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consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-5579/12-02-10-B



Testing laboratory

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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/Satellite Communications

Applicant

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Manufacturer

Research In Motion Limited
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PLZ Waterloo, ON N2L 3W8 / CANADA

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
Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands):
Category I Equipment

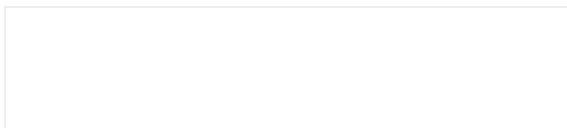
For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item: Blackberry GSM Phones
Model name: RFM121LW
FCC ID: L6ARFM120LW
IC: 2503A-RFM120LW
Frequency: ISM band 2400 MHz to 2483.5 MHz
(lowest channel 2402 MHz, highest channel 2480 MHz)
Technology tested: Bluetooth® +EDR
Antenna: Integrated antenna
Power Supply: 3.8 V DC by Li-Ion battery
Temperature Range: -20°C to +55°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:



Andreas Luckenbill
Expert

Test performed:


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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:	2013-01-04
Date of receipt of test item:	2013-03-20
Start of test:	2013-03-20
End of test:	2013-03-25
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15	2012-10	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio frequency devices
RSS - 210 Issue 8	2010-12	Spectrum Management and Telecommunications - Radio Standards Specification Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

3.1 Measurement guidance

DTS : KDB 558074	2012-04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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4 Test environment

Temperature:	T_{nom}	+20 °C during room temperature tests
	T_{max}	+55 °C during high temperature tests
	T_{min}	-20 °C during low temperature tests
Relative humidity content:		42 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	3.8 V DC by Li-Ion battery
	V_{max}	4.35 V
	V_{min}	3.6 V

5 Test item

Kind of test item	:	Blackberry GSM Phones
Type identification	:	RFM121LW
S/N serial number	:	Rad. IMEI 990002430036416; PIN 303E5B59 IMEI 990002430036317; PIN 303E5B4F Cond. IMEI 990002430024826; PIN 303E55A3
HW hardware status	:	CER-53013-001 Rev2-905-00 (conducted sample)
SW software status	:	127.0.1.4429 (OS Version conducted sample)
Frequency band [MHz]	:	ISM band 2400 MHz to 2483.5 MHz (lowest channel 2402 MHz, highest channel 2480 MHz)
Type of radio transmission	:	FHSS
Use of frequency spectrum	:	
Type of modulation	:	GFSK, Pi/4 DQPSK, 8DPSK
Number of channels	:	79
Antenna	:	Integrated antenna
Power supply	:	3.8 V DC by Li-Ion battery
Temperature range	:	-20°C to +55°C

5.1 Additional information

Test setup- and EUT-photos are included in test reports: 1-5579/12-02-01_AnnexA
1-5579/12-02-01_AnnexD

6 Test laboratories sub-contracted

None

7 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 RSS 210, Issue 8, Annex 8	Passed	2013-04-04	-/-

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

Note: NA = Not Applicable; NP = Not Performed

8 RF measurements

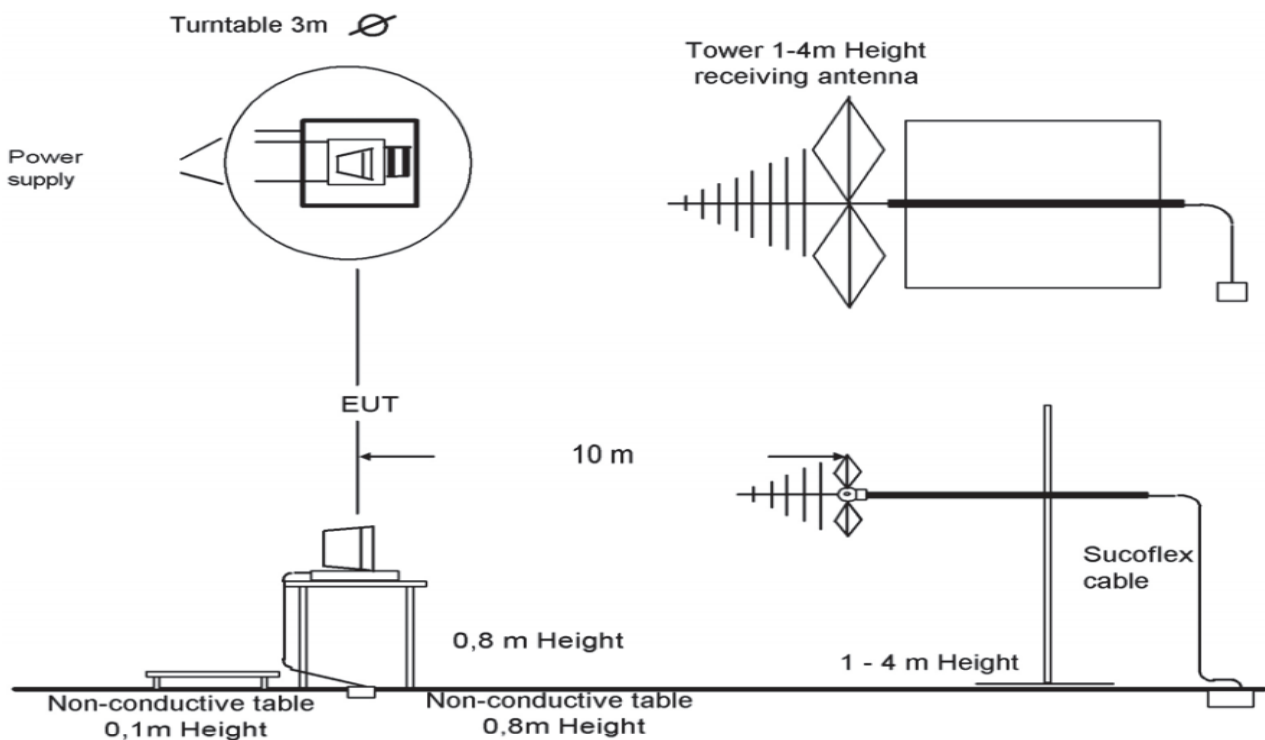
8.1 Description of test setup

8.1.1 Radiated measurements

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 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 C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5. 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 C63-4-2003 clause 4.2.

Antennas are confirmed with ANSI C63.2-1996 item 15.

Semi anechoic chamber



Picture 1: Diagram radiated measurements

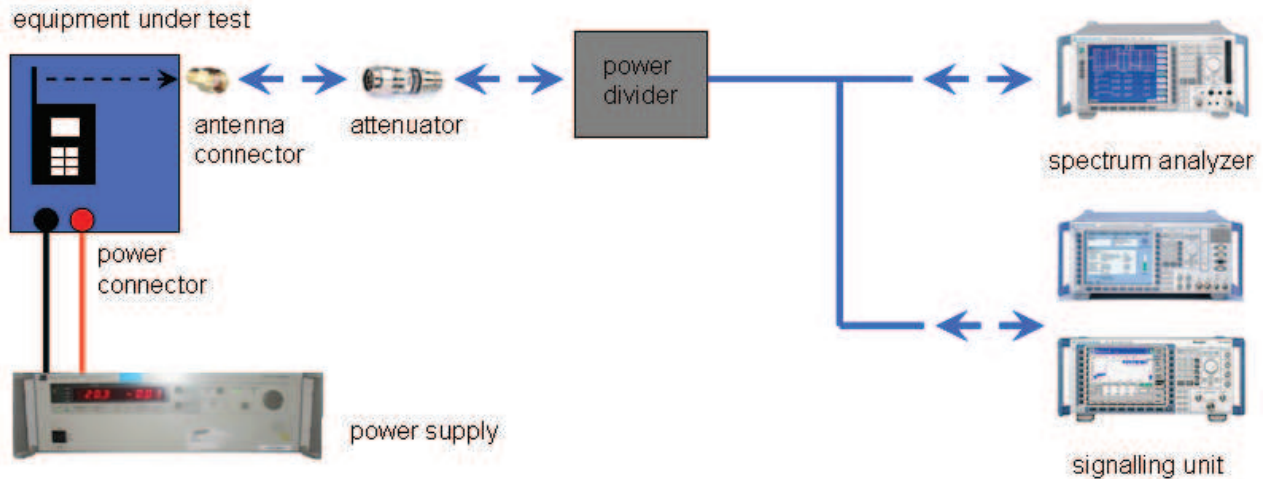
9 kHz - 30 MHz:	active loop antenna
30 MHz – 1 GHz:	tri-log antenna
> 1 GHz:	horn antenna

All measurements are done in accordance with the Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705 and Appendix A "BLUETOOTH® APPROVALS"

The EUT is powered by an external power supply with nominal voltage. The signalling is performed from outside the chamber with a signalling unit (CMU200 or other) by air link using signalling antenna.

8.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is first 10dB attenuated before it is power divided (~6dB loss per branch). One of the signal paths is connected to the communication base Station (CMU200 or other), the other one is connected to the spectrum analyzer. The specific losses for both signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



Picture 2: Diagram conducted measurements

8.2 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

9 Measurement results

9.1 Antenna gain

Not performed! Tests according to manufacturer test plan!

9.2 Power spectral density

Description:

Measurement of the power spectral density of a digital modulated system. This requirement is only valid for digitally modulated systems without hopping functionality.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	500 s
Video bandwidth:	3 kHz
Resolution bandwidth:	3 kHz
Span:	150 kHz
Trace-Mode:	Max Hold

Limits:

FCC	IC
Power Spectral Density	
For digitally modulated systems the transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration.	

Results:

Modulation	Power spectral density [dBm/3kHz]		
	2412 MHz	2437 MHz	2462 MHz
Frequency			
GFSK	Not required for hopping systems!		
Pi/4 DQPSK			
8DPSK			
Measurement uncertainty	± 1.5 dB		

9.3 Frequency & Power stability

Additional measurements according to manufacturers test plan

Channel Number	Nominal Frequency (MHz)	DC Input Voltage (Volts)	Test Temperature (Celsius)	MIN Frequency Error - (kHz)	MAX Frequency Error + (kHz)	Average Burst Power (dBm)
0	2402	3,6	20	0,9	19,8	10,5
39	2441	3,6	20	-7,0	13,9	10,9
78	2480	3,6	20	-14,1	7,5	9,6
0	2402	3,8	20	-0,1	18,4	10,5
39	2441	3,8	20	-6,0	13,6	10,9
78	2480	3,8	20	-14,9	12,4	9,6
0	2402	4,35	20	1,5	18,8	10,5
39	2441	4,35	20	-6,1	12,4	10,9
78	2480	4,35	20	-14,1	8,0	9,5
0	2402	3,6	-20	5,5	24,6	10,9
39	2441	3,6	-20	0,1	17,8	11,1
78	2480	3,6	-20	-7,3	12,3	10,0
0	2402	3,8	-20	6,9	24,9	10,4
39	2441	3,8	-20	-2,1	17,5	10,8
78	2480	3,8	-20	-9,8	8,4	9,6
0	2402	4,35	-20	2,2	21,9	10,5
39	2441	4,35	-20	-1,4	13,8	11,1
78	2480	4,35	-20	-9,5	8,8	9,6
0	2402	3,6	55	-8,0	6,9	10,1
39	2441	3,6	55	-15,2	0,8	10,2
78	2480	3,6	55	-24,4	-5,1	8,7
0	2402	3,8	55	-7,3	7,8	10,1
39	2441	3,8	55	-15,9	2,6	10,3
78	2480	3,8	55	-22,1	-5,4	8,8
0	2402	4,35	55	-8,7	8,5	10,1
39	2441	4,35	55	-15,8	2,6	10,3
78	2480	4,35	55	-21,0	-5,2	8,7

Result: not rated

9.4 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.	

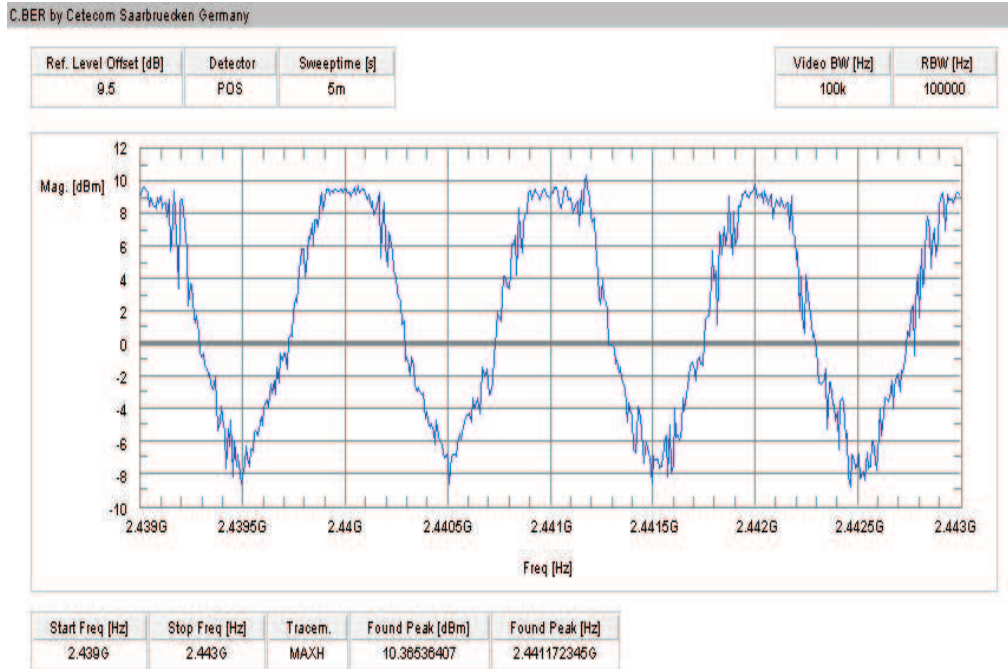
Result:

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

Result: Passed

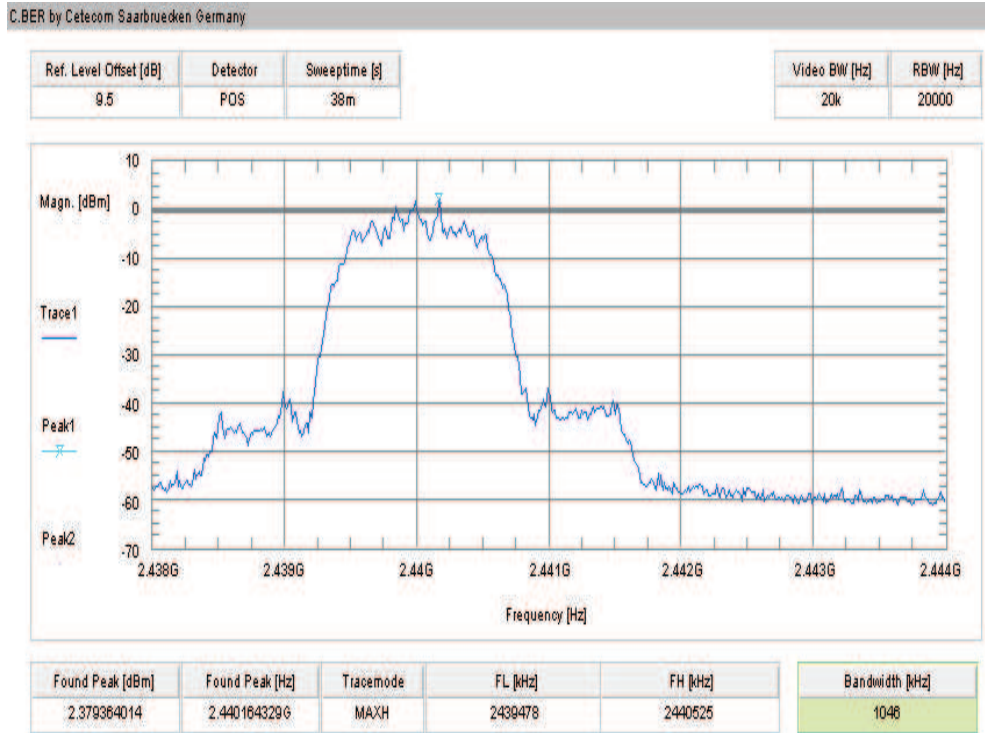
Plot:

Plot 1: Carrier frequency separation (GFSK modulation, hopping mode)

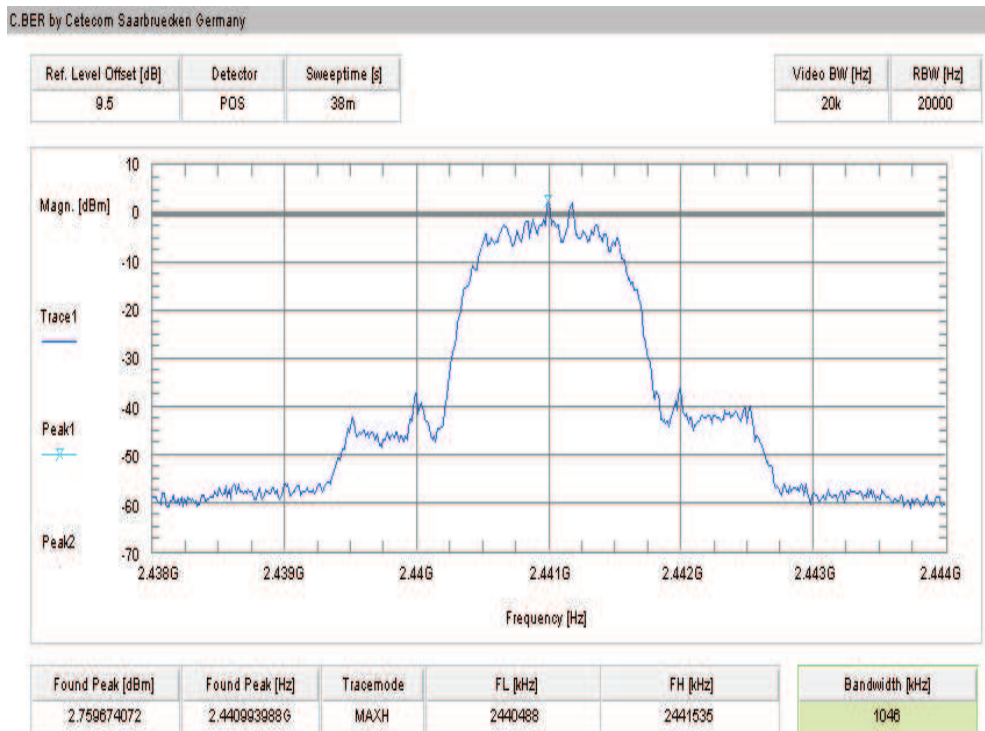


Additional measurements according to manufacturers test plan:

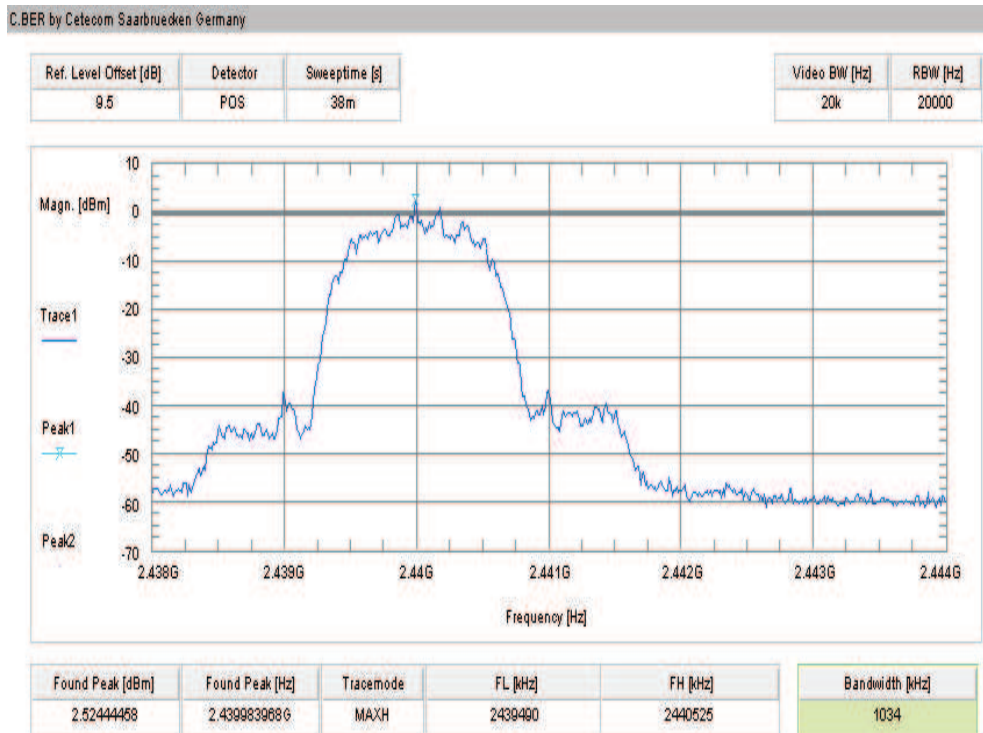
Plot 2: Carrier frequency separation (Pi/4 DQPSK modulation, hopping off, channel 38)



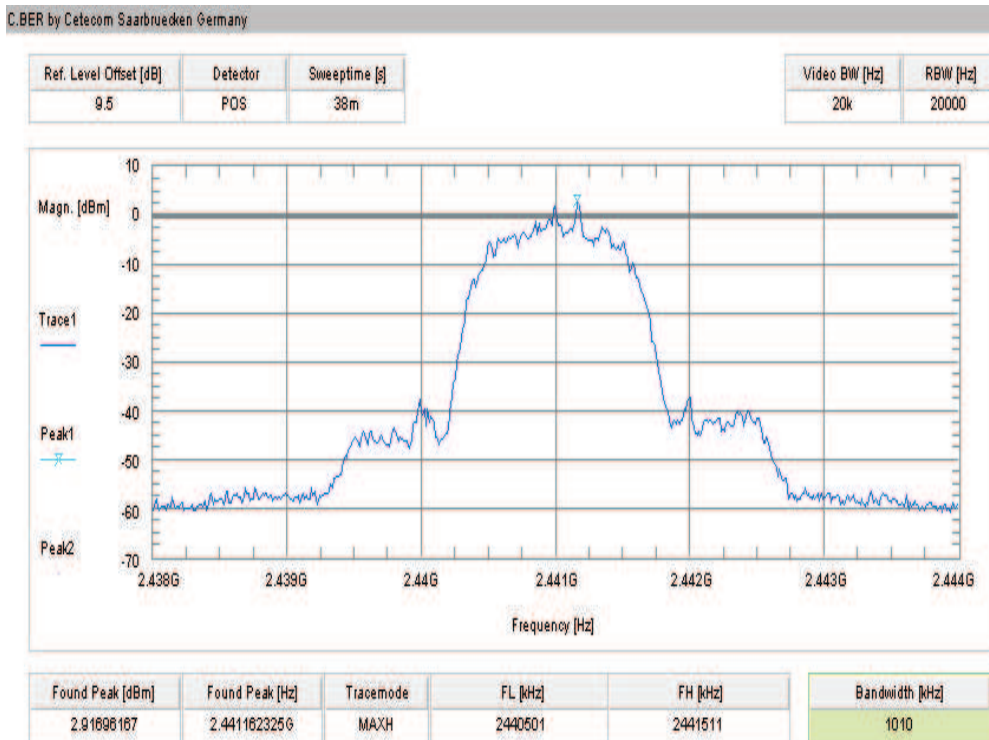
Plot 3: Carrier frequency separation (Pi/4 DQPSK modulation, hopping off, channel 39)



Plot 4: Carrier frequency separation (8DPSK modulation, hopping off, channel 38)



Plot 5: Carrier frequency separation (8DPSK modulation, hopping off, channel 39)



9.5 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 Plot 2: 2445 – 2485 MHz
Trace-Mode:	Max Hold

Limits:

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

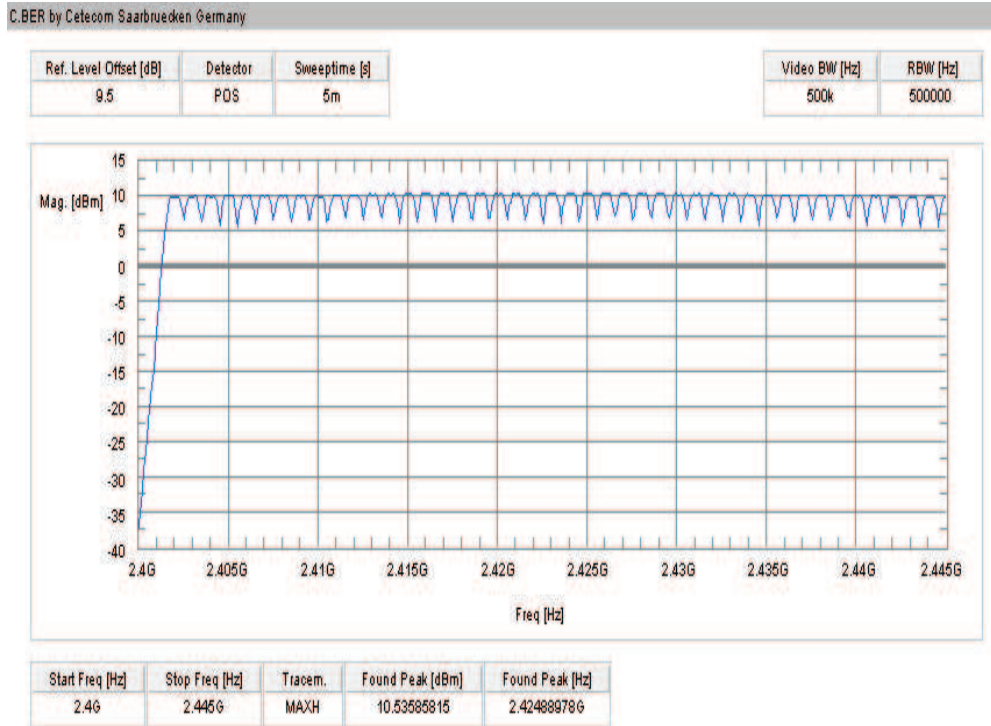
Result:

Number of hopping channels	79
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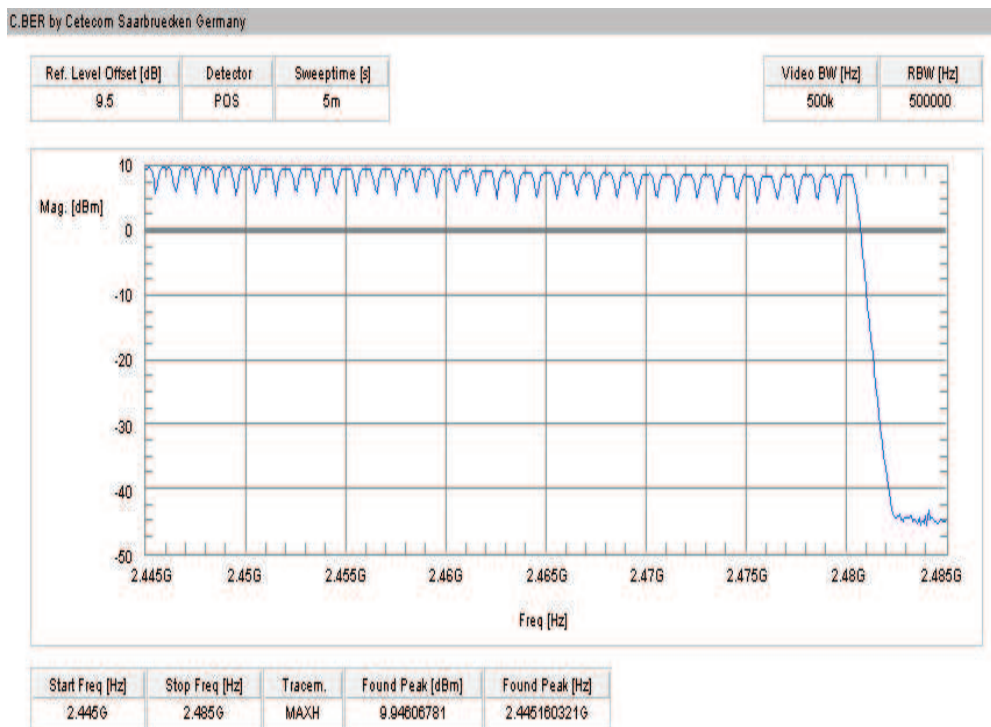
Result: Passed

Plots:

Plot 1: Number of hopping channels (GFSK modulation)



Plot 2: Number of hopping channels (GFSK modulation)



9.6 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 as 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 = $625 \mu\text{s} * 1600 * 1/\text{s} / 79 * 31.6 \text{ s} = 0.4 \text{ s}$ (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 = $3 * 625 \mu\text{s} * 1600/3 * 1/\text{s} / 79 * 31.6 \text{ s} = 0.4 \text{ s}$ (in a 31.6 s period)

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

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

The following table shows the relations:

Packet Size	Pulse Width [ms] *	Max. number of transmissions per channel in 31.6 sec (RX DH1 assumed)
DH1	0.366	320
DH3	1.622	160
DH5	2.870	107

* according to Bluetooth® specification

Results:

Packet Size	Pulse Width [ms]*	Max. number of transmissions in 31.6 sec (RX DH1 assumed)	Dwell time [Pulse width * Number of transmissions]
DH1	0.366	320	117.1
DH3	1.622	160	259.2 ms
DH5	2.870	107	307.1 ms

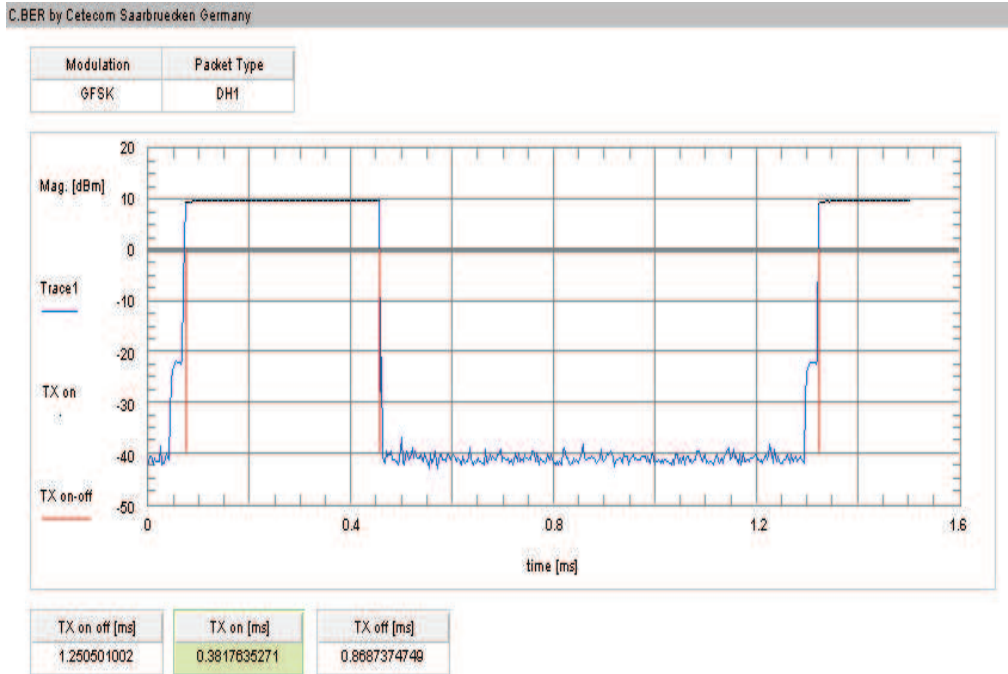
Limits:

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.	

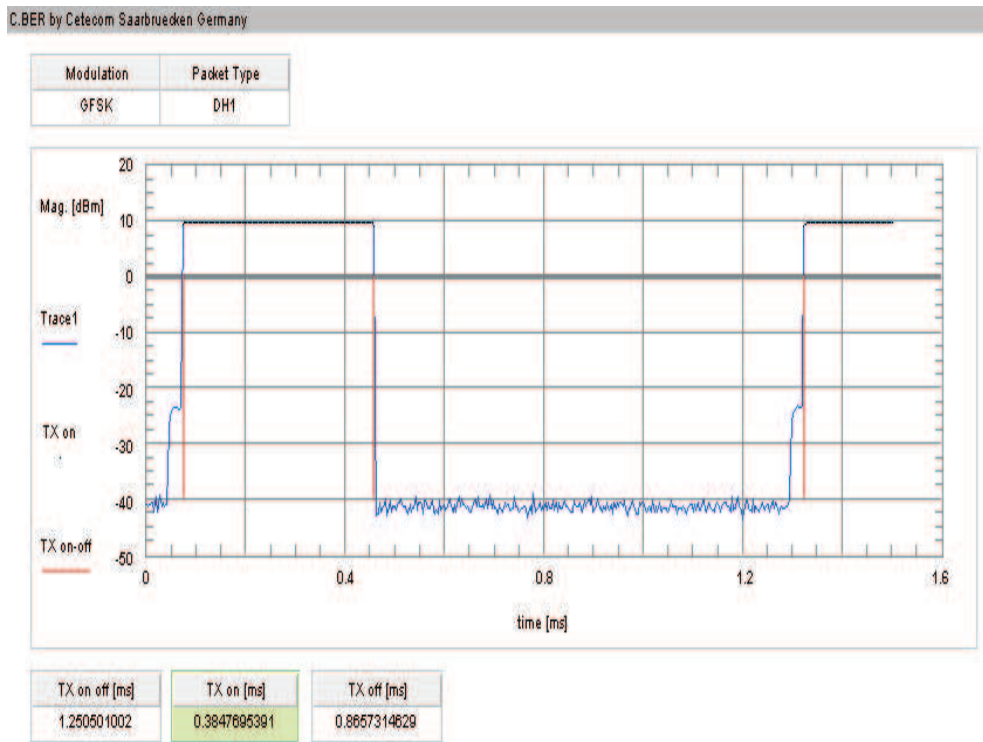
Result: Passed

Additional measurements according to manufacturers test plan:

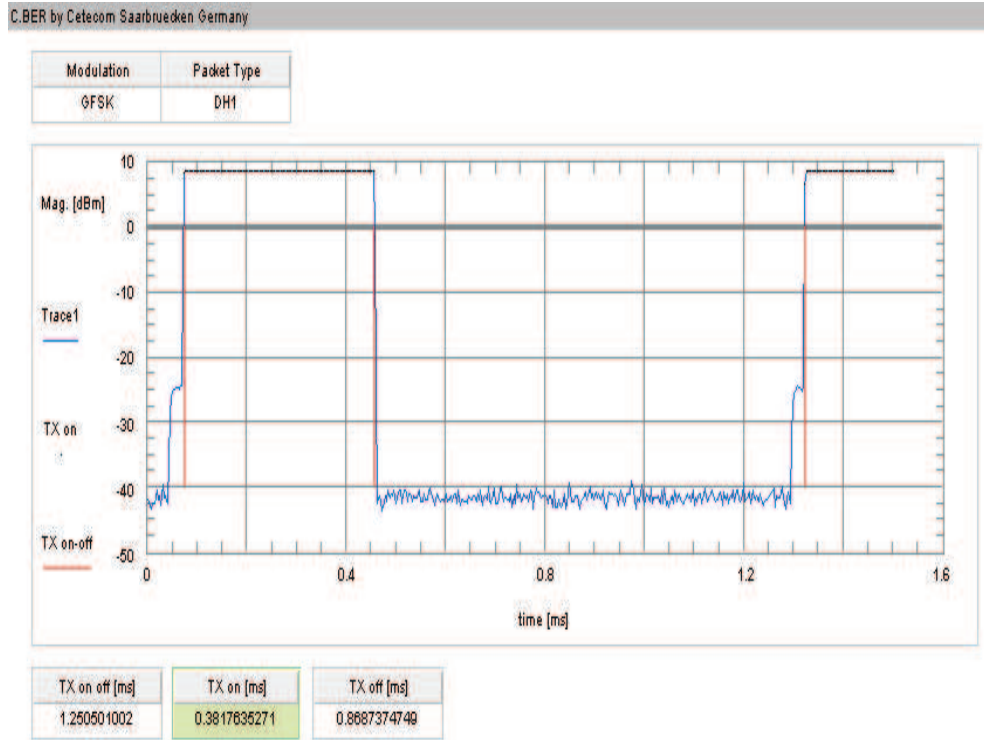
Plot 1: Dwell time DH1, channel 00



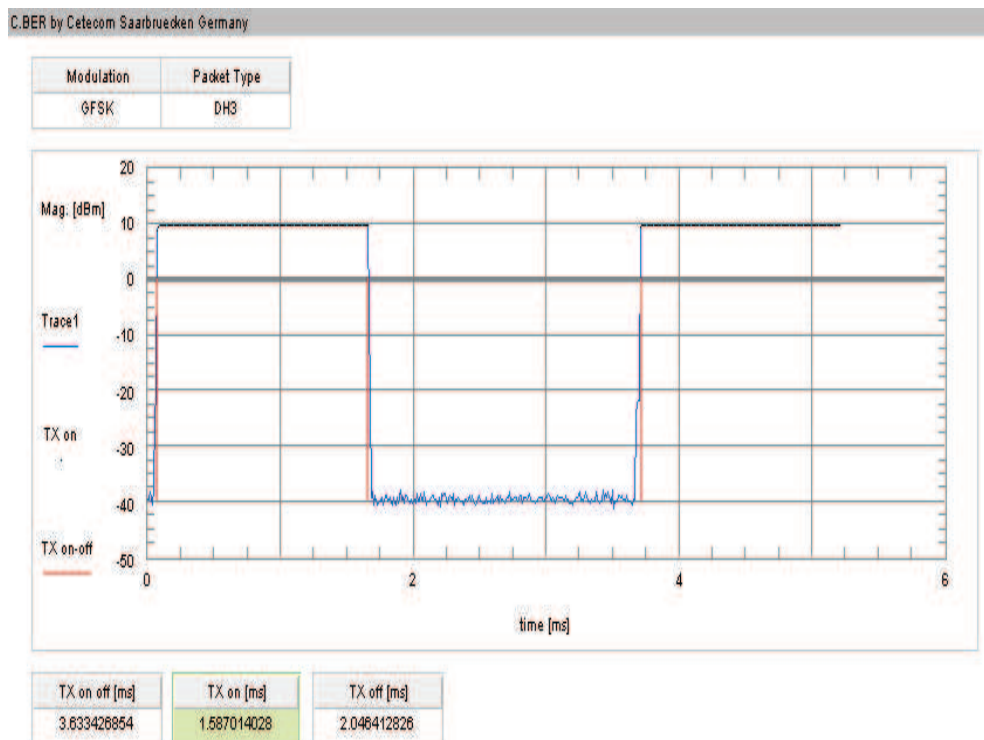
Plot 2: Dwell time DH1, channel 39



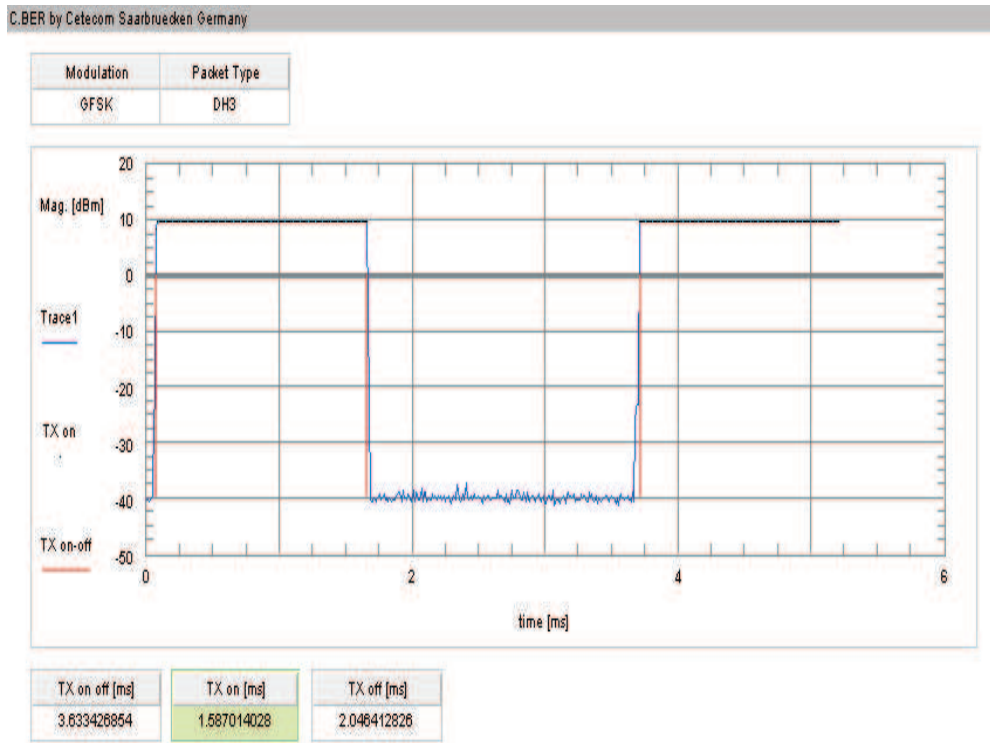
Plot 3: Dwell time DH1, channel 78



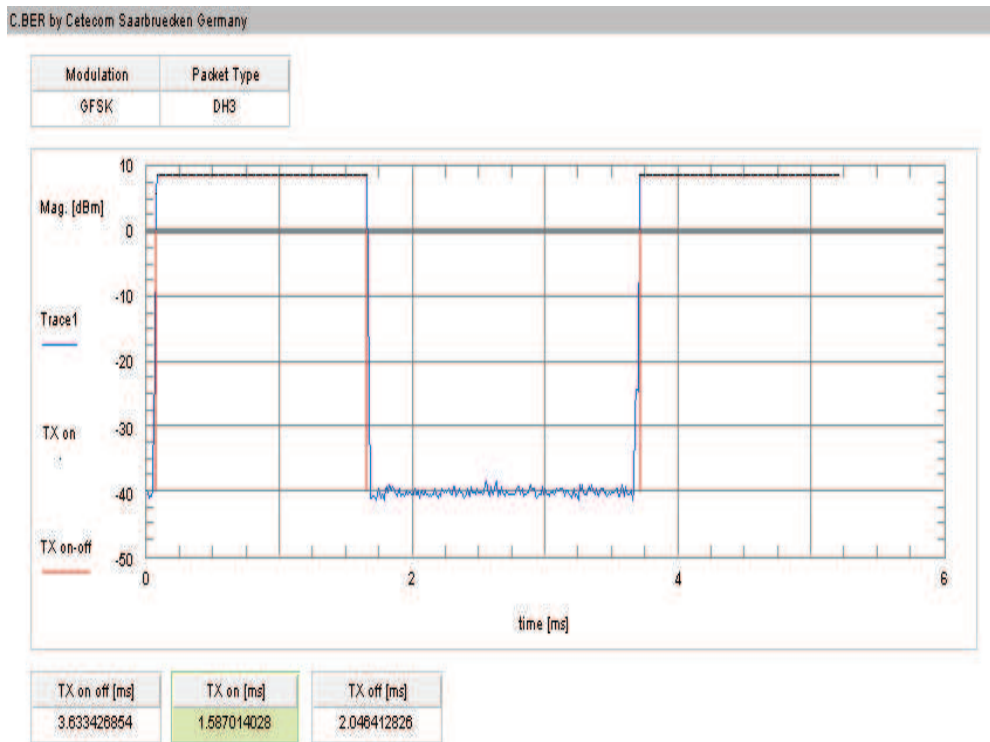
Plot 4: Dwell time DH3, channel 00



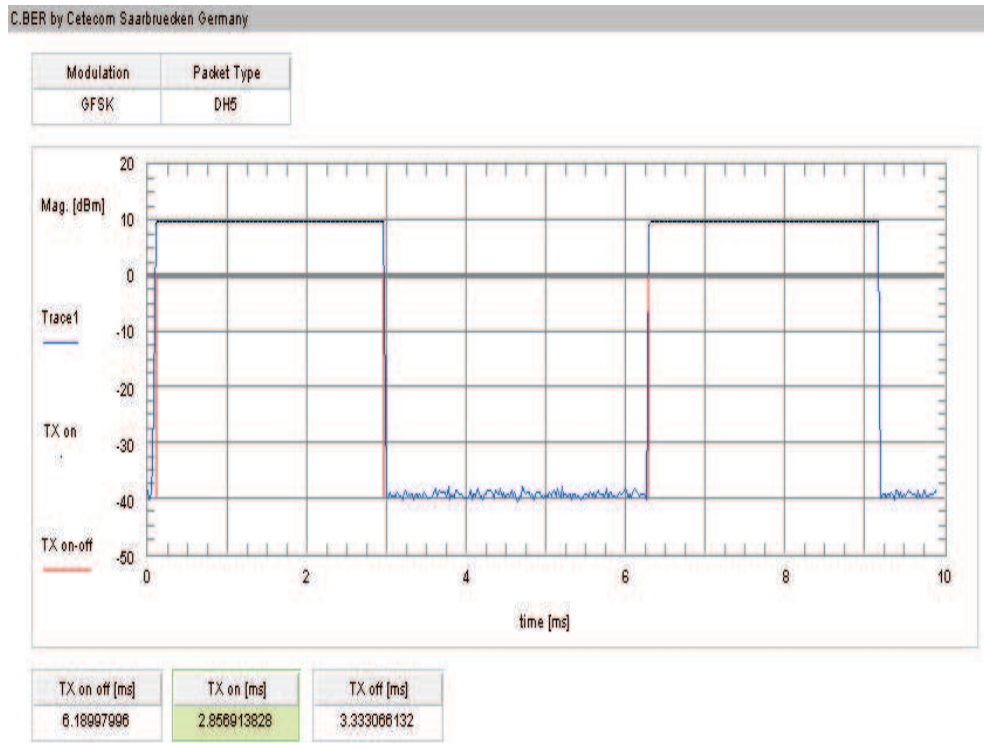
Plot 5: Dwell time DH3, channel 39



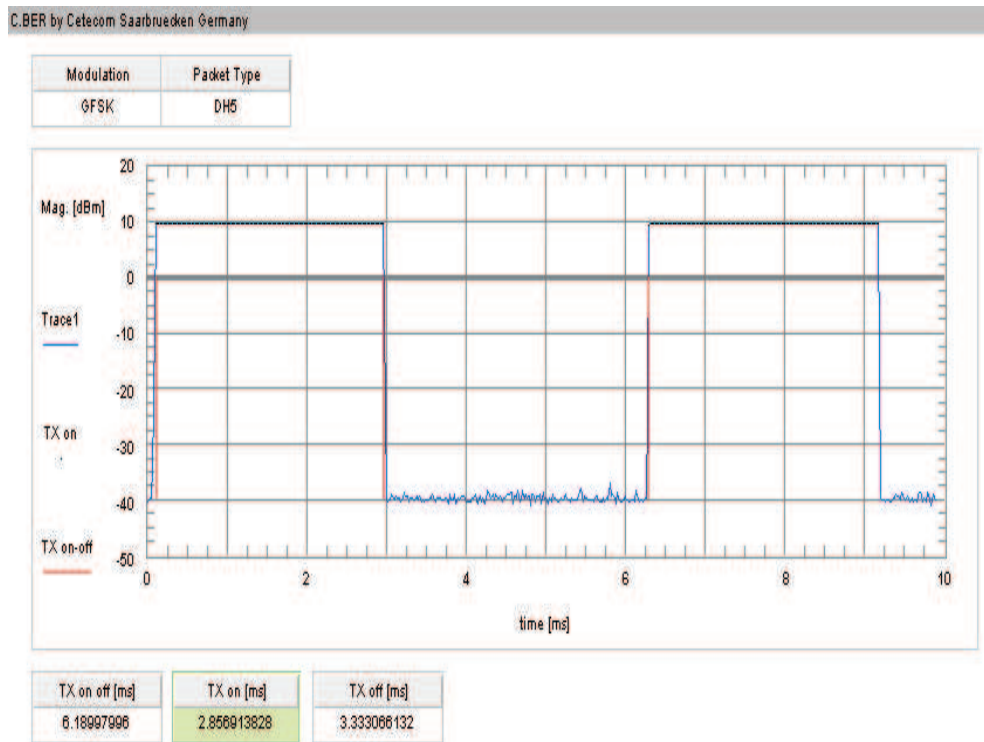
Plot 6: Dwell time DH3, channel 78



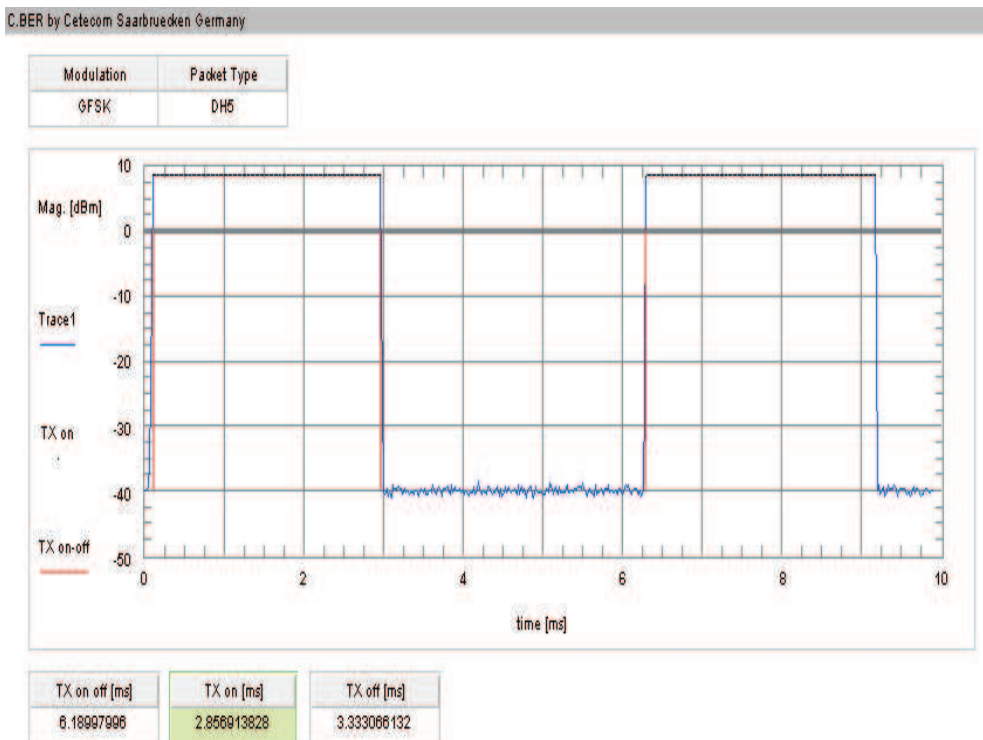
Plot 7: Dwell time DH5, channel 0



Plot 8: Dwell time DH5, channel 39



Plot 9: Dwell time DH5, channel 78



Results:

Channel	Mode	Tx Time (ms)	Dwell Time/31.6 sec. (ms)	Limit (ms.)	Margin (ms)
0	DH1	0,3820	0,382 x 320.0 = 122	400	277,76
39	DH1	0,3850	0,385 x 320.0 = 123	400	276,80
78	DH1	0,3820	0,382 x 320.0 = 122	400	277,76
0	DH3	1,5870	1,587 x 320.0 = 508	400	146,24
39	DH3	1,5870	1,587 x 320.0 = 508	400	146,24
78	DH3	1,5870	1,587 x 320.0 = 508	400	146,24
0	DH5	2,8570	2,857 x 320.0 = 914	400	94,87
39	DH5	2,8570	2,857 x 320.0 = 914	400	94,87
78	DH5	2,8570	2,857 x 320.0 = 914	400	94,87

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

9.7 Spectrum bandwidth of a FHSS system – 20 dB 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:	2 s
Video bandwidth:	30 kHz
Resolution bandwidth:	10 kHz
Span:	3 MHz
Trace-Mode:	Max Hold

Limits:

FCC	IC
Spectrum bandwidth of a FHSS system – 20 dB bandwidth	
GFSK < 1500 kHz Pi/4 DQPSK < 1500 kHz 8DPSK < 1500 kHz	

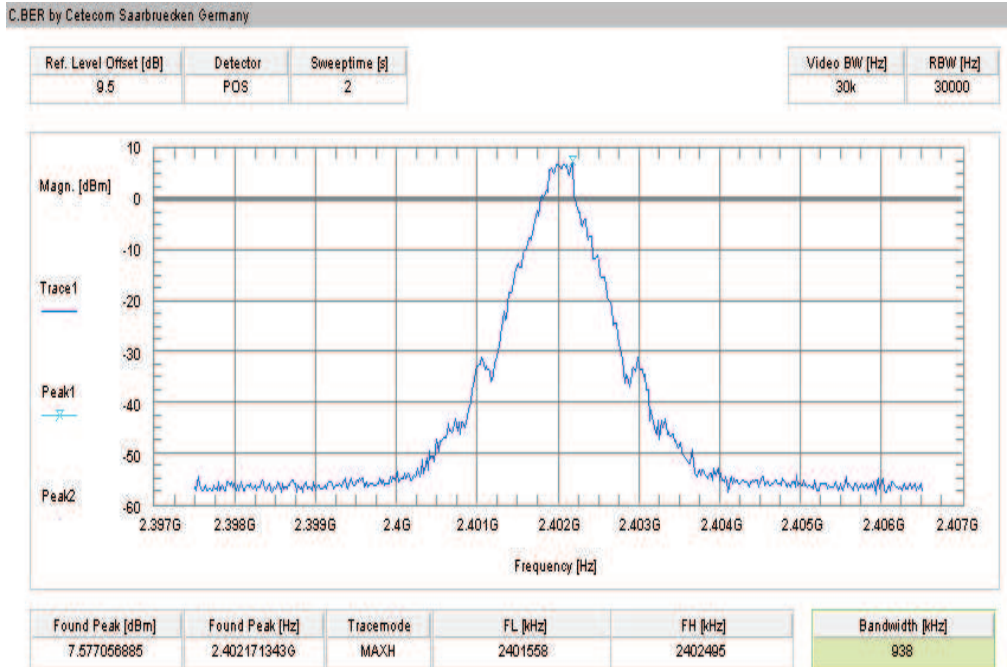
Results:

Modulation	20 dB BANDWIDTH [kHz]		
	2402 MHz	2441 MHz	2480 MHz
Frequency			
GFSK	938	956	992
Pi/4 DQPSK	1335	1353	1335
8DPSK	1317	1317	1317
Measurement uncertainty	± 10 kHz		

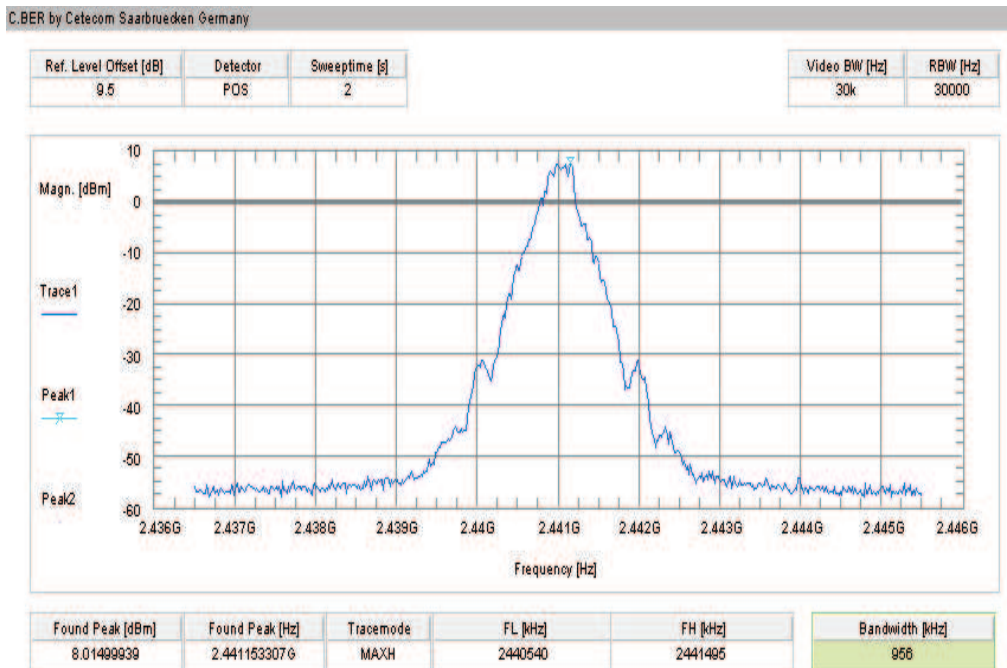
Result: Passed

Plots:

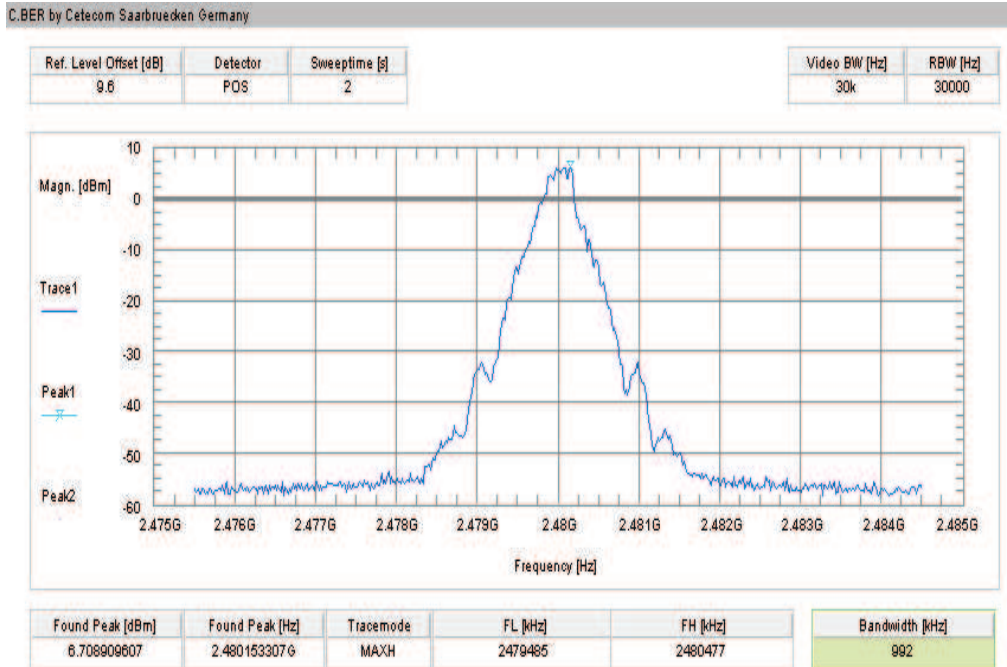
Plot 1: lowest channel – 2402 MHz, GFSK modulation



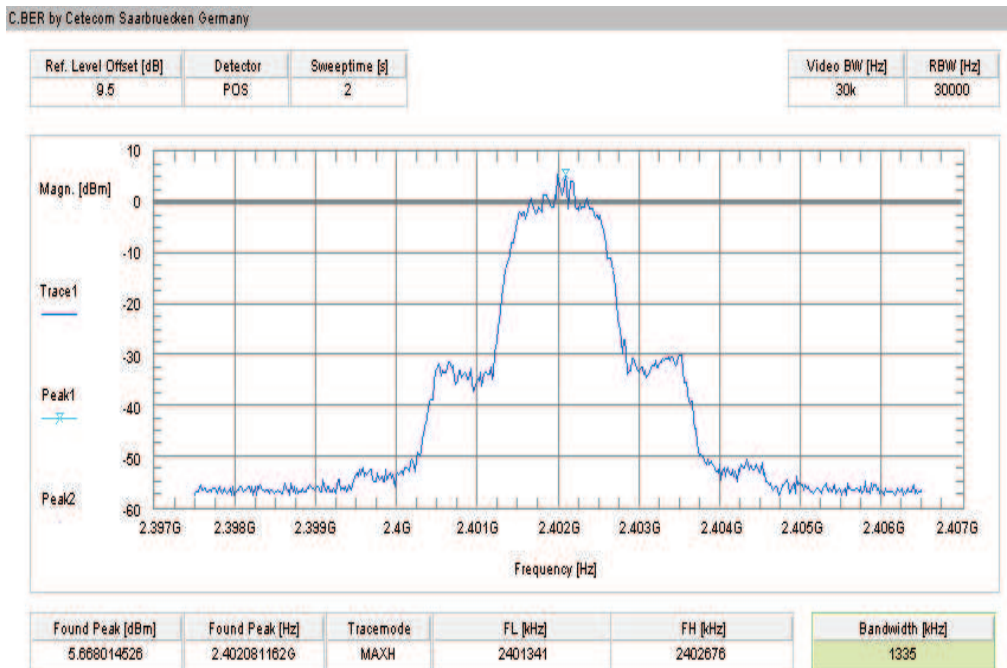
Plot 2: middle channel – 2441 MHz, GFSK modulation



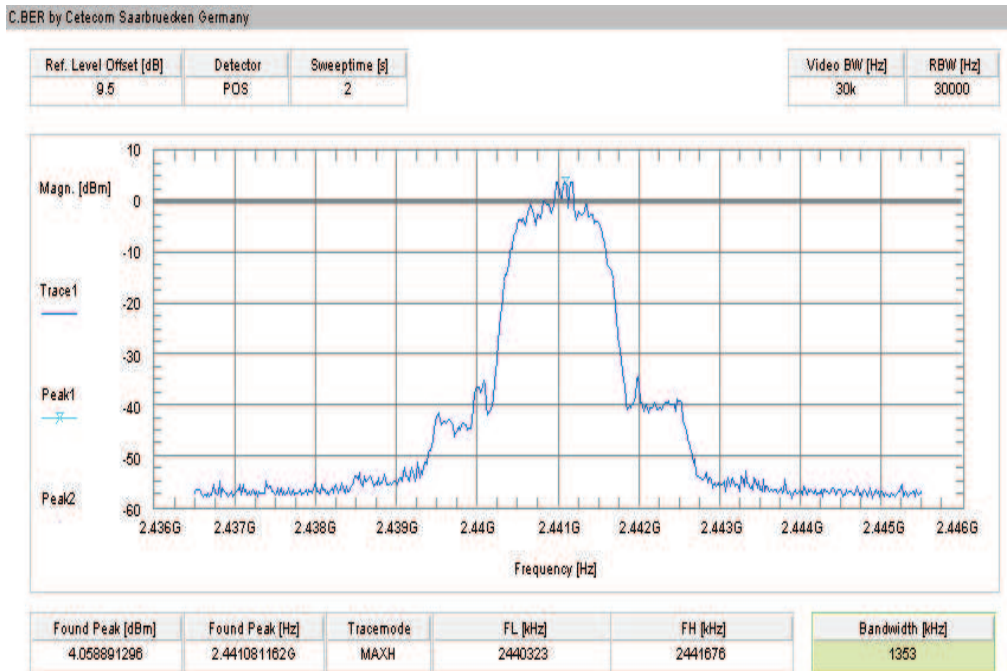
Plot 3: highest channel – 2480 MHz, GFSK modulation



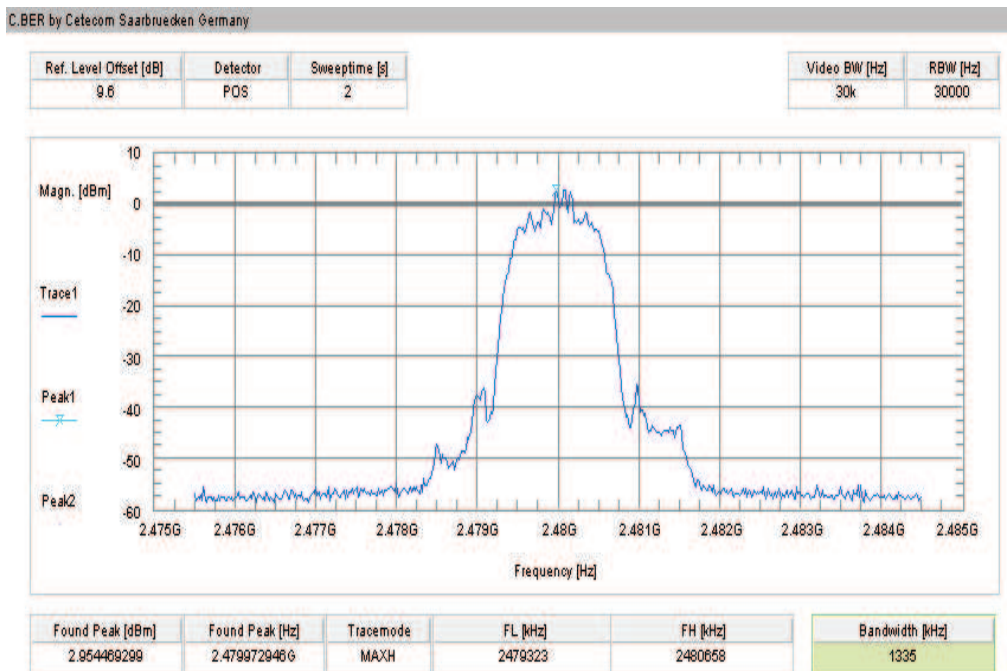
Plot 4: lowest channel – 2402 MHz, Pi / DQPSK modulation



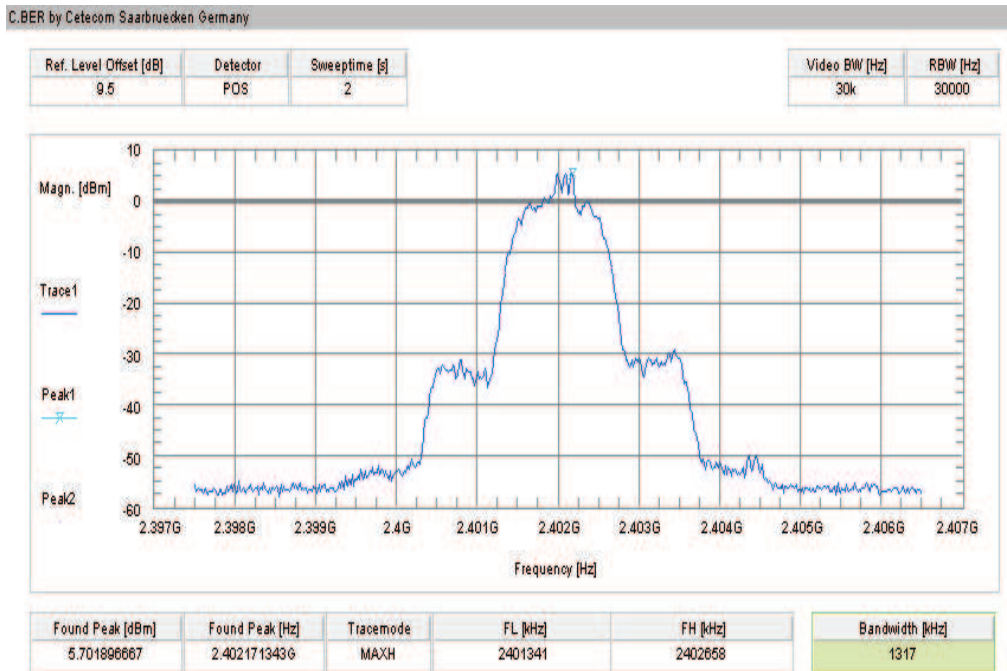
Plot 5: middle channel – 2441 MHz, Pi / DQPSK modulation



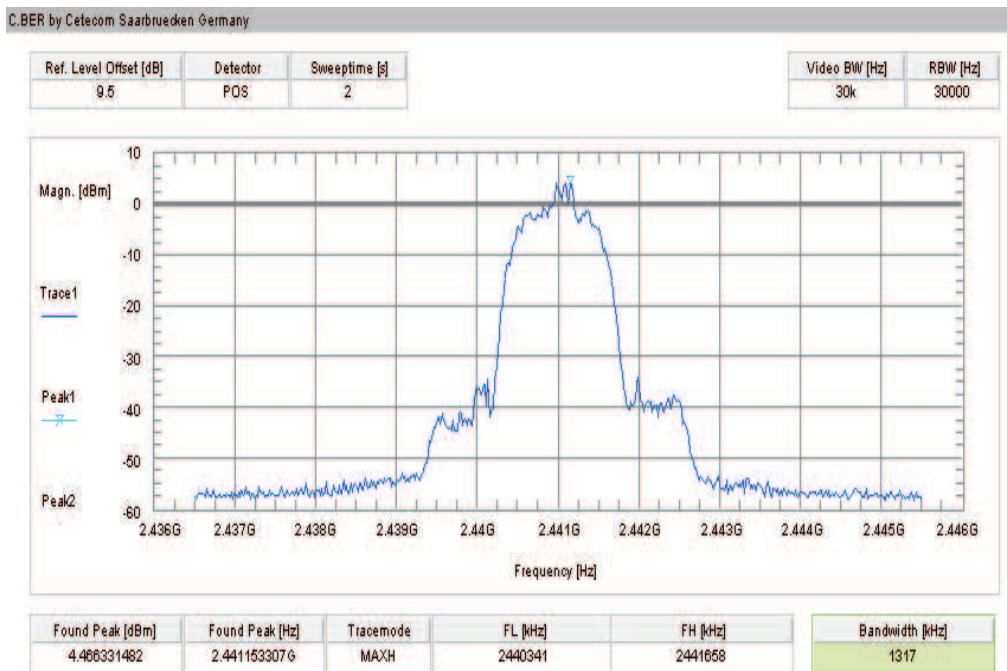
Plot 6: highest channel – 2480 MHz, Pi / DQPSK modulation



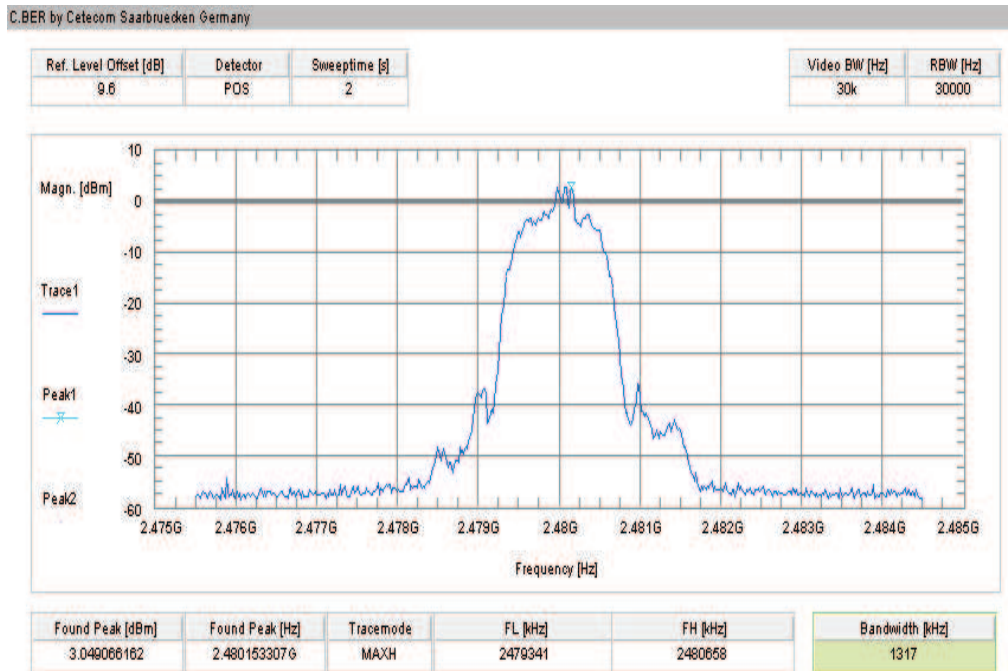
Plot 7: lowest channel – 2402 MHz, 8 DPSK modulation



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



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



9.8 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] Systems using more than 75 hopping channels: Conducted: 1.0 W – antenna gain max. 6 dBi	

Results:

Modulation Frequency	Maximum output power conducted [dBm]		
	2402 MHz	2441 MHz	2480 MHz
GFSK	10.2	10.2	9.0
Pi/4 DQPSK	9.8	9.0	7.7
8DPSK	10.1	9.3	8.2
Measurement uncertainty	± 1 dB		

Result: Passed**Results:**

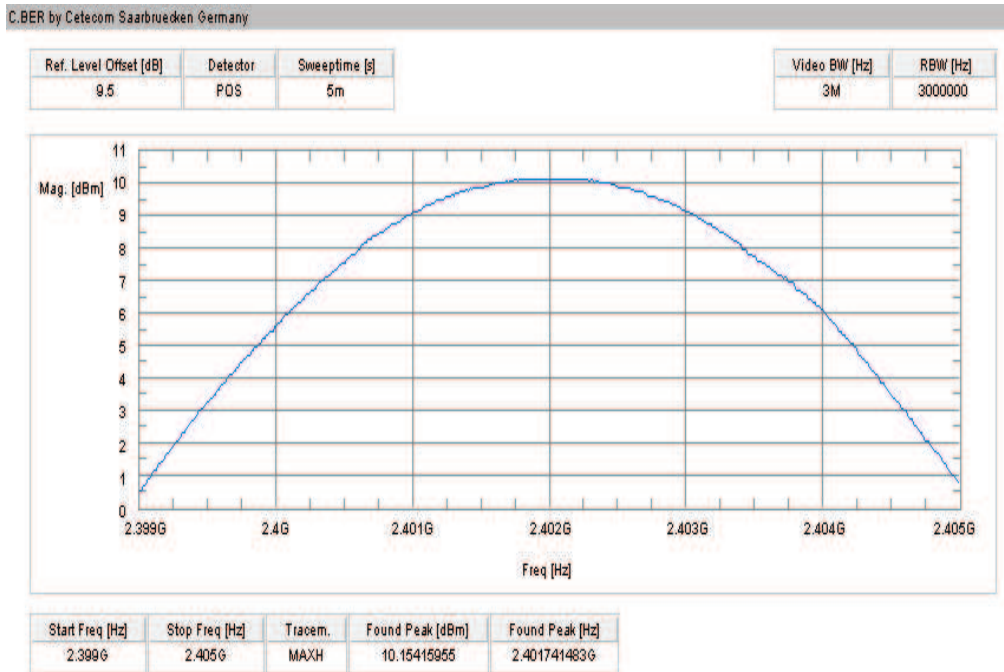
Modulation Frequency	Maximum output power radiated - EIRP [dBm]		
	2402 MHz	2441 MHz	2480 MHz
GFSK	Not performed !		
Pi/4 DQPSK *)			
8DPSK *)			
Measurement uncertainty	± 3 dB		

*) - Values calculated with antenna gain

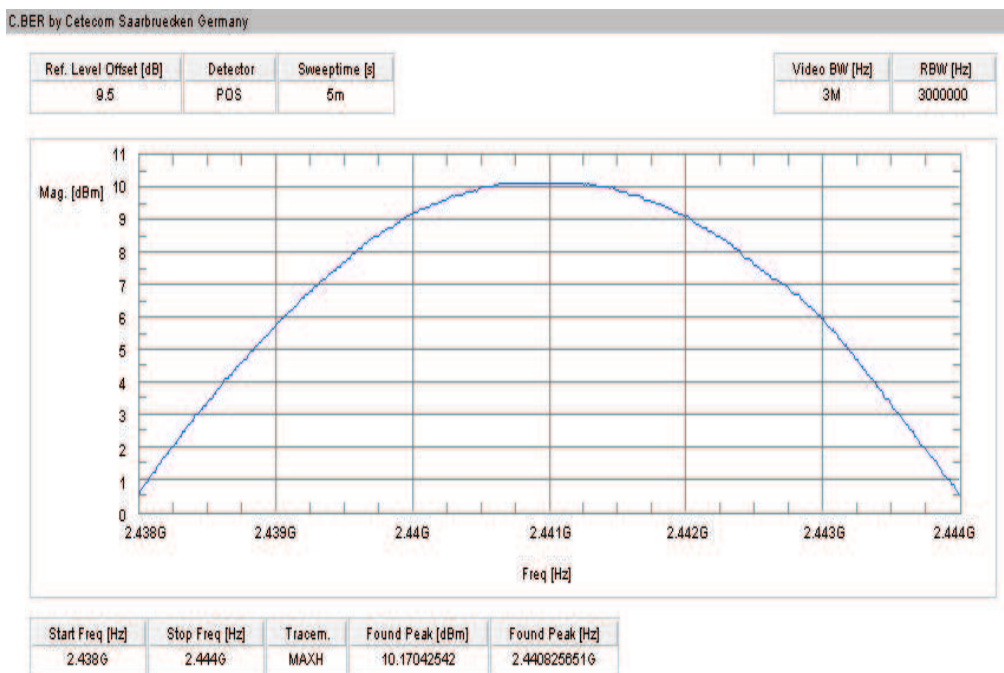
Result: Passed

Plots:

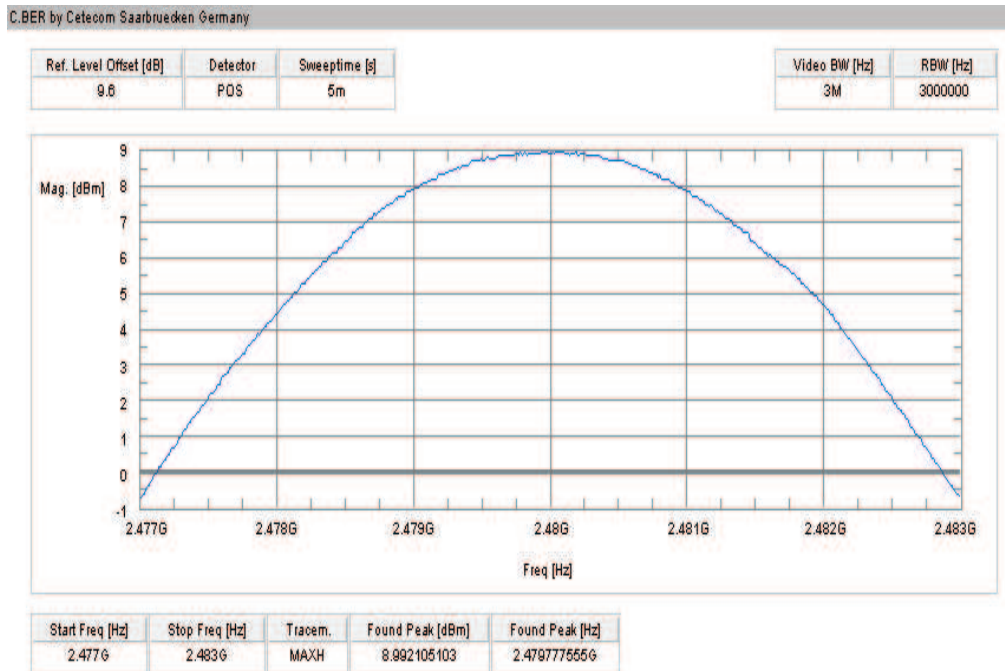
Plot 1: lowest channel – 2402 MHz, GFSK modulation



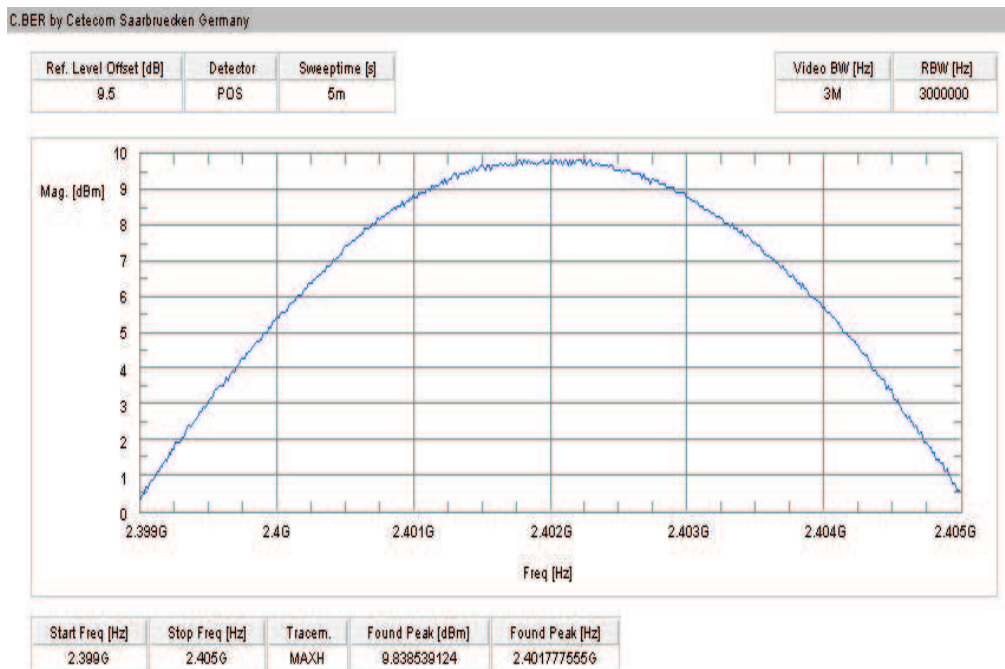
Plot 2: middle channel – 2441 MHz, GFSK modulation



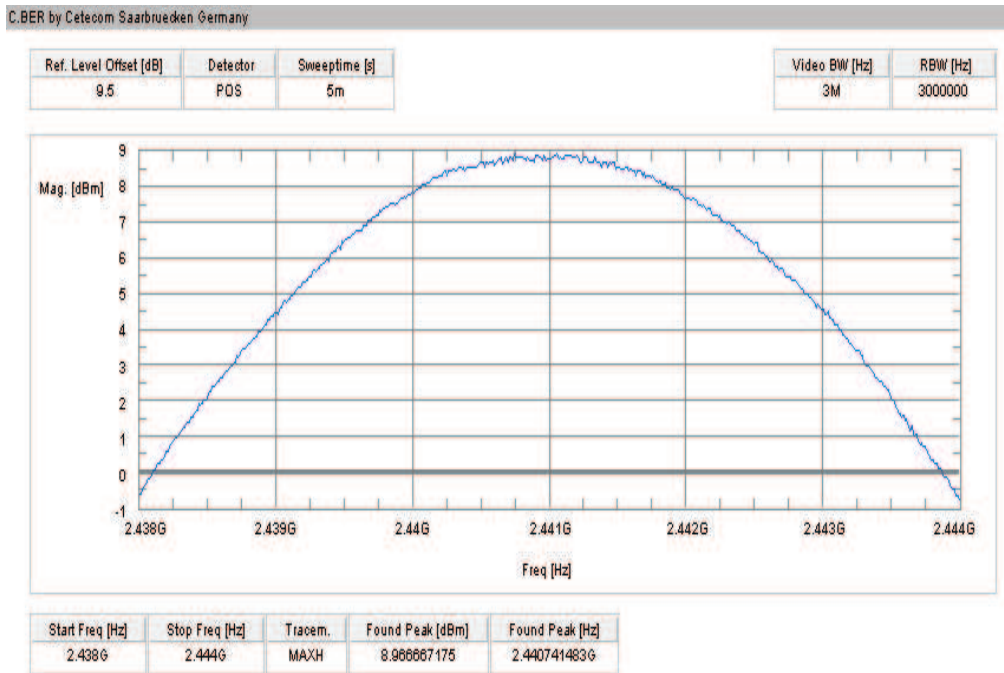
Plot 3: highest channel – 2480 MHz, GFSK modulation



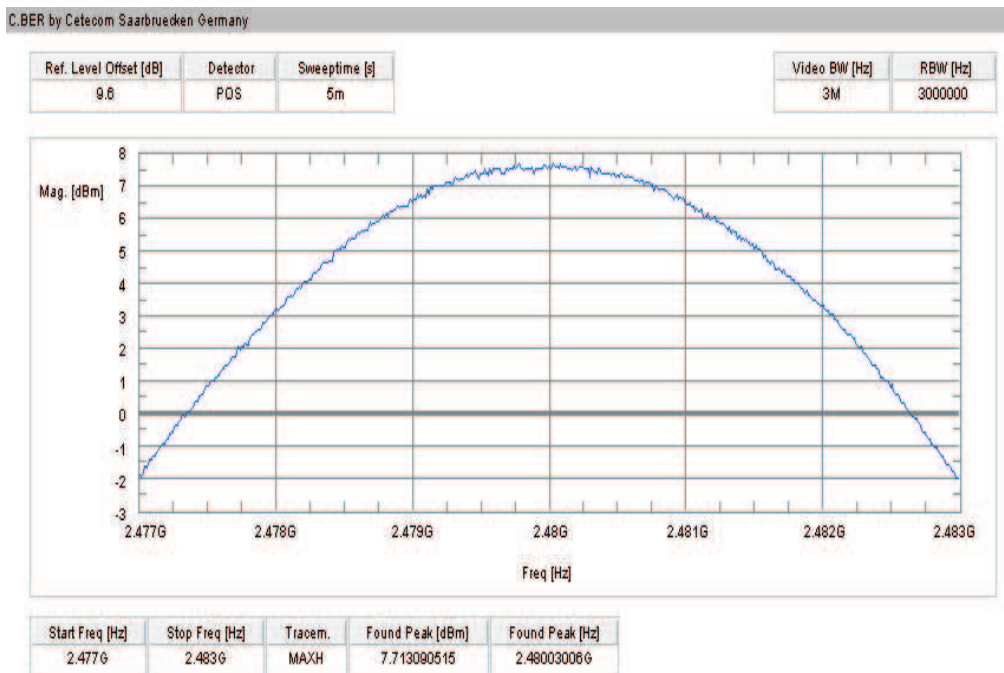
Plot 4: lowest channel – 2402 MHz, Pi / DQPSK modulation



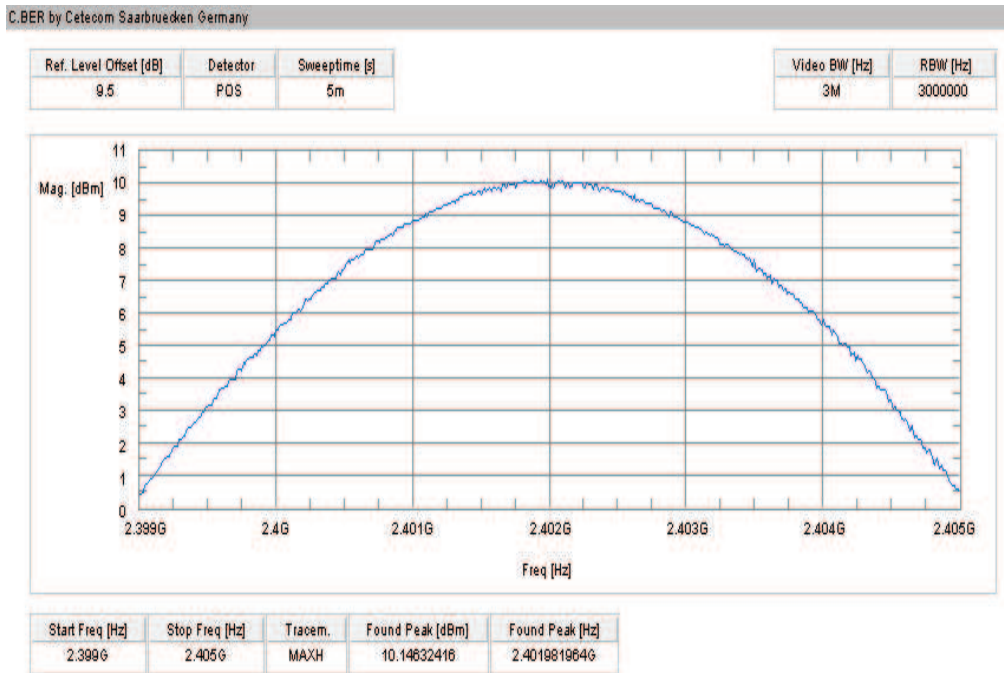
Plot 5: middle channel – 2441 MHz, Pi / DQPSK modulation



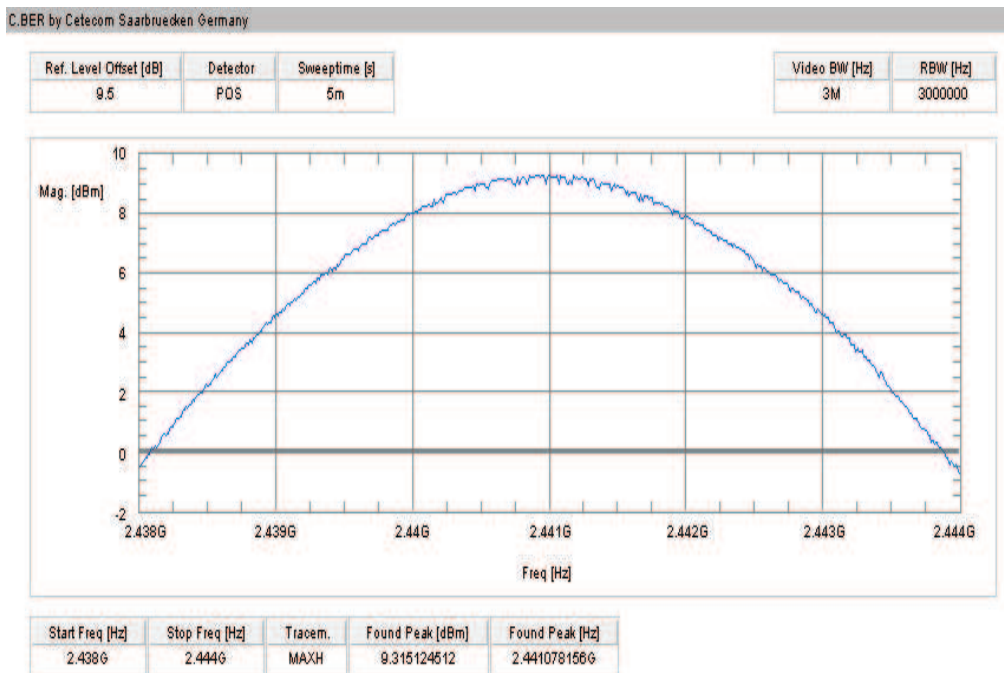
Plot 6: highest channel – 2480 MHz, Pi / DQPSK modulation



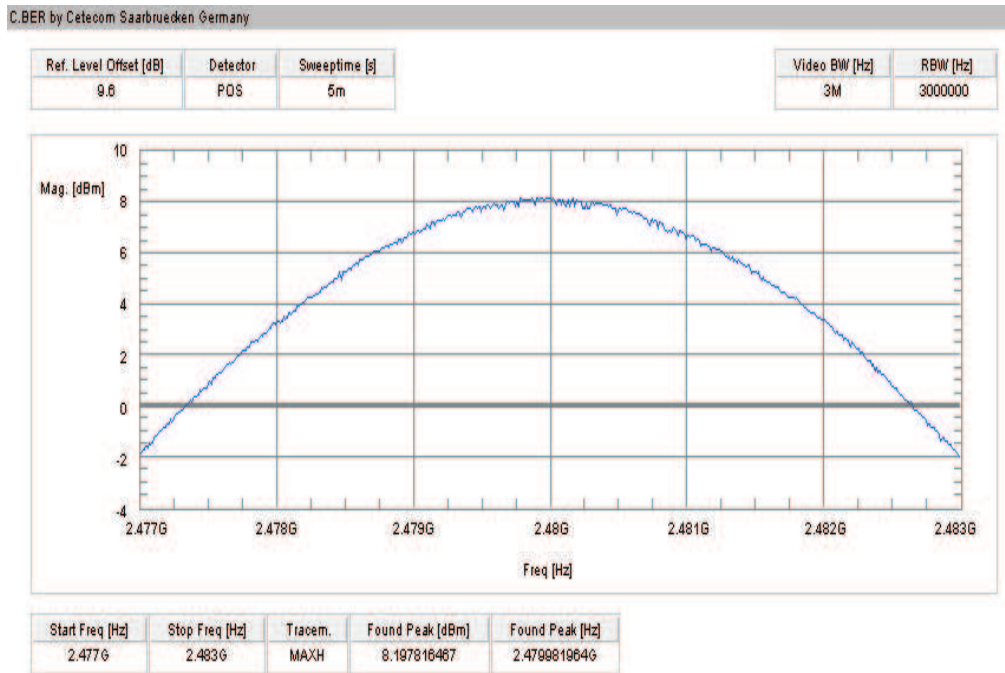
Plot 7: lowest channel – 2402 MHz, 8 DPSK modulation



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



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



9.9 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 higher Band Edge: 2478 – 2489 MHz
Trace-Mode:	Max Hold

Limits:

FCC	IC
Band edge compliance conducted	
<p>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.</p>	

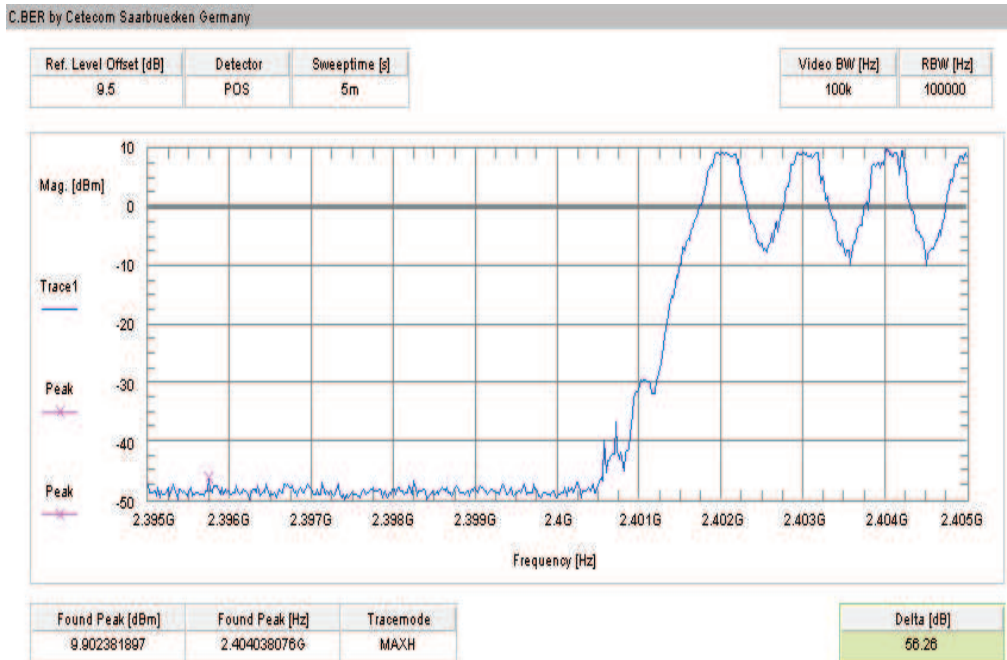
Results:

Scenario Modulation	Band edge compliance conducted [dB]		
	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		

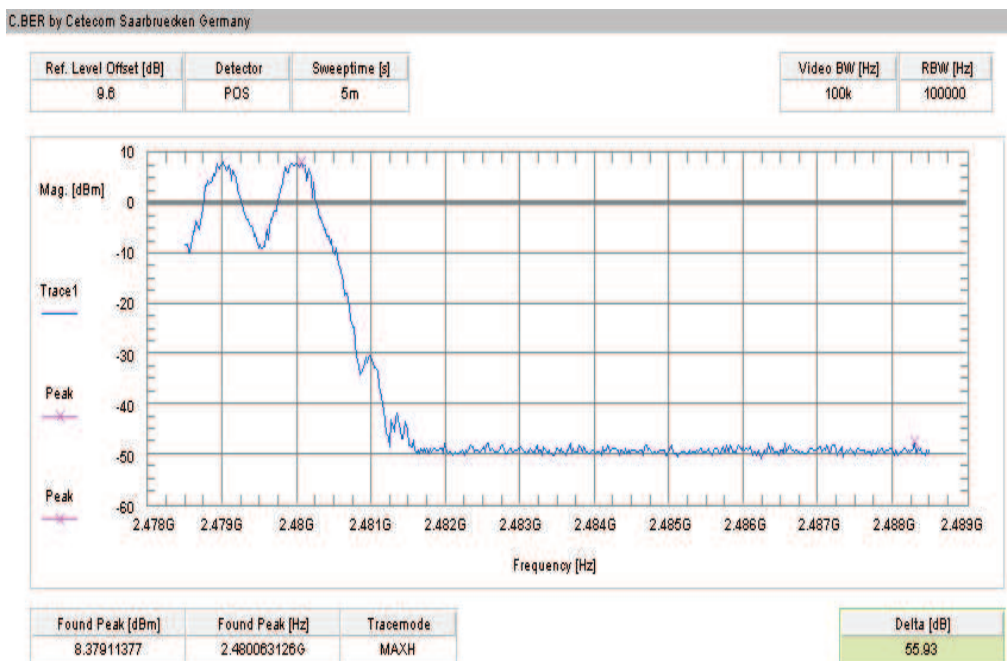
Result: Passed

Plots:

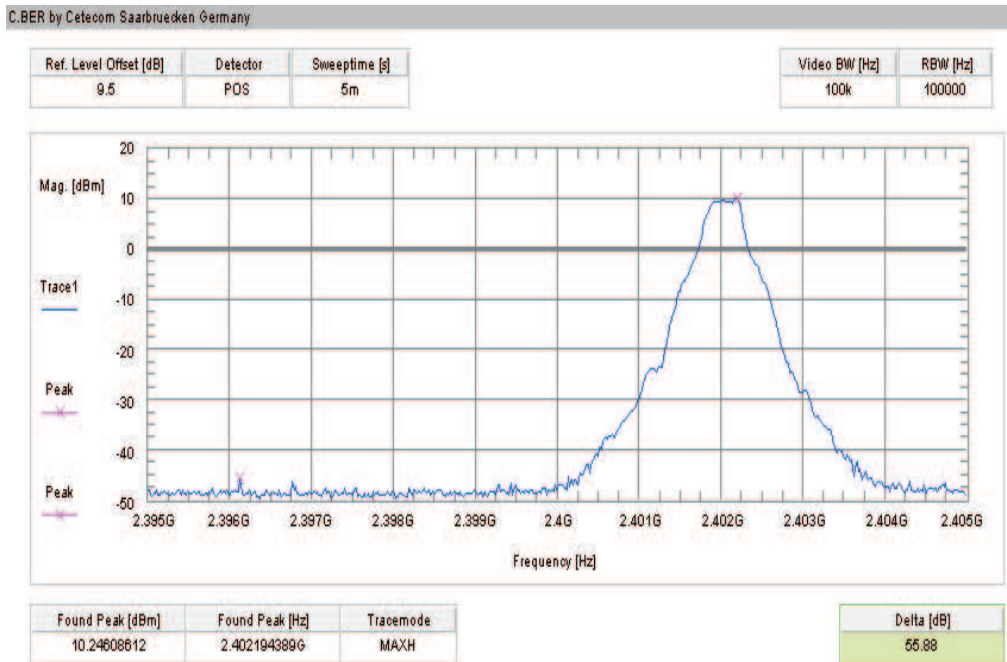
Plot 1: Lower band edge – hopping on, GFSK modulation



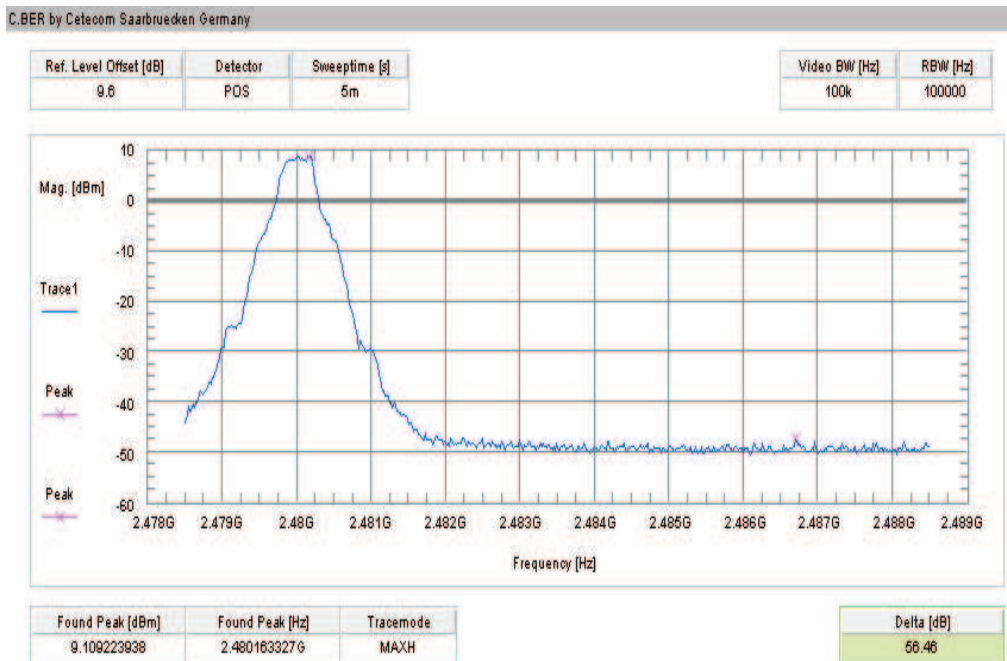
Plot 2: Upper band edge – hopping on, GFSK modulation



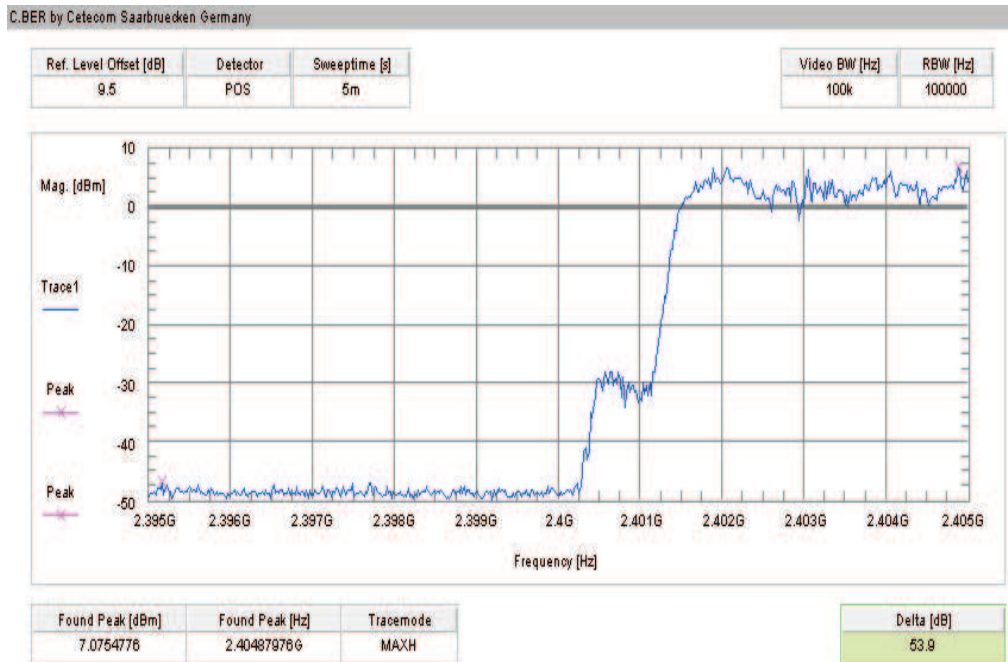
Plot 3: Lower band edge – hopping off, GFSK modulation



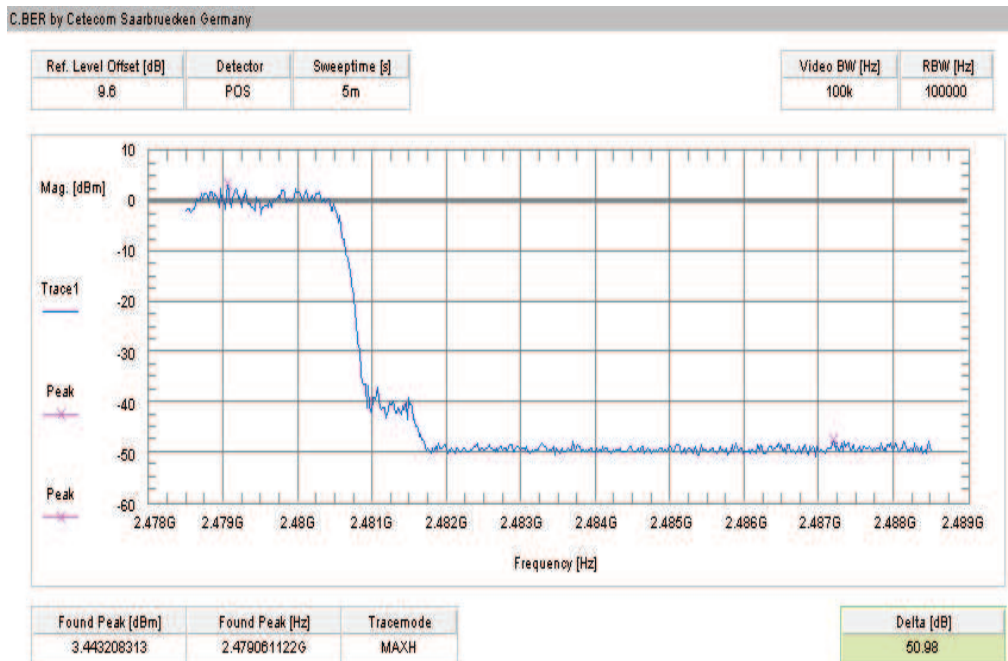
Plot 4: Upper band edge – hopping off, GFSK modulation



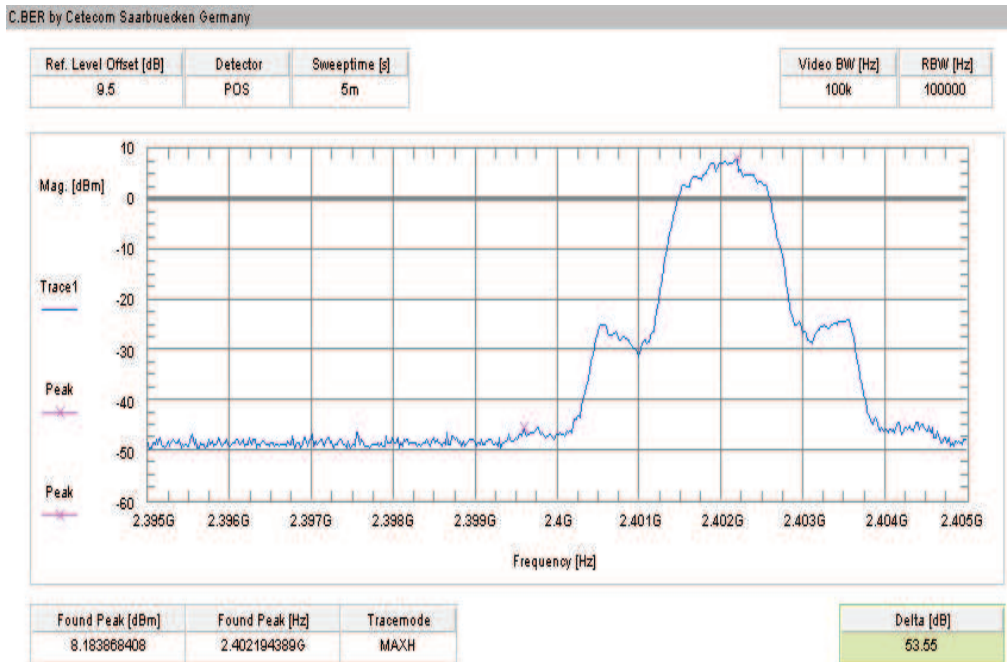
Plot 5: Lower band edge – hopping on, Pi/4 DQPSK modulation



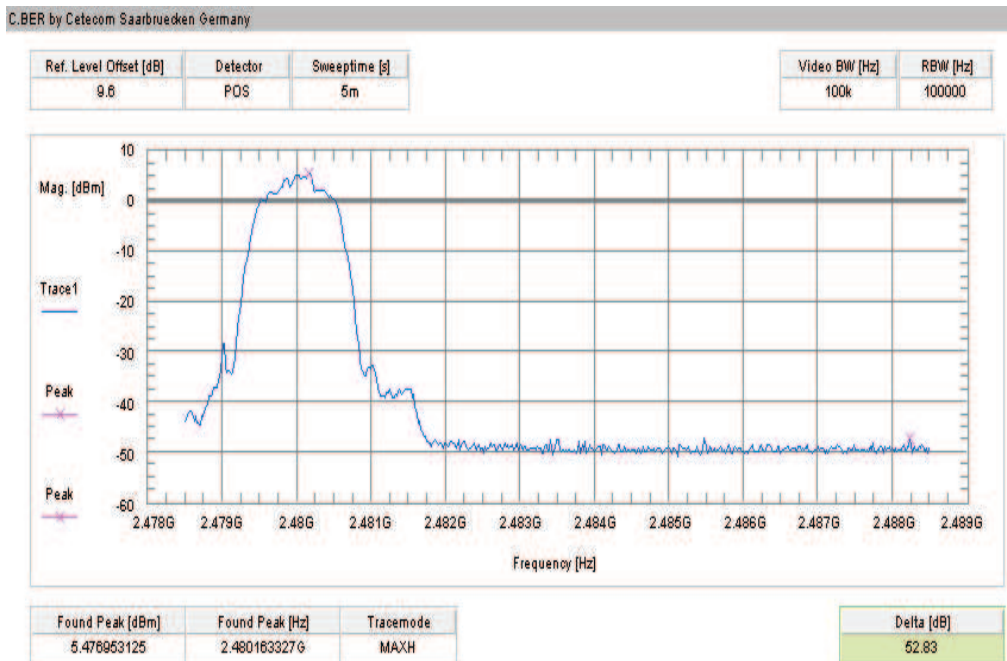
Plot 6: Upper band edge – hopping on, Pi/4 DQPSK modulation



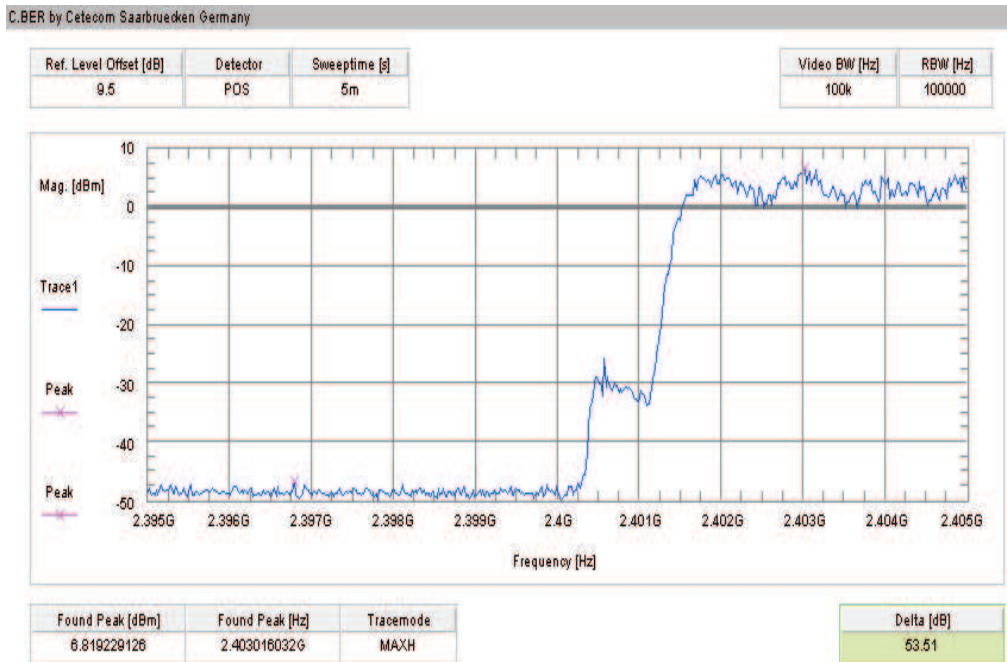
Plot 7: Lower band edge – hopping off, Pi/4 DQPSK modulation



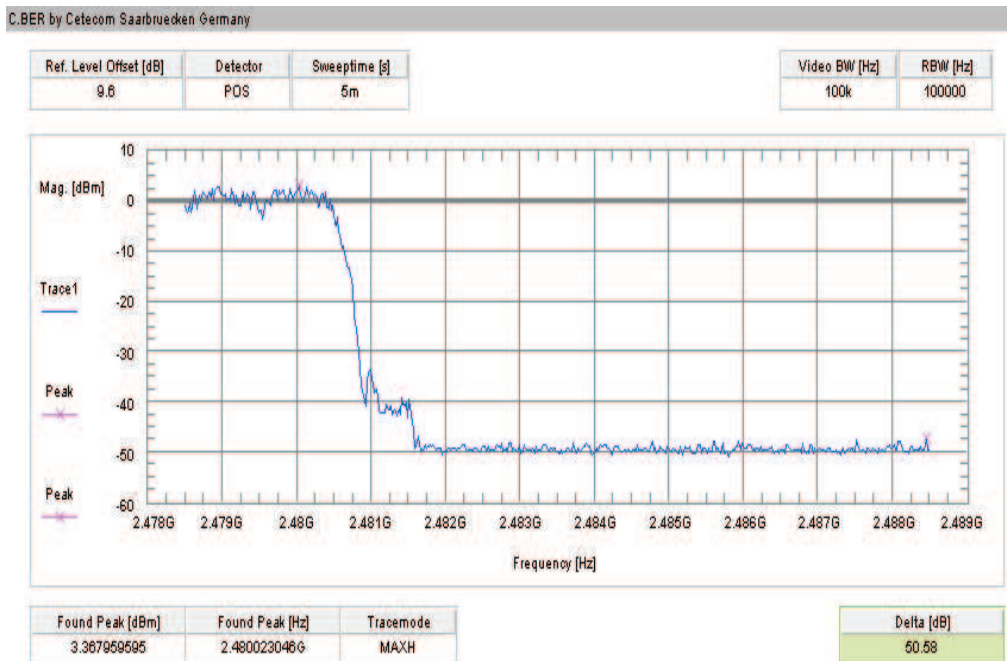
Plot 8: Upper band edge – hopping off, Pi/4 DQPSK modulation



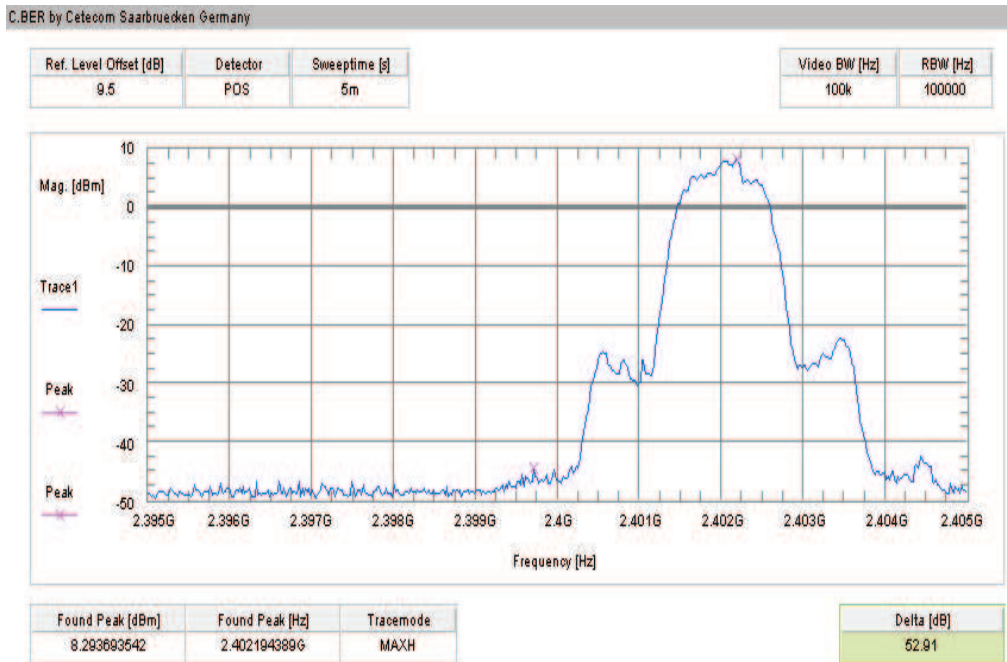
Plot 9: Lower band edge – hopping on, 8DPSK modulation



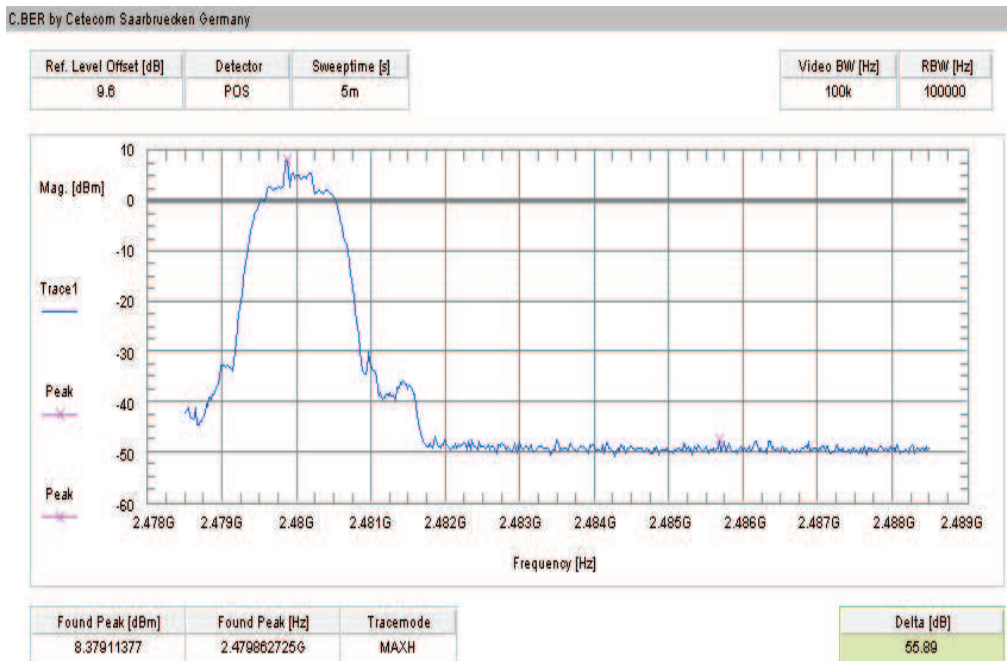
Plot 10: Upper band edge – hopping on, 8DPSK modulation



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



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



9.10 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 higher Band: 2480 – 2500 MHz
Trace-Mode:	Max Hold

Limits:

FCC	IC
Band edge compliance radiated	
<p>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)).</p>	
54 dB μ V/m AVG 74 dB μ V/m Peak	

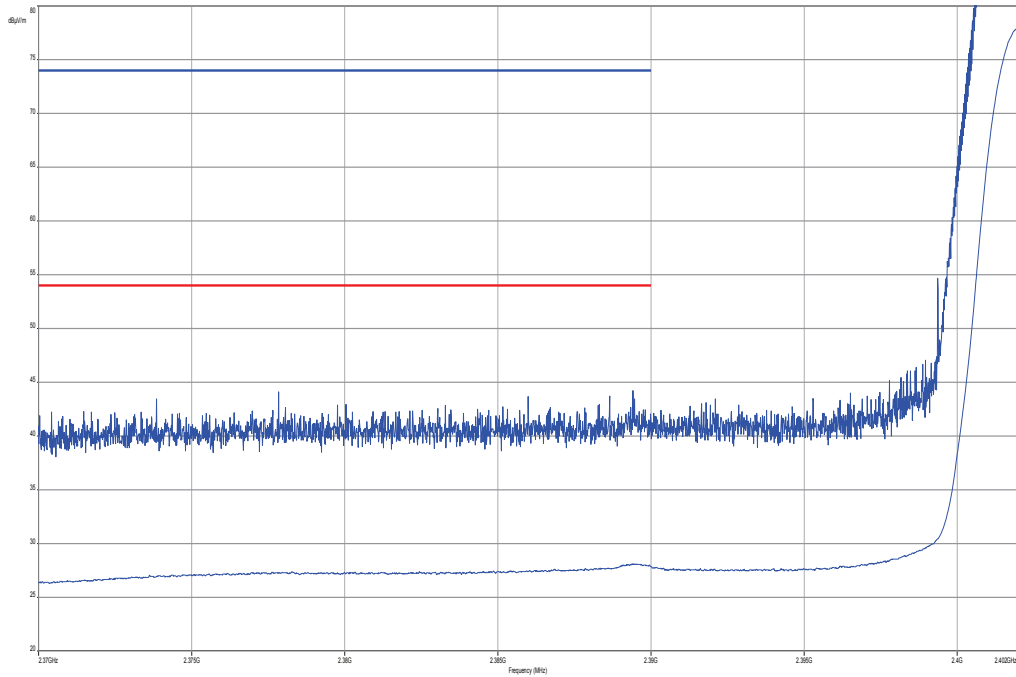
Results:

Scenario Modulation	Band edge compliance radiated [dB μ V/m]		
	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	\pm 3 dB		

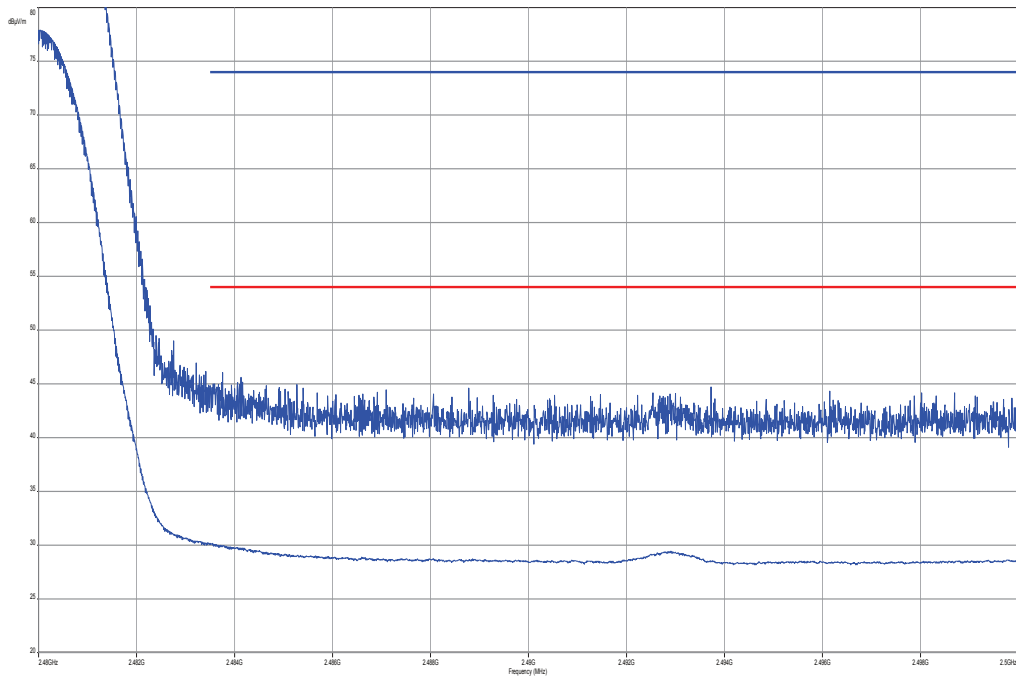
Result: Passed

Plots:

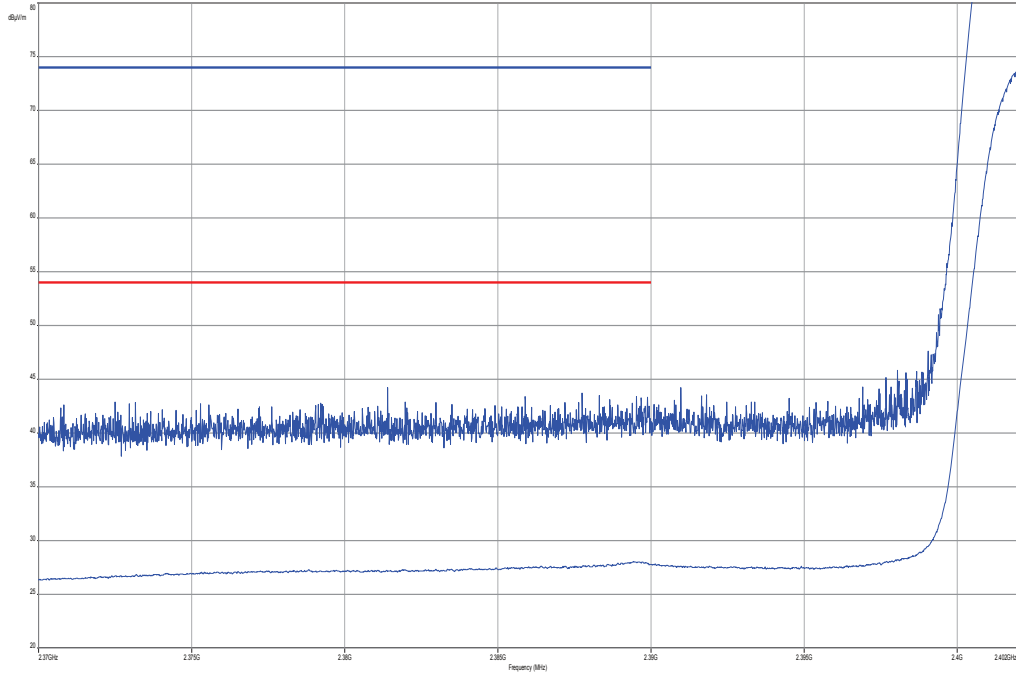
Plot 1: Lower band edge, GFSK modulation, vertical & horizontal polarization



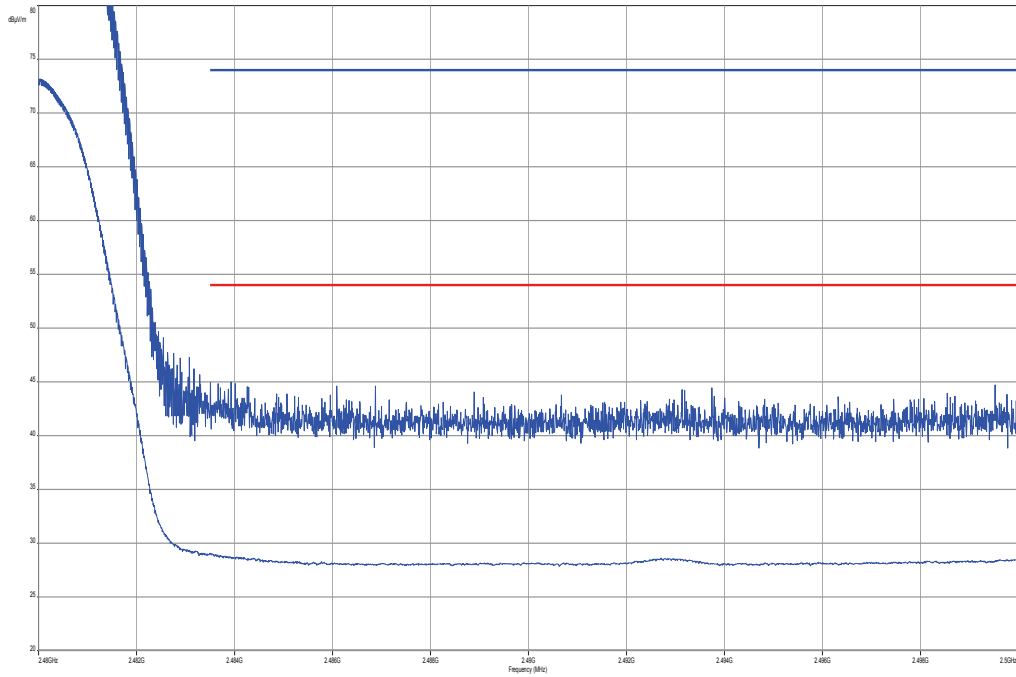
Plot 2: Upper band edge, GFSK modulation, vertical & horizontal polarization



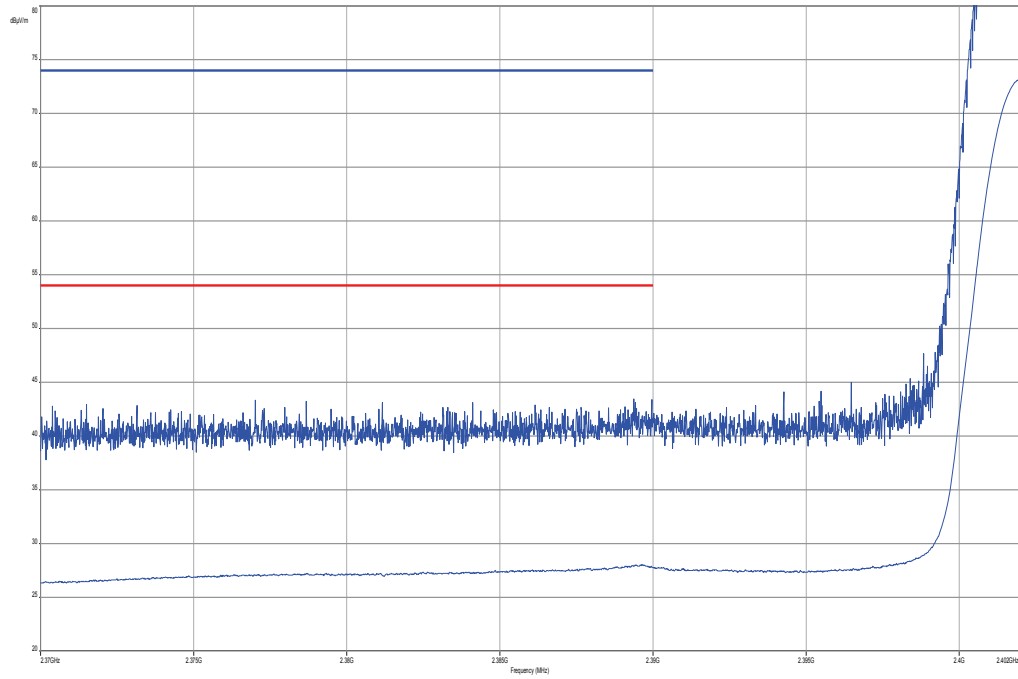
Plot 3: Lower band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization



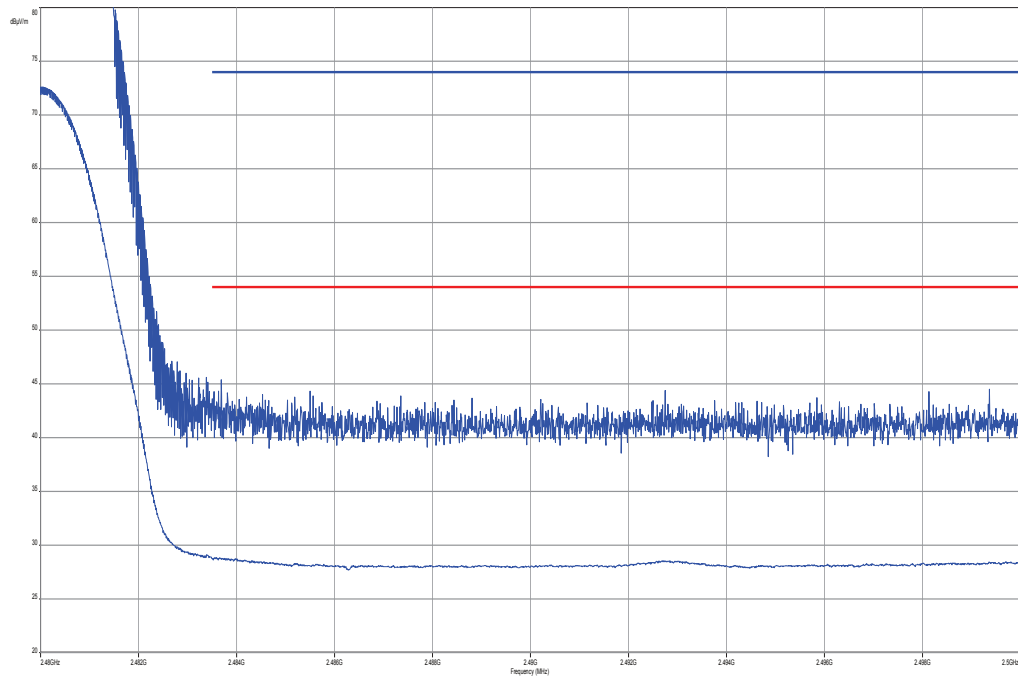
Plot 4: Upper band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization



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



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



9.11 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: 500 kHz F > 1 GHz: 500 kHz
Resolution bandwidth:	F < 1 GHz: 100 kHz 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			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2441			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2480			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-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			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2441			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2480			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
Measurement uncertainty		± 3dB			

Result: Passed

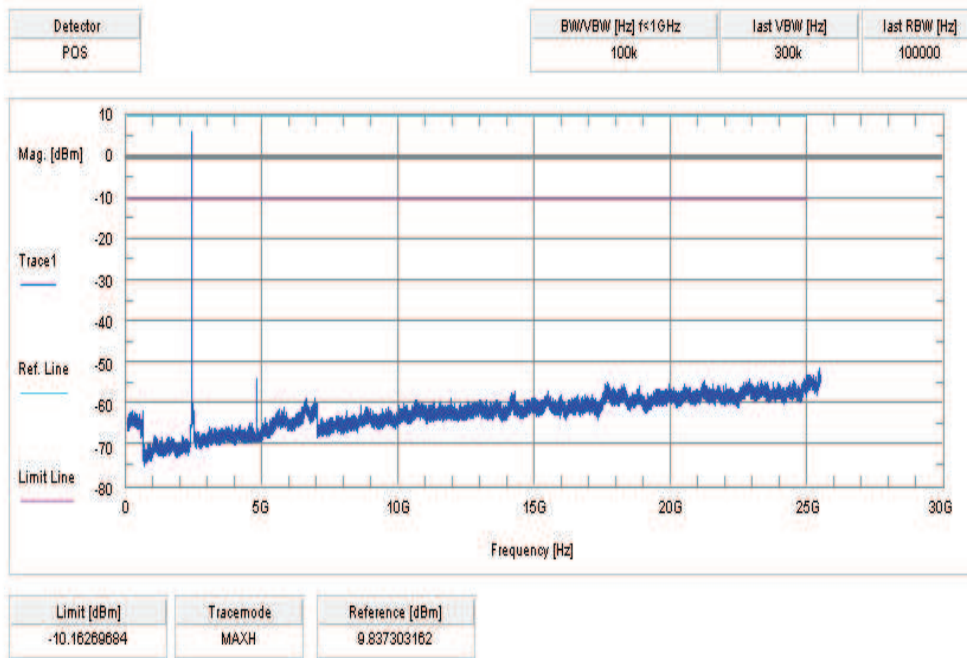
Results:

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			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2441			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
2480			30 dBm		Operating frequency
<i>No critical peaks detected</i>			-20 dBc		complies
Measurement uncertainty		± 3dB			

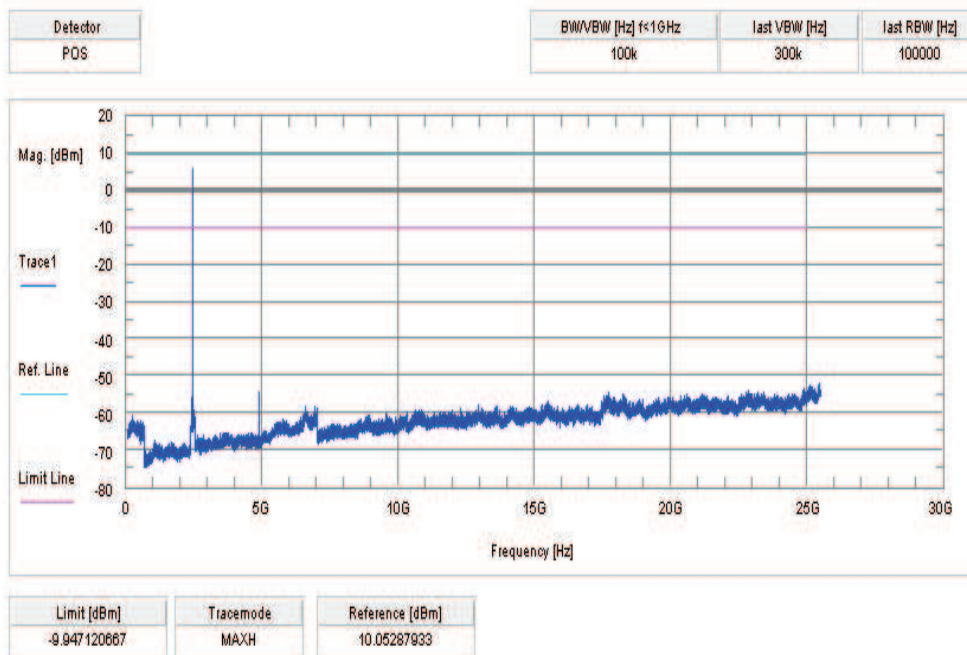
Result: Passed

Plots:

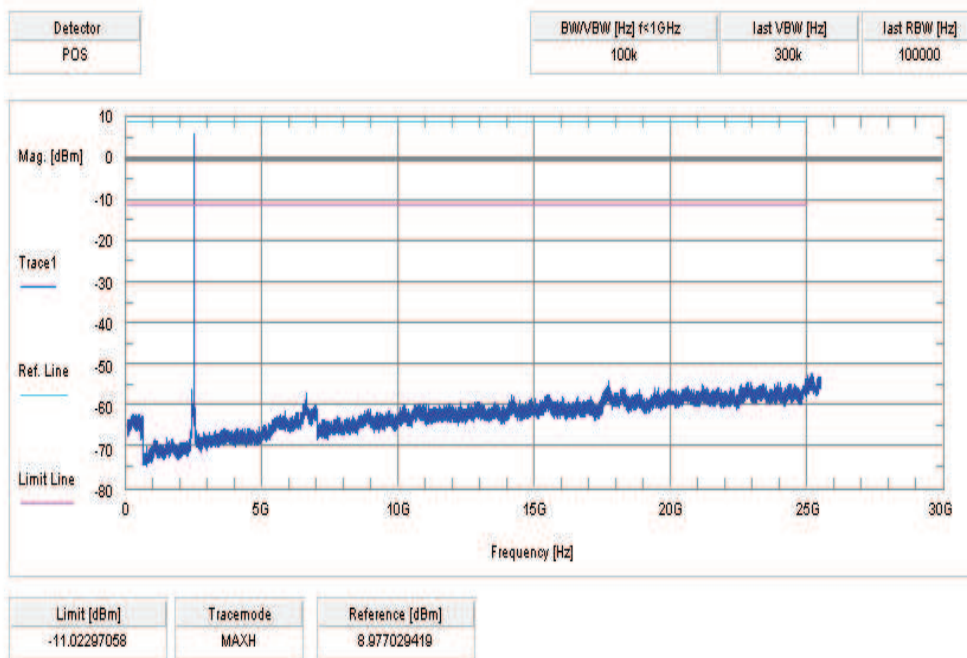
Plot 1: lowest channel – 2402 MHz, GFSK modulation



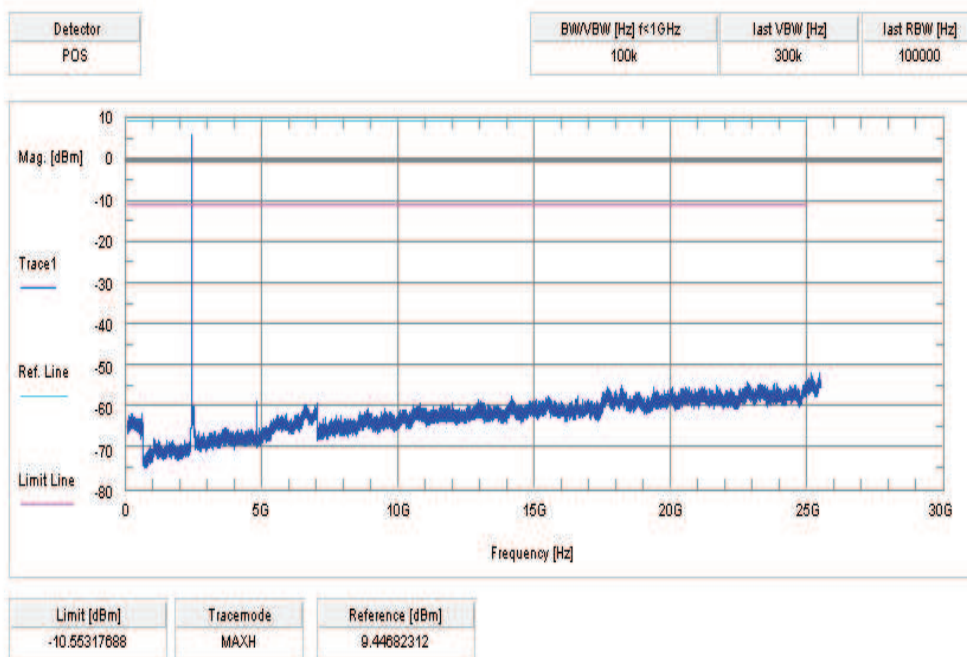
Plot 2: middle channel – 2441 MHz, GFSK modulation



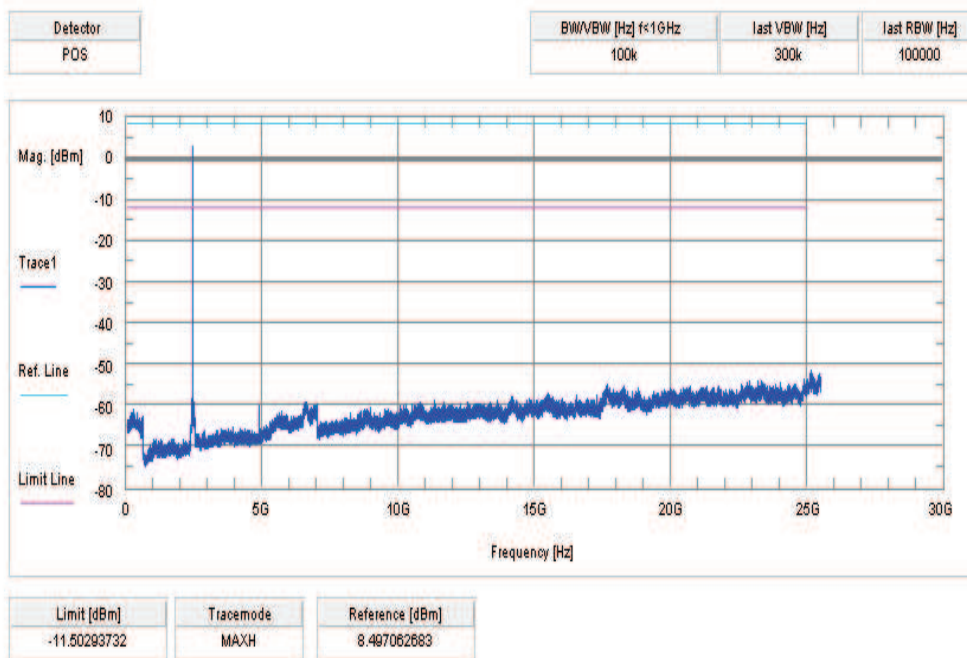
Plot 3: highest channel – 2480 MHz, GFSK modulation



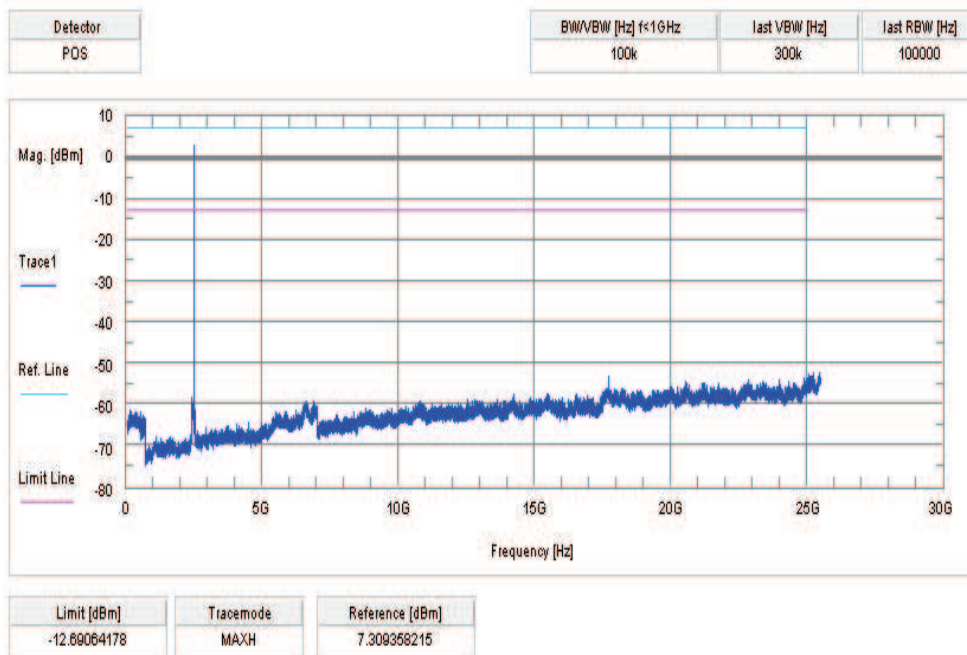
Plot 4: lowest channel – 2402 MHz, Pi / DQPSK modulation



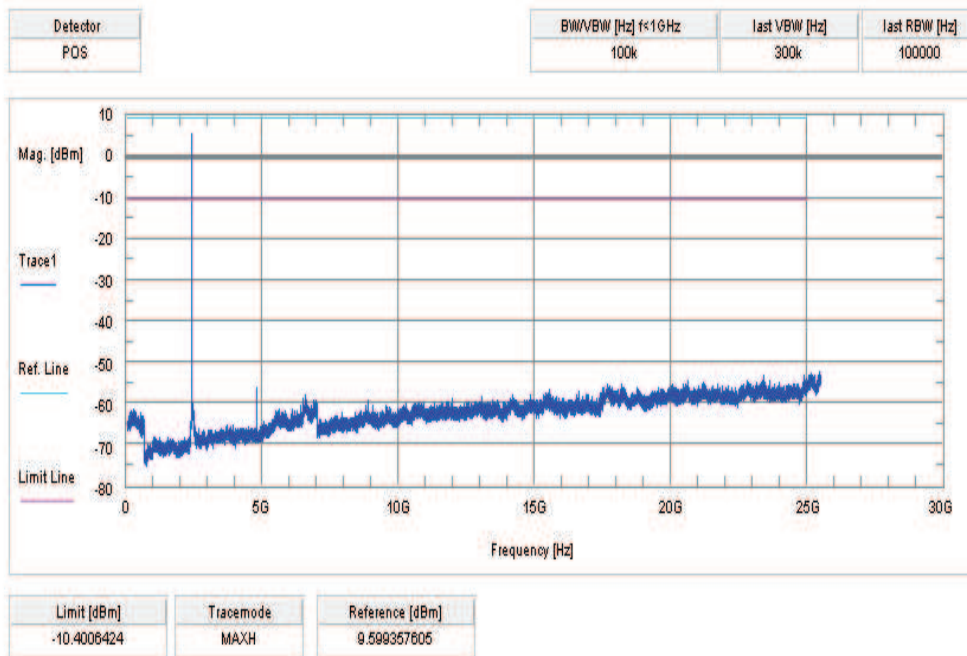
Plot 5: middle channel – 2441 MHz, Pi / DQPSK modulation



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

