3500 CARLING AVENUE
OTTAWA ONTARIO CANADA
K2H 8E9

NORTEL 4G HW Infrastructure

EXHIBIT 2B

Conducted Spurious Emissions (CSE) Test Report

Applicant : NORTEL

For original Equipment Application on :

FCC : AB6NT2G1LTEFRM3

IC : 332AF-2G1LTEFRM3

Issue date: April 3, 2008
Document Prime: Yan Papernov

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List of Consultants

The following people have reviewed this document prior to its release and have recommended its approval:

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Igor Acimovic	Systems Design	2M40
Yan Papernov	Systems Design	2M04

Decision Maker

Table 2: Decision maker

Ratifier's Name	Signature	Date
Yan Papernov		

Decision Ratifier

The release of this document has been reviewed and approved for distribution and use by the following:

Table 3: Ratifier

Ratifier's Name	Signature	Date
Mark Willetts		

Revision History

Table 4: History

Stream/Issue	Revision Date	Reason for Change	Author (Dept.)
00/1.0	22 Feb. 2008	First draft	Igor Acimovic (2M40)
00/2.0	26 Mar. 2008	Post-review updates	Igor Acimovic (2M40)

Acronyms and Abbreviations

AWS	Advanced Wireless Services
BTS	Basestation Transceiver Subsystem
BW	Bandwidth
CDMA	Code Division Multiple Access
CR	Cost Reduced
DE	Digital Equipment
IS	Interim Standard
LO	Local Oscillator
LPF	Lowpass Filter
LTE	Long Term Evolution
MIMO	Multiple Input Multiple Output
MFRM-3	Multi-Carrier Flexible Radio Module
OFDM	Orthogonal Frequency Division Multiplex
OFDMA	Orthogonal Frequency Division Multiple Access
PA	Power Amplifier
PC	Personal Computer
PoC	Proof of Concept
RBW	Resolution Bandwidth
RF	Radio Frequency
Rx	Receive
SA	Spectrum Analyzer
SISO	Single Input Single Output
SW	Software
TDPM	Tri-sector Duplexer Preselector Module
TRM	Transmitter Receiver Module
Tx	Transmit

1 Introduction

This test report supports FCC filing for Proof of Concept (PoC) LTE AWS MFRM-3. This filing includes two transmitter Multiple Input Multiple Output (MIMO) and one transmitter Single Input Single Output (SISO) configurations for a 10MHz LTE Orthogonal Frequency Division Multiplex (OFDM) signal in 2110MHz to 2155MHz Advanced Wireless Services (AWS) band. The 10MHz LTE OFDM signal consists of 600 subcarriers spaced 15kHz apart all of which are modulated using QPSK, 16QAM, and 64QAM modulation schemes.

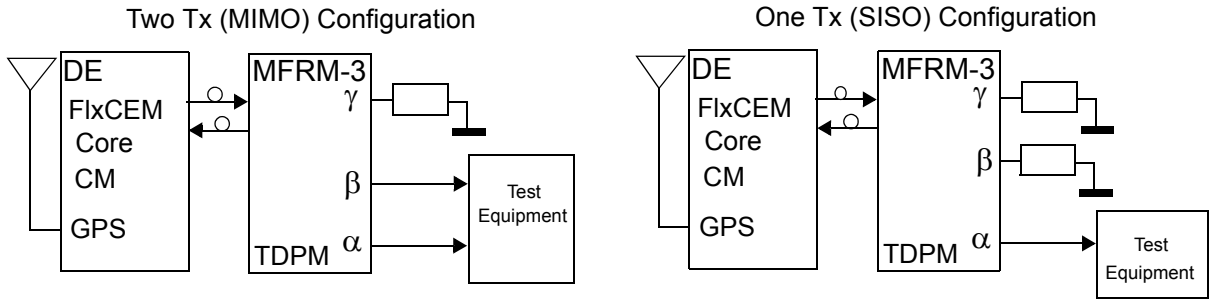


Figure 1 : Transmitter configurations used

The following tests were performed: RF Power Output, Occupied Bandwidth, Spurious Emissions at Antenna Terminals, and Transmitter Test (LTE OFDM Transmitter). Emissions testing was conducted at -48VDC at room temperature. Frequency over voltage and temperature test results are included (the frequency stability tests were done in CDMA mode).

This test report will be submitted in accordance with the FCC Rules and Regulations, Part 2, Subpart J, Sections 2.1046 through 2.1057 for equipment authorization of Nortel's LTE AWS Multi carrier Flexible Radio Module 3 (MFRM-3).

The LTE AWS MFRM3 is intended for use in the Domestic Public Cellular Radio Telecommunications Service and is designed in accordance with the following standards:

- *CFR 47, Part 27, Subpart C, Miscellaneous Wireless Communications Services [1]*
- *CFR 47, Part 2, Subpart J, Equipment Authorization Procedures - Equipment Authorization[2]*

The MFRM3 is capable of transmitting simultaneously on three ports, two ports were used in two-Tx (MIMO) configuration (remaining port was not used for transmission and it was terminated) and one port is used in one-Tx (SISO) configuration (ramaining two ports were not used for trans-

mission and were terminated).

1.1 Required Tests

Table summarizes the required tests for the LTE AWS MFRM-3.

Table 5: Required Tests

FCC Measurement Specification	FCC Limit Specification	Description	Test to be Performed?
2.1033		PA current specification	Yes
2.1046		RF Power Output	Yes
2.1049		Occupied Bandwidth	Yes
2.1051, 2.1057	27.53	Spurious Emissions at Antenna Terminals	Yes
2.1053, 2.1057		Field Strength of Spurious Emissions	Yes
2.1055	27.54	Frequency Stability	Yes

2 Engineering Declaration

The LTE AWS Multicarrier Flexible Radio Module3 has been tested in accordance with the requirements contained in the Federal Communications Commission Rules and Regulations Part 2 and 27.

To the best of my knowledge, these tests were performed in accordance with good engineering practices using measurement procedures consistent with industry or commission standards or previous Commission correspondence or guidance and demonstrate that this equipment complies with the appropriate standards. All tests were conducted on a representative sample of the equipment for which equipment authorization is sought.

3 Equipment Authorization Application Requirements

3.1 Standard Test Conditions and Test Equipment

The MFRM3 was tested under the following standard test conditions unless otherwise noted:

- Ambient Temperature: 20 to 35 degrees C
- Ambient Humidity: 20 to 40%
- DC Supply Voltage: -48 Vdc (nominal)
- Input modulation: QPSK, 16QAM, 64QAM (LTE 10MHz)

3.2 EUT Identification List

Table shows the identification of the components required for testing.

Table 6: EUT Identification List

Equipment Description	Model / Part Number	Release Number	Serial Number
AWS Multi carrier Flexible Radio Module	NNTGZ70CB	B2	NNTMEEW0100J
AWS TDPM	NTGZ83AAE6	N1	FING010EY00J
AWS FAM3	NTGZ85AA	N2	NNTM84G027R6
FlxCEM	NTGZ91AA	R1	NNTM74X1G0T5
XCEM-64 Modem	NTBW70BA	15	NNTM5377G1NR
XCEM-192 Modem	NTRZ80BA	01	NNTM74X0TX4P
TDPM Power/Data Cable	NTGZ8000		N0043622
TDM / TDPM to Tx port Cable	NTGZ8042E6		N0081665

3.3 Test Equipment List

Table shows the identification of the test equipment required.

Table 7: Test Equipment List

Description	Manufacturer	Model	Serial Number	Cal. Due Date
9kHz to 7 GHz Spectrum Analyzer	Rhode & Schwarz	FSEB	847158/022	26 July 2008
9kHz to 26GHz Spectrum Analyzer	Agilent	PSA	MY46187461	25 Dec. 2008
RF Power Meter	Agilent	E4419B	MY45102221	29 May 2008
RF Power Sensor Head	Agilent	8482A	MY41093860	25 Sep. 2008
30dB Attenuator (>100W)	Narda	NA	NA	VBU[a]
RF Cables	Huber + Suhner	NA	NA	VBU

a. Verified before use, path attenuation was calibrated

4 Transmitter Tests

4.1 Certification Requirements

4.1.1 Application for certification

FCC Part 2.1033 Application for certification.

(c) Applications for equipment other than that operating under parts 15 and 18 of the rules shall be accompanied by a technical report containing the following information:

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

4.1.2 Test Method

This information required for this section is available from:

Title: MFRM-3 AWS (2.1GHz) Power Amplifier (PA) Assembly Verification Notice

Dataset Name: VPGZ74EA
Document Status: Draft
Stream: 00 Issue: 01

http://livelink2.ca.nortel.com/livelink/livelink.exe?func=ll&objId=24807149&objAction=browse&viewType=

4.1.3 Test Setup

See above document.

4.1.4 Test Results

The MFRM-3 AWS has three PA pallets. Each pallet has 2 transistors (connected in parallel) comprising the final gain block. The average current below is identical for all PA pallets.

Table 8: Average Current Values @ Pout_total =46dBm

Average Current Values @ Pout_total =46dBm		
	25 °C	
	Q1	Q2
Mean	2.34A	0.55A

4.2 RF Power Output

4.2.1 RF Power Output Requirements

FCC Part 2.1046

(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 Sec. 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

4.2.2 Test Method

Configure the BTS via the BTS controller to enable the MFRM3 to transmit at the rated power of 43dBm per transmitter in two-Tx configuration and 46dBm in one-Tx configuration in baseband modulation formats QPSK, 16QAM, 64QAM (LTE, 10MHz). Measurements were made on channels at the bottom and top of the AWS band with the MFRM-3 operating at -48Vdc. The RF output power was measured using a power meter. The measured power was maintained within +/- 0.25 dB.

4.2.3 Test Setup

The set-up required for the MFRM3 RF output power test is illustrated in Figure 2. RF output power measurements were referenced to the antenna port of the TDPM. The measured power represents transmit RF power per tranmitter.

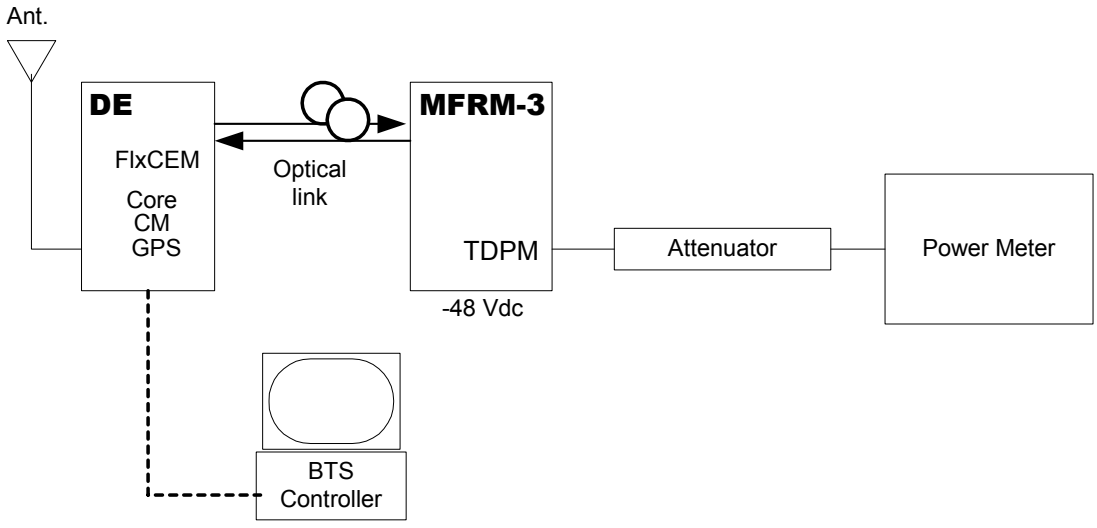


Figure 2 : Test Setup for RF Power Output Measurement

4.2.4 RF Output Power Test Results (Composite sector power)

Table 9: RF Output Power AWS MFRM3, one-Tx configuration, QPSK (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	46.08	46
800	2150	46.06	46

Table 10: RF Output Power AWS MFRM3, one-Tx configuration, 16QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	46.10	46
800	2150	46.11	46

Table 11: RF Output Power AWS MFRM3, one-Tx configuration, 64QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	46.14	46
800	2150	46.10	46

Table 12: RF Output Power AWS MFRM3, two-Tx configuration, QPSK (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	43.12	43
800	2150	43.08	43

Table 13: RF Output Power AWS MFRM3, two-Tx configuration, 16QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	43.14	43
800	2150	43.07	43

Table 14: RF Output Power AWS MFRM3, two-Tx configuration, 64QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured RF Output Power (dBm)	Typical Maximum Rated Power (dBm)
100	2115	43.16	43
800	2150	43.11	43

4.3 Occupied Bandwidth

4.3.1 Occupied Bandwidth Requirements

FCC Part 2.1049

The OBW, 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:

(g) Transmitter in which the modulating baseband comprises not more than three independent channels - when modulated by the full complement of signals for which the transmitter is rated. The level of modulation for each channel should be set to that prescribed in rule parts applicable to the services for which the transmitter is intended. If specific modulation levels are not set forth in the rules, the tests should provide the manufacturer's maximum rated condition.

(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 discretion of the user.

4.3.2 Test Method

Configure the BTS via the BTS controller to enable the MFRM3 to transmit at the rated power of 43dBm per transmitter in two-Tx configuration and 46dBm in one-Tx configuration in baseband modulation formats QPSK, 16QAM, 64QAM (LTE, 10MHz). Measurements were made on channels at the bottom and top of the band.

The Occupied Bandwidth was measured using the 99% channel power feature of the spectrum analyzer.

4.3.3 Test Setup

The set-up required for the MFRM3 Occupied bandwidth test is illustrated in Figure 3.

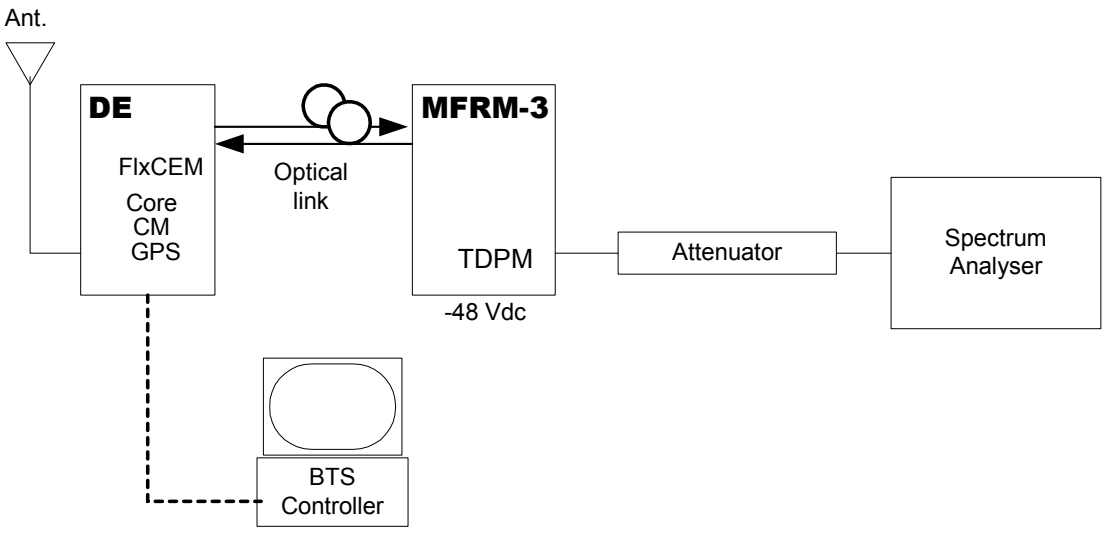


Figure 3 : Test Setup for Occupied Bandwidth Measurement

4.3.4 Test Result

Table 15: Measured Occupied Bandwidth LTE AWS MFRM3, one-Tx configuration, QPSK (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.897795
800	2150	8.927855

Table 16: Measured Occupied Bandwidth LTE AWS MFRM3, one-Tx configuration, 16QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.927855
800	2150	8.957915

Table 17: Measured Occupied Bandwidth LTE AWS MFRM3, one-Tx configuration, 64QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.927855
800	2150	8.927855

Table 18: Measured Occupied Bandwidth LTE AWS MFRM3, two-Tx configuration, QPSK (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.927855
800	2150	8.957915

Table 19: Measured Occupied Bandwidth LTE AWS MFRM3, two-Tx configuration, 16QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.957915
800	2150	8.957915

Table 20: Measured Occupied Bandwidth LTE AWS MFRM3, two-Tx configuration, 64QAM (LTE 10MHz)

Channel Number	Frequency (MHz)	Measured Occupied Bandwidth (MHz) (LTE 10MHz)
100	2115	8.897795
800	2150	8.957915

Figure 4 : Occupied Bandwidth, one-Tx configuration, Channel 100, QPSK (LTE 10MHz)

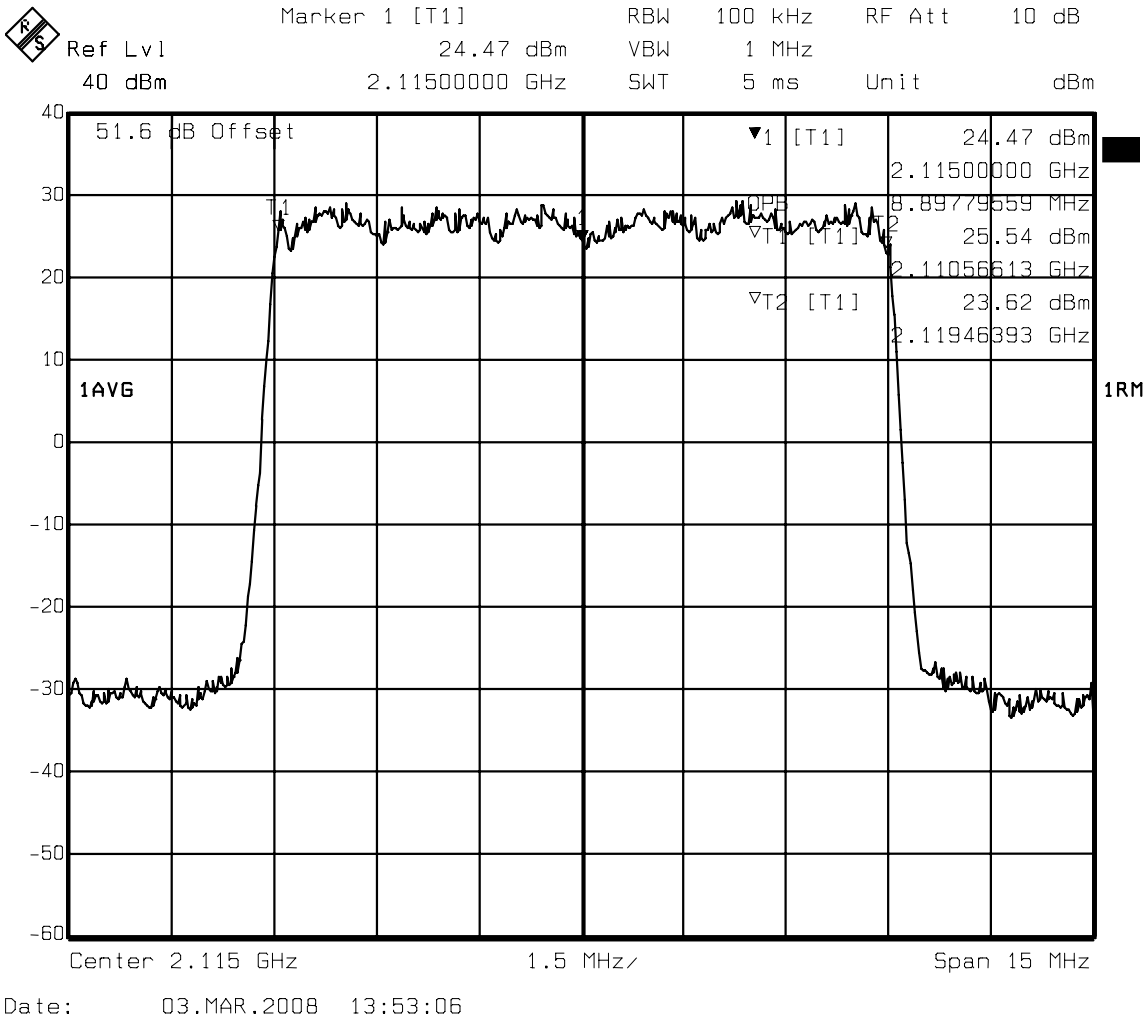


Figure 5 : Occupied Bandwidth, one-Tx configuration, Channel 800, QPSK (LTE 10MHz)

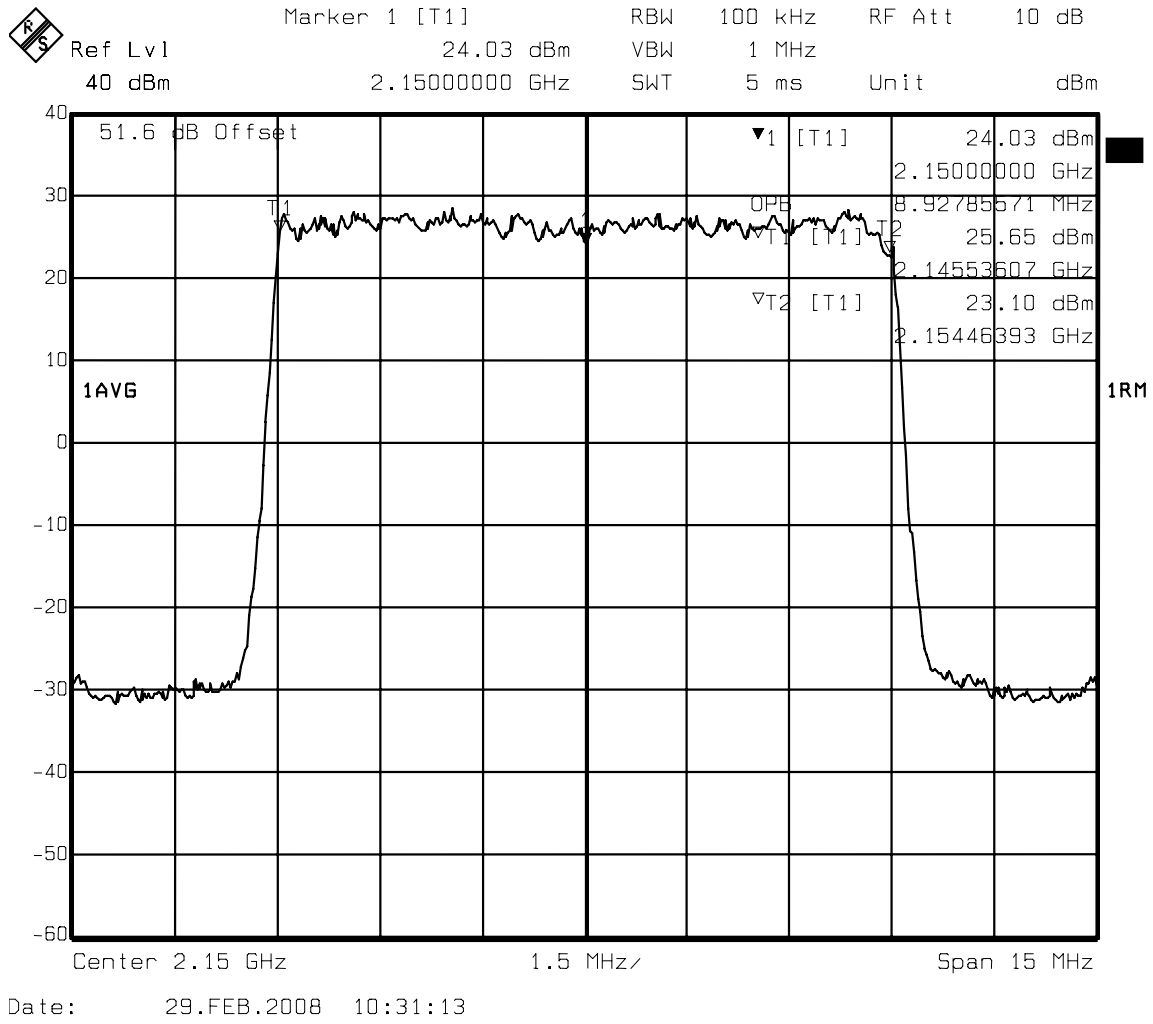


Figure 6 : Occupied Bandwidth, one-Tx configuration, Channel 100, 16QAM (LTE 10MHz)

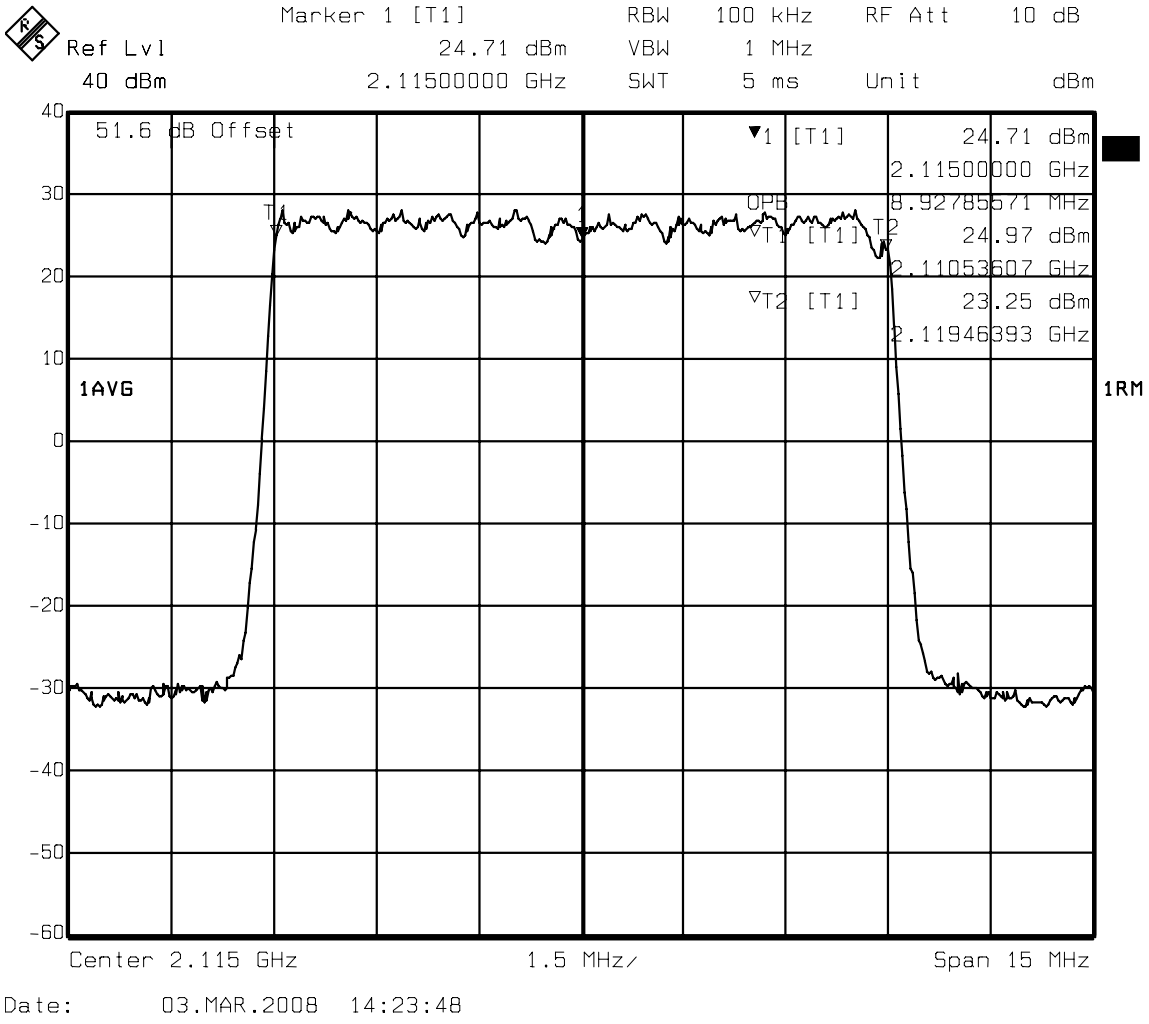


Figure 7 : Occupied Bandwidth, one-Tx configuration, Channel 800, 16QAM (LTE 10MHz)

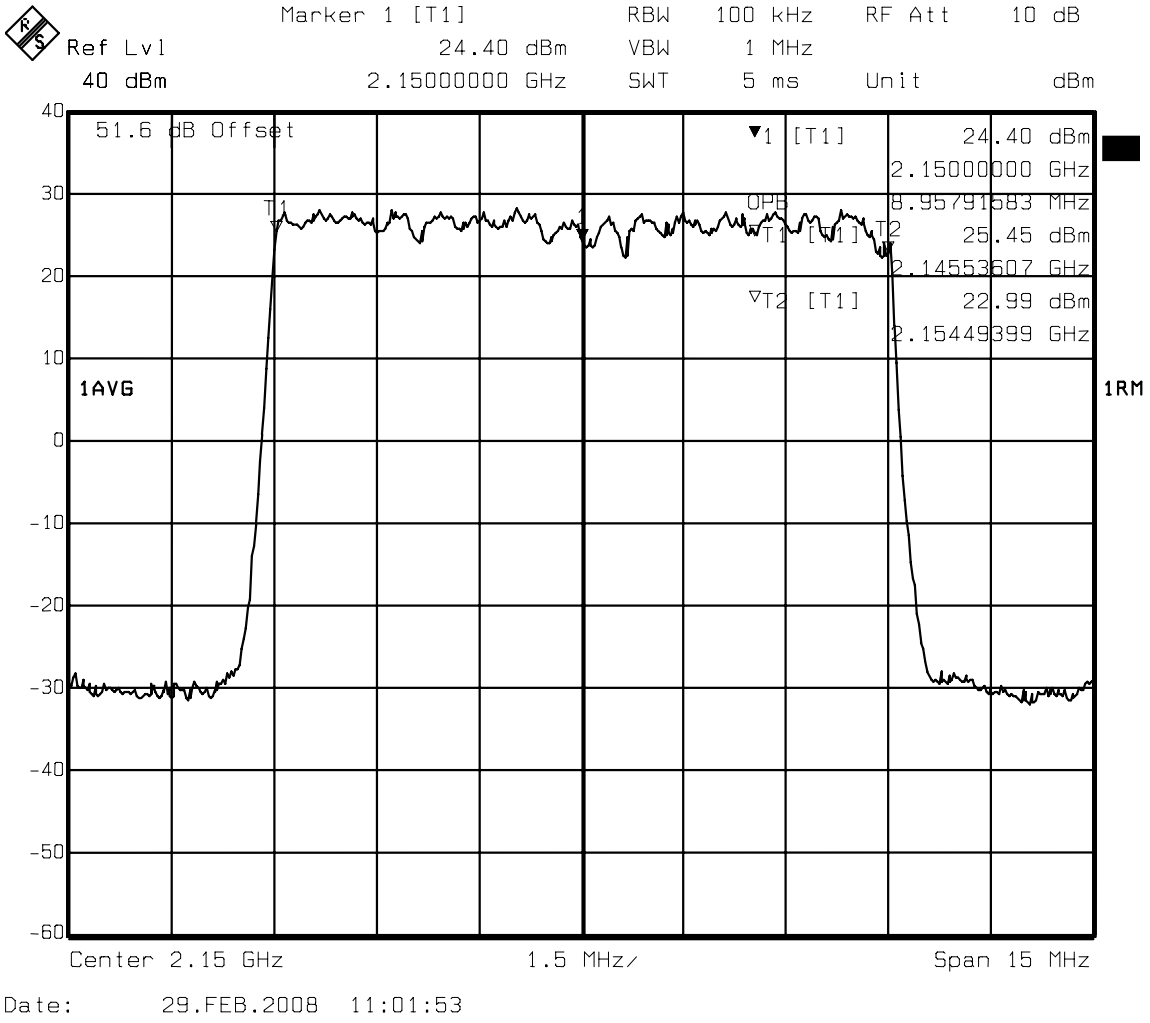


Figure 8 : Occupied Bandwidth, one-Tx configuration, Channel 100, 64QAM (LTE 10MHz)

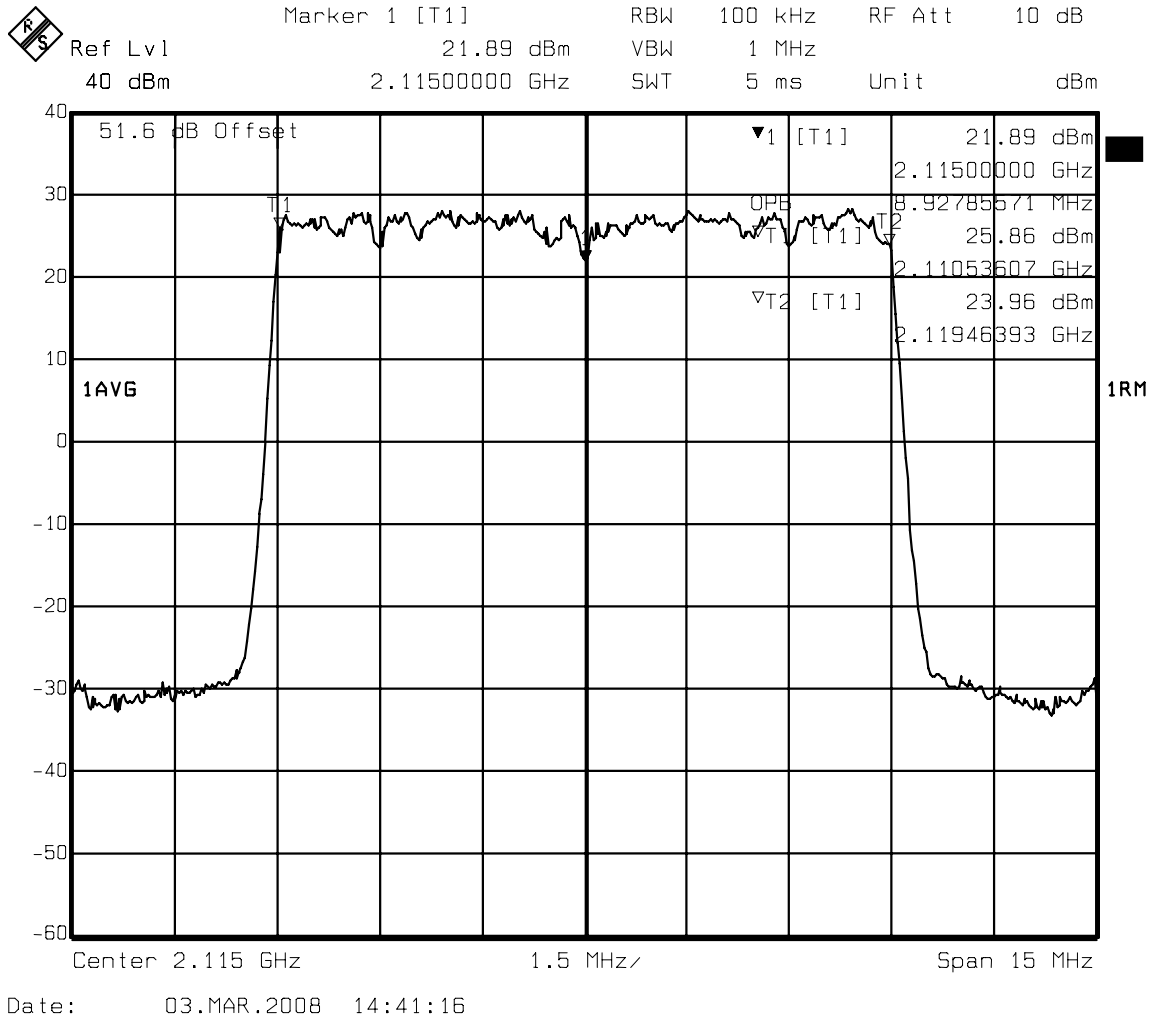


Figure 9 : Occupied Bandwidth, one-Tx configuration, Channel 800, 64QAM (LTE 10MHz)

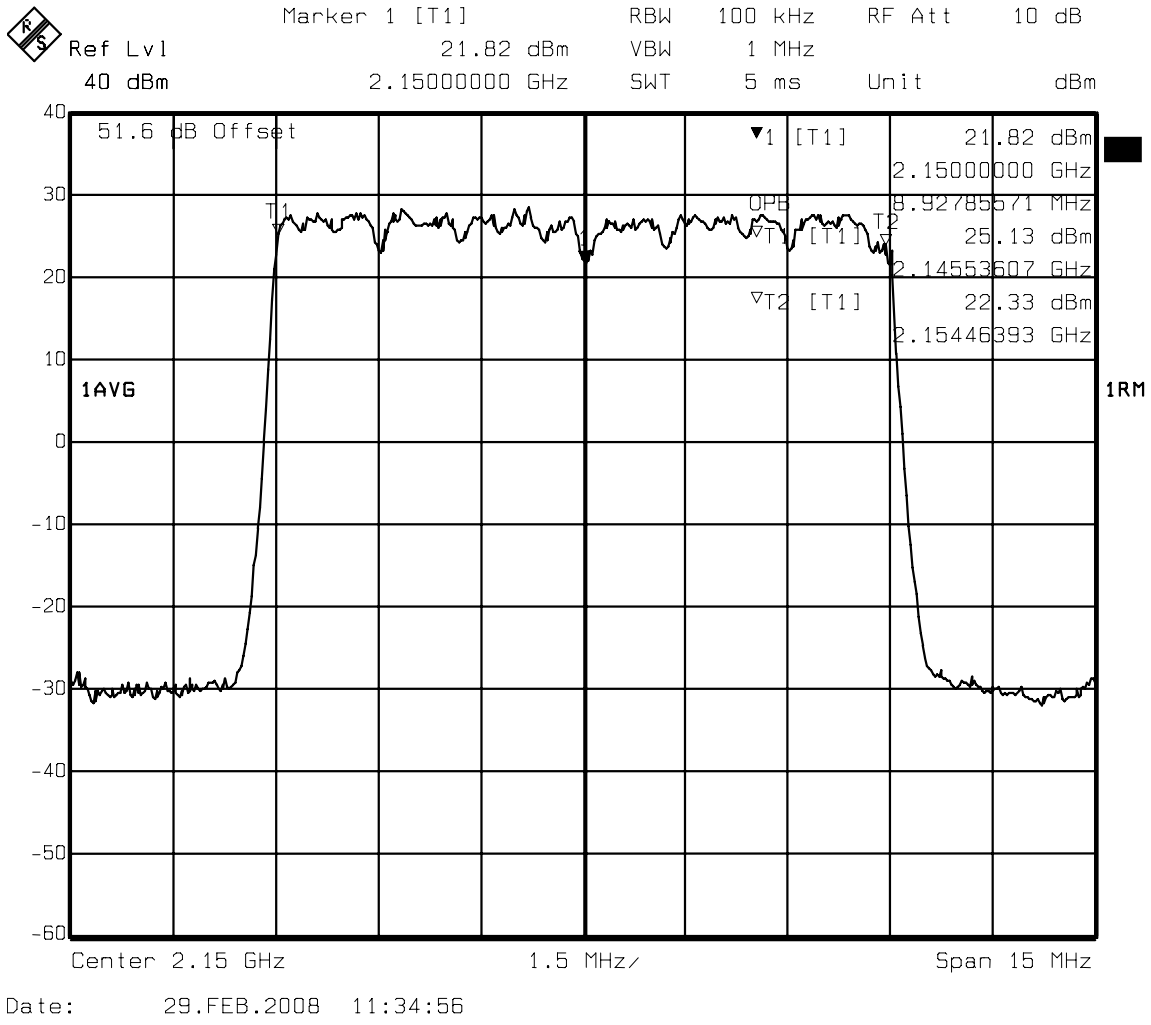


Figure 10 : Occupied Bandwidth, two-Tx configuration, Channel 100, QPSK (LTE 10MHz)

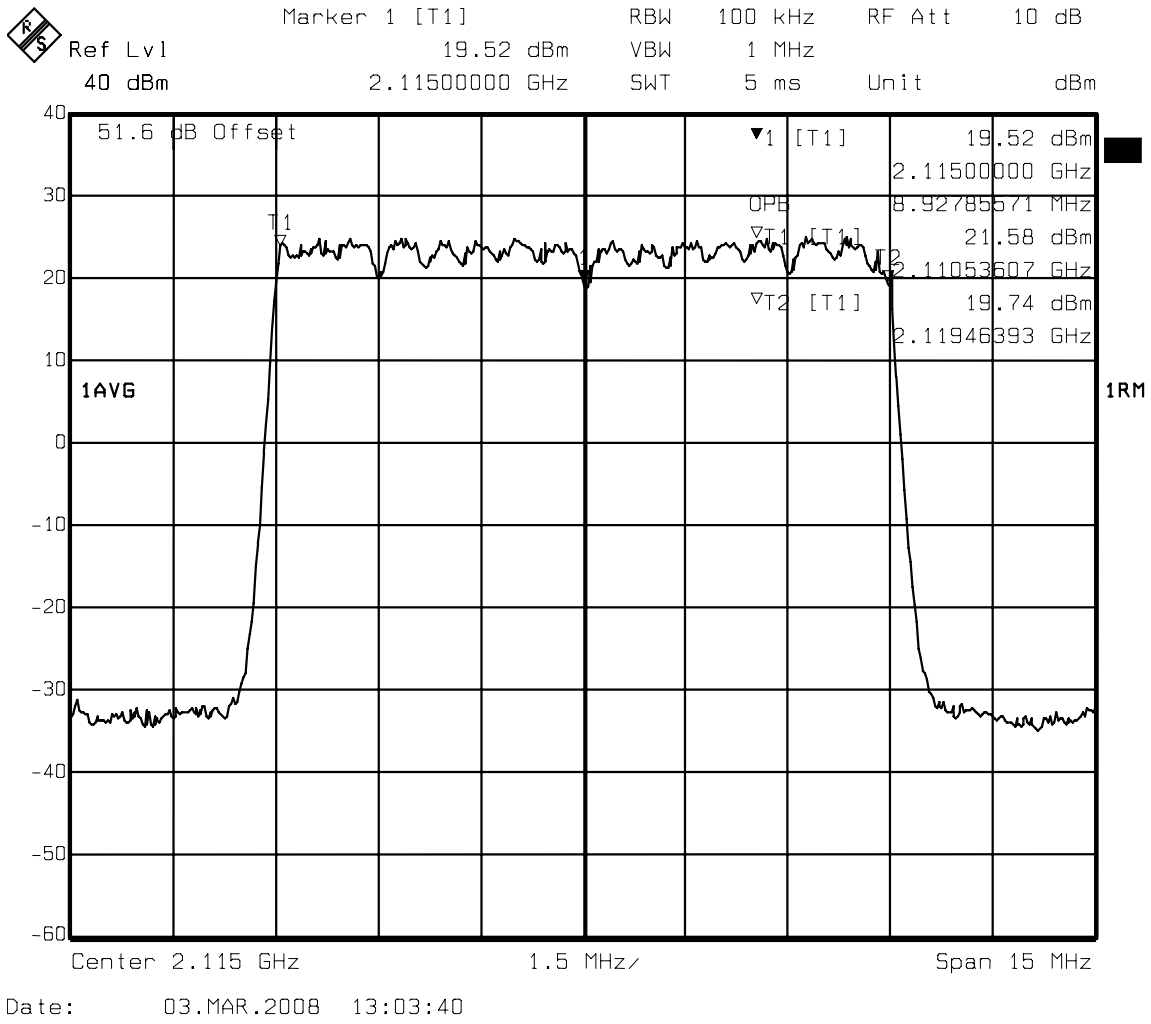


Figure 11 : Occupied Bandwidth, two-Tx configuration, Channel 800, QPSK (LTE 10MHz)

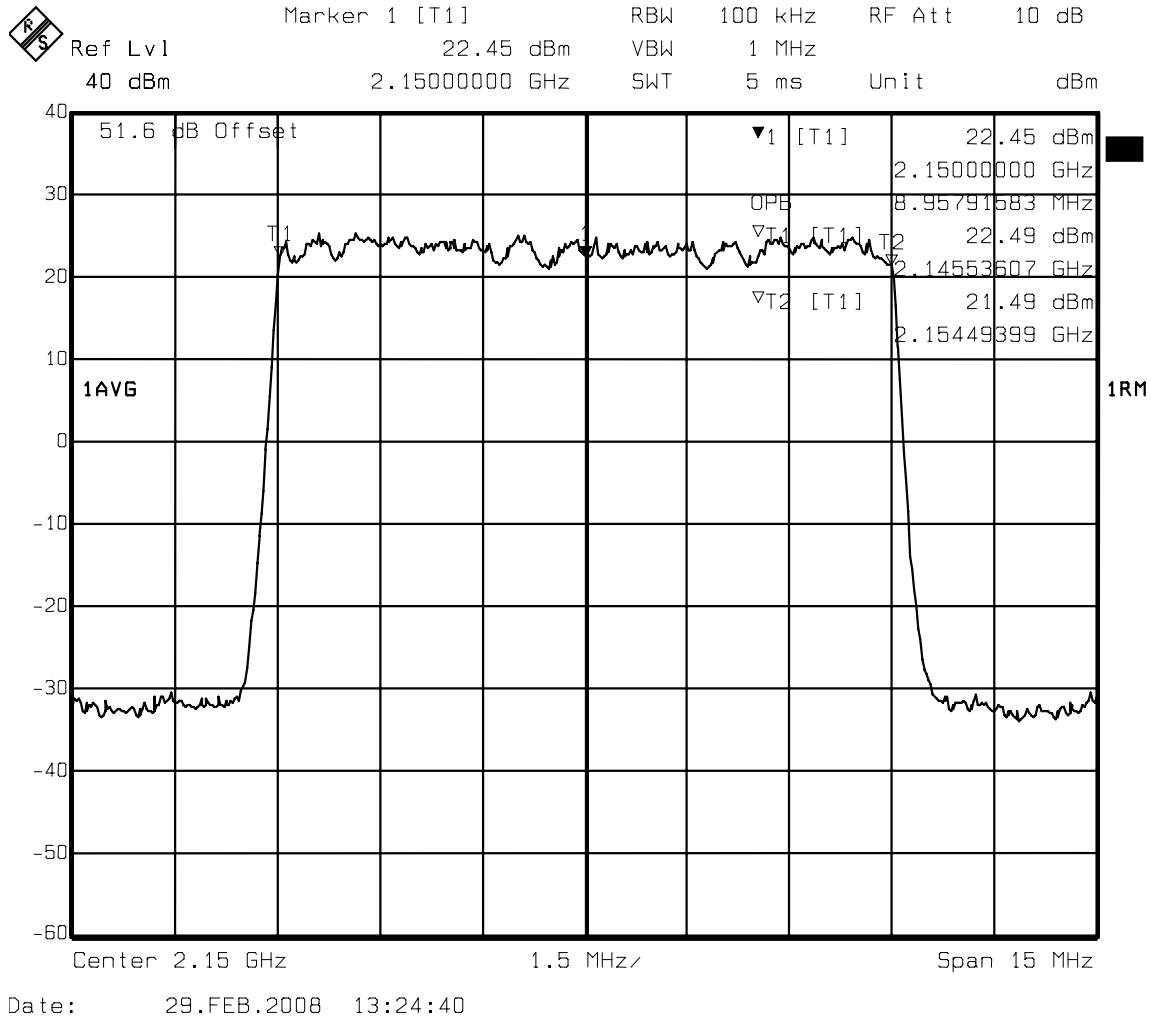


Figure 12 : Occupied Bandwidth, two-Tx configuration, Channel 100, 16QAM (LTE 10MHz)

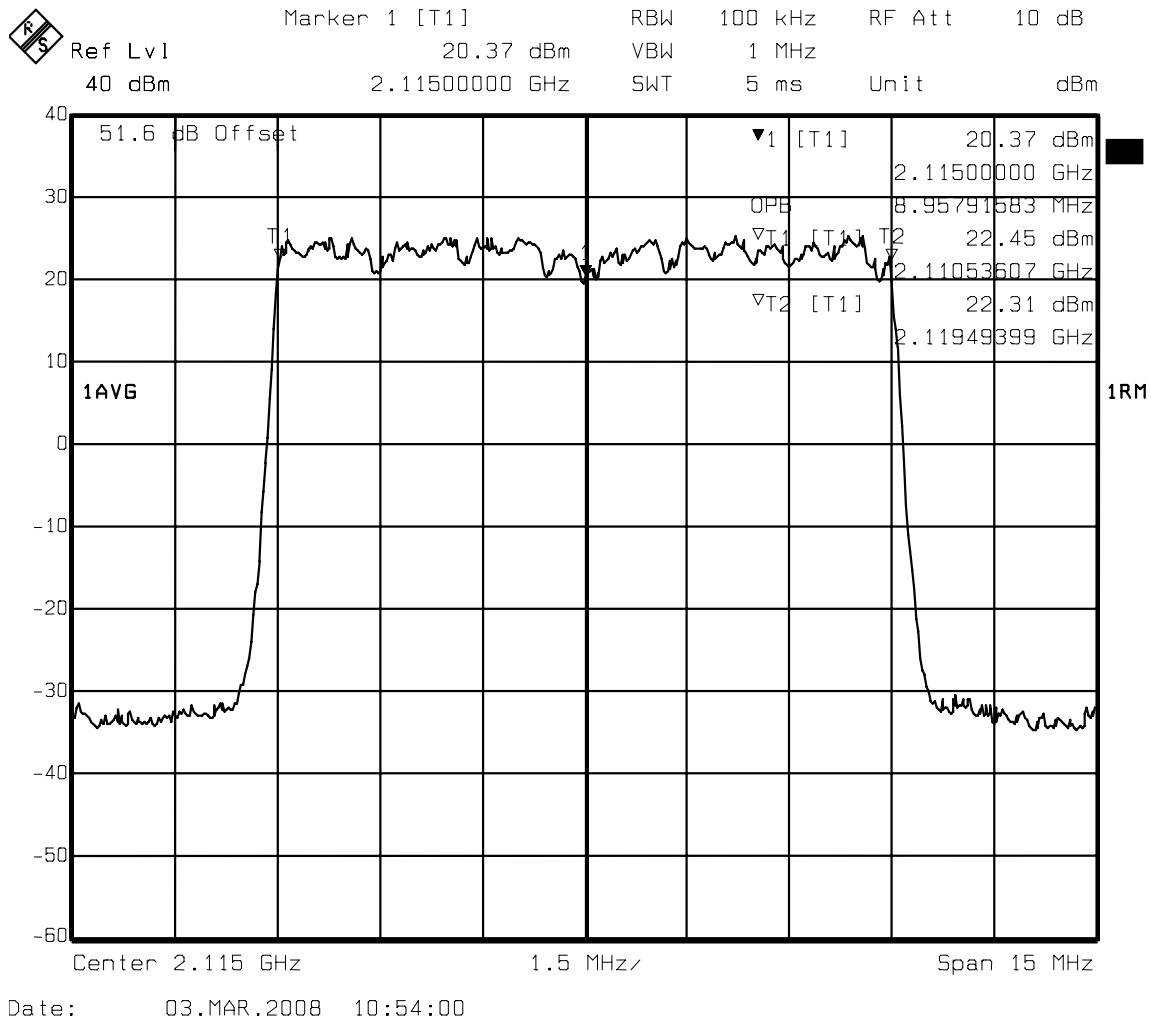


Figure 13 : Occupied Bandwidth, two-Tx configuration, Channel 800, 16QAM (LTE 10MHz)

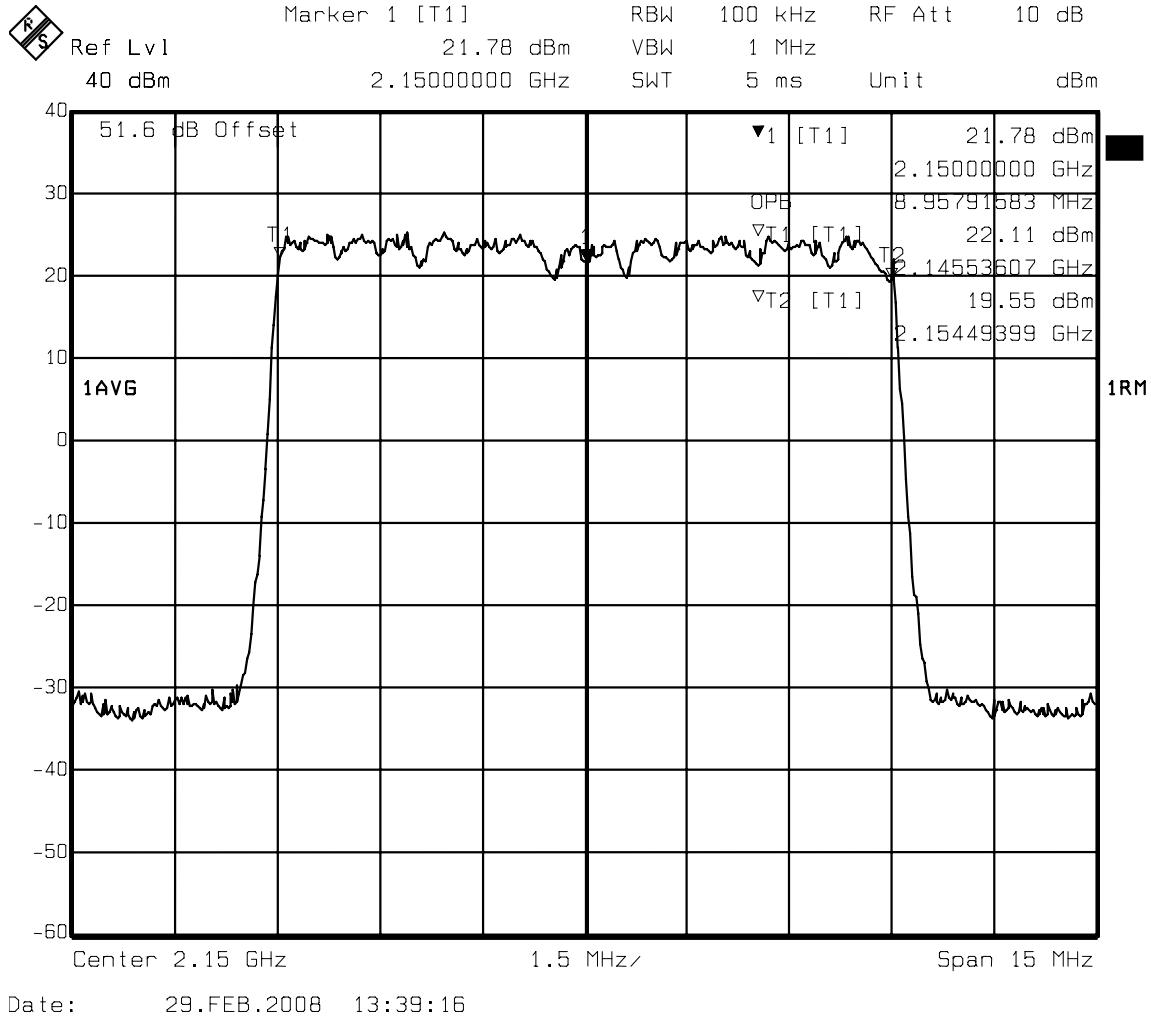


Figure 14 : Occupied Bandwidth, two-Tx configuration, Channel 100, 64QAM (LTE 10MHz)

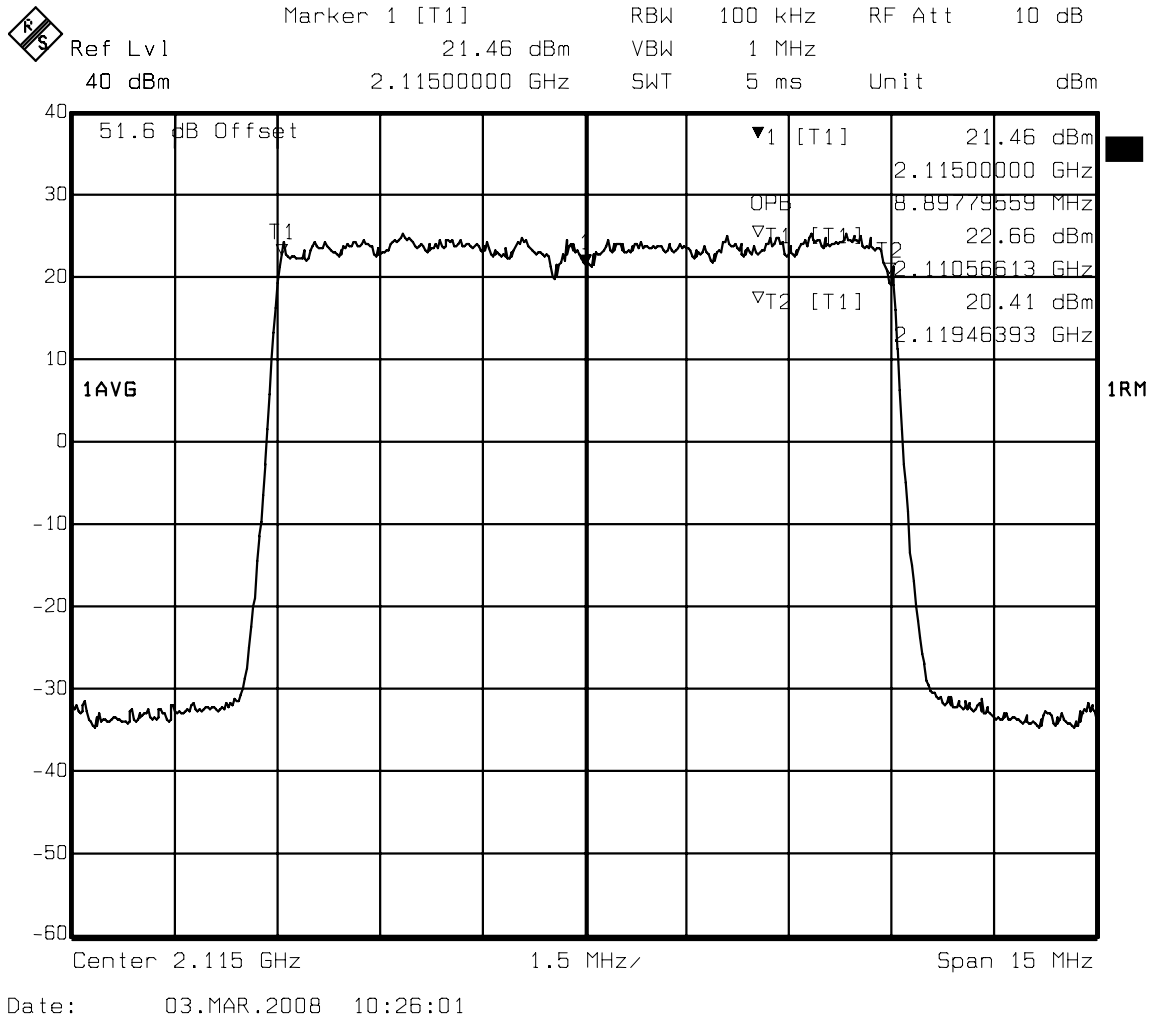
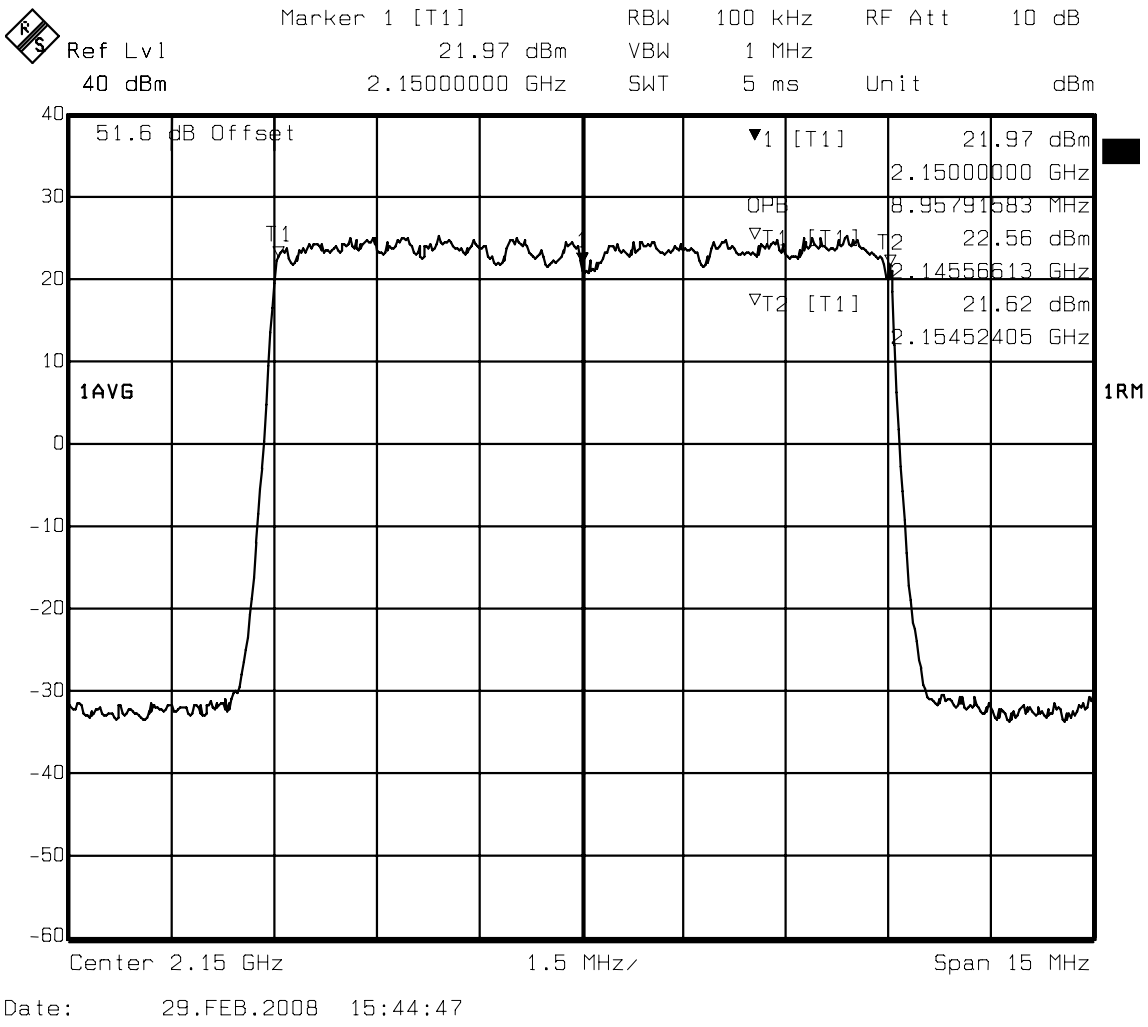


Figure 15 : Occupied Bandwidth, two-Tx configuration, Channel 800, 64QAM (LTE 10MHz)



4.4 Spurious Emissions at Antenna Terminals

4.4.1 Spurious Emissions Requirements

FCC Part 2.1051

The radio frequency voltage or powers 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.

FCC Part 2.1057 - Frequency Spectrum to be investigated

(a) In all of the measurements set forth in Sec. 2.1051, 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 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.

FCC Part 27.53 Limit

(g) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.

(1) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

4.4.2 Test Method

Configure the BTS via the BTS controller to enable the MFRM3 to transmit at the rated power of 43dBm per transmitter in two-Tx configuration and 46dBm in one-Tx configuration in baseband modulation formats QPSK, 16QAM, 64QAM (LTE, 10MHz). Measurements were made on channels at the bottom and top of the AWS band. The following spectrum analyzer settings were used for the measurement of the antenna port (TDPM) spurious emissions:

4.4.2.1 Noise Floor

Table 21 lists the noise floor of the measurement system with no signal present.

Table 21: Spectrum Analyzer Noise Floor Level

Frequency (Band)	Noise Floor Level (dBm)
9 kHz to lower adjacent 1MHz (2109MHz)	-32.3
Lower adjacent 1 MHz (2109 - 2110MHz)	-42.3
Upper adjacent 1 MHz (2155 - 2156MHz)	-43.3
upper adjacent 1MHz to 5 GHz (2156 - 5000MHz)	-33.3
5 GHz to 22 GHz	-23.0

4.4.2.2 Adjacent 1MHz to indicated suband (Upper and Lower)

Table 22: Adjacent 1MHZ: Spectrum Analyzer Settings

Setting	one-Tx configuration (BW 10MHz)	two-Tx configuration (BW 10MHz)
Resolution Bandwidth[a]:	100 kHz	100 kHz
Video Bandwidth (3x RBW)[b]	(10x RBW)	(10x RBW)
Video Average	10 Averages	10 Averages
Span	Set accordingly	Set accordingly
Detector	RMS	RMS
Attenuation[c]	10 dB	10 dB
Ref. Level	40 dBm	40 dBm

Table 22: Adjacent 1MHZ: Spectrum Analyzer Settings

Setting	one-Tx configuration (BW 10MHz)	two-Tx configuration (BW 10MHz)
Ref. Offset	51.6 dB	51.6 dB

a. If the spectrum analyzer cannot be set to the specified RBW the next highest RBW should be used and all measurements corrected to the specified RBW
b. If the spectrum analyzer cannot be set to the specified Video Bandwidth the next highest Video Bandwidth should be used.
c. The lowest value of attenuator should be used to improve measurement accuracy, without overdriving the Spectrum Analyzer.

All spectrum analyzer settings were coupled as per the manufacturers recommendations to improve measurement time, without compromising data.

All other Spurious Emissions up to 22 GHz

Table 23: All other Emissions: Spectrum Analyzer Settings

Setting	one-Tx configuration (BW 10MHz)	two-Tx configuration (BW 10MHz)
Resolution Bandwidth	1 MHz	1 MHz
Video Bandwidth (10x RBW)	10 MHz	10 MHz
Video Average	10 Averages	10 Averages
Span	Set accordingly	Set accordingly
Detector	RMS	RMS
Attenuation[a]	10 dB	10 dB
Ref. Level	Set accordingly	Set accordingly
Ref. Level Offset (Upper Adjacent 1MHz to 5GHz)	51.6 dB	51.6 dB
Ref. Level Offset (5GHz to 22GHz)	65 dB	65 dB

a. The lowest value of attenuator should be used to improve measurement accuracy, without overdriving the Spectrum Analyzer.

The emissions will be investigated up to 22 GHz (the 10^{th} harmonic of the fundamental emission) for all carrier configurations (1, 2, 3) as per FCC Part 27.

4.4.3 Test Setup

The set-up required for the MFRM3 Antenna Port Spurious Emission test is illustrated in Figure 16.

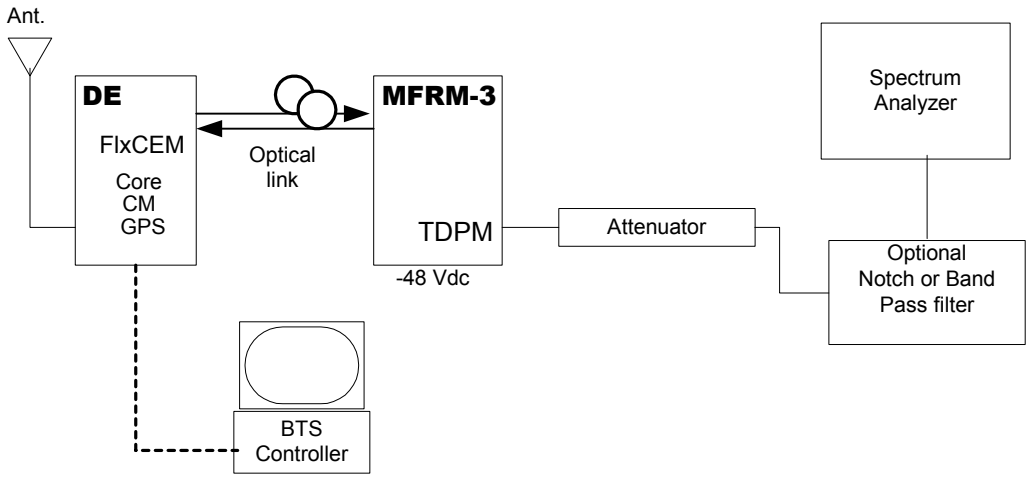


Figure 16 : Test Setup for Spurious Emissions Measurement

4.4.4 Test Results OFDM (LTE 10MHz)

Table 24: Spurious Emissions at LTE AWS MFRM3 Ant. Port: one-Tx configuration, QPSK (LTE 10MHz)

Frequency	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-26.85	13.85
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-26.42	13.42
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-21.83	8.83
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-23.25	10.25
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-22.88	9.88

Table 25: Spurious Emissions at LTE AWS MFRM3 Ant. Port: one-Tx configuration, 16QAM (LTE 10MHz)

Frequency (Band)	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-27.75	14.75
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-27.49	14.49
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-21.52	8.52
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-23.09	10.09
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-21.94	8.94

Table 26: Spurious Emissions at LTE AWS MFRM3 Ant. Port: one-Tx configuration, 64QAM (LTE 10MHz)

Frequency (Band)	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-27.68	14.68
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-27.03	14.03
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-21.21	8.21
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-23.28	10.28
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-22.47	9.47

Table 27: Spurious Emissions at the LTE AWS MFRM3 Ant. Port: two-Tx configuration, QPSK (LTE 10MHz)

Frequency (Band)	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-29.84	16.84
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-30.37	17.37
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-23.15	10.15
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-25.01	12.01
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-22.46	9.46

Table 28: Spurious Emissions at LTE AWS MFRM3 Ant. Port: two-Tx configuration, 16QAM (LTE 10MHz)

Frequency (Band)	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-30.02	17.02
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-29.42	16.42
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-22.58	9.58
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-25.44	12.44
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-22.52	9.52

Table 29: Spurious Emissions at LTE AWS MFRM3 Ant. Port: two-Tx configuration, MIMO, 64QAM (LTE 10MHz)

Frequency (Band)	Spurious Emissions Level (dBm)	Margin to FCC Limit of -13 dBm (dB)
2109 to 2110 MHz (RBW=100 kHz); Transmitting on Channel 100	-30.69	17.69
2155 to 2156 MHz (RBW=100 kHz); Transmitting on Channel 800	-30.68	17.68
9 kHz to 2109 MHz (RBW=1 MHz); Transmitting on Channel 100	-21.84	8.84
2156 MHz to 5 GHz (RBW=1 MHz); Transmitting on Channel 800	-25.43	12.43
5 GHz to 22 GHz (RBW=1 MHz); Transmitting on Channel 800	-22.64	9.64

4.5 Frequency Stability (CDMA)

4.5.1 Frequency Stability Requirements

FCC Part 2.1055

(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 subparagraphs (2) and (3) of this paragraph.

(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.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

FCC Part 27.54 Limit

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

4.5.2 Test Procedure

The test equipment was configured as shown in figure 17.

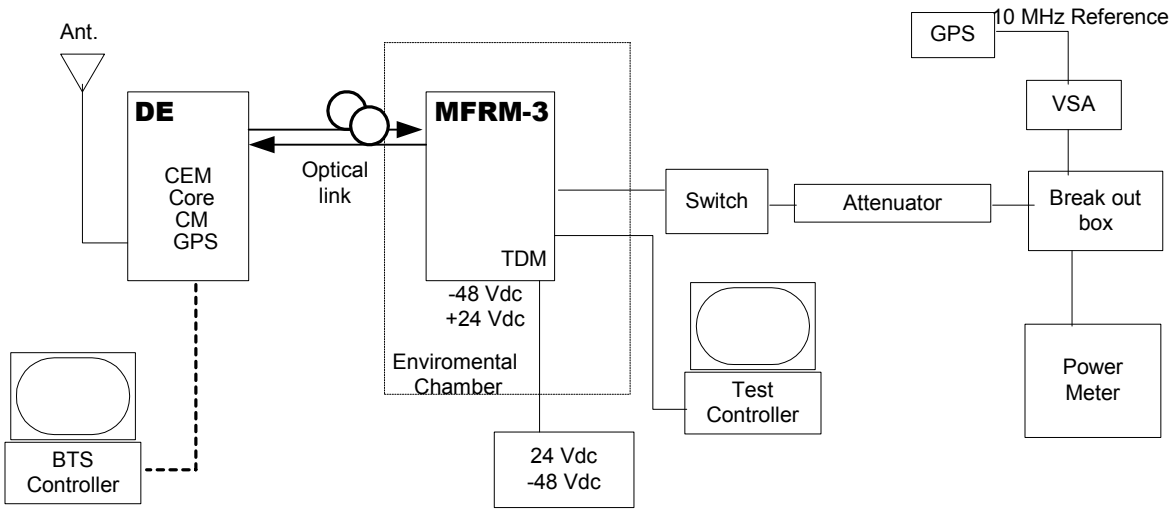


Figure 17 : Test configuration for Frequency Stability

4.5.3 Frequency Results

The test results for Frequency stability provided in this section were measured with the BTS configured in CDMA IS-95 mode with MFRM-3 transmitting on AWS channels 425, 450, 475. The BTS was configured to transmit at maximum transmit power. The frequency stability is dependent on GPS timing source and entirely independent of the type of modulation used. Since the same GPS timing modules were used for LTE signal type testing as for the CDMA type signals the frequency stability data obtained for CDMA type signals is valid for LTE type signals as well. The LTE AWS MFRM-3 radio module uses the same reference timing mechanisms as CDMA AWS MFRM-3.

Table 30: Test results for Frequency Stability versus Power supply Voltage

Voltage (Vdc)	Maximum Carrier Frequency Deviation (PPM)	Maximum Carrier Frequency Deviation (Hz)
-40	0.00142	3.019
-48 nominal	0.00121	2.557
-56	0.00170	3.623
20	0.00170	3.619
24 nominal	0.00135	2.885
28	0.00137	2.930

Table 31: Test results for Frequency Stability versus Temperature at -48V operation

Temperature (ºC)	Maximum Carrier Frequency Deviation (PPM)	Maximum Carrier Frequency Deviation (Hz)
-40	0.00162	3.452
-30	0.00391	8.337
-20	0.00212	4.524
-10	0.00231	4.926
0	0.00150	3.205
10	0.00147	3.172
20	0.00108	2.302
30	0.00152	3.234
40	0.00095	2.022
50	0.00118	2.518

Table 32: Test results for Frequency Stability versus Temperature at 24V operation

Temperature (ºC)	Maximum Carrier Frequency Deviation (PPM)	Maximum Carrier Frequency Deviation (Hz)
-40	0.00234	4.991
-30	0.00202	4.297
-20	0.00191	4.066
-10	0.00173	3.693
0	0.00120	2.567
10	0.00149	3.185
20	0.00130	2.781
30	0.00194	4.139
40	0.00161	3.431
50	0.00154	3.289

References

[1] FCC Part 27 Subpart C, “Miscellaneous Wireless Communications Services”, http://www.access.gpo.gov/nara/cfr/waisidx_06/47cfr27_06.html

[2] FCC Part 2 Subpart J, “Frequency allocations and radio treaty matters; general rules and regulations”, http://www.access.gpo.gov/nara/cfr/waisidx_01/47cfr2_01.html

[3] TIA/EIA-97-E “Recommended Minimum Performance Standards for Base Stations Supporting Dual Mode Spread Spectrum Systems”,

[4] Industry Canada “Information on the 99% Bandwidth measurement” Author Brain Kasper. http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/vwapj/occupied-bandwidth.pdf/$FILE/occupied-bandwidth.pdf

[5] MFRM-3 AWS (2.1GHz) Power Amplifier (PA) Assembly Verification Notice, Dataset Name: VPGZ74EA; Document Status: Draft; Stream: 00 Issue: 01; Document Prime: Philip Khoury

[6] 3GPP TS 36.104 V8.0.0 (2007-12); http://www.3gpp.org/ftp/Specs/html-info/36104.htm

[7] 3GPP TR 36.804 V1.0.0 (2007-11); http://www.3gpp.org/ftp/Specs/html-info/36804.htm

APPENDIX PLOTS

Figure 18 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, QPSK (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

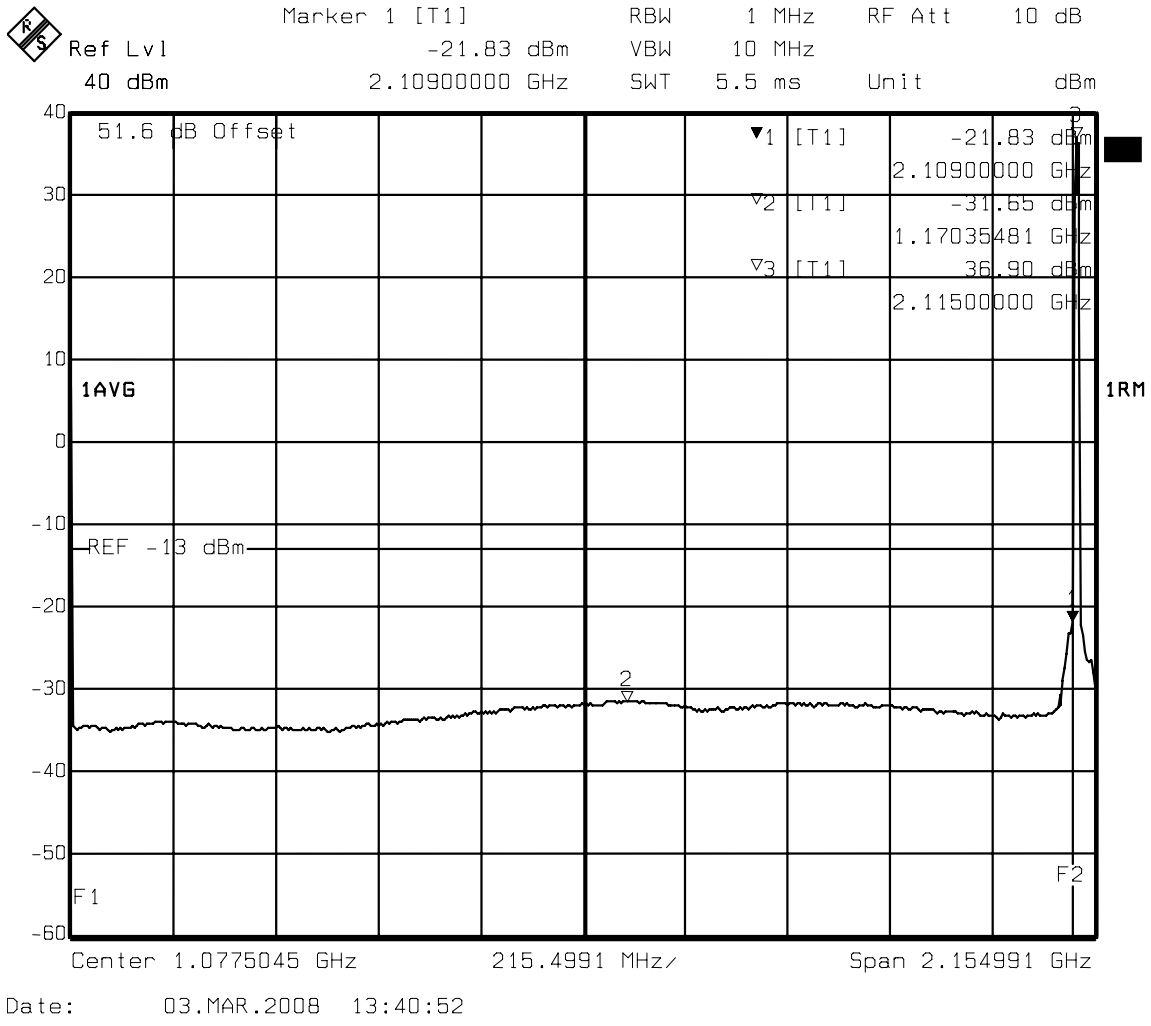
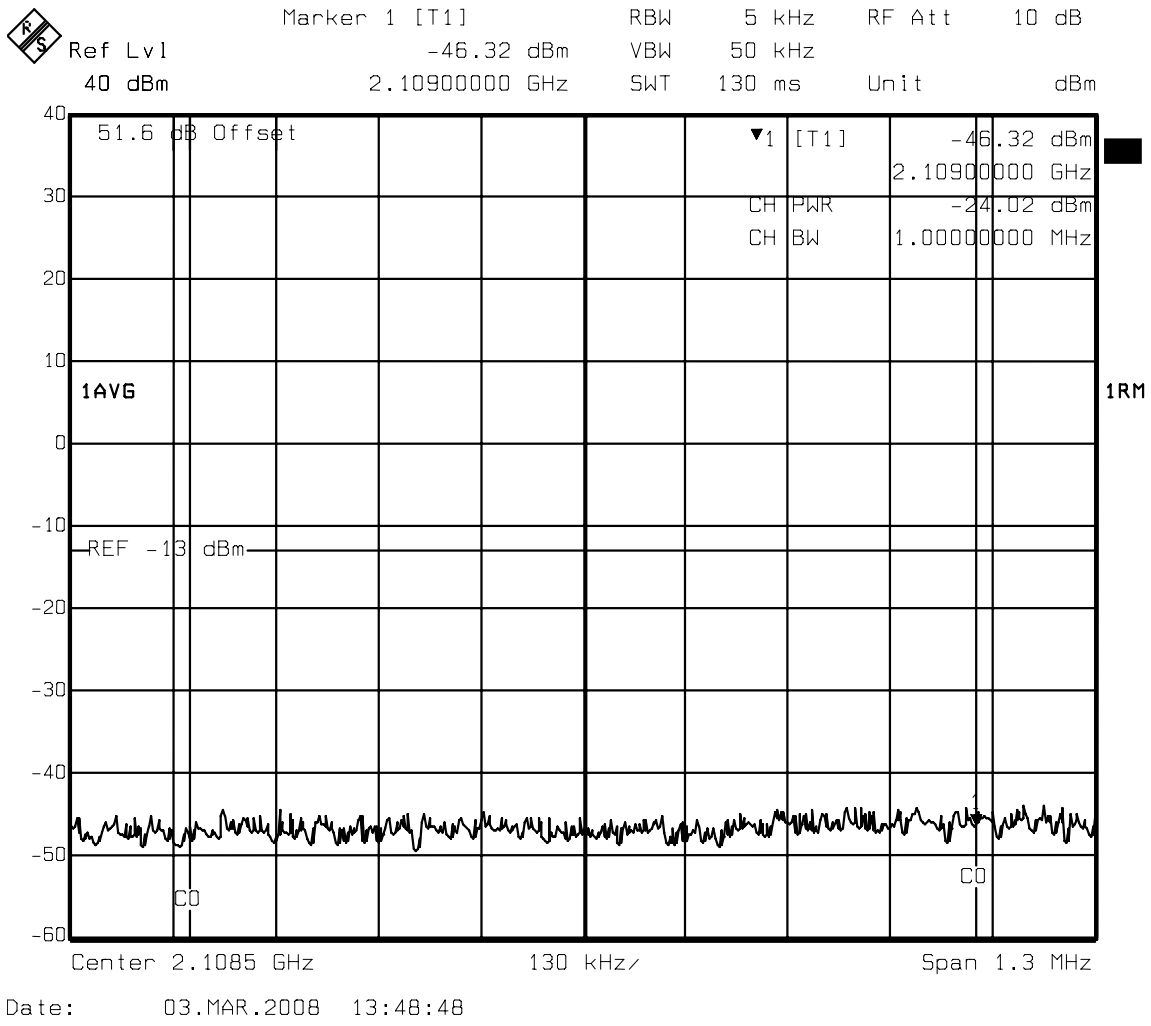


Figure 19 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, QPSK (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 20 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, QPSK (LTE 10MHz), (Lower Adjacent 1MHz)

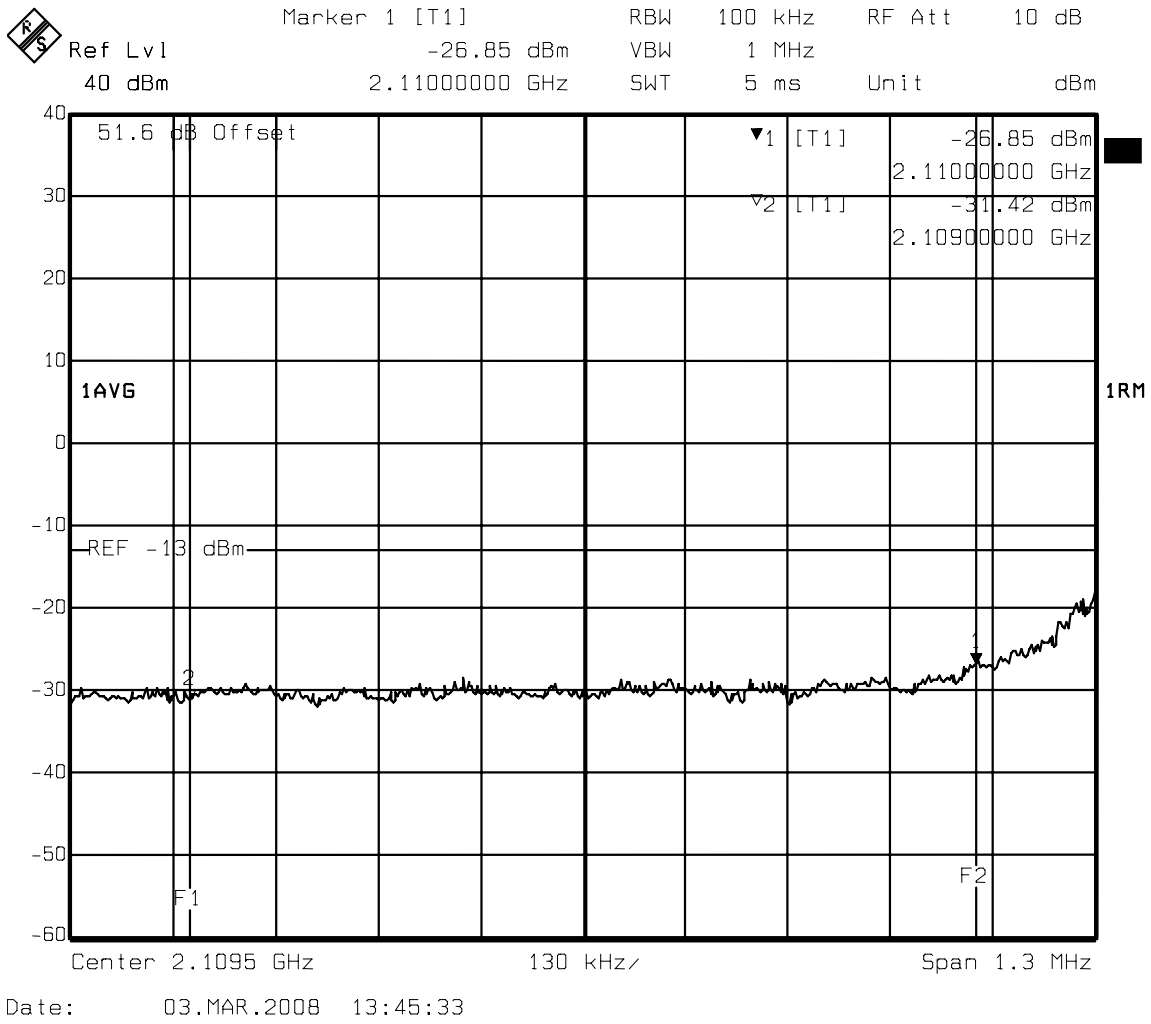


Figure 21 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz)

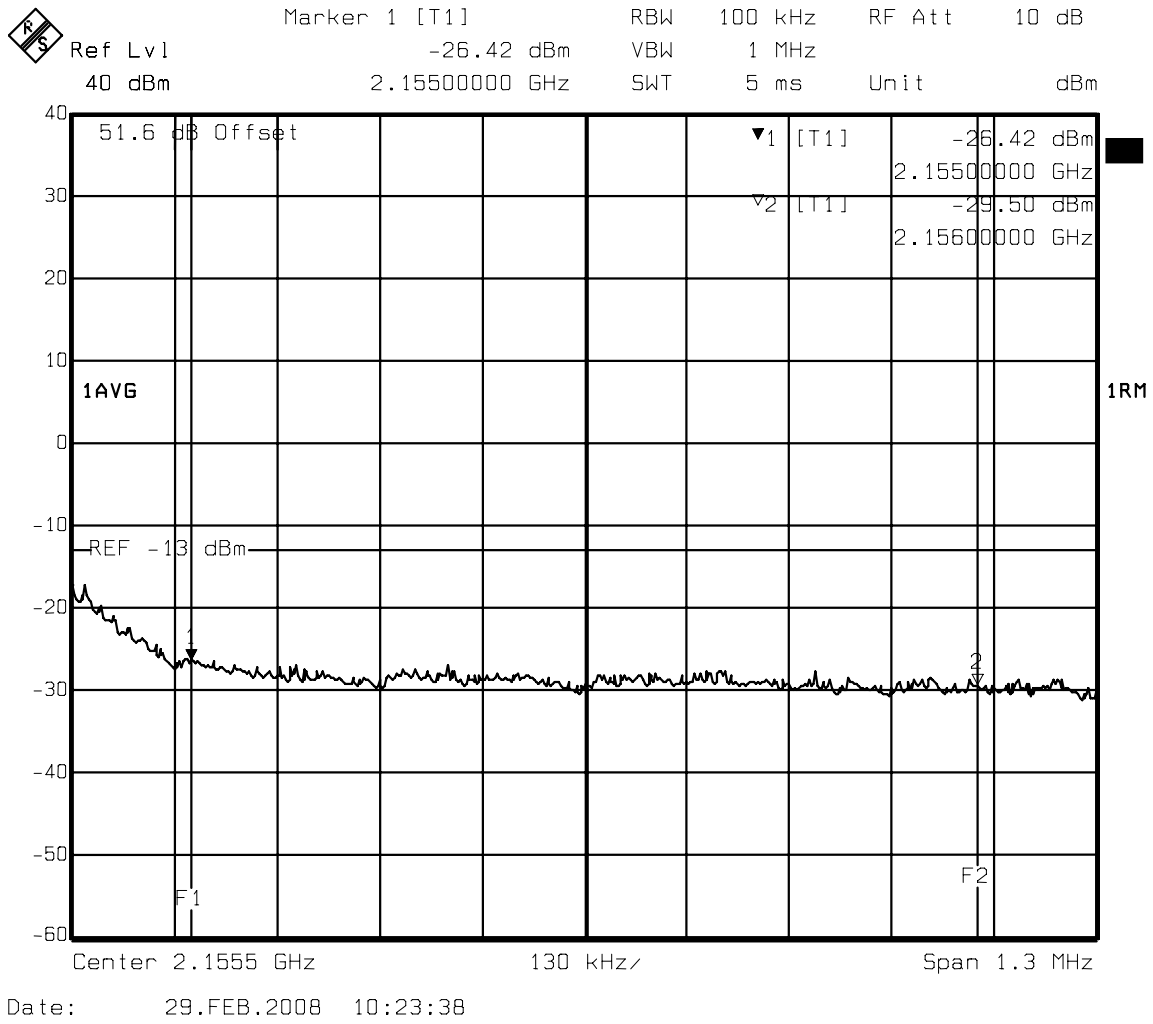


Figure 22 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

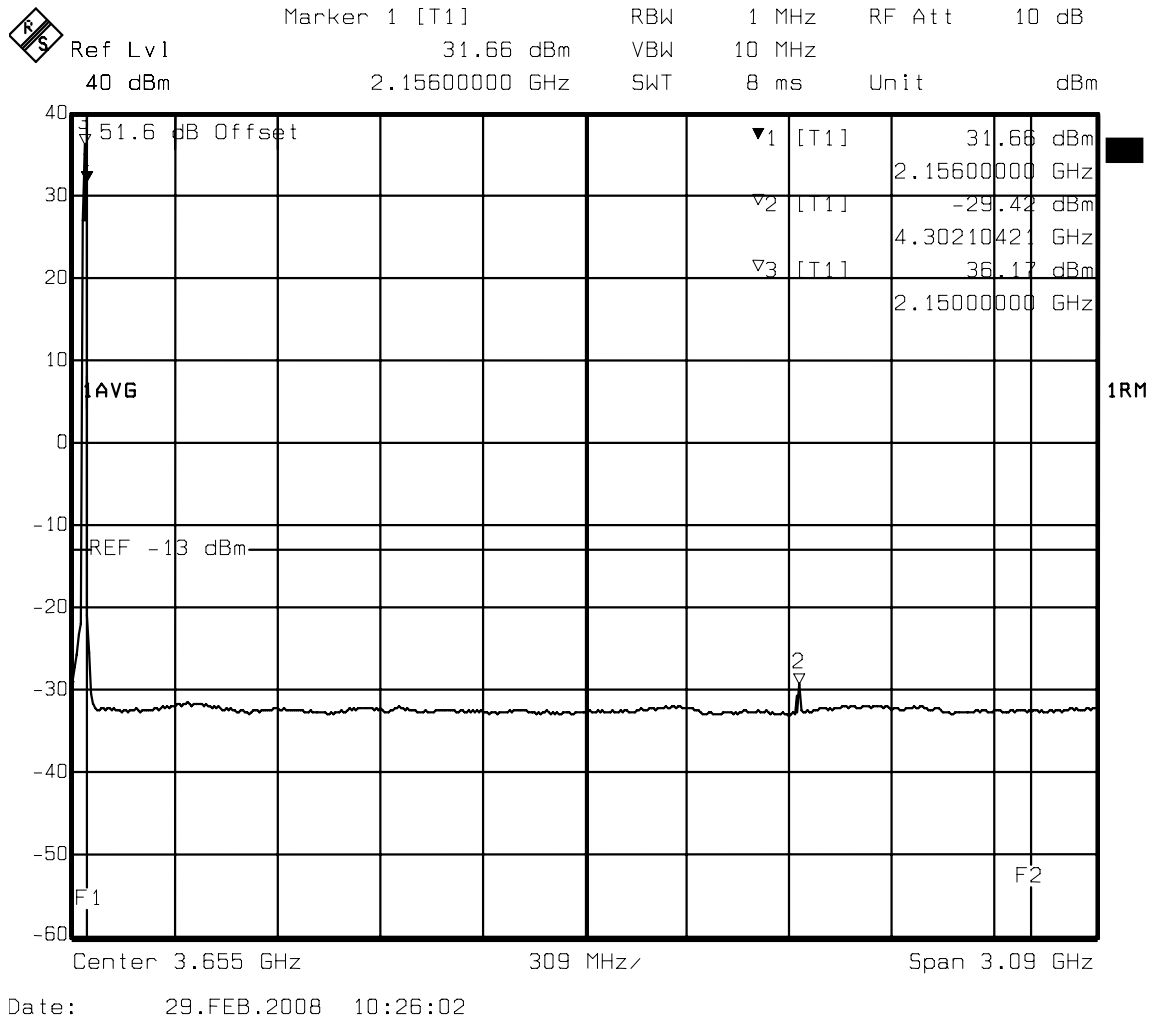
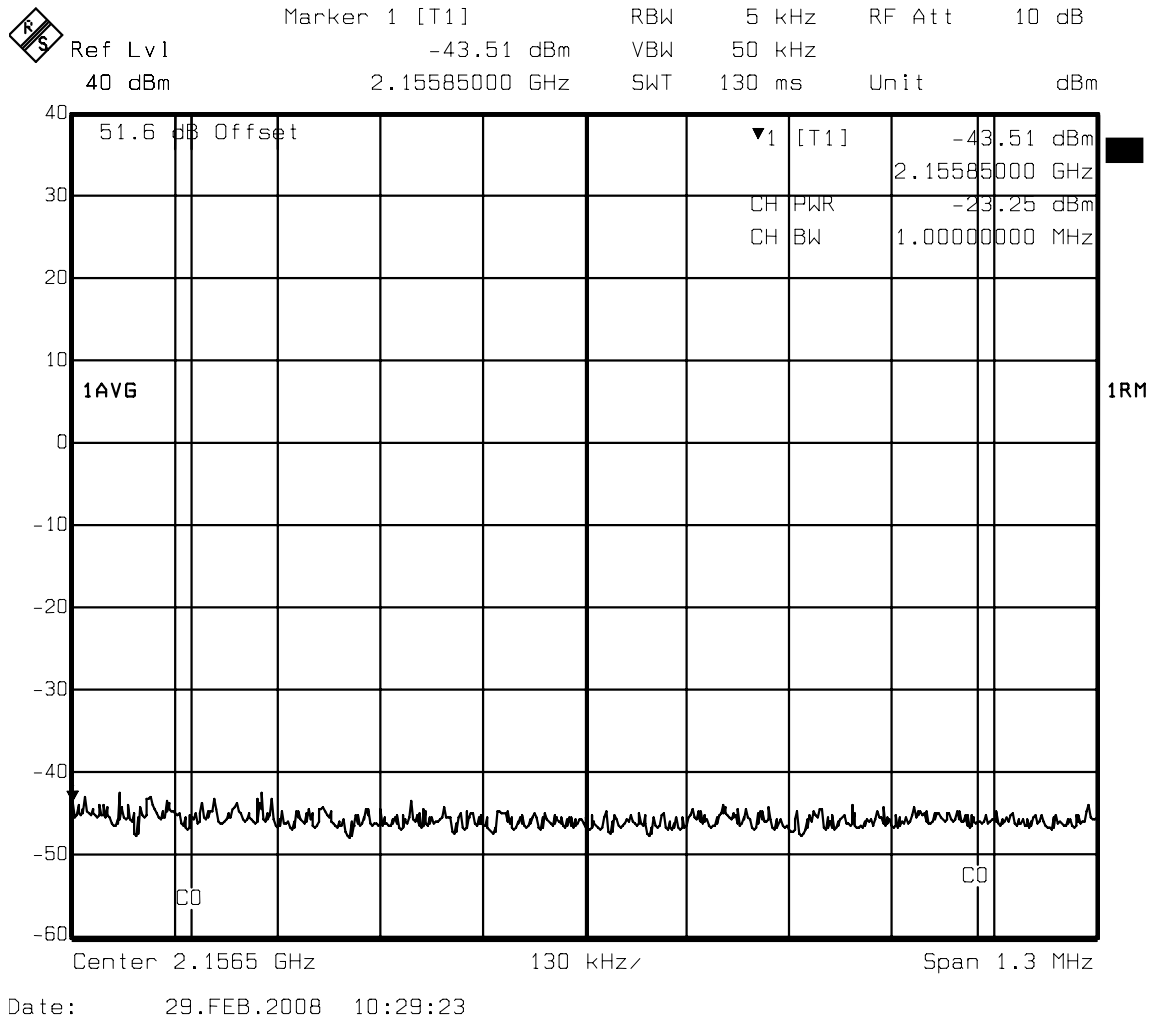


Figure 23 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 24 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, QPSK (LTE 10MHz), (5GHz to 22GHz)

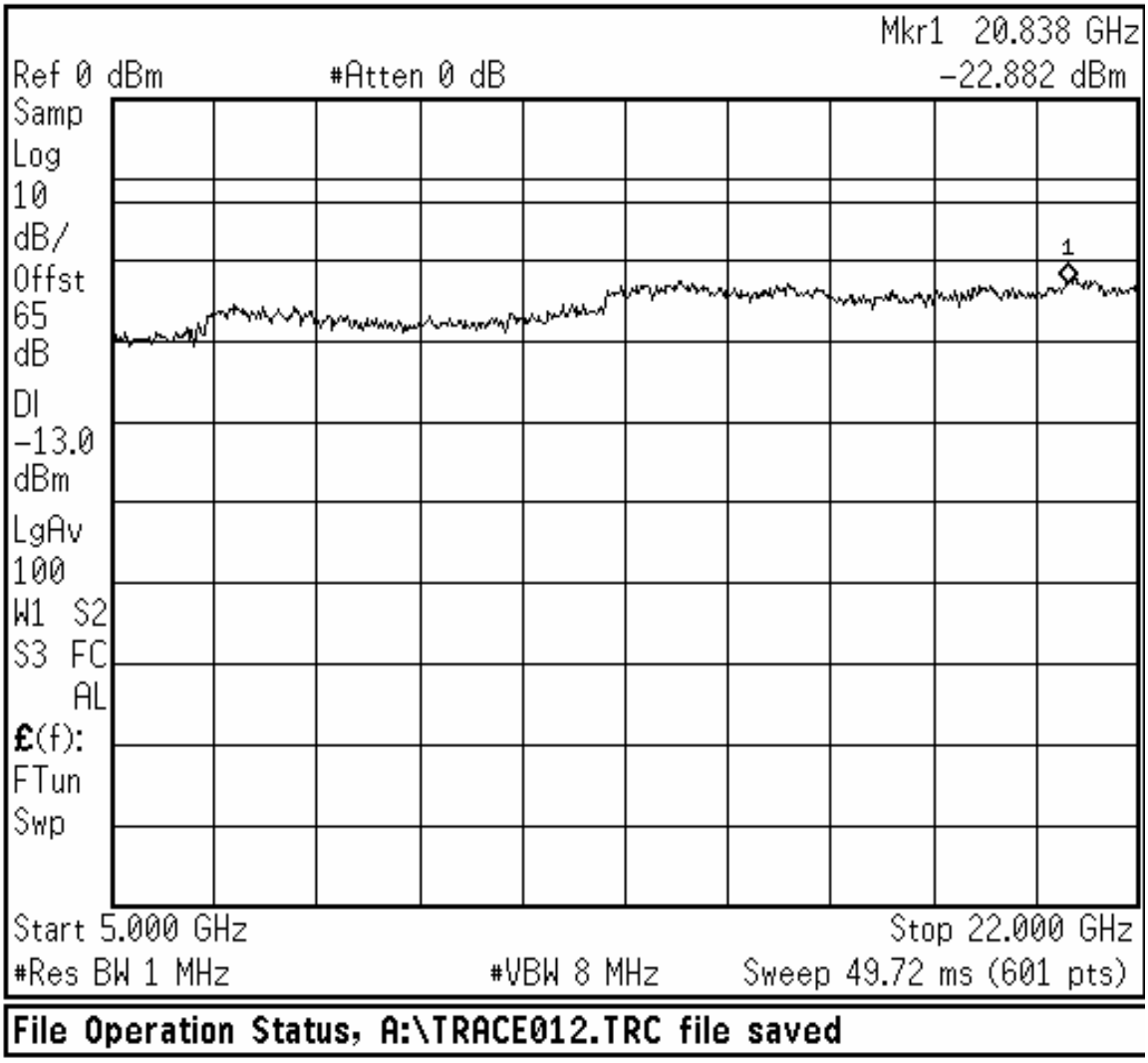


Figure 25 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

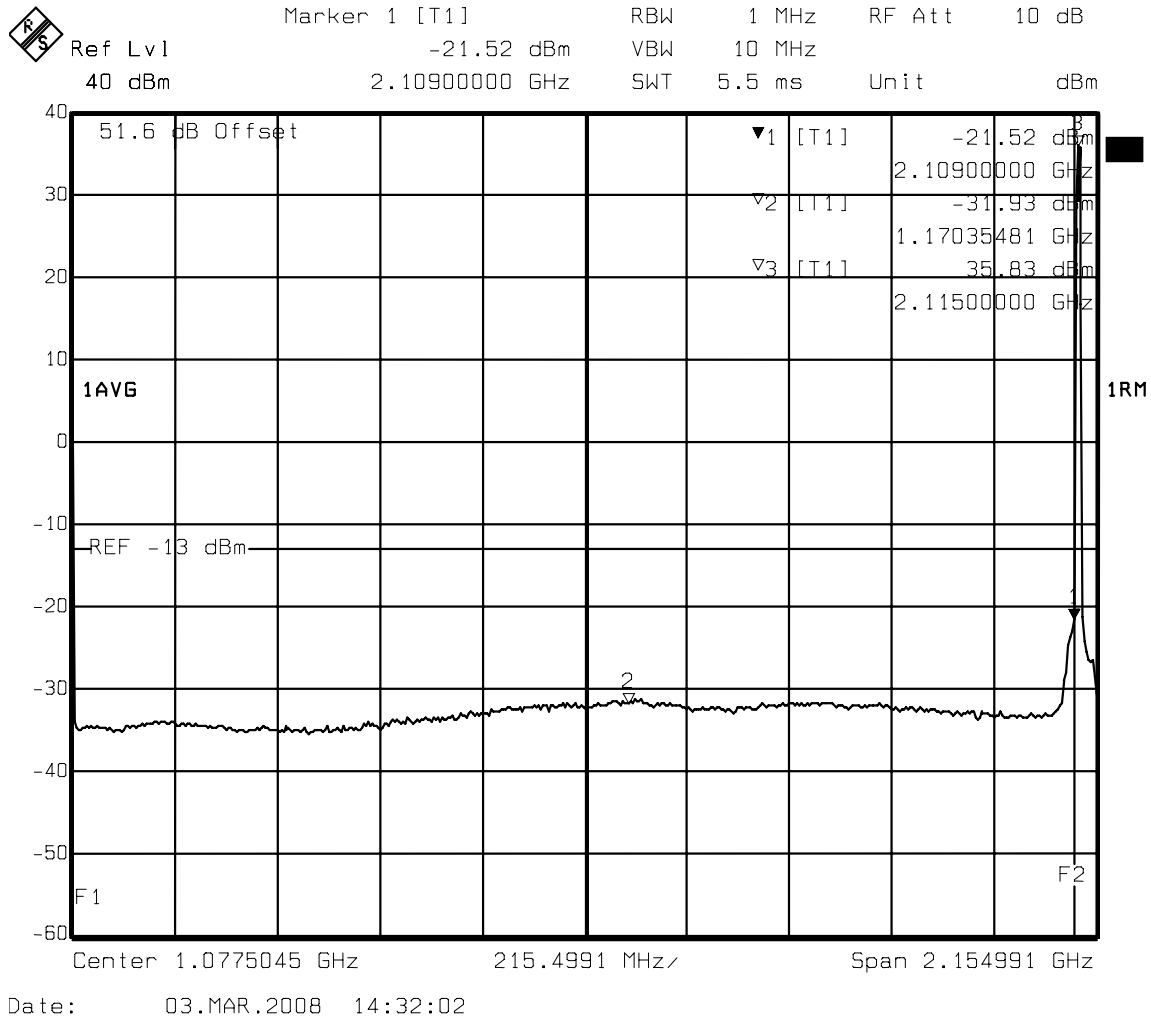
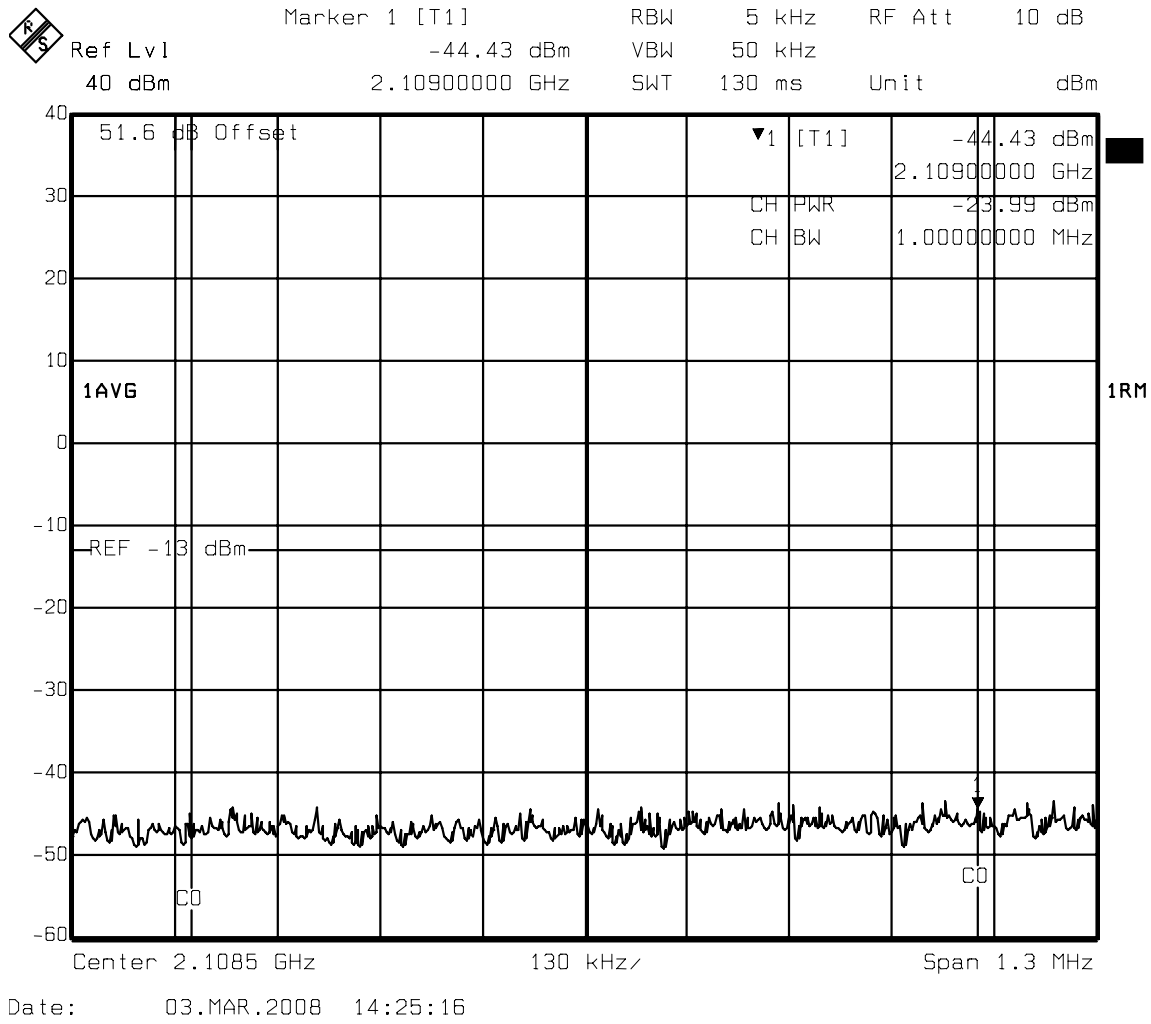


Figure 26 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 27 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (Lower Adjacent 1MHz)

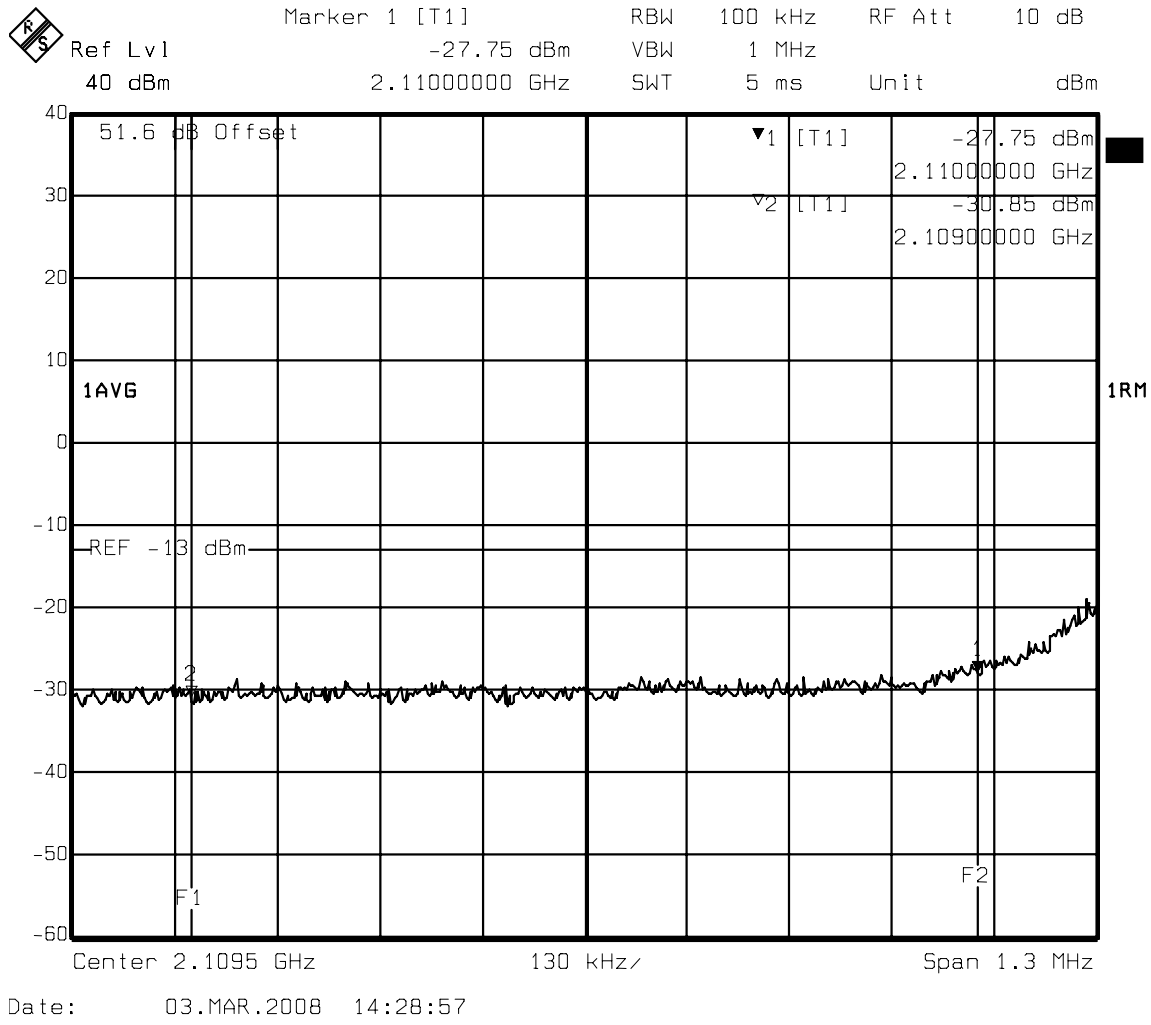


Figure 28 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz)

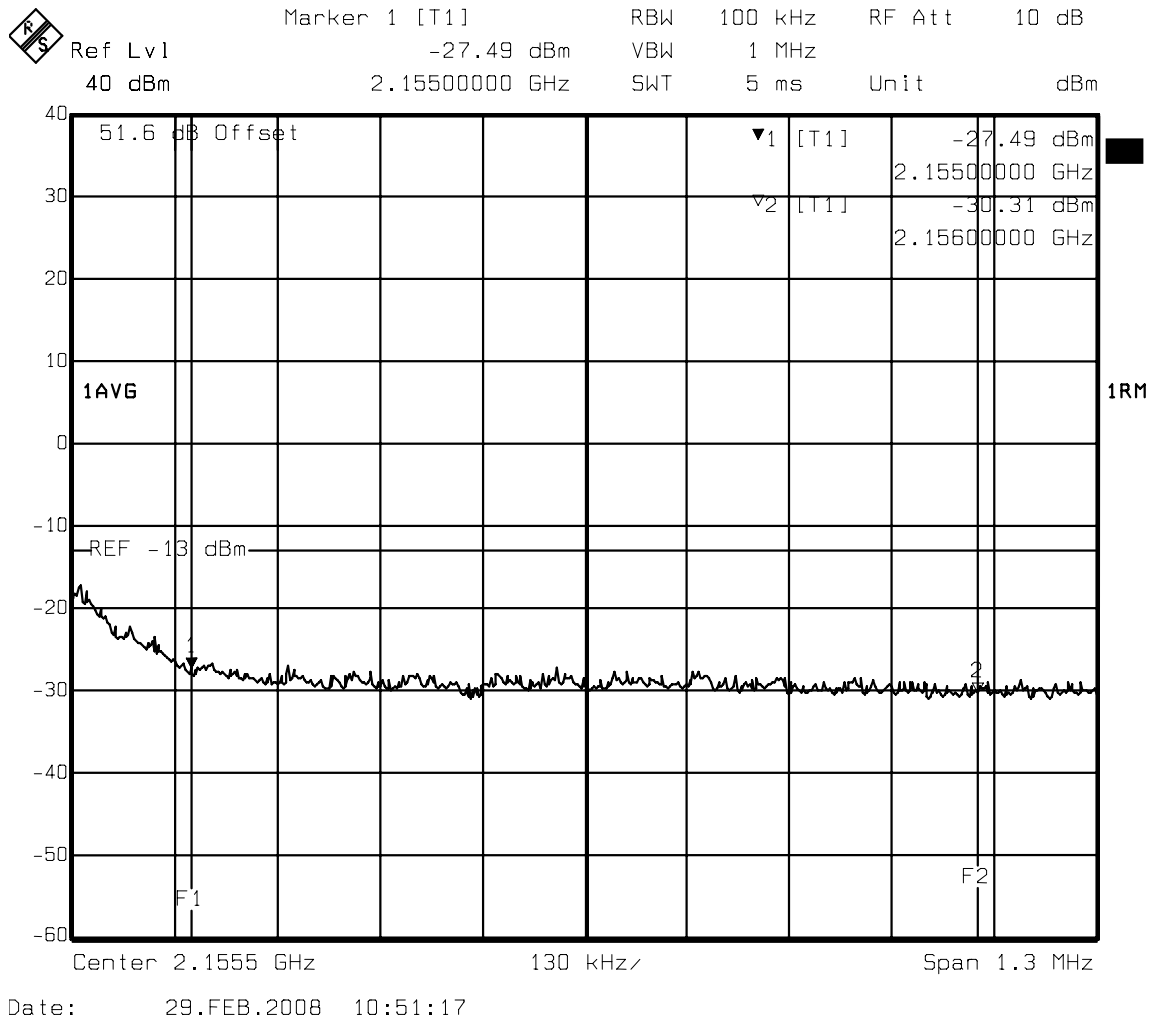


Figure 29 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

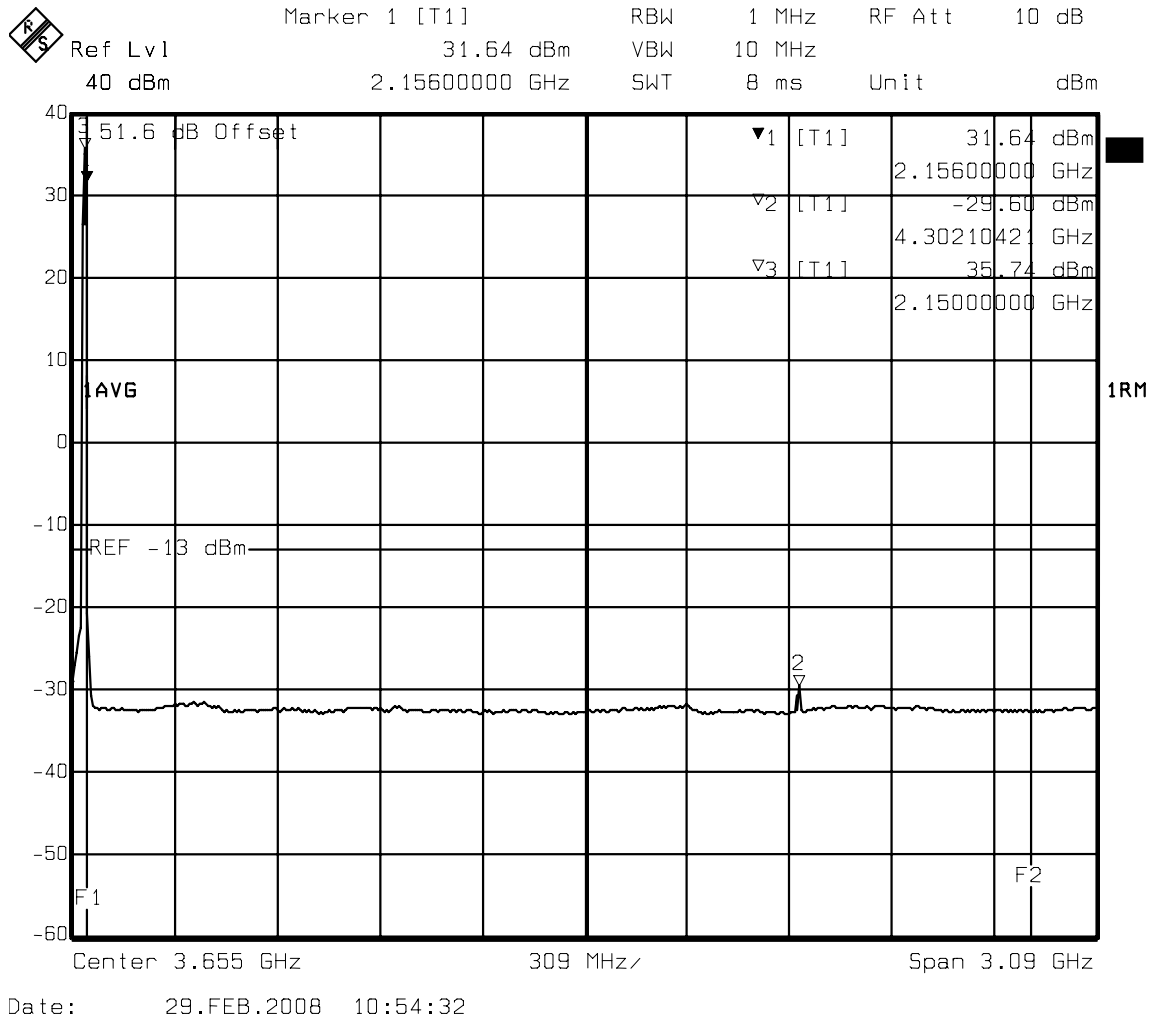
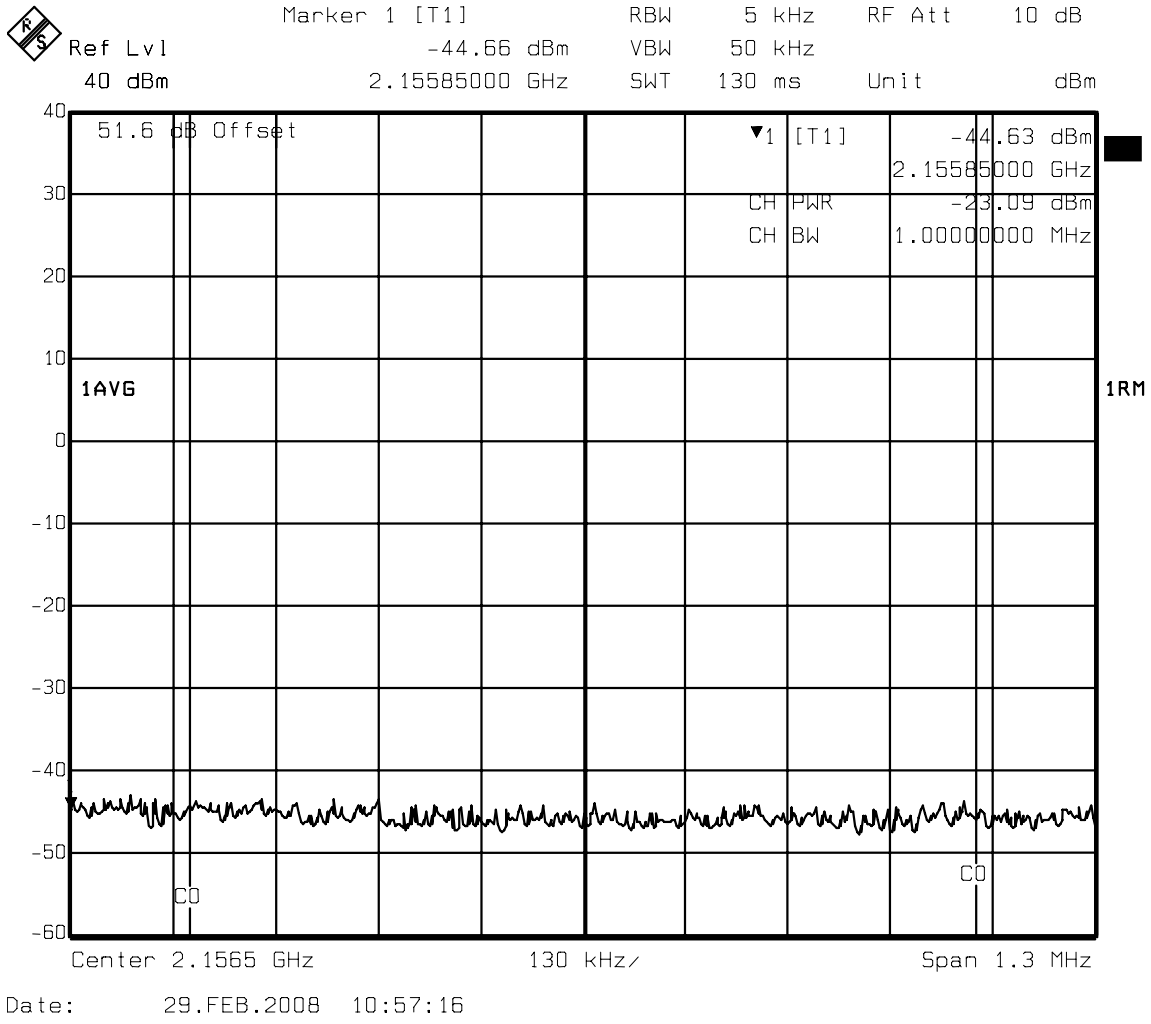


Figure 30 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 31 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (5GHz to 22GHz)

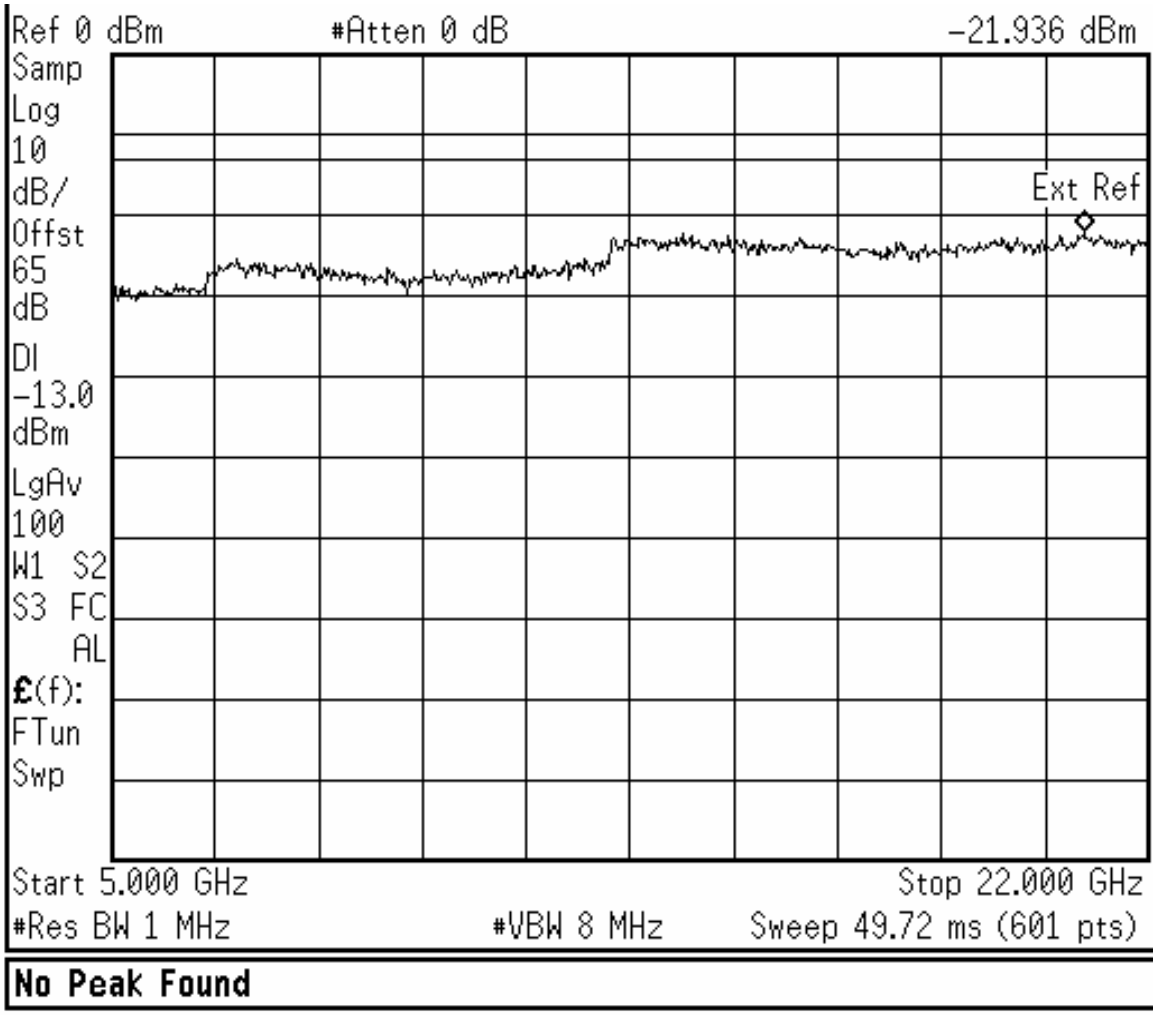


Figure 32 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

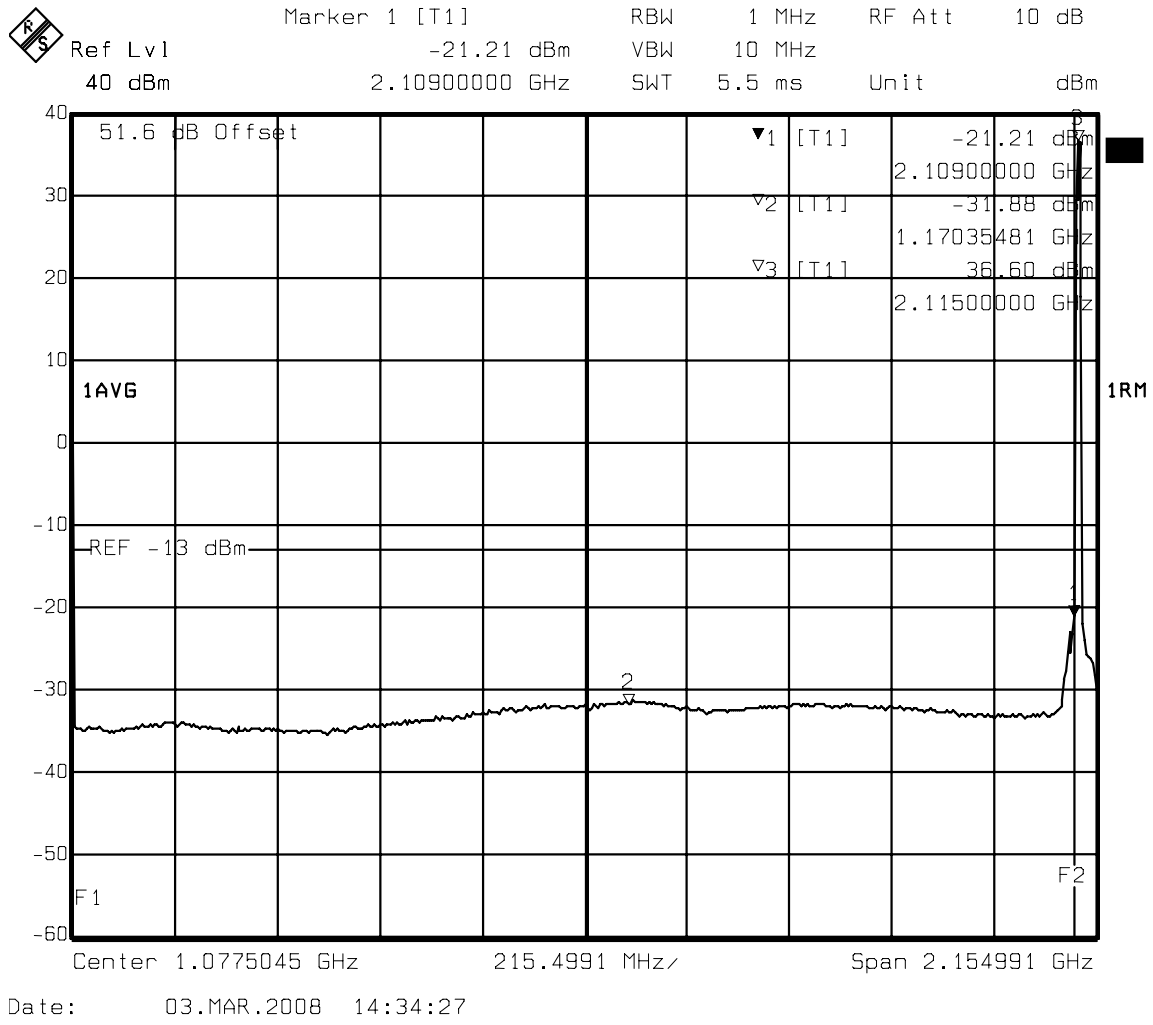
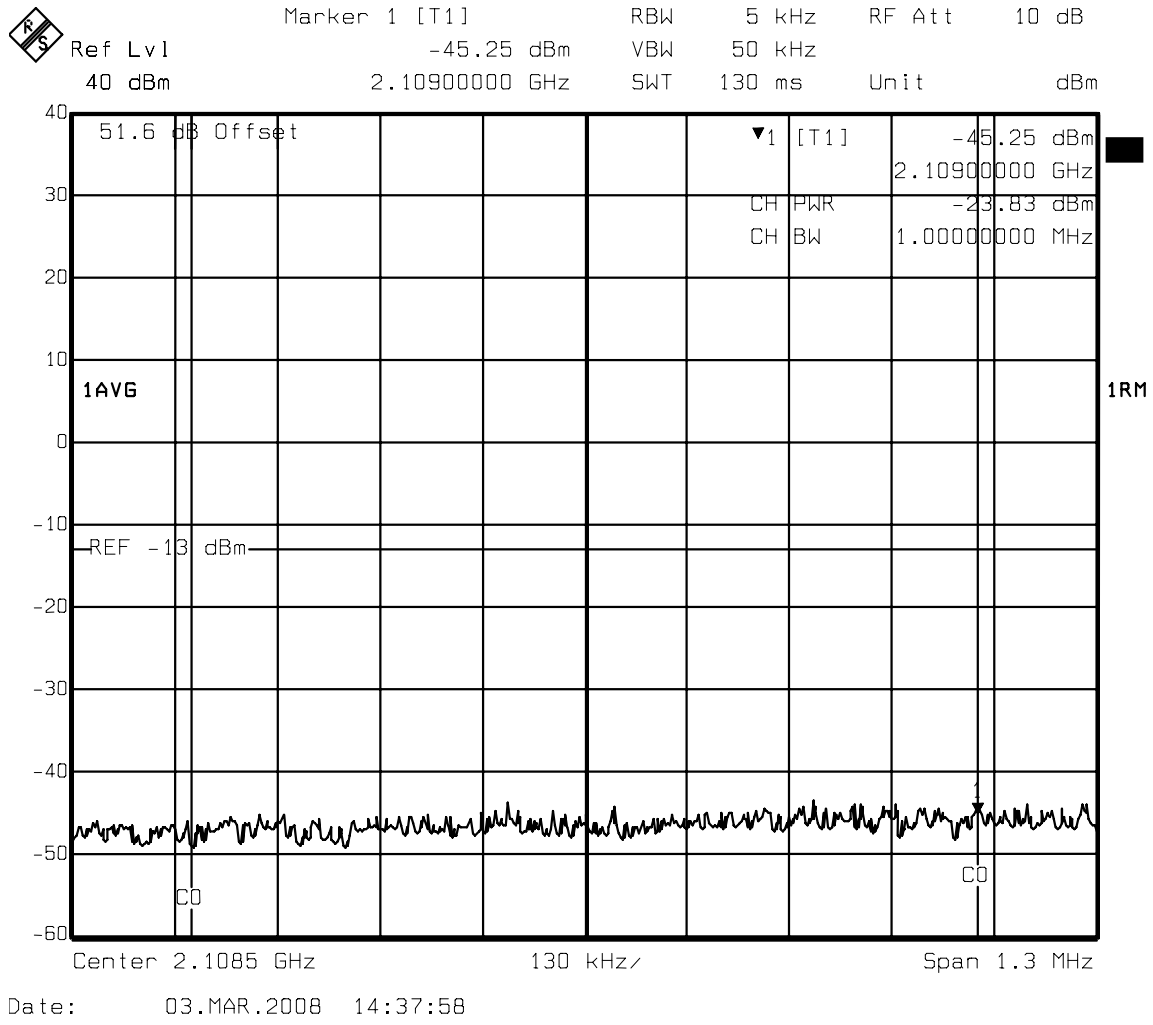


Figure 33 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 34 : Conducted Spurious Emissions - one-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (Lower Adjacent 1MHz)

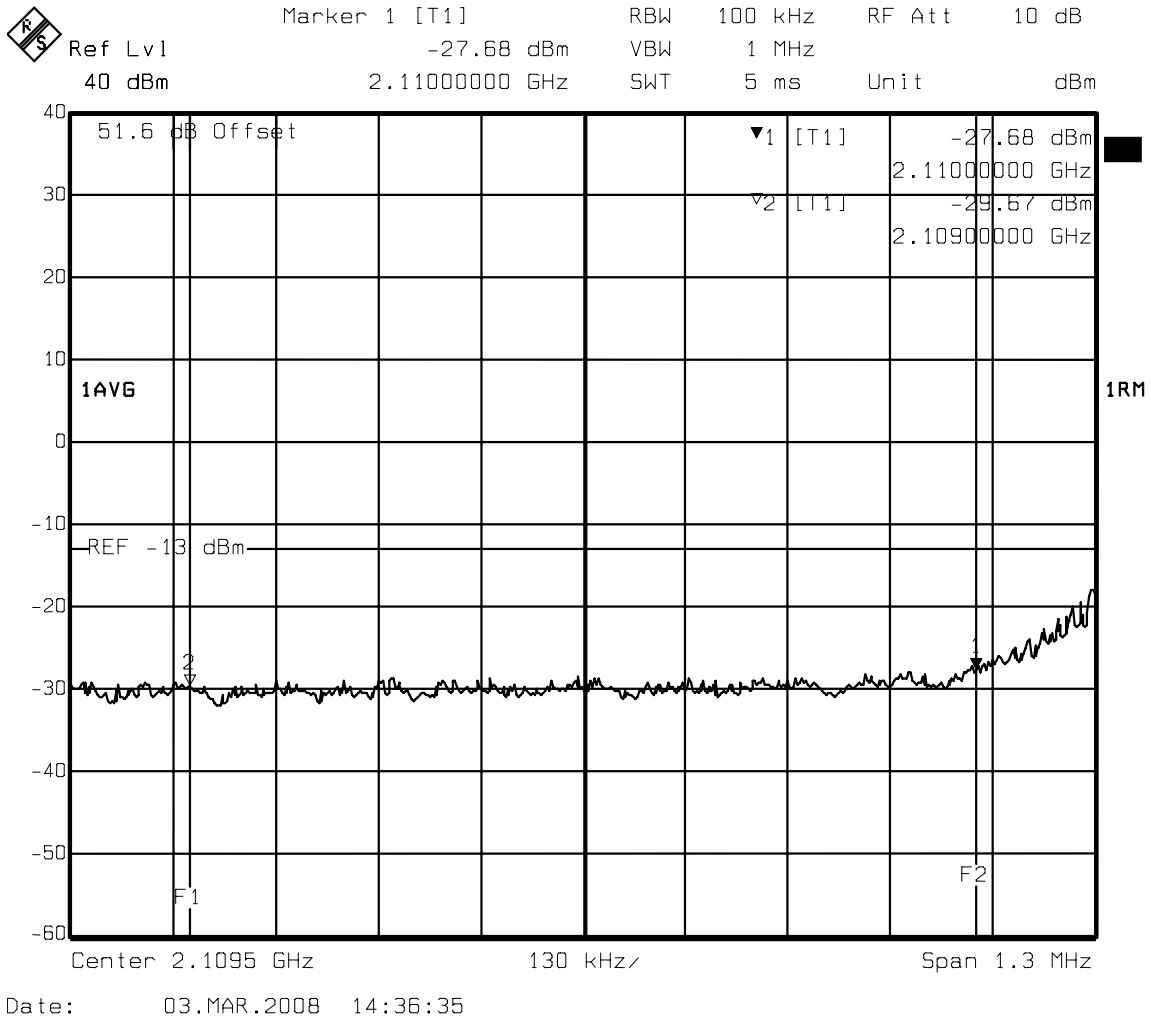


Figure 35 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz)

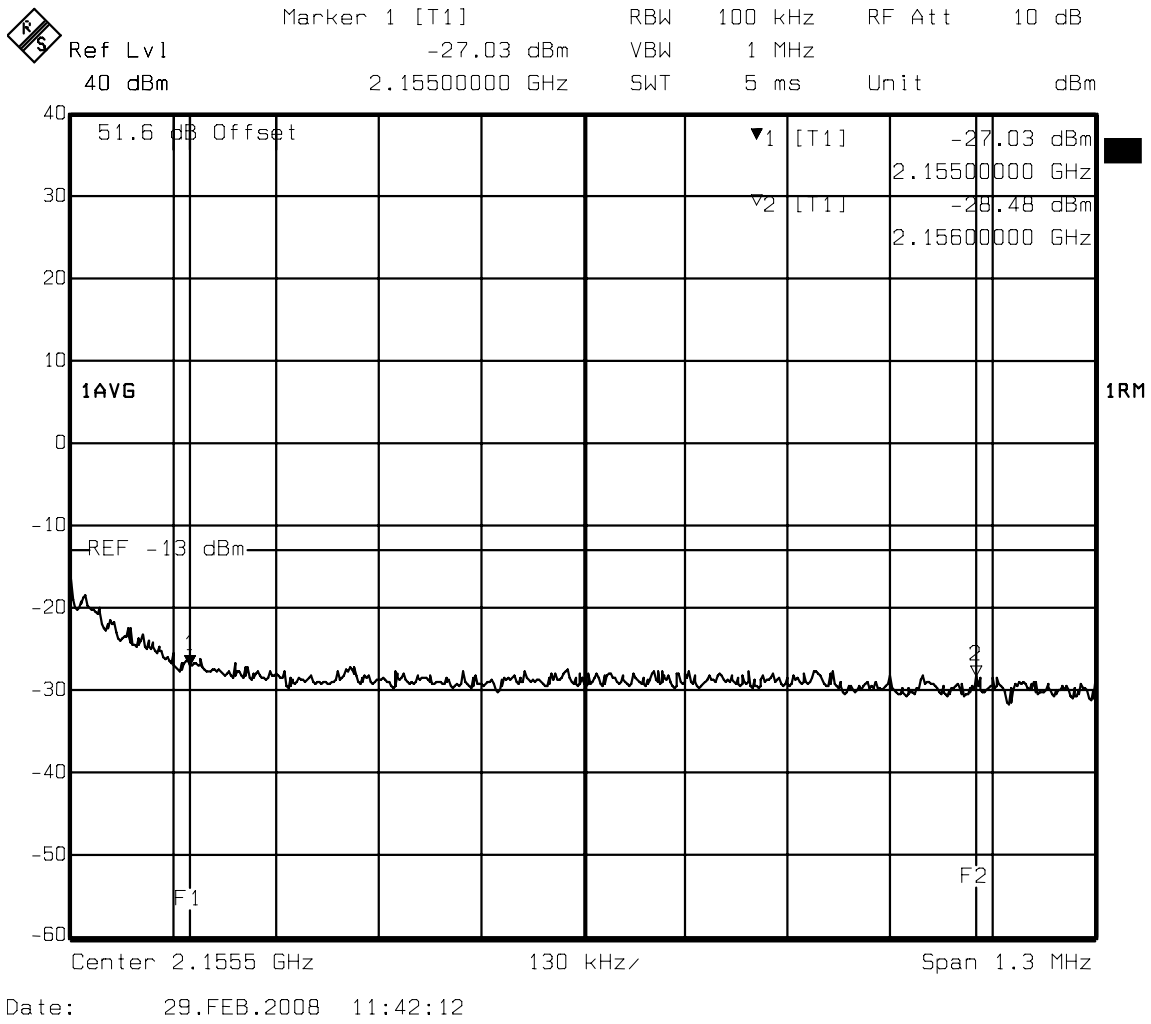


Figure 36 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

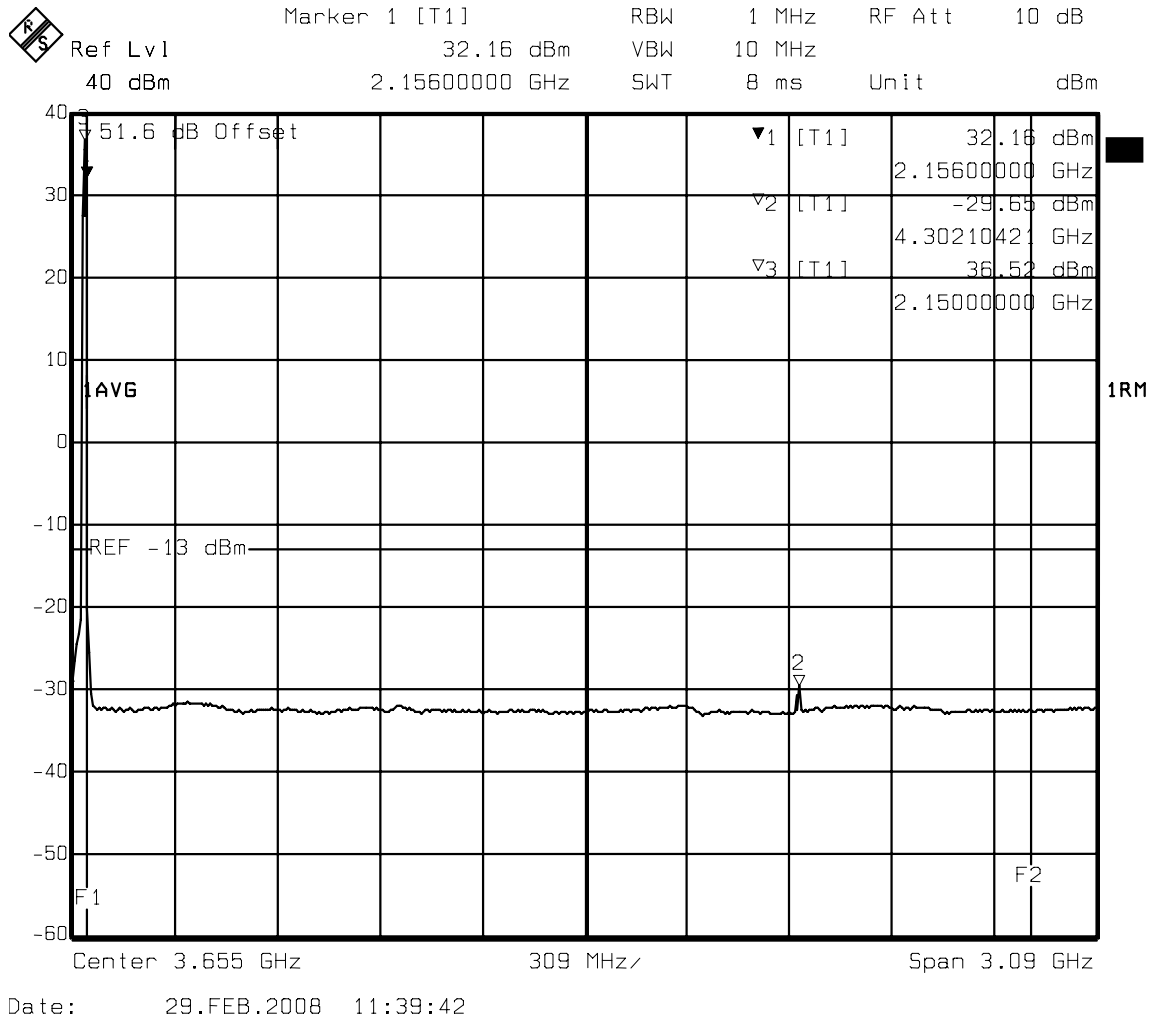
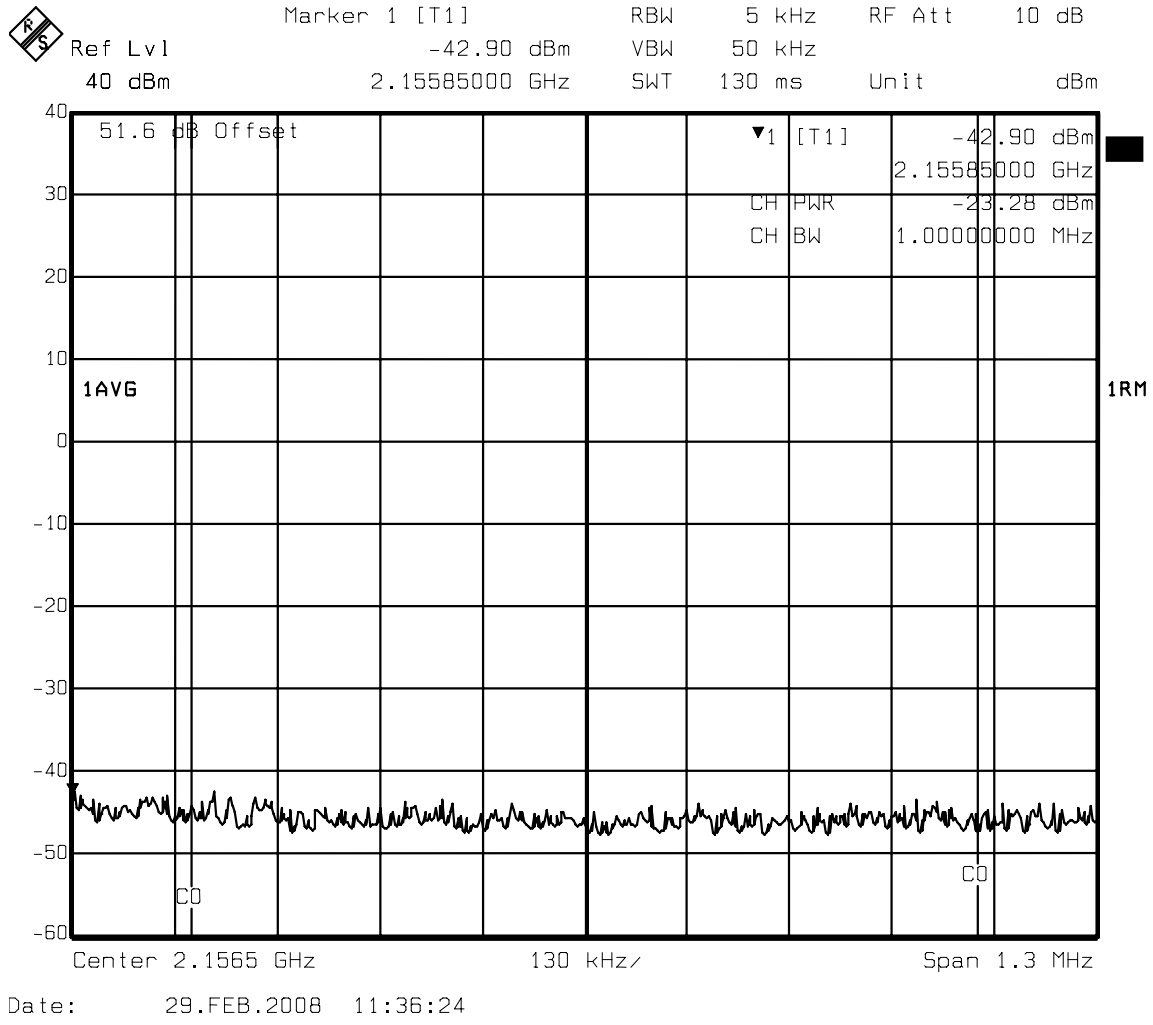


Figure 37 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 38 : Conducted Spurious Emissions - one-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (5GHz to 22GHz)

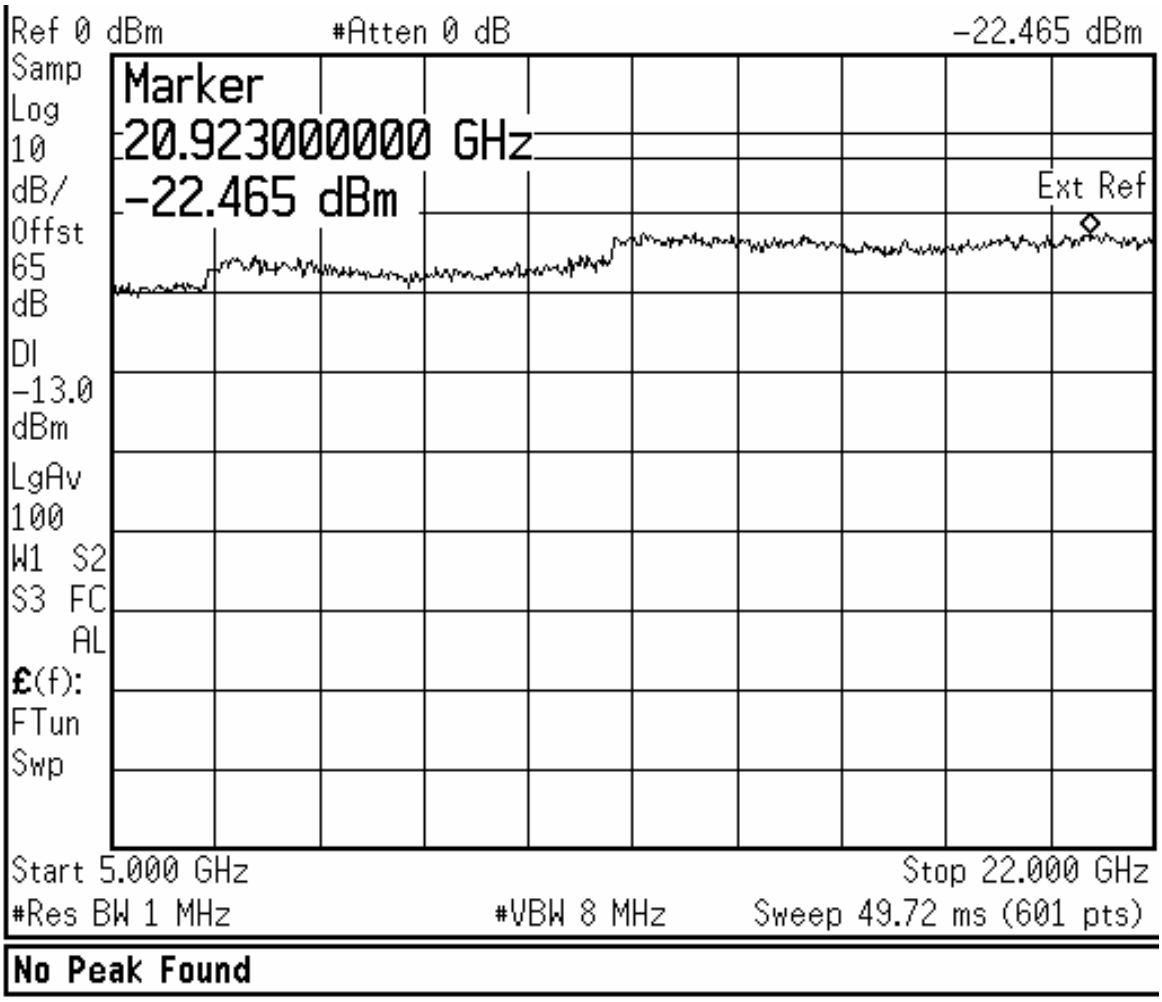


Figure 39 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, QPSK (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

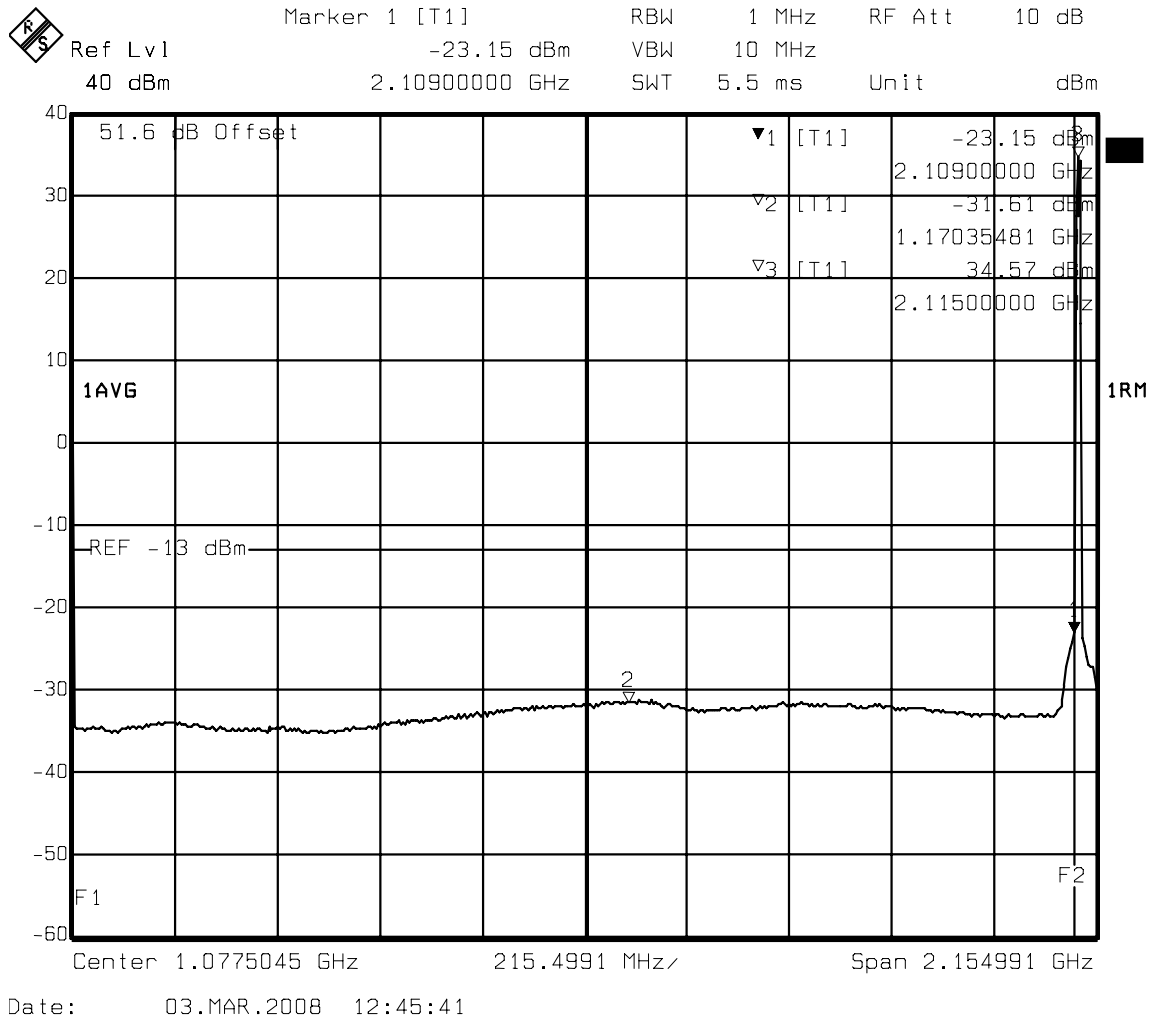
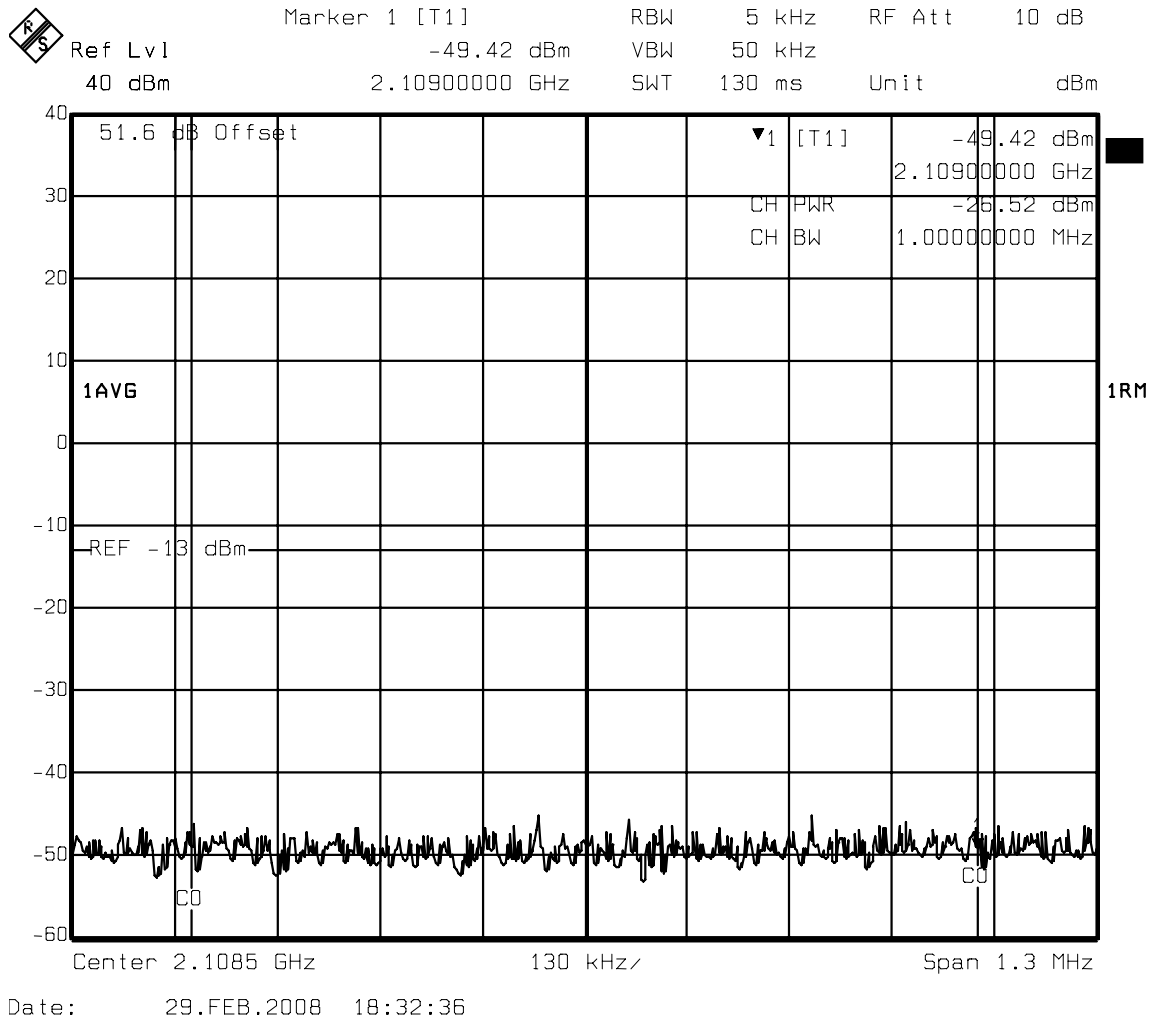


Figure 40 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, QPSK (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 41 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, QPSK (LTE 10MHz), (Lower Adjacent 1MHz)

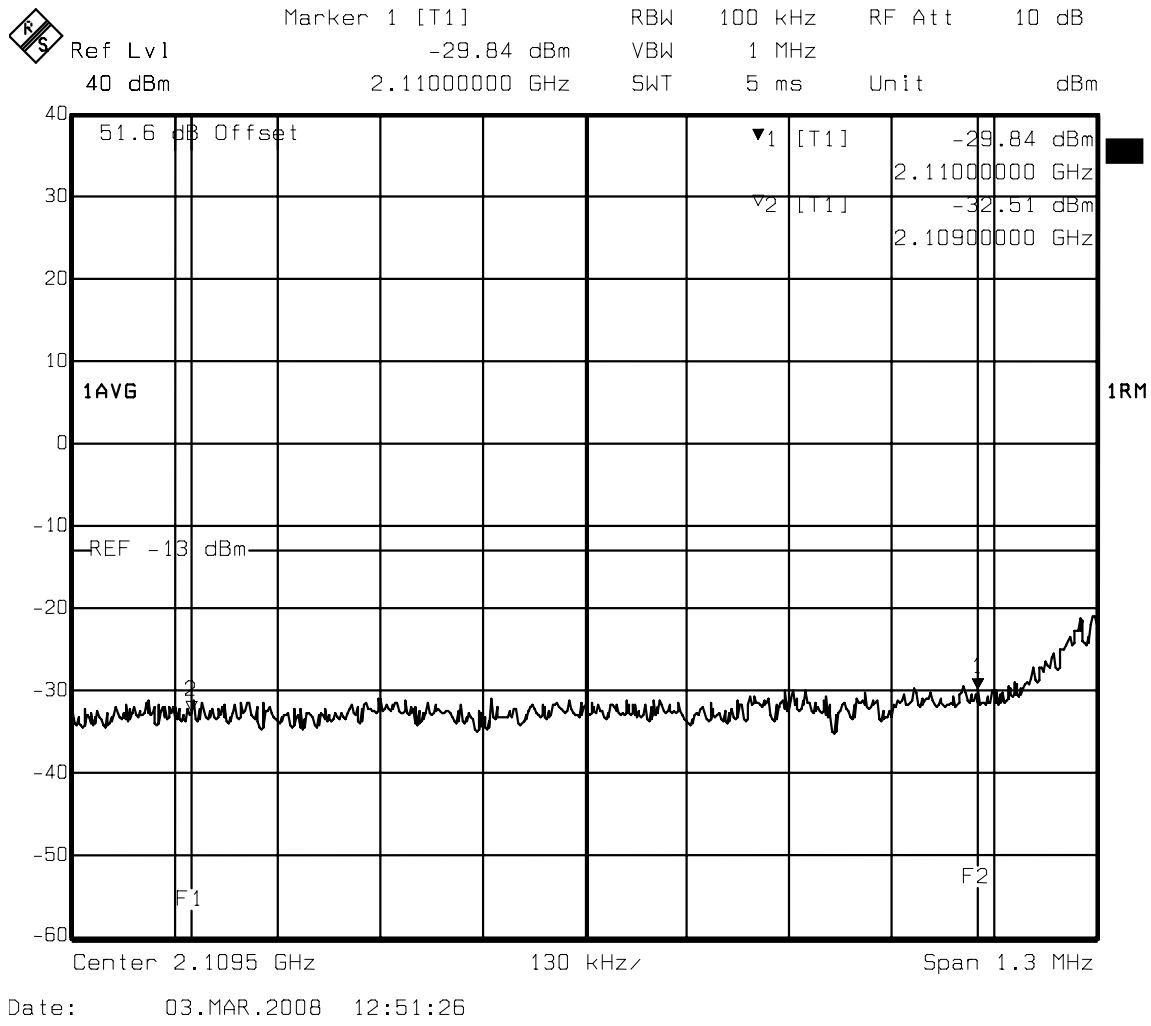


Figure 42 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz)

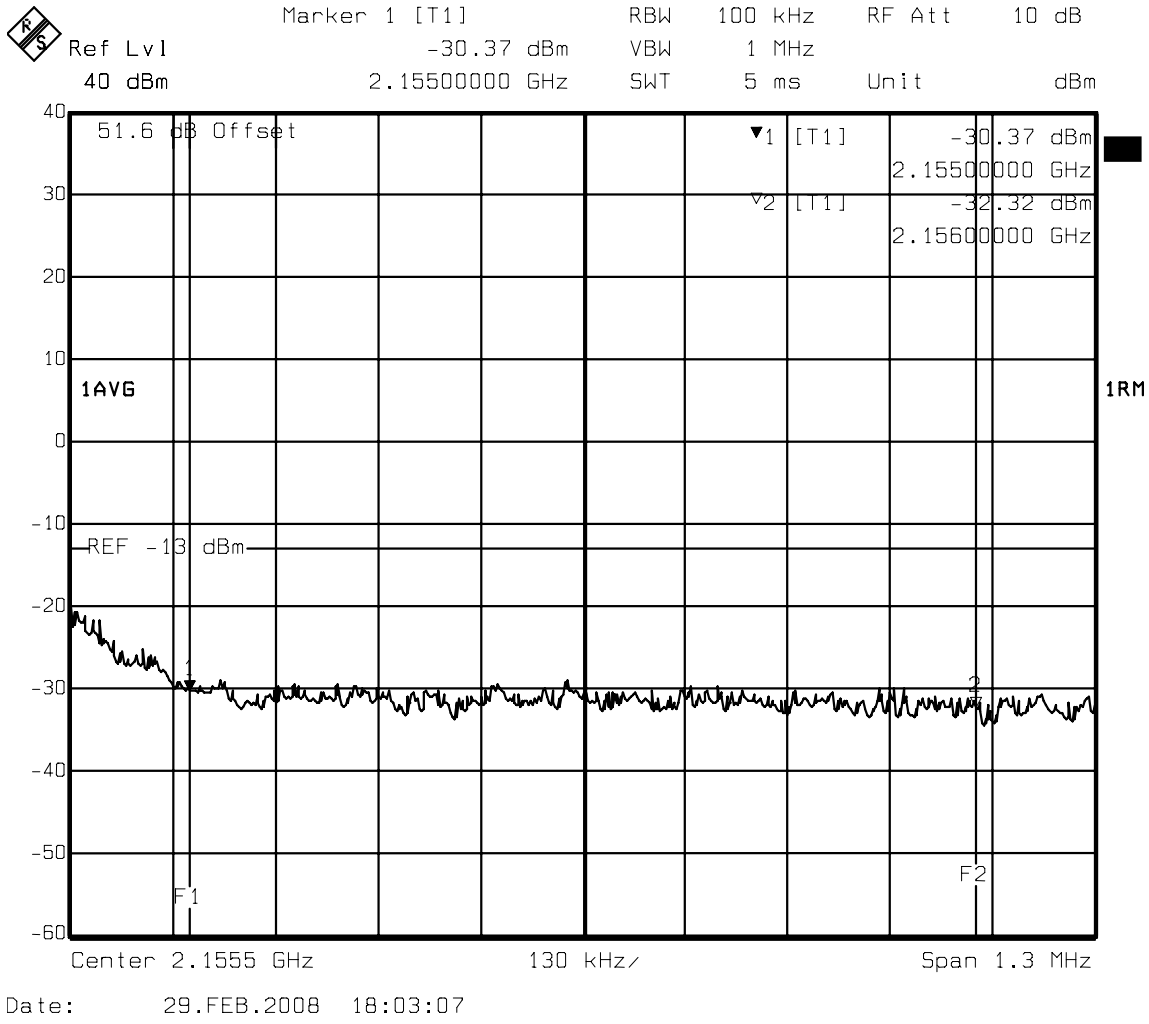


Figure 43 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

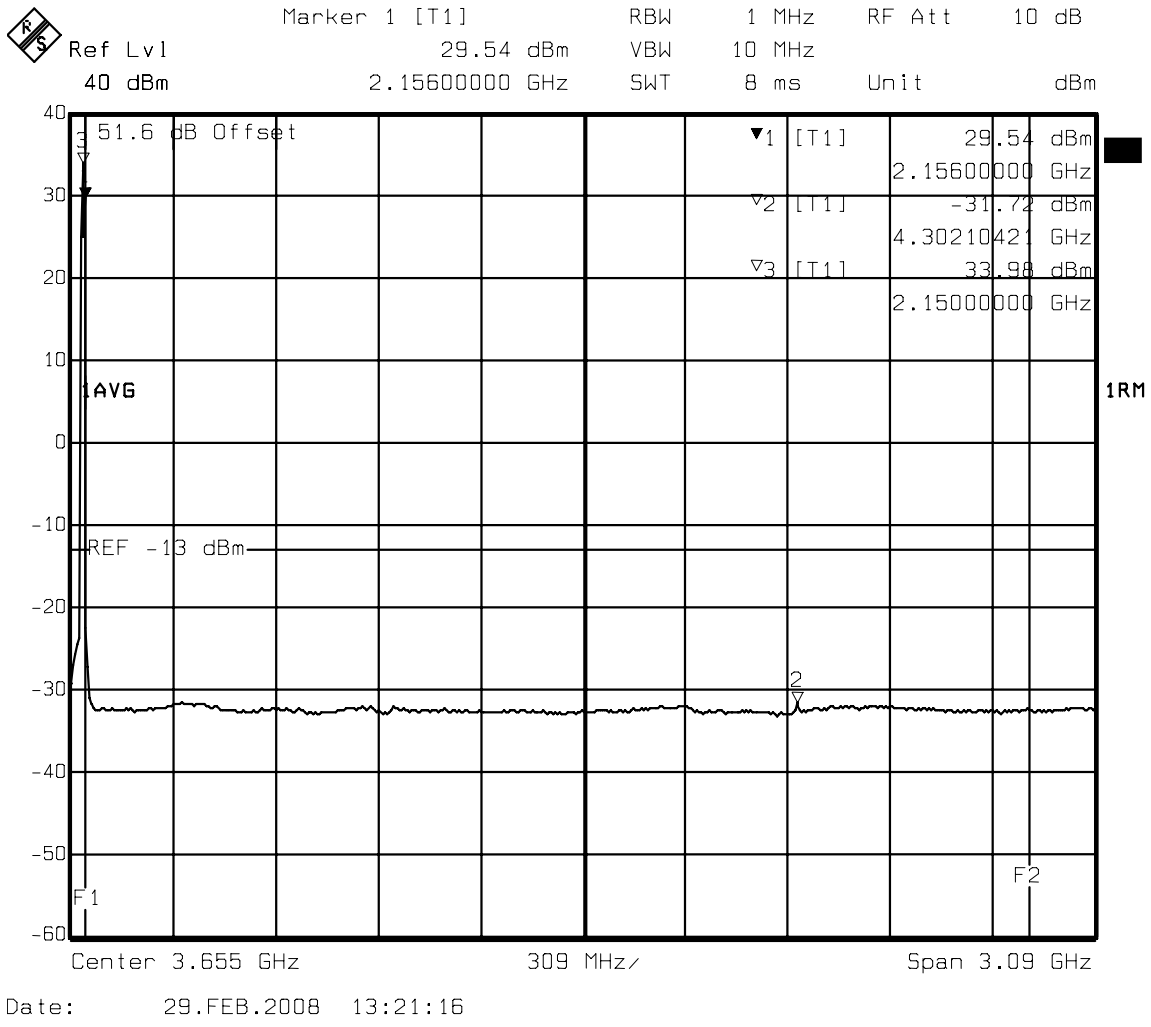
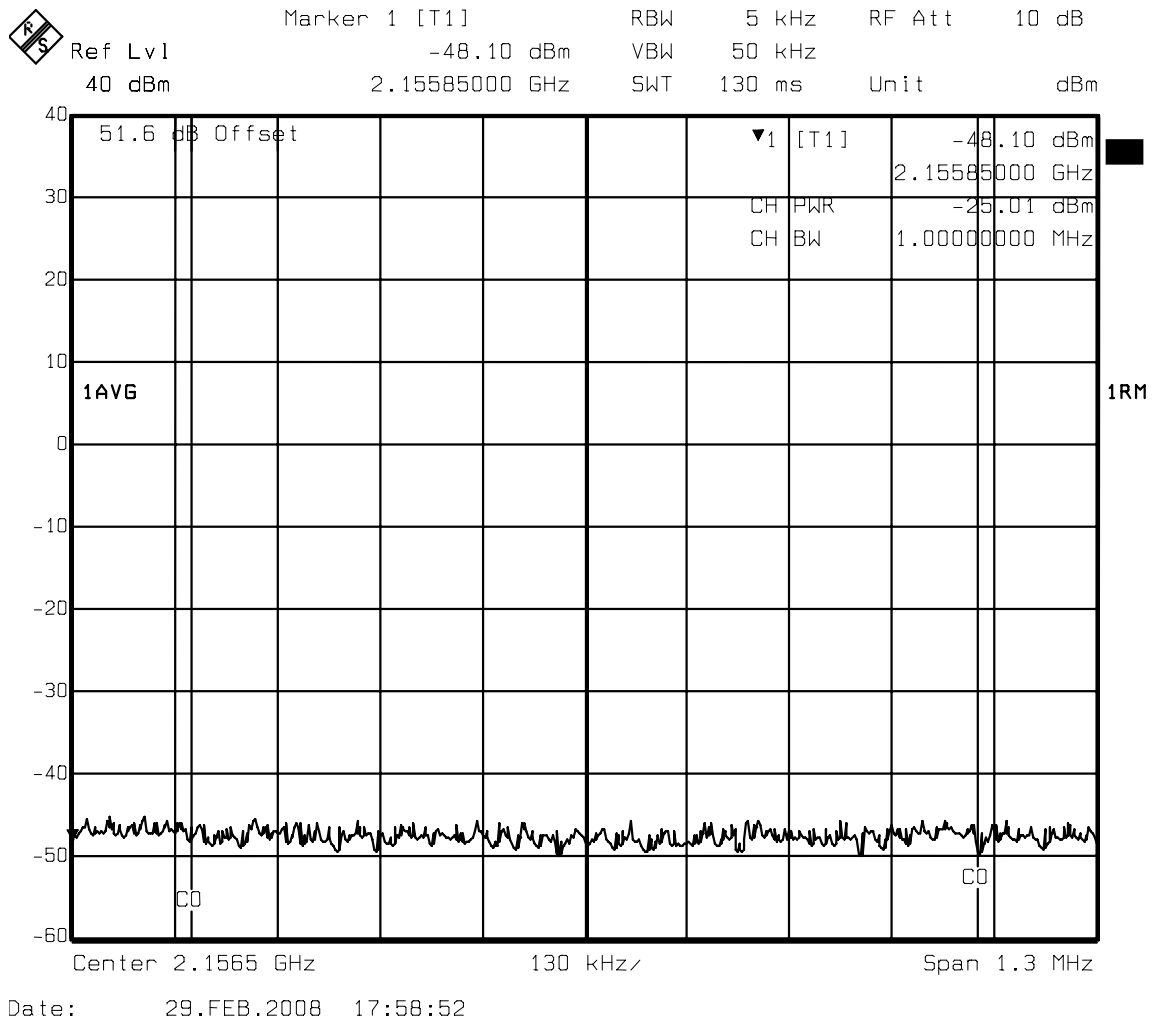


Figure 44 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, QPSK (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 45 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, QPSK (LTE 10MHz), (5GHz to 22GHz)

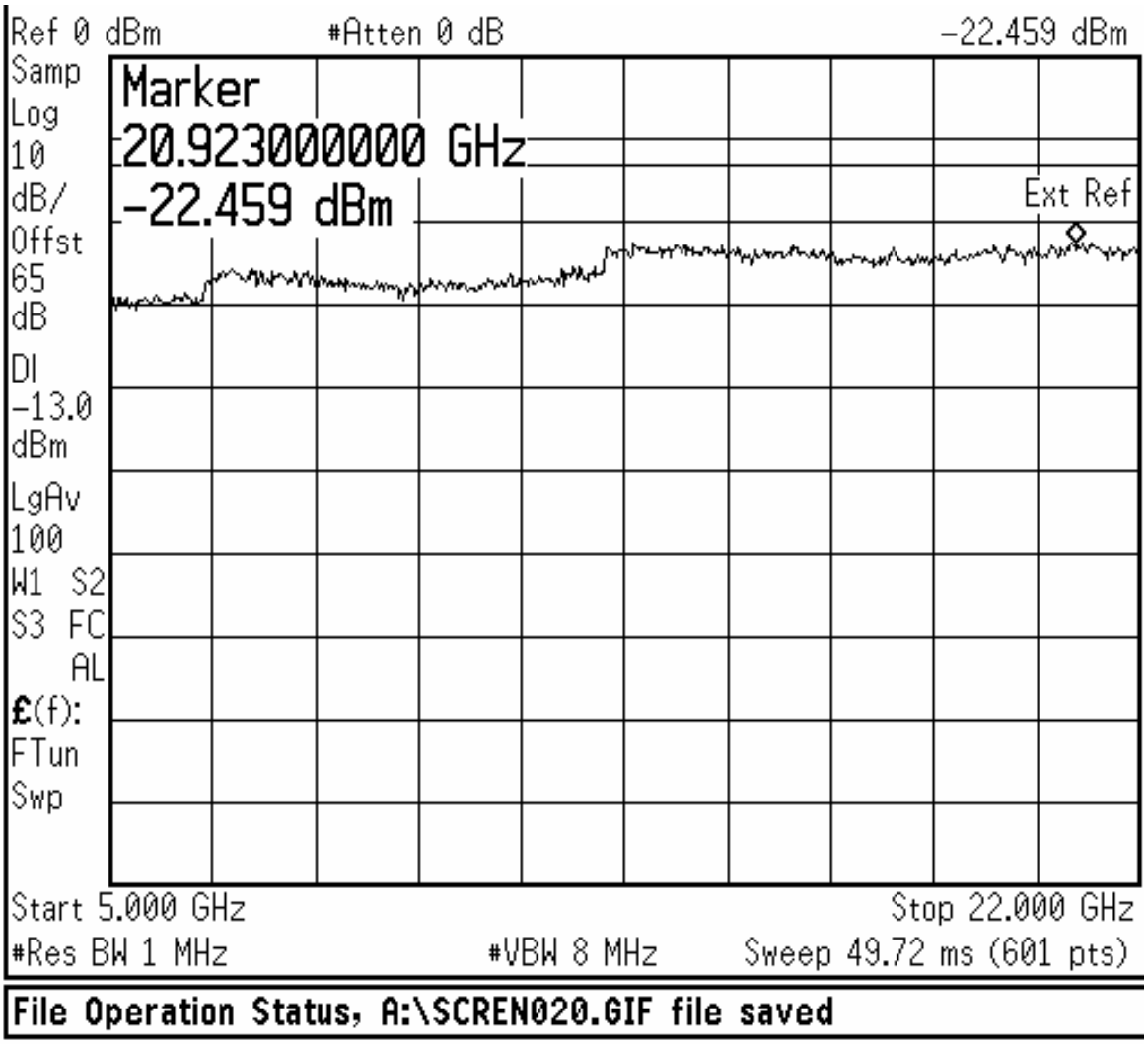


Figure 46 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

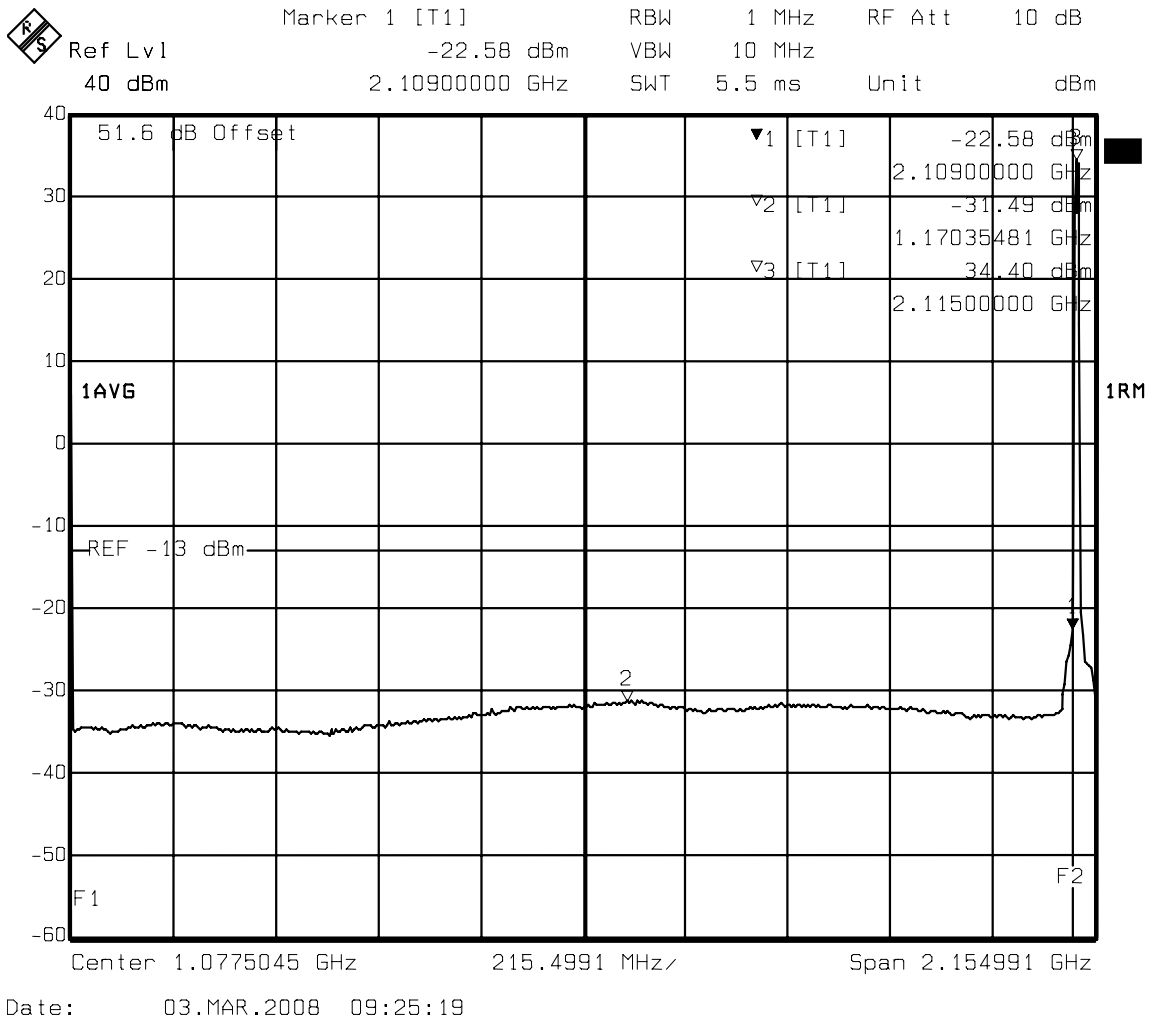
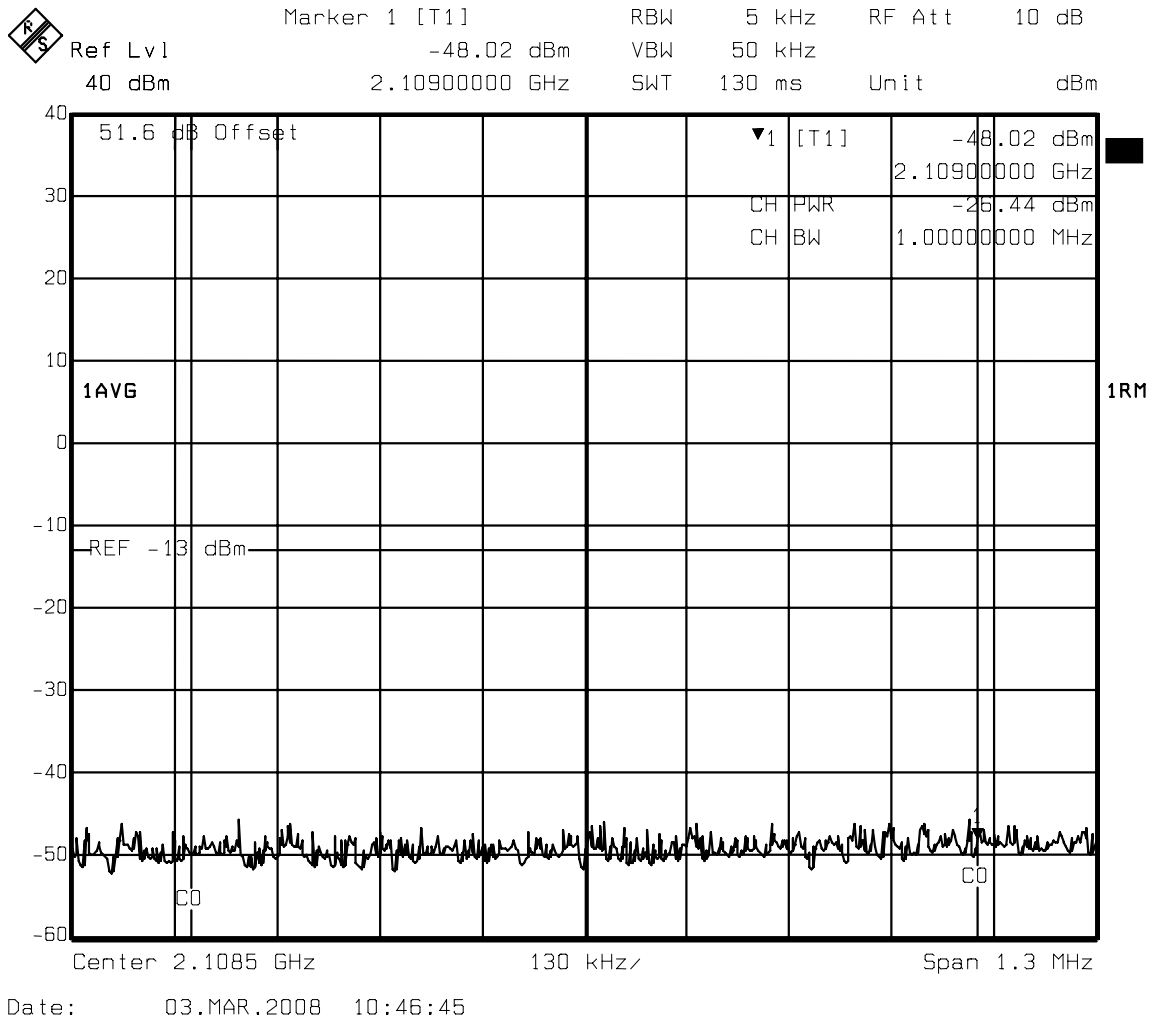


Figure 47 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 48 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 16QAM (LTE 10MHz), (Lower Adjacent 1MHz)

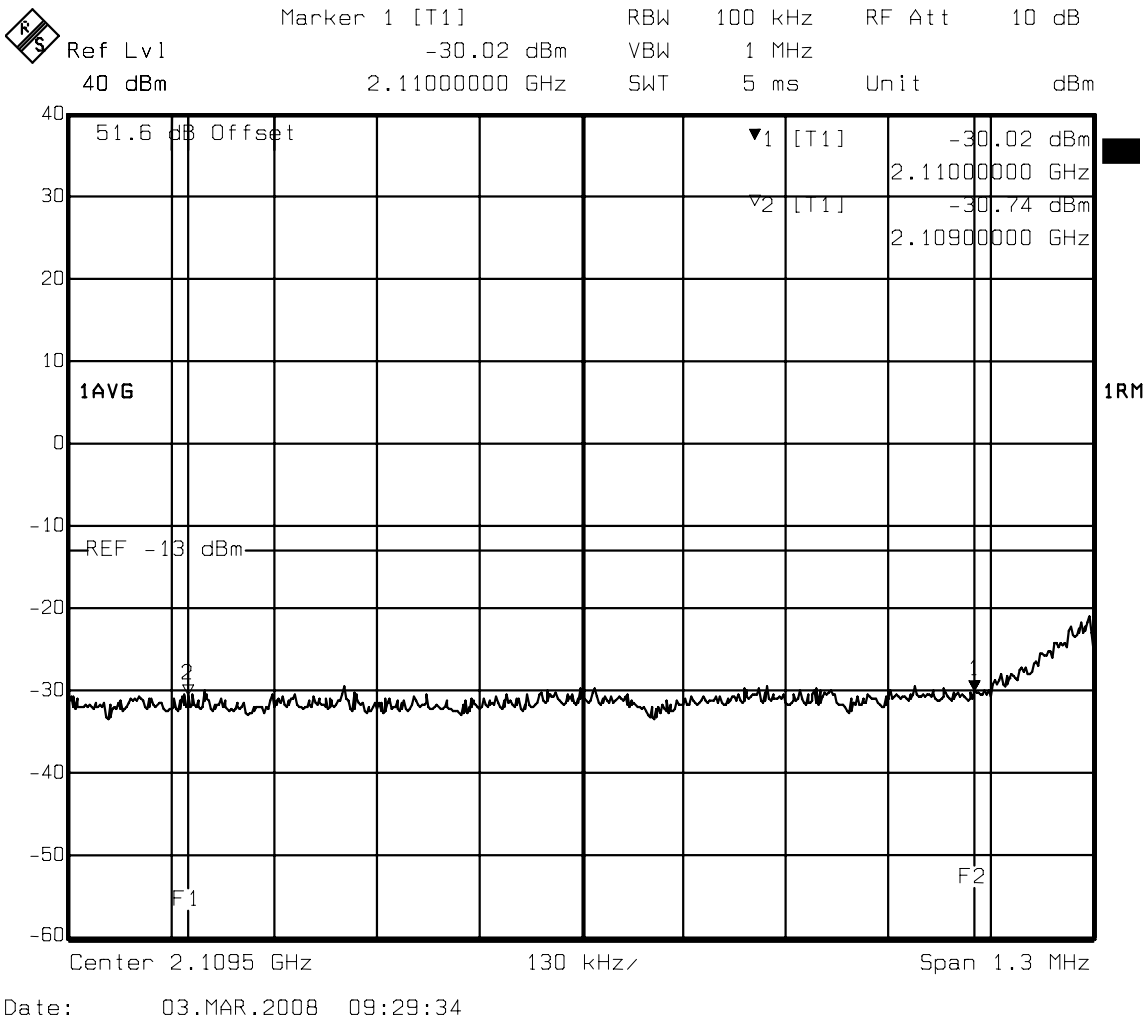


Figure 49 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz)

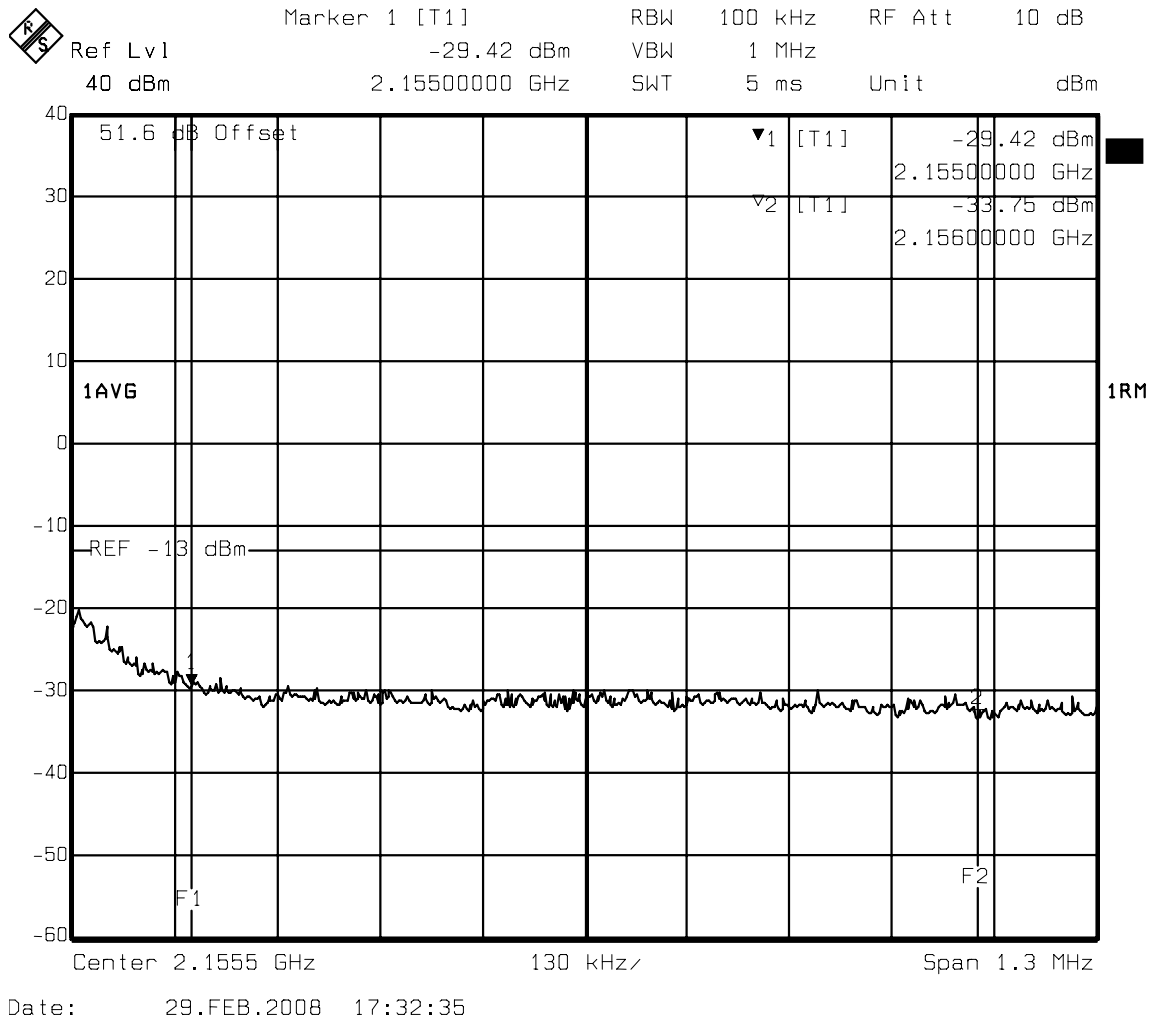


Figure 50 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

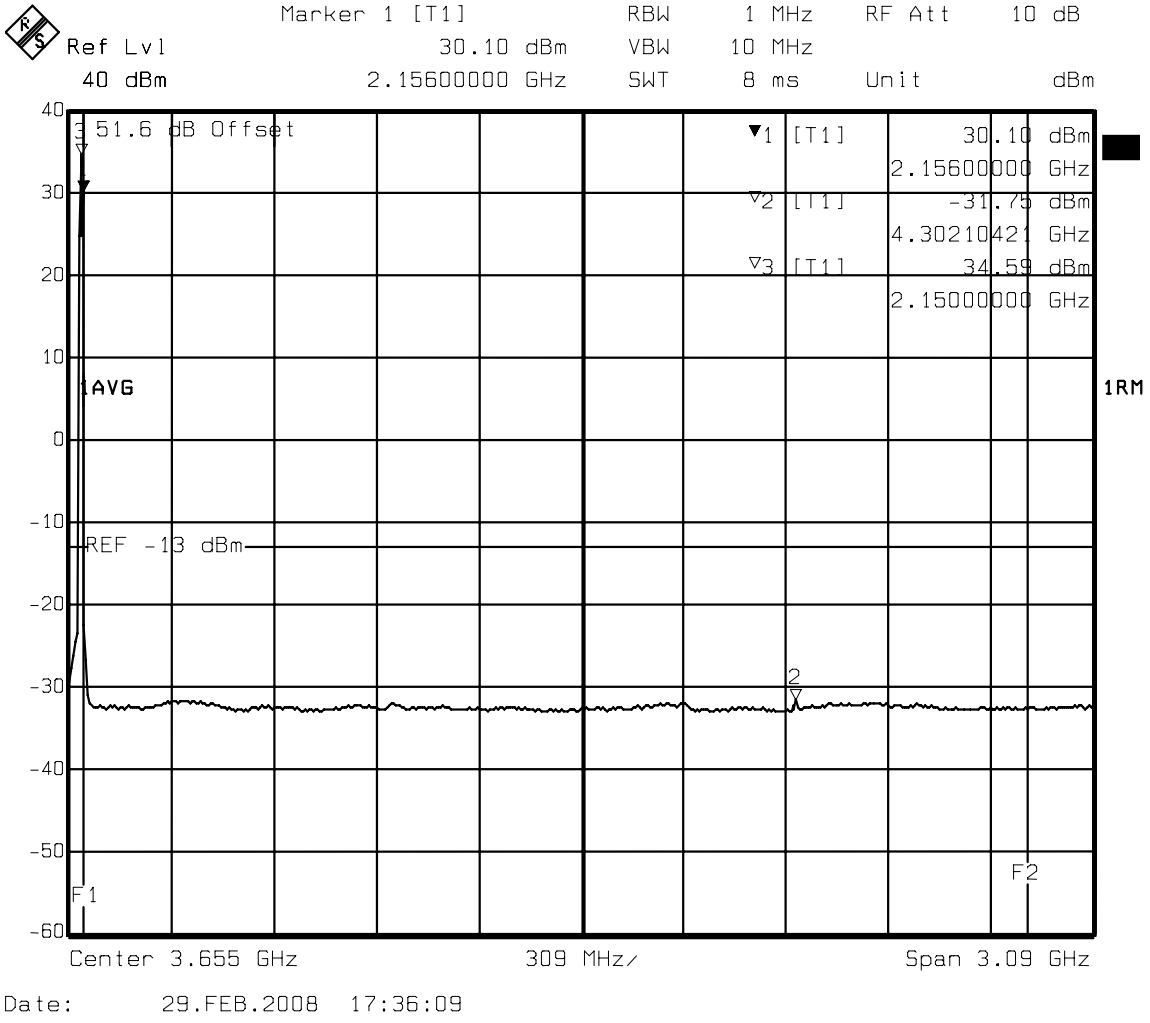
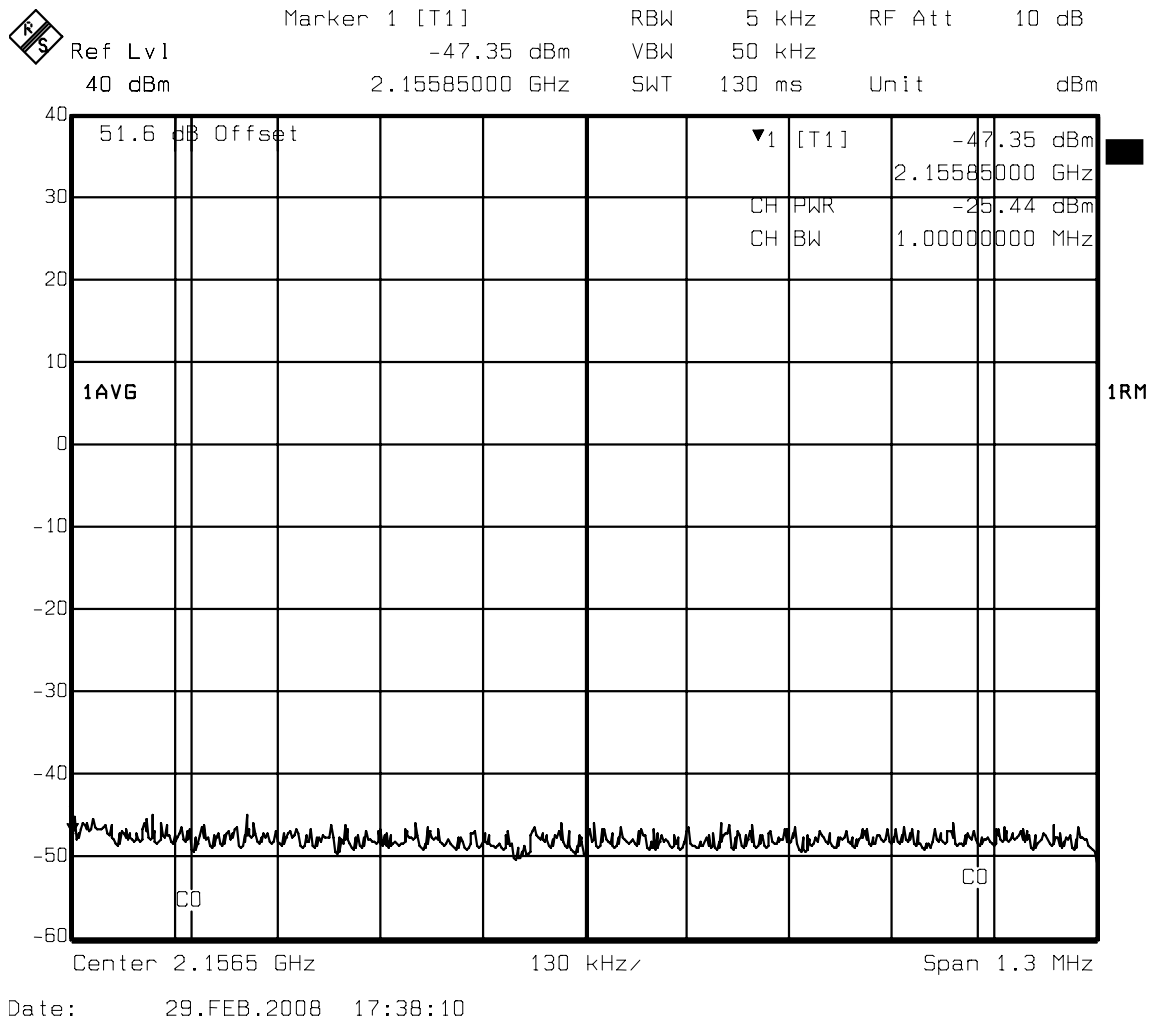


Figure 51 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 52 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 16QAM (LTE 10MHz), (5GHz to 22GHz)

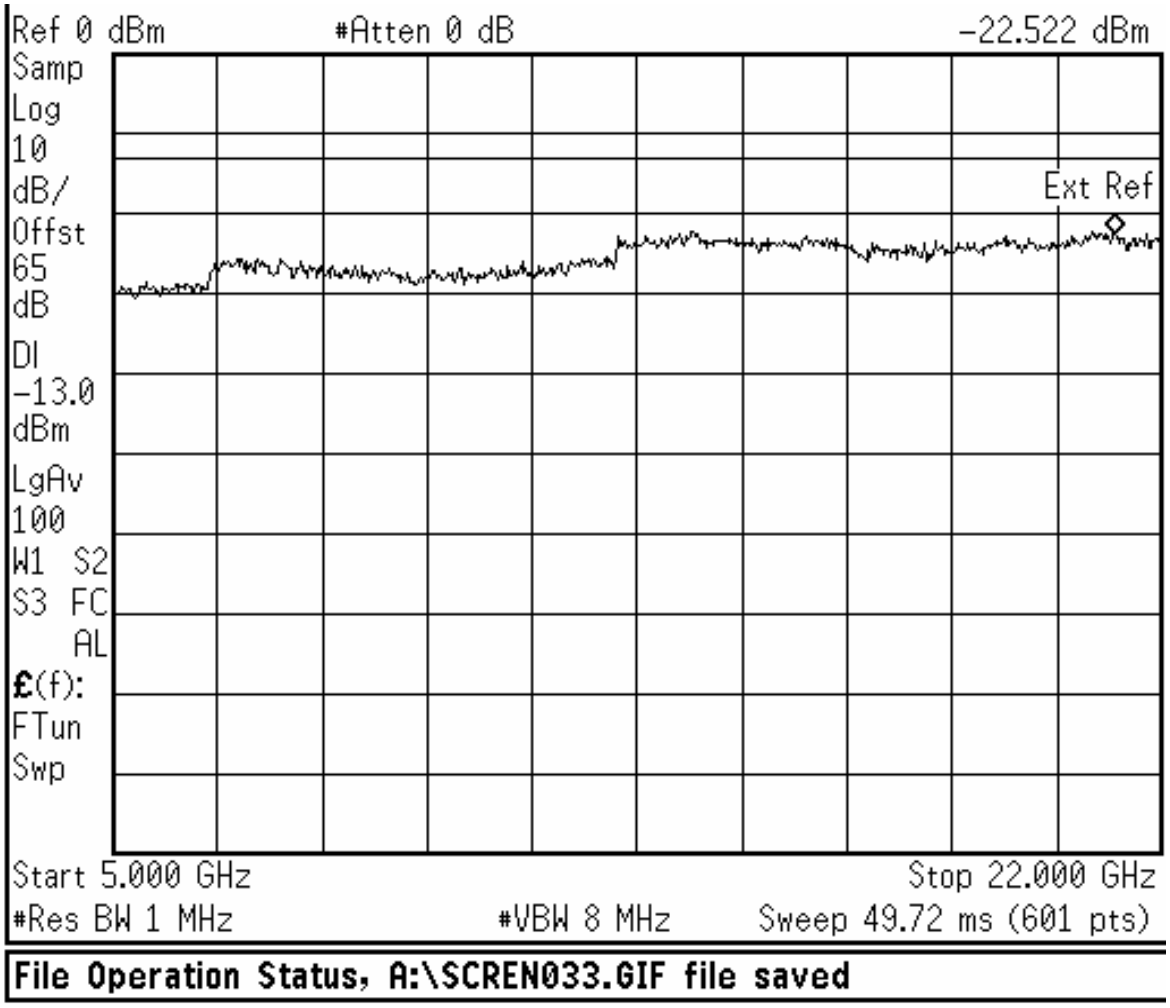


Figure 53 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz)

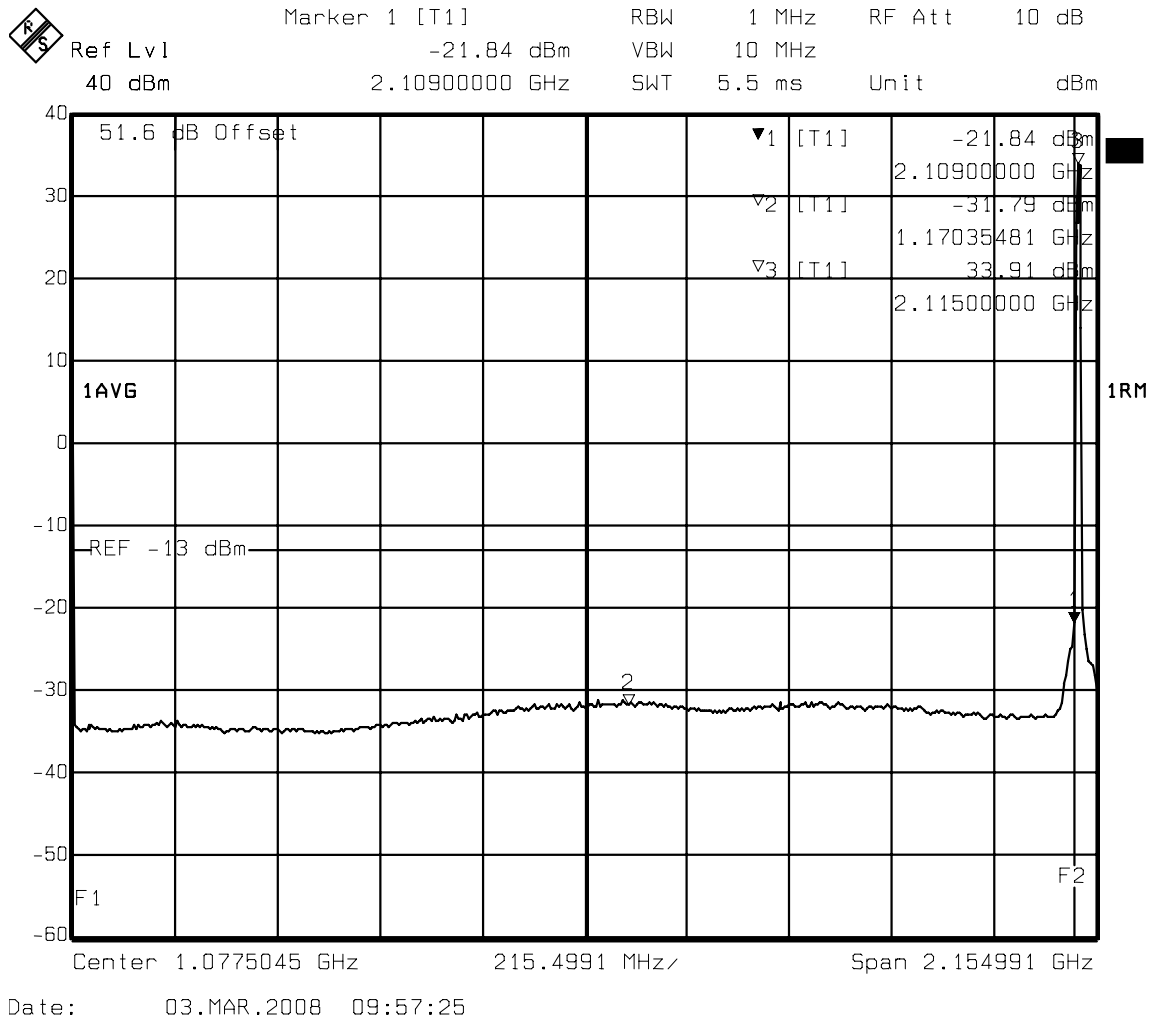
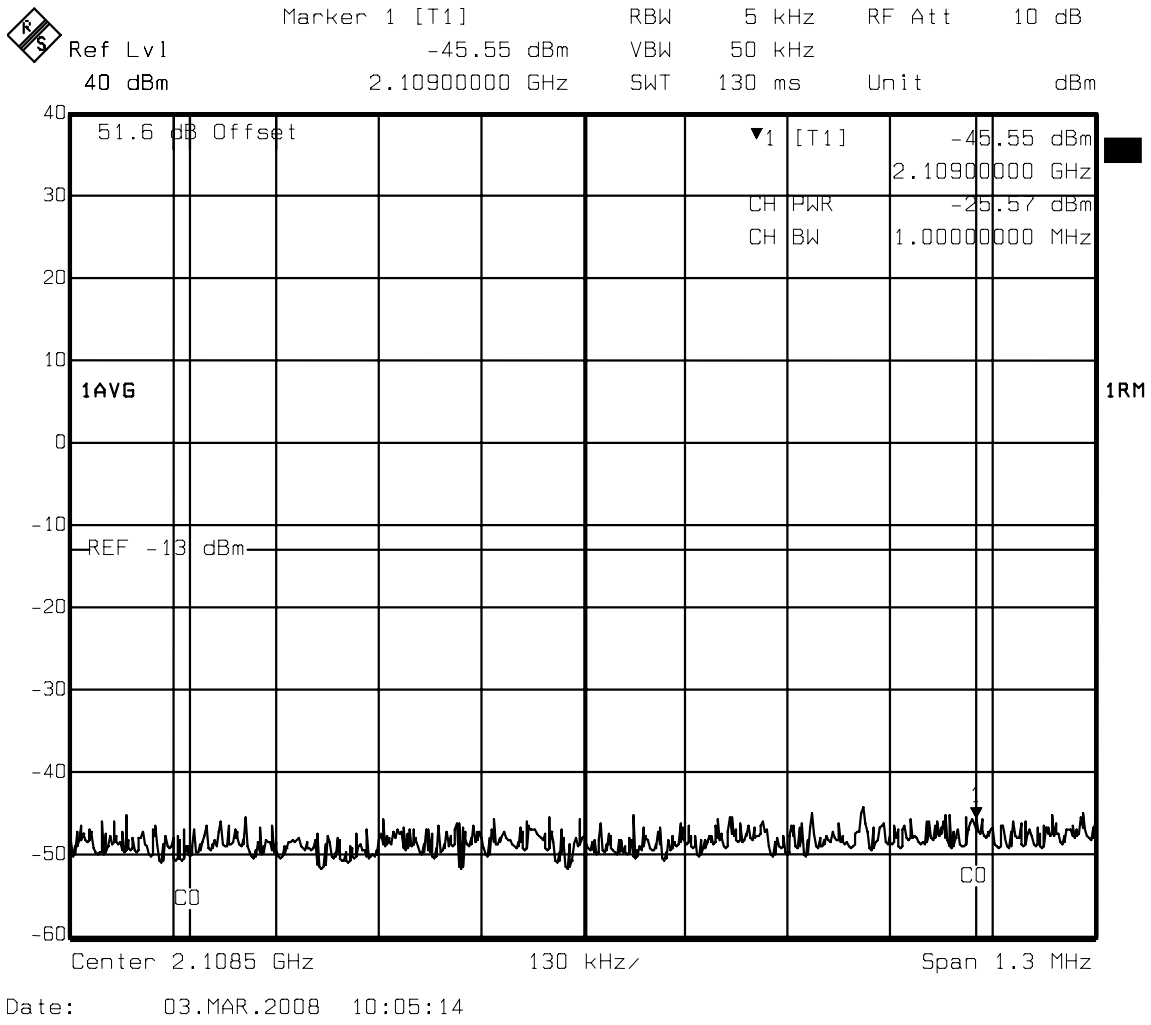


Figure 54 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (9kHz to Lower Adjacent 1MHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2108MHz and 2109MHz. Spectral power density is expected to be the highest in the top 1MHz of the 9kHz to 2109MHz measurement band, therefore measuring the RF power contained in 2108MHz to 2109MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 55 : Conducted Spurious Emissions - two-Tx configuration, Ch 100, 64QAM (LTE 10MHz), (Lower Adjacent 1MHz)

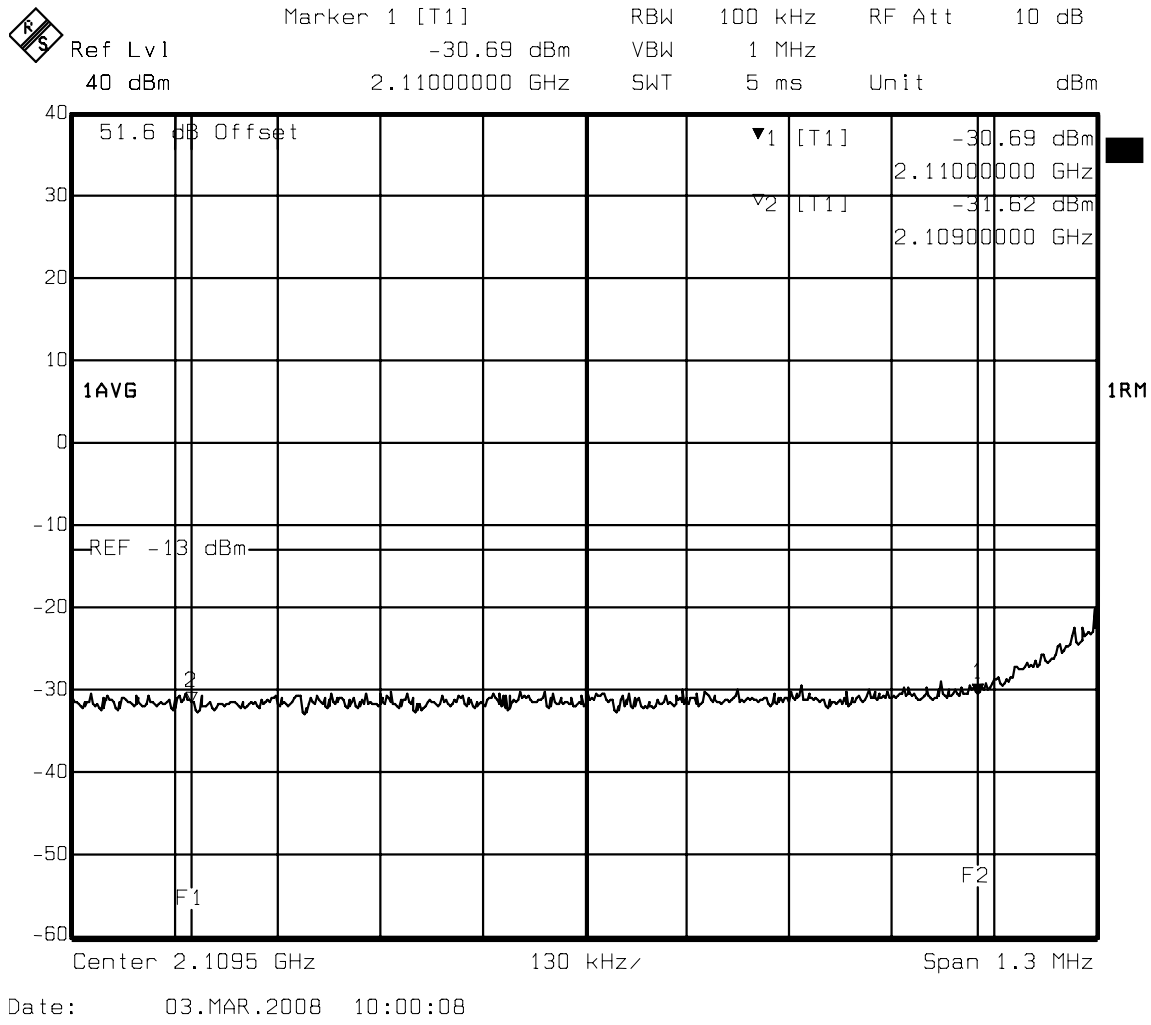


Figure 56 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz)

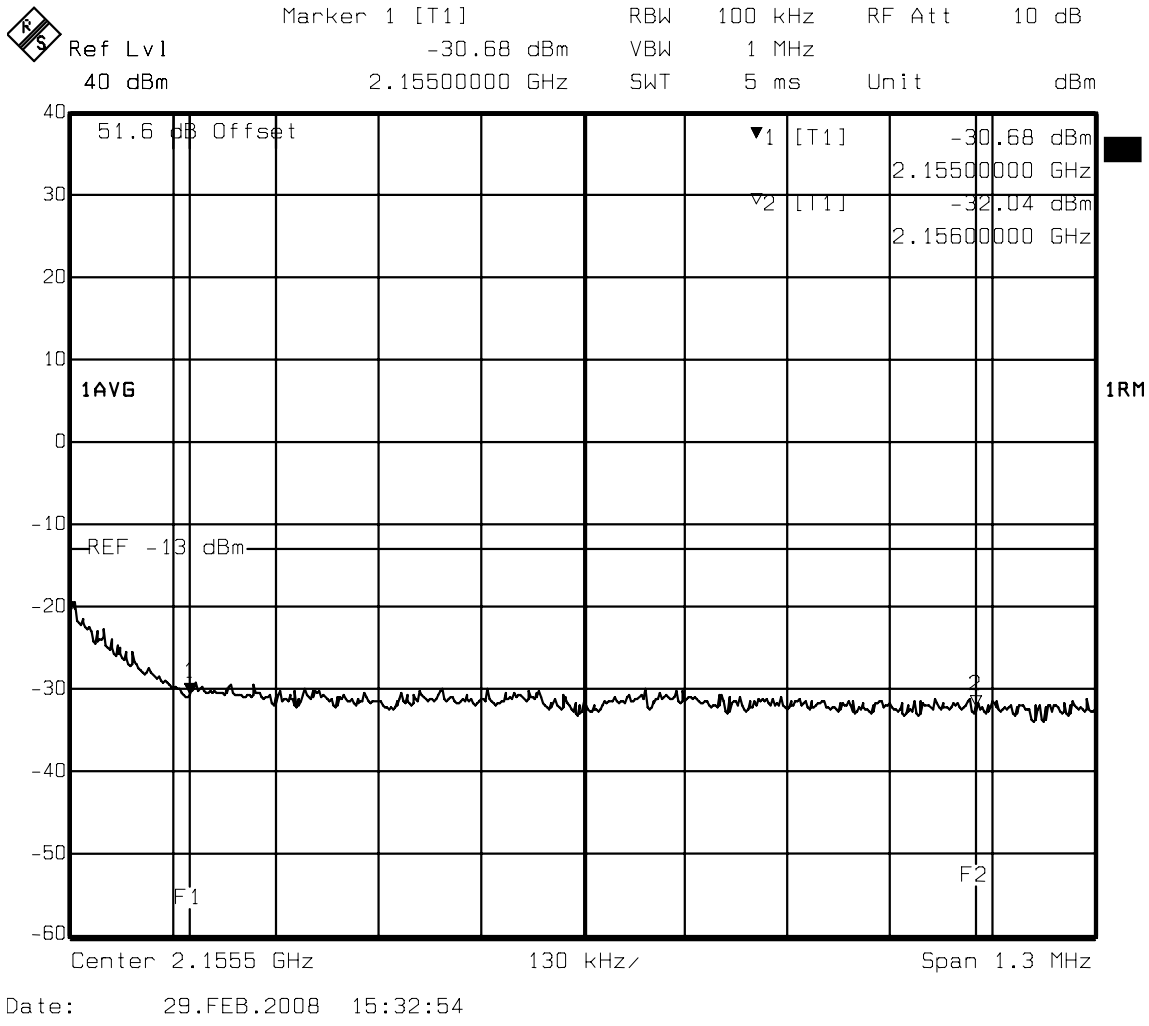


Figure 57 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz)

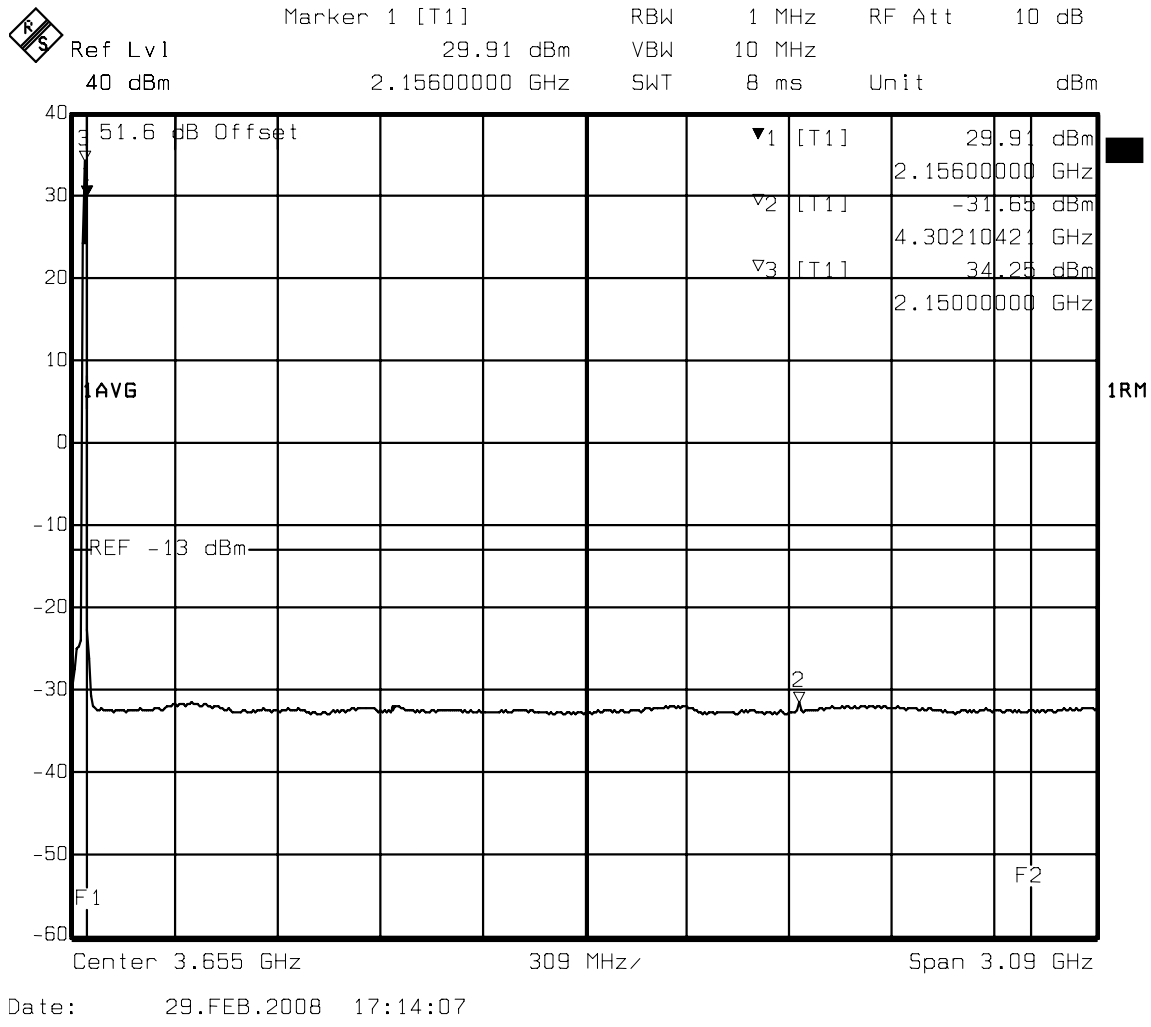
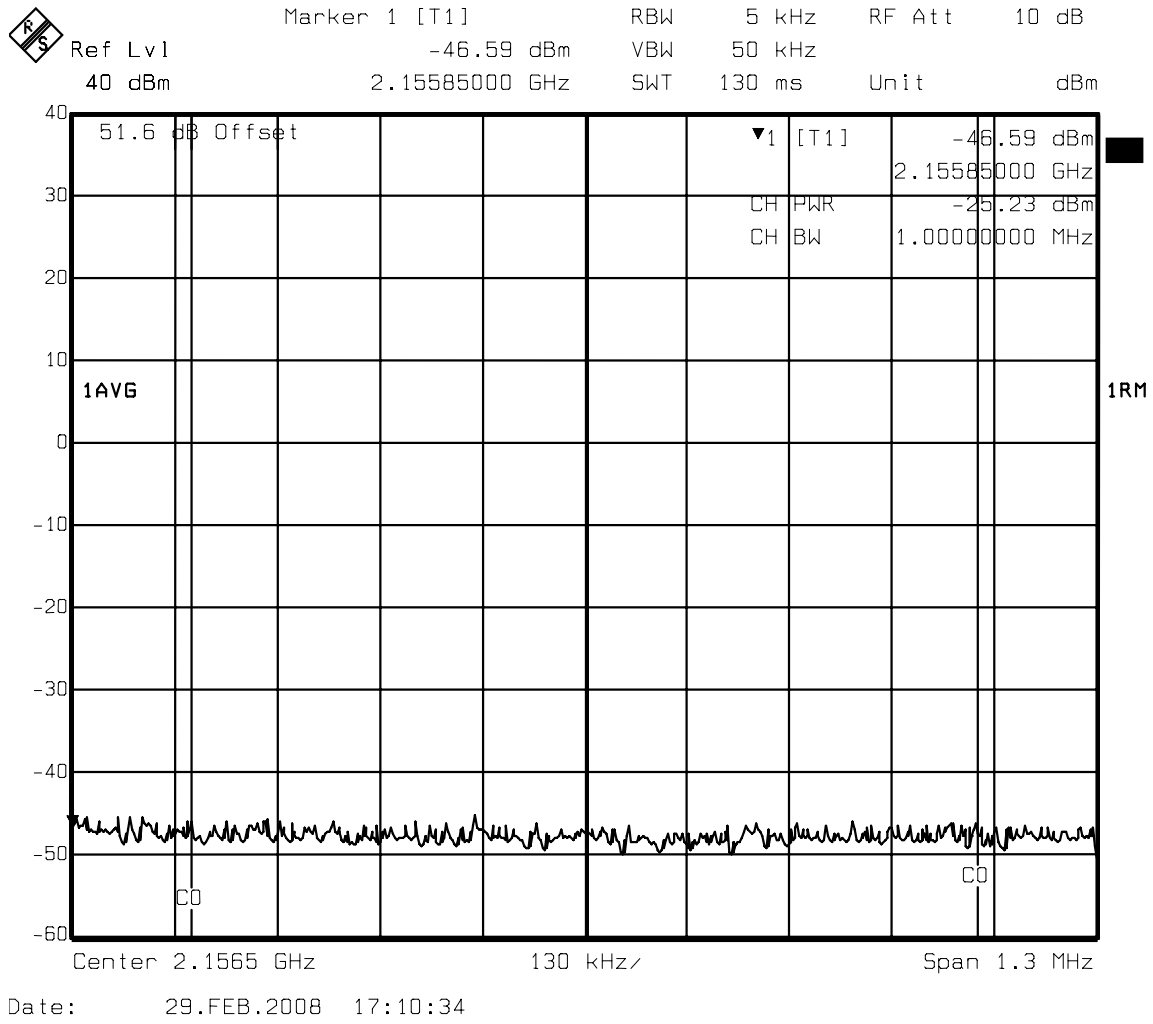


Figure 58 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (Upper Adjacent 1MHz to 5GHz) Verification



The purpose of this screen shot is to provide more exact RF power measurement in the 1MHz band between 2156MHz and 2157MHz. Spectral power density is expected to be the highest in the bottom 1MHz of the 2156MHz to 5000MHz measurement band, therefore measuring the RF power contained in 2156MHz to 2157MHz band verifies that RF emissions within this 1MHz band are indeed below -13dBm.

Figure 59 : Conducted Spurious Emissions - two-Tx configuration, Ch 800, 64QAM (LTE 10MHz), (5GHz to 22GHz)