

**CETECOM**™

**CETECOM ICT Services**  
consulting - testing - certification >>>

## TEST REPORT

Test report no.: 1-1364/16-01-07-A



**DAkkS**  
Deutsche  
Akreditierungsstelle  
D-PL-12076-01-01

### Testing laboratory

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#### Accredited Testing Laboratory:

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

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

### Applicant

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### Manufacturer

#### Continental Automotive GmbH

Heinrich-Hertz-Str. 45  
78052 Villingen-Schwenningen / GERMANY

### 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: **Vehicle Data Recorder**

Model name: **VDO RoadLog**

FCC ID: **2AHPQ3290X**

IC: **21323-3290X**

Frequency: GSM/PCS: 824.2 – 848.8 MHz, 1850.2 – 1909.8 MHz  
UMTS: 826.4 – 846.6 MHz, 1852.4 – 1907.6 MHz

Technology tested: **GSM, PCS, UMTS**

Antenna: **Integrated and external antenna**

Power supply: **9.0 V to 16.0 V DC by battery**

Temperature range: **-20°C to +70°C**



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

### Test report authorized:

p.o.

Stefan Bös  
Lab Manager  
Radio Communications & EMC

### Test performed:

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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

**This test report replaces the test report with the number 1-1364/16-01-07 and dated 2016-05-26**

### 2.2 Application details

Date of receipt of order:	2016-04-13
Date of receipt of test item:	2016-05-02
Start of test:	2016-05-04
End of test:	2016-06-15
Person(s) present during the test:	-/-

## 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

## 4 Test environment

Temperature :	$T_{\text{nom}}$	+20 °C during room temperature tests
	$T_{\text{max}}$	+70 °C during high temperature tests
	$T_{\text{min}}$	-20 °C during low temperature tests
Relative humidity content :		55 %
Barometric pressure :		not relevant for this kind of testing
Power supply :	$V_{\text{nom}}$	12.0 V DC by battery
	$V_{\text{max}}$	16.0 V
	$V_{\text{min}}$	9.0 V

## 5 Test item

## 5.1 General description

Kind of test item	:	Vehicle Data Recorder
Type identification	:	VDO RoadLog
HMN	:	-/-
PMN	:	RoadLog
HVIN	:	3290-X
FVIN	:	-/-
S/N serial number	:	670160100067
HW hardware status	:	3290-X
SW software status	:	1.XX
Frequency band	:	GSM/PCS: 824.2 – 848.8 MHz, 1850.2 – 1909.8 MHz UMTS: 826.4 – 846.6 MHz, 1852.4 – 1907.6 MHz
Type of modulation	:	GMSK, 8-PSK, QPSK
Antenna	:	Integrated and external antenna
Power supply	:	9.0 V to 16.0 V DC by battery
Temperature range	:	-20°C to +70°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: 1-1364/16-01-01\_AnnexA  
1-1364/16-01-01\_AnnexB  
1-1364/16-01-01 AnnexD

## **6 Test laboratories sub-contracted**

None

## 7 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).

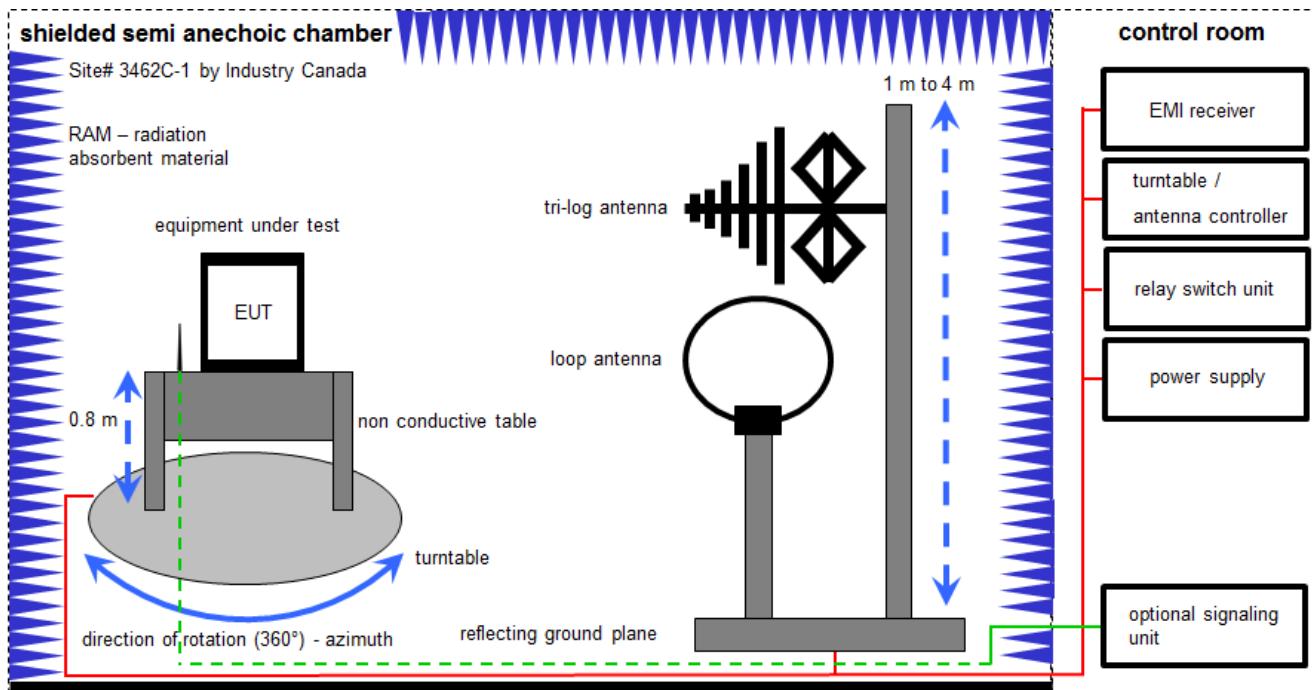
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

### 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
vlkl!	Attention: extended calibration interval	*	next calibration ordered / currently in progress
NK!	Attention: not calibrated		

## 7.1 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, loop 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:

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

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

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

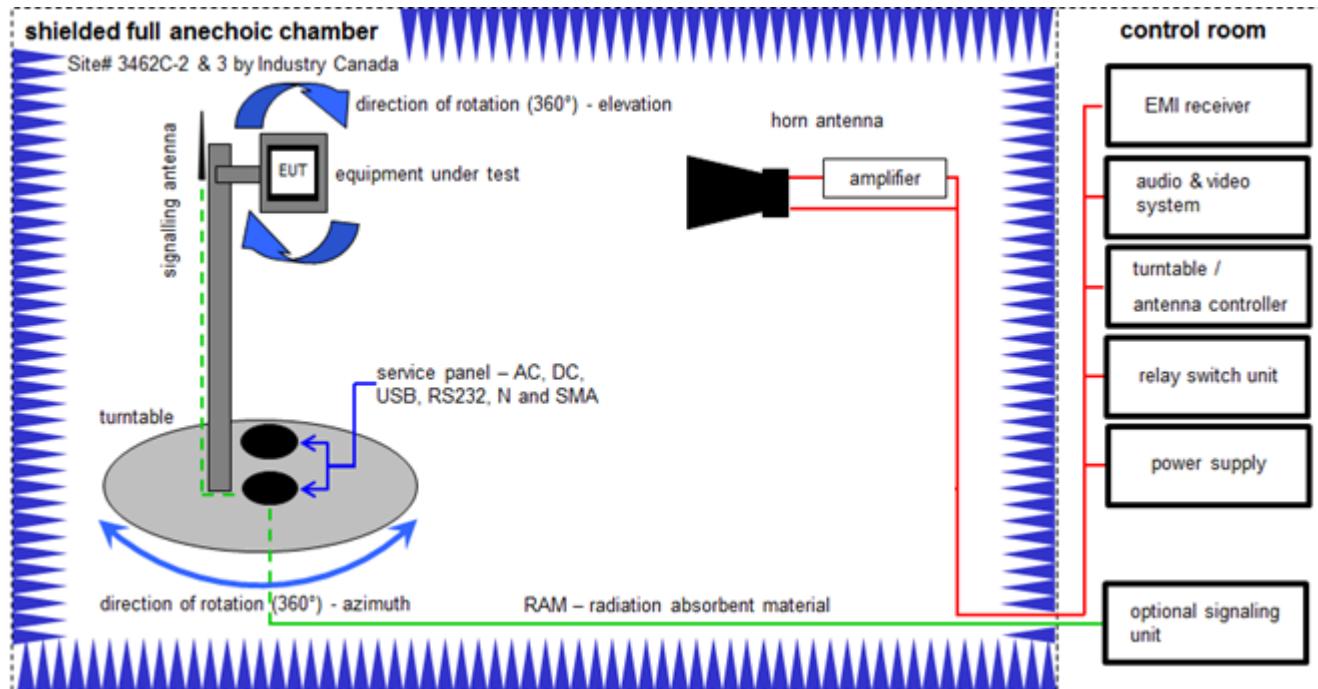
Example calculation:

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

**Equipment table:**

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Software Option für CMU 200	CMU-K62	R&S	103288	300003600	ne	-/-	-/-
2	A	Software Option für CMU 200	CMU-K61	R&S	103354	300003612	ne	-/-	-/-
3	A	Software Option für CMU 200	CMU-K64	R&S	102017	300003613	ne	-/-	-/-
4	A	Software Option für CMU 200	CMU-K56	R&S	100251	300003614	ne	-/-	-/-
5	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
6	A+B	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	08.03.2016	08.03.2017
7	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
8	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
9	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
10	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	25.04.2016	25.04.2018
11	B	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017

## 7.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter / 1 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)

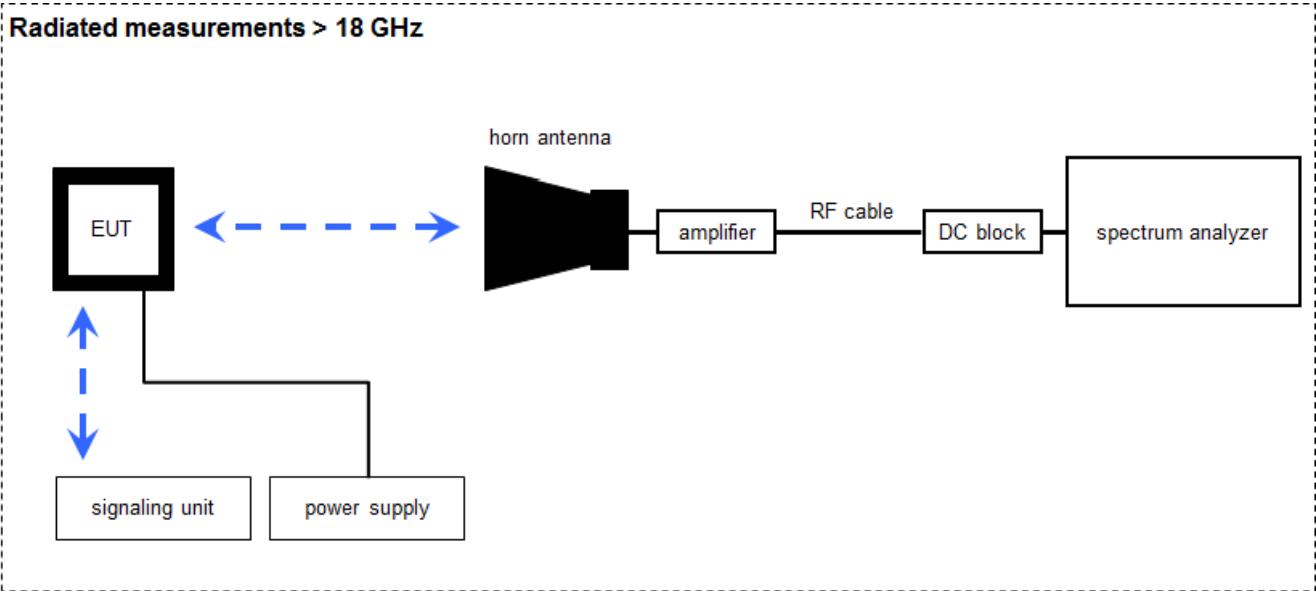
### Example calculation:

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

### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Software	CMU-K64	R&S	102017	300003613	ne	-/-	-/-
2	A	Software	CMU-K56	R&S	100251	300003614	ne	-/-	-/-
3	A	Tunable Band Reject Filter	WRCT1850/2170-5/40-10EEK	Wainwright	40	300003872	ev	-/-	-/-
4	A	Tunable Band Reject Filter	WRCT824/894-5/40-8EEK	Wainwright	27	300003873	ev	-/-	-/-
5	A	Double-Ridged Waveguide Horn Antenna 1-18GHz	3115	EMCO	9005-3440	300002190	ne	-/-	-/-
6	A	Power Supply 0-20V	6632A	HP	2851A01814	300000924	ne	09.11.2005	-/-
7	A	CMU	CMU200	R&S	106826	300003346	k	10.02.2016	10.02.2017
8	A	Ultra Stable Notch Filter	WRCD1887.82/1889.55-5EE	Wainwright	1	300000115	ne	-/-	-/-
9	A	EMI Test Receiver 20Hz- 26.5GHz	ESU26	R&S	100037	300003555	k	02.02.2016	02.02.2017
10	A	HF-Schaltmatrixgrundgerät	TS-RSP 1144.1500K03	R&S	100300	300003556	ev	-/-	-/-
11	A	Software	CMU-K62	R&S	103288	300003600	ne	-/-	-/-
12	A	Software	CMU-K61	R&S	103354	300003612	ne	-/-	-/-
13	A	Software	CMU-K64	R&S	102017	300003613	ne	-/-	-/-
14	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
15	A	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	14.08.2015	14.08.2017
16	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017

### 7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 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:

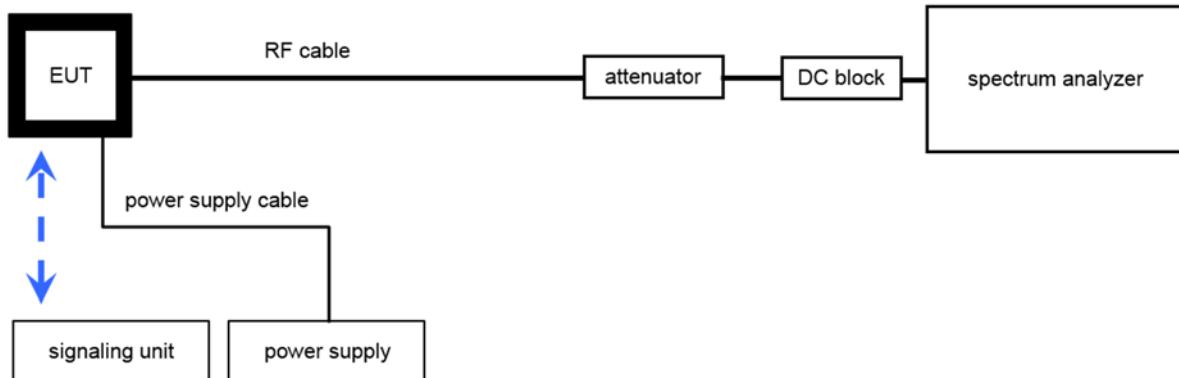
$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50.0 \text{ [dB]} - 20.0 \text{ [dBi]} + 5.0 \text{ [dB]} = -30 \text{ [dBm]} (1 \mu\text{W})$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8402	300000486	k	10.09.2015	10.09.2017
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017

## 7.4 Conducted measurements

### Conducted measurements normal conditions



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

#### Example calculation:

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

#### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Hygro-Thermometer	-/-, 5-45C, 20-100rF		-/-	400000108	ev	07.09.2015	07.09.2017
2	A	Power Supply 0-20V, 0-5A	6632B	Agilent Technologies	GB42110541	400000562	viKI!	26.01.2016	26.01.2019
3	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	Agilent Technologies	2V2403033A45 23	300004589	ne	-/-	-/-
4	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A45 23	300004590	ne	-/-	-/-
5	A, B	RF-Cable	ST18/SMAm/SMAm/72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
6	A, B	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 699714	400001185	ev	-/-	-/-
7	A	Wideband Radio Communication Tester	CMW500	R&S	102375	300004187	k	14.12.2015	14.12.2017
8	B	CMU	CMU200	R&S	106826	300003346	k	10.02.2016	10.02.2017

## 8 Sequence of testing

### 8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

## 8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8.4 Sequence of testing radiated spurious above 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

### Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

### Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 9 Measurement uncertainty

Measurement uncertainty	
Test case	Uncertainty
RF output power conducted	± 1 dB
RF output power radiated	± 3 dB
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	± RBW

## 10 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	2016-06-23	-/-

### 10.1 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"/>	-/-

### 10.2 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"/>	-/-

### 10.3 UMTS band II

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"/>	-/-

### 10.4 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

## 11 RF measurements

### 11.1 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.

#### 11.1.1 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.

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	1 MHz
Resolution bandwidth:	1 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Measurement uncertainty:	see section 9
Test setup:	see section 7.1 – A, 7.4 – A

**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) GMSK mode			
Frequency (MHz)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
824.2	32.3*	32.5*	0.15
836.4	31.7*	32.5*	0.78
848.8	31.4*	32.4*	1.00

\*measured at the external antenna connector

Output Power (conducted) 8-PSK mode			
Frequency (MHz)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
824.2	25.6*	29.8*	4.12
836.4	26.4*	29.8*	3.30
848.8	26.4*	29.7*	3.24

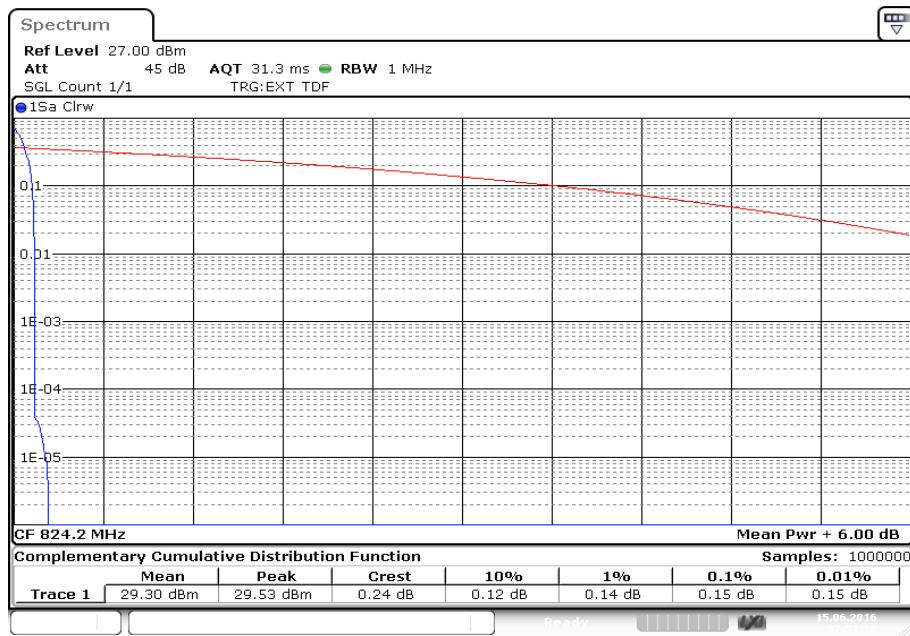
\*measured at the external antenna connector

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2	27.1*
836.4	29.0*
848.8	31.2*

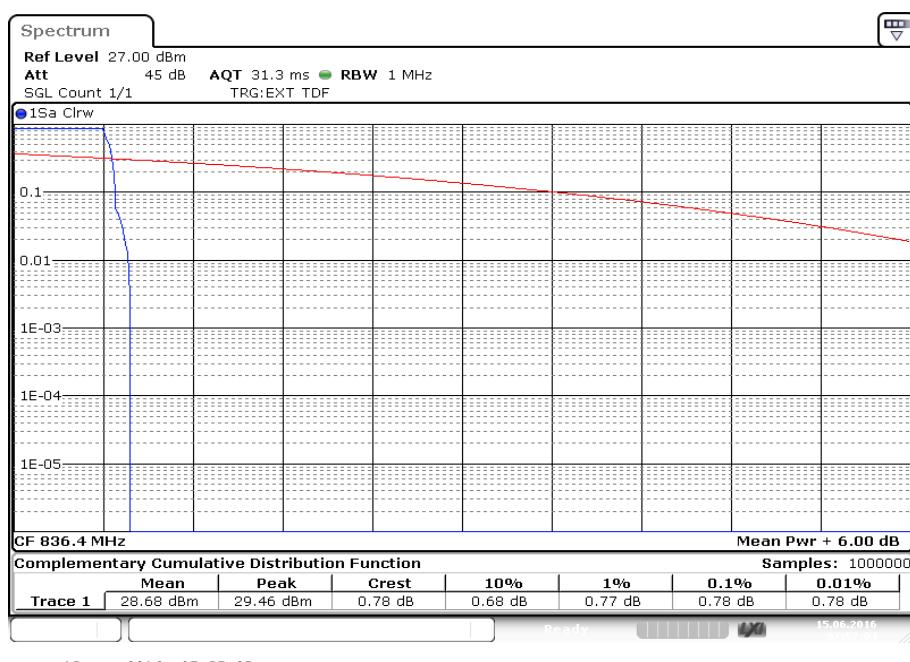
\*measured with integrated antenna

Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2	20.4*
836.4	23.7*
848.8	26.2*

\*measured with integrated antenna

**Plots:****Plot 1: GSM850, GMSK, low channel**

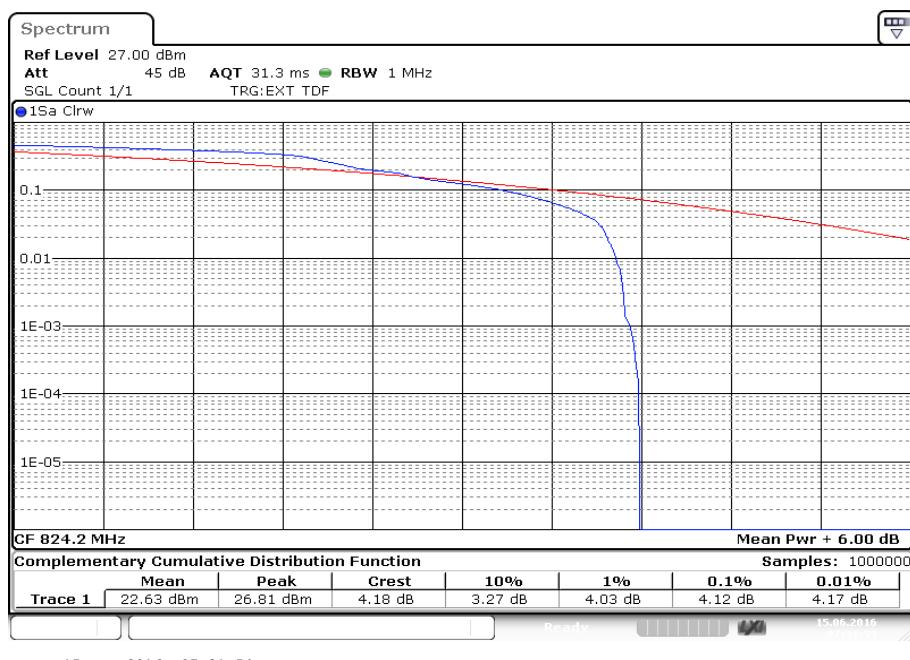
+additional cable attenuation: 3dB

**Plot 2: GSM850, GMSK, mid channel**

+additional cable attenuation: 3dB

**Plot 3:** GSM850, GMSK, high channel

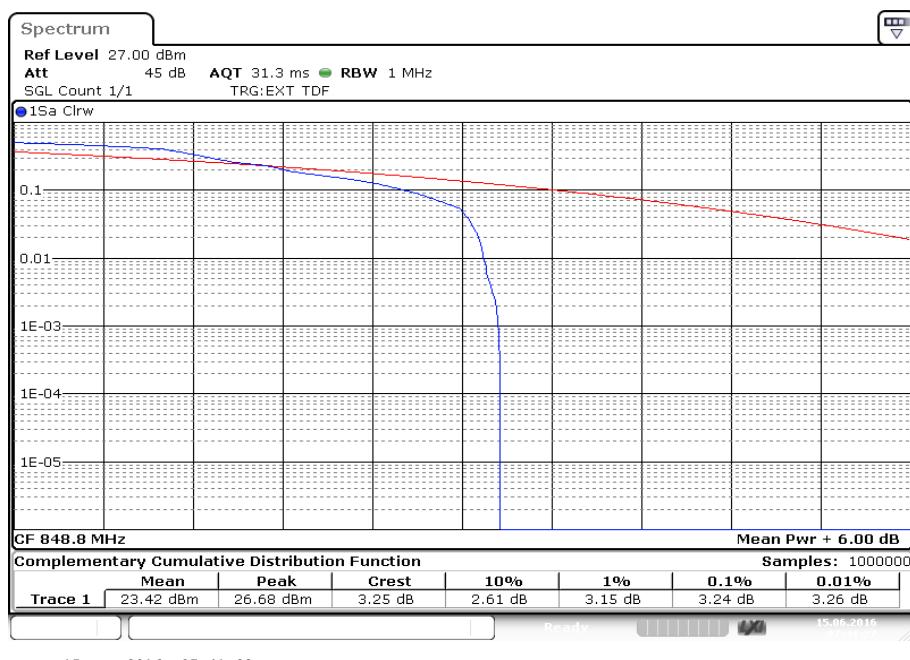
+additional cable attenuation: 3dB

**Plot 4:** EDGE850, 8-PSK, low channel

+additional cable attenuation: 3dB

**Plot 5:** EDGE850, 8-PSK, mid channel

+additional cable attenuation: 3dB

**Plot 6:** EDGE850, 8-PSK, high channel

+additional cable attenuation: 3dB

## 11.1.2 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  $V_{\text{nom}}$  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  $V_{\text{nom}}$ . Vary supply voltage to  $V_{\text{min}}$  and measure the carrier frequency then setup  $V_{\text{max}}$  and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

### Measurement:

Measurement parameters	
Detector:	
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	Measured with CMU200
Span:	
Trace mode:	
Test setup:	See chapter 7.4 – B
Measurement uncertainty:	See chapter 9

### Limits:

FCC	IC
± 2.5 ppm	

**Results:****AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
9	21	0.00000251	0.0251
12	-7	-0.00000084	-0.0084
16	-12	-0.00000143	-0.0143

**AFC FREQ ERROR versus TEMPERATURE**

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	24	0.00000287	0.0287
-20	15	0.00000179	0.0179
-10	-10	-0.00000120	-0.0120
± 0	-14	-0.00000167	-0.0167
10	-30	-0.00000359	-0.0359
20	-6	-0.00000072	-0.0072
30	4	0.00000048	0.0048
40	-16	-0.00000191	-0.0191
50	10	0.00000120	0.0120

### 11.1.3 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. 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 GSM-850 band.

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

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- b) The antenna output was terminated in a 50 ohm load (if possible).
- c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) 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.
- e) 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:	300 kHz
Resolution bandwidth:	100 kHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold
Measurement uncertainty:	see section 9
Test setup:	see section 7.1 – A, 7.2 – A, 7.4 – A

#### 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 GSM-850 band (824.2 MHz, 836.4 MHz and 848.8 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 GSM-850 band 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.

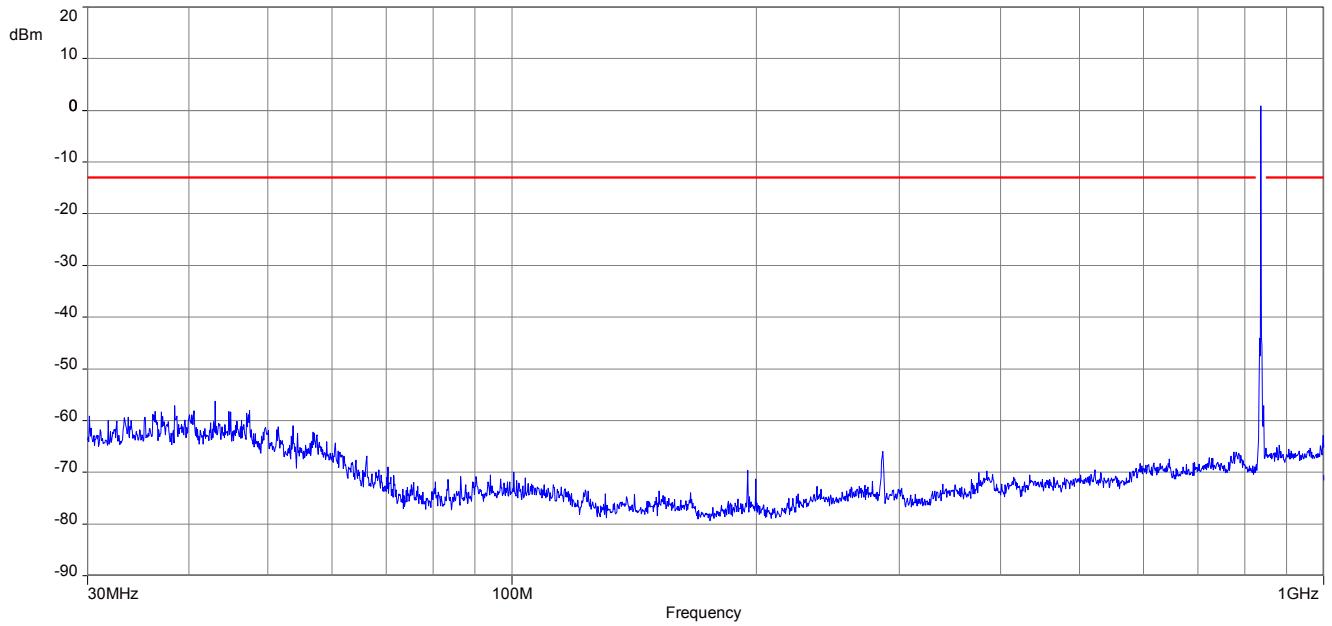
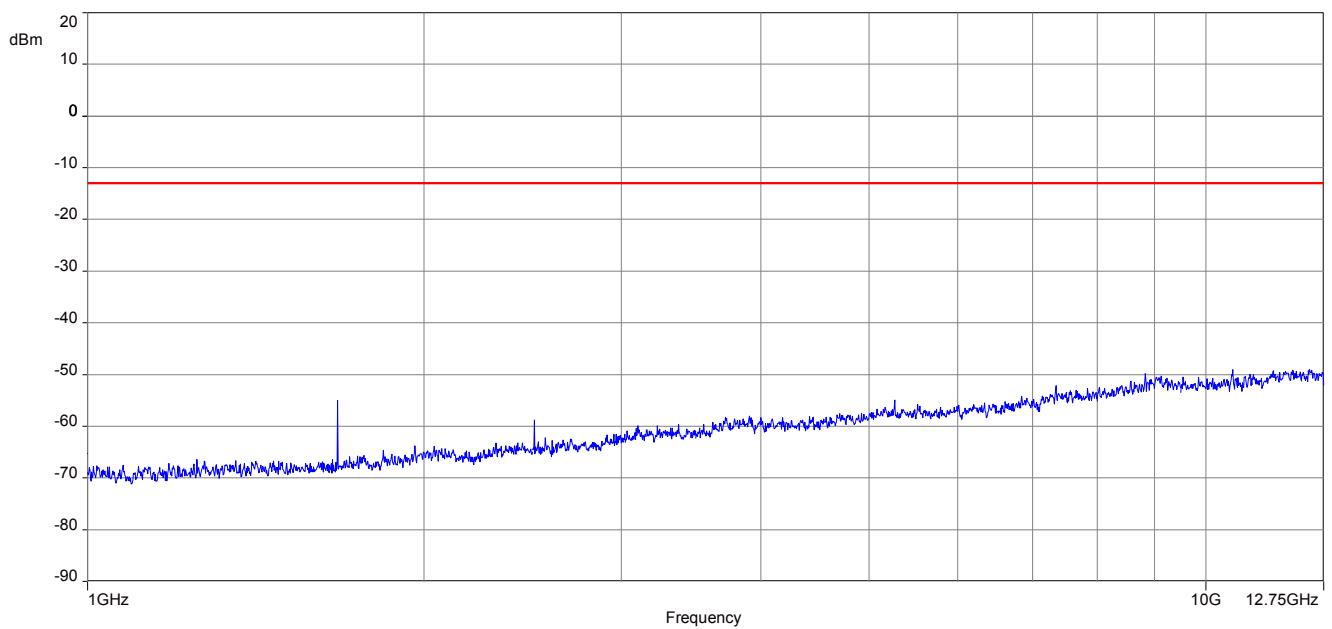
The final open field radiated levels are presented on the next pages.

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

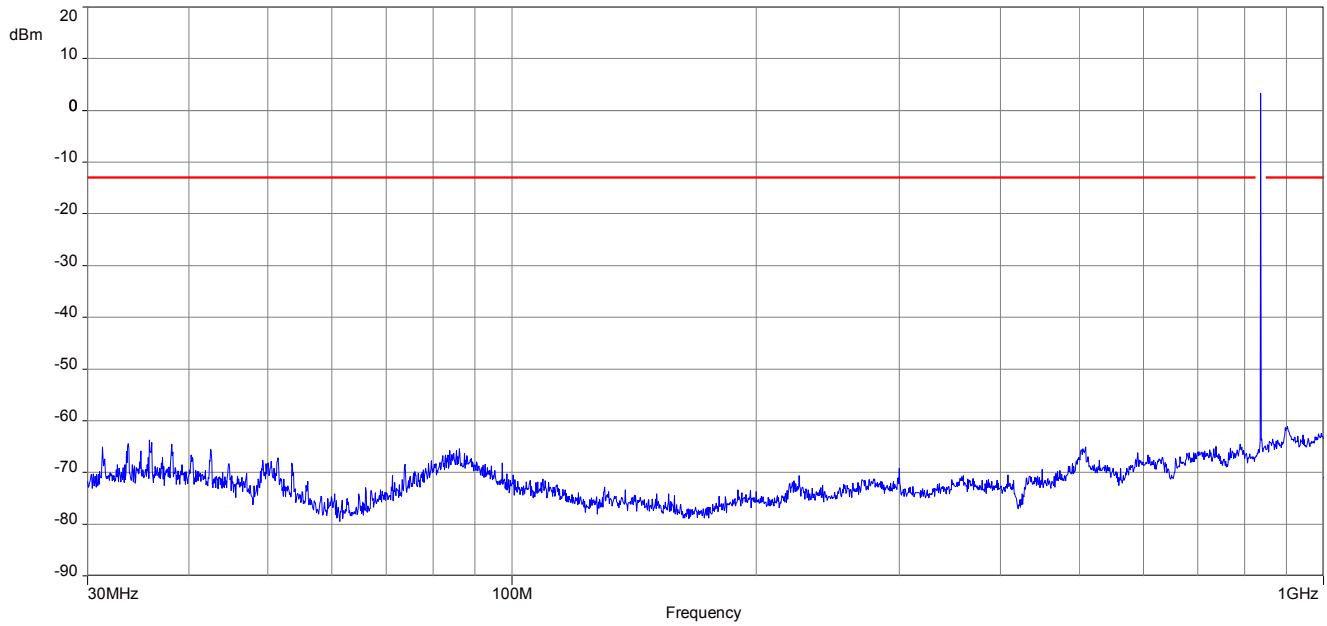
The plots show only the middle channel. If spurious were detected, the lowest and highest channel were checked too. The found values are stated in the table below.

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

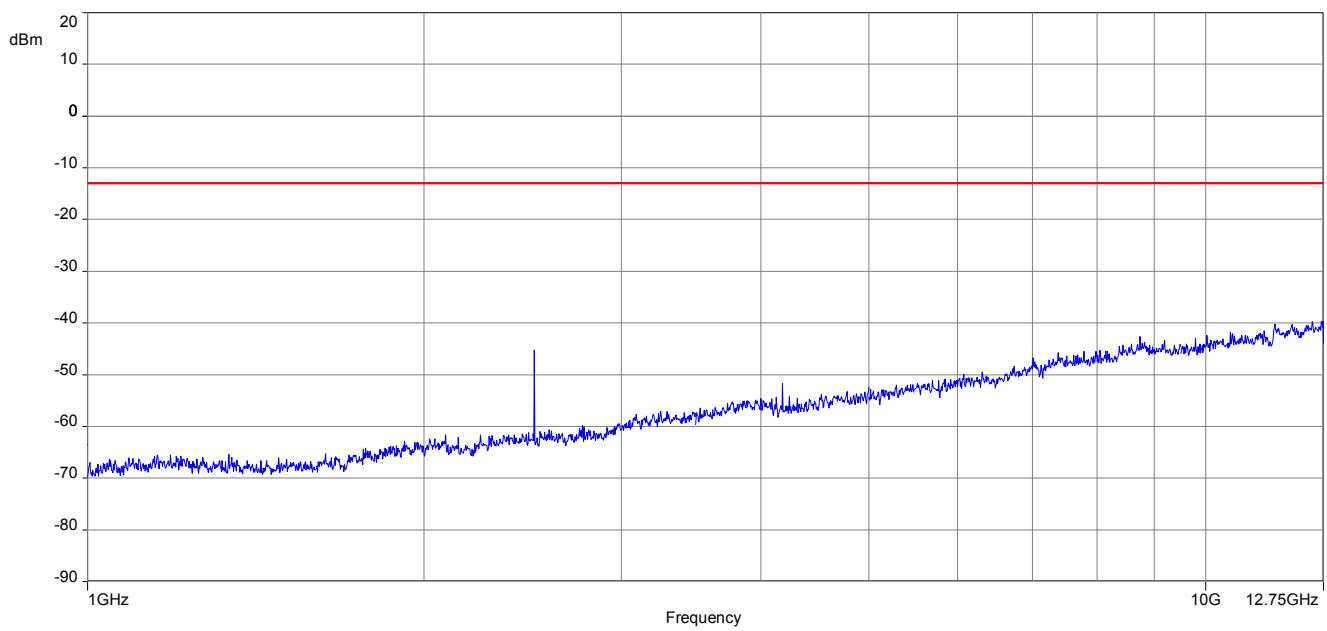
Spurious Emission Level (dBm)								
Harmonic	Ch. 128 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 189 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 251 Freq. (MHz)	Level [dBm]
2	1648.4	-	2	1672.8	-	2	1697.6	-
3	2472.6	-	3	2509.2	-	3	2546.4	-
4	3296.8	-	4	3345.6	-	4	3395.2	-
5	4121.0	-	5	4182.0	-	5	4244.0	-
6	4945.2	-	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:****Plot 1:** Channel 189 (30 MHz – 1 GHz) internal antenna**Plot 2:** Channel 189 (1 GHz – 12.75 GHz) internal antenna

**Plot 3:** Channel 189 (30 MHz – 1 GHz) external antenna



**Plot 4:** Channel 189 (1 GHz – 12.75 GHz) external antenna



### 11.1.4 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:**

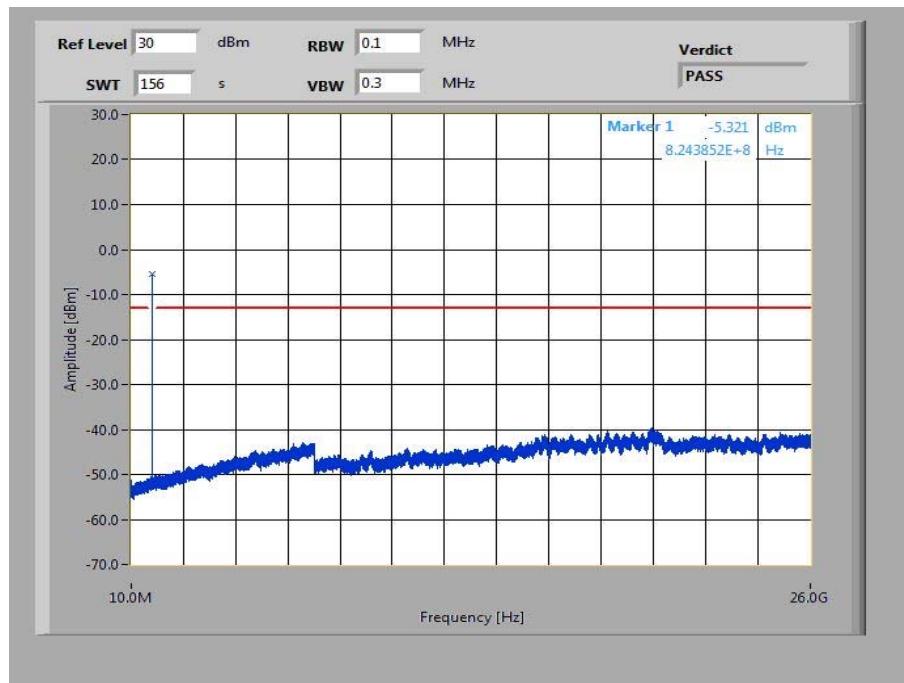
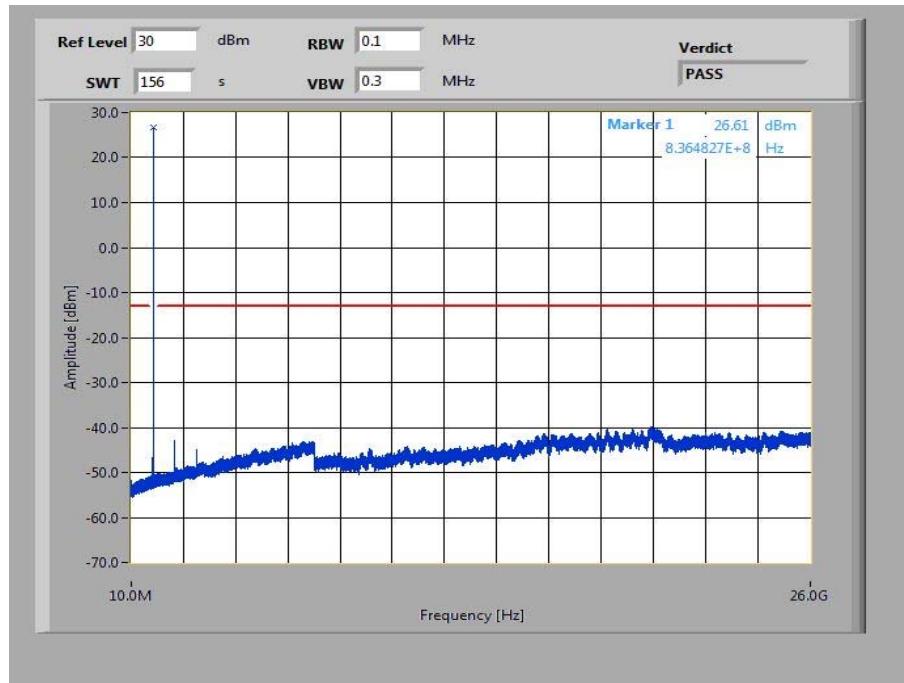
<b>Measurement parameters</b>	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 26 GHz
Trace mode:	Max Hold
Used equipment:	see section 7.4 – A
Measurement uncertainty:	See chapter 9

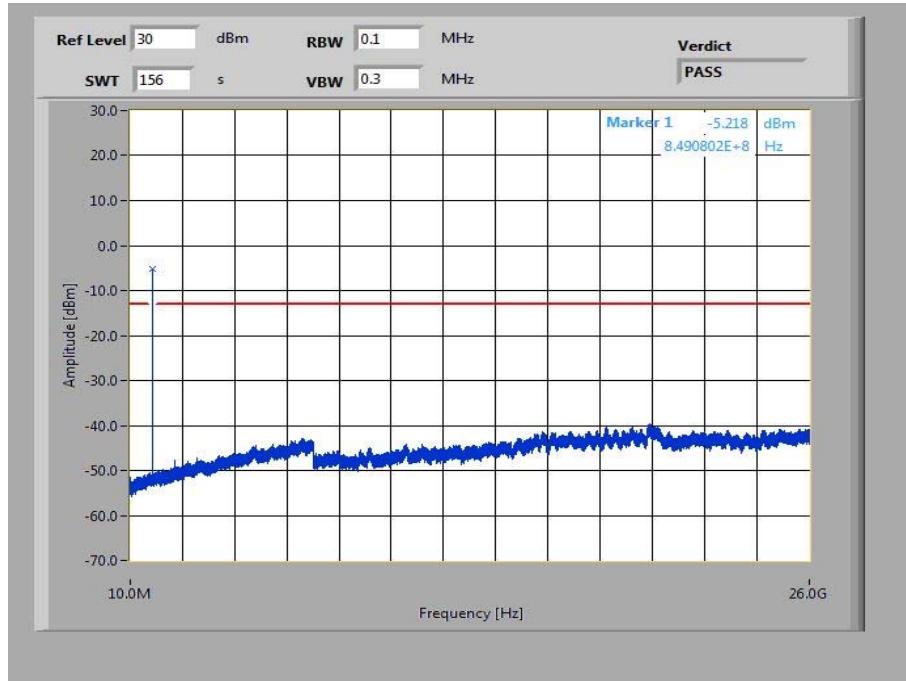
**Limits:**

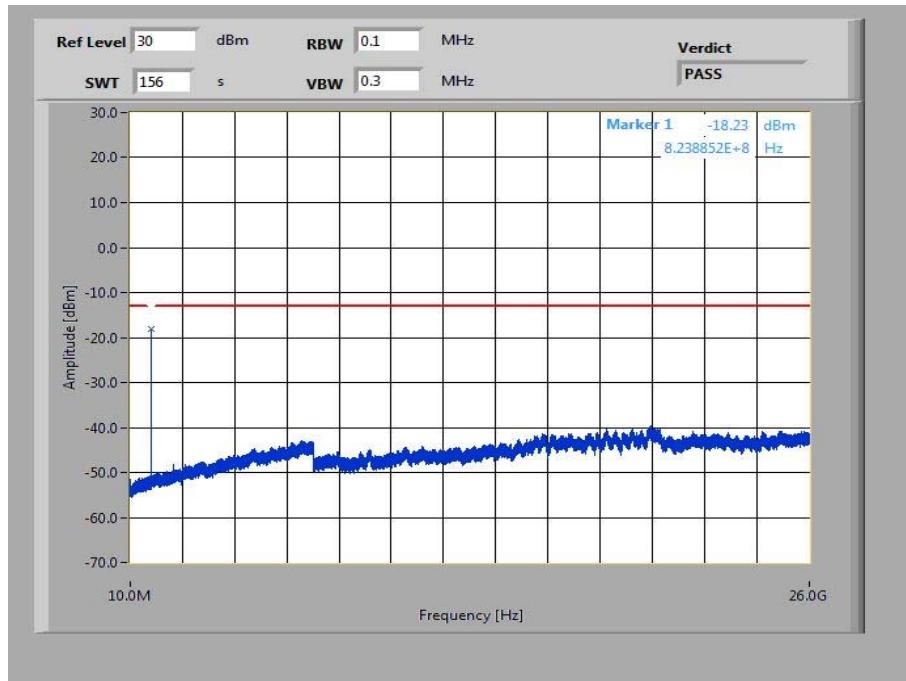
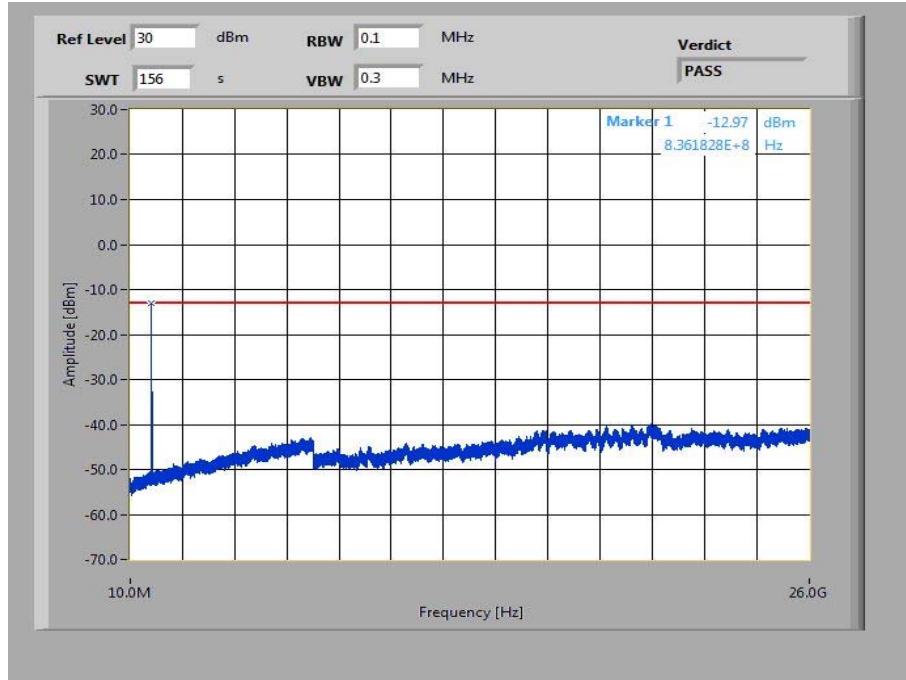
FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

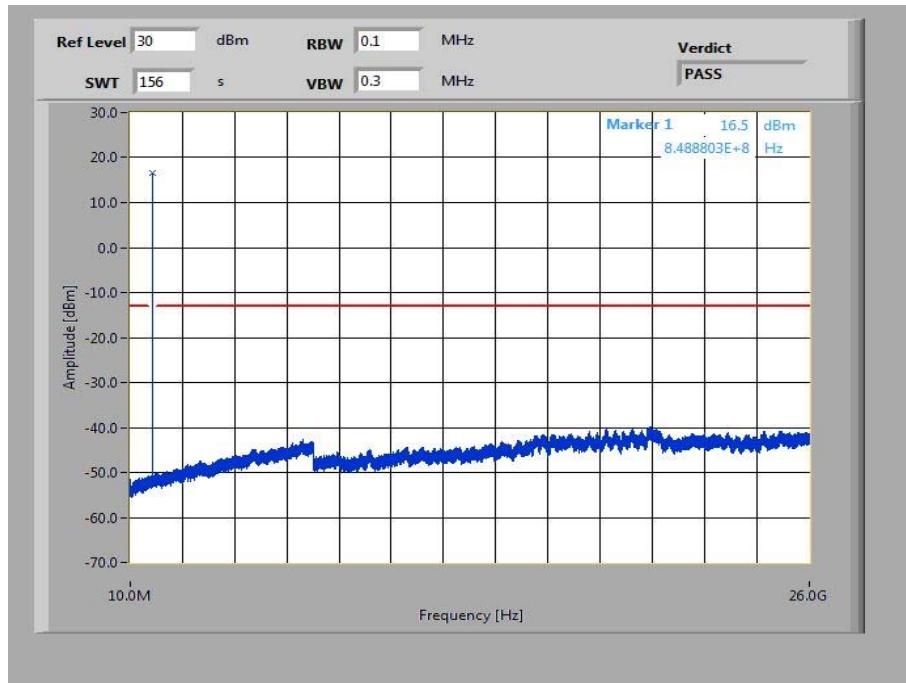
**Results:**

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 - 26 GHz)**Plot 2:** Channel 189 (10 MHz - 26 GHz)

**Plot 3:** Channel 251 (10 MHz - 26 GHz)

**Plots:** 8 PSK**Plot 1:** Channel 128 (10 MHz - 26 GHz)**Plot 2:** Channel 189 (10 MHz - 26 GHz)

**Plot 3:** Channel 251 (10 MHz - 26 GHz)

### 11.1.5 Block edge compliance

#### Description:

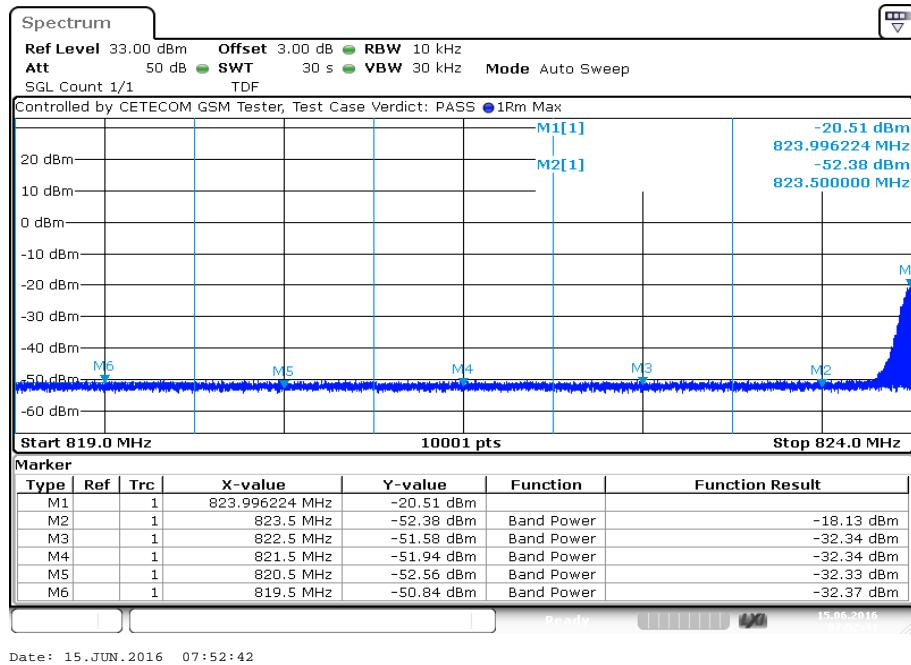
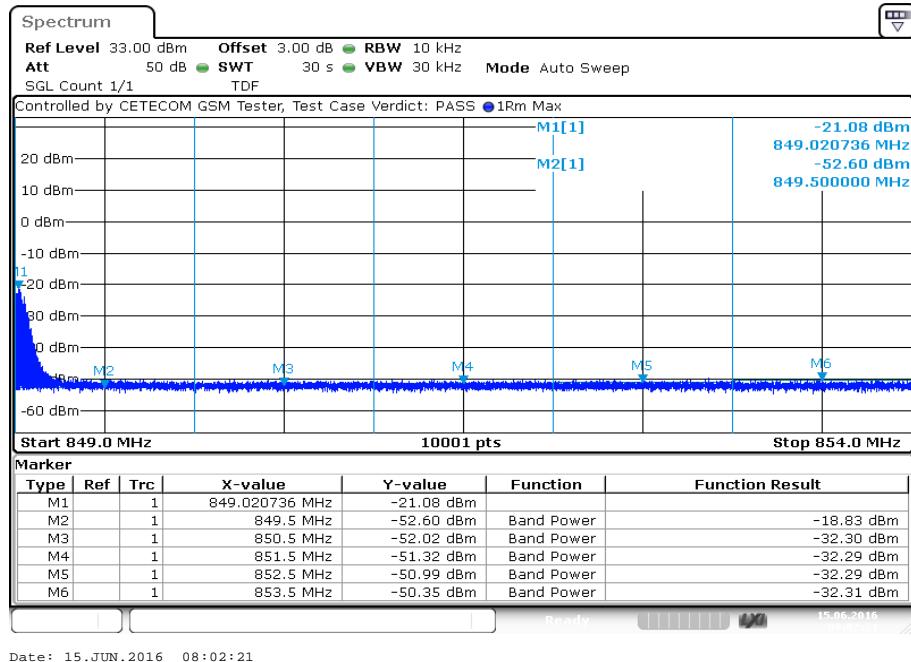
The spectrum at the band edges must comply with the spurious emissions limits.

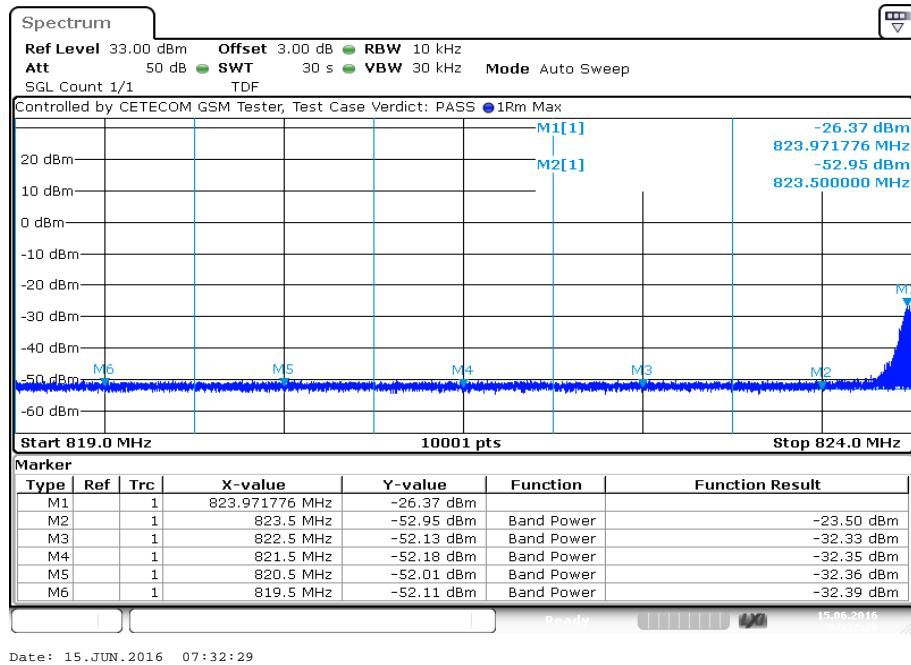
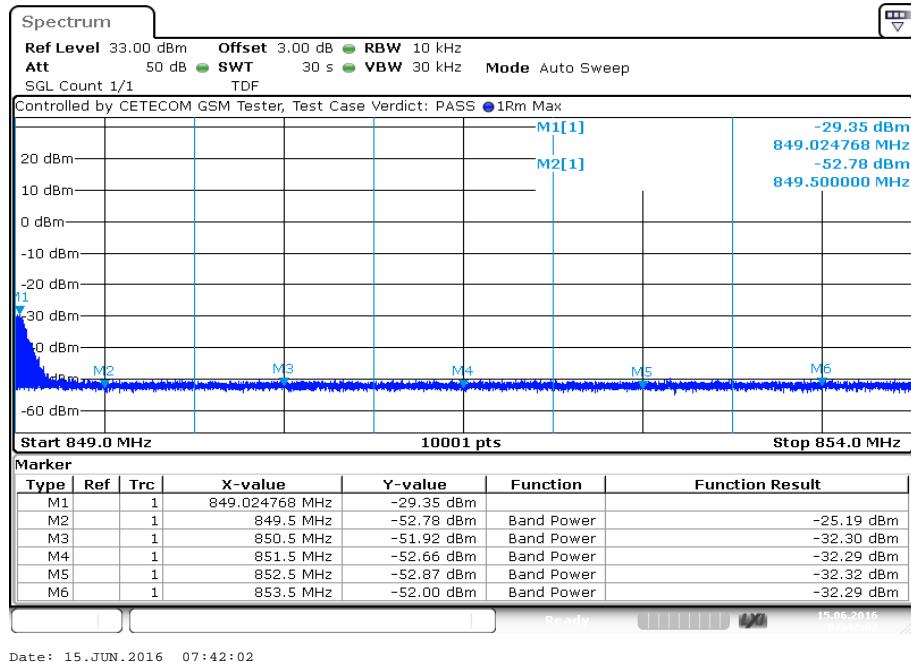
#### Measurement:

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 7.4 – A
Measurement uncertainty:	See chapter 9

#### 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**

### 11.1.6 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 7.4 – A
Measurement uncertainty:	See chapter 9

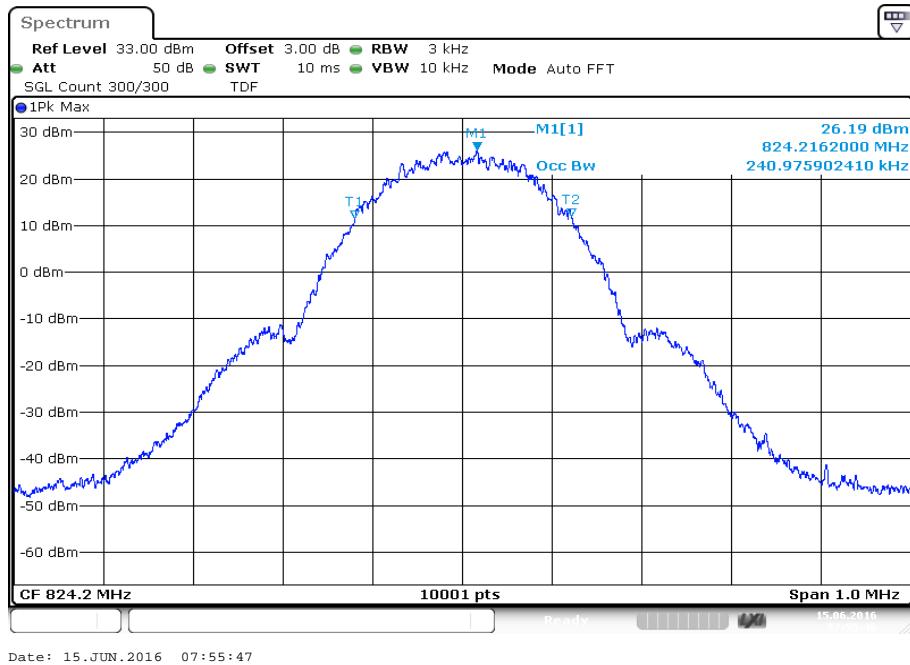
#### Limits:

FCC	IC
Spectrum must fall completely in the specified band	

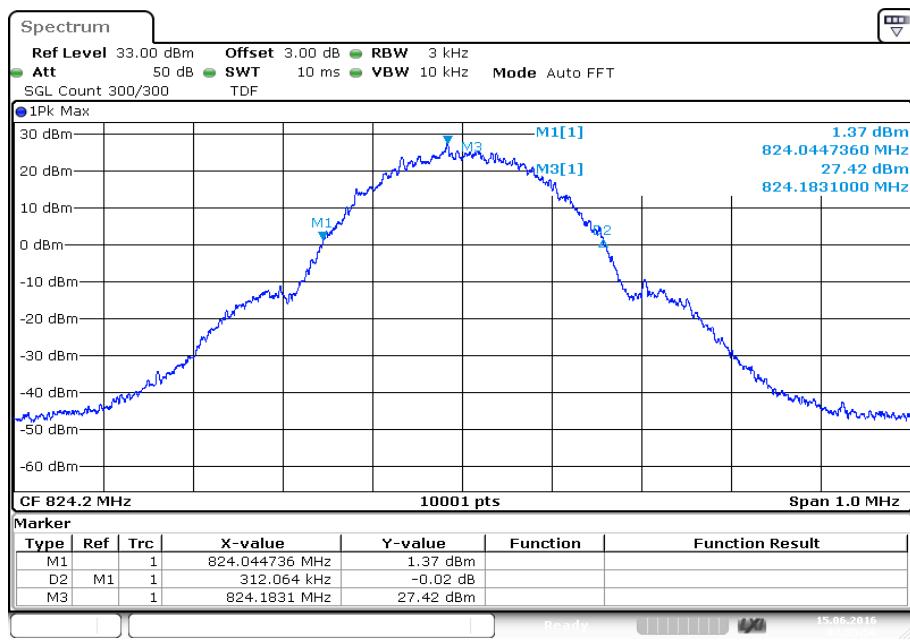
**Results:**

Occupied bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	241	312
836.4	243	314
848.8	242	315

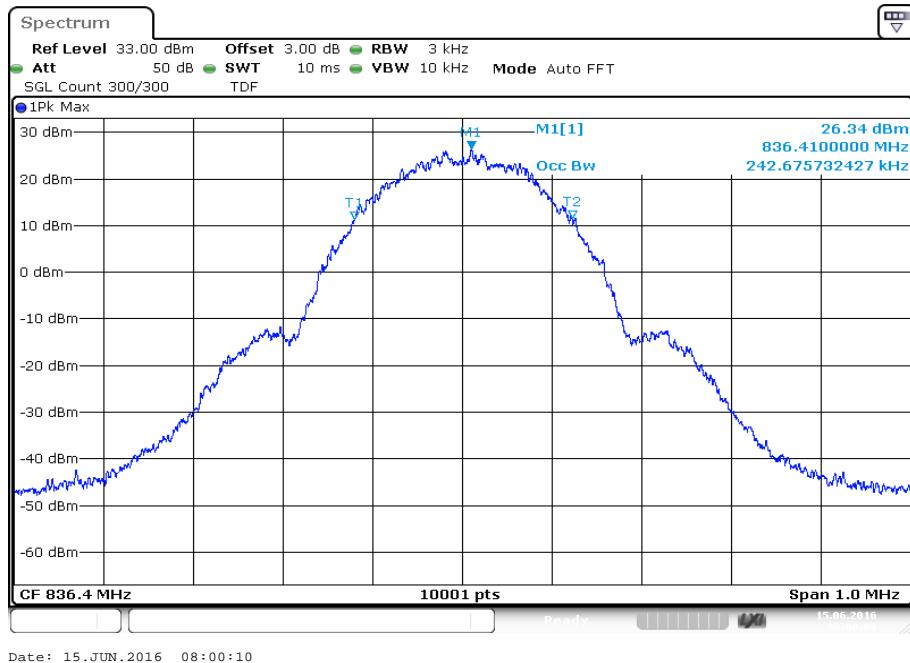
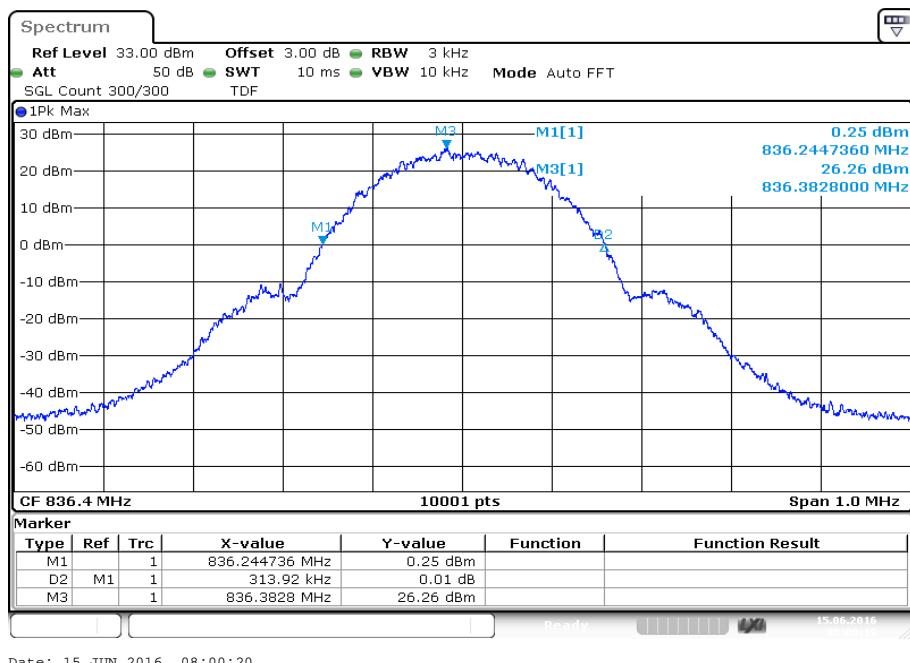
Occupied bandwidth – 8 PSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	238	308
836.4	237	308
848.8	238	310

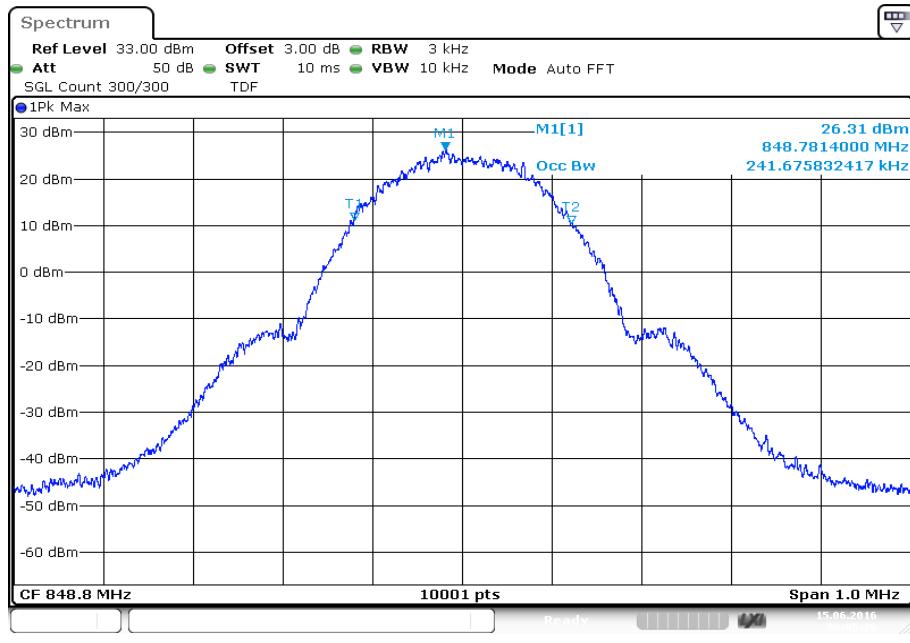
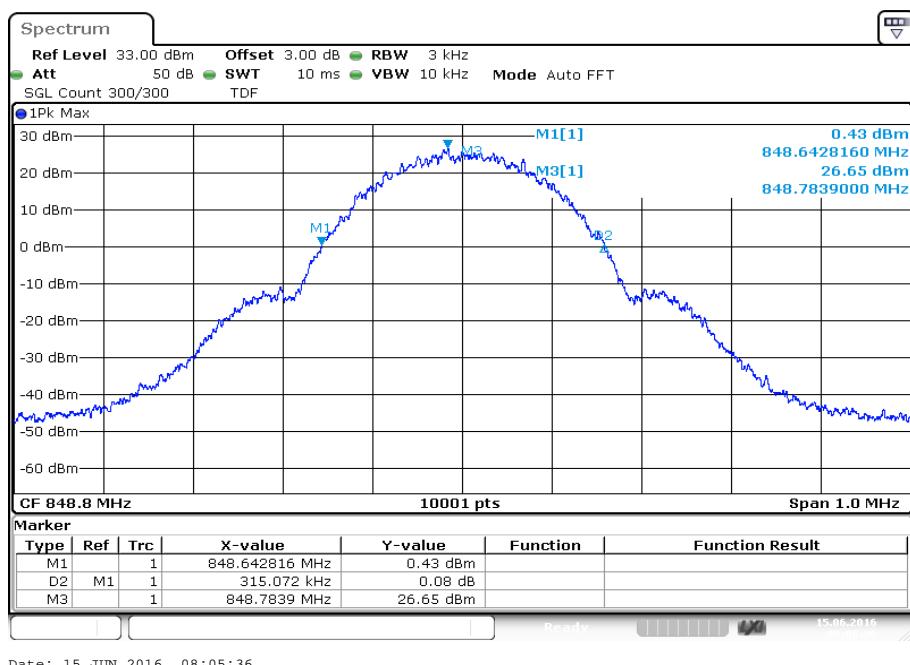
**Plots:** GMSK**Plot 1:** Channel 128 (99% bandwidth)

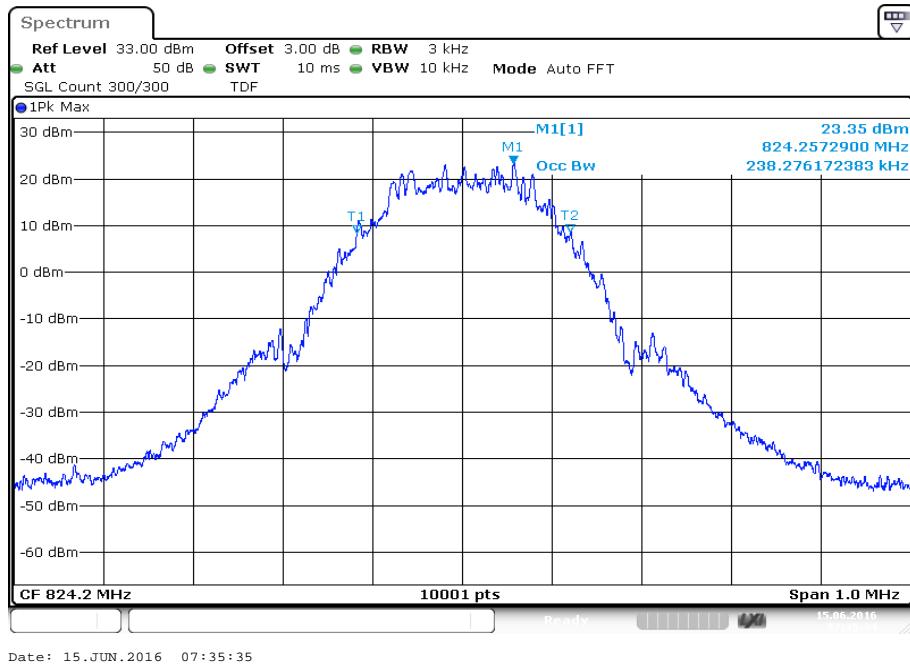
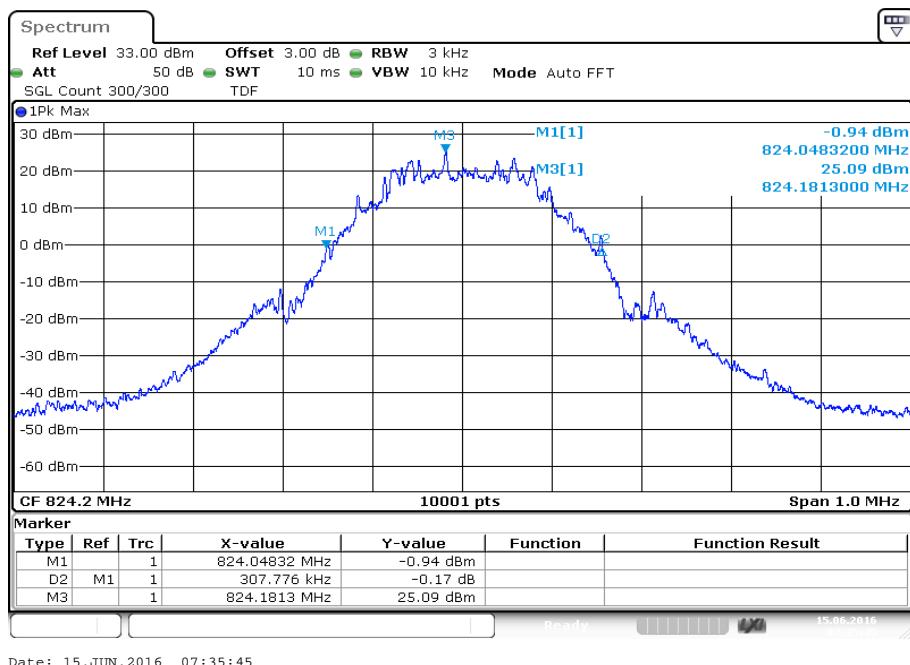
Date: 15.JUN.2016 07:55:47

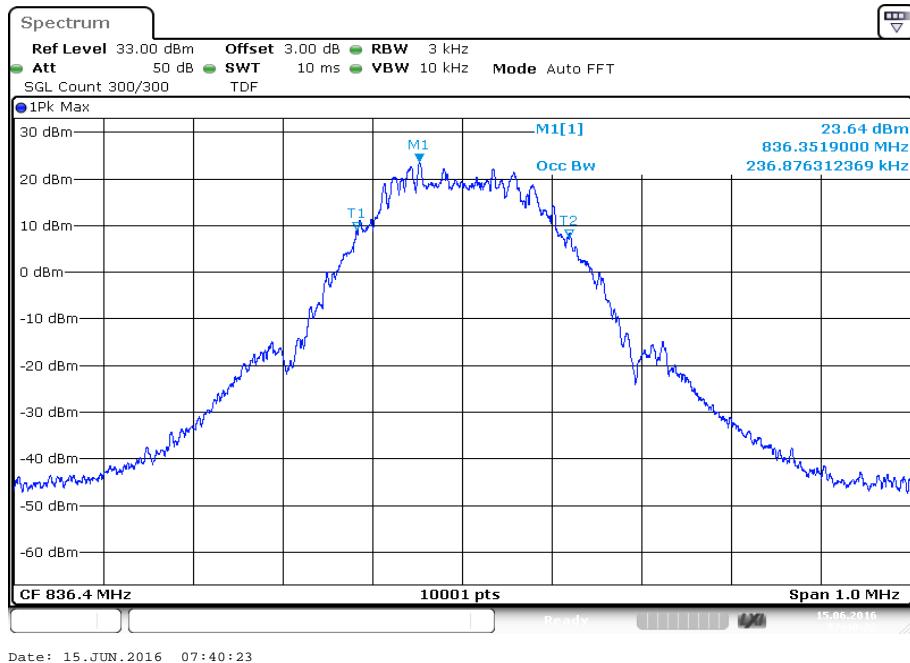
**Plot 2:** Channel 128 (-26 dBc bandwidth)

Date: 15.JUN.2016 07:55:57

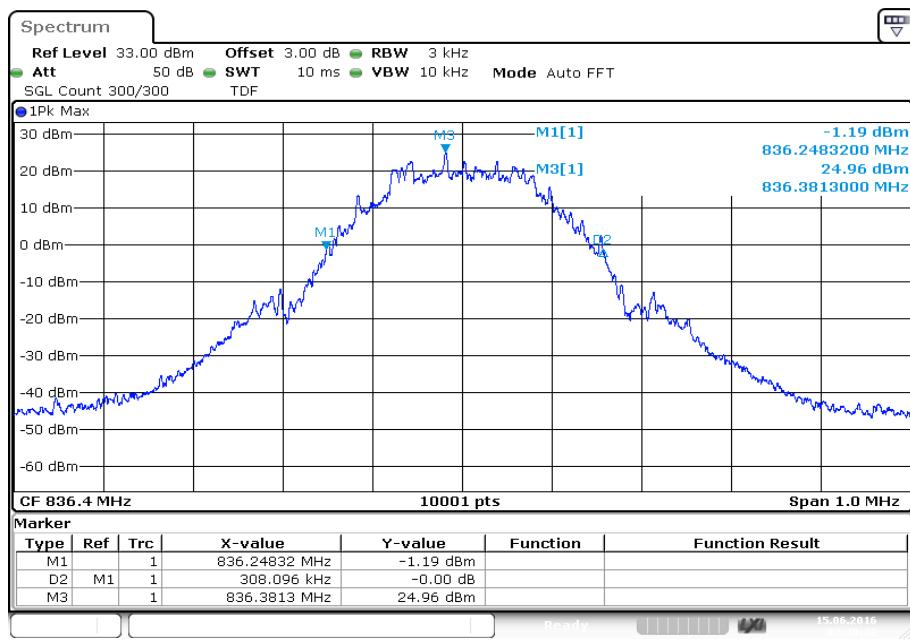
**Plot 3:** Channel 189 (99% bandwidth)**Plot 4:** Channel 189 (-26 dBc bandwidth)

**Plot 5:** Channel 251 (99% bandwidth)**Plot 6:** Channel 251 (-26 dBc bandwidth)

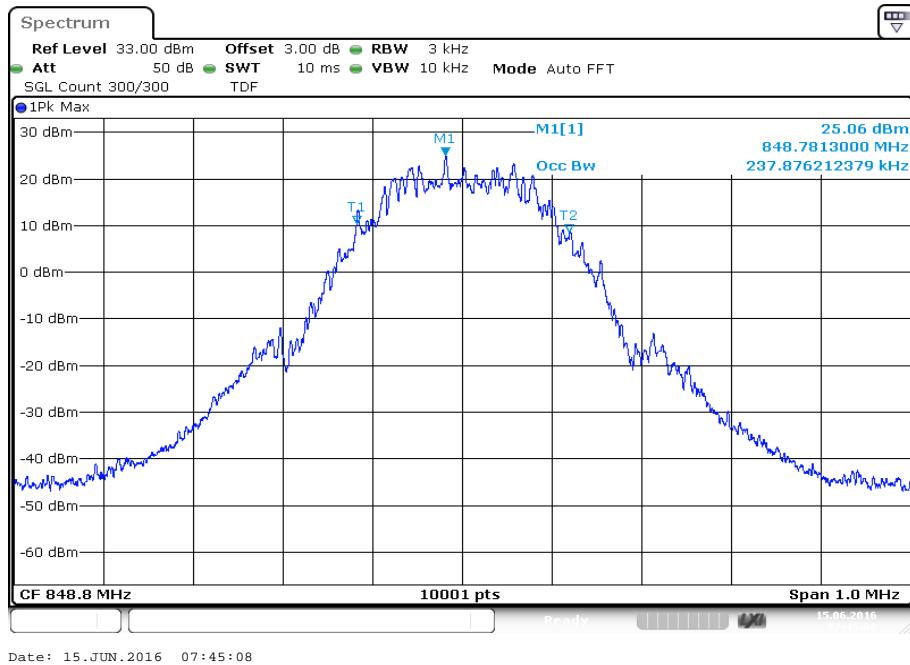
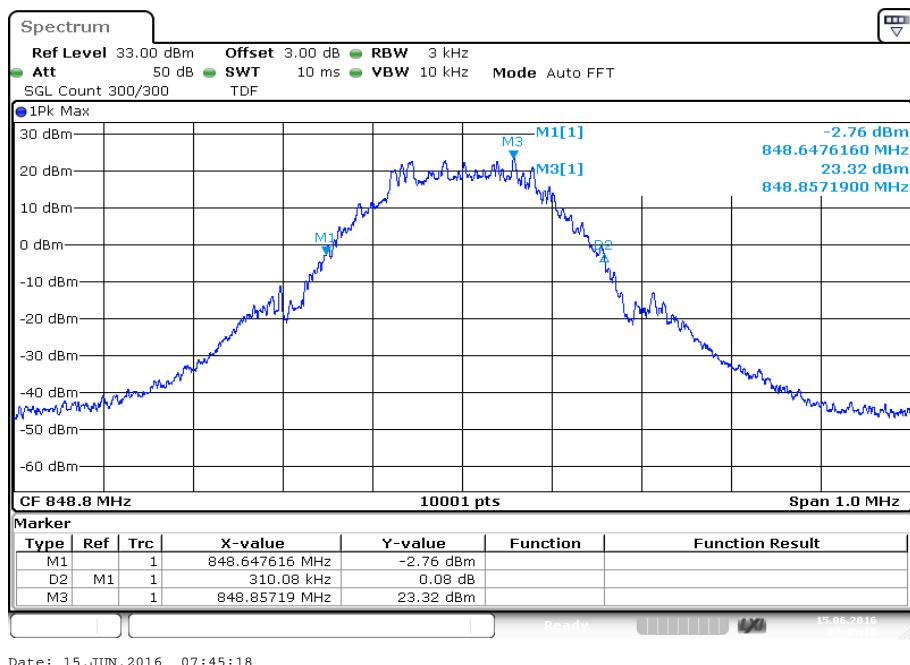
**Plots:** 8 PSK**Plot 1: Channel 128 (99% bandwidth)****Plot 2: Channel 128 (-26 dBc bandwidth)**

**Plot 3:** Channel 189 (99% bandwidth)

Date: 15.JUN.2016 07:40:23

**Plot 4:** Channel 189 (-26 dBc bandwidth)

Date: 15.JUN.2016 07:40:33

**Plot 5:** Channel 251 (99% bandwidth)**Plot 6:** Channel 251 (-26 dBc bandwidth)

## 11.2 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.

### 11.2.1 RF output power

**Description:**

This paragraph contains average power, peak output power and EIRP 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.

<b>Measurement parameters</b>	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	1 MHz
Resolution bandwidth:	1 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	see section 7.2 – A, 7.4 – A

**Limits:**

FCC	IC
CFR Part 24.232 CFR Part 2.1046	RSS 133
Nominal Peak Output Power	
+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)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
1850.2	28.8*	29.7*	0.88
1880.0	28.6*	29.6*	1.03
1909.8	29.5*	29.7*	0.20

\*measured at the external antenna connector

Output Power (conducted) 8-PSK mode			
Frequency (MHz)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
1850.2	24.9*	28.7*	3.75
1880.0	24.8*	29.6*	4.71
1909.8	25.4*	28.7*	3.35

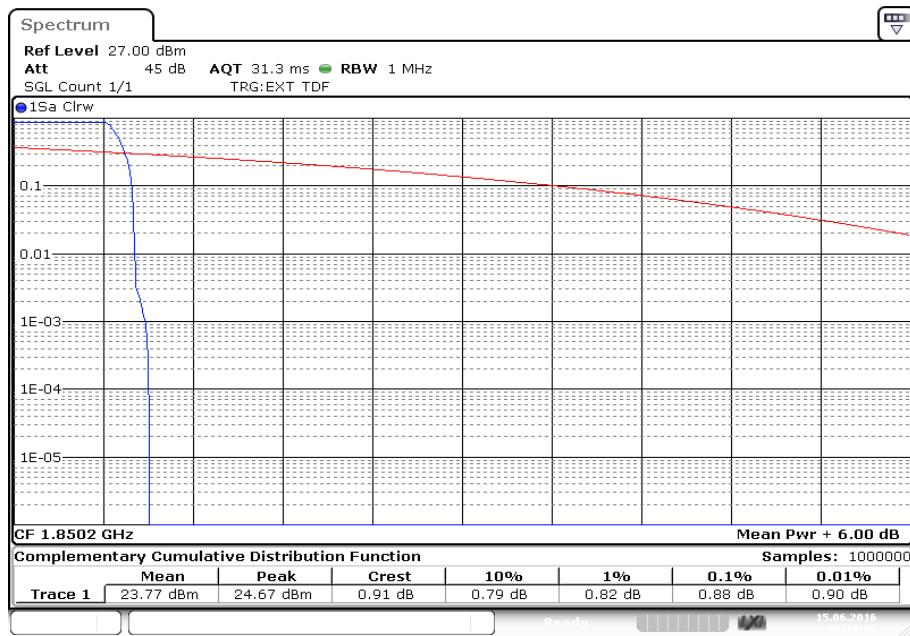
\*measured at the external antenna connector

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) – EIRP
1850.2	29.0*
1880.0	30.5*
1909.8	31.3*

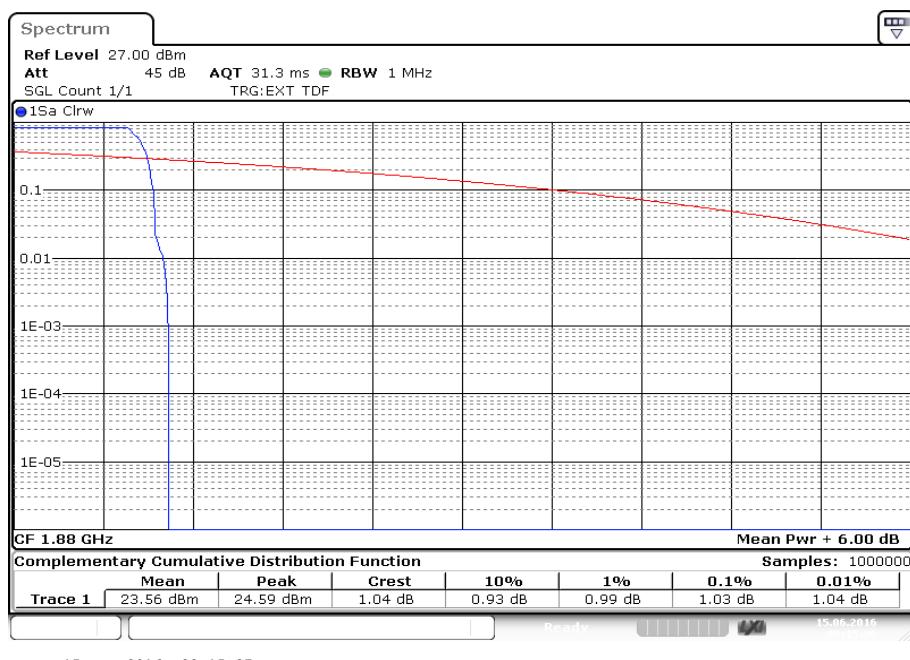
\*measured with integrated antenna

Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1850.2	25.1*
1880.0	26.7*
1909.8	27.2*

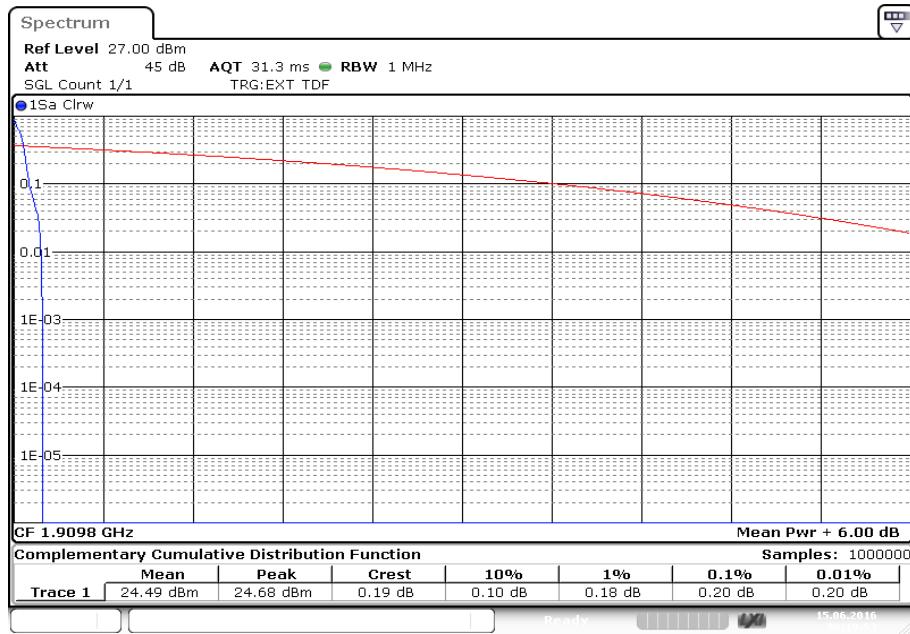
\*measured with integrated antenna

**Plots:****Plot 1:** PCS1900, GMSK, low channel

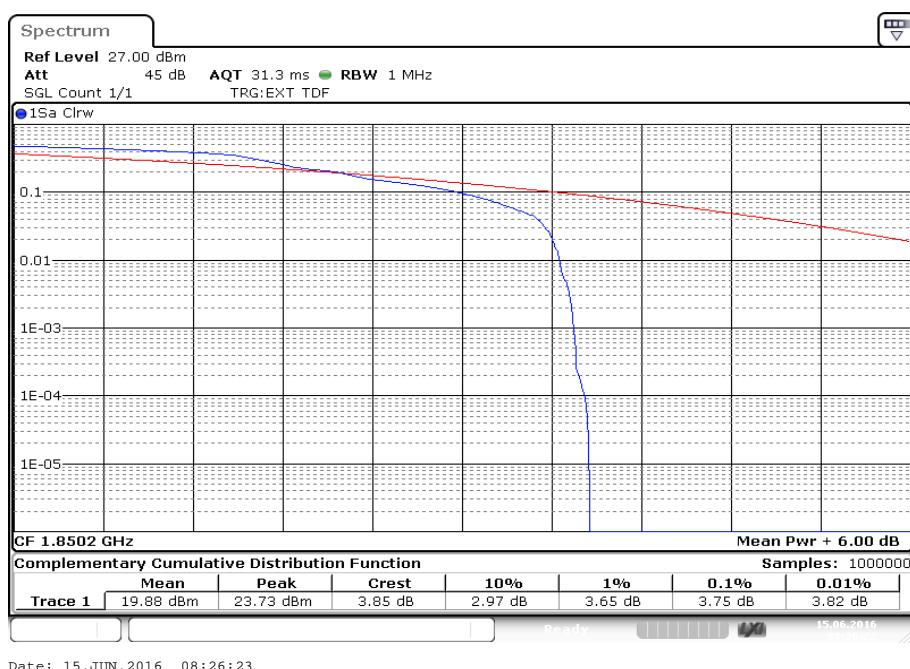
+additional cable attenuation: 5dB

**Plot 2:** PCS1900, GMSK, mid channel

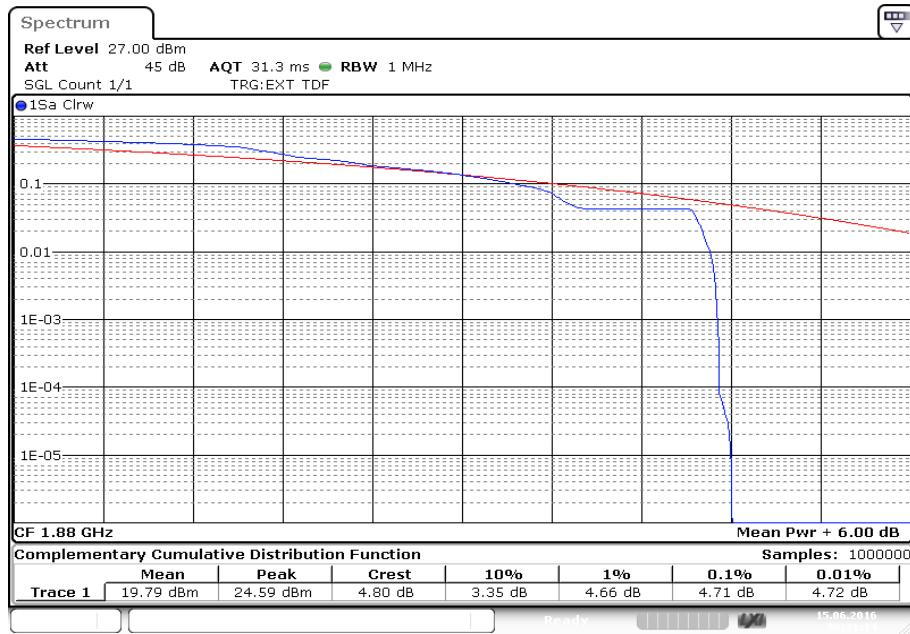
+additional cable attenuation: 5dB

**Plot 3:** PCS1900, GMSK, high channel

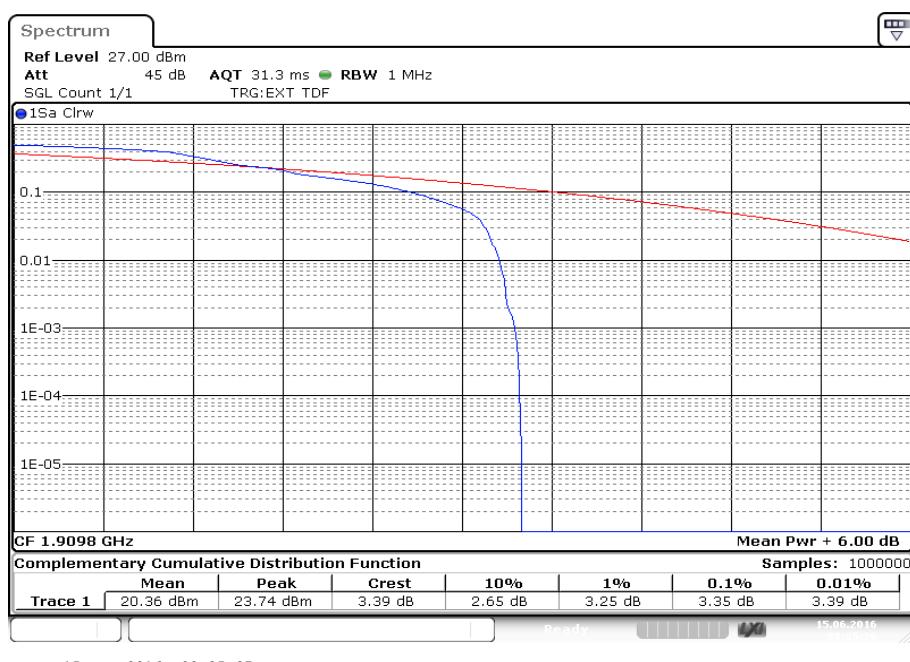
+additional cable attenuation: 5dB

**Plot 4:** PCS1900, 8-PSK, low channel

+additional cable attenuation: 5dB

**Plot 5:** PCS1900, 8-PSK, mid channel

+additional cable attenuation: 5dB

**Plot 6:** PCS1900, 8-PSK, high channel

+additional cable attenuation: 5dB

## 11.2.2 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.

7. Measure the carrier frequency at room temperature.
8. Subject the mobile station to overnight soak at -30 C.
9. With the mobile station powered with  $V_{\text{nom}}$  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.
10. 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.
11. Remeasure carrier frequency at room temperature with  $V_{\text{nom}}$ . Vary supply voltage to  $V_{\text{min}}$  and measure the carrier frequency then setup  $V_{\text{max}}$  and repeat the measurement.
12. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

### Measurement:

Measurement parameters	
Detector:	
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	Measured with CMU200
Span:	
Trace mode:	
Test setup:	See chapter 7.4 – B
Measurement uncertainty:	See chapter 9

### Limits:

FCC	IC
± 2.5 ppm	

**Results:****AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
9	-10	-0.00000053	-0.0053
12	8	0.00000043	0.0043
16	28	0.00000149	0.0149

**AFC FREQ ERROR versus TEMPERATURE**

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	30	0.00000160	0.0160
-20	19	0.00000101	0.0101
-10	-4	-0.00000021	-0.0021
± 0	-40	-0.00000213	-0.0213
10	-15	-0.00000080	-0.0080
20	-5	-0.00000027	-0.0027
30	9	0.00000048	0.0048
40	-29	-0.00000154	-0.0154
50	15	0.00000080	0.0080

### 11.2.3 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:

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- b) The antenna output was terminated in a 50 ohm load (if possible).
- c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) 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.
- e) 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
Measurement uncertainty:	See section 9
Test setup:	A (as of section 7.2 and 7.3)

#### Limits:

FCC	IC
CFR Part 24.238 CFR Part 2.1053	RSS 133
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 PCS1900 band (1850.2 MHz, 1880.0 MHz and 1909.8 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 PCS1900 band 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.

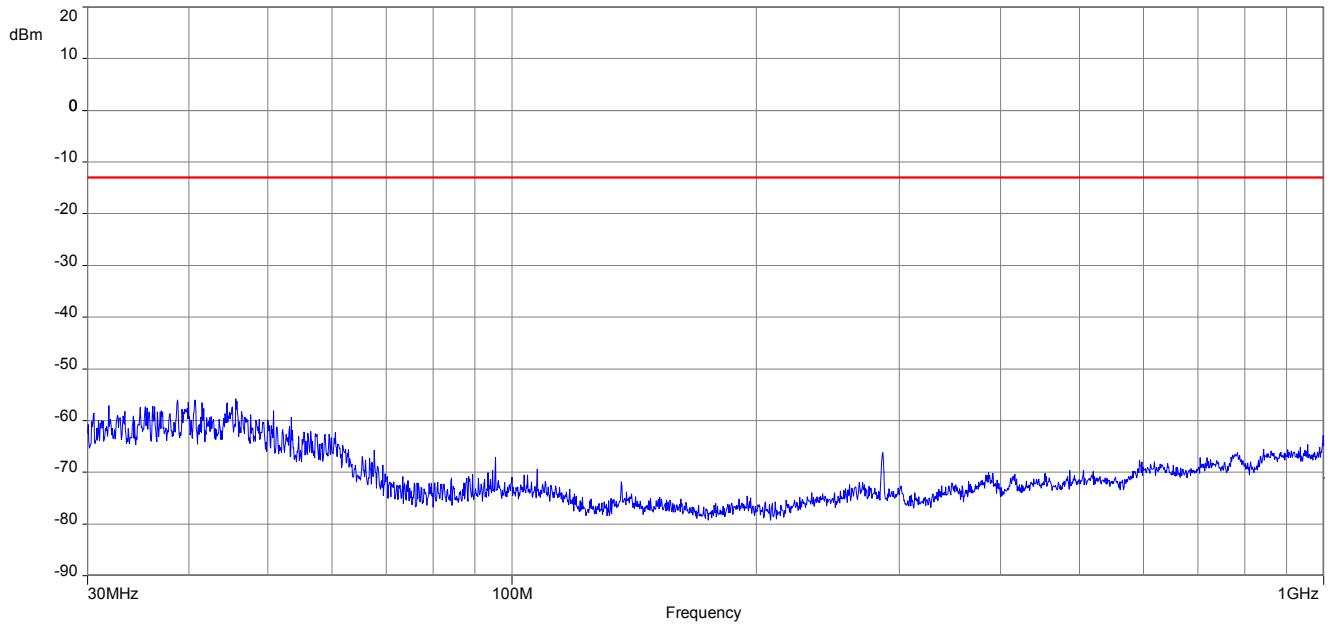
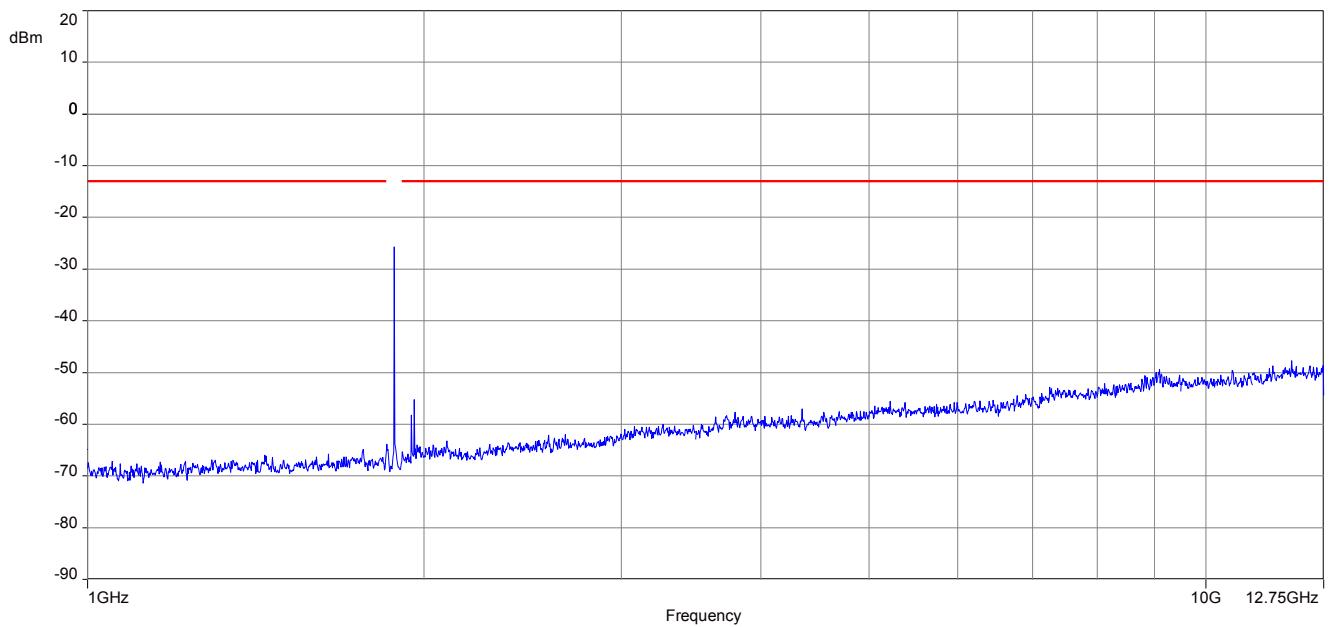
The final open field radiated levels are presented on the next pages.

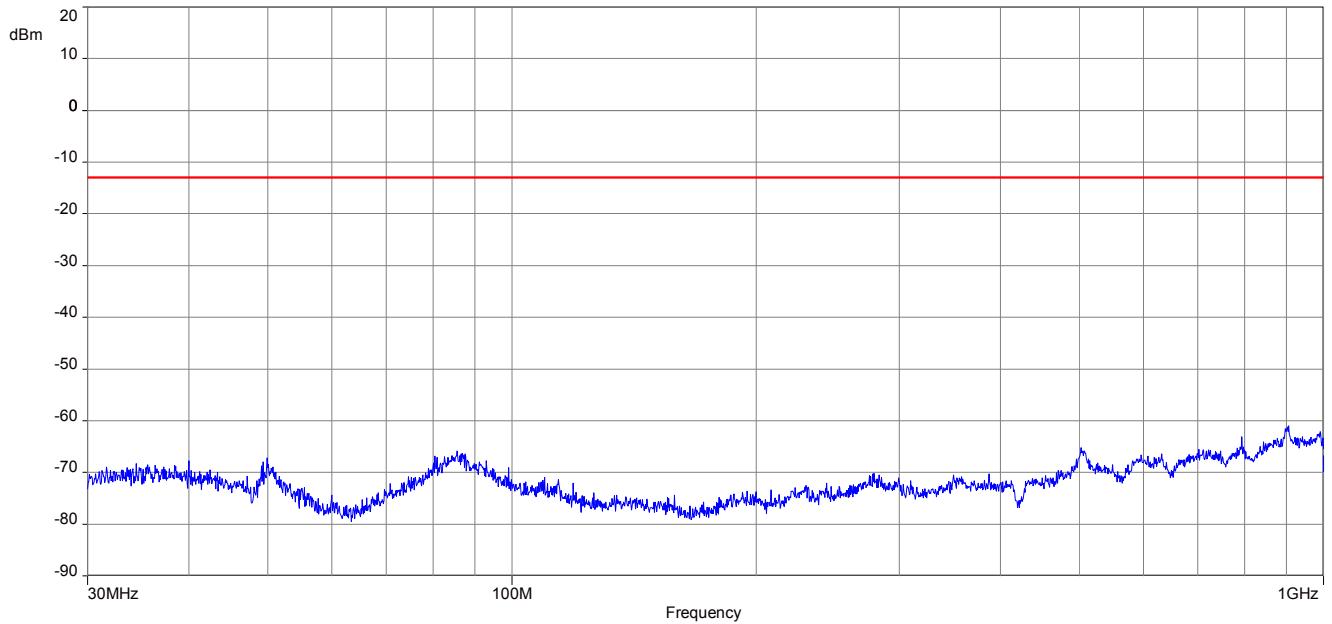
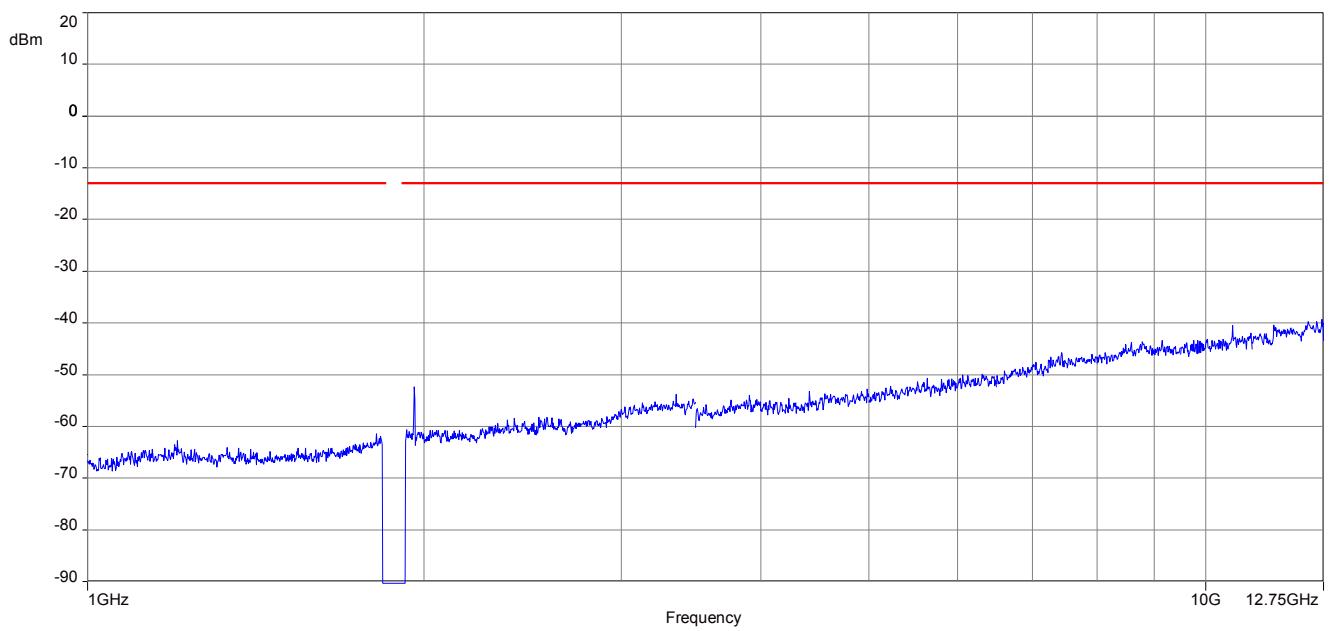
All measurements were done in horizontal and vertical polarization; the plots show the worst case.

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.

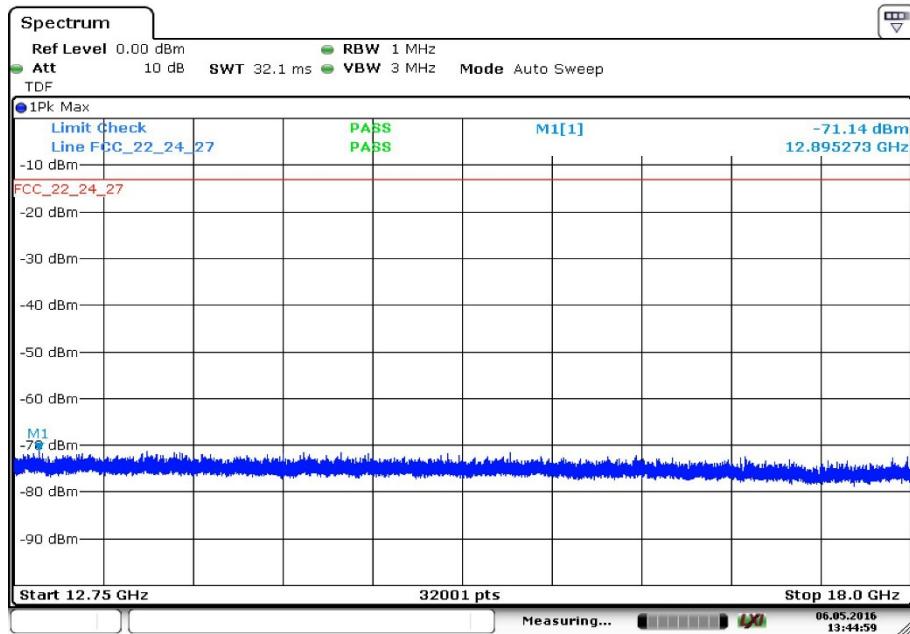
As can be seen from this data, the emissions from the test item were within the specification limit.

Spurious Emission Level (dBm)								
Harmonic	Ch. 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	-

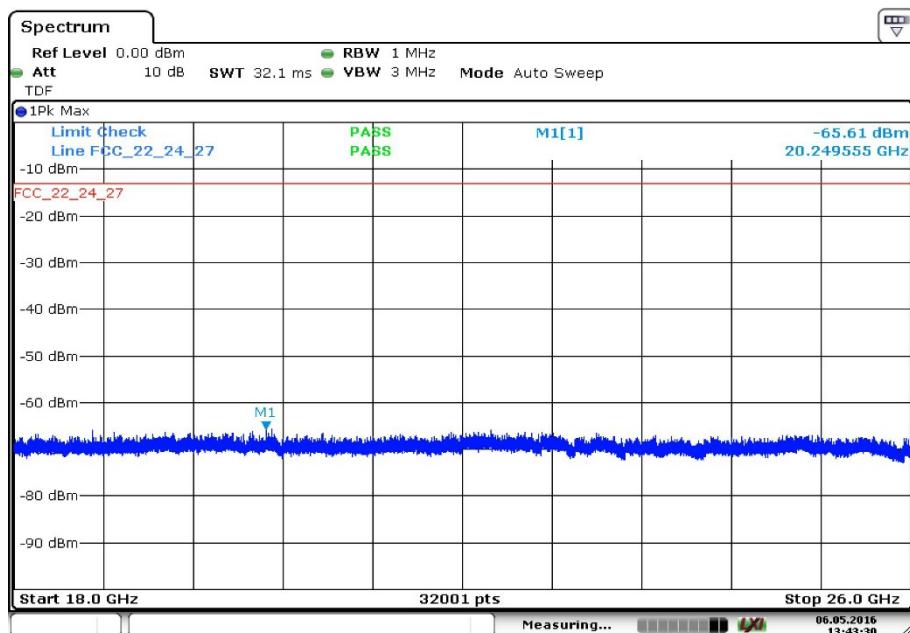
**Plots:****Plot 1:** Channel 661 (30 MHz – 1 GHz) internal antenna**Plot 2:** Channel 661 (1 GHz – 12.75 GHz) internal antenna*Carrier notched with 1.9 GHz rejection filter*

**Plot 3:** Channel 661 (30 MHz – 1 GHz) internal antenna**Plot 4:** Channel 661 (1 GHz – 12.75 GHz) internal antenna

*Carrier notched with 1.9 GHz rejection filter*

**Plot 5:** Channel 661 (12.75 GHz - 18 GHz) – valid for both antennas

Date: 6.MAY.2016 13:44:59

**Plot 6:** Channel 661 (18 GHz - 26 GHz) – valid for both antennas

Date: 6.MAY.2016 13:43:31

### 11.2.4 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:**

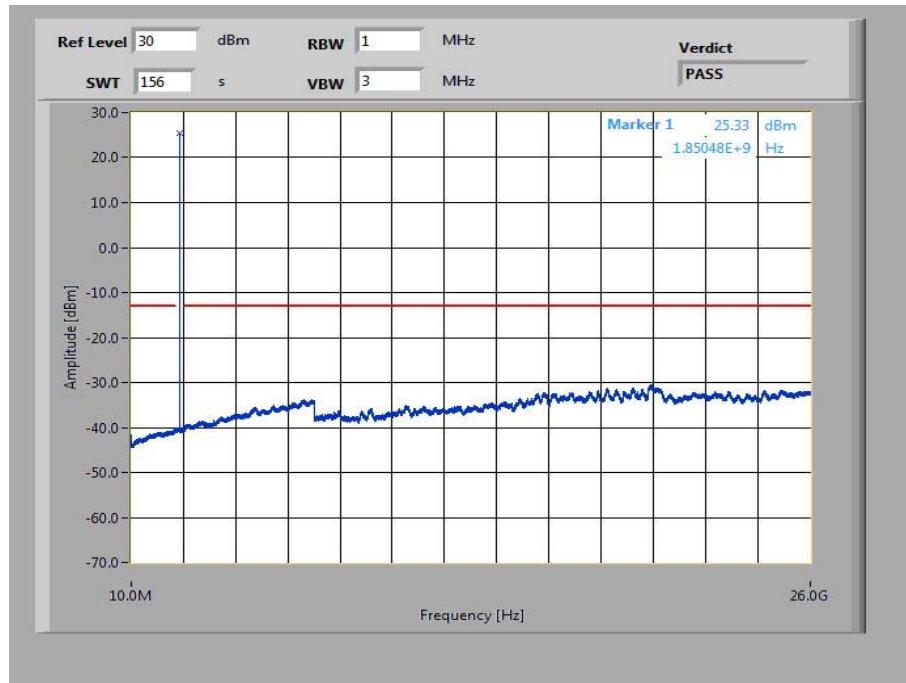
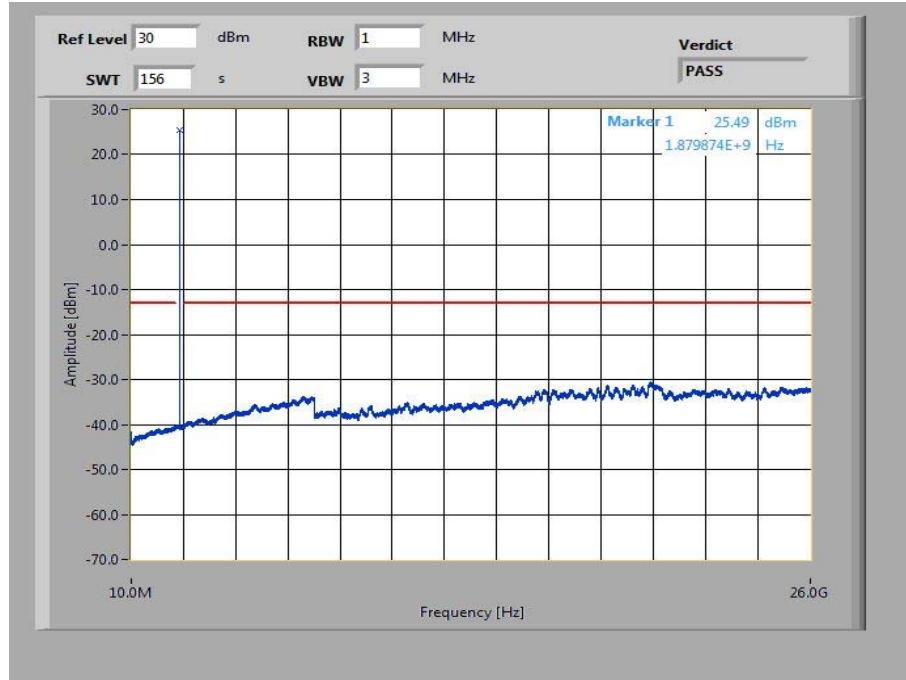
<b>Measurement parameters</b>	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	10 MHz – 26 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 - A
Measurement uncertainty:	See chapter 9

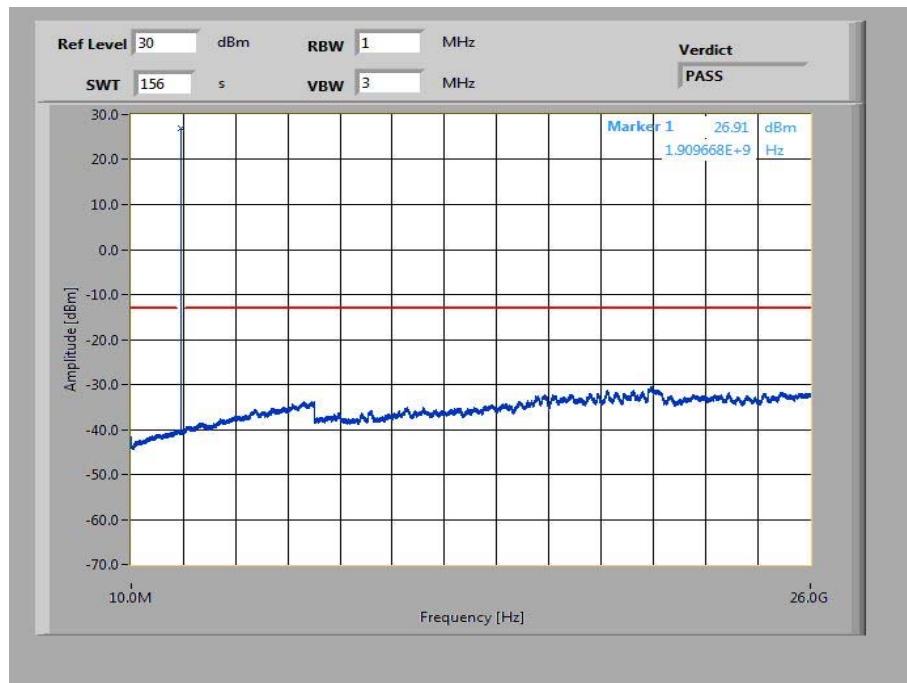
**Limits:**

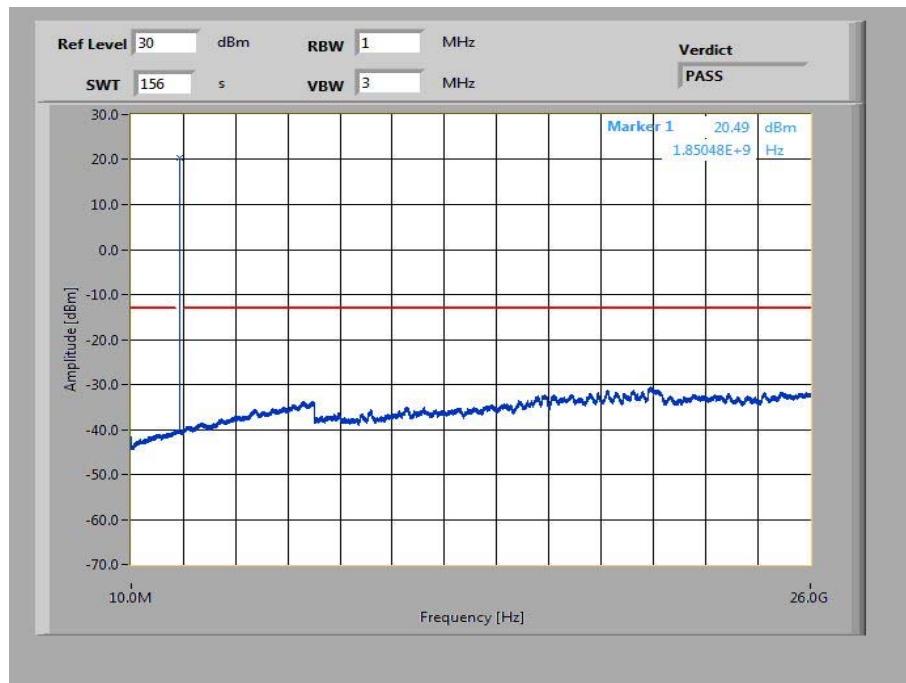
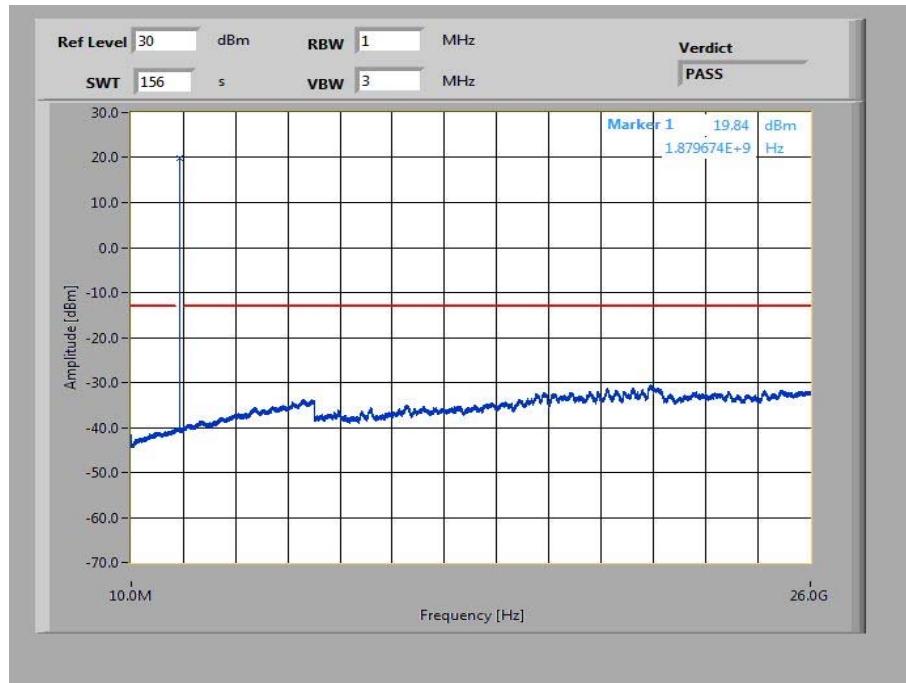
FCC	IC
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

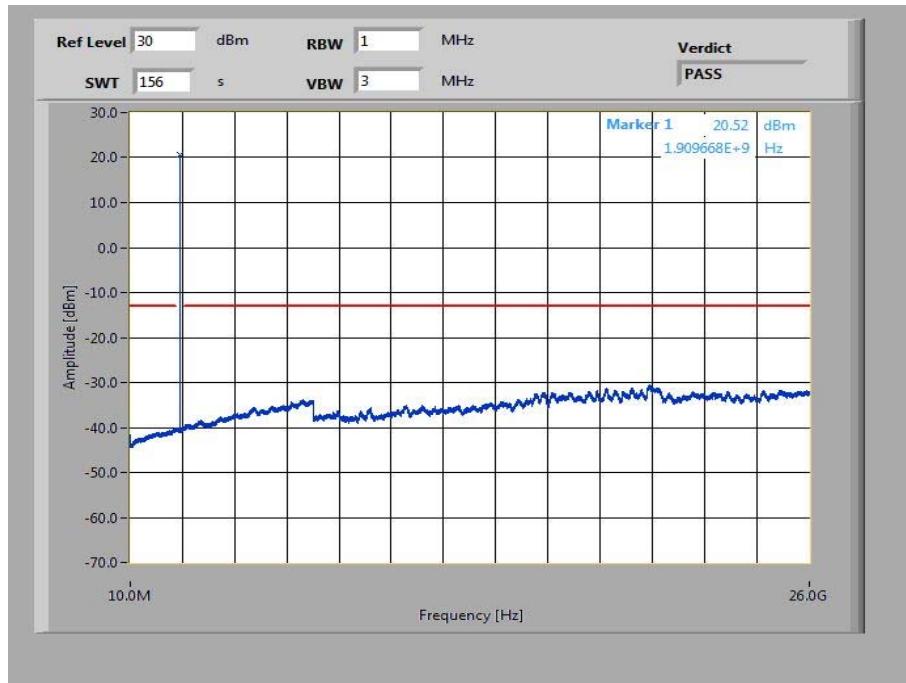
**Results:**

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 - 26 GHz)**Plot 2:** Channel 661 (10 MHz - 26 GHz)

**Plot 3:** Channel 810 (10 MHz - 26 GHz)

**Plots:** 8 PSK**Plot 1:** Channel 512 (10 MHz - 26 GHz)**Plot 2:** Channel 661 (10 MHz - 26 GHz)

**Plot 3:** Channel 810 (10 MHz - 26 GHz)

### 11.2.5 Block edge compliance

#### Description:

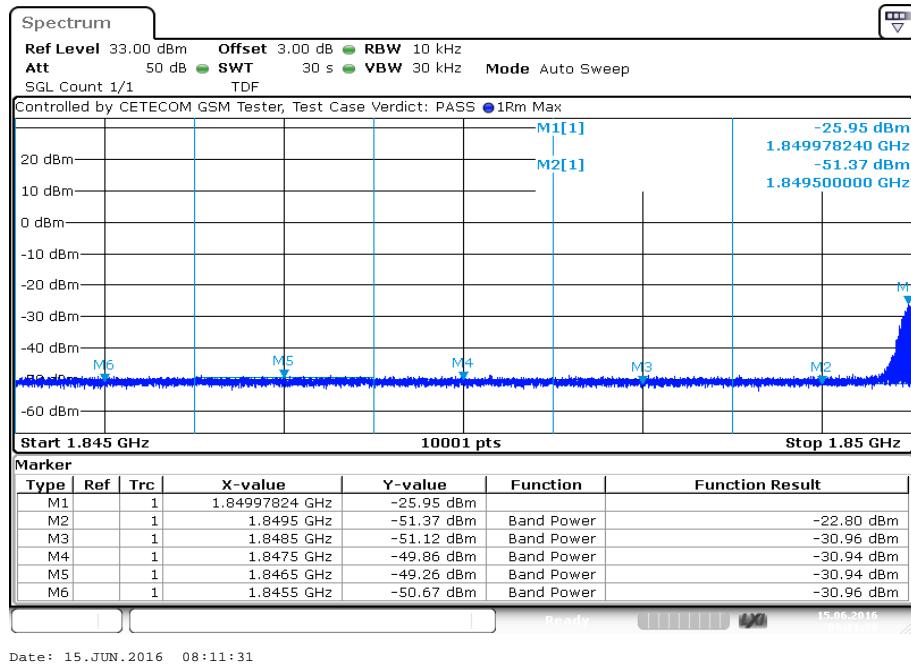
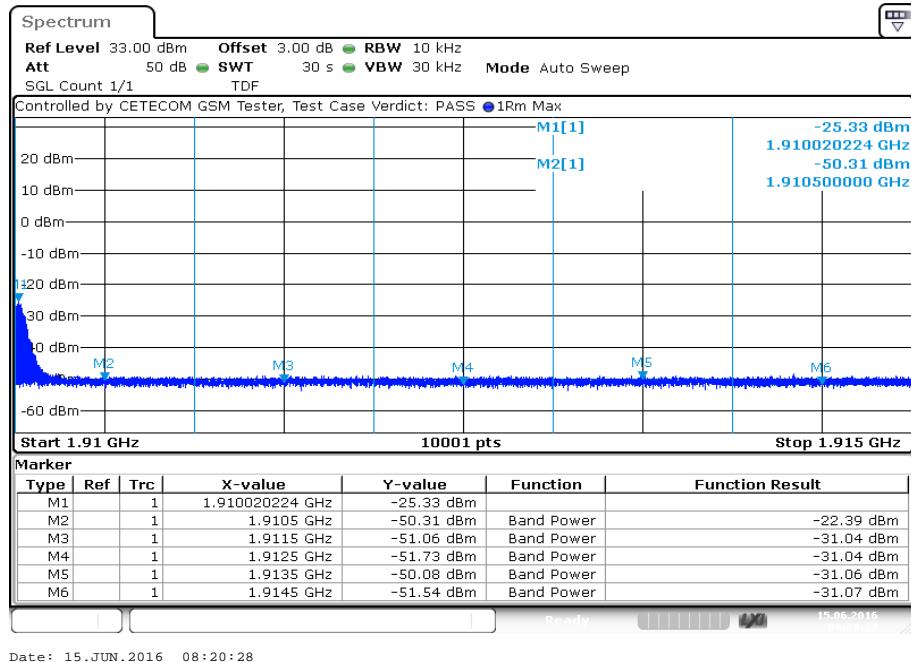
The spectrum at the band edges must comply with the spurious emissions limits.

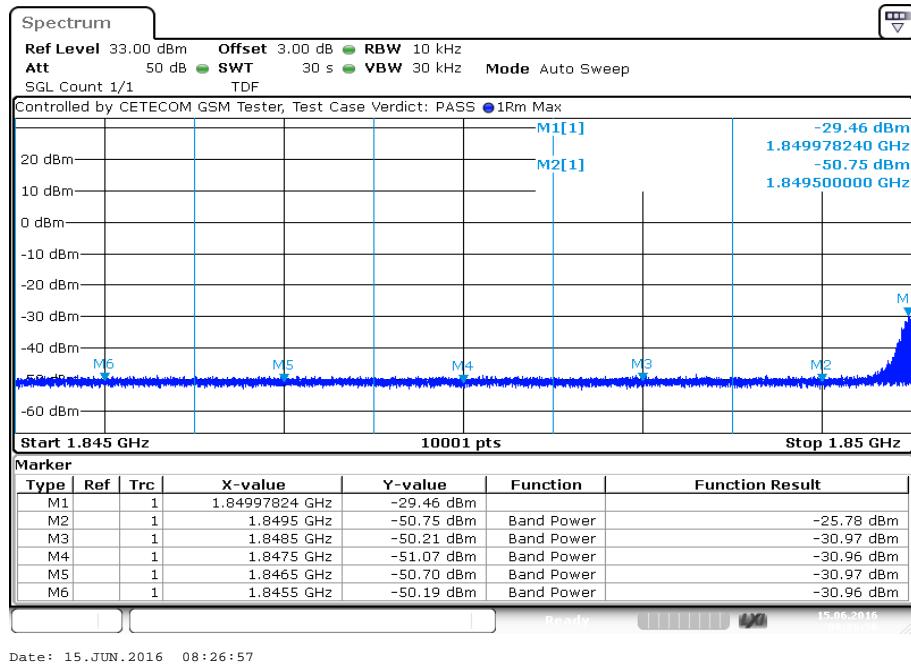
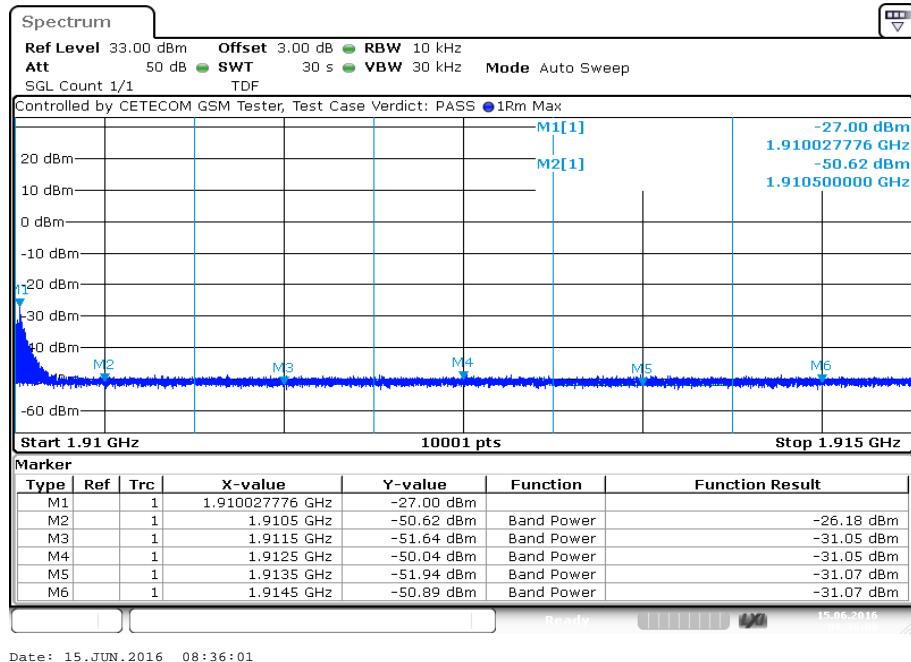
#### Measurement:

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 7.4 - A
Measurement uncertainty:	See chapter 9

#### 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**

## 11.2.6 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 7.4 - A
Measurement uncertainty:	See chapter 9

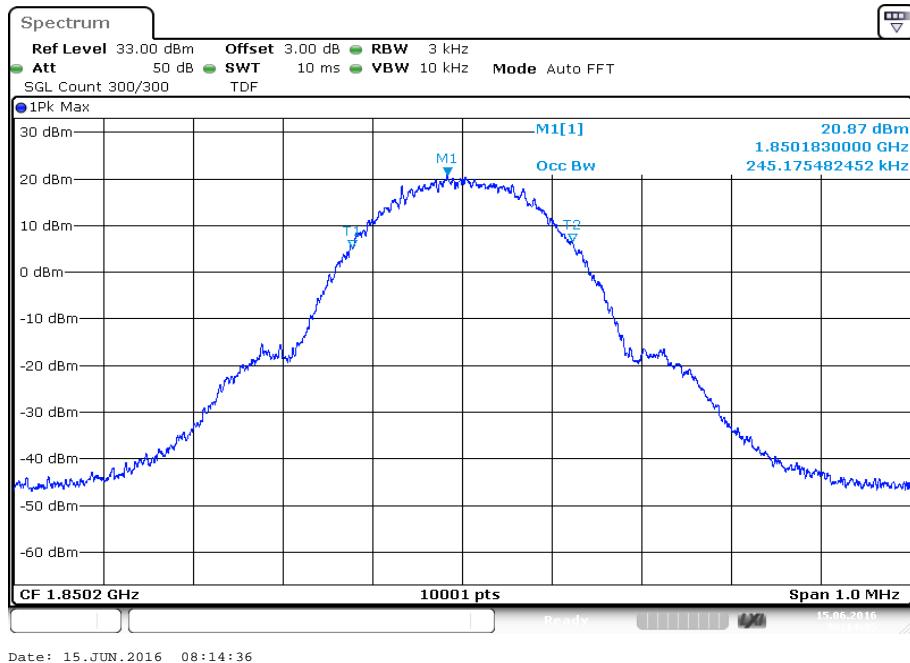
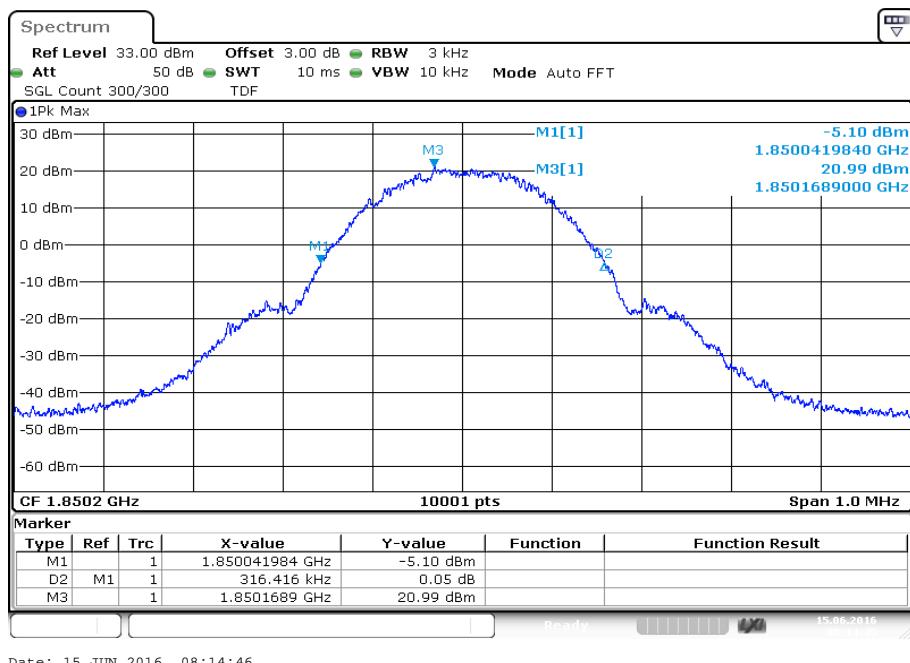
### Limits:

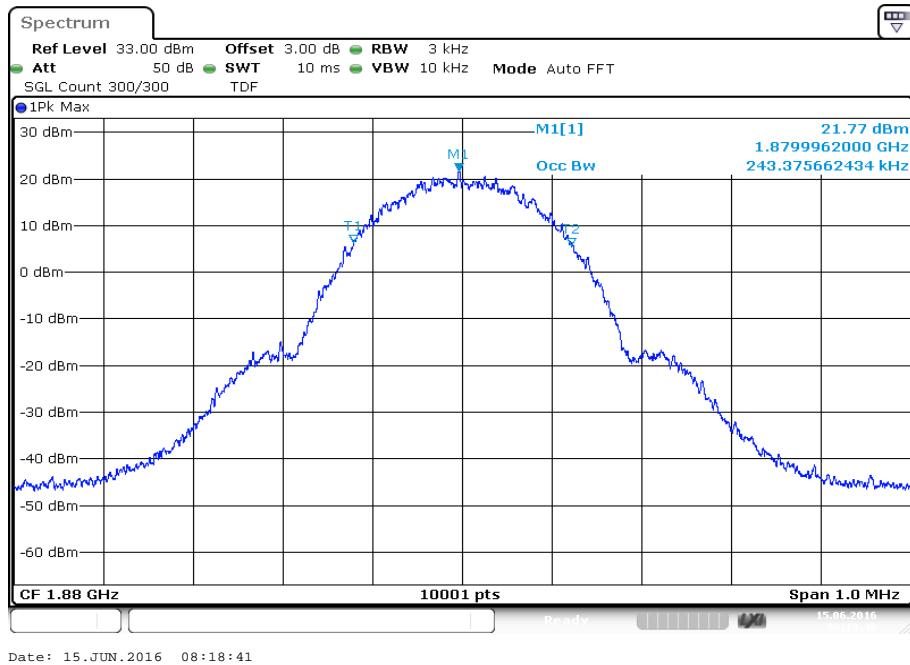
FCC	IC
Spectrum must fall completely in the specified band	

**Results:**

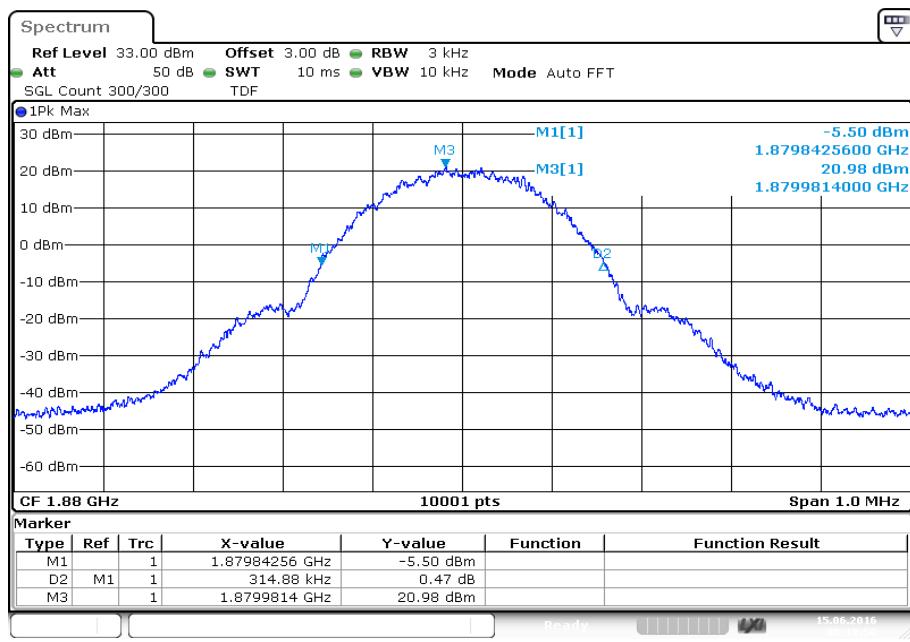
Occupied Bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	245	316
1880.0	243	315
1909.8	244	316

Occupied Bandwidth – 8-PSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	242	308
1880.0	239	310
1909.8	240	310

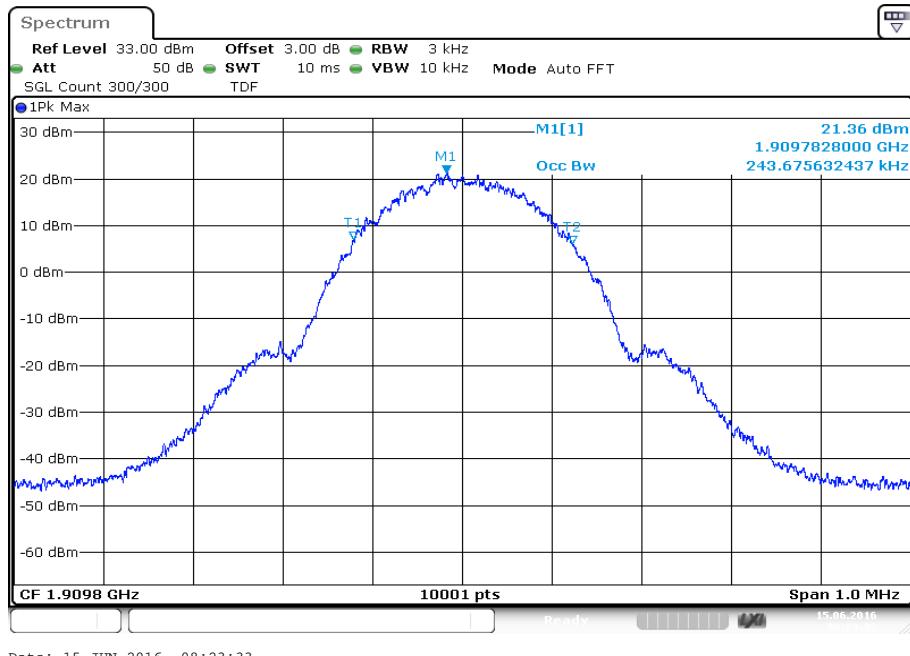
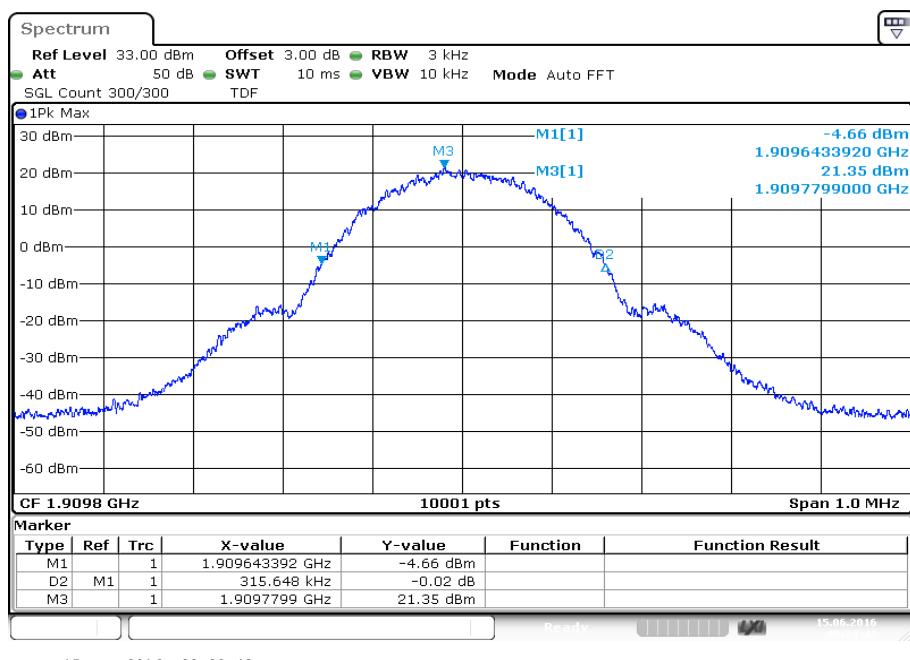
**Plots:** GMSK**Plot 1:** Channel 512 (99% bandwidth)**Plot 2:** Channel 512 (-26 dBc bandwidth)

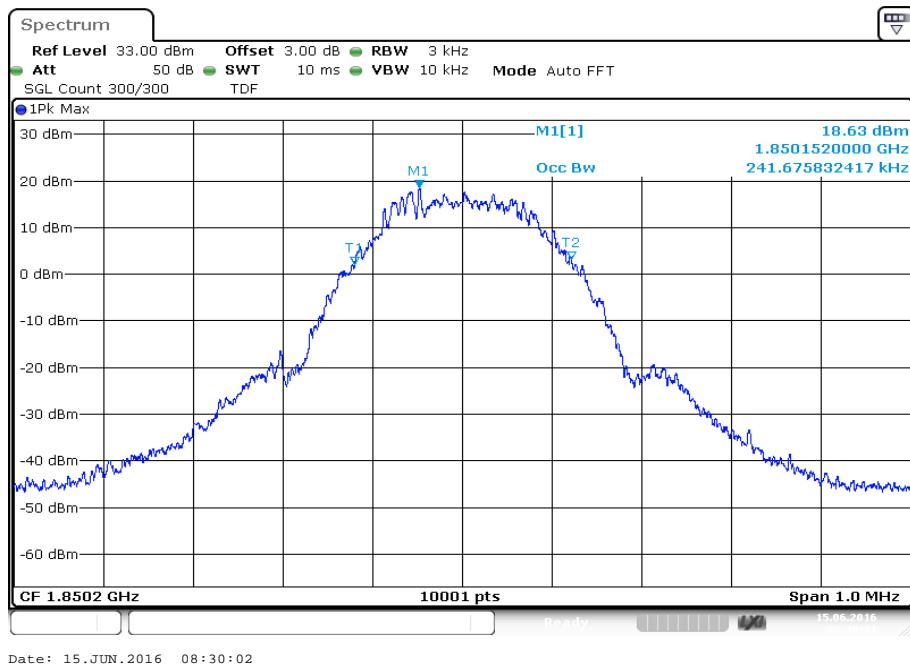
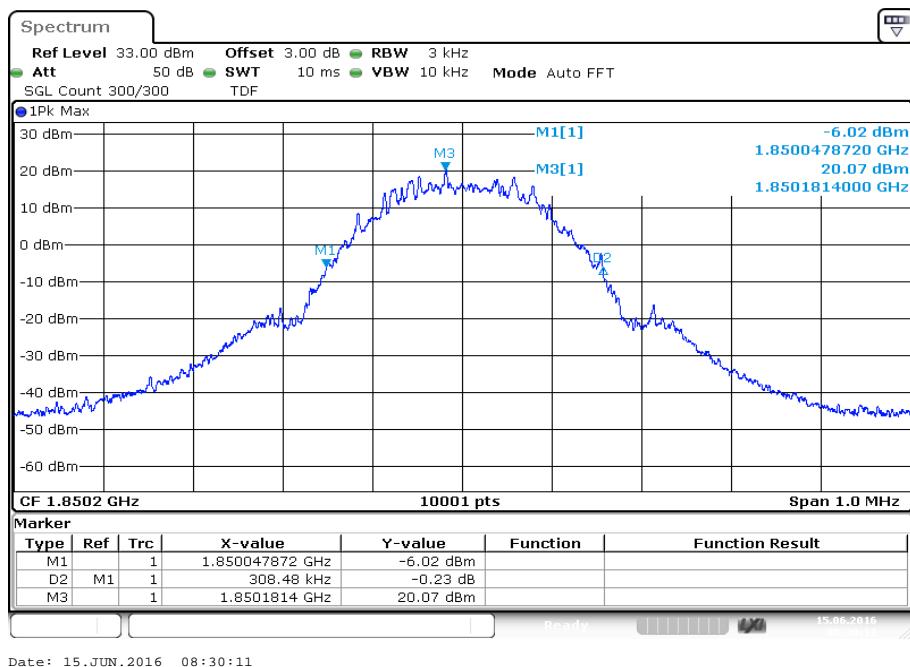
**Plot 3:** Channel 661 (99% bandwidth)

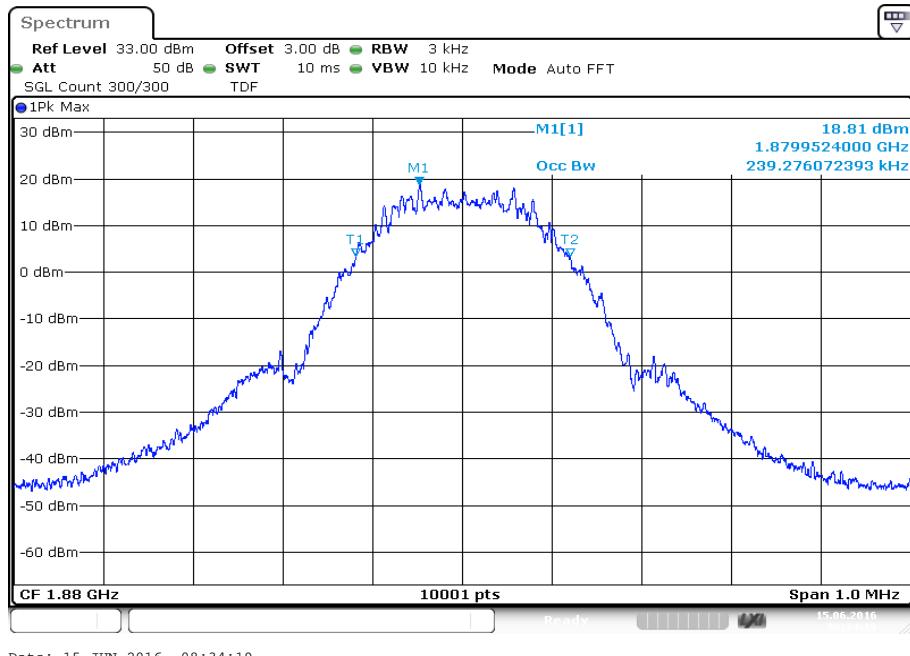
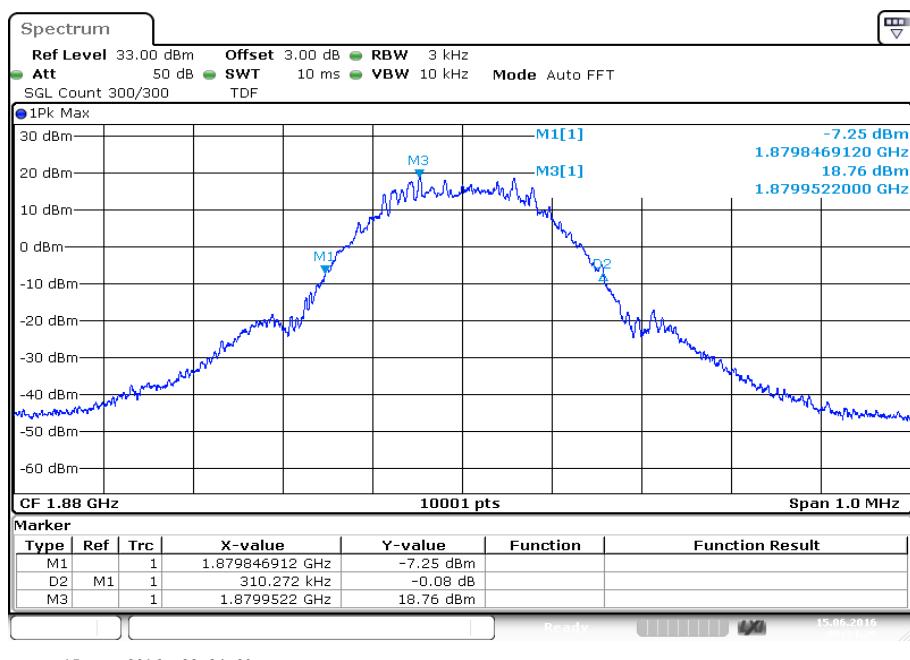
Date: 15.JUN.2016 08:18:41

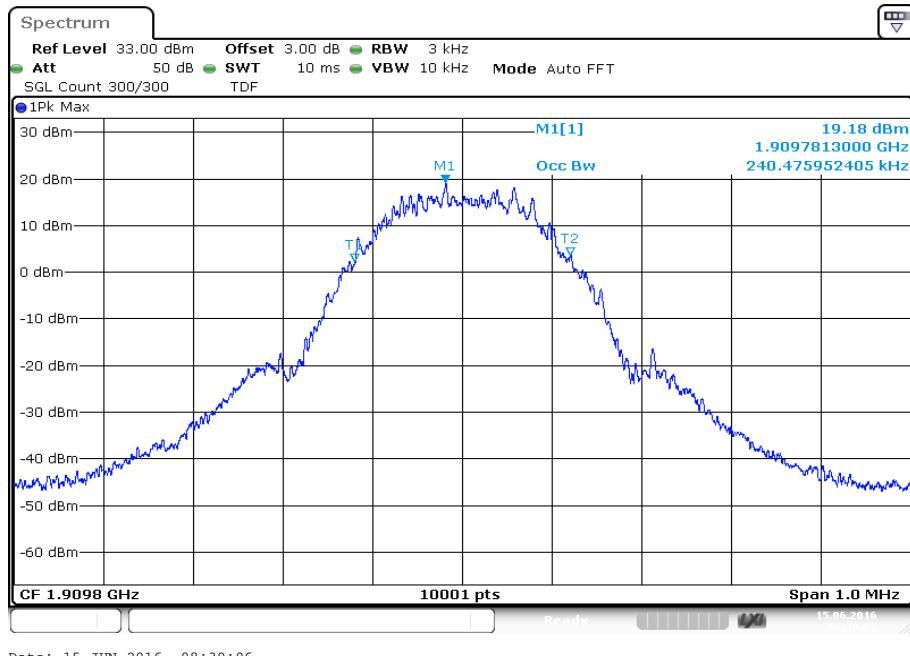
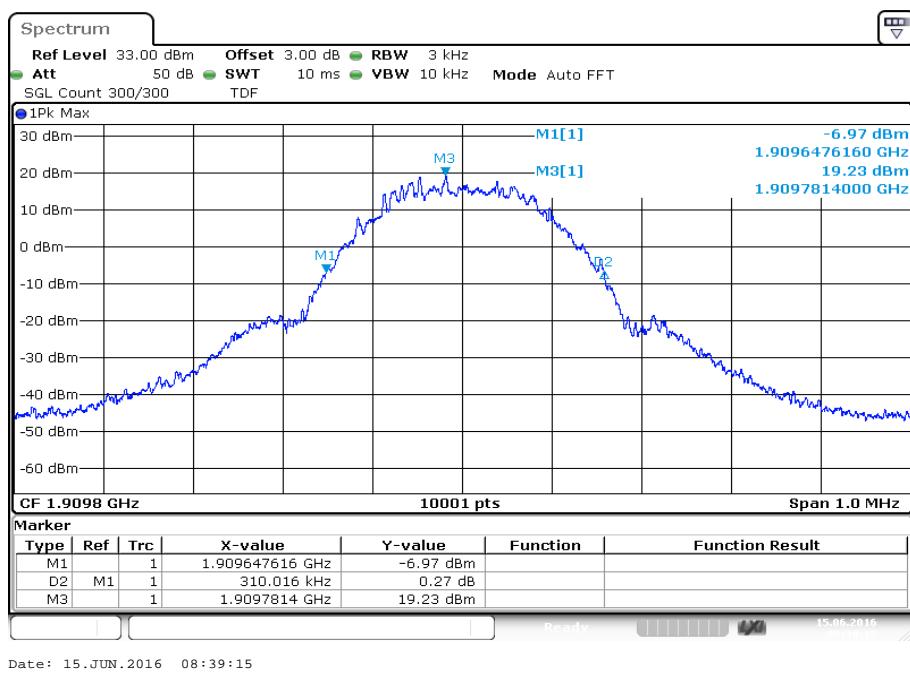
**Plot 4:** Channel 661 (-26 dBc bandwidth)

Date: 15.JUN.2016 08:18:51

**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)

## 11.3 Results UMTS band II

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)

### 11.3.1 RF output power

#### Description:

This paragraph contains average power, peak output power and EIRP 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
Measurement uncertainty:	See section 9
Test setup:	see section 7.2 – A, 7.4 – A

#### Limits:

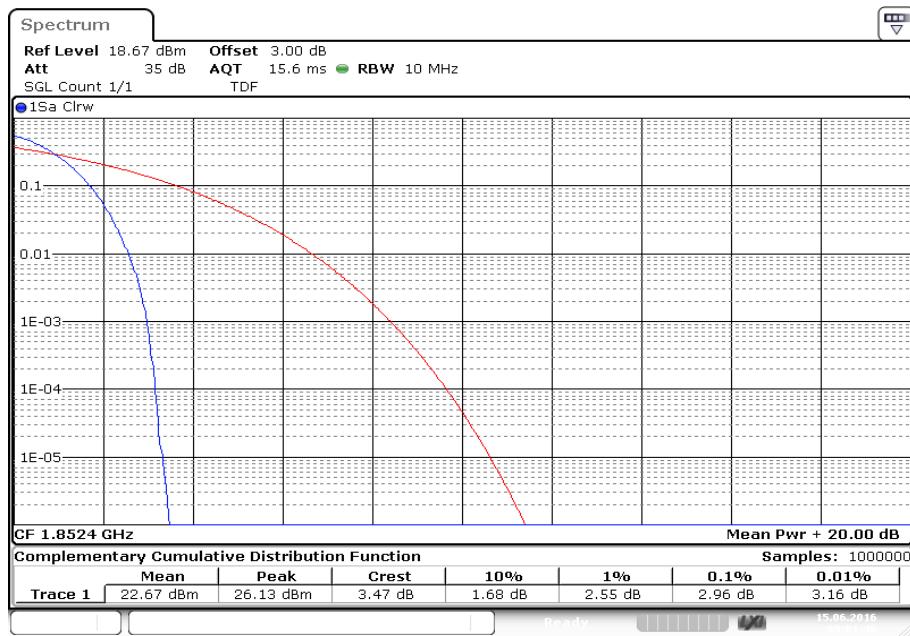
FCC	IC
CFR Part 24.232 CFR Part 2.1046	RSS 133
Nominal Peak Output Power	
+33.00 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

Output Power (conducted) WCDMA mode			
Frequency (MHz)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
1852.4	24.7*	28.1*	2.96
1880.0	22.9*	26.0*	2.81
1907.6	22.9*	26.0*	2.78

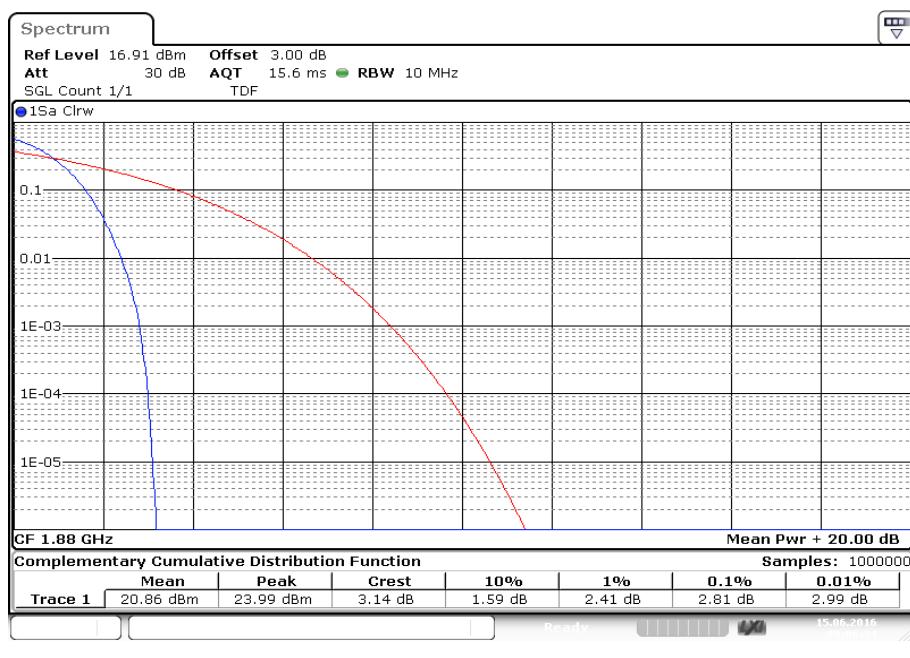
\*measured at the external antenna connector

Output Power (radiated) WCDMA mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1852.4	27.4*
1880.0	26.8*
1907.6	27.7*

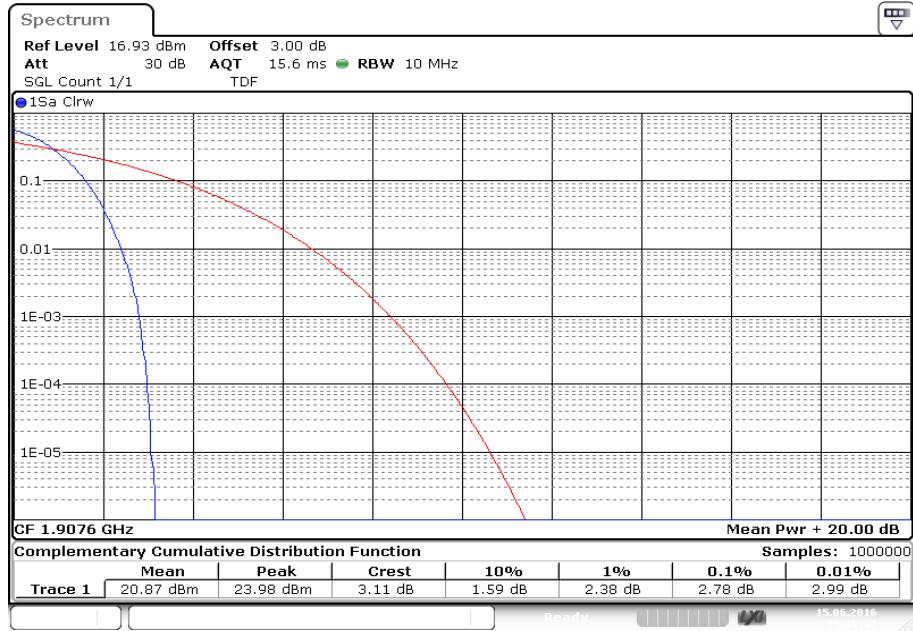
\*measured with integrated antenna

**Plots:****Plot 1: UMTS Band II, low channel**

+additional cable attenuation: 2dB

**Plot 2: UMTS Band II, mid channel**

+additional cable attenuation: 2dB

**Plot 3:** UMTS Band II, high channel

+additional cable attenuation: 2dB

### 11.3.2 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.

13. Measure the carrier frequency at room temperature.
14. Subject the mobile station to overnight soak at -30 C.
15. With the mobile station powered with  $V_{\text{nom}}$  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.
16. 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.
17. Remeasure carrier frequency at room temperature with  $V_{\text{nom}}$ . Vary supply voltage to  $V_{\text{min}}$  and measure the carrier frequency then setup  $V_{\text{max}}$  and repeat the measurement.
18. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

**Measurement:**

<b>Measurement parameters</b>	
Detector:	
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	Measured with CMU200
Span:	
Trace mode:	
Test setup:	See chapter 7.4 – B
Measurement uncertainty:	See chapter 9

**Limits:**

FCC	IC
± 2.5 ppm	

**Results:****AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
9	-10	-0.00000053	-0.0053
12	8	0.00000043	0.0043
16	28	0.00000149	0.0149

**AFC FREQ ERROR versus TEMPERATURE**

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	30	0.00000160	0.0160
-20	19	0.00000101	0.0101
-10	-4	-0.00000021	-0.0021
± 0	-40	-0.00000213	-0.0213
10	-15	-0.00000080	-0.0080
20	-5	-0.00000027	-0.0027
30	9	0.00000048	0.0048
40	-29	-0.00000154	-0.0154
50	15	0.00000080	0.0080

### 11.3.3 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. This was rounded up to 20 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 UMTS band II.

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

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- b) The antenna output was terminated in a 50 ohm load (if possible).
- c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) 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.
- e) 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
Measurement uncertainty:	See section 9
Test setup:	A (as of section 7.2 and 7.3)

#### Limits:

FCC	IC
CFR Part 24.238 CFR Part 2.1053	RSS 133
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 II (1852.4 MHz, 1880.0 MHz and 1907.6 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 II 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.

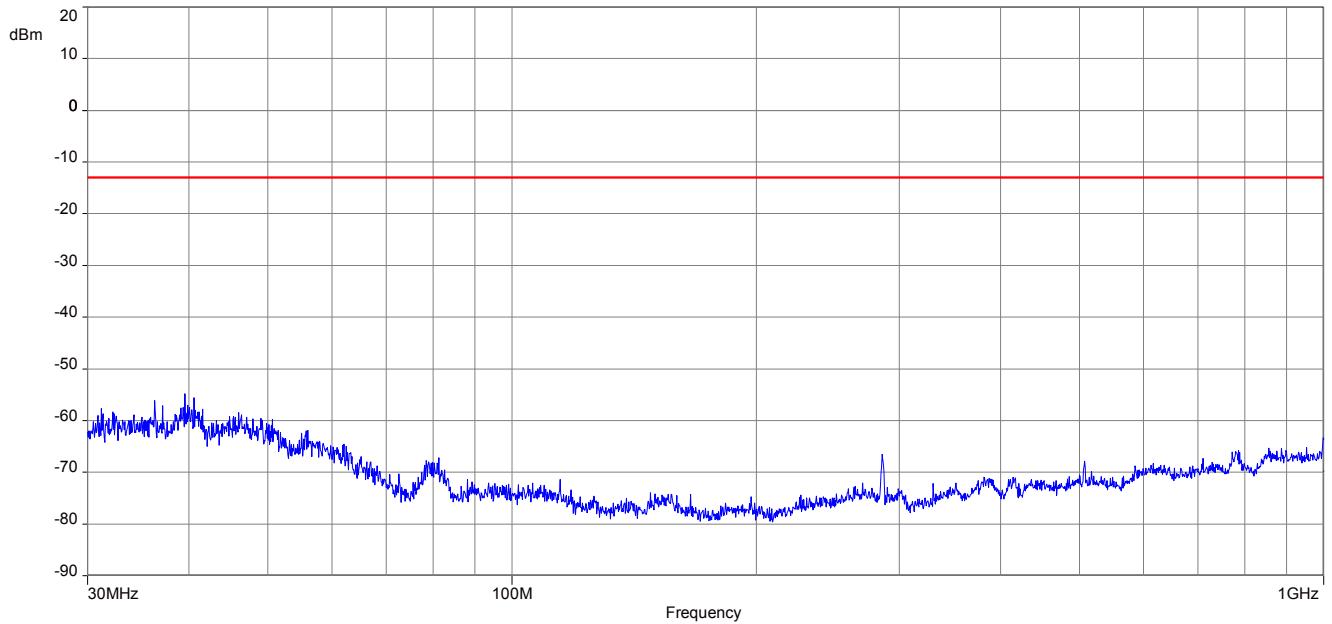
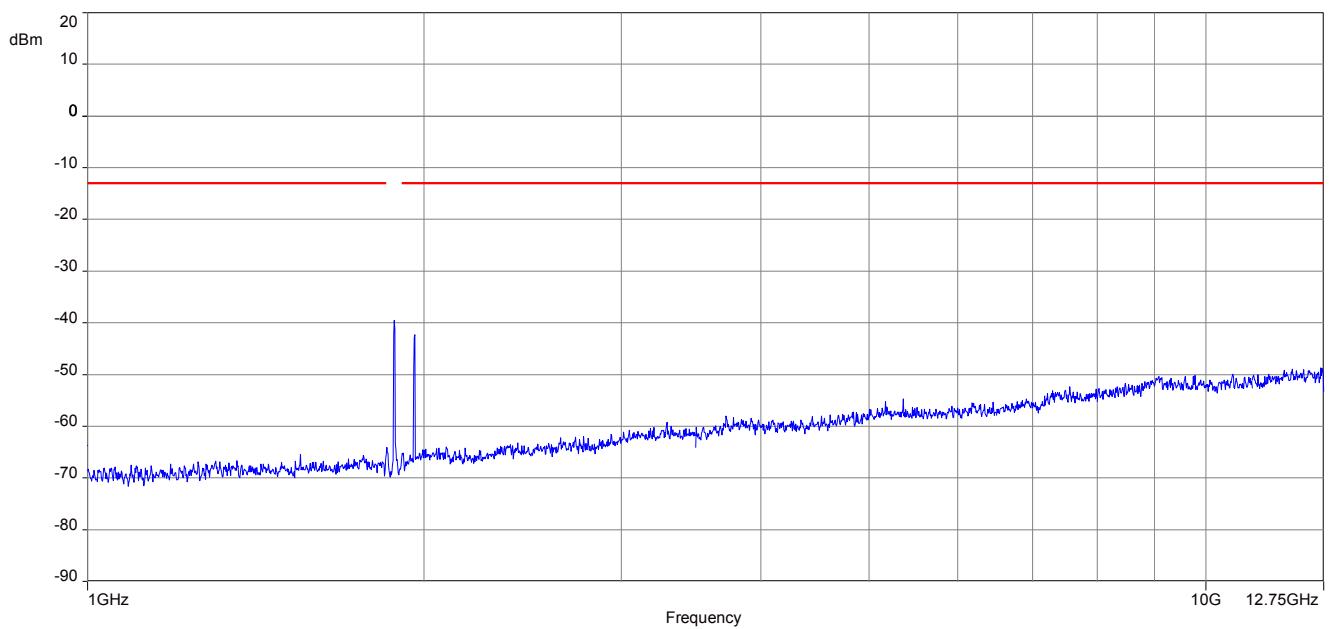
The final open field radiated levels are presented on the next pages.

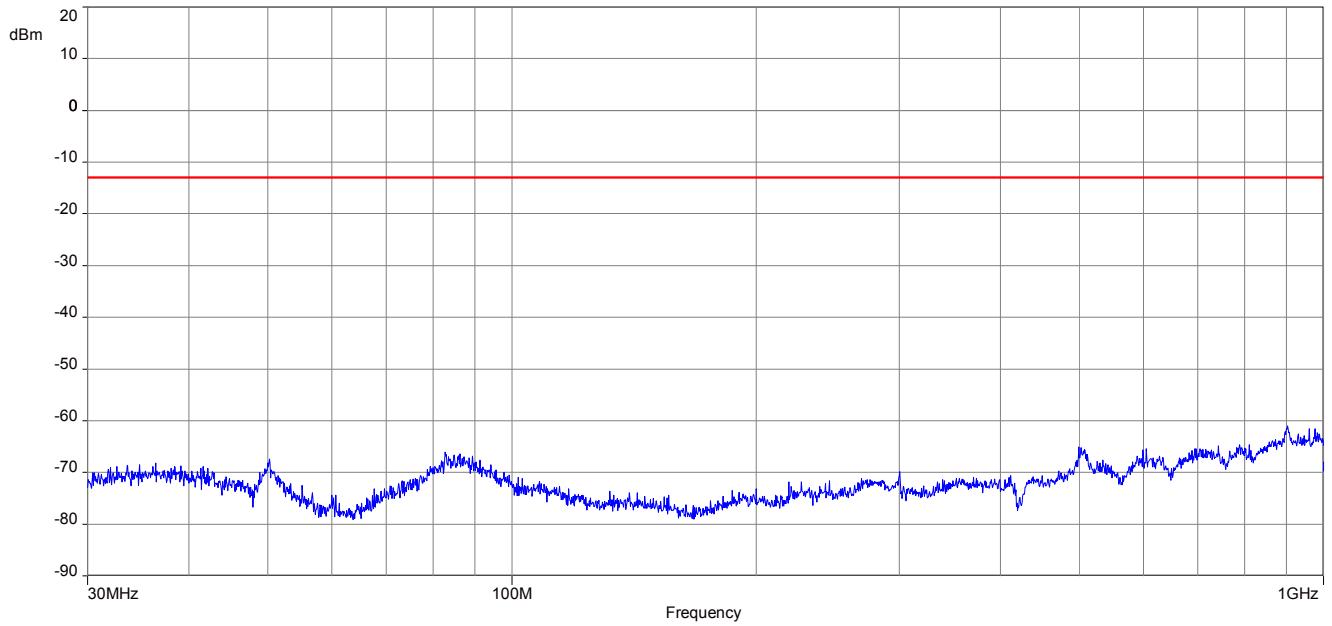
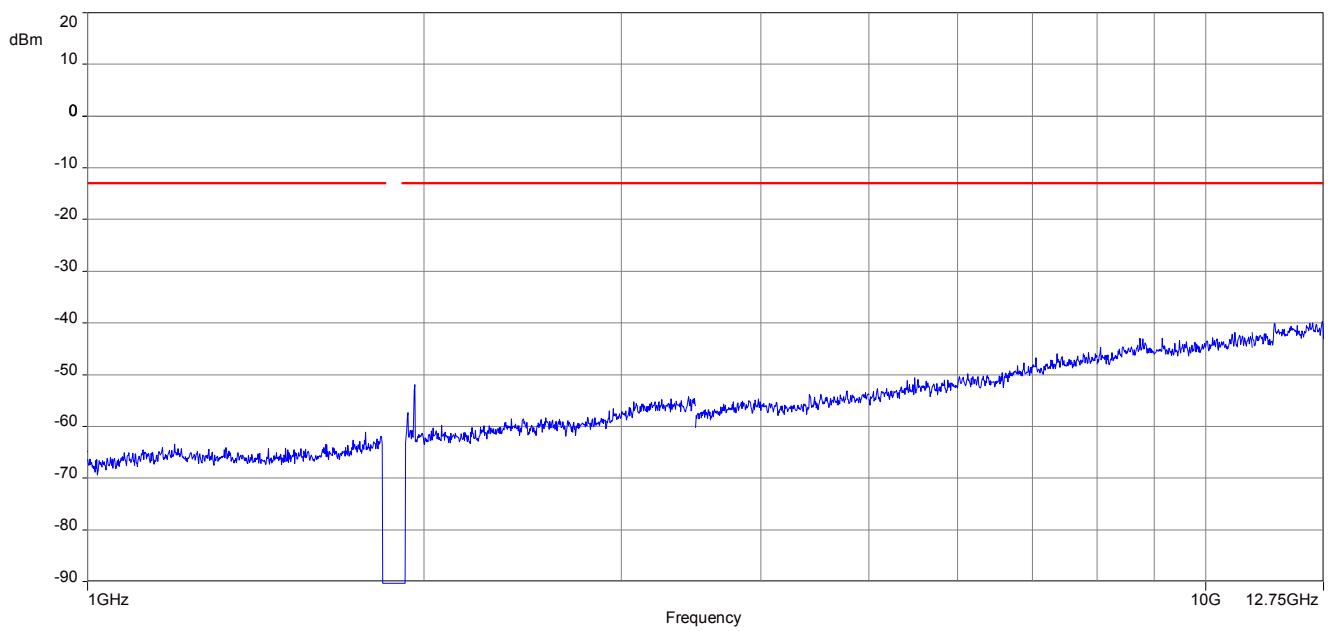
All measurements were done in horizontal and vertical polarization; the plots show the worst case.

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.

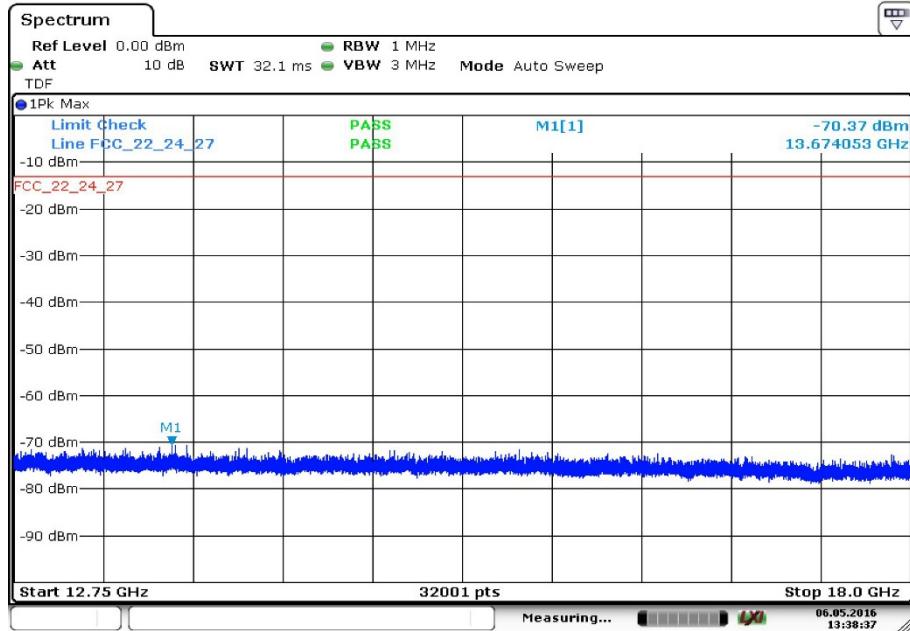
As can be seen from this data, the emissions from the test item were within the specification limit.

Spurious Emission Level (dBm)								
Harmonic	Ch. 9262 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9400 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9538 Freq. (MHz)	Level [dBm]
2	3704.8	-	2	3760.0	-	2	3815.2	-
3	5557.2	-	3	5640.0	-	3	5722.8	-
4	7409.6	-	4	7520.0	-	4	7630.4	-
5	9262.0	-	5	9400.0	-	5	9538.0	-
6	11114.4	-	6	11280.0	-	6	11445.6	-
7	12966.8	-	7	13160.0	-	7	13353.2	-
8	14819.2	-	8	15040.0	-	8	15260.8	-
9	16671.6	-	9	16920.0	-	9	17168.4	-
10	18524.0	-	10	18800.0	-	10	19076.0	-

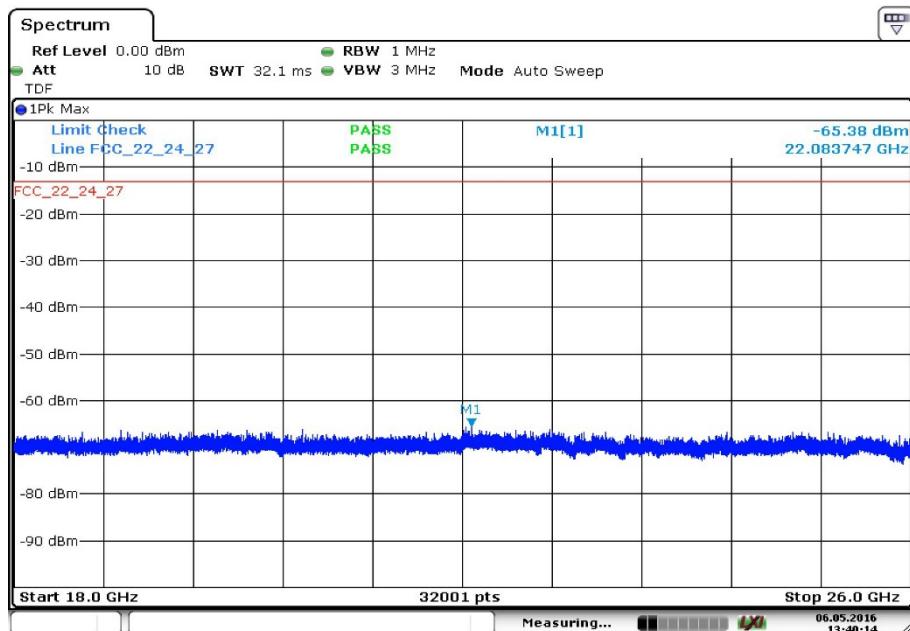
**Plots:****Plot 1:** Channel 9400 (30 MHz – 1 GHz) integrated antenna**Plot 2:** Channel 9400 (1 GHz – 12.75 GHz) integrated antenna*Carrier notched with 1.9 GHz rejection filter*

**Plot 3:** Channel 9400 (30 MHz – 1 GHz) external antenna**Plot 4:** Channel 9400 (1 GHz – 12.75 GHz) external antenna

*Carrier notched with 1.9 GHz rejection filter*

**Plot 5:** Channel 9400 (12.75 GHz - 18 GHz) – valid for both antennas

Date: 6.MAY.2016 13:38:37

**Plot 6:** Channel 9400 (18 GHz - 26 GHz) – valid for both antennas

Date: 6.MAY.2016 13:40:14

### 11.3.4 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 20 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

UMTS band II Transmitter Channel Frequency

9262 1852.4 MHz

9400 1880.0 MHz

9538 1907.6 MHz

#### Measurement:

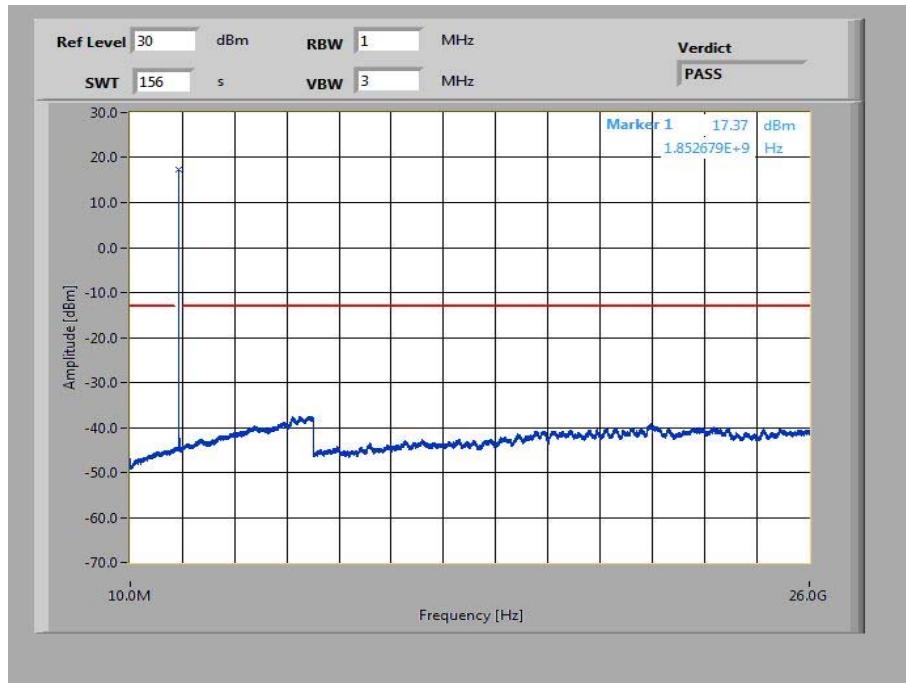
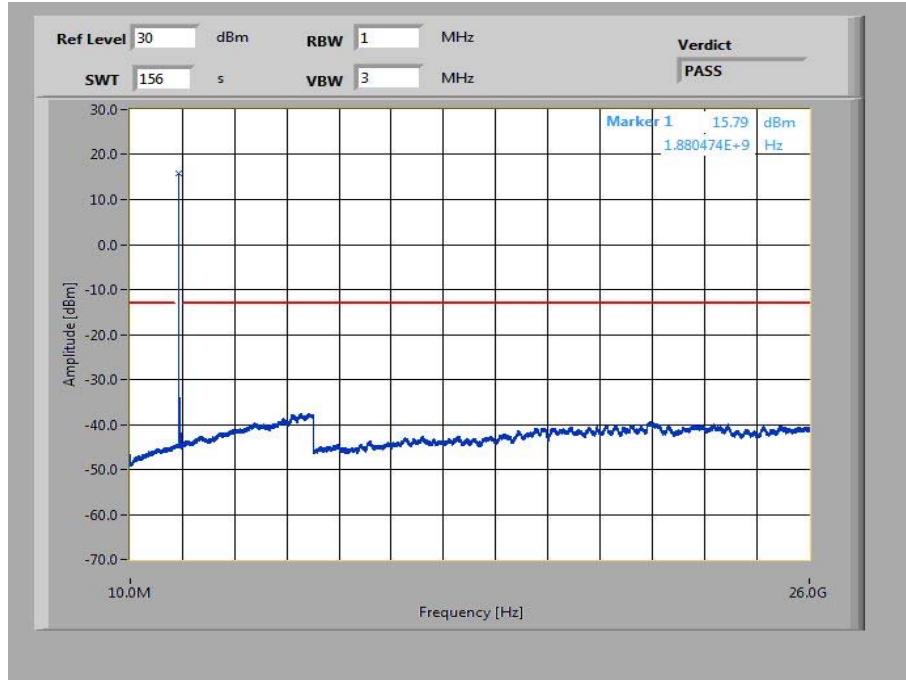
Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	steps
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

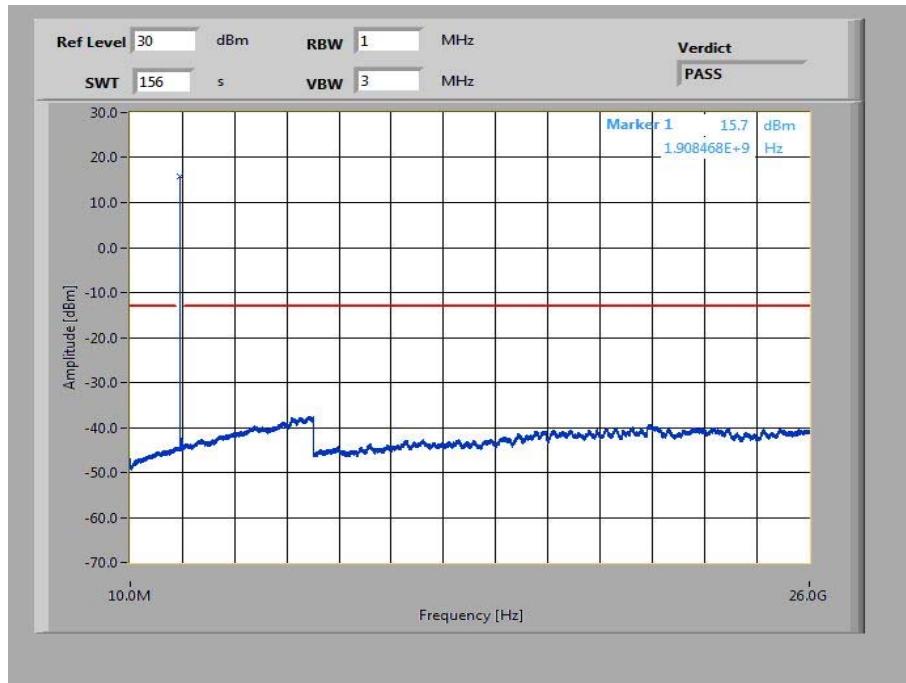
#### Limits:

FCC	IC
CFR Part 24.238 CFR Part 2.1051	RSS 133
Spurious Emissions Conducted	
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

**Results:**

Spurious Emission Level (dBm)								
Harmonic	Ch. 9262 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9400 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9538 Freq. (MHz)	Level [dBm]
2	3704.8	-	2	3760.0	-	2	3815.2	-
3	5557.2	-	3	5640.0	-	3	5722.8	-
4	7409.6	-	4	7520.0	-	4	7630.4	-
5	9262.0	-	5	9400.0	-	5	9538.0	-
6	11114.4	-	6	11280.0	-	6	11445.6	-
7	12966.8	-	7	13160.0	-	7	13353.2	-
8	14819.2	-	8	15040.0	-	8	15260.8	-
9	16671.6	-	9	16920.0	-	9	17168.4	-
10	18524.0	-	10	18800.0	-	10	19076.0	-

**Plots:****Plot 1:** Channel 9262 (10 MHz - 26 GHz)**Plot 2:** Channel 9400 (10 MHz - 26 GHz)

**Plot 3:** Channel 9538 (10 MHz - 26 GHz)

### 11.3.5 Block edge compliance

#### Description:

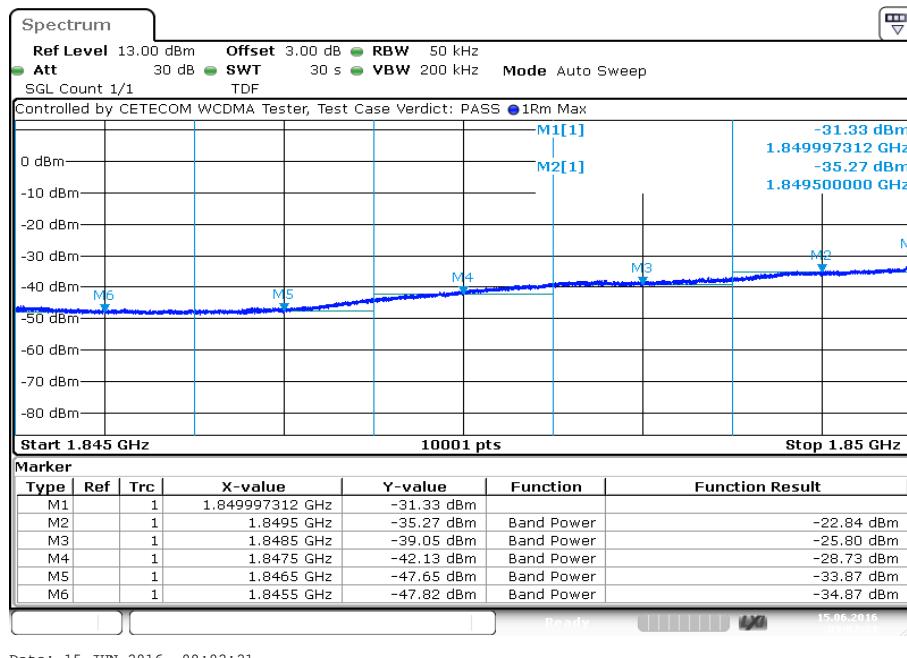
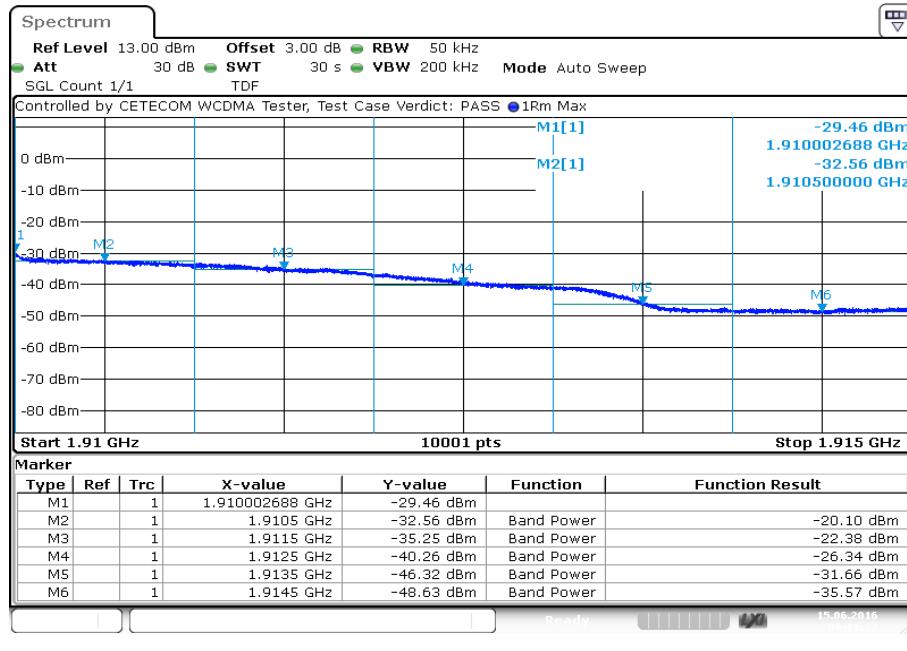
The spectrum at the band edges must comply with the spurious emissions limits.

#### Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

#### Limits:

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

**Plots:****Plot 1: Channel 9262****Plot 2: Channel 9538**

### 11.3.6 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 II frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 24.238 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.

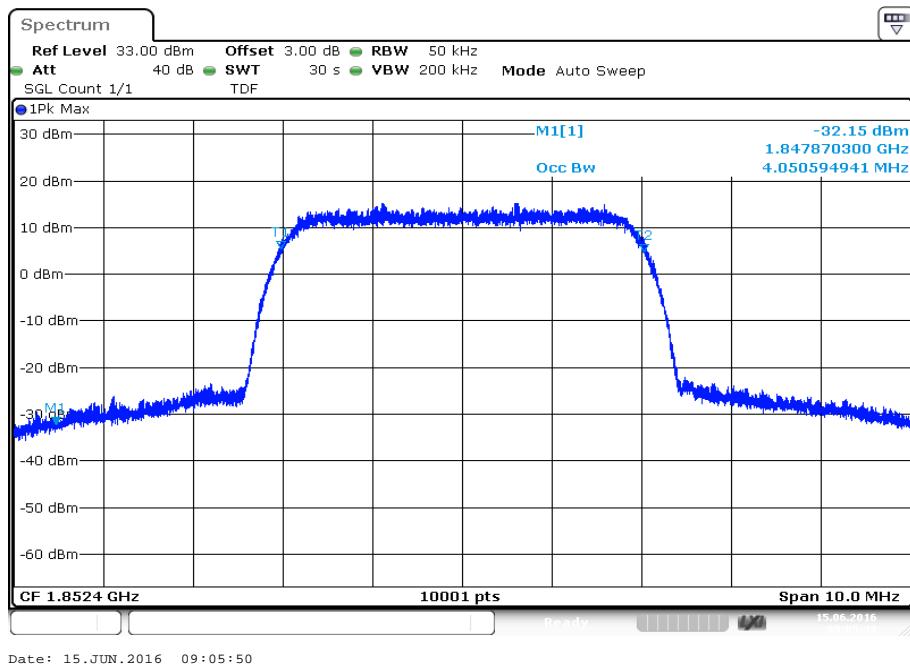
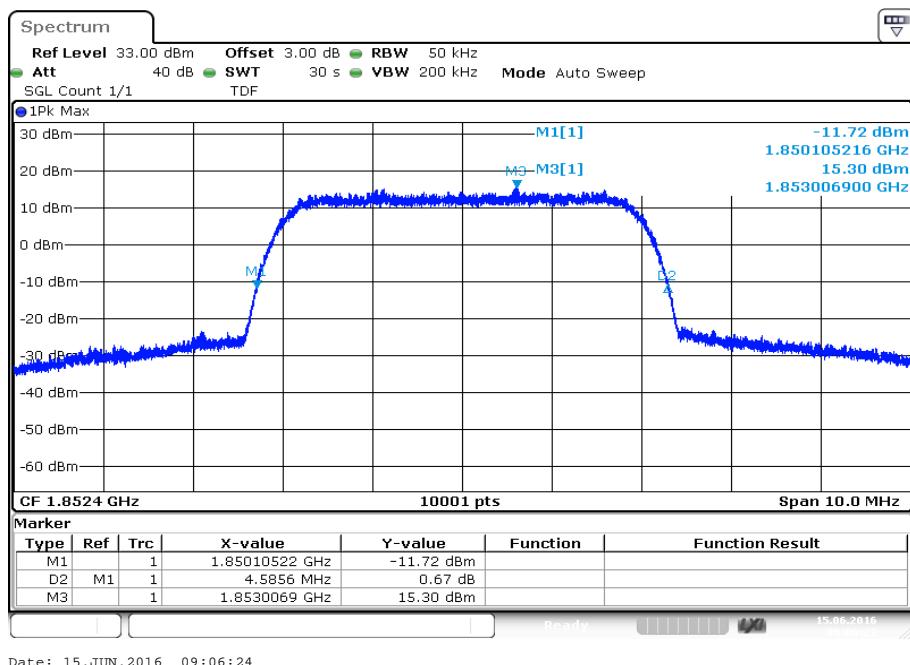
<b>Measurement parameters</b>	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

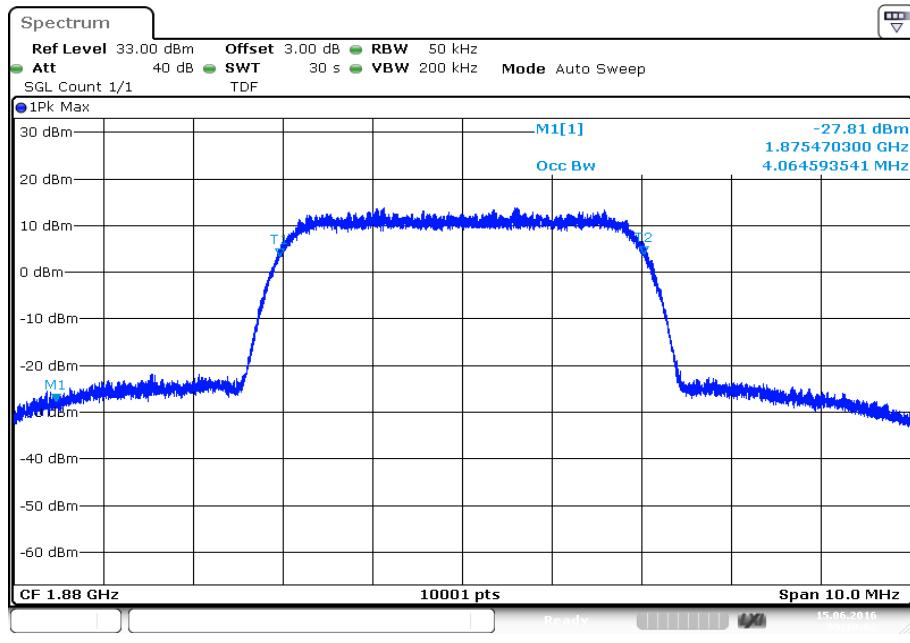
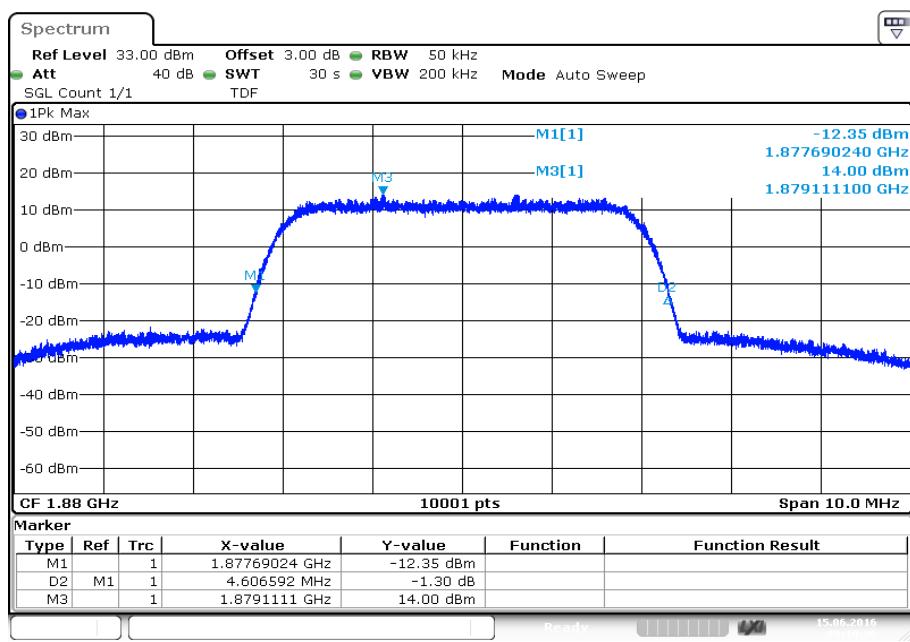
**Limits:**

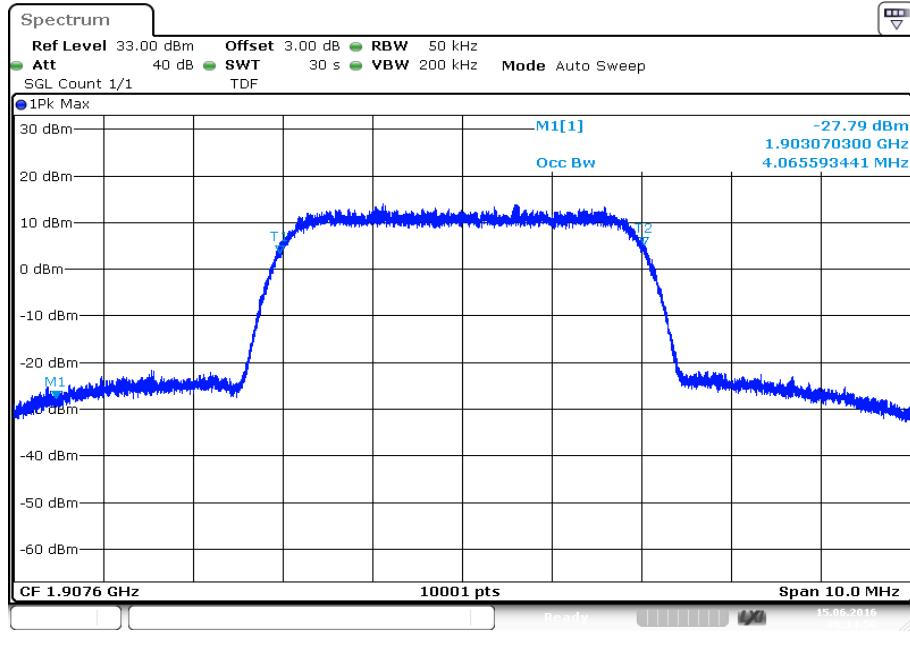
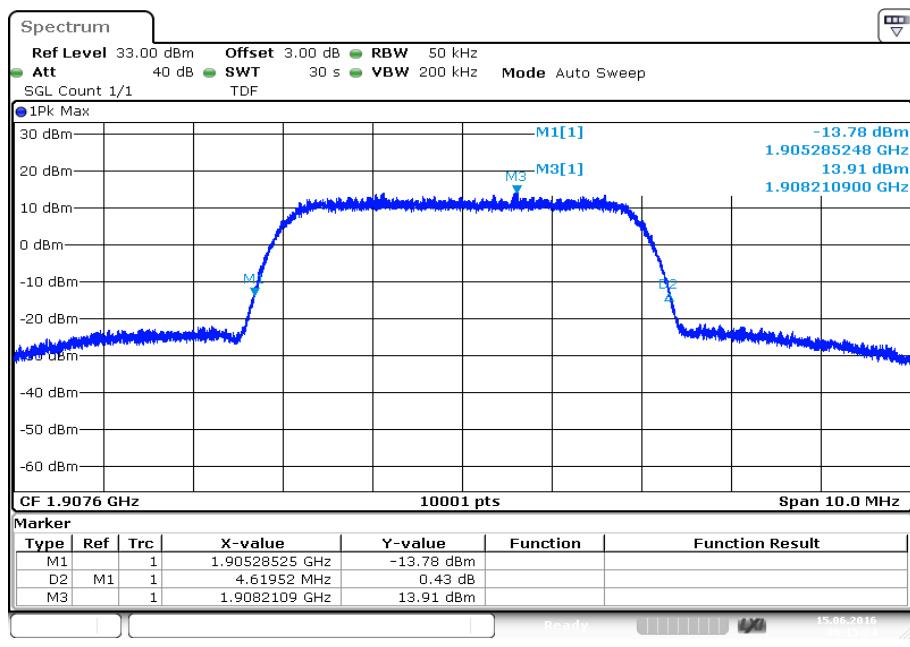
FCC	IC
CFR Part 24.238 CFR Part 2.1049	RSS 133
Occupied Bandwidth	
Spectrum must fall completely in the specified band	

**Results:**

<b>Occupied Bandwidth</b>		
<b>Frequency (MHz)</b>	<b>99% OBW (kHz)</b>	<b>-26 dBc BW (kHz)</b>
1852.4	4051	4586
1880.0	4065	4607
1907.6	4066	4620
Measurement uncertainty	$\pm 100$ kHz	

**Plots:****Plot 1: Channel 9262 (99% - OBW)****Plot 2: Channel 9262 (-26 dBc BW)**

**Plot 3: Channel 9400 (99% - OBW)****Plot 4: Channel 9400 (-26 dBc BW)**

**Plot 5: Channel 9538 (99% - OBW)****Plot 6: Channel 9538 (-26 dBc BW)**

## 11.4 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)

### 11.4.1 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
Measurement uncertainty:	See section 9
Test setup:	A (as of section 7.1)

#### Limits:

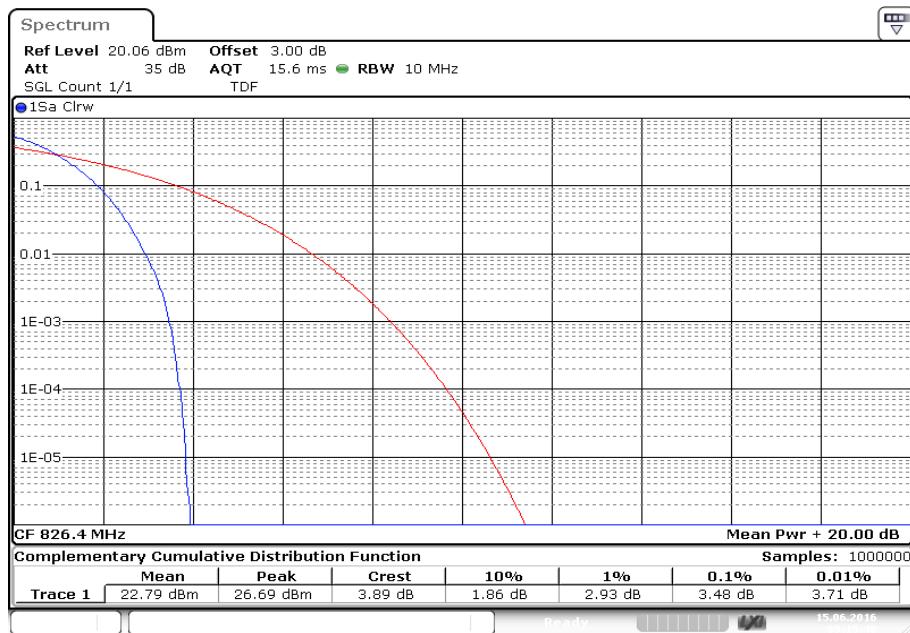
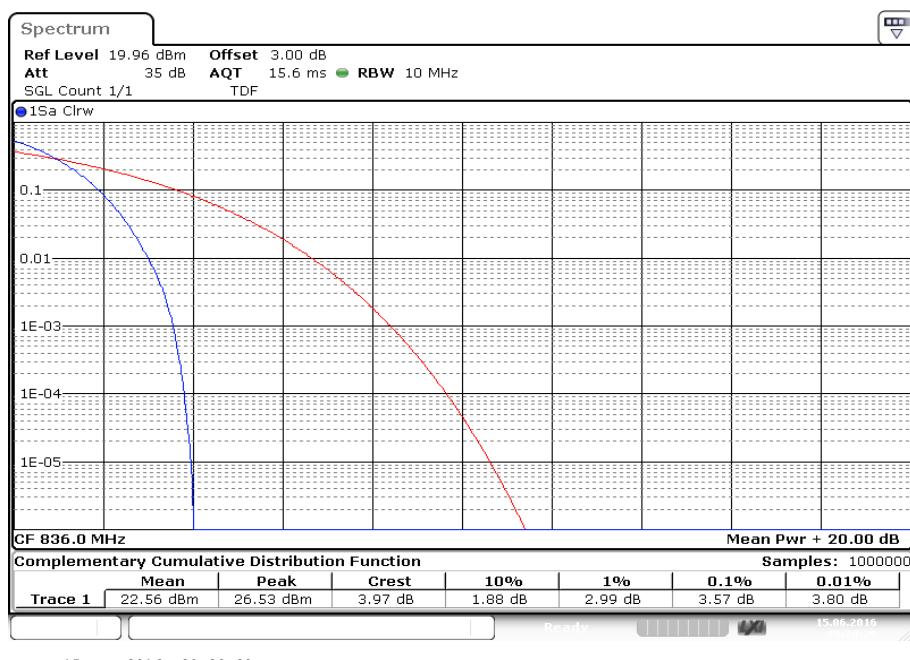
FCC	IC
CFR Part 22.913 CFR Part 2.1046	RSS 132
Nominal Peak Output Power	
+38.45 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

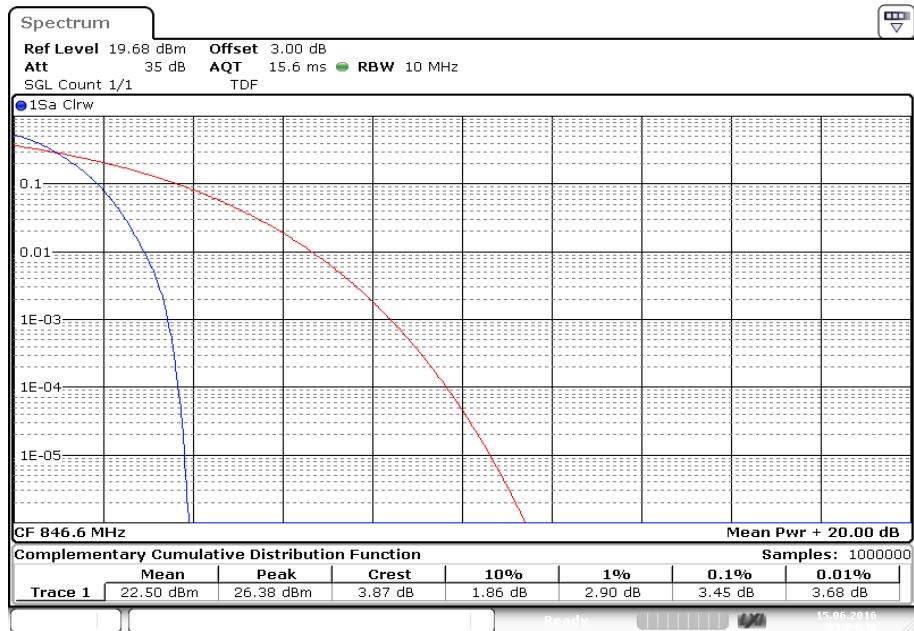
Output Power (conducted) WCDMA mode			
Frequency (MHz)	Average Output Power (dBm)	Peak output power (dBm)	Peak to Average Ratio 0.1% (dB)
826.4	22.8*	26.7*	3.48
836.0	22.6*	26.5*	3.57
846.6	22.5*	26.4*	3.45

\*measured at the external antenna connector

Output Power (radiated) WCDMA mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
826.4	18.7*
836.0	20.9*
846.6	22.8*

\*measured with integrated antenna

**Plots:****Plot 1: UMTS Band V, low channel****Plot 2: UMTS Band V, mid channel**

**Plot 3:** UMTS Band V, high channel

Date: 15.JUN.2016 09:24:42

## 11.4.2 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.

19. Measure the carrier frequency at room temperature.
20. Subject the mobile station to overnight soak at -30 C.
21. With the mobile station powered with  $V_{\text{nom}}$  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.
22. 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.
23. Remeasure carrier frequency at room temperature with  $V_{\text{nom}}$ . Vary supply voltage to  $V_{\text{min}}$  and measure the carrier frequency then setup  $V_{\text{max}}$  and repeat the measurement.
24. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

### Measurement:

Measurement parameters	
Detector:	
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	Measured with CMU200
Span:	
Trace mode:	
Test setup:	See chapter 7.4 – B
Measurement uncertainty:	See chapter 9

### Limits:

FCC	IC
± 2.5 ppm	

**Results:****AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
9	12	0.00000144	0.0144
12	2	0.00000024	0.0024
16	-11	-0.00000132	-0.0132

**AFC FREQ ERROR versus TEMPERATURE**

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	-19	-0.00000227	-0.0227
-20	-11	-0.00000132	-0.0132
-10	-4	-0.00000048	-0.0048
± 0	2	0.00000024	0.0024
10	-7	-0.00000084	-0.0084
20	-15	-0.00000179	-0.0179
30	-14	-0.00000167	-0.0167
40	12	0.00000144	0.0144
50	3	0.00000036	0.0036

### 11.4.3 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. Measured 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 UMTS band V.

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

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- b) The antenna output was terminated in a 50 ohm load (if possible).
- c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) 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.
- e) 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
Measurement uncertainty:	See section 9
Test setup:	A + B (as of section 7.1)

#### 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.

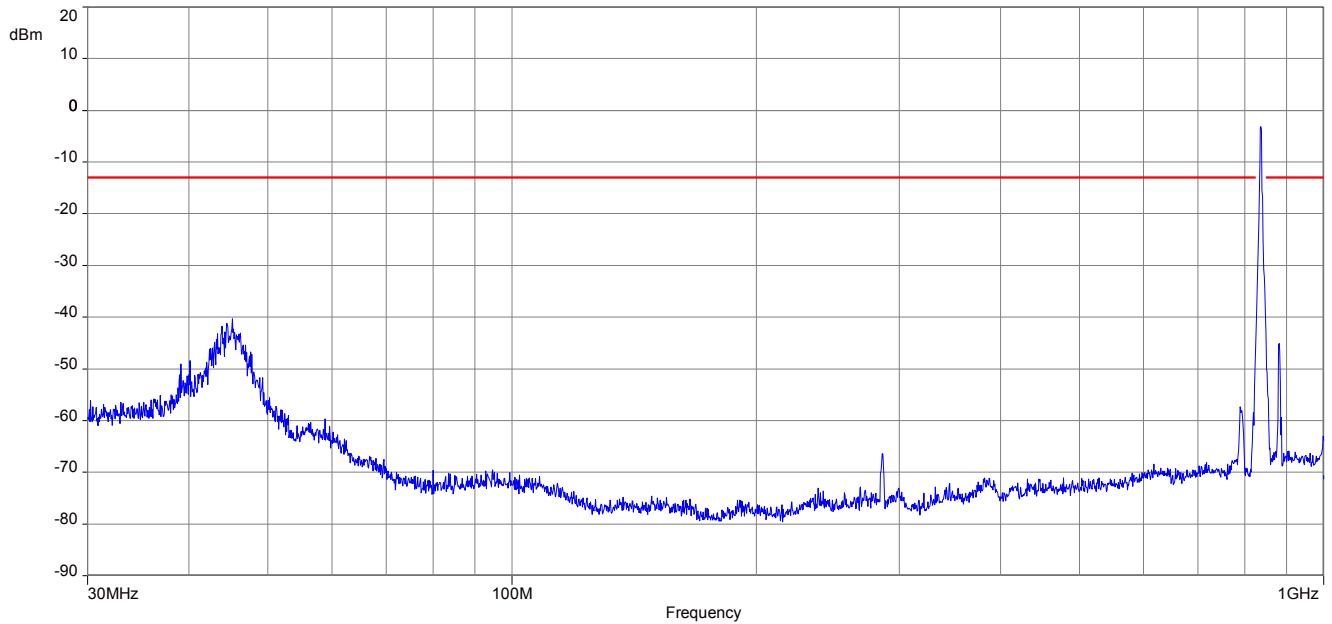
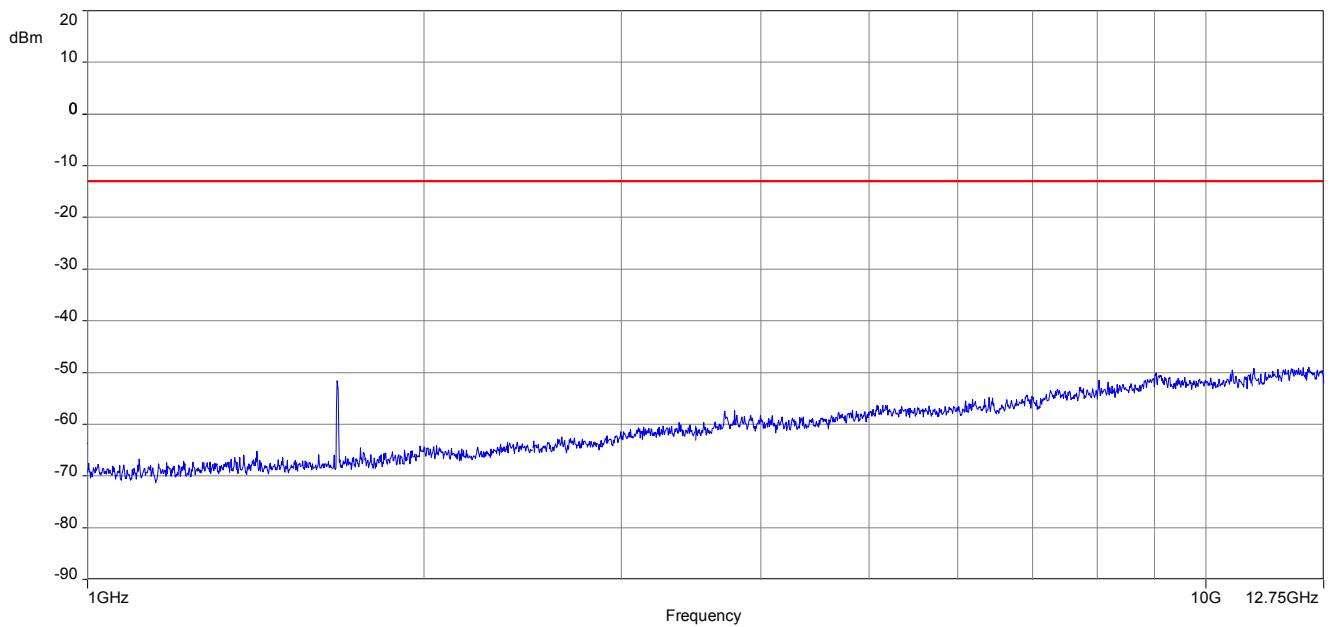
The final open field radiated levels are presented on the next pages.

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

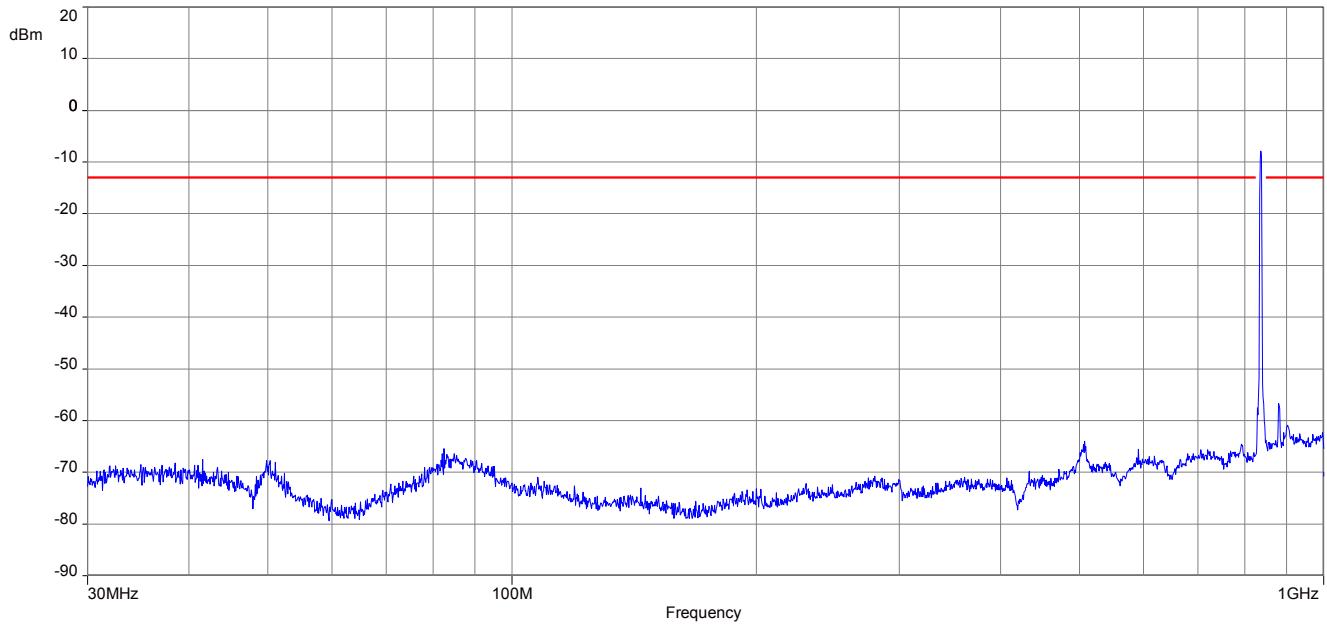
The plots show only the middle channel. If spurious were detected, the lowest and highest channel were checked too. The found values are stated in the table below.

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

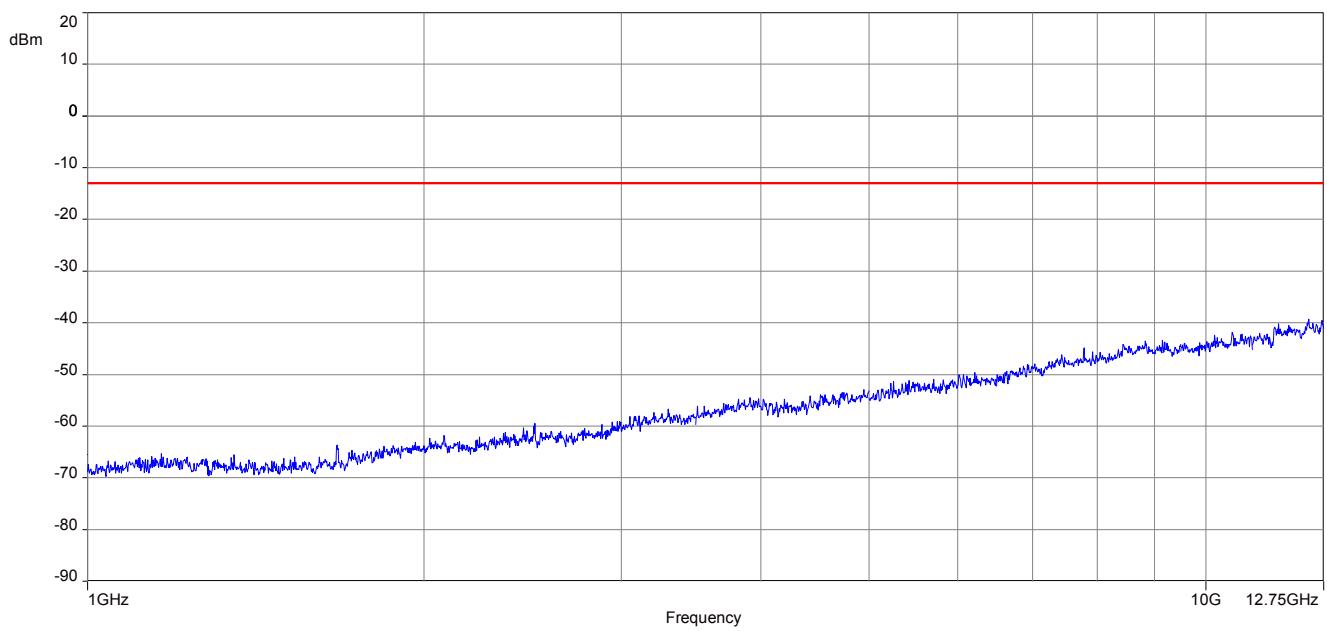
Spurious Emission Level (dBm)								
Harmonic	Ch. 4132 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4180 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4233 Freq. (MHz)	Level [dBm]
2	1652.8	-	2	1672.0	-	2	1693.2	-
3	2479.2	-	3	2508.0	-	3	2539.8	-
4	3305.6	-	4	3344.0	-	4	3386.4	-
5	4132.0	-	5	4180.0	-	5	4233.0	-
6	4958.4	-	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) internal antenna**Plot 2:** Channel 4180 (1 GHz – 12.75 GHz) internal antenna

**Plot 3:** Channel 4180 (30 MHz – 1 GHz) external antenna



**Plot 4:** Channel 4180 (1 GHz – 12.75 GHz) external antenna



#### 11.4.4 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:

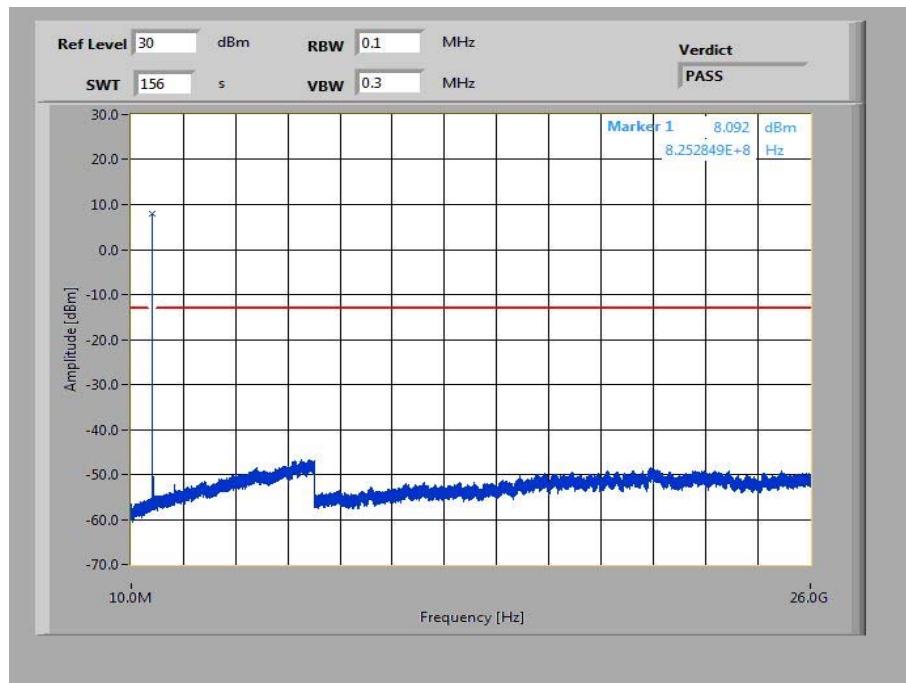
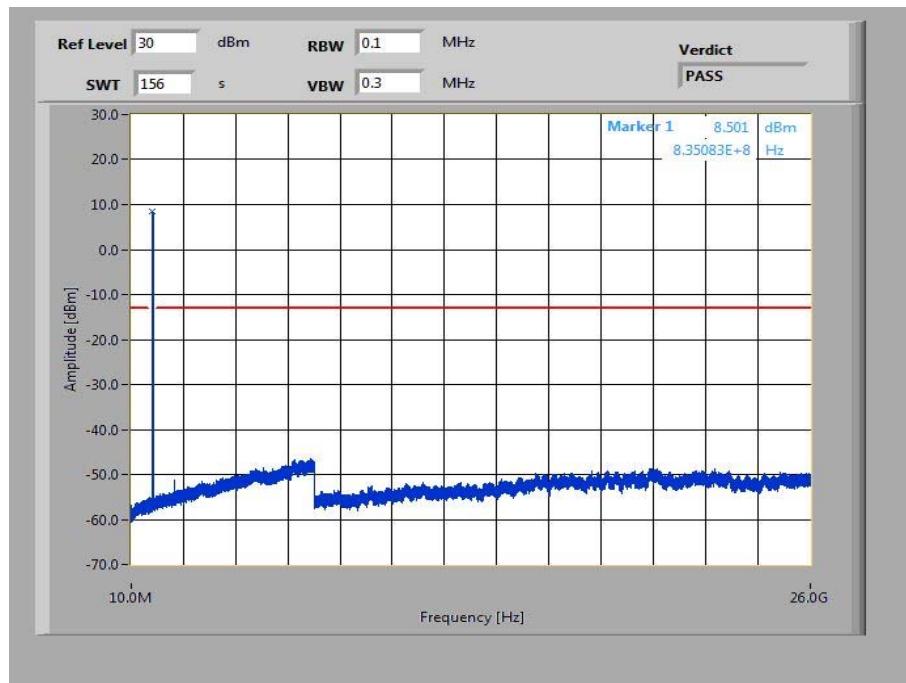
Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	steps
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

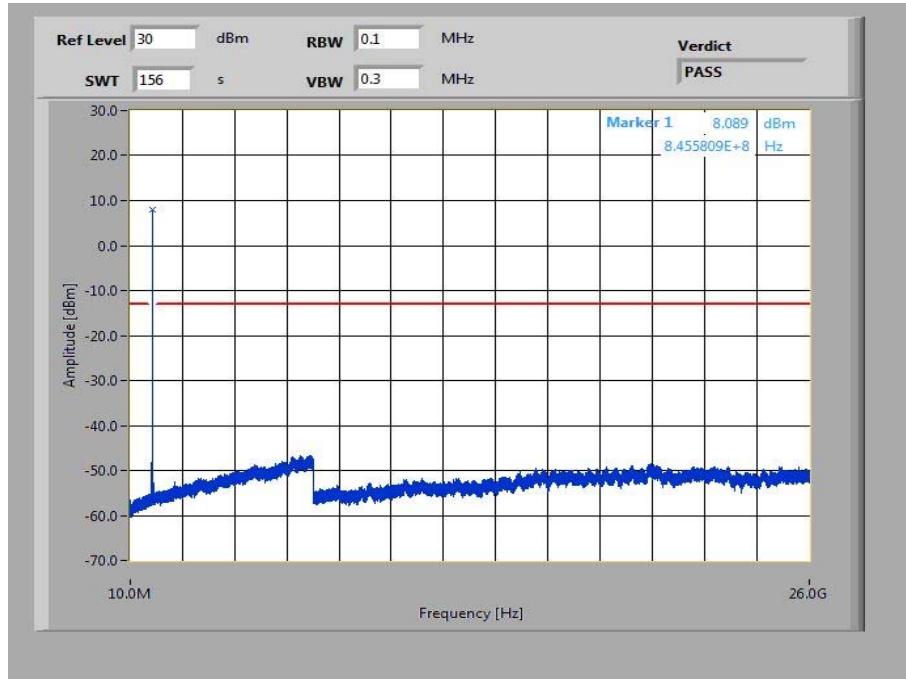
##### Limits:

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 - 26 GHz)**Plot 2:** Channel 4180 (10 MHz - 26 GHz)

**Plot 3:** Channel 4233 (10 MHz - 26 GHz)

### 11.4.5 Block edge compliance

#### Description:

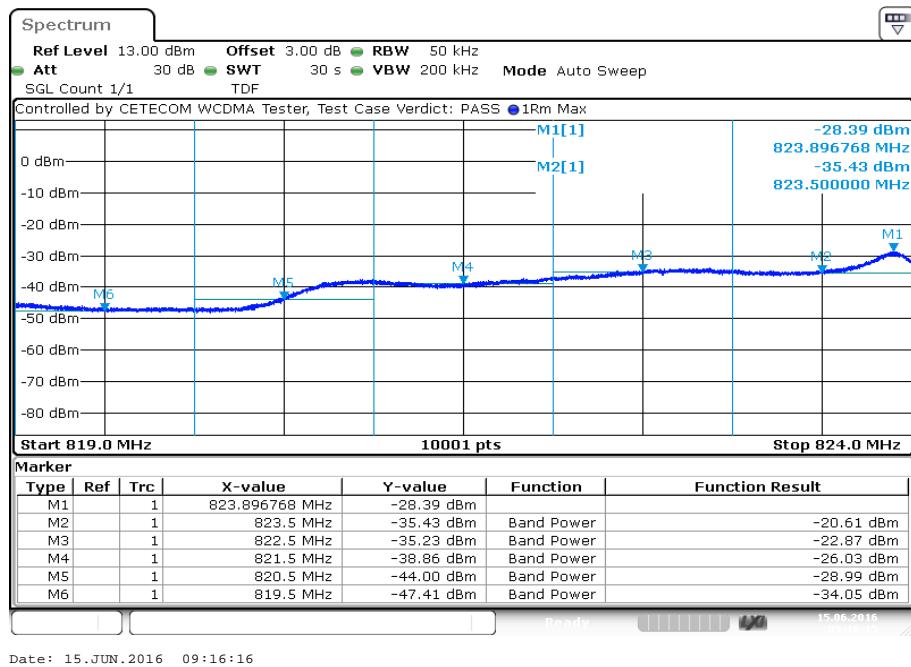
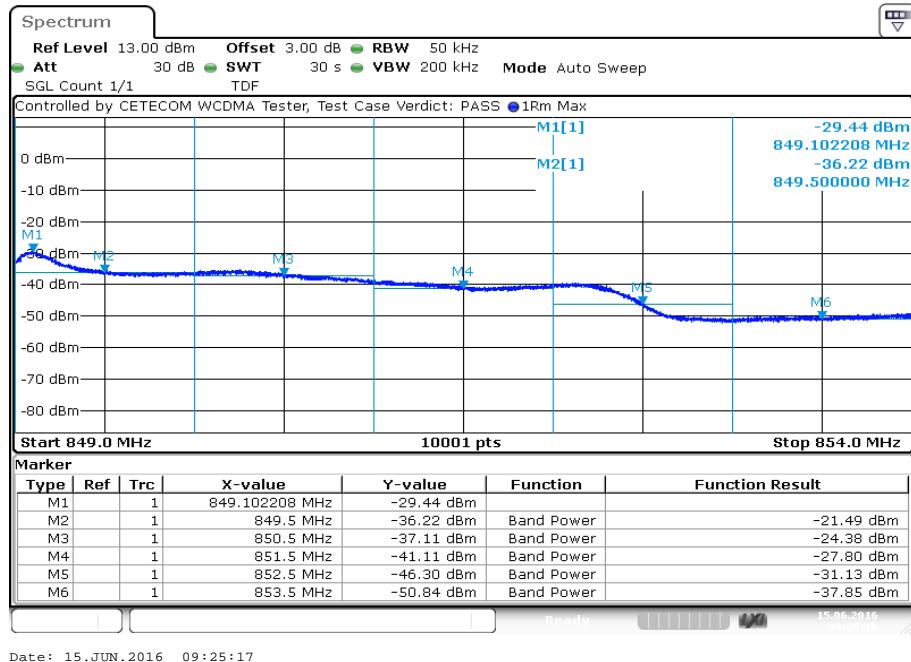
The spectrum at the band edges must comply with the spurious emissions limits.

#### Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

#### Limits:

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

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

## 11.4.6 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.

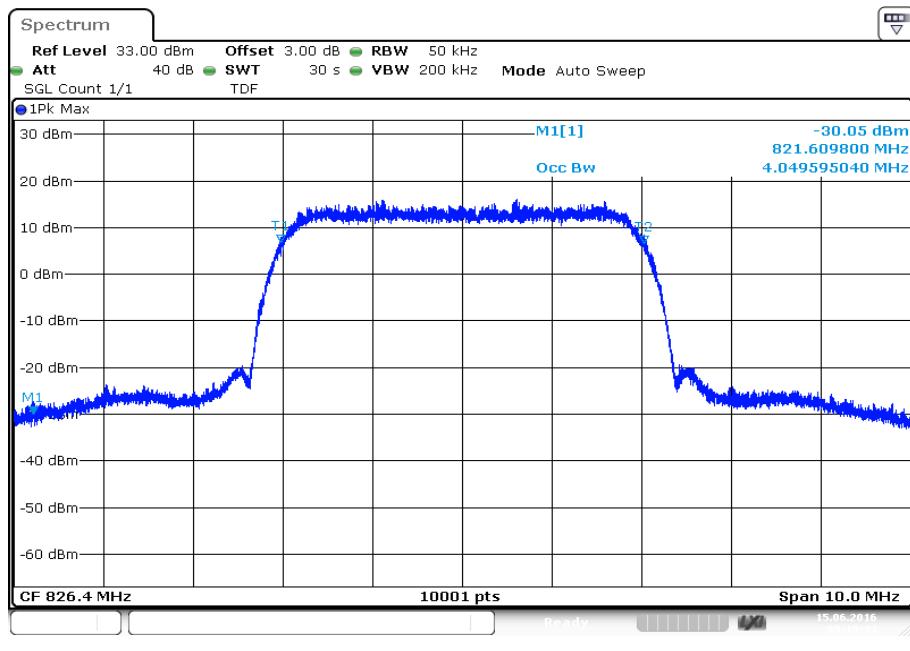
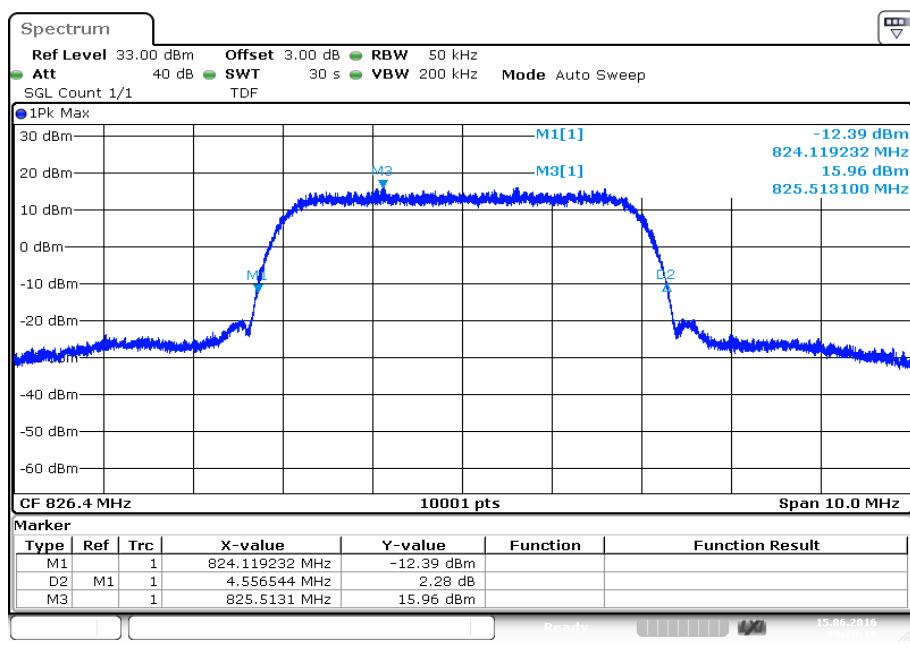
Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Measurement uncertainty:	See section 9
Test setup:	See chapter 7.4 - A

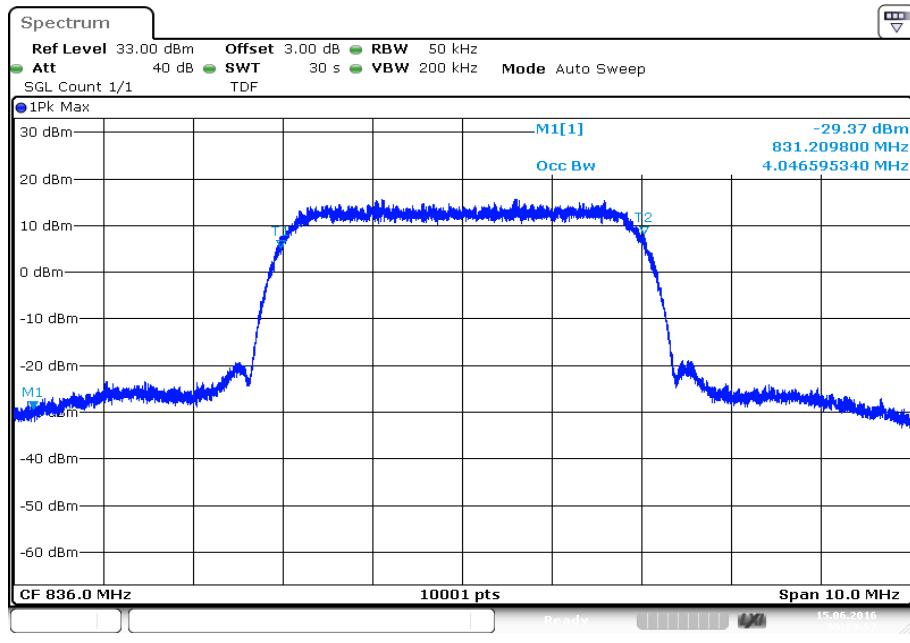
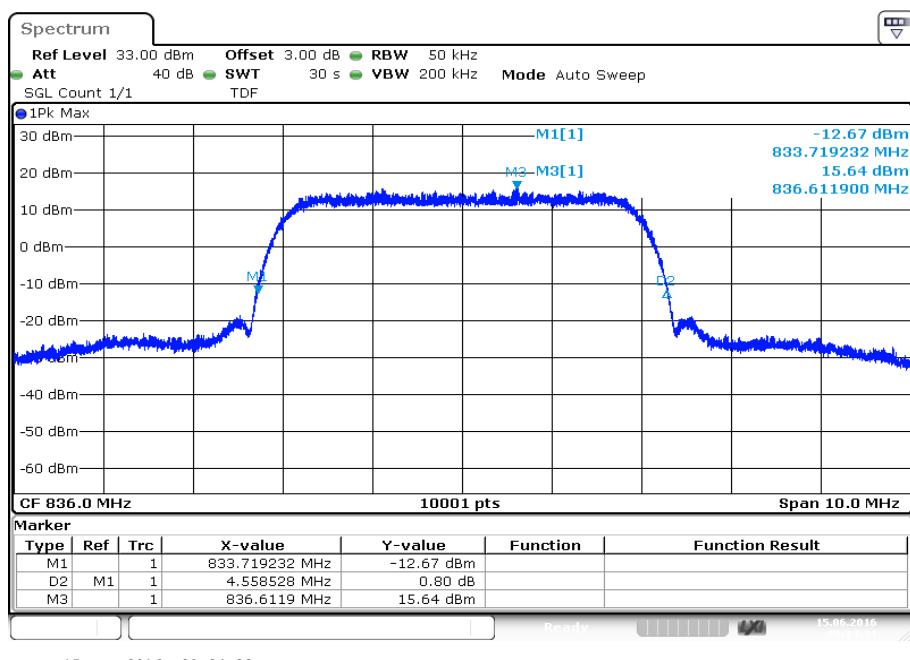
### Limits:

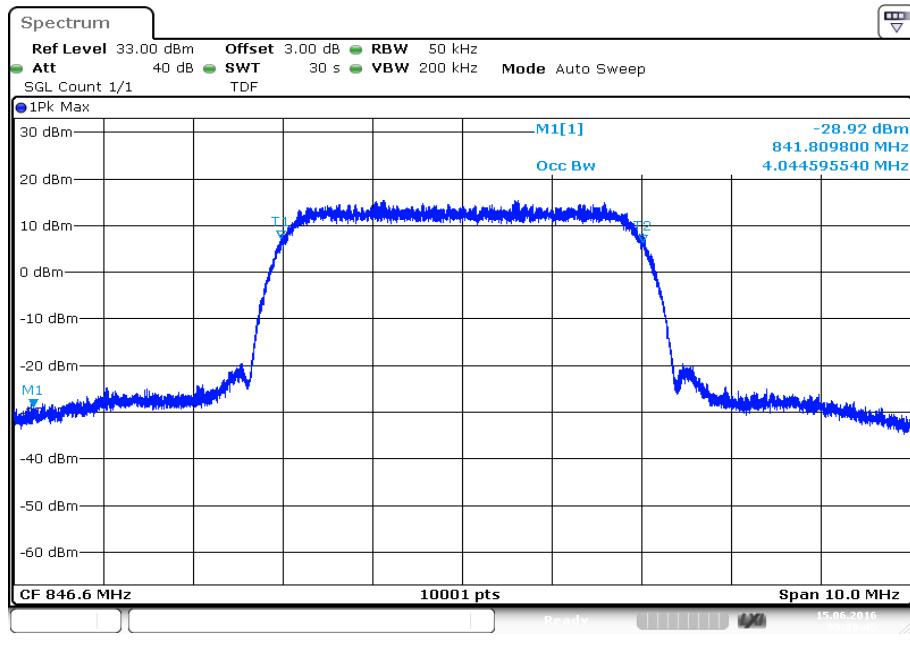
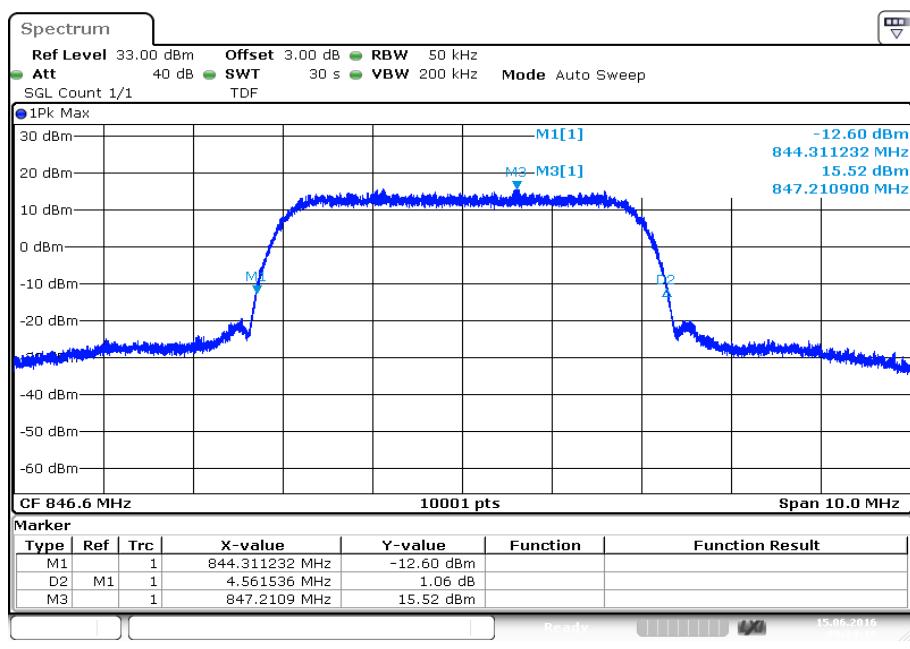
FCC	IC
CFR Part 22.917 CFR Part 2.1049	RSS 132
Occupied Bandwidth	
Spectrum must fall completely in the specified band	

### Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
826.4	4050	4557
836.0	4047	4559
846.6	4045	4562

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

**Plot 3: Channel 4180 (99% - OBW)****Plot 4: Channel 4180 (-26 dBc BW)**

**Plot 5: Channel 4233 (99% - OBW)****Plot 6: Channel 4233 (-26 dBc BW)**

## 12 Observations

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

## Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-05-24
-A	conducted results from external antenna connector added measurements with external antenna added	2016-06-23

## 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

## Annex C Accreditation Certificate

Front side of certificate

Back side of certificate



Deutsche Akkreditierungsstelle GmbH

Berelehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV  
Unterzeichnerin der Multilateralen Abkommen  
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Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

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

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Automotive  
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US-Anforderungen  
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Frankfurt, 04.05.2016  
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Im Auftrag Dipl.-Ing. (FH) Ralf Egner  
Abteilungsleiter

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