FCC RF Test Report

APPLICANT	**:**	**HMD Global Oy**
EQUIPMENT	**:**	**GSM/WCDMA/LTE Mobile Phone**
BRAND NAME	**:**	**Nokia**
MODEL NAME	**:**	**TA-1136**
FCC ID	**:**	**2AJOTTA-1136**
STANDARD	**:**	**47 CFR Part 2, 22(H), 24(E), 27(L), 27(M), 27(F), 27(H)**
CLASSIFICATION	**:**	**PCS Licensed Transmitter Held to Ear (PCE)**

The product was received on Sep. 18, 2018 and completely tested on Oct. 31, 2018. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.26-2015 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

James Huang

Approved by: James Huang / Manager

NVLAP TESTING
NVLAP LAB CODE 600155-0

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG832115-23B	Rev. 01	Initial issue of report	Nov. 01, 2018

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.4	§2.1046	Conducted Output Power	Reporting Only	PASS	-
	§27.50(d)(4)	Equivalent Isotropic Radiated Power (Band 4)	EIRP < 1Watt	PASS	-
3.5	N/A	Peak-to-Average Ratio	<13 dB	PASS	-
3.6	§2.1049	Occupied Bandwidth	Reporting Only	PASS	-
3.7	§2.1051 §27.53(h)	Conducted Band Edge Measurement (Band 4)	< 43+10log10(P[Watts])	PASS	-
3.8	§2.1051 §27.53(h)	Conducted Spurious Emission (Band 4)	< 43+10log10(P[Watts])	PASS	-
3.9	§2.1055 §27.54	Frequency Stability Temperature & Voltage	Within Authorized Band	PASS	-
4.4	§2.1053 §27.53(h)	Radiated Spurious Emission (Band 4)	< 43+10log10(P[Watts])	PASS	Under limit 21.43 dB at 5190.000 MHz

1 General Description

1.1 Applicant

HMD Global Oy
Bertel Jungin aukio 9, 02600 Espoo, Finland

1.2 Manufacturer

HMD Global Oy
Bertel Jungin aukio 9, 02600 Espoo, Finland

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	GSM/WCDMA/LTE Mobile Phone
Brand Name	Nokia
Model Name	TA-1136
FCC ID	2AJOTTA-1136
EUT supports Radios application	GSM/GPRS/EGPRS/WCDMA/HSPA/DC-HSDPA/HSPA+ (16QAM uplink is not supported)/LTE WLAN 2.4GHz 802.11b/g/n HT20/HT40 Bluetooth BR / EDR / LE
IMEI Code	Conducted: 004402971553569 Radiation: 004402971552777
HW Version	HW0141
SW Version	000C_0_040
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx Frequency	LTE Band 2 : 1850.7 MHz ~ 1909.3 MHz LTE Band 4 : 1710.7 MHz ~ 1754.3 MHz LTE Band 5 : 824.7 MHz ~ 848.3 MHz LTE Band 7 : 2502.5 MHz ~ 2567.5 MHz LTE Band 12 : 699.7 MHz ~ 715.3 MHz LTE Band 13 : 779.5 MHz ~ 784.5 MHz LTE Band 17 : 706.5 MHz ~ 713.5 MHz LTE Band 38 : 2572.5MHz ~ 2617.5MHz
Rx Frequency	LTE Band 2 : 1930.7 MHz ~ 1989.3 MHz LTE Band 4 : 2110.7 MHz ~ 2154.3 MHz LTE Band 5 : 869.7 MHz ~ 893.3 MHz LTE Band 7 : 2622.5MHz ~ 2687.5 MHz LTE Band 12 : 729.7 MHz ~ 745.3 MHz LTE Band 13 : 748.5 MHz ~ 753.5 MHz LTE Band 17 : 736.5 MHz ~ 743.5 MHz LTE Band 38 : 2572.5MHz ~ 2617.5MHz
Bandwidth	LTE Band 4 : 1.4MHz / 3MHz / 5MHz / 10MHz / 15MHz / 20MHz
Maximum Output Power to Antenna	LTE Band 4 : 23.40 dBm
Antenna Gain	LTE Band 4 : -2.00 dBi
Antenna Type	PIFA Antenna
Type of Modulation	QPSK / 16QAM

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Re-use of Measured Data

1.6.1 Introduction Section

This application re-uses data collected on a similar device. The subject device of this application (Model: TA-1136, FCC ID: 2AJOTTA-1136) is electrically identical to the reference device (Model: TA-1084, FCC ID: 2AJOTTA-1084) for the portions of the circuitry corresponding to the data being re-used, as treated by KDB Publication 484596 D01.

1.6.2 Difference Section

For details concerning the similarity with respect to component placement, mechanical/electrical design etc., please refer to the Product Equality Declaration.

The re-used RF data includes the following bands provided in Appendix D (Sporton RF Report No. FG832104B for the reference device Model: TA-1084, FCC ID: 2AJOTTA-1084) and LTE Band 4 to re-test.

1.6.3 Reference detail Section:

Equipment Class	Reference FCC ID	Folder Test	Report Title/Section
PCE (LTE)	2AJOTTA-1084	Part22H. 24E. 27L. 27M. 27F. 27H (FG832104B)	All sections applicable(except for Part 27L)

1.6.4 Spot Check Verification Data Section

In order to confirm hardware similarity of the subject device with the reference device, spot check measurements were performed on the subject device for the following test items, the test result were consistent with FCC ID: 2AJOTTA-1084.

Assertions concerning the similarity of these devices are based on representations by the applicant. The applicant accepts full responsibility for the validity of the similarity claim, and for the determination that verification test data are sufficient to support it.

Test Item	Mode	Worst Result 2AJOTTA-1136	Worst Result 2AJOTTA-1084	Difference (dB)
Radiated Spurious Emission (dBm)	LTE Band 2	-39.06	-40.17	1.11
	LTE Band 7	-44.48	-46.97	2.49
	LTE Band 12	-39.50	-38.46	1.04
	LTE Band 13	-51.05	-49.33	1.72
	LTE Band 38	-37.82	-39.91	2.09

1.7 Maximum EIRP Power, Frequency Tolerance, and Emission Designator

LTE Band 4		QPSK			16QAM		
BW (MHz)	Frequency Range (MHz)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)
1.4	1710.7 ~ 1754.3	1M10G7D	-	0.1309	1M10W7D	-	0.1064
3	1711.5 ~ 1753.5	2M72G7D	-	0.1274	2M72W7D	-	0.1021
5	1712.5 ~ 1752.5	4M49G7D	-	0.1380	4M52W7D	-	0.1042
10	1715.0 ~ 1750.0	9M03G7D	0.0047	0.1309	9M01W7D	-	0.1009
15	1717.5 ~ 1747.5	13M4G7D	-	0.1327	13M4W7D	-	0.1114
20	1720.0 ~ 1745.0	18M3G7D	-	0.1355	18M4W7D	-	0.1107

1.8 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0).

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China TEL : 86-512-57900158 FAX : 86-512-57900958		
Test Site No.	**Sporton Site No.**	**FCC designation No.**	**FCC Test Firm Registration No.**
	TH01-KS 03CH05-KS	CN5013	630927

1.9 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 2, 22(H), 24(E), 27(L), 27(M), 27(F), 27(H)
- ANSI C63.26-2015
- FCC KDB 971168 D01 Power Meas License Digital Systems v03r01
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

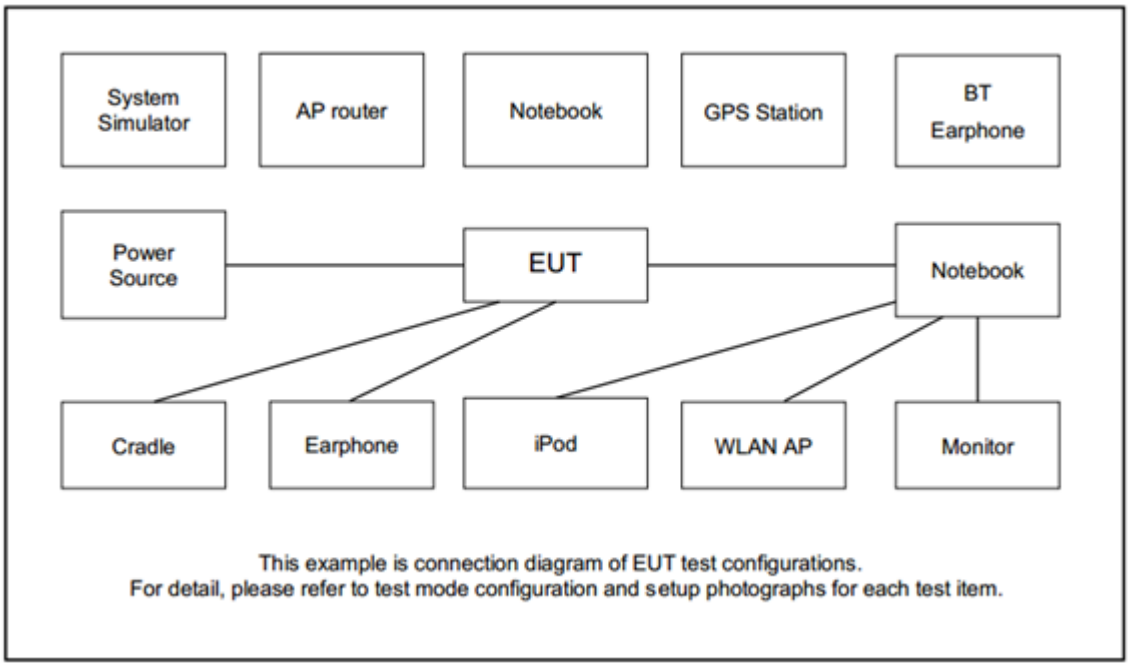
2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas License Digital Systems v03r01 with maximum output power.

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes to find the maximum emission.

Test Items	Band	Bandwidth (MHz)						Modulation			RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	M	H
Max. Output Power	4	v	v	v	v	v	v	v	v	-	v	v	v	v	v	v
Peak-to-Average Ratio	4						v	v	v	-	v		v	v	v	v
26dB and 99% Bandwidth	4	v	v	v	v	v	v	v	v	-			v	v	v	v
Conducted Band Edge	4	v	v	v	v	v	v	v	v	-	v		v	v		v
Conducted Spurious Emission	4	v	v	v	v	v	v	v	v	-	v			v	v	v
Frequency Stability	4				v			v		-			v		v	
E.I.R.P	4	v	v	v	v	v	v	v	v	-	v			v	v	v
Radiated Spurious Emission	4	Worst Case													v	
Note	1. The mark "**v** " means that this configuration is chosen for testing 2. The mark "-" means that this bandwidth is not supported. 3. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported.															

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Power Supply	GWINSTEK	PSS-2002	N/A	N/A	Unshielded, 1.8 m
2.	LTE Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m

2.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss .

Following shows an offset computation example with cable loss 5.3 dB.

Example :

Offset(dB) = RF cable loss(dB).

= 5.3 (dB)

2.5 Frequency List of Low/Middle/High Channels

LTE Band 4 Channel and Frequency List				
BW [MHz]	**Channel/Frequency(MHz)**	**Lowest**	**Middle**	**Highest**
20	Channel	20050	20175	20300
	Frequency	1720	1732.5	1745
15	Channel	20025	20175	20325
	Frequency	1717.5	1732.5	1747.5
10	Channel	20000	20175	20350
	Frequency	1715	1732.5	1750
5	Channel	19975	20175	20375
	Frequency	1712.5	1732.5	1752.5
3	Channel	19965	20175	20385
	Frequency	1711.5	1732.5	1753.5
1.4	Channel	19957	20175	20393
	Frequency	1710.7	1732.5	1754.3

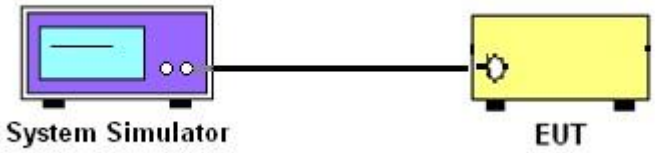
3 Conducted Test Items

3.1 Measuring Instruments

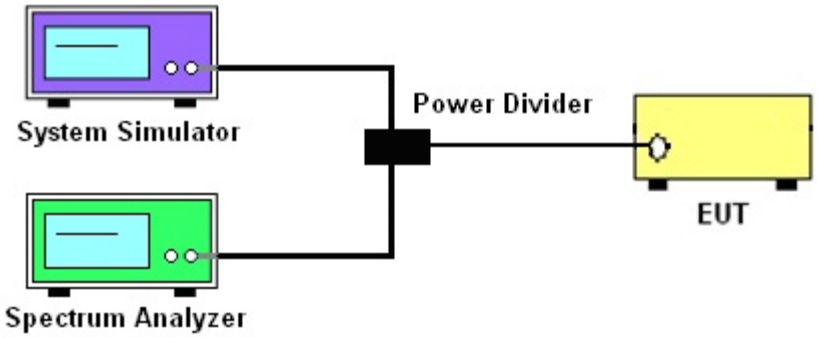
See list of measuring instruments of this test report.

3.2 Test Setup

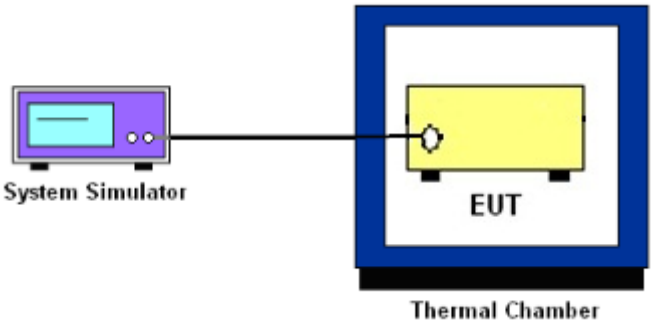
3.2.1 Conducted Output Power



3.2.2 Peak-to-Average Ratio, Occupied Bandwidth ,Conducted Band-Edge and Conducted Spurious Emission



3.2.3 Frequency Stability



3.3 Test Result of Conducted Test

Please refer to Appendix A.

3.4 Conducted Output Power and EIRP

3.4.1 Description of the Conducted Output Power Measurement and EIRP Measurement

A system simulator was used to establish communication with the EUT. Its parameters were set to force the EUT transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The EIRP of mobile transmitters must not exceed 1 Watts for LTE Band 4.

According to KDB 412172 D01 Power Approach,

EIRP = $P_T + G_T – L_C$, ERP = EIRP -2.15, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

L_C = signal attenuation in the connecting cable between the transmitter and antenna in dB

3.4.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.2
2. The transmitter output port was connected to the system simulator.
3. Set EUT at maximum power through the system simulator.
4. Select lowest, middle, and highest channels for each band and different modulation.
5. Measure and record the power level from the system simulator.

3.5 Peak-to-Average Ratio

3.5.1 Description of the PAR Measurement

Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth. 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.

3.5.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.2.3.4 (CCDF).
2. The EUT was connected to spectrum and system simulator via a power divider.
3. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
4. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.
5. Record the deviation as Peak to Average Ratio.

3.6 Occupied Bandwidth

3.6.1 Description of Occupied Bandwidth Measurement

The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.

3.6.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.4
2. The EUT was connected to spectrum analyzer and system simulator via a power divider.
3. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between two and five times the anticipated OBW.
4. The nominal resolution bandwidth (RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
5. Set the detection mode to peak, and the trace mode to max hold.
6. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace. (this is the reference value)
7. Determine the “-26 dB down amplitude” as equal to (Reference Value – X).
8. Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “–X dB down amplitude” determined in step 6. If a marker is below this “-X dB down amplitude” value it shall be placed as close as possible to this value. The OBW is the positive frequency difference between the two markers.
9. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

3.7 Conducted Band Edge

3.7.1 Description of Conducted Band Edge Measurement

27.53 (h)

For operations in the 1710 – 1755 MHz band, the FCC limit is 43 + $10\log_{10}$(P[Watts]) dB below the transmitter power P(Watts) in a 1 MHz bandwidth. However, in the 1MHz 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.

3.7.2 Test Procedures

1. The testing follows ANSI C63.26 section 5.7
2. The EUT was connected to spectrum analyzer and system simulator via a power divider.
3. The band edges of low and high channels for the highest RF powers were measured.
4. Set RBW >= 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.
5. Beyond the 1 MHz band from the band edge, RBW=1MHz was used or a narrower RBW was used and the measured power was integrated over the full required measurement bandwidth of 1 MHz.
6. Set spectrum analyzer with RMS detector.
7. Offset has included the duty factor for LTE Band 41. Duty factor =10 log (1/x), where x is the measured duty cycle
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
9. Checked that all the results comply with the emission limit line.

   Example:

   The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)

   = P(W)- [43 + 10log(P)] (dB)

   = [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB) = -13dBm.

3.8 Conducted Spurious Emission

3.8.1 Description of Conducted Spurious Emission Measurement

The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least 43 + 10 log (P) dB.

It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10^{th} harmonic.

3.8.2 Test Procedures

1. The testing follows ANSI C63.26 section 5.7
2. The EUT was connected to spectrum analyzer and system simulator via a power divider.
3. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
4. The middle channel for the highest RF power within the transmitting frequency was measured.
5. The conducted spurious emission for the whole frequency range was taken.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
7. Set spectrum analyzer with RMS detector.
8. Taking the record of maximum spurious emission.
9. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
10. The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)
    = P(W)- [43 + 10log(P)] (dB)
    = [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)
    = -13dBm.

3.9 Frequency Stability

3.9.1 Description of Frequency Stability Measurement

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5ppm) of the center frequency.

3.9.2 Test Procedures for Temperature Variation

1. The testing follows ANSI C63.26 section 5.6.4
2. The EUT was set up in the thermal chamber and connected with the system simulator.
3. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
4. With power OFF, the temperature was raised in 10°C step up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

3.9.3 Test Procedures for Voltage Variation

1. The testing follows ANSI C63.26 section 5.6.5
2. The EUT was placed in a temperature chamber at 20±5°C and connected with the system simulator.
3. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value for other than hand carried battery equipment.
4. For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.
5. The variation in frequency was measured for the worst case.

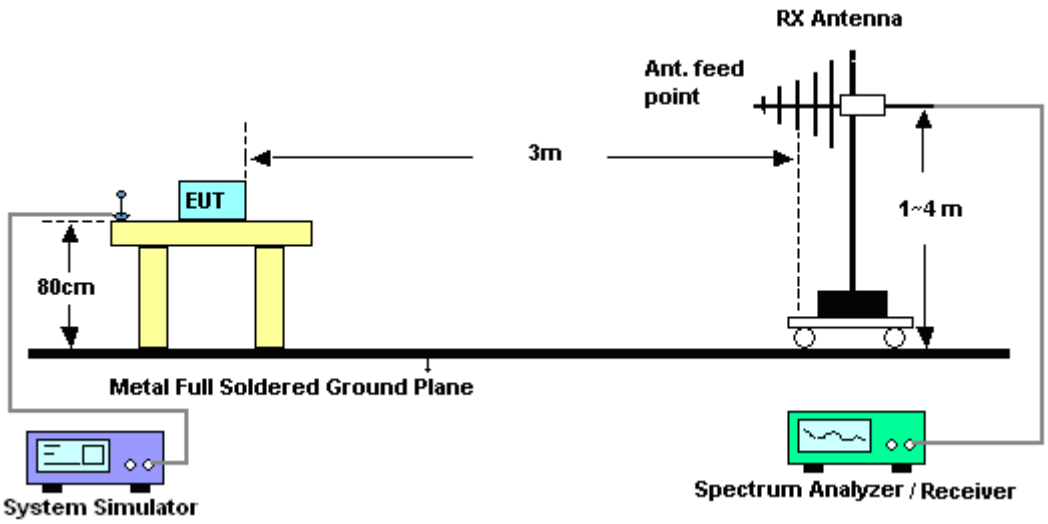
4 Radiated Test Items

4.1 Measuring Instruments

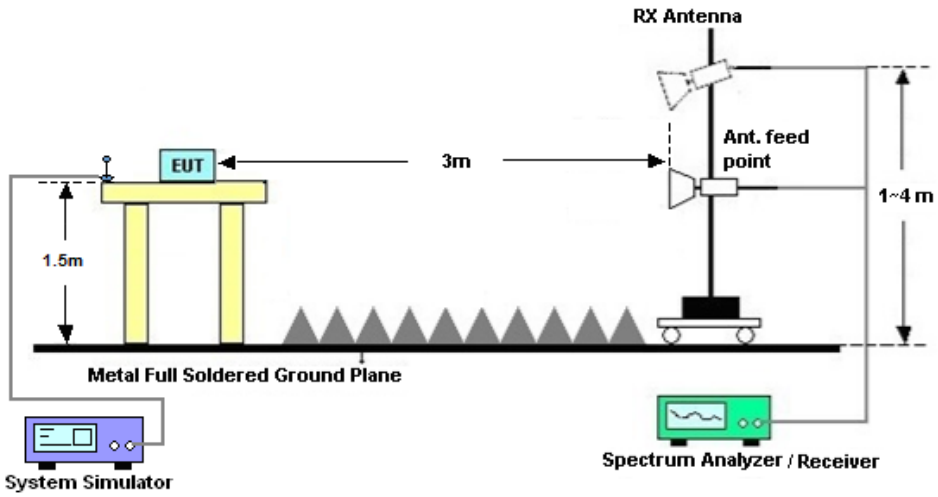
See list of measuring instruments of this test report.

4.2 Test Setup

4.2.1 For radiated test from 30MHz to 1GHz



4.2.2 For radiated test above 1GHz



4.3 Test Result of Radiated Test

Please refer to Appendix B.

4.4 Radiated Spurious Emission

4.4.1 Description of Radiated Spurious Emission

The radiated spurious emission was measured by substitution method according to ANSI C63.26. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

4.4.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.5
2. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
4. The table was rotated 360 degrees to determine the position of the highest spurious emission.
5. The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
6. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
7. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
8. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
9. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
10. EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
11. ERP (dBm) = EIRP - 2.15
12. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
    The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)
    = P(W)- [43 + 10log(P)] (dB)
    = [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)
    = -13dBm.

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Aug. 07, 2018	Oct. 31, 2018	Aug. 06, 2019	Conducted (TH01-KS)
Temperature &humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jun. 27, 2018	Oct. 31, 2018	Jun. 26, 2019	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44GHz	Apr. 17, 2018	Oct. 31, 2018	Apr. 16, 2019	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	Jun. 12, 2018	Oct. 31, 2018	Jun. 11, 2019	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Jan. 21, 2018	Oct. 31, 2018	Jan. 20, 2019	Radiation (03CH05-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA170249	15GHz~40GHz	Feb. 07, 2018	Oct. 31, 2018	Feb. 06, 2019	Radiation (03CH05-KS)
Amplifier	com-power	PA-103A	161069	1MHz ~1000MHz / 32 dB	Apr. 17, 2018	Oct. 31, 2018	Apr. 16, 2019	Radiation (03CH05-KS)
Amplifier	MITEQ	TTA1840-35-HG	1887435	18~40GHz	Feb. 08, 2018	Oct. 31, 2018	Feb. 07, 2019	Radiation (03CH05-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Apr. 17, 2018	Oct. 31, 2018	Apr. 16, 2019	Radiation (03CH05-KS)
Amplifier	Keysight	83017A	MY57280106	500MHz~26.5GHz	Apr. 18, 2018	Oct. 31, 2018	Apr. 17, 2019	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Oct. 31, 2018	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Oct. 31, 2018	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Oct. 31, 2018	NCR	Radiation (03CH05-KS)

NCR: No Calibration Required

6 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Uncertainty of Radiated Emission Measurement (1 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power)

LTE Band 4 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
20	1	0	QPSK	22.76	22.95	23.15
20	1	49		23.04	23.32	23.18
20	1	99		22.76	22.70	22.96
20	50	0		22.04	22.08	22.25
20	50	24		22.13	22.09	22.19
20	50	50		22.10	21.97	22.12
20	100	0		22.05	22.06	22.05
20	1	0	16-QAM	22.30	22.40	22.35
20	1	49		21.90	22.19	22.44
20	1	99		21.51	21.84	21.64
20	50	0		20.86	21.04	21.33
20	50	24		21.17	21.08	21.28
20	50	50		21.03	20.94	21.22
20	100	0		21.09	21.05	21.14
15	1	0	QPSK	22.79	23.00	22.94
15	1	37		22.97	23.20	23.23
15	1	74		22.89	22.87	23.15
15	36	0		21.98	22.14	22.21
15	36	20		22.13	22.07	22.14
15	36	39		22.08	22.02	22.12
15	75	0		22.11	22.11	22.14
15	1	0	16-QAM	21.24	22.23	22.32
15	1	37		21.47	22.36	22.47
15	1	74		21.31	21.80	22.40
15	36	0		21.03	20.89	21.19
15	36	20		21.07	20.95	21.22
15	36	39		21.02	21.00	21.11
15	75	0		20.96	21.09	21.22

LTE Band 4 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
10	1	0	QPSK	22.82	22.91	23.03
10	1	25		22.99	22.93	23.17
10	1	49		22.80	22.78	23.01
10	25	0		21.93	22.05	22.20
10	25	12		22.05	22.13	22.21
10	25	25		22.15	22.05	22.19
10	50	0		22.02	22.06	22.12
10	1	0	16-QAM	21.72	21.44	21.57
10	1	25		21.60	21.55	22.04
10	1	49		21.42	21.61	21.89
10	25	0		20.80	20.97	21.18
10	25	12		20.92	21.10	21.20
10	25	25		21.01	21.03	21.08
10	50	0		21.10	21.03	21.22
5	1	0	QPSK	22.78	22.94	23.09
5	1	12		22.95	22.80	23.40
5	1	24		22.98	22.68	23.20
5	12	0		21.90	22.00	22.17
5	12	7		21.93	22.03	22.09
5	12	13		21.93	22.01	22.17
5	25	0		21.95	22.03	22.17
5	1	0	16-QAM	21.43	22.18	21.63
5	1	12		21.49	21.78	21.85
5	1	24		21.68	21.46	21.66
5	12	0		20.77	20.89	20.90
5	12	7		20.77	20.92	20.89
5	12	13		20.72	20.83	20.99
5	25	0		20.92	20.92	21.18

LTE Band 4 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
3	1	0	QPSK	22.85	23.05	22.88
3	1	8		22.70	22.74	22.68
3	1	14		22.67	22.79	22.93
3	8	0		21.80	22.03	21.83
3	8	4		21.87	22.08	22.01
3	8	7		21.86	21.97	21.92
3	15	0		21.81	22.04	21.98
3	1	0	16-QAM	22.04	22.09	21.46
3	1	8		21.91	21.95	21.56
3	1	14		21.66	21.93	21.55
3	8	0		20.84	20.85	20.90
3	8	4		20.92	20.90	21.14
3	8	7		20.83	20.77	20.84
3	15	0		20.94	20.94	21.08
1.4	1	0	QPSK	22.71	22.83	22.88
1.4	1	3		22.82	22.81	22.98
1.4	1	5		22.62	22.75	22.96
1.4	3	0		22.87	22.97	23.15
1.4	3	1		22.91	23.10	23.17
1.4	3	3		22.90	22.98	23.11
1.4	6	0		21.81	22.11	22.08
1.4	1	0	16-QAM	22.02	21.61	22.26
1.4	1	3		22.10	21.83	22.27
1.4	1	5		22.08	21.41	22.20
1.4	3	0		21.83	21.95	21.94
1.4	3	1		21.85	21.90	21.89
1.4	3	3		21.76	21.82	21.91
1.4	6	0		20.70	20.77	20.92

EIRP

LTE Band 4 (GT - LC = -2.00 dBi) QPSK									
Bandwidth	1.4M			3M			5M		
Channel	19957	20175	20393	19965	20175	20385	19975	20175	20375
	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)
Frequency (MHz)	1710.7	1732.5	1754.3	1711.5	1732.5	1753.5	1712.5	1732.5	1752.5
Conducted Power (dBm)	22.91	23.10	23.17	22.85	23.05	22.88	22.95	22.80	23.40
Conducted Power (Watts)	0.1954	0.2042	0.2075	0.1928	0.2018	0.1941	0.1972	0.1905	0.2188
EIRP(dBm)	20.91	21.10	21.17	20.85	21.05	20.88	20.95	20.80	21.40
EIRP(Watts)	0.1233	0.1288	0.1309	0.1216	0.1274	0.1225	0.1245	0.1202	0.1380

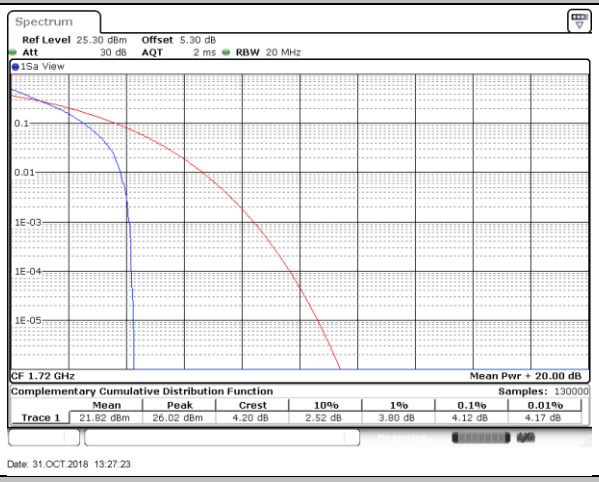
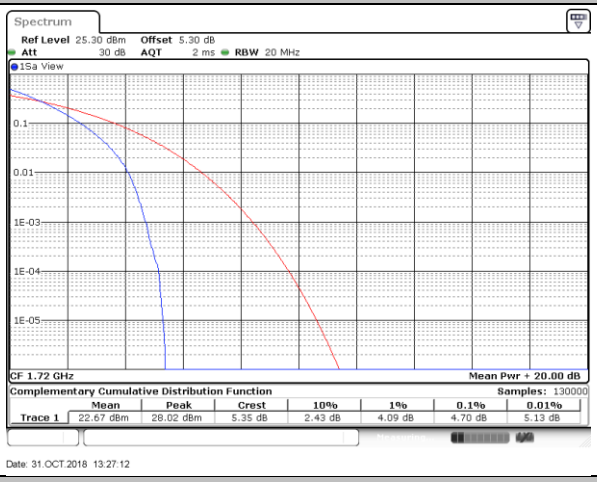
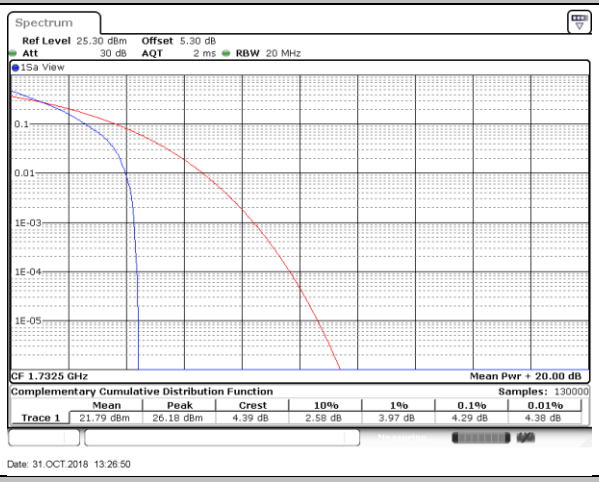
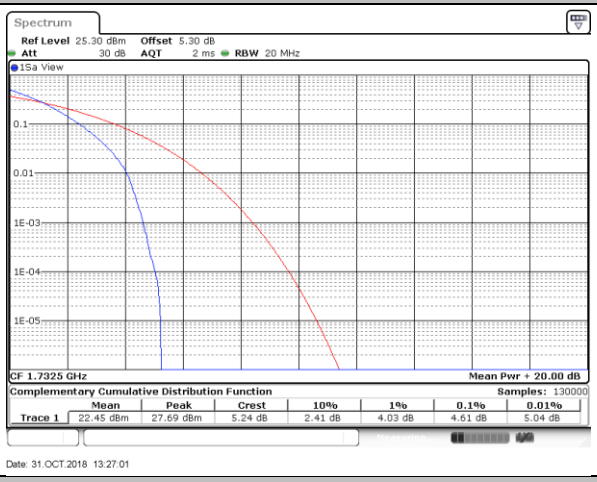
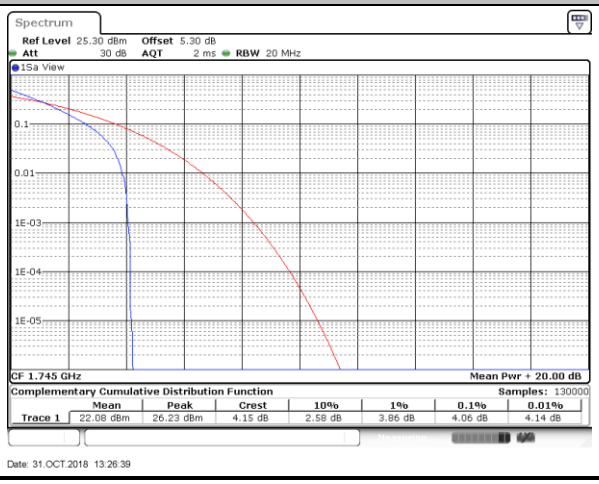
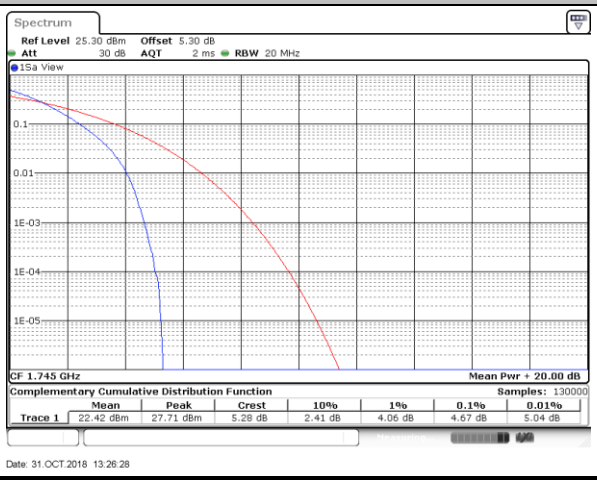
LTE Band 4 (GT - LC = -2.00 dBi) QPSK									
Bandwidth	10M			15M			20M		
Channel	20000	20175	20350	20025	20175	20325	20050	20175	20300
	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)
Frequency (MHz)	1715	1732.5	1750	1717.5	1732.5	1747.5	1720	1732.5	1745
Conducted Power (dBm)	22.99	22.93	23.17	22.97	23.20	23.23	23.04	23.32	23.18
Conducted Power (Watts)	0.1991	0.1963	0.2075	0.1982	0.2089	0.2104	0.2014	0.2148	0.2080
EIRP(dBm)	20.99	20.93	21.17	20.97	21.20	21.23	21.04	21.32	21.18
EIRP(Watts)	0.1256	0.1239	0.1309	0.1250	0.1318	0.1327	0.1271	0.1355	0.1312

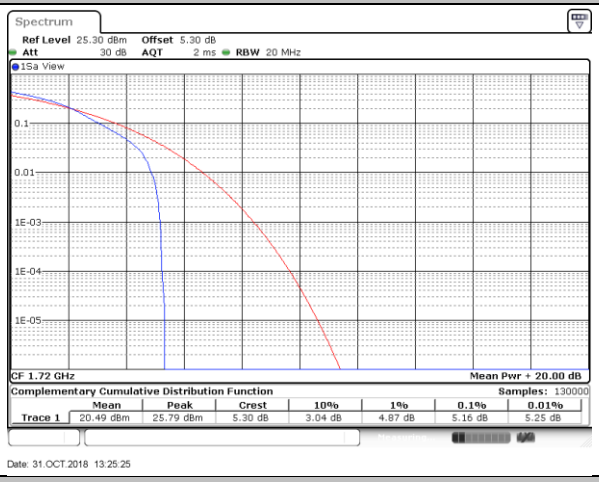
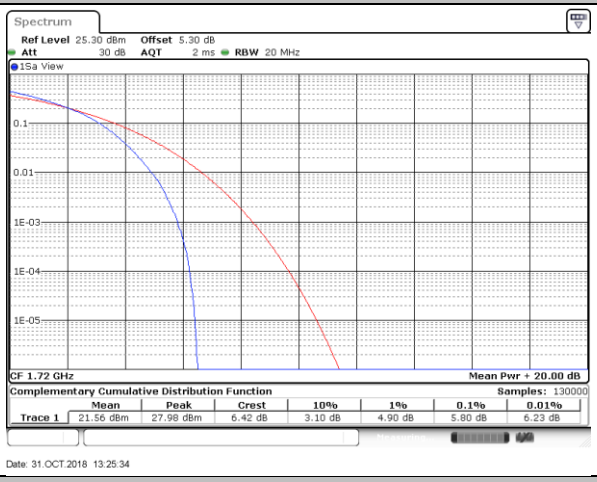
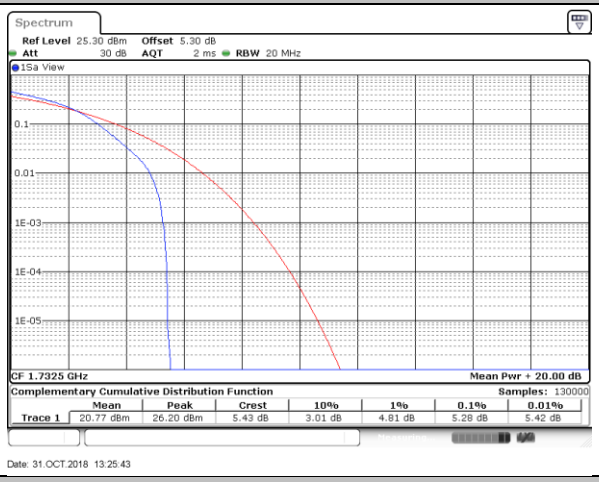
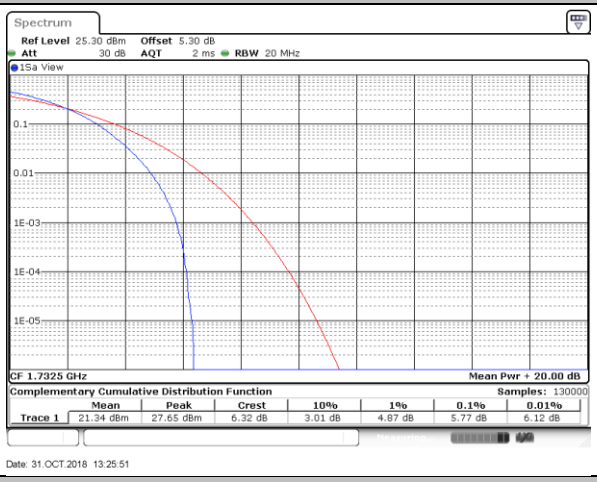
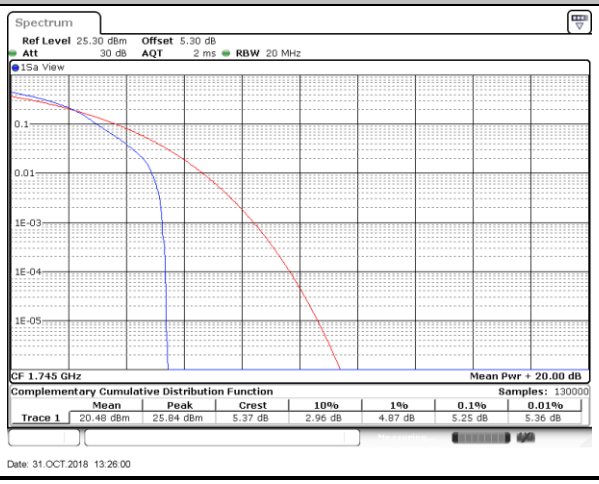
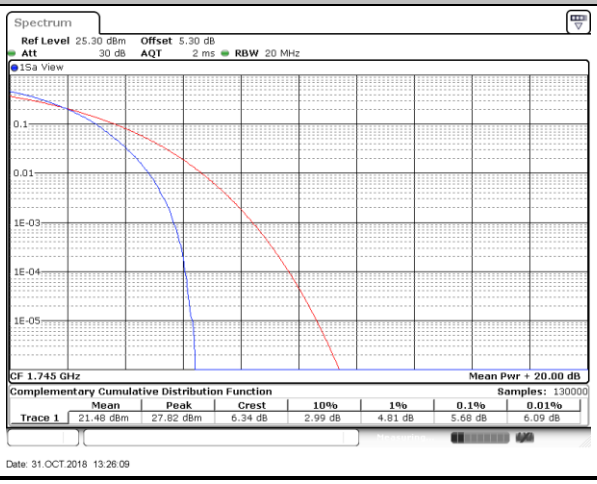
LTE Band 4 (GT - LC = -2.00 dBi) 16QAM									
Bandwidth	1.4M			3M			5M		
Channel	19957	20175	20393	19965	20175	20385	19975	20175	20375
	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)
Frequency (MHz)	1710.7	1732.5	1754.3	1711.5	1732.5	1753.5	1712.5	1732.5	1752.5
Conducted Power (dBm)	22.10	21.83	22.27	22.04	22.09	21.46	21.43	22.18	21.63
Conducted Power (Watts)	0.1622	0.1524	0.1687	0.1600	0.1618	0.1400	0.1390	0.1652	0.1455
EIRP(dBm)	20.10	19.83	20.27	20.04	20.09	19.46	19.43	20.18	19.63
EIRP(Watts)	0.1023	0.0962	0.1064	0.1009	0.1021	0.0883	0.0877	0.1042	0.0918

LTE Band 4 (GT - LC = -2.00 dBi) 16QAM									
Bandwidth	10M			15M			20M		
Channel	20000	20175	20350	20025	20175	20325	20050	20175	20300
	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)	(Low)	(Mid)	(High)
Frequency (MHz)	1715	1732.5	1750	1717.5	1732.5	1747.5	1720	1732.5	1745
Conducted Power (dBm)	21.60	21.55	22.04	21.47	22.36	22.47	21.90	22.19	22.44
Conducted Power (Watts)	0.1445	0.1429	0.1600	0.1403	0.1722	0.1766	0.1549	0.1656	0.1754
EIRP(dBm)	19.60	19.55	20.04	19.47	20.36	20.47	19.90	20.19	20.44
EIRP(Watts)	0.0912	0.0902	0.1009	0.0885	0.1086	0.1114	0.0977	0.1045	0.1107

Peak-to-Average Ratio

Mode	LTE Band 4 / 20MHz				
Mod.	QPSK		16QAM		Limit: 13dB
RB Size	1RB	Full RB	1RB	Full RB	Result
Lowest CH	4.12	4.7	5.16	5.8	PASS
Middle CH	4.29	4.61	5.28	5.77	
Highest CH	4.06	4.67	5.25	5.68	

LTE Band 4 / 20MHz / QPSK	
Lowest Channel / 1RB	**Lowest Channel / Full RB**
	
Middle Channel / 1RB	**Middle Channel / Full RB**
	
Highest Channel / 1RB	**Highest Channel / Full RB**
	

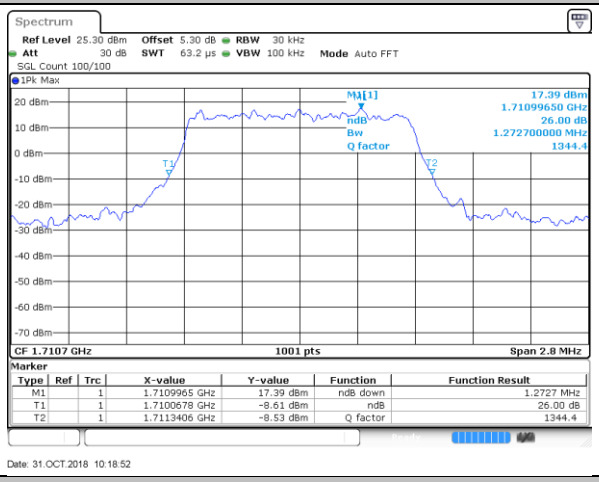
LTE Band 4 / 20MHz / 16QAM	
Lowest Channel / 1RB	**Lowest Channel / Full RB**
	
Middle Channel / 1RB	**Middle Channel / Full RB**
	
Highest Channel / 1RB	**Highest Channel / Full RB**
	

26dB Bandwidth

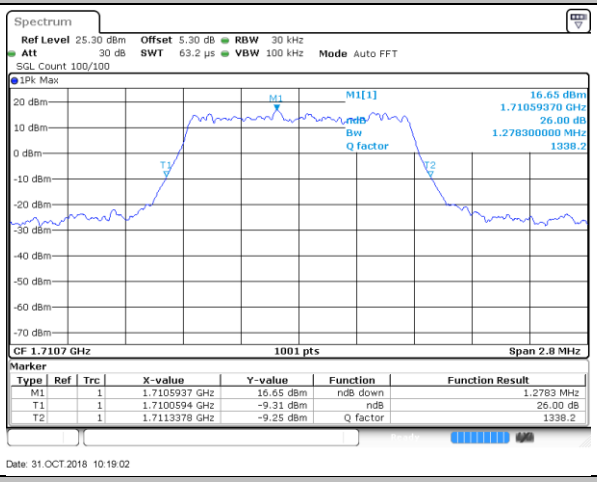
Mode	LTE Band 4 : 26dB BW(MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	1.273	1.278	3.015	3.009	4.995	4.935	10.01	9.83	14.326	14.386	20.18	20.1
Middle CH	1.287	1.262	3.009	3.039	4.935	4.985	9.81	9.87	14.356	14.146	20.3	20.14
Highest CH	1.267	1.264	2.979	3.009	4.875	4.905	9.91	9.77	14.266	14.326	20.06	20.14

LTE Band 4

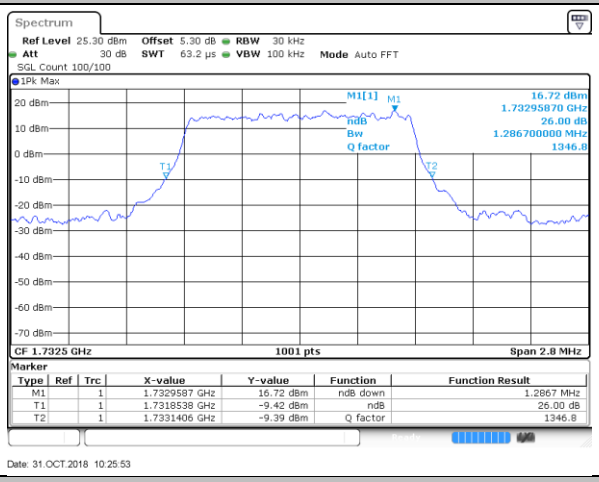
Lowest Channel / 1.4MHz / QPSK



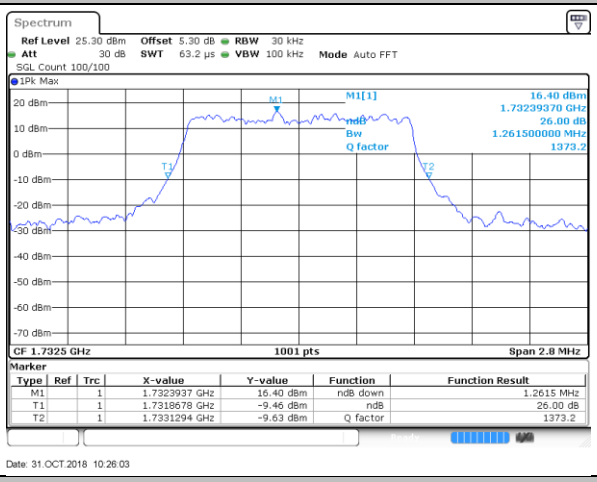
Lowest Channel / 1.4MHz / 16QAM



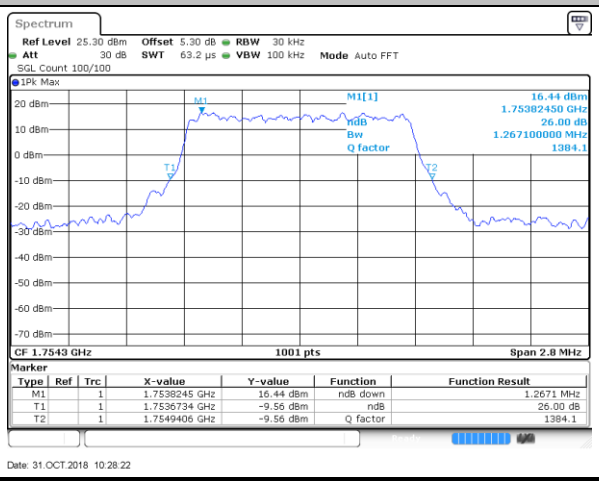
Middle Channel / 1.4MHz / QPSK



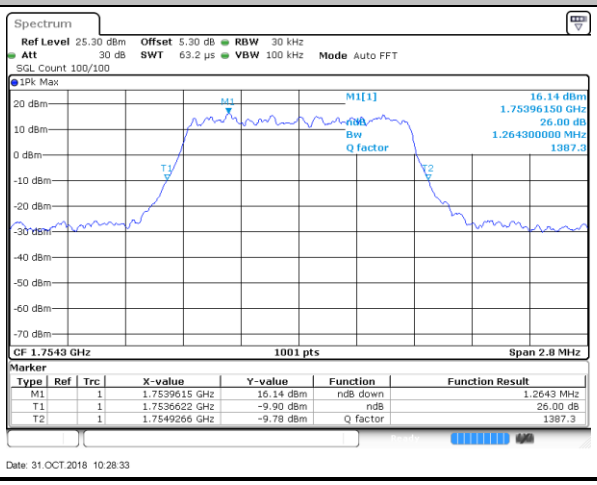
Middle Channel / 1.4MHz / 16QAM



Highest Channel / 1.4MHz / QPSK

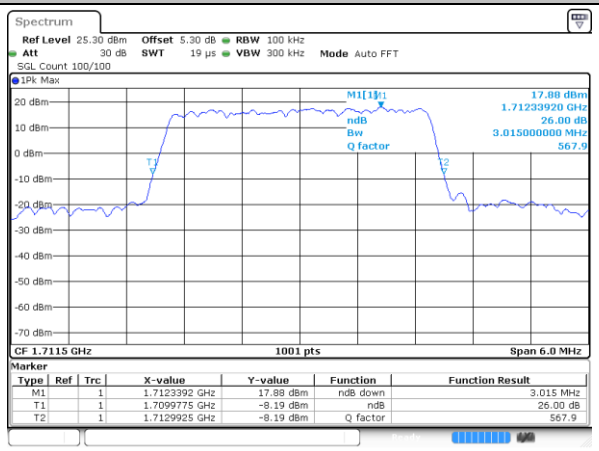


Highest Channel / 1.4MHz / 16QAM

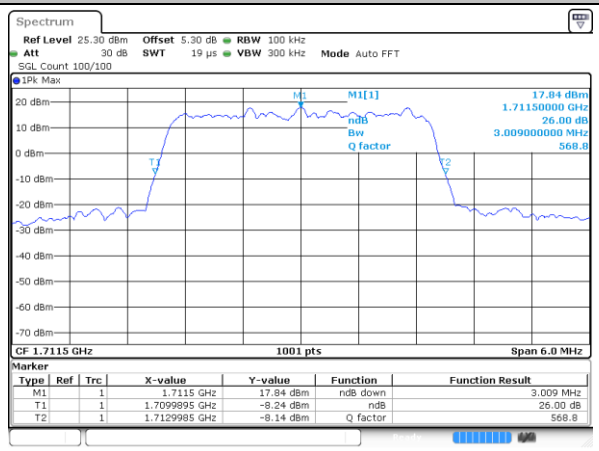


LTE Band 4

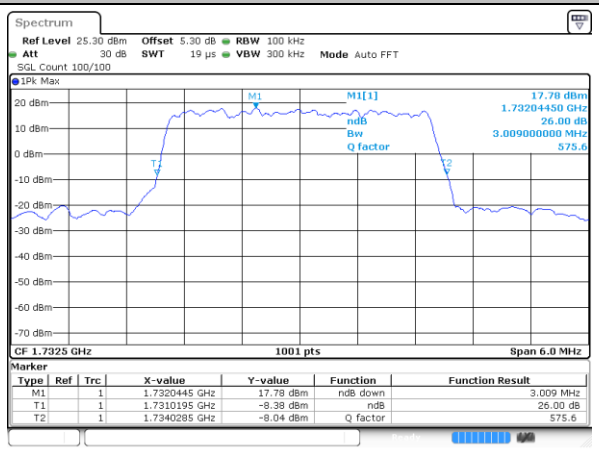
Lowest Channel / 3MHz / QPSK



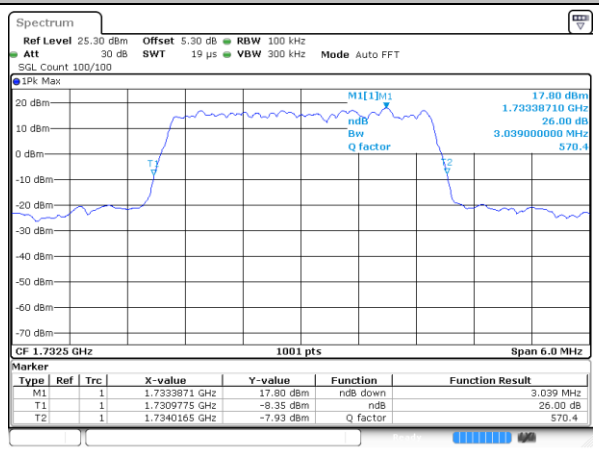
Lowest Channel / 3MHz / 16QAM



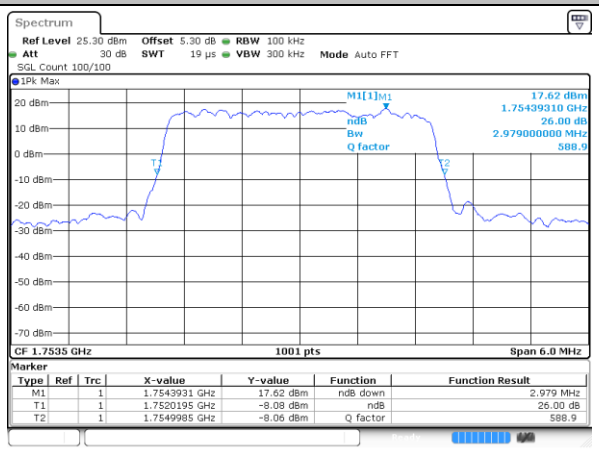
Middle Channel / 3MHz / QPSK



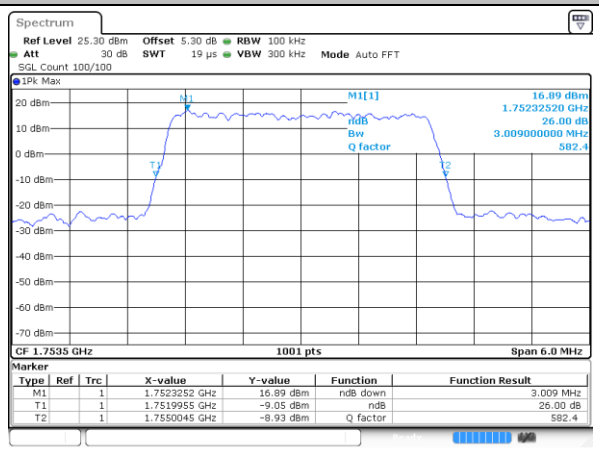
Middle Channel /3MHz / 16QAM



Highest Channel /3MHz / QPSK

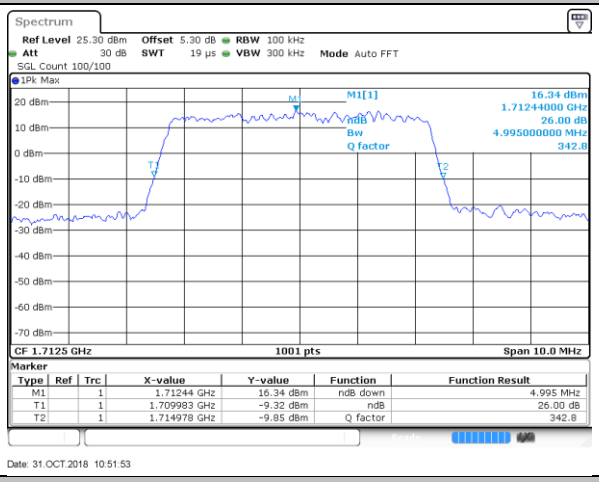


Highest Channel /3MHz / 16QAM

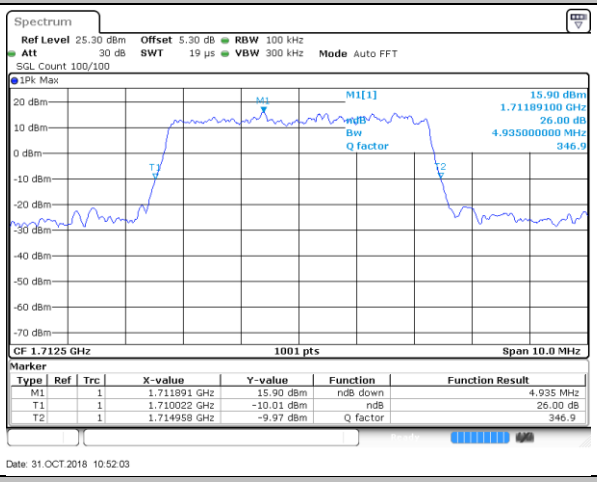


LTE Band 4

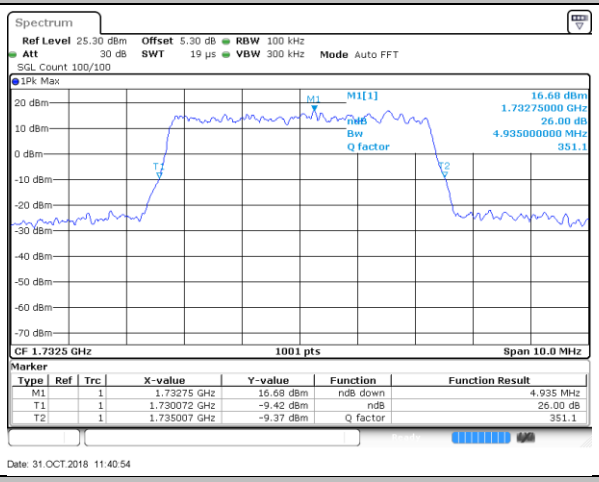
Lowest Channel / 5MHz / QPSK



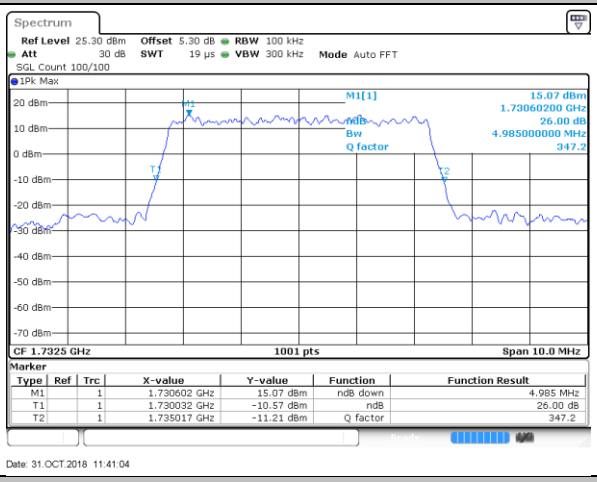
Lowest Channel / 5MHz / 16QAM



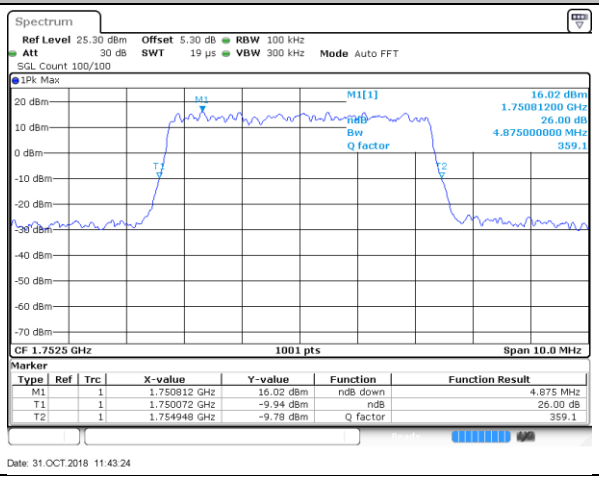
Middle Channel / 5MHz / QPSK



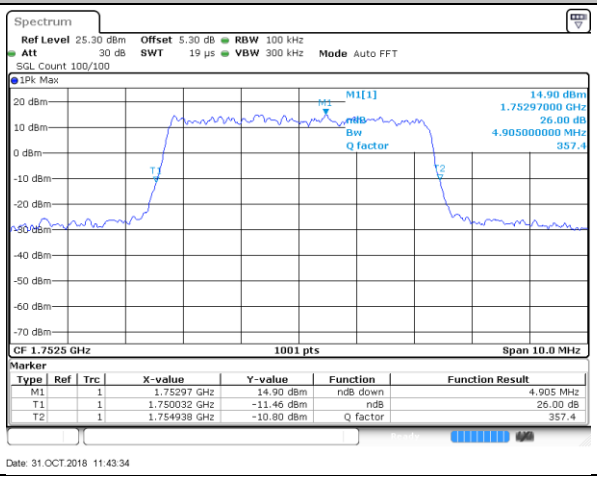
Middle Channel / 5MHz / 16QAM



Highest Channel / 5MHz / QPSK

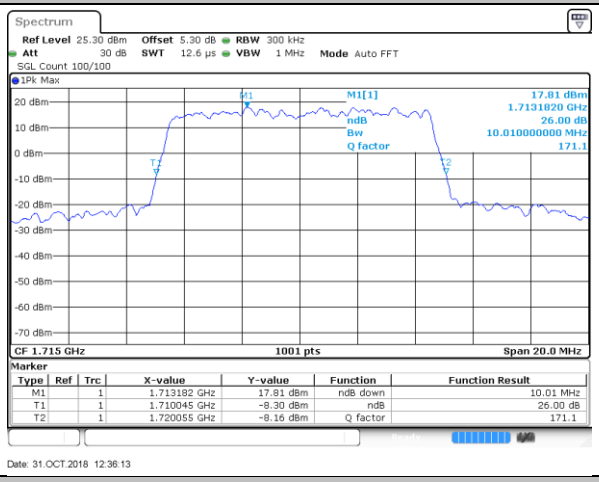


Highest Channel / 5MHz / 16QAM

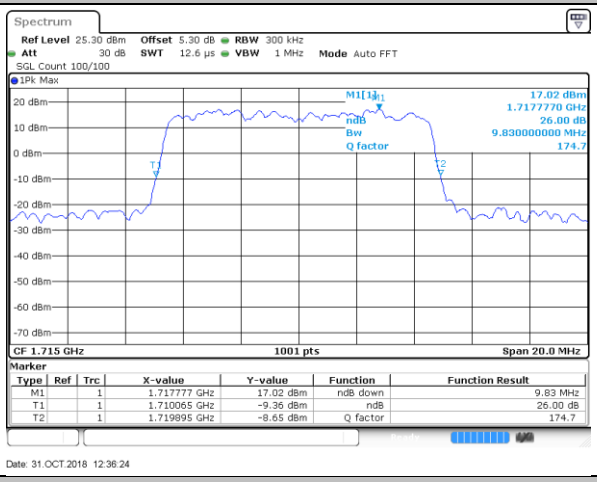


LTE Band 4

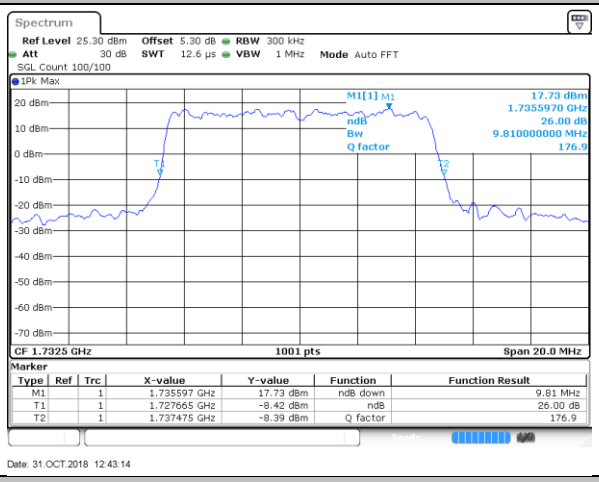
Lowest Channel / 10MHz / QPSK



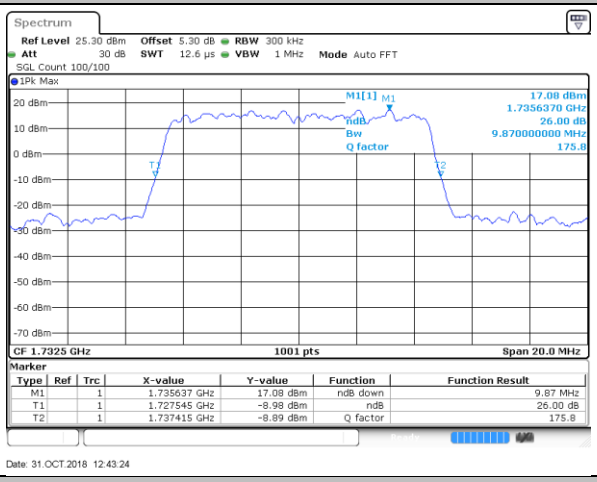
Lowest Channel / 10MHz / 16QAM



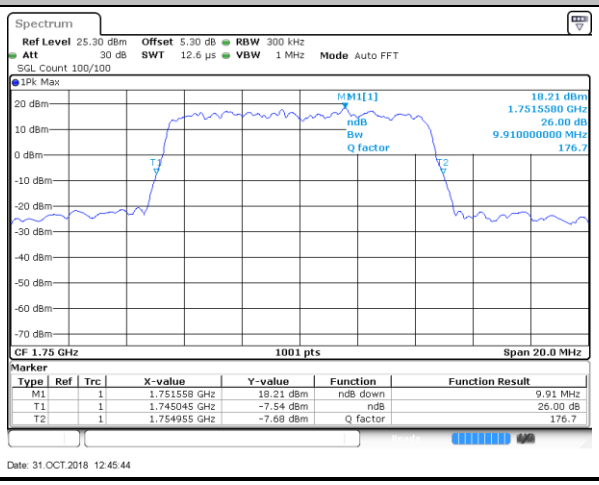
Middle Channel / 10MHz / QPSK



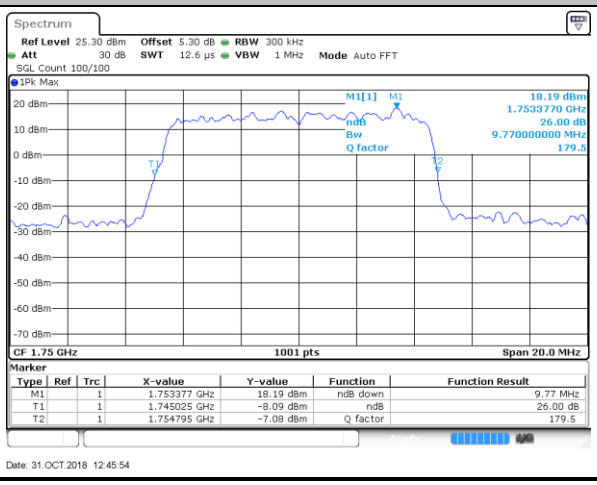
Middle Channel / 10MHz / 16QAM



Highest Channel / 10MHz / QPSK

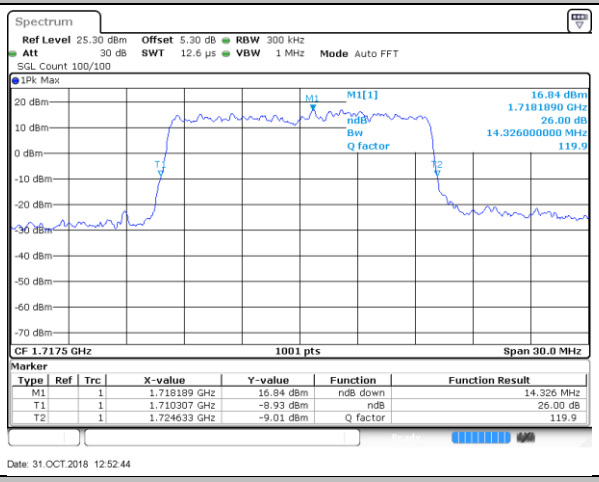


Highest Channel / 10MHz / 16QAM

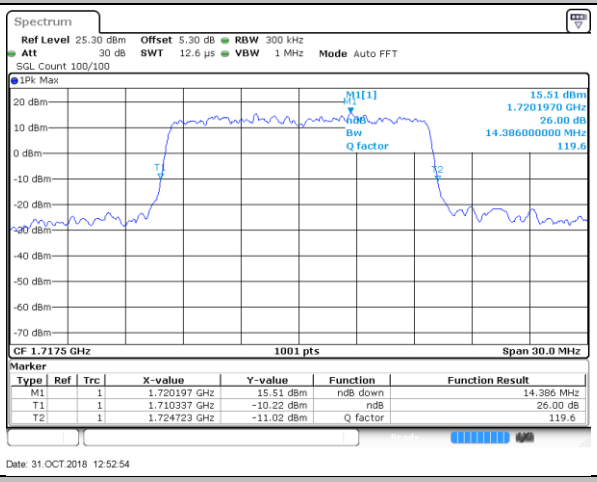


LTE Band 4

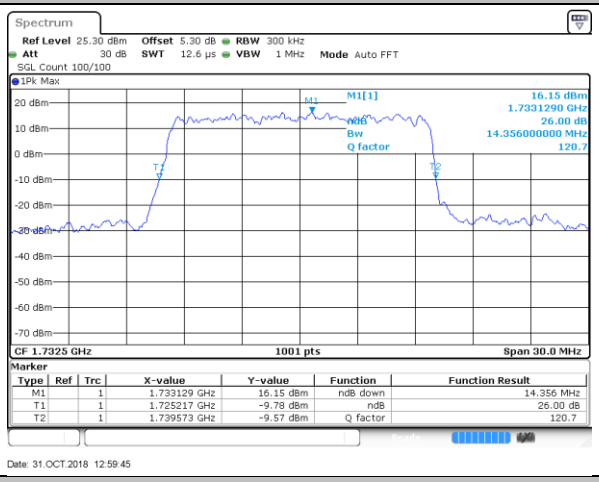
Lowest Channel / 15MHz / QPSK



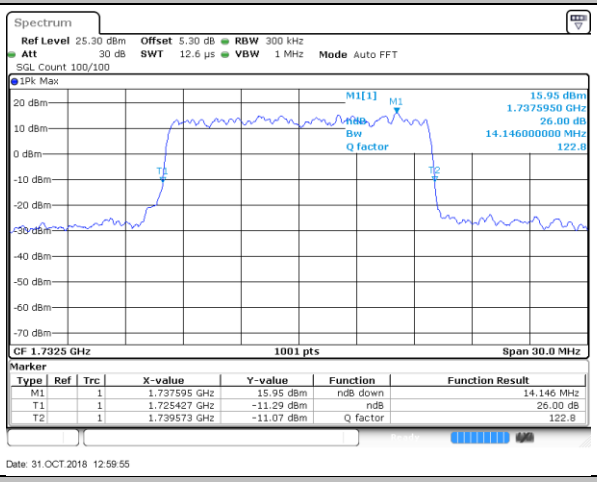
Lowest Channel / 15MHz / 16QAM



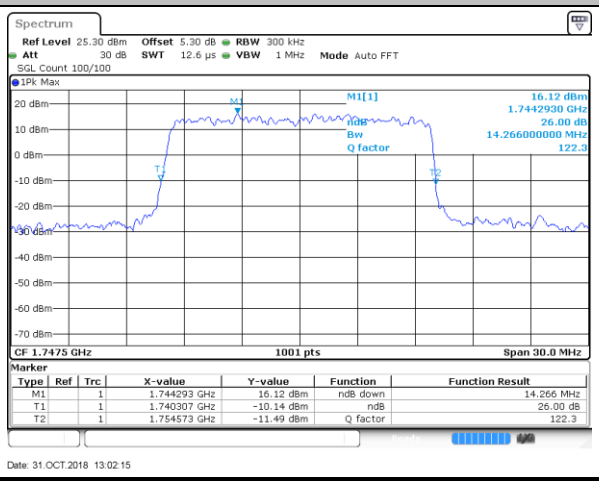
Middle Channel / 15MHz / QPSK



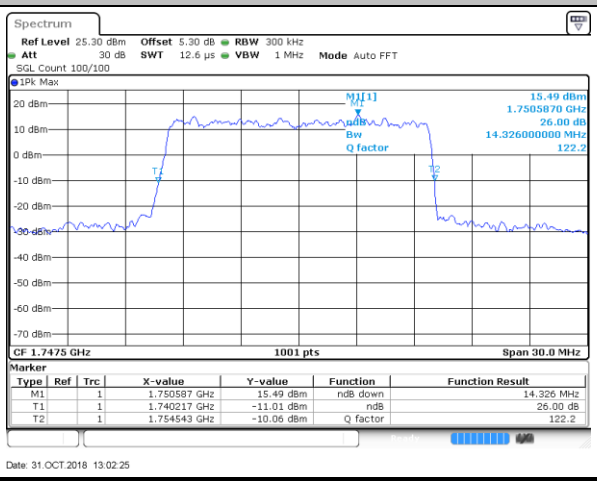
Middle Channel / 15MHz / 16QAM



Highest Channel / 15MHz / QPSK

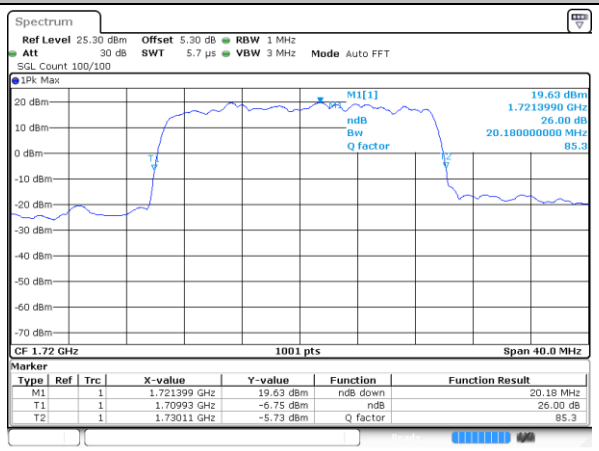


Highest Channel / 15MHz / 16QAM

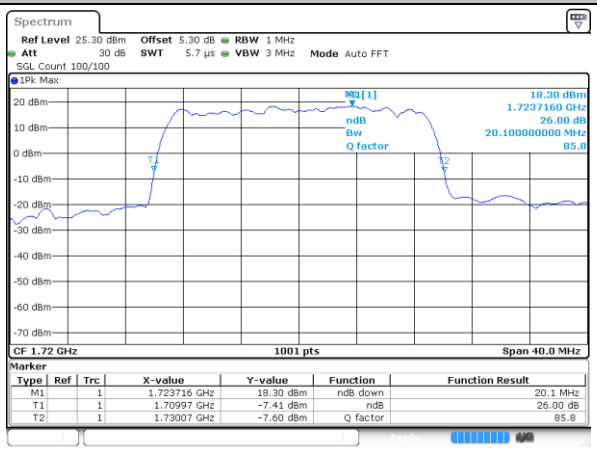


LTE Band 4

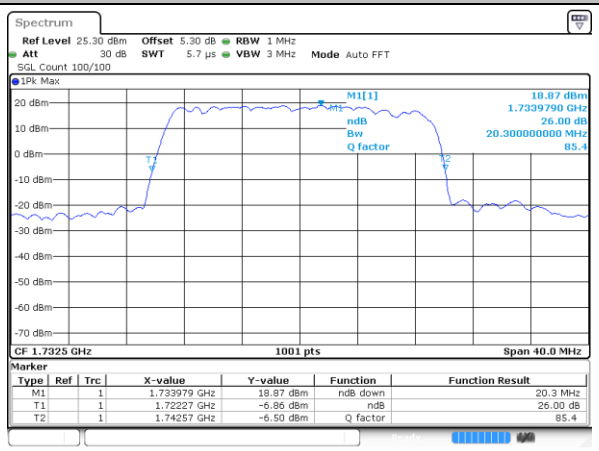
Lowest Channel / 20MHz / QPSK



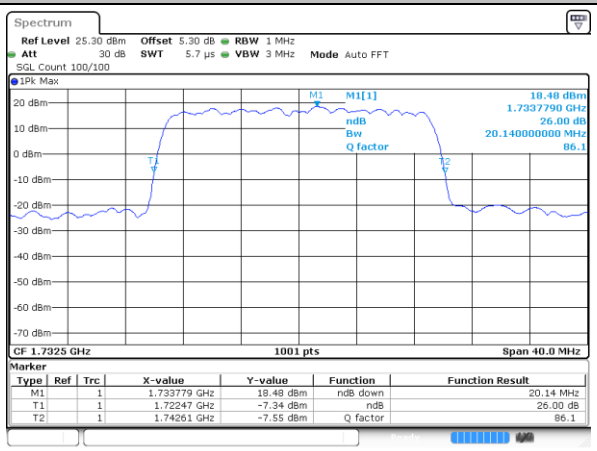
Lowest Channel / 20MHz / 16QAM



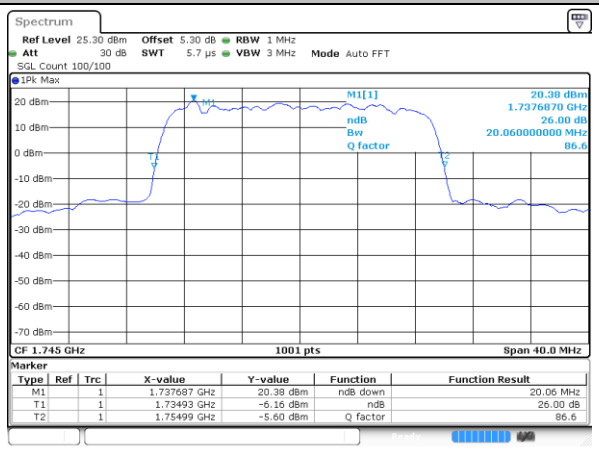
Middle Channel / 20MHz / QPSK



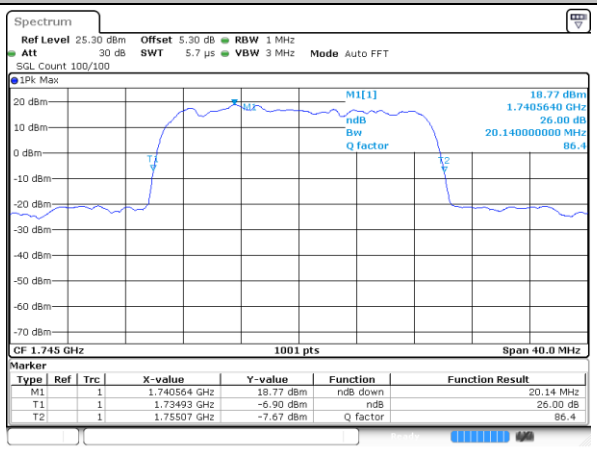
Middle Channel / 20MHz / 16QAM



Highest Channel / 20MHz / QPSK



Highest Channel / 20MHz / 16QAM

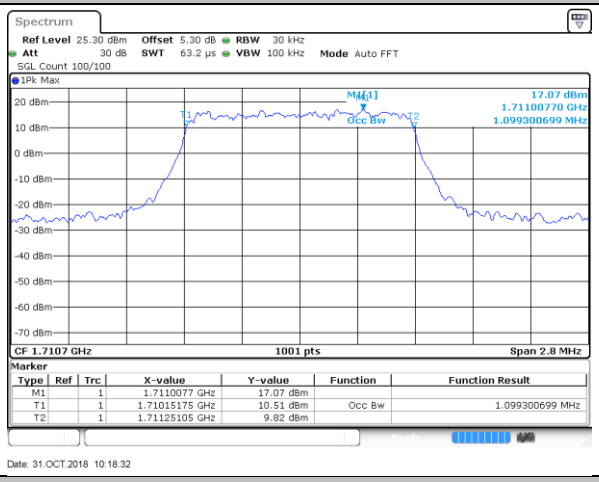


Occupied Bandwidth

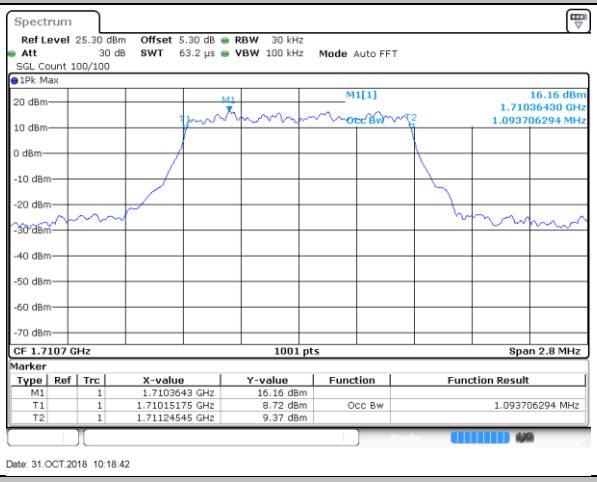
Mode	LTE Band 4 : 99%OBW(MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	1.1	1.09	2.72	2.72	4.49	4.5	9.03	9.01	13.4	13.43	18.22	18.38
Middle CH	1.08	1.09	2.72	2.7	4.49	4.48	8.99	9.01	13.34	13.37	18.22	18.18
Highest CH	1.09	1.1	2.72	2.71	4.49	4.52	8.93	8.95	13.37	13.37	18.3	18.26

LTE Band 4

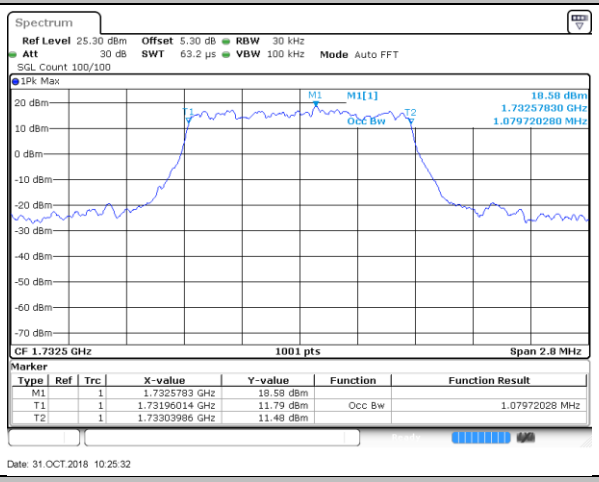
Lowest Channel / 1.4MHz / QPSK



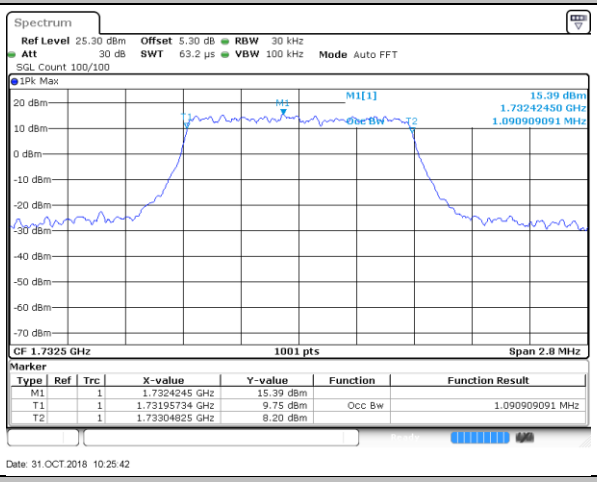
Lowest Channel / 1.4MHz / 16QAM



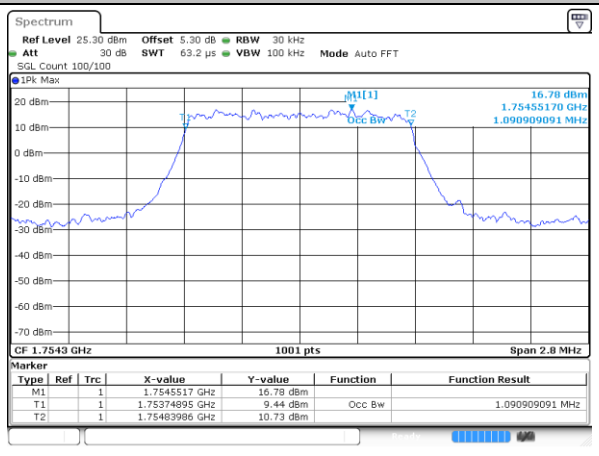
Middle Channel / 1.4MHz / QPSK



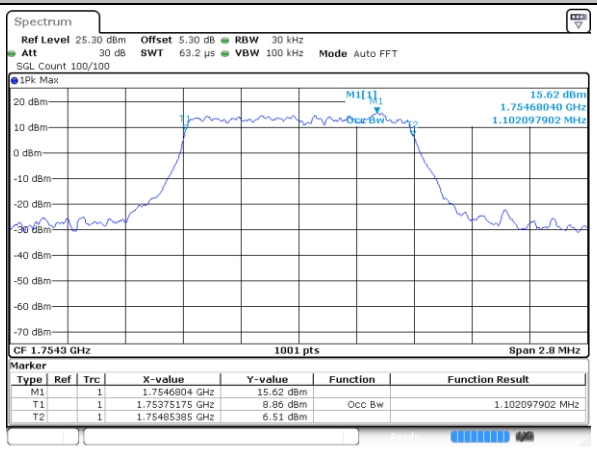
Middle Channel / 1.4MHz / 16QAM



Highest Channel / 1.4MHz / QPSK

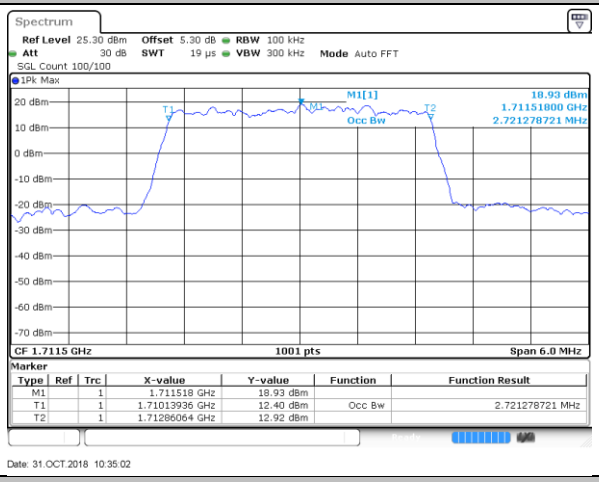


Highest Channel / 1.4MHz / 16QAM

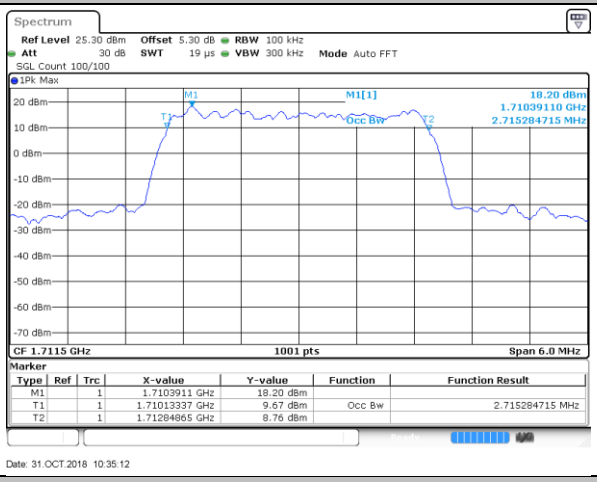


LTE Band 4

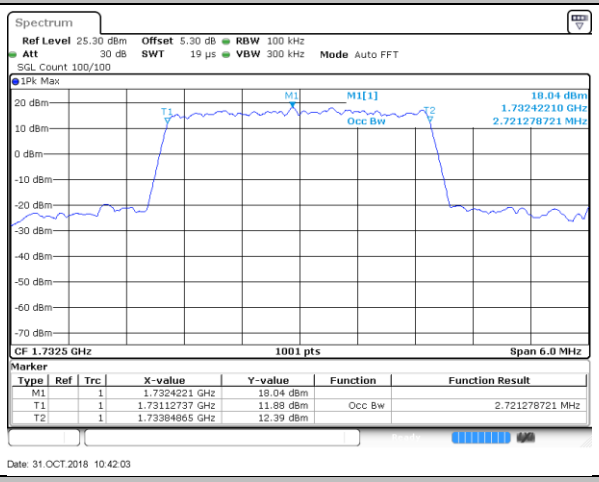
Lowest Channel / 3MHz / QPSK



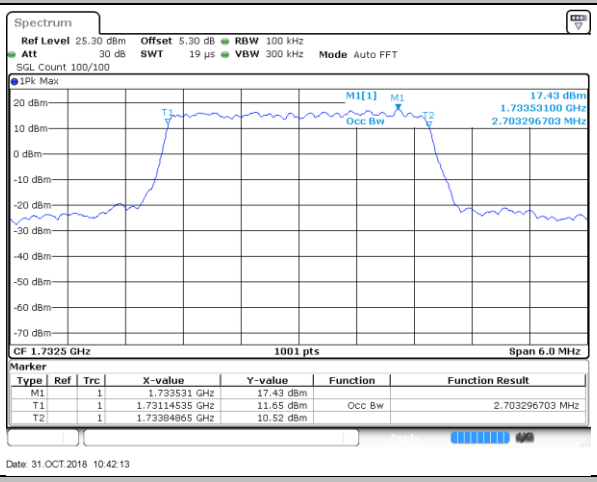
Lowest Channel / 3MHz / 16QAM



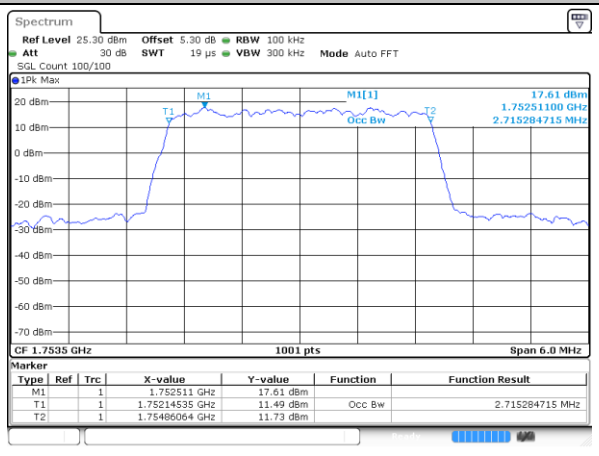
Middle Channel / 3MHz / QPSK



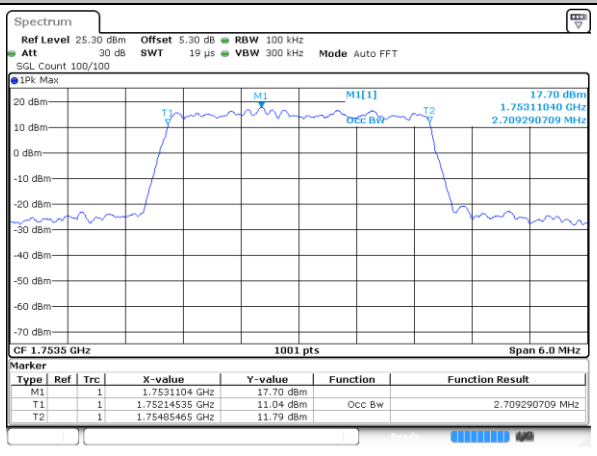
Middle Channel / 3MHz / 16QAM



Highest Channel / 3MHz / QPSK

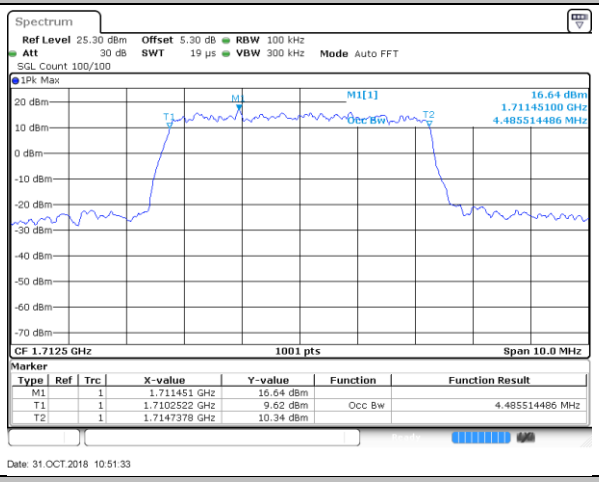


Highest Channel / 3MHz / 16QAM

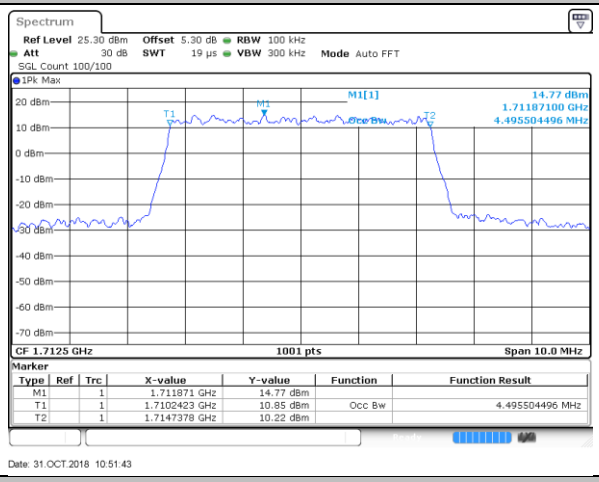


LTE Band 4

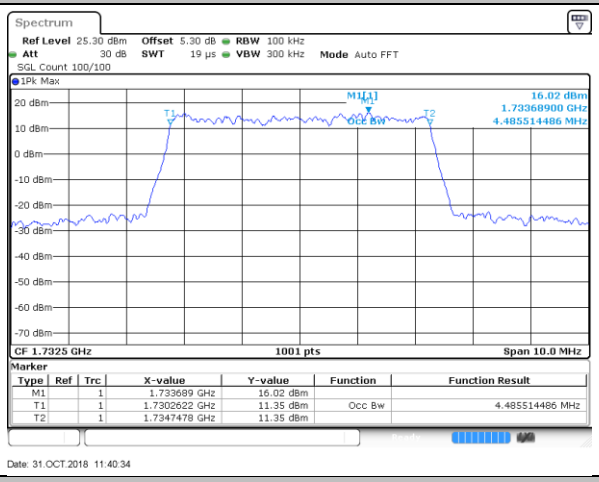
Lowest Channel / 5MHz / QPSK



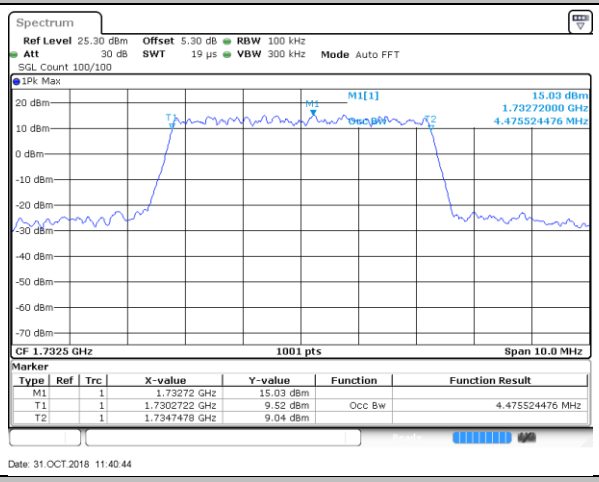
Lowest Channel / 5MHz / 16QAM



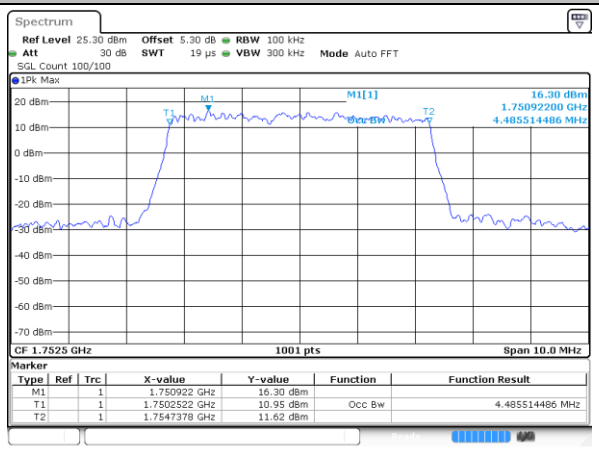
Middle Channel / 5MHz / QPSK



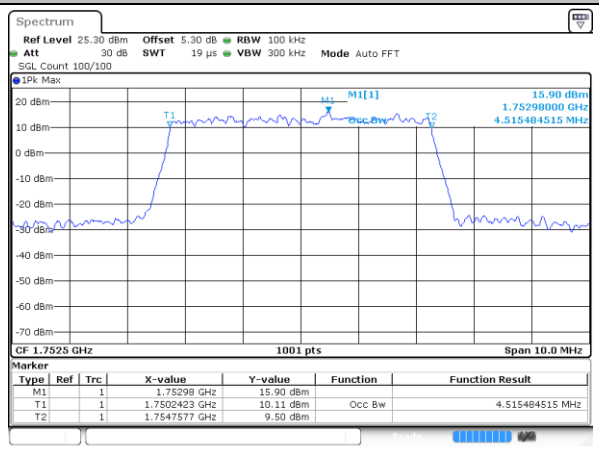
Middle Channel / 5MHz / 16QAM



Highest Channel / 5MHz / QPSK

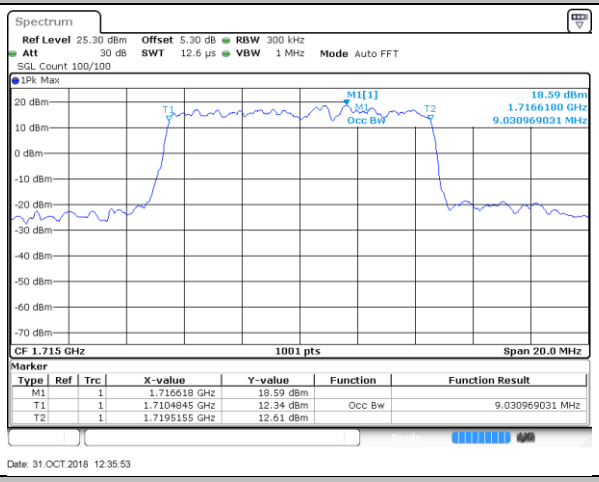


Highest Channel / 5MHz / 16QAM

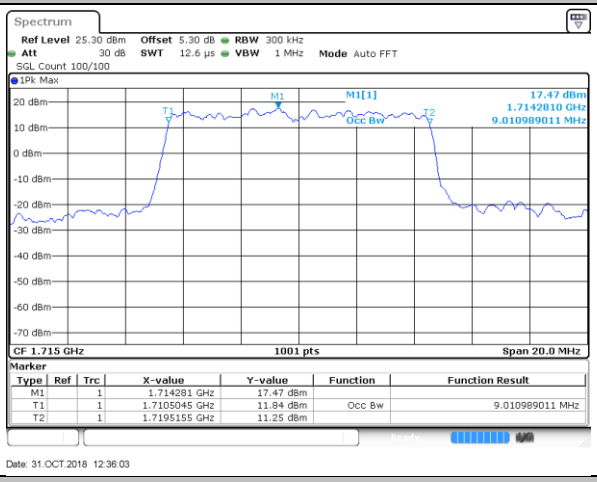


LTE Band 4

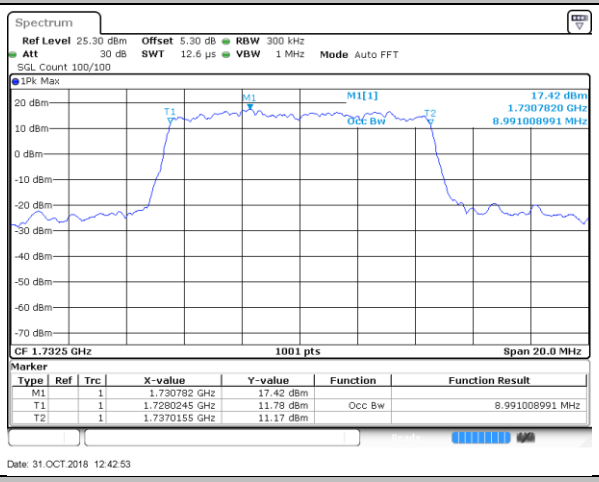
Lowest Channel / 10MHz / QPSK



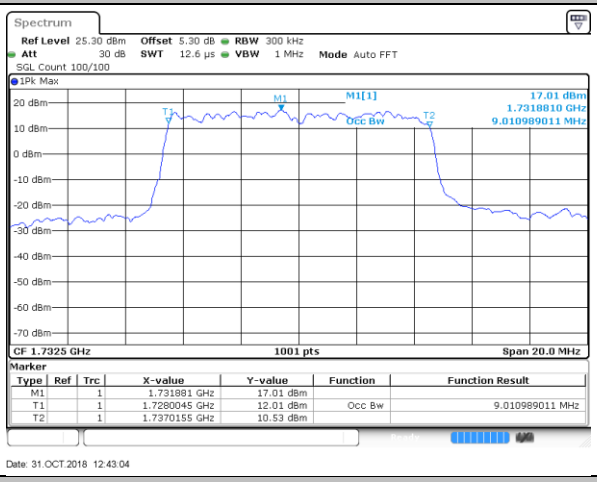
Lowest Channel / 10MHz / 16QAM



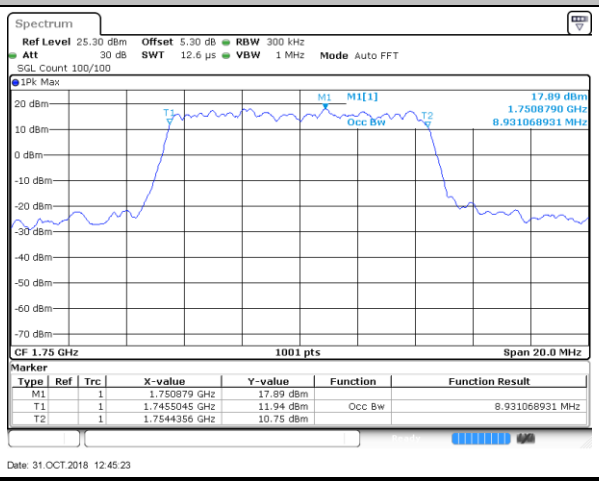
Middle Channel / 10MHz / QPSK



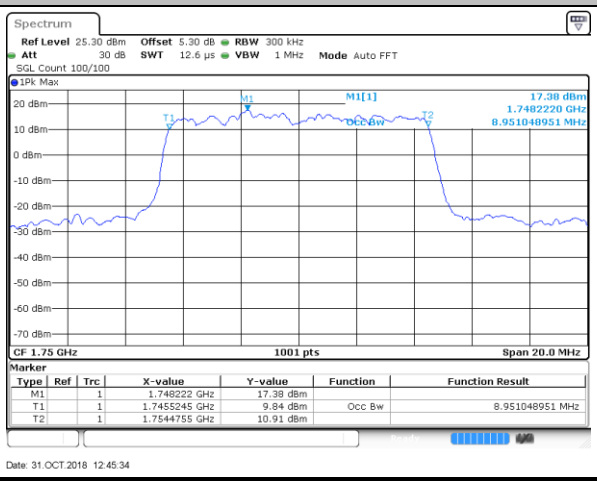
Middle Channel / 10MHz / 16QAM



Highest Channel / 10MHz / QPSK

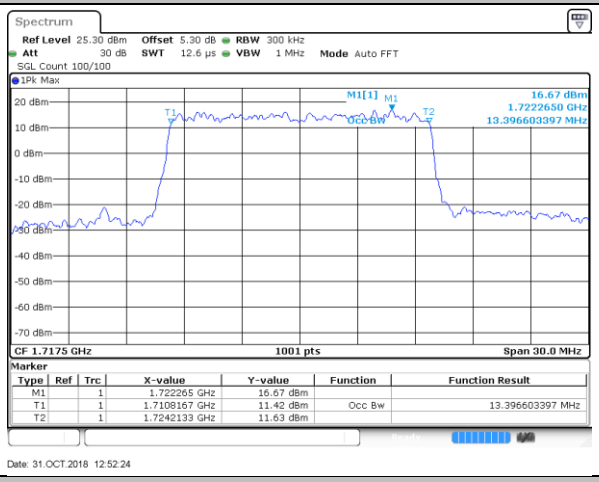


Highest Channel / 10MHz / 16QAM

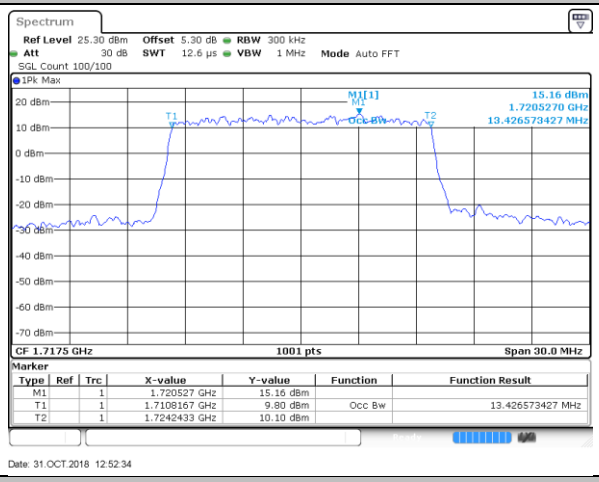


LTE Band 4

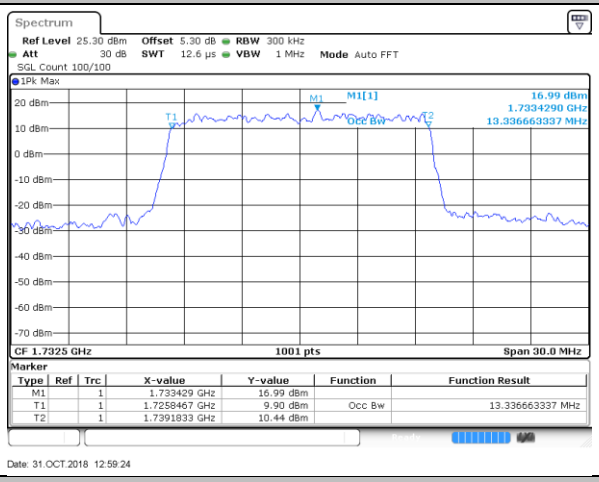
Lowest Channel / 15MHz / QPSK



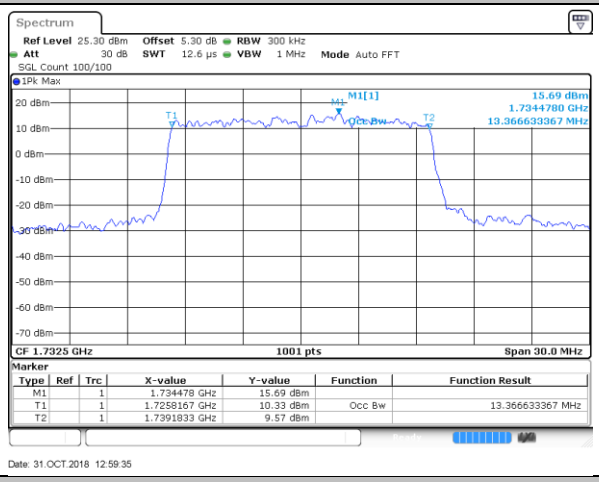
Lowest Channel / 15MHz / 16QAM



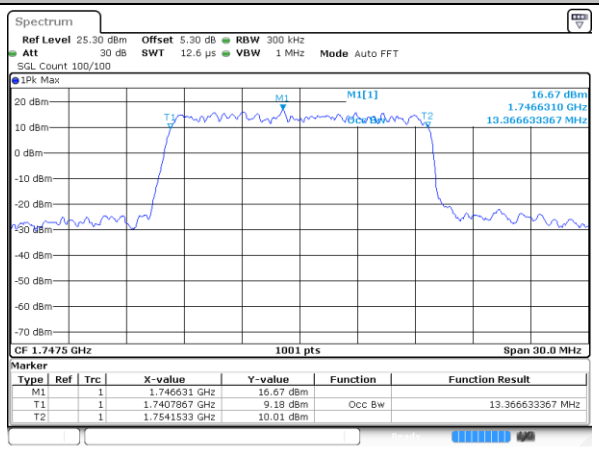
Middle Channel / 15MHz / QPSK



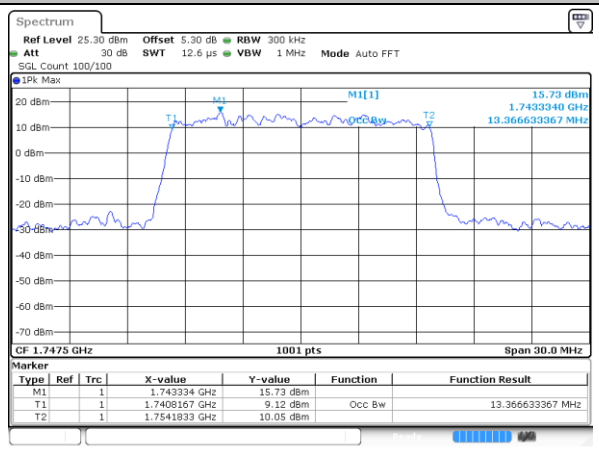
Middle Channel / 15MHz / 16QAM



Highest Channel / 15MHz / QPSK

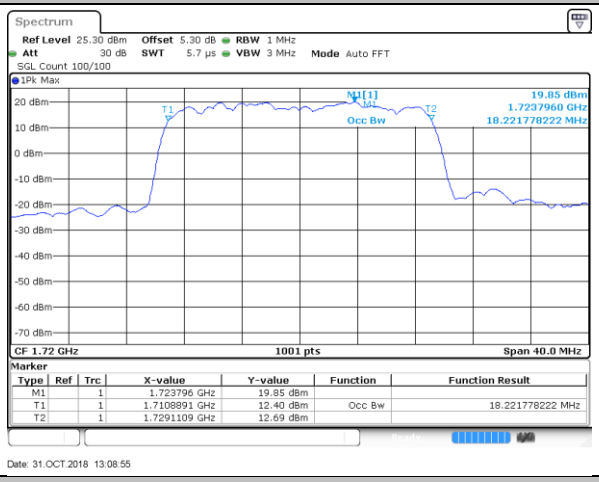


Highest Channel / 15MHz / 16QAM

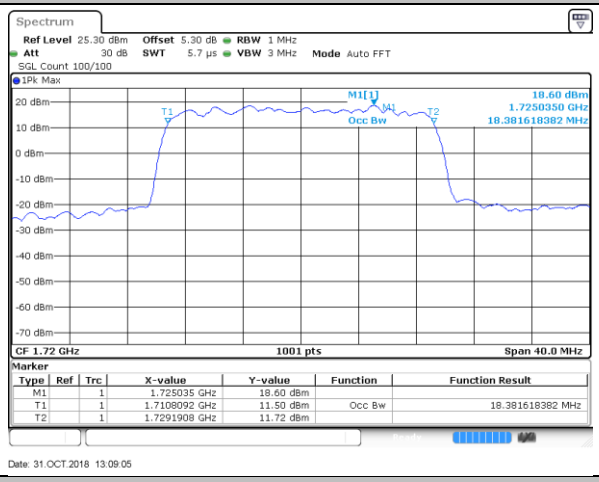


LTE Band 4

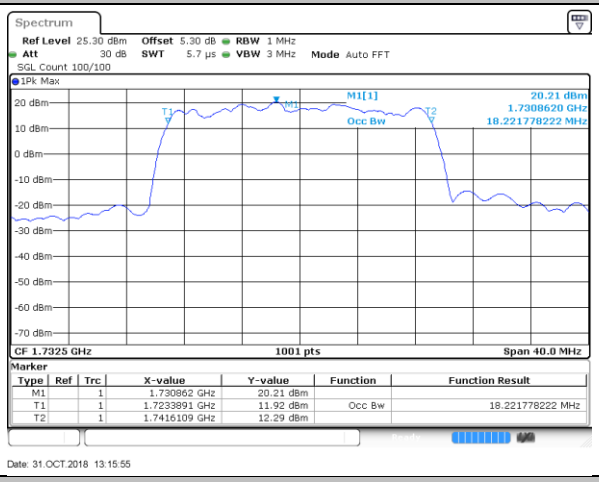
Lowest Channel / 20MHz / QPSK



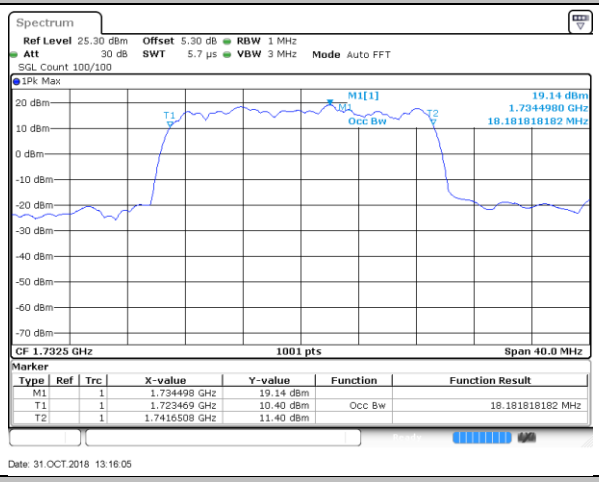
Lowest Channel / 20MHz / 16QAM



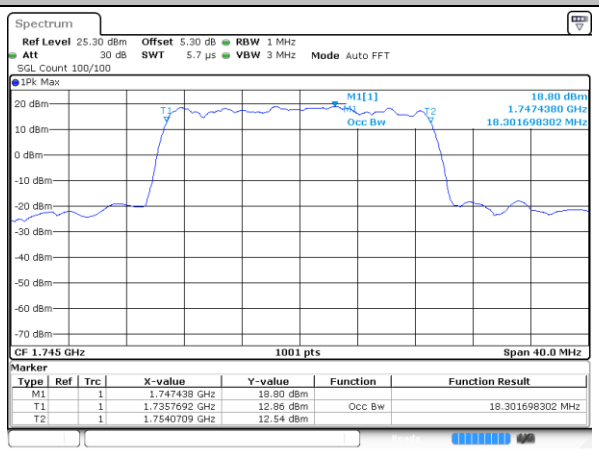
Middle Channel / 20MHz / QPSK



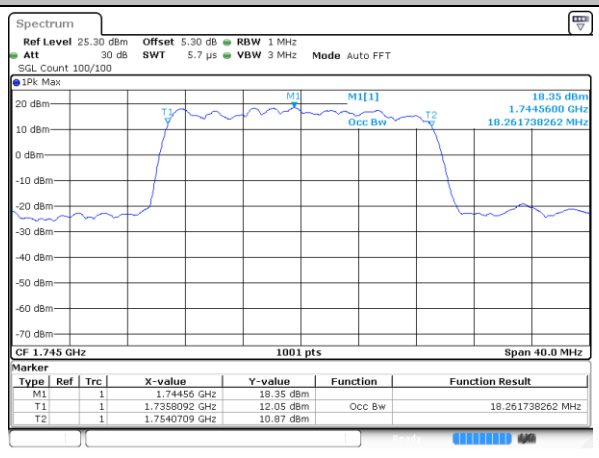
Middle Channel / 20MHz / 16QAM



Highest Channel / 20MHz / QPSK



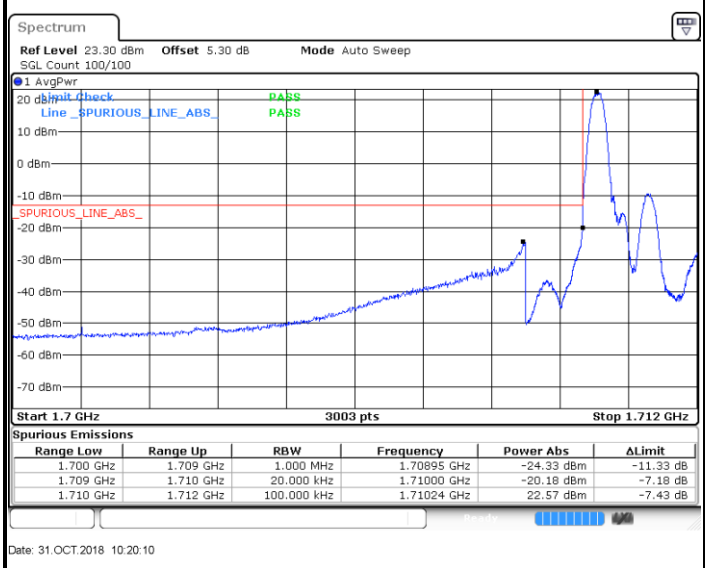
Highest Channel / 20MHz / 16QAM



Conducted Band Edge

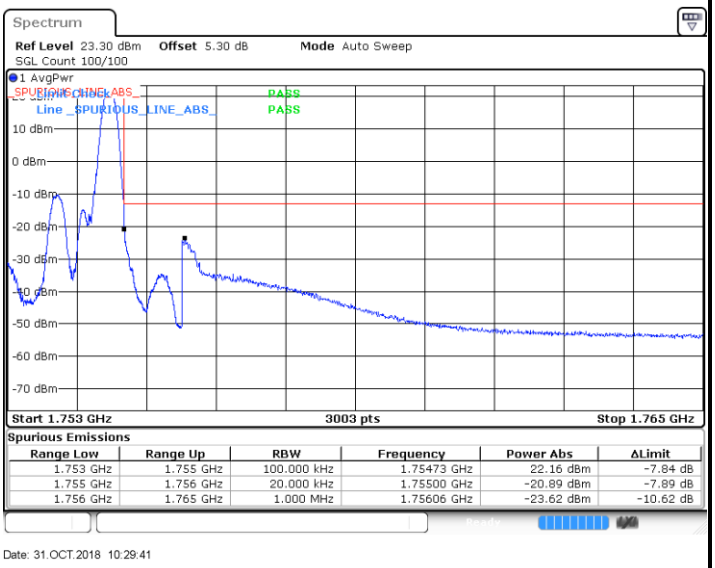
LTE Band 4 / 1.4MHz / QPSK

Lowest Band Edge / 1RB



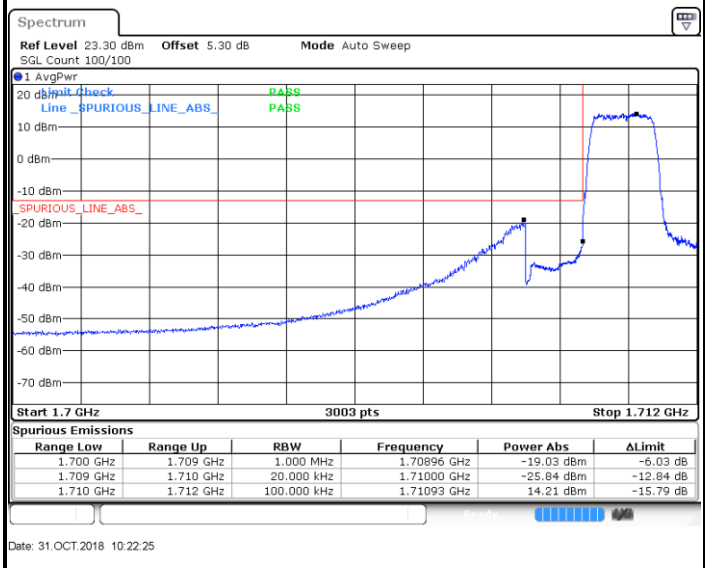
Date: 31.OCT.2018 10:20:10

Highest Band Edge / 1RB



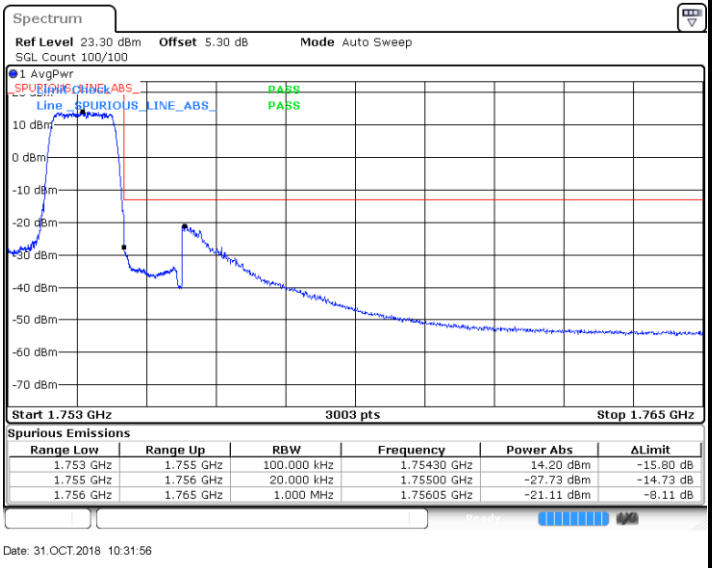
Date: 31.OCT.2018 10:29:41

Lowest Band Edge / Full RB



Date: 31.OCT.2018 10:22:25

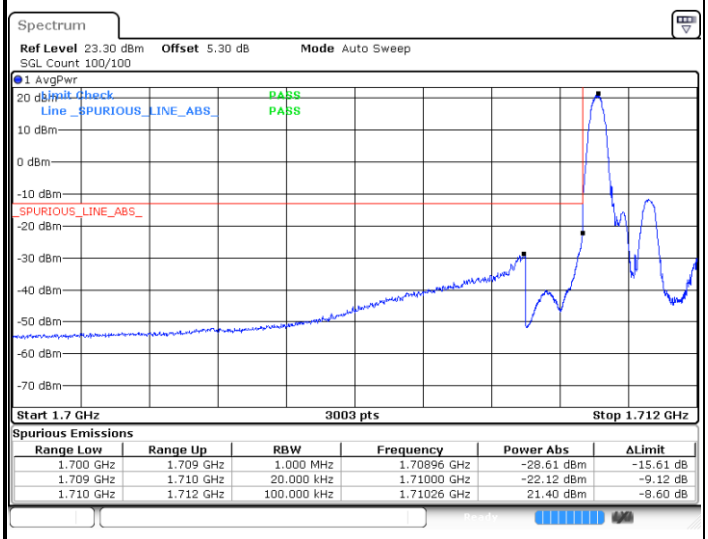
Highest Band Edge / Full RB



Date: 31.OCT.2018 10:31:56

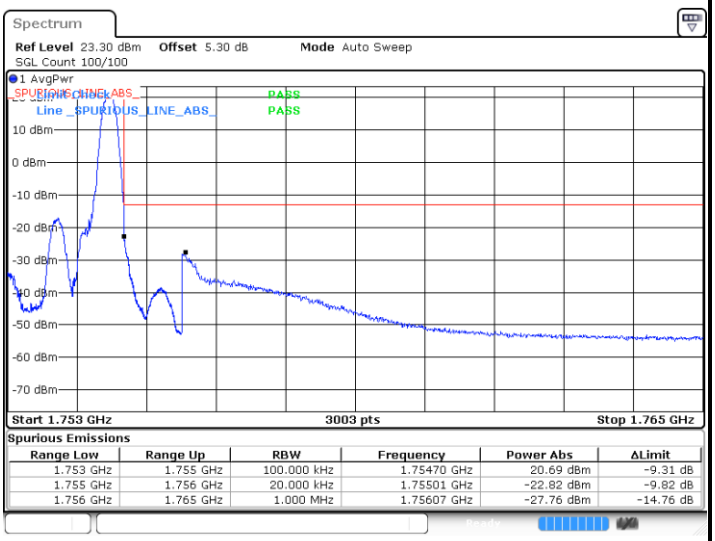
LTE Band 4 / 1.4MHz / 16QAM

Lowest Band Edge / 1 RB



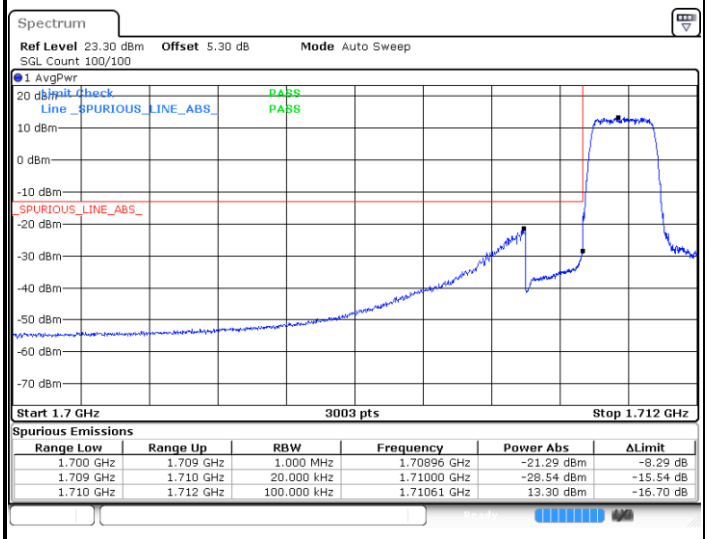
Date: 31.OCT.2018 10:21:18

Highest Band Edge / 1 RB



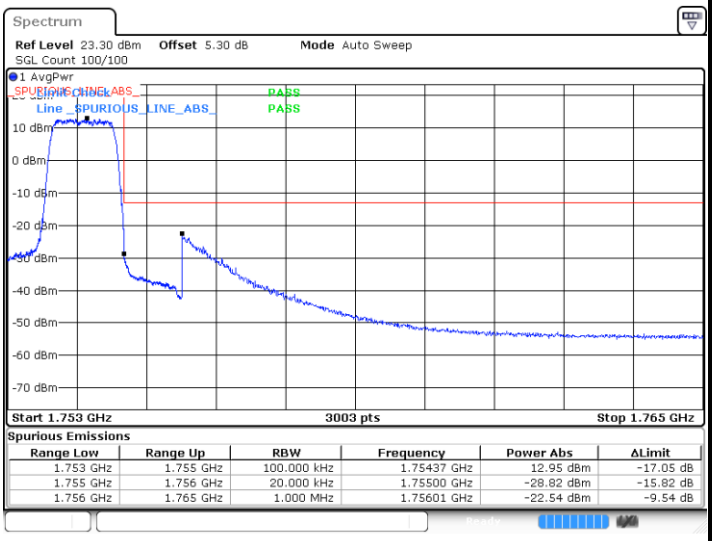
Date: 31.OCT.2018 10:30:48

Lowest Band Edge / Full RB



Date: 31.OCT.2018 10:23:33

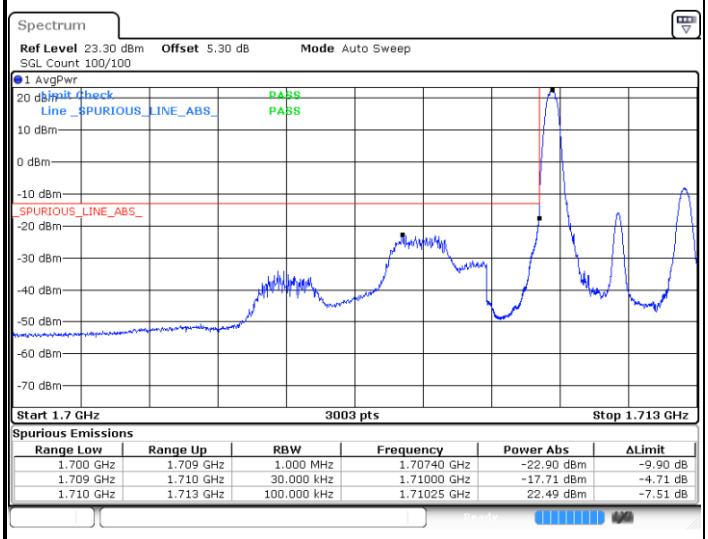
Highest Band Edge / Full RB



Date: 31.OCT.2018 10:33:03

LTE Band 4 / 3MHz / QPSK

Lowest Band Edge / 1RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.700 GHz	1.709 GHz	1.000 MHz	1.70740 GHz	-22.90 dBm	-9.90 dB
1.709 GHz	1.710 GHz	30.000 kHz	1.71000 GHz	-17.71 dBm	-4.71 dB
1.710 GHz	1.713 GHz	100.000 kHz	1.71025 GHz	22.49 dBm	-7.51 dB

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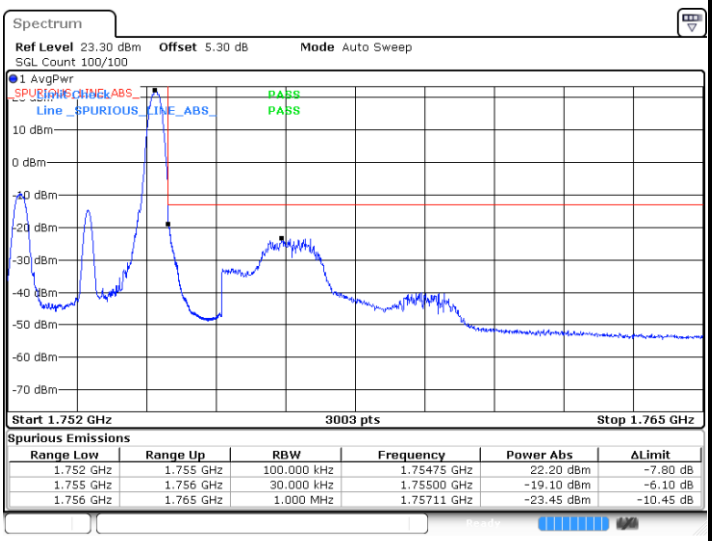
Highest Band Edge / 1 RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.752 GHz	1.755 GHz	100.000 kHz	1.75475 GHz	22.20 dBm	-7.80 dB
1.755 GHz	1.756 GHz	30.000 kHz	1.75500 GHz	-19.10 dBm	-6.10 dB
1.756 GHz	1.765 GHz	1.000 MHz	1.75711 GHz	-23.45 dBm	-10.45 dB

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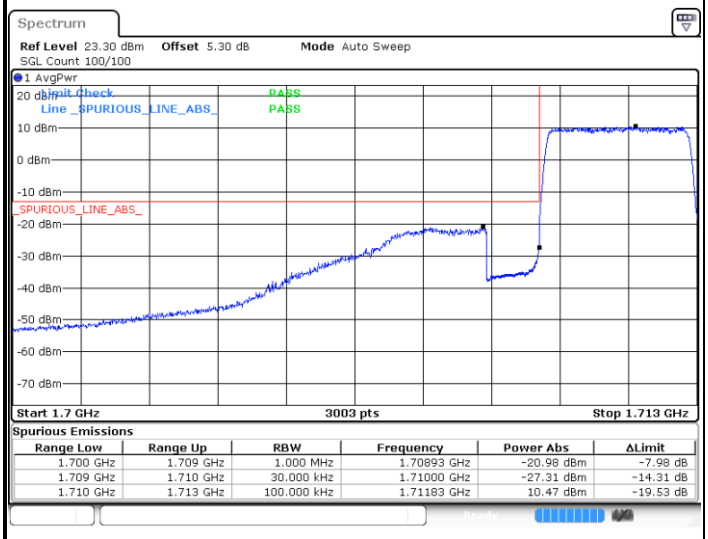
Lowest Band Edge / Full RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.700 GHz	1.709 GHz	1.000 MHz	1.70893 GHz	-20.98 dBm	-7.98 dB
1.709 GHz	1.710 GHz	30.000 kHz	1.71000 GHz	-27.31 dBm	-14.31 dB
1.710 GHz	1.713 GHz	100.000 kHz	1.71183 GHz	10.47 dBm	-19.53 dB

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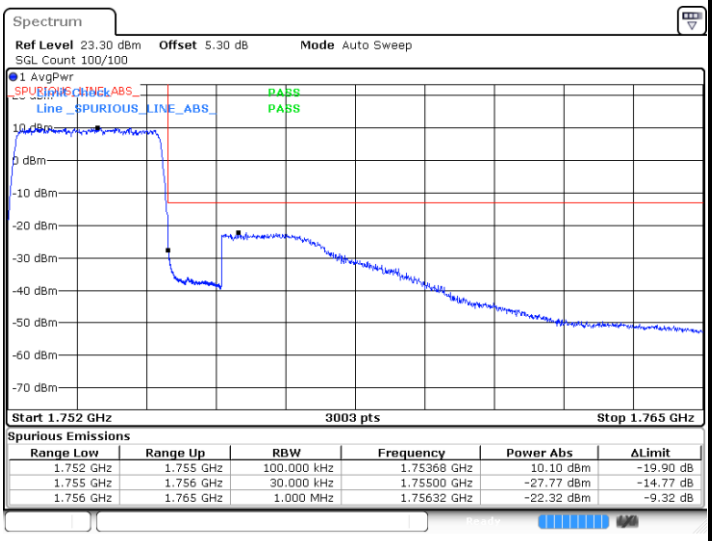
Highest Band Edge / Full RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.752 GHz	1.755 GHz	100.000 kHz	1.75368 GHz	10.10 dBm	-19.90 dB
1.755 GHz	1.756 GHz	30.000 kHz	1.75500 GHz	-27.77 dBm	-14.77 dB
1.756 GHz	1.765 GHz	1.000 MHz	1.75632 GHz	-22.32 dBm	-9.32 dB

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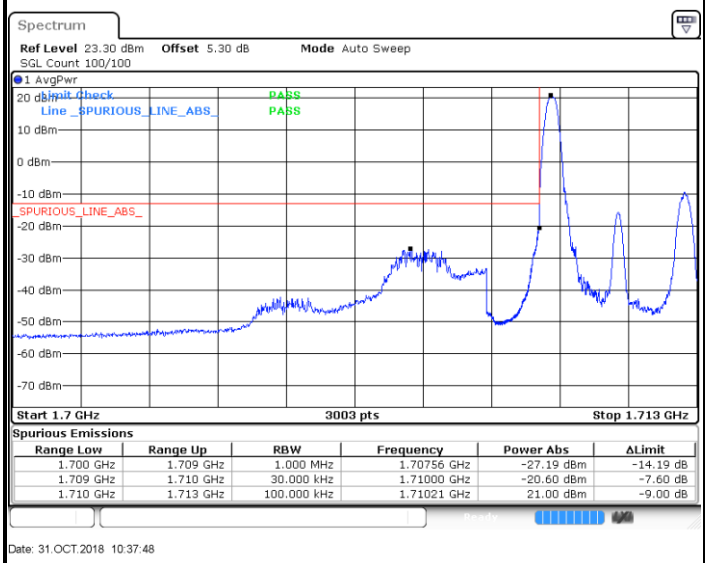
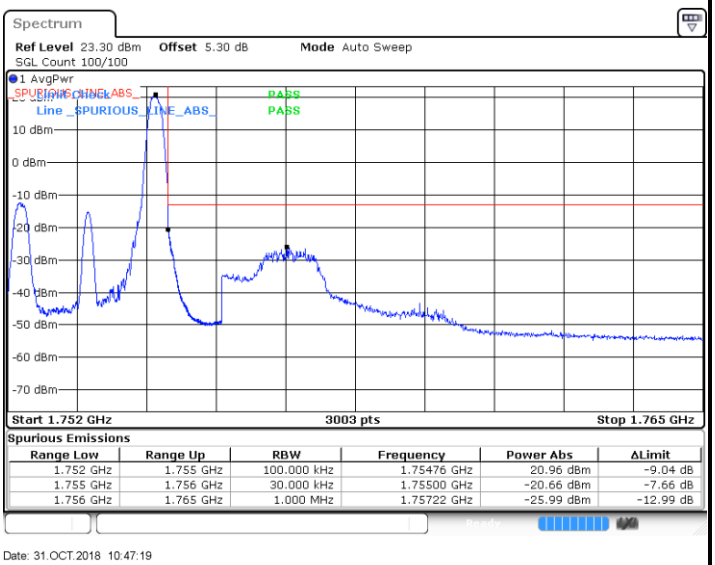
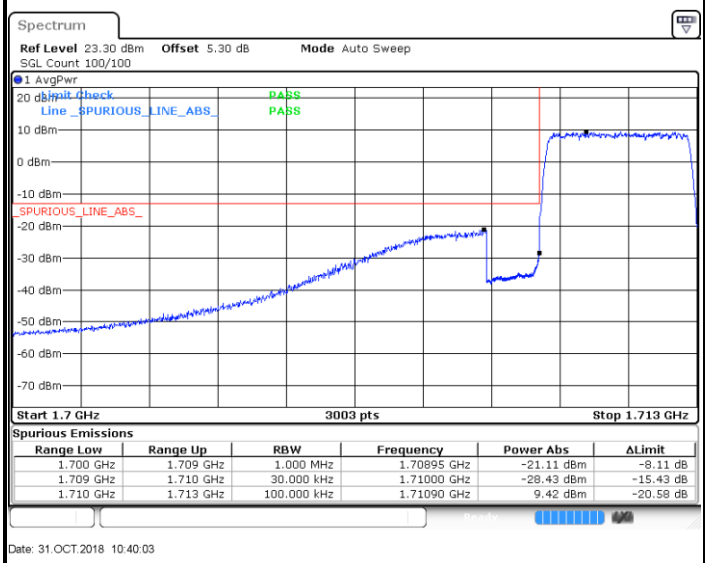
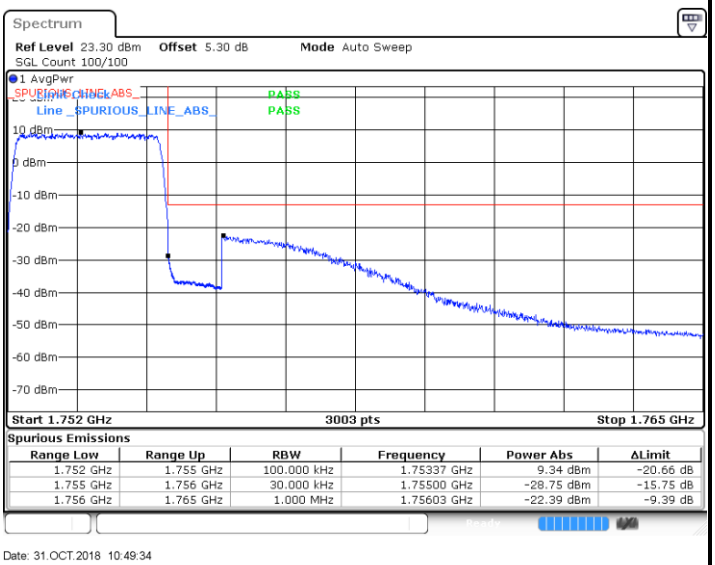
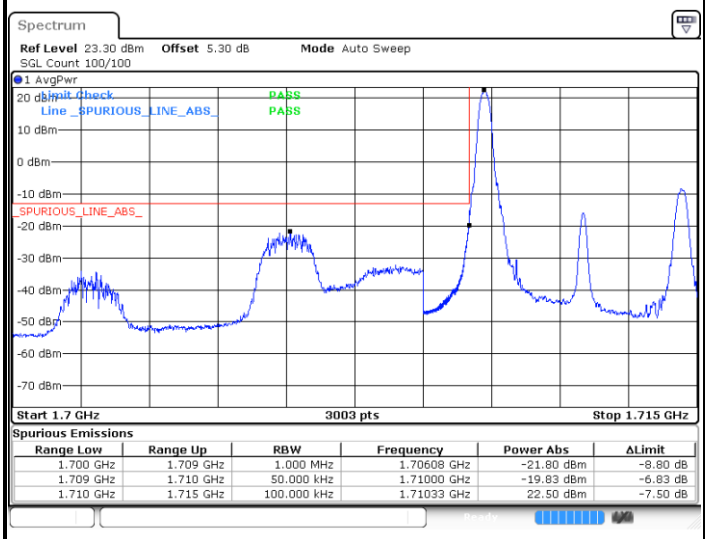
LTE Band 4 / 3MHz / 16QAM	
Lowest Band Edge / 1 RB	**Highest Band Edge /1 RB**
	
Lowest Band Edge / Full RB	**Highest Band Edge / Full RB**
	

LTE Band 4 / 5MHz / QPSK

Lowest Band Edge / 1 RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.700 GHz	1.709 GHz	1.000 MHz	1.70608 GHz	-21.80 dBm	-8.80 dB
1.709 GHz	1.710 GHz	50.000 kHz	1.71000 GHz	-19.83 dBm	-6.83 dB
1.710 GHz	1.715 GHz	100.000 kHz	1.71033 GHz	22.50 dBm	-7.50 dB

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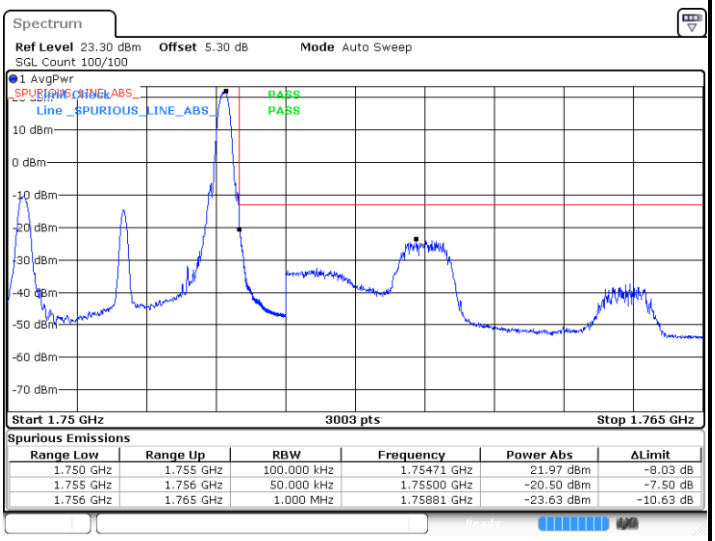
Highest Band Edge / 1 RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.750 GHz	1.755 GHz	100.000 kHz	1.75471 GHz	21.97 dBm	-8.03 dB
1.755 GHz	1.756 GHz	50.000 kHz	1.75500 GHz	-20.50 dBm	-7.50 dB
1.756 GHz	1.765 GHz	1.000 MHz	1.75881 GHz	-23.63 dBm	-10.63 dB

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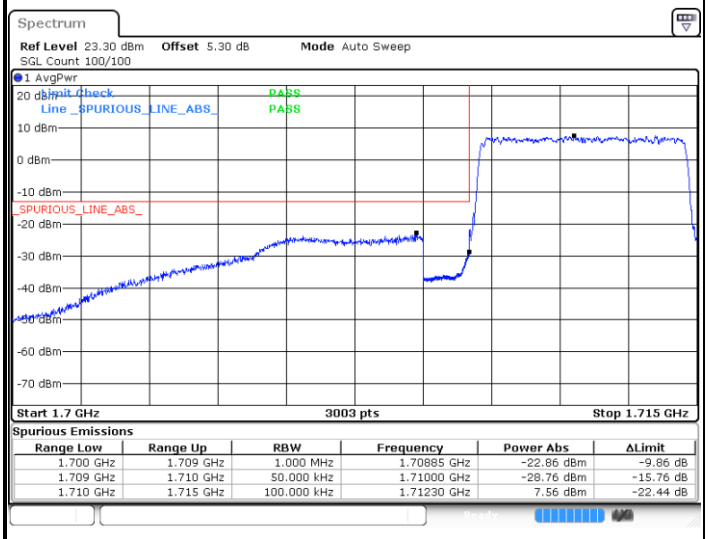
Lowest Band Edge / Full RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.700 GHz	1.709 GHz	1.000 MHz	1.70885 GHz	-22.86 dBm	-9.86 dB
1.709 GHz	1.710 GHz	50.000 kHz	1.71000 GHz	-28.76 dBm	-15.76 dB
1.710 GHz	1.715 GHz	100.000 kHz	1.71230 GHz	7.56 dBm	-22.44 dB

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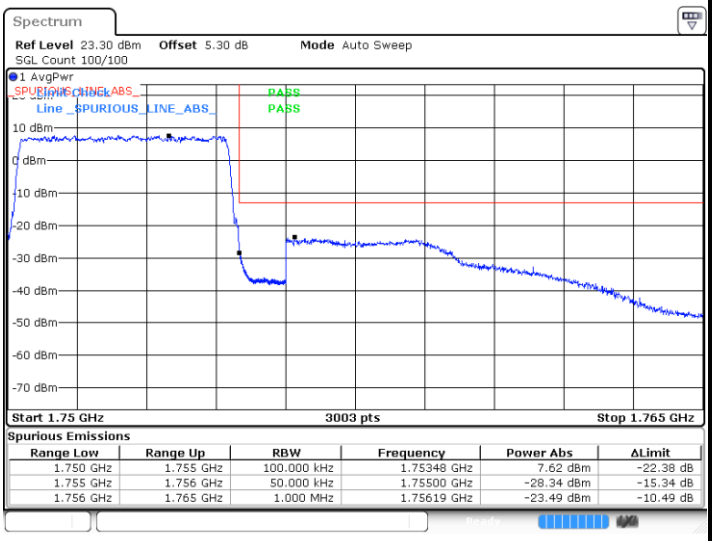
Highest Band Edge / Full RB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
1.750 GHz	1.755 GHz	100.000 kHz	1.75348 GHz	7.62 dBm	-22.38 dB
1.755 GHz	1.756 GHz	50.000 kHz	1.75500 GHz	-28.34 dBm	-15.34 dB
1.756 GHz	1.765 GHz	1.000 MHz	1.75619 GHz	-23.49 dBm	-10.49 dB

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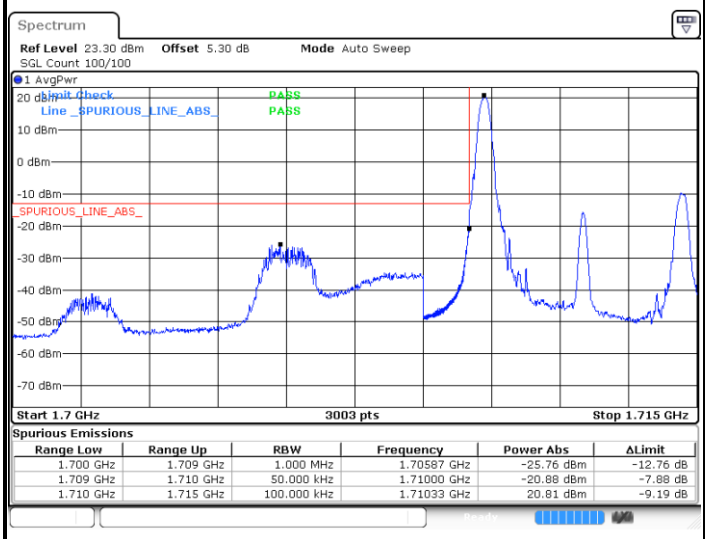
LTE Band 4 / 5MHz / 16QAM

Lowest Band Edge / 1RB



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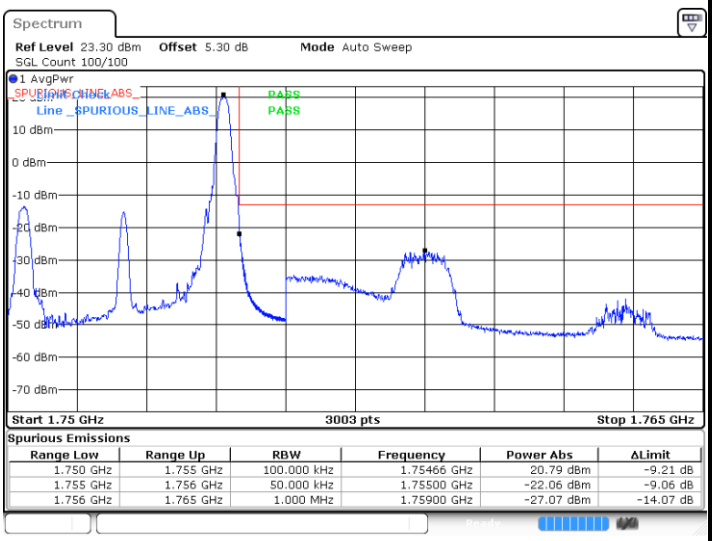
Highest Band Edge / 1 RB



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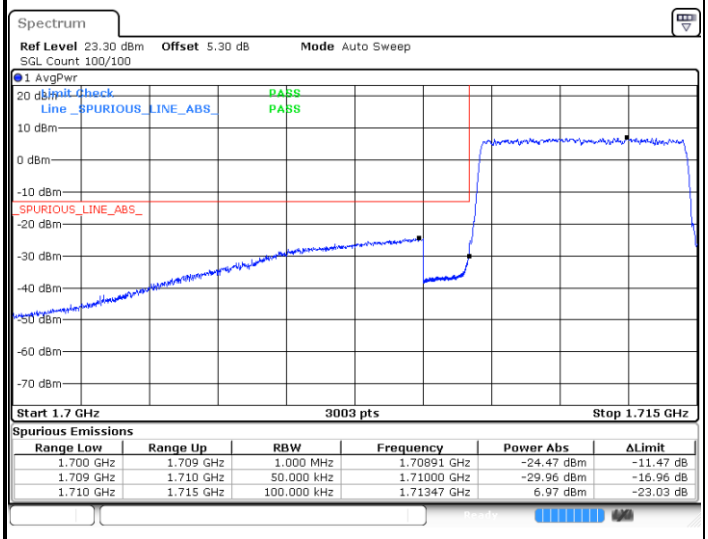
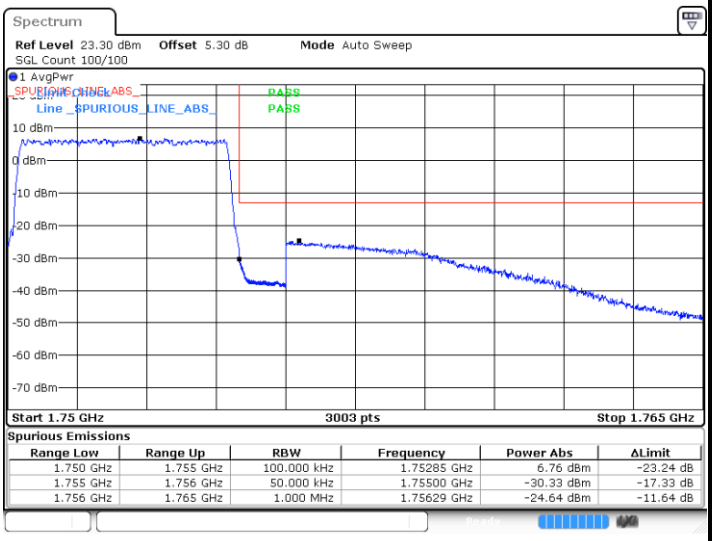
Lowest Band Edge / Full RB



Date: 31.OCT.2018 11:38:35

Highest Band Edge / Full RB



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