

CETECOM™

CETECOM ICT Services
consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-8297/14-04-02-A



Deutsche
Akkreditierungsstelle
D-PL-12076-01-00

Testing laboratory

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

Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-00

Applicant

peiker acustic GmbH & Co. KG
Max-Planck Str. 28-32
61381 Friedrichsdorf / GERMANY
Phone: -/-
Fax: +49 6172 767-220
Contact: Martin Fleckenstein
e-mail: martin.fleckenstein@peiker.de
Phone: +49 6172 767-1379

Manufacturer

peiker acustic GmbH & Co. KG
Max-Planck Str. 28-32
61381 Friedrichsdorf / 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: Advanced Telecommunication module (ATM) Roof Version
Model name: ATM-01 R1-RoW-4G
FCC ID: QWY-ATM-R-132

Frequency: GSM: 824.2 – 848.8 MHz, 1850.2 – 1909.8 MHz
UMTS: 826.4 – 846.6 MHz
Technology tested: GSM / EDGE, UMTS
Antenna: External and internal antenna
Power supply: 14.0 V DC by external power supply
Temperature range: -30°C to +60°C



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

Test report authorised:

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

Andreas Luckenbill
Lab Manager
Radio Communications & EMC

1 Table of contents

1 Table of contents2

2 General information3

 2.1 Notes and disclaimer3

 2.2 Application details.....3

3 Test standard/s3

 3.1 Measurement guidance.....3

4 Test environment.....4

5 Test item4

 5.1 Additional information4

6 Test laboratories sub-contracted4

7 Summary of measurement results5

 7.1 GSM 850.....5

 7.2 PCS 19005

 7.3 UMTS band V.....6

8 Description of test setup7

 8.1 Shielded fully anechoic chamber8

 8.2 Conducted measurements normal and extreme conditions.....9

9 Test Results10

 9.1 Results GSM 85010

 9.1.1 RF output power10

 9.1.2 Frequency stability12

 9.1.3 Spurious emissions conducted14

 9.1.4 Spurious emissions radiated.....18

 9.1.5 Block edge compliance24

 9.1.6 Occupied bandwidth27

 9.2 Results PCS 190035

 9.2.1 RF output power35

 9.2.2 Frequency stability37

 9.2.3 Spurious emissions radiated.....39

 9.2.4 Spurious emissions conducted47

 9.2.5 Block edge compliance51

 9.2.6 Occupied bandwidth54

 9.3 Results UMTS band V62

 9.3.1 RF output power62

 9.3.2 Frequency stability64

 9.3.3 Spurious emissions radiated.....66

 9.3.4 Spurious emissions conducted71

 9.3.5 Block edge compliance75

 9.3.6 Occupied bandwidth77

10 Observations82

Annex A Document history83

Annex B Further information.....83

Annex C Accreditation Certificate84

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.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.

The testing service provided by CETECOM ICT Services GmbH has been rendered under the current "General Terms and Conditions for CETECOM ICT Services GmbH".

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

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

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

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

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

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

This test report replaces the test report with the number 1-8297/14-04-02 and dated 2015-04-22

2.2 Application details

Date of receipt of order:	2014-12-19
Date of receipt of test item:	2015-02-17
Start of test:	2015-03-19
End of test:	2015-07-22
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard 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

3.1 Measurement guidance

Guidance	Version	Description
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices

4 Test environment

Temperature:	T_{nom}	+22 °C during room temperature tests
	T_{max}	+60 °C during high temperature tests
	T_{min}	-30 °C during low temperature tests
Relative humidity content:		42 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	14.0 V DC by external power supply
	V_{max}	18.0 V
	V_{min}	4.5 V

5 Test item

Kind of test item	:	Advanced Telecommunication module (ATM) Roof Version
Type identification	:	ATM-01 R1-RoW-4G
S/N serial number	:	Radiated unit: 0000503806 Conducted unit: 0000503803
HW hardware status	:	112.010.010
SW software status	:	001.017.047
Frequency band	:	GSM: 824.2 – 848.8 MHz, 1850.2 – 1909.8 MHz UMTS: 826.4 – 846.6 MHz
Type of modulation	:	GMSK, 8-PSK, QPSK
Antenna	:	External and internal antenna
Power supply	:	14.0 V DC by external power supply
Temperature range	:	-30°C to +60°C

5.1 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: 1-8297/14-04-01_AnnexA
1-8297/14-04-01_AnnexB
1-8297/14-04-01_AnnexC

6 Test laboratories sub-contracted

None

7 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	See table!	2015-07-22	-/-

7.1 GSM 850

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

Note: NA = Not applicable; NP = Not performed

7.2 PCS 1900

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

Note: NA = Not applicable; NP = Not performed

7.3 UMTS band V

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

Note: NA = Not applicable; NP = Not performed

8 Description of test setup

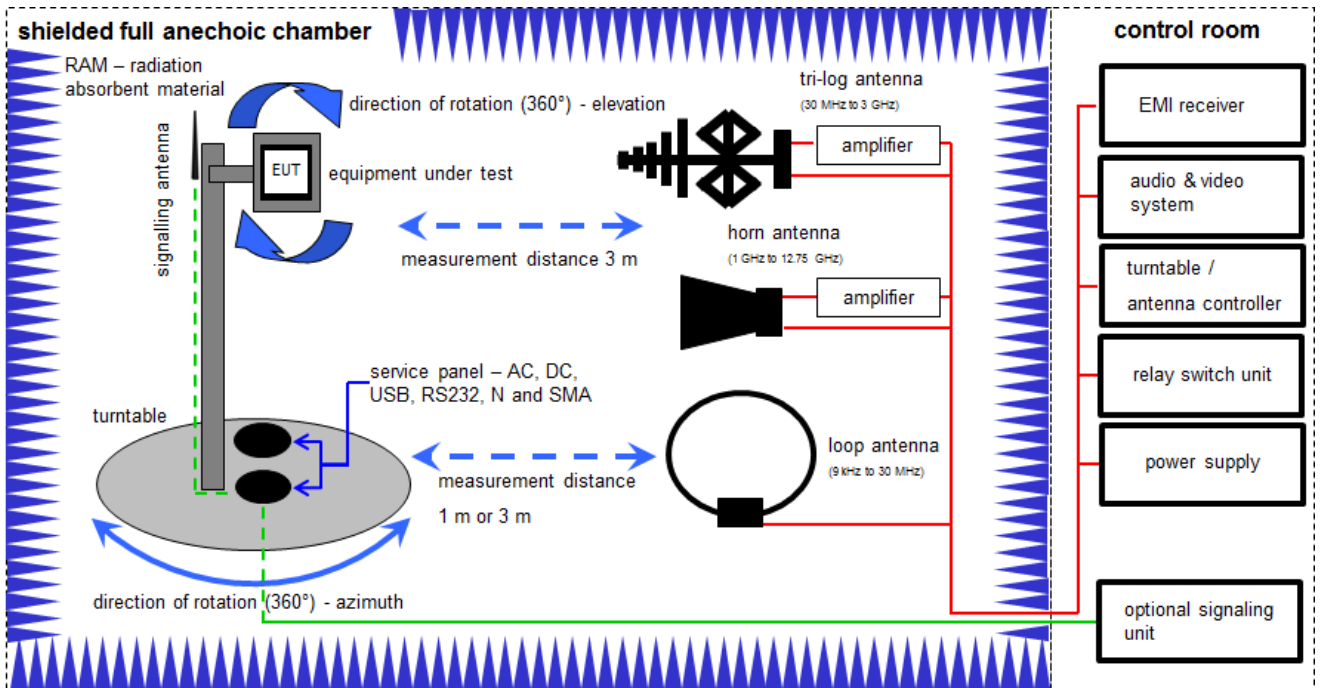
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signalling equipment as well as measuring receivers and analysers 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
vkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

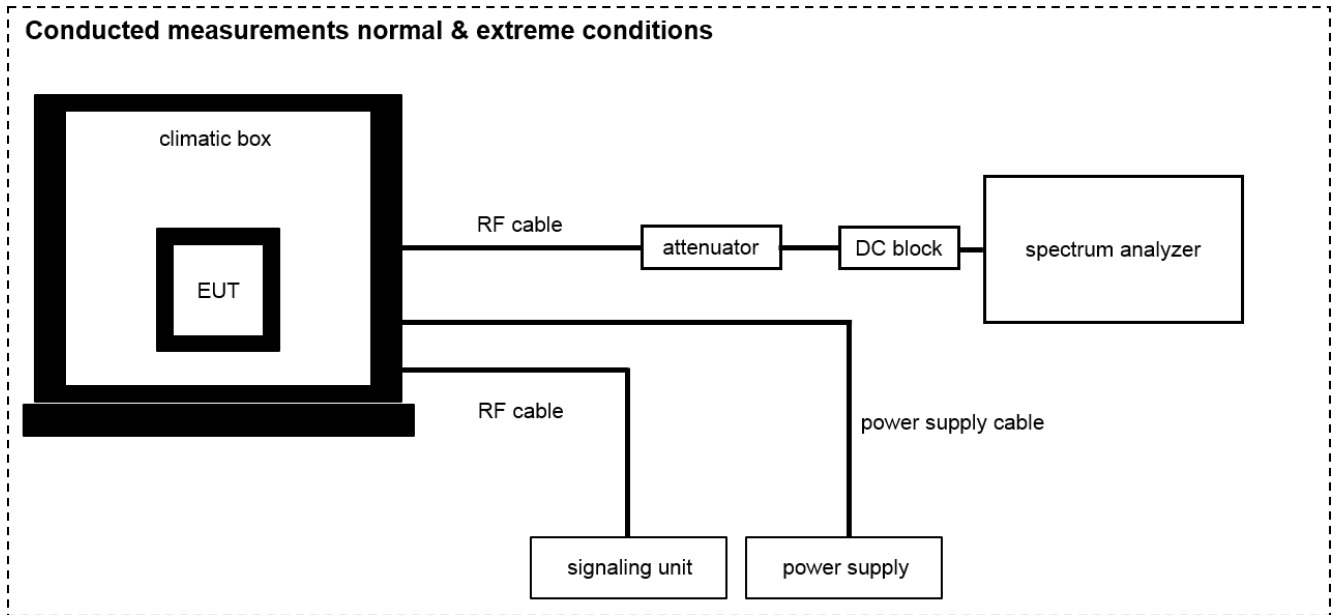
8.1 Shielded fully anechoic chamber



Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
2	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	08.05.2013	08.05.2015
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
4	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne		
5	9	Artificial Mains 9 kHz to 30 MHz	ESH3-Z5	R&S	828576/020	300001210	Ve	30.01.2014	30.01.2016
6	9	Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155	ne		
7	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2013	13.06.2015
8	90	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
9	90	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev		
10	90	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vIKI!	29.10.2014	29.10.2017
11	90	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	13.03.2014	13.03.2015
12	11b	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev		
13	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
14	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
15	A029	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016

8.2 Conducted measurements normal and extreme 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 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Switch / Control Unit	3488A	HP	2605e08770	300001443	ne		
2	n. a.	Signal Analyzer 20Hz-26,5GHz-150 to + 30 DBM	FSiQ26	R&S	835111/0004	300002678	Ve	22.01.2015	22.01.2017
3	n. a.	Power Supply 0-20V; 0-5A	6632B	HP	US37478366	400000117	vIKI!	20.01.2015	20.01.2017
4	n. a.	Universal Communication Tester	CMU200	R&S	106240	300003321	vIKI!	12.06.2013	12.06.2015
5	n. a.	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	Ve	26.09.2013	26.09.2015

9 Test Results

9.1 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.

9.1.1 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
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 22.913 CFR Part 2.1046
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 to Average Ratio (dB)
824.2	32.0	0.07
836.4	31.5	0.03
848.8	31.2	0.03
Measurement uncertainty	± 0.5 dB	

Output Power (conducted) 8-PSK mode		
Frequency. (MHz)	Average Output Power (dBm)	Peak to Average Ratio (dB)
824.2	26.3	3.12
836.4	26.1	3.13
848.8	26.0	3.12
Measurement uncertainty	± 0.5 dB	

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2 (internal antenna)	26.2
824.2 (external antenna)	28.3
836.4 (external antenna)	29.2
848.8 (external antenna)	27.9
Measurement uncertainty	± 2.0 dB

Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
824.2 (internal antenna)	20.5
824.2 (external antenna)	22.5
836.4 (external antenna)	23.8
848.8 (external antenna)	22.7
Measurement uncertainty	± 2.0 dB

Verdict: [complies](#)

9.1.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a R&S CMU200 DIGITAL RADIOCOMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom} , connected to the CMU200 and in a simulated call on channel 189 (centre 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 +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage from V_{min} to V_{max} . Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	see chapter 8.2
Used test setup:	

Limits:

FCC
CFR Part 22.355 CFR Part 2.1055
Frequency Stability
± 2.5 ppm

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
4.5	-16	-0.00000191	-0.0191
4.8	-16	-0.00000191	-0.0191
8.0	-11	-0.00000132	-0.0132
14.0	-9	-0.00000108	-0.0108
18.0	-5	-0.00000060	-0.0060

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	-21	-0.00000251	-0.0251
-20	-8	-0.00000096	-0.0096
-10	-11	-0.00000132	-0.0132
± 0	-6	-0.00000072	-0.0072
10	-8	-0.00000096	-0.0096
20	5	0.00000060	0.0060
30	-5	-0.00000060	-0.0060
40	-10	-0.00000120	-0.0120
50	-7	-0.00000084	-0.0084
60	-11	-0.00000132	-0.0132

Verdict: [complies](#)

9.1.3 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 25 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

GSM-850 Transmitter Channel Frequency

- 128 824.2 MHz
- 189 836.4 MHz
- 251 848.8 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
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:	30 MHz – 25 GHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

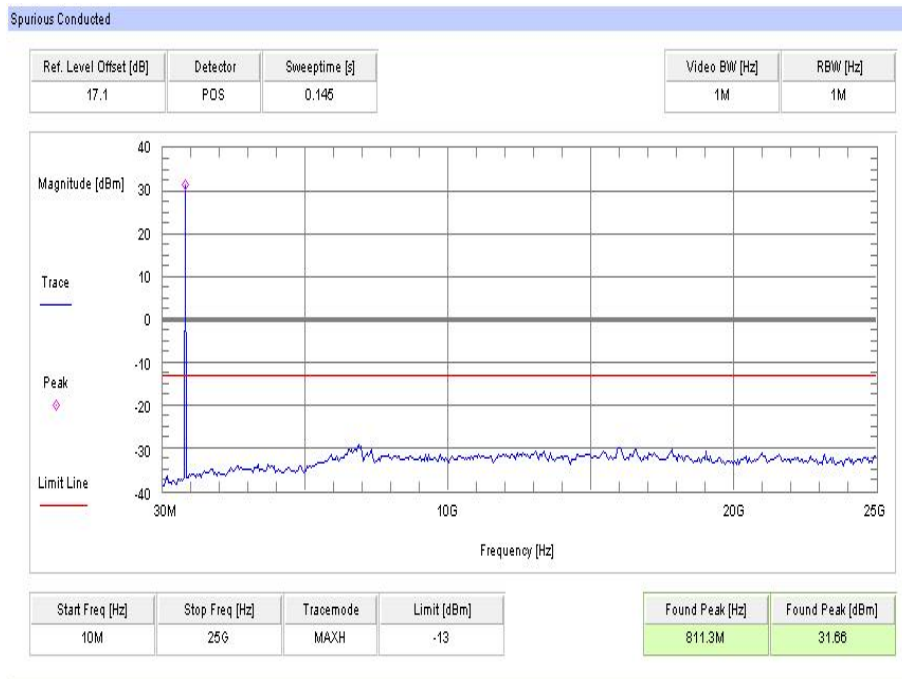
Results:

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	-
Measurement uncertainty					± 3dB			

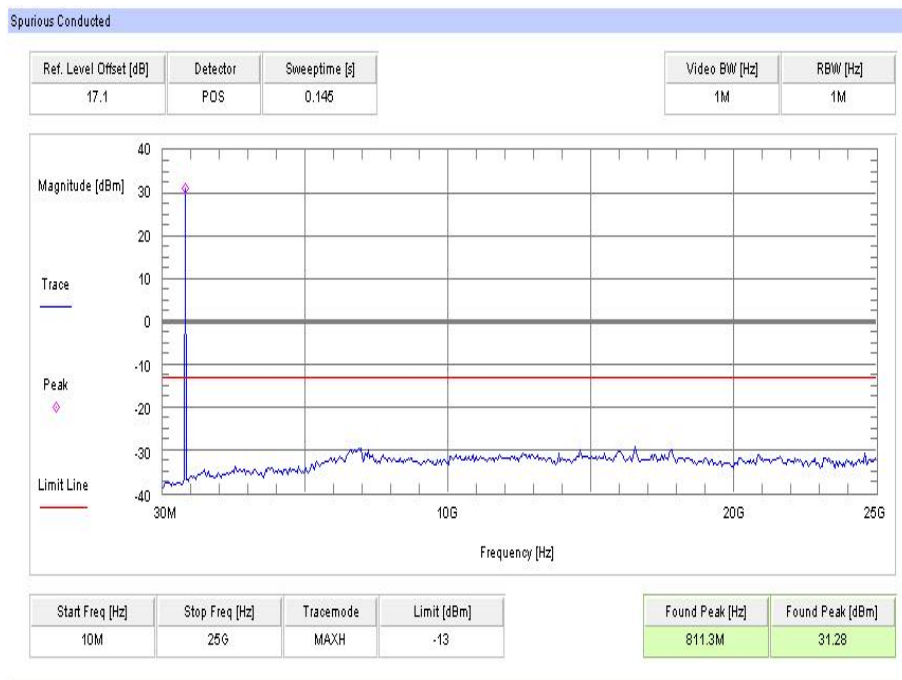
Verdict: [complies](#)

Plots:

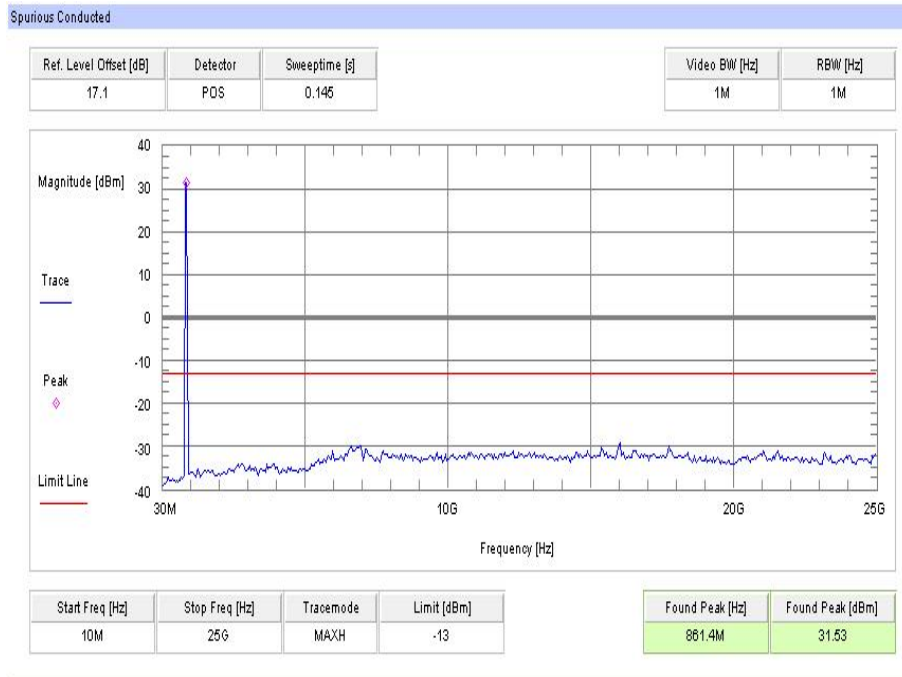
Plot 1: Channel 128 (10 MHz - 25 GHz)



Plot 2: Channel 189 (10 MHz - 25 GHz)



Plot 3: Channel 251 (10 MHz - 25 GHz)



9.1.4 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. Measurement made up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the GSM-850 band.

- 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. For measurements above 1 GHz the EUT is placed on a 1.5 meter high stand.
- 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
Used test setup:	see chapter 8.1

Limits:

FCC
CFR Part 22.917 CFR Part 2.1053
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.

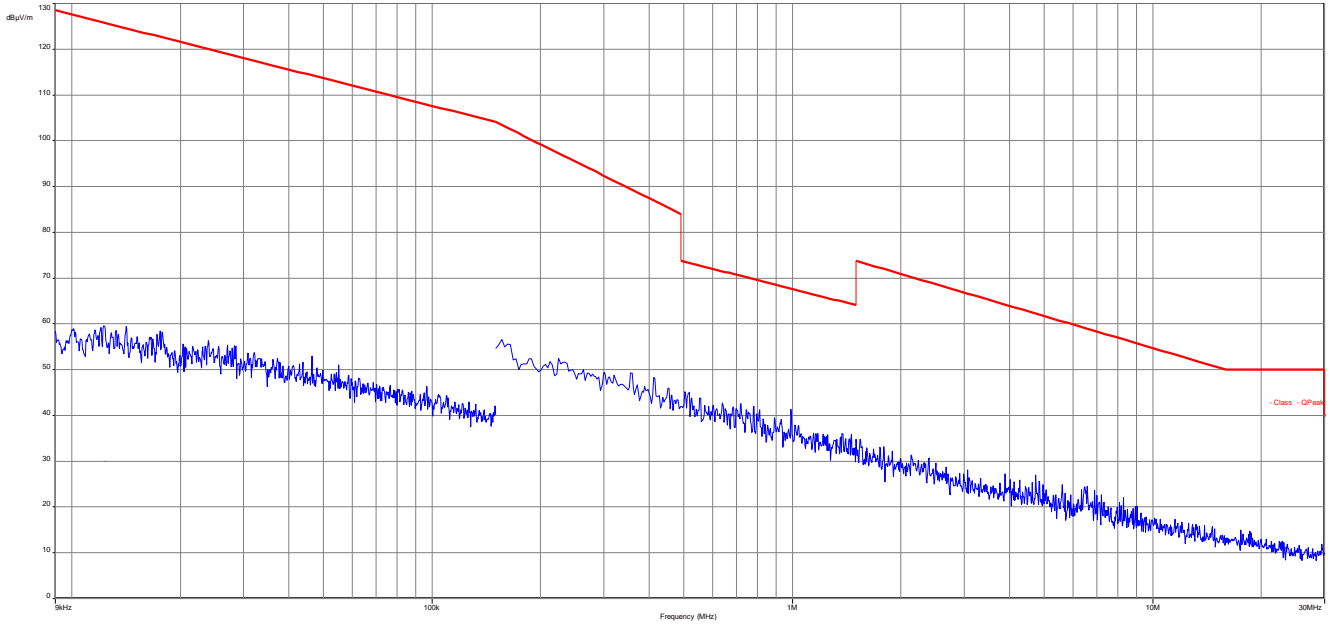
As can be seen from this data, the emissions from the test item were within the specification limit.

Spurious Emission Level GMSK (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	-
Measurement uncertainty					± 3dB			

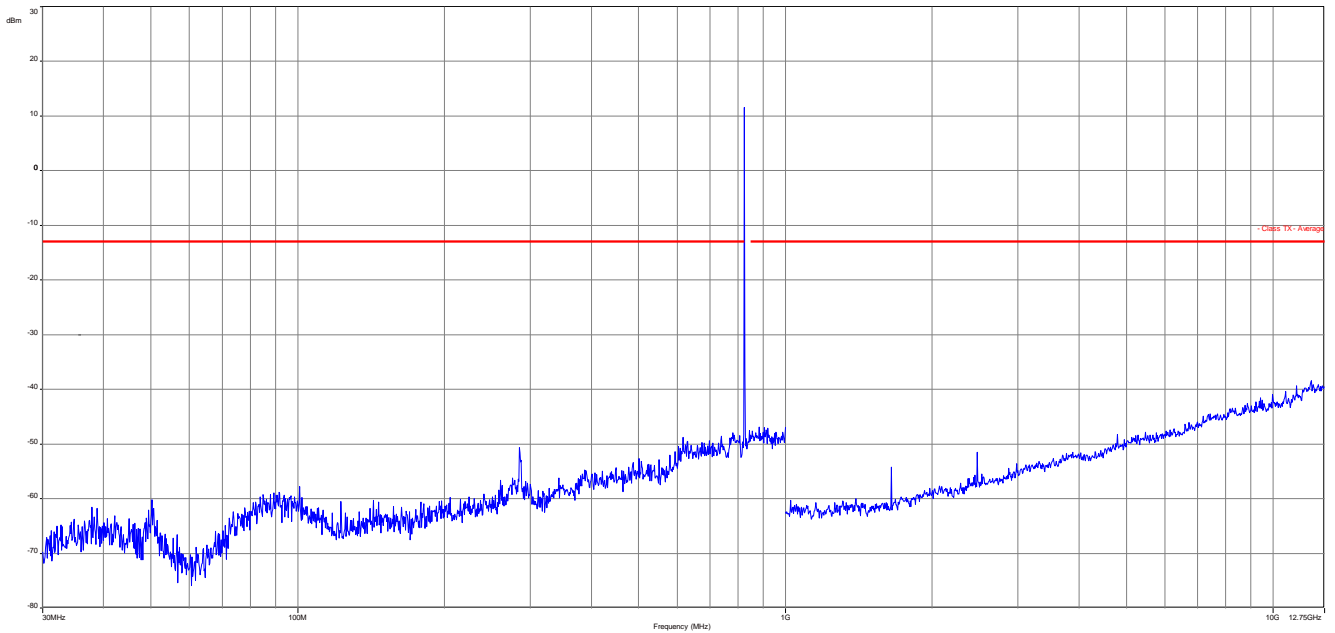
Verdict: [complies](#)

Plots: (external antenna)

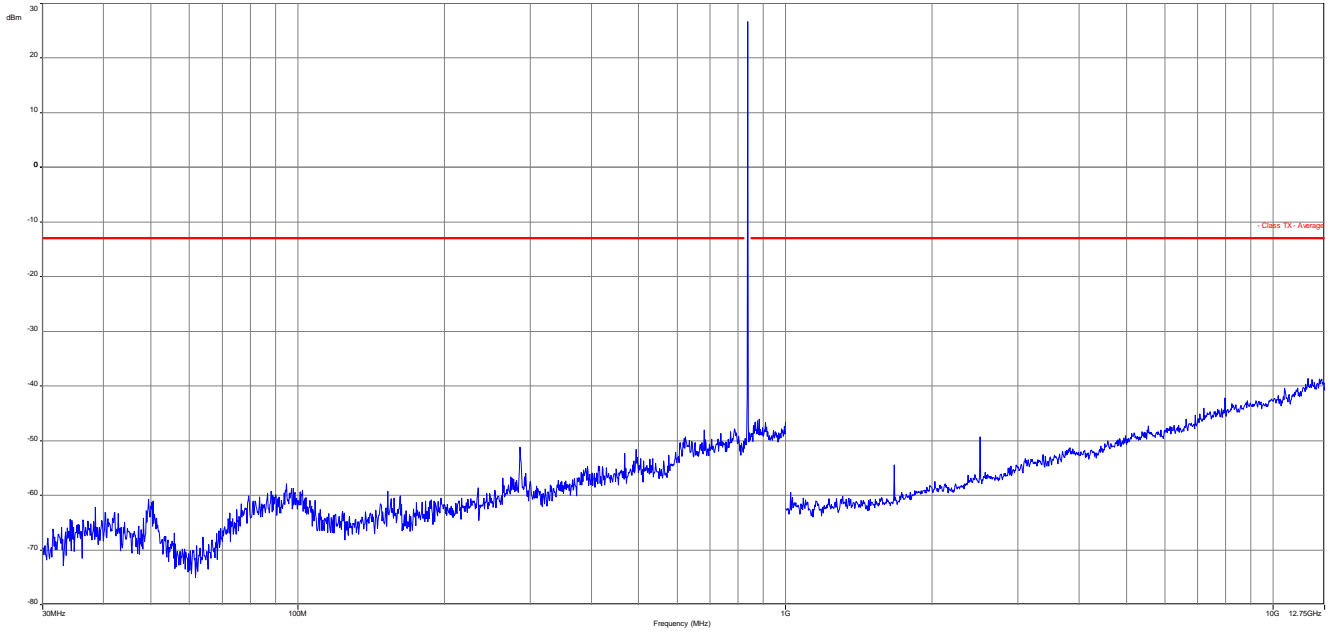
Plot 1: Channel 189 (Traffic mode up to 30 MHz), GSM



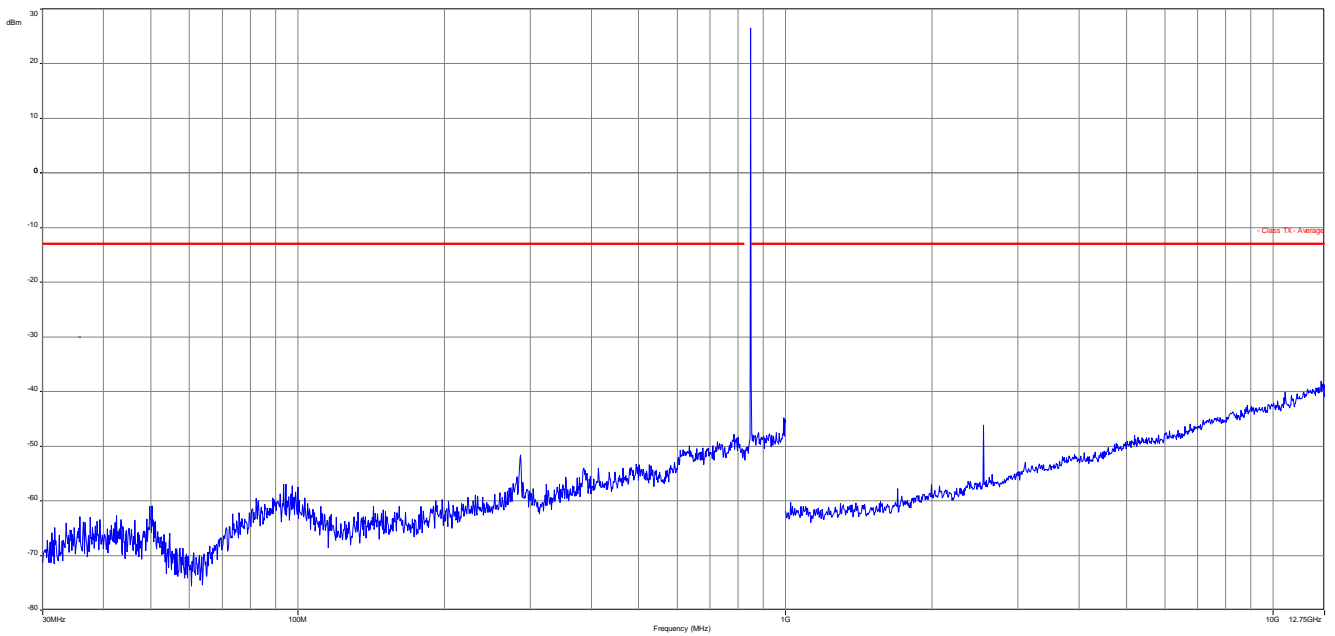
Plot 2: Channel 128 (30 MHz – 12.75 GHz), GSM



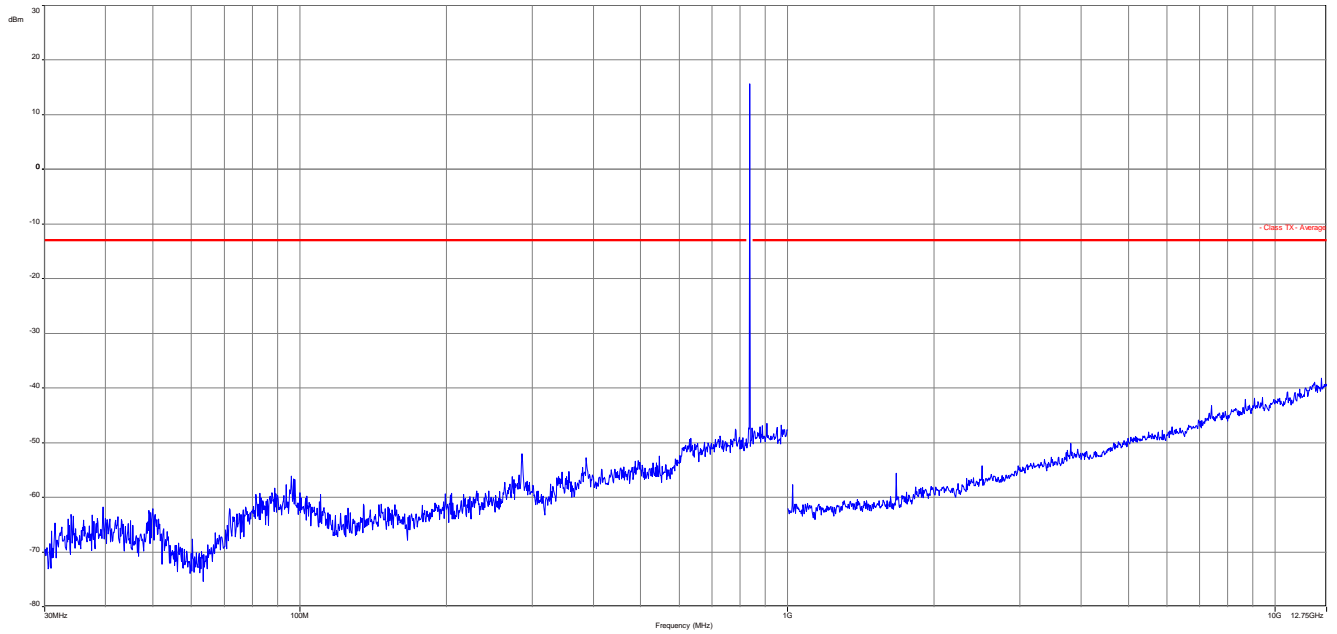
Plot 3: Channel 189 (30 MHz – 12.75 GHz), GSM



Plot 4: Channel 251 (30 MHz – 12.75 GHz), GSM

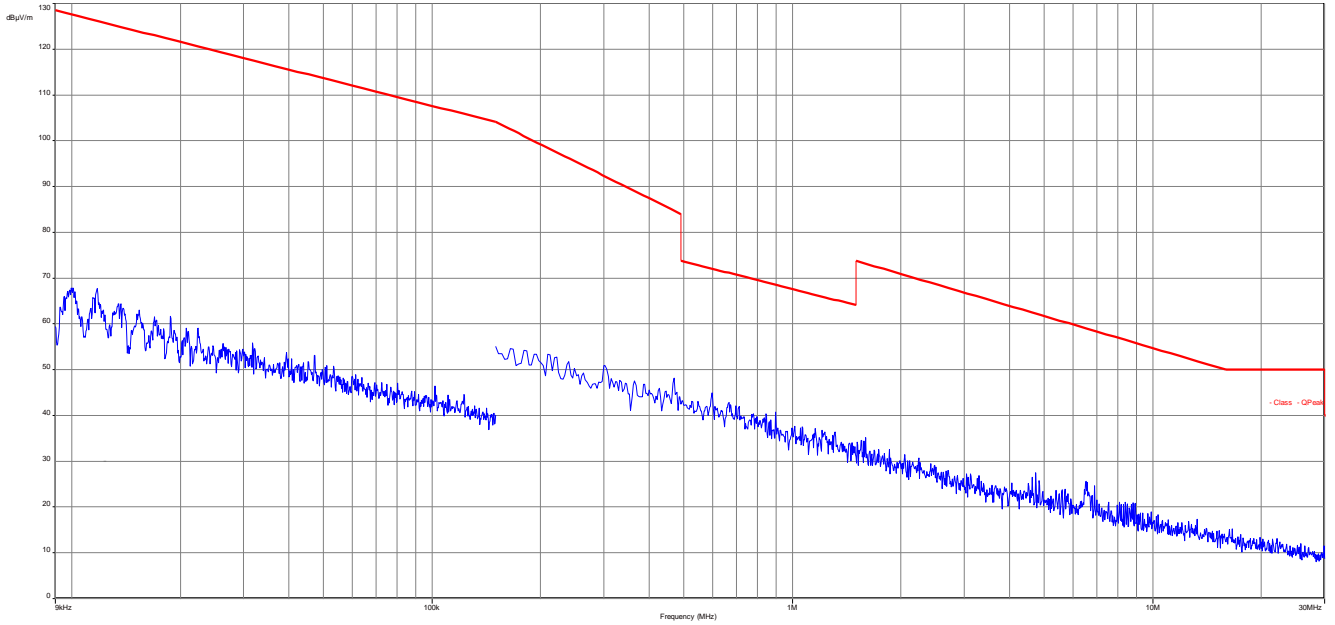


Plot 5: Channel 189 (30 MHz – 12.75 GHz), EDGE

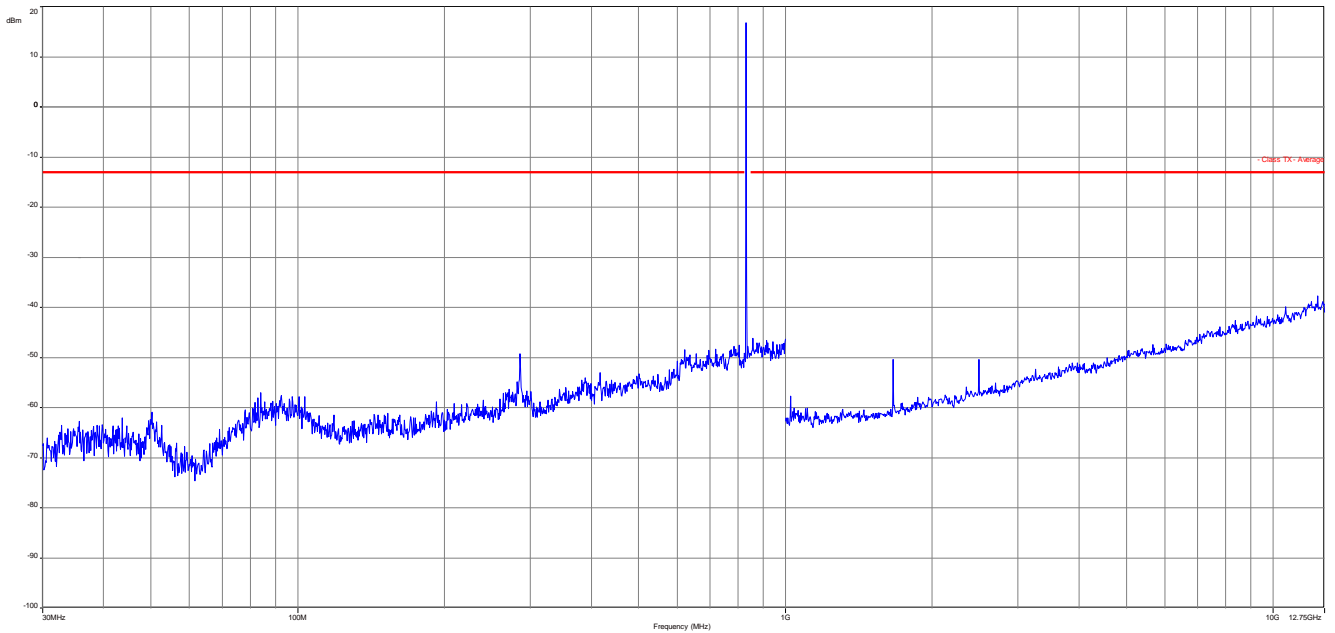


Plots: (internal antenna)

Plot 1: Channel 251 (Traffic mode up to 30 MHz), GSM



Plot 2: Channel 251 (30 MHz – 12.75 GHz), GSM



9.1.5 Block edge compliance

Description:

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

Measurement:

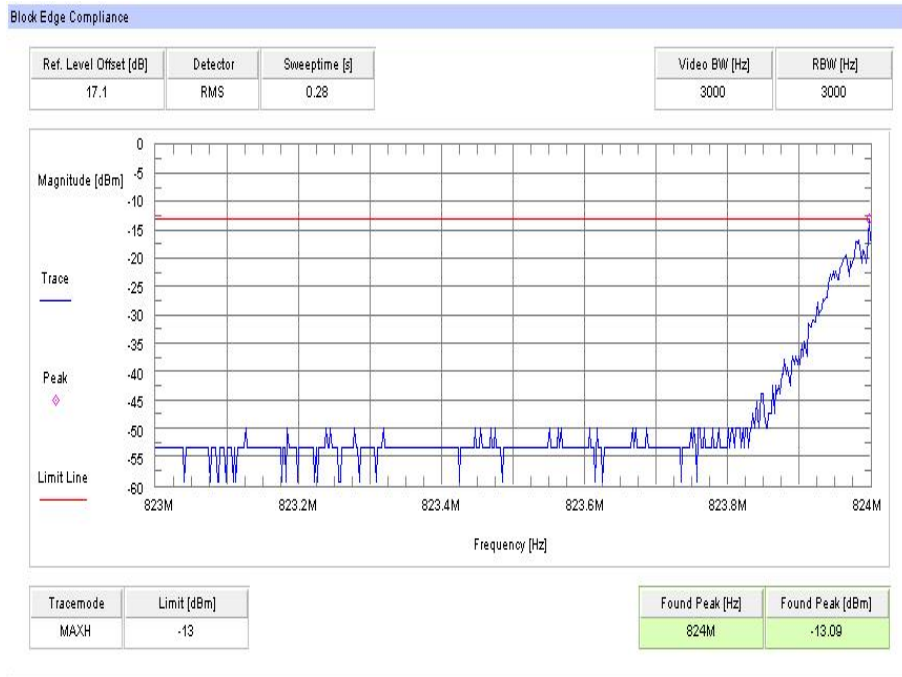
Measurement parameters	
Detector:	RMS
Sweep time:	Auto
Video bandwidth:	3 kHz
Resolution bandwidth:	3 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

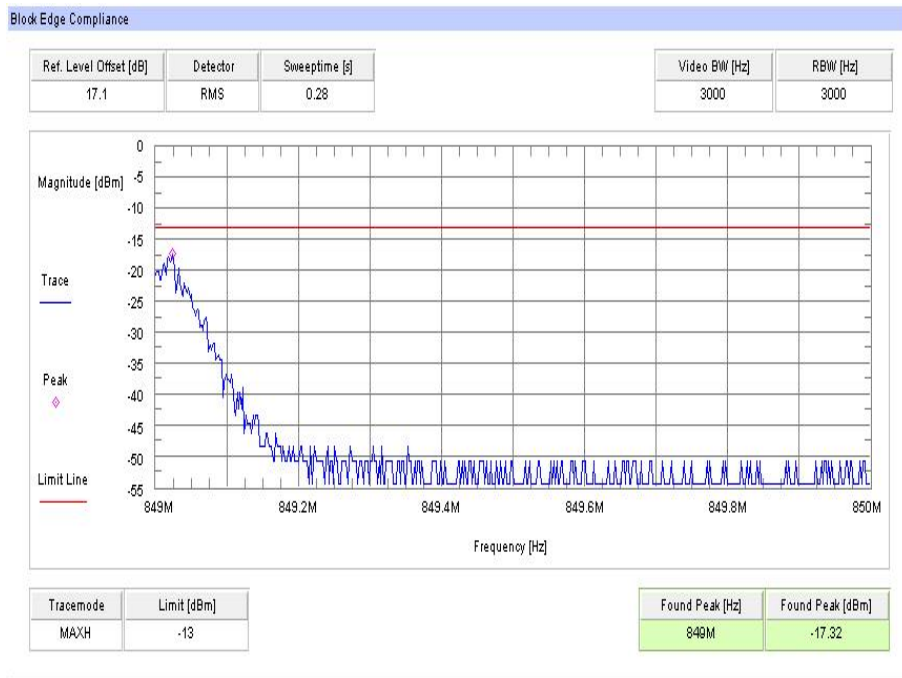
FCC
CFR Part 22.917 CFR Part 2.1051
Block Edge Compliance
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)
-13 dBm

Plots:

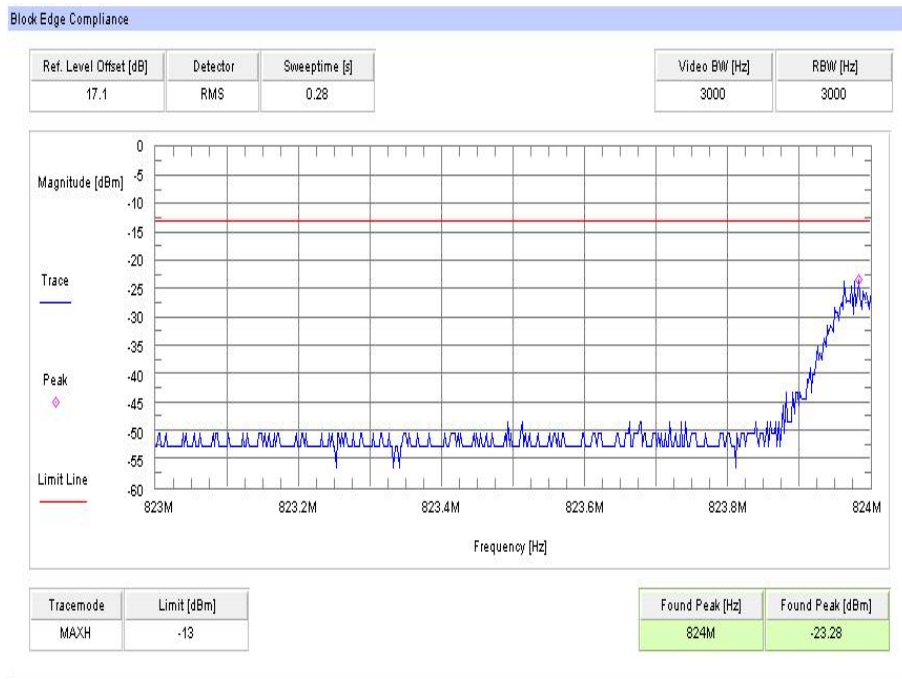
Plot 1: Channel 128 (GSM-mode)



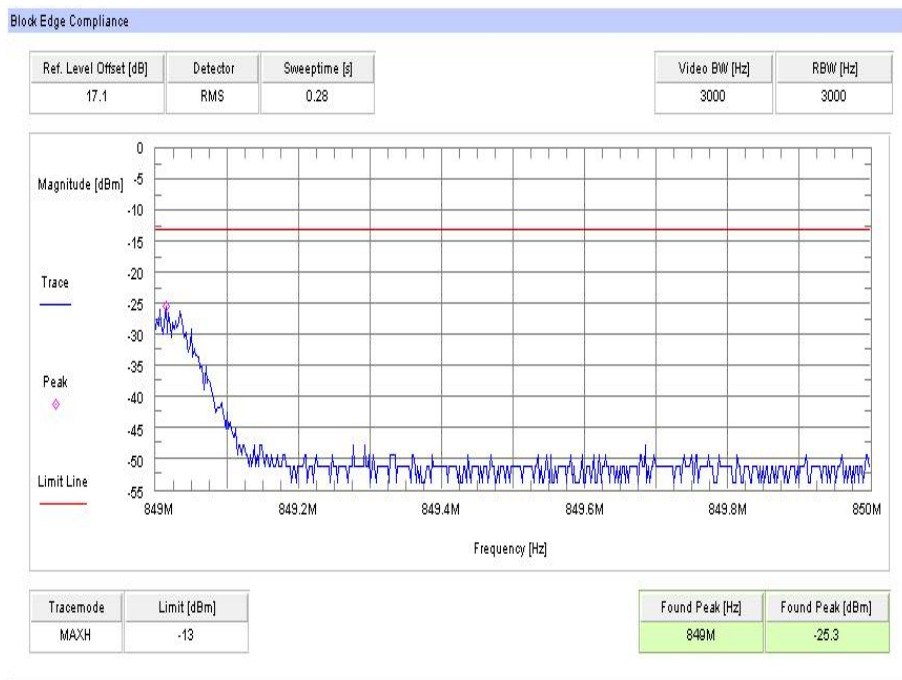
Plot 2: Channel 251 (GSM-mode)



Plot 3: Channel 128 (EDGE-mode)



Plot 4: Channel 251 (EDGE-mode)



Verdict: [complies](#)

9.1.6 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.

Part 22.917 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300 kHz, this equates to a resolution bandwidth of at least 3 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	30 kHz
Resolution bandwidth:	10 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

Results:

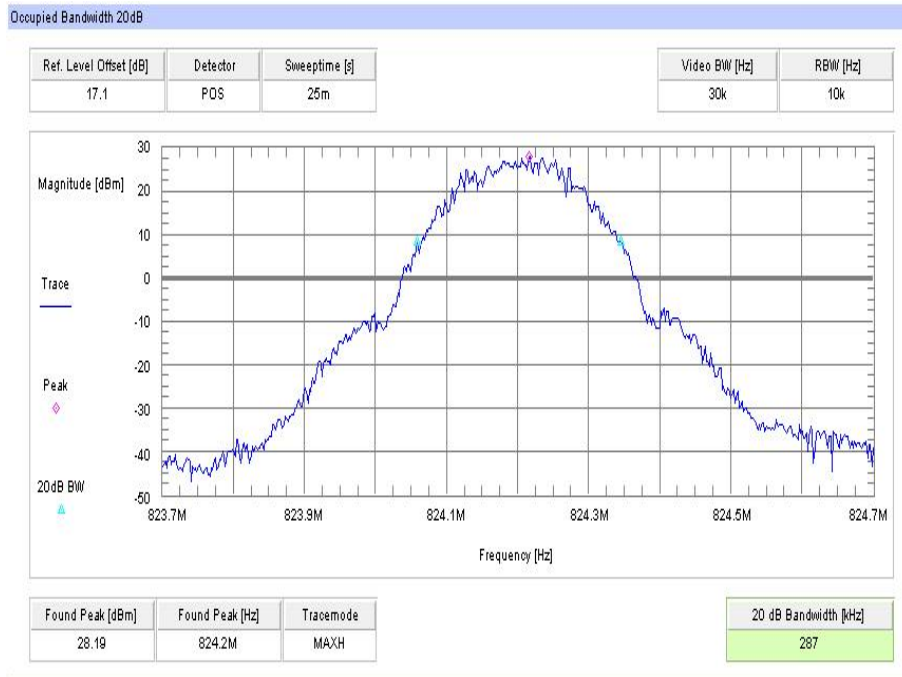
Occupied Bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	287	319
836.4	277	319
848.8	277	319
Measurement uncertainty	± 3 kHz	

Occupied Bandwidth – 8-PSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
824.2	285	313
836.4	275	307
848.8	279	315
Measurement uncertainty	± 3 kHz	

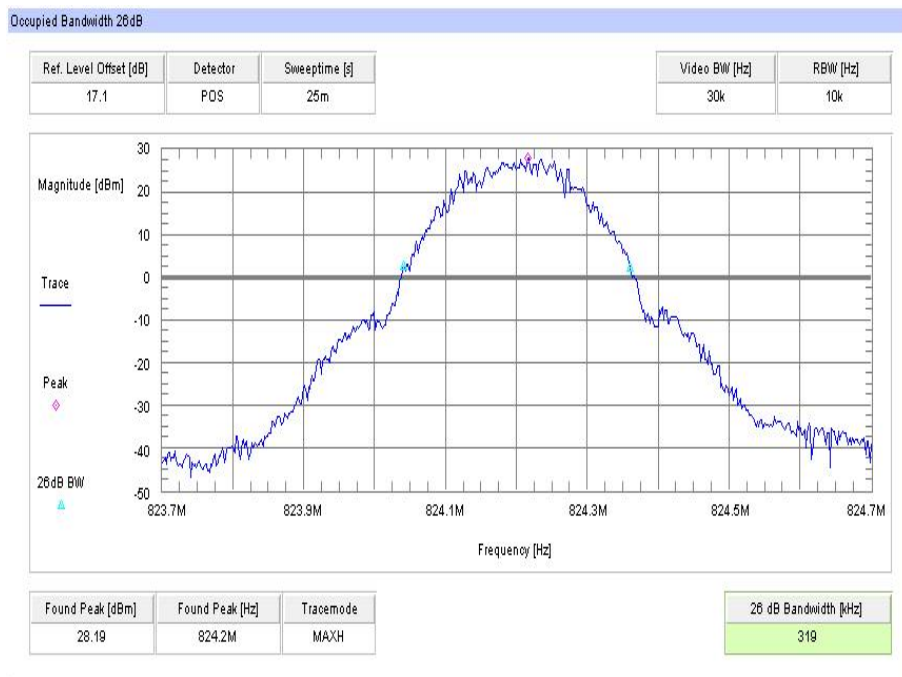
Verdict: [complies](#)

Plots:

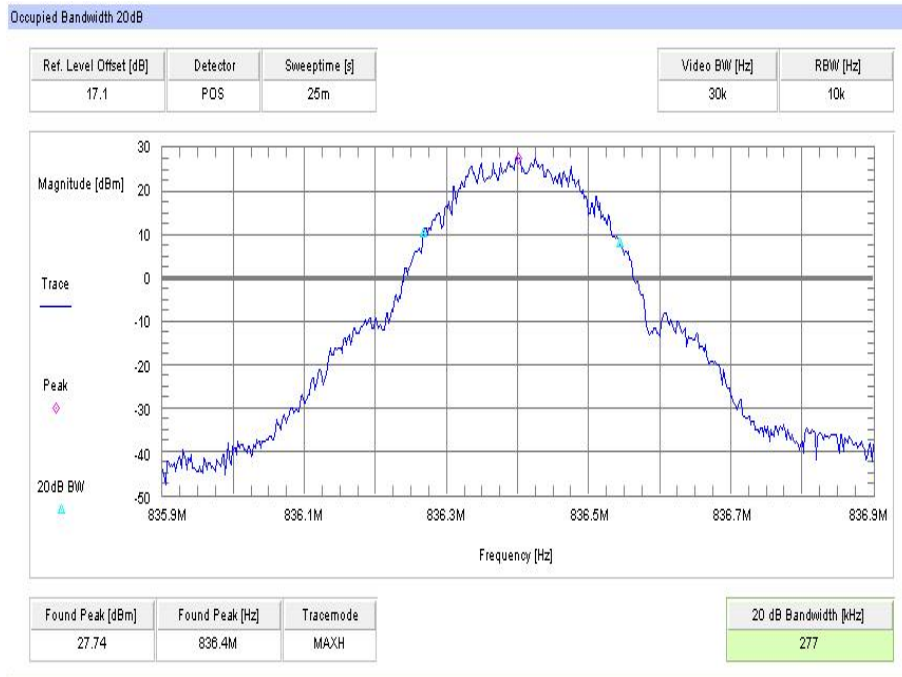
Plot 1: Channel 128 (99% - OBW)



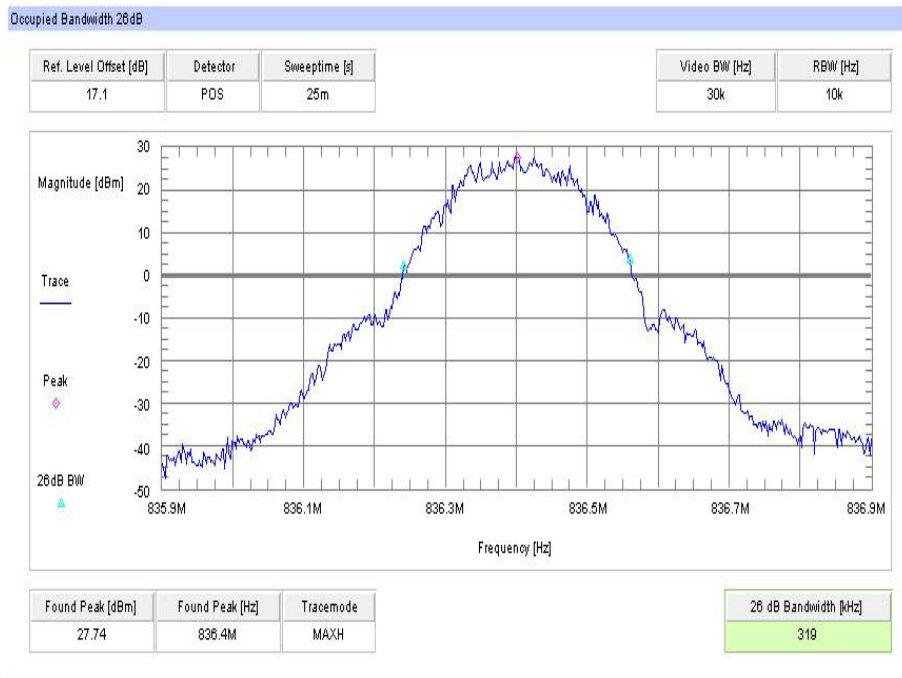
Plot 2: Channel 128 (-26 dBc BW)



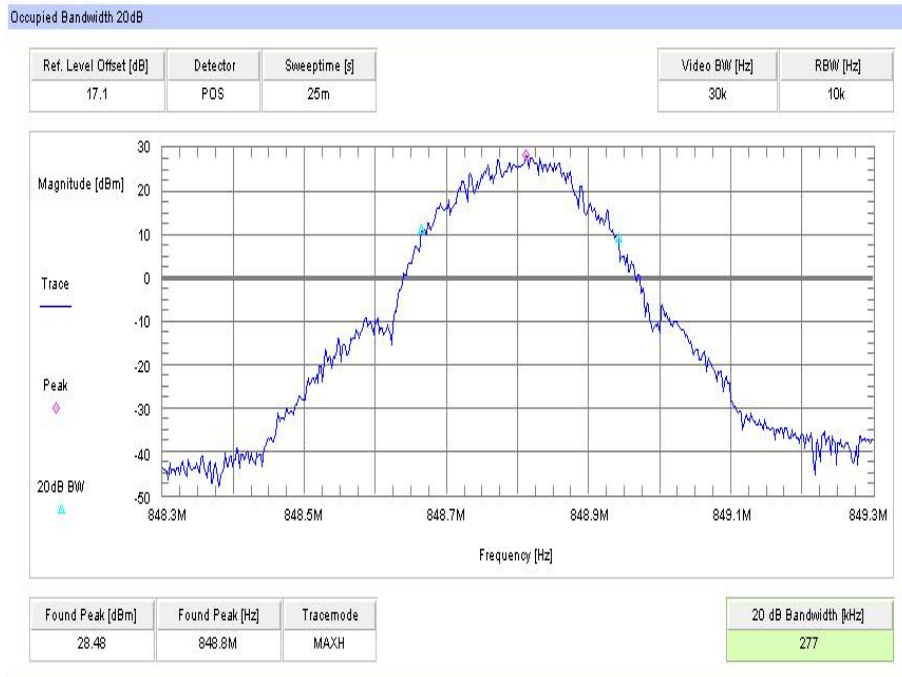
Plot 3: Channel 189 (99% - OBW)



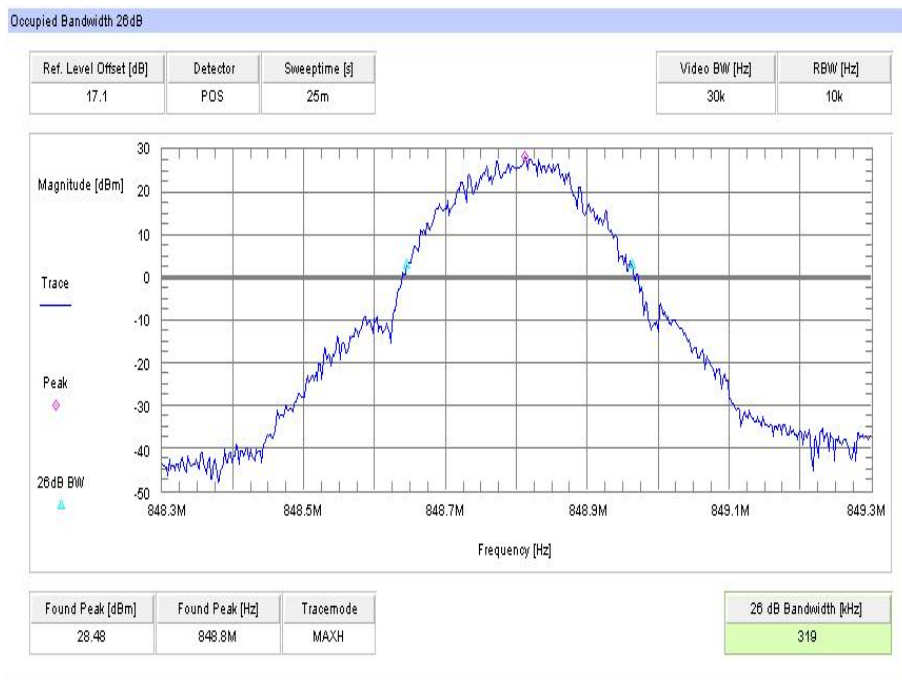
Plot 4: Channel 189 (-26 dBc BW)



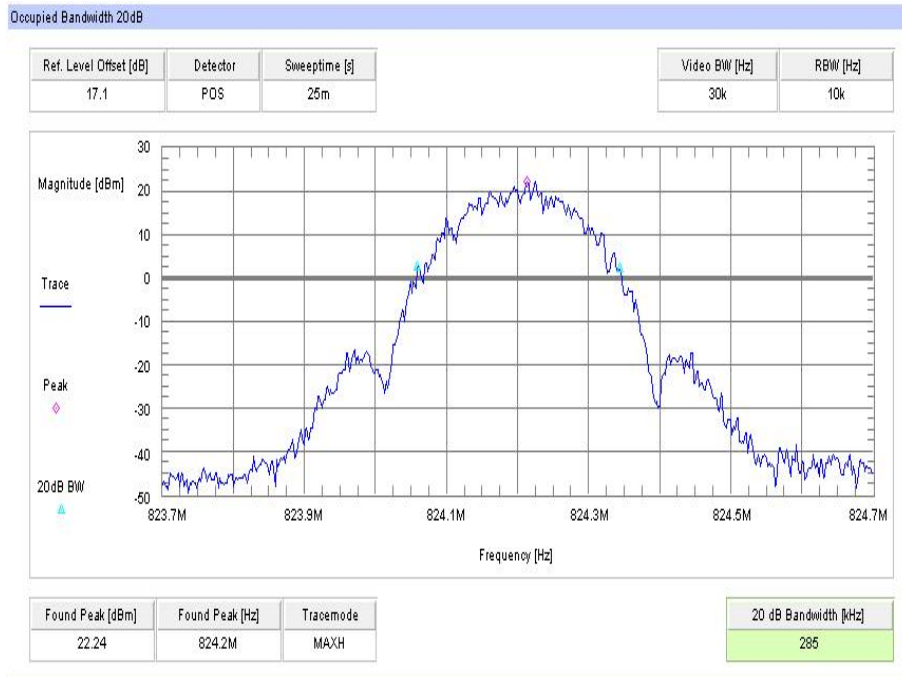
Plot 5: Channel 251 (99% - OBW)



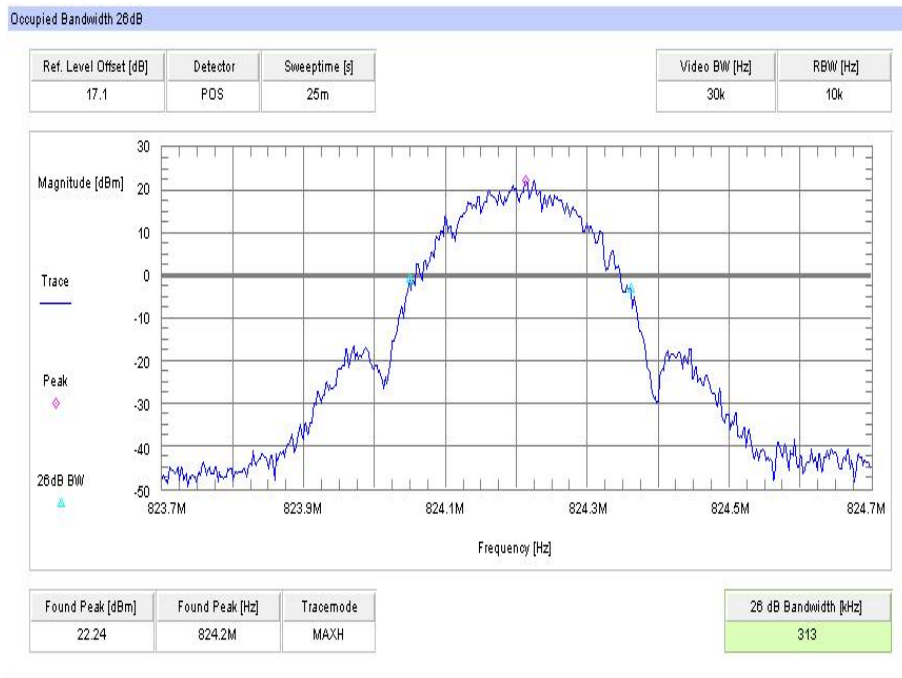
Plot 6: Channel 251 (-26 dBc BW)



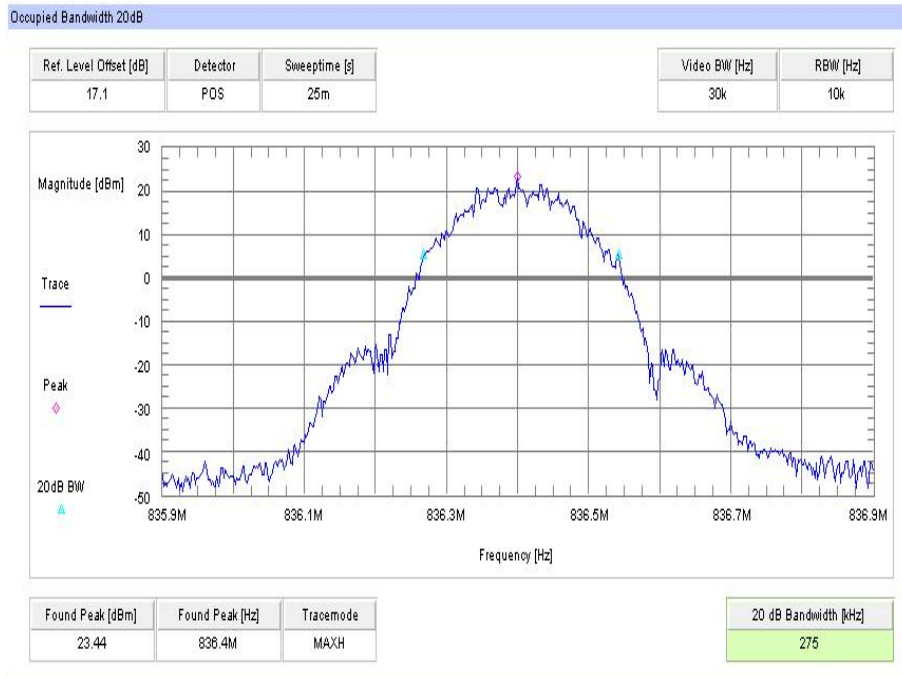
Plot 7: Channel 128 (99% - OBW) – 8-PSK



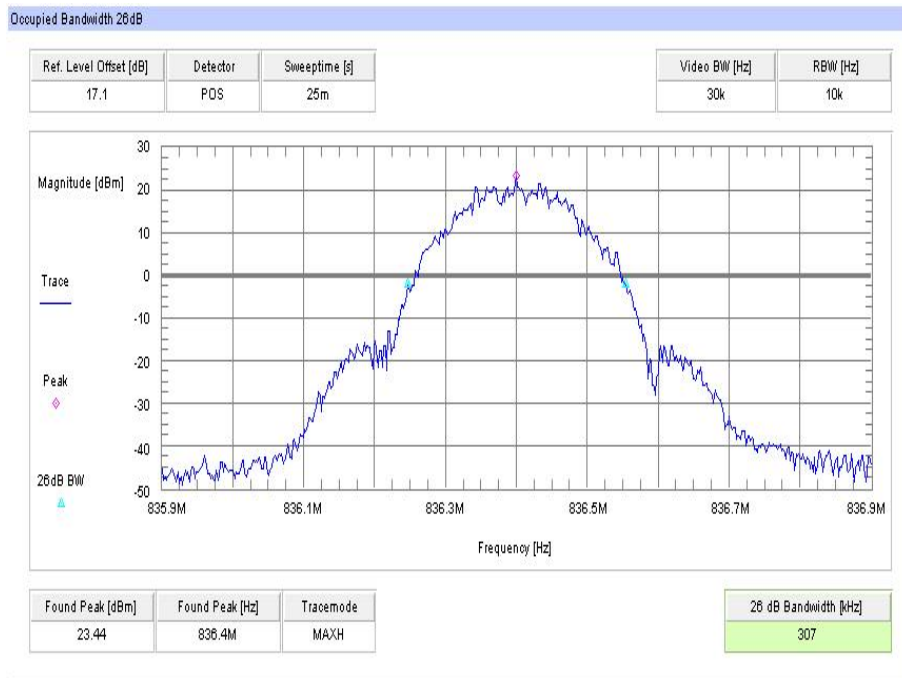
Plot 8: Channel 128 (-26 dBc BW) - 8-PSK



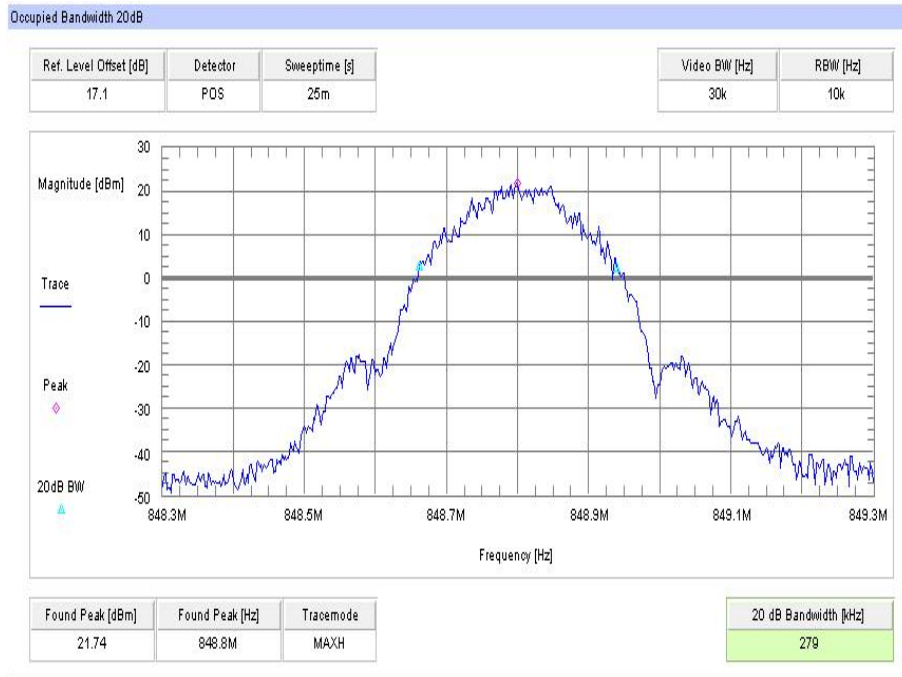
Plot 9: Channel 189 (99% - OBW) - 8-PSK



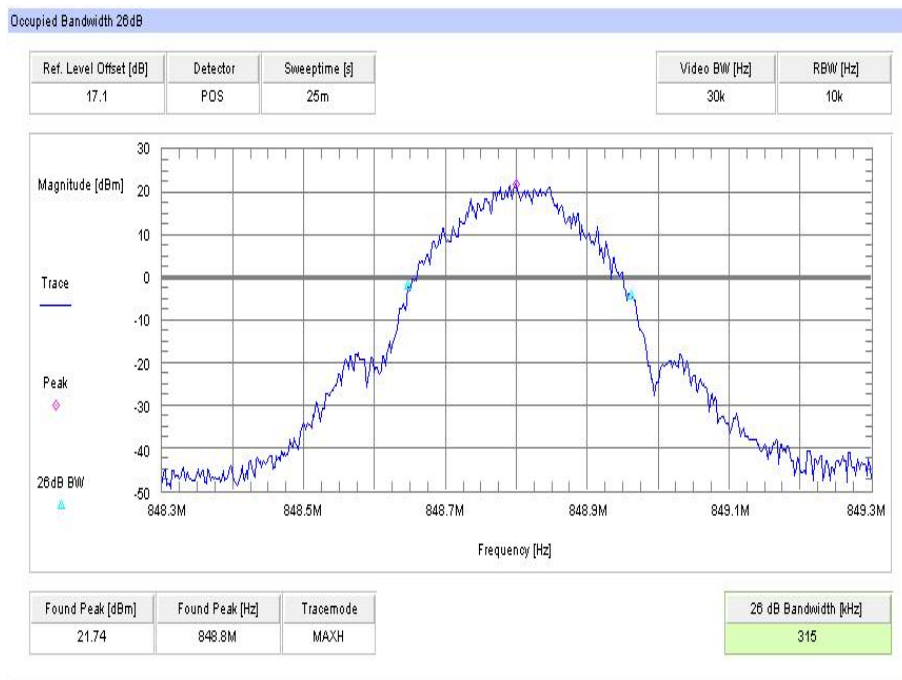
Plot 10: Channel 189 (-26 dBc BW) - 8-PSK



Plot 11: Channel 251 (99% - OBW) - 8-PSK



Plot 12: Channel 251 (-26 dBc BW) - 8-PSK



9.2 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.

9.2.1 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.

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
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 24.232 CFR Part 2.1046
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 to Average Ratio (dB)
1850.2	29.2	0.05
1880.0	29.3	0.04
1909.8	30.2	0.03
Measurement uncertainty	± 0.5 dB	

Output Power (conducted) 8-PSK mode		
Frequency (MHz)	Average Output Power (dBm)	Peak to Average Ratio (dB)
1850.2	25.3	3.07
1880.0	25.3	3.17
1909.8	25.7	3.27
Measurement uncertainty	± 0.5 dB	

Output Power (radiated) GMSK mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1850.2 (external antenna)	30.0
1880.0 (external antenna)	28.5
1909.8 (external antenna)	28.7
1909.8 (internal antenna)	31.9
Measurement uncertainty	± 2.0 dB

Output Power (radiated) 8-PSK mode	
Frequency (MHz)	Average Output Power (dBm) - EIRP
1850.2 (external antenna)	26.1
1880.0 (external antenna)	24.6
1909.8 (external antenna)	24.2
1909.8 (internal antenna)	27.4
Measurement uncertainty	± 2.0 dB

Verdict: [complies](#)

9.2.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a R&S CMU200 DIGITAL RADIOCOMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom} , connected to the CMU200 and in a simulated call on channel 661 (centre 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 +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage from V_{min} to V_{max} . Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	see chapter 8.2
Used test setup:	

Limits:

FCC
CFR Part 24.235 CFR Part 2.1055
Frequency Stability
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Results:**AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
4.5	11	0.00000059	0.0059
4.8	23	0.00000122	0.0122
8.0	11	0.00000059	0.0059
14.0	-7	-0.00000037	-0.0037
18.0	15	0.00000080	0.0080

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	-8	-0.00000043	-0.0043
-20	-11	-0.00000059	-0.0059
-10	-20	-0.00000106	-0.0106
± 0	-17	-0.00000090	-0.0090
10	-12	-0.00000064	-0.0064
20	-21	-0.00000112	-0.0112
30	-7	-0.00000037	-0.0037
40	-1	-0.00000005	-0.0005
50	6	0.00000032	0.0032
60	10	0.00000053	0.0053

Verdict: [complies](#)

9.2.3 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 26 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
Used test setup:	see chapter 8.1

Limits:

FCC
CFR Part 24.238 CFR Part 2.1053
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.

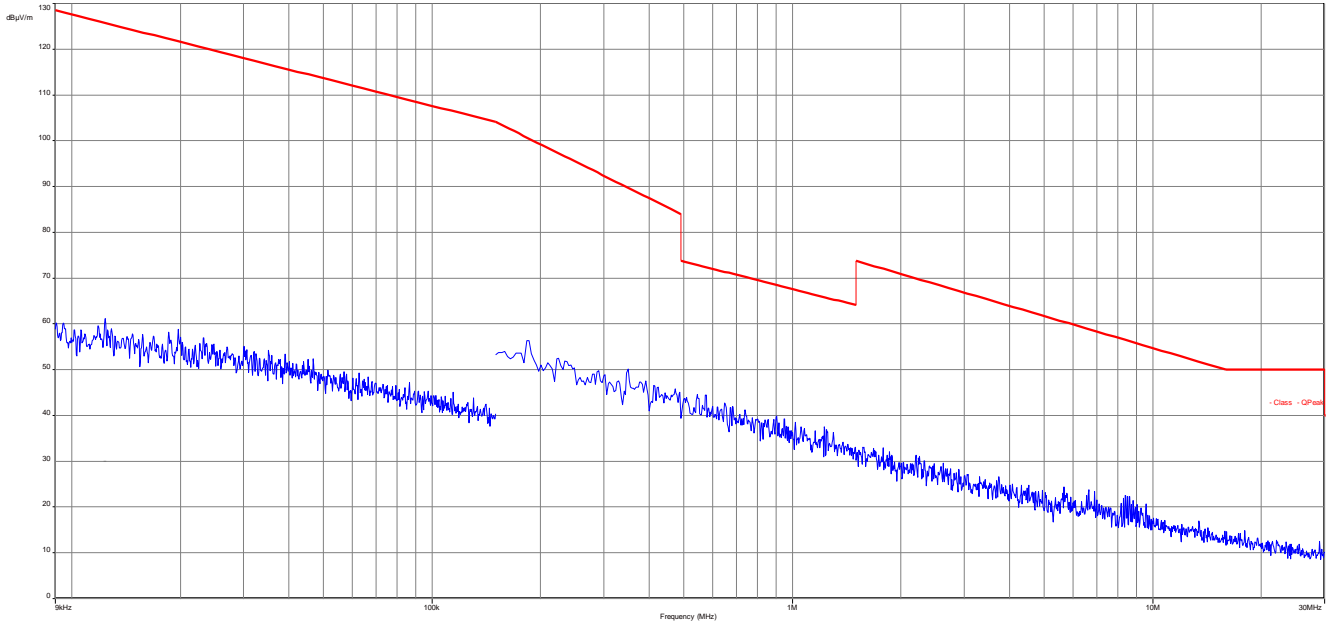
As can be seen from this data, the emissions from the test item were within the specification limit.

Spurious Emission Level GMSK (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	-
Measurement uncertainty					± 3dB			

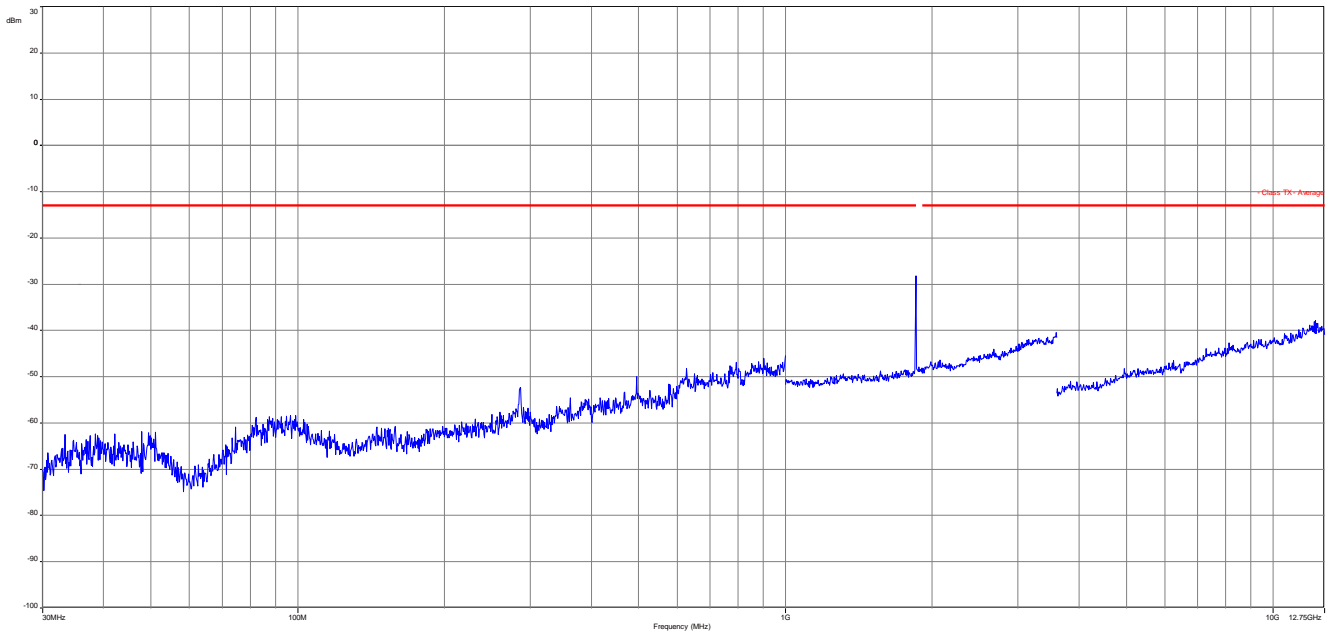
Verdict: [complies](#)

Plots: (external antenna)

Plot 1: Channel 661 (Traffic mode up to 30 MHz), GSM

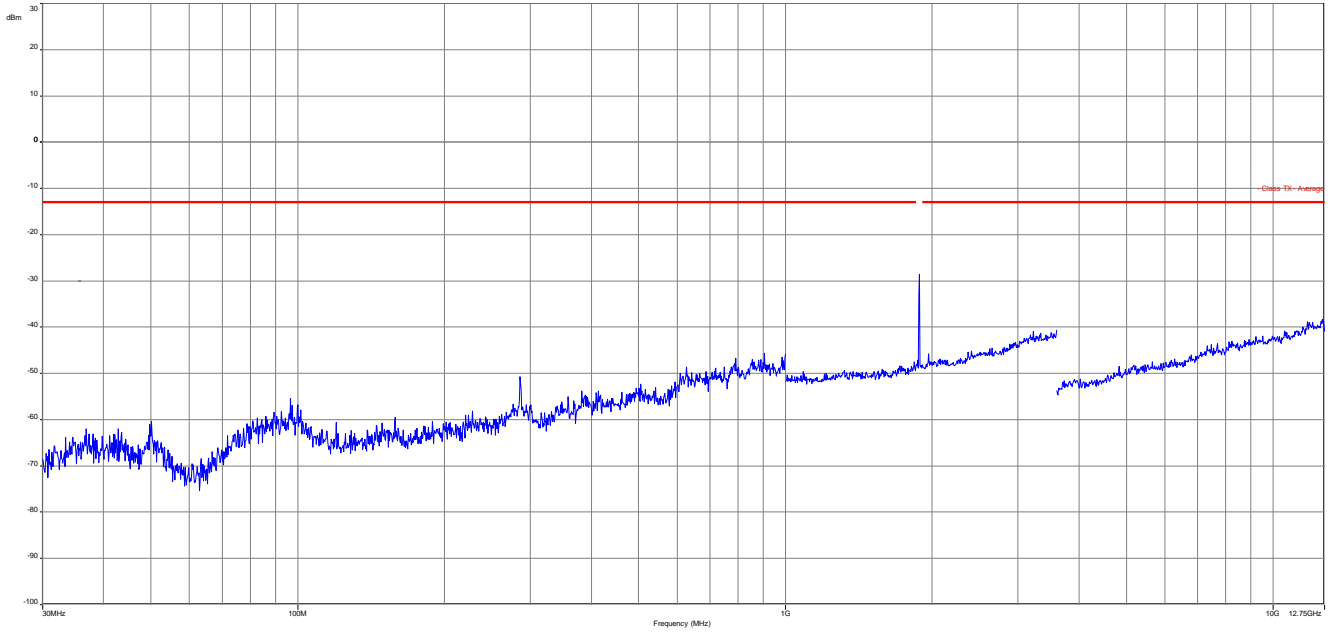


Plot 2: Channel 512 (30 MHz – 12.75 GHz), GSM



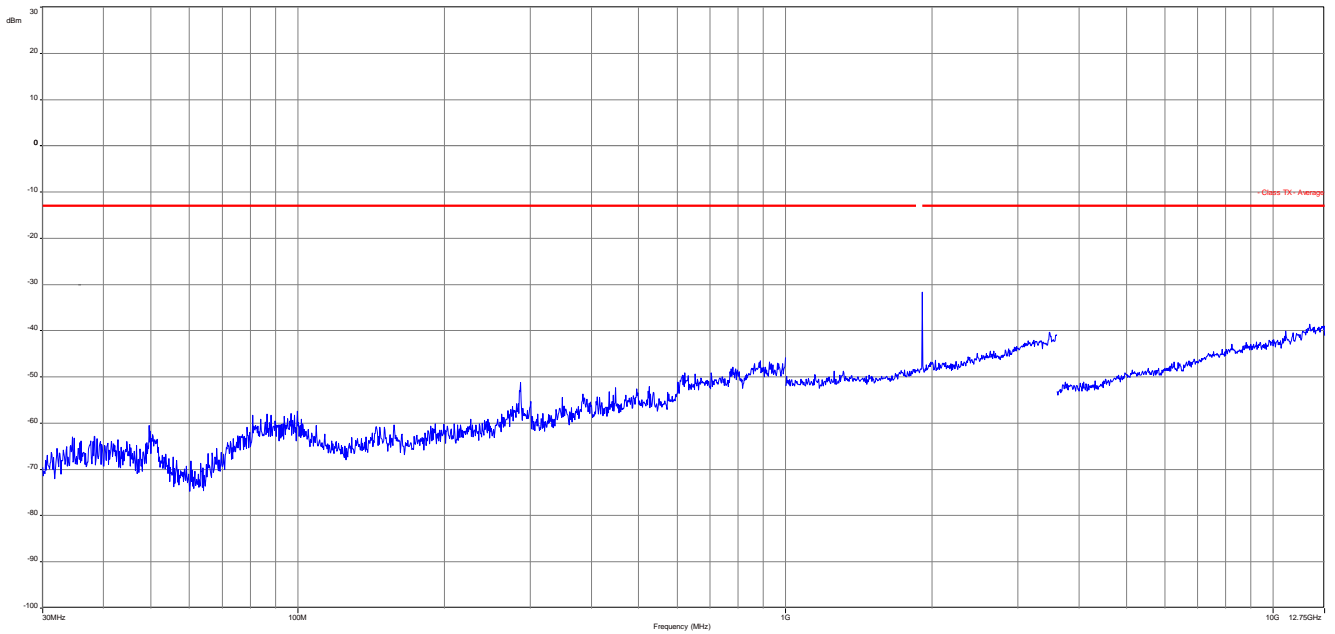
Carrier notched with 1.9 GHz rejection filter

Plot 3: Channel 661 (30 MHz – 12.75 GHz), GSM



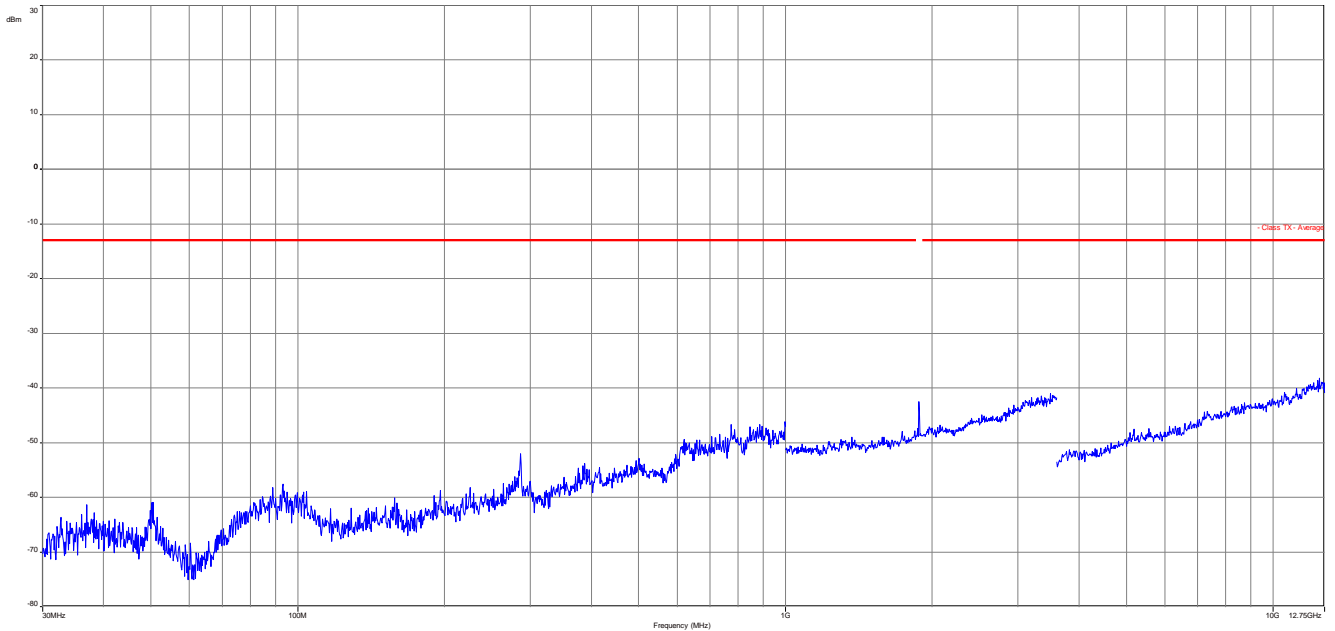
Carrier notched with 1.9 GHz rejection filter

Plot 4: Channel 810 (30 MHz – 12.75 GHz), GSM



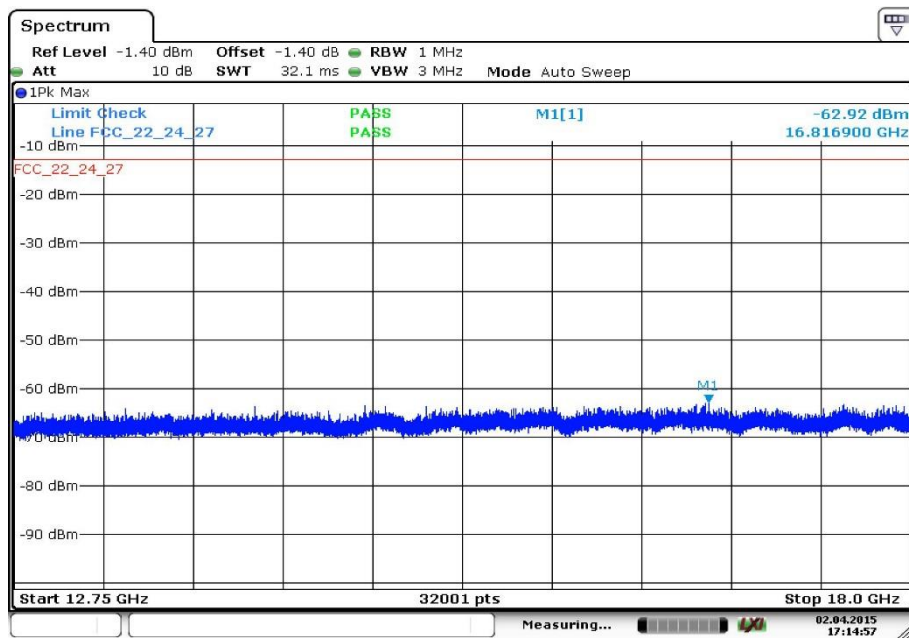
Carrier notched with 1.9 GHz rejection filter

Plot 5: Channel 661 (30 MHz – 12.75 GHz), EDGE



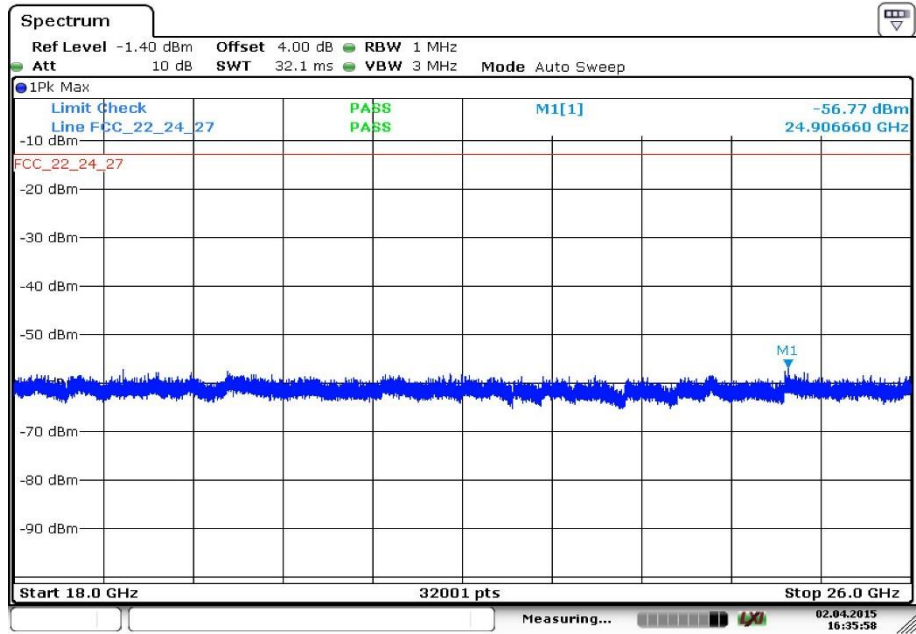
Carrier notched with 1.9 GHz rejection filter

Plot 6: Channel 661 (12.75 GHz - 18 GHz), GSM



Date: 2.APR.2015 17:14:57

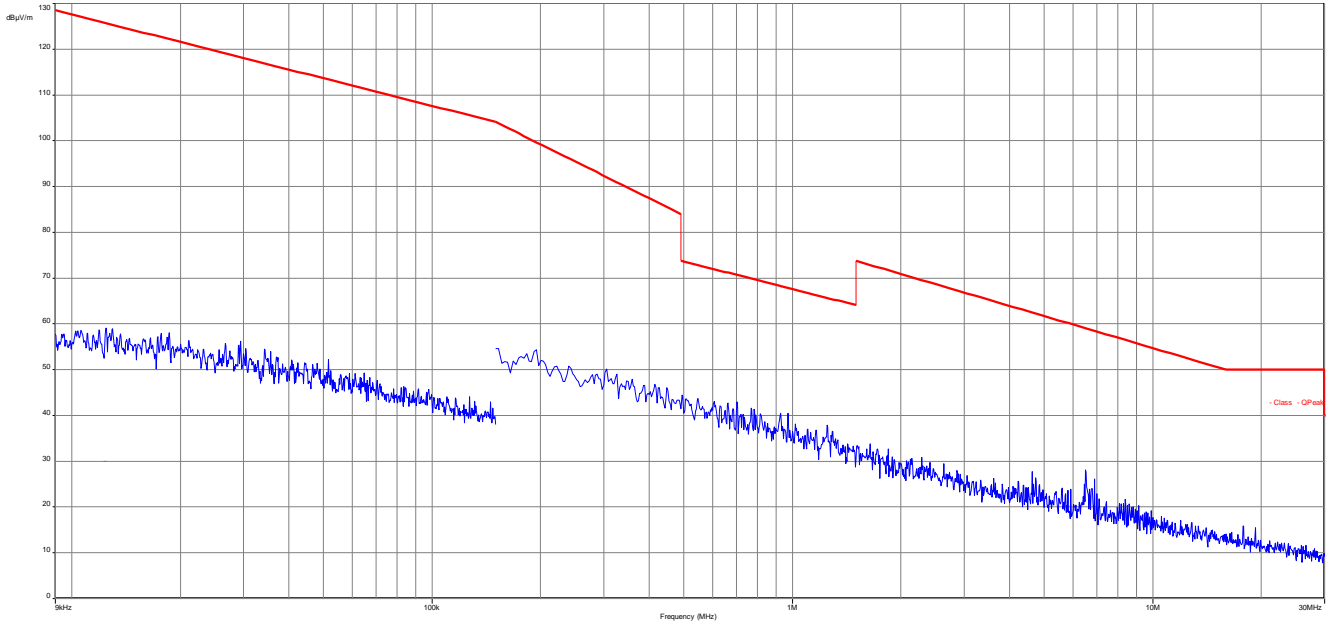
Plot 7: Channel 661 (18 GHz - 26 GHz), GSM



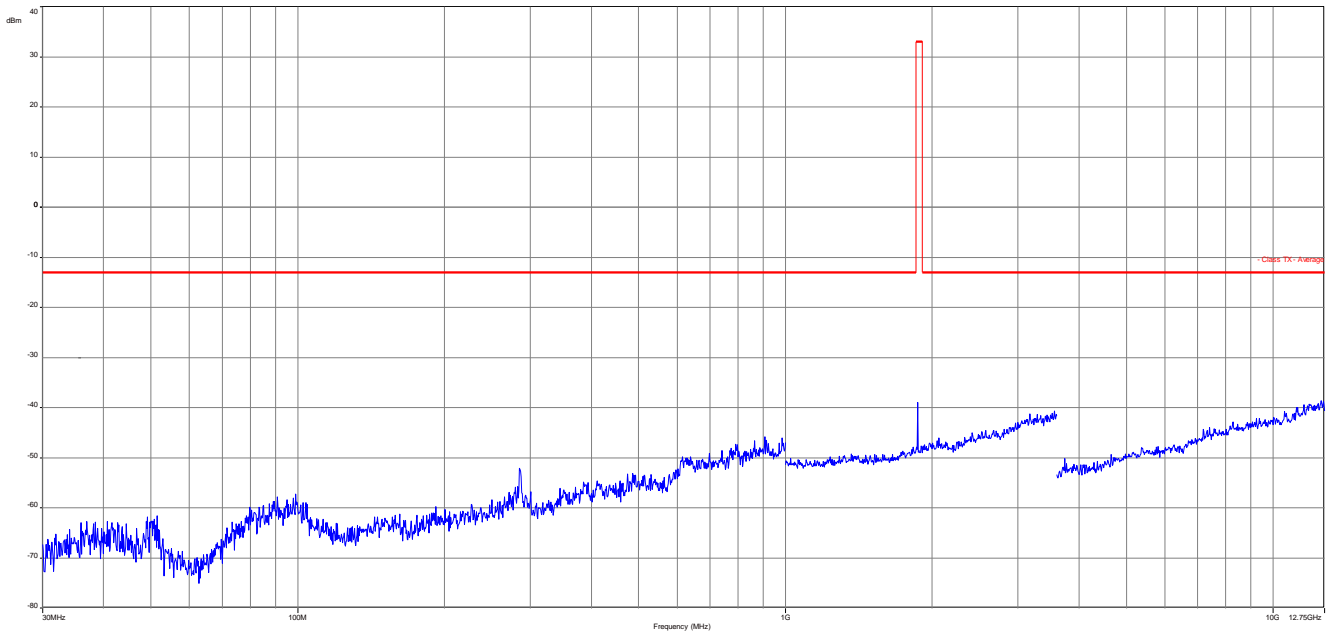
Date: 2.APR.2015 16:35:58

Plots: (internal antenna)

Plot 1: Channel 661 (Traffic mode up to 30 MHz), GSM

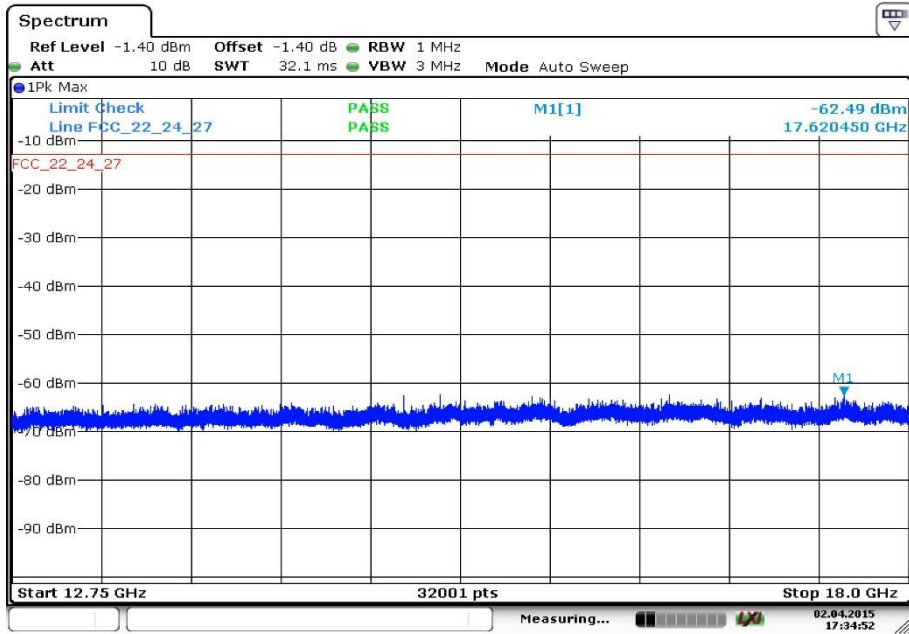


Plot 2: Channel 810 (30 MHz – 12.75 GHz), GSM



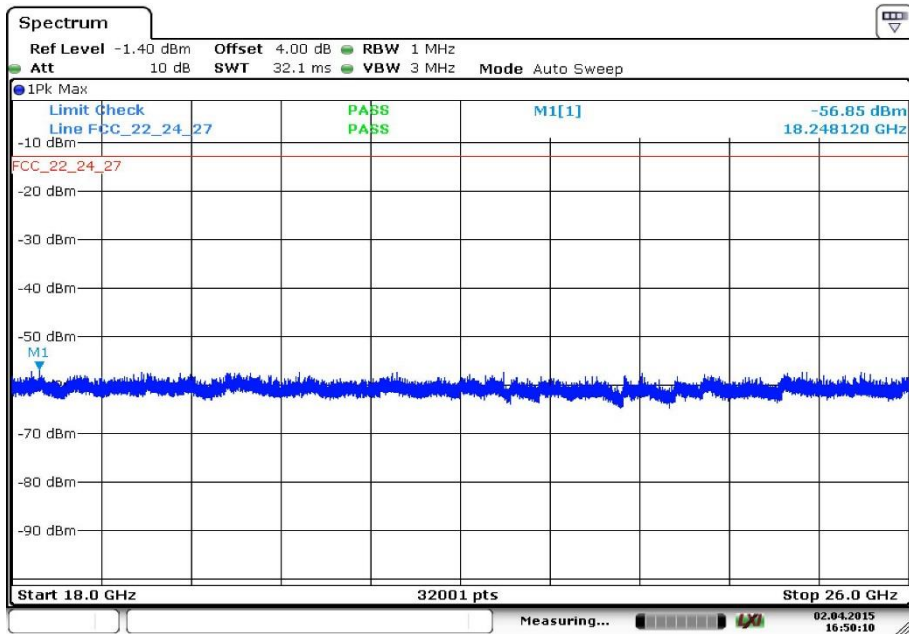
Carrier notched with 1.9 GHz rejection filter

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



Date: 2.APR.2015 17:34:52

Plot 4: Channel 661 (18 GHz - 26 GHz), GSM



Date: 2.APR.2015 16:50:10

9.2.4 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 25 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

PCS1900 Transmitter Channel Frequency

512 1850.2 MHz

661 1880.0 MHz

810 1909.8 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
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:	30 MHz – 25 GHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

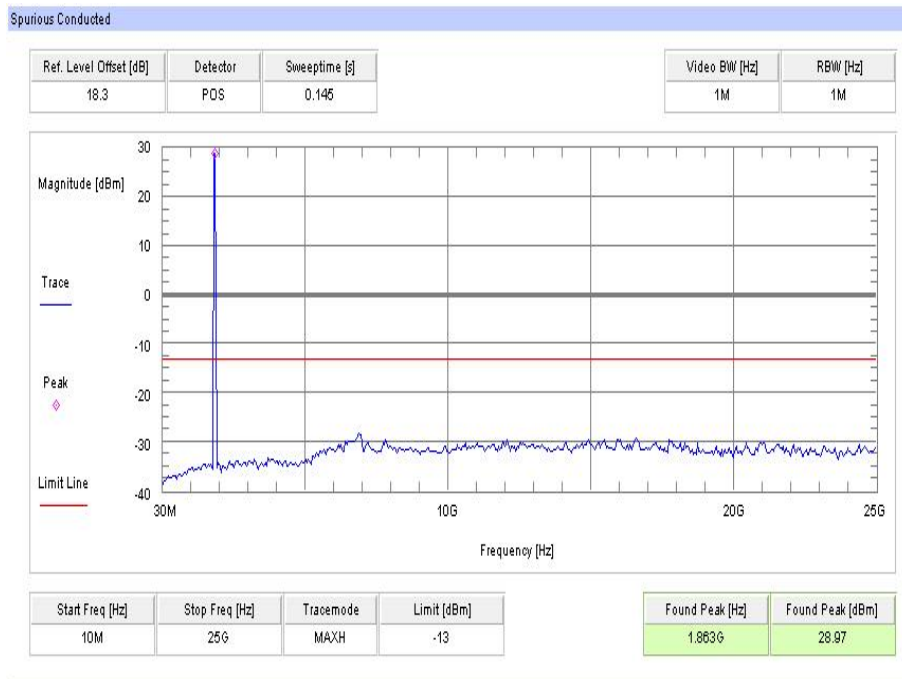
Results:

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	-
Measurement uncertainty					± 3dB			

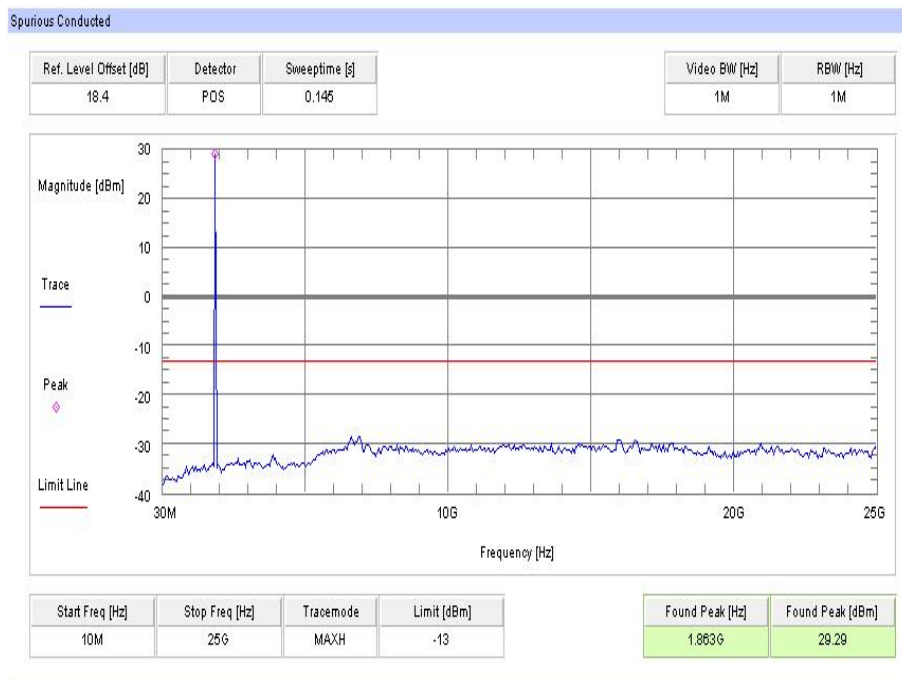
Verdict: [complies](#)

Plots:

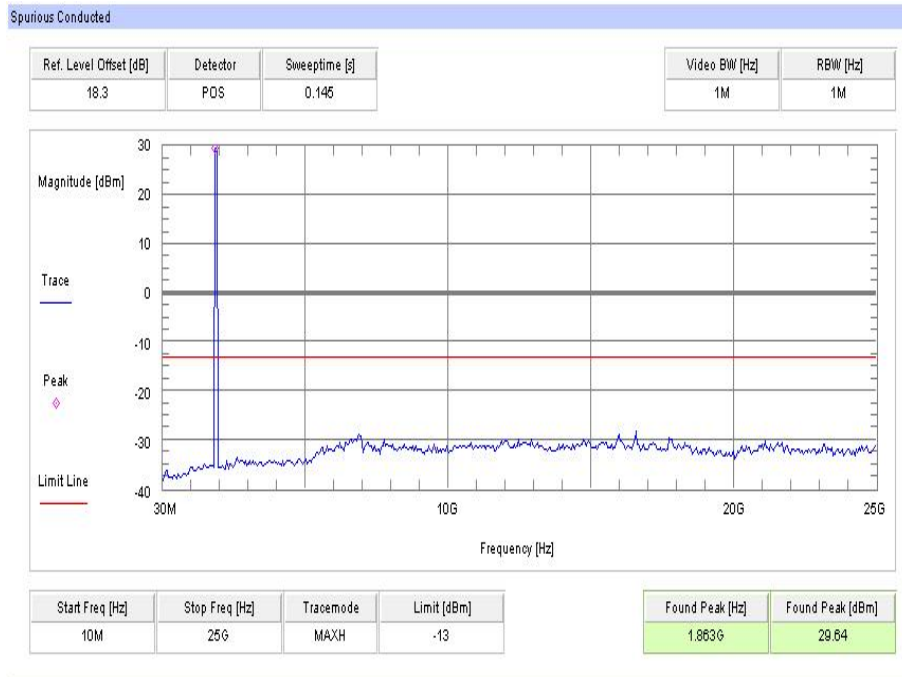
Plot 1: Channel 512 (10 MHz - 25 GHz)



Plot 2: Channel 661 (10 MHz - 25 GHz)



Plot 3: Channel 810 (10 MHz - 25 GHz)



9.2.5 Block edge compliance

Description:

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

Measurement:

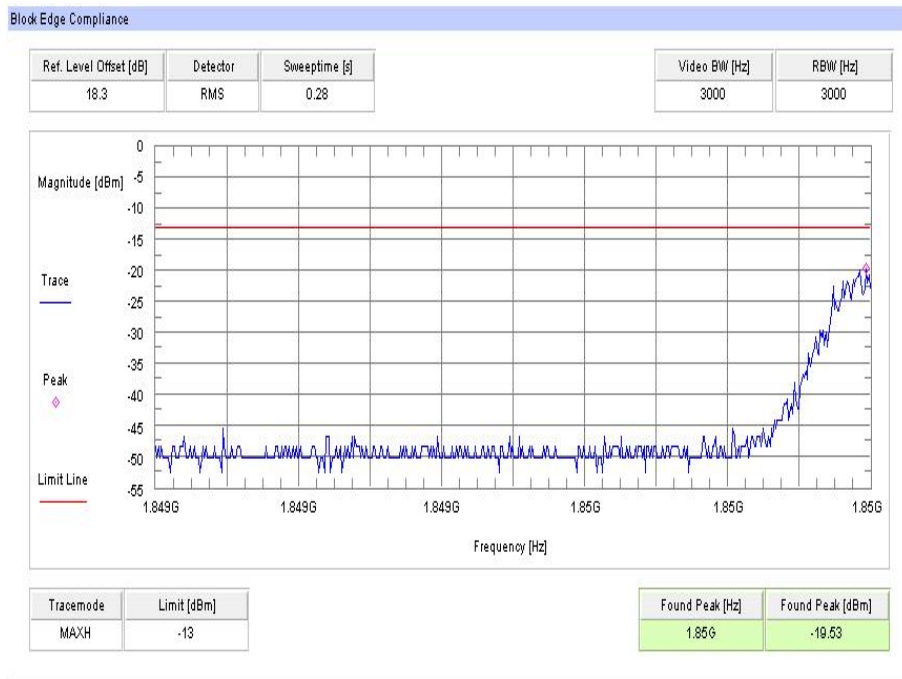
Measurement parameters	
Detector:	RMS
Sweep time:	Auto
Video bandwidth:	3 kHz
Resolution bandwidth:	3 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

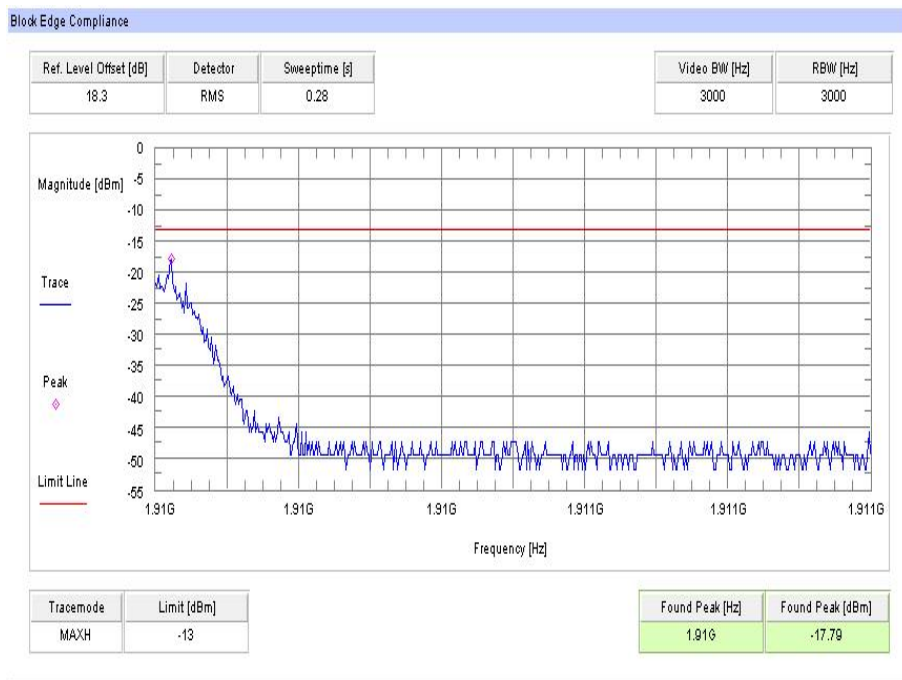
FCC
CFR Part 24.238 CFR Part 2.1051
Block Edge Compliance
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)
-13 dBm

Plots:

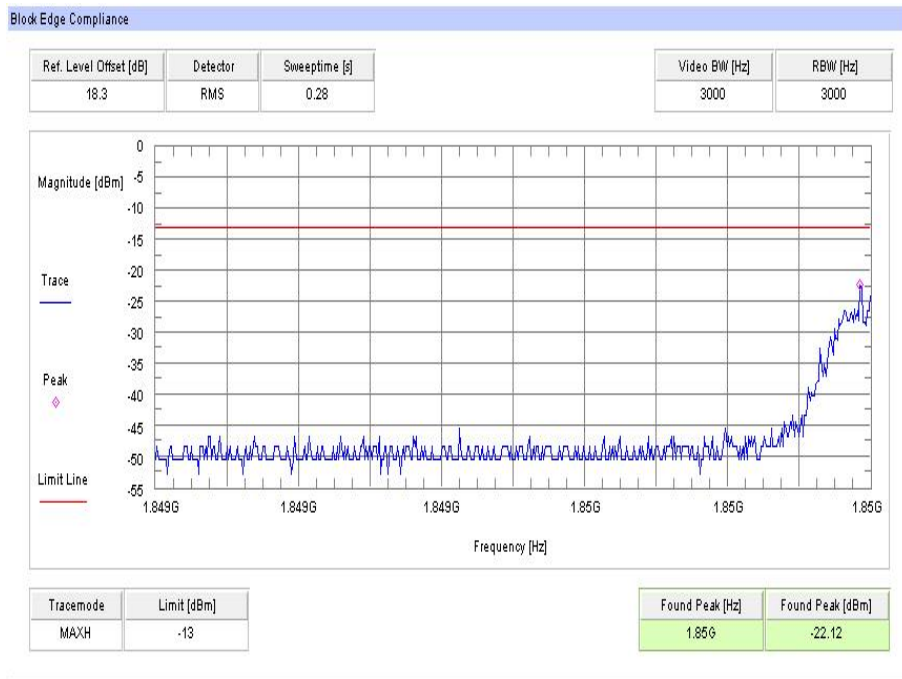
Plot 1: Channel 512 (GSM-mode)



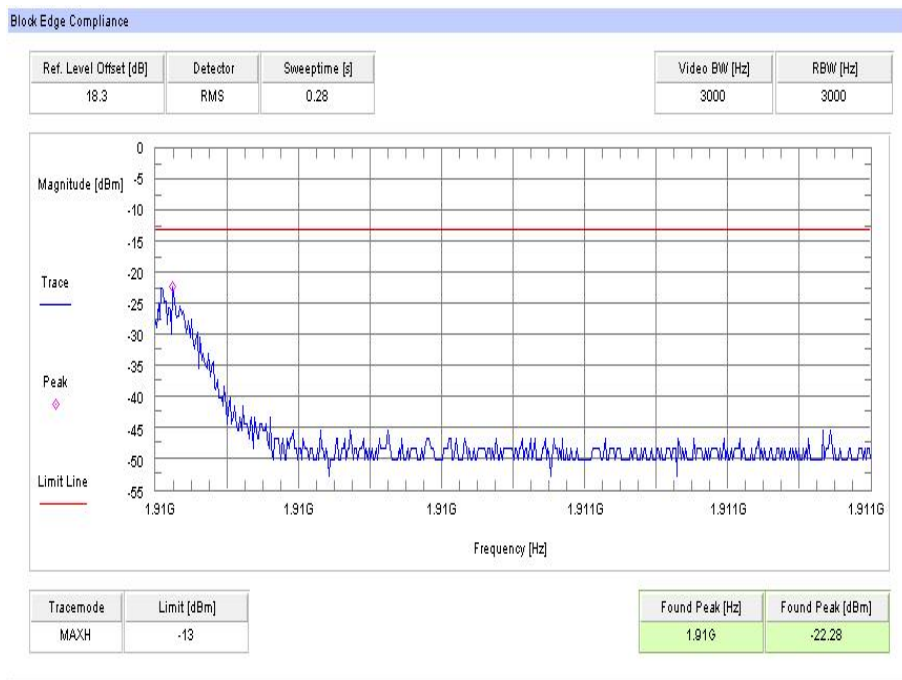
Plot 2: Channel 810 (GSM-mode)



Plot 3: Channel 512 (EDGE-mode)



Plot 4: Channel 810 (EDGE-mode)



Verdict: [complies](#)

9.2.6 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.

Part 24.238 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300 kHz, this equates to a resolution bandwidth of at least 3.0 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	30 kHz
Resolution bandwidth:	10 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

Results:

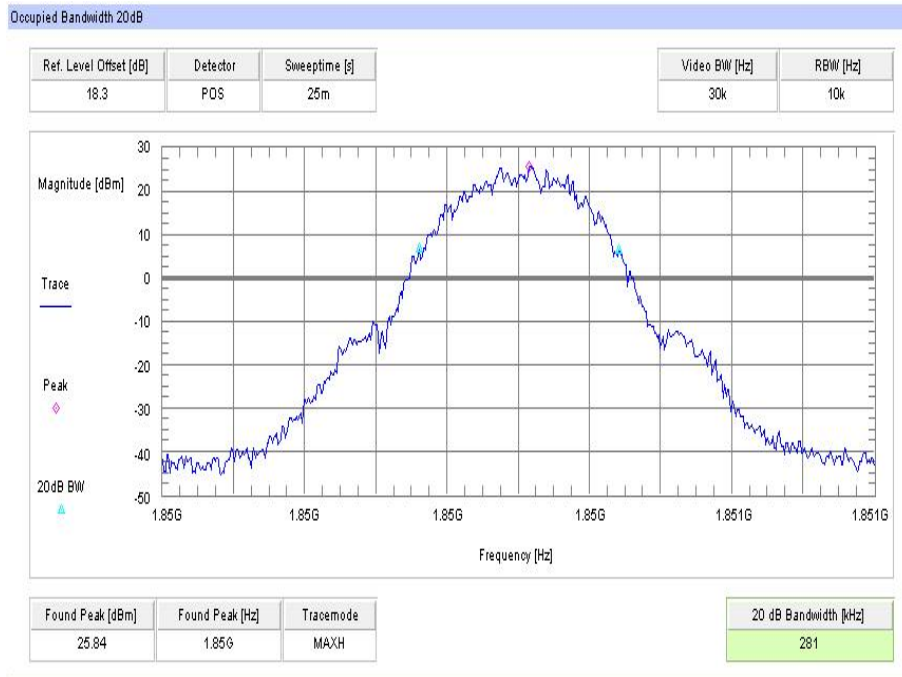
Occupied Bandwidth - GMSK mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	281	315
1880.0	273	311
1909.8	261	315
Measurement uncertainty	± 3 kHz	

Occupied Bandwidth - EDGE mode		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1850.2	275	303
1880.0	261	299
1909.8	255	291
Measurement uncertainty	± 3 kHz	

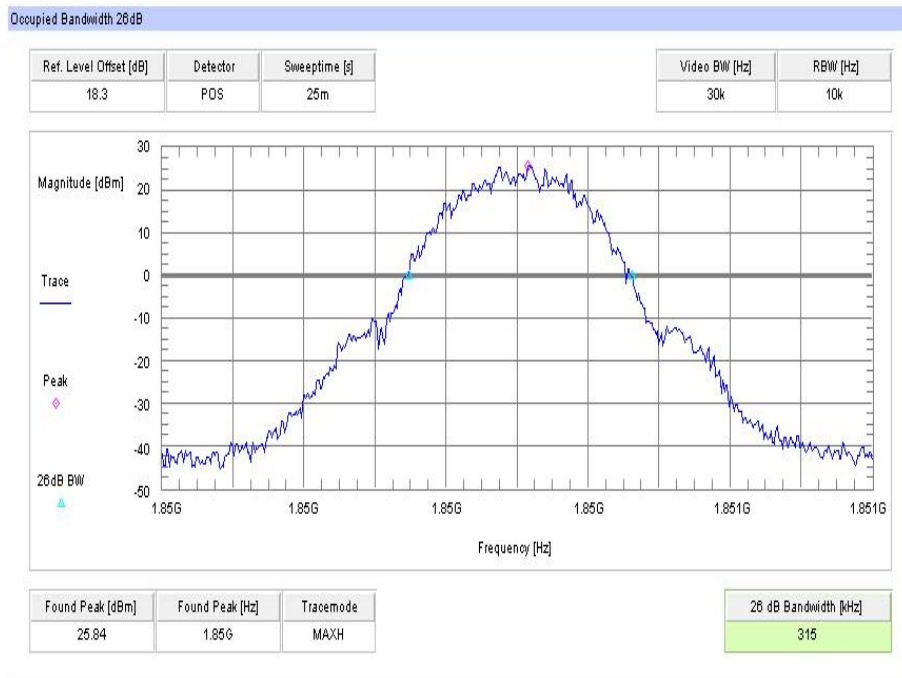
Verdict: [complies](#)

Plots:

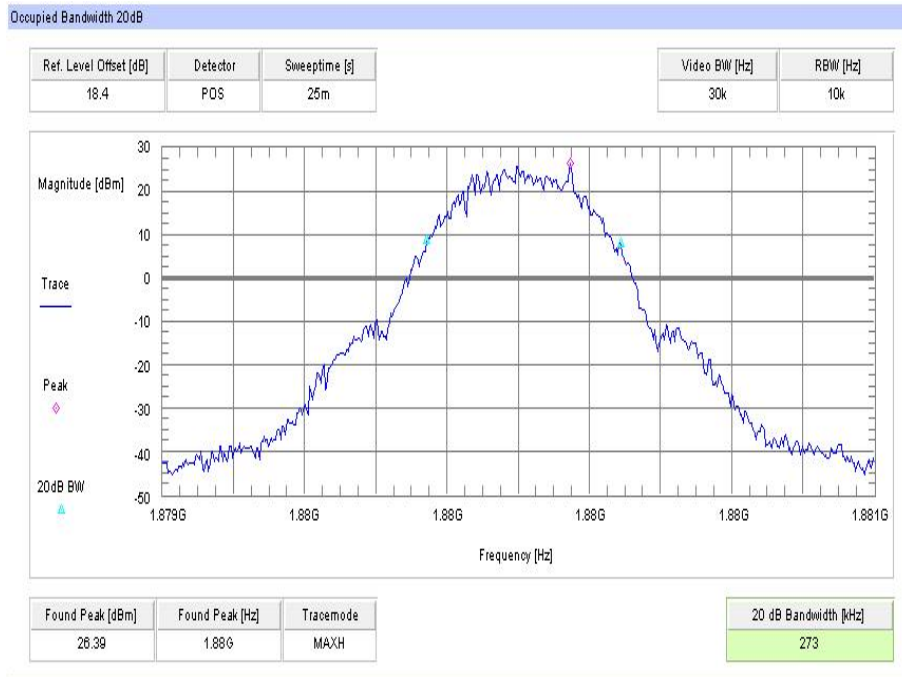
Plot 1: Channel 512 (99% - OBW)



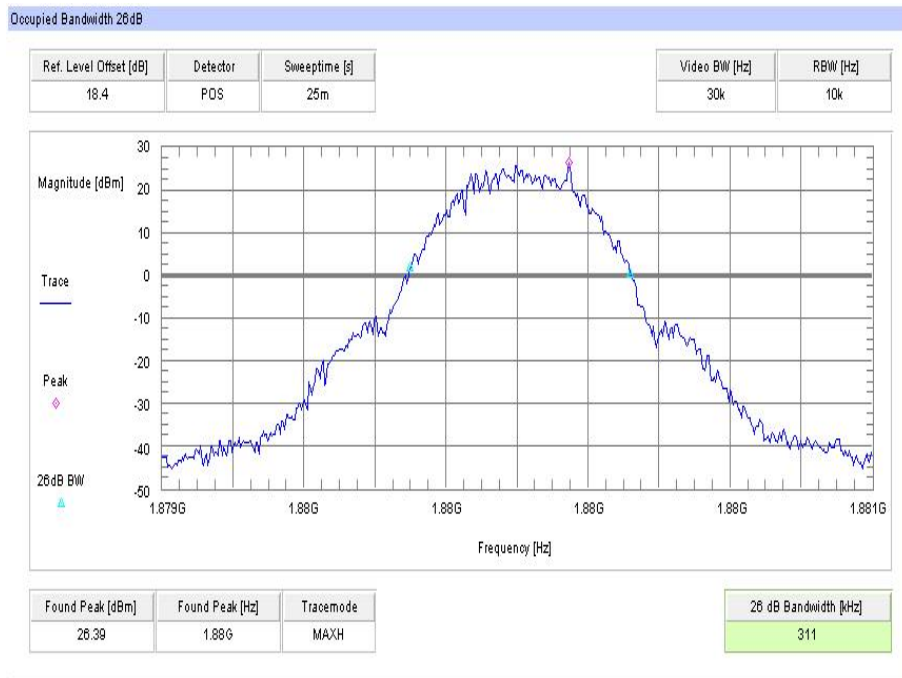
Plot 2: Channel 512 (-26 dBc BW)



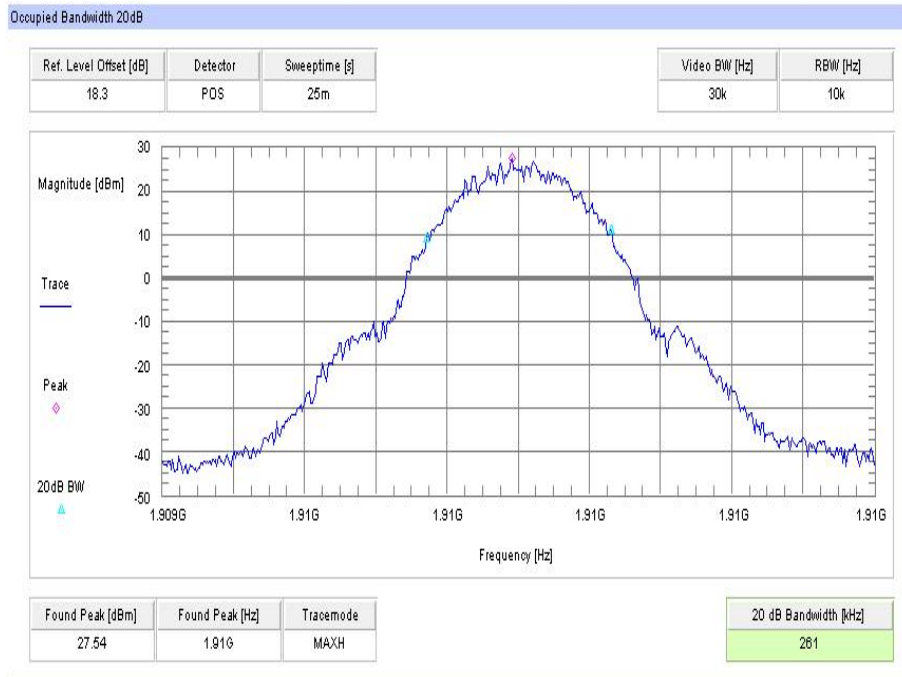
Plot 3: Channel 661 (99% - OBW)



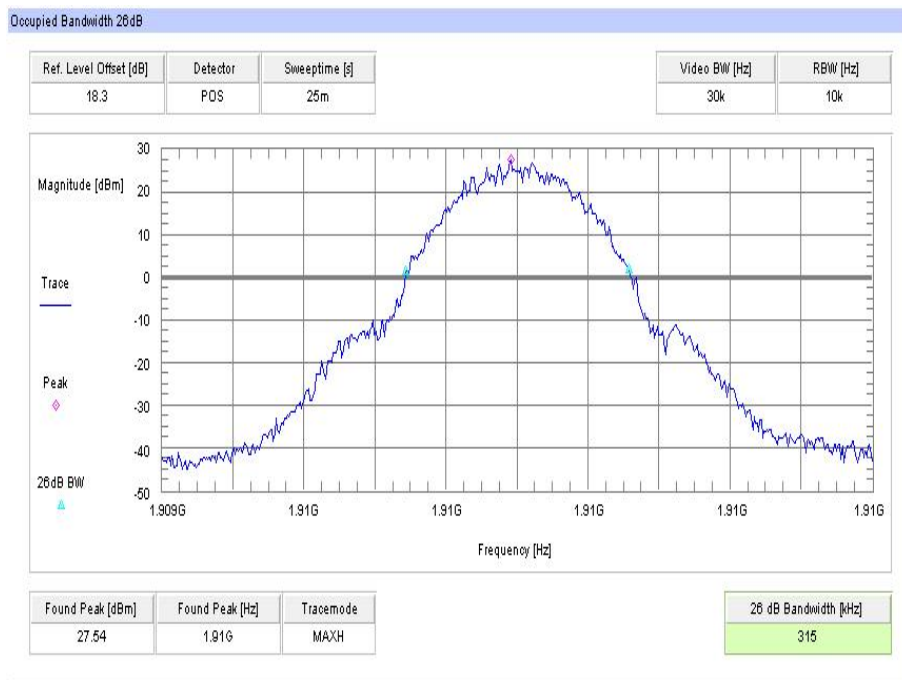
Plot 4: Channel 661 (-26 dBc BW)



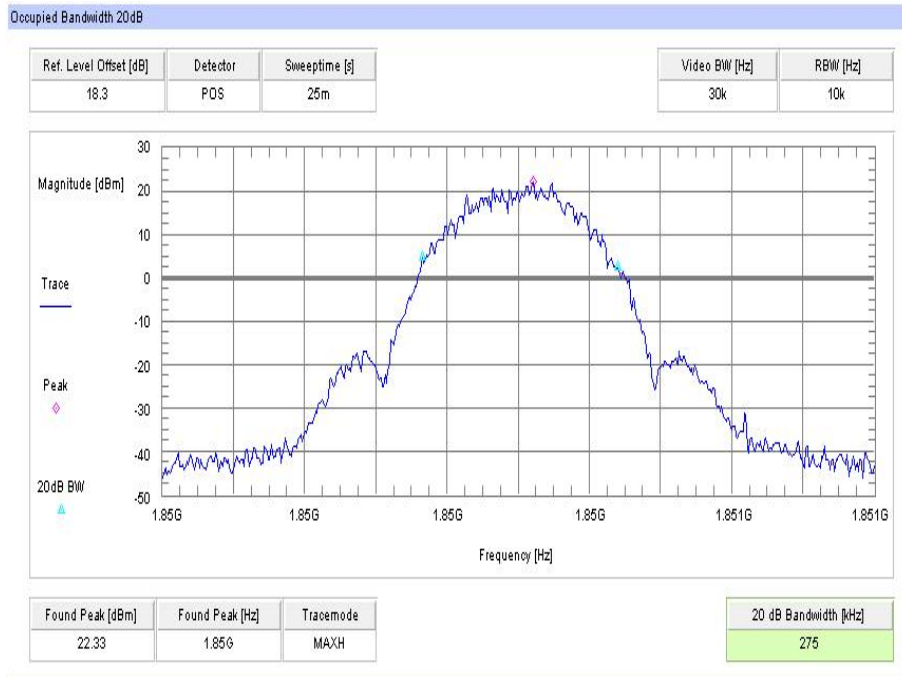
Plot 5: Channel 810 (99% - OBW)



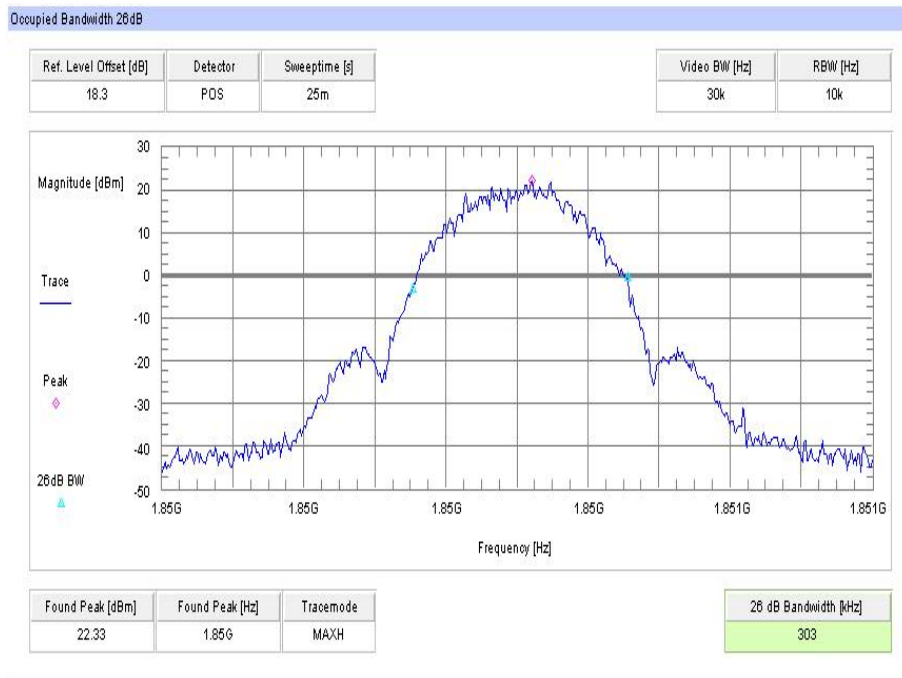
Plot 6: Channel 810 (-26 dBc BW)



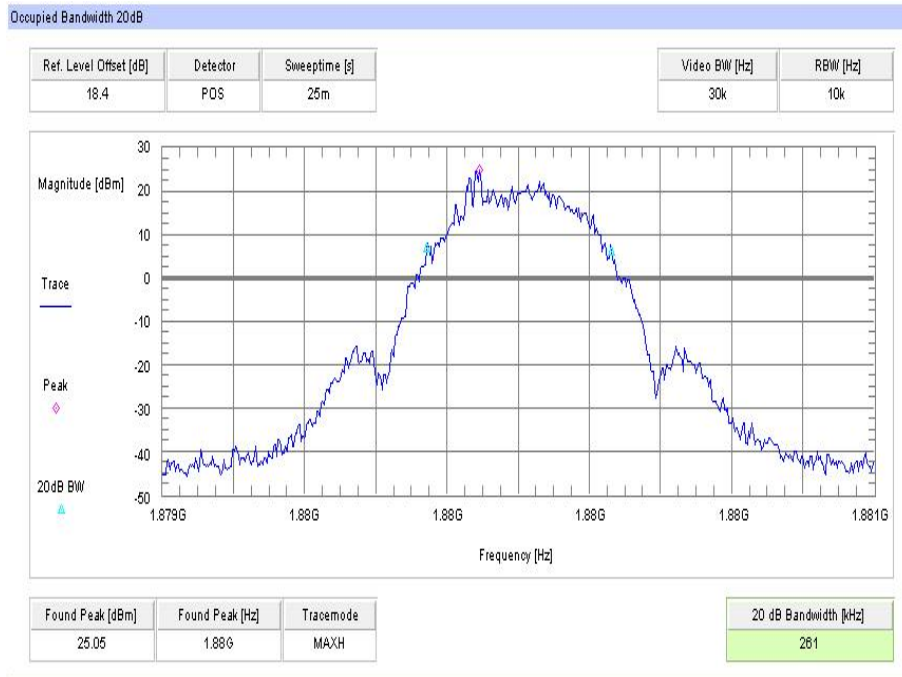
Plot 7: Channel 512 (99% - OBW) - EDGE



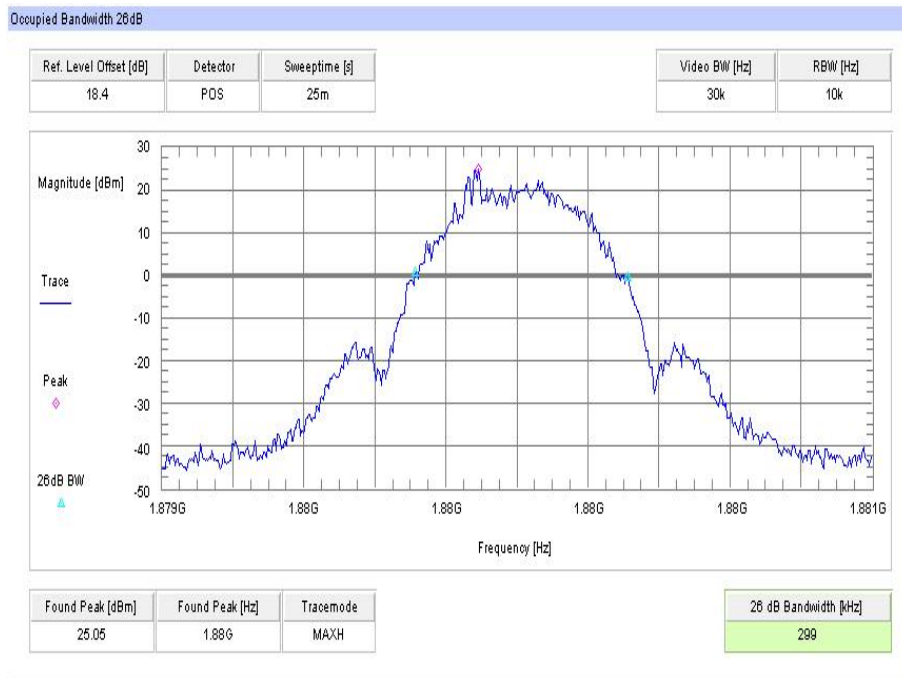
Plot 8: Channel 512 (-26 dBc BW) - EDGE



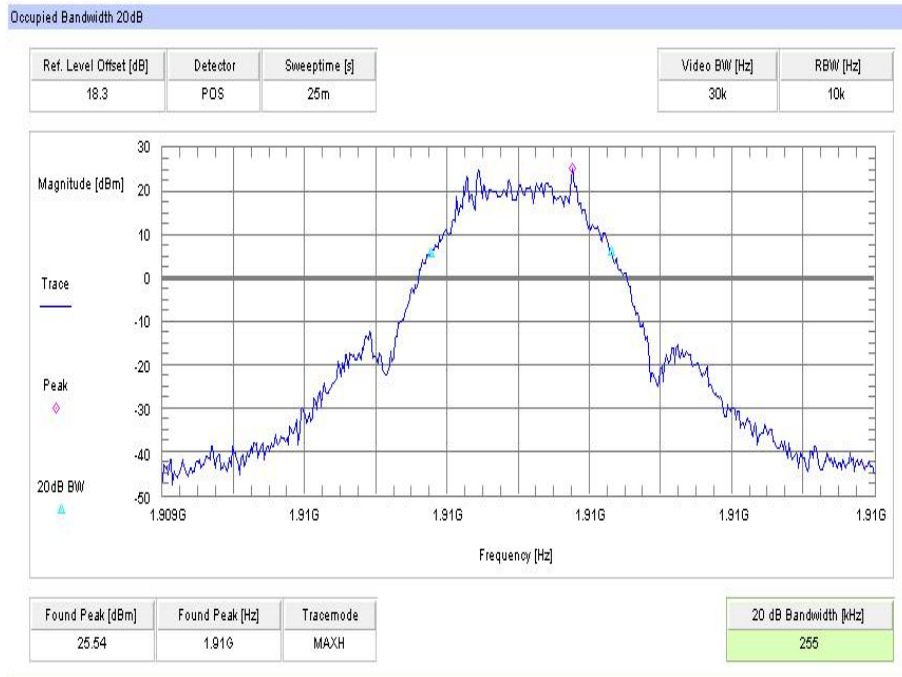
Plot 9: Channel 661 (99% - OBW) - EDGE



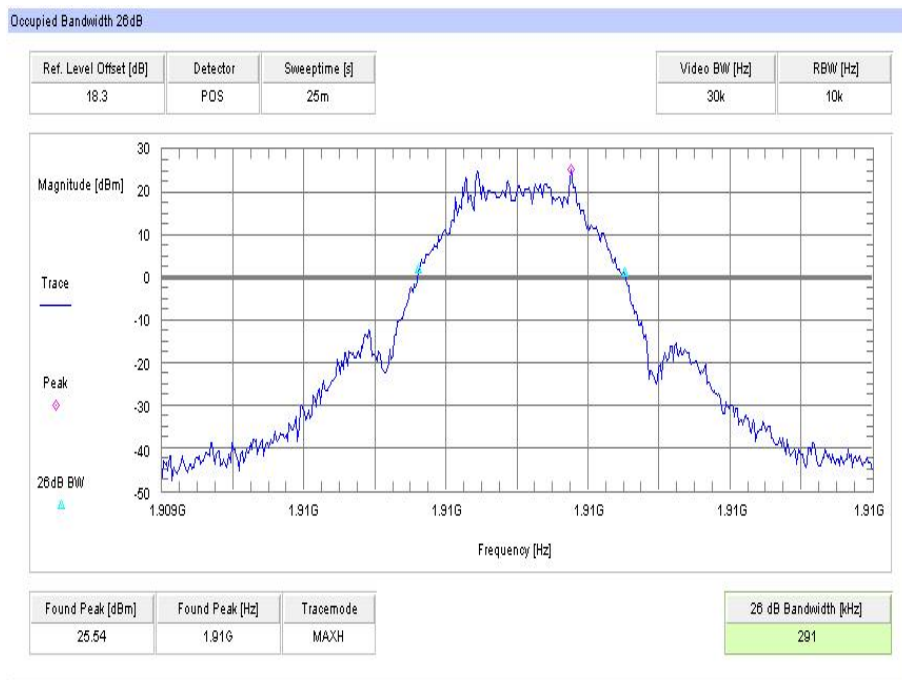
Plot 10: Channel 661 (-26 dBc BW) - EDGE



Plot 11: Channel 810 (99% - OBW) - EDGE



Plot 12: Channel 810 (-26 dBc BW) - EDGE



9.3 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)

9.3.1 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.

The peak to average value is calculated by the difference between peak value and avg value.

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	10 MHz
Resolution bandwidth:	10 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

Results:

Output Power (conducted) WCDMA mode		
Frequency (MHz)	Average Output Power (dBm)	Peak to Average Ratio (dB)
826.4	22.7	3.41
836.0	22.7	3.54
846.6	22.8	3.48
Measurement uncertainty	± 0.5 dB	

Output Power (radiated) WCDMA mode	
Frequency (MHz)	Average Output Power (dBm) - ERP
826.4 (external antenna)	19.0
836.0 (external antenna)	20.4
846.6 (external antenna)	19.5
846.6 (internal antenna)	17.0
Measurement uncertainty	± 2.0 dB

Verdict: [complies](#)

9.3.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a R&S CMU200 DIGITAL RADIOCOMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom} , connected to the CMU200 and in a simulated call on channel 4180 (centre 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 +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom} . Vary supply voltage from V_{min} to V_{max} . Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	see chapter 8.2
Used test setup:	

Limits:

FCC
CFR Part 22.355 CFR Part 2.1055
Frequency Stability
± 0.1 ppm

Results:**AFC FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
4.5	-6	-0.00000072	-0.0072
4.8	-4	-0.00000048	-0.0048
8.0	7	0.00000084	0.0084
14.0	3	0.00000036	0.0036
18.0	1	0.00000012	0.0012

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	1	0.00000012	0.0012
-20	-4	-0.00000048	-0.0048
-10	3	0.00000036	0.0036
± 0	-3	-0.00000036	-0.0036
10	-3	-0.00000036	-0.0036
20	4	0.00000048	0.0048
30	3	0.00000036	0.0036
40	-2	-0.00000024	-0.0024
50	-4	-0.00000048	-0.0048
60	3	0.00000036	0.0036

Verdict: [complies](#)

9.3.3 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 846.6 MHz. Measurement made up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the 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
Used test setup:	see chapter 8.1

Limits:

FCC
CFR Part 22.917 CFR Part 2.1053
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.

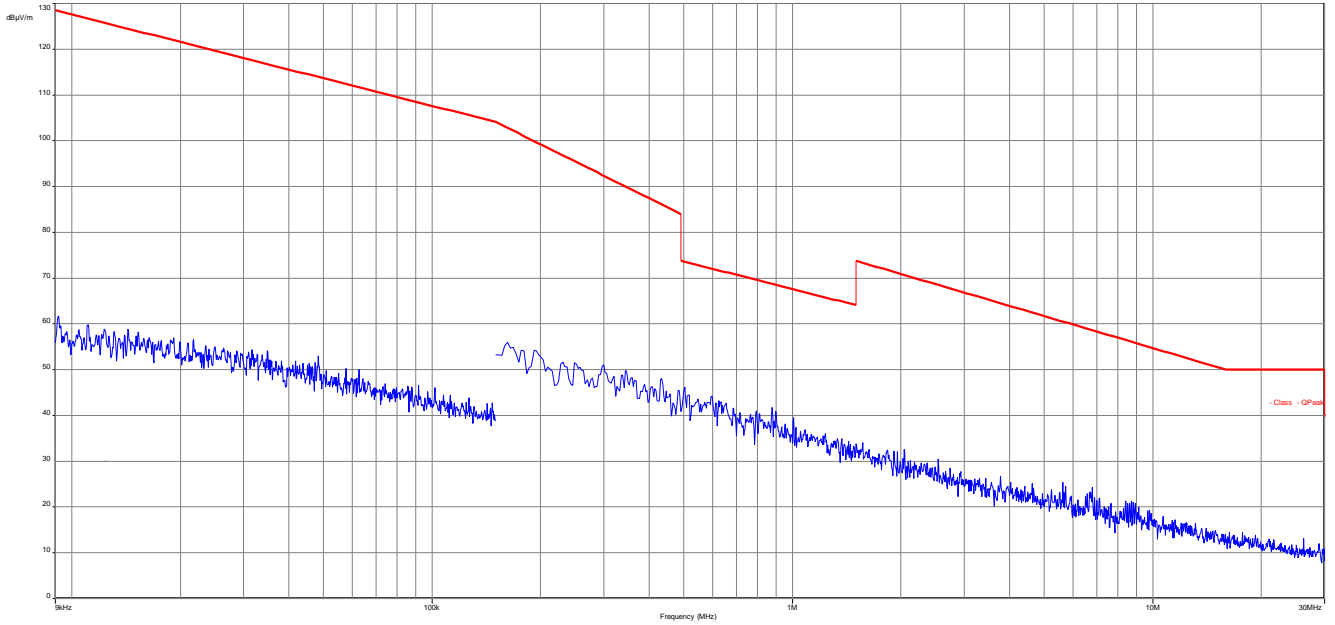
As can be seen from this data, the emissions from the test item were within the specification limit.

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	-
Measurement uncertainty					± 3dB			

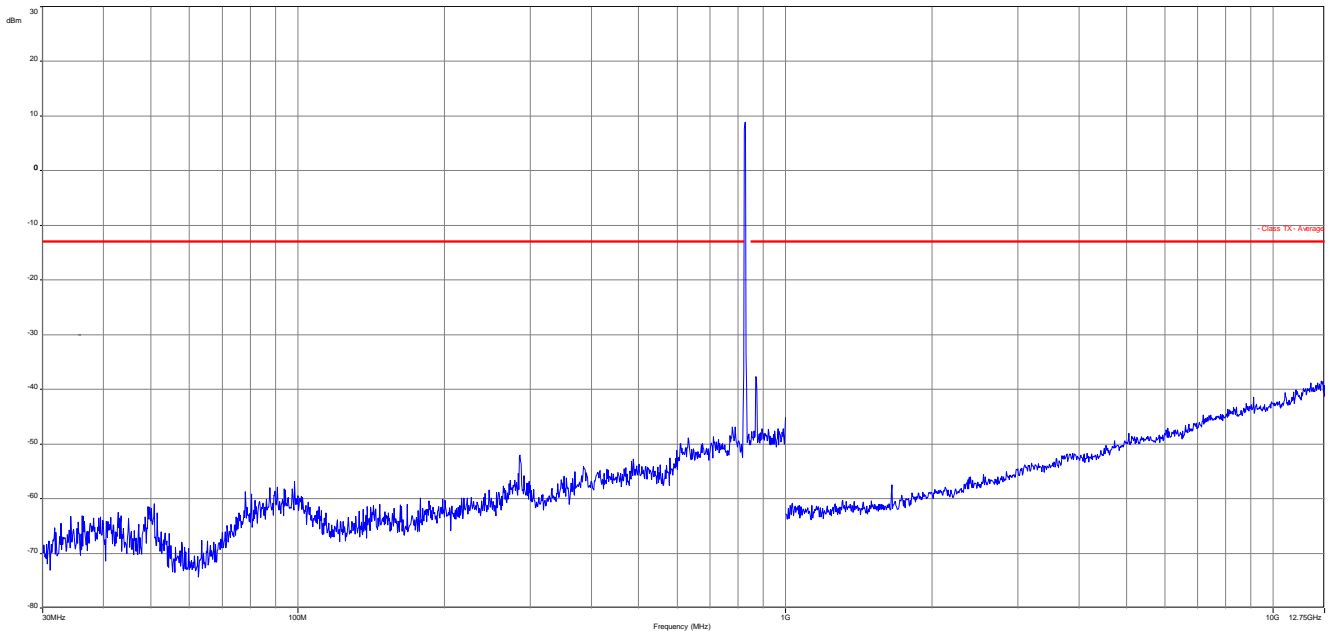
Verdict: [complies](#)

Plots: (external antenna)

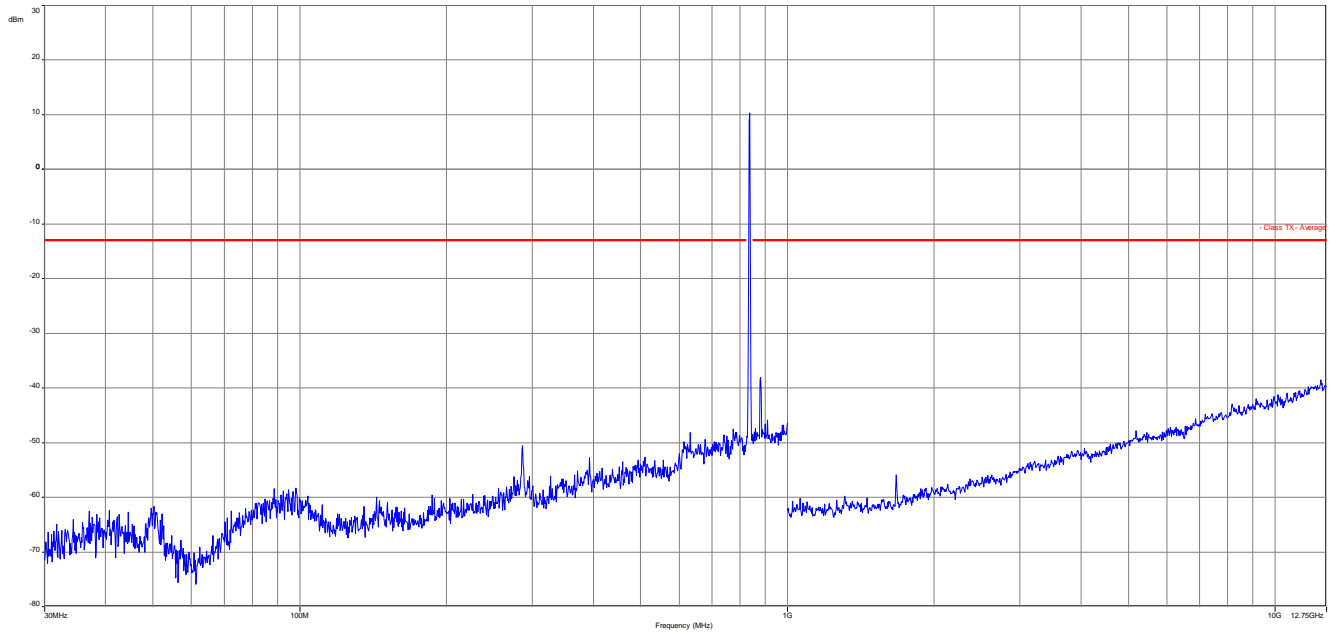
Plot 1: Channel 4180 (Traffic mode up to 30 MHz)



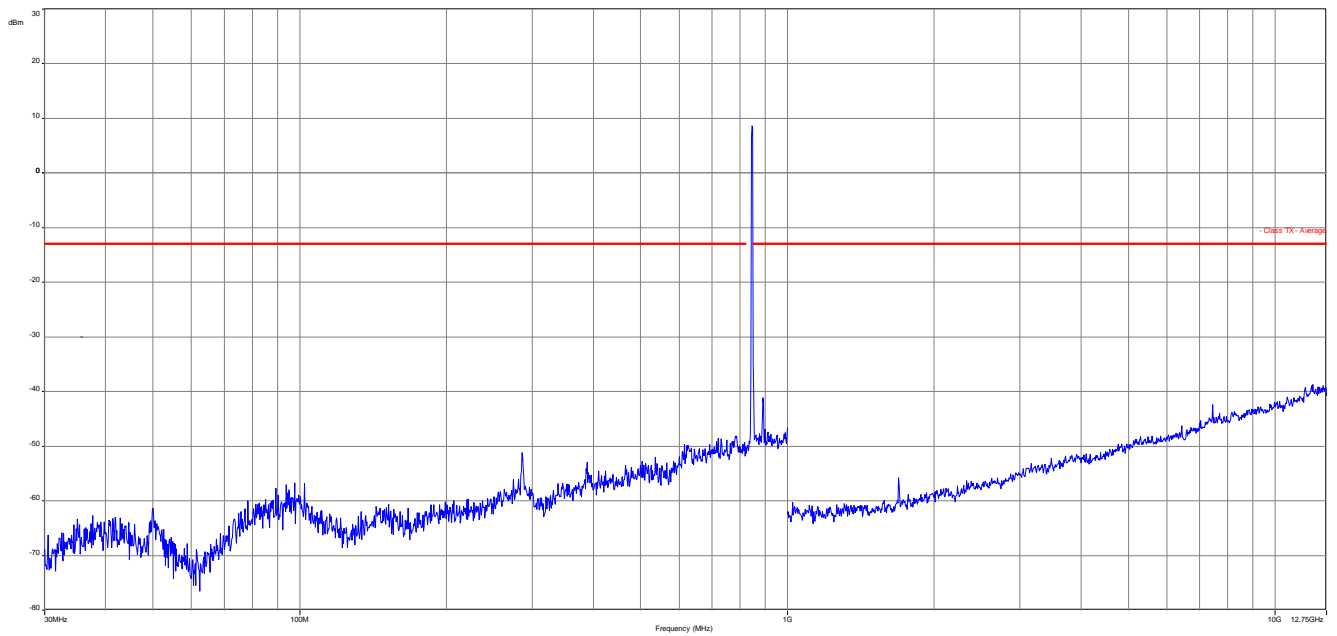
Plot 2: Channel 4132 (30 MHz – 12.75 GHz)



Plot 3: Channel 4180 (30 MHz – 12.75 GHz)

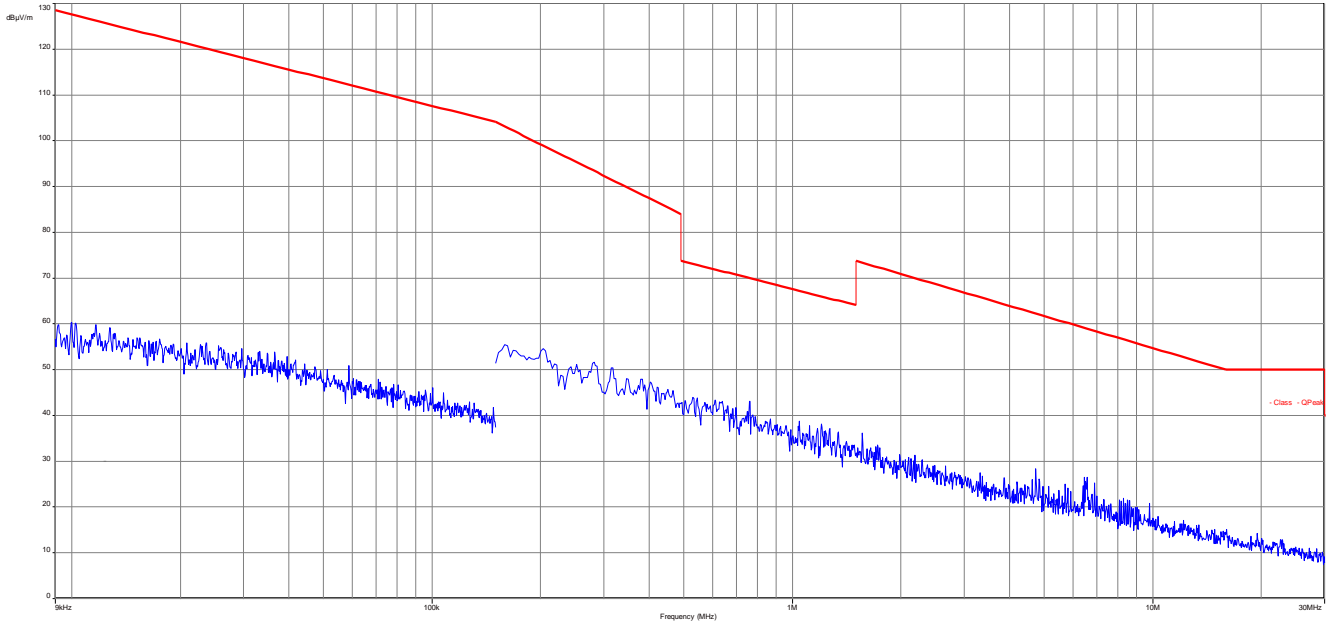


Plot 4: Channel 4233 (30 MHz – 12.75 GHz)

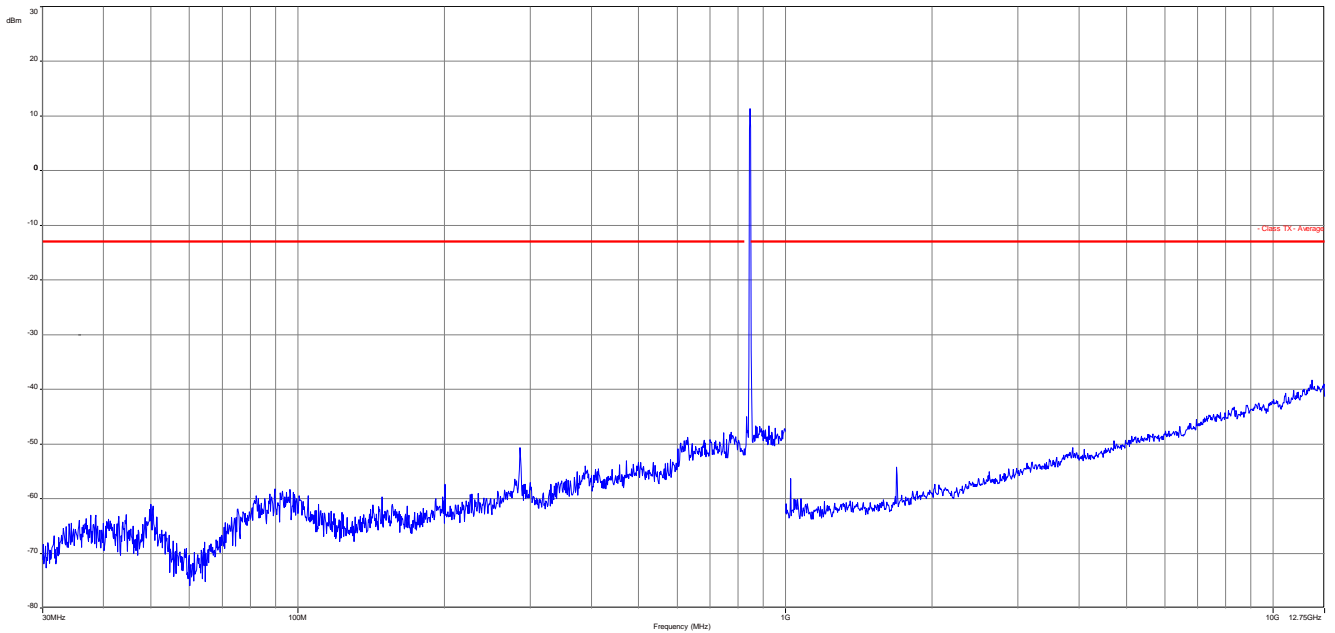


Plots: (internal antenna)

Plot 1: Channel 4233 (Traffic mode up to 30 MHz)



Plot 2: Channel 4233 (30 MHz – 12.75 GHz)



9.3.4 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 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:	30 MHz – 25 GHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

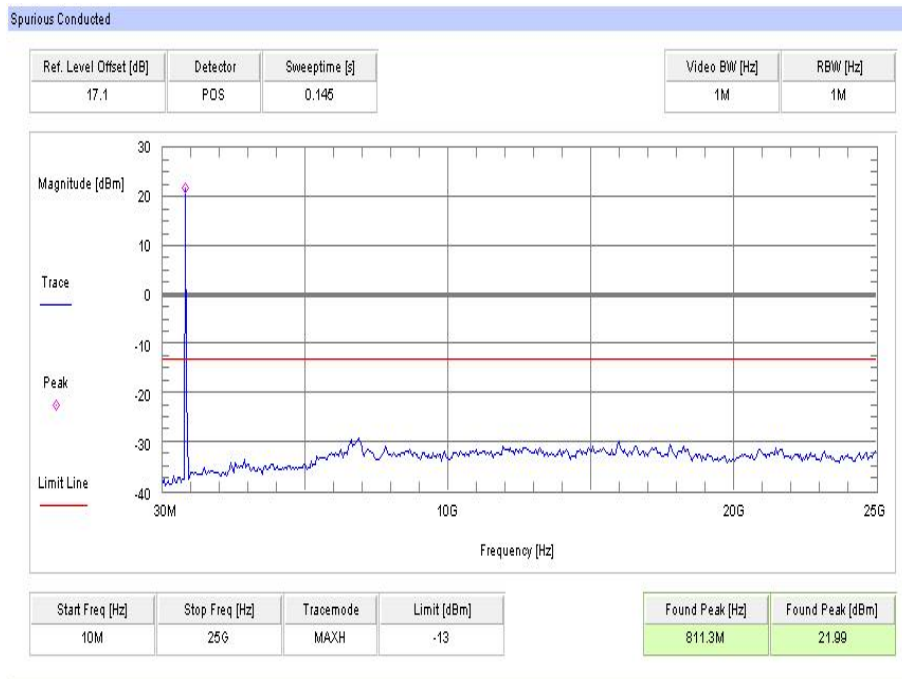
Results:

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	-
Measurement uncertainty					± 3dB			

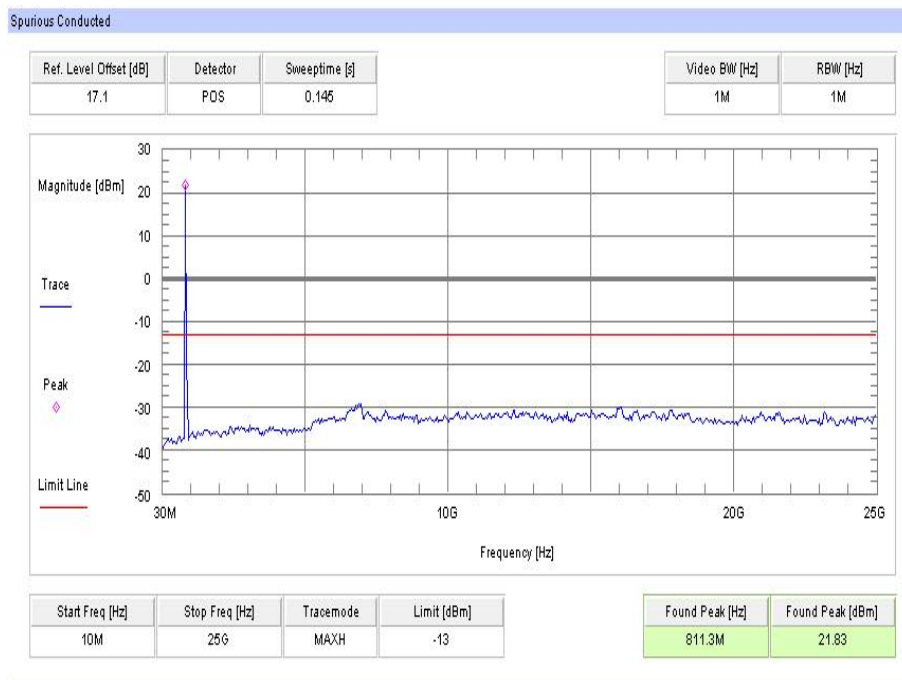
Verdict: [complies](#)

Plots:

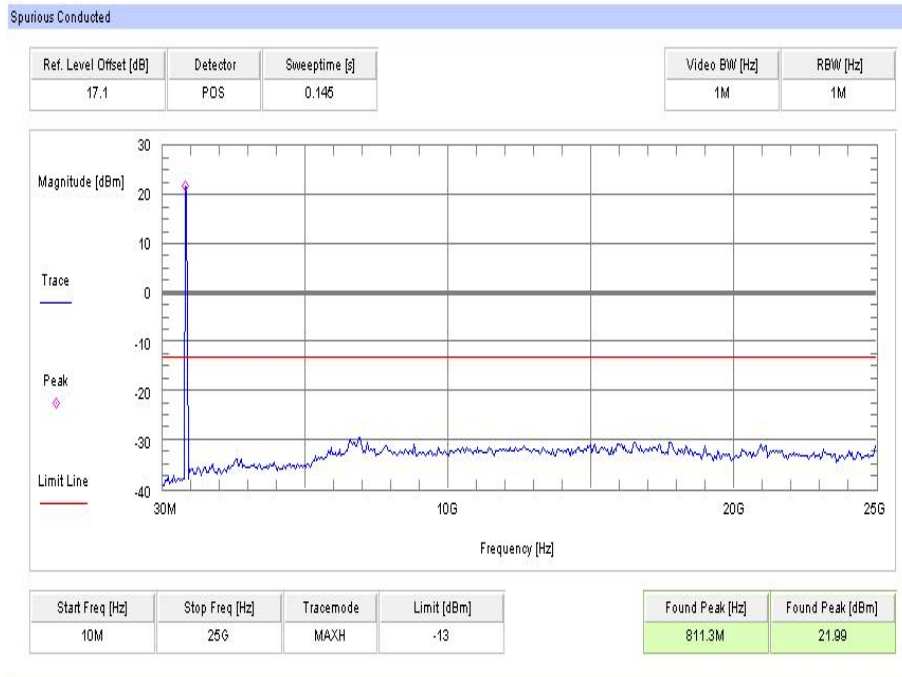
Plot 1: Channel 4132 (10 MHz - 25 GHz)



Plot 2: Channel 4180 (10 MHz - 25 GHz)



Plot 3: Channel 4233 (10 MHz - 25 GHz)



9.3.5 Block edge compliance

Description:

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

Measurement:

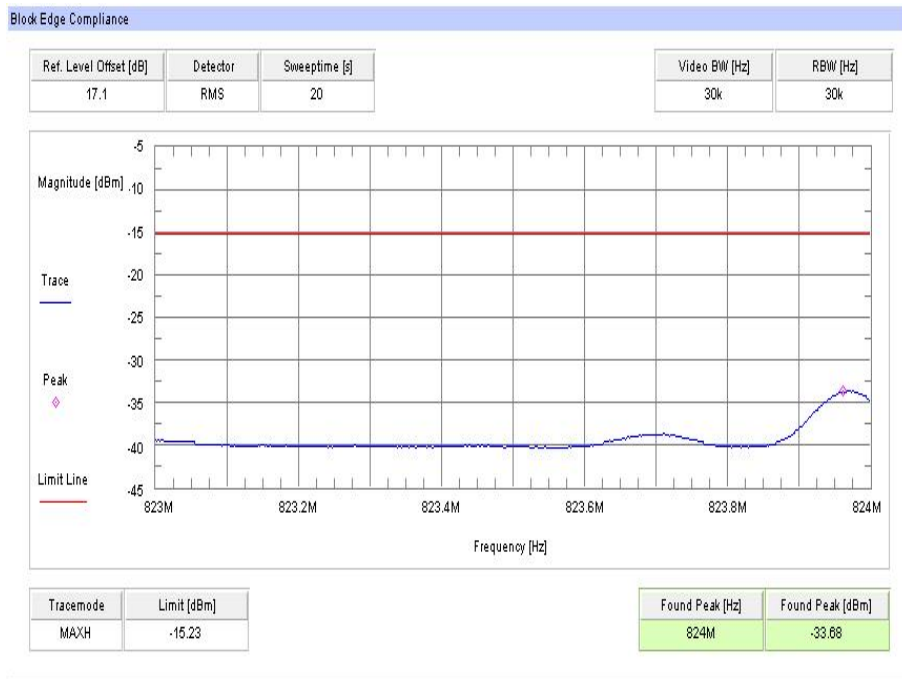
Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

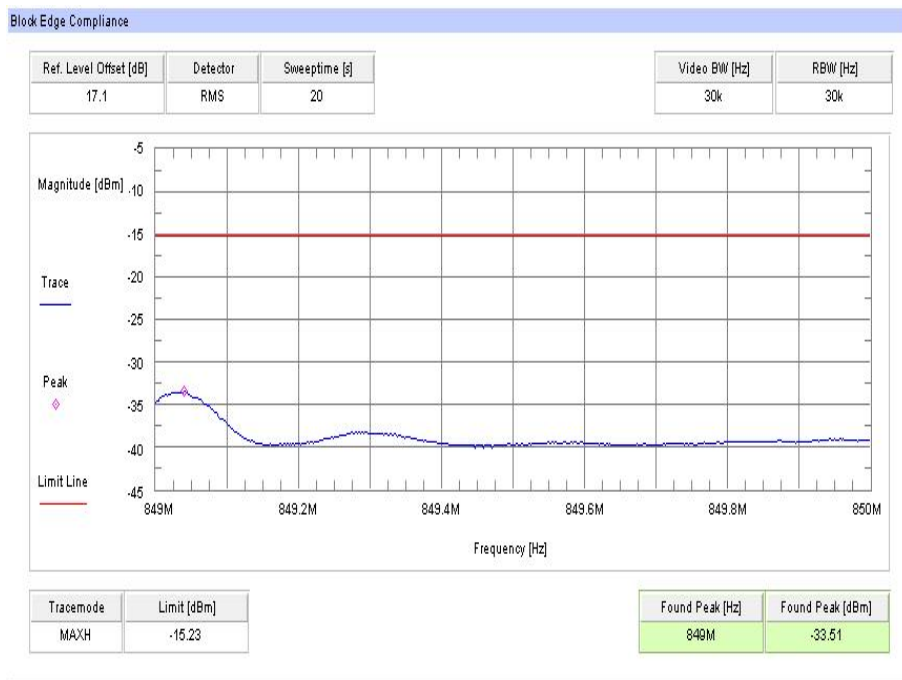
FCC
CFR Part 22.917 CFR Part 2.1051
Block Edge Compliance
Part 22.917 specifies that "the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB."
However, in publication number 890810, The FCC Office of Engineering and Technology specified the following correction to the limits when a resolution bandwidth smaller than 1% of the emission bandwidth is used:
"An alternative is to add an additional correction factor of $10 \log(RBW1/RBW2)$ to the $43 + 10 \log(P)$ limit. RBW1 is the narrower measurement resolution bandwidth and RBW2 is either the 1% emissions bandwidth or 1 MHz."
When using a 30 kHz bandwidth, this yields a -2.2185 adjustment to the limit [$10 \log(30\text{kHz}/50\text{kHz}) = -2.2185$]. When this adjustment is applied to the limit, the limit becomes -15.2185.
-15.22 dBm

Plots:

Plot 1: Channel 4132



Plot 2: Channel 4233



Verdict: complies

9.3.6 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 V. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

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

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

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

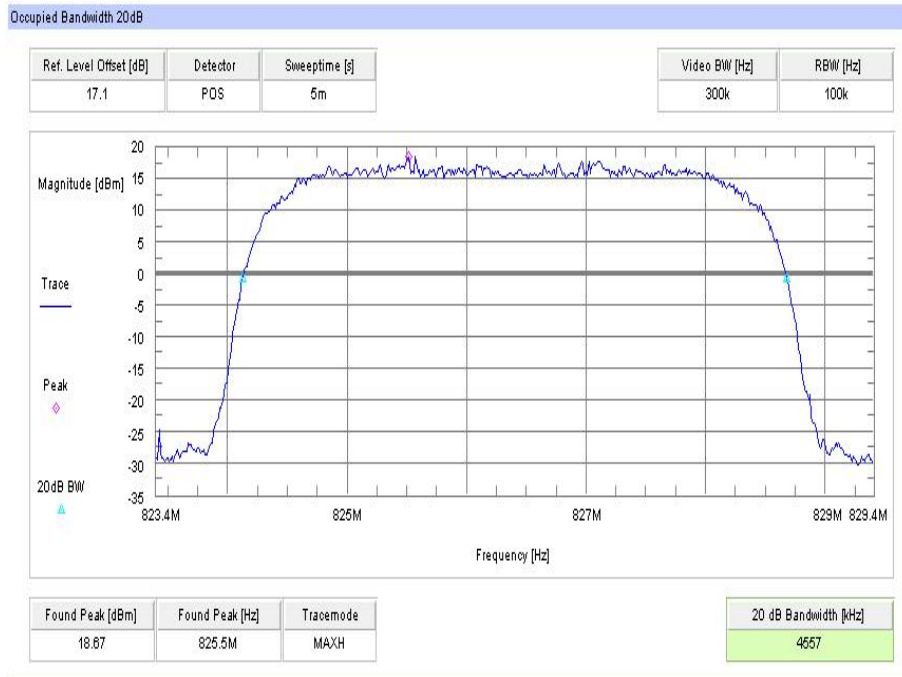
Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
826.4	4557	4677
836.0	4557	4665
846.6	4557	4665
Measurement uncertainty	± 100 kHz	

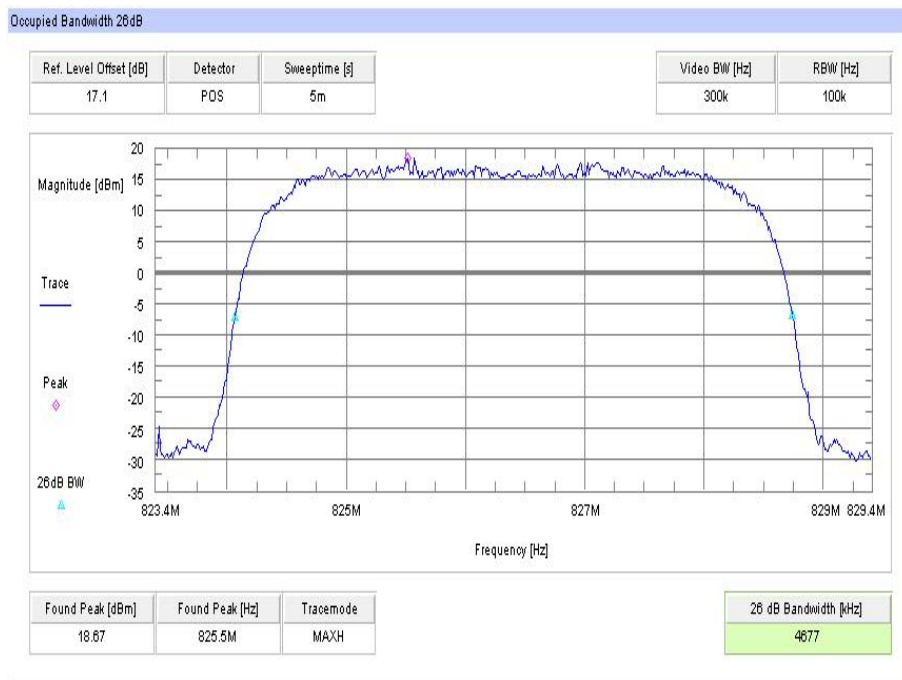
Verdict: [complies](#)

Plots:

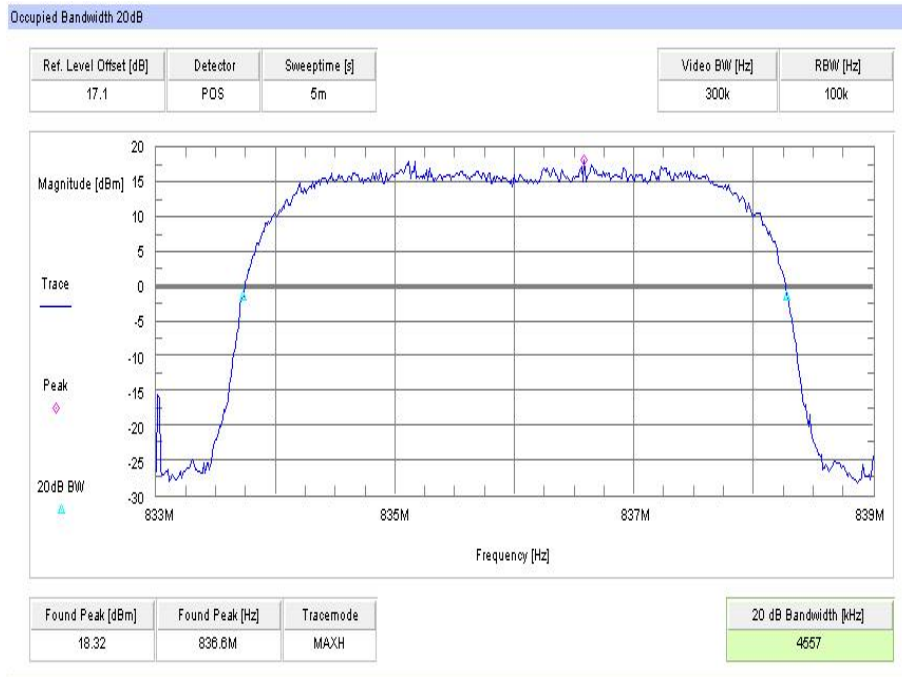
Plot 1: Channel 4132 (99% - OBW)



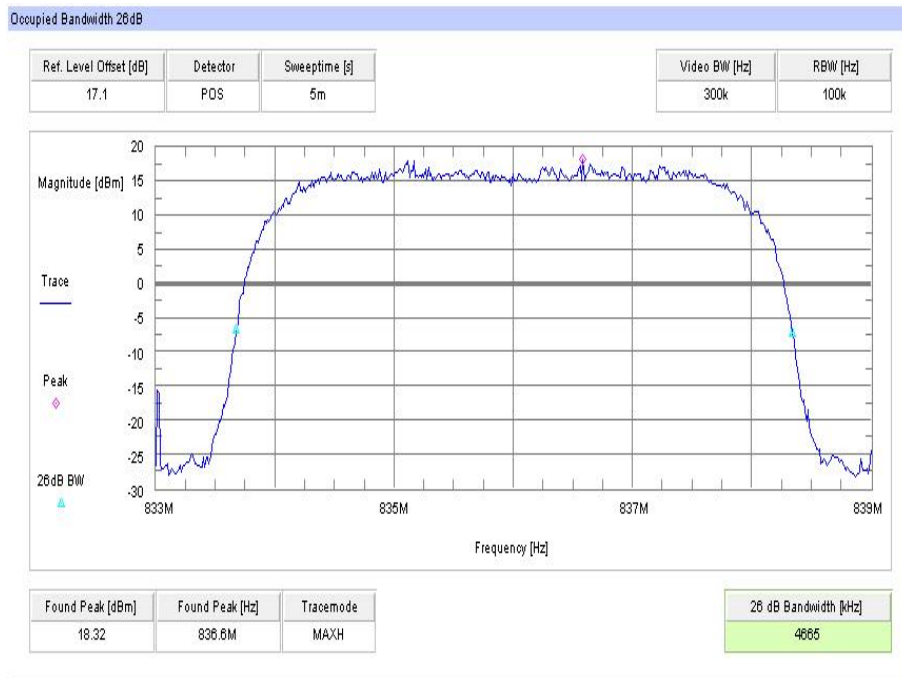
Plot 2: Channel 4132 (-26 dBc BW)



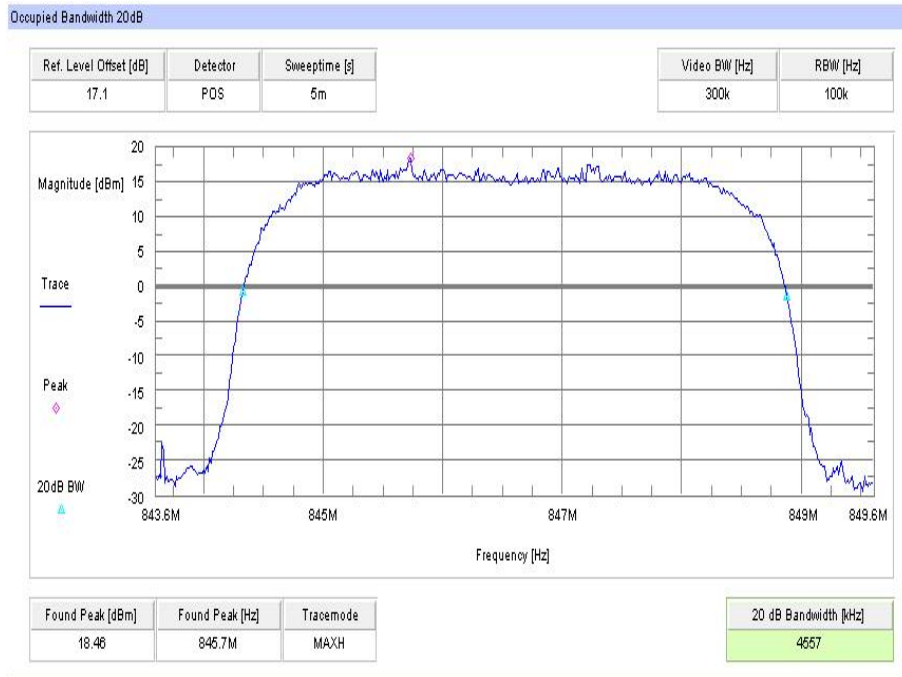
Plot 3: Channel 4180 (99% - OBW)



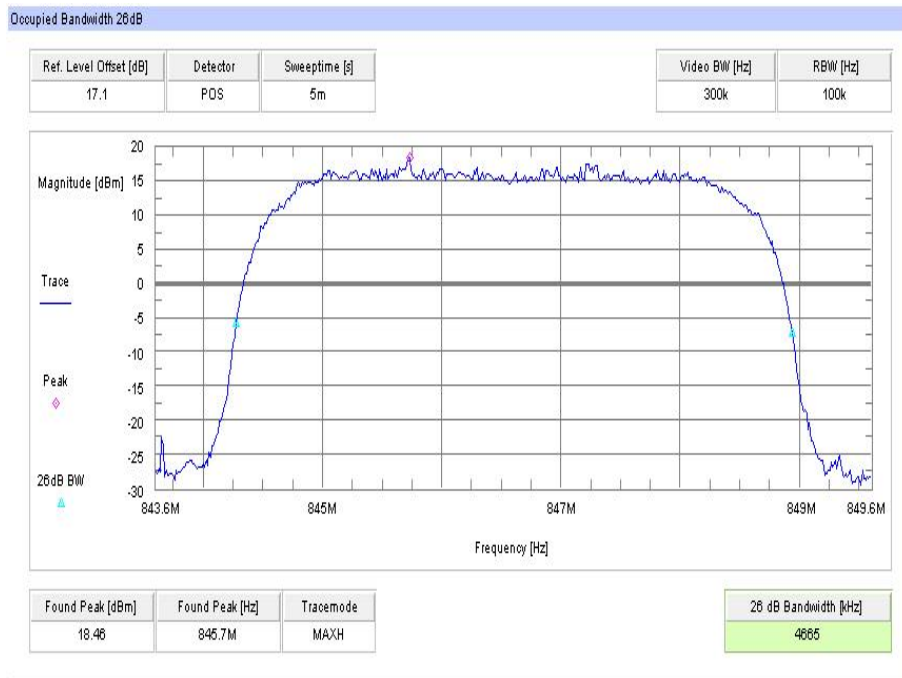
Plot 4: Channel 4180 (-26 dBc BW)



Plot 5: Channel 4233 (99% - OBW)



Plot 6: Channel 4233 (-26 dBc BW)



10 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	2015-04-22
A	Editorial changes – references to IC removed Measurement results for frequency stability 4.5 V added	2015-07-22

Annex B Further information**Glossary**

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

Annex C Accreditation Certificate

Front side of certificate

Back side of certificate



Deutsche Akkreditierungsstelle GmbH

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

Akkreditierung



Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

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

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

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

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 07.02.2014 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 77 Seiten.

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

Frankfurt am Main, 07.02.2014

deutsche-akkreditierungsstelle.de

[Signature]
 In Auftrag gegeben: Dr. Gerd Hoffmann
 Abteilungsleiter

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
 Spittelmarkt 10
 10117 Berlin

Standort Frankfurt am Main
 Gartenstraße 6
 60594 Frankfurt am Main

Standort Braunschweig
 Bundesallee 100
 38115 Braunschweig

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

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

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2005 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abt. L 318 vom 9. Juli 2008, S. 30). Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der Europäischen Organisation für Akkreditation (EA), des Internationalen Akkreditations Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

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

Note:

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

<http://www.cetecom.com/eu/de/cetecom-group/europa/deutschland-saarbruecken/akkreditierungen.html>