

FCC RF Test Report

APPLICANT : Nokia Shanghai Bell Co., Ltd.
EQUIPMENT : NOK 5G21 GATEWAY GRY KIT
BRAND NAME : T-Mobile
MODEL NAME : 5G21-12W-A
FCC ID : 2ADZR5G2112WA
STANDARD : 47 CFR Part 2, 96
CLASSIFICATION : Citizens Band End User Devices (CBE)
EQUIPMENT TYPE : End User Equipment

The product was received on Mar. 11, 2020 and completely tested on Aug. 18, 2020. 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 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.



Reviewed by: Jason Jia / Supervisor



Approved by: James Huang / Manager



Sporton International (Kunshan) Inc.

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China**



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History of this test report

Report No.	Version	Description	Issued Date
FG9D2705B	01	Initial issue of report	Aug. 28, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
-	§96.41	Peak-to-Average Ratio	Not Required	Not applicable for End User Devices
3.3	§96.41	Maximum E.I.R.P	Pass	-
		Maximum Power Spectral Density	Not Required	Not applicable for End User Devices
3.4	§2.1049 §96.41	Occupied Bandwidth	Reporting only	-
3.5	§2.1051 §96.41	Conducted Band Edge Measurement	Pass	-
3.6	§2.1051 §96.41	Conducted Spurious Emission	Pass	-
0	§2.1055	Frequency Stability for Temperature & Voltage	Pass	-
0	§2.1051 §96.41	Radiated Spurious Emission	Pass	Under limit 4.77 dB at 7230.00 MHz

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1. General Description

1.1 Applicant

Nokia Shanghai Bell Co., Ltd.

388#, Ningqiao Road, China (Shanghai) Pilot Free Trade Zone, Shanghai 201206, China

1.2 Manufacturer

Nokia Solutions and Networks Oy

Karakaari 7, 02610 Espoo, Finland

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	NOK 5G21 GATEWAY GRY KIT
Brand Name	T-Mobile
Model Name	5G21-12W-A
FCC ID	2ADZR5G2112WA
Tx Frequency	LTE Band 48: 3552.5 MHz ~ 3697.5 MHz
Rx Frequency	LTE Band 48: 3552.5 MHz ~ 3697.5 MHz
Bandwidth	5MHz / 10MHz / 15MHz / 20MHz
Uplink CA Band(s)	48C
Antenna Gain	4.1 dBi
Type of Modulation	QPSK / 16QAM / 64QAM / 256QAM
HW Version	3TG00739A
SW Version	HB5GGW_D010000B42T0101E0379.tar
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This is a variant report for 5G21-12W-A, the change note could be referred to the product equality declaration which is exhibit separately. For LTE B48C supports any RB configuration, added 1RB test data, all the other test results are leveraged from original report FG9D2703B.

Specification of Accessory				
AC Adapter 1	Brand Name	DELTA	Model Name	UPD-480WNAB B
	Power Rating	I/P: 100-240Vac, 1600mA, O/P:12Vdc, 4000mA		
AC Adapter 2	Brand Name	FSP	Model Name	FSP048-A12U01
	Power Rating	I/P: 100-240Vac, 1300mA, O/P:12Vdc, 4000mA		

Remark: Use adapter 1 for all tests.

1.4 Maximum ERP Power, Frequency Tolerance, and Emission Designator

LTE Band 48		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)
5	3552.5~3697.5	4M50G7D	-	0.1603	4M50W7D	-	0.1742
10	3555~3695	9M03G7D	0.0019	0.1521	9M05W7D	-	0.1679
15	3557.5~3692.5	13M5G7D	-	0.1560	13M6W7D	-	0.1694
20	3560~3690	17M9G7D	-	0.1531	17M9W7D	-	0.1656
LTE Band 48		64QAM			256QAM		
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)
5	3552.5~3697.5	4M49W7D	-	0.1897	4M49W7D	-	0.1866
10	3555~3695	9M05W7D	-	0.1807	9M03W7D	-	0.1820
15	3557.5~3692.5	13M5W7D	-	0.1722	13M5W7D	-	0.1795
20	3560~3690	17M9W7D	-	0.1714	18M0W7D	-	0.1702



LTE Band 48 CA	QPSK			16QAM		
BW (MHz)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)
5MHz+20MHz	23M4G7D	-	0.0388	23M3W7D	-	0.0351
10MHz+20MHz	28M1G7D	-	0.0387	28M1W7D	-	0.0342
15MHz+20MHz	32M9G7D	-	0.0382	32M9W7D	-	0.0335
20MHz+5MHz	23M4G7D	-	0.0388	23M3W7D	-	0.0334
20MHz+10MHz	28M1G7D	-	0.0390	28M1W7D	-	0.0333
20MHz+15MHz	32M9G7D	-	0.0387	32M9W7D	-	0.0328
20MHz+20MHz	37M8G7D	-	0.0379	37M7W7D	-	0.0336
LTE Band 48 CA	64QAM			256QAM		
BW (MHz)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)	Emission Designator (99%OBW)	Frequency Tolerance (ppm)	Maximum EIRP(W)
5MHz+20MHz	23M3W7D	-	0.0320	23M1W7D	-	0.0335
10MHz+20MHz	28M2W7D	-	0.0324	28M1W7D	-	0.0337
15MHz+20MHz	32M9W7D	-	0.0327	32M6W7D	-	0.0334
20MHz+5MHz	23M4W7D	-	0.0325	23M3W7D	-	0.0333
20MHz+10MHz	28M1W7D	-	0.0323	27M9W7D	-	0.0338
20MHz+15MHz	32M8W7D	-	0.0327	32M7W7D	-	0.0333
20MHz+20MHz	37M7W7D	-	0.0327	37M5W7D	-	0.0333

1.5 Testing Site

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	03CH04-KS TH01-KS	CN1257	314309

1.6 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH04-KS	AUDIX	E3	6.2009-8-24a

1.7 Applied Standards

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

- ♦ ANSI C63.26-2015
- ♦ ANSI / TIA-603-E
- ♦ 47 CFR Part 2, 96
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 940660 D01 Part 96 CBRS v02
- ♦ 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

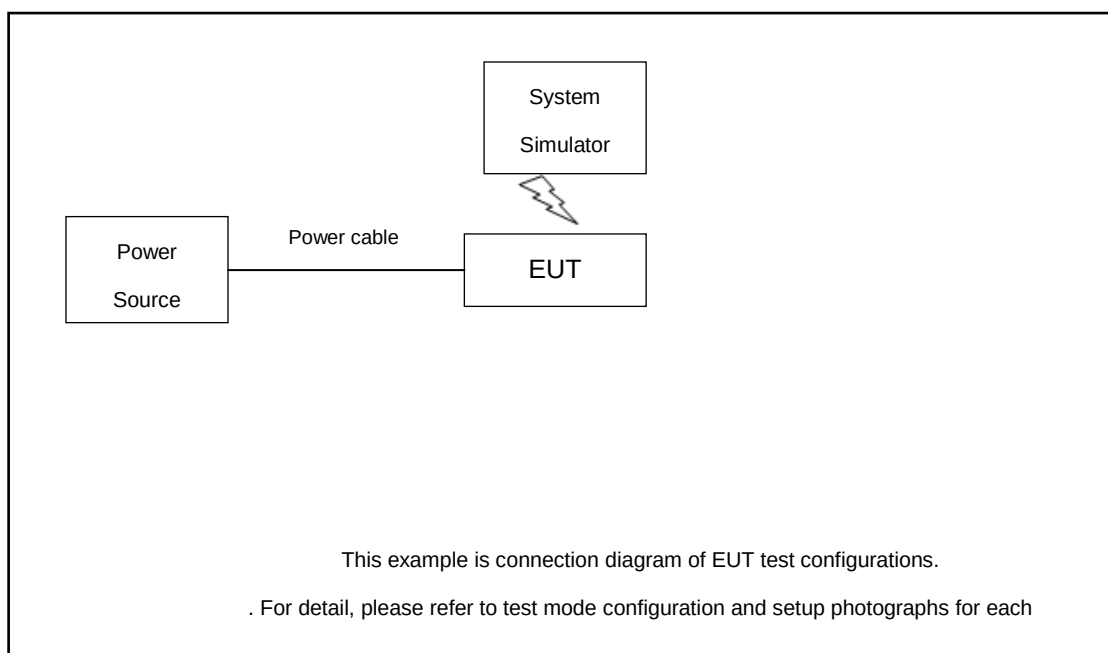
Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.

Test Items	Band	Bandwidth (MHz)						Modulation				RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	64 QAM	256 QAM	1	Half	Full	L	M	H
Max. Output Power	48	-	-	v	v	v	v	v	v	v	v	v	v	v	v	v	v
26dB and 99% Bandwidth	48	-	-	v	v	v	v	v	v	v	v			v	v	v	v
Conducted Band Edge	48	-	-	v	v	v	v	v	v	v	v	v		v	v		v
Conducted Spurious Emission	48	-	-	v	v	v	v	v	v	v	v	v			v	v	v
E.R.P / E.I.R.P	48	-	-	v	v	v	v	v	v	v	v	v			v	v	v
Frequency Stability	48	-	-		v			v	v	v	v	v			v	v	v
Radiated Spurious Emission	48	Worst Case														v	
Remark	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. 4. All the radiated test cases were performed with Adapter 1.																

Test Items	Band	Bandwidth (MHz)							Modulation				RB #			Test Channel		
		20+20	20+15	15+20	20+10	10+20	20+5	5+20	QPSK	16QAM	64QAM	256QAM	1	Half	Full	L	M	H
Max. Output Power	48C	v	v	v	v	v	v	v	v	v	v	v	v		v	v	v	v
26dB and 99% Bandwidth	48C	v	v	v	v	v	v	v	v	v	v	v			v	v	v	v
Conducted Band Edge	48C	v	v	v	v	v	v	v	v	v	v	v	v		v	v		v
Conducted Spurious Emission	48C	v	v	v	v	v	v	v	v	v	v	v	v			v	v	v
E.R.P / E.I.R.P	48C	v	v	v	v	v	v	v	v	v	v	v			v	v	v	v
Radiated Spurious Emission	48C	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. 4. All the radiated test cases were performed with Adapter 1. 5. Frequency stability only shows the worst case of LTE band 48/48C.																	

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration

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	MT8821C	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 9.98 dB.

Example :

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)}. \\
 &= 9.98 \text{ (dB)}
 \end{aligned}$$

2.5 Frequency List of Low/Middle/High Channels

LTE Band 48 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	55340	55990	56640
	Frequency	3560.0	3625.0	3690.0
15	Channel	55315	55990	56665
	Frequency	3557.5	3625.0	3692.5
10	Channel	55290	55990	56690
	Frequency	3555.0	3625.0	3695.0
5	Channel	55265	55990	56715
	Frequency	3552.5	3625.0	3697.5

LTE Band 48C_CA Channel and Frequency List					
BW [MHz]	Channel/Frequency(MHz)		Lowest	Middle	Highest
5 + 20	PCC	Channel	55273	55898	56523
		Frequency	3553.3	3615.8	3678.3
	SCC	Channel	55390	56015	56640
		Frequency	3565	3627.5	3690
20 + 5	PCC	Channel	55340	55965	56590
		Frequency	3560	3622.5	3685
	SCC	Channel	55457	56082	56707
		Frequency	3571.7	3634.2	3696.7
10 + 20	PCC	Channel	55295	55896	56496
		Frequency	3555.5	3615.6	3675.6
	SCC	Channel	55439	56040	56640
		Frequency	3569.9	3630	3690
20 + 10	PCC	Channel	55340	55941	56541
		Frequency	3560	3620.1	3680.1
	SCC	Channel	55484	56085	56685
		Frequency	3574.4	3634.5	3694.5
15 + 20	PCC	Channel	55318	55893	56469
		Frequency	3557.8	3615.3	3672.9
	SCC	Channel	55489	56064	56640
		Frequency	3574.9	3632.4	3690
20 + 15	PCC	Channel	55340	55916	56491
		Frequency	3560	3617.6	3675.1
	SCC	Channel	55511	56087	56662
		Frequency	3577.1	3634.7	3692.2
20 + 20	PCC	Channel	55340	55891	56442
		Frequency	3560	3615.1	3670.2
	SCC	Channel	55538	56089	56640
		Frequency	3579.8	3634.9	3690

3. Conducted Test Items

3.1 Measuring Instruments

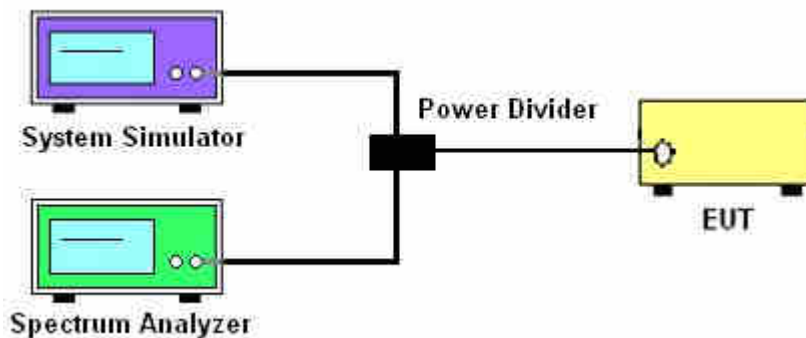
See list of measuring instruments of this test report.

3.1.1 Test Setup

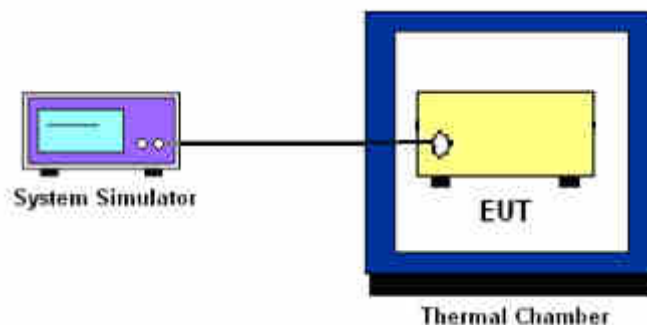
3.1.2 Conducted Output Power



3.1.3 EIRP, Occupied Bandwidth, Conducted Band-Edge and Conducted Spurious Emission



3.1.4 Frequency Stability



3.1.5 Test Result of Conducted Test

Please refer to Appendix A.

3.2 Conducted Output Power

3.2.1 Description of the Conducted Output Power 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.

3.2.2 Test Procedures

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

3.3 EIRP

3.3.1 Description of the EIRP Measurement

EIRP and PSD limits for CBRS equipment as below table:

Device		Maximum EIRP (dBm/10 MHz)	Maximum PSD (dBm/MHz)
☒	End User Device	23	n/a
☐	Category A CBSD	30	20
☐	Category B CBSD	47	37

Remark: Maximum PSD values are radiated. Measurements can be done conducted and add antenna gain back in.

1. Set instrument center frequency to OBW center frequency.
2. Set span to at least 2 times the OBW.
3. Set the RBW to the specified reference bandwidth (often 1 MHz).
4. Set VBW $\geq 3 \times$ RBW.
5. Detector = RMS (power averaging).
6. Ensure that the number of measurement points in the sweep $\geq 2 \times$ span/RBW.
7. Sweep time = auto couple.
8. Employ trace averaging (RMS) mode over a minimum of 100 traces.
9. Use the peak marker function to determine the maximum amplitude level within the reference bandwidth (PSD).
10. Determine the EIRP by adding the effective antenna gain to the adjusted power level.
11. Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission.

The testing follows ANSI C63.26-2015 Section 5.2.5.5

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$, 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 Occupied Bandwidth

3.4.1 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.

3.4.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.4.3 (26dB) and Section 5.4.4 (99OB)

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. 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.
3. 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.
4. Set the detection mode to peak, and the trace mode to max hold.
5. 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)
6. Determine the “-26 dB down amplitude” as equal to (Reference Value – X).
7. 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.
8. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

3.5 Conducted Band Edge

3.5.1 Description of Conducted Band Edge Measurement

Part 96.41 (e) (1) (i)

For CBSD the emission limits outside the fundamental are as follows:

Within 0 MHz to 10 MHz above and below the assigned channel ≤ -13 dBm/MHz

Greater than 10 MHz above and below the assigned channel ≤ -25 dBm/MHz

Part 96.41 (e) (1) (ii)

For End User Devices the emission limits outside the fundamental are as follows:

Within 0 MHz to B MHz above and below the assigned channel ≤ -13 dBm/MHz

Greater than B MHz above and below the assigned channel ≤ -25 dBm/MHz

where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device.

Part 96.41 (e) (2)

For CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed -25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz

3.5.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The band edges of low and high channels for the highest RF powers were measured.
3. Set RBW $\geq 1\%$ EBW in the 1MHz band immediately outside and adjacent to the band edge.
4. Beyond the 1 MHz band from the band edge, RBW=1MHz was used
5. Offset has included the duty factor for LTE Band 48. Duty factor $=10 \log (1/x)$, where x is the measured duty cycle.
6. Set spectrum analyzer with RMS detector.
7. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.6 Conducted Spurious Emission

3.6.1 Description of Conducted Spurious Emission Measurement

96.41 (e)(2)

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.

3.6.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. 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.
3. The middle channel for the highest RF power within the transmitting frequency was measured.
4. The conducted spurious emission for the whole frequency range was taken.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
6. Set spectrum analyzer with RMS detector.
7. Taking the record of maximum spurious emission.
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
9. The limit line is -40dBm/MHz.

3.7 Frequency Stability

3.7.1 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 $\pm 0.00025\%$ ($\pm 2.5\text{ppm}$) of the center frequency

3.7.2 Test Procedures for Temperature Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was set up in the thermal chamber and connected with the system simulator.
2. 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.
3. 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.

3.7.3 Test Procedures for Voltage Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was placed in a temperature chamber at $25\pm 5^{\circ}\text{C}$ and connected with the system simulator.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

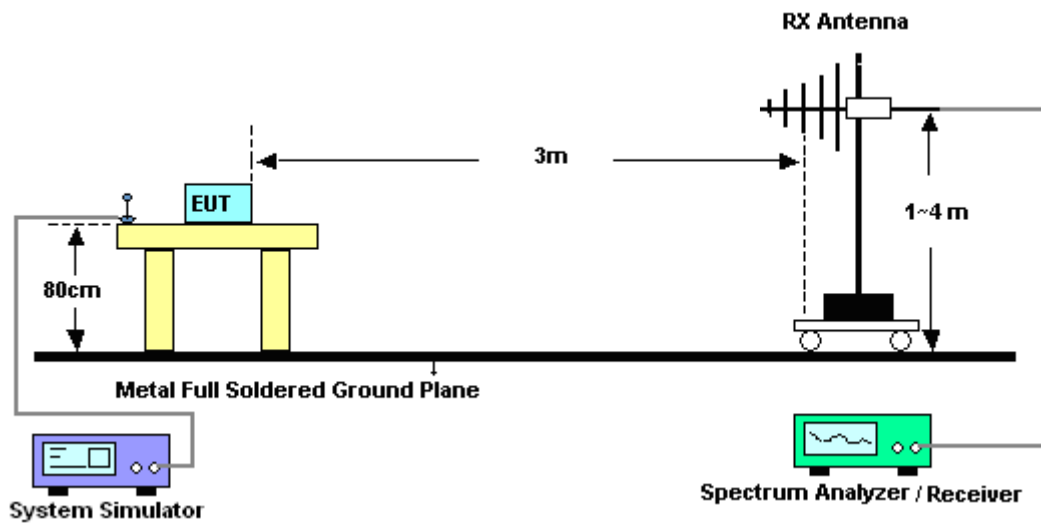
4. Radiated Test Items

4.1 Measuring Instruments

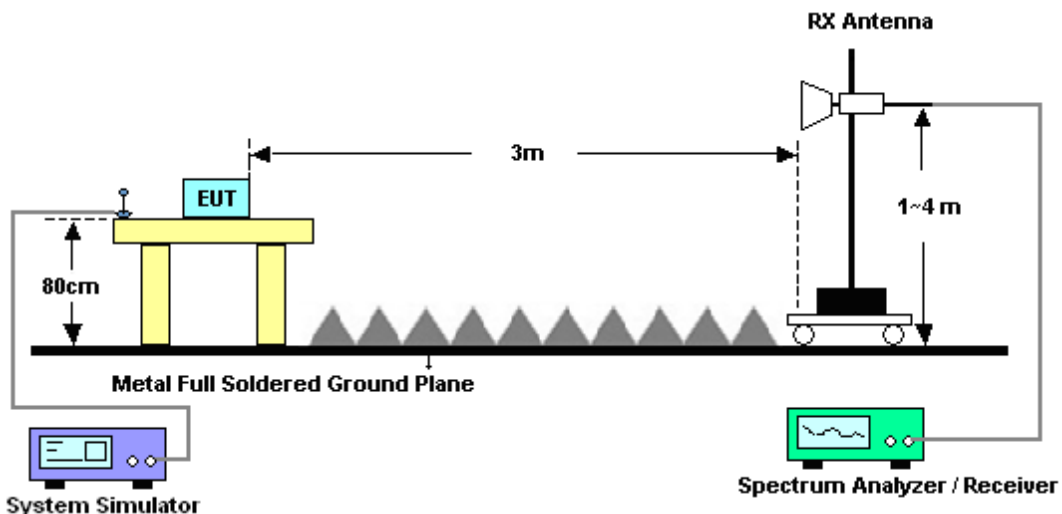
See list of measuring instruments of this test report.

4.2 Test Setup

For radiated emissions from 30MHz to 1GHz



For radiated emissions 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 Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. 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 -40dBm / MHz.

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

4.4.2 Test Procedures

1. 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.
2. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
7. A horn antenna was substituted in place of the EUT and was driven by a signal generator. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
$$\text{EIRP (dBm)} = \text{S.G. Power} - \text{Tx Cable Loss} + \text{Tx Antenna Gain}$$
$$\text{ERP (dBm)} = \text{EIRP} - 2.15$$
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
The limit line is -40dBm/MHz

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	Nov. 02, 2019	Apr. 07, 2020~ Aug. 18, 2020	Nov. 01, 2020	Conducted (TH01-KS)
Thermal Chamber	Ten Billion	TTC-B3S	TBN-9605 02	-40~+150°C	Oct. 28, 2019	Apr. 07, 2020~ Aug. 18, 2020	Oct. 27, 2020	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY551502 44	10Hz-44G,MAX 30dB	Apr. 15, 2020	May 21, 2020	Apr. 14, 2021	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 30, 2019	May 21, 2020	May 29, 2020	Radiation (03CH04-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1356	1GHz~18GHz	Apr. 20, 2020	May 21, 2020	Apr. 19, 2021	Radiation (03CH04-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Nov. 10, 2019	May 21, 2020	Nov. 09, 2020	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	Aug. 06, 2019	May 21, 2020	Aug. 05, 2020	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GG A	060728	18~40GHz	Jan. 08, 2020	May 21, 2020	Jan. 07, 2021	Radiation (03CH04-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	1Ghz-18Ghz	Aug. 16, 2019	May 21, 2020	Aug. 15, 2020	Radiation (03CH04-KS)
Amplifier	Keysight	83017A	MY572801 06	500MHz~26.5G Hz	Oct. 15, 2019	May 21, 2020	Oct. 14, 2020	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F1040900 04	N/A	NCR	May 21, 2020	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 21, 2020	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 21, 2020	NCR	Radiation (03CH04-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% ($U = 2Uc(y)$)	3.3dB
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.8dB
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Appendix A. Test Results of Conducted Test

A1. LTE Band 48

A1.1. EIRP

1RB0

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)											
BW	5MHz		10MHz		15MHz		20MHz		5MHz	10MHz	15MHz	20MHz
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	64QAM	64QAM	64QAM	64QAM
Lowest CH	22.05	22.26	21.70	22.20	21.73	22.07	21.85	22.05	22.18	22.25	21.82	22.03
Middle CH	21.63	22.08	21.69	22.25	21.93	22.10	21.47	22.19	22.59	21.96	22.36	21.99
Highest CH	21.57	22.23	21.82	21.73	21.27	22.27	21.29	22.07	21.99	21.91	22.00	22.08
Limit	23dBm /10MHz											
Result	Pass											

1RB Max

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)											
BW	5MHz		10MHz		15MHz		20MHz		5MHz	10MHz	15MHz	20MHz
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	64QAM	64QAM	64QAM	64QAM
Lowest CH	21.63	22.03	21.58	21.77	21.13	21.80	21.49	22.00	22.18	21.87	22.00	21.76
Middle CH	21.50	22.41	21.80	22.21	21.73	22.29	21.78	22.10	22.78	22.57	22.16	22.34
Highest CH	21.58	22.03	21.49	22.17	21.62	22.07	21.54	21.91	22.16	22.34	21.78	22.05
Limit	23dBm /10MHz											
Result	Pass											

Full RB0

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)											
BW	5MHz		10MHz		15MHz		20MHz		5MHz	10MHz	15MHz	20MHz
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	64QAM	64QAM	64QAM	64QAM
Lowest CH	21.46	21.61	20.78	21.03	19.76	20.15	19.10	19.27	21.74	21.13	20.38	19.53
Middle CH	21.44	22.06	21.13	20.91	20.40	20.15	19.41	19.48	21.48	21.15	20.54	19.56
Highest CH	21.33	21.56	20.65	21.13	19.89	19.96	19.31	19.49	21.59	21.20	20.36	19.47
Limit	23dBm /10MHz											
Result	Pass											

1RB0

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)			
BW	5MHz	10MHz	15MHz	20MHz
Mod.	256QAM	256QAM	256QAM	256QAM
Lowest CH	22.35	22.54	22.02	22.14
Middle CH	22.71	22.60	22.54	22.30
Highest CH	22.47	22.14	21.63	21.95
Limit	23dBm /10MHz			
Result	Pass			

1RB Max

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)			
BW	5MHz	10MHz	15MHz	20MHz
Mod.	256QAM	256AM	256QAM	256QAM
Lowest CH	22.16	22.03	21.93	21.88
Middle CH	22.64	22.28	22.18	22.31
Highest CH	21.85	22.16	22.16	21.90
Limit	23dBm /10MHz			
Result	Pass			

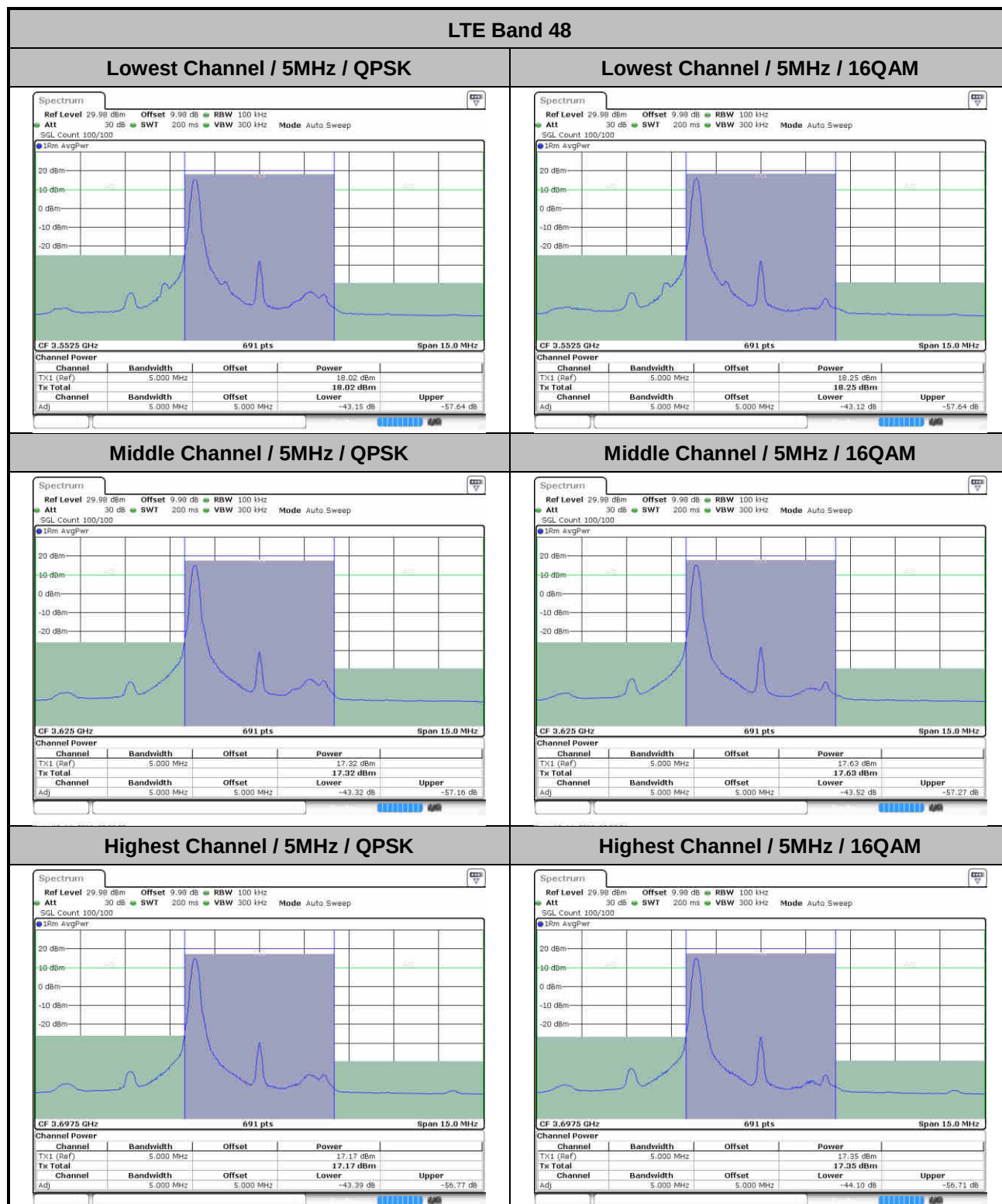
Full RB0

Mode	LTE Band 48 : Conducted EIRP (dBm/10MHz)			
BW	5MHz	10MHz	15MHz	20MHz
Mod.	256QAM	256QAM	256QAM	256QAM
Lowest CH	21.86	20.83	20.09	19.32
Middle CH	21.74	21.11	19.98	19.56
Highest CH	21.64	20.92	20.07	19.22
Limit	23dBm /10MHz			
Result	Pass			



ACLR

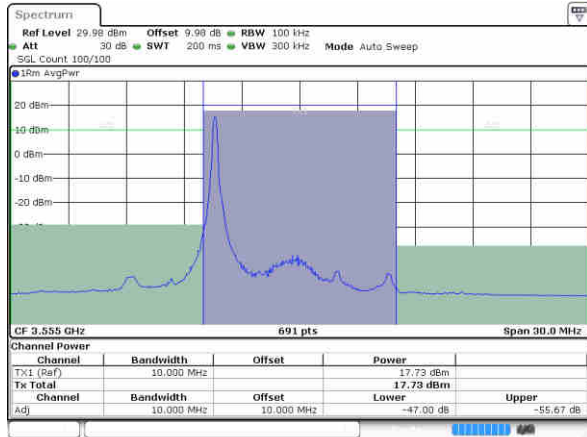
1RB0



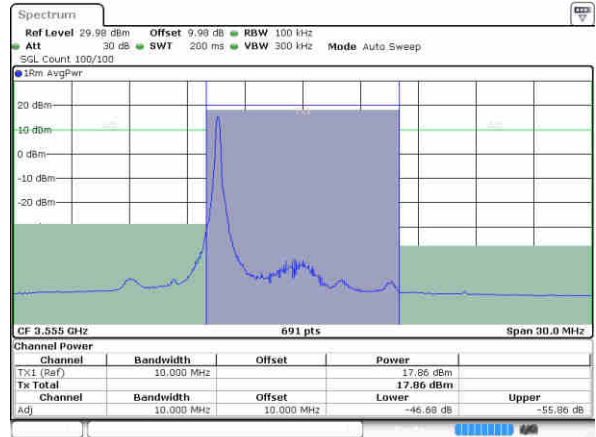


LTE Band 48

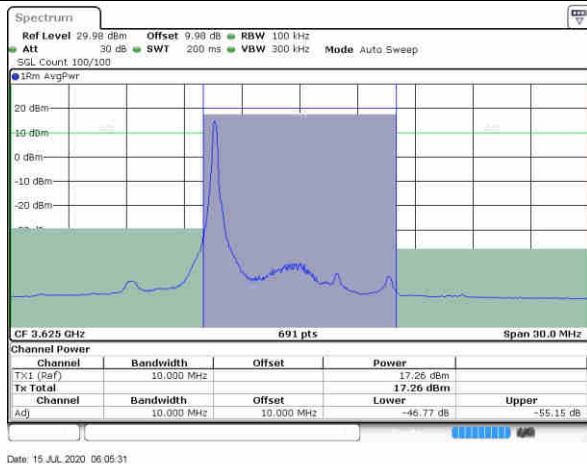
Lowest Channel / 10MHz / QPSK



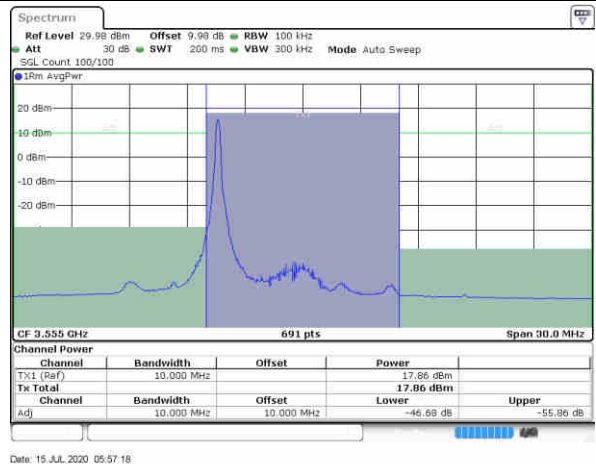
Lowest Channel / 10MHz / 16QAM



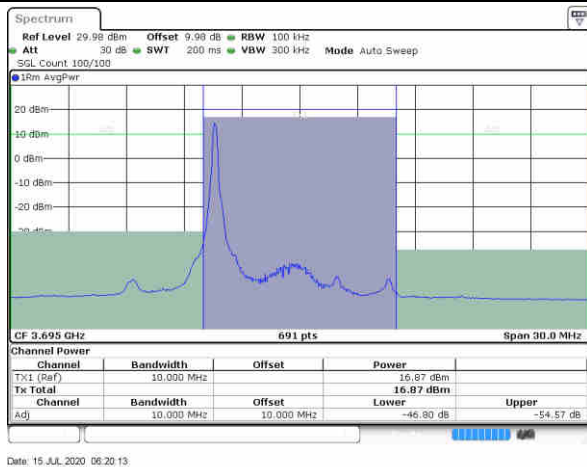
Middle Channel / 10MHz / QPSK



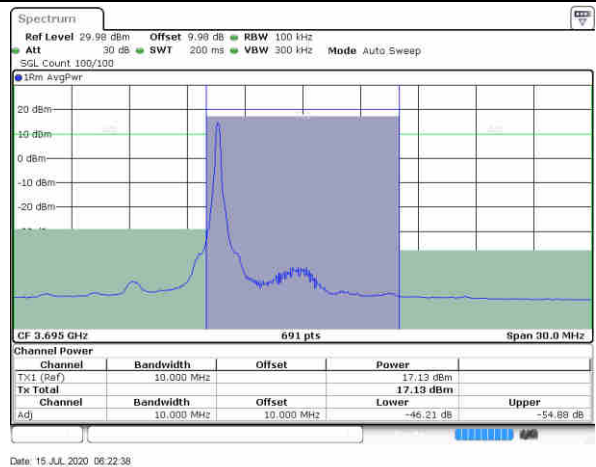
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Highest Channel / 10MHz / QPSK



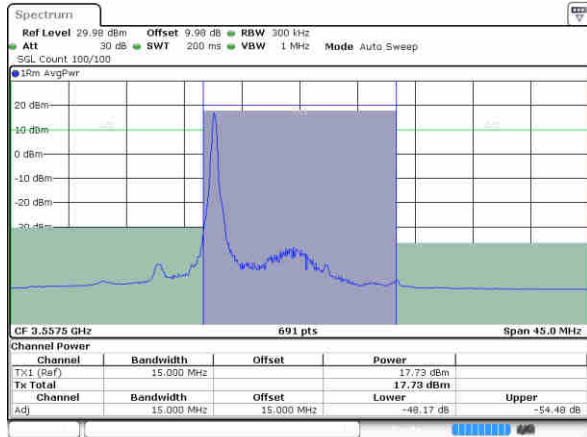
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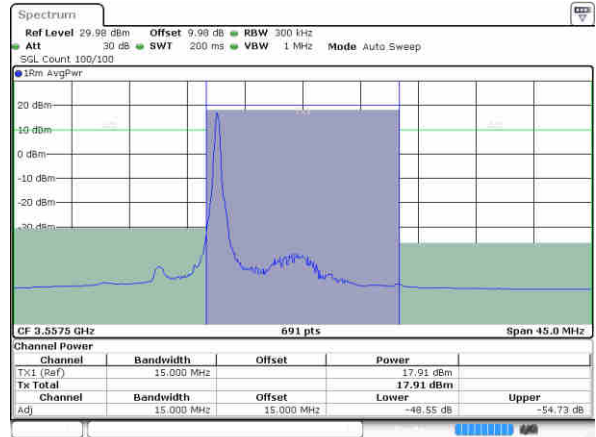


LTE Band 48

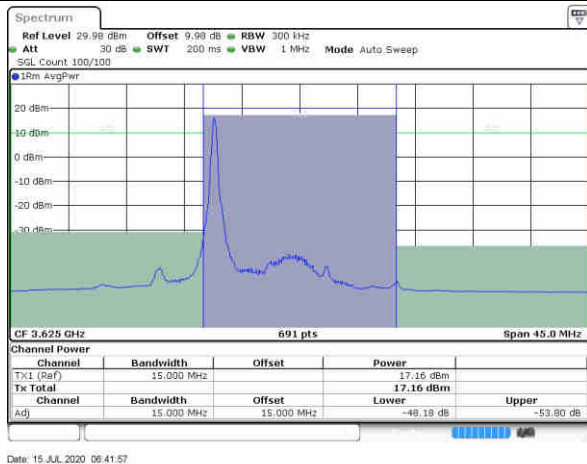
Lowest Channel / 15MHz / QPSK



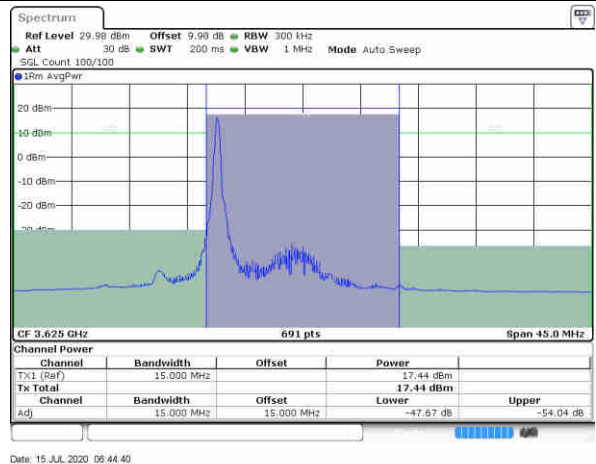
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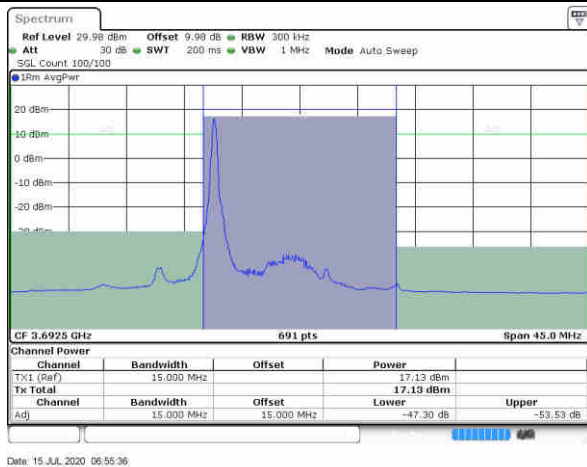
Middle Channel / 15MHz / QPSK



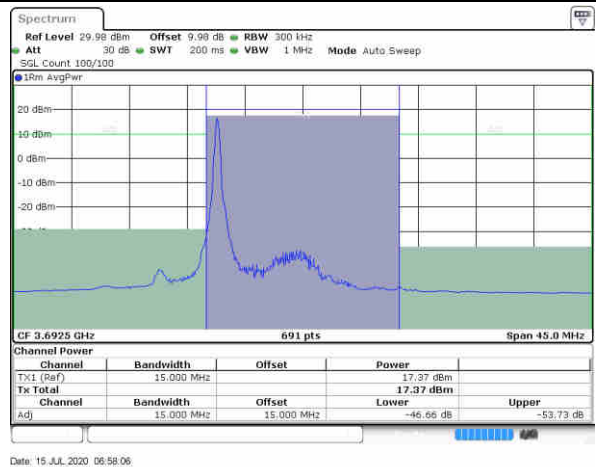
Middle Channel / 15MHz / 16QAM



Highest Channel / 15MHz / QPSK



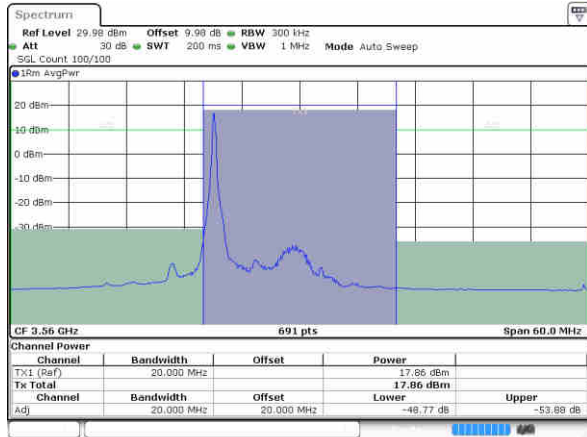
Highest Channel / 15MHz / 16QAM



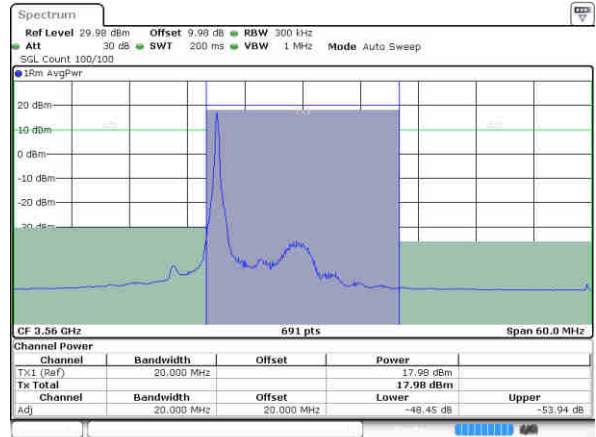


LTE Band 48

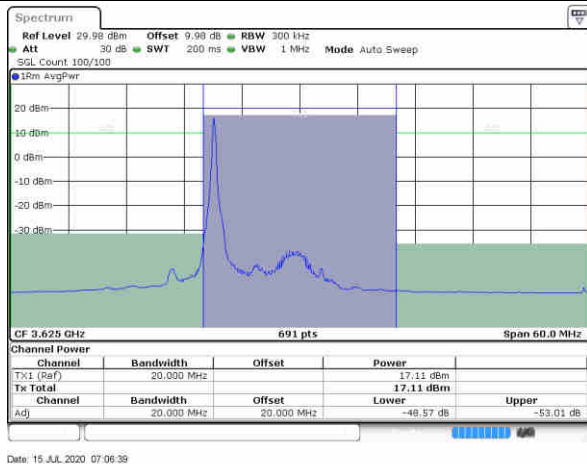
Lowest Channel / 20MHz / QPSK



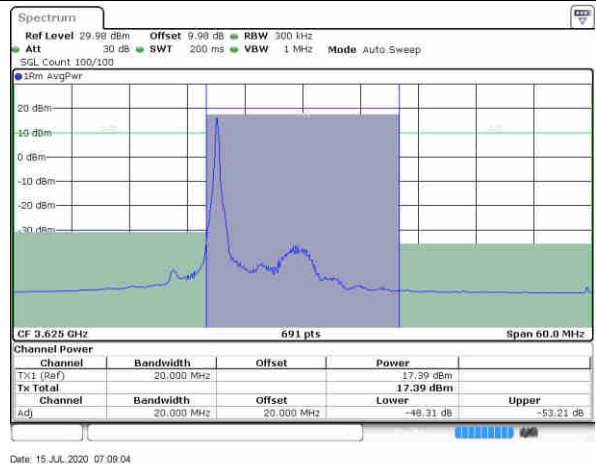
Lowest Channel / 20MHz / 16QAM



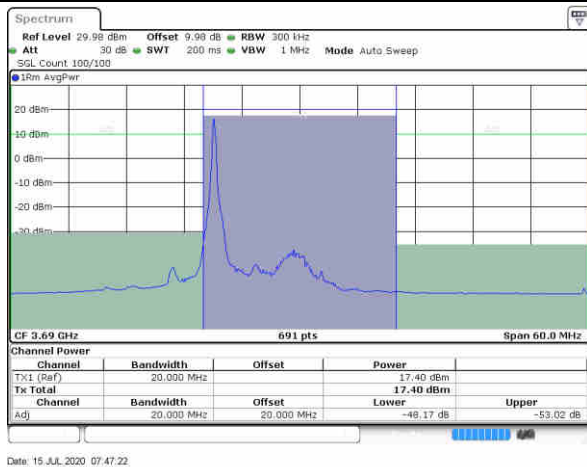
Middle Channel / 20MHz / QPSK



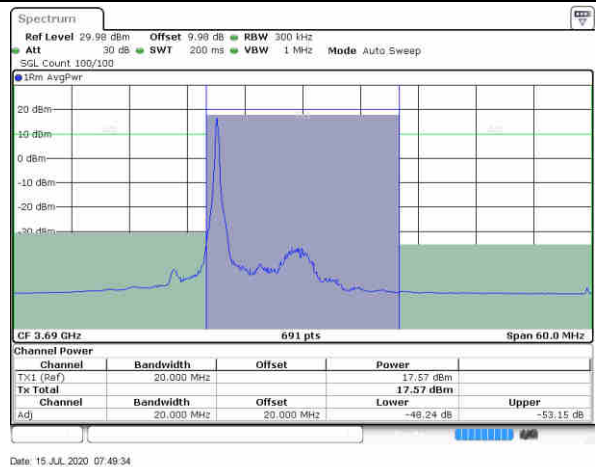
Middle Channel / 20MHz / 16QAM

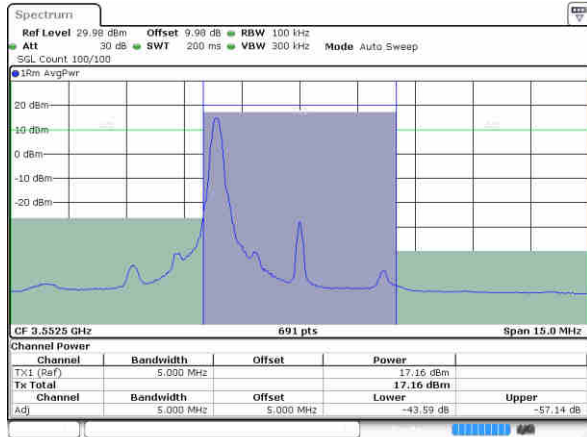


Highest Channel / 20MHz / QPSK

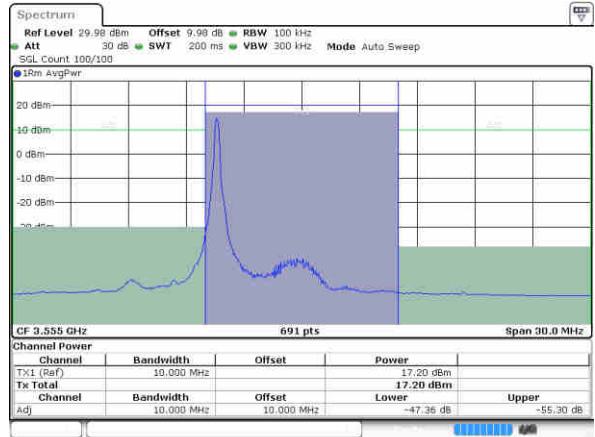


Highest Channel / 20MHz / 16QAM

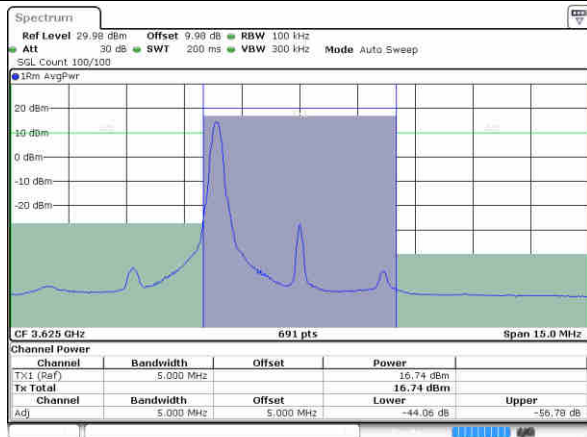


LTE Band 48
Lowest Channel / 5MHz / 64QAM


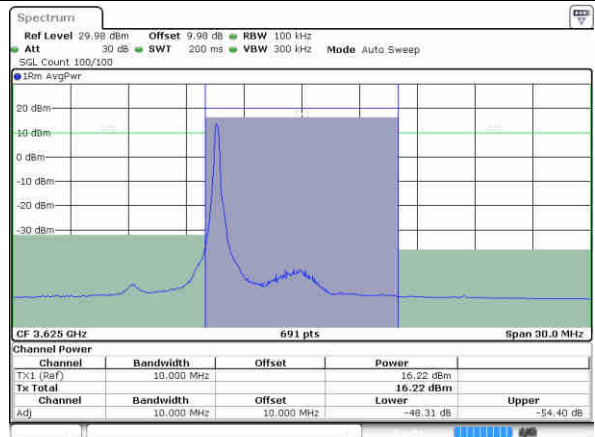
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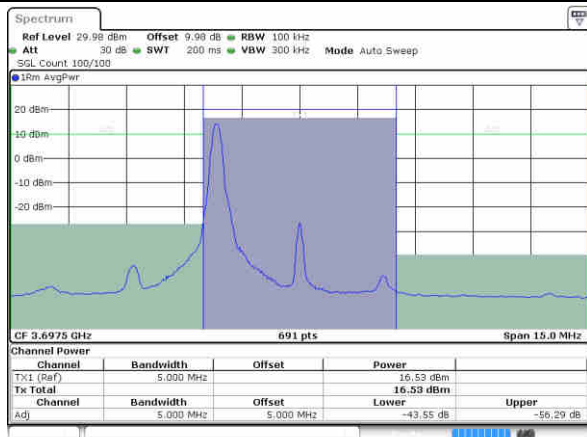
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Middle Channel / 5MHz / 64QAM


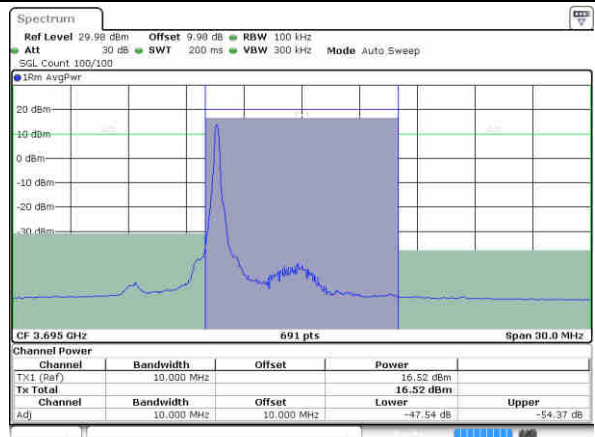
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Middle Channel / 10MHz / 64QAM


Date: 15 JUL 2020 06:10:44

Highest Channel / 5MHz / 64QAM


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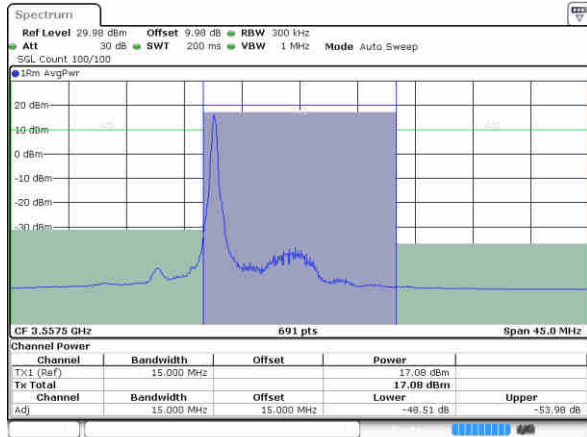
Highest Channel / 10MHz / 64QAM


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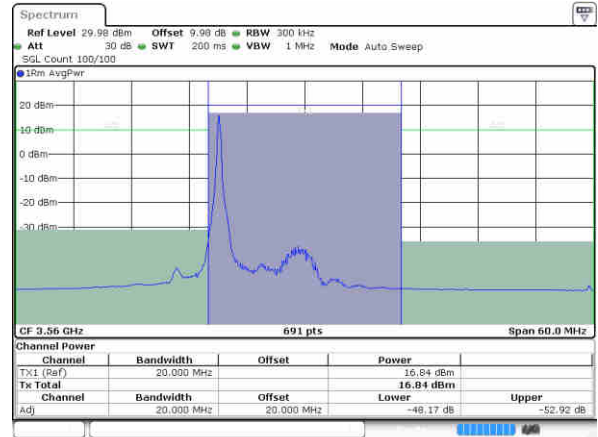


LTE Band 48

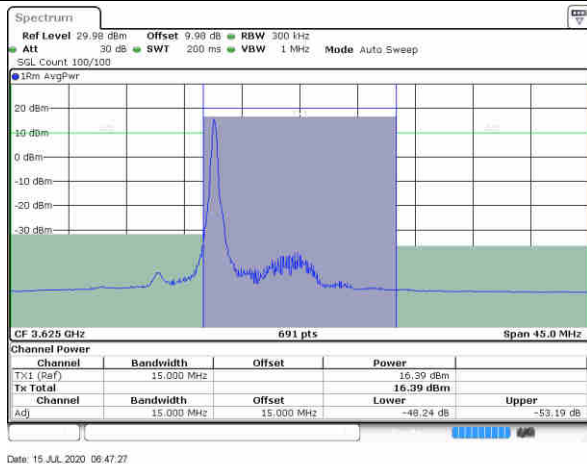
Lowest Channel / 15MHz / 64QAM



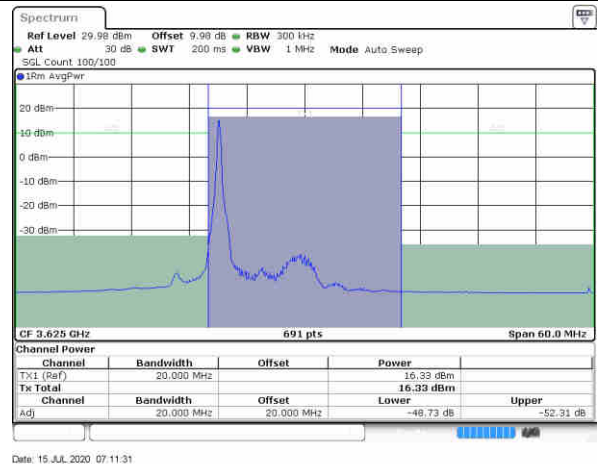
Lowest Channel / 20MHz / 64QAM



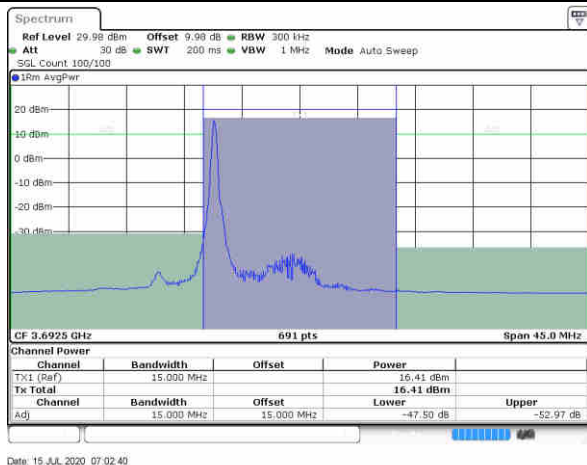
Middle Channel / 15MHz / 64QAM



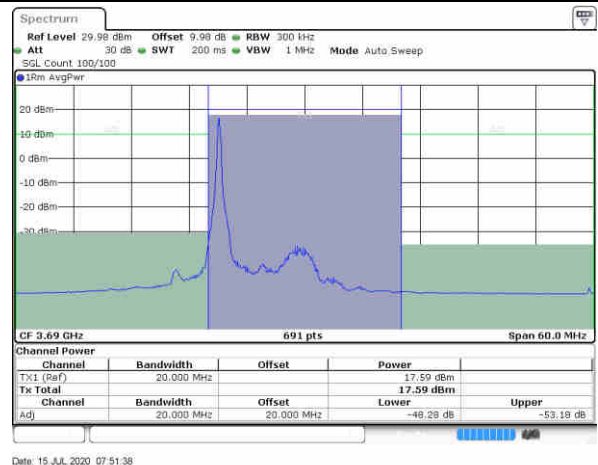
Middle Channel / 20MHz / 64QAM



Highest Channel / 15MHz / 64QAM



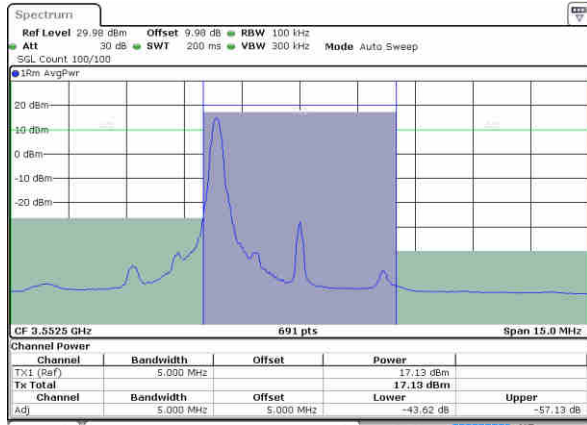
Highest Channel / 20MHz / 64QAM





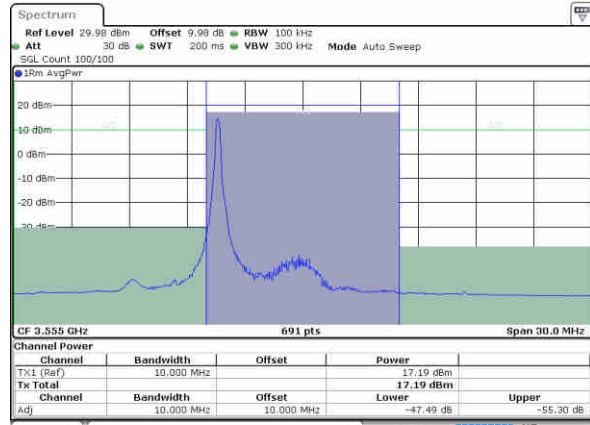
LTE Band 48

Lowest Channel / 5MHz / 256QAM



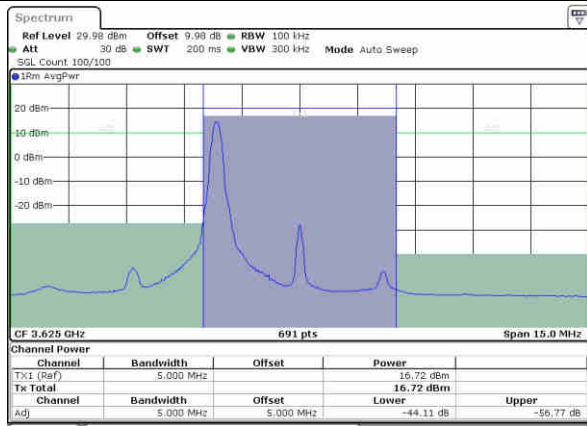
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Lowest Channel / 10MHz / 256QAM



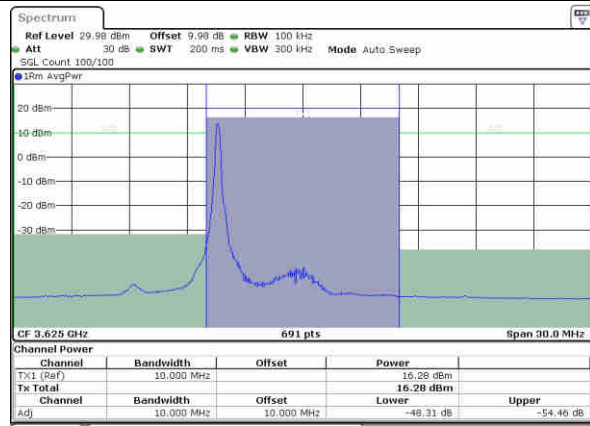
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Middle Channel / 5MHz / 256QAM



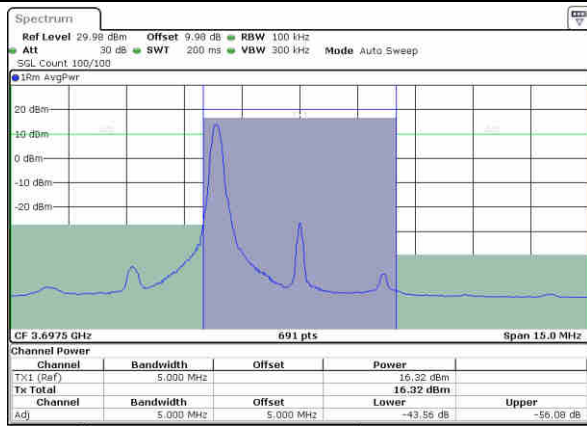
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Middle Channel / 10MHz / 256QAM



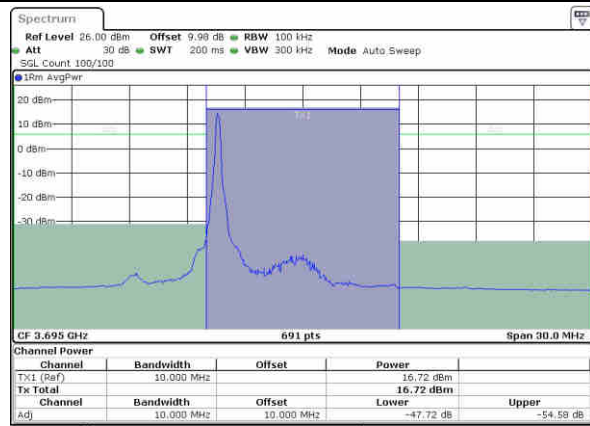
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Highest Channel / 5MHz / 256QAM



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Highest Channel / 10MHz / 256QAM

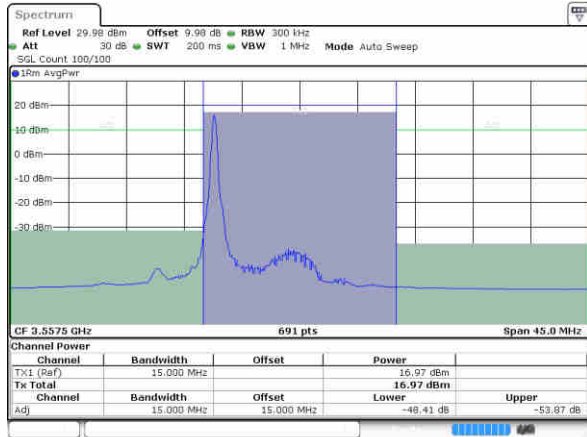


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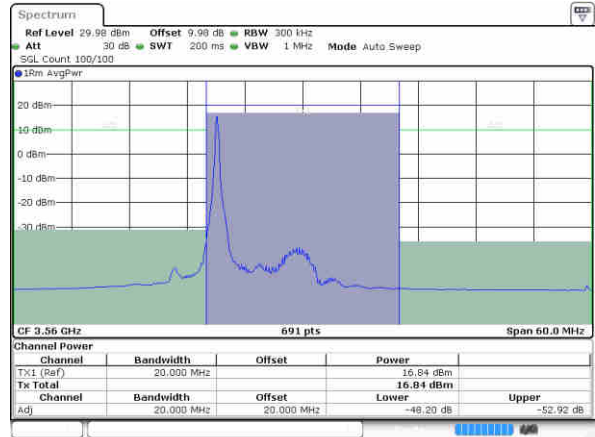


LTE Band 48

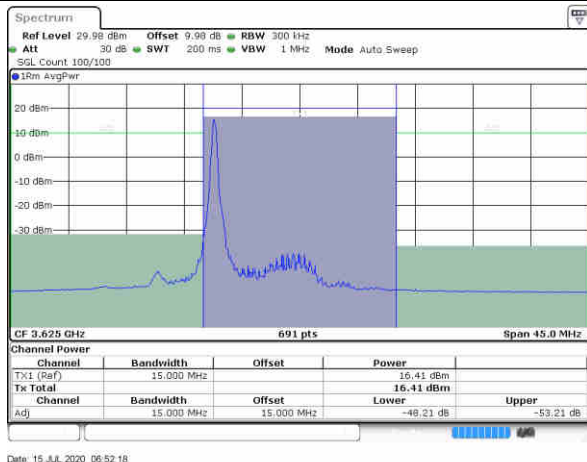
Lowest Channel / 15MHz / 256QAM



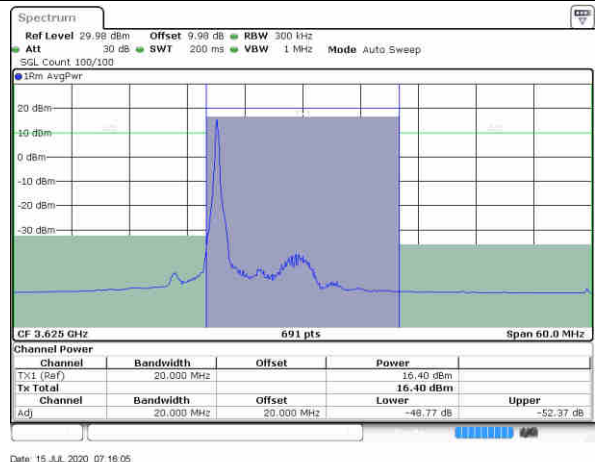
Lowest Channel / 20MHz / 256QAM



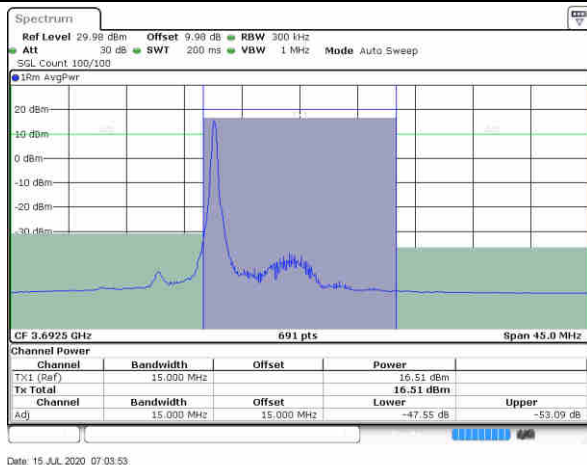
Middle Channel / 15MHz / 256QAM



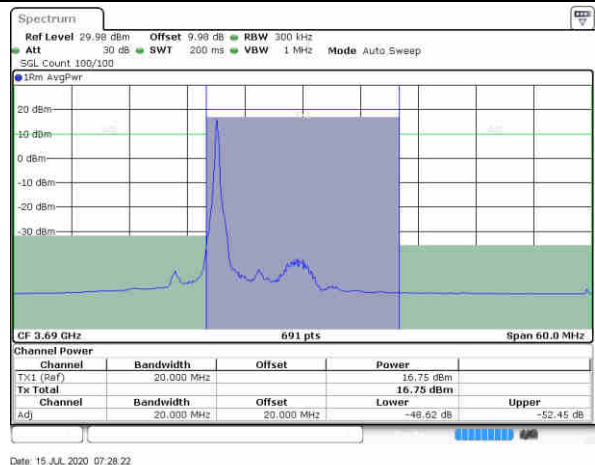
Middle Channel / 20MHz / 256QAM



Highest Channel / 15MHz / 256QAM



Highest Channel / 20MHz / 256QAM

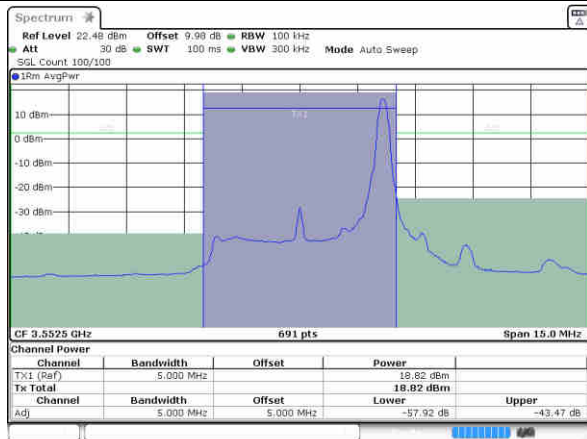




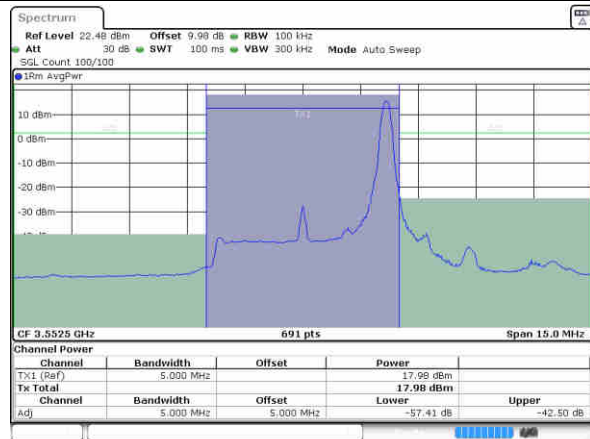
1RB Max

LTE Band 48

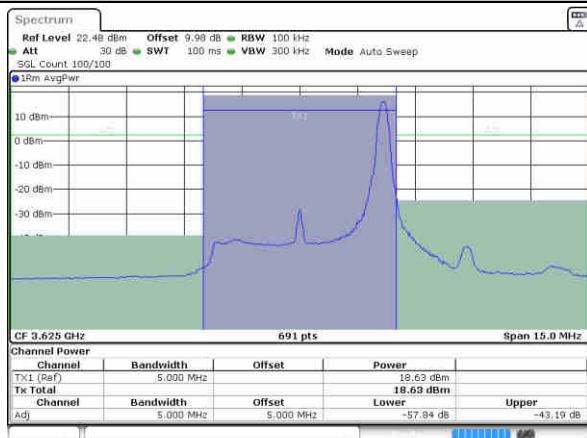
Lowest Channel / 5MHz / QPSK



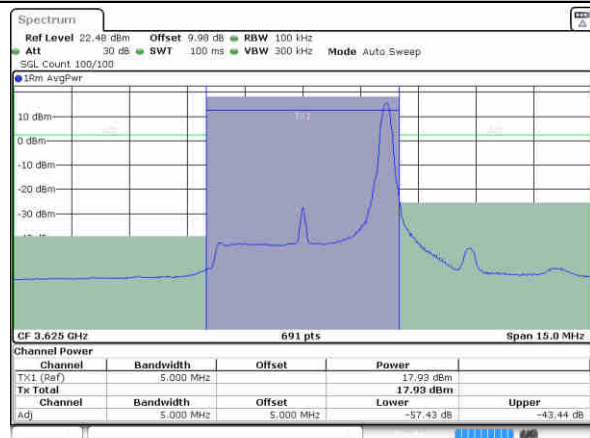
Lowest Channel / 5MHz / 16QAM



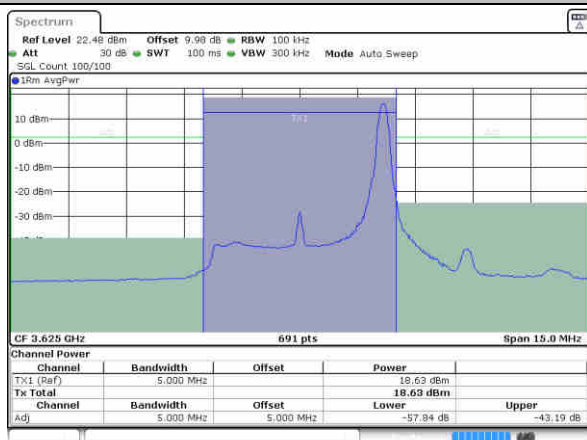
Middle Channel / 5MHz / QPSK



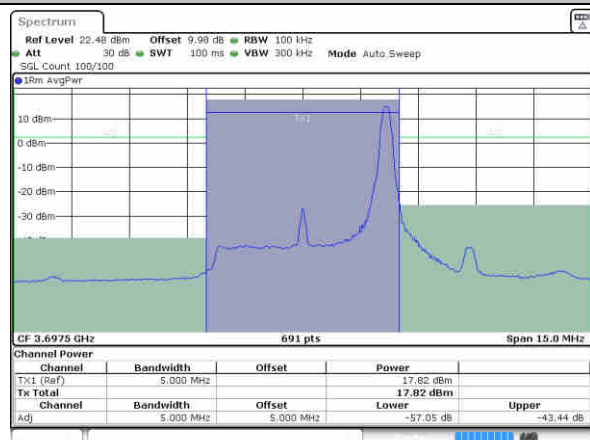
Middle Channel / 5MHz / 16QAM



Highest Channel / 5MHz / QPSK



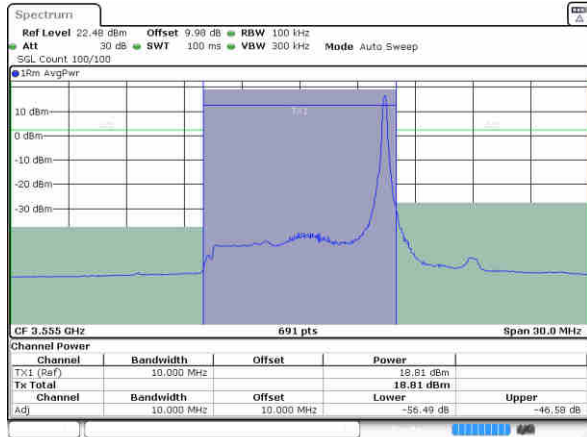
Highest Channel / 5MHz / 16QAM



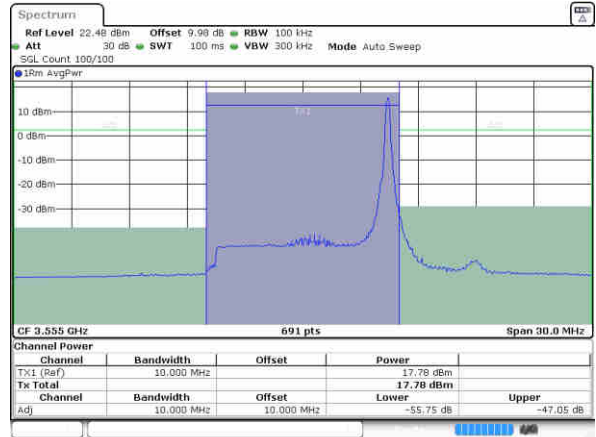


LTE Band 48

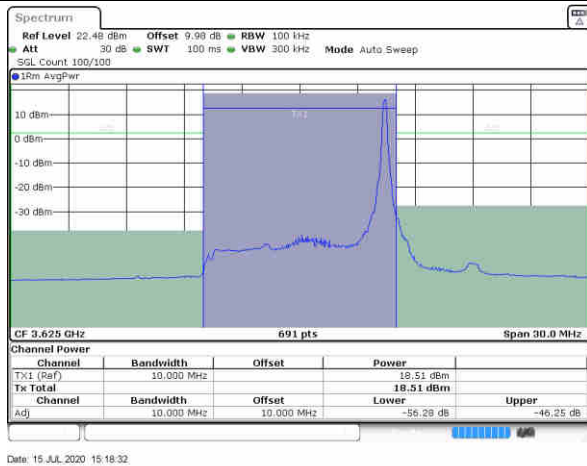
Lowest Channel / 10MHz / QPSK



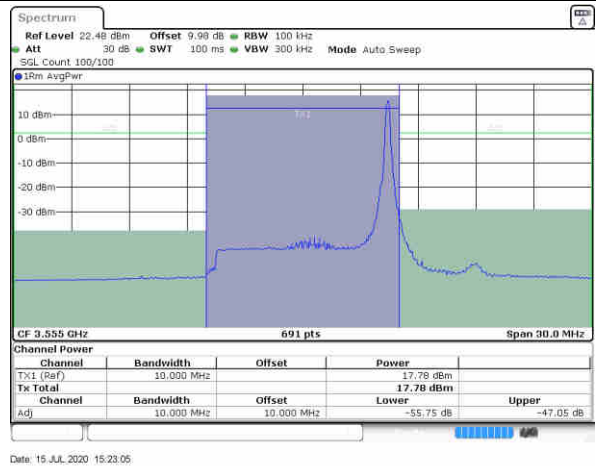
Lowest Channel / 10MHz / 16QAM



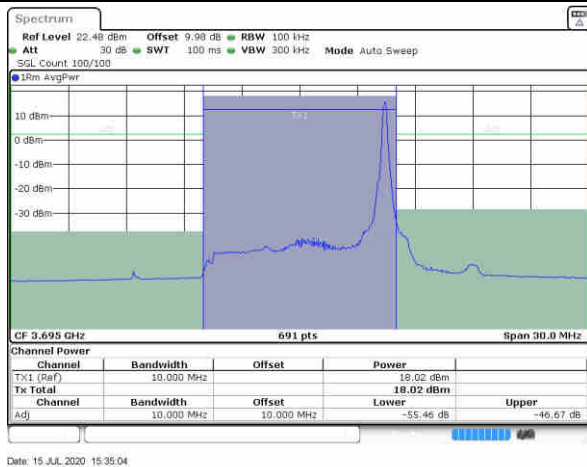
Middle Channel / 10MHz / QPSK



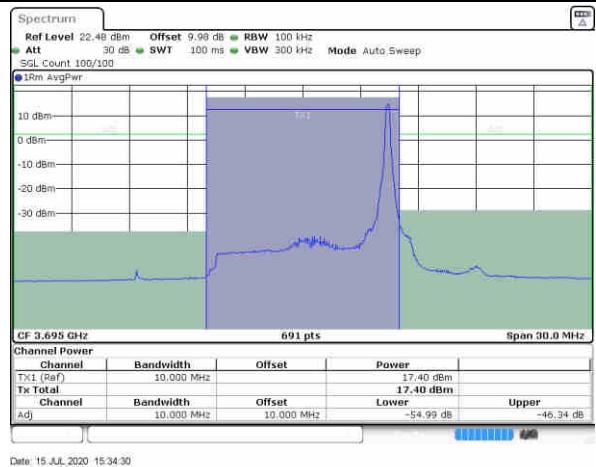
Middle Channel / 10MHz / 16QAM



Highest Channel / 10MHz / QPSK

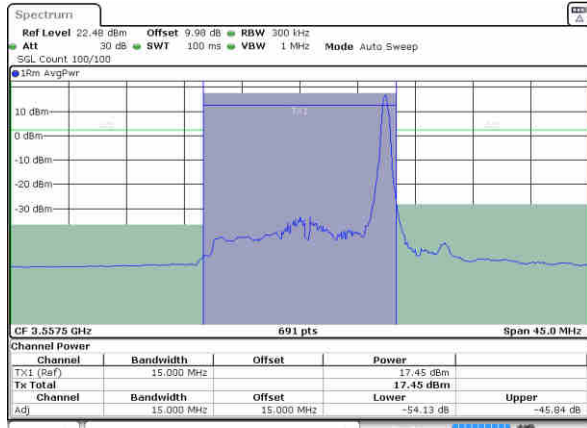


Highest Channel / 10MHz / 16QAM



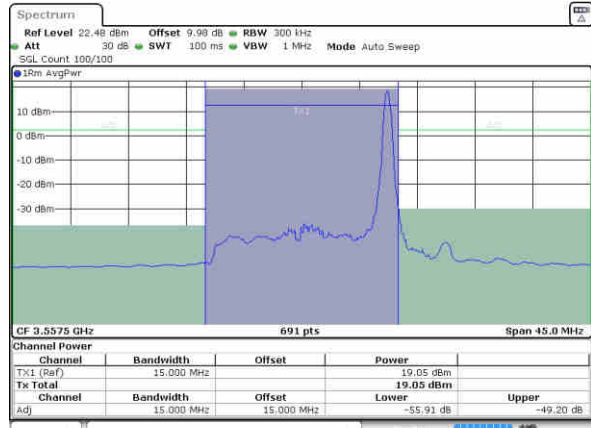
LTE Band 48

Lowest Channel / 15MHz / QPSK



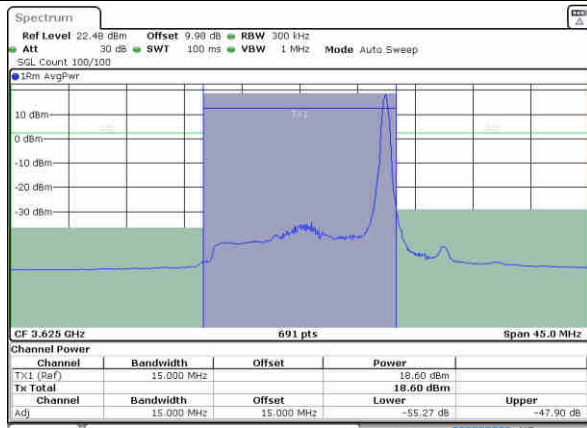
Date: 15 JUL 2020 15:58:34

Lowest Channel / 15MHz / 16QAM



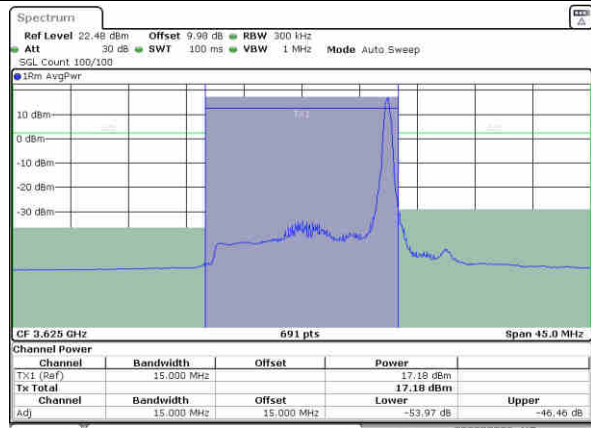
Date: 15 JUL 2020 16:00:32

Middle Channel / 15MHz / QPSK



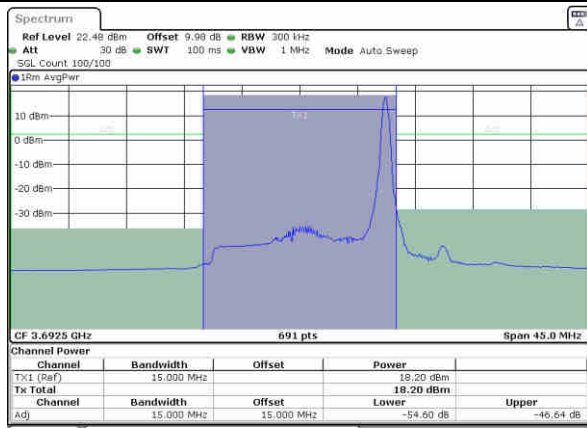
Date: 15 JUL 2020 15:39:59

Middle Channel / 15MHz / 16QAM



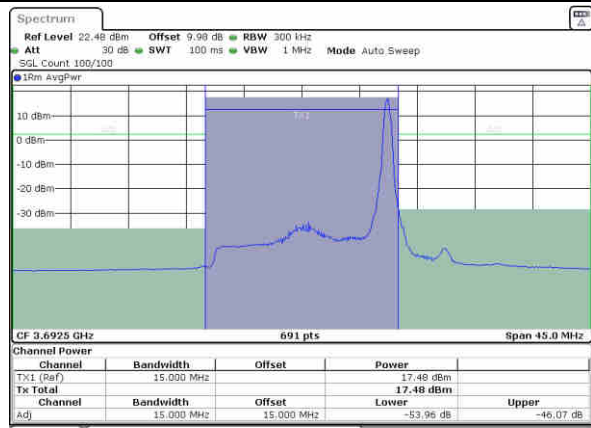
Date: 15 JUL 2020 15:39:24

Highest Channel / 15MHz / QPSK



Date: 15 JUL 2020 16:05:55

Highest Channel / 15MHz / 16QAM

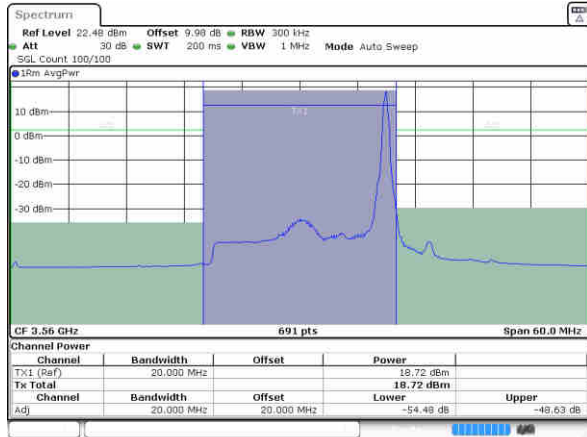


Date: 15 JUL 2020 16:05:24

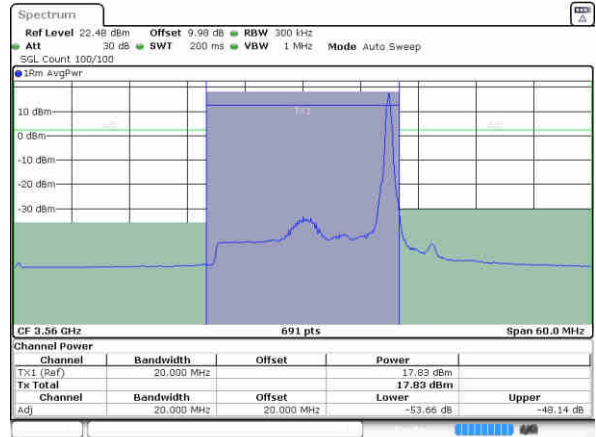


LTE Band 48

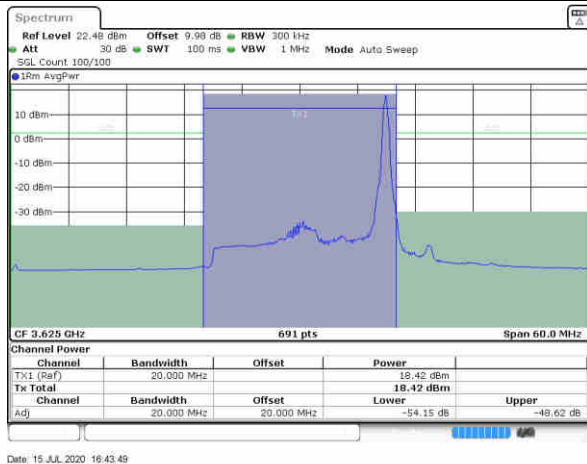
Lowest Channel / 20MHz / QPSK



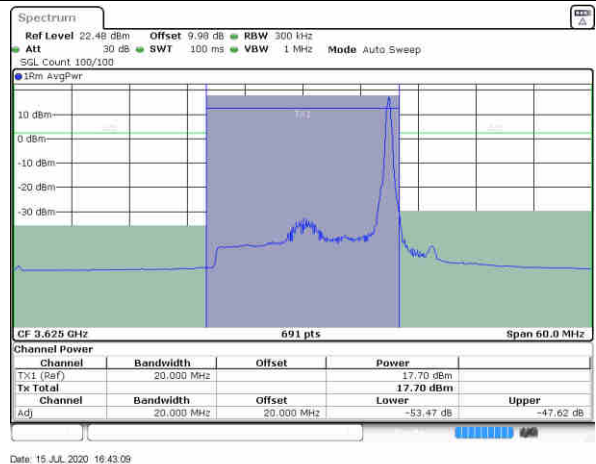
Lowest Channel / 20MHz / 16QAM



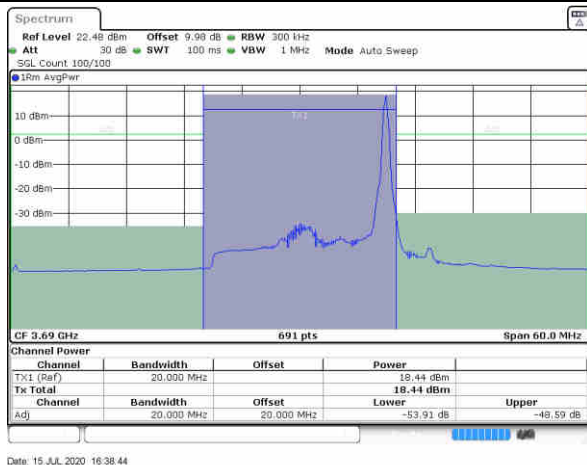
Middle Channel / 20MHz / QPSK



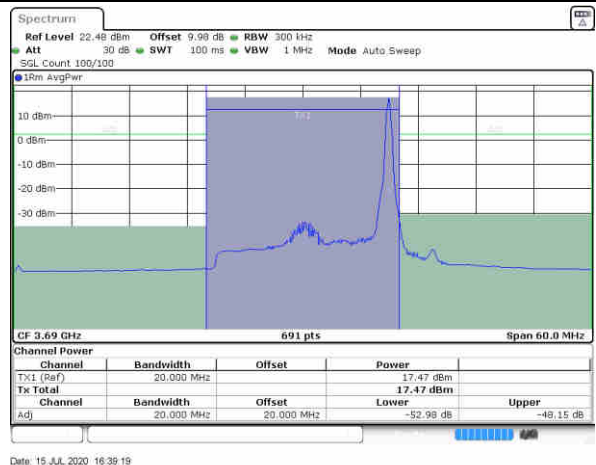
Middle Channel / 20MHz / 16QAM



Highest Channel / 20MHz / QPSK



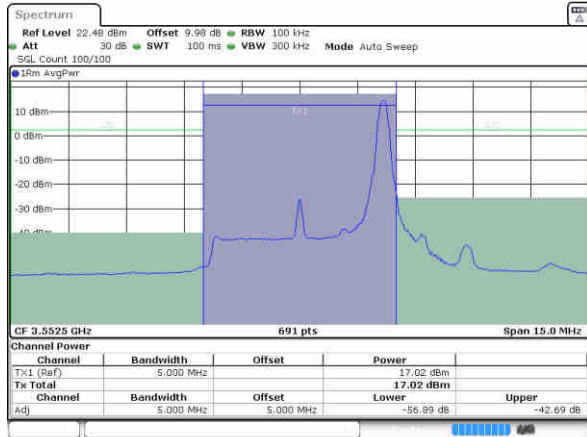
Highest Channel / 20MHz / 16QAM



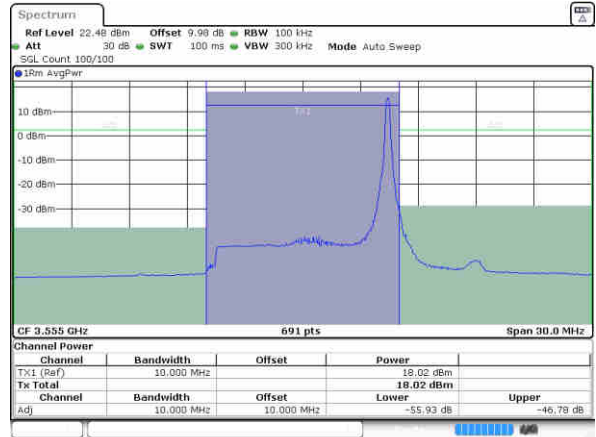


LTE Band 48

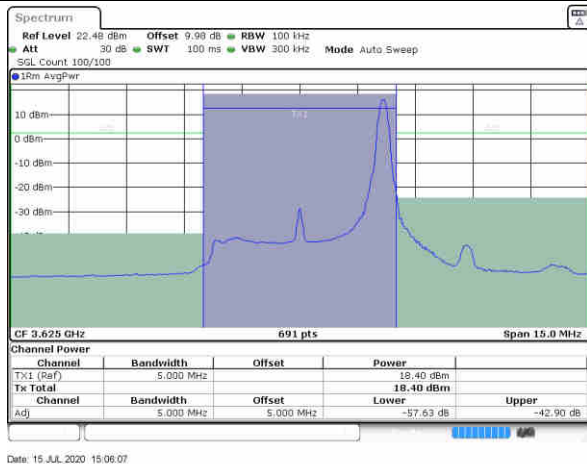
Lowest Channel / 5MHz / 64QAM



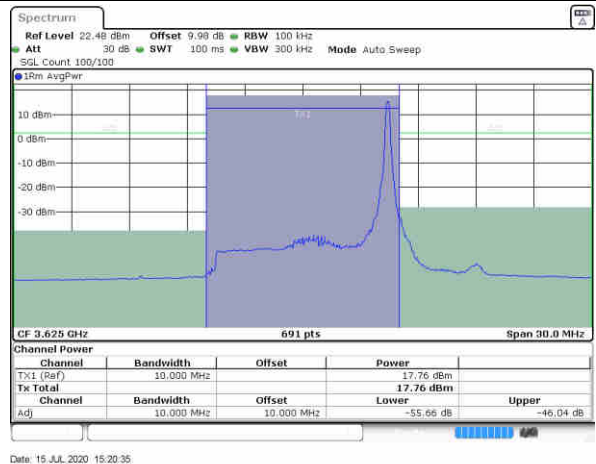
Lowest Channel / 10MHz / 64QAM



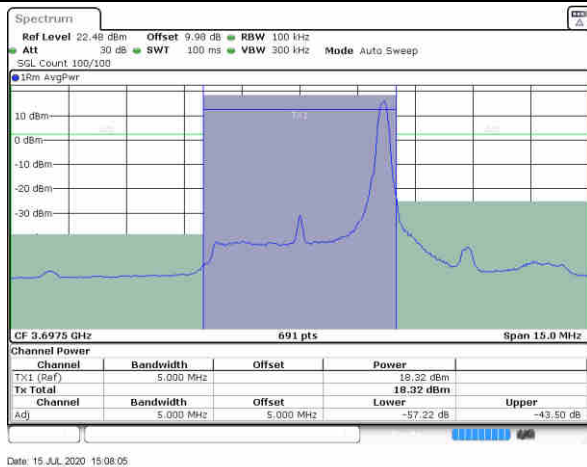
Middle Channel / 5MHz / 64QAM



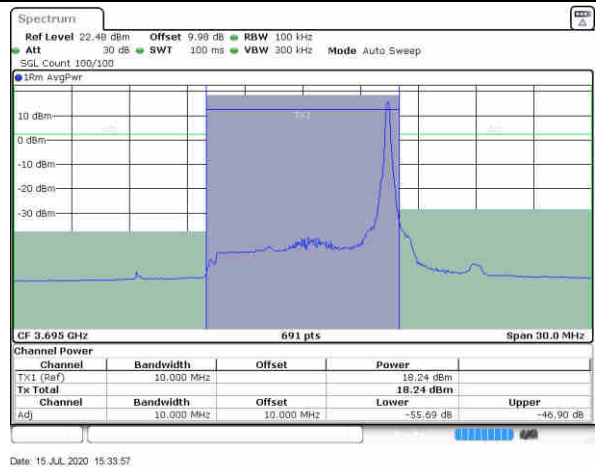
Middle Channel / 10MHz / 64QAM



Highest Channel / 5MHz / 64QAM



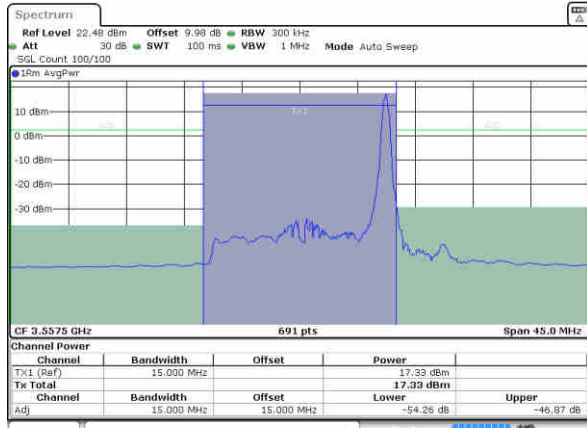
Highest Channel / 10MHz / 64QAM





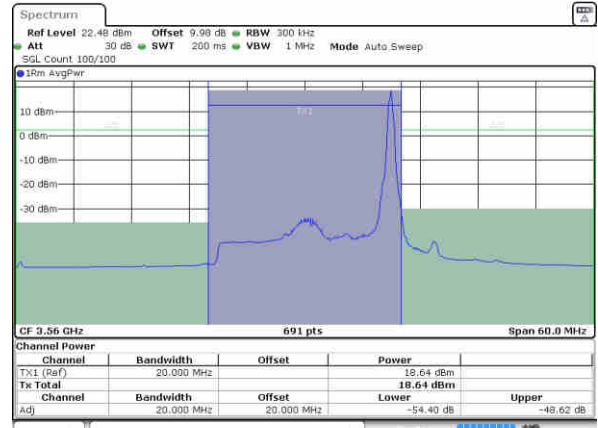
LTE Band 48

Lowest Channel / 15MHz / 64QAM



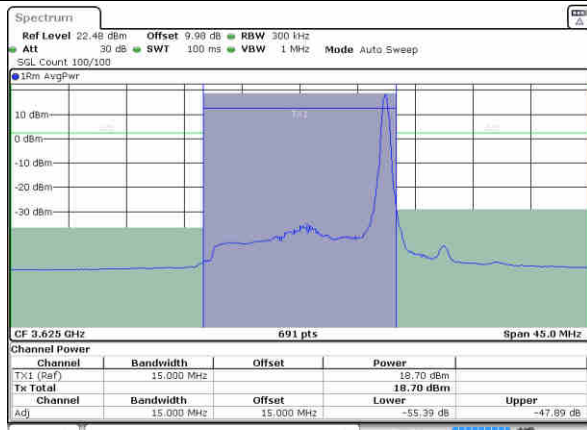
Date: 15 JUL 2020 16:01:59

Lowest Channel / 20MHz / 64QAM



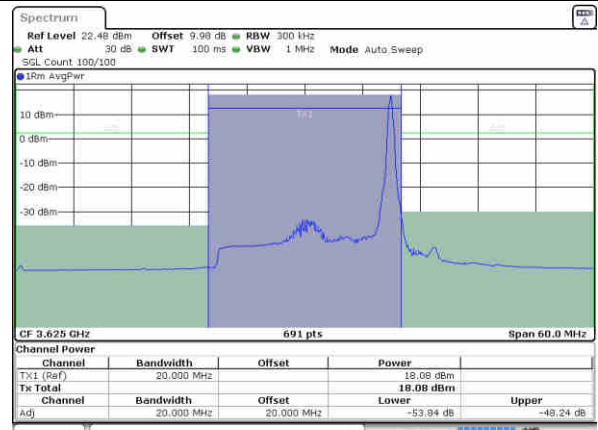
Date: 15 JUL 2020 16:46:47

Middle Channel / 15MHz / 64QAM



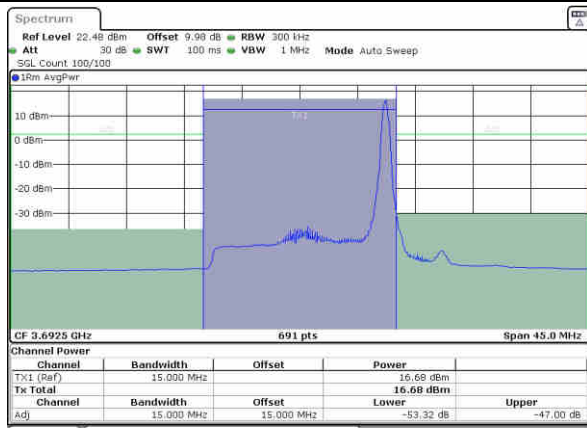
Date: 15 JUL 2020 15:38:49

Middle Channel / 20MHz / 64QAM



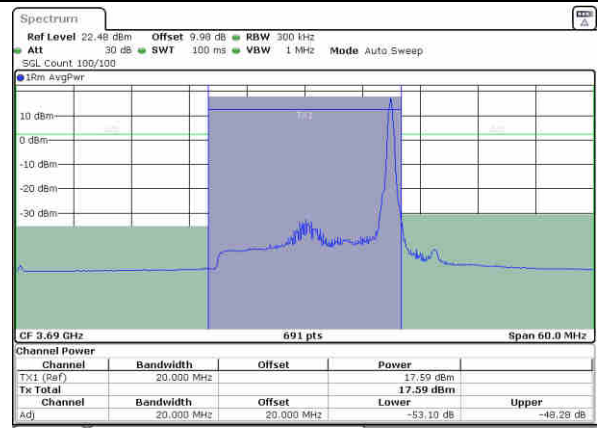
Date: 15 JUL 2020 16:42:38

Highest Channel / 15MHz / 64QAM



Date: 15 JUL 2020 16:04:49

Highest Channel / 20MHz / 64QAM

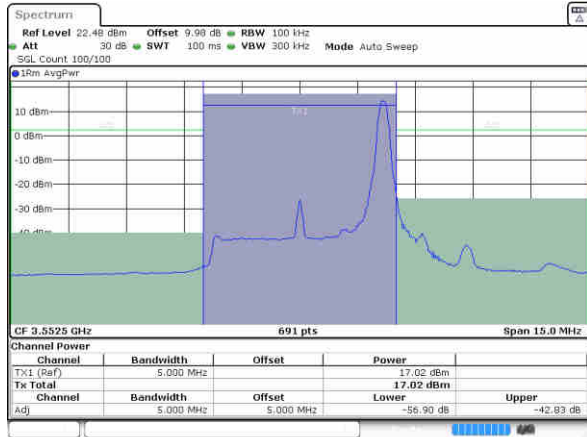


Date: 15 JUL 2020 16:40:53

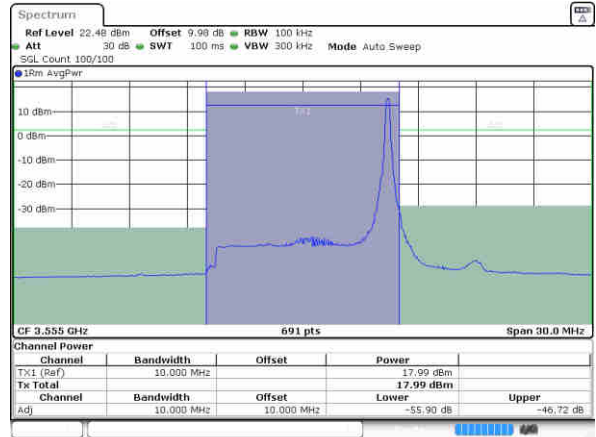


LTE Band 48

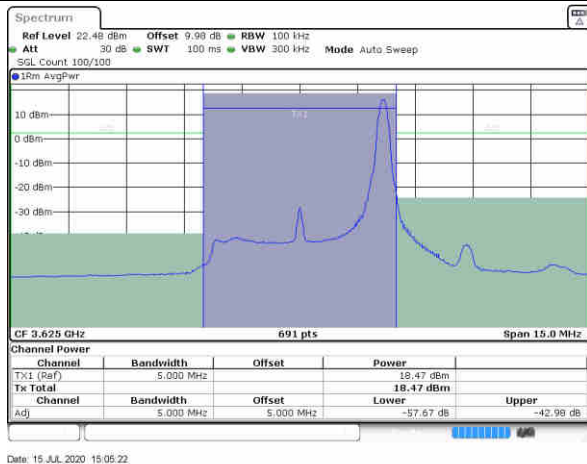
Lowest Channel / 5MHz / 256QAM



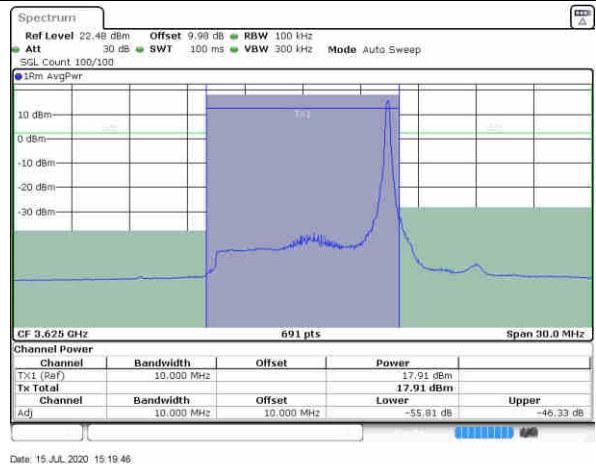
Lowest Channel / 10MHz / 256QAM



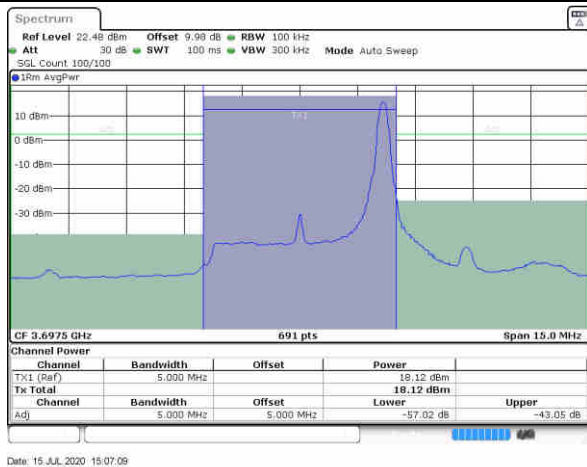
Middle Channel / 5MHz / 256QAM



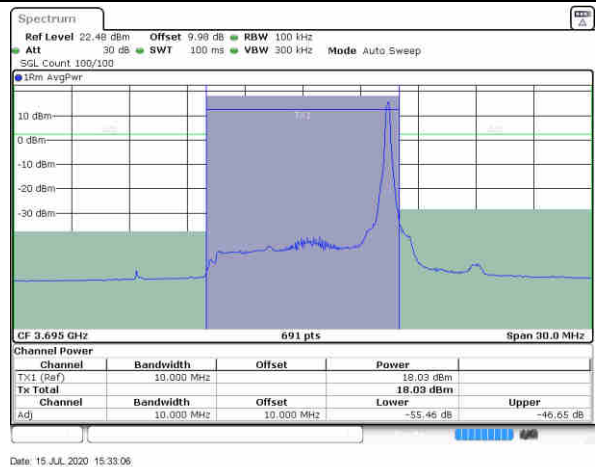
Middle Channel / 10MHz / 256QAM



Highest Channel / 5MHz / 256QAM



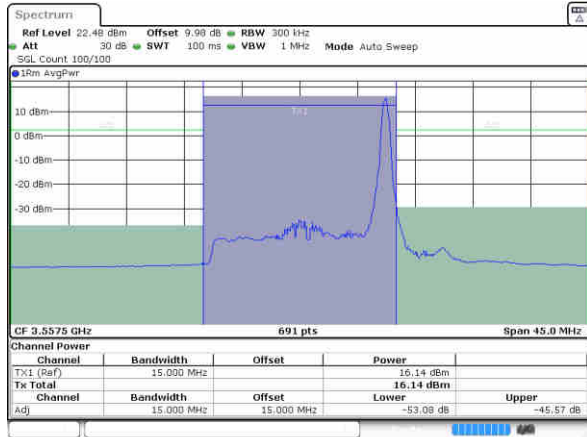
Highest Channel / 10MHz / 256QAM



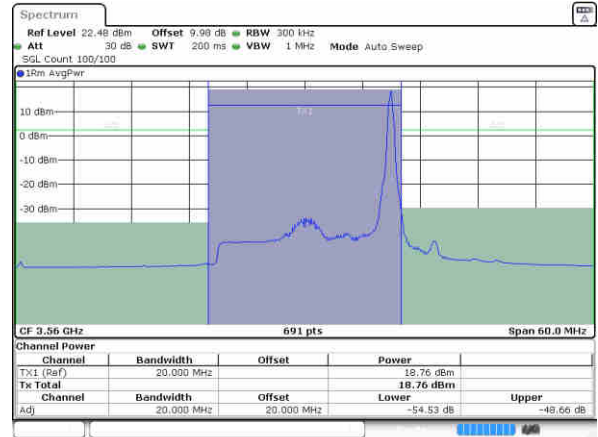


LTE Band 48

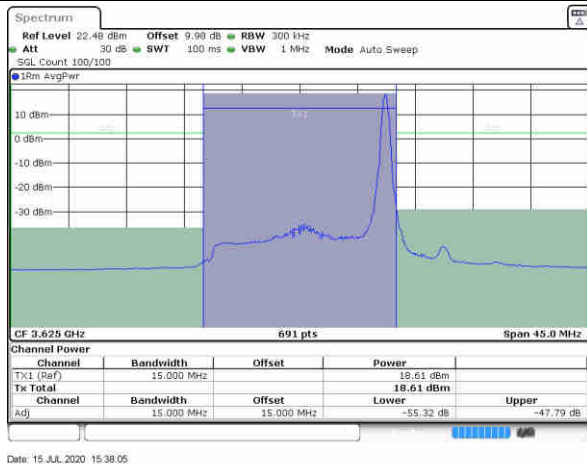
Lowest Channel / 15MHz / 256QAM



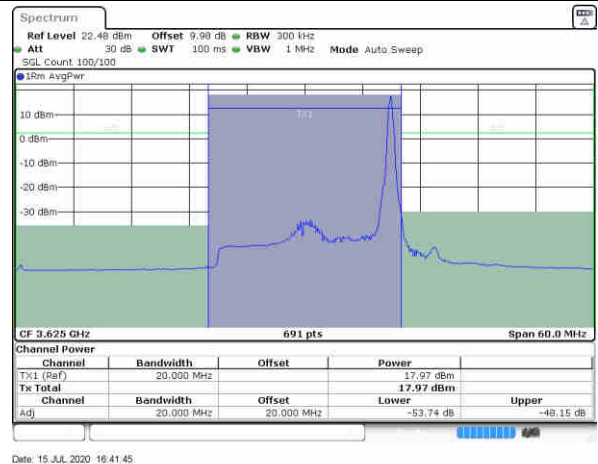
Lowest Channel / 20MHz / 256QAM



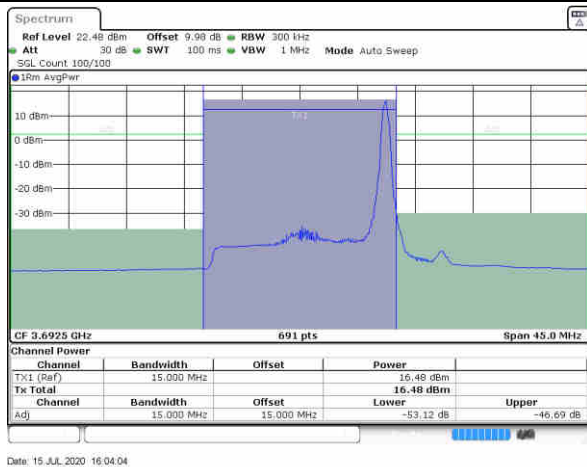
Middle Channel / 15MHz / 256QAM



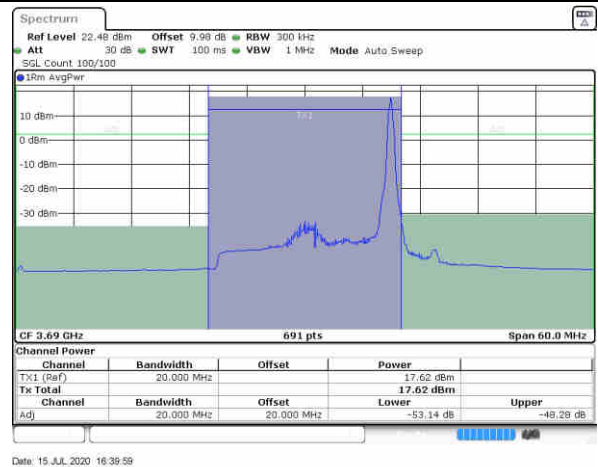
Middle Channel / 20MHz / 256QAM



Highest Channel / 15MHz / 256QAM



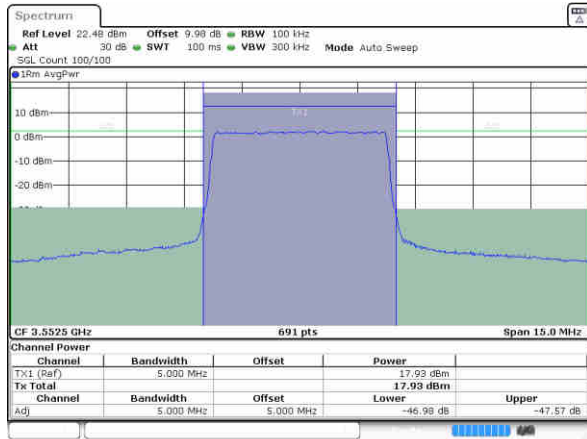
Highest Channel / 20MHz / 256QAM



Full RB

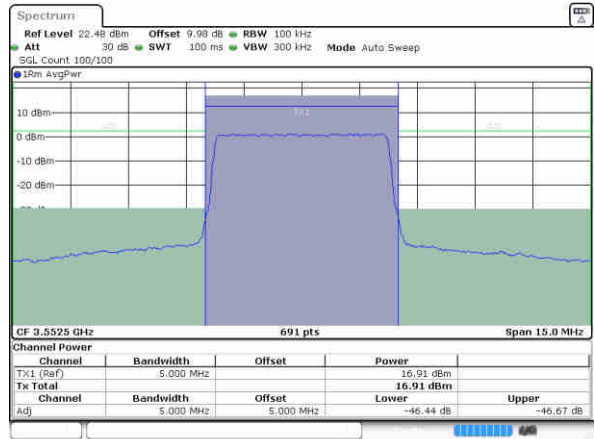
LTE Band 48

Lowest Channel / 5MHz / QPSK



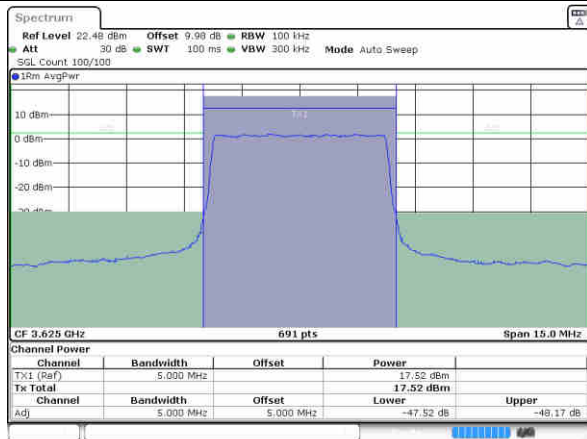
Date: 15 JUL 2020 14:51:15

Lowest Channel / 5MHz / 16QAM



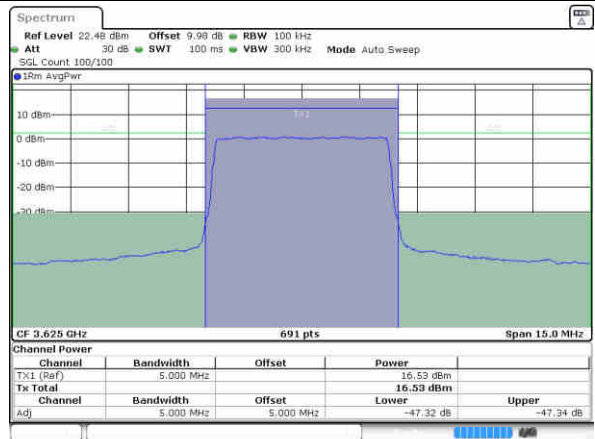
Date: 15 JUL 2020 14:45:09

Middle Channel / 5MHz / QPSK



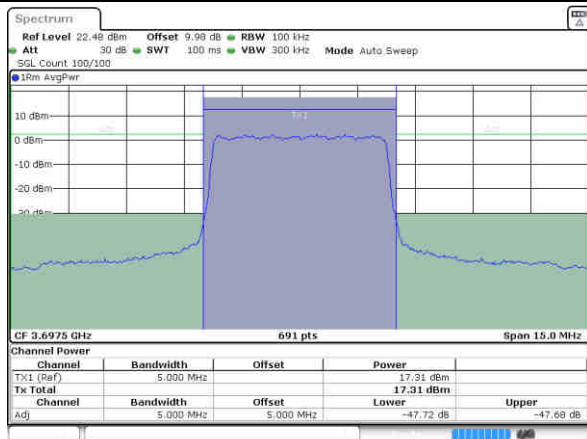
Date: 15 JUL 2020 14:58:08

Middle Channel / 5MHz / 16QAM



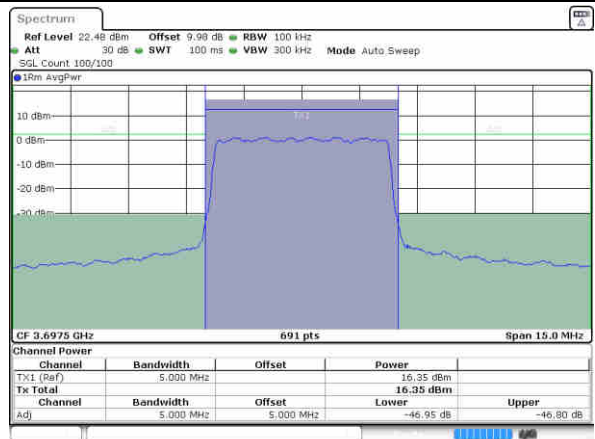
Date: 15 JUL 2020 14:58:54

Highest Channel / 5MHz / QPSK



Date: 15 JUL 2020 15:10:18

Highest Channel / 5MHz / 16QAM

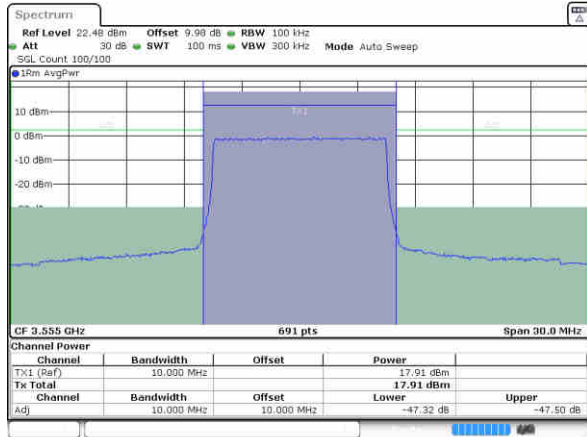


Date: 15 JUL 2020 15:10:54

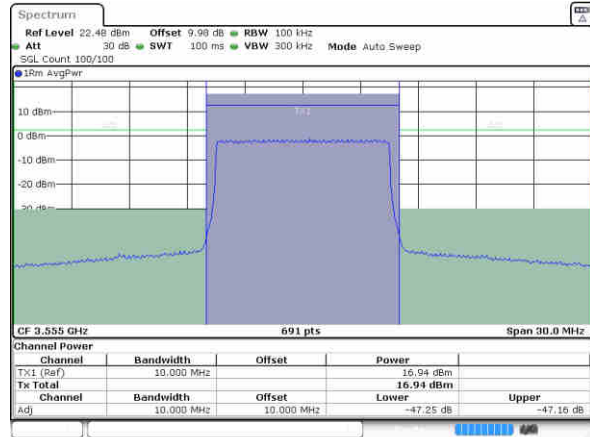


LTE Band 48

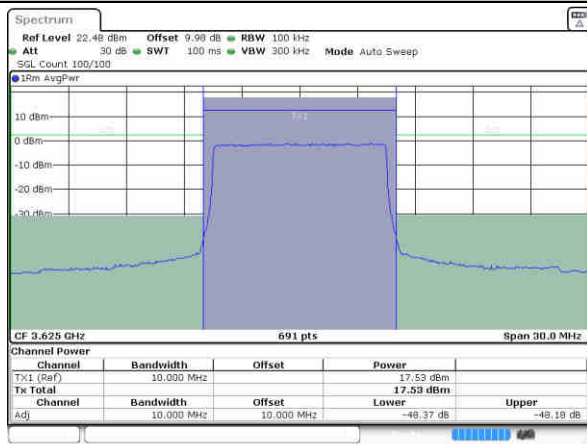
Lowest Channel / 10MHz / QPSK



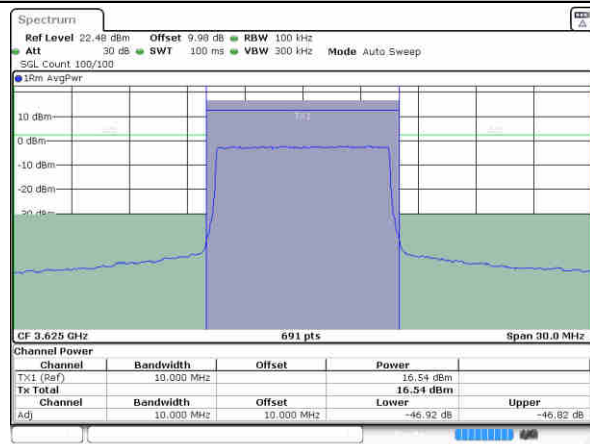
Lowest Channel / 10MHz / 16QAM



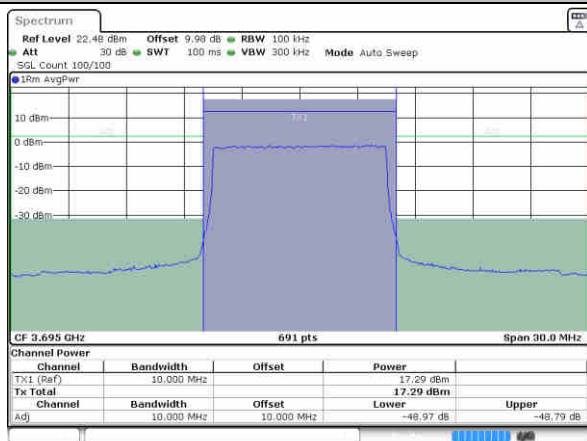
Middle Channel / 10MHz / QPSK



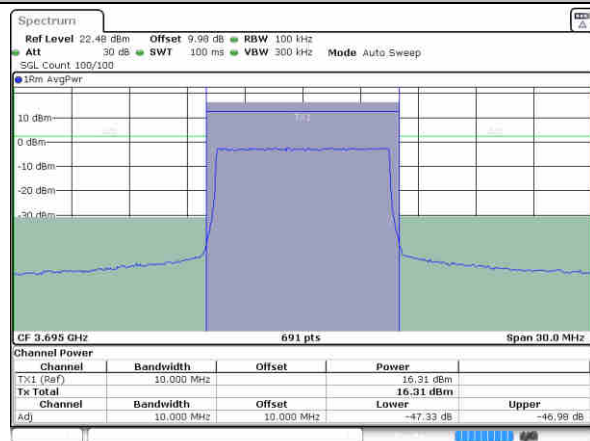
Middle Channel / 10MHz / 16QAM



Highest Channel / 10MHz / QPSK



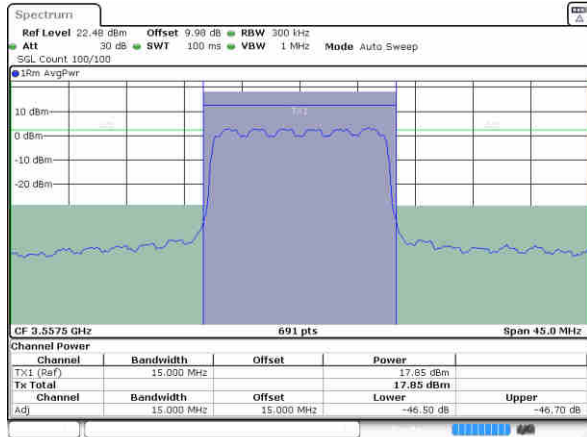
Highest Channel / 10MHz / 16QAM



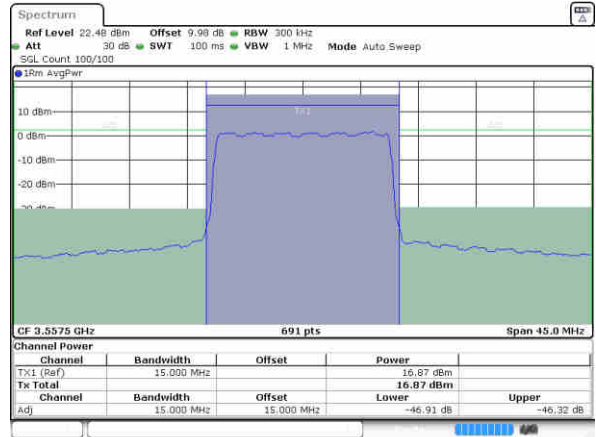


LTE Band 48

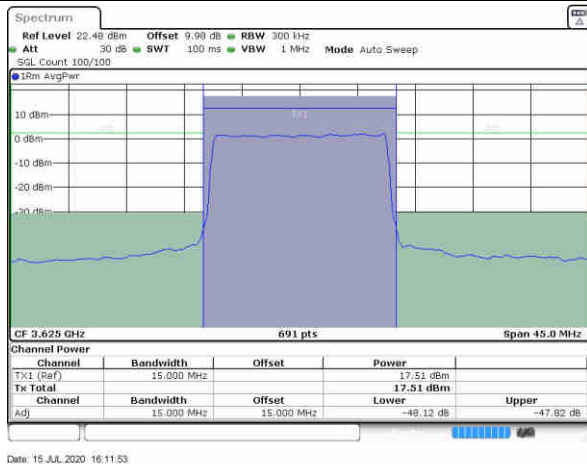
Lowest Channel / 15MHz / QPSK



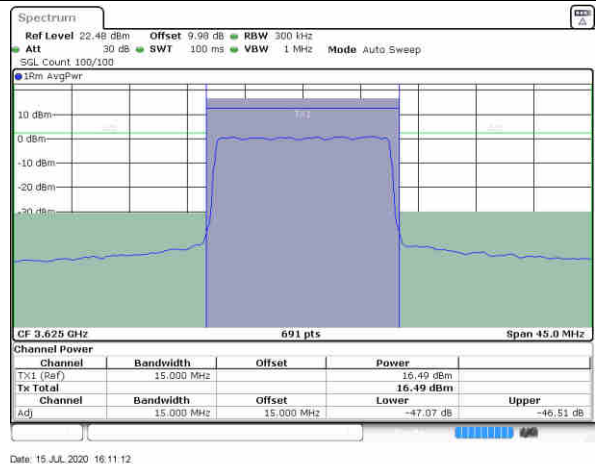
Lowest Channel / 15MHz / 16QAM



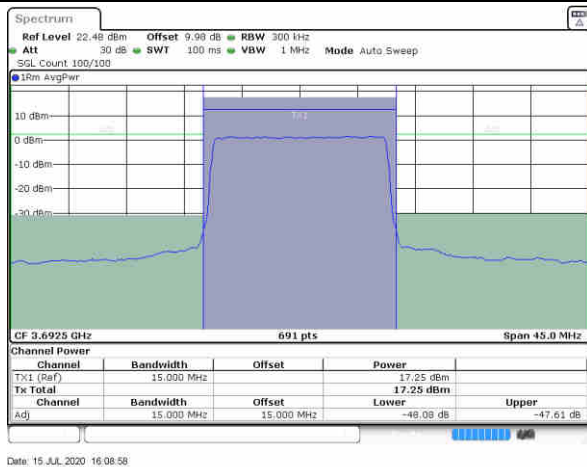
Middle Channel / 15MHz / QPSK



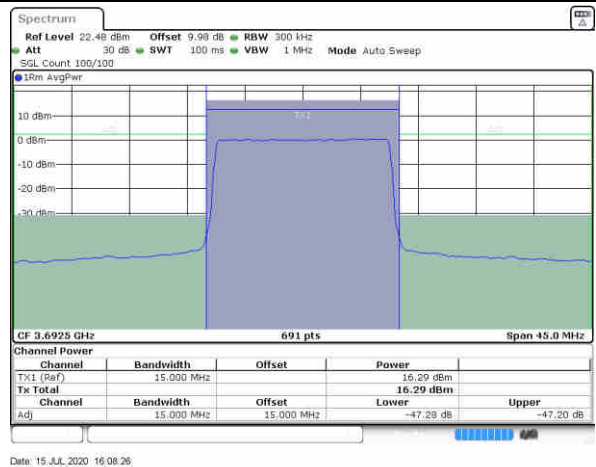
Middle Channel / 15MHz / 16QAM



Highest Channel / 15MHz / QPSK



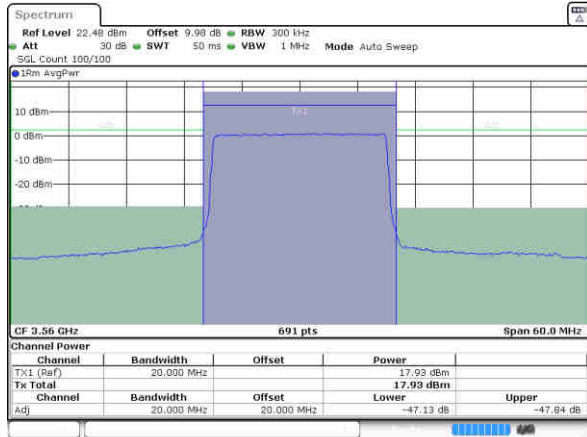
Highest Channel / 15MHz / 16QAM



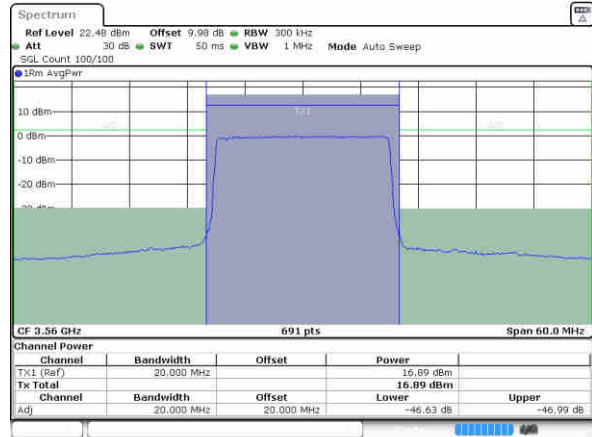


LTE Band 48

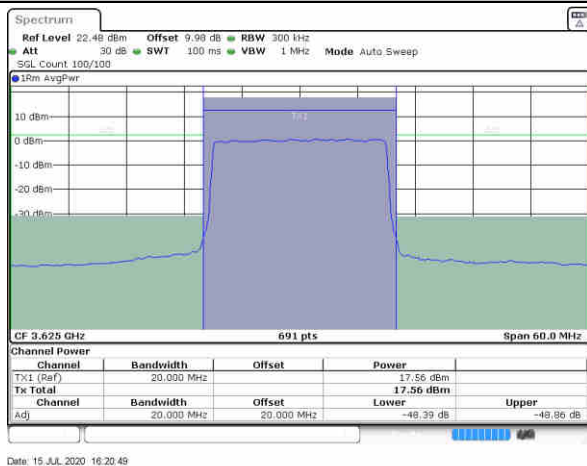
Lowest Channel / 20MHz / QPSK



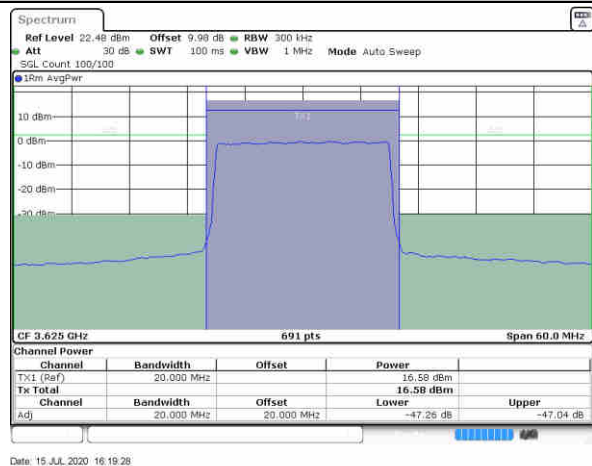
Lowest Channel / 20MHz / 16QAM



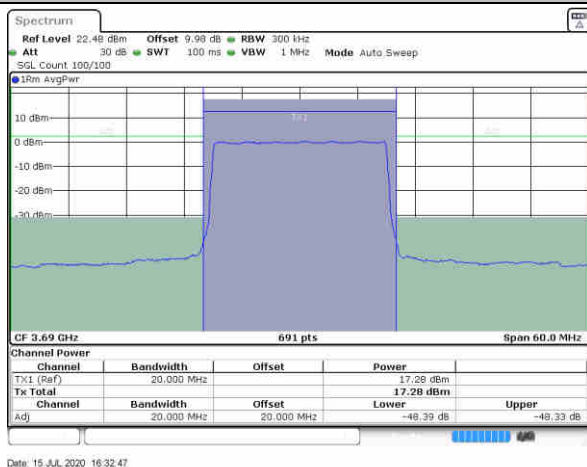
Middle Channel / 20MHz / QPSK



Middle Channel / 20MHz / 16QAM



Highest Channel / 20MHz / QPSK



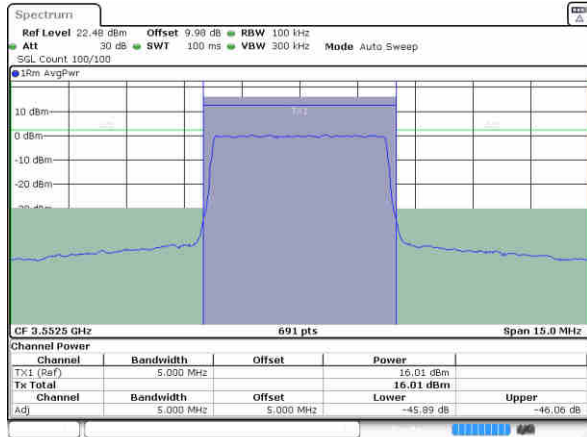
Highest Channel / 20MHz / 16QAM



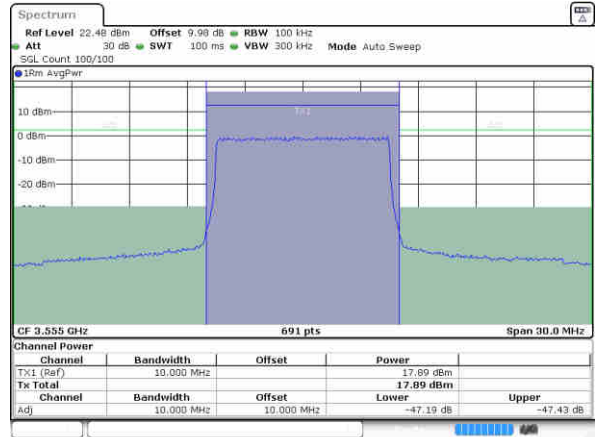


LTE Band 48

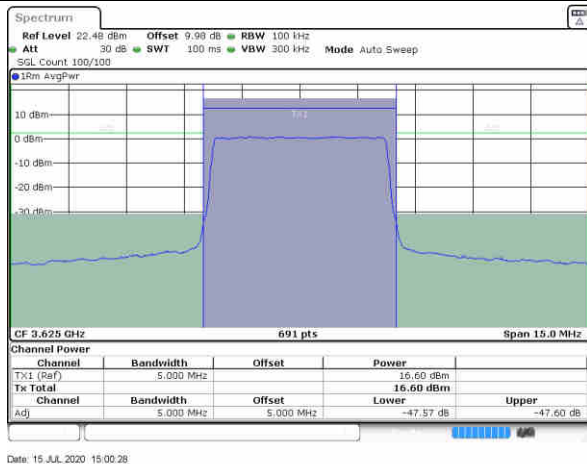
Lowest Channel / 5MHz / 64QAM



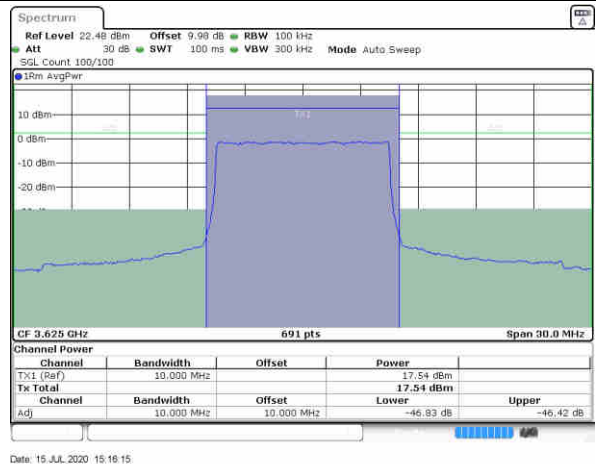
Lowest Channel / 10MHz / 64QAM



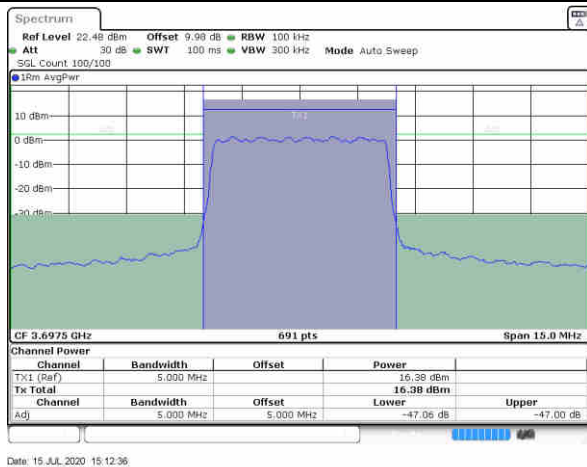
Middle Channel / 5MHz / 64QAM



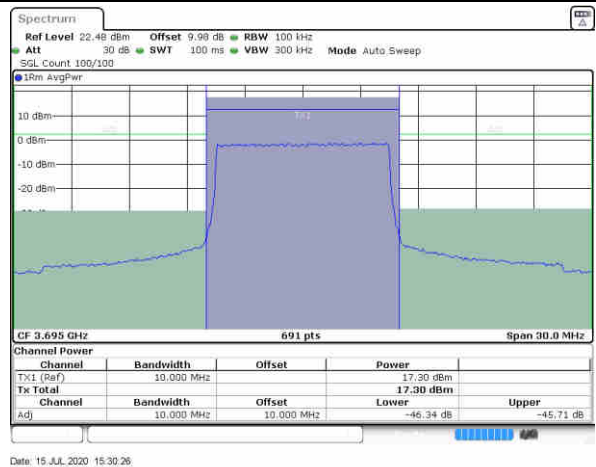
Middle Channel / 10MHz / 64QAM



Highest Channel / 5MHz / 64QAM



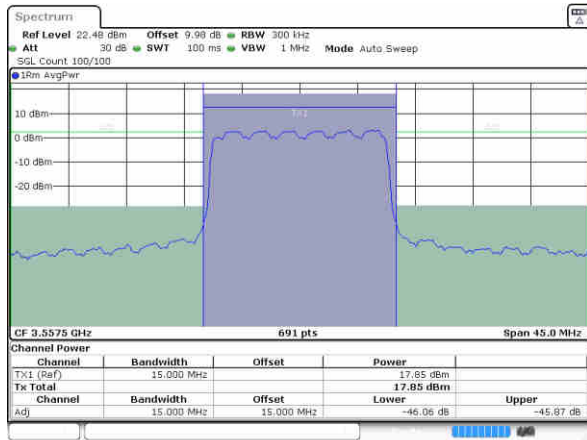
Highest Channel / 10MHz / 64QAM



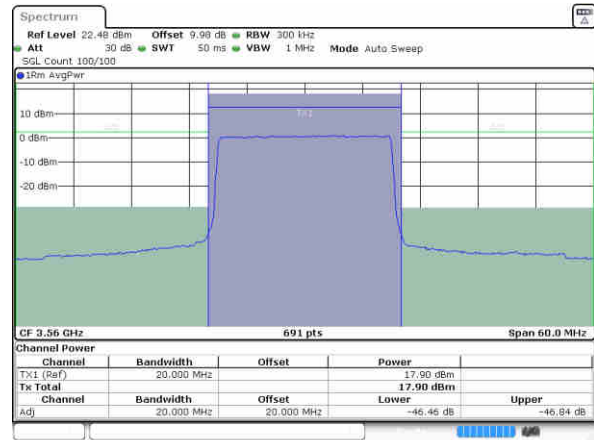


LTE Band 48

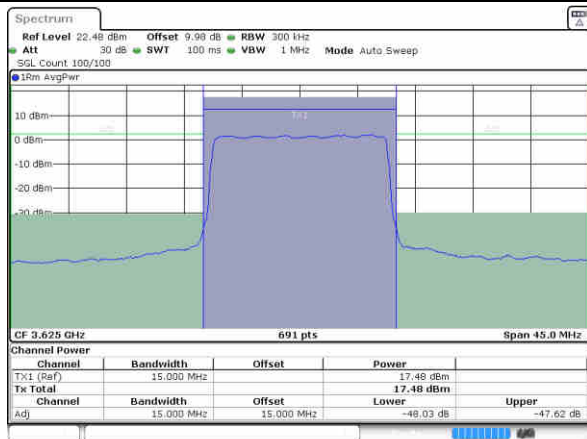
Lowest Channel / 15MHz / 64QAM



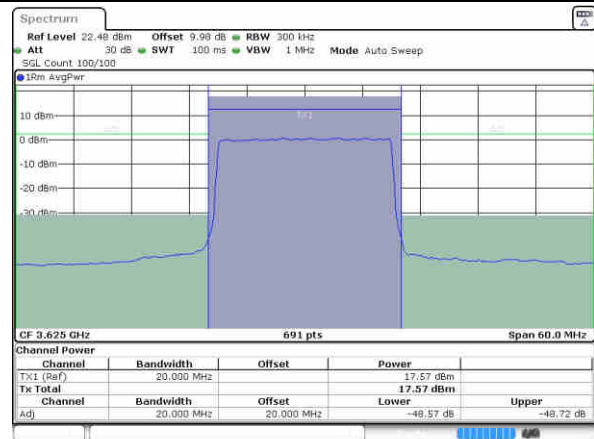
Lowest Channel / 20MHz / 64QAM



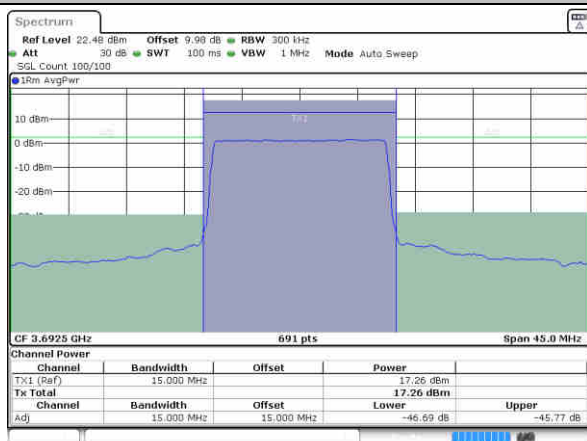
Middle Channel / 15MHz / 64QAM



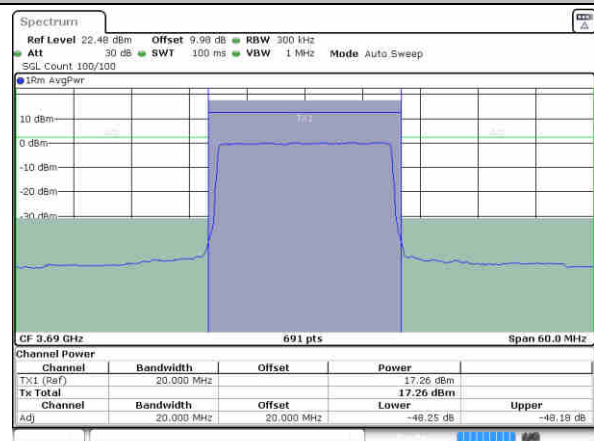
Middle Channel / 20MHz / 64QAM



Highest Channel / 15MHz / 64QAM



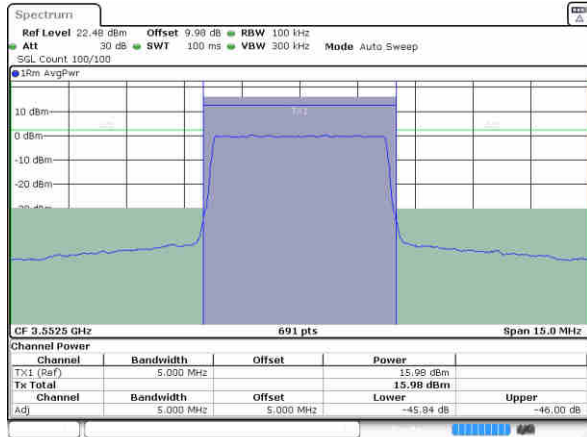
Highest Channel / 20MHz / 64QAM



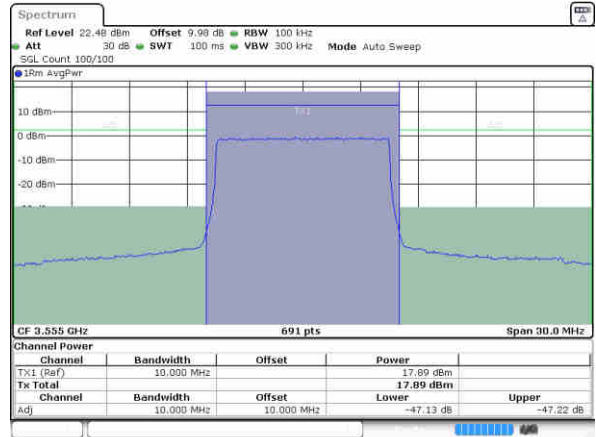


LTE Band 48

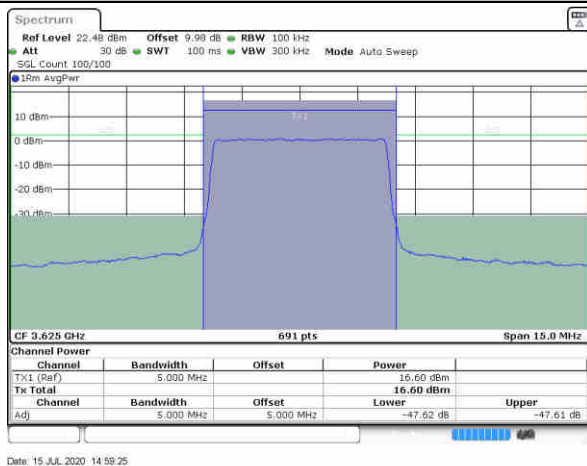
Lowest Channel / 5MHz / 256QAM



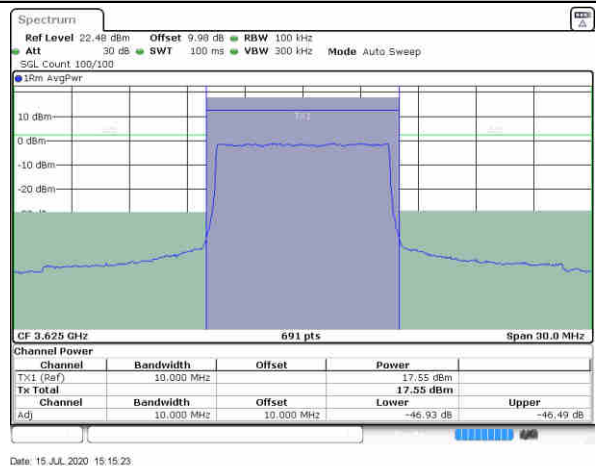
Lowest Channel / 10MHz / 256QAM



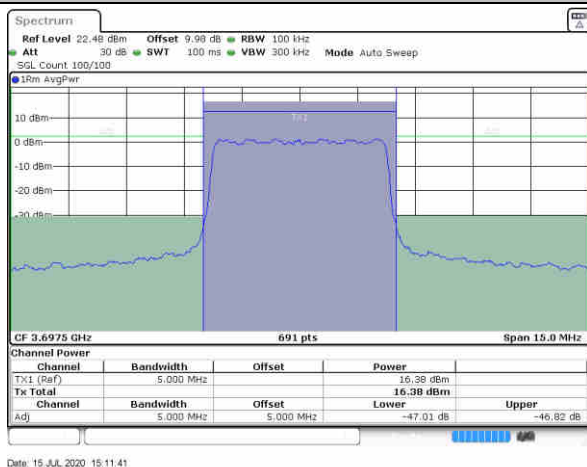
Middle Channel / 5MHz / 256QAM



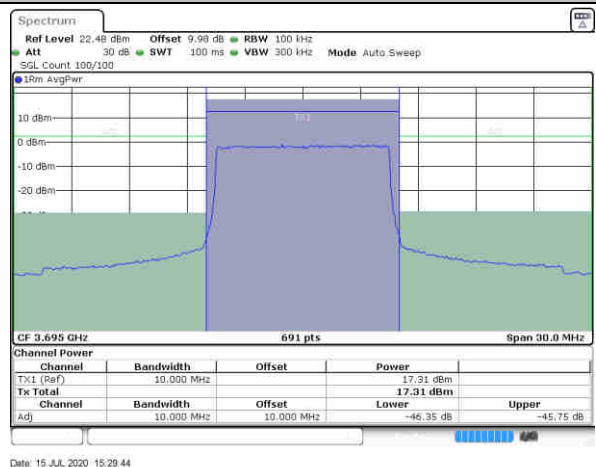
Middle Channel / 10MHz / 256QAM



Highest Channel / 5MHz / 256QAM



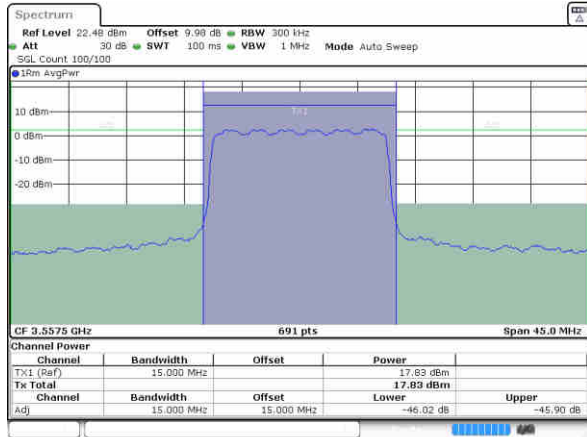
Highest Channel / 10MHz / 256QAM



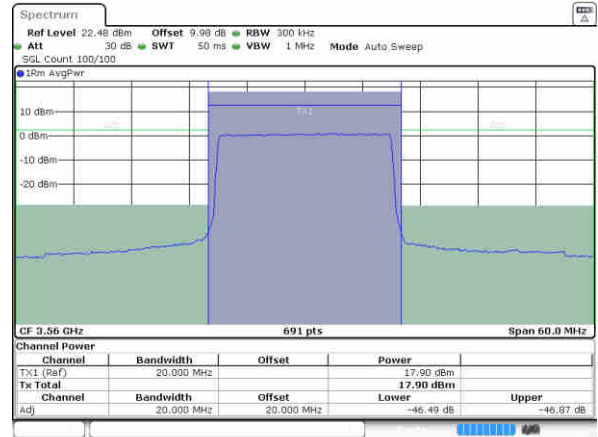


LTE Band 48

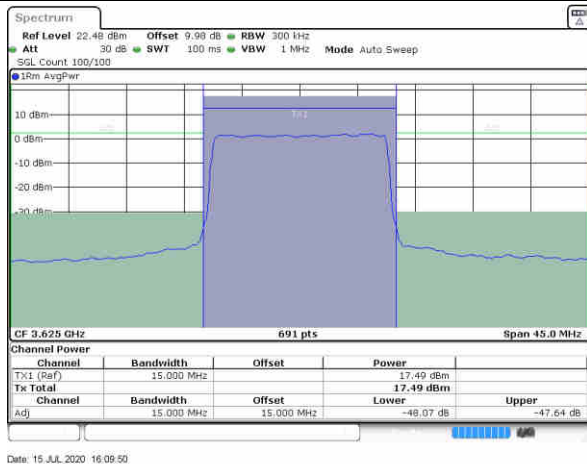
Lowest Channel / 15MHz / 256QAM



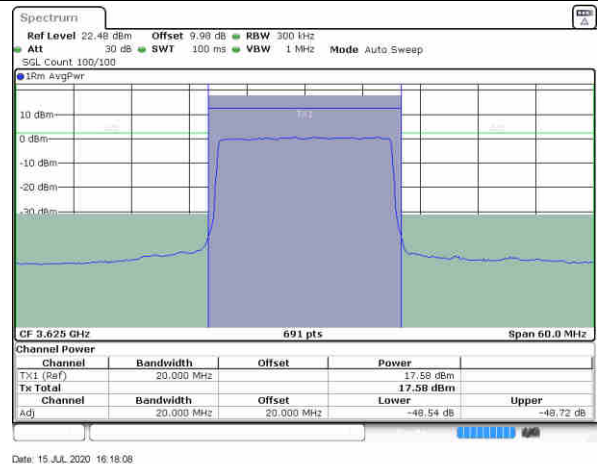
Lowest Channel / 20MHz / 256QAM



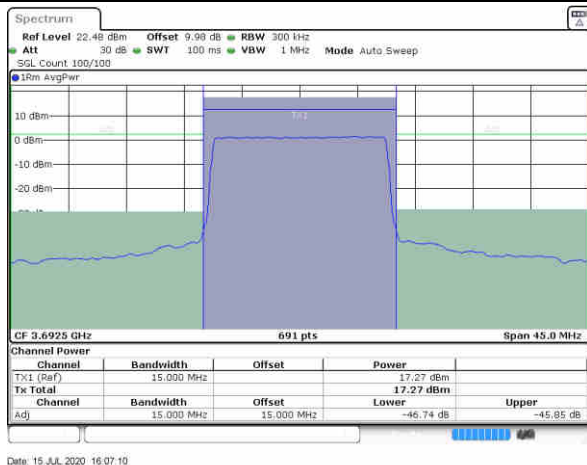
Middle Channel / 15MHz / 256QAM



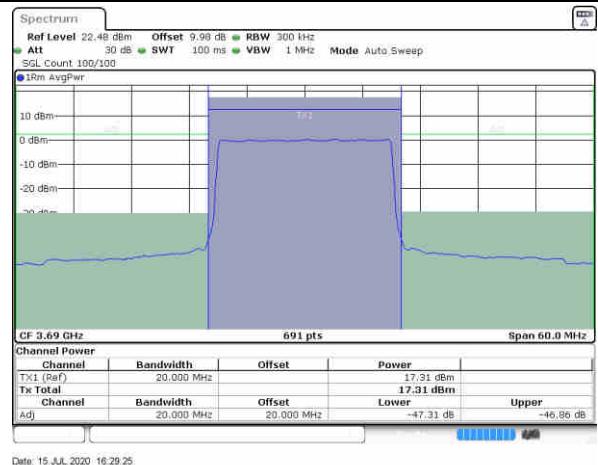
Middle Channel / 20MHz / 256QAM



Highest Channel / 15MHz / 256QAM



Highest Channel / 20MHz / 256QAM



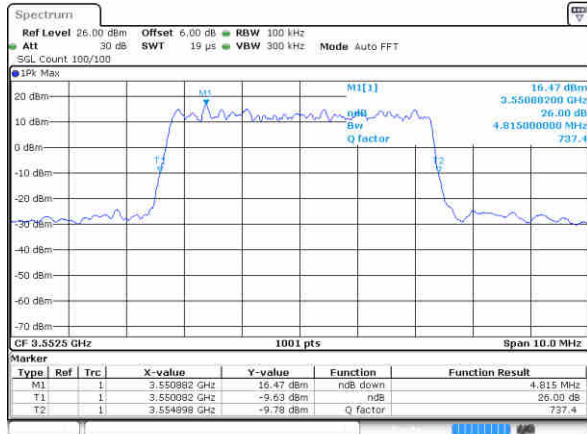
A1.2. 26dB Bandwidth

Mode	LTE Band 48 : 26dB BW(MHz)							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	4.82	4.92	9.75	9.75	14.42	14.33	18.86	18.86
Middle CH	4.90	4.82	9.63	9.77	14.18	14.60	19.02	19.02
Highest CH	4.84	4.89	9.71	9.77	14.39	14.42	18.90	18.94
Mode	LTE Band 48 : 26dB BW(MHz)							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM
Lowest CH	4.89	4.87	9.87	9.67	14.15	14.33	19.06	18.78
Middle CH	4.92	4.87	9.71	9.75	14.30	14.36	18.98	19.18
Highest CH	4.88	4.87	9.71	9.65	14.21	14.18	18.62	18.78

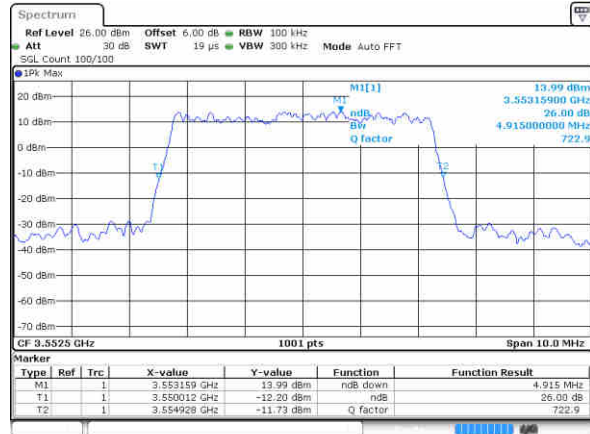


LTE Band 48

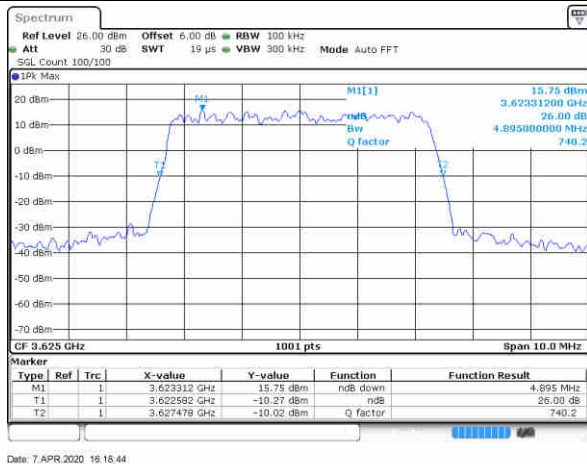
Lowest Channel / 5MHz / QPSK



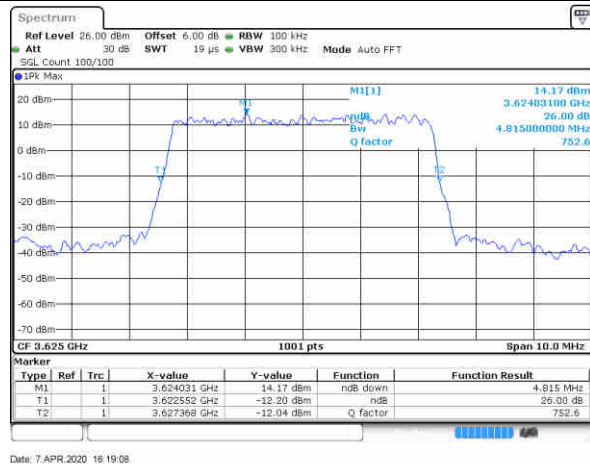
Lowest Channel / 5MHz / 16QAM



Middle Channel / 5MHz / QPSK



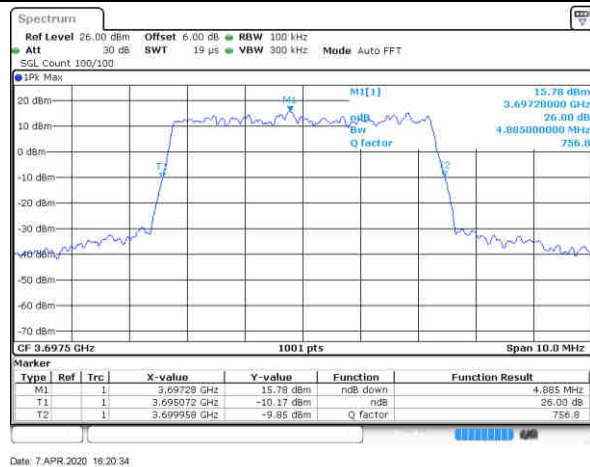
Middle Channel / 5MHz / 16QAM



Highest Channel / 5MHz / QPSK



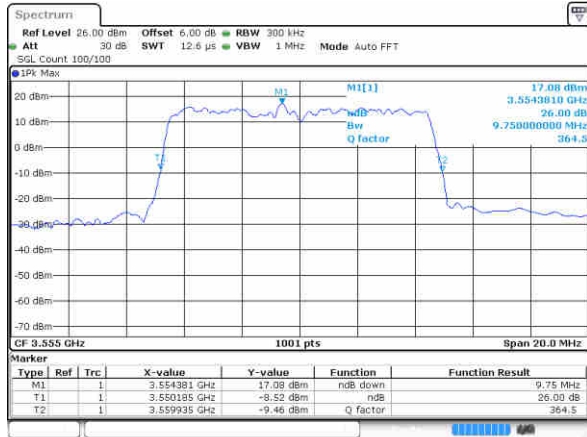
Highest Channel / 5MHz / 16QAM



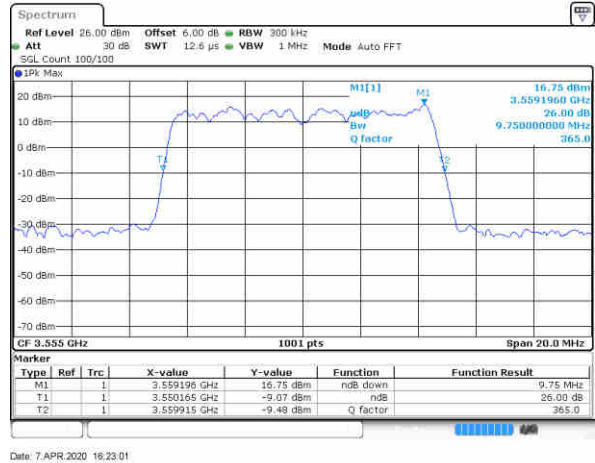


LTE Band 48

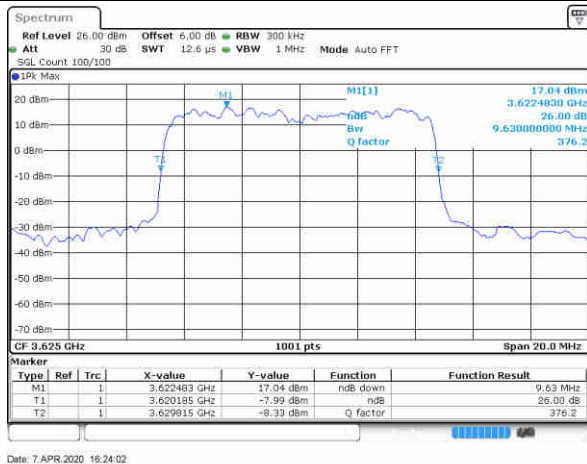
Lowest Channel / 10MHz / QPSK



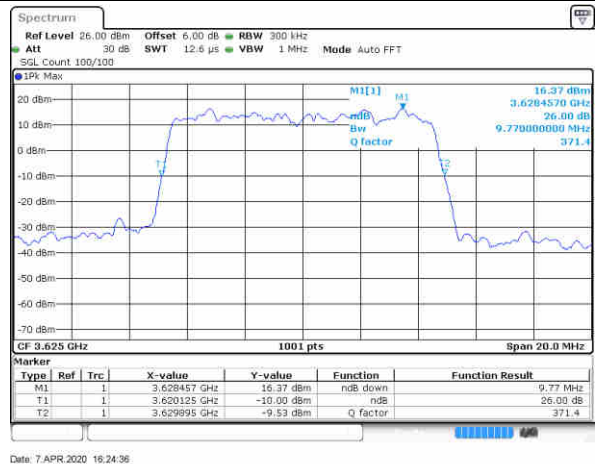
Lowest Channel / 10MHz / 16QAM



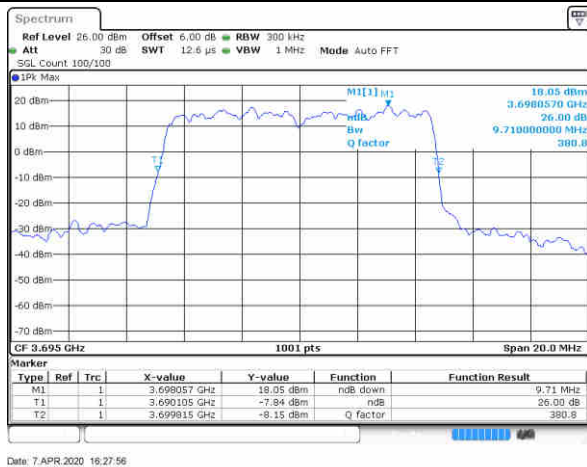
Middle Channel / 10MHz / QPSK



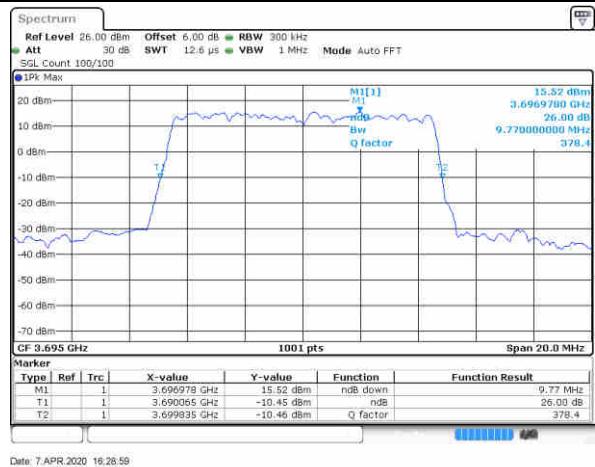
Middle Channel / 10MHz / 16QAM



Highest Channel / 10MHz / QPSK



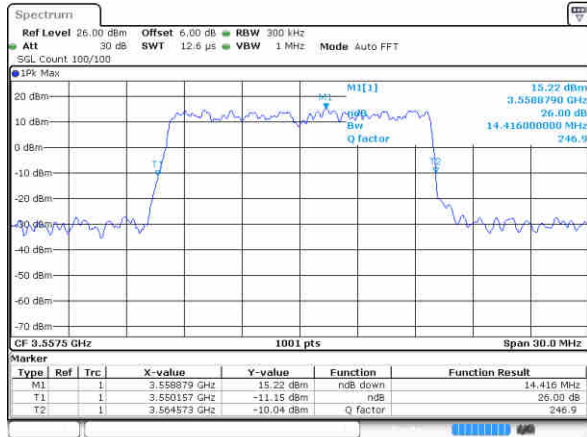
Highest Channel / 10MHz / 16QAM



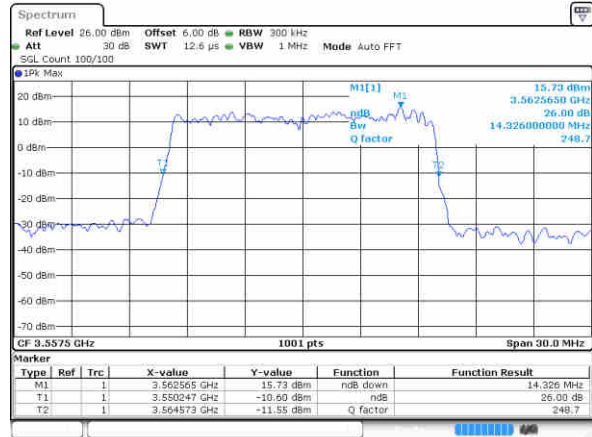


LTE Band 48

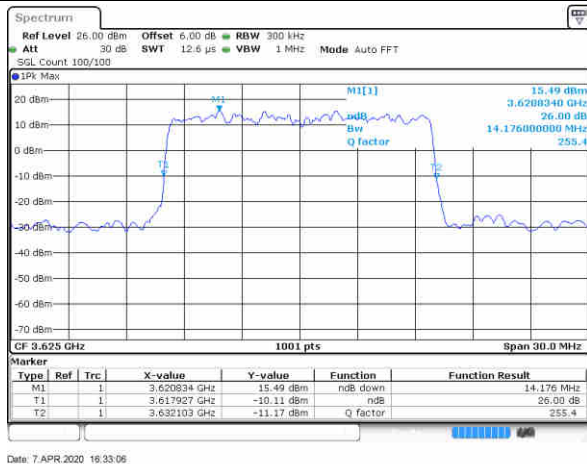
Lowest Channel / 15MHz / QPSK



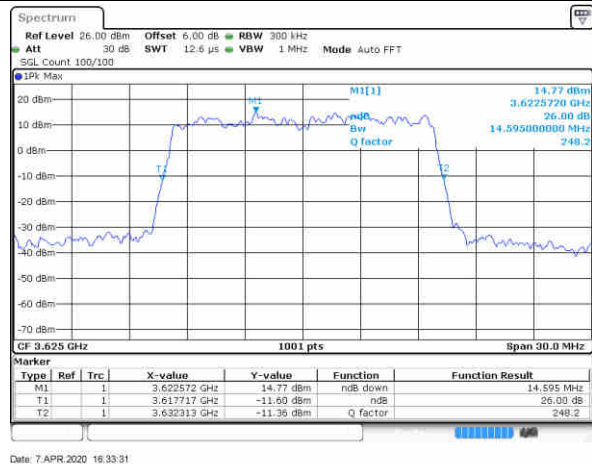
Lowest Channel / 15MHz / 16QAM



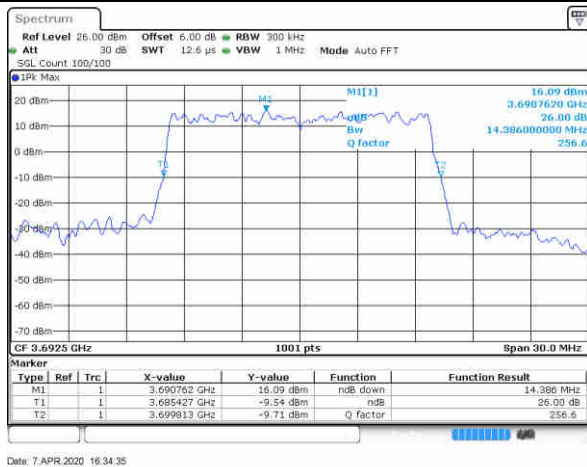
Middle Channel / 15MHz / QPSK



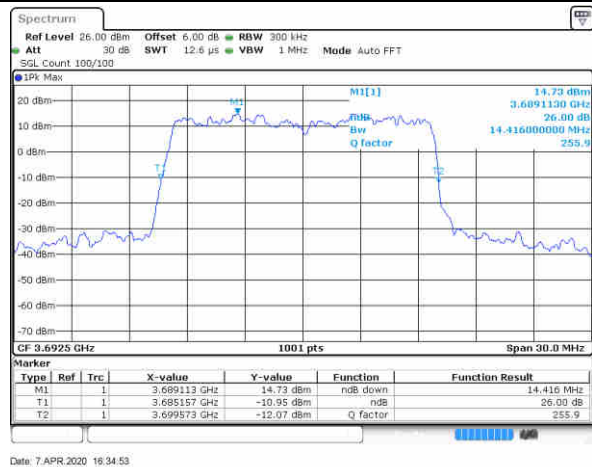
Middle Channel / 15MHz / 16QAM



Highest Channel / 15MHz / QPSK



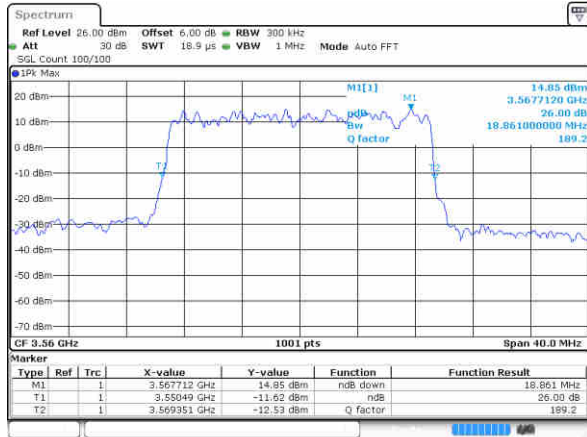
Highest Channel / 15MHz / 16QAM



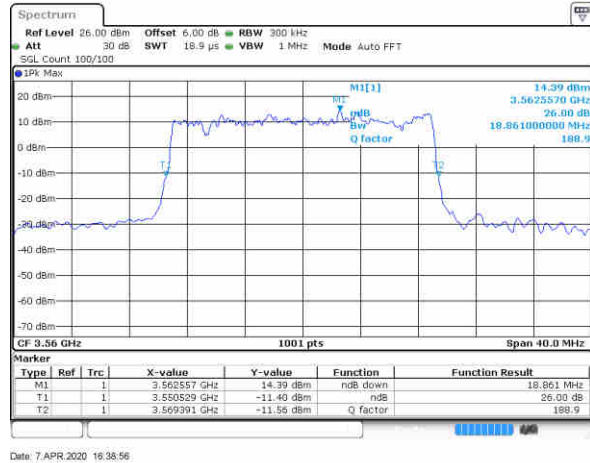


LTE Band 48

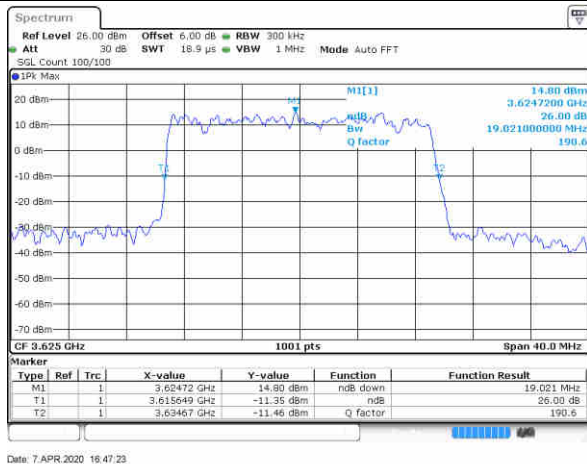
Lowest Channel / 20MHz / QPSK



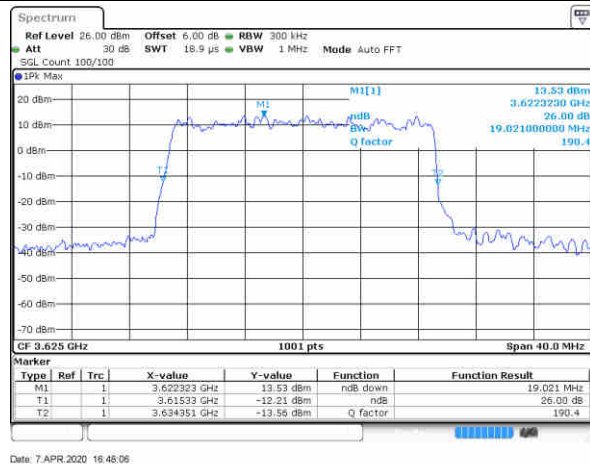
Lowest Channel / 20MHz / 16QAM



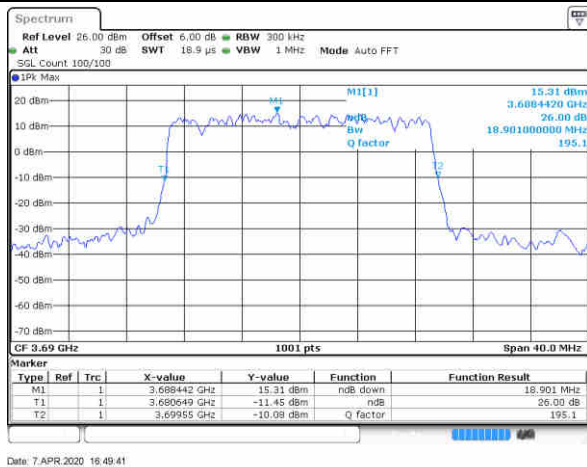
Middle Channel / 20MHz / QPSK



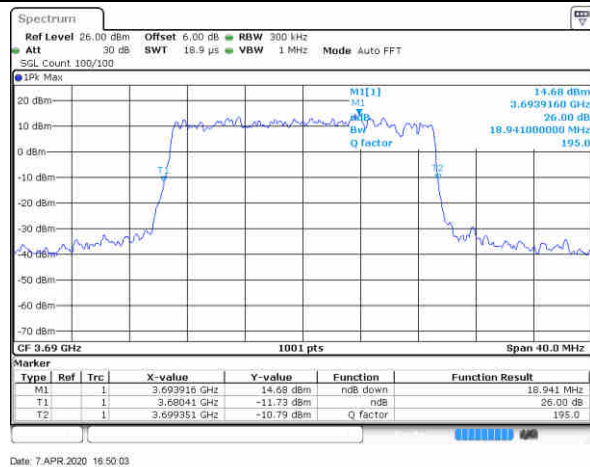
Middle Channel / 20MHz / 16QAM



Highest Channel / 20MHz / QPSK



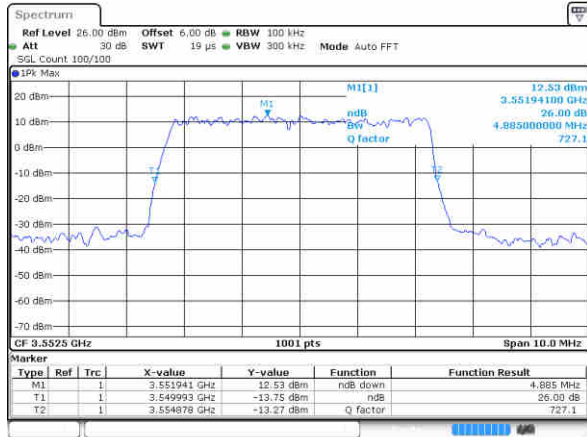
Highest Channel / 20MHz / 16QAM





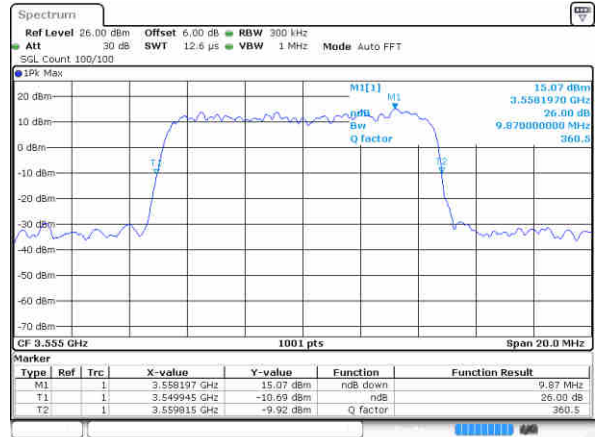
LTE Band 48

Lowest Channel / 5MHz / 64QAM



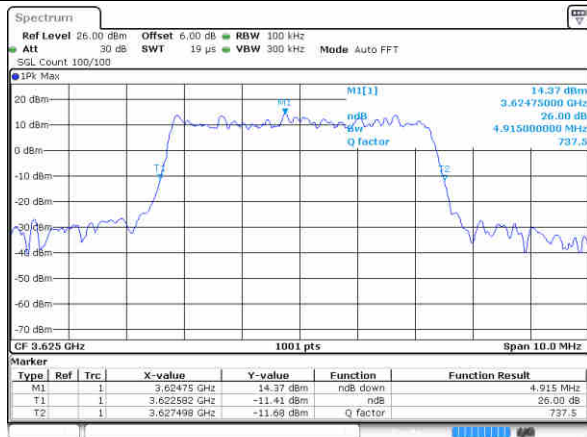
Date: 7 APR 2020 16:17:03

Lowest Channel / 10MHz / 64QAM



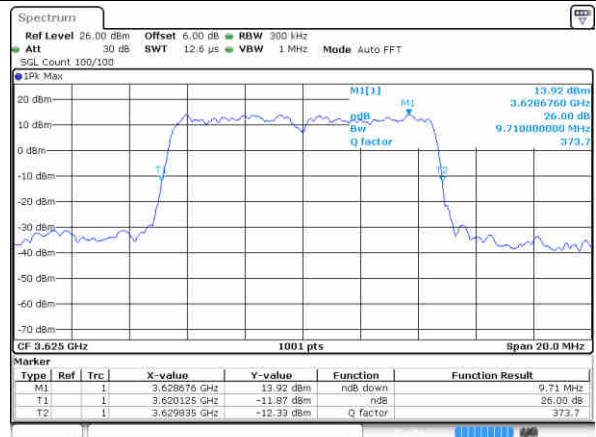
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Middle Channel / 5MHz / 64QAM



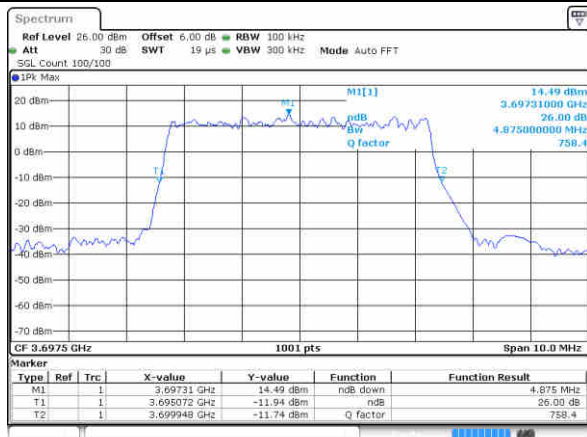
Date: 7 APR 2020 16:19:26

Middle Channel / 10MHz / 64QAM



Date: 7 APR 2020 16:24:57

Highest Channel / 5MHz / 64QAM



Date: 7 APR 2020 16:20:56

Highest Channel / 10MHz / 64QAM



Date: 7 APR 2020 16:30:16