



Connectivity to be trusted.

Spot Check Test

Report— part 2, part 22h, part 24e, part 27, part 90

V27SD-42

HW Build 0502



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1 ADMINISTRATIVE DATA

1.1 Identification of laboratory

Company name: Bittium Wireless Ltd
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Telephone: +358 40 344 2000
Responsible test lab
Manager: M.Sc.(EE) Mikko Miettinen

1.2 Identification of customer

Company name: Bittium Wireless Ltd
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90590 OULU
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Contact person: Tomi Latvasalo
Organizational items: Internal Customer

1.3 Organizational items

Laboratory manager: Mikko Miettinen
Test Engineer: Pekka Pulkkinen

2 TEST RESULTS

2.1 Summary of test results

Table 1 shows summary of test results. Detailed results for each test case are documented in Chapter 8 of this test report.

Test case	Frequency band	Setup	Result
FCC CFR47 part 2, 99% Occupied Bandwidth	LTE FDD Band 14	Conducted setup	PASS
FCC CFR47 part 2, Frequency stability	LTE FDD Band 14	Conducted setup	PASS
FCC CFR47 part 22, Conducted RF output power	GSM 850 / WCDMA FDD 5 / LTE FDD 5	Conducted setup	PASS
FCC CFR47 part 22, Band edge compliance	GSM 850 / WCDMA FDD 5 / LTE FDD 5	Conducted setup	PASS
FCC CFR47 part 22, Spurious emissions at antenna terminals	GSM 850 / WCDMA FDD 5 / LTE FDD 5	Conducted setup	PASS
FCC CFR47 part 22, Spurious radiated emissions –TX on (up to 10 th harm.)	GSM 850 / WCDMA FDD 5 / LTE FDD 5	Radiated setup	PASS
FCC CFR47 part 24, Conducted RF output power	GSM 1900 / WCDMA FDD 2 / LTE FDD 2	Conducted setup	PASS
FCC CFR47 part 24, Band edge compliance	GSM 1900 / WCDMA FDD 2 / LTE FDD 2	Conducted setup	PASS
FCC CFR47 part 24, Spurious emissions at antenna terminals	GSM 1900 / WCDMA FDD 2 / LTE FDD 2	Conducted setup	PASS
FCC CFR47 part 24, Spurious radiated emissions –TX on (up to 10 th harm.)	GSM 1900 / WCDMA FDD 2 / LTE FDD 2	Radiated setup	PASS

Test case	Frequency band	Setup	Result
FCC CFR47 part 27, Conducted RF output power	WCDMA FDD4 / LTE FDD 4	Conducted setup	PASS
FCC CFR47 part 27, Band edge compliance	WCDMA FDD4 / LTE FDD 4	Conducted setup	PASS
FCC CFR47 part 27, Spurious emissions at antenna terminals	WCDMA FDD4 / LTE FDD 4	Conducted setup	PASS
FCC CFR47 part 27, Spurious radiated emissions –TX on (up to 10 th harm.)	WCDMA FDD4 / LTE FDD 4	Radiated setup	PASS
FCC CFR47 part90, Maximum channel power	LTE FDD 14	Conducted setup	PASS
FCC CFR47 part90, Band edge compliance	LTE FDD 14	Conducted setup	PASS
FCC CFR47 part90, Spurious emissions at antenna terminals	LTE FDD 14	Conducted setup	PASS
FCC CFR47 part90, Spurious radiated emissions –TX on (up to 10 th harm.)	LTE FDD 14	Radiated setup	PASS

Table 1: Summary of test results

2.2 Validity of test results

The Test Results given in this report only relate to the EUT's listed in chapter 4.2.

2.3 Conclusion

Bittium EMC laboratory has verified that relevant test cases as presented above in the chapter 2.1, have been performed and final conclusion of results is PASS.



M.Sc.(EE) Mikko Miettinen
Bittium Ltd. HW laboratory manager



B.Sc. Pekka Pulkkinen
Specialist, EMC

3 TEST EQUIPMENT

Device	Manufacturer	Model	Calibration date / Calibration due date
EMC test receiver	Rohde Schwarz	ESR26	2015-10-31 / 2016-10-31
EMC-Chamber	ETS-Lindgren	3 Meter compact Anechoic Chamber 7m x 3m x 3m	
Bilog antenna	EMCO	3142D	
Horn antenna 1 – 18 GHz	EMCO	3115	
Horn antenna 18 – 26.5 GHz	Microwave vision Italy s.r.l	SGH1800-27	
Emission test software	Bittium	Agilent Vee tailor made	
Radio communication tester	Rohde Schwarz	CMU200	2016-02-10 / 2017-02-10
Radio Communication tester	Rohde Schwarz	CMW500	2016-03-10 / 2017-03-10
Radio communication tester	Anritsu	MT8820C	2016-05-26 / 2017-05-26
High Pass Filter	Wainwright	WHKX1.0/15G-12SS	
Turn device	Innco	DE3700-RH	
Antenna stand	ETS-Lindgren	TR-7 antenna stand	
Device controller	EMCO	EMCO Model 2090	
Directional coupler	Narda	4226-10	
Temperature chamber	Vötcsh	VT4004	
Power splitter	Mini-circuits	ZN2PD2-50-S+ (500- 5000MHz)	

Table 2: List of test equipment

4 Equipment under test

4.1 Identification of EUT

Manufacturer: Bittium Wireless Ltd.

Type Name: V27SD-42

Frequency bands: GSM 850/900/1800/1900, WCDMA FDD 1/FDD 2/ FDD 4/ FDD 5/FDD 8, LTE FDD 1 / FDD 2 / FDD 3 / FDD 4 / FDD 5 / FDD7 / FDD 8 / FDD 14 / FDD 20 / FDD 28

Notes: Photos of EUT's can be found at appendix chapter.

4.2 Identification of used Test Samples of EUT

EUT Id	Serial number	HW Version	SW Version
Rad_1	K0161603805	0502	5.6.5
Cond_2	K0161603808	0502	5.6.5
Cond_3	K0161603820	0502	5.6.5

Table 3: Used sample ID's

4.3 Identification of used accessories

Accessory ID	Description	Serial number	HW version	SW version
1	Celltech Li-Ion battery	N/A	Model 3700034	N/A

Table 4: Used accessories

5 APPLIED TEST STANDARDS

The equipment under test has been tested in Bittium EMC laboratory according to harmonized EMC standards listed in the table 5 below.

No.	Identity	Document title	Version / Date
1	FCC CFR47 part 2	Frequency allocations and radio treaty matters; general rules and regulations	Current
2	FCC CFR47 part 22	Public mobile services, Subpart H – Cellular Radiotelephone Service	Current
3	FCC CFR47 part 24	Personal communications services, Subpart E - Broadband PCS	Current
4	FCC CFR47 part 27	Miscellaneous wireless communications services, Subpart C – Technical standards	Current
5	FCC CFR47 part 90	Private land mobile radio services, Subpart I - General Technical Standards, Subpart S - Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, and 935-940 MHz Bands	Current
6	TIA-603-D	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	Revision D

Table 5: Applied test standards

6 Test Specifications

6.1 FCC part 2 and 22

6.1.1 RF power output §2.1046, §22.913

6.1.2 Spurious emissions at antenna terminals §2.1051, §22.917

6.1.3 Field strength of spurious radiation §2.1053, §22.917

Frequency band = 850, Mode = GSM, Channel = 128, Frequency = 824.2MHz

Frequency band = 850, Mode = GSM, Channel = 190, Frequency = 836.6MHz

Frequency band = 850, Mode = GSM, Channel = 251, Frequency = 848.8MHz

Frequency band = WCDMA FDD 5, Mode = WCDMA, Channel = 4132, Frequency = 826.4

Frequency band = WCDMA FDD 5, Mode = WCDMA, Channel = 4183, Frequency = 836.6MHz

Frequency band = WCDMA FDD 5, Mode = WCDMA, Channel = 4233, Frequency = 846.6MHz

Frequency band = LTE FDD 5, Mode = QPSK 5 MHz, Channel = 20425, Frequency = 826.5MHz

Frequency band = LTE FDD 5, Mode = QPSK 5 MHz, Channel = 20525, Frequency = 836.5MHz

Frequency band = LTE FDD 5, Mode = QPSK 5 MHz, Channel = 20625, Frequency = 846.5MHz

6.1.4 Band edge compliance §2.1053, §22.917

6.2 FCC part 2 and 24

6.2.1 RF power output §2.1046, §24.232

6.2.2 Spurious emissions at antenna terminals §2.1051, §24.238

6.2.3 Field strength of spurious radiation §2.1053, §24.238

Frequency band = 1900, Mode = GSM, Channel = 512, Frequency = 1850.2MHz

Frequency band = 1900, Mode = GSM, Channel = 661, Frequency = 1880MHz

Frequency band = 1900, Mode = GSM, Channel = 810, Frequency = 1909.8MHz

Frequency band = WCDMA FDD 2, Mode = WCDMA, Channel = 9262, Frequency = 1852.4MHz

Frequency band = WCDMA FDD 2, Mode = WCDMA, Channel = 9400, Frequency = 1880MHz

Frequency band = WCDMA FDD 2 Mode = WCDMA, Channel = 9538, Frequency = 1907.6MHz

Frequency band = LTE FDD 2, Mode = QPSK 5MHz, Channel = 18625, Frequency = 1852.5Hz

Frequency band = LTE FDD 2, Mode = QPSK 5MHz, Channel = 18900, Frequency = 1880MHz

Frequency band = LTE FDD 2, Mode = QPSK 5MHz, Channel = 19175, Frequency = 1907.5MHz

6.2.4 Band edge compliance §2.1053, §24.238

6.3 FCC part 2 and 27

6.3.1 RF power output §2.1046, §27.250

6.3.2 Spurious emissions at antenna terminals §2.1051, §27.53

6.3.3 Field strength of spurious radiation §2.1053, 27.53

Frequency band = WCDMA FDD 4, Channel = 19975, Frequency = 1712.4 MHz

Frequency band = WCDMA FDD 4, Channel = 1412, Frequency = 1732.4MHz

Frequency band = WCDMA FDD 4, Channel = 1513, Frequency = 1752.6MHz

Frequency band = LTE FDD 4, Mode = QPSK 5 MHz, Channel = 19975, Frequency = 1712.5 MHz

Frequency band = LTE FDD 4, Mode = QPSK 5 MHz, Channel = 20175, Frequency = 1732.5MHz

Frequency band = LTE FDD 4, Mode = QPSK 5 MHz, Channel = 20375, Frequency = 1752.5MHz

6.3.4 Band edge compliance §2.1053, §27.53

6.4 FCC part 2 and 90

6.4.1 Maximum Channel Power, §2.1046, §90.205 & §90.542

6.4.2 Occupied Bandwidth, §2.1046, §90.209

6.4.3 Frequency stability, §2.1055, §90.230

6.4.4 Spurious emissions at antenna terminals, §2.1051, §90.210 & §90.543

6.4.5 Radiated spurious emission, §2.1053, §90.210

Frequency band = LTE FDD 14, Mode = QPSK 5 MHz, Channel = 23305, Frequency = 790.5 MHz

Frequency band = LTE FDD 14, Mode = QPSK 5 MHz, Channel = 23330, Frequency = 793 MHz

Frequency band = LTE FDD 14, Mode = QPSK 5 MHz, Channel = 23355, Frequency = 795.5 MHz

6.4.6 Band edge compliance, §2.1053, §90.543

7 Test Setups

Photos of test setups can be found at appendix A.1.

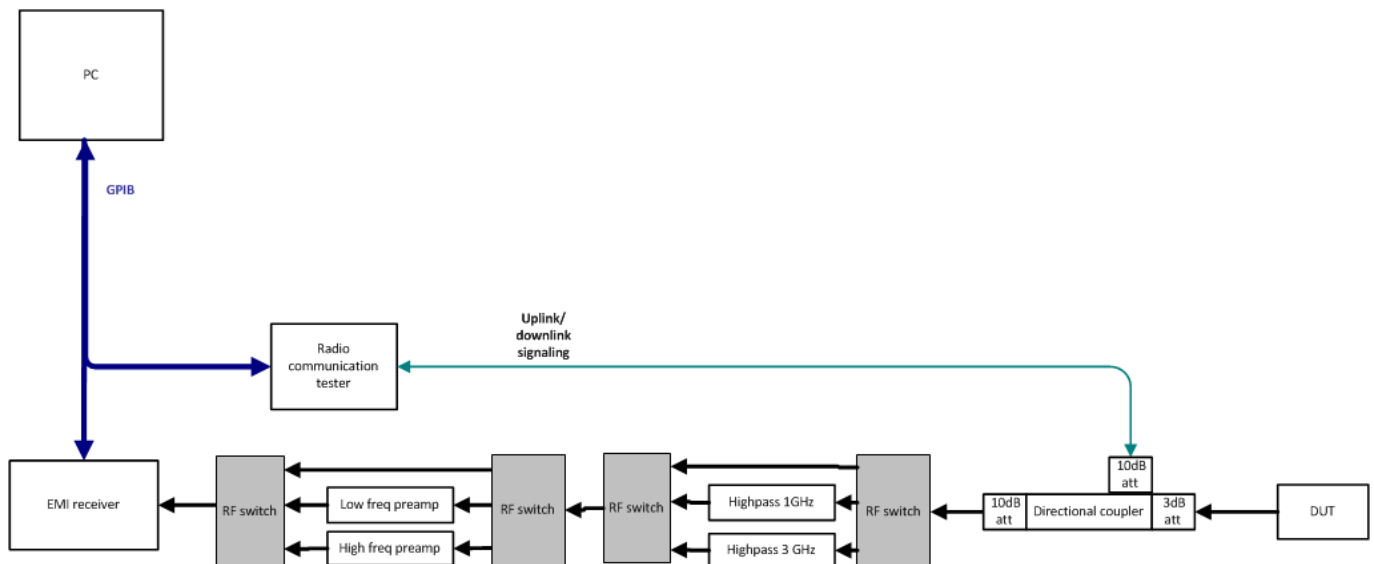
7.1 Conducted setup

Conducted measurements setup is represented at picture 1 below. All items of setup except PC, Radio communication tester and EMI receiver were inside shielded box. Temperature chamber VT4004 was used at Frequency stability at temperatures test.

EUT was placed inside shielded box and cable from directional coupler was connected to antenna connector. Active call was setup and maintained with radio communication tester. PC software controlled EMI receiver was used to perform all the measurements.

Total insertion losses were measured and used to correct readings from EMI receiver.

Conducted emissions test setup



Picture 1: Conducted setup

7.1.1 Conducted measurements test procedures

7.1.1.1 RF Output power

- 1) Conducted measurement setup was used
- 2) A call with maximum power level was established on a Traffic Channel between the EUT and Communication Tester.
- 3) The transmitted power of the EUT was recorded by using an EMI receiver.
- 4) RBW = 30 kHz, VBW = 300 kHz

7.1.1.2 Emission and occupied bandwidth

- 5) Conducted measurement setup was used
- 6) A call with maximum power level was established on a Traffic Channel between the EUT and Communication Tester.
- 7) Important EMI receiver settings:
 - a. RBW: >1% of the manufacturer stated occupied bandwidth
- 8) The maximum spectral level of the modulated signal was recorded as the reference.
- 9) The emission bandwidth is measured as follows: the furthest frequencies above and below the frequency of the maximum reference level where the spectrum is -26 dB down have to be found.
- 10) The occupied Bandwidth (99% bandwidth) is measured as follows: the occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 percent of the total mean power.

7.1.1.3 Spurious emissions at antenna terminals

- 1) Conducted measurement setup was used
- 2) A call with maximum power level was established on a Traffic Channel between the EUT and Communication Tester.
- 3) Important EMI receiver settings:
 - a. [RBW]
 - i. [1 kHz] from 9 kHz to 150 kHz
 - ii. [10 kHz] from 150 kHz to 30 MHz
 - iii. [100 kHz] from 30 MHz to 1 GHz
 - iv. [1 MHz] above 1 GHz to 10th harmonic of transmitting signal
 - b. Sweep time: depending on the transmitting signal, the span and the RBW
- 4) The spurious emissions peaks were measured in the frequency range 9 kHz to 10th harmonic of transmitting signal during the call was established. The amplitude of spurious emission which are attenuated more than 20 dB below the permissible value was not reported.

7.1.1.4 Frequency stability

- 1) The EUT was placed inside a temperature chamber
- 2) The EUT was coupled to a Communication tester
- 3) The EUT was powered by laboratory power supply via adapter at nominal supply voltage. A call was established on a Traffic channel between the EUT and The Communication tester. The frequency error of the EUT was recorded by using an internal measurement function of the Communication tester.
- 4) Supply voltage was reduced to battery operating end point and the frequency error of the EUT was recorded by using an internal measurement function of the Communication tester.
- 5) Supply voltage was set to nominal voltage.
- 6) The temperature chamber was cycled down/up to a certain temperature, starting with the EUT minimum temperature.
- 7) After the temperature was stabilized the EUT was switched on and a call was established on a Traffic channel between the EUT and The Communication tester. Mid channel was used and output power set to maximum.
- 8) The frequency error of the EUT was recorded by using an internal measurement function of the Communication tester one minute, five minutes and 10 minutes after call was established.
- 9) This measurement procedure was performed for temperature variation from -30°C to +50°C in increments of 10°C.

7.1.1.5 Band edge compliance

- 1) Conducted measurement setup was used
- 2) A call with maximum power level was established on a Traffic Channel between the EUT and Communication Tester.
- 3) EMI receiver settings:
 - a. RBW = VBW: 1% of occupied bandwidth

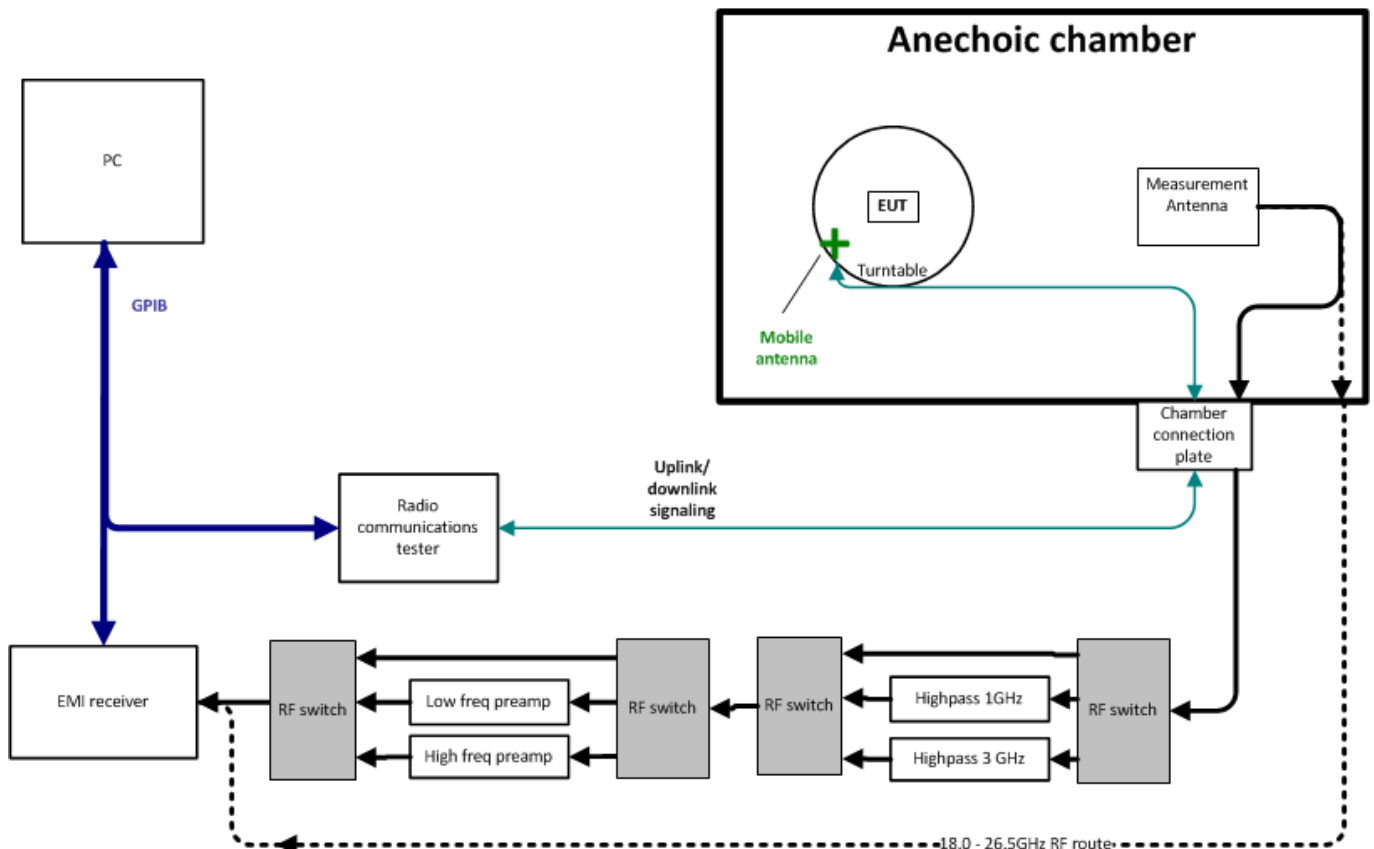
7.2 Radiated test setup

7.2.1 Description of test facilities

Radiated emissions tests were performed at full-anechoic chamber ETS-Lindgren's SpaceSaver 3 Meter compact Anechoic Chamber (Size 7m x 3m x 3m). At full-anechoic chamber absorbers are fitted to all four walls, ceiling and floor to attenuate all reflections of radiation. Turntable and antenna mast controller is EMCO2090.

Radiated measurements setup is presented at picture 2 below.

Radiated emissions test setup



Picture 2: Radiated spurious emissions setup

7.2.2 Radiated measurement test procedure

Measurements were done with both vertical and horizontal antenna polarization and all orientations (X, Y, Z) of EUT have been measured. Pre-sweep was performed at four turn table angles (0, 90, 180 and 270 degrees) and if peaks less than 20 dB margin occurs they were selected to final measurement.

The EUT was placed inside a full-anechoic chamber at non-conductive support height of 150cm. Height of measuring antenna is also 150cm. The EUT was coupled to a Communication Tester via signaling antenna. Refer to picture 2.

- 1) A call with maximum power level was established on a Traffic Channel between the EUT and Communication Tester.
- 2) A pre-calibration procedure was used so the readings from EMI receiver are corrected and represent directly the equivalent power.
- 3) All spurious radiation measurements were made from 30 MHz to 10th harmonic of transmit frequency. The frequency range from 9 kHz to 30 MHz has been examined during the conducted spurious emission measurements.
- 4) Important EMI receiver settings
 - a) [RBW/VBW]
 - i. [100 kHz / 300 kHz] from 30 MHz to 1 GHz
 - ii. [1 MHz / 3MHz] above 1GHz
 - Sweep time: Depending on the transmitting signal, the span and the RBW
- 5) After this initial test, final test according to TIA-603-D 2.2.12 Unwanted Emissions is performed on signals which are identified as being close to limit.

8 DETAILED TEST RESULTS

8.1 FCC Part 2 and 22

8.1.1 RF power output §2.1046, §22.913

Result: Passed

Setup: Conducted setup, Cond_2 EUT

Test specification FCC part 2 and part 22

V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 12 (GSM 850 and WCDMA FDD5)

MDE_ELEKT_1502_FCCh, page 11 (LTE FDD5)

Note: Testing has been done according to KDB 971168 D01.

Equation for determining the EIRP is: $EIRP = P_{Meas} + G_T - L_C$

Where P_{Meas} = measured transmitter output power (dBm)

G_T = gain of the transmitting antenna (dBi)

L_C = signal attenuation in the connecting cable between the transmitter and antenna (negligible)

G_T used to calculate EIRP for GSM/EDGE 850, WCDMA FDD5 and LTE FDD5 is -3.5dBi.

Band	Mode	Channel	Frequency (MHz)	Peak Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
850	GSM	Low	824.2	32.77	40.6	29.27	PASS
		Mid	836.6	32.94	40.6	29.44	PASS
		High	846.6	32.83	40.6	29.33	PASS
850	EDGE	Low	858.2	30.92	40.6	27.42	PASS
		Mid	869.4	30.95	40.6	27.45	PASS
		High	880.6	30.64	40.6	27.14	PASS

Table 6: Detailed results GSM/EDGE 850

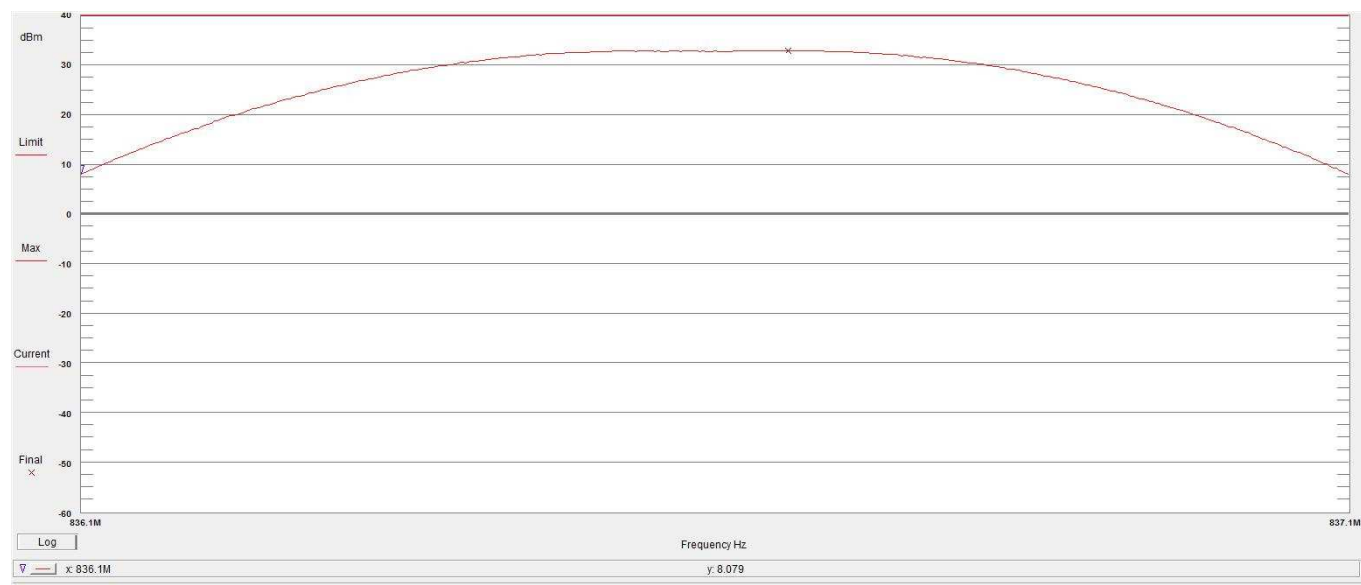
Band	Mode	Channel	Frequency (MHz)	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
FDD 5	WCDMA	Low	826.4	24.2	40.6	20.7	PASS
		Mid	836.6	24.3	40.6	20.8	PASS
		High	846.6	24.3	40.6	20.8	PASS

Table 7: Detailed results WCDMA FDD 5

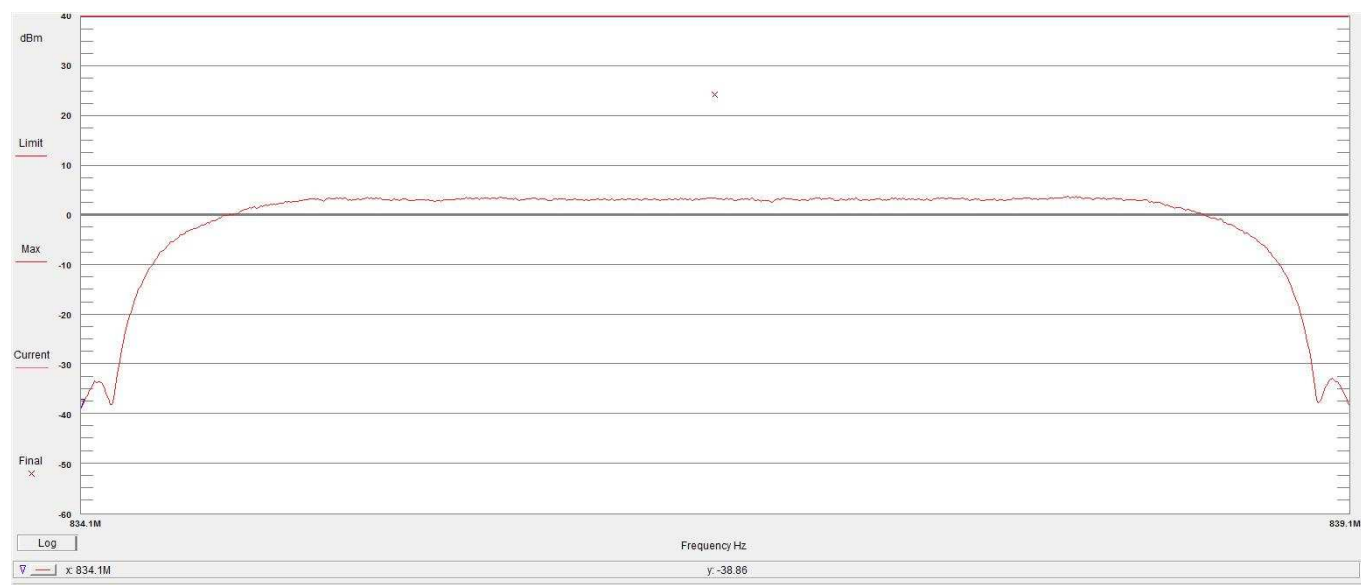
Band	Bandwidth	Channel	Modulation	RB	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
LTE FDD 5	1.4 MHz	20425	QPSK	1	22.85	40.6	19.35	PASS
			QPSK	3	22.9	40.6	19.4	PASS
			QPSK	6	21.88	40.6	18.38	PASS
			16QAM	1	22.06	40.6	18.56	PASS
			16QAM	6	20.94	40.6	17.44	PASS
		20525	QPSK	1	23.14	40.6	19.64	PASS
			QPSK	3	23.3	40.6	19.8	PASS
			QPSK	6	22.3	40.6	18.8	PASS
			16QAM	1	22.04	40.6	18.54	PASS
			16QAM	6	21.18	40.6	17.68	PASS
		20625	QPSK	1	23.37	40.6	19.87	PASS
			QPSK	3	23.4	40.6	19.9	PASS
			QPSK	6	22.3	40.6	18.8	PASS
			16QAM	1	22.16	40.6	18.66	PASS
			16QAM	6	21.2	40.6	17.7	PASS
LTE FDD 5	3 MHz	20425	QPSK	1	22.92	40.6	19.42	PASS
			QPSK	15	21.77	40.6	18.27	PASS
			16QAM	1	22.07	40.6	18.57	PASS
			16QAM	15	20.85	40.6	17.35	PASS
		20525	QPSK	1	23.22	40.6	19.72	PASS
			QPSK	15	22.24	40.6	18.74	PASS
			16QAM	1	22.04	40.6	18.54	PASS
			16QAM	15	21.21	40.6	17.71	PASS
		20625	QPSK	1	23.42	40.6	19.92	PASS
			QPSK	15	22.25	40.6	18.75	PASS
LTE FDD 5	5 MHz	20425	16QAM	1	22.07	40.6	18.57	PASS
			16QAM	15	21.21	40.6	17.71	PASS
LTE FDD 5	5 MHz	20425	QPSK	1	22.78	40.6	19.28	PASS

Band	Bandwidth	Channel	Modulation	RB	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
			QPSK	12	21.8	40.6	18.3	PASS
			QPSK	25	21.77	40.6	18.27	PASS
			16QAM	1	22.04	40.6	18.54	PASS
			16QAM	25	20.83	40.6	17.33	PASS
		20525	QPSK	1	23.4	40.6	19.9	PASS
			QPSK	12	22.3	40.6	18.8	PASS
			QPSK	25	22.34	40.6	18.84	PASS
			16QAM	1	22.18	40.6	18.68	PASS
			16QAM	25	21.27	40.6	17.77	PASS
		20625	QPSK	1	23.35	40.6	19.85	PASS
			QPSK	12	22.28	40.6	18.78	PASS
			QPSK	25	22.3	40.6	18.8	PASS
			16QAM	1	22.21	40.6	18.71	PASS
			16QAM	25	21.28	40.6	17.78	PASS
LTE FDD 5	10 MHz	20425	QPSK	1	23.06	40.6	19.56	PASS
			QPSK	25	22.13	40.6	18.63	PASS
			16QAM	1	22.09	40.6	18.59	PASS
			16QAM	25	21.21	40.6	17.71	PASS
		20525	QPSK	1	23.21	40.6	19.71	PASS
			QPSK	50	22.27	40.6	18.77	PASS
			16QAM	1	22.02	40.6	18.52	PASS
			16QAM	50	21.19	40.6	17.69	PASS
		20625	QPSK	1	23.38	40.6	19.88	PASS
			QPSK	50	22.24	40.6	18.74	PASS
			16QAM	1	22.07	40.6	18.57	PASS
			16QAM	50	21.21	40.6	17.71	PASS

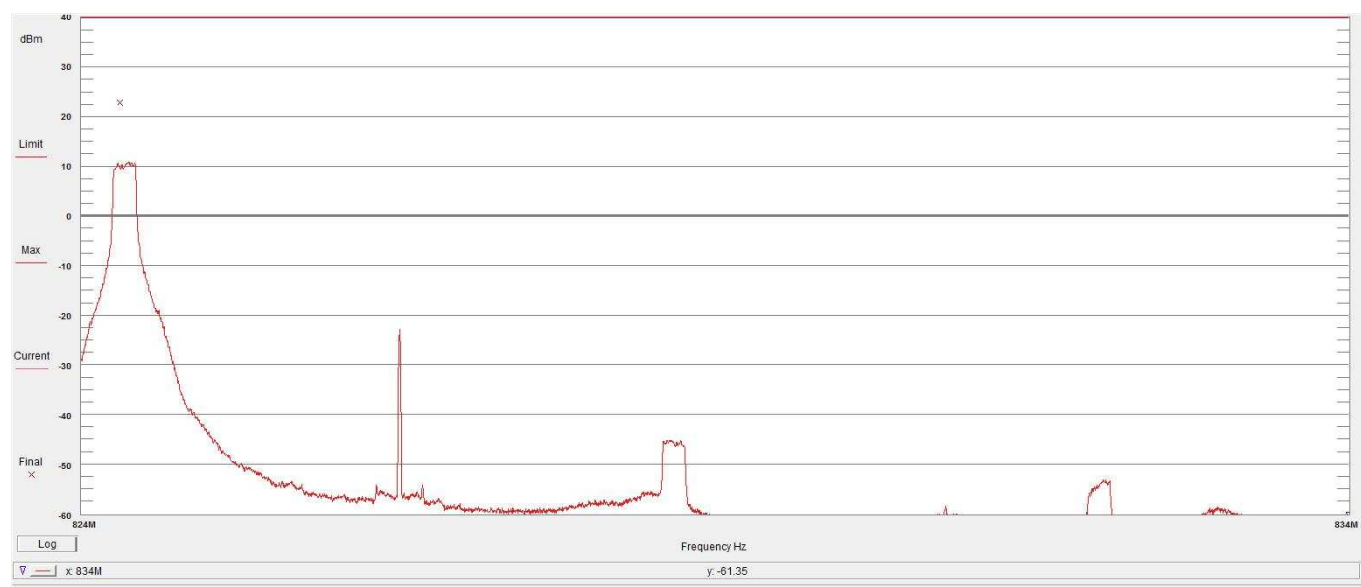
Table 8: Detailed results LTE FDD 5



Picture 3: GSM 850 Output power measurement, Ch128 (824.2MHz), RBW 300 kHz, VBW 300 kHz



Picture 4: WCDMA FDD 5, Output power measurement, Ch4183 (836.6 MHz), RBW 30 kHz, VBW 300 kHz



Picture 5: LTE FDD 5, Output power measurement, Ch20425 (826.5 MHz), 1 RB, RBW 30 KHz, VBW 300 kHz

8.1.2 Spurious emissions at antenna terminals §2.1051, §22.917

Result: Passed. With WCDMA FDD 5 and LTE FDD 5 band there were no peaks with a margin less than 30 dB

Setup: Conducted setup, Cond_2 EUT

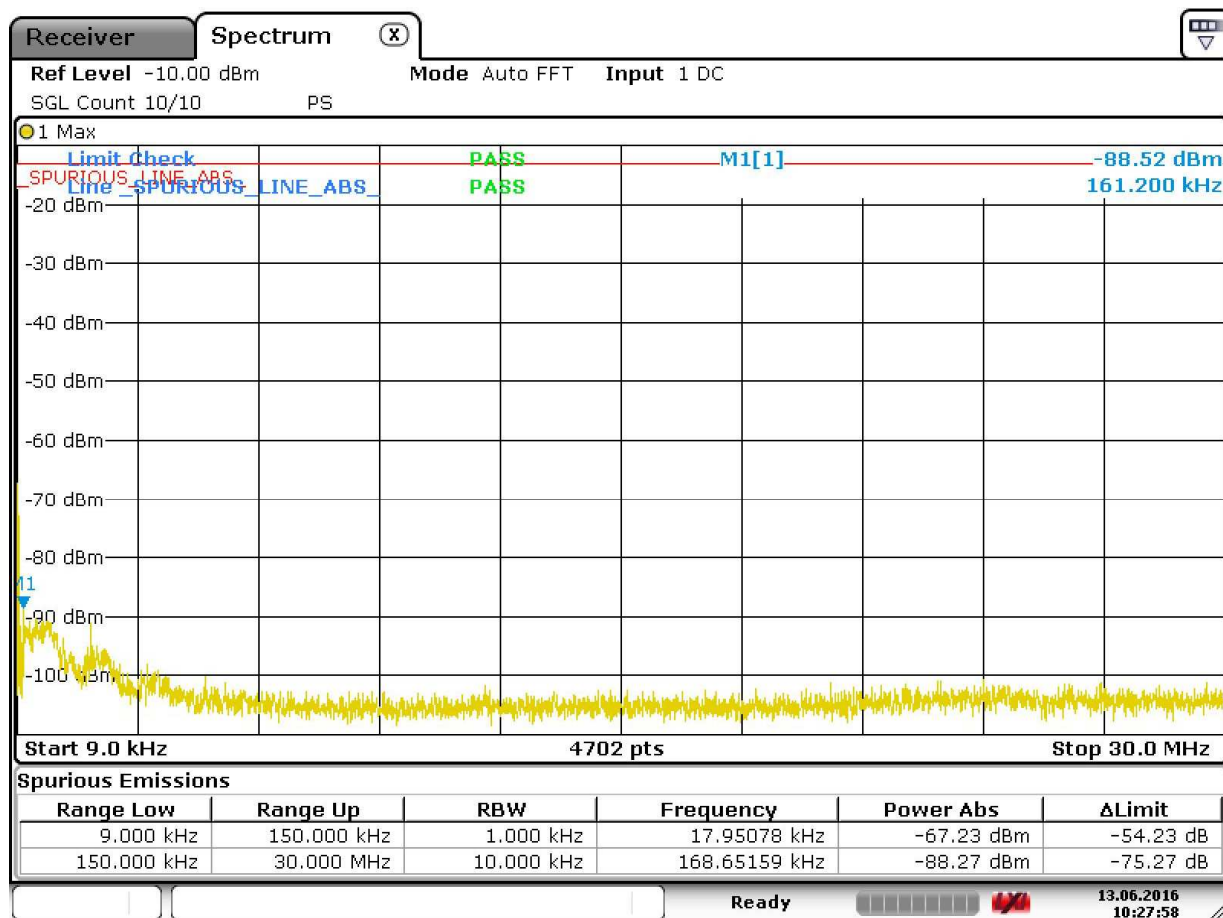
Test specification FCC part 2 and part 22

V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 25 (GSM 850 and WCDMA FDD5)

MDE_ELEKT_1502_FCCh, page 15 (LTE FDD5)

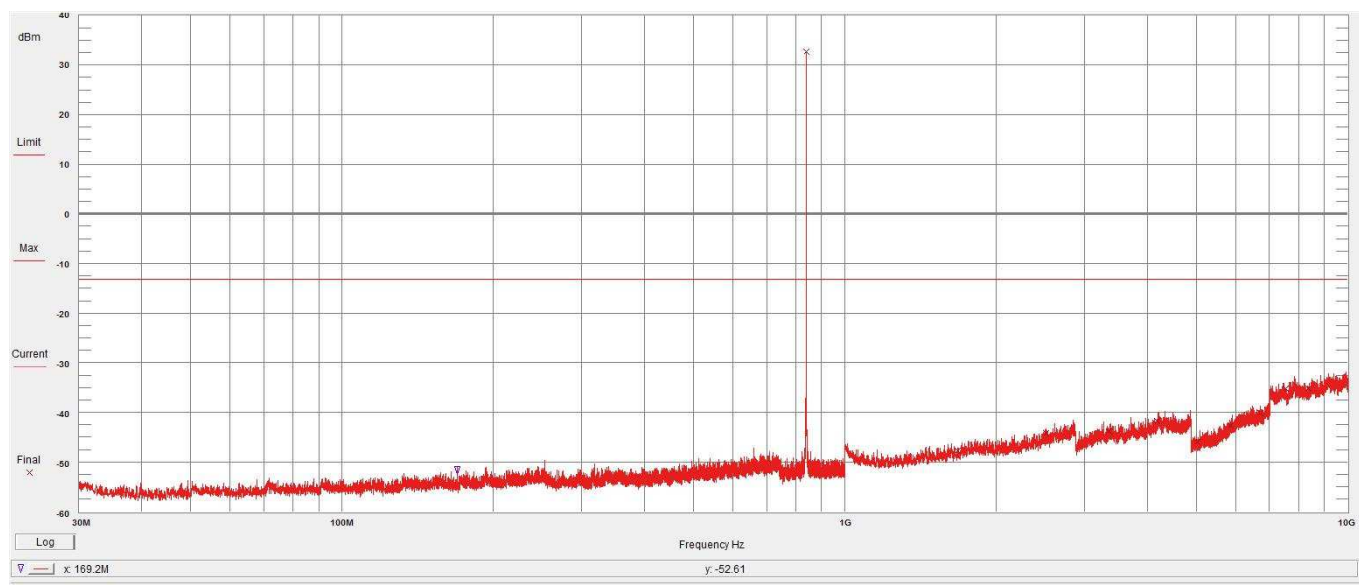
Band	Mode	Channel	Detector	Frequency	Peak value	FCC limit	Margin	Verdict
850	GSM	128	Peak	8242 MHz	-34.6 dBm	-13 dBm	-21.6 dB	PASS
850	GSM	190	Peak	7529.4 MHz	-35.2 dBm	-13 dBm	-22.2 dB	PASS
850	GSM	251	Peak	8488 MHz	-34.4 dBm	-13 dBm	-21.4 dB	PASS

Table 9: Detailed results GSM 850, Spurious emissions at antenna terminals

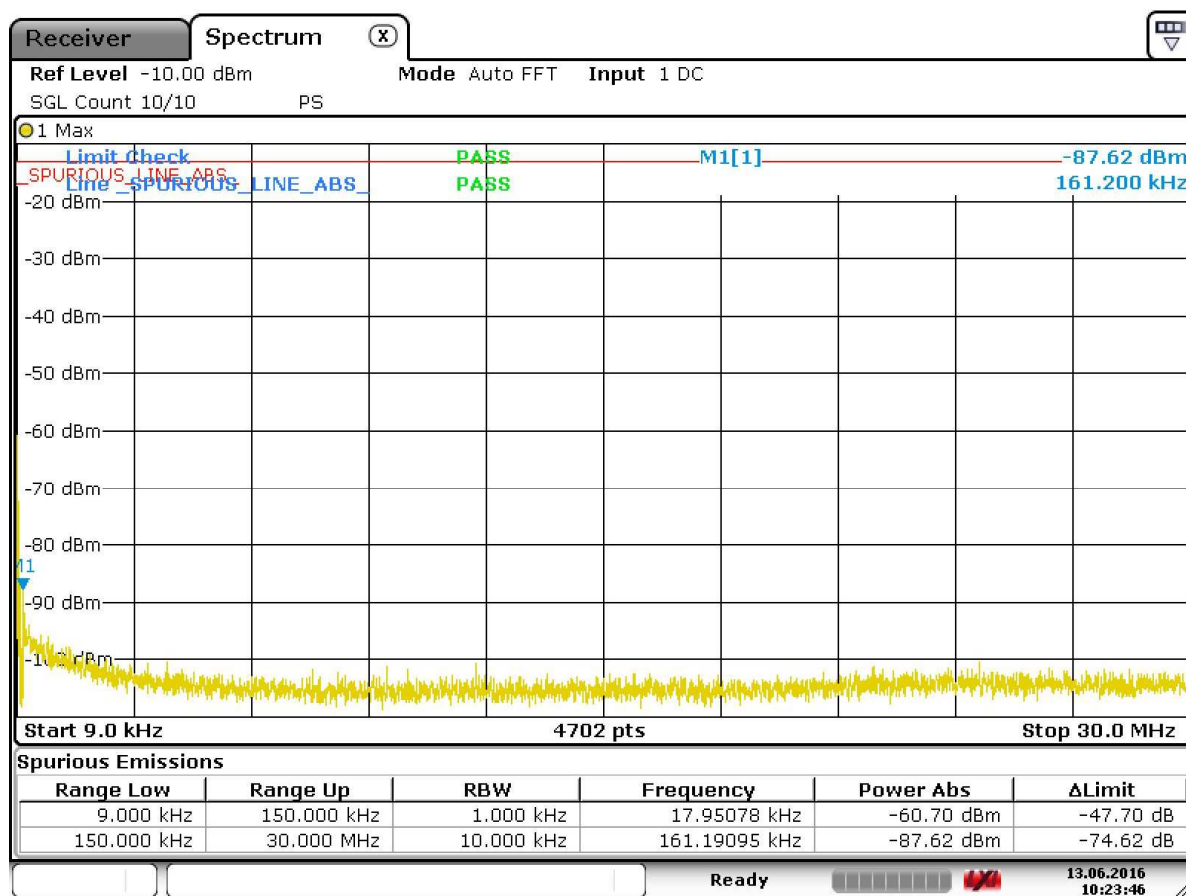


Date: 13.JUN.2016 10:27:58

Picture 6: GSM850, Ch. 190, Spurious emissions at antenna terminals 9kHz – 30 MHz

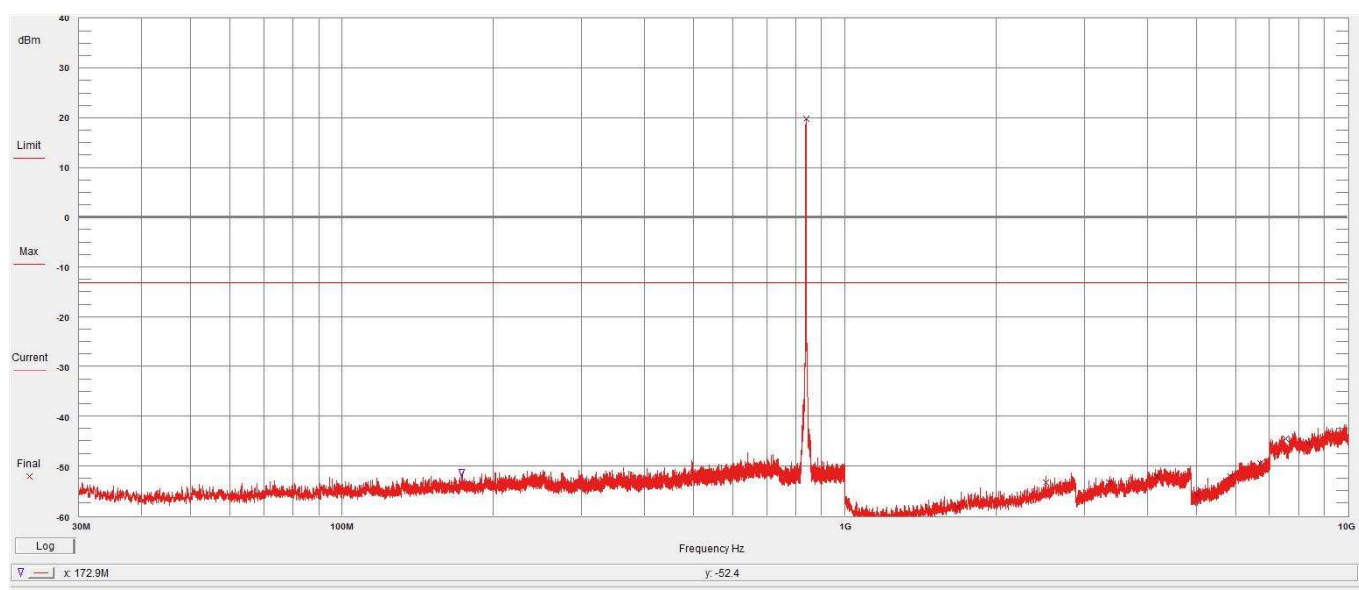


Picture 7: GSM850, Ch. 190, Spurious emissions at antenna terminals 30 MHz – 10 GHz. Peak at 836.6 MHz is fundamental, RBW 100 kHz, VBW 300 kHz (freq<1GHz), RBW 1MHz, VBW 3MHz (freq >1 GHz)

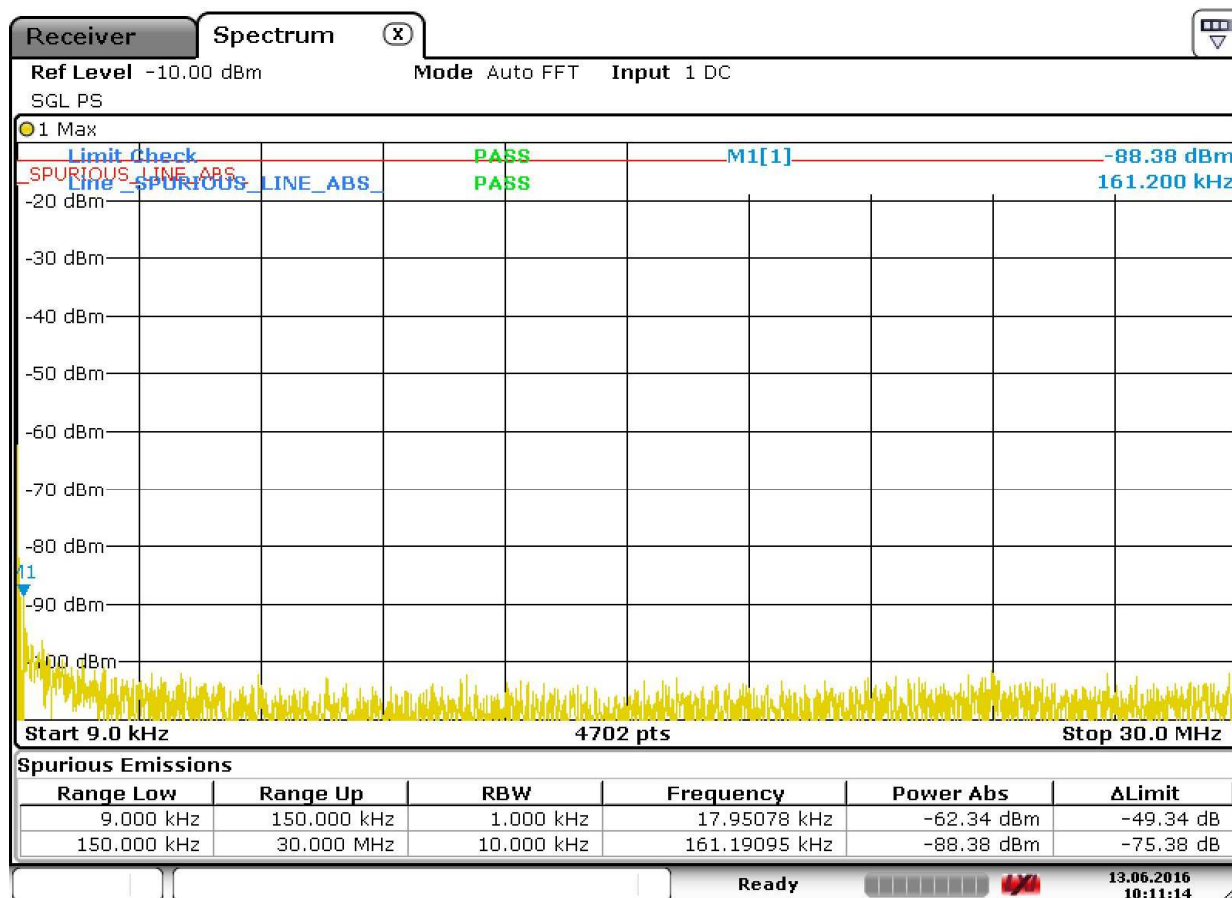


Date: 13.JUN.2016 10:23:46

Picture 8: WCDMA FDD 5, Ch4183, Spurious emissions at antenna terminals 9kHz – 30 MHz

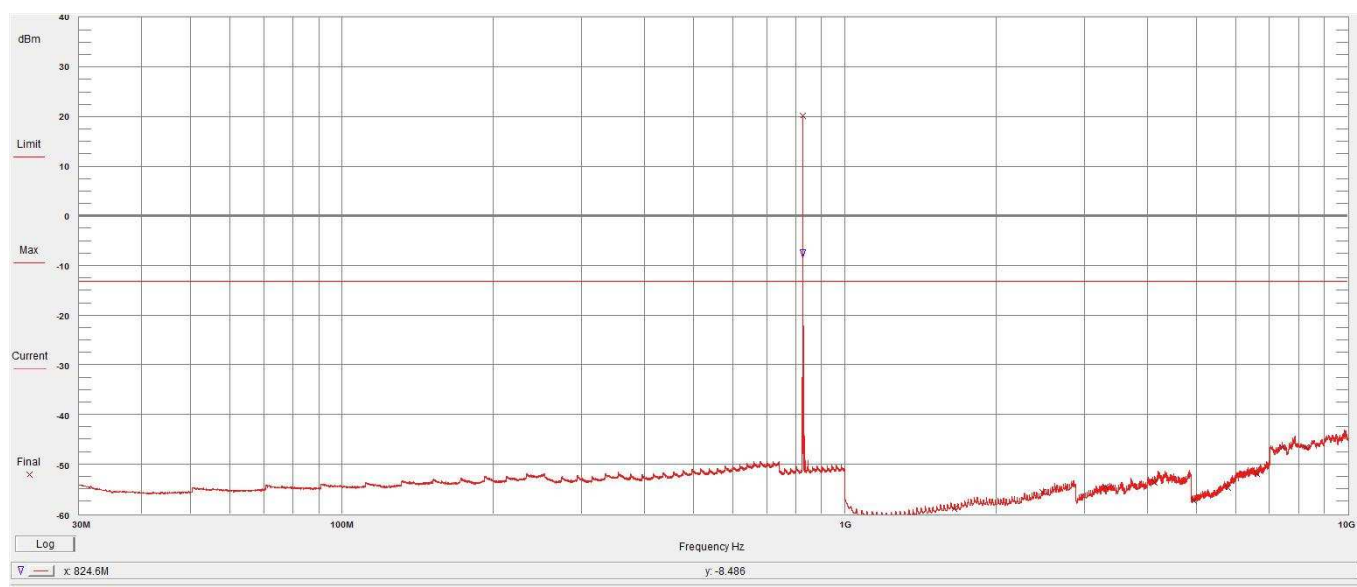


Picture 9: WCDMA FDD 5, Ch4183, Spurious emissions at antenna terminals 30 MHz – 10 GHz. Peak at 836.6 MHz is fundamental, RBW 100 kHz, VBW 300 kHz (freq<1GHz), RBW 1MHz, VBW 3MHz (freq >1 GHz)



Date: 13.JUN.2016 10:11:15

Picture 10: LTE FDD 5, Ch. 20525, BW 5 MHz, 1 RB, Spurious emissions at antenna terminals 9kHz – 30 MHz



Picture 11: LTE FDD 5, Ch. 20525, BW 5 MHz, 1 RB, Spurious emissions at antenna terminals 30 MHz – 10 GHz. Peak at 836.5 MHz is fundamental, RBW 100 kHz, VBW 300 kHz (freq<1GHz), RBW 1MHz, VBW 3MHz (freq >1 GHz).

8.1.3 Field strength of spurious radiation §2.1053, §22.917

Result: Passed, at pre-tests there were no peaks with a margin less than 20 dB with all measured channels (low, mid, high)

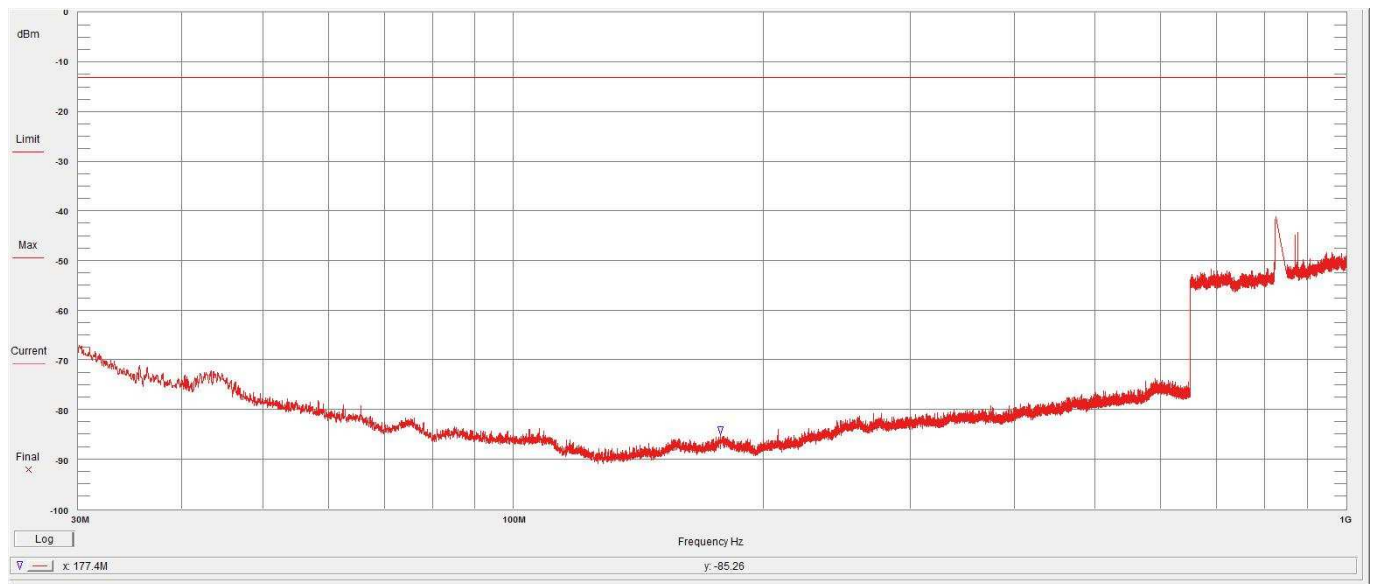
Setup: Radiated pre-test setup, Rad_1 EUT

Test specification FCC part 2 and part 22

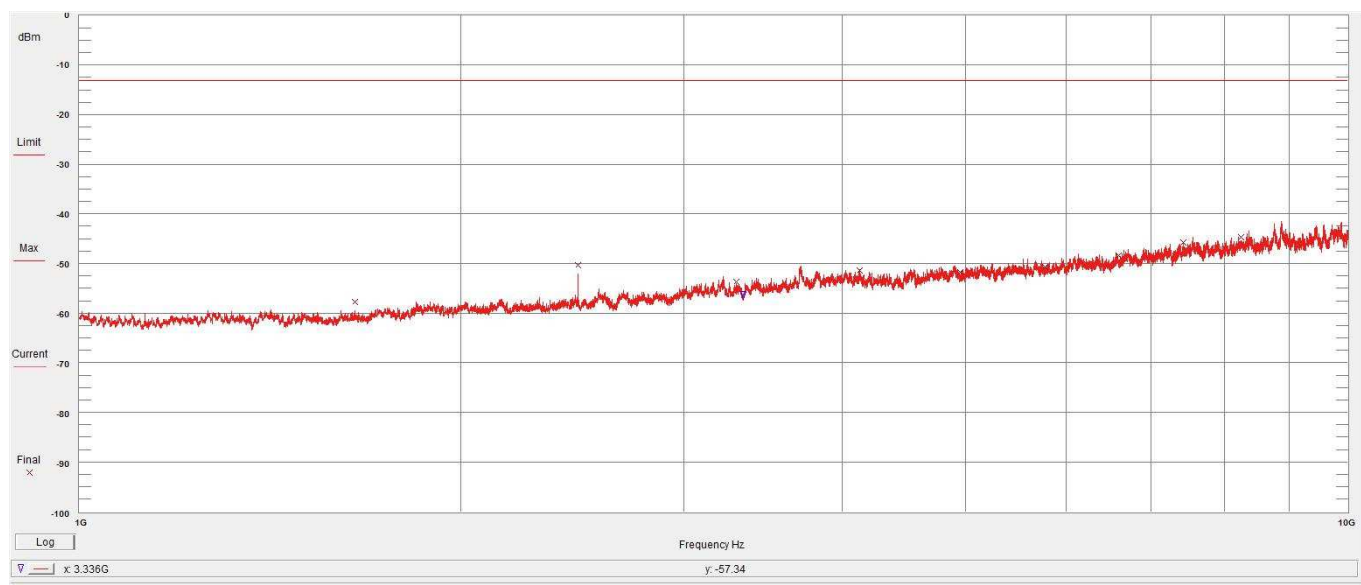
V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 27 (GSM 850 and WCDMA FDD 5)

MDE_ELEKT_1502_FCCh, page 16 (LTE FDD5)

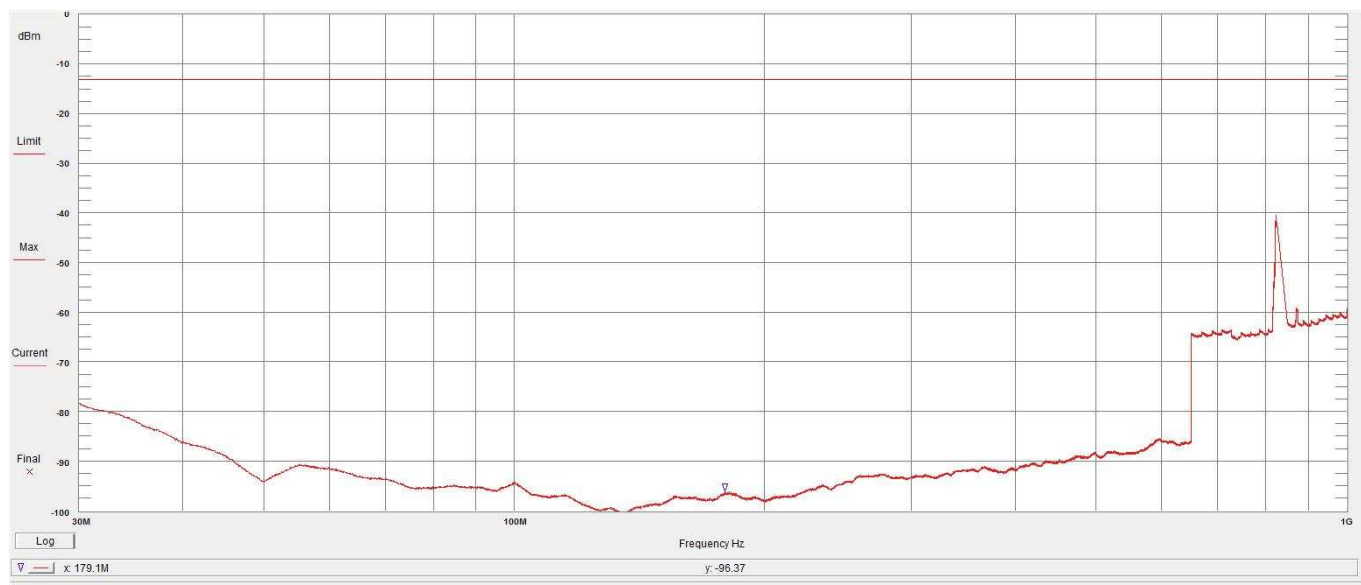
Limit = $43 + \log_{10}(P) = -13\text{dBm}$



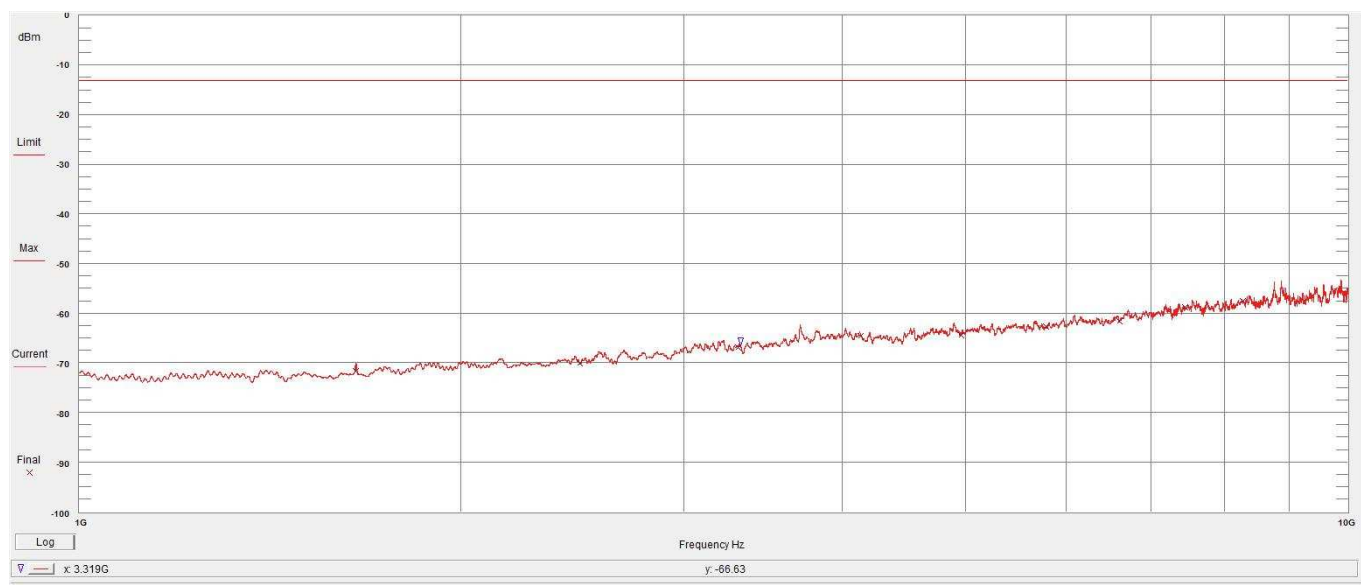
Picture 12: Field strength of spurious radiation, GSM 850, ch128, 30 – 1000 MHz, RBW 100 kHz, VBW 300 kHz.



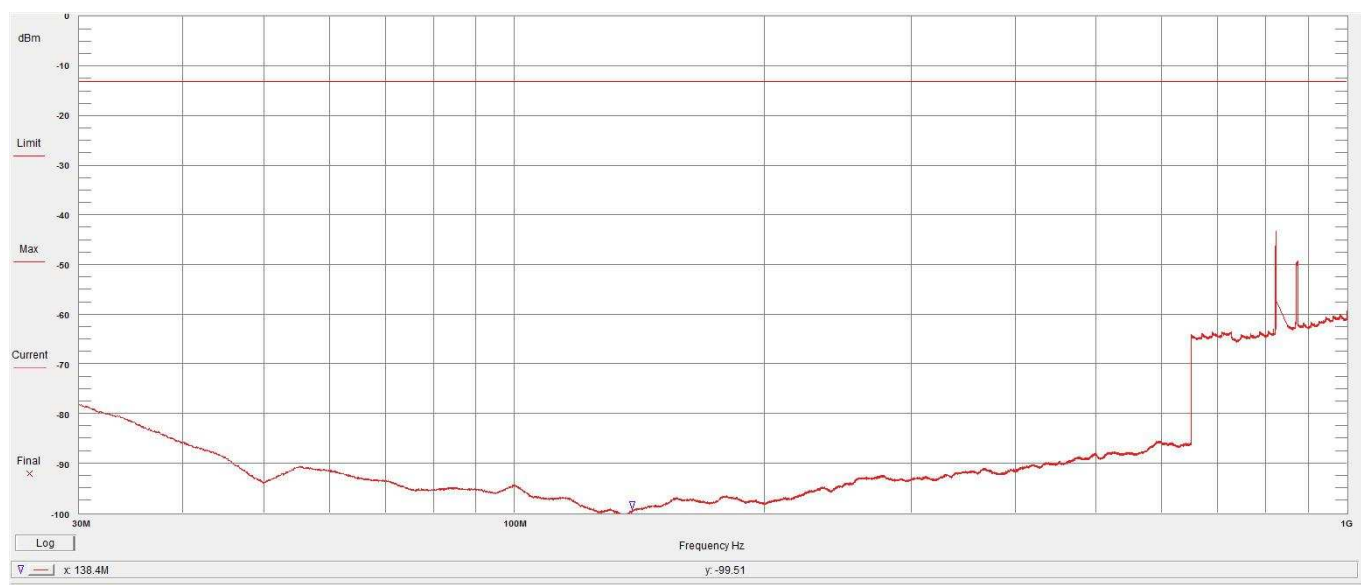
Picture 13: Field strength of spurious radiation, GSM 850, ch128, 1 – 10 GHz, RBW 1 MHz, VBW 3 MHz



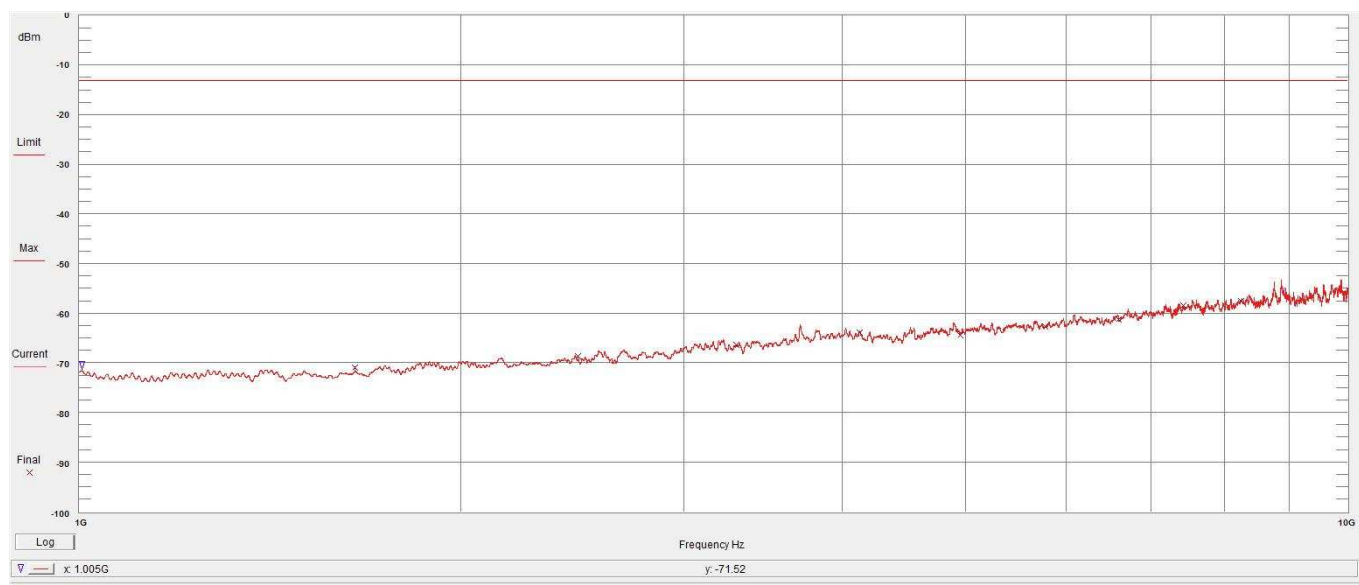
Picture 14: Field strength of spurious radiation, WCDMA FDD 5, ch4132, 30 – 1000 MHz, RBW 100kHz, VBW 300 kHz.



Picture 15: Field strength of spurious radiation, WCDMA FDD 5, ch4132, 1 – 10 GHz, RBW 1 MHz, VBW 3 MHz



Picture 16: Field strength of spurious radiation, LTE FDD 5, ch20425, BW 5 MHz, 1 RB, 30 – 1000MHz, RBW 100kHz, VBW 300 kHz.



Picture 17: Field strength of spurious radiation, LTE FDD 5, ch20425, BW 5 MHz, 1RB, 1 – 10 GHz, RBW 1 MHz, VBW 3 MHz

8.1.4 Band edge compliance §2.1053, §22.917

Result: Passed

Setup: Conducted setup, Cond_2 EUT

Test specification FCC part 2 and part 22

V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 45 (GSM 850 and WCDMA FDD5)

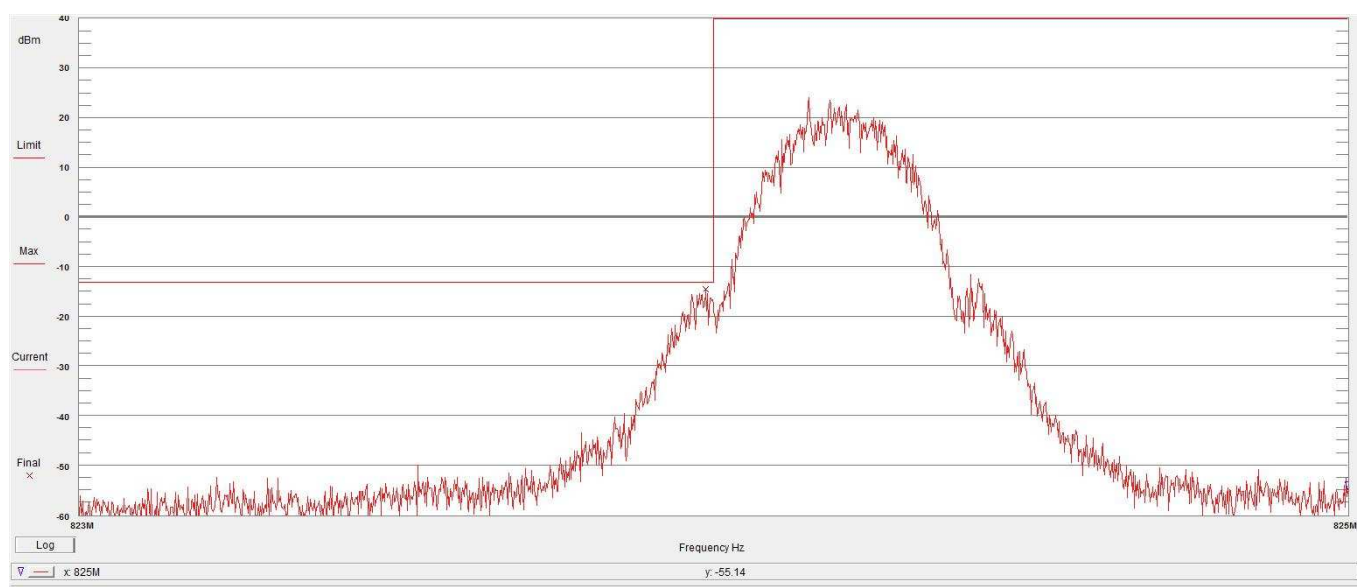
MDE_ELEKT_1502_FCCh, page 25 (LTE FDD5)

Band	Mode	Channel	Detector	RBW / VBW	Frequency MHz	Peak value	FCC limit	Margin dB	Verdict
850	GSM	128	Peak	3kHz	823.98	-14.4	-13	1.4	PASS
		251	Peak	3kHz	849.02	-14.1	-13	1.1	PASS
850	EDGE	128	Peak	3kHz	824	-21	-13	8.0	PASS
		251	Peak	3kHz	849.02	-21.2	-13	8.2	PASS
FDD 5	WCDMA	4132	RMS	50 kHz	823.97	-24.6	-13	11.6	PASS
		4233	RMS	50 kHz	849.01	-21.7	-13	8.7	PASS

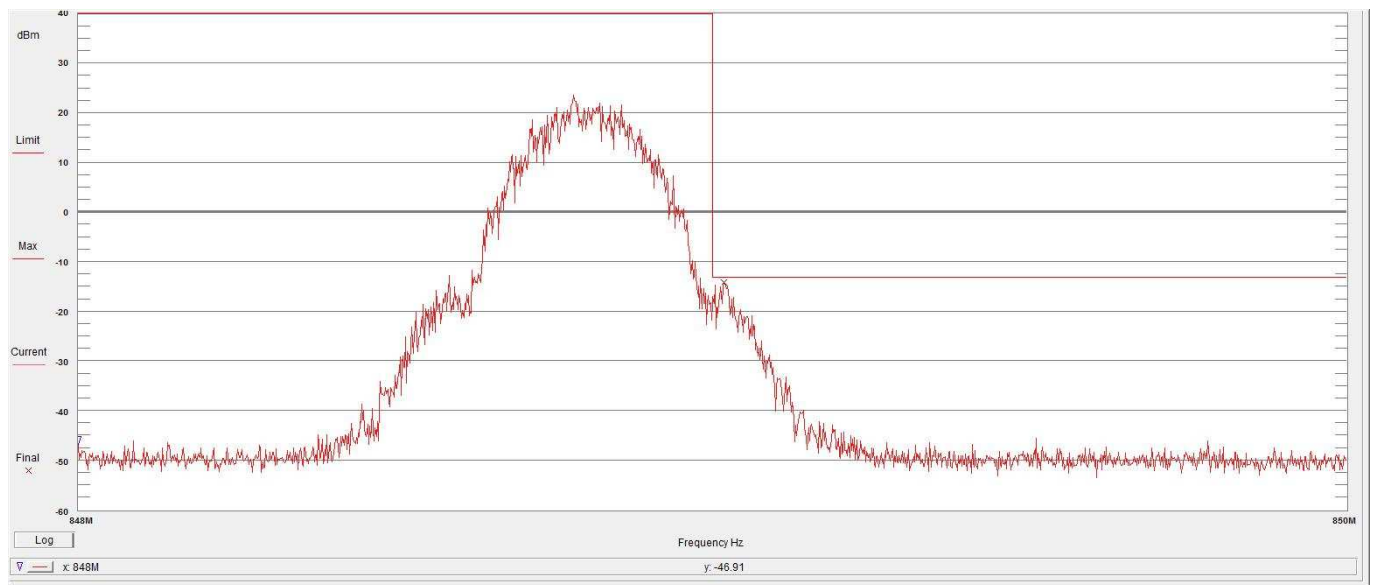
Table 10: Detailed results GSM 850 and WCDMA FDD 5, Band edge

Band	Mode	BW MHz	Modulation	RB	Channel	Frequency MHz	Detector	RBW / VBW	Peak value	FCC limit	Margin dB	Verdict
FDD 5	LTE	1.4	QPSK	6	20407	824	RMS	30kHz	-27	-13	14	PASS
				6	20643	849	RMS	30kHz	-29.2	-13	16.2	PASS
			16QAM	6	20407	824	RMS	30kHz	-29.3	-13	16.3	PASS
				6	20643	849	RMS	30kHz	-31.1	-13	28.1	PASS
		3	QPSK	15	20415	824	RMS	30kHz	-29.9	-13	16.9	PASS
				15	20635	849	RMS	30kHz	-28.1	-13	15.1	PASS
			16QAM	15	20415	824	RMS	30kHz	-29.9	-13	16.9	PASS
				15	20635	849	RMS	30kHz	-29.5	-13	16.5	PASS
		5	QPSK	25	20425	824	RMS	50kHz	-28.8	-13	15.8	PASS
				25	20625	849	RMS	50kHz	-28.9	-13	15.9	PASS
			16QAM	25	20425	824	RMS	50kHz	-30.7	-13	17.7	PASS
				25	20625	849	RMS	50kHz	-31	-13	17	PASS
		10	QPSK	50	20450	824	RMS	100kHz	-27.8	-13	14.8	PASS
				50	20600	849	RMS	100kHz	-31.3	-13	28.3	PASS
			16QAM	50	20450	824	RMS	100kHz	-29.5	-13	16.5	PASS
				50	20600	849	RMS	100kHz	-32.9	-13	19.9	PASS

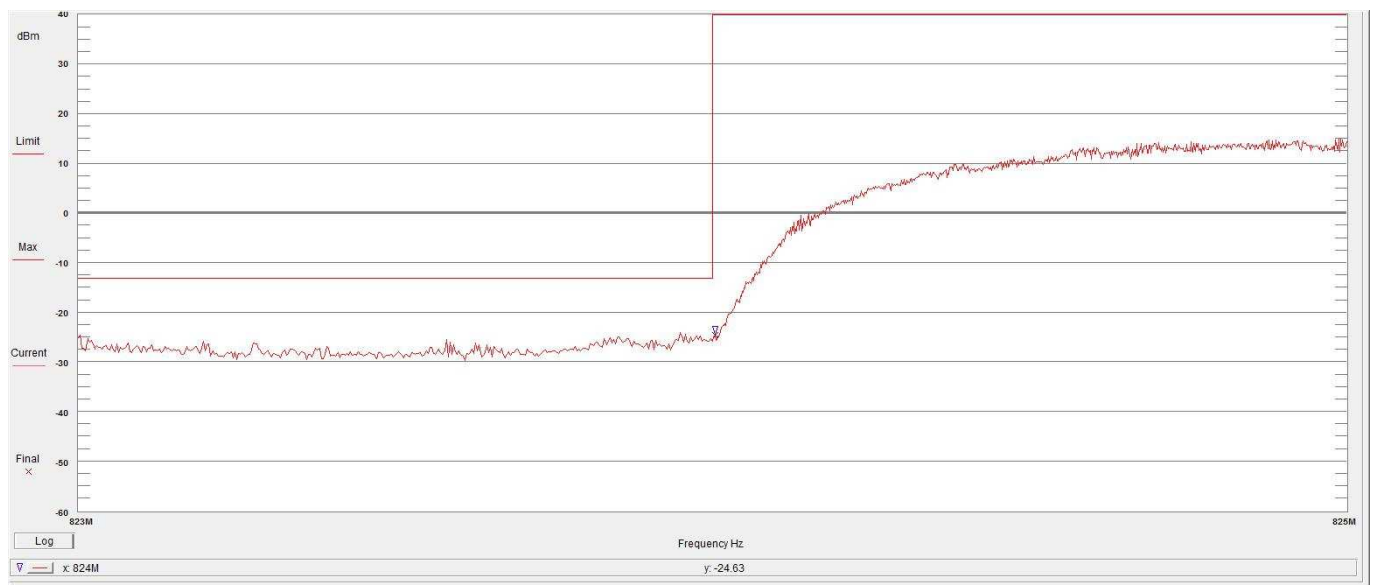
Table 11: Detailed results LTE FDD 5, Band edge



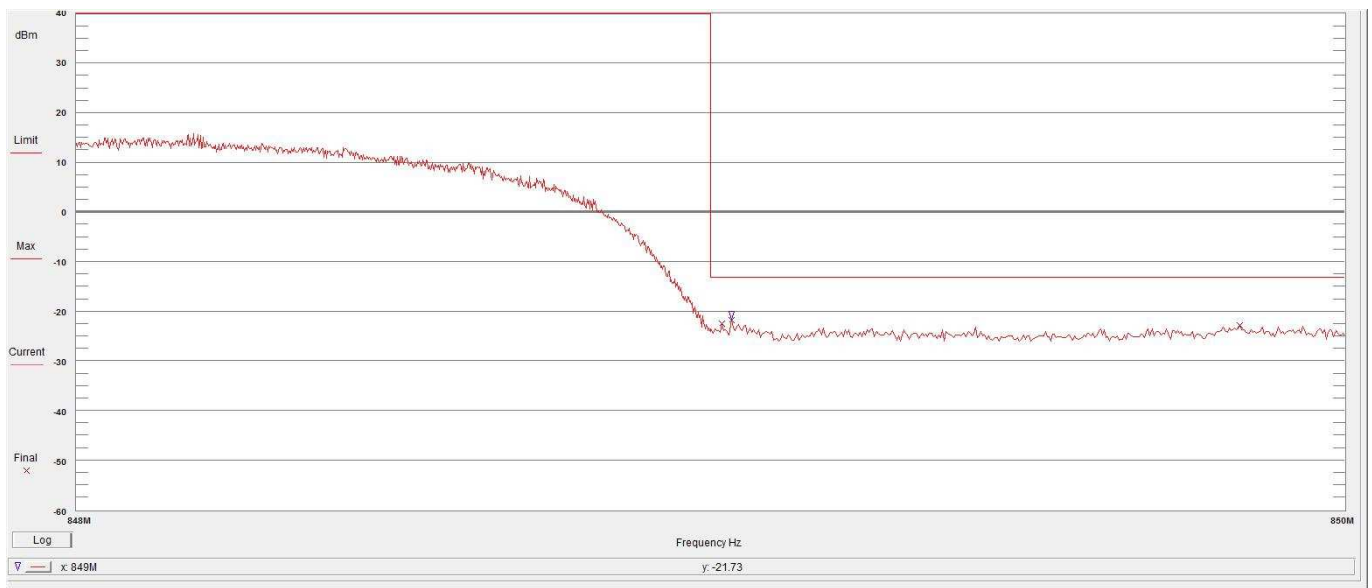
Picture 18: GSM 850 Band Edge, Ch128



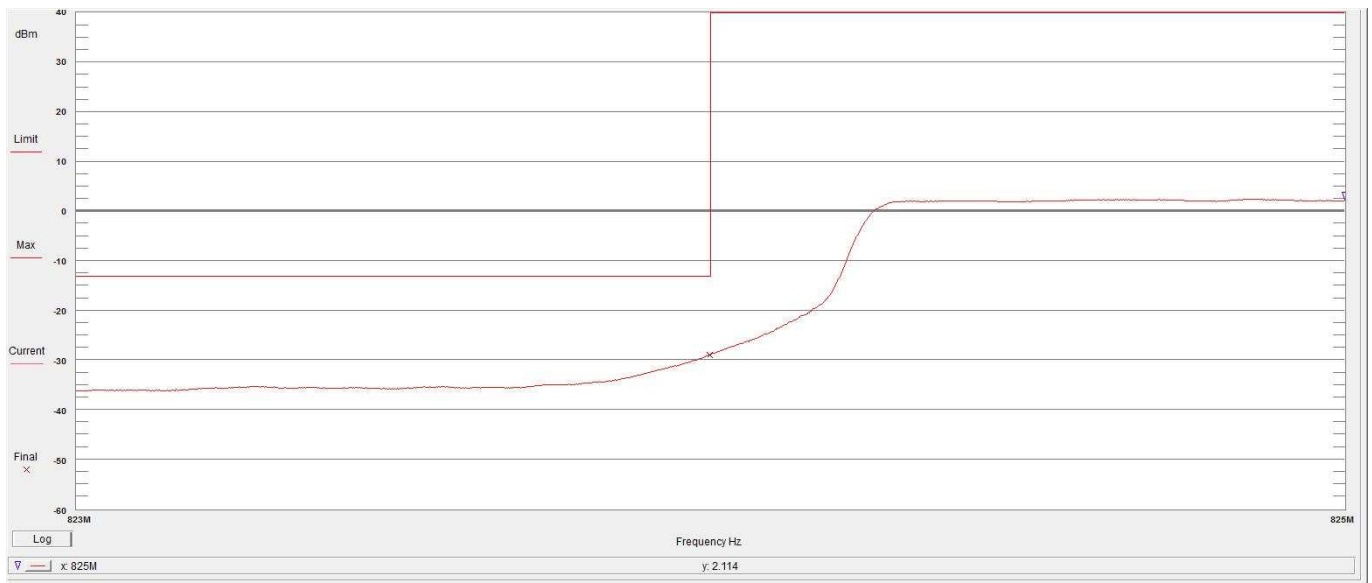
Picture 19: GSM 850 Band Edge, Ch251



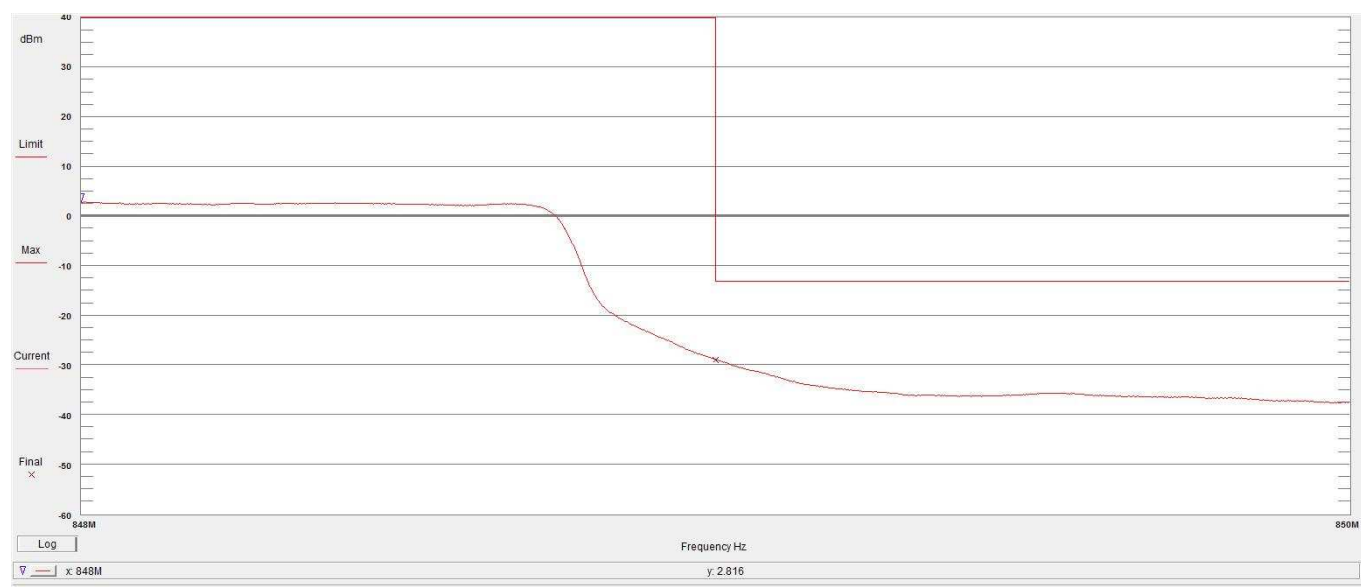
Picture 20: WCDMA FDD 5 Band Edge, Ch4132



Picture 21: WCDMA FDD 5 Band Edge, Ch4233



Picture 22: LTE FDD 5 Band Edge, Ch20425



Picture 23: LTE FDD 5 Band Edge, Ch20625

8.2 FCC Part 2 and 24

8.2.1 RF power output §2.1046, §24.232

Result: Passed

Setup: Conducted setup, Cond_2 EUT

Test specification FCC part 2 and part 24

V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 48 (GSM 1900 and WCDMA FDD2)

MDE_ELEKT_1502_FCCh, page 30 (LTE FDD2)

Note: Testing has been done according to KDB 971168 D01.

Equation for determining the EIRP is: $EIRP = P_{Meas} + G_T - L_C$

Where P_{Meas} = measured transmitter output power (dBm)

G_T = gain of the transmitting antenna (dBi)

L_C = signal attenuation in the connecting cable between the transmitter and antenna (negligible)

G_T used to calculate EIRP for GSM/EDGE 1900, WCDMA FDD2 and LTE FDD2 is 0dBi.

Band	Mode	Channel	Frequency (MHz)	Peak Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
1900	GSM	Low	1850.2	28.96	33	28.96	PASS
		Mid	1880	28.8	33	28.8	PASS
		High	1909.8	29.02	33	29.02	PASS
1900	EDGE	Low	1850.2	28.34	33	28.34	PASS
		Mid	1880	28.3	33	28.3	PASS
		High	1909.8	28.37	33	28.37	PASS

Table 12: Detailed results GSM/EDGE 1900, RF power output

Band	Mode	Channel	Frequency (MHz)	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
FDD 2	WCDMA	Low	1852.4	24.01	33	24.01	PASS
		Mid	1880	24.3	33	24.3	PASS
		High	1907.6	24.39	33	24.39	PASS

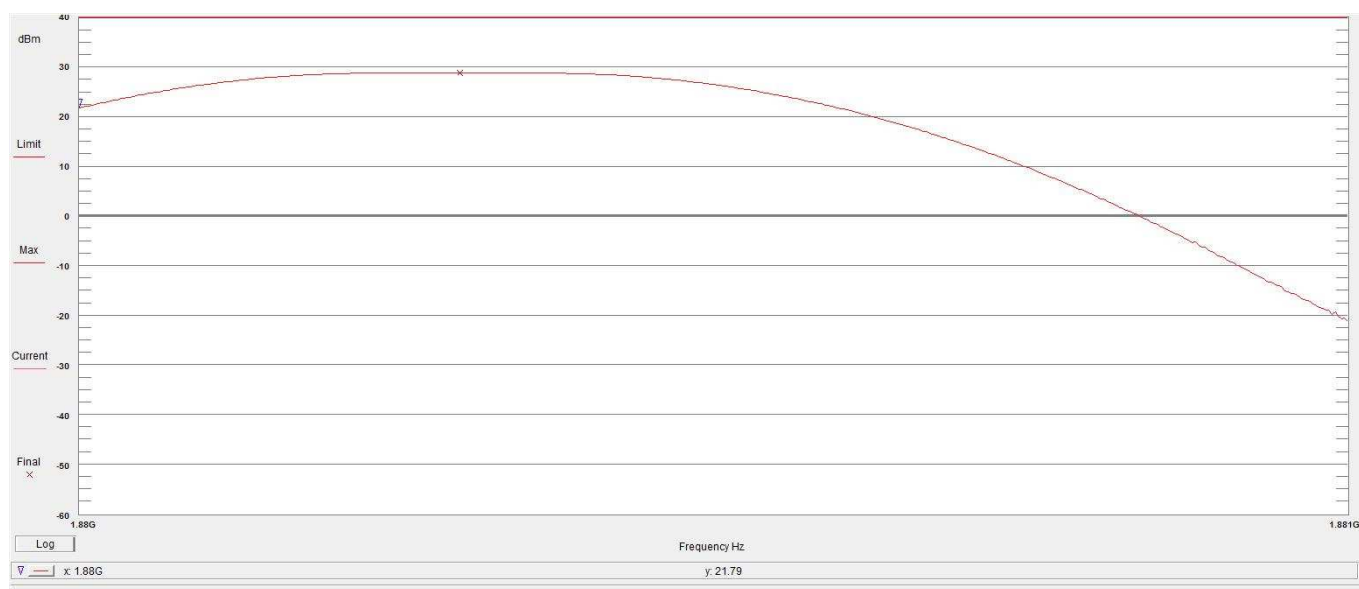
Table 13: Detailed results WCDMA FDD 2, RF power output

Band	Bandwidth	Channel	Modulation	RB	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
LTE FDD 2	1.4 MHz	18607	QPSK	1	23.63	33	23.63	PASS
			QPSK	3	23.63	33	23.63	PASS
			QPSK	6	22.57	33	22.57	PASS
			16QAM	1	22.4	33	22.4	PASS
			16QAM	6	21.5	33	21.5	PASS
		18900	QPSK	1	23.49	33	23.49	PASS
			QPSK	3	23.52	33	23.52	PASS
			QPSK	6	22.51	33	22.51	PASS
			16QAM	1	22.3	33	22.3	PASS
			16QAM	6	21.47	33	21.47	PASS
		19193	QPSK	1	23.61	33	23.61	PASS
			QPSK	3	23.58	33	23.58	PASS
			QPSK	6	22.59	33	22.59	PASS
			16QAM	1	22.5	33	22.5	PASS
			16QAM	6	21.55	33	21.55	PASS
	3 MHz	18615	QPSK	1	23.67	33	23.67	PASS
			QPSK	15	22.52	33	22.52	PASS
			16QAM	1	22.42	33	22.42	PASS
			16QAM	15	21.5	33	21.5	PASS
		18900	QPSK	1	23.54	33	23.54	PASS
			QPSK	15	22.47	33	22.47	PASS
			16QAM	1	22.36	33	22.36	PASS
			16QAM	15	21.46	33	21.46	PASS
		19185	QPSK	1	23.66	33	23.66	PASS
			QPSK	15	22.62	33	22.62	PASS
			16QAM	1	22.54	33	22.54	PASS
			16QAM	15	21.58	33	21.58	PASS
	5 MHz	18625	QPSK	1	23.66	33	23.66	PASS
			QPSK	12	21.6	33	21.6	PASS
			QPSK	25	22.5	33	22.5	PASS
			16QAM	1	22.43	33	22.43	PASS
			16QAM	25	21.57	33	21.57	PASS
		18900	QPSK	1	23.59	33	23.59	PASS
			QPSK	12	21.51	33	21.51	PASS
			QPSK	25	22.5	33	22.5	PASS
			16QAM	1	22.33	33	22.33	PASS
			16QAM	25	21.51	33	21.51	PASS
		19175	QPSK	1	23.66	33	23.66	PASS

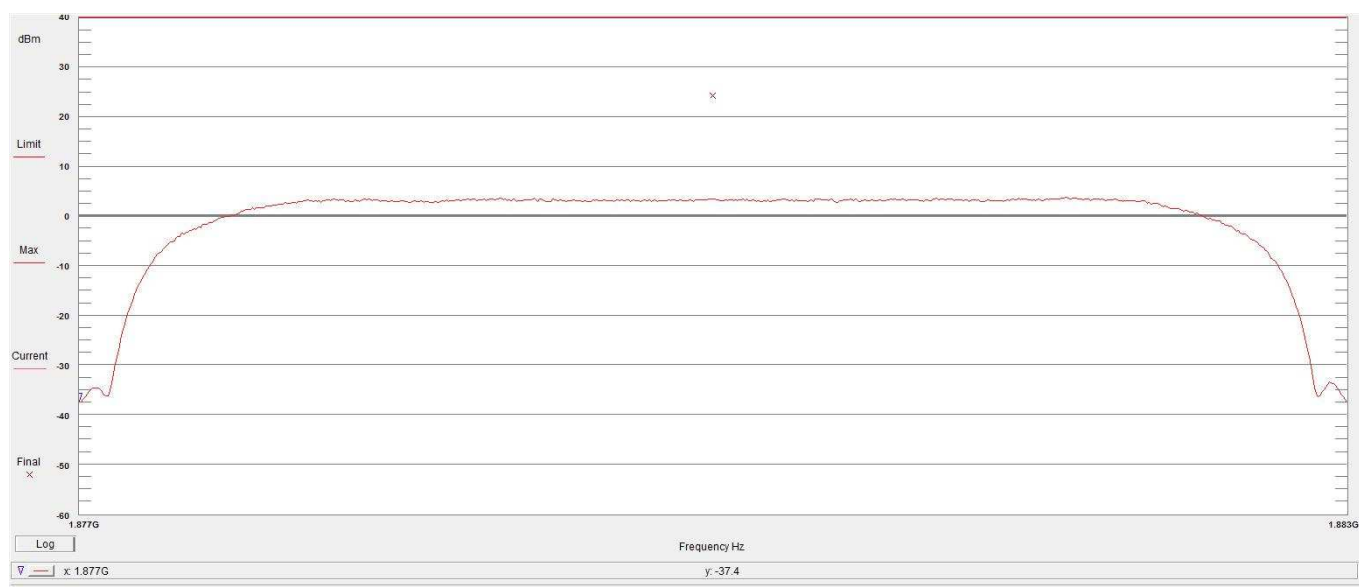
Band	Bandwidth	Channel	Modulation	RB	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
			QPSK	12	21.62	33	21.62	PASS
			QPSK	25	22.57	33	22.57	PASS
			16QAM	1	22.48	33	22.48	PASS
			16QAM	25	21.61	33	21.61	PASS
	10 MHz	18650	QPSK	1	23.67	33	23.67	PASS
			QPSK	50	22.47	33	22.47	PASS
			16QAM	1	22.5	33	22.5	PASS
			16QAM	50	21.43	33	21.43	PASS
		18900	QPSK	1	23.52	33	23.52	PASS
			QPSK	50	22.46	33	22.46	PASS
			16QAM	1	22.39	33	22.39	PASS
			16QAM	50	21.49	33	21.49	PASS
		19150	QPSK	1	23.6	33	23.6	PASS
			QPSK	50	22.61	33	22.61	PASS
			16QAM	1	22.51	33	22.51	PASS
			16QAM	50	21.62	33	21.62	PASS
	15 MHz	18675	QPSK	1	22.48	33	22.48	PASS
			QPSK	36	21.44	33	21.44	PASS
			QPSK	75	21.38	33	21.38	PASS
			16QAM	1	22.47	33	22.47	PASS
			16QAM	75	21.37	33	21.37	PASS
		18900	QPSK	1	22.41	33	22.41	PASS
			QPSK	36	21.47	33	21.47	PASS
			QPSK	75	21.48	33	21.48	PASS
			16QAM	1	22.39	33	22.39	PASS
			16QAM	75	21.51	33	21.51	PASS
		19125	QPSK	1	22.49	33	22.49	PASS
			QPSK	36	21.58	33	21.58	PASS
			QPSK	75	21.66	33	21.66	PASS
			16QAM	1	22.48	33	22.48	PASS
			16QAM	75	21.67	33	21.67	PASS
	20 MHz	18650	QPSK	1	22.52	33	22.52	PASS
			QPSK	100	21.43	33	21.43	PASS
			16QAM	1	22.51	33	22.51	PASS
			16QAM	100	21.44	33	21.44	PASS
		18900	QPSK	1	22.41	33	22.41	PASS
			QPSK	100	21.49	33	21.49	PASS
			16QAM	1	22.41	33	22.41	PASS

Band	Bandwidth	Channel	Modulation	RB	RMS Conducted power (dBm)	FCC EIRP limit (dBm)	Calculated EIRP (dBm)	Verdict
			16QAM	100	21.51	33	21.51	PASS
			QPSK	1	22.49	33	22.49	PASS
			QPSK	100	21.68	33	21.68	PASS
			16QAM	1	22.5	33	22.5	PASS
		19150	16QAM	100	21.68	33	21.68	PASS

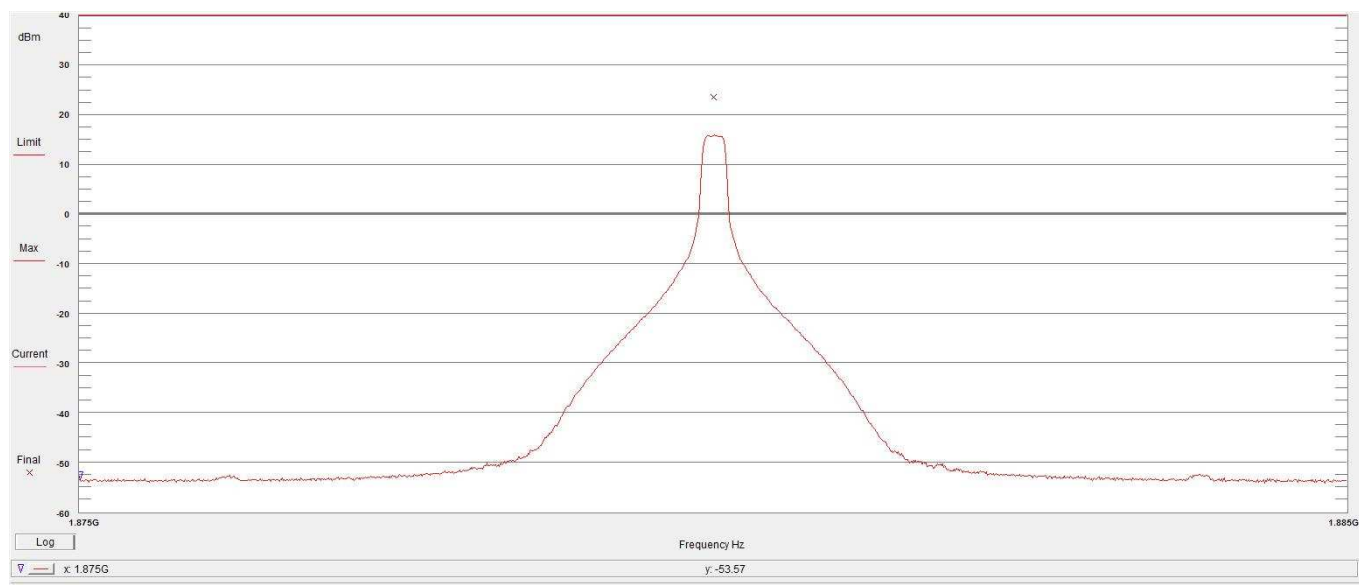
Table 14: Detailed results LTE FDD 2, RF power output



Picture 24: GSM 1900, Ch. 661, RF power output, RBW 300kHz, VBW 300 kHz



Picture 25: WCDMA FDD 2, Ch. 9400, RF power output, RBW 30 kHz, VBW 300 kHz



Picture 26: LTE FDD 2, Ch. 18900, BW 5MHz, QPSK, 1 RB, RF power output, RBW 30 kHz, VBW 300 kHz

8.2.2 Spurious emissions at antenna terminals §2.1051, §24.238

Result: Passed, with WCDMA FDD 2 and LTE FDD 2 bands there were no peaks with a margin less than 20 dB

Setup: Conducted setup, Cond_2 EUT

Test specification FCC part 2 and part 24

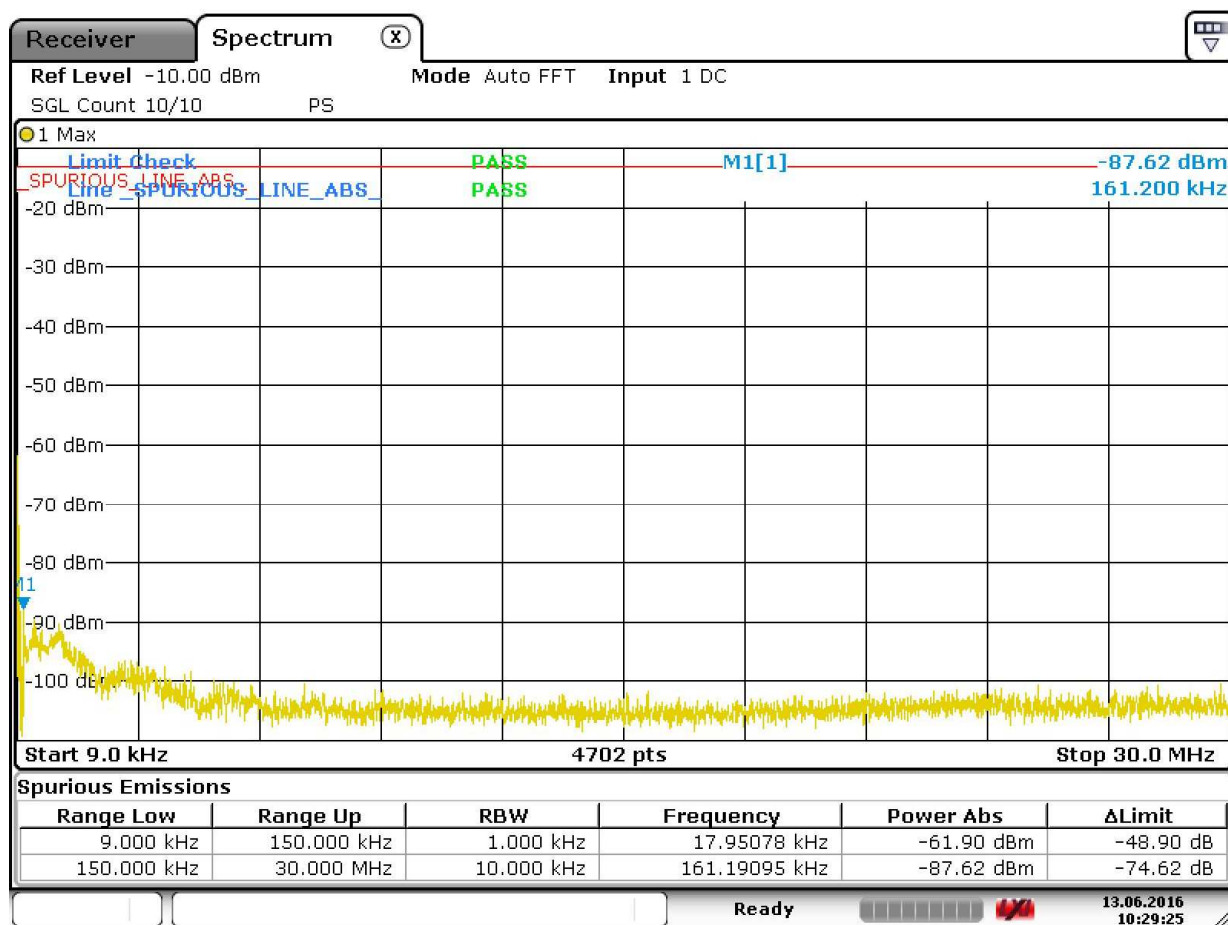
V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 61 (GSM 1900 and WCDMA FDD2)

MDE_ELEKT_1502_FCCh, page 35 (LTE FDD2)

Band	Mode	Channel	Detector	Frequency	Peak value	FCC limit	Margin	Verdict
1900	GSM	512	Peak	2845.75 MHz	-23.4 dBm	-13 dBm	-10.4 dB	PASS
1900	GSM	512	Peak	11101.2 MHz	-32.7 dBm	-13 dBm	-19.7 dB	PASS
1900	GSM	512	Peak	12951.4 MHz	-32.0 dBm	-13 dBm	-19.0 dB	PASS
1900	GSM	512	Peak	14801.6 MHz	-27.8 dBm	-13 dBm	-14.8 dB	PASS
1900	GSM	512	Peak	15685.5 MHz	-23.7 dBm	-13 dBm	-10.7 dB	PASS

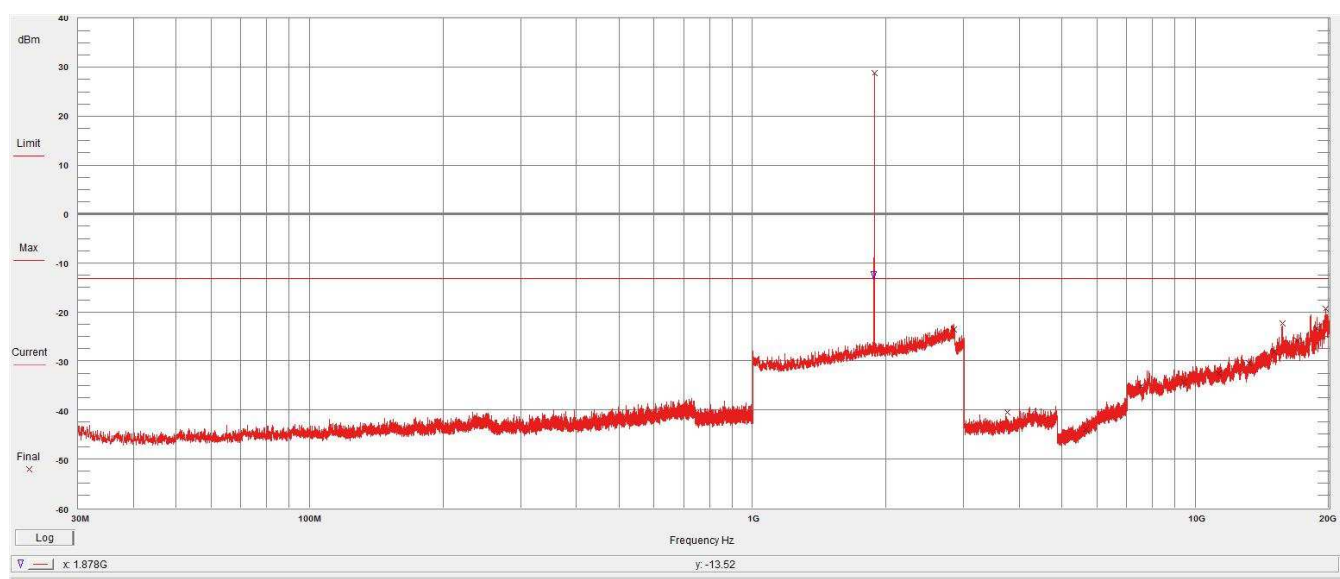
Band	Mode	Channel	Detector	Frequency	Peak value	FCC limit	Margin	Verdict
1900	GSM	512	Peak	16651.8 MHz	-27.8 dBm	-13 dBm	-14.8 dB	PASS
1900	GSM	512	Peak	18502 MHz	-26.2 dBm	-13 dBm	-13.2 dB	PASS
1900	GSM	512	Peak	19630.75 MHz	-19.9 dBm	-13 dBm	-6.91 dB	PASS
1900	GSM	661	Peak	2837.5 MHz	-23.4 dBm	-13 dBm	-10.4 dB	PASS
1900	GSM	661	Peak	11280 MHz	-32.4 dBm	-13 dBm	-19.4 dB	PASS
1900	GSM	661	Peak	13160 MHz	-30.3 dBm	-13 dBm	-17.3 dB	PASS
1900	GSM	661	Peak	15040 MHz	-28.0 dBm	-13 dBm	-15.0 dB	PASS
1900	GSM	661	Peak	15687.25 MHz	-22.3 dBm	-13 dBm	-9.32 dB	PASS
1900	GSM	661	Peak	16920 MHz	-25.7 dBm	-13 dBm	-12.7 dB	PASS
1900	GSM	661	Peak	18800 MHz	-23.2 dBm	-13 dBm	-10.2 dB	PASS
1900	GSM	661	Peak	19614.5 MHz	-19.1 dBm	-13 dBm	-6.19 dB	PASS
1900	GSM	810	Peak	2814.25 MHz	-23.8 dBm	-13 dBm	-10.8 dB	PASS
1900	GSM	810	Peak	11458.8 MHz	-32.9 dBm	-13 dBm	-19.9 dB	PASS
1900	GSM	810	Peak	13368.6 MHz	-31.2 dBm	-13 dBm	-18.2 dB	PASS
1900	GSM	810	Peak	15278.4 MHz	-26.9 dBm	-13 dBm	-13.9 dB	PASS
1900	GSM	810	Peak	15688.75 MHz	-23.9 dBm	-13 dBm	-10.9 dB	PASS
1900	GSM	810	Peak	17188.2 MHz	-27.4 dBm	-13 dBm	-14.4 dB	PASS
1900	GSM	810	Peak	19098 MHz	-23.4 dBm	-13 dBm	-10.4 dB	PASS
1900	GSM	810	Peak	19610.25 MHz	-19.4 dBm	-13 dBm	-6.48 dB	PASS

Table 15: Detailed results GSM 1900, Ch. 661 Spurious at antenna terminal

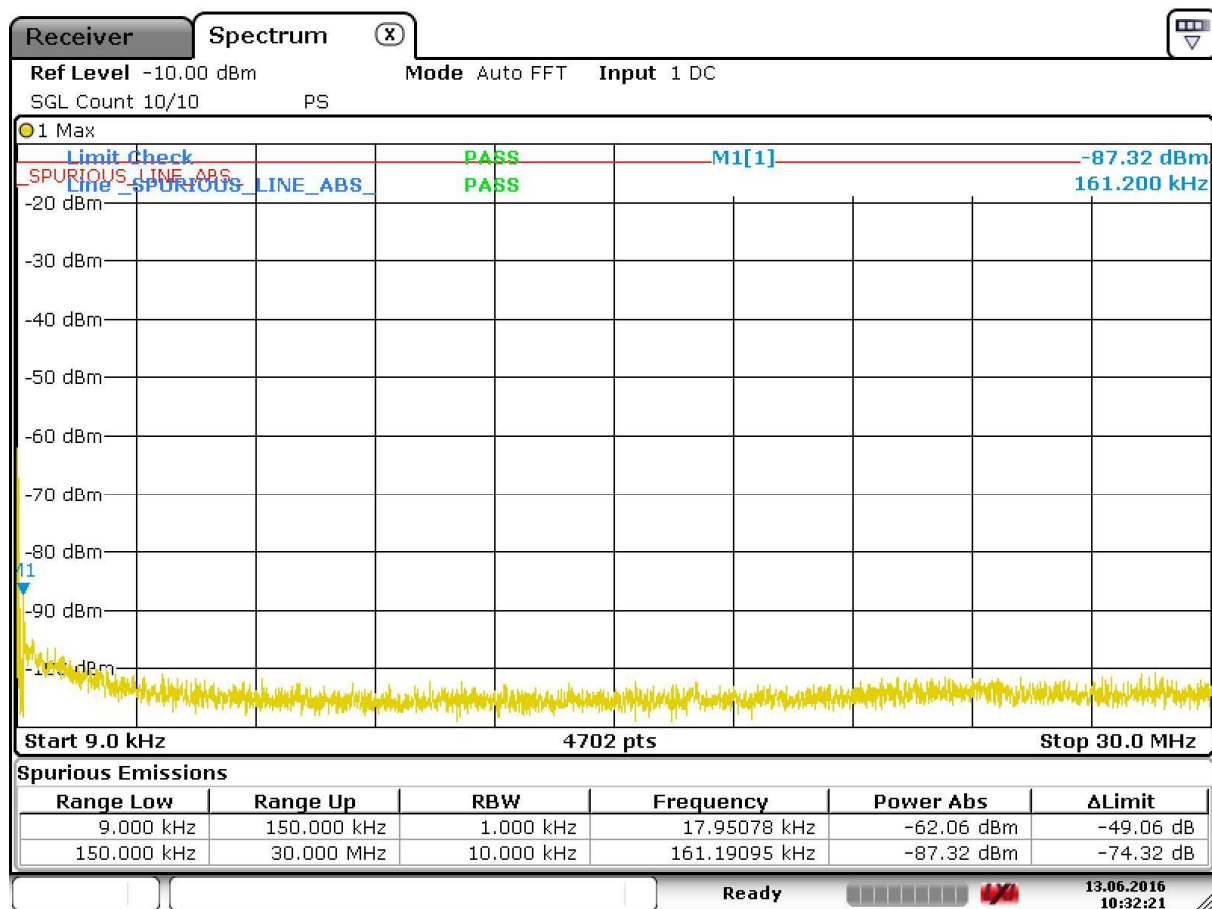


Date: 13.JUN.2016 10:29:26

Picture 27: GSM 1900, Ch661, spurious at antenna terminal, 9 kHz – 30 MHz

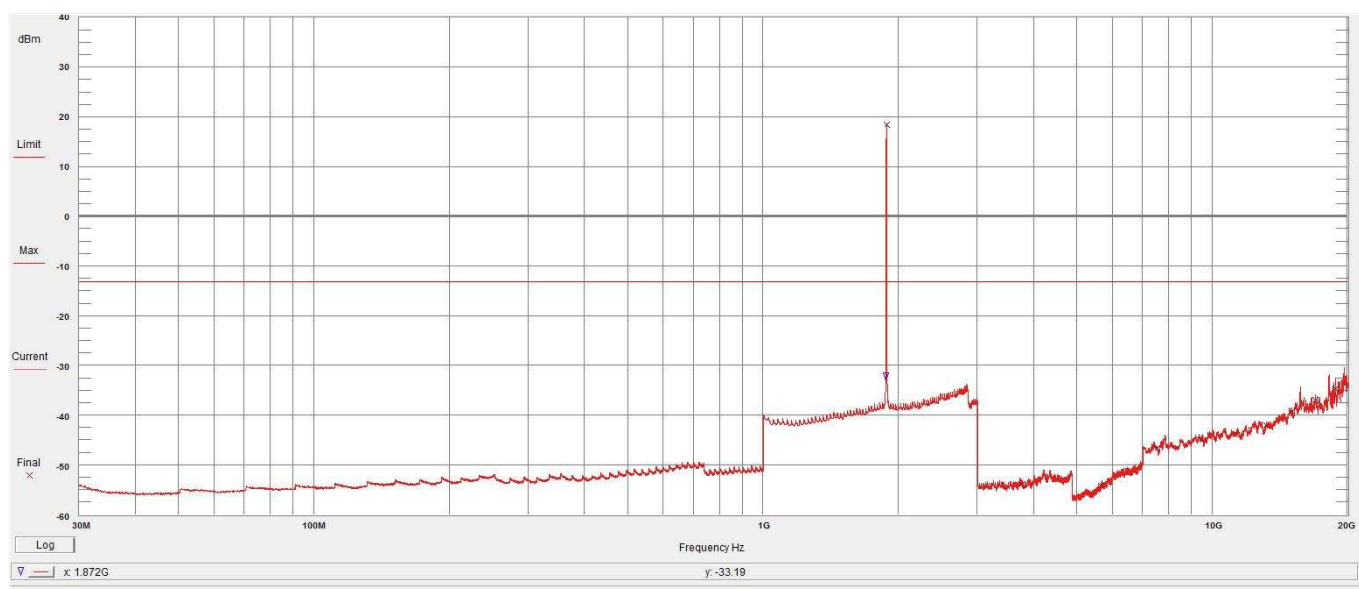


Picture 28: GSM 1900, Ch661, spurious at antenna terminal, 30 MHz – 20 GHz, peak is fundamental, RBW 100 kHz, VBW 300 kHz (freq<1GHz), RBW 1MHz, VBW 3MHz (freq >1 GHz)

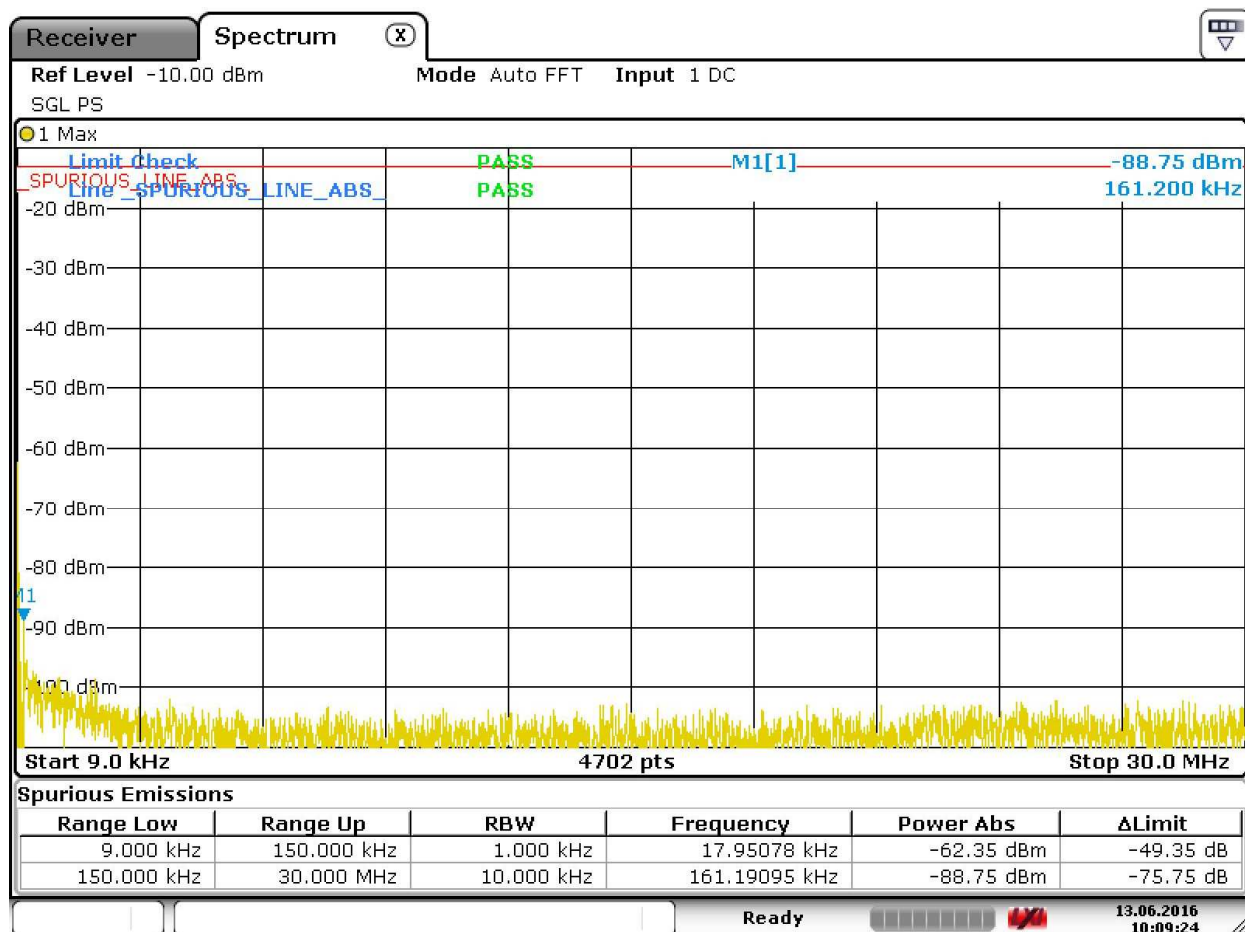


Date: 13.JUN.2016 10:32:21

Picture 29: WCDMA FDD 2, Ch9400, spurious at antenna terminal, 9 kHz – 30 MHz

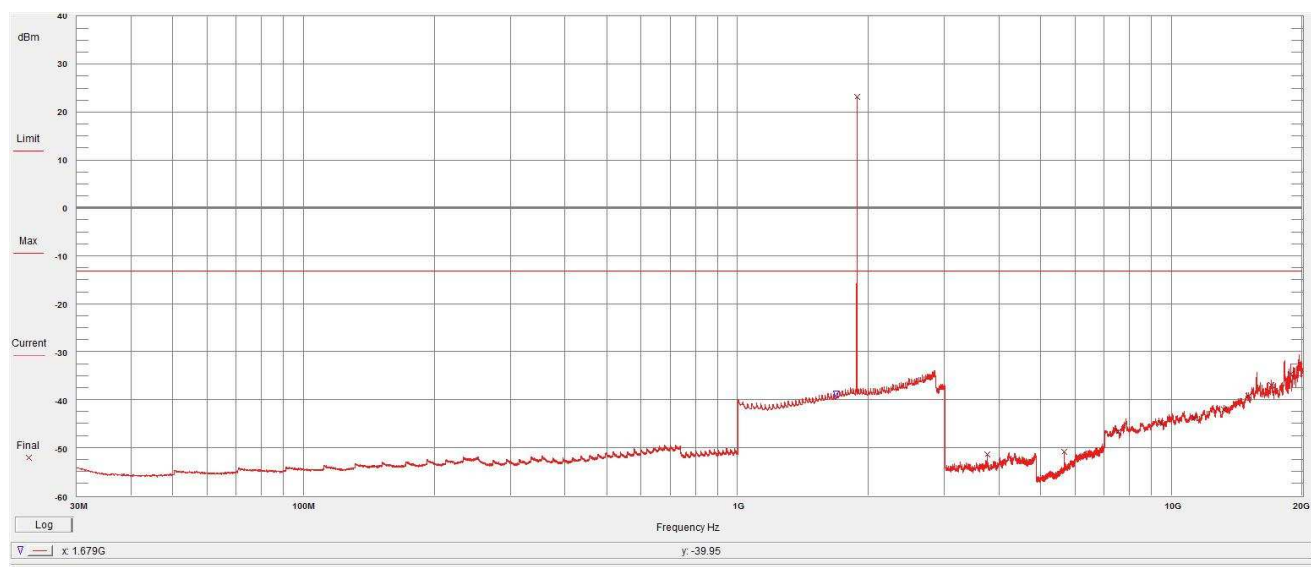


Picture 30: WCDMA FDD 2, Ch9400, spurious at antenna terminal, 30 MHz – 18 GHz, peak is fundamental, RBW 100 kHz, VBW 300 kHz (freq < 1 GHz), RBW 1 MHz, VBW 3 MHz (freq > 1 GHz)



Date: 13.JUN.2016 10:09:24

Picture 31: LTE FDD 2, Ch18900, spurious at antenna terminal, 9 kHz – 30 MHz



Picture 32: LTE FDD 2, Ch18900, spurious at antenna terminal, 30 MHz – 18 GHz, peak is fundamental, RBW 100 kHz, VBW 300 kHz (freq<1GHz), RBW 1MHz, VBW 3MHz (freq >1 GHz)

8.2.3 Field strength of spurious radiation §2.1053, §24.238

Result: Passed, at pre-tests there were no peaks with a margin less than 20 dB with all measured channels (low, mid, high)

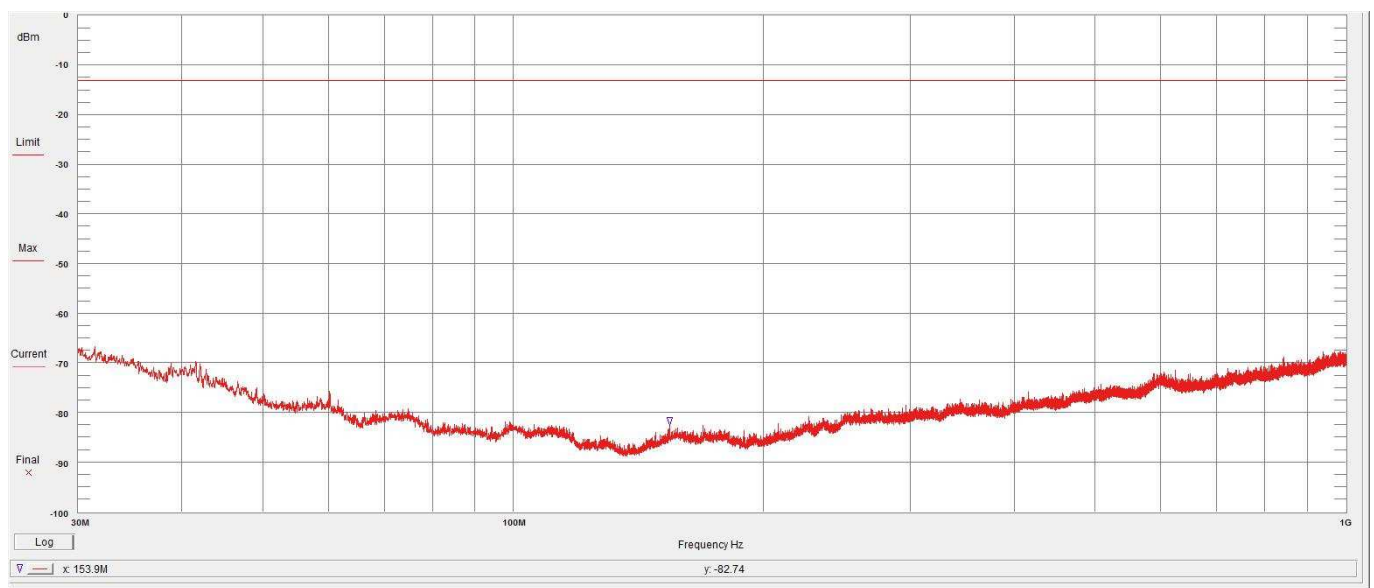
Setup: Radiated pre-test setup, Rad_1 EUT

Test specification FCC part 2 and part 24

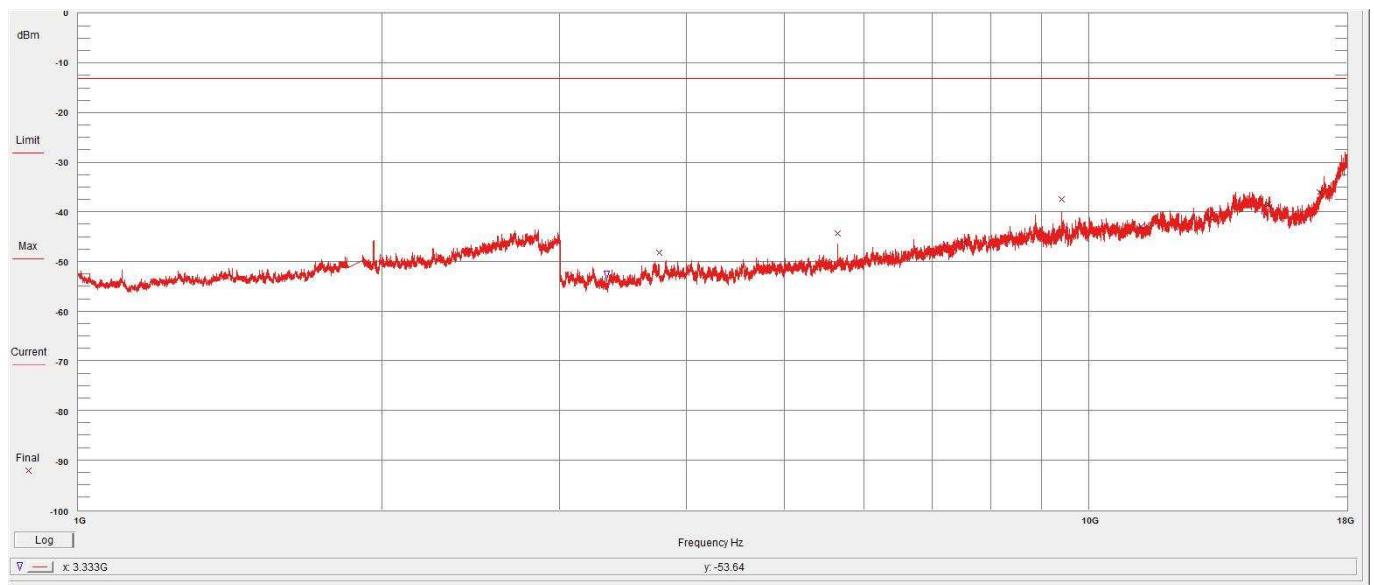
V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 63 (GSM 1900 and WCDMA FDD2)

MDE_ELEKT_1502_FCCh, page 36 (LTE FDD2)

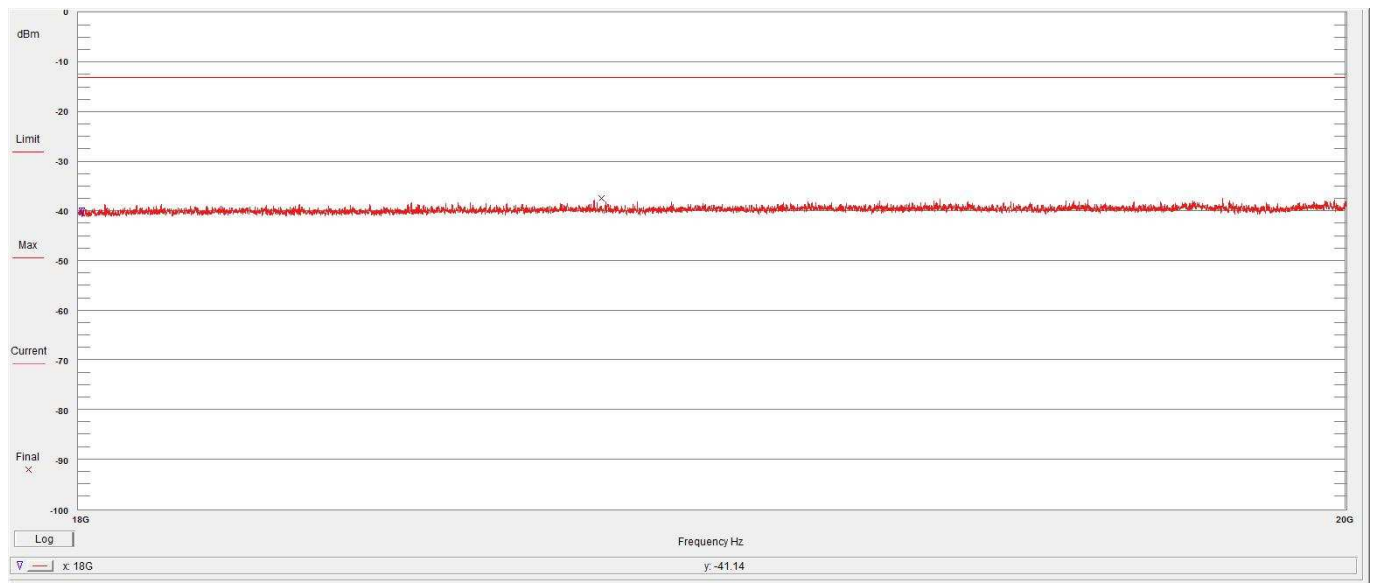
Limit = $43 + \log_{10}(P) = -13\text{dBm}$



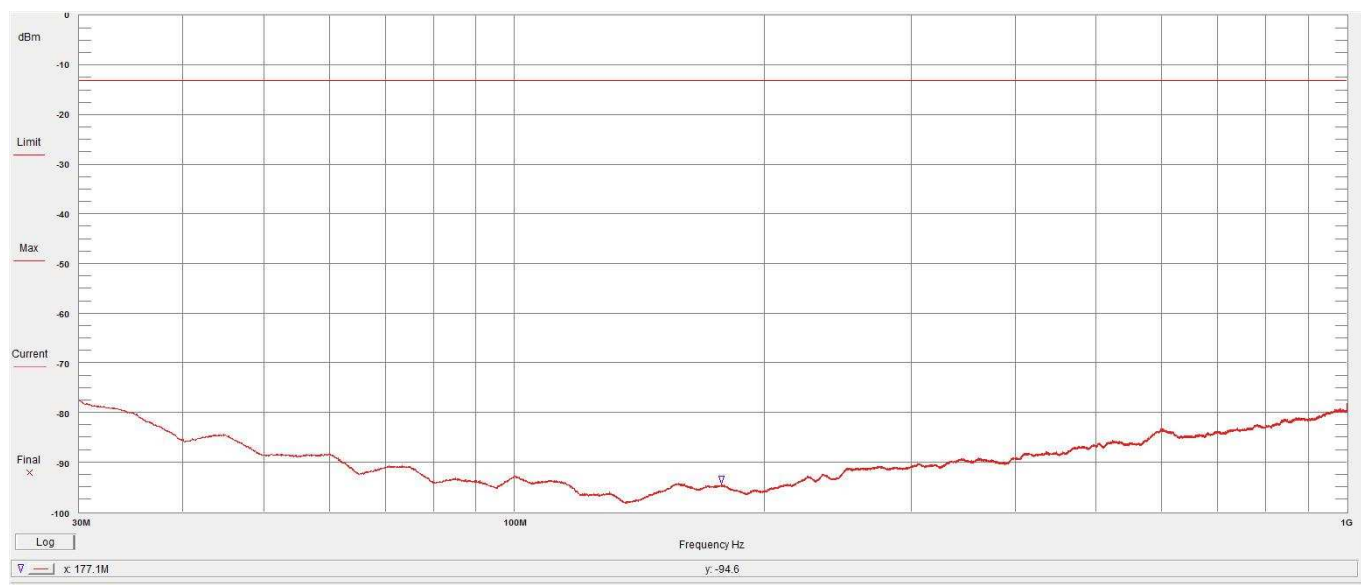
Picture 33: GSM 1900, Field strength of spurious radiation, Ch661, 30 – 1000 MHz, RBW 100 kHz, VBW 300 kHz.



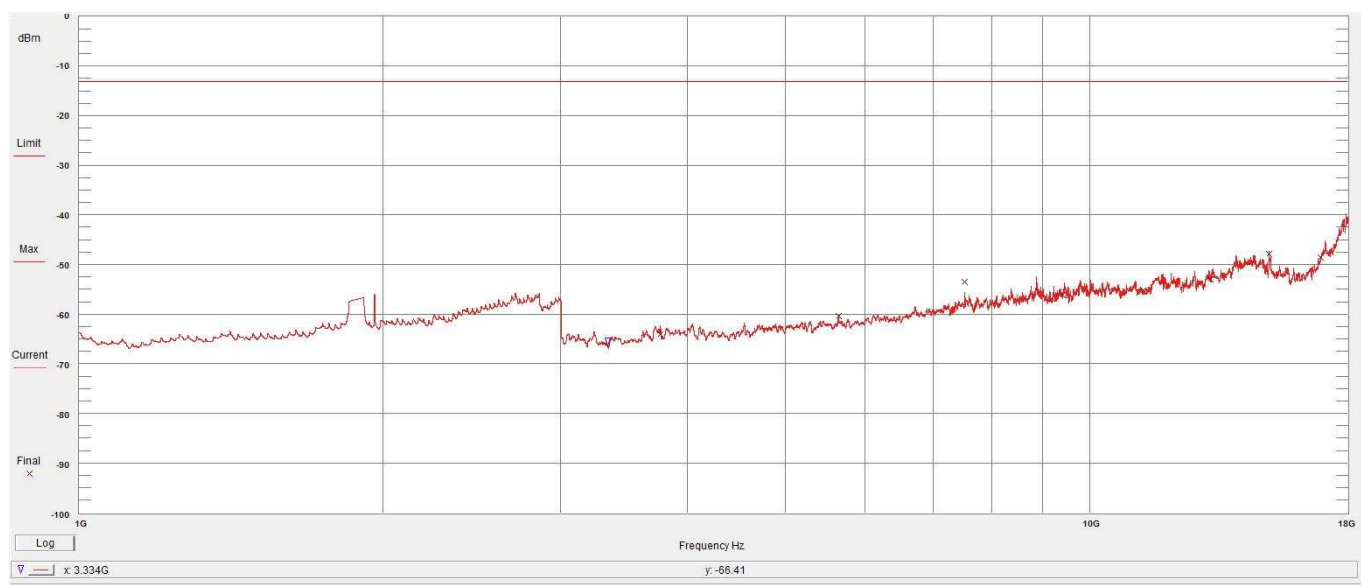
Picture 34: GSM 1900, Field strength of spurious radiation, Ch661, 1 – 18 GHz, RBW 1 MHz, VBW 3 MHz



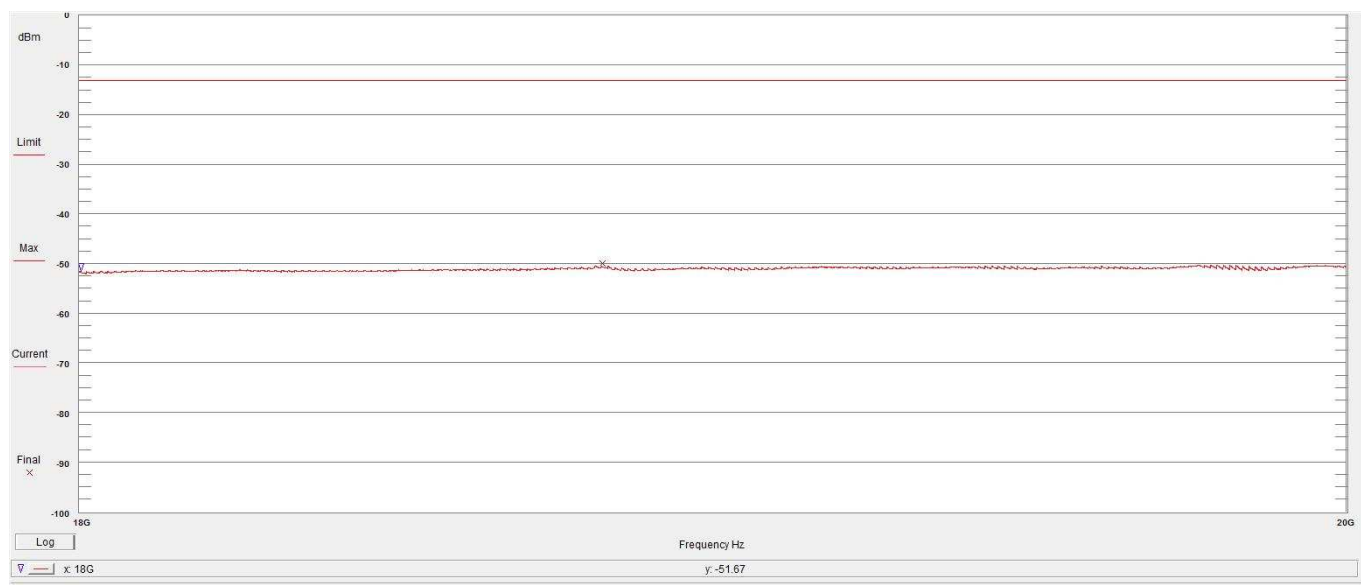
Picture 35: GSM 1900, Field strength of spurious radiation, Ch661, 18 – 20 GHz, RBW 1 MHz, VBW 3 MHz



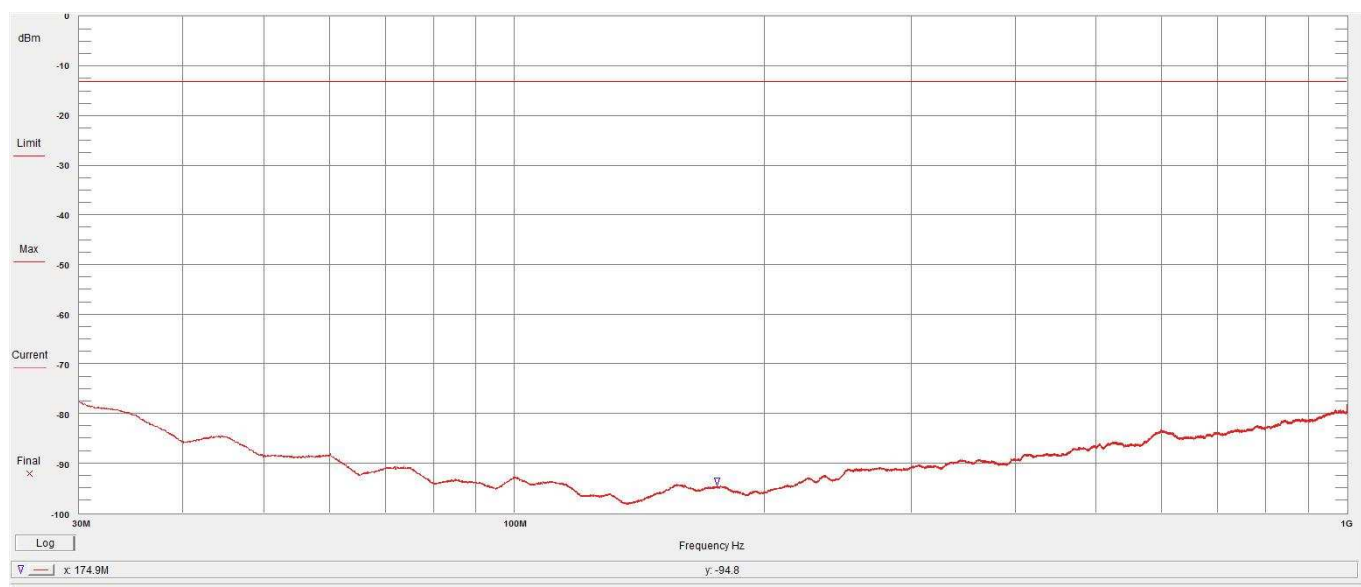
Picture 36: WCDMA FDD 2, Field strength of spurious radiation, Ch9400, 30 – 1000 MHz, RBW 100 kHz, VBW 300 kHz.



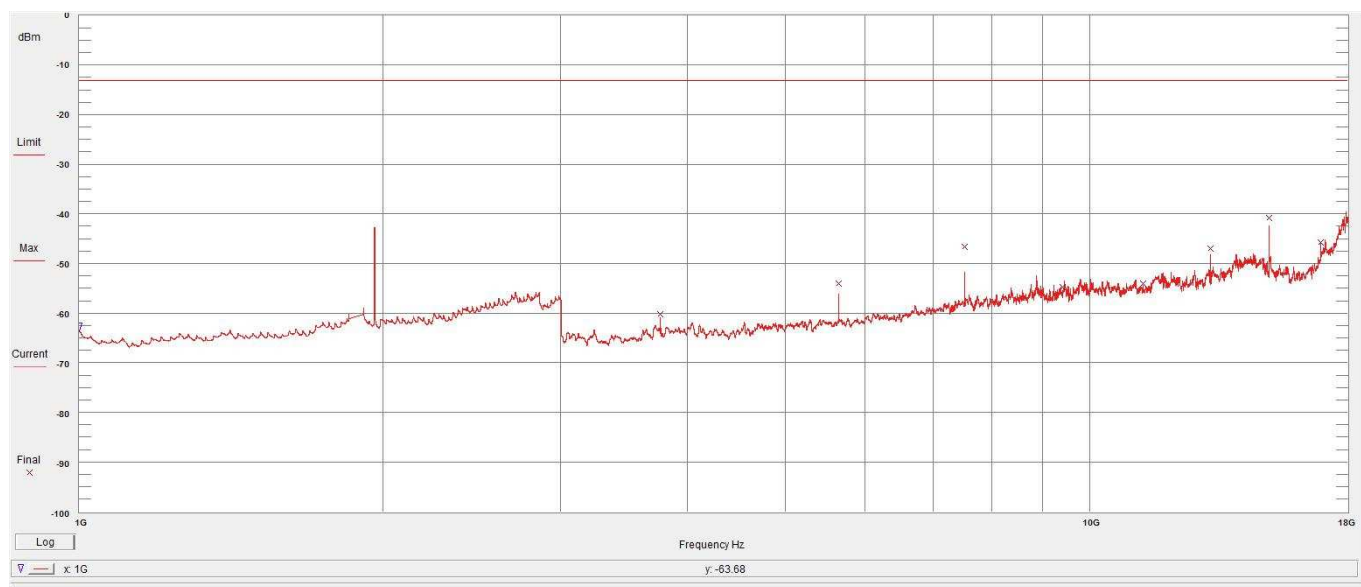
Picture 37: WCDMA FDD 2, Field strength of spurious radiation, Ch9400, 1 – 18 GHz, RBW 1 MHz, VBW 3 MHz



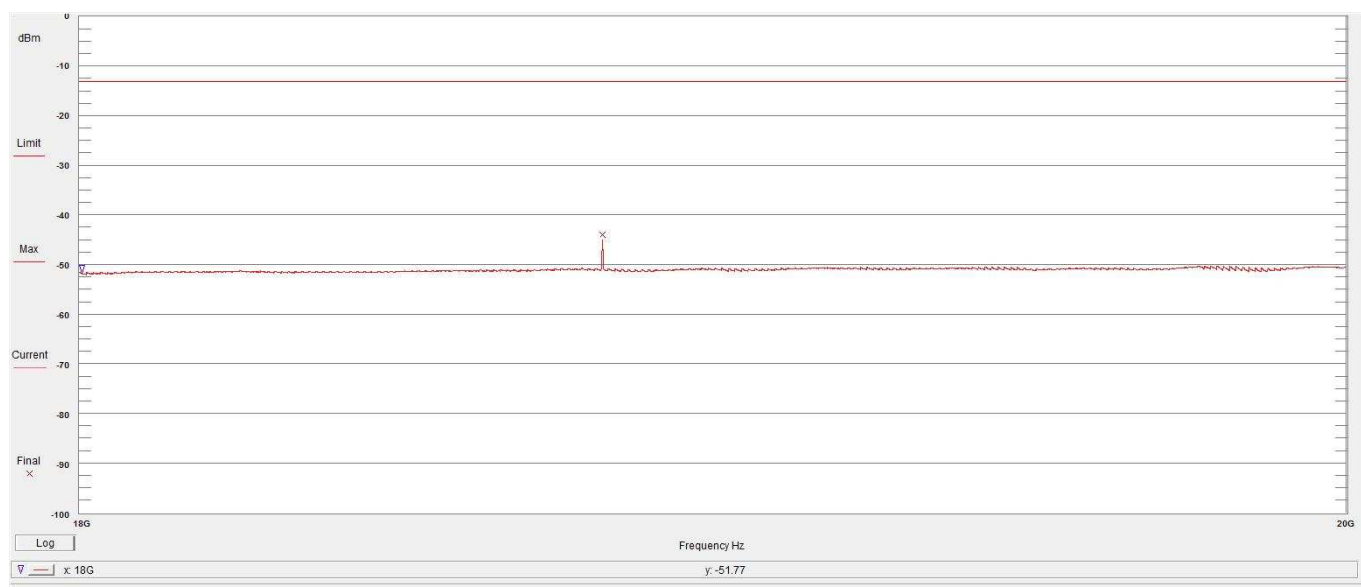
Picture 38: WCDMA FDD 2, Field strength of spurious radiation, Ch9400, 18 – 20 GHz, RBW 1 MHz, VBW 3 MHz



Picture 39: LTE FDD 2, Field strength of spurious radiation, Ch18900, BW 5 MHz, 1 RB, 30 – 1000 MHz, RBW 100 kHz, VBW 300 kHz.



Picture 40: LTE FDD 2, Field strength of spurious radiation, 18900, BW 5 MHz, 1 RB, 1 – 18 GHz, RBW 1 MHz, VBW 3 MHz



Picture 41: LTE FDD 2, Field strength of spurious radiation, 18900, BW 5 MHz, 1 RB, 18 – 20 GHz, RBW 1 MHz, VBW 3 MHz

8.2.4 Band edge compliance §2.1053, §24.238

Result: Passed

Setup: Conducted setup, Cond_2 EUT

Test specification FCC part 2 and part 24

V27SD-41 reference data: MDE_ELEKT_1502_FCCg, page 81 (GSM 1900 and WCDMA FDD2)

MDE_ELEKT_1502_FCCh, page 47 (LTE FDD2)

Band	Mode	Channel	Detector	RBW/VBW	Frequency MHz	Peak value (dBm)	FCC limit (dBm)	Margin (dB)	Verdict
1900	GSM	512	Peak	3kHz	1850	-15.4	-13	2.45	PASS
		810	Peak	3kHz	1910	-18.1	-13	5.15	PASS
1900	EDGE	512	Peak	3kHz	1850	-25.6	-13	12.6	PASS
		810	Peak	3kHz	1910	-24.6	-13	11.6	PASS
FDD 2	WCDMA	9262	RMS	50kHz	1850	-24.2	-13	11.2	PASS
		9538	RMS	50kHz	1910	-18.2	-13	5.2	PASS

Table 16: Detailed results, Band Edge Compliance GSM1900 & WCDMA FDD 2

Band	Mode	BW MHz	Modulation	RB / Offset	Channel	Frequency MHz	Detector	RBW / VBW	Peak value	FCC limit	Margin dB	Verdict
FDD 2	LTE	1.4	QPSK	6	18607	1850	RMS	30kHz	-28.1	-13	15.1	PASS
				6	19193	1910	RMS	30kHz	-28.4	-13	15.4	PASS
			16QAM	6	18607	1850	RMS	30kHz	-31.1	-13	18.1	PASS
				6	19193	1910	RMS	30kHz	-29.4	-13	16.4	PASS
		3	QPSK	15	18615	1850	RMS	30kHz	-29.3	-13	16.3	PASS
				15	19185	1910	RMS	30kHz	-28.1	-13	15.1	PASS
			16QAM	15	18615	1850	RMS	30kHz	-31.6	-13	18.6	PASS
				15	19185	1910	RMS	50kHz	-29	-13	16	PASS
		5	QPSK	25	18625	1850	RMS	50kHz	-29.7	-13	16.7	PASS
				25	19175	1910	RMS	50kHz	-29.3	-13	16.3	PASS
			16QAM	25	18625	1850	RMS	50kHz	-32.2	-13	19.2	PASS
				25	19175	1910	RMS	50kHz	-30.3	-13	17.3	PASS
		10	QPSK	50	18650	1850	RMS	100kHz	-31.2	-13	18.2	PASS
				50	19150	1910	RMS	100kHz	-27.4	-13	14.4	PASS
			16QAM	50	18650	1850	RMS	100kHz	-32.9	-13	19.9	PASS
				50	19150	1910	RMS	100kHz	-28.5	-13	15.5	PASS
		15	QPSK	75	18675	1850	RMS	150kHz	-26.3	-13	13.3	PASS
				75	19125	1910	RMS	150kHz	-24.5	-13	11.5	PASS
		15	16QAM	75	18675	1850	RMS	150kHz	-28.5	-13	15.5	PASS
				75	18675	1850	RMS	150kHz	-28.5	-13	15.5	PASS