

TEST REPORT

Test report no.: 1-1110/16-21-02-B



Deutsche
Akkreditierungsstelle
D-PL-12076-01-01

Testing laboratory

CTC advanced GmbH

Untertuerkheimer Strasse 6 – 10

66117 Saarbruecken / Germany

Phone: + 49 681 5 98 - 0

Fax: + 49 681 5 98 - 9075

Internet: <http://www.ctcadvanced.com>

e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

Ibaraki Fuji Co., Ltd

471 Shimokido, Shimotsuma-city

Ibaraki-ken 304-0028 / JAPAN

Phone: +81-296-43-3465

Fax: +81-296-43-3184

Contact: Mr. Seiji Matsuda

e-mail: matsuda-seiji@fujielectric.co.jp

Phone: +81-3-6663-8990

Manufacturer

Ibaraki Fuji Co., Ltd

471 Shimokido, Shimotsuma-city

Ibaraki-ken 304-0028 / JAPAN

Test standard/s

47 CFR Part 22

Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services

47 CFR Part 24

Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services

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

Test Item

Kind of test item: M2M device for vehicles

Model name: M2M device

FCC ID: 2AKG8KMTC

IC: 22187-KMTC

Frequency: GSM: 824.2 – 848.8 MHz, 1850.2 – 1909.2 MHz
UMTS: 826.4 – 846.6 MHz

Technology tested: GPRS, EGPRS, WCDMA

Antenna: External antenna

Power supply: 24.0 V DC by external power supply

Temperature range: -30°C to +55°C



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

Test report authorized:

p.o.

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

p.o.

Andreas Luckenbill
Lab Manager
Radio Communications & EMC

1 Table of contents

1	Table of contents.....	2
2	General information	3
2.1	Notes and disclaimer	3
2.2	Application details	3
2.3	Test laboratories sub-contracted	3
3	Test standard/s and references.....	4
4	Test environment	5
5	Test item	5
5.1	General description.....	5
5.2	Additional information	5
6	Description of the test setup	6
6.1	Shielded semi anechoic chamber	7
6.2	Shielded fully anechoic chamber	8
6.3	Radiated measurements > 18 GHz	9
6.4	Conducted measurements.....	10
7	Measurement uncertainty.....	11
8	Summary of measurement results	12
8.1	GSM 850.....	12
8.2	PCS 1900.....	12
8.3	UMTS band V	13
9	Results GSM 850	14
9.1	RF output power	14
9.2	Frequency stability	20
9.3	Spurious emissions radiated	22
9.4	Spurious emissions conducted	26
9.5	Block edge compliance.....	32
9.6	Occupied bandwidth	35
10	Results PCS 1900	43
10.1	RF output power	43
10.2	Frequency stability	49
10.3	Spurious emissions radiated	51
10.4	Spurious emissions conducted	57
10.5	Block edge compliance.....	63
10.6	Occupied bandwidth.....	66
11	Results UMTS band V	74
11.1	RF output power	74
11.2	Frequency stability	78
11.3	Spurious emissions radiated	80
11.4	Spurious emissions conducted	83
11.5	Block edge compliance.....	87
11.6	Occupied bandwidth	89
Annex A	Document history	93
Annex B	Further information.....	93
Annex C	Accreditation Certificate	94

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. CTC advanced 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.

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 CTC advanced GmbH.

The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".

CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.

All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH.

In no case this test report can be considered as a Letter of Approval.

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.

This test report replaces the test report with the number 1-1110/16-21-02 and dated 2016-12-21

2.2 Application details

Date of receipt of order:	2016-10-21
Date of receipt of test item:	2016-11-14
Start of test:	2016-11-14
End of test:	2017-01-16
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 22	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services
47 CFR Part 24	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services
RSS - 132 Issue 3	January 2013	Spectrum Management and Telecommunications Radio Standards Specification - Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS - 133 Issue 6	January 2013	Spectrum Management and Telecommunications Policy - Radio Standards Specifications, 2 GHz Personal Communication Services

Guidance	Version	Description
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz

4 Test environment

Temperature	:	T _{nom} T _{max} T _{min}	+22 °C during room temperature tests +55 °C during high temperature tests -30 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V _{nom} V _{max} V _{min}	24.0 V DC by external power supply 26.4 V 21.6 V

5 Test item

5.1 General description

Kind of test item	:	M2M device for vehicles
Type identification	:	M2M device
HMN	:	-/-
PMN	:	KMT-C
HVIN	:	KMT-C
FVIN	:	-/-
S/N serial number	:	-/-
HW hardware status	:	No information available!
SW software status	:	No information available!
Frequency band	:	GSM: 824.2 – 848.8 MHz, 1850.2 – 1909.2 MHz UMTS: 826.4 – 846.6 MHz
Type of modulation	:	GMSK, 8-PSK, BPSK, QPSK
Antenna	:	External antenna
Power supply	:	24.0 V DC by external power supply
Temperature range	:	-30°C to +55°C

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report:

1-1110/16-21-01_AnnexA
 1-1110/16-21-01_AnnexB
 1-1110/16-21-01_AnnexC

6 Description of the test setup

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

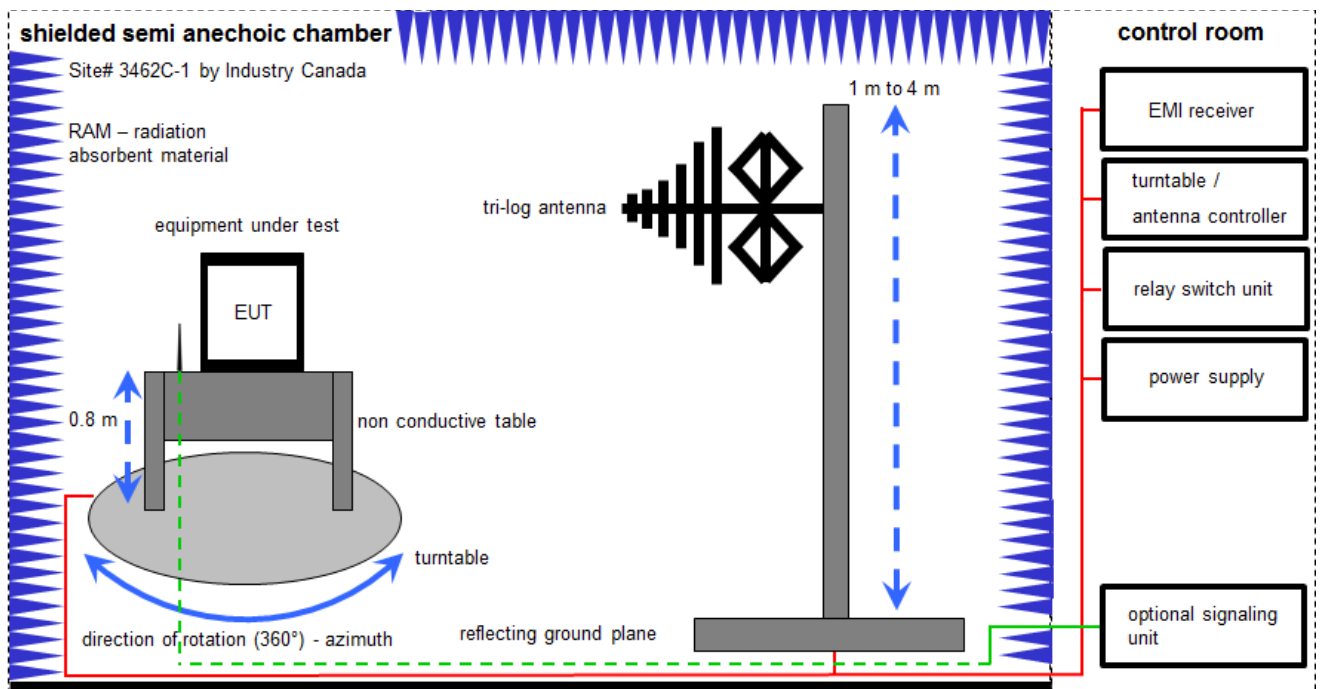
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

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

6.1 Shielded semi anechoic chamber

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



Measurement distance: tri-log antenna 10 meter

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

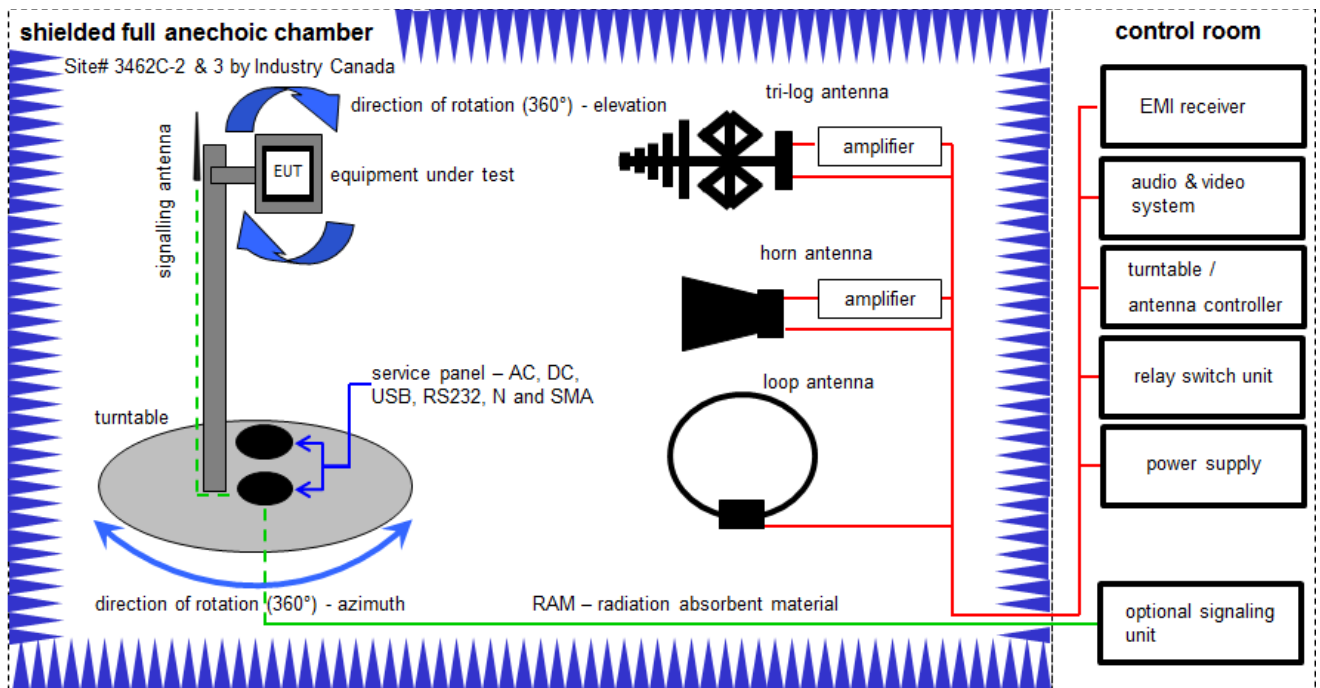
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	27.11.2006	-/-
4	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	08.03.2016	08.03.2017
5	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
6	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
7	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
8	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	25.04.2016	25.04.2018

6.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

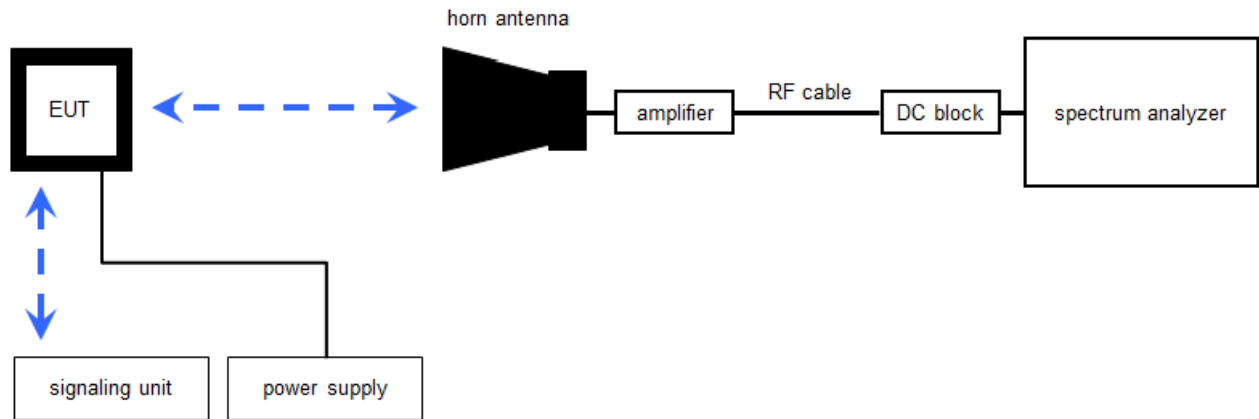
$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50 \text{ [dB]} - 20 \text{ [dBi]} + 5 \text{ [dB]} = -30 \text{ [dBm]} (1 \text{ }\mu\text{W})$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Horn Antenna 18,0-40,0 GHz	LHAF180	Microw.Devel	39180-103-022	300001748	k	22.05.2015	22.05.2018
2	A	Double-Ridged Wav eguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017
3	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	318	300003696	k	22.04.2014	22.04.2017
4	A	Universal Communication Tester	CMU200	R&S	106826	300003346	k	10.02.2016	10.02.2017
5	A	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	02.02.2016	02.02.2017
6	A	Band Reject Filter	WRCG1850/1910-1835/1925-40/8SS	Wainwright	23	400000149	ne	-/-	-/-
7	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
8	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22050	300004482	ev	-/-	-/-
9	A	Power Supply 0-20V	6632A	HP	2851A01814	300000924	ne	09.11.2005	-/-
10	A	Messrechner und Monitor	Intel Core i3 3220/3,3 GHz, Prozessor	CERNEX	2V2403033A54 21	300004591	ne	-/-	-/-
11	A	NEXIO EMV-Software	BAT EMC	EMCO	2V2403033A54 21	300004682	ne	-/-	-/-

6.3 Radiated measurements > 18 GHz

Radiated measurements > 18 GHz



Measurement distance: horn antenna 25 cm

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

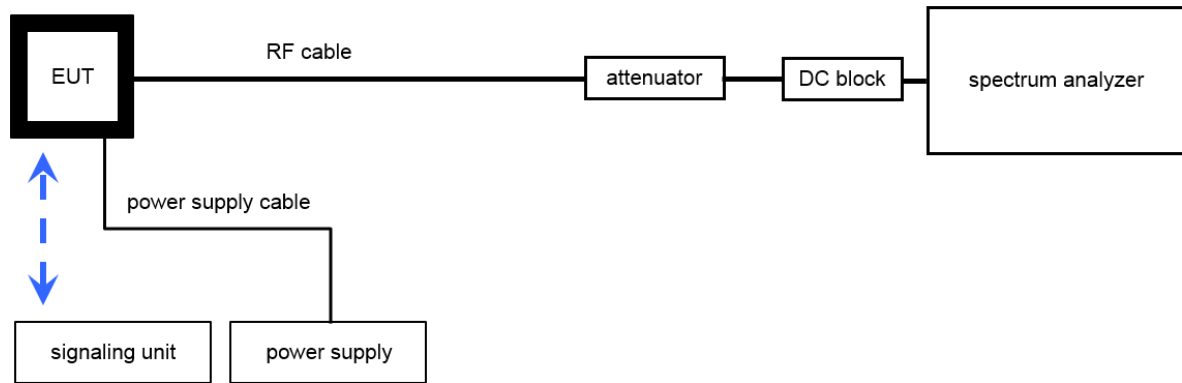
$$OP \text{ [dBm]} = -59.0 \text{ [dBm]} + 44.0 \text{ [dB]} - 20.0 \text{ [dBi]} + 5.0 \text{ [dB]} = -30 \text{ [dBm]} \text{ (1 } \mu\text{W)}$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	RF-Cable	ST18/SMAM/SMAM/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
2	A	RF-Cable	ST18/SMAM/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
3	A	Horn Antenna 18,0-40,0 GHz	LHAF180	Microw.Devel	39180-103-022	300001748	k	22.05.2015	22.05.2018
4	A	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	14.08.2015	14.08.2017
5	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
6	A	Universal Communication Tester	CMU200	R&S	103992	300003231	vIKI!	29.01.2015	29.01.2017
7	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	MITEQ	2V2403033A4523	300004589	ne	-/-	-/-

6.4 Conducted measurements

Conducted measurements normal conditions



$$OP = AV + CA$$

(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:

$$OP \text{ [dBm]} = 6.0 \text{ [dBm]} + 11.7 \text{ [dB]} = 17.7 \text{ [dBm]} \text{ (58.88 mW)}$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Power Supply 0-20V, 0-5A	6632B	Agilent Technologies	GB42110541	400000562	v IKI!	26.01.2016	26.01.2019
2	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A4523	300004590	ne	-/-	-/-
3	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	MITEQ	2V2403033A4523	300004589	ne	-/-	-/-
4	A, B	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 699714	400001185	ev	-/-	-/-
5	A, B	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
6	A, B	Universal Communication Tester	CMU200	R&S	103992	300003231	v IKI!	29.01.2015	29.01.2017
7	A, B	Wideband Radio Communication Tester	CMW500	R&S	102375	300004187	k	14.12.2015	14.12.2017
8	A, B	PowerSplitter/Combiner 150-6000MHz N-Type	ZB3PD-63-N+	Mini-Circuits	2V2403033A4523	400000451	ev	-/-	-/-
9	A, B	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
10	A, B	RF-Cable	ST18/SMAm/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
11	A, B	RF-Cable	ST18/SMAm/SMAm/72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
12	B	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	ev	03.09.2015	03.09.2017

7 Measurement uncertainty

Measurement uncertainty	
Test case	Uncertainty
RF output power conducted	± 1 dB
RF output power radiated	± 3 dB
Frequency stability	± 20 Hz
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted	± 3 dB
Block edge compliance	± 3 dB
Occupied bandwidth	\pm RBW

8 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 22, 24 RSS 132, 133	See table!	2017-03-28	-/-

8.1 GSM 850

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Frequency Stability	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Radiated	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Conducted	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Block Edge Compliance	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Occupied Bandwidth	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

8.2 PCS 1900

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Frequency Stability	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Radiated	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Conducted	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Block Edge Compliance	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Occupied Bandwidth	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

8.3 UMTS band V

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Frequency Stability	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Radiated	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Conducted	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Block Edge Compliance	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Occupied Bandwidth	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

9 Results GSM 850

All GSM-band measurements are done in GSM mode only (circuit switched). All relevant tests have been repeated using 8-PSK modulation if EDGE mode is supported. All tests were performed with one timeslot in uplink activated and one timeslot in downlink activated. For each mode the highest output power was determined and used.

9.1 RF output power

Description:

This paragraph contains average power, peak output power, PAPR and ERP measurements for the mobile station.

The plots in this test report represents only an example of the measurements. All plots of this chapter are available on request.

The red line in the measurements indicates the ideal Gaussian distribution for the measured amplitude range.

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 6.1 – A & 6.4 – A
Measurement uncertainty:	see chapter 7

Limits:

FCC	IC
+38.45 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

Results:

Output Power (conducted) GMSK mode			
Frequency (MHz)	Peak Output Power (dBm)	Average Output Power (dBm)	Peak to Average Ratio (dB) CCDF
824.2	32.8	31.8	1.01
836.4	32.8	32.6	0.23
848.8	33.0	32.8	0.24

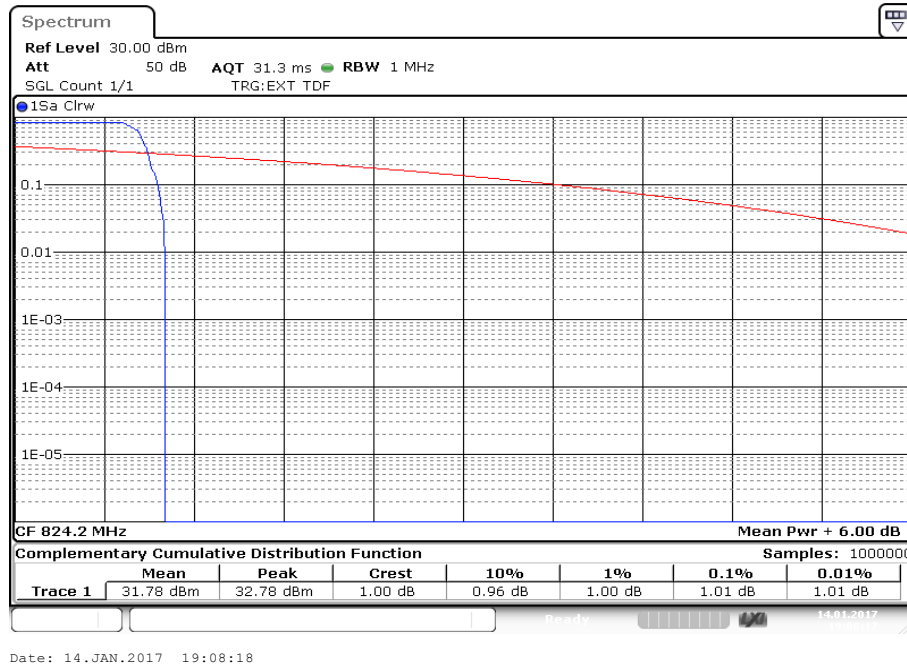
Output Power (conducted) 8-PSK mode			
Frequency (MHz)	Peak Output Power (dBm)	Average Output Power (dBm)	Peak to Average Ratio (dB) CCDF
824.2	29.2	25.5	3.68
836.4	29.2	25.8	3.33
848.8	29.3	25.7	3.43

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2	30.8
836.4	32.1
848.8	32.0

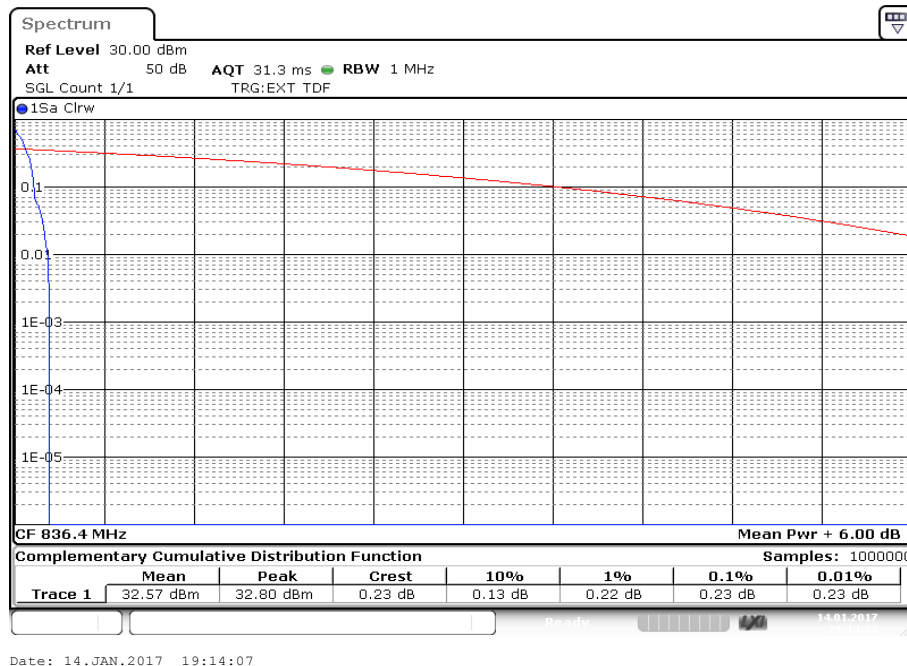
Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2	24.5
836.4	25.3
848.8	24.9

Plots: GMSK

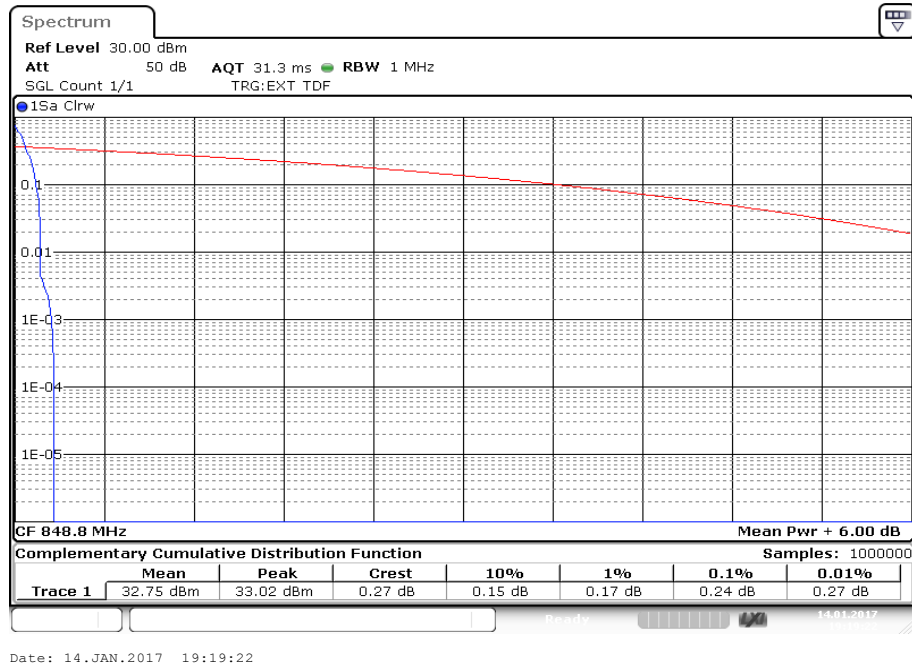
Plot 1: CCDF, channel 128



Plot 2: CCDF, channel 189

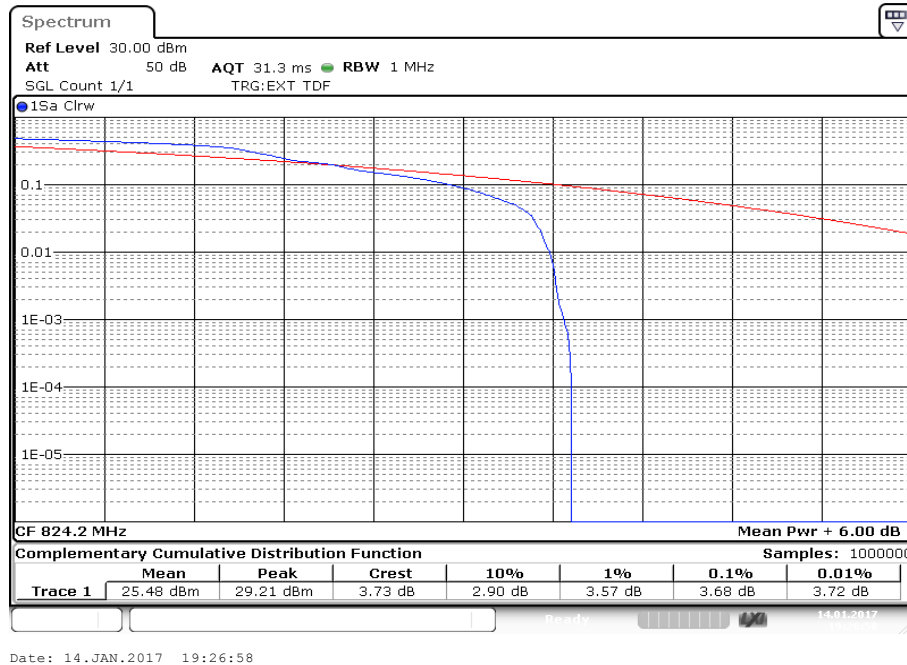


Plot 3: CCDF, channel 251

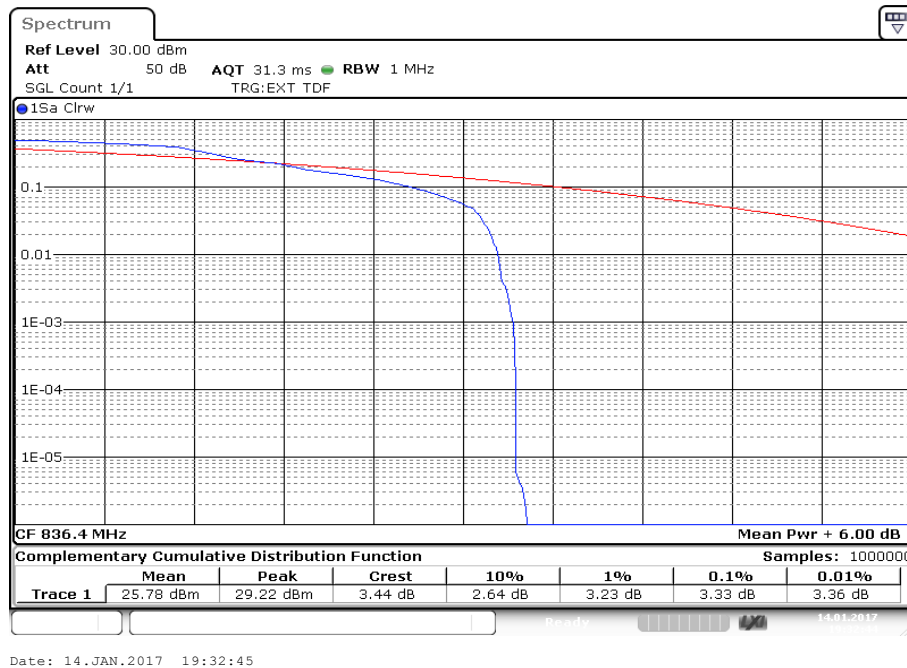


Plots: 8 PSK

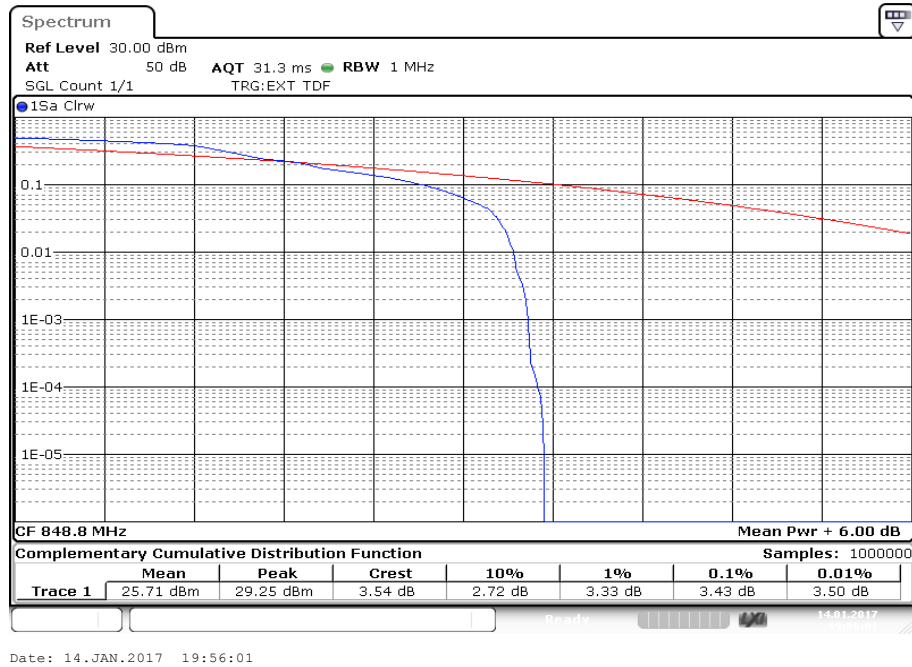
Plot 1: CCDF, channel 128



Plot 2: CCDF, channel 189



Plot 3: CCDF, channel 251



9.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to R&S CMU200 Wideband Radio Communication Tester.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 °C.
3. With the mobile station powered with V_{nom} connected to the CMU200 on the center channel. Measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature unpowered before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace mode:	
Test setup:	See chapter 6.4 – B
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
± 2.5 ppm	

Results:**AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
21.6	-12	-0.00000143	-0.0143
24.0	-1	-0.00000012	-0.0012
26.4	-2	-0.00000024	-0.0024

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	10	0.00000120	0.0120
-20	1	0.00000012	0.0012
-10	8	0.00000096	0.0096
± 0	-3	-0.00000036	-0.0036
10	12	0.00000143	0.0143
20	-8	-0.00000096	-0.0096
30	17	0.00000203	0.0203
40	-12	-0.00000143	-0.0143
50	16	0.00000191	0.0191

9.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 848.8 MHz. Measurements made up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the GSM-850 band.

The final open field emission (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load (if possible).
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
- Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 6.1 – A & 6.2 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

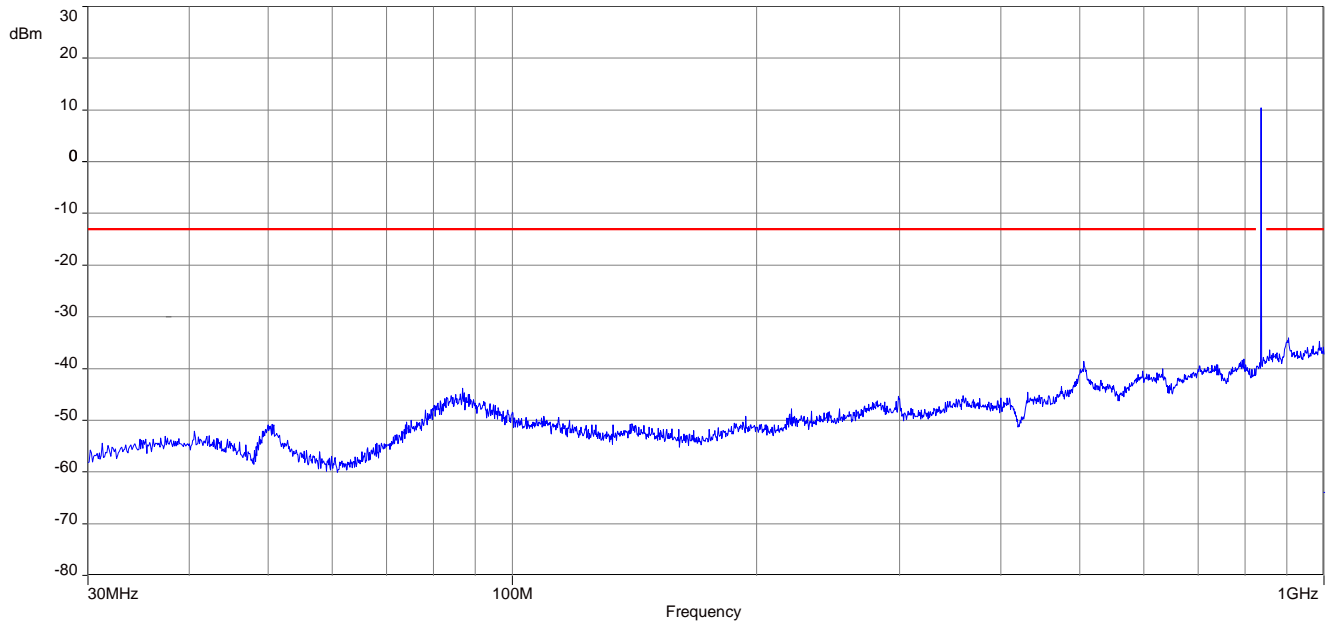
Results GPRS & EGPRS:

Radiated emissions measurements were made only at the center carrier frequency of the GSM-850 band (836.4 MHz). The measurements shows the cabinet radiation in transmit mode. The antenna port can be terminated with 50 Ω .

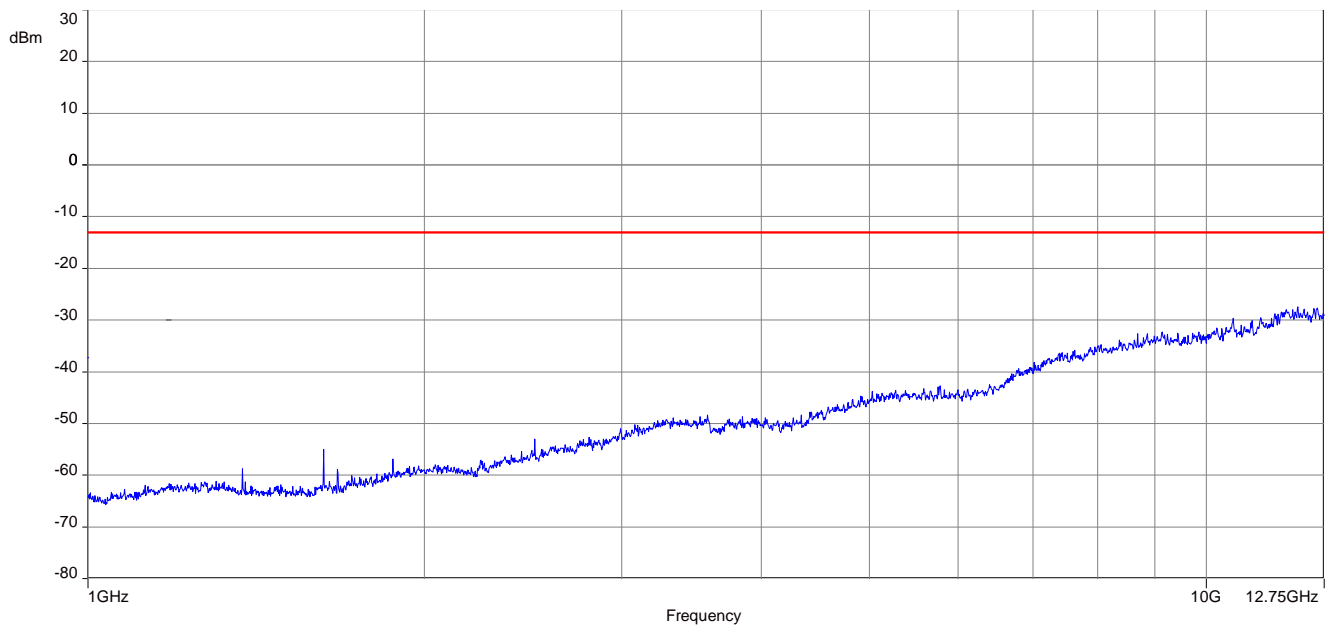
Spurious emission level (dBm)								
Harmonic	Ch. 128 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 189 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 251 Freq. (MHz)	Level [dBm]
2	1648.4	-	2	1672.8	-	2	1697.6	-
3	2472.6	-	3	2509.2	-	3	2546.4	-
4	3296.8	-	4	3345.6	-	4	3395.2	-
5	4121.0	-	5	4182.0	-	5	4244.0	-
6	4945.2	-	6	5018.4	-	6	5092.8	-
7	5769.4	-	7	5854.8	-	7	5941.6	-
8	6593.6	-	8	6691.2	-	8	6790.4	-
9	7417.8	-	9	7527.6	-	9	7639.2	-
10	8242.0	-	10	8364.0	-	10	8488.0	-

Plots: GMSK

Plot 1: Channel 189 (30 MHz – 1 GHz)

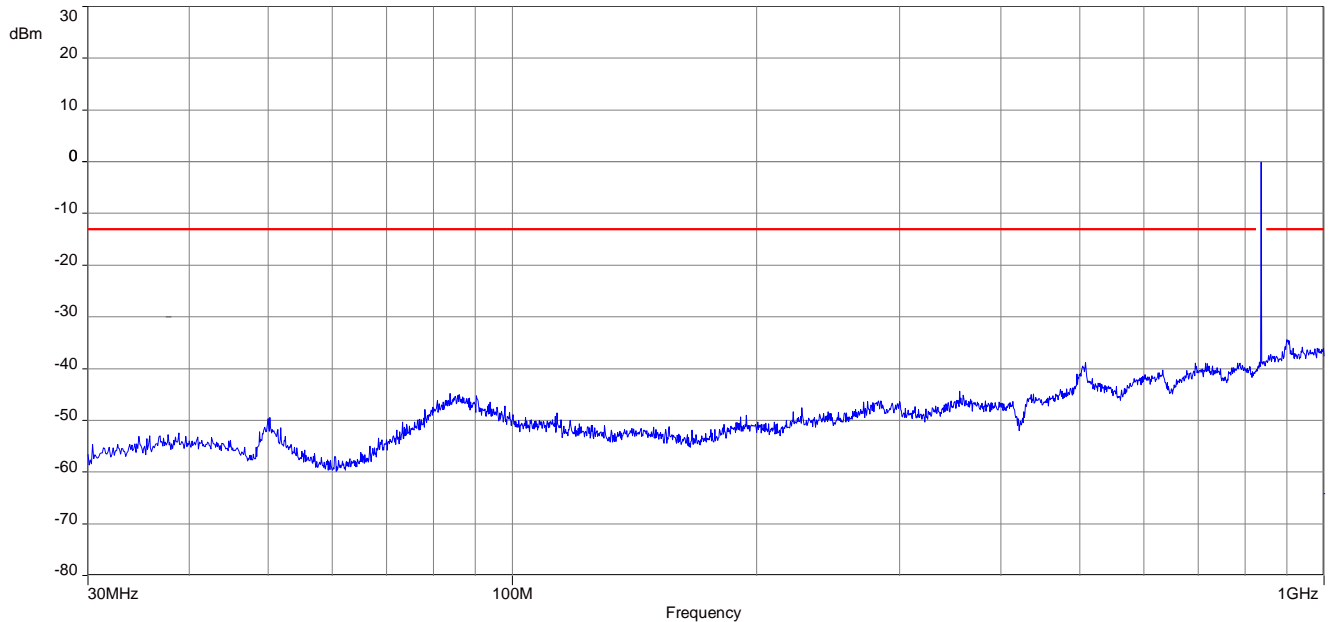


Plot 2: Channel 189 (1 GHz – 12.75 GHz)

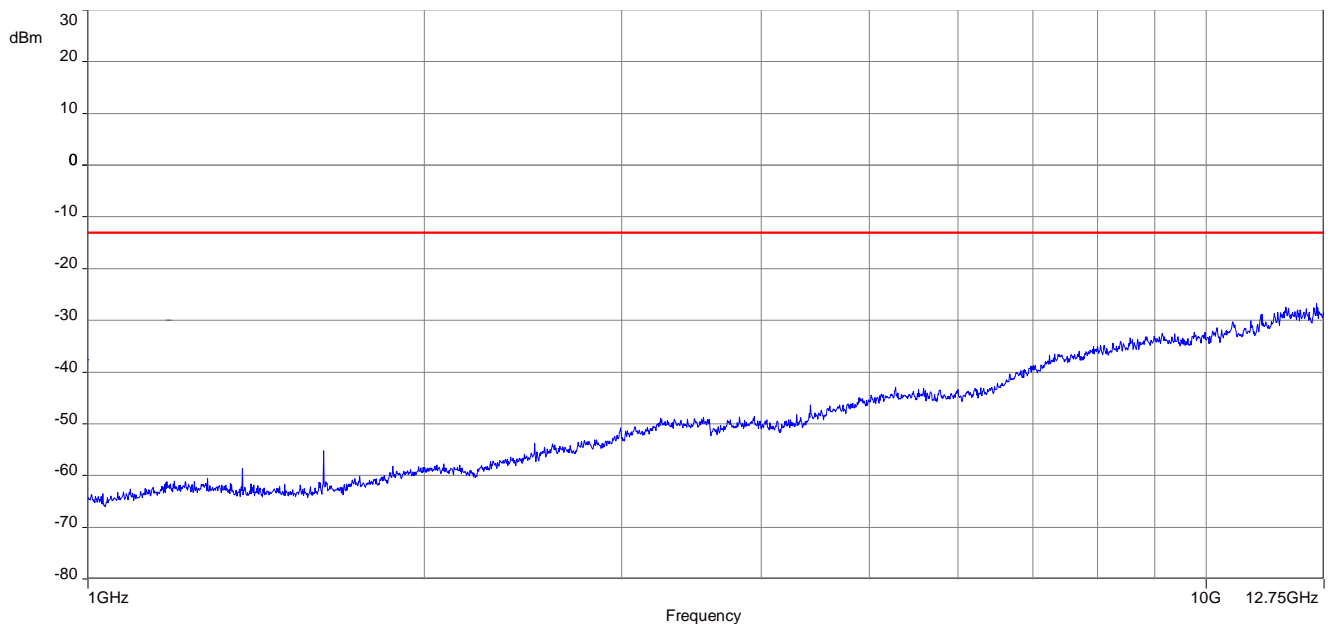


Plots: 8 PSK

Plot 1: Channel 189 (30 MHz – 1 GHz)



Plot 2: Channel 189 (1 GHz – 12.75 GHz)



9.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 26 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

GSM-850 Transmitter Channel Frequency

128 824.2 MHz

189 836.4 MHz

251 848.8 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 26 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 7

Limits:

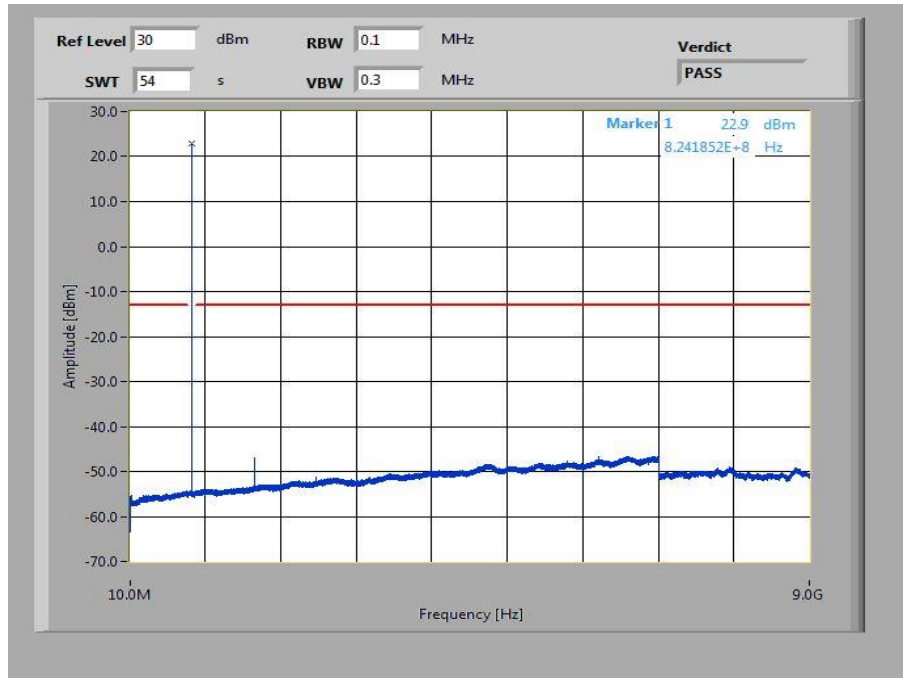
FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Results:

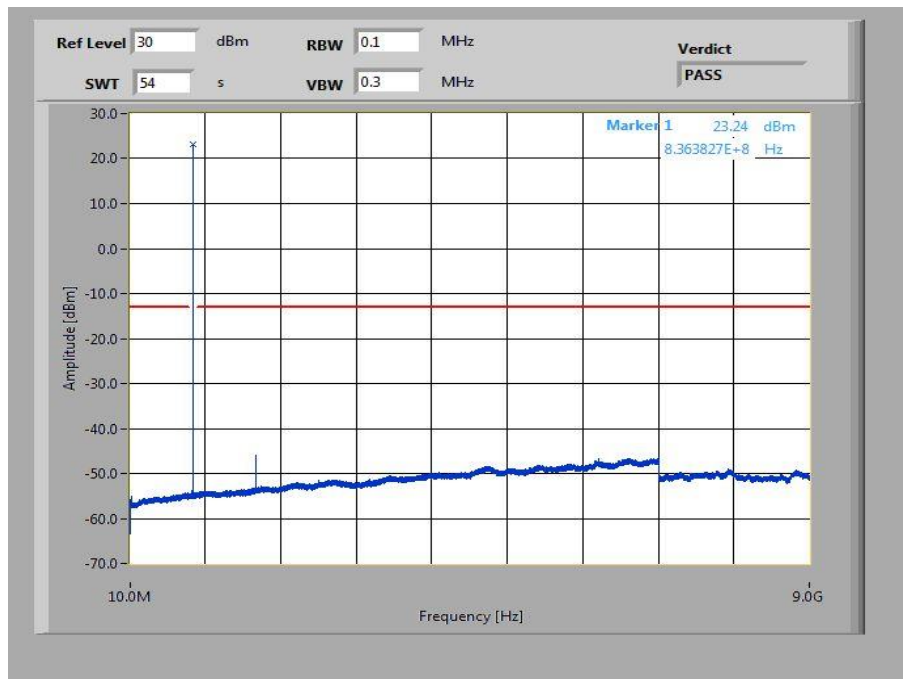
Spurious emission level (dBm)								
Harmonic	Ch. 128 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 189 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 251 Freq. (MHz)	Level [dBm]
2	1648.4	-	2	1672.8	-	2	1697.6	-
3	2472.6	-	3	2509.2	-	3	2546.4	-
4	3296.8	-	4	3345.6	-	4	3395.2	-
5	4121.0	-	5	4182.0	-	5	4244.0	-
6	4945.2	-	6	5018.4	-	6	5092.8	-
7	5769.4	-	7	5854.8	-	7	5941.6	-
8	6593.6	-	8	6691.2	-	8	6790.4	-
9	7417.8	-	9	7527.6	-	9	7639.2	-
10	8242.0	-	10	8364.0	-	10	8488.0	-

Plots: GMSK

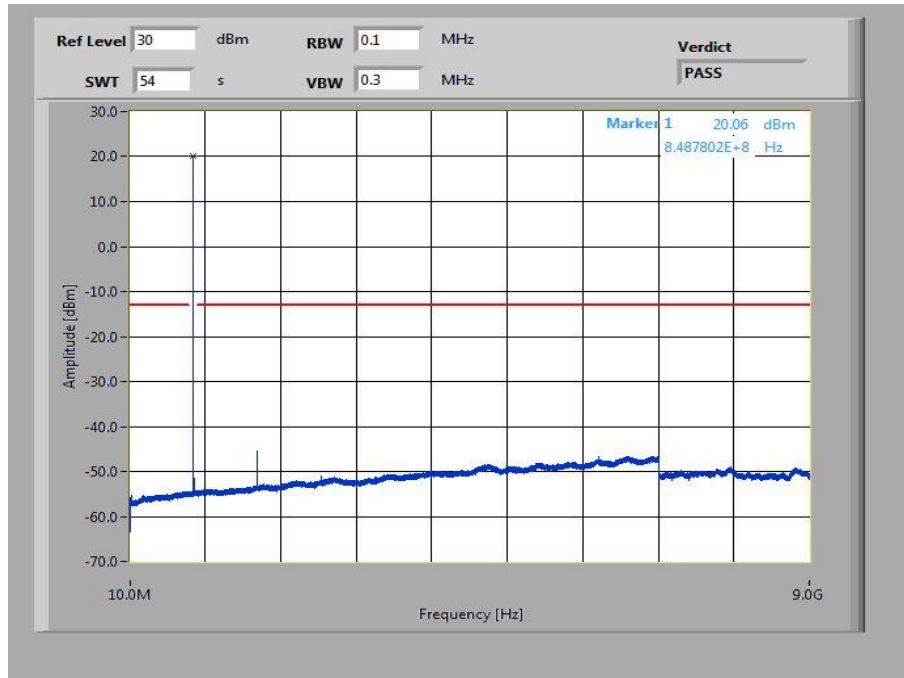
Plot 1: Channel 128 (10 MHz - 9 GHz)



Plot 2: Channel 189 (10 MHz - 9 GHz)

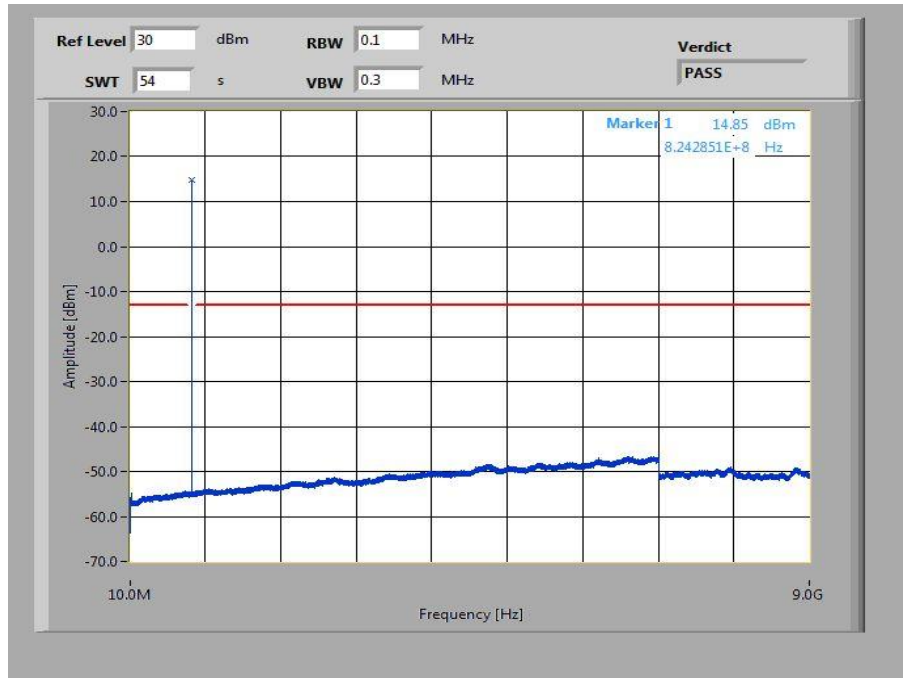


Plot 3: Channel 251 (10 MHz - 9 GHz)

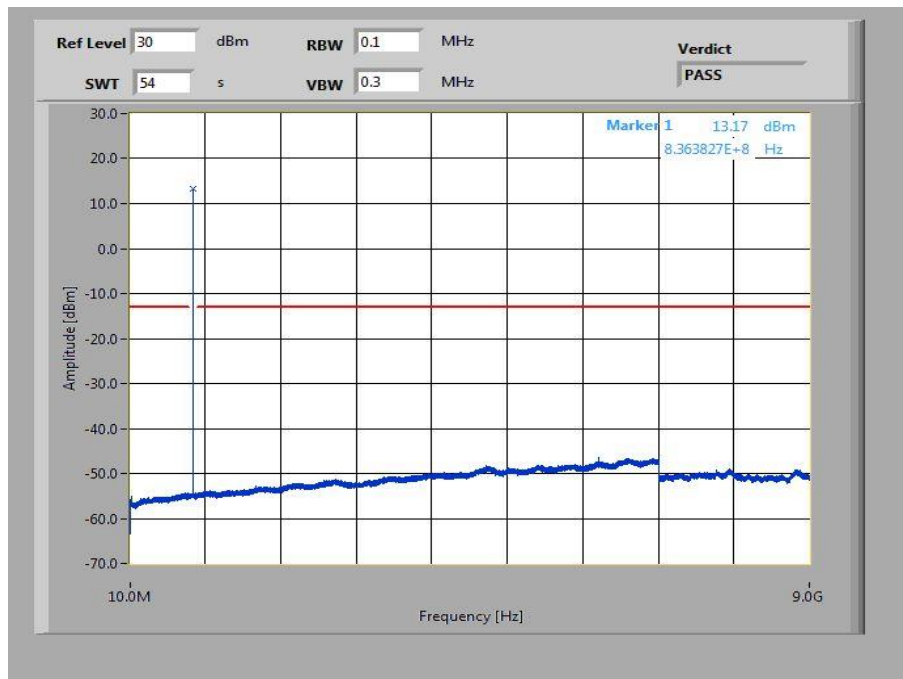


Plots: 8 PSK

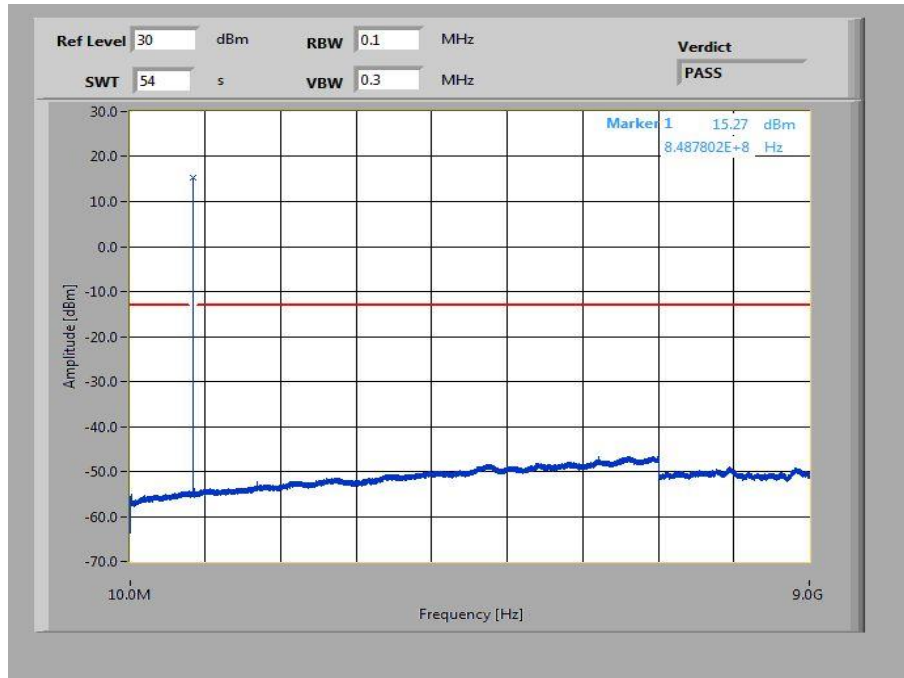
Plot 1: Channel 128 (10 MHz - 9 GHz)



Plot 2: Channel 189 (10 MHz - 9 GHz)



Plot 3: Channel 251 (10 MHz - 9 GHz)



9.5 Block edge compliance

Description:

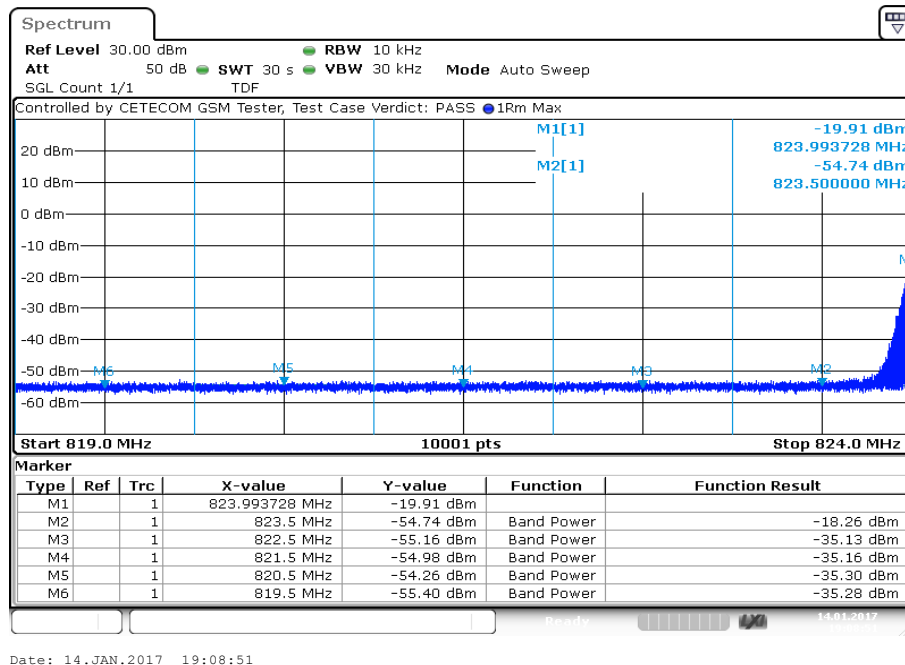
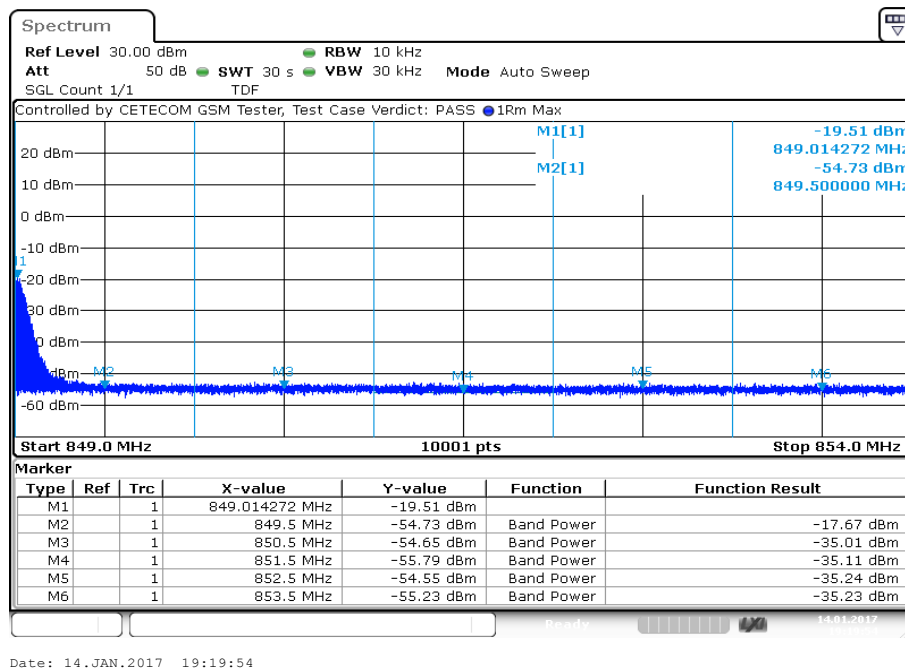
The spectrum at the band edges must comply with the spurious emissions limits.

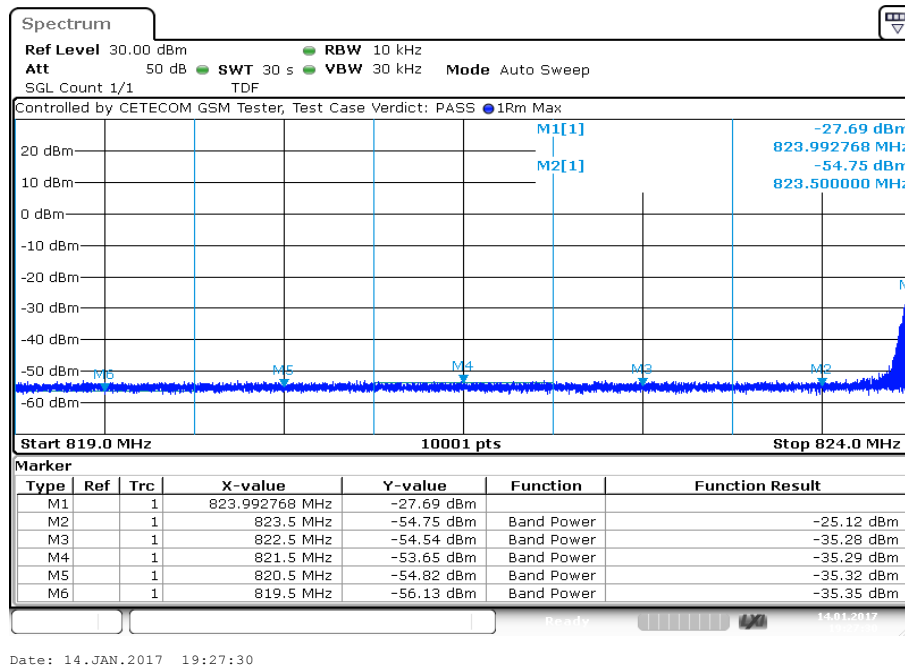
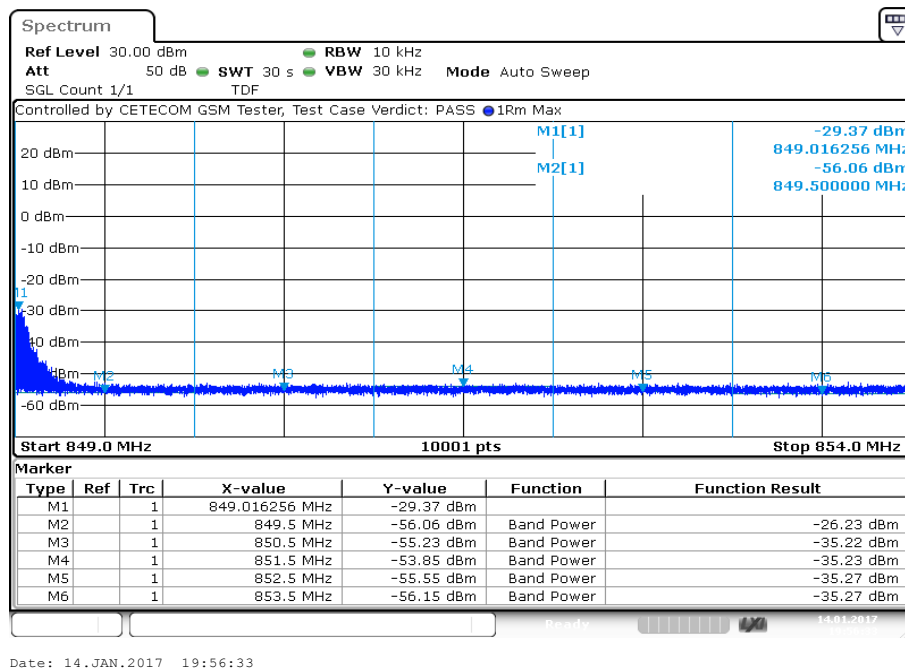
Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	30 sec.
Video bandwidth:	1% - 5% of the OBW
Resolution bandwidth:	$\geq 3 \times \text{RBW}$
Span:	5 MHz
Trace mode:	Max Hold
Used equipment:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Plots: GMSK**Plot 1:** Channel 128**Plot 2:** Channel 251

Plots: 8 PSK**Plot 1:** Channel 128**Plot 2:** Channel 251

9.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the GSM-850 frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1% - 5% of the OBW
Video bandwidth:	$\geq 3 \times \text{RBW}$
Span:	2 x nominal BW
Trace mode:	Max Hold
Used equipment:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
Spectrum must fall completely in the specified band	

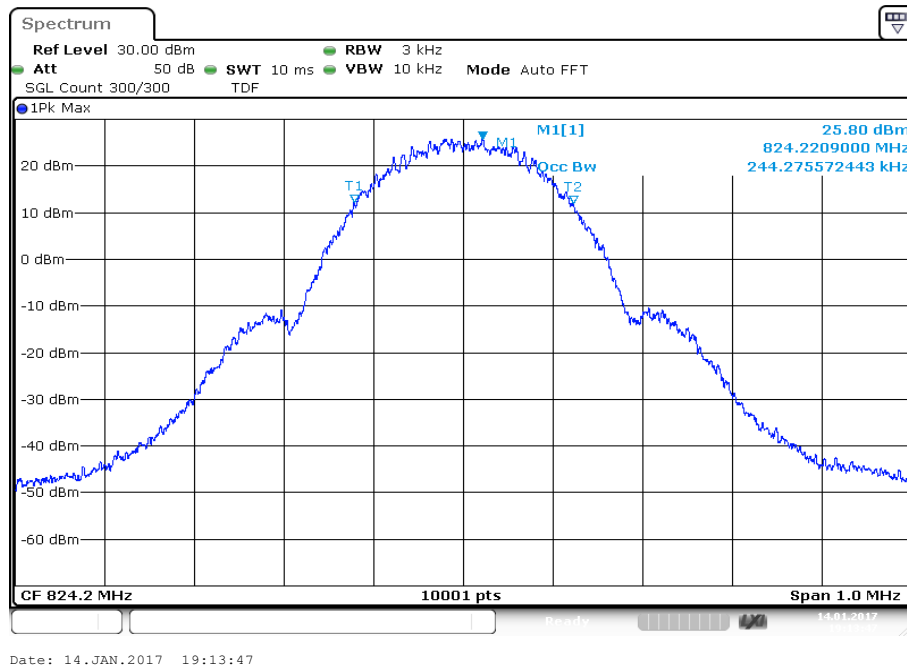
Results:

Occupied bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	244	317
836.4	242	314
848.8	242	314

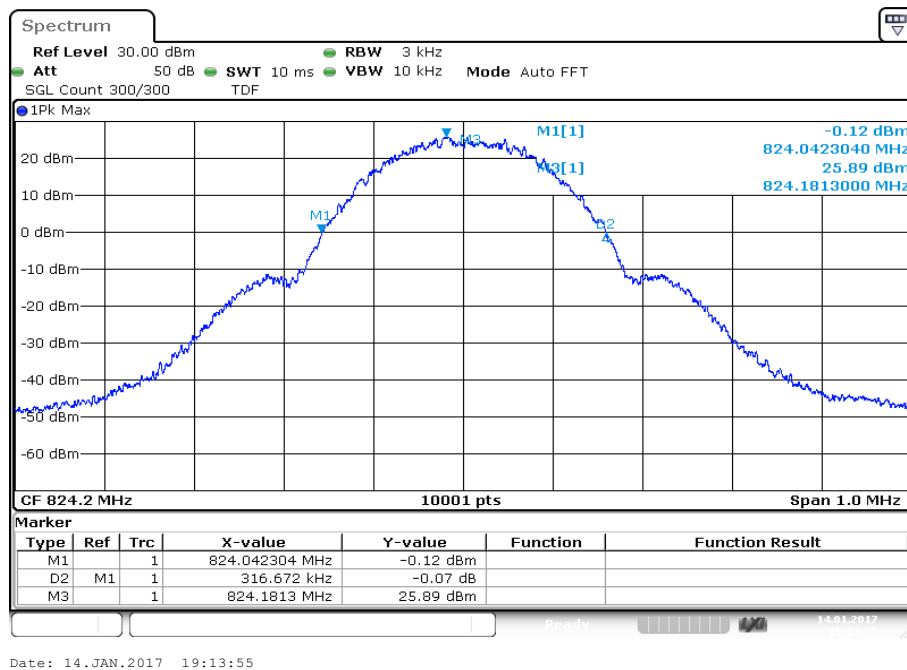
Occupied bandwidth – 8 PSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	238	313
836.4	237	312
848.8	239	314

Plots: GMSK

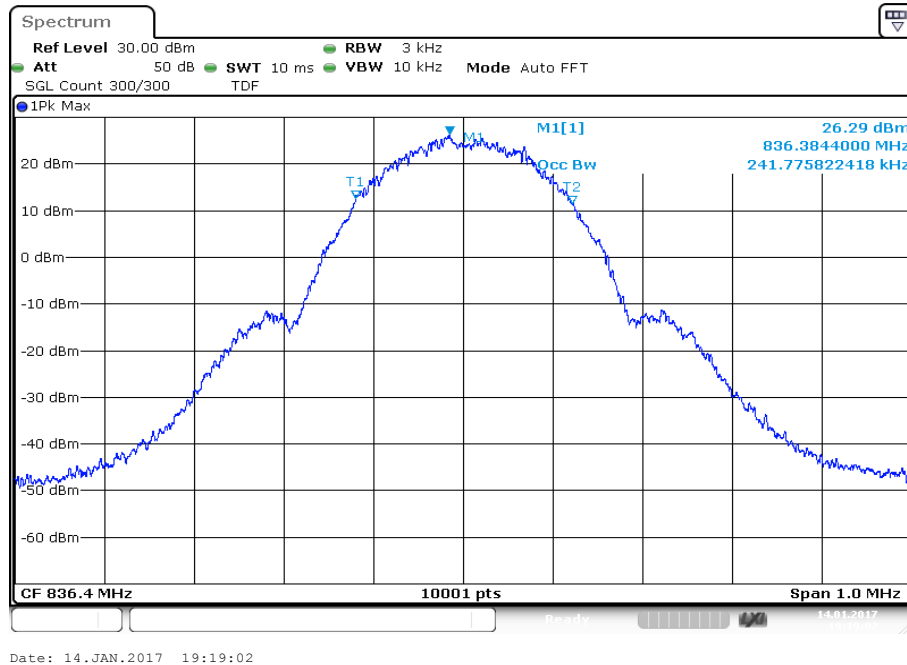
Plot 1: Channel 128 (99% bandwidth)



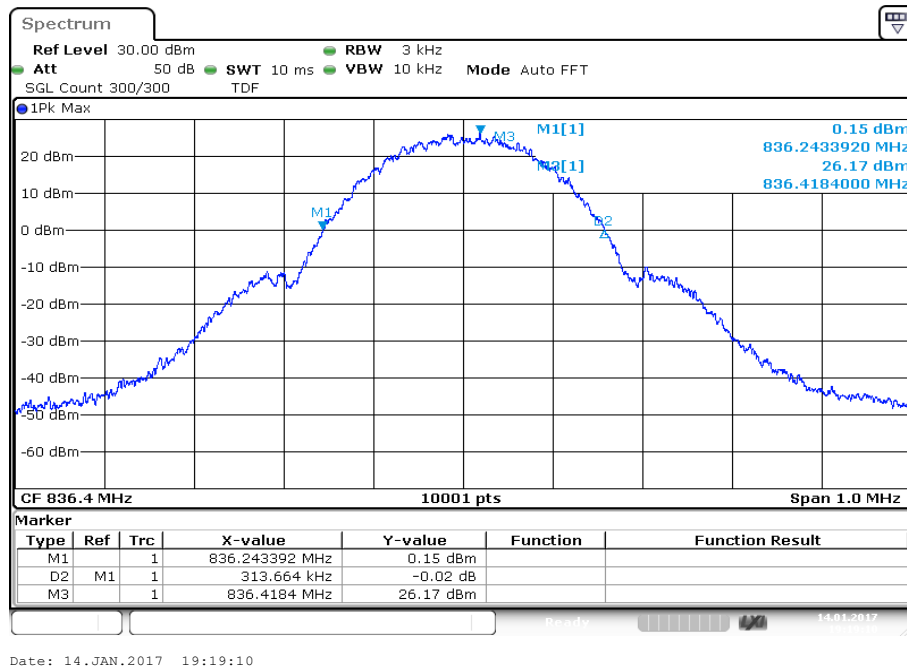
Plot 2: Channel 128 (-26 dBc bandwidth)



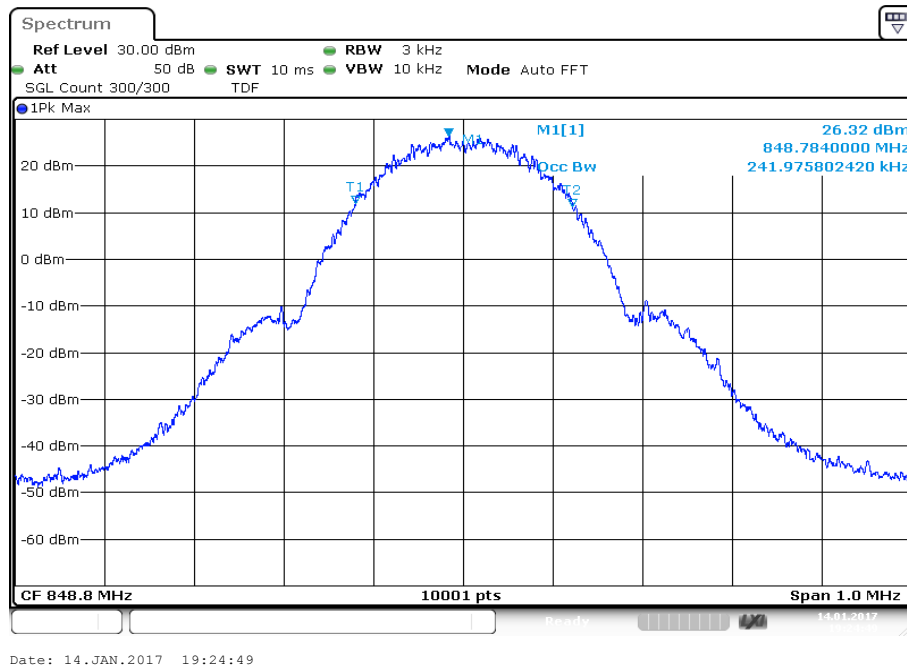
Plot 3: Channel 189 (99% bandwidth)



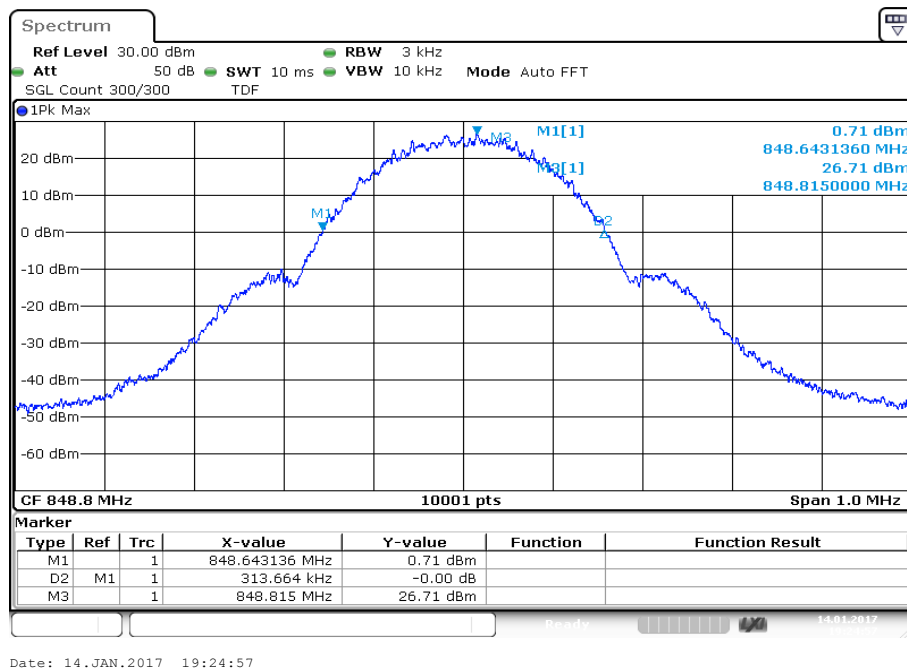
Plot 4: Channel 189 (-26 dBc bandwidth)

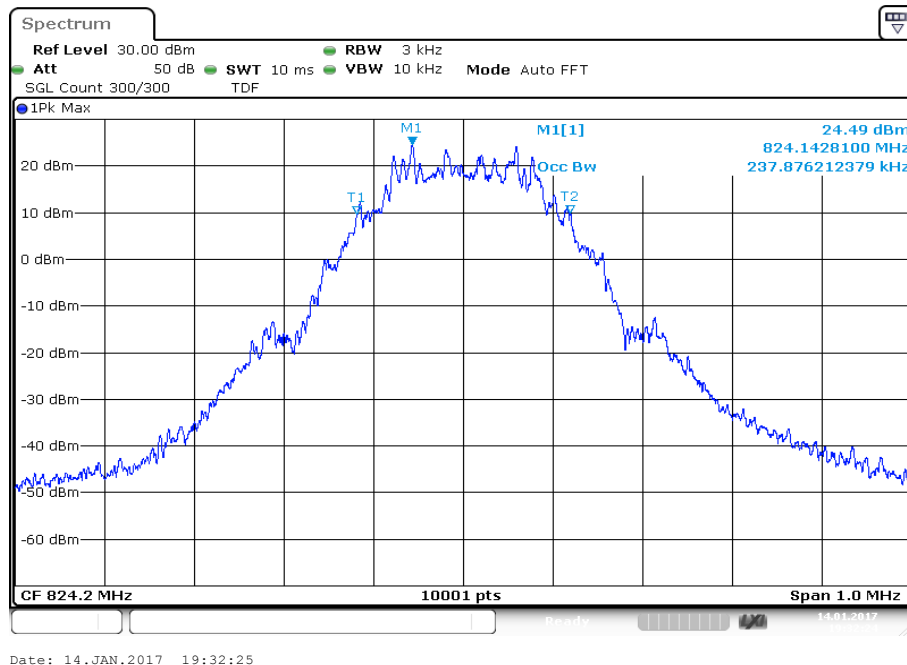
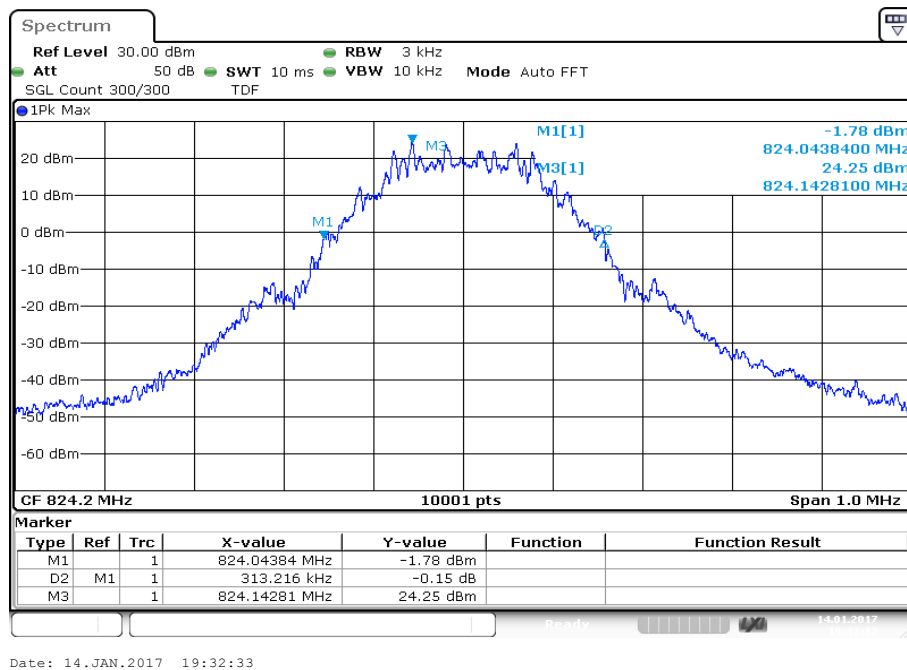


Plot 5: Channel 251 (99% bandwidth)

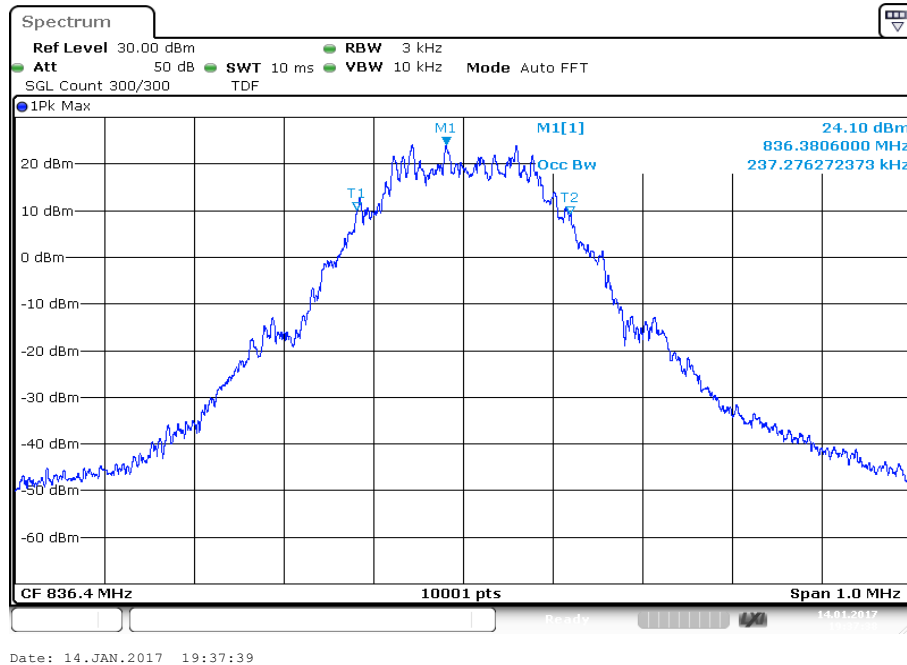


Plot 6: Channel 251 (-26 dBc bandwidth)

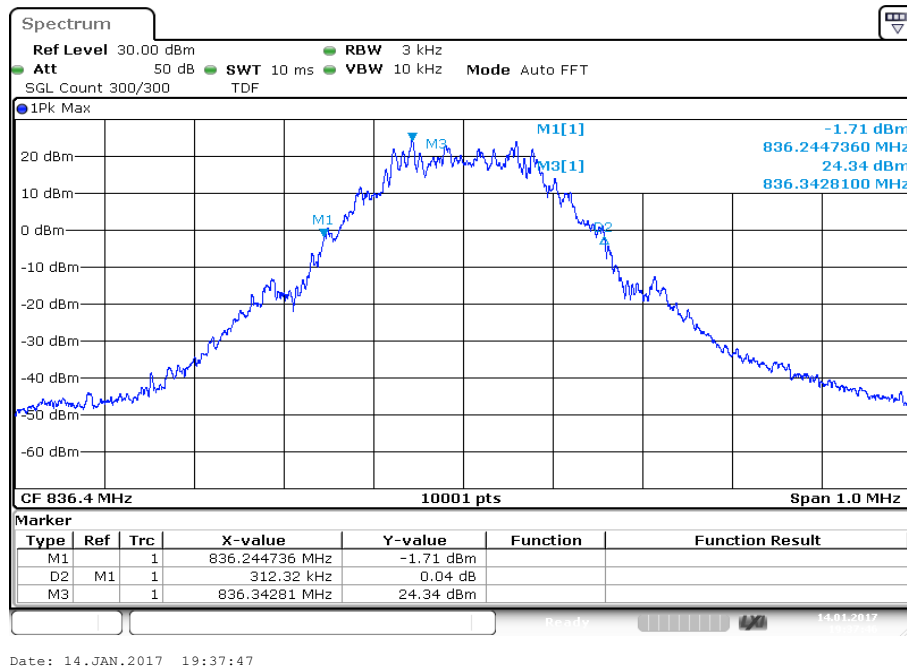


Plots: 8 PSK**Plot 1:** Channel 128 (99% bandwidth)**Plot 2:** Channel 128 (-26 dBc bandwidth)

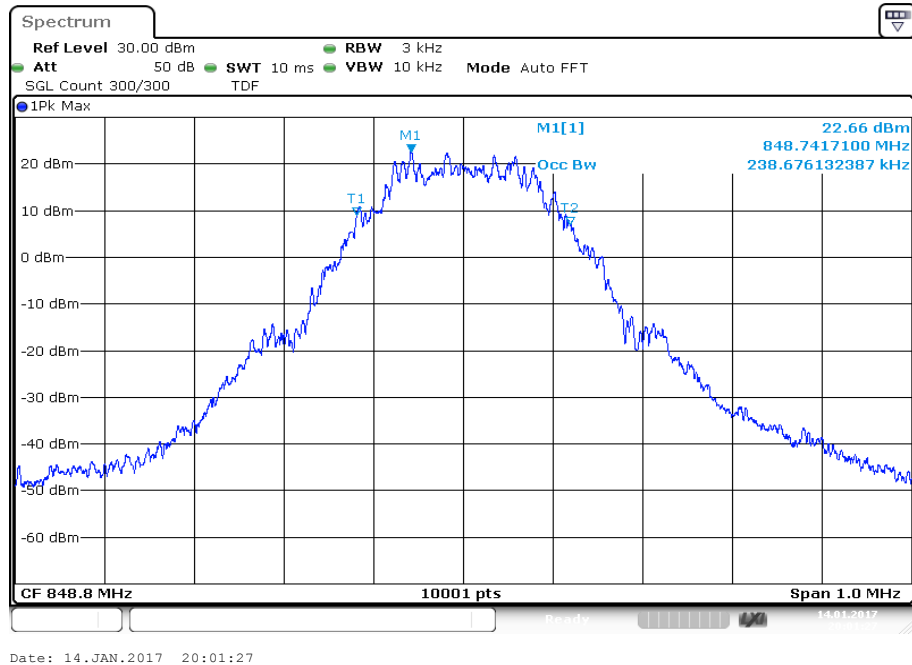
Plot 3: Channel 189 (99% bandwidth)



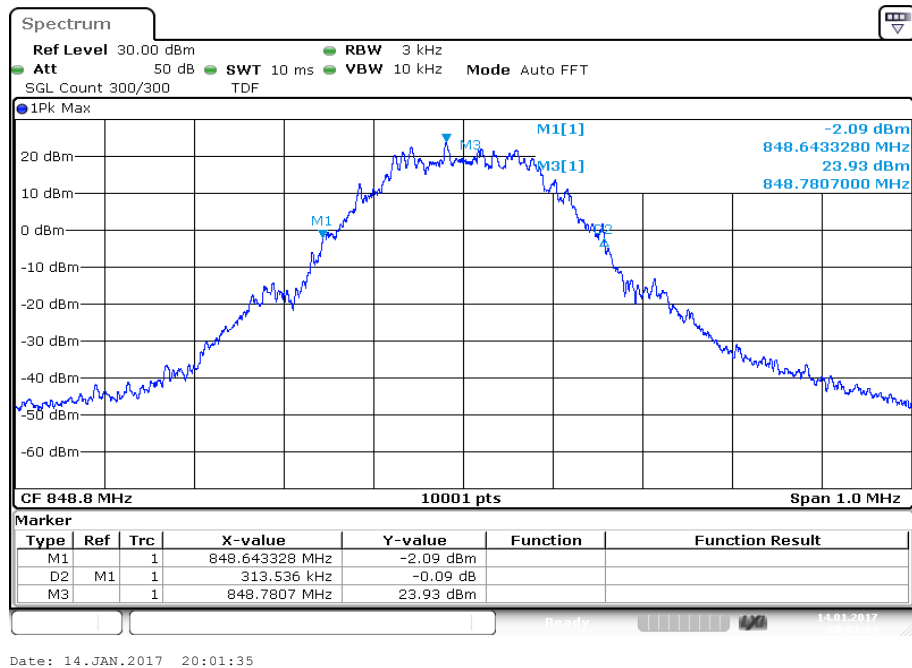
Plot 4: Channel 189 (-26 dBc bandwidth)



Plot 5: Channel 251 (99% bandwidth)



Plot 6: Channel 251 (-26 dBc bandwidth)



10 Results PCS 1900

All GSM-band measurements are done in GSM mode only (circuit switched). All relevant tests have been repeated using 8-PSK modulation if EDGE mode is supported. All tests were performed with one timeslot in uplink activated and one timeslot in downlink activated. For each mode the highest output power was determined and used.

10.1 RF output power

Description:

This paragraph contains average power, peak output power, PAPR and ERP measurements for the mobile station.

The plots in this test report represents only an example of the measurements. All plots of this chapter are available on request.

The red line in the measurements indicates the ideal Gaussian distribution for the measured amplitude range.

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	see chapter 6.2 – A & 6.4 – A
Measurement uncertainty:	see chapter 7

Limits:

FCC	IC
+33.00 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

Results:

Output Power (conducted) GMSK mode			
Frequency (MHz)	Peak Output Power (dBm)	Average Output Power (dBm)	Peak to Average Ratio (dB) CCDF
1850.2	29.6	28.6	1.01
1880.0	29.8	28.8	1.01
1909.8	30.1	29.1	0.93

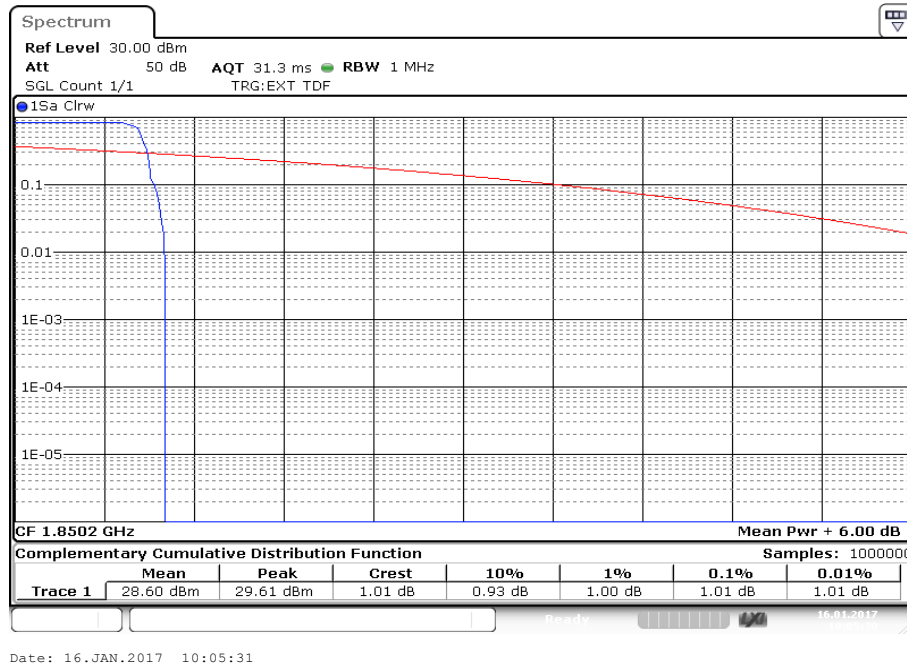
Output Power (conducted) 8-PSK mode			
Frequency (MHz)	Peak Output Power (dBm)	Average Output Power (dBm)	Peak to Average Ratio (dB) CCDF
1850.2	28.8	24.8	3.83
1880.0	28.7	25.2	3.41
1909.8	28.8	25.4	3.35

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1850.2	28.6
1880.0	28.6
1909.8	29.5

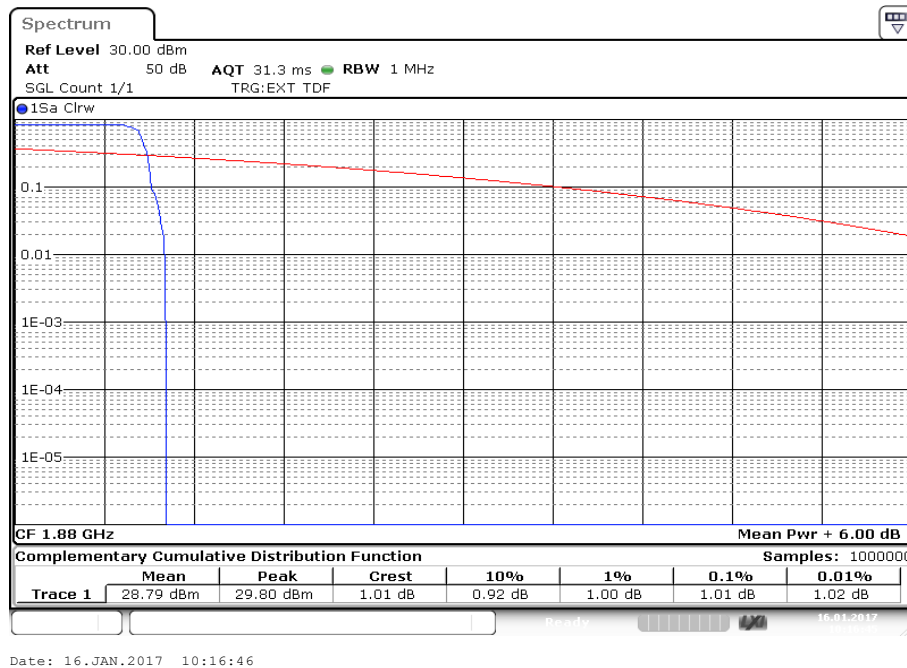
Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1850.2	24.8
1880.0	25.0
1909.8	25.8

Plots: GMSK

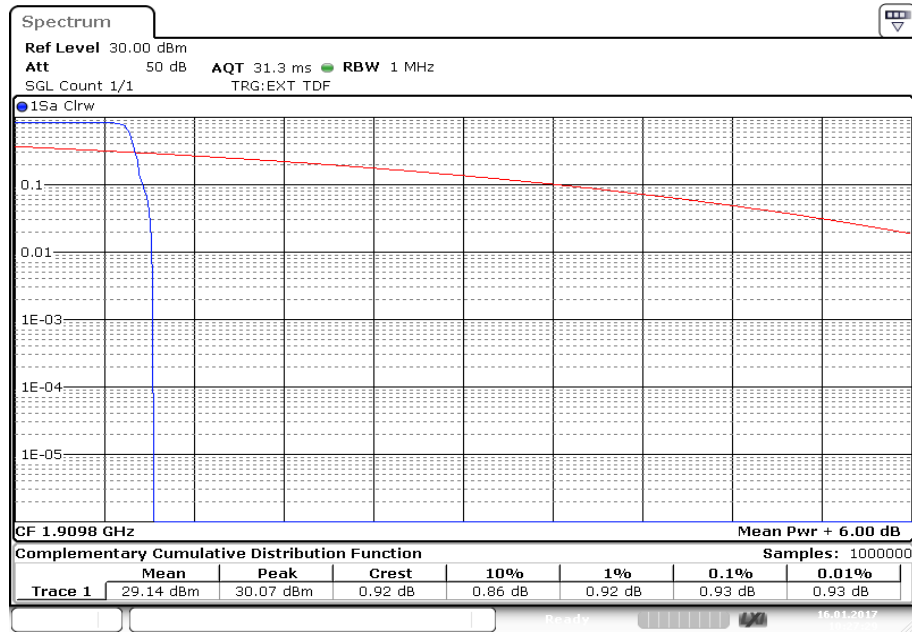
Plot 1: CCDF, channel 512



Plot 2: CCDF, channel 661

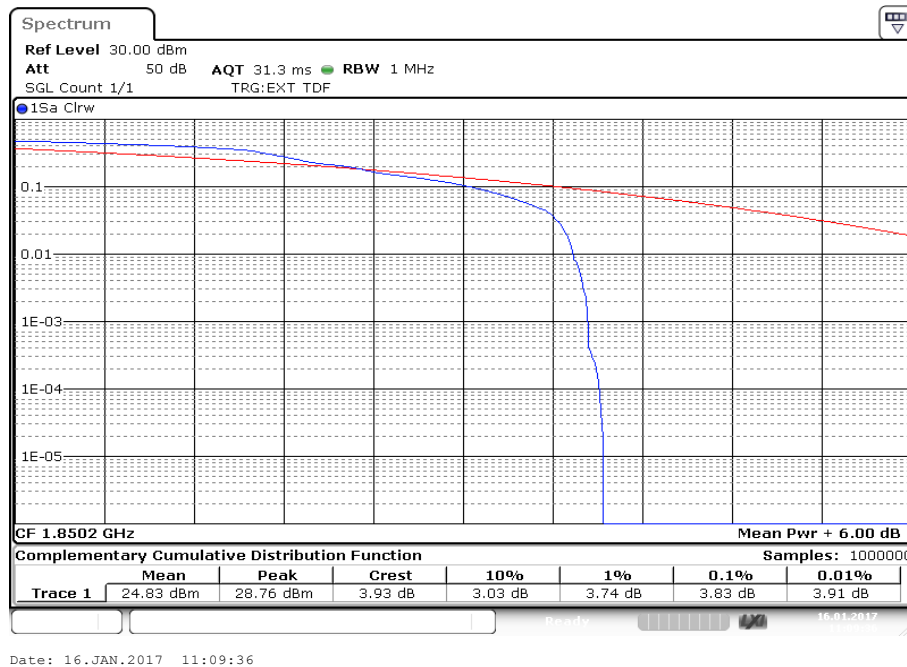


Plot 3: CCDF, channel 810

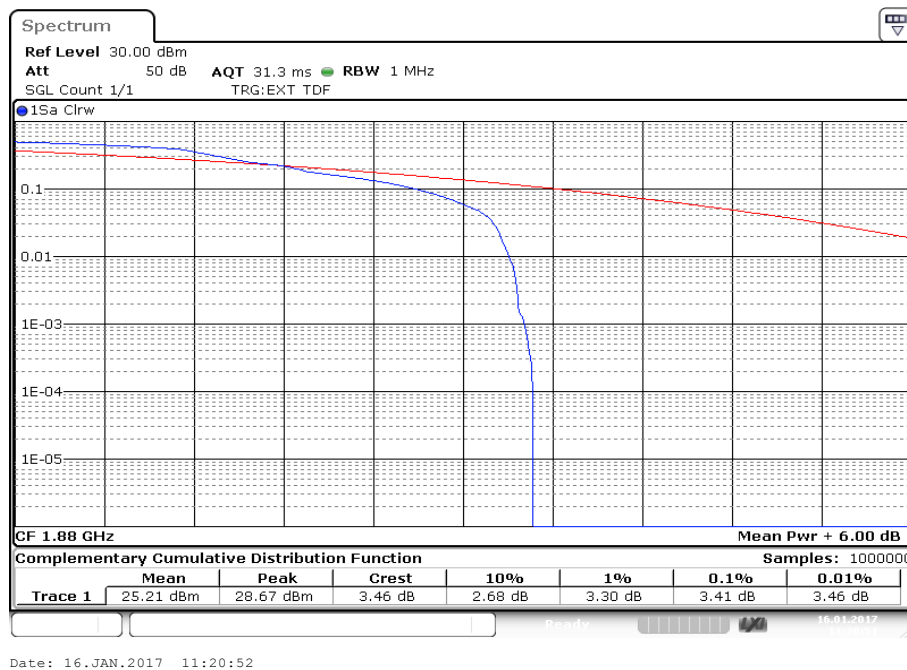


Plots: 8 PSK

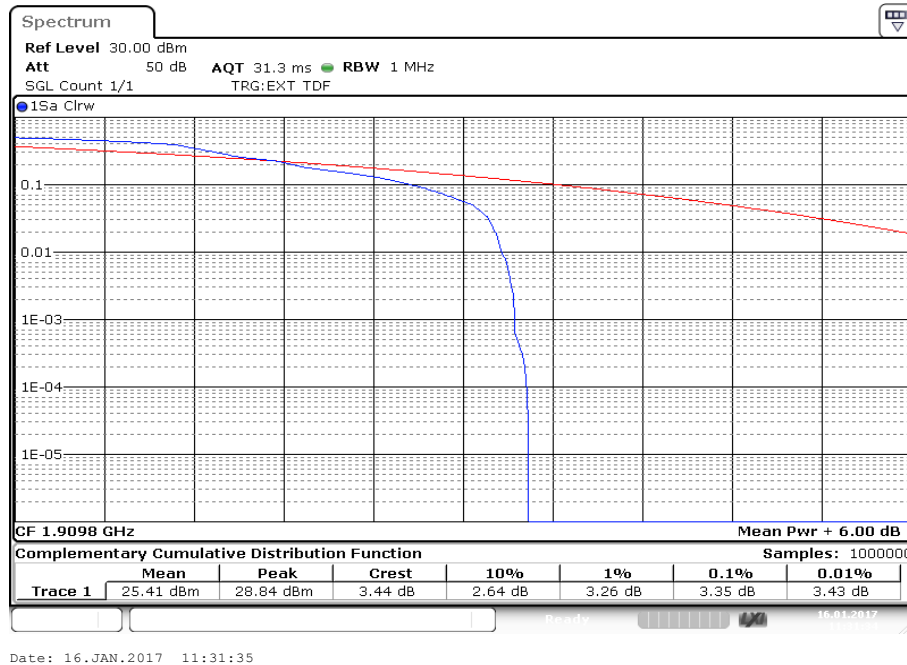
Plot 1: CCDF, channel 512



Plot 2: CCDF, channel 661



Plot 3: CCDF, channel 810



10.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to a R&S CMU200 Wideband Radio Communication Tester.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 °C.
3. With the mobile station powered with V_{nom} connected to the CMU200 on the center channel. Measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature unpowered before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace mode:	
Test setup:	See chapter 6.4 – B
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.	

Results:**AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
21.6	-30	-0.00000160	-0.0160
24.0	47	0.00000250	0.0250
26.4	17	0.00000090	0.0090

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	4	0.00000021	0.0021
-20	-5	-0.00000027	-0.0027
-10	30	0.00000160	0.0160
± 0	36	0.00000191	0.0191
10	-39	-0.00000207	-0.0207
20	-2	-0.00000011	-0.0011
30	-26	-0.00000138	-0.0138
40	-6	-0.00000032	-0.0032
50	52	0.00000277	0.0277

10.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. Measurement made up to 25 GHz. The resolution bandwidth is set as outlined in Part 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the PCS1900 band.

The final open field emission (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load (if possible).
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
- Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 6.1 – A, 6.2 – A & 6.3 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Results GPRS & EGPRS:

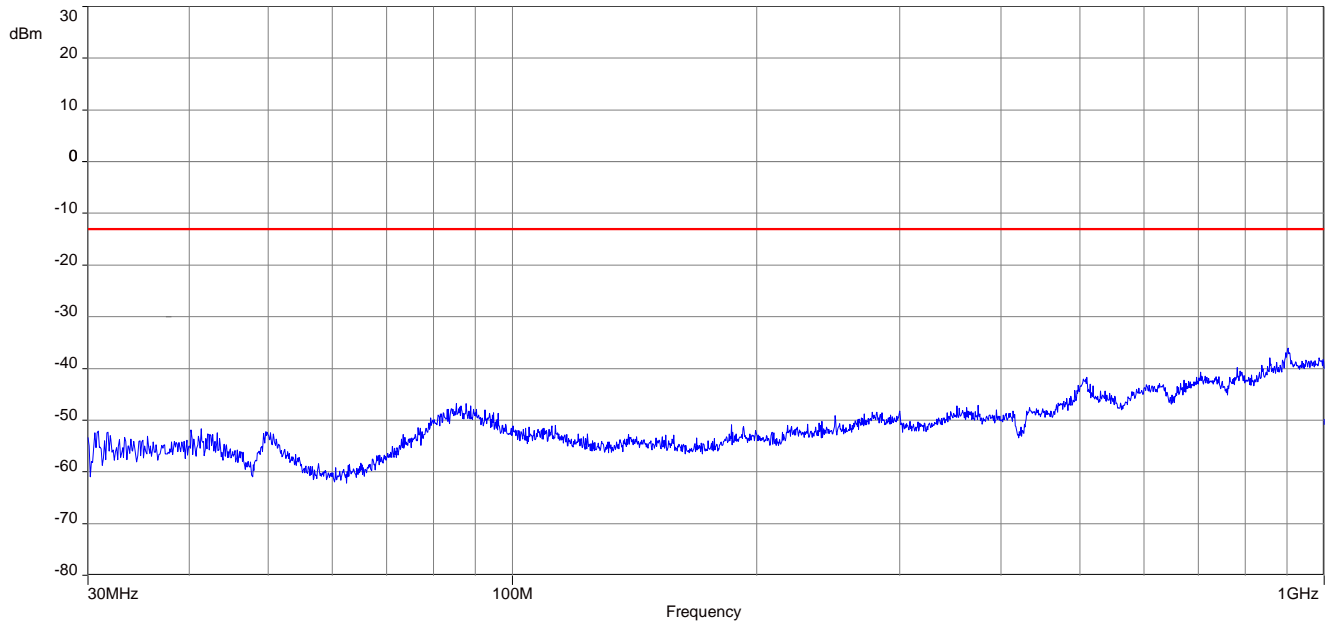
Radiated emissions measurements were made only at the center carrier frequencies of the PCS1900 band (1880.0 MHz) to show the compliance with cabinet radiation limits.

Results:

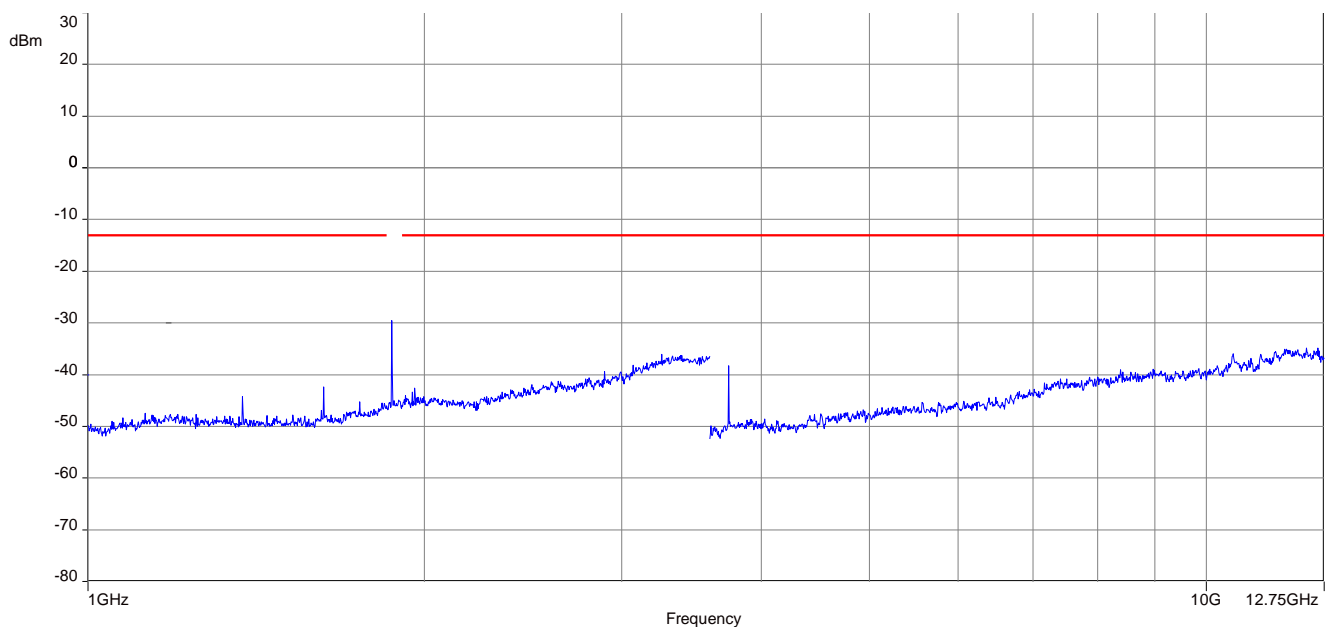
Spurious emission level (dBm)								
Harmonic	Ch. 512 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 661 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 810 Freq. (MHz)	Level [dBm]
2	3700.4	-	2	3760.0	-	2	3819.6	-
3	5550.6	-	3	5640.0	-	3	5729.4	-
4	7400.8	-	4	7520.0	-	4	7639.2	-
5	9251.0	-	5	9400.0	-	5	9549.0	-
6	11101.2	-	6	11280.0	-	6	11458.8	-
7	12951.4	-	7	13160.0	-	7	13368.6	-
8	14801.6	-	8	15040.0	-	8	15278.4	-
9	16651.8	-	9	16920.0	-	9	17188.2	-
10	18502.0	-	10	18800.0	-	10	19098.0	-

Plots: GMSK

Plot 1: Channel 661 (30 MHz – 1 GHz)

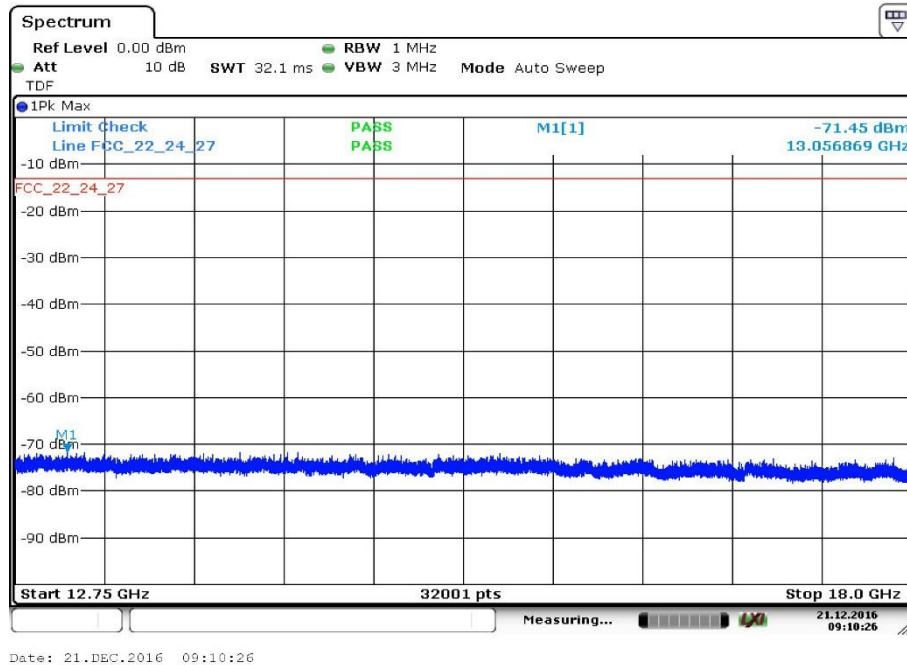


Plot 2: Channel 661 (1 GHz – 12.75 GHz)

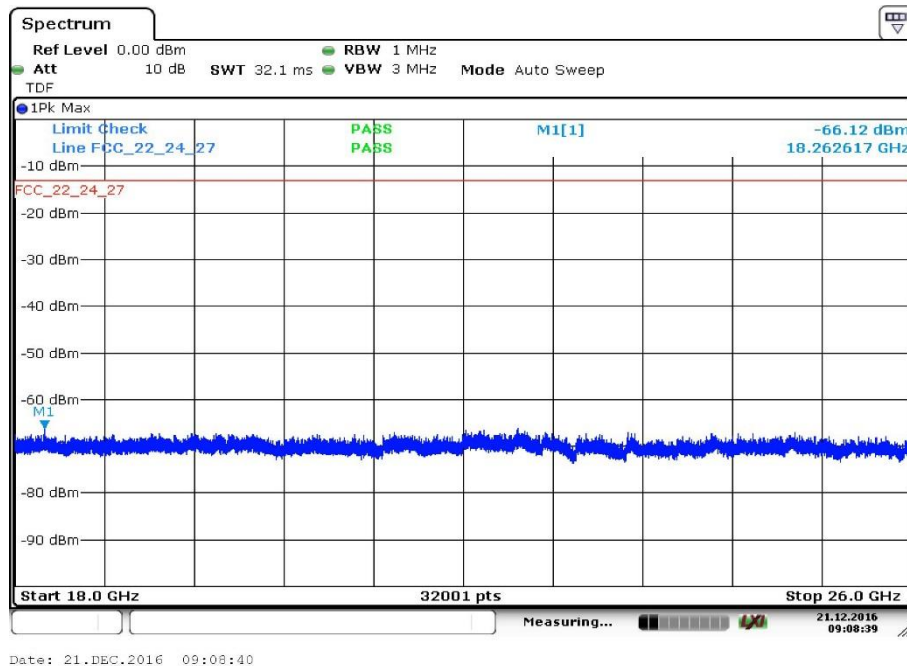


Carrier notched with 1.9 GHz rejection filter

Plot 3: Channel 661 (12.75 GHz - 18 GHz)

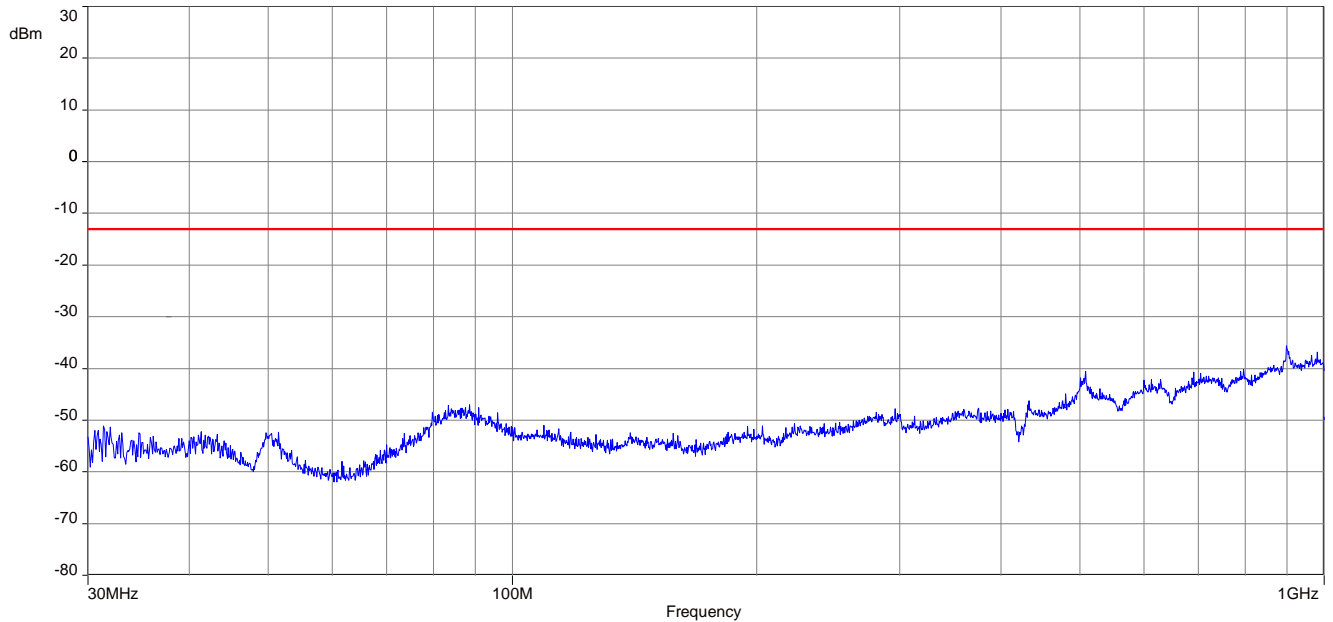


Plot 3: Channel 661 (18 GHz - 26 GHz)

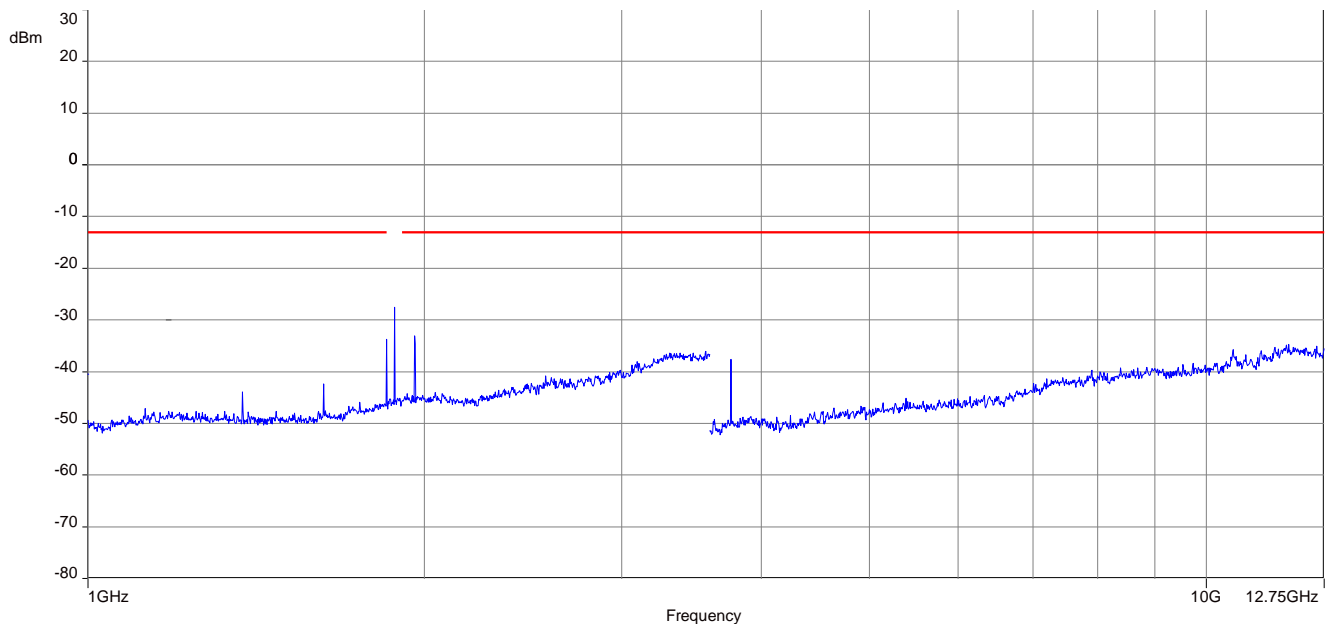


Plots: 8 PSK

Plot 1: Channel 661 (30 MHz – 1 GHz)

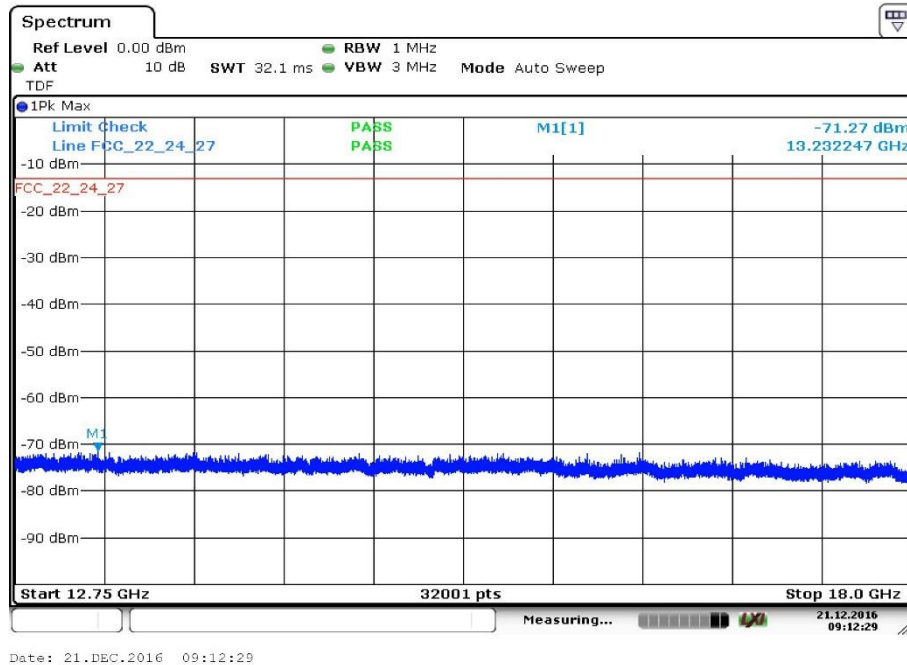


Plot 2: Channel 661 (1 GHz – 12.75 GHz)

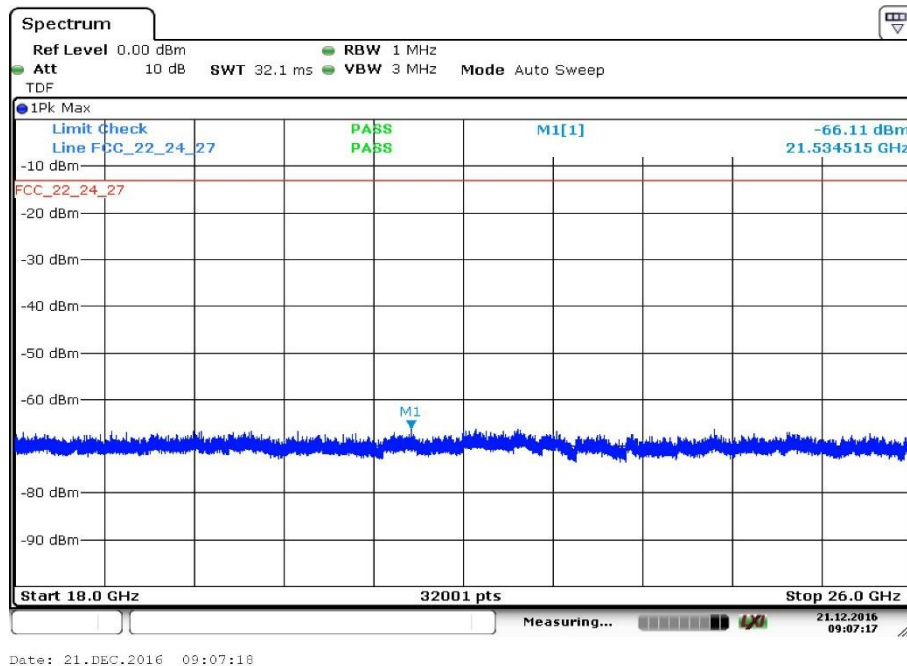


Carrier notched with 1.9 GHz rejection filter

Plot 3: Channel 661 (12.75 GHz - 18 GHz)



Plot 3: Channel 661 (18 GHz - 26 GHz)



10.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 26 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

PCS1900 Transmitter Channel Frequency

512 1850.2 MHz

661 1880.0 MHz

810 1909.8 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	10 MHz – 26 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 6.3 – A
Measurement uncertainty:	See chapter 7

Limits:

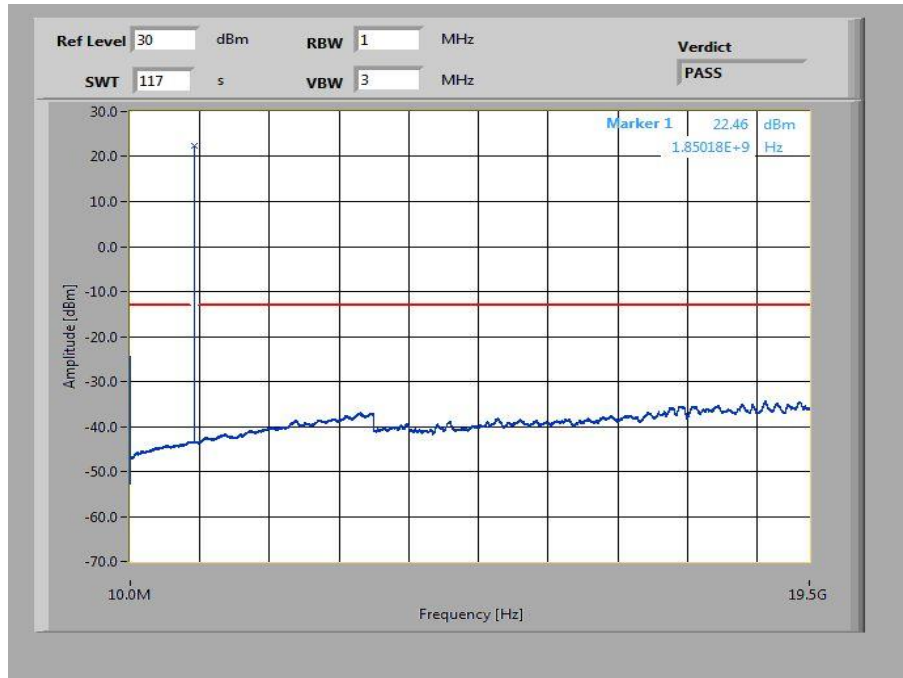
FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Results:

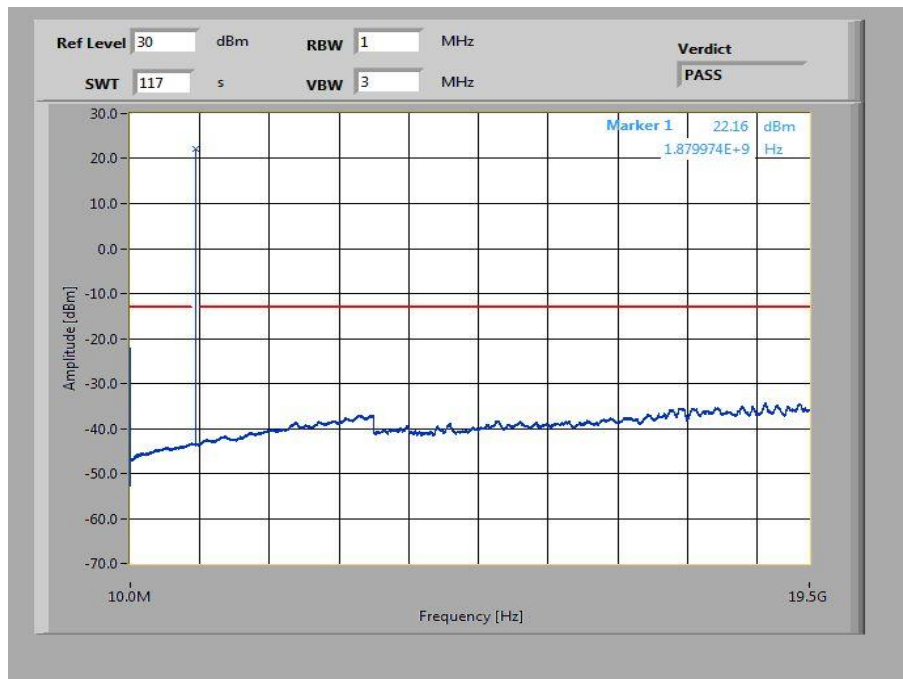
Spurious emission level (dBm)								
Harmonic	Ch. 512 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 661 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 810 Freq. (MHz)	Level [dBm]
2	3700.4	-	2	3760.0	-	2	3819.6	-
3	5550.6	-	3	5640.0	-	3	5729.4	-
4	7400.8	-	4	7520.0	-	4	7639.2	-
5	9251.0	-	5	9400.0	-	5	9549.0	-
6	11101.2	-	6	11280.0	-	6	11458.8	-
7	12951.4	-	7	13160.0	-	7	13368.6	-
8	14801.6	-	8	15040.0	-	8	15278.4	-
9	16651.8	-	9	16920.0	-	9	17188.2	-
10	18502.0	-	10	18800.0	-	10	19098.0	-

Plots: GMSK

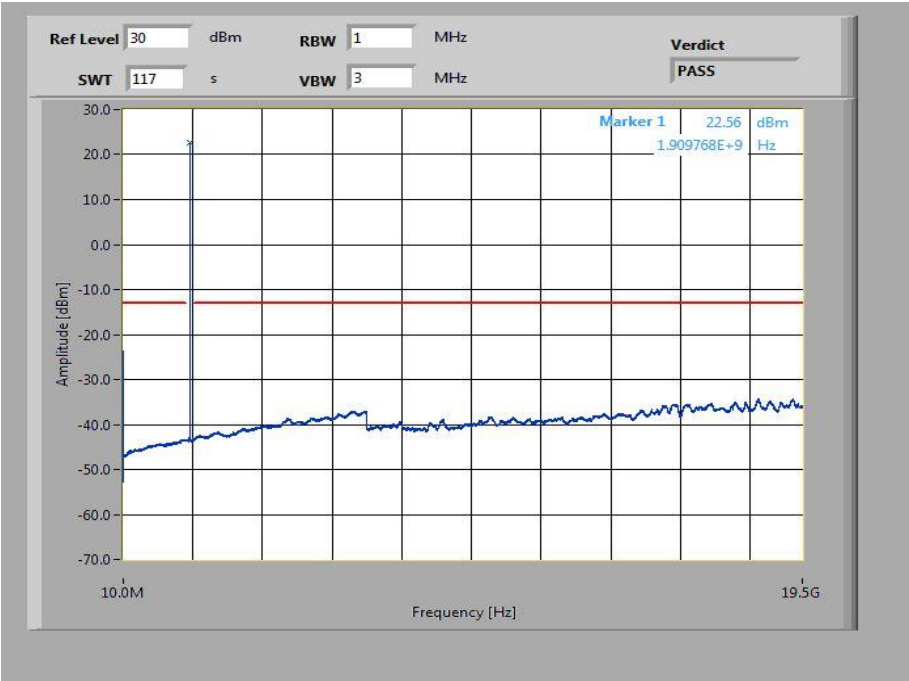
Plot 1: Channel 512 (10 MHz – 19.5 GHz)



Plot 2: Channel 661 (10 MHz – 19.5 GHz)

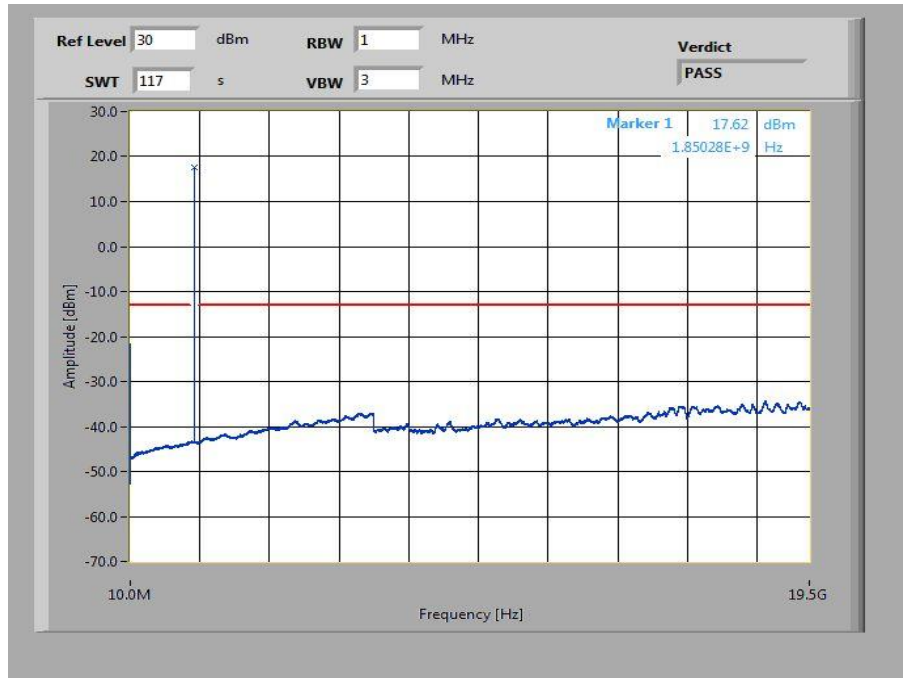


Plot 3: Channel 810 (10 MHz – 19.5 GHz)

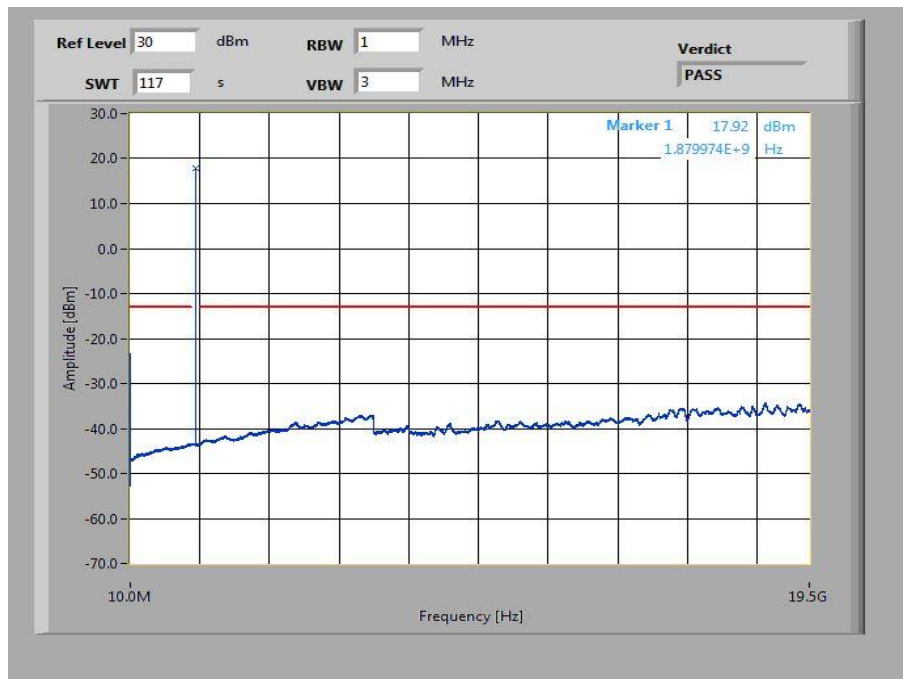


Plots: 8 PSK

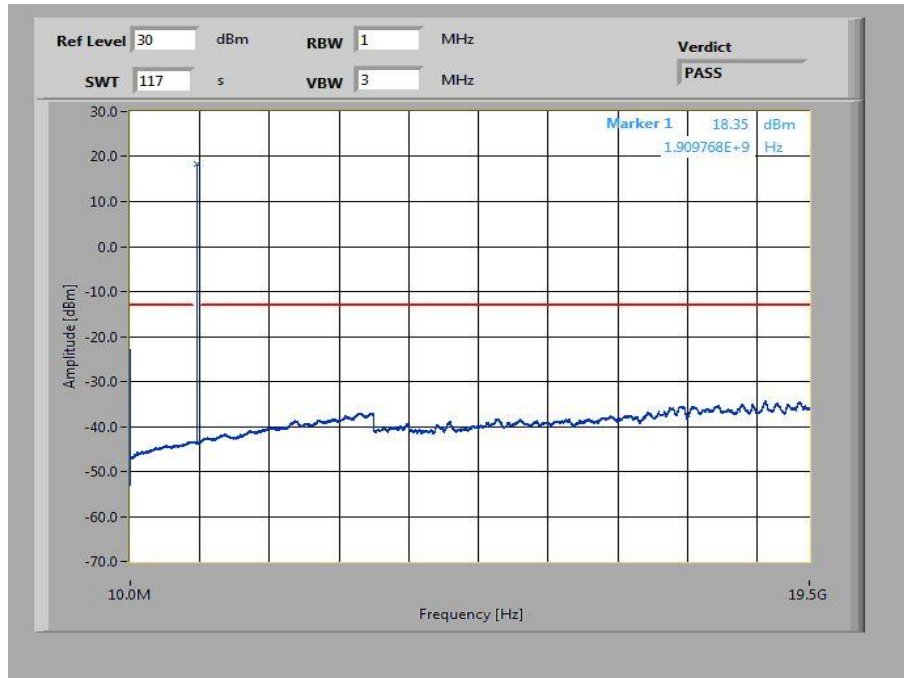
Plot 1: Channel 512 (10 MHz – 19.5 GHz)



Plot 2: Channel 661 (10 MHz – 19.5 GHz)



Plot 3: Channel 810 (10 MHz – 19.5 GHz)



10.5 Block edge compliance

Description:

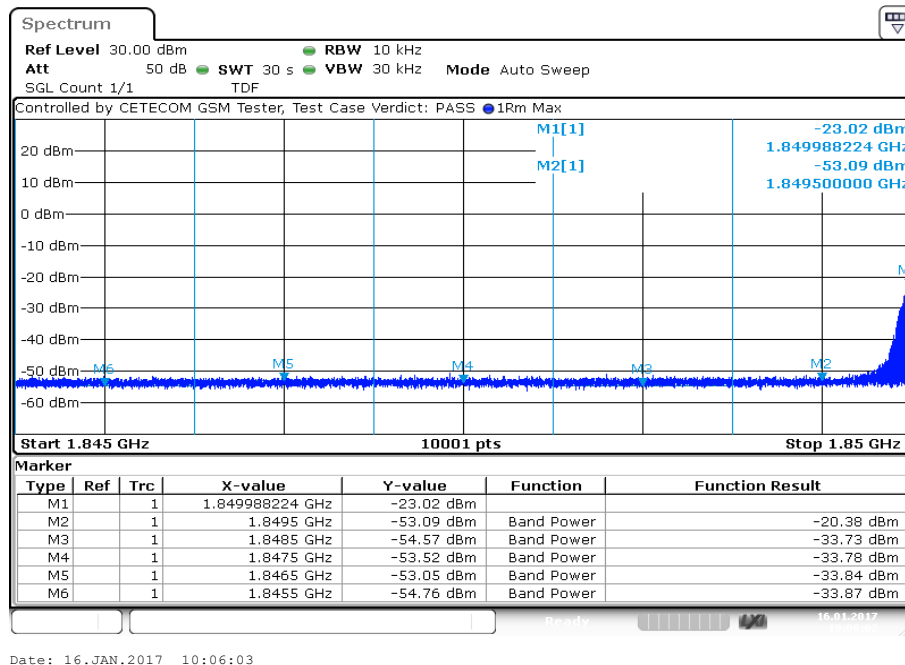
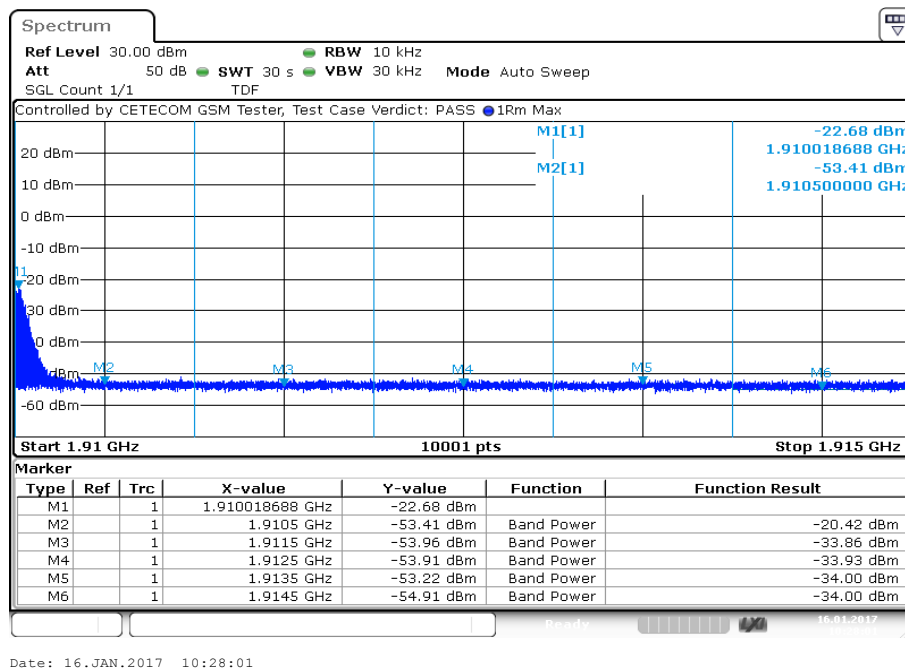
The spectrum at the band edges must comply with the spurious emissions limits.

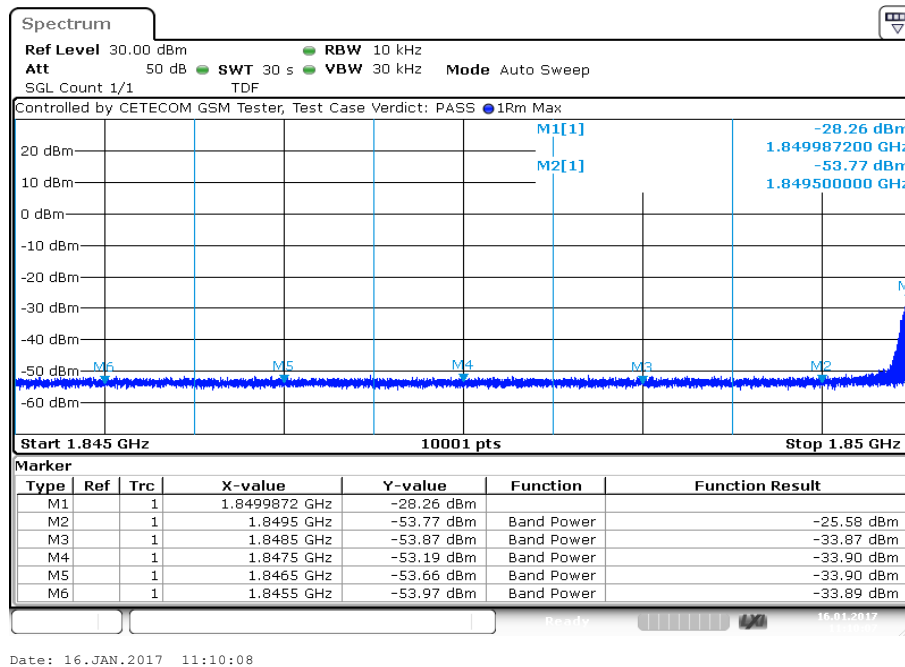
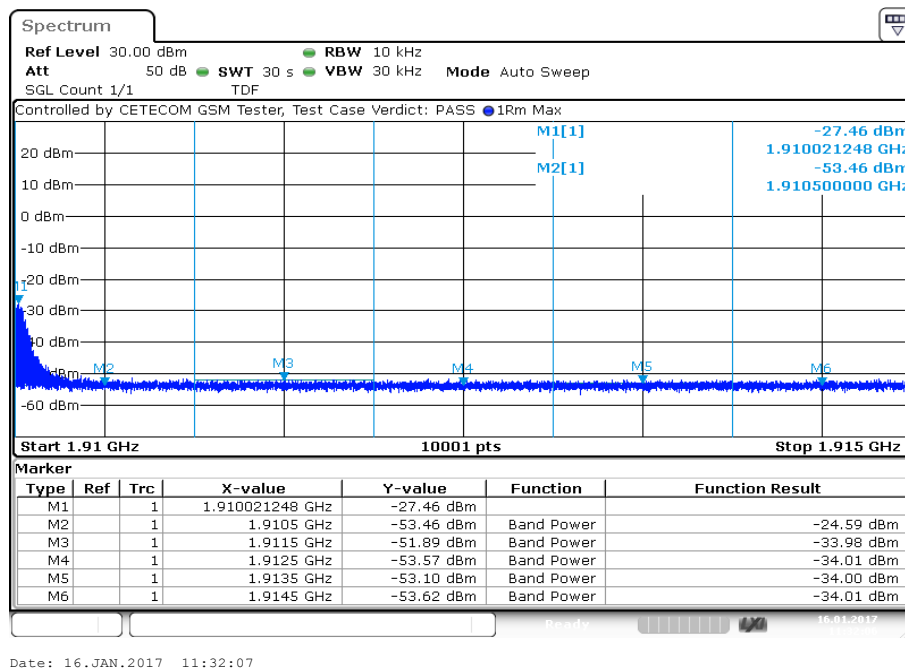
Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	30 sec.
Video bandwidth:	1% - 5% of the OBW
Resolution bandwidth:	$\geq 3 \times \text{RBW}$
Span:	5 MHz
Trace mode:	Max Hold
Used equipment:	See chapter 6.4 - A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Plots: GMSK**Plot 1:** Channel 512**Plot 2:** Channel 810

Plots: 8 PSK**Plot 1:** Channel 512**Plot 2:** Channel 810

10.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the PCS1900 frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1% - 5% of the OBW
Video bandwidth:	$\geq 3 \times \text{RBW}$
Span:	2 x nominal BW
Trace mode:	Max Hold
Used equipment:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 7

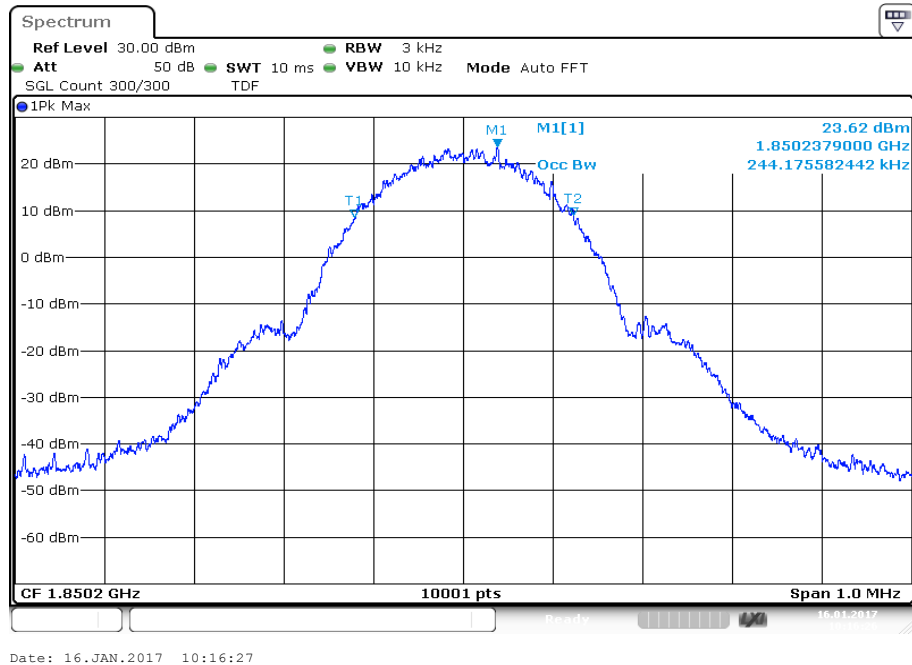
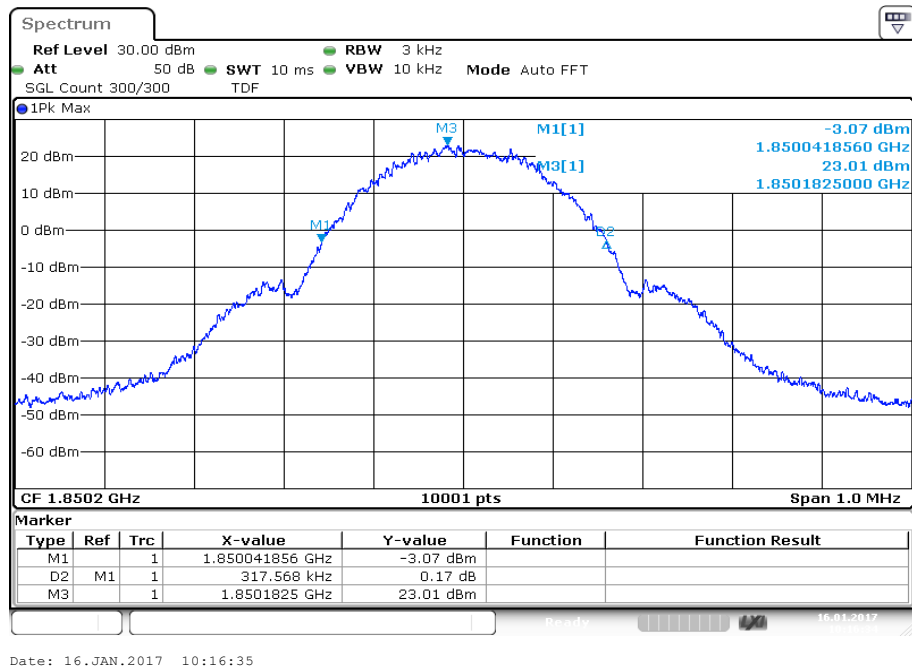
Limits:

FCC	IC
Spectrum must fall completely in the specified band	

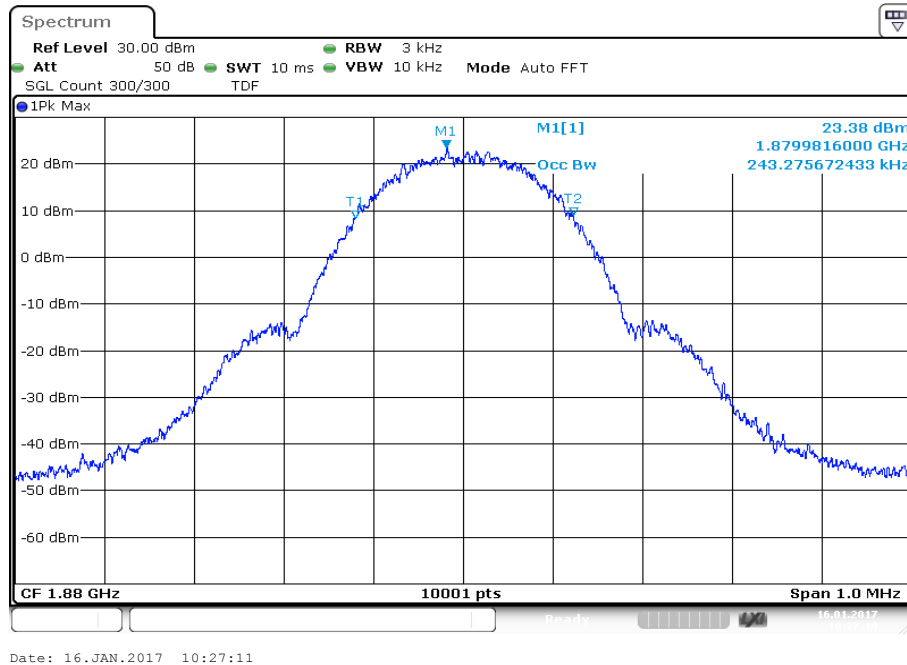
Results:

Occupied Bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	244	318
1880.0	243	314
1909.8	243	319

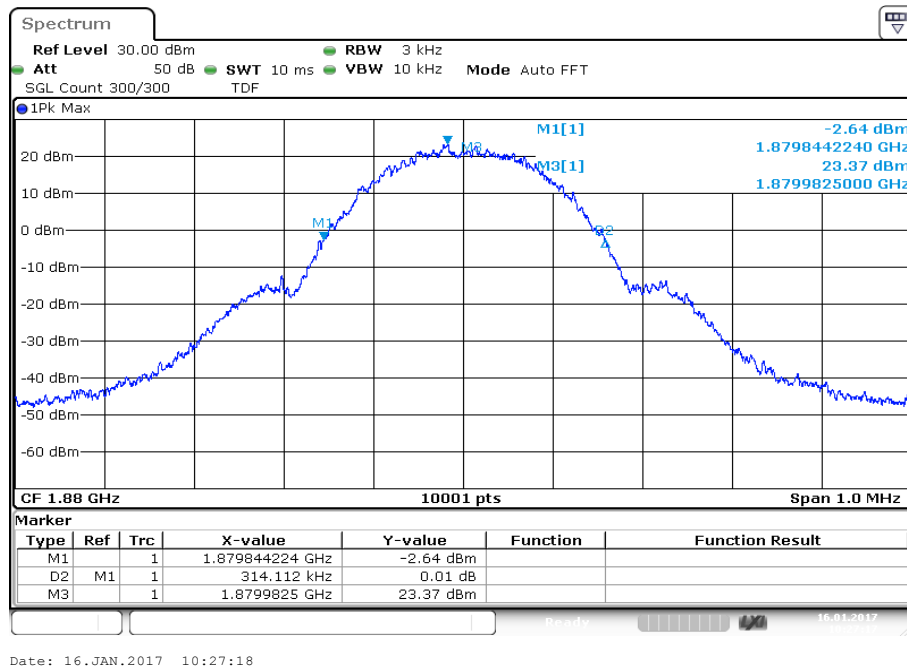
Occupied Bandwidth – 8-PSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	240	314
1880.0	241	313
1909.8	238	314

Plots: GMSK**Plot 1:** Channel 512 (99% bandwidth)**Plot 2:** Channel 512 (-26 dBc bandwidth)

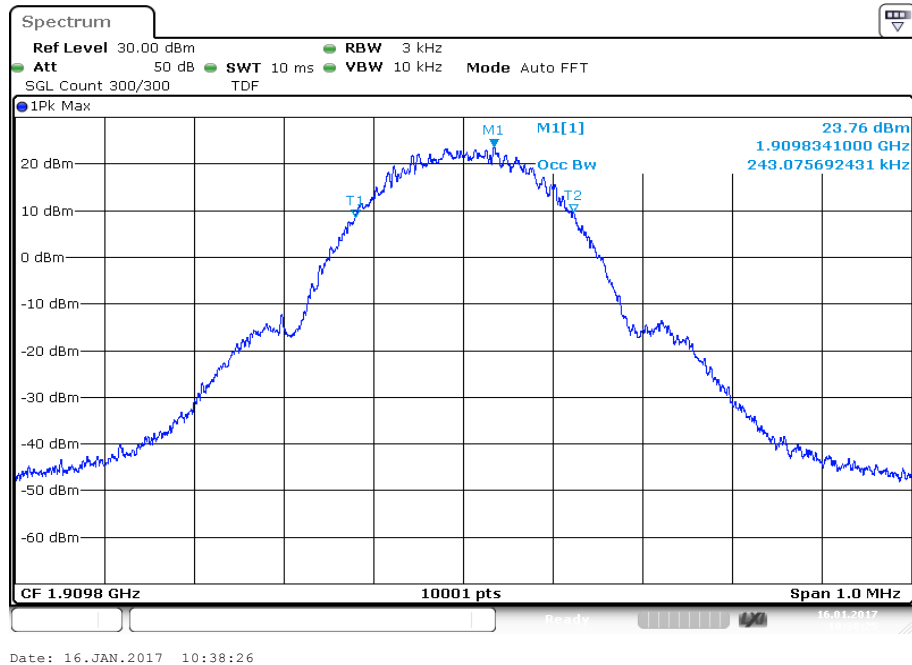
Plot 3: Channel 661 (99% bandwidth)



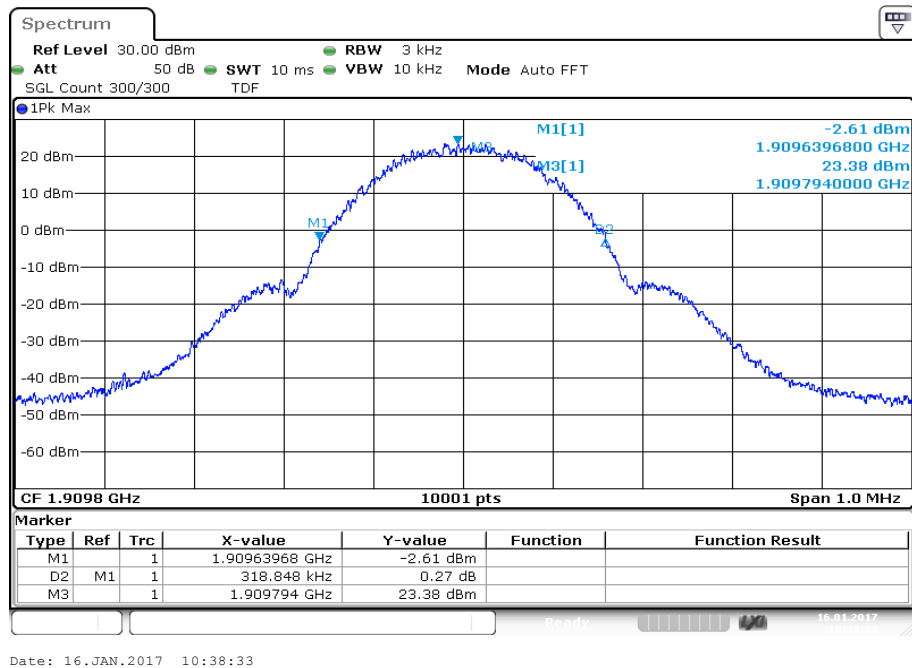
Plot 4: Channel 661 (-26 dBc bandwidth)



Plot 5: Channel 810 (99% bandwidth)

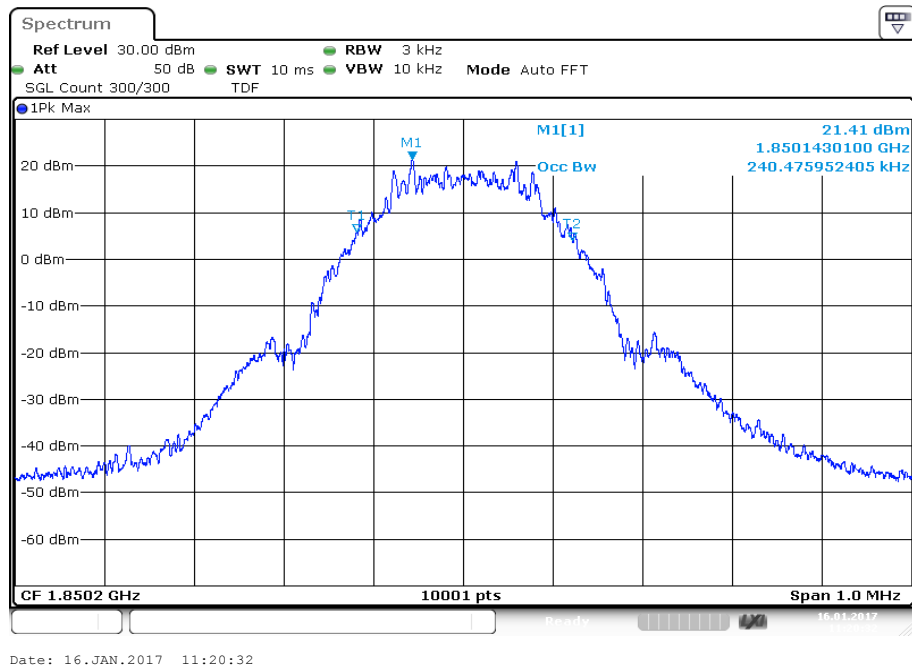


Plot 6: Channel 810 (-26 dBc bandwidth)

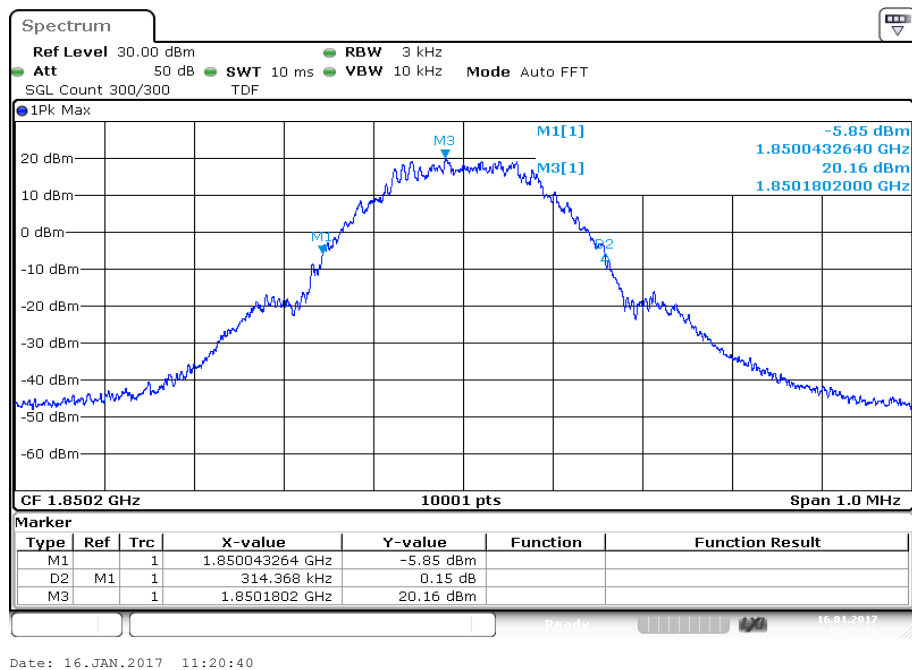


Plots: 8 PSK

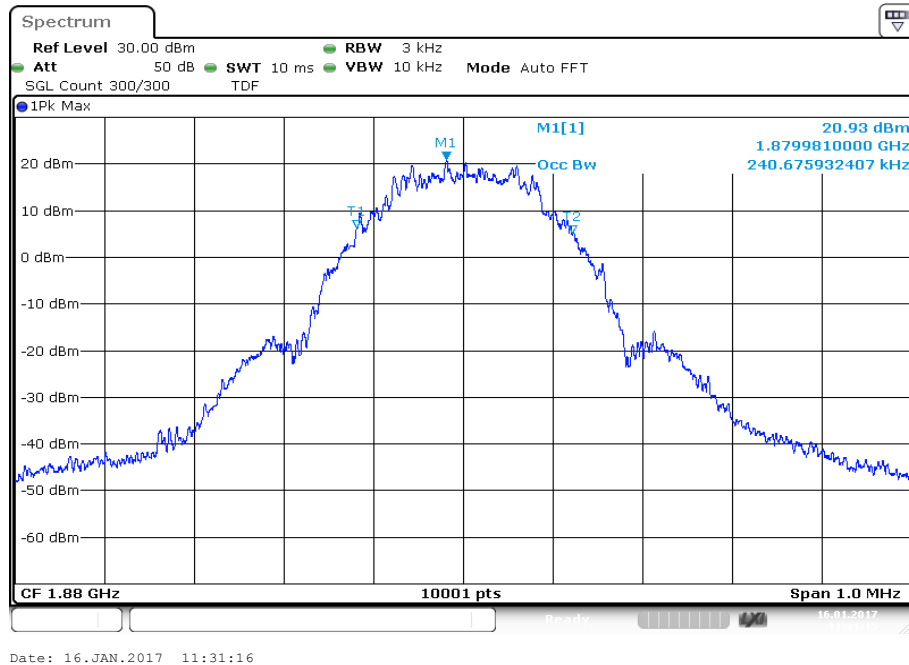
Plot 1: Channel 512 (99% bandwidth)



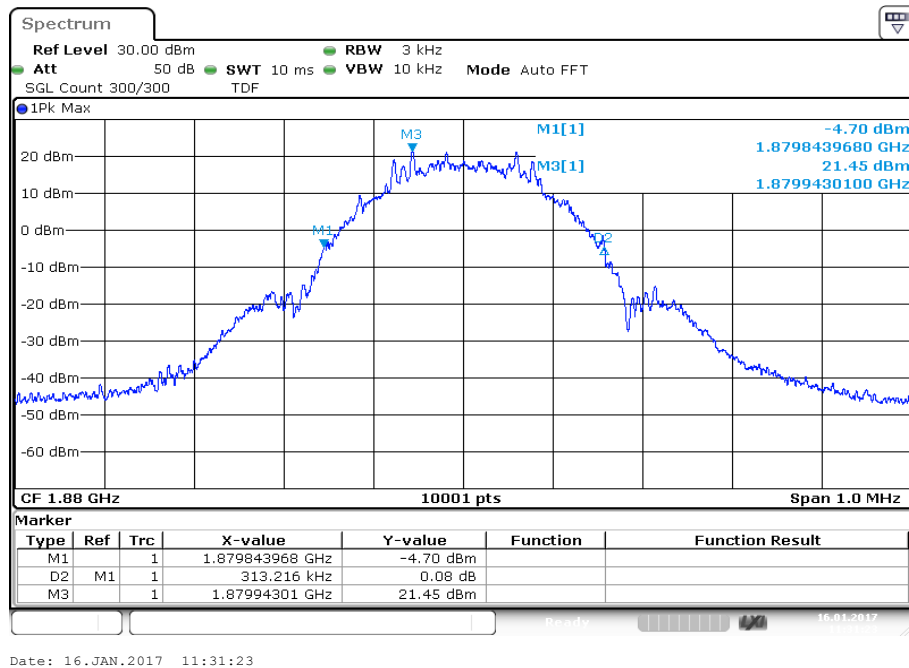
Plot 2: Channel 512 (-26 dBc bandwidth)



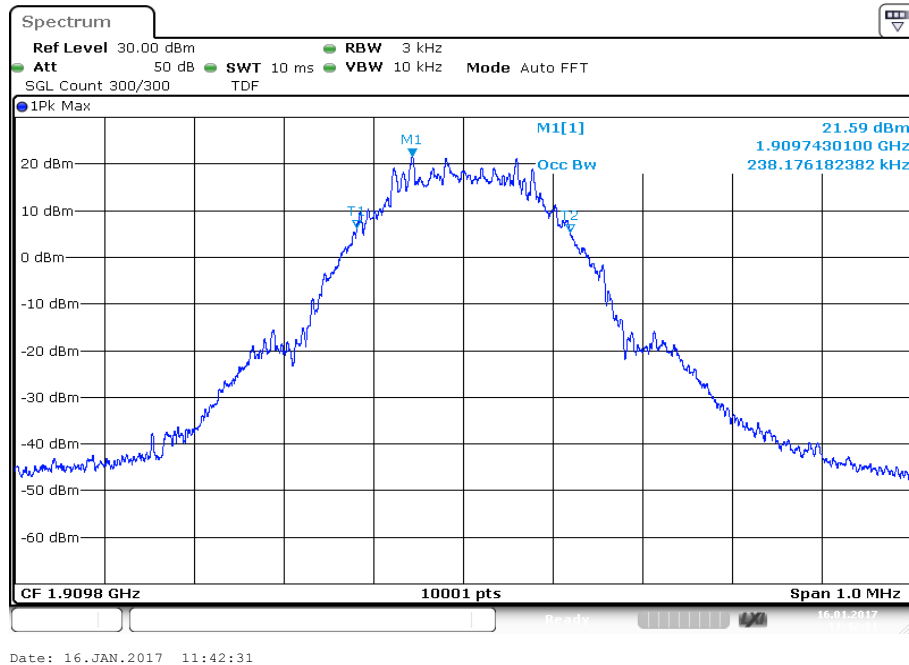
Plot 3: Channel 661 (99% bandwidth)



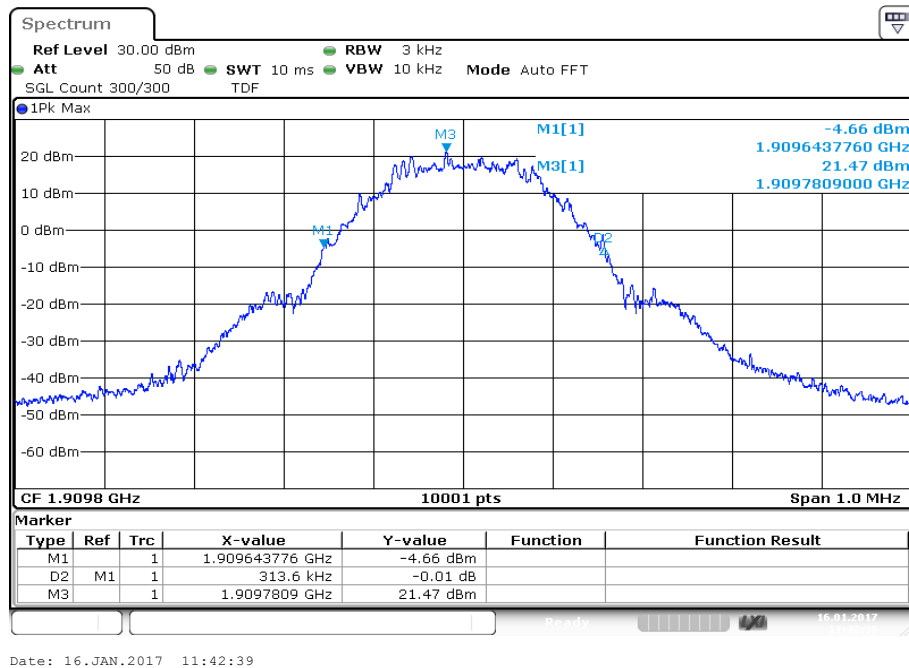
Plot 4: Channel 661 (-26 dBc bandwidth)



Plot 5: Channel 810 (99% bandwidth)



Plot 6: Channel 810 (-26 dBc bandwidth)



11 Results UMTS band V

All UMTS-band measurements are done in WCDMA mode only.

The connection was established with the following setup: WCDMA CS-RMC, Max Power (All Bit up)

11.1 RF output power

Description:

This paragraph contains average power, peak output power and ERP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	10 MHz
Resolution bandwidth:	10 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.1 – A & 6.4 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
CFR Part 22.913 CFR Part 2.1046	RSS 132
Nominal Peak Output Power	
+38.45 dBm	
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

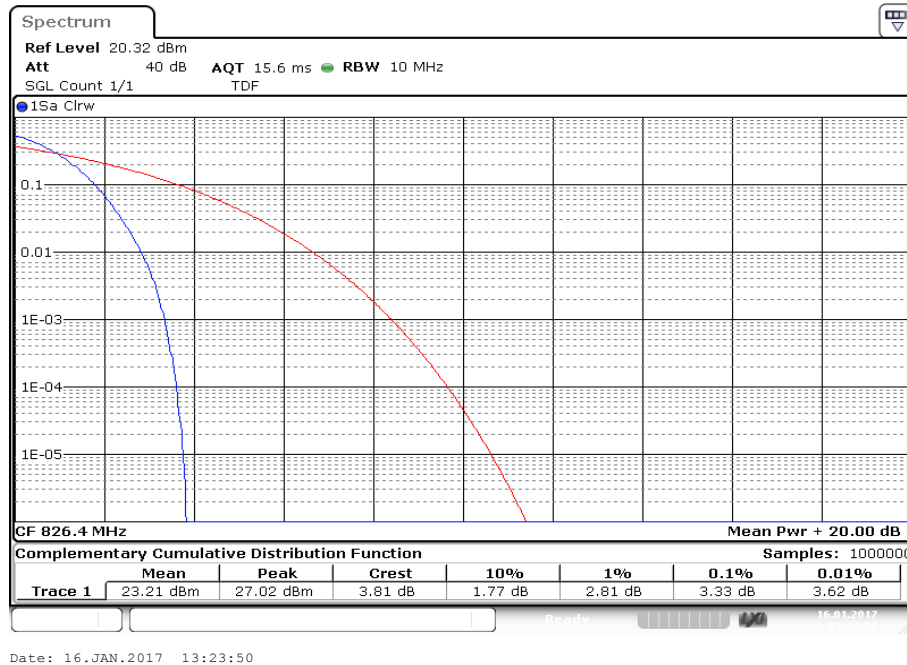
Results:

Output Power (conducted) WCDMA mode			
Frequency (MHz)	Peak Output Power (dBm)	Average Output Power (dBm)	Peak to Average Ratio (dB) CCDF
826.4	27.0	23.2	3.33
836.0	26.6	22.9	3.33
846.6	26.5	22.7	3.39

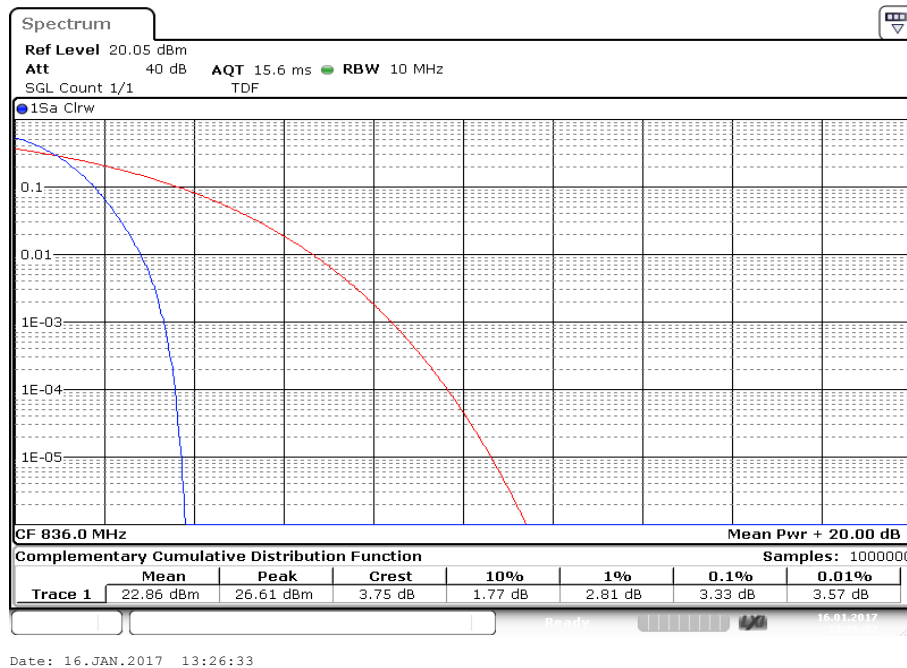
Output Power (radiated) WCDMA mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
826.4	22.2
836.0	22.4
846.6	21.9

Plots:

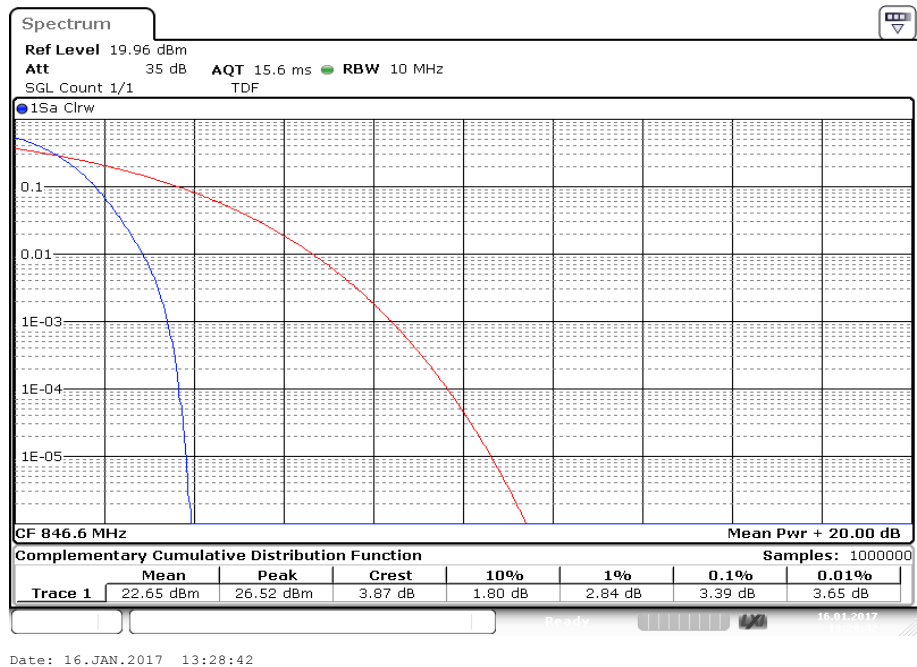
Plot 1: CCDF, channel 4132



Plot 2: CCDF, channel 4180



Plot 3: CCDF, channel 4233



11.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to R&S CMU200 Wideband Radio Communication Tester.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 °C.
3. With the mobile station powered with V_{nom} connected to the CMU200 on the center channel. Measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature unpowered before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace mode:	
Test setup:	See chapter 6.4 – B
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
CFR Part 22.355 CFR Part 2.1055	RSS 132
Frequency Stability	
± 0.1 ppm	

Results:**AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
21.4	11	0.00000132	0.0132
24.0	9	0.00000108	0.0108
26.4	1	0.00000012	0.0012

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	2	0.00000024	0.0024
-20	6	0.00000072	0.0072
-10	-2	-0.00000024	-0.0024
± 0	-1	-0.00000012	-0.0012
10	-2	-0.00000024	-0.0024
20	1	0.00000012	0.0012
30	3	0.00000036	0.0036
40	-7	-0.00000084	-0.0084
50	-7	-0.00000084	-0.0084

11.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 846.6 MHz. This was rounded up to 12 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the UMTS band V.

The final open field emission (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load (if possible).
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
- Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Video bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.1 – A & 6.2 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
CFR Part 22.917 CFR Part 2.1053	RSS 132
Spurious Emissions Radiated	
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Results:

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the UMTS band V (826.4 MHz, 836.0 MHz and 846.6 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the UMTS band V into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

The final open field radiated levels are presented on the next pages.

All measurements were done in horizontal and vertical polarization; the plots show the worst case.

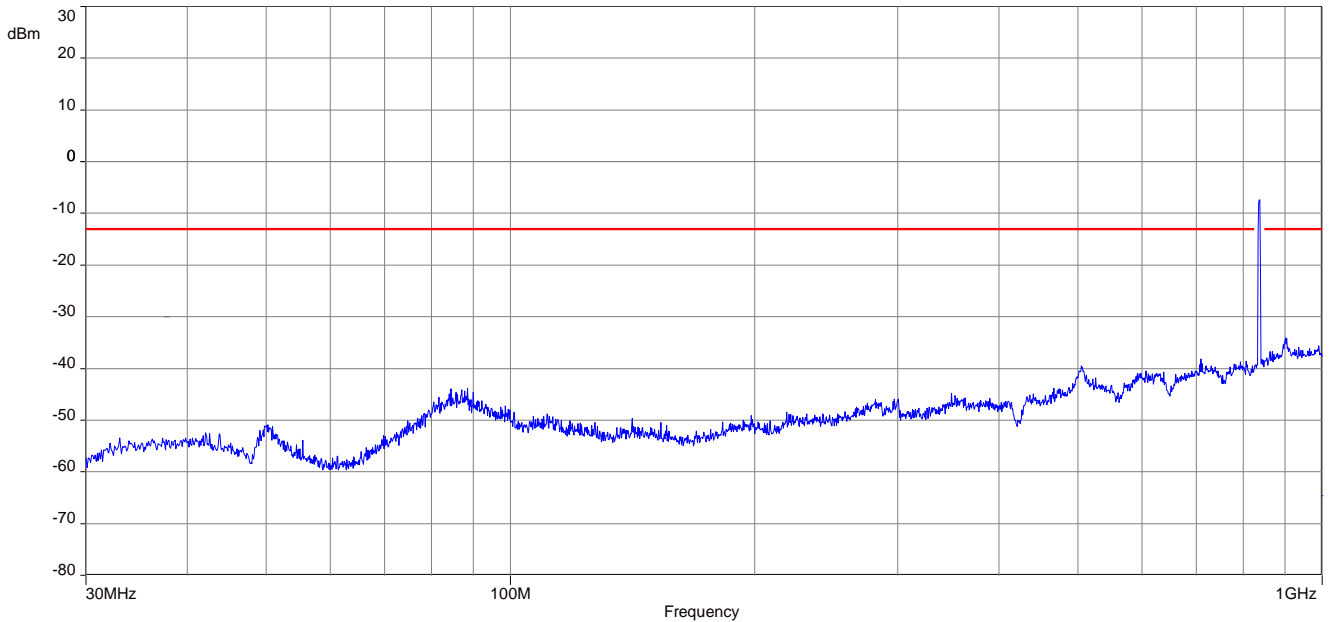
The plots show only the middle channel. If spurious were detected, the lowest and highest channel were checked too. The found values are stated in the table below.

As can be seen from this data, the emissions from the test item were within the specification limit.

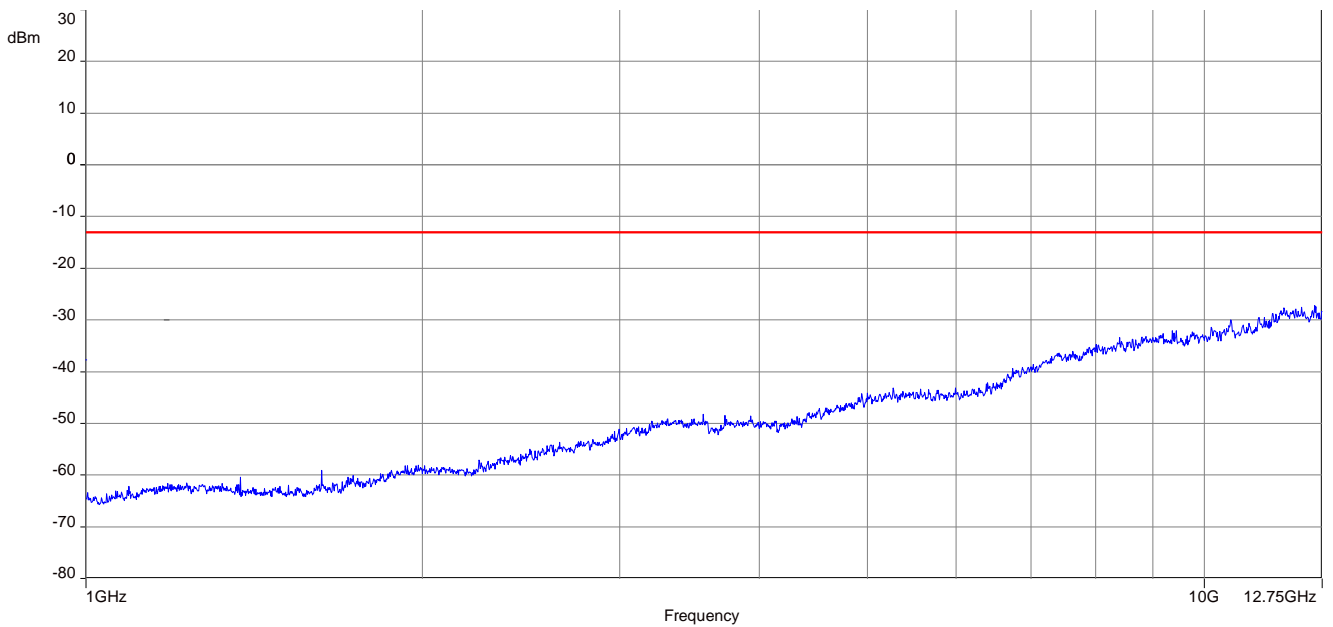
Spurious Emission Level (dBm)								
Harmonic	Ch. 4132 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4180 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4233 Freq. (MHz)	Level [dBm]
2	1652.8	-	2	1672.0	-	2	1693.2	-
3	2479.2	-	3	2508.0	-	3	2539.8	-
4	3305.6	-	4	3344.0	-	4	3386.4	-
5	4132.0	-	5	4180.0	-	5	4233.0	-
6	4958.4	-	6	5016.0	-	6	5079.6	-
7	5784.8	-	7	5852.0	-	7	5926.2	-
8	6611.2	-	8	6688.0	-	8	6772.8	-
9	7437.6	-	9	7524.0	-	9	7619.4	-
10	8264.0	-	10	8360.0	-	10	8466.0	-

Plots:

Plot 1: Channel 4180 (30 MHz – 1 GHz)



Plot 2: Channel 4180 (1 GHz – 12.75 GHz)



11.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 12 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

UMTS band V Transmitter Channel Frequency

4132 826.4 MHz

4180 836.0 MHz

4233 846.6 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	30 MHz – 26 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.4 - A
Measurement uncertainty:	See chapter 7

Limits:

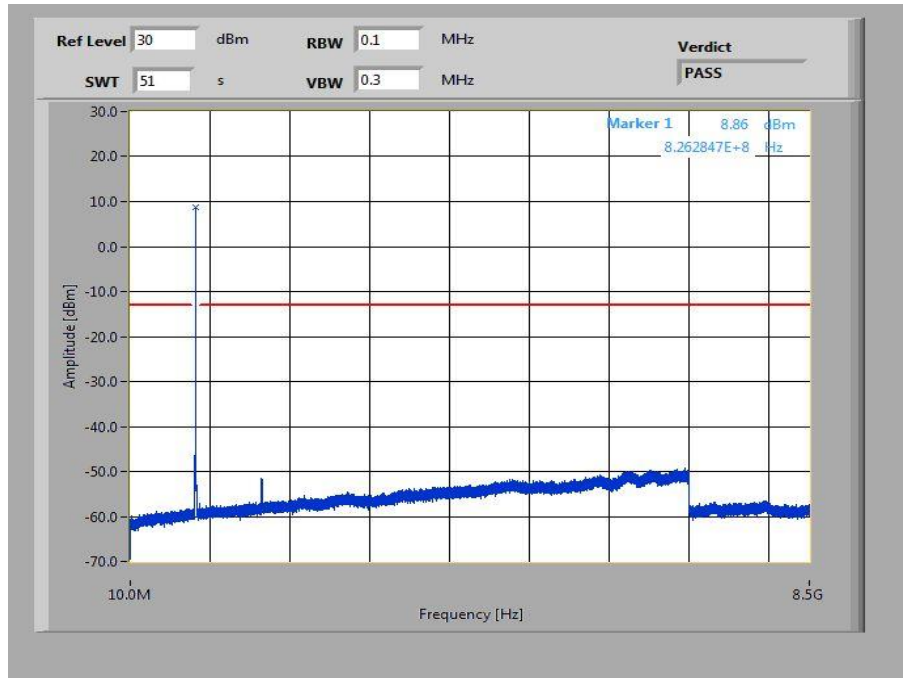
FCC	IC
CFR Part 22.917 CFR Part 2.1051	RSS 132
Spurious Emissions Conducted	
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Results:

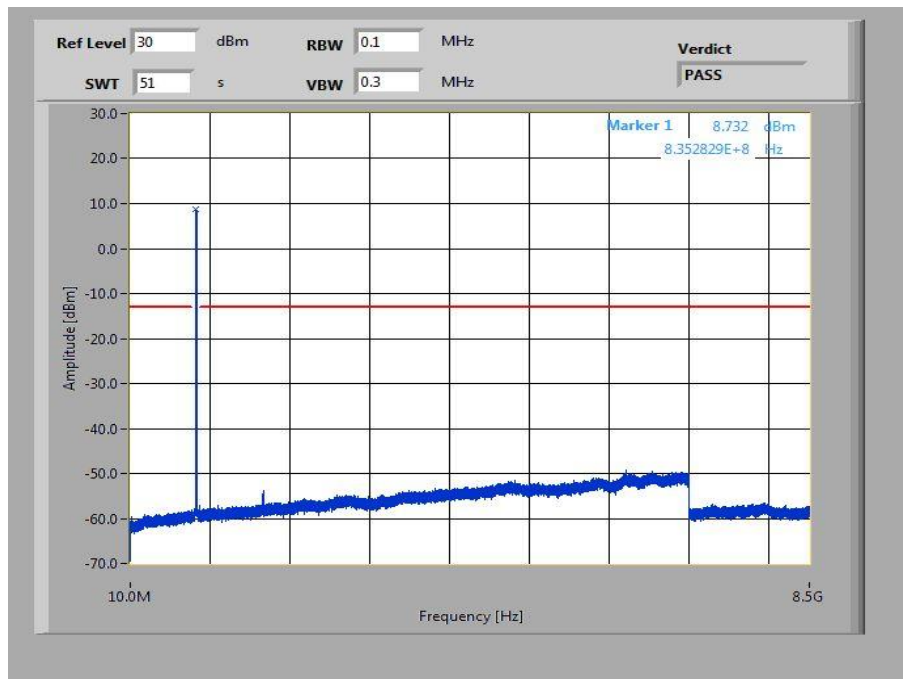
Spurious Emission Level (dBm)								
Harmonic	Ch. 4132 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4180 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4233 Freq. (MHz)	Level [dBm]
2	1652.8	-	2	1672.0	-	2	1693.2	-
3	2479.2	-	3	2508.0	-	3	2539.8	-
4	3305.6	-	4	3344.0	-	4	3386.4	-
5	4132.0	-	5	4180.0	-	5	4233.0	-
6	4958.4	-	6	5016.0	-	6	5079.6	-
7	5784.8	-	7	5852.0	-	7	5926.2	-
8	6611.2	-	8	6688.0	-	8	6772.8	-
9	7437.6	-	9	7524.0	-	9	7619.4	-
10	8264.0	-	10	8360.0	-	10	8466.0	-

Plots:

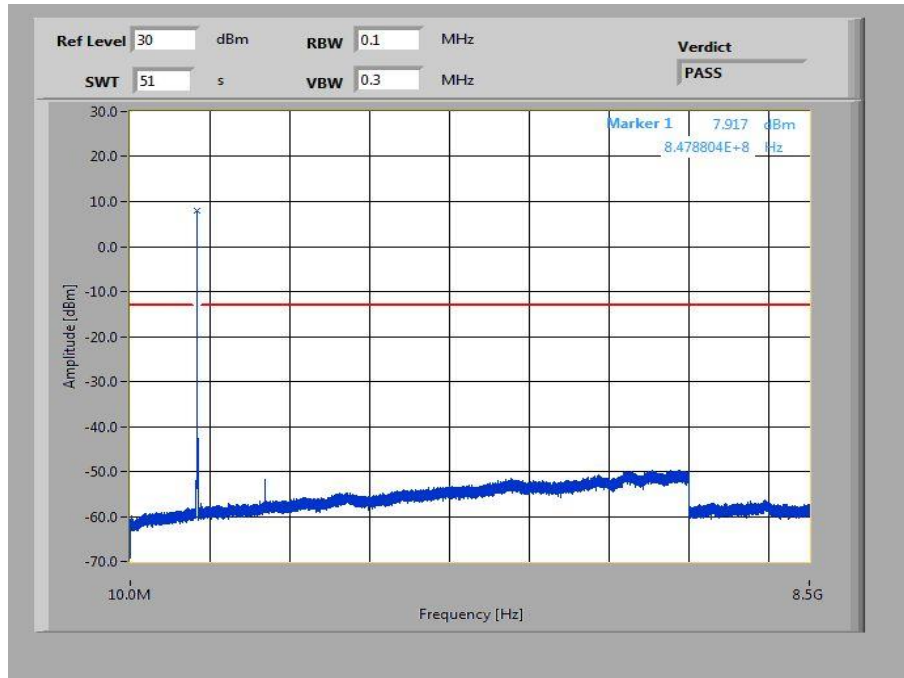
Plot 1: Channel 4132 (10 MHz – 8.5 GHz)



Plot 2: Channel 4180 (10 MHz – 8.5 GHz)



Plot 3: Channel 4233 (10 MHz – 8.5 GHz)



11.5 Block edge compliance

Description:

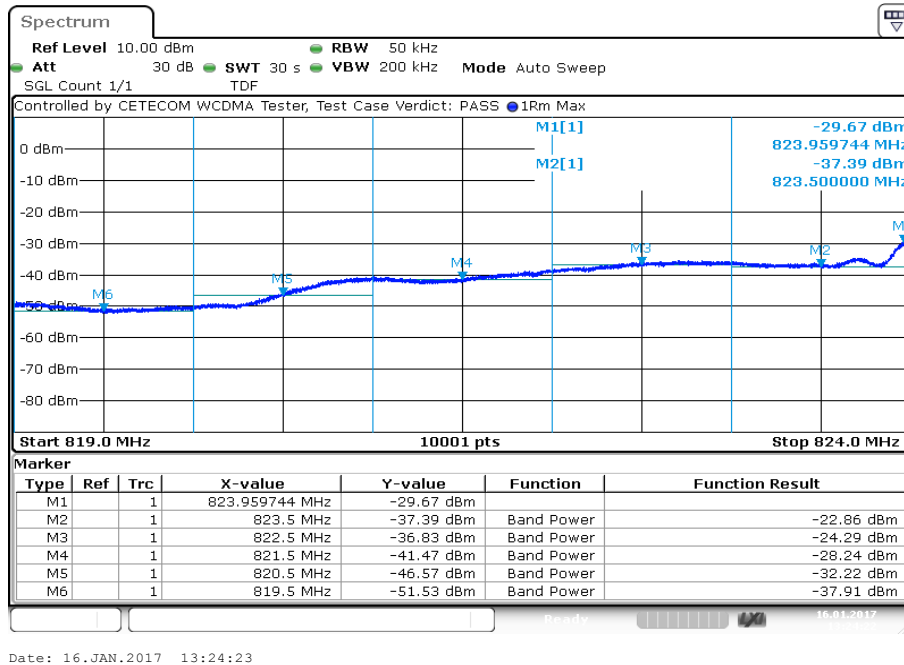
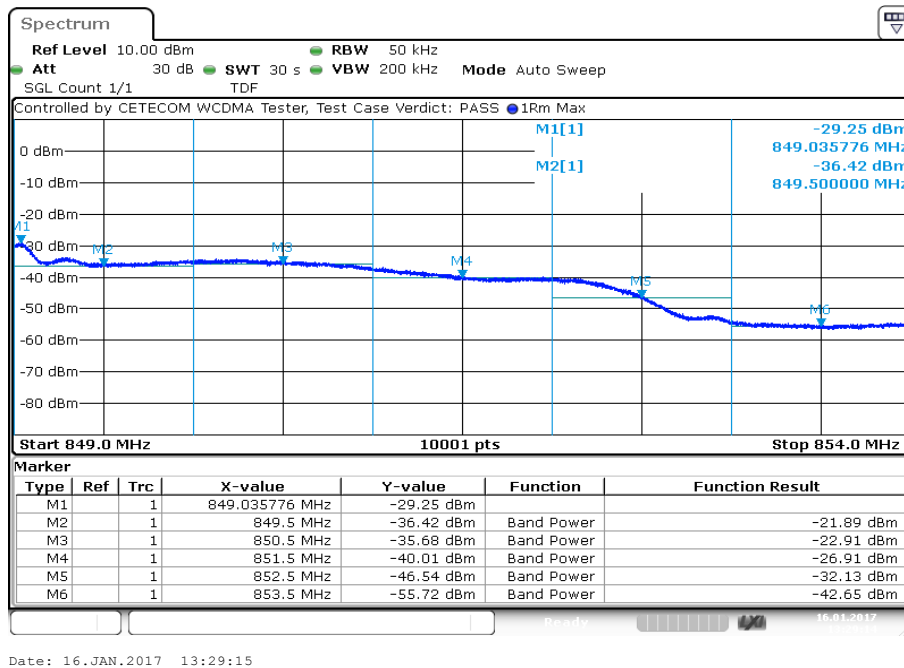
The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 7

Limits:

FCC	IC
CFR Part 22.917 CFR Part 2.1051	RSS 132
Block Edge Compliance	
-13 dBm	

Plots:**Plot 1: Channel 4132****Plot 2: Channel 4233**

11.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the UMTS band V. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 22.917 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 4700 kHz, this equates to a resolution bandwidth of at least 50 kHz. For this testing, a resolution bandwidth 100 kHz was used.

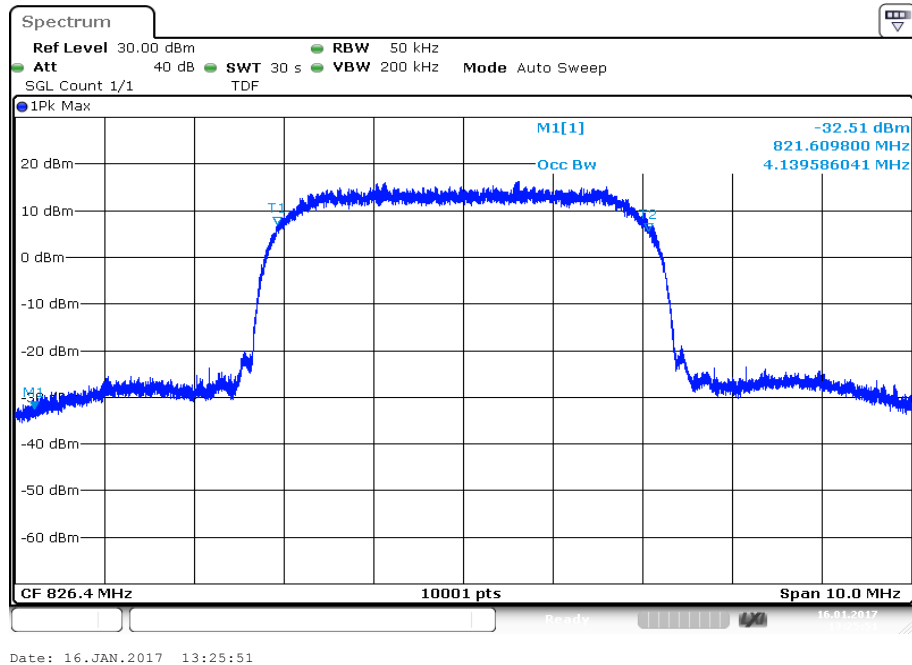
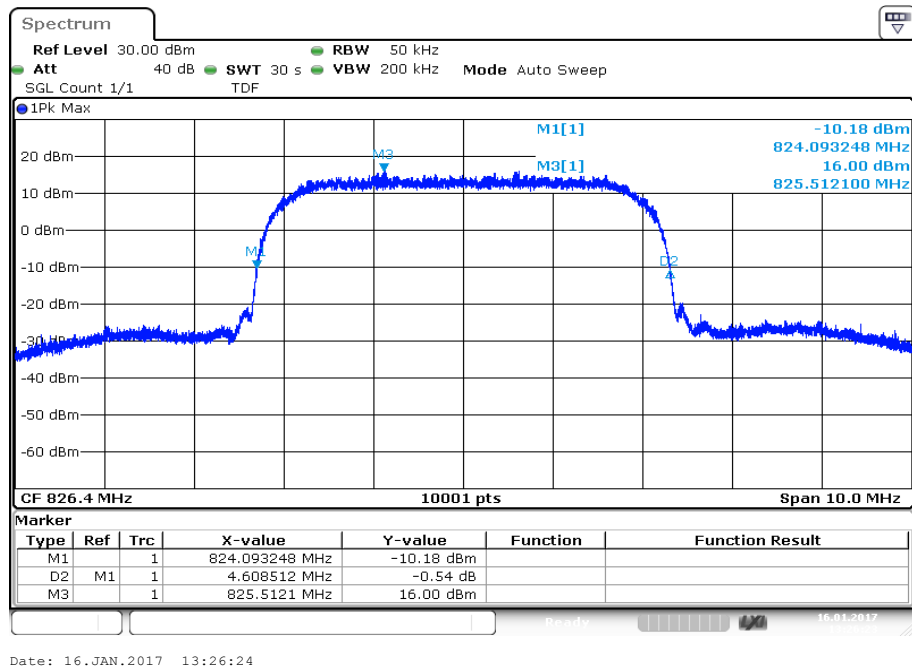
Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.4 - A
Measurement uncertainty:	See chapter 7

Limits:

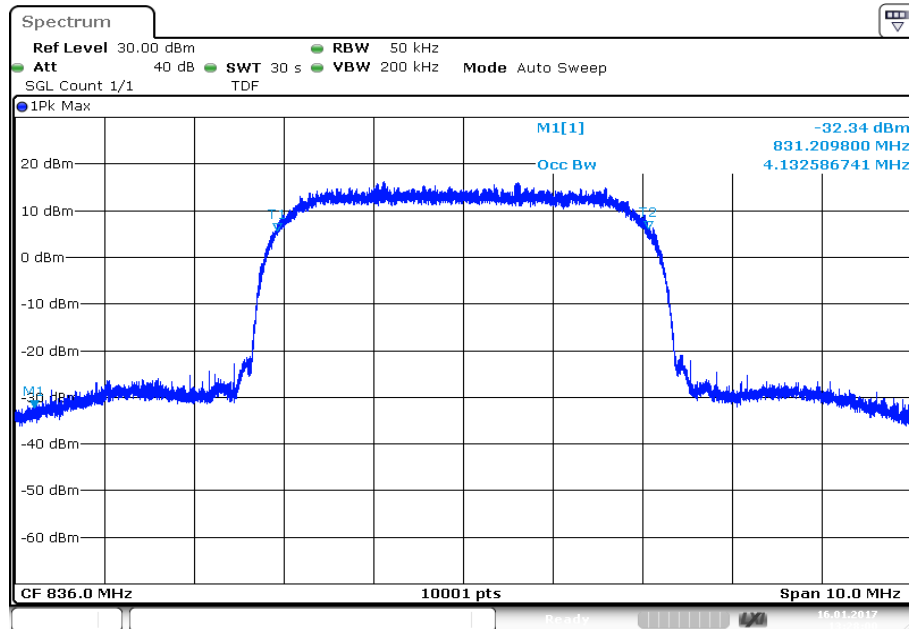
FCC	IC
CFR Part 22.917 CFR Part 2.1049	RSS 132
Occupied Bandwidth	
Spectrum must fall completely in the specified band	

Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
826.4	4140	4609
836.0	4133	4608
846.6	4140	4610

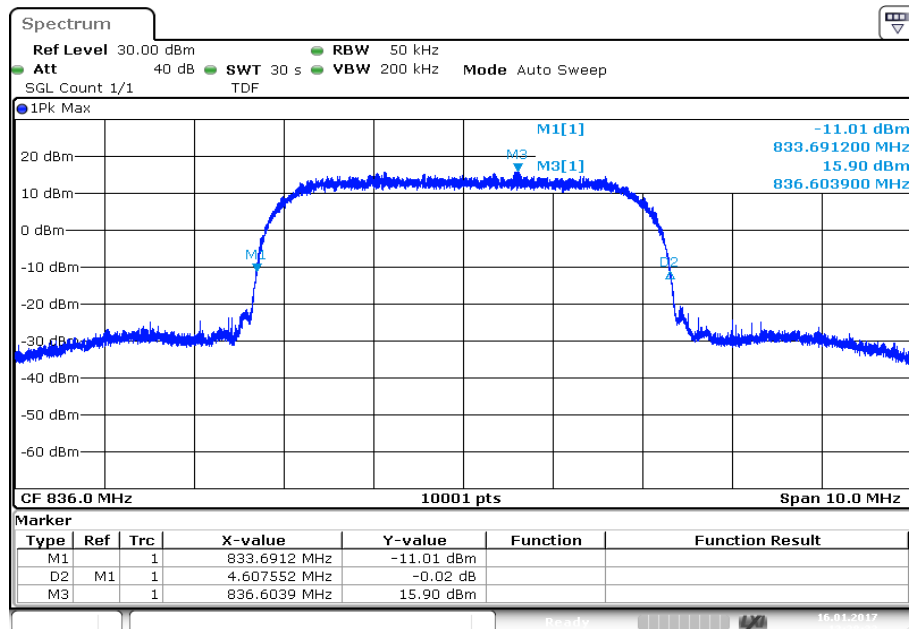
Plots:**Plot 1: Channel 4132 (99% - OBW)****Plot 2: Channel 4132 (-26 dBc BW)**

Plot 3: Channel 4180 (99% - OBW)



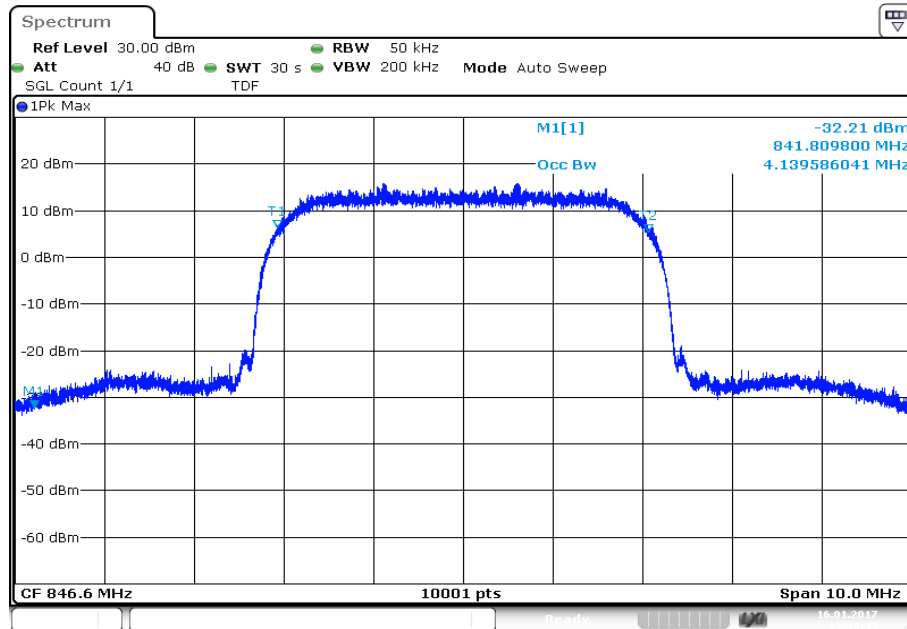
Date: 16.JAN.2017 13:28:01

Plot 4: Channel 4180 (-26 dBc BW)



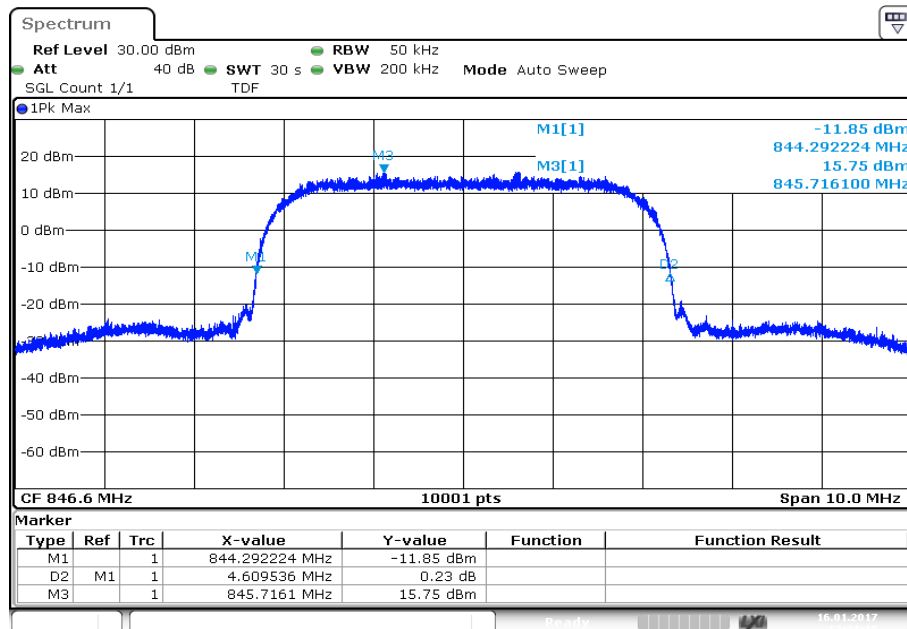
Date: 16.JAN.2017 13:28:33

Plot 5: Channel 4233 (99% - OBW)



Date: 16.JAN.2017 13:30:43

Plot 6: Channel 4233 (-26 dBc BW)



Date: 16.JAN.2017 13:31:16

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-12-16
A	Re-measurement of the conducted tests	2017-01-17
B	Editorial corrections	2017-03-28

Annex B Further information

Glossary

AVG	-	Average
DUT	-	Device under test
EMC	-	Electromagnetic Compatibility
EN	-	European Standard
EUT	-	Equipment under test
ETSI	-	European Telecommunications Standard Institute
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	Not applicable
PP	-	Positive peak
QP	-	Quasi peak
S/N	-	Serial number
SW	-	Software
PMN	-	Product marketing name
HMN	-	Host marketing name
HVIN	-	Hardware version identification number
FVIN	-	Firmware version identification number
OBW		Occupied Bandwidth
OC		Operating Channel
OCW		Operating Channel Bandwidth
OOB		Out Of Band

Annex C Accreditation Certificate

first page

last page



Deutsche Akkreditierungsstelle GmbH

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

Akkreditierung



Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CTC advanced GmbH
 Untertürkheimer Straße 6-10, 66117 Saarbrücken

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

Funk
 Mobilfunk (GSM / DCS) + OTA
 Elektromagnetische Verträglichkeit (EMV)
 Produktsicherheit
 SAR / EMF
 Umwelt
 Smart Card Technology
 Bluetooth®
 Automotive
 Wi-Fi-Services
 Kanadische Anforderungen
 US-Anforderungen
 Akustik
 Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 25.11.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

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

Frankfurt, 25.11.2016

Bitte Hinweisen auf der Rückseite

Im Auftrag Dipl.-Ing. Ralf Eigner
 Abteilungsleiter

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
 Spittelmarkt 10
 10117 Berlin

Standort Frankfurt am Main
 Europa-Allee 52
 60327 Frankfurt am Main

Standort Braunschweig
 Bundesallee 100
 38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAKKS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAKKS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abi. L 218 vom 9. Juli 2008, S. 30). Die DAKKS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
 EA: www.european-accreditation.org
 ILAC: www.ilac.org
 IAF: www.iaf.nu

Note:

The current certificate including annex can be received on request.