Deutscher Akkreditierungs Rat

Accredited testing-laboratory

DAR registration number: DAT-P-176/94-D1

Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97

Recognized by the Federal Communications Commission
Anechoic chamber registration no.: 90462 (FCC)
Anechoic chamber registration no.: 3463A-1 (IC)
Certification ID: DE 0001
Accreditation ID: DE 0002

Accredited Bluetooth® Test Facility (BQTF)

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

Test report no.	**:**	**2-4883-29-04/08**
Type identification	**:**	**AAD-3052091-BV**
Applicant	**:**	**Sony Ericsson Mobile Communications AB**
FCC ID	**:**	**PY7A3052091**
IC Certification No	**:**	**4170B-A3052091**
Test standards	**:**	**47 CFR Part 15**
		RSS - 210 Issue 7

Table of contents

1 General information 3
1.1 Notes 3
1.2 Testing laboratory 4
1.3 Details of applicant 4
1.4 Application details 4
2 Test standard/s: 5
3 Technical tests 6
3.1 Details of manufacturer 6
3.1.1 Test item 6
3.1.2 Additional EUT information For IC Canada (appendix 2) 7
3.2 Prediction of MPE limit at given distance 8
3.2.1 RF Technical Brief Cover Sheet acc. To RSS-102 9
3.2.2 EUT operating modes 10
3.2.3 Extreme conditions testing values 10
4 Summary of Measurement Results and list of all performed test cases 11
5 RF measurement testing 12
5.1 Description of test set-up 12
5.1.1 Radiated measurements 12
5.1.2 Conducted measurements 12
5.2 Referenced documents 13
5.3 Additional comments 13
5.4 Antenna gain 13
5.5 Carrier frequency separation §15.247(a)(1) 14
5.6 Number of hopping channels §15.247(a)(1) 15
5.7 Time of occupancy (dwell time) §15.247(a)(1)(iii) 16
5.8 Power Spectral density (Hybrid system in Inquiry mode/Page scan) §15.247(e) 17
5.9 Spectrum Bandwidth of a FHSS System / 20dB Bandwidth §15.247(a)(1) 18
5.10 Maximum output power (conducted) § 15.247 (b)(1) 23
5.11 Max. peak output power (radiated) § 15.247 (b)(1) 28
5.12 Band-edge compliance of conducted emissions §15.247 (d) 29
5.13 Band-edge compliance of radiated emissions §15.205 36
5.14 Spurious Emissions - conducted (Transmitter) § 15.247 (c)(1) 45
5.15 Spurious Emissions > 30 MHz- radiated (Transmitter) § 15.247 (c)(1) 51
5.16 Spurious Emissions - radiated (Receiver) § 15.109 59
5.17 Spurious Emissions < 30 MHz - Transmitter radiated § 15.209 62
5.18 Conducted Emissions <30 MHz § 15.107/207 63
6 Test equipment and ancillaries used for tests 65
7 Photographs of the Test Set-up 68
8 Photographs of the EUT 69

1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 3.1.1. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

Test laboratory manager:

2008-05-02	**Bertolino Marco**	M. Bertolino
Date	Name	Signature

Technical responsibility for area of testing:

2008-05-02	**Michael Berg**	
Date	Name	Signature

1.2 Testing laboratory

CETECOM ICT Services GmbH

Untertürkheimer Straße 6 - 10
66117 Saarbrücken
Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
e-mail: info@ICT.cetecom.de
Internet: http://www.cetecom-ict.de

State of accreditation: **The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025**
DAR registration number: DAT-P-176/94-D1

Accredited by: **Federal Motor Transport Authority (KBA)**
DAR registration number: KBA-P 00070-97

Testing location, if different from CETECOM ICT Services GmbH:

Name :
Street :
Town :
Country :
Phone :
Fax :

1.3 Details of applicant

Name:	**Sony Ericsson Mobile Communications AB**
Street:	**Nya Vattentornet**
Town:	**22188 Lund**
Country:	**Sweden**
Telephone:	**+46-46-19-3000**
Fax:	**+46-46-19-3295**
Contact:	**Peter Lindeborg**
E-mail:	**peter.lindeborg@sonyericsson.com**
Telephone:	**+46-46-212-6180**

1.4 Application details

Date of receipt of order:	**2008-04-24**
Date of receipt of test item:	**2008-04-25**
Date of start test:	**2008-04-28**
Date of end test	**2008-05-02**
Persons(s) who have been present during the test:	**-/-**

2 Test standard/s:

47 CFR Part 15	**2007-09**	**Title 47 of the Code of Federal Regulations; Chapter I-Federal Communications Commission subchapter A - general, Part 15-Radio frequency devices**
RSS - 210 Issue 7	**2007-06**	**Spectrum Management and Telecommunications - Radio Standards Specification Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment**

3 Technical tests

3.1 Details of manufacturer

Name:	**Sony Ericsson Mobile Communications AB**
Street:	**Nya Vattentornet**
Town:	**22188 Lund**
Country:	**Sweden**

3.1.1 Test item

Kind of test item	:	**GSM 850/900/1800/1900 G10 EDGE, UMTS 1, BT-EDR, FM**
Type identification	:	**AAD-3052091-BV**
S/N serial number	:	**CB510YGH5T conducted sample (1) EUT** **CB510YGGZP conducted sample (2)** **CB510YGHMY radiated sample (3) EUT** **CB510YGH37 radiated sample (4)**
HW hardware status	:	**A**
SW software status	:	**-/-**
Frequency Band [MHz]	:	**ISM 2.400 - 2.483,5**
Type of Modulation	:	**GFSK, Pi/4 DQPSK, 8 DPSK**
Number of channels	:	**79**
Antenna	:	**Integrated antenna**
Power Supply	:	**4.0 V DC by power supply / Li-polymer battery BST-38**
Temperature Range	:	**-10 °C to +55 °C**

Max. power radiated: **3.07 dBm**
Max. power conducted: **4.14 dBm**

FCC ID: **PY7A3052091**
IC: **4170B-A3052091**

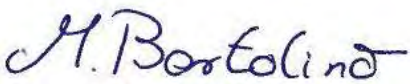
3.1.2 Additional EUT information For IC Canada (appendix 2)

IC Registration Number:	**4170B-A3052091**
Model Name:	**AAD-3052091-BV**
Manufacturer (complete Address):	**Sony Ericsson Mobile Communications AB Nya Vattentornet 22188 Lund Sweden**
Tested to Radio Standards Specification (RSS) No.:	**RSS-210 Issue 7**
Open Area Test Site Industry Canada Number:	**IC 3463A-1**
Frequency Range (or fixed frequency) [MHz]:	**2400 – 2483.5 MHz**
RF: Power [W] (max):	**GFSK modulation: Rad. EIRP: 2.03 mW Conducted : 2.59 mW Pi/4 DQPSK modulation: Rad. EIRP: 1.60 mW Conducted : 2.09 mW 8 DPSK modulation: Rad. EIRP: 1.74 mW Conducted : 2.28 mW**
Antenna Type:	**Integrated antenna**
Occupied Bandwidth (99% BW) [kHz]:	**926 GFSK 1329 Pi/4 DQPSK 1269 8 DPSK**
Type of Modulation:	**GFSK, Pi/4 DQPSK, 8 DPSK**
Emission Designator (TRC-43):	**926KFXD GFSK 1M33FXD Pi/4 DQPSK 1M27FXD 8 DPSK**
Transmitter Spurious (worst case) [µV/m in 3m]:	**No critical peaks detected.**
Receiver Spurious (worst case) [µV/m in 3m]:	**No critical peaks detected.**

ATTESTATION:

I attest that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned departmental standard(s), and that the radio equipment identified in this application has been subject to all applicable test conditions specified in the departmental standards and all of the requirements of the standards have been met.

Signature:



Test engineer: Bertolino Marco Date: 2008-05-02

3.2 Prediction of MPE limit at given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG / 4\pi R^2$

where: S = Power density
P = Power input to the antenna
G = Antenna gain
R = Distance to the center of radiation of the antenna

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled "Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure"

Frequency Range (MHz)	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
300 -1500	f/1500	30
1500 - 100000	1.0	30

where f = Frequency (MHz)

Prediction:

P	Max power input to the antenna:	
R	Distance:	20 cm
S	MPE limit for uncontrolled exposure:	1 mW/cm^2

Calculated Power density: 0.004 W/m^2

This prediction demonstrates the following:

The power density levels at a distance of 20 cm are below the maximum levels allowed by FCC regulations.

3.2.1 RF Technical Brief Cover Sheet acc. To RSS-102

All Fields must be completed with the requested information or the following codes: N/A for Not Applicable, N/P for Not Performed or N/V for Not Available. Where applicable, check appropriate box.

1. COMPANY NUMBER: **4170B**

2. MODEL NUMBER: **AAD-3052091-BV**

3. MANUFACTURER: **Sony Ericsson Mobile Communications AB**

4. TYPE OF EVALUATION: **(c) RF Evaluation**

- Evaluated against exposure limits: General Public Use ☒ Controlled Use ☐
- Duty cycle used in evaluation: 99 %
- Standard used for evaluation: RSS-102 Issue 2 (2005-11)
- Measurement distance: 0.20 m
- RF value: 0.004 V/m □ A/m □ W/m^2 ☒

Measured ☐ Computed ☐ Calculated ☒

Declaration of RF Exposure Compliance

ATTESTATION:

I attest that the information provided in this test report are correct; that a Technical Brief was prepared and the information it contains is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed and that the device meets the SAR and/or RF exposure limits of RSS-102.

Name: Marco Bertolino
Title: Dipl.-Ing. (FH)
Company: Cetecom ICT Services GmbH

3.2.2 EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
Op. 0	Normal mode	Normal temperature and power source conditions
Op. 1		low temperature, low power source conditions
Op. 2		low temperature, high power source conditions
Op. 3		high temperature, low power source conditions
Op. 4		high temperature, high power source conditions

*) EUT operating mode no. is used to simplify the test plan

3.2.3 Extreme conditions testing values

Description	Shortcut	Unit	Value
Nominal Temperature	T_{nom}	°C	**23**
Nominal Humidity	H_{nom}	%	**46**
Nominal Power Source	V_{nom}	V	**4.0**

Type of power source: **DC by power supply / Li-polymer battery BST-38**

Deviations from these values are reported in chapter 2

4 Summary of Measurement Results and list of all performed test cases

☒ **No deviations from the technical specifications were ascertained**

☐ There were deviations from the technical specifications ascertained

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC Part 15 §15.247 - CANADA RSS-210	passed	2008-05-02	-/-

Test Specification Clause	Test Case	Modulation	Pass	Fail	N/A	Not performed
None	Antenna Gain	GFSK	Yes			
§15.247(a1)	Carrier frequency separation	GFSK	Yes			
§15.247(a1)	Number of hopping channels	GFSK	Yes			
§15.247(a)(1)(iii)	Time of occupancy (dwell time)	--	Yes			
§15.247(e)	Power Spectral density (Hybrid system in Inquiry mode/Page scan)	--			Yes	
§15.247(a)(1)	Spectrum Bandwidth of a FHSS System / 20dB Bandwith	GFSK Pi/4 DQPSK 8 DPSK	Yes Yes Yes			
§ 15.247 (b)(1)	Maximum output power (conducted)	GFSK Pi/4 DQPSK 8 DPSK	Yes Yes Yes			
§ 15.247 (b)(1)	Max. peak output power (radiated)	GFSK	Yes			
§ 15.247 (d)	Band-edge compliance of conducted emissions	GFSK Pi/4 DQPSK 8 DPSK	Yes Yes Yes			
§ 15.205	Band-edge compliance of radiated emissions	GFSK Pi/4 DQPSK 8 DPSK	Yes Yes Yes			
§ 15.247 (d)	Spurious Emission - conducted (Transmitter)	GFSK Pi/4 DQPSK 8 DPSK	Yes Yes Yes			
§ 15.247 (d)	Spurious Emission - radiated (Transmitter) >30 MHz	GFSK	Yes			
§ 15.109	Spurious Emissions - radiated (Receiver)	GFSK	Yes			
§ 15.209	Spurious Emissions - radiated (Transmitter) <30 MHz	GFSK	Yes			
§ 15.107/207	Conducted Emissions <30 MHz	GFSK	Yes			

5 RF measurement testing

5.1 Description of test set-up

5.1.1 Radiated measurements

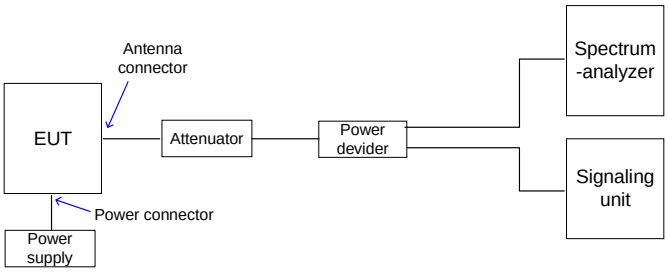
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas 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.

9 kHz - 150 kHz: Quasi Peak measurement, 200 Hz Bandwidth, passive loop antenna.
150 kHz - 30 MHz: Quasi Peak measurement, 9 kHz Bandwidth, passive loop antenna.
30 MHz - 200 MHz: Quasi Peak measurement, 120 kHz Bandwidth, biconical antenna
200MHz - 1GHz: Quasi Peak measurement, 120 kHz Bandwidth, log periodic antenna
>1GHz: Average, RBW 1MHz, VBW 10 Hz, waveguide horn

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.

5.1.2 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.



5.2 Referenced documents

None

5.3 Additional comments

None

5.4 Antenna gain

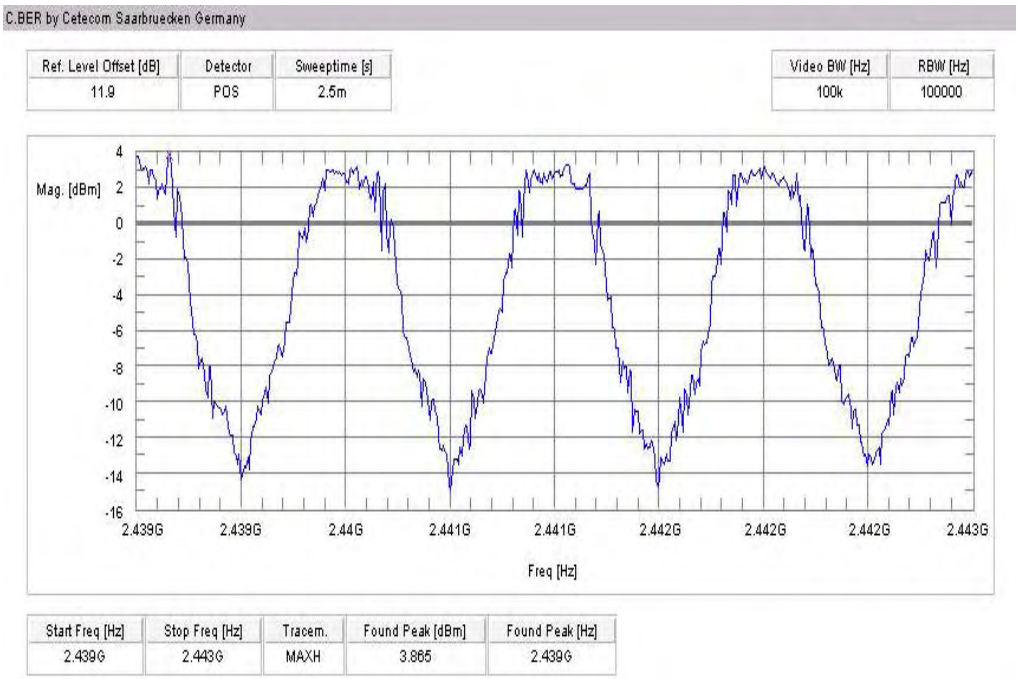
The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

TEST	lowest frequency 2402 MHz	middle frequency 2441 MHz	highest frequency 2480 MHz
Conducted power [dBm] Measured, GFSK modulation	3.61	4.06	**4.14**
Radiated power [dBm] Measured, GFSK modulation	2.21	**3.07**	2.63
Gain [dBi] Calculated	- 1.40	**- 0.99**	- 1.51

5.5 Carrier frequency separation §15.247(a)(1)

Modulation: GFSK

Plot 1 of 1:



Result: Channel separation is: ~ 1 MHz

Limits:

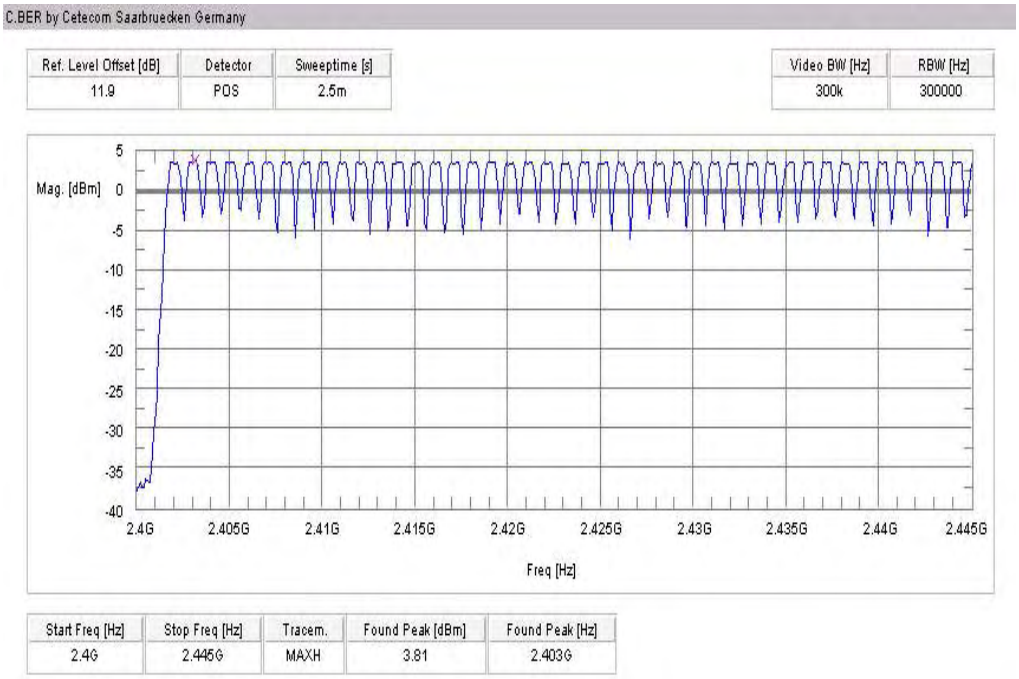
Under normal test conditions only	Minimum 25 kHz or 20 dB Bandwidth of the hopping system

5.6 Number of hopping channels §15.247(a)(1)

Modulation: GFSK

Plot 1 of 2:

Plot 2 of 2:



Result: The number of hopping channels is: 79

Limits:

Under normal test conditions only	at least 15 non-overlapping channels

5.7 Time of occupancy (dwell time) §15.247(a)(1)(iii)

For Bluetooth devices:

The dwell time of 0.4 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:

Dwell 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)
Dwell time = 625 µs * 1600 1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.
Example for a DH5 packet (with a maximum length of five time slots)
Dwell time = 5 * 625 µs * 1600 * 1/5 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

This is according the Bluetooth Core Specification V 1.1 & V 1.2 & V2.0 (+ critical errata) for all Bluetooth devices.
Therefore, all Bluetooth devices comply with the FCC dwell time requirement in the data mode.
This was checked during the Bluetooth Qualification tests.
The Dwell time in hybrid mode is approximately 2.6 ms (in a 12.8s period).

5.8 Power Spectral density (Hybrid system in Inquiry mode/Page scan) §15.247(e)

Plot 1 of 1:

Not applicable

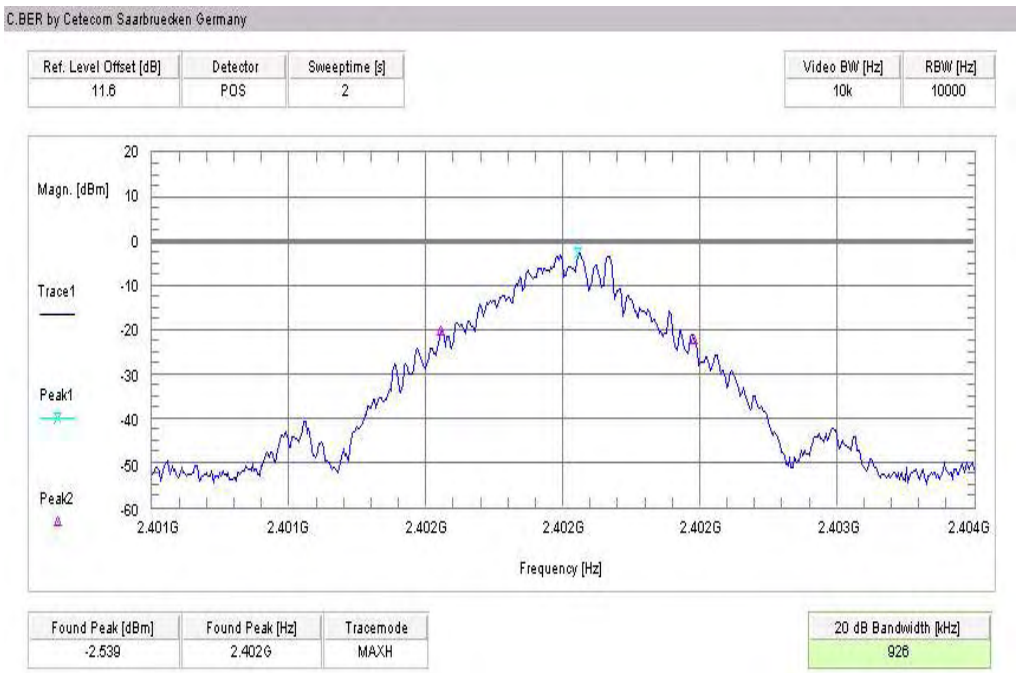
Result: Power density: - dBm/Hz = - dBm / 3 kHz
Correction factor from dBm/Hz to dBm / 3 kHz is +34,8 dB

Limits:

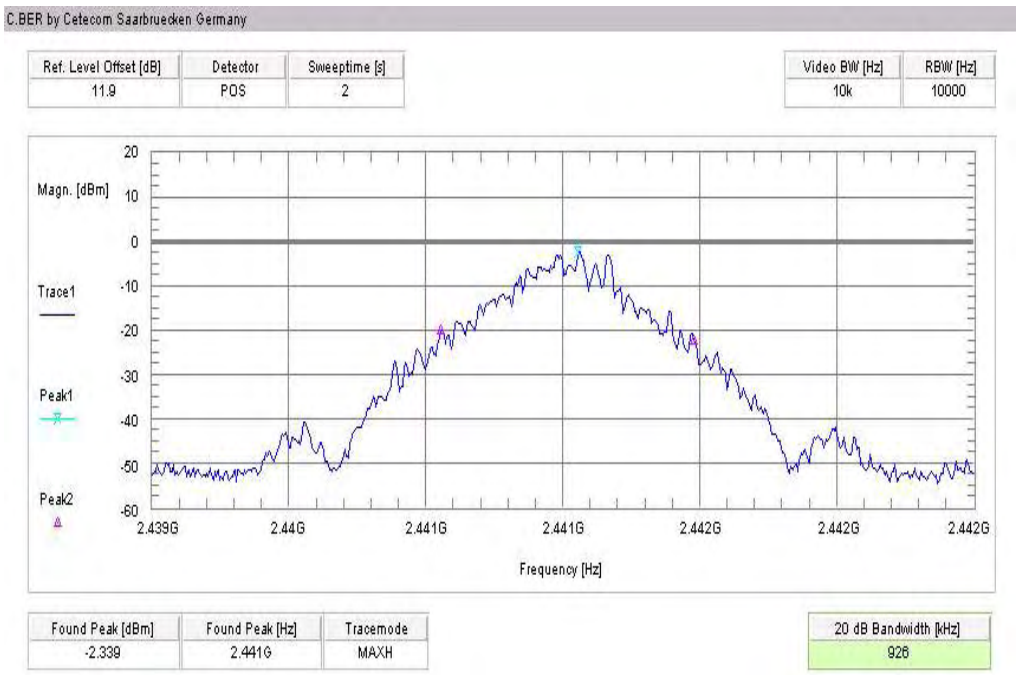
Under normal test conditions only	For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

5.9 Spectrum Bandwidth of a FHSS System / 20dB Bandwidth §15.247(a)(1)

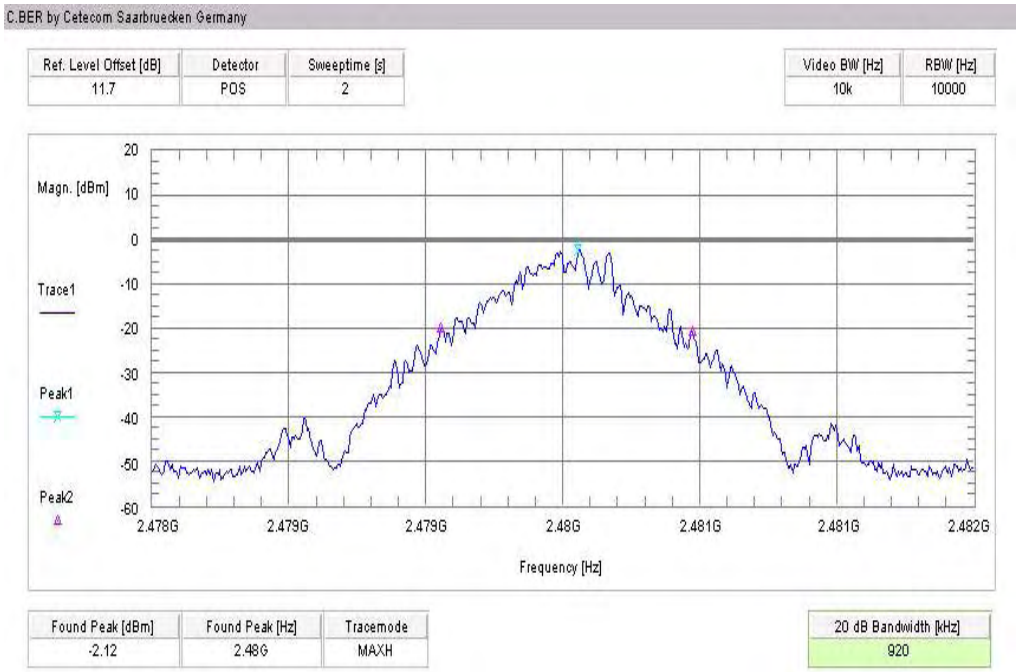
Plot 1: GFSK



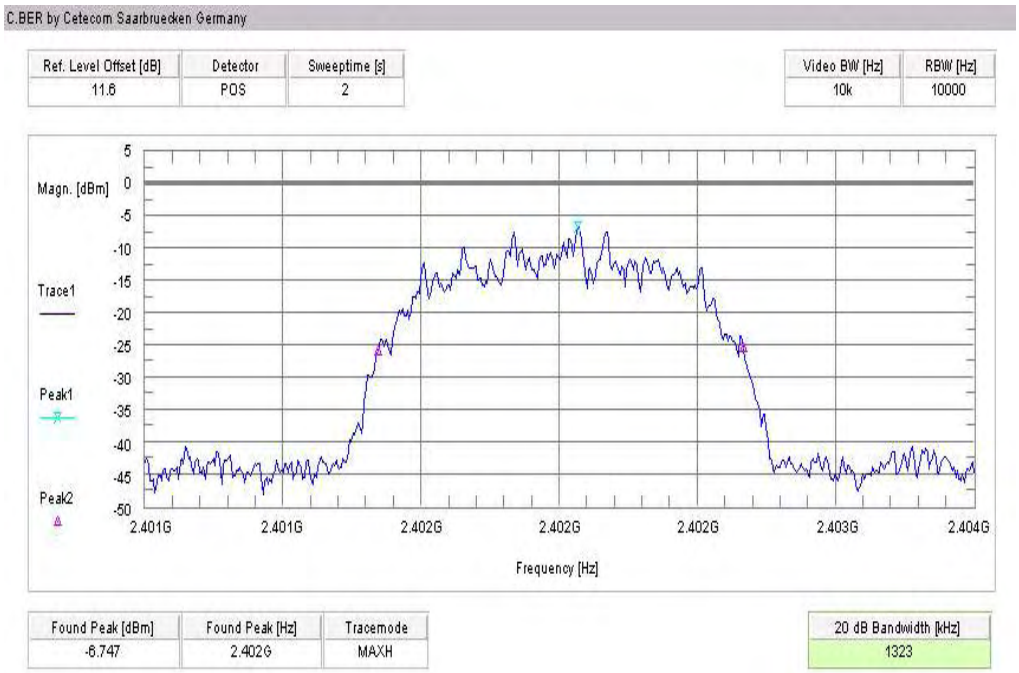
Plot 2: GFSK



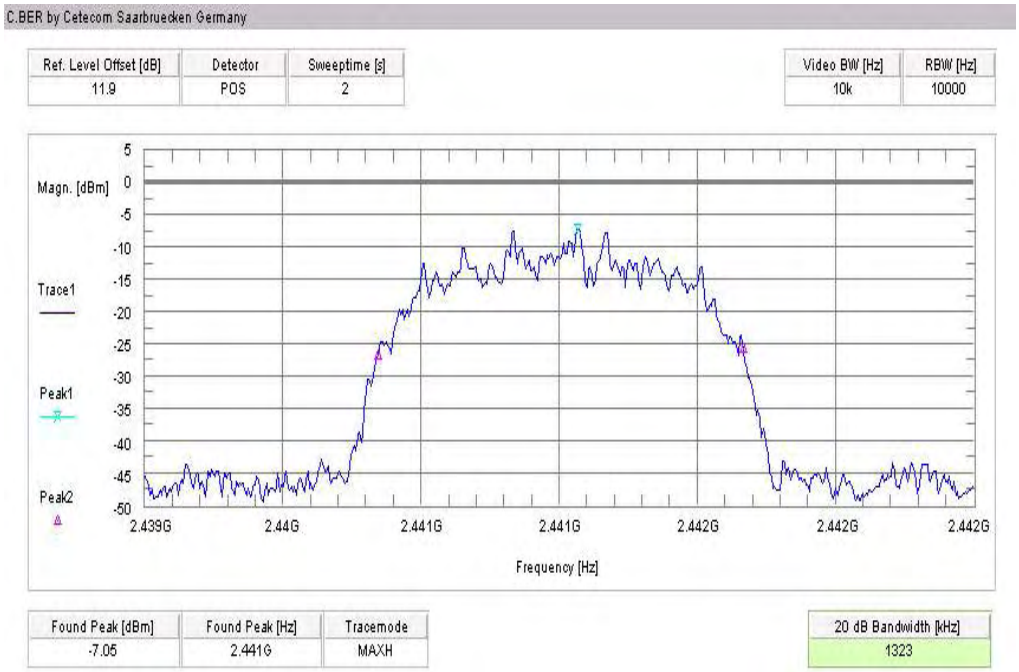
Plot 3: GFSK



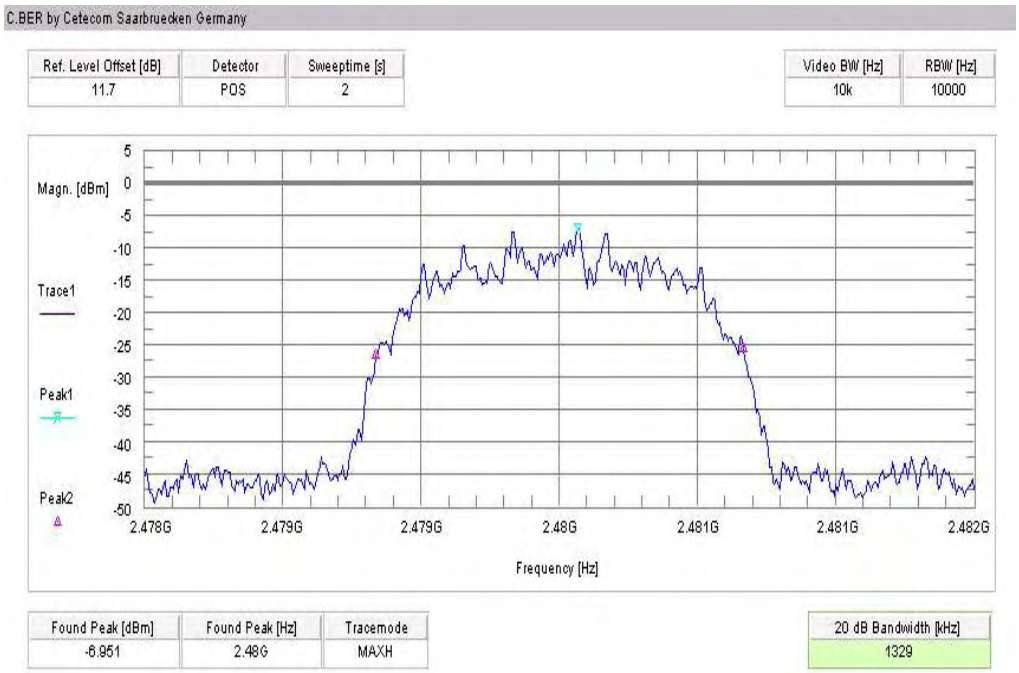
Plot 4: Pi/4 DQPSK



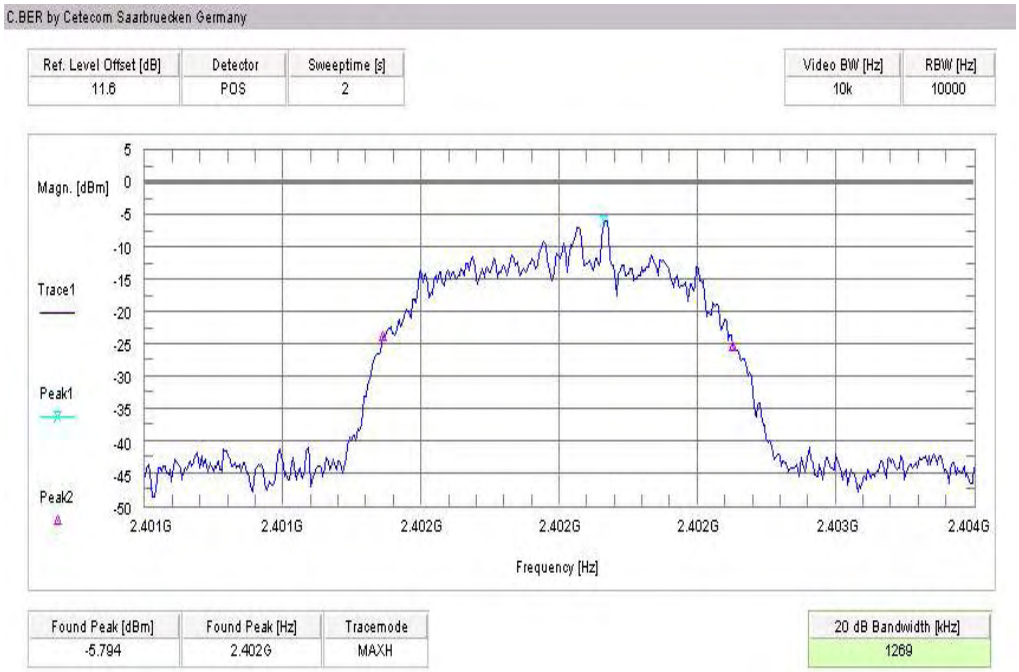
Plot 5: Pi/4 DQPSK



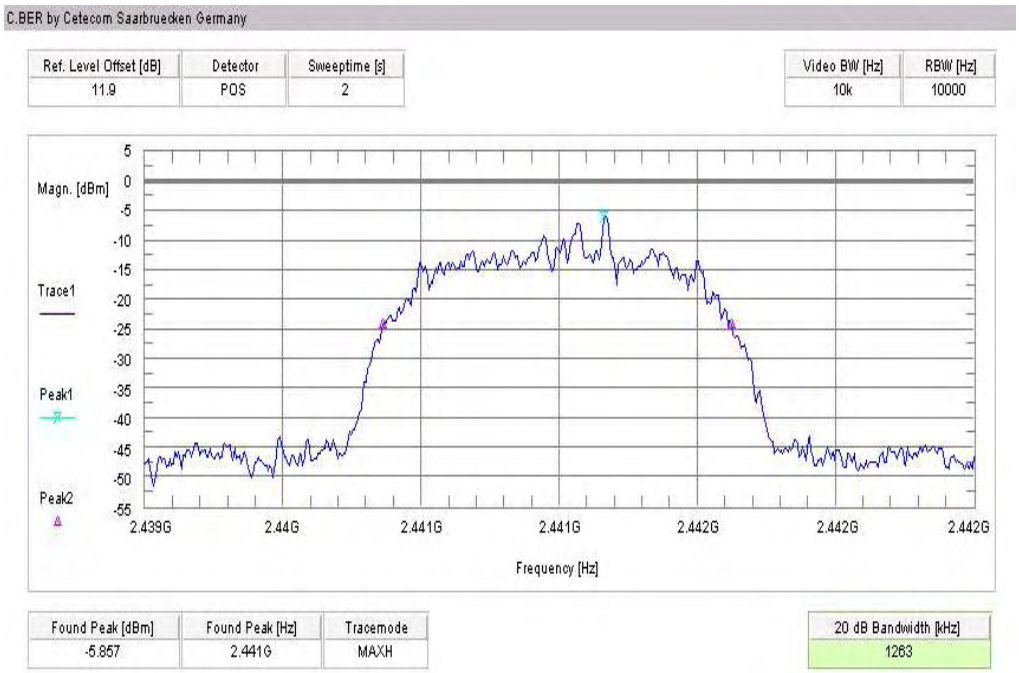
Plot 6: Pi/4 DQPSK



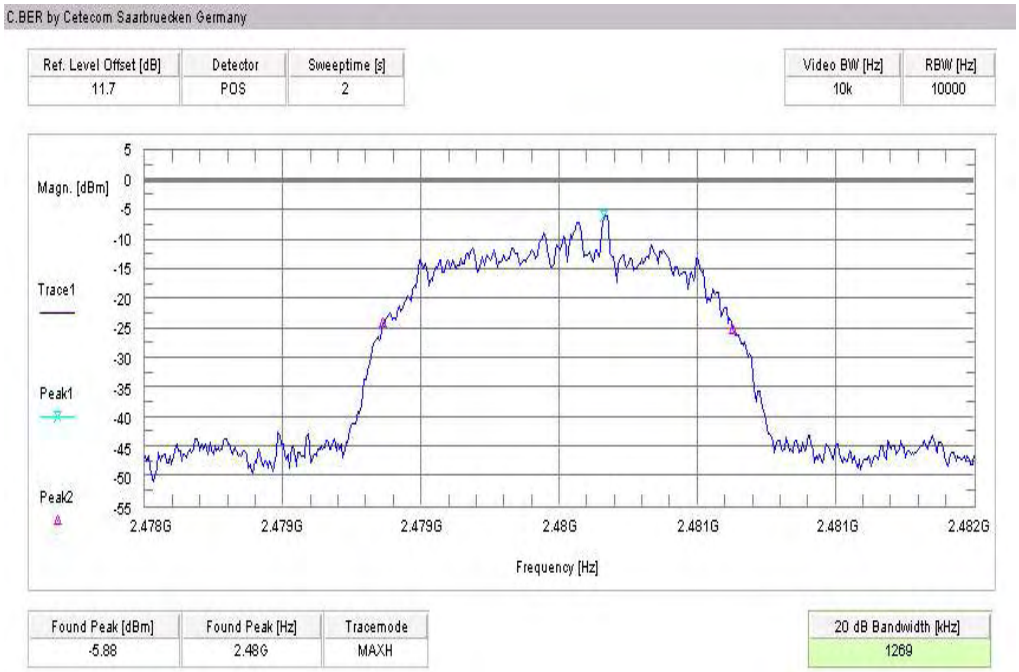
Plot 7: 8DPSK



Plot 8: 8DPSK



Plot 9: 8DPSK



Result:

Modulation	**20 dB BANDWIDTH [kHz]**		
Frequency [MHz]	2402	2441	2480
GFSK	**926**	**926**	920
Pi/4 DQPSK	1323	1323	**1329**
8DPSK	**1269**	1263	**1269**
Measurement uncertainty	±1kHz		

RBW / VBW as provided in the „Measurement Guidelines“ (DA 00-705, March 30, 2000)
RBW: 10 kHz / VBW 10 kHz

Limits:

Under normal test conditions only	GFSK < 1000 kHz Pi/4 DQPSK < 1500 8DPSK < 1500

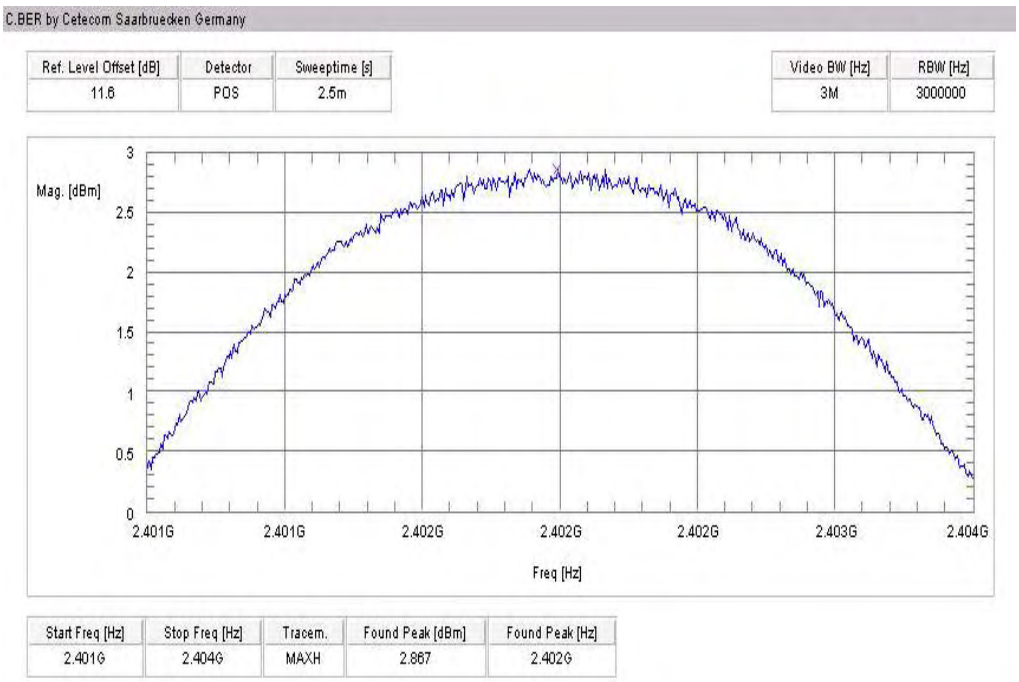
5.10 Maximum output power (conducted) § 15.247 (b)(1)

Plot 1: GFSK

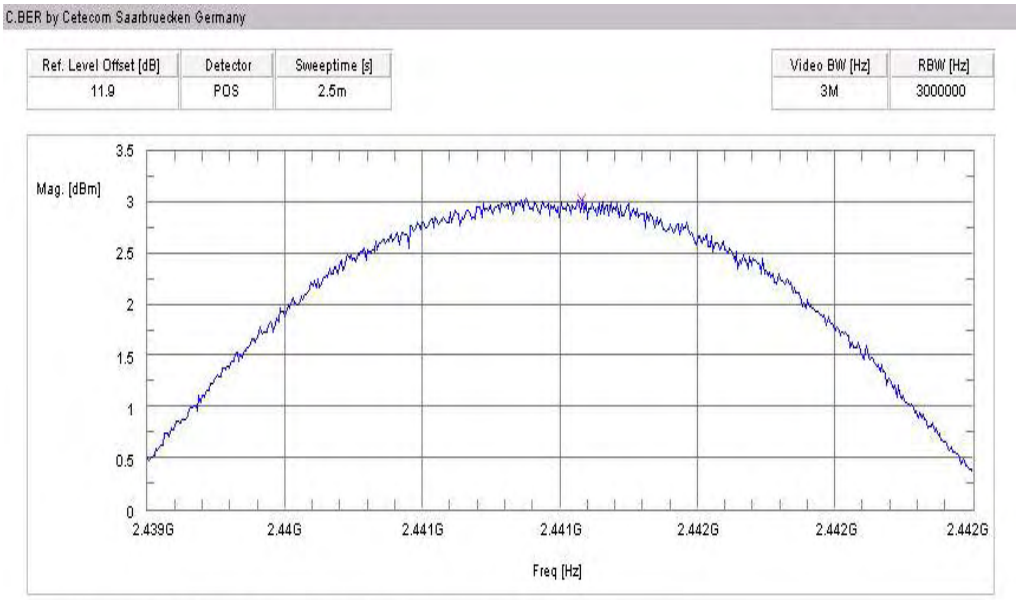
Plot 2: GFSK

Plot 3: GFSK

Plot 4: Pi/4 DQPSK



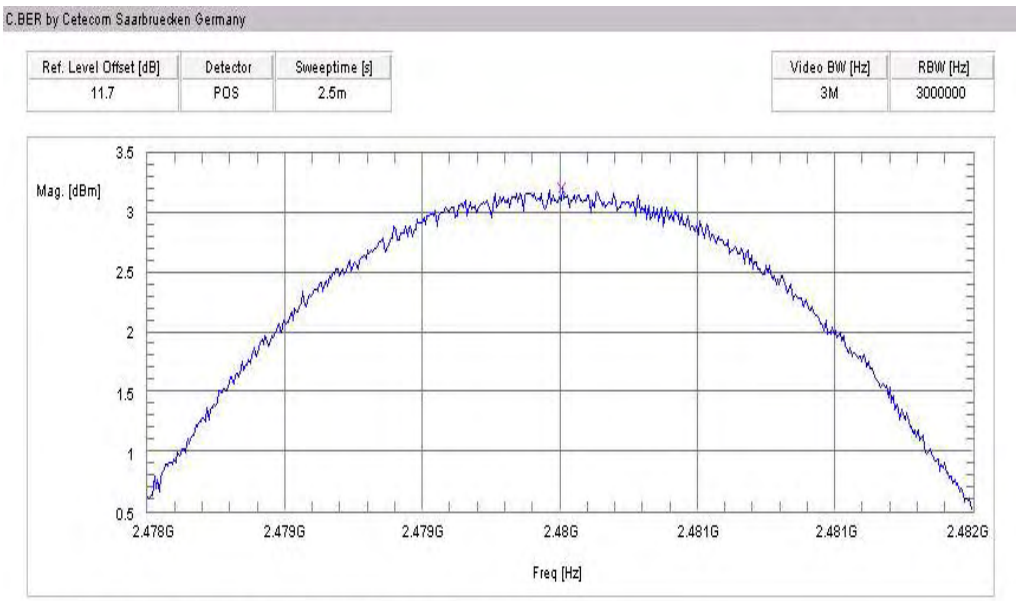
Plot 5: Pi/4 DQPSK



Ref. Level Offset [dB]	Detector	Sweeptime [s]	Video BW [Hz]	RBW [Hz]
11.9	POS	2.5m	3M	3000000

Start Freq [Hz]	Stop Freq [Hz]	Tracem.	Found Peak [dBm]	Found Peak [Hz]
2.439G	2.442G	MAXH	3.031	2.441G

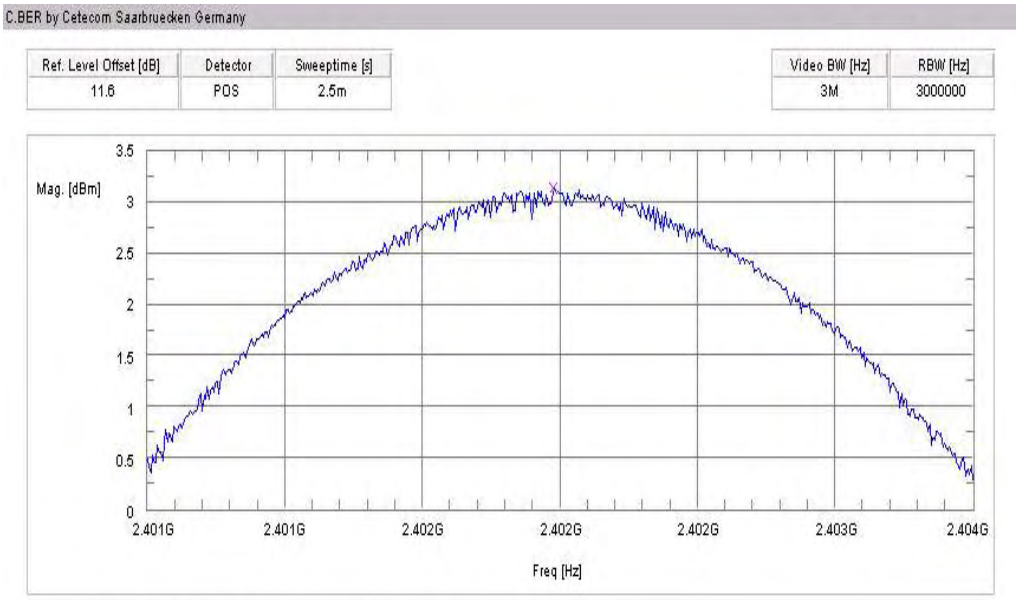
Plot 6: Pi/4 DQPSK



Ref. Level Offset [dB]	Detector	Sweeptime [s]	Video BW [Hz]	RBW [Hz]
11.7	POS	2.5m	3M	3000000

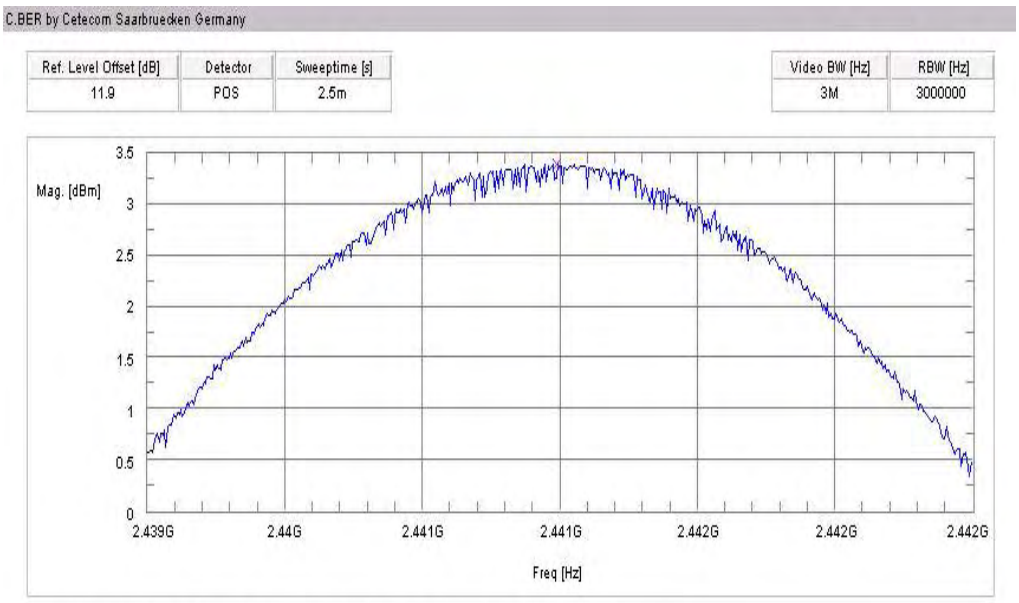
Start Freq [Hz]	Stop Freq [Hz]	Tracem.	Found Peak [dBm]	Found Peak [Hz]
2.478G	2.482G	MAXH	3.208	2.48G

Plot 7: 8DPSK



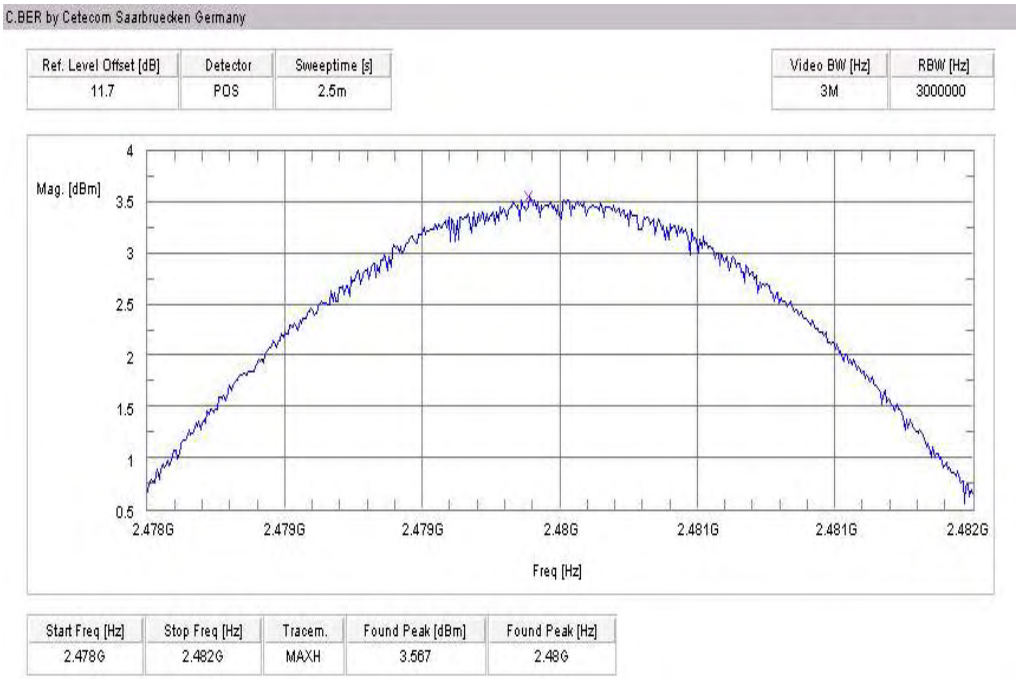
Start Freq [Hz]	Stop Freq [Hz]	Tracem.	Found Peak [dBm]	Found Peak [Hz]
2.401G	2.404G	MAXH	3.139	2.402G

Plot 8: 8DPSK



Start Freq [Hz]	Stop Freq [Hz]	Tracem.	Found Peak [dBm]	Found Peak [Hz]
2.439G	2.442G	MAXH	3.402	2.441G

Plot 9: 8DPSK



Results:

Modulation	**Max. peak output power [dBm]**		
Frequency [MHz]	2402	2441	2480
GFSK	3.61	4.06	**4.14**
Pi/4 DQPSK	2.87	3.03	**3.21**
8DPSK	3.14	3.40	**3.57**
Measurement uncertainty	±2dB		

RBW / VBW: 3 MHz

Limits:

Under normal test conditions only, for frequency range 2400-2483.5 MHz	Max. 1.0 Watt

5.11 Max. peak output power (radiated) § 15.247 (b)(1)

Modulation: GFSK

Results:

Test conditions		**Max. peak output power EIRP [dBm]**		
Frequency [MHz]		2402	2442	2480
T_{nom}	V_{nom}	2.21	**3.07**	2.63
Measurement uncertainty		±3dB		

RBW / VBW: 3 MHz
Measured at a distance of 3m

Modulation: Pi/4 DQPSK

Results:

Test conditions		**Max. peak output power EIRP [dBm]**		
Frequency [MHz]		2402	2442	2480
T_{nom}	V_{nom}	1.47	**2.04**	1.70
Measurement uncertainty		±3dB		

RBW / VBW: 3 MHz
Measured at a distance of 3m

Modulation: 8 DPSK

Results:

Test conditions		**Max. peak output power EIRP [dBm]**		
Frequency [MHz]		2402	2442	2480
T_{nom}	V_{nom}	1.74	**2.41**	2.06
Measurement uncertainty		±3dB		

RBW / VBW: 3 MHz
Measured at a distance of 3m

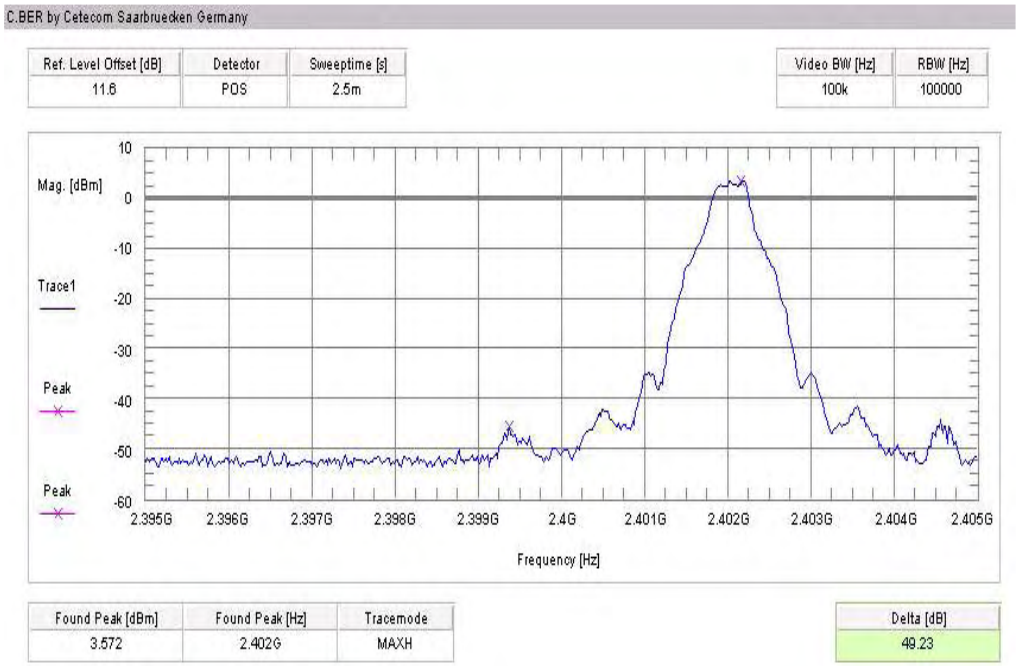
Limits:

Under normal test conditions only, for frequency range 2400-2483.5 MHz	Max. 1.0 Watt

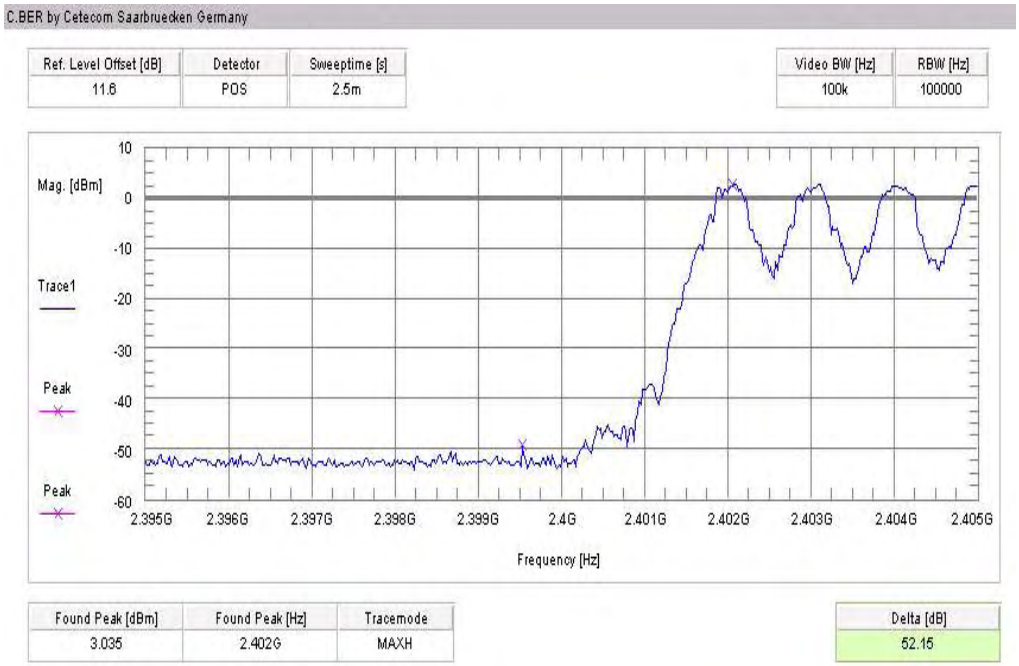
5.12 Band-edge compliance of conducted emissions §15.247 (d)

Modulation: GFSK

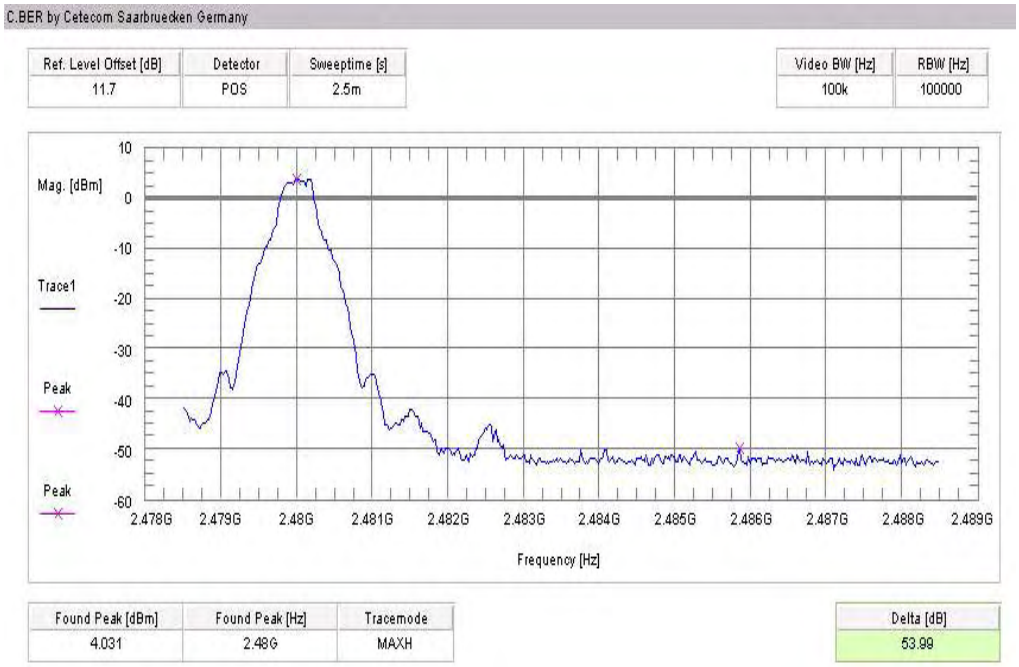
Plot 1 of 4 (hopping off, lowest frequency):



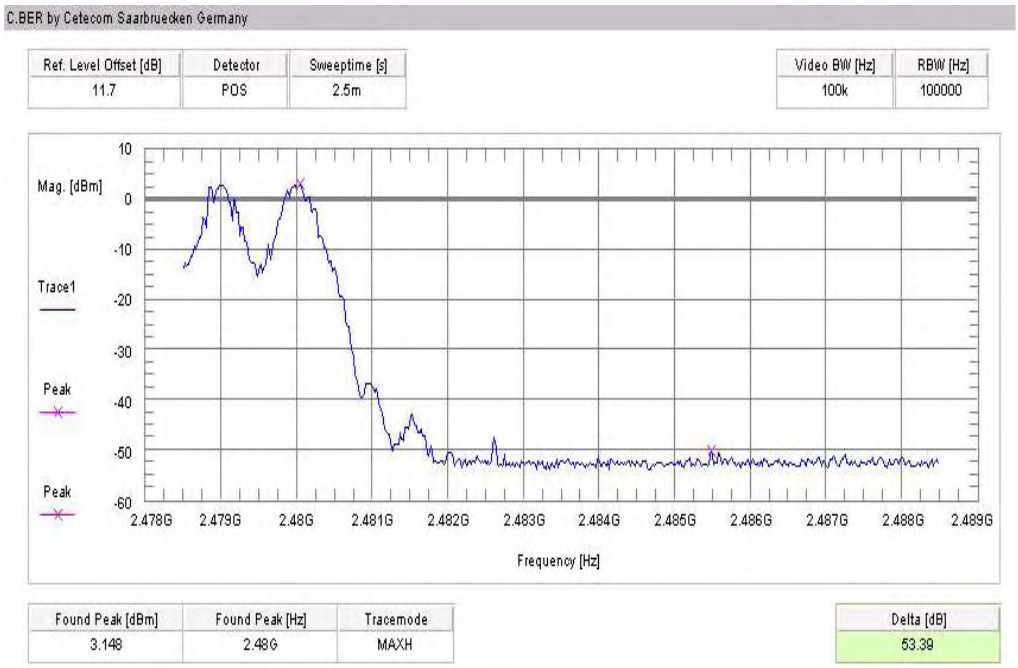
Plot 2 of 4 (hopping on, lowest frequency):



Plot 3 of 4 (hopping off, highest frequency):



Plot 4 of 4 (hopping on, highest frequency):

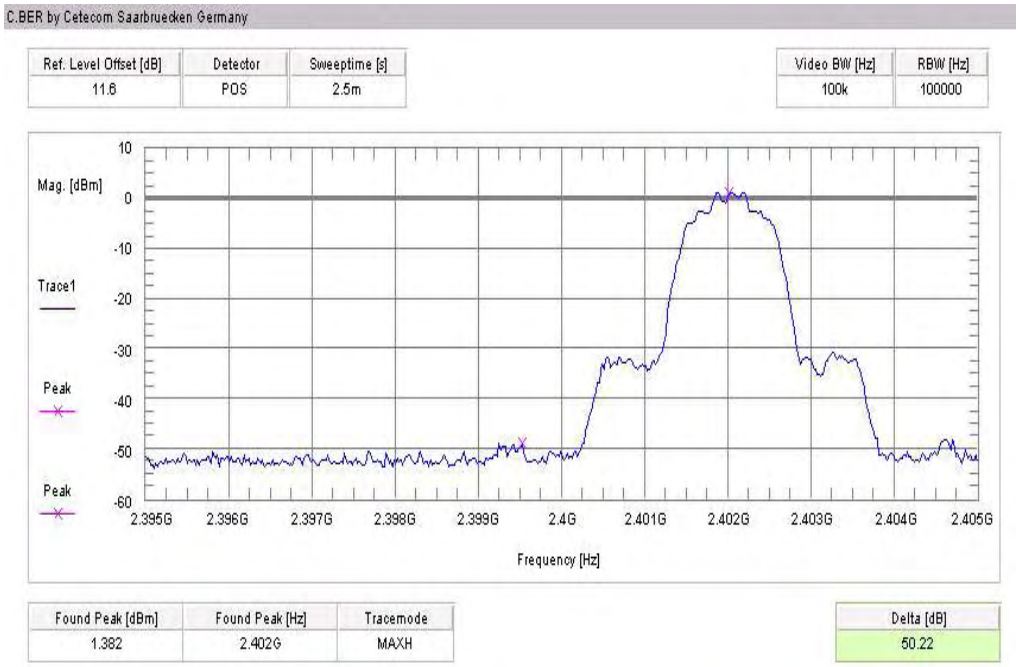


<u>Results:</u>

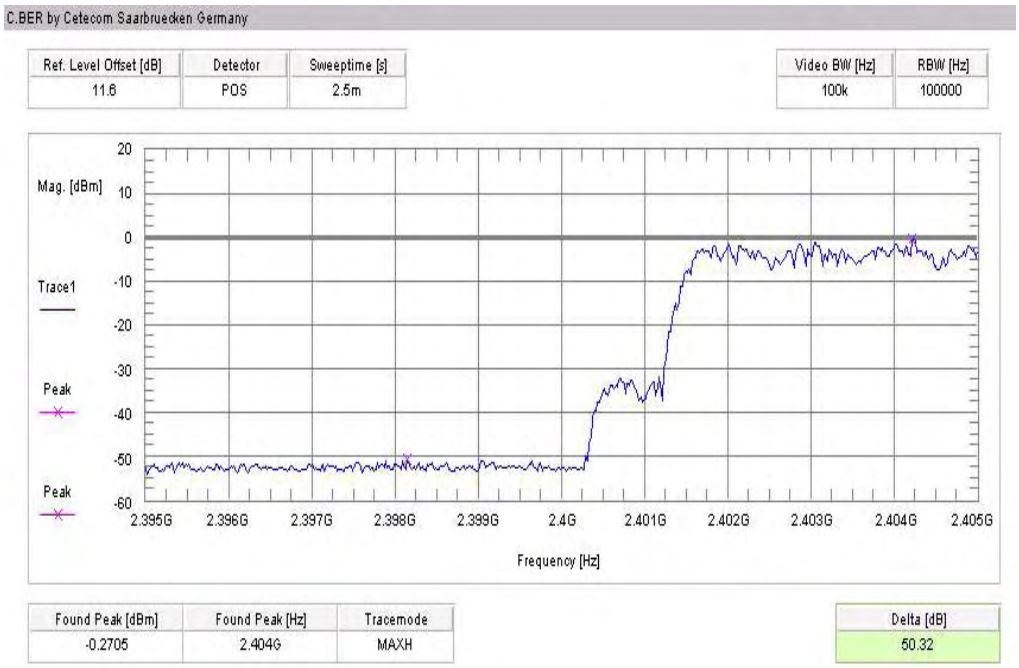
SZENARIO	DELTA VALUE [DB]
hopping off, lowest frequency	> 20 dB
hopping on, lowest frequency	> 20 dB
hopping off, highest frequency	> 20 dB
hopping on, highest frequency	> 20 dB
Measurement uncertainty	±1,5dB

Modulation: Pi/4 DQPSK

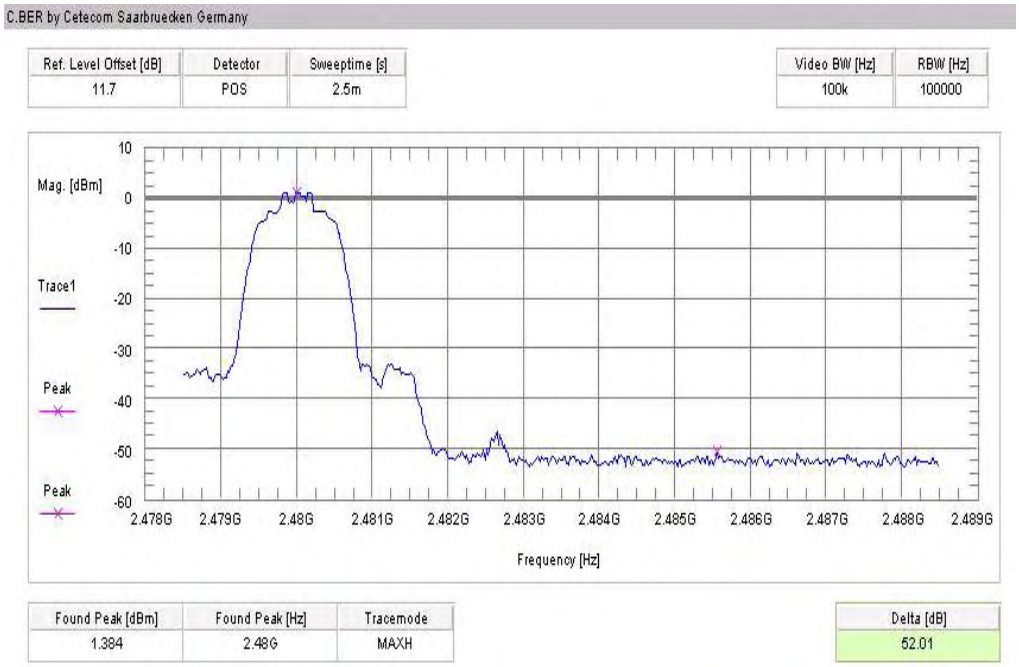
Plot 1 of 4 (hopping off, lowest frequency):



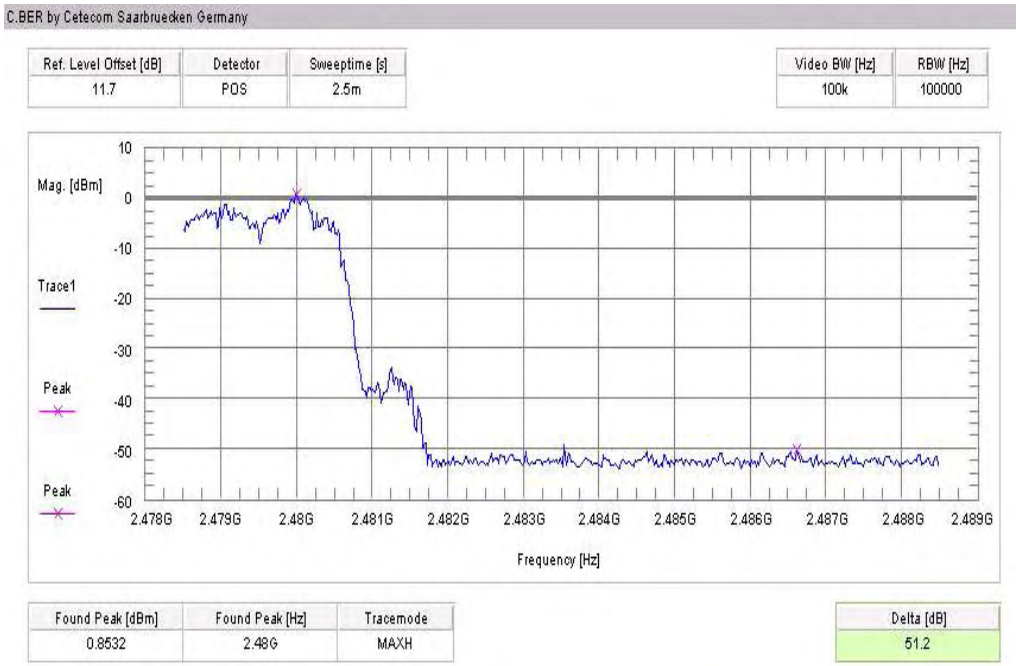
Plot 2 of 4 (hopping on, lowest frequency):



Plot 3 of 4 (hopping off, highest frequency):



Plot 4 of 4 (hopping on, highest frequency):

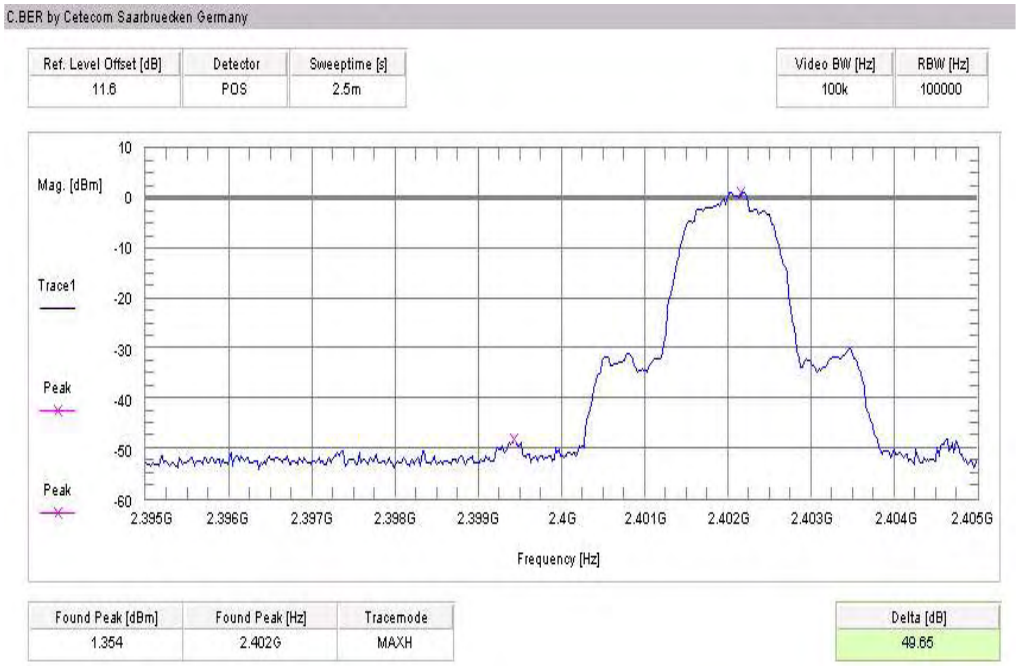


Results:

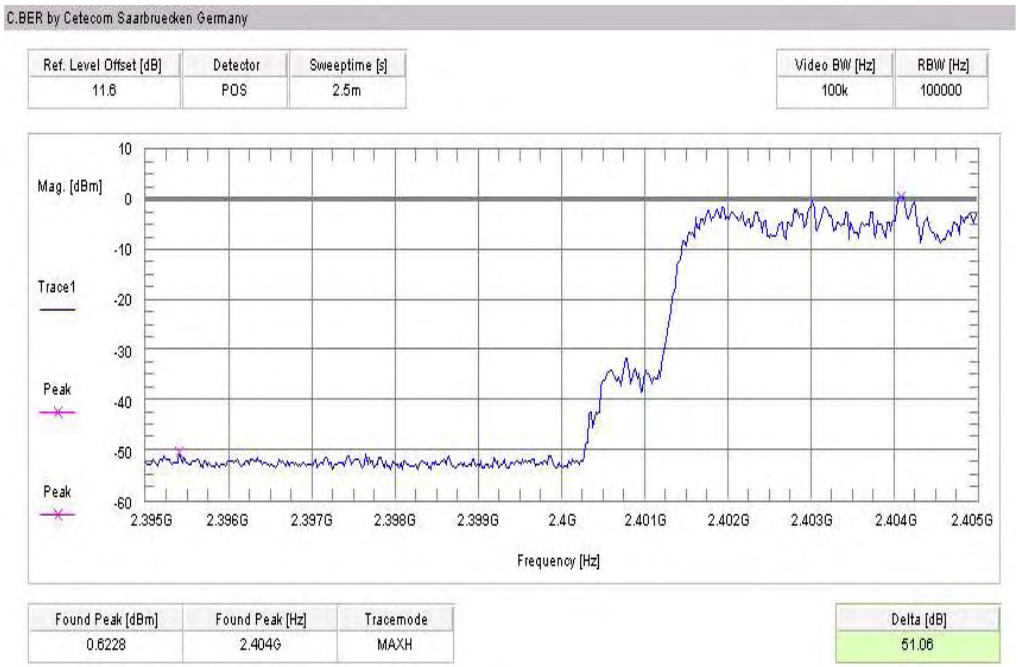
SZENARIO	DELTA VALUE [DB]
hopping off, lowest frequency	> 20 dB
hopping on, lowest frequency	> 20 dB
hopping off, highest frequency	> 20 dB
hopping on, highest frequency	> 20 dB
Measurement uncertainty	±1,5dB

Modulation: 8 DPSK

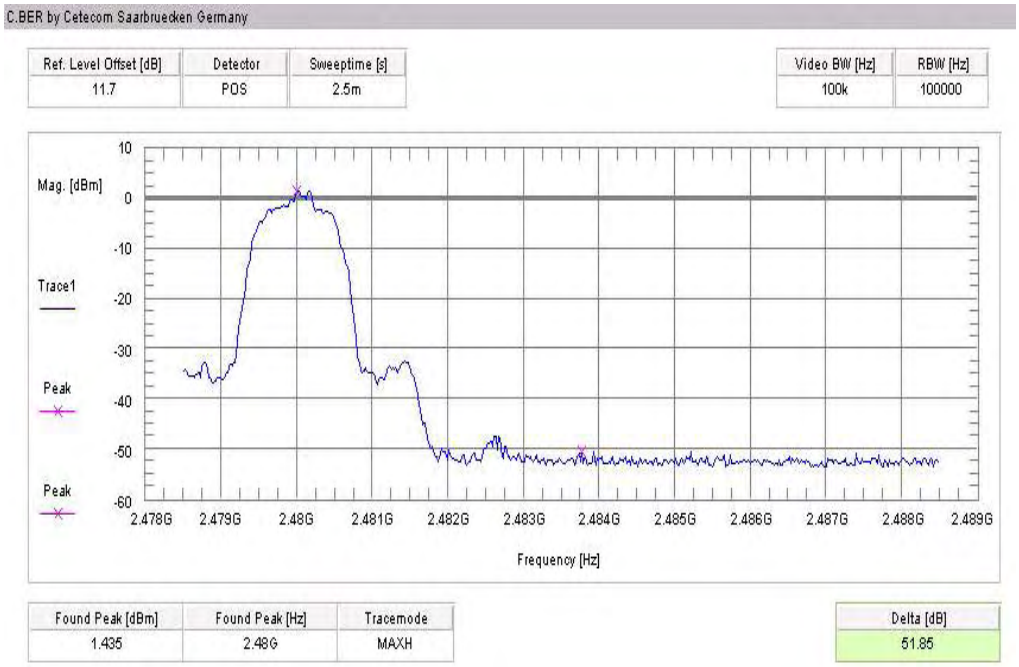
Plot 1 of 4 (hopping off, lowest frequency):



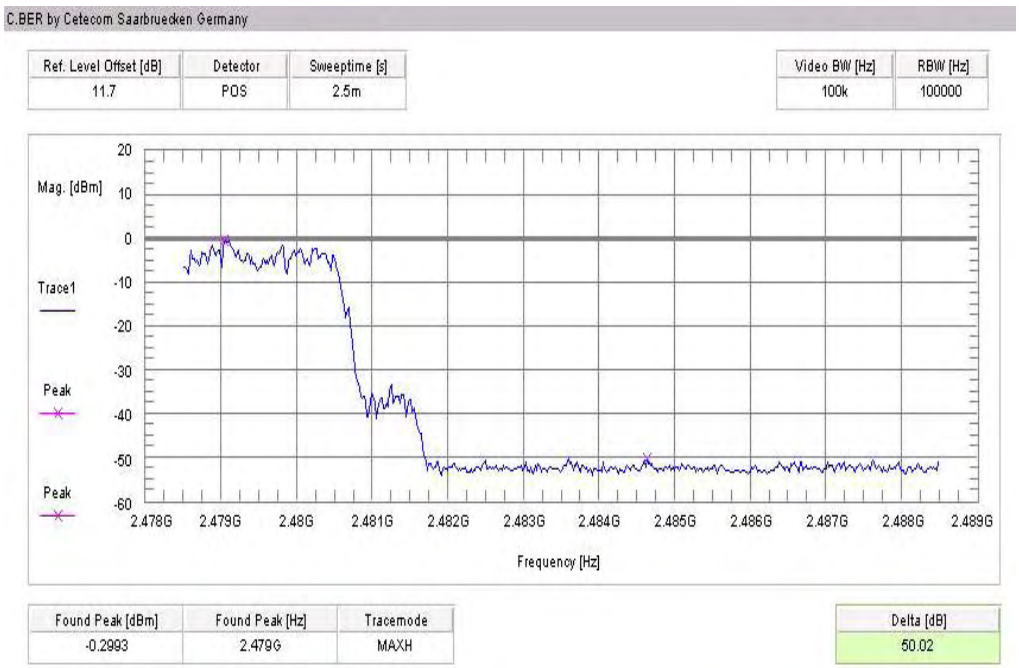
Plot 2 of 4 (hopping on, lowest frequency):



Plot 3 of 4 (hopping off, highest frequency):



Plot 4 of 4 (hopping on, highest frequency):



Results:

SZENARIO	DELTA VALUE [DB]
hopping off, lowest frequency	> 20 dB
hopping on, lowest frequency	> 20 dB
hopping off, highest frequency	> 20 dB
hopping on, highest frequency	> 20 dB
Measurement uncertainty	±1,5dB

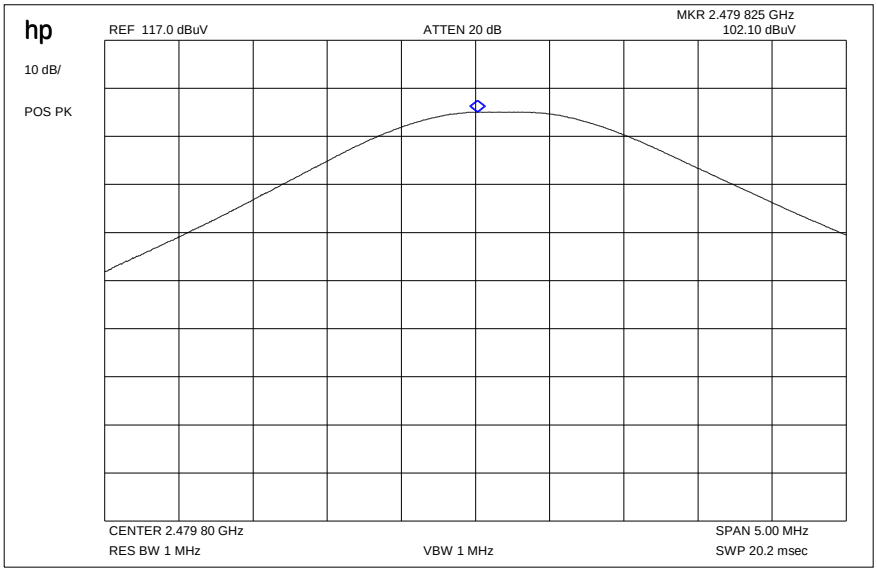
Limits:

Under normal test conditions only	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)).

5.13 Band-edge compliance of radiated emissions §15.205

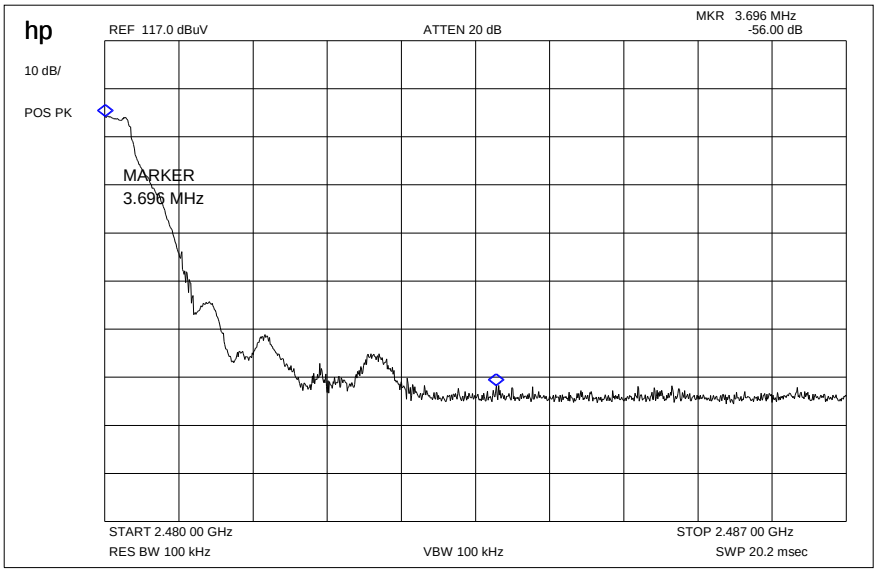
Modulation: GFSK

Plot 1: Max field strength in 3m distance (single frequency)



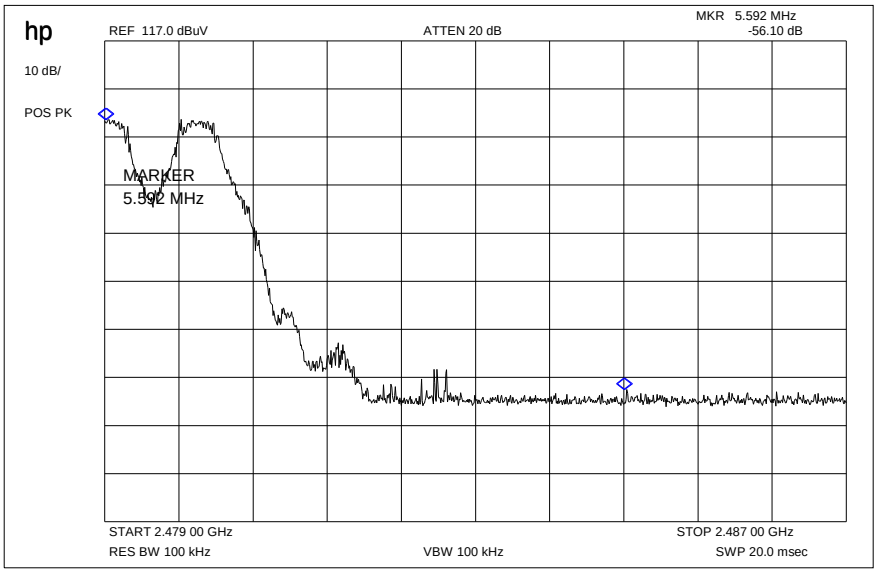
Result: 102.10 dBµV/m

Plot 2: Marker-Delta Method (single carrier)



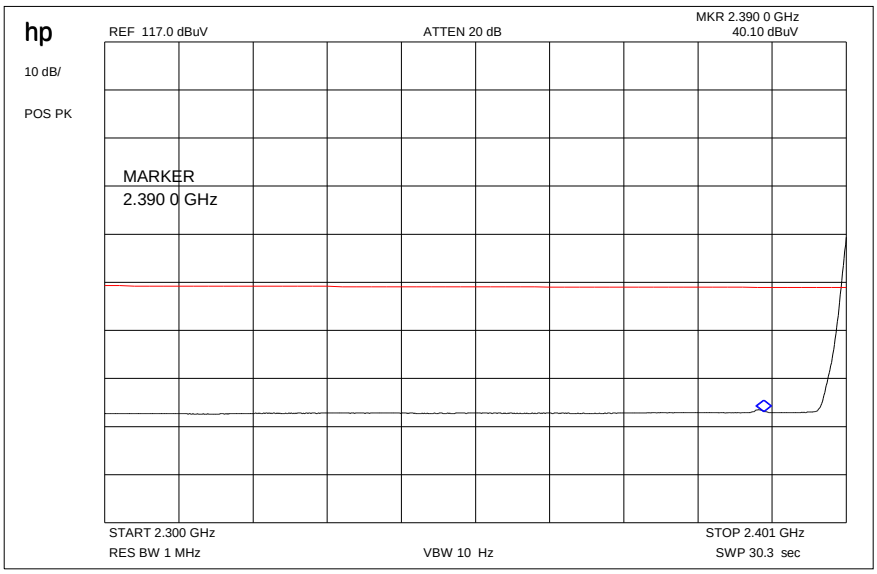
Marker-Delta-Value: 56.00 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 3: Marker-Delta Method (hopping)

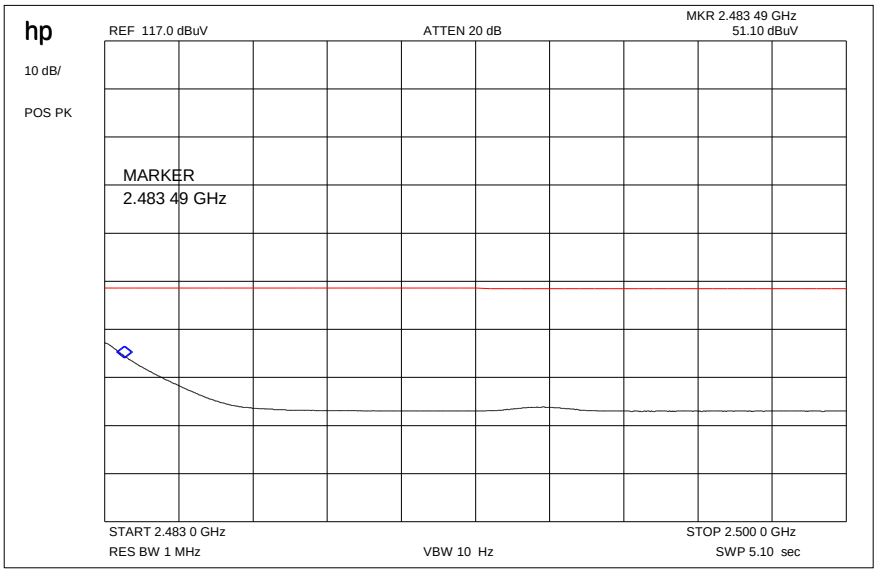


<u>Marker-Delta-Value:</u> 56.10 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 4: Restricted Bands low



Plot 5: Restricted Bands high



Results & Limits:

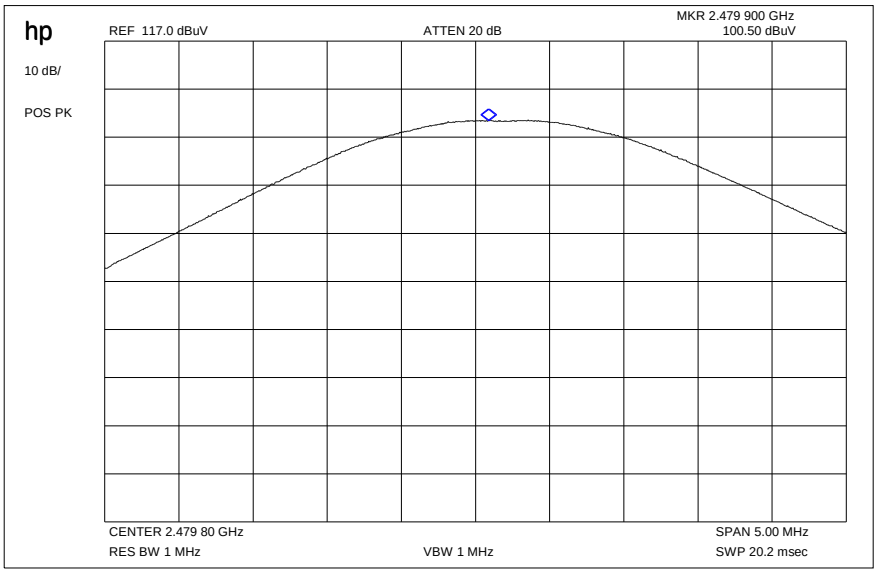
Radiated field strength

The field strength was measured with an EMI measuring receiver and 1 MHz RBW / VBW for peak and with 1MHz RBW / 10Hz VBW for average at a distance of 3m.

high channel	setup	measured value (3m)	correction factor (3m)	calculated value (3m)
Max. peak value	1 MHz RBW 1 MHz VBW	102.10 dBµV/m	-6.3	95.80 dBµV/m
Max. average value	Calculated with duty cycle correction factor	95.80 dBµV/m peak	-1,07dB duty cycle correction factor (worst case DH5)	94.73 dBµV/m
Delta value	Peak 100 kHz RBW/VBW	56.00 dB (single carrier) 56.10 dB (hopping mode)	-	-
Value at band edge	limit 54 dBµV/m			38.73 dBµV/m (single carrier) 38.63 dBµV/m (hopping mode)
Statement:				**Complies**

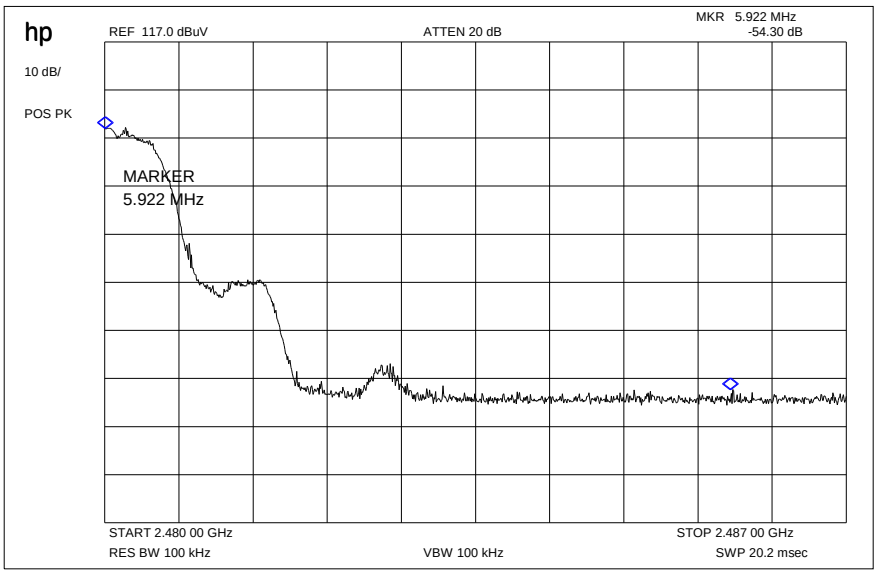
Modulation: Pi/4 DQPSK

Plot 1: Max field strength in 3m distance (single frequency)



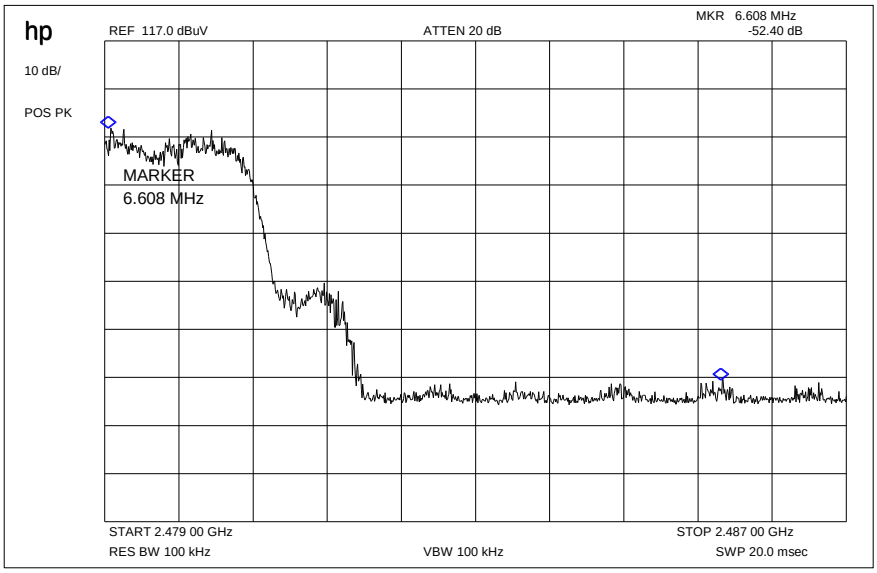
Result: 100.50 dBµV/m

Plot 2: Marker-Delta Method (single carrier)



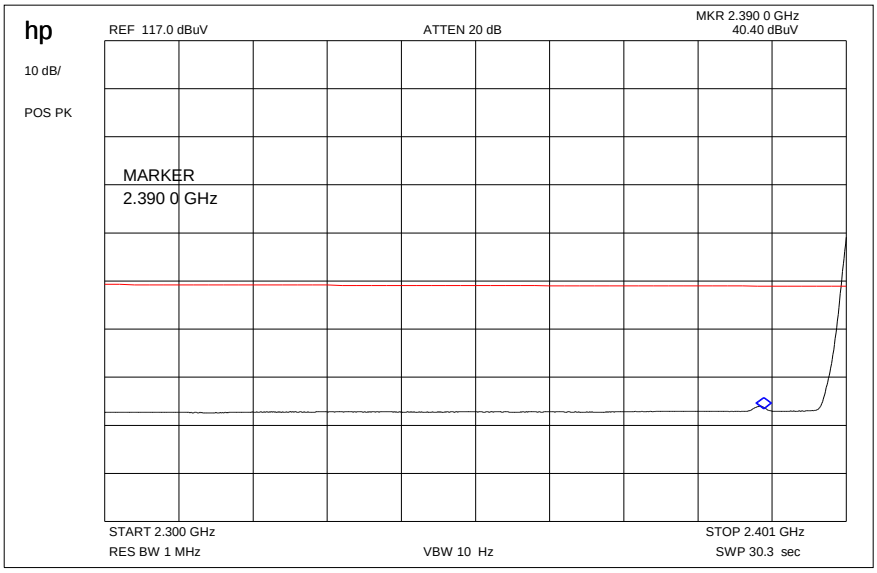
Marker-Delta-Value: 54.30 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 3: Marker-Delta Method (hopping)

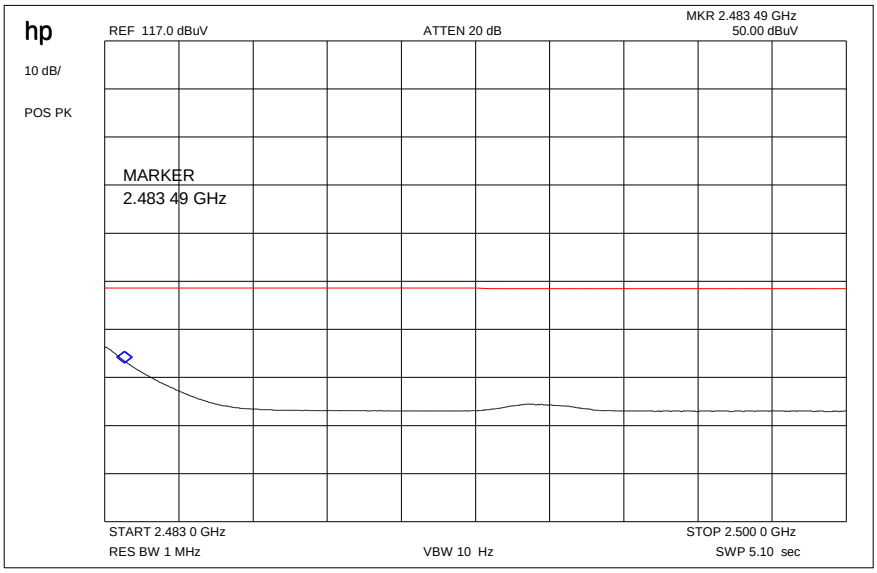


<u>Marker-Delta-Value:</u> 52.40 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 4: Restricted Bands low



Plot 5: Restricted Bands high



Results & Limits:

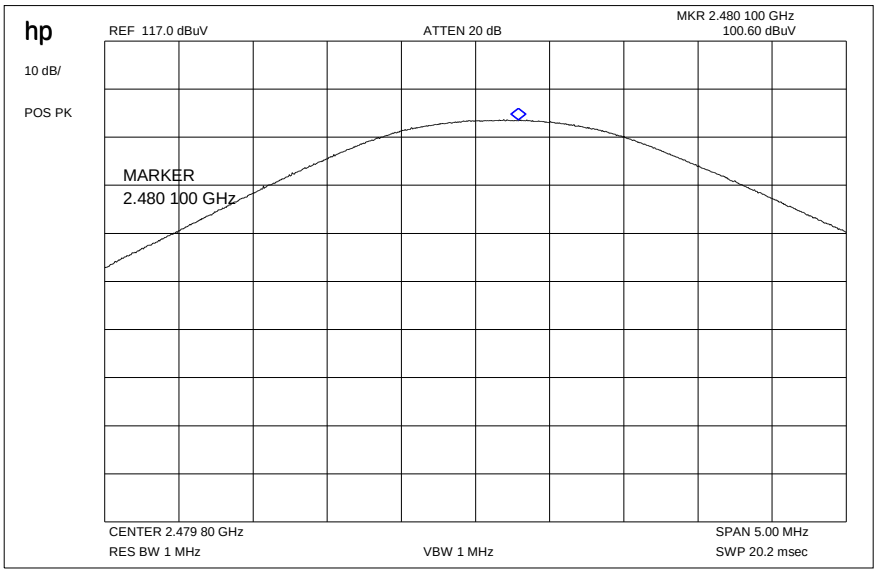
Radiated field strength

The field strength was measured with an EMI measuring receiver and 1 MHz RBW / VBW for peak and with 1MHz RBW / 10Hz VBW for average at a distance of 3m.

high channel	setup	measured value (3m)	correction factor (3m)	calculated value (3m)
Max. peak value	1 MHz RBW 1 MHz VBW	100.50 dBµV/m	-6.3	94.20 dBµV/m
Max. average value	Calculated with duty cycle correction factor	94.20 dBµV/m peak	-1,07dB duty cycle correction factor (worst case DH5)	93.13 dBµV/m
Delta value	Peak 100 kHz RBW/VBW	54.30 dB (single carrier) 52.40 dB (hopping mode)	-	-
Value at band edge	limit 54 dBµV/m			38.83 dBµV/m (single carrier) 40.73 dBµV/m (hopping mode)
Statement:				**Complies**

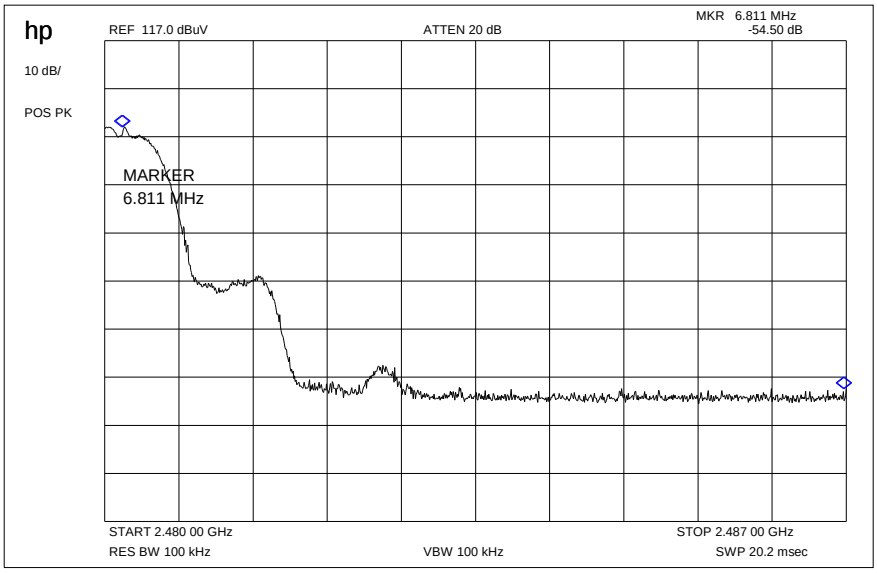
Modulation: 8 DPSK

Plot 1: Max field strength in 3m distance (single frequency)



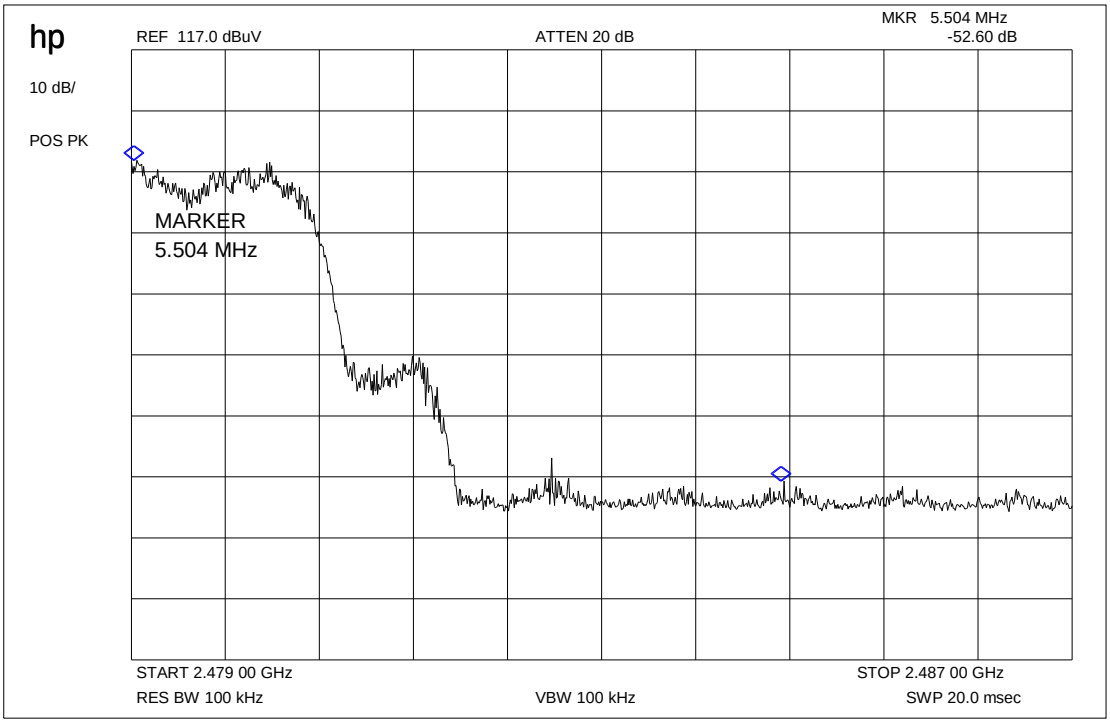
Result: 100.60 dBµV/m

Plot 2: Marker-Delta Method (single carrier)



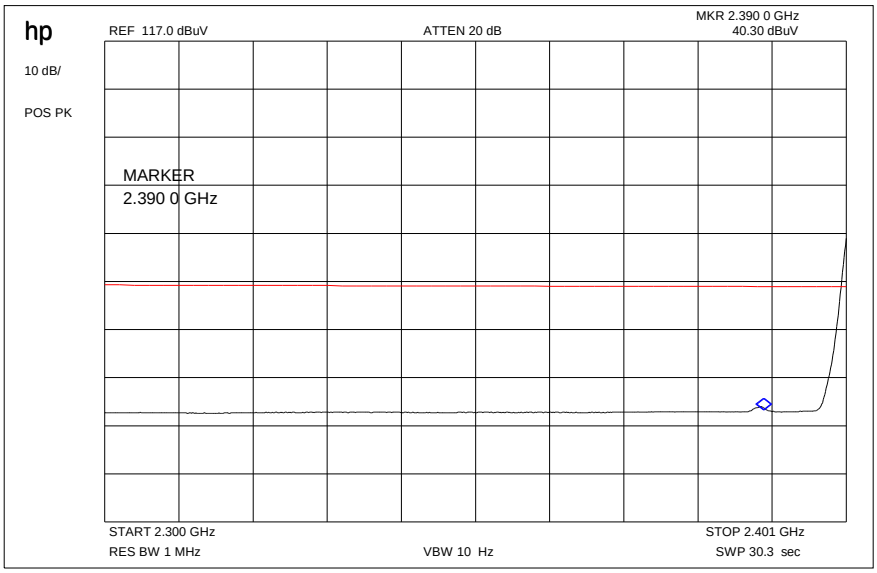
Marker-Delta-Value: 54.50 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 3: Marker-Delta Method (hopping)

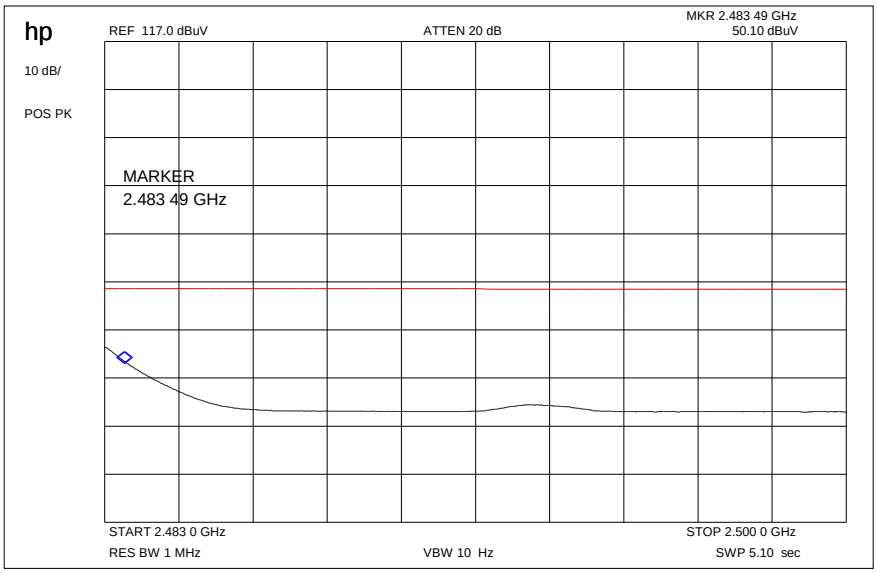


<u>Marker-Delta-Value:</u> 52.60 dB
This measurement was made to show that the behaviour of the system is conform to FCC 15.205 (restricted bands)

Plot 4: Restricted Bands low



Plot 5: Restricted Bands high



Results & Limits:

Radiated field strength

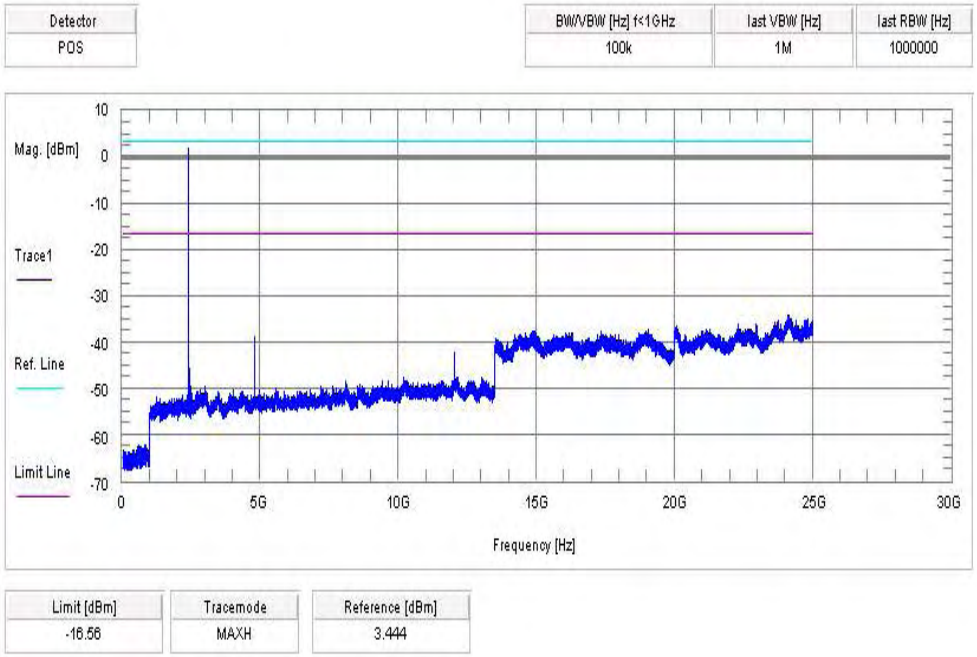
The field strength was measured with an EMI measuring receiver and 1 MHz RBW / VBW for peak and with 1MHz RBW / 10Hz VBW for average at a distance of 3m.

high channel	setup	measured value (3m)	correction factor (3m)	calculated value (3m)
Max. peak value	1 MHz RBW 1 MHz VBW	100.60 dBµV/m	-6.3	94.30 dBµV/m
Max. average value	Calculated with duty cycle correction factor	94.30 dBµV/m peak	-1,07dB duty cycle correction factor (worst case DH5)	93.23 dBµV/m
Delta value	Peak 100 kHz RBW/VBW	54.50 dB (single carrier) 52.60 dB (hopping mode)	-	-
Value at band edge	limit 54 dBµV/m			38.73 dBµV/m (single carrier) 40.63 dBµV/m (hopping mode)
Statement:				**Complies**

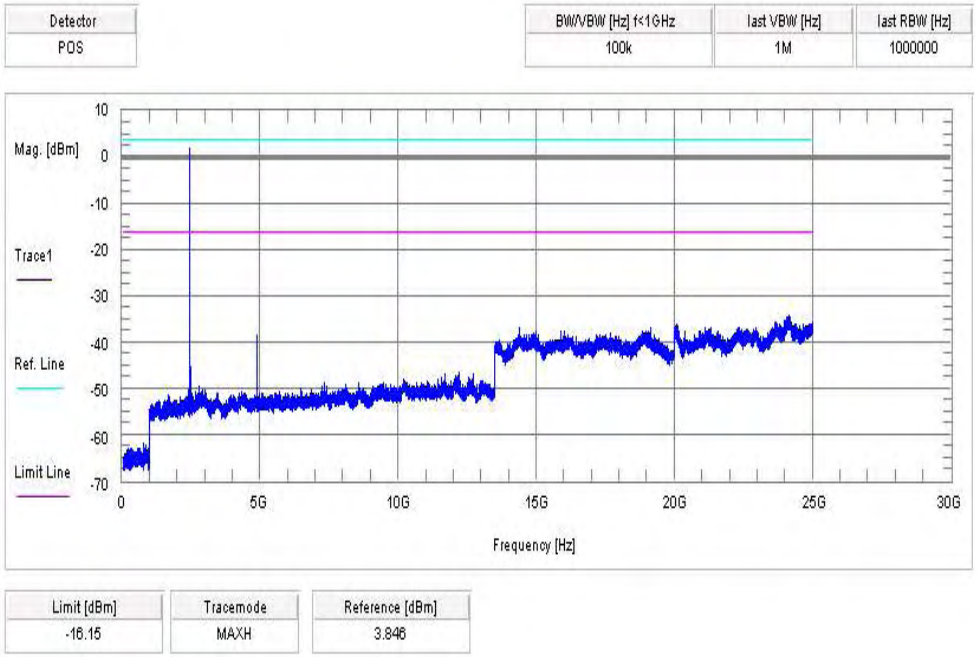
5.14 Spurious Emissions - conducted (Transmitter) § 15.247 (c)(1)

Modulation: GFSK

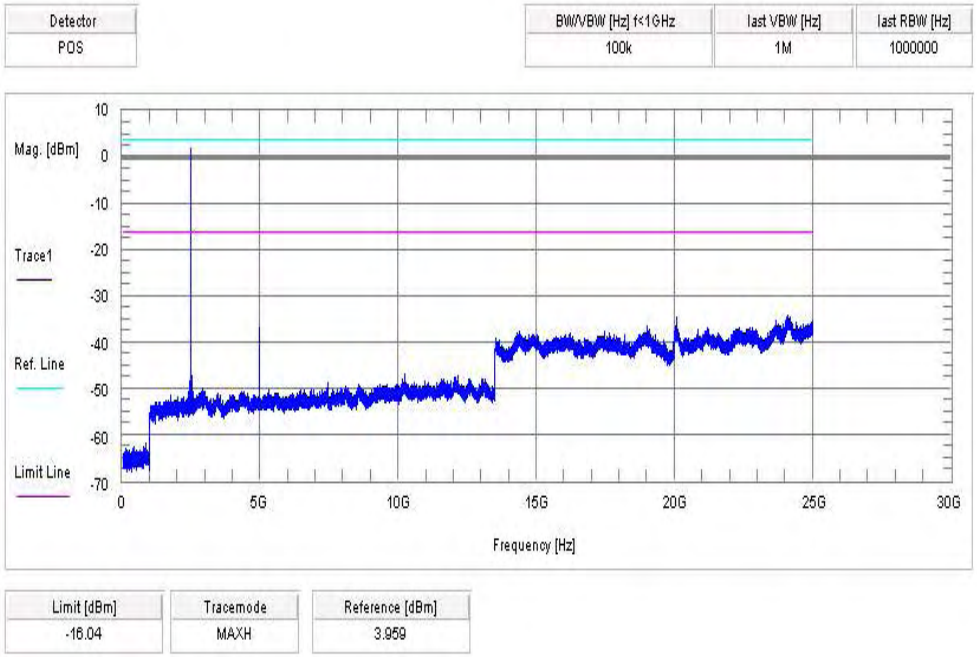
Plot 1 of 3: lowest channel



Plot 2 of 3: middle channel



Plot 3 of 3: highest channel



Result & Limits:

Emission Limitation					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402		3.44	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2441		3.85	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2480		3.96	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
Measurement uncertainty		± 3dB			

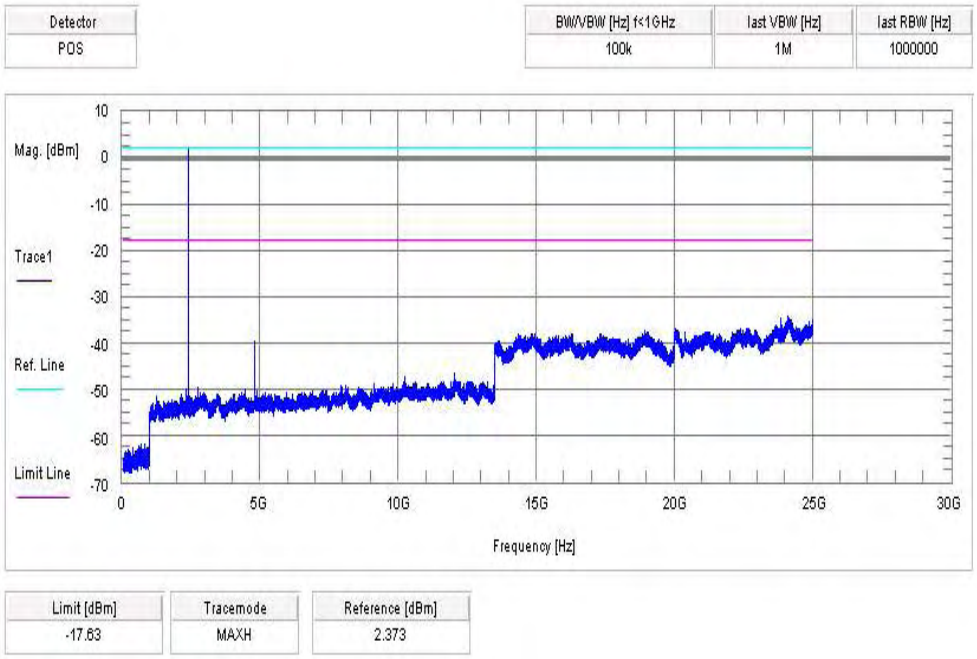
F < 1 GHz: RBW: 100 kHz VBW: 100 kHz
F > 1 GHz: RBW: 1 MHz VBW: 1 MHz

Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. 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)).

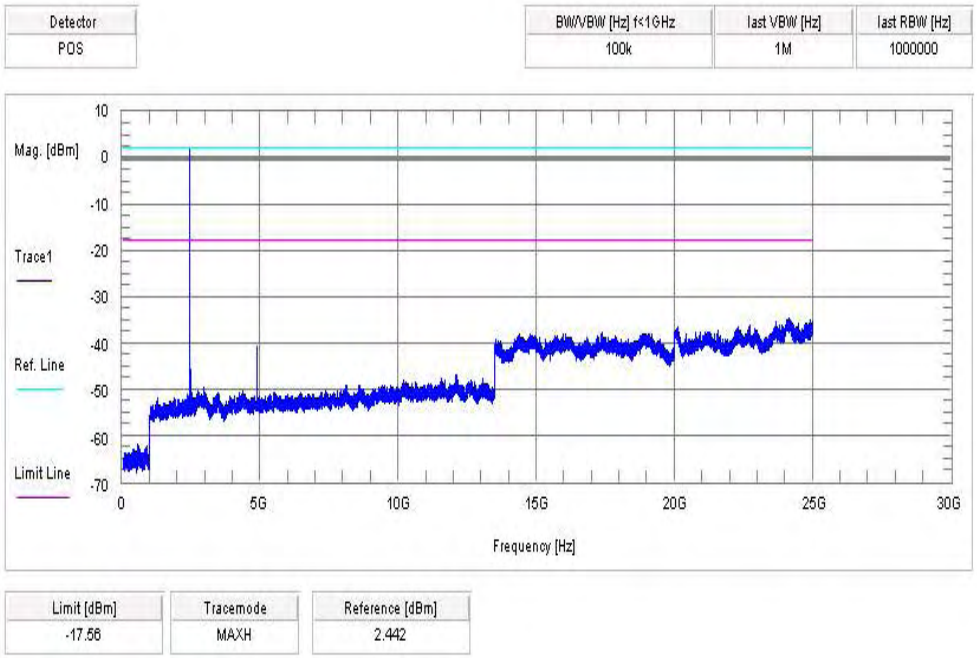
Note: For emissions that fall into restricted bands you find the radiated emissions later in the report.

Modulation: Pi/4 DQPSK

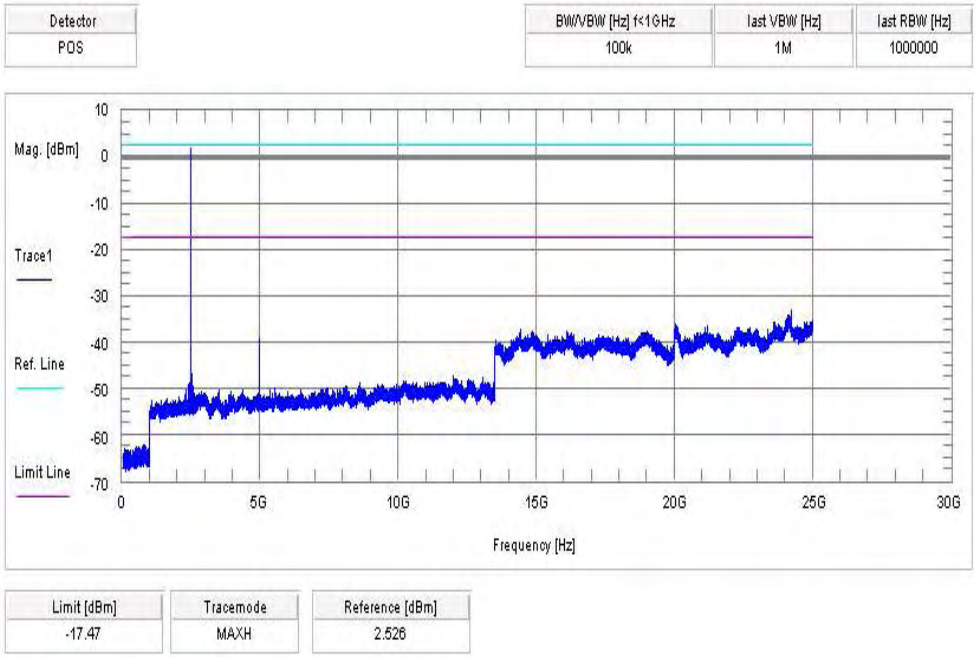
Plot 1 of 3: lowest channel



Plot 2 of 3: middle channel



Plot 3 of 3: highest channel



Result & Limits:

Emission Limitation					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402		2.37	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2441		2.44	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2480		2.53	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
Measurement uncertainty		± 3dB			

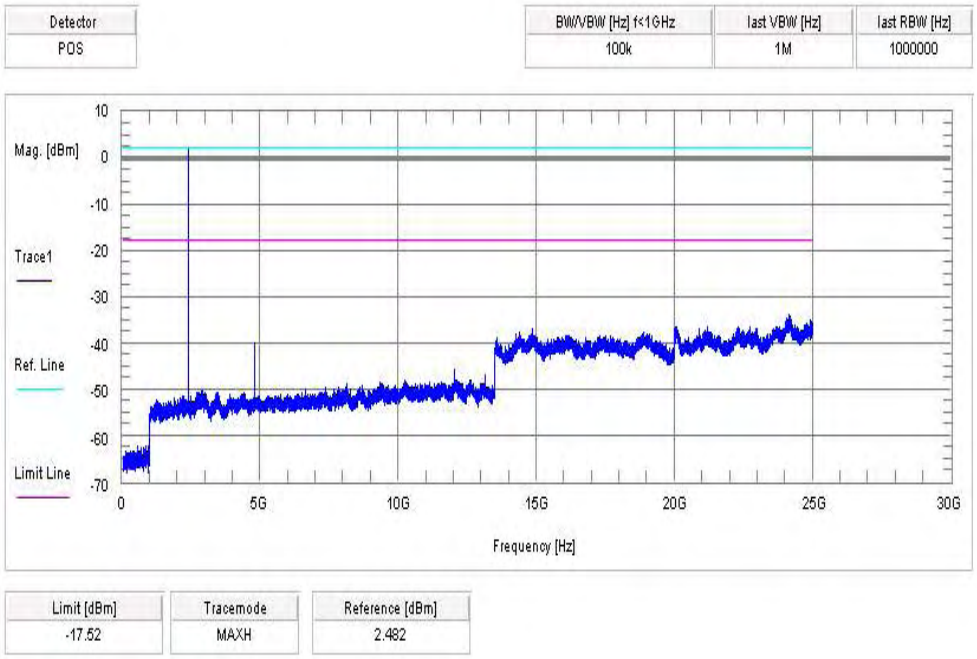
F < 1 GHz: RBW: 100 kHz VBW: 100 kHz
F > 1 GHz: RBW: 1 MHz VBW: 1 MHz

Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. 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)).

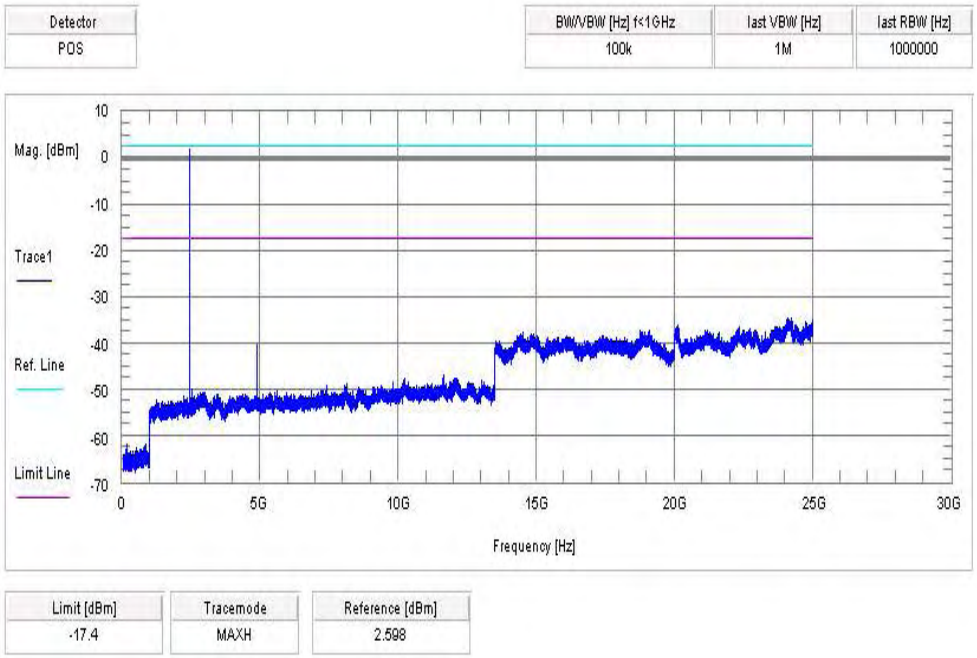
Note: For emissions that fall into restricted bands you find the radiated emissions later in the report.

Modulation: 8 DPSK

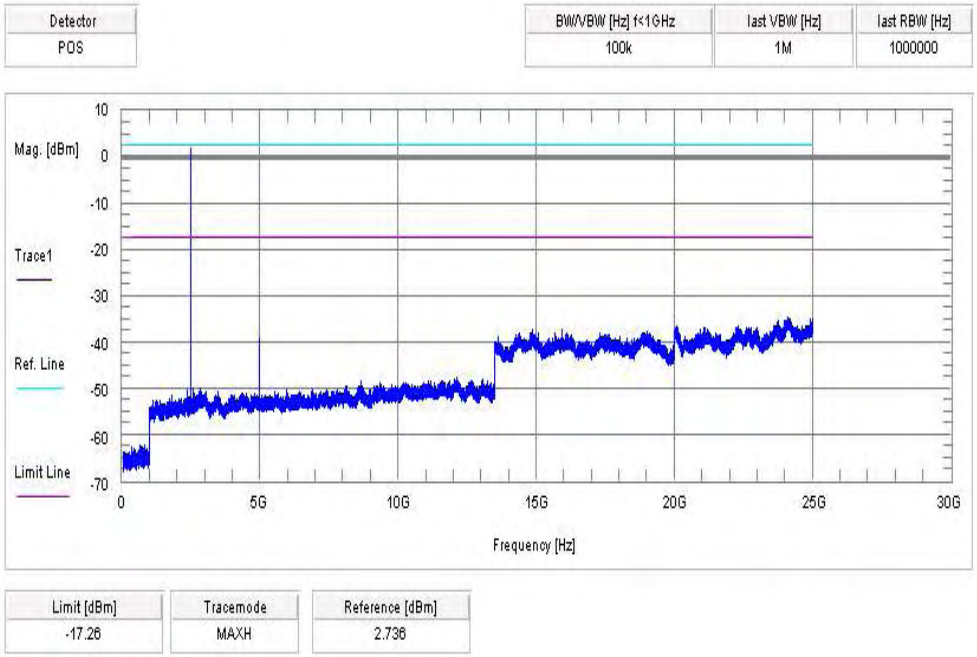
Plot 1 of 3: lowest channel



Plot 2 of 3: middle channel



Plot 3 of 3: highest channel



Result & Limits:

Emission Limitation					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402		2.48	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2441		2.60	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
2480		2.74	30 dBm		Operating frequency
No critical peaks detected! All found peaks are below -30 dBm.			-20 dBc		complies
Measurement uncertainty		± 3dB			

F < 1 GHz: RBW: 100 kHz VBW: 100 kHz
F > 1 GHz: RBW: 1 MHz VBW: 1 MHz

Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. 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)).

Note: For emissions that fall into restricted bands you find the radiated emissions later in the report.

5.15 Spurious Emissions > 30 MHz- radiated (Transmitter) § 15.247 (c)(1)

Modulation: GFSK

Plot 1: 0.03 - 1 GHz vertical/horizontal (lowest channel)

Information

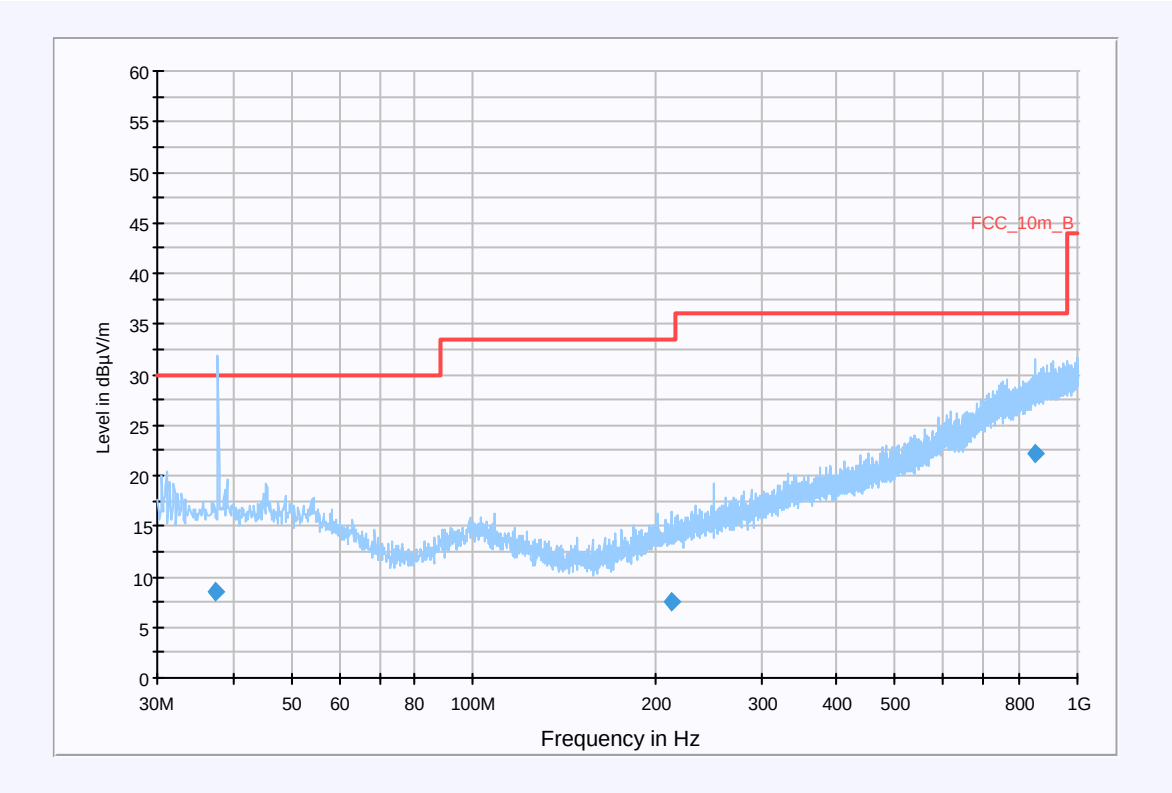
EUT:	AAD-3052091-BV + Charger (CAA-0002001-BV)
Serial Number:	CB510YGH37 + 2207W29704729
Test Description:	FCC Part 15
Operating Conditions:	BT Testmode (TX channel 0; EDR)
Operator Name:	Kraus
Comment:	AC 115V /60Hz

Scan Setup: STAN_Fin [EMI radiated]

Hardware Setup:	EMI radiated\Electric Field (NOS)
Level Unit:	dBµV/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	QuasiPeak	120kHz	15s	Receiver

FCC_Short_1GHz



Final Measurement Detector 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
37.318600	8.5	1000.000	120.000	120.0	H	-1.0	13.4	21.5	30.0	
213.347550	7.5	1000.000	120.000	120.0	V	29.0	12.4	26.0	33.5	
852.994700	22.2	1000.000	120.000	120.0	H	23.0	25.4	13.8	36.0	

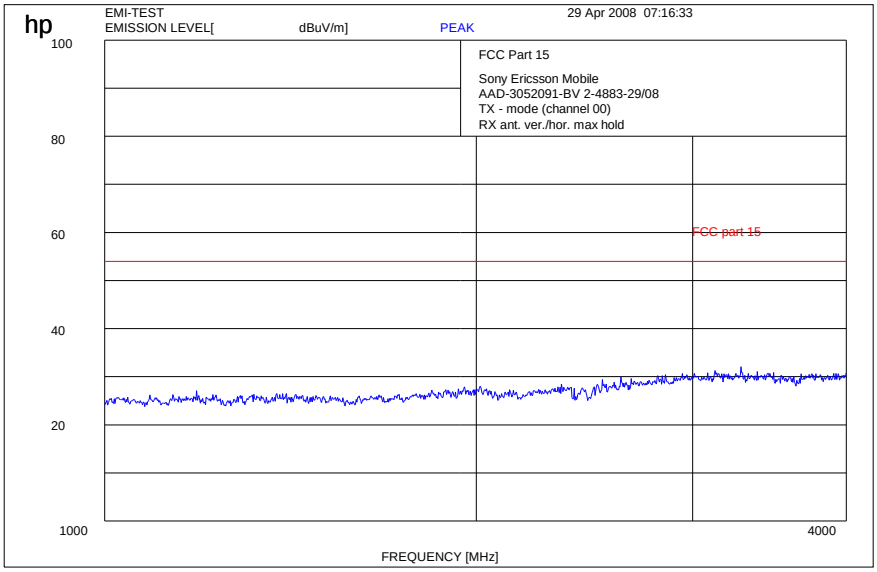
Plot No. 1 (0.03 - 1 GHz vertical/horizontal lowest channel) shows a critical peak above the limit line. This peak (37.3186 MHz) doesn't fall into the restricted band by 37.5 – 38.25 MHz. Ergo it is possible to re-measure with the quasi peak function. The result of the measurement is passed.

Hardware Setup: EMI radiated\Electric Field (NOS) - [EMI radiated]

Subrange 1

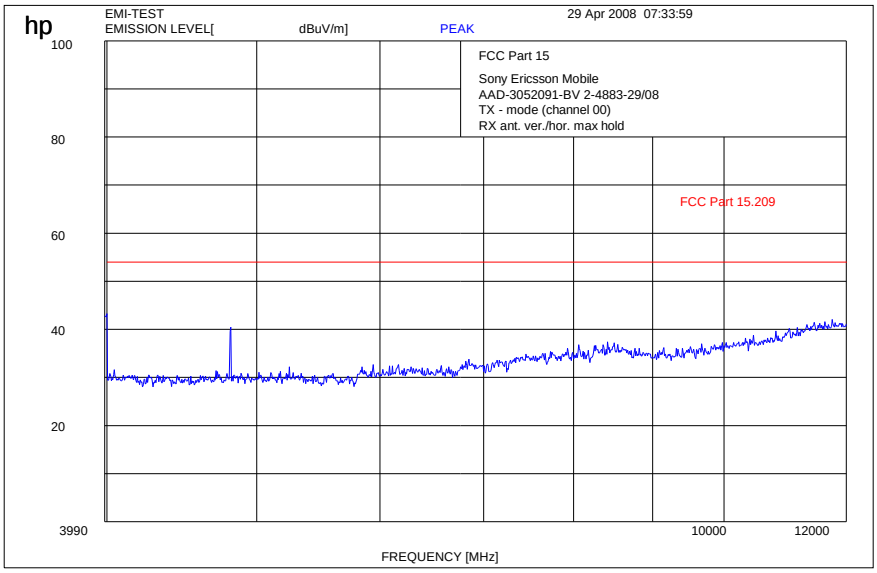
Frequency Range:	30MHz - 2GHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 3.32, CAL 07.01.2009
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163 SN 9163-295, FW ---, CAL 08.04.2010 Correction Table (vertical): VULP6113 Correction Table (horizontal): VULP6113 Correction Table: Cabel with switch (0408)
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9)

Plot 2: 1 - 4 GHz vertical/horizontal (lowest channel)

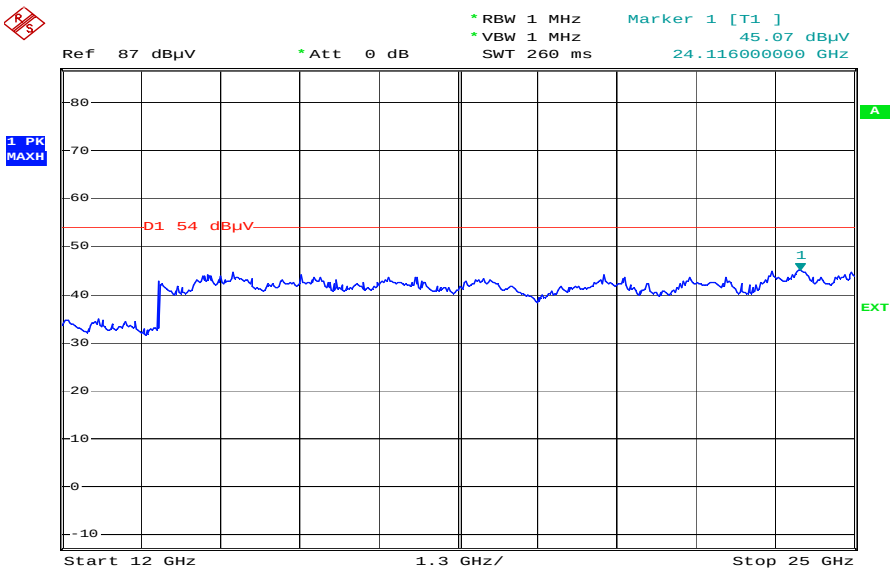


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 3: 4 - 12 GHz vertical/horizontal (lowest channel)



Plot 4: 12 - 25 GHz vertical/horizontal (valid for all channels)



Date: 3.MAY.2008 09:16:06

Plot 5: 0.03 - 1 GHz vertical/horizontal (middle channel)

Information

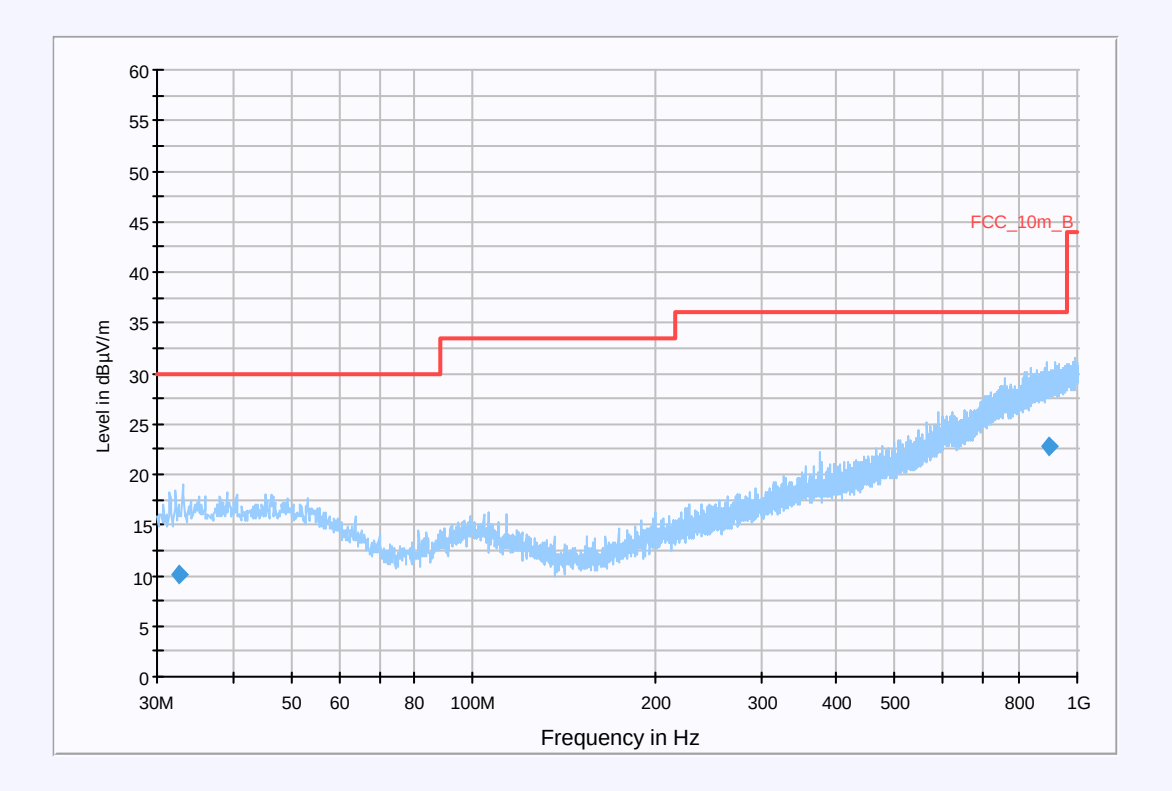
EUT:	AAD-3052091-BV + Charger (CAA-0002001-BV)
Serial Number:	CB510YGH37 + 2207W29704729
Test Description:	FCC Part 15
Operating Conditions:	BT Testmode (TX channel 39; EDR)
Operator Name:	Kraus
Comment:	AC 115V /60Hz

Scan Setup: STAN_Fin [EMI radiated]

Hardware Setup:	EMI radiated\Electric Field (NOS)
Level Unit:	dBµV/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	QuasiPeak	120kHz	15s	Receiver

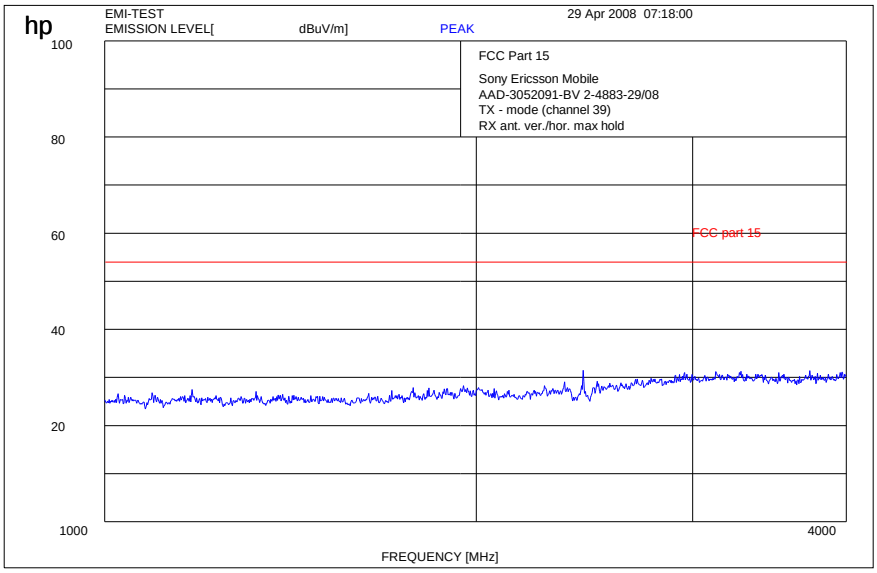
FCC_Short_1GHz



Final Measurement Detector 1

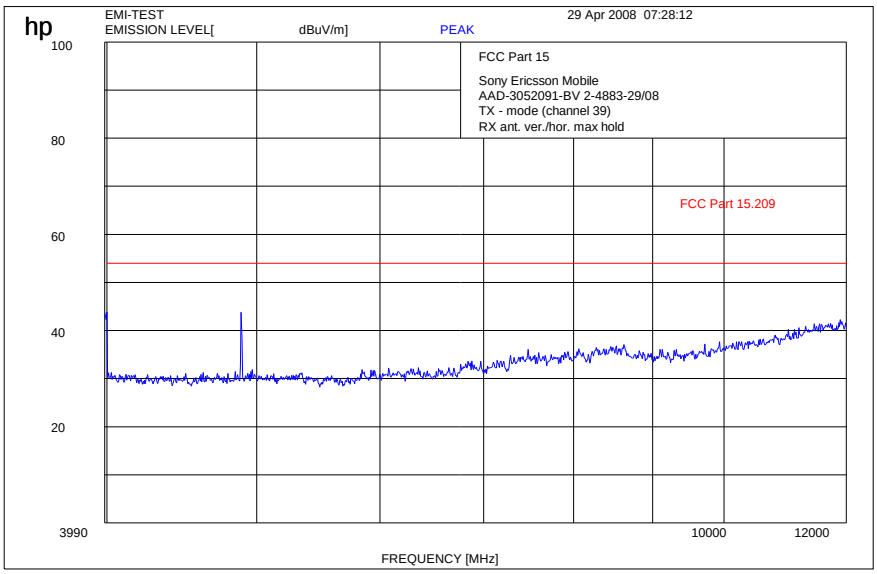
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
32.631200	10.1	1000.000	120.000	120.0	V	60.0	12.9	19.9	30.0	
894.998400	22.8	1000.000	120.000	120.0	V	356.0	26.0	13.2	36.0	

Plot 6: 1 - 4 GHz vertical/horizontal (middle channel)



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

Plot 7: 4 - 12 GHz vertical/horizontal (middle channel)



Plot 8: 0.03 - 1 GHz vertical/horizontal (highest channel)

Information

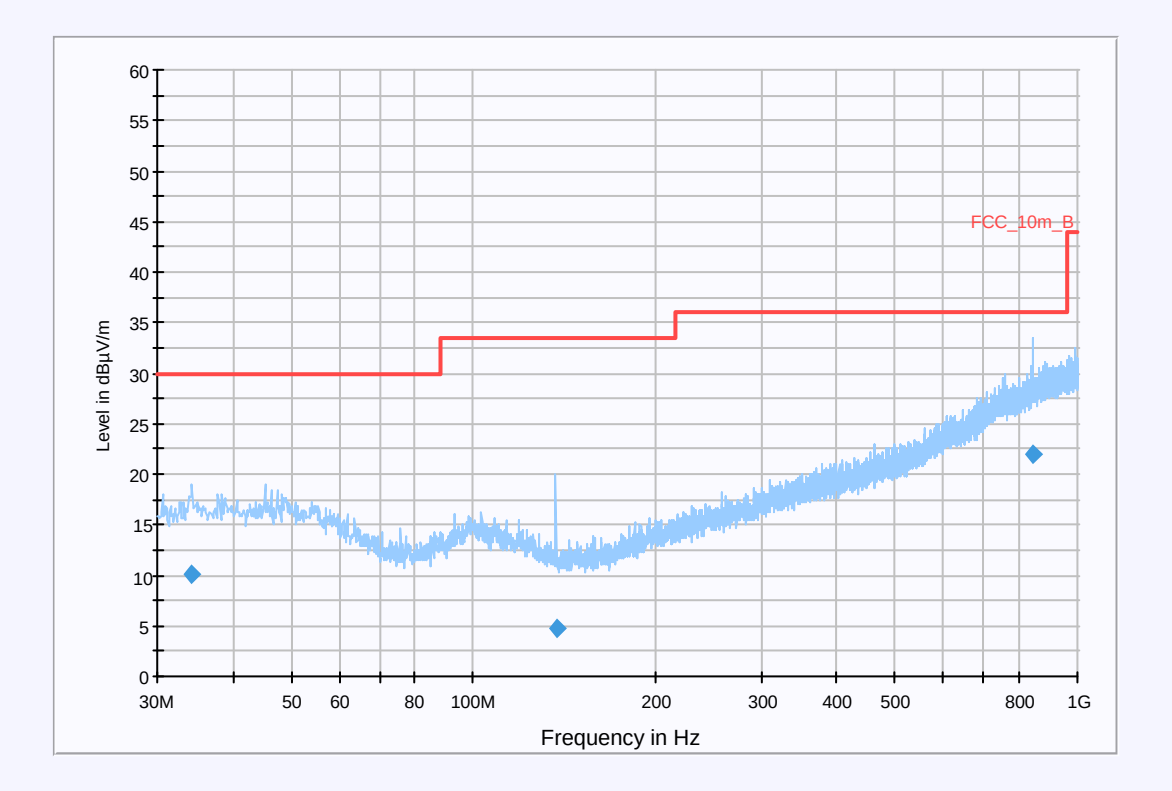
EUT:	AAD-3052091-BV + Charger (CAA-0002001-BV)
Serial Number:	CB510YGH37 + 2207W29704729
Test Description:	FCC Part 15
Operating Conditions:	BT Testmode (TX channel 78; EDR)
Operator Name:	Kraus
Comment:	AC 115V /60Hz

Scan Setup: STAN_Fin [EMI radiated]

Hardware Setup:	EMI radiated\Electric Field (NOS)
Level Unit:	dBµV/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	QuasiPeak	120kHz	15s	Receiver

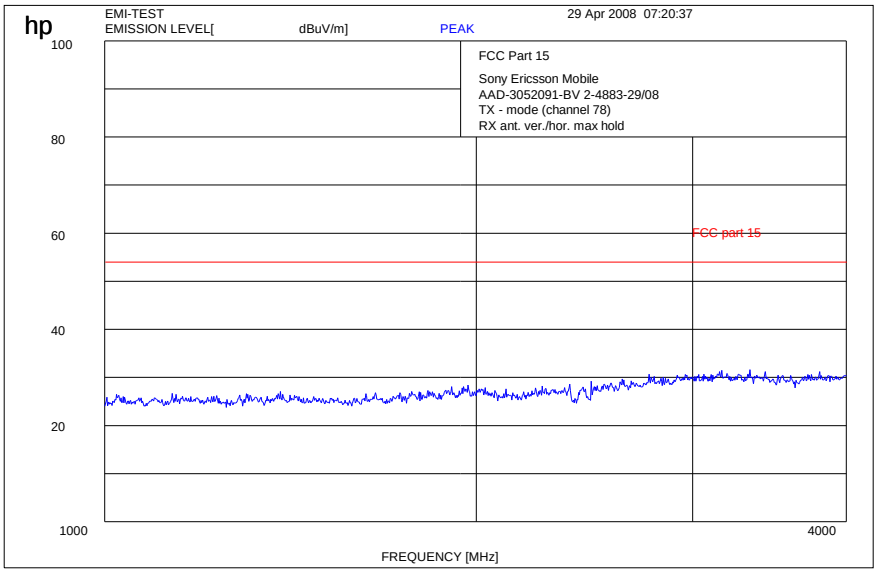
FCC_Short_1GHz



Final Measurement Detector 1

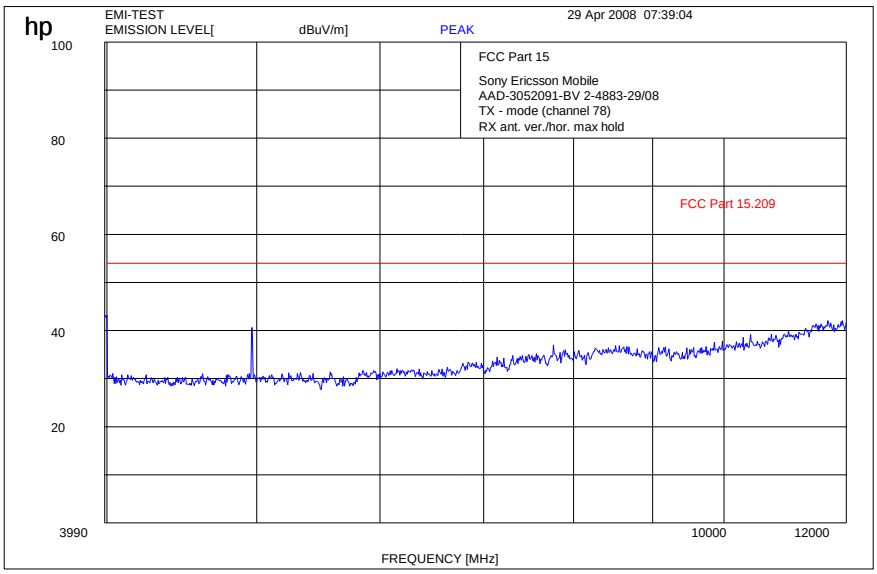
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
34.183900	10.2	1000.000	120.000	120.0	V	289.0	13.1	19.8	30.0	
137.232650	4.8	1000.000	120.000	120.0	V	240.0	9.2	28.7	33.5	
843.622950	22.0	1000.000	120.000	120.0	V	-1.0	25.2	14.0	36.0	

Plot 9: 1 - 4 GHz vertical/horizontal (highest channel)



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

Plot 10: 4 - 12 GHz vertical/horizontal (highest channel)



Results:

SPURIOUS EMISSIONS LEVEL (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]
No critical peaks detected.			No critical peaks detected.			No critical peaks detected.		
Measurement uncertainty			±3 dB					

f < 1 GHz : RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz

Limits: § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. 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)).

Limits: § 15.109

Frequency (MHz)	**Field strength (dBµV/m)**	**Measurement distance (m)**
30 - 88	30.0	10
88 - 216	33.5	10
216 - 960	36.0	10
above 960	54.0	3

5.16 Spurious Emissions - radiated (Receiver) § 15.109

Modulation: GFSK

Plot 1: 0.03 - 1 GHz vertical/horizontal (receiver)

Information

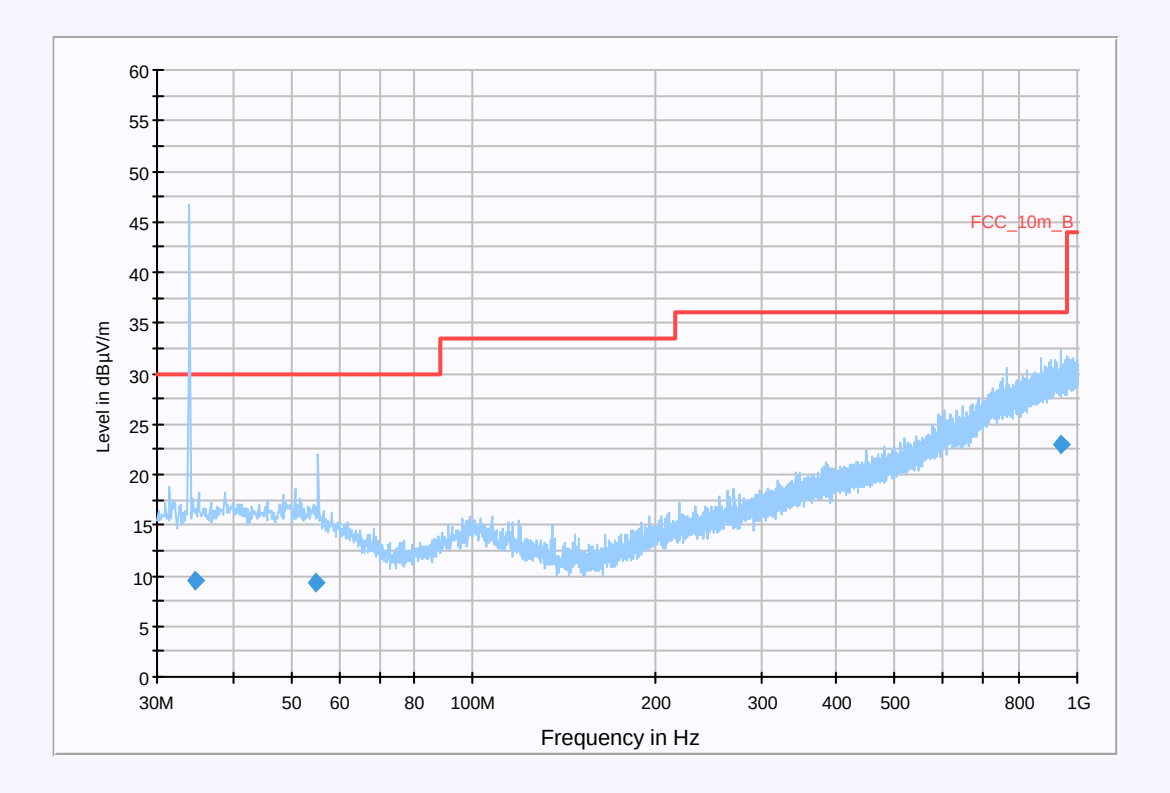
EUT:	AAD-3052091-BV + Charger (CAA-0002001-BV)
Serial Number:	CB510YGH37 + 2207W29704729
Test Description:	FCC Part 15
Operating Conditions:	BT Testmode (RX)
Operator Name:	Kraus
Comment:	AC 115V /60Hz

Scan Setup: STAN_Fin [EMI radiated]

Hardware Setup:	EMI radiated\Electric Field (NOS)
Level Unit:	dBµV/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	QuasiPeak	120kHz	15s	Receiver

FCC_Short_1GHz

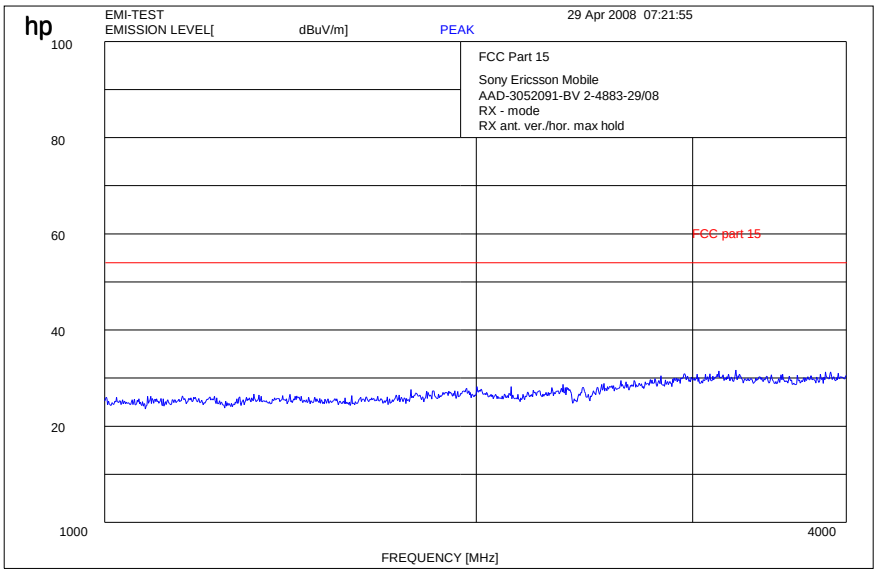


Final Measurement Detector 1

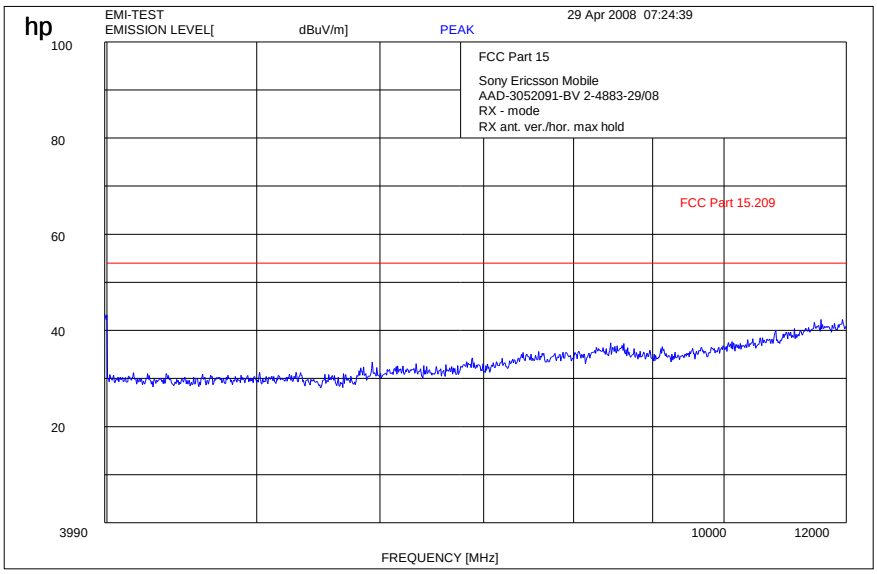
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
34.573200	9.4	1000.000	120.000	120.0	H	-1.0	13.1	20.6	30.0	
54.901800	9.2	1000.000	120.000	120.0	V	20.0	13.2	20.8	30.0	
940.416150	23.0	1000.000	120.000	120.0	V	343.0	26.3	13.0	36.0	

Plot No. 1 (0.03 - 1 GHz vertical/horizontal receiver) shows a critical peak above the limit line. This peak (34.5732 MHz) doesn't fall into the restricted band by 37.5 – 38.25 MHz. Ergo it is possible to re-measure with the quasi peak function. The result of the measurement is passed.

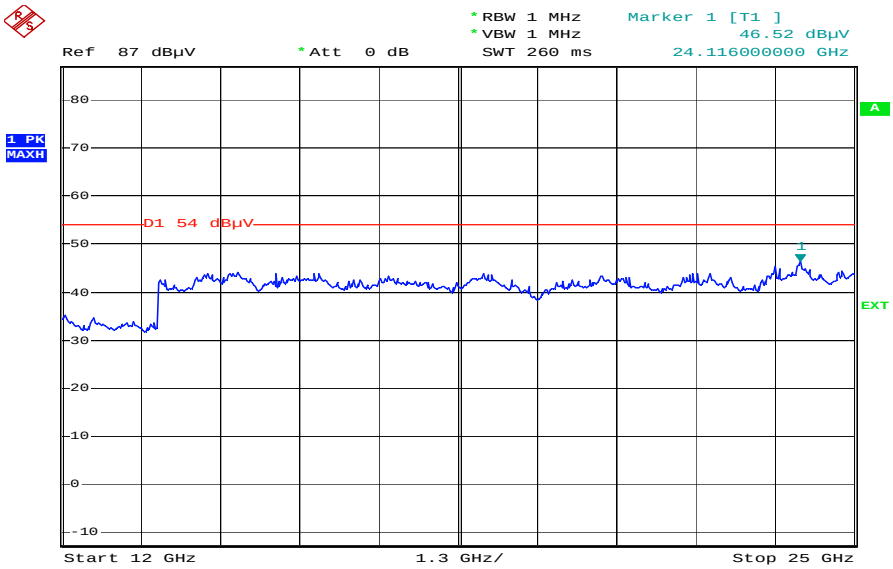
Plot 2: 1 - 4 GHz vertical/horizontal (receiver)



Plot 3: 4 - 12 GHz vertical/horizontal (receiver)



Plot 4: 12 - 25 GHz vertical/horizontal (receiver)



Date: 3.MAY.2008 09:14:50

Spurious Emissions level [dBµV/m]		
f[MHz]	Detector	Level [dBµV/m]
No critical peaks detected.		
Measurement uncertainty	±3 dB	

f < 1 GHz: RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz
See above plots

Measurement distance see table

Limits: § 15.109

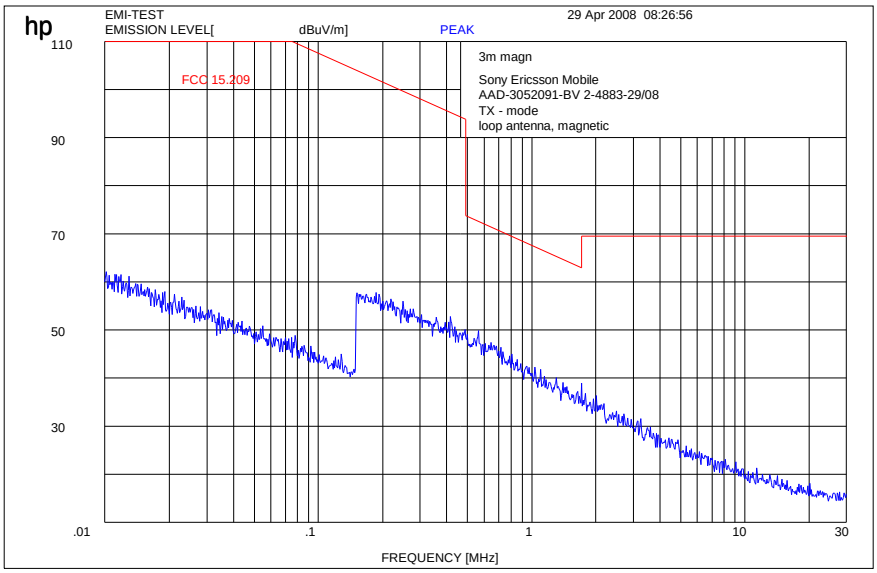
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance (m)
30 - 88	30.0	10
88 - 216	33.5	10
216 - 960	36.0	10
above 960	54.0	3

5.17 Spurious Emissions < 30 MHz - Transmitter radiated § 15.209

Modulation: GFSK

Measured at 3 m distance.
Values recalculated with 40 dB/decade according to FCC rules.

Plot 1:



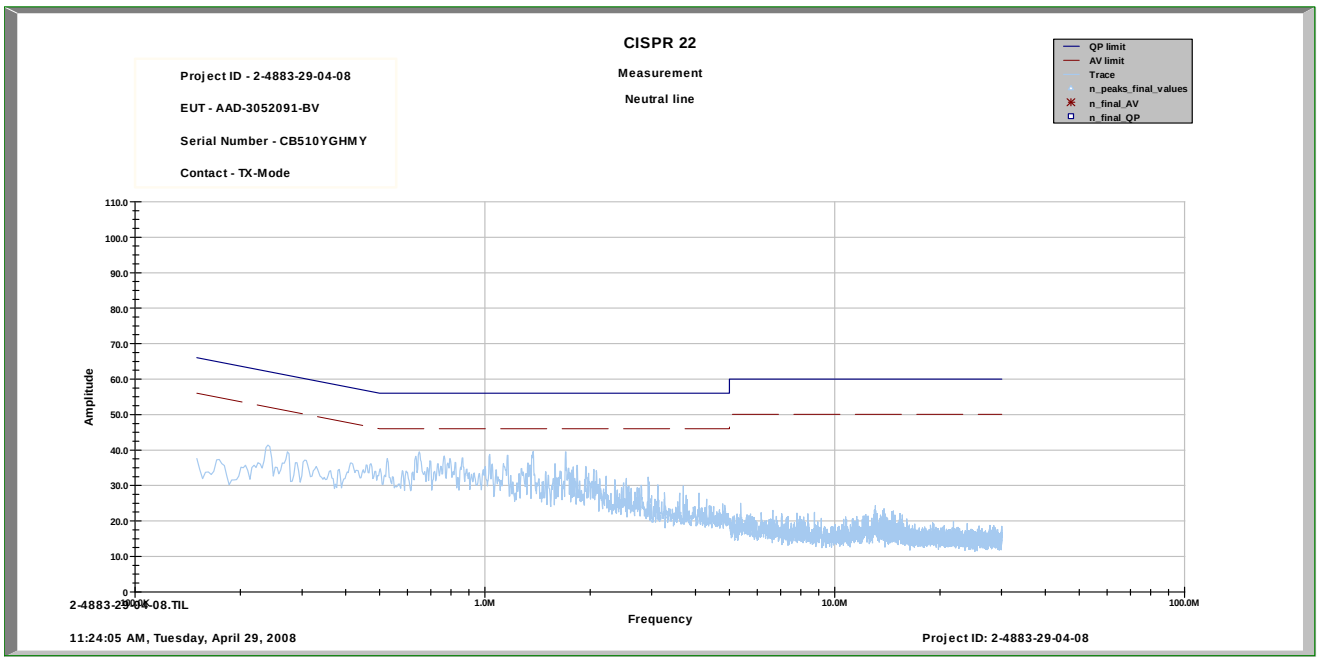
Limits:

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30 / 29.5 dBµV/m	30

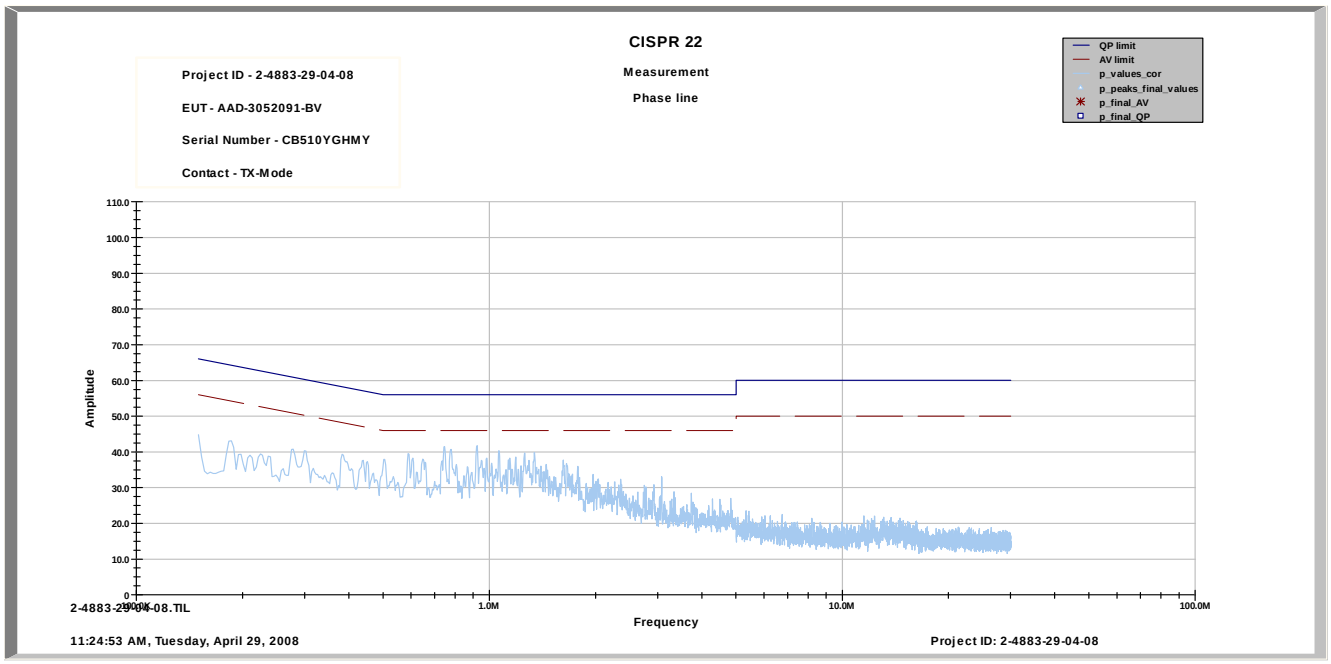
5.18 Conducted Emissions <30 MHz § 15.107/207

Modulation: GFSK

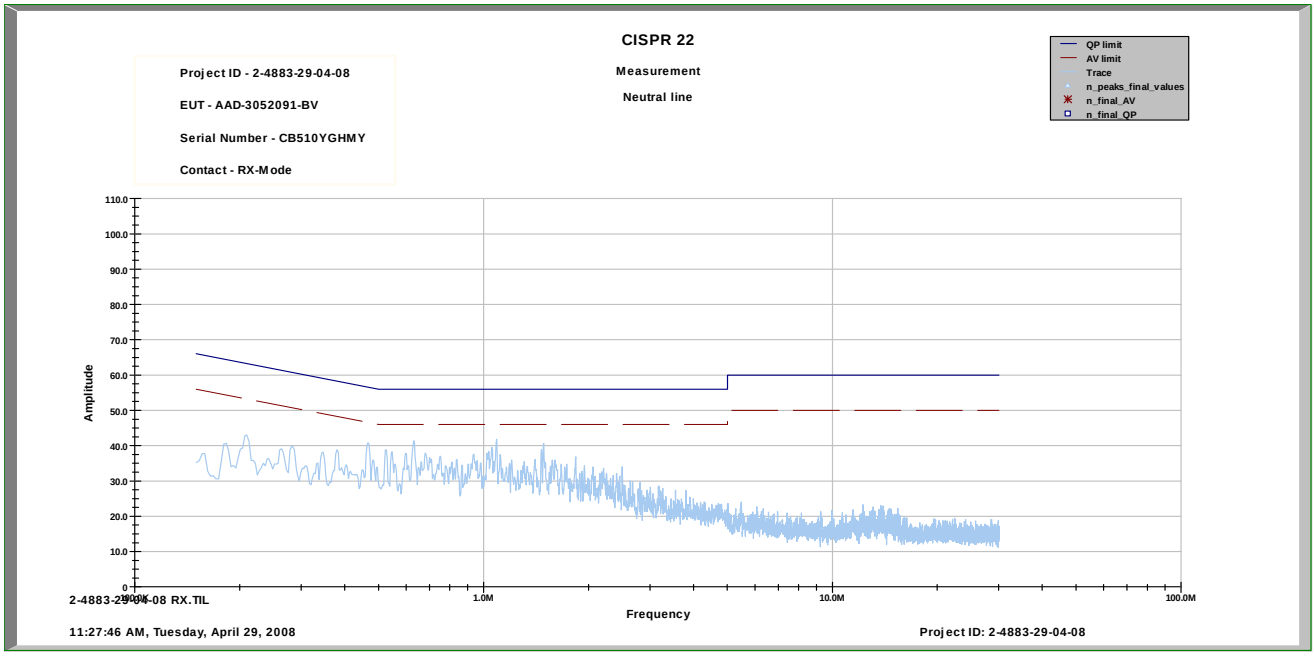
Plot 1: TX mode



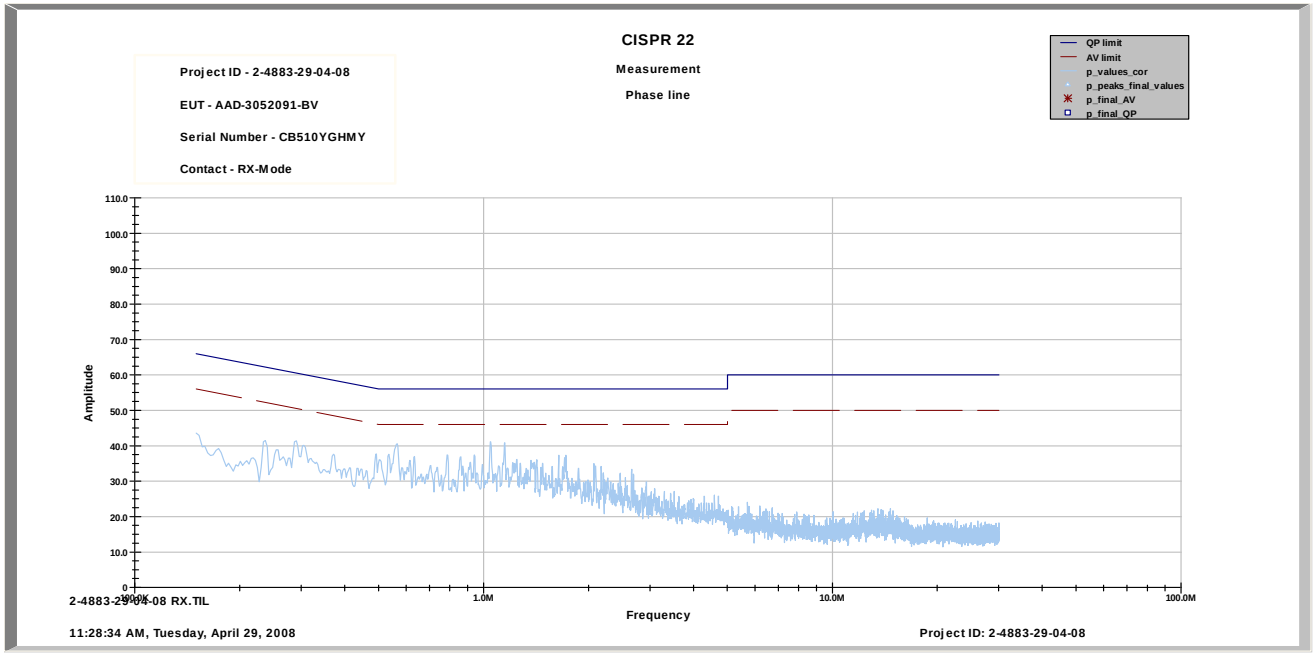
Plot 2: TX mode



Plot 3: RX mode



Plot 4: RX mode



Limits:

Under normal test conditions only	See plots

6 Test equipment and ancillaries used for tests

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

Anechoic chamber C:

No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	Anechoic chamber	MWB	87400/02	300000996	Monthly verification		
2	System-Rack 85900	HP I.V.	*	300000222	n.a.		
3	Measurement System 1						
4	Spektrum Analyzer 8566B	HP	2747A05306	300001000	05.10.2006	24	05.10.2008
5	Spektrum Analyzer Display 85662A	HP	2816A16541	300002297	05.10.2006	24	05.10.2008
6	Quasi-Peak-Adapter 85650A	HP	2811A01131	300000999	05.10.2006	24	05.10.2008
7	RF-Preselector 85685A	HP	2837A00779	300000218	08.11.2006	24	08.11.2008
8	PC Vectra VL	HP		300001688	n.a.		
9	Software EMI	HP		300000983	n.a.		
10	Measurement System 2						
11	FSP 30	R&S	100623	ICT 300003464	05.10.2007	24	15.10.2009
12	PC	F+W			n.a.		
13	TILE	TILE			n.a.		
14	Biconical antenna	EMCO	S/N: 860 942/003		Monthly verification (System cal.)		
15	Log. Period. Antenna 3146	EMCO	2130	300001603	Monthly verification (System cal.)		
16	Double Ridged Antenna HP 3115P	EMCO	3088	300001032	Monthly verification (System cal.)		
17	Active Loop Antenna 6502	EMCO	2210	300001015	Monthly verification (System cal.)		
18	Power Supply 6032A	HP	2818A03450	300001040	12.05.2007	36	12.05.2010
19	Busisolator	Kontron		300001056	n.a.		
20	Leitungsteiler 11850C	HP		300000997	Monthly verification (System cal.)		
21	Power attenuator 8325	Byrd	1530	300001595	Monthly verification (System cal.)		
22	Band reject filter WRCG1855/1910	Wainwright	7	300003350	Monthly verification (System cal.)		
23	Band reject filter WRCG2400/2483	Wainwright	11	300003351	Monthly verification (System cal.)		

Sytstem Rack Room 005 :

No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	FSP 30	R&S		300003575	02.04.2007	24	02.04.2009
2	CBT	R&S	100313	300003516	24.10.2006	24	24.10.2008
3	Switch Matrix	HP		300000929	n.a.		
4	Power Supply	HP	3041A00544	300002270	13.05.2007	36	13.05.2010
5	Signal Generator	R&S	836206/0092	300002680	30.05.2007	36	30.05.2010

C.BER Bluetooth Rack Room AC2:

No	Equipment/Type	Manufact.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	System Controller with XP Prof. & C.BER Control Software	F&W	300003580	na		
2	GPIB to USB Converter	Agilent	300003426	na		
3	Spectrum Analyser FSIQ26	R&S	300002681-005	1.08.2006	24	1.08.2008
	Sampling System FSIQ-B70	R&S	300002681-005	1.08.2006	24	1.08.2008
	Tracking Generator FSIQ-B10 for FSIQ26	R&S	300002681-005	1.08.2006	24	1.08.2008
4	RF-Generator SMIQ03 (Interferer Signal)	R&S	300002681-001	1.08.2006	24	1.08.2008
	Modulation Coder SMIQ-B20	R&S	300002681-001	1.08.2006	24	1.08.2008
	Data Generator SMIQ-B11	R&S	300002681-001	1.08.2006	24	1.08.2008
	RF Rear Connection SMIQ-B19	R&S	300002681-001	1.08.2006	24	1.08.2008
	Fast CPU SM-B50	R&S	300002681-001	1.08.2006	24	1.08.2008
	FM Modulator SM-B5	R&S	300002681-001	1.08.2006	24	1.08.2008
5	Rubidium Standard RUB	R&S	300002681-009	1.08.2006	24	1.08.2008
6	Switching Unit 3488A including 2 44476A cards	HP	300000926	Verified with path compensation		
	44472A VHF switch	HP	300000926	Verified with path compensation		
7	Signalling Unit: CBT with EDR	R&S	300003416	24.06.2006	24	24.06.2008
8	RF-cable set	different	no	Verified with path compensation		
9	IEEE-cables	R&S	no	na		
10	NGPE programmable Power Supply for EUT	R&S	400000078	1.08.2006	24	1.08.2008
11	Coupling Unit 4324-2	Narda	no	Verified with path compensation		
12	Climatic Chamber VT4002	Voetch	300003019	11.05.2207	24	11.05.2009
13	6 dB Attenuator 1W	Narda	no	Verified with path compensation		
14	DCBlocker 30 MHz to 12.75 GHz 1W	Narda	no	Verified with path compensation		

Anechoic chamber F:

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
	Radiated emission in chamber F				
F-1	Control Computer	F+W		FW0502032	300003303
F-2	Bilog antenna	Chase	CBL 6112A	2110	300000573
F-3a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-4b	Switch	HP	3488A	- / -	300000368
F-5	EMI Test receiver	R&S	ESCI	100083	300003312
F-6	Turntable Controller	EMCO	1061 3M	1218	300000661
F-7	Tower Controller	EMCO	1051 Controller	1262	300000625
F-8	Tower	EMCO	1051 Tower	1262	300000625
F-9	Ultra Notch-Filter Rejected band Ch. 62	WRCD		9	
	Radiated immunity in chamber F				
F-10	Control Computer	F+W		FW0502032	300003303
F-11	Signal Generator	R&S	SML 03	102519	300003407
F-12	RF-Amplifier	ar	50W1000	12932	300001438
F-13	Directional Coupler	ar	DC 3010	12708	300001428
F-14	Logper Antenna	R&S	HL023A1	323704/016	300001476
F-15	RF-Amplifier	ar	60S1G3	313649	300003410
F-16	Directional Coupler	ar	DC7144A	312786	300003411
F-17	Horn Antenna	ar	AT 4002	19739	300000633
F-18	Power Meter	R&S	NRV	860327/024	F033
F-19	Power sensor	R&S	URV5-Z2	839080/005	300002844.02
F-20	Power sensor	R&S	URV5-Z2	830755/057	F032
	Harmonics and flicker in front of chamber F				
F-21	Flicker and Harmonics Test System	Spitzenberger & Spies	PHE4500/B I PHE4500/B II	B5983 B5984	300000210
F-22	Control Unit	Spitzenberger & Spies	STE	B5980	300000210
F-23	Power Amplifier	Spitzenberger & Spies	EP 4500/B	B5976	300000210
F-24	Conect Panel	Spitzenberger & Spies	Conect panel	B5982	300000210
F-25	Power Supply	Spitzenberger & Spies	NT-EP 4500	B3977	300000210
F-26	Additional transformer	Spitzenberger & Spies	UT-EP 4500	B5978	300000210
F-27	Analyzer Reference System	Spitzenberger & Spies	ARS 16/1	A3509 07/0 0205	300003314
F-26	Power Supply	Hewlett Packard	6032 A	2920 A 04466	300000580