EM7700 Module

Test Report

for

FCC Certification

FCC ID: N7NEM7700

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1 Introduction and Purpose

This document provides test data for the EM7700 Module output power intended for FCC certification.

2 Test Summary

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3 Description of Equipment Under Test

The EM7700 Module, referred to as “EUT” hereafter, is a multi-band wireless modem operating on the UMTS/LTE networks. In the US and Canada, cellular and PCS bands are used for UMTS operation, and LTE Band 17 and Band 4 are used, so this test report only contains data for these four bands (850MHz, 1900MHz, 700MHz Band 17, and 1700MHz Band 4).

4 RF Power Output

FCC 2.1046, 27.53(h)

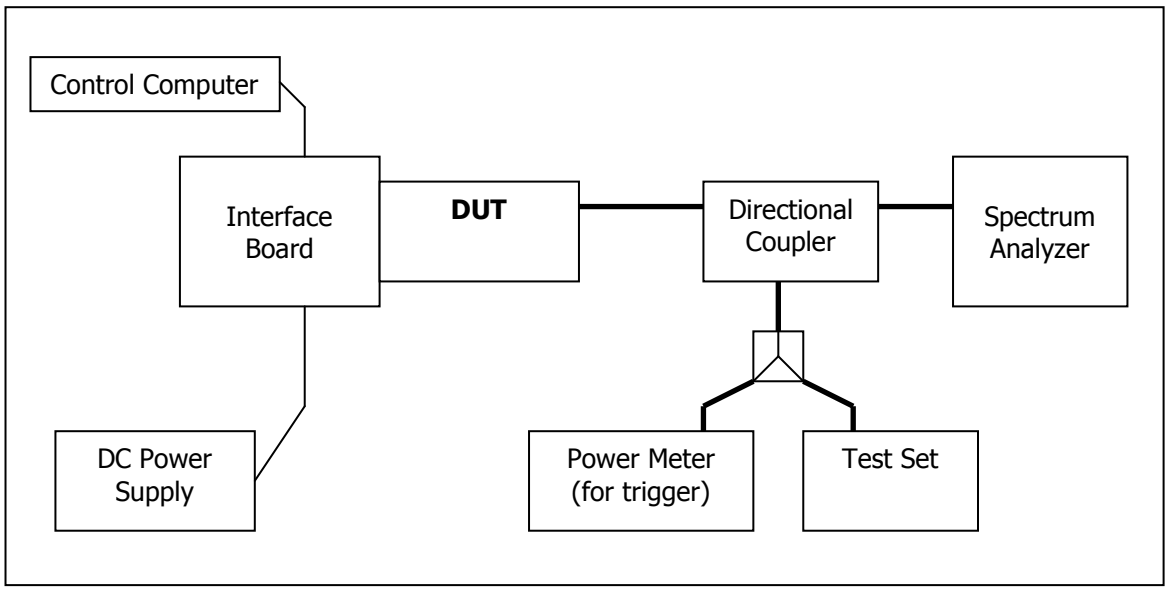
4.1 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

4.2 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMU200 Test Set (WCDMA) or a CMW500 (for LTE) and configured to operate at maximum power in a call. The power was measured using the spectrum analyzer at three equally spaced operating frequencies for each band. The RBW was set to 5MHz for the WCDMA and HSPA measurements, and 5 MHz or 10 MHz for LTE. The spectrum analyzer was set to measure the RF output power with the cable and coupler losses accounted for.

Test Setup



4.2.1 WCDMA/HSDPA/HSUPA Max Power Setup

Configure the call box to support all WCDMA tests in respect to the 3GPP 34.121 (listed in Table 4.2). Measure the power at Ch4132, 4182 and 4233 for US cell; Ch9262, 9400 and 9538 for US PCS band.

For Rel99 per 3GPP 34.121 5.2

- Set a Test Mode 1 loop back with a 12.2kbps Reference Measurement Channel (RMC)
- Set and send continuously Up power control commands to the EM7700 module.
- Measure the power at the EM7700 module antenna connector using the power meter with average detector

For HSDPA Rel 7 per 3GPP 34.121 5.2AA

- Establish a Test Mode 1 loop back with both a 12.2kbps RMC and an H-Set1 Fixed Reference Channel (FRC). With the CMU200 this is accomplished by setting the signal Channel Coding to "Fixed Reference Channel" and configuring for HSET-1 QPSK.
- Set beta values and HSDPA settings for HSDPA Subtest1 according to Table 4.2
- Send continuously Up power control commands to the EM7700 module
- Measure the power at the EM7700 module antenna connector using the power meter with modulated average detector
- Repeat the measurement for the HSDPA Subtest2, 3 and 4 as given in Table 4.2

For HSUPA Rel 6 per 3GPP 34.121 5.2B

- Use UL RMC 12.2kbps and FRC H-Set1 QPSK, Test Mode 1 loop back. With the CMU200 this is accomplished by setting the signal Channel Coding to "E-DCH Test Channel" and configuring the equipment category to Cat5_10ms.
- Set the Absolute Grant for HSUPA Subtest1 according to Table 4.2
- Set the EM7700 power to be at least 5dB lower than the Maximum output power
- Send power control bits to give one TPC_cmd = +1 command to the UNDP. If UNDP doesn't send any E-DPCH data with decreased E-TFCI within 500ms, then repeat this process until the decreased E-TFCI is reported.
- Confirm that the E-TFCI transmitted by the EM7700 module is equal to the target E-TFCI in Table 4.2. If the E-TFCI transmitted by the EM7700 module is not equal to the target E-TFCI, then send power control bits to give one TPC_cmd = -1 command to the UE. If UE sends any E-DPCH data with decreased E-TFCI within 500 ms, send new power control bits to give one TPC_cmd = -1 command to the UE. Then confirm that the E-TFCI transmitted by the UE is equal to the target E-TFCI in Table 4.2. If the E-TFCI transmitted by the UE is not equal to the target E-TFCI, then fail the UE
- Measure the power using the power meter with an average detector
- Repeat the measurement for the HSUPA Subtest2, 3 and 4 as given in Table 4.2
- Test case 5 is tested using all up bits for maximum output power per 3GPP 34.121.

Table 4.2 3GPP Rel99/HSPA Subtest Settings

						Common Settings					HSDPA Specific Settings							HSUPA Sepcific Settings			HSUPA Additional Info	
Subtest	Mode	Loopback Mode	Rel99 RMC	HDPA FRC	HSUPA Test	βc	βd	CM	MPR	Power Class 3 limit (dBm)	ΔACK	ΔNAK	ΔCQI	ACK-NAK repetition factor	CQI Feedback (Table 5.2B.4)	CQI Repetition Factor (Table 5.2B.4)	Ahs = βhs/βc	Δ E-DPCCH	ΔHARQ	AG Index	ERFCI (from 34.121 Table C.11.1.3)	Associated Max UL Data Rate kbps
1	Rel99	Testmode 1	12.2kbps	-	-			-		24 (+1.7/-3.7 dB)												
1	Rel6 HSDPA	Testmode 1	12.2kbps	H-Set 1	-	2/15	15/15	0	0	24 (+1.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15					
2	Rel6 HSDPA	Testmode 1	12.2kbps	H-Set 1	-	12/15	15/15	1	0	24 (+1.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15					
3	Rel6 HSDPA	Testmode 1	12.2kbps	H-Set 1	-	15/15	8/15	1.5	0.5	23.5 (+2.2/-3.7 dB)	8	8	8	3	4 ms	2	30/15					
4	Rel6 HSDPA	Testmode 1	12.2kbps	H-Set 1	-	15/15	4/15	1.5	0.5	23.5 (+2.2/-3.7 dB)	8	8	8	3	4 ms	2	30/15					
1	Rel6 HSUPA	Testmode 1	12.2kbps	H-Set 1	HSUPA Loopback	11/15	15/15	1	0	24 (+1.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15	6	0	20	75	242.1
2	Rel6 HSUPA	Testmode 1	12.2kbps	H-Set 1	HSUPA Loopback	6/15	15/15	3	2	22 (+3.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15	8	0	12	67	174.9
3	Rel6 HSUPA	Testmode 1	12.2kbps	H-Set 1	HSUPA Loopback	15/15	9/15	2	1	23 (+2.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15	8	0	15	92	482.8
4	Rel6 HSUPA	Testmode 1	12.2kbps	H-Set 1	HSUPA Loopback	2/15	15/15	3	2	22 (+3.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15	5	0	17	71	205.8
5	Rel6 HSUPA	Testmode 1	12.2kbps	H-Set 1	HSUPA Loopback	15/15	15/15	1	0	24 (+1.7/-3.7 dB)	8	8	8	3	4 ms	2	30/15	7	0	81	81	308.9

4.2.2 LTE Max Power Setup

Configure the CMW500 call box to support all LTE tests in respect to the 3GPP 36.521.

- UE term. Conn: User defined Channels
- Exp. Nominal Power Mode: According to UL Power Control Settings
- RS EPRE: -75.0 dBm/15kHz Full Cell BW Power: -50.2 dBm
- PSS Power Offset = SSS Power Offset = PBCH Power Offset = PCFICH Power Offset = PDCCH Power Offset = 0.0 dB
- PHICH Power Offset = -12 dB
- OCNG ON
- PDSCH Power Offset PA: 0 dB, Power Ratio Index PB: 0 (rhoB/rhoA: 1)
- Active TPC Setup: Max Power
- Security Settings: Authentication OFF, NAS Security OFF, AS Security OFF
- Integrity Algortithm: NULL
- Milenage: OFF

- Configure the desired channel, BW, resource block allocation and modulation.
- Connect to test set.
- Set CMW500 TPC Setup to Max Power (Up power control command).
- Measure the power at the EM7700 module antenna connector using the CMW multi evaluation LTE measurement.

4.3 Maximum Transmit Power Test Results

4.3.1 Test Results for WCDMA/HSDPA/HSUPA Output Power

		Band V (800 MHz) Channel Power (dBm)			Band II (1900 MHz) Channel Power (dBm)			
Mode	3GPP Subtest	4132	4182	4233	9262	9400	9538	MPR
Rel99	1	22.98	22.95	22.94	23.0	22.87	22.89	N/A
Rel6 HSDPA	1	22.31	22.4	22.28	22.42	22.39	22.37	0
	2	22.42	22.57	22.51	22.65	22.41	22.42	0
	3	22.02	22.04	22.01	22.25	21.9	21.91	0.5
	4	22.01	22.03	22.01	22.11	21.99	21.99	0.5
Rel6 HSUPA	1	21.80	22.45	22.45	22.00	22.56	22.39	0
	2	20.66	20.56	20.46	21.07	20.56	20.60	2
	3	21.63	21.39	21.41	21.90	21.47	21.49	1
	4	21.43	21.44	21.39	21.54	21.45	21.41	2
	5	22.48	22.53	22.49	22.67	22.57	22.59	0

Note: All measurements are based on an average detector.

4.3.2 Test Results for LTE Output Power

According to 3GPP 36.521, V9.1.0, the output power level for Power Class 3 LTE is to be 23.0dBm ± 2.7dB. The lower limit is shifted down by the MPR amount allowed for certain configurations.

Maximum Power Reduction (MPR) is allowed due to higher order modulation and transmit bandwidth configurations. These MPR levels reduce the lower limit of each output power by the either 1 or 2dB per 3GPP 36.521.

4.3.2.1 Output Power Results for LTE Band 4, 5 MHz Bandwidth

FREQUENCY (MHz)	UL CHANNEL	MODULATION	UL NO RB	RB START	MAX POWER (RMS)	MAX POWER (PK)	MPR (dB)
1712.5	19975	QPSK	1	0	22.71	27.9	0
			1	12	22.7	27.83	0
			1	24	22.71	27.9	0
			8	0	22.7	28.24	0
			8	10	22.83	28.23	0
			8	17	22.7	28.2	0
			12	0	21.69	28.05	1
			12	6	21.7	27.96	1
			12	13	21.7	28.06	1
			25	0	21.78	28.15	1
		16QAM	1	0	21.58	28.38	1
			1	12	21.61	28.35	1
			1	24	21.52	28.3	1
			8	0	21.88	28.15	1
			8	10	21.93	28.09	1
			8	17	21.86	28.12	1
			12	0	21.12	28	2
			12	6	21.1	27.9	2
			12	13	21.14	27.94	2
			25	0	20.9	28.06	2
1732.5	20175	QPSK	1	0	22.66	27.5	0
			1	12	22.66	27.4	0
			1	24	22.69	27.46	0
			8	0	22.68	28.25	0
			8	10	22.65	28.14	0
			8	17	22.67	28.23	0
			12	0	21.76	28.15	1
			12	6	21.76	27.95	1
			12	13	21.77	28.06	1
			25	0	21.87	27.89	1

		16QAM	1	0	22.2	27.94	1
			1	12	22.21	27.84	1
			1	24	22.17	27.88	1
			8	0	21.66	28.38	1
			8	10	21.67	28.29	1
			8	17	21.65	28.3	1
			12	0	20.79	27.54	2
			12	6	20.74	27.45	2
			12	13	20.75	27.53	2
			25	0	21.27	27.9	2
1752.5	20375	QPSK	1	0	22.78	27.55	0
			1	12	22.8	27.56	0
			1	24	22.79	27.6	0
			8	0	22.81	28.8	0
			8	10	22.81	28.72	0
			8	17	22.66	28.66	0
			12	0	21.78	27.71	1
			12	6	21.84	27.64	1
			12	13	21.75	27.66	1
			25	0	21.84	27.8	1
		16QAM	1	0	22.09	27.96	1
			1	12	22.1	27.93	1
			1	24	22.02	27.99	1
			8	0	22.01	28.28	1
			8	10	22.03	28.21	1
			8	17	21.9	28.21	1
			12	0	20.81	28.08	2
			12	6	20.85	28.09	2
			12	13	20.81	28.15	2
			25	0	20.78	27.69	2

4.3.2.2 Output Power Results for LTE Band 4, 10 MHz Bandwidth

FREQUENCY (MHz)	UL CHANNEL	MODULATION	UL NO RB	RB START	MAX POWER (RMS)	MAX POWER (PK)	MPR (dB)
1750	20000	QPSK	1	0	22.78	28.26	0
			1	25	22.82	28.27	0
			1	49	22.69	28.24	0
			12	0	22.71	28.2	0
			12	19	22.83	28.23	0
			12	38	22.87	28.28	0
			25	0	21.73	28.1	1
			25	12	21.76	28.04	1

			25	25	21.76	28.11	1
			50	0	21.78	28.25	1
		16QAM	1	0	21.77	27.87	1
			1	25	21.74	27.67	1
			1	49	21.66	27.72	1
			12	0	22.27	28.7	1
			12	19	22.26	28.66	1
			12	38	22.21	28.7	1
			25	0	20.45	27.65	2
			25	12	20.51	27.6	2
			25	25	20.47	27.65	2
			50	0	20.79	27.76	2
1732.5	20175	QPSK	1	0	22.8	28.07	0
			1	25	22.77	27.9	0
			1	49	22.82	28.04	0
			12	0	22.69	28.62	0
			12	19	22.71	28.58	0
			12	38	22.69	28.56	0
			25	0	21.84	27.96	1
			25	12	21.89	27.93	1
			25	25	21.9	27.92	1
			50	0	21.88	28.74	1
		16QAM	1	0	21.75	28.16	1
			1	25	21.8	28.04	1
			1	49	21.74	28.06	1
			12	0	21.73	28.33	1
			12	19	21.84	28.28	1
			12	38	21.74	28.23	1
			25	0	20.82	27.7	2
			25	12	20.85	27.69	2
			25	25	20.77	27.56	2
			50	0	21	28.41	2
1750	20350	QPSK	1	0	22.78	27.75	0
			1	25	22.69	27.62	0
			1	49	22.74	27.8	0
			12	0	22.8	28.65	0
			12	19	22.72	28.54	0
			12	38	22.7	28.5	0
			25	0	21.9	28.15	1
			25	12	21.94	28.04	1
			25	25	21.88	28.15	1
			50	0	21.9	28.8	1
		16QAM	1	0	21.66	28.22	1

			1	25	21.7	28.23	1
			1	49	21.74	28.32	1
			12	0	22.13	28.51	1
			12	19	22.19	28.52	1
			12	38	22.15	28.6	1
			25	0	21.05	27.93	2
			25	12	21.01	27.92	2
			25	25	20.97	28.07	2
			50	0	20.86	27.88	2

4.3.2.3 Output Power Results for LTE Band 17, 5 MHz Bandwidth

FREQUENCY (MHz)	UL CHANNEL	MODULATION	UL NO RB	RB START	MAX POWER (RMS)	MAX POWER (PK)	MPR (dB)
706.5	23755	QPSK	1	0	22.77	28.58	0
			1	12	22.76	28.77	0
			1	24	22.75	28.72	0
			8	0	22.6	29	0
			8	10	22.61	29.18	0
			8	17	22.53	28.99	0
			12	0	21.56	28.75	1
			12	6	21.56	28.67	1
			12	13	21.57	29.21	1
			25	0	21.68	28.19	1
		16QAM	1	0	21.38	29.13	1
			1	12	21.37	29.24	1
			1	24	21.34	29.2	1
			8	0	21.74	28.87	1
			8	10	21.72	29.04	1
			8	17	21.63	29.07	1
			12	0	20.96	28.53	2
			12	6	20.99	28.8	2
			12	13	20.96	29.17	2
			25	0	20.66	28.45	2
710	23790	QPSK	1	0	22.73	28.34	0
			1	12	22.7	28.14	0
			1	24	22.7	28.13	0
			8	0	22.42	29.05	0
			8	10	22.6	29.02	0
			8	17	22.48	29.05	0
			12	0	21.4	28.81	1
			12	6	21.59	29.07	1
			12	13	21.57	28.87	1

			25	0	21.62	28.64	1
		16QAM	1	0	22	28.75	1
			1	12	22.09	28.59	1
			1	24	21.67	28.85	1
			8	0	21.72	30.02	1
			8	10	21.67	29.68	1
			8	17	21.61	29.75	1
			12	0	20.65	28.54	2
			12	6	20.7	28.61	2
			12	13	20.6	28.21	2
			25	0	20.59	28.25	2
713.5	23825	QPSK	1	0	22.74	28.3	0
			1	12	22.78	28.01	0
			1	24	22.77	28.43	0
			8	0	22.69	29.49	0
			8	10	22.65	29.4	0
			8	17	22.56	29.31	0
			12	0	21.77	28.26	1
			12	6	21.67	28.3	1
			12	13	21.61	28.17	1
			25	0	21.61	27.91	1
		16QAM	1	0	21.66	28.85	1
			1	12	21.48	28.27	1
			1	24	21.7	28.6	1
			8	0	21.8	29.74	1
			8	10	21.74	29.56	1
			8	17	21.8	29.54	1
			12	0	20.77	28.11	2
			12	6	20.7	28.15	2
			12	13	20.66	27.97	2
			25	0	20.65	27.55	2

4.3.2.4 Output Power Results for LTE Band 17, 10 MHz Bandwidth

FREQUENCY (MHz)	UL CHANNEL	MODULATION	UL NO RB	RB START	MAX POWER (RMS)	MAX POWER (PK)	MPR (dB)
710	23790	QPSK	1	0	22.85	29.23	0
			1	25	22.77	28.74	0
			1	49	22.77	28.9	0
			12	0	22.56	29.53	0
			12	19	22.53	29.23	0
			12	38	22.59	29.34	0
			25	0	21.54	28.71	1

			25	12	21.57	29	1
			25	25	21.58	28.27	1
			50	0	21.55	29.43	1
		16QAM	1	0	21.5	28.33	1
			1	25	21.28	27.76	1
			1	49	21.47	28.07	1
			12	0	21.99	29.87	1
			12	19	21.89	29.46	1
			12	38	21.97	29.63	1
			25	0	20.36	29.06	2
			25	12	20.7	29.22	2
			25	25	20.5	28.67	2
			50	0	20.84	29.27	2

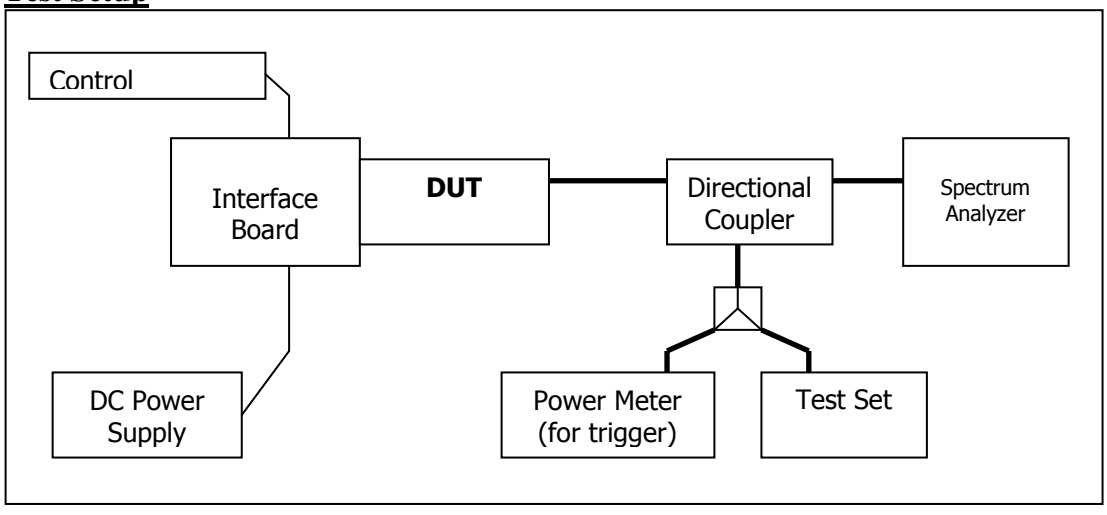
5 Occupied Bandwidth

FCC 2.1049, 24.238(a)(b), 27.53(h)

5.1 Test Procedure

The transmitter output was connected to a spectrum analyzer through a calibrated coaxial cable and a directional coupler. The occupied bandwidth (defined as the 99% Power Bandwidth) was measured with the spectrum analyzer at low, middle, and high frequencies in each band. The –26dB bandwidth was also measured and recorded.

Test Setup



5.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

5.3 Test Results

The WCDMA tests were performed with an RMC 12.2kps configuration, because it is the standard generic loopback call setup used in 3GPP testing.

The LTE tests were performed with full resource block allocation in order to maximize the occupied bandwidth.

5.3.1 WCDMA Summary Results

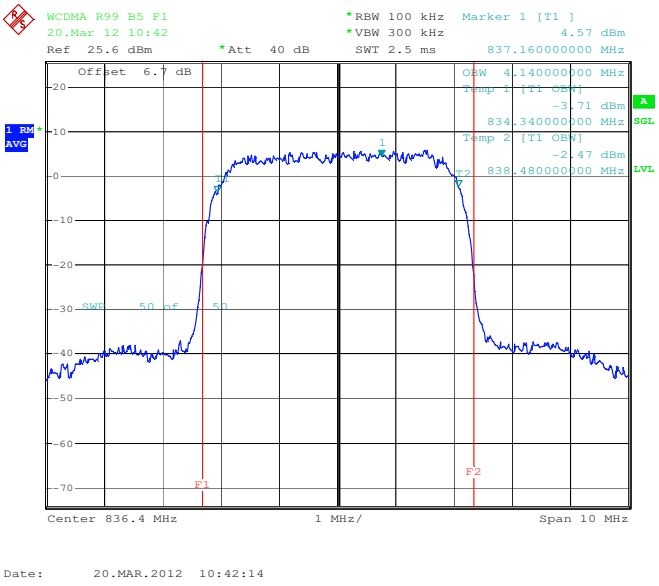
Mode	Frequency (MHz)	Channel	99% Occupied Bandwidth (MHz)	-26dBc Occupied Bandwidth (MHz)	Corresponding Plot number
WCDMA (R99)	836.4	4182	4.16	4.66	Plot 5.3.3.1
	1880	9400	4.17	4.68	Plot 5.3.3.2
HSDPA (R5)	836.4	4182	4.15	4.66	Plot 5.3.4.1
	1880	9400	4.17	4.68	Plot 5.3.4.2
HSUPA (R6)	836.4	4182	4.15	4.66	Plot 5.3.5.1
	1880	9400	4.17	4.68	Plot 5.3.5.2

5.3.2 LTE Summary Results

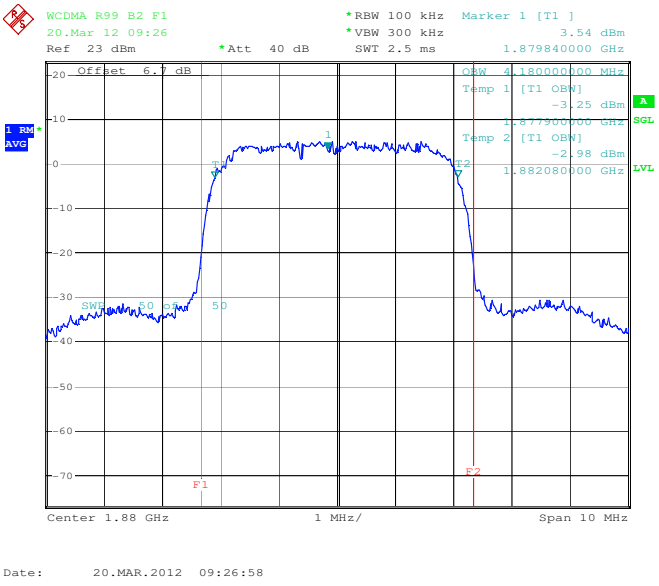
Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	99% Occupied Bandwidth (MHz)	-26dBc Occupied Bandwidth (MHz)	Corresponding Plot number
LTE	QPSK	B4	5	25	0	1732.5	20175	4.52	4.76	Plot 5.3.6.1
			10	50	0	1732.5	20175	9.04	9.96	Plot 5.3.6.2
		B17	5	25	0	710	23790	4.52	4.76	Plot 5.3.6.3
			10	50	0	710	23790	9.12	10.04	Plot 5.3.6.4
	16QAM	B4	5	25	0	1732.5	20175	4.52	4.76	Plot 5.3.6.5
			10	50	0	1732.5	20175	9.04	9.96	Plot 5.3.6.6
		B17	5	25	0	710	23790	4.52	4.78	Plot 5.3.6.7
			10	50	0	710	23790	9.16	10.04	Plot 5.3.6.8

5.3.3 WCDMA Rel99 Test Plots

5.3.3.1 WCDMA Occupied Bandwidth, Cellular Middle channel, 836.4 MHz, 99% BW

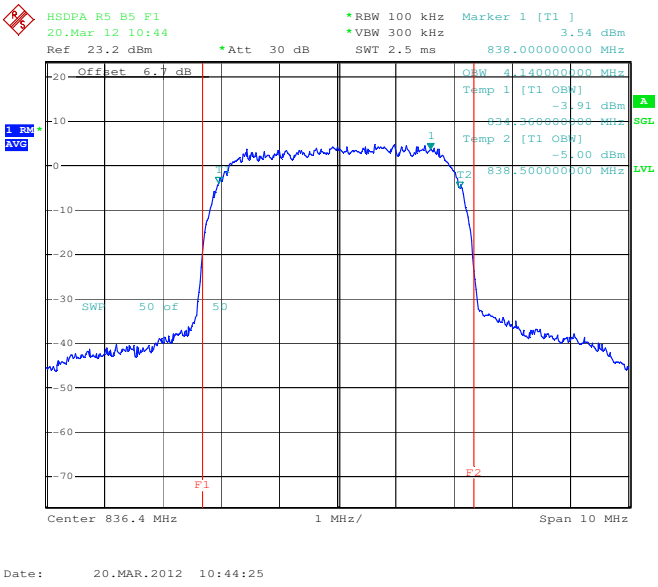


5.3.3.2 WCDMA Occupied Bandwidth, PCS Middle channel, 1880 MHz, 99% BW

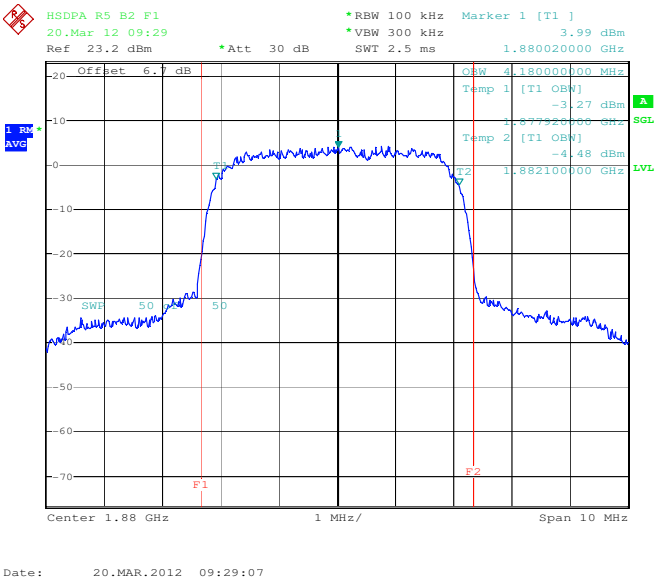


5.3.4 HSDPA Rel5 Test Plots

5.3.4.1 HSDPA Occupied Bandwidth, Cellular Middle channel, 836.4 MHz, 99% BW

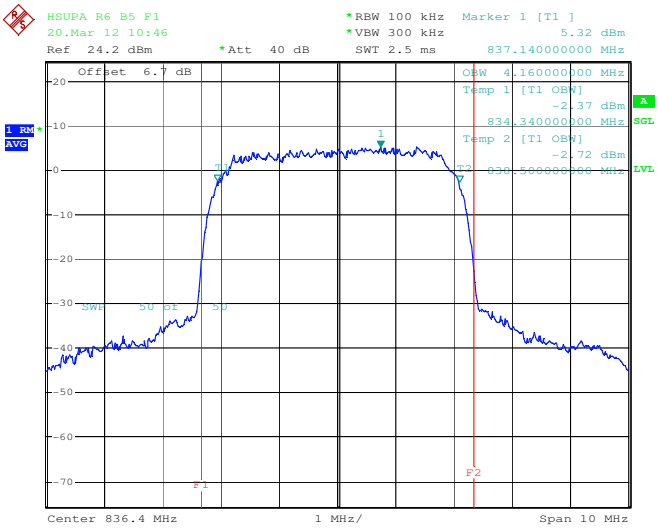


5.3.4.2 HSDPA Occupied Bandwidth, PCS Middle channel, 1880 MHz, 99% BW

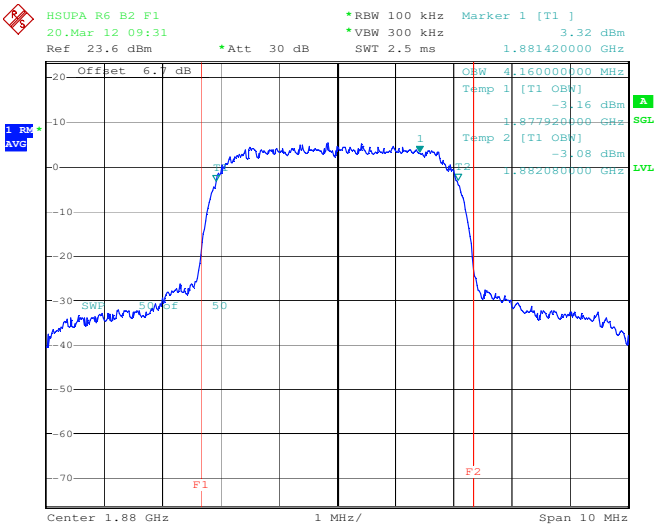


5.3.5 HSUPA Rel6 Test Plots

5.3.5.1 HSUPA Occupied Bandwidth, Cellular Middle channel, 836.4 MHz, 99% BW

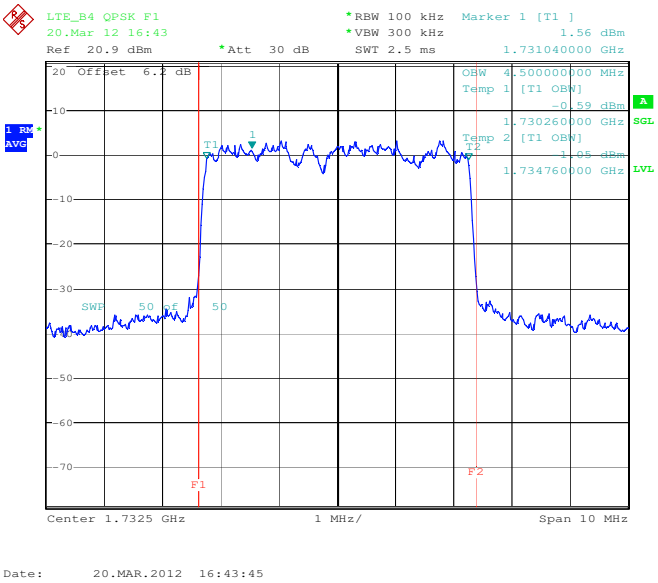


5.3.5.2 HSUPA Occupied Bandwidth, PCS Middle channel, 1880 MHz, 99% BW

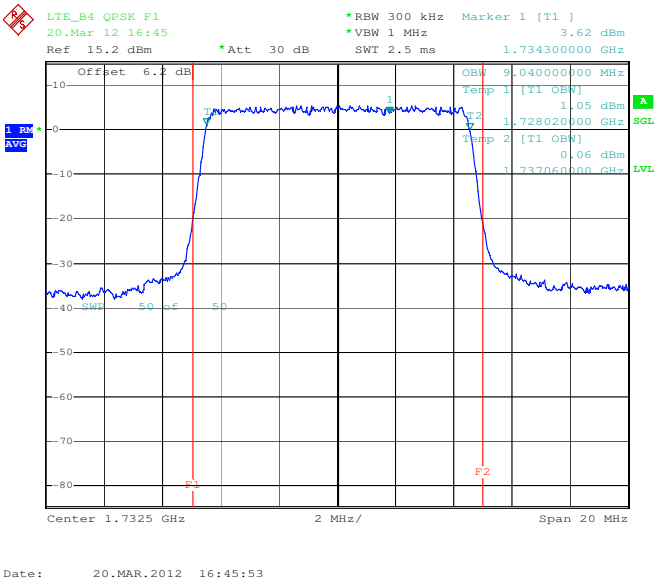


5.3.6 LTE Test Plots

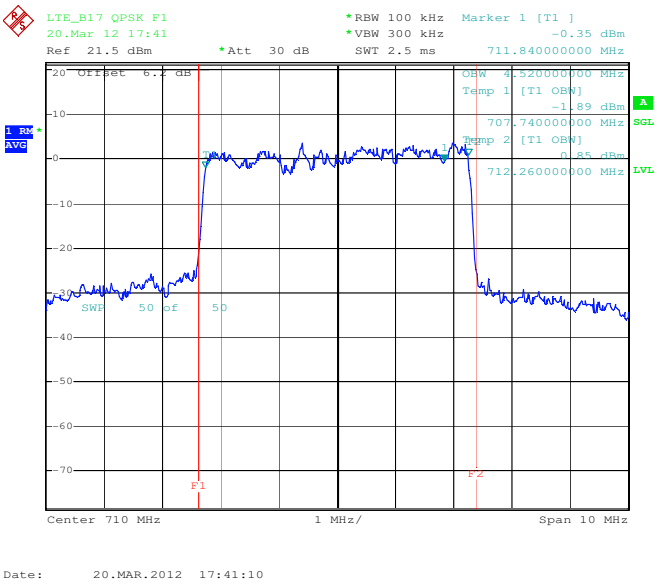
5.3.6.1 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=5MHz, RB=25, RB Offset=0, QPSK 99% BW



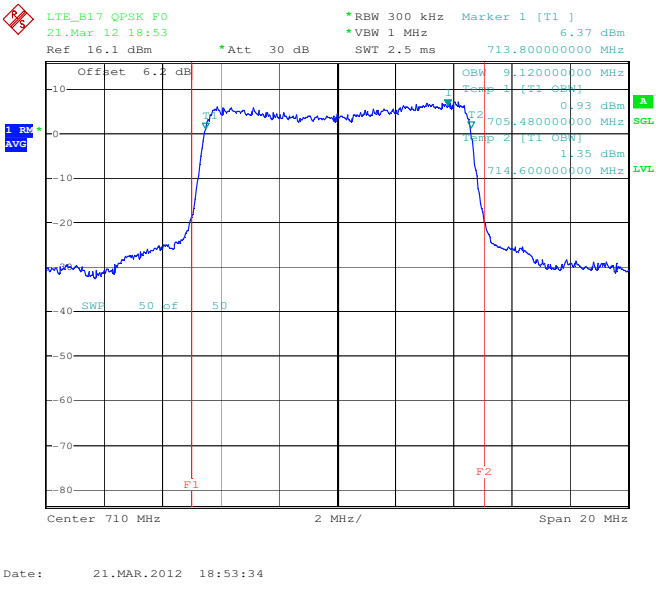
5.3.6.2 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=10MHz, RB=50, RB Offset=0, QPSK 99% BW



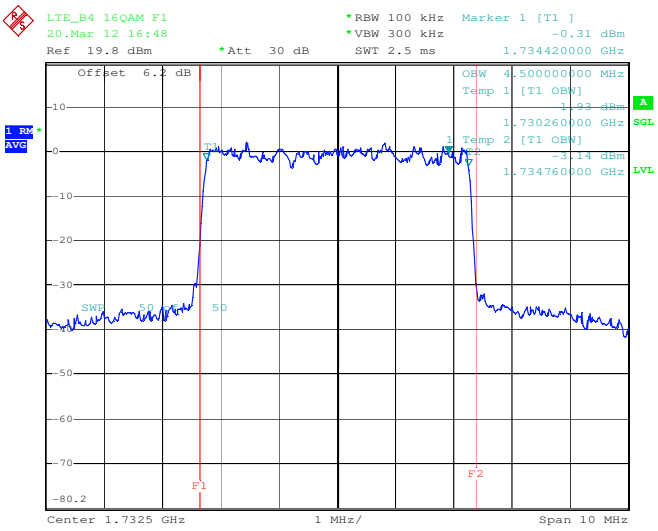
5.3.6.3 LTE Occupied Bandwidth, Band17 mid channel (23790) BW=5MHz, RB=25, RB Offset=0, QPSK 99% BW



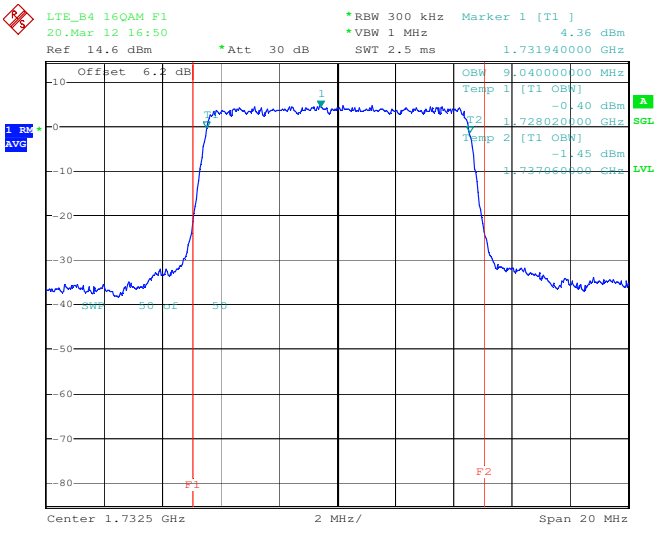
5.3.6.4 LTE Occupied Bandwidth, Band17 mid channel (23790) BW=10MHz, RB=50, RB Offset=0, QPSK 99% BW



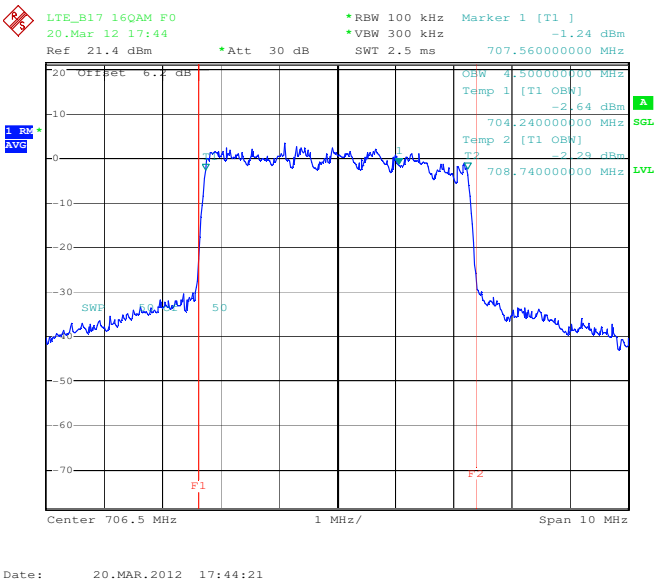
5.3.6.5 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=5MHz, RB=25, RB Offset=0, 16QAM 99% BW



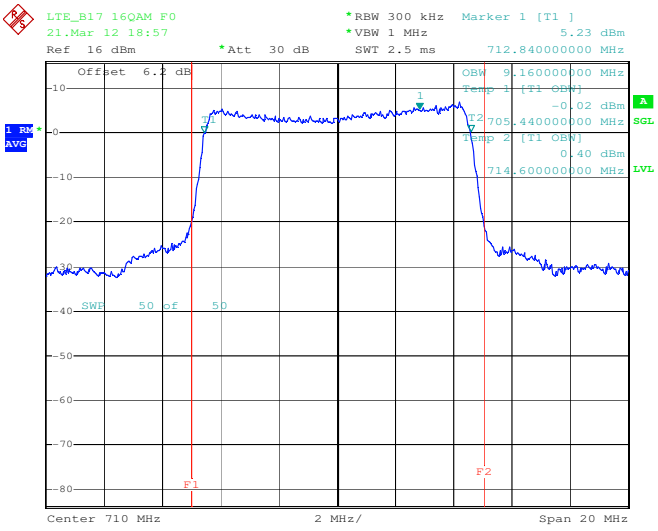
5.3.6.6 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=10MHz, RB=50, RB Offset=0, 16QAM 99% BW



5.3.6.7 LTE Occupied Bandwidth, Band17 mid channel (23790) BW=5MHz, RB=25, RB Offset=0, 16QAM 99% BW



5.3.6.8 LTE Occupied Bandwidth, Band17 mid channel (23790) BW=10MHz, RB=50, RB Offset=0, 16QAM 99% BW



6 Out of Band Emissions at Antenna Terminals

FCC 22.901(d), 22.917, 24.238(a), 27.53(g)(h)

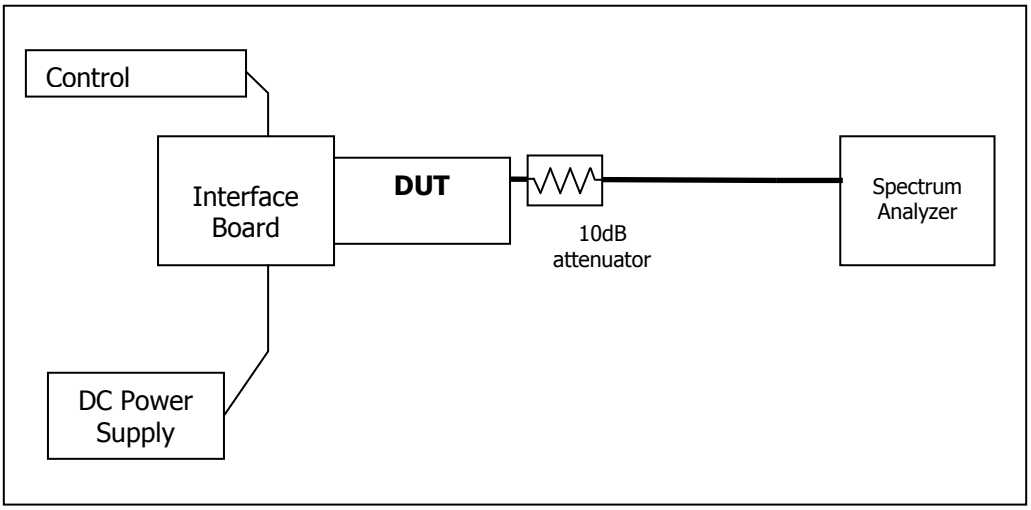
Out of Band Emissions:
The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by at least (43 + 10 log P) dB. The out of band emission limit translates to a worst case absolute limit of -13dBm in this case.

Band	Frequency	FCC Specification	Measurement BW
B2	1850–1910 MHz and 1930–1990 MHz	24.238(a)	1 MHz or >1% EBW
B4	1710–1755 MHz and 2110–2155 MHz	27.53(h)	1 MHz
B5	824-849 MHz and 869-894 MHz	22.917(b)	>= 100 kHz or >1% EBW
B17	698–746 MHz	27.53(g)	>= 100 kHz

6.1 Test Procedure

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band emissions, if any, up to 10th harmonic. The EUT was scanned for spurious emissions from 1MHz to 20GHz with sufficient bandwidth and video resolution. Data plots are included. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were captured.

Test Setup



6.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

6.3 Test Results

Refer to the following plots.

Note: Only R99 was tested for WCDMA because the modulation is the same (QPSK) and the maximum power for HSDPA and HSUPA is less than WCDMA R99 maximum power.

Note: LTE was only measured using 1 RB with RB offset equal to 12 (5 MHz BW) or 25 (10 MHz BW) and QPSK modulation because this configuration produces maximum power for the device.

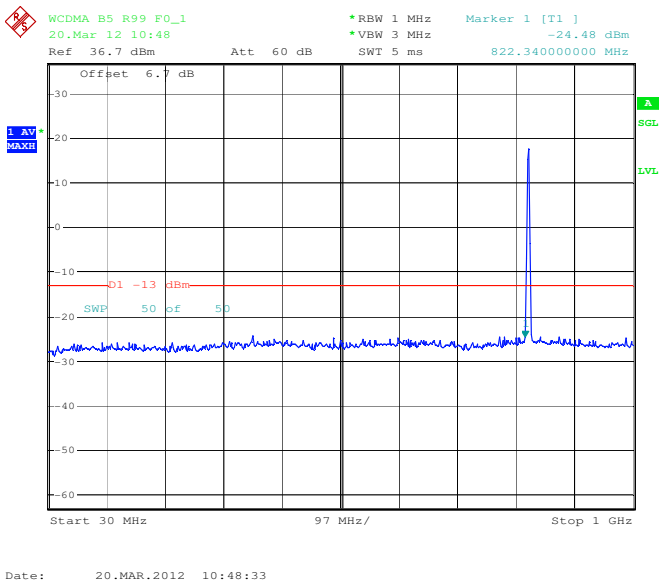
Mode		Frequency (MHz)	Channel	Corresponding Plot number
WCDMA Rel99	B5	826.4	4132	Plot 6.3.1.1, Plot 6.3.1.2
		836.4	4182	Plot 6.3.1.3, Plot 6.3.1.4
		846.6	4233	Plot 6.3.1.5, Plot 6.3.1.6
	B2	1852.4	9262	Plot 6.3.1.7 - Plot 6.3.1.9
		1880.0	9400	Plot 6.3.1.10 - Plot 6.3.1.12
		1907.5	9538	Plot 6.3.1.13 - Plot 6.3.1.15

Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	Corresponding Plot number
LTE	QPSK	B4	5	1	12	1712.5	19975	Plot 6.3.2.1 - Plot 6.3.2.3
						1732.5	20175	Plot 6.3.2.4 - Plot 6.3.2.6
						1752.5	20375	Plot 6.3.2.7 - Plot 6.3.2.9
			10	1	25	1715.0	20000	Plot 6.3.2.10 - Plot 6.3.2.12
						1732.5	20175	Plot 6.3.2.13 - Plot 6.3.2.15
						1750.0	20350	Plot 6.3.2.16 - Plot 6.3.2.18
		B17	5	1	12	706.5	23755	Plot 6.3.2.19 - Plot 6.3.2.20
						710.0	23790	Plot 6.3.2.21 - Plot 6.3.2.22
						713.5	23825	Plot 6.3.2.23 - Plot 6.3.2.24
			10	1	25	710.0	23790	Plot 6.3.2.25 - Plot 6.3.2.26

The plots below show that the conducted emission limits requirements are met.

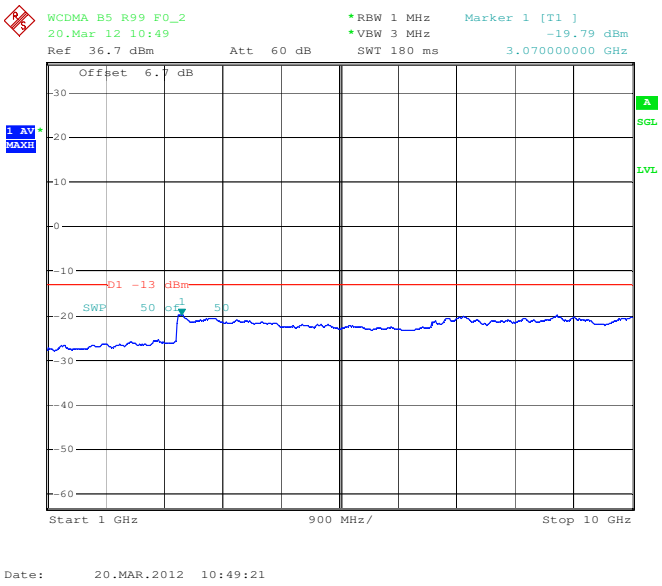
6.3.1 WCDMA Rel99 Test Plots

6.3.1.1 Out of Band Emissions at Antenna Terminals WCDMA, Low channel, 826.4 MHz, 30 MHz to 1 GHz

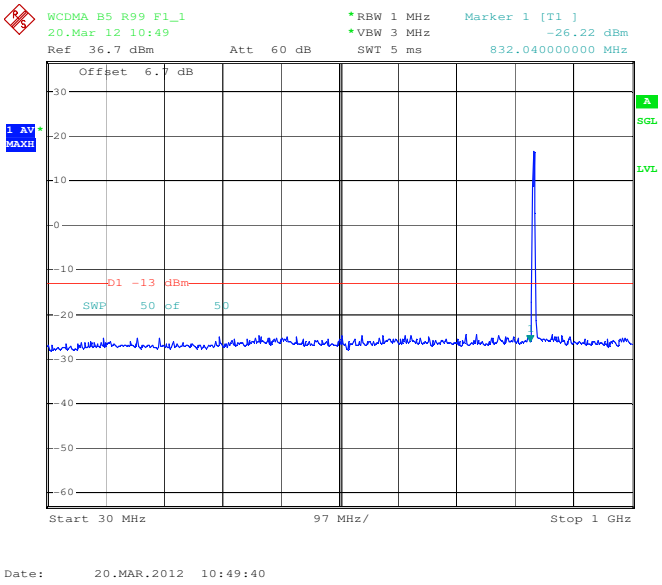


Note: The strong emission shown in each case is the carrier signal.

6.3.1.2 Out of Band Emissions at Antenna Terminals WCDMA, Low channel, 826.4 MHz, 1 GHz to 20 GHz

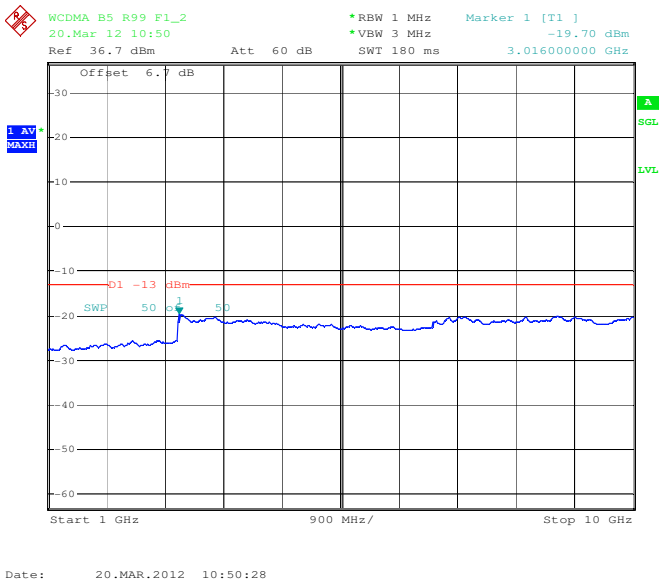


6.3.1.3 Out of Band Emissions at Antenna Terminals WCDMA, Middle channel, 836.4 MHz, 30M Hz to 1 GHz

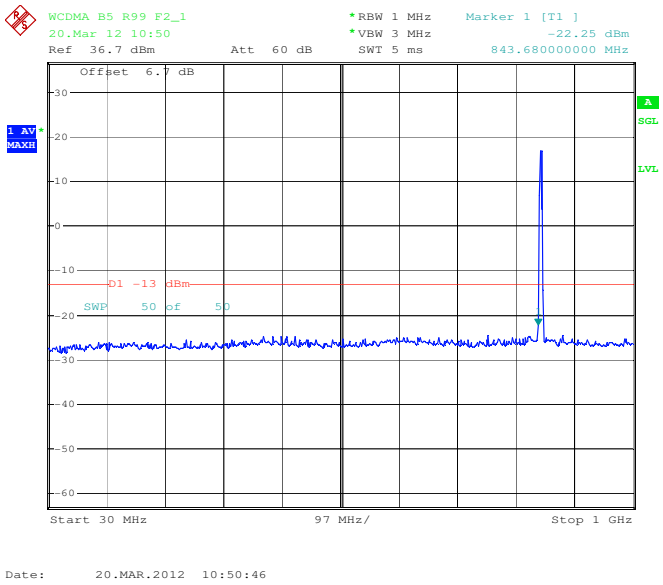


Note: The strong emission shown in each case is the carrier signal.

6.3.1.4 Out of Band Emissions at Antenna Terminals WCDMA, Middle channel, 836.4 MHz, 1 GHz to 20 GHz

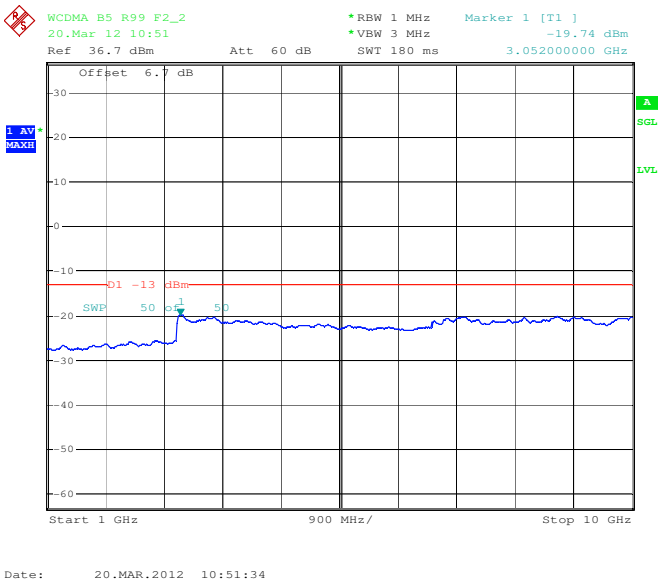


6.3.1.5 Out of Band Emissions at Antenna Terminals WCDMA, High Channel, 846.6 MHz, 30M Hz to 1 GHz

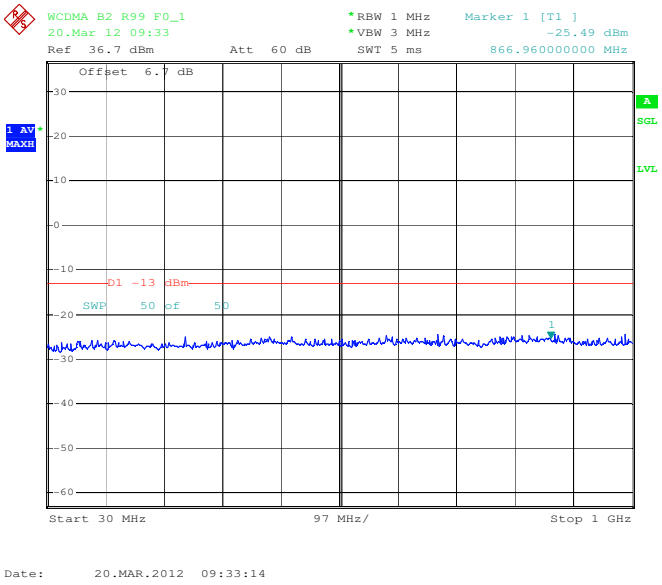


Note: The strong emission shown in each case is the carrier signal.

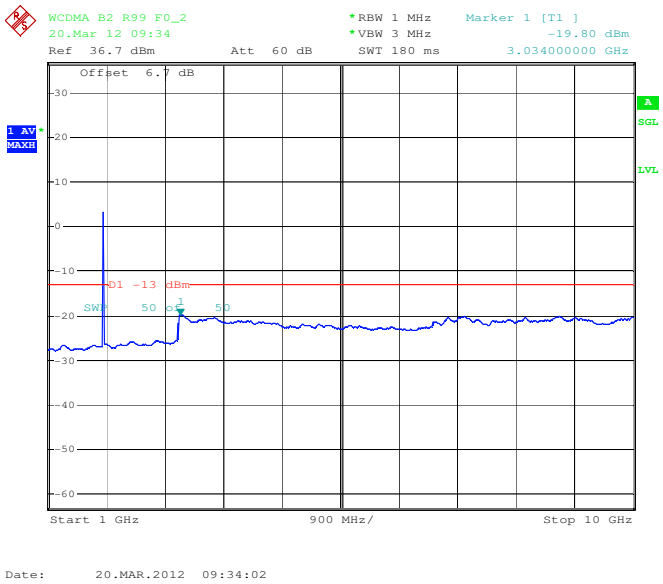
6.3.1.6 Out of Band Emissions at Antenna Terminals WCDMA, High Channel, 846.6 MHz, 1 GHz to 20 GHz



6.3.1.7 Out of Band Emissions at Antenna Terminals WCDMA, Low channel, 1852.4 MHz, 30MHz to 1 GHz

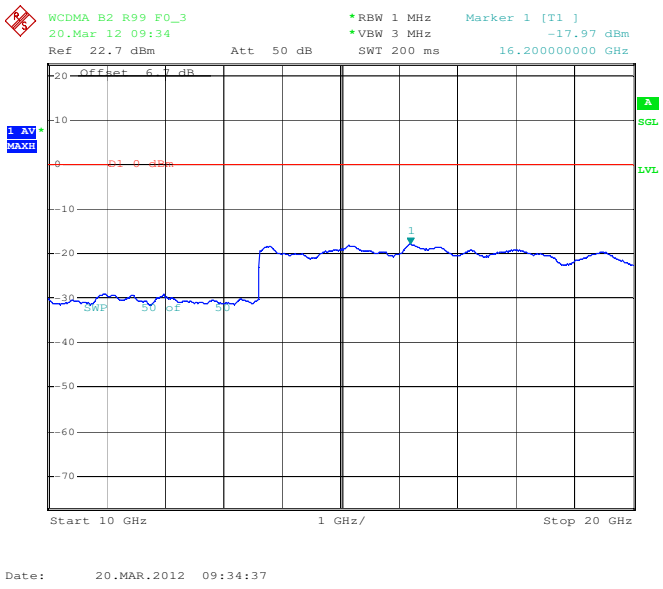


6.3.1.8 Out of Band Emissions at Antenna Terminals WCDMA, Low channel, 1852.4 MHz, 1 GHz to 10 GHz

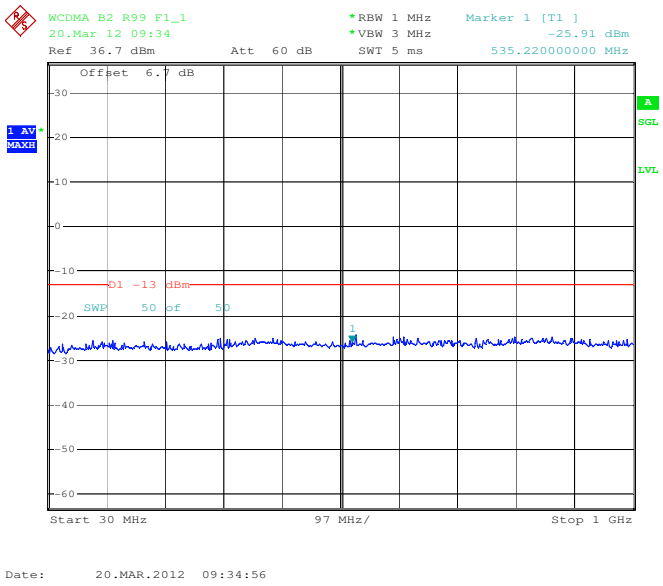


Note: The strong emission shown is the carrier signal.

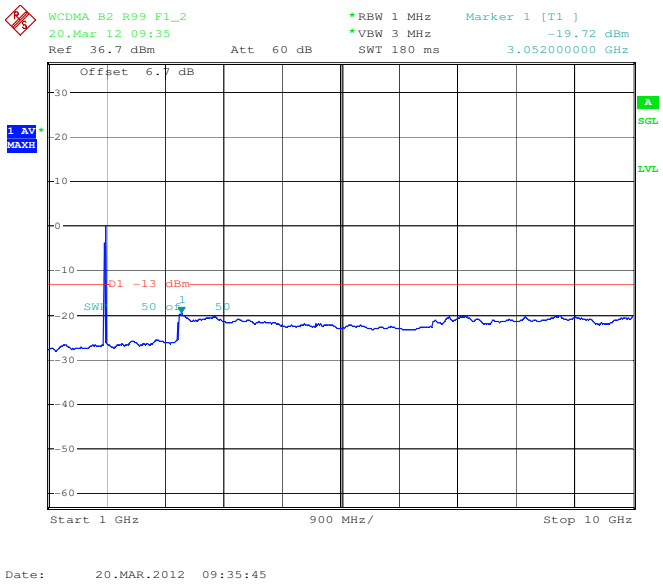
6.3.1.9 Out of Band Emissions at Antenna Terminals WCDMA, Low channel, 1852.4 MHz, 10 GHz to 20 GHz



6.3.1.10 Out of Band Emissions at Antenna Terminals WCDMA, Middle channel, 1880 MHz, 30M Hz to 1 GHz

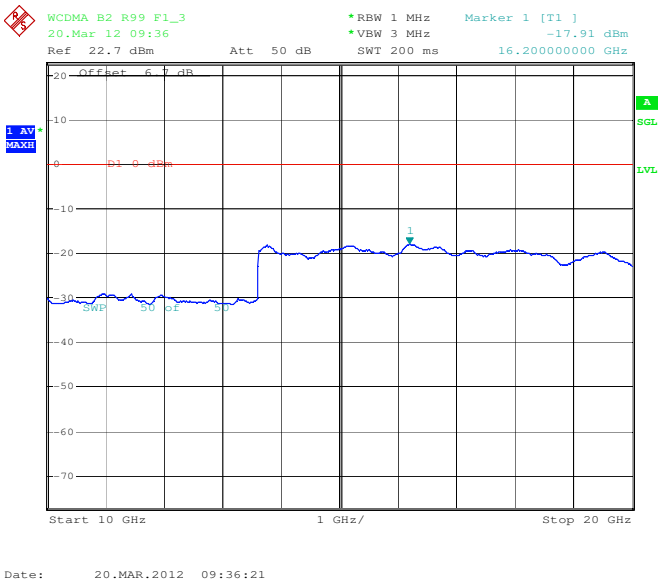


6.3.1.11 Out of Band Emissions at Antenna Terminals WCDMA, Middle channel, 1880 MHz, 1 GHz to 10 GHz

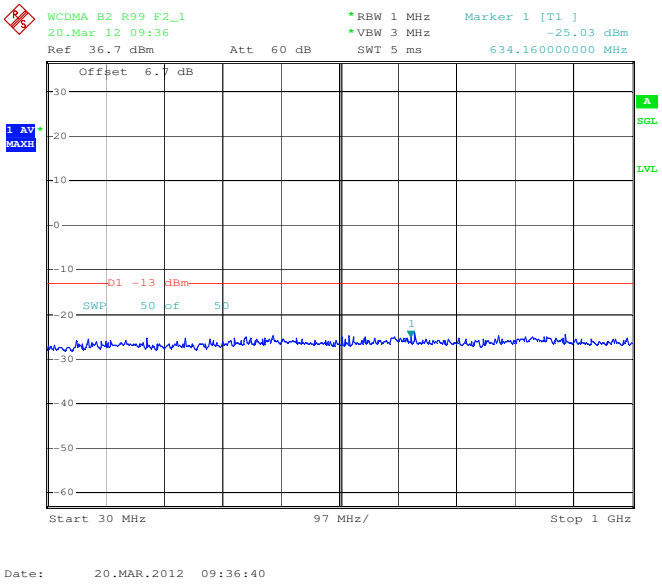


Note: The strong emission shown is the carrier signal.

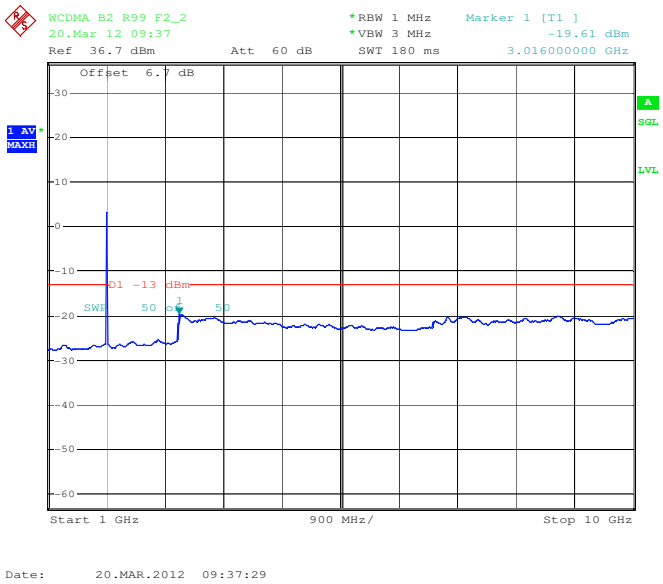
6.3.1.12 Out of Band Emissions at Antenna Terminals WCDMA, Middle channel, 1880 MHz, 10 GHz to 20 GHz



6.3.1.13 Out of Band Emissions at Antenna Terminals WCDMA, High channel, 1907.6 MHz, 30MHz to 1 GHz

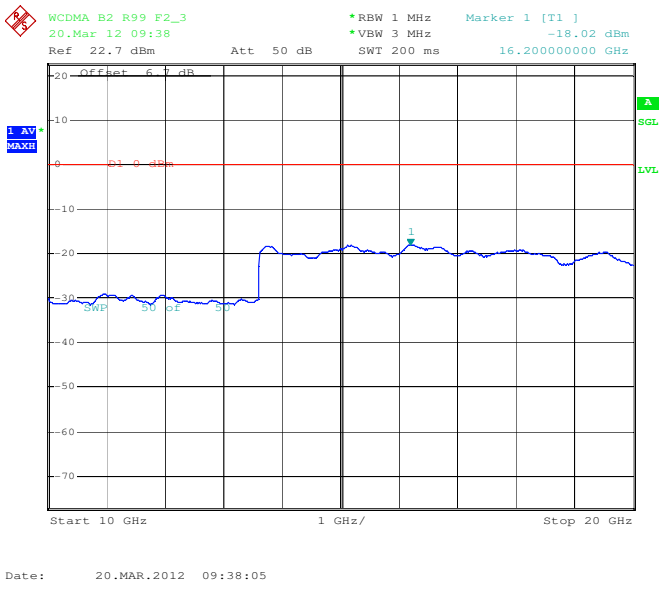


6.3.1.14 Out of Band Emissions at Antenna Terminals WCDMA, High channel, 1907.6 MHz, 1 GHz to 10 GHz



Note: The strong emission shown is the carrier signal.

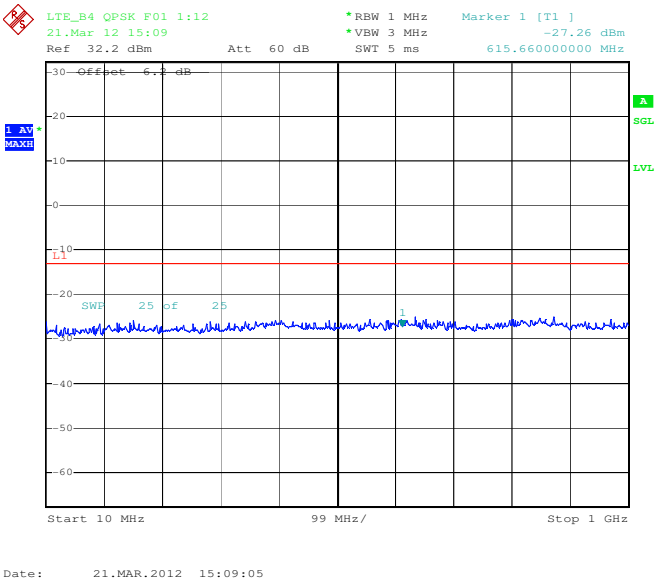
6.3.1.15 Out of Band Emissions at Antenna Terminals WCDMA, High channel, 1907.6 MHz, 10 GHz to 20 GHz



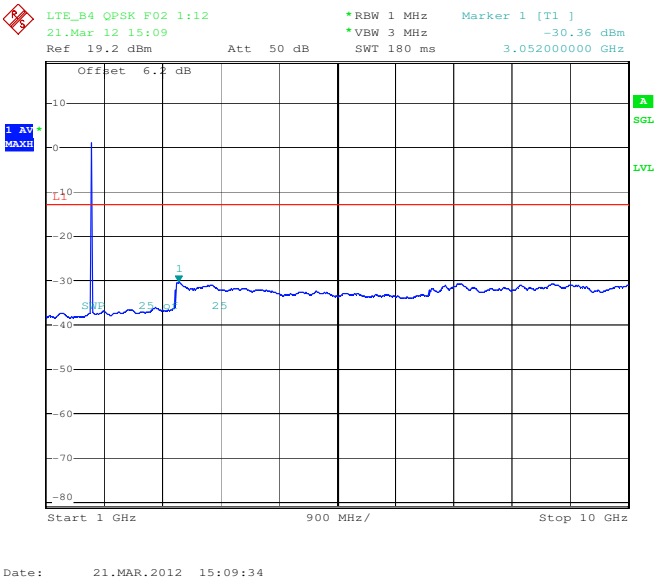
6.3.2 LTE Test Plots

Note 1: Only Out of Band Emissions for maximum transmit power are provided.
Note 2: For plots with RBW < 1% OBW the power has been integrated over a 1 MHz measurement bandwidth.

6.3.2.1 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1712.5 MHz, 5 MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

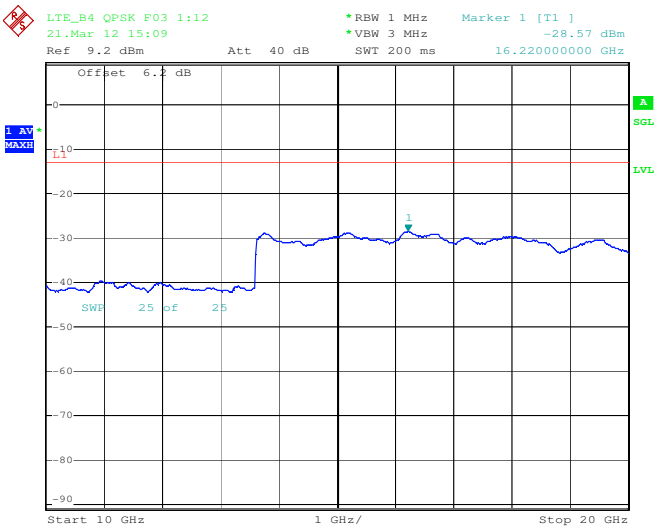


6.3.2.2 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1712.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1GHz to 10 GHz

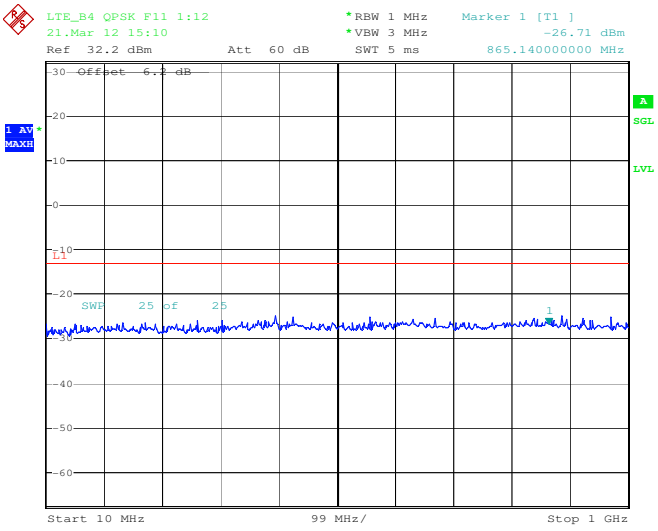


Note: The strong emission shown in each case is the carrier signal.

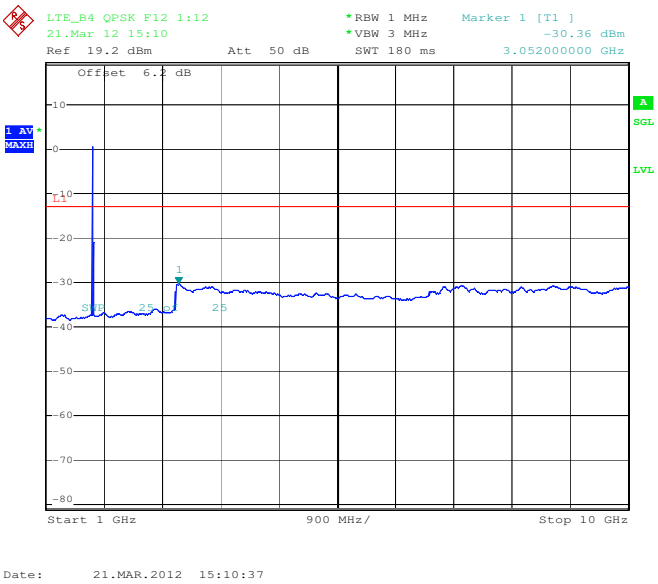
6.3.2.3 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1712.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 10 GHz to 20 GHz



6.3.2.4 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

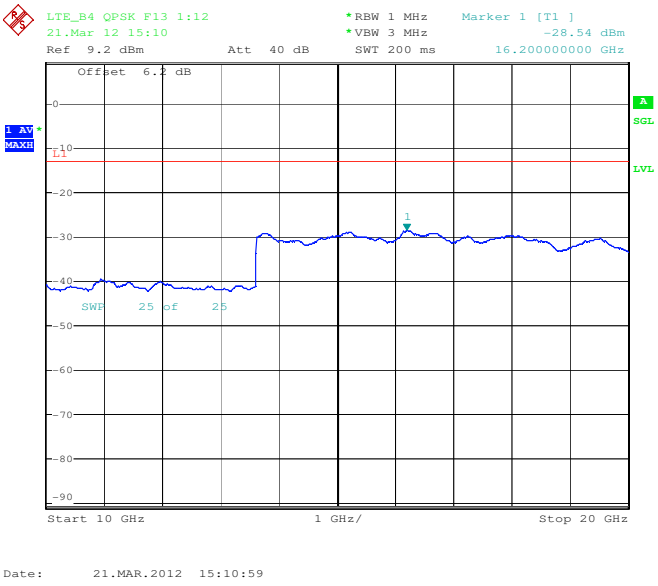


6.3.2.5 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1 GHz to 10 GHz

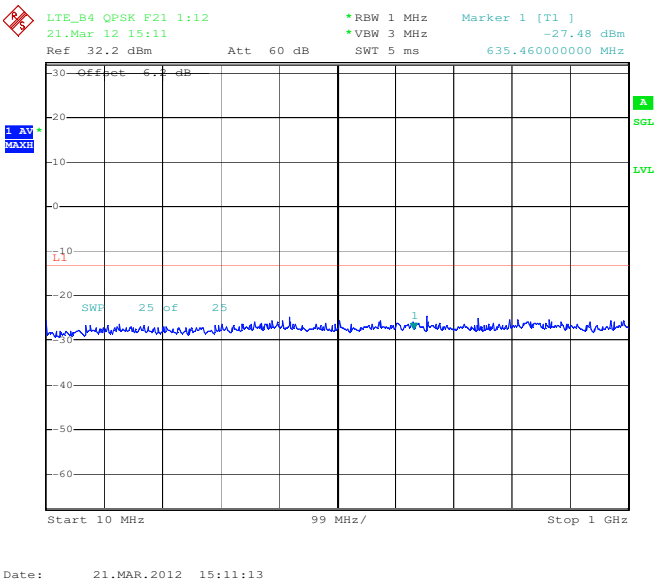


Note: The strong emission shown in each case is the carrier signal.

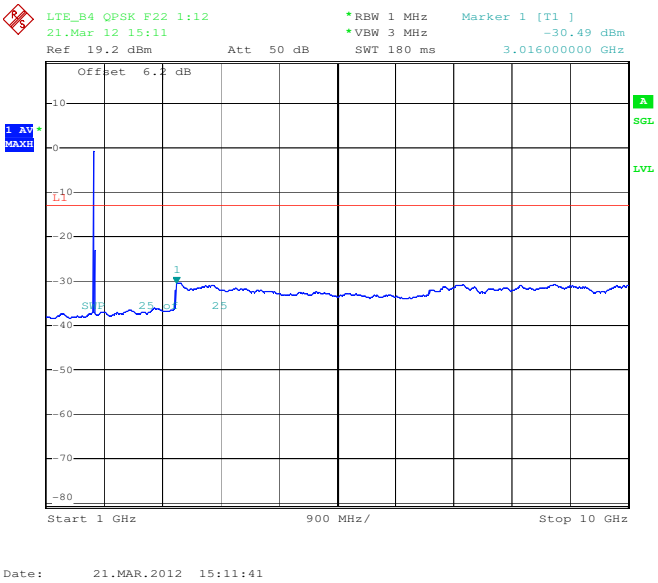
6.3.2.6 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1 GHz to 20 GHz



6.3.2.7 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1752.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

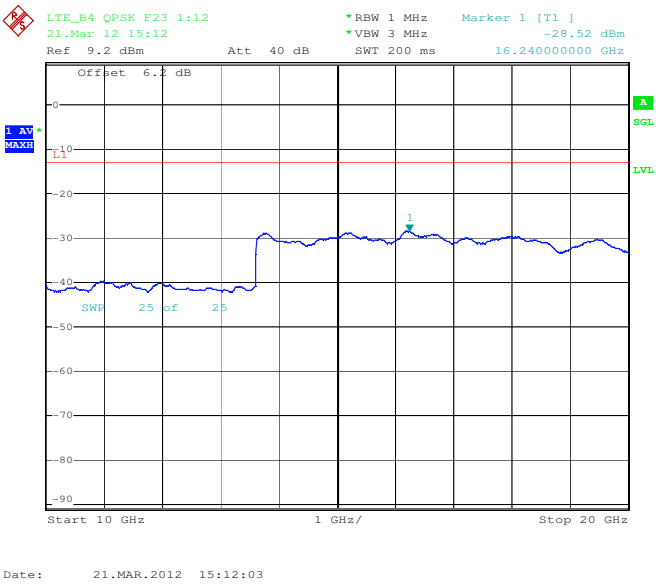


6.3.2.8 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1752.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1 GHz to 10 GHz

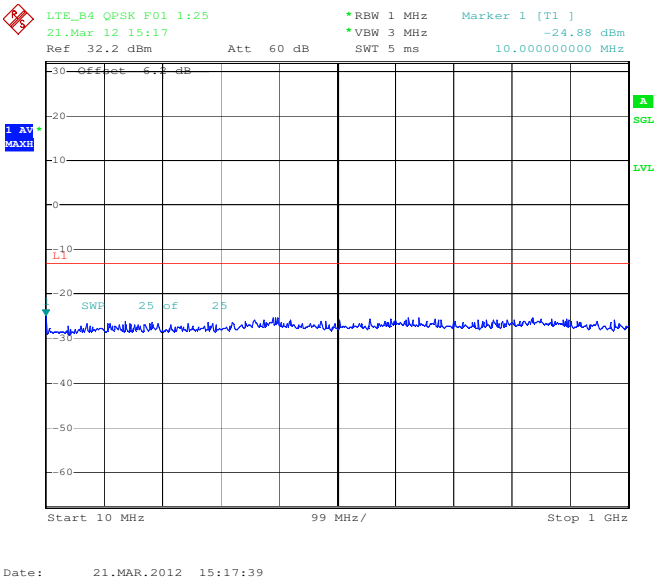


Note: The strong emission shown in each case is the carrier signal.

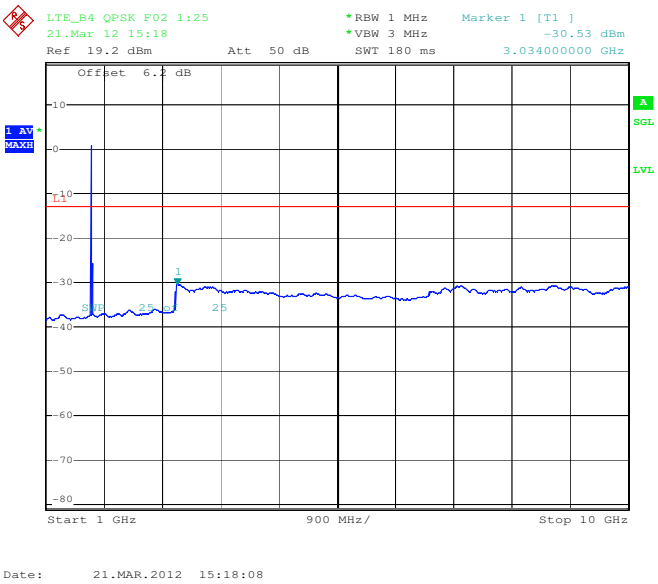
6.3.2.9 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1752.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 10 GHz to 20 GHz



6.3.2.10 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1715.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 30MHz to 1 GHz

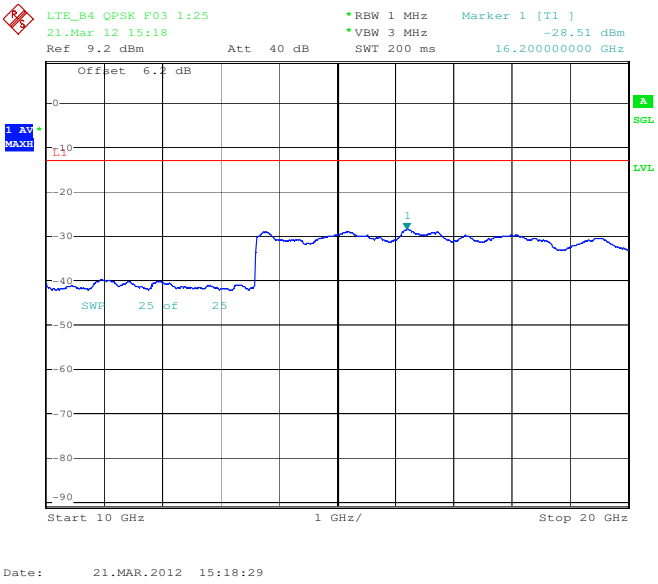


6.3.2.11 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1715.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 1GHz to 10 GHz

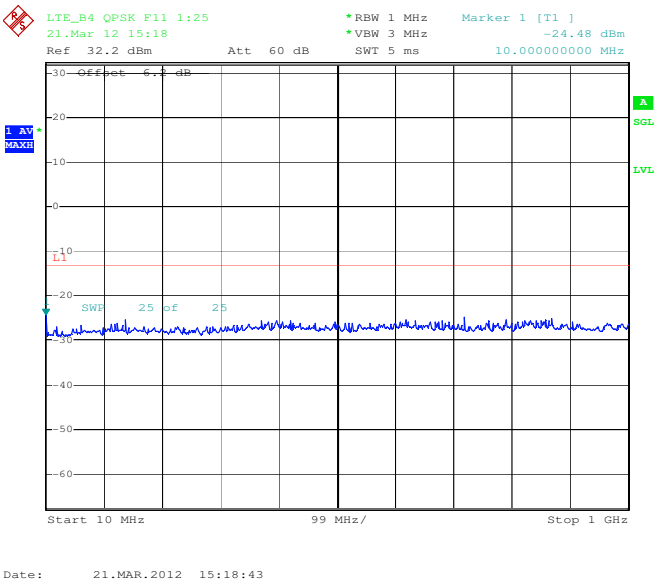


Note: The strong emission shown in each case is the carrier signal.

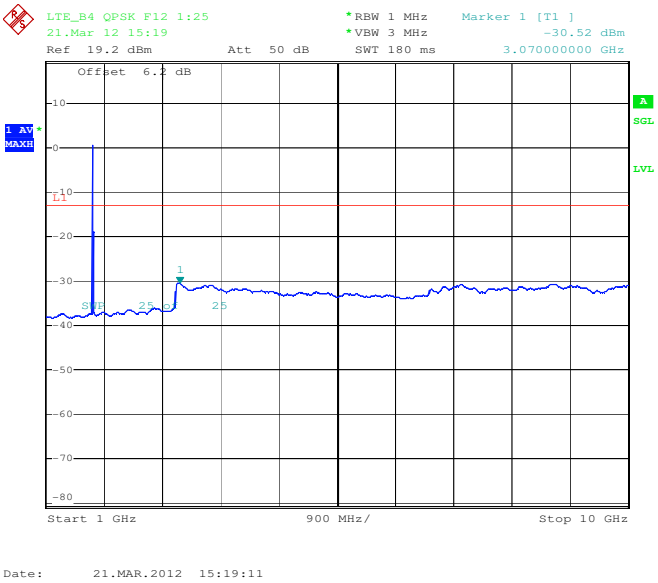
6.3.2.12 Out of Band Emissions at Antenna Terminals LTE B4, Low channel, 1715.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 10 GHz to 20 GHz



6.3.2.13 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 30MHz to 1 GHz

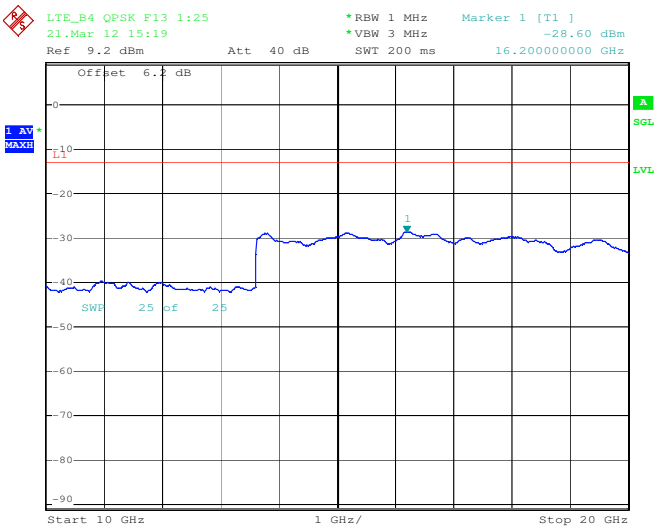


6.3.2.14 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 1 GHz to 10 GHz

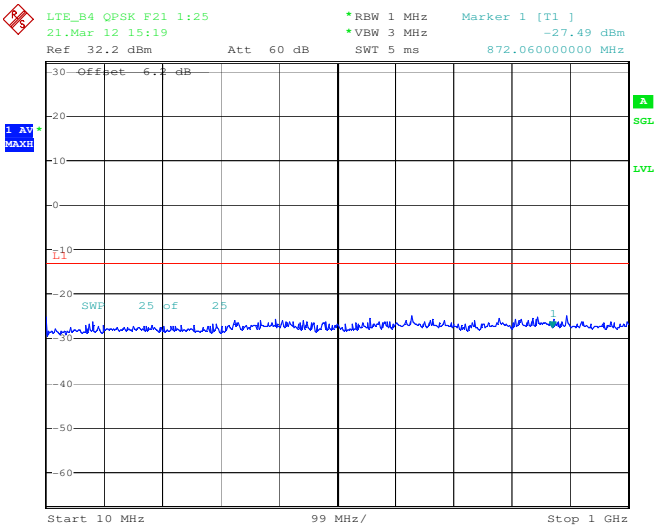


Note: The strong emission shown in each case is the carrier signal.

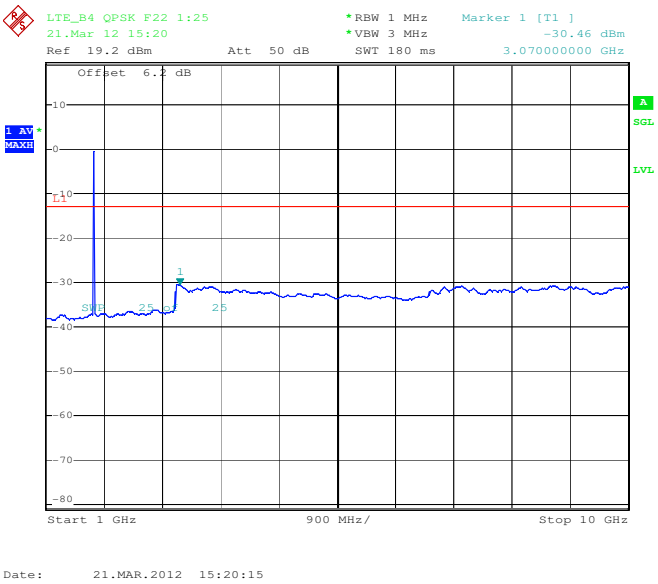
6.3.2.15 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 1 GHz to 20 GHz



6.3.2.16 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1750.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 30MHz to 1 GHz

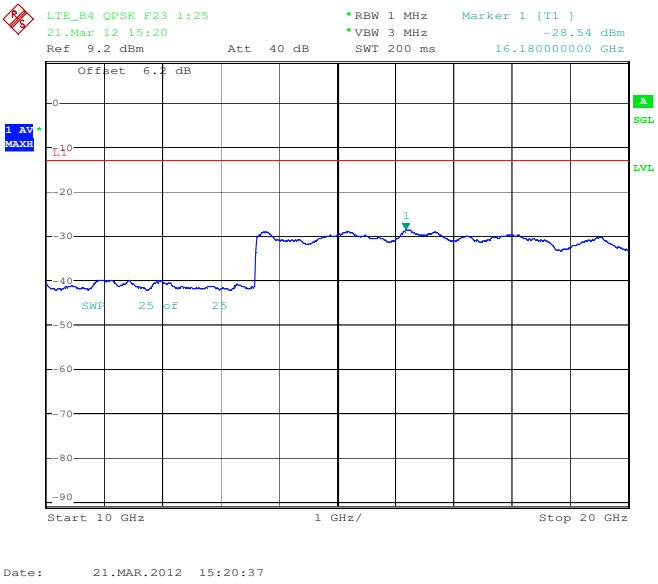


6.3.2.17 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1750.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 1 GHz to 10 GHz

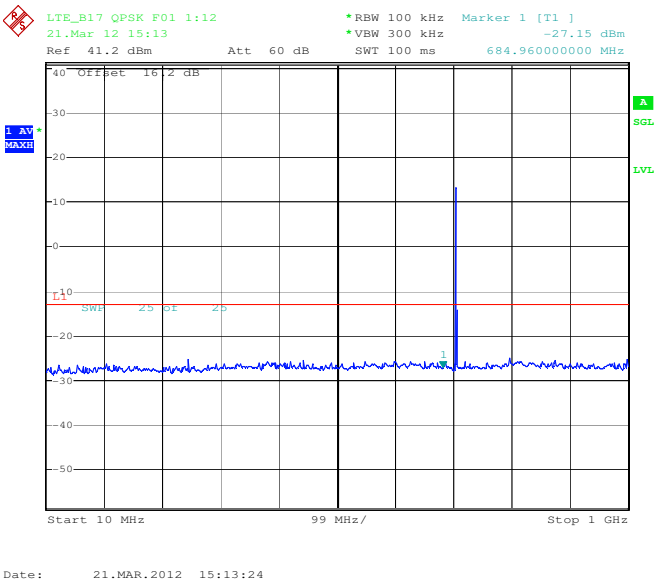


Note: The strong emission shown in each case is the carrier signal.

6.3.2.18 Out of Band Emissions at Antenna Terminals LTE B4, High channel, 1750.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 10 GHz to 20 GHz

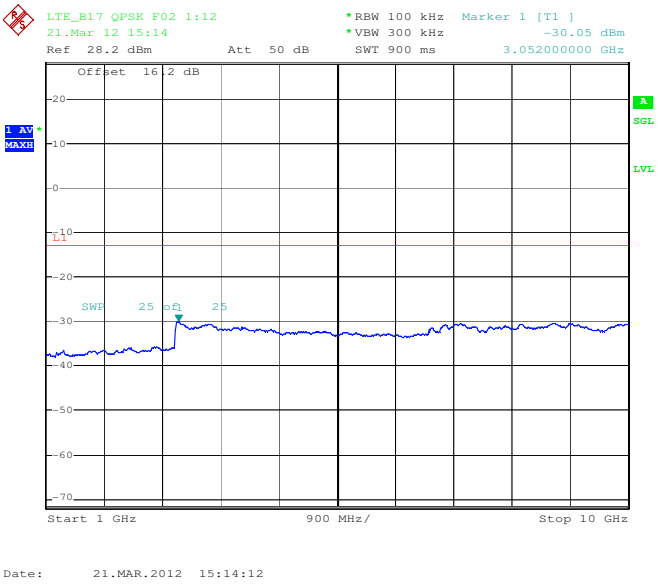


6.3.2.19 Out of Band Emissions at Antenna Terminals LTE B17, Low channel, 706.5 MHz, 5 MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

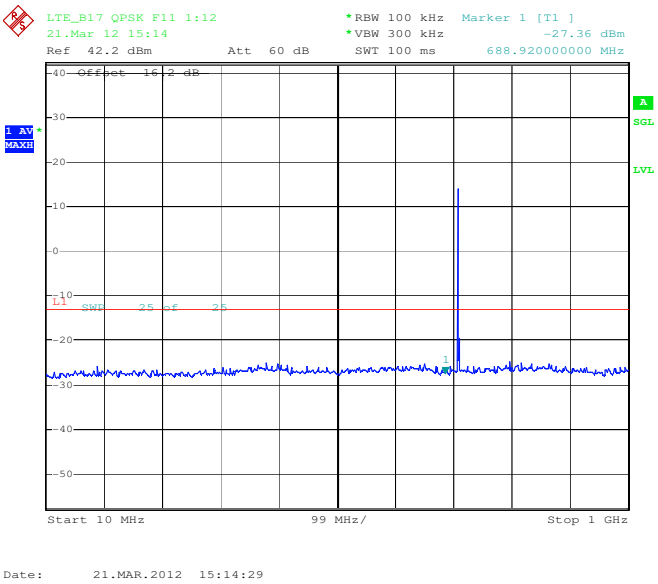


Note: The strong emission shown in each case is the carrier signal.

6.3.2.20 Out of Band Emissions at Antenna Terminals LTE B17, Low channel, 706.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1GHz to 10 GHz

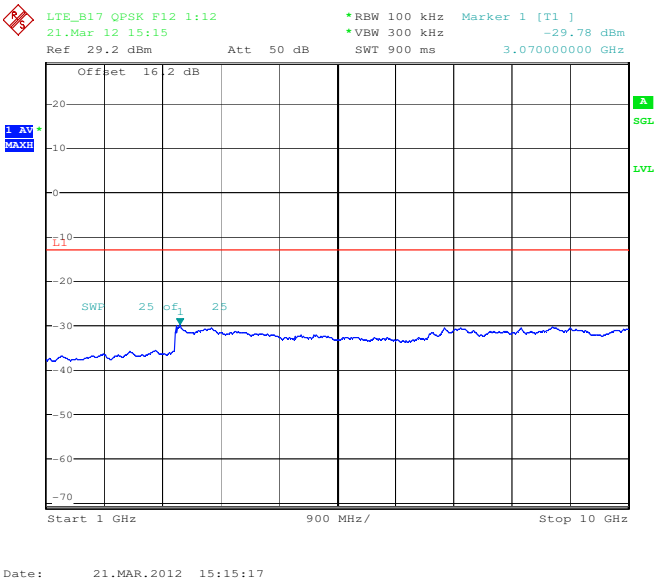


6.3.2.21 Out of Band Emissions at Antenna Terminals LTE B17, Mid channel, 710.0 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

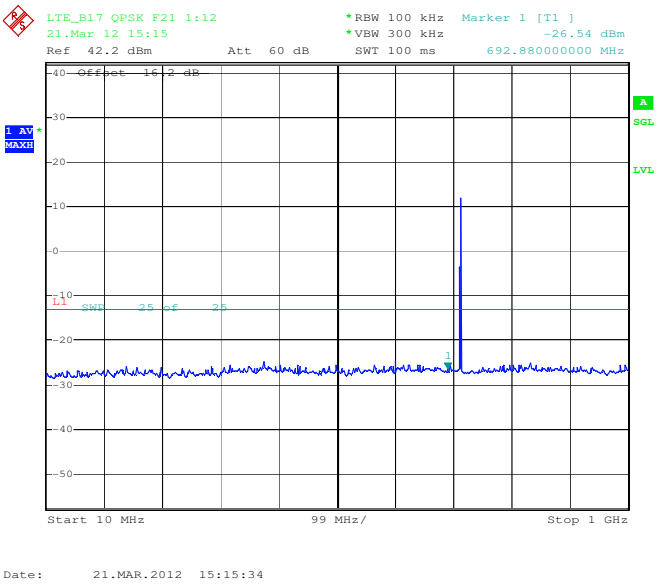


Note: The strong emission shown in each case is the carrier signal.

6.3.2.22 Out of Band Emissions at Antenna Terminals LTE B17, Mid channel, 710.0 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1 GHz to 10 GHz

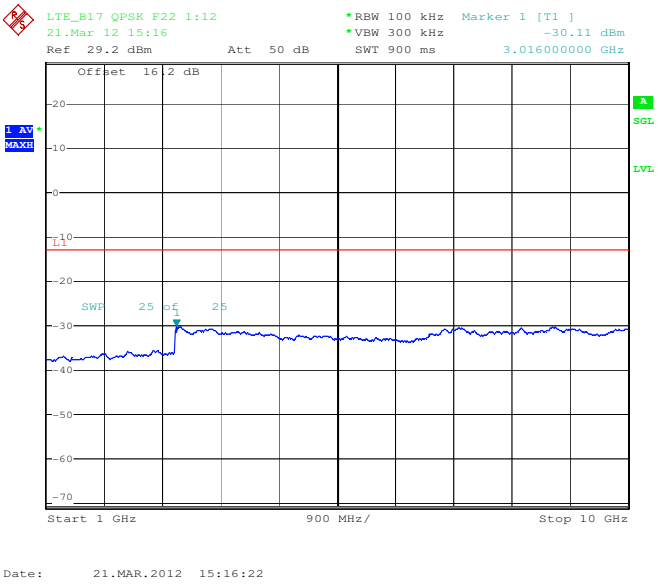


6.3.2.23 Out of Band Emissions at Antenna Terminals LTE B17, High channel, 713.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 30MHz to 1 GHz

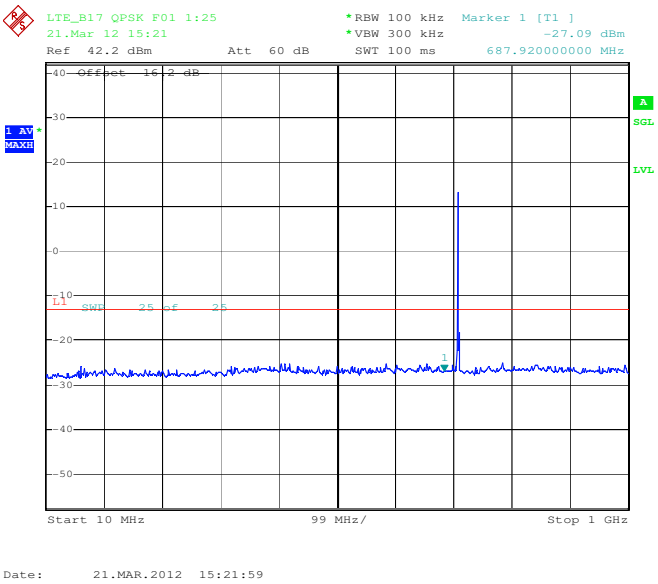


Note: The strong emission shown in each case is the carrier signal.

6.3.2.24 Out of Band Emissions at Antenna Terminals LTE B17, High channel, 713.5 MHz, 5MHz BW, 1 RB, RB Offset = 12, QPSK, 1 GHz to 10 GHz

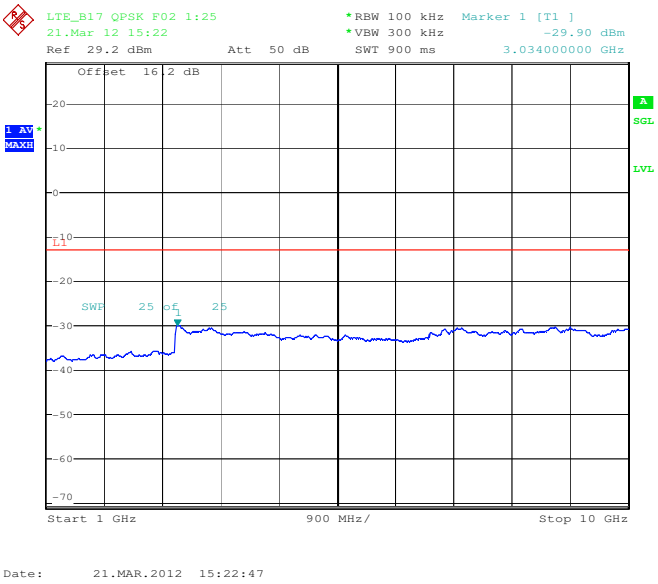


6.3.2.25 Out of Band Emissions at Antenna Terminals LTE B17, Mid channel, 710.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 30MHz to 1 GHz



Note: The strong emission shown in each case is the carrier signal.

6.3.2.26 Out of Band Emissions at Antenna Terminals LTE B17, Mid channel, 710.0 MHz, 10MHz BW, 1 RB, RB Offset = 25, QPSK, 1 GHz to 10 GHz



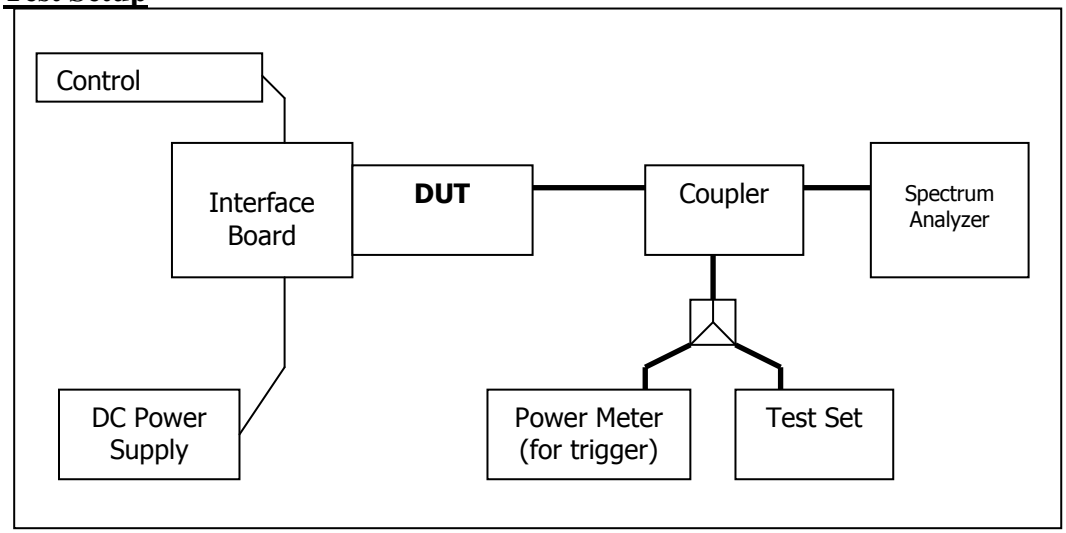
7 Block Edge Compliance

FCC Part 22(h)/24(e)/27.53(h)(m)

7.1 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMU200 Test Set (or CMW500 for LTE), through a coaxial RF cable and a directional coupler, and configured to operate at maximum power. The block edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

Test Setup



7.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

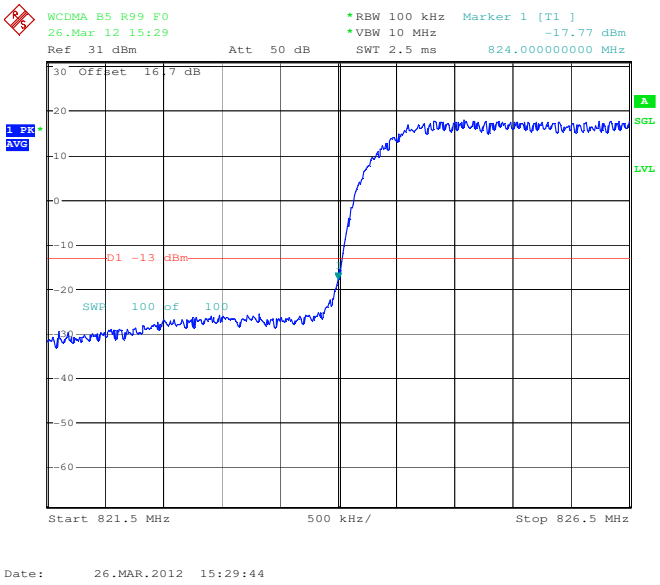
7.3 Test Results

Block Test	Frequency Boundaries (MHz)	Channels Tested	Corresponding Plots	Result
WCDMA (R99)	Below 824MHz	4132	7.3.1.1	Complies
	Above 849MHz	4233	7.3.1.2	Complies
	Below 1850MHz	9262	7.3.1.3	Complies
	Above 1910MHz	9538	7.3.1.4	Complies
HSDPA (R5)	Below 824MHz	4132	7.3.2.1	Complies
	Above 849MHz	4233	7.3.2.2	Complies
	Below 1850MHz	9262	7.3.2.3	Complies
	Above 1910MHz	9538	7.3.2.4	Complies
HSUPA (R6)	Below 824MHz	4132	7.3.3.1	Complies
	Above 849MHz	4233	7.3.3.2	Complies
	Below 1850MHz	9262	7.3.3.3	Complies
	Above 1910MHz	9538	7.3.3.4	Complies

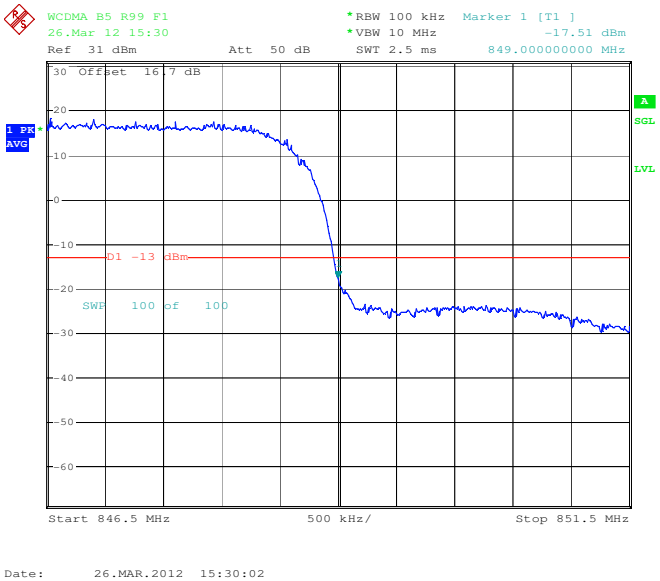
Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	Corresponding Plot number
LTE	QPSK	B4	5	1	0	1712.5	19975	7.3.4.1
					24	1752.5	20375	7.3.4.2
				25	0	1712.5	19975	7.3.4.9
					0	1752.5	20375	7.3.4.10
			10	1	0	1710.0	20000	7.3.4.5
					49	1750.0	20350	7.3.4.6
				50	0	1710.0	20000	7.3.4.13
					0	1750.0	20350	7.3.4.14
		B17	5	1	0	706.5	23755	7.3.4.17
					24	713.5	23825	7.3.4.18
				25	0	706.5	23755	7.3.4.25
					0	713.5	23825	7.3.4.26
			10	1	0	709.0	23780	7.3.4.21
					49	711.0	23800	7.3.4.22
				50	0	709.0	23780	7.3.4.29
					0	711.0	23800	7.3.4.30
	16-QAM	B4	5	1	0	1712.5	19975	7.3.4.3
					24	1752.5	20375	7.3.4.4
				25	0	1712.5	19975	7.3.4.11
					0	1752.5	20375	7.3.4.12
			10	1	0	1710.0	20000	7.3.4.7
					49	1750.0	20350	7.3.4.8
				50	0	1710.0	20000	7.3.4.15
					0	1750.0	20350	7.3.4.16
		B17	5	1	0	706.5	23755	7.3.4.19
					24	713.5	23825	7.3.4.20
				25	0	706.5	23755	7.3.4.27
					0	713.5	23825	7.3.4.28
			10	1	0	709.0	23780	7.3.4.23
					49	711.0	23800	7.3.4.24
				50	0	709.0	23780	7.3.4.31
					0	711.0	23800	7.3.4.32

7.3.1 WCDMA Test Plots

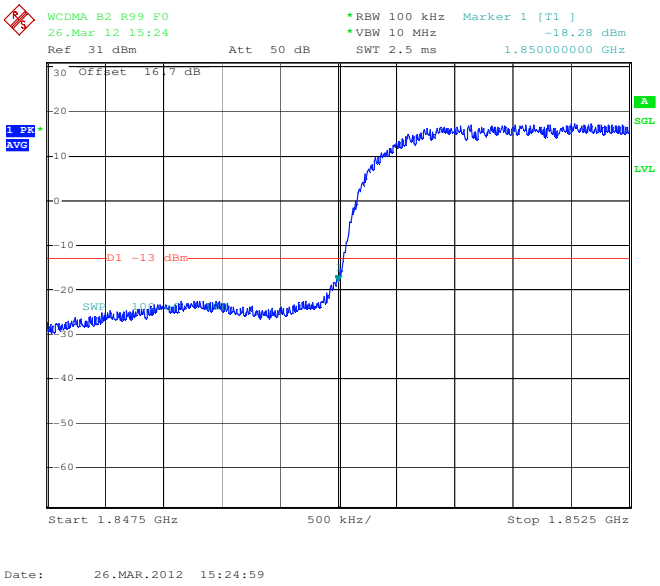
7.3.1.1 WCDMA; Cellular low channel, below 824 MHz



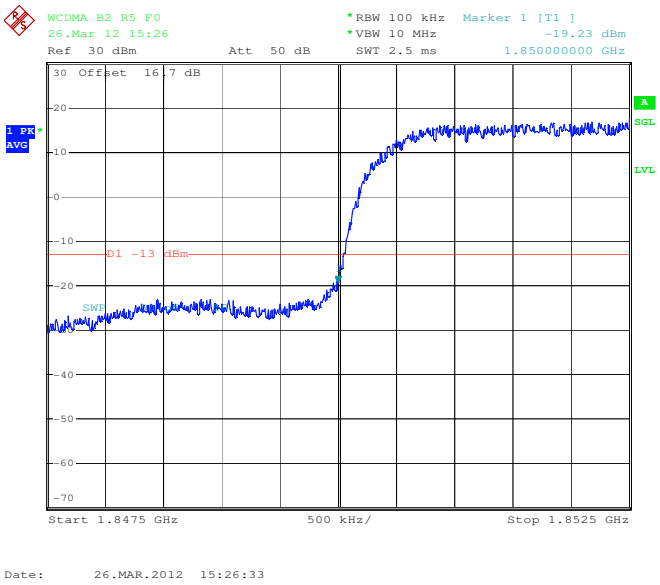
7.3.1.2 WCDMA; Cellular high channel, above 849 MHz



7.3.1.3 WCDMA; PCS low channel, below 1850 MHz

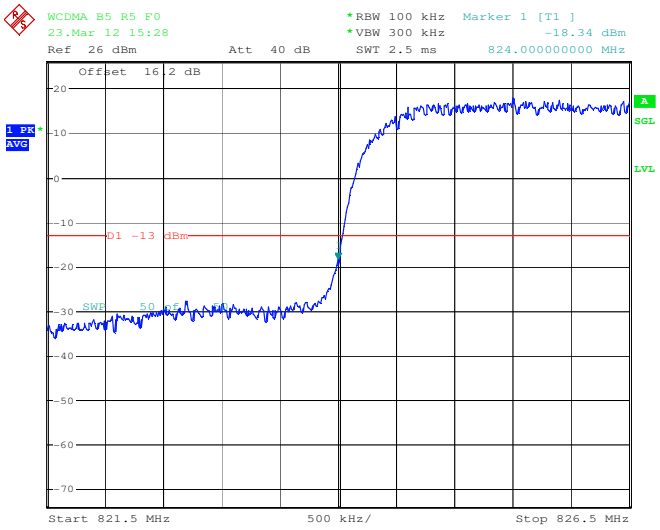


7.3.1.4 WCDMA; PCS high channel, above 1910 MHz

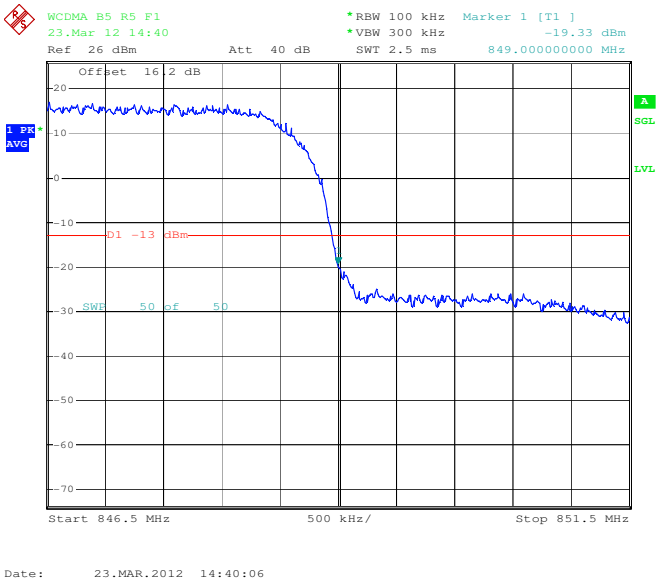


7.3.2 HSDPA Test Plots

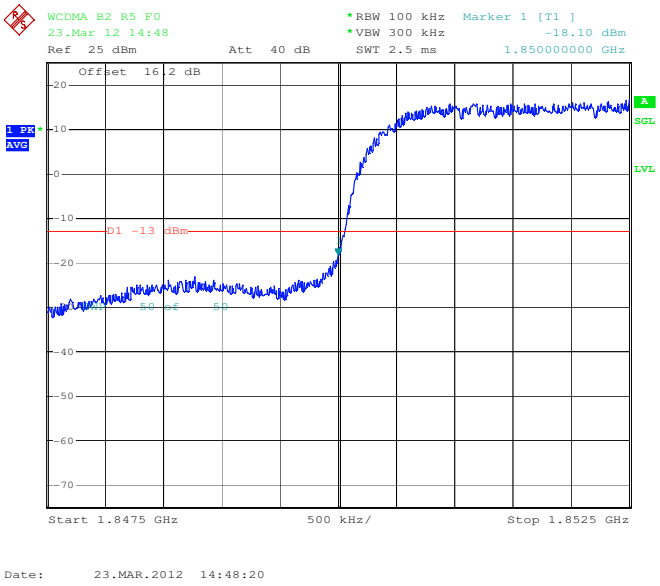
7.3.2.1 HSDPA; Cellular low channel, below 824 MHz



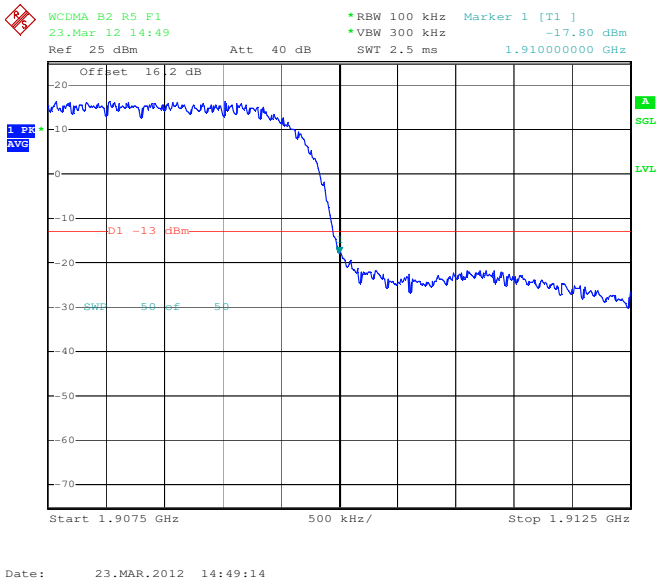
7.3.2.2 HSDPA; Cellular high channel, above 849 MHz



7.3.2.3 HSDPA; PCS low channel, below 1850 MHz

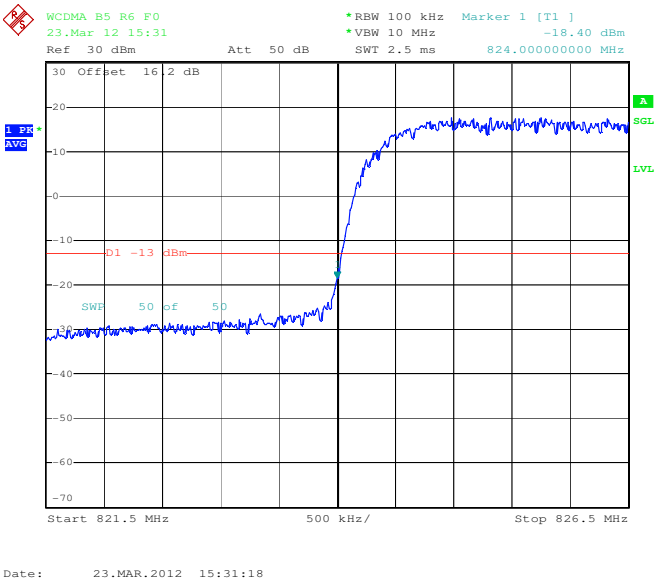


7.3.2.4 HSDPA; PCS high channel, above 1910 MHz

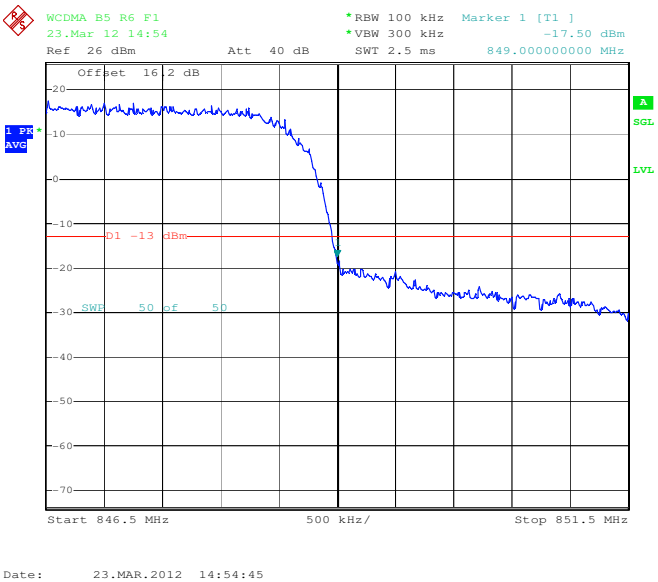


7.3.3 HSUPA Test Plots

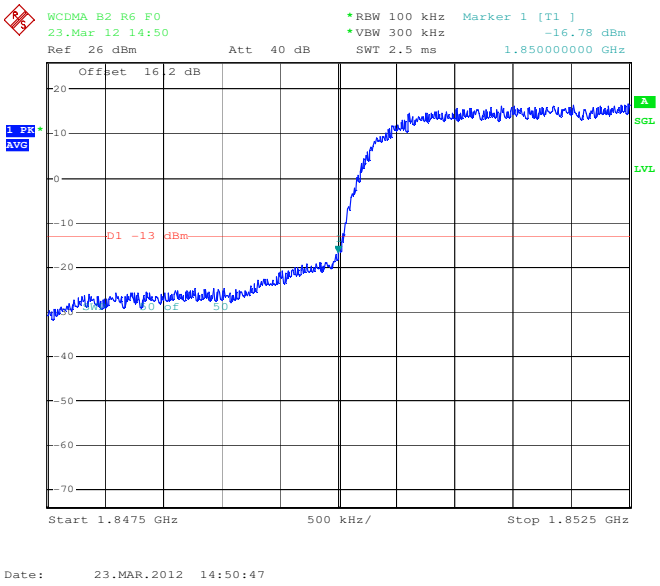
7.3.3.1 HSUPA; Cellular low channel, below 824 MHz



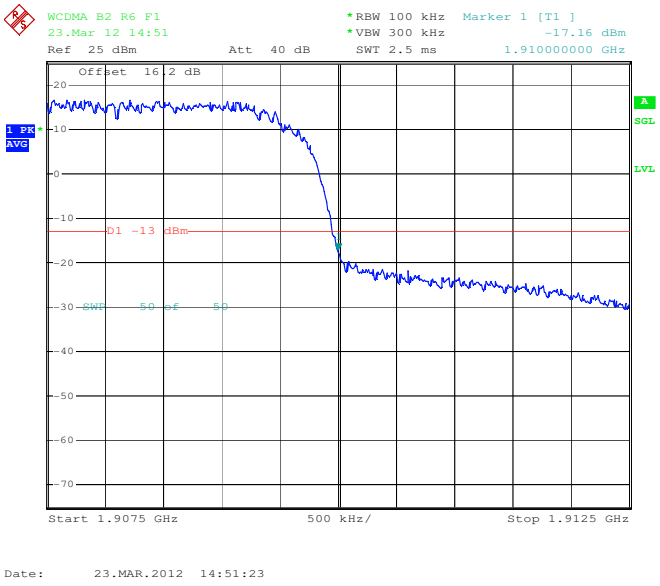
7.3.3.2 HSUPA; Cellular high channel, above 849 MHz



7.3.3.3 HSUPA; PCS low channel, below 1850 MHz



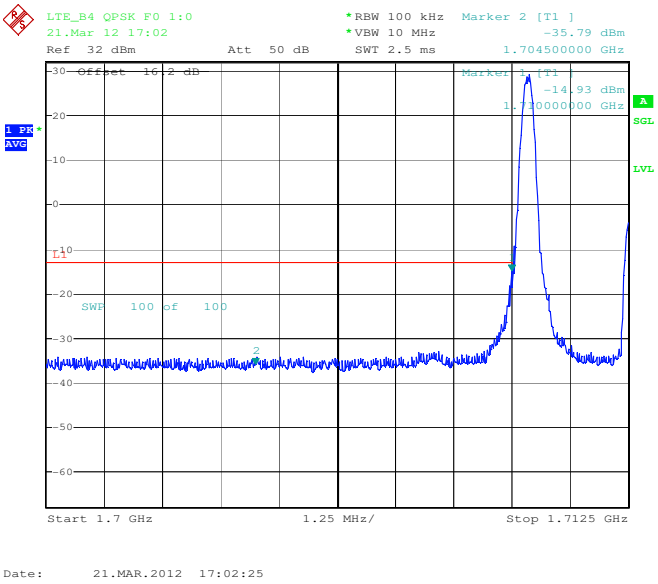
7.3.3.4 HSUPA; PCS high channel, above 1910 MHz



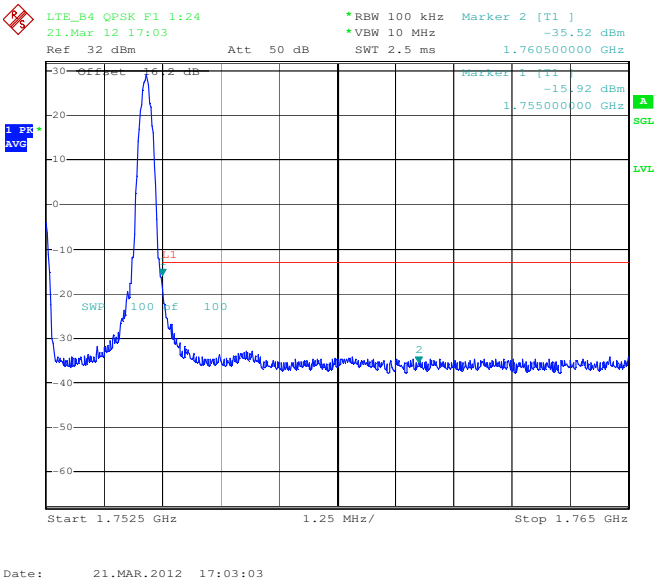
7.3.4 LTE Test Plots

Note: LTE B4 power has been adjusted by 10*log(RBW) to reflect a 1 MHz measurement bandwidth.

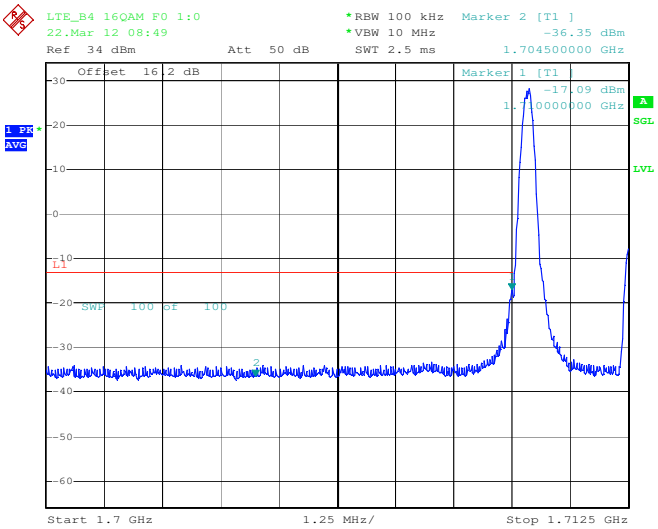
7.3.4.1 LTE; Band4 below 1710 MHz, with ch19975, 5MHz, QPSK, 1RB, RB Offset=0



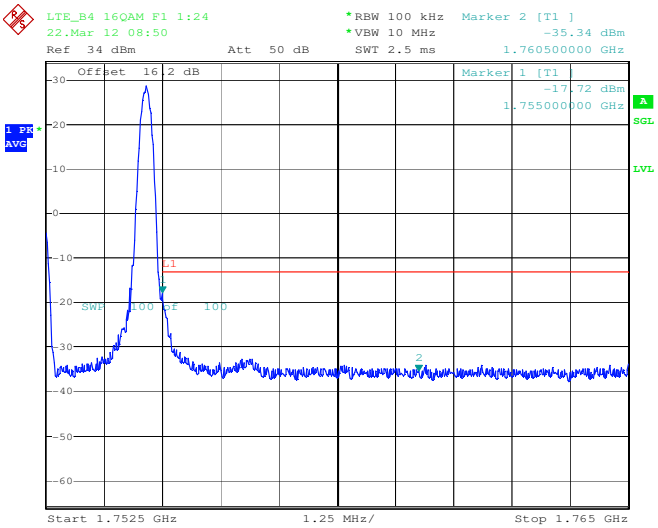
7.3.4.2 LTE; Band4 above 1755 MHz, with ch20375, 5MHz, QPSK, 1RB, RB Offset=24



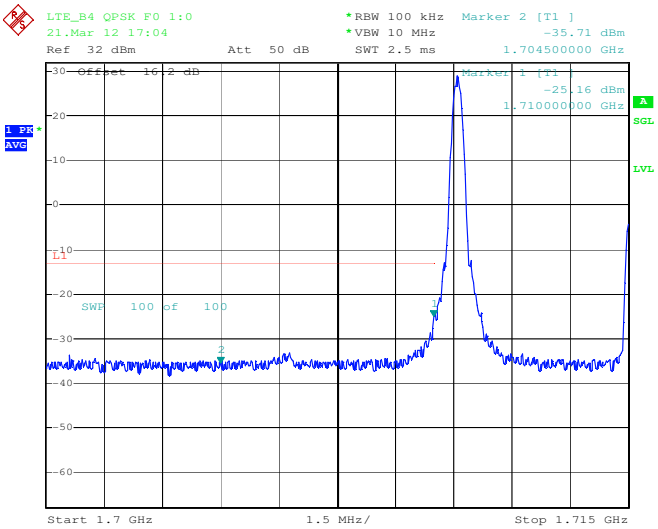
7.3.4.3 LTE; Band4 below 1710 MHz, with ch19975, 5MHz, 16QAM, 1RB, RB Offset=0



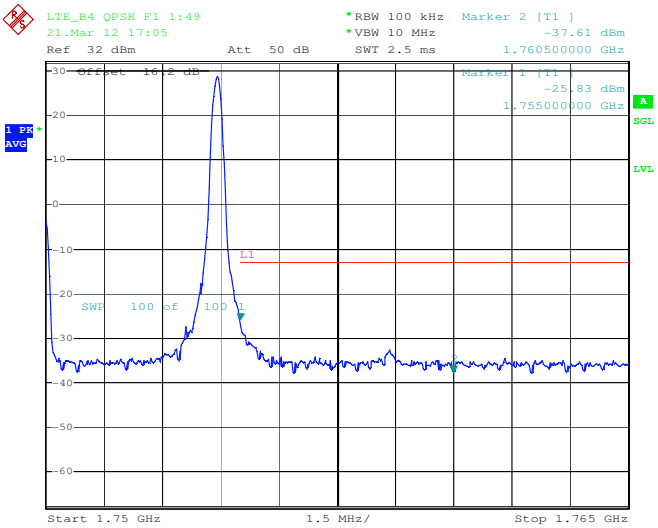
7.3.4.4 LTE; Band4 above 1755 MHz, with ch20375, 5MHz, 16QAM, 1RB, RB Offset=24



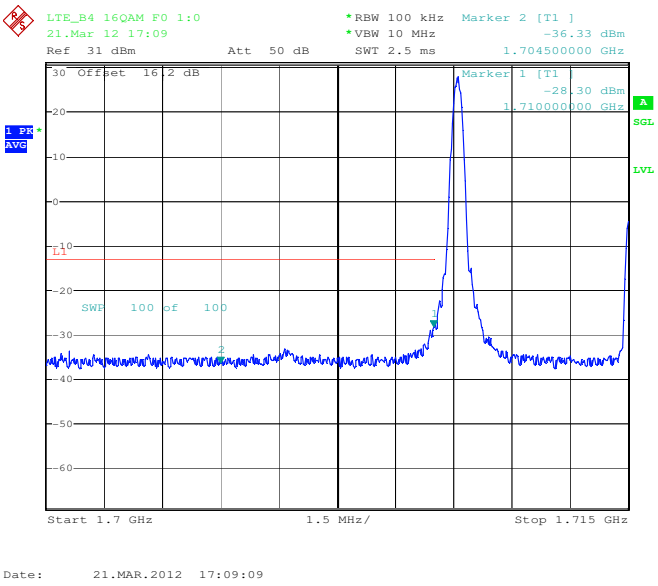
7.3.4.5 LTE; Band4 below 1710 MHz, with ch20000, 10MHz, QPSK, 1RB, RB Offset=0



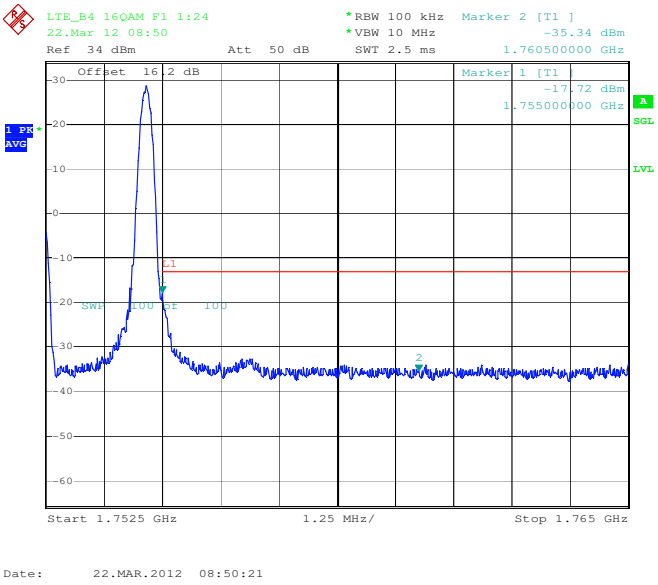
7.3.4.6 LTE; Band4 above 1755 MHz, with ch20350, 10MHz, QPSK, 1RB, RB Offset=49



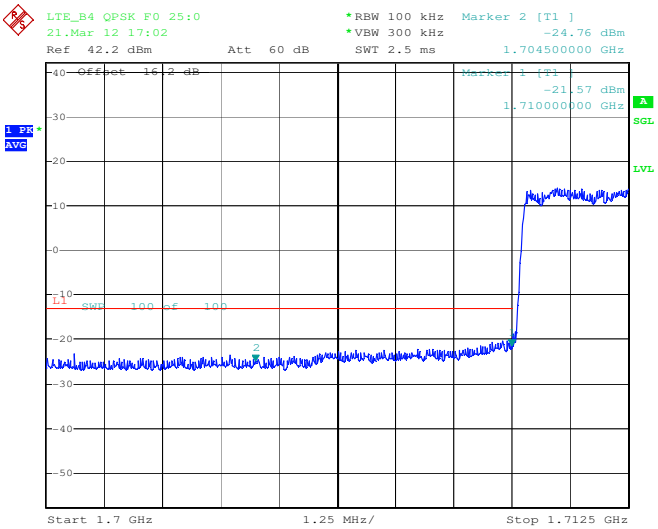
7.3.4.7 LTE; Band4 below 1710 MHz, with ch20000, 10MHz, 16QAM, 1RB, RB Offset=0



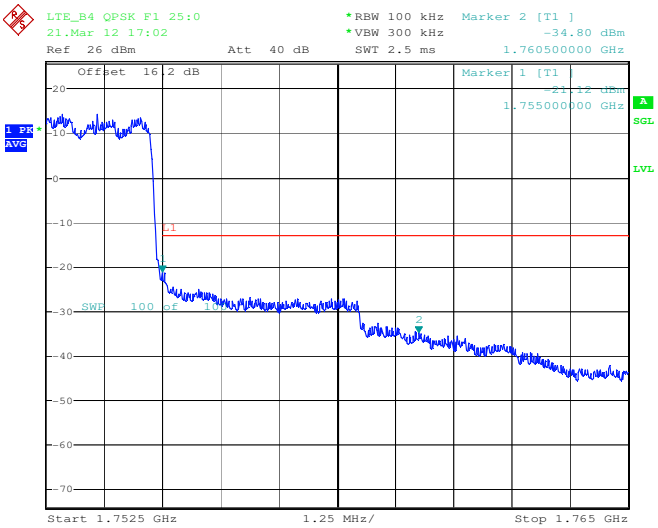
7.3.4.8 LTE; Band4 above 1755 MHz, with ch20350, 10MHz, 16QAM, 1RB, RB Offset=49



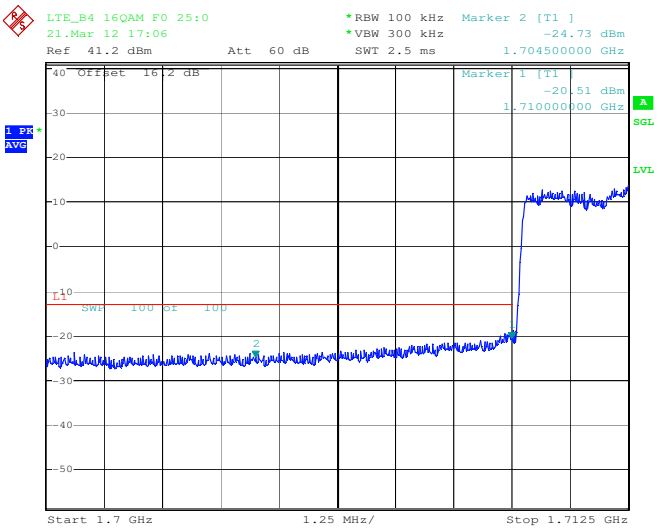
7.3.4.9 LTE; Band4 below 1710 MHz, with ch19975, 5MHz, QPSK, 25RB, RB Offset=0



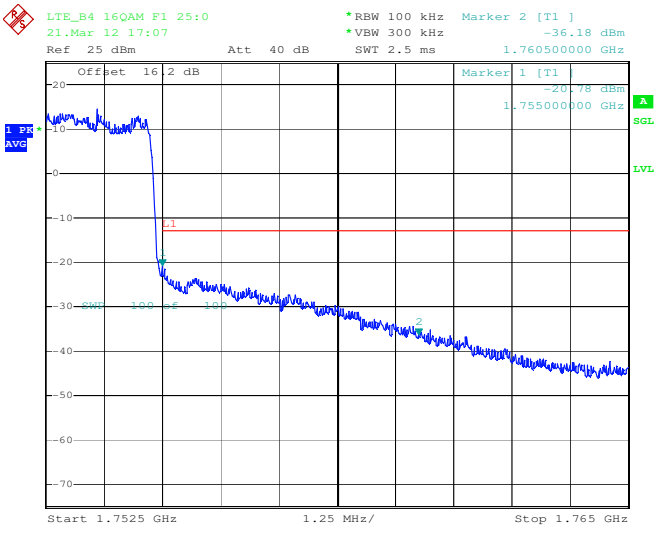
7.3.4.10 LTE; Band4 above 1755 MHz, with ch20375, 5MHz, QPSK, 25RB, RB Offset=0



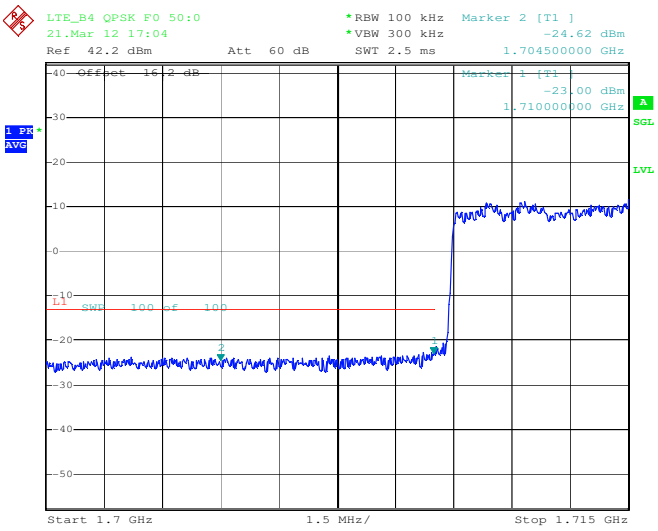
7.3.4.11 LTE; Band4 below 1710 MHz, with ch19975, 5MHz, 16QAM, 25RB, RB Offset=0



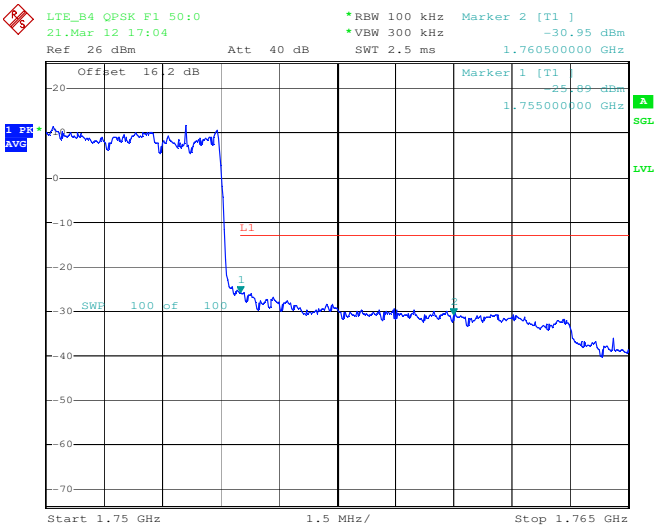
7.3.4.12 LTE; Band4 above 1755 MHz, with ch20375, 5MHz, 16QAM, 25RB, RB Offset=0



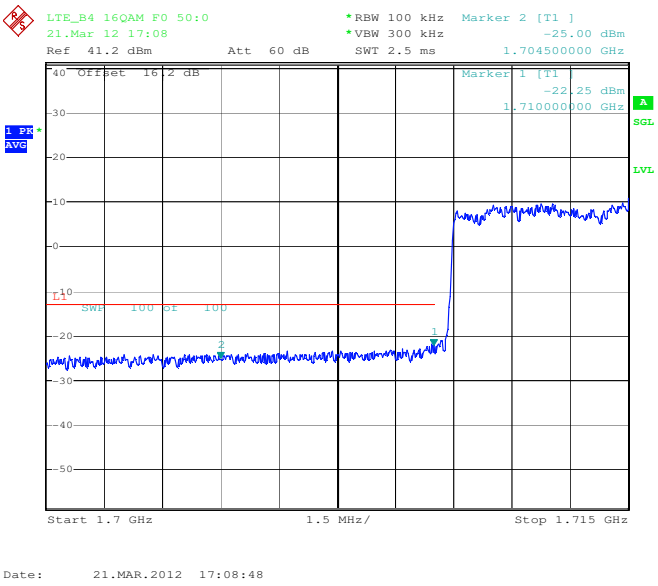
7.3.4.13 LTE; Band4 below 1710 MHz, with ch20000, 10MHz, QPSK, 50RB, RB Offset=0



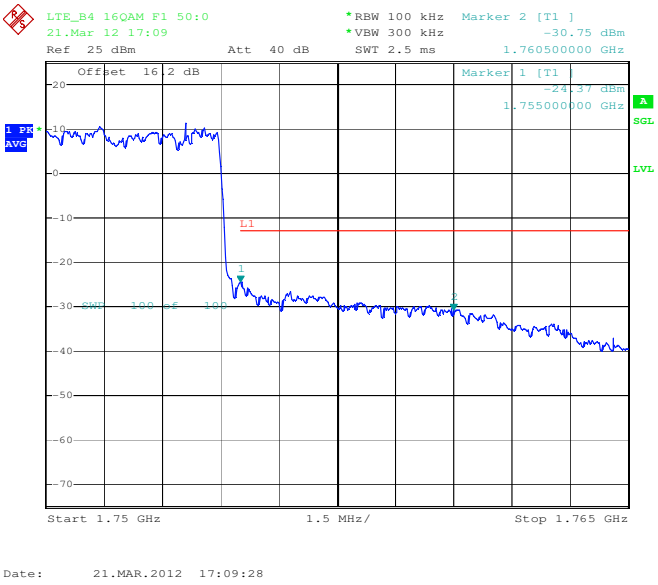
7.3.4.14 LTE; Band4 above 1755 MHz, with ch20350, 10MHz, QPSK, 50RB, RB Offset=0



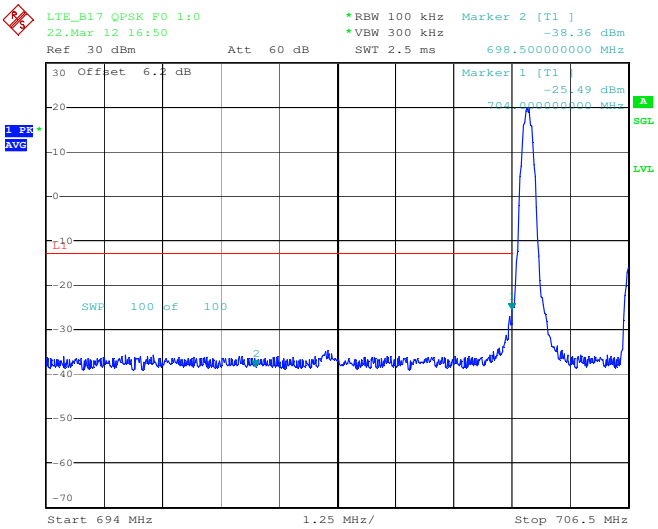
7.3.4.15 LTE; Band4 below 1710 MHz, with ch20000, 10MHz, 16QAM, 50RB, RB Offset=0



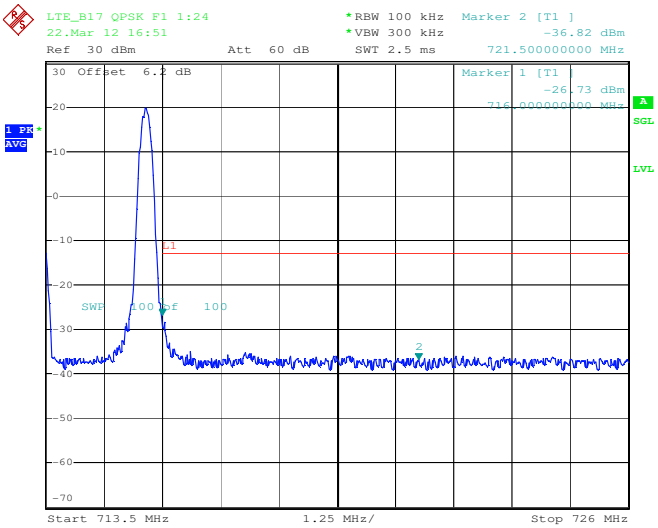
7.3.4.16 LTE; Band4 above 1755 MHz, with ch20350, 10MHz, 16QAM, 50RB, RB Offset=0



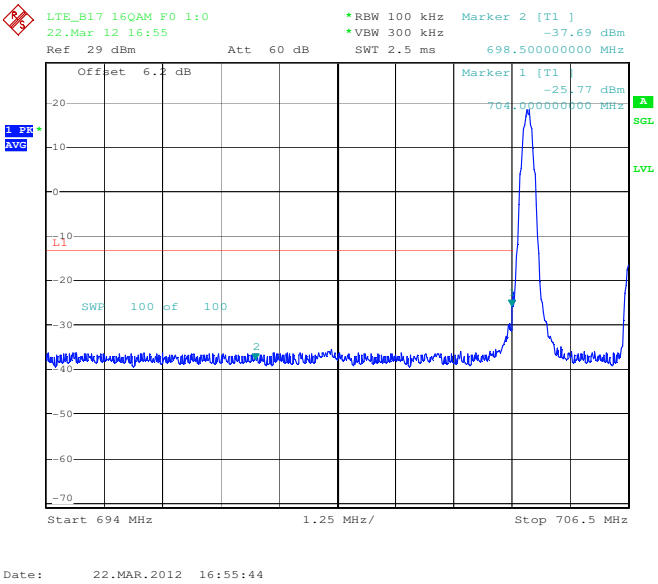
7.3.4.17 LTE; Band17 below 704 MHz, with ch23755, 5MHz, QPSK, 1RB, RB Offset=0



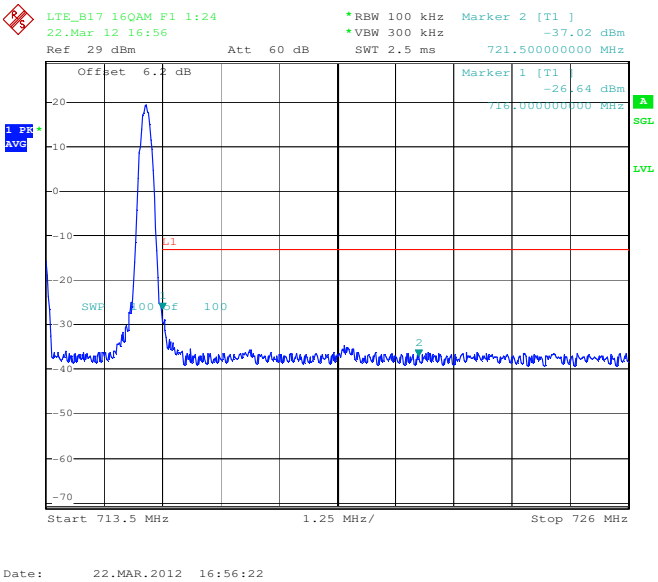
7.3.4.18 LTE; Band17 above 716 MHz, with ch23825, 5MHz, QPSK, 1RB, RB Offset=24



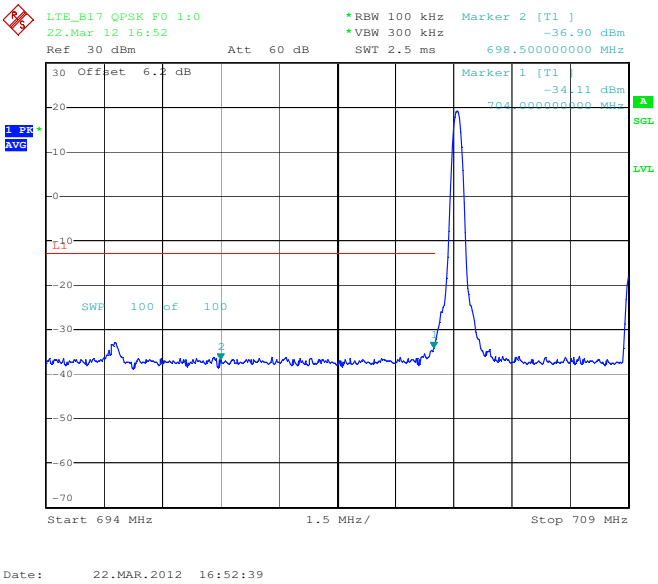
7.3.4.19 LTE; Band17 below 704 MHz, with ch23755, 5MHz, 16QAM, 1RB, RB Offset=0



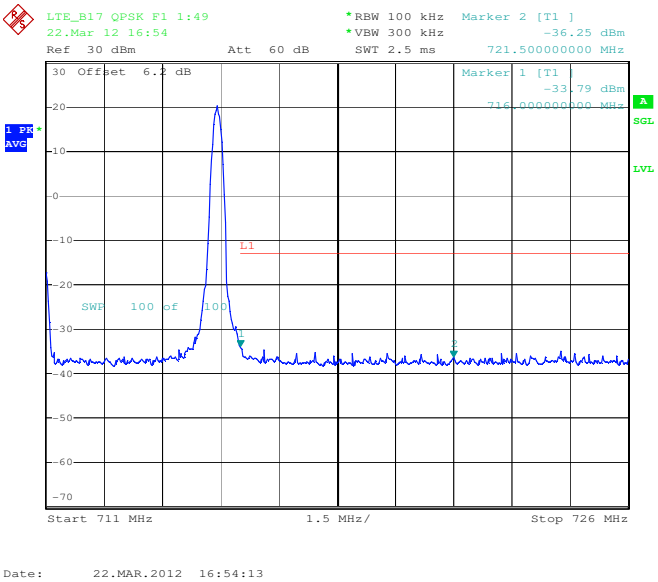
7.3.4.20 LTE; Band17 above 716 MHz, with ch23825, 5MHz, 16QAM, 1RB, RB Offset=24



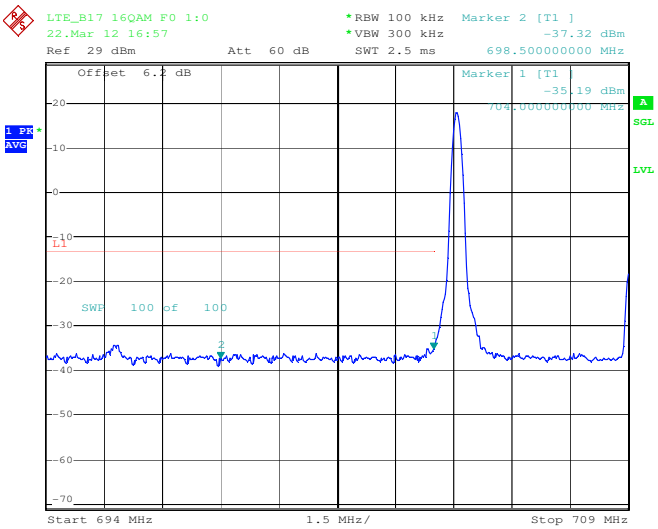
7.3.4.21 LTE; Band17 below 704 MHz, with ch23780, 10MHz, QPSK, 1RB, RB Offset=0



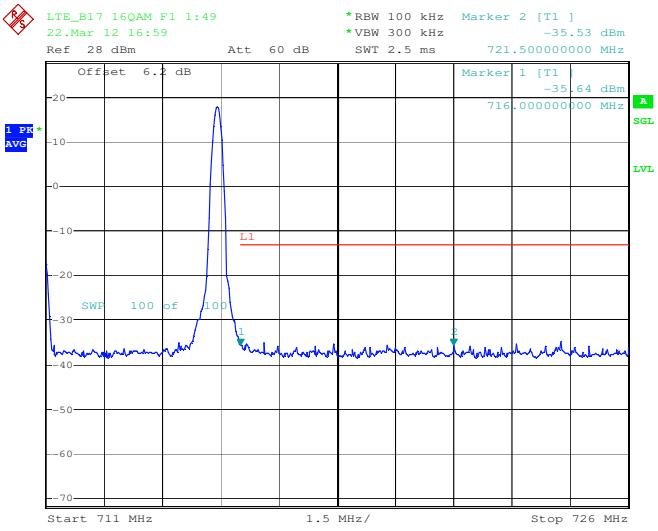
7.3.4.22 LTE; Band17 above 716 MHz, with ch23800, 10MHz, QPSK, 1RB, RB Offset=49



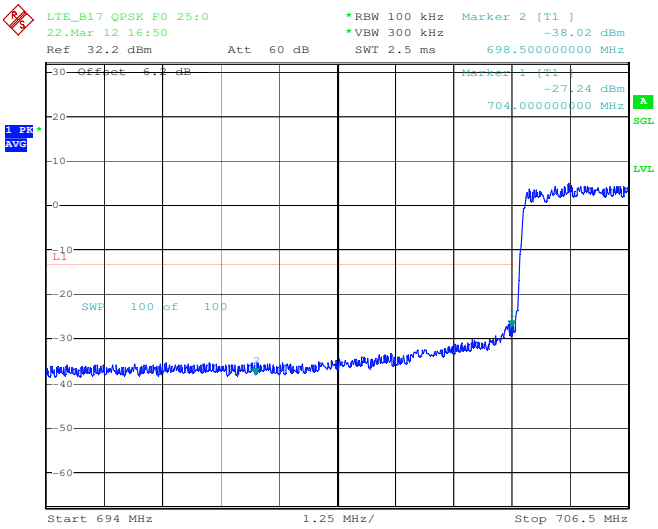
7.3.4.23 LTE; Band17 below 704 MHz, with ch23780, 10MHz, 16QAM, 1RB, RB Offset=0



7.3.4.24 LTE; Band17 above 716 MHz, with ch23800, 10MHz, 16QAM, 1RB, RB Offset=49

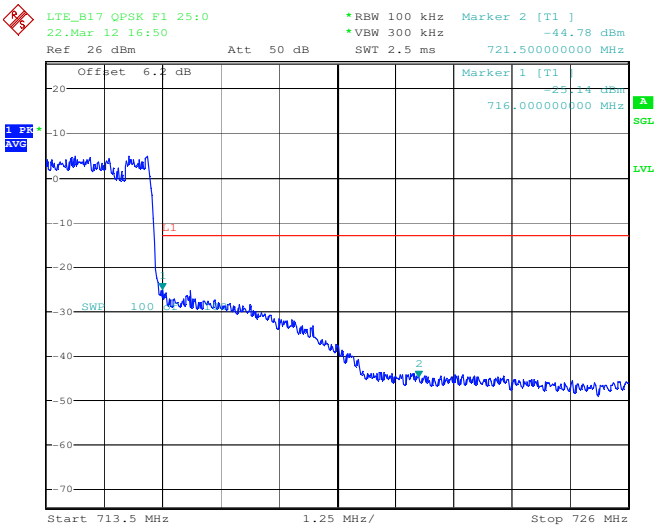


7.3.4.25 LTE; Band17 below 704 MHz, with ch23755, 5MHz, QPSK, 25RB, RB Offset=0



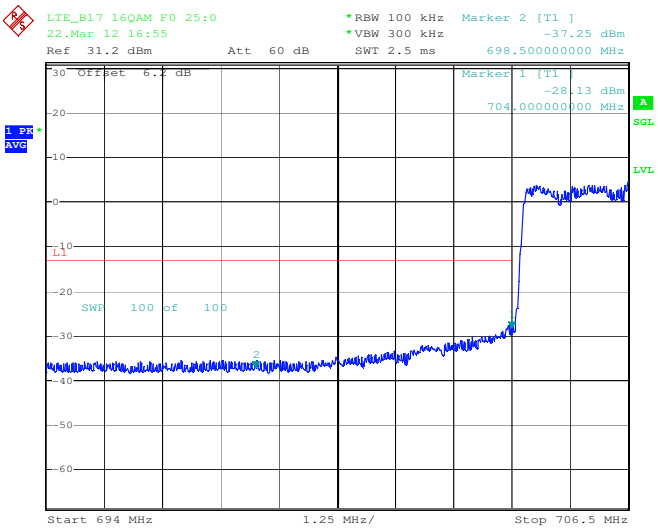
Date: 22.MAR.2012 16:50:13

7.3.4.26 LTE; Band17 above 716 MHz, with ch23825, 5MHz, QPSK, 25RB, RB Offset=0

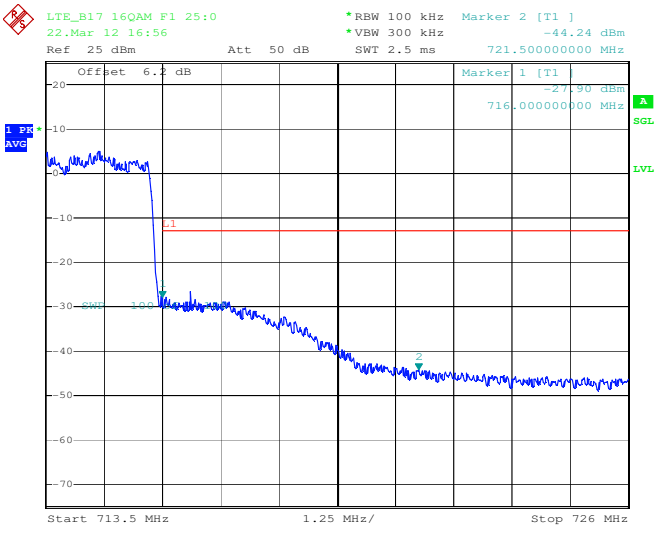


Date: 22.MAR.2012 16:50:49

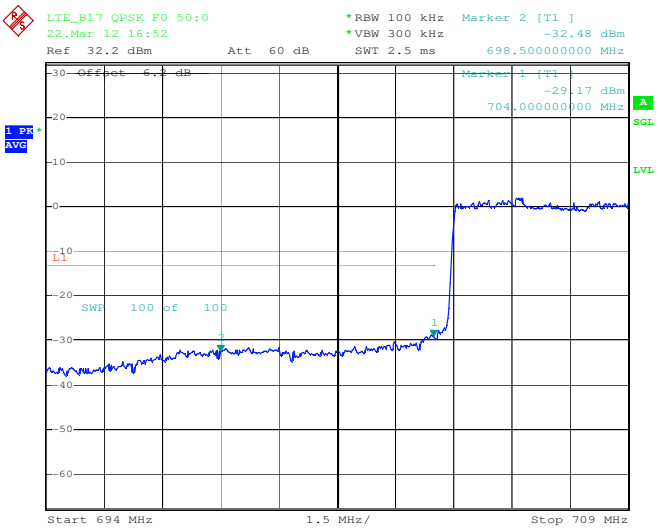
7.3.4.27 LTE; Band17 below 704 MHz, with ch23755, 5MHz, 16QAM, 25RB, RB Offset=0



7.3.4.28 LTE; Band17 above 716 MHz, with ch23825, 5MHz, 16QAM, 25RB, RB Offset=0

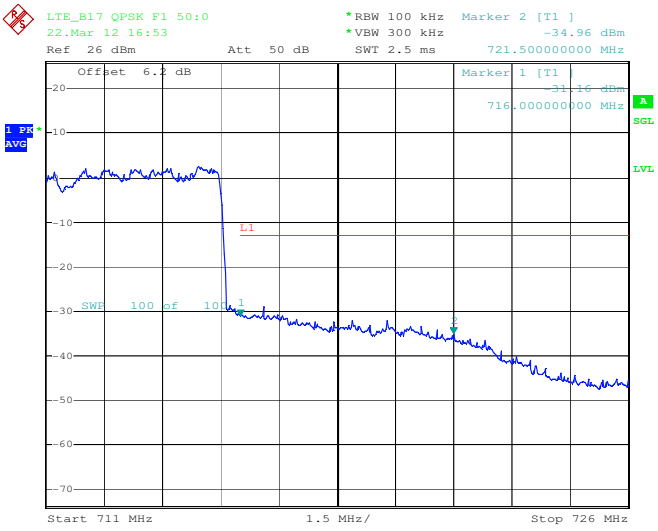


7.3.4.29 LTE; Band17 below 704 MHz, with ch23780, 10MHz, QPSK, 50RB, RB Offset=0



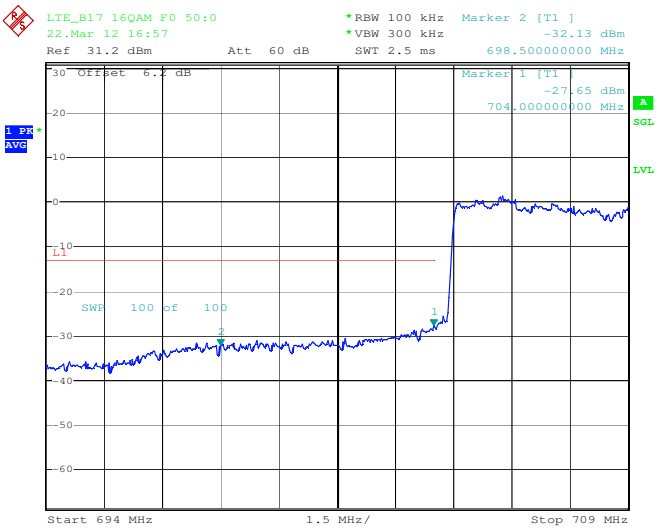
Date: 22.MAR.2012 16:52:24

7.3.4.30 LTE; Band17 above 716 MHz, with ch23800, 10MHz, QPSK, 50RB, RB Offset=0



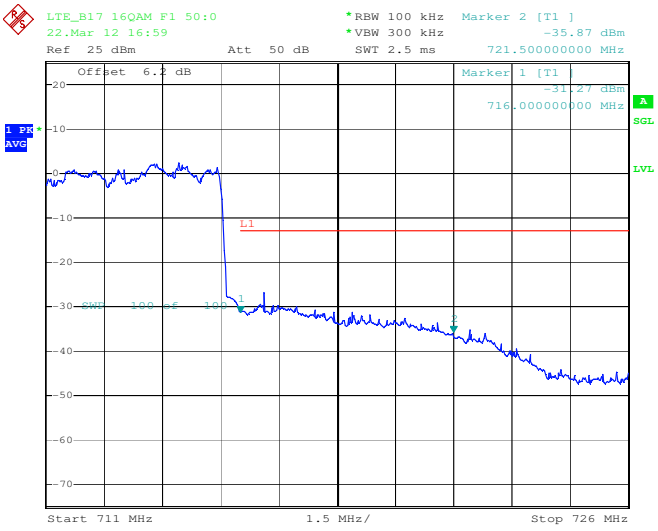
Date: 22.MAR.2012 16:53:56

7.3.4.31 LTE; Band17 below 704 MHz, with ch23780, 10MHz, 16QAM, 50RB, RB Offset=0



Date: 22.MAR.2012 16:57:44

7.3.4.32 LTE; Band17 above 716 MHz, with ch23800, 10MHz, 16QAM, 50RB, RB Offset=0



Date: 22.MAR.2012 16:59:26

8 Frequency Stability versus Temperature

FCC 2.1055, FCC 22.355, FCC 24.235, FCC 27.54

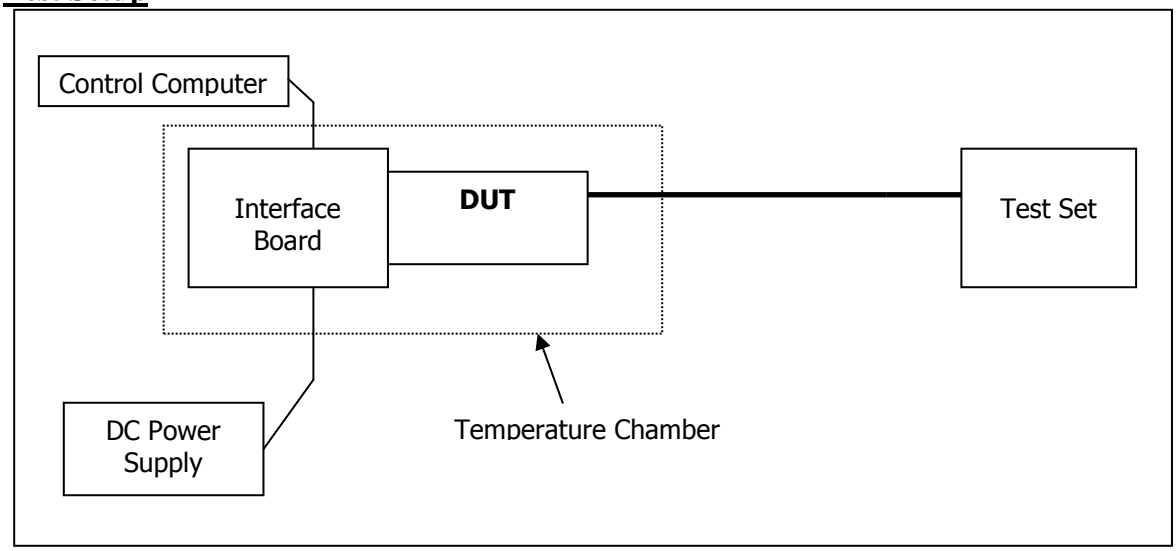
8.1 Summary of Results

The EUT's Frequency Stability versus temperature meets the requirements of less than 2.5ppm when temperature varies from -30°C to +60°C.

8.2 Test Procedure

The EUT was placed inside a temperature chamber. The temperature was set to -30°C and maintained to stabilize. After sufficient soak time, the transmitting frequency error was measured. The temperature was then increased by 10 degrees, maintained to stabilize, and the measurement was repeated. This procedure was repeated until +60°C is reached. Frequency metering included internal averaging of the CMU200 (for WCDMA) or the CMW500 (for LTE) to stabilize the reading. Reference power supply voltage for these tests is 3.7 volts.

Test Setup



8.3 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

8.4 Test Results

8.4.1 UMTS Frequency Error over Temperature

Temp (°C)	UMTS Mode			
	850 MHz Band		1900 MHz Band	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
-30	1.96	0.0023	2.7	0.0014
-20	2.9	0.0035	2.07	0.0011
-10	1.87	0.0022	2.73	0.0015
0	-0.87	-0.0010	3.48	0.0019
10	-1.13	-0.0014	3.42	0.0018
20	-0.13	-0.0002	1.67	0.0009
30	0.36	0.0004	2.02	0.0011
40	-0.1	-0.0001	2.9	0.0015
50	0.49	0.0006	2.88	0.0015
60	2.98	0.0036	2	0.0011

8.4.2 LTE Frequency Error over Temperature

Temp (°C)	LTE Band 4				LTE Band 17			
	QPSK Mode		16QAM Mode		QPSK Mode		16QAM Mode	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
-30	2.26	0.0013	-1.82	-0.0010	0.4	0.0006	-0.41	-0.0006
-20	3.33	0.0019	-2.47	-0.0014	-0.73	-0.0010	0.44	0.0006
-10	1.87	0.0011	-2.83	-0.0016	-0.87	-0.0012	-0.44	-0.0006
0	2.39	0.0014	-0.29	-0.0002	0.41	0.0006	-0.59	-0.0008
10	1.52	0.0009	-0.24	-0.0001	-0.59	-0.0008	-0.51	-0.0007
20	1.3	0.0007	2.65	0.0015	-0.29	-0.0004	-0.03	0.0000
30	2.62	0.0015	1.5	0.0009	-0.41	-0.0006	-1.17	-0.0016
40	3.19	0.0018	4.08	0.0023	0.57	0.0008	-0.33	-0.0005
50	3.2	0.0018	3.19	0.0018	0.04	0.0001	0.13	0.0002
60	2.9	0.0017	2.16	0.0012	-0.41	-0.0006	-0.26	-0.0004

9 Frequency Stability versus Voltage

FCC 2.1055, FCC 22.355, FCC 24.235, FCC 27.54

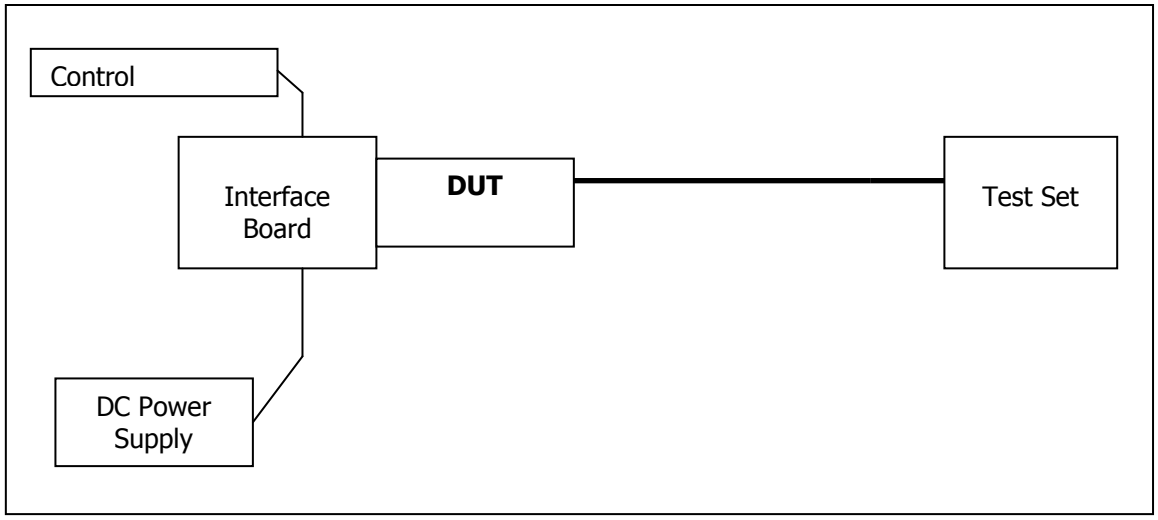
9.1 Summary of Results

The EUT is specified to operate with a supply voltage varying between 3.40 VDC and 4.20 VDC, having a nominal voltage of 3.70 VDC. It meets the frequency stability limit of less than 2.5ppm when supply voltage varies within the specified limits. Operation above or below these voltage limits is prohibited by firmware in order to prevent improper operation.

9.2 Test Procedure

The EUT was connected to a DC Power Supply and a UMTS test set (CMU 200, or LTE test set CMW500) with frequency error measurement capability. The power supply output was adjusted to the test voltage as measured at the input terminals to the device while transmitting. A voltmeter was used to confirm the terminal voltage. The peak frequency error is recorded (worst case). The test voltages are 3.40 volts to 4.20 volts.

Test Setup



9.3 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

9.4 Test Results

9.4.1 UMTS Frequency Error over Voltage

Voltage (V)	850 MHz Band (B5)		1900 MHz Band(B2)	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
3.4	1.511	0.0018	-1.129	-0.0006
3.7	3.204	0.0038	2.747	0.0015
4.2	-0.61	-0.0007	0.763	0.0004

9.4.2 LTE Frequency Error over Voltage

Voltage (V)	LTE Band 4				LTE Band 17			
	QPSK Mode		16QAM Mode		QPSK Mode		16QAM Mode	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
3.4	-2.73	-0.0016	1.99	0.0011	-0.86	-0.0012	-0.72	-0.0010
3.7	-1.75	-0.0010	1.87	0.0011	0.14	0.0002	-0.62	-0.0009
4.2	-0.92	-0.0005	2.45	0.0014	-0.62	-0.0009	-0.34	-0.0005

10 Peak to Average Ratio

FCC 27.50(d)

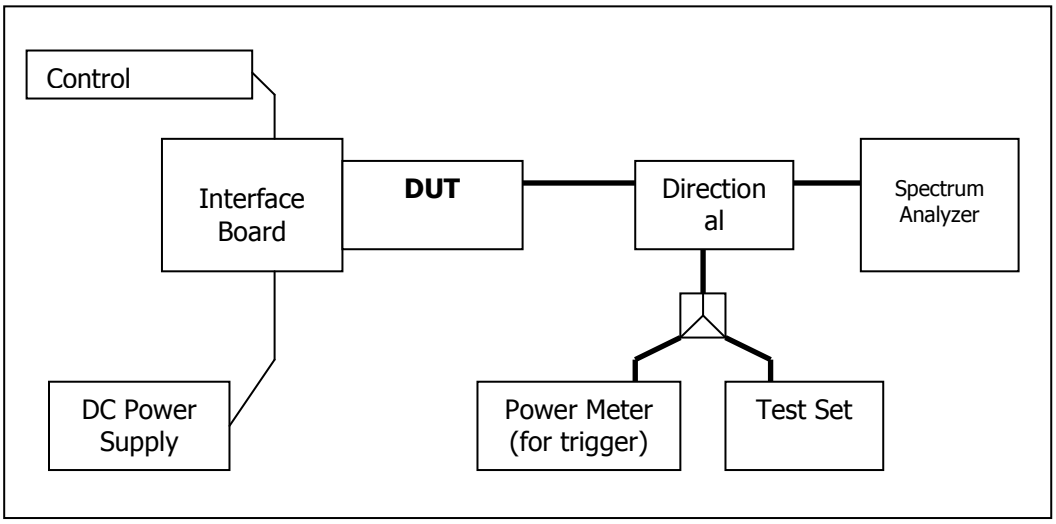
10.1 Summary of Results

The EUT meets the requirement of having a peak to average ratio of less than 13dB.

10.2 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMW500 through a coaxial RF cable and directional coupler, and configured to operate at maximum power. The peak to average ratio was measured at the required operating frequencies in each band on the Spectrum Analyzer.

Test Setup



10.3 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110521	October 30, 2012
Wireless Test Set	Rohde & Schwarz	CMW500	101060	October 12, 2013
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 31, 2012
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

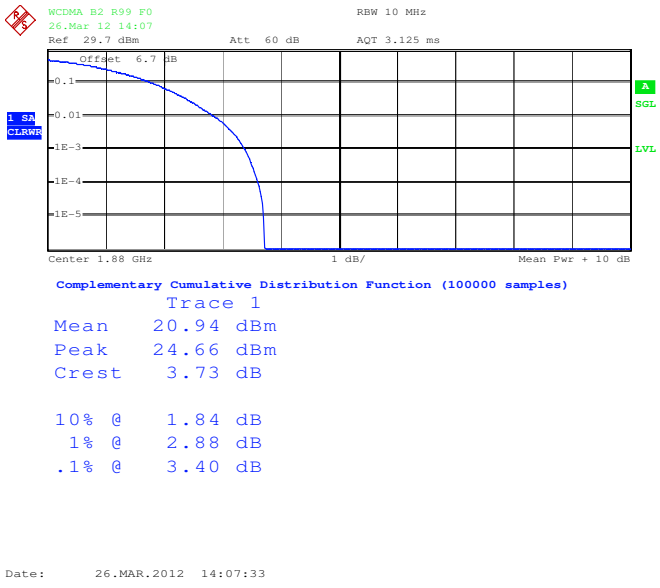
10.4 Test Results

	Band	Frequency (MHz)	Channel	Plots	Peak to Average Ratio (dB)
WCDMA	B2	1880	9400	10.4.1.1	3.40
	B5	836.4	4182	10.4.1.2	3.32
HSDPA	B2	1880	9400	10.4.2.1	3.58
	B5	836.4	4182	10.4.2.2	3.42
HSUPA	B2	1880	9400	10.4.3.1	5.22
	B5	836.4	4182	10.4.3.2	5.10

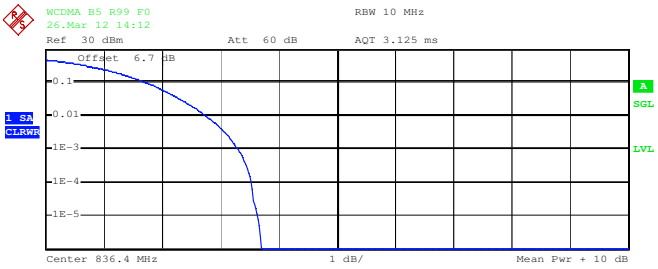
	Band	Frequency (MHz)	Channel	Modulation	BW	RB	Plots	Peak to Average Ratio (dB)
LTE	B4	1732.5	20175	QPSK	5	25	10.4.4.1	5.52
		1732.5	20175	16-QAM	5	25	10.4.4.2	6.3
	B17	710	23790	QPSK	5	25	10.4.4.3	6.69
		710	23790	16-QAM	5	25	10.4.4.4	7.2

10.4.1 WCDMA Test Plots

10.4.1.1 WCDMA peak to average ratio, Band2, Mid channel 9400, 1880.0 MHz



10.4.1.2 WCDMA peak to average ratio, Band5, Mid channel 4182, 836.4 MHz



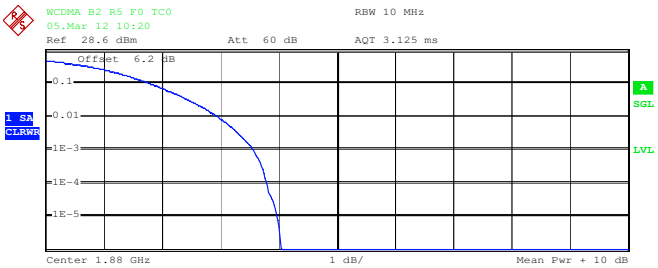
Complementary Cumulative Distribution Function (100000 samples)

Trace 1	
Mean	21.45 dBm
Peak	25.16 dBm
Crest	3.71 dB
10% @	1.76 dB
1% @	2.78 dB
.1% @	3.32 dB

Date: 26.MAR.2012 14:12:38

10.4.2 HSDPA Test Plots

10.4.2.1 HSDPA peak to average ratio, Band2, Mid channel 9400, 1880.0 MHz

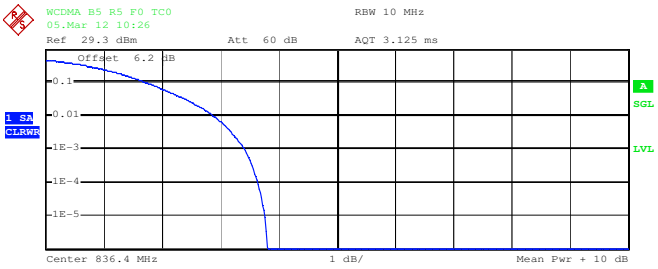


Complementary Cumulative Distribution Function (100000 samples)

Trace 1	
Mean	19.55 dBm
Peak	23.60 dBm
Crest	4.05 dB
10% @	1.82 dB
1% @	2.96 dB
.1% @	3.58 dB

Date: 5.MAR.2012 10:20:13

10.4.2.2 HSDPA peak to average ratio, Band5, Mid channel 4182, 836.4 MHz



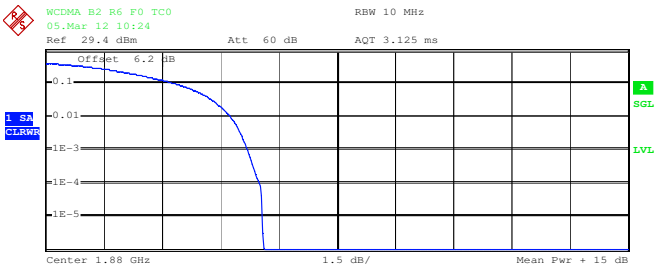
Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	20.57 dBm
Peak	24.37 dBm
Crest	3.80 dB
10% @	1.78 dB
1% @	2.90 dB
.1% @	3.42 dB

Date: 5.MAR.2012 10:26:09

10.4.3 HSUPA Test Plots

10.4.3.1 HSUPA peak to average ratio, Band2, Mid channel 9400, 1880.0 MHz

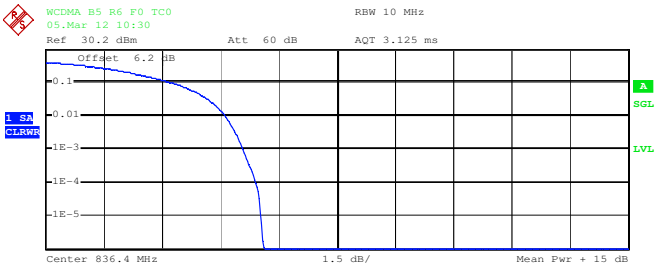


Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	18.63 dBm
Peak	24.23 dBm
Crest	5.60 dB
10% @	3.39 dB
1% @	4.77 dB
.1% @	5.22 dB

Date: 5.MAR.2012 10:24:37

10.4.3.2 HSUPA peak to average ratio, Band5, Mid channel 4182, 836.4 MHz



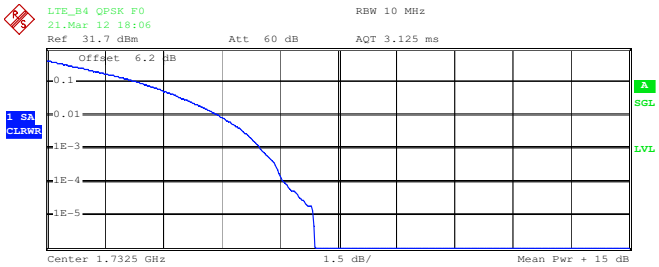
Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	19.47 dBm
Peak	25.08 dBm
Crest	5.61 dB
10% @	3.33 dB
1% @	4.65 dB
.1% @	5.10 dB

Date: 5.MAR.2012 10:30:33

10.4.4 LTE Test Plots

10.4.4.1 LTE peak to average ratio, QPSK Band4, Mid channel, 1732.5 MHz, 5MHz BW, 25RB

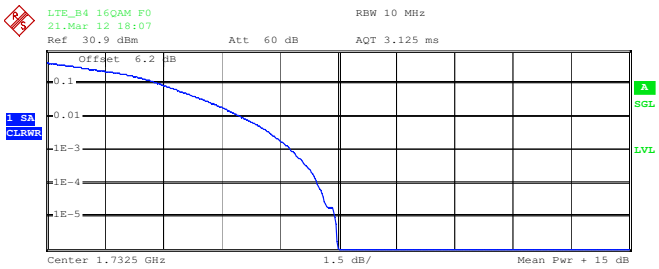


Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	19.76 dBm
Peak	26.67 dBm
Crest	6.90 dB
10% @	2.43 dB
1% @	4.47 dB
.1% @	5.52 dB

Date: 21.MAR.2012 18:06:02

10.4.4.2 LTE peak to average ratio, 16-QAM Band4, Mid channel, 1732.5 MHz, 5MHz BW, 25RB

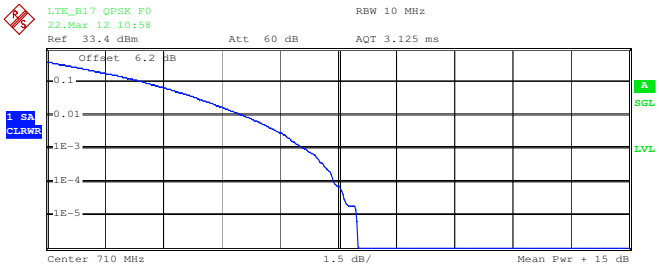


Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	18.71 dBm
Peak	26.21 dBm
Crest	7.50 dB
10% @	2.97 dB
1% @	5.07 dB
.1% @	6.30 dB

Date: 21.MAR.2012 18:07:34

10.4.4.3 LTE peak to average ratio, QPSK Band17, Mid channel, 710.0 MHz, 5MHz BW, 25RB

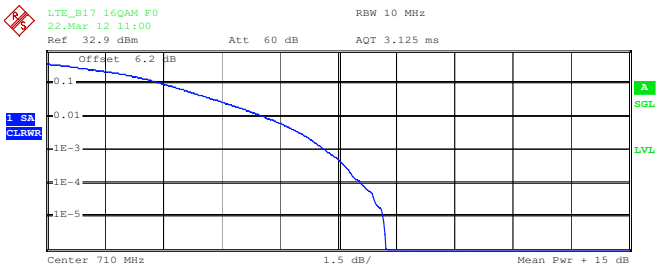


Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	20.13 dBm
Peak	28.14 dBm
Crest	8.02 dB
10% @	2.61 dB
1% @	5.13 dB
.1% @	6.69 dB

Date: 22.MAR.2012 10:58:33

10.4.4.4 LTE peak to average ratio, 16QAM Band17, Mid channel, 710.0 MHz, 5MHz BW, 25RB



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	19.15 dBm
Peak	27.88 dBm
Crest	8.73 dB
10% @	3.06 dB
1% @	5.67 dB
.1% @	7.20 dB

Date: 22.MAR.2012 11:00:06