MC7700 Module

C2PC Test Report

FOR

FCC and IC Certifications

IC: 2417C-MC7700
FCC ID: N7NMC7700

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1 Introduction and Purpose

This document provides additional test data in support of a Class II permissive change filing for the MC7700 module with FCC and Industry Canada, in which 15MHz and 20 MHz bandwidth operations in LTE Band 4 are enabled through a firmware update.

2 Test Summary

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3 Description of Equipment under Test

The MC7700 module, referred to as "EUT" hereafter, is a multi-band wireless modem operating on the GSM/GPRS/EDGE/UMTS/LTE networks. The table below shows the supported North American bands for the device.

Technology	Band	UL Freq. (MHz)	DL Freq. (MHz)	Max Power
LTE	B4	1710 – 1755	2110 – 2155	23 dBm (+/- 1 dB)
	B17	704 – 716	734 – 746	23 dBm (+/- 1 dB)
WCDMA / HSDPA/ HSUPA / HSPA+	B1	1920 - 1980	2110 - 2155	23 dBm (+/- 1 dB)
	B2	1850 – 1910	1930 – 1990	23 dBm (+/- 1 dB)
	B5	824 – 849	869 – 894	23 dBm (+/- 1 dB)
GSM	G850	824 – 849	869 – 894	32dBm (+/-1dB)
	G1900	1850 – 1910	1930 – 1990	29dBm (+/-1dB)
EDGE	G850	824 – 849	869 – 894	27dBm (+/-1dB)
	G1900	1850 – 1910	1930 – 1990	26dBm (+/-1dB)

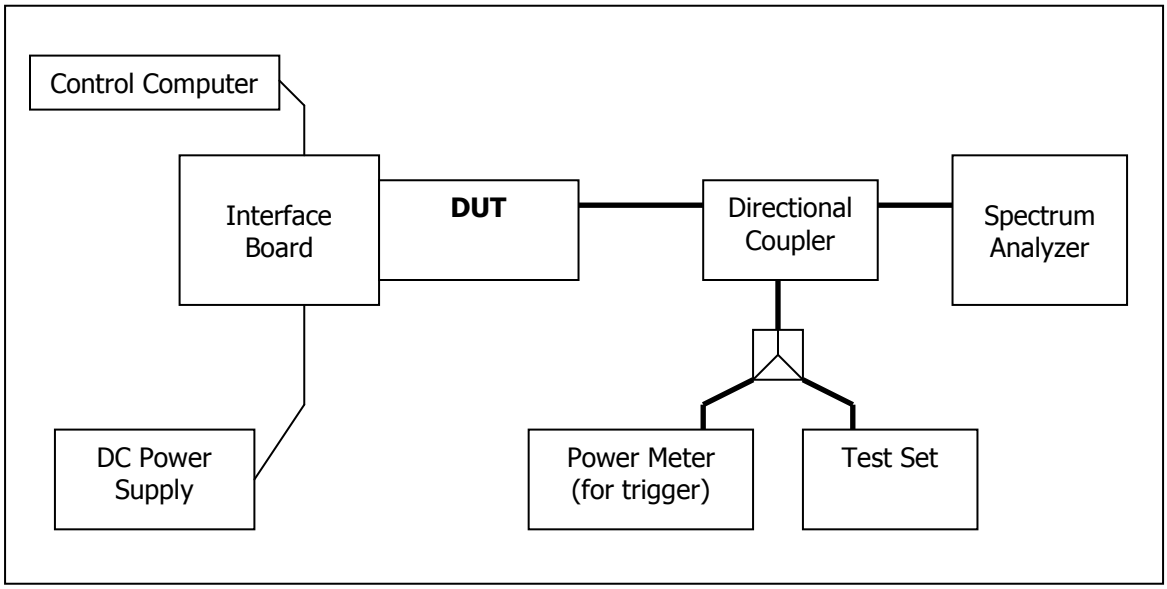
4 Compliance Test Equipment List

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE

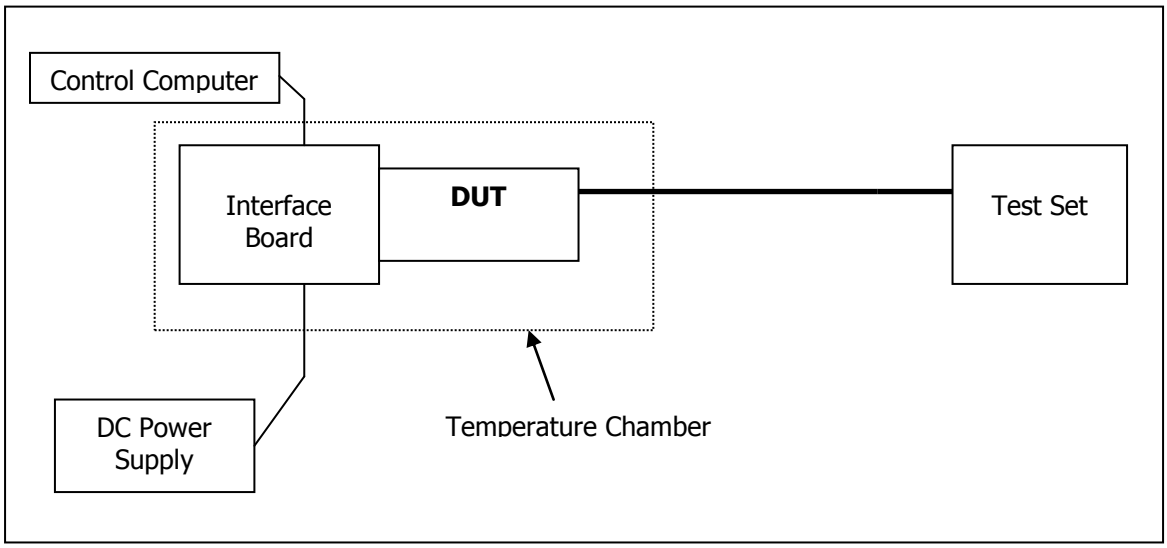
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMW500	101060	June 08, 2014
Spectrum Analyzer	Rohde & Schwarz	FSP	100060	October 13, 2013
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

5 Test Setup Block Diagrams

5.1 Test Setup 1



5.2 Test Setup 2



6 RF Power Output

FCC 2.1046, 27.53(h)

6.1 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMW500 and configured to operate at maximum power in a call. The maximum power was measured using the LTE power measurement of the CMW500. Refer to Test Setup 1.

6.1.1 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 MC7700 module antenna connector using the CMW multi evaluation LTE measurement.

6.2 Maximum Transmit Power Test Results

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 transmission bandwidth configurations. These MPR levels reduce the lower limit of each output power by the either 1 or 2dB per 3GPP 36.521.

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

6.2.1 LTE B4 Output Power Results

6.2.1.1 Output Power Results for LTE Band 4, 15 MHz Bandwidth

CHANNEL/FREQ	NO. RB	RB START	MODULATION	MAX POWER (RMS)	MAX POWER (PK)	MPR
20025 (1717.5 MHz)	1	0	QPSK	23.02	28.06	0
	1	74	QPSK	23.04	27.97	0
	75	0	QPSK	21.85	28.33	1
	1	0	16QAM	21.86	28.34	1
	1	74	16QAM	21.87	28.36	1
	75	0	16QAM	20.87	28.06	2
20175 (1732.5 MHz)	1	0	QPSK	22.9	27.52	0
	1	74	QPSK	23.08	27.48	0
	75	0	QPSK	22.12	28.31	1
	1	0	16QAM	22.39	28.75	1
	1	74	16QAM	22.52	28.55	1
	75	0	16QAM	21.18	28.35	2
20325 (1747.5 MHz)	1	0	QPSK	23.27	27.99	0
	1	74	QPSK	23.05	27.86	0
	75	0	QPSK	22.03	28.12	1
	1	0	16QAM	22.99	28.15	1
	1	74	16QAM	22.78	28.07	1
	75	0	16QAM	21.09	27.83	2

6.2.1.2 Output Power Results for LTE Band 4, 20 MHz Bandwidth

CHANNEL/FREQ	NO. RB	RB START	MODULATION	MAX POWER (RMS)	MAX POWER (PK)	MPR
20050 (1720.0 MHz)	1	0	QPSK	23.08	28.22	0
	1	99	QPSK	23.14	28.26	0
	100	0	QPSK	21.73	28.18	1
	1	0	16QAM	22.53	29.04	1
	1	99	16QAM	22.59	29.09	1
	100	0	16QAM	20.92	28.47	2
20175 (1732.5 MHz)	1	0	QPSK	22.8	27.95	0
	1	99	QPSK	23.11	28.09	0
	100	0	QPSK	21.92	28.38	1
	1	0	16QAM	21.9	28.09	1
	1	99	16QAM	22.1	28.17	1

	100	0	16QAM	20.84	28.37	2
20300 (1745.0 MHz)	1	0	QPSK	23.22	28.4	0
	1	99	QPSK	23.04	28.35	0
	100	0	QPSK	21.91	28.17	1
	1	0	16QAM	23.58	28.79	1
	1	99	16QAM	22.87	28.61	1
	100	0	16QAM	20.88	28.22	2

7 Occupied Bandwidth

FCC 2.1049, 27.53(h)

7.1 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 mid frequency in each band. The –26dB bandwidth was also measured and recorded. Refer to Test Setup 1.

7.2 Test Results

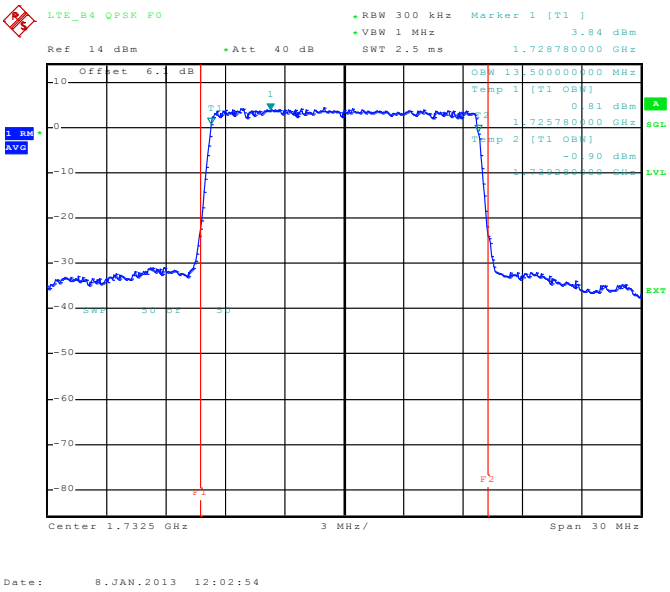
Occupied Bandwidth was only measured at maximum resource block allocation and at center of band for each supported LTE BW.

7.2.1 LTE Summary Results

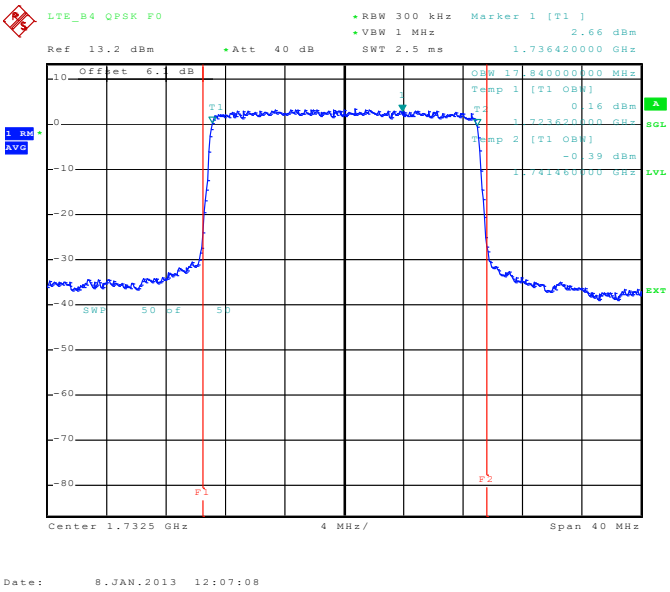
Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	99% Occupied Bandwidth (MHz)	-26dBc Occupied Bandwidth (MHz)	Corresponding Plot number
LTE	QPSK	B4	15	75	0	1732.5	20175	13.44	14.52	7.2.2.1
			20	100				17.84	18.96	7.2.2.2
	16QAM		15	75				13.44	14.4	7.2.2.3
			20	100				17.92	19.04	7.2.2.4

7.2.2 LTE Test Plots

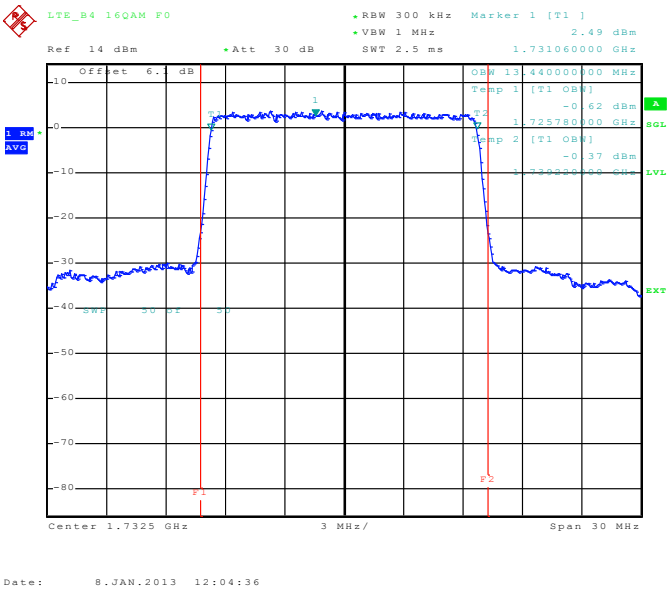
7.2.2.1 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=15MHz RB=75 RB Offset=0 QPSK 99% BW



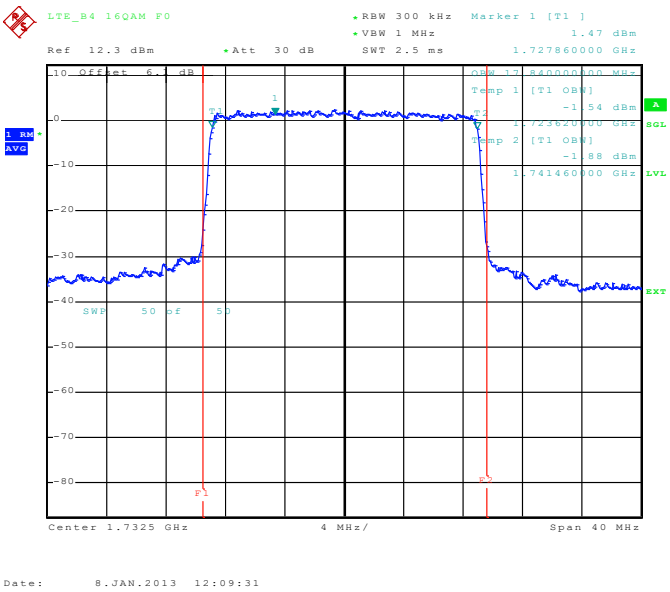
7.2.2.2 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=20MHz RB=100 RB Offset=0 QPSK 99% BW



7.2.2.3 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=15MHz RB=75 RB Offset=0 16-QAM 99% BW



7.2.2.4 LTE Occupied Bandwidth, Band4 mid channel (20175) BW=20MHz RB=100 RB Offset=0 16-QAM 99% BW



8 Out of Band Emissions at Antenna Terminals

FCC 22.901(d), 27.53(h)(m)

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.

8.1 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. Refer to Test Setup 2.

8.2 Test Results

Refer to the following plots.

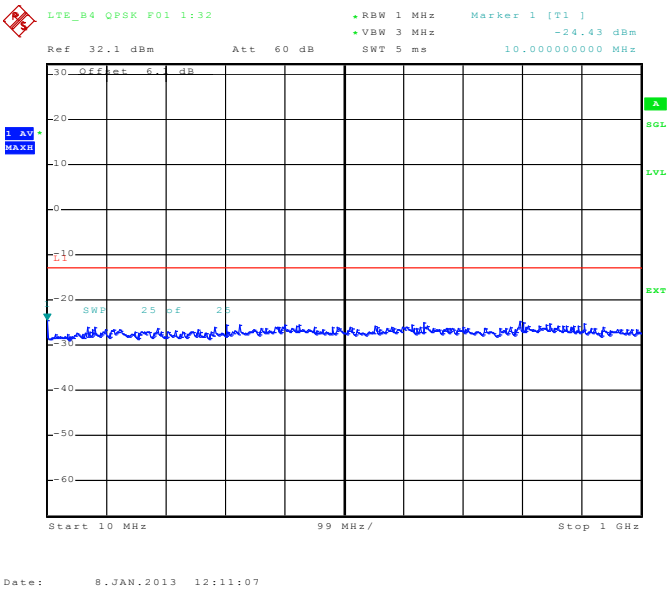
Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	Corresponding Plot number
LTE	QPSK	B4	15	1	32	1732.5	20175	8.2.1.1 -8.2.1.3
			20		50			8.2.1.3 -8.2.1.5

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

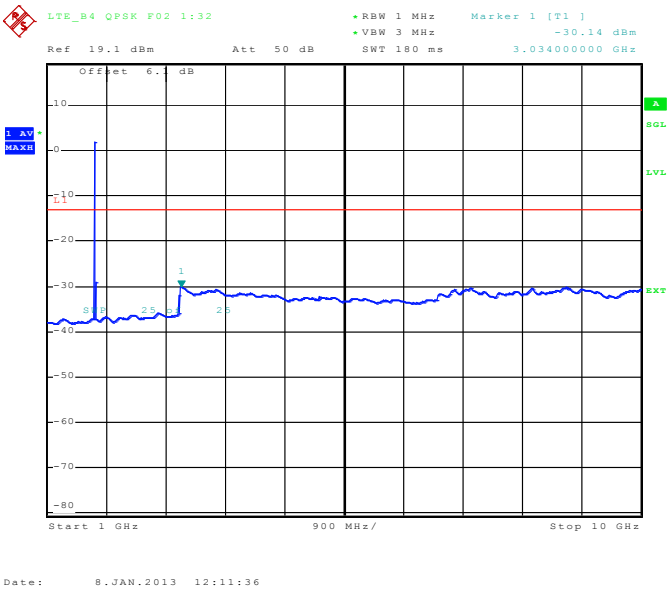
8.2.1 LTE Test Plots

LTE B4

8.2.1.1 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 15MHz BW, 1RB, RB Offset 32, QPSK, 30MHz to 1 GHz

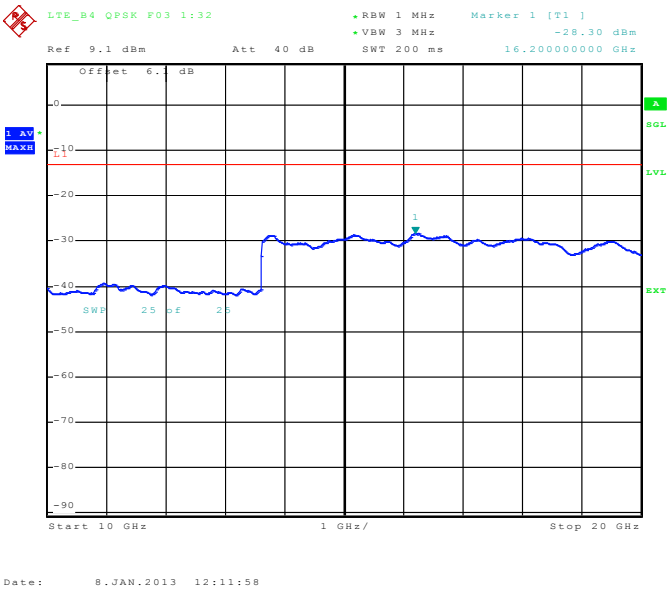


8.2.1.2 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 15MHz BW, 1RB, RB Offset 32, QPSK, 1 GHz to 10 GHz

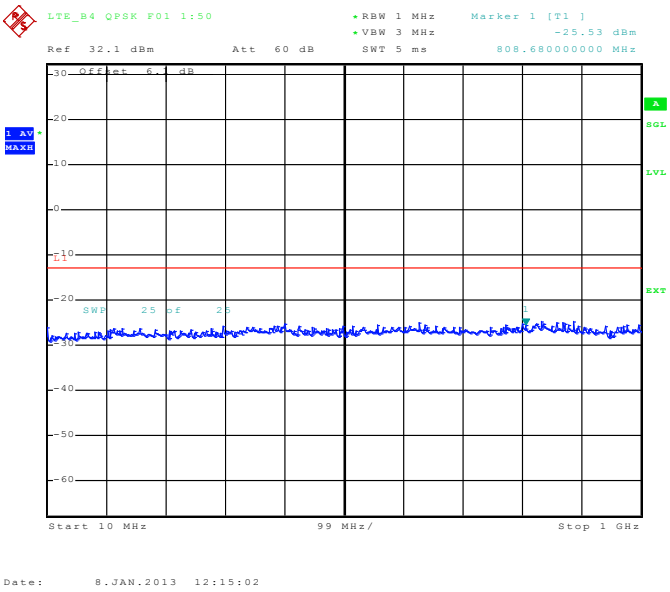


Note: The strong emission shown in each case is the carrier signal.

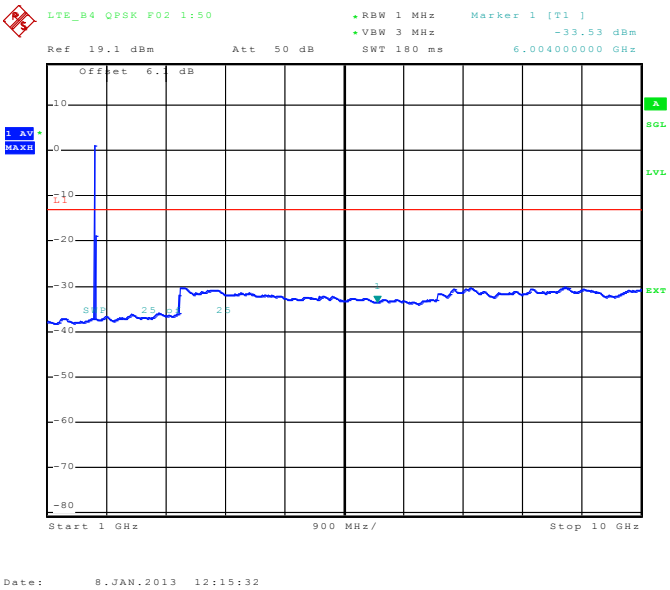
8.2.1.3 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 15MHz BW, 1RB, RB Offset 32, QPSK, 10 GHz to 20 GHz



8.2.1.4 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 20MHz BW, 1RB, RB Offset 50, QPSK, 30MHz to 1 GHz

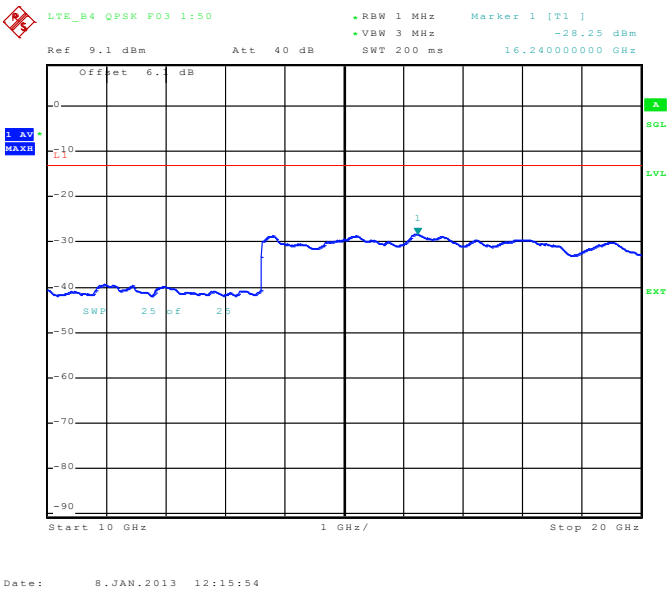


8.2.1.5 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 20MHz BW, 1RB, RB Offset 50, QPSK, 1 GHz to 10 GHz



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

8.2.1.6 Out of Band Emissions at Antenna Terminals LTE B4, Mid channel, 1732.5 MHz, 20MHz BW, 1RB, RB Offset 50, QPSK, 10 GHz to 20 GHz



9 Block Edge Compliance

FCC Part 27.53(h)(m)

9.1 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMW500, 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. Refer to Test Setup 1.

The resolution bandwidth was set to at least 1% of the emission bandwidth (where applicable). The power was scaled accordingly:

Power offset = 10*log(FCC_RBW/Measurement_RBW)

9.2 Test Results

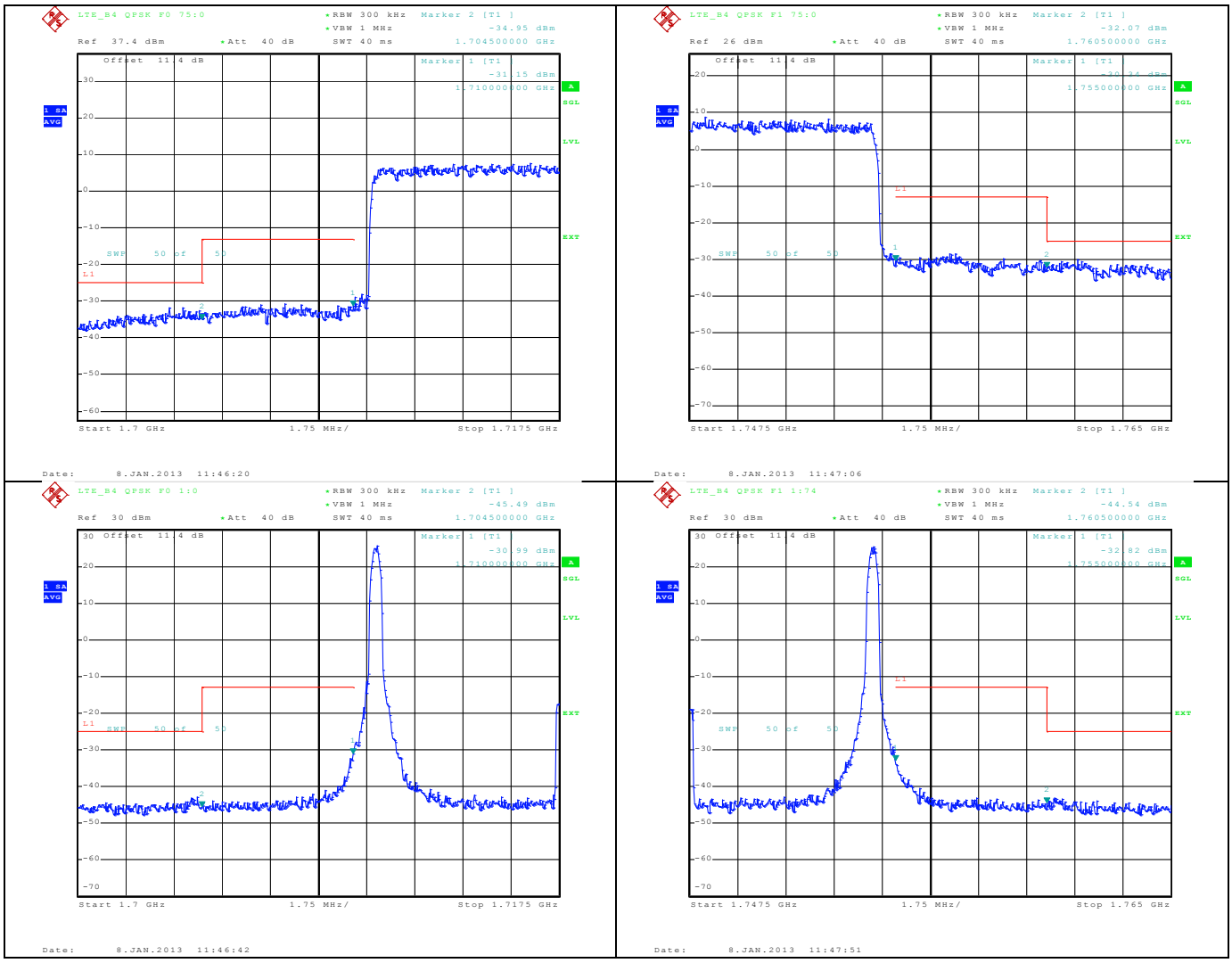
LL = lower left, LR = lower right, UL = upper left, UR = upper right

Mode		Band	BW (MHz)	No. RB	RB Offset	Frequency (MHz)	Channel	Corresponding Plot number
LTE	QPSK	B4	15	1	0	1717.5	20025	9.2.1.1 LL
				75	0			9.2.1.1 UL
				1	74	1747.5	20325	9.2.1.1 LR
				75	0			9.2.1.1 UR
		B4	20	1	0	1720	20050	9.2.1.2 LL
				100	0			9.2.1.2 UL
				1	99	1745	20300	9.2.1.2 LR
				100	0			9.2.1.2 UR
	16-QAM	B4	15	1	0	1717.5	20025	9.2.1.3 LL
				75	0			9.2.1.3 UL
				1	74	1747.5	20325	9.2.1.3 LR
				75	0			9.2.1.3 UR
		B4	20	1	0	1720	20050	9.2.1.4 LL
				100	0			9.2.1.4 UL
				1	99	1745	20300	9.2.1.4 LR
				100	0			9.2.1.4 UR

9.2.1 LTE Test Plots

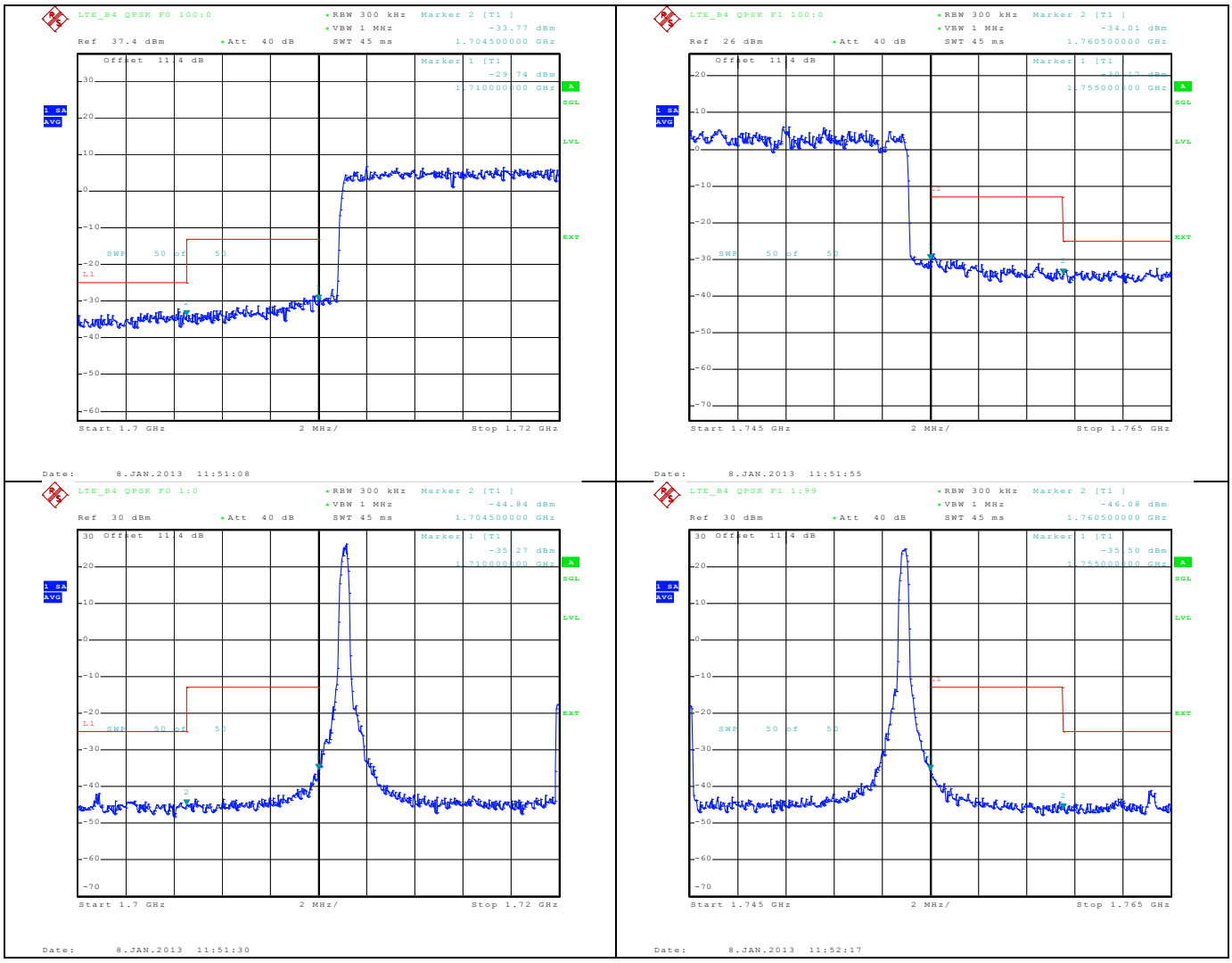
9.2.1.1 LTE; Band4, 15 MHz BW, QPSK

Below 1710 MHz	Above 1755 MHz



9.2.1.2 LTE; Band4, 20 MHz BW, QPSK

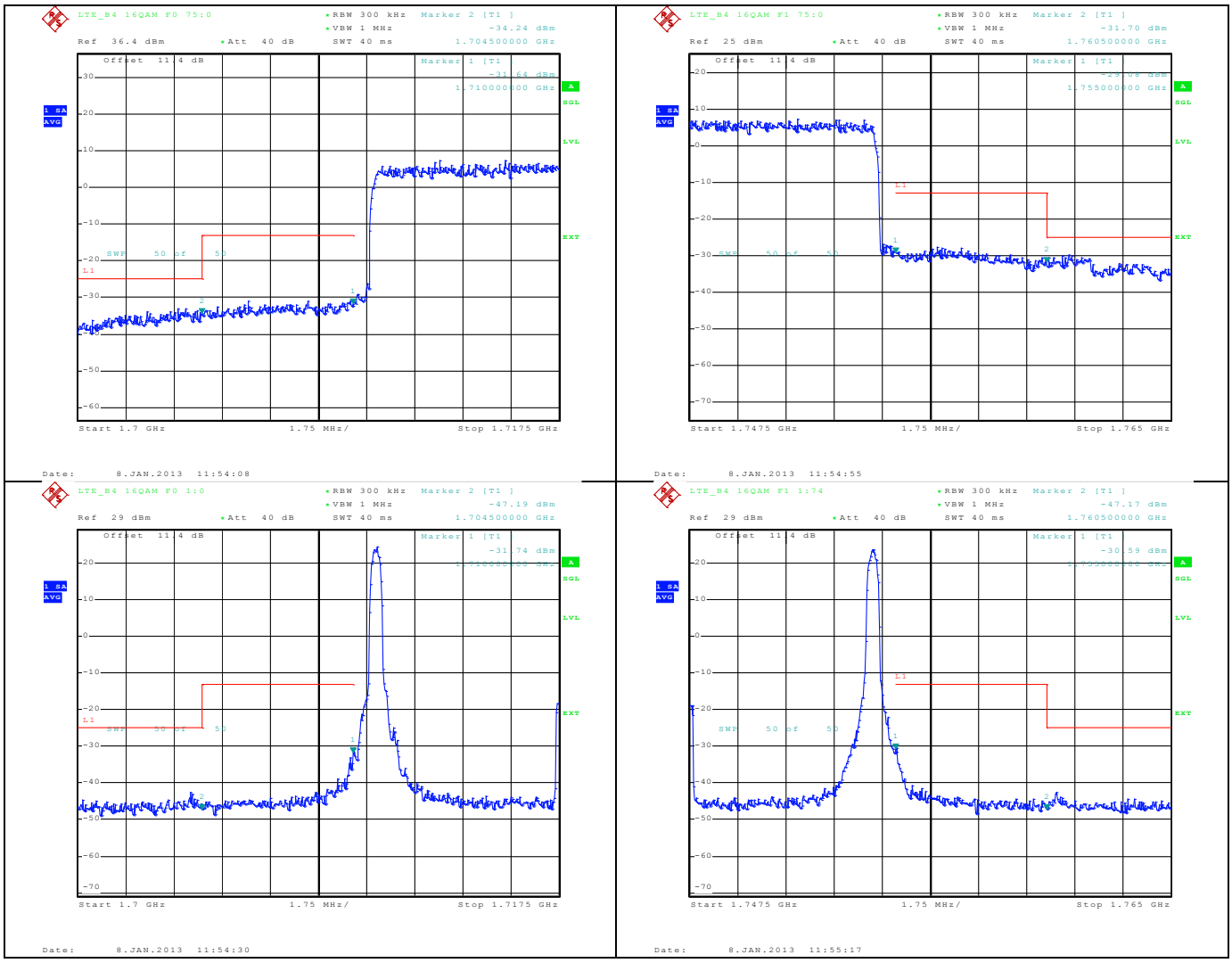
Below 1710 MHz	**Above 1755 MHz**



LTE B4

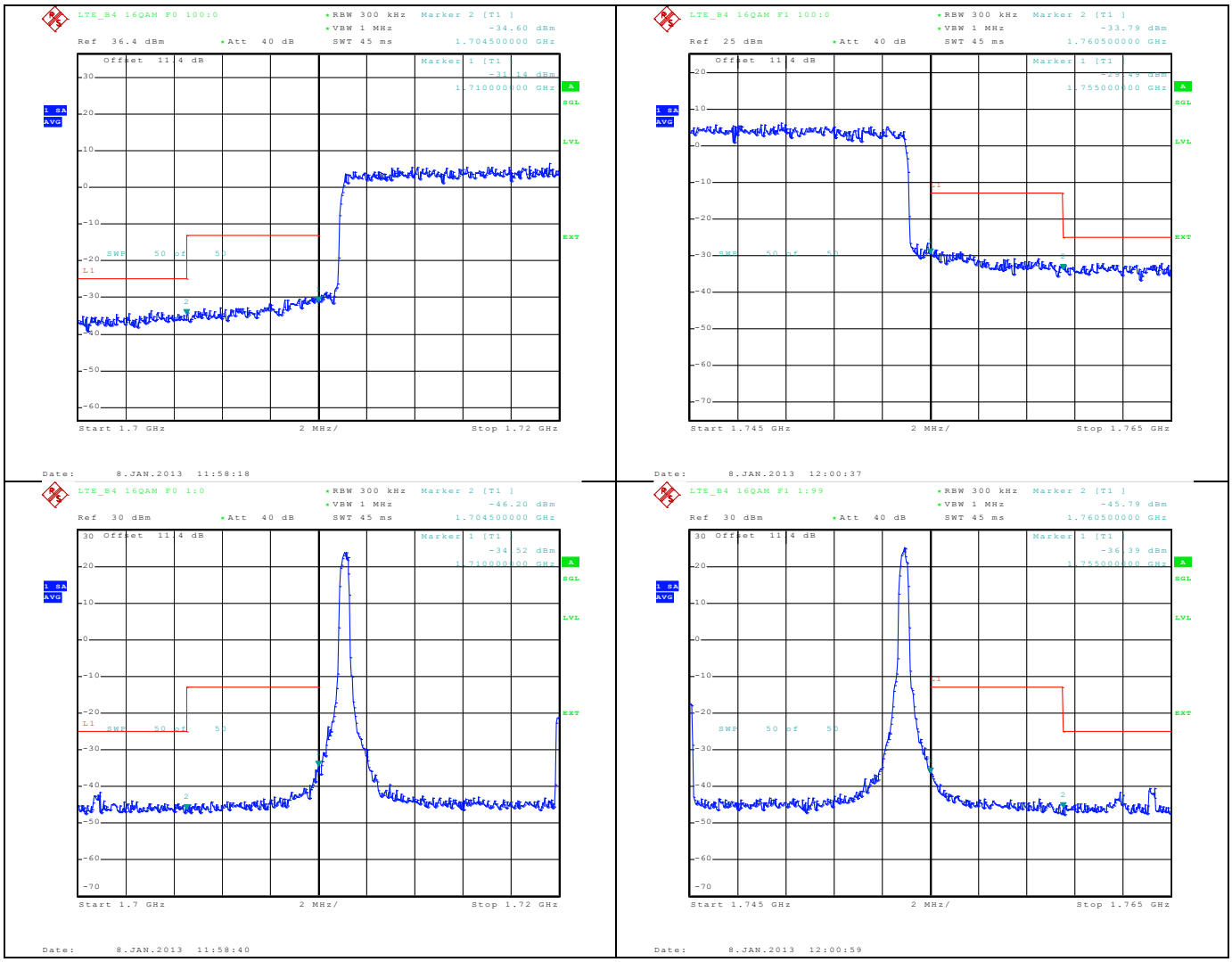
9.2.1.3 LTE; Band4, 15 MHz BW, 16-QAM

Below 1710 MHz	**Above 1755 MHz**



9.2.1.4 LTE; Band4, 20 MHz BW, 16-QAM

Below 1710 MHz	Above 1755 MHz



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. Refer to Test Setup 1.

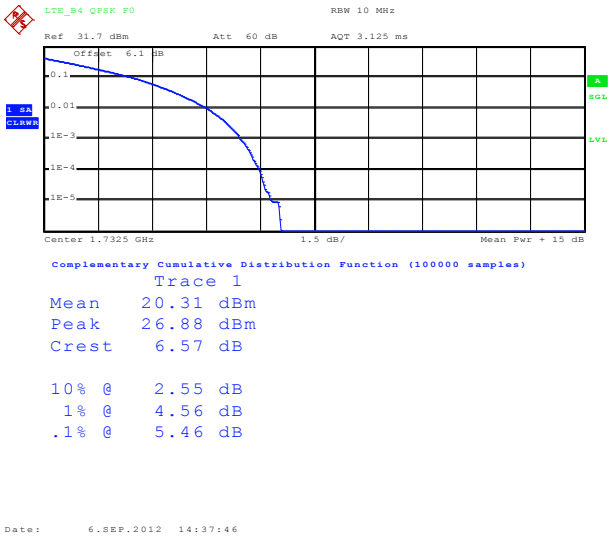
10.3 Test Results

The Peak to Average ration is not bandwidth dependent. The results below were measured with a 5 MHz transmission bandwidth (25 RB).

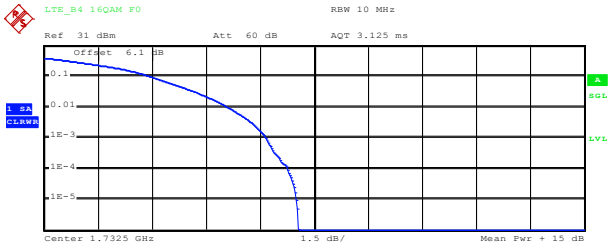
Band	Channel	Modulation	Plot No.	Peak to Average Ratio
B4	20175	QPSK	12.3.1.1	5.46
		16-QAM	12.3.1.2	6.18

10.3.1 Test Plots

10.3.1.1 LTE peak to average ratio, QPSK Band4, Mid channel, 1732.5 MHz



10.3.1.2 LTE peak to average ratio, 16-QAM Band4, Mid channel, 1732.5 MHz



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	19.18 dBm
Peak	26.26 dBm
Crest	7.07 dB
10% @	3.03 dB
1% @	5.16 dB
.1% @	6.18 dB

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