RADIO TEST REPORT

No. 1405683STO-004 Ed. 2

RF performance

EQUIPMENT UNDER TEST

Equipment :	Remote Terminal Unit with 3G connection
Type / model :	R7-101
Additional model	R7-102
Manufacturer :	Creowave Oy
Tested by request of :	Creowave Oy

SUMMARY

Referring to the emission limits and the operating mode during the tests specified in this report the equipment complies with the requirements according to

47 CFR Part 2, Part 22 subpart H, Part 24 subpart E
RSS-Gen Issue 4 (2014) (not accredited),
RSS-132 Issue 3 (2013) (not accredited), RSS-133 Issue 6 (2013) (not accredited)

Date of issue: 2015-03-30

Tested by: Matti Virkki

Approved by: Stefan Andersson

Revision History

Edition	Date	Description
1	2015-03-16	First release
2	2015-03-30	ERP and EIRP output power values added.

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1 CLIENT INFORMATION

The EUT has been tested by request of

Company:	Creowave Oy Yrttipellontie 10H 90230 Oulu Finland
Name of contact:	Taisto Soikkeli

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment:	Remote Terminal Unit
Tested Model:	R7-101
Additional model:	R7-102
Brand name:	Creowave
Serial number:	F9000170ABF0A
Manufacturer:	Creowave Oy
Transmitter frequency range:	824.2 – 848.8 MHz, 826.4 – 846.6 MHz, 1850.2 – 1909.8 MHz, 1852.4 – 1907.6 MHz
Receiver frequency range:	869 – 894 MHz, 1930 – 1975 MHz
Frequency agile or hopping:	☐ Yes ☒ No
Antenna:	☐ Internal antenna ☒ External antenna
Antenna connector:	☐ None, internal antenna ☒ Yes, type N
Antenna gain:	
Rating RF output power:	850 GSM 31.64 dBm, 1900 GSM 27.98 dBm, 850 EDGE 32 dBm, 1900 EDGE 27.98 dBm 850 WCDMA 26.18 dBm, 1900 WCDMA 24.37 dBm (measured conducted)
Type of modulation:	GMSK, QPSK
Temperature range:	☐ Category I (General): -20°C to +55°C ☐ Category II (Portable equipment): -10°C to +55°C ☐ Category III (Equipment for normal indoor use): +5°C to +35°C ☒ Other: -30°C to +55°C
Power rating:	12V
Transmitter standby mode supported:	☒ Yes ☐ No

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2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Part number	Serial number
Remote Terminal Unit	R7-101	F9000170ABF0A
3 x Antenna	Extronics iANT200-24-S-1	
Antenna	Aerial AV1950-1520FN1	
Antenna	Extronics iANT213-QB	

EUT has three identical Zigbee transceivers and a cellular radio module.

Models R-101 and R-102 are electrically identical.
R-102 model has connectors for armoured cables.

2.3 Additional information about the EUT

During the tests the EUT supported the following software:

Version / Release
1.0

2.4 Peripheral equipment

Peripheral equipment is defined as equipment needed for correct operation of the EUT during the tests, but not included as a part of the testing and evaluation of the EUT.

Equipment	Manufacturer / Type	Inventory number
PC	HP / Compaq NC6320	12913
Communication tester	Rohde & Schwarz CMW500	32597

2.5 Test signals

Continuous transmission on full power
GSM and EDGE modes GMSK modulation
WCDMA mode QPSK modulation

2.6 Modification during the tests

Band pass filters were added to 2,4 GHz rf outputs to prevent unwanted emissions.
Filter type ACFF-1024 (Avago, FBAR-filter).

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3 TEST SPECIFICATIONS

3.1 Standards

47 CFR Part 2, Part 22 subpart H, Part 24 subpart E
RSS-Gen Issue 4 (2014), RSS-132 Issue 3 (2013), RSS-133 Issue 6 (2013)

Test methods in:

ANSI TIA 603-C (2004),
KDB 971168 D01

3.2 Additions, deviations and exclusions from standards and accreditation

RSS-GEN issue 4 RSS-132 Issue 3 (2013), RSS-133 Issue 6 (2013) are not within accreditation scope

No other additions, deviations or exclusions have been made from standards and accreditation.

3.3 Test site

Measurements were performed at:

Intertek Semko AB.
Torshamnsgatan 43,
P.O. Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
Björk hallen	Semi-anechoic 3m	2042G-1
RADIOHALLEN	Fully-anechoic 3m	--

3.4 Test set-up

EUT antenna port was connected to spectrum analyser and communication tester via power divider rf-cables and 10 and 20 dB attenuators.

Analyser's Reference level offset was used to compensate cable and attenuator losses.
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3.5 Test conditions

If not additionally specified, the tests were performed under the following environmental conditions:

Parameter	Normal	Extreme
Supplying voltage, V	12	-
Air temperature, °C	22	-

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4 TEST SUMMARY

The results in this report apply only to the tested sample:

Test	Result	Section in report	Note
Standard test methods			
RF output power	Pass	5	
Modulation characteristics	Pass	12	
Occupied bandwidth	Pass	6	
Spurious emission at antenna terminals	Pass	7, 8	
Field strength of spurious radiation	Pass	10, 11	
Frequency stability	Pass	9	
	Pass		

NT = Not Tested, by request of the Client
NA = Not Applicable

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5 RF OUTPUT POWER

Date of test:	2015-02-03 / 2015-02-17	Test location:	EMC Center
EUT Serial:	F9000170ABF0A	Ambient temp. ˚C	22 / 21
Tested by:	Matti Virkki	Relative humidity %	27 / 28
Test result:	Pass	Margin:	5.79 dB (conducted) 0.79 dB with iANT 213-QB

5.1 Requirement

Reference: FCC §2.1049, §22.913 (a)(2), RSS-132 section 5.4

The average power of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts ERP or 11.5 W EIRP.

Reference: FCC §24.232(c), RSS-133 6.4, SRSP-510 section 5.1.2

Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

5.2 Test set-up

EUT antenna port was connected to spectrum analyser and communication tester via power divider rf-cables and 10 and 20 dB attenuators.

Analyser's Reference level offset was used to compensate cable and attenuator losses.

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5.3 Test data

GSM 850

Frequency MHz	Peak power dBm	Average power dBm	ERP peak With iANT213-QB dBm	Limit ERP dBm	Peak to avg limit margin
824.2	31.64	29.65	33.49	38.45	4.96
836.6	31.51	31.21	33.36	38.45	5.09
848.8	30.83	30.59	32.63	38.45	5.82

EDGE 850

Frequency MHz	Peak power dBm	Average power dBm	ERP peak With iANT213-QB dBm	Limit ERP dBm	Peak to avg limit margin
824.2	32.00	31.92	33.85	38.45	4.60
836.6	31.32	30.38	33.77	38.45	4.68
848.8	30.64	30.69	32.49	38.45	5.96

WCDMA 850

Frequency MHz	Peak power dBm	Average power dBm	ERP peak With iANT213-QB dBm	Limit dBm	Peak to avg limit margin
826.4	24.75	21.58	28.75	38.45	9.70
836.6	24.62	20.96	28.62	38.45	9.83
846.6	26.18	21.92	30.18	38.45	8.27

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GSM 1900

Frequency MHz	Peak power dBm	Average power dBm	Peak to average dB	Peak EIRP With iANT213-QB dBmi	Limit dBmi	Peak to avg limit margin
1850.2	27.98	27.21	0.77	32.98	33	0.02
1880.0	27.25	26.02	1.23	31.02	33	1.98
1909.8	26.99	26.44	0.55	31.44	33	1.56

EDGE 1900

Frequency MHz	Peak power dBm	Average power dBm	Peak to average dB	Peak EIRP With iANT213-QB dBmi	Limit dBmi	Peak to avg limit margin
1850.2	27.98	27.21	0.77	32.98	33	0.02
1880.0	27.02	26.25	0.77	32.02	33	0.98
1909.8	26.58	25.66	0.92	31.42	33	1.58

WCDMA 1900

Frequency MHz	Peak power dBm	Average power dBm	Peak to average dB	Peak EIRP With iANT213-QB dBmi	Limit dBmi	Peak to avg limit margin dB
1852.4	23.63	19.86	3.77	28.63	33	4.37
1880.0	23.74	20.60	3.14	28.74	33	4.26
1907.6	24.37	20.74	3.63	29.37	33	3.23

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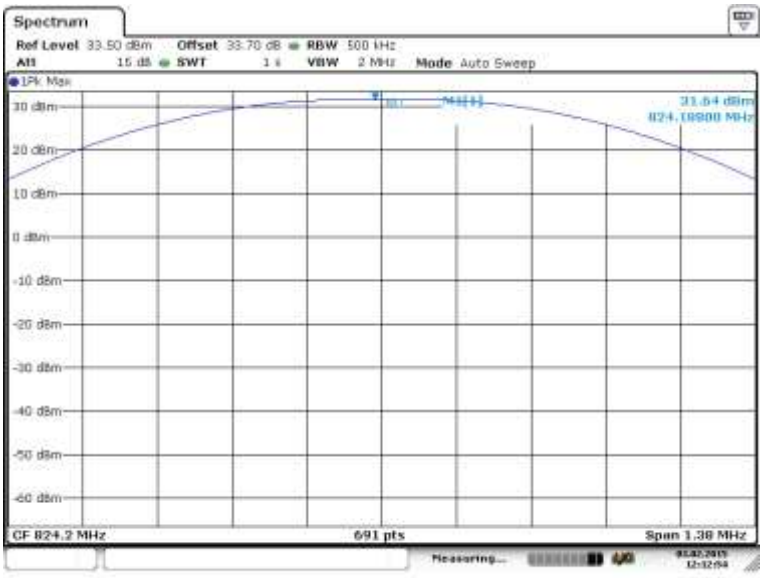
GSM 850 Ch. 128



GSM 850 Ch. 128

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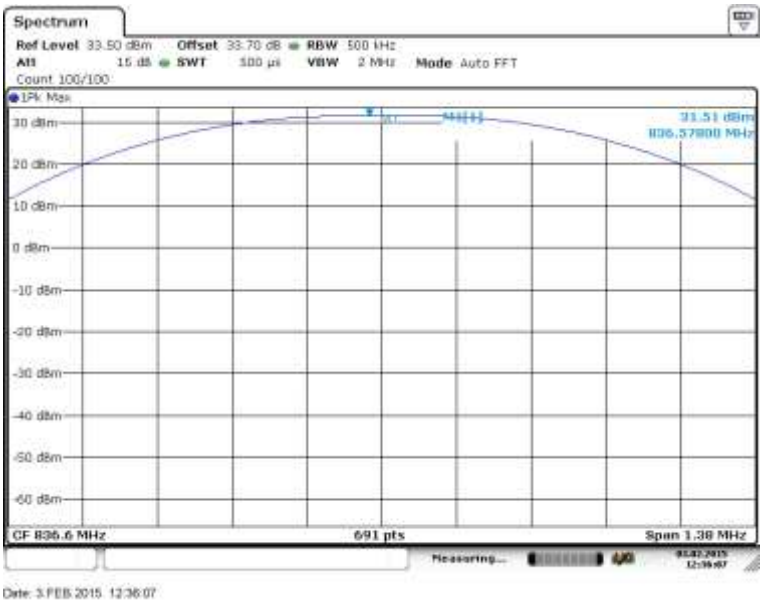
GSM 850 Ch. 190



GSM 850 Ch. 190

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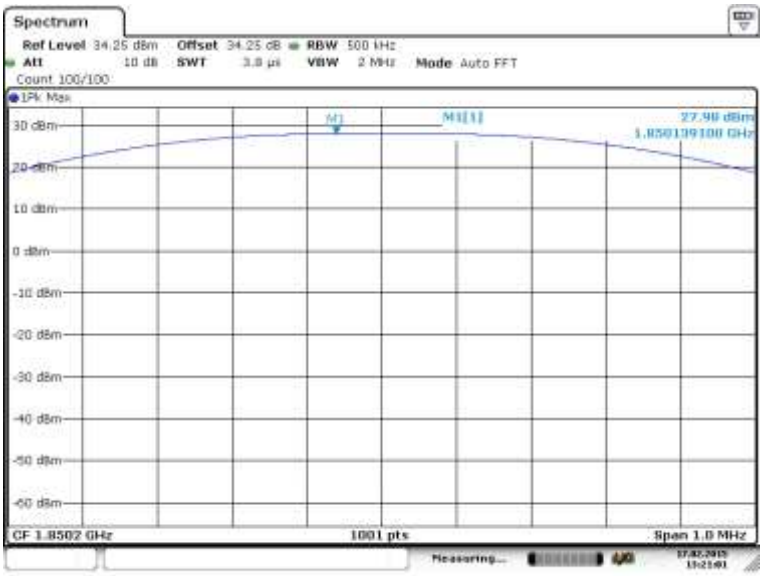
GSM 850 Ch. 251

GSM 850 Ch. 251

GSM 1900 ch 512



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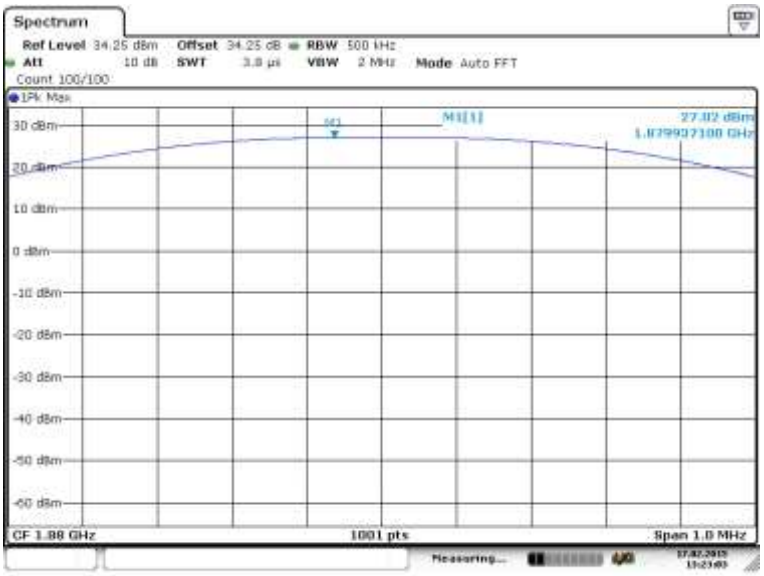
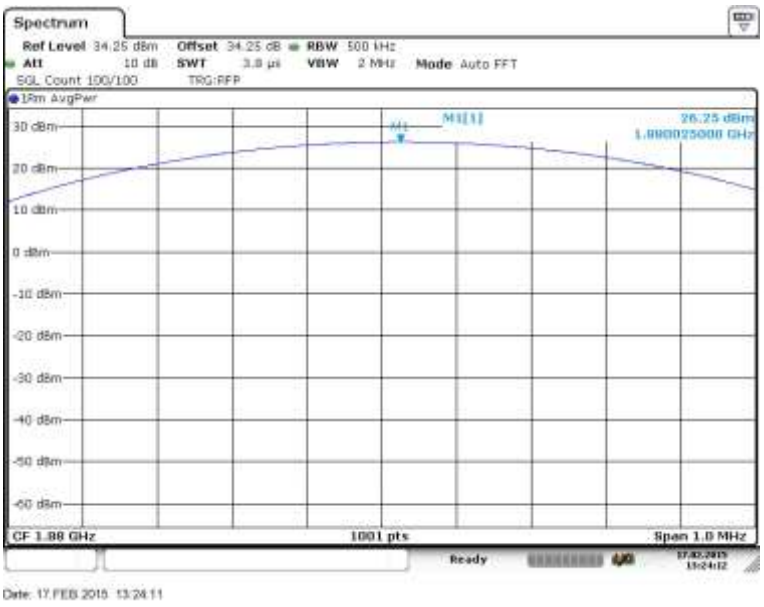
GSM 1900 ch 661





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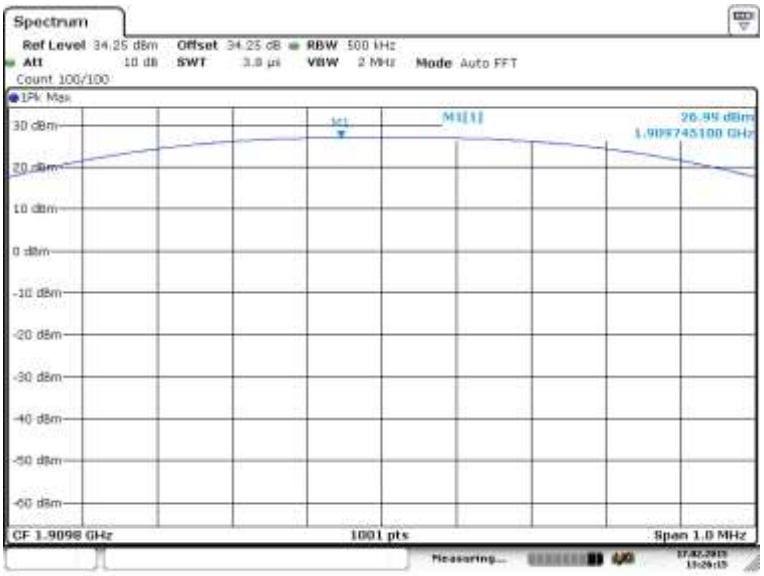
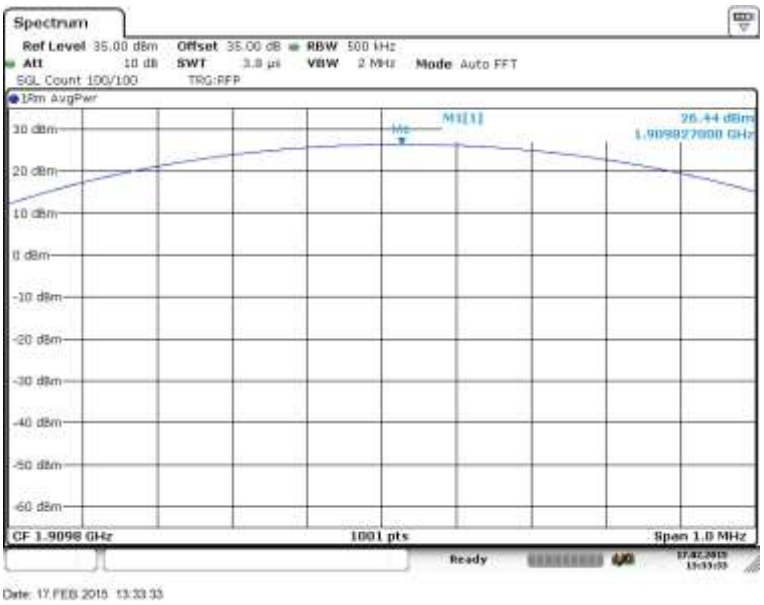
GSM 1900 ch 810





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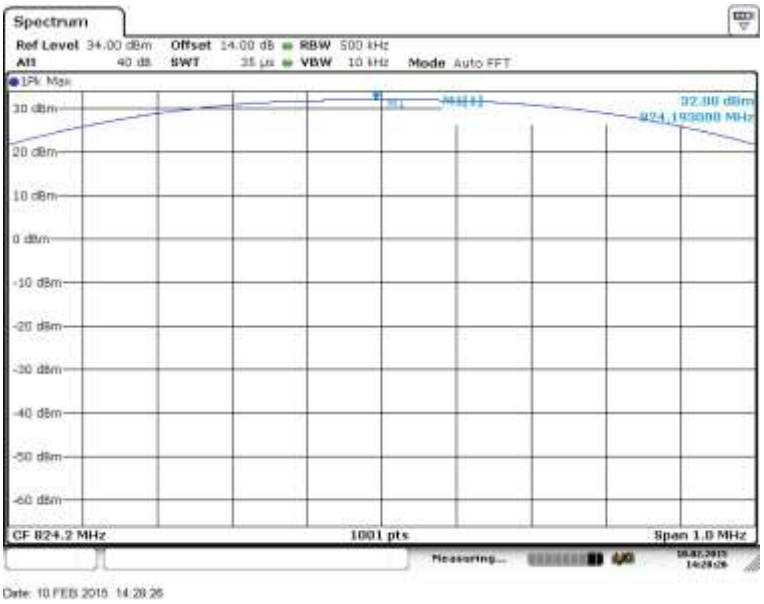
EDGE 850 Ch. 128



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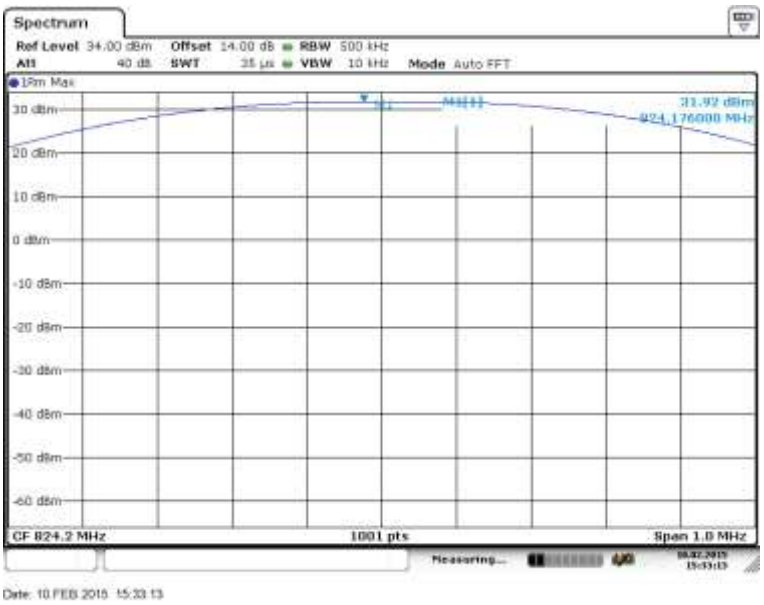

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EDGE 850 Ch. 190

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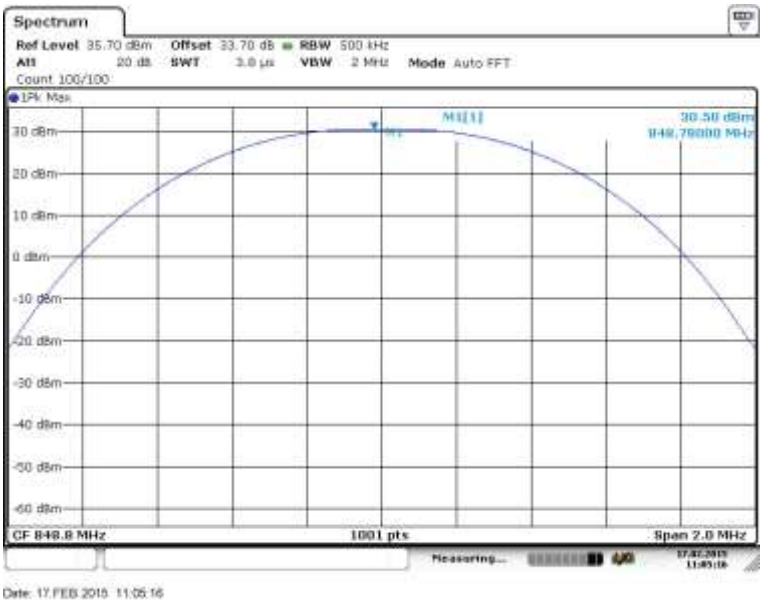
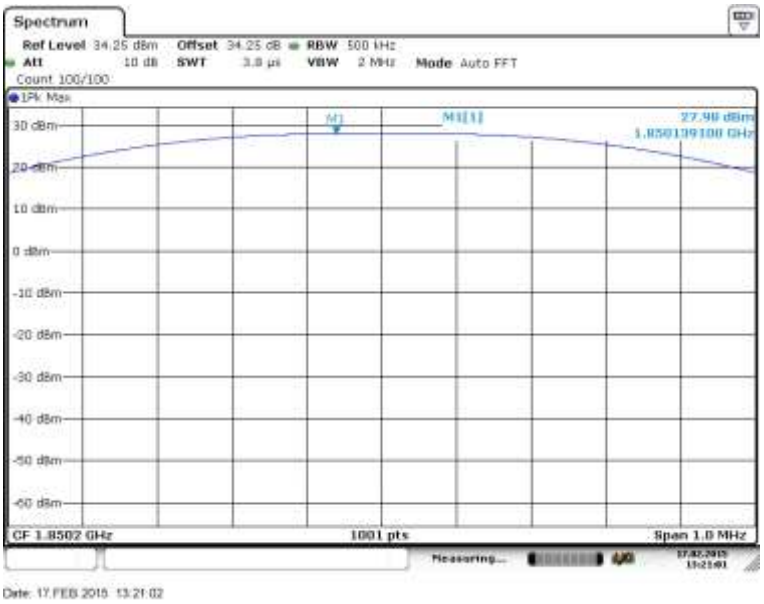


EDGE 850 Ch. 251

EDGE 1900 Ch. 512



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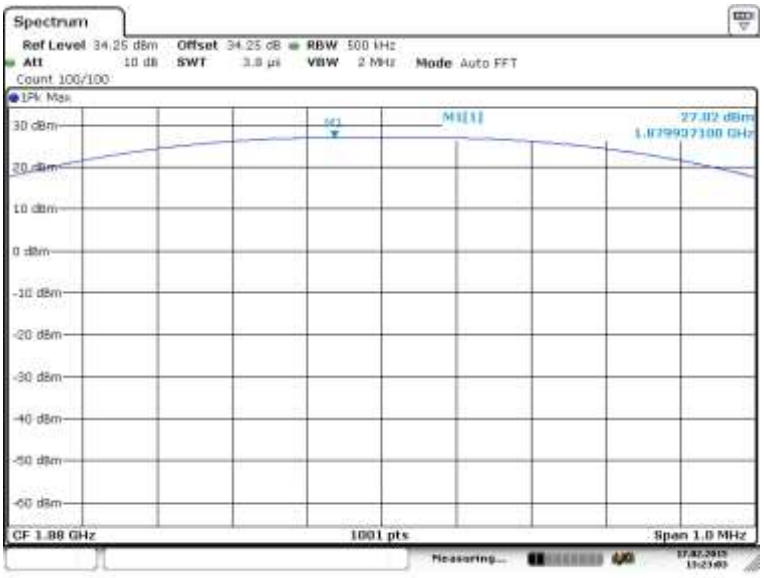

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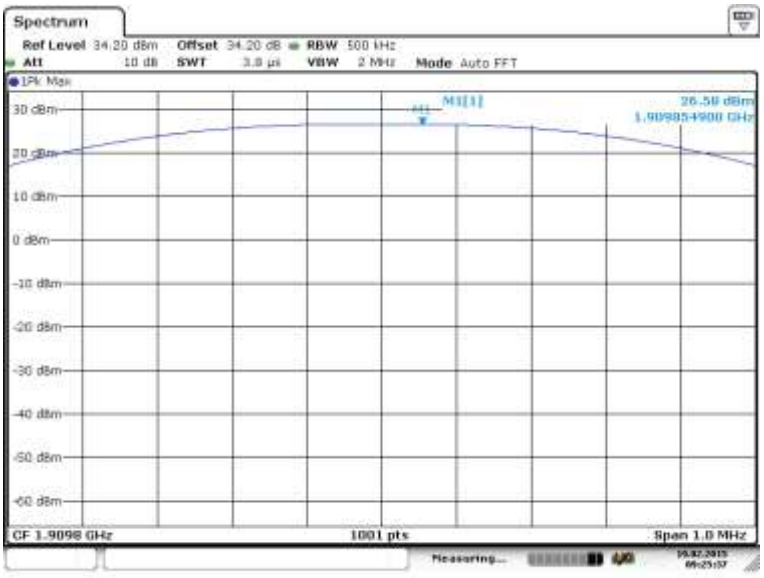
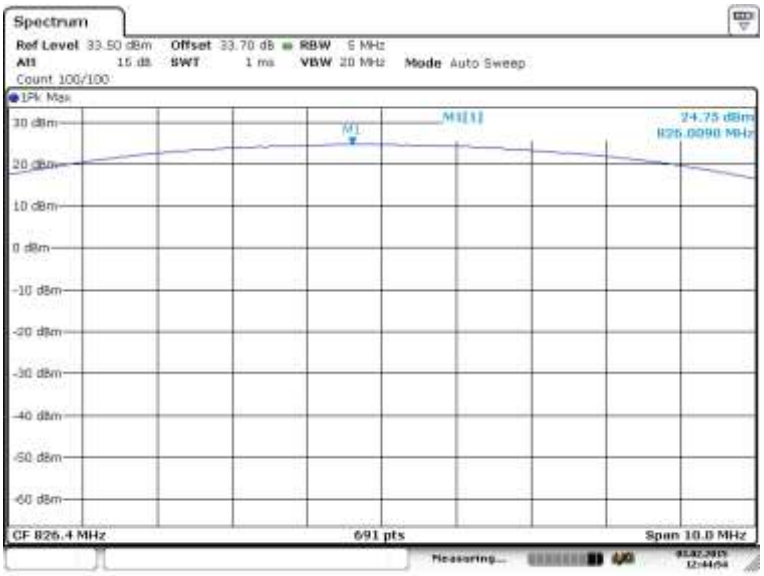
EDGE 1900 Ch. 810



EDGE 1900 Ch. 810

WCDMA 850 Ch. 4132



WCDMA 850 Ch. 4132

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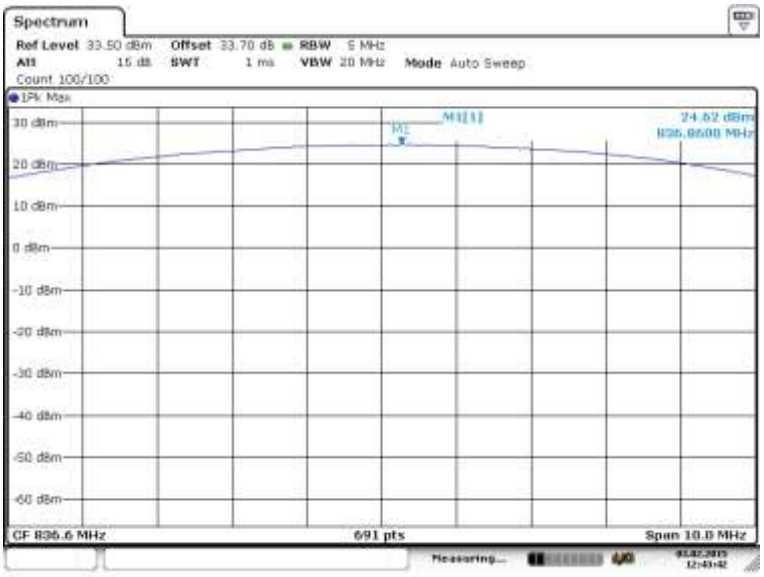
WCDMA 850 Ch. 4183



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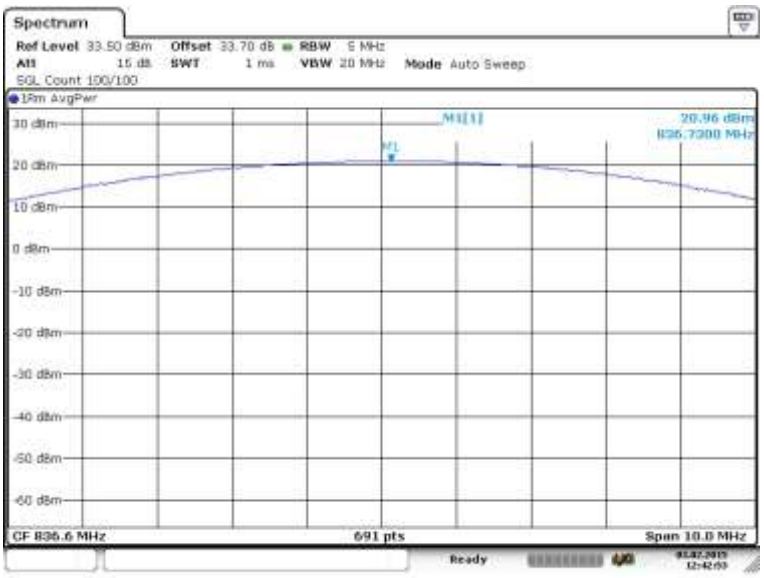

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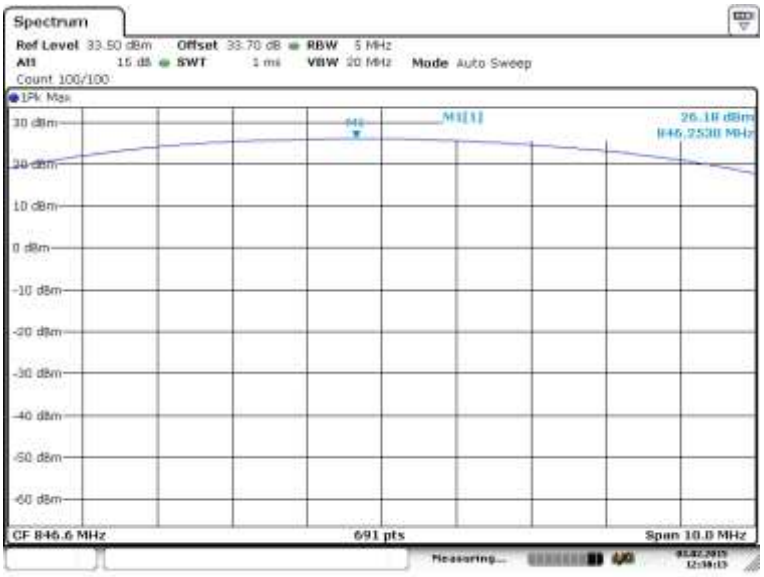
WCDMA 850 Ch. 4233



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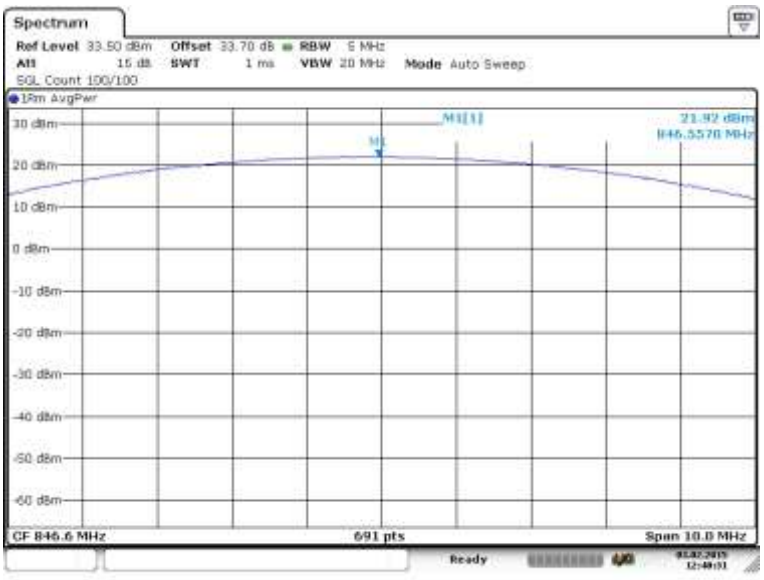

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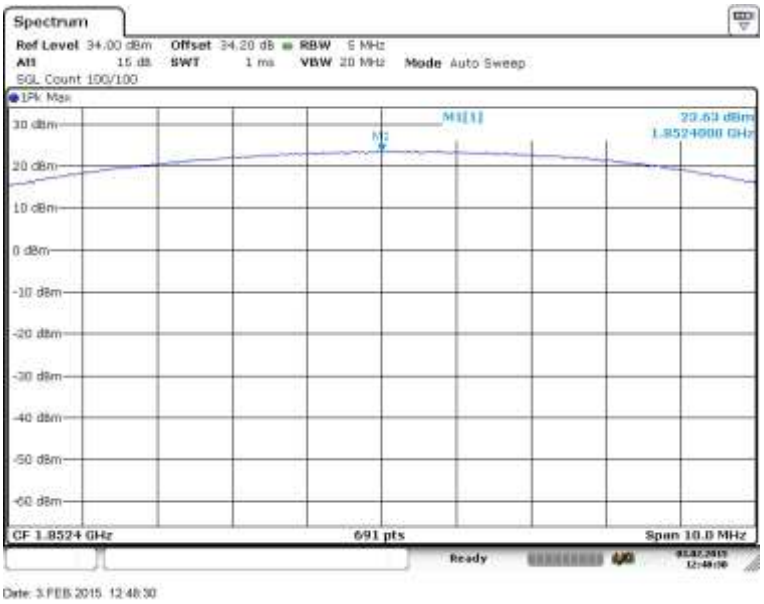
WCDMA 1900 Ch. 9262



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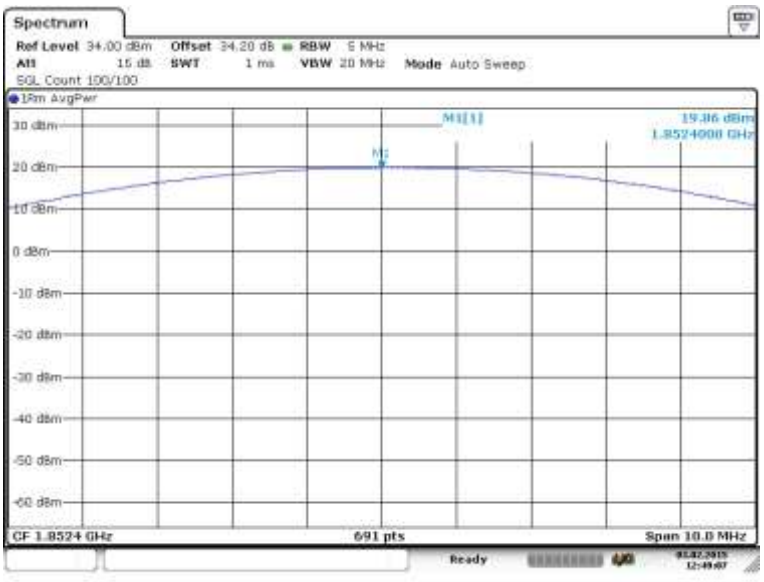

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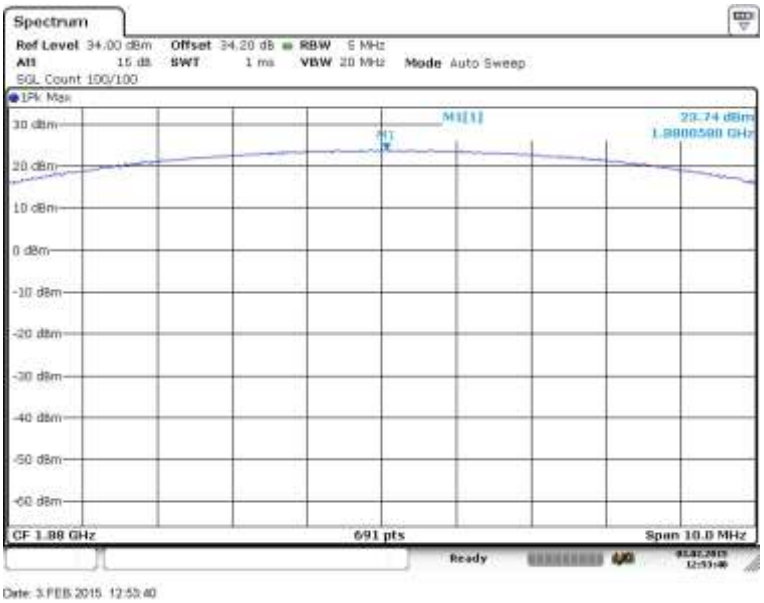
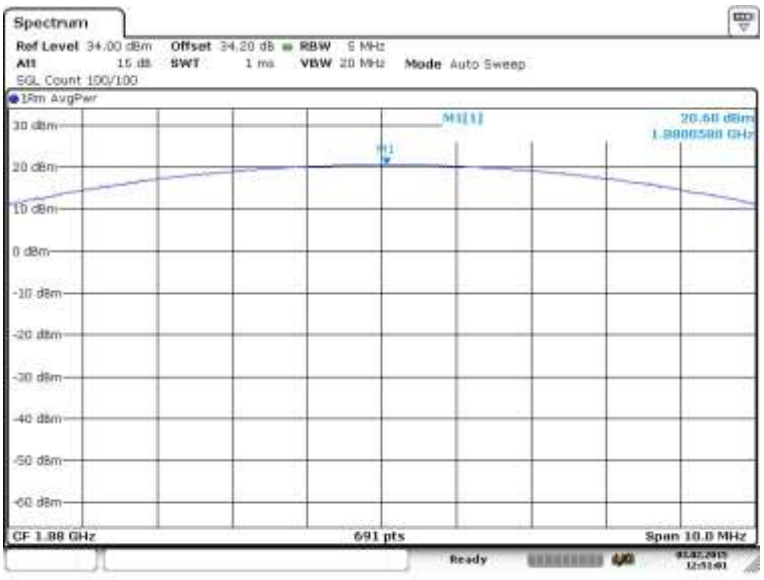
WCDMA 1900 Ch. 9400



Date: 3.FEB.2015 12:53:40

WCDMA 1900 Ch. 9400



Date: 3.FEB.2015 12:51:01

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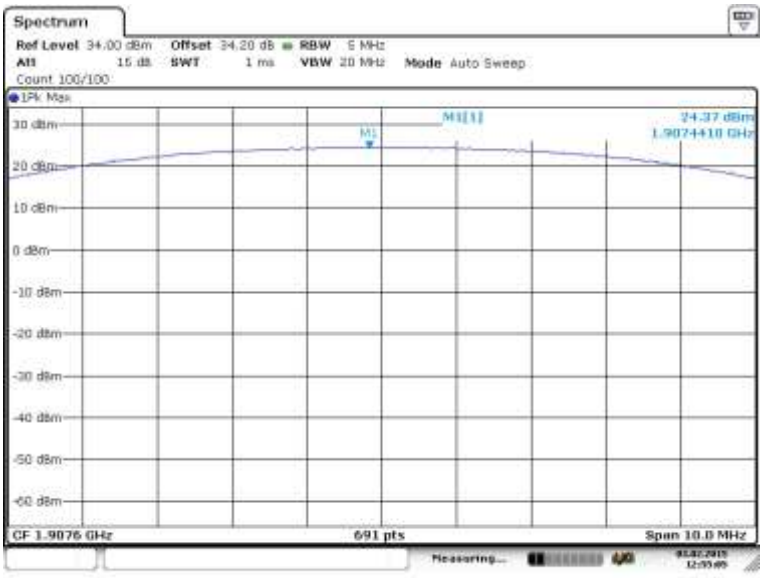
WCDMA 1900 Ch. 9538



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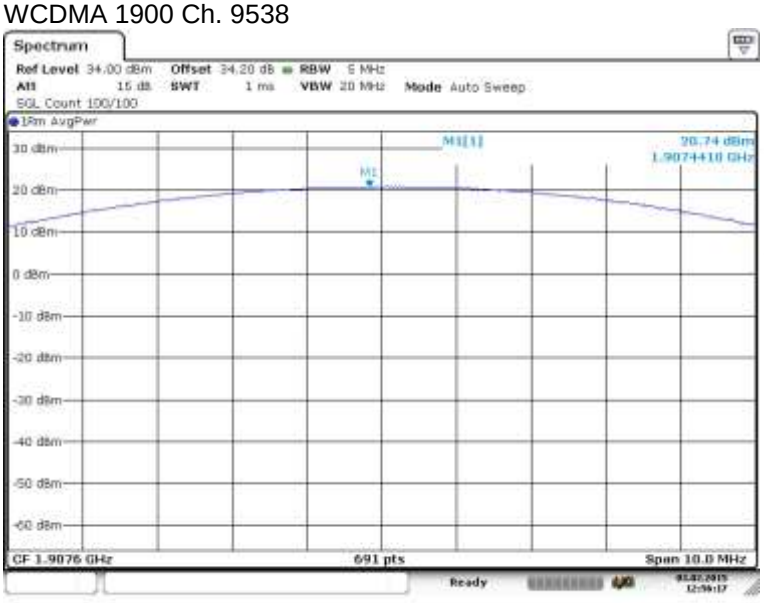

5.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Radio communication tester	Rohde & Schwarz	CMW500	32597	7/2015
Power divider	ET industries	D-0518-2	32551	--
Rf-attenuator	H+S	5910_N-010 20dB	32697	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

6 OCCUPIED BANDWIDTH

Date of test:	2015-02-02/10/19	Test location:	EMC Center
EUT Serial:	F9000170ABF0A	Ambient temp.	22/21/22°C
Tested by:	Matti Virkki	Relative humidity	26/27/25%
Test result:	Pass	Margin:	--

6.1 Requirement

Reference: FCC §2.1049, §22.917, §24.238
RSS-Gen Issue 4 section 6.6, RSS-132 section 5.5, RSS-133 section 6.5

6.2 Test set-up

EUT antenna port was connected to spectrum analyser and communication tester via power divider rf-cables and 10 and 20 dB attenuators.

Analyser's Reference level offset was used to compensate cable and attenuator losses.

6.3 Test data

GSM 850

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
824.2	318.4	244.57
836.6	320.7	244.57
848.8	314.1	243.13

EDGE 850

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
824.2	316.7	245.75
836.6	315.7	240.76
848.8	317.7	243.76

WCDMA 850

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
826.4	4618.7	4118.90
836.4	4580.9	4139.08
846.6	4614.0	4124.70

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GSM 1900

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
1850.2	318.4	244.57
1880.0	320.7	244.57
1909.8	314.1	243.13

EDGE 1900

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
1850.2	318.7	240.76
1880.0	318.7	243.76
1909.8	316.7	237.76

WCDMA 1900

Frequency MHz	26 dB bandwidth kHz	99% bandwidth kHz
1852.4	4623.5	4134.29
1880.0	4618.7	4139.09
1907.6	4623.5	4139.08

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GSM 850 Ch. 128

Date: 2.FEB.2015 13:09:50

GSM 850 Ch. 128

Date: 2.FEB.2015 13:06:13

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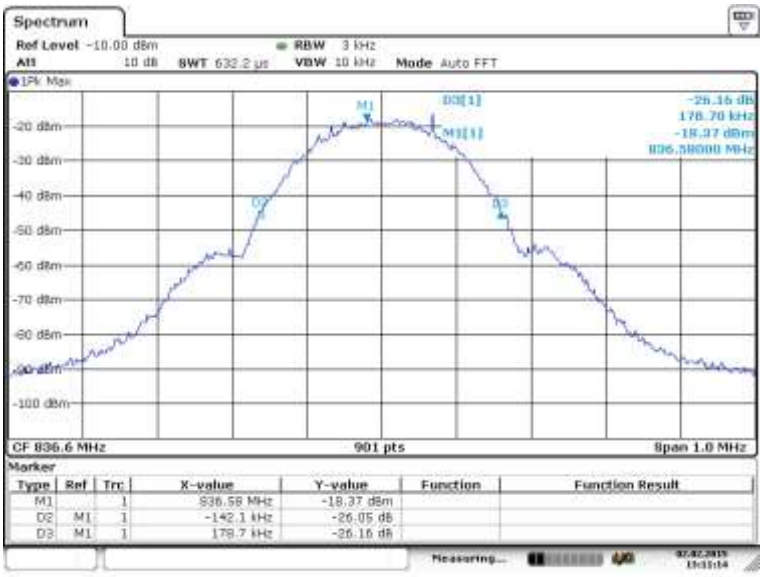
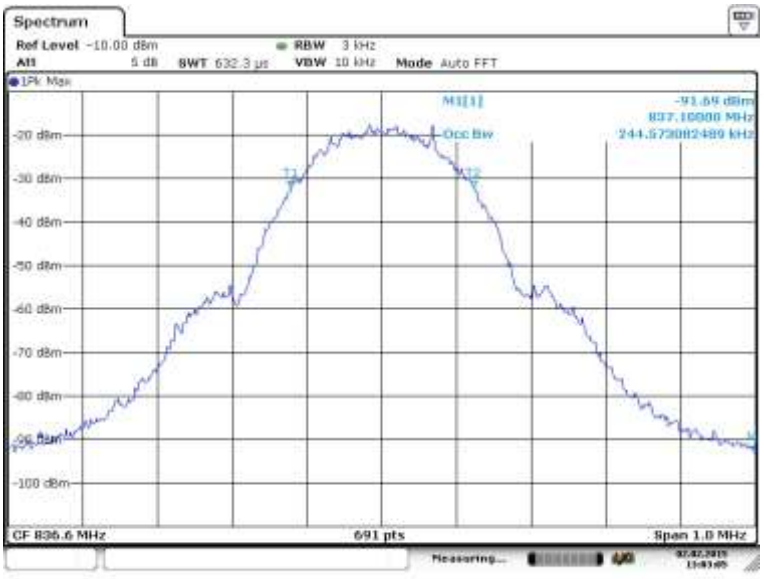
GSM 850 Ch. 190



GSM 850 Ch. 190



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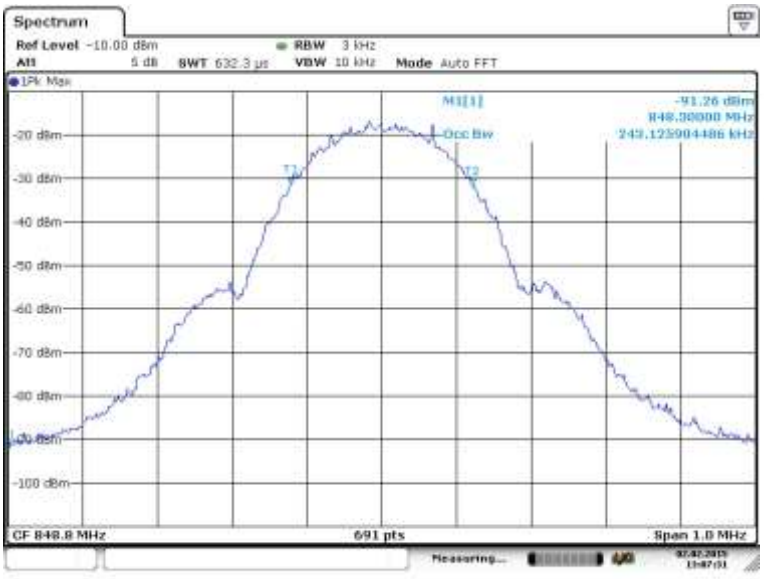
GSM 850 Ch. 251

GSM 850 Ch. 251



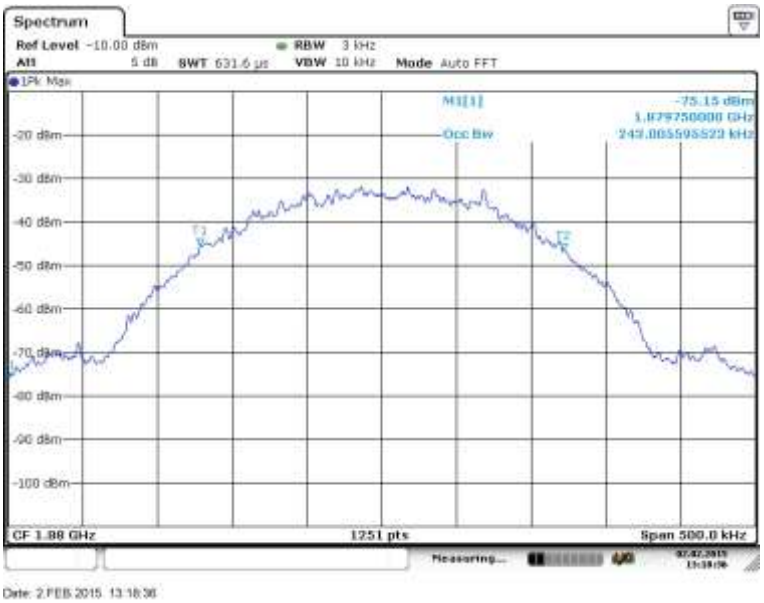
GSM 1900 Ch. 512

Date: 2.FEB.2015 13:34:26

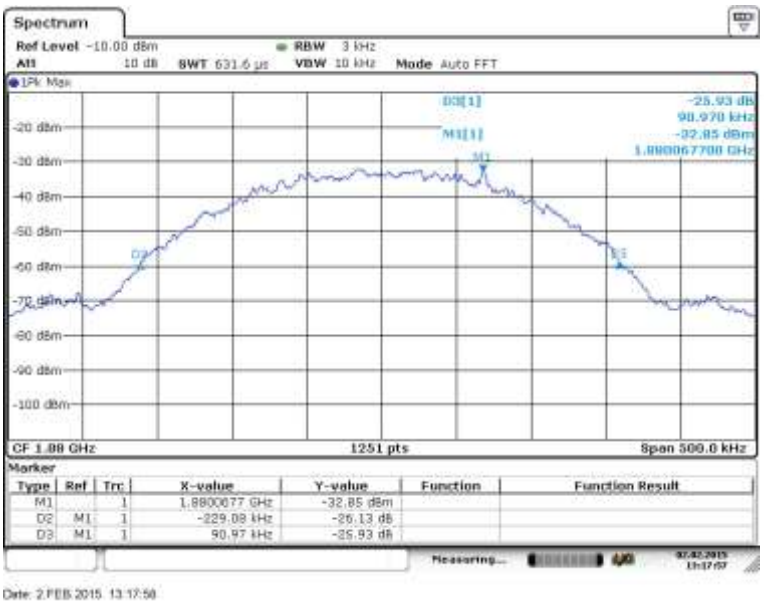
GSM 1900 Ch. 512

Date: 2.FEB.2015 13:33:13

GSM 1900 Ch. 661



GSM 1900 Ch. 661



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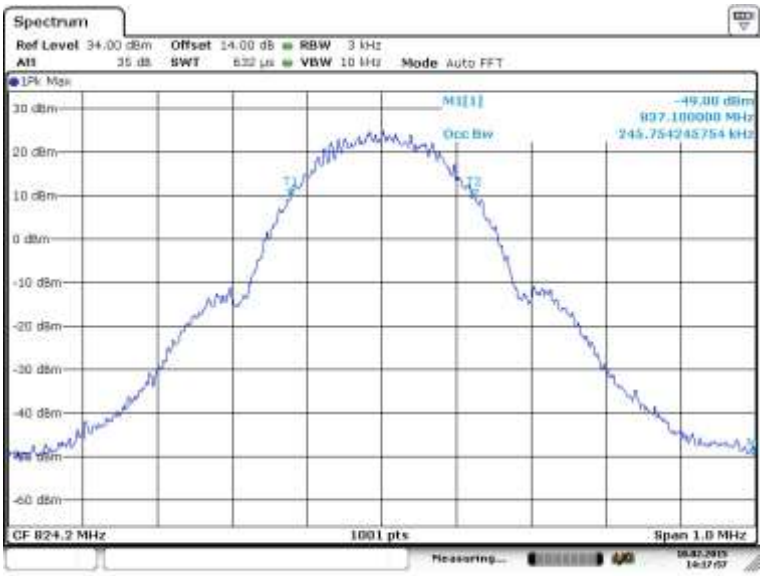
EDGE Ch. 128



EDGE Ch.128

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EDGE Ch. 190

EDGE Ch.190

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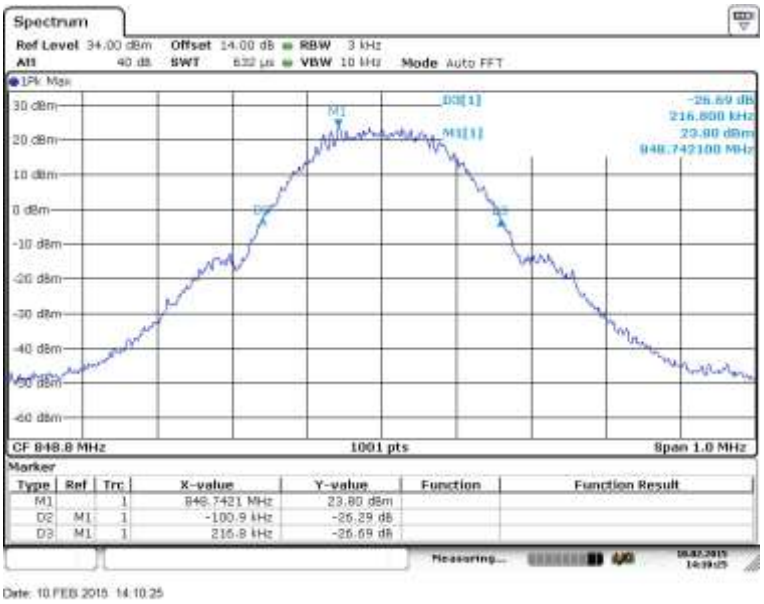
EDGE Ch. 251



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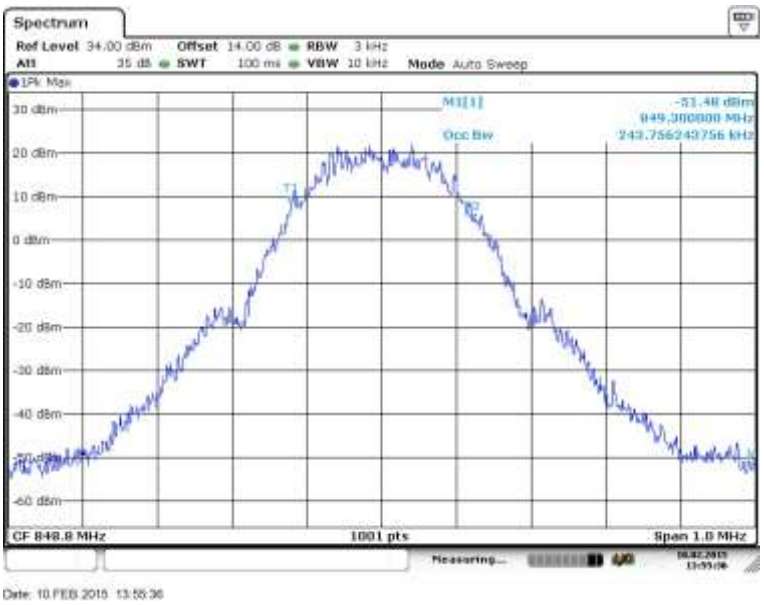

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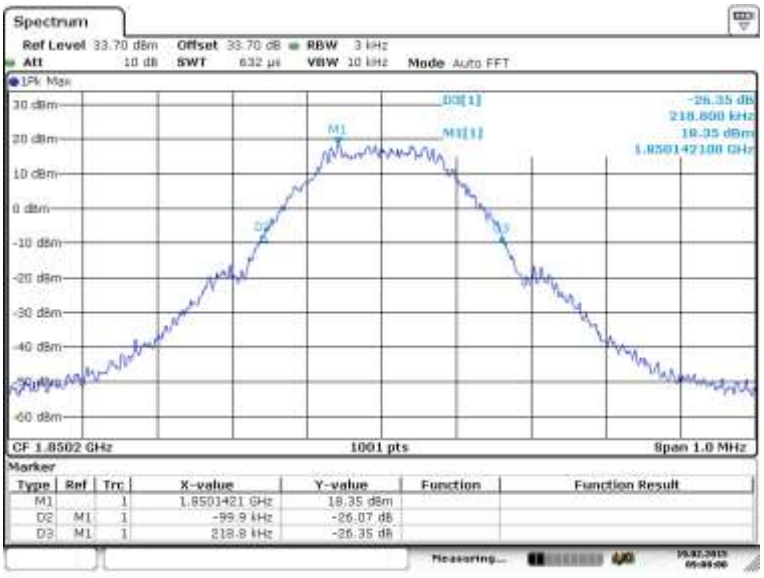
EDGE Ch. 512



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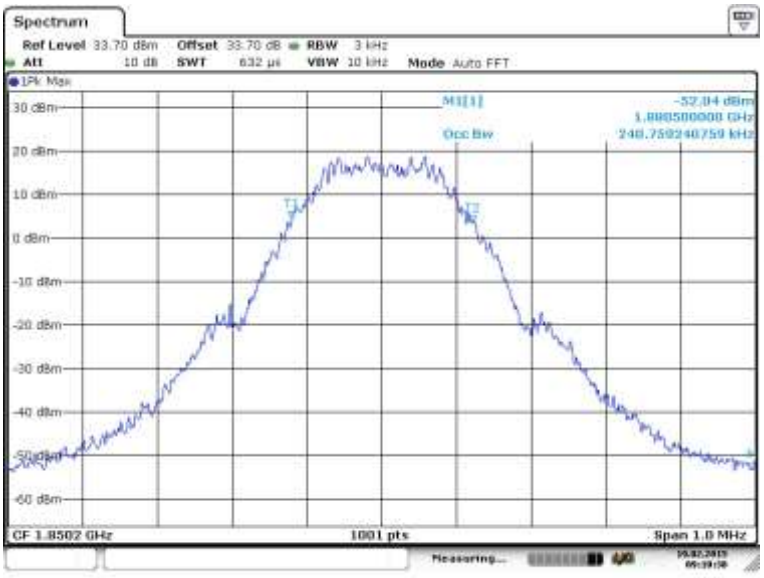

Date: 19.FEB.2015 09:10:39

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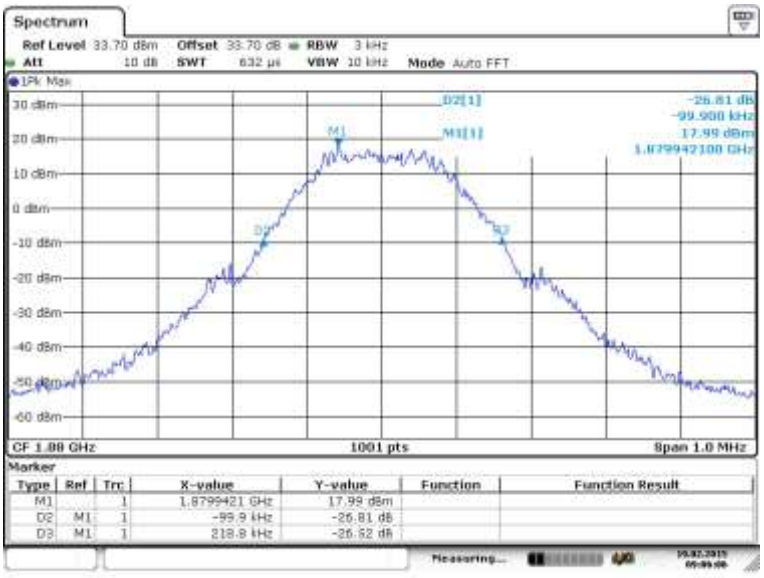
EDGE Ch. 661



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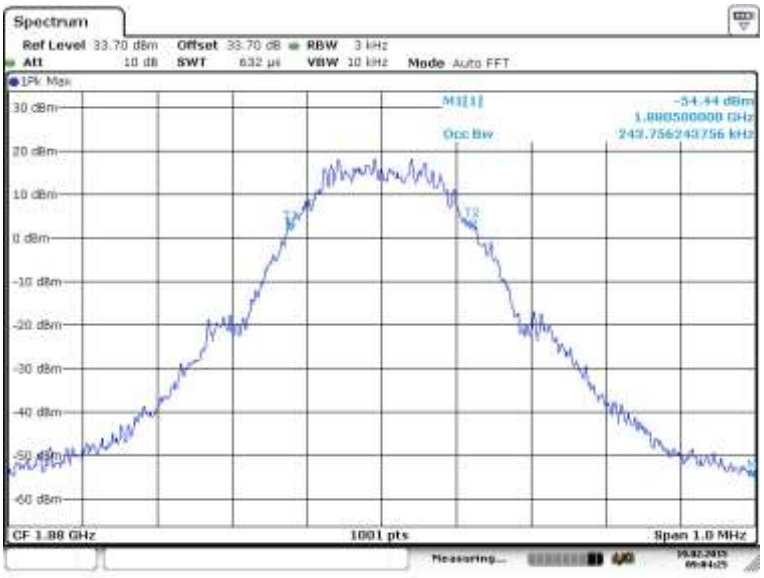

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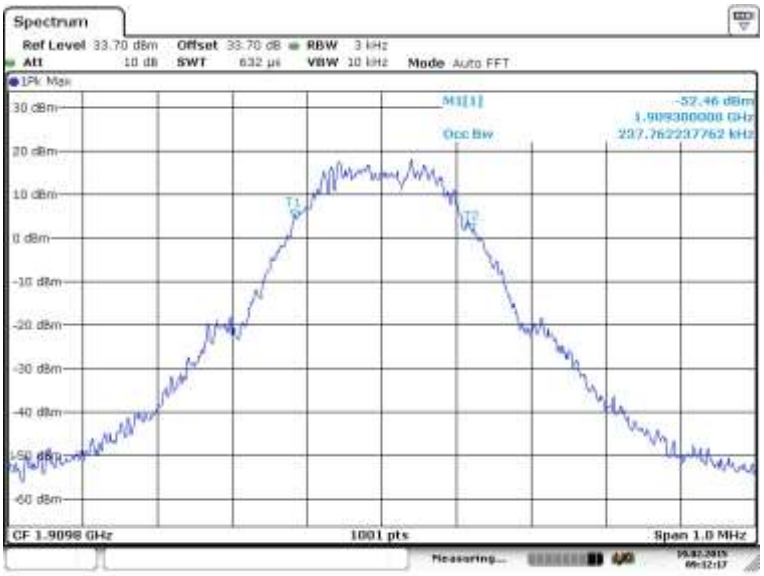
EDGE Ch. 810



EDGE Ch. 810

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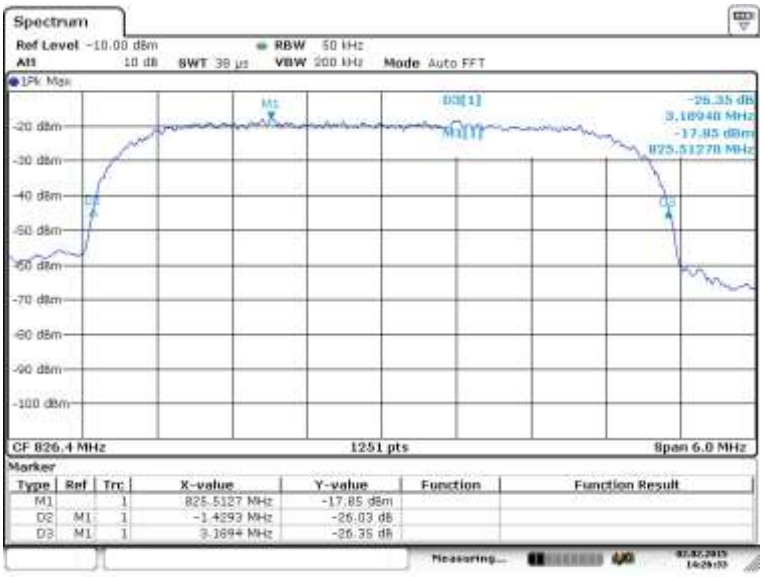
WCDMA 850 Ch. 4132



Date: 2.FEB.2015 14:26:34

WCDMA 850 Ch. 4132

Date: 2.FEB.2015 14:25:29

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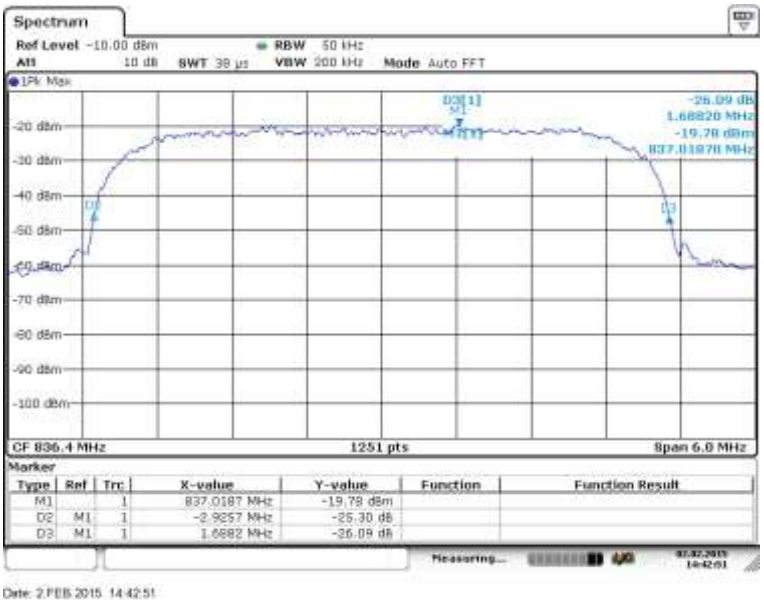
WCDMA 850 Ch. 4182



Date: 2.FEB.2015 14:42:51

WCDMA 850 Ch. 4182

Date: 2.FEB.2015 14:38:48

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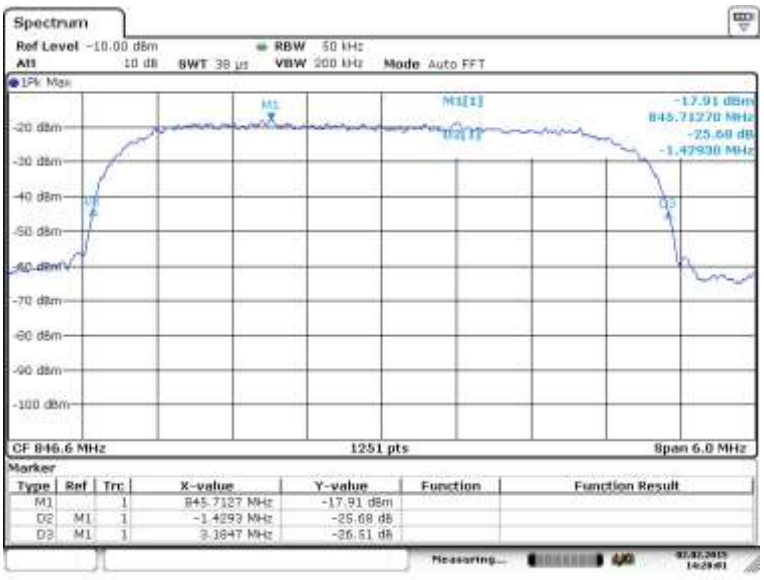
WCDMA 850 Ch. 4233

Date: 2.FEB.2015 14:28:36

WCDMA 850 Ch. 4233



Date: 2.FEB.2015 14:28:02

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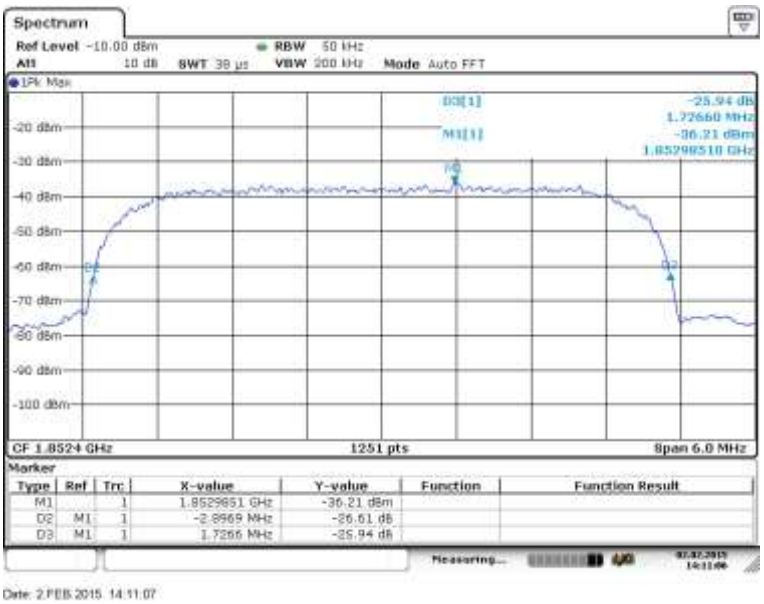
WCDMA 1900 Ch. 9262

WCDMA 1900 Ch. 9262



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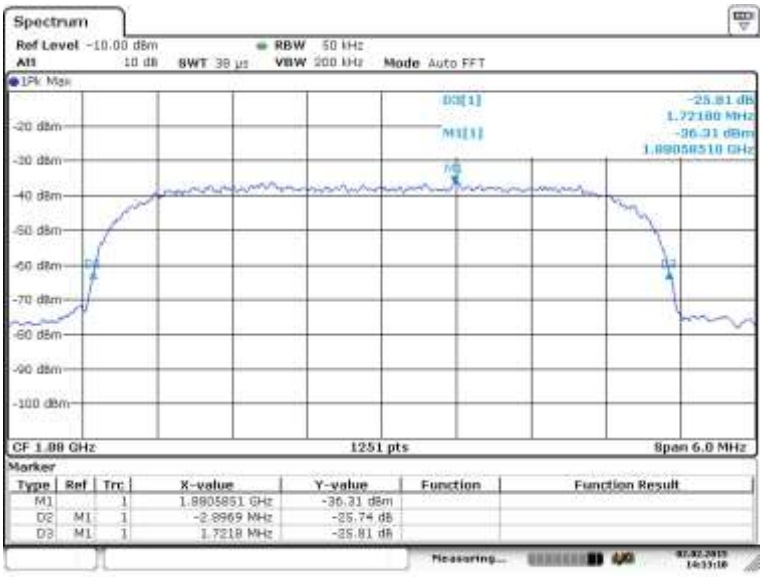
WCDMA 1900 Ch. 9400

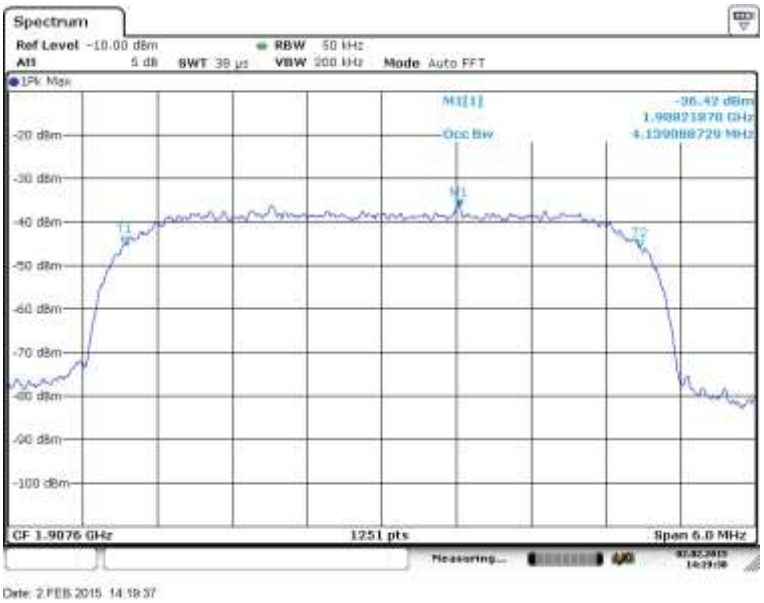


Date: 2.FEB.2015 14:13:11

WCDMA 1900 Ch. 9400

Date: 2.FEB.2015 14:12:03

WCDMA 1900 Ch. 9538



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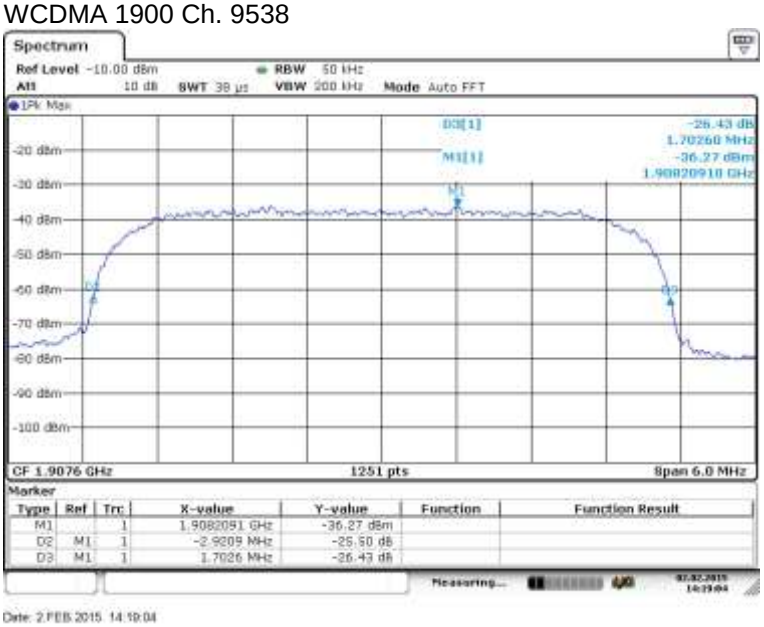

6.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Radio communication tester	Rohde & Schwarz	CMW500	32597	7/2015
Rf-attenuator	H+S	5910_N-010 20dB	32697	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015
Power divider	ET industries	D-0518-2	32551	--

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7 BAND EDGE

Date of test:	2014-07-02	Test location:	EMC Center
EUT Serial:	F9000170ABF0A	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	5.07 dB (conducted) 1.07 with iANT 213-QB

7.1 Requirement

§2.1051, RSS-GEN section 6.13

§22.917 (a) *Out of band emissions.*
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.

(b) *Measurement procedure.*
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132 section 5.5
Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p (watts).
After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$ p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

§24.238 (a) *Out of band emissions.*
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.

(b) *Measurement procedure.*
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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RSS-133 section.6.51
Equipment shall comply with the limits in (i) and (ii) below.
In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts).
After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

7.2 Test set-up

EUT antenna port was connected to spectrum analyser and communication tester via power divider rf-cables and 10 and 20 dB attenuators.

Analyser's Reference level offset was used to compensate cable and attenuator losses.

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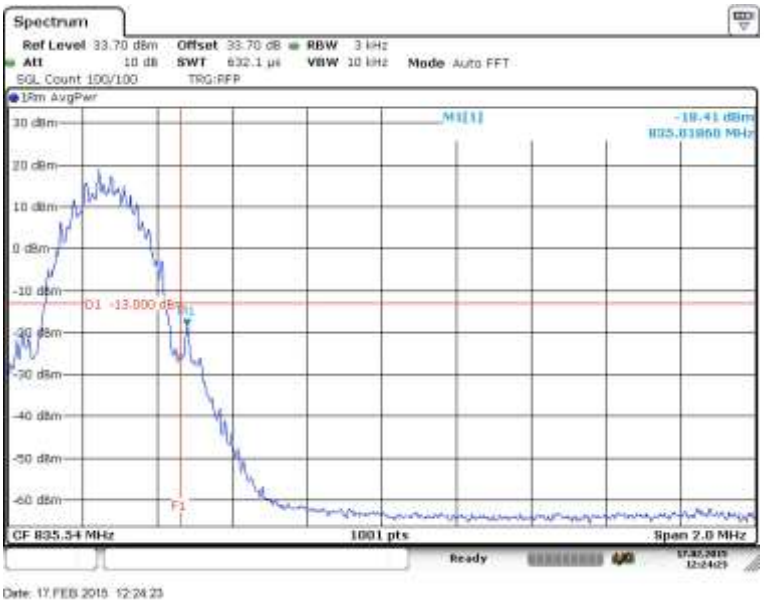
7.3 Test data

Ch 128

Date: 17.FEB.2015 12:26:02

Ch. 181



Date: 17.FEB.2015 12:24:23

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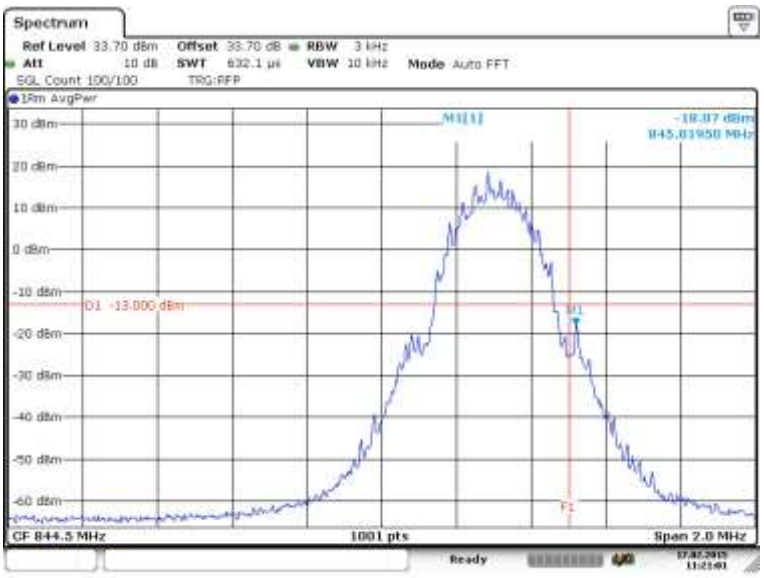
Ch. 183

Date: 17.FEB.2015 12:21:02

Ch. 231



Date: 17.FEB.2015 11:21:01

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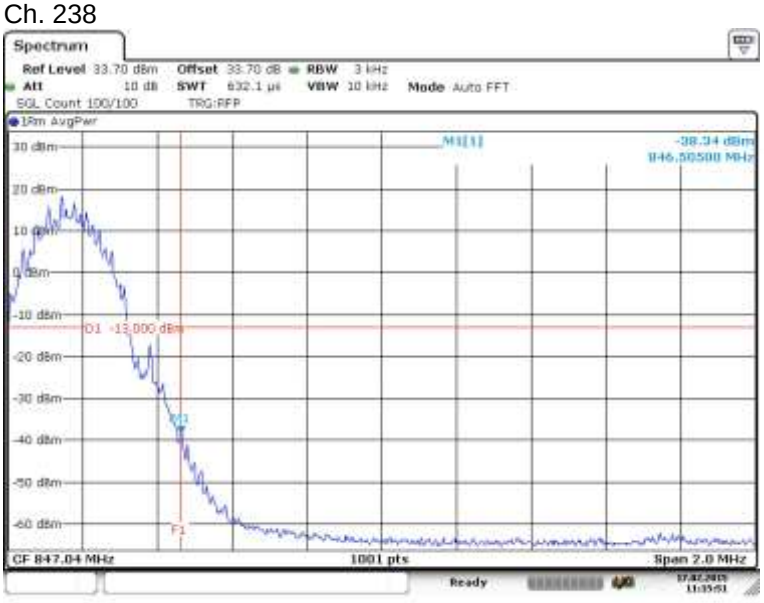
Ch. 233

Date: 17.FEB.2015 11:20:13

Ch. 238



Date: 17.FEB.2015 11:15:51

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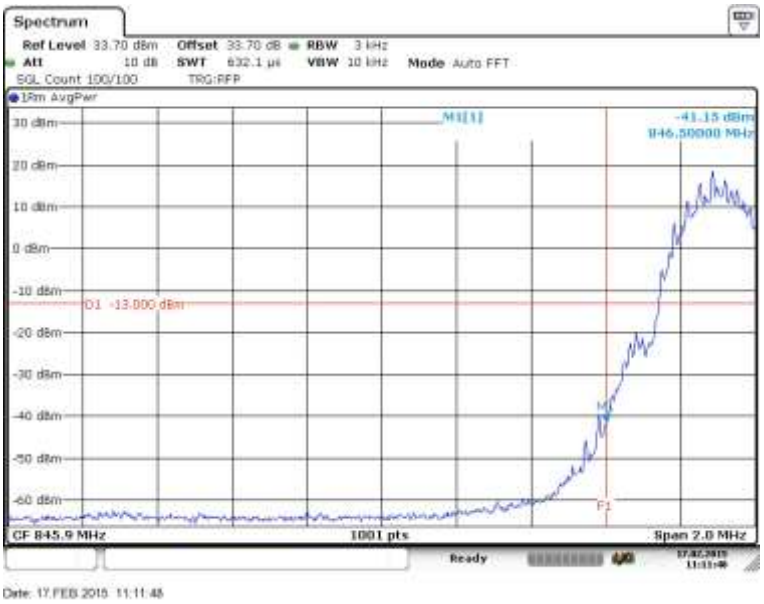
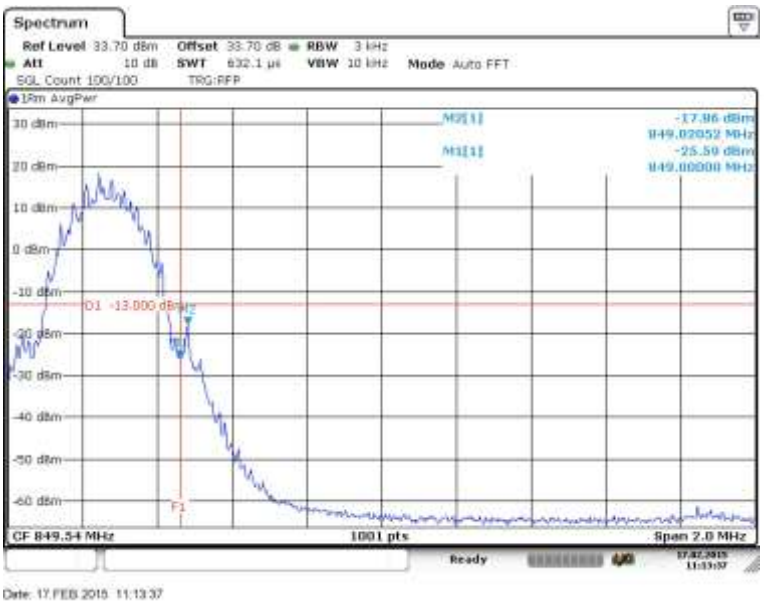
Ch. 241



Date: 17.FEB.2015 11:11:48

Ch. 251



Date: 17.FEB.2015 11:13:37

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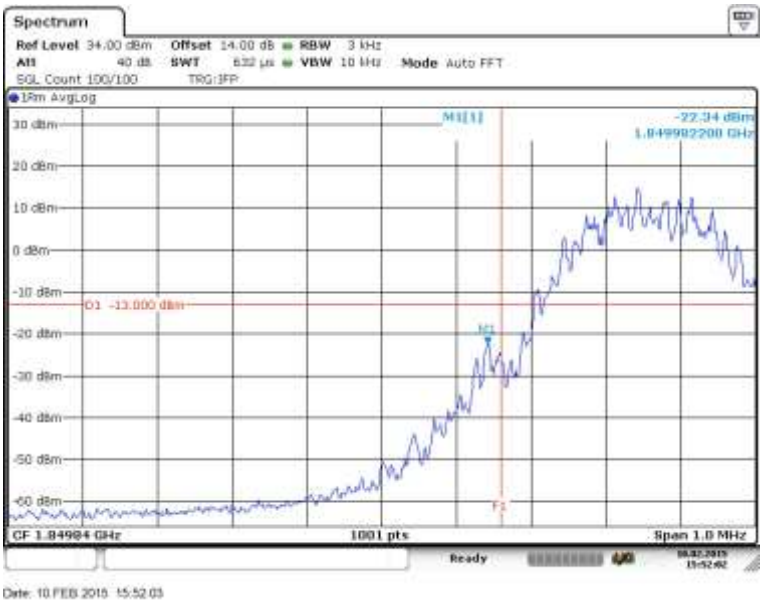
Ch. 512



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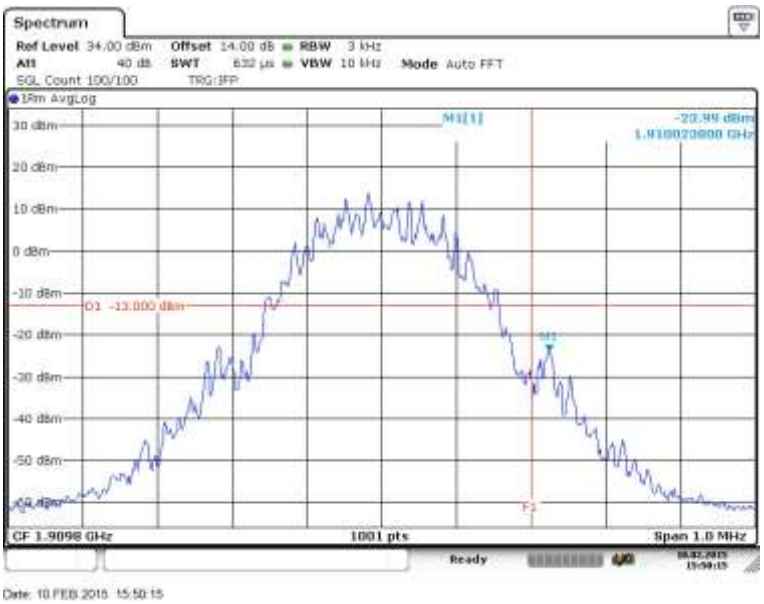

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www.intertek.se
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Ch. 4132

Date: 17.FEB.2015 12:35:01

Ch. 4163

Date: 17.FEB.2015 12:38:41

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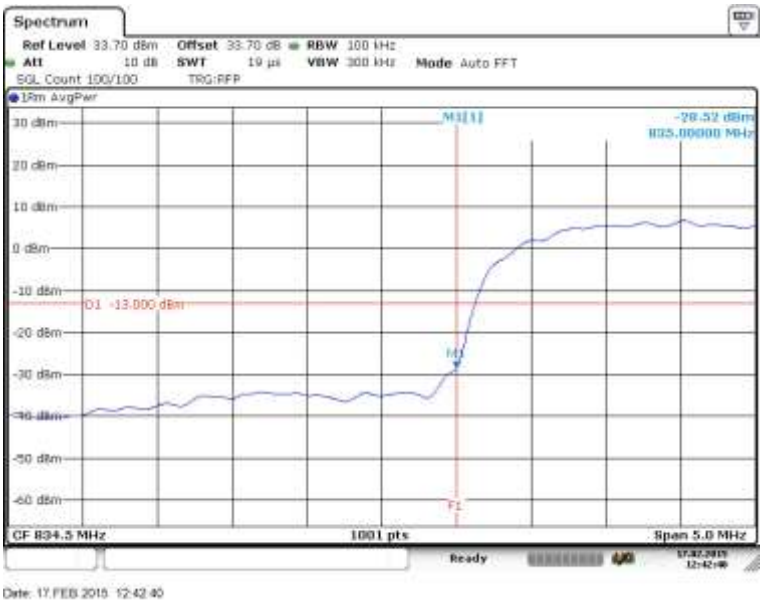

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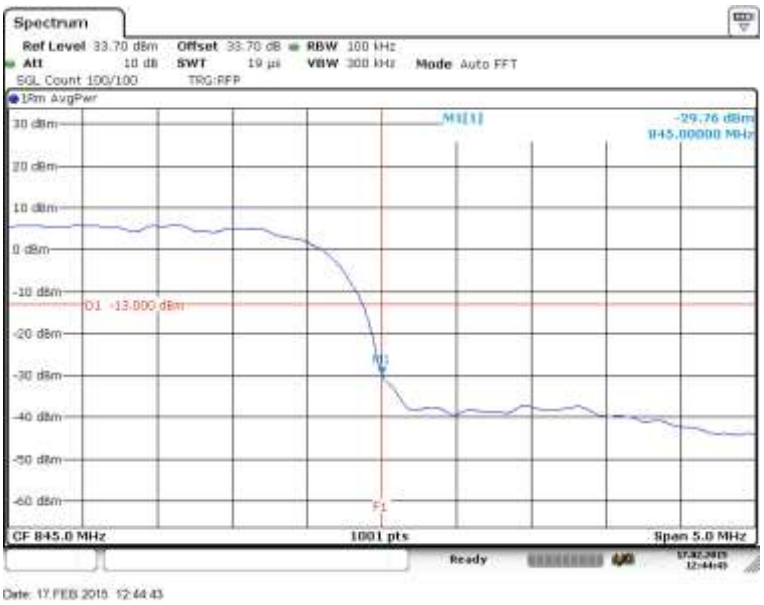

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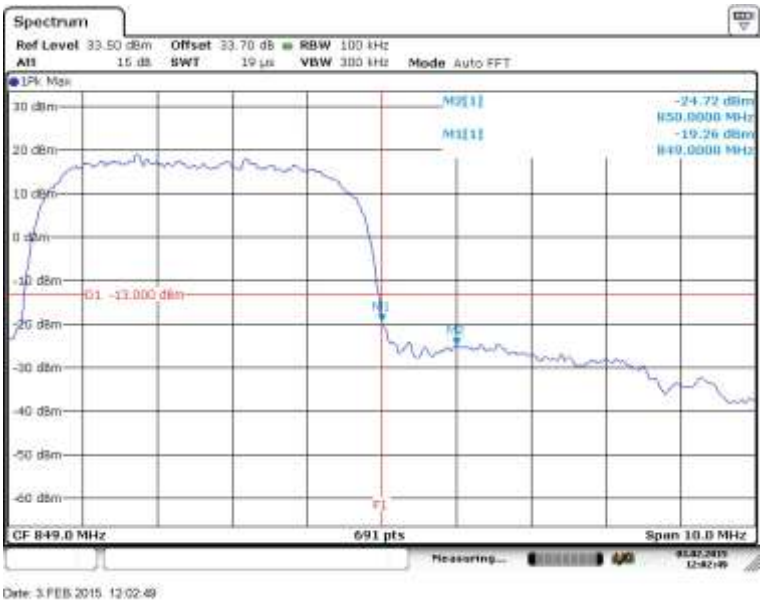

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Ch. 9262 band edge

Ch. 9262 out of band

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Ch. 9538 band edge

Ch. 9538 out of band

7.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Radio communication tester	Rohde & Schwarz	CMW500	32597	7/2015
Power divider	ET industries	D-0518-2	32551	--
Rf-attenuator	H+S	5910_N-010 20dB	32697	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

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8 CONDUCTED SPURIOUS EMISSION

Date of test:	2015-02-04	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	>20 dB

8.1 Requirement

§2.1051, RSS-GEN section 6.13

§22.917 (a) *Out of band emissions.*
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.

(b) *Measurement procedure.*
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132 section 5.5
Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p (watts).
After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$ p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

§24.238 (a) *Out of band emissions.*
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.

(b) *Measurement procedure.*
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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RSS-133 section.6.51
Equipment shall comply with the limits in (i) and (ii) below.
In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts).
After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required

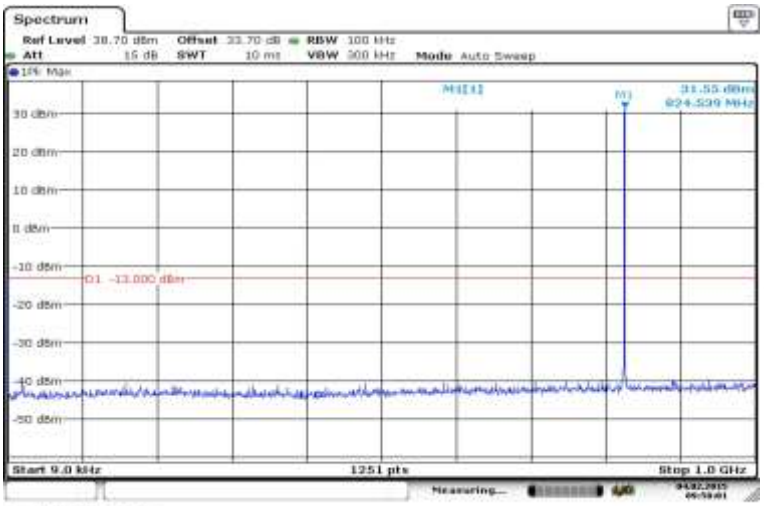
8.2 Test set-up

EUT antenna port was connected to spectrum analyser and communication tester via power divider rf-cables and 10 and 20 dB attenuators.

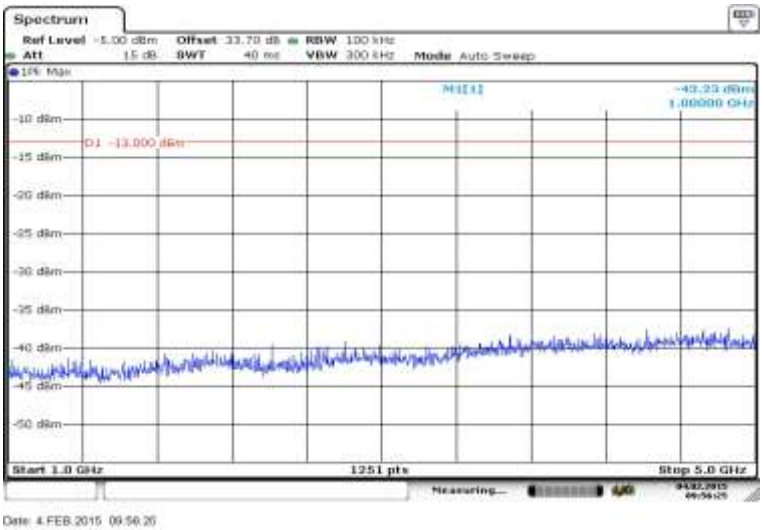
Analyser's Reference level offset was used to compensate cable and attenuator losses.

8.3 Test data

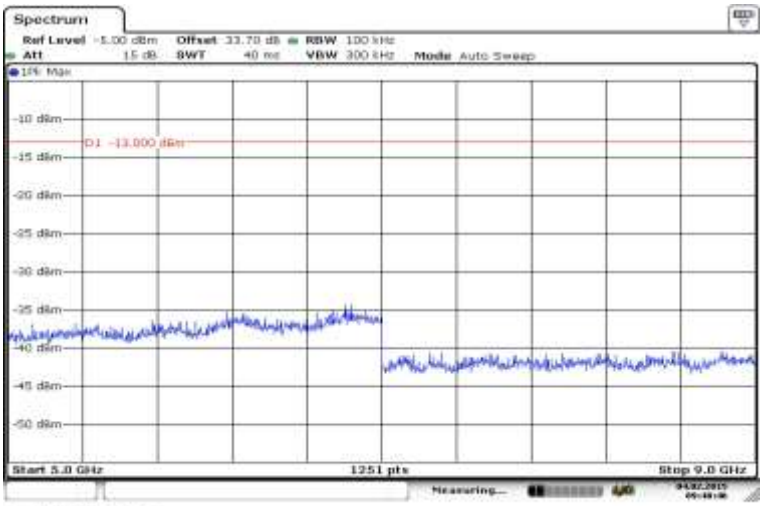
GSM ch 128



GSM ch 128



GSM ch 128



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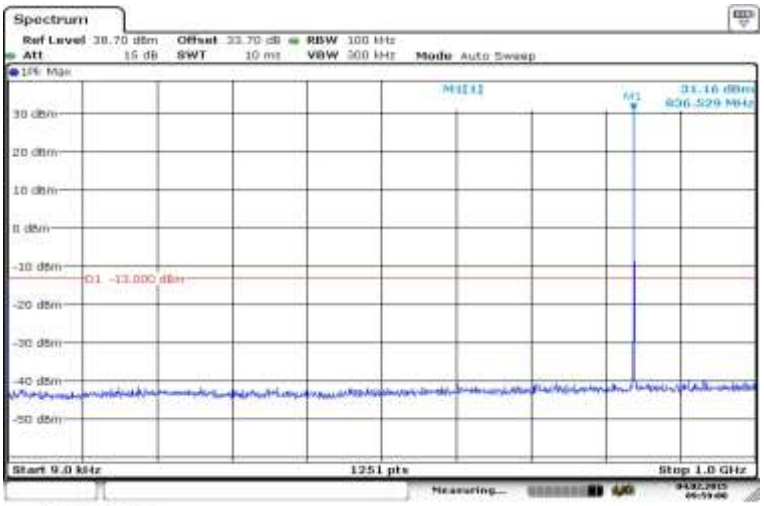

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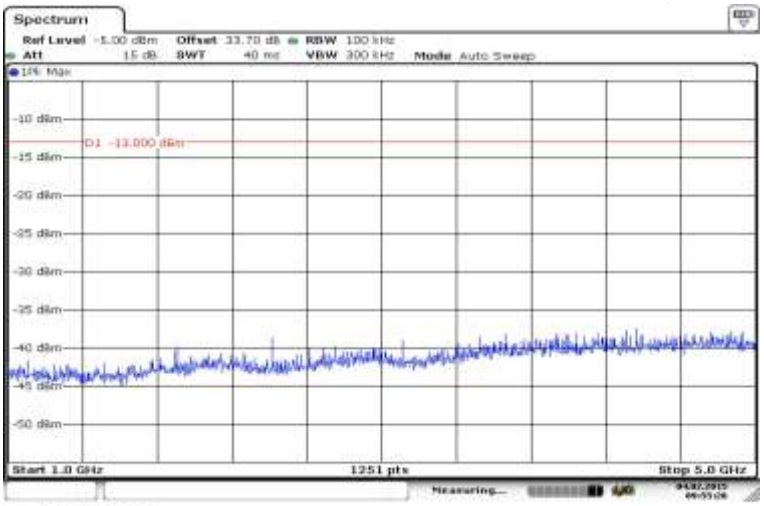

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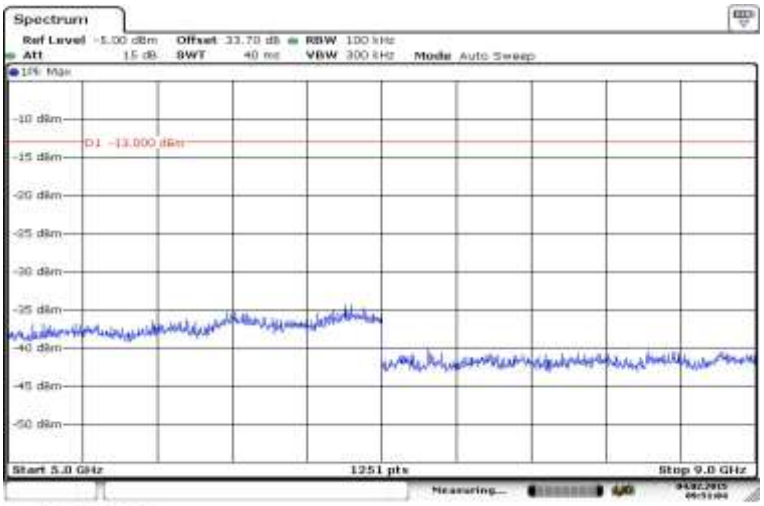
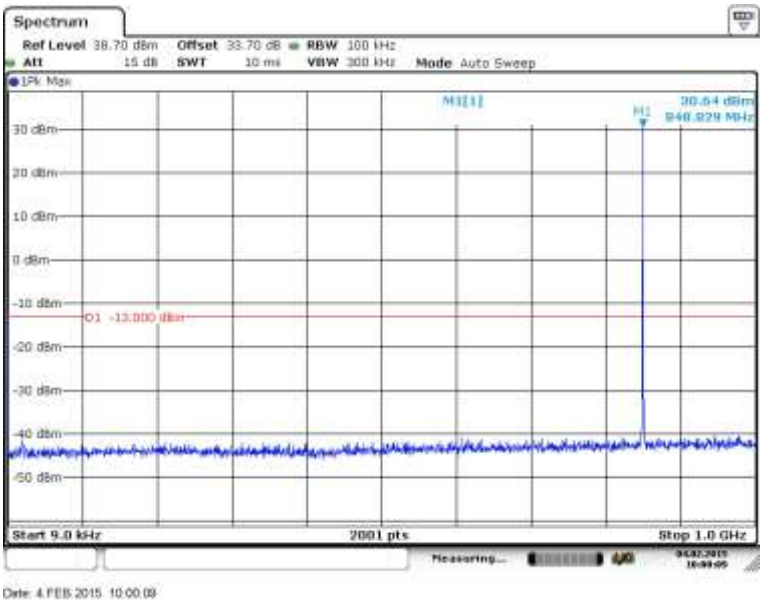


GSM ch 251



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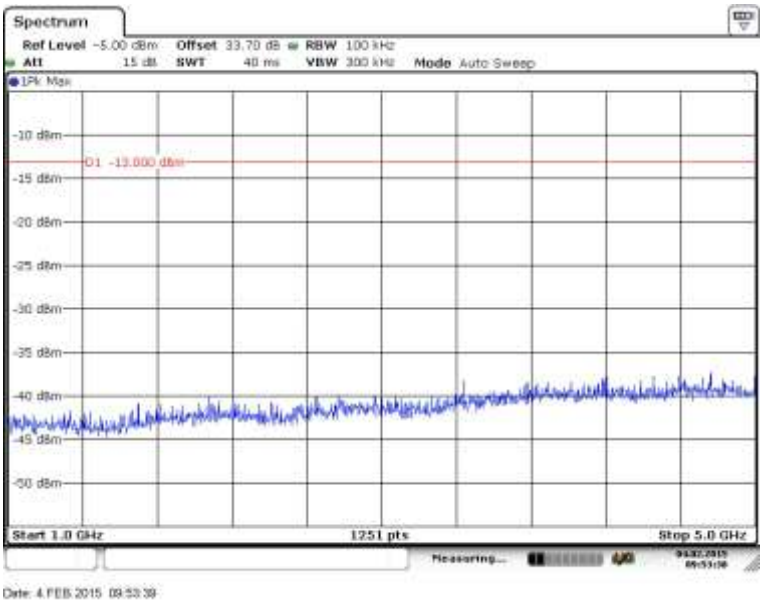
GSM ch 251



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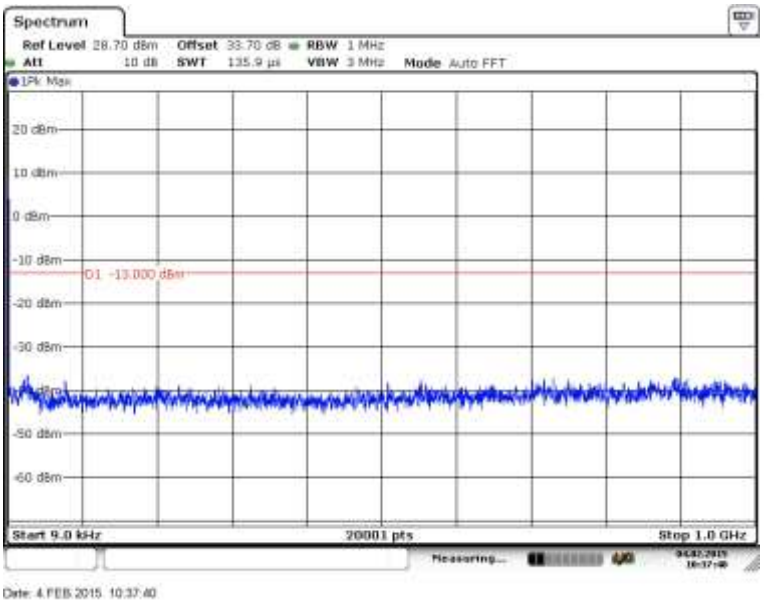

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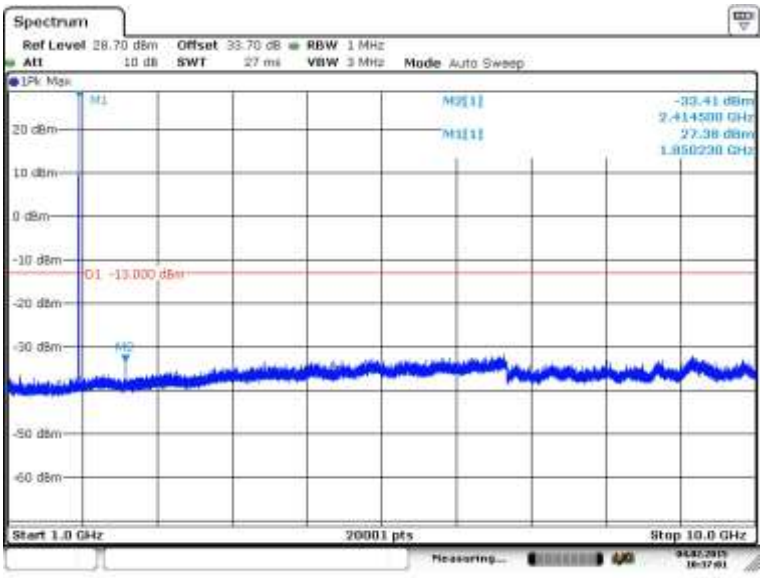

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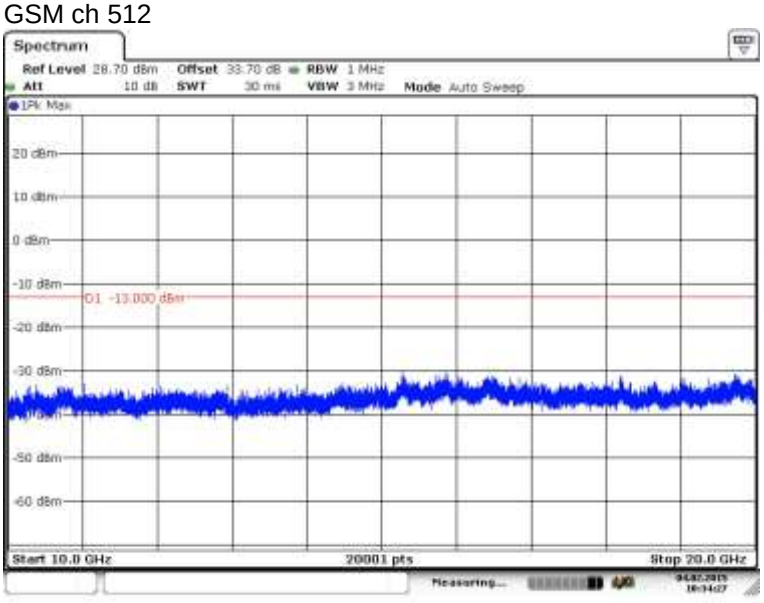

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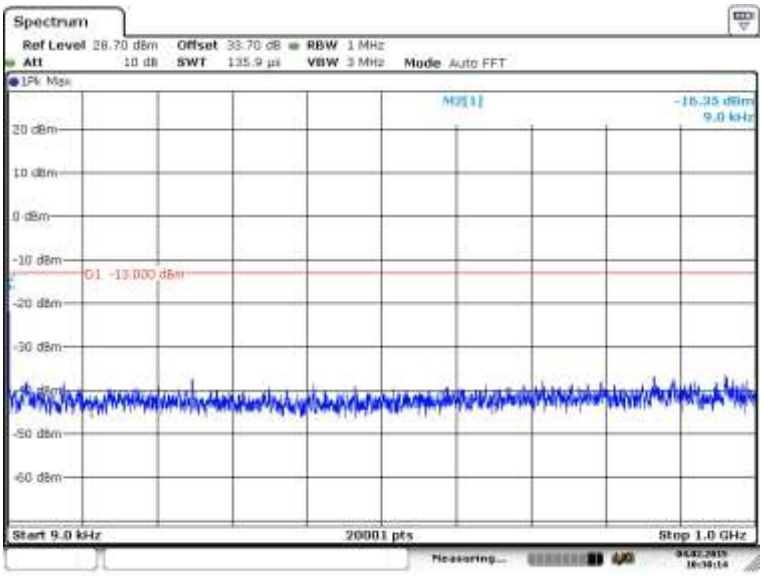
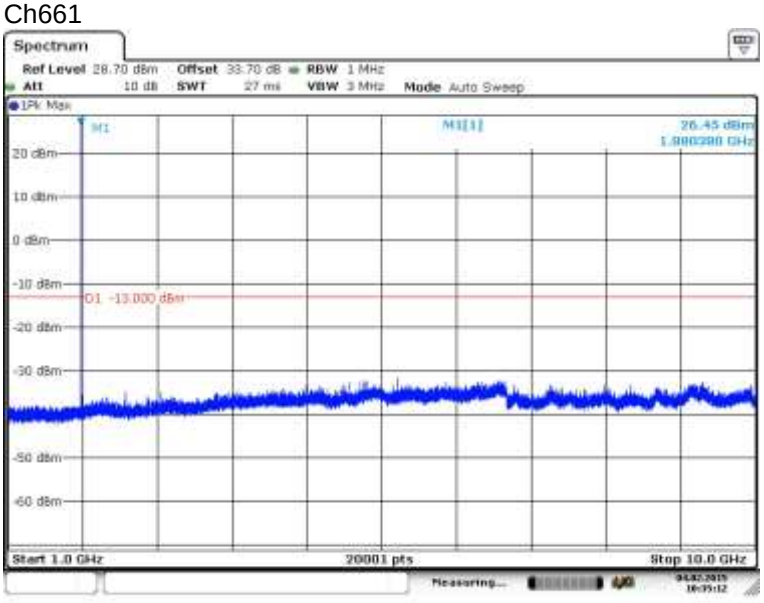
Ch661



Ch661



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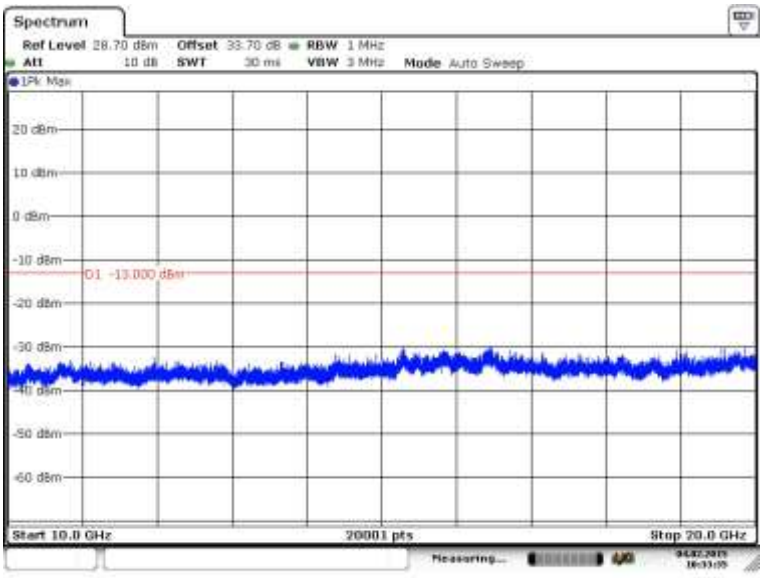

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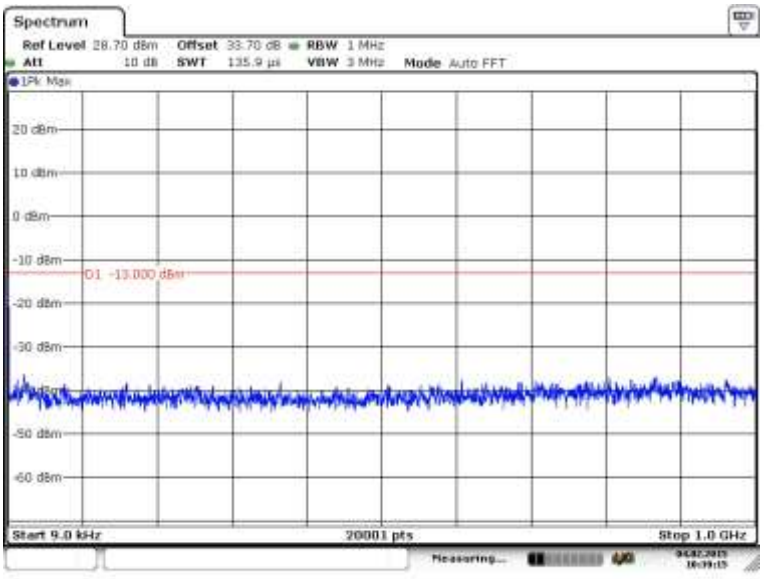

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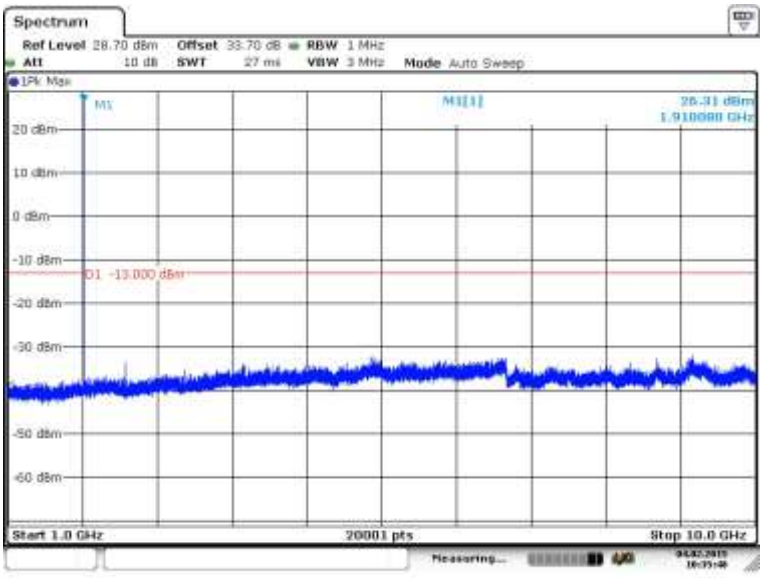

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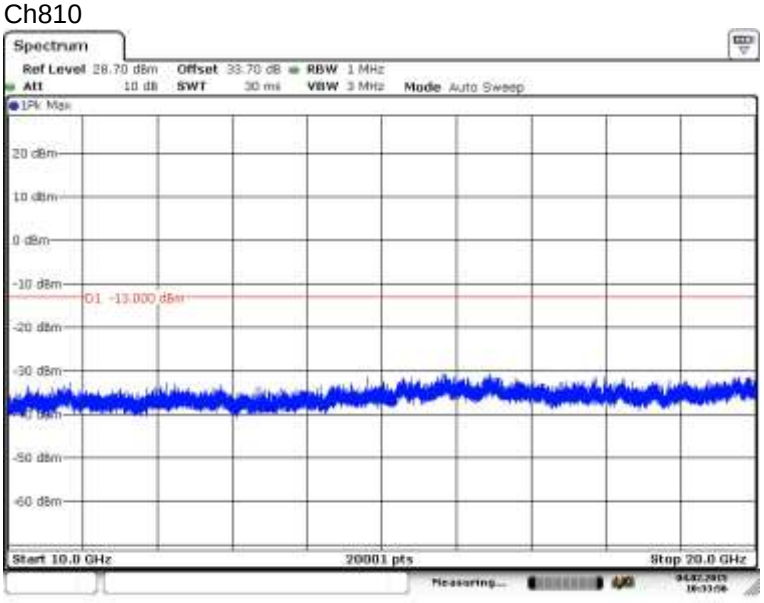

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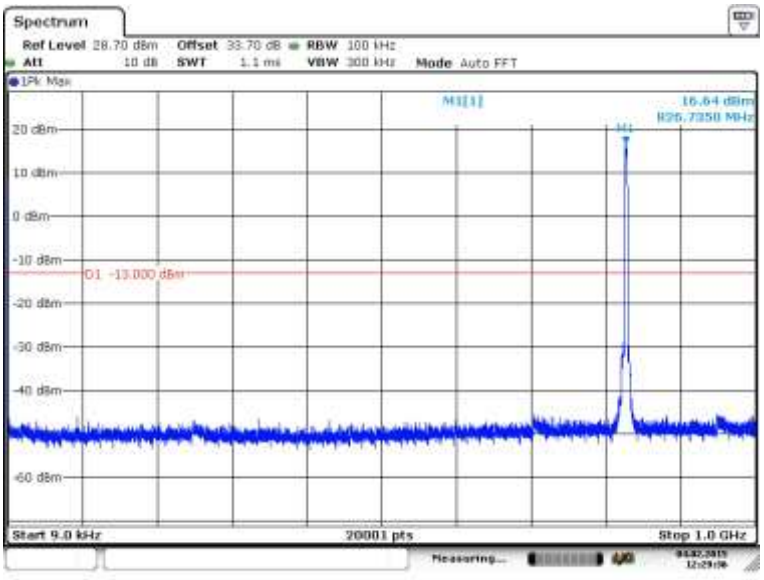
Ch 4132



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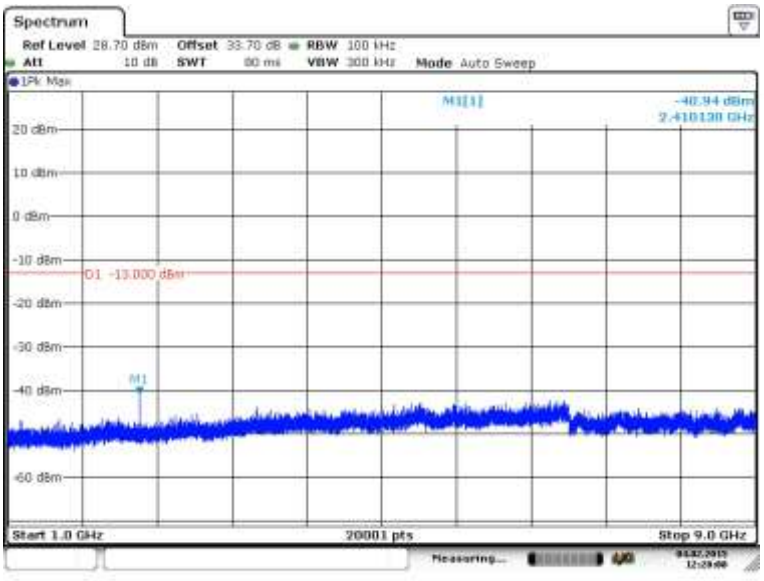
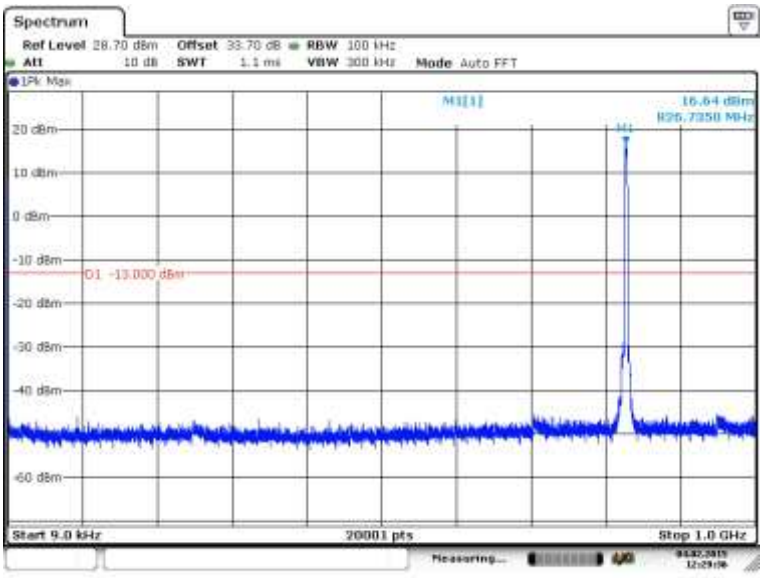


Ch 4183



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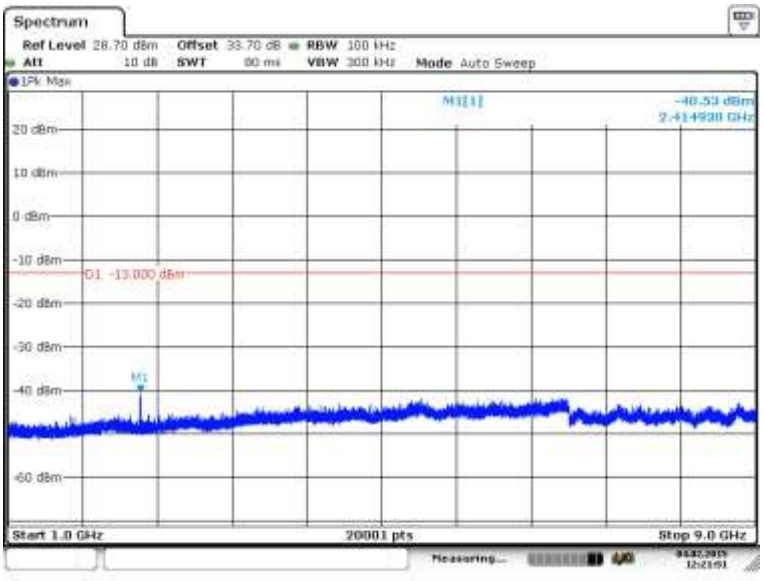

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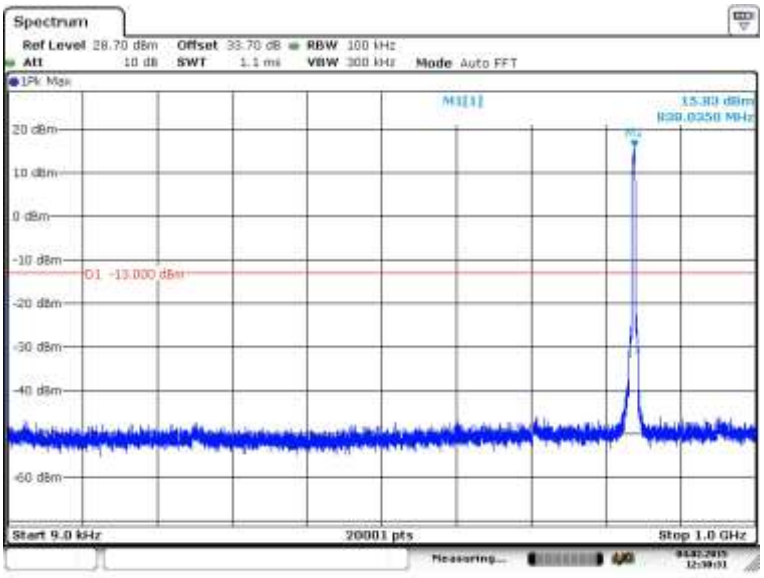
Ch. 4232



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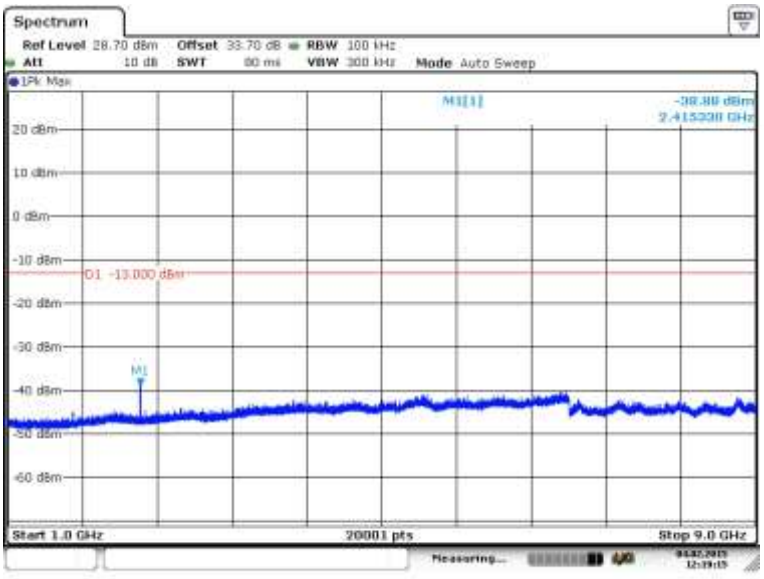
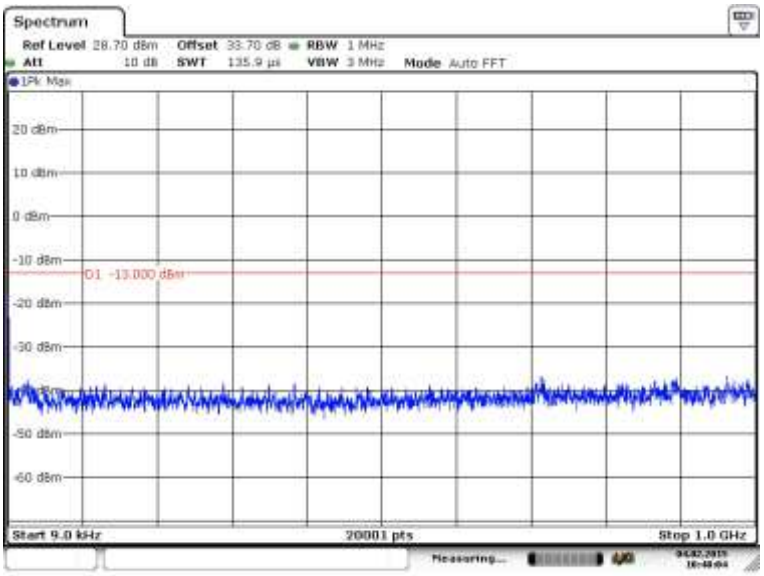


Ch. 9262



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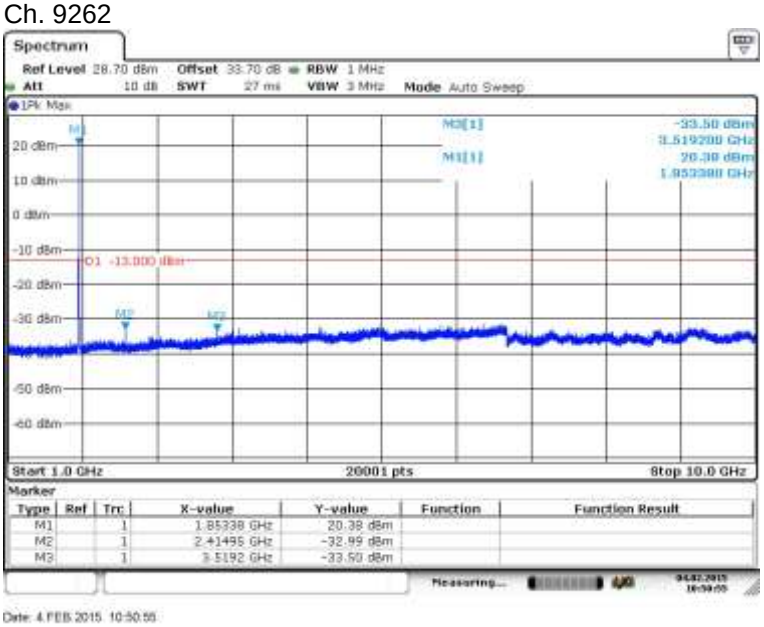

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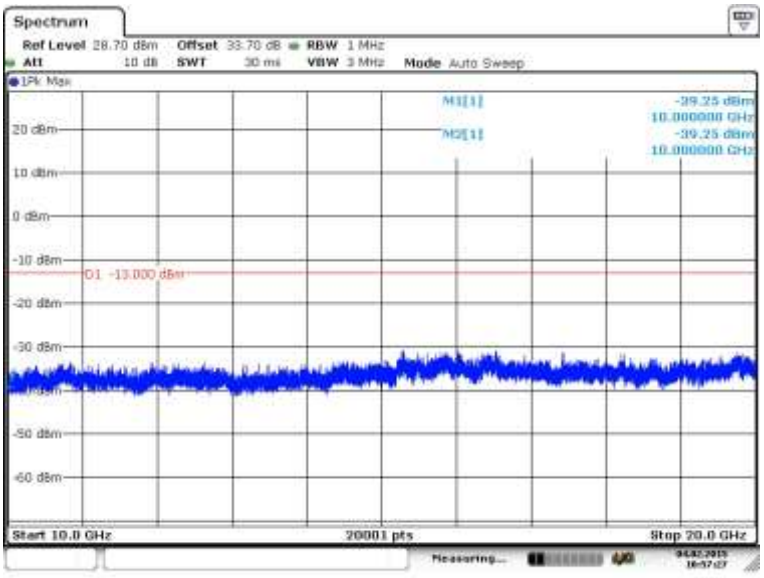

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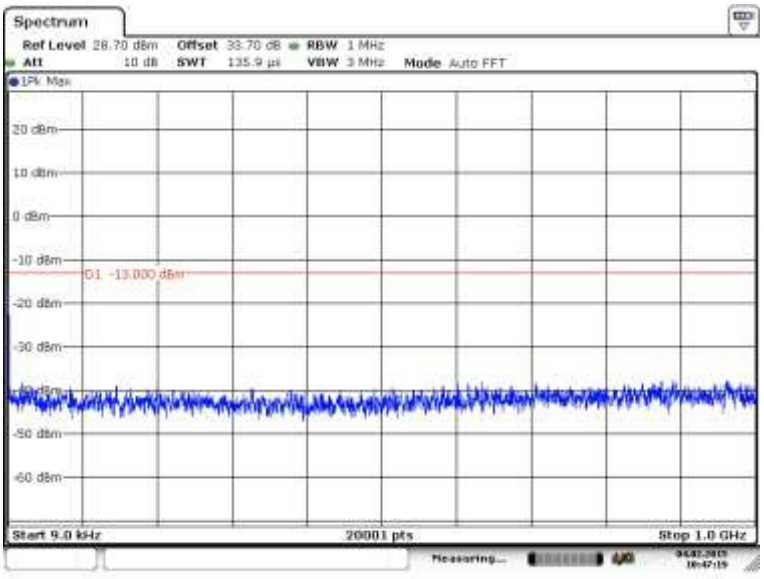

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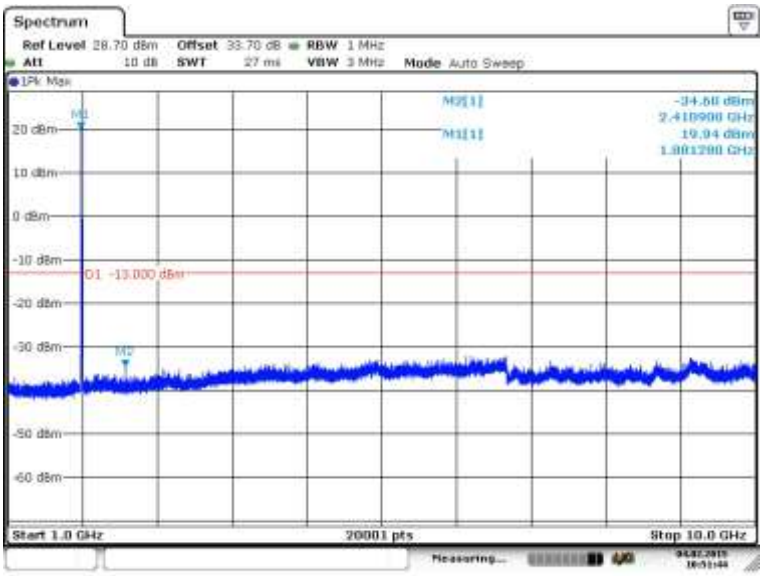

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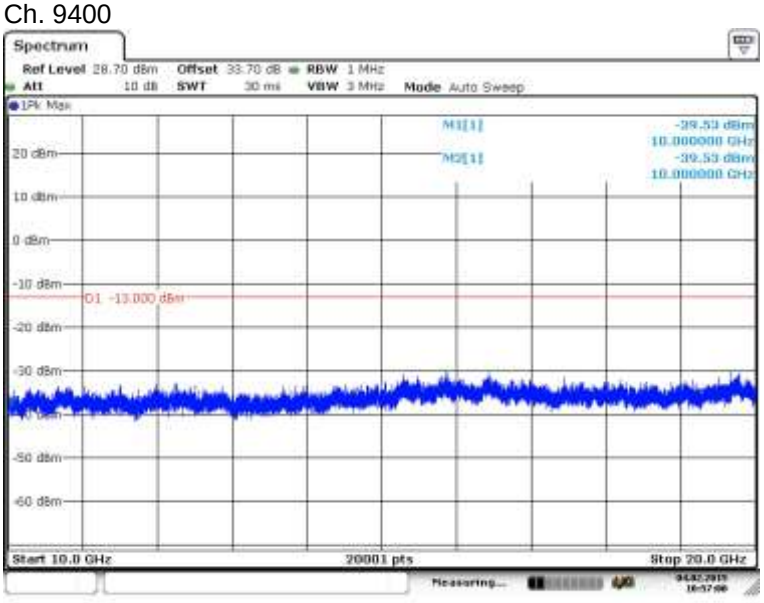

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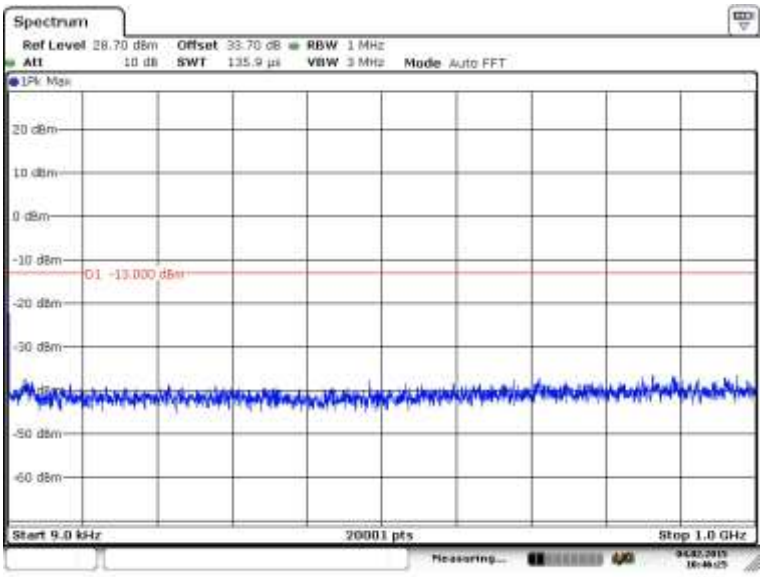
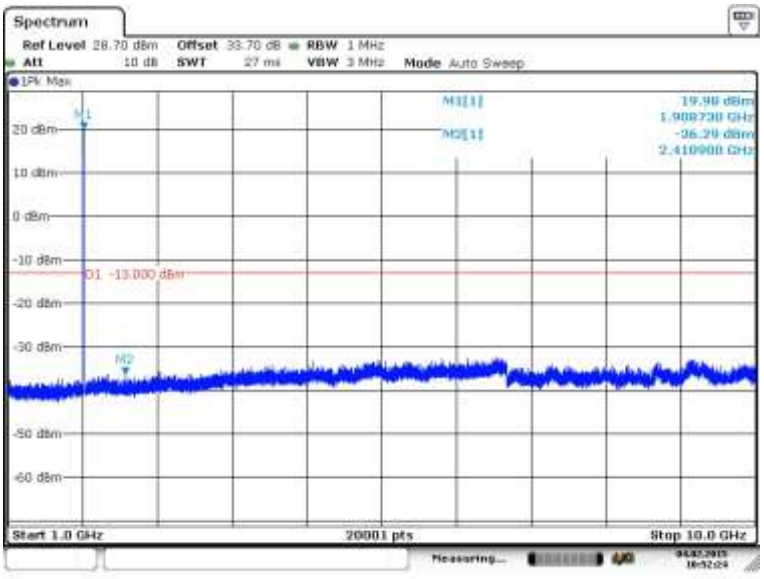
Ch. 9538



Ch. 9538



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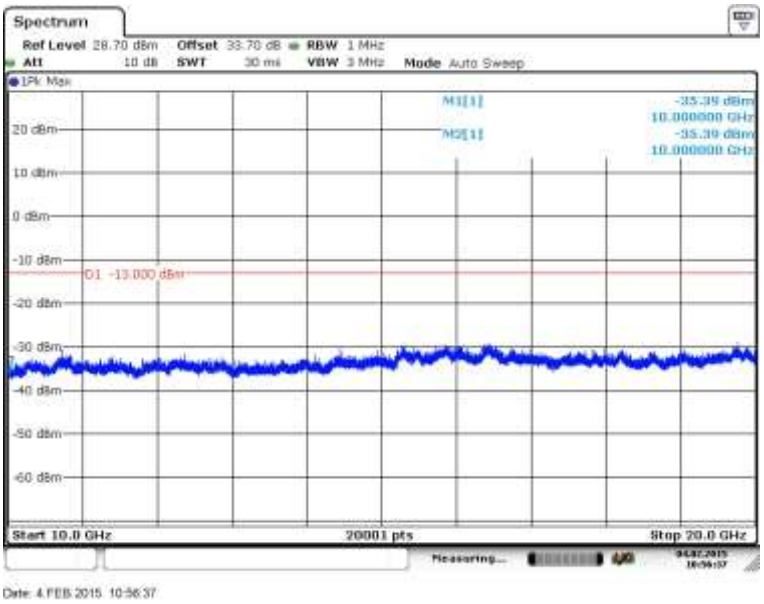
Ch. 9538



8.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Radio communication tester	Rohde & Schwarz	CMW500		7/2015
Power divider	Merrimac	PDM 21M 1.5 G	796033	--
Power divider	ET industries	D-0518-2	32551	--
Rf-attenuator	H+S	5910_N-010 20dB	32697	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

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9 FREQUENCY STABILITY

Date of test:	2015-02-02	Test location:	EMC Center
EUT Serial:	F9000170ABF0A	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	2073 Hz

9.1 Requirement

Reference:
§2.1055 Measurements required: Frequency stability.
(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From −30° to +50° centigrade for all equipment e
(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range.

§22.355 Frequency stability limit for mobile devices in 821 to 896 MHz range 2.5 ppm
§24.235 The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS-GEN 6.11
With the transmitter installed in an environmental test chamber, the un-modulated carrier frequency shall be measured under the conditions specified below. A sufficient stabilization period at each temperature shall be used prior to each frequency measurement. The following temperatures and supply voltage ranges apply, unless specified otherwise in the applicable RSS:
(a) at the temperatures of −30°C (−22°F), +20°C (+68°F) and +50°C (+122°F), and at the manufacturer's rated supply voltage; and
(b) at the temperature of +20°C (+68°F) and at ±15% of the manufacturer's rated supply voltage.

RSS-132 5.3
The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for mobile stations and ±1.5 ppm for base stations.

RSS-133 6.3
The carrier frequency shall not depart from the reference frequency, in excess of ±2.5 ppm for mobile stations and ±1.0 ppm for base stations.

9.2 Test set-up

EUT was placed into climate chamber and set to un-modulated carrier test mode EUT antenna port was connected to spectrum analyser rf-cable and 10 dB attenuator.

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9.3 Test data

V	T (˚C)	f_{nom} (Hz)	error start(Hz)	error 2 min(Hz)	error 5 min(Hz)	error 10 min(Hz)
nom	20	1880,000,000	-18	- 9	-12	-8
min	20	1880,000,000	-17	-7	-1	-11
max	20	1880,000,000	-12	-11	-7	-6
nom	50	1880,000,000	2	-10	-9	-5
nom	40	1880,000,000	5	7	3	5
nom	30	1880,000,000	12	11	9	7
nom	10	1880,000,000	14	11	13	12
nom	0	1880,000,000	9	7	13	10
nom	-10	1880,000,000	14	35	30	33
nom	-20	1880,000,000	22	25	32	30
nom	-30	1880,000,000	25	25	10	6

Limit: ± 2.5ppm = ±4700 Hz

V	T (˚C)	f_{nom} (Hz)	error start(Hz)	error 2 min(Hz)	error 5 min(Hz)	error 10 min(Hz)
nom	20	836,6000,000	-13	-14	-11	-12
min	20	836,6000,000	-16	-17	-15	-13
max	20	836,6000,000	-17	-11	-16	-15
nom	50	836,6000,000	-18	-14	-15	-12
nom	40	836,6000,000	-13	-9	-12	-10
nom	30	836,6000,000	-11	-13	-15	-9
nom	10	836,6000,000	-10	-11	-9	-7
nom	0	836,6000,000	-7	-9	-3	6
nom	-10	836,6000,000	-6	-6	4	-1
nom	-20	836,6000,000	-4	-6	3	-3
nom	-30	836,6000,000	15	-8	-10	-7

Limit: ± 2.5 ppm = ±2091 Hz

9.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Climate chamber	Vötsch	VC 018	12282	2/2015
Rf-attenuator	H+S	5910_N-010 20dB	32697	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

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10 RADIATED EMISSIONS MEASUREMENTS FROM 30 MHZ TO 1000MHZ

Date of test:	2015-02-10	Test location:	Björkhallen
EUT Serial:	F9000170ABF0A	Ambient temp.	23 °C
Tested by:	Matti Virkki	Relative humidity	35 %
Test result:	Pass	Margin:	>20 dB

1.1 Requirement

§2.1053, RSS-GEN section 6.13

§22.917 (a) Out of band emissions.
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.

(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132 section 5.5
Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts).
After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

§24.238 (a) Out of band emissions.
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.

(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

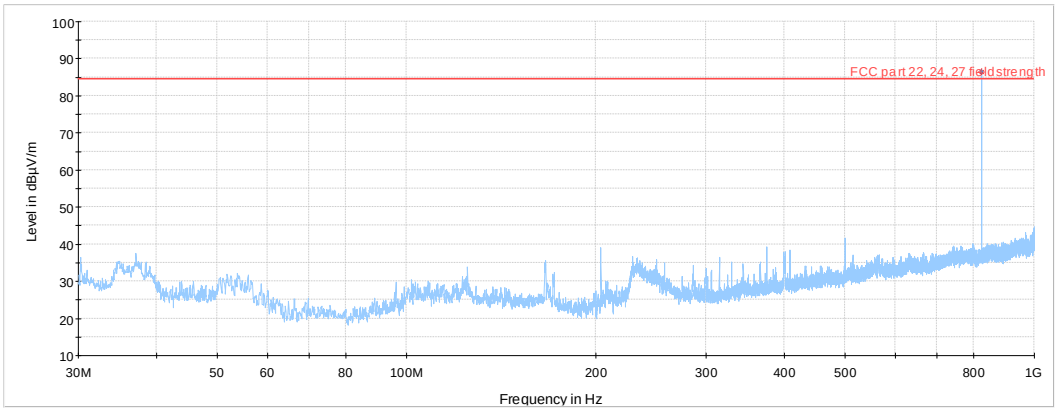
RSS-133 section.6.51
Equipment shall comply with the limits in (i) and (ii) below.
In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts).
After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required

10.1 Test setup details

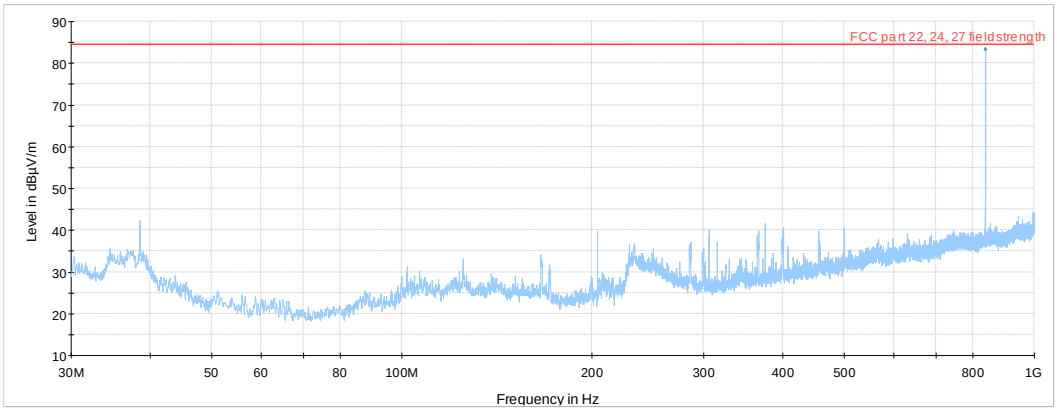
EUT was placed in semi anechoic room on a non-conductive table 80 cm above the ground plane.

10.2 Test data

Overview sweeps performed with peak detectors, GSM Ch. 128



Overview sweeps performed with peak detectors, GSM Ch. 190



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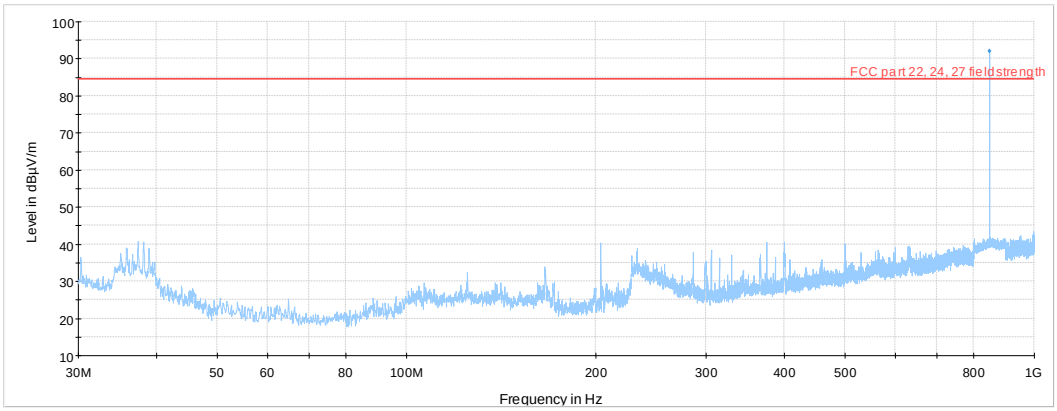
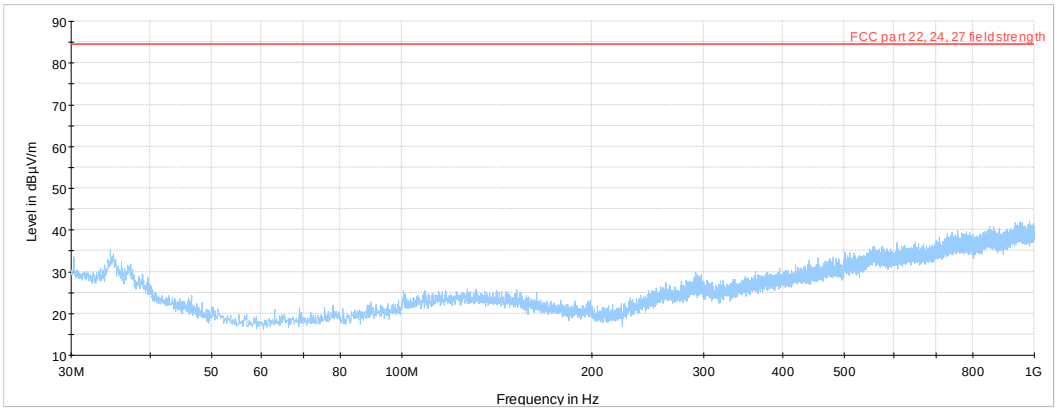
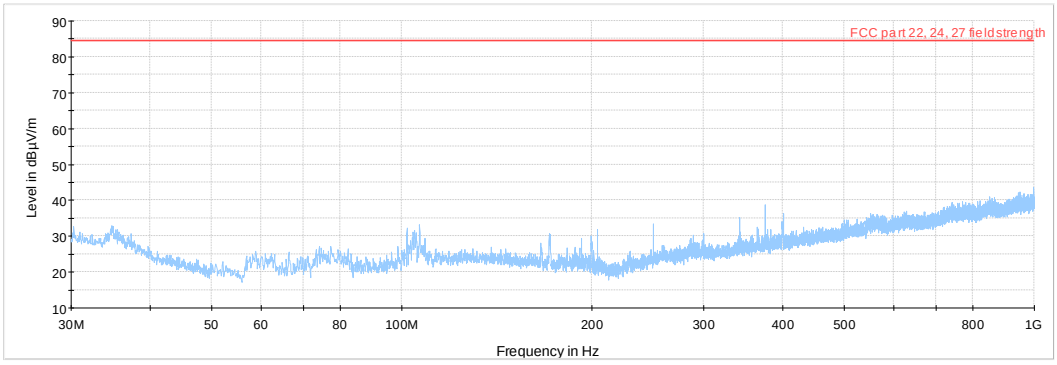
Overview sweeps performed with peak detectors, GSM Ch. 251



Overview sweeps performed with peak detectors, GSM Ch. 512



Overview sweeps performed with peak detectors, GSM Ch. 661



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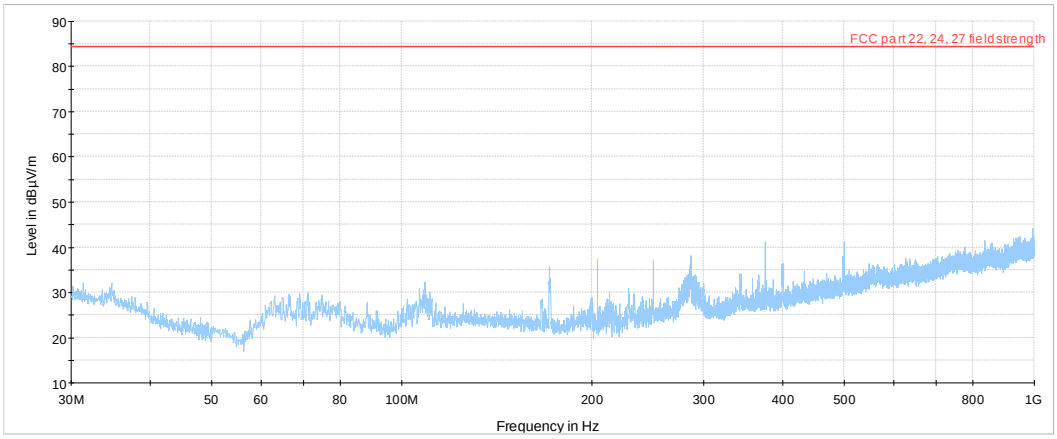
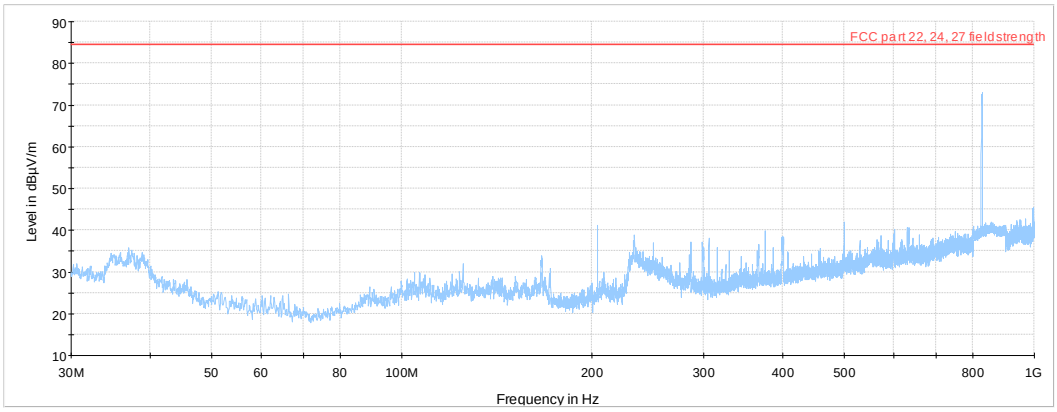
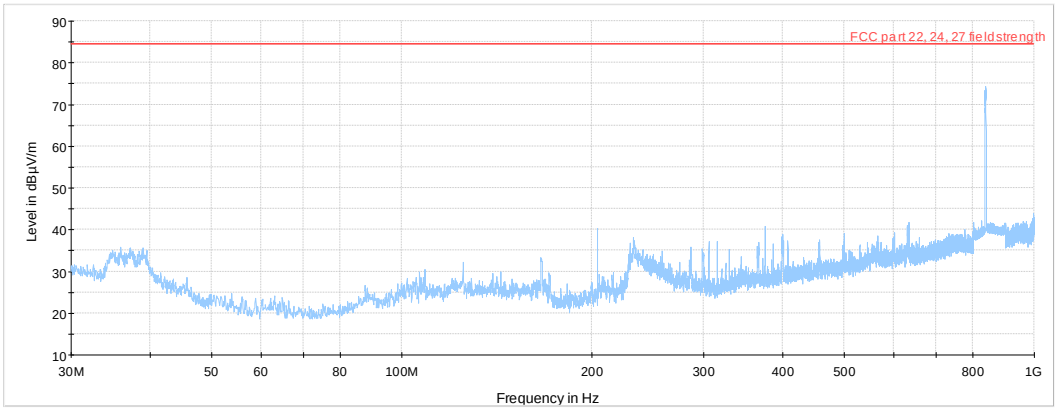
Overview sweeps performed with peak detectors, GSM Ch. 810



Overview sweeps performed with peak detectors, WCDMA Ch. 4132



Overview sweeps performed with peak detectors, WCDMA Ch. 4183



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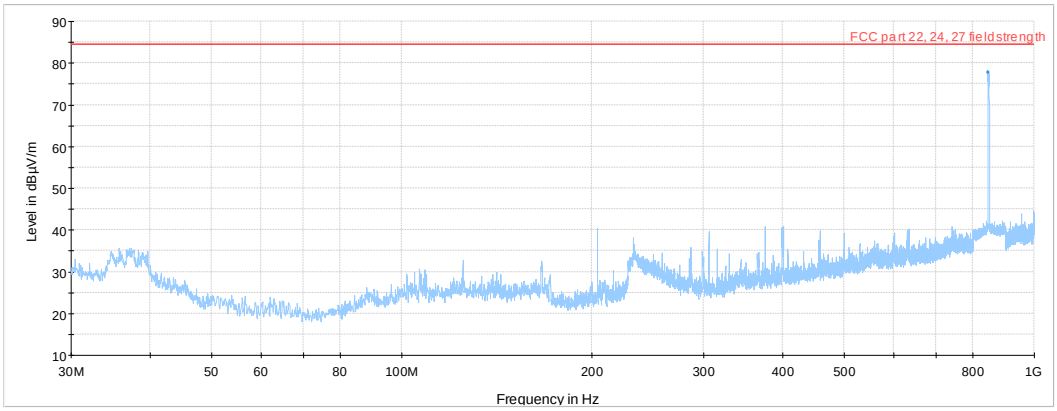
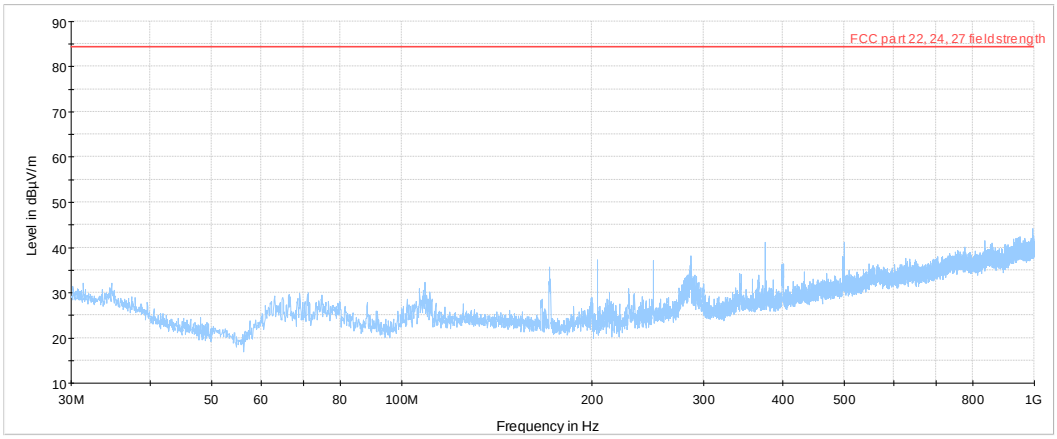
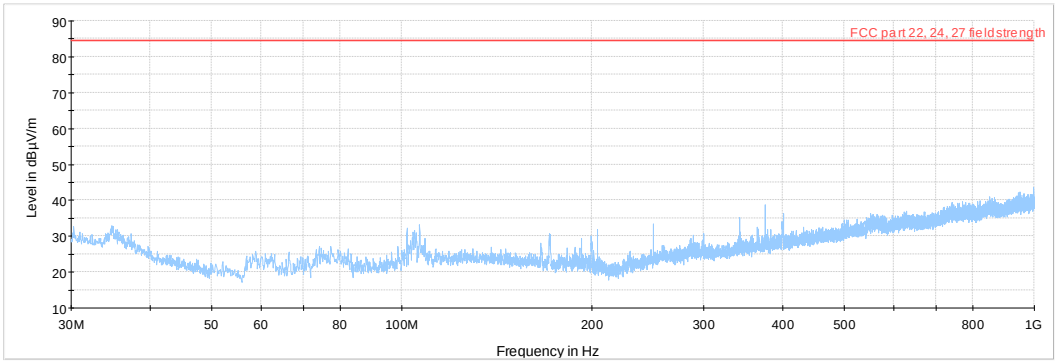
Overview sweeps performed with peak detectors, WCDMA Ch. 4233



Overview sweeps performed with peak detectors, WCDMA Ch. 9262



Overview sweeps performed with peak detectors, WCDMA Ch. 9400



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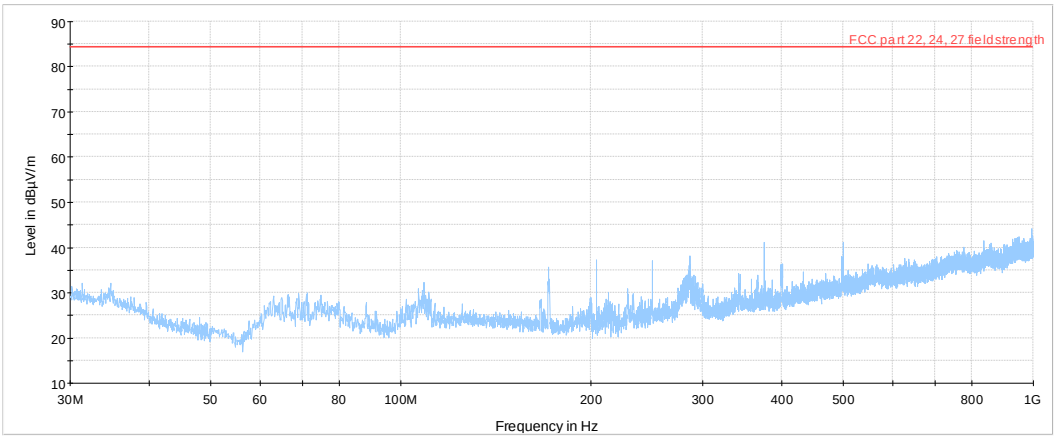
Overview sweeps performed with peak detectors, WCDMA Ch. 9538



Measured level [dBµV/m] = Analyser reading [dBµV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [dB/m]

10.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESI	32291	7/2015
UltraLog antenna	Rohde & Schwarz	HL 562	30711	12/2014
Hornantenna	Rohde & Schwarz	HF907	32307	6/2015
Pre amplifier	Rohde & Schwarz	TS-PRE1	32306	7/2015
Switch unit	Rohde & Schwarz	OSP130	32300	7/2015
Filter unit	Rohde & Schwarz	OSP-F7-B	32301	--

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11 RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ

Date of test:	2015-02-11/12	Test location:	Radio hallen / Björkhallen
EUT Serial:	F9000170ABF0A	Ambient temp.	21 ˚C, 21˚C
Tested by:	Matti Virkki	Relative humidity	26 %, 27%
Test result:	Pass	Margin:	>20 dB

11.1 Requirement

§2.1053, RSS-GEN section 6.13

§22.917 (a) Out of band emissions.
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.

(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132 section 5.5
Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts).
After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

§24.238 (a) Out of band emissions.
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.

(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-133 section.6.51
Equipment shall comply with the limits in (i) and (ii) below.
In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts).
After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required

11.2 Test setup details

EUT was placed on non-conductive table 80 cm above the ground plane.

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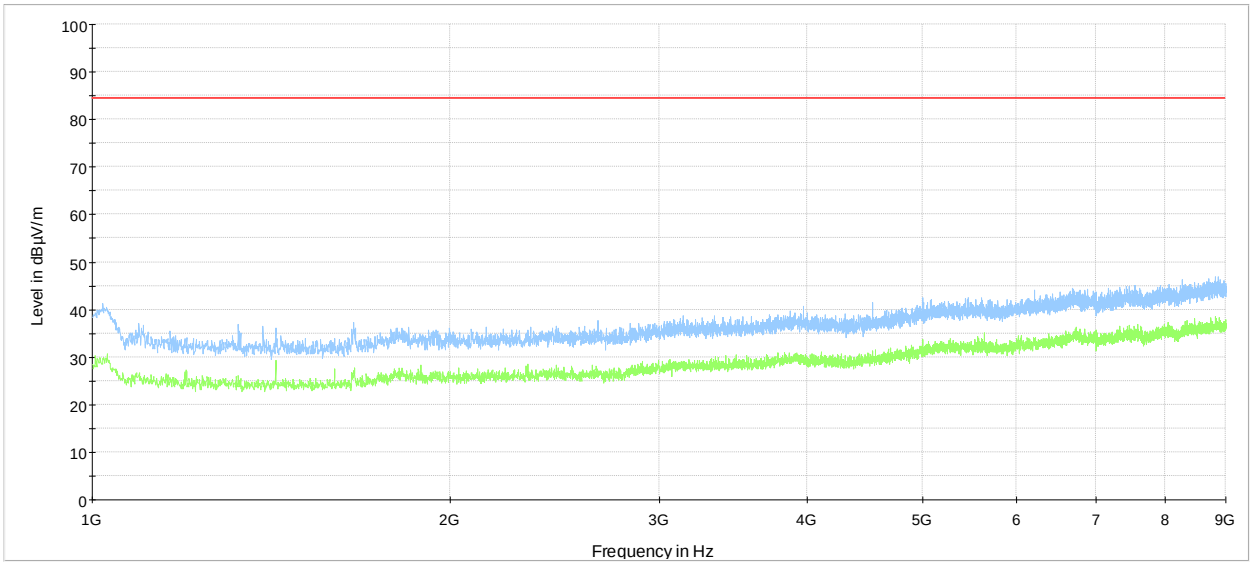
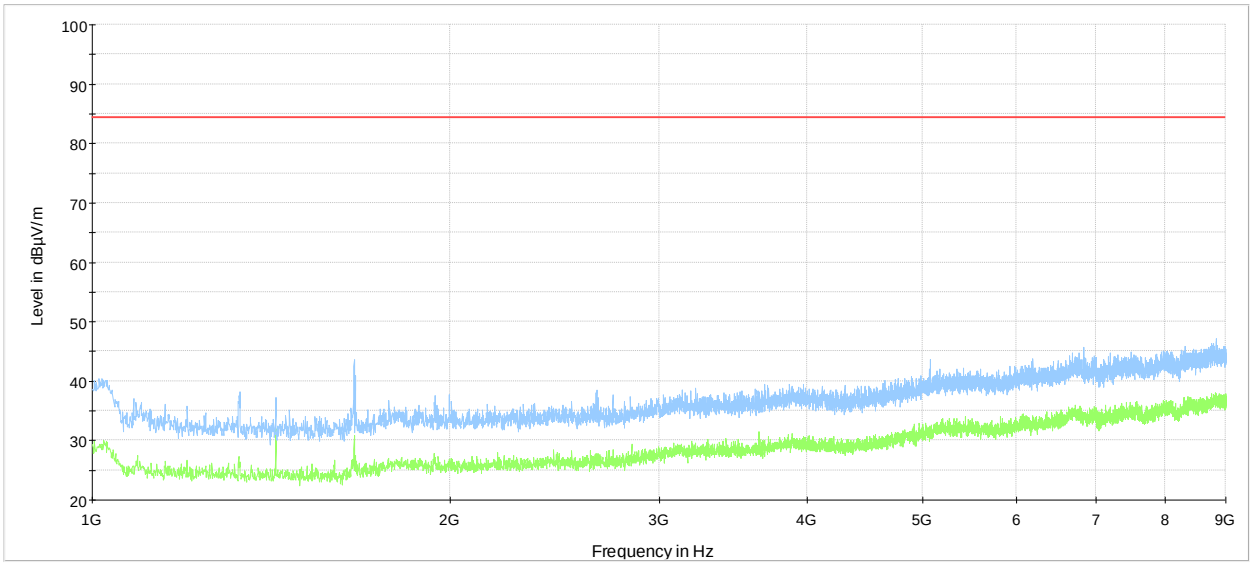
11.3 Test data

Overview sweeps performed with peak detectors, Ch 128



Overview sweeps performed with peak detectors, Ch 190



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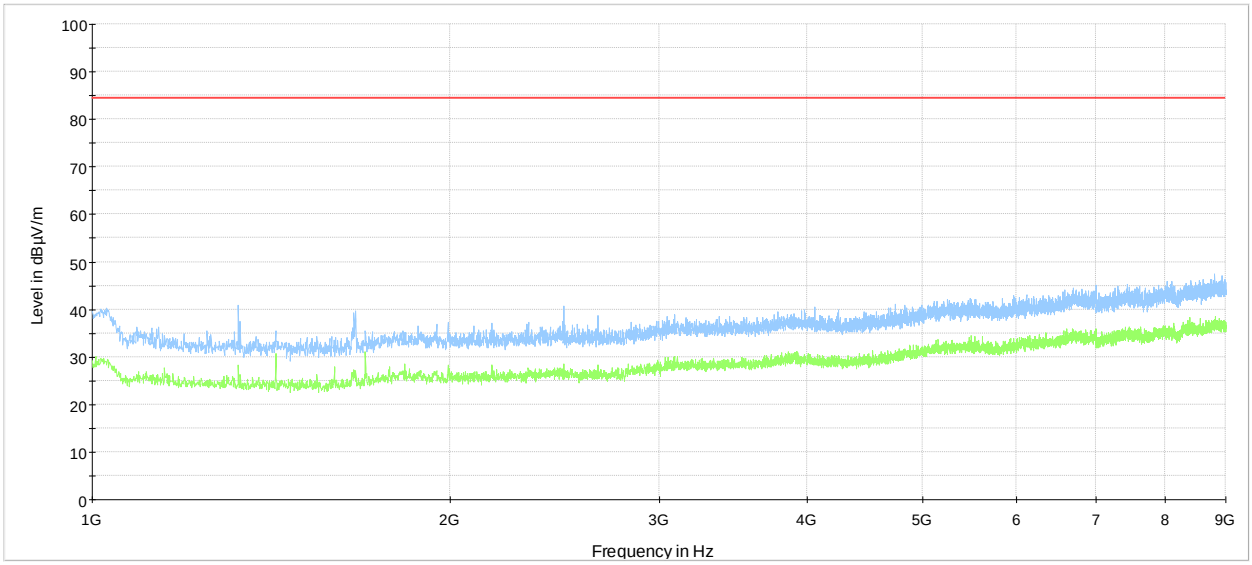
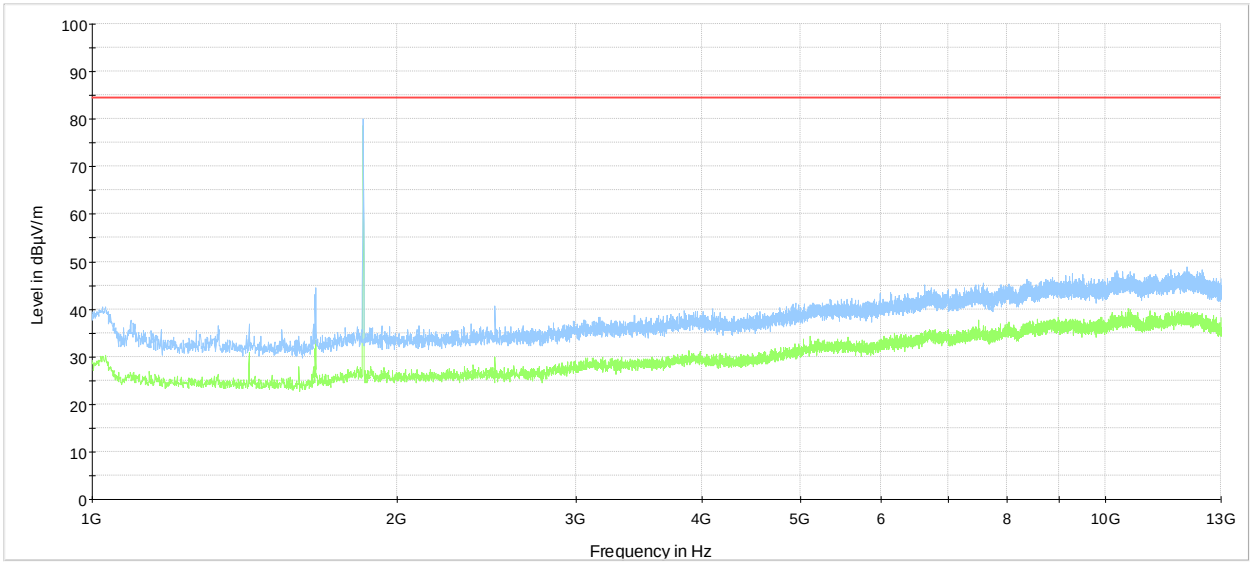
Overview sweeps performed with peak detectors, Ch 251



Overview sweeps performed with peak detectors, Ch 512



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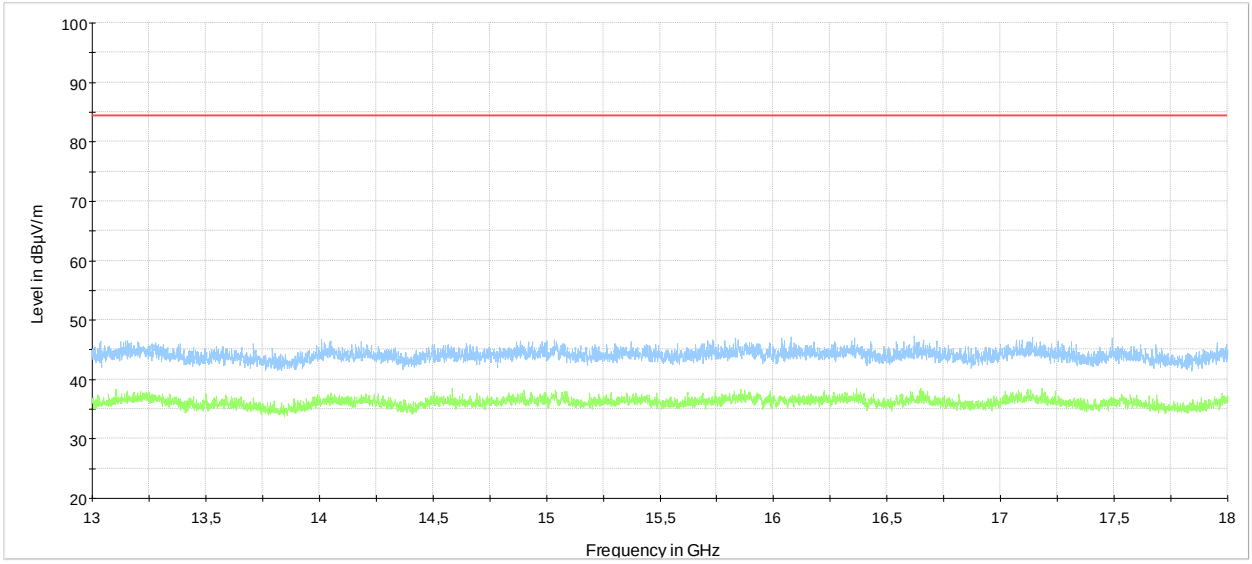
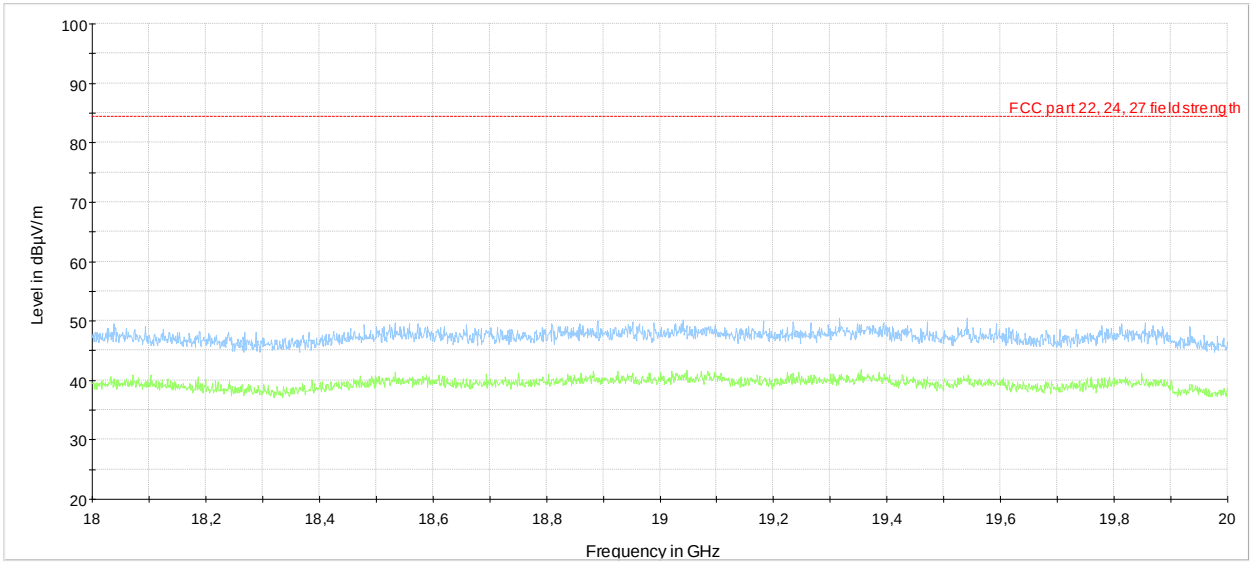
Overview sweeps performed with peak detectors, Ch 512



Overview sweeps performed with peak detectors, Ch 512



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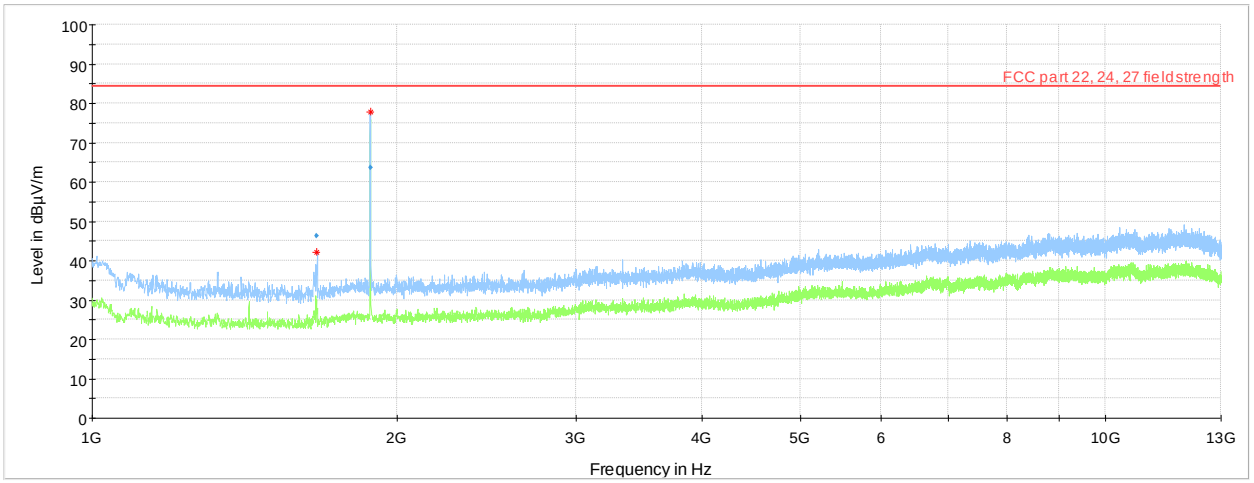
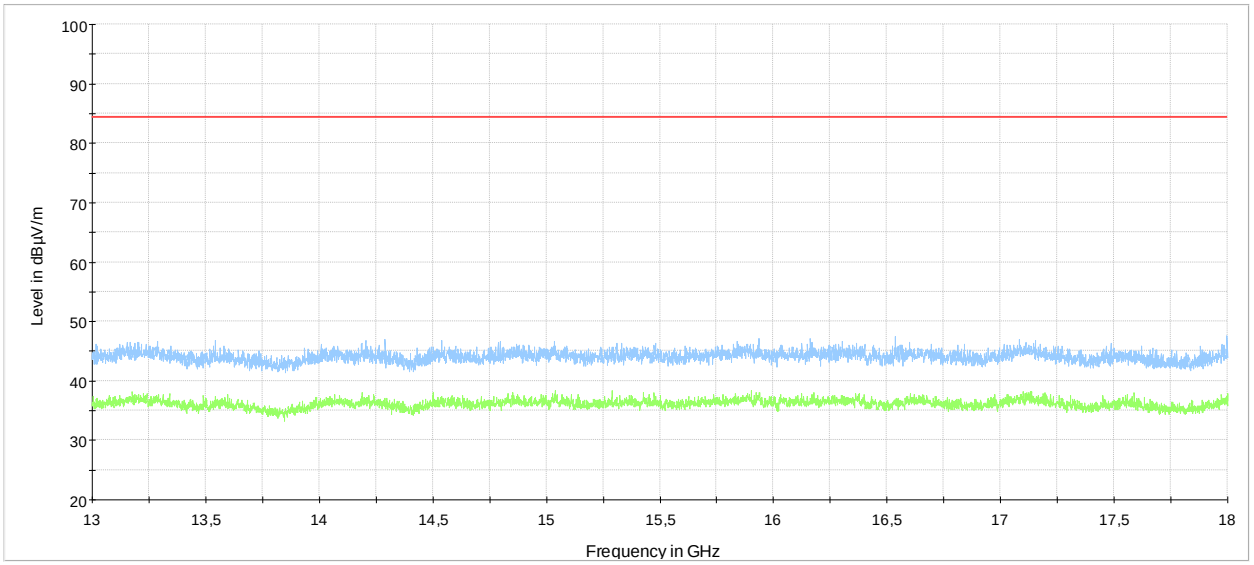
Ch 661



Ch 661



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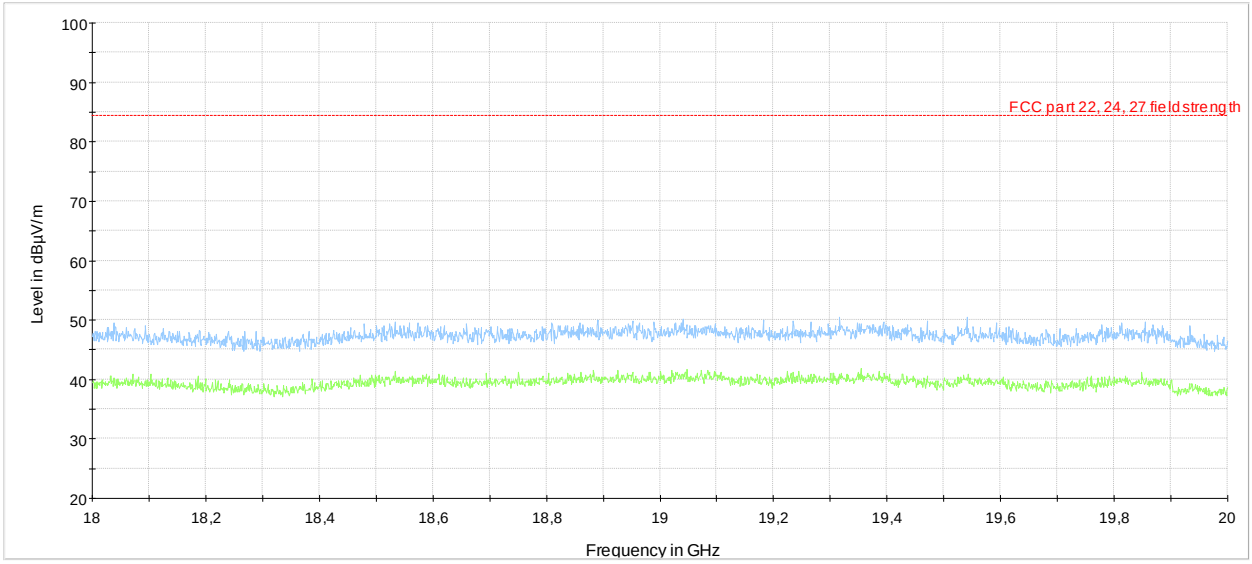
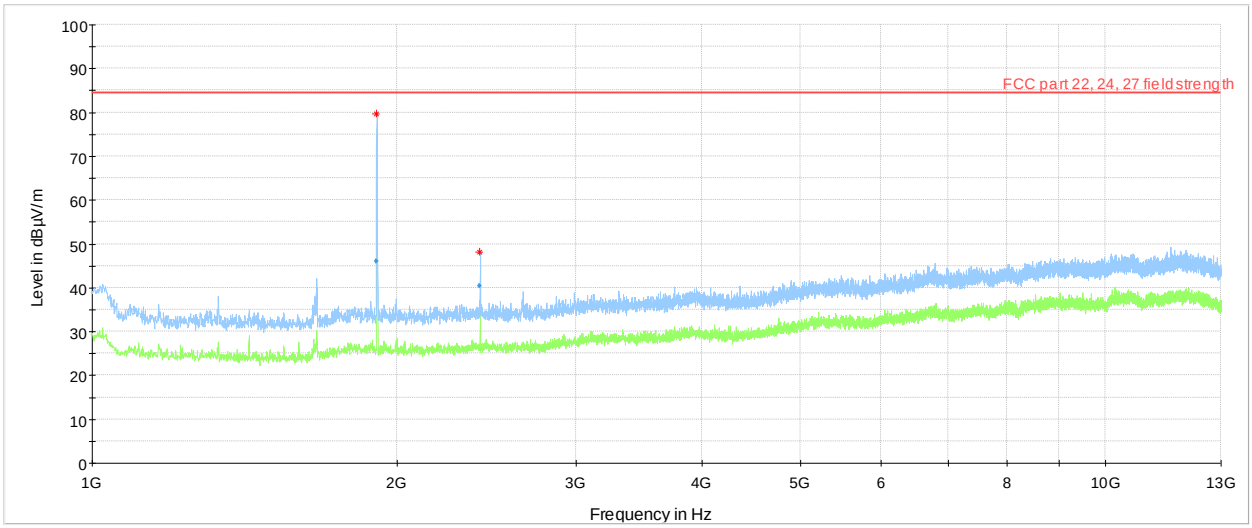
Ch 661



Ch.810



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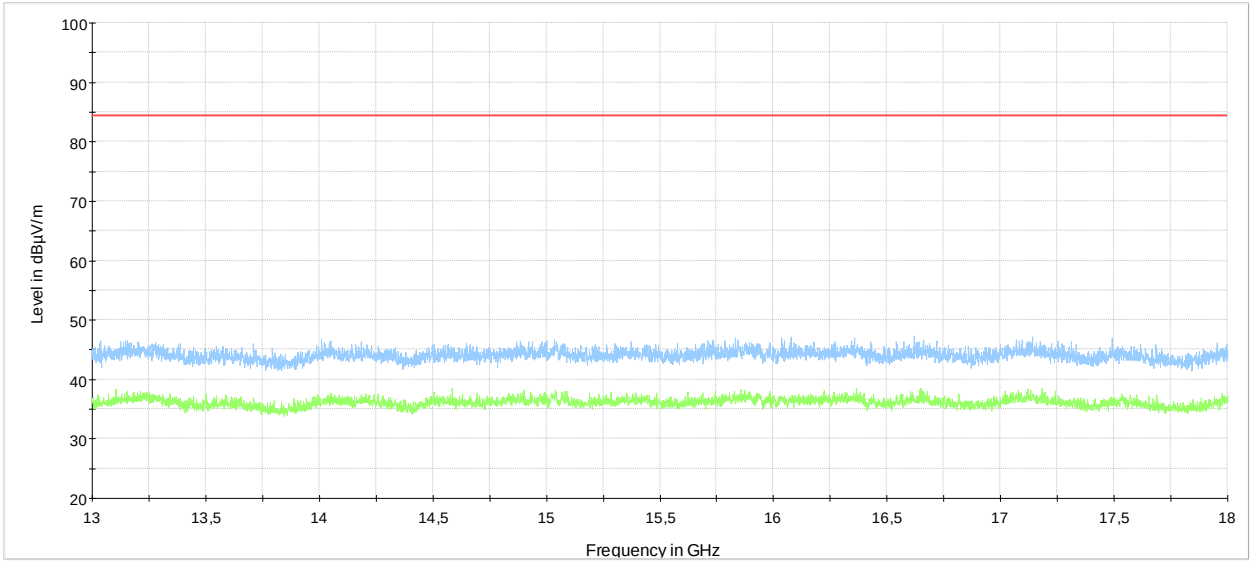
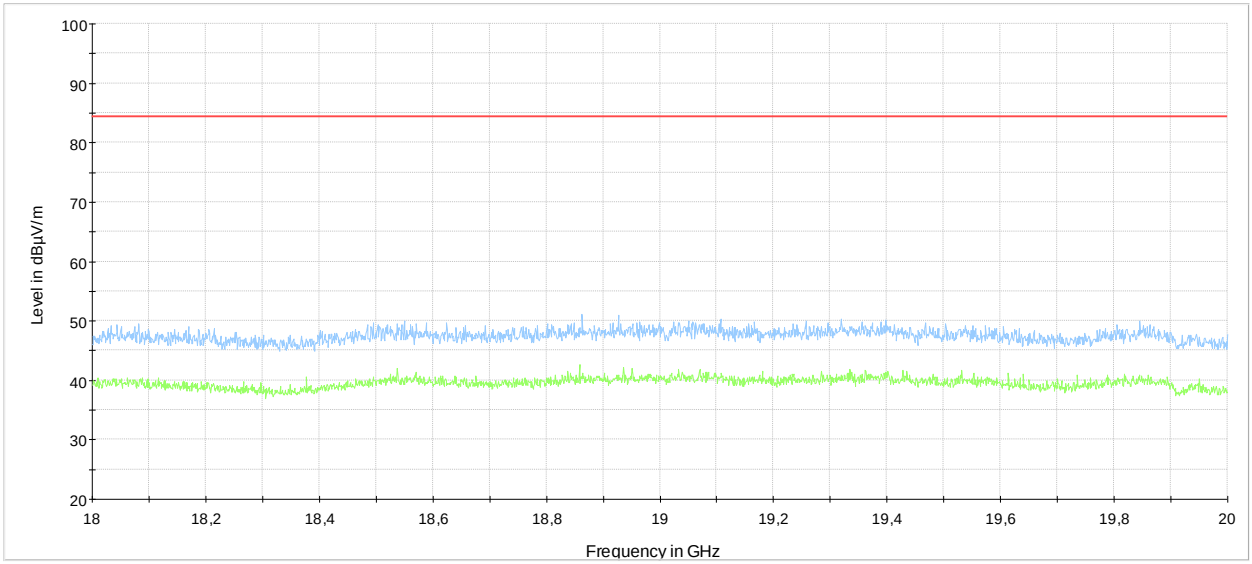
Ch. 810



Ch. 810



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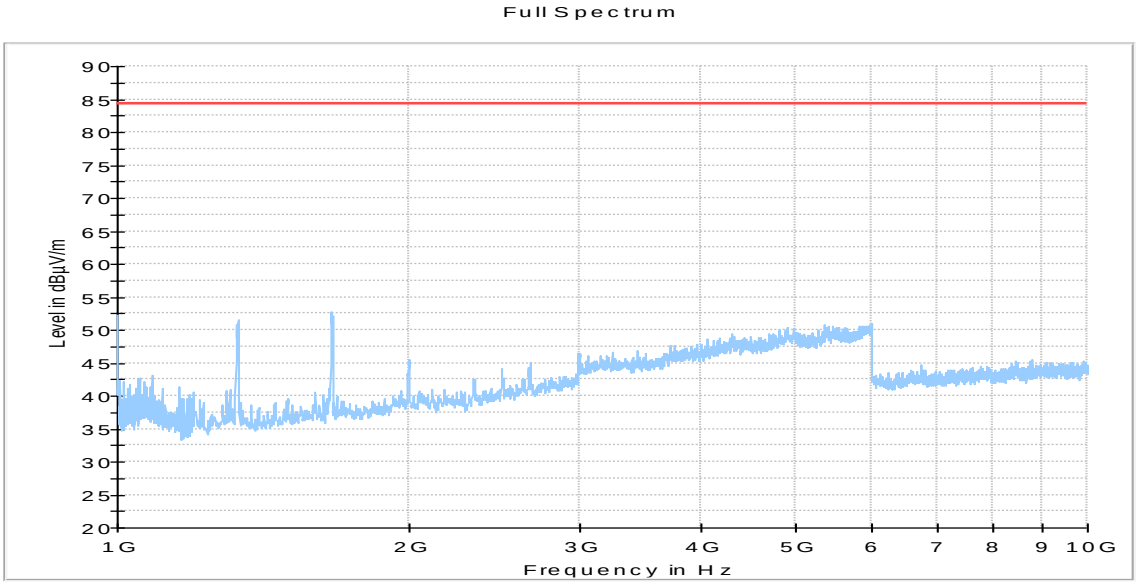
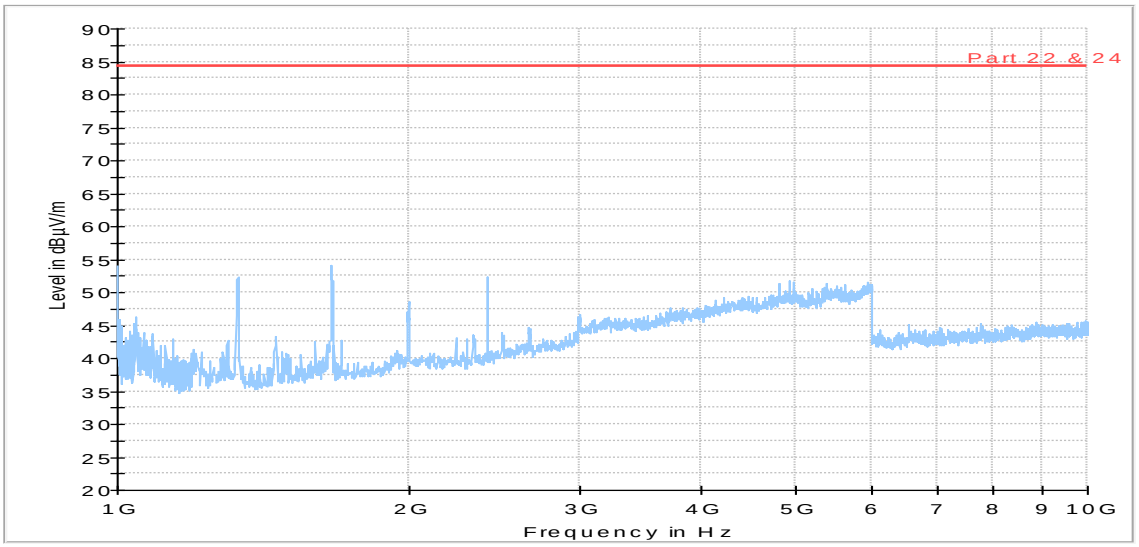
Ch. 4132



Ch. 4183



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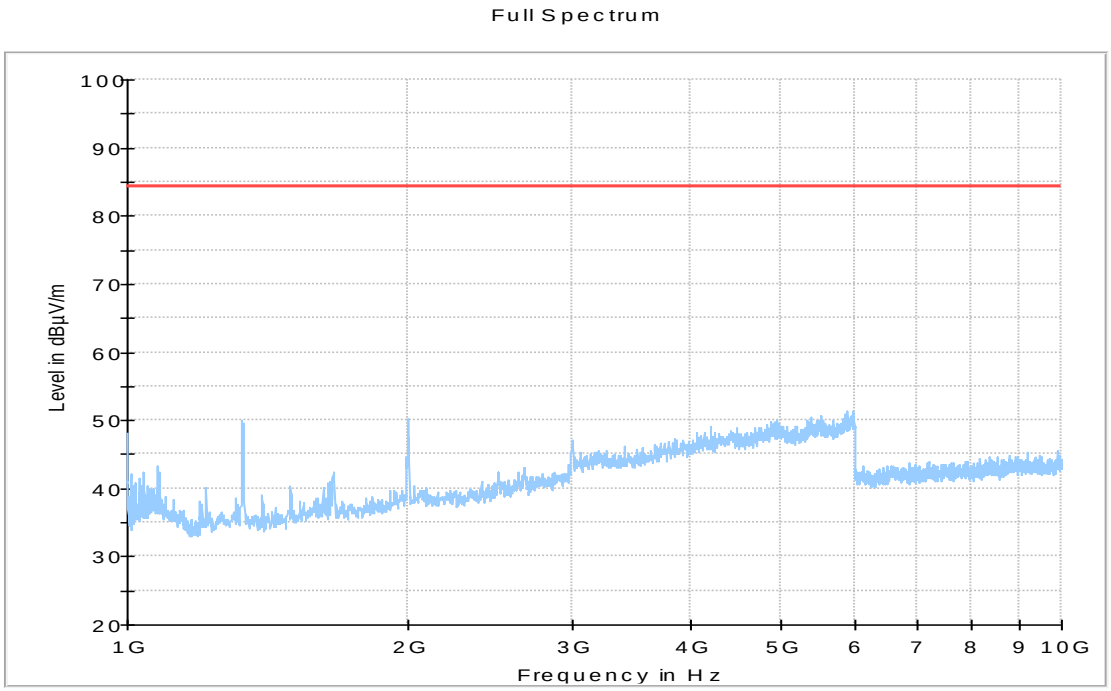
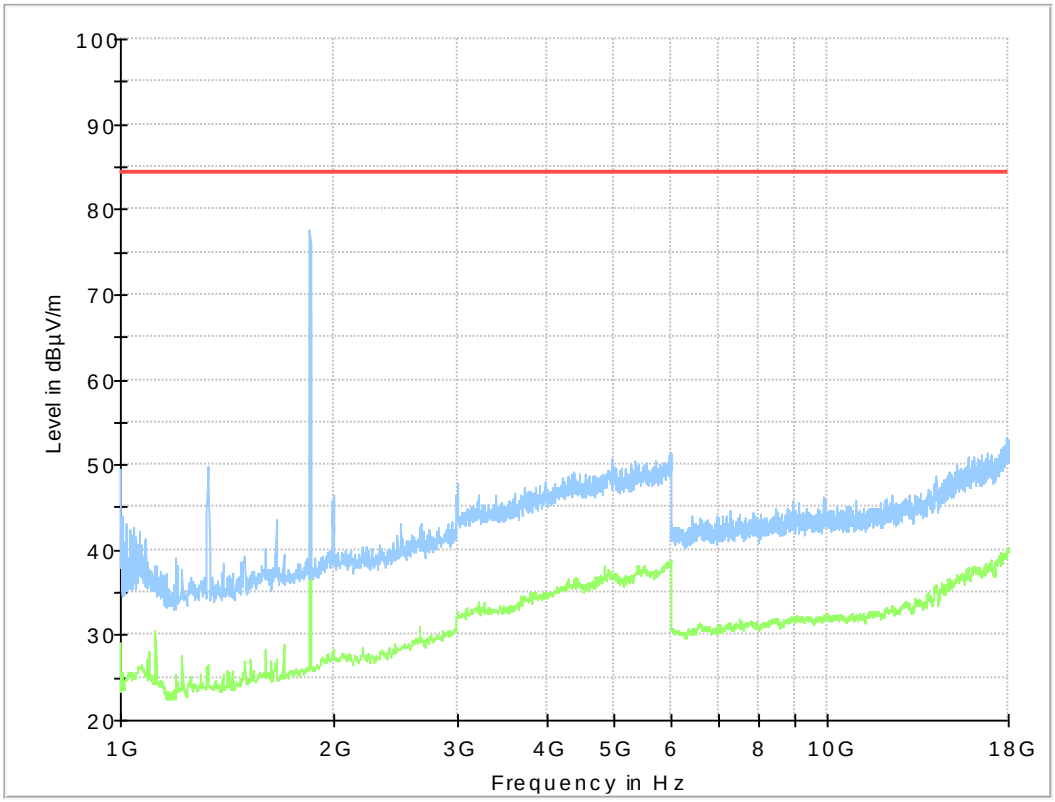
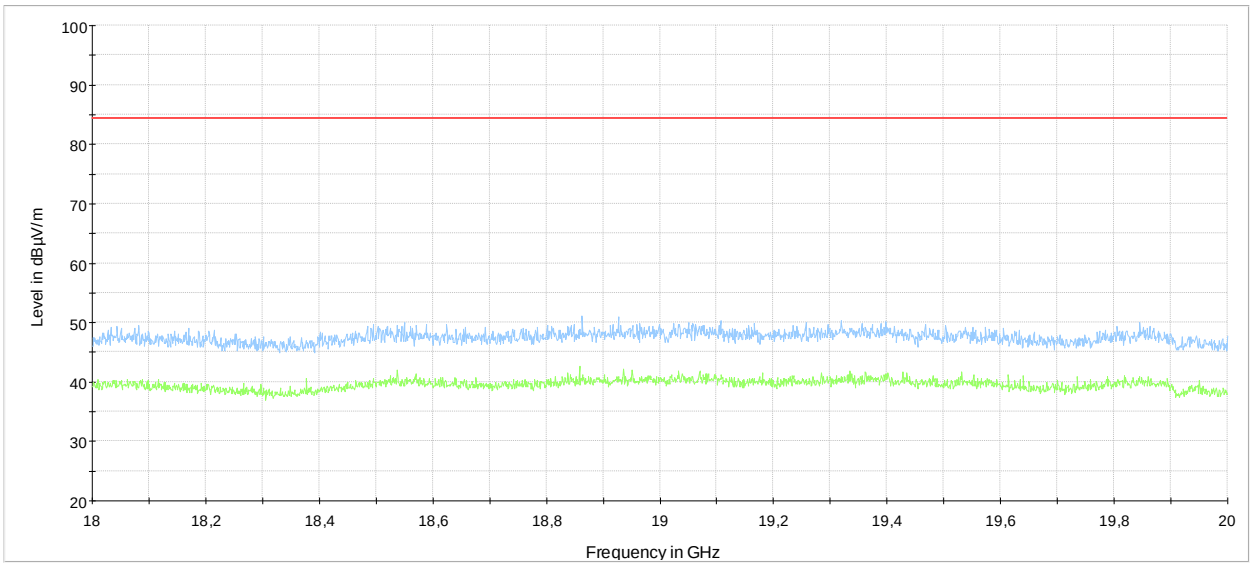
Ch. 4223



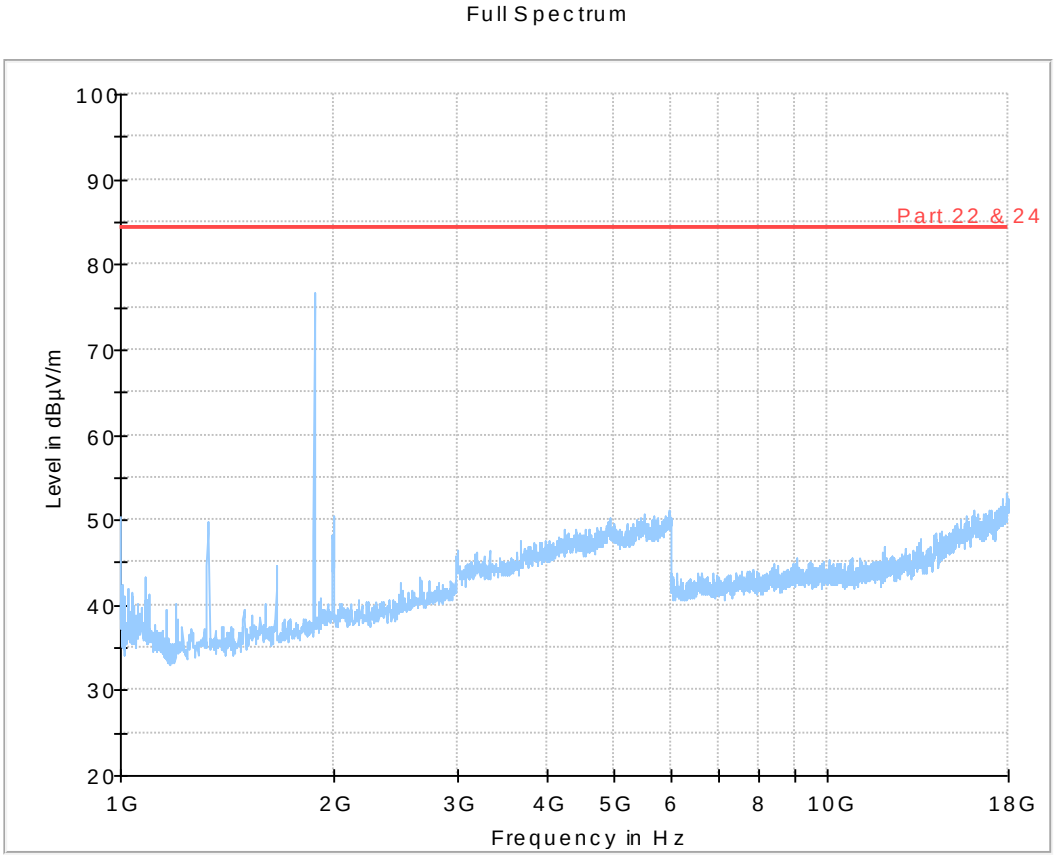
Ch. 92621



Ch. 92621



Ch. 9400



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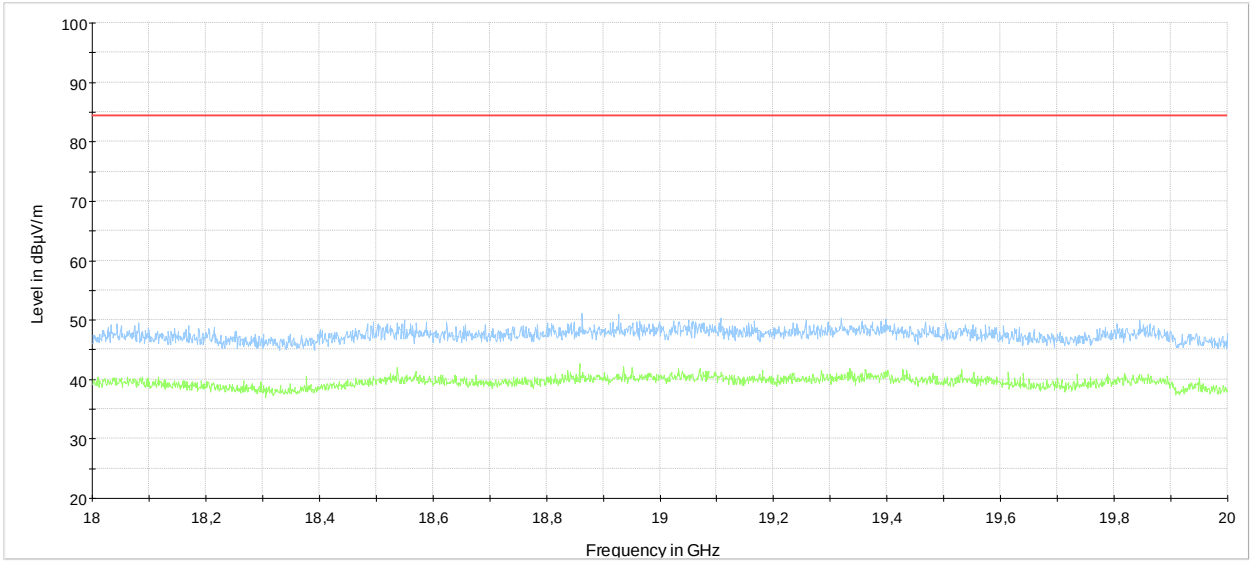
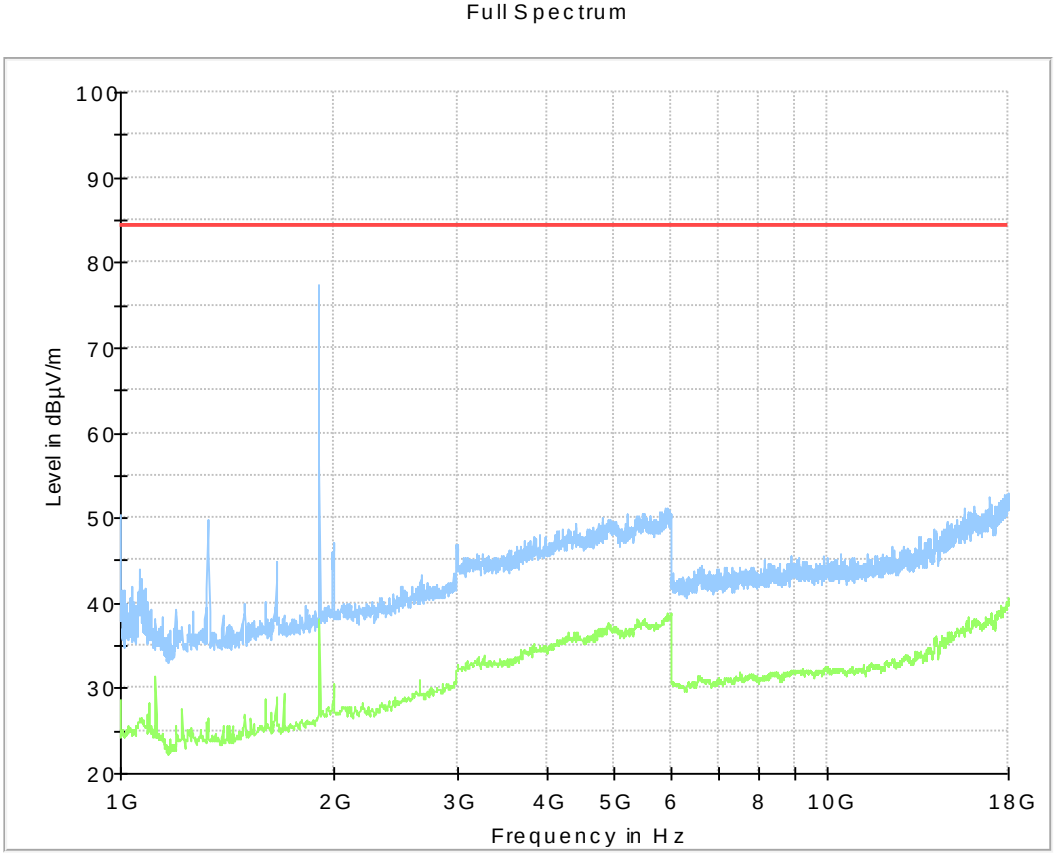
Ch. 9400



Ch.9538



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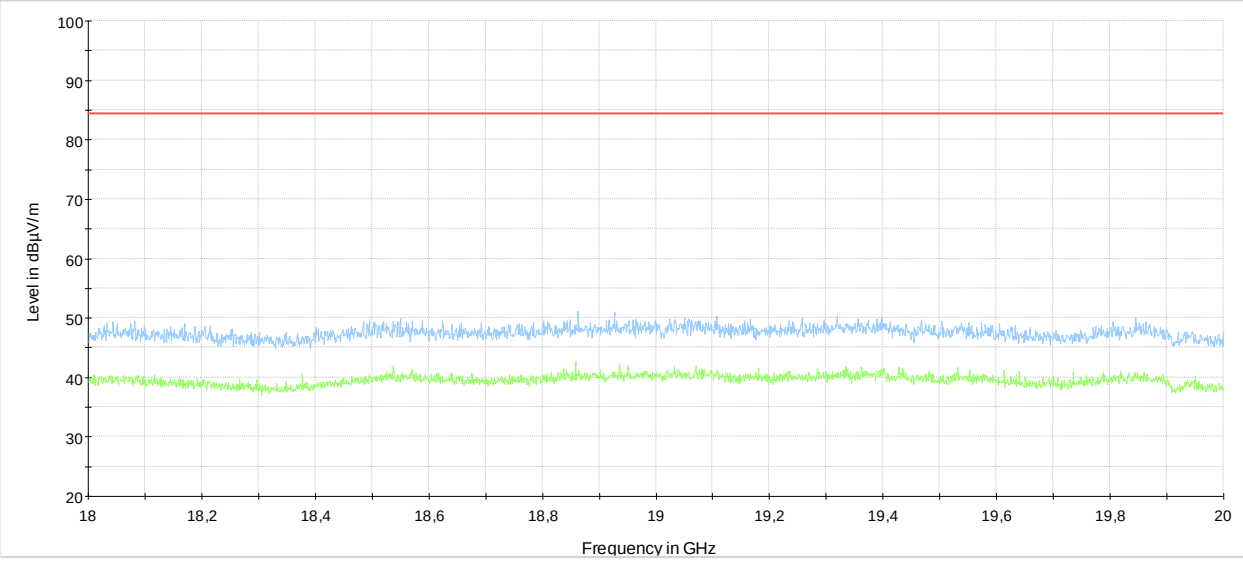
Ch.9538



No unwanted emissions were found within 20 dB from limit.
Therefore substitution measurements were not performed.

11.4 Test equipment

Measurement software	Rohde & Schwarz	EMC 32	--	--
Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESI	32291	7/2015
UltraLog antenna	Rohde & Schwarz	HL 562	30711	12/2014
Hornantenna	Rohde & Schwarz	HF907	32307	6/2015
Pre amplifier	Rohde & Schwarz	TS-PRE1	32306	7/2015
Switch unit	Rohde & Schwarz	OSP130	32300	7/2015
Switch unit	Rohde & Schwarz	OSP-F7-B	32301	--

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12 MODULATION CHARACTERISITICS

12.1 Requirement

Reference:

§2.1047 Measurements required: Modulation characteristics.
(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

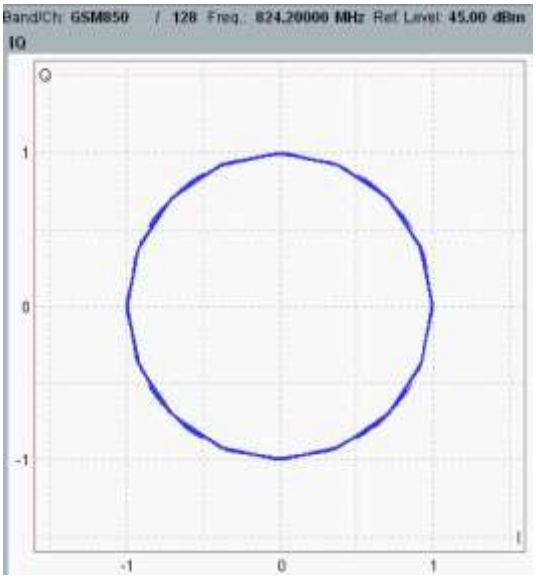
§22.357 Emission types.
Any authorized station in the Public Mobile Services may transmit emissions of any type(s) that comply with the applicable emission rule, *i.e.* §22.359, §22.861 or §22.917.

RSS-132 section 5.2 Types of Modulation
Equipment certified under this standard shall use digital modulation.

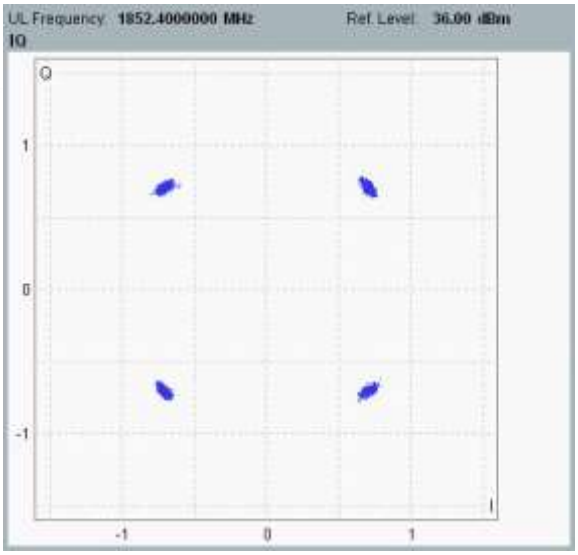
RSS-133 section 6.2 Types of Modulation
Equipment certified under this standard shall use digital modulation

12.2 Test data

Screenshots from communication tester



GMSK modulation



QPSK modulation

EUT uses digital modulation

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13 UNCERTAINTIES SUMMARY

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.
Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95% (k=2).

Radiated disturbance, field strength, 30 MHz - 1000 MHz	
30 to 300 MHz at 3 m	± 4,7 dB
200 to 1000 MHz at 3 m	± 4,8 dB
Radiated disturbance, field strength, 1 to 40 GHz in Semi Anechoic Chambers "Stora Hallen"and "Björkhallen"	
1 to 18 GHz with filter or attenuator	± 5,4 dB
1 to 18 GHz without filter or attenuator	± 5,2 dB
18 to 26 GHz without filter or attenuator	± 5,5 dB
Conducted disturbances at the antenna port on radio equipment	
Frequency range 9 kHz – 1 GHz	± 0,9 dB
Frequency range 1 GHz – 7 GHz	± 1,4 dB
Frequency range 7 GHz -18GHz	± 2,4 dB
Frequency range 18 GHz -26,5GHz	± 3,0 dB
Output power	
Digital signals, conducted	± 0,6 dB
Peak power density	
Conducted:	
Spectrum analyser	± 2,5 dB

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14 PHOTO OF THE EUT

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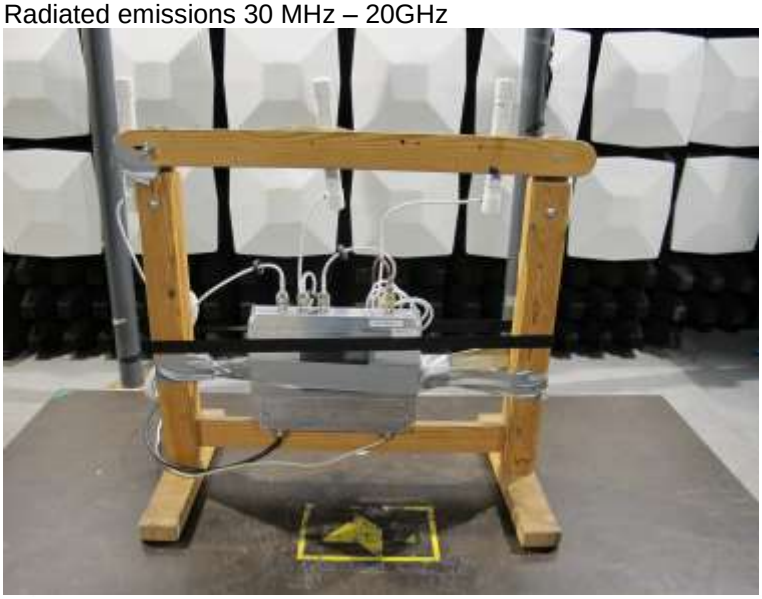
TEST SETUP PICTURES

Radiated emissions 30 MHz – 1GHz

Radiated emissions 30 MHz – 20GHz



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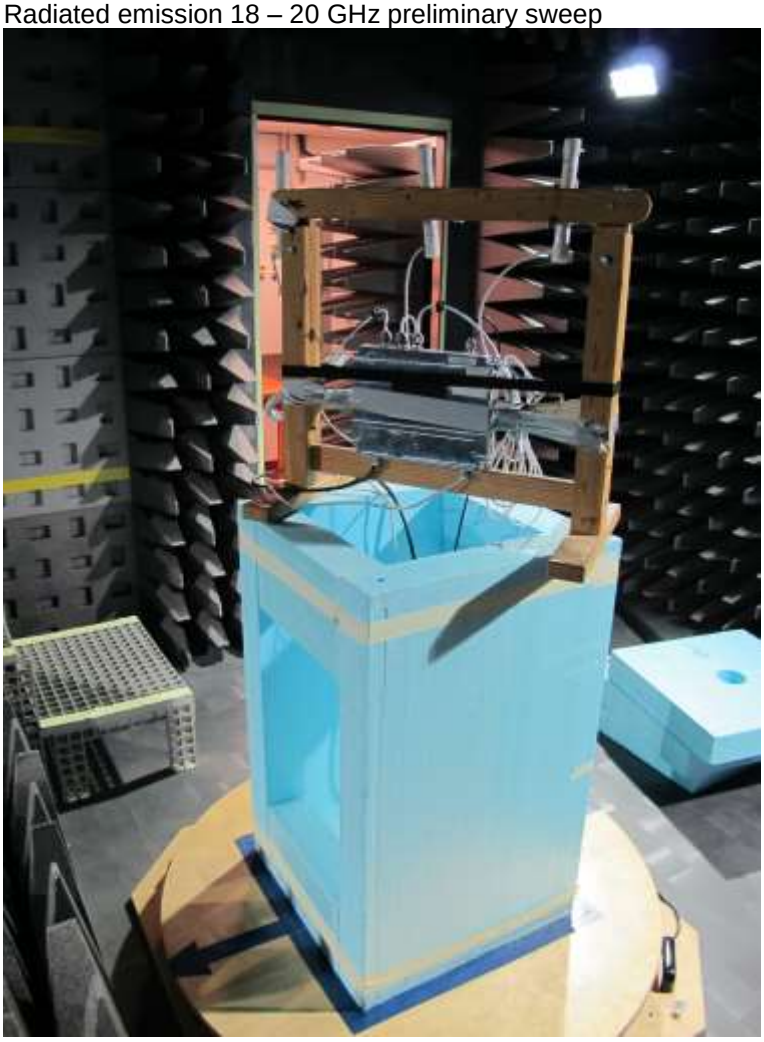
Radiated emission 1 – 18 GHz

Radiated emission 18 – 20 GHz preliminary sweep



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