

Ericsson AB

RF TEST REPORT

Report Type:

FCC Part 27 & RSS-130 RF report

PRODUCT NAME:

Radio 4478 B12A

REPORT NUMBER:

200702203SHA-001

ISSUE DATE:

July 15, 2020

DOCUMENT CONTROL NUMBER:

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TEST REPORT

Applicant: Ericsson AB
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Manufacturer: Ericsson AB
Isafjordsgatan 10 SE-164 80 Stockholm 16480 Sweden

FCC ID: TA8AKRC161881-3

IC: 287AB-AS1618813

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

FCC CFR 47 Part 27: MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

ISED RSS-130 Issue 2: Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz

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Reviewer
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TEST REPORT

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Revision History

Report No.	Version	Description	Issued Date
200702203SHA-001	Rev. 01	Initial issue of report	July 15, 2020

Measurement result summary

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Max Output Power and Peak to Average Power Ratio and EIRP	27.50(c) 2.1046	RSS-130 4.6	Pass
Occupied Bandwidth	27.53(g) 2.1049	RSS-GEN 6.7	Pass
Unwanted Emissions at Band Edge	27.53(g) 2.1051	RSS-130 4.7	Pass
Conducted Unwanted Emission	27.53(g) 2.1051	RSS-130 4.7	Pass
Radiated Unwanted Emissions	27.53(g) 2.1053	RSS-130 4.7	Pass
Frequency Stability	27.54 2.1055	RSS-130 4.5	Pass

Note: The unit is tested with maximum output power. The manufacturer declares that in commercial deployment the output power can be reduced to meet the ERP/EIRP limit using licenses.

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Description:	Remote Radio Unit
Product name:	Radio 4478 B12A
Product number:	KRC 161 881/3
HVIN	AS1618813
Serial Number(s)	DY3E000104
Rating:	-48VDC
Software Version:	CXP9017316/7_R83EC
Hardware Version:	R1A
Sample received date:	July 6, 2020
Date of test:	July 6, 2020 ~ July 14, 2020

1.2 Technical Specification

Frequency Range:	TX: 729-745 MHz, RX: 699-715 MHz
Number of Antenna ports:	4 TX/RX
Supported RAT:	NR, LTE, NB-IoT In-band/Guard-band/Standalone
Max RF bandwidth (IBW):	16MHz
Supported Number of Carriers per port:	Maximum 3 carriers (2 carriers for NB-IoT Standalone)
Supported modulation:	NR & LTE: QPSK, 16QAM, 64QAM, 256QAM NB-IoT standalone: QPSK
Supported Channel Bandwidth:	NR & LTE: 5MHz, 10MHz, 15MHz NB-IoT Standalone: 200 kHz
Declaration output power:	46.0 dBm (40W)

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address 1:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Address 2:	No. 5 Lize East Street, Ericsson Tower, Chaoyang District, Beijing 100102 P.R.C.
Telephone:	+86 21 61278200
Telefax:	+86 21 54262353
The test facility is recognized, certified, or accredited by these organizations:	FCC Accredited Lab Designation Number: CN1175, CN1258
	IC Registration Lab CAB identifier.: CN0051
	A2LA Accreditation Lab Certificate Number: 3309.02, 3309.04

2 TEST SPECIFICATIONS

2.1 Related documents

FCC Part 27 (2019)
FCC Part 2 (2019)
ISED RSS-130 issue 2 February 2019
ISED RSS-Gen issue 5 March 2019 Amendment 1
ANSI C63.26:2015
KDB 971168 D01 v03r01
KDB 662911 D01 v02r01

2.2 Product Information

The Equipment Under Test (EUT) is an Ericsson Remote Radio Unit in the wireless communications services 700MHz band which provides communication connections to network in LTE / NB-IoT / NR modes and mixed modes. The Radio 4478 B12A operates from a -48V DC.

The EUT includes 4 TX/RX ports and it can be configured to transmit in MIMO mode for LTE and NR carriers, and MIMO mode was used for measurements as the worst configuration. The complete testing was performed with the EUT transmitting at maximum RF power unless otherwise stated.

A full technical description can be found in the Manufacturer's documentation.

2.3 Configuration Description

Initial pre-testing was carried out to determine the worst-case modulation scheme by measuring the output power from QPSK, 16QAM, 64QAM and 256QAM on the middle channel of one antenna port. From these tests, it was determined that QPSK was the worst-case modulation scheme and was used for all testing.

Complete testing was carried out on the worst-case antenna port which was determined by the highest output power from the 4 measured ports on worst-case modulation scheme. The worst antenna port for LTE and NR was antenna port D.

The settings below were used for all measurements unless otherwise noted:

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NR	NR-MIMO-1C	1	5	731.5	737	742.5
			10	734	737	740
			15	736.5	737	737.5
	NR-MIMO-2C	2	5	-	731.5+742.5	-
	NR-MIMO-3C	3	5	-	731.5+737+742.5	-

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
LTE	LTE-MIMO-1C	1	5	731.5	737	742.5
			10	734	737	740
			15	736.5	737	737.5
	LTE-MIMO-2C	2	5	-	731.5+742.5	-
	LTE-MIMO-3C	3	5	-	731.5+737+742.5	-

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-Standalone-1C	1	0.2	729.2	737	744.8
	NB-IoT-Standalone-2C	2	0.2	-	729.2+744.8	-

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-InBand-1C	1	5	731.5	737	742.5
			10	734	737	740
			15	736.5	737	737.5

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Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-GuardBand-1C	1	10	734	737	740
			15	736.5	737	737.5

Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	LTE Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)
					Middle
NR+LTE	NR+LTE-MC-1	1NR+1LTE	5	5	(NR)731.5+(L)742.5
			5	10	(NR)731.5+(L)740
			10	5	(NR)734+(L)742.5
	NR+LTE-MC-2	1NR+2LTE	5	5	(NR)731.5+(L)737.5+742.5

Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	NB Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)
					Middle
NR+NB-IoT	NR+NB-IoT-MC-1	1SA+1NR	5	0.2	(NB)729.2+(NR)742.5
	NR+NB-IoT-MC-2	1SA+1NR+1SA	5	0.2	(NB)729.2+(NR)737+(NB)744.8

Mode	Configuration	Carriers	LTE Channel Bandwidth (MHz)	NB Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)
					Middle
LTE+NB-IoT	LTE+NB-IoT-MC-1	1SA+1LTE	5	0.2	(NB)729.2+(L)742.5
	LTE+NB-IoT-MC-2	1SA+1LTE+1SA	5	0.2	(NB)729.2+(L)737+(NB)744.8

Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	LTE Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)
					Middle
NR+LTE+NB-IoT	NR+LTE+NB-IoT-MC-1	1SA+1NR+1LTE+1SA	5	5	(NB)729.2+(NR)731.9+(L)742.1+(NB)744.8
	NR+LTE+NB-IoT-MC-2	1SA+1NR+2LTE+1SA	5	5	(NB)729.2+(NR)731.9+(L)737.1+742.1+(NB)744.8

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NR	NR-MIMO-1C-BE	1	5	731.5	-	742.5
			10	734	-	740
			15	736.5	-	737.5
	NR-MIMO-2C-BE	2	5	731.5+736.5	-	737.5+742.5
	NR-MIMO-3C-BE	3	5	731.5+736.5+741.5	-	732.5+737.5+742.5

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
LTE	LTE-MIMO-1C-BE	1	5	731.5	-	742.5
			10	734	-	740
			15	736.5	-	737.5
	LTE-MIMO-2C-BE	2	5	731.5+736.5	-	737.5+742.5
	LTE-MIMO-3C-BE	3	5	731.5+736.5+741.5	-	732.5+737.5+742.5

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-Standalone-1C-BE	1	0.2	729.2	-	744.8
	NB-IoT-Standalone-2C-BE	2	0.2	729.2+729.8	-	744.2+744.8

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-InBand-1C-BE	1	5	731.5	-	742.5
			10	734	-	740
			15	736.5	-	737.5

Mode	Configuration	No. of Carriers	Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
NB-IoT	NB-IoT-GuardBand-1C-BE	1	10	734	-	740
			15	736.5	-	737.5

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Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	LTE Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)	
					Bottom	Top
NR+LTE	NR+LTE-MC-1-BE	1NR+1LTE	5	5	(NR)731.5+(L)736.5	(L)737.5+(NR)742.5
			5	10	(NR)731.5+(L)739	(L)735+(NR)742.5
			10	5	(NR)734+(L)741.5	(L)732.5+(NR)740
	NR+LTE-MC-2-BE	1NR+2LTE	5	5	(NR)731.5+(L)736.5+741.5	(L)732.5+737.5+(NR)742.5

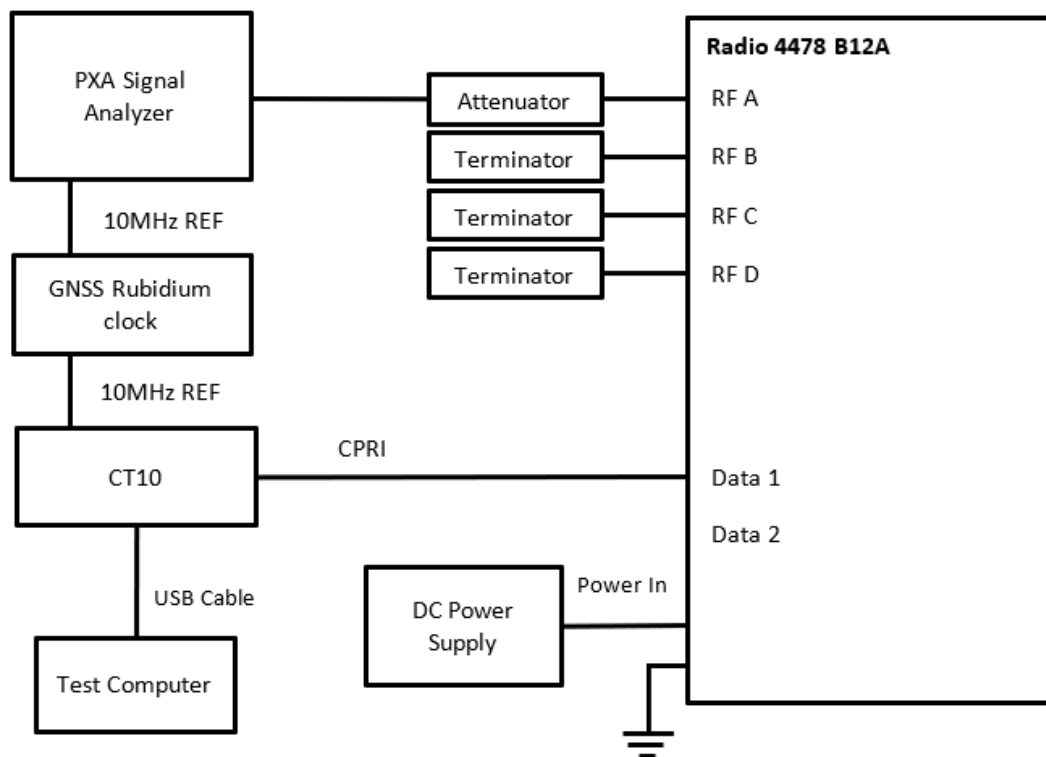
Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	NB Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)	
					Bottom	Top
NR+NB-IoT	NR+NB-IoT-MC-1-BE	1SA+1NR	5	0.2	(NB)729.2+(NR)731.9	(NR)742.1+(NB)744.8
	NR+NB-IoT-MC-2-BE	1SA+1NR+1SA	5	0.2	(NB)729.2+(NR)731.9+(NB)734.6	(NB)739.4+(NR)742.1+(NB)744.8

Mode	Configuration	Carriers	LTE Channel Bandwidth (MHz)	NB Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)	
					Bottom	Top
LTE+NB-IoT	LTE+NB-IoT-MC-1-BE	1SA+1LTE	5	0.2	(NB)729.2+(L)731.9	(L)742.1+(NB)744.8
	LTE+NB-IoT-MC-2-BE	1SA+1LTE+1SA	5	0.2	(NB)729.2+(L)731.9+(NB)734.6	(NB)739.4+(L)742.1+(NB)744.8

Mode	Configuration	Carriers	NR Channel Bandwidth (MHz)	LTE Channel Bandwidth (MHz)	Carrier Frequency Configuration (MHz)	
					Bottom	Top
NR+LTE+NB-IoT	NR+LTE+NB-IoT-MC-1-BE	1SA+1NR+1LTE+1SA	5	5	(NB)729.2+(NR)731.9+(L)736.9+(NB)739.6	(NB)734.4+(NR)737.1+(L)742.1+(NB)744.8
	NR+LTE+NB-IoT-MC-2-BE	1SA+1NR+2LTE+1SA	5	5	(NB)729.2+(NR)731.9+(L)736.9+741.9+(NB)744.6	(NB)729.4+(NR)732.1+(L)737.1+742.1+(NB)744.8

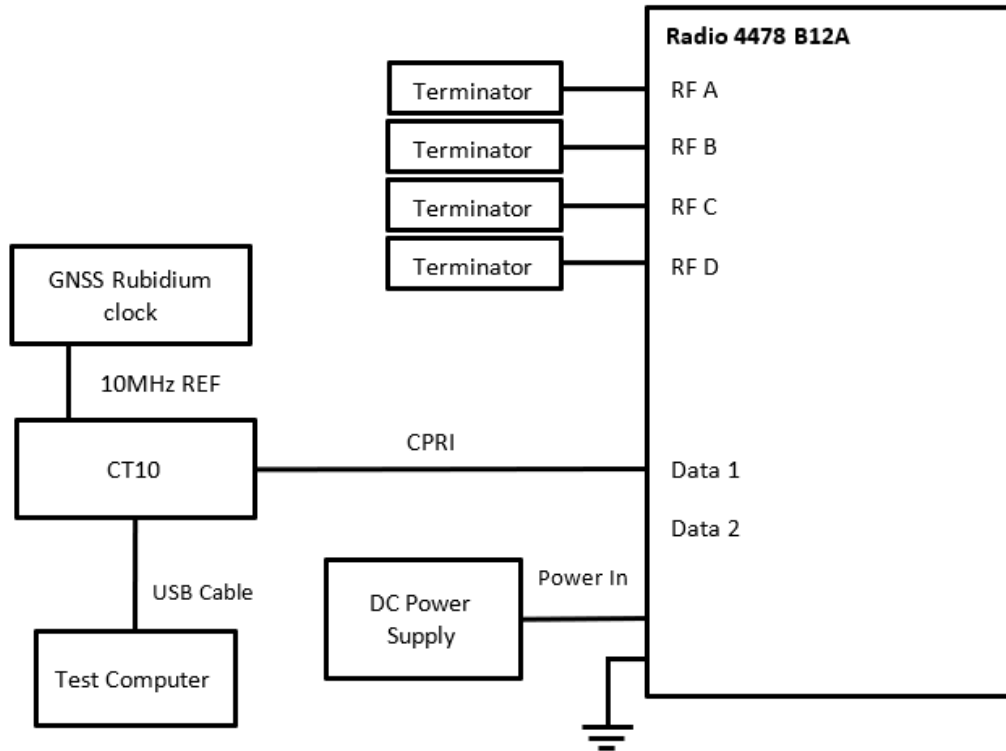
2.4 Test Setup

Conducted Measurement:



No.	Auxiliary Equipment	Product Number / Model Type	Version
1	Test computer	HP EliteBook 8470	-
2	CT10	BAMS-1001539632	R1C
3	GNSS Rubidium clock	HJ5418A-V1	-
4	DC Power Supply	Chroma 62024P-100-50	-
5	Attenuator	66-40-33	-
6	Terminator	TF200-4G	-
7	Terminator	TF200-4G-NK	-

Radiated Measurement:



No.	Auxiliary Equipment	Product Number / Model Type	Version
1	Test computer	HP EliteBook 8470	-
2	CT10	BAMS-1001539632	R1C
3	GNSS Rubidium clock	HJ5418A-V1	-
4	DC Power Supply	Chroma 62024P-100-50	-
5	Attenuator	66-40-33	-
6	Terminator	TF200-4G	-
7	Terminator	TF200-4G-NK	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Max Output Power and Peak to Average Power Ratio and EIRP	26°C	58% RH
Occupied Bandwidth		
Unwanted Emissions at Band Edge		
Conducted Unwanted Emission		
Radiated Unwanted Emissions	27°C	59% RH
Frequency Stability	Please refer to clause 8	

2.6 Instrument list

Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESIB 26	EC 3045	2020-09-16
☒	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2020-09-24
☒	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2021-06-11
☒	Horn antenna	R&S	HF 906	EC 3049	2021-01-17
☐	Horn antenna	ETS	3117	EC 4792-1	2021-02-25
☐	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2021-07-09
☐	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2021-03-14
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2021-03-16
☐	Power sensor	Agilent	U2021XA	EC 5338-1	2021-03-16
☐	Vector Signal Generator	Agilent	N5182B	EC 5175	2021-03-16
☐	Universal Radio Communication Tester	R&S	CMW500	EC5944	2020-12-09
☐	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2021-03-16
☐	Mobile Test System	Litepoint	lqxel	EC 5176	2021-01-16
☐	Test Receiver	R&S	ESCI 7	EC 4501	2020-09-16
☐	Climate chamber	GWS	MT3065	EC 6021	2021-07-04
☒	Climate chamber	ESQEC	SETH-Z-102U	EC 4315	2021-05-14
☒	Spectrum Analyzer	Keysight	N9030B	EC 6078	2021-06-11
Tet Site					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	Shielded room	Zhongyu	-	EC 2838	2021-01-12
☐	Shielded room	Zhongyu	-	EC 2839	2021-01-12
☒	Semi-anechoic chamber	Albatross project	-	EC 3048	2021-06-31
☐	Fully-anechoic chamber	Albatross project	-	EC 3047	2021-06-31
Additional instrument					

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Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2021-03-03
☐	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3481	2021-01-05
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3442	2021-01-05
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2020-09-05
☐	Pressure meter	YM3	Shanghai Mengde	EC 3320	2021-07-14

2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Maximum output power	0.73dB
Occupied Bandwidth	0.88%
Unwanted Emissions at Band Edge	3.03dB
Conducted Unwanted Emission	3.03dB
Radiated Unwanted Emissions below 1GHz	4.90dB
Radiated Unwanted Emissions above 1GHz	5.02dB
Frequency stability	0.77×10^{-7}

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3 Maximum Output Power and Peak to Average Power Ratio and EIRP

Test result: Pass

3.1 Limit

FCC: 1000 W (ERP)/MHz or 60 dBm/MHz for emission bandwidth > 1MHz

IC: 1640 W (EIRP)/MHz or 62.15 dBm/MHz for emission bandwidth > 1MHz

Peak to Average Ratio: ≤ 13 dB

3.2 Measurement Procedure

The EUT was configured to transmit on maximum power and proper modulation. The transmitter power shall be measured in terms of a root-mean-square (RMS) average value. In case of the EUT was configured to MIMO mode, since the EUT transmits on all antennas simultaneously in the same frequency range, using the Measure-and-Sum approach, the output power at all antennas were tested, and the total output power were then summed mathematically in linear power units according to FCC KDB 662911 D01.

A peak to average ratio measurement is performed at the conducted ports of the EUT for single carrier for single RAT mode. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) was used and 0.1% probability value recorded.

3.3 Measurement result

Configuration NR-MIMO-1C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	45.97	39.74	7.24	46.04	39.77	7.24	45.97	39.76	7.26
B	QPSK	5	46.01	39.77	7.25	46.11	39.86	7.24	46.01	39.80	7.27
C	QPSK	5	45.90	39.70	7.25	46.00	39.73	7.25	45.93	39.72	7.27
D	QPSK	5	46.02	39.77	7.25	46.12	39.88	7.24	46.04	39.83	7.27
Total			52.00	45.77	-	52.09	45.83	-	52.01	45.80	-

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	10	46.02	36.63	7.33	46.05	36.63	7.26	46.01	36.60	7.27
B	QPSK	10	46.02	36.64	7.37	46.08	36.65	7.29	46.06	36.67	7.24
C	QPSK	10	45.94	36.53	7.39	45.97	36.56	7.30	45.98	36.62	7.27
D	QPSK	10	46.07	36.68	7.39	46.08	36.67	7.31	46.07	36.66	7.28
Total			52.03	42.64	-	52.07	42.65	-	52.05	42.66	-

Antenna Port	Modulation	Carrier Bandwidth (MHz))	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	15	45.99	34.75	7.41	46.00	34.76	7.39	45.98	34.79	7.39
B	QPSK	15	46.01	34.81	7.44	46.02	34.83	7.37	45.99	34.79	7.37
C	QPSK	15	45.94	34.74	7.44	45.95	34.74	7.41	45.95	34.74	7.39
D	QPSK	15	46.06	34.83	7.35	46.05	34.83	7.36	46.05	34.84	7.29
Total			52.02	40.80	-	52.03	40.81	-	52.01	40.81	-

Configuration NR-MIMO-2C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	-	-	-	45.98	36.73	-	-	-	-
B	QPSK	5	-	-	-	45.96	36.72	-	-	-	-
C	QPSK	5	-	-	-	45.92	36.71	-	-	-	-
D	QPSK	5	-	-	-	46.00	36.75	-	-	-	-
Total			-	-	-	51.99	42.75	-	-	-	-

Configuration NR-MIMO-3C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	-	-	-	45.70	34.78	-	-	-	-
B	QPSK	5	-	-	-	45.67	34.76	-	-	-	-
C	QPSK	5	-	-	-	45.64	34.72	-	-	-	-
D	QPSK	5	-	-	-	45.74	34.81	-	-	-	-
Total			-	-	-	51.71	40.79	-	-	-	-

Configuration LTE-MIMO-1C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	45.95	39.71	7.29	46.05	39.76	7.26	45.97	39.70	7.26
B	QPSK	5	45.93	39.70	7.32	46.01	39.74	7.29	45.92	39.66	7.31
C	QPSK	5	45.86	39.63	7.32	45.94	39.66	7.28	45.89	39.63	7.30
D	QPSK	5	45.97	39.68	7.31	46.04	39.76	7.28	45.97	39.73	7.29
Total			51.95	45.70	-	52.03	45.75	-	51.96	45.70	-

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	10	45.99	36.75	7.33	46.04	36.77	7.27	45.98	36.76	7.28
B	QPSK	10	45.98	36.74	7.36	46.01	36.73	7.29	45.98	36.76	7.30
C	QPSK	10	45.94	36.71	7.37	45.97	36.69	7.29	45.93	36.67	7.29
D	QPSK	10	46.03	36.81	7.35	46.06	36.80	7.29	46.02	36.82	7.29
Total			52.01	42.77	-	52.04	42.77	-	52.00	42.77	-

TEST REPORT

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	15	46.05	35.07	7.34	46.02	35.04	7.32	46.07	35.06	7.30
B	QPSK	15	46.03	34.95	7.37	46.01	34.97	7.35	46.00	34.98	7.32
C	QPSK	15	45.92	34.90	7.38	45.93	34.91	7.34	45.93	34.91	7.34
D	QPSK	15	46.05	35.05	7.37	46.05	35.06	7.34	46.06	35.07	7.32
Total			52.03	41.01	-	52.02	41.02	-	52.04	41.03	-

Configuration LTE-MIMO-2C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	-	-	-	45.97	36.73	-	-	-	-
B	QPSK	5	-	-	-	45.96	36.72	-	-	-	-
C	QPSK	5	-	-	-	45.87	36.65	-	-	-	-
D	QPSK	5	-	-	-	45.99	36.74	-	-	-	-
Total			-	-	-	51.97	42.73	-	-	-	-

Configuration LTE-MIMO-3C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	-	-	-	45.68	34.67	-	-	-	-
B	QPSK	5	-	-	-	45.73	34.71	-	-	-	-
C	QPSK	5	-	-	-	45.59	34.57	-	-	-	-
D	QPSK	5	-	-	-	45.72	34.73	-	-	-	-
Total			-	-	-	51.70	40.69	-	-	-	-

NB-IoT-Standalone-1C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	0.2	42.78	42.75	4.99	42.76	42.72	4.95	42.63	42.59	4.97
B	QPSK	0.2	42.78	42.75	4.97	42.66	42.63	4.98	42.67	42.63	4.96
C	QPSK	0.2	42.75	42.71	4.99	42.60	42.57	4.98	42.57	42.53	4.96
D	QPSK	0.2	42.77	42.73	4.99	42.69	42.65	4.97	42.59	42.55	4.99

NB-IoT-Standalone-2C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	0.2	-	-	-	44.93	42.15	-	-	-	-
B	QPSK	0.2	-	-	-	44.83	42.04	-	-	-	-
C	QPSK	0.2	-	-	-	44.76	41.95	-	-	-	-
D	QPSK	0.2	-	-	-	44.84	42.12	-	-	-	-

NB-IoT-InBand-1C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	5	45.81	40.45	7.30	45.90	40.60	7.27	45.79	40.55	7.28
B	QPSK	5	45.94	40.54	7.31	46.04	40.72	7.28	45.94	40.69	7.30
C	QPSK	5	45.87	40.46	7.31	45.95	40.63	7.28	45.91	40.66	7.29
D	QPSK	5	45.93	40.57	7.30	46.05	40.77	7.28	45.92	40.69	7.29
Total			51.91	46.53	-	52.01	46.70	-	51.91	46.67	-

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	10	45.88	38.03	7.34	45.90	37.97	7.28	45.87	37.86	7.29
B	QPSK	10	45.96	38.09	7.36	45.97	38.05	7.29	45.94	37.91	7.29
C	QPSK	10	45.92	38.07	7.37	45.97	38.05	7.30	45.94	37.93	7.30
D	QPSK	10	45.98	38.07	7.35	46.00	38.08	7.30	45.94	37.90	7.29
Total			51.96	44.09	-	51.98	44.06	-	51.94	43.92	-

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	15	45.87	35.96	7.35	45.88	36.00	7.34	45.88	36.01	7.32
B	QPSK	15	45.93	36.00	7.37	45.94	36.04	7.35	45.92	36.05	7.32
C	QPSK	15	45.94	35.96	7.38	45.95	36.02	7.35	46.00	36.10	7.33
D	QPSK	15	45.96	36.05	7.35	45.96	36.06	7.33	45.95	36.06	7.32
Total			51.95	42.01	-	51.95	42.05	-	51.96	42.08	-

TEST REPORT

NB-IoT-GuardBand-1C

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	10	45.75	36.85	7.52	45.77	36.96	7.44	45.75	37.01	7.43
B	QPSK	10	45.76	36.94	7.45	45.72	36.80	7.53	45.73	37.00	7.43
C	QPSK	10	45.75	36.80	7.54	45.81	37.01	7.47	45.80	37.03	7.44
D	QPSK	10	45.78	36.89	7.52	45.80	36.97	7.44	45.78	37.08	7.44
Total			51.78	42.89	-	51.80	42.96	-	51.79	43.05	-

Antenna Port	Modulation	Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)								
			Channel position B			Channel position M			Channel position T		
			Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)	Power (dBm)	Power (dBm /MHz)	PAR (dB)
A	QPSK	15	45.79	35.06	7.47	45.81	35.11	7.45	45.82	35.13	7.43
B	QPSK	15	45.78	35.03	7.48	45.77	35.06	7.44	45.76	35.09	7.43
C	QPSK	15	45.80	35.01	7.49	45.81	35.05	7.49	45.82	35.11	7.45
D	QPSK	15	45.83	35.11	7.46	45.79	35.10	7.45	45.80	35.11	7.44
Total			51.82	41.07	-	51.82	41.10	-	51.82	41.13	-

NR+LTE-MC-1

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	5	45.92	36.71	-
B	QPSK	5	5	45.90	36.68	-
C	QPSK	5	5	45.90	36.72	-
D	QPSK	5	5	45.99	36.76	-
Total				51.95	42.74	-

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	10	45.97	36.71	-
B	QPSK	5	10	45.93	36.66	-
C	QPSK	5	10	45.97	36.76	-
D	QPSK	5	10	45.99	36.71	-
Total				51.99	42.73	-

TEST REPORT

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	10	5	45.97	36.65	-
B	QPSK	10	5	45.93	36.61	-
C	QPSK	10	5	45.96	36.67	-
D	QPSK	10	5	45.98	36.68	-
Total				51.98	42.67	-

NR+LTE-MC-2

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	5	45.70	34.71	-
B	QPSK	5	5	45.62	34.63	-
C	QPSK	5	5	45.69	34.70	-
D	QPSK	5	5	45.71	34.72	-
Total				51.70	40.71	-

NR+NB-IoT-MC-1

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	NB Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	0.2	45.23	41.80	-
B	QPSK	5	0.2	45.17	41.70	-
C	QPSK	5	0.2	45.21	41.72	-
D	QPSK	5	0.2	45.28	41.86	-
Total				51.24	47.79	-

NR+NB-IoT-MC-2

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	NB Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	0.2	44.94	39.99	-
B	QPSK	5	0.2	44.82	39.86	-
C	QPSK	5	0.2	44.83	39.86	-
D	QPSK	5	0.2	44.92	40.03	-
Total				50.90	45.96	-

TEST REPORT

LTE+NB-IoT-MC-1

Antenna Port	Modulation	LTE Carrier Bandwidth (MHz)	NB Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	0.2	45.18	41.81	-
B	QPSK	5	0.2	45.17	41.72	-
C	QPSK	5	0.2	45.15	41.67	-
D	QPSK	5	0.2	45.26	41.85	-
Total				51.21	47.78	-

LTE+NB-IoT-MC-2

Antenna Port	Modulation	LTE Carrier Bandwidth (MHz)	NB Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	0.2	44.90	39.96	-
B	QPSK	5	0.2	44.82	39.88	-
C	QPSK	5	0.2	44.81	39.83	-
D	QPSK	5	0.2	44.94	40.03	-
Total				50.89	45.95	-

NR+LTE+NB-IoT-MC-1

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	5	45.39	39.21	-
B	QPSK	5	5	45.33	39.14	-
C	QPSK	5	5	45.29	39.06	-
D	QPSK	5	5	45.34	39.25	-
Total				51.36	45.19	-

NR+LTE+NB-IoT-MC-2

Antenna Port	Modulation	NR Carrier Bandwidth (MHz)	LTE Carrier Bandwidth (MHz)	Output power / Peak-to-Average Ratio (PAR)		
				Channel position M		
				Power (dBm)	Power (dBm/MHz)	PAR (dB)
A	QPSK	5	5	45.64	38.38	-
B	QPSK	5	5	45.53	38.27	-
C	QPSK	5	5	45.50	38.19	-
D	QPSK	5	5	45.62	38.37	-
Total				51.59	44.32	-

4 Occupied Bandwidth

Test result: Pass

4.1 Measurement Procedure

The EUT was set to transmit at maximum power and testing was carried out on bottom, middle and top channels. Using the Occupied Bandwidth measurement function in the spectrum analyzer, the 26dB bandwidth was measured in accordance with FCC KDB 971168 D01 Clause 4.2.

The measurement method is from KDB 971168 4.2:

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).
- b) The nominal IF filter bandwidth (3 dB 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.
- c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least $10\log(\text{OBW} / \text{RBW})$ below the reference level.
- d) Set the detection mode to peak, and the trace mode to max hold.
- e) Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

4.2 Measurement result

Configuration NR-MIMO-1C

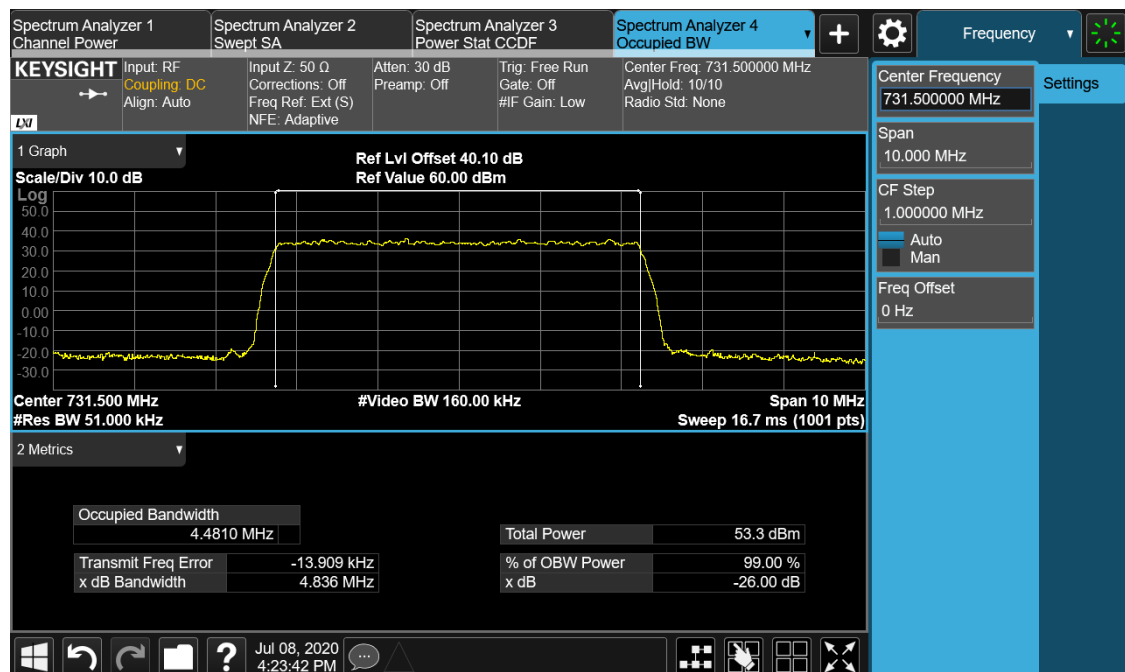
99% Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.4810	4.4842	4.4836
D	QPSK	10MHz	9.2993	9.2986	9.2991
D	QPSK	15MHz	14.110	14.110	14.109

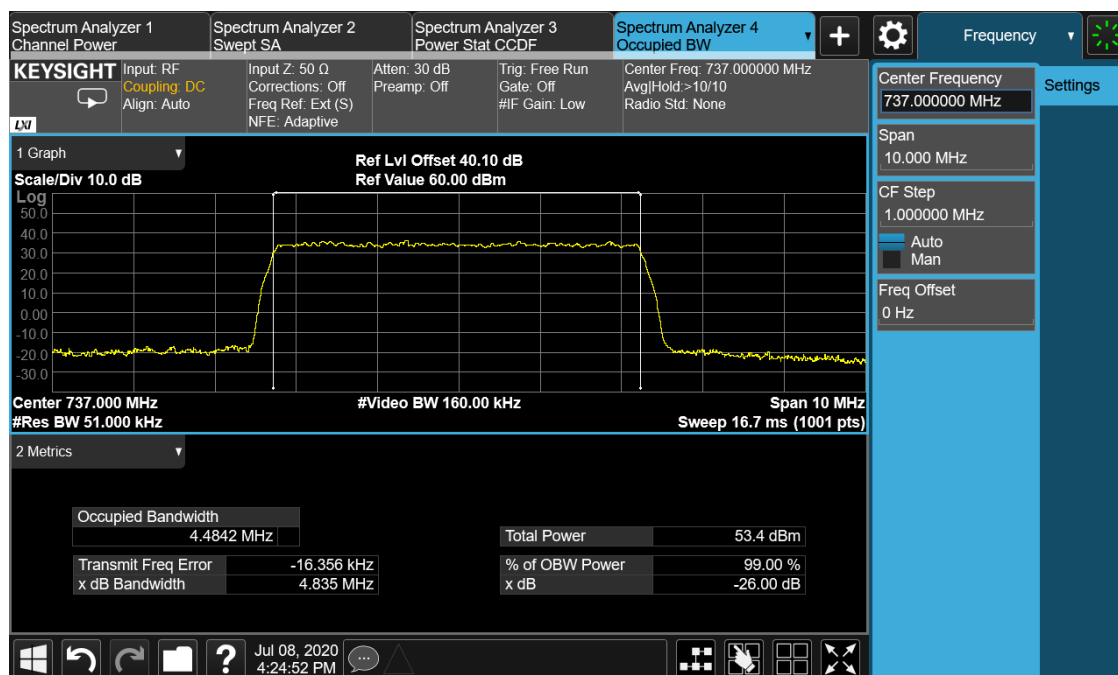
-26dBc Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.836	4.835	4.835
D	QPSK	10MHz	9.809	9.813	9.811
D	QPSK	15MHz	14.78	14.81	14.81

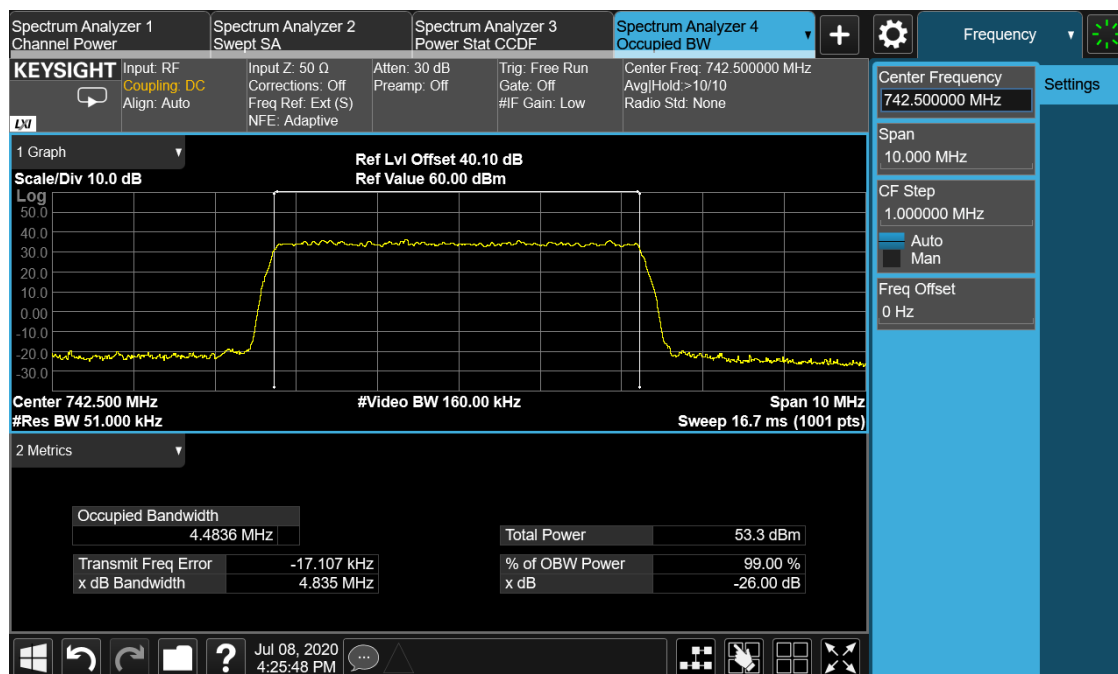
QPSK, 5MHz, Channel position B



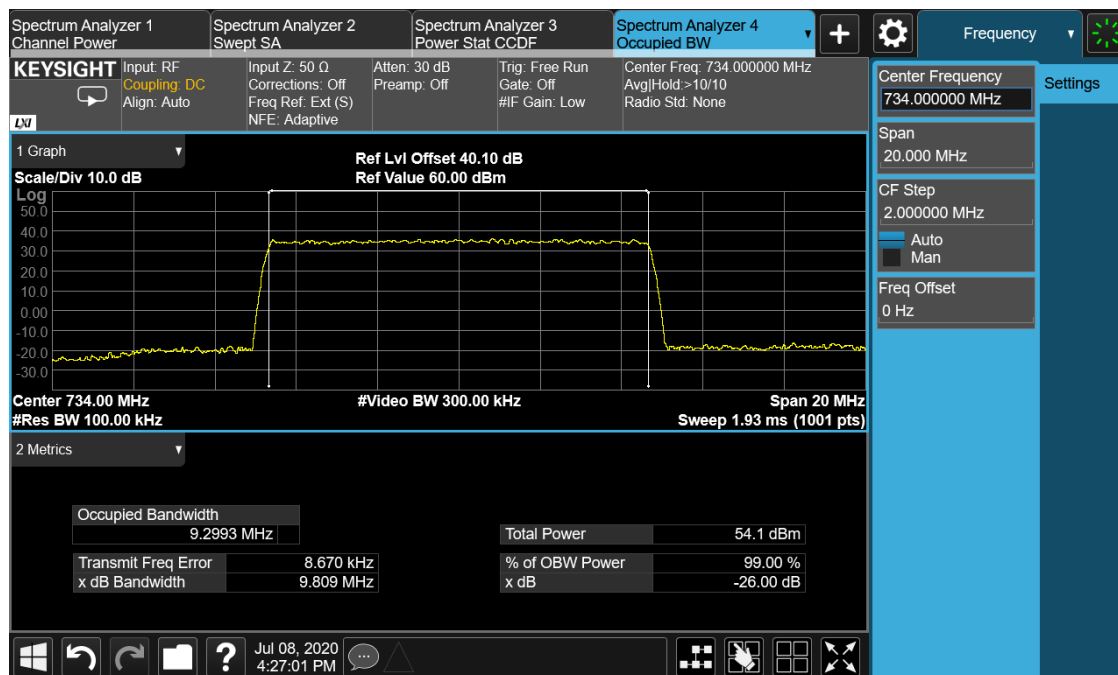
QPSK, 5MHz, Channel position M



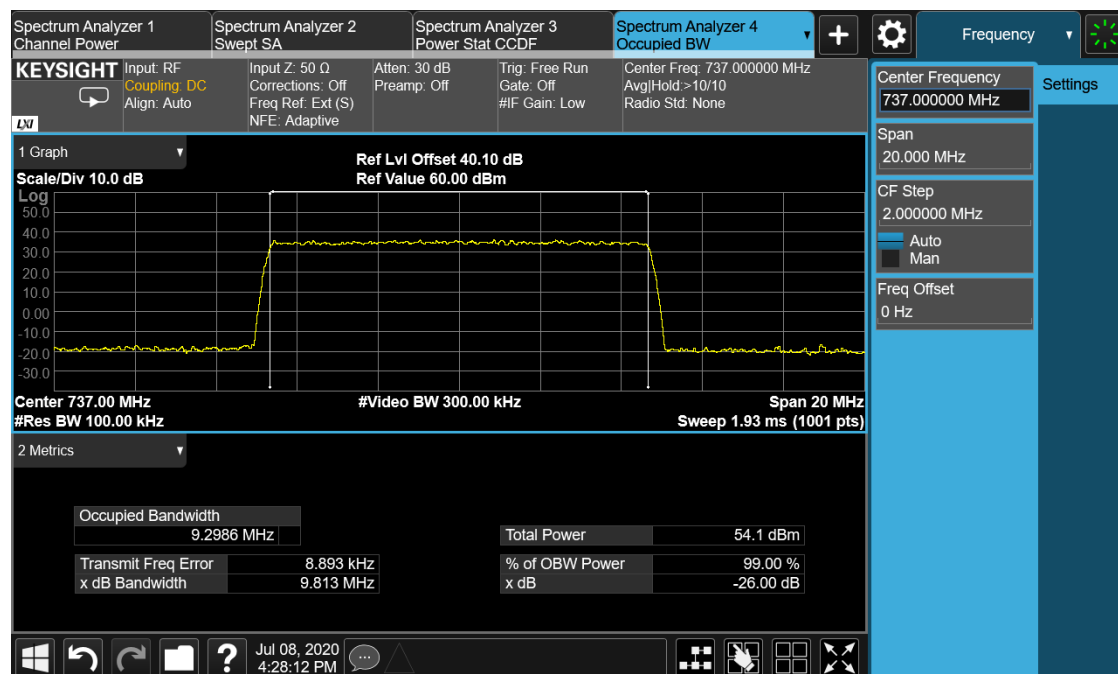
QPSK, 5MHz, Channel position T



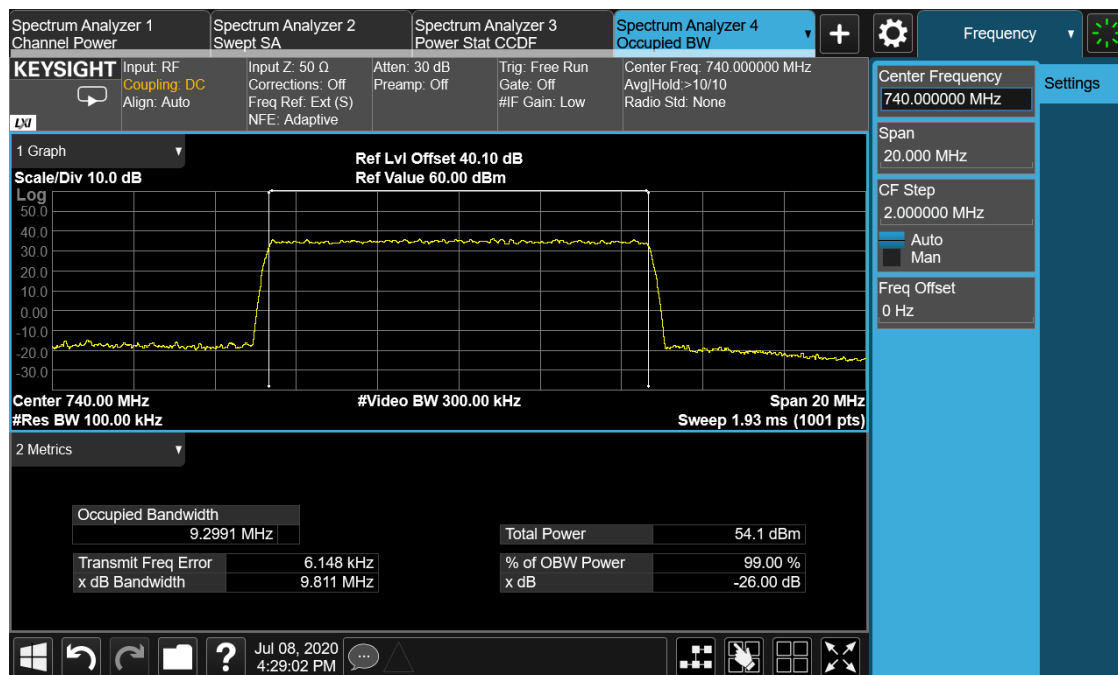
QPSK, 10MHz, Channel position B



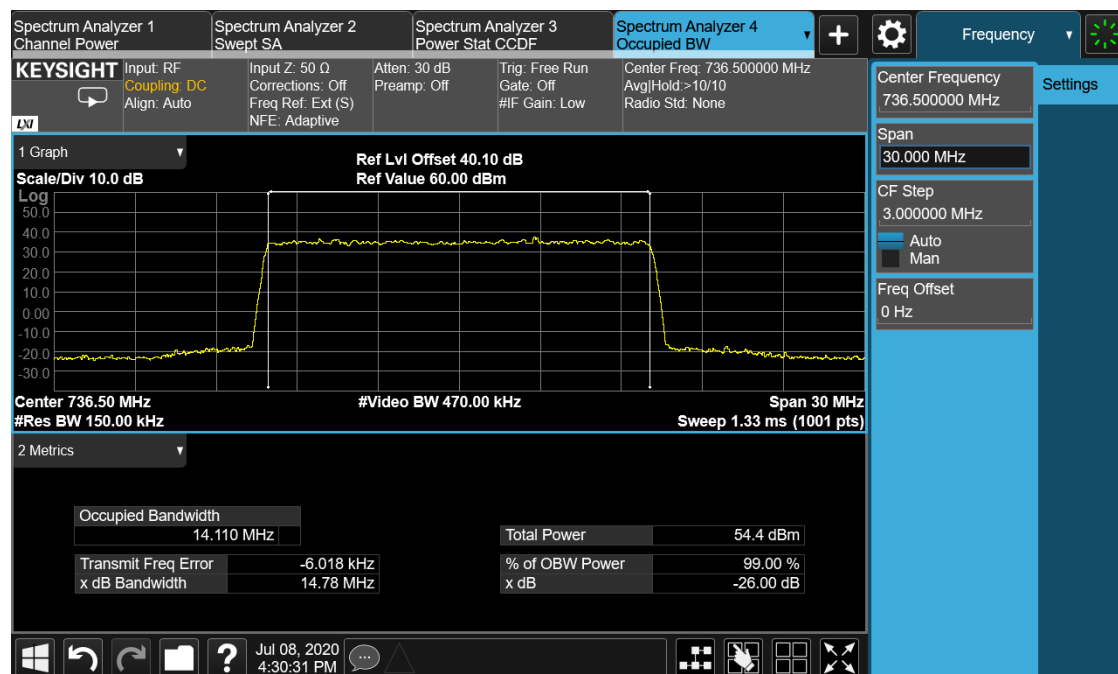
QPSK, 10MHz, Channel position M



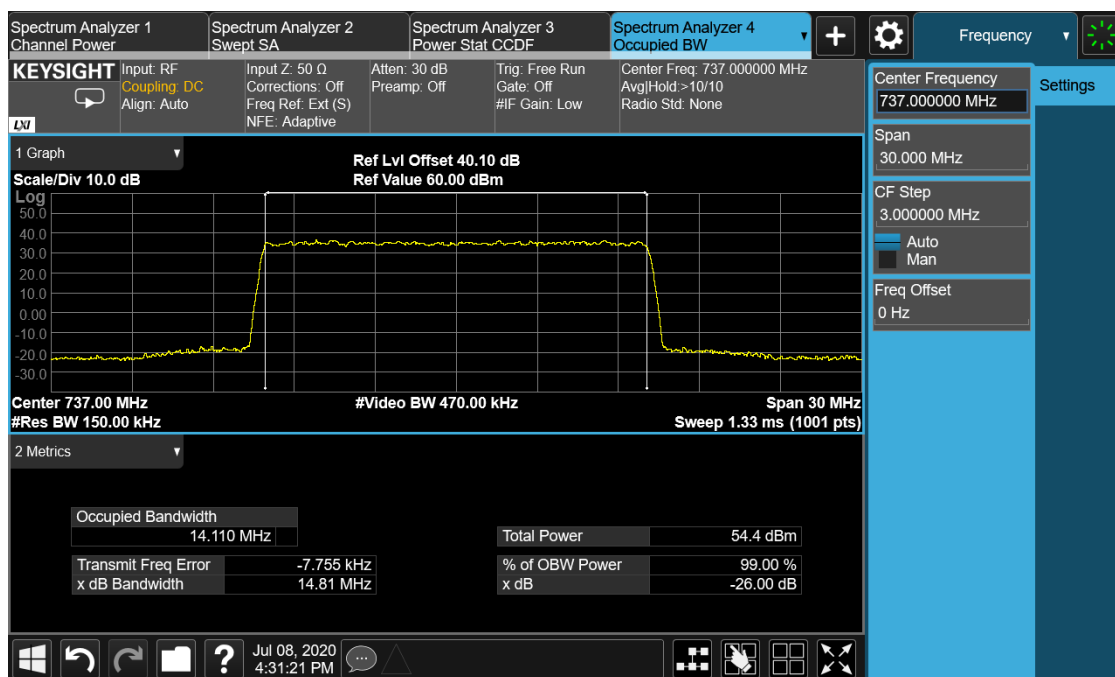
QPSK, 10MHz, Channel position T



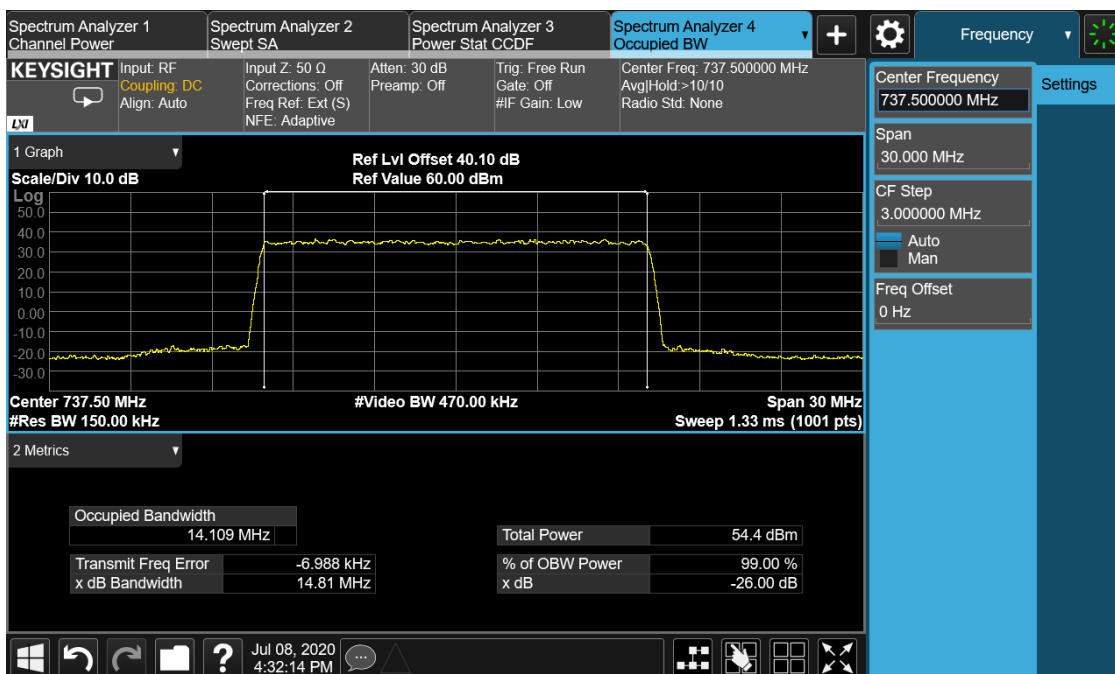
QPSK, 15MHz, Channel position B



QPSK, 15MHz, Channel position M



QPSK, 15MHz, Channel position T



TEST REPORT

Configuration LTE-MIMO-1C

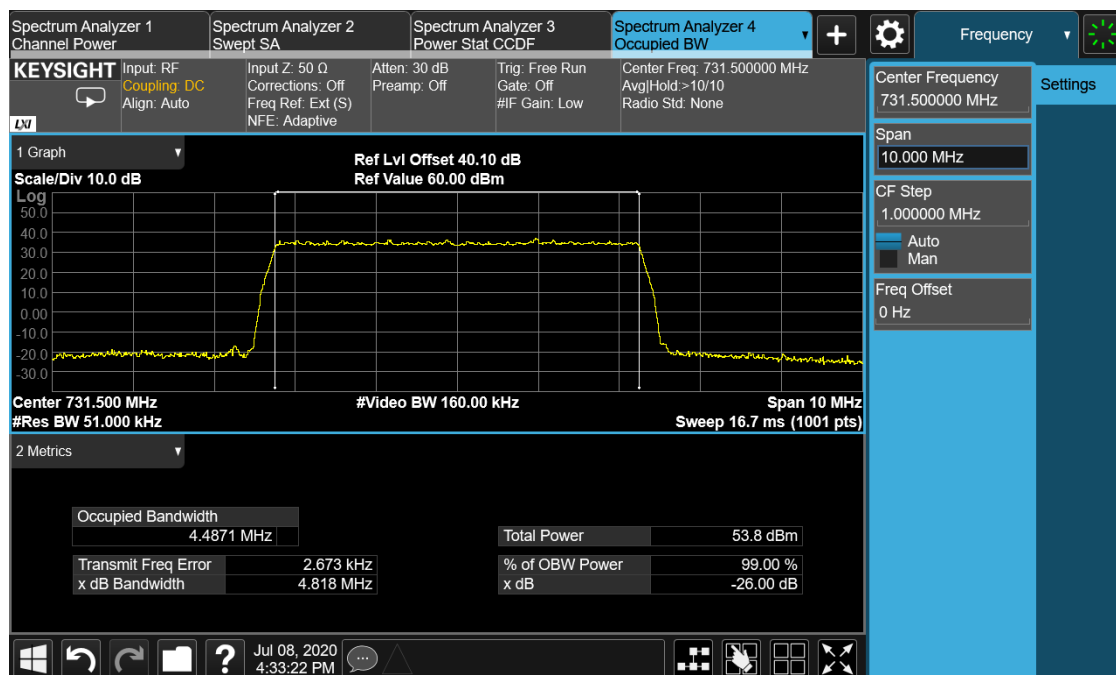
99% Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.4871	4.4854	4.4864
D	QPSK	10MHz	8.9701	8.9637	8.9717
D	QPSK	15MHz	13.426	13.422	13.424

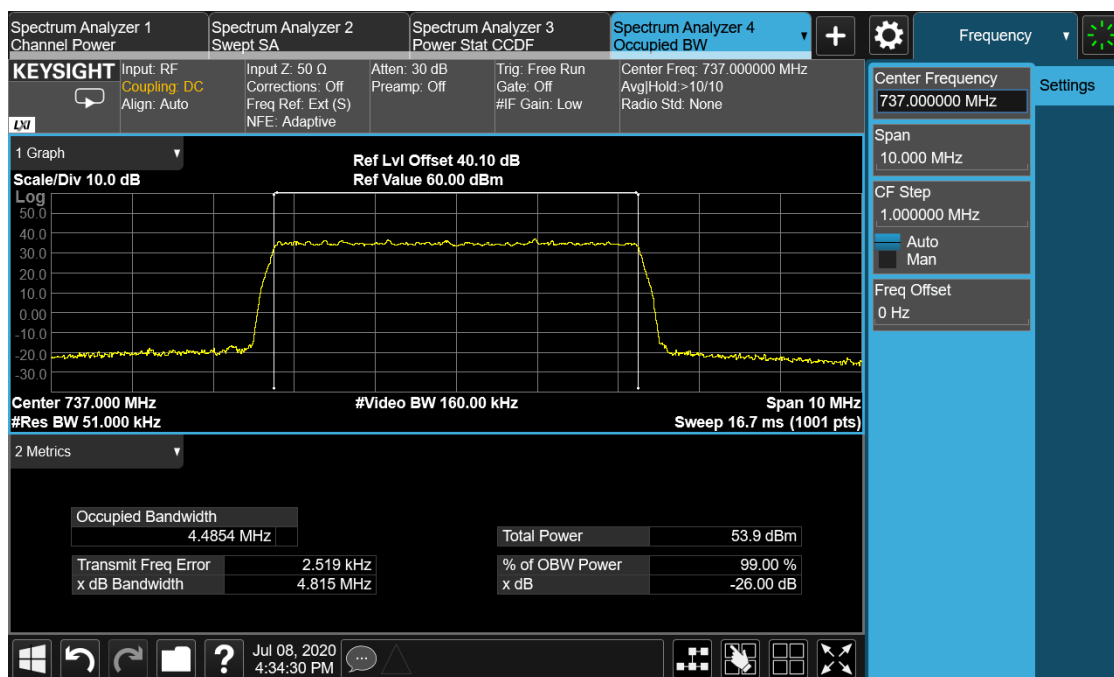
-26dBc Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.818	4.815	4.819
D	QPSK	10MHz	9.655	9.645	9.661
D	QPSK	15MHz	14.40	14.39	14.41

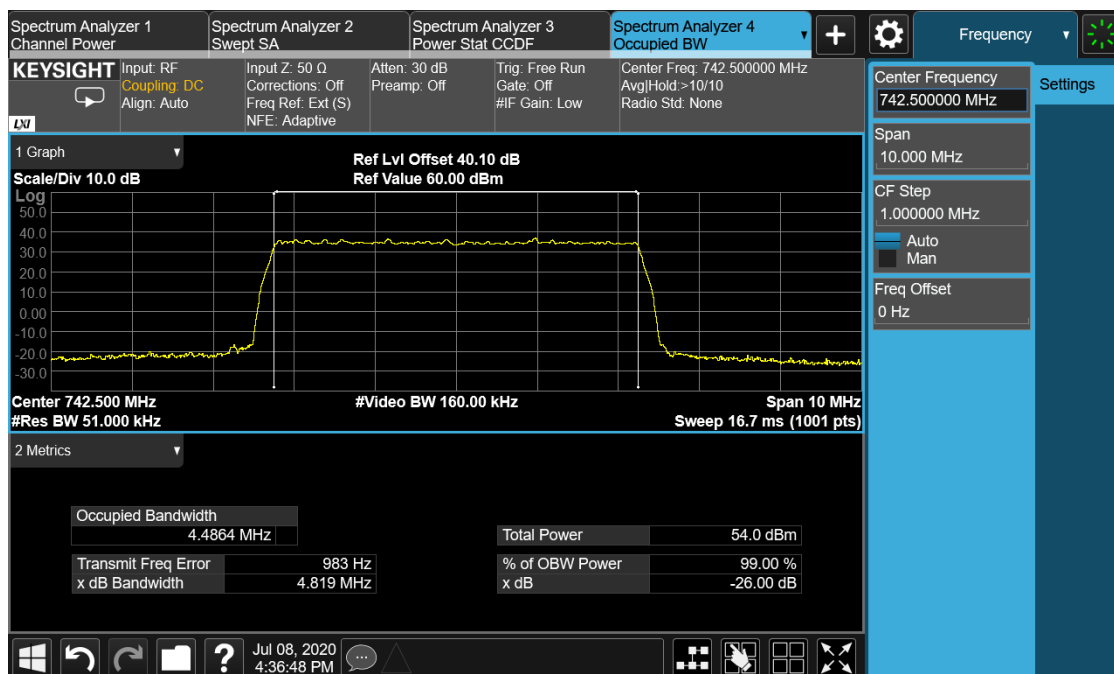
QPSK, 5MHz, Channel position B



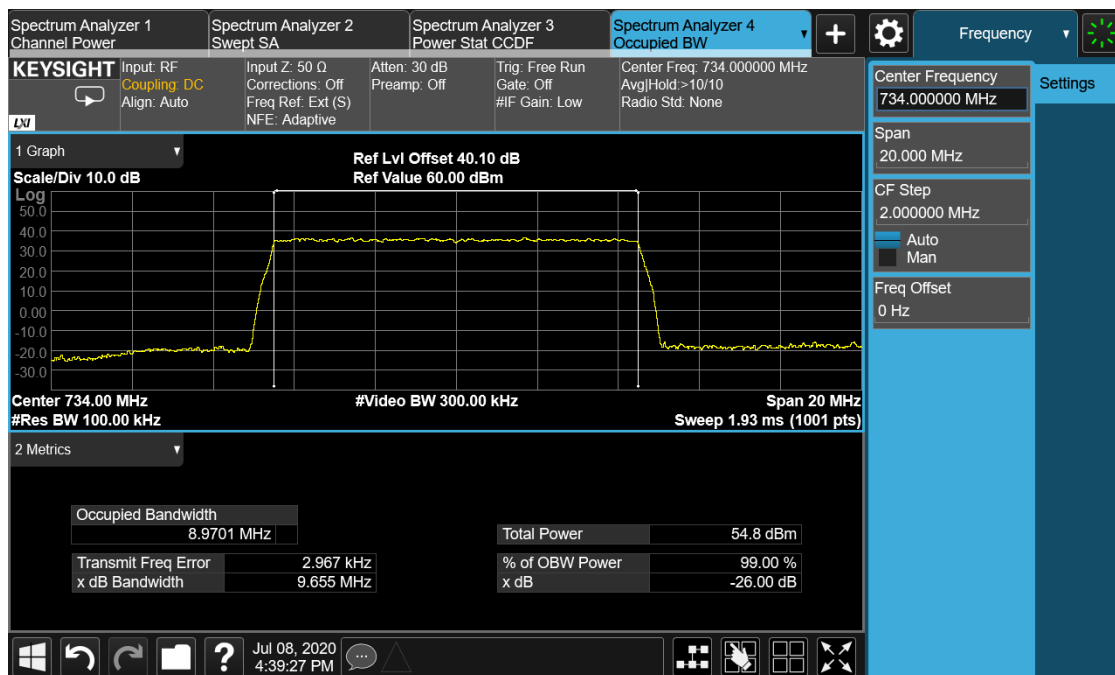
QPSK, 5MHz, Channel position M



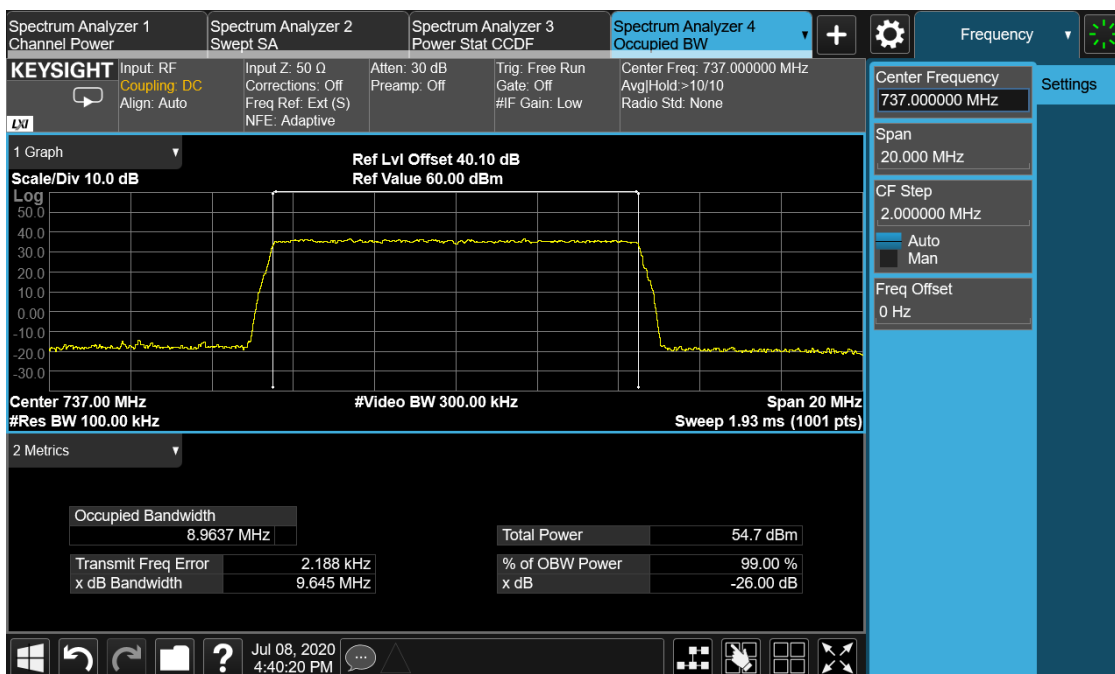
QPSK, 5MHz, Channel position T



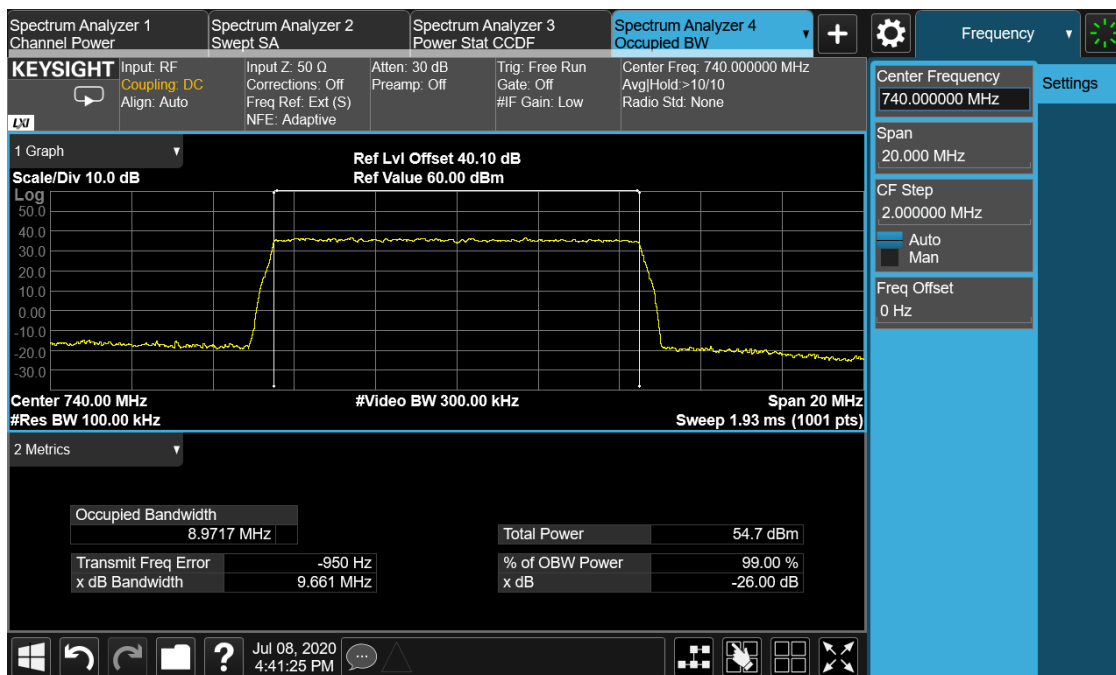
QPSK, 10MHz, Channel position B



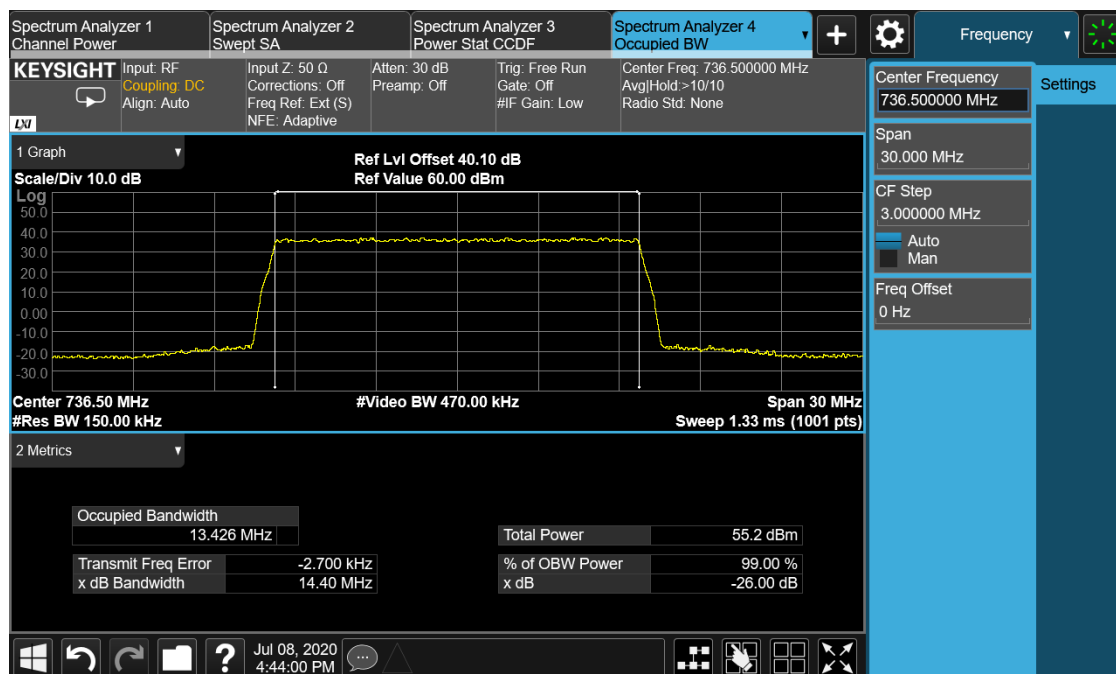
QPSK, 10MHz, Channel position M



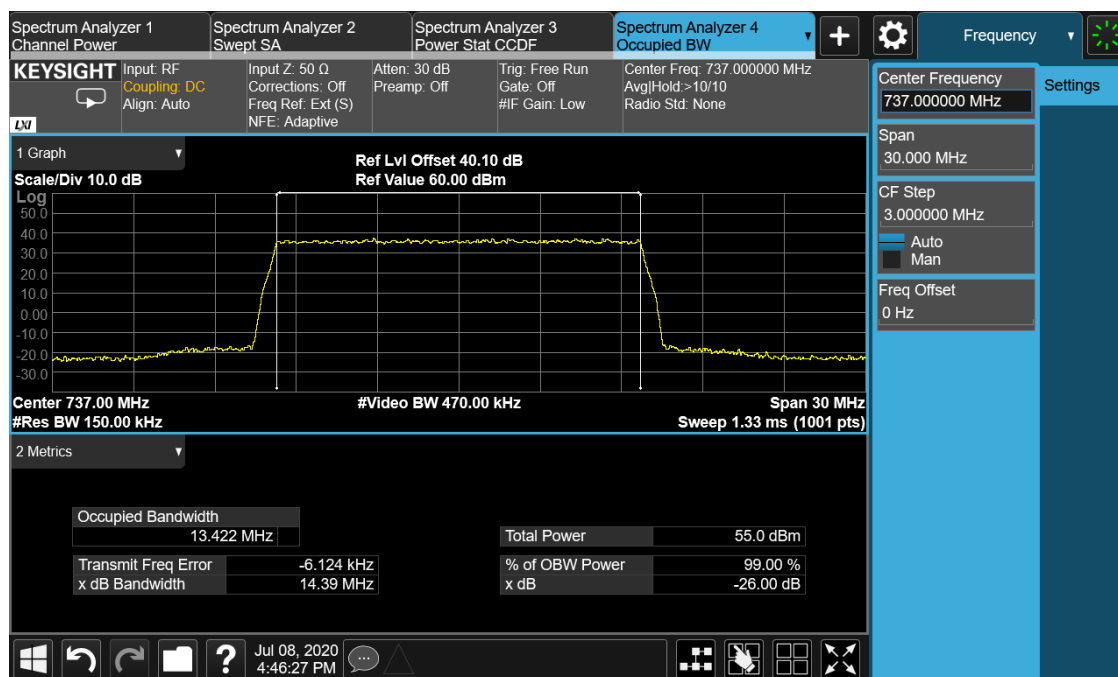
QPSK, 10MHz, Channel position T



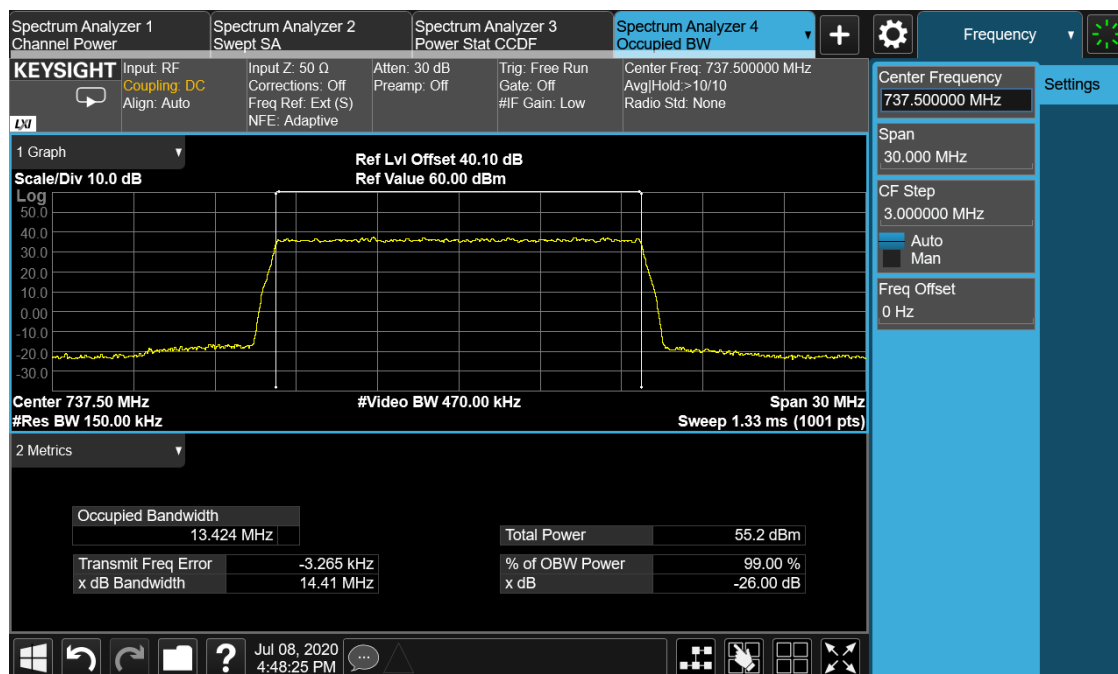
QPSK, 15MHz, Channel position B



QPSK, 15MHz, Channel position M



QPSK, 15MHz, Channel position T



TEST REPORT

Configuration NB-IoT-Standalone-1C

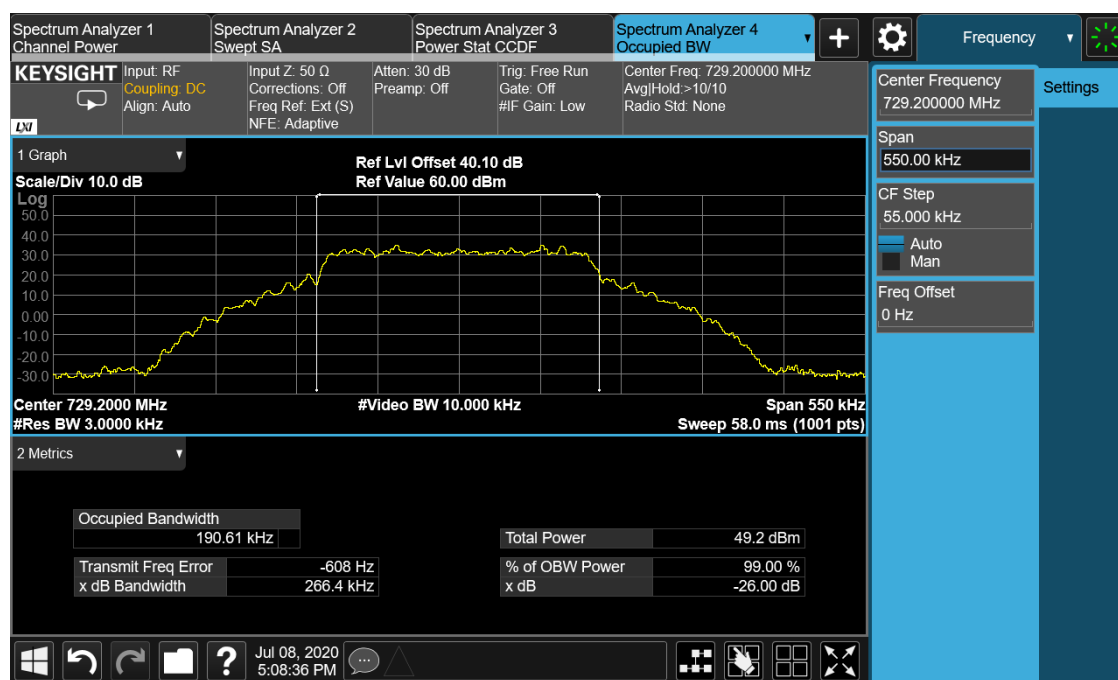
99% Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (kHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	0.2MHz	190.61	190.43	190.60

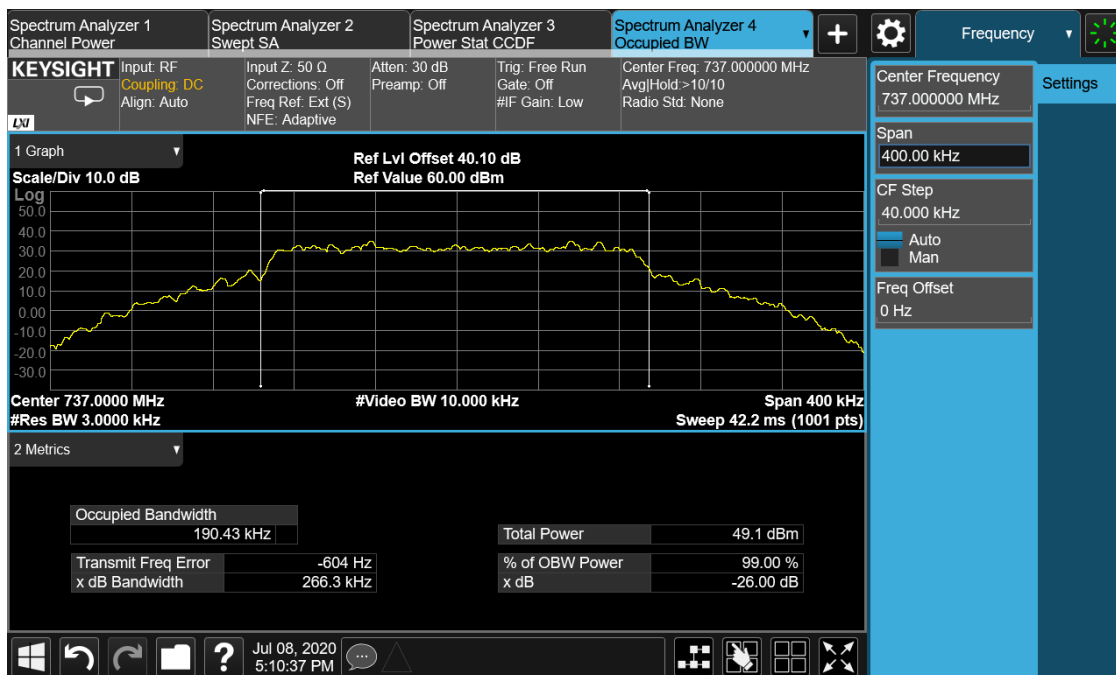
-26dBc Occupied Bandwidth

Antenna Port	Modulation	Bandwidth	Occupied Bandwidth (kHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	0.2MHz	266.4	266.3	266.7

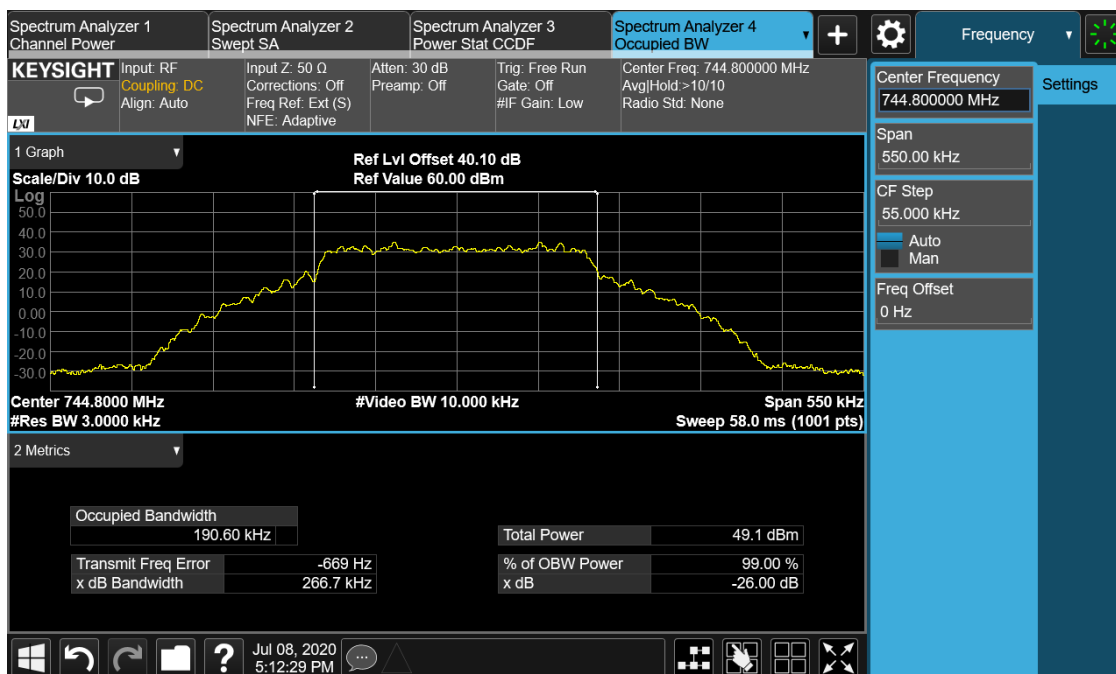
Channel position B



Channel position M



Channel position T



Configuration NB-IoT-InBand-1C

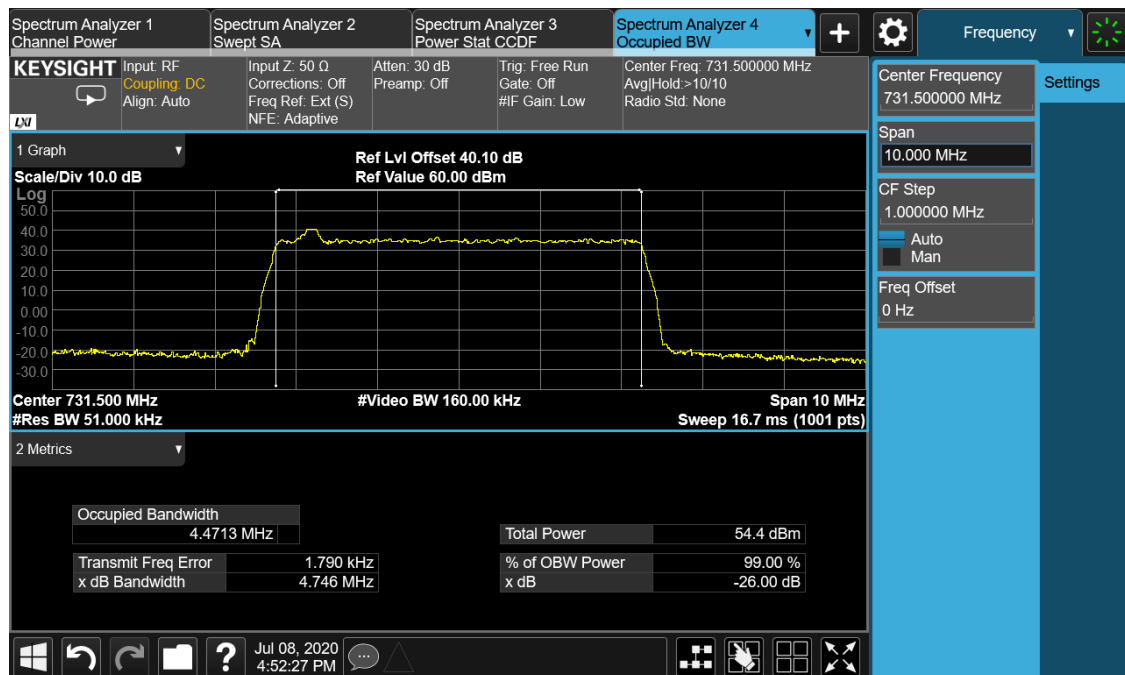
99% Occupied Bandwidth

Antenna Port	Modulation	LTE Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.4713	4.4682	4.4707
D	QPSK	10MHz	8.9513	8.9518	8.9518
D	QPSK	15MHz	13.429	13.470	13.441

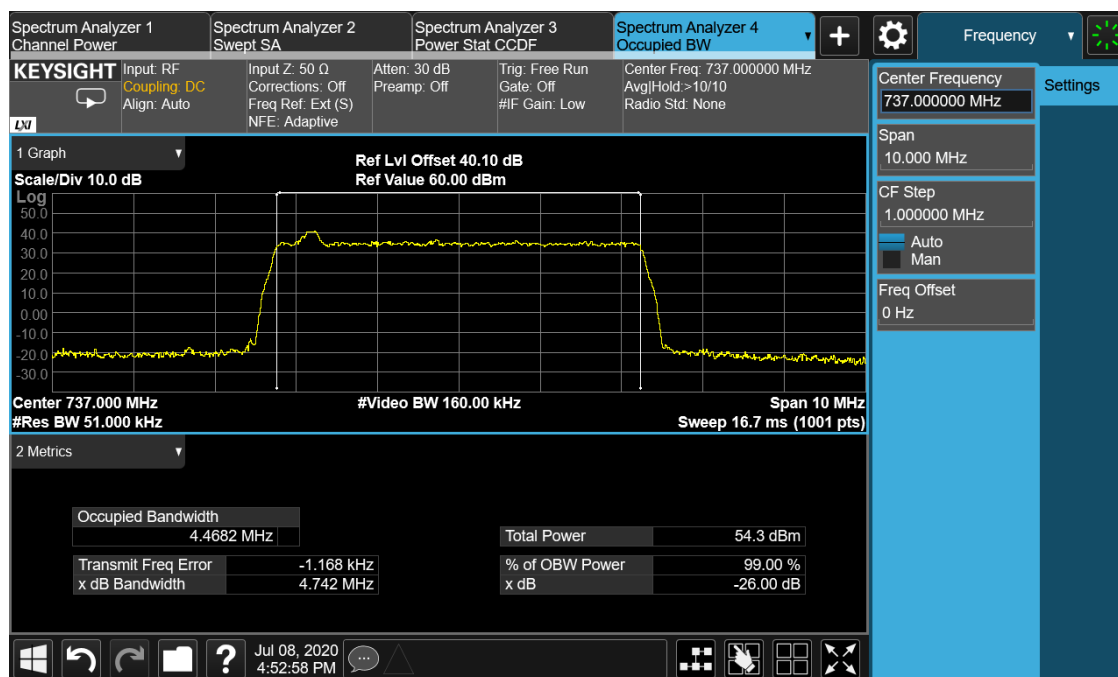
-26dBc Occupied Bandwidth

Antenna Port	Modulation	LTE Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	5MHz	4.746	4.742	4.743
D	QPSK	10MHz	9.521	9.558	9.537
D	QPSK	15MHz	14.35	14.31	14.33

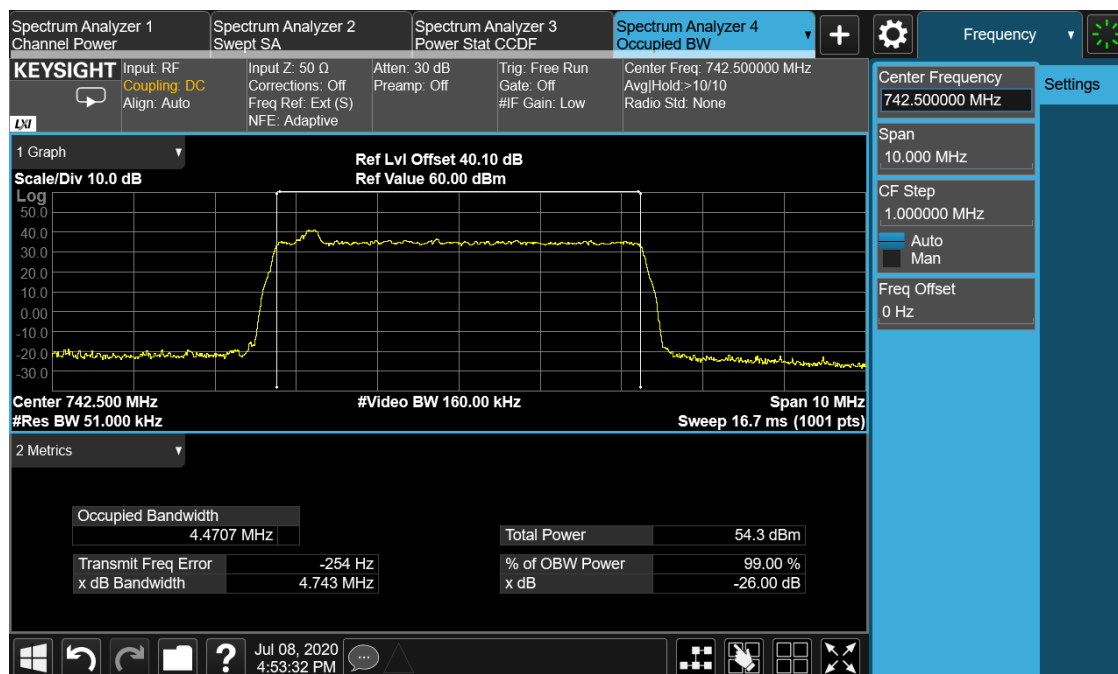
QPSK, 5MHz, Channel position B



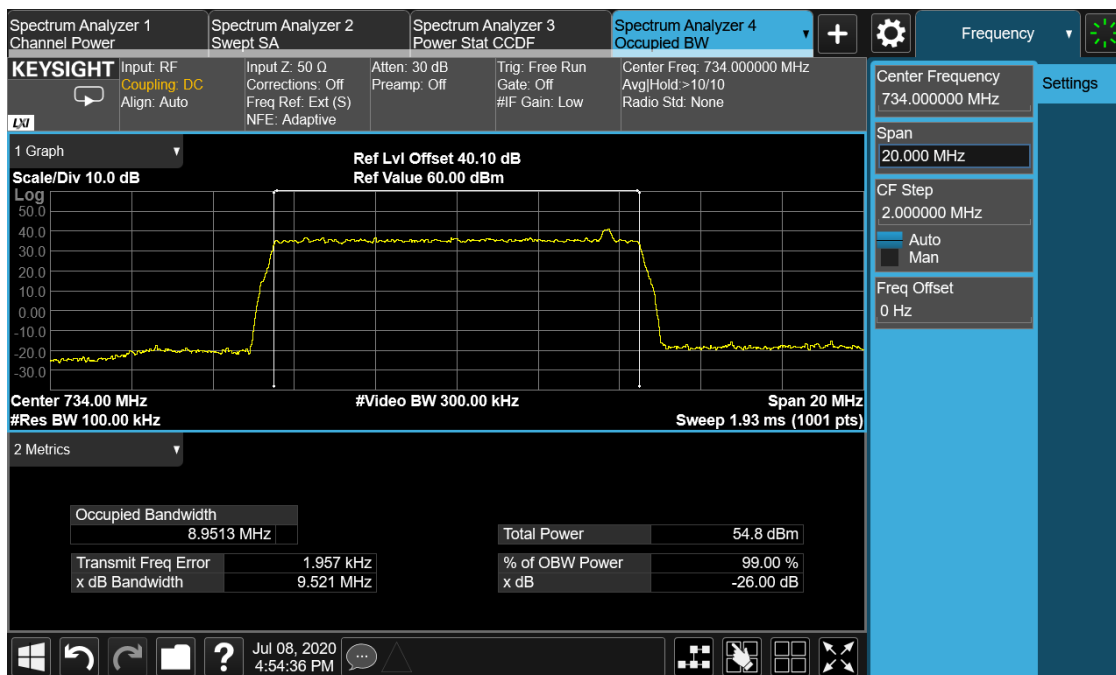
QPSK, 5MHz, Channel position M



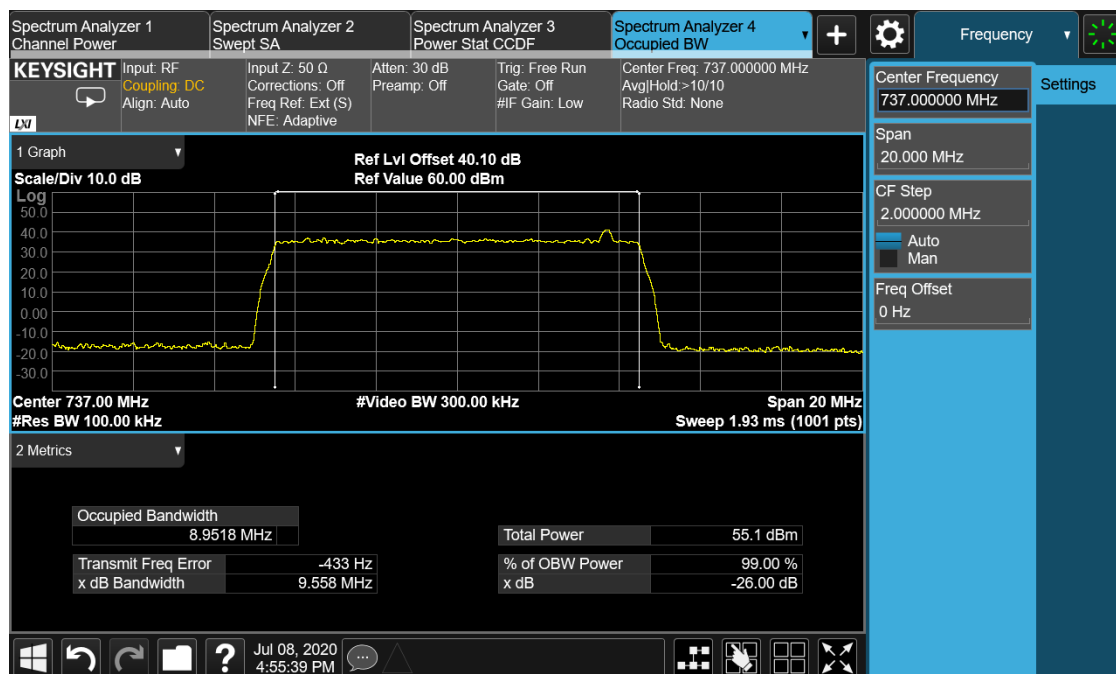
QPSK, 5MHz, Channel position T



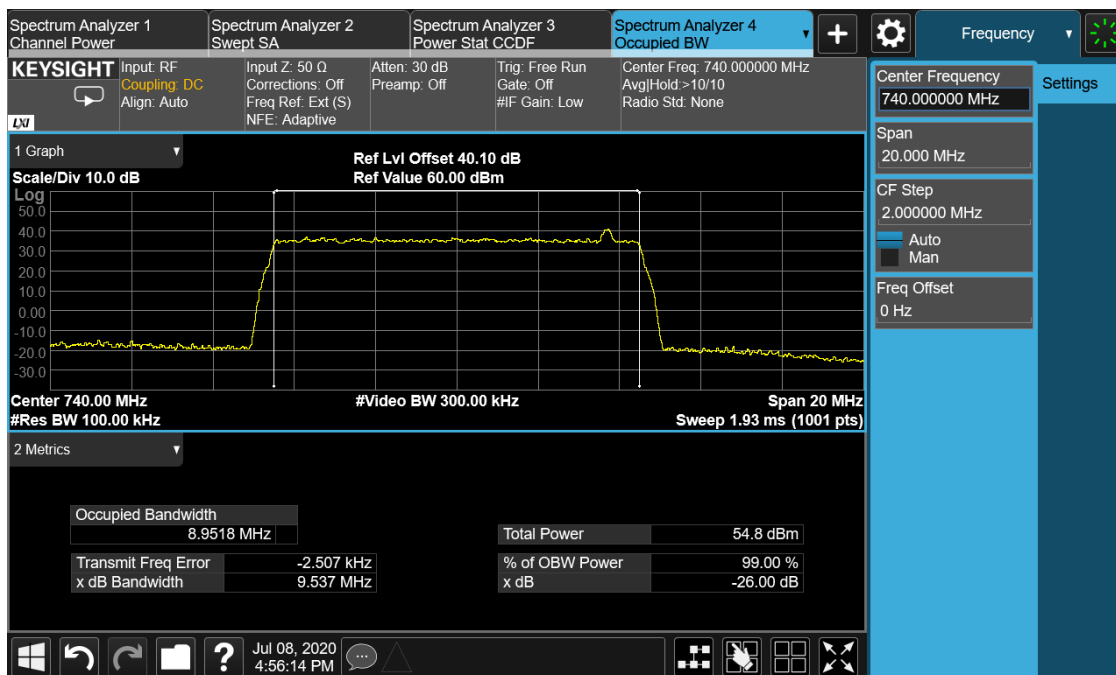
QPSK, 10MHz, Channel position B



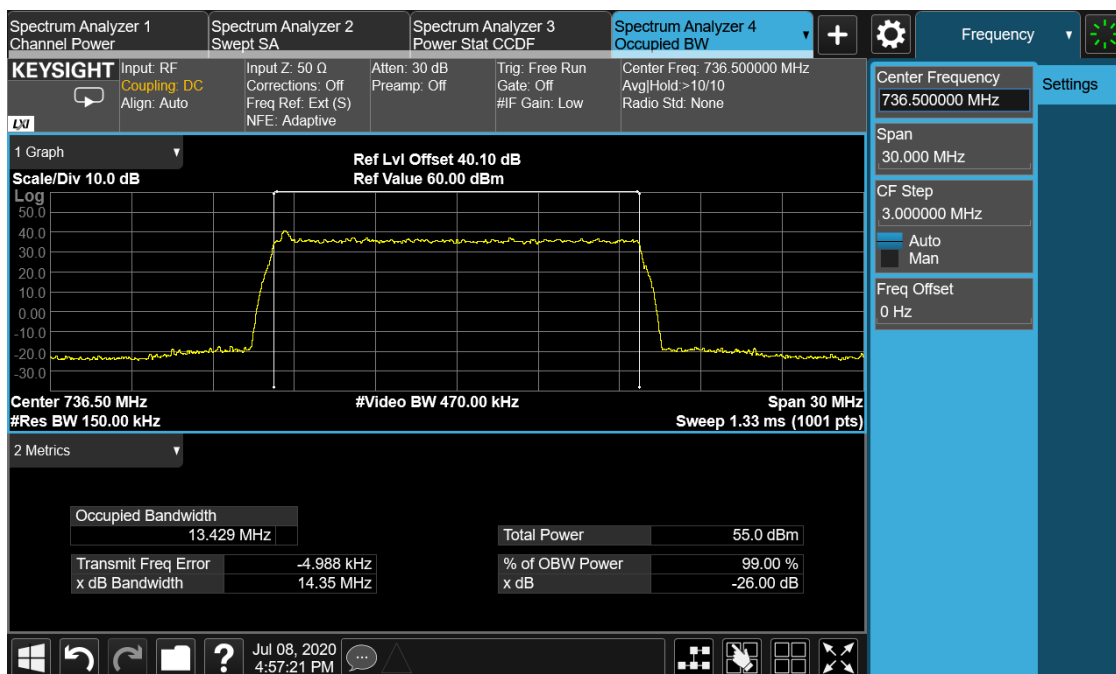
QPSK, 10MHz, Channel position M



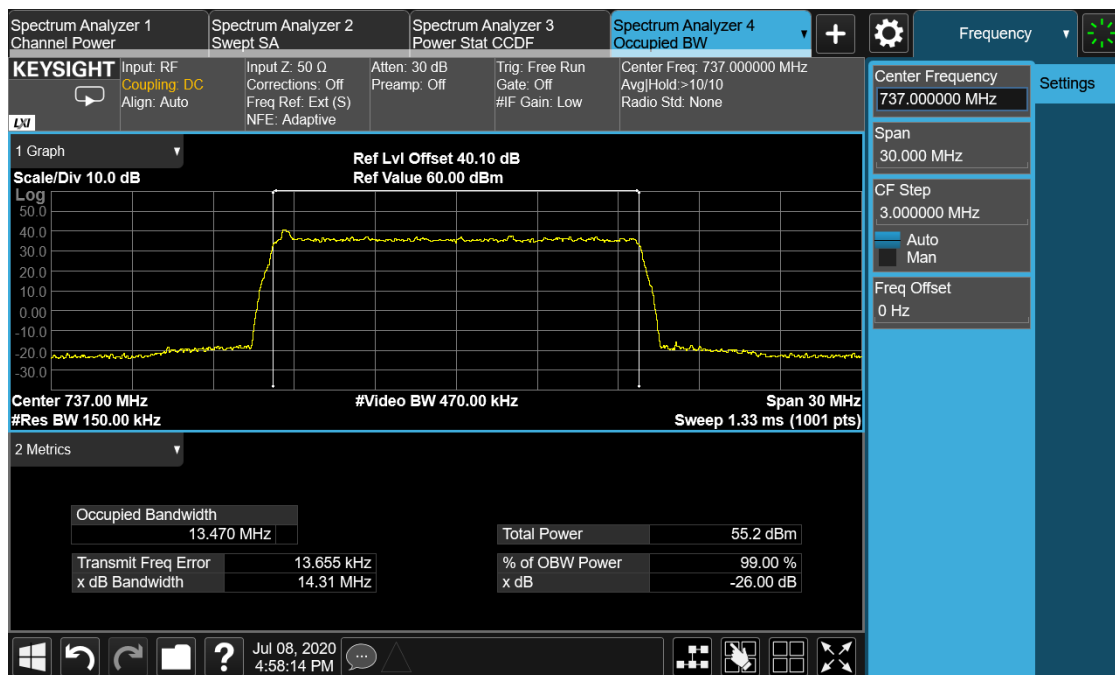
QPSK, 10MHz, Channel position T



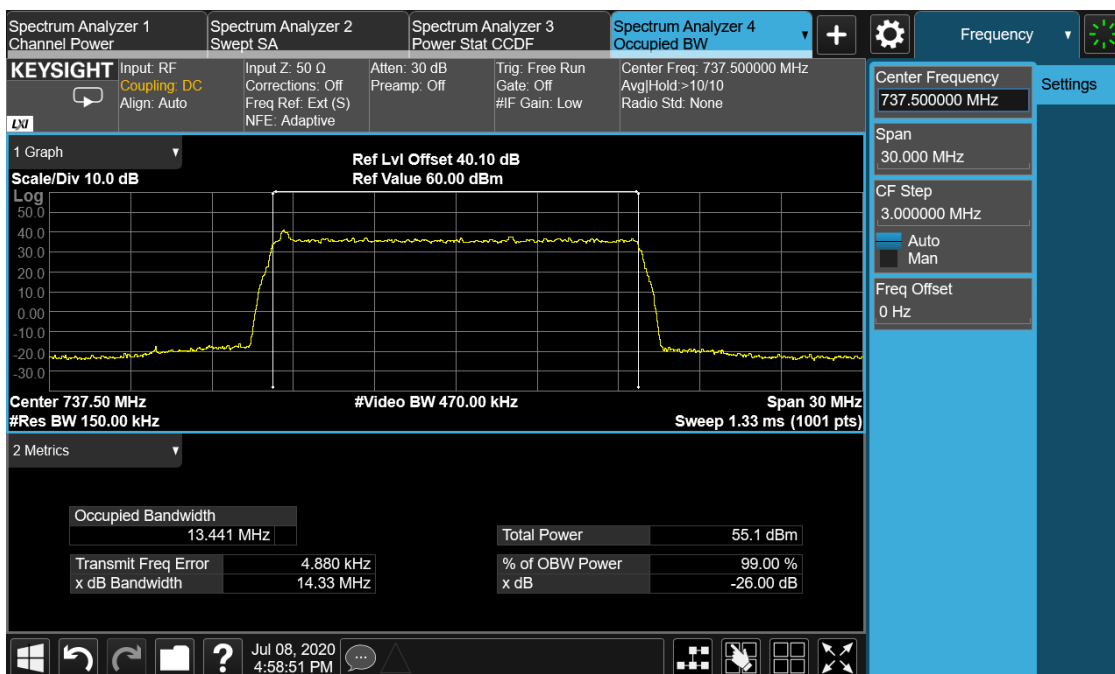
QPSK, 15MHz, Channel position B



QPSK, 15MHz, Channel position M



QPSK, 15MHz, Channel position T



TEST REPORT

Configuration NB-IoT-GuardBand-1C

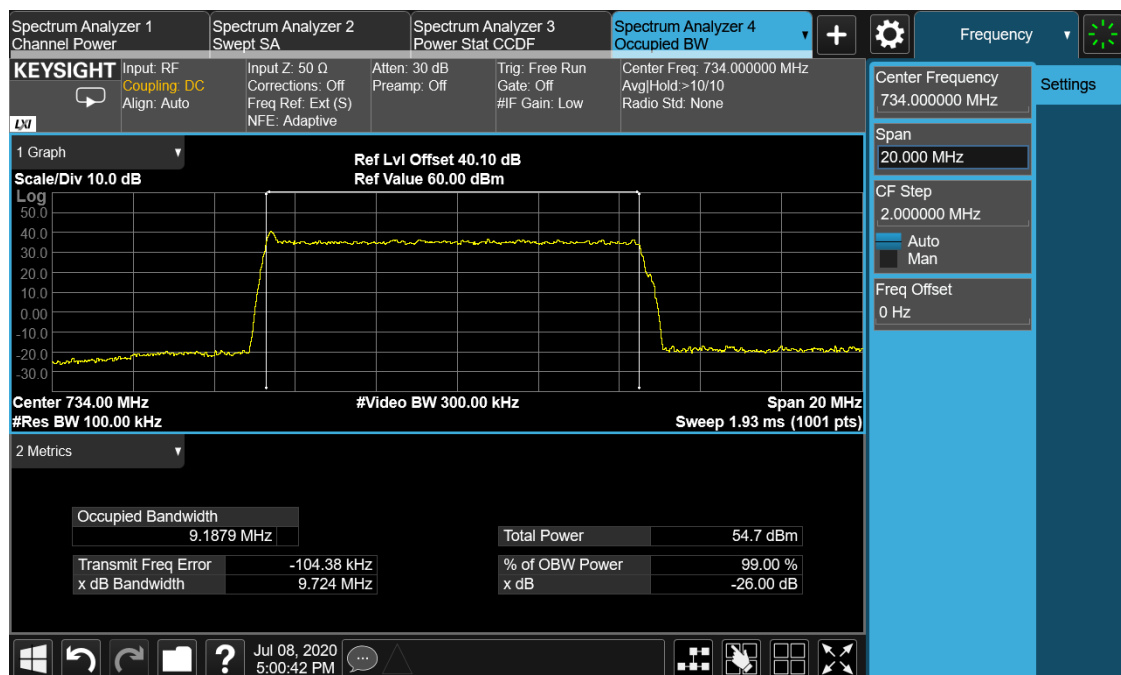
99% Occupied Bandwidth

Antenna Port	Modulation	LTE Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	10MHz	9.1879	9.1900	9.1747
D	QPSK	15MHz	13.705	13.707	13.729

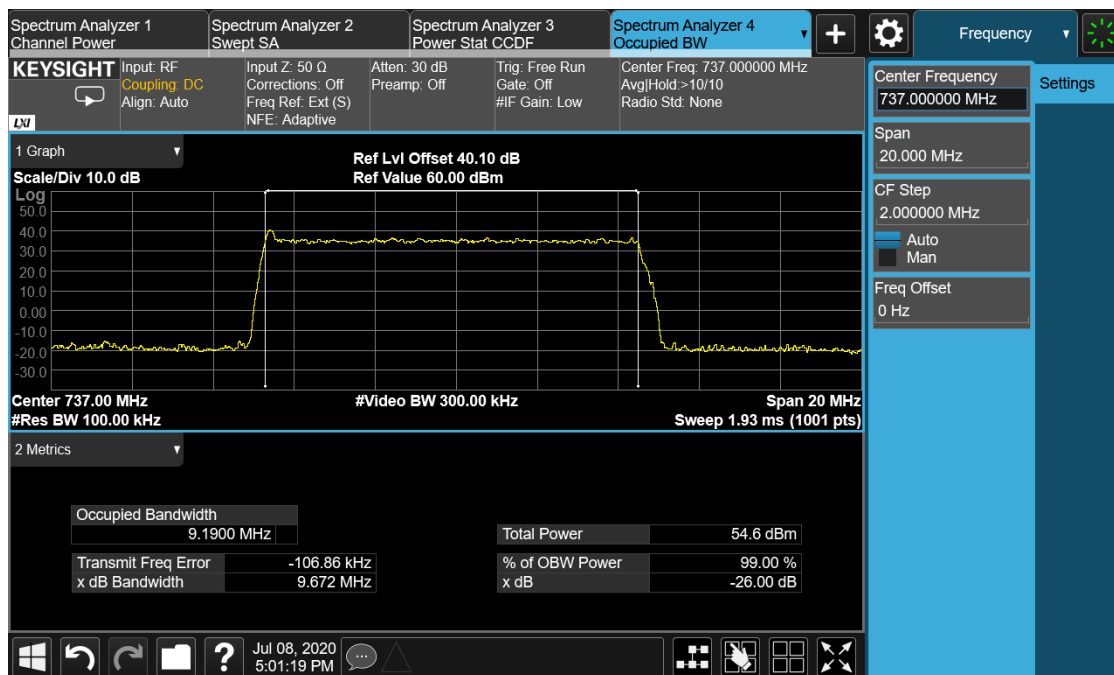
-26dBc Occupied Bandwidth

Antenna Port	Modulation	LTE Bandwidth	Occupied Bandwidth (MHz)		
			Channel Position B	Channel Position M	Channel Position T
D	QPSK	10MHz	9.724	9.672	9.711
D	QPSK	15MHz	14.49	14.51	14.54

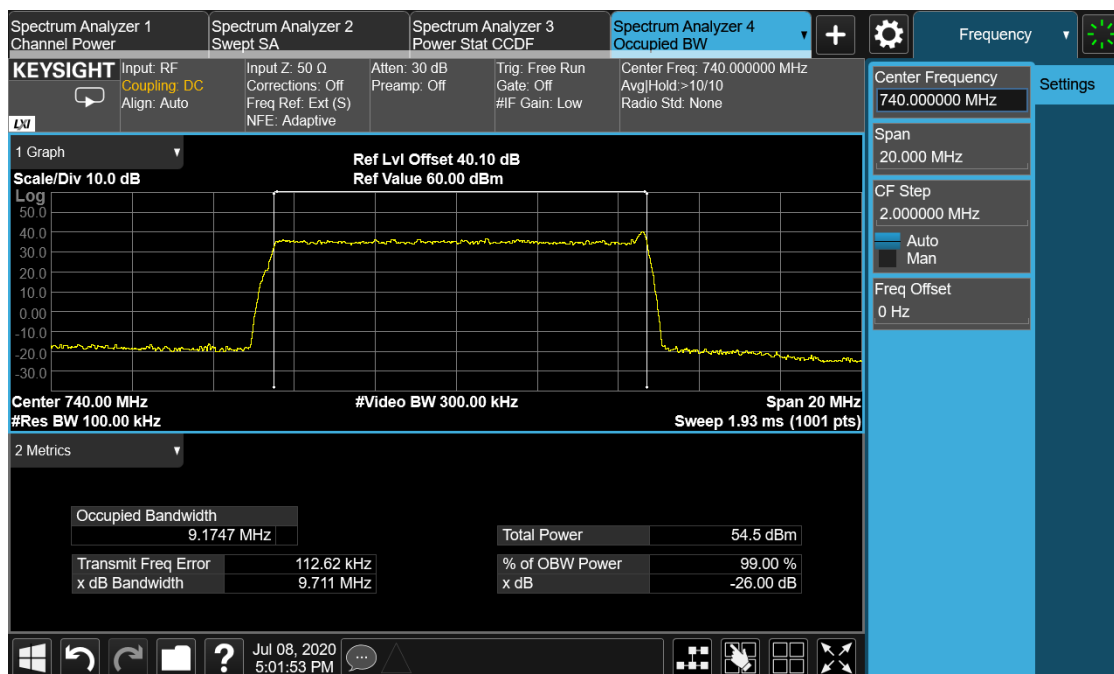
QPSK, 10MHz, Channel position B



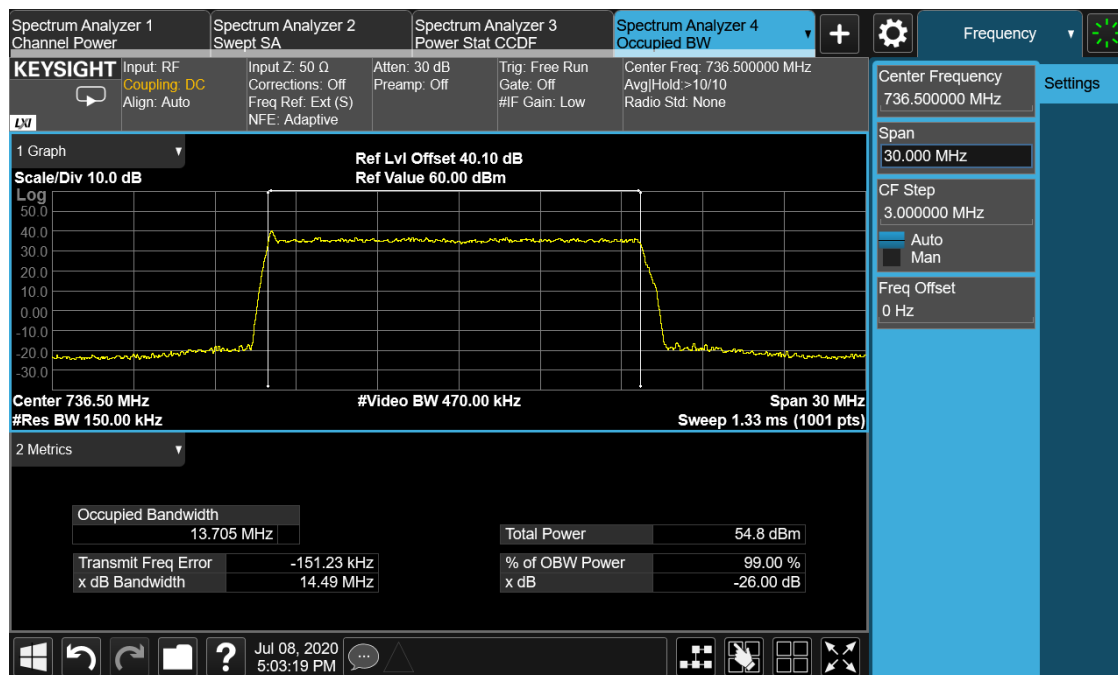
QPSK, 10MHz, Channel position M



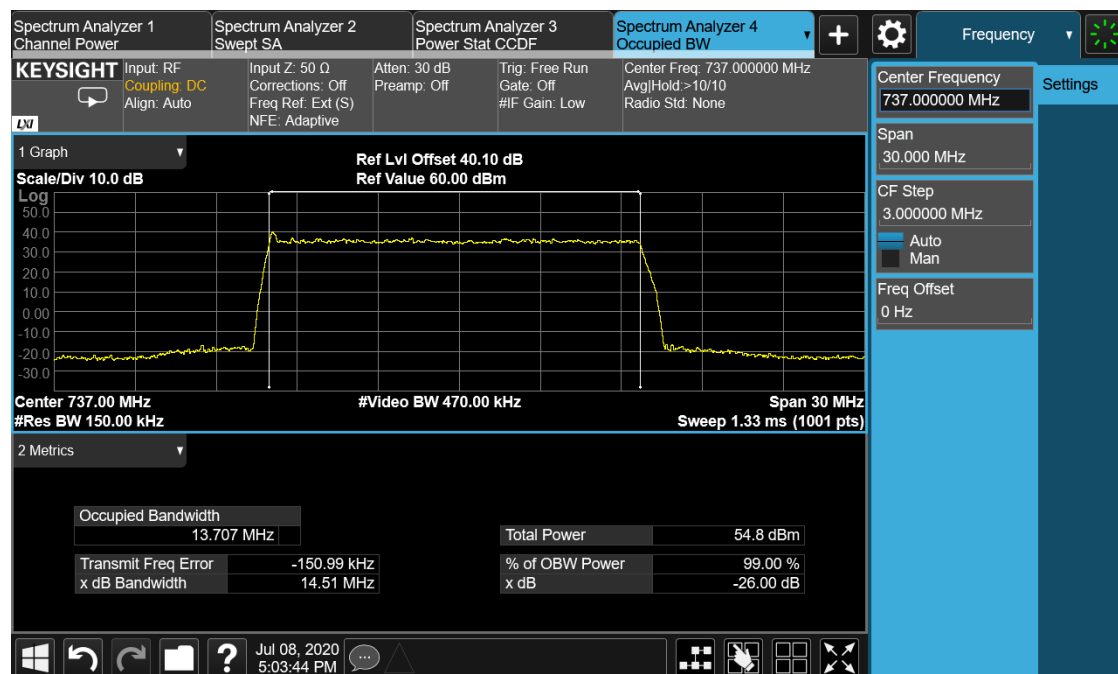
QPSK, 10MHz, Channel position T



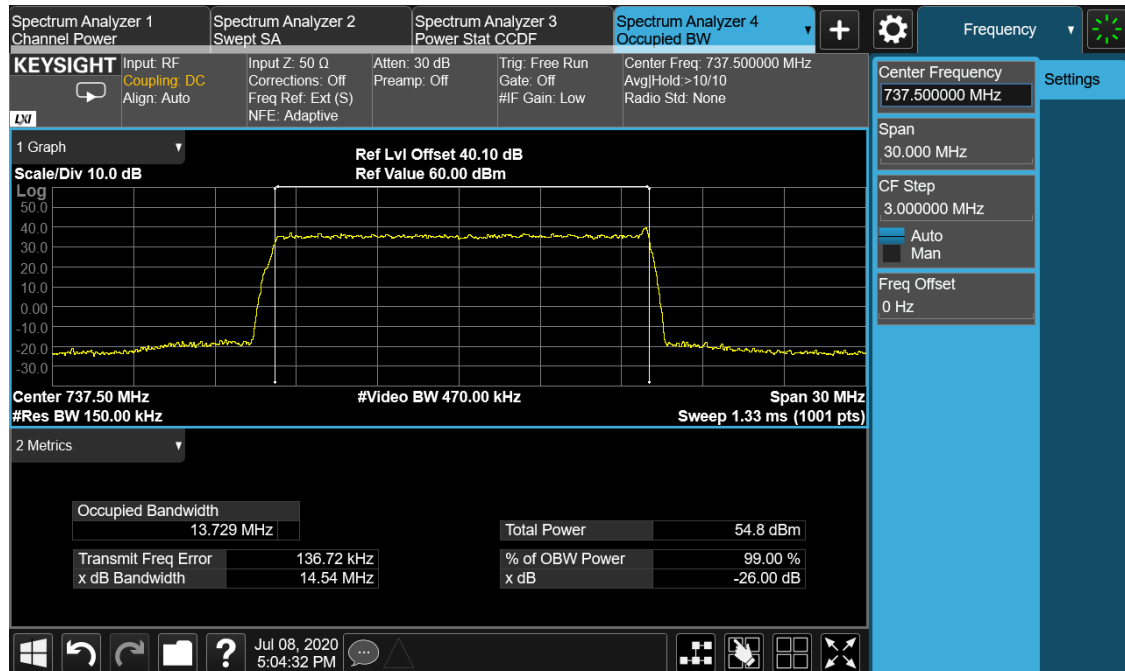
QPSK, 15MHz, Channel position B



QPSK, 15MHz, Channel position M



QPSK, 15MHz, Channel position T



5 Unwanted Emissions at Band Edge

Test result: Pass

5.1 Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10\log(P)$ dB.

5.2 Measurement Procedure

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB.

Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

For MIMO mode configurations, the limit was adjusted with a correction of -6dB [$10\log(1/4)$] by using the Measure and Add $10\log(N)$ dB technique according to KDB 662911 D01 Multiple Transmitter Output accounting for simultaneous transmission from antenna ports . Then the limit was adjusted to -19dBm.

For NB-IoT SA mode, 2TX diversity is supported, so the limit was adjusted with a correction of -3dB [$10\log(1/2)$], then the limit was adjusted to -16dBm.

Spectrum analyzer detector was set as RMS.