
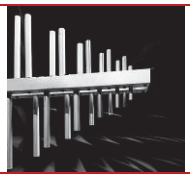
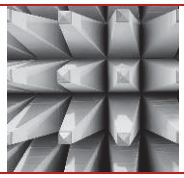

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*consulting - testing - certification* ➤➤➤

# TEST REPORT

**Test report no.: 1-6593/13-01-08**

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

## Testing laboratory


**CETECOM ICT Services GmbH**
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.com


**Accredited Testing Laboratory:**
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01
Area of Testing:
Radio Communications & EMC (RCE)

## Applicant


**SIEMENS Audiologische Technik GmbH**
Gebbertstrasse 125
91058 Erlangen / GERMANY
Phone:
Fax: +49 9131 308-3207
Contact: Clemens Meythaler
e-mail: clemens.meythaler@siemens.com
Phone: +49 9131 308-3000


## Manufacturer

**Hi-P Tianjin Electronics Co., Ltd.**
No29, 3th Street Xinye, Factory#7, Western TEDA
300462 Tianjin / CHINA

## Test standard/s

| | |
|---|---|
| 47 CFR Part 15 | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 210 Issue 8 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment |

For further applied test standards please refer to section 3 of this test report.

## Test Item

| | |
|---|---|
| **Kind of test item:** | **Remote Controller** |
| **Model name:** | **easyTek** |
| **FCC ID:** | **SGI-WL400** |
| **IC:** | **267AB-WL400** |
| Frequency: | 2400 MHz – 2483.5 MHz ISM Band |
| Technology tested: | Bluetooth®, +EDR |
| Antenna: | Integrated antenna |
| Power supply: | 3.7V Li-ion Battery |
| Temperature range: | 0°C to +45°C |

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## Test report authorised:

Digitally signed by Joerg Warken
DN: cn=Joerg Warken, o=CETECOM ICT Services GmbH, ou=WAK-111223, email=Joerg.Warken@cetecom.com, c=DE
Date: 2014.05.20 12:53:49 +02'00'

Joerg Warken
Senior Testing Manager

## Test performed:

cn=David Lang, o=CETECOM ICT Services GmbH, ou=LNG-131017, email=david.lang@cetecom.com, c=DE
2014.05.19 07:51:22 +02'00'

David Lang
Testing Manager

# 1 Table of contents

# 2 General information

## 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2014-05-06 |
| Date of receipt of test item: | 2014-04-28 |
| Start of test: | 2014-04-29 |
| End of test: | 2014-05-06 |
| Person(s) present during the test: | -/- |

# 3 Test standard/s

| Test standard | Date | Test standard description |
|---|---|---|
| 47 CFR Part 15 | | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 210 Issue 8 | 01.12.2010 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment |

## 4 Test environment

| | | | |
|---|---|---|---|
| Temperature: | $T_{nom}$ | +22 | °C during room temperature tests |
| | $T_{max}$ | +45 | °C during high temperature tests |
| | $T_{min}$ | 0 | °C during low temperature tests |
| Relative humidity content: | | 42 % | |
| Barometric pressure: | | not relevant for this kind of testing | |
| Power supply: | $V_{nom}$ | 3.7 V | Li-ion Battery |
| | $V_{max}$ | 4.2 V | |
| | $V_{min}$ | 3.0 V | |

## 5 Test item

| | | |
|---|---|---|
| **Kind of test item** | **:** | **Remote Controller** |
| **Type identification** | **:** | **easyTek** |
| | | |
| **S/N serial number** | **:** | **Rad. YD00148**<br>**Cond. 001FF8F79CD9** |
| **HW hardware status** | **:** | **Proto 2.5** |
| **SW software status** | **:** | **BC7 0.12.2/ D9 240.11.1** |
| **Frequency band [MHz]** | **:** | **2400 MHz – 2483.5 MHz ISM Band** |
| **Type of radio transmission**<br>**Use of frequency spectrum** | **:**<br>**:** | **FHSS** |
| **Type of modulation** | **:** | **GFSK, Pi/4 QPSK, 8DPSK** |
| **Number of channels** | **:** | **79** |
| **Antenna** | **:** | **Integrated antenna** |
| **Power supply** | **:** | **3.7 V Li-ion Battery** |
| **Temperature range** | **:** | **0°C to +45 °C** |

## 5.1 Additional information

Test setup- and EUT-photos are included in test report: 1-6593/13-01-01_AnnexA
1-6593/13-01-01_AnnexB
1-6593/13-01-01_AnnexD

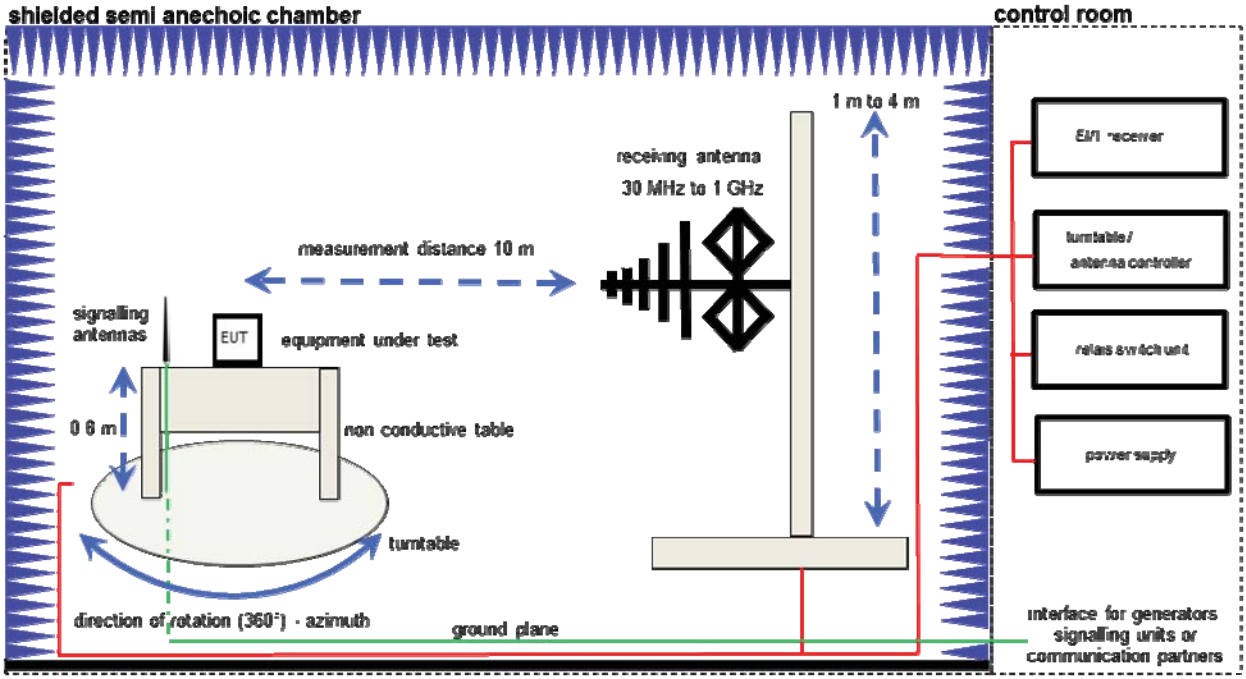
## 6 Test laboratories sub-contracted

None

# 7 Description of the test setup

## 7.1 Radiated measurements chamber F

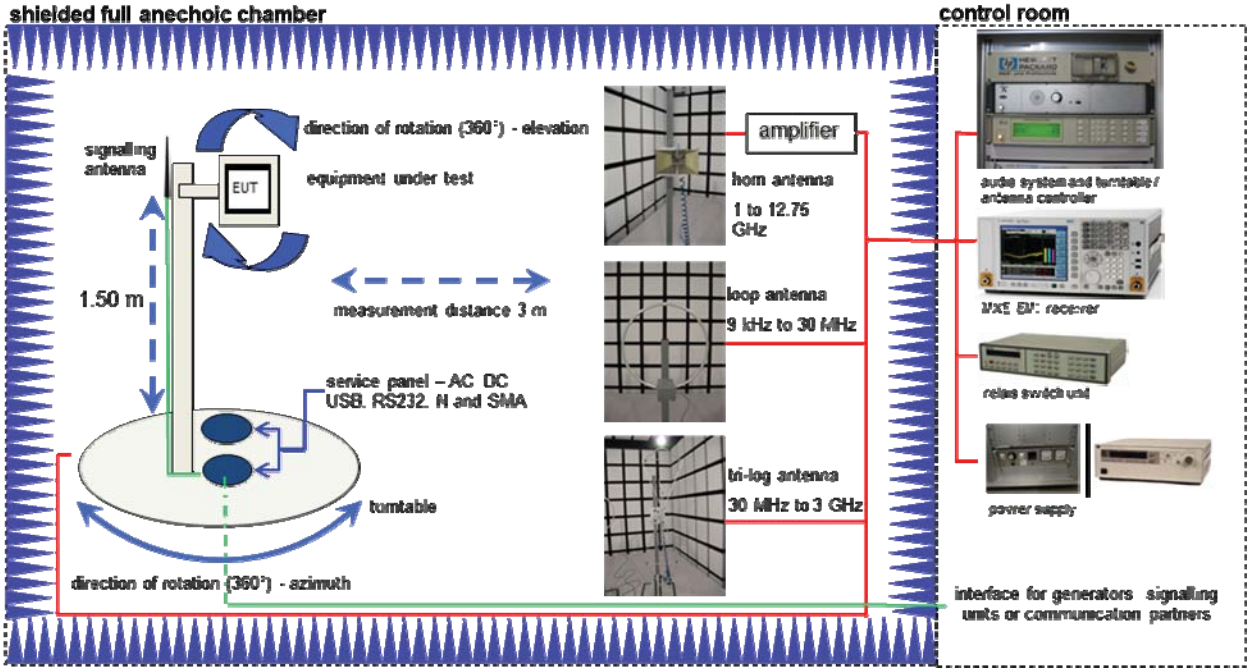
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.




**Equipment table:**

| Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom |
|---|---|---|---|---|
| Switch-Unit | 3488A | HP Meßtechnik | 2719A14505 | 300000368 |
| DC power supply, 60Vdc, 50A, 1200 W | 6032A | HP Meßtechnik | 2920A04466 | 300000580 |
| EMI Test Receiver | ESCI 3 | R&S | 100083 | 300003312 |
| Amplifier | JS42-00502650-28-5A | MITEQ | 1084532 | 300003379 |
| Antenna Tower | Model 2175 | ETS-LINDGREN | 64762 | 300003745 |
| Positioning Controller | Model 2090 | ETS-LINDGREN | 64672 | 300003746 |
| Turntable Interface-Box | Model 105637 | ETS-LINDGREN | 44583 | 300003747 |
| TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck | 295 | 300003787 |
| CBT (Bluetooth Tester + EDR Signalling) | CBT 1153.9000K35, CBT-B55, CBT-K55 | R&S | 100313 | 300003516 |

## 7.2 Radiated measurements chamber C




**Equipment table:**

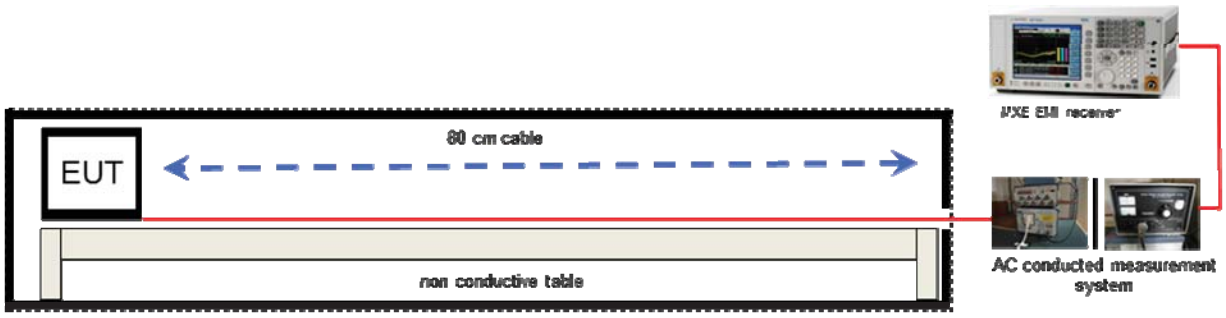
| Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom |
|---|---|---|---|---|
| MXE EMI Receiver 20 Hz bis 26,5 GHz | N9038A | Agilent Technologies | MY51210197 | 300004405 |
| TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck | 371 | 300003854 |
| Band Reject filter | WRCG2400/2483-2375/2505-50/10SS | Wainwright | 11 | 300003351 |
| Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 18 | 300003789 |
| Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO | 8812-3088 | 300001032 |
| Active Loop Antenna | 6502 | EMCO | 8905-2342 | 300000256 |
| Anechoic chamber | FAC 3/5m | MWB / TDK | 87400/02 | 300000996 |
| Switch / Control Unit | 3488A | HP Meßtechnik | * | 300000199 |
| Switch / Control Unit | 3488A | HP Meßtechnik | 2719A15013 | 300001156 |
| Isolating Transformer | MPL IEC625 Bus Regeltrenntravo | Erfi | 91350 | 300001155 |
| Three-Way Power Splitter, 50 Ohm | 11850C | HP Meßtechnik | | 300000997 |
| Amplifier | js42-00502650-28-5a | Parzich GMBH | 928979 | 300003143 |
| CBT (Bluetooth Tester + EDR Signalling) | CBT 1153.9000K35, CBT-B55, CBT-K55 | R&S | 100313 | 300003516 |

## 7.3 Radiated measurements 12.75 GHz to 25 GHz


**Equipment table:**

| Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom |
|---|---|---|---|---|
| Std. Gain Horn Antenna 12.4 to 18.0 GHz | 639 | Narda | 8402 | 300000787 |
| Std. Gain Horn Antenna 18.0 to 26.5 GHz | 638 | Narda | 8205 | 300002442 |
| Microwave System Amplifier, 0.5-26.5 GHz | 83017A | HP Meßtechnik | 00419 | 300002268 |
| Spectrum Analyzer 20 Hz - 50 GHz | FSU50 | R&S | 200012 | 300003443 |
| Signal Analyzer 40 GHz | FSV40 | R&S | 101042 | 300004517 |
| CBT (Bluetooth Tester + EDR Signalling) | CBT 1153.9000K35, CBT-B55, CBT-K55 | R&S | 100313 | 300003516 |

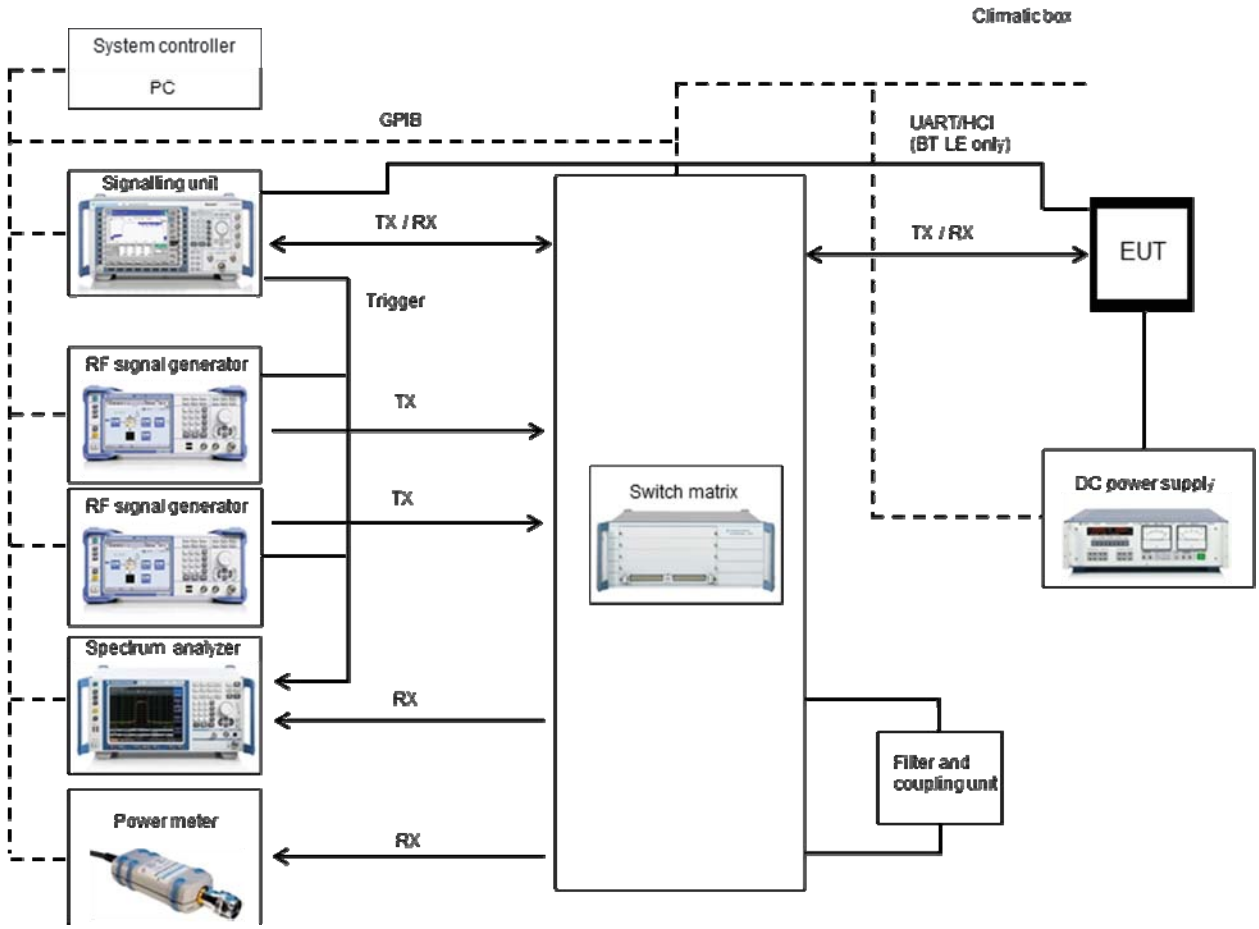
## 7.4 AC conducted




**Equipment table:**

| Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom |
|---|---|---|---|---|
| MXE EMI Receiver 20 Hz bis 26,5 GHz | N9038A | Agilent Technologies | MY51210197 | 300004405 |
| Isolating Transformer | MPL IEC625 Bus Regeltrenntravo | Erfi | 91350 | 300001155 |
| Switch / Control Unit | 3488A | HP Meßtechnik | * | 300000199 |
| Switch / Control Unit | 3488A | HP Meßtechnik | 2719A15013 | 300001168 |
| Artificial Mains 9 kHz to 30 MHz | ESH3-Z5 | R&S | 828576/020 | 300001210 |
| CBT (Bluetooth Tester + EDR Signalling) | CBT 1153.9000K35, CBT-B55, CBT-K55 | R&S | 100313 | 300003516 |

## 7.5 Conducted bluetooth test system




**Equipment table:**

| Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom |
|---|---|---|---|---|
| Vector Signal Generator, 300 kHz to 2.2 GHz | SMIQ03B | R&S | 835541/055 | 300002681-0001 |
| Switch / Control Unit | 3488A | HP Meßtechnik | | 300001691 |
| Power Supply DC | NGPE 40/40 | R&S | 388 | 400000078 |
| Spectrum Analyzer 9kHz to 30GHz -140..+30dBm | Spectrum Analyzer 9kHz to 30GHz -140..+30dBm | Spectrum Analyzer 9kHz to 30GHz -140..+30dBm | Spectrum Analyzer 9kHz to 30GHz -140..+30dBm | Spectrum Analyzer 9kHz to 30GHz -140..+30dBm |
| FSP30 | FSP30 | FSP30 | FSP30 | FSP30 |

## 8 Summary of measurement results

| | |
|---|---|
| ☒ | **No deviations from the technical specifications were ascertained** |
| ☐ | There were deviations from the technical specifications ascertained |

| TC Identifier | Description | Verdict | Date | Remark |
|---|---|---|---|---|
| RF-Testing | CFR Part 15<br>RSS 210, Issue 8, Annex 8 | Passed | 2014-05-19 | -/- |

| Test specification clause | Test case | Temperature conditions | Power source voltages | Mode | Pass | Fail | NA | NP | Remark |
|---|---|---|---|---|---|---|---|---|---|
| §15.247(b)(4)<br>RSS 210 /<br>A8.4(2) | Antenna gain | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(e)<br>RSS 210 /<br>A8.2(b) | Power spectral density | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☐ | ☐ | ☒ | ☐ | Not applicable for FHSS! |
| §15.247(a)(1)<br>RSS 210 /<br>A8.1(b) | Carrier frequency separation | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(a)(1)<br>RSS 210 /<br>A8.1(d) | Number of hopping channels | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(a)(1)<br>(iii)<br>RSS 210 /<br>A8.3(1) | Time of occupancy (dwell time) | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(a)(1)<br>RSS 210 /<br>A8.2(a) | Spectrum bandwidth of a FHSS system 20dB bandwidth | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒<br>☒<br>☒ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | complies |
| §15.247(b)(1)<br>RSS-210 /<br>A8.4(2) | Maximum output power | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒<br>☒<br>☒ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | complies |
| §15.247(d)<br>RSS-210 / A8.5 | Band edge compliance conducted | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒<br>☒<br>☒ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | complies |
| §15.205<br>RSS-210 / A8.5 | Band edge compliance radiated | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒<br>☒<br>☒ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | complies |
| §15.247(d)<br>RSS-210 / A8.5 | TX spurious emissions conducted | Nominal | Nominal | GFSK<br>Pi/4 DQPSK<br>8 DPSK | ☒<br>☒<br>☒ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | ☐<br>☐<br>☐ | complies |
| §15.247(d)<br>RSS-210 / A8.5 | TX spurious emissions radiated | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.109<br>RSS-Gen | RX spurious emissions radiated | Nominal | Nominal | -/- | ☒ | ☐ | ☐ | ☐ | complies |
| §15.209(a)<br>RSS-Gen | TX spurious emissions radiated < 30 MHz | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |
| §15.107(a)<br>§15.207 | Conducted emissions < 30 MHz | Nominal | Nominal | GFSK | ☒ | ☐ | ☐ | ☐ | complies |

**Note:** NA = Not Applicable; NP = Not Performed

## 9 Additional comments

The Bluetooth® word mark and logos are owned by the Bluetooth SIG Inc. and any use of such marks by Cetecom ICT Services GmbH is under license.

Reference documents: None

Special test descriptions: None

Configuration descriptions: TX tests: were performed with x-DH5 packets and static PRBS pattern payload.
RX/Standby tests: BT test mode enabled, scan enabled, TX Idle

Test mode:

☒ Bluetooth Test mode loop back enabled
(EUT is controlled over CBT/CMU)

☐ Special software is used.
EUT is transmitting pseudo random data by itself

# 10 Measurement results

## 10.1 RF- Output power

**Measurement:**

Based on the conducted output power measured the E.I.R.P was calculated using the Gain information provided by the customer. To simplify the calculation a worst case antenna gain of 0.0 dBi was used instead of -1.2 dBi reported by the customer.

**Measurement parameters:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 3 MHz |
| Resolution bandwidth: | 3 MHz |
| Span: | 5 MHz |
| Trace-Mode: | Max hold |

**Limits:**

| FCC | IC |
|---|---|
| Maximum output power | |
| [Conducted: 0.125 W – antenna gain max. 6 dBi]<br>Systems using more than 75 hopping channels:<br>Conducted: 1.0 W – antenna gain max. 6 dBi | |

**Results:**

GFSK

| $T_{nom}$ | $V_{nom}$ | lowest channel 2402 MHz | middle channel 2441 MHz | highest channel 2480 MHz |
|---|---|---|---|---|
| Conducted power [dBm] Measured with GFSK modulation | | 0.23 | 2.53 | 3.5 |
| Gain [dBi]* | | 0.0 | 0.0 | 0.0 |
| Radiated power [dBm] Measured with GFSK modulation [calculated] | | 0.23 | 2.53 | 3.5 |

*provided by the customer.

Pi/4 DQPSK

| $T_{nom}$ | $V_{nom}$ | lowest channel 2402 MHz | middle channel 2441 MHz | highest channel 2480 MHz |
|---|---|---|---|---|
| Conducted power [dBm] Measured with Pi/4 DQPSK modulation | | -2.0 | -0.1 | -1.2 |
| Gain [dBi]* | | 0.0 | 0.0 | 0.0 |
| Radiated power [dBm] Measured with GFSK modulation [calculated] | | -2.0 | -0.1 | -1.2 |

*provided by the customer.

8 DPSK

| $T_{nom}$ | $V_{nom}$ | lowest channel 2402 MHz | middle channel 2441 MHz | highest channel 2480 MHz |
|---|---|---|---|---|
| Conducted power [dBm] Measured with 8 DPSK modulation | | -1.4 | -0.5 | 1.7 |
| Gain [dBi]* | | 0.0 | 0.0 | 0.0 |
| Radiated power [dBm] Measured with GFSK modulation [calculated] | | -1.4 | -0.5 | 1.7 |

*provided by the customer.

**Result:** **Passed**

## 10.2 Carrier frequency separation

**Description:**

Measurement of the carrier frequency separation of a hopping system. The carrier frequency separation is constant for all modulation-modes. We use GFSK-modulation to show compliance. EUT in hopping mode.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 100 kHz |
| Resolution bandwidth: | 100 kHz |
| Span: | 4 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Carrier Frequency Separation | |
| Minimum 25 kHz or two-thirds of the 20 dB bandwidth of the hopping system whichever is greater. | |

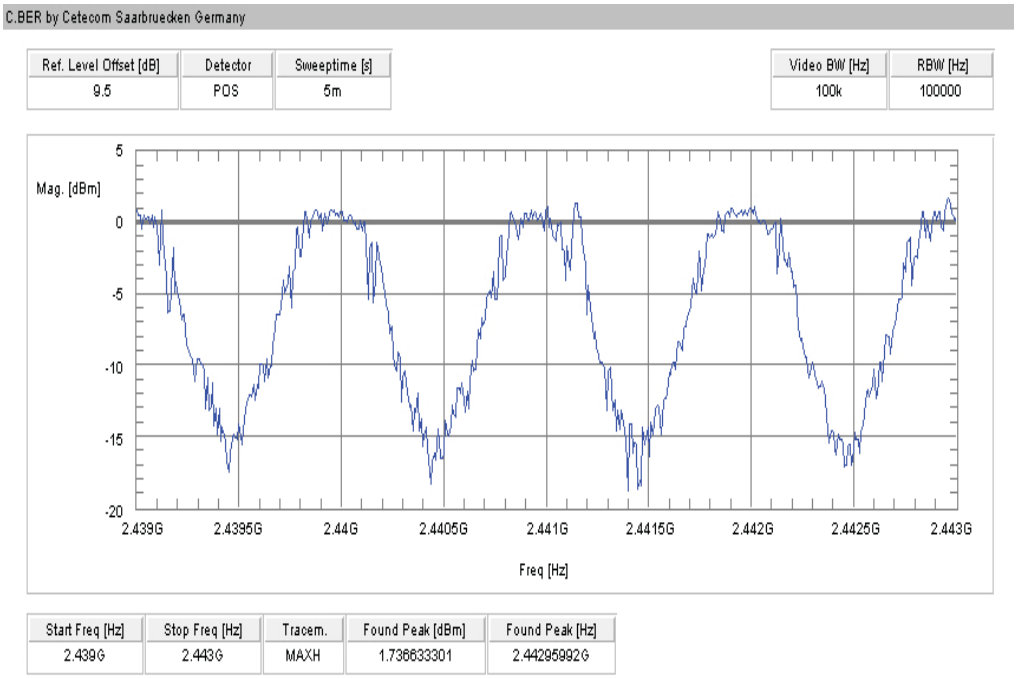
**Result:**

| | |
|---|---|
| Carrier frequency separation | ~ 1 MHz |

**Result:** Passed

**Plot:**

**Plot 1:** Carrier frequency separation (GFSK modulation)



## 10.3 Number of hopping channels

**Description:**

Measurement of the total number of used hopping channels. The number of hopping channels is constant for all modulation-modes. We use GFSK-modulation to show compliance. EUT in hopping mode.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 500 kHz |
| Resolution bandwidth: | 500 kHz |
| Span: | Plot 1: 2400 – 2445 MHz<br>Plot 2: 2445 – 2485 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Number of hopping channels | |
| At least 15 non overlapping hopping channels | |

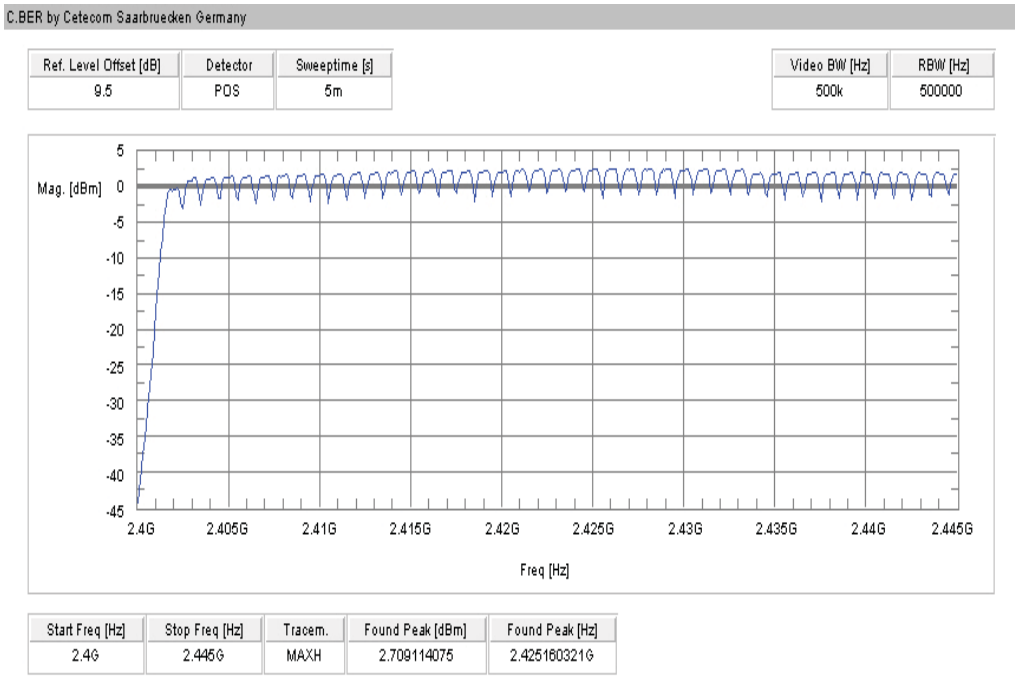
**Result:**

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

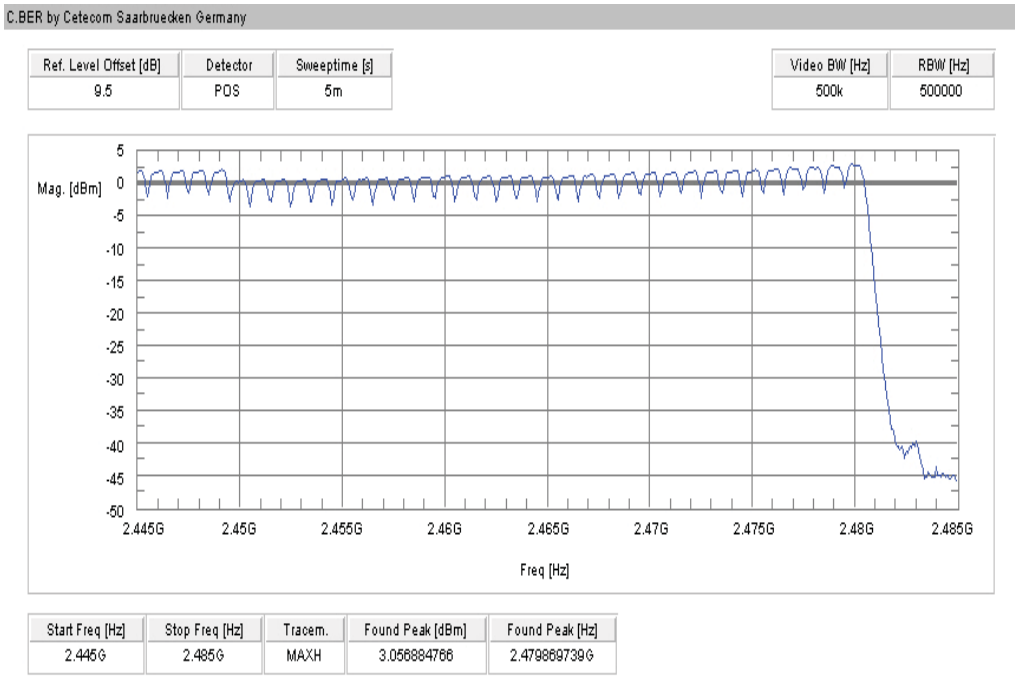
**Result:** Passed

**Plots:**

**Plot 1:** Number of hopping channels (GFSK modulation)




**Plot 2:** Number of hopping channels (GFSK modulation)



## 10.4 Time of occupancy (dwell time)

**Measurement:**

For Bluetooth® devices no measurements mandatory depending on the fixed requirements according to the Bluetooth® Core Specifications!

**For Bluetooth® devices:**

The channel staying time of 0.4 s within a 31.6 second period in data mode is constant for Bluetooth® devices and independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:

Channel staying time = time slot length * hop rate / number of hopping channels * 31.6 s

Example for a DH1 packet (with a maximum length of one time slot)
Channel staying time = 625 µs * 1600*1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

For multi-slot packets the hopping is reduced according to the length of the packet.

Example for a DH3 packet (with a maximum length of three time slots)
Channel staying time = 3 * 625 µs * 1600/3 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

Example for a DH5 packet (with a maximum length of five time slots)
Channel staying time = 5 * 625 µs * 1600/5 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

This is according the Bluetooth® Core Specification V2.0 & V2.1 & V3.0 & V4.0 (+ errata) for all Bluetooth® devices and all modulations.

**The following table shows the relations:**

| Packet Size | Pulse Width [ms] * | Max. number of transmissions per channel in 31.6 sec |
|---|---|---|
| DH1 | 0.366 | 640 |
| DH3 | 1.622 | 214 |
| DH5 | 2.870 | 128 |

* according Bluetooth® specification

**Results:**

| Packet Size | Pulse Width [ms]* | Max. number of transmissions in 31.6 sec | Dwell time [Pulse width * Number of transmissions] |
|---|---|---|---|
| DH1 | 0.366 | 640 | 234.2 ms |
| DH3 | 1.622 | 214 | 347.1 ms |
| DH5 | 2.870 | 128 | 367.4 ms |

**Limits:**

| FCC | IC |
|---|---|
| Time of occupancy (dwell time) | |
| The frequency hopping operation shall have an average time of occupancy on any frequency not exceeding 0.4 seconds within a duration in seconds equal to the number of hopping frequencies multiplied by 0.4. | |

**Result:** Passed

## 10.5 Spectrum bandwidth of a FHSS system – 99 % bandwidth

**Description:**

Measurement of the 20dB bandwidth of the modulated signal. The measurement is performed according to the "Measurement Guidelines" (DA 00-705, March 30, 2000). EUT in single channel mode.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 30 kHz |
| Resolution bandwidth: | 30 kHz |
| Span: | 6 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Spectrum bandwidth of a FHSS system – 99% bandwidth | |
| GFSK < 1500 kHz<br>Pi/4 DQPSK < 1500 kHz<br>8DPSK < 1500 kHz | |

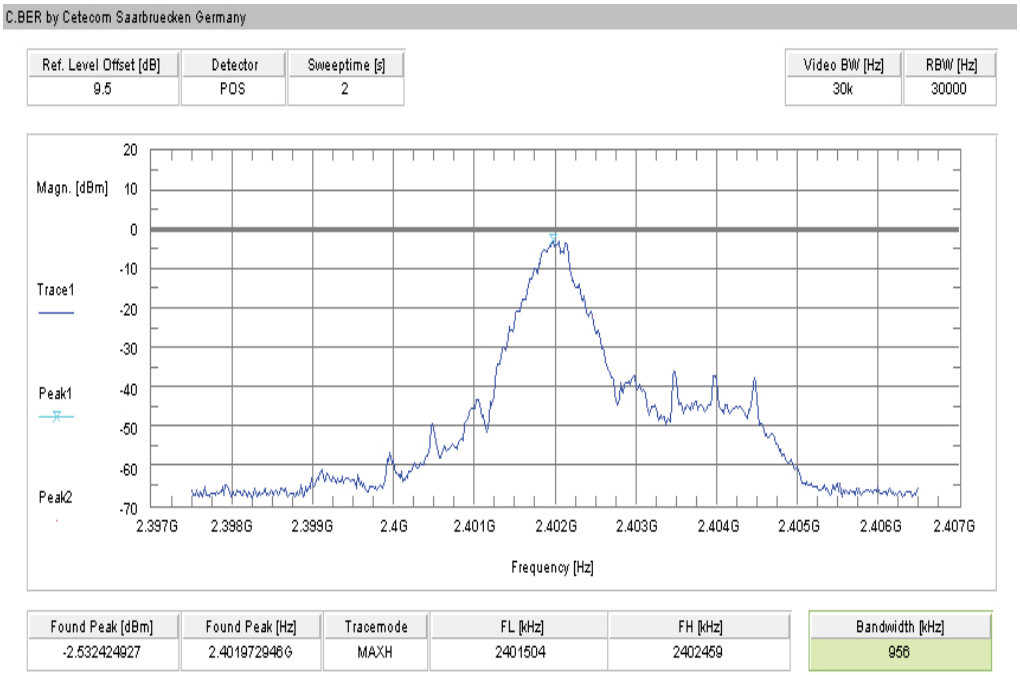
**Results:**

| Modulation | 99 % bandwidth [kHz] | | |
|---|---|---|---|
| Frequency | 2402 MHz | 2441 MHz | 2480 MHz |
| GFSK | 956 | 938 | 938 |
| Pi/4 DQPSK | 1244 | 1244 | 1244 |
| 8DPSK | 1244 | 1263 | 1263 |
| Measurement uncertainty | ± 30 kHz | | |

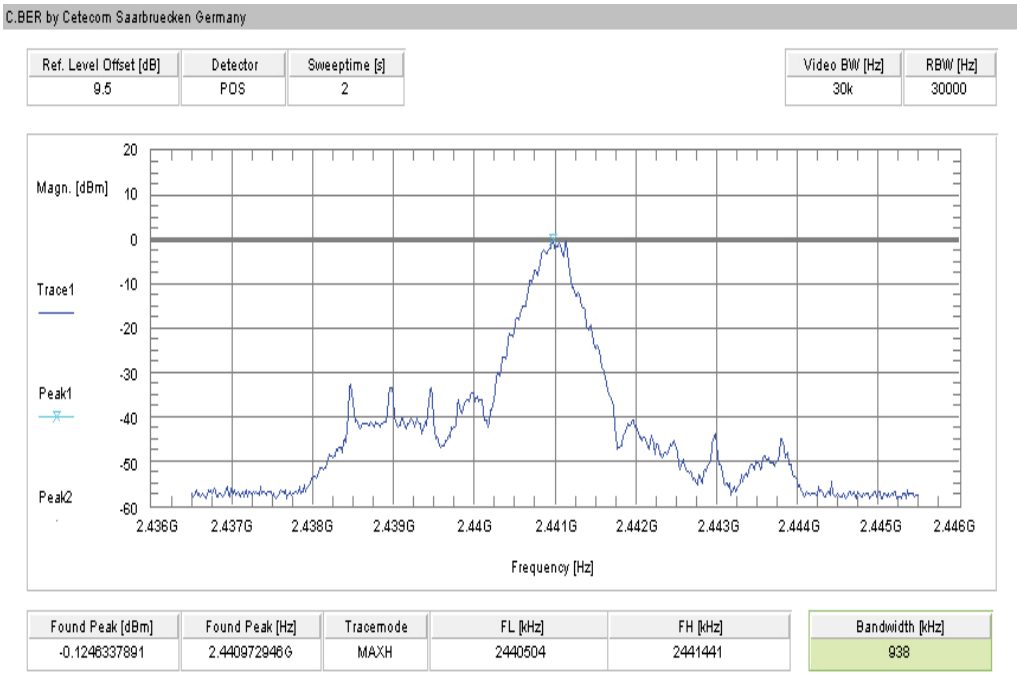
**Result:** Passed

**Plots:**

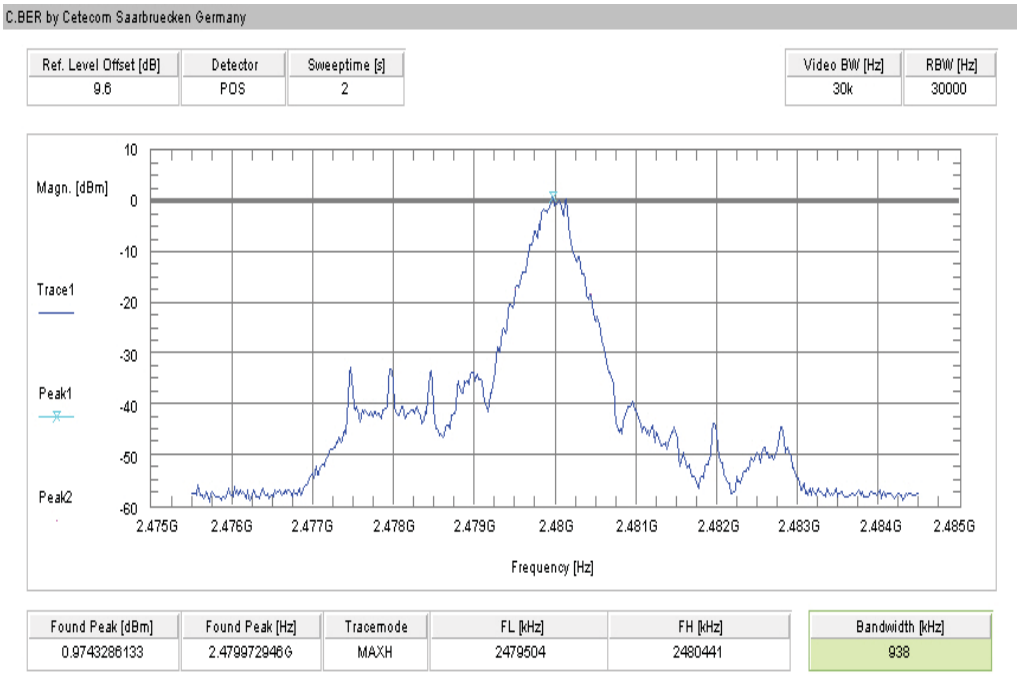
**Plot 1:** lowest channel – 2402 MHz, GFSK modulation



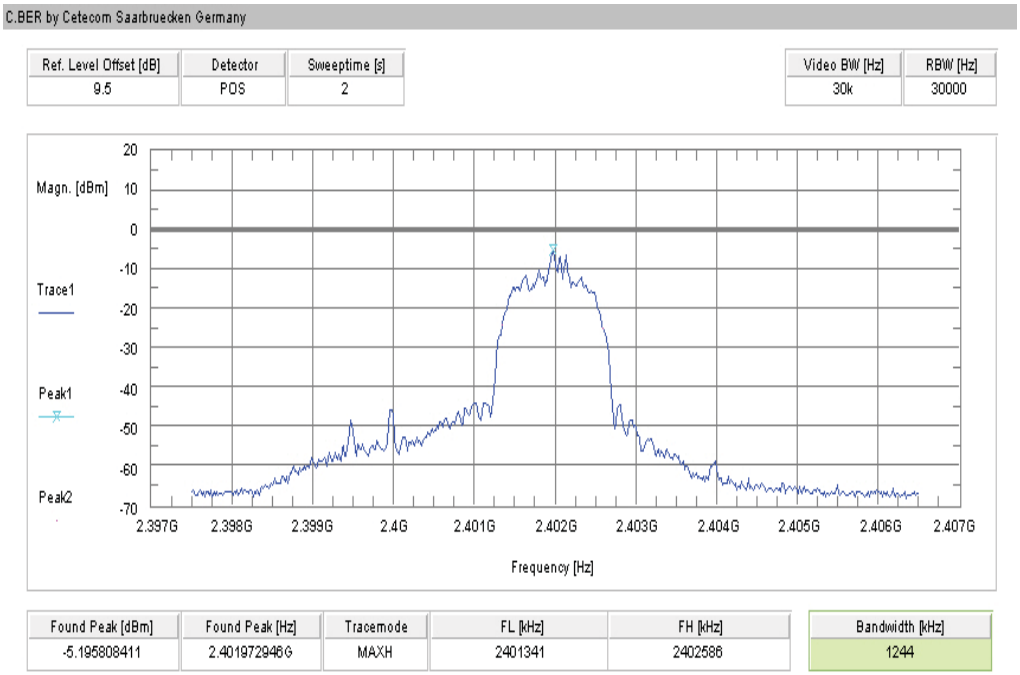

**Plot 2:** middle channel – 2441 MHz, GFSK modulation



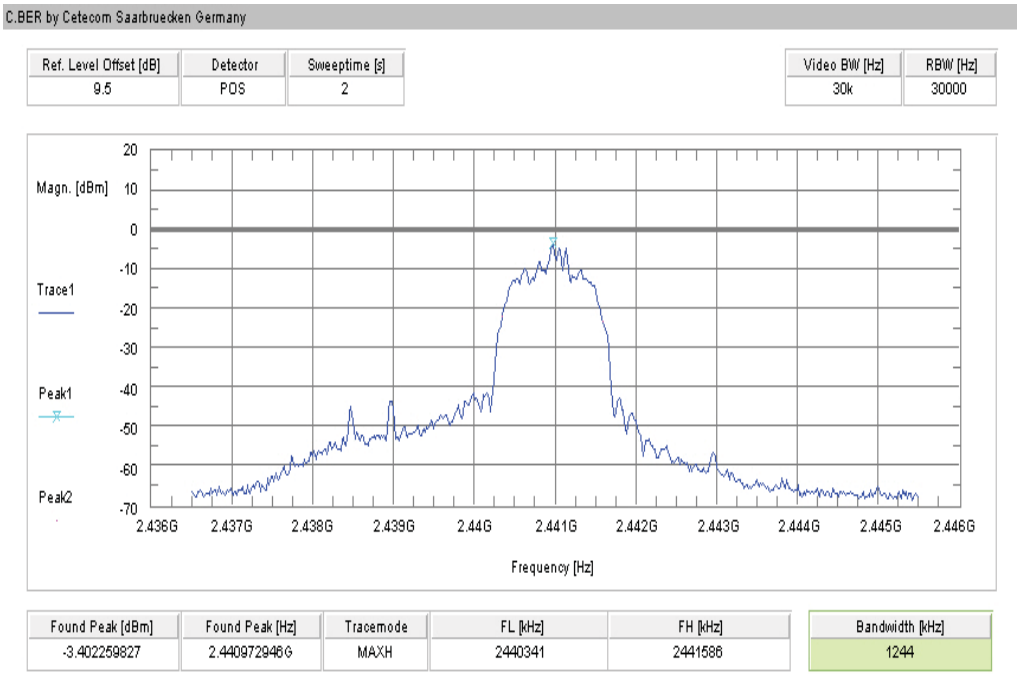
**Plot 3:** highest channel – 2480 MHz, GFSK modulation



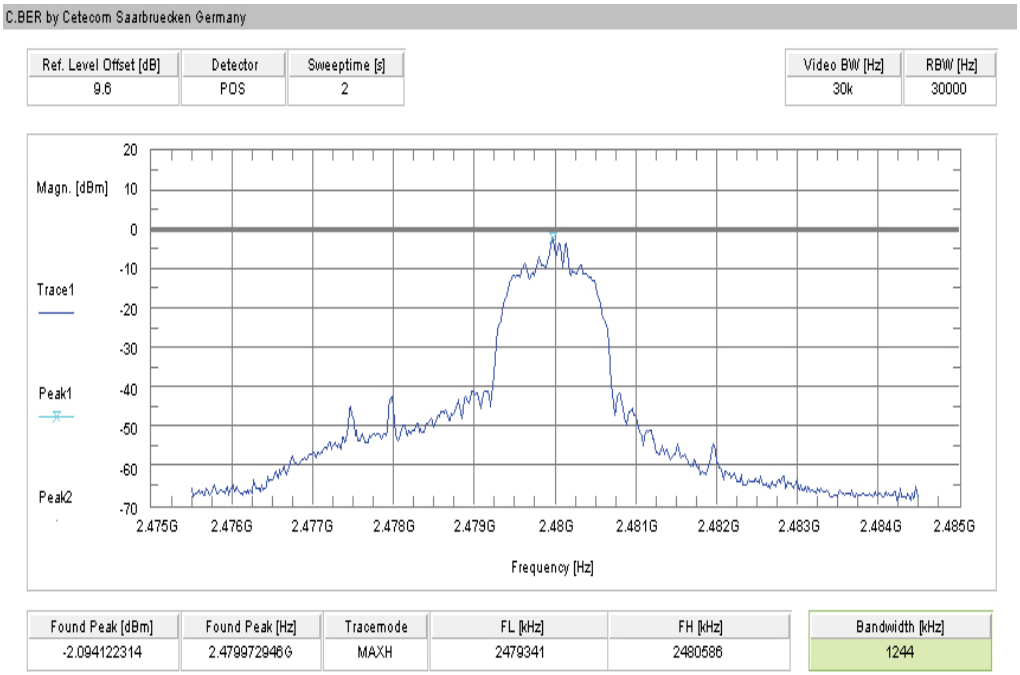

**Plot 4:** lowest channel – 2402 MHz, Pi / DQPSK modulation



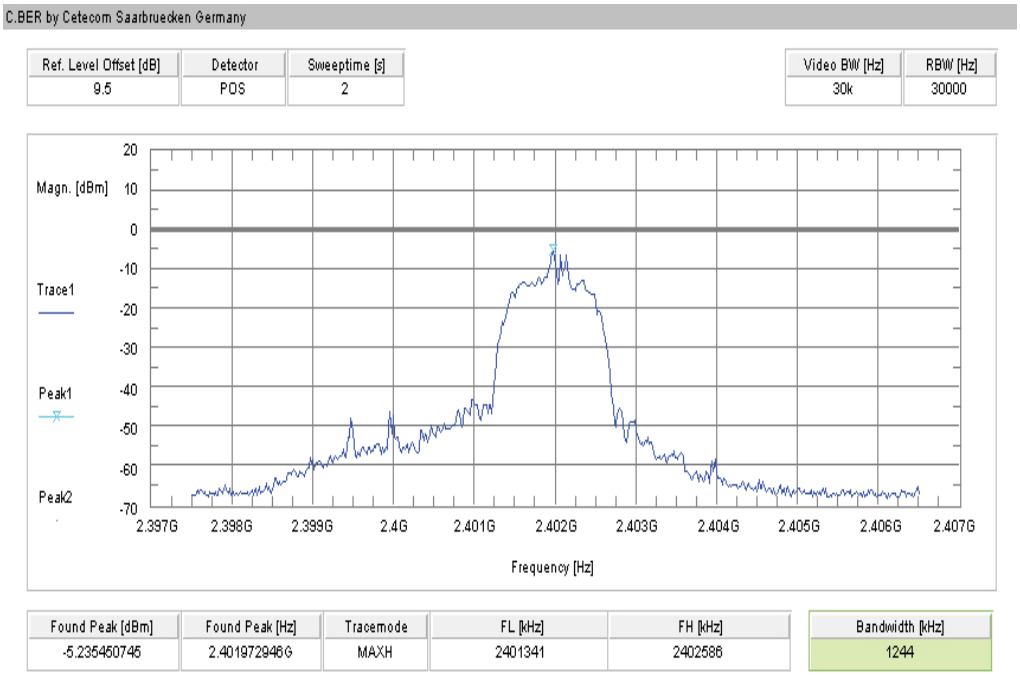
**Plot 5:** middle channel – 2441 MHz, Pi / DQPSK modulation



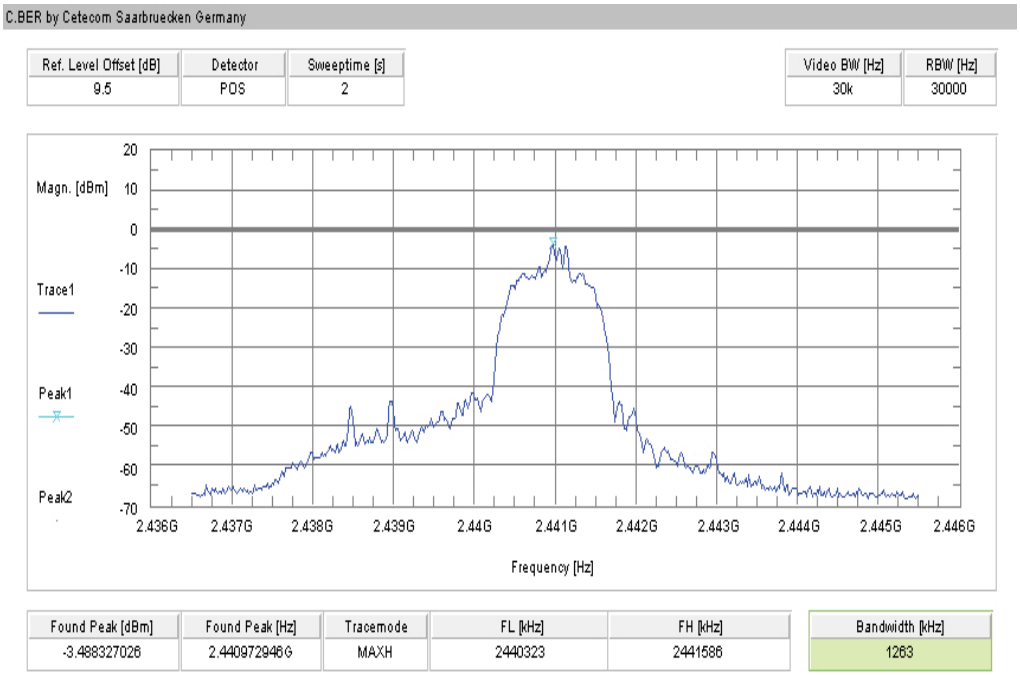

**Plot 6:** highest channel – 2480 MHz, Pi / DQPSK modulation



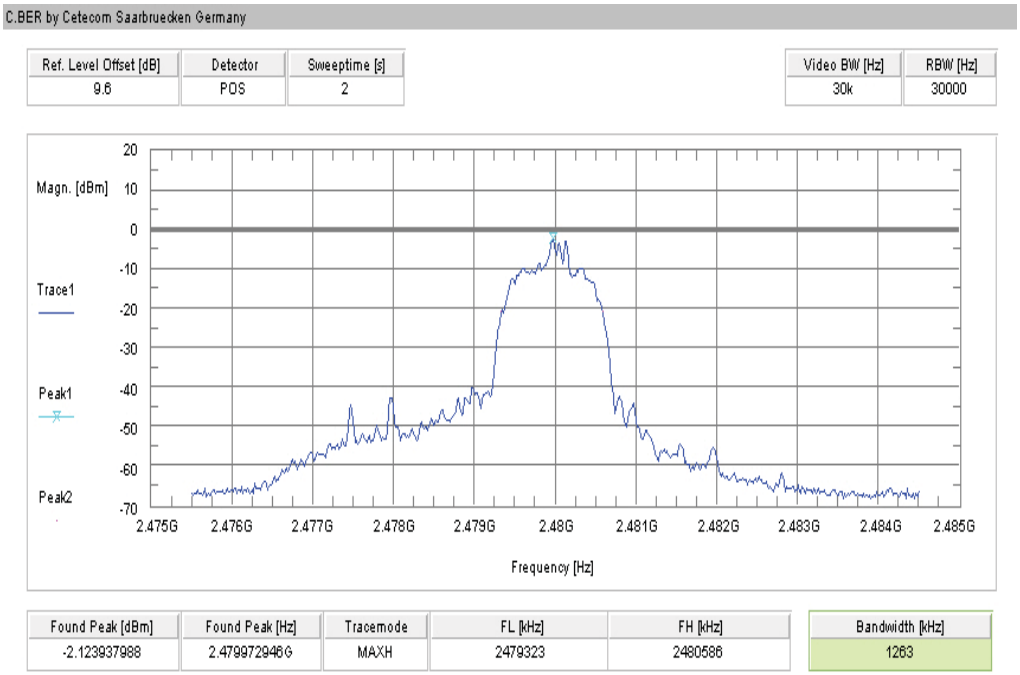
**Plot 7:** lowest channel – 2402 MHz, 8 DPSK modulation




**Plot 8:** middle channel – 2441 MHz, 8 DPSK modulation



**Plot 9:** highest channel – 2480 MHz, 8 DPSK modulation



## 10.6 Maximum output power

**Description:**

Measurement of the maximum output power conducted and radiated. EUT in single channel mode.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 3 MHz |
| Resolution bandwidth: | 3 MHz |
| Span: | 5 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Maximum output power | |
| [Conducted: 0.125 W – antenna gain max. 6 dBi]<br>Systems using more than 75 hopping channels:<br>Conducted: 1.0 W – antenna gain max. 6 dBi | |

**Results:**

| Modulation | Maximum output power conducted [dBm] | | |
|---|---|---|---|
| Frequency | 2402 MHz | 2441 MHz | 2480 MHz |
| GFSK | 0.2 | 2.5 | 3.5 |
| Pi/4 DQPSK | -2.0 | -0.1 | 1.2 |
| 8DPSK | 1.3 | 0.5 | 1.7 |
| Measurement uncertainty | ± 1 dB | | |

**Result:** Passed

**Results:**

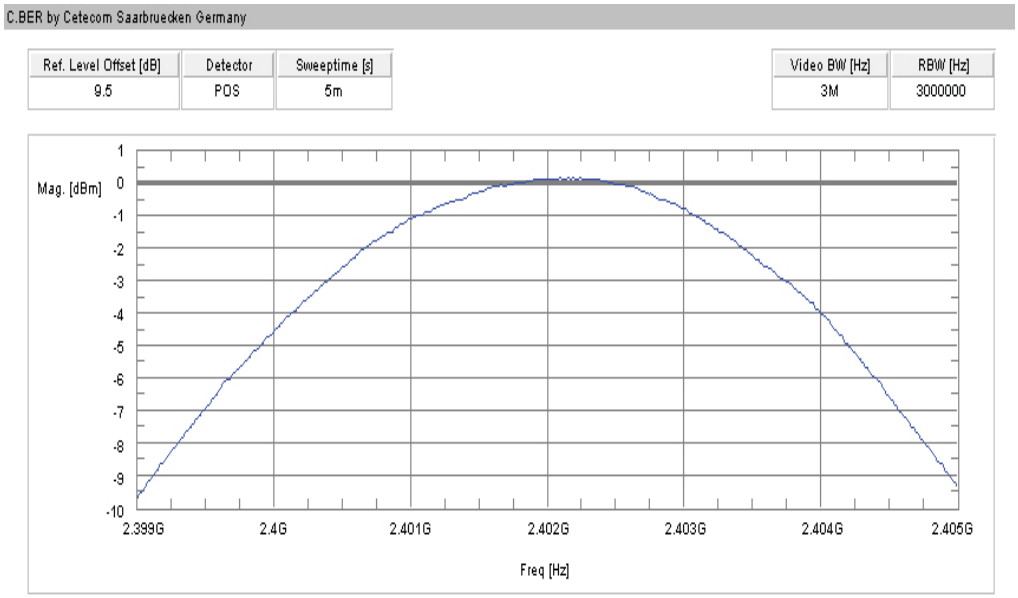
| Modulation | Maximum output power radiated - EIRP [dBm] | | |
|---|---|---|---|
| Frequency | 2402 MHz | 2441 MHz | 2480 MHz |
| GFSK *) | 0.2 | 2.5 | 3.5 |
| Pi/4 DQPSK *) | -2.0 | -0.1 | 1.2 |
| 8DPSK *) | 1.3 | 0.5 | 1.7 |
| Measurement uncertainty | ± 3 dB | | |

*) - Values calculated with antenna gain provided by customer. (0dBi)

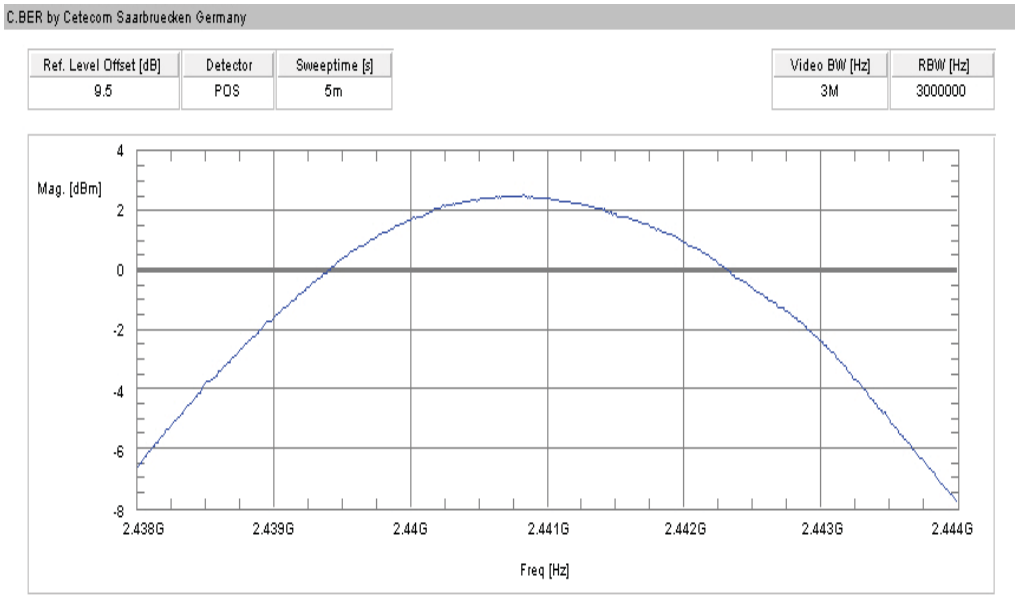
**Result:** Passed

**Plots:**

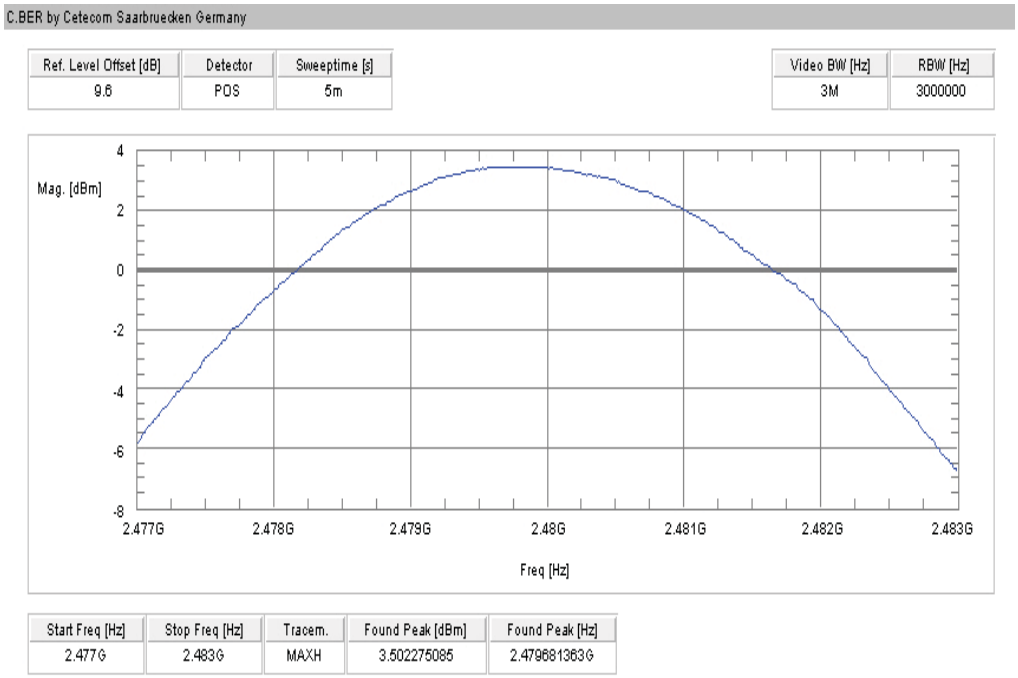
**Plot 1:** lowest channel – 2402 MHz, GFSK modulation



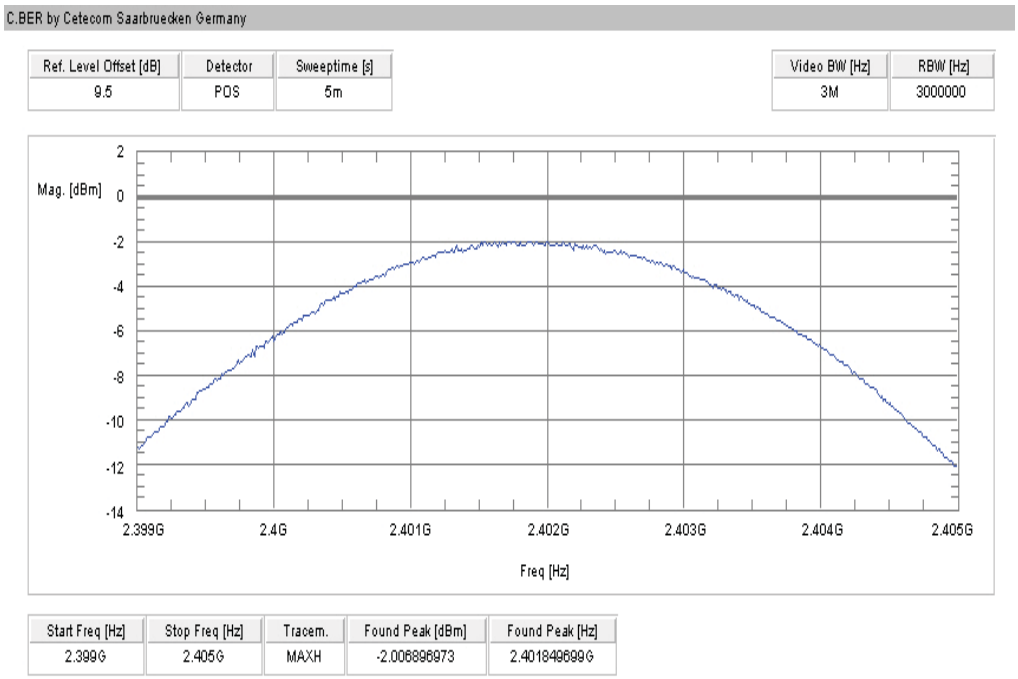

**Plot 2:** middle channel – 2441 MHz, GFSK modulation



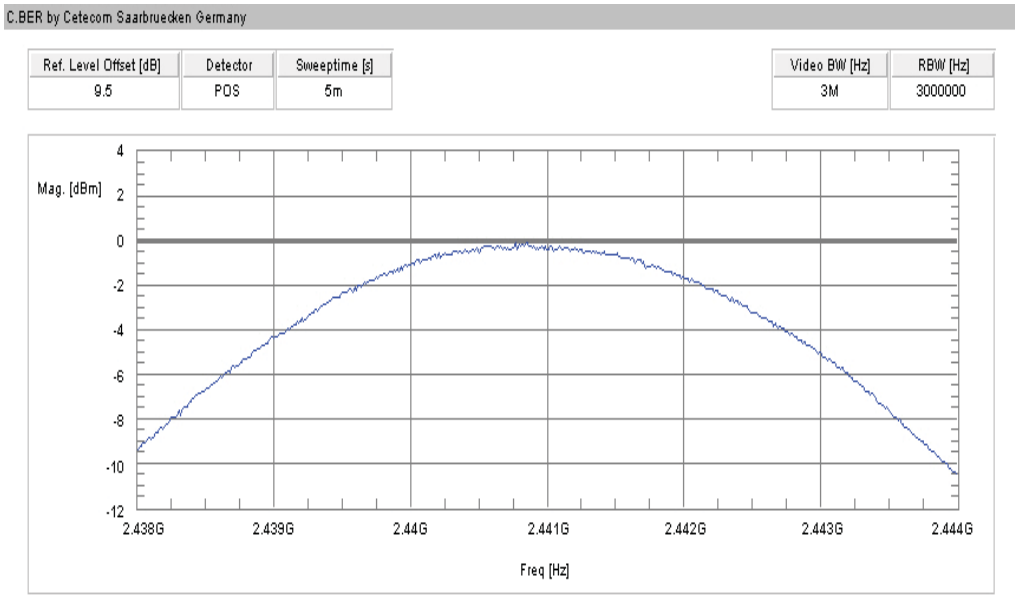
**Plot 3:** highest channel – 2480 MHz, GFSK modulation



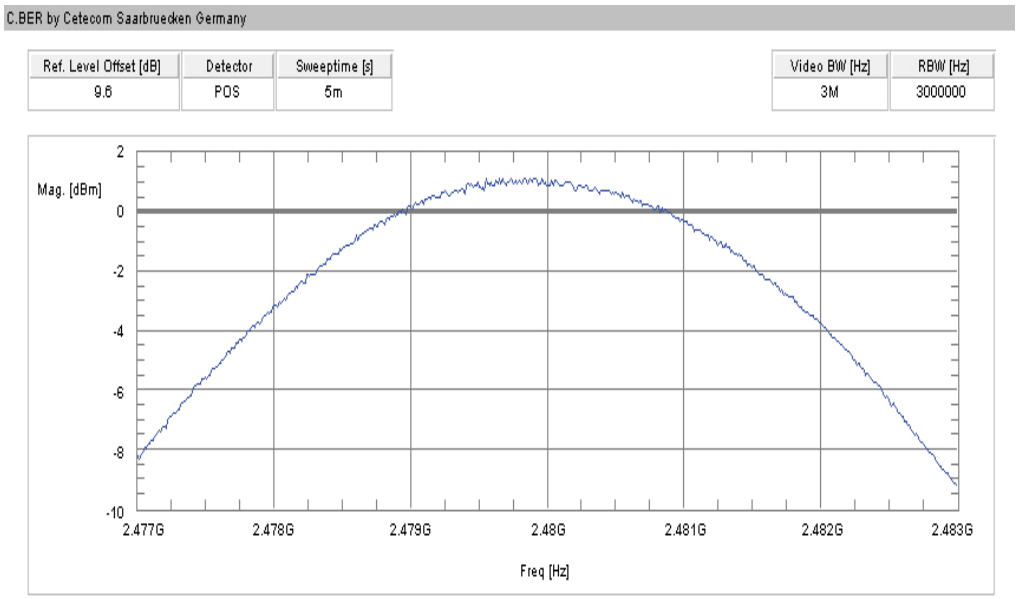

**Plot 4:** lowest channel – 2402 MHz, Pi / DQPSK modulation



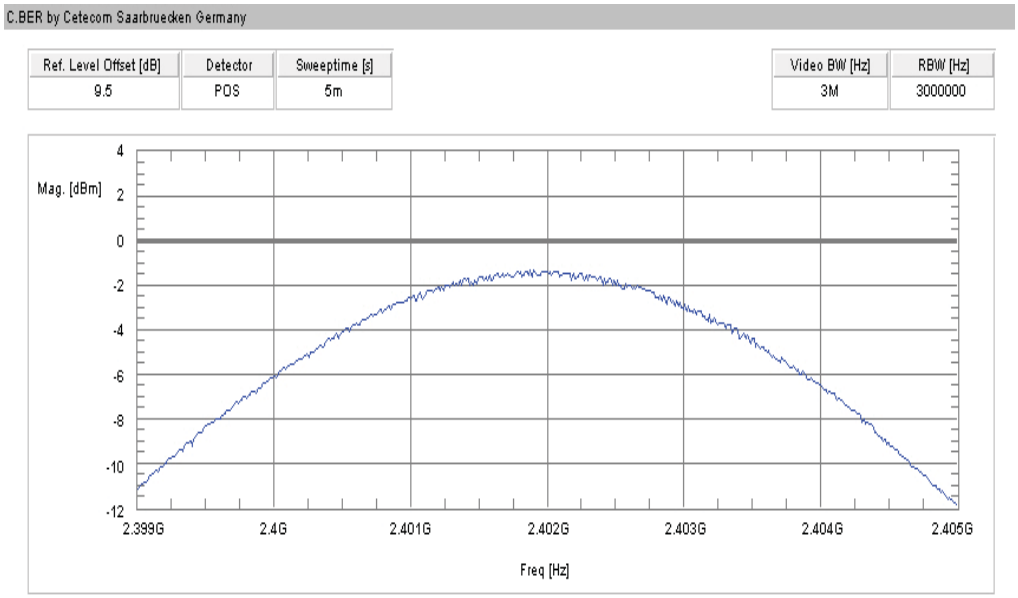
**Plot 5:** middle channel – 2441 MHz, Pi / DQPSK modulation



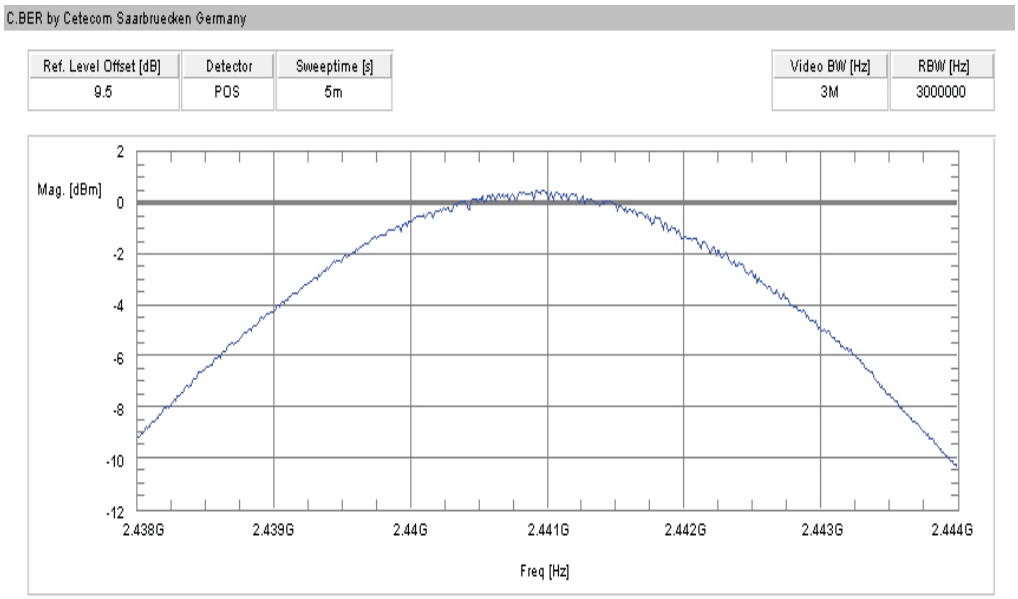

**Plot 6:** highest channel – 2480 MHz, Pi / DQPSK modulation



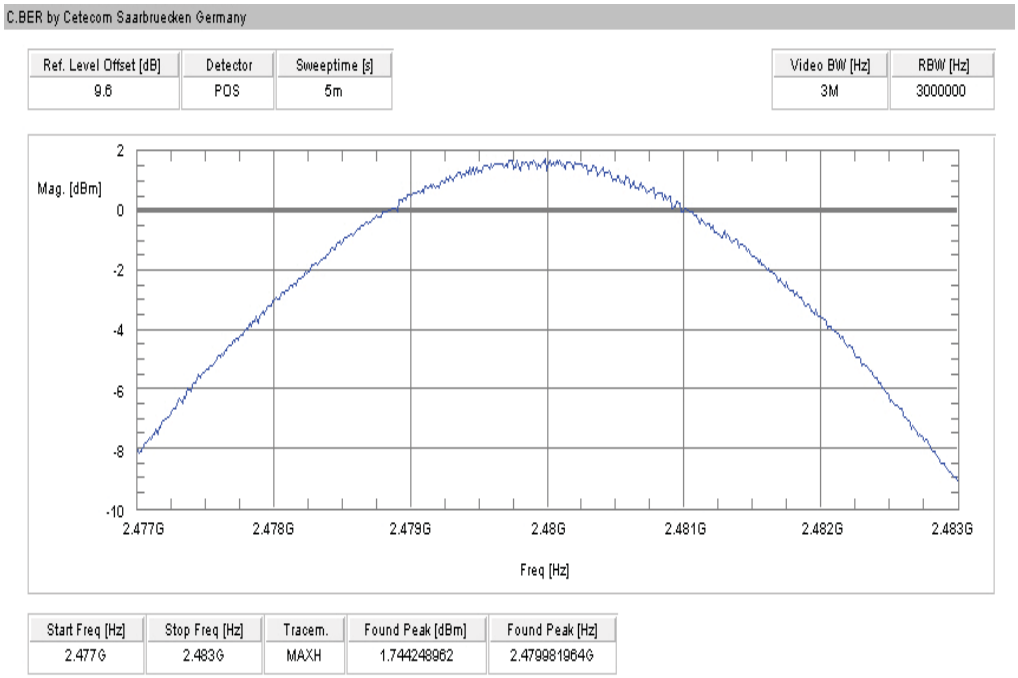
**Plot 7:** lowest channel – 2402 MHz, 8 DPSK modulation




**Plot 8:** middle channel – 2441 MHz, 8 DPSK modulation



**Plot 9:** highest channel – 2480 MHz, 8 DPSK modulation



## 10.7 Band edge compliance conducted

**Description:**

Measurement of the conducted band edge compliance. EUT is measured at the lower and upper band edge in single channel and hopping mode. The measurement is repeated for all modulations.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 100 kHz |
| Resolution bandwidth: | 100 kHz |
| Span: | Lower Band Edge: 2395 – 2405 MHz<br>Upper Band Edge: 2478 – 2489 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Band edge compliance conducted | |
| 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. Attenuation below the general limits specified in Section 15.209(a) is not required. | |

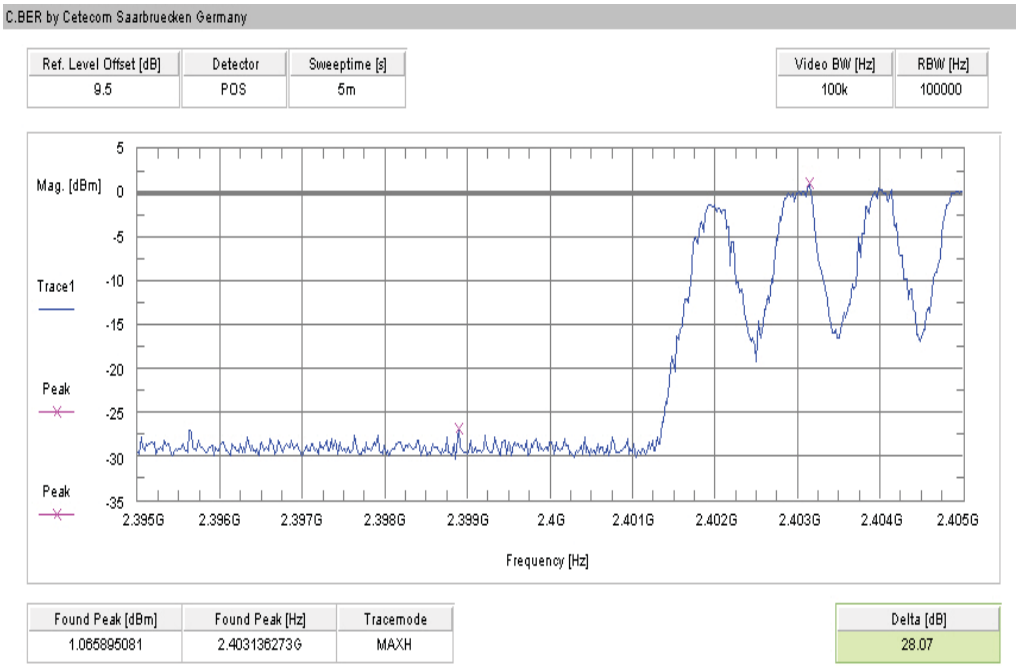
**Results:**

| Scenario | Band edge compliance conducted [dB] | | |
|---|---|---|---|
| Modulation | GFSK | Pi/4 DQPSK | 8DPSK |
| Lower band edge – hopping off | > 20 dB | > 20 dB | > 20 dB |
| Lower band edge – hopping on | > 20 dB | > 20 dB | > 20 dB |
| Upper band edge – hopping off | > 20 dB | > 20 dB | > 20 dB |
| Upper band edge – hopping on | > 20 dB | > 20 dB | > 20 dB |
| Measurement uncertainty | ± 1.5 dB | | |

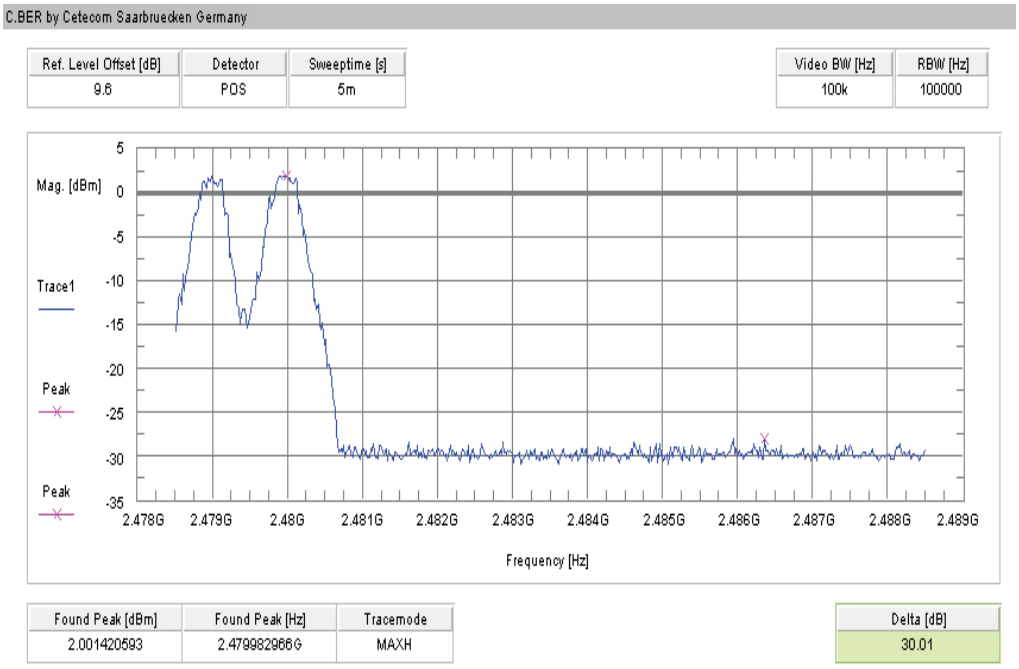
**Result:** Passed

**Plots:**

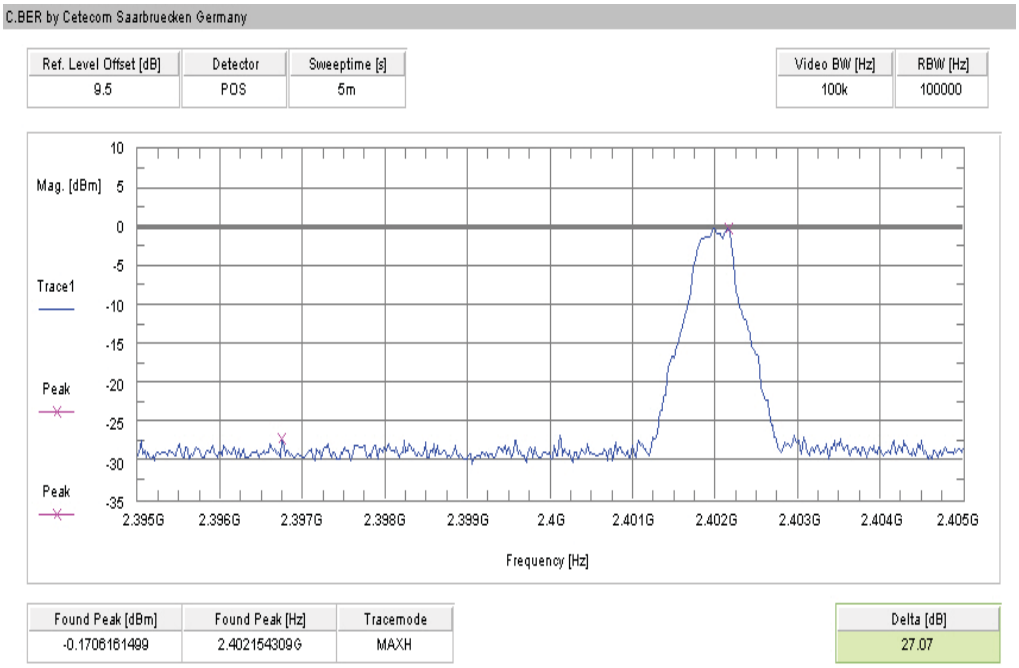
**Plot 1:** Lower band edge – hopping on, GFSK modulation



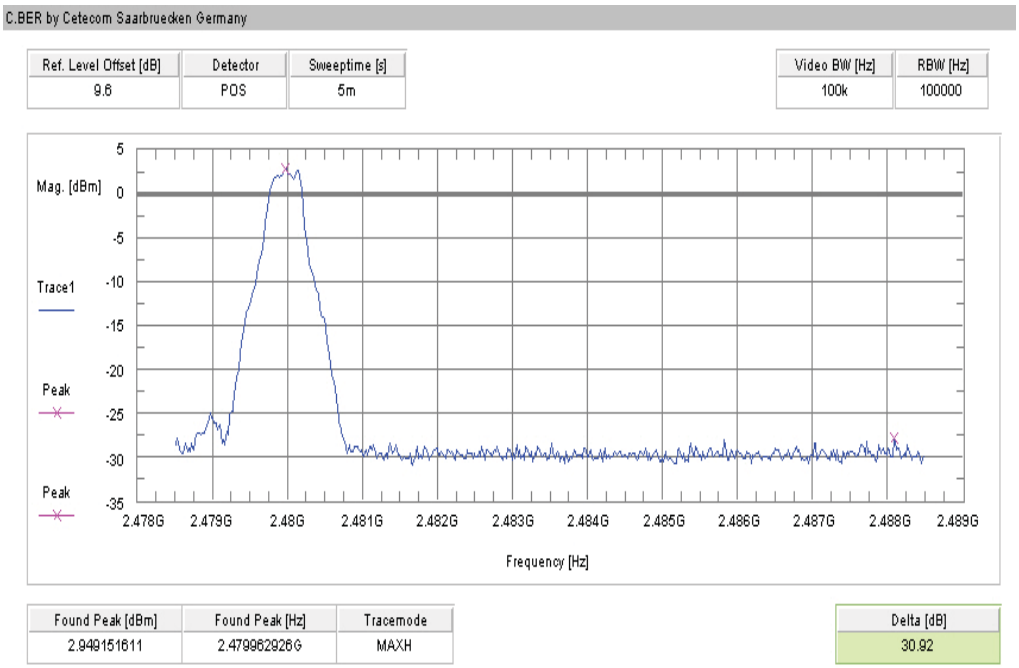

**Plot 2:** Upper band edge – hopping on, GFSK modulation



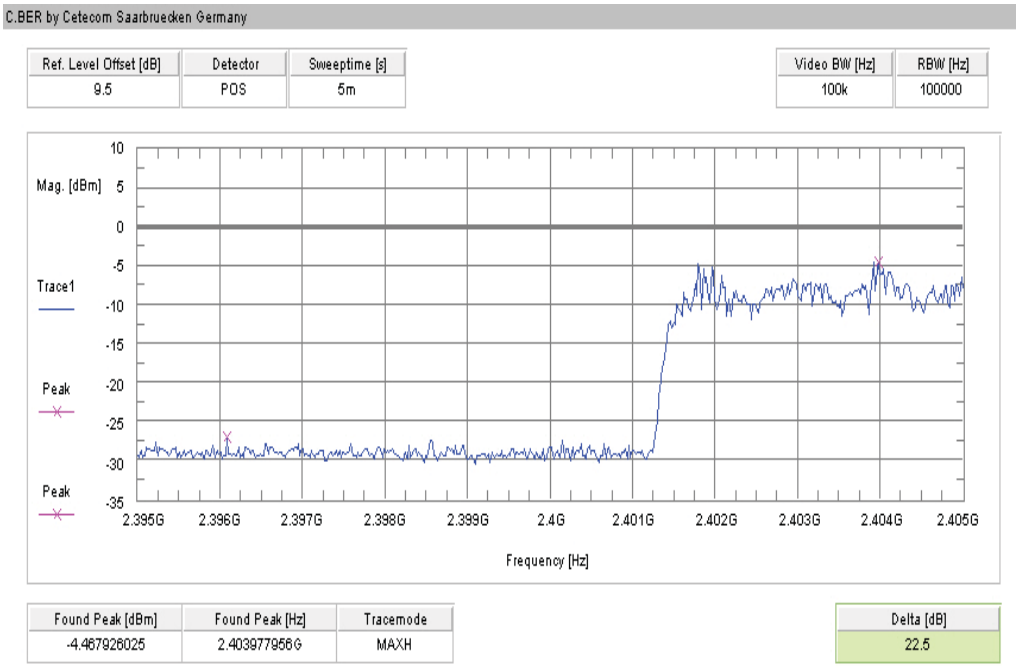
**Plot 3:** Lower band edge – hopping off, GFSK modulation



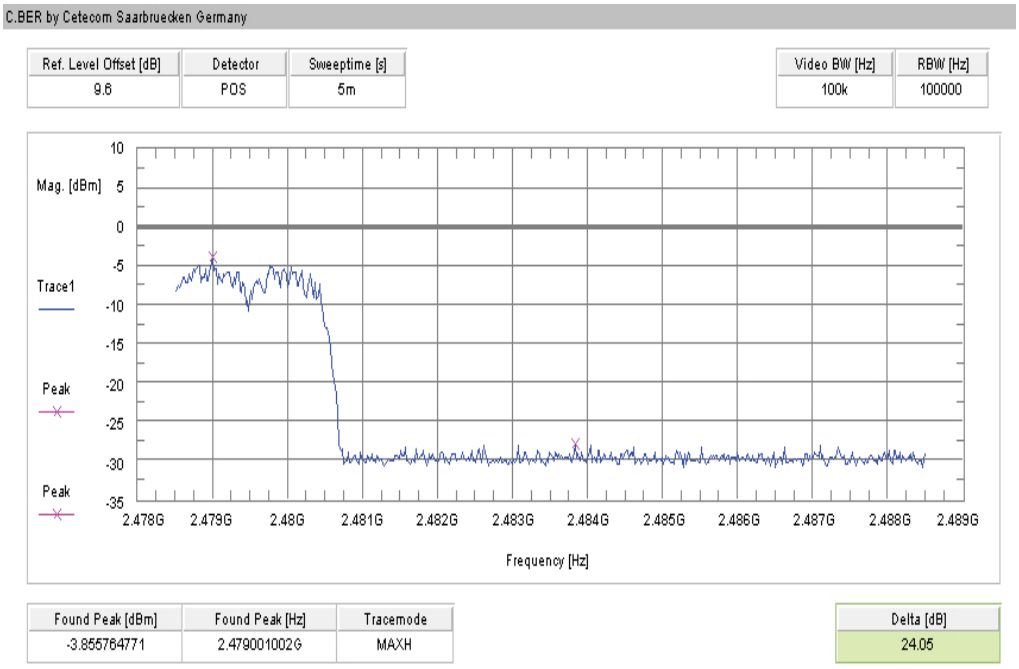

**Plot 4:** Upper band edge – hopping off, GFSK modulation



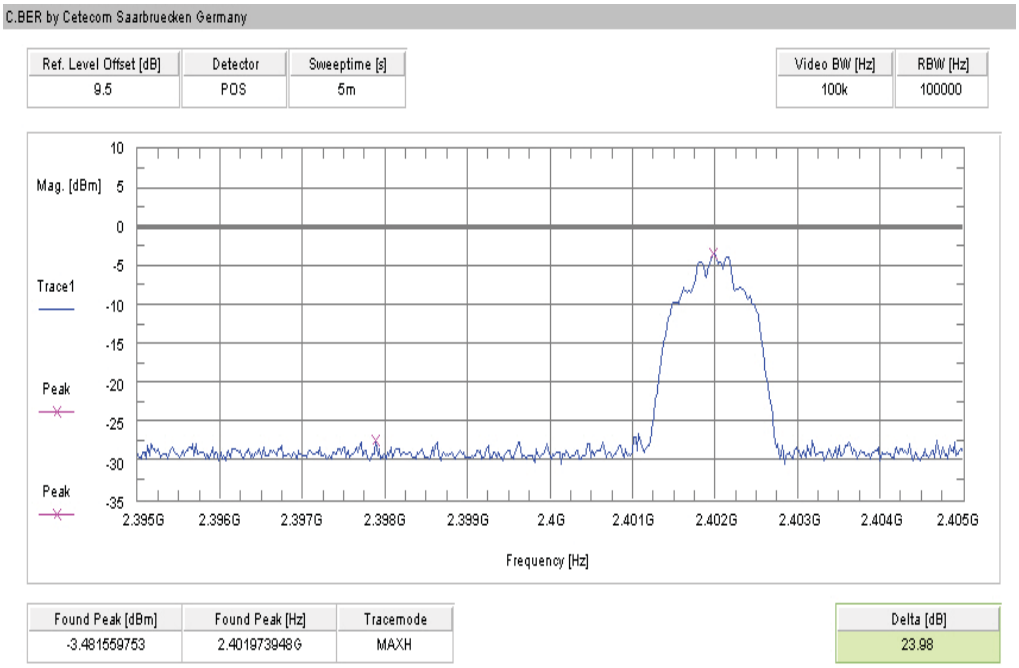
**Plot 5:** Lower band edge – hopping on, Pi/4 DQPSK modulation



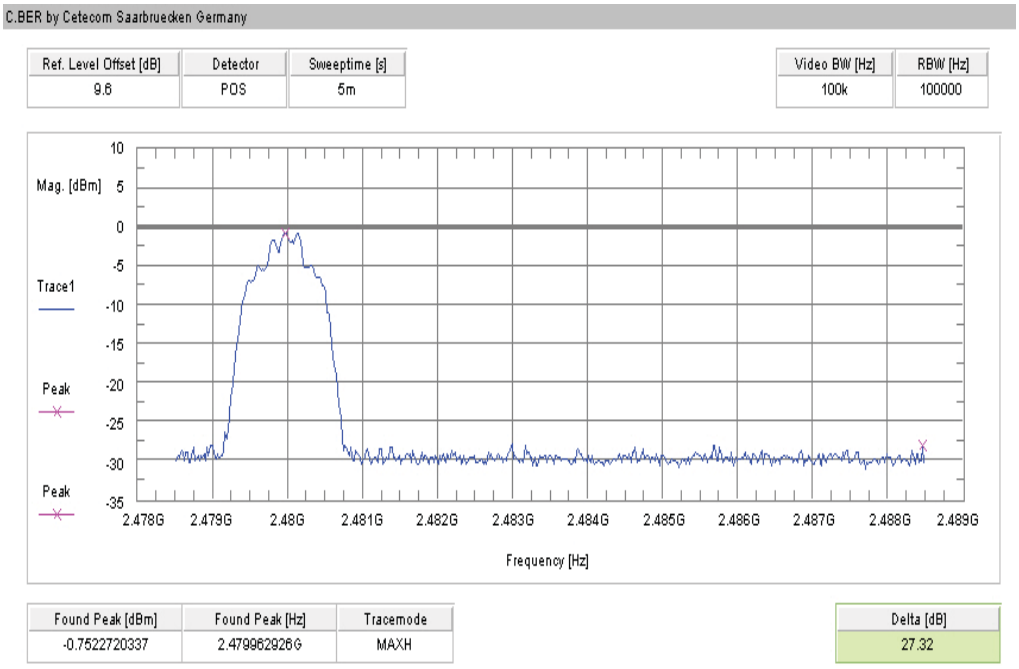

**Plot 6:** Upper band edge – hopping on, Pi/4 DQPSK modulation



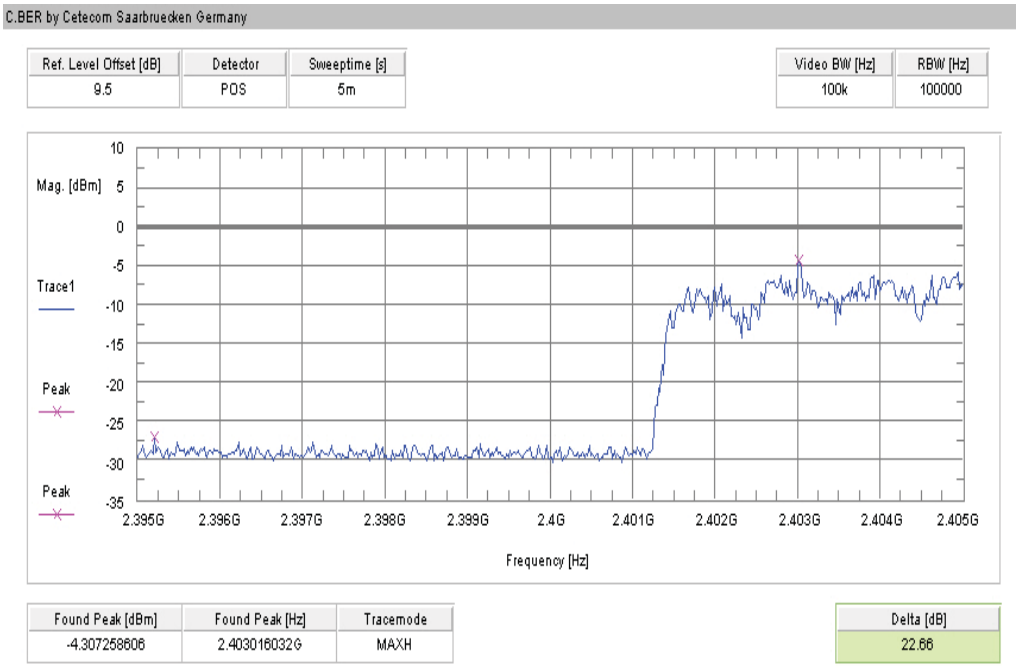
**Plot 7:** Lower band edge – hopping off, Pi/4 DQPSK modulation



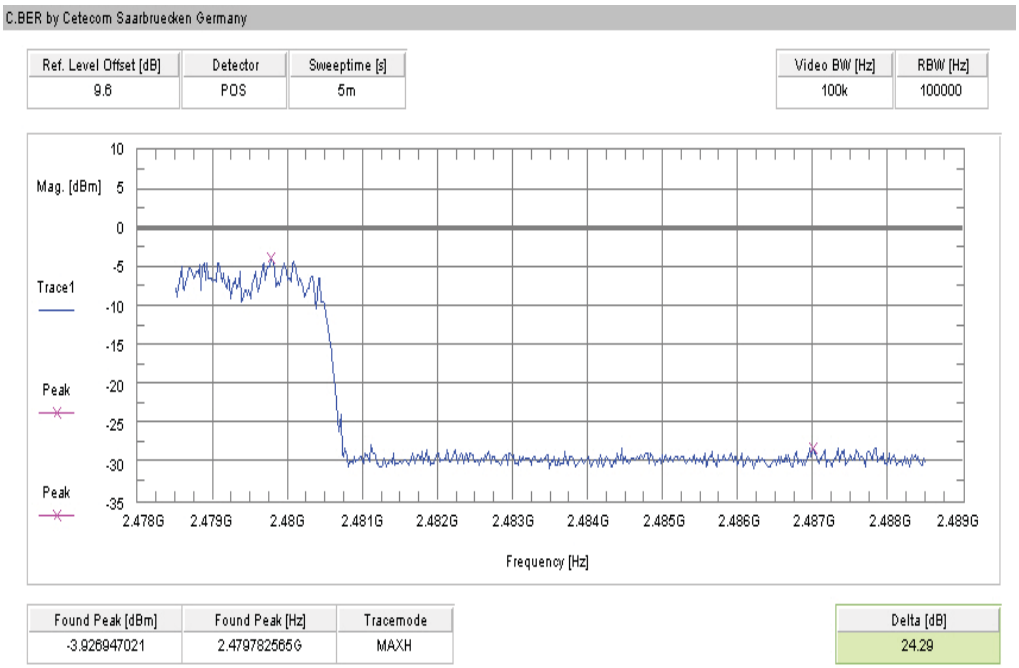

**Plot 8:** Upper band edge – hopping off, Pi/4 DQPSK modulation



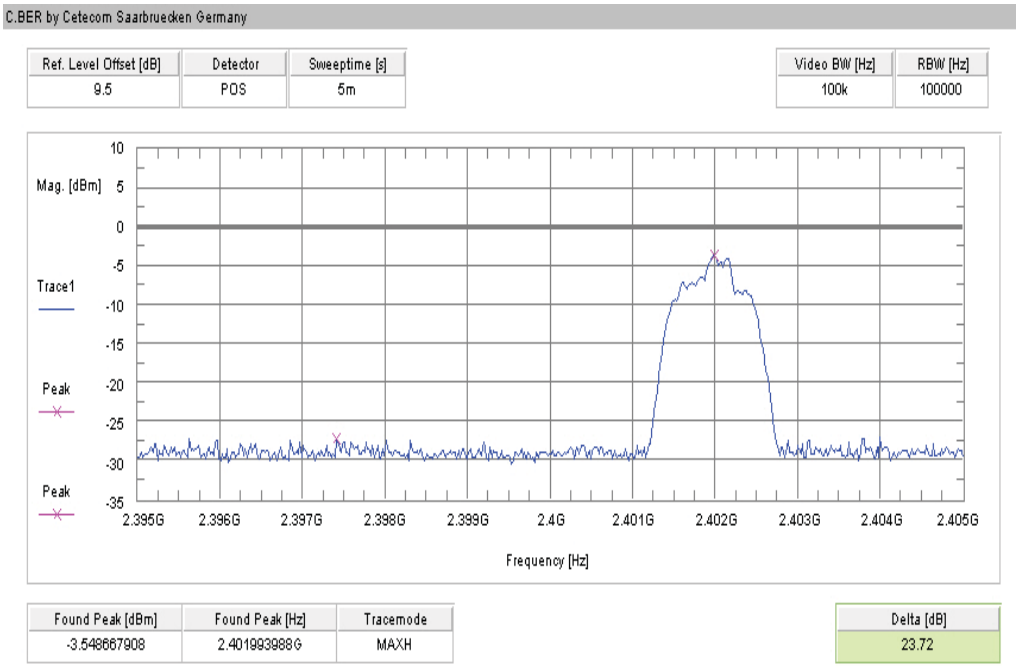
**Plot 9:** Lower band edge – hopping on, 8DPSK modulation



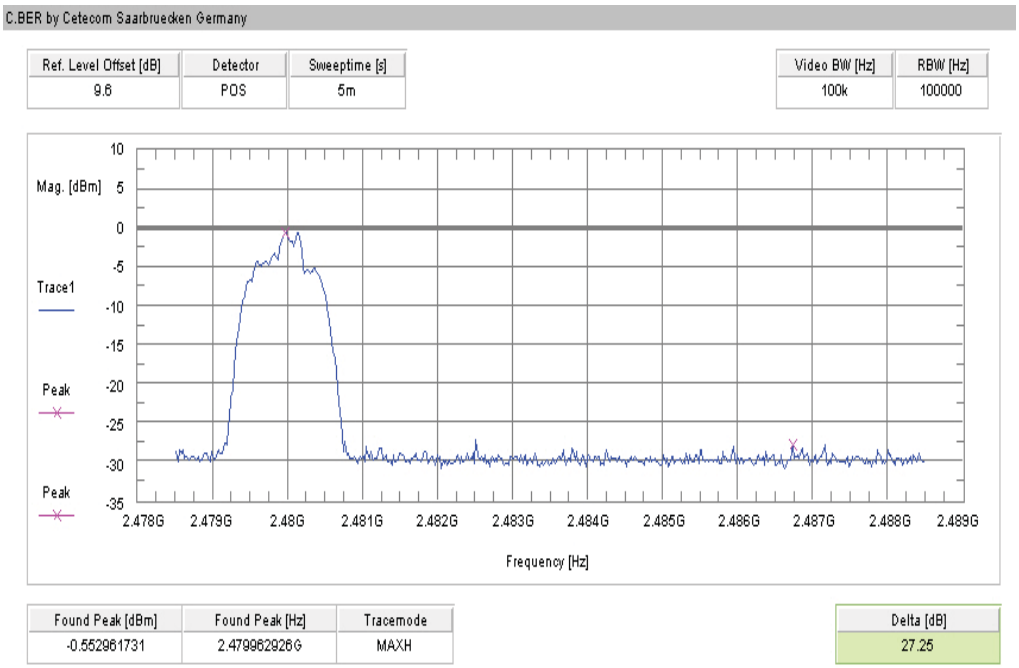

**Plot 10:** Upper band edge – hopping on, 8DPSK modulation



**Plot 11:** Lower band edge – hopping off, 8DPSK modulation




**Plot 12:** Upper band edge – hopping off, 8DPSK modulation



## 10.8 Band edge compliance radiated

**Description:**

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to single channel mode and the transmit channel is channel 00 for the lower restricted band and channel 78 for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3m.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | 1 MHz Peak / 10 Hz AVG |
| Resolution bandwidth: | 1 MHz |
| Span: | Lower Band: 2370 – 2400 MHz<br>Upper Band: 2480 – 2500 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| Band edge compliance radiated | |
| 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. 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 5.205(c)). | |
| 54 dBµV/m AVG<br>74 dBµV/m Peak | |

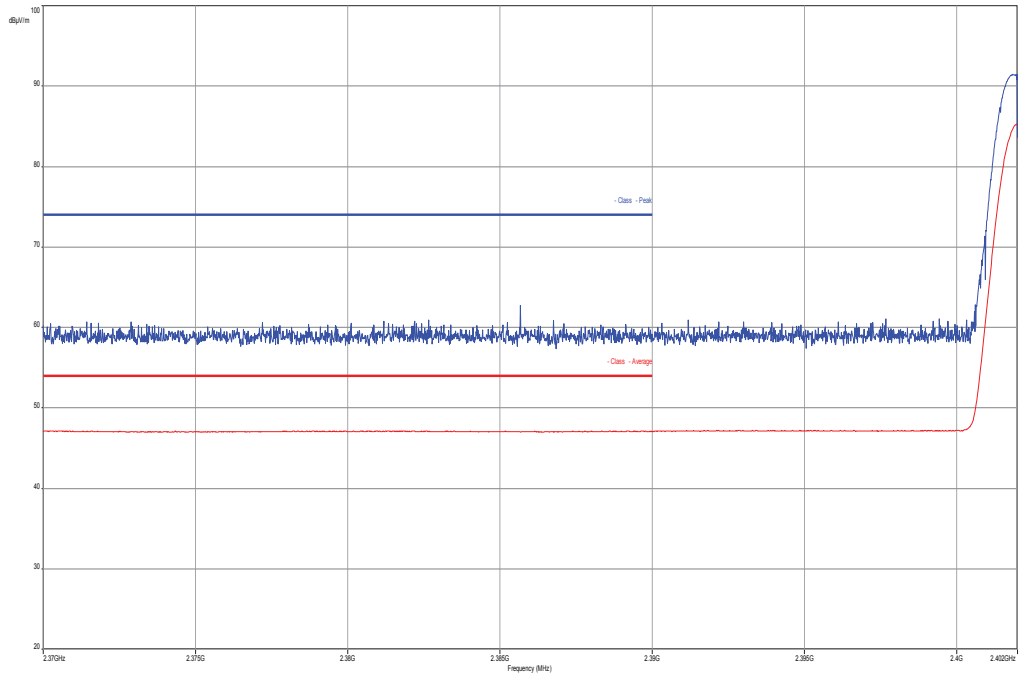
**Results:**

| Scenario | Band edge compliance radiated [dBµV/m] | | |
|---|---|---|---|
| Modulation | GFSK | Pi/4 DQPSK | 8DPSK |
| Lower restricted band | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP |
| Upper restricted band | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP |
| Measurement uncertainty | ± 3 dB | | |

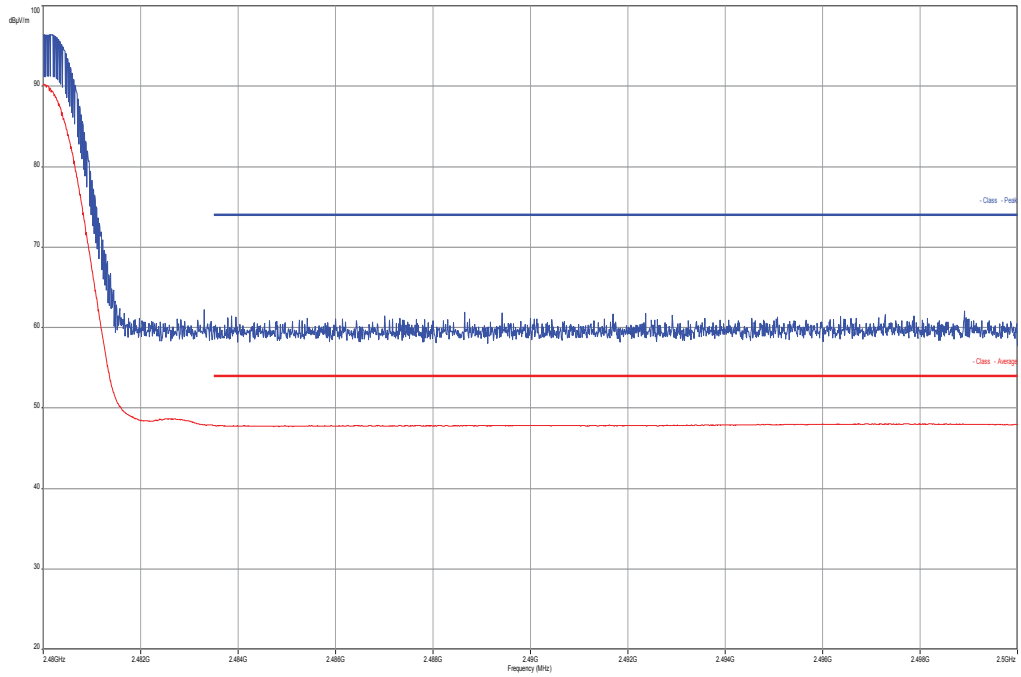
**Result:** Passed

**Plots:**

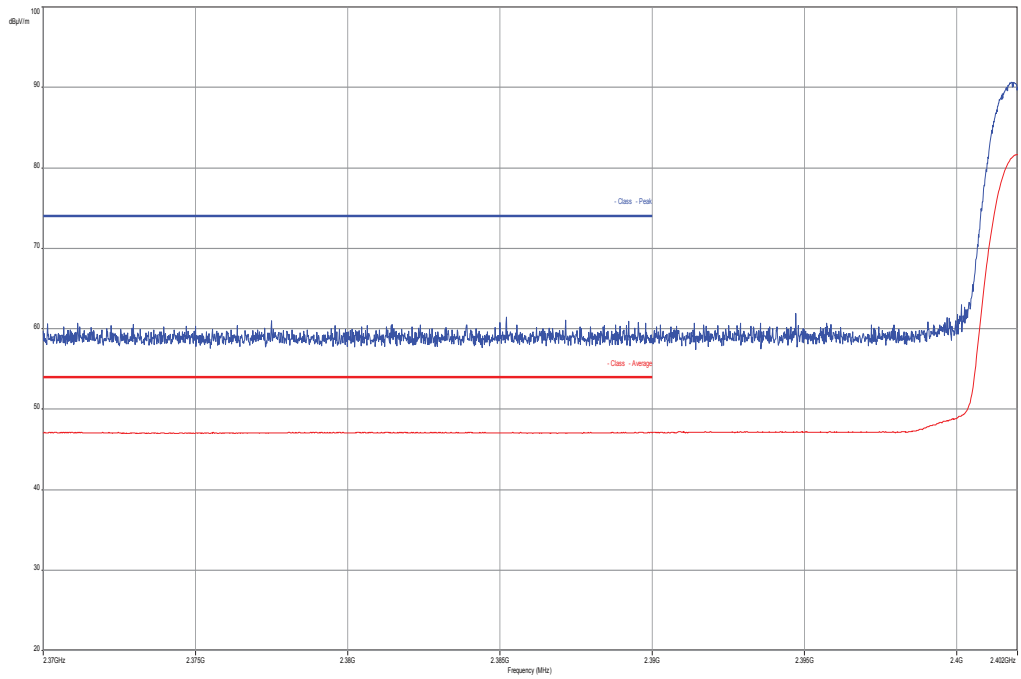
**Plot 1:** Lower band edge, GFSK modulation, vertical & horizontal polarization



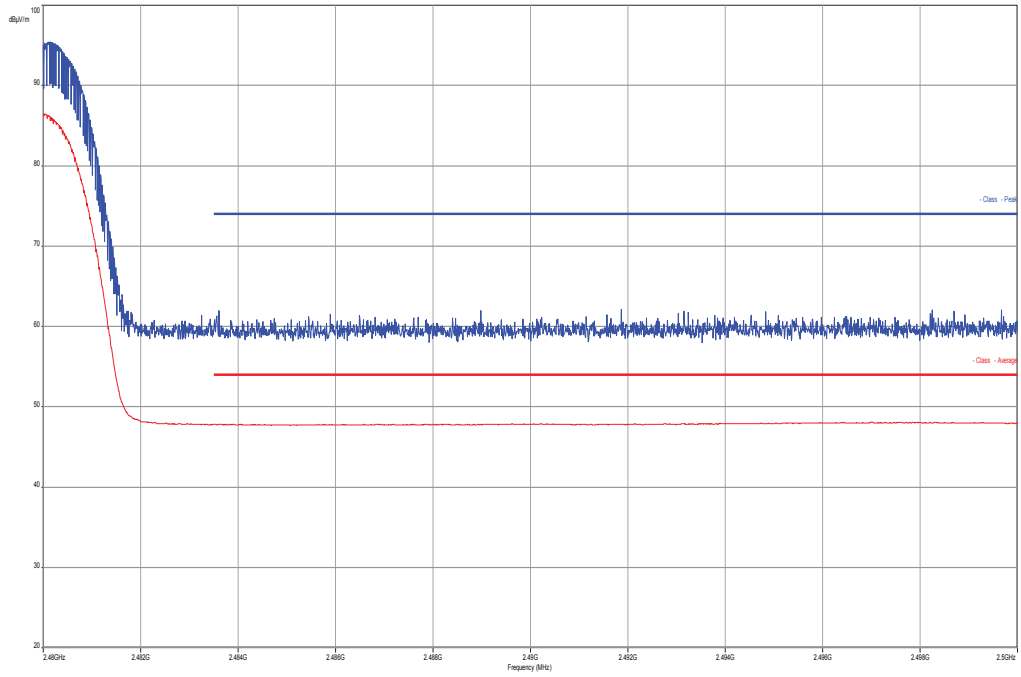

**Plot 2:** Upper band edge, GFSK modulation, vertical & horizontal polarization



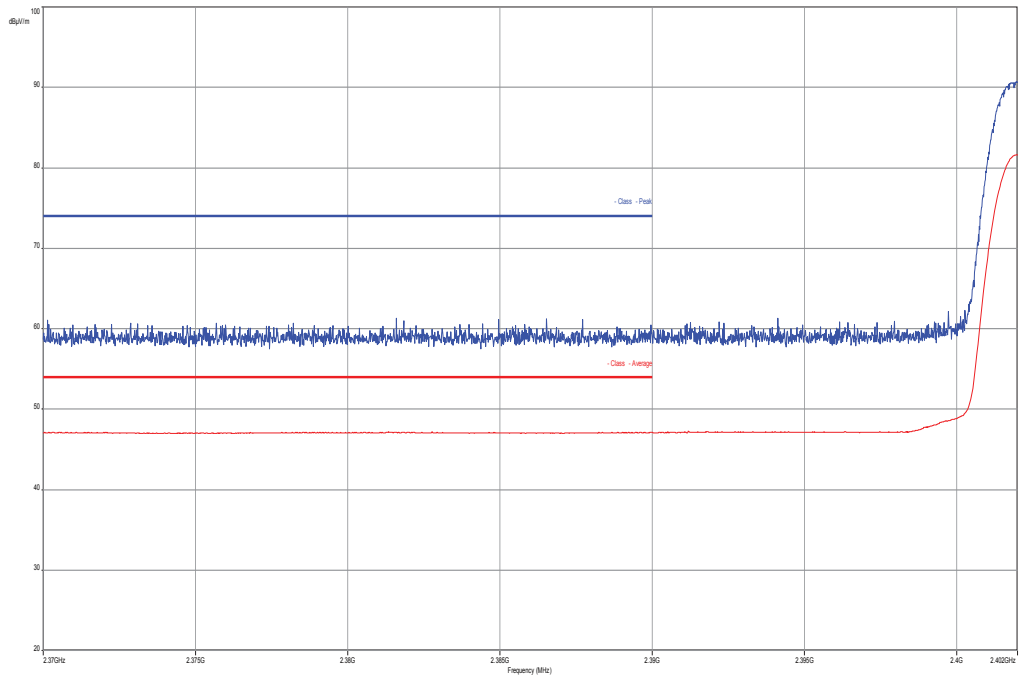
**Plot 3:** Lower band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization



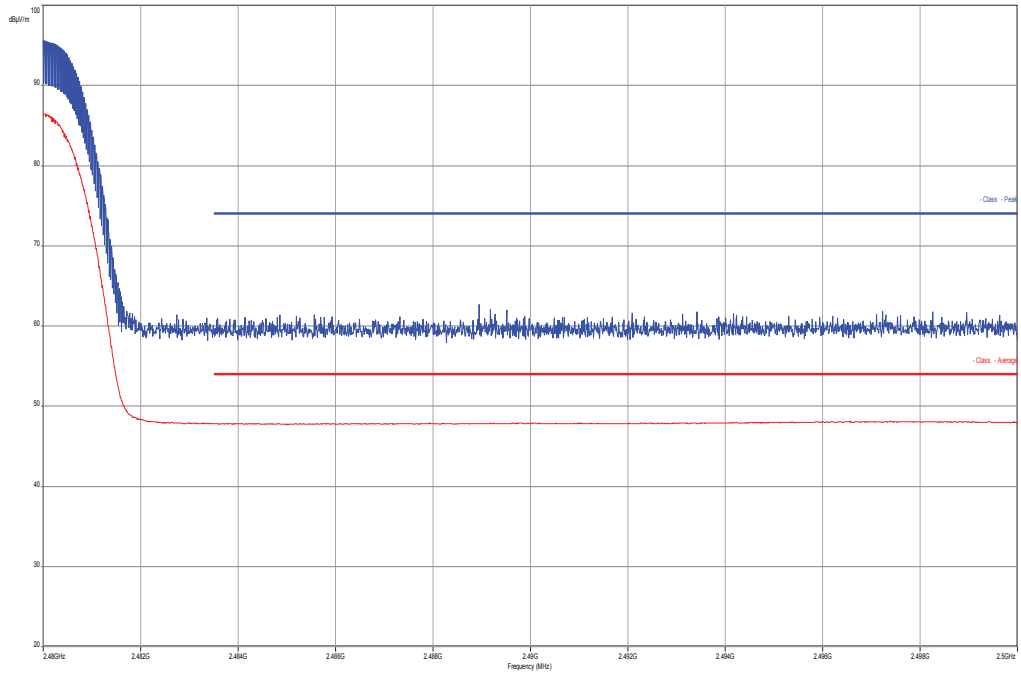

**Plot 4:** Upper band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization



**Plot 5:** Lower band edge, 8 DPSK modulation, vertical & horizontal polarization




**Plot 6:** Upper band edge, 8 DPSK modulation, vertical & horizontal polarization



## 10.9 TX spurious emissions conducted

**Description:**

Measurement of the conducted spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is repeated for all modulations.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Video bandwidth: | F < 1 GHz: 300 kHz<br>F > 1 GHz: 300 kHz |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 100 kHz |
| Span: | 9 kHz to 25 GHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | IC |
|---|---|
| TX spurious emissions conducted | |
| 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. Attenuation below the general limits specified in Section 15.209(a) is not required | |

**Results:**

| TX spurious emissions conducted | | | | | |
|---|---|---|---|---|---|
| GFSK - mode | | | | | |
| f [MHz] | | amplitude of emission [dBm] | limit max. allowed emission power | actual attenuation below frequency of operation [dB] | results |
| 2402 | | 0.0 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2441 | | 2.2 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2480 | | 3.2 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| Measurement uncertainty | | ± 3 dB | | | |

**Result:** **Passed**

**Results:**

| TX spurious emissions conducted | | | | | |
|---|---|---|---|---|---|
| Pi/4-DQPSK - mode | | | | | |
| f [MHz] | | amplitude of emission [dBm] | limit max. allowed emission power | actual attenuation below frequency of operation [dB] | results |
| 2402 | | -2.5 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2441 | | -0.7 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2480 | | 0.4 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| Measurement uncertainty | | ± 3dB | | | |

**Result:** **Passed**

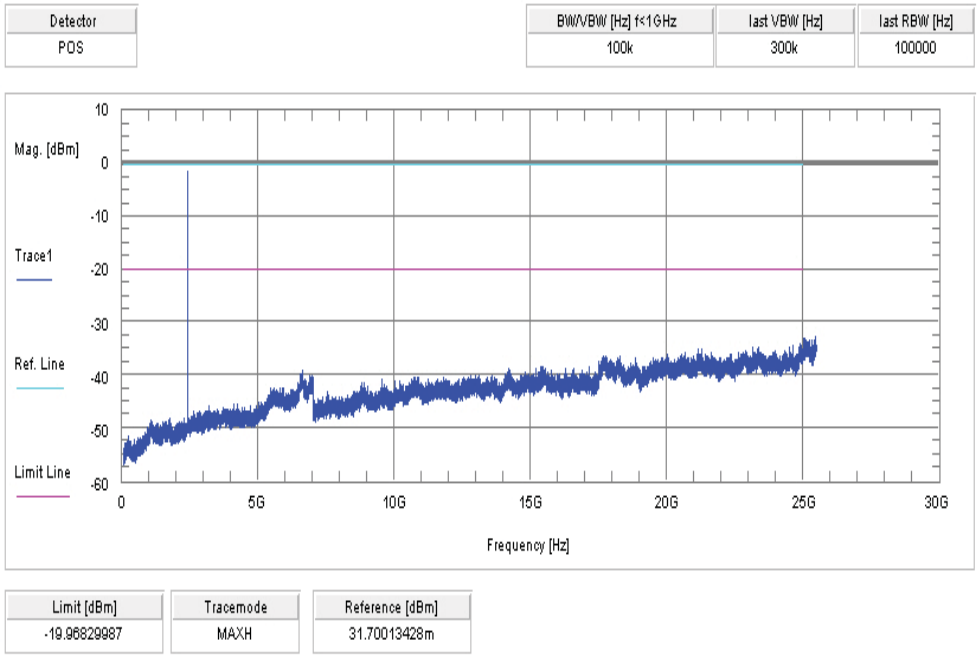
**Results:**

| TX spurious emissions conducted | | | | | |
|---|---|---|---|---|---|
| 8DPSK - mode | | | | | |
| f [MHz] | | amplitude of emission [dBm] | limit max. allowed emission power | actual attenuation below frequency of operation [dB] | results |
| 2402 | | -2.4 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2441 | | -0.6 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| 2480 | | 0.6 | 30 dBm | > 20 | Operating frequency |
| *No peaks detected* | | | -20 dBc | | complies |
| | | | | | |
| | | | | | |
| Measurement uncertainty | | ± 3dB | | | |

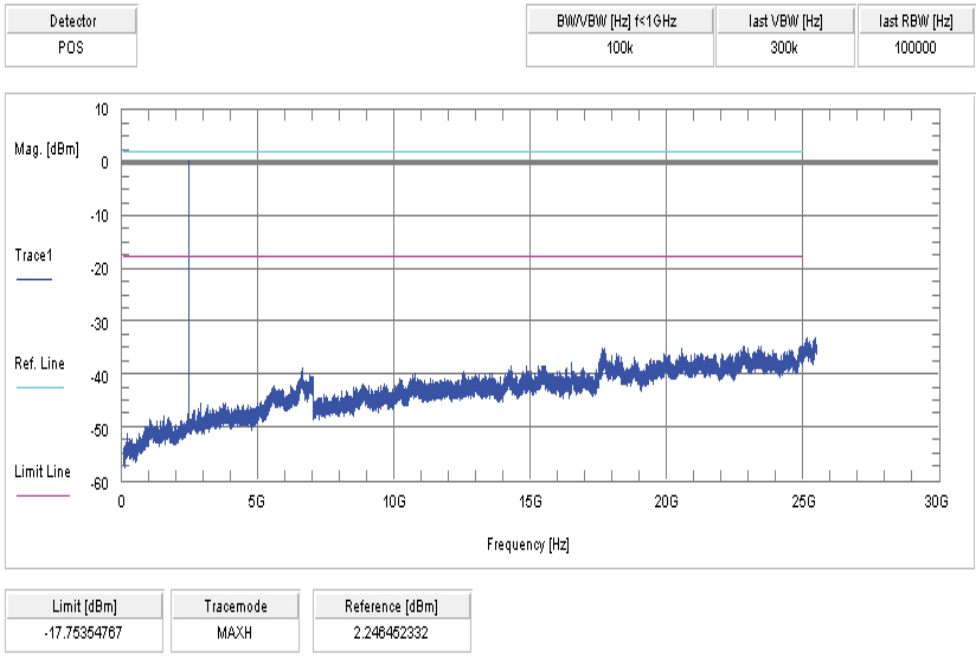
**Result:** **Passed**

**Plots:**

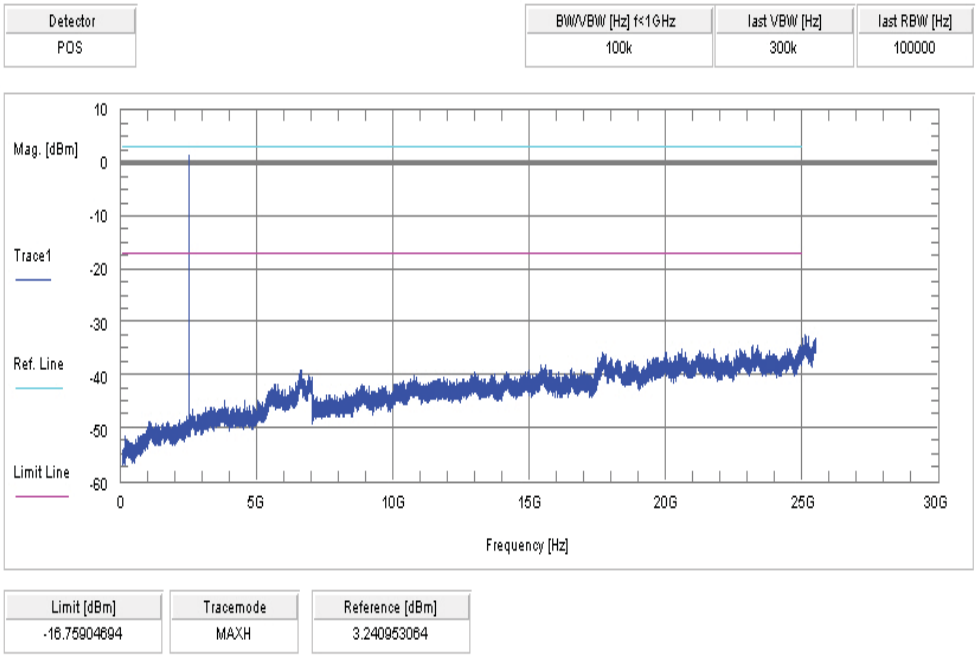
**Plot 1:** lowest channel – 2402 MHz, GFSK modulation



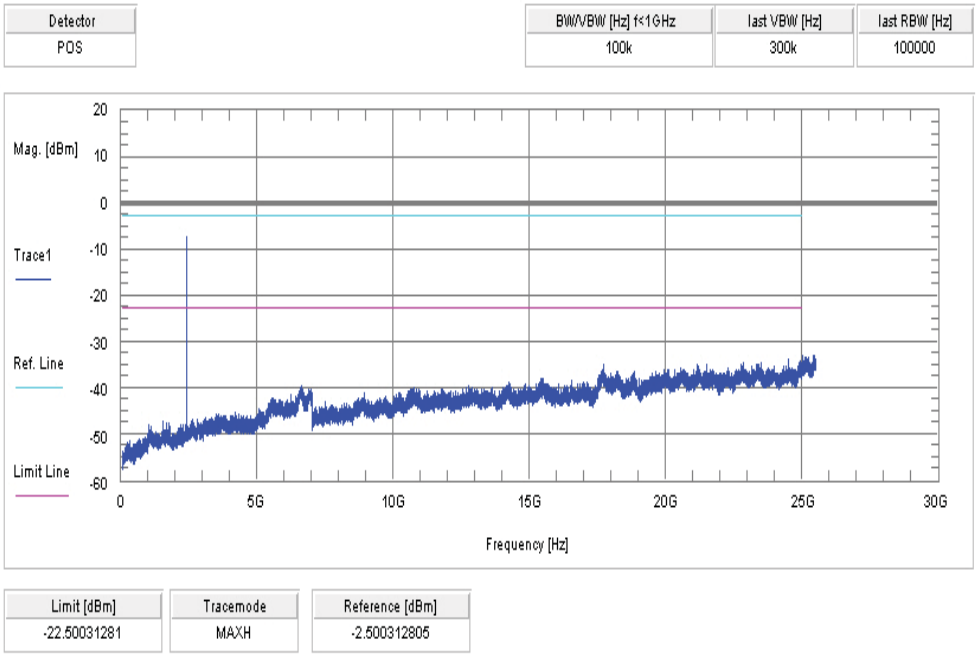

**Plot 2:** middle channel – 2441 MHz, GFSK modulation



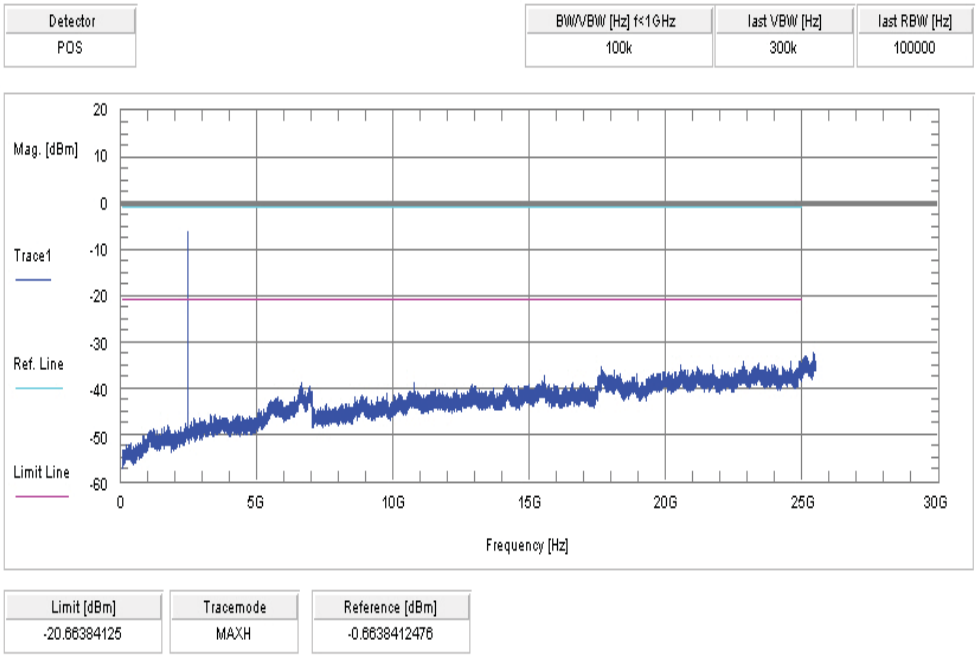
**Plot 3:** highest channel – 2480 MHz, GFSK modulation



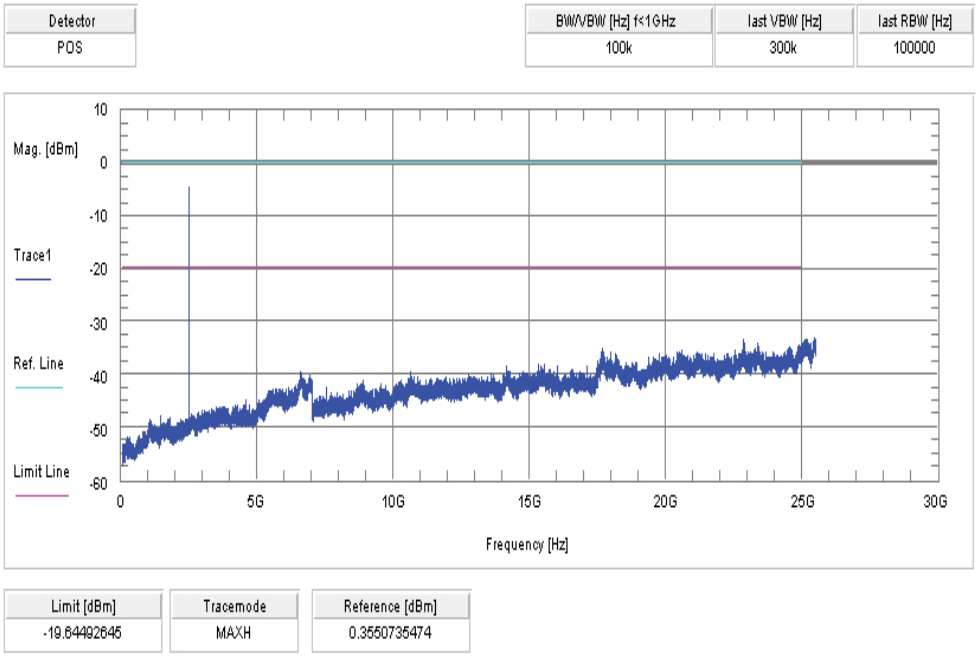

**Plot 4:** lowest channel – 2402 MHz, Pi / DQPSK modulation



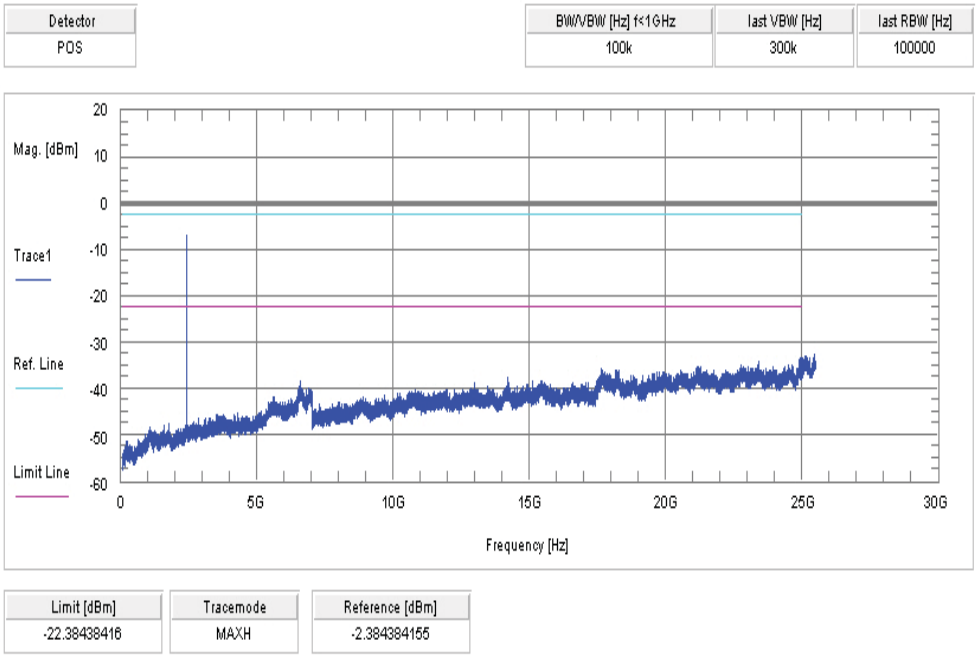
**Plot 5:** middle channel – 2441 MHz, Pi / DQPSK modulation



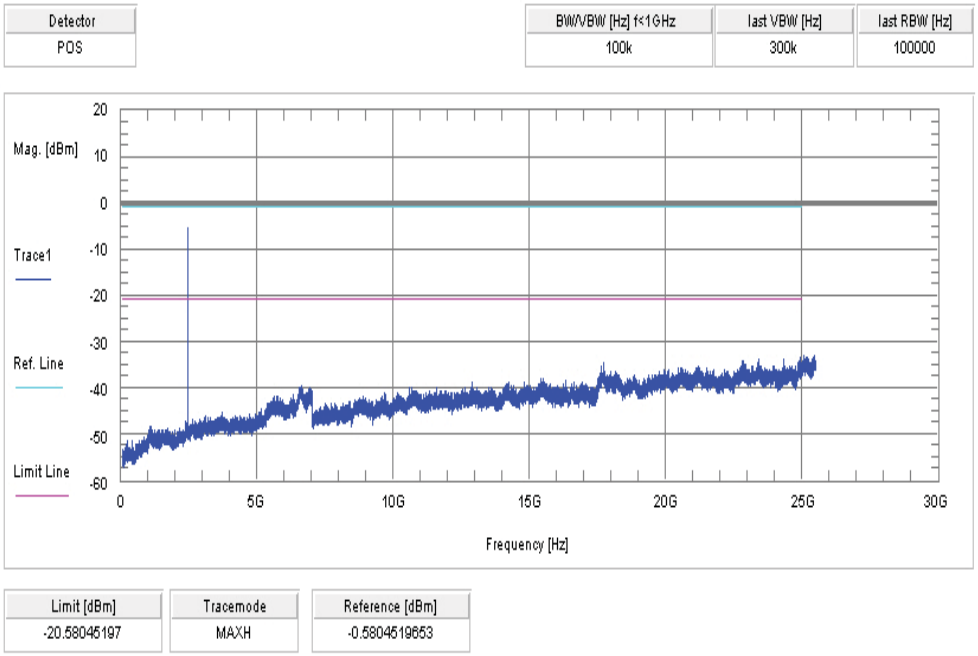

**Plot 6:** highest channel – 2480 MHz, Pi / DQPSK modulation



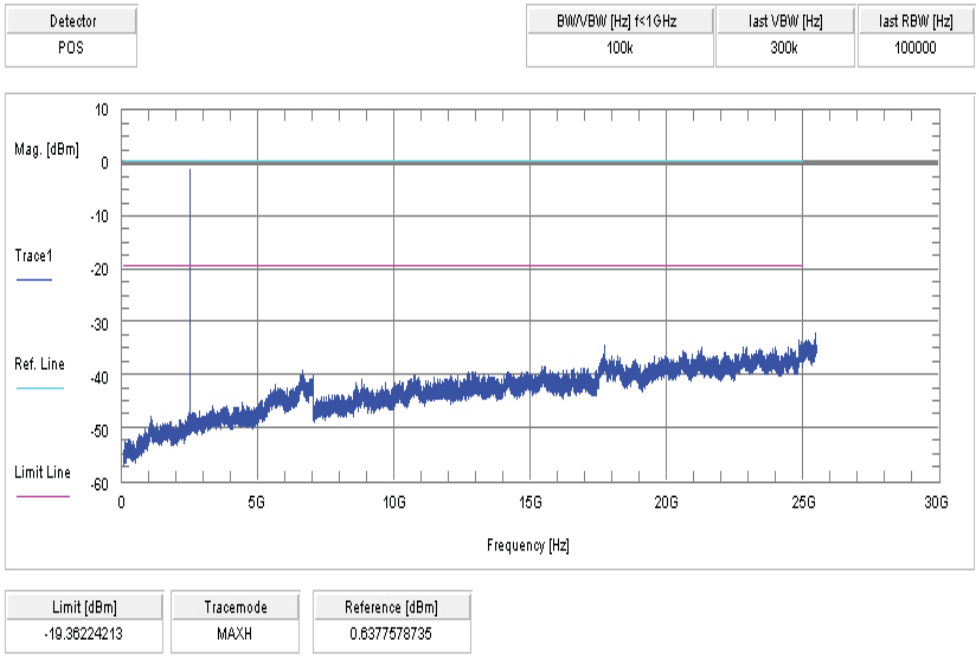
**Plot 7:** lowest channel – 2402 MHz, 8 DPSK modulation




**Plot 8:** middle channel – 2441 MHz, 8 DPSK modulation



**Plot 9:** highest channel – 2480 MHz, 8 DPSK modulation



## 10.10 TX spurious emissions radiated

**Description:**

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is performed in the mode with the highest output power.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi Peak |
| Sweep time: | Auto |
| Video bandwidth: | 3 x RBW<br>Remeasurement: 10 Hz |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 1 MHz |
| Span: | 30 MHz to 25 GHz |
| Trace-Mode: | Max Hold |
| Measured Modulation: | ☒ GFSK ☐ Pi/4 DQPSK ☐ 8DPSK |

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

**Limits:**

| FCC | IC | |
|---|---|---|
| TX spurious emissions radiated | | |
| 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. 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 §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). | | |
| §15.209 | | |
| Frequency (MHz) | Field strength (dBµV/m) | Measurement distance |
| 30 - 88 | 30.0 | 10 |
| 88 – 216 | 33.5 | 10 |
| 216 – 960 | 36.0 | 10 |
| Above 960 | 54.0 | 3 |

**Results:**

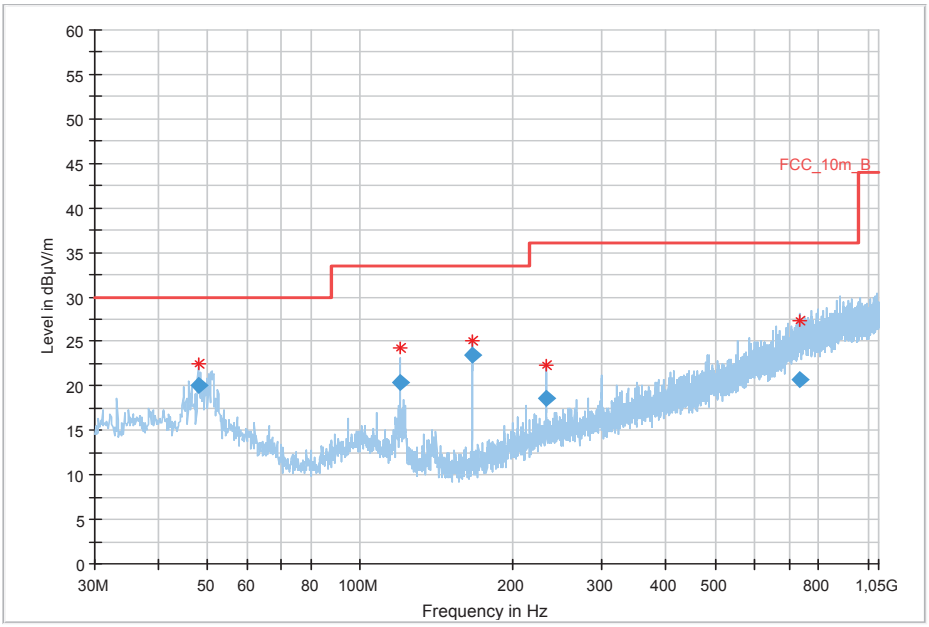
| TX spurious emissions radiated [dBµV/m] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2402 MHz | | | 2441 MHz | | | 2480 MHz | | |
| F [MHz] | Detector | Level [dBµV/m] | F [MHz] | Detector | Level [dBµV/m] | F [MHz] | Detector | Level [dBµV/m] |
| For emissions below 1 GHz, please take a look at the table below the 1 GHz plot. | | | For emissions below 1 GHz, please take a look at the table below the 1 GHz plot. | | | For emissions below 1 GHz, please take a look at the table below the 1 GHz plot. | | |
| 15201.4 | Peak | 34.1 | | | | | | |
| 19220.1 | Peak | 30.4 | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Measurement uncertainty | | | ± 3 dB | | | | | |

**Result:** **Passed**

**Note:** The limit was recalculated with 20 dB / decade (Part 15.31) for all radiated spurious emissions 30 MHz to 1 GHz from 3 meter limit to a 10 meter distance. (40dB/decade for emissions < 30MHz)

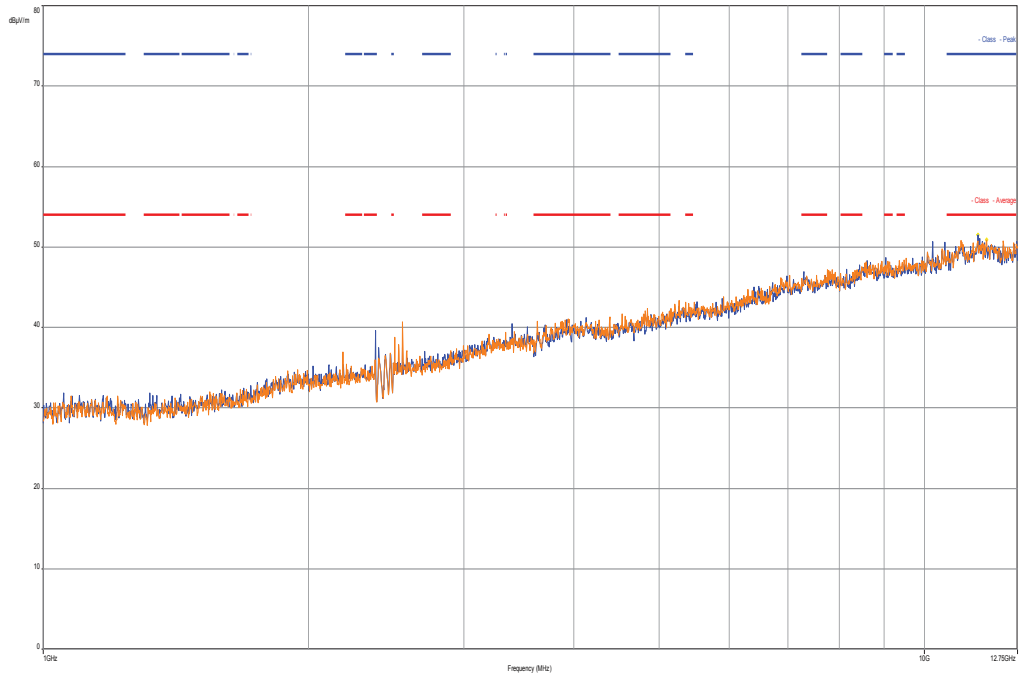
**Plots:**

**Plot 1:** 30 MHz to 1 GHz, TX mode, channel 00, vertical & horizontal polarization



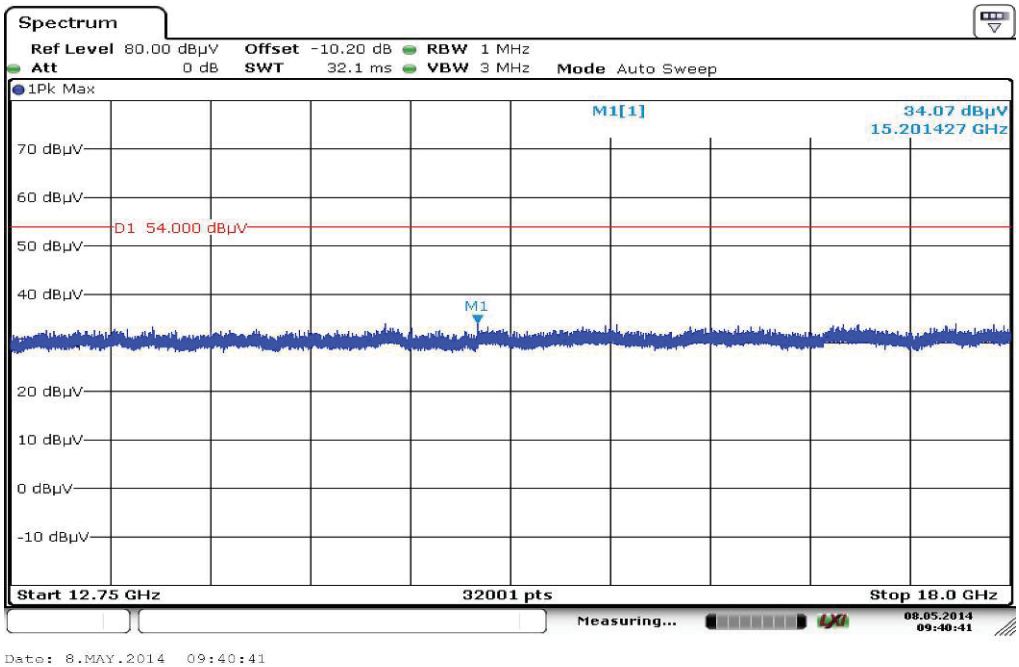

| Frequency (MHz) | Quasi Peak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 48.036000 | 20.01 | 30.00 | 9.99 | 1000.0 | 120.000 | 105.0 | V | 94.0 | 13.3 |
| 120.014100 | 20.36 | 33.50 | 13.14 | 1000.0 | 120.000 | 170.0 | V | 190.0 | 10.2 |
| 166.578000 | 23.45 | 33.50 | 10.05 | 1000.0 | 120.000 | 98.0 | V | 100.0 | 9.6 |
| 233.226600 | 18.63 | 36.00 | 17.37 | 1000.0 | 120.000 | 116.0 | V | 280.0 | 12.8 |
| 735.502800 | 20.63 | 36.00 | 15.37 | 1000.0 | 120.000 | 170.0 | H | 271.0 | 23.3 |

**Plot 2:** 1 GHz to 12.75 GHz, TX mode, channel 00, vertical & horizontal polarization

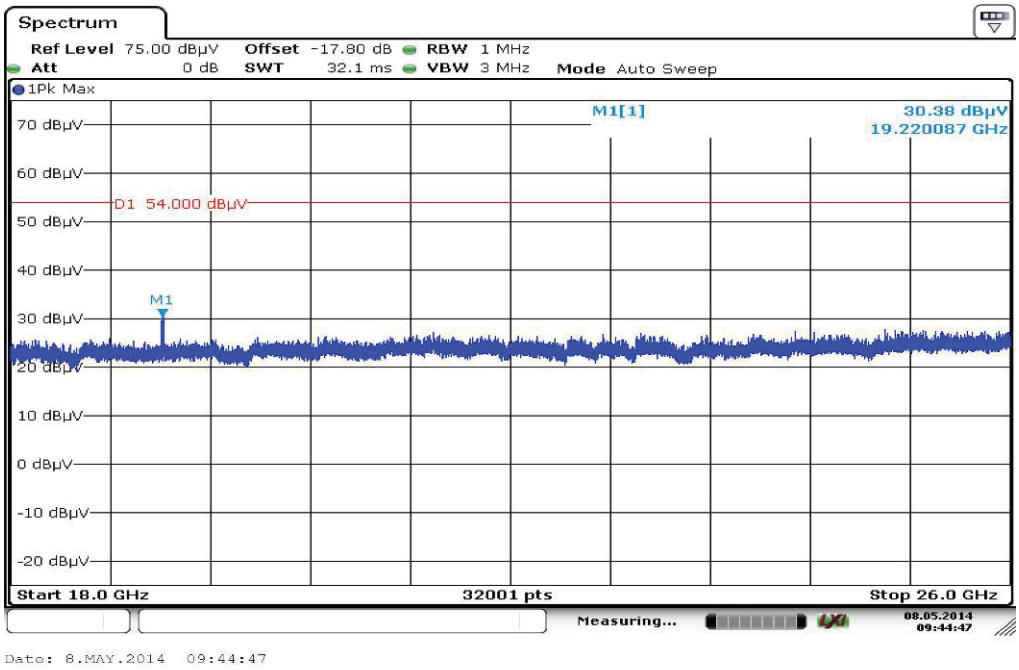


The carrier signal is notched with a 2.4 GHz band rejection filter.

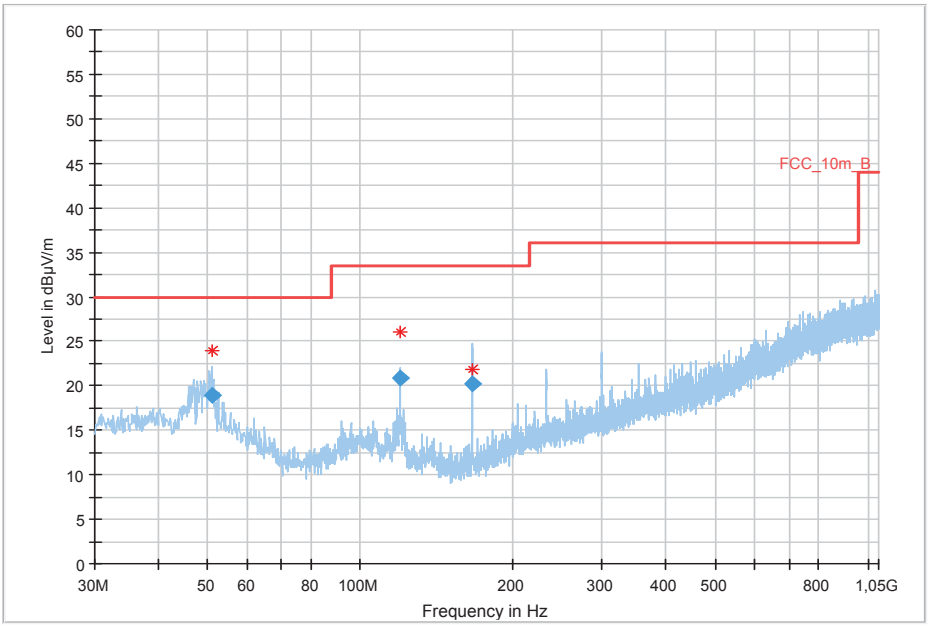
**Plot 3:** 12.75 GHz to 18 GHz, TX mode, channel 00, vertical & horizontal polarization



**Plot 4:** 18 GHz to 26 GHz, TX mode, channel 00, vertical & horizontal polarization

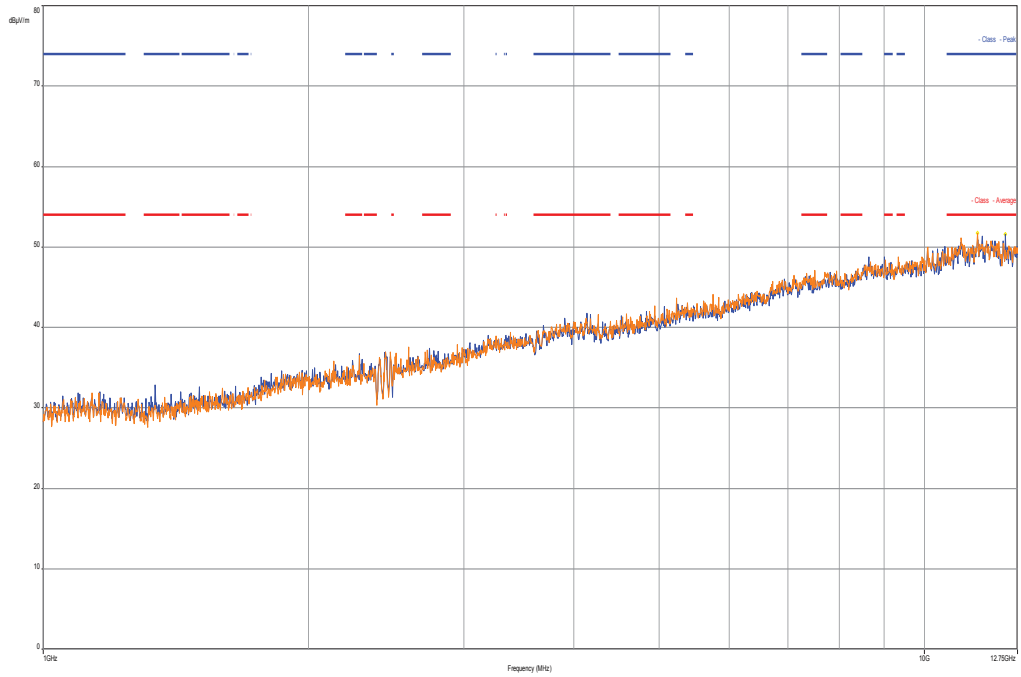


**Plot 5:** 30 MHz to 1 GHz, TX mode, channel 39, vertical & horizontal polarization



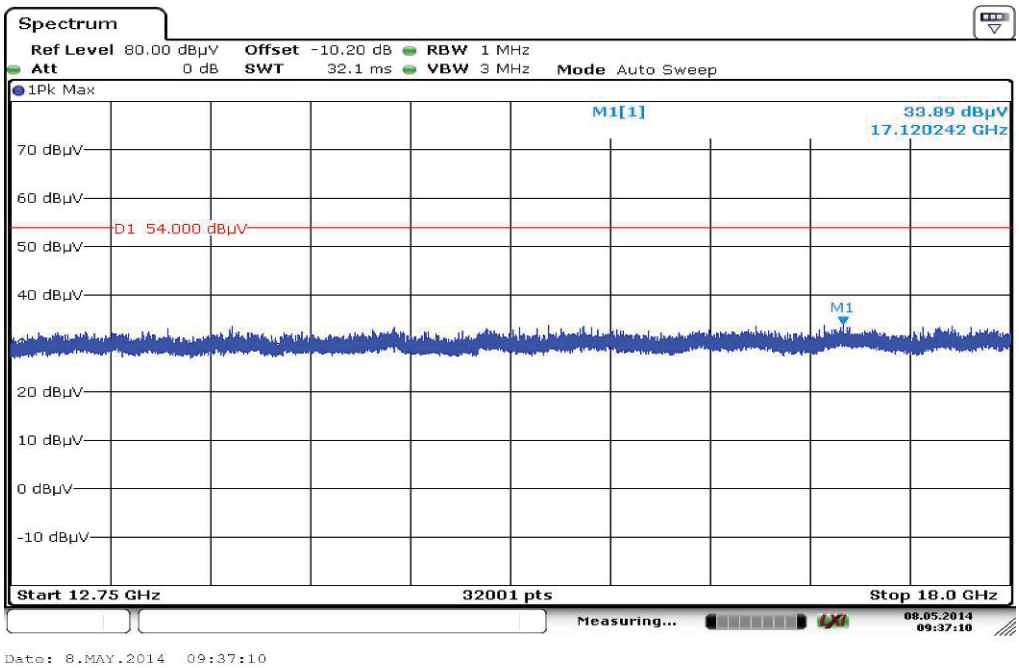

| Frequency (MHz) | Quasi Peak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 51.031350 | 18.97 | 30.00 | 11.03 | 1000.0 | 120.000 | 98.0 | V | 261.0 | 13.3 |
| 120.009750 | 20.88 | 33.50 | 12.62 | 1000.0 | 120.000 | 105.0 | V | 171.0 | 10.2 |
| 166.016700 | 20.28 | 33.50 | 13.22 | 1000.0 | 120.000 | 127.0 | V | 100.0 | 9.6 |

**Plot 6:** 1 GHz to 12.75 GHz, TX mode, channel 39, vertical & horizontal polarization

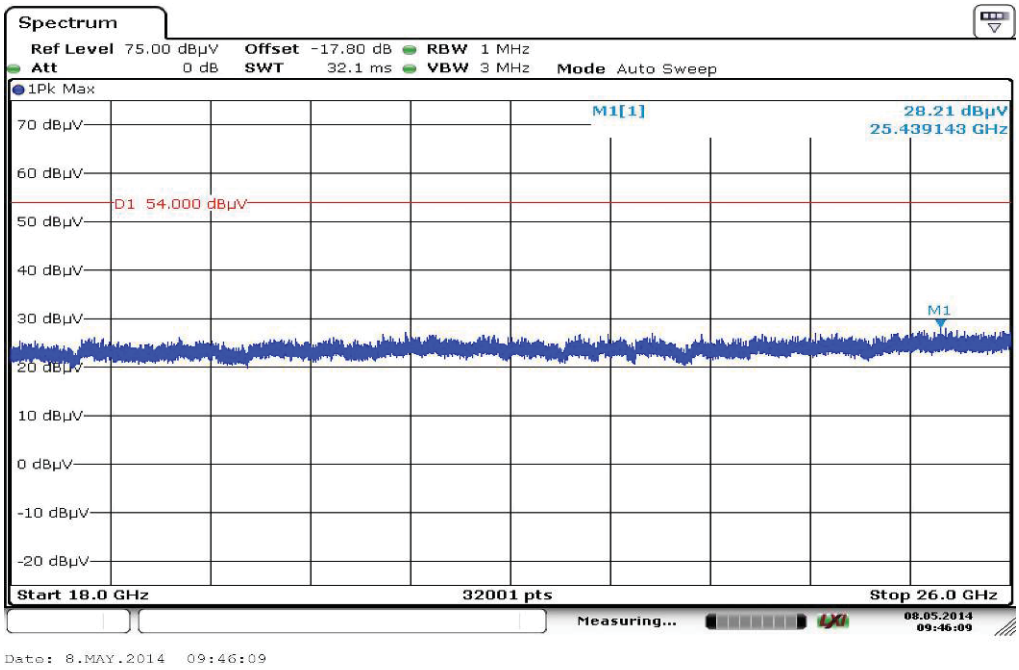


The carrier signal is notched with a 2.4 GHz band rejection filter.

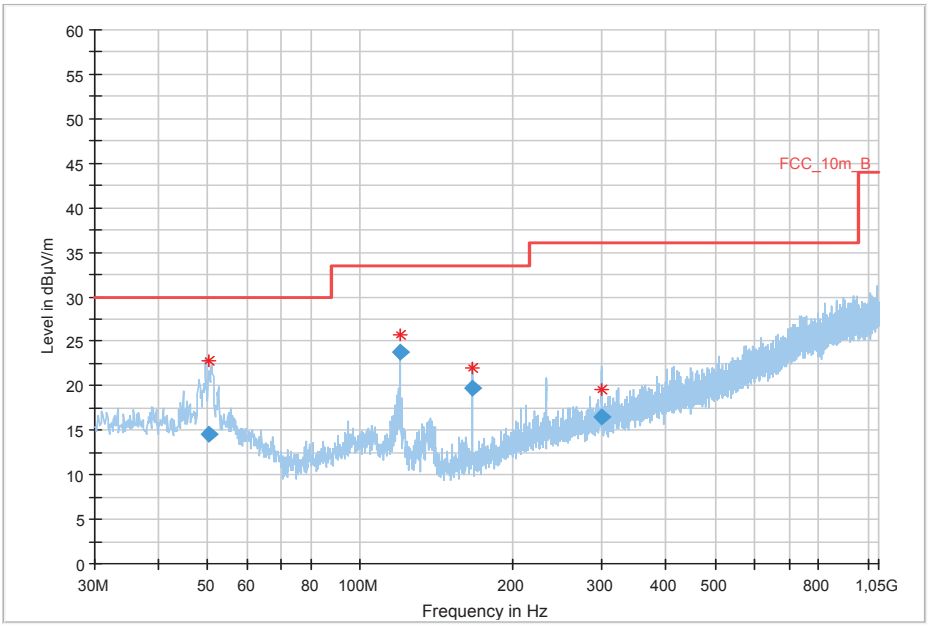
**Plot 7:** 12.75 GHz to 18 GHz, TX mode, channel 39, vertical & horizontal polarization



**Plot 8:** 18 GHz to 26 GHz, TX mode, channel 39, vertical & horizontal polarization

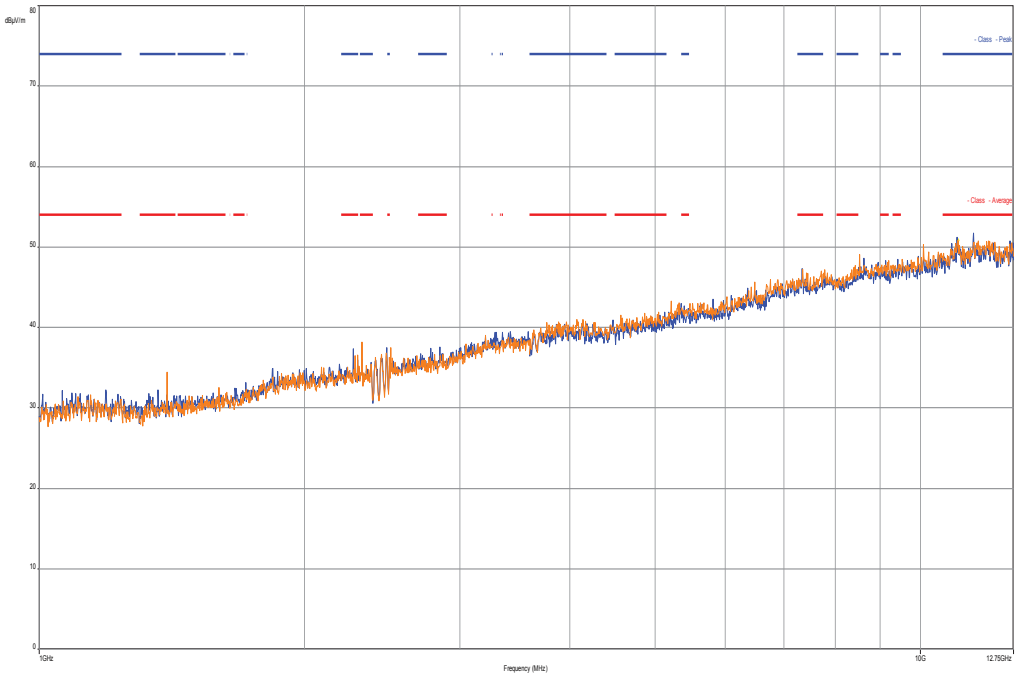


**Plot 9:** 30 MHz to 1 GHz, TX mode, channel 78, vertical & horizontal polarization



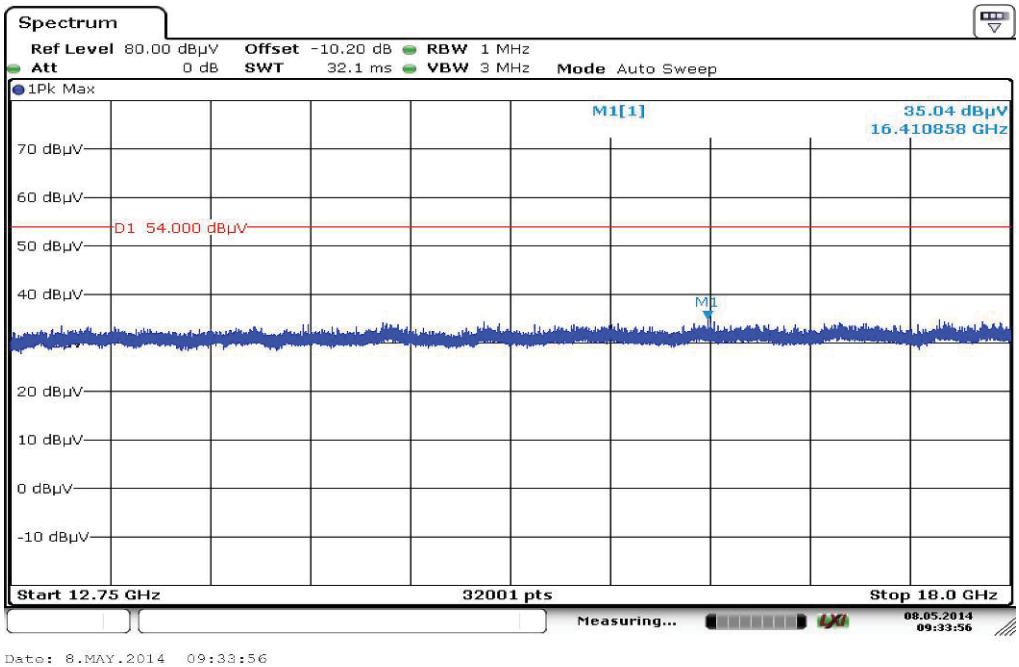

| Frequency (MHz) | Quasi Peak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 50.231550 | 14.57 | 30.00 | 15.43 | 1000.0 | 120.000 | 105.0 | V | 273.0 | 13.4 |
| 119.998800 | 23.70 | 33.50 | 9.80 | 1000.0 | 120.000 | 106.0 | V | 190.0 | 10.2 |
| 166.551600 | 19.75 | 33.50 | 13.75 | 1000.0 | 120.000 | 98.0 | V | 10.0 | 9.6 |
| 299.848800 | 16.55 | 36.00 | 19.45 | 1000.0 | 120.000 | 98.0 | V | 1.0 | 14.5 |

**Plot 10:** 1 GHz to 12.75 GHz, TX mode, channel 78, vertical & horizontal polarization

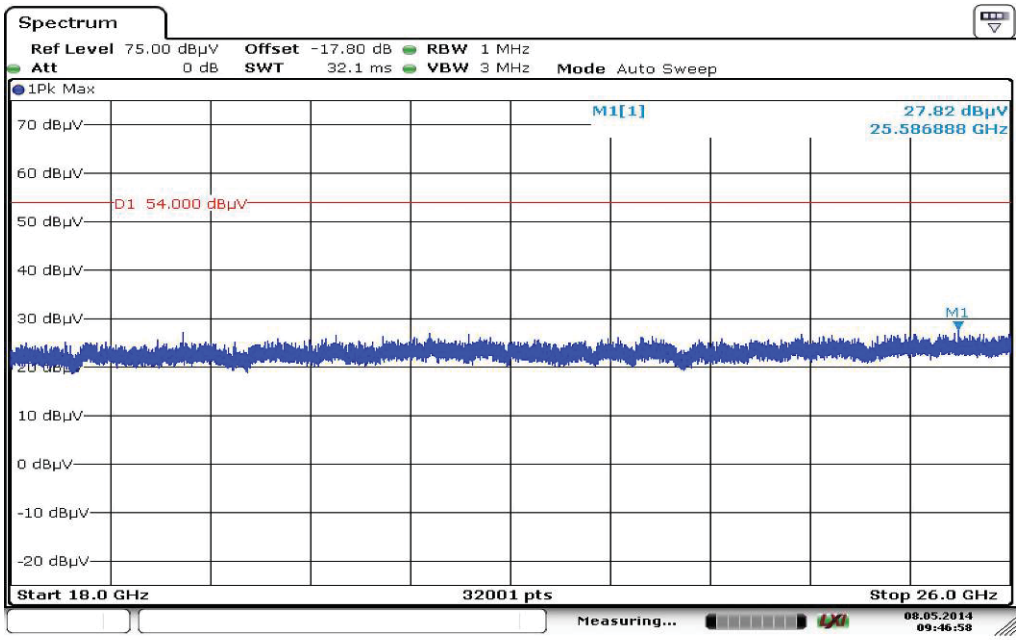


The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 11:** 12.75 GHz to 18 GHz, TX mode, channel 78, vertical & horizontal polarization



**Plot 12:** 18 GHz to 26 GHz, TX mode, channel 78, vertical & horizontal polarization



## 10.11 RX spurious emissions radiated

**Description:**

Measurement of the radiated spurious emissions in idle/receive mode. The EUT is detached so all oscillators are active.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi peak |
| Sweep time: | Auto |
| Video bandwidth: | 3 x RBW<br>Remeasurement: 10 Hz |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 1 MHz |
| Span: | 30 MHz to 25 GHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | | IC |
|---|---|---|
| RX Spurious Emissions Radiated | | |
| Frequency (MHz) | Field strength (dBµV/m) | Measurement distance |
| 30 - 88 | 30.0 | 10 |
| 88 – 216 | 33.5 | 10 |
| 216 – 960 | 36.0 | 10 |
| Above 960 | 54.0 | 3 |

**Results:**

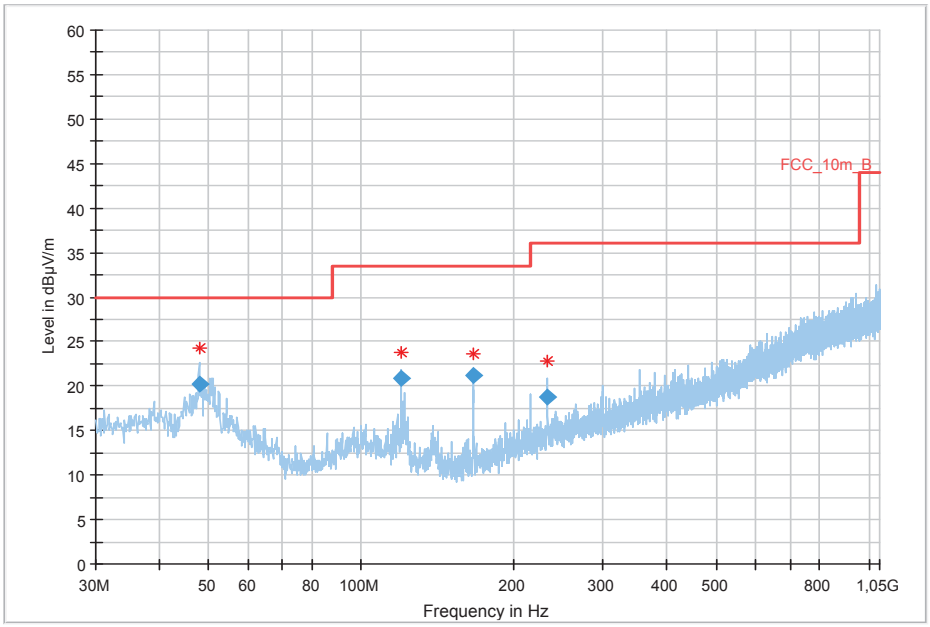
| RX spurious emissions radiated [dBµV/m] | | |
|---|---|---|
| F [MHz] | Detector | Level [dBµV/m] |
| For emissions below 1 GHz, please take a look at the table below the 1 GHz plot. | | |
| | | |
| | | |
| | | |
| | | |
| Measurement uncertainty | ±3 dB | |

**Result:** Passed

**Note:** The limit was recalculated with 20 dB / decade (Part 15.31) for all radiated spurious emissions 30 MHz to 1 GHz from 3 meter limit to a 10 meter distance. (40dB/decade for emissions < 30MHz)

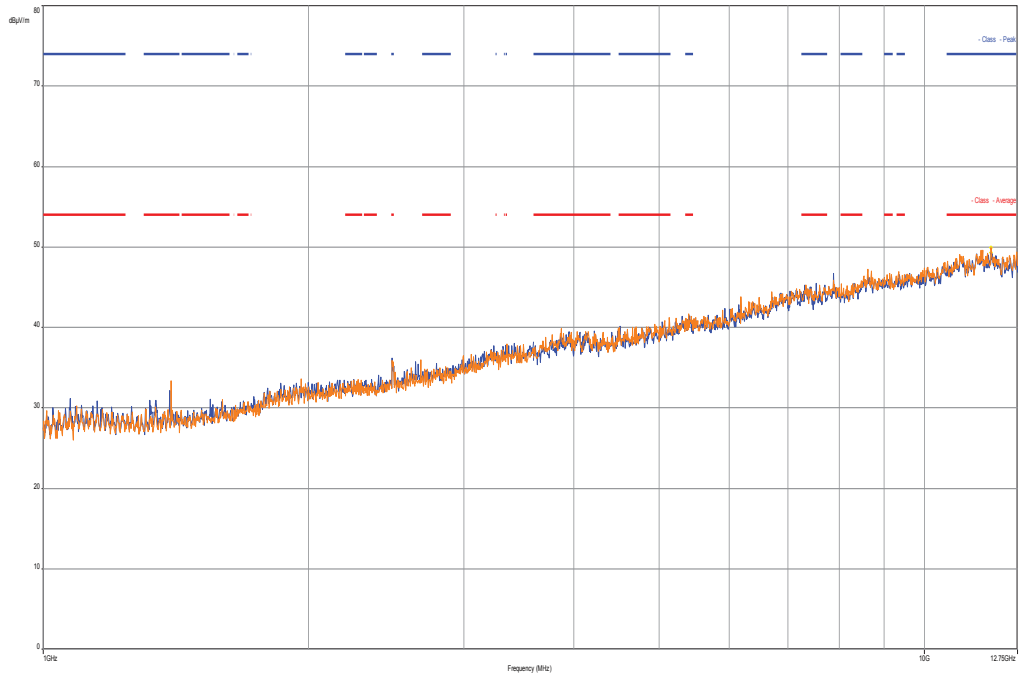
**Plots:**

**Plot 1:** 30 MHz to 1 GHz, RX mode, vertical & horizontal polarization

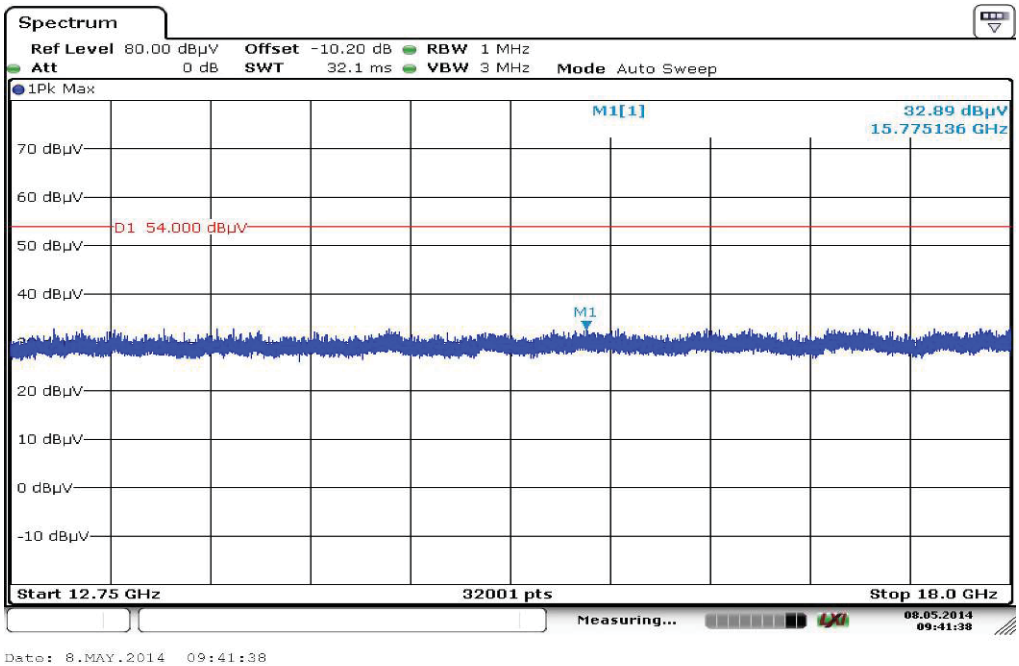



| Frequency (MHz) | Quasi Peak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 47.975100 | 20.21 | 30.00 | 9.79 | 1000.0 | 120.000 | 134.0 | V | 88.0 | 13.3 |
| 119.986050 | 20.88 | 33.50 | 12.62 | 1000.0 | 120.000 | 98.0 | V | 171.0 | 10.2 |
| 166.008000 | 21.12 | 33.50 | 12.38 | 1000.0 | 120.000 | 98.0 | V | 100.0 | 9.6 |
| 232.388250 | 18.74 | 36.00 | 17.26 | 1000.0 | 120.000 | 131.0 | V | 280.0 | 12.8 |

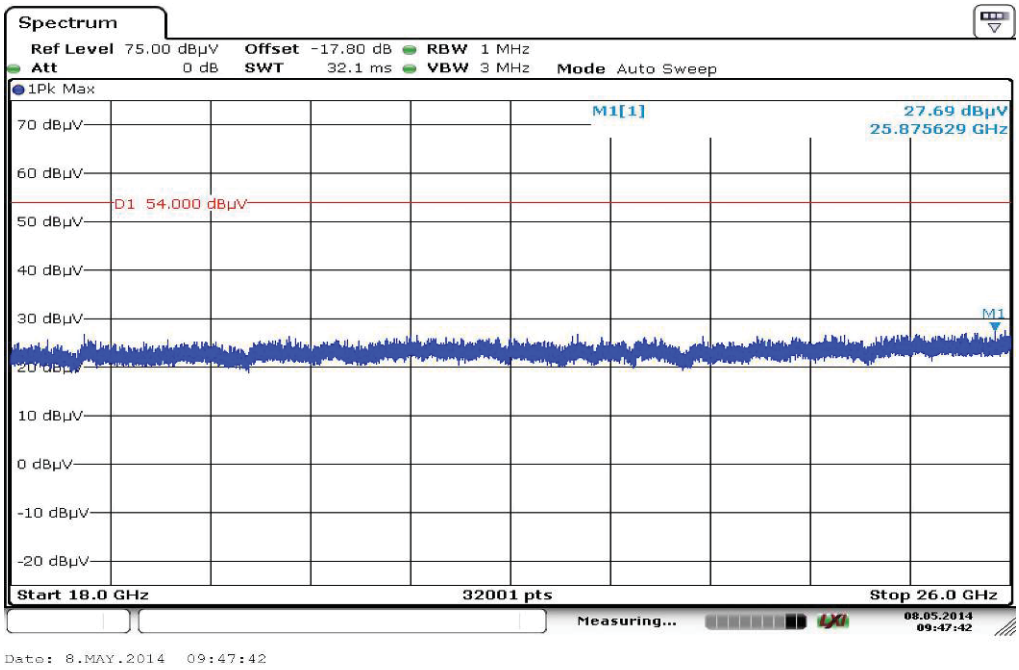
**Plot 2:** 1 GHz to 12.75 GHz, RX mode, vertical & horizontal polarization



**Plot 3:** 12.75 GHz to 18 GHz, RX mode, vertical & horizontal polarization



**Plot 4:** 18 GHz to 26 GHz, RX mode, vertical & horizontal polarization



## 10.12 Spurious emissions radiated < 30 MHz

**Description:**

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channel is channel 39. This measurement is representative for all channels and modes. If peaks are found channel 00 and channel 78 will be measured too. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi peak |
| Sweep time: | Auto |
| Video bandwidth: | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz |
| Resolution bandwidth: | F < 150 kHz: 1 kHz<br>F > 150 kHz: 100 kHz |
| Span: | 9 kHz to 30 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | | IC |
|---|---|---|
| TX spurious emissions radiated < 30 MHz | | |
| Frequency (MHz) | Field strength (dBµV/m) | Measurement distance |
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |

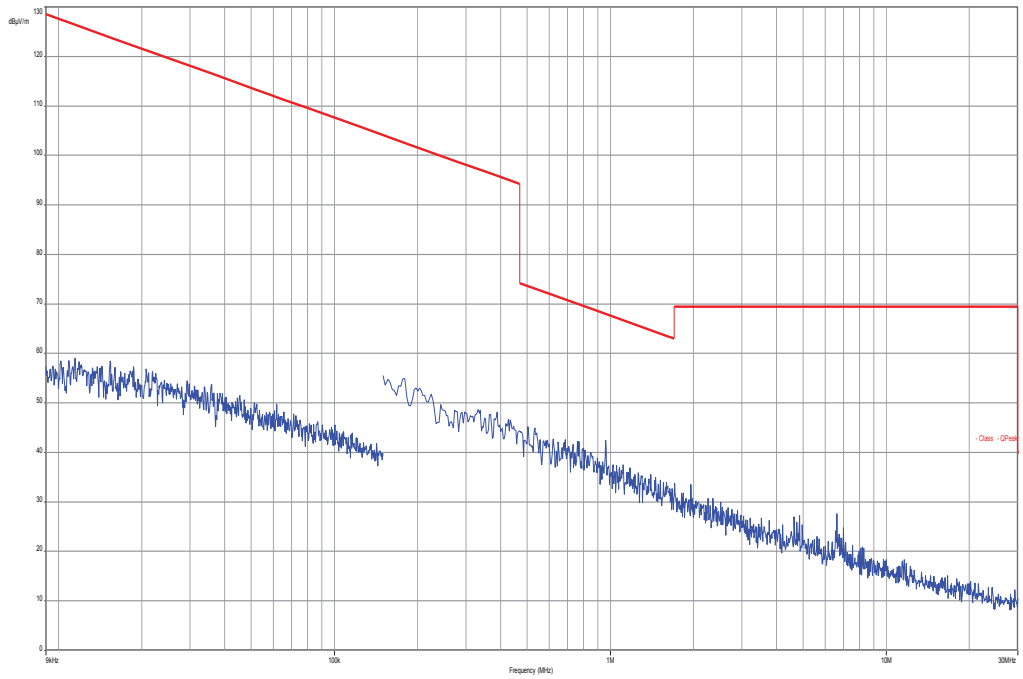
**Results:**

| TX spurious emissions radiated < 30 MHz [dBµV/m] | | |
|---|---|---|
| F [MHz] | Detector | Level [dBµV/m] |
| No peaks detected | | |
| | | |
| | | |
| Measurement uncertainty | ± 3 dB | |

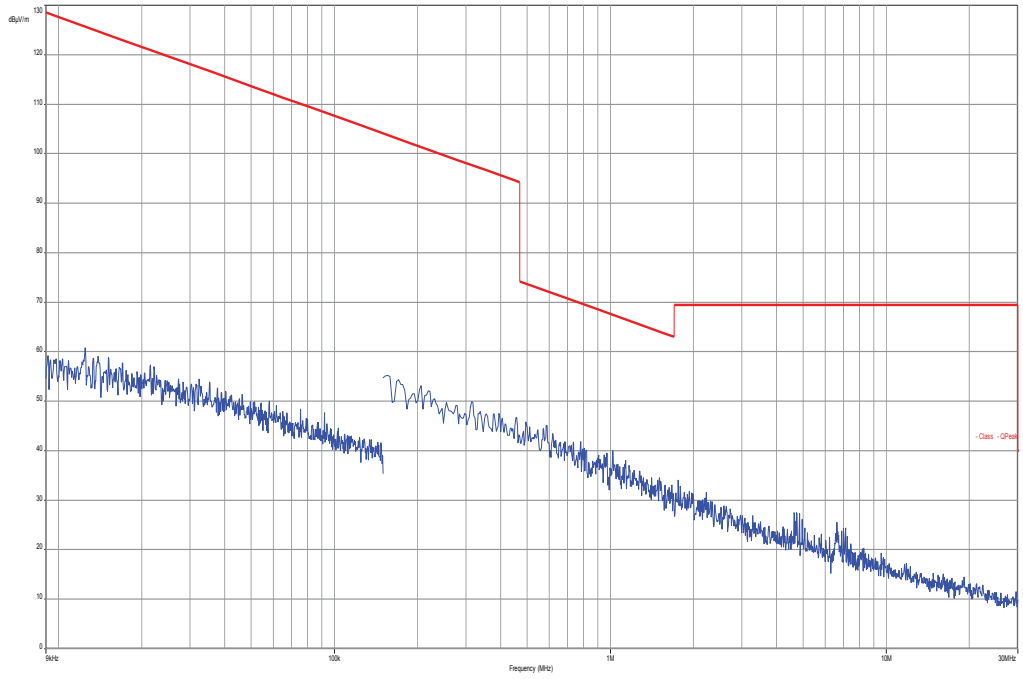
**Result:** Passed

**Plots:**

**Plot 1:** 9 kHz to 30 MHz, TX mode




**Plot 4:** 9 kHz to 30 MHz, RX mode



## 10.13 Spurious emissions conducted < 30 MHz

**Description:**

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channel is channel 39. This measurement is representative for all channels and modes. If peaks are found channel 00 and channel 78 will be measured too. The measurement is performed in the mode with the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak - Quasi peak / average |
| Sweep time: | Auto |
| Video bandwidth: | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz |
| Resolution bandwidth: | F < 150 kHz: 1 kHz<br>F > 150 kHz: 100 kHz |
| Span: | 9 kHz to 30 MHz |
| Trace-Mode: | Max Hold |

**Limits:**

| FCC | | IC |
|---|---|---|
| TX spurious emissions conducted < 30 MHz | | |
| Frequency (MHz) | Quasi-peak (dBµV/m) | Average (dBµV/m) |
| 0.15 – 0.5 | 66 to 56* | 56 to 46* |
| 0.5 – 5 | 56 | 46 |
| 5 – 30.0 | 60 | 50 |

*Decreases with the logarithm of the frequency

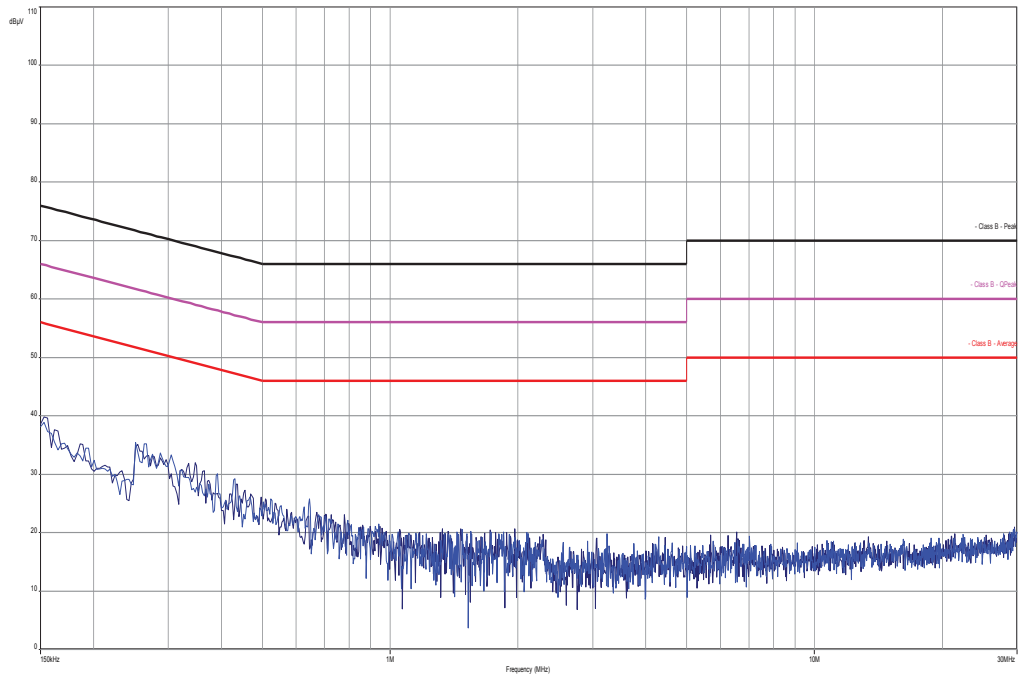
**Results:**

| TX spurious emissions conducted < 30 MHz [dBµV/m] | | |
|---|---|---|
| F [MHz] | Detector | Level [dBµV/m] |
| No peaks detected | | |
| | | |
| | | |
| | | |
| | | |
| Measurement uncertainty | ± 3 dB | |

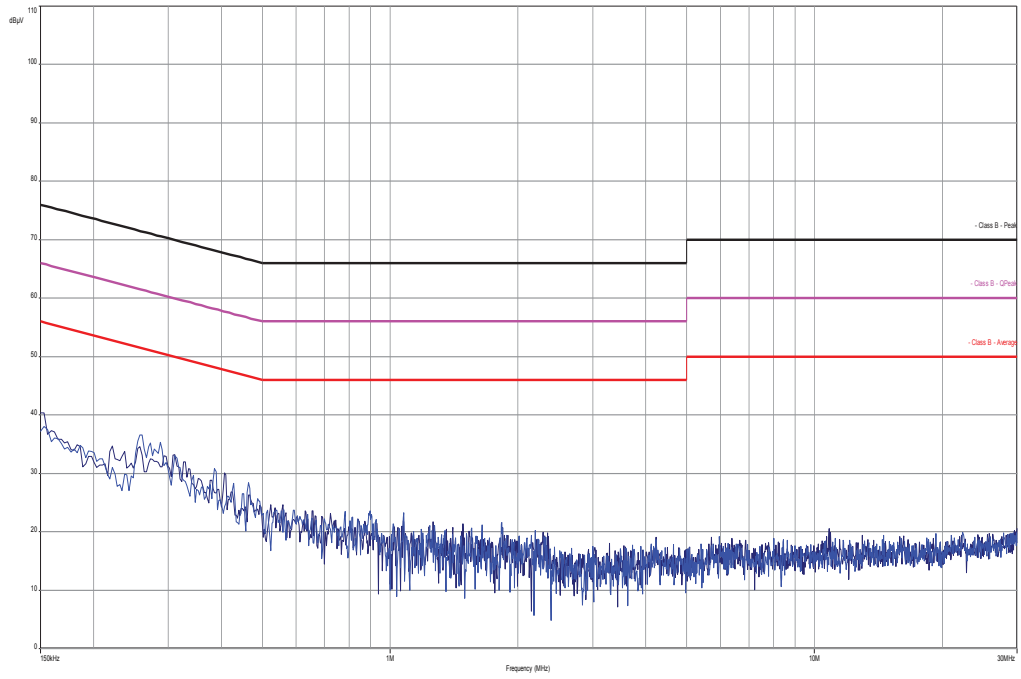
**Result:** Passed

**Plots:**

**Plot 1:** 150 kHz to 30 MHz, TX mode




**Plot 2:** 150 kHz to 30 MHz, RX mode



## 11 Test equipment and ancillaries used for tests

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

| No. | Lab / Item | Equipment | Type | Manufact. | Serial No. | INV. No Cetecom | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 9 | Artificial Mains 9 kHz to 30 MHz | ESH3-Z5 | R&S | 828576/020 | 300001210 | Ve | 30.01.2014 | 30.01.2016 |
| 2 | 9 | Isolating Transformer | MPL IEC625 Bus Regeltrennt ravo | Erfi | 91350 | 300001155 | ne | | |
| 3 | n. a. | Switch / Control Unit | 3488A | HP Meßtechnik | | 300001691 | ne | | |
| 4 | n. a. | Power Supply DC | NGPE 40/40 | R&S | 388 | 400000078 | vlKl! | 21.08.2012 | 21.08.2014 |
| 5 | n. a. | Power Sensor 50 Ohms, 10 MHz - 18 GHz, 1 nW - 20 mW | NRV-Z1 | R&S | 833894/011 | 300002681-0010 | k | 22.08.2012 | 22.08.2014 |
| 6 | n. a. | Hygro-Thermometer | -/-, 5-45°C, 20-100%rF | Thies Clima | -/- | 400000080 | izw | 29.10.2013 | 29.10.2015 |
| 7 | n. a. | Vector Signal Generator, 300 kHz to 2.2 GHz | SMIQ03B | R&S | 835541/055 | 300002681-0001 | k | 18.08.2011 | 18.08.2014 |
| 8 | n. a. | Signal Generator 0.01/2 - 20 GHz, Frequ. Resol. 0.1Hz | SMP02 | R&S | 835133/011 | 300002681-0003 | k | 12.08.2011 | 12.08.2014 |
| 9 | n. a. | Dual Channel Power Meter | NRVD | R&S | 835430/044 | 300002681-0004 | k | 22.08.2012 | 22.08.2014 |
| 10 | n. a. | Signal Analyzer 20Hz-26,5GHz-150 to + 30 DBM | FSIQ26 | R&S | 835540/018 | 300002681-0005 | k | 30.01.2014 | 30.01.2016 |
| 11 | n. a. | Frequency Standard (Rubidium Frequency Standard) | MFS (Rubidium) | R&S (Datum) | 002 | 300002681-0009 | Ve | 21.08.2012 | 21.08.2014 |
| 12 | n. a. | Directional Coupler | 101020010 | Krytar | 70215 | 300002840 | ev | | |
| 13 | n. a. | DC-Blocker | 8143 | Inmet Corp. | none | 300002842 | ne | | |
| 14 | n. a. | Powersplitter | 6005-3 | Inmet Corp. | | 300002841 | ev | | |
| 15 | n. a. | Temperature Test Chamber | VT 4002 | Heraeus Voetsch | 58566046820 010 | 300003019 | Ve | 26.09.2013 | 26.09.2015 |
| 16 | n. a. | CBT (Bluetooth Tester + EDR Signalling) | CBT 1153.9000 K35 | R&S | 100185 | 300003416 | vlKl! | 21.08.2012 | 21.08.2014 |
| 17 | n. a. | Spectrum Analyzer 9kHz to 30GHz - 140..+30dBm | FSP30 | R&S | 100886 | 300003575 | k | 22.08.2012 | 22.08.2014 |
| 18 | n. a. | NRP Power meter Display and control unit AC sup | NRP + NRP-Z81 | R&S | 100212 + 100010 | 300003780 | vlKl! | 22.01.2014 | 22.01.2016 |
| 19 | n. a. | CBT-K57 Software-Option for CBT/CBT32 | CBT-K57 | R&S | 101051 | 300003910 | ne | | |
| 20 | 45 | Switch-Unit | 3488A | HP Meßtechnik | 2719A14505 | 300000368 | g | | |
| 21 | n. a. | EMI Test Receiver | ESCI 3 | R&S | 100083 | 300003312 | k | 27.01.2014 | 27.01.2015 |
| 22 | n. a. | Antenna Tower | Model 2175 | ETS- | 64762 | 300003745 | izw | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | LINDGREN | | | | | |
| 23 | n. a. | Positioning Controller | Model 2090 | ETS-LINDGREN | 64672 | 300003746 | izw | | |
| 24 | n. a. | Turntable Interface-Box | Model 105637 | ETS-LINDGREN | 44583 | 300003747 | izw | | |
| 25 | n. a. | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck | 295 | 300003787 | k | 22.04.2014 | 21.04.2016 |
| 26 | n. a. | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO Elektronik | 9709-5290 | 300000212 | k | 23.07.2013 | 23.07.2015 |
| 27 | n. a. | Highpass Filter | WHK1.1/15G-10SS | Wainwright | 37 | 400000148 | ne | | |
| 28 | n. a. | Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 18 | 300003789 | ne | | |
| 29 | n. a. | Spectrum-Analyzer | FSU26 | R&S | 200809 | 300003874 | k | 22.01.2014 | 22.01.2015 |
| 30 | n. a. | Broadband Amplifier 0.5-18 GHz | CBLU5184540 | CERNEX | 22050 | 300004482 | ev | | |
| 31 | n. a. | 4U RF Switch Platform | L4491A | Agilent Technologies | MY50000032 | 300004510 | ne | | |
| 32 | n. a. | Messrechner und Monitor | Intel Core i3 3220/3,3 GHz, Prozessor | | 2V2403033A5421 | 300004591 | ne | | |
| 33 | n. a. | NEXIO EMV-Software | BAT EMC | EMCO | | 300004682 | ne | | |

**Agenda:** Kind of Calibration

| | | | |
|---|---|---|---|
| k | calibration / calibrated | EK | limited calibration |
| ne | not required (k, ev, izw, zw not required) | zw | cyclical maintenance (external cyclical maintenance) |
| ev | periodic self verification | izw | internal cyclical maintenance |
| Ve | long-term stability recognized | g | blocked for accredited testing |
| vlkI! | Attention: extended calibration interval | | |
| NK! | Attention: not calibrated | *) | next calibration ordered / currently in progress |

## 12 Observations

No observations exceeding those reported with the single test cases have been made.

## Annex A Document history

| Version | Applied changes | Date of release |
|---|---|---|
| | Initial release | 2014-05-19 |

## Annex B Further information

**Glossary**

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software

## Annex C Accreditation Certificate

Front side of certificate

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

**Akkreditierung**

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

**CETECOM ICT Services GmbH**
**Untertürkheimer Straße 6-10, 66117 Saarbrücken**

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

**Drahtgebundene Kommunikation einschließlich xDSL**
**VoIP und DECT**
**Akustik**
**Funk einschließlich WLAN**
**Short Range Devices (SRD)**
**RFID**
**WiMax und Richtfunk**
**Mobilfunk (GSM / DCS, Over the Air (OTA) Performance)**
**Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive**
**Produktsicherheit**
**SAR und Hearing Aid Compatibility (HAC)**
**Umweltsimulation**
**Smart Card Terminals**
**Bluetooth**
**Wi-Fi- Services**

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 07.03.2014 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 77 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-00**

Frankfurt am Main, 07.03.2014

Im Auftrag Dipl.-Ing. (FH) Rolf Egner
Abteilungsleiter

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

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ILAC: www.ilac.org
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**Note:**

**The current certificate including annex is published on our website (see link below) or may be received from CETECOM ICT Services on request.**

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