



FCC Test Report

FOR:

Sequans Corporation

Model Number: VZ120Q

Product Description: LTE Module

FCC ID: 2AAGMVZ120Q

47 CFR Part 27 for LTE bands

TEST REPORT #: EMC_VERIZ-036-15002_FCC27_LTE_WWAN
DATE: 2015-11-05



FCC Recognized
A2LA Accredited
IC recognized # 3462E-1

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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

Table of Contents

1	Assessment	4
2	Administrative Data.....	5
2.1	Identification of the Testing Laboratory Issuing the Test Report	5
2.2	Identification of the Client	5
2.3	Identification of the Manufacturer	5
3	Equipment under Test (EUT)	6
3.1	Specification of the Equipment under Test.....	6
3.2	Identification of the Equipment under Test (EUT)	7
3.3	Identification of Accessory equipment	7
3.4	Environmental conditions during Test	7
3.5	Dates of Testing	7
4	Subject of Investigation	8
5	Summary of Measurement Results.....	9
5.1	LTE Band 4 (1700 MHz):	9
5.2	LTE Band 4 worst case condition for EIRP and PAR	10
5.3	LTE Band 13 (700 MHz):	11
5.4	LTE Band 13 worst case condition for EIRP and PAR	11
6	Measurements	12
6.1	Measurement Uncertainty	12
6.2	RF Power Output	13
6.2.1	<i>References</i>	13
6.2.2	<i>Measurement Requirements:</i>	13
6.2.3	<i>Limits:</i>	13
6.2.4	<i>Measurement Procedure:</i>	13
6.2.5	<i>Test Results</i>	15
6.2.6	<i>Test Verdict</i>	72
6.3	PEAK-AVERAGE Ratio	72
6.3.1	<i>References</i>	72
6.3.2	<i>Limits:</i>	72
6.3.3	<i>Results:</i>	72
6.3.4	<i>Verdict:</i>	72
6.4	Occupied Bandwidth.....	73
6.4.1	<i>References</i>	73
6.4.2	<i>Limits</i>	73
6.4.3	<i>Measurement Requirements:</i>	73
6.4.4	<i>Test Method:</i>	73
6.4.5	<i>Test Results / Plots</i>	74
6.5	Frequency Stability	102
6.5.1	<i>References</i>	102
6.5.2	<i>Measurement requirements:</i>	102
6.5.3	<i>Limits</i>	102
6.5.4	<i>Summary Test Data:</i>	103
6.5.5	<i>Test Notes:</i>	103
6.6	Band Edge (Conducted) / Transmitter Unwanted Emissions.....	122
6.6.1	<i>References</i>	122
6.6.2	<i>Limits</i>	122
6.6.3	<i>Measurement Procedure</i>	123
6.6.4	<i>Plots LTE Band 4 (1710 MHz – 1755 MHz) QPSK</i>	124
6.6.5	<i>Plots LTE Band 4 (1710 MHz – 1755 MHz) QPSK, cont.</i>	125

6.6.6	<i>Plots LTE Band 4 (1710 MHz – 1755 MHz) QAM</i>	130
6.6.7	<i>Plots LTE Band 13 (777 MHz – 787 MHz) QPSK</i>	134
6.6.8	<i>Plots LTE Band 13 (777 MHz – 787 MHz) QAM</i>	138
6.7	TX Radiated Spurious Emissions	142
6.7.1	<i>References</i>	142
6.7.2	<i>Limits</i>	142
6.7.3	<i>Measurement requirements:</i>	142
6.7.4	<i>Radiated out of band measurement procedure:</i>	143
6.7.5	<i>Sample Calculations for Radiated Measurements</i>	144
6.7.6	<i>Measurement Survey:</i>	144
6.7.7	<i>Test Conditions:</i>	145
6.7.8	<i>Test Results:</i>	145
7	Test Equipment and Ancillaries used for tests	170
7.1.1	<i>San Diego EMC Lab</i>	170
8	Test Setup Diagrams	171
9	Revision History	174

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules parts 27 of Title 47 of the Code of Federal Regulations . No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Sequans	Sequans VZ120Q LTE Module	VZ120Q

Responsible for Testing Laboratory:

2015-11-05 Compliance Milton Ponce Deleon
 (Test Lab Manager)

Date	Section	Name	Signature
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Responsible for the Report:

2015-11-05 Compliance Anthony Planinac
 (EMC Engineer)

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Section3. CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	6370 Nancy Ridge Drive, Suite 101 San Diego, CA 92121 U.S.A.
Telephone:	+1 (858) 362 2400
Fax:	+1 (858) 587 4809
Test Lab Manager:	Milton Deleon

2.2 Identification of the Client

Applicant's Name:	Sequans Communications
Street Address:	15-55, Boulevard Charles de Gaulle
City/Zip Code	92700 Colombes, France
Country	France
Contact Person:	Sankara Subramanian
Phone No.	+ 1 32-859-4724
Fax:	
e-mail:	sankara@sequans.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	Sequans VZ120Q Module
Model Number:	VZ120Q
FCC-ID :	2AAGMVZ120Q
Product Description:	LTE Module Category1
Operating Frequency Ranges (MHz) / Channels:	LTE Band 13 (700MHz): 777 MHz – 787 MHz LTE Band 4 (1700 MHz): 1710 -1755 MHz
Type(s) of Modulation:	QPSK and 16 QAM
Antenna info (antenna presented for testing with the development board):	LTE Band 4 (1700): Antenna gain = 2 dBi LTE Band 13 (700MHz): Antenna gain = -8 dBi
Rated Operating Voltage Range for VZ120Q	Vmin: 3.6V/ Vnom: 3.9V / Vmax: 4.2V
Rated Operating Temperature Range:	-10°C ~ +55°C
Test Sample Status:	Prototype
Other Radios included:	

Note: For category 1 devices the max number of bits for uplink is limited to 5160. As a result, Category 1 devices will drop any UL allocations above these values (eg each allocation, in which the couple mcs and number of RBs gives a Transport Block size bigger than allowed by Category 1 requirement, will be dropped). Therefore for TX signals under 16QAM, the max number of RBs will be 27 under CAT1 devices (ref. ETSI TS 136 306, ETSI TS 136 213)

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	Sample	HW/SW Version
1	USI-15-16-0368	Radiated/Conducted	1.0/LR4.3.0

3.3 Identification of Accessory equipment

AE #	Type	Model	HW Version	SW Version	
1	AC adapter	YS12-050020U	NA	NA	Output 5V, 2A
2	External Antenna	OmniLOG 90200	NA	NA	700MHz – 2.4GHz

3.4 Environmental conditions during Test

The following environmental conditions were maintained during the course of testing:

Ambient Temperature: 20-25°C

Relative Humidity: 40-60%

3.5 Dates of Testing

2015-06-26 – 2015-06-17

4 Subject of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

47 CFR Part 2: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.

47 CFR Part 27: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter B- common carrier services; Part 27-Miscellaneous wireless communication services

This test report is to support a request for new equipment authorization under the FCC ID: 2AAGMVZ120Q

5 Summary of Measurement Results

5.1 LTE Band 4 (1700 MHz):

Specifications	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046 §27.50(d)(4)	RF Output Power	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§27.50(d)(5)	Peak-to-average Ratio	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1055 §27.54	Frequency Stability	Extreme	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1049 §27.53(h)	Occupied Bandwidth	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1051 §27.53(h)	Band Edge Compliance	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1053 §27.53(h)	Unwanted Emissions	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					

NA= Not Applicable; NP= Not Performed.

5.2 LTE Band 4 worst case condition for EIRP and PAR

Test Case	Mode	Condition
RF Output Power	QPSK	24.62dBm @ mid channel 1RB
	16 QAM	24.03dBm @ mid channel 1RB
Peak-to-average Ratio	QPSK	8.91dB @ low chanel 50RBs, 10MHz BW
	16 QAM	8.06dB @ high channel 50RBs, 15 MHz BW

5.3 LTE Band 13 (700 MHz):

Specifications	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046 §27.50(b)(10)	RF Output Power	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
27.50(d)(5)	Peak-to-average Ratio	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1055 §27.54	Frequency Stability	Extreme	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1049 §27.53(h)	Occupied Bandwidth	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1051 §27.53(h)	Band Edge Compliance	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					
§2.1053 §27.53(h)	Unwanted Emissions	Nominal	QPSK	■	□	□	□	Complies
			16 QAM					

Note: NA= Not Applicable; NP= Not Performed.

5.4 LTE Band 13 worst case condition for EIRP and PAR

Test Case	Mode	Condition
RF Output Power	QPSK	14.66dBm @ low channel 1RB
	16 QAM	13.99 dBm @ low channel 1RB
Peak-to-average Ratio	QPSK	7.58dB @ 50RBs, 10MHz BW
	16 QAM	7.90dB @ mid channel 25RBs, 5 MHz BW

6 Measurements

6.1 Measurement Uncertainty

For Power Output, Peak-Average Ratio, Band Edge Unwanted Emissions and Radiated Spurious Emissions the measurement uncertainty has been determined to:

	Uncertainty in dB radiated <30MHz	Uncertainty in in dB radiated 30MHz - 1GHz	Uncertainty in dB radiated > 1GHz	Uncertainty in dB Conducted measurement
standard deviation k=1	2.48	1.94	2.16	0.64
95% confidence interval in dB	4.86	3.79	4.24	1.25
95% confidence interval in dB in delta to Result	+/-2.5 dB	+/-2.0 dB	+/- 2.3dB	+/-0.7dB

Assesment from 3-12-2014 including contributions (as applicable) for NSA of chamber, VSWR of chamber, Uncertainty contribution of the antennas, Uncertainty contributions of ESU40, Uncertainty contribution of non-conducting table and all mismatch uncertainties of the involved equipment.

For OBW and Frequency Stability the measurement uncertainty is only determined by the FSU40 receiver. Maximum uncertainty is 2Hz.

6.2 RF Power Output

6.2.1 References

- FCC: CFR Part 2.1046, CFR Part 27.50
- 971168 D01 Power Meas License Digital Systems v02r02

6.2.2 Measurement Requirements:

6.2.2.1 FCC 2.1046: RF power output.

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 circuit elements as specified. The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

6.2.3 Limits:

6.2.3.1 Band4 1700 MHz

FCC Part 27.50 (d) (4) (6)

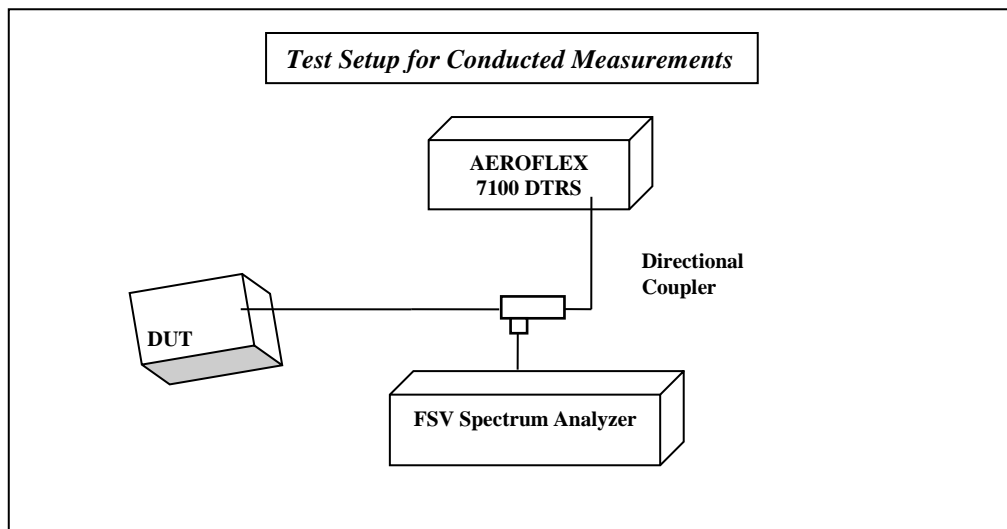
FCC: Average EIRP < 30 dBm (1W)

6.2.3.2 Band13 (777-787 MHz)

FCC Part 27.50 (b) (10)

FCC: Average ERP < 34.8 dBm (3W)

6.2.4 Measurement Procedure:



The DUT is using as much total output power as permissible according to the standards independent of physical bandwidth used. In order to achieve this goal the amplifier gain or baseband signal level inside the DUT is dynamically adjusted when the bandwidth changes.

Different modulations have different peak to average ratios so 16QAM and QPSK have been tested.

Testing for Low, Mid and High channel is the basic procedure from all radio base standards to catch frequency response over the band.

The power measurements were carried out with the R&S Spectrum Analyzer FSV13. It returns peak and average results. Internally it uses a time domain power measurement function for Peak and RMS power. The measurements are including a range of at least 25LTE frames to ensure stable and reproduceable results for peak and average.

The gains have been taken from the customer documentation. RF cable losses for various LTE bands are calculated and entered into the RF config menu in FSV and as RF level offset for spectrum analyser measurements.

6.2.4.1 Cable Loss:

The test setup losses between the DUT and measurement equipment, were verified and compensated, taken as reference the RF connector located on the module board

6.2.4.2 Test Conditions:

Tnom: 22°C; Vnom: 3.9 V

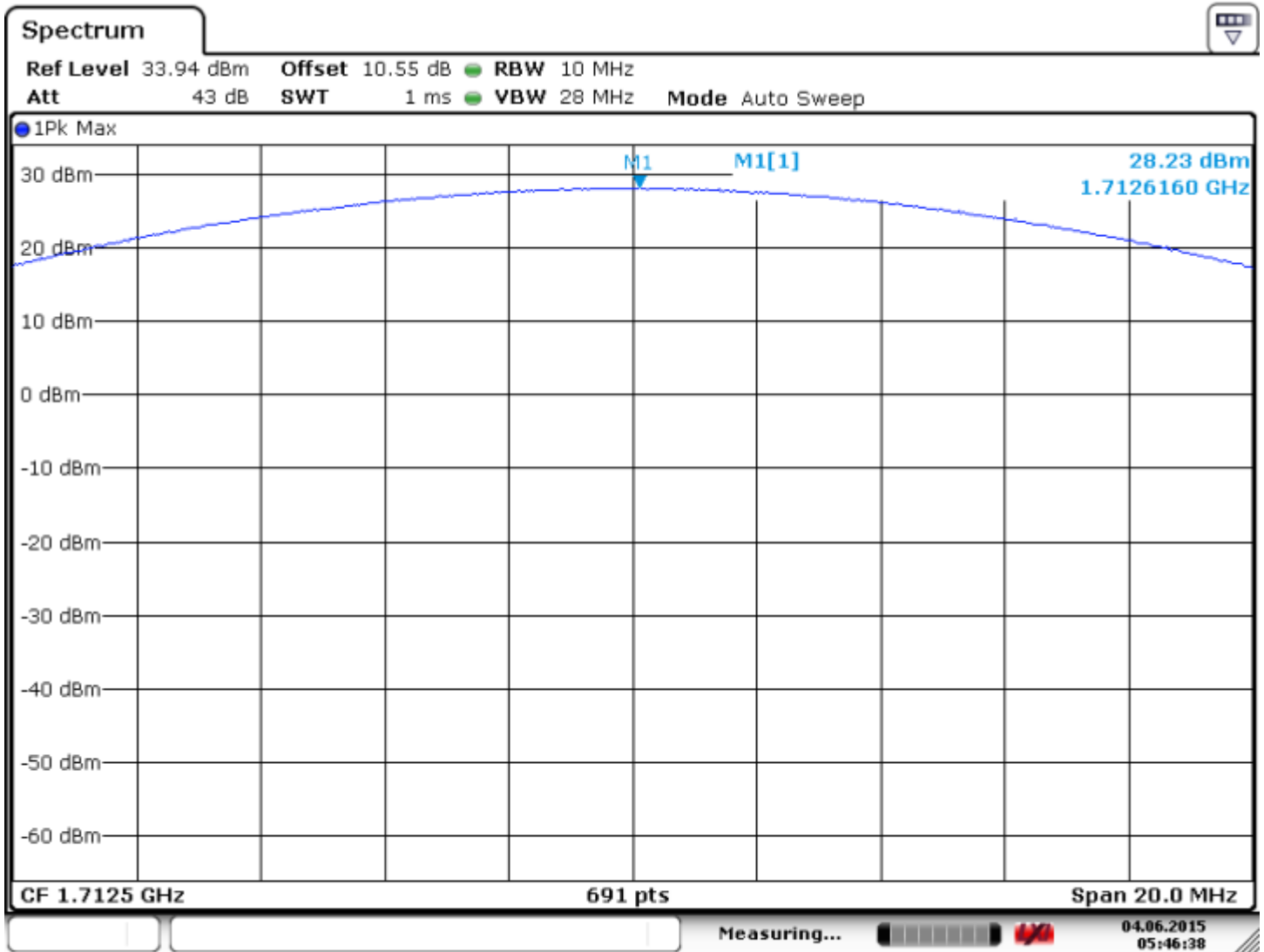
6.2.5 Test Results

6.2.5.1.1 Conducted Output Power LTE Band 4 full RB:

6.2.5.1.2 Conducted Output Power LTE Band 4 QPSK 5 MHz (100% RB)

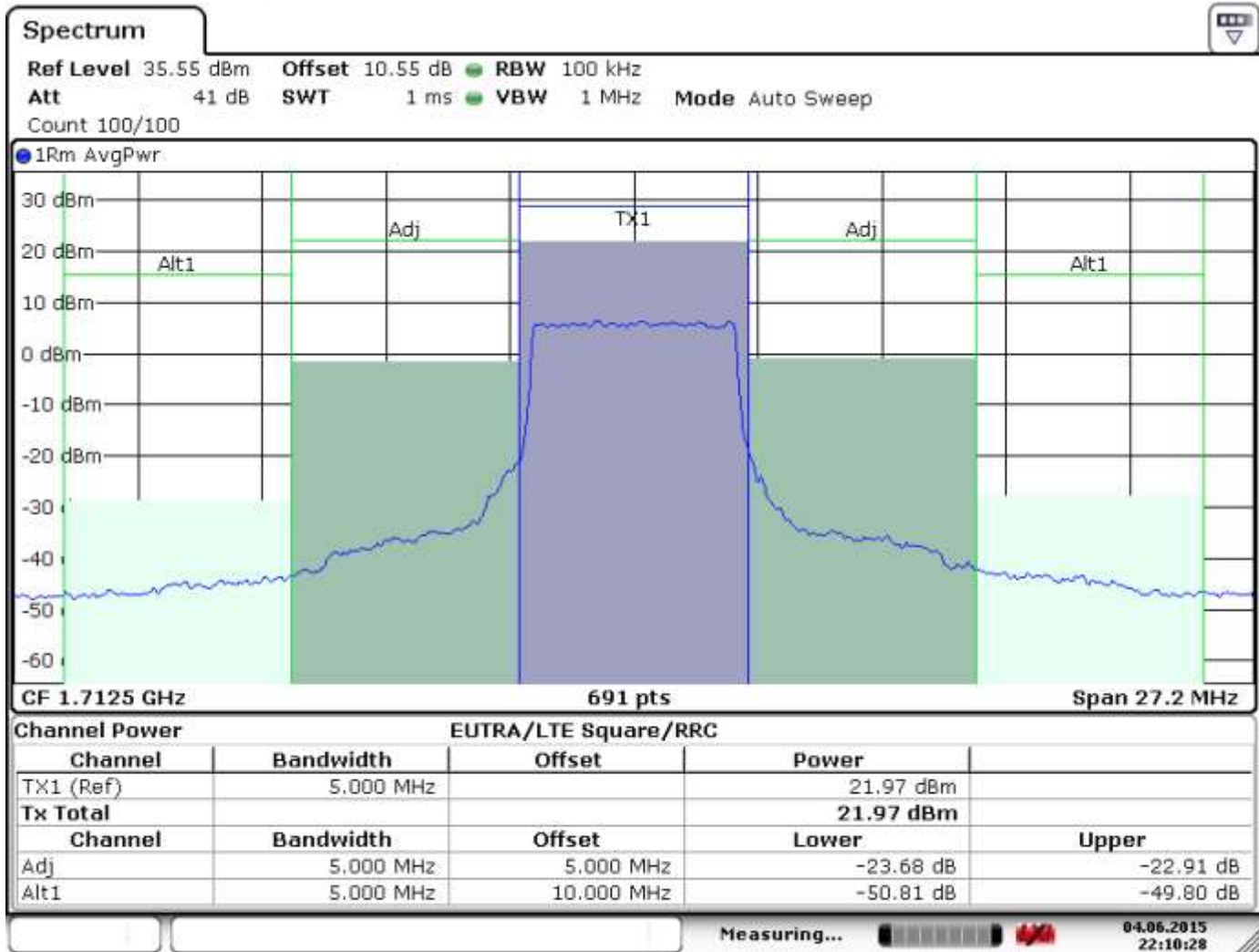
LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 25				BW (MHz) = 5.0			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1712.5	28.23	21.97	6.26	2	23.97	30	Pass
20175/1732.5	27.88	21.79	6.09	2	23.79	30	Pass
20375/1752.5	27.99	21.71	6.28	2	23.71	30	Pass

6.2.5.1.3 Figure 1 Pk Pwr Band4_Lo_5



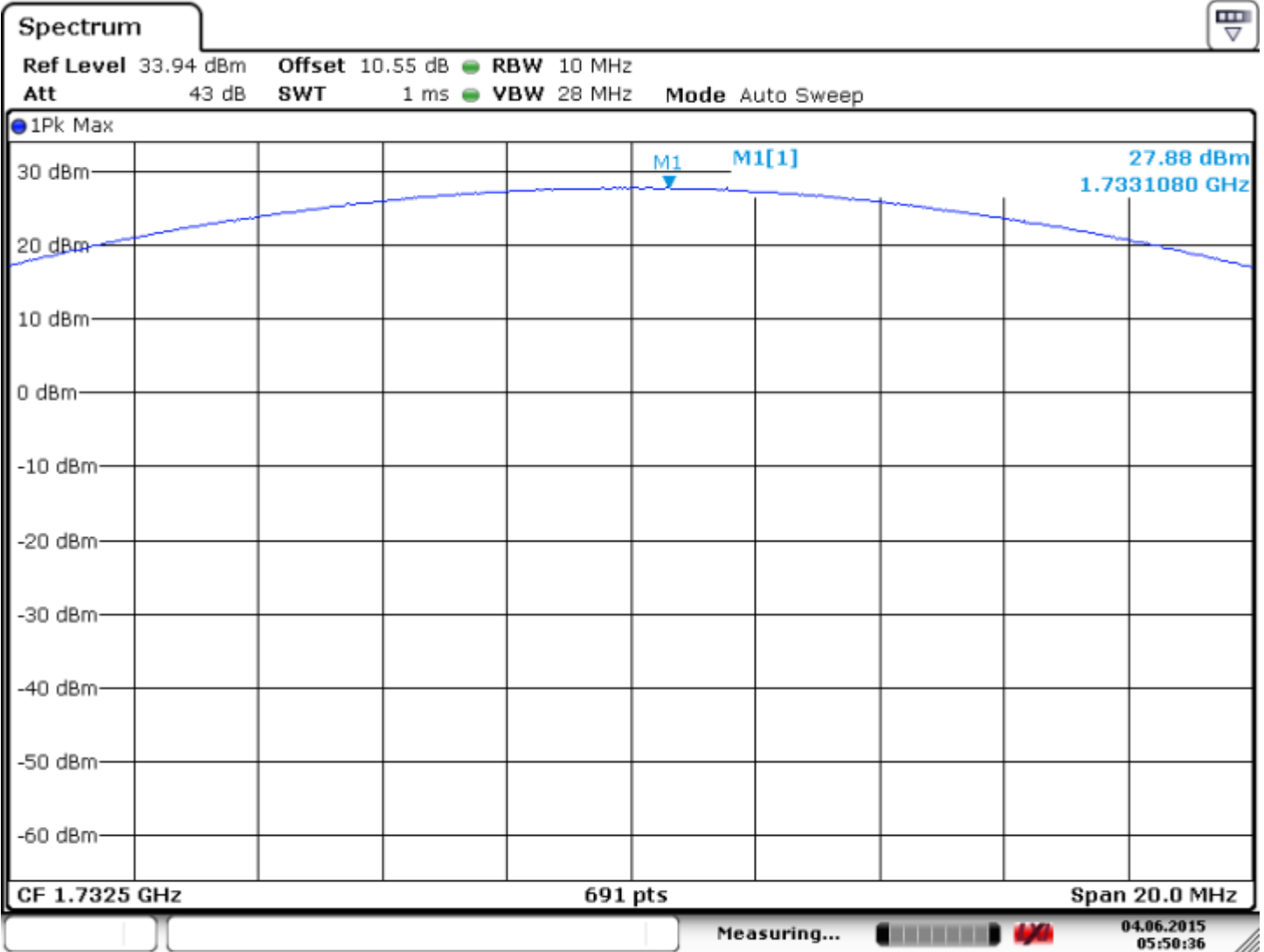
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6.2.5.1.4 Figure 2 Avg Pwr Band4_Lo_5



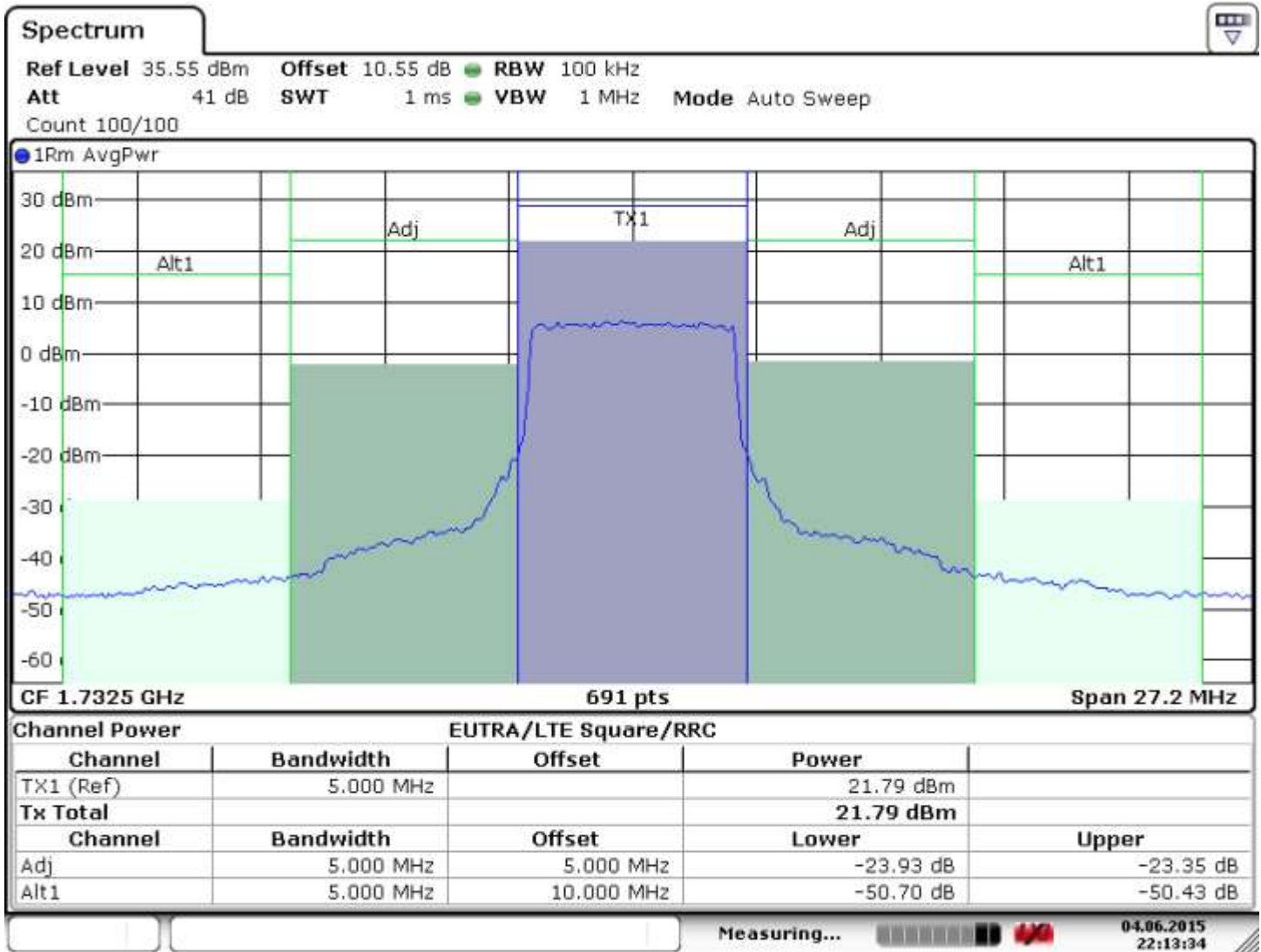
Date: 4.JUN.2015 22:10:28

6.2.5.1.5 Figure 3 Pk Pwr Band4_Mid_5



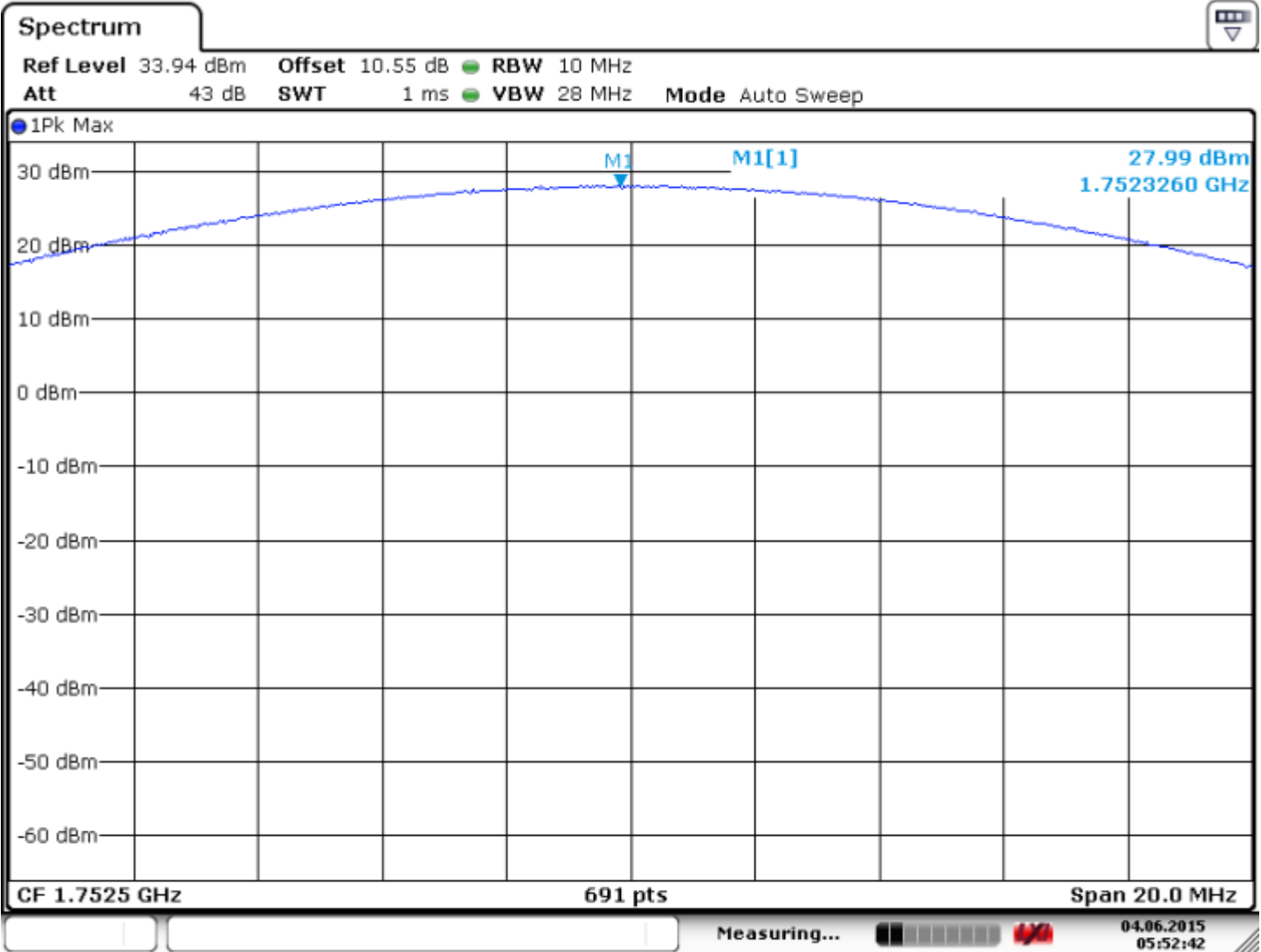
Date: 4.JUN.2015 05:50:36

6.2.5.1.6 Figure 4 Avg Pwr_Band4_mid_5



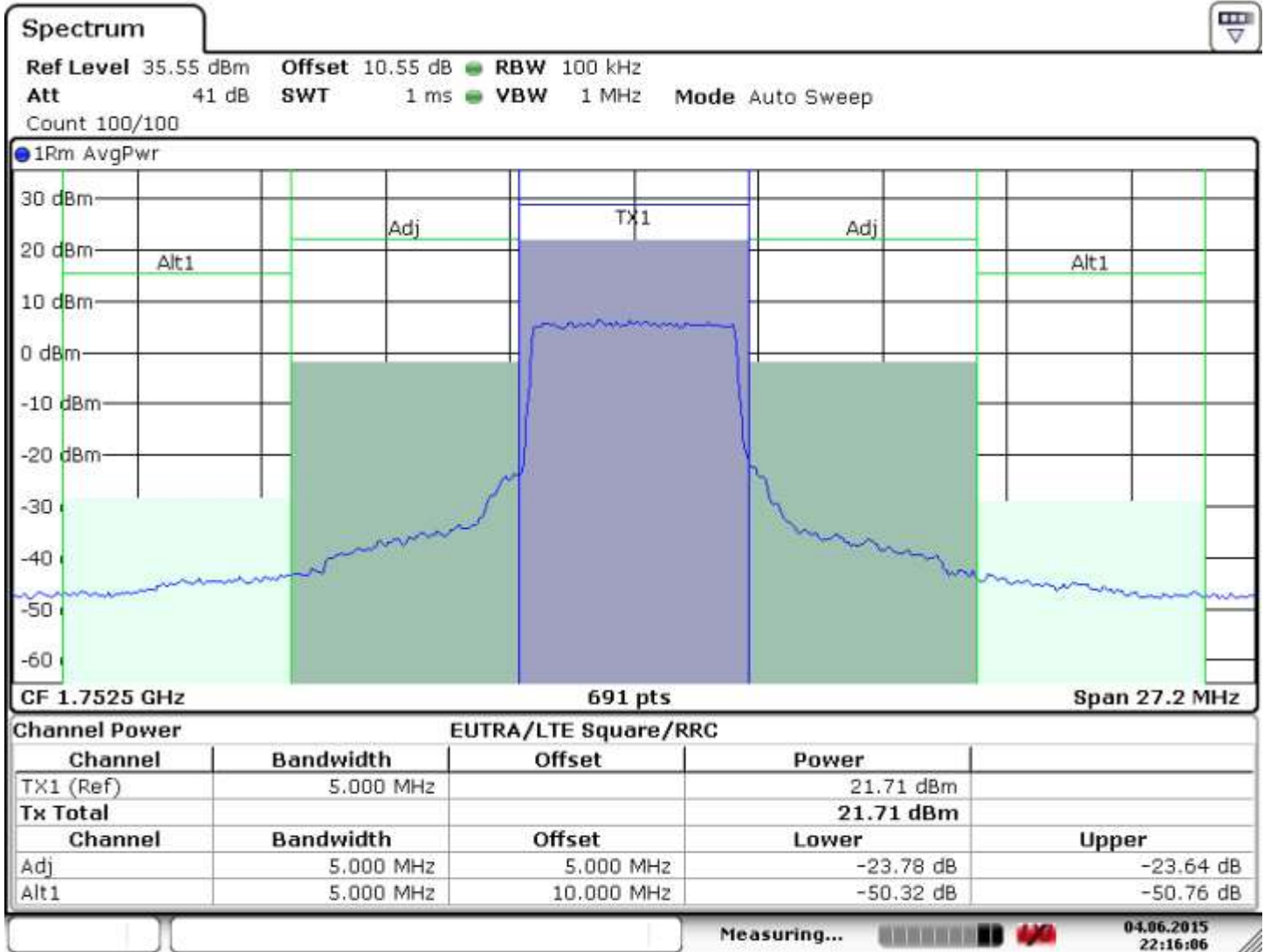
Date: 4.JUN.2015 22:13:34

6.2.5.1.7 Figure 5 Pk Pwr Band4_hi_5



Date: 4.JUN.2015 05:52:42

6.2.5.1.8 Figure 6 Avg Pwr Band4_hi_5

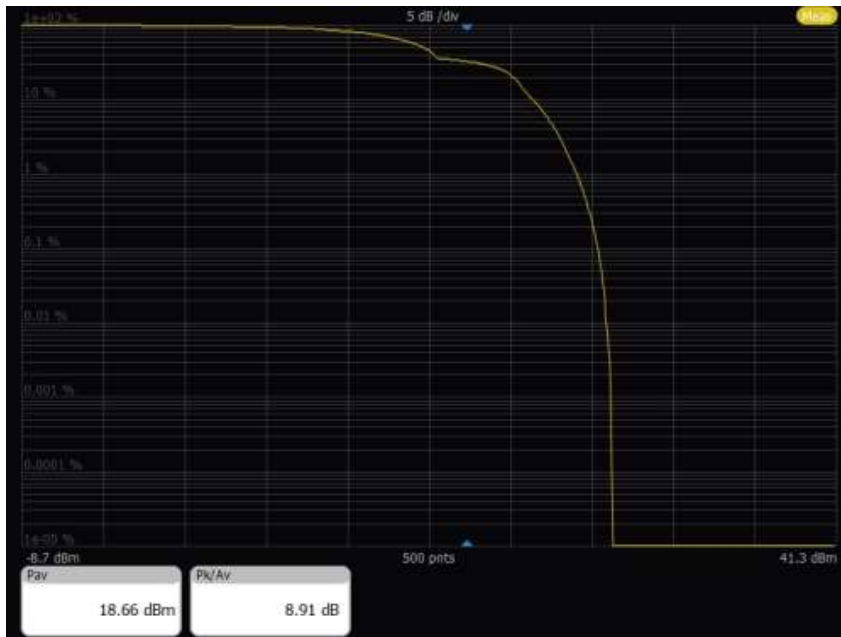


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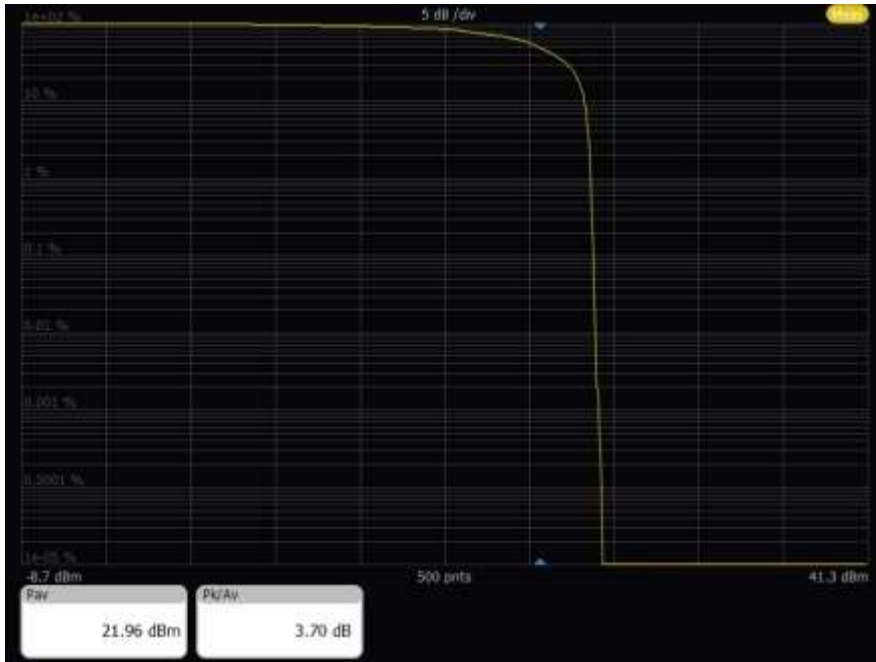
6.2.5.1.9 Conducted Output Power LTE Band 4 QPSK 10 MHz (100% RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 50				BW (MHz) = 10			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
20050/1720	27.57	18.66	8.91	2	20.66	30	Pass
20175/1732.5	25.66	21.96	3.70	2	23.96	30	Pass
20300/1745	27.98	21.25	6.73	2	21.25	30	Pass

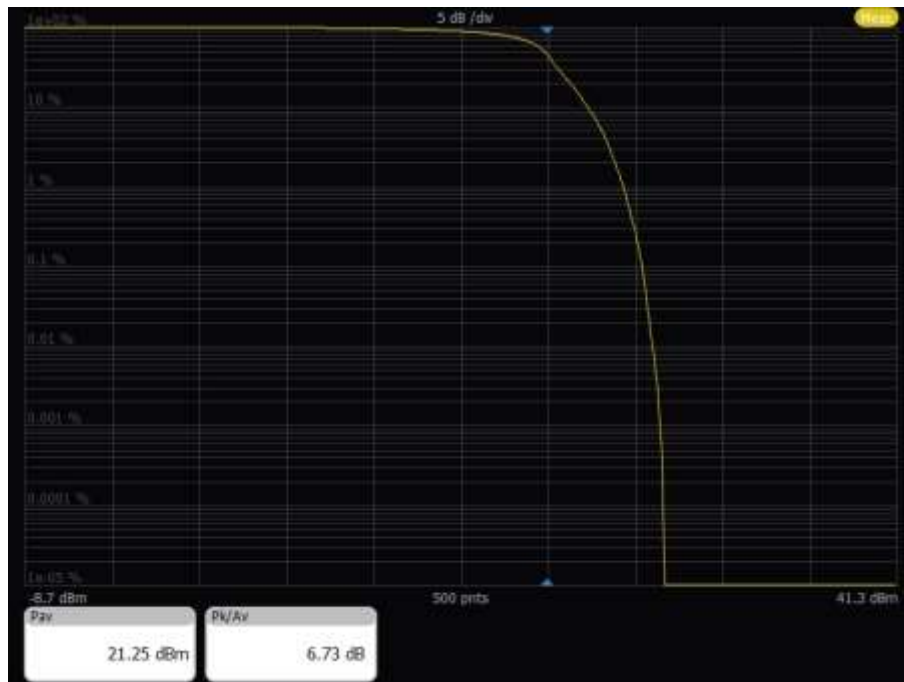
6.2.5.1.10 Figure 7 Avg Pwr Band4_Low_10



6.2.5.1.11 Figure 8 Avg Pwr Band4_Mid_10



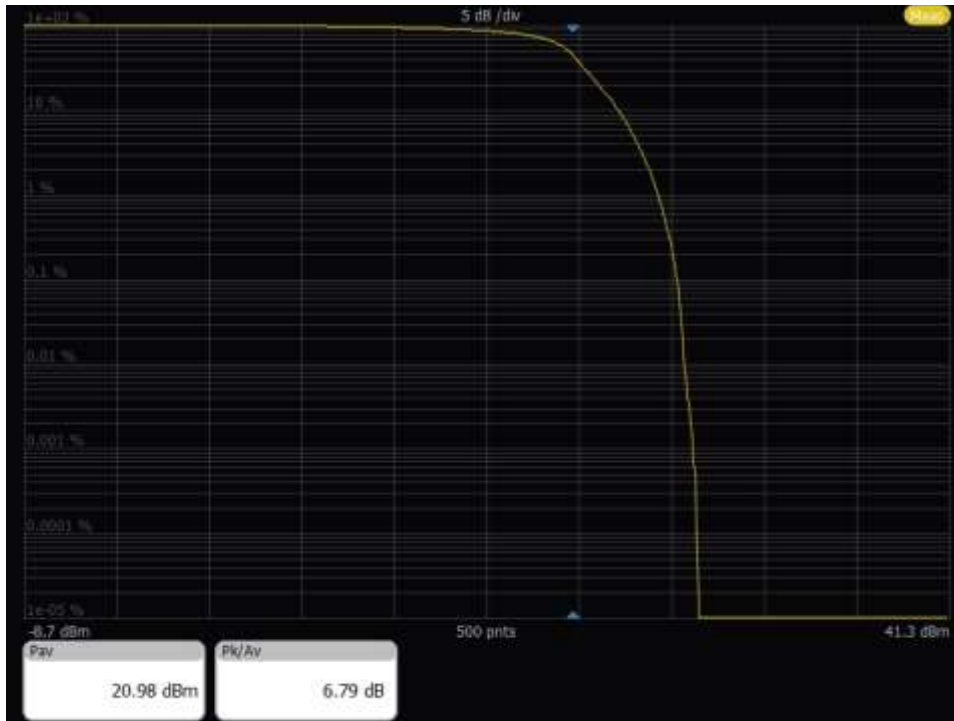
6.2.5.1.12 Figure 9 Avg Pwr Band4_High_10



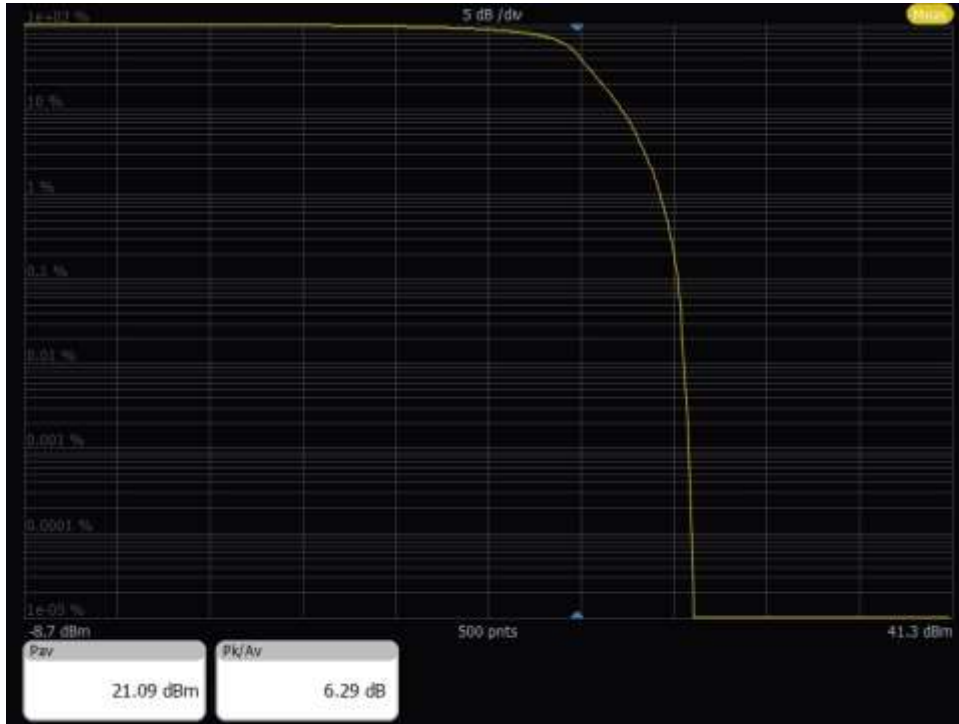
6.2.5.1.13 Conducted Output Power LTE Band 4 QPSK 15 MHz (100% RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 75				BW (MHz) = 15			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
20050/1720	27.96	20.98	6.98	2	22.98	30	Pass
20175/1732.5	27.38	21.09	6.29	2	23.08	30	Pass
20300/1745	27.57	21.12	6.45	2	23.12	30	Pass

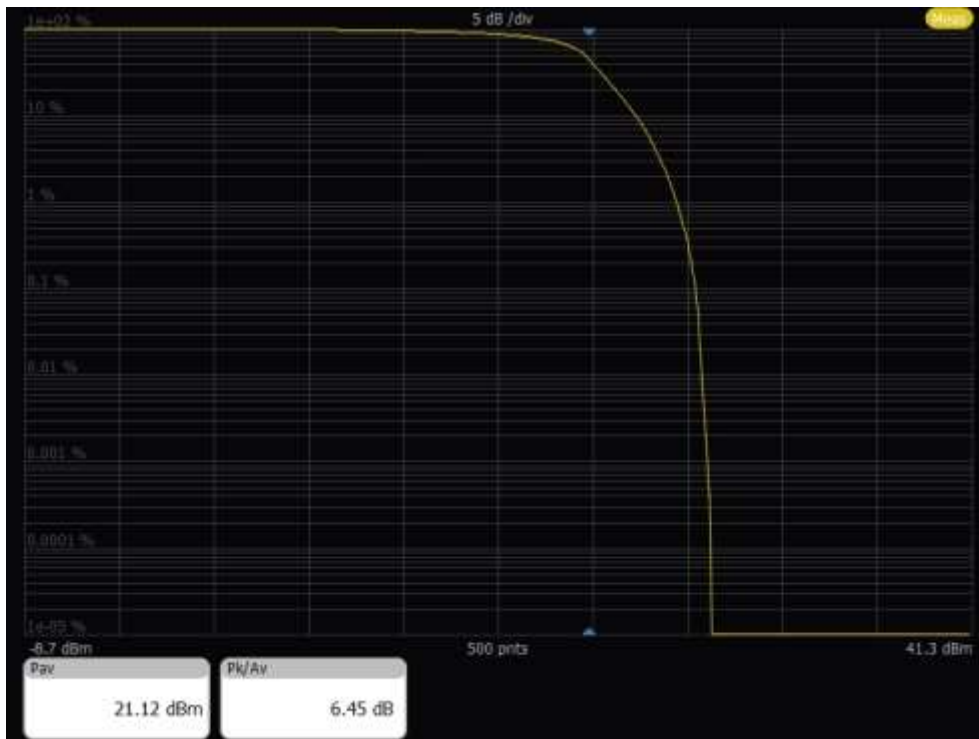
6.2.5.1.14 Figure 10 Avg Pwr Band4_Low_15



6.2.5.1.15 Figure 11 Avg Pwr Band4_Mid_15



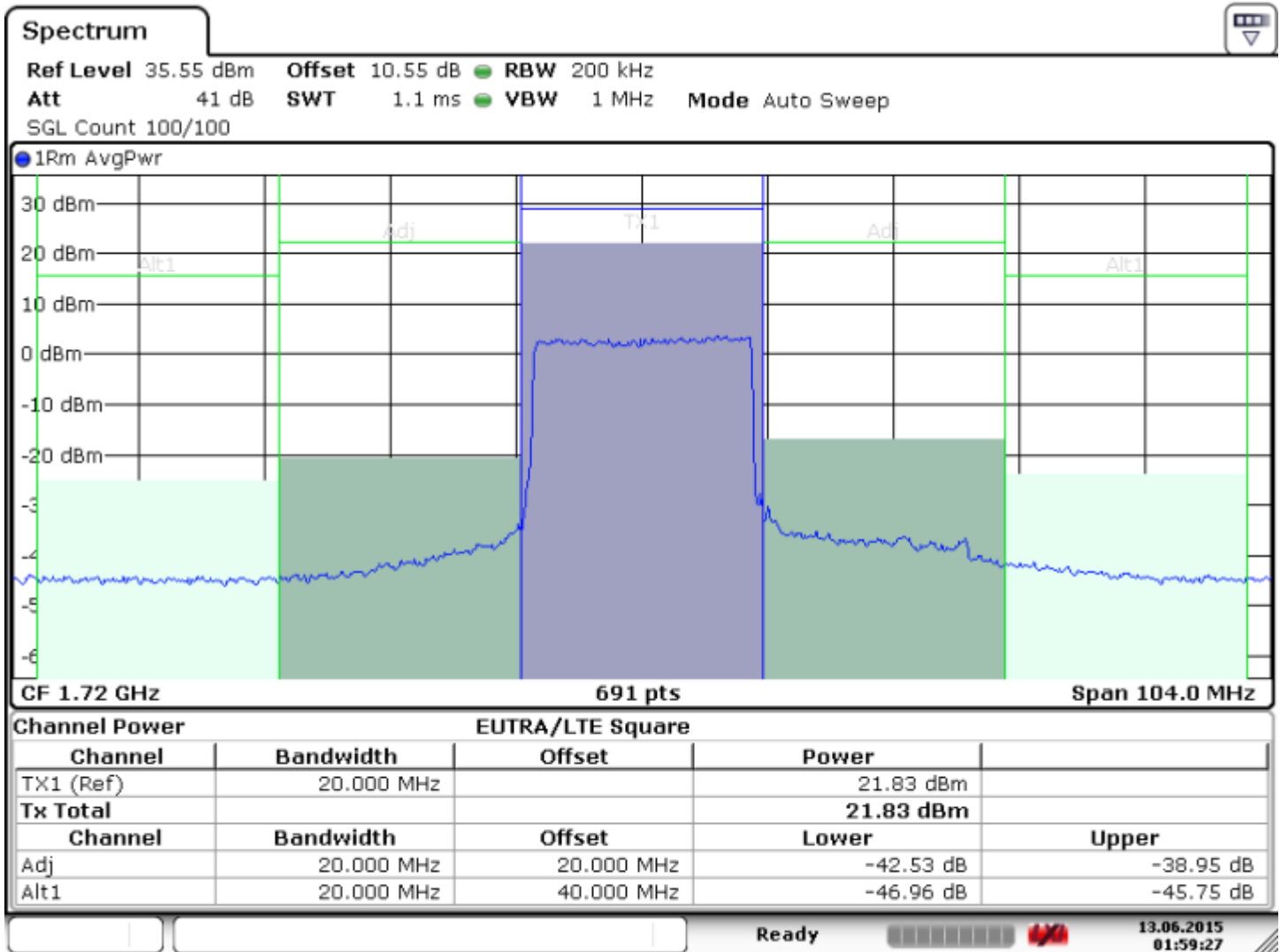
6.2.5.1.16 Figure 12 Avg Pwr Band4_High_15



6.2.5.1.17 Conducted Output Power LTE Band 4 QPSK 20 MHz (100% RB)

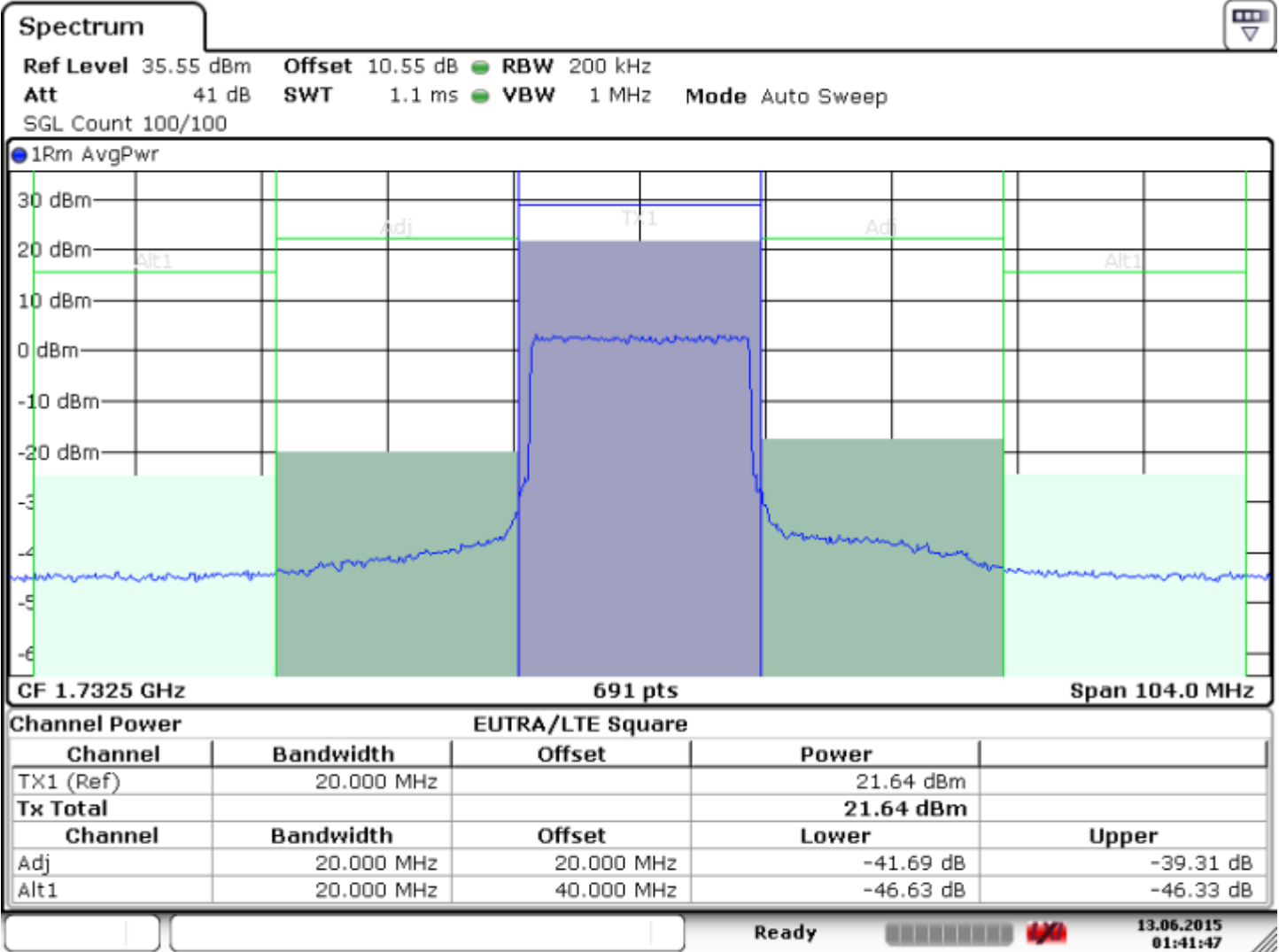
LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 100				BW (MHz) = 20			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
20050/1720	28.09	21.83	6.26	2	23.83	30	Pass
20175/1732.5	27.73	21.64	6.09	2	23.64	30	Pass
20300/1745	28.19	21.91	6.28	2	23.91	30	Pass

6.2.5.1.18 Figure 13 Avg Pwr Band4 lo_20



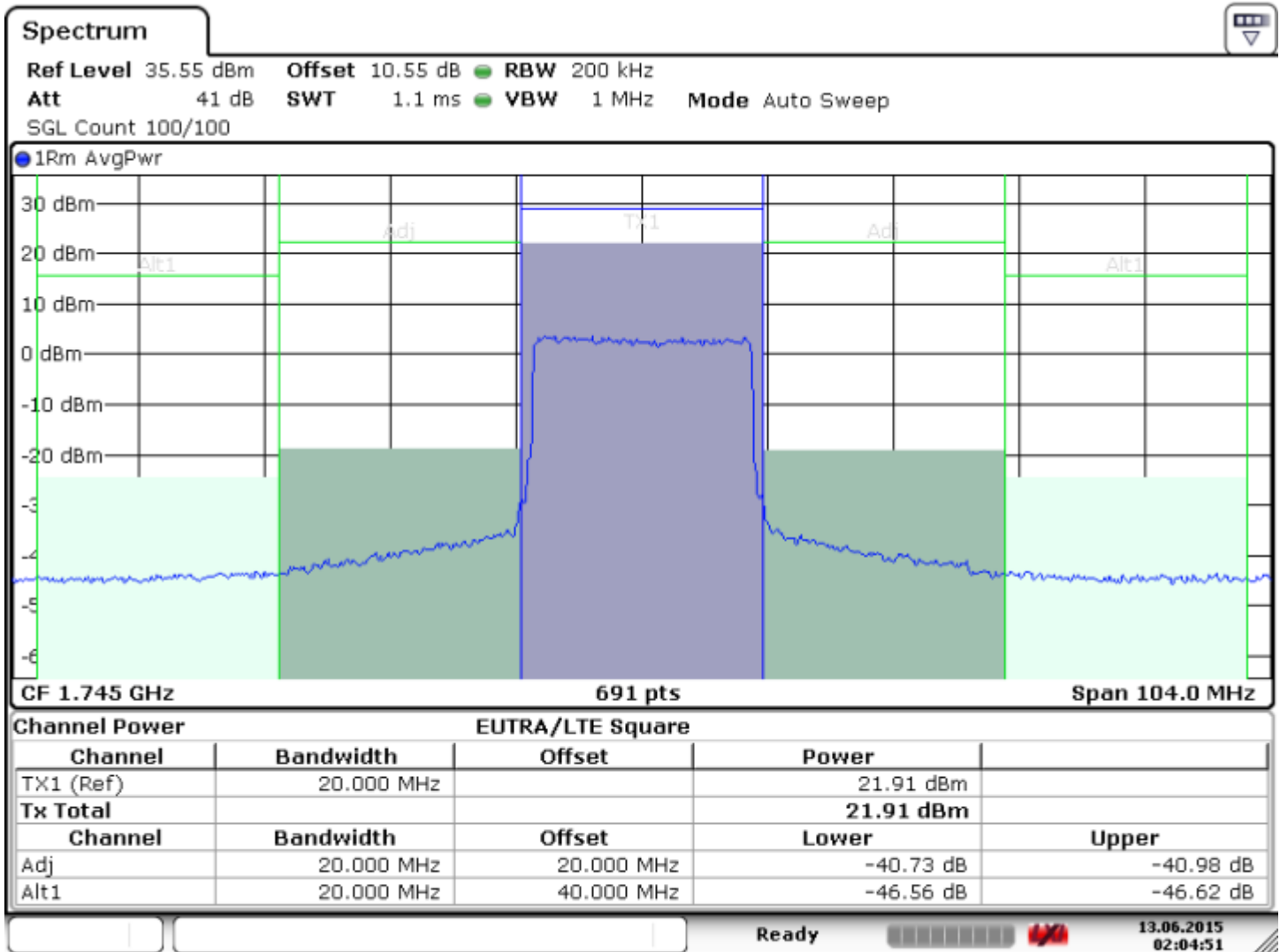
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6.2.5.1.19 Figure 14 Avg Pwr Band4 mid 20



Date: 13.JUN.2015 01:41:47

6.2.5.1.20 Figure 15 Avg Pwr Band4_hi_20



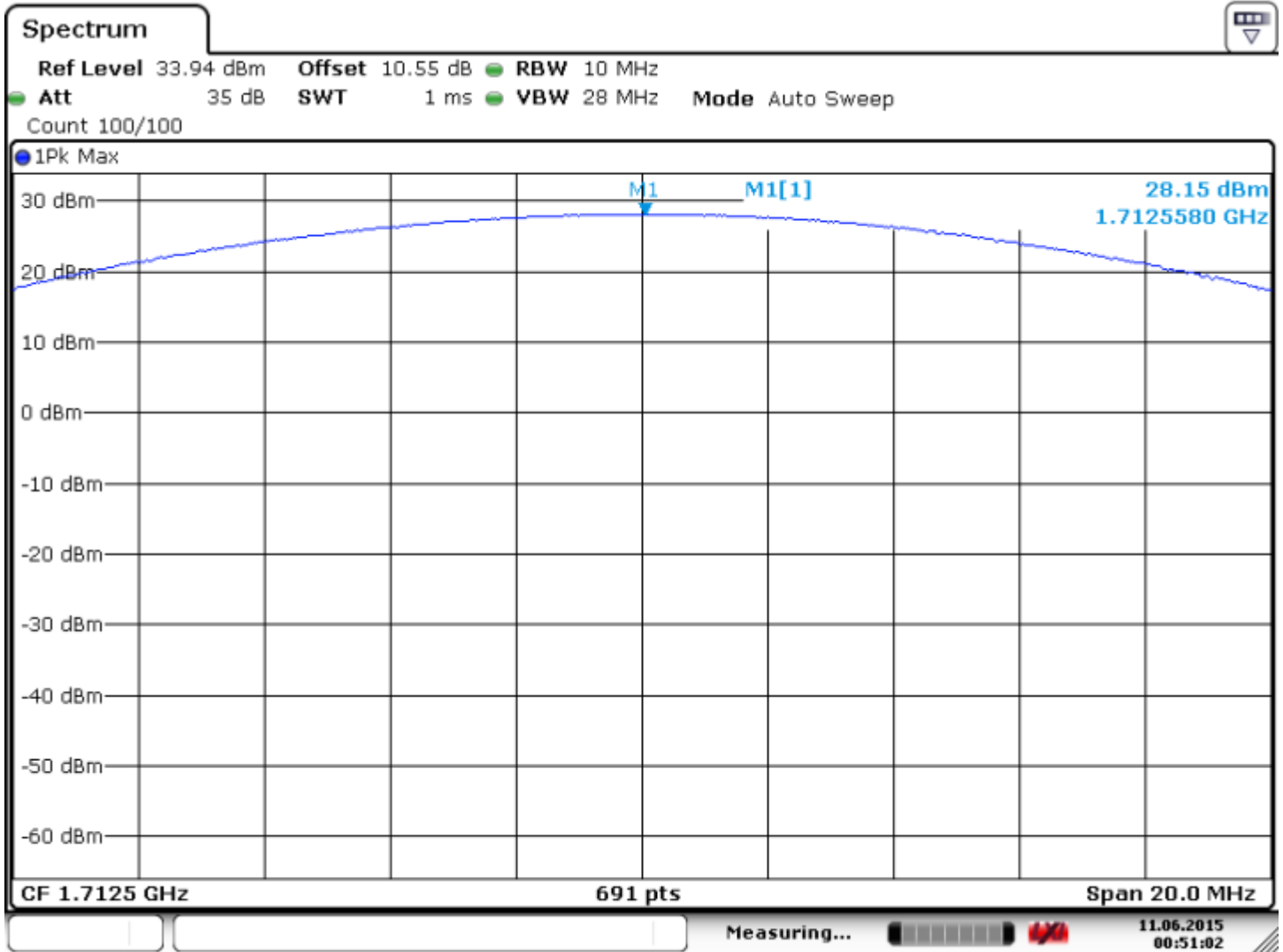
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6.2.5.1.21 Conducted Output Power LTE Band 4 QAM 5 MHz (100% RB)

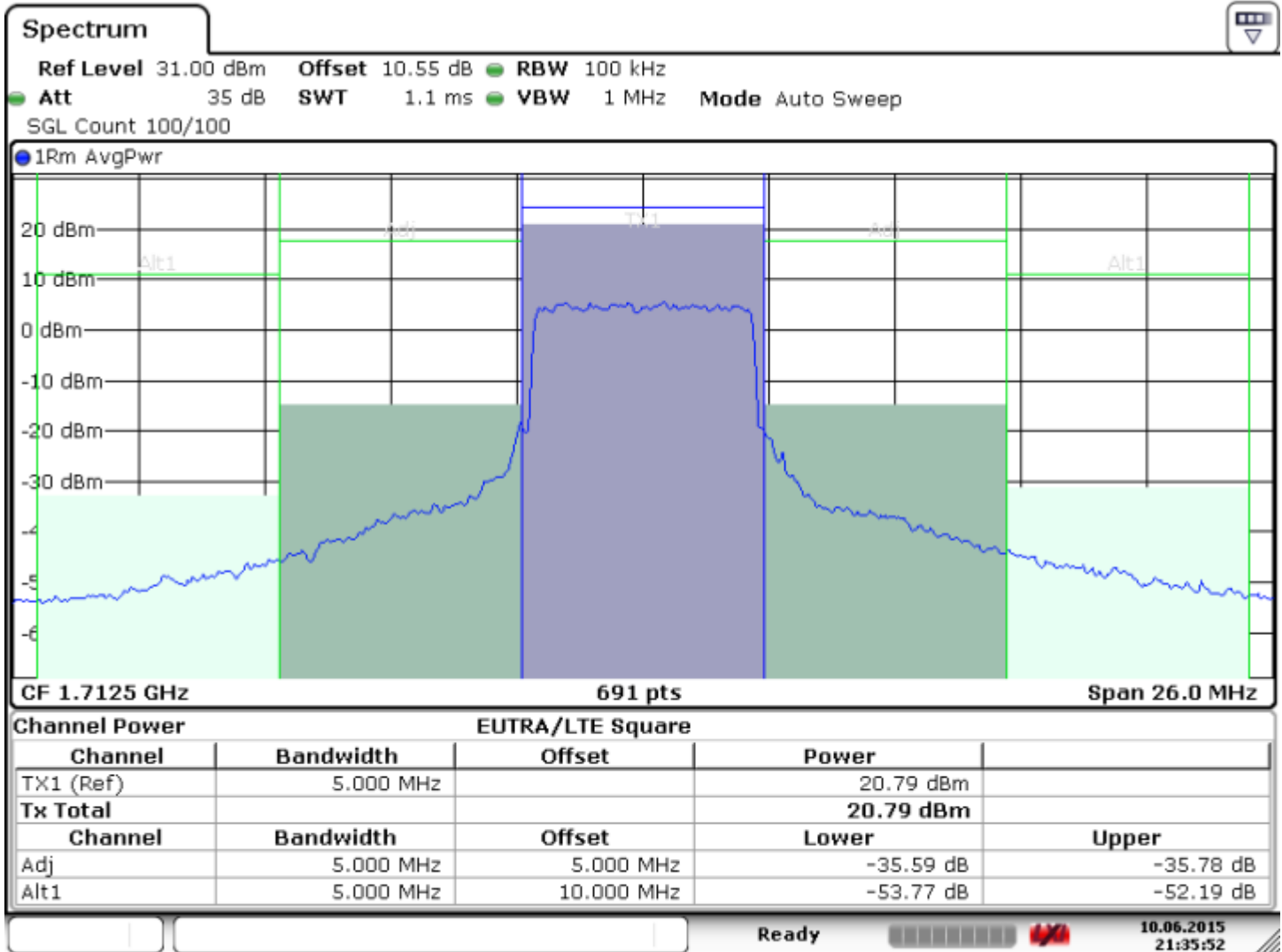
LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 25				BW (MHz) = 5.0			
Modulation: QAM							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1712.5	28.15	20.79	7.36	2	22.79	30	Pass
20175/1732.5	27.93	20.76	7.17	2	22.76	30	Pass
20375/1752.5	27.94	20.75	7.19	2	22.75	30	Pass

6.2.5.1.22 Figure 16 Pk Pwr Band 4 Lo 5



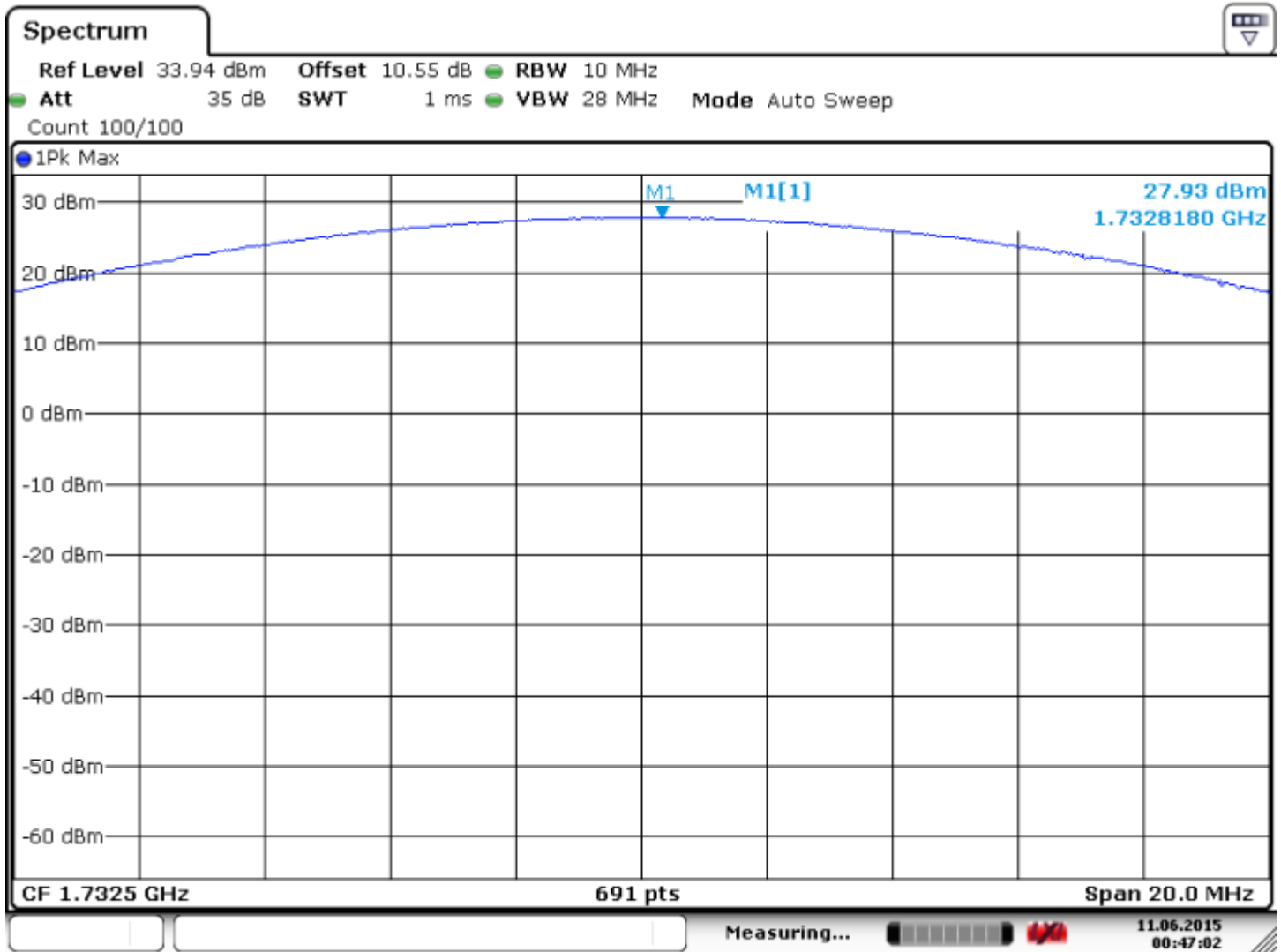
Date: 11.JUN.2015 00:51:02

6.2.5.1.23 Figure 17 Avg Pwr Band 4 Lo 5



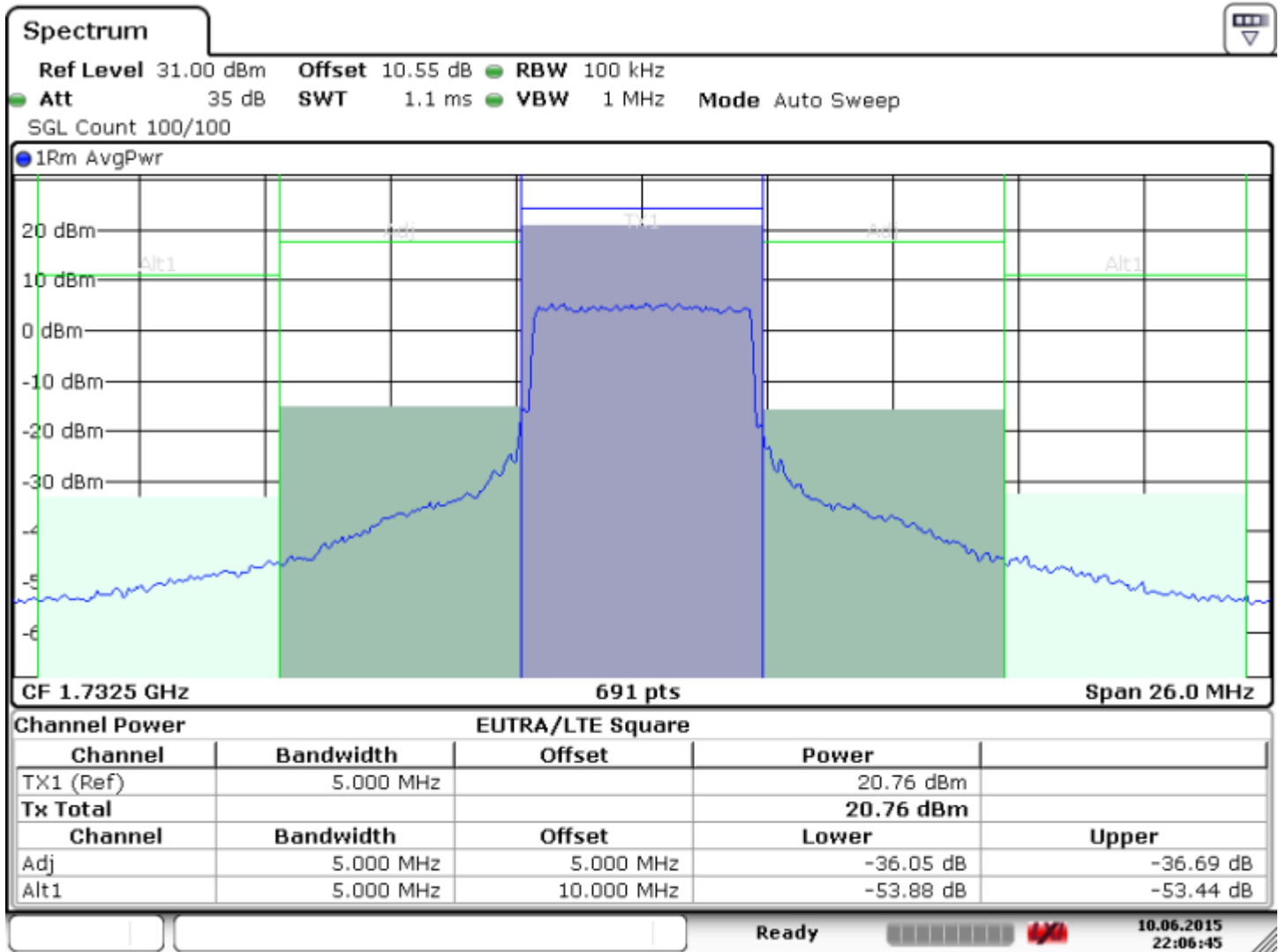
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6.2.5.1.24 Figure 18 Pk Pwr Band 4 mid 5



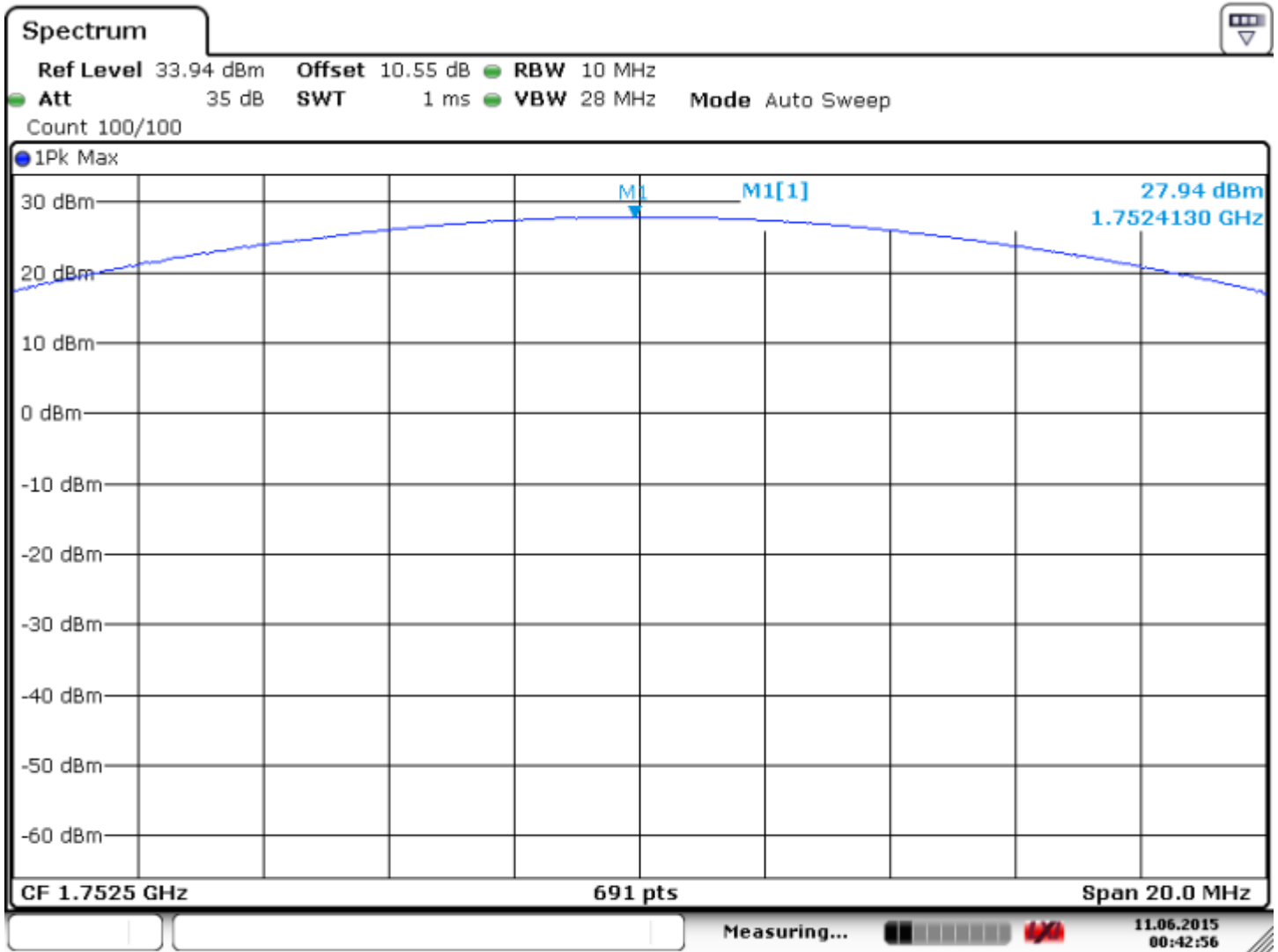
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6.2.5.1.25 Figure 119 Avg Pwr Band 4 mid_5



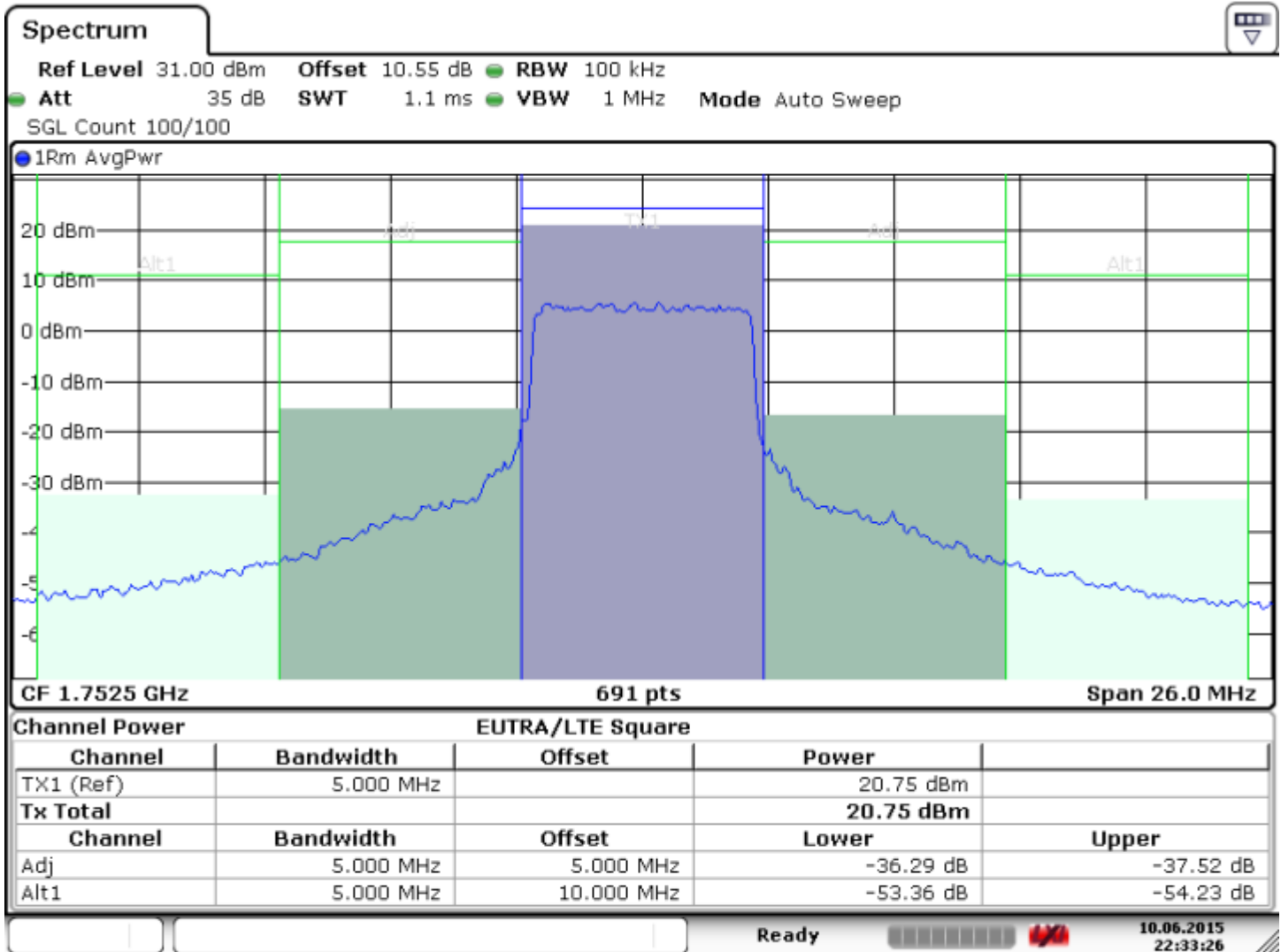
Date: 10.JUN.2015 22:06:45

6.2.5.1.26 Figure 20 Pk Pwr Band 4 Hi 5



Date: 11.JUN.2015 00:42:56

6.2.5.1.27 Figure 21 Avg Pwr Band 4 Hi 5

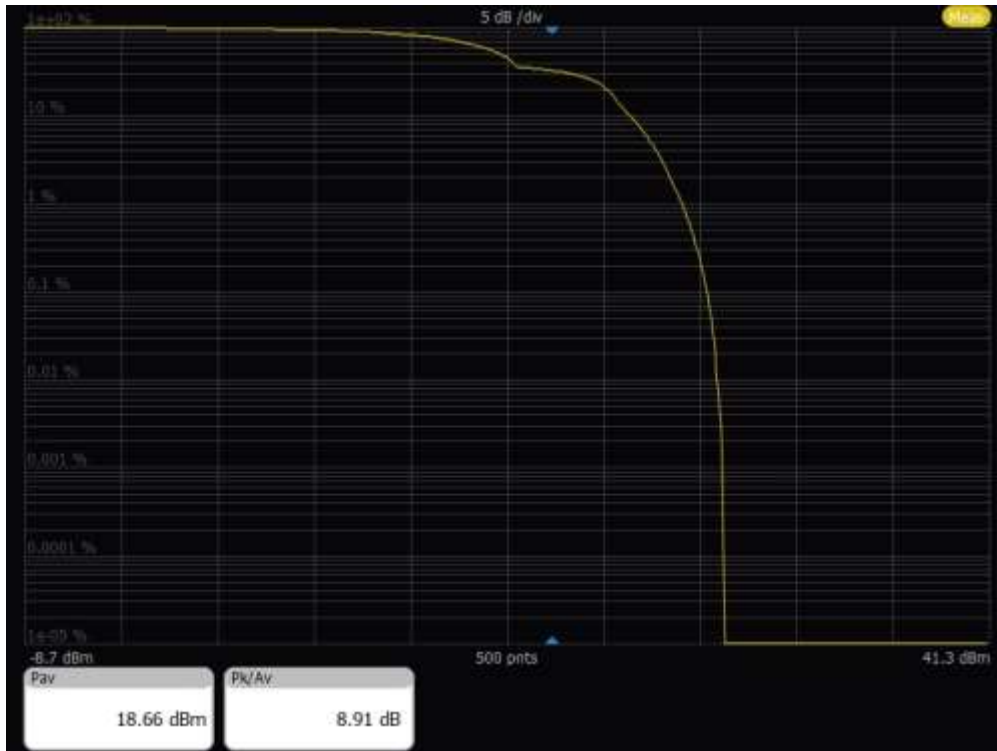


Date: 10.JUN.2015 22:33:26

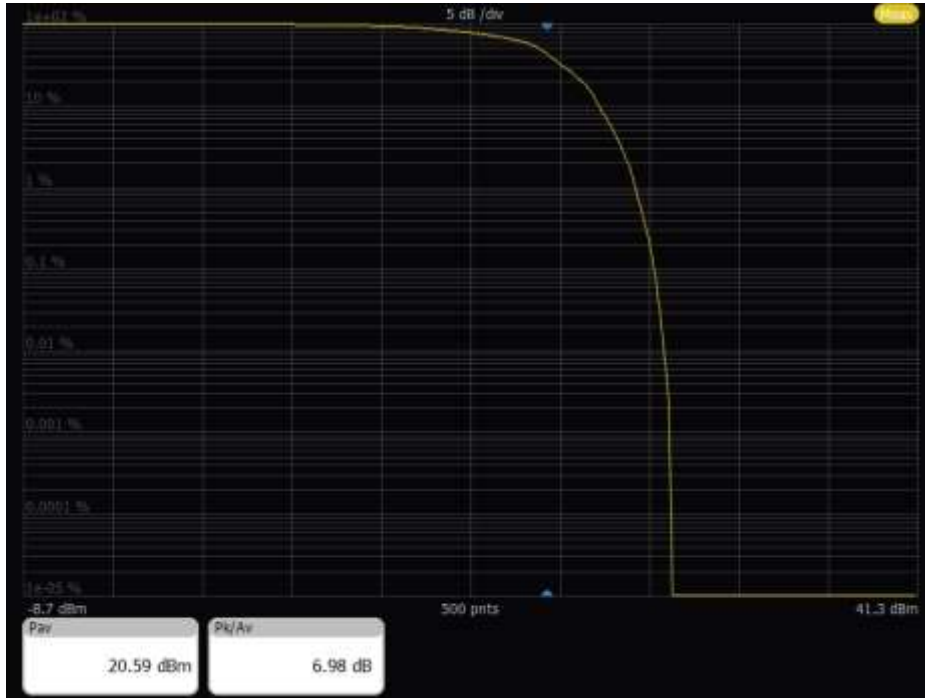
6.2.5.1.28 Conducted Output Power LTE Band 4 QAM 10 MHz (100% RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 50				BW (MHz) = 10.0			
Modulation: QAM							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1720	27.57	20.37	7.20	2	22.37	30	Pass
20175/1732.5	27.57	20.59	6.98	2	22.59	30	Pass
20375/1745	28.97	21.13	7.84	2	22.13	30	Pass

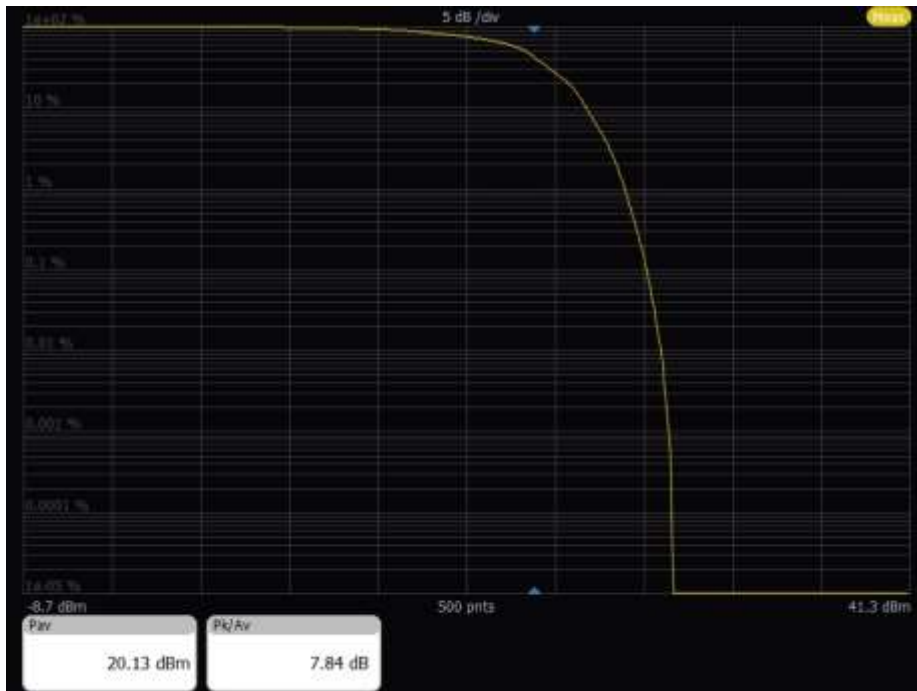
6.2.5.1.29 Figure 22 Avg Pwr Band 4 Low 10



6.2.5.1.30 Figure 23 Avg Pwr Band 4 Mid 10



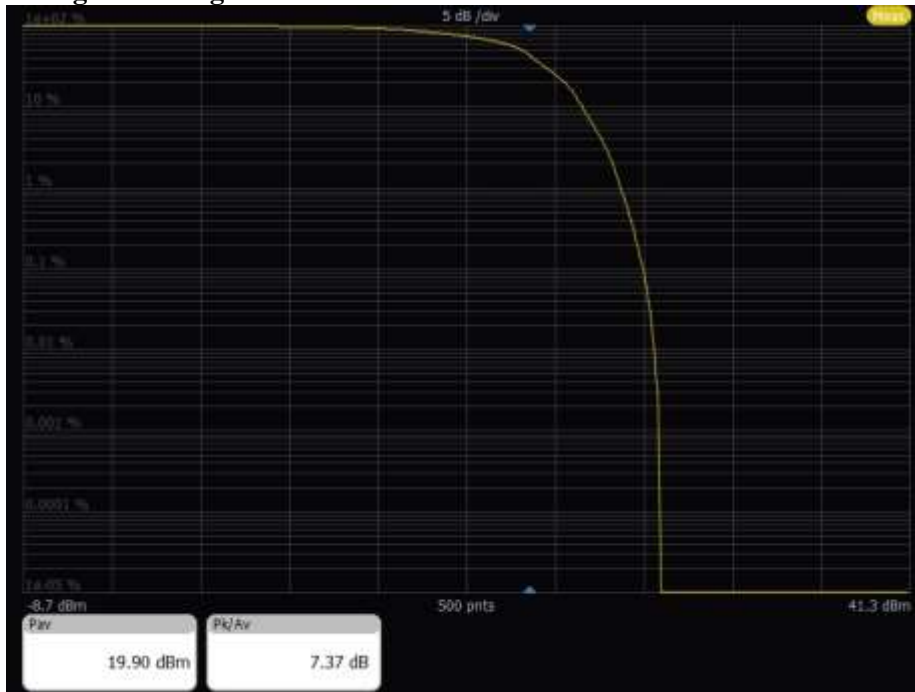
6.2.5.1.31 Figure 23 Avg Pwr Band 4 High 10



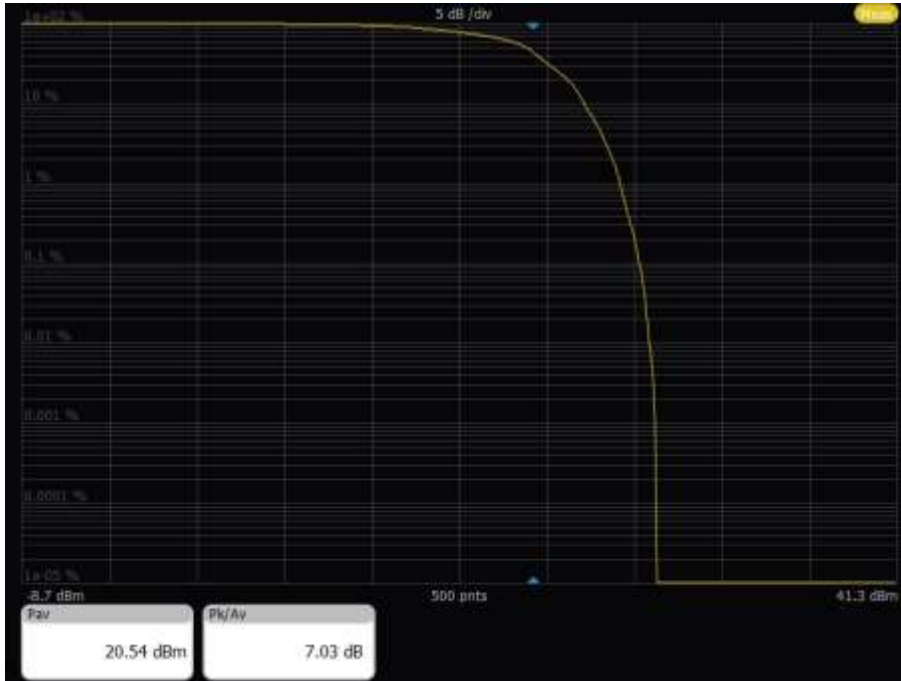
6.2.5.1.32 Conducted Output Power LTE Band 4 QAM 15 MHz (100% RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 75				BW (MHz) = 15.0			
Modulation: QAM (29 RB supported)							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1720	27.27	19.90	7.37	2	21.90	30	Pass
20175/1732.5	27.57	20.54	7.03	2	22.54	30	Pass
20375/1745	27.68	19.62	8.06	2	21.62	30	Pass

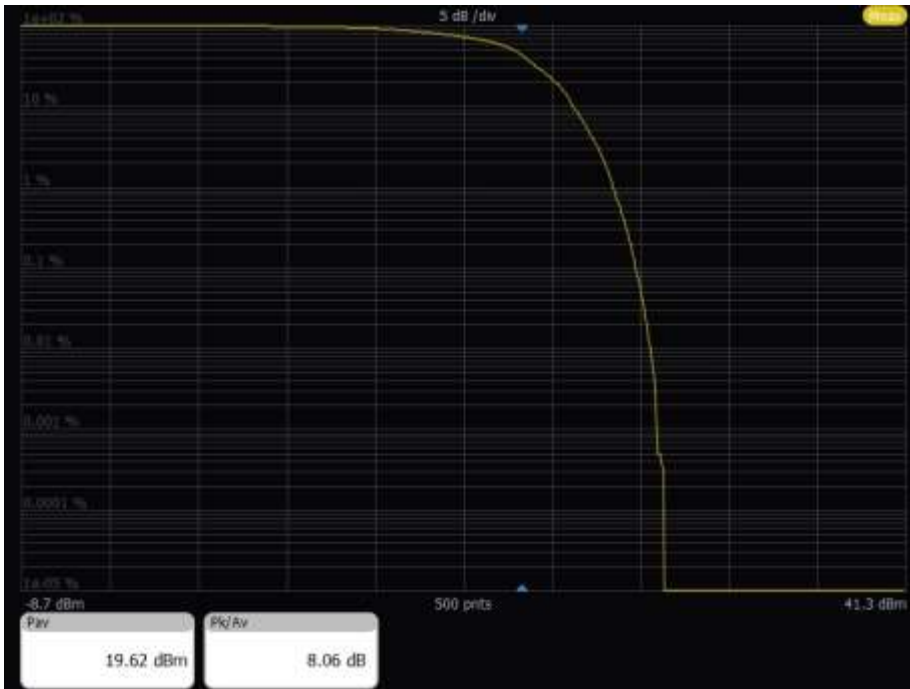
6.2.5.1.33 Figure 24 Avg Pwr Band 4 Low 15



6.2.5.134 Figure 25 Avg Pwr Band 4 Mid 15



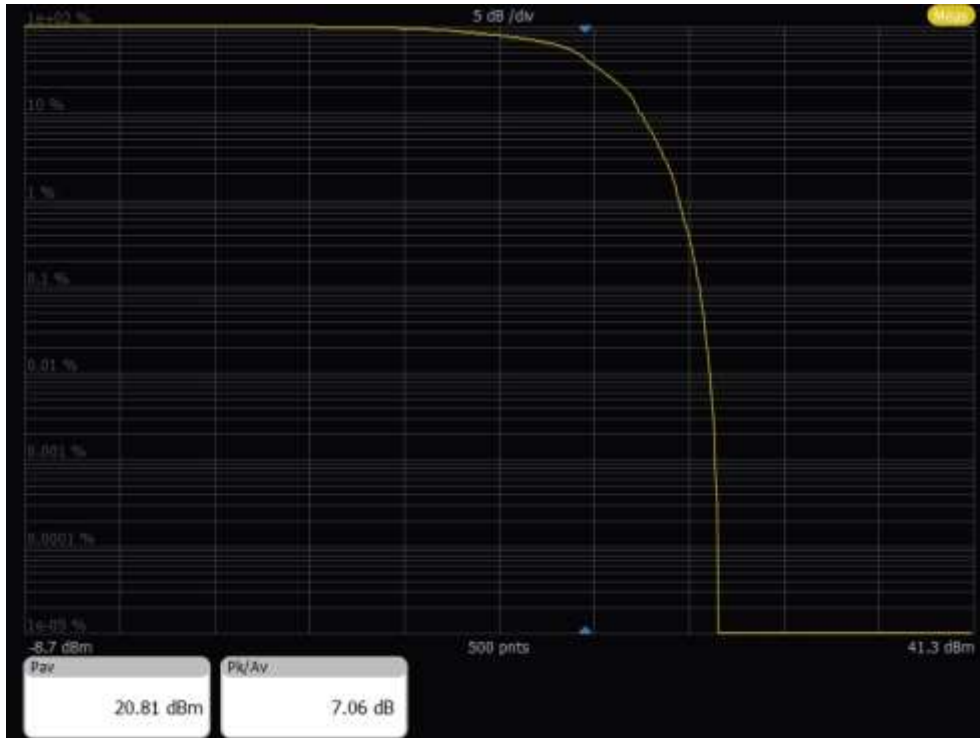
6.2.5.135 Figure 26 Avg Pwr Band 4 High 15



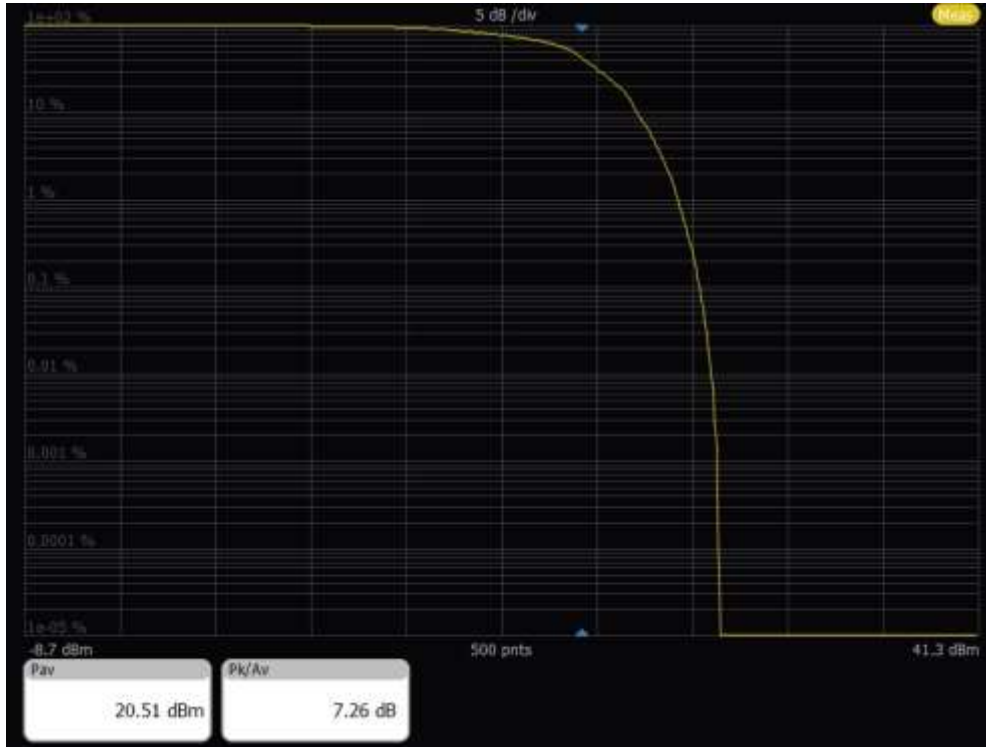
6.2.5.1.36 Conducted Output Power LTE Band 4 QAM 20 MHz (100% RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 100				BW (MHz) = 20.0			
Modulation: QAM (29 RB supported)							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1720	27.87	20.81	7.06	2	22.81	30	Pass
20175/1732.5	27.77	20.51	7.26	2	22.51	30	Pass
20375/1745	28.18	20.54	7.64	2	22.54	30	Pass

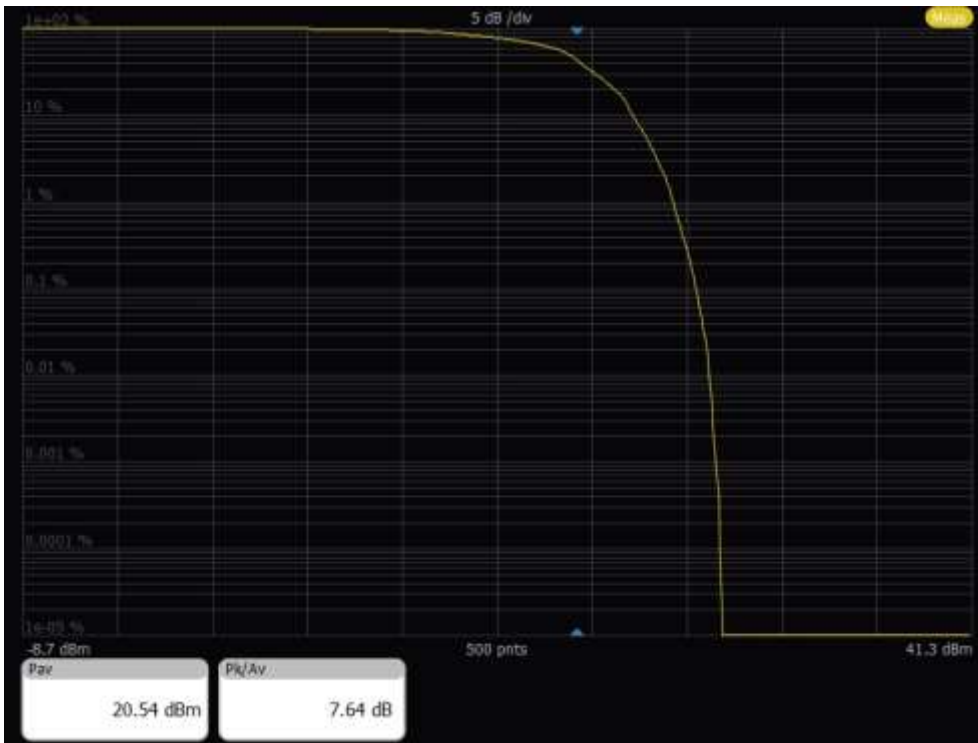
6.2.5.1.37 Figure 27 Avg Pwr Band 4 Low 20



6.2.5.1.38 Figure 28 Avg Pwr Band 4 Mid 20



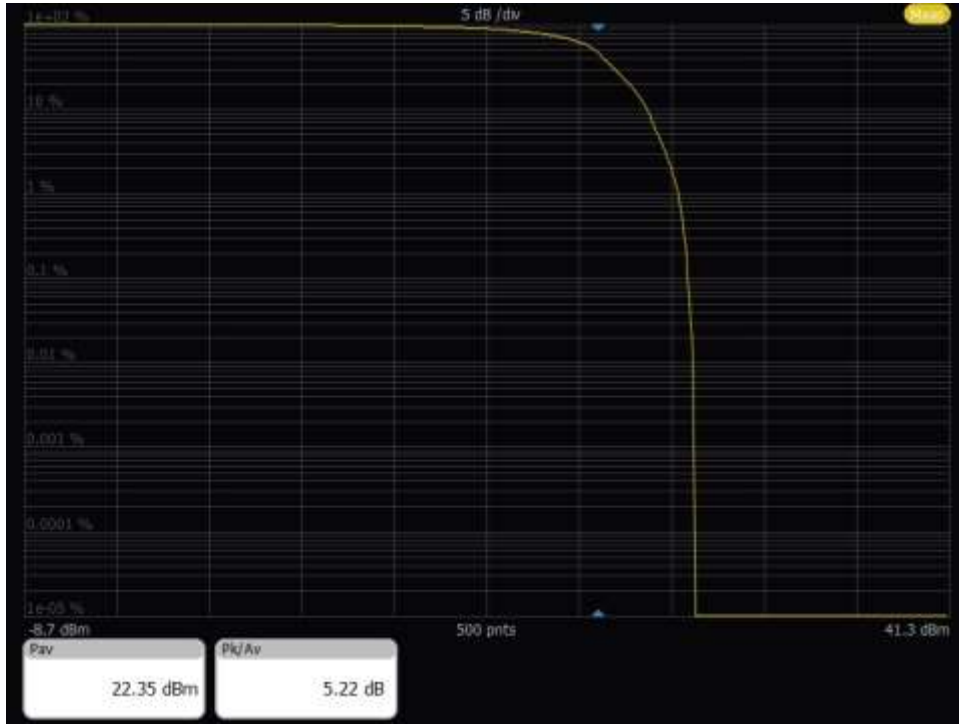
6.2.5.1.39 Figure 29 Avg Pwr Band 4 High 20



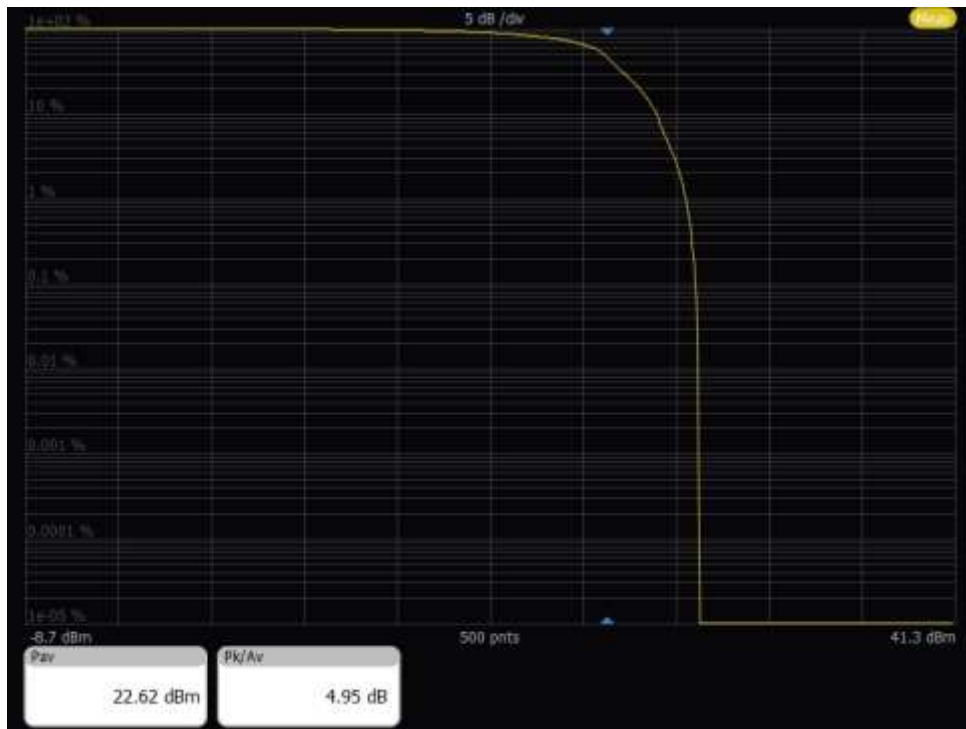
6.2.5.2 Conducted Output Power LTE Band 4 QPSK 5 MHz (1 RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 1				BW (MHz) = 5.0			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1712.5	27.57	22.35	5.22	2	24.35	30	Pass
20175/1732.5	27.57	22.62	4.95	2	24.62	30	Pass
20375/1752.5	27.77	21.76	6.01	2	23.76	30	Pass

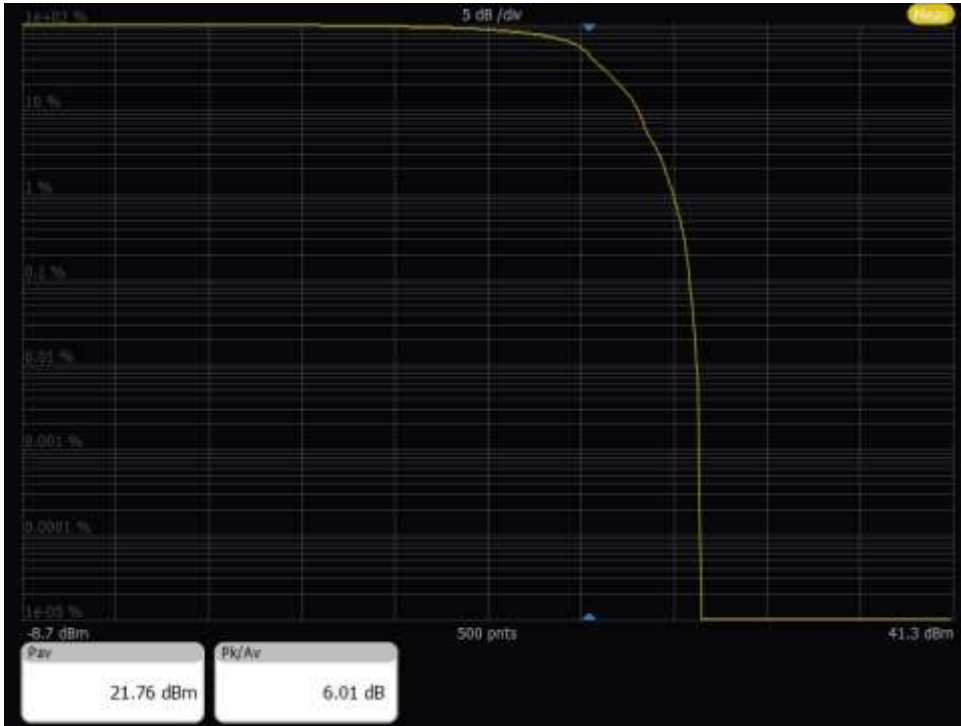
6.2.5.2.1 Figure 30 Avg Pwr Band 4 lo 5



6.2.5.2.2 Figure 31 Avg Pwr Band 4 Mid 5



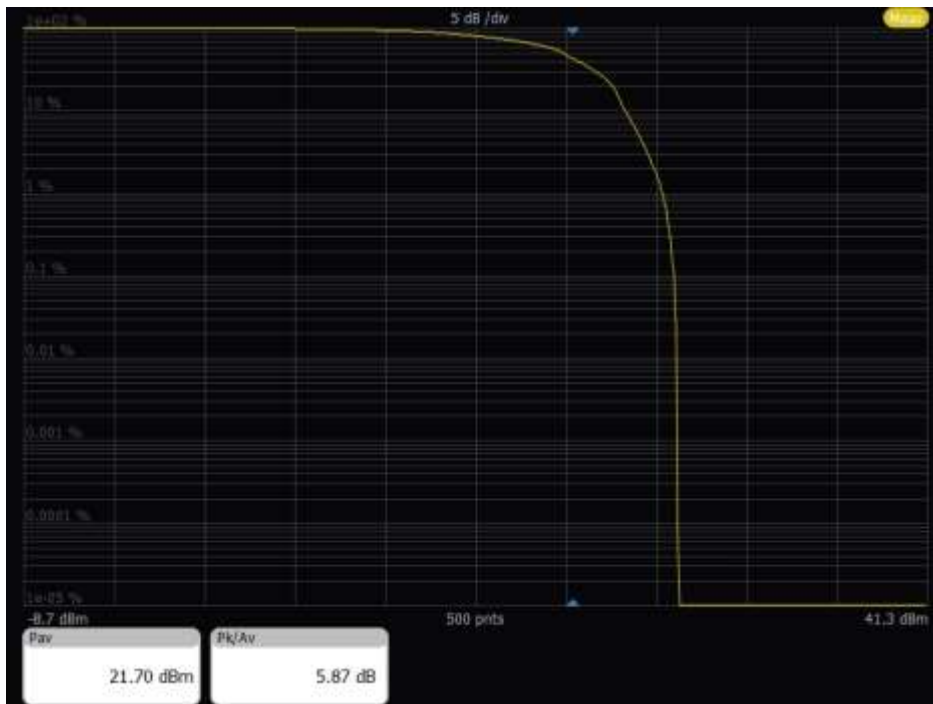
6.2.5.2.3 Figure 32 Avg Pwr Band 4 High 5



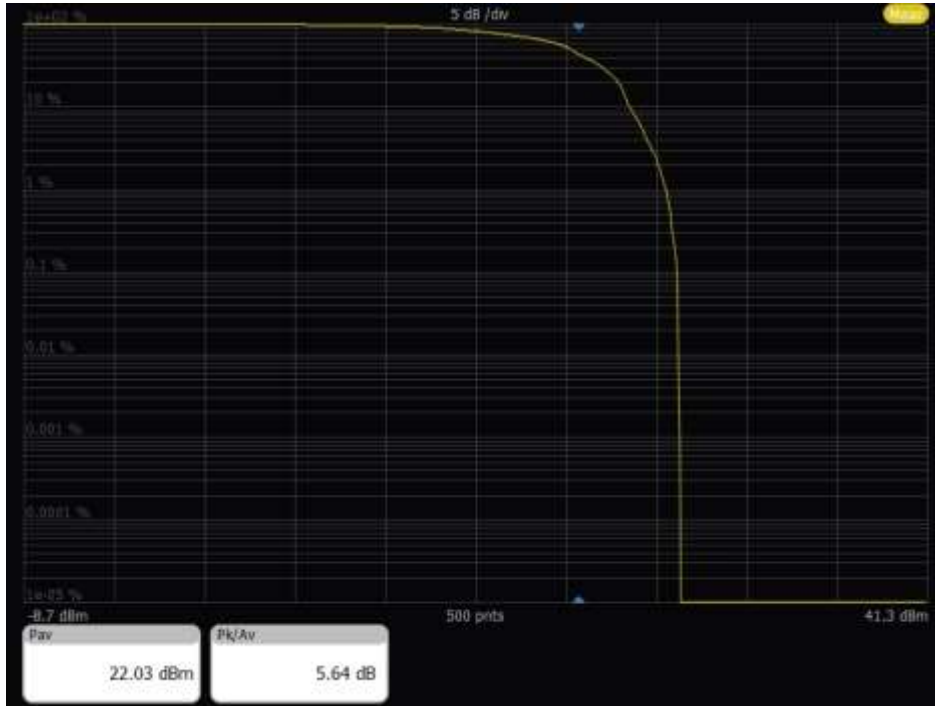
6.2.5.3 Conducted Output Power LTE Band 4 QAM 5 MHz (1 RB)

LTE Band 4 (1710 MHz – 1755 MHz)							
RB Size = 1				BW (MHz) = 5.0			
Modulation: QAM							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
19975/1712.5	27.57	21.70	5.87	2	23.70	30	Pass
20175/1732.5	27.67	22.03	5.64	2	24.03	30	Pass
20375/1752.5	27.77	21.76	6.01	2	23.76	30	Pass

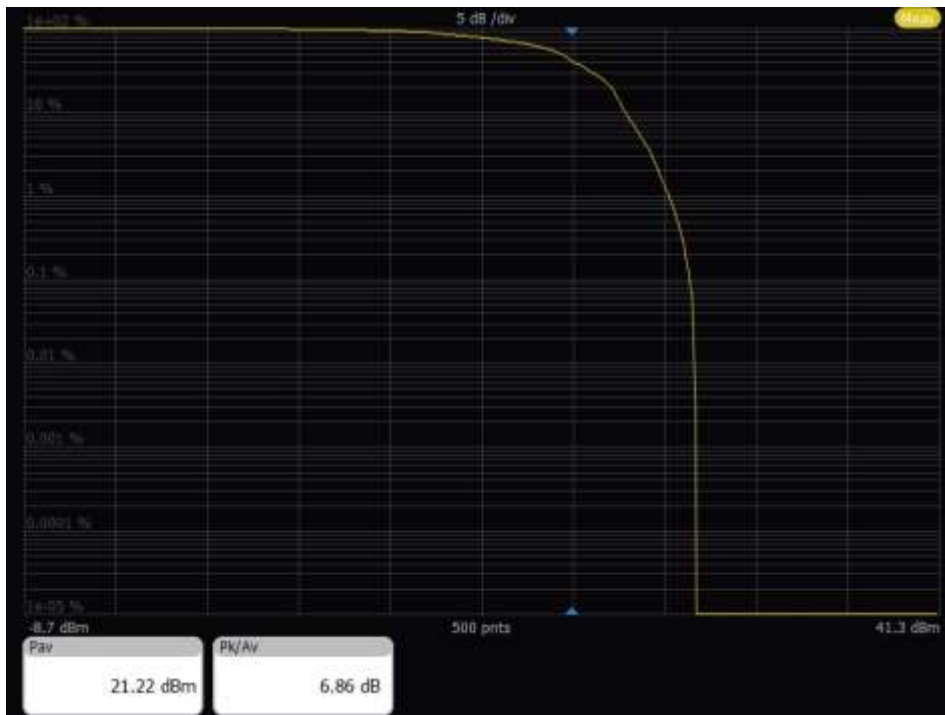
6.2.5.3.1 Figure 33 Avg Pwr Band 4 Low 5



6.2.5.3.2 Figure 34 Avg Pwr Band 4 Mid 5



6.2.5.3.3 Figure 35 Avg Pwr Band 4 High 5



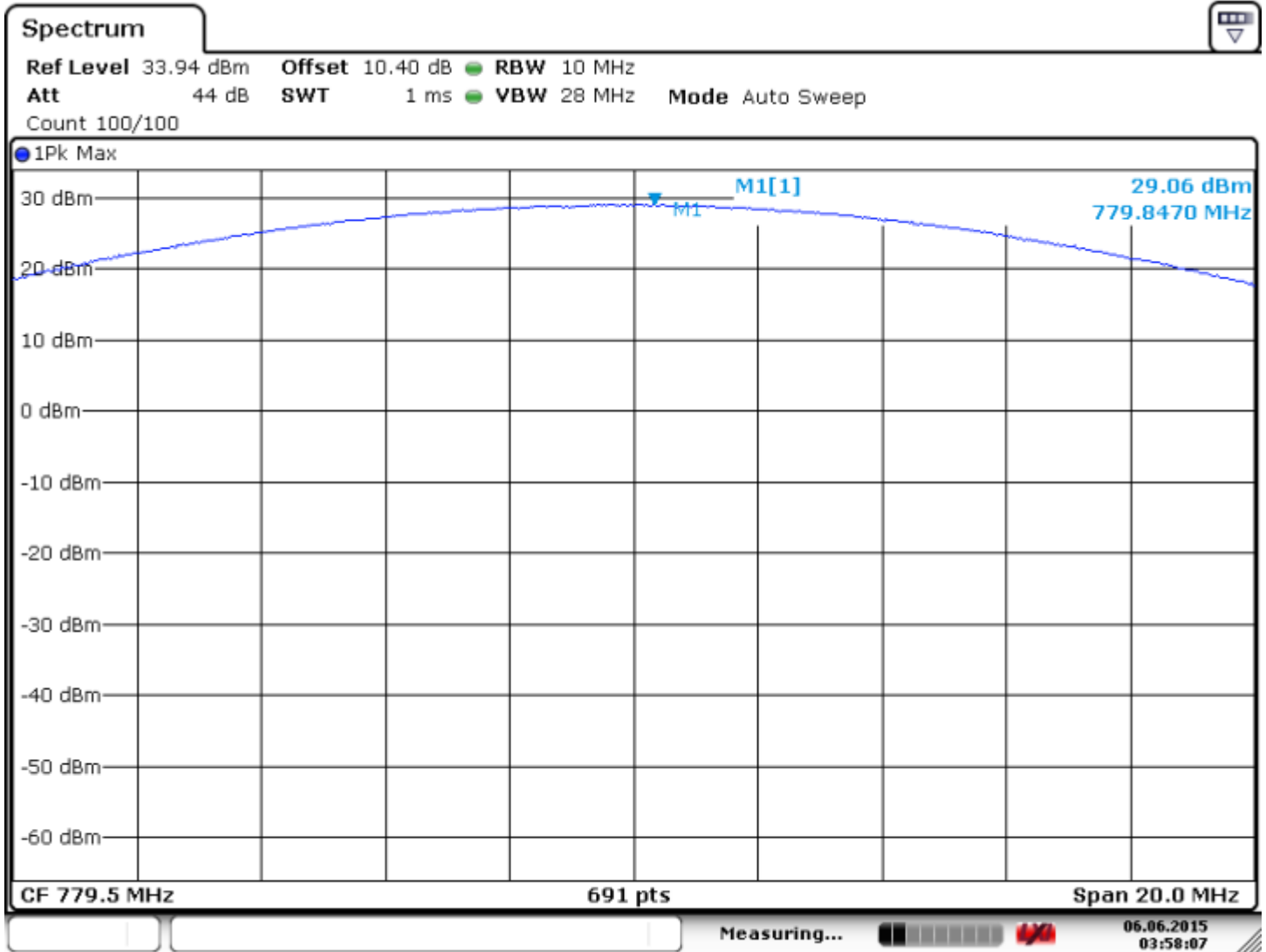


6.2.5.4 Conducted Output Power LTE Band 13 (full RB)

6.2.5.4.1 Conducted Output Power LTE Band 13 QPSK 5 MHz

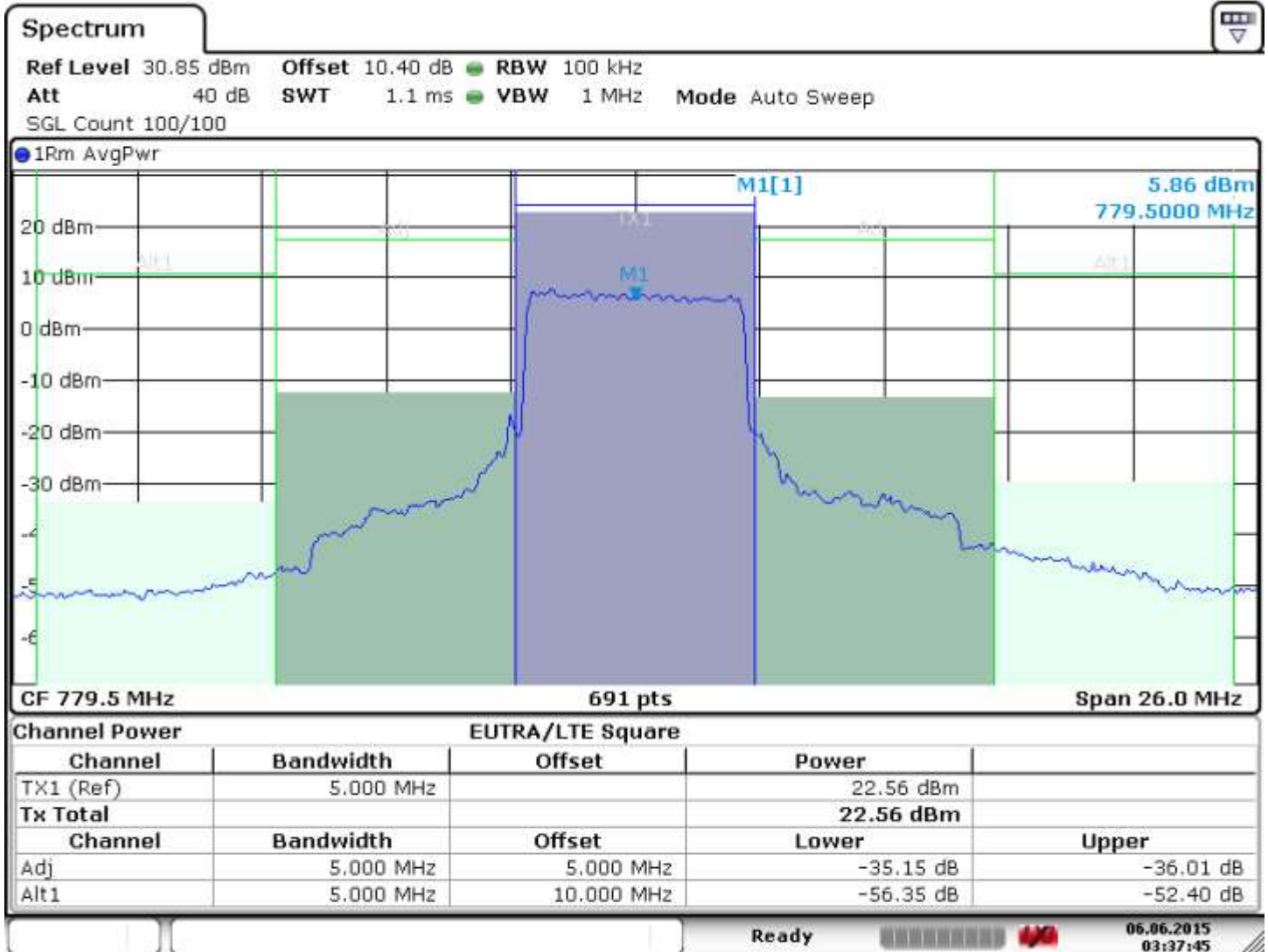
LTE Band 13 (777 MHz – 787 MHz)							
RB Size = 25				BW (MHz) = 5			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
23205/779.5	29.06	22.56	6.50	-8	14.56	34.8	Pass
23230/782	29.14	22.16	6.98	-8	14.16	34.8	Pass
23255/784.5	29.03	22.26	6.77	-8	14.26	34.8	Pass

6.2.5.4.2 Figure 36 Pk Pwr Band 13 lo 5



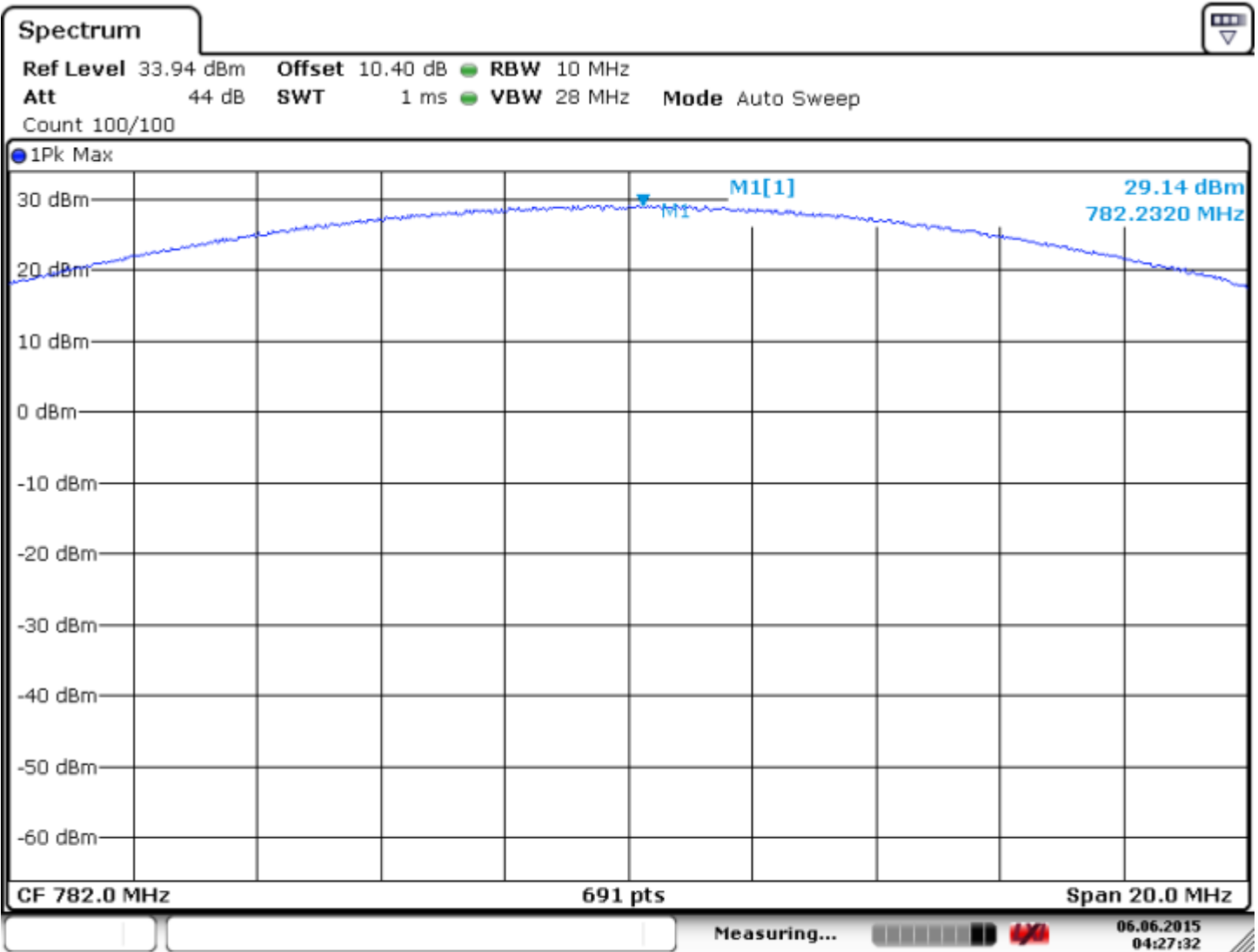
Date: 6.JUN.2015 03:58:07

6.2.5.4.3 Figure 37 AVG PWR Band 13_lo_5



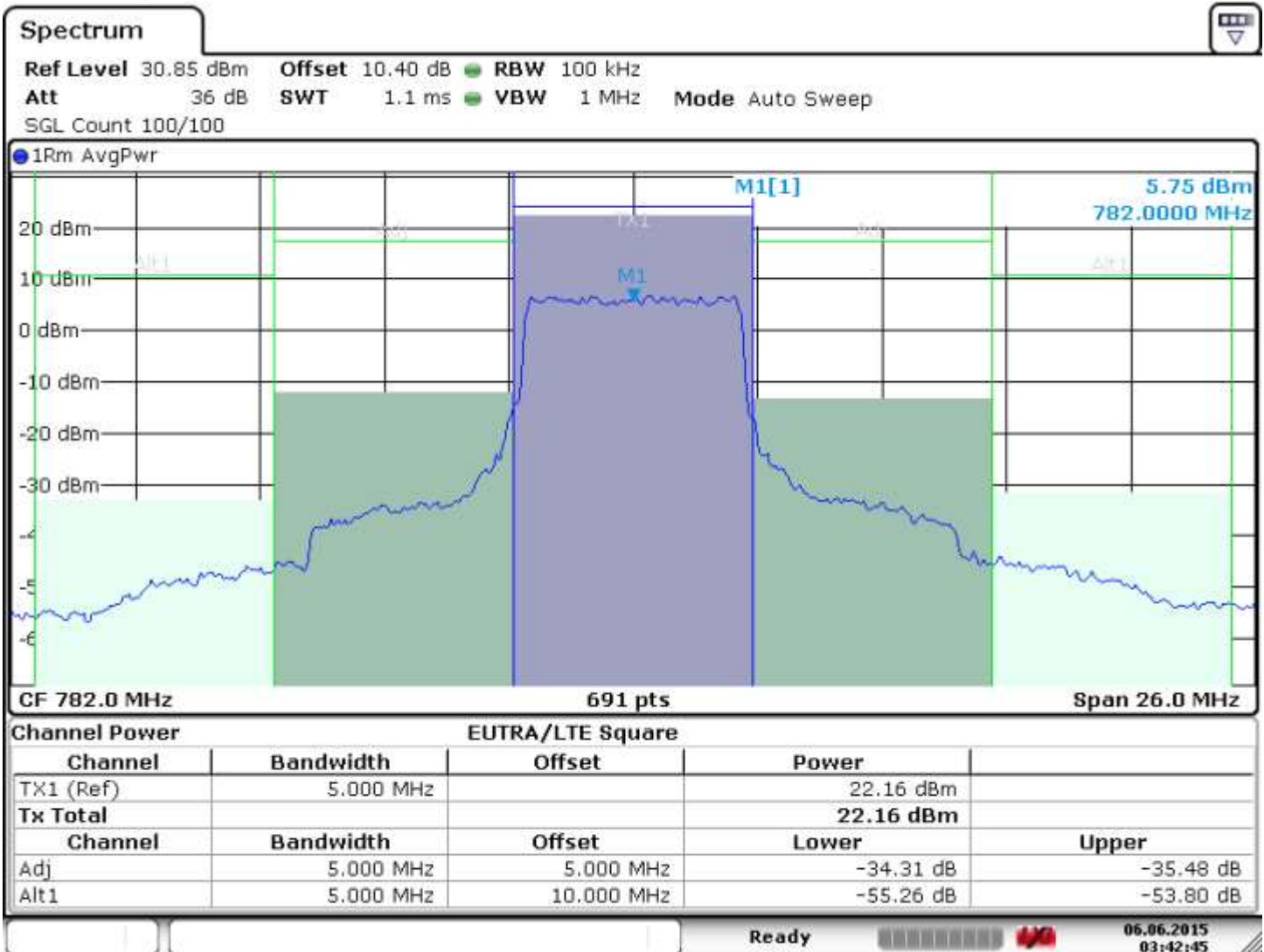
Date: 6.JUN.2015 03:37:45

6.2.5.4.4 Figure 38 Pk Pwr Band 13 mid 5



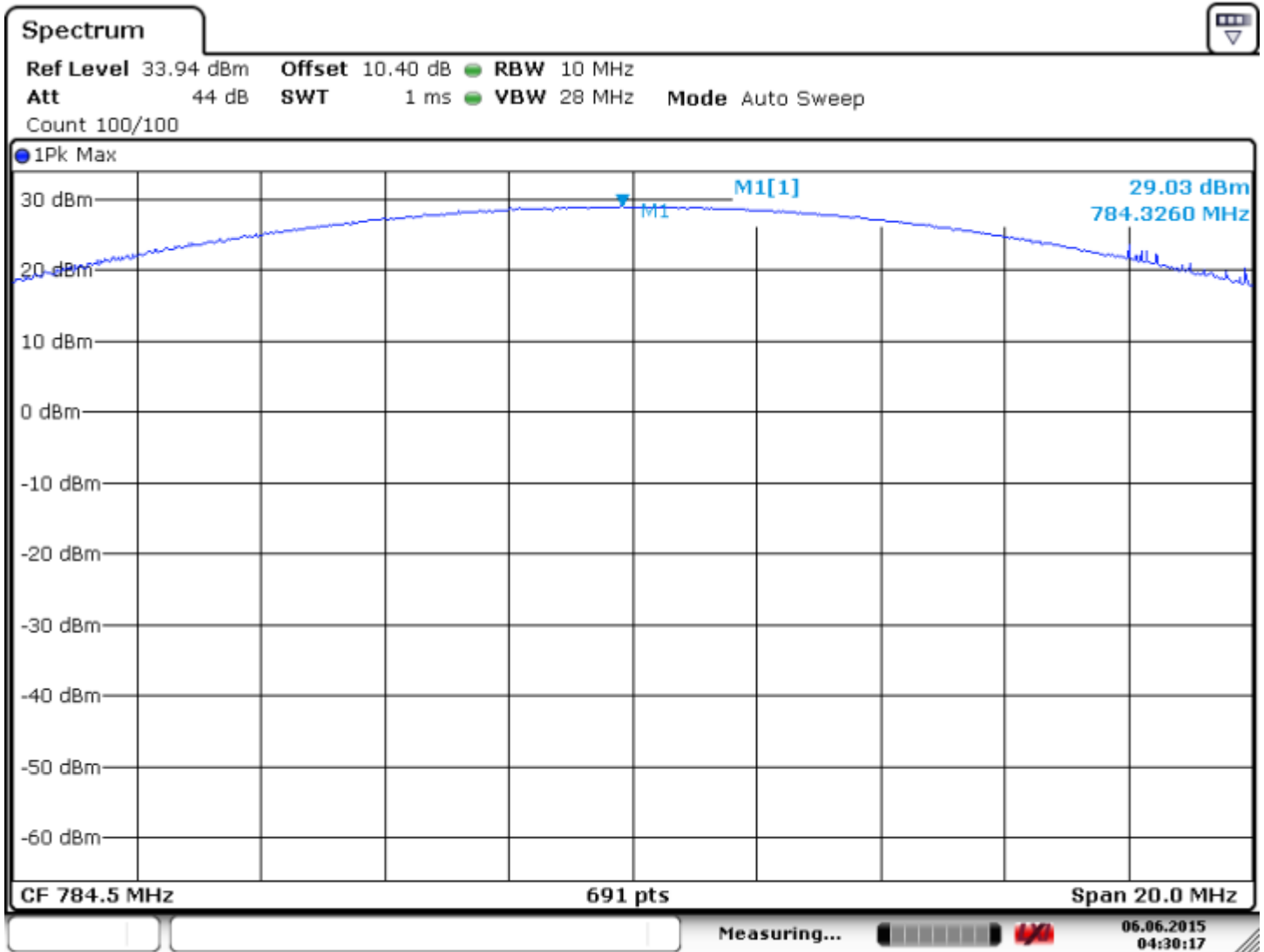
Date: 6.JUN.2015 04:27:32

6.2.5.4.5 Figure 39 AVG_PWR_13_mid_5



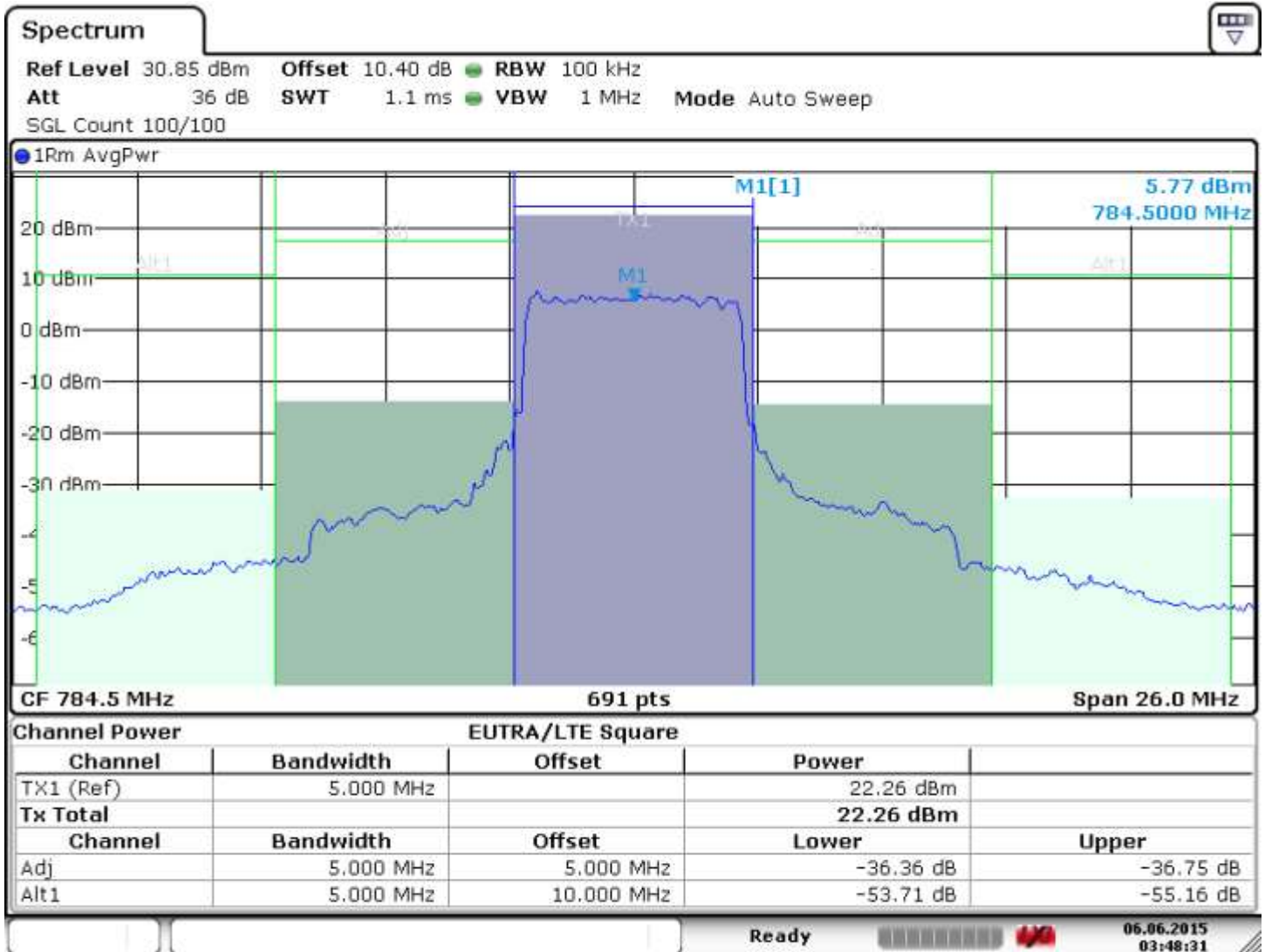
Date: 6.JUN.2015 03:42:45

6.2.5.4.6 Figure 40 Pk Pwr Band 13 Hi 5



Date: 6.JUN.2015 04:30:17

6.2.5.4.7 Figure 41 AVG PWR_Band 13 Hi_5



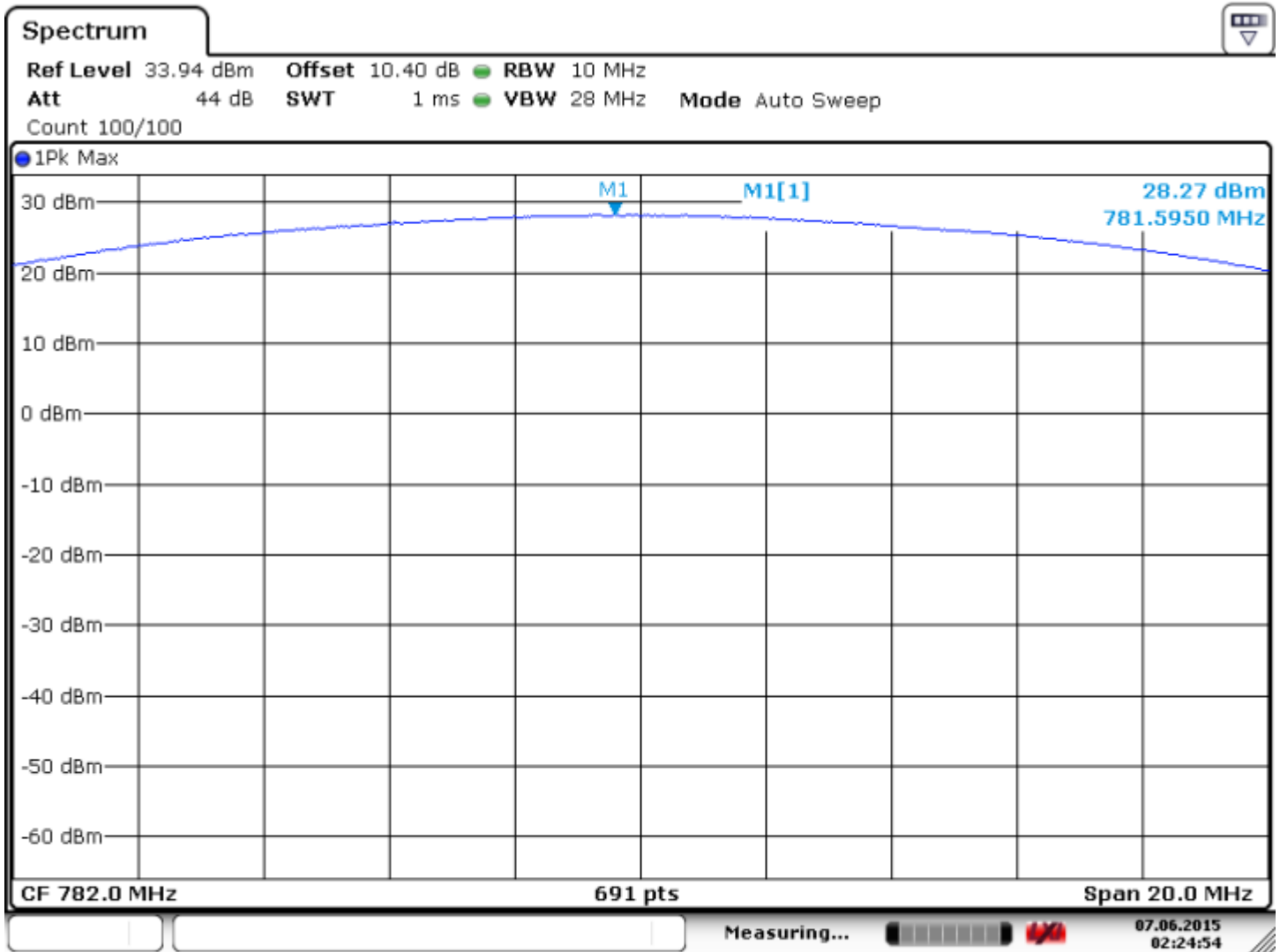
Date: 6.JUN.2015 03:48:31



6.2.5.4.8 Conducted Output Power LTE Band 13 QPSK 10 MHz

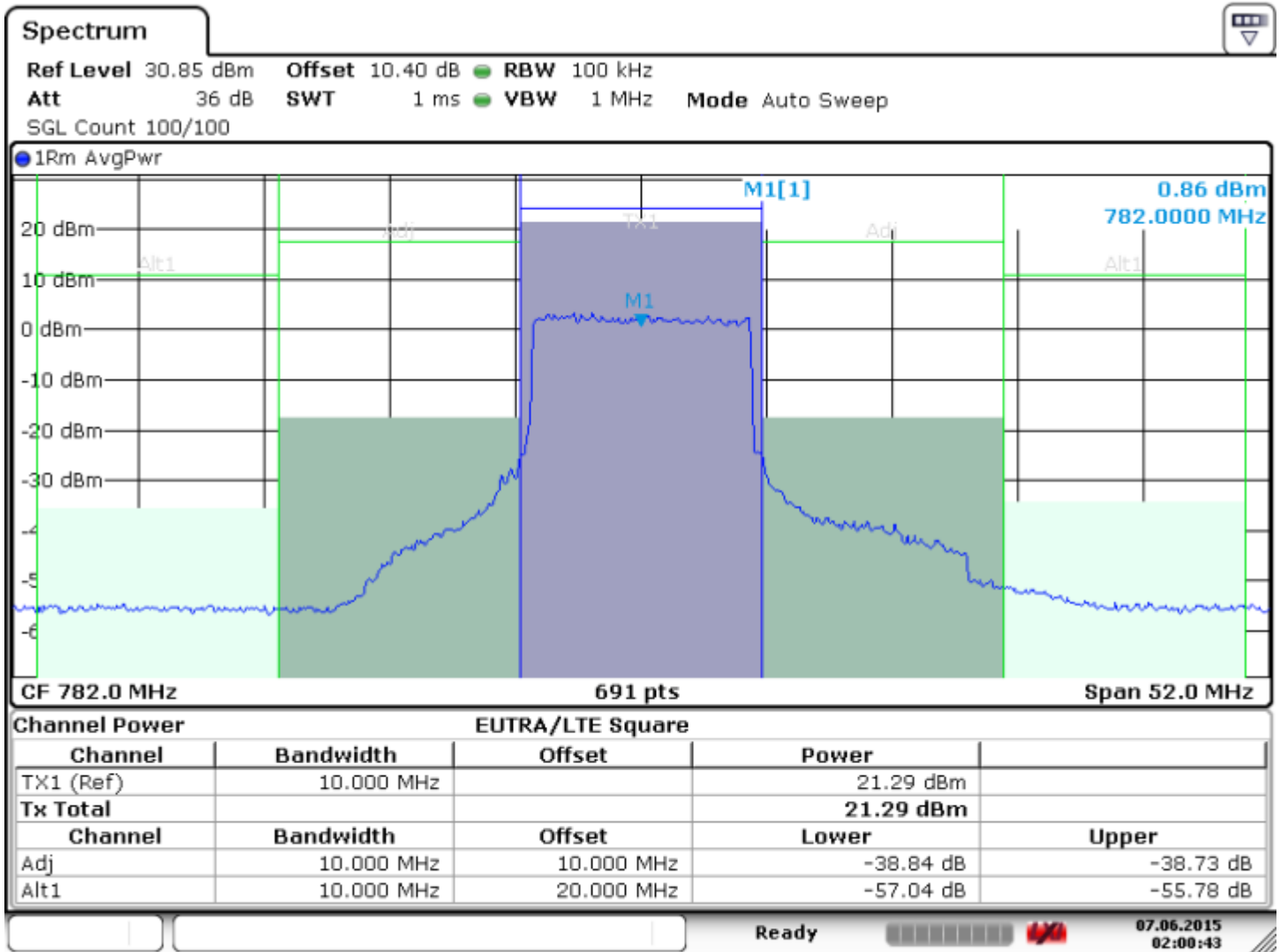
LTE Band 13 (777 MHz – 787 MHz)							
RB Size = 50				BW (MHz) = 10			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
23230/782	28.87	21.29	7.58	-8	13.29	34.8	Pass

6.2.5.4.9 Figure 42 Pk_Power Band 13 mid 10



Date: 7.JUN.2015 02:24:55

6.2.5.4.10 Figure 43 Avg Power Band 13 Mid 10



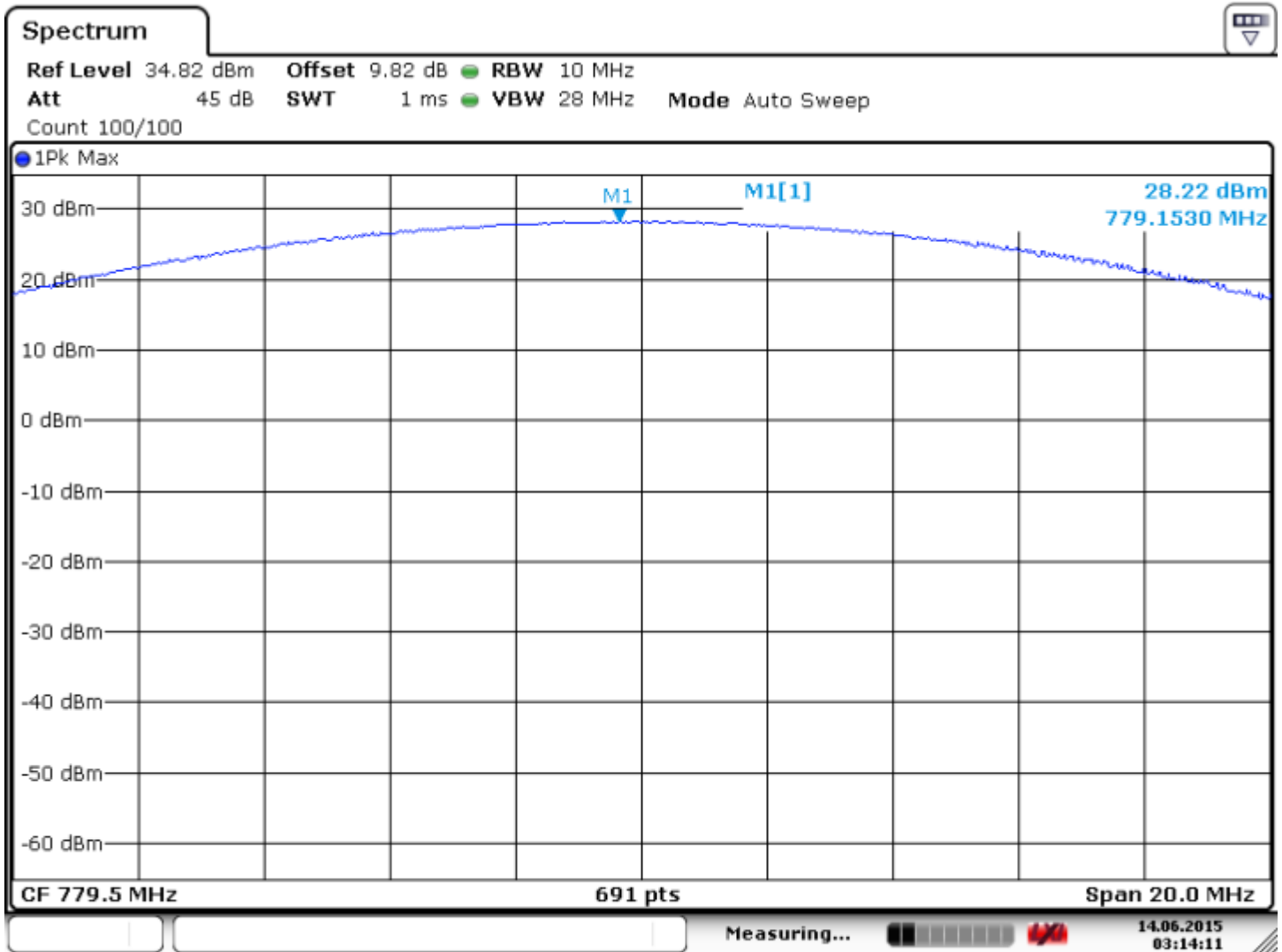
Date: 7.JUN.2015 02:00:43



6.2.5.4.11 Conducted Output Power LTE Band 13 QAM 5 MHz

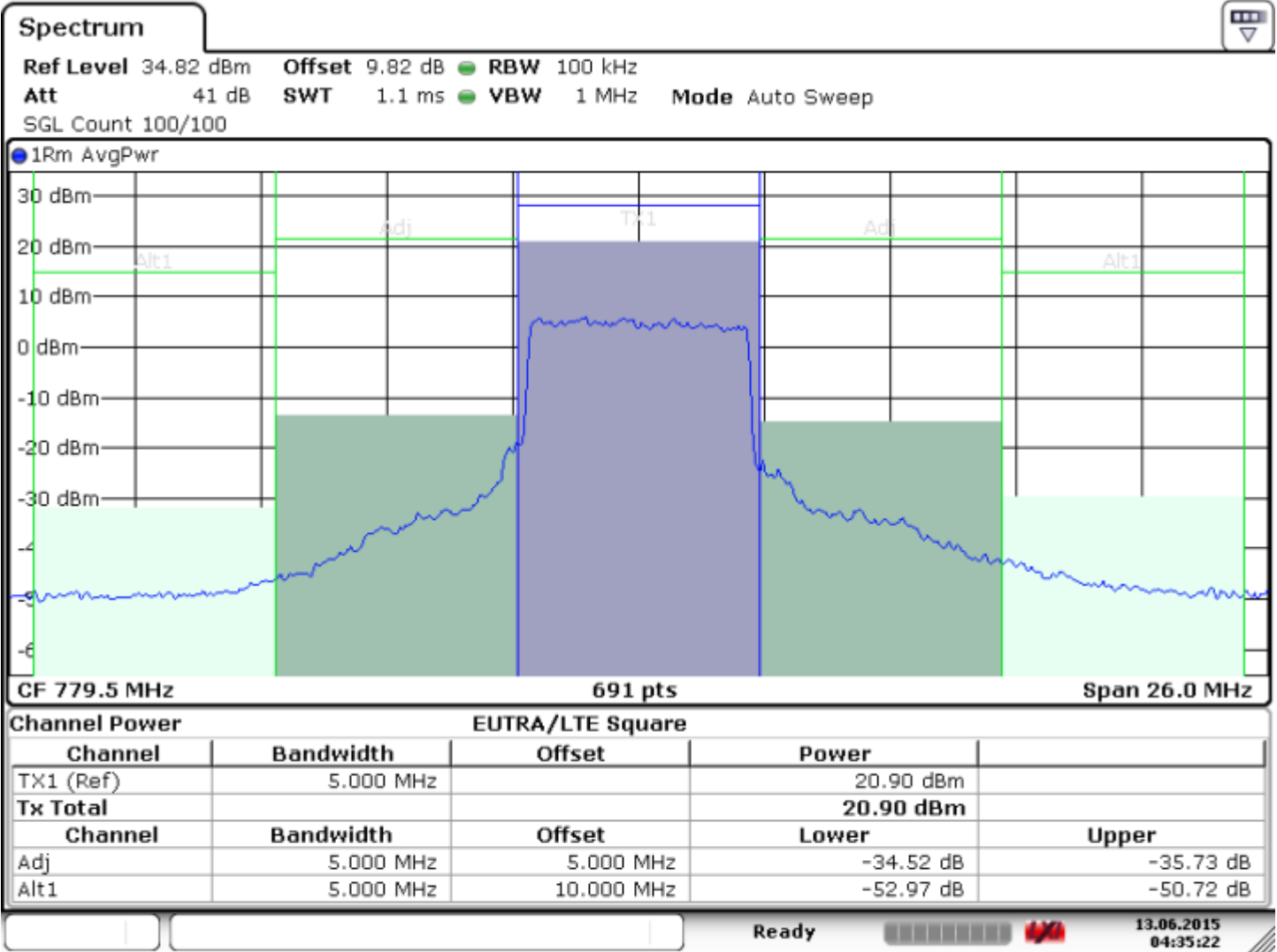
LTE Band 13 (777 MHz – 787 MHz)							
RB Size = 25				BW (MHz) = 5			
Modulation: QAM							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm) FCC	Results
23205/779.5	28.22	20.90	7.32	-8	12.90	34.8	Pass
23230/782	28.43	20.53	7.9	-8	12.53	34.8	Pass
23255/784.5	28.60	20.76	7.84	-8	12.76	34.8	Pass

6.2.5.4.12 Figure 44 Peak Power Band 13 Lo 5



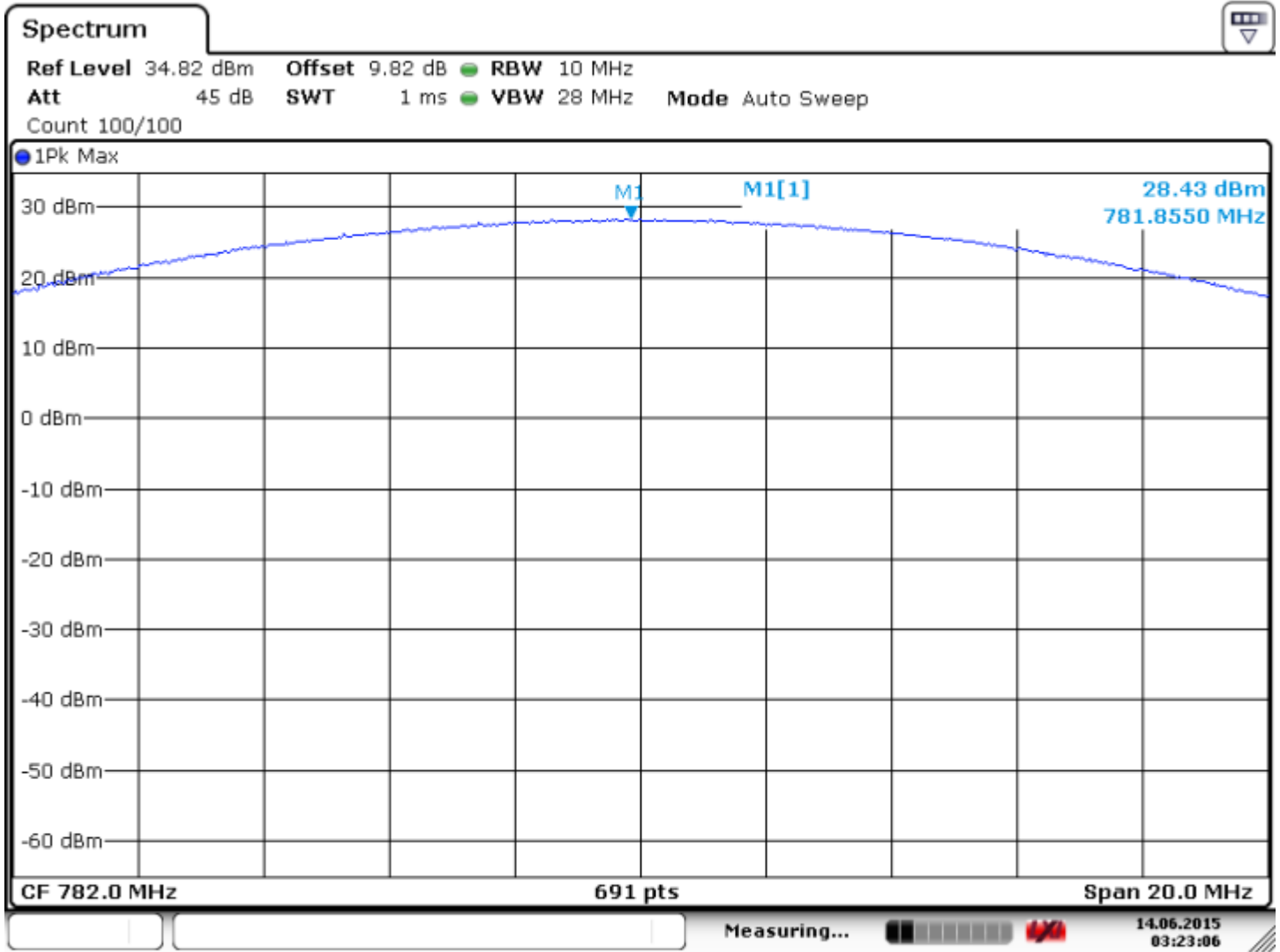
Date: 14.JUN.2015 03:14:11

6.2.5.4.13 Figure 45 Avg Power Band 13 Lo 5



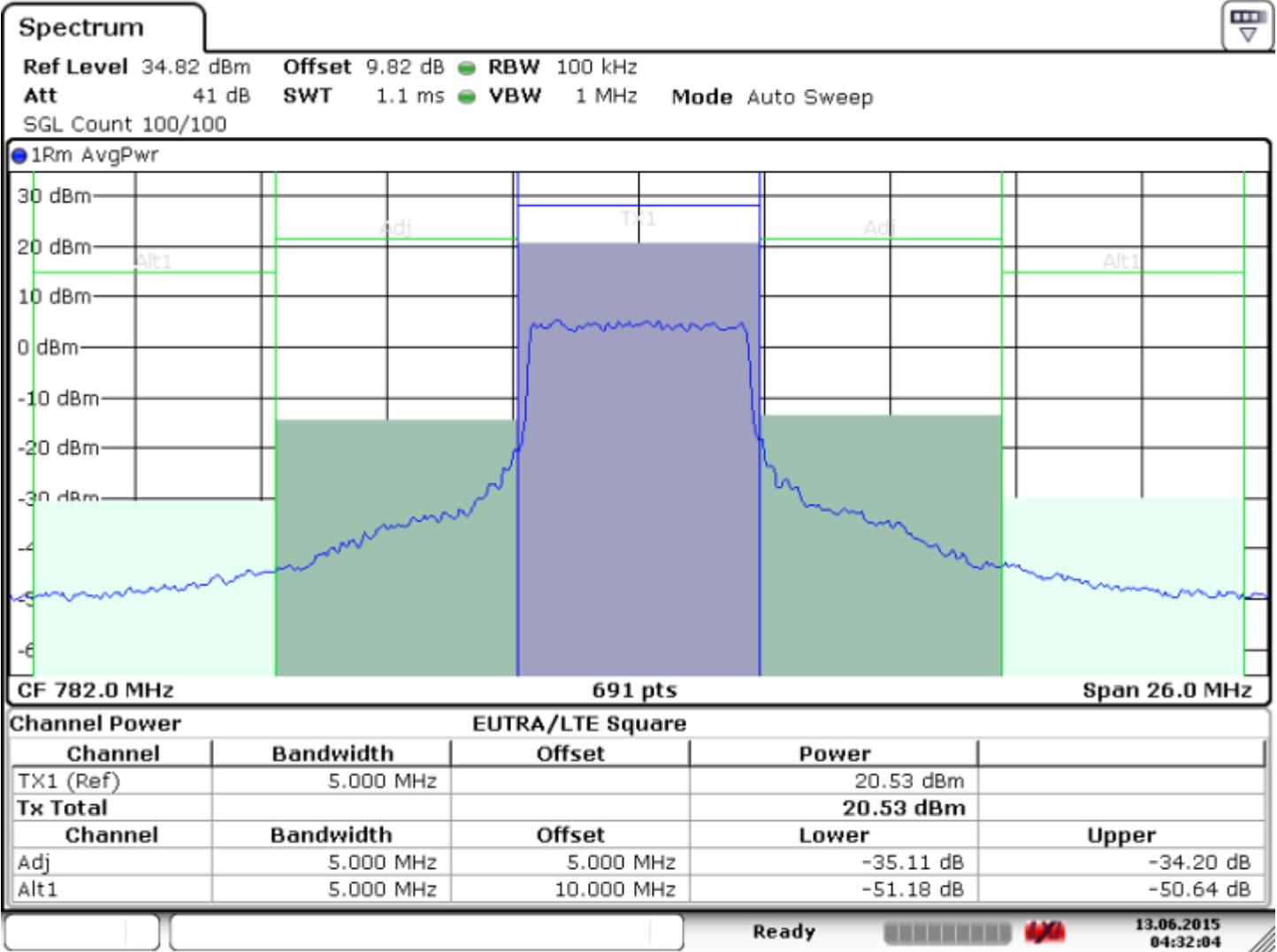
Date: 13.JUN.2015 04:35:22

6.2.5.4.14 Figure 48 Peak Power Band 13 Mid 5



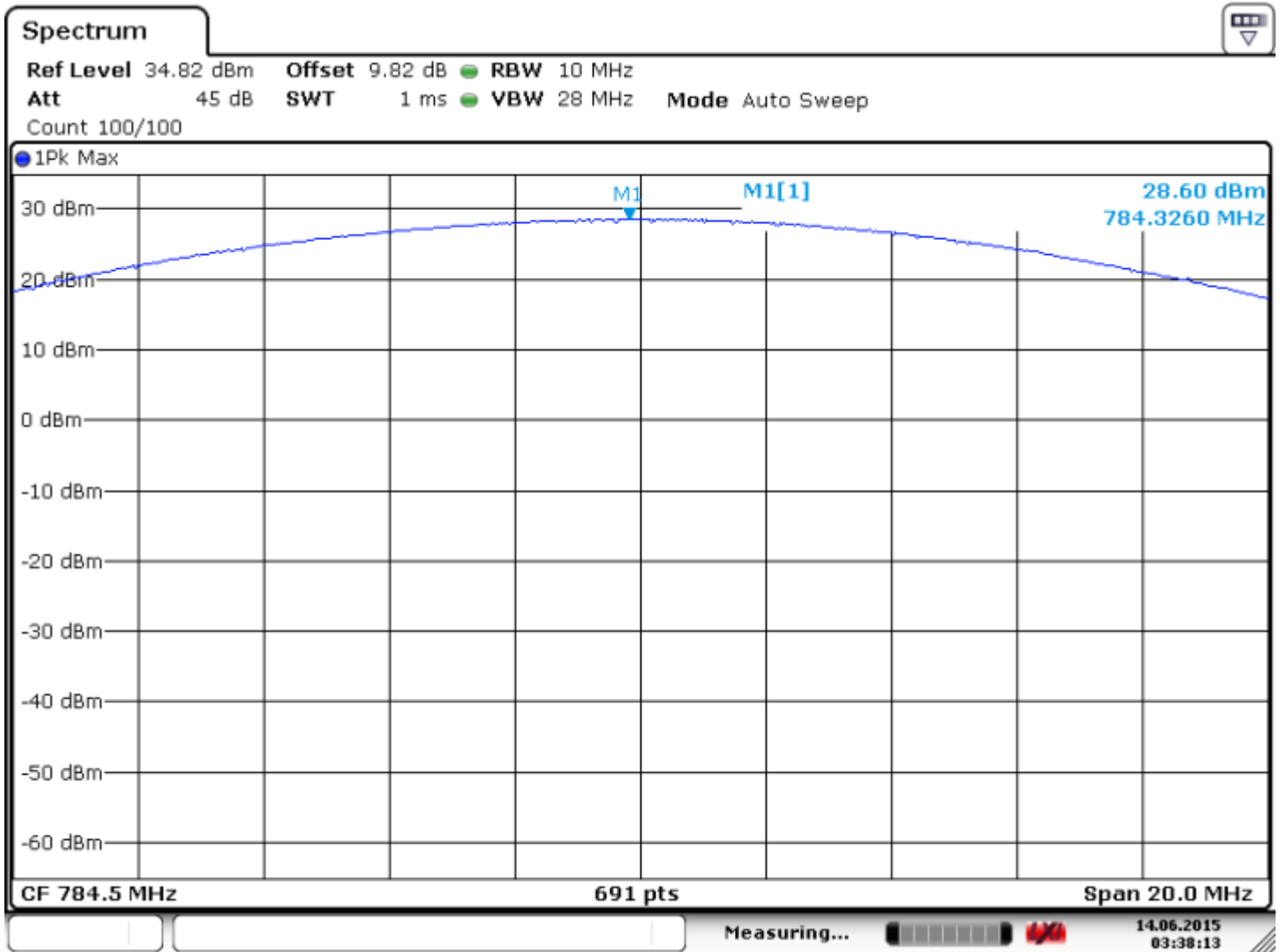
Date: 14.JUN.2015 03:23:06

6.2.5.4.15 Figure 49 Avg Power Band 13 Mid 5



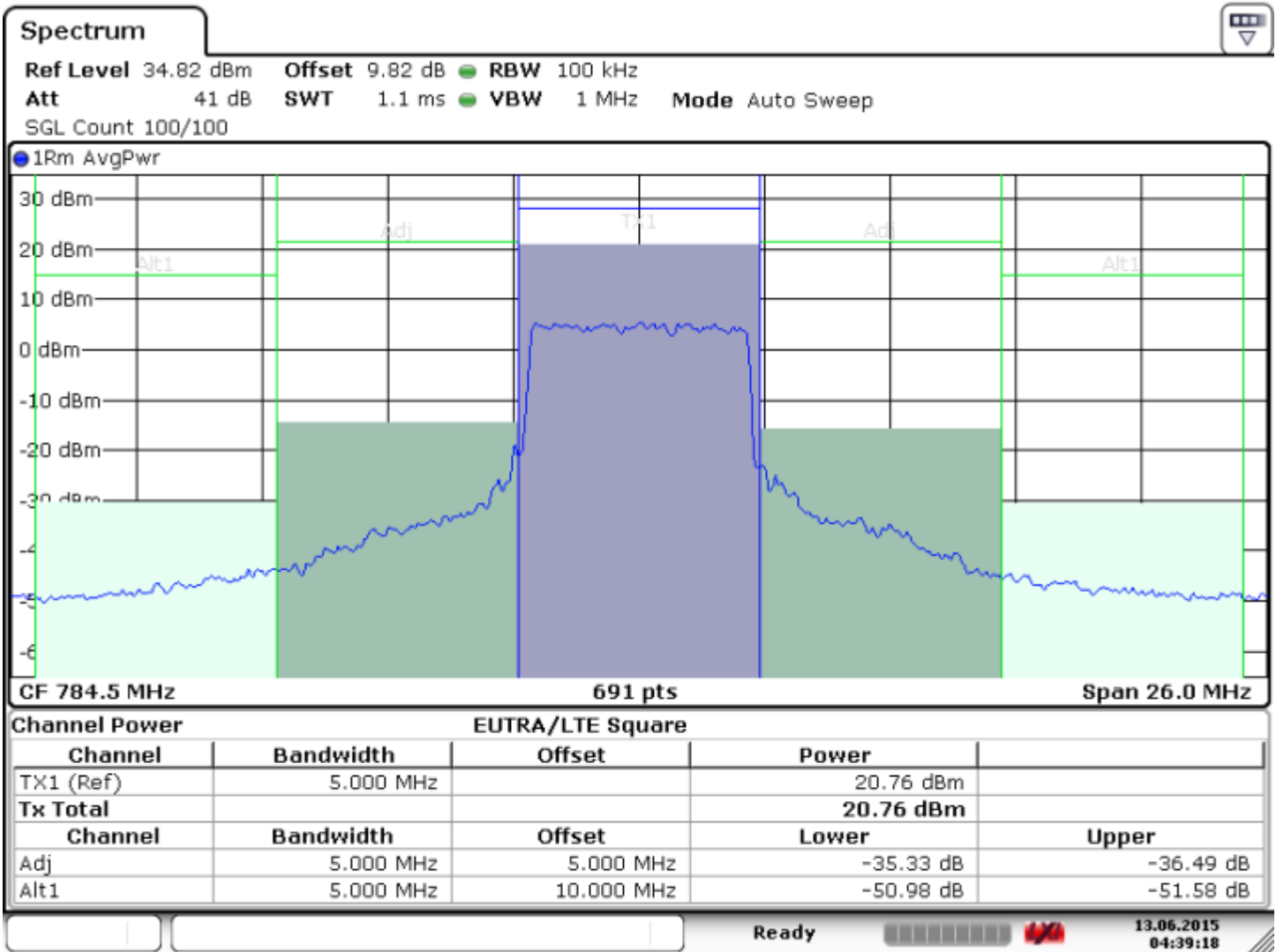
Date: 13.JUN.2015 04:32:04

6.2.5.4.16 Figure 50 Peak Power Band 13 Hi 5



Date: 14.JUN.2015 03:38:13

6.2.5.4.17 Figure 51 Avg Power Band 13 Hi 5



Date: 13.JUN.2015 04:39:18



6.2.5.4.18 Conducted Output Power LTE Band 13 QAM 10 MHz

LTE Band 13 (777 MHz – 787 MHz)

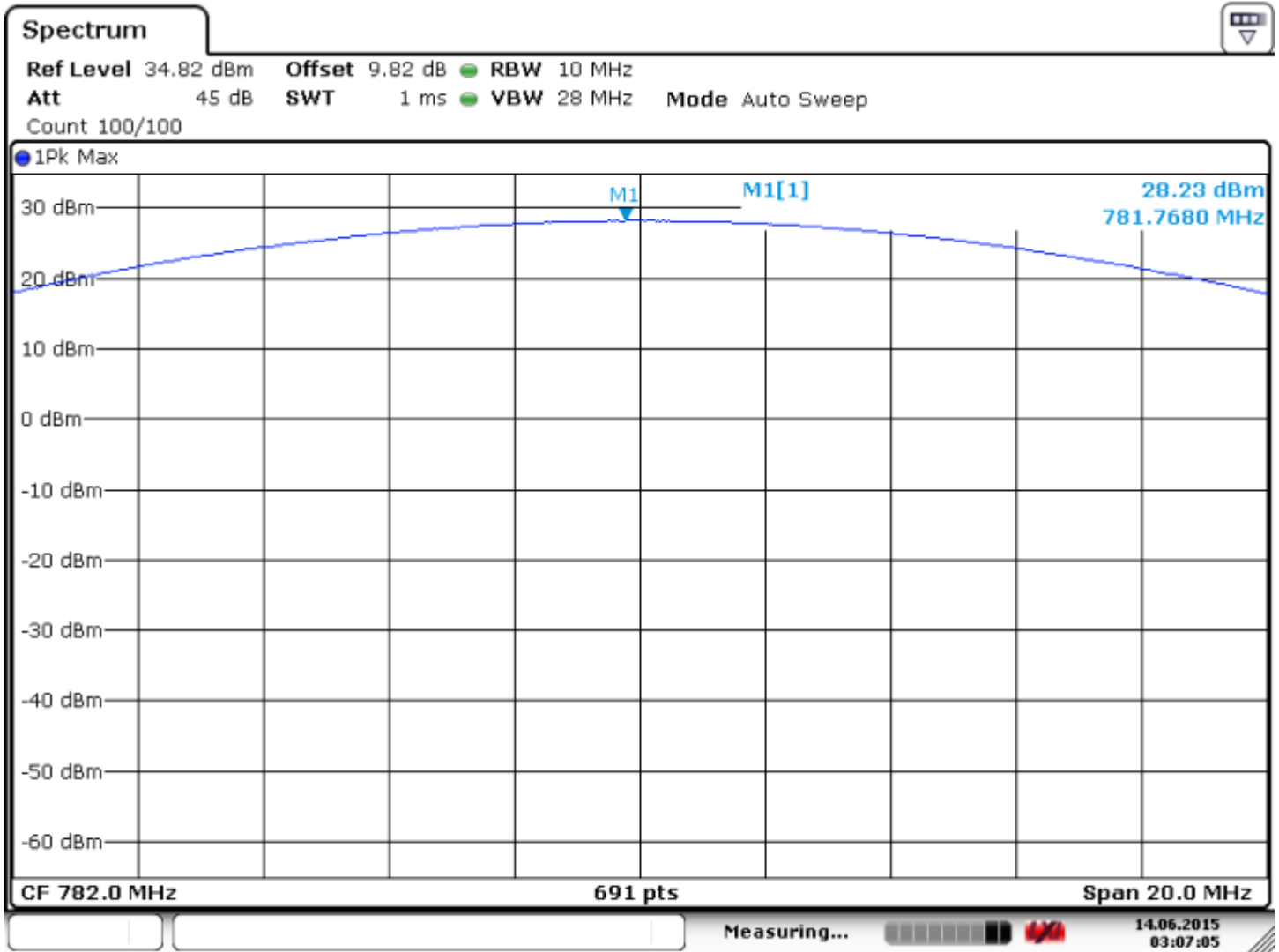
RB Size = 50

BW (MHz) = 10

Modulation: QAM

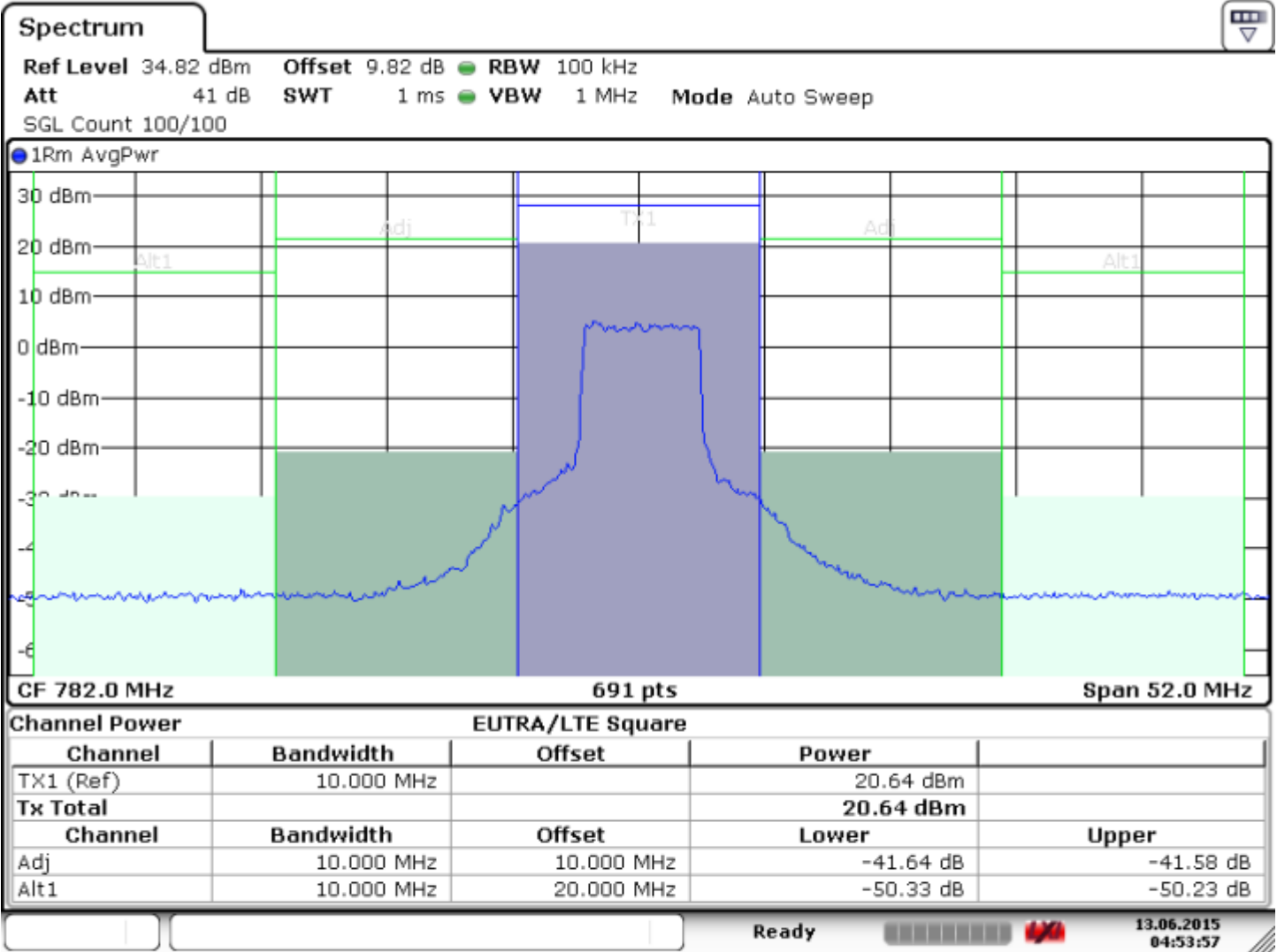
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR (limit 13dB)	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
23230/782	28.23	20.64	7.59	-8	12.64	34.8	Pass

6.2.5.4.19 Figure 52 Pk Power Band 13 Mid 10



Date: 14.JUN.2015 03:07:05

6.2.5.4.20 Figure 53 Avg Power Band 13 Mid 10

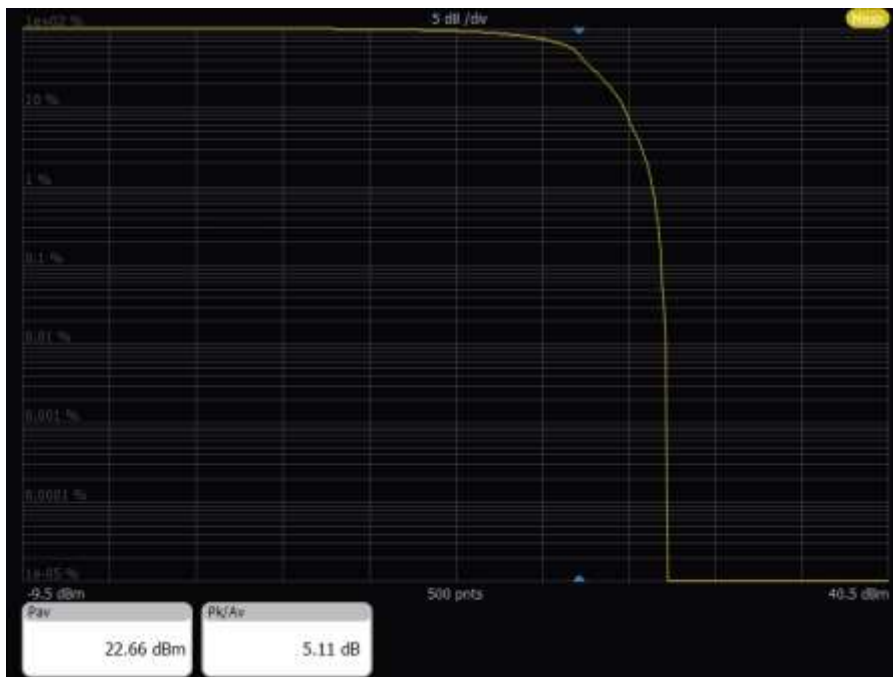


Date: 13.JUN.2015 04:53:57

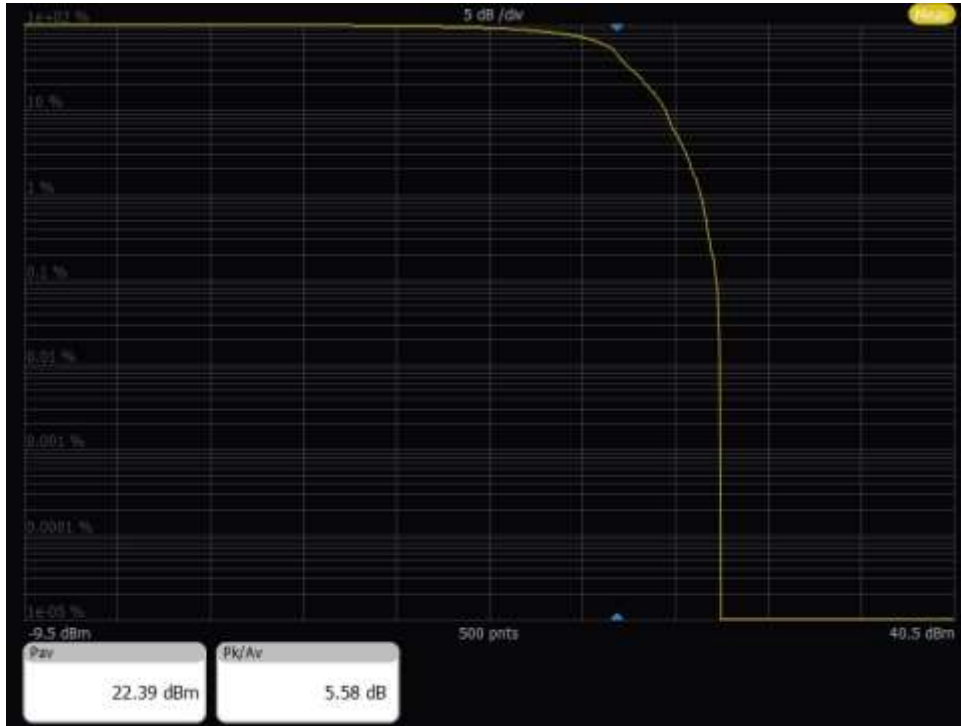
6.2.5.5 Conducted Output Power LTE Band 13 QPSK 5 MHz (1 RB)

LTE Band 13 (777 MHz – 787 MHz)							
RB Size = 1				BW (MHz) = 5			
Modulation: QPSK							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
23205/779.5	27.77	22.66	5.11	-8	14.66	34.8	Pass
23230/782	27.97	22.39	5.58	-8	14.39	34.8	Pass
23255/784.5	27.88	21.97	5.91	-8	13.97	34.8	Pass

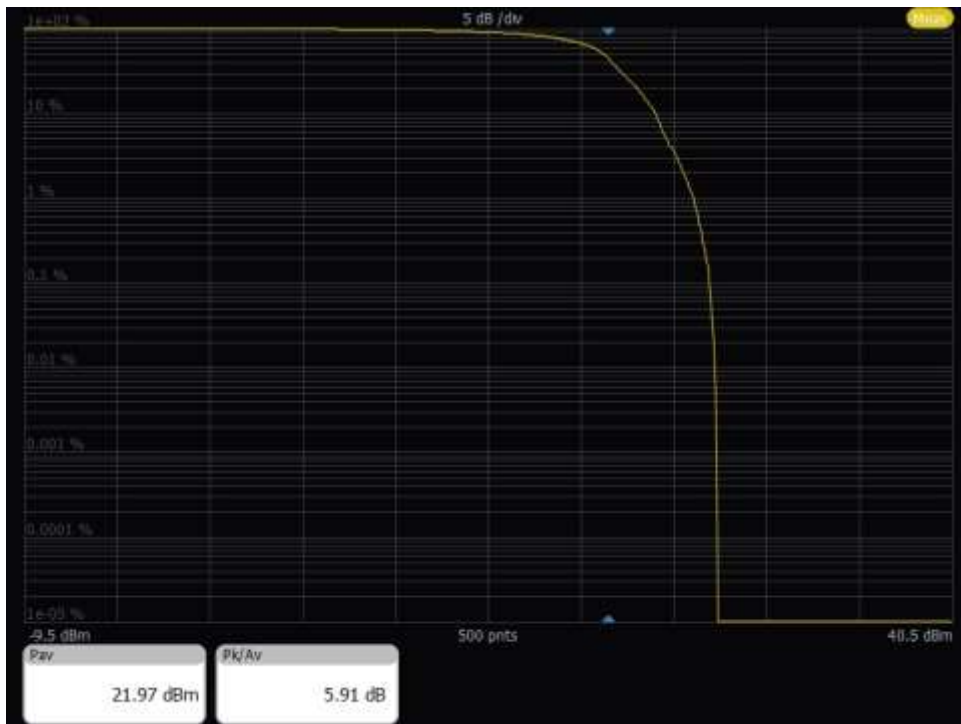
6.2.5.5.1 Figure 54 Avg Power Band 13 Low 5



6.2.5.5.2 Figure 55 Avg Power Band 13 LMid 5



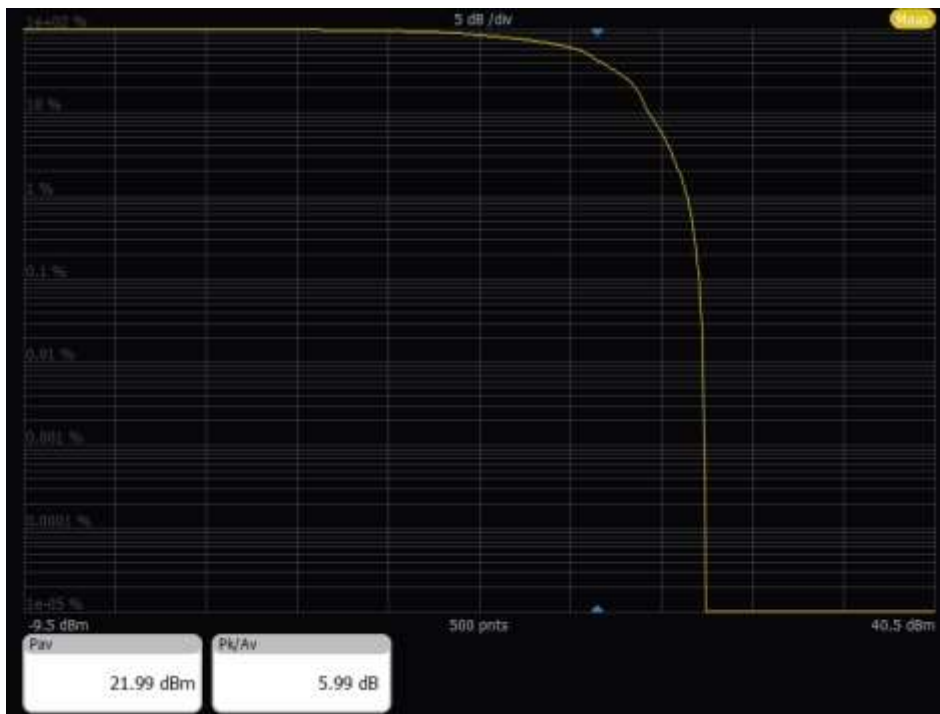
6.2.5.5.3 Figure 56 Avg Power Band 13 High 5



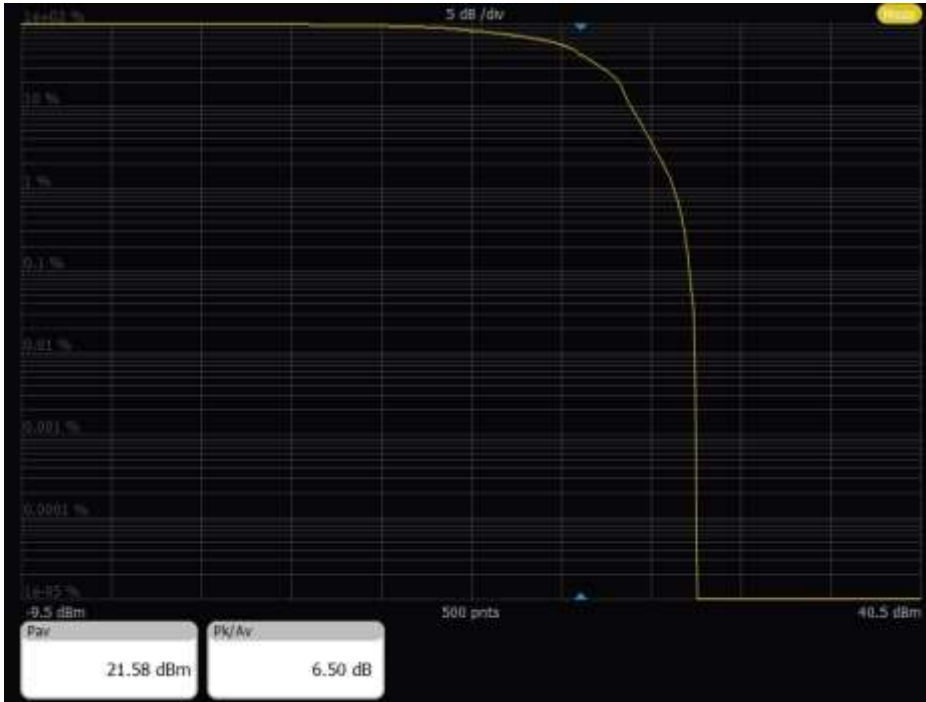
6.2.5.6 Conducted Output Power LTE Band 13 QAM 5 MHz (1 RB)

LTE Band 13 (777 MHz – 787 MHz)							
RB Size = 1				BW (MHz) = 5			
Modulation: QAM							
Ch/Frequency (MHz)	Conducted Output Power Peak(dBm)	Conducted Output Power Average(dBm)	PAR	Antenna Gain (dBi)	EIRP Average (dBm)	EIRP Average Limit (dBm)	Results
23205/779.5	27.98	21.99	5.99	-8	13.99	34.8	Pass
23230/782	28.08	21.58	6.50	-8	13.58	34.8	Pass
23255/784.5	27.97	21.40	6.57	-8	13.40	34.8	Pass

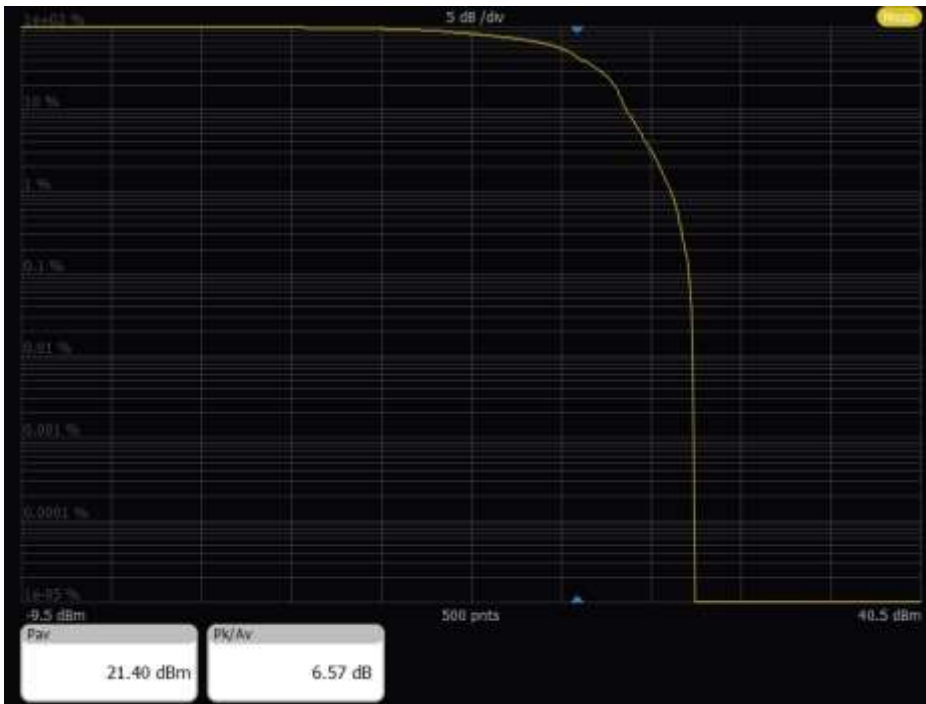
6.2.5.6.1 Figure 57 Avg Power Band 13 Low 5



6.2.5.6.2 Figure 58 Avg Power Band 13 Mid 5



6.2.5.6.3 Figure 59 Avg Power Band 13 High 5



6.2.6 Test Verdict

Pass

6.3 PEAK-AVERAGE Ratio

6.3.1 References

FCC CFR 47 §24.232 (D); FCC CFR 47 §27.50 (D) (5)

6.3.2 Limits:

Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

6.3.3 Results:

The results are contained in the tables of the previous section under column 'PAR'.

6.3.4 Verdict:

Pass

6.4 Occupied Bandwidth

6.4.1 References

FCC: CFR Part 2.1053, CFR Part 27.53 (g), CFR Part 90.209 (b)

6.4.2 Limits

The channel bandwidth shall be equal to or greater than 1MHz and shall be reported by the certification applicant.

6.4.3 Measurement Requirements:

The occupied bandwidth in lieu of 99% bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

The 26 dB bandwidth is the width of the emission signal between 2 points, one below the carrier center frequency and one above the carrier frequency, outside of which all emissions are attenuated by 26 dB below the transmitter power.

6.4.4 Test Method:

Measurements for Occupied bandwidth (OBW) are done according to the FCC KDB procedure 971168 D01 Power Meas License Digital Systems v02r02 Section 4.

Section 4.1 for 26dB bandwidth

Section 4.2 for 99% OBW

6.4.5 Test Results / Plots

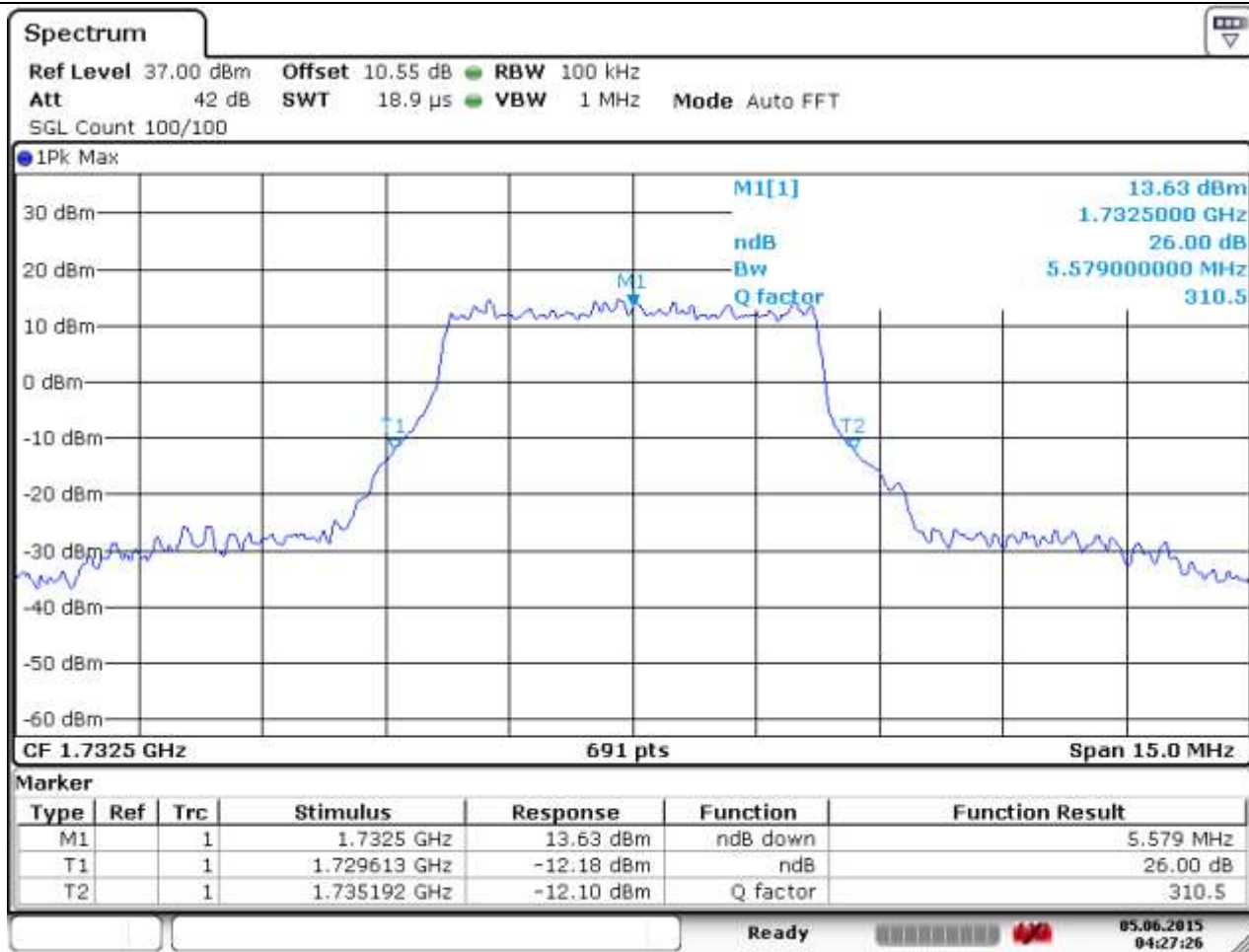
6.4.5.1 OBW LTE FDD Band 4 tables QPSK:

LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK			
Channel No.	Frequency (MHz)	26 dB (MHz)	99% (MHz)
RB Size =25	RB Offset = 0	BW (MHz) = 5	
20175	1732.5	5.579	4.573
RB Size =50	RB Offset = 0	BW (MHz) = 10	
20175	1732.5	10.883	9.001
RB Size =75	RB Offset = 0	BW (MHz) = 15	
20175	1732.5	15.847	13.459
RB Size = 100	RB Offset = 0	BW (MHz) = 20	
20175	1732.5	20.260	17.945

6.4.5.2 OBW LTE FDD Band 4 plots:

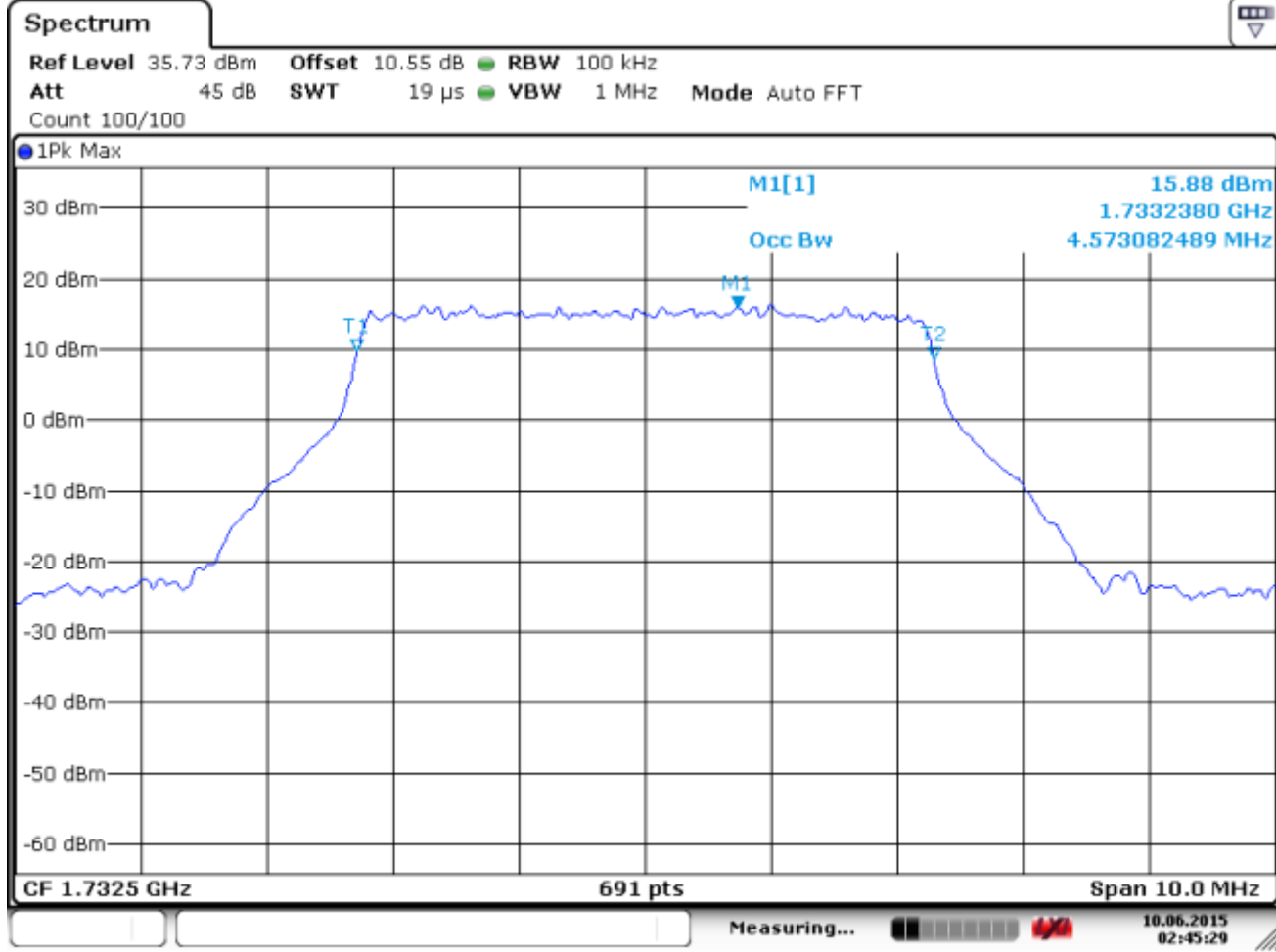
Channel 20175 (1732.5 MHz) – RB Size = 25; RB Offset = 0; BW = 5 MHz

26 OBW Modulation = QPSK



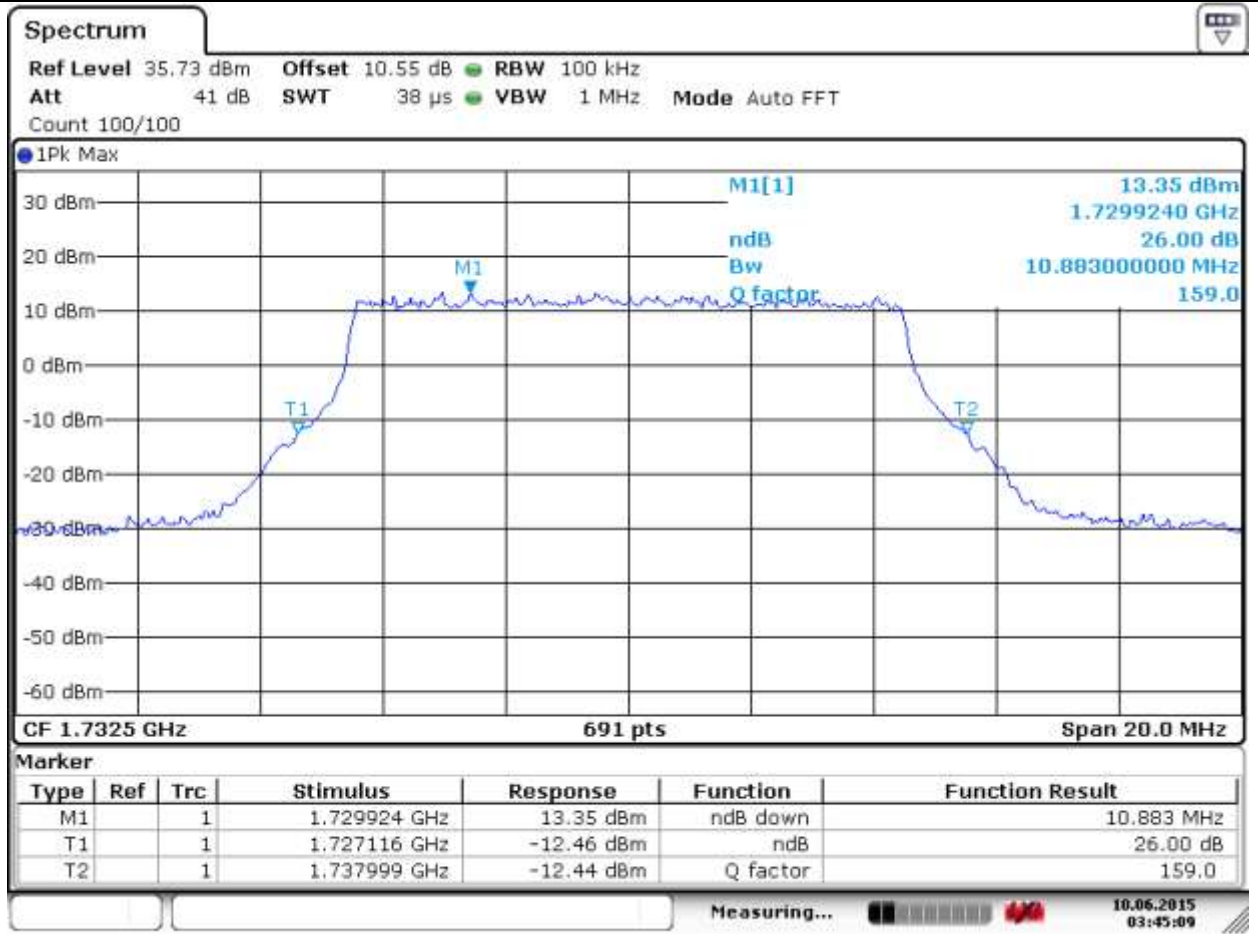
Date: 5.JUN.2015 04:27:27

99% OBW Modulation = QPSK



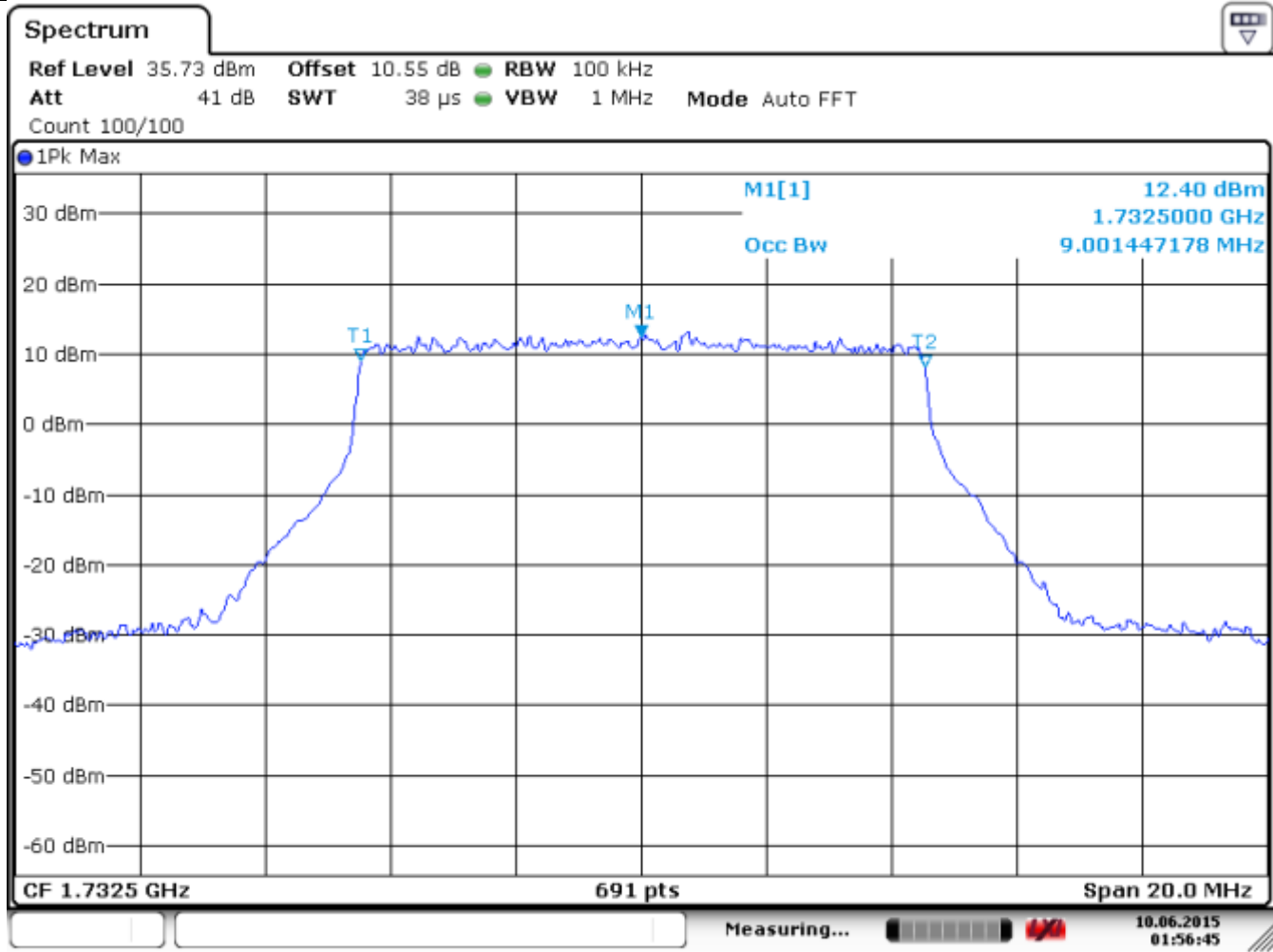
Date: 10.JUN.2015 02:45:29

Channel **20175 (1732.5 MHz)** – RB Size = 50; RB Offset = 0; BW = 10.0 MHz
 26 OBW Modulation = QPSK



Date: 10.JUN.2015 03:45:09

99% OBW Modulation = QPSK



Date: 10.JUN.2015 01:56:45

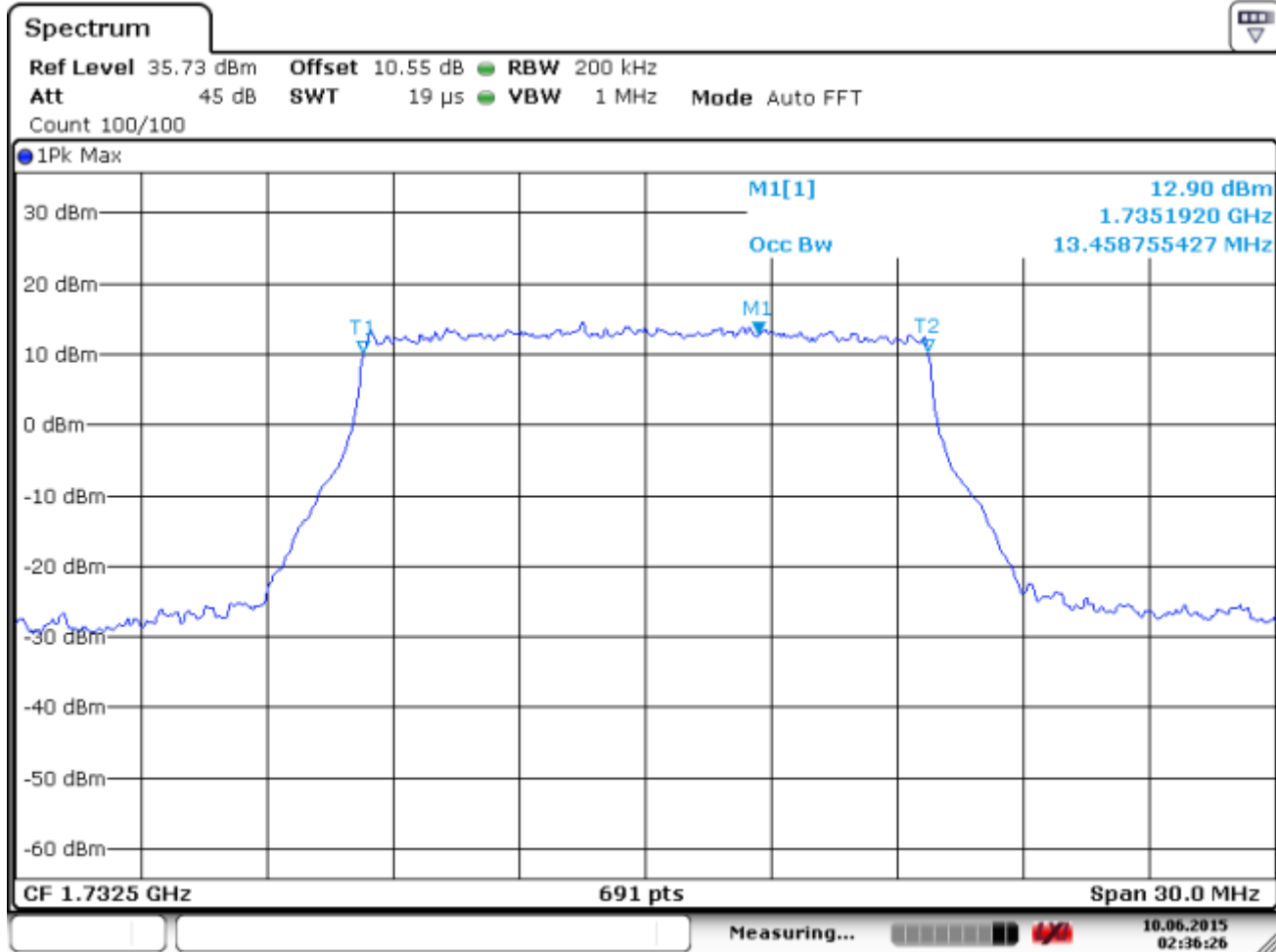
Channel 20175 (1732.5 MHz) – RB Size = 75; RB Offset = 0; BW = 15 MHz

26 OBW Modulation = QPSK



Date: 10.JUN.2015 03:27:37

99% OBW Modulation = QPSK

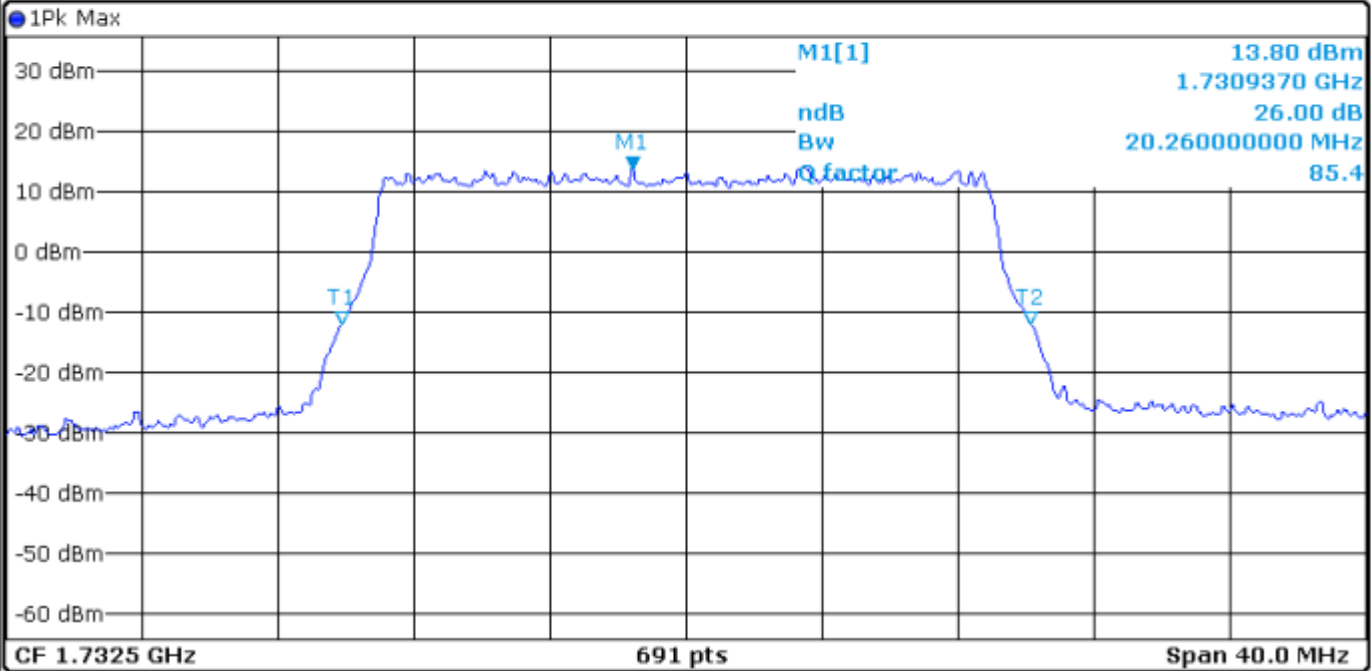


Date: 10.JUN.2015 02:36:26

Channel **20175 (1732.5 MHz)** – RB Size = **100**; RB Offset = 0; BW = **20.0 MHz**
26 OBW Modulation = **QPSK**

Spectrum [Icons]

Ref Level 35.73 dBm Offset 10.55 dB RBW 200 kHz
 Att 45 dB SWT 28.4 μs VBW 1 MHz Mode Auto FFT
 Count 100/100



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	1.730937 GHz	13.80 dBm	ndB down	20.26 MHz
T1		1	1.72237 GHz	-12.04 dBm	ndB	26.00 dB
T2		1	1.74263 GHz	-12.08 dBm	Q factor	85.4

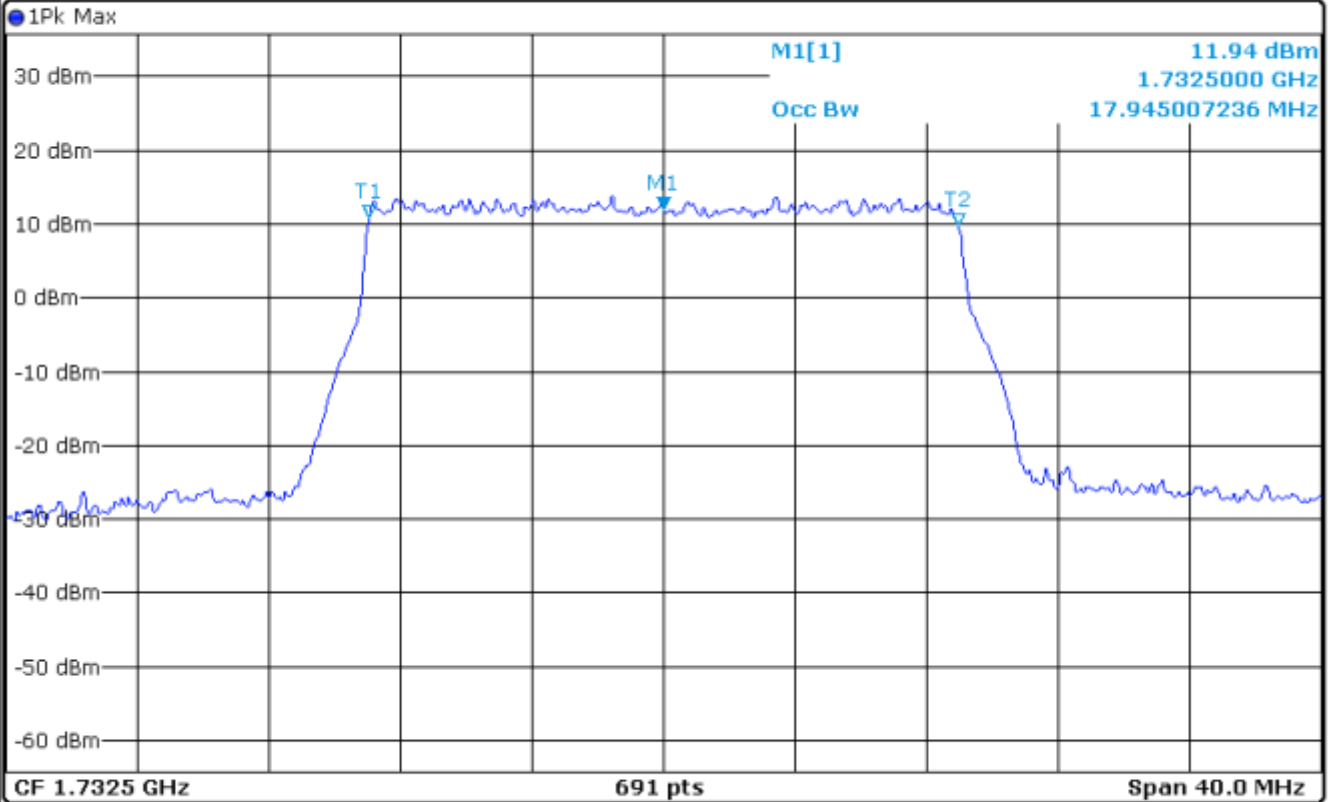
Measuring... 10.06.2015 02:55:34

Date: 10.JUN.2015 02:55:34

99% OBW Modulation = QPSK

Spectrum

Ref Level 35.73 dBm Offset 10.55 dB RBW 200 kHz
Att 45 dB SWT 28.4 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring... 10.06.2015 02:59:52

Date: 10.JUN.2015 02:59:52

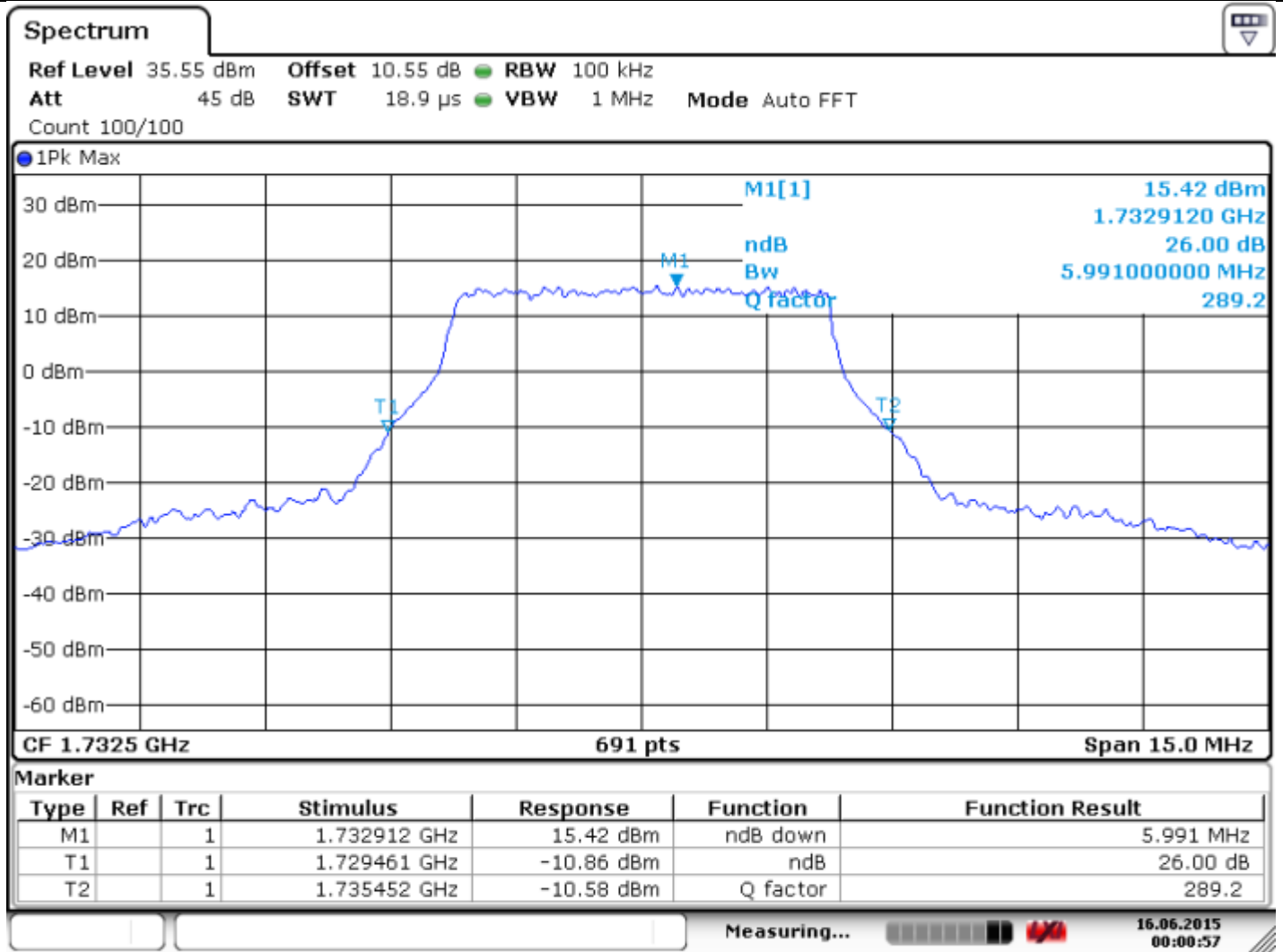
6.4.5.3 OBW LTE FDD Band 4 tables QAM:

LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QAM			
Channel No.	Frequency (MHz)	26 dB (MHz)	99% (MHz)
RB Size =25	RB Offset = 0	BW (MHz) = 5	
20175	1732.5	5.99	4.58
RB Size =50 (27)	RB Offset = 0 (12)	BW (MHz) = 10	
20175	1732.5	7.03	5.04
RB Size =75 (27)	RB Offset = 0 (12)	BW (MHz) = 15	
20175	1732.5	7.09	5.01
RB Size = 100 (27)	RB Offset = 0 (12)	BW (MHz) = 20	
20175	1732.5	7.12	5.04

6.4.5.4 OBW LTE FDD Band 4 plots QAM:

Channel **20175 (1732.5 MHz)** – RB Size = 25; RB Offset = 0; BW = 5 MHz

26 OBW Modulation = QAM

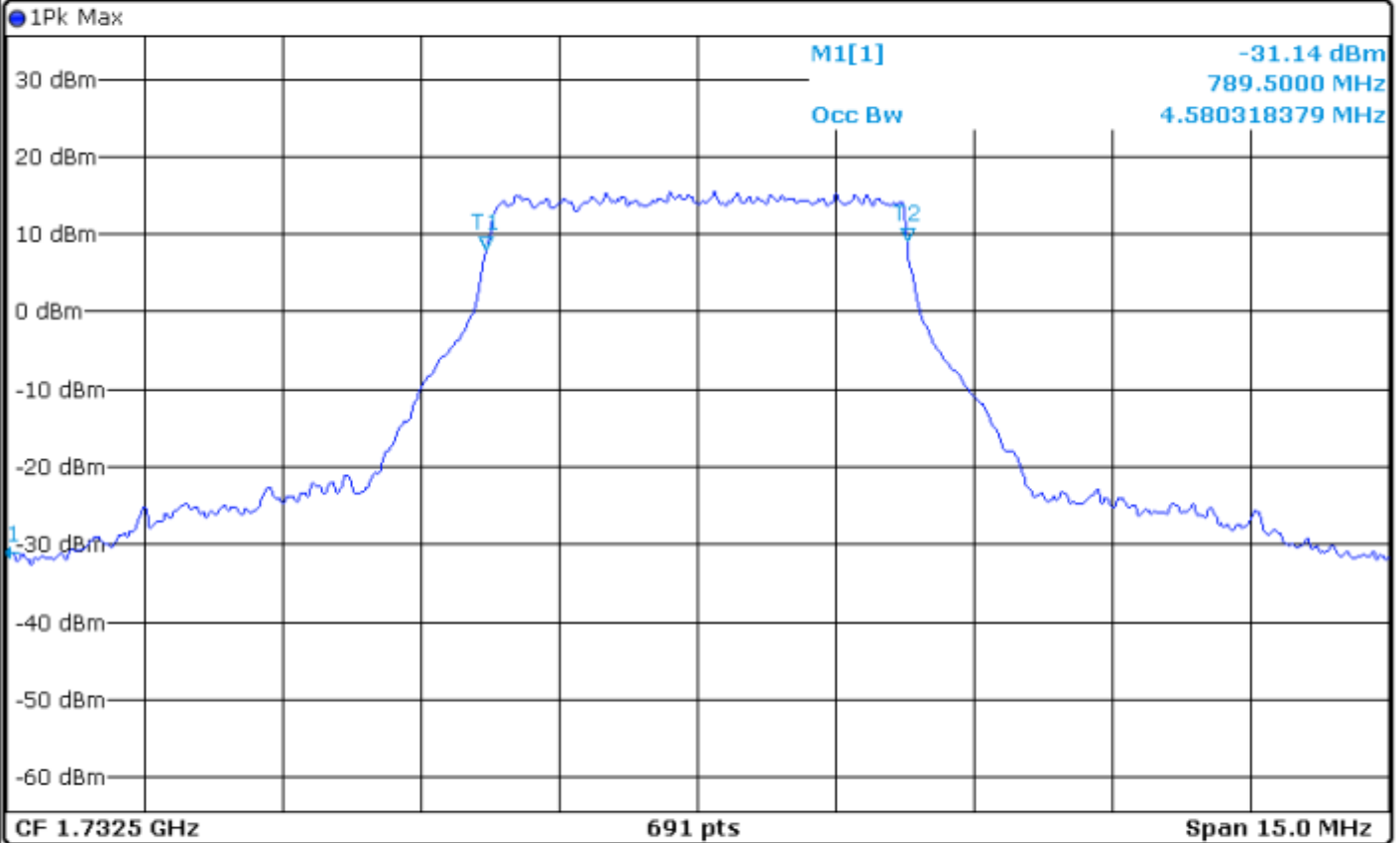


Date: 16.JUN.2015 00:00:57

99% OBW Modulation = QAM

Spectrum

Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
Att 45 dB SWT 18.9 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



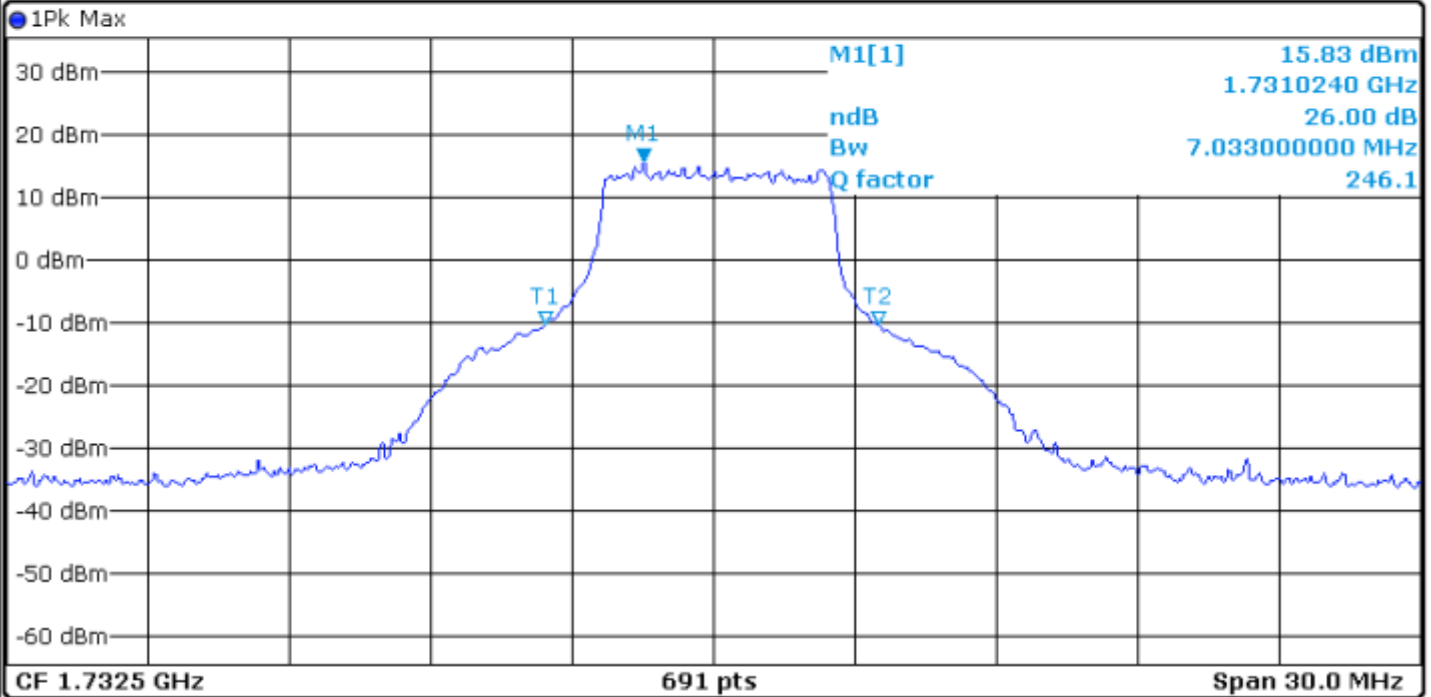
CF 1.7325 GHz 691 pts Span 15.0 MHz
Measuring... 15.06.2015 23:57:21

Date: 15.JUN.2015 23:57:21

Channel **20175 (1732.5 MHz)** – RB Size = 50; RB Offset = 0; BW = 10.0 MHz
 26 OBW Modulation = QAM

Spectrum

Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
 Att 45 dB SWT 37.9 µs VBW 1 MHz Mode Auto FFT
 Count 100/100



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	1.731024 GHz	15.83 dBm	ndB down	7.033 MHz
T1		1	1.72894 GHz	-10.11 dBm	ndB	26.00 dB
T2		1	1.735973 GHz	-10.21 dBm	Q factor	246.1

Measuring...

16.06.2015
00:08:59

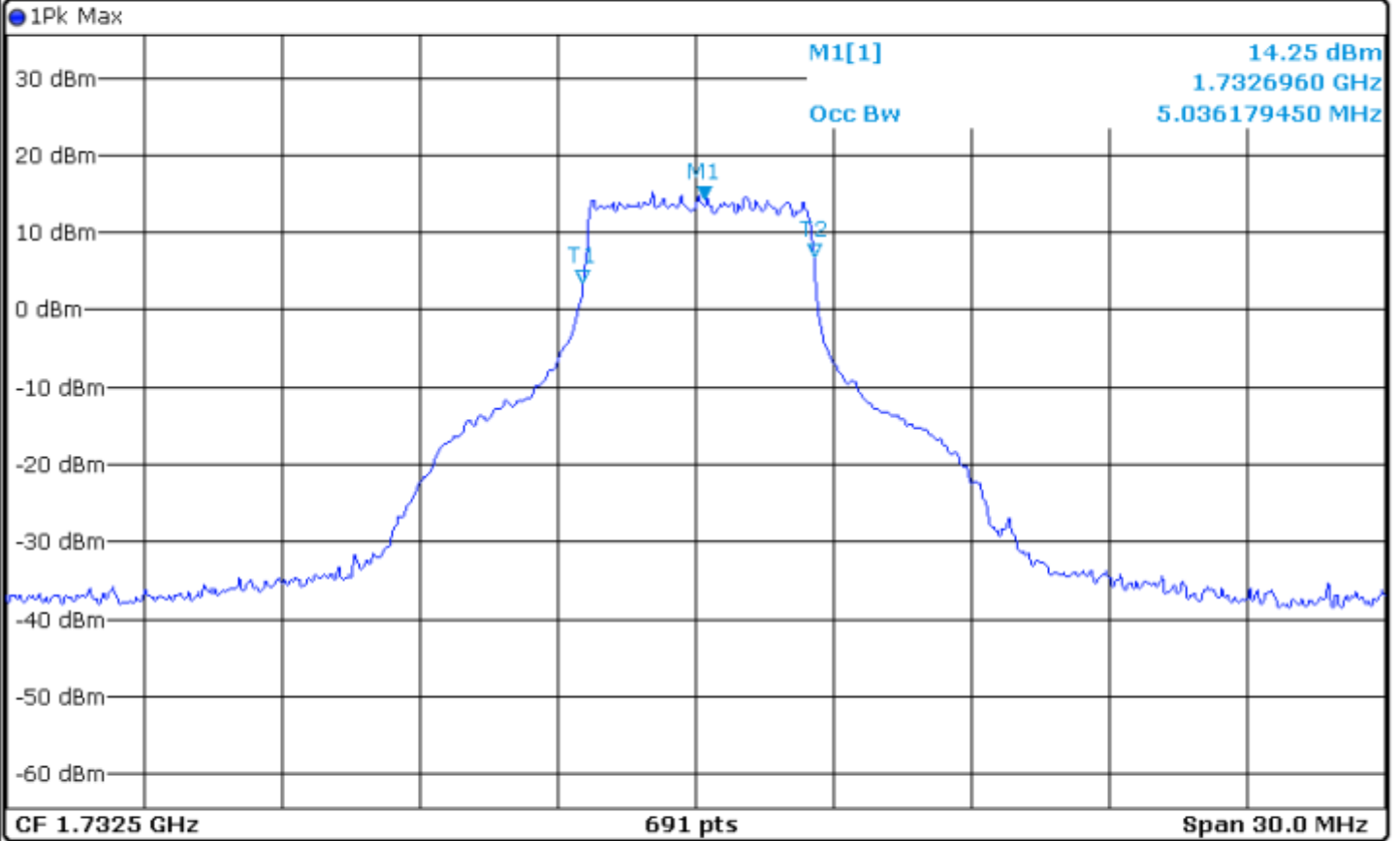
Date: 16.JUN.2015 00:08:58

99% OBW Modulation = QAM

Spectrum



Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
Att 41 dB SWT 37.9 μs VBW 1 MHz Mode Auto FFT
Count 100/100

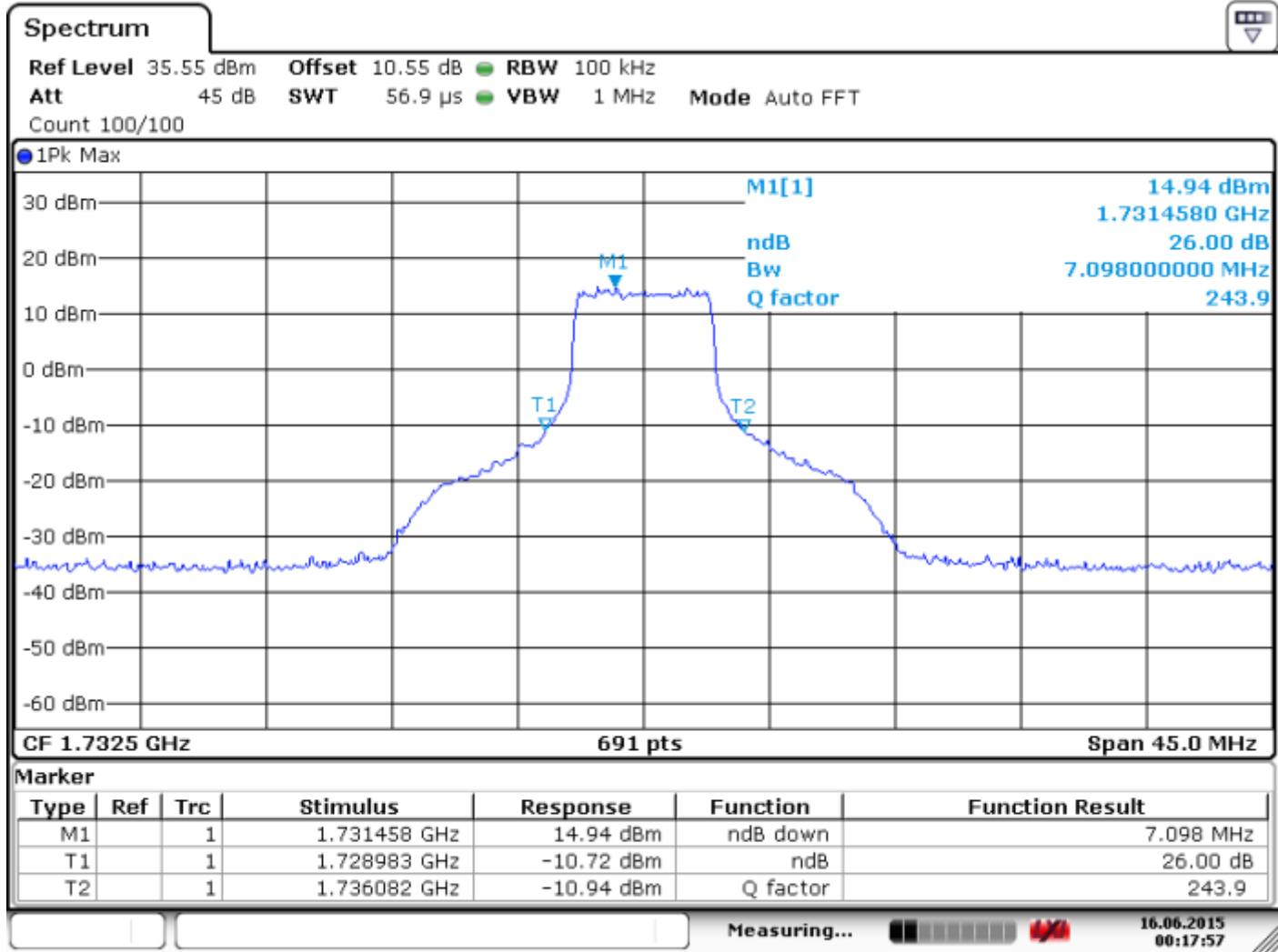


Measuring... 16.06.2015 00:05:17

Date: 16.JUN.2015 00:05:17

Channel 20175 (1732.5 MHz) – RB Size = 27; RB Offset = 24; BW = 15 MHz

26 OBW Modulation = QAM

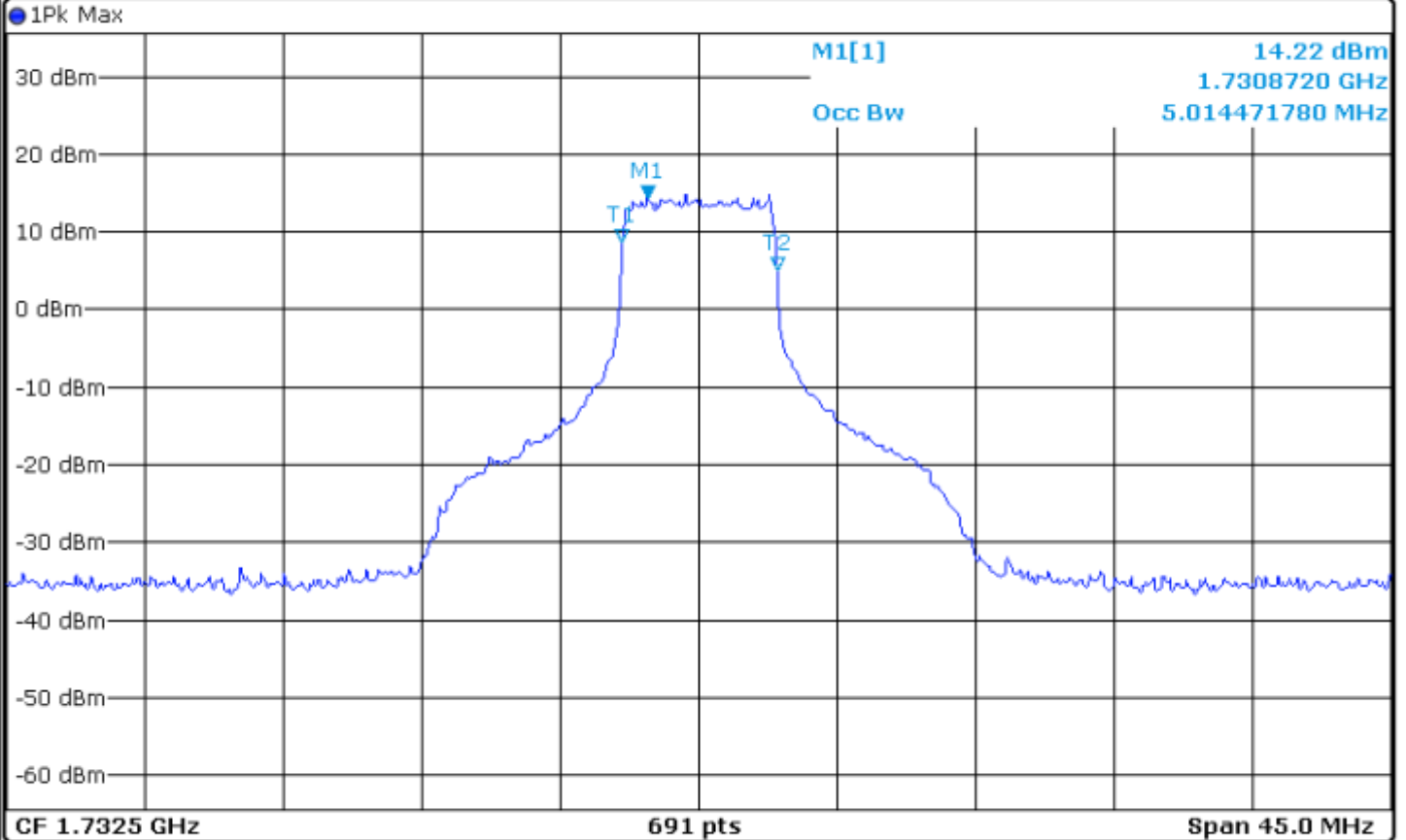


Date: 16.JUN.2015 00:17:57

99% OBW Modulation = QAM

Spectrum

Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
Att 45 dB SWT 56.9 μs VBW 1 MHz Mode Auto FFT
Count 100/100



CF 1.7325 GHz 691 pts Span 45.0 MHz

Measuring...



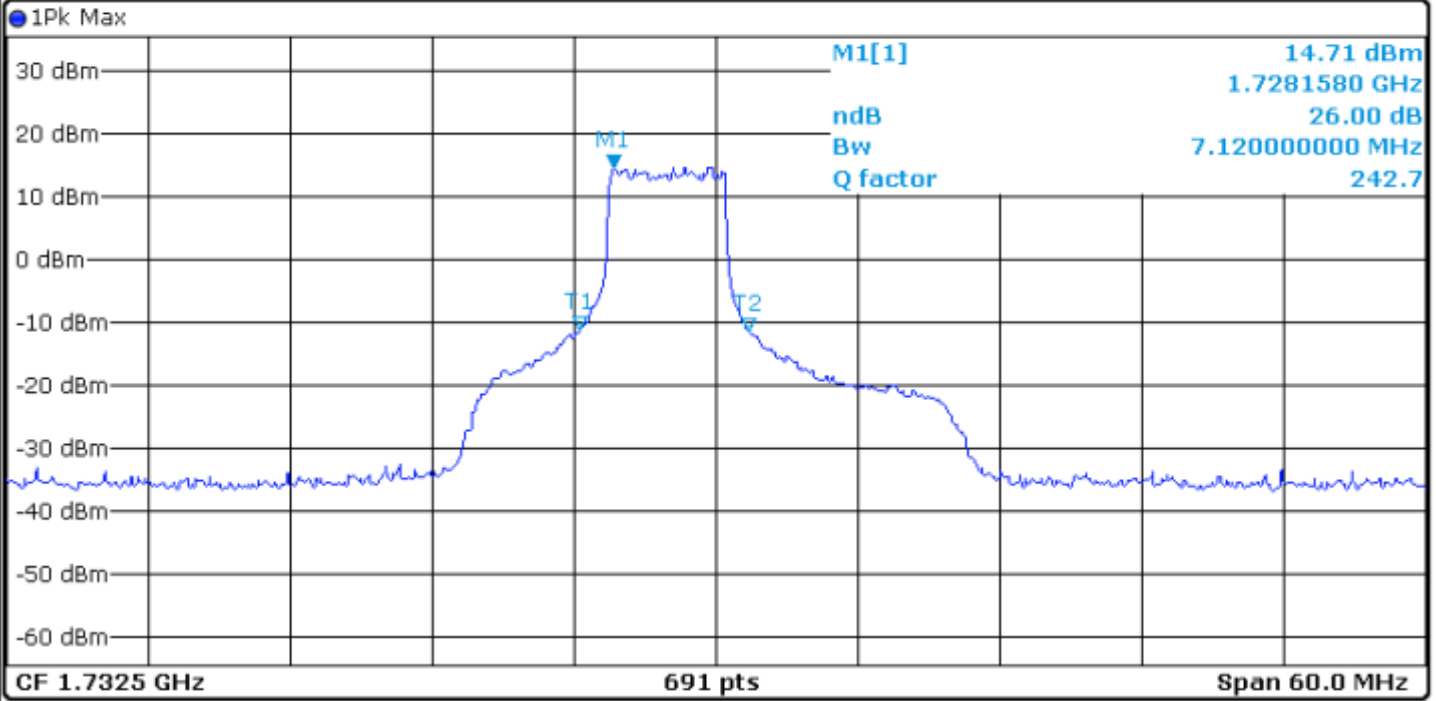
16.06.2015 00:15:23

Date: 16.JUN.2015 00:15:23

Channel **20175 (1732.5 MHz)** – RB Size = **27**; RB Offset = **25**; BW = **20.0 MHz**
26 OBW Modulation = **QAM**

Spectrum

Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
 Att 45 dB SWT 75.8 μs VBW 1 MHz Mode Auto FFT
 Count 100/100



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	1.728158 GHz	14.71 dBm	ndB down	7.12 MHz
T1		1	1.726769 GHz	-11.10 dBm	ndB	26.00 dB
T2		1	1.733889 GHz	-11.39 dBm	Q factor	242.7

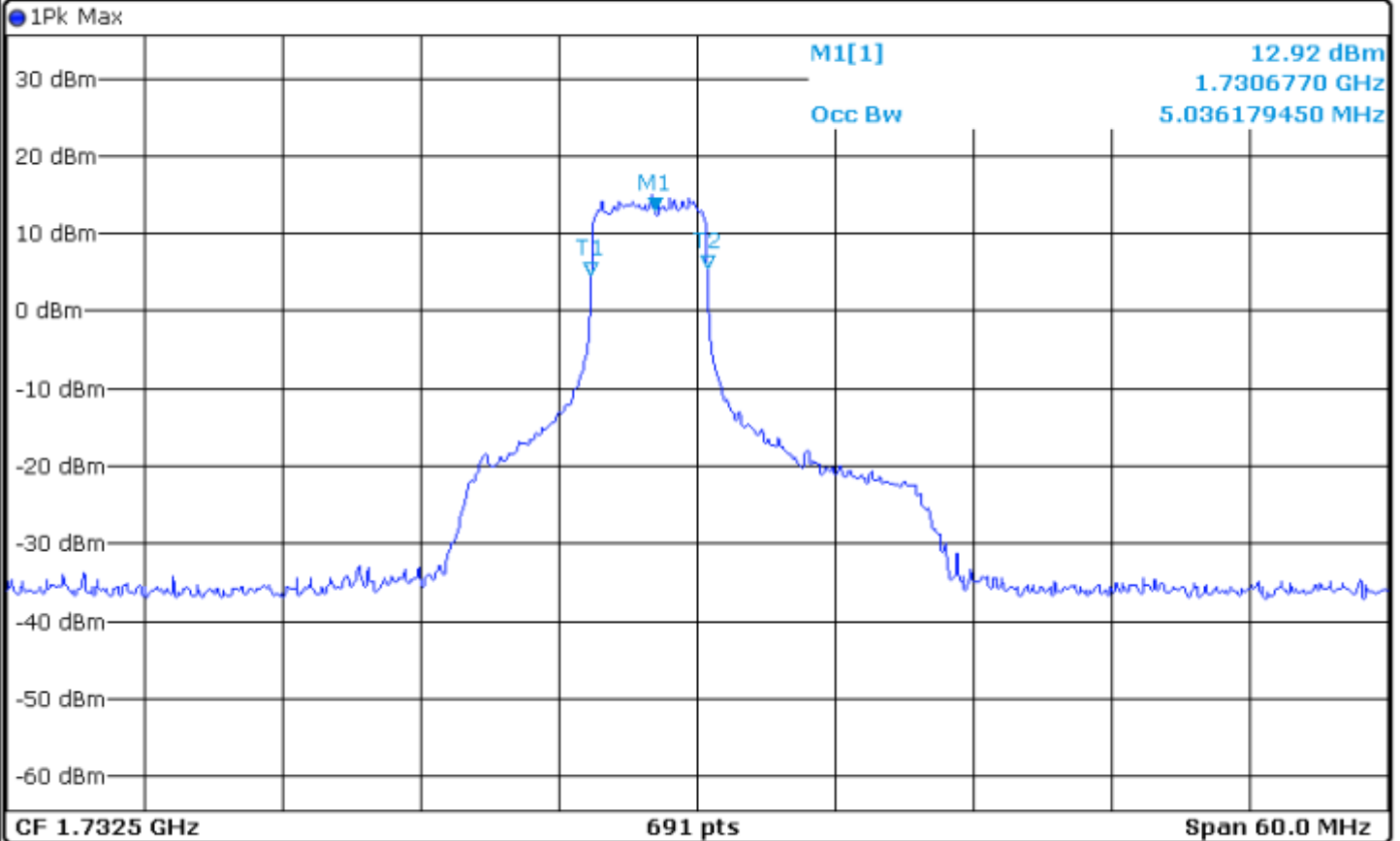
Measuring... 16.06.2015 00:31:11

Date: 16.JUN.2015 00:31:11

99% OBW Modulation = QAM

Spectrum

Ref Level 35.55 dBm Offset 10.55 dB RBW 100 kHz
Att 45 dB SWT 75.8 μs VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring... 16.06.2015 00:28:11

Date: 16.JUN.2015 00:28:11

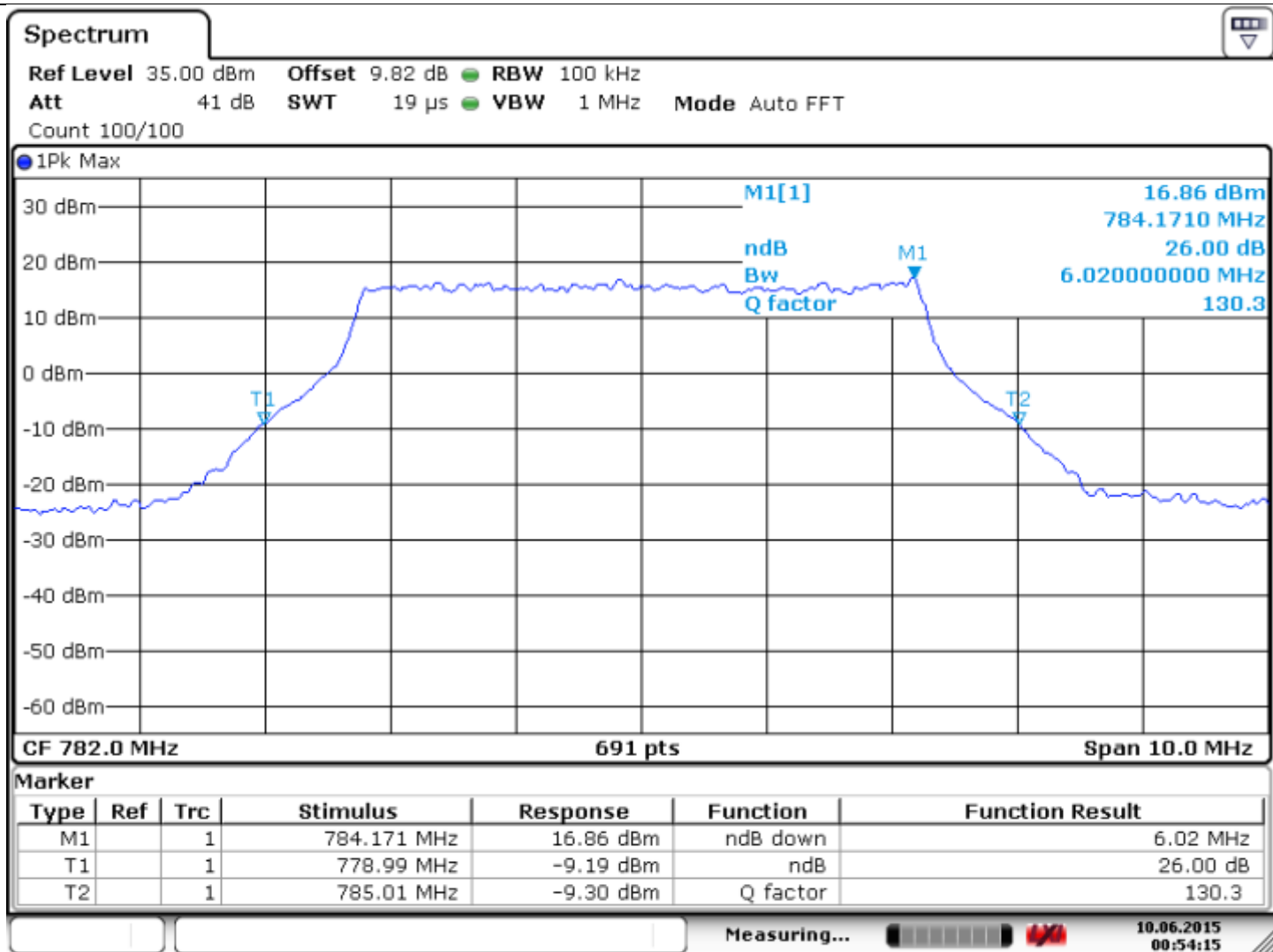
6.4.5.5 OBW LTE FDD Band 13 tables QPSK:

LTE Band 13 (777 MHz – 787 MHz) Modulation QPSK			
Channel No.	Frequency (MHz)	26 dB (MHz)	99% (MHz)
RB Size = 25		RB Offset = 0	
		BW (MHz) = 5	
23230	782	6.020	4.587
RB Size = 50		RB Offset = 0	
		BW (MHz) = 10	
23230	782	11.491	9.030

6.4.5.6 OBW LTE FDD Band 13 plots QPSK:

Channel 23230 (782 MHz) – RB Size = 25; RB Offset = 0; BW = 5 MHz

26 OBW Modulation = QPSK

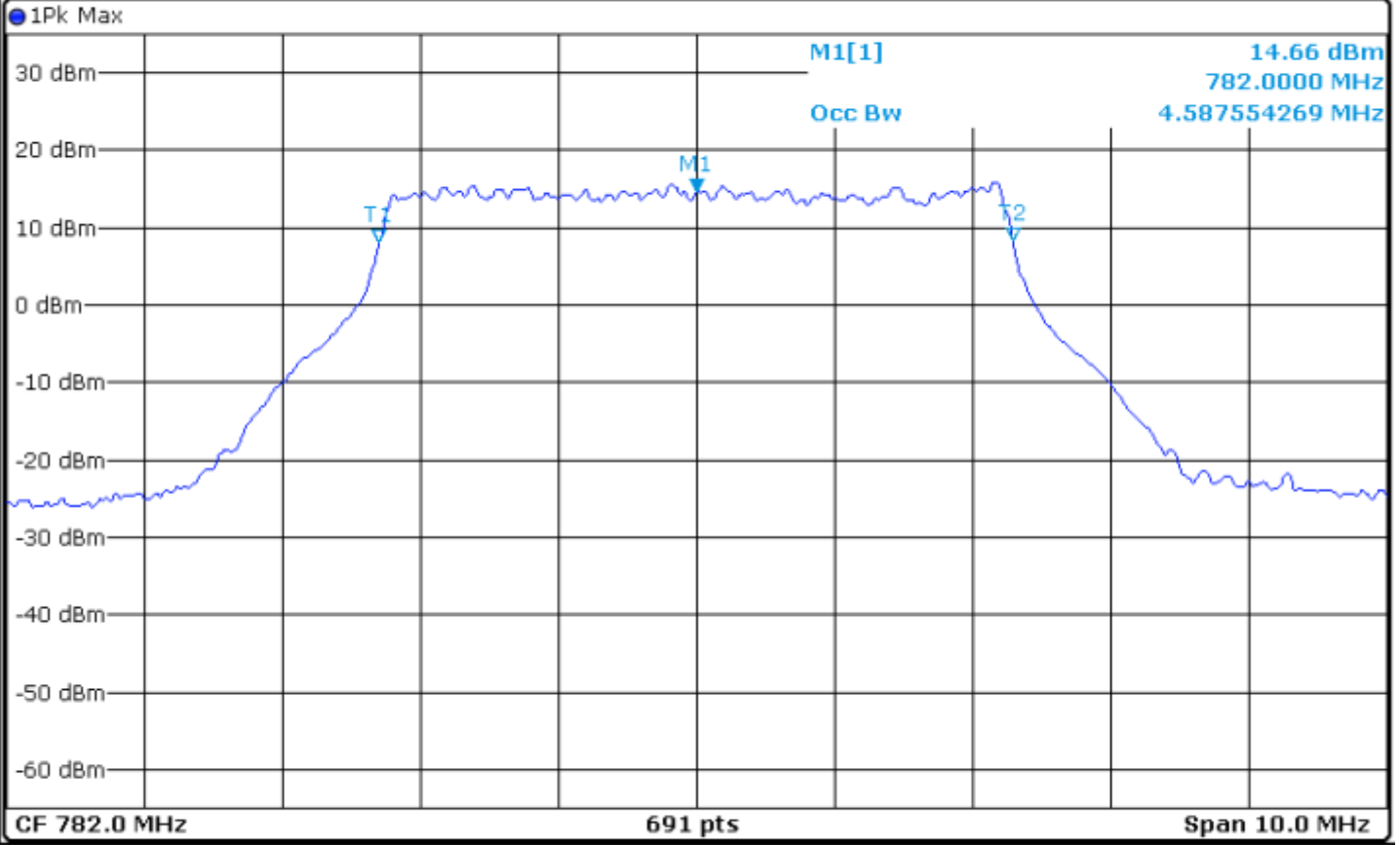


Date: 10.JUN.2015 00:54:15

99% OBW Modulation = QPSK

Spectrum

Ref Level 35.00 dBm Offset 9.82 dB RBW 100 kHz
Att 41 dB SWT 19 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring...



10.06.2015
00:45:10

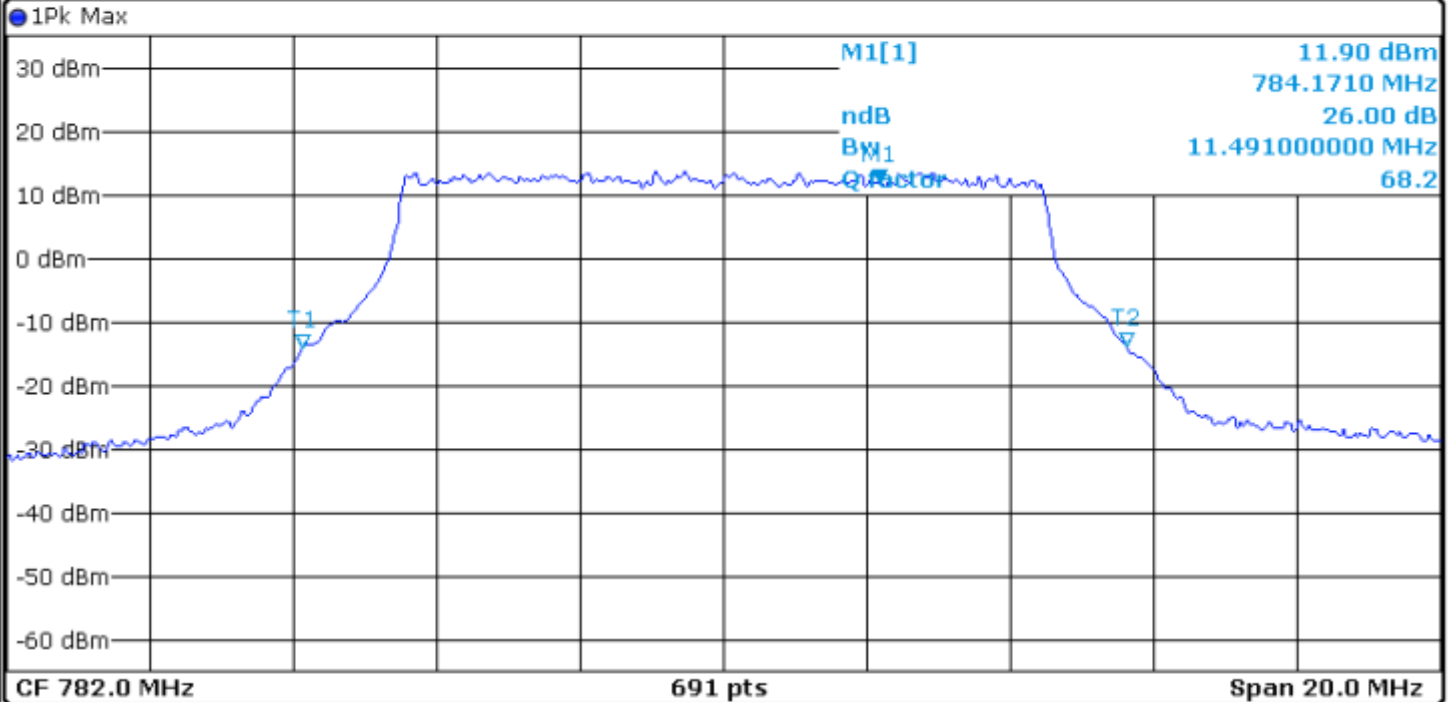
Date: 10.JUN.2015 00:45:10

Channel 23230 (782 MHz) – RB Size = 50; RB Offset = 0; BW = 10 MHz

26 OBW Modulation = QPSK

Spectrum

Ref Level 35.00 dBm Offset 9.82 dB RBW 100 kHz
 Att 45 dB SWT 38 μ s VBW 1 MHz Mode Auto FFT
 Count 100/100



Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	784.171 MHz	11.90 dBm	ndB down	11.491 MHz
T1		1	776.124 MHz	-14.28 dBm	ndB	26.00 dB
T2		1	787.615 MHz	-13.99 dBm	Q factor	68.2

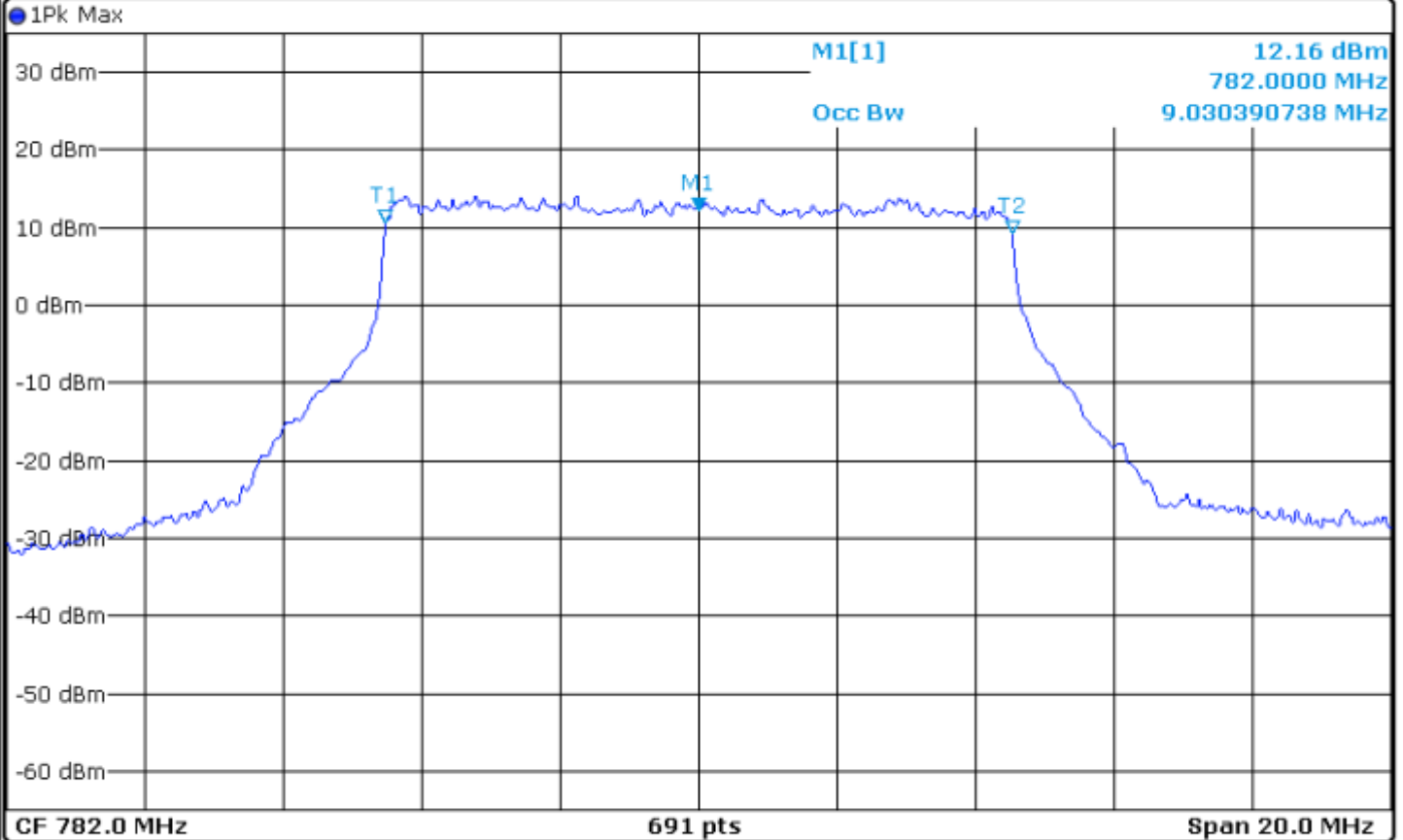
CF 782.0 MHz 691 pts Span 20.0 MHz Measuring... 10.06.2015 01:03:44

Date: 10.JUN.2015 01:03:44

99% OBW Modulation = QPSK

Spectrum

Ref Level 35.00 dBm Offset 9.82 dB RBW 100 kHz
Att 41 dB SWT 38 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring... 10.06.2015 00:38:28

Date: 10.JUN.2015 00:38:28

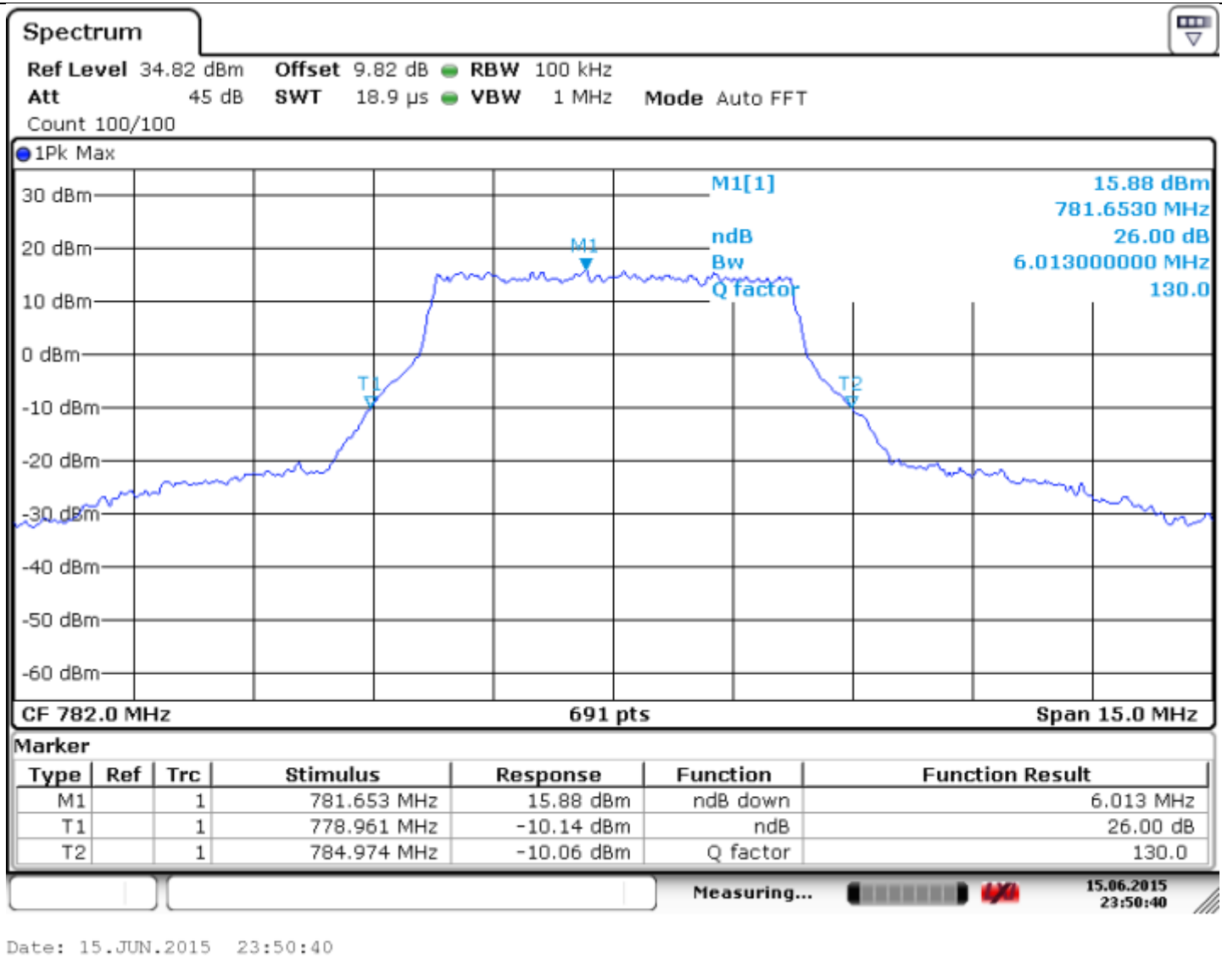
6.4.5.7 OBW LTE FDD Band 13 tables QAM:

LTE Band 13 (777 MHz – 787 MHz) Modulation QAM			
Channel No.	Frequency (MHz)	26 dB (MHz)	99% (MHz)
RB Size = 25	RB Offset = 0	BW (MHz) = 5	
23230	782	6.01	4.58
RB Size = 50 (27)	RB Offset = 0 (12)	BW (MHz) = 10	
23230	782	7.69	4.99

6.4.5.8 OBW LTE FDD Band 13 plots QAM:

Channel **23230 (782 MHz)** – RB Size = 25; RB Offset = 0; BW = 5 MHz

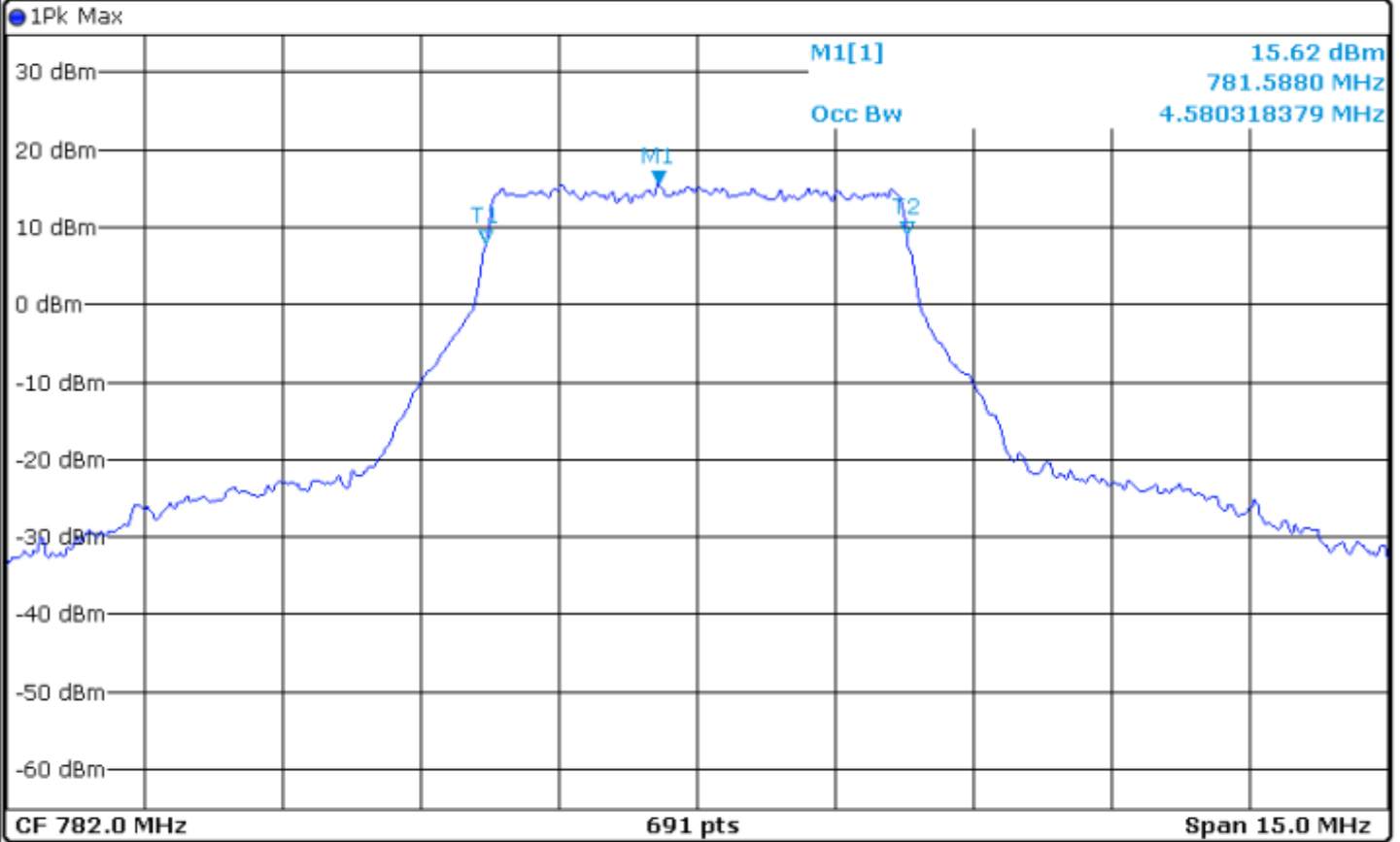
26 OBW Modulation = QAM



99% OBW Modulation = QAM

Spectrum

Ref Level 34.82 dBm Offset 9.82 dB RBW 100 kHz
Att 41 dB SWT 18.9 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring... 15.06.2015 22:15:07

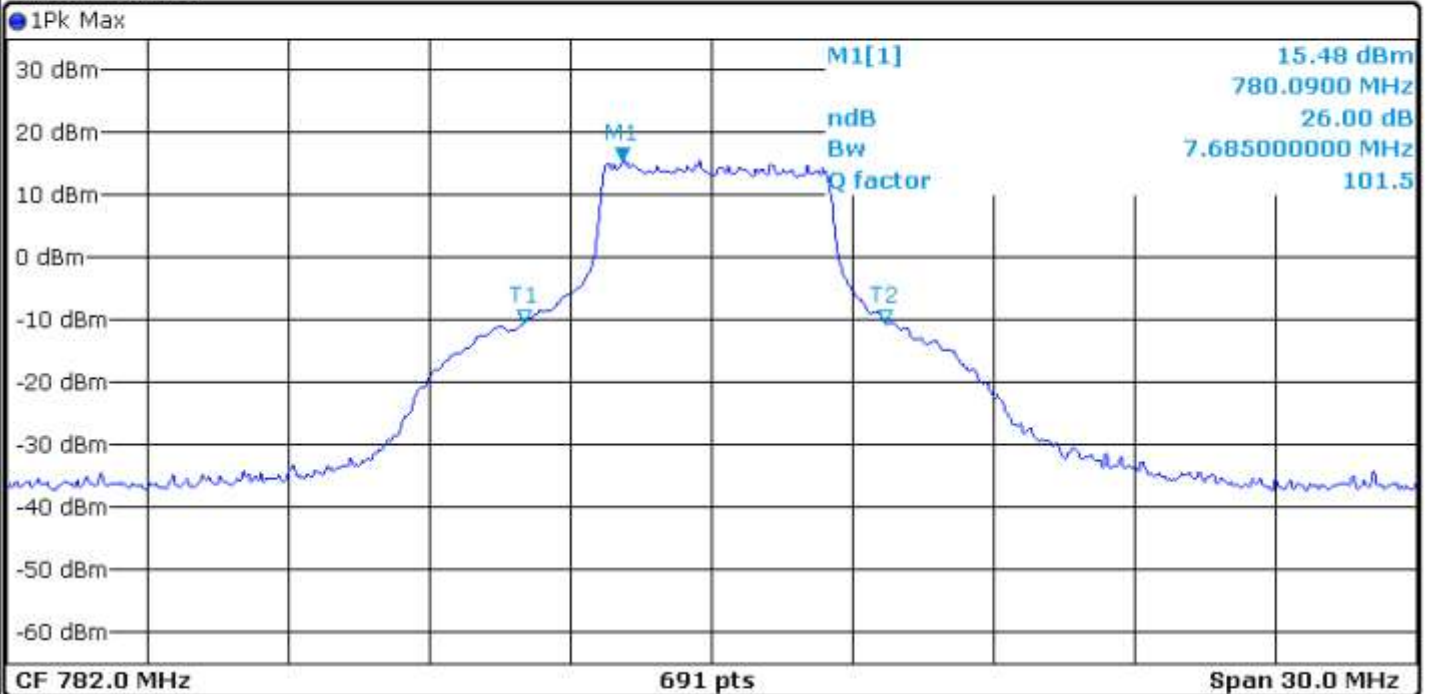
Date: 15.JUN.2015 22:15:07

Channel **23230 (782 MHz)** – RB Size = 27; RB Offset = 12; BW = **10 MHz**

26 OBW Modulation = QAM

Spectrum

Ref Level 34.82 dBm Offset 9.82 dB RBW 100 kHz
 Att 45 dB SWT 37.9 μ s VBW 1 MHz Mode Auto FFT
 Count 100/100



Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	780.09 MHz	15.48 dBm	ndB down	7.685 MHz
T1		1	778.006 MHz	-10.61 dBm	ndB	26.00 dB
T2		1	785.69 MHz	-10.61 dBm	Q factor	101.5

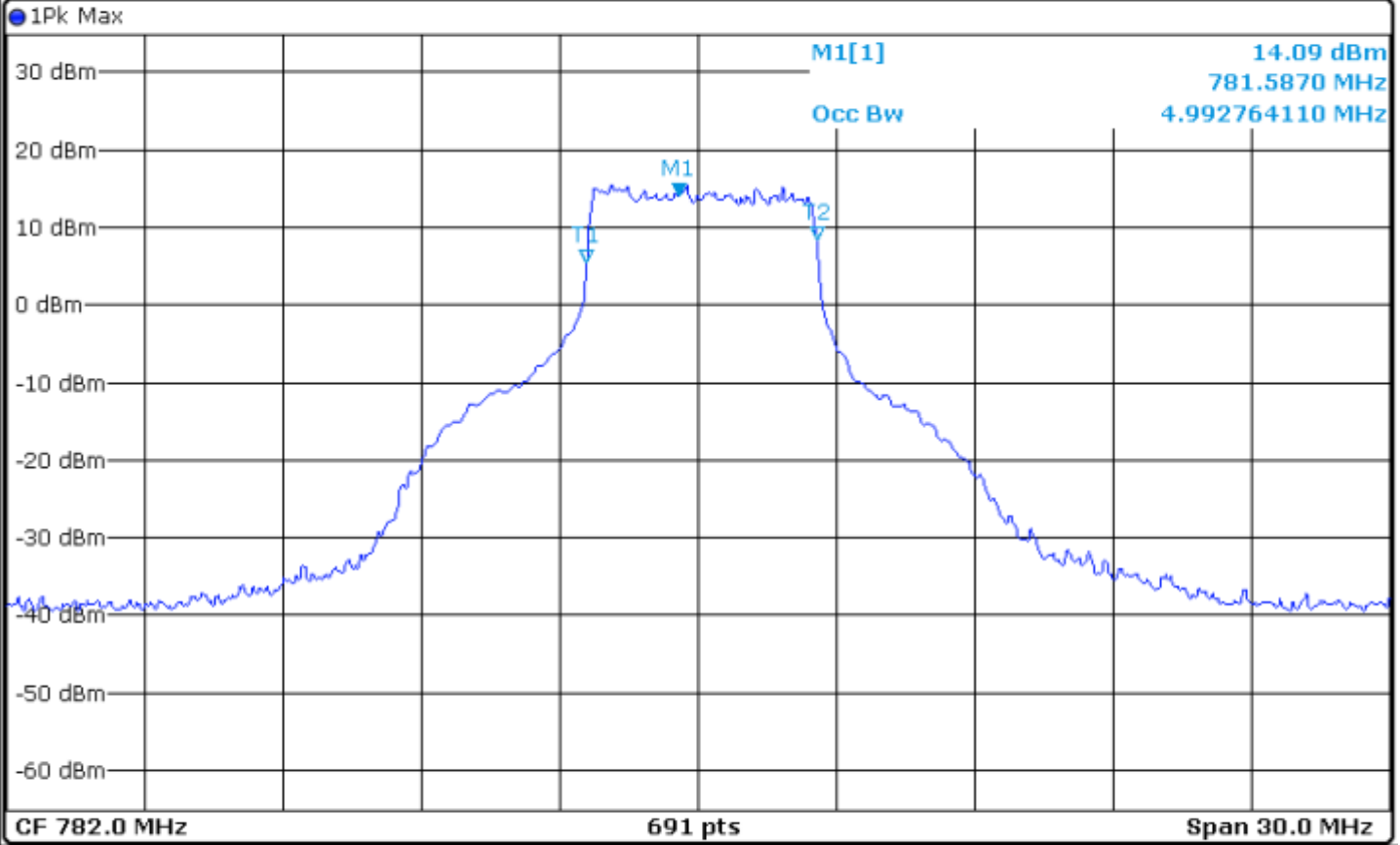
Measuring... 15.06.2015 23:21:42

Date: 15.JUN.2015 23:21:42

99% OBW Modulation = QAM

Spectrum

Ref Level 34.82 dBm Offset 9.82 dB RBW 100 kHz
Att 41 dB SWT 37.9 μ s VBW 1 MHz Mode Auto FFT
Count 100/100



Measuring... 15.06.2015 23:17:00

Date: 15.JUN.2015 23:17:00

6.5 Frequency Stability

6.5.1 References

FCC: CFR Part 2.1055, CFR Part 27.54

6.5.2 Measurement requirements:

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage. A hand-held device that is only capable of operating using internal batteries shall be tested using a new battery without any further requirement to vary the supply voltage. Alternatively, an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

6.5.3 Limits

NOTE: Freq. Error (ppm) = Freq. Error (Hz) / Declared Freq (MHz)

Limit is +/- 1.5ppm for base stations

Limit is +/- 2.5ppm for mobile devices

For Hand carried battery powered equipment:

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235/22.355 Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.6VDC and 4.2VDC, with a nominal voltage of 3.8VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of – 5.0% and +10.5%. For the purposes of measuring frequency stability these voltage limits are to be used.

6.5.4 Summary Test Data:

Band	Temp, °C	Voltage	Upper Freq, MHz	Lower Freq, MHz	Nominal Freq, MHz	Center Freq Calc, MHz	Deviation in ppm
4	22	3.9	1732.59318	1732.40708	1732.5	1732.50013	0.08
4	22	3.5	1732.59288	1732.40718	1732.5	1732.50003	0.02
4	22	4.3	1732.59278	1732.40718	1732.5	1732.49998	-0.01
13	22	3.9	782.0934	781.9067	782	782.00005	0.06
13	22	3.5	782.0934	781.9067	782	782.00005	0.06
13	22	4.3	782.0934	781.9067	782	782.00005	0.06
4	-10	3.9	1732.59298	1732.40705	1732.5	1732.500015	0.01
4	-10	3.5	1732.59318	1732.40705	1732.5	1732.500115	0.07
4	-10	4.3	1732.59328	1732.40705	1732.5	1732.500165	0.10
13	-10	3.9	782.09345	781.90695	782	782.0002	0.26
13	-10	3.5	782.09345	781.90695	782	782.0002	0.26
13	-10	4.3	782.09345	781.90695	782	782.0002	0.26
4	50	3.9	1732.5934	1732.4069	1732.5	1732.50015	0.09
4	50	3.5	1732.5934	1732.4069	1732.5	1732.50015	0.09
4	50	4.3	1732.5934	1732.4069	1732.5	1732.50015	0.09
13	50	3.9	782.09345	781.90685	782	782.00015	0.19
13	50	3.5	782.09345	781.90695	782	782.0002	0.26
13	50	4.3	782.09355	781.90675	782	782.00015	0.19

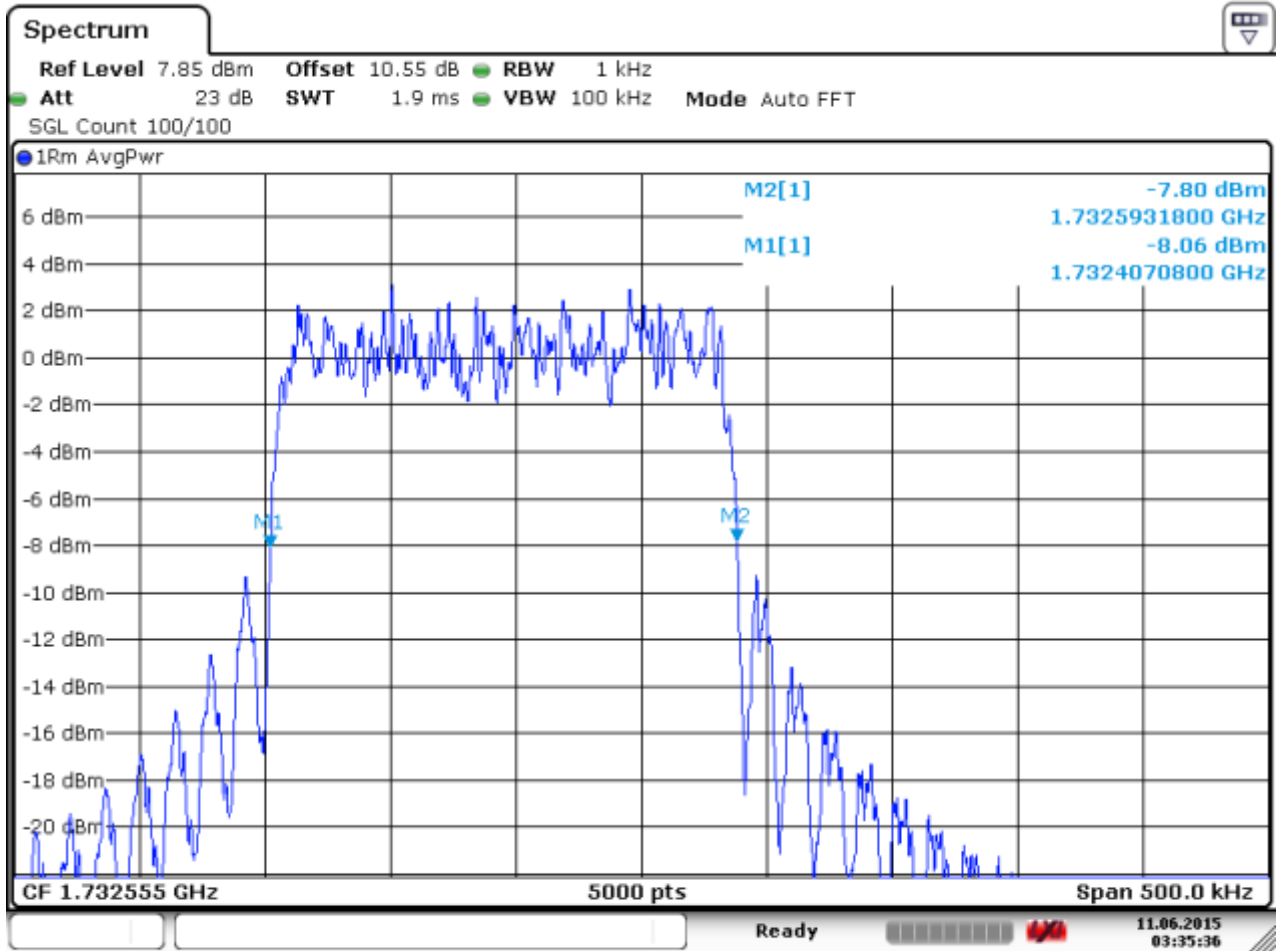
6.5.5 Test Notes:

No mode of operation with a CW signal was available to measure the frequency stability so the measurement was taken according to the following methods:

1. For optimum comparison to nominal frequency 5 MHz channelisation with the center Resource Block, (RB), of the 25 RB has been applied.
2. 5000 sweep points, a span of 500 kHz and an RBW of 10kHz have been chosen for maximum resolution of the steep slopes of the signal.
3. Two cursors have been set a identical level at the steepest part of the slopes on either side of the signal.
4. The actual center frequency has been calculated as $f_c = f_{low} + (f_{high} - f_{low}) / 2$
5. The measurement has been carried out for the extremes of voltage and temperature specified for the EUT.
6. The spectrum analyzer FSV has been used as a frequency reference (10MHz) by coupling it to the Aeroflex call box and setting the call box to external reference.

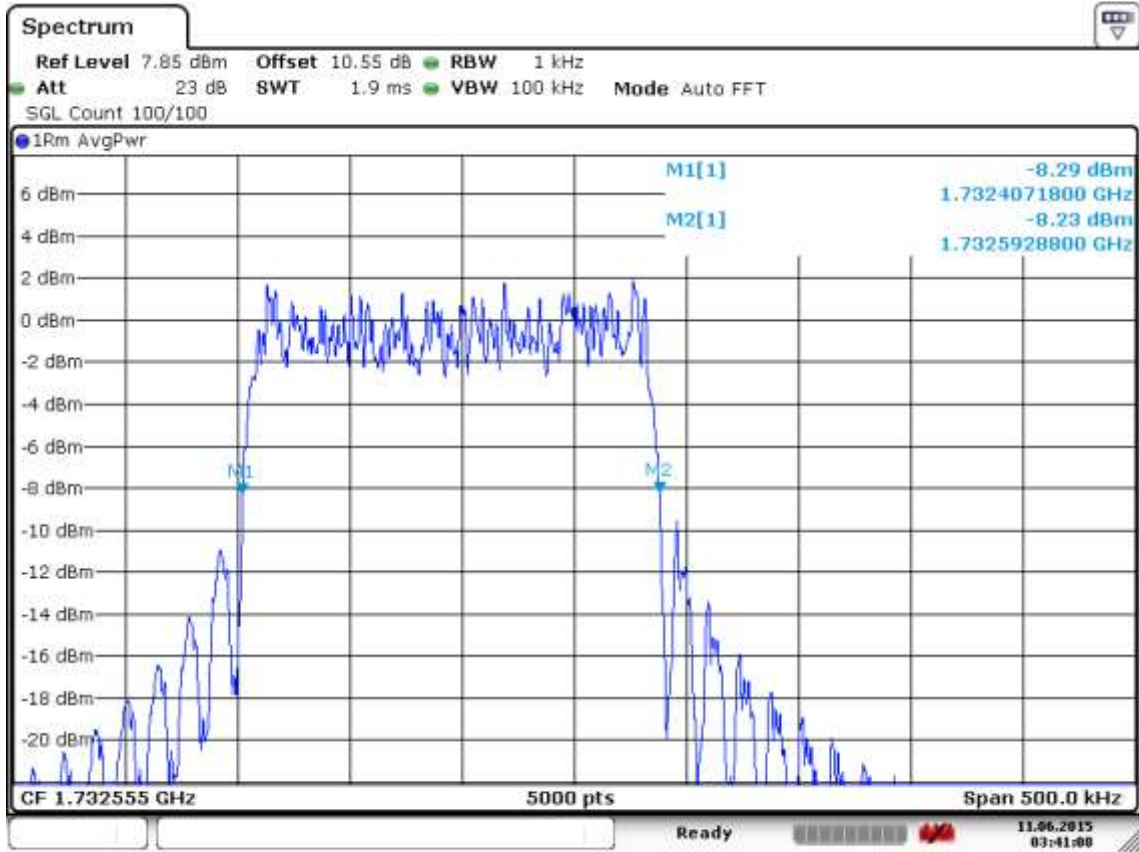
6.5.5.1 LTE Band 4 data

6.5.5.1.1 LTE Band 4_Vnom_Tnom



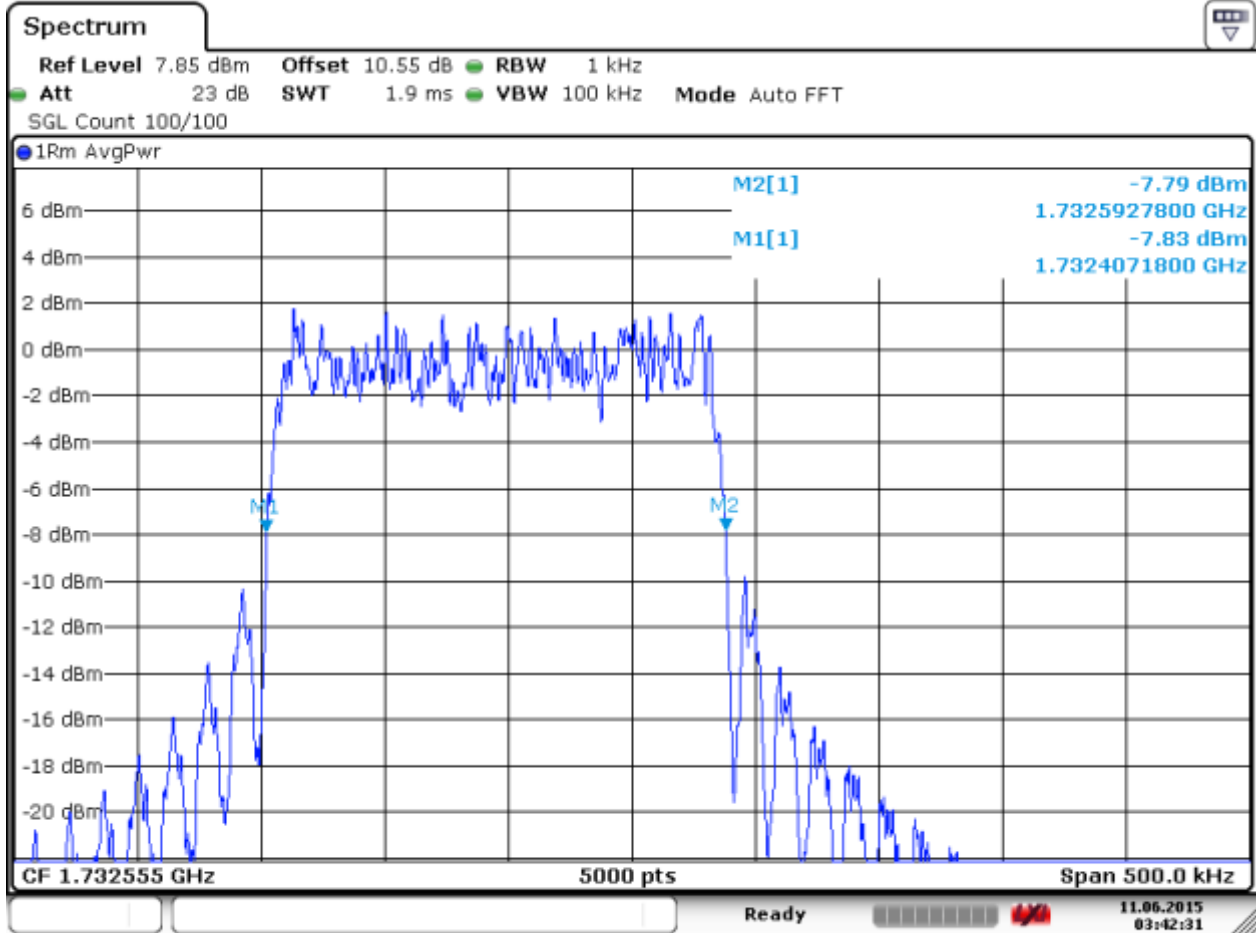
Date: 11.JUN.2015 03:35:36

6.5.5.1.2 LTE Band 4_Vlo_Tnom



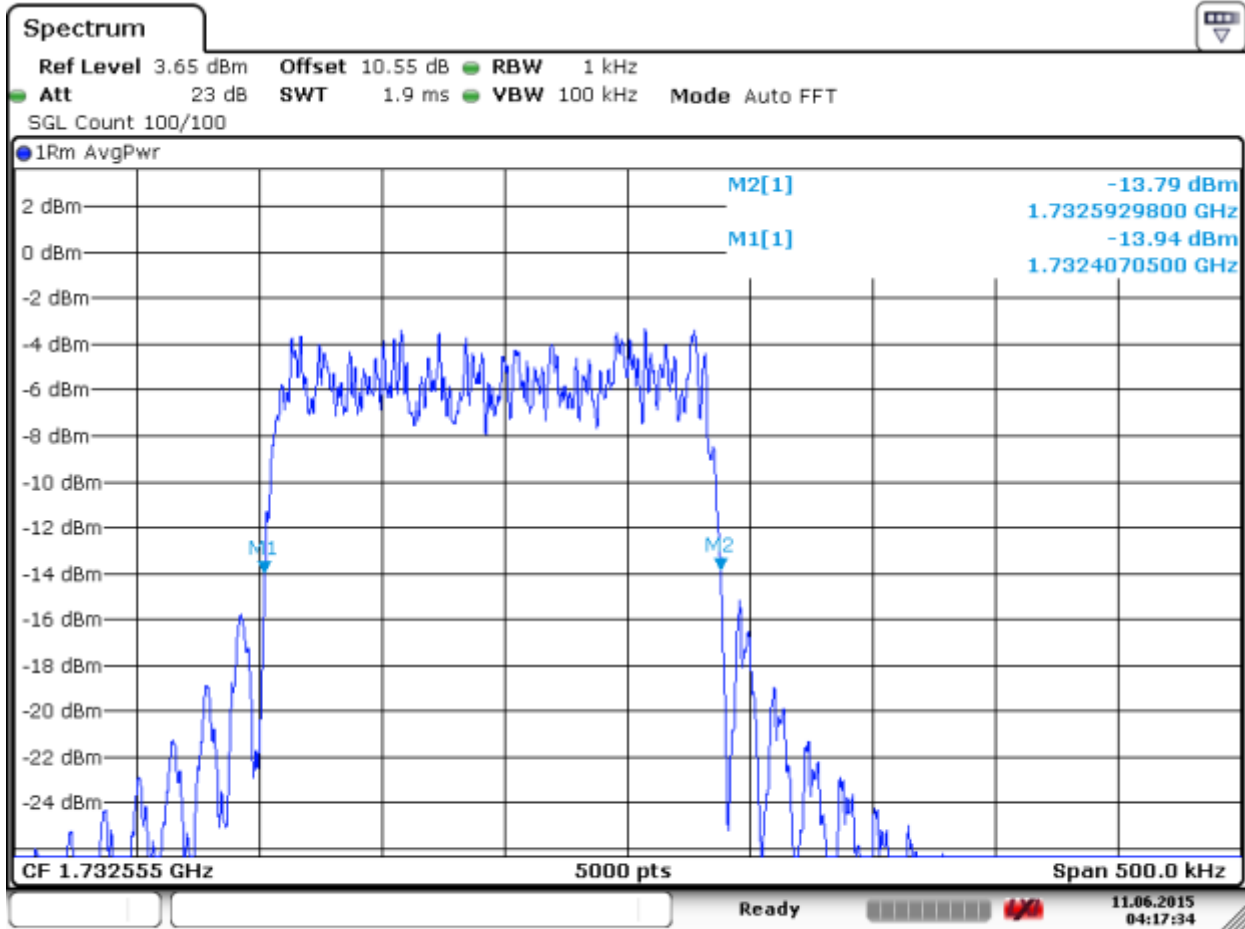
Date: 11.JUN.2015 03:41:08

6.5.5.1.3 LTE Band 4_Vhi_Tnom



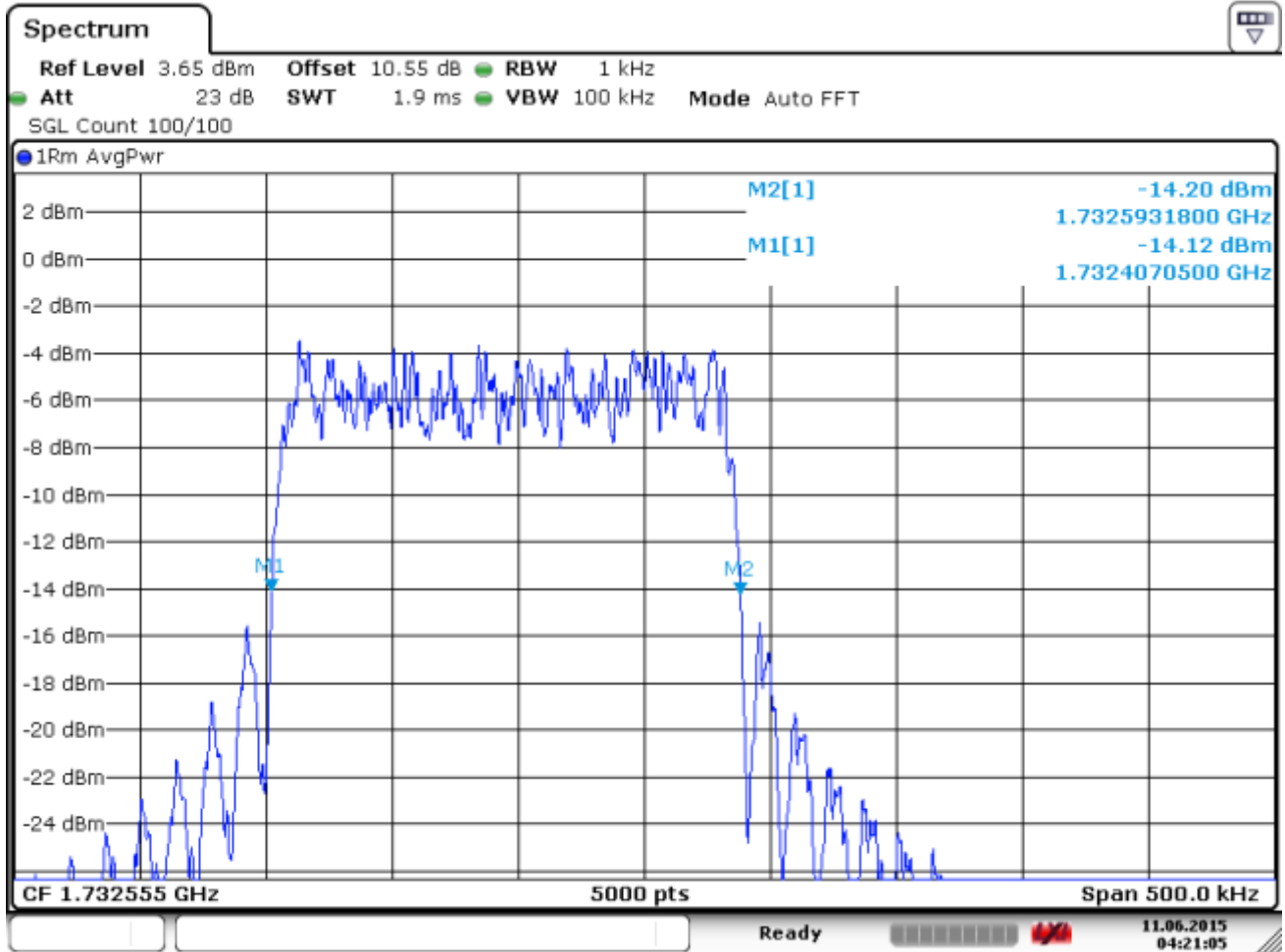
Date: 11.JUN.2015 03:42:31

6.5.5.1.4 LTE Band 4_Vnom_Tlow



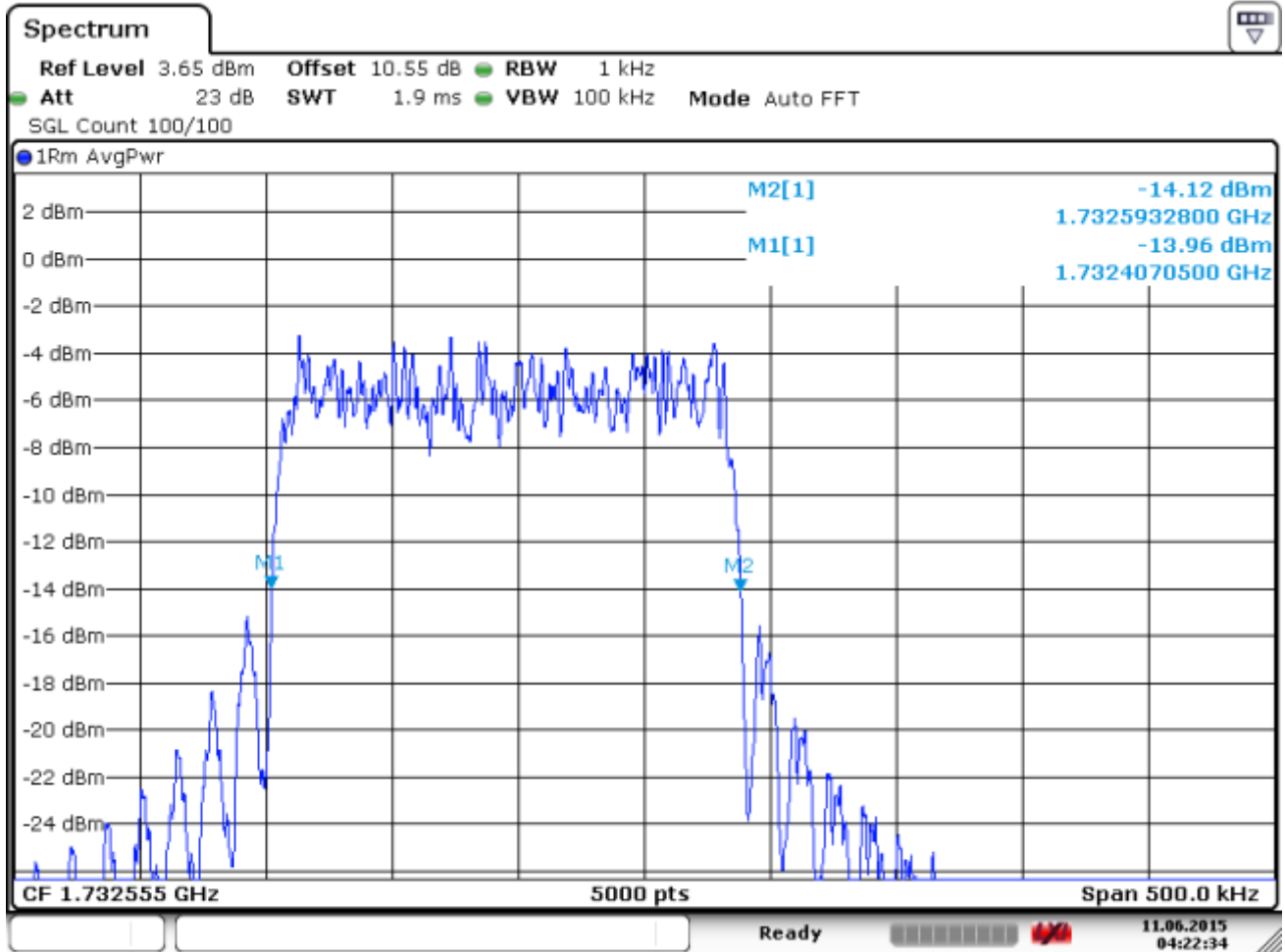
Date: 11.JUN.2015 04:17:34

6.5.5.1.5 LTE Band 4_Vlo_Tlow



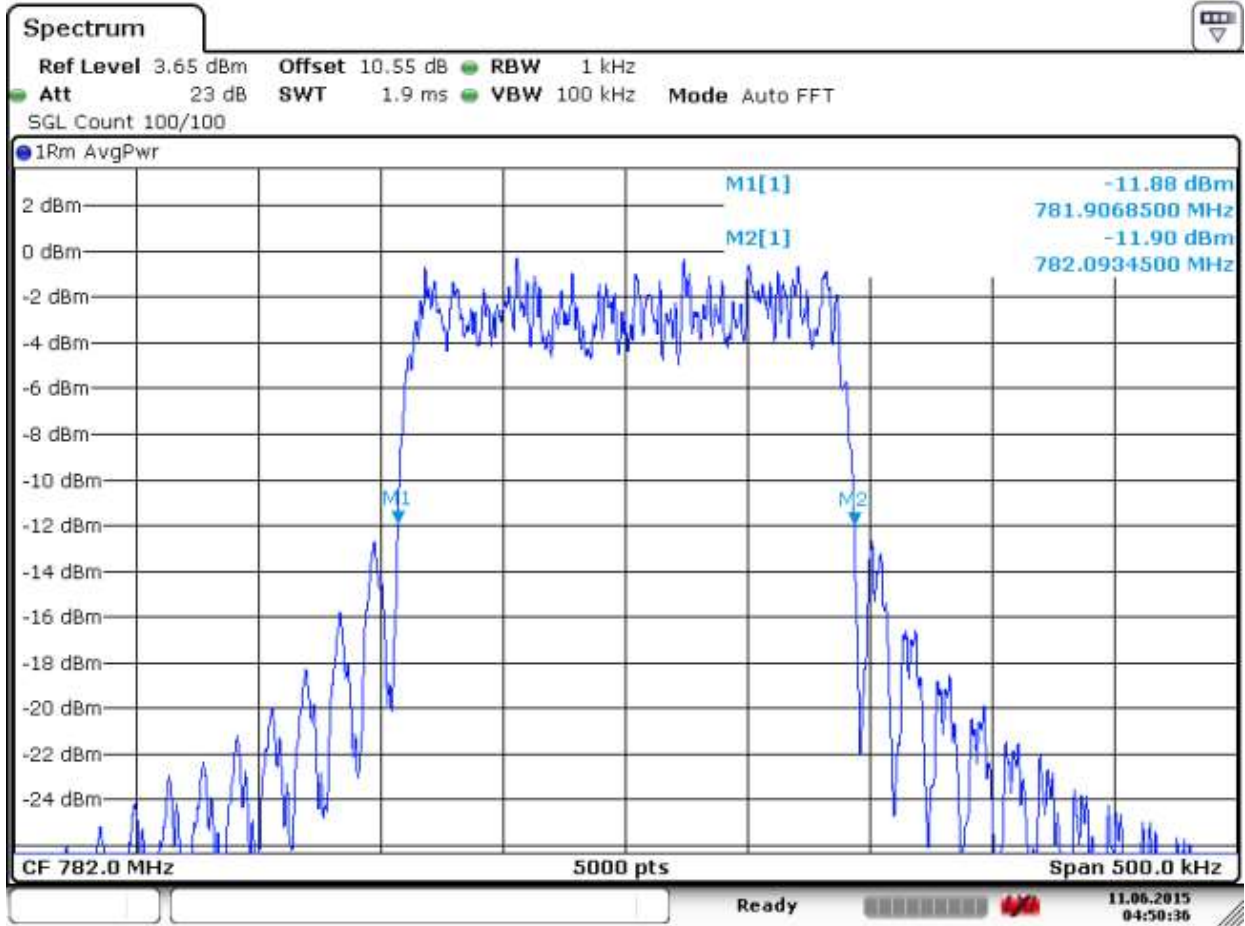
Date: 11.JUN.2015 04:21:06

6.5.5.1.6 LTE Band 4_Vhi_Tlow



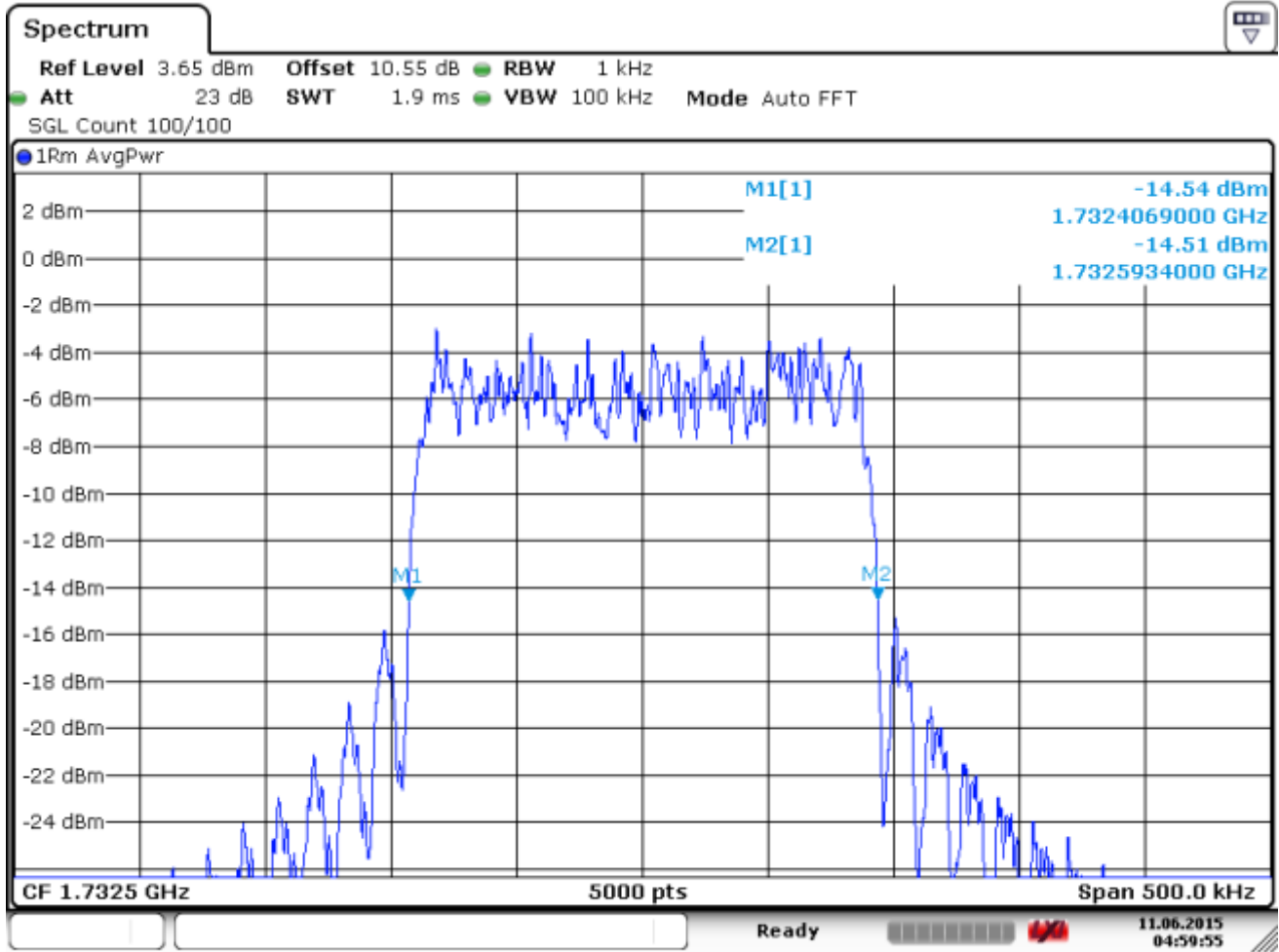
Date: 11.JUN.2015 04:22:34

6.5.5.1.7 LTE Band 4_Vnom_Thi



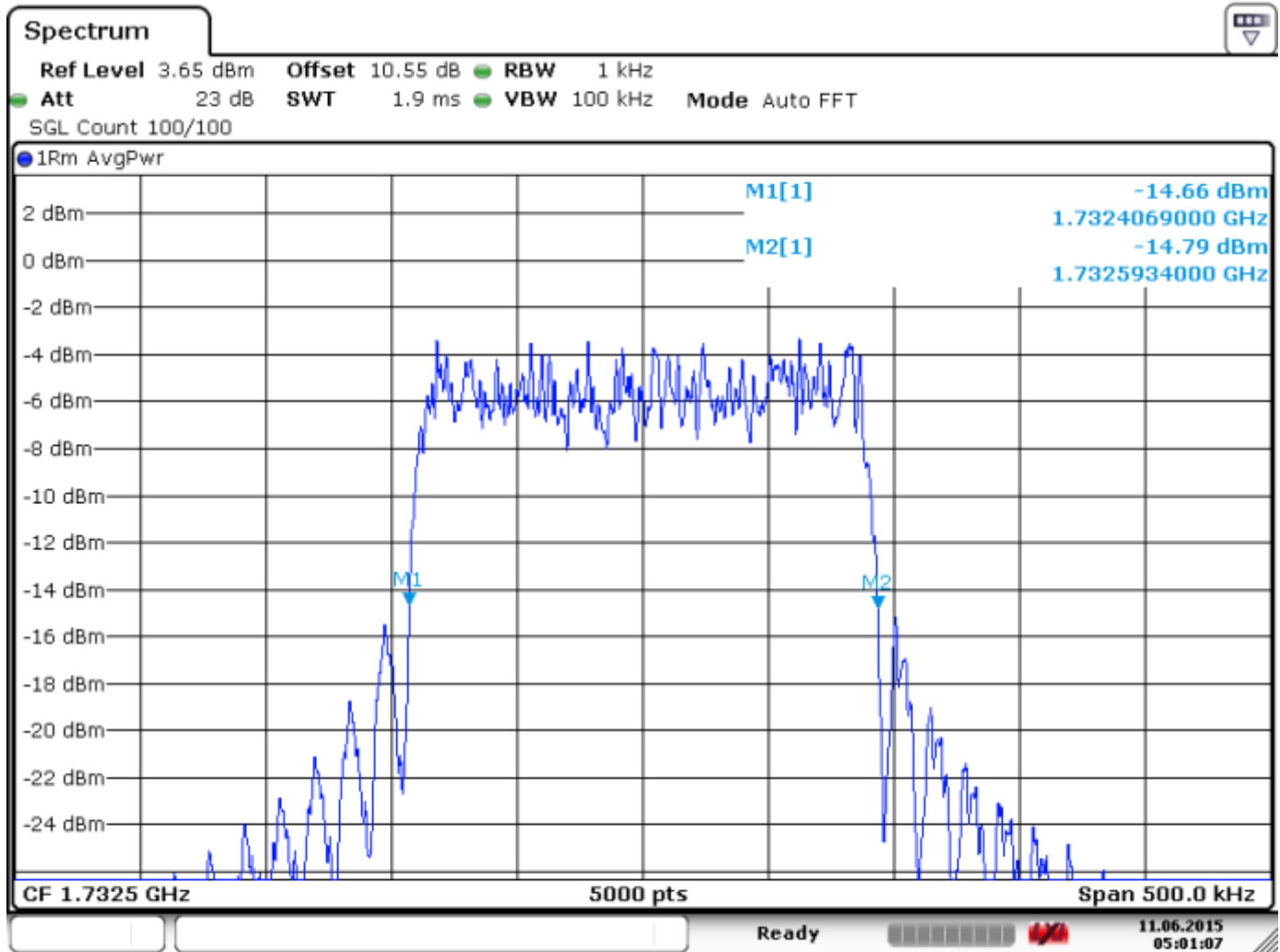
Date: 11.JUN.2015 04:50:37

6.5.5.1.8 LTE Band 4_Vlo_Thi



Date: 11.JUN.2015 04:59:55

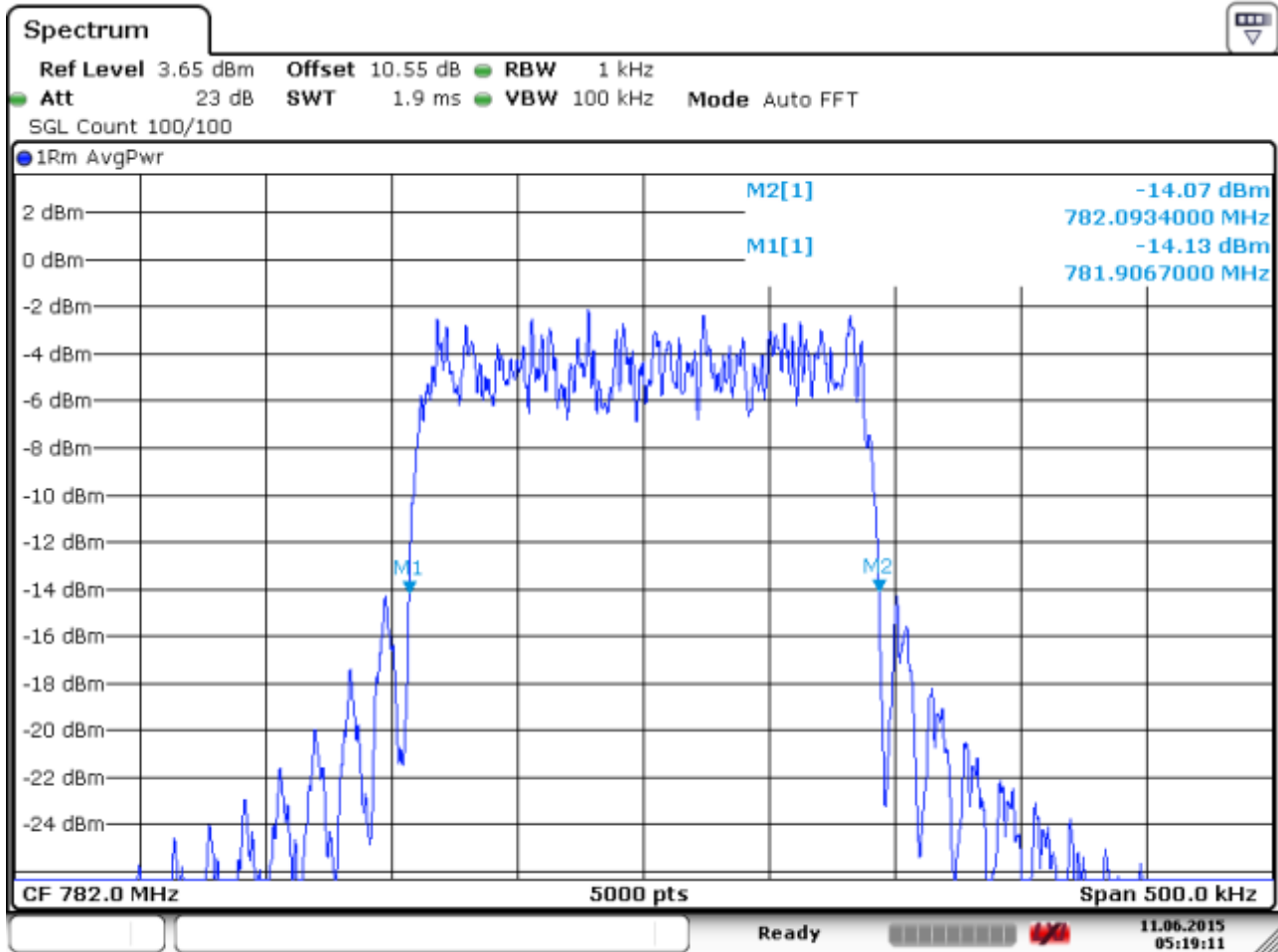
6.5.5.1.9 LTE Band 4_Vhi_Thi



Date: 11.JUN.2015 05:01:07

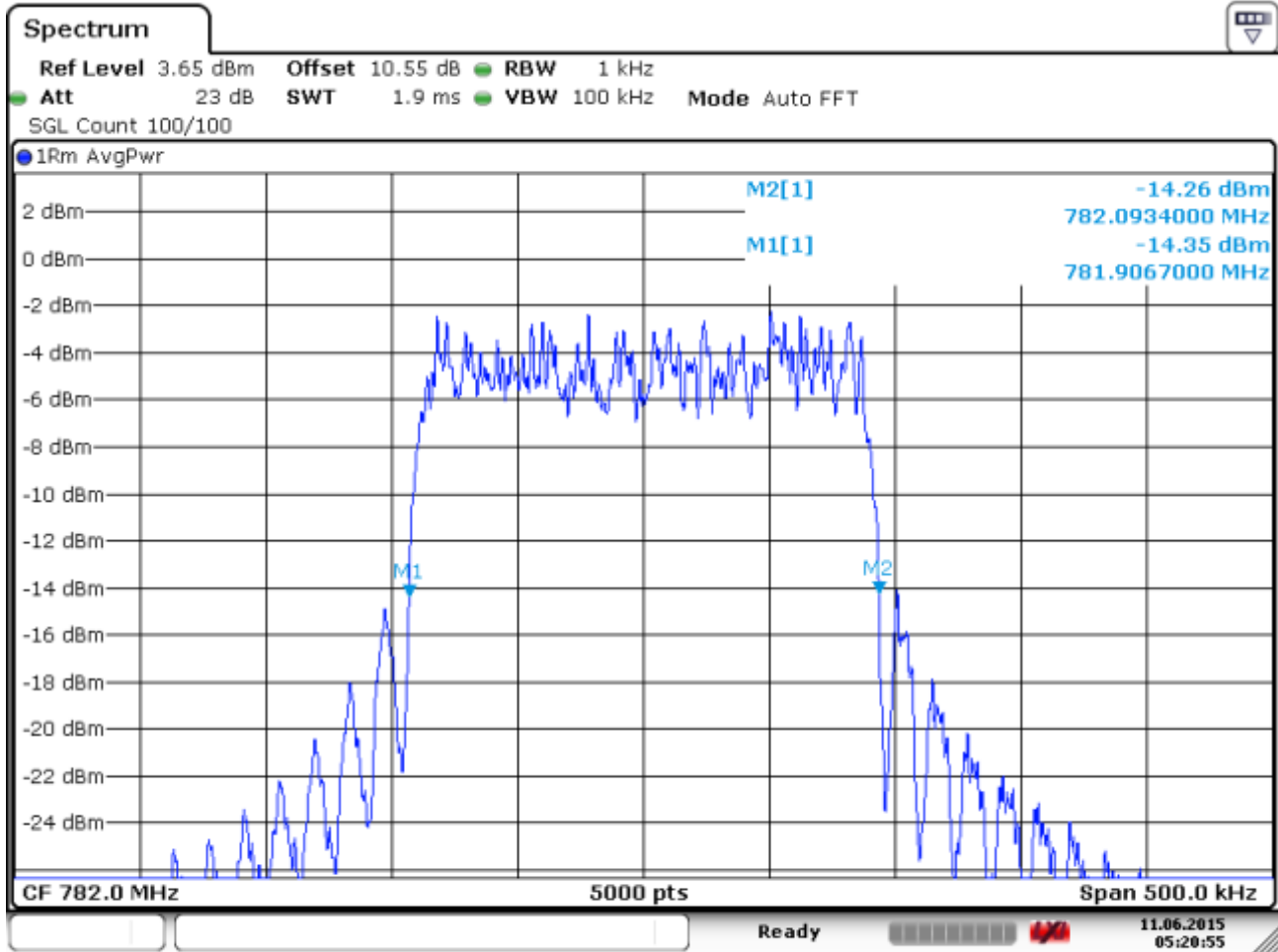
6.5.5.2 LTE Band 13

6.5.5.2.1 LTE Band 13_Vnom Tnom



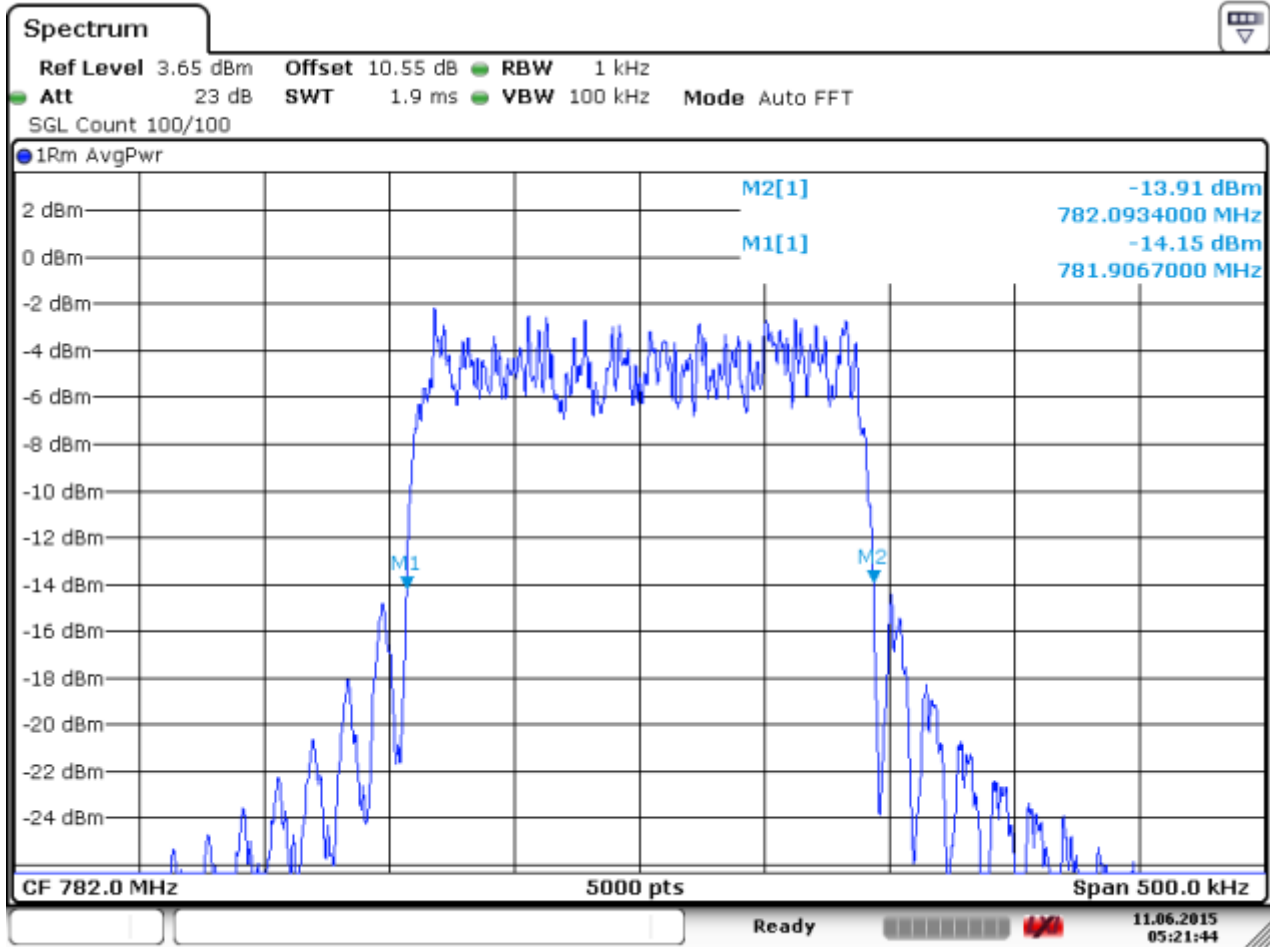
Date: 11.JUN.2015 05:19:11

6.5.5.2.2 LTE Band 13_Vlo Tnom



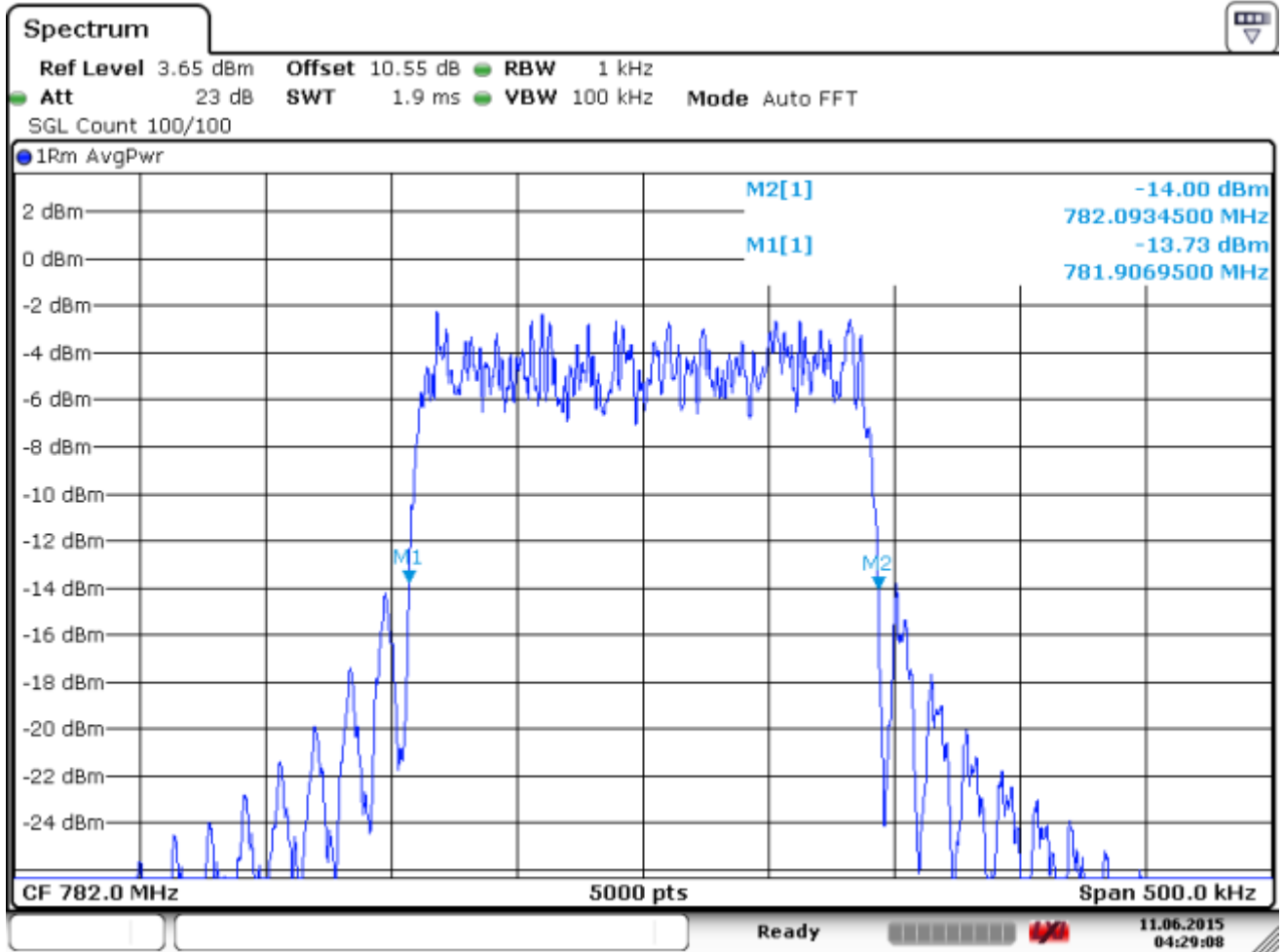
Date: 11.JUN.2015 05:20:55

6.5.5.2.3 LTE Band 13_Vhi Tnom



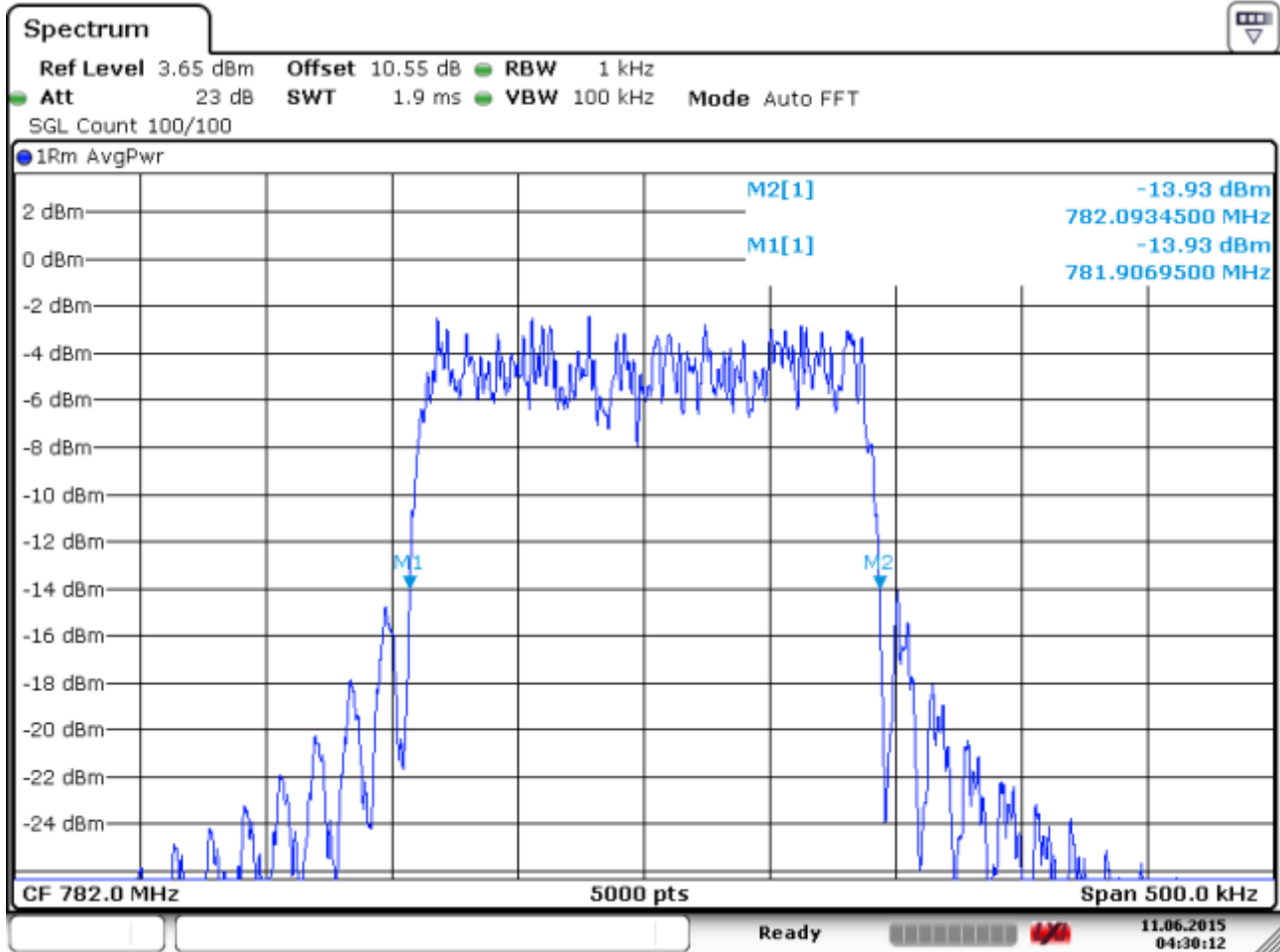
Date: 11.JUN.2015 05:21:45

6.5.5.2.4 LTE Band 13_Vnom Tlow



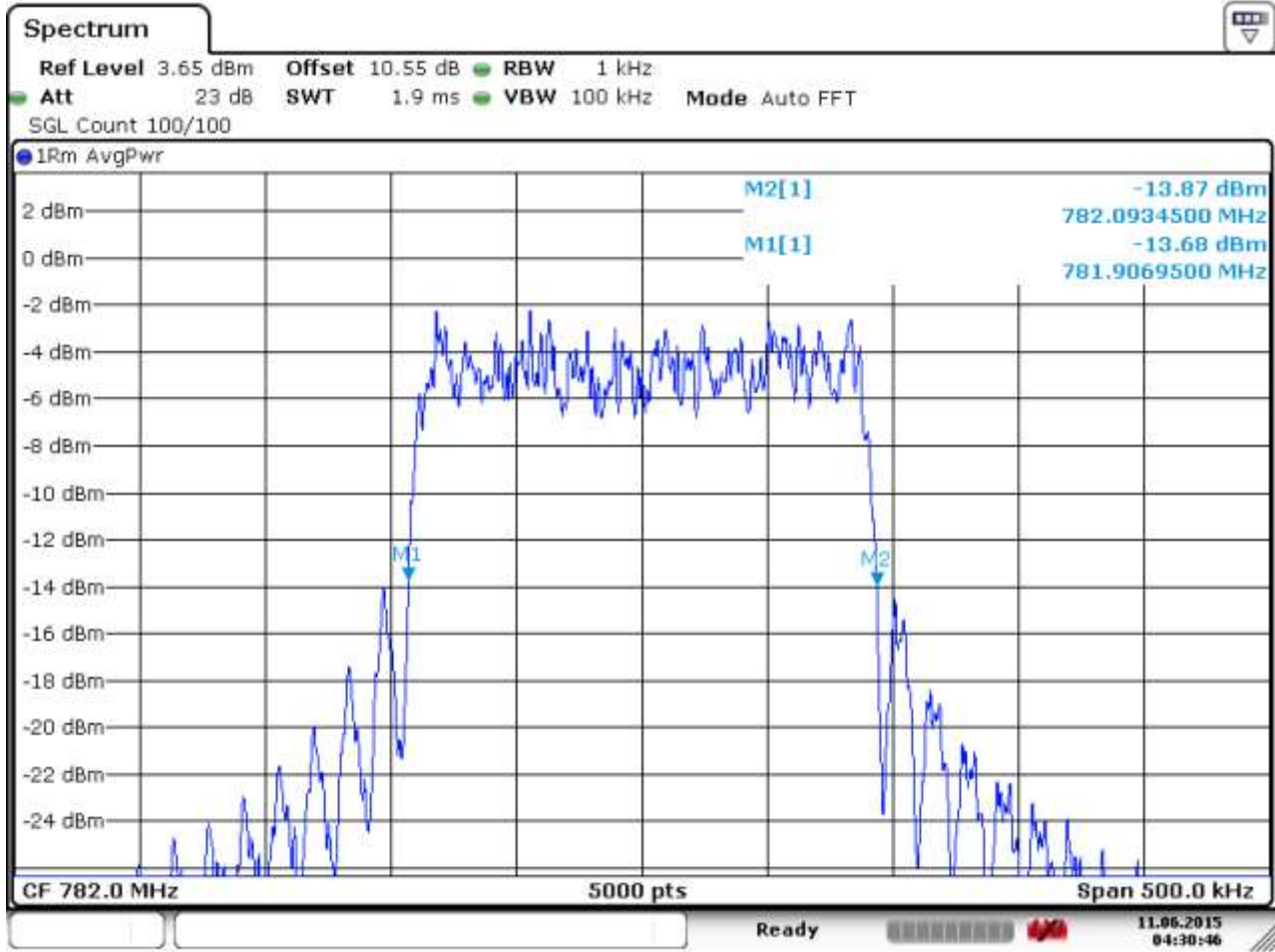
Date: 11.JUN.2015 04:29:08

6.5.5.2.5 LTE Band 13_Vlo Tlow



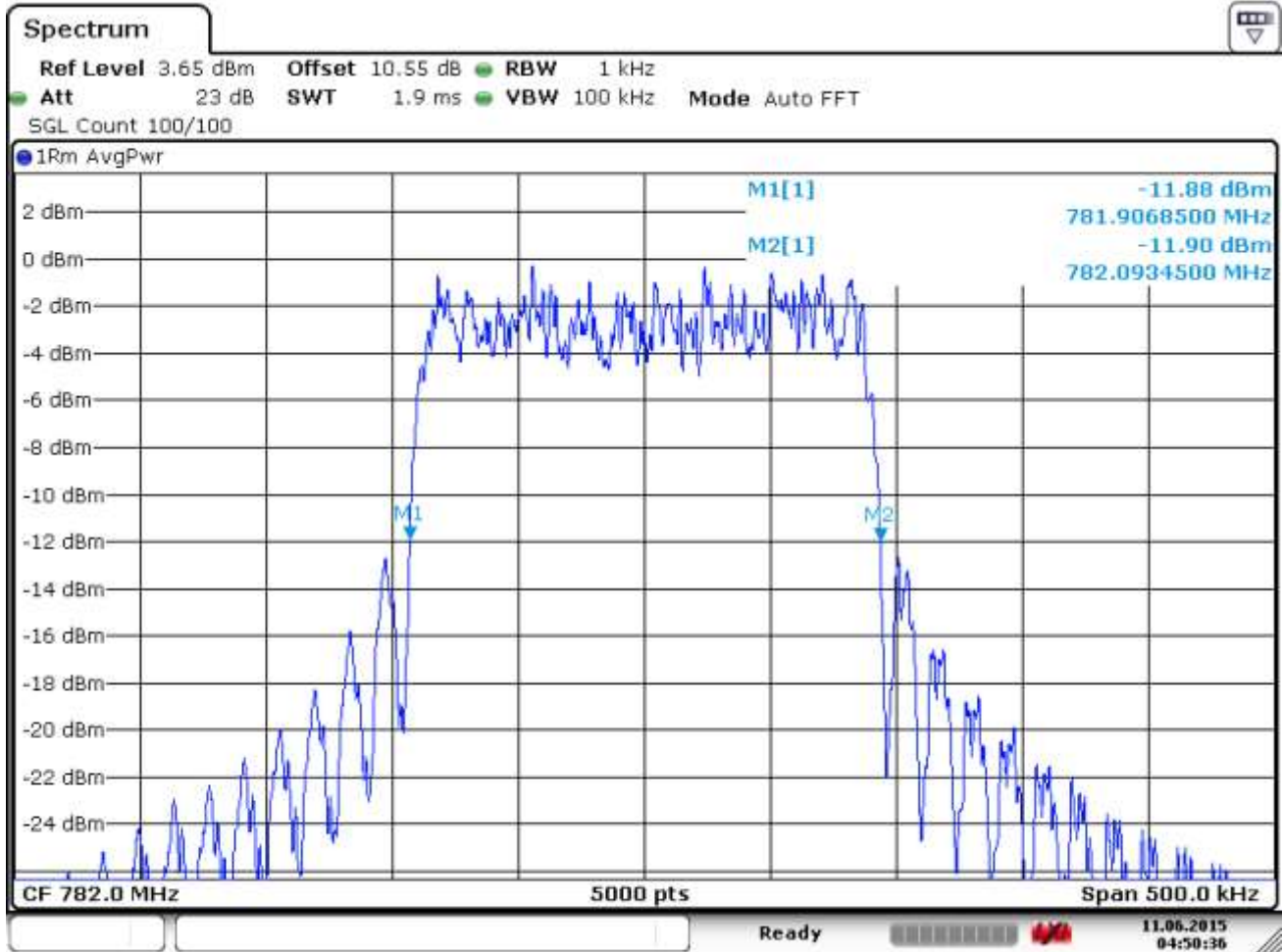
Date: 11.JUN.2015 04:30:12

6.5.5.2.6 LTE Band 13_Vhi Tlow



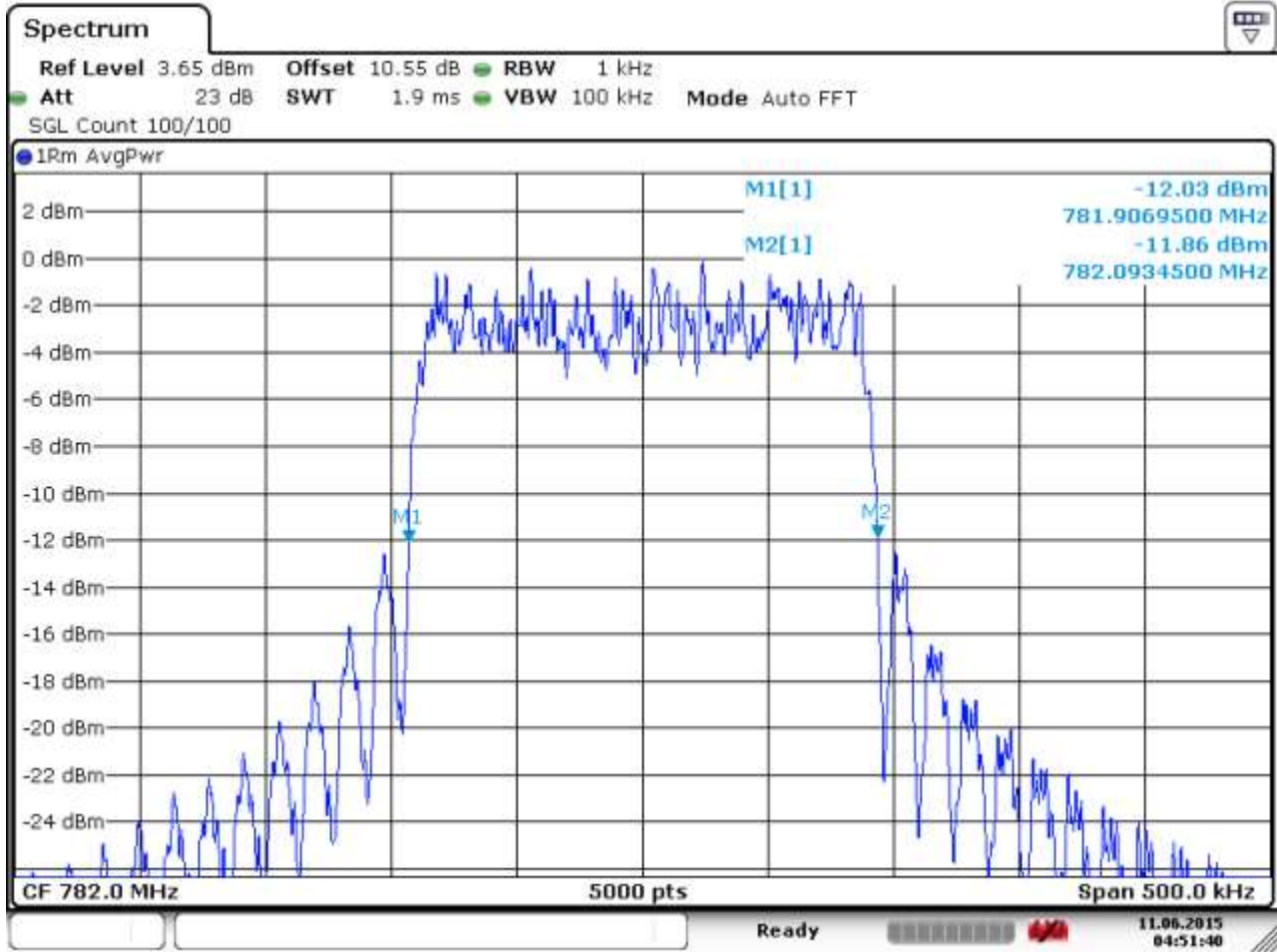
Date: 11.JUN.2015 04:30:46

6.5.5.2.7 LTE Band 13_Vnom Thi



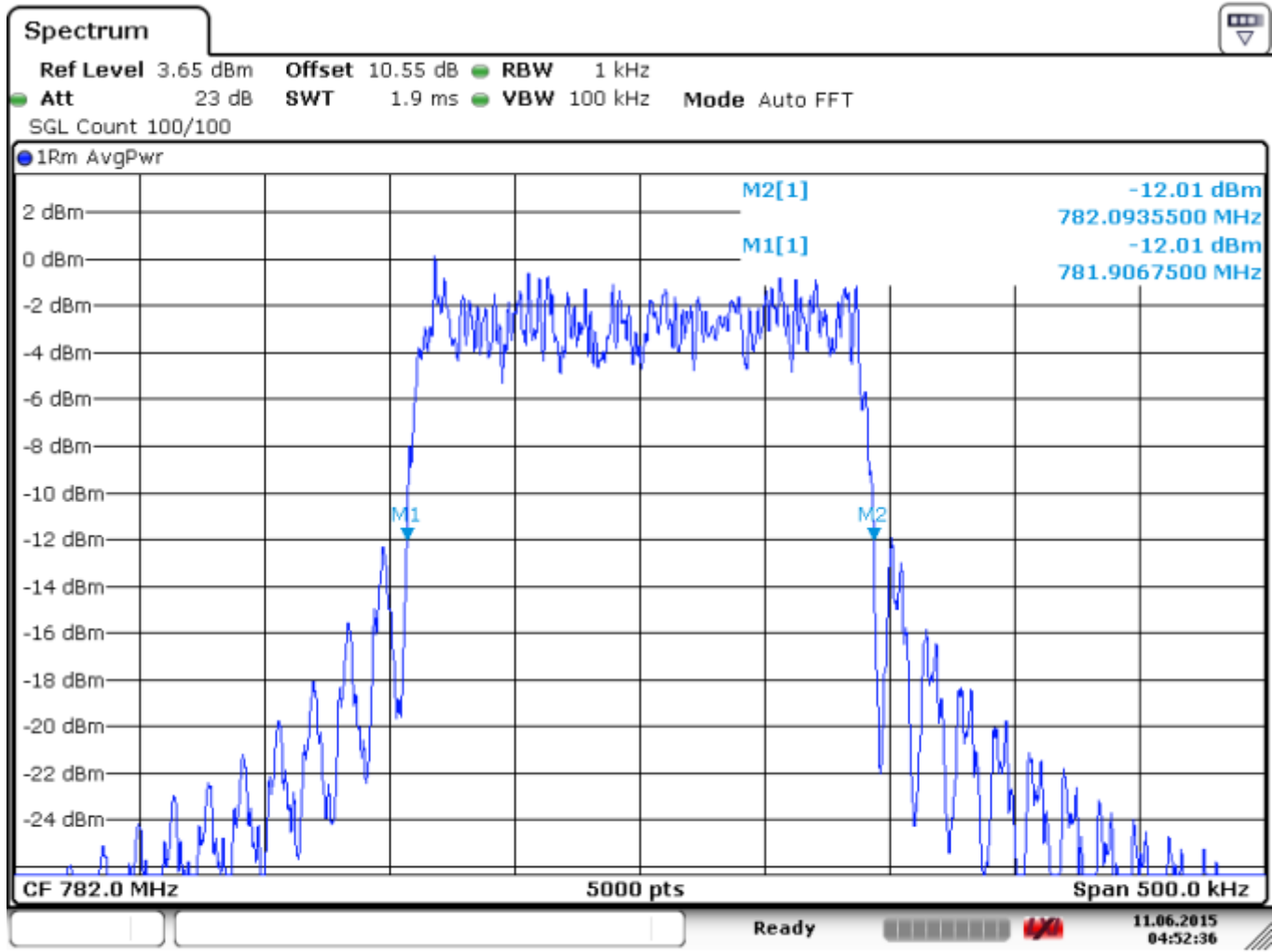
Date: 11.JUN.2015 04:50:37

6.5.5.2.8 LTE Band 13_Vlo Thi



Date: 11.JUN.2015 04:51:41

6.5.5.2.9 LTE Band 13_Vhi Thi



Date: 11.JUN.2015 04:52:37

6.6 Band Edge (Conducted) / Transmitter Unwanted Emissions

6.6.1 References

FCC: CFR Part 2.1053, CFR Part 27.53 (g), CFR Part 27.53 (f), CFR Part 27.53 (l), CFR Part 90.691(a)

6.6.2 Limits

Note: The text below is taken from the FCC 1700MHz band rule in 27.53.h and 27.53.c

6.6.2.1 LTE Band 4

(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB.

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

6.6.2.2 LTE Band 13

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

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

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

6.6.3 Measurement Procedure

Measurements are made according to FCC KDB 971168 D01 v02r02 section 6.

Frequency and marker: lower or upper band edge frequency

Span: 10MHz

RBW: 100kHz below 1GHz, 1MHz above 1GHz

VBW: 3x RBW

Detector: RMS (because the fundamental limits are RMS and nothing stated otherwise according to 971168 D01 Power Meas License Digital Systems v02r01 section 6.0)

Trace: AVG over at least 100 sweeps. TX signal is 100% duty cycle, it transmits continuously

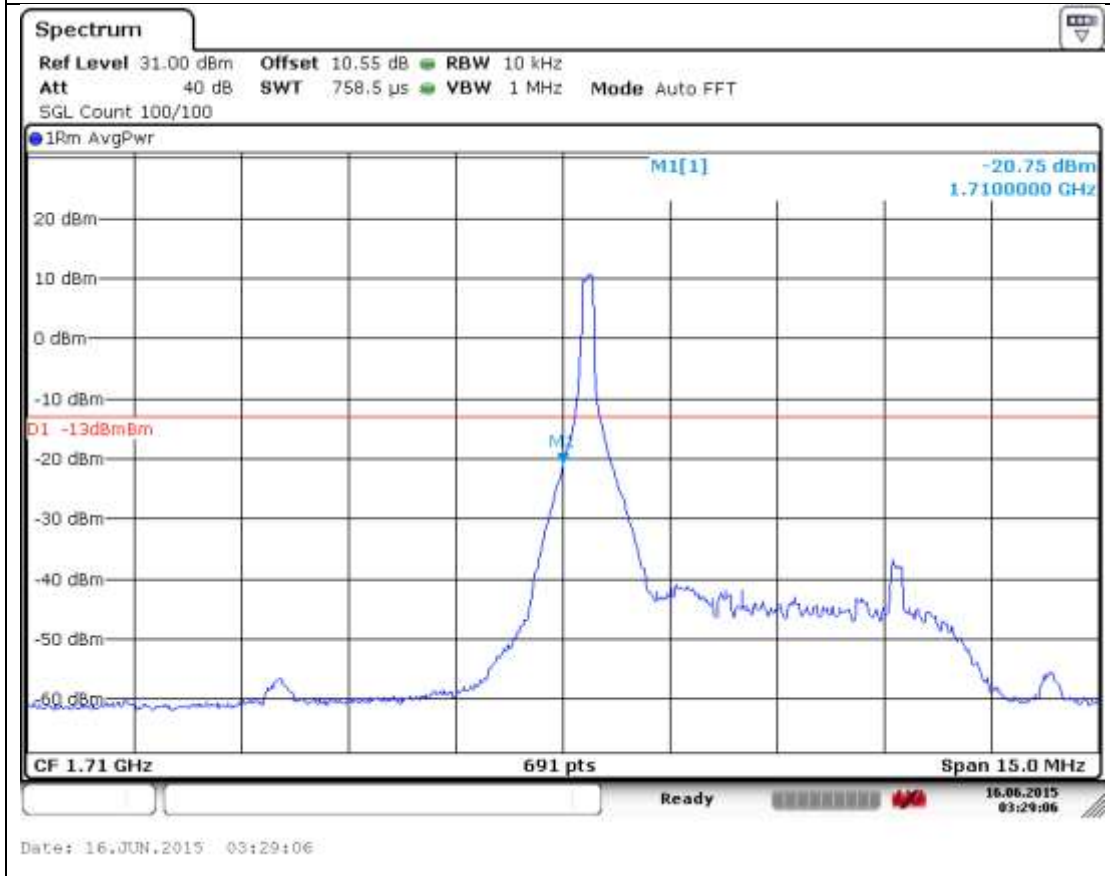
Sweep time: AUTO

Note 1: For band 4 in case the result should be above the limit, choose RBW to 1% of the emission bandwidth as measured above and repeat the measurement.

6.6.4 Plots LTE Band 4 (1710 MHz – 1755 MHz) QPSK

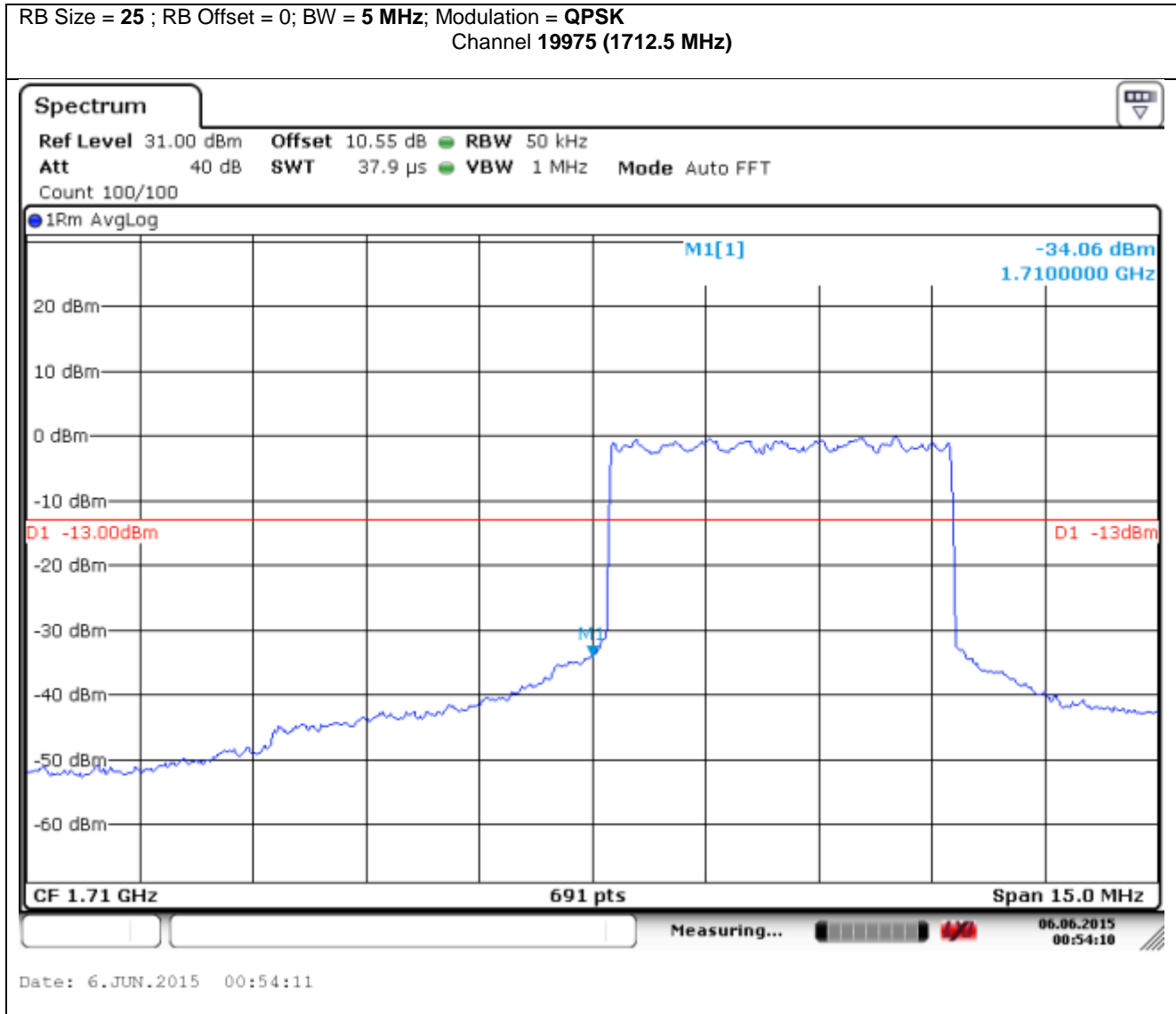
Lower BE (LTE Band 4)

RB Size = 1 ; RB Offset = 0; BW = 5 MHz; Modulation = QPSK
Channel 19975 (1712.5 MHz)

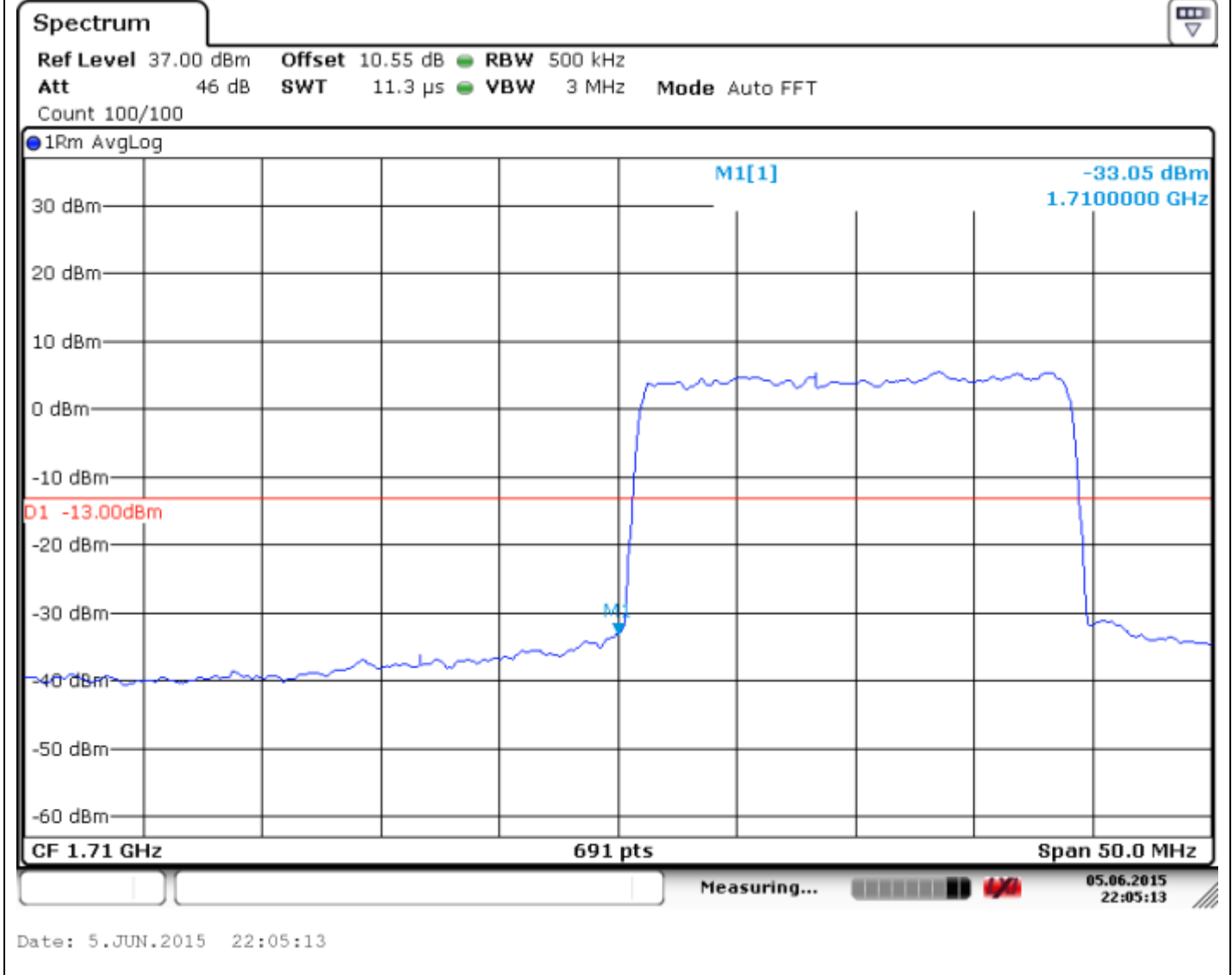


6.6.5 Plots LTE Band 4 (1710 MHz – 1755 MHz) QPSK, cont.

Lower BE (LTE Band 4)



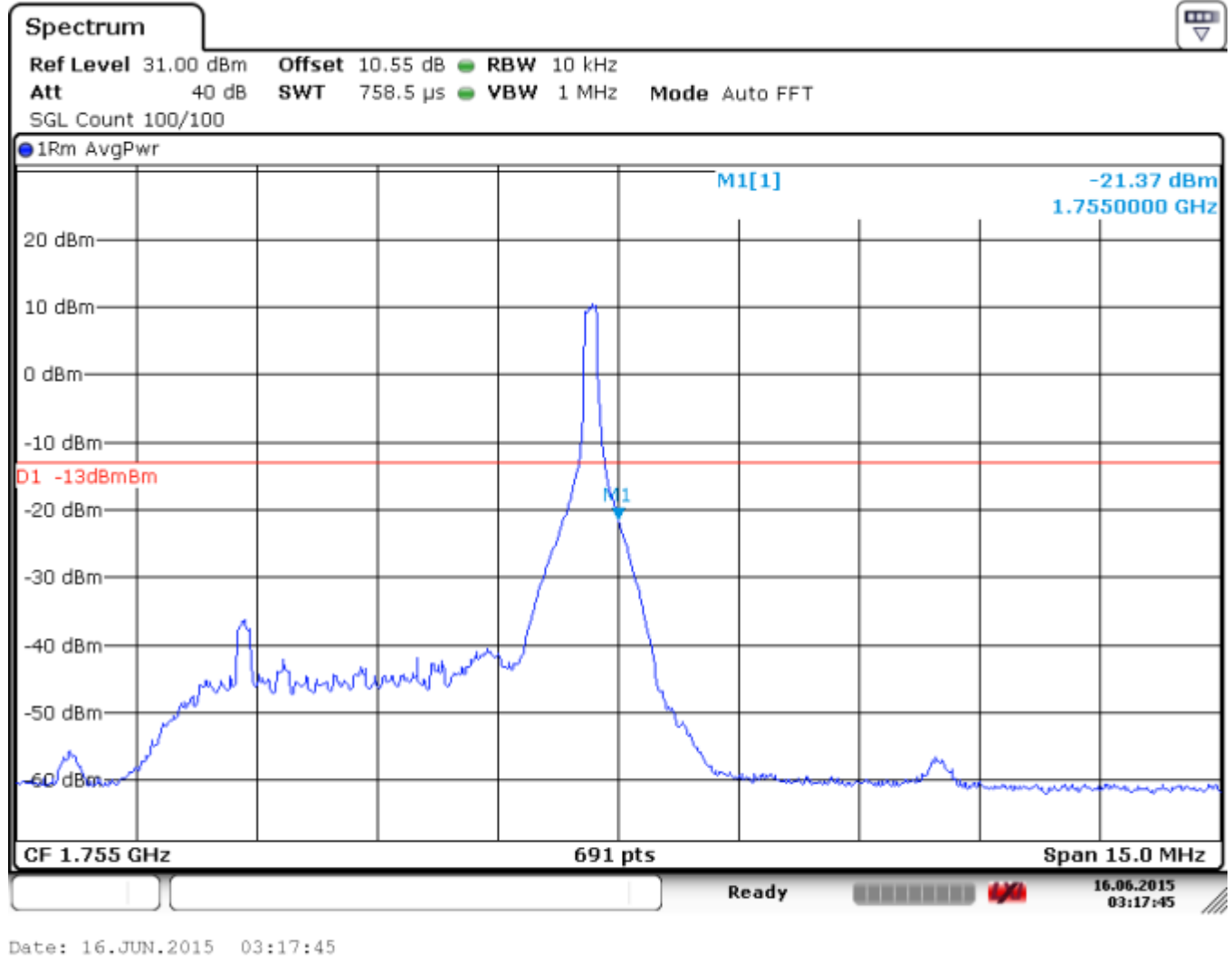
RB Size = 100 ; BW = 20 MHz; Modulation =QPSK
Channel 20050 (1720 MHz)



Upper BE (LTE Band 4)

RB Size = 1 ; RB Offset = 24; BW = 5 MHz; Modulation = QPSK

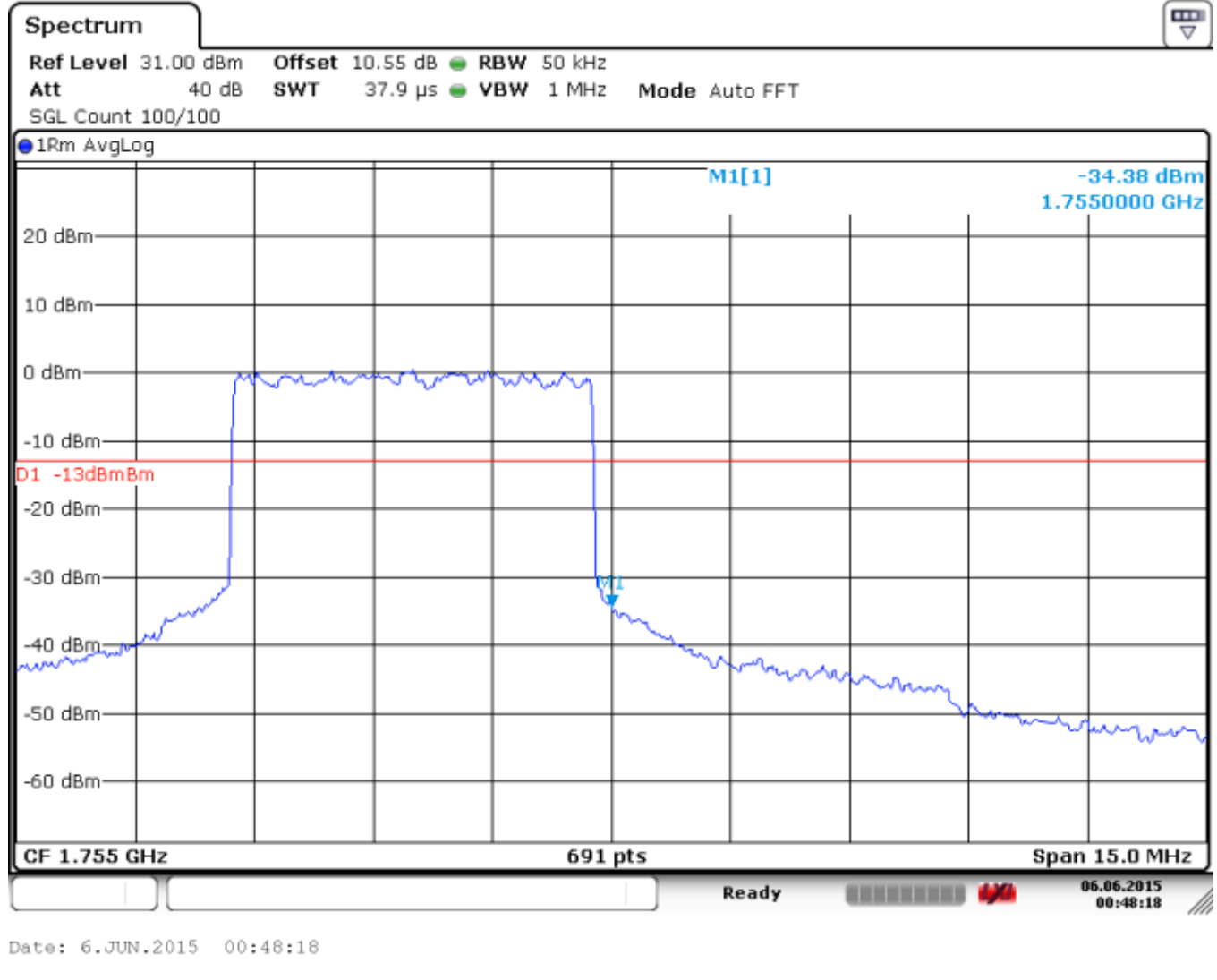
Channel 20375 (1752.5 MHz)



Upper BE (LTE Band 4), (cont.)

RB Size = 25 ; RB Offset = 0; BW = 5 MHz; Modulation = QPSK

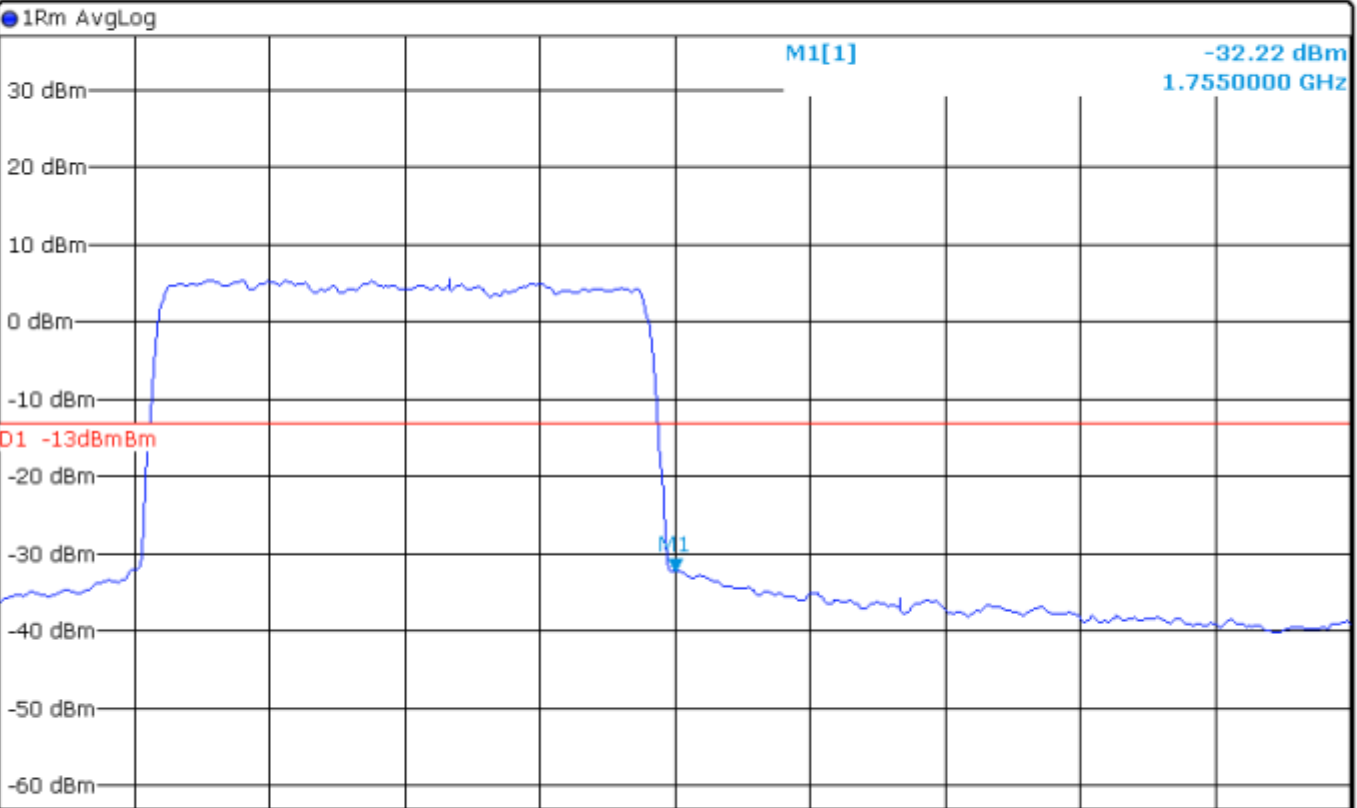
Channel 20375 (1752.5 MHz)



RB Size = 100 ; BW = 20 MHz; Modulation =QPSK
Channel 20300 (1745 MHz)

Spectrum

Ref Level 37.00 dBm Offset 10.55 dB RBW 500 kHz
Att 46 dB SWT 11.3 μs VBW 3 MHz Mode Auto FFT
Count 100/100



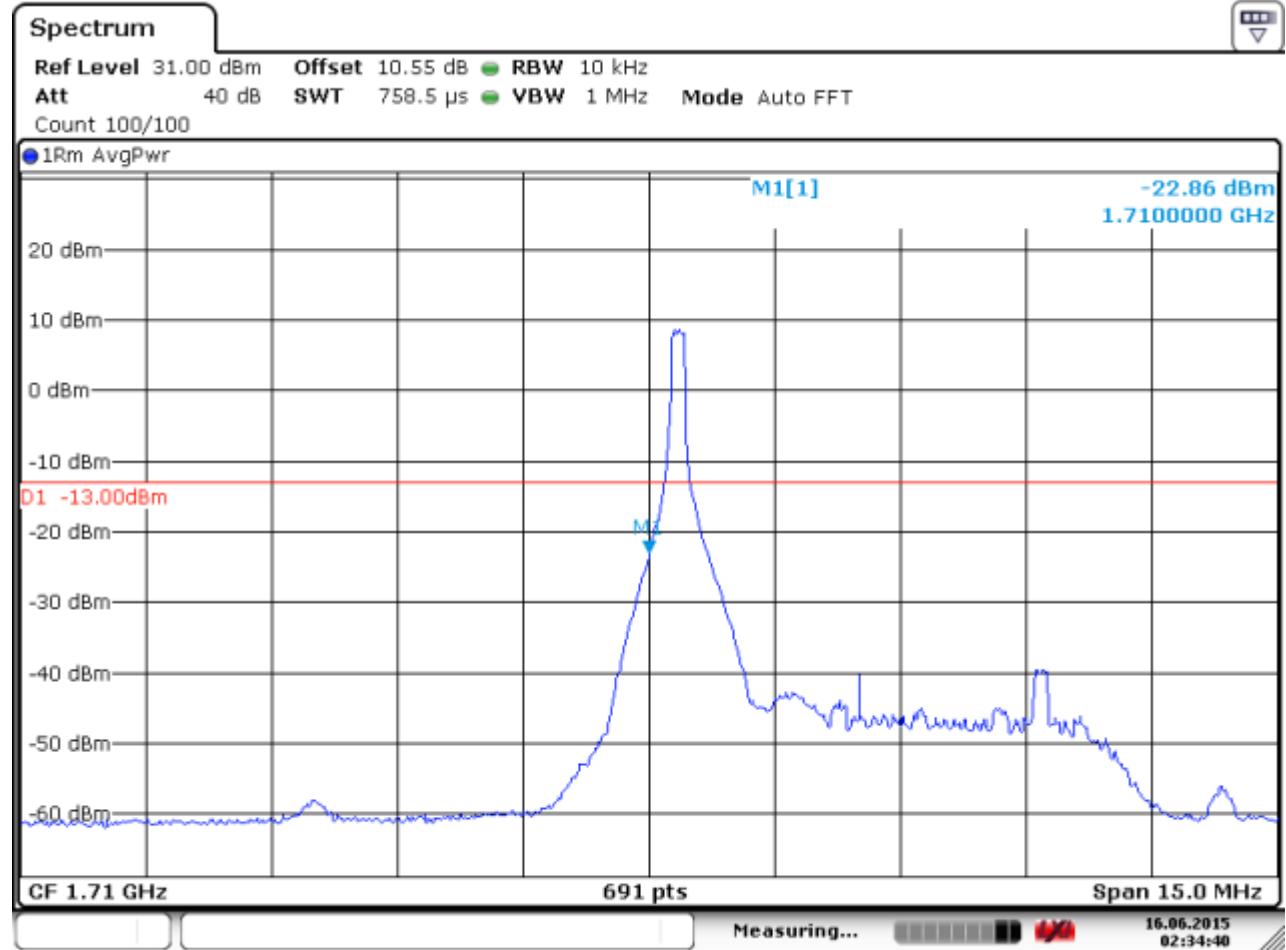
CF 1.755 GHz 691 pts Span 50.0 MHz
Measuring... 06.06.2015 00:11:56

Date: 6.JUN.2015 00:11:56

6.6.6 Plots LTE Band 4 (1710 MHz – 1755 MHz) QAM

Lower BE (LTE Band 4)

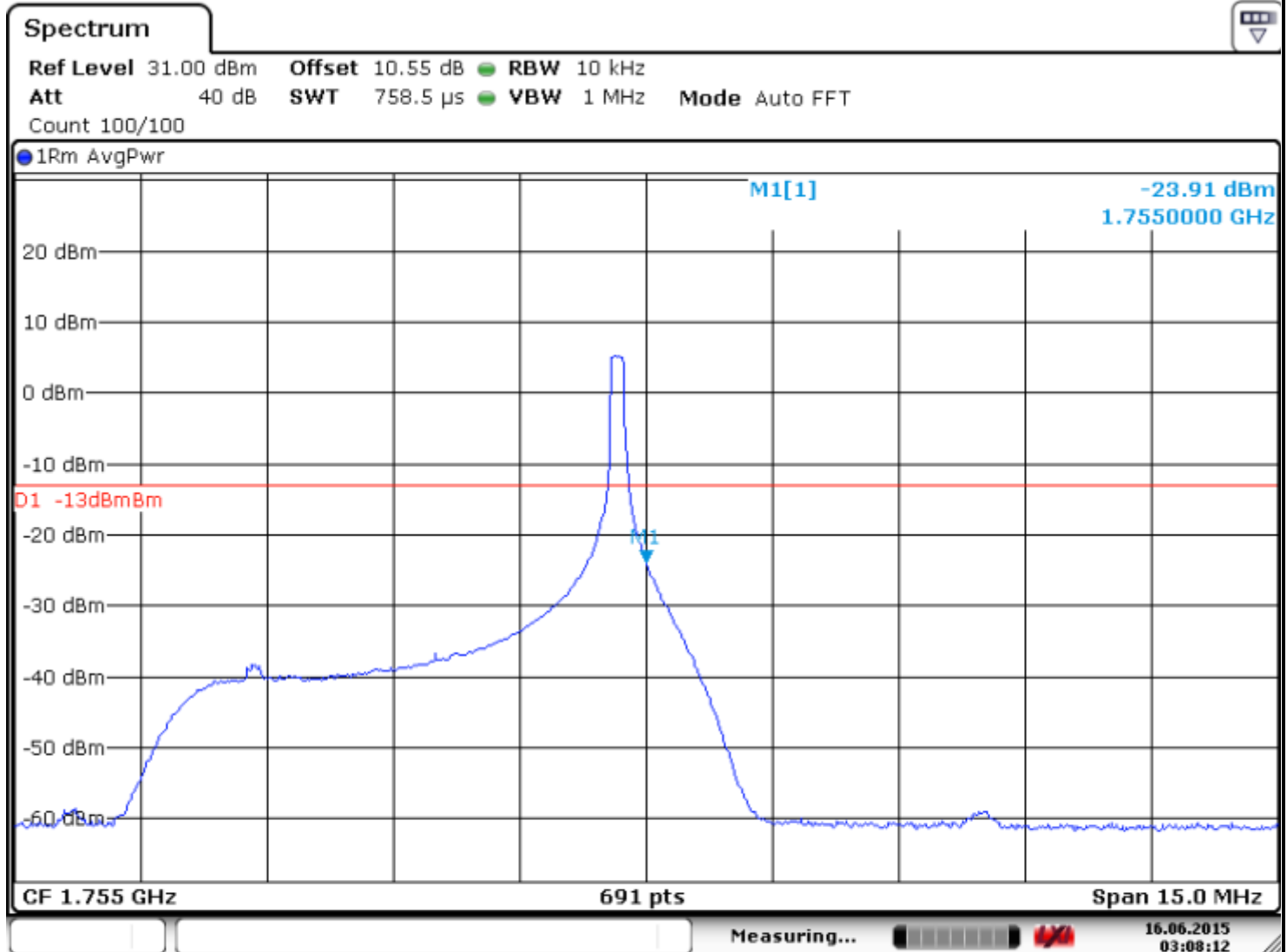
RB Size = 1 ; RB Offset = 0; BW = 5 MHz; Modulation = QAM
Channel 19975 (1712.5 MHz)



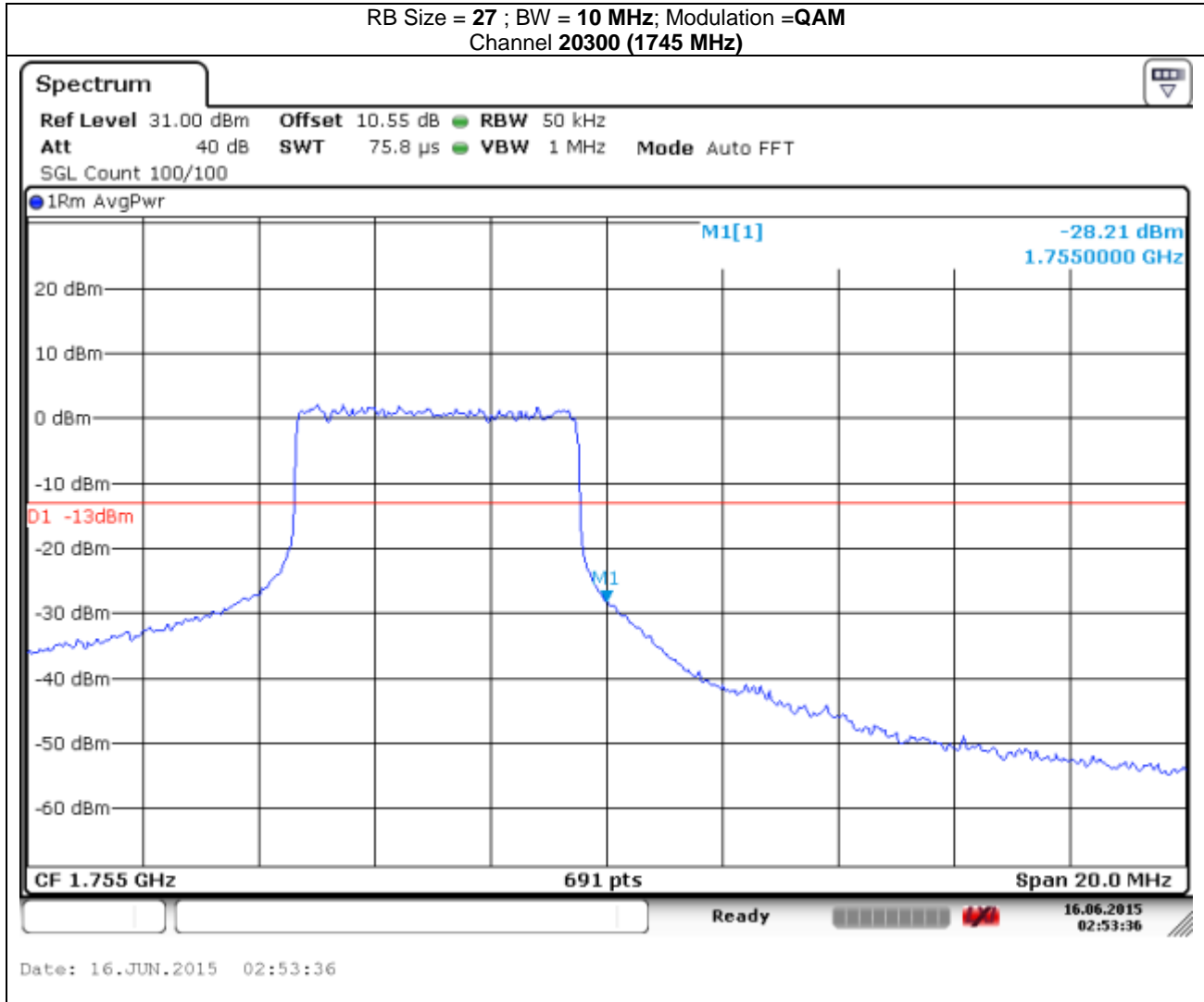
Date: 16.JUN.2015 02:34:40

Upper BE (LTE Band 4)

RB Size = 1 ; RB Offset = 0; BW = 5 MHz; Modulation = QAM
Channel 20375 (1752.5 MHz)



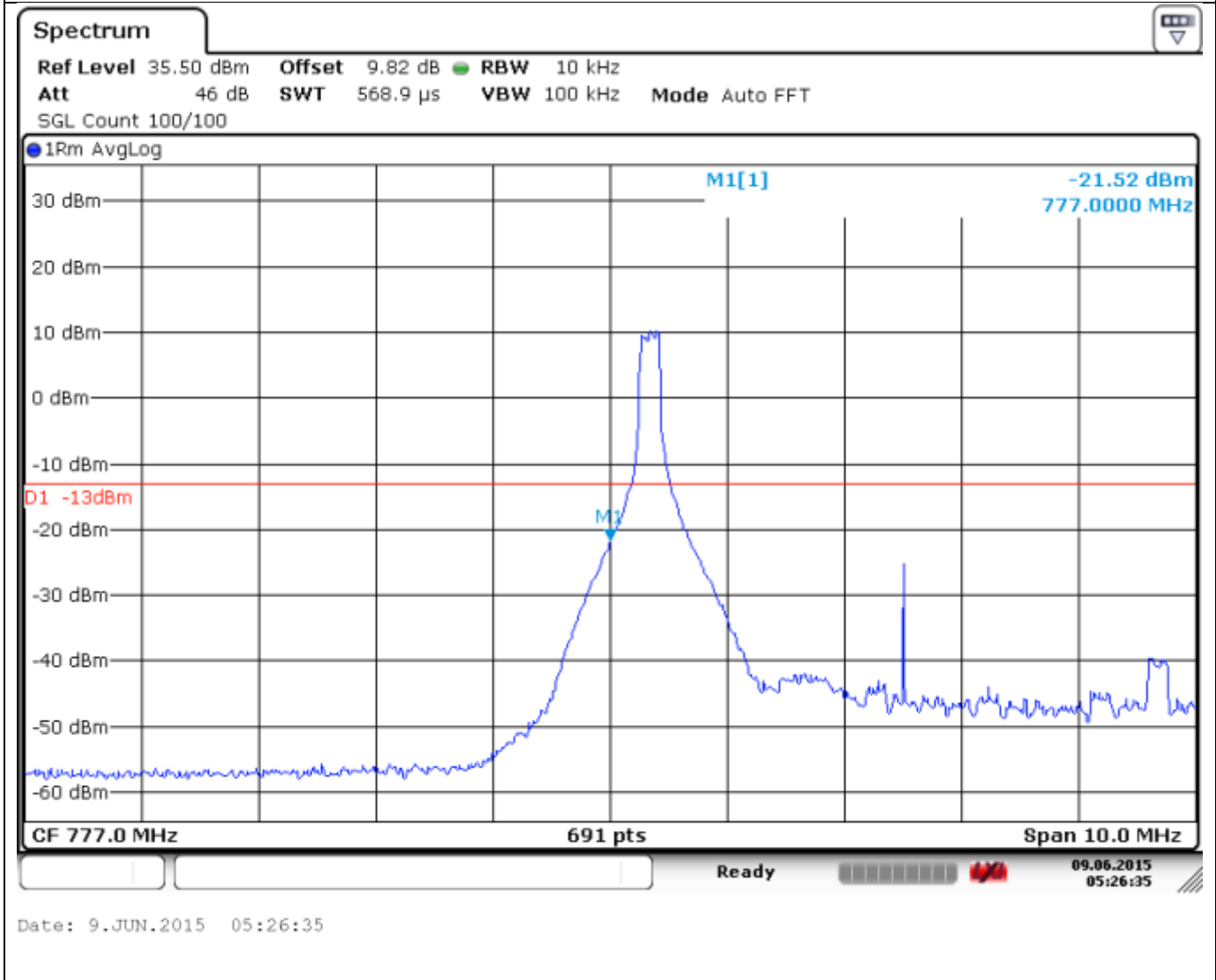
Date: 16.JUN.2015 03:08:11



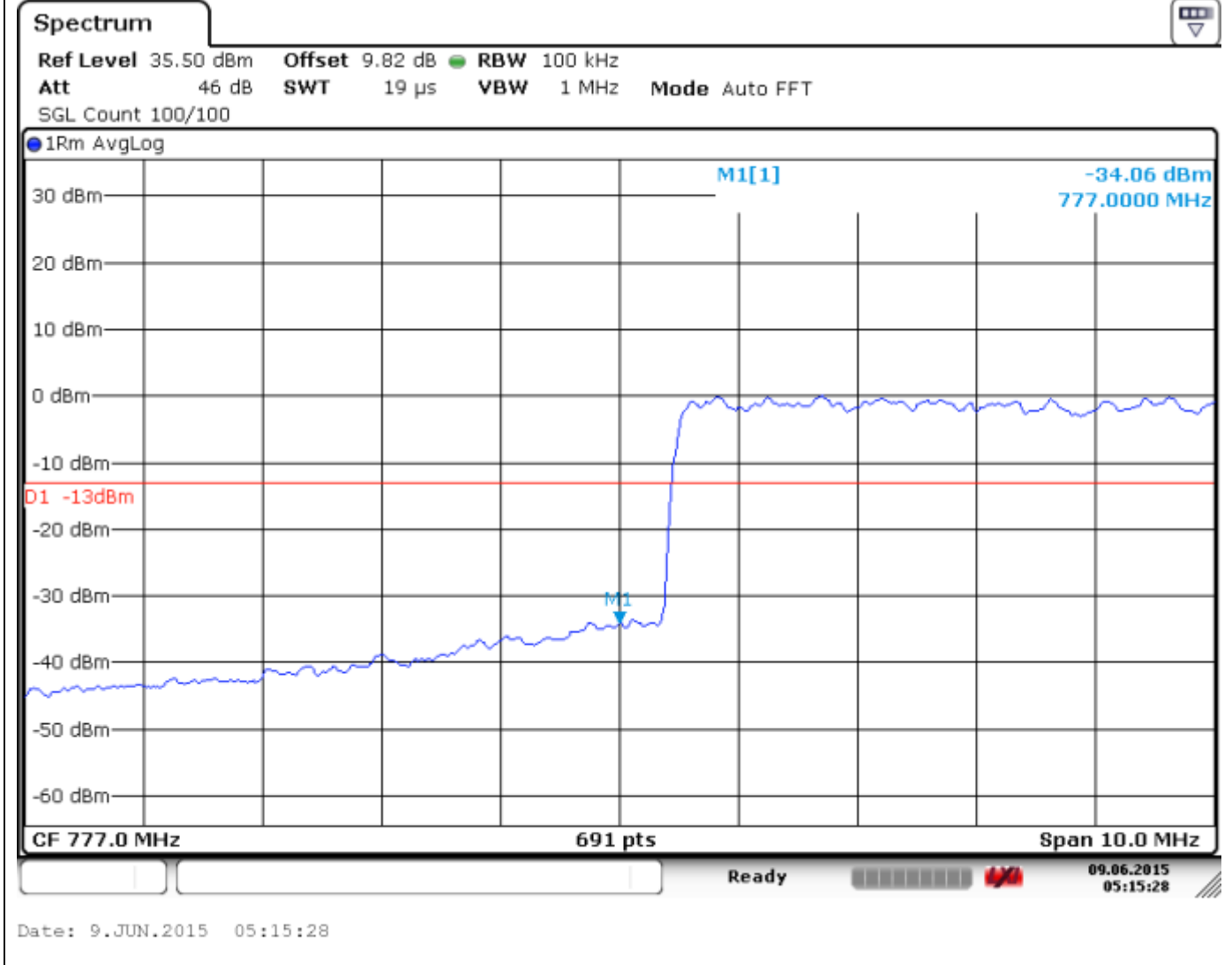
6.6.7 Plots LTE Band 13 (777 MHz – 787 MHz) QPSK

Lower BE (LTE Band 13)

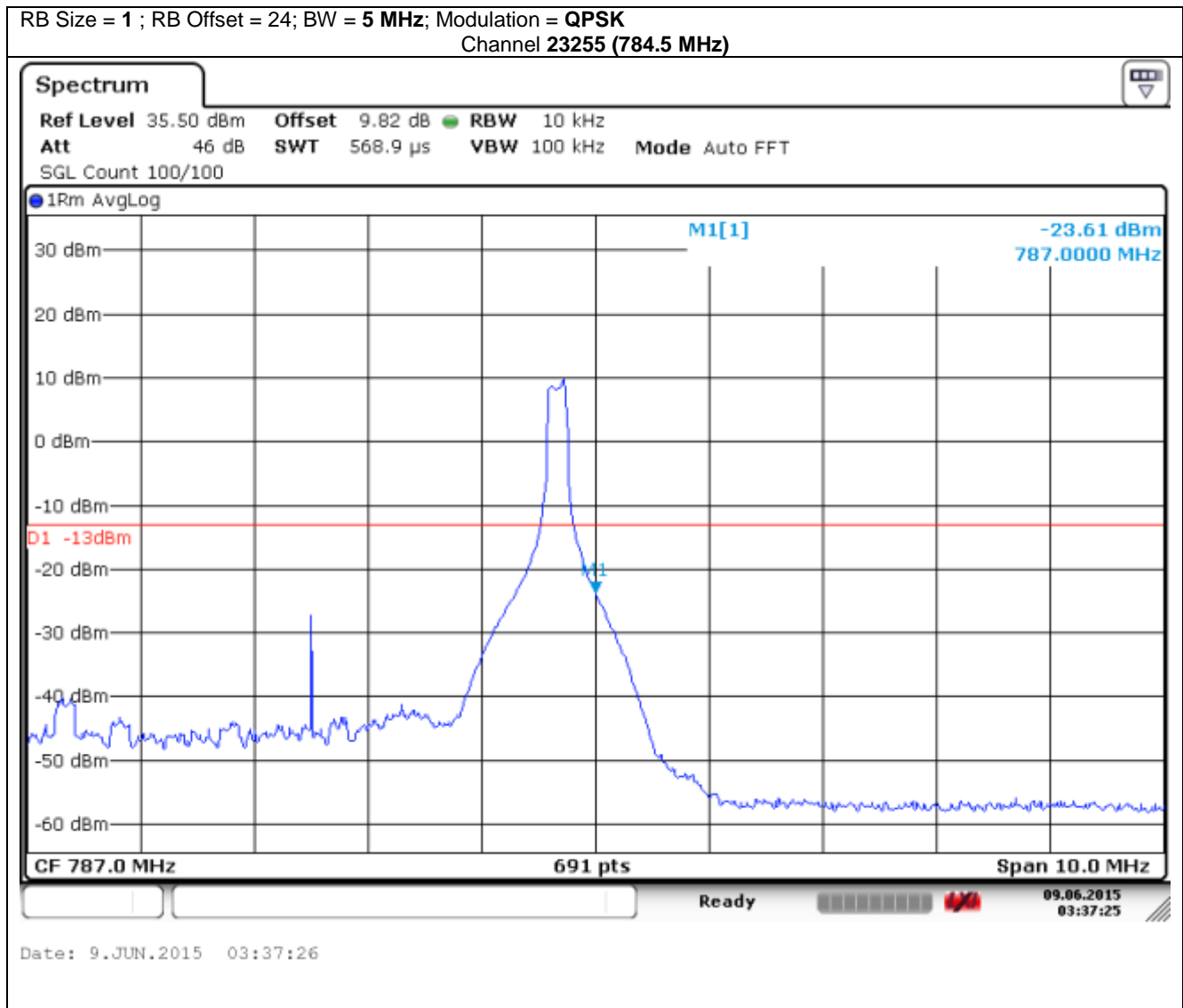
RB Size = 1 ; RB Offset = 0; BW = 5 MHz; Modulation = QPSK
Channel 23205 (779.5 MHz)



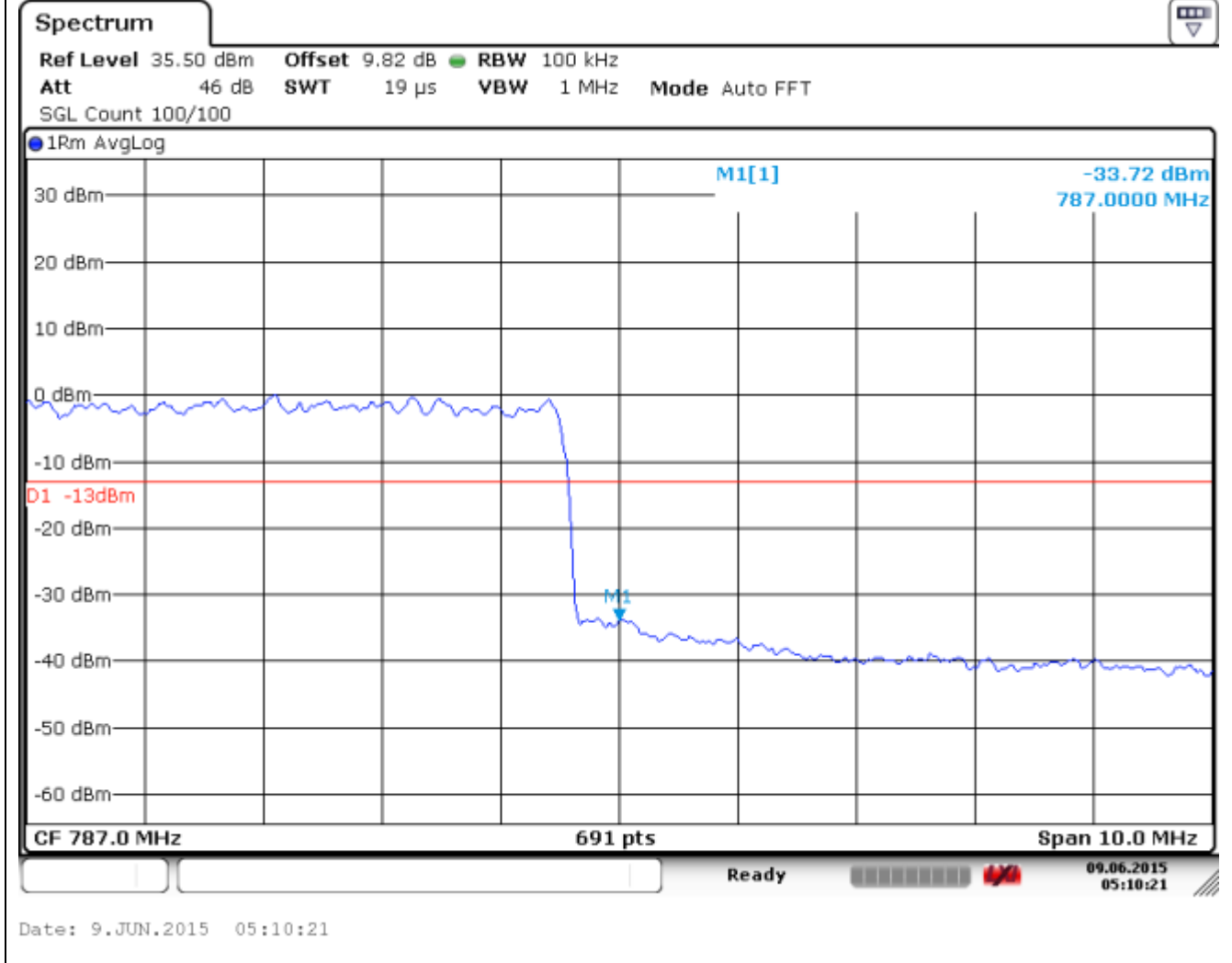
RB Size = 50 ; BW = 10 MHz; Modulation = QPSK
Channel 23230 (782 MHz)



Upper BE (LTE Band 13)



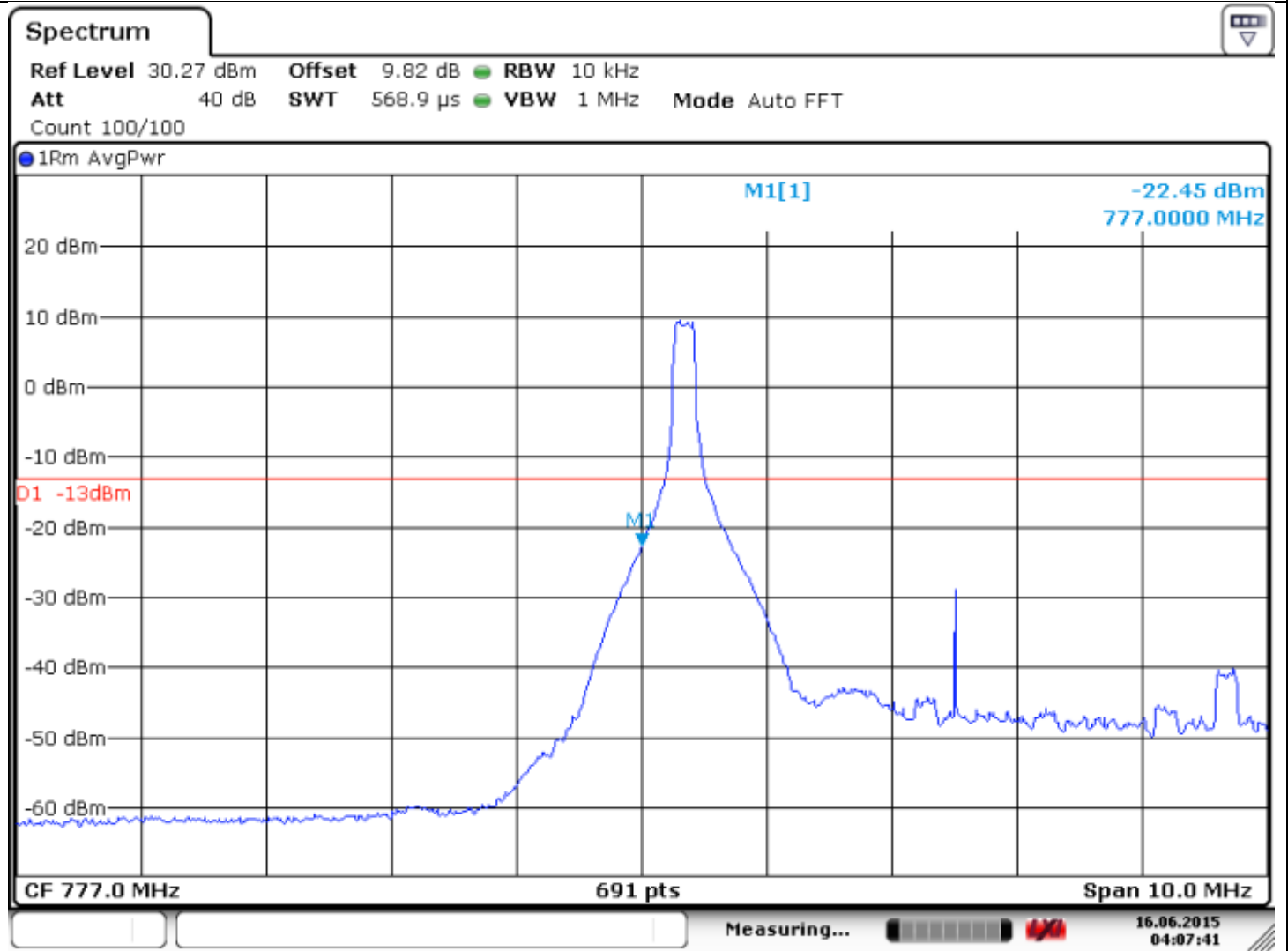
RB Size = 50 ; BW = 10 MHz; Modulation = QPSK
Channel 23230 (782 MHz)



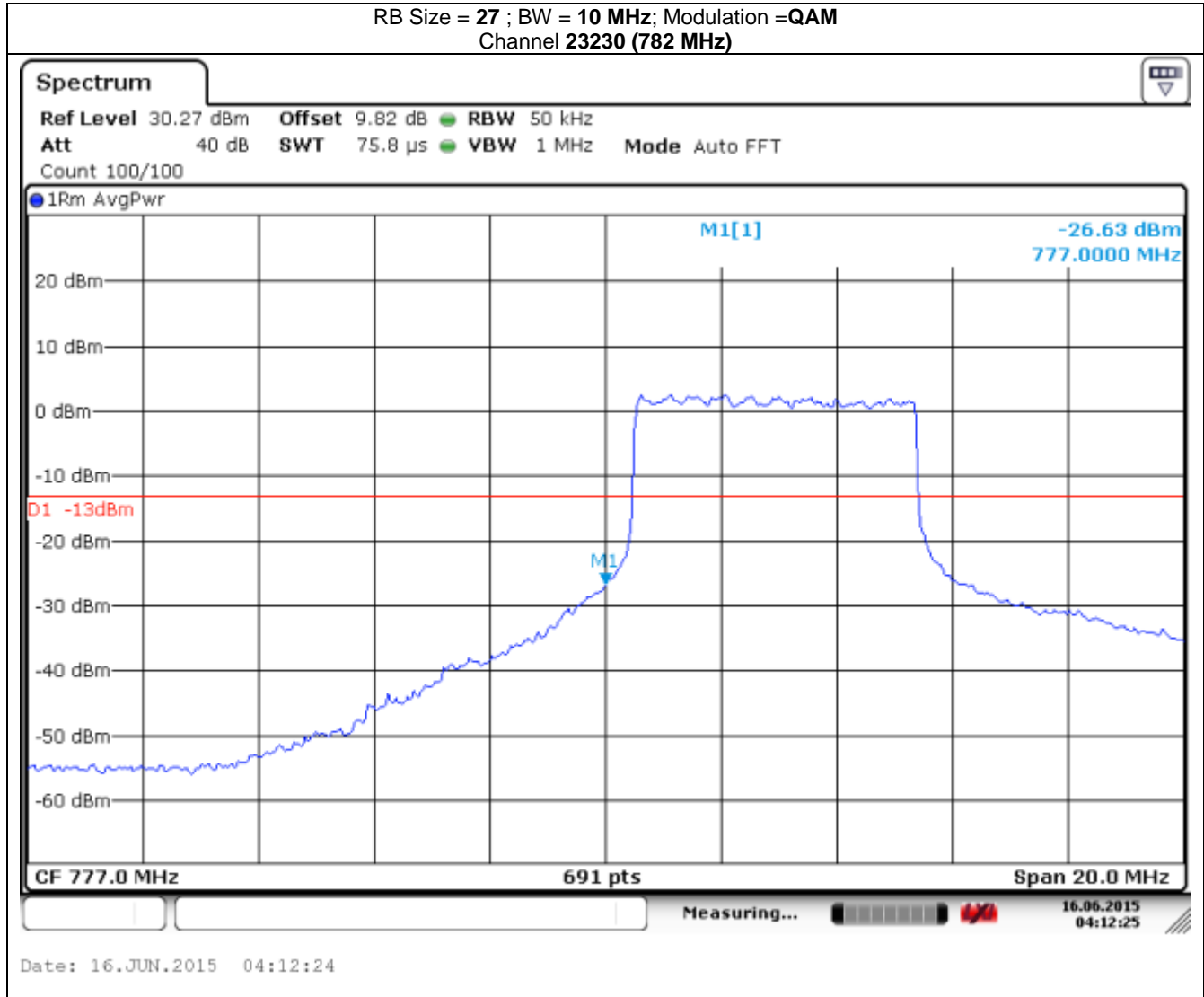
6.6.8 Plots LTE Band 13 (777 MHz – 787 MHz) QAM

Lower BE (LTE Band 13)

RB Size = 1 ; RB Offset = 0; BW = 5 MHz; Modulation = QAM
Channel 23205 (779.5 MHz)

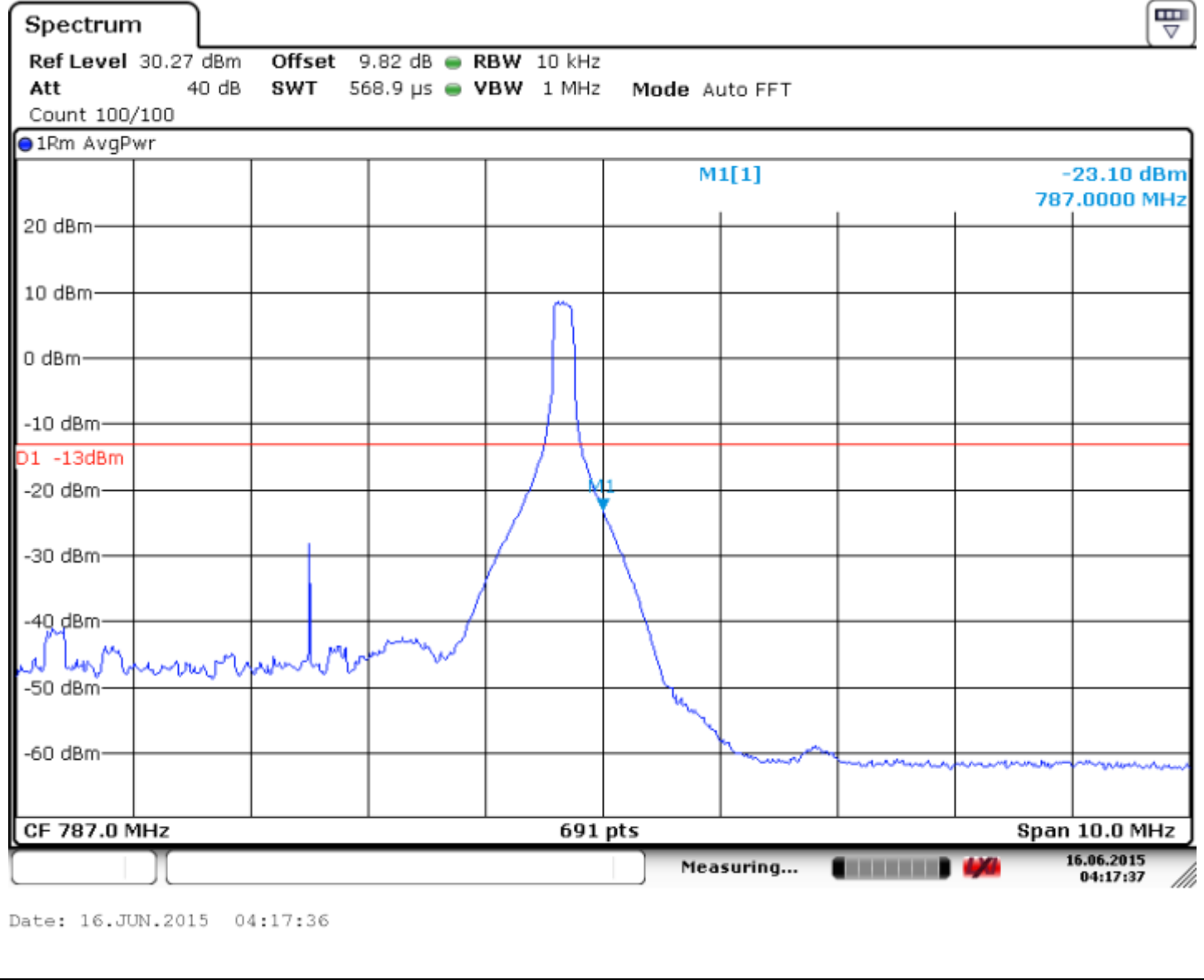


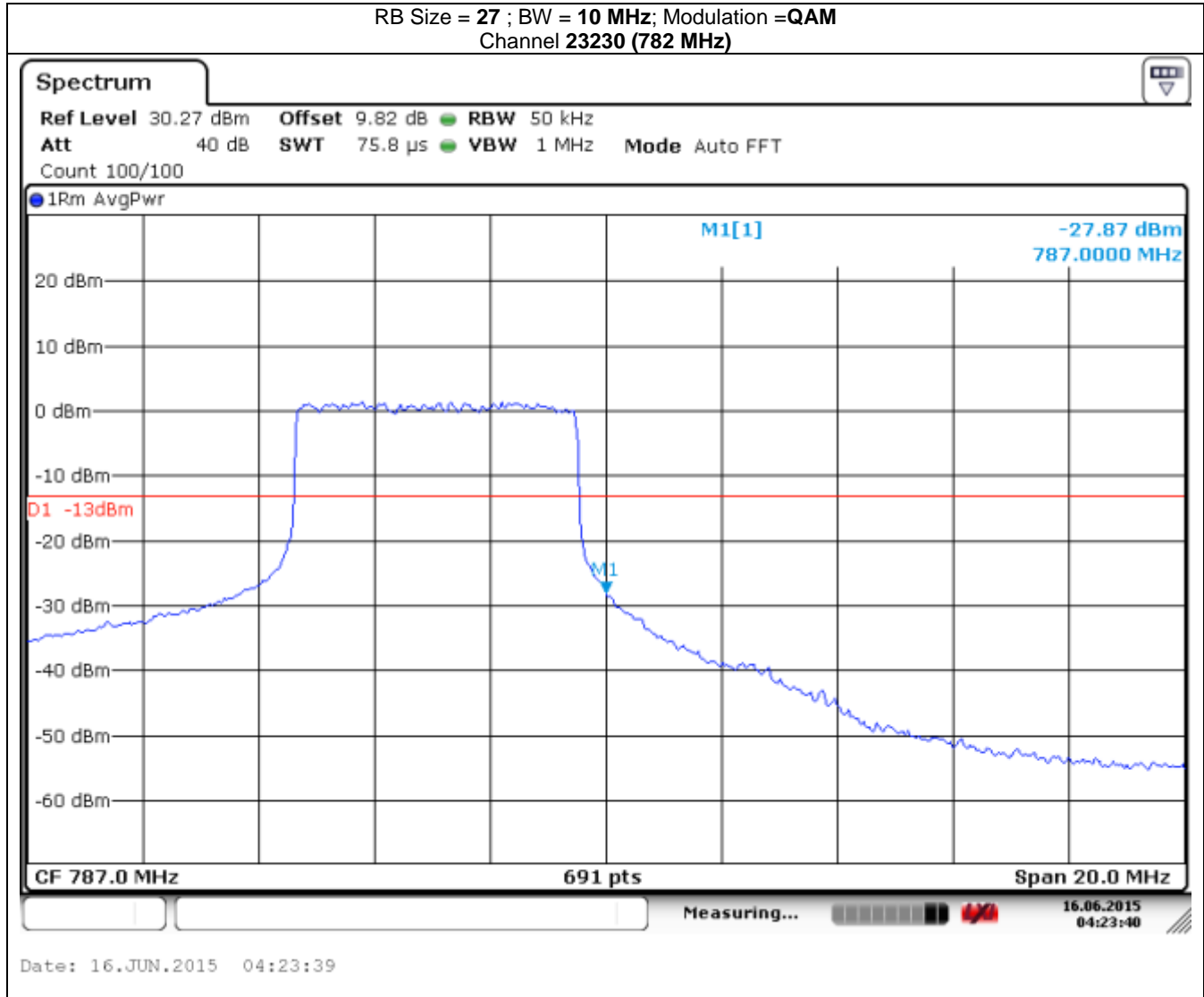
Date: 16.JUN.2015 04:07:41



Upper BE (LTE Band 13)

RB Size = 1 ; RB Offset = 24; BW = 5 MHz; Modulation = QAM
Channel 23255 (784.5 MHz)





6.7 TX Radiated Spurious Emissions

6.7.1 References

See chapter with Band Edge measurements

6.7.2 Limits

See chapter with Band Edge measurements

6.7.3 Measurement requirements:

6.7.3.1 FCC §2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

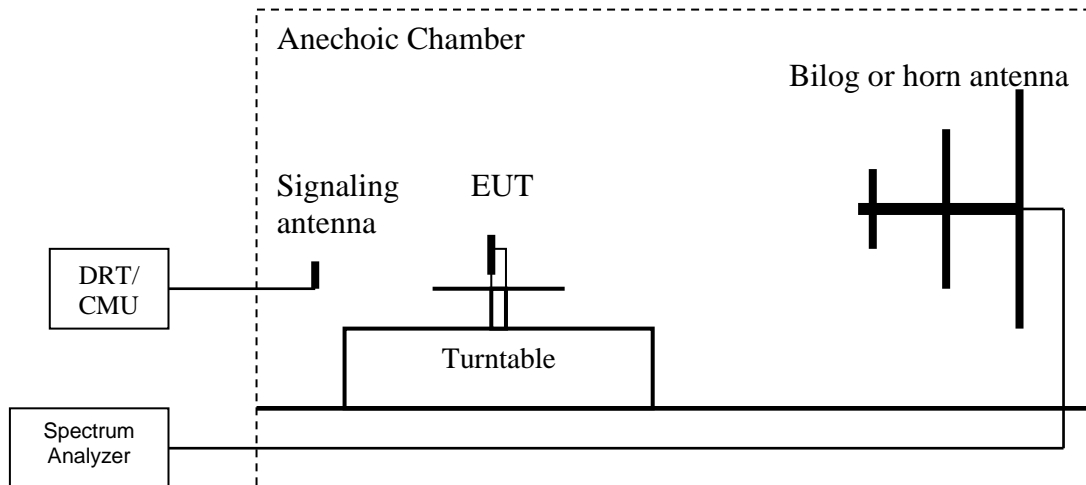
(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

6.7.3.2 FCC 2.1053: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

6.7.4 Radiated out of band measurement procedure:

Ref: TIA-603C 2004- 2.2.12 Unwanted emissions: Radiated Spurious



Connect the equipment as shown in the above diagram with the EUT's antenna in a horizontal orientation.

Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.

Set the spectrum analyzer to measure peak hold with the required settings.

Place the measurement antenna in a horizontal orientation. Rotate the EUT 360°. Raise the measurement antenna up to 4 meters in 0.5 meters increments and rotate the EUT 360° at each height to maximize all emissions. Measure and record all spurious emissions (**LVL**) up to the tenth harmonic of the carrier frequency.

Replace the EUT with a horizontally polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.

Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS**). **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).

Determine the level of spurious emissions using the following equation:

$$\text{Spurious (dBm)} = \text{LVL (dBm)} + \text{LOSS (dB)}$$

Repeat steps 4, 5 and 6 with all antennas vertically polarized.

Determine the level of spurious emissions using the following equation:

$$\text{Spurious (dBm)} = \text{LVL (dBm)} + \text{LOSS (dB)}$$

Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

(**Note:** Steps 5 and 6 above are performed prior to testing and **LOSS** is recorded by test software. Steps 3, 4 and 7 above are performed with test software.)

6.7.5 Sample Calculations for Radiated Measurements

6.7.5.1 Power Measurements using Substitution Procedure:

The measurement on the Spectrum Analyzer is used as a basis for the Substitution procedure.

The EUT is replaced with a Signal Generator and an antenna. The setting on the Signal Generator is varied until the Spectrum Analyzer displays the original reading. EIRP is calculated as-

$$\text{EIRP (dBm)} = \text{Signal Generator setting (dBm)} - \text{Cable Loss (dB)} + \text{Antenna Gain (dBi)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Signal Generator setting (dBm)	Antenna Gain (dBi)	Dipole Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
1000	95.5	24.5	6.5	0	3.5	27.5

6.7.6 Measurement Survey:

The site is constructed in accordance with ANSI C63.4 requirements and is recognized by the FCC to be in compliance for a 3m site. The spectrum is scanned from 9kHz to the 10th harmonic of the highest frequency generated by the EUT.

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of all supported LTE bands.

The configuration with 1 Resource Block has been chosen as a worst case configuration because 1RB represents the highest power density and thus the highest peak powers of all supported bandwidth configurations. Additionally, configuration with full resource block for each band is also being tested as worst case since greater the physical bandwidth results in larger modulation spectrum residuals. Both QPSK and 16QAM modulations have been tested but only mid channel plots of 16QAM are shown in the report for brevity purposes. It's been observed that both modulations show near identical results.

For low channel the lowest resource block has been chosen and for high channel the highest to represent the worst case in terms of band edge proximity.

For 9kHz-30MHz and 18GHz-26GHz(if applicable) measurement ranges, only mid channel with QPSK modulation is tested. This is because at these extreme frequency ranges, there is a very low probability to have spurious emissions from TX signal, so mid channel is good enough representation to comply at these ranges.

For radiated measurements, all data in this report shows the worst case emissions data between H/V antenna polarizations and for all 3 orthogonal orientations of the EUT.

Unless mentioned otherwise, the emission signals above the limit line in the plots are from the carrier.

6.7.7 Test Conditions:

Tnom: 20°C; Vnom: 3.6 V

6.7.8 Test Results:

6.7.8.1 Spurious Emission LTE Band 4:

6.7.8.1.1 QPSK/ 5 MHz/ Low Channel/ 9kHz to 30MHz

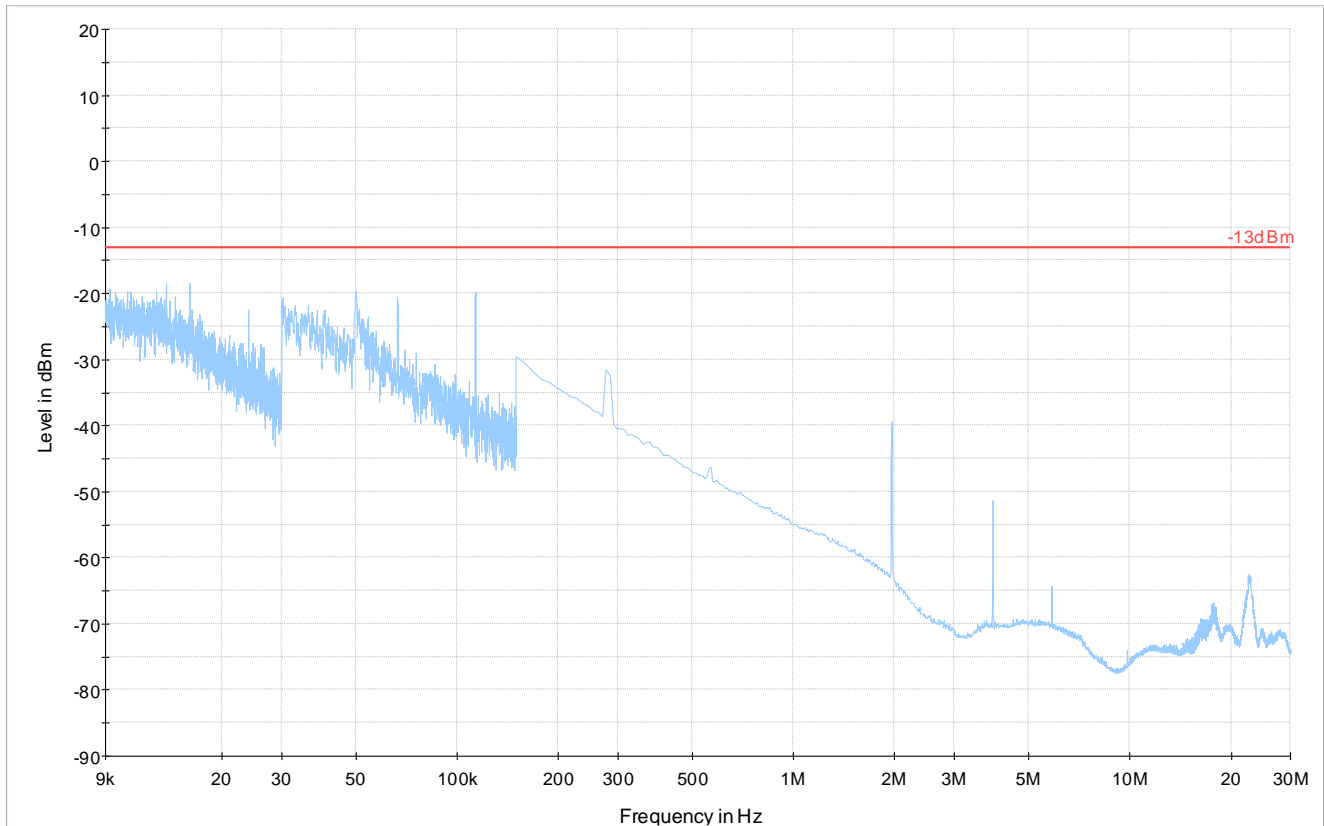
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 9 kHz – 30 MHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-AVG

6.7.8.1.2 QPSK/ 5 MHz/ Mid Channel/ 9kHz to 30MHz

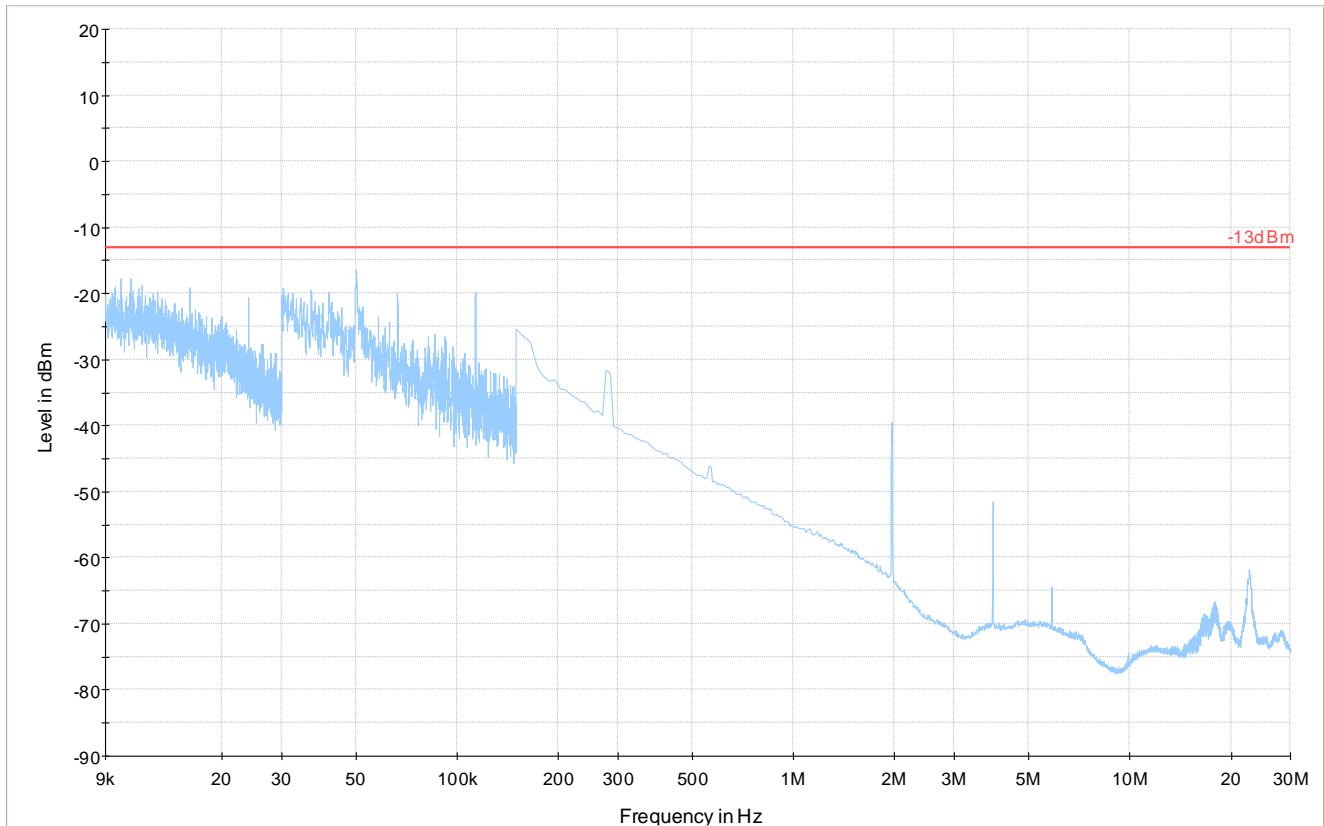
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 9 kHz – 30 MHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-AVG

6.7.8.1.3 QPSK/ 5 MHz/ Hi Channel/ 9kHz to 30MHz

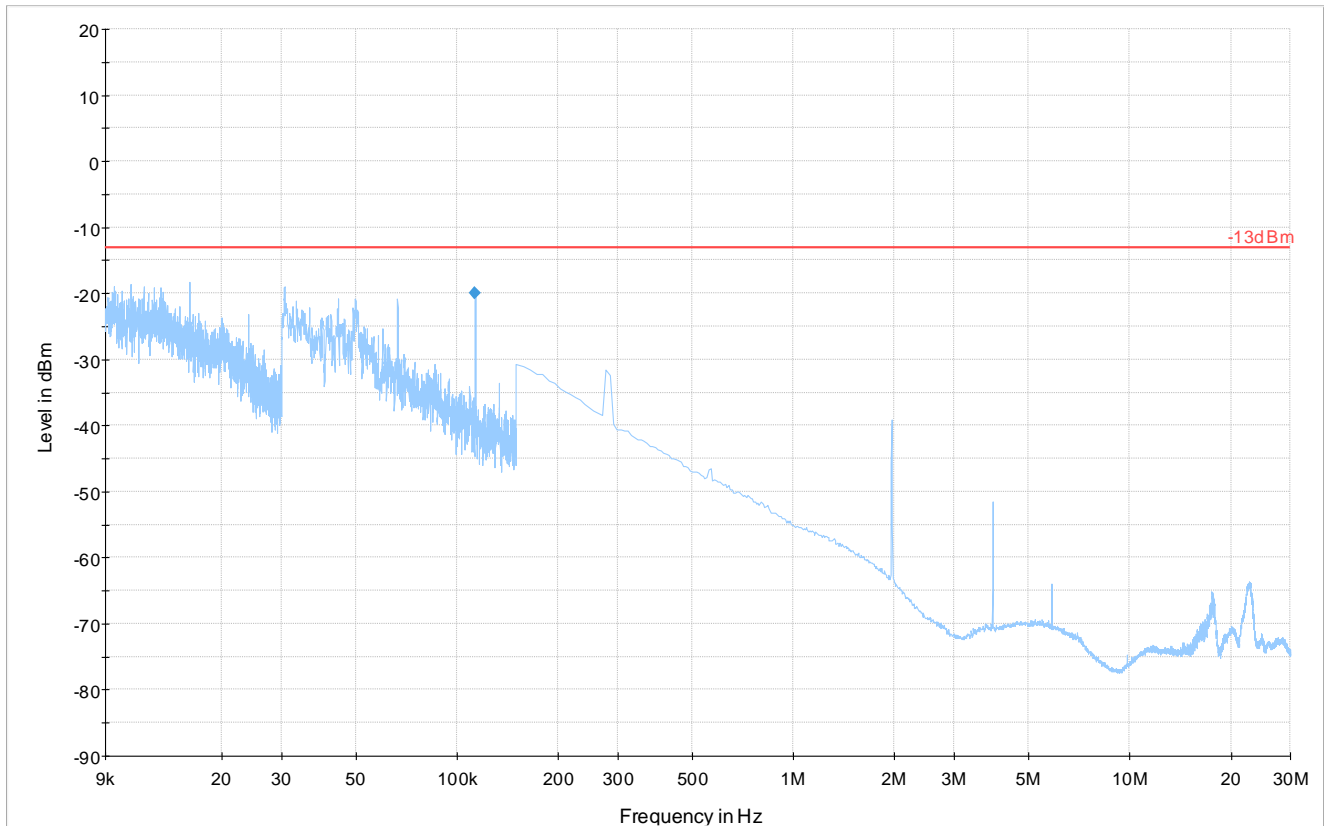
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 9 kHz – 30 MHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-AVG ◆ Final Result 1-QPK

6.7.8.1.4 QPSK/ 5 MHz/ Low Channel/ 30MHz to 1GHz

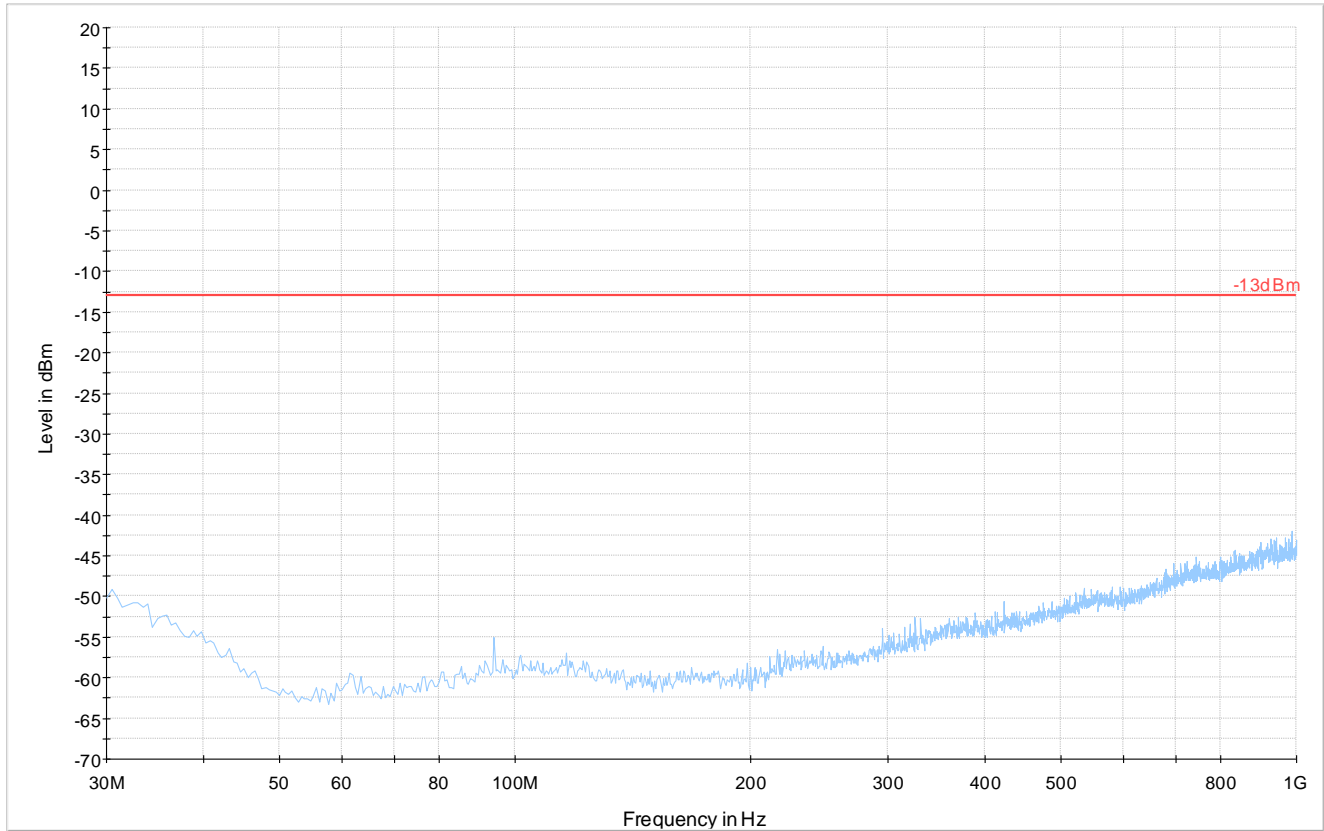
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 30MHz to 1GHz

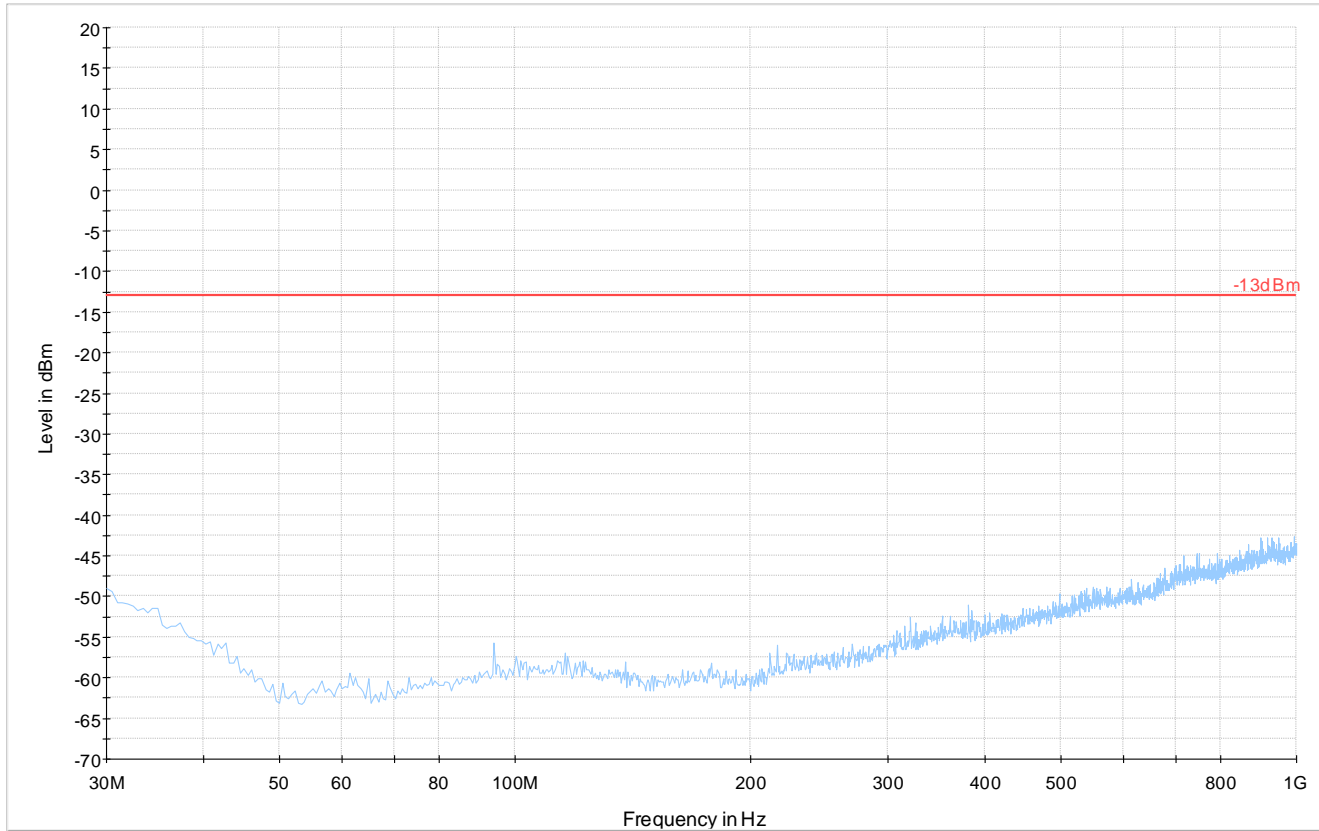
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.1.5 QPSK/ 5 MHz/ High Channel/ 30MHz to 1GHz

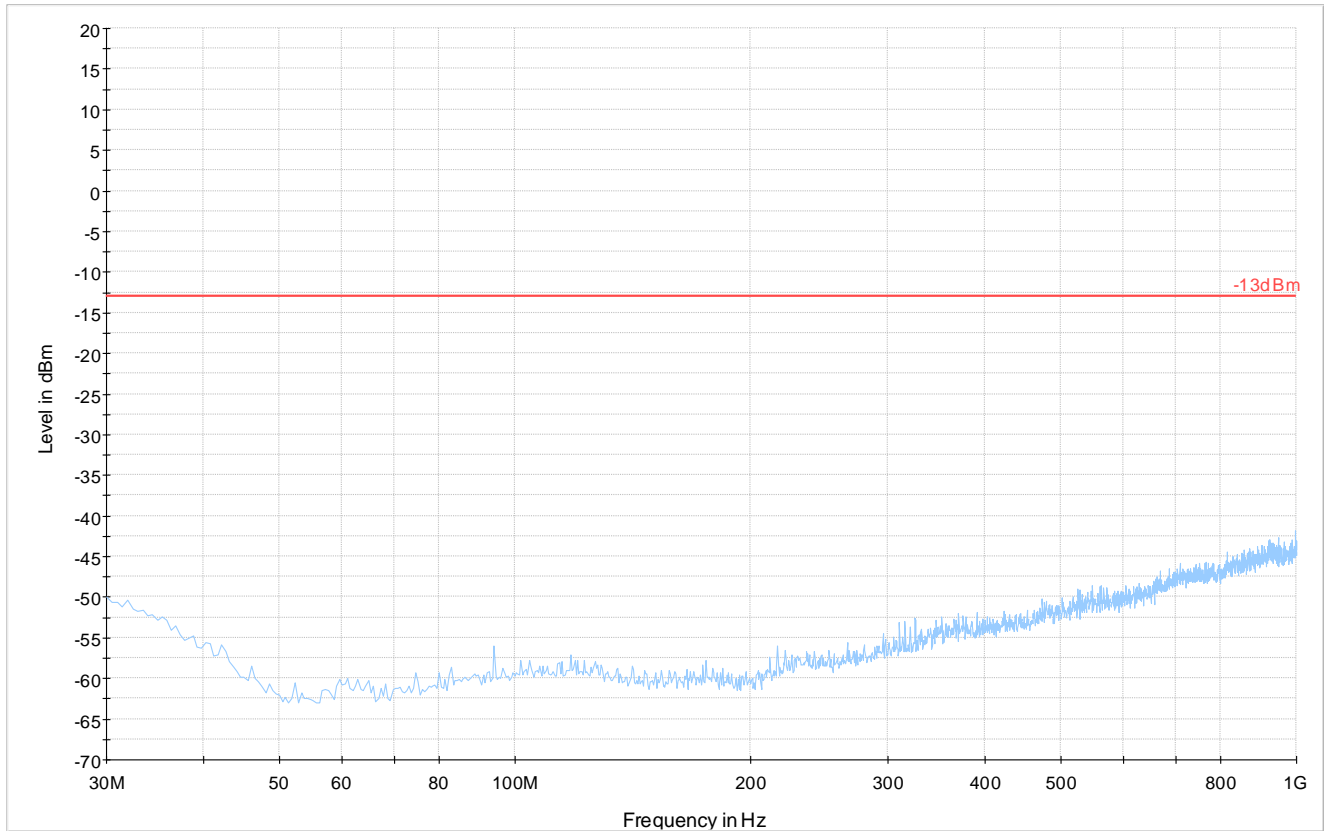
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.1.6 QPSK/ 5 MHz/ Low Channel/ 1GHz to 3GHz

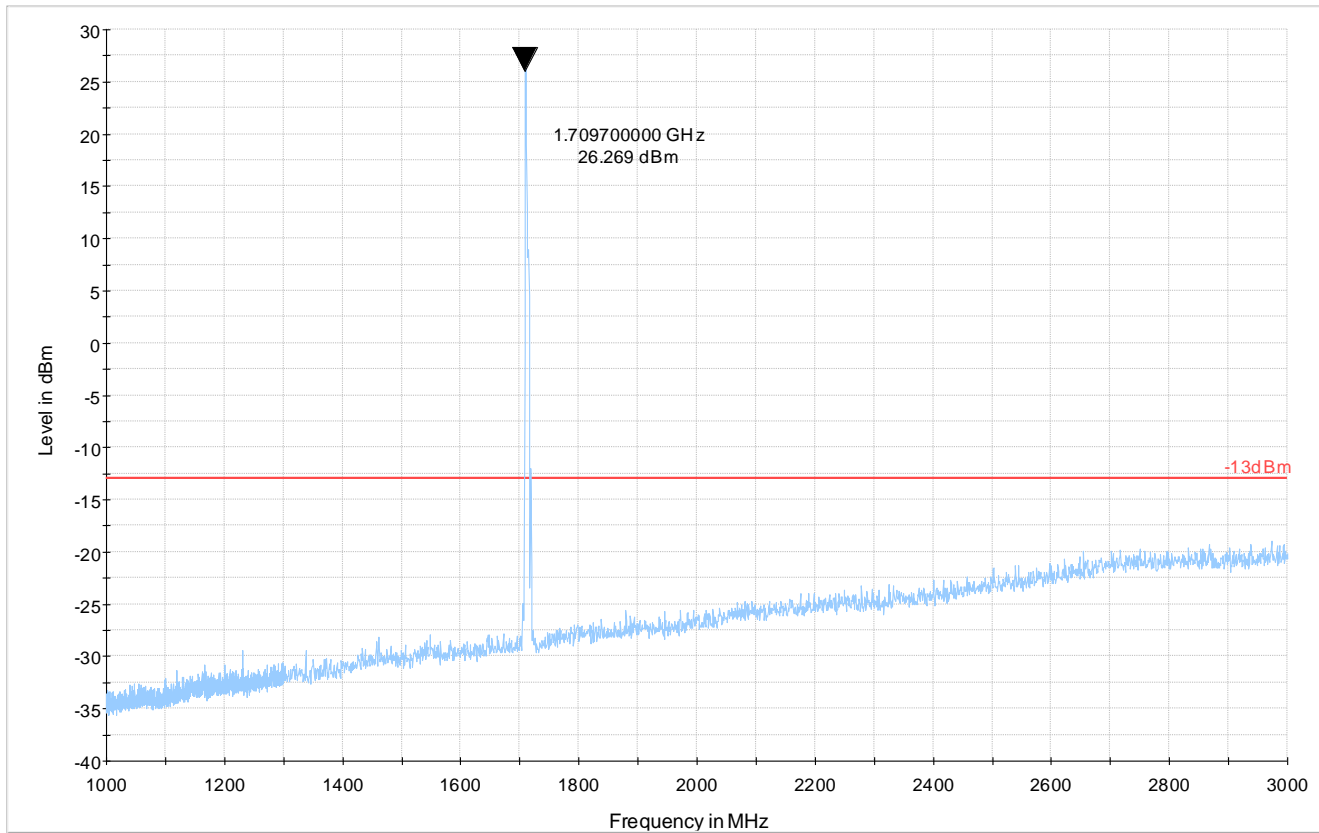
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 1 GHz – 3 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 1GHz to 3GHz

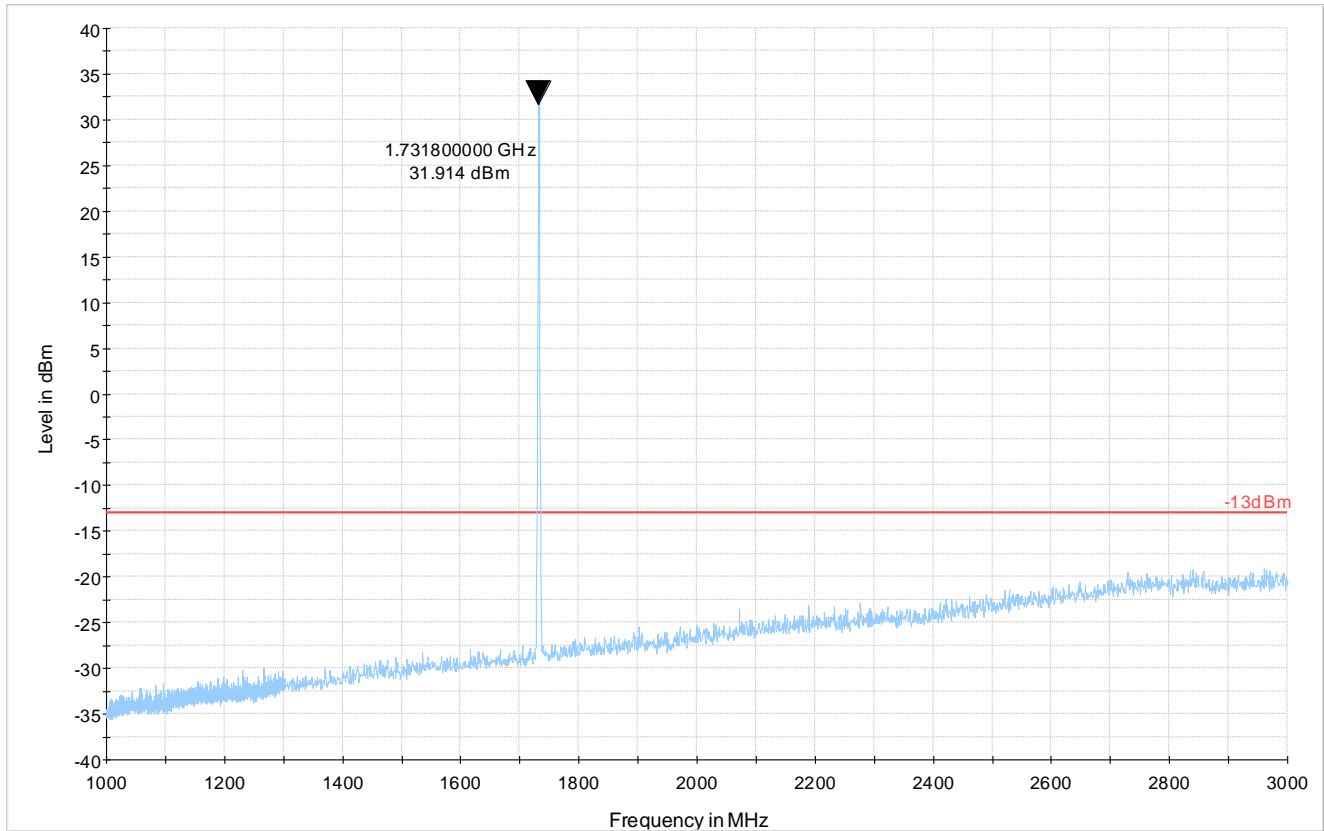
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 1 GHz – 3 GHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-PK+

6.7.8.1.7 QPSK/ 5 MHz/ High Channel/ 1GHz to 3GHz

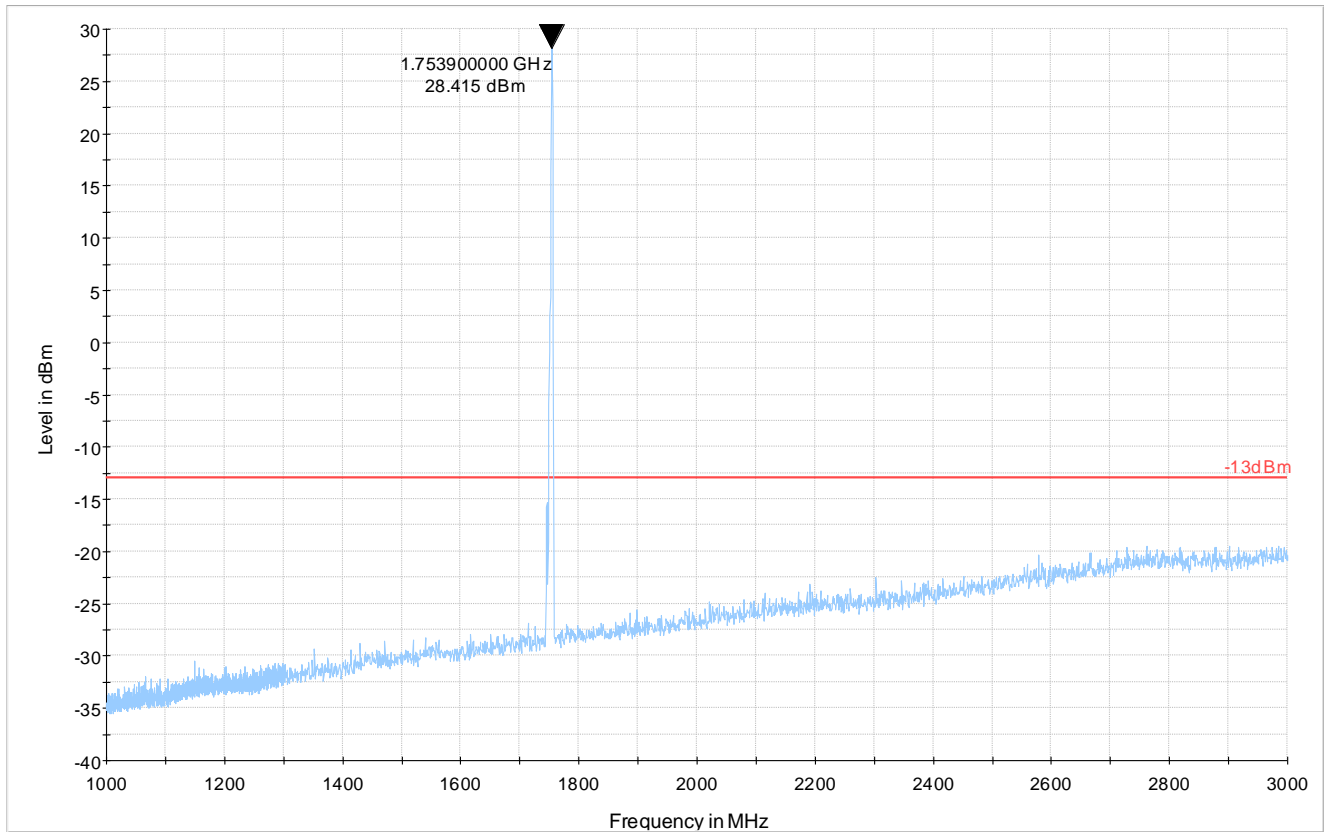
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 1 GHz – 3 GHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.1.8 QPSK/ 5 MHz/ Low Channel/ 3GHz to 18GHz

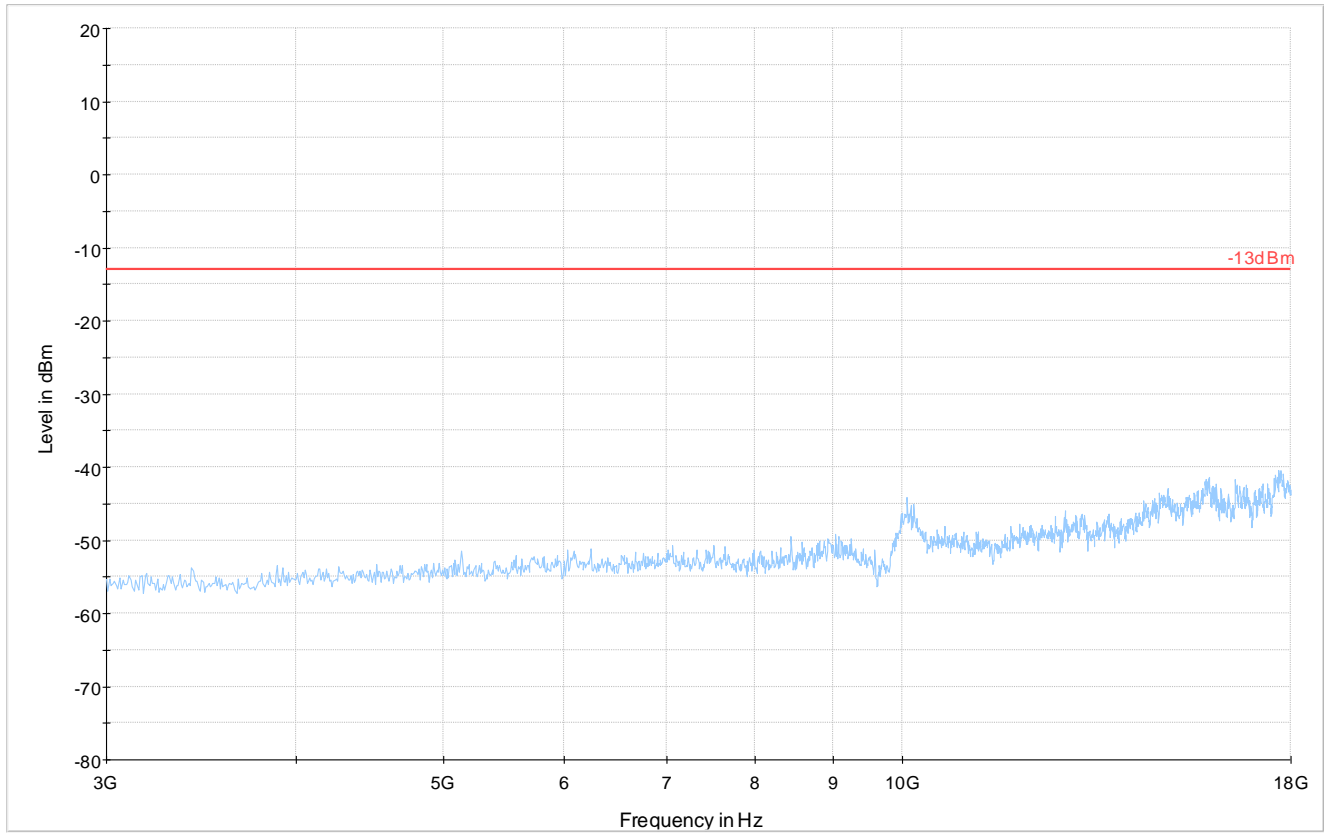
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 3GHz to 18GHz

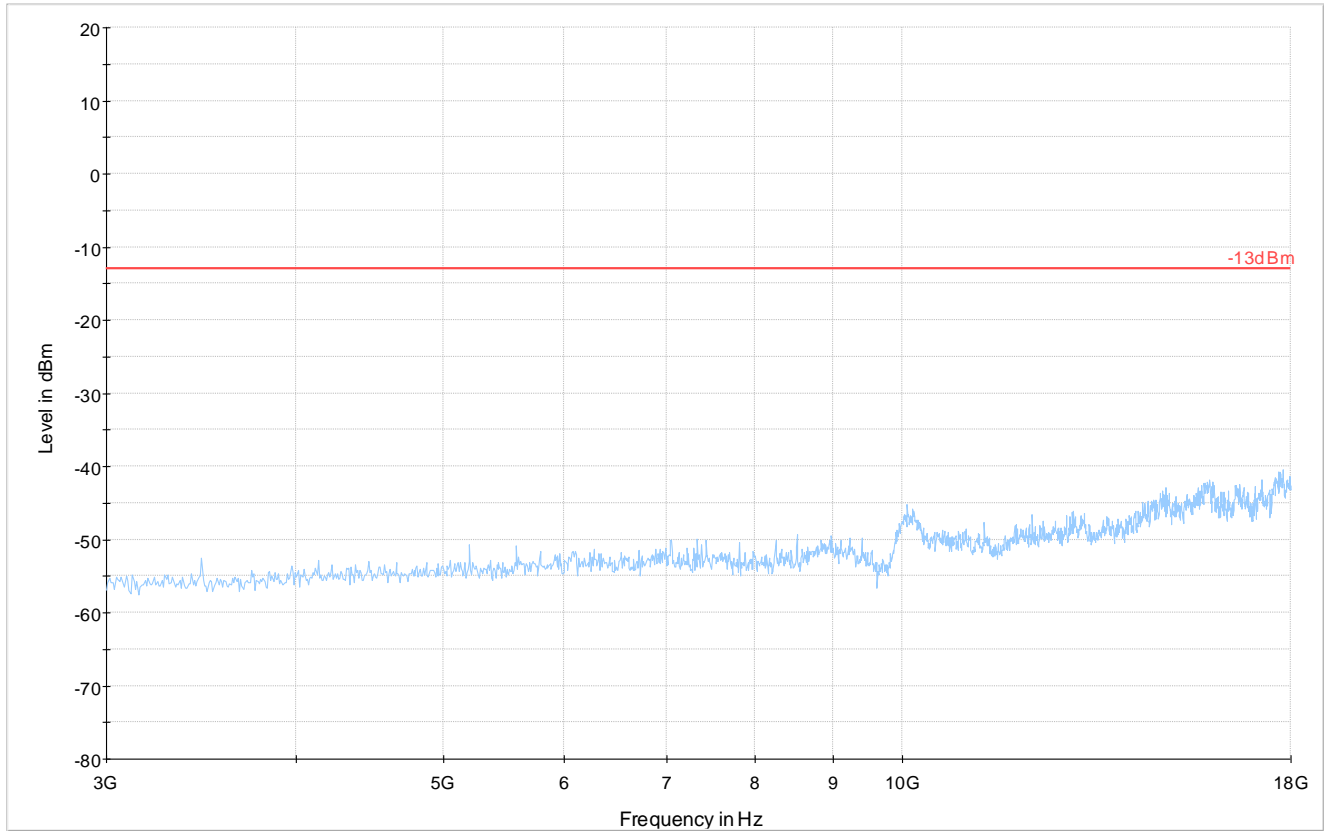
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.1.9 QPSK/ 5 MHz/ High Channel/ 3GHz to 18GHz

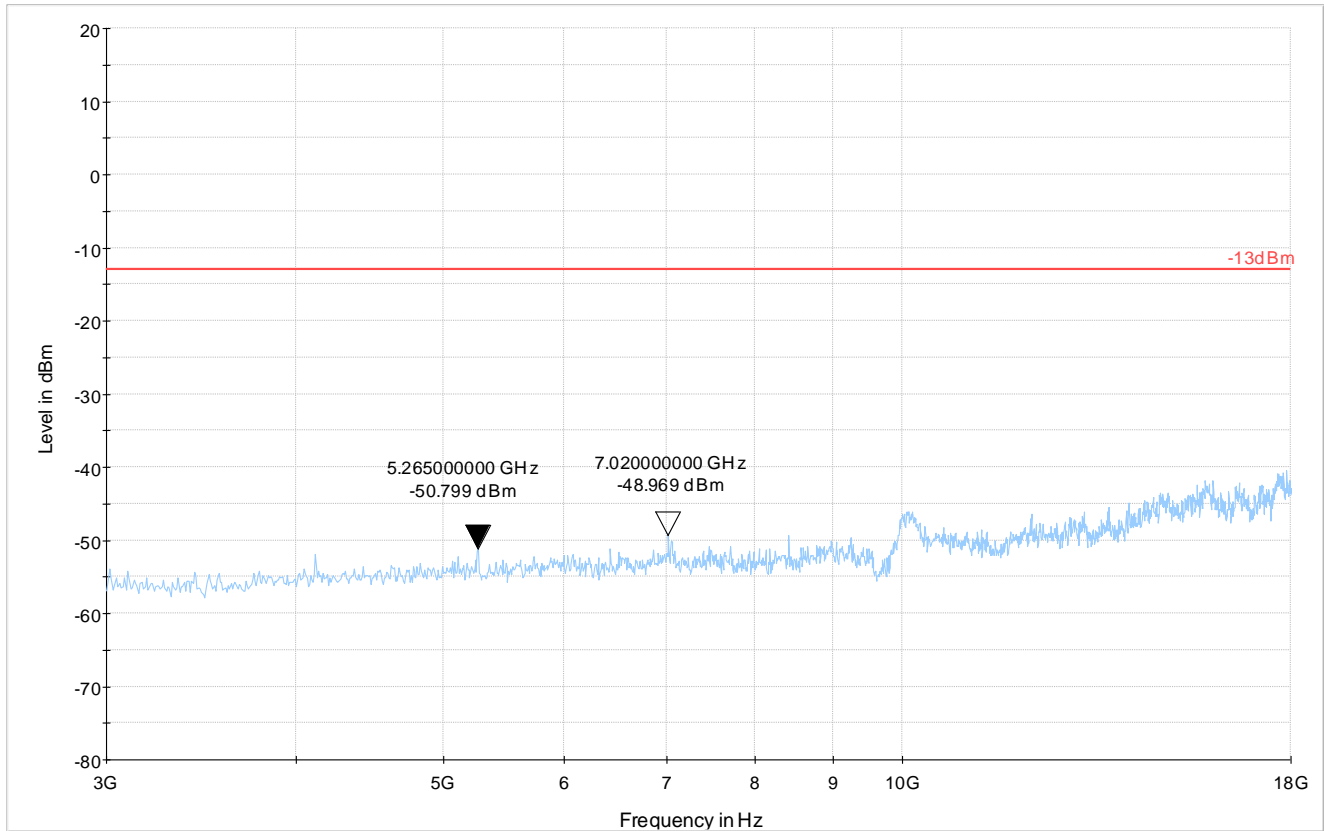
LTE Band 4 (1710 MHz – 1755 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5

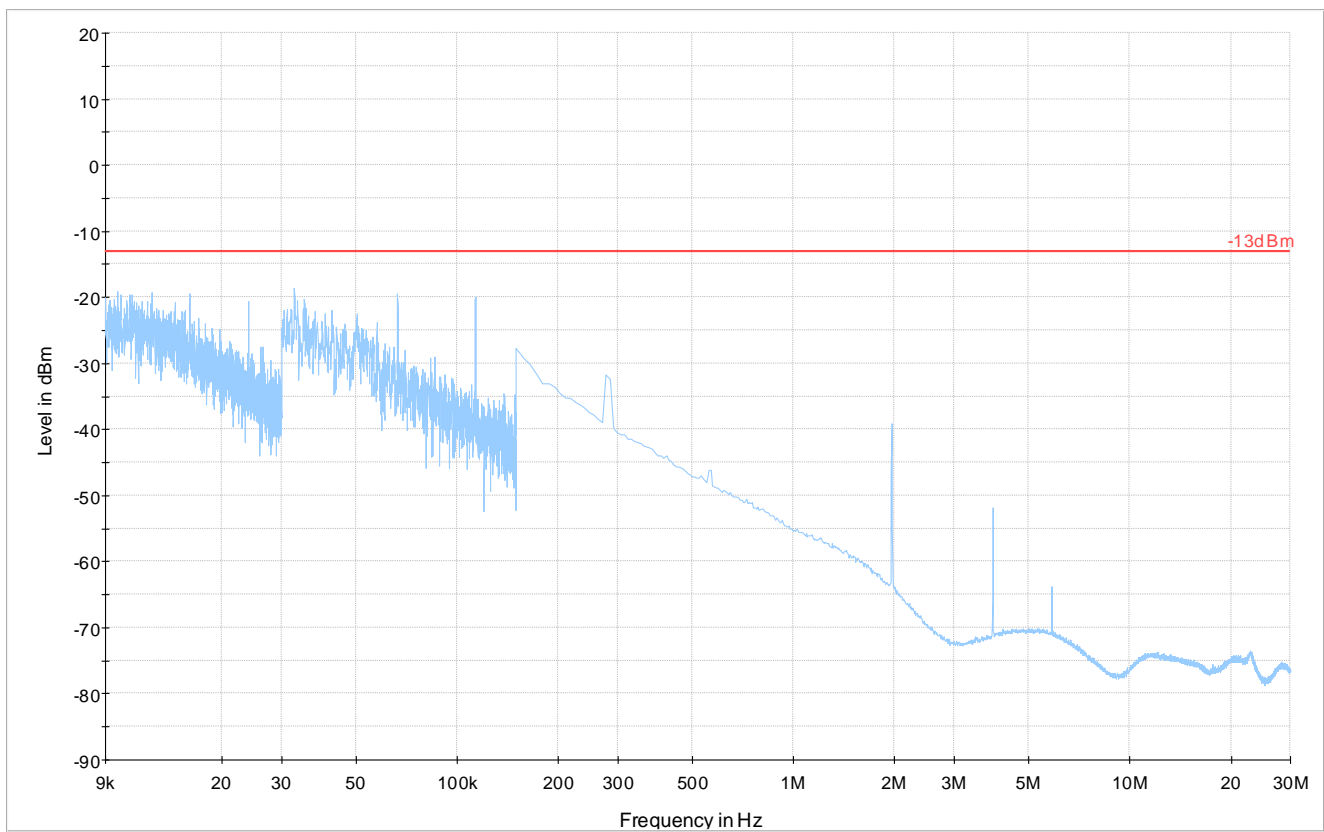


— -13dBm — Preview Result 1-PK+ * Data Reduction Result 1 [3]-PK+

6.7.8.2 Spurious Emission LTE Band 13:

6.7.8.2.1 QPSK/ 5 MHz/ Low Channel/ 9kHz to 30MHz

LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK		
Measurement results – 9 kHz – 30 MHz -Low Channel		
RB Size = 1	RB Offset = 0	BW (MHz) = 5



— -13dBm — Preview Result 1-AVG

6.7.8.2.2 QPSK/ 5 MHz/ Mid Channel/ 9kHz to 30MHz

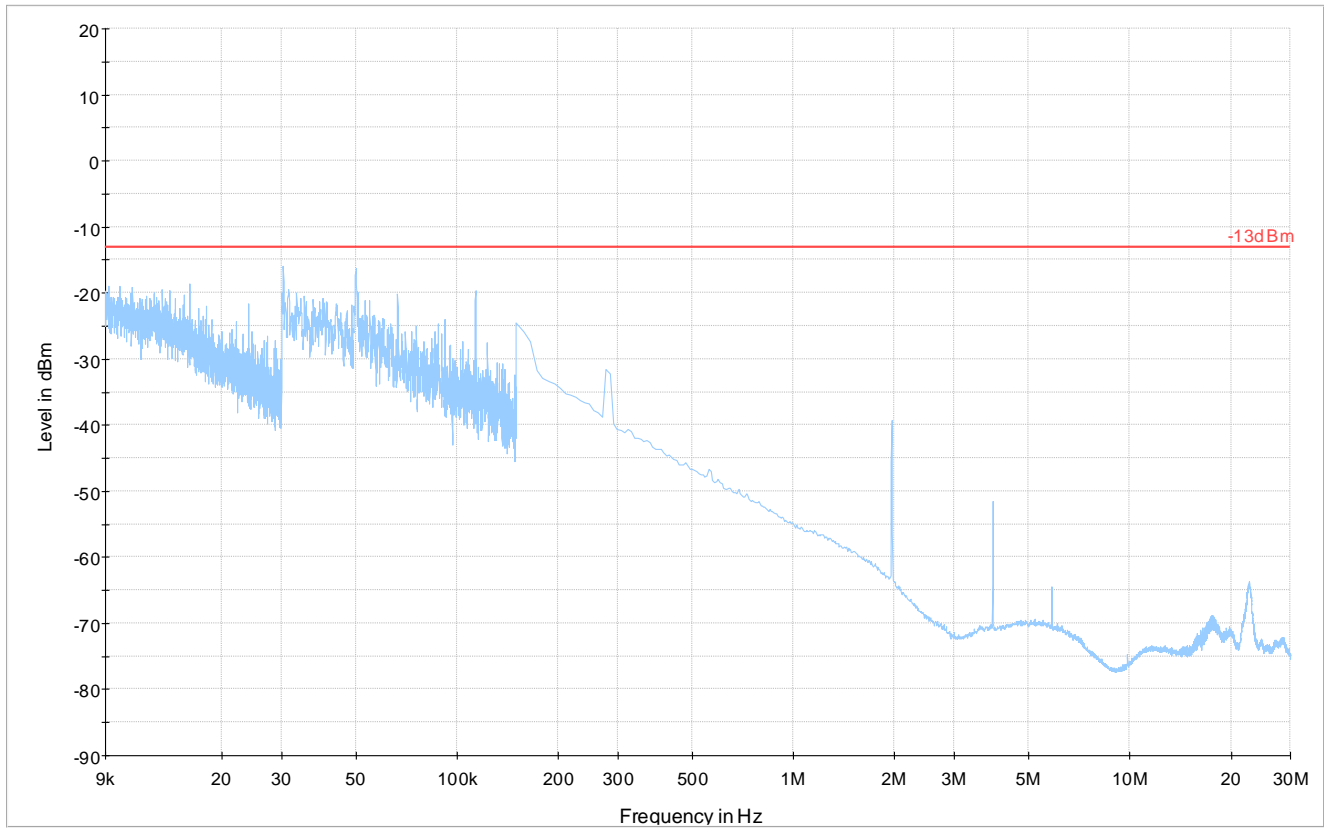
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 9 kHz – 30 MHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-AVG

6.7.8.2.3 QPSK/ 5 MHz/ Hi Channel/ 9kHz to 30MHz

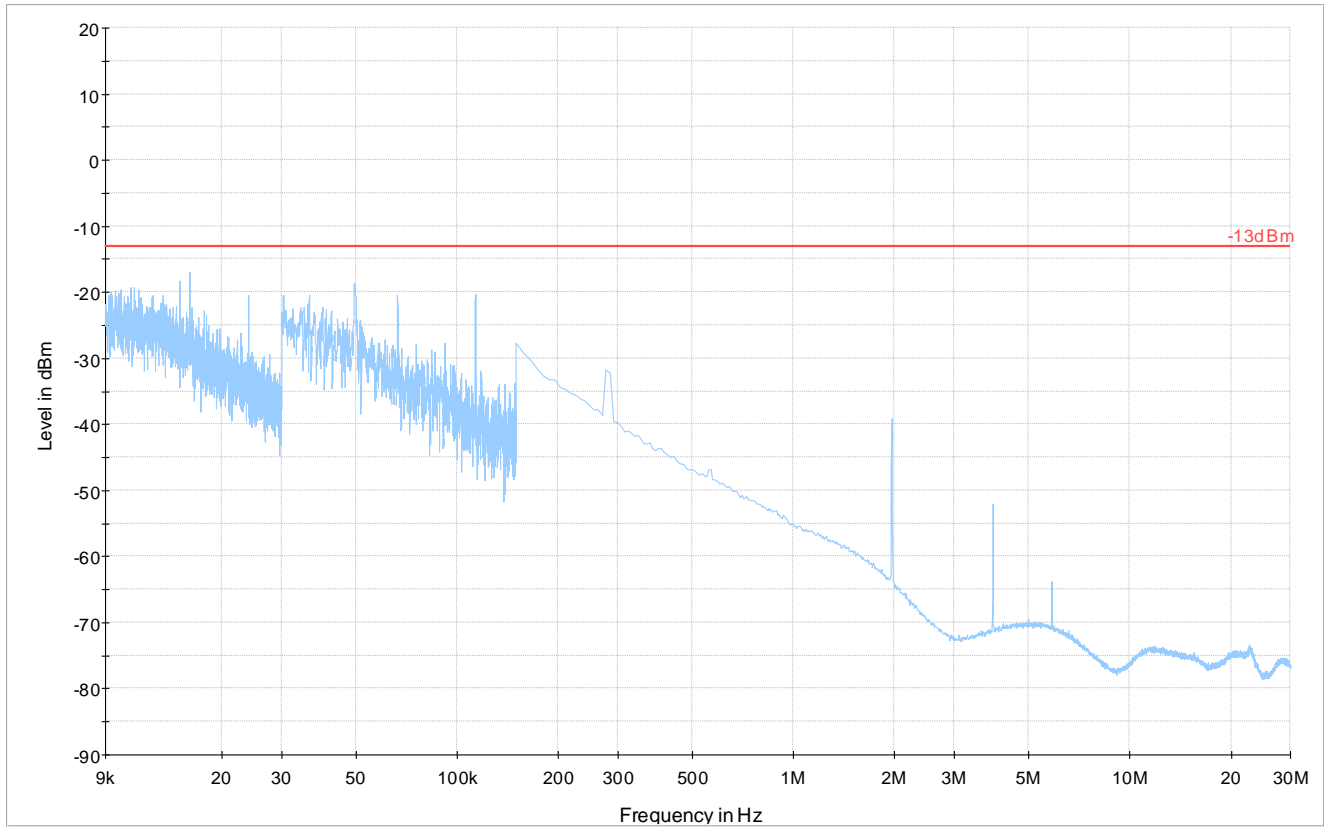
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 9 kHz – 30 MHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-AVG

QPSK/ 5 MHz/ Low Channel/ 30MHz to 1GHz

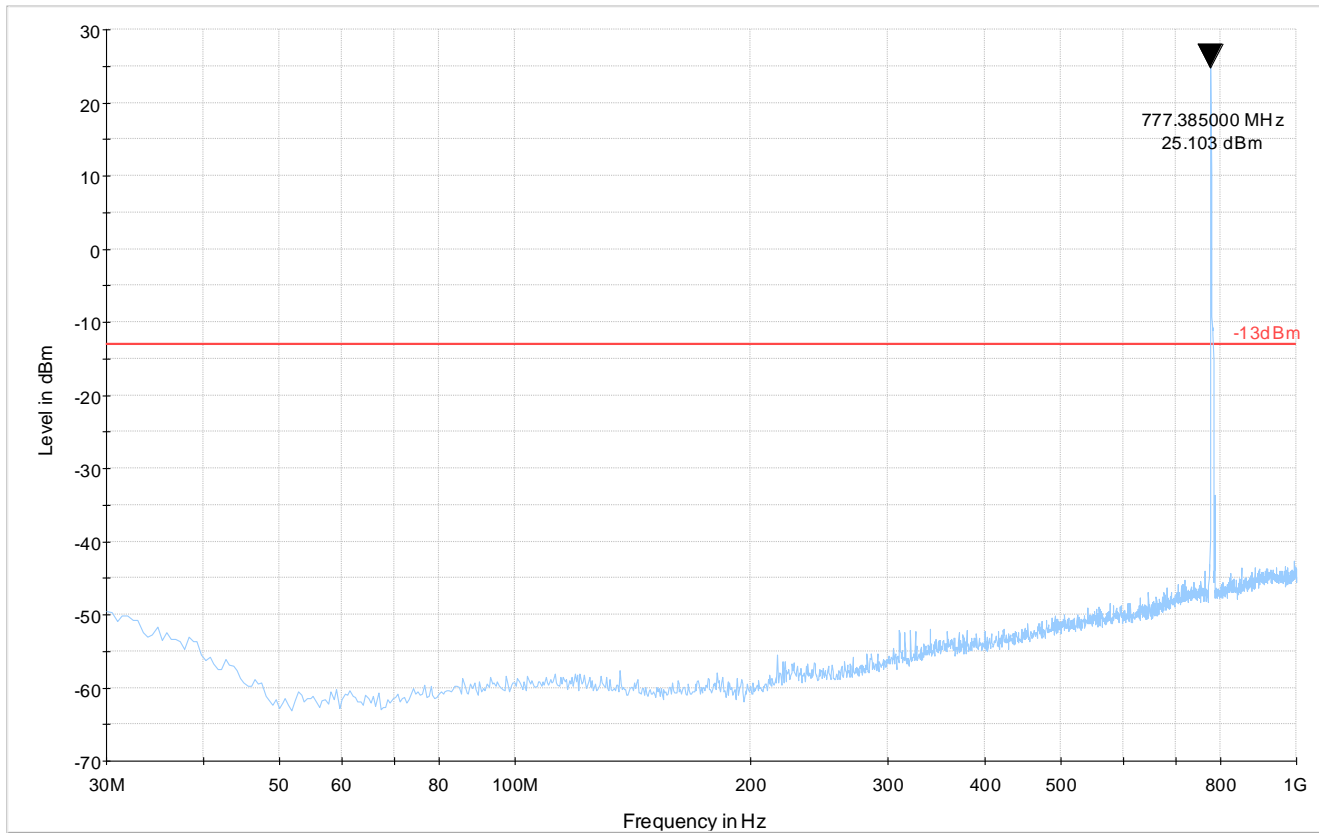
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 30MHz to 1GHz

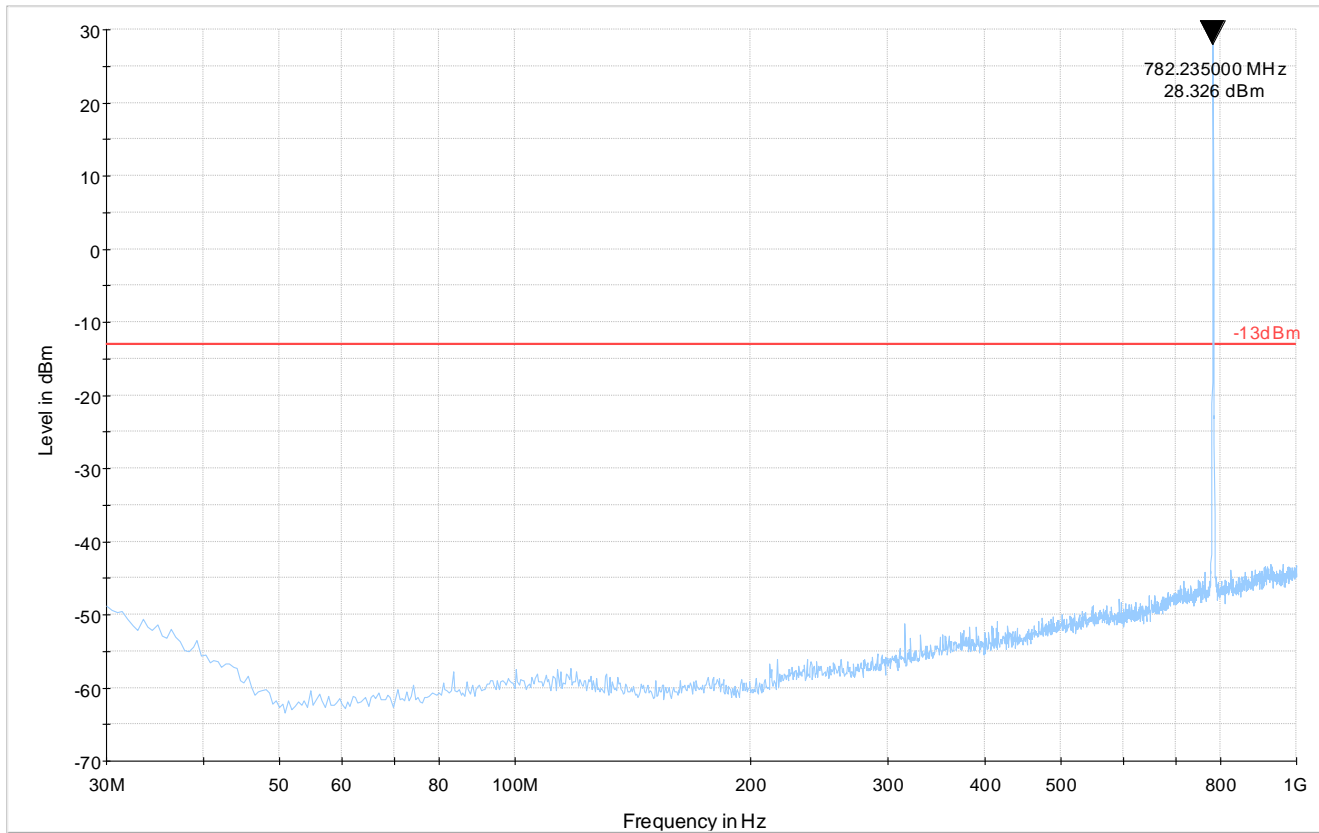
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-PK+

6.7.8.2.4 QPSK/ 5 MHz/ High Channel/ 30MHz to 1GHz

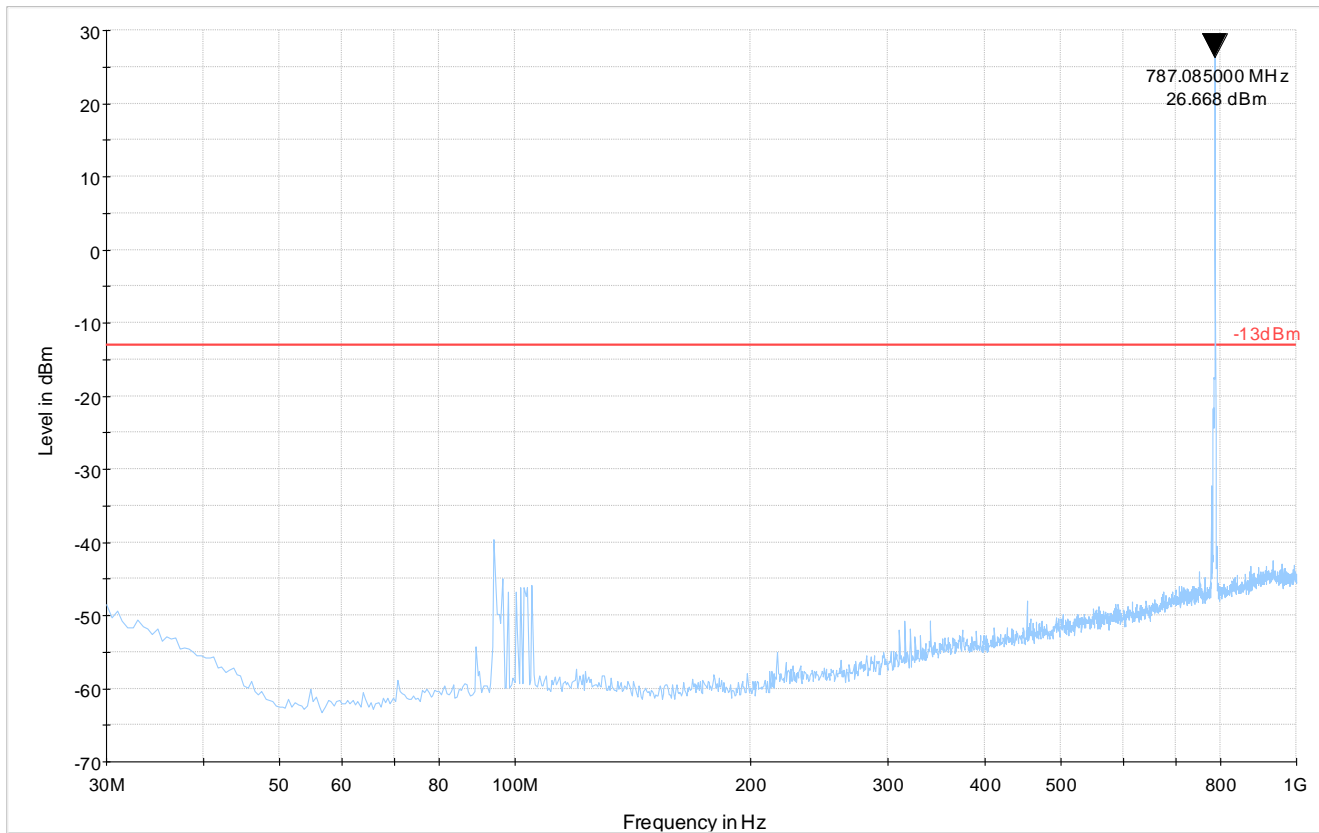
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 30 MHz – 1 GHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.2.5 QPSK/ 5 MHz/ Low Channel/ 1GHz to 3GHz

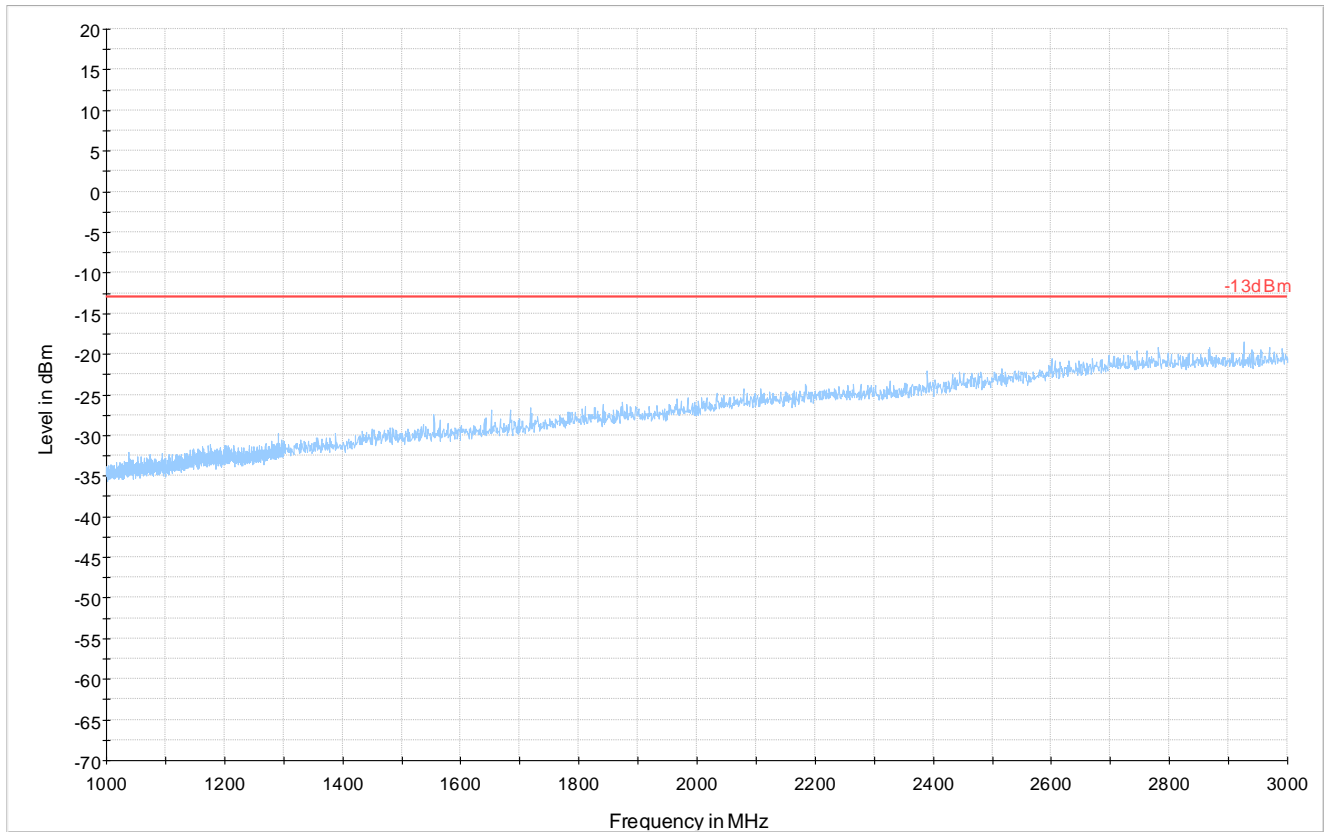
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 1 GHz – 3 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 1GHz to 3GHz

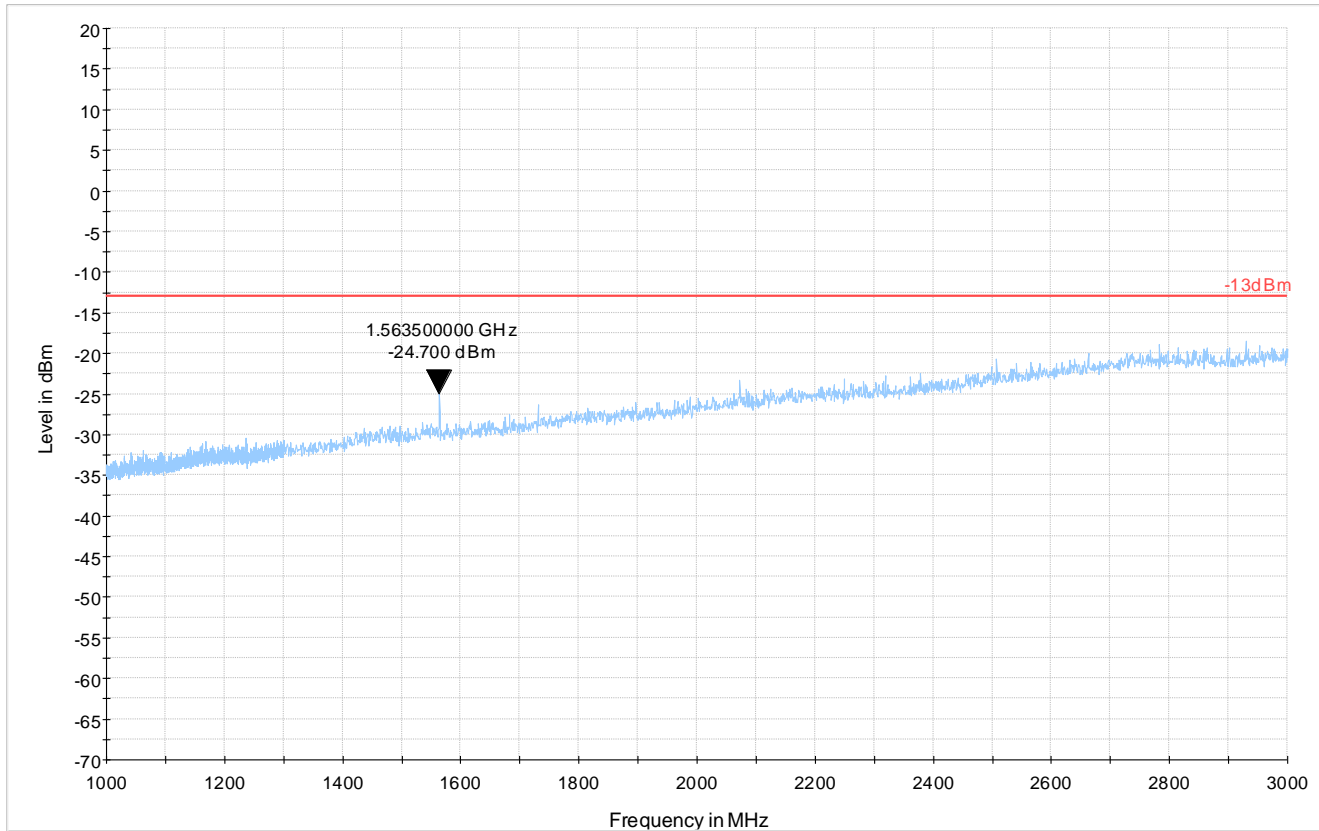
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 1 GHz – 3 GHz -Mid Channel

RB Size = 1

RB Offset = 0

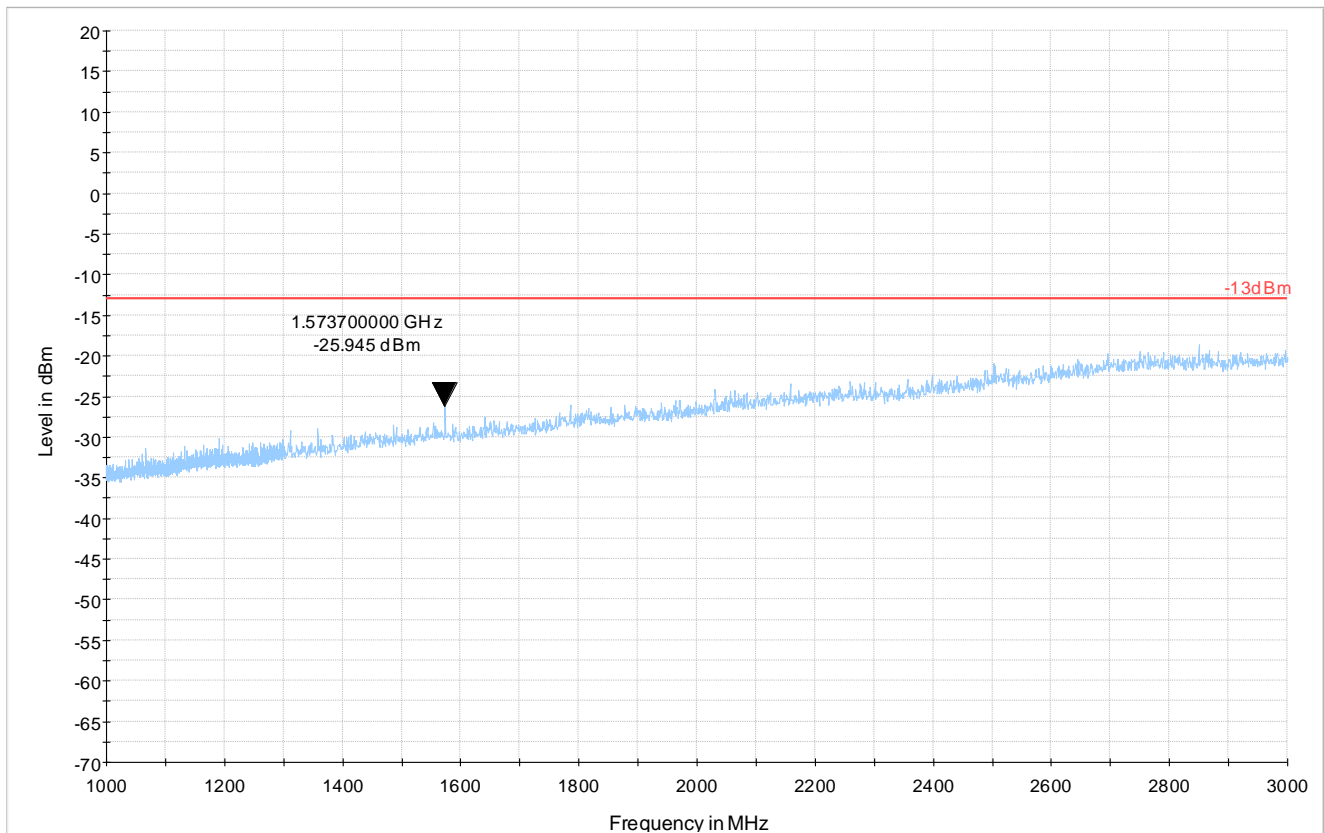
BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.2.6 QPSK/ 5 MHz/ High Channel/ 1GHz to 3GHz

LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK		
Measurement results – 1 GHz – 3 GHz -High Channel		
RB Size = 1	RB Offset = 0	BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.2.7 QPSK/ 5 MHz/ Low Channel/ 3GHz to 18GHz

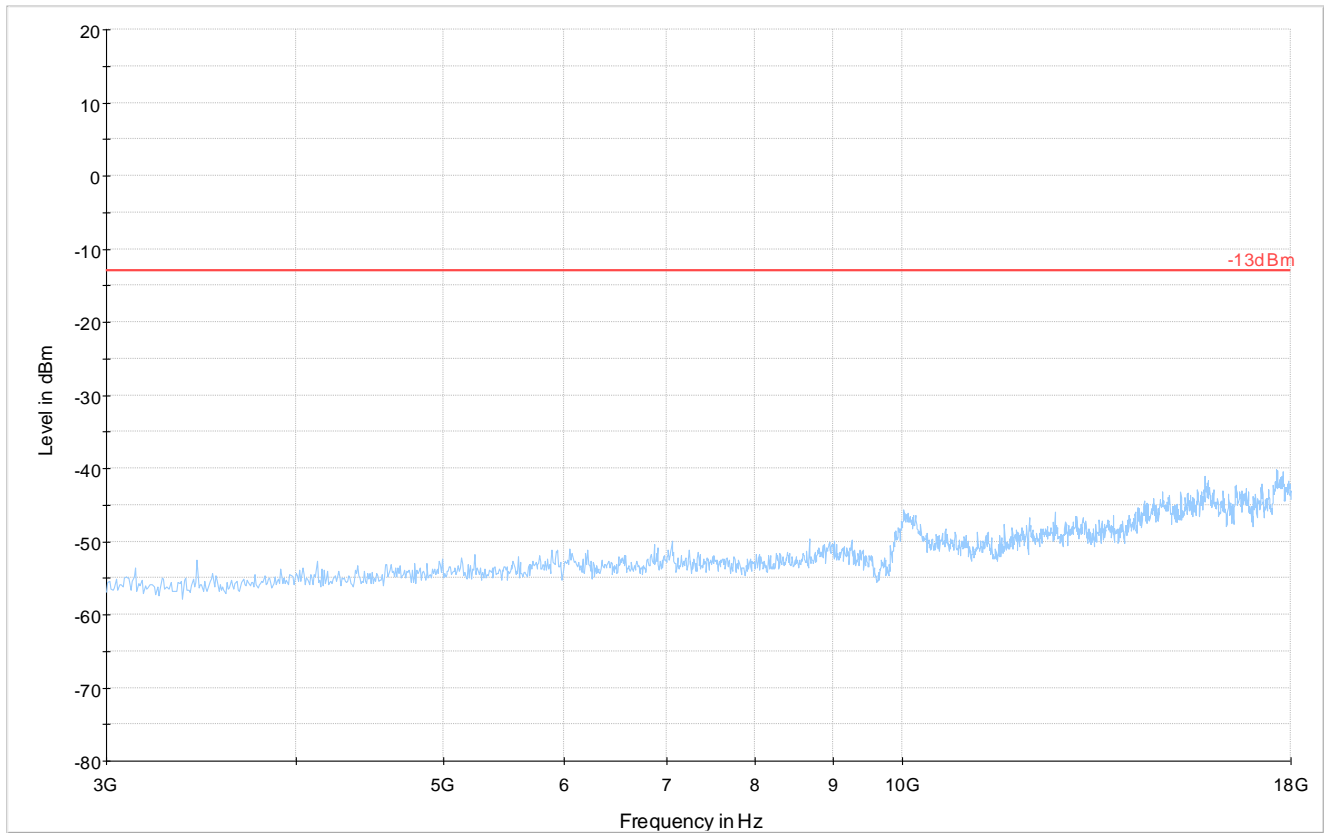
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -Low Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



-13dBm Preview Result 1-PK+

QPSK/ 5 MHz/ Mid Channel/ 3GHz to 18GHz

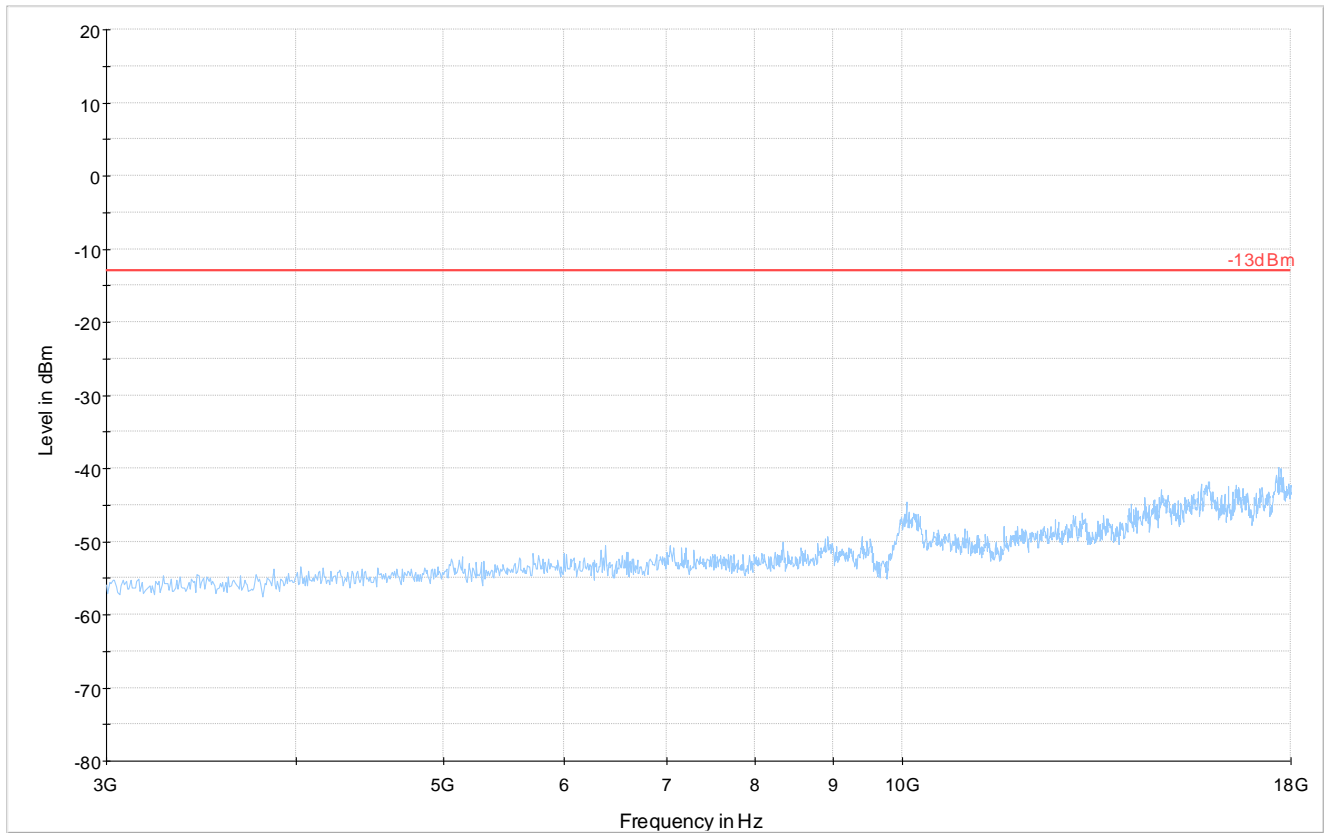
LTE Band 13(777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -Mid Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

6.7.8.2.8 QPSK/ 5 MHz/ High Channel/ 3GHz to 18GHz

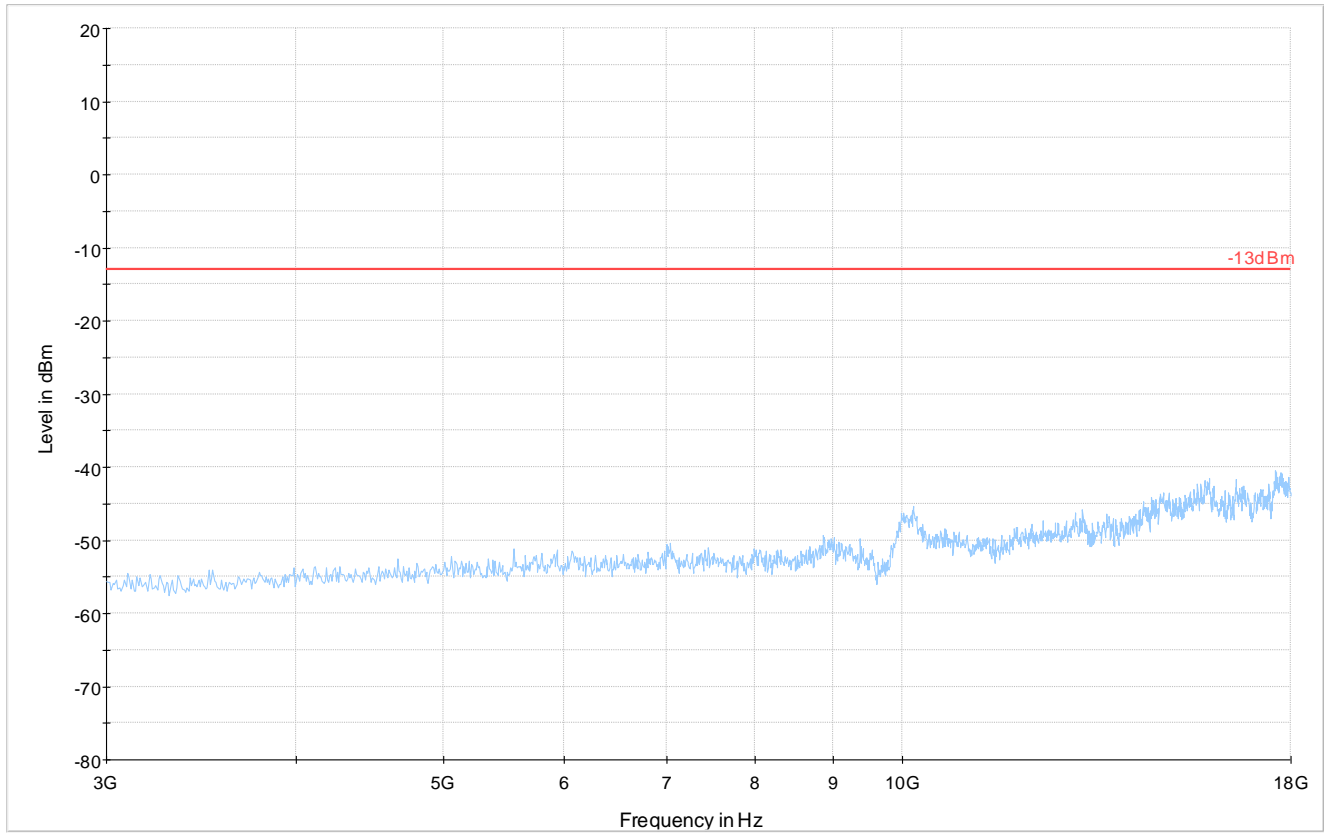
LTE Band 13 (777 MHz – 787 MHz) -Modulation: QPSK

Measurement results – 3 GHz – 18 GHz -High Channel

RB Size = 1

RB Offset = 0

BW (MHz) = 5



— -13dBm — Preview Result 1-PK+

7 Test Equipment and Ancillaries used for tests

7.1.1 San Diego EMC Lab

Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber:						
Spectrum Analyzer	Rohde und Schwarz	FSV 40	101022	7/2014	3 years	7/2017
Receiver	Rohde und Schwarz	ESR3	101663	2/2013	3 years	2/2016
LISN	Rohde und Schwarz	ESV 216	101129	1/2013	3 years	1/2016
Radiocommunication Tester	Rohde and Schwarz	CMU 200	121672	7/2013	2 years	7/2015
Log Periodic Antenna	Rohde and Schwarz	HL 050	100515	4/2013	3 year	4/2016
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	5/2015	3 year	5/2018
Double-ridge Horn Antenna (1G-18G)	ETS-Lindgren	3117-PA	00167061	7/2014	3 year	7/2017
Double-ridge Horn Antenna (18G-40G)	ETS-Lindgren	3116C-PA	00166821	7/2014	3 year	7/2017
Loop Antenna	ETS-Lindgren	6512	00164698	7/2014	3 year	7/2017
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extention Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/60709 10	n/a		
Compact antenna Mast	Maturo	CAM 4.0-P	CAM4.0- P/067/6000910	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		

Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
Conducted RF Bench:						
Spectrum Analyzer	Rohde und Schwarz	FSU 13	101014	9/2014	2 years	9/2016
Callbox	Aeroflex	7100 DRTS	710000291	n/a		
Directional Coupler	M/A-COM	10dB coupler	96341	na		

Calibration status valid at the time of testing.

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

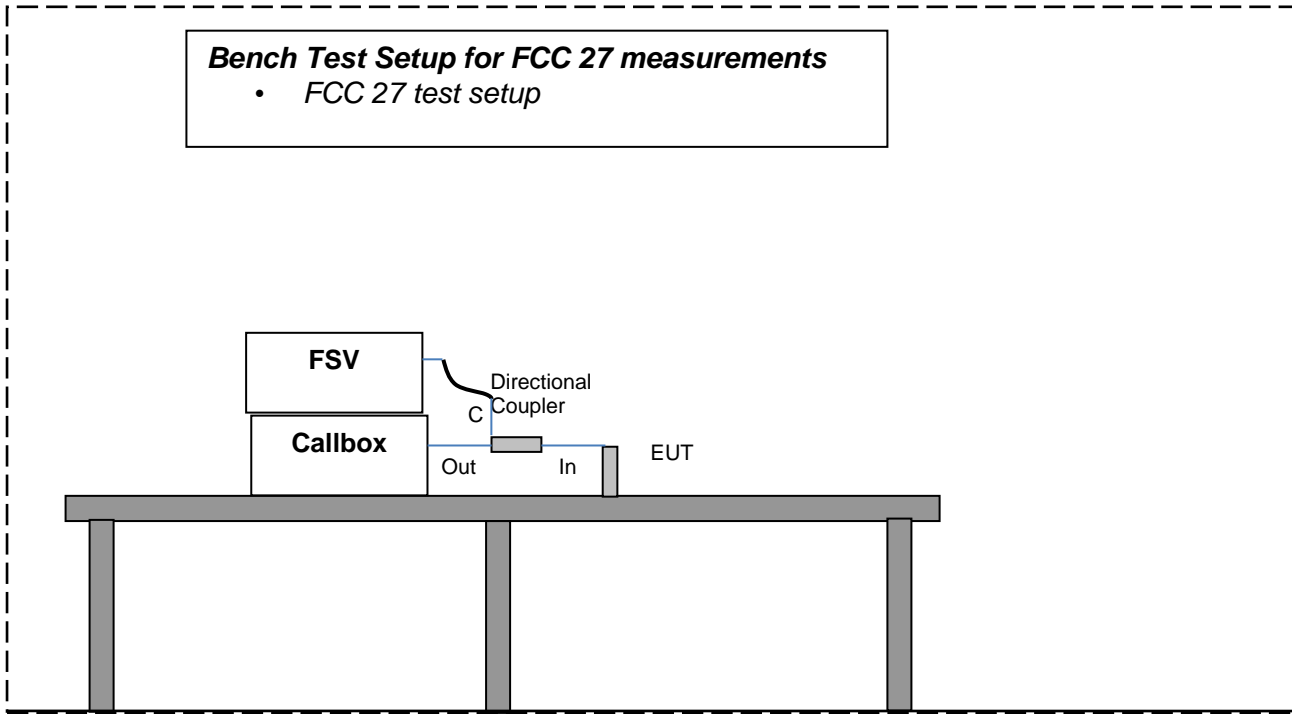
Calibration due dates, unless defined specifically, falls on the last day of the month.

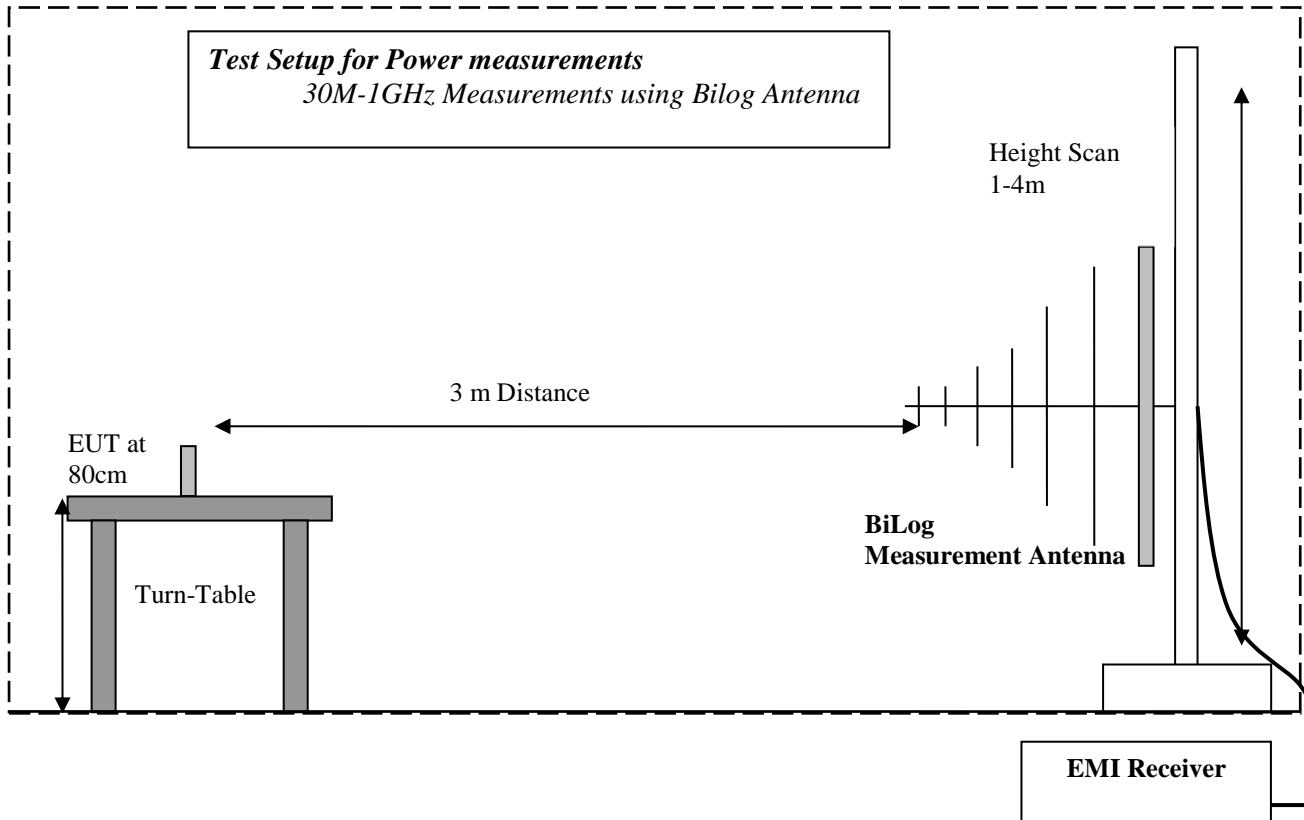
Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

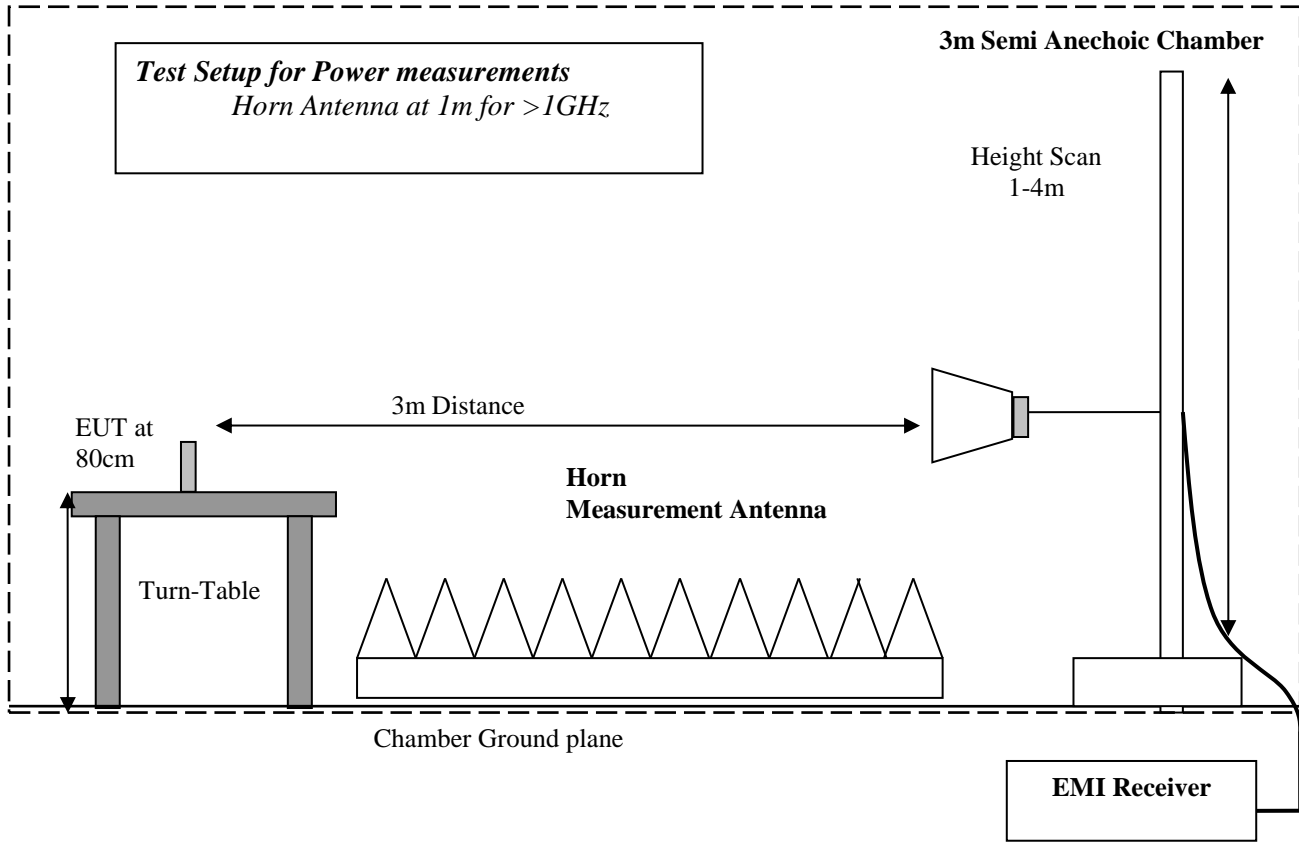
8 Test Setup Diagrams

Bench Test Setup for FCC 27 measurements

- FCC 27 test setup







9 Revision History

Date	Report Name	Changes to report	Report prepared by
2015-10-15	EMC_VERIZ-036-15002_FCC27_LTE_WWAN_v1.0.docx	First release	T. Planinac
2015-11-05	EMC_VERIZ-036-15002_FCC27_LTE_WWAN_v1.1.docx	Update Product description	MPDL