FCC RADIO TEST REPORT

FCC ID	:	**S9GQ410US01**
Equipment	:	**LTE Access Point**
Brand Name	:	**Ruckus**
Model Name	:	**Q410US01**
Applicant	:	**Ruckus Wireless Inc.** **350 W. Java Dr., Sunnyvale CA 94089 USA**
Manufacturer	:	**Ruckus Wireless Inc.** **350 W. Java Dr., Sunnyvale CA 94089 USA**
Standard	:	**47 CFR Part 2, 96**

The product was received on May 14, 2020 and testing was started from May 18, 2020 and completed on May 19, 2020. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any agency of government.

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

Approved by: Ken Chen

Sporton International (USA) Inc.
1175 Montague Expressway, Milpitas, CA 95035

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Appendix A. Test Results of Conducted Test

History of this test report

Report No.	Version	Description	Issued Date
FG200218003	01	Initial issue of report	May 25, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.4	§2.1046	Conducted Output Power	Reporting only	-
-	§96.41	Peak-to-Average Ratio	Not Required	-
3.5	§96.41	Effective Isotropic Radiated Power	Pass	-
		Power Density	Pass	-
3.6	§2.1049 §96.41	Occupied Bandwidth	Reporting only	-
-	§2.1051 §96.41	Conducted Band Edge Measurement	Not Required	-
-	§2.1051 §96.41	Conducted Spurious Emission	Not Required	-
-	§2.1055	Frequency Stability for Temperature & Voltage	Not Required	-
-	§2.1051 §96.41	Radiated Spurious Emission	Not Required	-

Remark: This is a variant report by adding 256QAM modulation. All the test cases were performed on original report which can be referred to FCC ID: S9GQ410US01.

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 Product Feature of Equipment Under Test

LTE

Product Specification subjective to this standard	
Antenna Type	PIFA Antenna

1.2 Modification of EUT

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

1.3 Testing Location

Test Site	Sporton International (USA) Inc.
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL : 408 9043300
Test Site No.	**Sporton Site No.**
	TH01-CA
Test Engineer	Jordan Huang
Temperature	21~25°C
Relative Humidity	51~54%

1.4 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 Eqpt v02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- 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. The TAF code is not including all the FCC KDB listed without accreditation.

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.

Test Items	Band	Bandwidth (MHz)						Modulation				RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	64QAM	256QAM	1	Half	Full	L	M	H
Max. Output Power	48	-	-		v		v				v	v	v	v	v	v	v
EIRP Power Density	48	-	-		v		v				v			v	v	v	v
26dB and 99% Bandwidth	48	-	-		v		v				v			v	v	v	v
E.I.R.P	48	-	-		v		v				v			v	v	v	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.																

2.2 EUT Operation Test Setup

The RF test items, utility “TMCIDVtClient tool ” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.3 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor 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 and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Example :

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

2.4 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
10	Channel	55290	55990	56690
	Frequency	3555.0	3625.0	3695.0

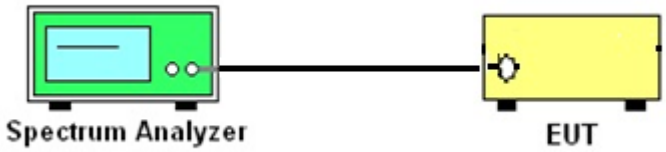
3 Conducted Test Items

3.1 Measuring Instruments

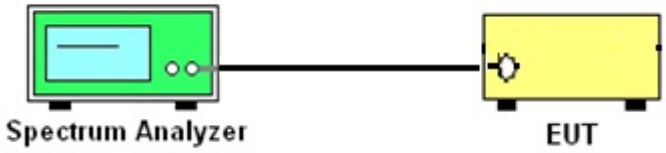
See list of measuring instruments of this test report.

3.2 Test Setup

3.2.1 Conducted Output Power



3.2.2 EIRP Power Density, Occupied Bandwidth



3.3 Test Result of Conducted Test

Please refer to Appendix A.

3.4 Conducted Output Power

3.4.1 Description of the Conducted Output Power Measurement

The EUT shall be set at maximum power through commands provided by manufacturer. The measured power in the radio frequency at the transmitter output terminals shall be reported.

3.4.2 Test Procedures

1. Connect the transmitter output port of EUT to the spectrum analyzer.
2. Set EUT to transmit at maximum output power.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure the maximum power at RF output terminals.

3.5 EIRP and Power Density

3.5.1 Description of the EIRP and Power Density Measurement

The EUT shall be set at maximum power through commands provided by manufacturer, and the EIRP limit shall apply to any 10 MHz portion of the bandwidth.

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

EIRP and PSD limits for CBRS equipment as below tabel:

Device	Maximum EIRP (dBm/10 MHz)	Maximum PSD (dBm/MHz)
Category A CBSD	30	20

3.5.2 Test Procedures

The testing follows procedure in Section 5.2 of ANSI C63.26-2015 and KDB 940660 D01 Part 96 Eqpt v02 Section 3.2(b)

1. Set instrument center frequency to OBW center frequency.
2. Set span to at least 1.5 times the OBW.
3. Set the RBW to the specified reference bandwidth (often 1 MHz).
4. Set VBW ≥ 3 × RBW.
5. Detector = RMS (power averaging).
6. Ensure that the number of measurement points in the sweep ≥ 2 × span/RBW.
7. Sweep time = auto couple.
8. Trace mode = max hold.
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. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
    Method (c): Measure and add 10 log(N_{ANT}) dB.
    With this technique, spectrum measurements are performed at each output of the device, but rather than summing the spectra or the spectral peaks across the outputs, the quantity 10 log(N_{ANT}) dB is added to each spectrum value before comparing to the emission limit. The addition of 10 log(N_{ANT}) dB serves to apportion the emission limit among the N_{ANT} outputs so that each output is permitted to contribute no more than $1/N_{ANT}$ th of the PSD limit.

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

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 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.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	608-H1	45142595	N/A	Aug. 07, 2019	May 18, 2020~ May 19, 2020	Aug. 06, 2020	Conducted (TH01-CA)
Signal Analyzer	Rohde & Schwarz	FSV40	101089	10Hz~40GHz	Aug. 29, 2019	May 18, 2020~ May 19, 2020	Aug. 28, 2020	Conducted (TH01-CA)

Appendix A. Test Results of Conducted Test

LTE Band 48

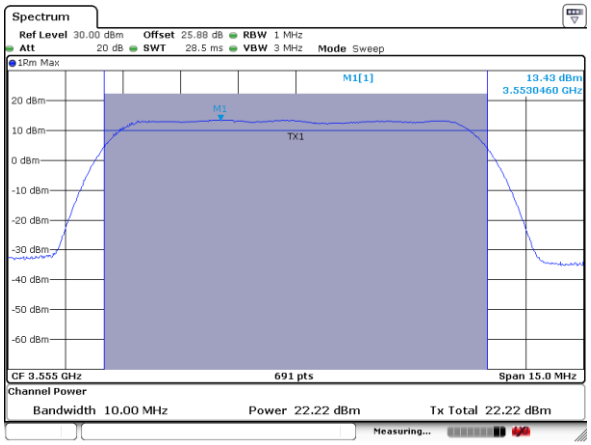
Average Power

LTE_10MHz_256QAM_2TX						
Channel	Frequency (MHz)	DG (dBi)	Port 1 (dBm)	Port 2 (dBm)	Power (dBm)	Power (W)
55290	3555	2.62	22.22	21.35	24.82	0.3032
55990	3625	2.62	22.13	21.47	24.82	0.3036
56690	3695	2.62	21.28	21.49	24.40	0.2752

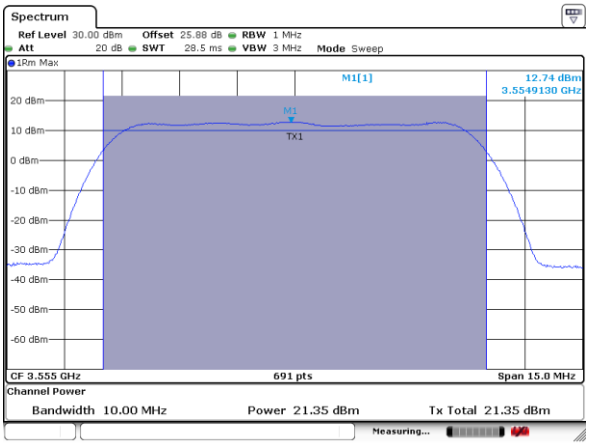
LTE_20MHz_256QAM_2TX						
Channel	Frequency (MHz)	DG (dBi)	Port 1 (dBm)	Port 2 (dBm)	Power (dBm)	Power (W)
55340	3560	2.62	22.37	22.32	25.36	0.3432
55990	3625	2.62	21.96	20.95	24.49	0.2815
56640	3690	2.62	21.85	21.32	24.60	0.2886

LTE Band 48

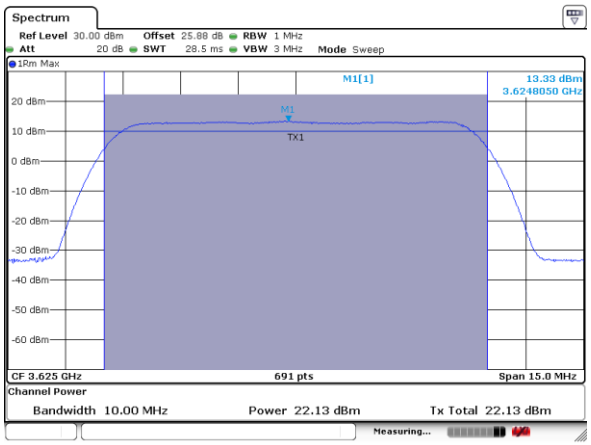
Lowest Channel / 10MHz / 256QAM Port 1



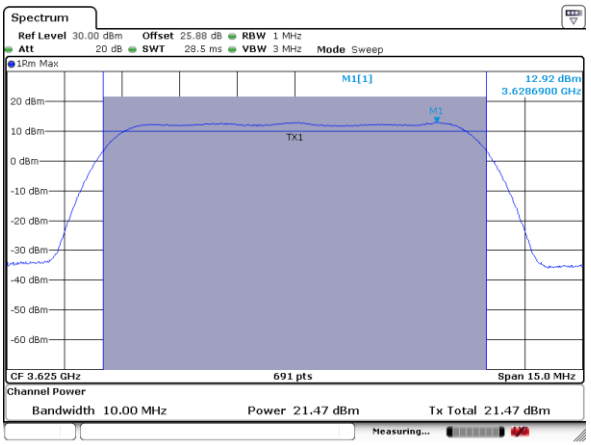
Lowest Channel / 10MHz / 256QAM Port 2



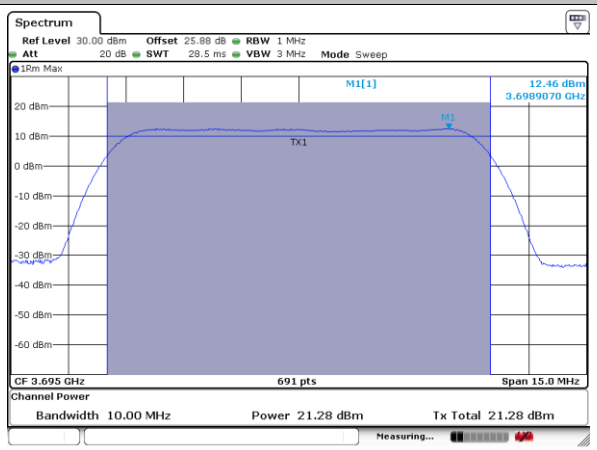
Middle Channel / 10MHz / 256QAM Port 1



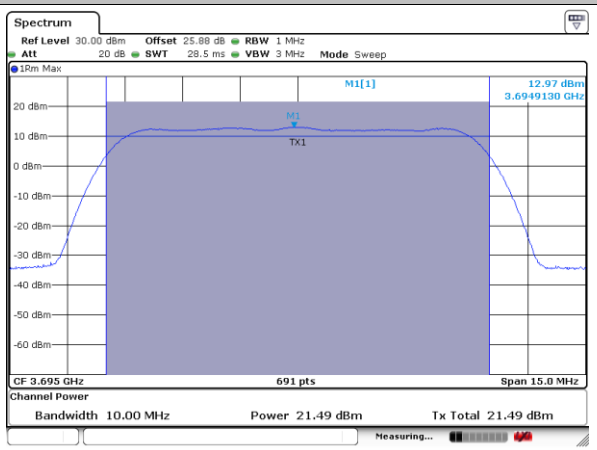
Middle Channel / 10MHz / 256QAM Port 2



Highest Channel / 10MHz / 256QAM Port 1

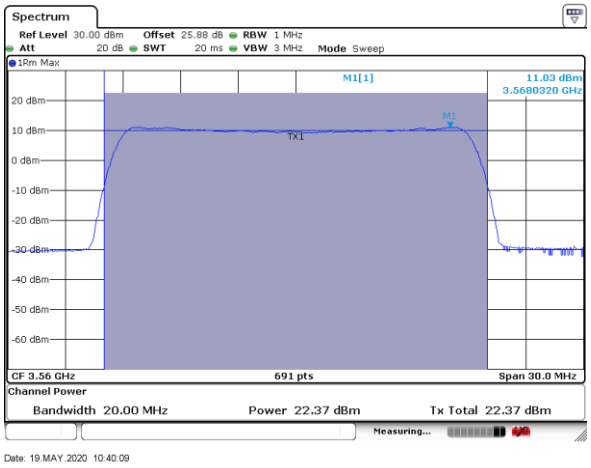


Highest Channel / 10MHz / 16QAM Port 2

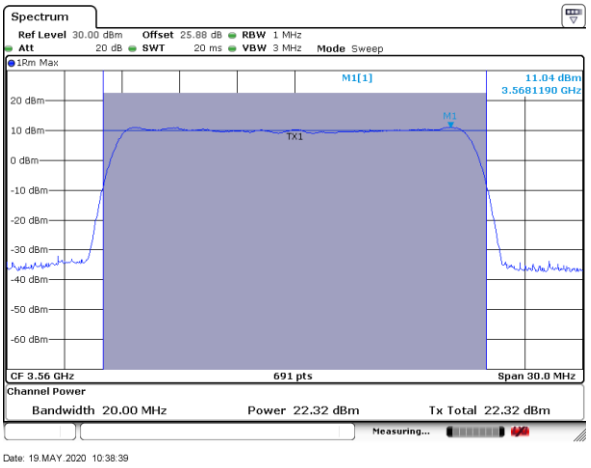


LTE Band 48

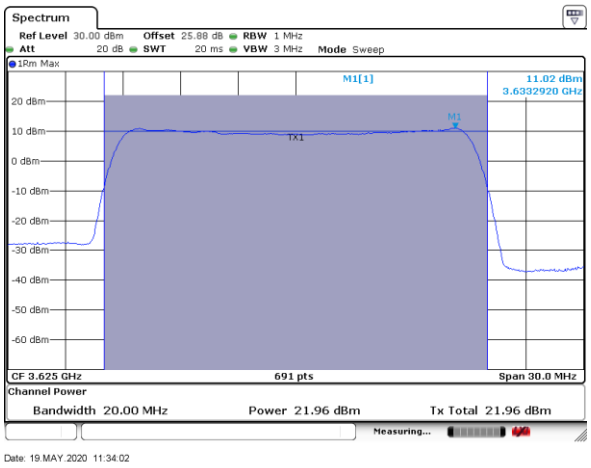
Lowest Channel / 20MHz / 256QAM Port 1



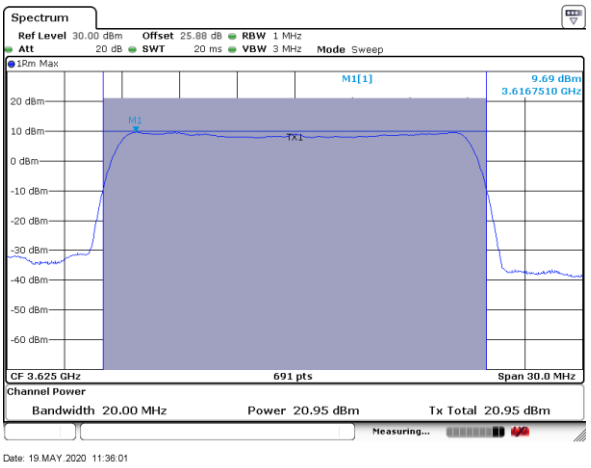
Lowest Channel / 20MHz / 256QAM Port 2



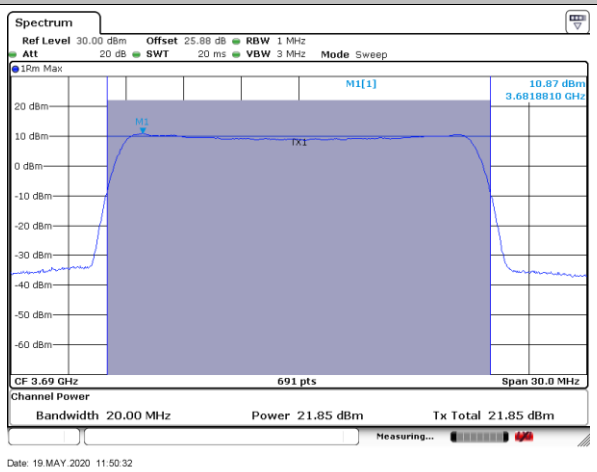
Middle Channel / 20MHz / 256QAM Port 1



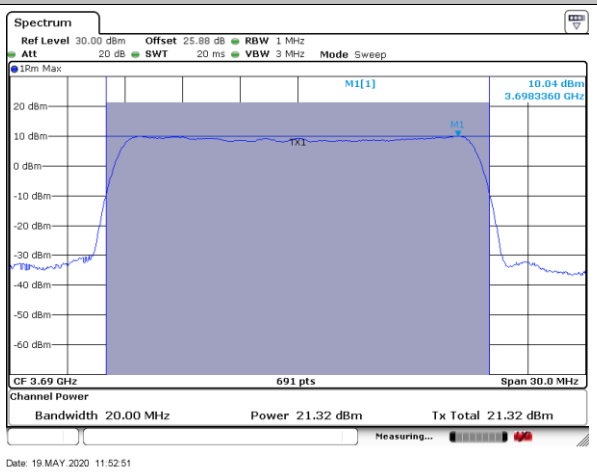
Middle Channel / 20MHz / 256QAM Port 2



Highest Channel / 20MHz / 256QAM Port 1



Highest Channel / 20MHz / 256QAM Port 2



EIRP Power Density

LTE_10MHz_256QAM_2TX						
Channel	Frequency (MHz)	DG (dBi)	Power (dBm)	Power (W)	EIRP (dBm)	EIRP (W)
55290	3555	2.62	24.82	0.3032	27.44	0.5542
55990	3625	2.62	24.82	0.3036	27.44	0.5550
56690	3695	2.62	24.40	0.2752	27.02	0.5031

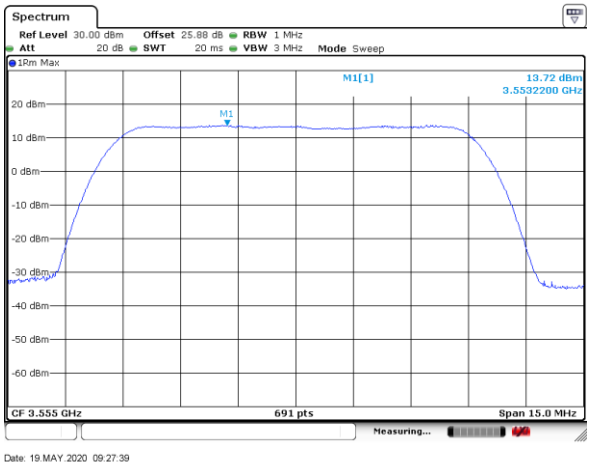
LTE_10MHz_256QAM_2TX							
Channel	Frequency (MHz)	DG (dBi)	Port 1 (dBm/MHz)	Port 2 (dBm/MHz)	PSD (dBm/MHz)	EIRP PSD (dBm/MHz)	EIRP PSD Limit (dBm/MHz)
55290	3555	2.62	13.72	13.42	16.58	19.20	20
55990	3625	2.62	13.61	13.50	16.57	19.19	
56690	3695	2.62	12.84	13.53	16.21	18.83	

LTE_20MHz_256QAM_2TX						
Channel	Frequency (MHz)	DG (dBi)	Power (dBm)	Power (W)	EIRP (dBm)	EIRP (W)
55340	3560	2.62	25.36	0.3432	27.98	0.6274
55990	3625	2.62	24.49	0.2815	27.11	0.5146
56640	3690	2.62	24.60	0.2886	27.22	0.5276

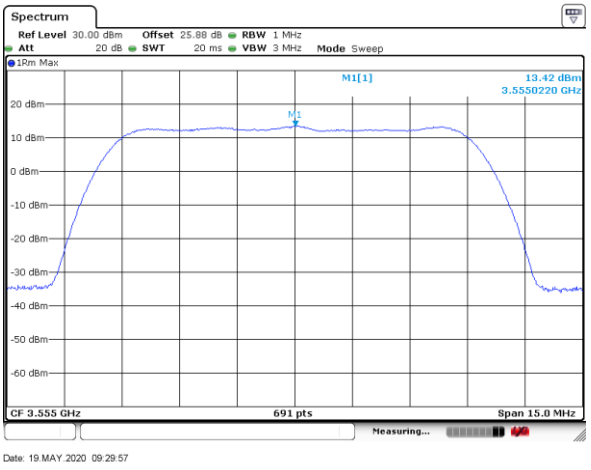
LTE_20MHz_256QAM_2TX							
Channel	Frequency (MHz)	DG (dBi)	Port 1 (dBm/MHz)	Port 2 (dBm/MHz)	PSD (dBm/MHz)	EIRP PSD (dBm/MHz)	EIRP PSD Limit (dBm/MHz)
55340	3560	2.62	11.09	11.06	14.09	16.71	20
55990	3625	2.62	11.11	9.68	13.46	16.08	
56640	3690	2.62	10.95	10.03	13.52	16.14	

LTE Band 48 / 10MHz

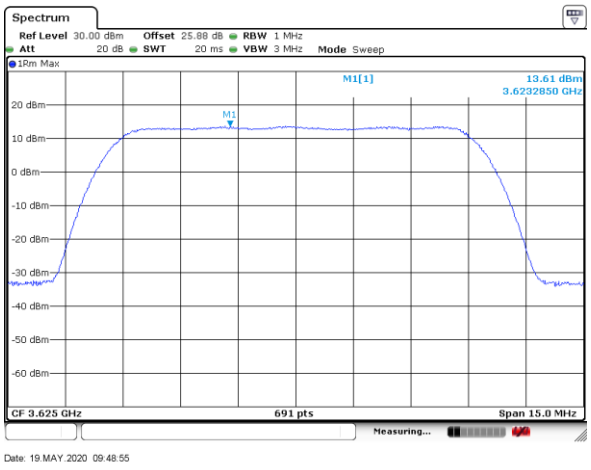
Lowest Channel / 10MHz / 256QAM Port 1



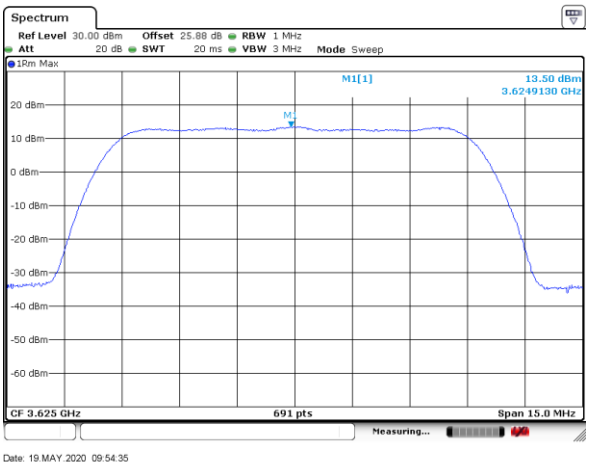
Lowest Channel / 10MHz / 256QAM Port 2



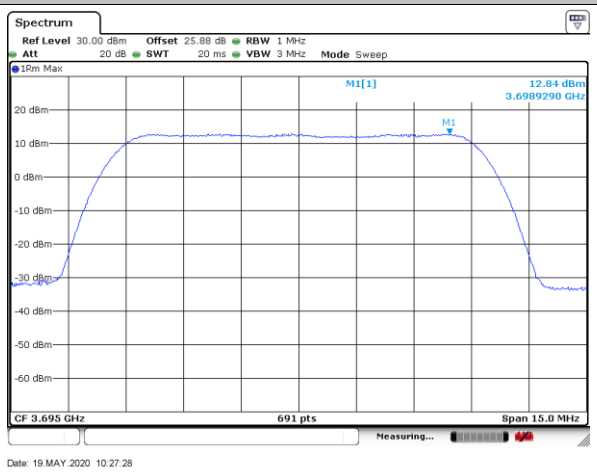
Middle Channel / 10MHz / 256QAM Port 1



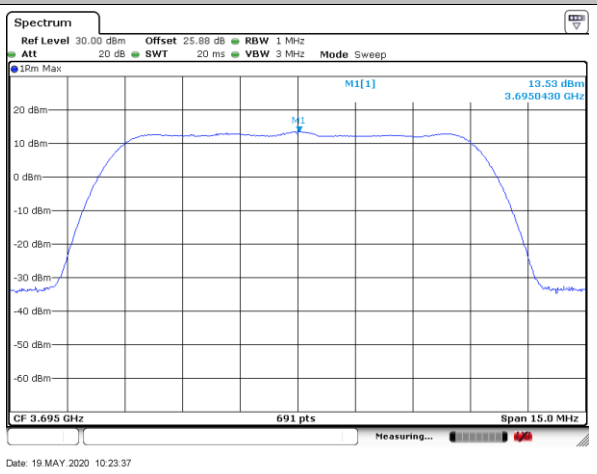
Middle Channel / 10MHz / 256QAM Port 2



Highest Channel / 10MHz / 256QAM Port 1

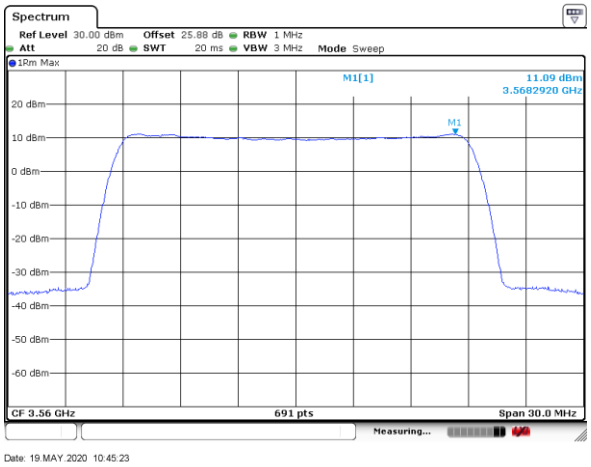


Highest Channel / 10MHz / 256QAM Port 2

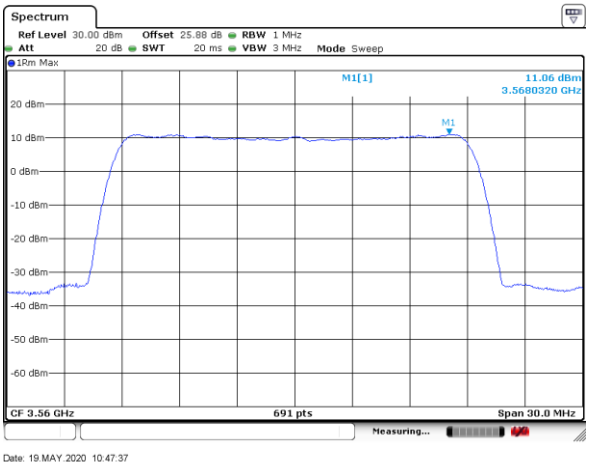


LTE Band 48 / 20MHz

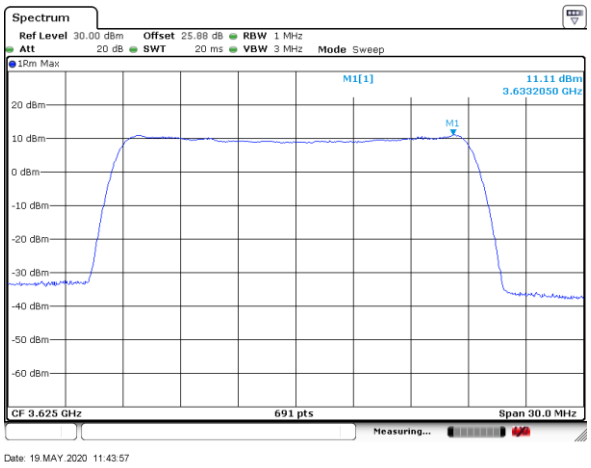
Lowest Channel / 20MHz / 256QAM Port 1



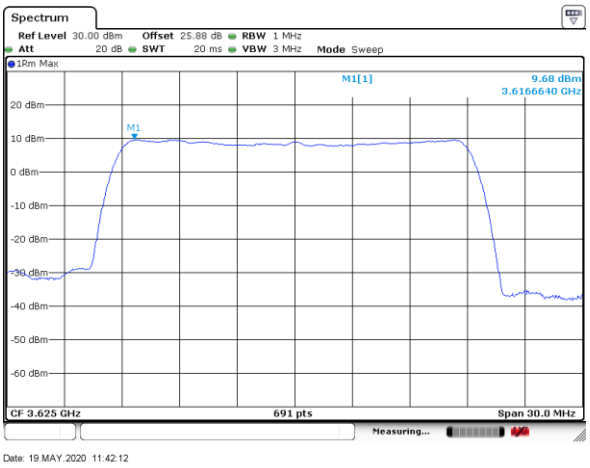
Lowest Channel / 20MHz / 256QAM Port 2



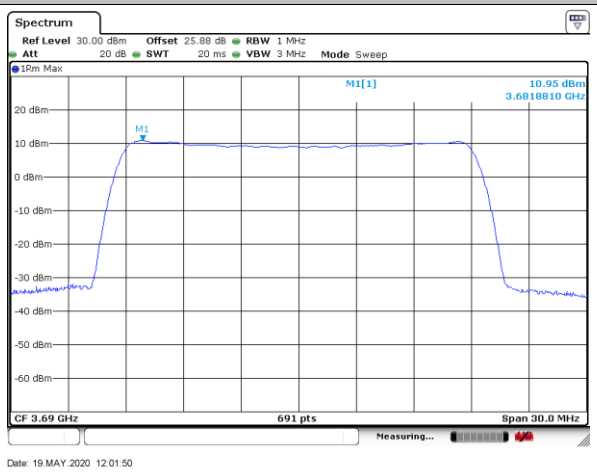
Middle Channel / 20MHz / 256QAM Port 1



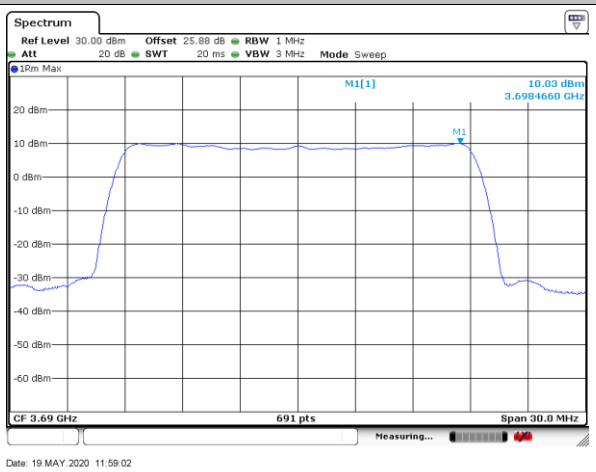
Middle Channel / 20MHz / 256QAM Port 2



Highest Channel / 20MHz / 256QAM Port 1



Highest Channel / 20MHz / 256QAM Port 2

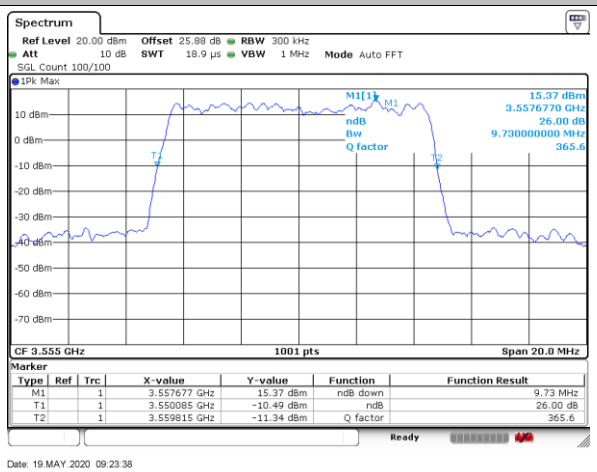


26dB Bandwidth

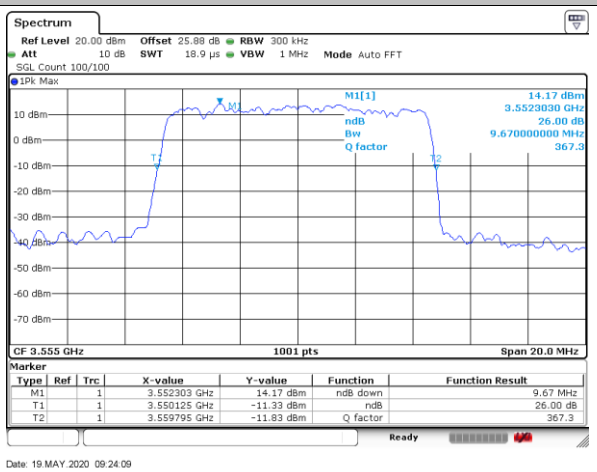
Mode	LTE Band 48 : 26dB BW(MHz)			
Mod.	256QAM			
BW	10MHz		20MHz	
Port	Port 1	Port 2	Port 1	Port 2
Lowest CH	9.73	9.67	18.74	18.74
Middle CH	9.67	9.71	18.74	18.74
Highest CH	9.73	9.71	18.70	18.78

LTE Band 48

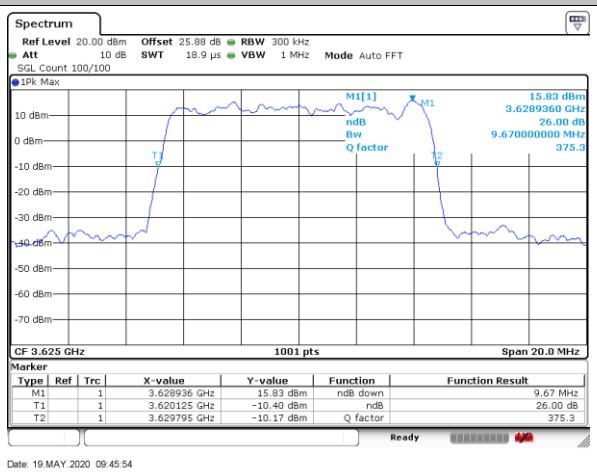
Lowest Channel / 10MHz / 256QAM Port 1



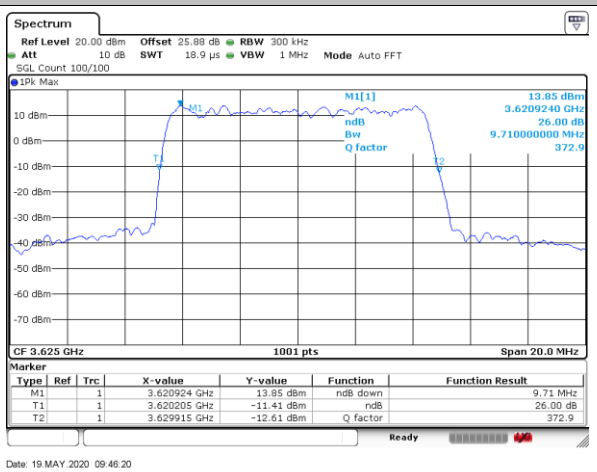
Lowest Channel / 10MHz / 256QAM Port 2



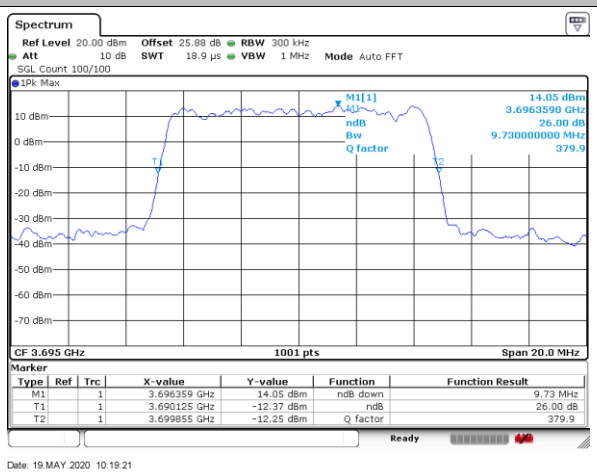
Middle Channel / 10MHz / 256QAM Port 1



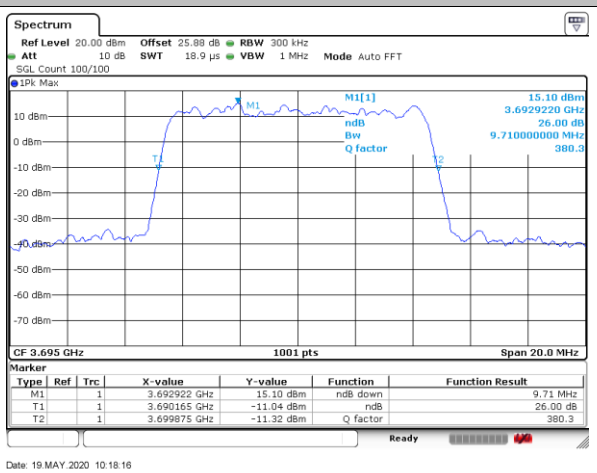
Middle Channel / 10MHz / 256QAM Port 2



Highest Channel / 10MHz / 256QAM Port 1

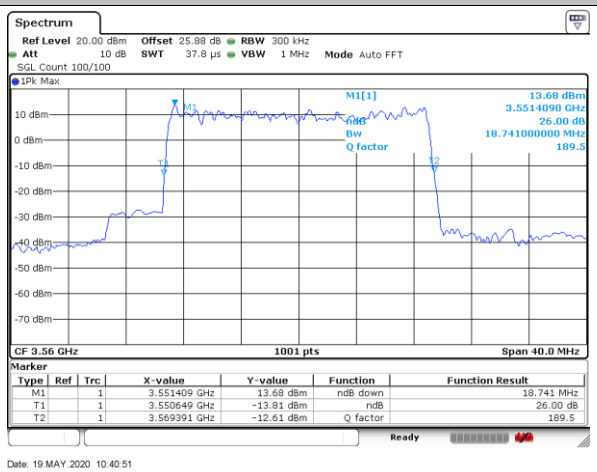


Highest Channel / 10MHz / 16QAM Port 2



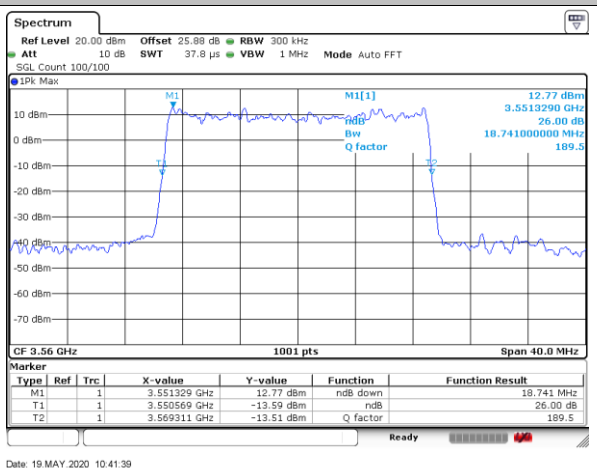
LTE Band 48

Lowest Channel / 20MHz / 256QAM Port 1



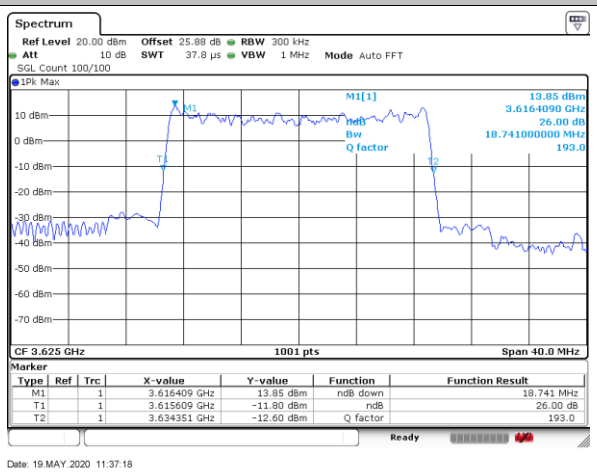
Date: 19.MAY.2020 10:40:51

Lowest Channel / 20MHz / 256QAM Port 2



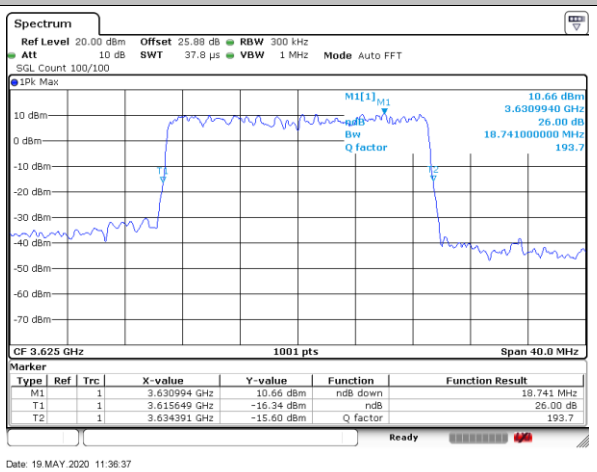
Date: 19.MAY.2020 10:41:39

Middle Channel / 20MHz / 256QAM Port 1



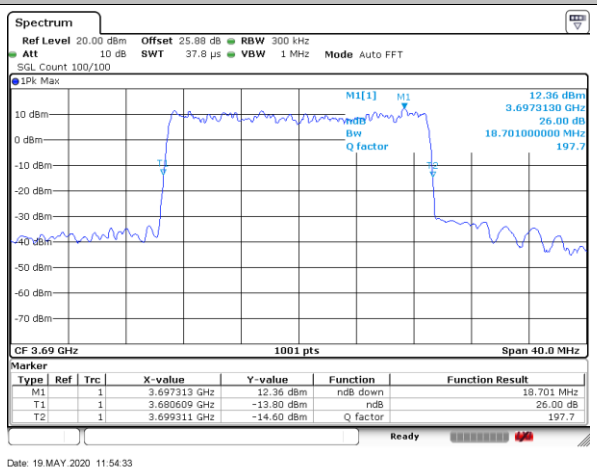
Date: 19.MAY.2020 11:37:18

Middle Channel / 20MHz / 256QAM Port 2



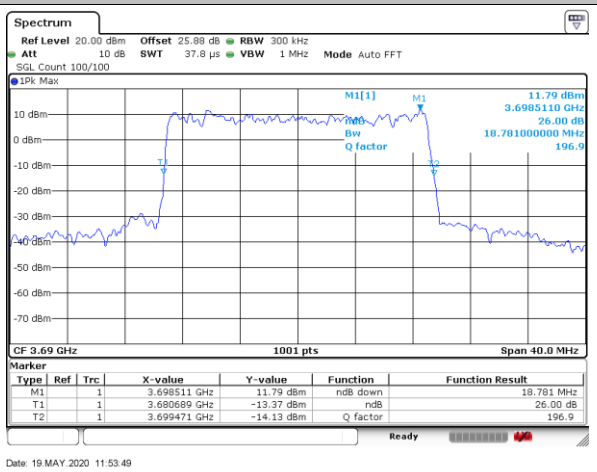
Date: 19.MAY.2020 11:36:37

Highest Channel / 20MHz / 256QAM Port 1



Date: 19.MAY.2020 11:54:33

Highest Channel / 20MHz / 256QAM Port 2



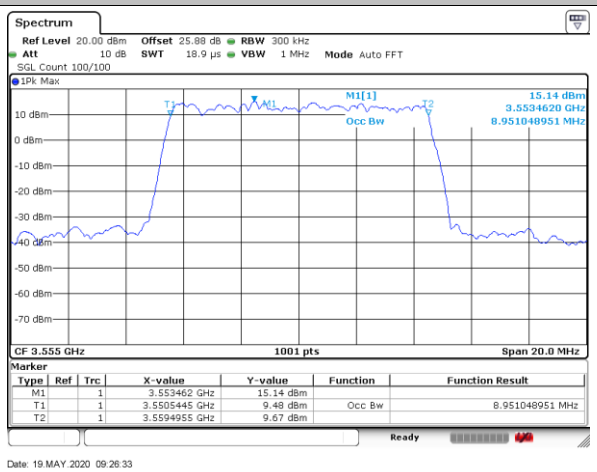
Date: 19.MAY.2020 11:53:49

Occupied Bandwidth

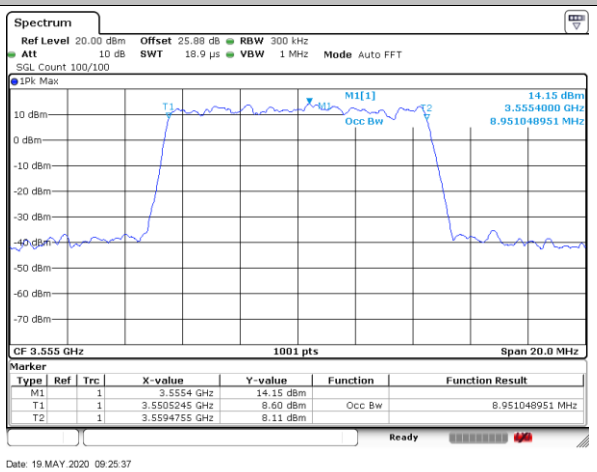
Mode	LTE Band 48 : 99%OBW(MHz)			
Mod.	256QAM			
BW	10MHz		20MHz	
Port	Port 1	Port 2	Port 1	Port 2
Lowest CH	8.95	8.95	17.90	17.90
Middle CH	8.95	8.95	17.90	17.90
Highest CH	8.95	8.95	17.90	17.90

LTE Band 48

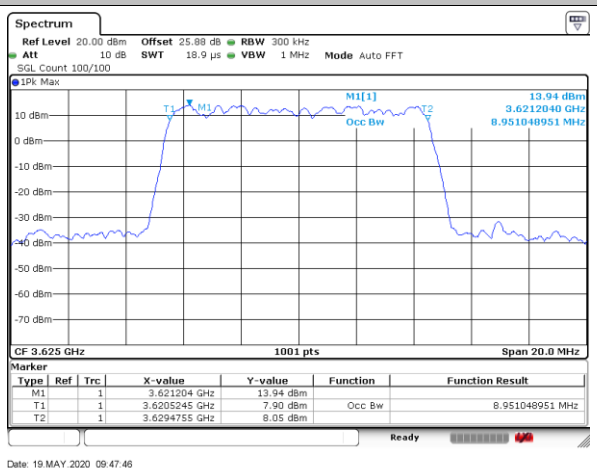
Lowest Channel / 10MHz / 256QAM Port 1



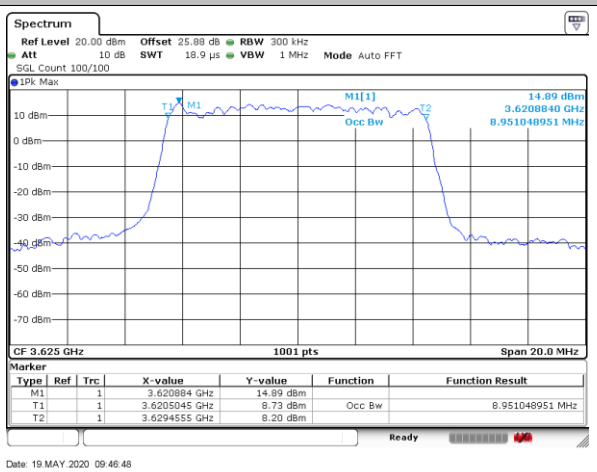
Lowest Channel / 10MHz / 256QAM Port 2



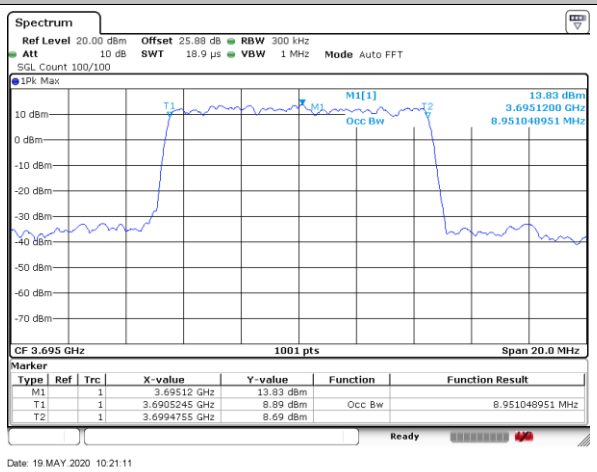
Middle Channel / 10MHz / 256QAM Port 1



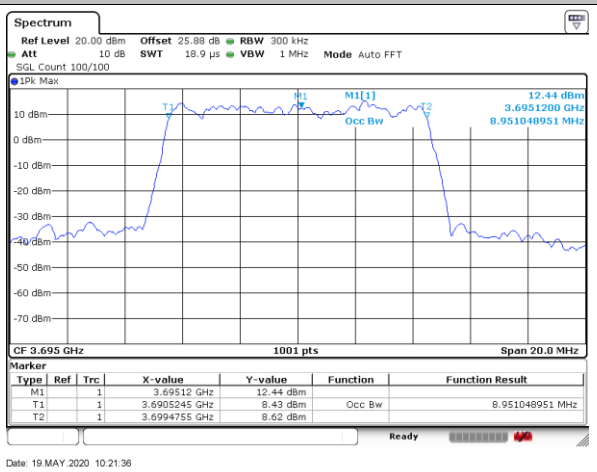
Middle Channel / 10MHz / 256QAM Port 2



Highest Channel / 10MHz / 256QAM Port 1

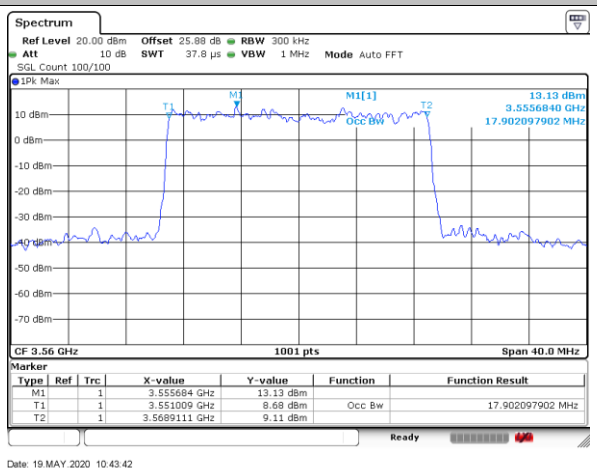


Highest Channel / 10MHz / 16QAM Port 2

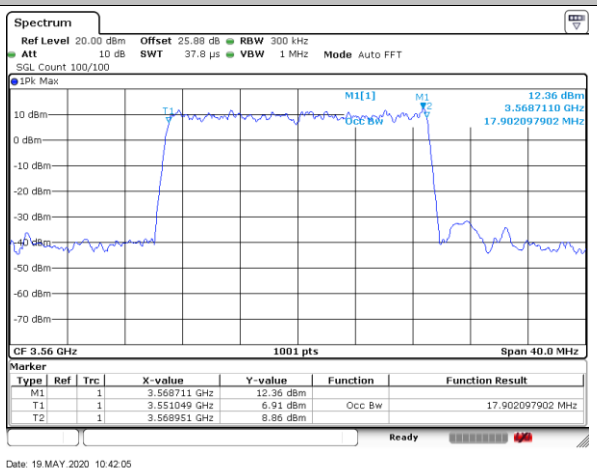


LTE Band 48

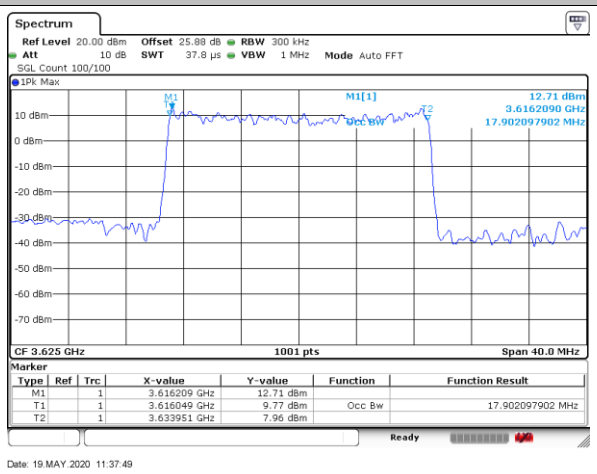
Lowest Channel / 20MHz / 256QAM Port 1



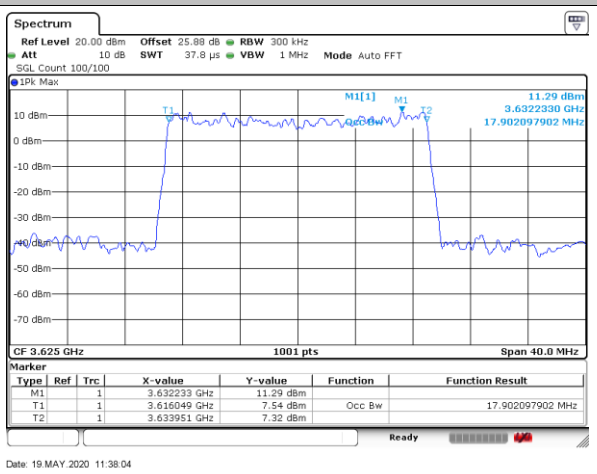
Lowest Channel / 20MHz / 256QAM Port 2



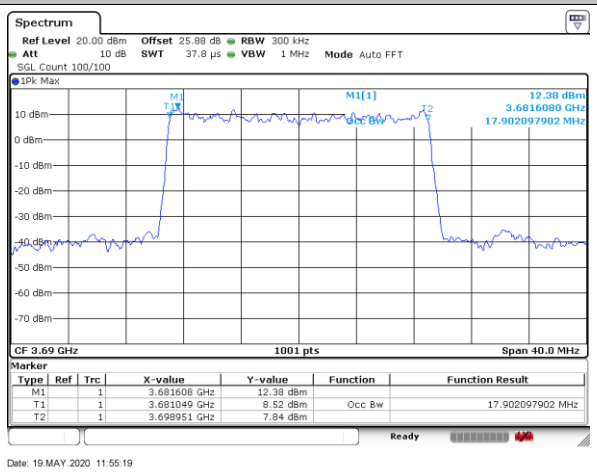
Middle Channel / 20MHz / 256QAM Port 1



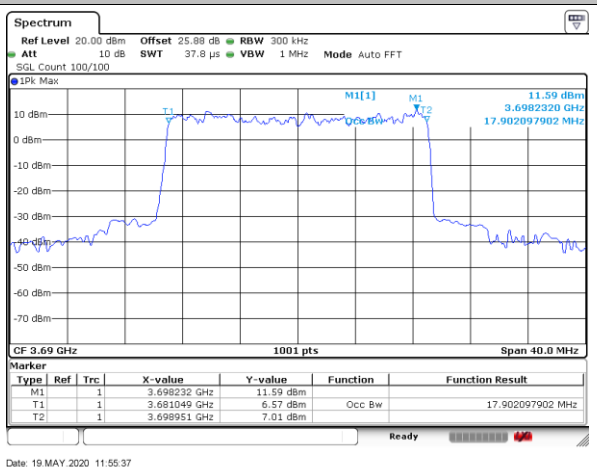
Middle Channel / 20MHz / 256QAM Port 2



Highest Channel / 20MHz / 256QAM Port 1



Highest Channel / 20MHz / 256QAM Port 2



THE END