unit in the active Bluetooth radio-link "over-the-air." The Bluetooth test mode is completely documented in the Bluetooth Specifications.

2.7.1 Software to control the EUT directly

None.

2.7.2 Software to enable control the EUT by a signalling unit

Integrated in the EUT.

2.8 Product labelling

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Conducted emissions (AC power line)

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

The test was performed according to: ANSI C63.4–2009

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN) which meets the requirements of ANSI C63.4–2009, Annex B, in the frequency range of the measurements. The LISN's unused connections were terminated with 50 Ohm loads.

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

Step 1: Preliminary scan

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

EMI receiver settings:

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

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

Step 2: Final measurement

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

EMI receiver settings:

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

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

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

The highest value is reported.



3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

| Frequency Range (MHz) | QP Limit (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).

3.1.3 Test Protocol

Temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 32 %

| Op. Mode | Setup | Port |
|-----------|----------|----------------------|
| op-mode 2 | Setup_02 | AC Port (power line) |

| Power line | Frequency MHz | Measured value QP dBµV | Measured value AV dBµV | QP Limit dBµV | AV Limit dBµV | Delta to QP limit dB | Delta to AV limit dB |
|------------|---------------|------------------------|------------------------|---------------|---------------|----------------------|----------------------|
| N | – | – | – | – | – | – | – |
| L | – | – | – | – | – | – | – |

Remark: No final measurement was performed because no frequencies (peaks) were found within the offset for acceptance analysis during the preliminary scan. Please see annex for the measurement plot.
 The chosen operating mode is selected as representative mode to generate “worst-case” conditions, i.e. high power consumption.

3.1.4 Test result: Conducted emissions (AC power line)

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



3.2 Occupied bandwidth

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

The test was performed according to: FCC §15.31

3.2.1 Test Description

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

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 30 kHz.

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

3.2.2 Test Requirements / Limits

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

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Implication by the test laboratory:

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

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

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

The measured output power of the system is below 125 mW (21.0 dBm).

For the results, please refer to the related chapter of this report.

Therefore the limit is determined as 1.5 MHz.

3.2.3 Test Protocol

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 1 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 0.956 | - |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 2 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 0.962 | - |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 3 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 0.968 | - |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 6 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.312 | - |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 7 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.312 | - |

Remark: Please see annex for the measurement plot.



| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 8 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.252 | – |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 10 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.312 | – |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 11 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.258 | – |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 12 | Setup_01 | Antenna connector |

| 20 dB bandwidth MHz | Remarks |
|---------------------|---------|
| 1.288 | – |

Remark: Please see annex for the measurement plot.

3.2.4 Test result: Occupied bandwidth

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

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

The test was performed according to: FCC §15.31

3.3.1 Test Description

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

3.3.2 Test Requirements / Limits

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

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

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

==> Maximum Output Power: 30 dBm

3.3.3 Test Protocol

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 1 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 1.0 | The EIRP including antenna gain (-2.34 dBi) is -1.34 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 2 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 1.1 | The EIRP including antenna gain (-2.34 dBi) is -1.24 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 3 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 0.7 | The EIRP including antenna gain (-2.34 dBi) is -1.64 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 6 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 1.1 | The EIRP including antenna gain (-2.34 dBi) is -1.24 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 7 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 1.4 | The EIRP including antenna gain (-2.34 dBi) is -0.94 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 8 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 0.8 | The EIRP including antenna gain (-2.34 dBi) is -1.54 dBm |

Remark: Please see annex for the measurement plot.



| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 10 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 0.6 | The EIRP including antenna gain (-2.34 dBi) is -1.74 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 11 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 1.4 | The EIRP including antenna gain (-2.34 dBi) is -0.94 dBm |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 12 | Setup_01 | Antenna connector |

| Output power dBm | Remarks |
|------------------|--|
| 0.2 | The EIRP including antenna gain (-2.34 dBi) is -2.14 dBm |

Remark: Please see annex for the measurement plot.

3.3.4 Test result: Peak power output

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

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

The test was performed according to: FCC §15.31

3.4.1 Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.

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

Analyzer settings:

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

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

3.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)

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

3.4.3 Test Protocol

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 1 | Setup_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| – | – | 0.8 | –19.2 | – |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| – | – | 1.0 | –19.0 | – |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| – | – | 0.4 | –19.6 | – |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| – | – | –1.6 | –21.6 | – |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| – | – | –1.6 | –21.6 | – |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| - | - | -2.0 | -22.0 | - |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| - | - | -1.6 | -21.6 | - |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| - | - | -1.6 | -21.6 | - |

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_01 | Antenna connector |

| Frequency MHz | Corrected measurement value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|---------------------------------|---------------------|-----------|-------------------|
| - | - | -2.2 | -22.2 | - |

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

3.4.4 Test result: Spurious RF conducted emissions

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

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

The test was performed according to: ANSI C63.4–2009

3.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

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

1. Measurement up to 30 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009. 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 μ s (BT Timing 1.25 ms)
- Turntable angle range: -180 to $+180^\circ$
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

Step 2: second measurement

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

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

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

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

The last two values have now the following accuracy:

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

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved.

This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by $\pm 22.5^\circ$ around this value.

During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

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

Step 4: final measurement with QP detector

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

EMI receiver settings for step 4:



- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

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

EMI receiver settings:

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

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

For the enhanced data rate packets the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at basic data rate. Typically, the measurement for these packets is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the basic data rate. Please refer to the results for the used frequency range.

3.5.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

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

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

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

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

§15.35(b)

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

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

3.5.3 Test Protocol

Temperature: 26 °C
 Air Pressure: 1011 hPa
 Humidity: 34 %

3.5.3.1 Measurement up to 30 MHz

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 2 | Setup_01 | 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 99.2 kHz is an emission from the loop antenna's power supply.

3.5.3.2 Measurement above 30 MHz

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 1 | Setup_01 | 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 | 4804 | – | 49.8 | 37.8 | – | 74.0 | 54.0 | 24.2 | 16.2 |

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

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 2 | Setup_01 | 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 | – | – | – | – | – | – | – | – | – |

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

Op. Mode **Setup** **Port**
 op-mode 3 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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

Op. Mode **Setup** **Port**
 op-mode 6 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.

Op. Mode **Setup** **Port**
 op-mode 7 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.

Op. Mode **Setup** **Port**
 op-mode 8 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.



Op. Mode **Setup** **Port**
 op-mode 10 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.

Op. Mode **Setup** **Port**
 op-mode 11 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.

Op. Mode **Setup** **Port**
 op-mode 12 Setup_01 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 | – | – | – | – | – | – | – | – | – |

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 frequency range in op-mode 1, 2 and 3.

3.5.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C

| Op. Mode | Result |
|------------|--------|
| op-mode 1 | passed |
| op-mode 2 | passed |
| op-mode 3 | passed |
| op-mode 6 | passed |
| op-mode 7 | passed |
| op-mode 8 | passed |
| op-mode 10 | passed |
| op-mode 11 | passed |
| op-mode 12 | passed |

3.6 Band edge compliance

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

The test was performed according to: ANSI C63.4–2009, FCC §15.31

3.6.1 Test Description

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

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge is 2400 MHz.

Analyzer settings:

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

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

Analyzer settings for conducted measurement:

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

EMI receiver settings for radiated measurement:

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

3.6.2 Test Requirements / Limits

FCC Part 15.247 (d)

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

...

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

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

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

3.6.3 Test Protocol

3.6.3.1 Lower band edge

Conducted measurement

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 1 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2400.00 | -58.9 | 0.8 | -19.2 | 39.7 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 6 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2400.00 | -51.8 | -1.6 | -21.6 | 30.2 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 10 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2400.00 | -55.7 | -1.6 | -21.6 | 34.1 |

Remark: Please see annex for the measurement plot.

3.6.3.2 Higher band edge

Conducted measurement

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 3 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2483.50 | -63.7 | 0.4 | -19.6 | 44.1 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 8 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2483.50 | -63.8 | -2.0 | -22.0 | 41.8 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-------------------|
| op-mode 12 | Setup_01 | Antenna connector |

| Frequency MHz | Measured value dBm | Reference value dBm | Limit dBm | Delta to limit dB |
|---------------|--------------------|---------------------|-----------|-------------------|
| 2483.50 | -63.4 | -2.2 | -22.2 | 41.2 |

Remark: Please see annex for the measurement plot.

Radiated measurement

Temperature: 26 °C
 Air Pressure: 1011 hPa
 Humidity: 34 %

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 3 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.50 | Vertical + horizontal | 49.4 | 36.9 | 74.0 | 54.0 | 24.6 | 17.1 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 8 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.50 | Vertical + horizontal | 49.0 | 36.9 | 74.0 | 54.0 | 25.0 | 17.1 |

Remark: Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|------------|----------|-----------|
| op-mode 12 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.50 | Vertical + horizontal | 49.4 | 37.0 | 74.0 | 54.0 | 24.6 | 17.0 |

Remark: Please see annex for the measurement plot.

3.6.4 Test result: Band edge compliance

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



3.7 Dwell time

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

The test was performed according to: FCC §15.31

3.7.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

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

with:

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

The highest value of the dwell time is reported.

3.7.2 Test Requirements / Limits

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

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.



3.7.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1016 hPa
Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 2 | Setup_01 | Antenna connector |

| Packet type | Time slot length ms | Dwell time | Dwell time ms |
|-------------|------------------------|---|------------------|
| DH5 | 2.926 | time slot length * 1600/5 /79 * 31.6 | 374.53 |

Remark: Please see annex for the measurement plots.

3.7.4 Test result: Dwell time

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



3.8 Channel separation

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

The test was performed according to: FCC §15.31

3.8.1 Test Description

The Equipment Under Test (EUT) was set up to perform the channel separation measurements. The channel separation is independent from the modulation pattern. The EUT was connected to spectrum analyzer via a short coax cable.

Analyzer settings:

- Detector: Peak-Maxhold
- Span: 3 MHz
- Centre Frequency: a mid frequency of the 2.4 GHz ISM band
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

3.8.2 Test Requirements / Limits

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

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.



3.8.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1016 hPa
Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 4 | Setup_01 | Antenna connector |

| Channel separation MHz | Remarks |
|---------------------------|---------|
| 1.000 | - |

Remark: Please see annex for the measurement plot.

3.8.4 Test result: Channel separation

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



3.9 Number of hopping frequencies

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

The test was performed according to: FCC §15.31

3.9.1 Test Description

The Equipment Under Test (EUT) was set up to perform the number of hopping frequencies measurement. The number of hopping frequencies is independent from the modulation pattern.

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

Analyzer settings:

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

3.9.2 Test Requirements / Limits

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

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

3.9.3 Test Protocol

Temperature: 23 °C
 Air Pressure: 1016 hPa
 Humidity: 33 %

| Op. Mode | Setup | Port |
|-----------|----------|-------------------|
| op-mode 4 | Setup_01 | Antenna connector |

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

Remark: Please see annex for the measurement plot.

3.9.4 Test result: Number of hopping frequencies

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

4 Test Equipment

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

Test Equipment Anechoic Chamber

| | |
|----------------------|---------------------------------------|
| Lab ID: | Lab 2 |
| Manufacturer: | Frankonia |
| Description: | Anechoic Chamber for radiated testing |
| Type: | 10.58x6.38x6 m ³ |

Single Devices for Anechoic Chamber

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

Test Equipment Auxiliary Equipment for Conducted emissions

| | |
|----------------------|-----------------------------------|
| Lab ID: | Lab 1 |
| Manufacturer: | Rohde & Schwarz GmbH & Co.KG |
| Description: | EMI Conducted Auxiliary Equipment |

Single Devices for Auxiliary Equipment for Conducted emissions

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

Test Equipment Auxiliary Equipment for Radiated emissions

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

Single Devices for Auxiliary Equipment for Radiated emissions

| Single Device Name | Type | Serial Number | Manufacturer |
|------------------------------------|------------------------|---|----------------------------------|
| Antenna mast | AS 620 P | 620/37 | HD GmbH |
| Biconical dipole | VUBA 9117 | 9117-108 | Schwarzbeck |
| | Calibration Details | | Last Execution |
| | Standard Calibration | | 2008/10/27 2013/10/26 |
| Broadband Amplifier 18MHz-26GHz | JS4-18002600-32-5P | 849785 | Miteq |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Broadband Amplifier 1GHz-4GHz | AFS4-01000400-1Q-10P-4 | - | Miteq |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Broadband Amplifier 30MHz-18GHz | JS4-00101800-35-5P | 896037 | Miteq |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Cable "ESI to EMI Antenna" | EcoFlex10 | W18.01-2+W38.01-Kabel Kusch 2 | |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Cable "ESI to Horn Antenna" | UFB311A+UFB293C | W18.02-2+W38.02-Rosenberger Micro-Coax 2 | |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Double-ridged horn | HF 906 | 357357/001 | Rohde & Schwarz GmbH & Co. KG |
| | Calibration Details | | Last Execution |
| | Standard Calibration | | 2009/04/16 2012/04/15 |
| Double-ridged horn | HF 906 | 357357/002 | Rohde & Schwarz GmbH & Co. KG |
| | Calibration Details | | Last Execution |
| | Standard Calibration | | 2009/04/28 2012/04/27 |
| High Pass Filter | 4HC1600/12750-1.5-KK | 9942011 | Trilithic |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| High Pass Filter | 5HC2700/12750-1.5-KK | 9942012 | Trilithic |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| High Pass Filter | 5HC3500/12750-1.2-KK | 200035008 | Trilithic |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| High Pass Filter | WHKX 7.0/18G-8SS | 09 | Wainwright |
| | Calibration Details | | Last Execution |
| | Path Calibration | | 2010/11/06 2011/05/05 |
| Log.-per. Antenna | HL 562 Ultralog | 830547/003 | Rohde & Schwarz GmbH & Co. KG |

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

| Single Device Name | Type | Serial Number | Manufacturer | |
|--|----------------------------|------------------------|-------------------------------|-------------------|
| | <i>Calibration Details</i> | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard Calibration | | 2009/05/27 | 2012/05/26 |
| Loop Antenna | HFH2-Z2 | 829324/006 | Rohde & Schwarz GmbH & Co. KG | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | DKD calibration | | 2008/10/07 | 2011/10/06 |
| Network Analyzer | E5071B | MY42200813 | Agilent | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard Calibration | | 2010/11/09 | 2011/11/09 |
| Pyramidal Horn Antenna 3160-09 26,5 GHz | | 00083069 | EMCO Elektronik GmbH | |
| Pyramidal Horn Antenna 3160-10 40 GHz | | 00086675 | EMCO Elektronik GmbH | |
| Tilt device Maturo (Rohacell) | Antrieb TD1.5-10kg | TD1.5-10kg/024/3790709 | Maturo GmbH | |

Test Equipment Auxiliary Test Equipment

| | |
|-----------------------|---|
| Lab ID: | Lab 2 |
| Manufacturer: | see single devices |
| Description: | Single Devices for various Test Equipment |
| Type: | various |
| Serial Number: | none |

Single Devices for Auxiliary Test Equipment

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



Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 2
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

| <i>Single Device Name</i> | <i>Type</i> | <i>Serial Number</i> | <i>Manufacturer</i> | |
|---|--|----------------------|-------------------------------|--------------------|
| Bluetooth Signalling Unit CBT CBT | | 100589 | Rohde & Schwarz GmbH & Co. KG | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | | | 2008/08/14 | 2011/08/13 |
| Universal Radio Communication Tester | CMU 200 | 102366 | Rohde & Schwarz GmbH & Co. KG | |
| | <i>HW/SW Status</i> | | <i>Date of Start</i> | <i>Date of End</i> |
| | Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 --- | | 2007/07/16 | |
| Universal Radio Communication Tester | CMU 200 | 837983/052 | Rohde & Schwarz GmbH & Co. KG | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard calibration | | 2008/12/01 | 2011/11/30 |
| | <i>HW/SW Status</i> | | <i>Date of Start</i> | <i>Date of End</i> |
| | HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 --- | | 2007/01/02 | |
| | SW: K62, K69 | | 2008/11/03 | |



Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID: Lab 3
Description: Regulatory Bluetooth RF Tests
Type: Bluetooth RF
Serial Number: 001

Single Devices for Regulatory Bluetooth RF Test Solution

| Single Device Name | Type | Serial Number | Manufacturer |
|---------------------------------|----------------------------|---------------|---|
| ADU 200 Relay Box 7 | Relay Box | A04380 | Ontrak Control Systems Inc. |
| Power Meter NRVD | NRVD | 832025/059 | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2010/06/21 2011/06/20 |
| Power Sensor NRV Z1 A PROBE | | 832279/013 | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2010/06/22 2011/06/21 |
| Power Supply | NGSM 32/10 | 2725 | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2010/06/21 2011/06/20 |
| Rubidium Frequency Normal MFS | Datum MFS | 002 | Datum GmbH |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2010/07/05 2011/07/04 |
| Signal Analyser FSIQ26 | 1119.6001.26 | 832695/007 | Rohde & Schwarz GmbH & Co.KG |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2009/06/24 2011/06/23 |
| Vector Signal Generator SMIQ03B | SMIQ03B | 832870/017 | |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2010/06/23 2013/06/20 |

Test Equipment Shielded Room 02

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

Test Equipment Shielded Room 07

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



Test Equipment T/H Logger 04

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

Single Devices for T/H Logger 04

| <i>Single Device Name</i> | <i>Type</i> | <i>Serial Number</i> | <i>Manufacturer</i> |
|---|-------------|----------------------|-----------------------------------|
| ThermoHygro DataloggerOpus10 THI (8152.00) 04 (Environ) | | 7481 | Lufft Mess- und Regeltechnik GmbH |

Test Equipment Temperature Chamber 01

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

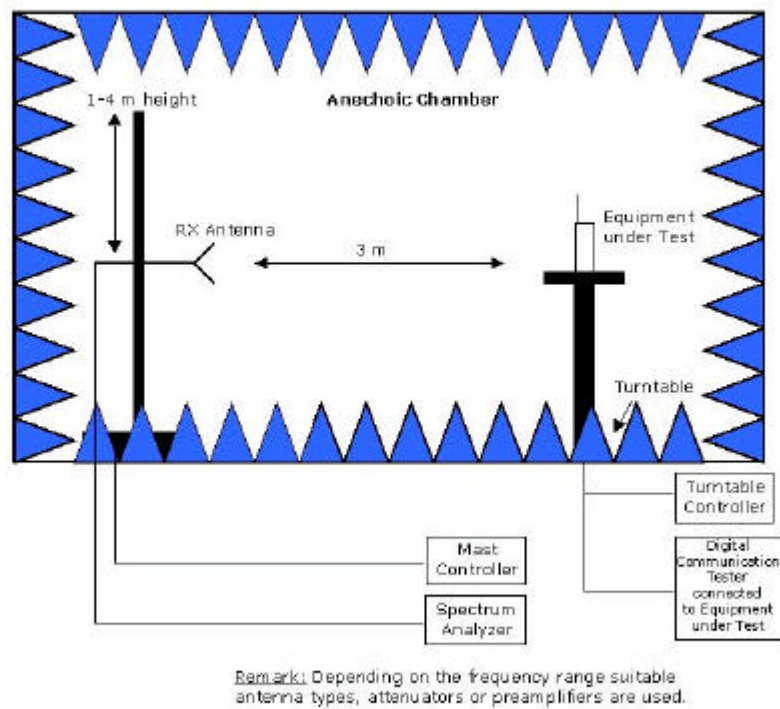
Single Devices for Temperature Chamber 01

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

5 Photo Report

Photos are included in an external report.

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces



7 FCC and IC Correlation of measurement requirements

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

Bluetooth® equipment

| Measurement | FCC reference | IC reference |
|---------------------------------|------------------------|------------------------------|
| Conducted emissions on AC mains | § 15.207 | RSS-Gen: 7.2.4 |
| Occupied bandwidth | § 15.247 (a) (1) | RSS-210: A8.1 |
| Peak power output | § 15.247 (b) (1) | RSS-210: A8.4 |
| Spurious RF conducted emissions | § 15.247 (d) | RSS-Gen: 6; RSS-210: A8.5 |
| Spurious radiated emissions | § 15.247 (d) | RSS-Gen: 6; RSS-210: A8.5 |
| Band edge compliance | § 15.247 (d) | RSS-210: A8.5 |
| Dwell time | § 15.247 (a) (1) (iii) | RSS-210: A8.1 |
| Channel separation | § 15.247 (a) (1) | RSS-210: A8.1 |
| No. of hopping frequencies | § 15.247 (a) (1) (iii) | RSS-210: A8.1 |
| Antenna requirement | § 15.203 / 15.204 | RSS-Gen: 7.1.2 |

Digital Apparatus

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

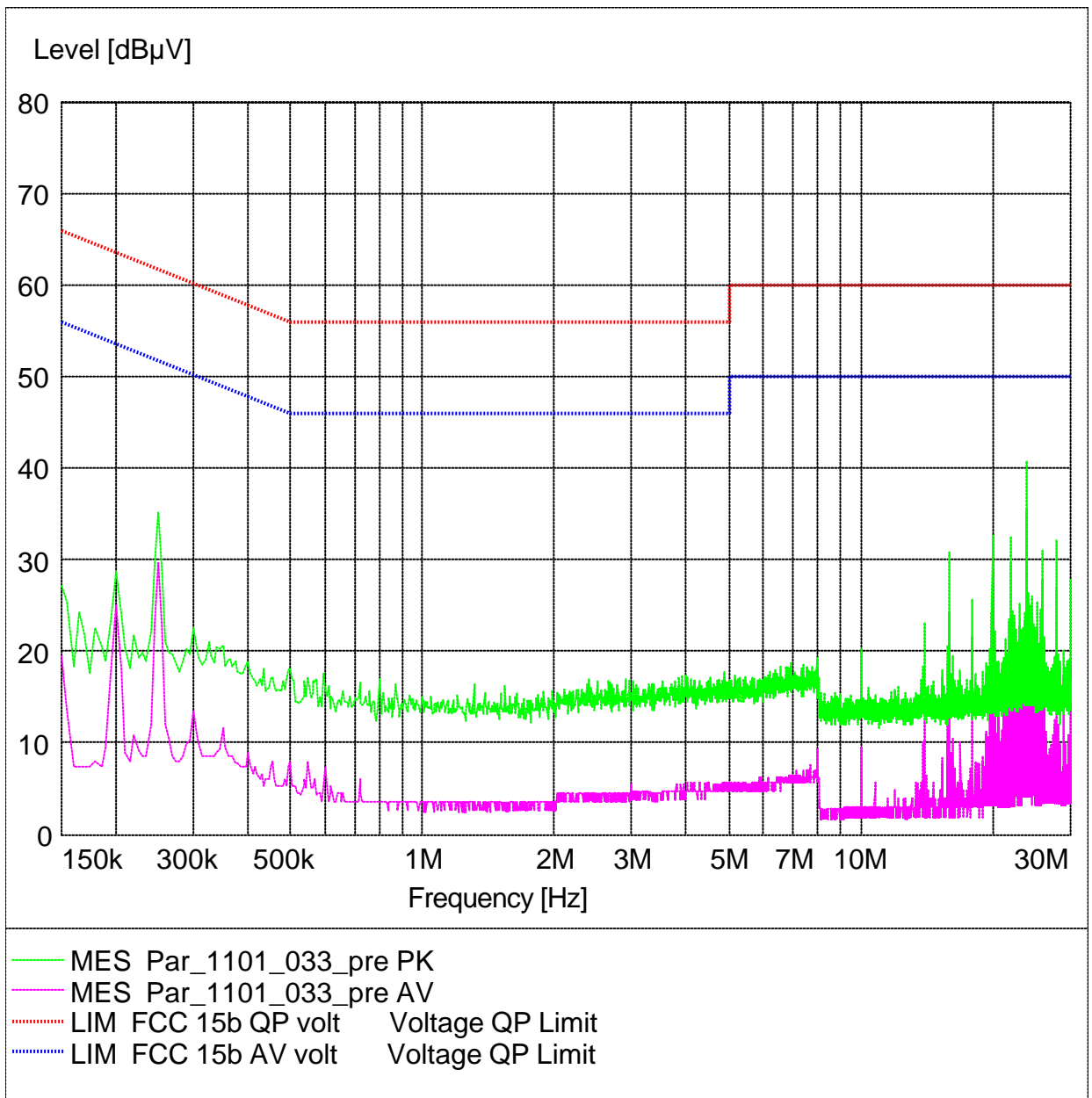
8 Annex measurement plots

8.1 AC Mains conducted

Op. Mode

op-mode 2

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



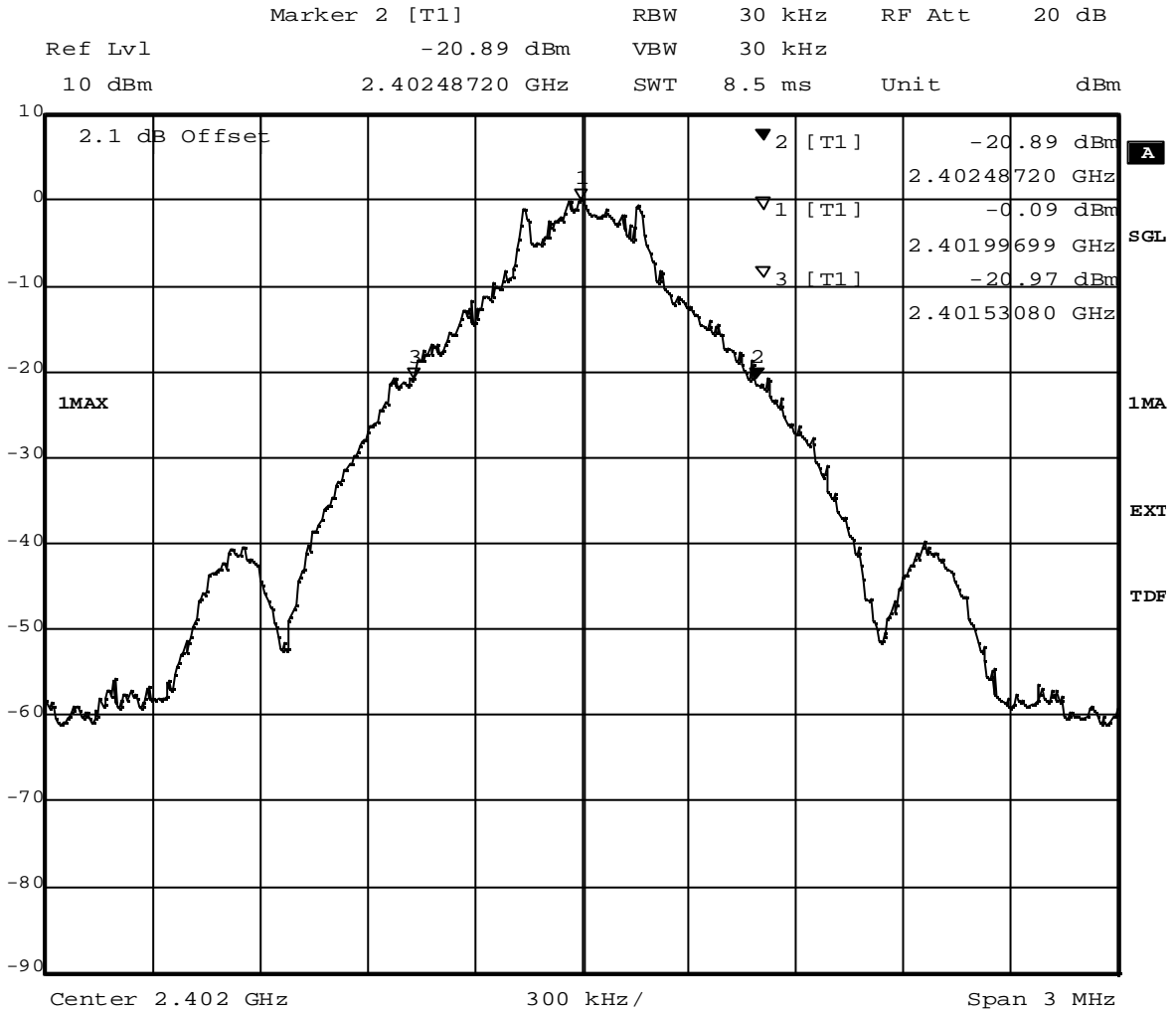


8.2 Occupied bandwidth

8.2.1 Occupied bandwidth operating mode 1

Op. Mode

op-mode 1



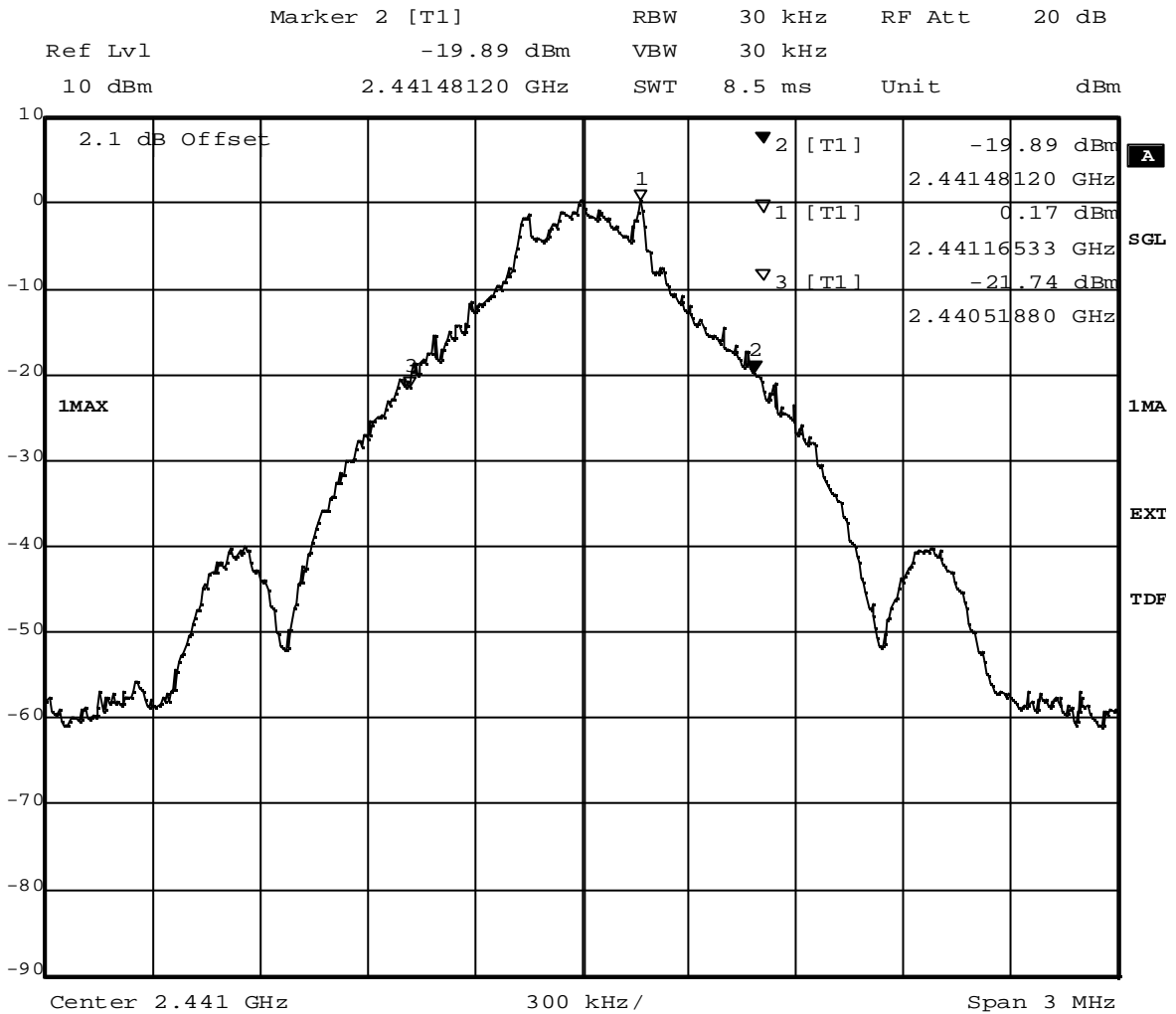
Title: 20dB Bandwidth
 Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):956.4
 Date: 21.APR.2011 08:56:05



8.2.2 Occupied bandwidth operating mode 2

Op. Mode

op-mode 2



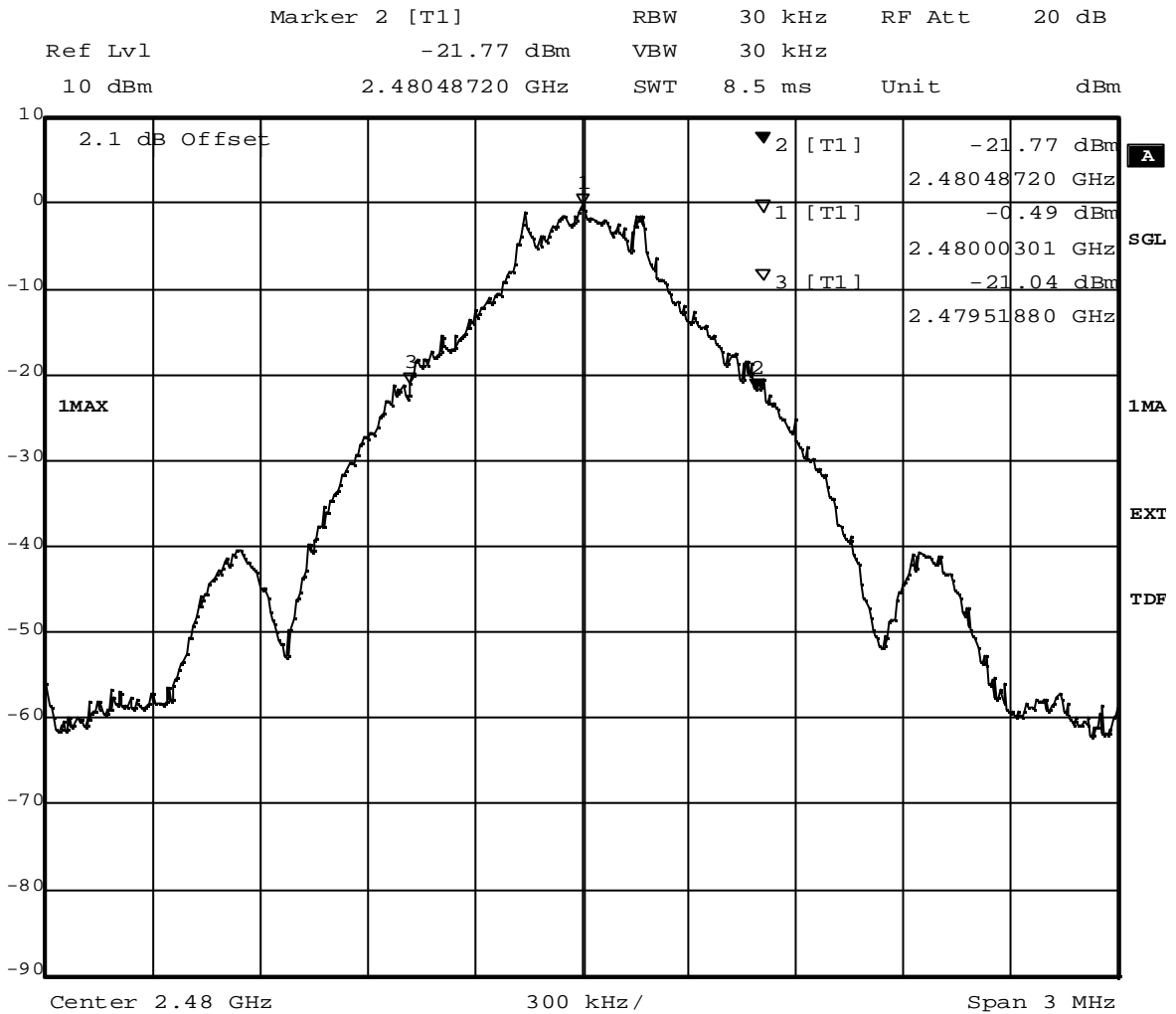
Title: 20dB Bandwidth
 Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):962.4
 Date: 21.APR.2011 09:20:29



8.2.3 Occupied bandwidth operating mode 3

Op. Mode

op-mode 3



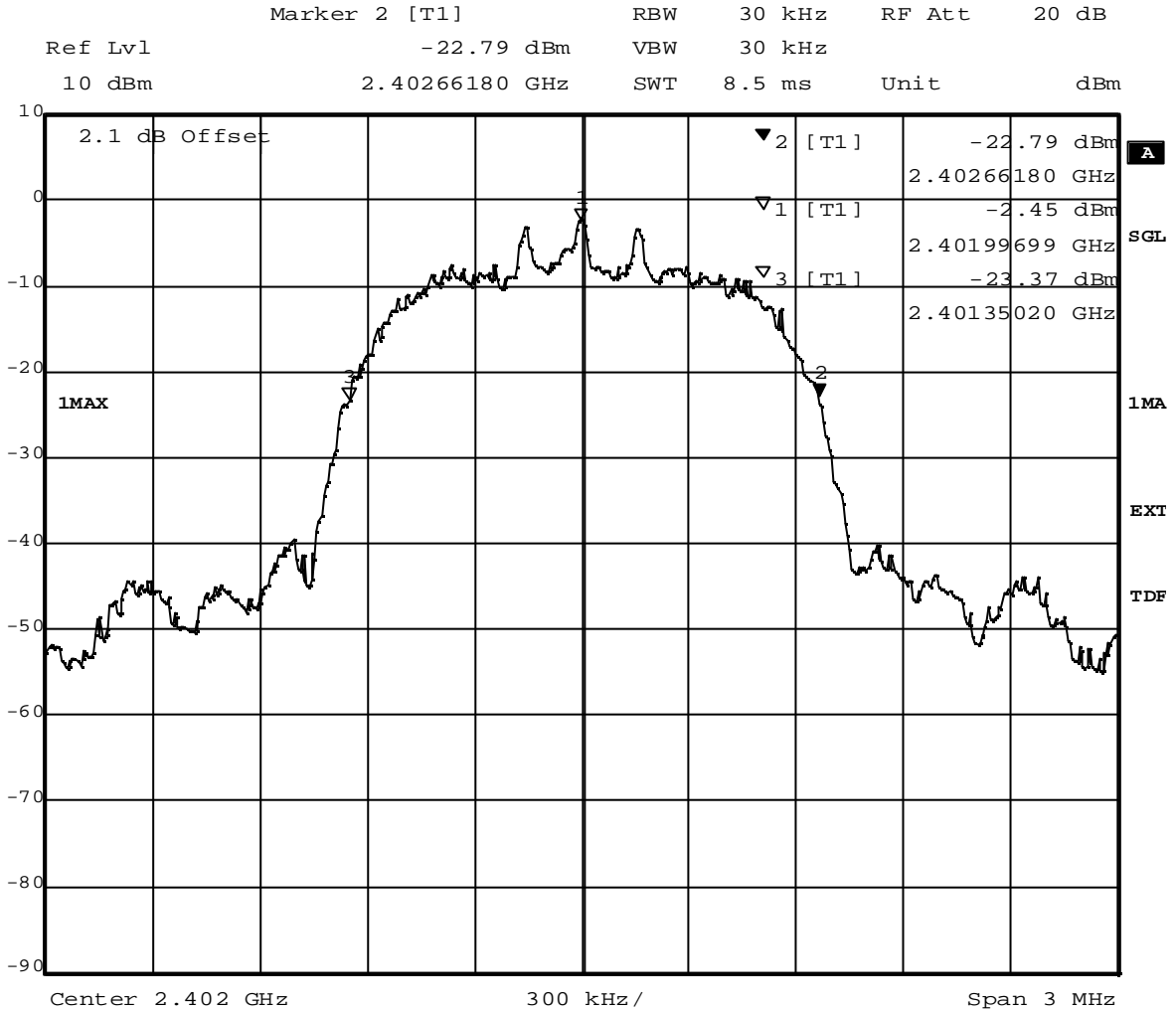
Title: 20dB Bandwidth
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):968.4
 Date: 21.APR.2011 09:40:57



8.2.4 Occupied bandwidth operating mode 6

Op. Mode

op-mode 6



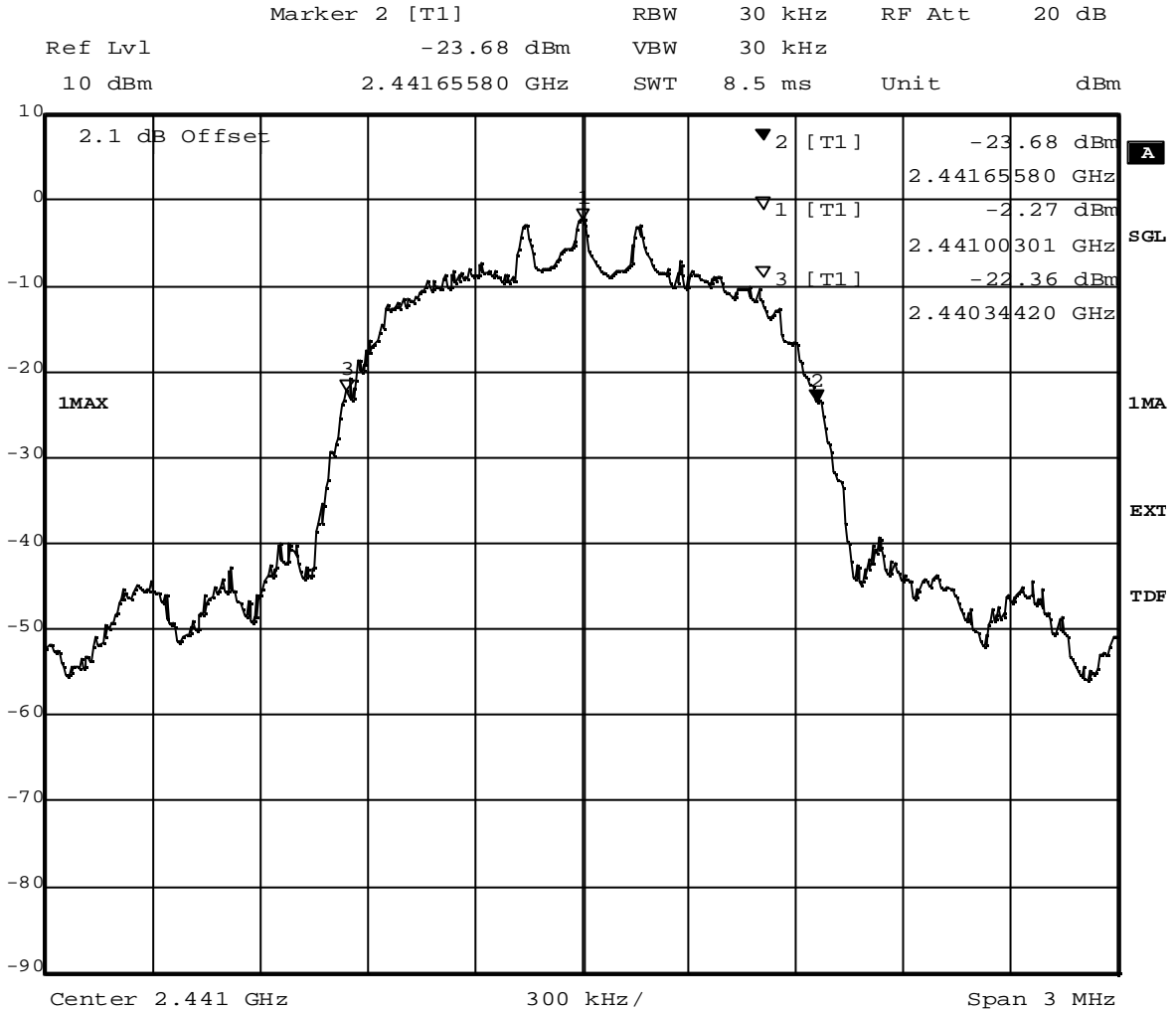
Title: 20dB Bandwidth
 Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1311.6
 Date: 21.APR.2011 12:05:16



8.2.5 Occupied bandwidth operating mode 7

Op. Mode

op-mode 7



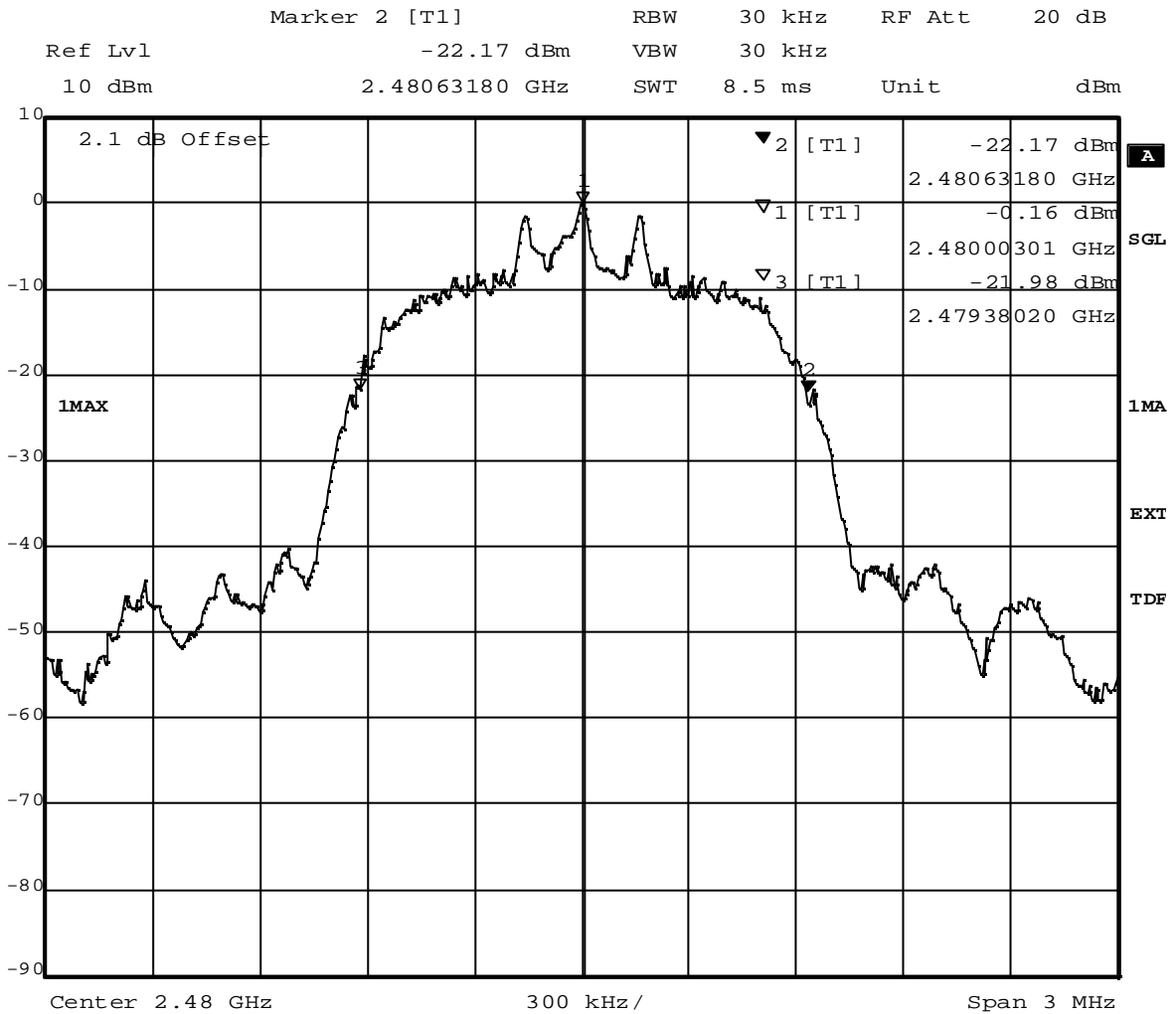
Title: 20dB Bandwidth
 Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1311.6
 Date: 21.APR.2011 12:27:08



8.2.6 Occupied bandwidth operating mode 8

Op. Mode

op-mode 8



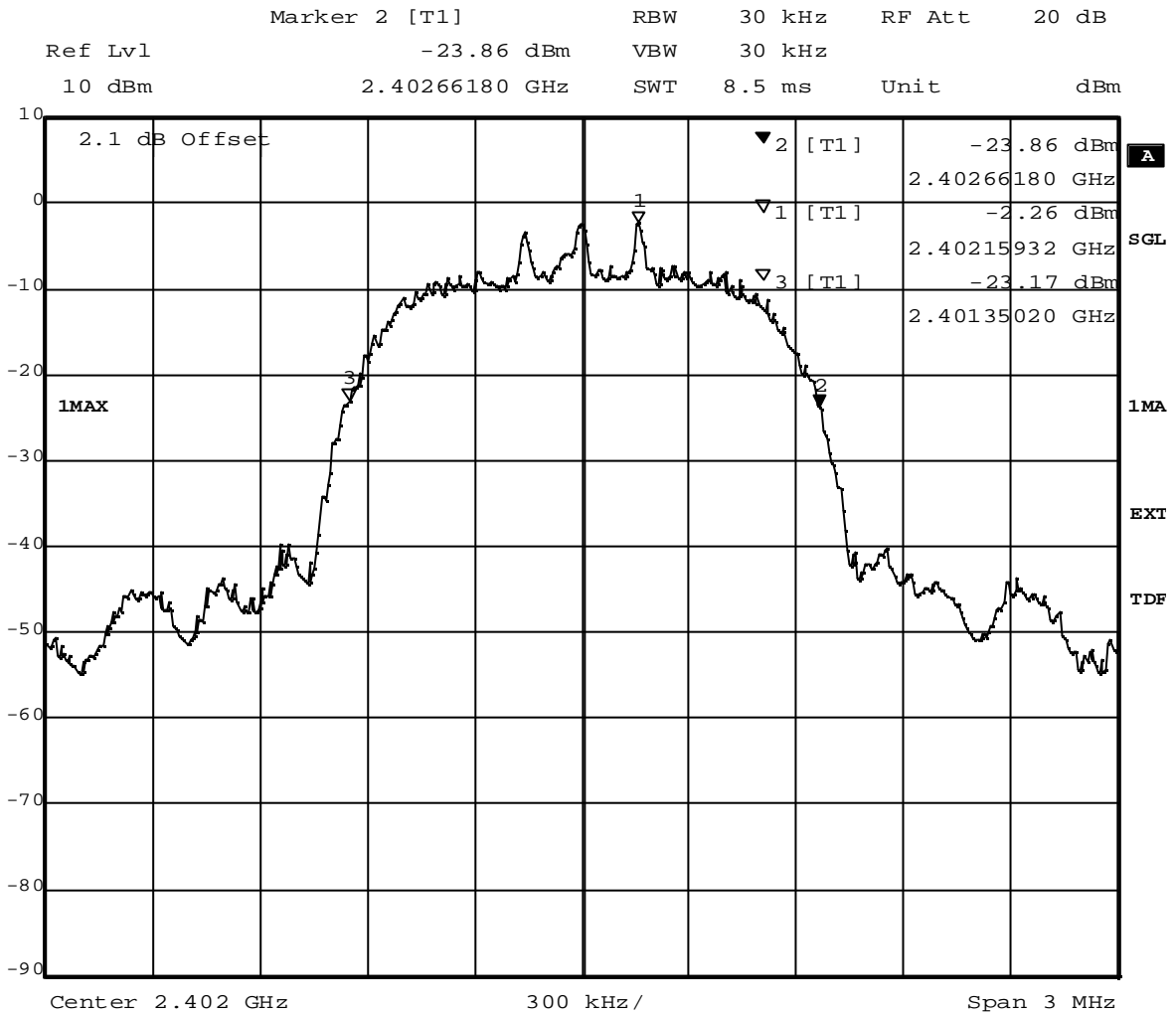
Title: 20dB Bandwidth
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1251.6
 Date: 21.APR.2011 12:48:26



8.2.7 Occupied bandwidth operating mode 10

Op. Mode

op-mode 10



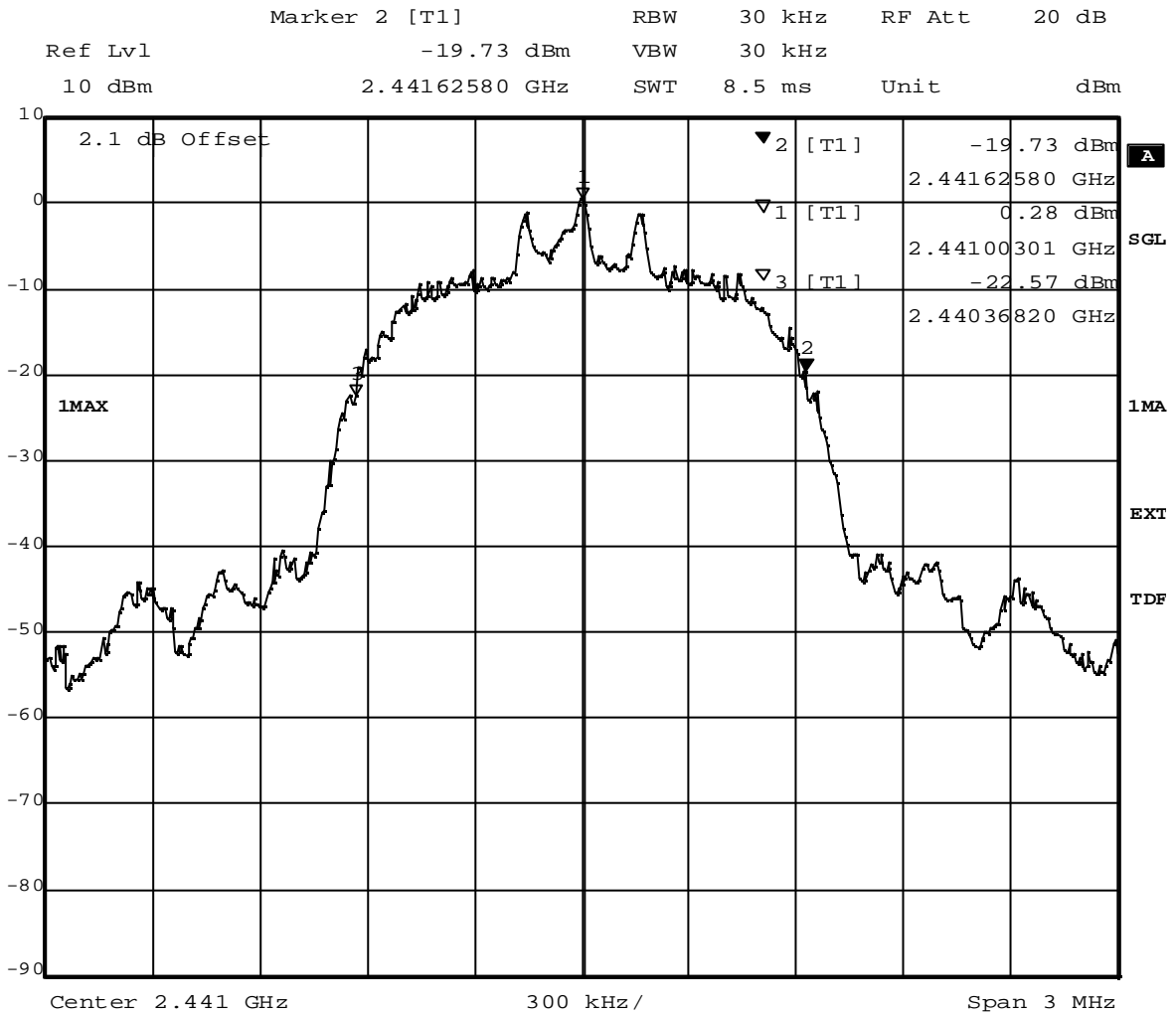
Title: 20dB Bandwidth
 Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1311.6
 Date: 21.APR.2011 10:21:29



8.2.8 Occupied bandwidth operating mode 11

Op. Mode

op-mode 11



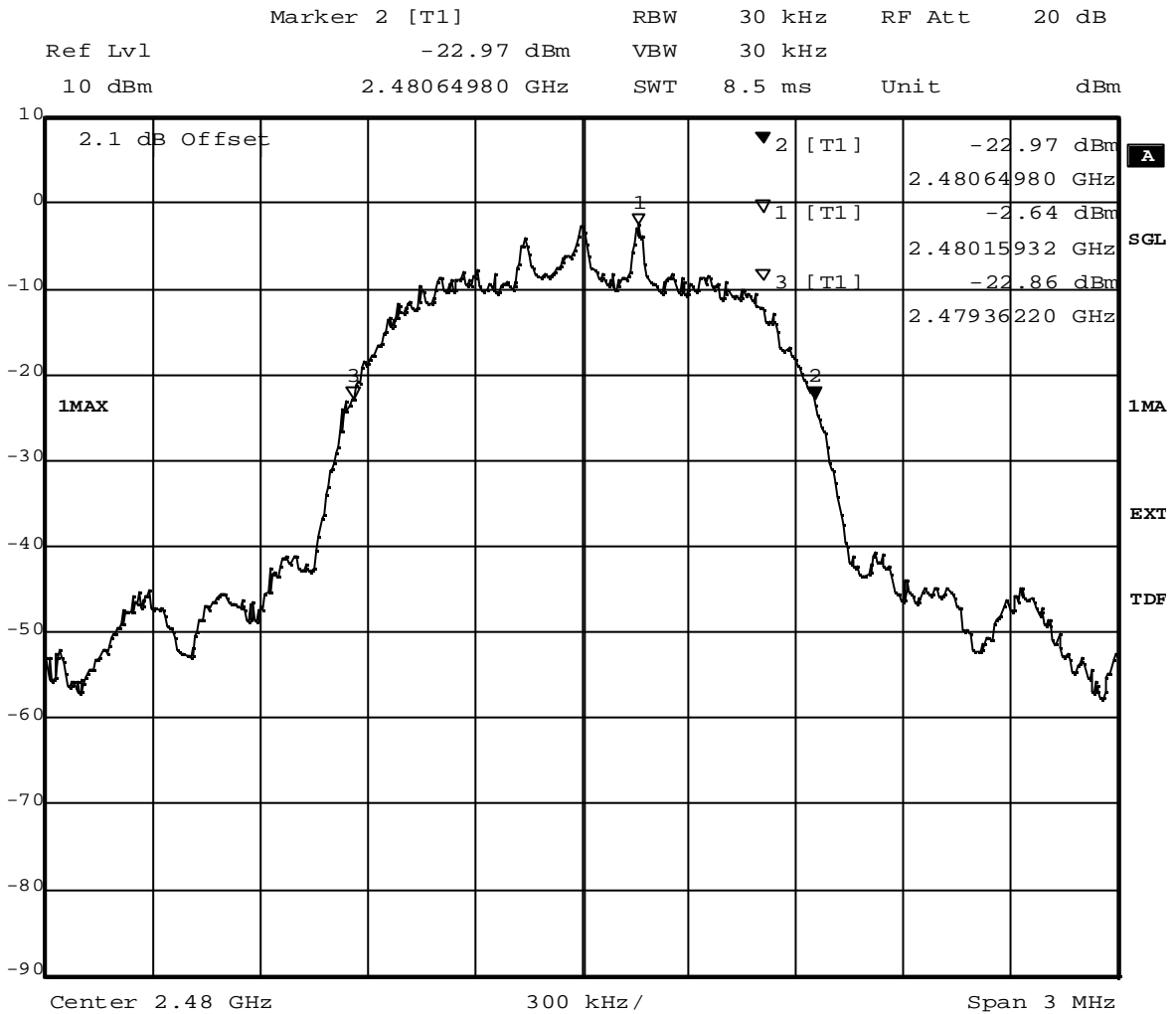
Title: 20dB Bandwidth
 Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1257.6
 Date: 21.APR.2011 11:00:05



8.2.9 Occupied bandwidth operating mode 12

Op. Mode

op-mode 12



Title: 20dB Bandwidth
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1287.6
 Date: 21.APR.2011 11:24:46

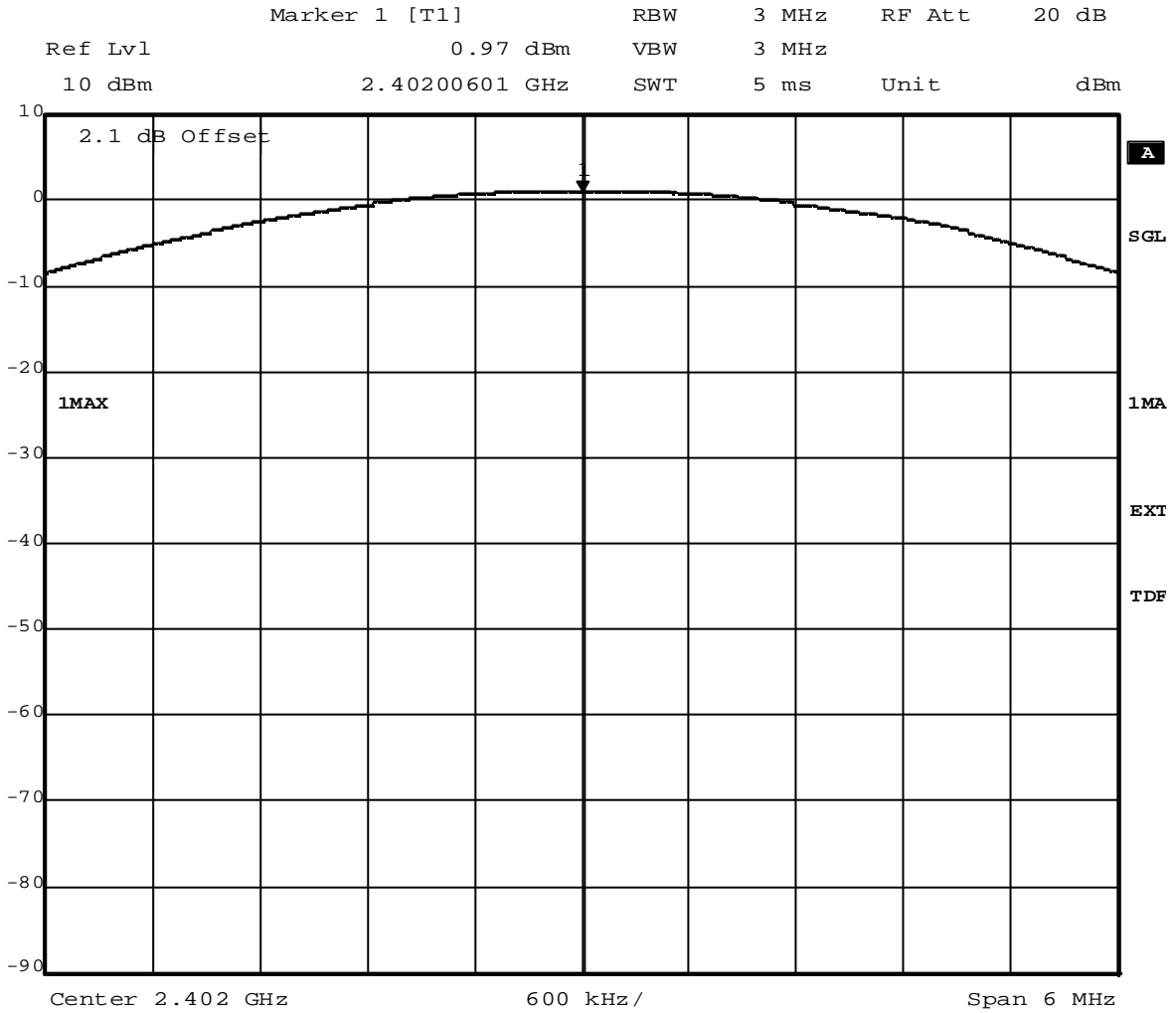


8.3 Peak power output

8.3.1 Peak power output operating mode 1

Op. Mode

op-mode 1



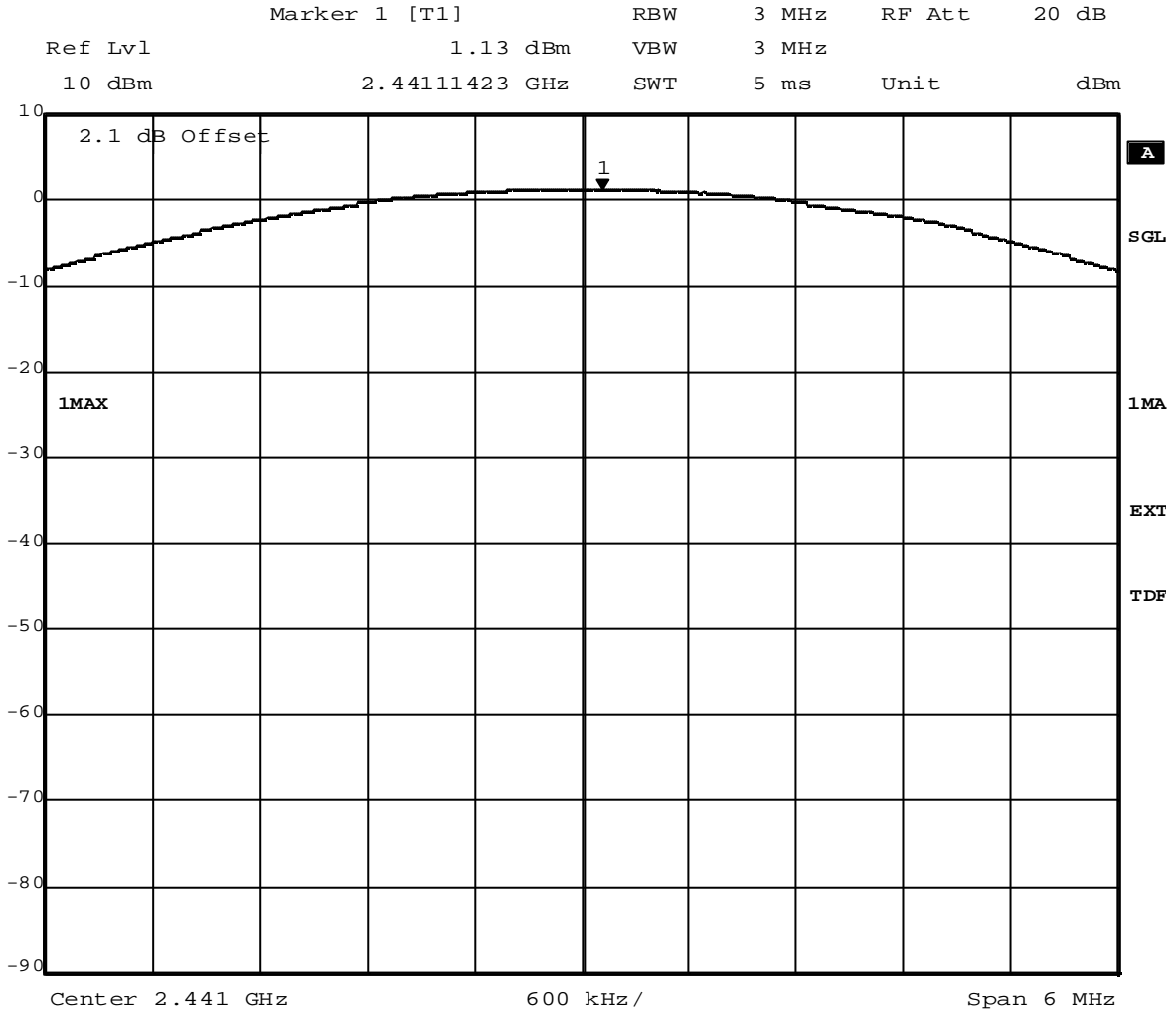
Title: Peak outputpower Power
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 08:58:52



8.3.2 Peak power output operating mode 2

Op. Mode

op-mode 2



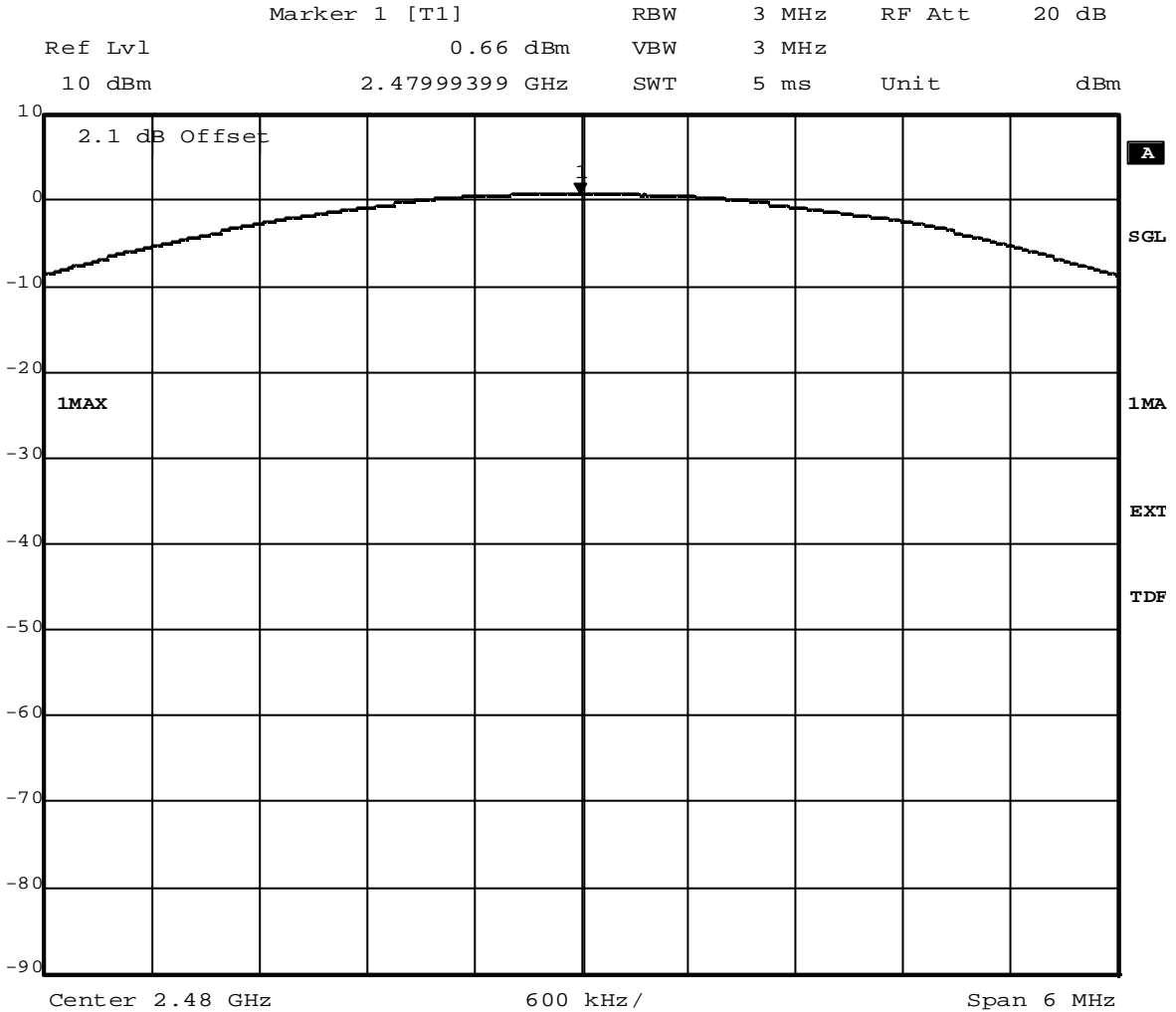
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 21.APR.2011 09:23:25



8.3.3 Peak power output operating mode 3

Op. Mode

op-mode 3



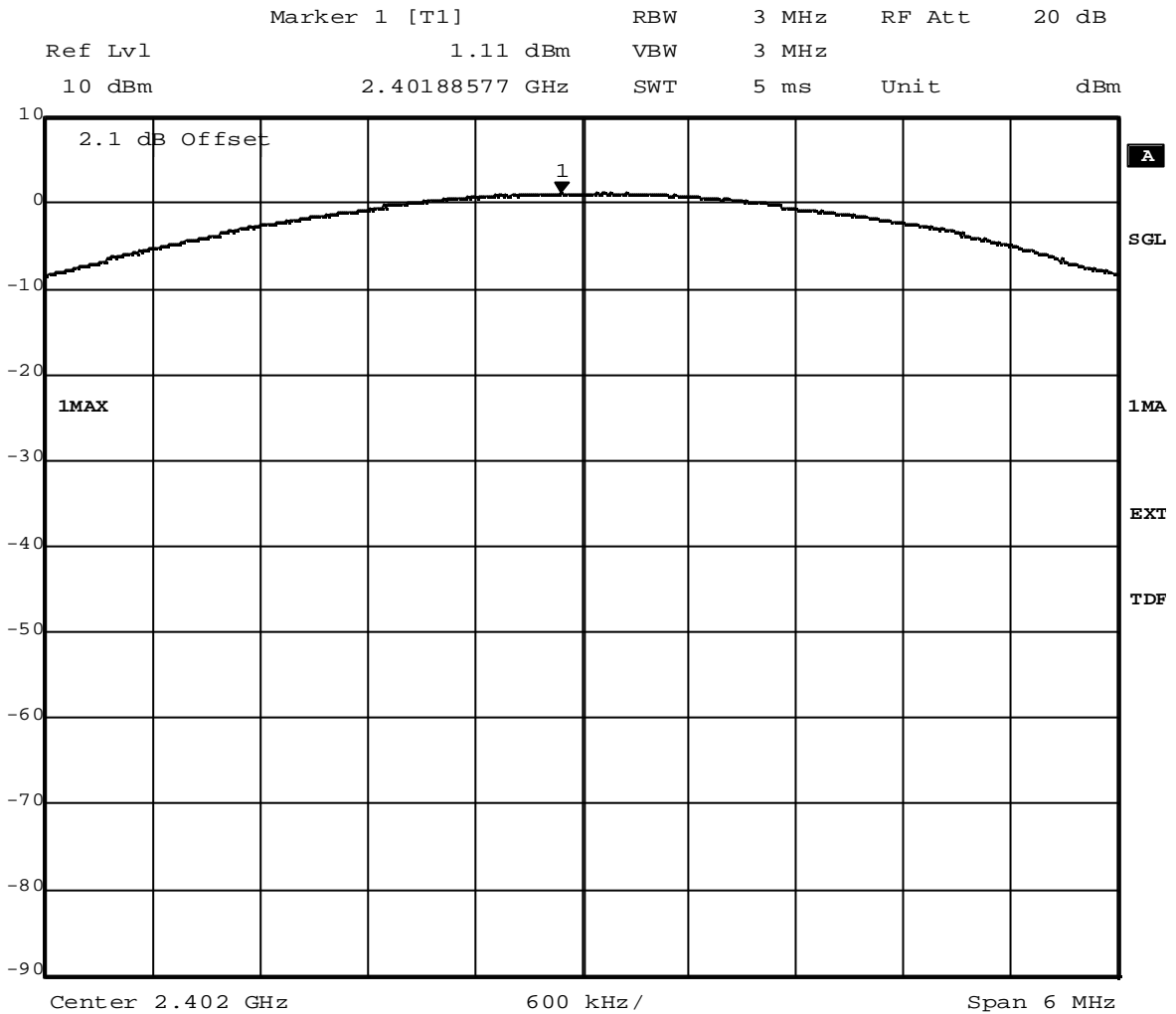
Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 21.APR.2011 09:43:21



8.3.4 Peak power output operating mode 6

Op. Mode

op-mode 6



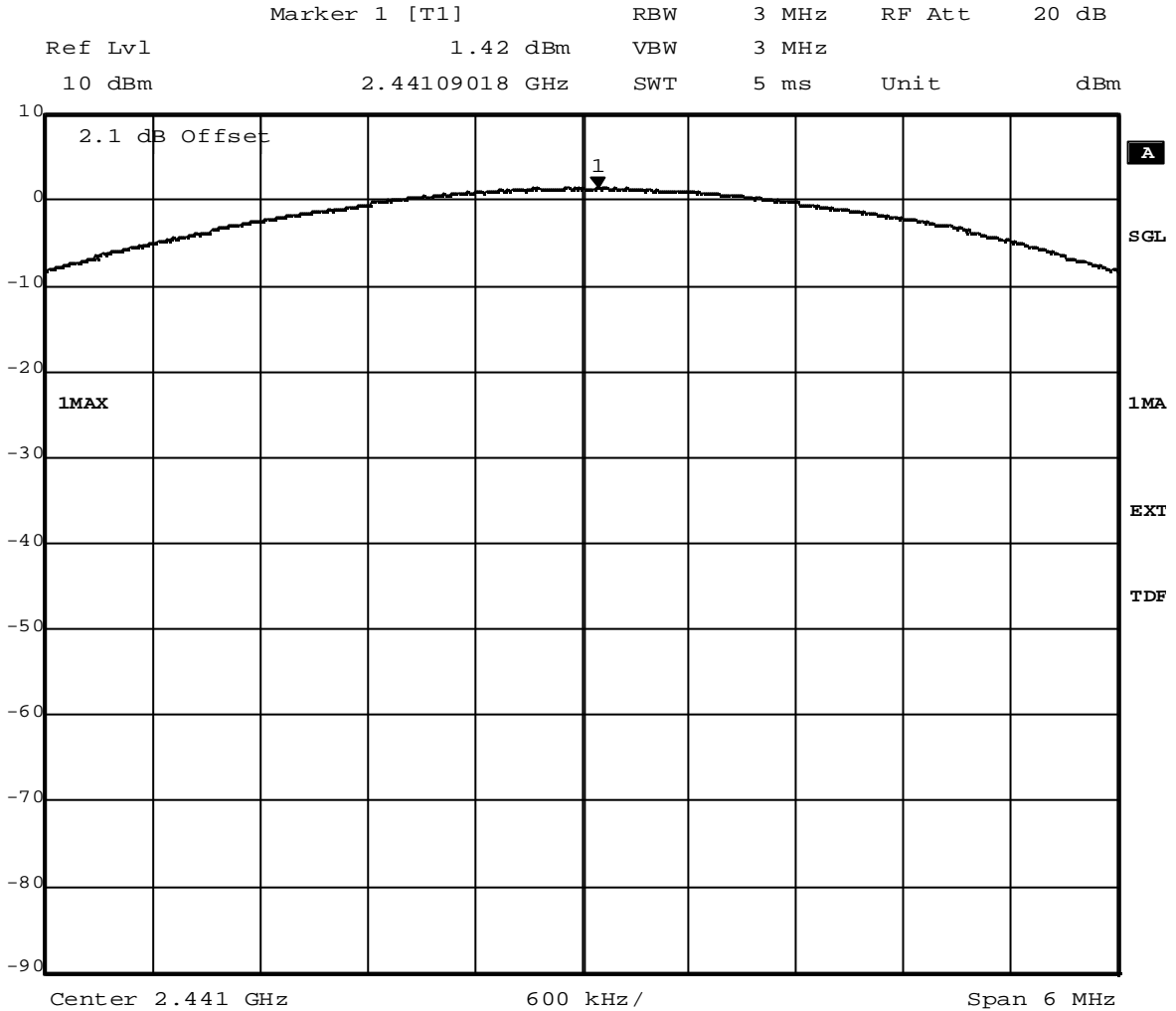
Title: Peak outputpower Power
Comment A: CH B: 2402 MHz
Date: 21.APR.2011 12:08:09



8.3.5 Peak power output operating mode 7

Op. Mode

op-mode 7



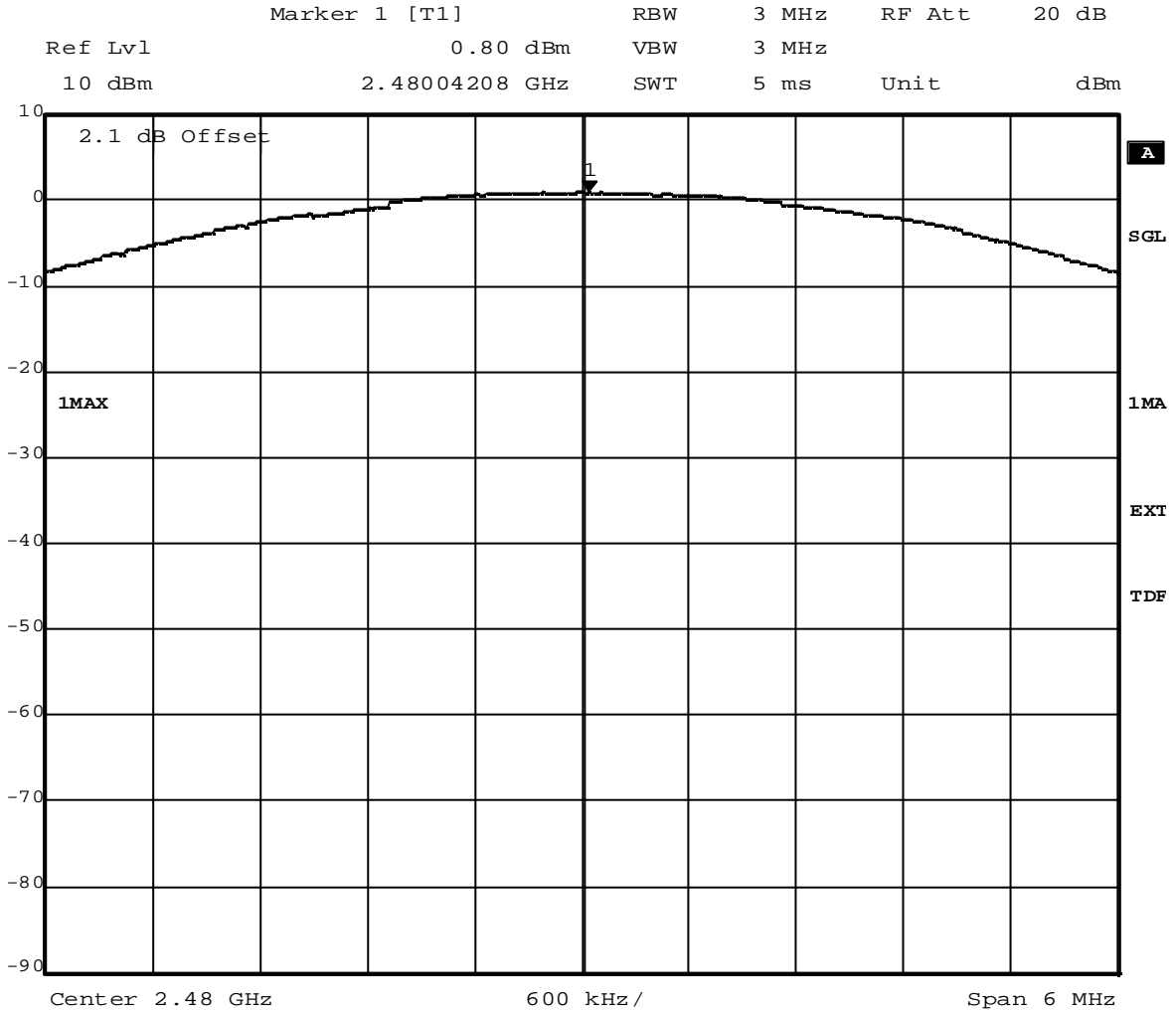
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 21.APR.2011 12:29:43



8.3.6 Peak power output operating mode 8

Op. Mode

op-mode 8



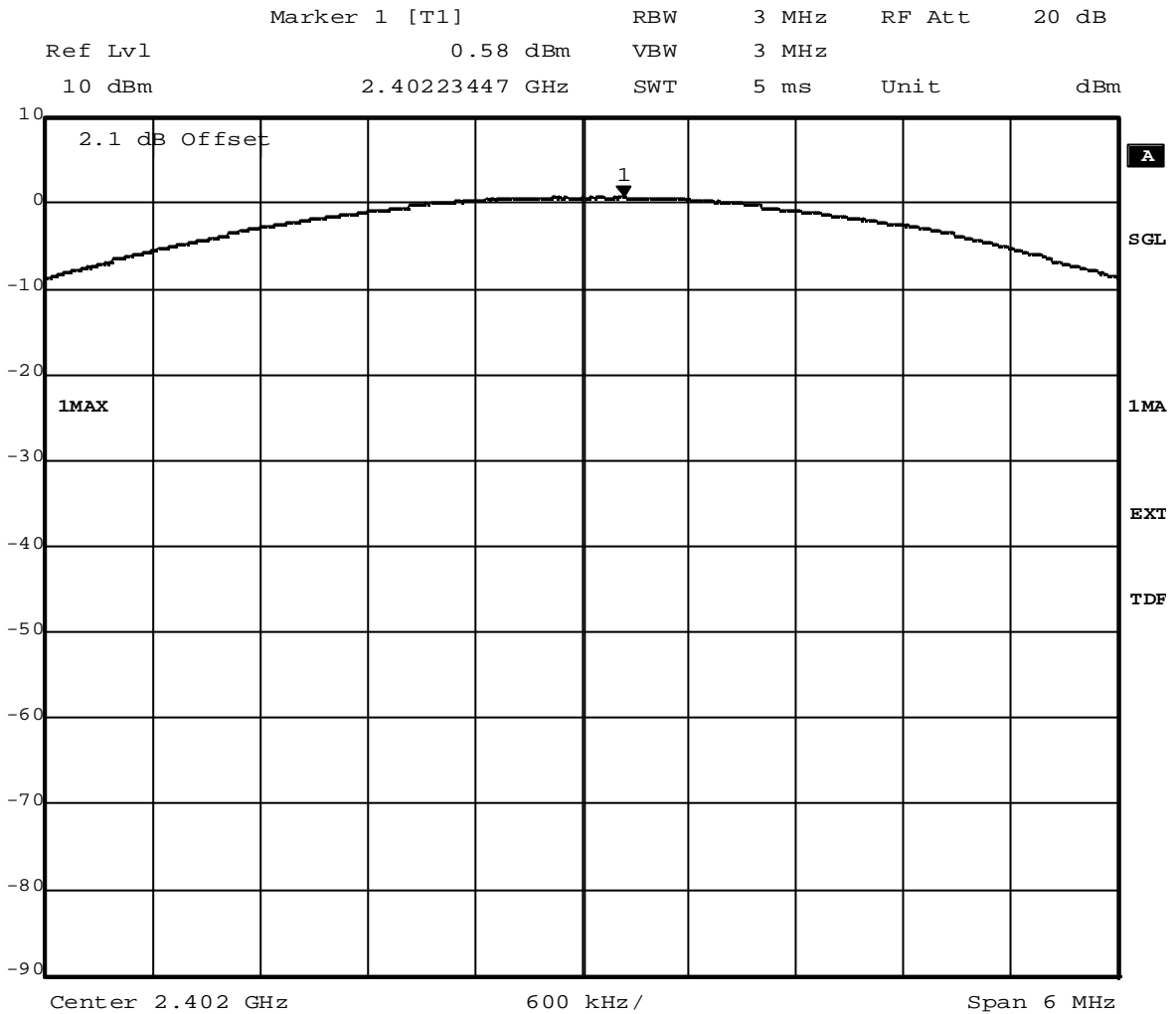
Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 21.APR.2011 12:51:04



8.3.7 Peak power output operating mode 10

Op. Mode

op-mode 10



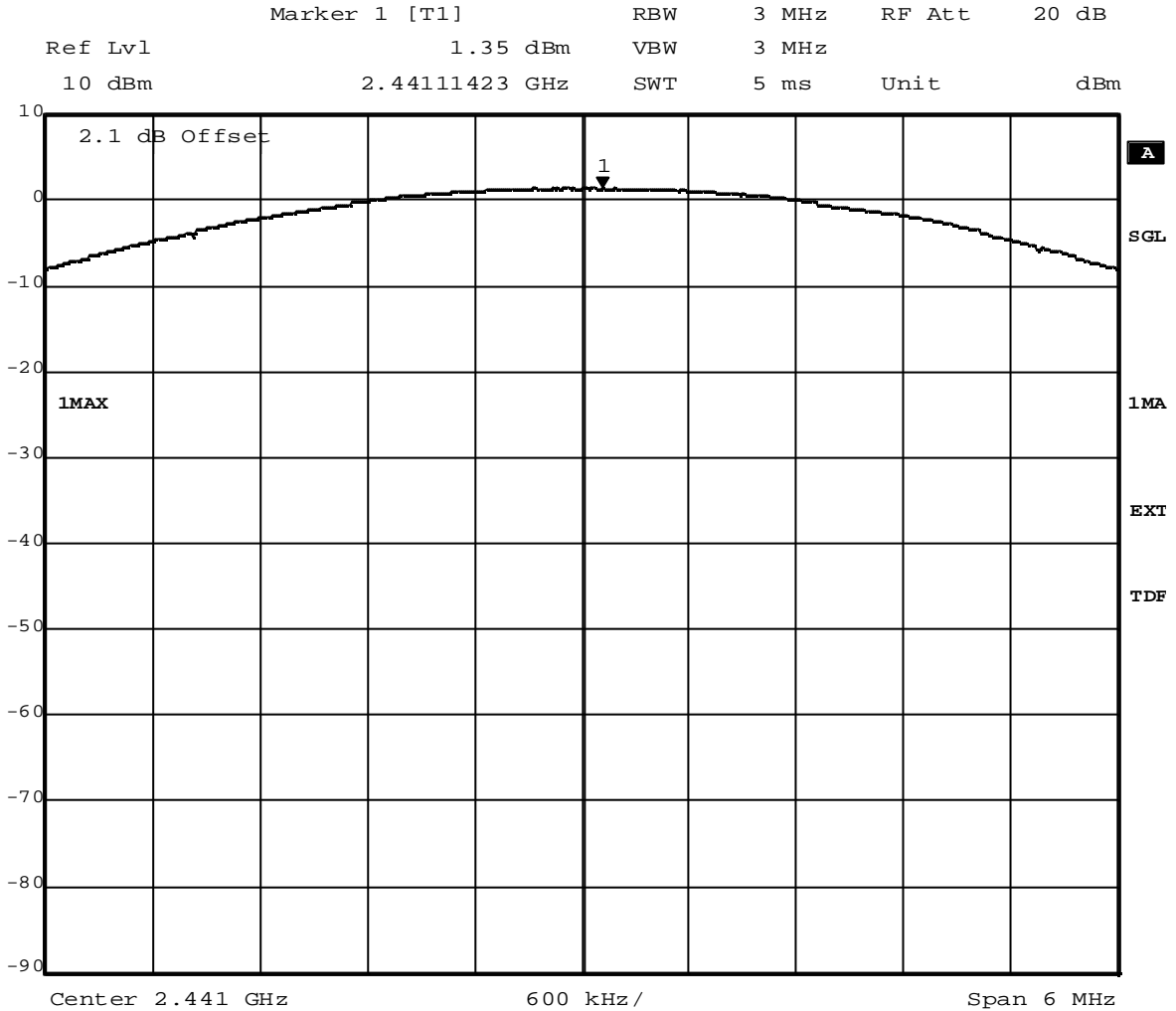
Title: Peak outputpower Power
Comment A: CH B: 2402 MHz
Date: 21.APR.2011 10:24:16



8.3.8 Peak power output operating mode 11

Op. Mode

op-mode 11



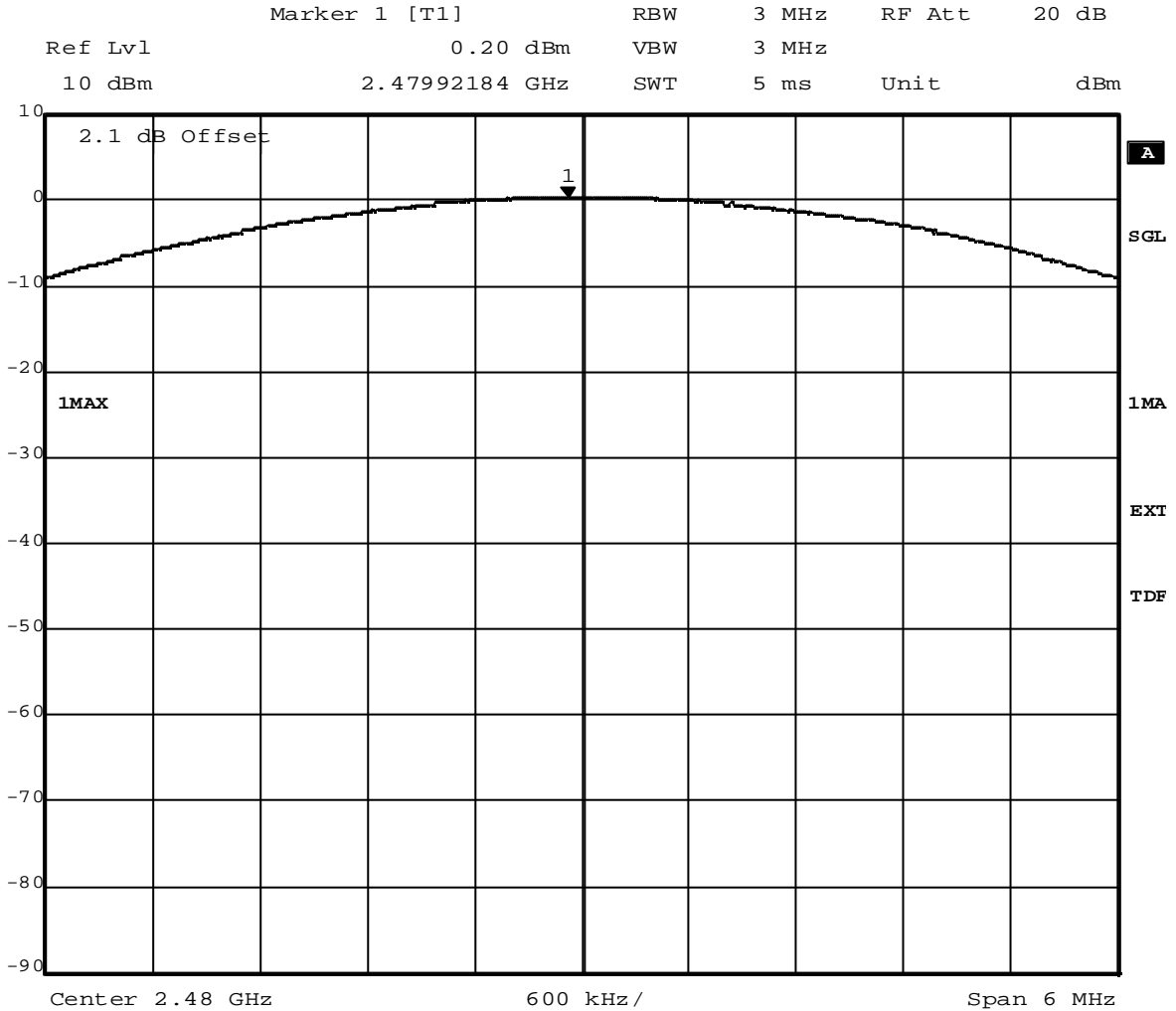
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 21.APR.2011 11:05:37



8.3.9 Peak power output operating mode 12

Op. Mode

op-mode 12



Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 21.APR.2011 11:27:17

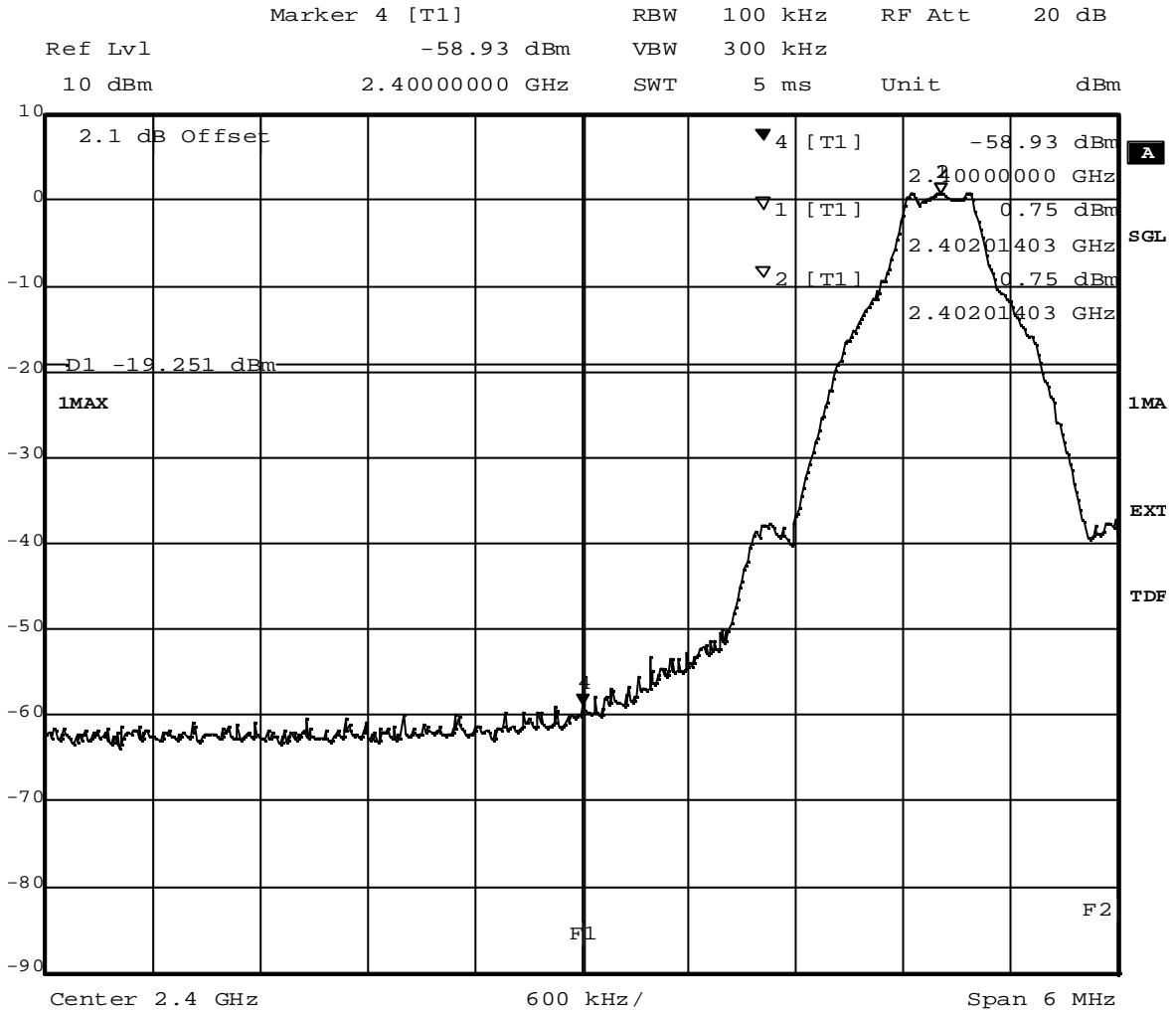


8.4 Band edge compliance conducted and Spurious RF conducted emissions

8.4.1 Band edge compliance conducted operating mode 1

Op. Mode

op-mode 1



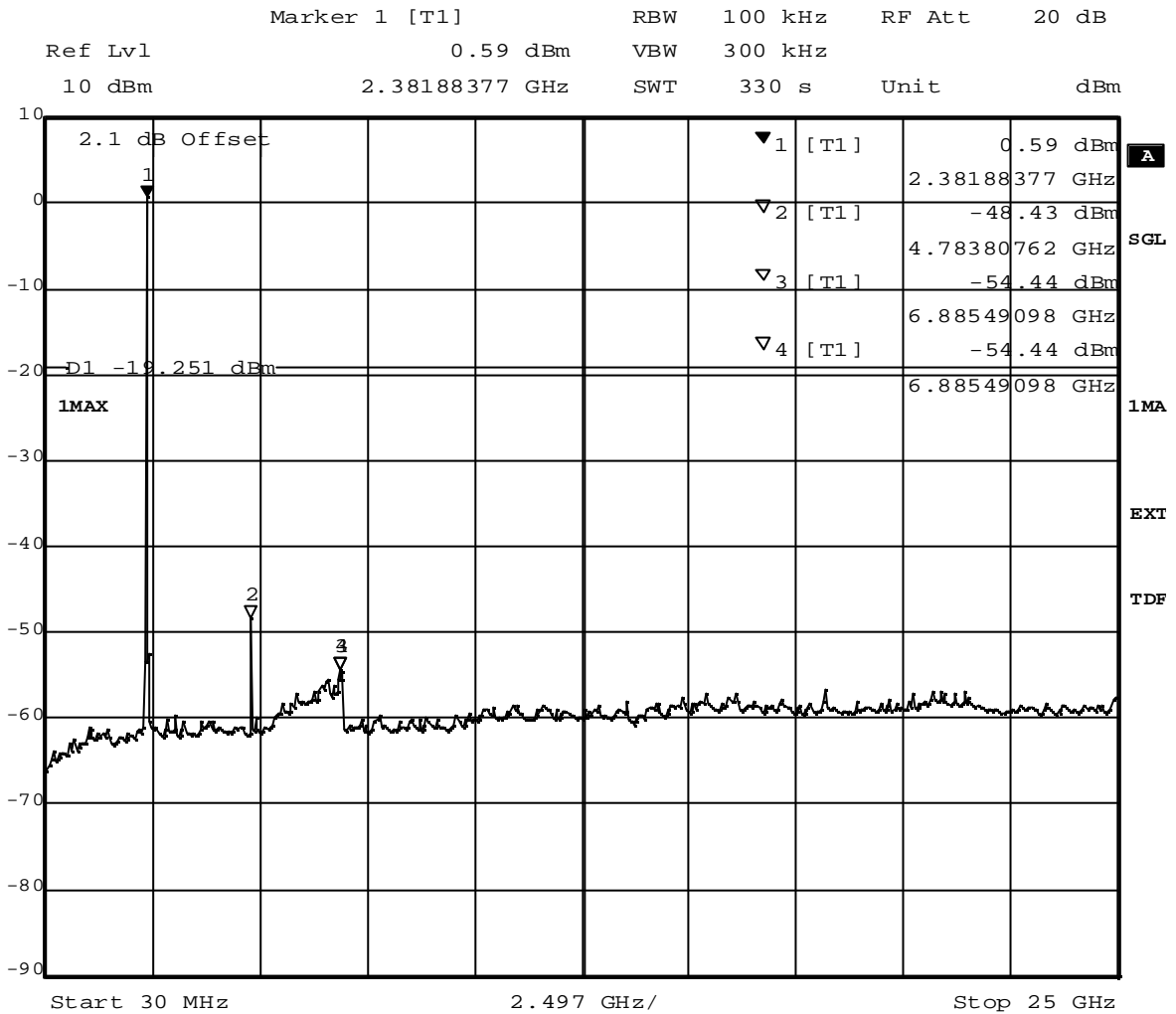
Title: Band Edge Compliance
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 08:40:28

(determination of reference value for spurious emissions measurement)

8.4.2 Spurious RF conducted emissions operating mode 1

Op. Mode

op-mode 1



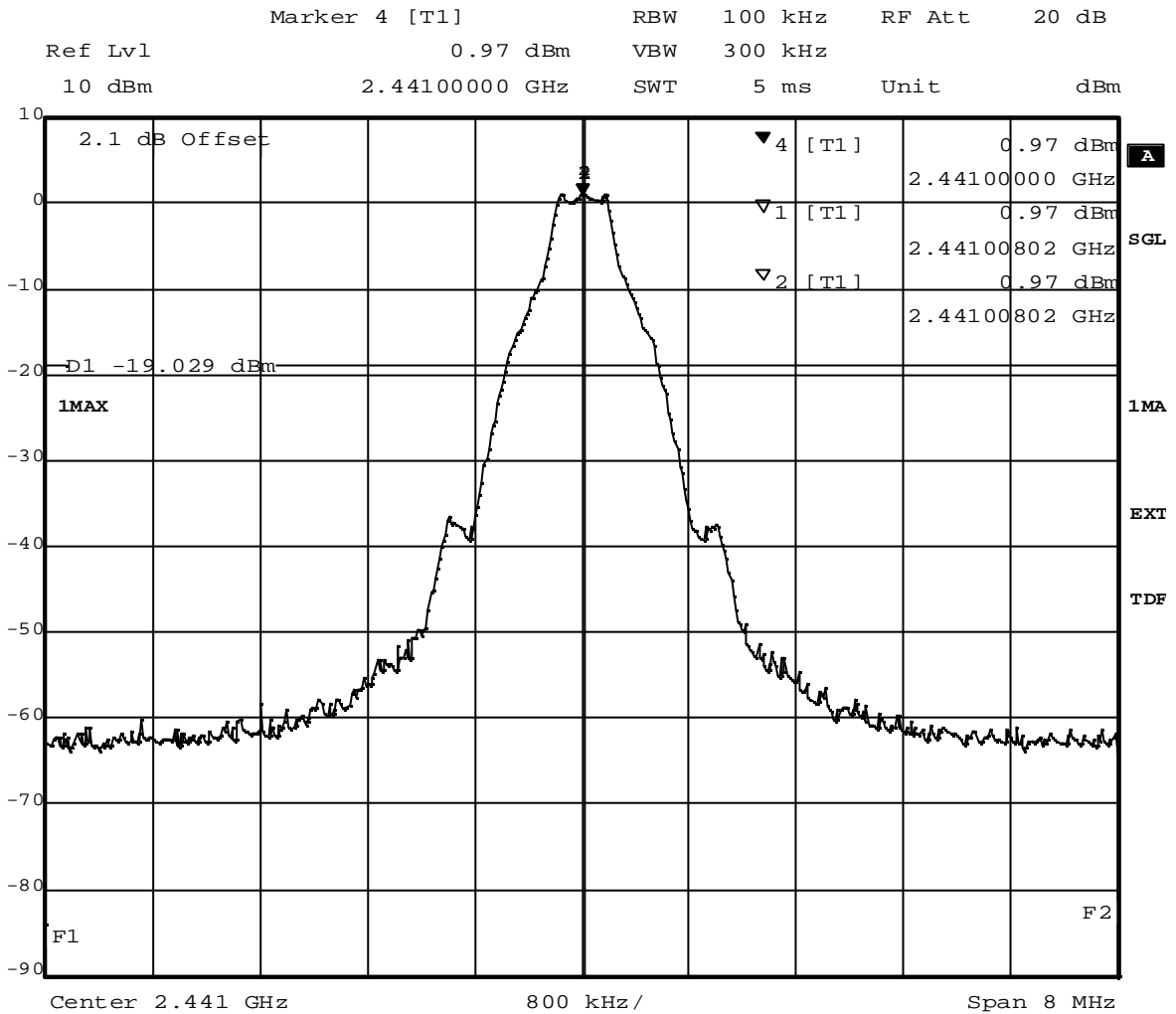
Title: spurious emissions
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 08:52:07

(spurious emissions measurement)

8.4.3 Spurious RF conducted emissions operating mode 2

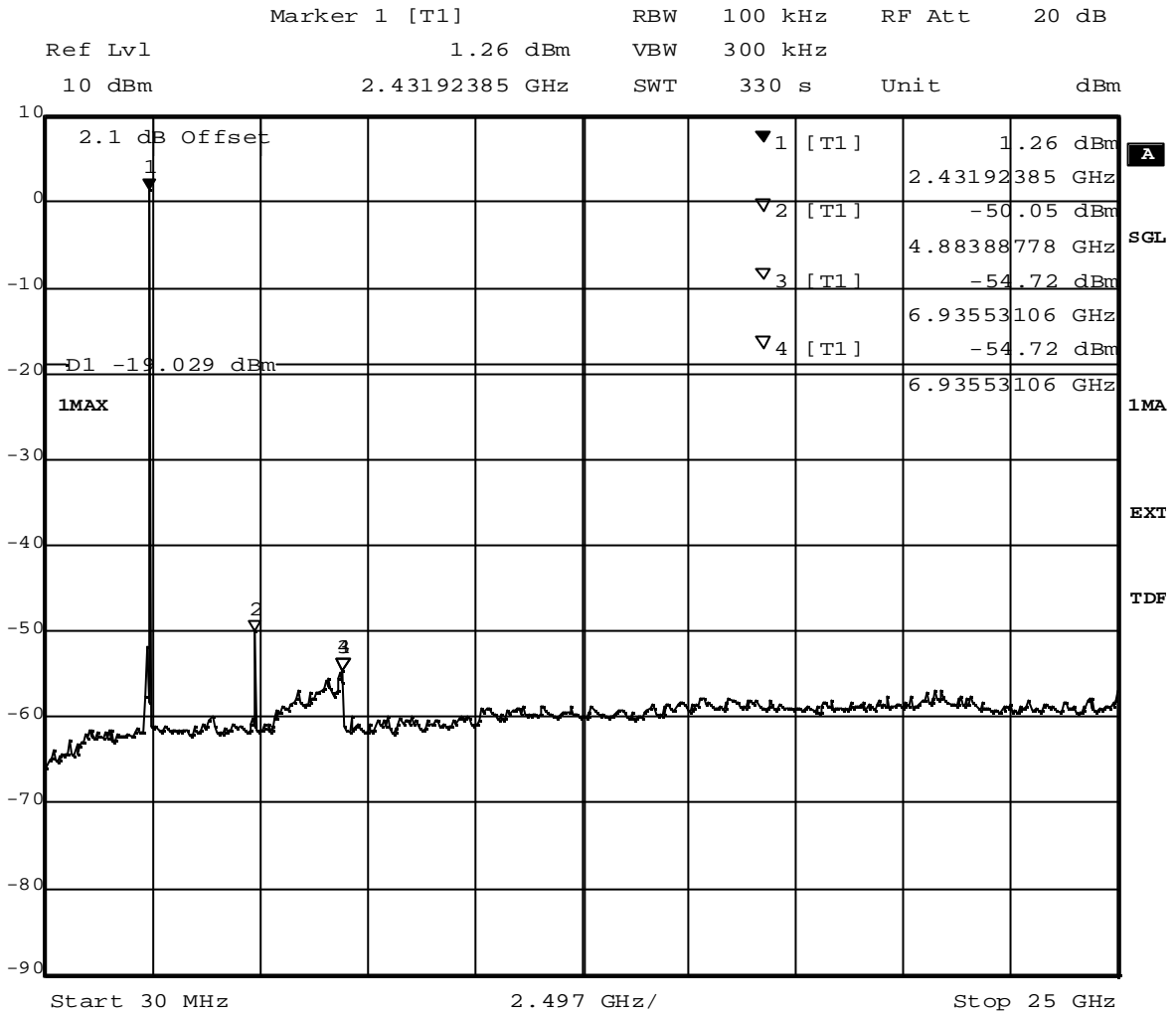
Op. Mode

op-mode 2



Title: Band Edge Compliance
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 09:05:28

(determination of reference value for spurious emissions measurement)



Title: spurious emissions
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 09:17:06

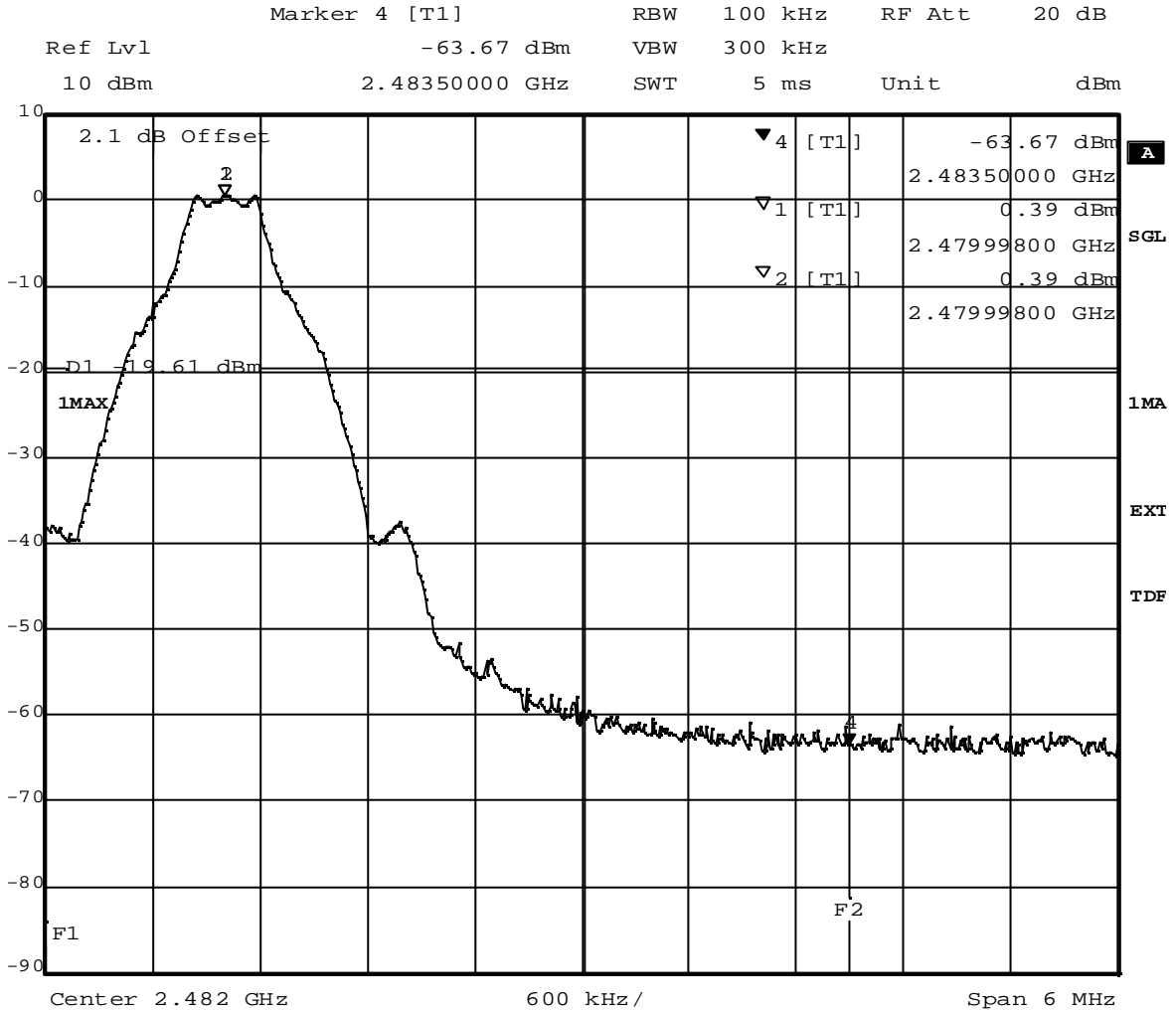
(spurious emissions measurement)



8.4.4 Band edge compliance conducted operating mode 3

Op. Mode

op-mode 3



Title: Band Edge Compliance
 Comment A: CH T: 2480 MHz
 Date: 21.APR.2011 09:25:54

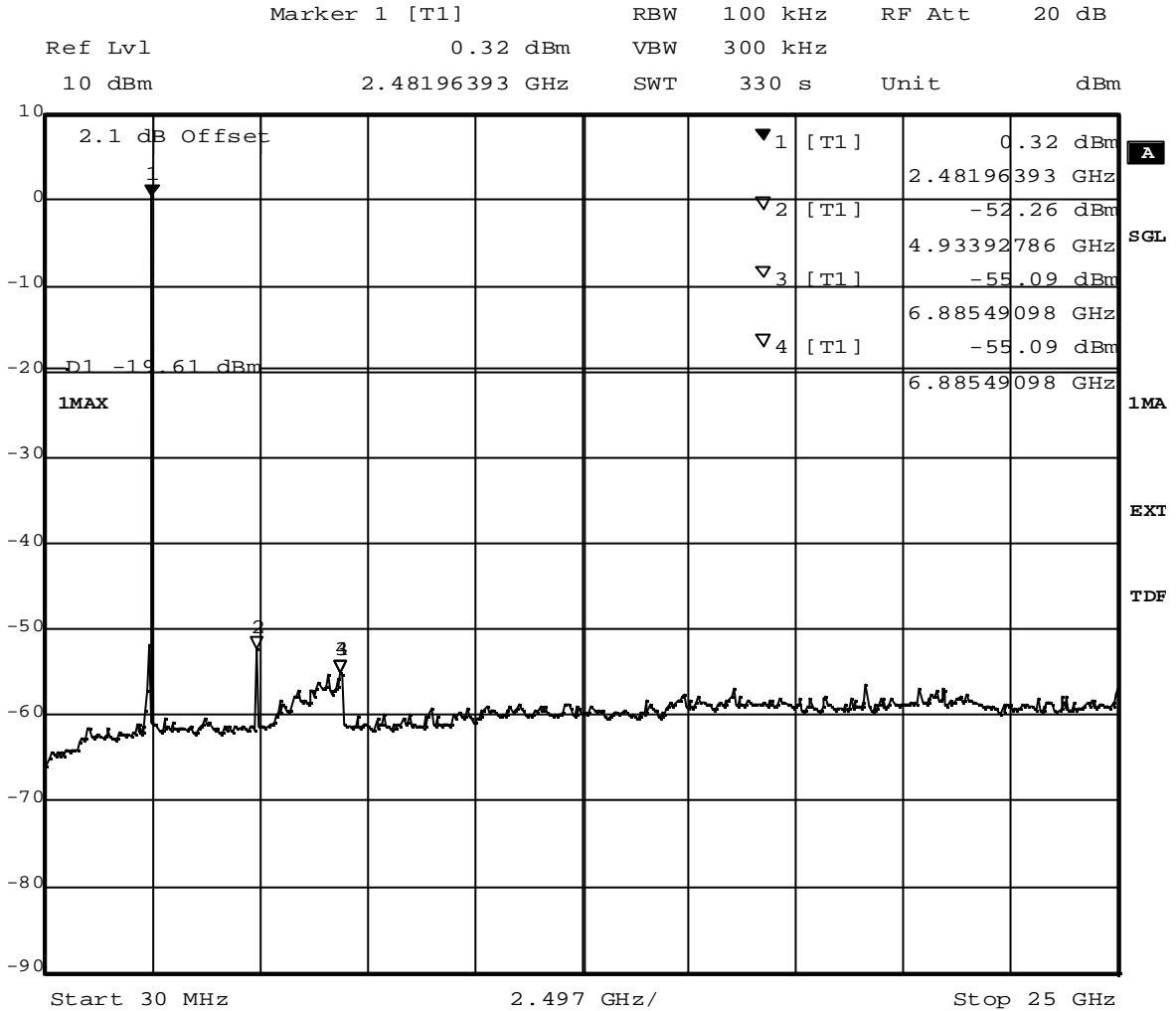
(determination of reference value for spurious emissions measurement)



8.4.5 Spurious RF conducted emissions operating mode 3

Op. Mode

op-mode 3



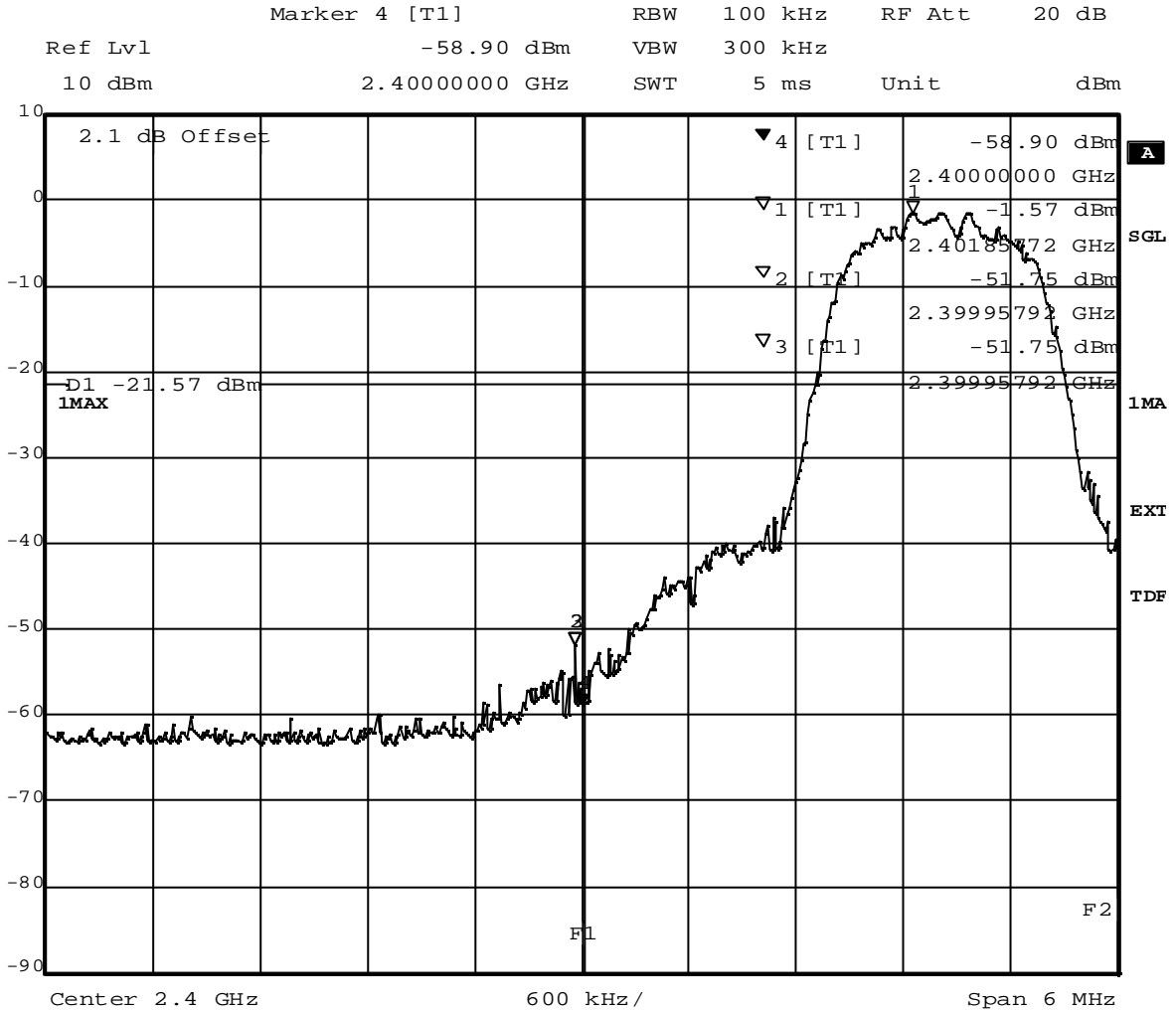
Title: spurious emissions
 Comment A: CH T: 2480 MHz
 Date: 21.APR.2011 09:37:32

(spurious emissions measurement)

8.4.6 Band edge compliance conducted operating mode 6

Op. Mode

op-mode 6



Title: Band Edge Compliance
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 11:44:35

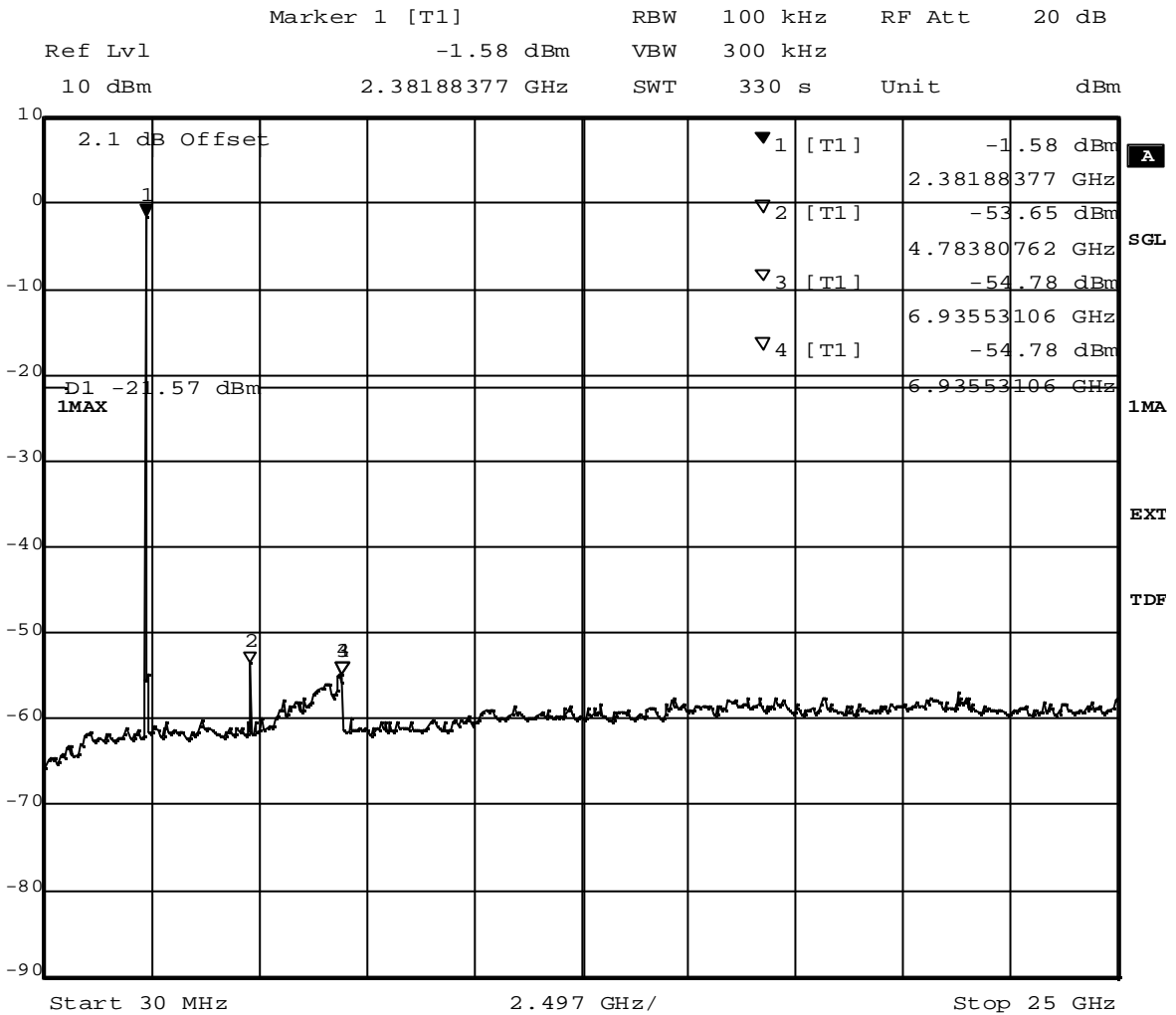
(determination of reference value for spurious emissions measurement)



8.4.7 Spurious RF conducted emissions operating mode 6

Op. Mode

op-mode 6



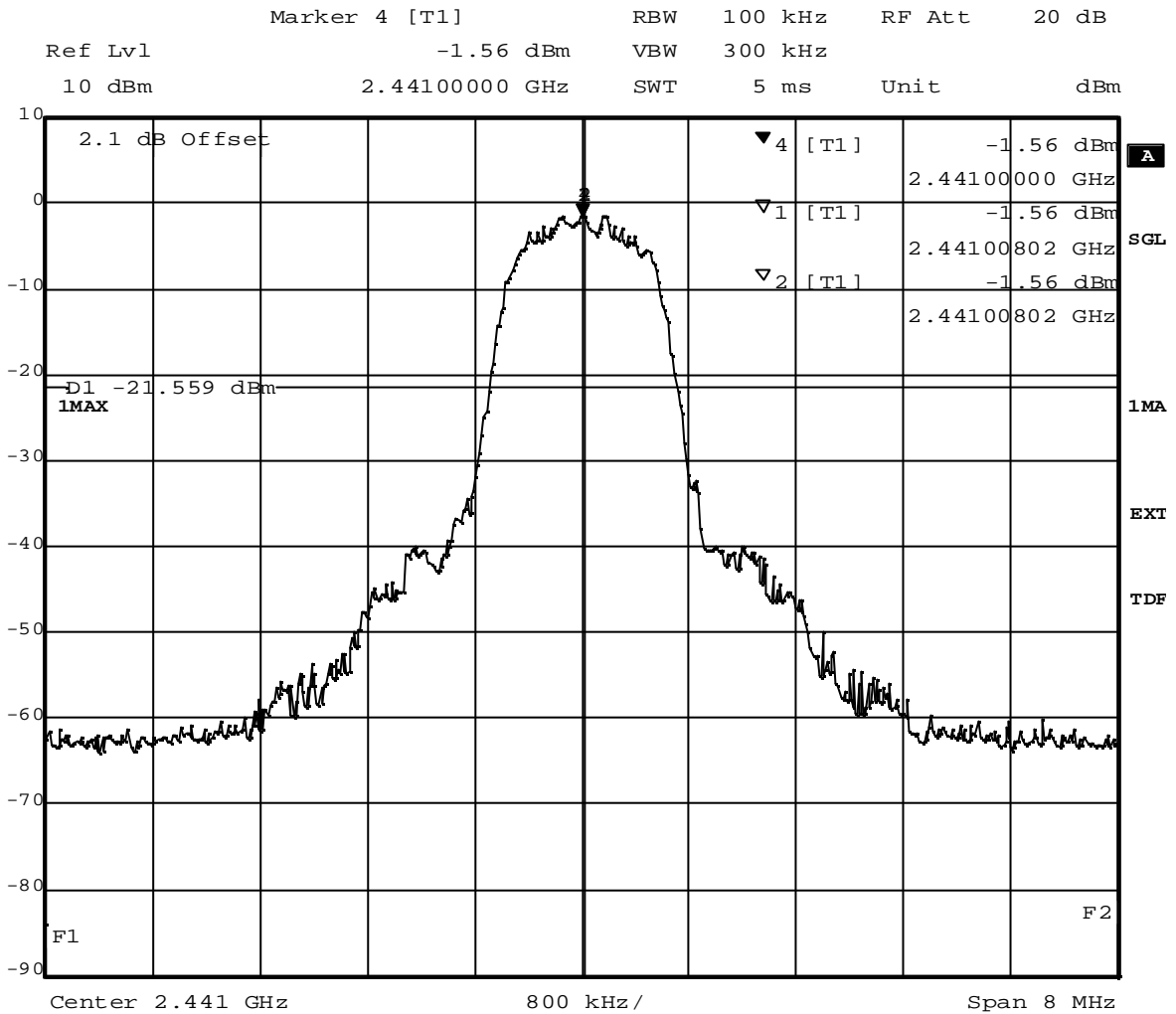
Title: spurious emissions
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 11:56:15

(spurious emissions measurement)

8.4.8 Spurious RF conducted emissions operating mode 7

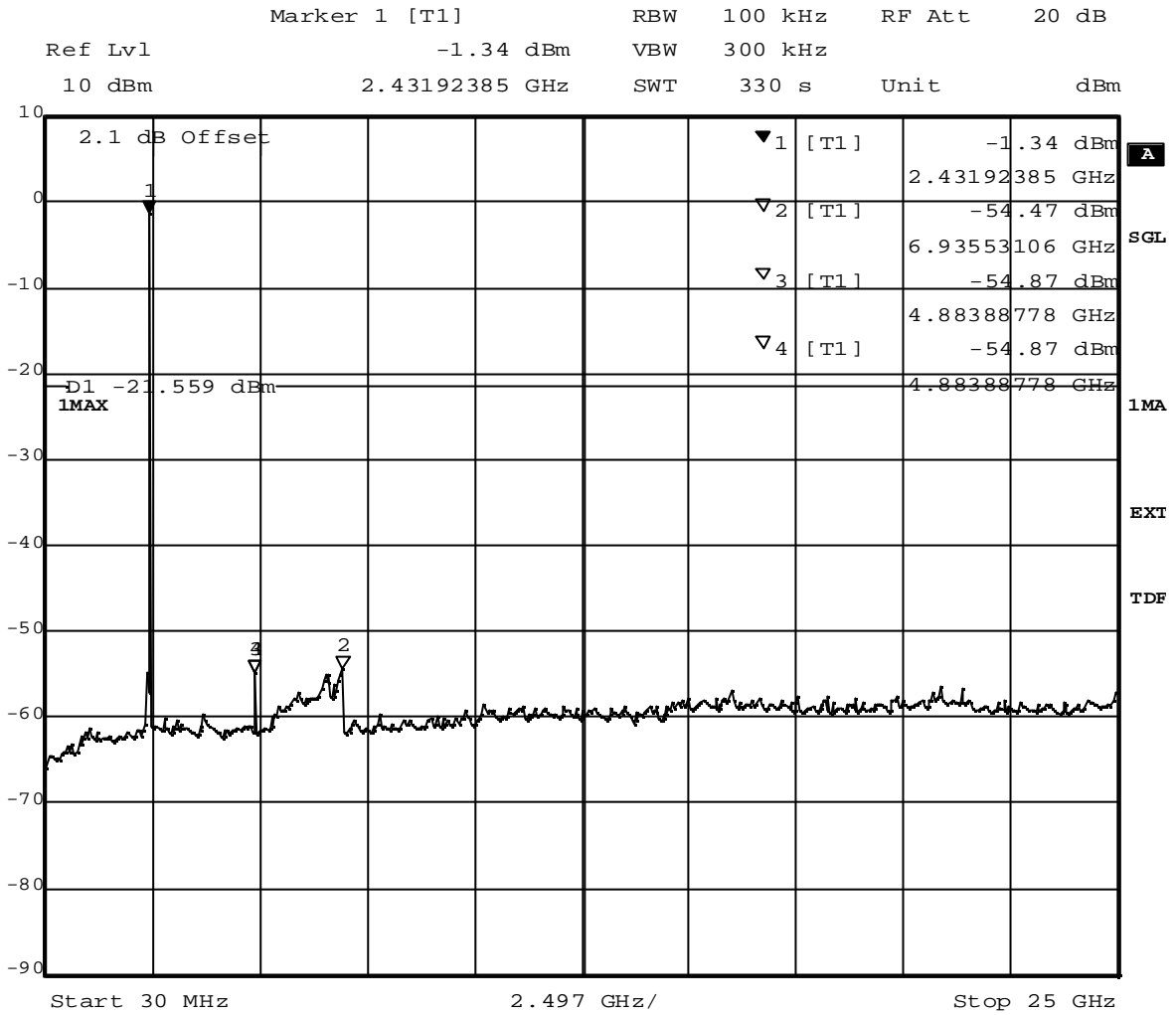
Op. Mode

op-mode 7



Title: Band Edge Compliance
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 12:10:48

(determination of reference value for spurious emissions measurement)



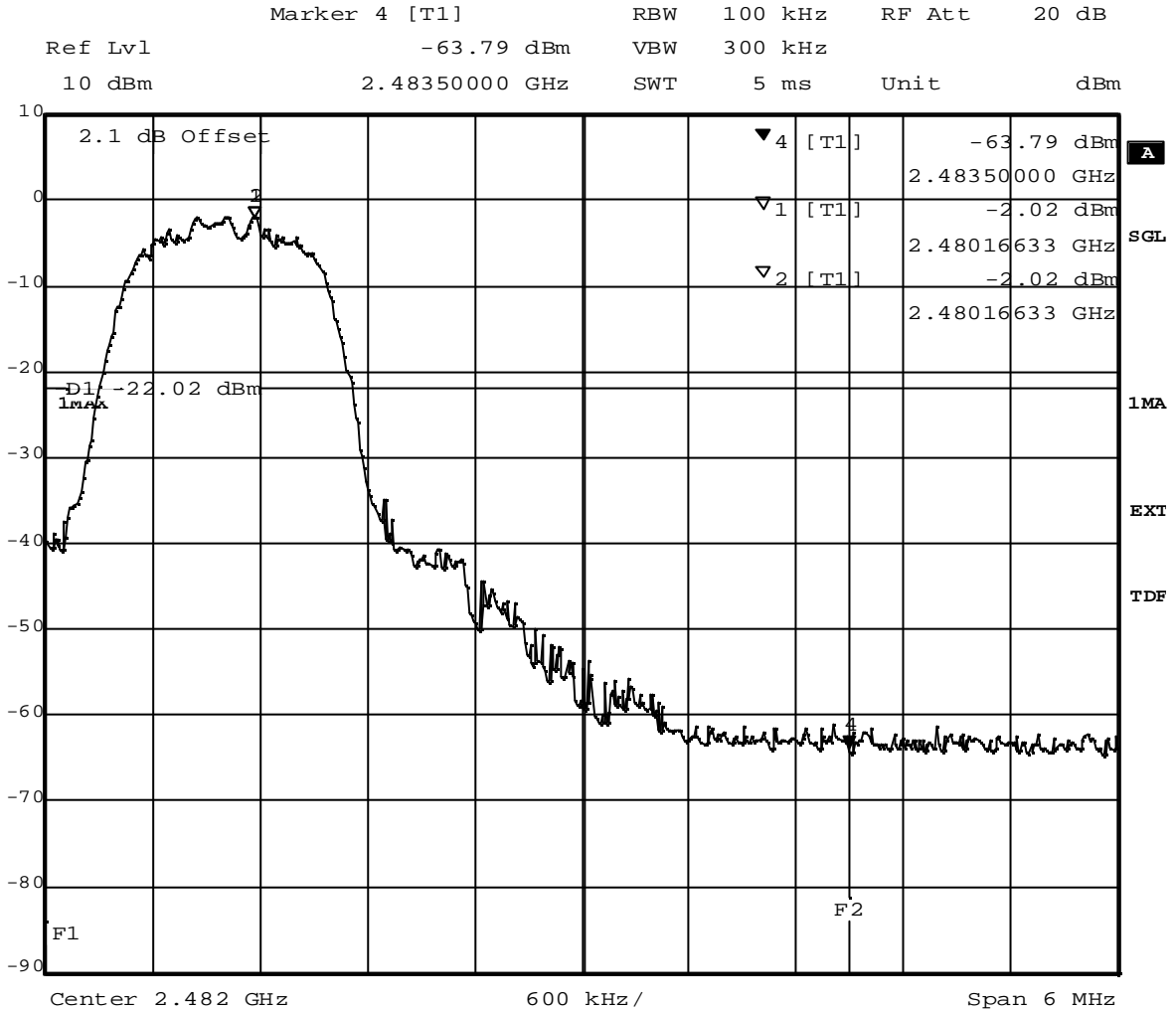
Title: spurious emissions
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 12:22:27

(spurious emissions measurement)

8.4.9 Band edge compliance conducted operating mode 8

Op. Mode

op-mode 8



Title: Band Edge Compliance
 Comment A: CH T: 2480 MHz
 Date: 21.APR.2011 12:32:30

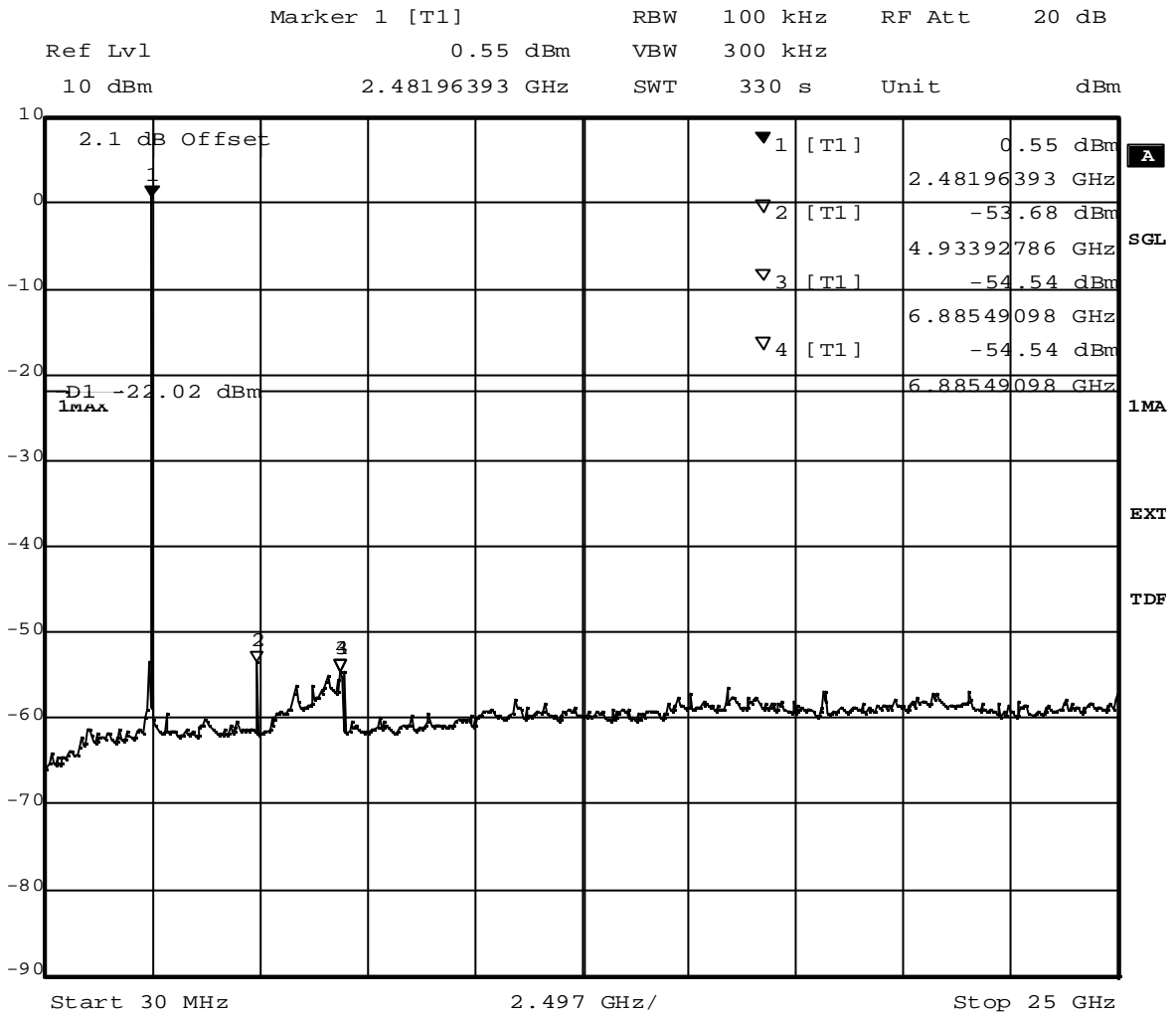
(determination of reference value for spurious emissions measurement)



8.4.10 Spurious RF conducted emissions operating mode 8

Op. Mode

op-mode 8



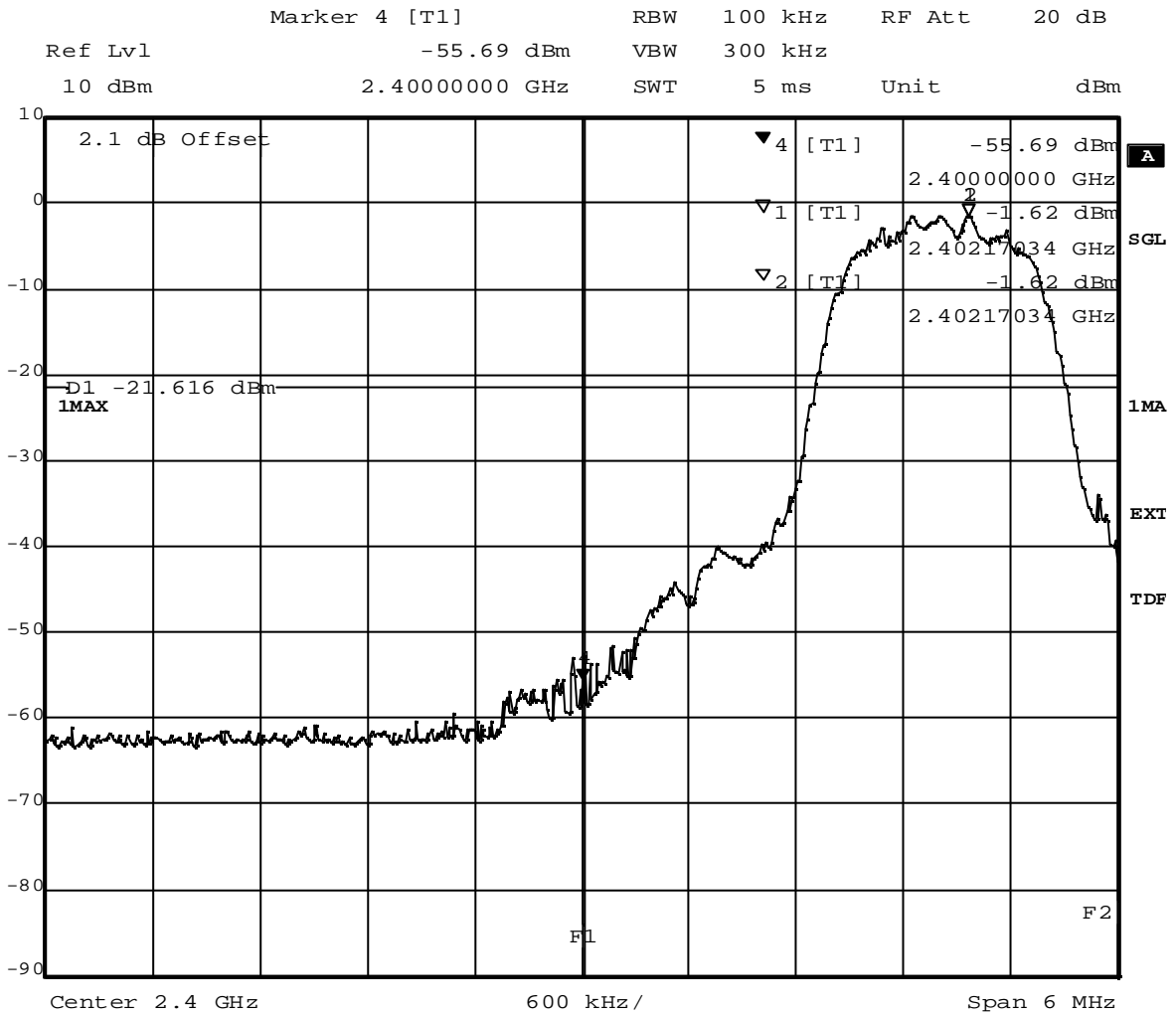
Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 21.APR.2011 12:44:09

(spurious emissions measurement)

8.4.11 Band edge compliance conducted operating mode 10

Op. Mode

op-mode 10



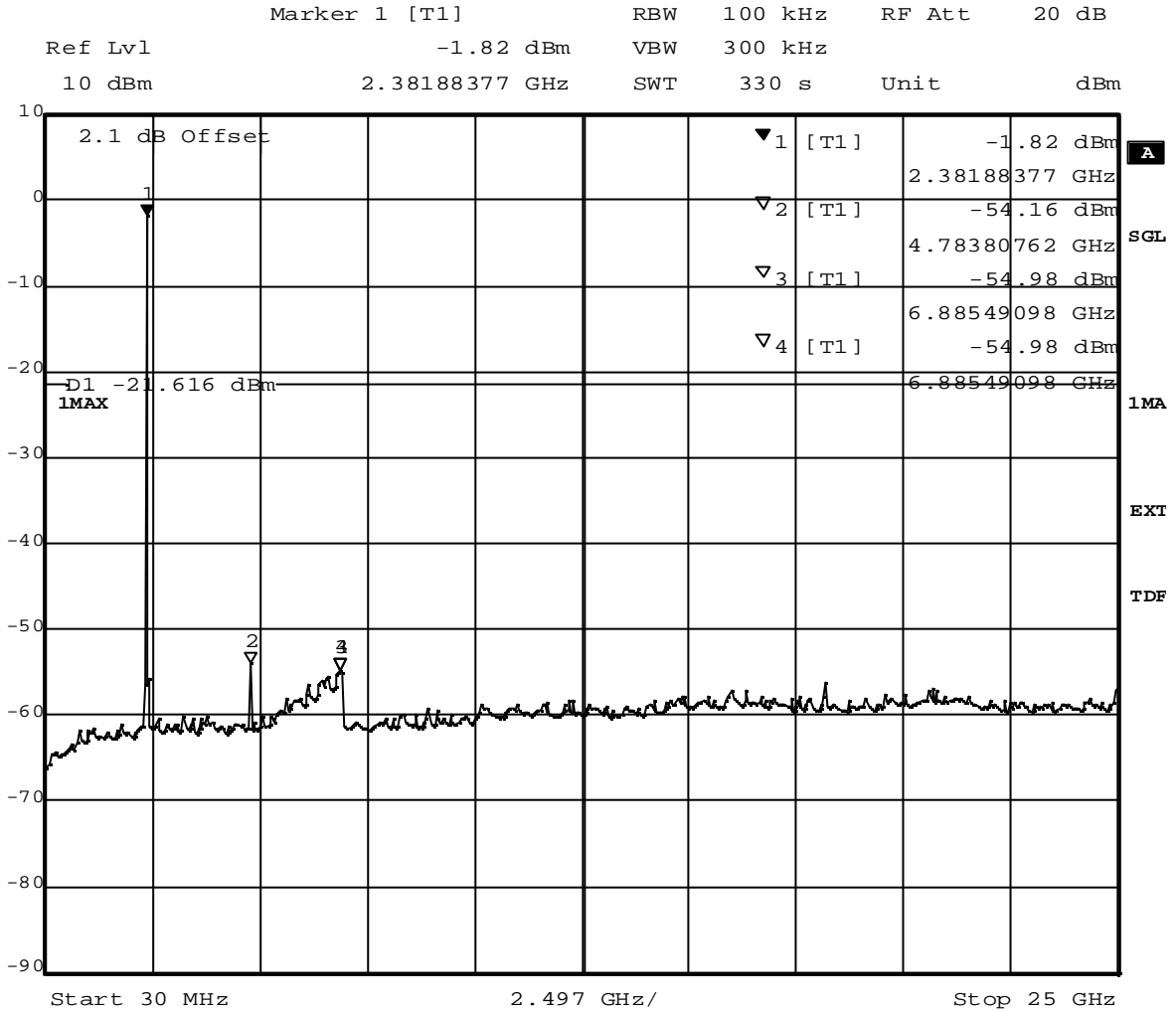
Title: Band Edge Compliance
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 10:06:37

(determination of reference value for spurious emissions measurement)

8.4.12 Spurious RF conducted emissions operating mode 10

Op. Mode

op-mode 10



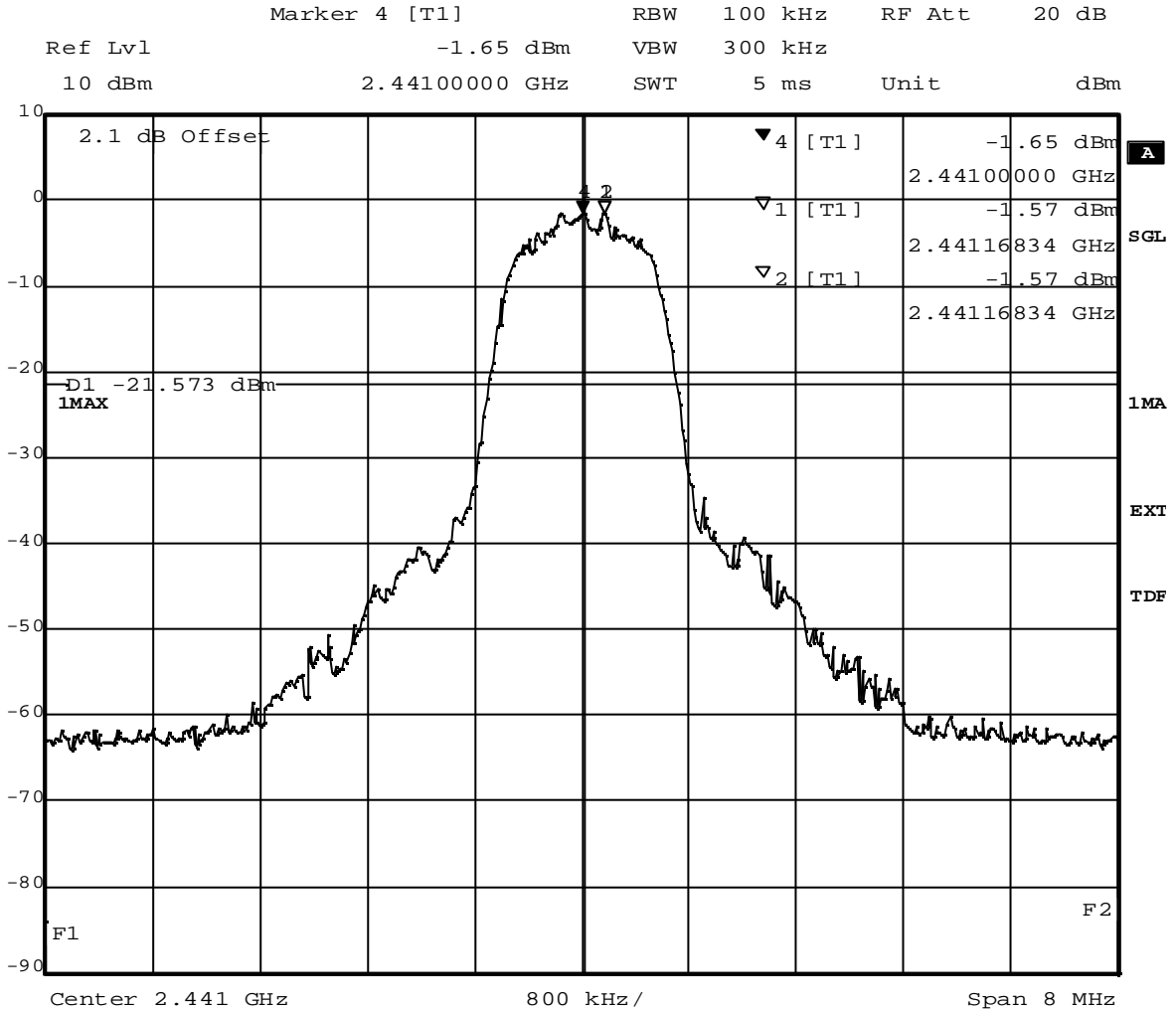
Title: spurious emissions
 Comment A: CH B: 2402 MHz
 Date: 21.APR.2011 10:18:16

(spurious emissions measurement)

8.4.13 Spurious RF conducted emissions operating mode 11

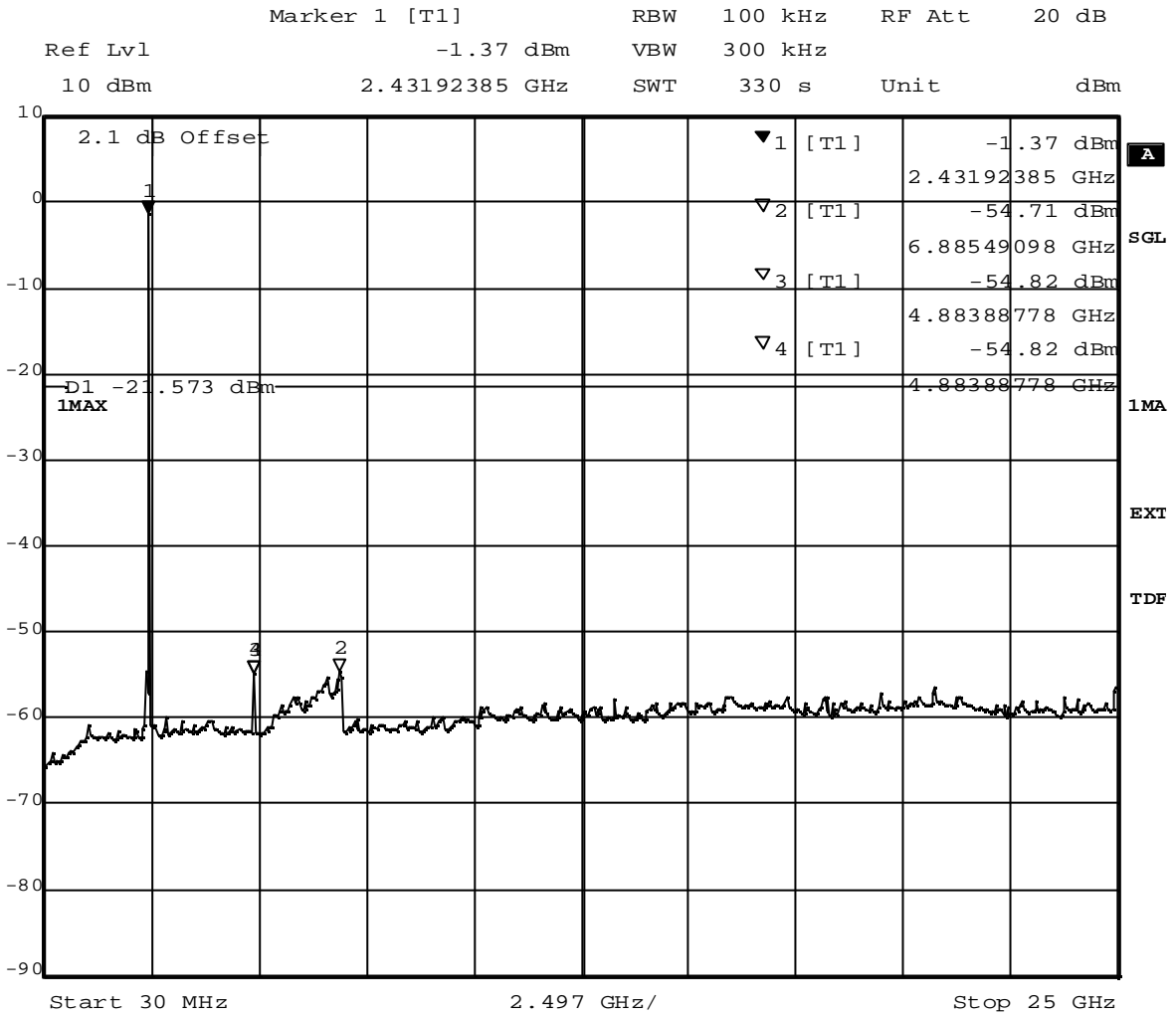
Op. Mode

op-mode 11



Title: Band Edge Compliance
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 10:45:21

(determination of reference value for spurious emissions measurement)



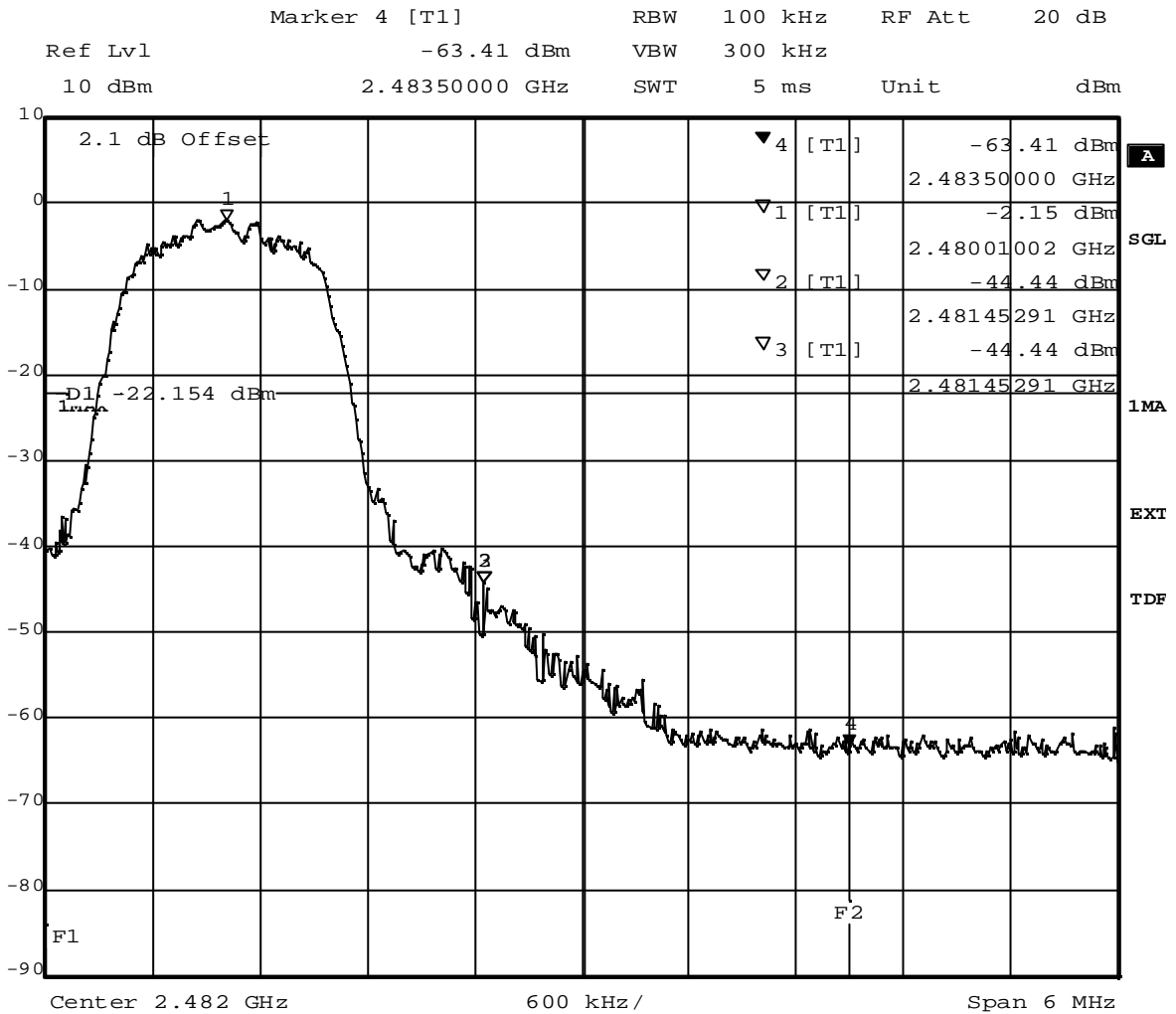
Title: spurious emissions
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 10:56:59

(spurious emissions measurement)

8.4.14 Band edge compliance conducted operating mode 12

Op. Mode

op-mode 12



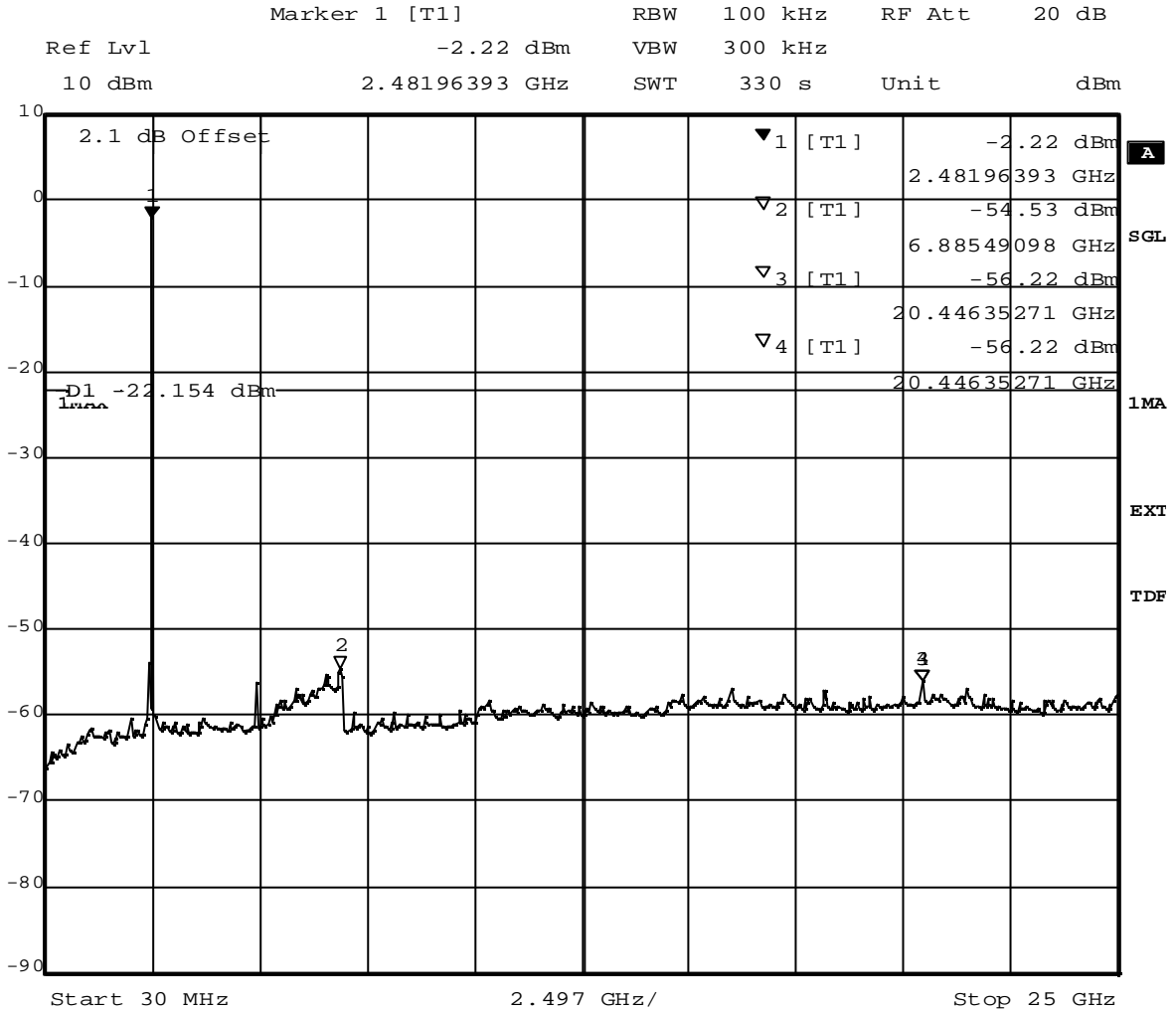
Title: Band Edge Compliance
 Comment A: CH T: 2480 MHz
 Date: 21.APR.2011 11:08:13

(determination of reference value for spurious emissions measurement)

8.4.15 Spurious RF conducted emissions operating mode 12

Op. Mode

op-mode 12



Title: spurious emissions
 Comment A: CH T: 2480 MHz
 Date: 21.APR.2011 11:19:52

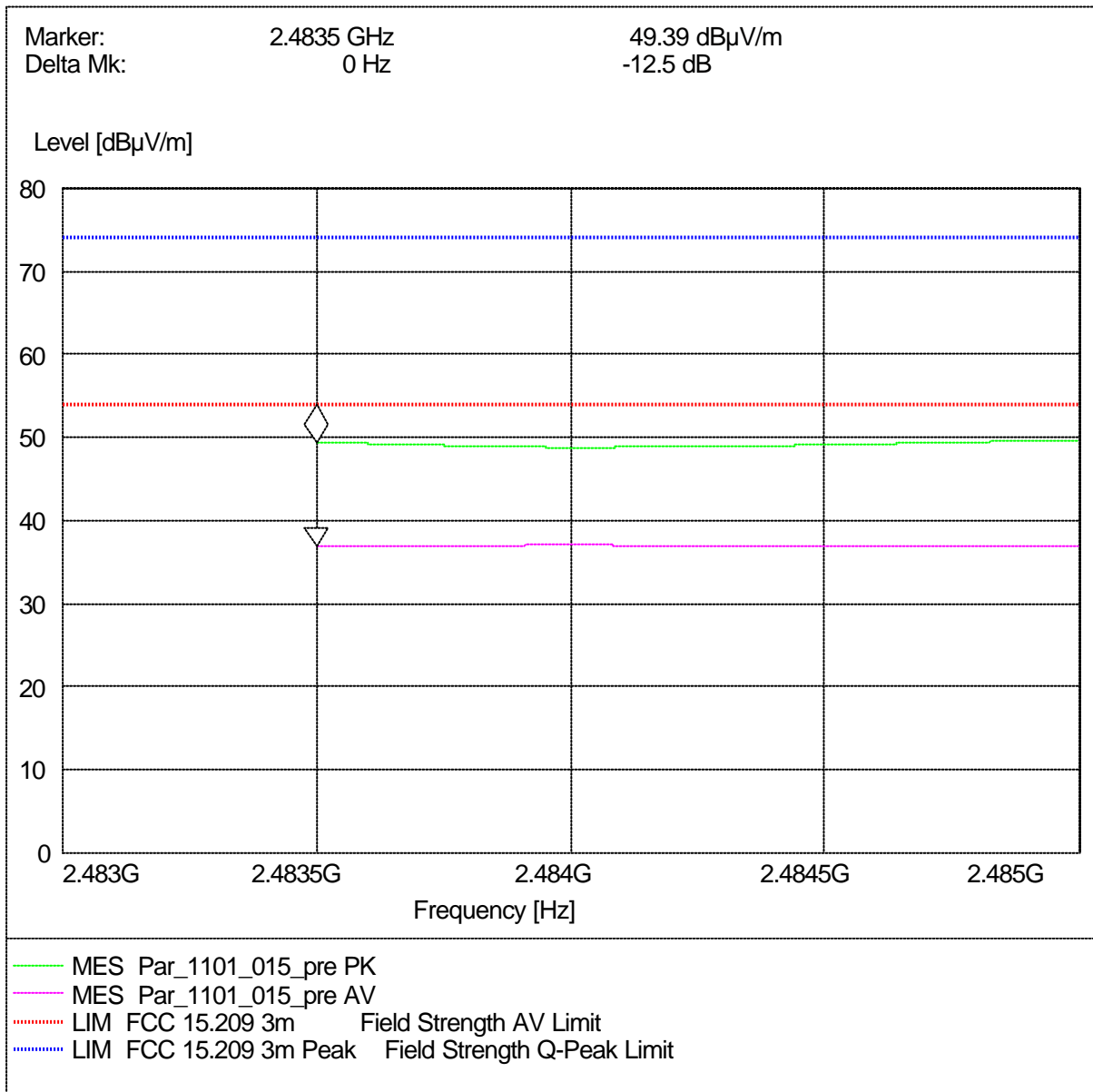
(spurious emissions measurement)

8.5 Band edge compliance radiated

8.5.1 Band edge compliance radiated operating mode 3

Op. Mode

op-mode 3

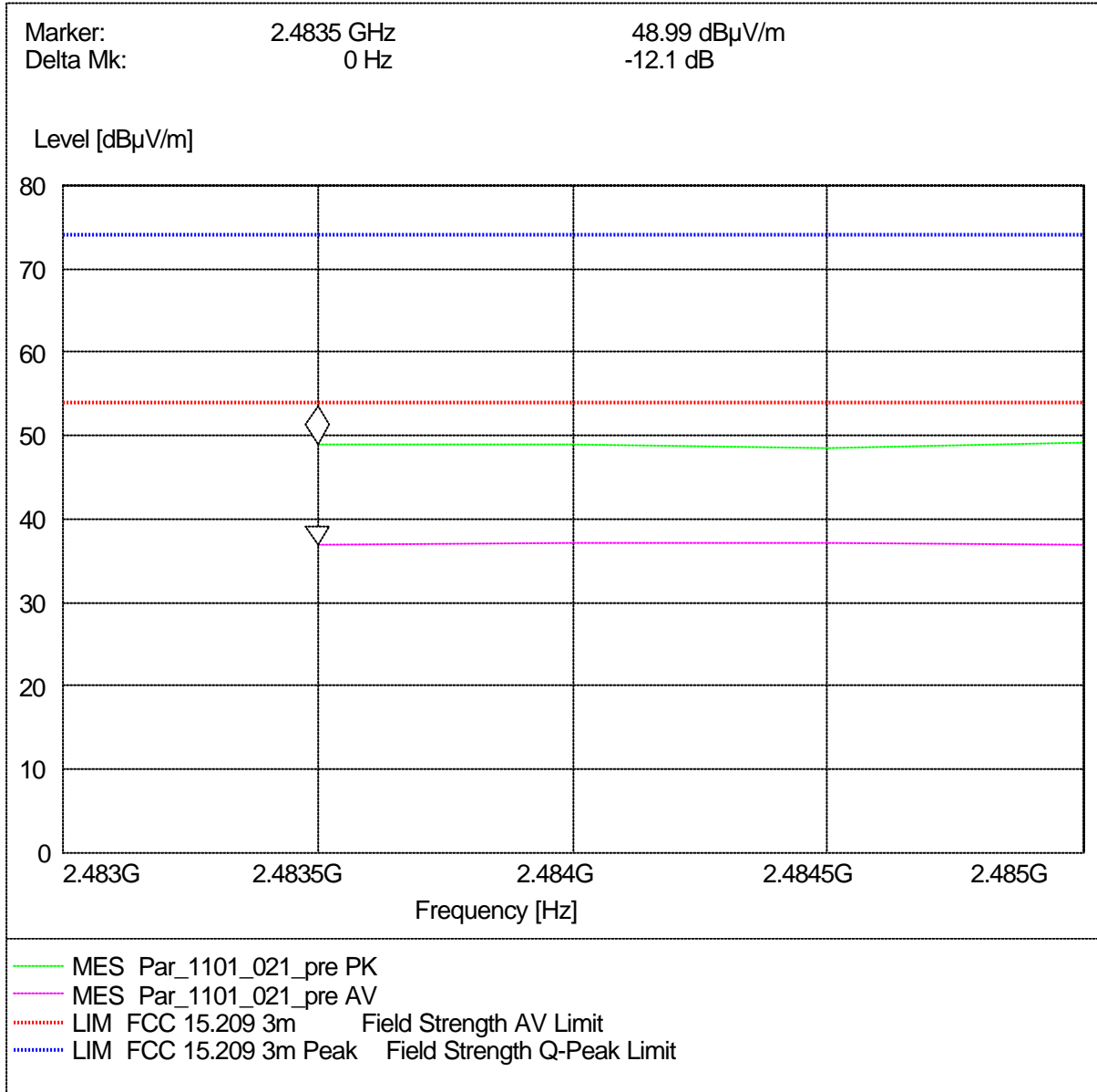


Radiated measurement (higher band edge)

8.5.2 Band edge compliance radiated operating mode 8

Op. Mode

op-mode 8

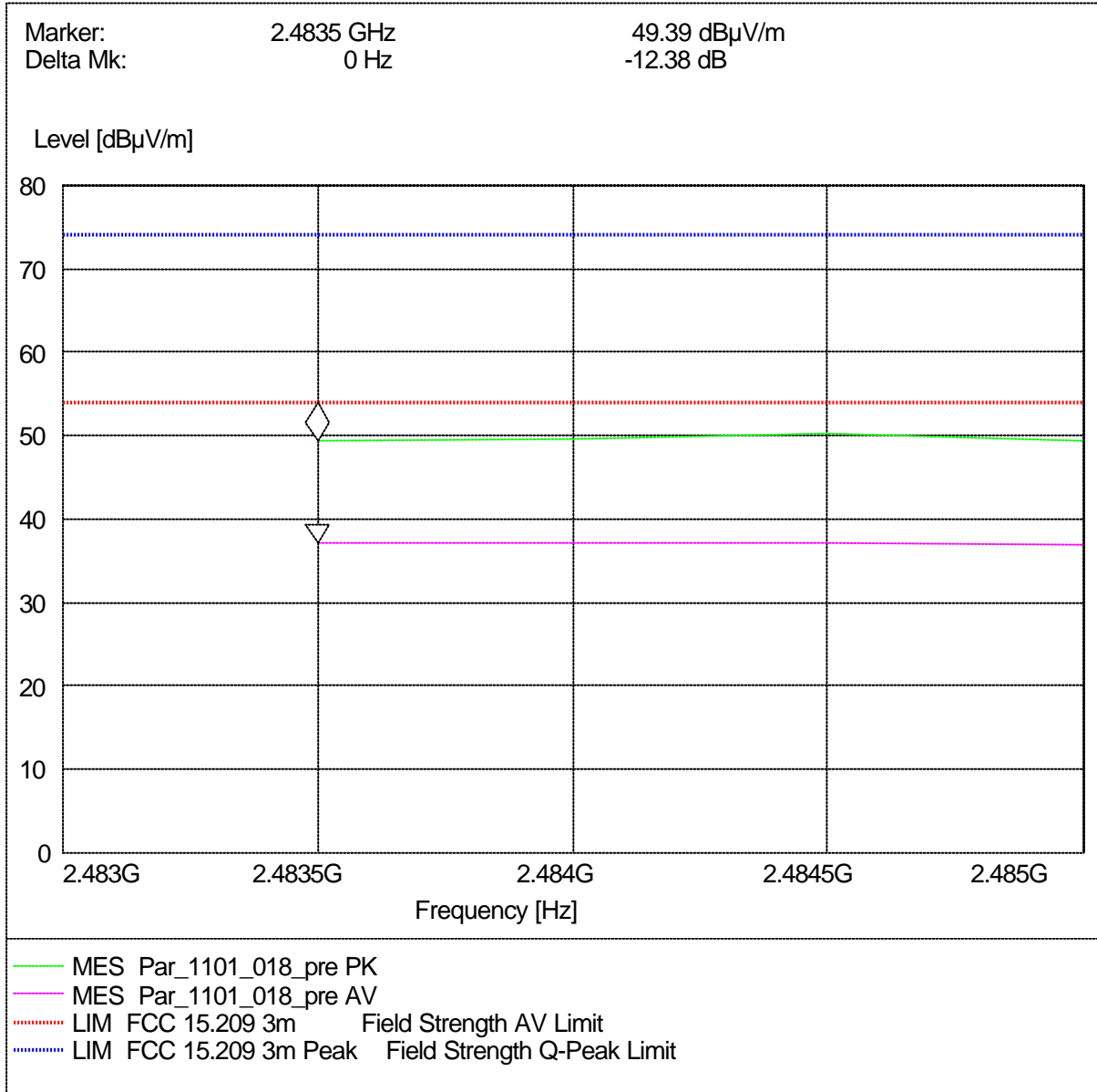


Radiated measurement (higher band edge)

8.5.3 Band edge compliance radiated operating mode 12

Op. Mode

op-mode 12



Radiated measurement (higher band edge)

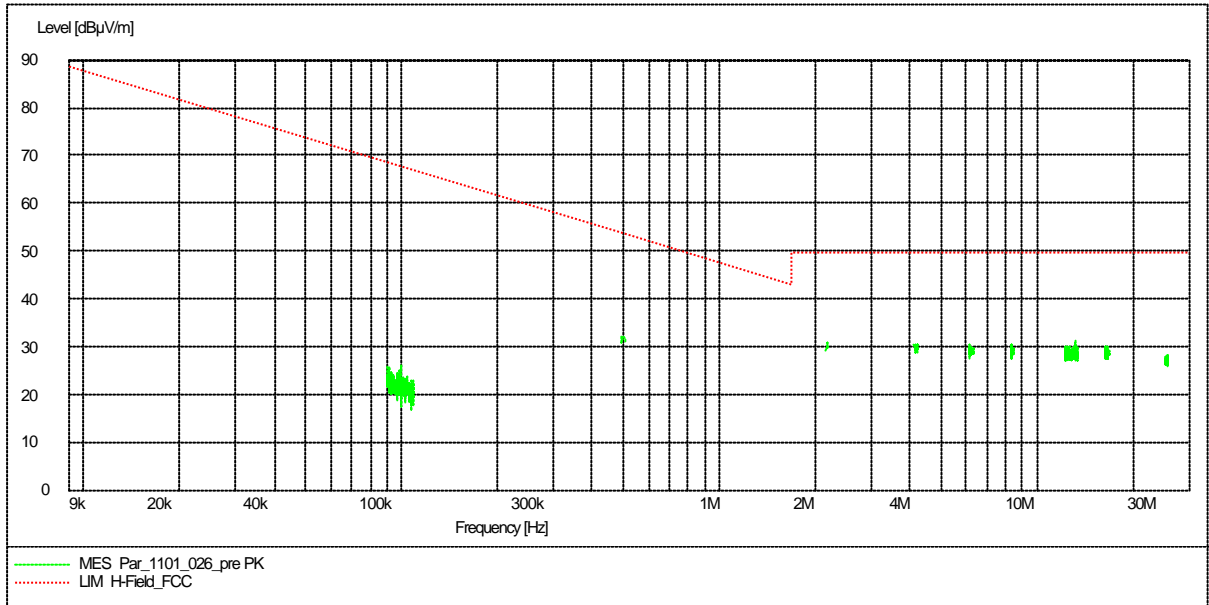
8.6 Radiated emissions (f < 30 MHz)

Op. Mode

op-mode 2

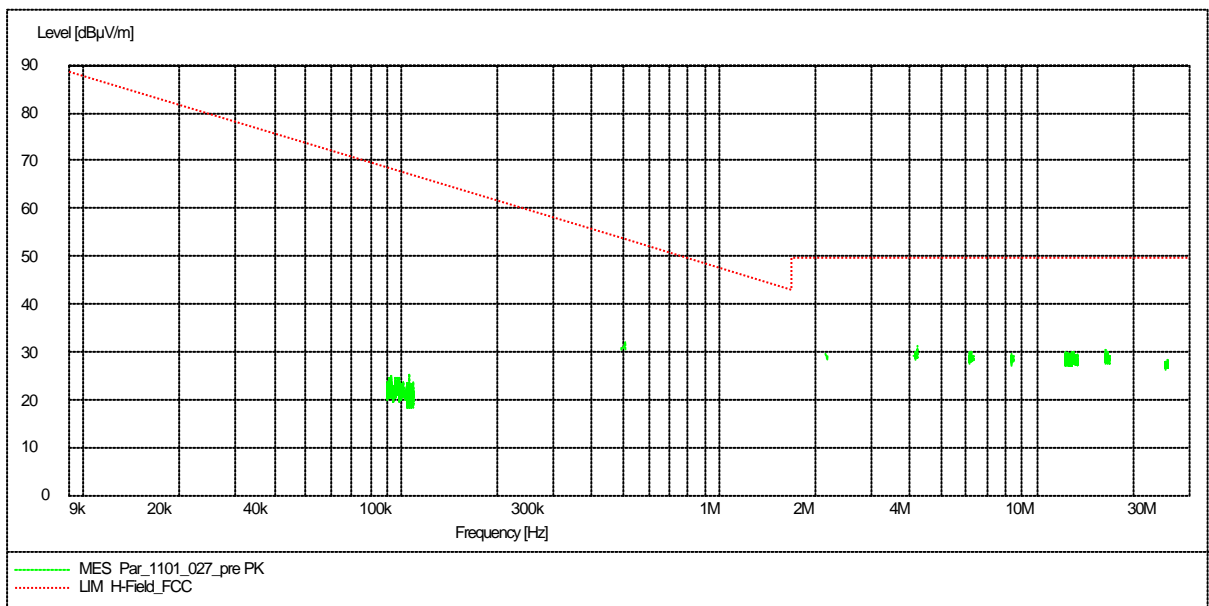
Antenna position 90°

EUT position front side



Antenna position 90°

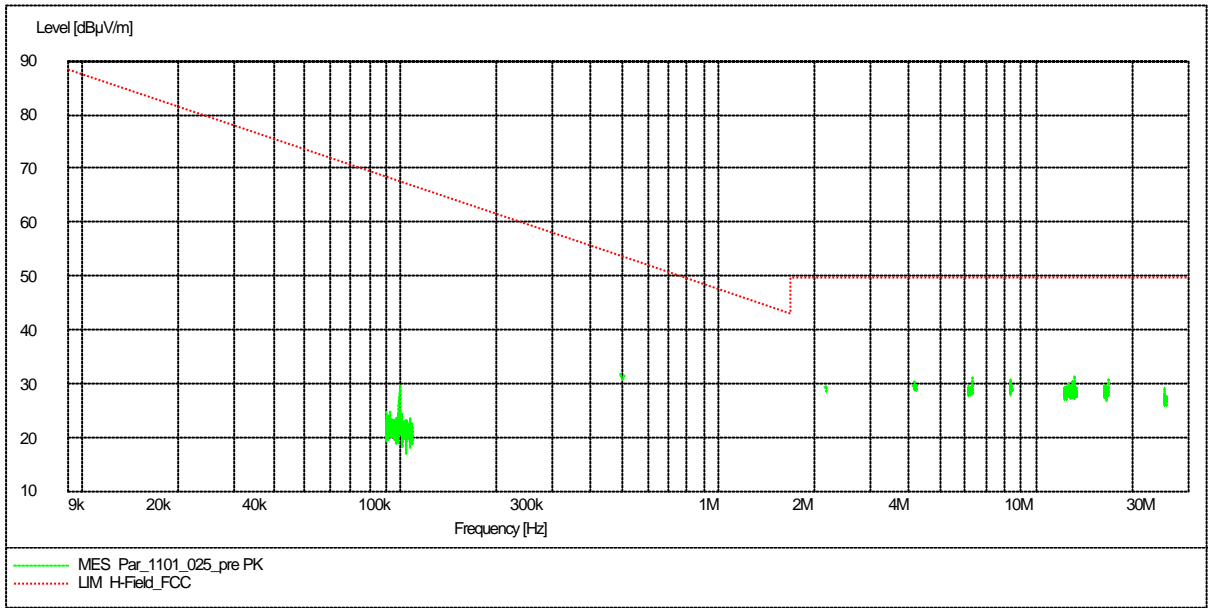
EUT position right side



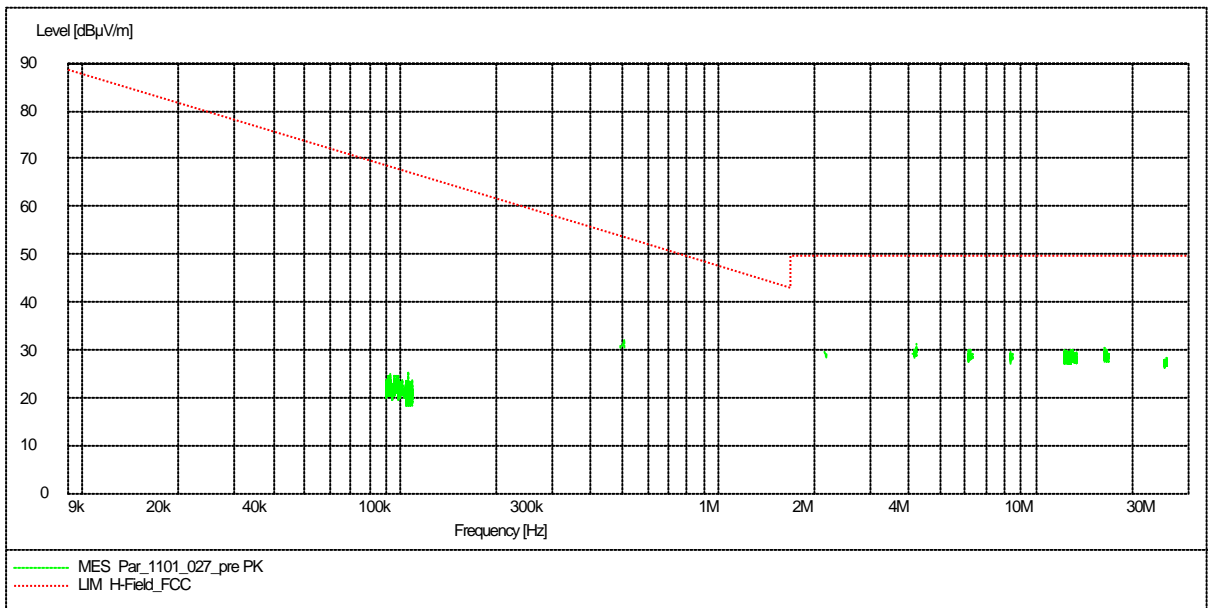
Op. Mode

op-mode 2

Antenna position 0°
EUT position front side



Antenna position 0°
EUT position right side

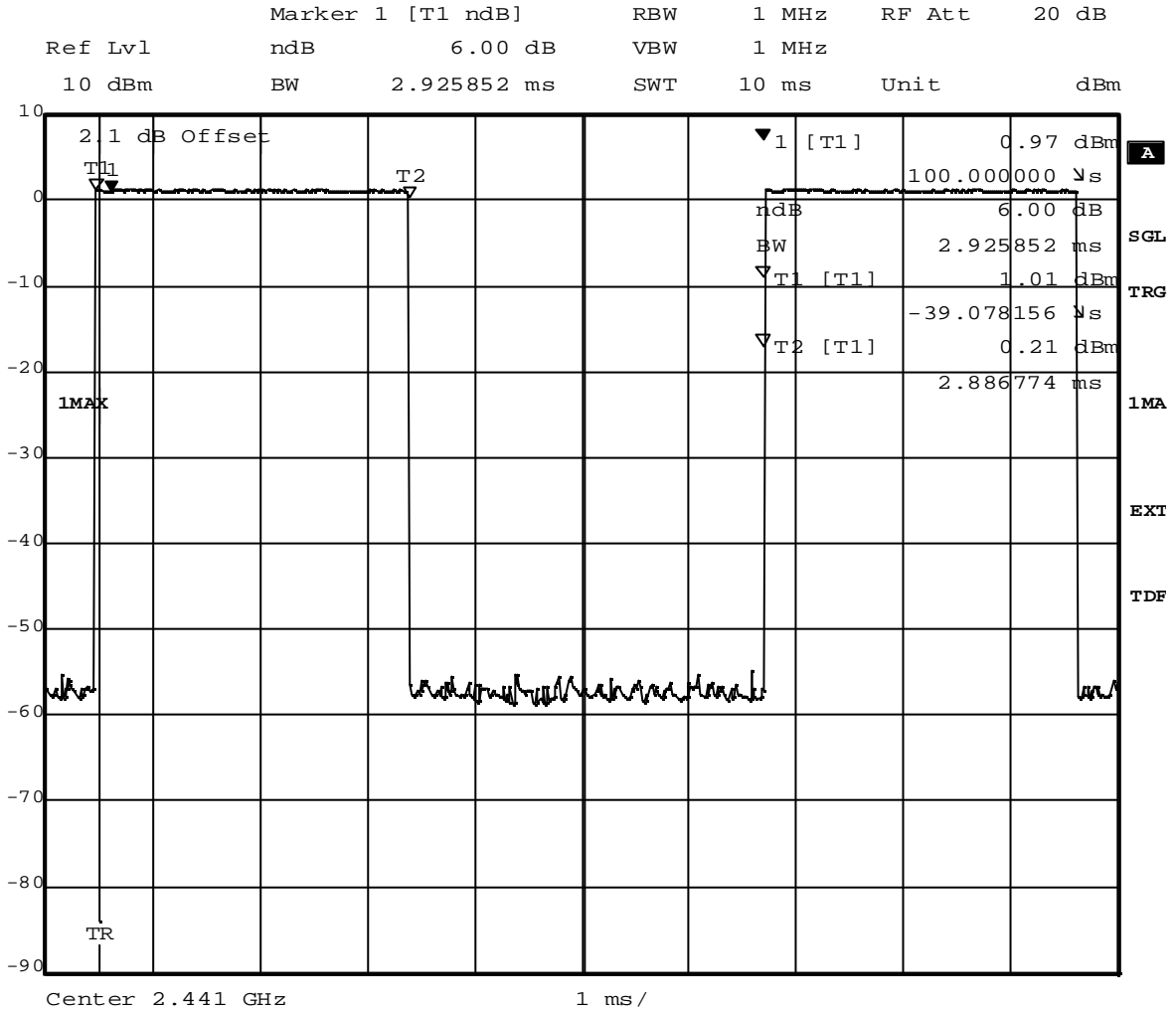




8.7 Dwell time

Op. Mode

op-mode 2 Time slot measurement of a DH5 packet

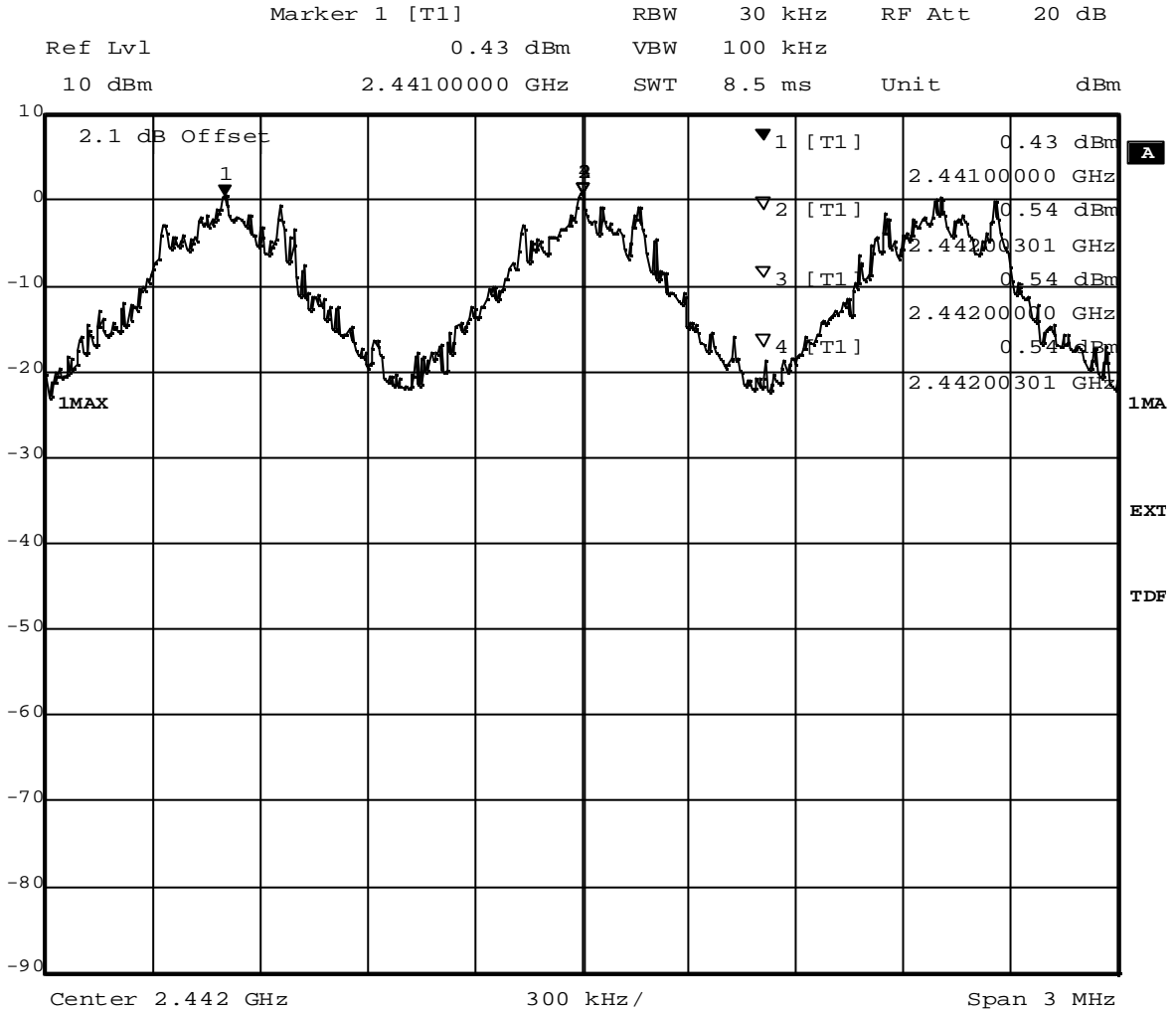


Title: Dwell time
 Comment A: CH M: 2441 MHz
 Date: 21.APR.2011 09:47:26

8.8 Channel separation

Op. Mode

op-mode 4



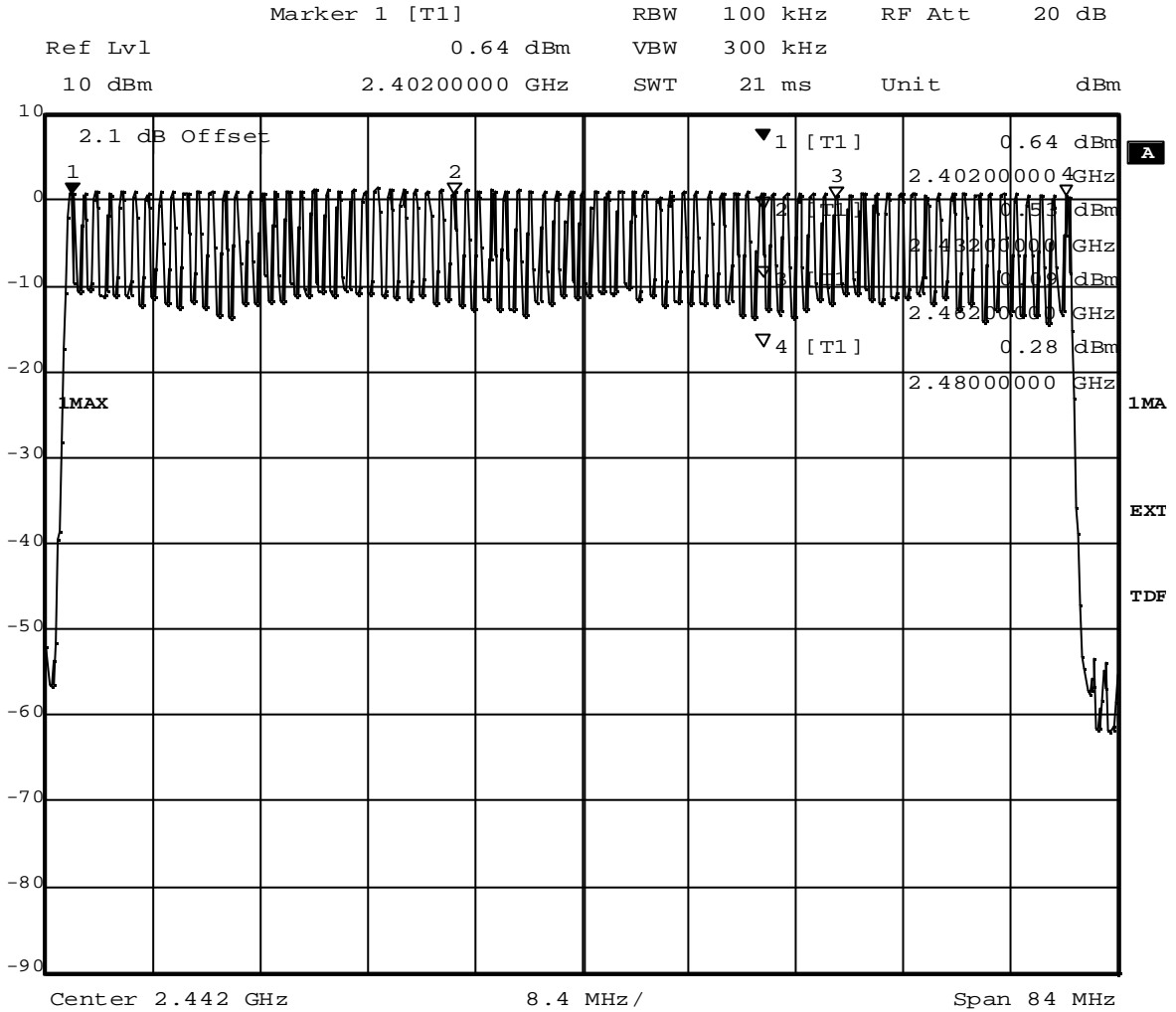
Title: Number of hopping frequencies
 Comment A: CH H: Hopping
 Date: 21.APR.2011 09:56:10



8.9 Number of hopping frequencies

Op. Mode

op-mode 4



Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 21.APR.2011 10:03:34