InterLab®

FCC Measurement/Technical Report on

TOBY-L201 UMTS/HSPA/LTE Data Module

FCC ID XPYTOBYL201
IC: 8595A-TOBYL201

Report Reference: MDE_UBLOX_1502_FCCd_rev1

according to FCC Part 27, Subpart C

Test Laboratory:
7Layers AG
Borsigstrasse 11
40880 Ratingen
Germany

DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

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0.1 Summary

0.2 Technical Report Summary

Type of Authorization
Certification for a GSM/WCDMA/LTE cellular radiotelephone device. This report covers only the LTE portion of this device.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 69. The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

§ 2.1046 Measurement required: RF power output
§ 2.1049 Measurement required: Occupied bandwidth
§ 2.1051 Measurement required: Spurious emissions at antenna terminals
§ 2.1053 Measurement required: Field strength of spurious radiation
§ 2.1055 Measurement required: Frequency stability
§ 2.1057 Frequency spectrum to be investigated

Part 27, Subpart C—Technical Standards

§ 27.50 Power and antenna height limits
§ 27.53 Emissions limits
§ 27.54 Frequency stability

Additional documents

ANSI TIA-603-C-2004

Correlation of measurement requirements for Cellular Equipment from FCC and IC

FCC Rule / IC Standard	Part 22 / RSS-132		Part 24 / RSS-133 (NA)		Part 27 / RSS-139 / RSS-199		
Effective (isotropic) Radiated Power	§2.1046 §22.913	RSS-GEN, §4.8 RSS-132, §5.4	§2.1046 §24.232	RSS-GEN, §4.8 RSS-133, §6.4	§2.1046 §27.50 (d)	RSS-GEN, §4.8 RSS-139; §6.4	RSS-GEN, §4.8 RSS-199; §4.4
Occupied Bandwidth	§2.1049	RSS-GEN §4.6	§2.1049	RSS-GEN §4.6	§2.1049	RSS-GEN §4.6	RSS-GEN §4.6
"Spuri" at Antenna Terminal	§2.1051 §22.917	RSS-GEN, §4.9 RSS-132, §5.5	§2.1051 §24.238	RSS-GEN, §4.9 RSS-132, §6.5	§2.1051 §27.5 (h)	RSS-GEN, §4.9 RSS-139, §6.5	RSS-GEN, §4.9 RSS-199, §4.6
Band Edge compliance	§2.1051 §22.917	RSS-GEN, §4.6	§2.1051 §24.238	RSS-GEN, §4.6	§2.1051 §27.5 (h)	RSS-GEN, §4.6	RSS-GEN, §4.6
Frequency Stability	§2.1055 §22.355	RSS-GEN, §4.7	§2.1055 §24.235	RSS-GEN, §4.7 RSS-132, §6.3	§2.1055 §27.51	RSS-GEN, §4.7 RSS-139, §6.3	RSS-GEN, §4.7 RSS-199, §4.3
Peak to Average Ration	N/A	RSS-132, §5.3	§2.1046 §24.232	RSS-133, §6.4	§2.1046 §27.50 (d)	RSS-139, §6.4	NA
Modulation Characteristics	§2.1047	RSS-132, §5.4	§2.1047	RSS-133, §6.2	§2.1047	RSS-139, §6.2	RSS-199, §4.1
Field Strength of Spurious Radiation	§2.1053 §22.917	RSS-132, §5.2	§2.1053 §24.235	RSS-GEN, §4.9 RSS-133, §6.5	§2.1053 §27.51	RSS-GEN, §4.9 RSS-139, §6.5	RSS-GEN, §4.9 RSS-199, §4.6

*) Receivers which are part of Transceivers are exempted with respect to Notice 2012-DRS0126.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.3 Measurement Summary

FCC Part 27, Subpart C		**§2.1046, §27.50(d)**	
RF Power Output			
	Setup	**Port**	**Final Result**
	Setup_01/04/05 1)	Temp.ant.connector	passed 2015-05-15
FCC Part 27, Subpart C		**§2.1055, §27.51**	
Frequency stability			
	Setup	**Port**	**Final Result**
	Setup_02/05 2)	Temp.ant.connector	passed 2015-04-13
FCC Part 27, Subpart C		**§2.1051, §27.53(h)**	
Spurious emissions at antenna terminals			
	Setup	**Port**	**Final Result**
	Setup_02/05 1)	Temp.ant.connector	passed 2015-04-13
FCC Part 27, Subpart C		**§2.1049**	
Emission and Occupied Bandwidth			
	Setup	**Port**	**Final Result**
	Setup_01/05 1)	Temp.ant.connector	passed 2015-04-13
FCC Part 27, Subpart C		**§2.1051, §27.53 (h)**	
Band edge compliance			
	Setup	**Port**	**Final Result**
	Setup_02/03/05 1)4)	Temp.ant.connector	passed 2015-04-13
FCC Part 27, Subpart C		**§2.1046, §27.50(d)**	
Peak-Average Ratio			
	Setup	**Port**	**Final Result**
	Setup_01	Temp.ant.connector	passed 2015-03-27
FCC Part 27, Subpart C		**§2.1046, §27.50(d)**	
Field strength of spurious radiation			
	Setup	**Port**	**Final Result**
	Setup_02/03/04/06 3)	Enclosure	Passed 2015-05-15

1) Setup_04 comparison measurement Band 4 after Software change in output power, Setup_05 comparison measurement Band 13 after Hardware Change related to Band 13.
2) Setup_05 additional measurement Band 13 for IC.
3) Run of complete frequency band:
   Mid Channel Band 4 and 17 tested with Setup_03,
   Low channel Band 4 tested with Setup_02,
   High Ch. Band 4, Low/High Channel Band 13 and 17 tested with Setup_04.

   Spot Checks with BWs other than complete run: Setup_04.

Comparison measurement Band 13 mid channel with Setup_06.

4) Bands 4 and 17 tested with Setup_02, Band 17 tested with Setup_03

The customer changed the software output power setting of band 4 during testing, as well as the hardware of the module after testing was performed.
According to the customer the hardware changes are only related to band 13 and no frequency stability relevant hardware was changed.

Due to this, the output power measurement of band 4 was repeated showing slightly higher values. The test cases "Frequency stability", "Spurious at antenna terminals", "Band Edge Compliance" and "Field Strength of spurious radiation" were tested with the new software power setting, while "Emission and Occupied Bandwidth" and "Peak-Average Ratio" were not repeated because no impact on the results is expected.
Regarding band 13 the following additional testing was performed:
The output power measurement was completely repeated, showing lower result values (see testcase RF Power Output for values of new HW and deviation to the old HW). This led to further spot checks on the remaining test cases with the exception of "Frequency stability" and "Peak-Average Ratio" showing similar results.

Responsible for Accreditation Scope: MARCO KULLIK 2015.06.10 18:32:03 +02'00'

Responsible for Test Report: DANIEL GALL 2015.06.10 18:30:54 +02'00'

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2015-05-29	--	invalid
rev1	2015-06-10	Extended Test Description testcase Field strength of spurious radiation, corrected various channel numbers and frequencies in chapter Operating Modes, added statement of compliance assessment for band edge measurement band 13 and 17.	valid

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7Layers AG
Address	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Marco Kullik Dipl.-Ing. Andreas Petz
Report Template Version:	2014-09-18

1.2 Project Data

Responsible for testing and report:	Daniel Gall
Date of Test(s):	2015-03-10 to 2015-05-15
Date of Report:	2015-06-10

1.3 Applicant Data

Company Name:	u-blox AG
Address:	Zürcherstrasse 68, CH-8800 Thalwil Switzerland
Contact Person:	Mr. Giulio Comar
Phone:	+41 44 722 7462
Email Address:	giulio.comar@u-blox.com

1.4 Manufacturer Data

Company Name:	please see applicant data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test:	UMTS/HSPA/LTE Data Module
Type Designation:	TOBY-L201
Kind of Device:	Module
(optional)	
Voltage Type:	DC
Voltage Level:	3.8 V
Tested Modulation Type:	QPSK;16QAM

General product description:

The Module is able to operating in the following bands:
UMTS/HSDPA/HSUPA FDD II, V
LTE eFDD 2, 4, 5, 13 and 17

*This report only covers the LTE portion.

The EUT provides the following ports:

Ports
Temporary antenna connector
Enclosure

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT A (Code: DE1015014aa01)	UMTS/LTE Module	TOBY-L201	358502060012807	218A02	09.81
EUT B (Code: DE1015014aa02)	UMTS/LTE Module	TOBY-L201	358502060012807	218A02	09.82
EUT C (Code: DE1015014ae01)	UMTS/LTE Module	TOBY-L201	358502060012930	218A02	09.81
EUT D (Code: DE1015014ae02)	UMTS/LTE Module	TOBY-L201	358502060012930	218A02	09.82
EUT E (Code: DE1015014ba04)	UMTS/LTE Module	TOBY-L201	358502060016972	218A03	09.84
EUT F (Code: DE1015014ba07)	UMTS/LTE Module	TOBY-L201	358502060016972	218A03	09.87
Remark: EUT A is equipped with a temporary antenna connector. The Module is not sold with a predefined antenna.					

NOTE: The code mentioned in short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE 1	AC/DC converter	UUX324-1215	-	-	E09-0291981	–
AE 2	AC/DC converter	UUX324-1215	-	-	E09-0291993	–
AE 3	AC/DC converter	UUX324-1215	-	-	E09-0291917	–
AE 4	Evaluation test board	EVB-WL3	NO_EVK_CS_191A00	-	-	-
AE 5	Evaluation test board	EVB-WL3	NO_EVK_CS_191A00	-	-	-
AE 6	Evaluation test board	EVB-WL3	NO_EVK_CS_191A00	-	-	-

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
*						

* No auxiliary equipment was required to operate the module

2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description and Rationale
Setup_01	EUT A + AE 1 + AE 4	setup for conducted measurements
Setup_02	EUT B + AE 1 + AE 4	setup for conducted and radiated measurements
Setup_03	EUT C + AE 2 + AE 5	setup for conducted and radiated measurements
Setup_04	EUT D + AE 2 + AE 5	setup for conducted and radiated measurements
Setup_05	EUT E + AE 3 + AE 6	setup for conducted measurements
Setup_06	EUT F + AE 3 + AE 6	setup for radiated measurements

2.6 Operating Modes

The below table shows the test frequencies and channels bandwidths used for testing.

TEST MODE	TX / RX	RF Channel		
		Low	Mid	High
LTE eFDD 4	TX (1.4M)	19957	20175	20393
		1710.7	1732.5	1754.3
	TX (3M)	CH 19965	CH 20175	CH 20385
		1711.50 MHz	1732.50 MHz	1753.50 MHz
	TX (5M)	CH 19975	CH 20175	CH 20375
		1712.50 MHz	1732.50 MHz	1752.50 MHz
	TX (10)	CH 20000	CH 20175	CH 20350
		1715.00 MHz	1732.50 MHz	1750.00 MHz
	TX (15M)	CH 20025	CH 20175	CH 20325
		1717.50 MHz	1732.50 MHz	1747.50 MHz
	TX (20M)	CH 20050	CH 20175	CH 20300
		1720.00 MHz	1732.50 MHz	1745.00 MHz
	RX (1.4M)	CH 1957	CH 2175	CH 2393
		2110.70 MHz	2132.50 MHz	2154.30 MHz
	RX (3M)	CH 1965	CH 2175	CH 2385
		2111.50 MHz	2132.50 MHz	2153.50 MHz
	RX (5M)	CH 1975	CH 2175	CH 2375
		2112.50 MHz	2132.50 MHz	2152.50 MHz
	RX (10M)	CH 2000	CH 2175	CH 2350
		2115.00 MHz	2132.50 MHz	2150.00 MHz
	RX (15M)	CH 2025	CH 2175	CH 2325
		2117.50 MHz	2132.50 MHz	2147.50 MHz
	RX (20M)	CH 2050	CH 2175	CH 2300
		2120.00 MHz	2132.50 MHz	2145.00 MHz

TEST MODE	TX / RX	RF Channel		
		Low	Mid	High
LTE eFDD 13	TX (5M)	CH 23205	CH 23230	CH 23255
		779.50 MHz	782.00 MHz	784.50 MHz
	TX (10)	CH 23230	CH 23230	CH 23230
		782.00 MHz	782.00 MHz	782.00 MHz
	RX (5M)	CH 5205	CH 5230	CH 5255
		748.50 MHz	751.00 MHz	753.50 MHz
	RX (10M)	CH 5230	CH 5230	CH 5230
		751.00 MHz	751.00 MHz	751.00 MHz

TEST MODE	TX / RX	RF Channel		
		Low	Mid	High
LTE eFDD 17	TX (5M)	CH 23755	CH 23790	CH 23825
		706.50 MHz	710.00 MHz	713.50 MHz
	TX (10)	CH 23780	CH 23790	CH 23800
		709.00 MHz	710.00 MHz	711.00 MHz
	RX (5M)	CH 5755	CH 5790	CH 5825
		736.50 MHz	740.00 MHz	743.50 MHz
	RX (10M)	CH 5780	CH 5790	CH 5800
		739.00 MHz	740.00 MHz	741.00 MHz

eFDD 4 Test configuration					
Setup Number	**Test ITEM**	**Channel Band width**	**Channels tested**	**Modulation**	**RB Allocation**
01/04	RF OUTPUT POWER	1.4 MHz	19957, 20175, 20393	QPSK, 16QAM	1RB, 3RB, 6RB
		3 MHz	19965, 20175, 20385	QPSK, 16QAM	1RB, 15RB
		5 MHz	19975, 20175, 20375	QPSK, 16QAM	1RB , 12RB , 25RB
		10 MHz	20000, 20175, 20350	QPSK, 16QAM	1RB, 50RB
		15 MHz	20025, 20175, 20325	QPSK, 16QAM	1RB, 36RB, 75RB
		20 MHz	20050, 20175, 20300	QPSK, 16QAM	1RB, 100RB
02	FREQUENCY STABILITY	1.4	20175	QPSK	1RB
01	OCCUPIED BANDWIDTH	1.4 MHz	19957, 20175, 20393	QPSK, 16QAM	6RB
		3 MHz	19965, 20175, 20385	QPSK, 16QAM	15RB
		5 MHz	19975, 20175, 20375	QPSK, 16QAM	25RB
		10 MHz	2000, 20175, 20350	QPSK, 16QAM	50RB
		15 MHz	20025, 20175, 20325	QPSK, 16QAM	75RB
		20 MHz	20050, 20175, 20300	QPSK, 16QAM	100RB
01	PEAK TO AVERAGE RATIO	5 MHz	19975, 20175, 20375	QPSK, 16QAM	25RB
02	BAND EDGE Compliance	1.4 MHz	19957, 20175, 20393	QPSK, 16QAM	6RB / Max offset
		3 MHz	19965, 20175, 20385	QPSK, 16QAM	15RB/ Max offset
		5 MHz	19975, 20175, 20375	QPSK, 16QAM	25RB/ Max offset
		10 MHz	20000, 20175, 20350	QPSK, 16QAM	50RB/ Max offset
		15 MHz	20025, 20175, 20325	QPSK, 16QAM	75RB/ Max offset
		20 MHz	20050, 20175, 20300	QPSK, 16QAM	100RB/ Max offset
02	CONDUCTED EMISSION	5 MHz	19975, 20175, 20375	QPSK, 16QAM	1RB
02/04	RADIATED EMISSION	10 MHz 1)	20000, 20175, 20350 1)	QPSK	1 RB (Mid Ch.) / 50 RB 1)

eFDD 13 Test configuration					
Setup Number	**Test ITEM**	**Channel Band width**	**Channels tested**	**Modulation**	**RB Allocation**
01/05	RF OUTPUT POWER	5 MHz	23205, 23230, 23255	QPSK, 16QAM	1RB , 12RB , 25RB
		10 MHz	23230	QPSK, 16QAM	1RB, 50RB
02/05	FREQUENCY STABILITY	5	23230	QPSK	1RB
01/05	OCCUPIED BANDWIDTH	5 MHz	23205, 23230, 23255	QPSK, 16QAM	25RB
		10 MHz	23230	QPSK, 16QAM	50RB
01	PEAK TO AVERAGE RATIO	5 MHz	23205, 23230, 23255	QPSK, 16QAM	25RB
02/05	BAND EDGE Compliance	5 MHz	23205, 23230, 23255	QPSK, 16QAM	25RB/ Max offset
		10 MHz	23230	QPSK, 16QAM	50RB/ Max offset
02/05	CONDUCTED EMISSION	5 MHz	23205, 23230, 23255	QPSK, 16QAM	1RB
04/06	RADIATED EMISSION	5 MHz 1)	23205, 23230, 23255 1)	QPSK	1 RB (Mid Ch.) / 25 RB 1)

eFDD 17 Test configuration					
Setup Number	**Test ITEM**	**Channel Band width**	**Channels tested**	**Modulation**	**RB Allocation**
01	RF OUTPUT POWER	5 MHz	23755, 23790, 23825	QPSK, 16QAM	1RB , 12RB , 25RB
		10 MHz	23780, 23790, 23800	QPSK, 16QAM	1RB, 50RB
02	FREQUENCY STABILITY	5	23790	QPSK	1RB
01	OCCUPIED BANDWIDTH	5 MHz	23755, 23790, 23825	QPSK, 16QAM	25RB
		10 MHz	23780, 23790, 23800	QPSK, 16QAM	50RB
01	PEAK TO AVERAGE RATIO	5 MHz	23755, 23790, 23825	QPSK, 16QAM	25RB
03	BAND EDGE Compliance	5 MHz	23755, 23790, 23825	QPSK, 16QAM	25RB/ Max offset
		10 MHz	23780, 23790, 23800	QPSK, 16QAM	50RB/ Max offset
02	CONDCUDETED EMISSION	5 MHz	23755, 23790, 23825	QPSK, 16QAM	1RB
03/04	RADIATED EMISSION	10 MHz 1)	23780, 23790, 23800 1)	QPSK	1 RB (Mid Ch.) / 50 RB 1)

1) Value of run over complete frequency range, spot checks performed on all BWs (1.4/3/5/10/15/20 Band 4, 5/10 Band 13/17) with 1 and max RB setting.

2.7 Special software used for testing

- NA

2.7.1 Software to control the EUT directly

- NA

2.7.2 Software to enable control the EUT by a signaling unit

- NA

2.8 Product labeling

-

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 RF Power Output

FCC Part 27, Subpart C

The test was performed according to: FCC §2.1046

3.1.1 Test Description (conducted procedure)

1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".

a) The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.
b) Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Channel (Frequency): please refer to the detailed results
4) The transmitted power of the EUT was recorded by using a spectrum analyser.
a. The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.

b. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

Test Description (radiated measurement procedure)

1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". The EUT was coupled to a Digital Communication Tester which was located outside the chamber via a small signalling antenna.

2) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Output Power: Maximum
- Channel: please refer to the detailed results

3) A substitution procedure is used so that the readings from the spectrum analyser are corrected and represent directly the equivalent radiated power (related to a lamda/2 dipole).

4) The output power was measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel, mid channel and on the highest channel. To find the worst case power all orientations (X, Y, Z) of the EUT have been measured.

5) The test procedure according to TIA-603-C-2004 has been considered.

3.1.2 Test Requirements / Limits

§2.1046 Measurements Required: RF Power Output
(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the output terminals when this test is made shall be stated.
§27.50 Power and antenna height limits.

(d) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz and 2110–2155 MHz bands:

(2) Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to a peak EIRP of 1 watt.

Fixed stations operating in this band are limited to a maximum antenna height of 10 meters above ground, and mobile and portable stations must employ a means for limiting power to the minimum necessary for successful communications.

Portable stations (hand-held devices) operating in the 704-716 MHz band are limited to 3 watts ERP

3.1.3 Test Protocol

Test Band	Bandwidth (MHz)	Channel	Modulation	RB	RMS Conducted Power new SW setting (dBm)	Deviation to old setting (dB)	FCC/IC EIRP Limit (W)	Max. Antenna Gain (dBi)	Verdict
eFDD4	1.4	19957	QPSK	RB 1	22.71	0.4	1	7.29	Passed
				RB 3	22.63	0.39	1	7.37	Passed
				RB 6	21.64	0.37	1	8.36	Passed
			16QAM	RB 1	21.68	0.4	1	8.32	Passed
				RB 6	20.7	0.43	1	9.3	Passed
		20175	QPSK	RB 1	23.23	0.66	1	6.77	Passed
				RB 3	23.14	0.55	1	6.86	Passed
				RB 6	22.24	0.59	1	7.76	Passed
			16QAM	RB 1	22.24	0.57	1	7.76	Passed
				RB 6	21.18	0.66	1	8.82	Passed
		20393	QPSK	RB 1	22.68	0.18	1	7.32	Passed
				RB 3	22.71	0.26	1	7.29	Passed
				RB 6	21.85	0.36	1	8.15	Passed
			16QAM	RB 1	21.86	0.3	1	8.14	Passed
				RB 6	20.74	0.33	1	9.26	Passed
	3	19956	QPSK	RB 1	22.63	0.38	1	7.37	Passed
				RB 15	21.58	0.32	1	8.42	Passed
			16QAM	RB 1	21.62	0.15	1	8.38	Passed
				RB 15	20.61	0.35	1	9.39	Passed
		20175	QPSK	RB 1	23.13	0.66	1	6.87	Passed
				RB 15	22.14	0.58	1	7.86	Passed
			16QAM	RB 1	22.27	0.63	1	7.73	Passed
				RB 15	21.21	0.67	1	8.79	Passed
		20385	QPSK	RB 1	22.62	0.28	1	7.38	Passed
				RB 15	21.78	0.4	1	8.22	Passed
			16QAM	RB 1	21.73	0.21	1	8.27	Passed
				RB 15	20.6	0.48	1	9.4	Passed
	5	19975	QPSK	RB 1	22.62	0.28	1	7.38	Passed
				RB 12	21.64	0.39	1	8.36	Passed
				RB 25	21.69	0.43	1	8.31	Passed
			16QAM	RB 1	21.8	0.35	1	8.2	Passed
				RB 25	20.69	0.37	1	9.31	Passed
		20175	QPSK	RB 1	23.12	0.79	1	6.88	Passed
				RB 12	22.11	0.6	1	7.89	Passed
				RB 25	22.14	0.79	1	7.86	Passed
			16QAM	RB 1	22.19	0.5	1	7.81	Passed
				RB 25	21.15	0.68	1	8.85	Passed
		20375	QPSK	RB 1	22.54	0.29	1	7.46	Passed
				RB 12	21.65	0.33	1	8.35	Passed
				RB 25	21.69	0.36	1	8.31	Passed
			16QAM	RB 1	21.79	0.36	1	8.21	Passed
				RB 25	20.59	0.4	1	9.41	Passed

Test Band	Bandwidth (MHz)	Channel	Modulation	RB	RMS Conducted Power new SW setting (dBm)	Deviation to old setting (dB)	FCC/IC EIRP Limit (W)	Max. Antenna Gain (dBi)	Verdict
eFDD4	10	20000	QPSK	RB 1	22.68	0.19	1	7.32	Passed
				RB 50	21.69	0.27	1	8.31	Passed
			16QAM	RB 1	21.6	0.14	1	8.4	Passed
				RB 50	20.72	0.3	1	9.28	Passed
		20175	QPSK	RB 1	23.21	0.6	1	6.79	Passed
				RB 50	22.12	0.62	1	7.88	Passed
			16QAM	RB 1	22.35	0.69	1	7.65	Passed
				RB 50	21.14	0.59	1	8.86	Passed
		20350	QPSK	RB 1	22.5	0.27	1	7.5	Passed
				RB 50	21.61	0.36	1	8.39	Passed
			16QAM	RB 1	21.59	0.21	1	8.41	Passed
				RB 50	20.51	0.21	1	9.49	Passed
	15	20025	QPSK	RB 1	22.69	0.22	1	7.31	Passed
				RB 36	21.58	0.17	1	8.42	Passed
				RB 75	21.68	0.15	1	8.32	Passed
			16QAM	RB 1	21.73	0.25	1	8.27	Passed
				RB 75	20.71	0.23	1	9.29	Passed
		20175	QPSK	RB 1	23.24	0.59	1	6.76	Passed
				RB 36	22.23	0.46	1	7.77	Passed
				RB 75	22.11	0.52	1	7.89	Passed
			16QAM	RB 1	22.43	0.62	1	7.57	Passed
				RB 75	21.09	0.51	1	8.91	Passed
		20325	QPSK	RB 1	22.47	0.35	1	7.53	Passed
				RB 36	21.79	0.54	1	8.21	Passed
				RB 75	21.65	0.43	1	8.35	Passed
			16QAM	RB 1	21.64	0.34	1	8.36	Passed
				RB 75	20.52	0.25	1	9.48	Passed
	20	20050	QPSK	RB 1	22.87	0.17	1	7.13	Passed
				RB 100	21.93	0.24	1	8.07	Passed
			16QAM	RB 1	21.9	0.22	1	8.1	Passed
				RB 100	20.92	0.21	1	9.08	Passed
		20175	QPSK	RB 1	23.22	0.62	1	6.78	Passed
				RB 100	22.17	0.49	1	7.83	Passed
			16QAM	RB 1	22.26	0.6	1	7.74	Passed
				RB 100	21.22	0.53	1	8.78	Passed
		20300	QPSK	RB 1	22.61	0.44	1	7.39	Passed
				RB 100	21.68	0.43	1	8.32	Passed
			16QAM	RB 1	21.87	0.5	1	8.13	Passed
				RB 100	20.7	0.41	1	9.3	Passed

Test Band	Bandwidth (MHz)	Channel	Modulation	RB	RMS Conducted Power new HW (dBm)	Deviation to values of old HW (dB)	FCC / IC EIRP limit (W)	Max. antenna gain (dBi)	Verdict
eFDD13	5	23205	QPSK	RB 1	22.02	-0.40	3	12.75	Passed
				RB 12	21.34	-0.14	3	13.43	Passed
				RB 25	21.10	-0.41	3	13.67	Passed
			16QAM	RB 1	21.17	-0.35	3	13.6	Passed
				RB 25	20.06	-0.38	3	14.71	Passed
		23230	QPSK	RB 1	21.83	-0.54	3	12.94	Passed
				RB 12	20.60	-0.99	3	14.17	Passed
				RB 25	20.76	-0.90	3	14.01	Passed
			16QAM	RB 1	20.74	-0.92	3	14.03	Passed
				RB 25	19.73	-0.71	3	15.04	Passed
		23255	QPSK	RB 1	22.25	-0.36	3	12.52	Passed
				RB 12	20.76	-0.89	3	14.01	Passed
				RB 25	21.08	-0.62	3	13.69	Passed
			16QAM	RB 1	21.41	-0.51	3	13.36	Passed
				RB 25	20.02	-0.50	3	14.75	Passed
	10	23230	QPSK	RB 1	21.89	-0.26	3	12.88	Passed
				RB 50	21.06	-0.46	3	13.71	Passed
			16QAM	RB 1	20.85	-0.79	3	13.92	Passed
				RB 50	19.98	-0.53	3	14.79	Passed

Negative deviation => values of new hardware are lower than values of old hardware.

Test Band	Bandwidth (MHz)	Channel	Modulation	RB	RMS Conducted power (dBM)	FCC ERP limit (W)	IC ERP limit per SRSP-503 (W)	Maximum antenna gain (dBD)	Verdict
eFDD17	5	23755	QPSK	RB 1	22.54	3	3	12.23	Passed
				RB 12	21.52	3	3	13.25	Passed
				RB 25	21.52	3	3	13.25	Passed
			16QAM	RB 1	21.46	3	3	13.31	Passed
				RB 25	20.47	3	3	14.3	Passed
		23790	QPSK	RB 1	22.67	3	3	12.1	Passed
				RB 12	21.66	3	3	13.11	Passed
				RB 25	21.57	3	3	13.2	Passed
			16QAM	RB 1	21.66	3	3	13.11	Passed
				RB 25	20.47	3	3	14.3	Passed
		23825	QPSK	RB 1	22.39	3	3	12.38	Passed
				RB 12	21.56	3	3	13.21	Passed
				RB 25	21.60	3	3	13.17	Passed
			16QAM	RB 1	21.55	3	3	13.22	Passed
				RB 25	20.51	3	3	14.26	Passed
	10	23780	QPSK	RB 1	22.70	3	3	12.07	Passed
				RB 50	21.44	3	3	13.33	Passed
			16QAM	RB 1	21.53	3	3	13.24	Passed
				RB 50	20.36	3	3	14.41	Passed
		23790	QPSK	RB 1	22.80	3	3	11.97	Passed
				RB 50	21.49	3	3	13.28	Passed
			16QAM	RB 1	21.74	3	3	13.03	Passed
				RB 50	20.41	3	3	14.36	Passed
		23800	QPSK	RB 1	23.05	3	3	11.72	Passed
				RB 50	21.60	3	3	13.17	Passed
			16QAM	RB 1	22.02	3	3	12.75	Passed
				RB 50	20.52	3	3	14.25	Passed

3.2 Frequency stability

Standard FCC Part 27, Subpart C

The test was performed according to: FCC §2.1055

3.2.1 Test Description

1) The EUT was placed inside a temperature chamber.
2) The EUT was coupled to a Digital Communication Tester. Refer to chapter "Setup Drawings".
3) The climatic chamber was cycled down/up to a certain temperature, starting with the EUT minimum temperature.
4) After the temperature was stabilized the EUT was switched on and a call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Output Power: Maximum
- Mid Channel
5) The frequency error of the EUT was recorded by using an internal measurement function of the Digital Communication Tester immediately after the call was established, five minutes after the call was established and ten minutes after the call was established.
6) This measurement procedure was performed for temperature variation from –30°C to +50°C in increments of 10°C, if not otherwise stated in the detailed results.
When the EUT did not operate at certain temperature levels, these measurements were left out.

3.2.2 Test Requirements / Limits

§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 except that specified in paragraphs (a) (2) and (3) of this section.
(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. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.
Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§27.54 Frequency stability

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7Layers interpretation of limit:

To ensure that the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block following limit was used:

+/- 2.5 ppm = 4350 Hz for channel 1450, frequency 1740.0 MHz
+/- 2.5 ppm = 4331 Hz for channel 1412, frequency 1732.4 MHz

in accordance with FCC Part 22, Subpart H, §22.355, table C-1: Frequency tolerance for the carrier frequency of mobile transmitters in the Public Mobile Service in the frequency range 821 to 896 MHz.

3.2.3 Test Protocol

eFDD4 new SW power settings
Channel: 20175 / 1.4MHz Bandwidth / 1 Resource Block / QPSK Modulation

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	4331.25	-2.78	-17.32	passed
-30	5			-6.84	-18.07	passed
-30	10			-3.78	-20.5	passed
-20	0	normal	4331.25	1	8.74	passed
-20	5			-0.41	-14.13	passed
-20	10			-0.56	9.78	passed
-10	0	normal	4331.25	-1.26	-9.26	passed
-10	5			-0.69	-10.61	passed
-10	10			-0.13	-12.17	passed
0	0	normal	4331.25	-0.97	-9.6	passed
0	5			-0.93	-10.41	passed
0	10			-0.31	-14.83	passed
10	0	normal	4331.25	2.26	20.43	passed
10	5			-1.3	-10.23	passed
10	10			-0.24	-9.48	passed
20	0	low	4331.25	-1.89	-16.51	passed
20	5			-1.36	-11.7	passed
20	10			-0.49	10.54	passed
20	0	normal	4331.25	-1.07	10.97	passed
20	5			-1.34	10.21	passed
20	10			-0.39	-13.96	passed
20	0	high	4331.25	-1.72	-8.3	passed
20	5			-2.25	11.53	passed
20	10			-0.37	15.85	passed
30	0	normal	4331.25	-0.93	12.17	passed
30	5			-3.98	-13.45	passed
30	10			-1.67	-12.33	passed
40	0	normal	4331.25	-1.57	-11.3	passed
40	5			-0.83	-13.85	passed
40	10			-0.79	12.17	passed
50	0	normal	4331.25	-0.93	-18.87	passed
50	5			-1.82	14.39	passed
50	10			-1.39	-17.9	passed

eFDD13 old HW
Channel: 23230 / 1.4MHz Bandwidth / 1 Resource Block / QPSK Modulation

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1955	-3.98	-23.92	passed
-30	5			-5.48	-27.39	passed
-30	10			-2.96	-17.78	passed
-20	0	normal	1955	-3.59	-14.69	passed
-20	5			-3.85	-26.25	passed
-20	10			-2.57	-19.47	passed
-10	0	normal	1955	-2.92	84.89	passed
-10	5			-4.05	16.51	passed
-10	10			-6.18	-19.81	passed
0	0	normal	1955	-5.05	-16.77	passed
0	5			-3.92	-21.41	passed
0	10			-4.81	-20.8	passed
10	0	normal	1955	-4.96	-16.05	passed
10	5			-6.71	-19.28	passed
10	10			-6.82	-27.51	passed
20	0	low	1955	-9.16	-25.15	passed
20	5			-3.28	-13.6	passed
20	10			-4.63	-17.47	passed
20	0	normal	1955	-4.23	-18.05	passed
20	5			-3.83	-13.65	passed
20	10			-6.42	-16.51	passed
20	0	high	1955	-4.53	-13.25	passed
20	5			-5.66	-14.52	passed
20	10			-10.63	-24.72	passed
30	0	normal	1955	-12.06	-27.98	passed
30	5			-3.38	-11.57	passed
30	10			-6.85	-15.11	passed
40	0	normal	1955	-5.45	-18.14	passed
40	5			-2.25	-10.64	passed
40	10			-2.27	-11.93	passed
50	0	normal	1955	-3.81	-12.69	passed
50	5			-3.56	-12.26	passed
50	10			-4.98	-13.33	passed

eFDD17
Channel: 23230 / 1.4MHz Bandwidth / 1 Resource Block / QPSK Modulation

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1775	-1.2	-16.61	passed
-30	5			-2.12	-13.93	passed
-30	10			-1.57	-15.11	passed
-20	0	normal	1775	-3.43	-15.91	passed
-20	5			-2.42	-19.76	passed
-20	10			-2.25	-13.7	passed
-10	0	normal	1775	-2.22	-14.63	passed
-10	5			-1.09	-12.07	passed
-10	10			-2.1	14.59	passed
0	0	normal	1775	-1.75	-14.38	passed
0	5			-2	17.45	passed
0	10			-0.96	13.62	passed
10	0	normal	1775	-3.93	-14.99	passed
10	5			-2.23	-12.6	passed
10	10			-2.26	18.12	passed
20	0	low	1775	-1.03	-17.14	passed
20	5			0.37	-11.94	passed
20	10			-2.17	-14.13	passed
20	0	normal	1775	-1.06	-38.94	passed
20	5			-0.17	-11.19	passed
20	10			-1.07	-11.42	passed
20	0	high	1775	-1.19	-11.86	passed
20	5			-0.72	-8.35	passed
20	10			-3.68	-17.14	passed
30	0	normal	1775	-0.89	-17.04	passed
30	5			-0.94	21.57	passed
30	10			-0.73	-8.91	passed
40	0	normal	1775	-1.26	14.29	passed
40	5			-0.97	-10.13	passed
40	10			-0.36	-12.47	passed
50	0	normal	1775	-0.72	13.42	passed
50	5			-1.65	-13.45	passed
50	10			-1.36	-9.07	passed

3.2.3.1 Additional measurements according RSS-130 4.3 bands eFDD13 and eFDD17

Results of worst case mode of pre measurements:

LTE eFDD13						
BW (MHz) / Resource Blocks	f_L (MHz)	f_H (MHz)	Max. Frequency Error (Hz)	Resulting Freq. (MHz)	Limit (MHz)	Result
5 / 25	777.1995	-	85	777.20	777	Passed
	-	786.797	85	786.80	787	Passed

LTE eFDD17						
BW (MHz) / Resource Blocks	f_L (MHz)	f_H (MHz)	Max. Frequency Error (Hz)	Resulting Freq. (MHz)	Limit (MHz)	Result
5 / 25	704.15267	-	39	704.15	704	Passed
	-	715.81846	39	715.82	716	Passed

3.3 Spurious emissions at antenna terminals

Standard FCC Part 27, Subpart C

The test was performed according to FCC §2.1051

3.3.1 Test Description

1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Output Power: Maximum
- Channel: please refer to the detailed results
4) Important Analyser Settings
- [Resolution Bandwidth]:
a) [>=1% of wanted signal bandwidth] in the Span of 1 MHz directly below and above the PCS-Band,
b) otherwise [100 kHz] (or [1 MHz] for accelerated sweep times)
c) [reduced resolution bandwidth] in case the curve of the analyser IF-Filter or the wanted EUT signal leads to an exceeding of the limit, in this case a correction factor was used
- Sweep Time: depending on the transmitting signal, the span and the resolution bandwidth
5) The spurious emissions peaks were measured in the frequency range from 9 kHz to 10 GHz (up to the 10th harmonic) during the call was established

3.3.2 Test Requirements / Limits

§ 2.1051 Spurious emissions at antenna terminals

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the

permissible value need not be reported.
(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 27.53 Emission limits

(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10(P) dB.
Remark of the test laboratory: This is calculated to be -13 dBm.
(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.
(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.
(3) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

For reporting only spurious emission levels reaching to the 20dB margin to limit were noted.

3.3.3 Test Protocol

Band / Band width	Modulation	Channel	resolution band width (kHz)	frequency (MHz)	peak value (dBm)	peak value new HW eFDD13 (dBm)	margin to limit (dB)	limit (dBm)	verdict
eFDD4 / 5 MHz	QPSK	19975	100	1708.960	-23.6		10.6	-13	Passed
		20175	-	-	-		-	-13	Passed
		20375	100	1756.020	-22.3		9.3	-13	Passed
	16QAM	19975	100	1708.930	-24.2		11.2	-13	Passed
		20175	-	-	-		-	-13	Passed
		20375	100	1756.050	-23.2		10.2	-13	Passed
eFDD13 / 5 MHz	QPSK	23205	50	777.000	-28.4	-28.3	15.4	-13	Passed
		23230	-	-	-	-	-	-13	Passed
		23255	50	787.000	-30.3		17.3	-13	Passed
	16QAM	23205	50	777.000	-29.1		16.1	-13	Passed
		23230	-	-	-		-	-13	Passed
		23255	50	787.010	-31.1		18.1	-13	Passed
eFDD17 / 5 MHz	QPSK	23755	50	703.990	-26		13	-13	Passed
		23790	-	-	-		-	-13	Passed
		23825	50	716.010	-26.2		13.2	-13	Passed
	16QAM	23755	50	704.000	-26.4		13.4	-13	Passed
		23790	-	-	-		-	-13	Passed
		23825	50	716.000	-27.7		14.7	-13	Passed

Detector: RMS, Trace: maxhold

3.4 Emission and Occupied Bandwidth

Standard FCC Part 27, Subpart C

The test was performed according to: FCC §2.1049

3.4.1 Test Description

1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Output Power: Maximum
- Channel: please refer to the detailed results
4) Important Analyser Settings:
- Resolution Bandwidth: >1% of the manufacturer's stated occupied bandwidth
5) The maximum spectral level of the modulated signal was recorded as the reference.
6) The emission bandwidth is measured as follows:
the two furthest frequencies above and below the frequency of the maximum reference level where the spectrum is –26 dB down have to be found.
7) 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.

The maximum number of resource blocks are used for each channel bandwidth.

3.4.2 Test Requirements / Limits

§ 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions (as applicable):

(h) Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

3.4.3 Test Protocol

The maximum number of resource blocks are used for each channel bandwidth.

LTE Band 4							
Channel BW: 1.4 MHz				Channel BW: 3 MHz			
		99% BW (MHz)				99% BW (MHz)	
Channel	Frequency (MHz)	QPSK	16QAM	Channel	Frequency (MHz)	QPSK	16QAM
19957	1710.7	1.12	1.13	19965	1711.5	2.79	2.81
20175	1732.5	1.12	1.11	20175	1732.5	2.78	2.78
20393	1754.3	1.12	1.11	20385	1753.5	2.78	2.79

LTE Band 4							
Channel BW: 5MHz				Channel BW: 10 MHz			
		99% BW (MHz)				99% BW (MHz)	
Channel	Frequency (MHz)	QPSK	16QAM	Channel	Frequency (MHz)	QPSK	16QAM
19975	1712.5	4.55	4.53	20000	1715.0	9.02	9.06
20175	1732.5	4.55	4.57	20175	1732.5	9.02	9.06
20375	1752.5	4.53	4.59	20350	1750.0	9.02	9.02

LTE Band 4							
Channel BW: 15MHz				Channel BW: 20 MHz			
		99% BW (MHz)				99% BW (MHz)	
Channel	Frequency (MHz)	QPSK	16QAM	Channel	Frequency (MHz)	QPSK	16QAM
20025	1717.5	13.6	13.5	20050	1720.0	18.0	18.0
20175	1732.5	13.5	13.5	20175	1732.5	18.1	18.0
20325	1747.5	13.5	13.5	20300	1745.0	18.0	18.1

Values of old software power setting.

LTE Band 13								
Channel BW: 5MHz				Channel BW: 10 MHz				
		99% BW (MHz)				99% BW (MHz)		
Channel	Frequency (MHz)	QPSK	16QAM	Channel	Frequency (MHz)	QPSK	16QAM	
23205	779.5	4.5	4.6	-	-	-	-	
23230	782.0	4.5	4.5	23230	782.0	9.0	9.0	1)
23255	784.5	4.5	4.5	23230	782.0	9.0	9.0	2)

1) Channel BW 10 MHz value old HW
2) Channel BW 10 MHz value new HW

LTE Band 17							
Channel BW: 5MHz				Channel BW: 10 MHz			
		99% BW (MHz)				99% BW (MHz)	
Channel	Frequency (MHz)	QPSK	16QAM	Channel	Frequency (MHz)	QPSK	16QAM
23755	706.5	4.5	4.5	23780	709.0	9.0	9.0
23790	710.0	4.5	4.6	23790	710.0	9.0	9.0
23825	713.5	4.5	4.6	23800	711.0	9.0	9.0

3.5 Band edge compliance

Standard FCC Part 24, Subpart C

The test was performed according to: FCC §27.53

3.5.1 Test Description

1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Output Power: Maximum
- Channel: please refer to the detailed results
4) Important Analyser Settings:
- Resolution Bandwidth = Video Bandwidth: >1% of the manufacturer's stated occupied bandwidth (Band 4)
- Resolution Bandwidth = Video Bandwidth = 50 kHz (Band 13/17).
  To comply with the higher resolution bandwidth requirement of 100 kHz in the range >100kHz from the band edge the assessment of compliance with the limit is done by adding 3 dB to the measured values of the result plot.

3.5.2 Test Requirements / Limits

§ 27.53 Emission limitations for cellular equipment

(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10(P) dB.
Remark of the test laboratory: This is calculated to be -13 dBm.
(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.
(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.
(3) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

For reporting only spurious emission levels reaching to the 20dB margin to limit were noted.

3.5.3 Test Protocol

Band	Band width (MHz)	Modulation	Resource Blocks / Offset	Channel	Detector	Frequency (MHz)	Peak Value (dBm)	Limit (dBm)	Verdict
eFDD4	1.4	QPSK	6 / 0	19957	Average	1710	-23.28	-13	Passed
					RMS		-21.42	-13	Passed
			6 / Max	20393	Average	1755	-24.3	-13	Passed
					RMS		-22.36	-13	Passed
		16QAM	6 / 0	19957	Average	1710	-24.15	-13	Passed
					RMS		-22.36	-13	Passed
			6 / Max	20393	Average	1755	-24.95	-13	Passed
					RMS		-23.01	-13	Passed
	3	QPSK	15 / 0	19965	Average	1710	-25.82	-13	Passed
					RMS		-23.14	-13	Passed
			15 / Max	20385	Average	1755	-27.22	-13	Passed
					RMS		-24.78	-13	Passed
		16QAM	15 / 0	19965	Average	1710	-26.6	-13	Passed
					RMS		-23.85	-13	Passed
			15 / Max	20385	Average	1755	-28.14	-13	Passed
					RMS		-25.46	-13	Passed
	5	QPSK	25 / 0	19975	Average	1710	-29.16	-13	Passed
					RMS		-25.64	-13	Passed
			25 / Max	20375	Average	1755	-28.38	-13	Passed
					RMS		-25.11	-13	Passed
		16QAM	25 / 0	19975	Average	1710	-30.32	-13	Passed
					RMS		-26.8	-13	Passed
			25 / Max	20375	Average	1755	-29.16	-13	Passed
					RMS		-25.64	-13	Passed
	10	QPSK	50 / 0	20000	Average	1710	-32.42	-13	Passed
					RMS		-29.44	-13	Passed
			50 / Max	20350	Average	1755	-31.66	-13	Passed
					RMS		-28.64	-13	Passed
		16QAM	50 / 0	20000	Average	1710	-34.16	-13	Passed
					RMS		-30.97	-13	Passed
			50 / Max	20350	Average	1755	-33.24	-13	Passed
					RMS		-30.32	-13	Passed
	15	QPSK	75 / 0	20025	Average	1710	-32.82	-13	Passed
					RMS		-29.72	-13	Passed
			75 / Max	20325	Average	1755	-30.64	-13	Passed
					RMS		-28.14	-13	Passed
		16QAM	75 / 0	20025	Average	1710	-33.69	-13	Passed
					RMS		-30.64	-13	Passed
			75 / Max	20325	Average	1755	-32.03	-13	Passed
					RMS		-29.16	-13	Passed
	20	QPSK	100 / 0	20050	Average	1710	-35.18	-13	Passed
					RMS		-32.82	-13	Passed
			100 / Max	20300	Average	1755	-32.03	-13	Passed
					RMS		-30.32	-13	Passed
		16QAM	100 / 0	20050	Average	1710	-36.34	-13	Passed
					RMS		-34.16	-13	Passed
			100 / Max	20300	Average	1755	-34.16	-13	Passed
					RMS		-32.03	-13	Passed

Values of new software power setting

Band	Band width (MHz)	Modulation	Resource Blocks / Offset	Channel	Detector	Frequency (MHz)	Peak Value old HW (dBm)	Peak Value new HW (dBm)	Limit (dBm)	Verdict
eFDD13	5	QPSK	25 / 0	23205	Average	777	-32.82	-32.82	-13	Passed
					RMS		-28.54	-28.78	-13	Passed
			25 / Max	23255	Average	787	-33.64	-34.56	-13	Passed
					RMS		-29.56	-31.04	-13	Passed
		16QAM	25 / 0	23205	Average	777	-34.09	-33.22	-13	Passed
					RMS		-29.84	-29.3	-13	Passed
			25 / Max	23255	Average	787	-34.56		-13	Passed
					RMS		-30.72		-13	Passed
	10	QPSK	50 / 0	23230	Average	787	-36.14		-13	Passed
					RMS		-33.64		-13	Passed
		16QAM	50 / 0		Average		-37.39		-13	Passed
					RMS		-35.06		-13	Passed

Band	Band width (MHz)	Modulation	Resource Blocks / Offset	Channel	Detector	Frequency (MHz)	Peak Value (dBm)	Limit (dBm)	Verdict
eFDD17	5	QPSK	25 / 0	23755	Average	704	-30.12	-13	Passed
					RMS		-26.22	-13	Passed
			25 / Max	23825	Average	716	-30.72	-13	Passed
					RMS		-26.8	-13	Passed
		16QAM	25 / 0	23755	Average	704	-30.72	-13	Passed
					RMS		-26.8	-13	Passed
			25 / Max	23825	Average	716	-30.42	-13	Passed
					RMS		-27.2	-13	Passed
	10	QPSK	50 / 0	23780	Average	704	-33.22	-13	Passed
					RMS		-30.72	-13	Passed
			50 / Max	23800	Average	716	-35.06	-13	Passed
					RMS		-32.43	-13	Passed
		16QAM	50 / 0	23780	Average	704	-34.09	-13	Passed
					RMS		-32.06	-13	Passed
			50 / Max	23800	Average	716	-35.06	-13	Passed
					RMS		-33.22	-13	Passed

3.6 Power to Average Ratio

Standard FCC §2.1046, §27.50 (d)

The test was performed according to: §2.1046, §27.50 (d)
A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth.
The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

KDB 971168 v02r01 – Section 5.7.1 was applied.

Test Settings
1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyser was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analysed. For continuous
signals (>98% duty cycle), the measurement interval was set to 1ms.

3.6.1 Test Protocol

Band	Bandwidth / Resource Blocks	Channel	Modulation	Measured Value (dB)	Limit (dB)	Verdict
eFDD4	1.4 MHz / 6 RB	19957	QPSK	5.68	13 dB	Passed
		20175		5.48	13 dB	Passed
		20393		5.57	13 dB	Passed
		19957	16-QAM	6.41	13 dB	Passed
		20175		6.2	13 dB	Passed
		20393		6.43	13 dB	Passed

Values old SW power setting

Band	Bandwidth / Resource Blocks	Channel	Modulation	Measured Value (dB)	Limit (dB)	Verdict
eFDD13	5 MHz / 25 RB	23205	QPSK	5.59	13 dB	Passed
		23230		5.54	13 dB	Passed
		23255		5.36	13 dB	Passed
		23205	16-QAM	6.29	13 dB	Passed
		23230		6.29	13 dB	Passed
		23255		6.12	13 dB	Passed

Values old HW

Band	Bandwidth / Resource Blocks	Channel	Modulation	Measured Value (dB)	Limit (dB)	Verdict
eFDD17	5 MHz / 25 RB	23755	QPSK	5.71	13	Passed
		23790		5.62	13	Passed
		23825		5.91	13	Passed
		23755	16-QAM	6.41	13	Passed
		23790		6.43	13	Passed
		23825		6.61	13	Passed

3.7 Field strength of spurious radiation

3.7.1 Test Description

1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". The EUT was coupled to the R&S CMW500 Digital Communication Tester which was located outside the chamber via coaxial cable.
2) A call was established on a Traffic Channel (TCH) between the EUT and the base station simulator (R&S CMW500 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequence)
- Output Power: Maximum
- Channel : Varied during measurements
3) A pre-calibration procedure is used so that the readings from the spectrum analyser are corrected and represent directly the equivalent radiated power (related to a lamda/2 dipole).
4) All spurious radiation measurements were made with spectrum analyser and the appropriate calibrated antennas for the frequency range of 30 MHz to 10 GHz (up to the 10th harmonic of the transmit frequency).
5) Important Analyser Settings
- [Resolution Bandwidth / Video Bandwidth]:
a) [30 kHz / 30 kHz] in the Span of 1 MHz directly below and above the LTE-Band (Bands 13 and 17), >1% of emission BW Band 4
b) [100 kHz / 100 kHz] close to the band edges but further than 100 kHz (Bands 13 and 17)
c) [10kHz / 10 kHz] in the ranges 758-775 MHz and 788-805 MHz (Band 13 only)
d) [1 MHz / 1 MHz] otherwise
- Sweep Time: Calculated by using a formula given in the Product Standard "11.10-1 edition 4" for spurious emissions measurements (depending on the transmitting signal, the span and the resolution bandwidth)
e) peak detector, except for ranges close to the band for all bands and the range 1559 MHz – 1610 MHz in band 13 where RMS detector is used.
6) The spurious emissions (peak) were measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel, mid channel and on the highest channel.
7) After this initial test, a final test according to TIA-603-C 2.2.12 Unwanted Emissions is performed on signals which are identified as being close to the limit. For any emissions found to be within 10 dB of the limit, a specific signal substitution measurement is performed at the frequency of the emission to determine the exact e.i.r.p. value.

3.7.2 Test Requirements / Limits

§ 2.1053 Measurements required: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field

measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(2) All equipment operating on frequencies higher than 25 MHz.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.
(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§27.53 Emission limits

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz

segment.

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

(2) Additional protection levels. Notwithstanding the foregoing paragraph (h)(1) of this section:

(i) Operations in the 2180-2200 MHz band are subject to the out-of-band emission requirements set forth in §27.1134 for the protection of federal government operations operating in the 2200-2290 MHz band.

(ii) For operations in the 2000-2020 MHz band, the power of any emissions below 2000 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iii) For operations in the 1915-1920 MHz band, the power of any emission between 1930-1995 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iv) For operations in the 1995-2000 MHz band, the power of any emission between 2005-2020 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(iii) The measurements of emission power can be expressed in peak or average values,

provided they are expressed in the same parameters as the transmitter power.

(4) Private agreements. (i) For AWS operations in the 2000-2020 MHz and 2180-2200 MHz bands, to the extent a licensee establishes unified operations across the AWS blocks, that licensee may choose not to observe the emission limit specified in paragraph (h)(1), above, strictly between its adjacent block licenses in a geographic area, so long as it complies with other Commission rules and is not adversely affecting the operations of other parties by virtue of exceeding the emission limit.

(ii) For AWS operations in the 2000-2020 MHz band, a licensee may enter into private agreements with all licensees operating between 1995 and 2000 MHz to allow the 70 + 10 log10(P) dB limit to be exceeded within the 1995-2000 MHz band.

(iii) An AWS licensee who is a party to a private agreement described in this section (4) must maintain a copy of the agreement in its station files and disclose it, upon request, to prospective AWS assignees, transferees, or spectrum lessees and to the Commission.

3.7.3 Test Protocol

eFDD4 worst case of pre-measurement (1.4 MHz 6RB)

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	verdict
rms	maxhold	20	1710	-21.43	-13	8.43	passed
rms	maxhold	20	1756	-27.07	-13	14.07	passed

no further values have been found with a margin of less than 20 dB

eFDD13 worst case of pre-measurement (5 MHz 1RB)

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	verdict
rms	maxhold	30	787.0	-16.21	-13.00	3.21	passed

no further values have been found with a margin of less than 20 dB

eFDD17 worst case of pre-measurement (5MHz 1RB)

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	verdict
rms	maxhold	100	703.8	-13.28	-13.00	0.28	passed
rms	maxhold	100	716.1	-13.19	-13.00	0.19	passed

no further values have been found with a margin of less than 20 dB

4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m³

Calibration Details	*Last Execution*	*Next Exec.*
NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m³	none	Frankonia

Calibration Details	*Last Execution*	*Next Exec.*
FCC listing 96716 3m Part15/18	2014/01/09	2017/01/08

Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 1**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Antenna mast	AM 4.0	AM4.0/180/11920513	Maturo GmbH
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG

Calibration Details	*Last Execution*	*Next Exec.*
Standard Calibration	2012/05/18	2015/05/17

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170	BBHA9170262		
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/12/18	2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG	
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD Calibration		2014/11/27	2017/11/27
Standard Gain / Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH	
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH	
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH	

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 1, Lab 2**
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	Calibration Details		*Last Execution* *Next Exec.*
	Customized calibration		2013/12/04 2015/12/03
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard		2014/02/10 2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard		2012/06/13 2015/06/12
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/07/29 2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 1, Lab 2**
Description:	Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standart calibration		2015/01/21	2018/01/19
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD calibration		2014/12/02	2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	HW/SW Status		*Date of Start*	*Date of End*
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD calibration		2014/12/03	2017/12/02
	HW/SW Status		*Date of Start*	*Date of End*
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02	
	SW: K62, K69		2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	

Test Equipment Emission measurement devices

Lab ID:	**Lab 1**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
EMI Receiver / Spectrum Analyser	ESR 7	101424	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Exec.*
	Initial Factory Calibration		2014/11/13	2016/11/12
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/05/13	2015/05/12
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/05/13	2015/05/12
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/06/24	2017/06/23
Spectrum Analyser	FSW 43	103779	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Exec.*
	Initial Factory Calibration		2014/11/17	2016/11/16
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/01/07	2016/01/31
	HW/SW Status		*Date of Start*	*Date of End*
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03	

Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 2**
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/05/13 2015/05/12
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/07/03 2015/07/02
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/05/13 2015/05/12
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/12/02 2017/12/01
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2013/05/06 2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Calibration after reparation		2015/04/02 2017/04/01

Test Equipment T/A Logger 13

Lab ID:	**Lab 1, Lab 2**
Description:	Lufft Opus10 TPR
Type:	Opus10 TPR
Serial Number:	13936

Single Devices for T/A Logger 13

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID:	**Lab 2**
Description:	Lufft Opus10
Serial Number:	7482

Single Devices for T/H Logger 03

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoHygro Datalogger 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 12

Lab ID:	**Lab 1**
Description:	Lufft Opus10
Serial Number:	12482

Single Devices for T/H Logger 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2015/03/10	2017/03/09

Test Equipment Temperature Chamber 05

Lab ID:	**Lab 2**
Manufacturer:	see single devices
Description:	Temperature Chamber VT4002
Type:	Vötsch
Serial Number:	see single devices

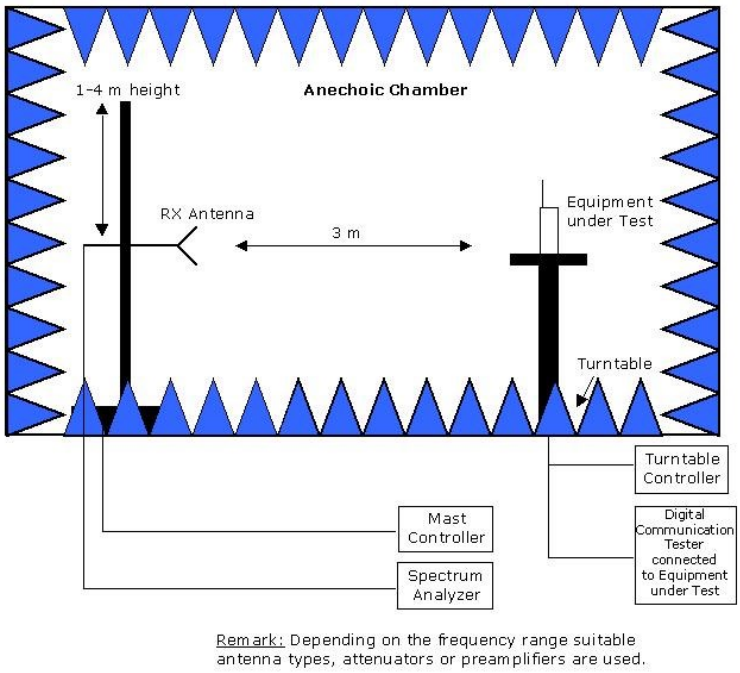
Single Devices for Temperature Chamber 05

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2014/03/11	2016/03/10

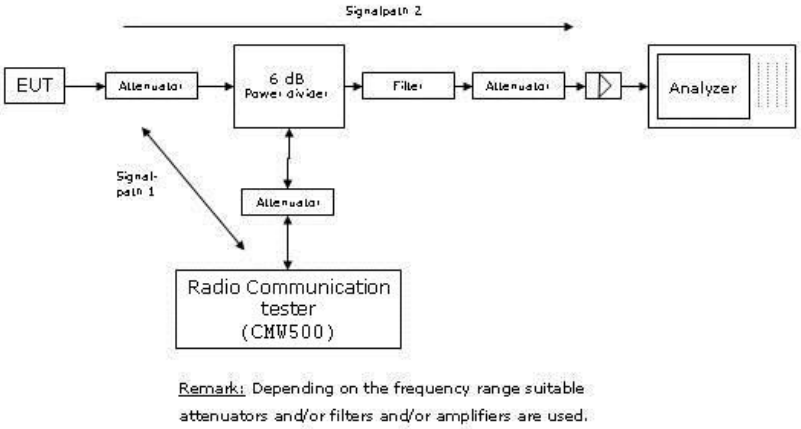
5 Photo Report

Photos are included in an external report.

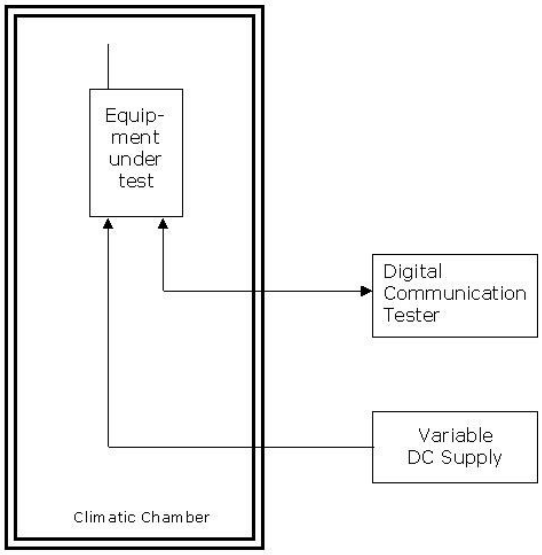
6 Setup Drawings



Drawing 1: Setup in the anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.



Principle set-up for conducted measurements under nominal conditions

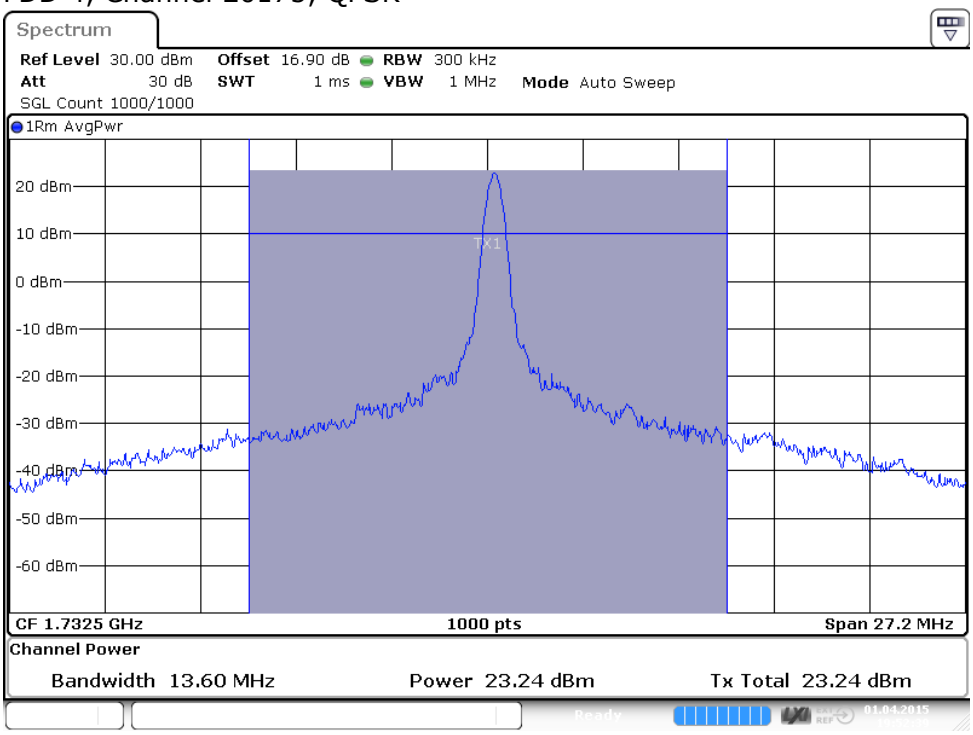


Principle set-up for tests under extreme test conditions

7 Annex measurement plots (worst case)

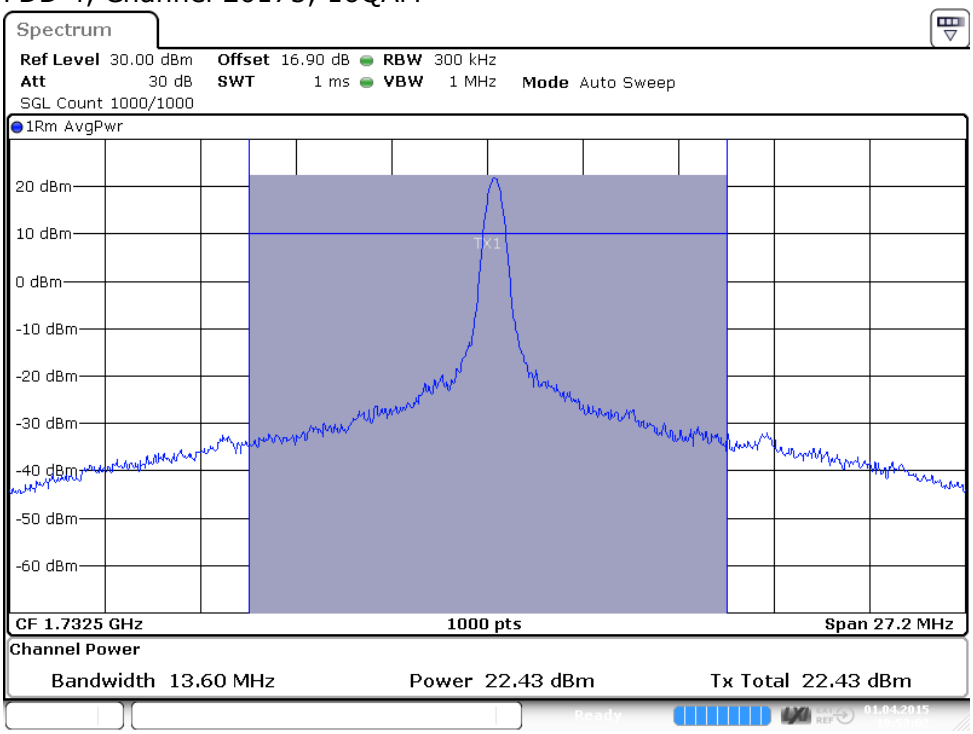
7.1 RF Power Output

FDD 4, Channel 20175, QPSK



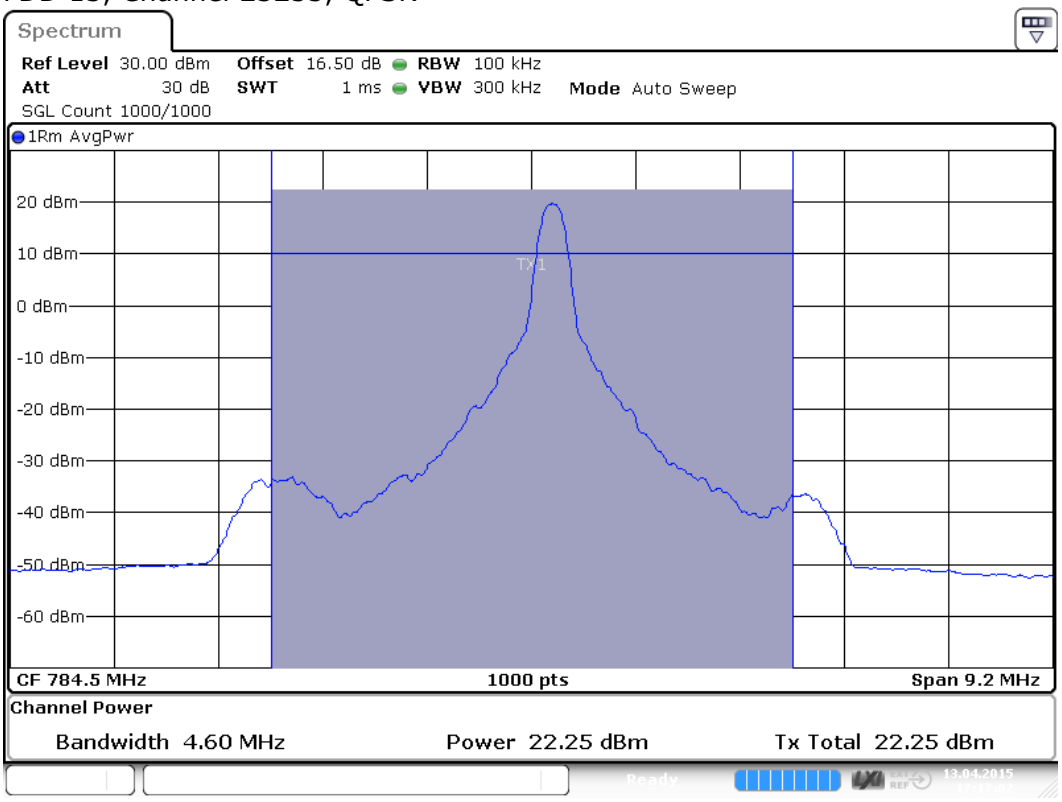
Date: 1.APR.2015 19:52:39

FDD 4, Channel 20175, 16QAM



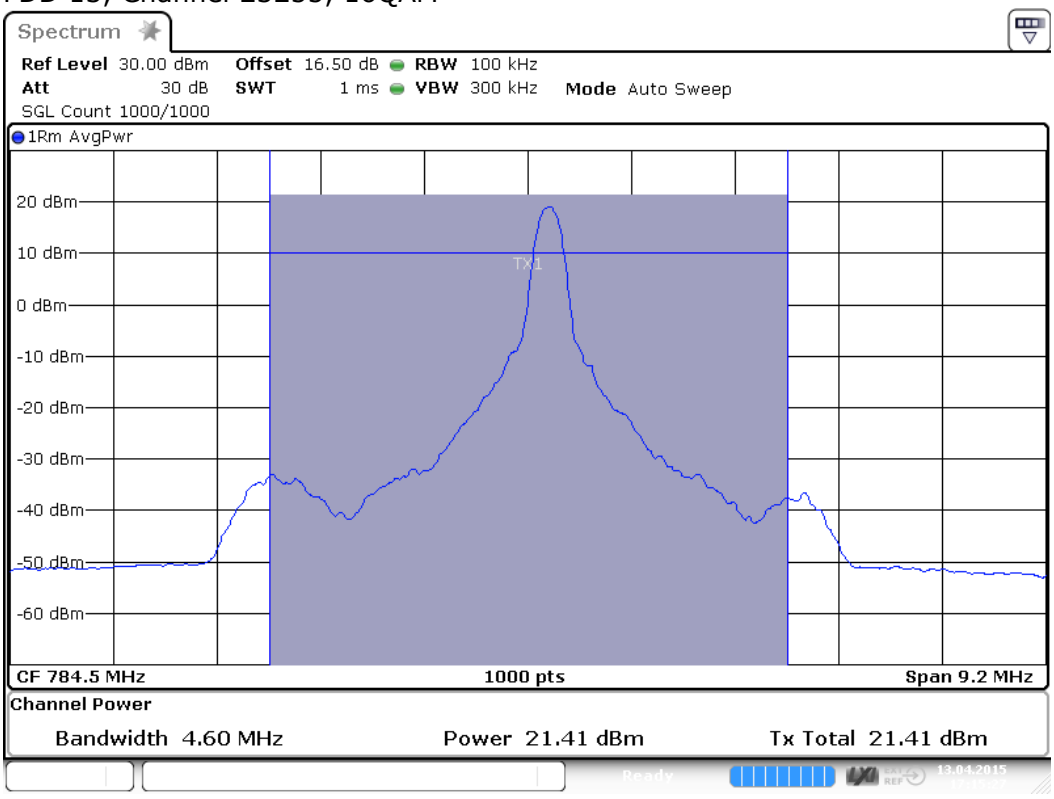
Date: 1.APR.2015 19:53:02

FDD 13, Channel 23255, QPSK



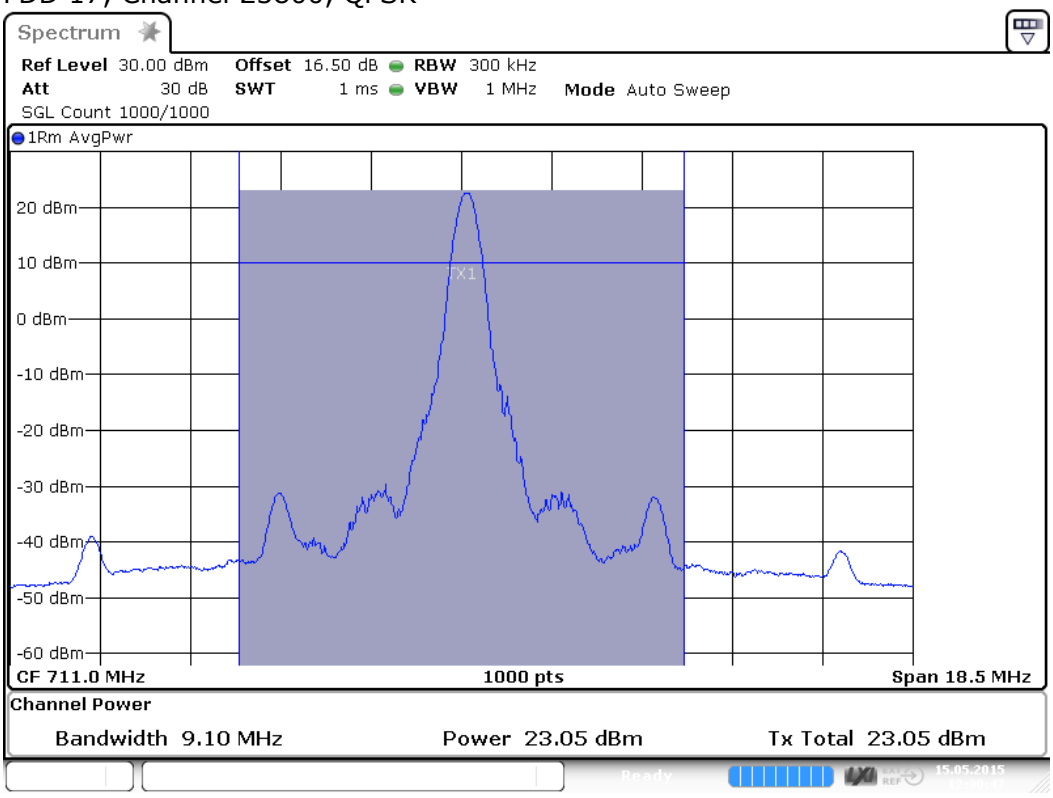
Date: 13.APR.2015 17:17:02

FDD 13, Channel 23255, 16QAM



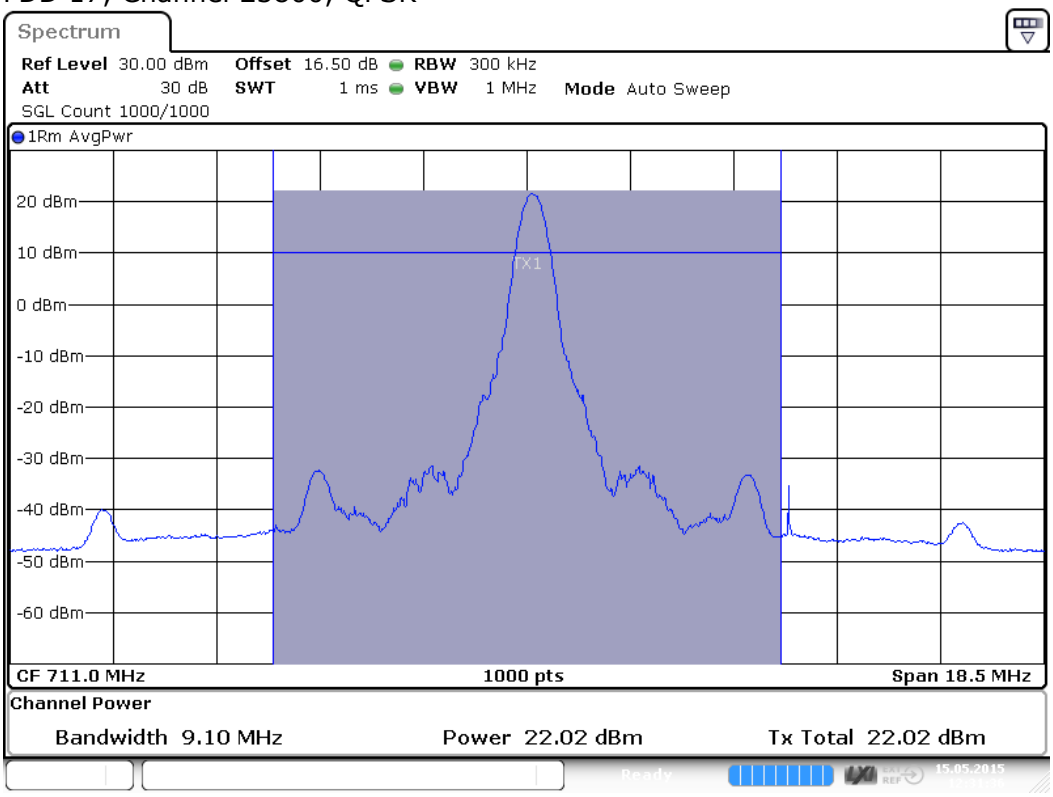
Date: 13.APR.2015 17:15:27

FDD 17, Channel 23800, QPSK



Date: 15.MAY.2015 12:30:47

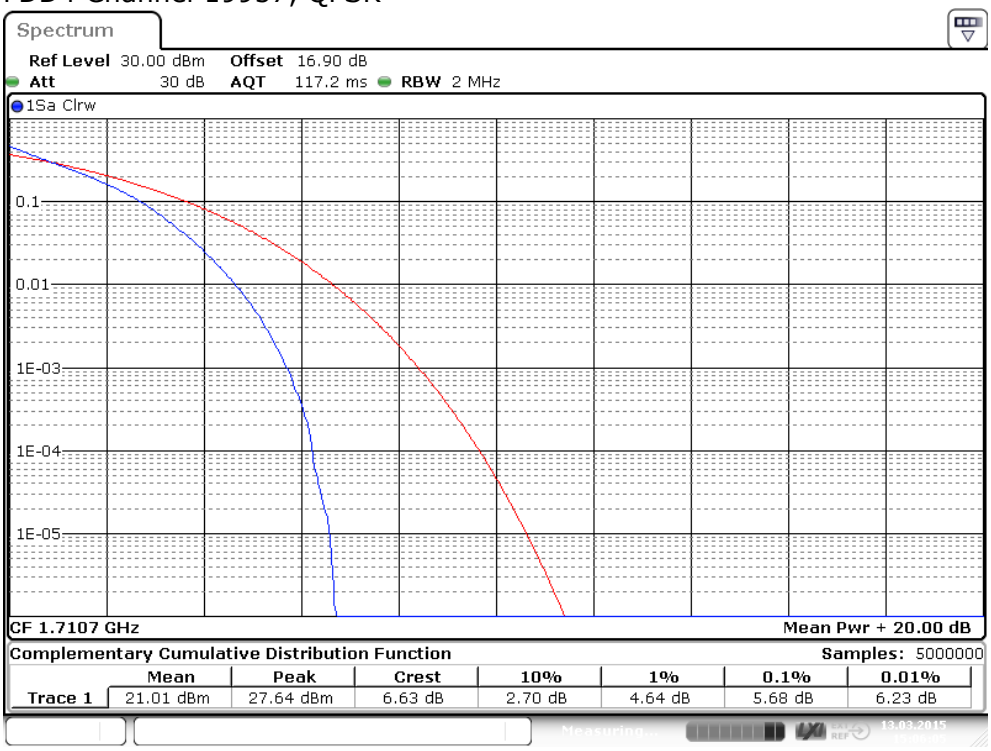
FDD 17, Channel 23800, QPSK



Date: 15.MAY.2015 12:31:36

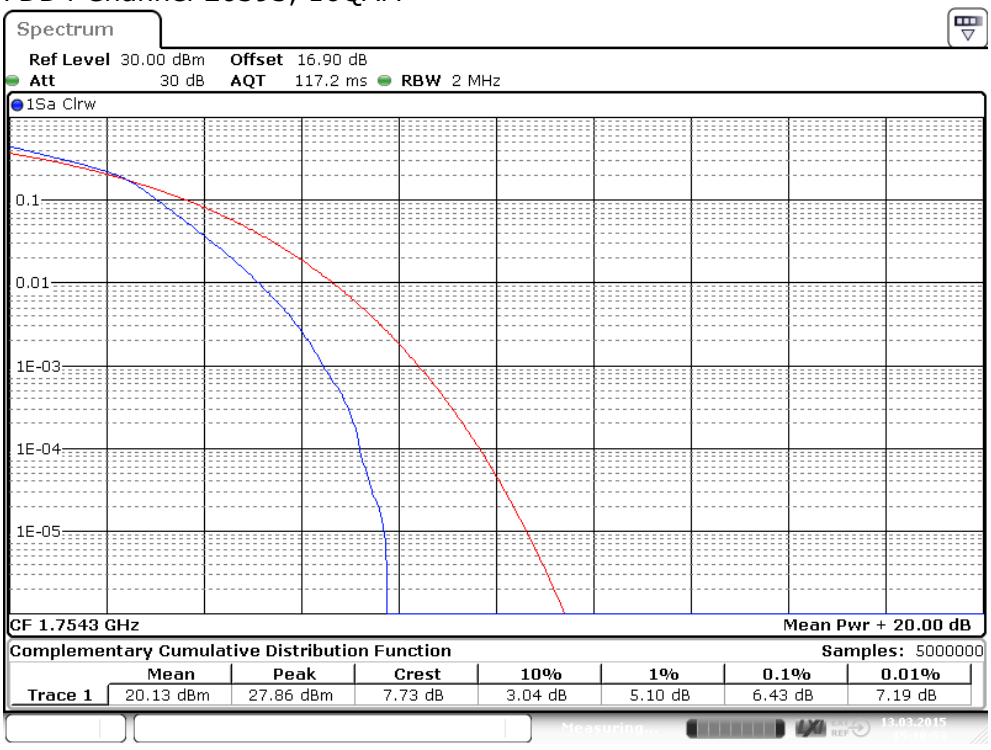
7.2 Peak to Average Ratio

FDD4 Channel 19957, QPSK



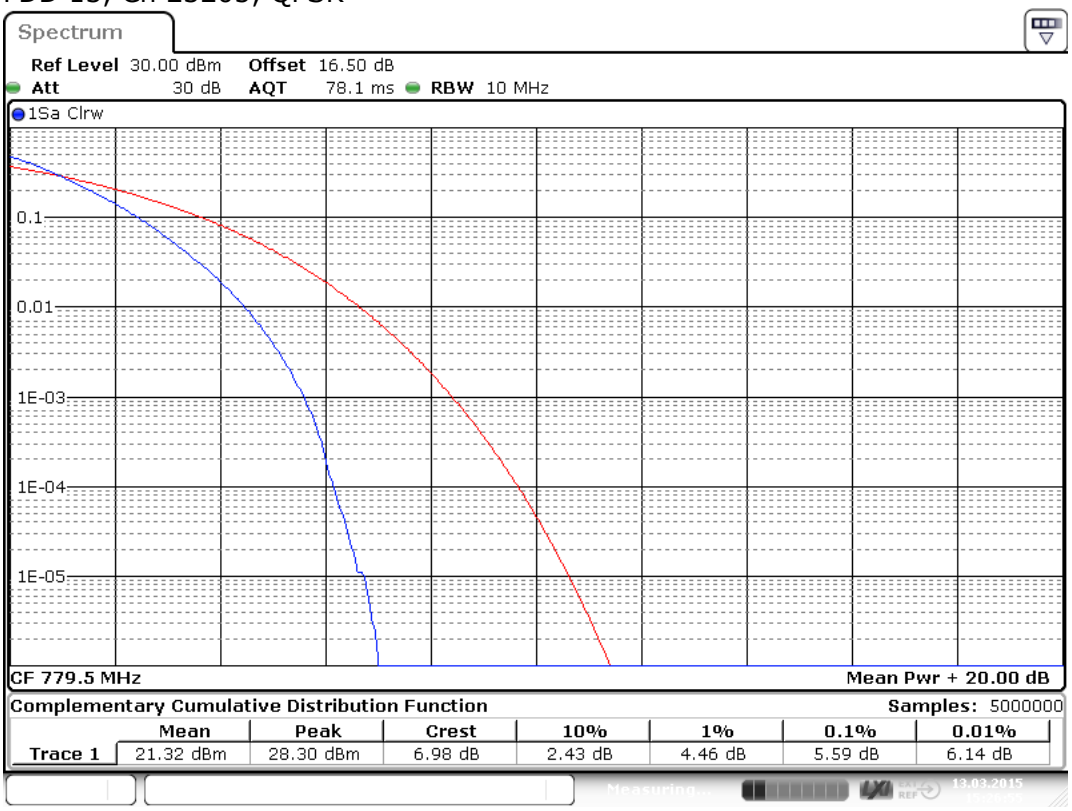
Date: 13.MAR.2015 15:06:05

FDD4 Channel 20393, 16QAM



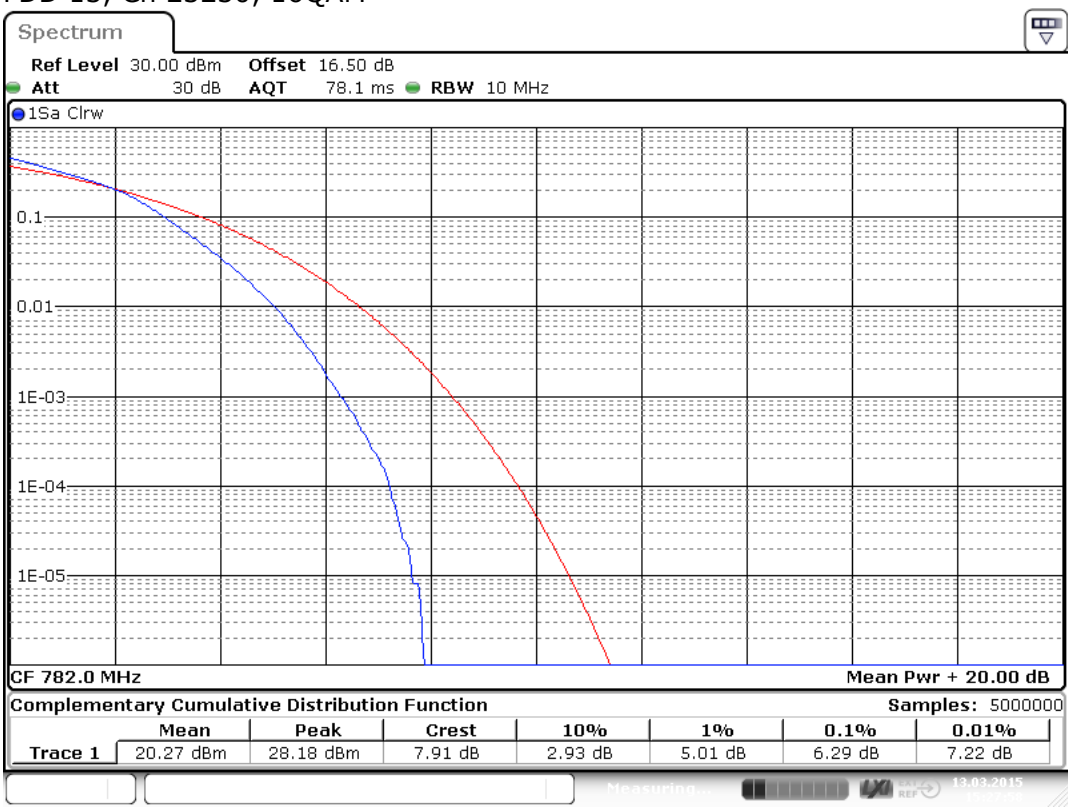
Date: 13.MAR.2015 15:10:53

FDD 13, Ch 23205, QPSK



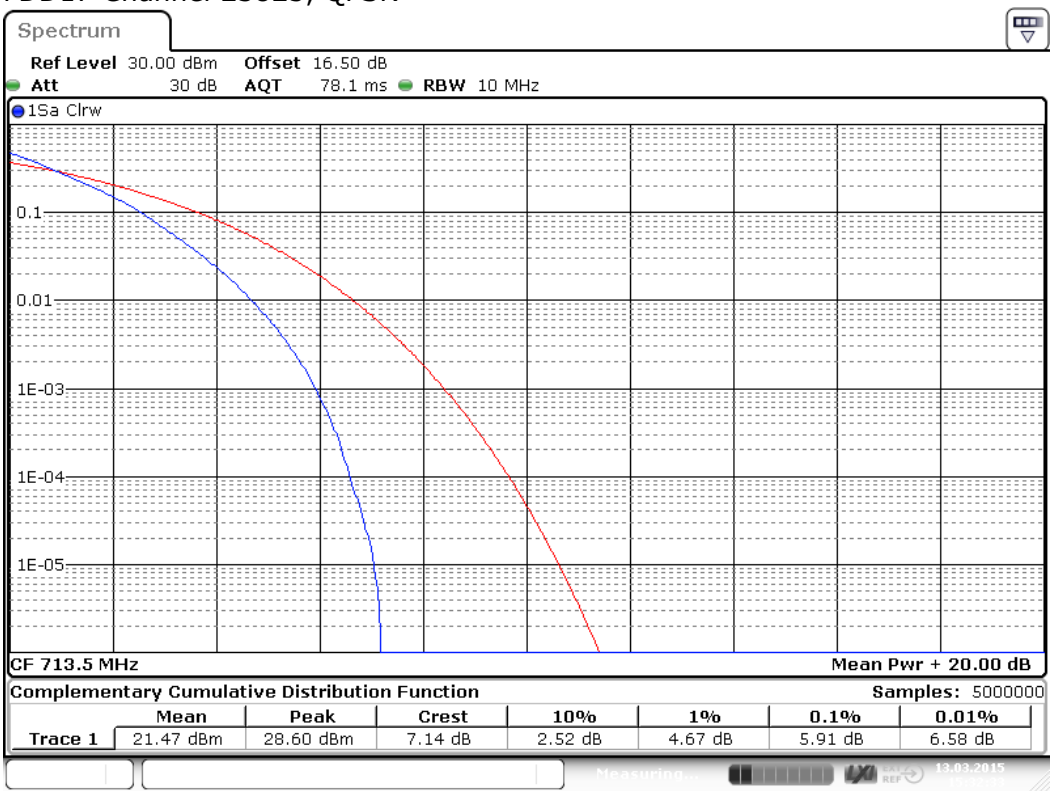
Date: 13.MAR.2015 15:26:55

FDD 13, Ch 23230, 16QAM



Date: 13.MAR.2015 15:27:59

FDD17 Channel 23825, QPSK



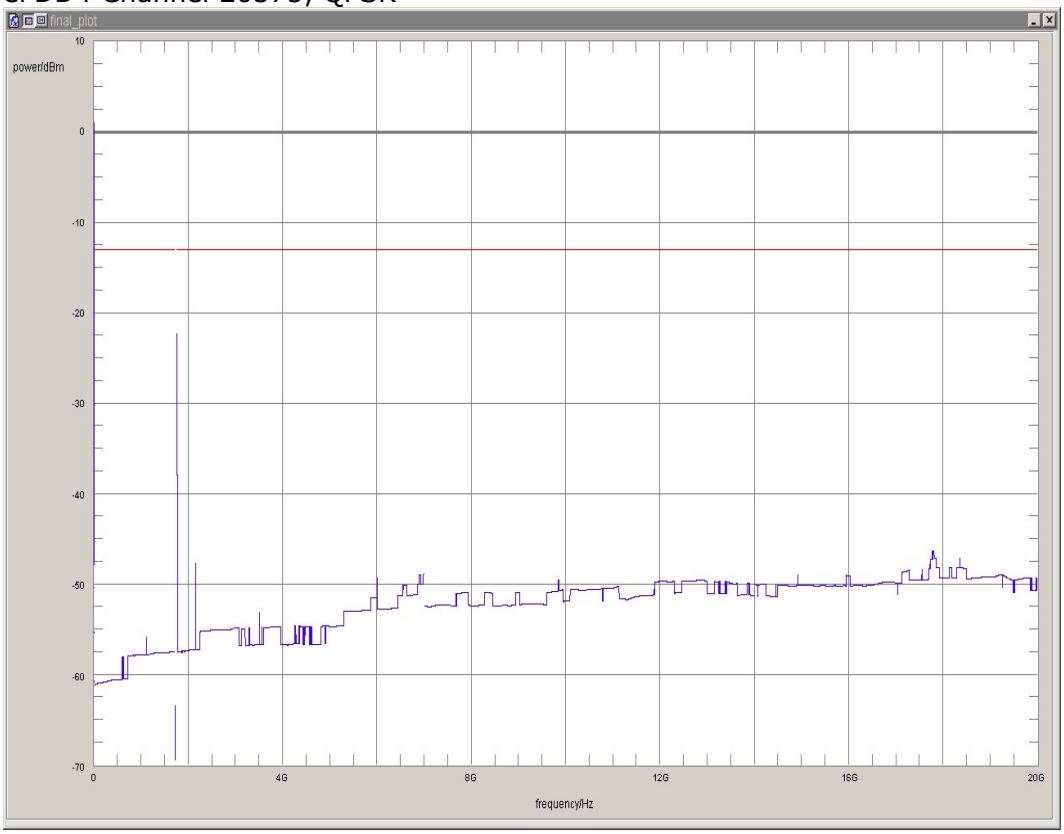
Date: 13.MAR.2015 15:32:34

FDD17 Channel 23825, 16QAM

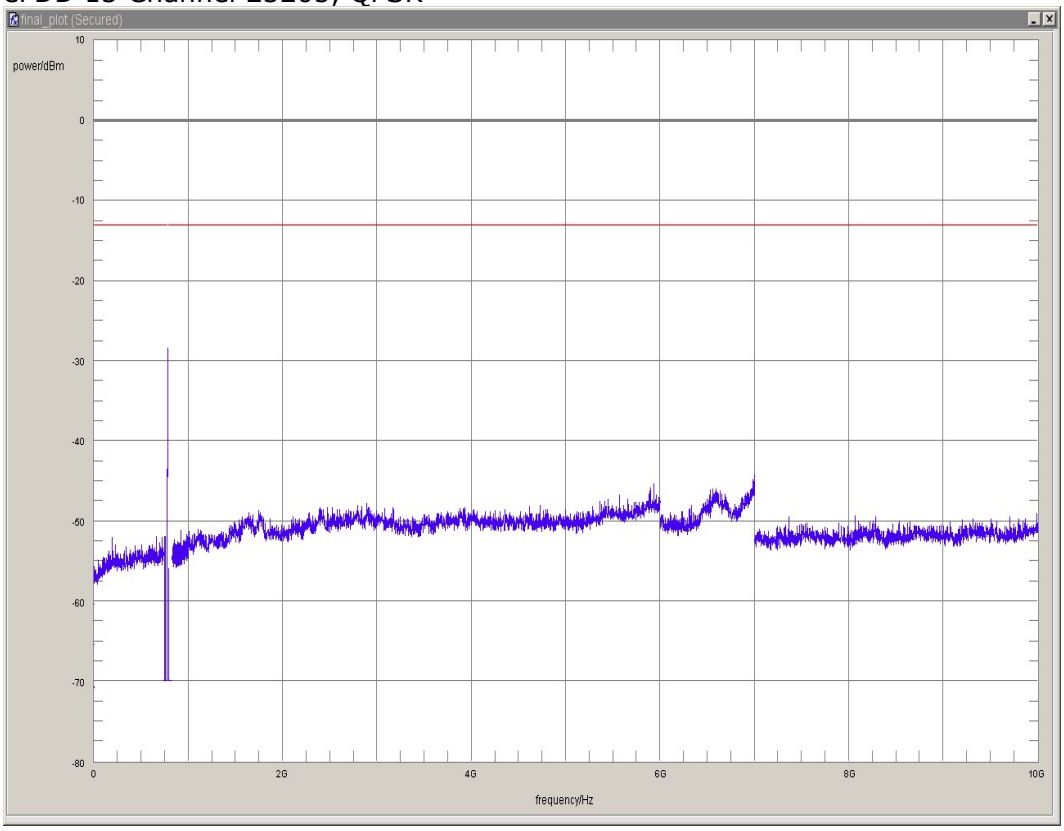
Date: 13.MAR.2015 15:32:58

7.3 Spurious emissions at antenna terminals

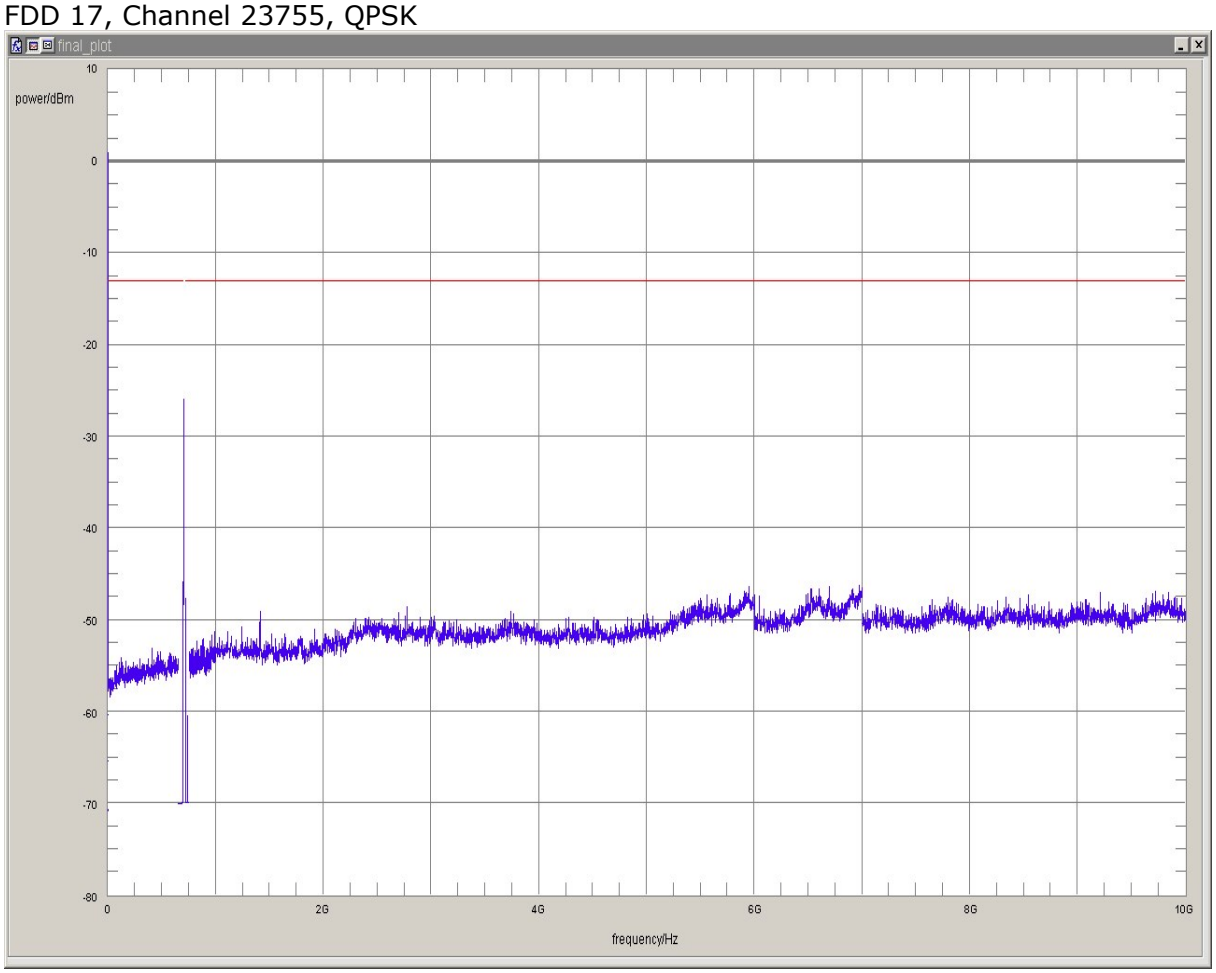
eFDD4 Channel 20375, QPSK



eFDD 13 Channel 23205, QPSK

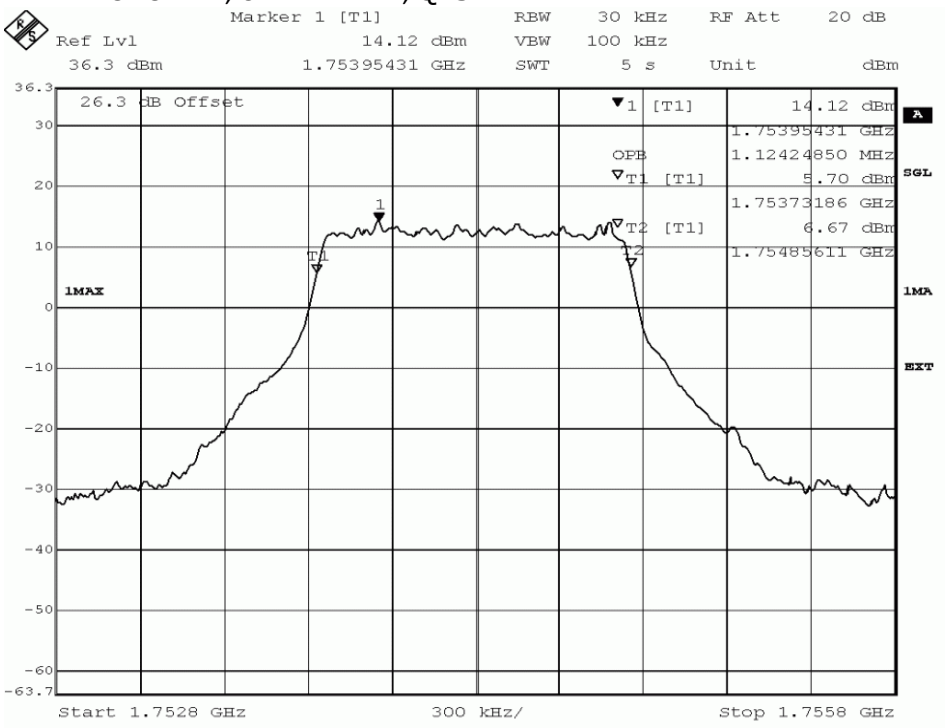


FDD 17, Channel 23755, QPSK



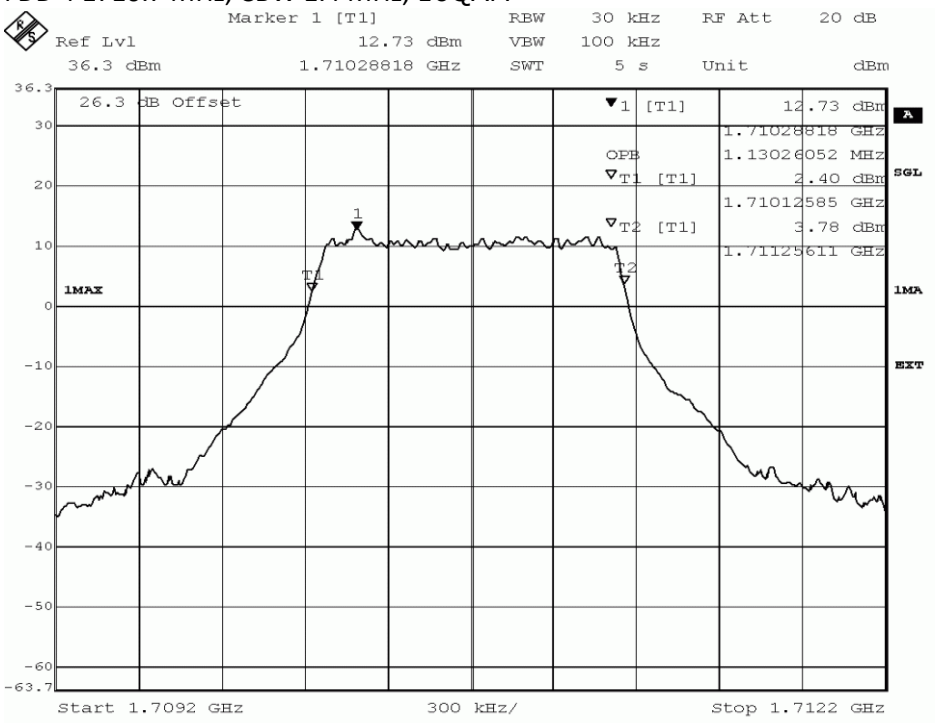
7.4 Emission and Occupied Bandwidth

FDD 4 1754.3 MHz, CBW 1.4 MHz, QPSK



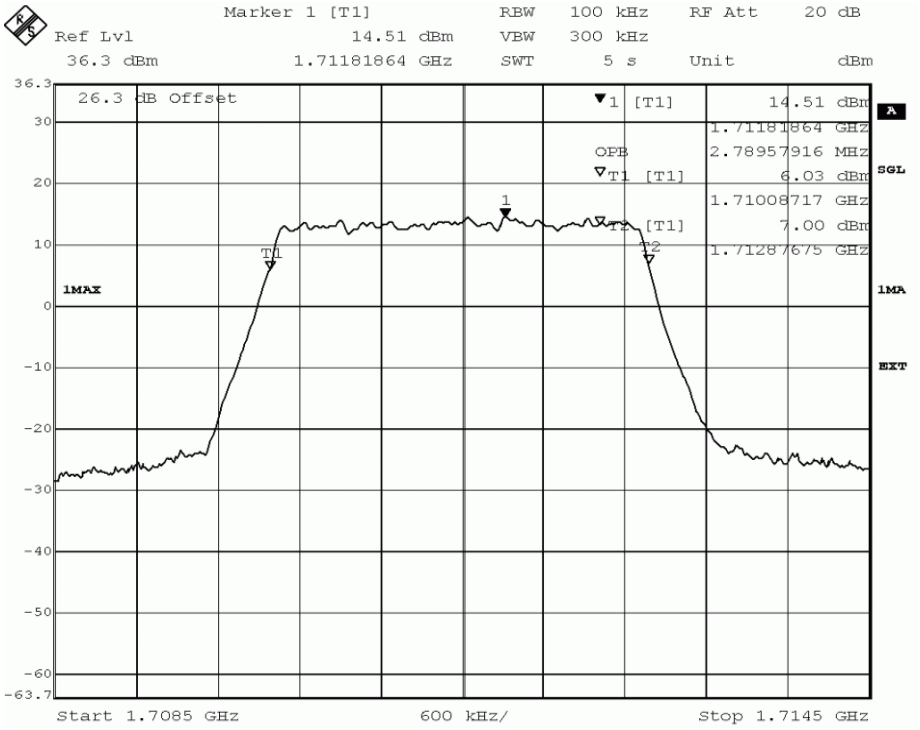
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%), channel 20393 (1754.3MHz)
Date: 11.MAR.2015 17:39:51

FDD 4 1710.7 MHz, CBW 1.4 MHz, 16QAM



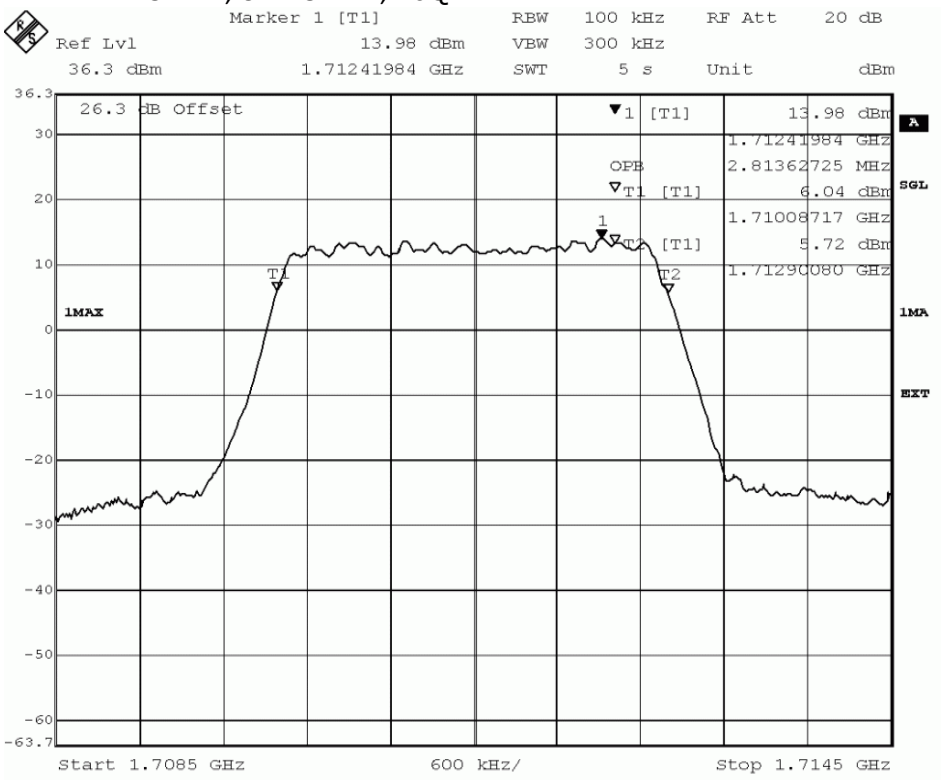
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%), channel 19957 (1710.7MHz)
Date: 11.MAR.2015 17:20:13

FDD 4 1711.5 MHz, CBW 3 MHz, QPSK



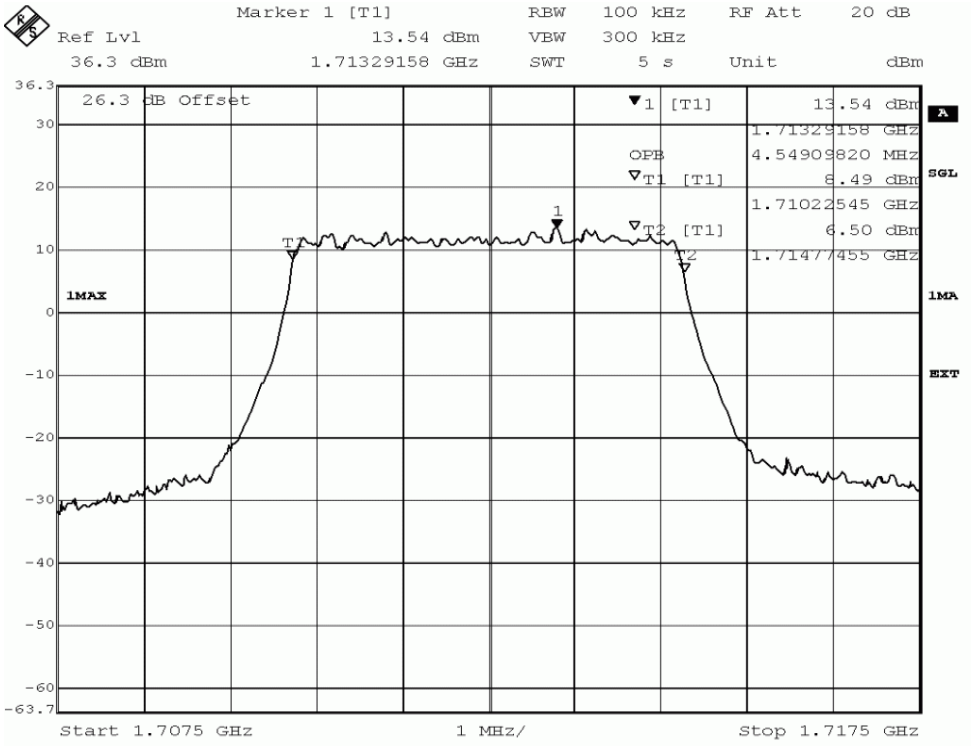
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 19965 (1711.5MHz)
Date: 11.MAR.2015 17:49:04

FDD 4 1711.5 MHz, CBW 3 MHz, 16QAM



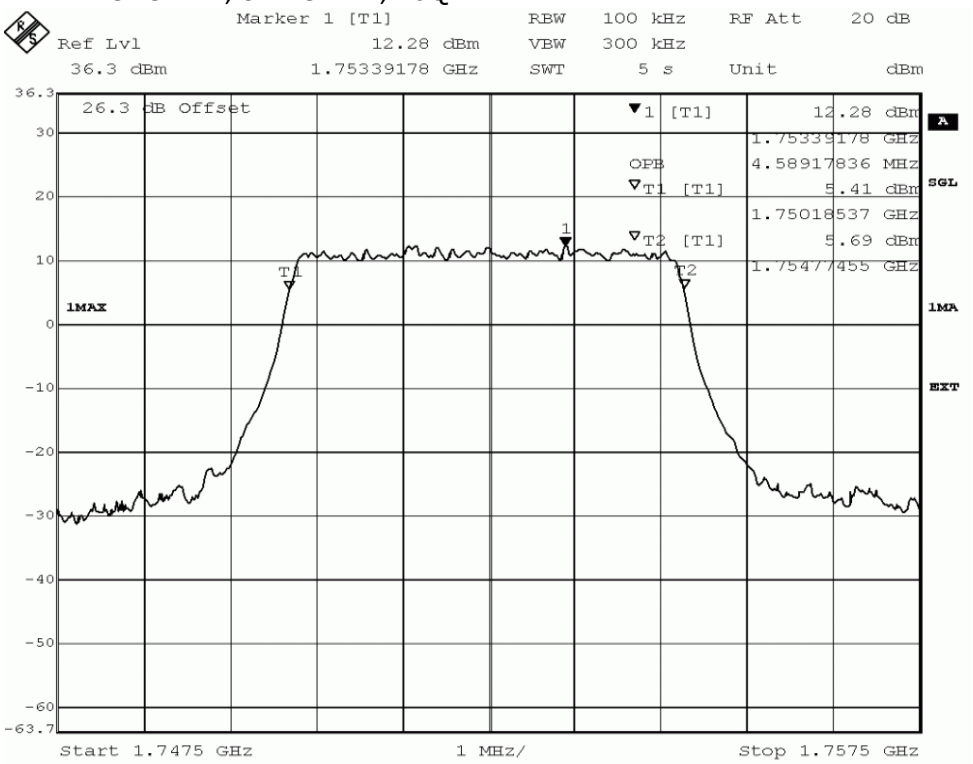
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 19965 (1711.5MHz)
Date: 11.MAR.2015 17:51:28

FDD 4 1712.5 MHz, CBW 5 MHz, QPSK



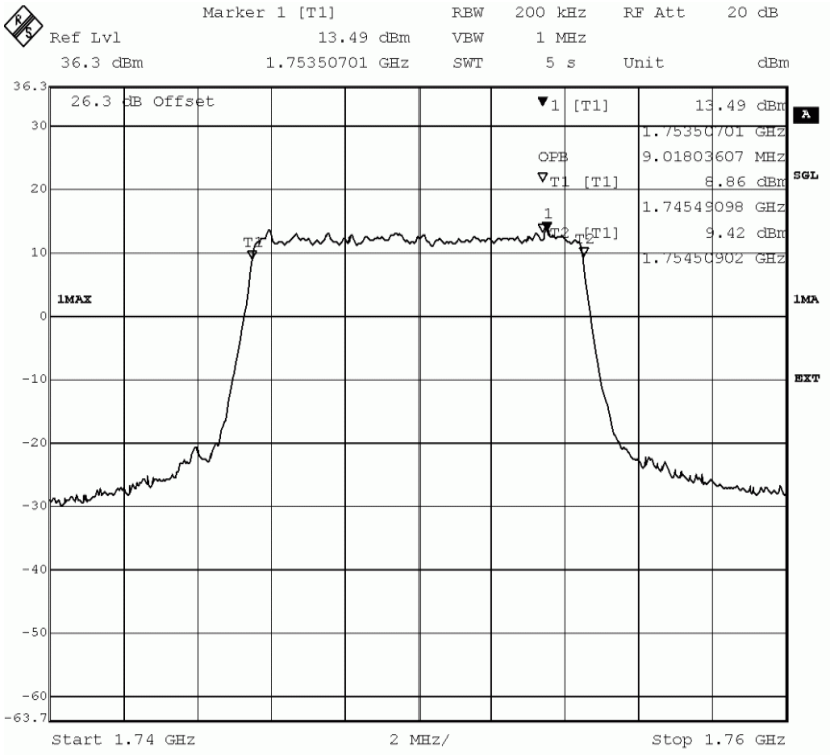
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 19975 (1712.5MHz)
Date: 11.MAR.2015 20:01:42

FDD 4 1752.5 MHz, CBW 5 MHz, 16QAM



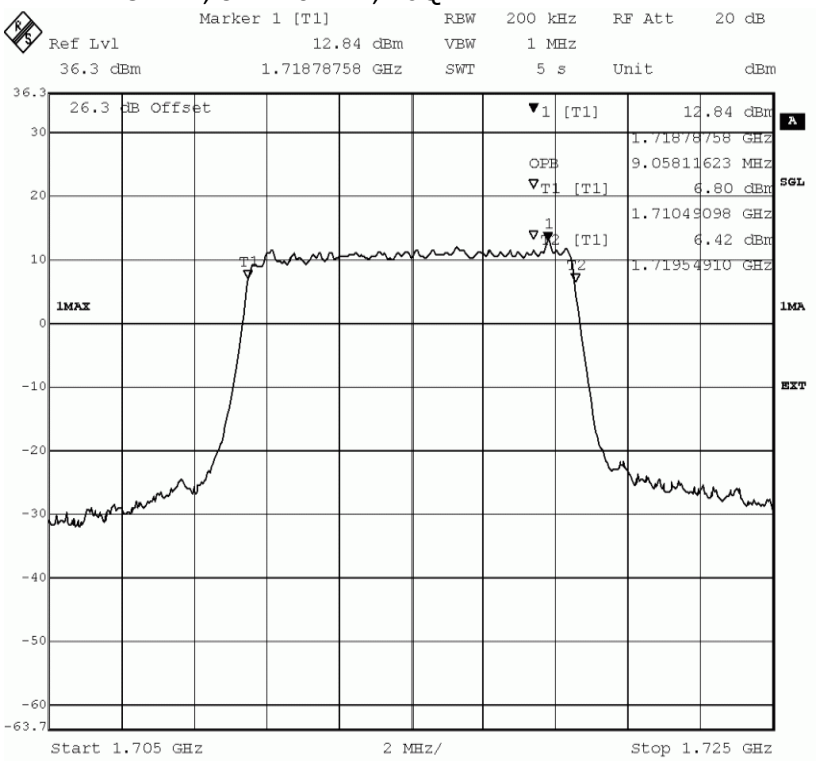
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 20375 (1752.5MHz)
Date: 11.MAR.2015 20:09:26

FDD 4 1750 MHz, CBW 10 MHz, QPSK



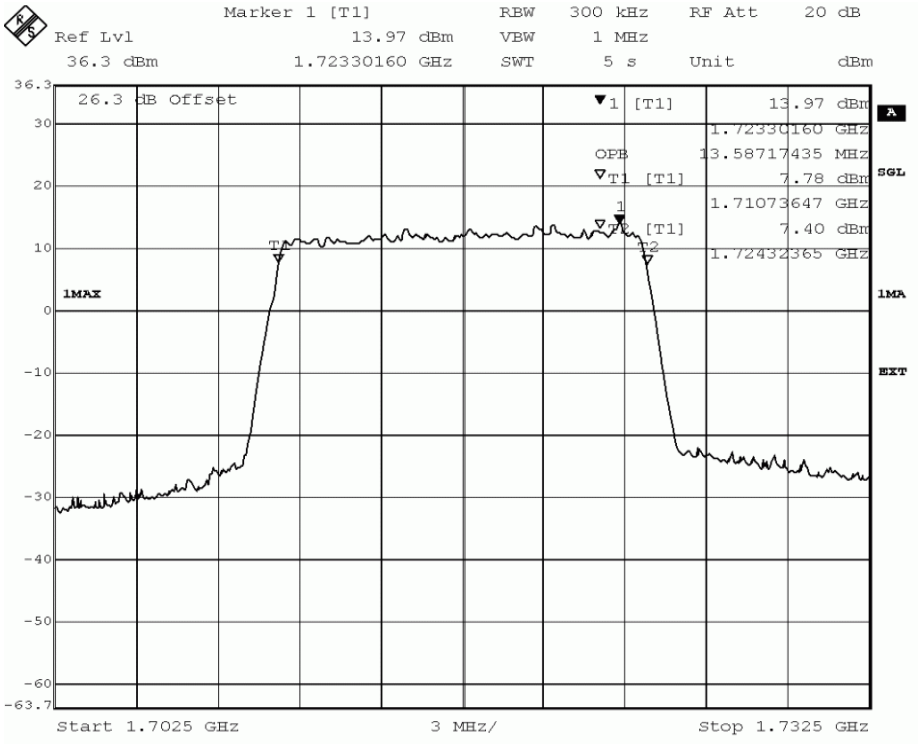
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 20350 (1750.0MHz)
Date: 11.MAR.2015 20:29:24

FDD 4 1715 MHz, CBW 10 MHz, 16QAM



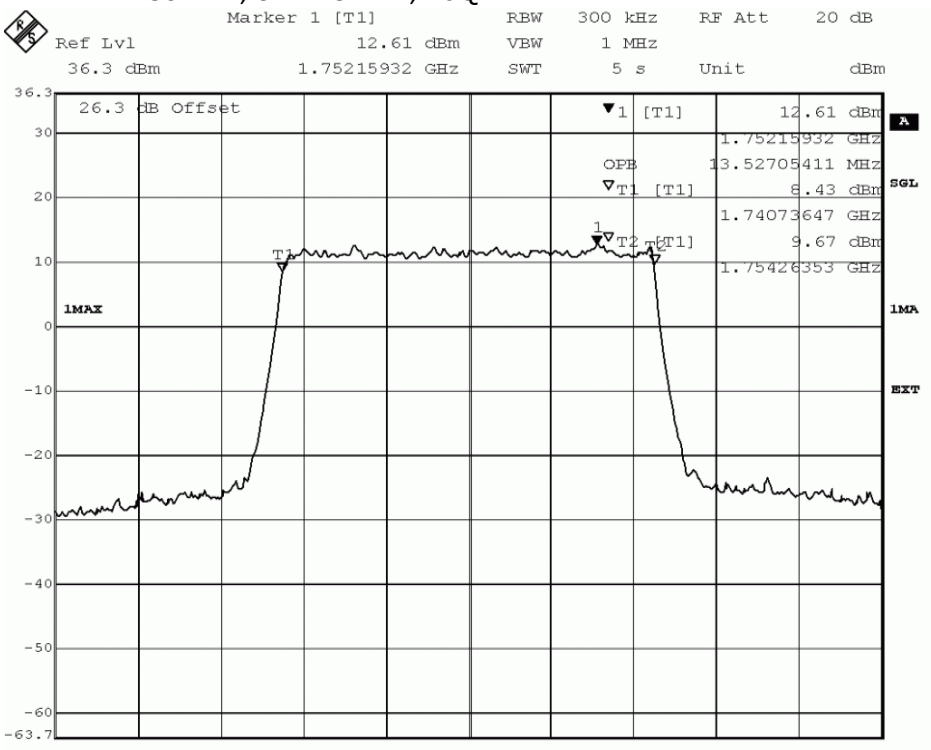
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 20000 (1715.0MHz)
Date: 11.MAR.2015 20:14:32

FDD 4 1717.50 MHz, CBW 15 MHz, QPSK



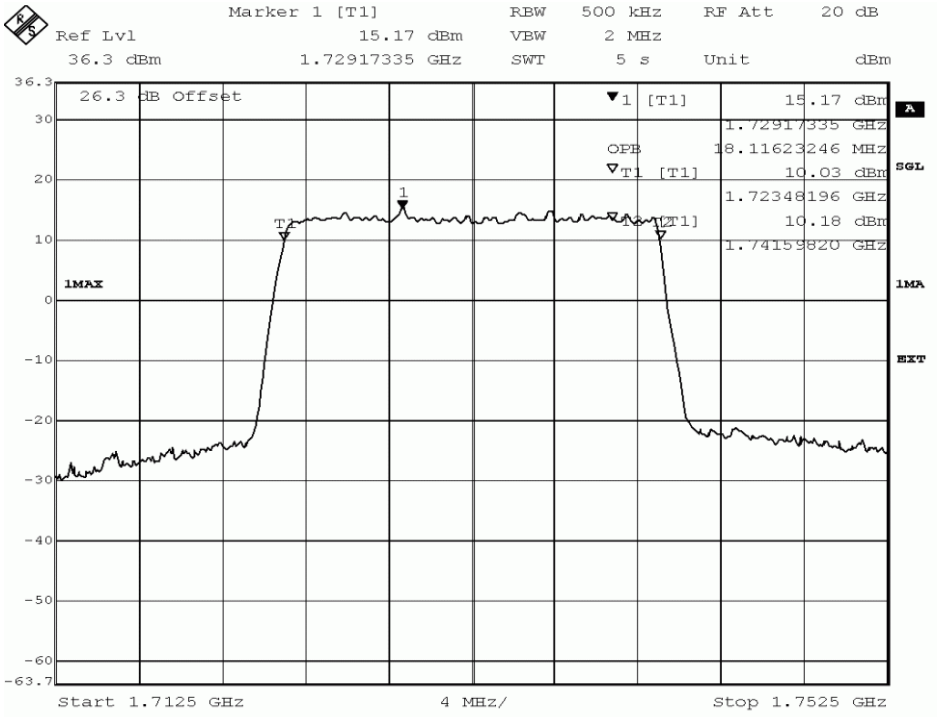
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%), channel 20025 (1717.5MHz)
Date: 11.MAR.2015 20:37:09

FDD 4 1747.50 MHz, CBW 15 MHz, 16QAM



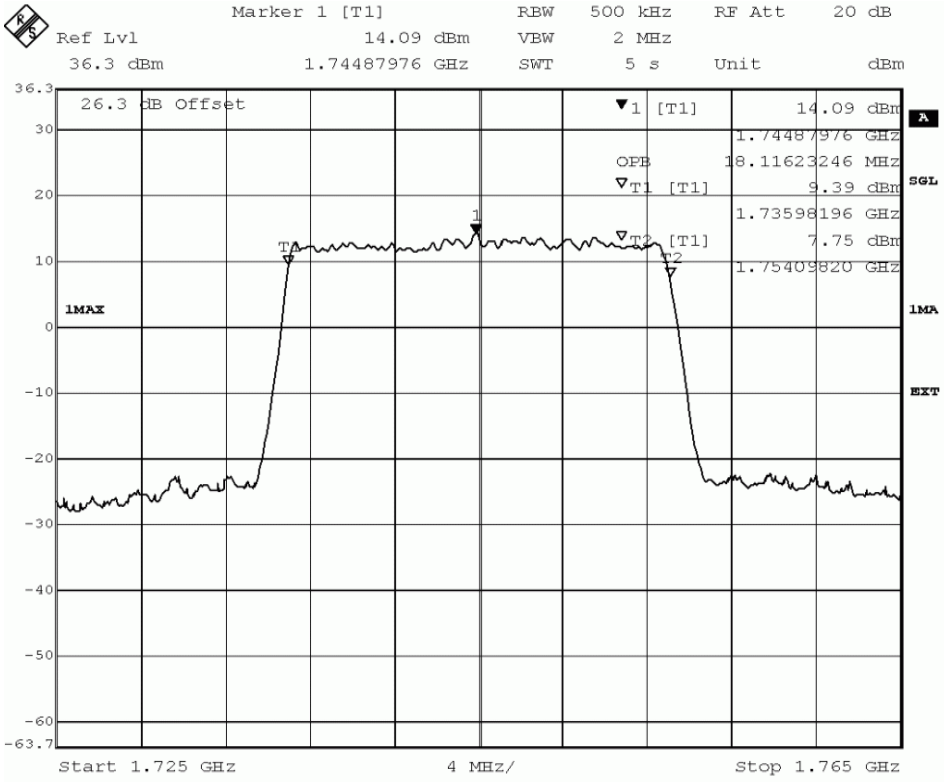
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%), channel 20325 (1747.5MHz)
Date: 11.MAR.2015 20:51:08

FDD 4 1735.50 MHz, CBW 20 MHz, QPSK



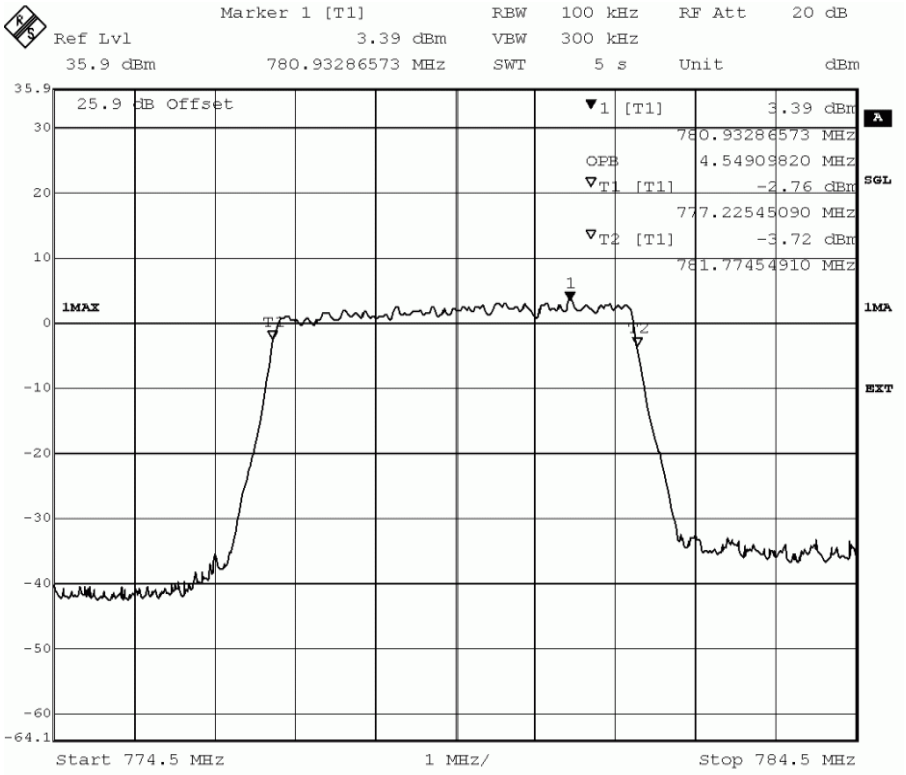
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 20175 (1732.5MHz)
Date: 11.MAR.2015 21:13:02

FDD 4 1745.00 MHz, CBW 20 MHz, 16QAM



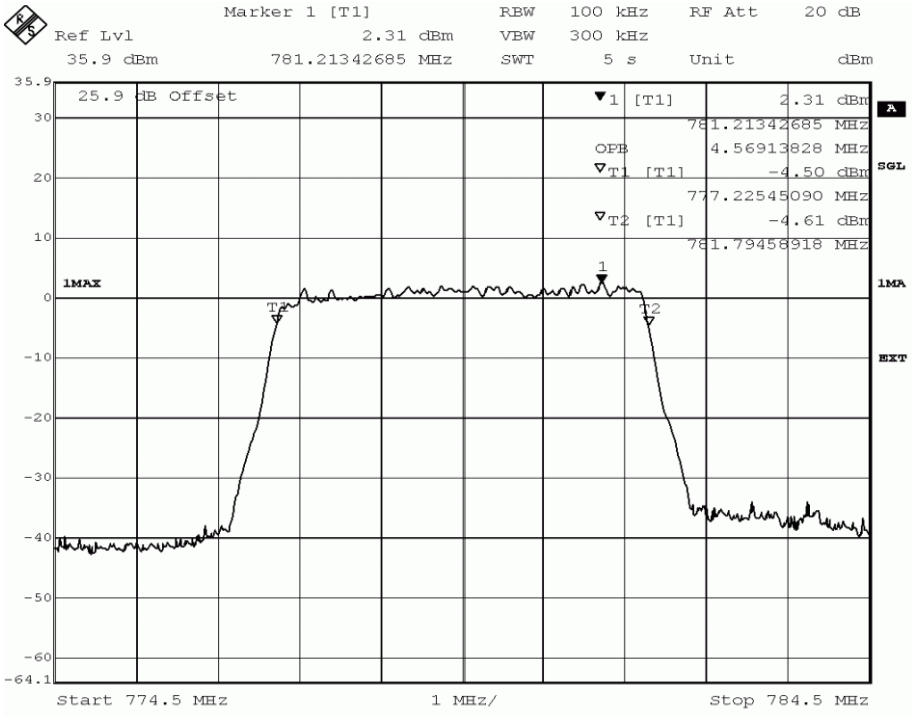
Title: bandwidth measurement
Comment A: DE1015014, eFDD4, occupied bandwidth (99%),
channel 20300 (1745.0MHz)
Date: 11.MAR.2015 21:17:33

FDD 13 779.50 MHz, CBW 5 MHz, QPSK



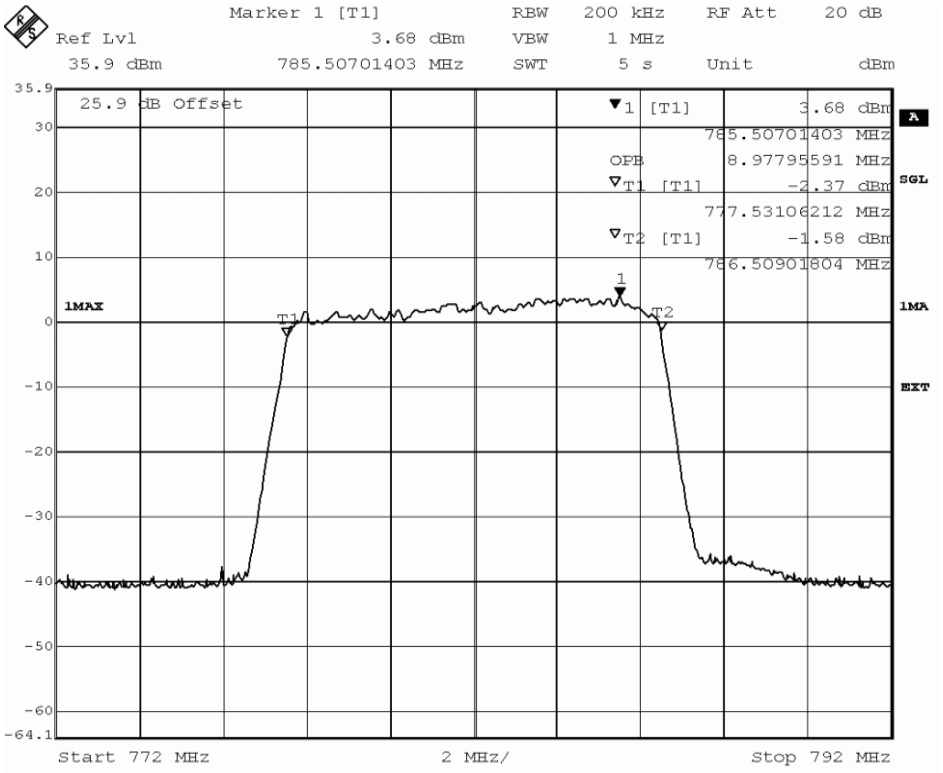
Title: bandwidth measurement
Comment A: DE1015014, eFDD13, occupied bandwidth (99%), channel 23205 (779.5MHz)
Date: 12.MAR.2015 16:24:49

FDD 13 779.50 MHz, CBW 5 MHz, 16QAM



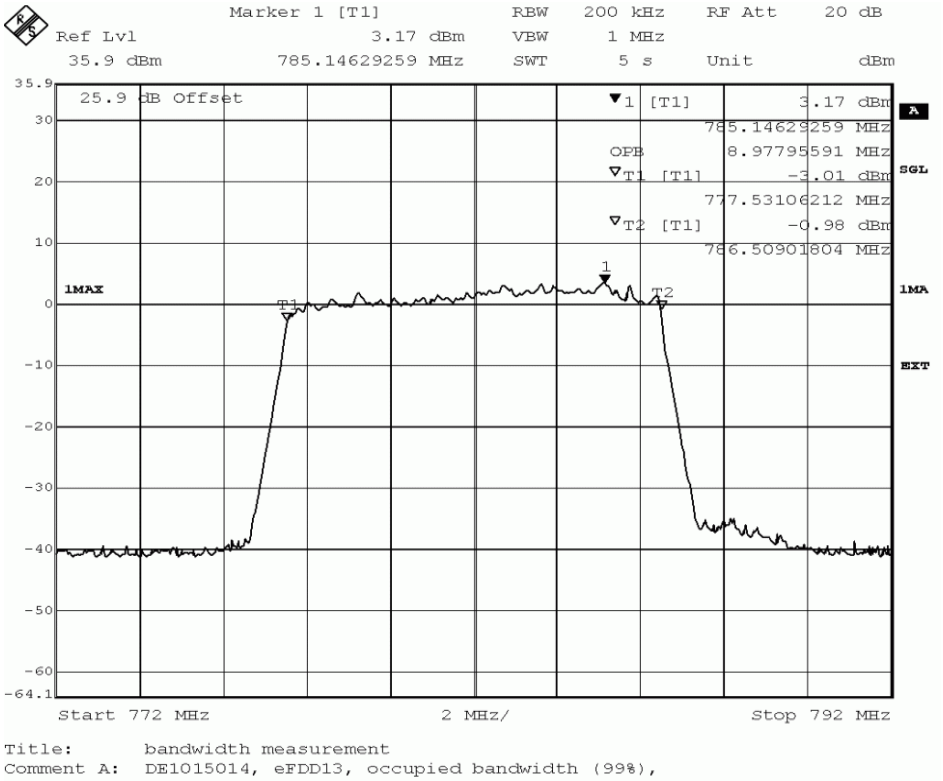
Title: bandwidth measurement
Comment A: DE1015014, eFDD13, occupied bandwidth (99%), channel 23205 (779.5MHz)
Date: 12.MAR.2015 16:22:05

FDD 13 782.00 MHz, CBW 10 MHz, QPSK



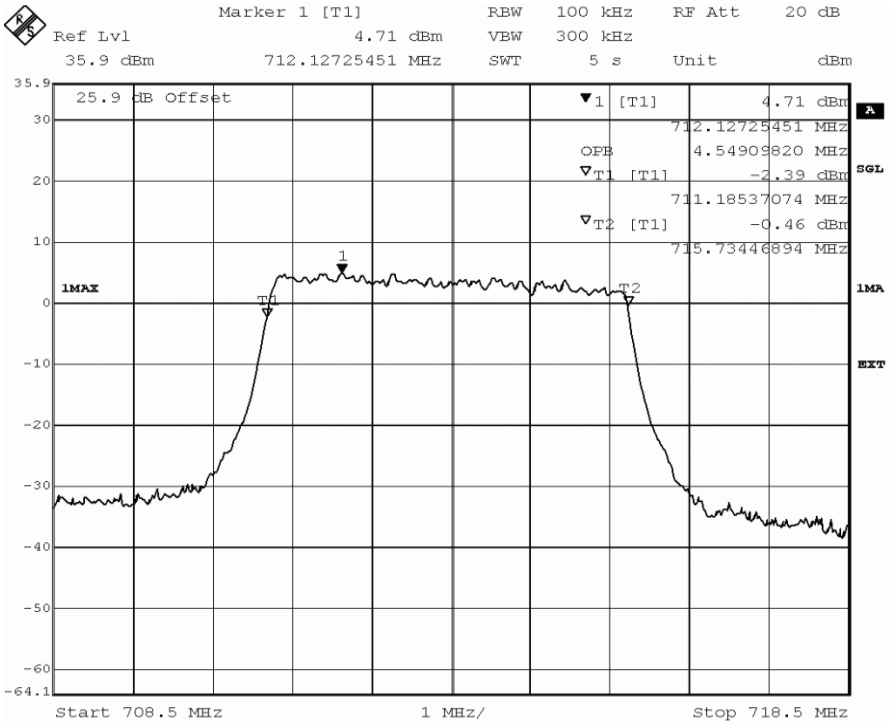
Title: bandwidth measurement
Comment A: DE1015014, eFDD13, occupied bandwidth (99%), channel 23230 (782.0MHz)
Date: 12.MAR.2015 16:34:24

FDD 13 782.00 MHz, CBW 10 MHz, 16QAM



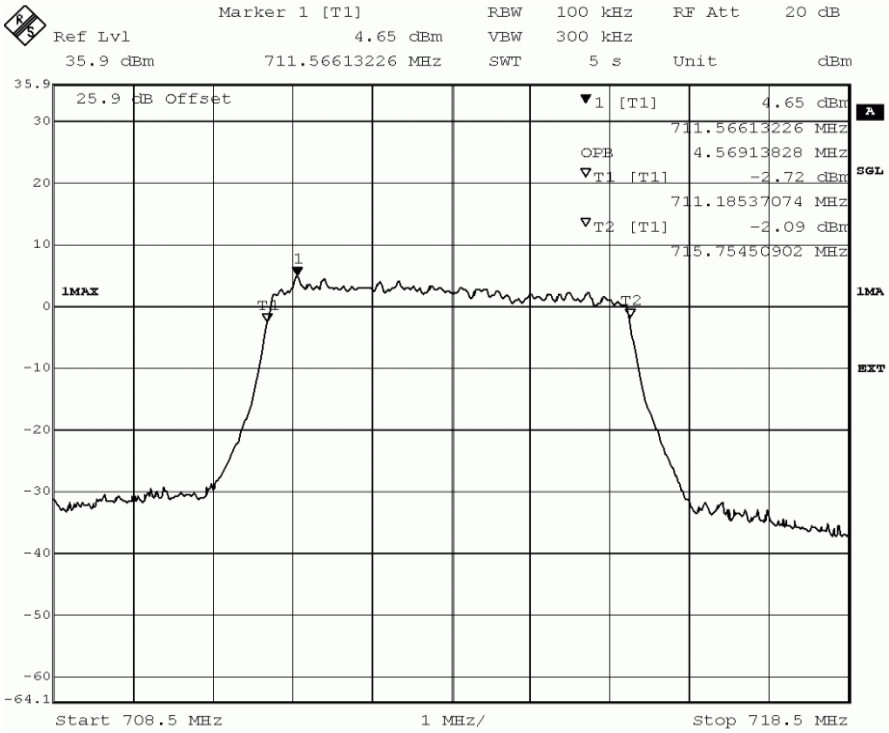
Title: bandwidth measurement
Comment A: DE1015014, eFDD13, occupied bandwidth (99%), channel 23230 (782.0MHz)
Date: 12.MAR.2015 16:32:58

FDD 17 713.50 MHz, CBW 5 MHz, QPSK



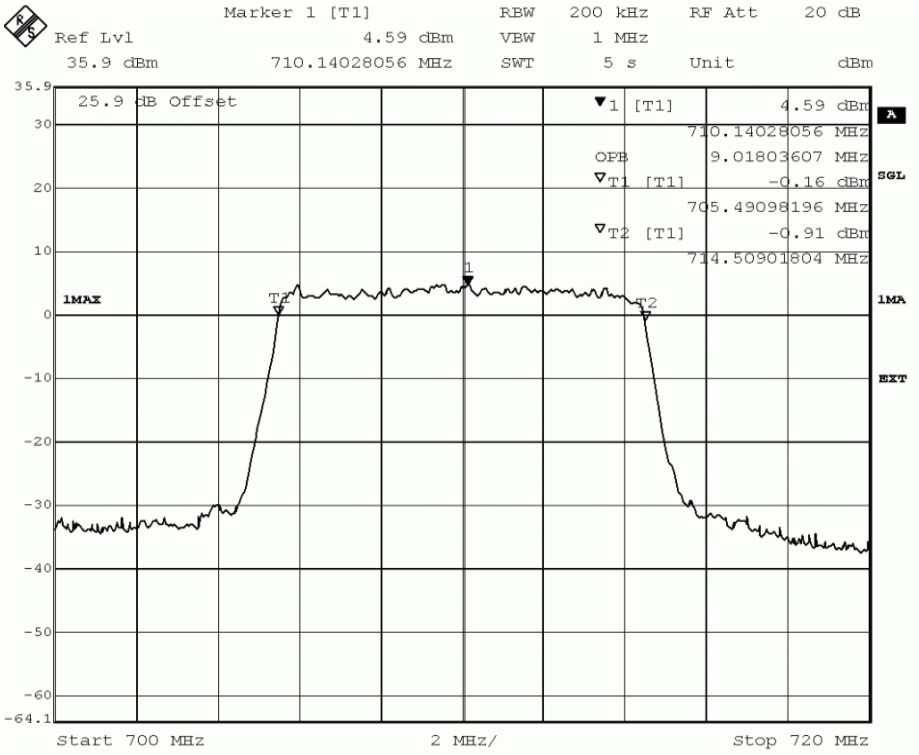
Title: bandwidth measurement
Comment A: DE1015014, eFDD17, occupied bandwidth (99%), channel 23825 (713.5MHz)
Date: 12.MAR.2015 16:45:31

FDD 17 713.50 MHz, CBW 5 MHz, 16QAM



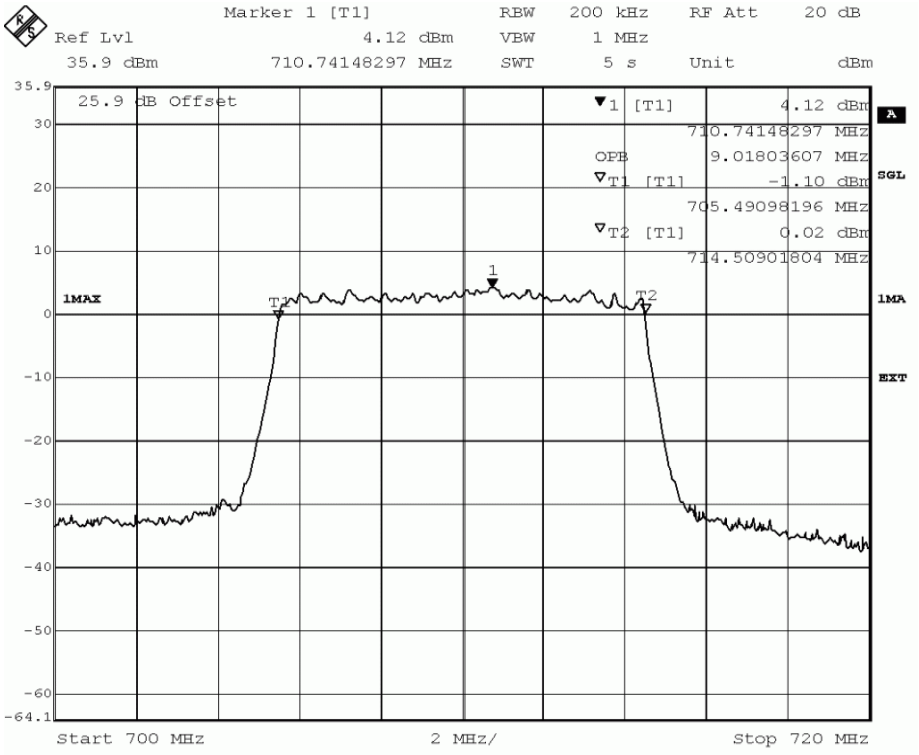
Title: bandwidth measurement
Comment A: DE1015014, eFDD17, occupied bandwidth (99%), channel 23825 (713.5MHz)
Date: 12.MAR.2015 16:43:58

FDD 17 710.00 MHz, CBW 10 MHz, QPSK



Title: bandwidth measurement
Comment A: DE1015014, eFDD17, occupied bandwidth (99%), channel 23790 (710.0MHz)
Date: 12.MAR.2015 16:50:13

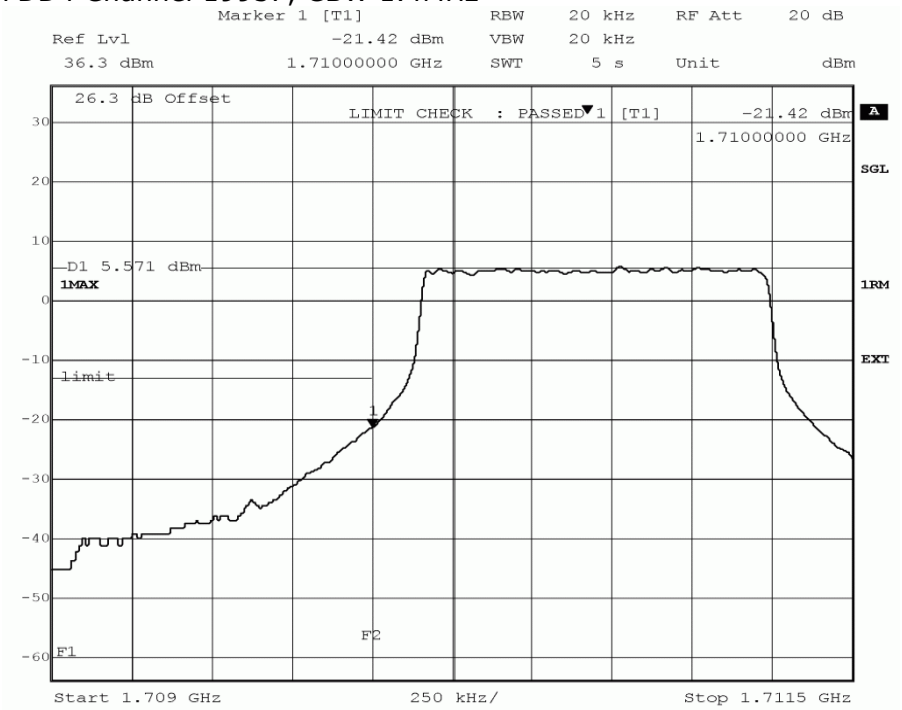
FDD 17 710.00 MHz, CBW 10 MHz, 16QAM



Title: bandwidth measurement
Comment A: DE1015014, eFDD17, occupied bandwidth (99%), channel 23790 (710.0MHz)
Date: 12.MAR.2015 16:51:53

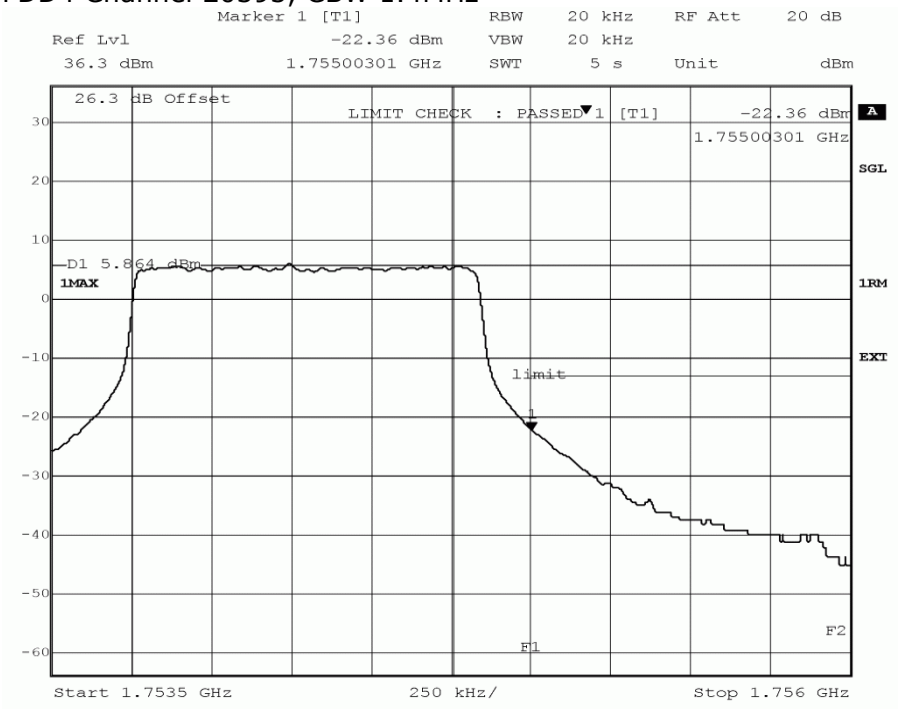
7.5 Band edge compliance

FDD4 Channel 19957, CBW 1.4MHz



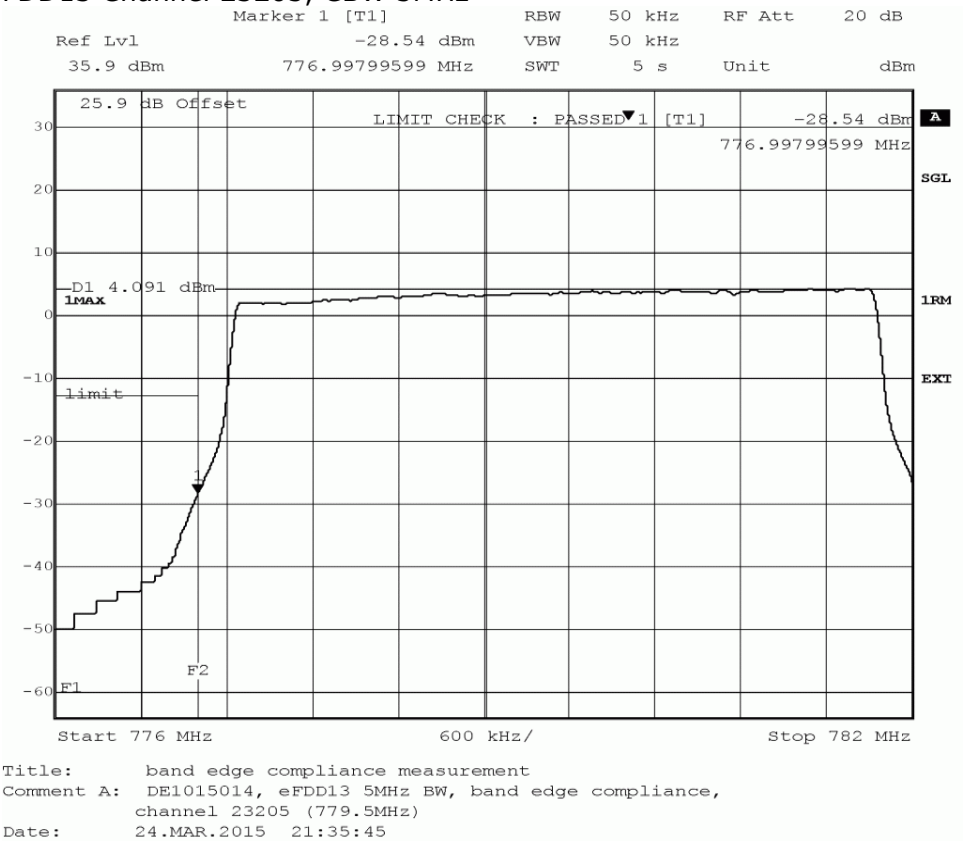
Title: band edge compliance measurement
Comment A: DE1015014, eFDD4 1.4MHz BW, band edge compliance, channel 19957 (1710.7MHz)
Date: 24.MAR.2015 13:52:15

FDD4 Channel 20393, CBW 1.4MHz



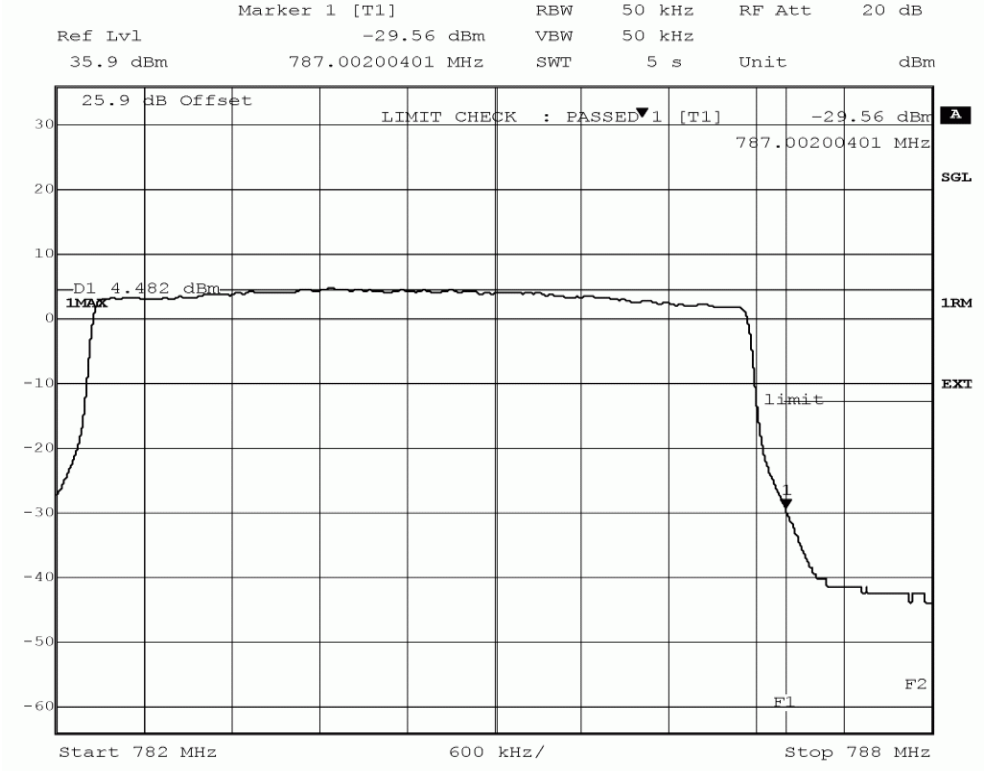
Title: band edge compliance measurement
Comment A: DE1015014, eFDD4 1.4MHz BW, band edge compliance, channel 20393 (1754.3MHz)
Date: 24.MAR.2015 14:00:11

FDD13 Channel 23205, CBW 5MHz



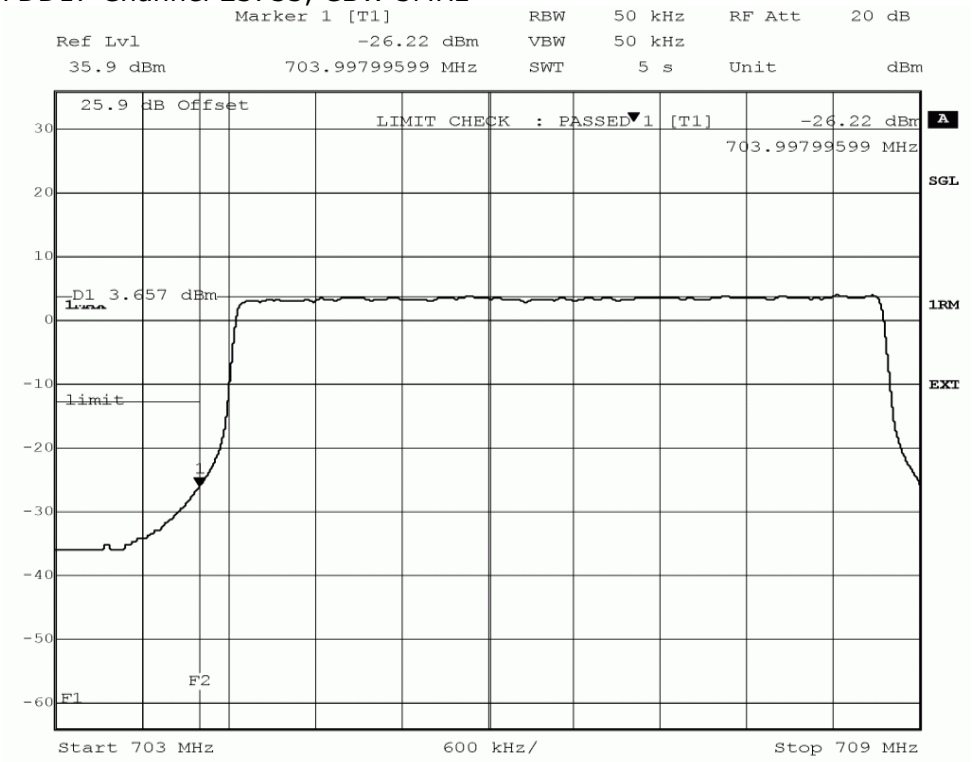
Title: band edge compliance measurement
Comment A: DE1015014, eFDD13 5MHz BW, band edge compliance, channel 23205 (779.5MHz)
Date: 24.MAR.2015 21:35:45

FDD13 Channel 23205, CBW 5MHz



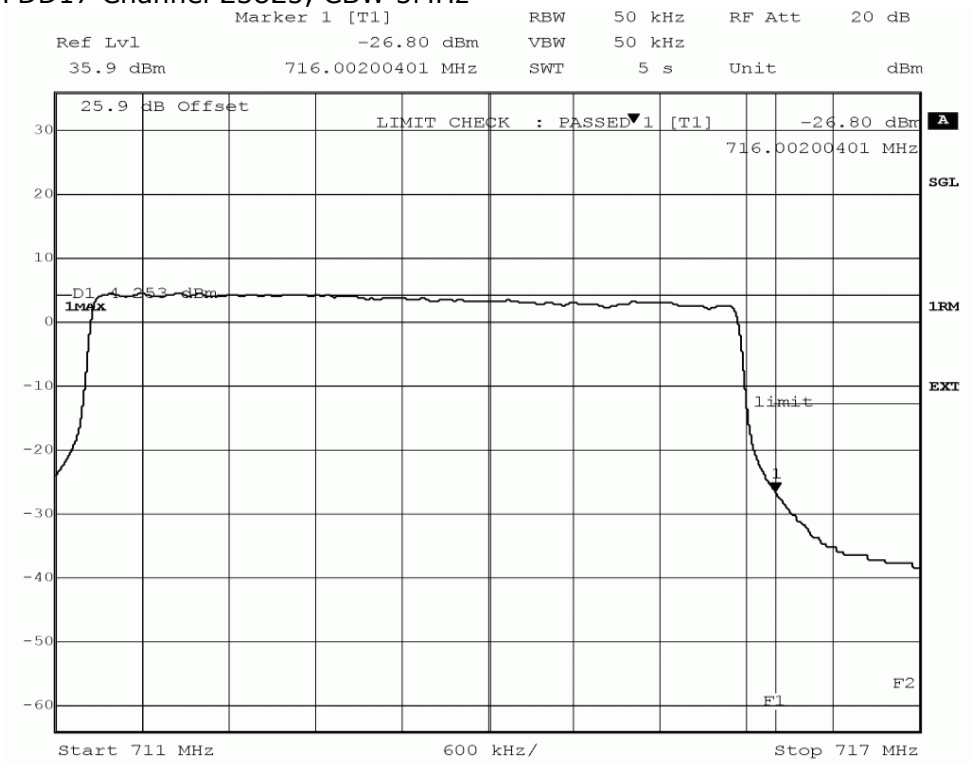
Title: band edge compliance measurement
Comment A: DE1015014, eFDD13 5MHz BW, band edge compliance, channel 23255 (784.5MHz)
Date: 24.MAR.2015 21:43:22

FDD17 Channel 23755, CBW 5MHz



Title: band edge compliance measurement
Comment A: DE1015014, eFDD17 5MHz BW, band edge compliance, channel 23755 (706.5MHz)
Date: 18.MAR.2015 19:42:25

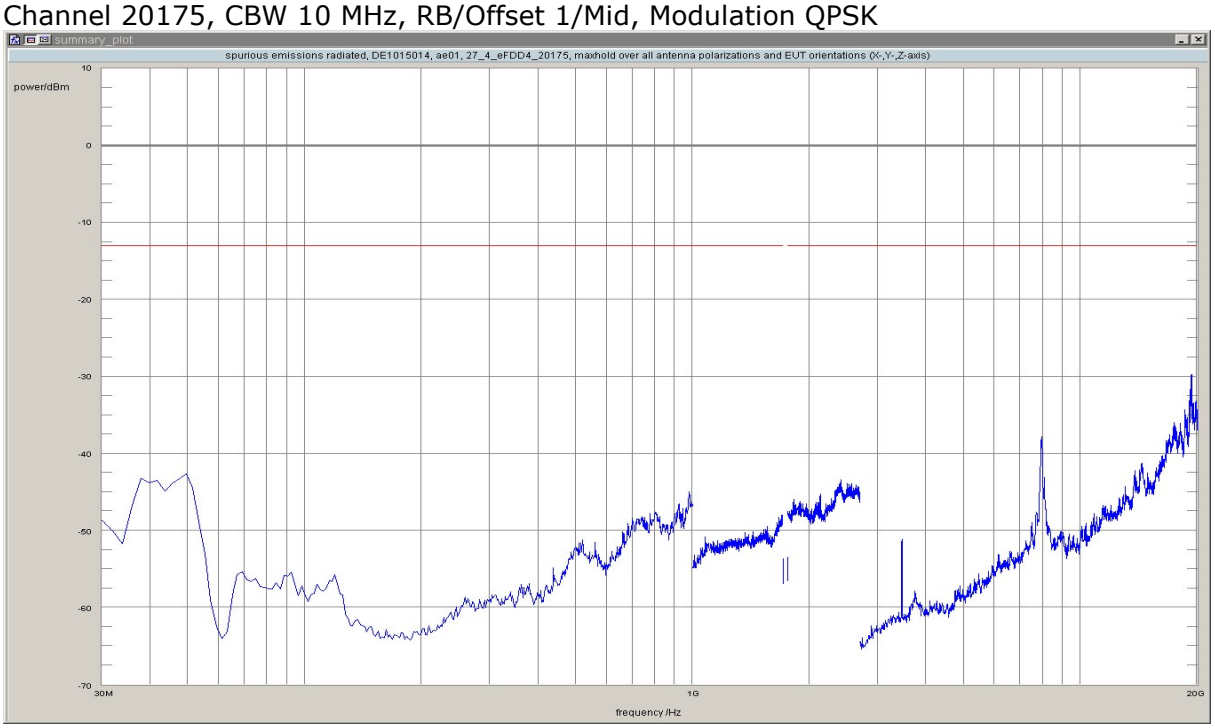
FDD17 Channel 23825, CBW 5MHz



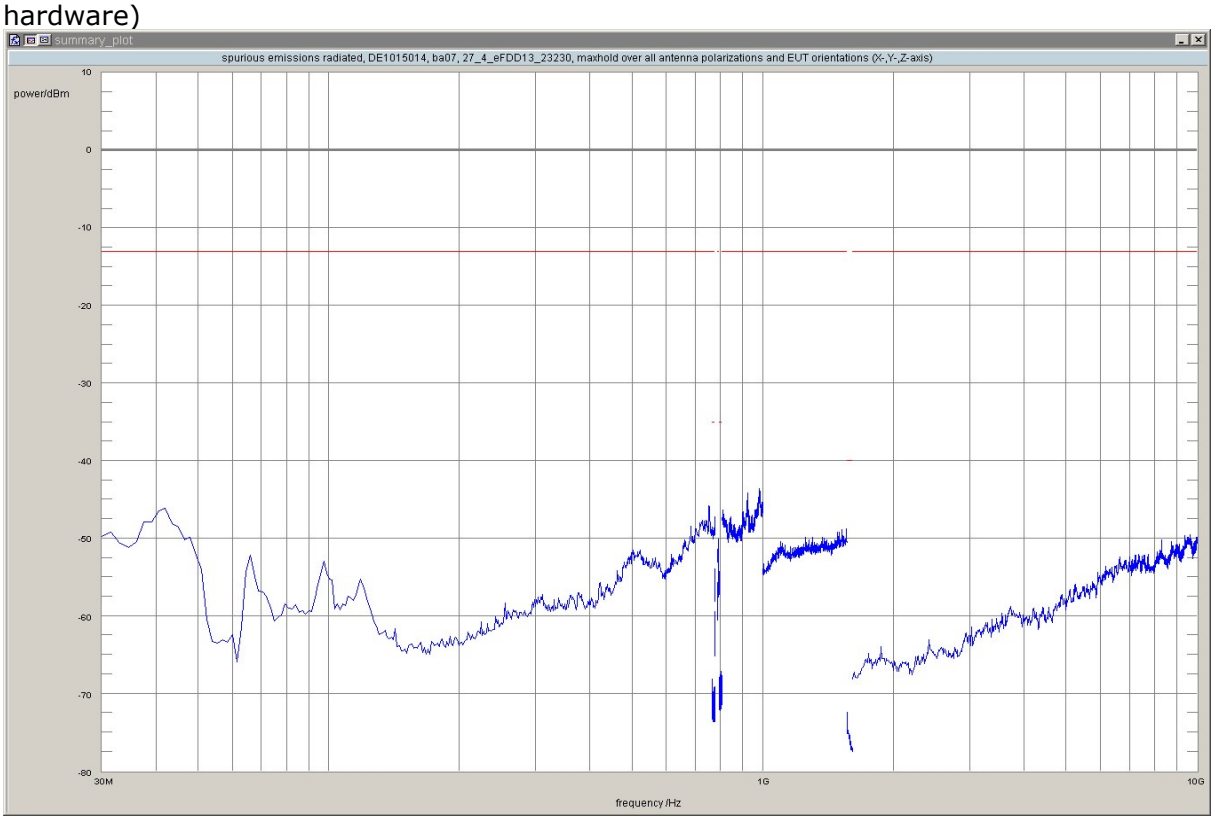
Title: band edge compliance measurement
Comment A: DE1015014, eFDD17 5MHz BW, band edge compliance, channel 23825 (713.5MHz)
Date: 18.MAR.2015 19:53:14

7.6 Field strength of spurious radiation §2.1046, §27.53

Channel 20175, CBW 10 MHz, RB/Offset 1/Mid, Modulation QPSK



Channel 23230, CBW 5 MHz, RB/Offset 1/Mid, Modulation QPSK (Setup_06, new hardware)



Channel 23790, CBW 10 MHz, RB/Offset 1/Mid, Modulation QPSK