



Test report No:
19A2056R-RF-US-P40V01

FCC & ISED TEST REPORT

Product Name	Wireless Module
Trademark	Telit
FCC ID	RI7NE310H2W1
IC	5131A-NE310H2W1
Model and /or type reference	NE310H2-W1
Applicant's name / address	Telit Communications S.p.A. Via Stazione di Prosecco 5/b – 34010 – Sgonico – Trieste, Italy
Test method requested, standard	FCC CFR Title 47 Part 22 & 24 & 27 & 90 ANSI C63.26: 2015 KDB971168 D01 v03r01, KDB971168 D02 v02r01 ANSI/TIA-603-E: 2016 RSS-130 Issue 2, RSS-132 Issue 3, RSS-133 Issue 6, RSS-139 Issue 3, RSS-Gen Issue 5
Verdict Summary	IN COMPLIANCE
Documented by (name / position & signature)	Kitty Li/Project Assistant 
Reviewed by (name / position & signature)	Frank He/Technical Supervisor 
Approved by (name / position & signature)	Jack Zhang/Supervisor 
Date of issue	2020-06-17
Report template No	19A2056R-RF-US-P40V01

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COMPETENCES AND GUARANTEES

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In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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GENERAL CONDITIONS

Test Location	No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China
Date(receive sample)	Oct. 14, 2019
Date (start test)	Oct. 15, 2019
Date (finish test)	Jun. 17, 2020

1. This report is only referred to the item that has undergone the test.
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ENVIRONMENTAL CONDITIONS

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

If explicitly required in the basic standard or applied product / product family standard the climatic values are recorded and documented separately in this test report.

POSSIBLE TEST CASE VERDICTS

Test case does not apply to test object	N/A
Test object does meet requirement	P (Pass) / PASS
Test object does not meet requirement	F (Fail) / FAIL
Not measured	N/M

ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply:

EUT	: Equipment Under Test
QP	: Quasi-Peak
CAV	: CISPR Average
AV	: Average
CDN	: Coupling Decoupling Network
SAC	: Semi-Anechoic Chamber
OATS	: Open Area Test Site
BW	: Bandwidth
AM	: Amplitude Modulation
PM	: Pulse Modulation
HCP	: Horizontal Coupling Plane
VCP	: Vertical Coupling Plane
U_N	: Nominal voltage
Tx	: Transmitter
Rx	: Receiver
N/A	: Not Applicable
N/M	: Not Measured

DOCUMENT HISTORY

Report No.	Version	Description	Issued Date
19A2056R-RF-US-P40V01	V1.0	Initial issue of report.	2020-04-30
19A2056R-RF-US-P40V01	V1.1	P130-142, modified test data of Spurious Emissions at antenna terminals at Block Edges.	2020-05-12
19A2056R-RF-US-P40V01	V1.2	P130-168, modified test data of Spurious Emissions at antenna terminals at Block Edges.	2020-05-15
19A2056R-RF-US-P40V01	V1.3	1. P34-36, modified power of band 26. 2. P130-168, modified test data of Spurious Emissions at antenna terminals at Block Edges.	2020-05-28
19A2056R-RF-US-P40V01	V1.4	1. P34, modified power of band 26. 2. P151-156, modified test data of Spurious Emissions at antenna terminals at Block Edges.	2020-06-17

REMARKS AND COMMENTS

1. The equipment under test (EUT) does meet the essential requirements of the stated standard(s)/test(s).
2. These test results on a sample of the device are for the purpose of demonstrating Compliance with FCC Part 22,24,27,90, RSS-130 Issue 2, RSS-132 Issue 3, RSS-133 Issue 6, RSS-139 Issue 3, RSS-Gen Issue 5.
3. The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result, unless the specification, standard or customer have special requirements.
4. The test results presented in this report relate only to the object tested.
5. The test results relate only to the samples tested.
6. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification (Suzhou) Co., Ltd.
7. This report will not be used for social proof function in China market.

USED EQUIPMENT

RF Output Power/Frequency Stability/Occupied Bandwidth/Spurious Emissions at antenna terminals/Spurious Emissions at antenna terminals at Block Edges / TR7

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2019.09.28	2020.09.27
Signal analyzer	R&S	FSV	104212	2019.12.28	2020.12.27
Wideband Radio Communication Tester	R&S	CMW 500	1201.0002K50-158243-jb	2019.08.30	2020.08.29
Directional Coupler	Midwest Microwave	CPL-5231-16-001	-	2019.08.31	2020.08.30
Dual Directional Coupler	Agilent	778D	20160	2019.09.28	2020.09.27
Temperature & Humidity Chamber	Gaoyu	TH-1P-B	WIT-05121302	2019.09.30	2020.09.29
Temperature/Humidity Meter	Zhichen	ZC1-2	TR7-TH	2019.08.21	2020.08.20

Radiated Emissions (1GHz-40GHz)/ AC5

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Signal analyzer	R&S	FSV	104212	2019.12.28	2020.12.27
Wideband Radio Communication Tester	R&S	CMW 500	1201.0002K50-158243-jb	2019.08.30	2020.08.29
ESG Vector Signal Generator	Agilent	E4438C	MY49070163	2019.09.30	2020.09.29
low Noise Amplifier	BXT	NA2651D	LNA17040209	2020.04.12	2021.04.11
Pre-Amplifier	Chengyi	EMC184045SE	980263	2020.06.13	2021.06.12
Half Wave Tuned Dipole Antenna	COM-POWER	AD-100	40137	2020.03.08	2021.03.07
Bilog Antenna	Schaffner	Schaffner	2932	2019.11.16	2020.11.15
DRG Horn	ETS-Lindgren	3117	00167055	2020.05.24	2021.05.23
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2020.03.23	2021.03.22
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2020.04.12	2021.04.11
Coaxial Cable	ROSENBERGER	LA1-C011-2000/3000	AC5-40G	2020.04.18	2021.04.17
Temperature/Humidity Meter	Riters	RTS-8S	AC5-TH	2019.09.02	2020.09.01
Dekra test software	Dekra	-	-	-	-

UNCERTAINTY

Uncertainties have been calculated according to the DEKRA internal document. The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%. The Uncertainties is comply with standard required as below.

Test item	Uncertainty
RF Output Power	± 1.2 dB
Frequency Stability	± 10 Hz
Occupied Bandwidth	± 10 Hz
Spurious Emissions at antenna terminals	± 1.2 dB
Spurious Emissions at antenna terminals at Block Edges	± 1.2 dB
Radiated Emissions	± 3.2 dB

1 GENERAL INFORMATION

1.1 General Description of the Item(s)

Product Name	Wireless Module
Model No.	NE310H2-W1
Trademark	Telit
Operating Temperature Range	-40~85°C
Manufacturer	Telit Communications S.p.A.
Manufacturer Address	Via Stazione di Prosecco 5/b – 34010 – Sgonico – Trieste, Italy

Wireless specification	NB-IoT
Support Band(s)	2/4/5/12/13/17/25/26/66/71/85
Uplink Frequency	Band 2: 1850-1910 MHz Band 4: 1710-1755 MHz Band 5: 824-849 MHz Band 12: 699-716 MHz Band 13: 777-787 MHz Band 17: 704-716 MHz Band 25: 1850-1915 MHz Band 26: 814-849 MHz Band 66: 1710-1780 MHz Band 71: 663-698 MHz Band 85: 698-716 MHz
Downlink Frequency	Band 2: 1930-1990 MHz Band 4: 2110-2155 MHz Band 5: 869-894 MHz Band 12: 729-746 MHz Band 13: 746-756 MHz Band 17: 734-746 MHz Band 25: 1930-1995 MHz Band 26: 859-894 MHz Band 66: 2110-2200 MHz Band 71: 617-652 MHz Band 85: 728-746 MHz
Type of Modulation	BPSK, QPSK

Rated power supply	Voltage and Frequency	
	<input type="checkbox"/>	AC: 220 – 240 V, 50/60 Hz
	<input type="checkbox"/>	AC: 100 – 120 V, 50/60 Hz
	<input checked="" type="checkbox"/>	DC: 3-3.6 Vdc
Mounting position	<input type="checkbox"/>	Battery: 3.7V
	<input type="checkbox"/>	Table top equipment
	<input type="checkbox"/>	Wall/Ceiling mounted equipment

<input type="checkbox"/>	Floor standing equipment
<input type="checkbox"/>	Hand-held equipment
<input checked="" type="checkbox"/>	Other: Module

NBloT Band	Channel & Frequency(MHz)		
	Lowest	Middle	Highest
2	18601	18900	19199
	1850.1	1880	1909.9
4	19951	20175	20399
	1710.1	1732.5	1754.9
5	20401	20525	20649
	824.1	836.5	848.9
12	23011	23095	23179
	699.1	707.5	715.9
13	23181	23230	23279
	777.1	178.5	178.9
17	23731	23790	23849
	704.1	710.0	715.9
25	26041	26365	26689
	1850.1	1882.5	1914.9
26(814-824MHz)	26691	Note	26789
	814.1		823.9
26(824MHz)	Note	26790	Note
		824	
26(824-849MHz)	26791	26915	27039
	824.1	836.5	848.9
66	131973	132322	132671
	1710.1	1745.0	1779.9
71	133123	133297	133471
	663.1	680.5	697.9
85	134003	134092	134181
	698.1	707.0	715.9

Note: Band 26(814-824MHz): frequency range belong to 1MHz to 10MHz, number of frequencies to be tested are 2, 1 near top and 1 near bottom; Band26(824MHz): there is only one channel.

1.2 Antenna Information

Antenna model / type number	LTE MAGNETIC ANTENNA / n° T-AT305		
Antenna serial number	N/A		
Antenna Delivery	<input checked="" type="checkbox"/>	1TX + 1RX	
	<input type="checkbox"/>	2TX + 2RX	
Antenna technology.....	<input checked="" type="checkbox"/>	SISO	
	<input type="checkbox"/>	MIMO	<input type="checkbox"/> CDD
			<input type="checkbox"/> Beam-forming
Antenna Type	<input checked="" type="checkbox"/>	External	<input checked="" type="checkbox"/> Dipole
			<input type="checkbox"/> Sectorized
	<input type="checkbox"/>	Internal	<input type="checkbox"/> PIFA
			<input type="checkbox"/> PCB
			<input type="checkbox"/> Ceramic Chip
		<input type="checkbox"/> Others.....	
Antenna Gain	2.14 dBi		

2 DESCRIPTION OF TEST SETUP

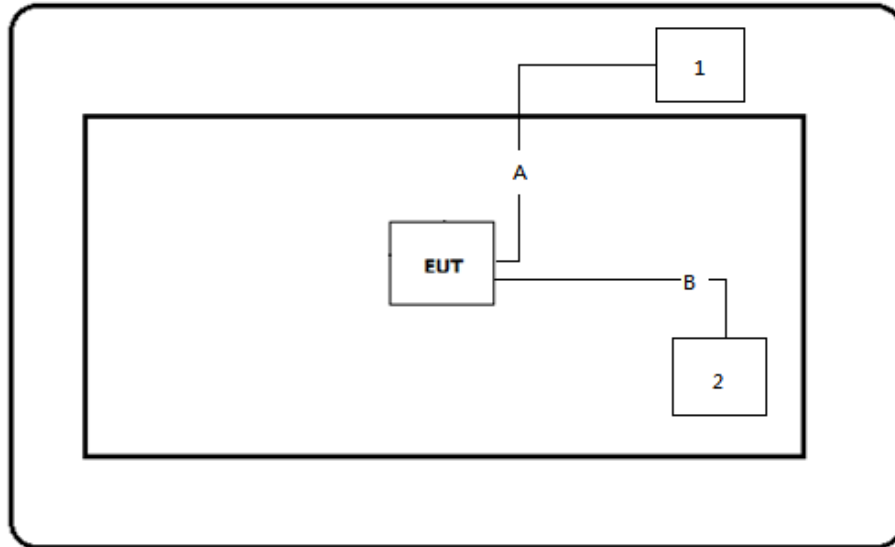
2.1 Auxiliary equipment / Test software for the EUT

No.	Auxiliary equipment	Model No.	Manufacturer	Supplied by
1	DC Power Supply	CD-035-020PR	IDRC	N/A
2	Wideband Radio Communication Tester	CMW 500	R&S	N/A

No.	Signal Cable Type	Signal Cable Description
A	Control Cable	Non-Shielded, 2m
B	Coaxial Cable	Shielded, 1.5m
C	Coaxial Cable	Shielded, 10m

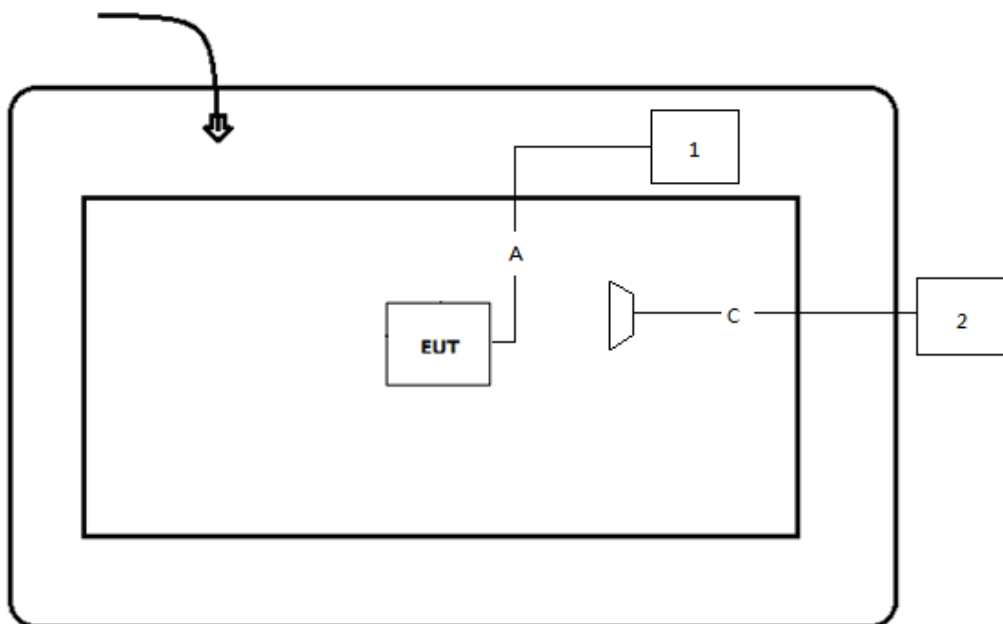
2.2 Test Configuration / Block diagram used for tests

Conducted Connection Diagram



Radiated Connection Diagram

Chamber



2.3 Testing process

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	EUT Communicate with CMW 500, then select channel to test.

3 VERDICT SUMMARY SECTION

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

3.1 Standards

Standard	Year	Description
FCC CFR Title 47 Part 2	2020	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
FCC CFR Title 47 Part 22	2020	PUBLIC MOBILE SERVICES
FCC CFR Title 47 Part 24	2020	PERSONAL COMMUNICATIONS SERVICES
FCC CFR Title 47 Part 27	2020	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES
FCC CFR Title 47 Part 90	2020	PRIVATE LAND MOBILE RADIO SERVICES
RSS-132 Issue 3	2013	Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS-133 Issue 6	2018	2 GHz Personal Communications Services
RSS-130 Issue 2	2019	Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
RSS-139 Issue 3	2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz

3.2 Deviation(s) from the Standard(s) / Test Specification(s)

The following deviation(s) was / were made from the published requirements of the listed standards: N/A.

(Please define the deviations from the standard(s) if applicable)

3.3 Overview of results

FCC Part 22/RSS-132			
Requirement – Test case	Basic standard(s)	Verdict	Remark
RF Output Power	Section 22.913/RSS-132 Section 5.4	PASS	
Frequency Stability	Section 22.355/RSS-132 Section 5.3	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 22.917/RSS-132 Section 5.5	PASS	
Radiated Emissions	Section 22.917/RSS-132 Section 5.5	PASS	

FCC Part 90			
Requirement – Test case	Basic standard(s)	Verdict	Remark
RF Output Power	Section 90.635(b)	PASS	
Frequency Stability	Section 90.213	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 90.691	PASS	
Radiated Emissions	Section 90.691	PASS	

FCC Part 24/RSS-133			
Requirement – Test case	Basic standard(s)	Verdict	Remark
RF Output Power	Section 24.232/RSS-133 Section 6.4	PASS	
Frequency Stability	Section 24.235/RSS-133 Section 6.3	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 24.238/RSS-133 Section 6.5	PASS	
Radiated Emissions	Section 24.238/RSS-133 Section 6.5	PASS	

FCC Part 27/RSS-130/RSS-139			
Requirement – Test case	Basic standard(s)	Verdict	Remark
RF Output Power	Section 27.50/RSS-130 Section 4.6/RSS-139 Section 6.5	PASS	
Frequency Stability	Section 27.54/RSS-130 Section 4.5/RSS-139 Section 6.4	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 27.53/RSS-130 Section 4.7/RSS-139 Section 6.6	PASS	
Radiated Emissions	Section 27.53/RSS-130 Section 4.7/RSS-139 Section 6.6	PASS	

3.4 Test Facility

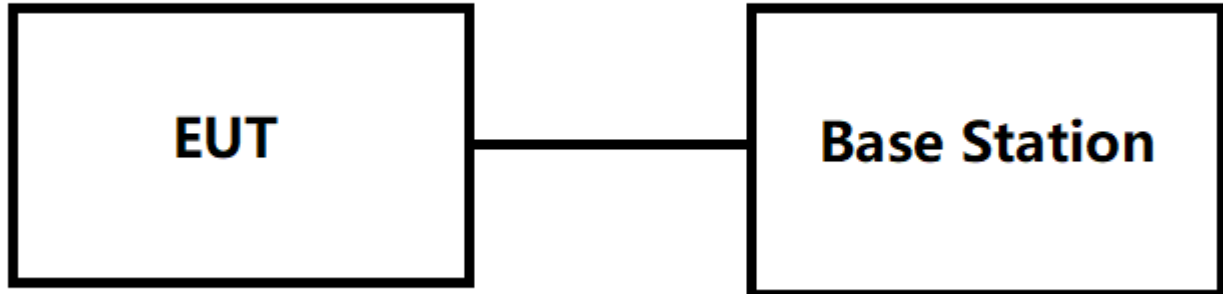
USA	:	FCC Designation Number: CN1199
CA	:	ISED CAB identifier: CN0040

4 TEST RESULTS

4.1 RF Output Power	VERDICT: PASS
----------------------------	----------------------

4.1.1 Limit	
NB IoT Band	Standard
5/26	FCC §2.1046 and §22.913: The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.
	RSS-132 Section 5.4: The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.
	FCC §90.635: The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).
2/25	FCC §2.1046 and §24.232: Mobile and portable stations are limited to 2 watts EIRP. The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.
	RSS-133 Section 6.4: In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.
12/13/17 /71/85	FCC §27.50(c)(10): Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.
	FCC §27.50(b)(10): Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.
	RSS-130 Section 4.6: For frequency bands 617-652 MHz and 663-698 MHz: The e.r.p. shall not exceed 3 watts for mobile equipment, fixed subscriber equipment and portable equipment. For frequency bands 698-756 MHz and 777-787 MHz: The e.r.p. shall not exceed 30 watts for mobile equipment and outdoor fixed subscriber equipment. The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment. In addition, the peak-toaverage power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.
4/66	FCC §27.50(d)(4): Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.
	RSS-139 Section 6.5: The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt. The e.i.r.p. for fixed and base stations in the band 1710-1780 MHz shall not exceed one watt. In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

4.1.2 Test Setup



4.1.3 Test Procedure

	References Rule	Chapter	Item
<input checked="" type="checkbox"/>	ANSI C63.26-2015	5.2	RF output power measurement procedures

The conducted RF Output Power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

Peak to average ratio(PAPR) is used equation $PAPR(dB)=PPK(dBm)-PAVG(dBm)$, where PPK is measured peak power, and PAVG is measured average power.

The maximum equivalent isotropically radiated power(e.i.r.p.) is calculated by adding the declared maximum antenna gain(dBi).

The maximum effective radiated power e.r.p. is calculated form the maximum equivalent isotropically radiated power(e.i.r.p.) by subtracting 2.15 dB: $E.R.P = E.I.R.P. - 2.15 dB$

4.1.4 Test Data

NBLoT Band 2

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) EIRP	PAPR (dB)		
18601	1850.1	BPSK	3.75	1	0	9.64	11.78	*		
				1	47	9.63	11.77	*		
			15	1	0	9.66	11.80	*		
				1	11	9.64	11.78	*		
		QPSK	3.75	1	0	9.63	11.77	*		
				1	47	9.64	11.78	*		
			15	1	0	9.65	11.79	0.59		
				1	11	9.66	11.80	0.64		
				12	0	9.57	11.71	6.16		
18602	1850.2	BPSK	3.75	1	0	22.87	25.01	*		
				1	47	22.89	25.03	*		
			15	1	0	22.97	25.11	*		
				1	11	23.00	25.14	*		
		QPSK	3.75	1	0	22.91	25.05	*		
				1	47	22.90	25.04	*		
			15	1	0	22.96	25.10	0.29		
				1	11	22.97	25.11	0.31		
				12	0	20.93	23.07	3.95		
		18900	1880	BPSK	3.75	1	0	22.93	25.07	*
						1	47	22.91	25.05	*
15	1				0	22.76	24.90	*		
	1				11	22.75	24.89	*		
QPSK	3.75			1	0	22.94	25.08	*		
				1	47	22.93	25.07	*		
	15			1	0	22.74	24.88	0.28		
				1	11	22.75	24.89	0.30		
				12	0	21.39	23.53	4.16		
19198	1909.8	BPSK	3.75	1	0	22.37	24.51			
				1	47	22.36	24.50			
			15	1	0	22.45	24.59			
				1	11	22.51	24.65			
		QPSK	3.75	1	0	22.40	24.54			
				1	47	22.40	24.54			

			15	1	0	22.51	24.65	0.31	
				1	11	22.55	24.69	0.35	
				12	0	21.10	23.24	4.61	
19199	1909.9	BPSK	3.75	1	0	10.23	12.37	*	
				1	47	10.22	12.36	*	
			15	1	0	10.18	12.32	*	
				1	11	10.17	12.31	*	
			QPSK	3.75	1	0	10.15	12.29	*
					1	47	10.13	12.27	*
		15		1	0	10.18	12.32	0.38	
				1	11	10.17	12.31	0.39	
				12	0	10.38	12.52	6.86	

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 4

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) EIRP	PAPR (dB)
19951	1710.1	BPSK	3.75	1	0	10.66	12.80	*
				1	47	10.67	12.81	*
			15	1	0	10.69	12.83	*
				1	11	10.70	12.84	*
		QPSK	3.75	1	0	10.68	12.82	*
				1	47	10.67	12.81	*
			15	1	0	10.71	12.85	0.36
				1	11	10.70	12.84	0.38
			12	0	10.87	13.01	5.68	
19952	1710.2	BPSK	3.75	1	0	23.06	25.20	*
				1	47	23.08	25.22	*
			15	1	0	23.04	25.18	*
				1	11	23.05	25.19	*
		QPSK	3.75	1	0	23.11	25.25	*
				1	47	23.09	25.23	*
			15	1	0	23.08	25.22	0.27
				1	11	23.07	25.21	0.29
			12	0	22.02	24.16	3.36	
20175	1732.5	BPSK	3.75	1	0	22.65	24.79	*
				1	47	22.68	24.82	*
			15	1	0	22.55	24.69	*
				1	11	22.59	24.73	*
		QPSK	3.75	1	0	22.66	24.80	*
				1	47	22.69	24.83	*
			15	1	0	22.58	24.72	0.31
				1	11	22.58	24.72	0.31
			12	0	21.77	23.91	3.45	
20398	1754.8	BPSK	3.75	1	0	22.54	24.68	*
				1	47	22.53	24.67	*
			15	1	0	22.55	24.69	*
				1	11	22.53	24.67	*
		QPSK	3.75	1	0	22.43	24.57	*
				1	47	22.46	24.60	*
			15	1	0	22.51	24.65	0.28
				1	11	22.52	24.66	0.31

				12	0	21.64	23.78	3.72
20399	1754.9	BPSK	3.75	1	0	10.05	12.19	*
				1	47	10.04	12.18	*
			15	1	0	10.10	12.24	*
				1	11	10.10	12.24	*
		QPSK	3.75	1	0	10.07	12.21	*
				1	47	10.05	12.19	*
			15	1	0	10.11	12.25	0.37
				1	11	10.10	12.24	0.38
				12	0	10.38	12.52	6.50

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 5

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
20401	824.1	BPSK	3.75	1	0	10.55	10.54	*
				1	47	10.54	10.53	*
			15	1	0	10.49	10.48	*
				1	11	10.47	10.46	*
		QPSK	3.75	1	0	10.56	10.55	*
				1	47	10.45	10.44	*
			15	1	0	10.49	10.48	0.33
				1	11	10.48	10.47	0.35
			12	0	10.53	10.52	5.81	
20402	824.2	BPSK	3.75	1	0	22.84	22.83	*
				1	47	22.83	22.82	*
			15	1	0	22.91	22.90	*
				1	11	22.89	22.88	*
		QPSK	3.75	1	0	22.92	22.91	*
				1	47	22.93	22.92	*
			15	1	0	22.97	22.96	0.27
				1	11	22.97	22.96	0.29
			12	0	21.78	21.77	3.83	
20525	836.5	BPSK	3.75	1	0	23.13	23.12	*
				1	47	23.19	23.18	*
			15	1	0	23.27	23.26	*
				1	11	23.25	23.24	*
		QPSK	3.75	1	0	23.23	23.22	*
				1	47	23.18	23.17	*
			15	1	0	23.23	23.22	0.31
				1	11	23.21	23.20	0.36
			12	0	21.88	21.87	3.74	
20648	848.8	BPSK	3.75	1	0	22.99	22.98	*
				1	47	22.81	22.80	*
			15	1	0	23.53	23.52	*
				1	11	23.48	23.47	*
		QPSK	3.75	1	0	22.80	22.79	*
				1	47	22.84	22.83	*
			15	1	0	23.46	23.45	0.31
				1	11	23.47	23.46	0.33

				12	0	23.42	23.41	4.02
20649	848.9	BPSK	3.75	1	0	10.51	10.50	*
				1	47	10.49	10.48	*
			15	1	0	10.56	10.55	*
				1	11	10.54	10.53	*
		QPSK	3.75	1	0	10.50	10.49	*
				1	47	10.49	10.48	*
			15	1	0	10.54	10.53	0.35
				1	11	10.52	10.51	0.37
				12	0	10.62	10.61	6.56

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 12

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
23011	699.1	BPSK	3.75	1	0	-6.47	-6.48	*
				1	47	-6.51	-6.52	*
			15	1	0	-6.38	-6.39	*
				1	11	-6.44	-6.45	*
		QPSK	3.75	1	0	-6.50	-6.51	*
				1	47	-6.51	-6.52	*
			15	1	0	-6.44	-6.45	0.63
				1	11	-6.45	-6.46	0.65
				12	0	-6.28	-6.29	6.71
23012	699.2	BPSK	3.75	1	0	22.71	22.70	*
				1	47	22.70	22.69	*
			15	1	0	22.86	22.85	*
				1	11	22.85	22.84	*
		QPSK	3.75	1	0	22.70	22.69	*
				1	47	22.71	22.70	*
			15	1	0	22.81	22.80	0.32
				1	11	22.78	22.77	0.32
				12	0	21.46	21.45	5.09
23095	707.5	BPSK	3.75	1	0	22.76	22.75	*
				1	47	22.76	22.75	*
			15	1	0	22.75	22.74	*
				1	11	22.76	22.75	*
		QPSK	3.75	1	0	22.75	22.74	*
				1	47	22.77	22.76	*
			15	1	0	22.74	22.73	0.29
				1	11	22.73	22.72	0.30
				12	0	21.50	21.49	5.03
23178	715.8	BPSK	3.75	1	0	22.74	22.73	*
				1	47	22.75	22.74	*
			15	1	0	23.43	23.42	*
				1	11	23.39	23.38	*
		QPSK	3.75	1	0	22.69	22.68	*
				1	47	22.71	22.70	*
			15	1	0	23.42	23.41	0.33
				1	11	23.44	23.43	0.34

				12	0	21.41	21.40	4.83
23179	715.9	BPSK	3.75	1	0	-5.80	-5.81	*
				1	47	-5.83	-5.84	*
			15	1	0	-5.84	-5.85	*
				1	11	-5.84	-5.85	*
		QPSK	3.75	1	0	-5.82	-5.83	*
				1	47	-5.81	-5.82	*
			15	1	0	-5.87	-5.88	0.56
				1	11	-5.86	-5.87	0.59
				12	0	-5.80	-5.81	6.73

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 13

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
23181	777.1	BPSK	3.75	1	0	-6.41	-6.42	*
				1	47	-6.39	-6.40	*
			15	1	0	-6.37	-6.38	*
				1	11	-6.35	-6.36	*
		QPSK	3.75	1	0	-6.43	-6.44	*
				1	47	-6.42	-6.43	*
			15	1	0	-6.54	-6.55	0.59
				1	11	-6.51	-6.52	0.61
			12	0	-6.42	-6.43	6.21	
23182	777.2	BPSK	3.75	1	0	22.78	22.77	*
				1	47	22.77	22.76	*
			15	1	0	22.79	22.78	*
				1	11	22.73	22.72	*
		QPSK	3.75	1	0	22.80	22.79	*
				1	47	22.78	22.77	*
			15	1	0	22.79	22.78	0.34
				1	11	22.78	22.77	0.35
			12	0	21.52	21.51	4.91	
23230	782	BPSK	3.75	1	0	22.71	22.70	*
				1	47	22.70	22.69	*
			15	1	0	22.81	22.80	*
				1	11	22.79	22.78	*
		QPSK	3.75	1	0	22.73	22.72	*
				1	47	22.72	22.71	*
			15	1	0	22.82	22.81	0.31
				1	11	22.81	22.80	0.33
			12	0	21.59	21.58	4.87	
23278	786.8	BPSK	3.75	1	0	22.73	22.72	*
				1	47	22.73	22.72	*
			15	1	0	22.79	22.78	*
				1	11	22.78	22.77	*
		QPSK	3.75	1	0	22.71	22.70	*
				1	47	22.72	22.71	*
			15	1	0	22.73	22.72	0.35
				1	11	22.71	22.70	0.37

				12	0	21.63	21.62	4.89
23279	786.9	BPSK	3.75	1	0	-5.97	-5.98	*
				1	47	-5.98	-5.99	*
			15	1	0	-5.97	-5.98	*
				1	11	-5.98	-5.99	*
		QPSK	3.75	1	0	-5.96	-5.97	*
				1	47	-5.97	-5.98	*
			15	1	0	-5.93	-5.94	0.54
				1	11	-5.94	-5.95	0.57
				12	0	-5.75	-5.76	6.47

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 17

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)	
23731	704.1	BPSK	3.75	1	0	-6.45	-6.46	*	
				1	47	-6.47	-6.48	*	
			15	1	0	-6.41	-6.42	*	
				1	11	-6.43	-6.44	*	
		QPSK	3.75	1	0	-6.45	-6.46	*	
				1	47	-6.44	-6.45	*	
			15	1	0	-6.42	-6.43	0.63	
				1	11	-6.45	-6.46	0.65	
				12	0	-6.30	-6.31	5.26	
23732	704.2	BPSK	3.75	1	0	22.82	22.81	*	
				1	47	22.81	22.80	*	
			15	1	0	22.79	22.78	*	
				1	11	22.84	22.83	*	
		QPSK	3.75	1	0	22.66	22.65	*	
				1	47	22.62	22.61	*	
			15	1	0	22.67	22.66	0.31	
				1	11	22.68	22.67	0.31	
				12	0	21.40	21.39	4.78	
23790	710	BPSK	3.75	1	0	22.57	22.56	*	
				1	47	22.59	22.58	*	
			15	1	0	22.56	22.55	*	
				1	11	22.59	22.58	*	
		QPSK	3.75	1	0	22.51	22.50	*	
				1	47	22.55	22.54	*	
			15	1	0	22.58	22.57	0.35	
				1	11	22.56	22.55	0.37	
				12	0	21.56	21.55	4.72	
23848	715.8	BPSK	3.75	1	0	22.62	22.61	*	
				1	47	22.64	22.63	*	
			15	1	0	22.63	22.62	*	
				1	11	22.63	22.62	*	
		QPSK	3.75	1	0	22.69	22.68	*	
				1	47	22.68	22.67	*	
			15	1	0	22.70	22.69	0.38	
				1	11	22.69	22.68	0.35	

				12	0	21.43	21.42	4.12
23849	715.9	BPSK	3.75	1	0	-5.97	-5.98	*
				1	47	-5.93	-5.94	*
			15	1	0	-5.96	-5.97	*
				1	11	-5.94	-5.95	*
		QPSK	3.75	1	0	-5.91	-5.92	*
				1	47	-5.95	-5.96	*
			15	1	0	-5.93	-5.94	0.57
				1	11	-5.94	-5.95	0.57
				12	0	-5.79	-5.80	6.63

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 25

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) EIRP	PAPR (dB)
26041	1850.1	BPSK	3.75	1	0	11.05	13.19	*
				1	47	10.96	13.10	*
			15	1	0	11.01	13.15	*
				1	11	11.00	13.14	*
		QPSK	3.75	1	0	10.98	13.12	*
				1	47	10.97	13.11	*
			15	1	0	11.02	13.16	0.48
				1	11	10.99	13.13	0.52
12	0			11.08	13.22	6.57		
26042	1850.2	BPSK	3.75	1	0	23.12	25.26	*
				1	47	23.14	25.28	*
			15	1	0	23.16	25.30	*
				1	11	23.15	25.29	*
		QPSK	3.75	1	0	23.15	25.29	*
				1	47	23.16	25.30	*
			15	1	0	23.16	25.30	0.26
				1	11	23.11	25.25	0.28
				12	0	21.60	23.74	3.96
26365	1882.5	BPSK	3.75	1	0	22.77	24.91	*
				1	47	22.80	24.94	*
			15	1	0	22.82	24.96	*
				1	11	22.81	24.95	*
		QPSK	3.75	1	0	22.79	24.93	*
				1	47	22.83	24.97	*
			15	1	0	22.82	24.96	0.38
				1	11	22.83	24.97	0.36
				12	0	21.35	23.49	4.04
26688	1914.8	BPSK	3.75	1	0	22.34	24.48	*
				1	47	22.29	24.43	*
			15	1	0	22.42	24.56	*
				1	11	22.39	24.53	*
		QPSK	3.75	1	0	22.39	24.53	*
				1	47	22.30	24.44	*
			15	1	0	22.41	24.55	0.36
				1	11	22.44	24.58	0.36

				12	0	21.02	23.16	4.57
26689	1914.9	BPSK	3.75	1	0	10.12	12.26	*
				1	47	10.11	12.25	*
			15	1	0	10.15	12.29	*
				1	11	10.14	12.28	*
		QPSK	3.75	1	0	10.10	12.24	*
				1	47	10.09	12.23	*
			15	1	0	10.15	12.29	0.51
				1	11	10.16	12.30	0.53
				12	0	10.42	12.56	6.72

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 26 814-824MHz

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP		
26691	814.1	BPSK	3.75	1	0	-5.09	-5.10		
				1	47	-5.09	-5.10		
			15	1	0	-5.08	-5.09		
				1	11	-5.12	-5.13		
			QPSK	3.75	1	0	-5.07	-5.08	
					1	47	-5.03	-5.04	
		15		1	0	-5.07	-5.08		
				1	11	-5.08	-5.09		
		12	0	-5.11	-5.12				
		26692	814.2	BPSK	3.75	1	0	22.83	22.82
						1	47	22.77	22.76
					15	1	0	22.81	22.80
1	11					22.80	22.79		
QPSK	3.75				1	0	22.81	22.80	
					1	47	22.79	22.78	
	15			1	0	22.77	22.76		
				1	11	22.81	22.80		
12	0			21.59	21.58				
26788	823.8			BPSK	3.75	1	0	22.85	22.84
						1	47	22.84	22.83
					15	1	0	22.81	22.80
		1	11			22.83	22.82		
		QPSK	3.75		1	0	22.85	22.84	
					1	47	22.85	22.84	
			15	1	0	22.84	22.83		
				1	11	22.81	22.80		
		12	0	21.70	21.69				
		26789	823.9	BPSK	3.75	1	0	-4.86	-4.87
						1	47	-4.84	-4.85
					15	1	0	-4.86	-4.87
1	11					-4.87	-4.88		
QPSK	3.75				1	0	-4.86	-4.87	
					1	47	-4.83	-4.84	
	15			1	0	-4.85	-4.86		
				1	11	-4.82	-4.83		
12	0			-4.88	-4.89				

NBLoT Band 26 824MHz

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP
26790	824	BPSK	3.75	1	0	22.86	22.85
				1	47	22.74	22.73
			15	1	0	22.79	22.78
				1	11	22.81	22.80
		QPSK	3.75	1	0	22.82	22.81
				1	47	22.83	22.82
			15	1	0	22.84	22.83
				1	11	22.84	22.83
				12	0	21.61	21.60

NBLoT Band 26 824-849MHz

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
26791	824.1	BPSK	3.75	1	0	10.32	10.31	*
				1	47	10.36	10.35	*
			15	1	0	10.35	10.34	*
				1	11	10.37	10.36	*
		QPSK	3.75	1	0	10.33	10.32	*
				1	47	10.34	10.33	*
			15	1	0	10.33	10.32	0.32
				1	11	10.35	10.34	0.47
				12	0	10.31	10.30	6.42

		15	1	0	22.96	22.95	*			
			1	11	22.97	22.96	*			
		3.75	1	0	23.00	22.99	*			
			1	47	22.95	22.94	*			
		QPSK	15	1	0	22.94	22.93	0.31		
				1	11	22.89	22.88	0.33		
				12	0	21.72	21.71	4.73		
		27038	848.8	BPSK	3.75	1	0	22.71	22.70	*
						1	47	22.78	22.77	*
15	1			0	22.92	22.91	*			
	1			11	22.90	22.89	*			
QPSK	3.75			1	0	22.81	22.80	*		
				1	47	22.85	22.84	*		
	15			1	0	22.93	22.92	0.34		
1				11	22.95	22.94	0.36			
12				0	21.48	21.47	4.89			
27039	848.9			BPSK	3.75	1	0	10.32	10.31	*
						1	47	10.31	10.30	*
				15	1	0	10.35	10.34	*	
		1	11		10.34	10.33	*			
		QPSK	3.75	1	0	10.31	10.30	*		
				1	47	10.32	10.31	*		
			15	1	0	10.35	10.34	0.38		
		1		11	10.34	10.33	0.41			
		12		0	10.32	10.31	6.04			

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 66

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) EIRP	PAPR (dB)
13197 3	1710.1	BPSK	3.75	1	0	10.80	12.94	*
				1	47	10.81	12.95	*
			15	1	0	10.82	12.96	*
				1	11	10.83	12.97	*
		QPSK	3.75	1	0	10.81	12.95	*
				1	47	10.82	12.96	*
			15	1	0	10.83	12.97	0.37
				1	11	10.82	12.96	0.38
			12	0	11.00	13.14	5.99	
13197 4	1710.2	BPSK	3.75	1	0	23.12	25.26	*
				1	47	23.11	25.25	*
			15	1	0	23.18	25.32	*
				1	11	23.23	25.37	*
		QPSK	3.75	1	0	23.13	25.27	*
				1	47	23.11	25.25	*
			15	1	0	23.18	25.32	0.26
				1	11	23.15	25.29	0.28
			12	0	22.01	24.15	3.22	
13232 2	1745	BPSK	3.75	1	0	22.52	24.66	*
				1	47	22.53	24.67	*
			15	1	0	23.32	25.46	*
				1	11	23.31	25.45	*
		QPSK	3.75	1	0	22.51	24.65	*
				1	47	22.52	24.66	*
			15	1	0	23.31	25.45	0.32
				1	11	23.32	25.46	0.33
			12	0	23.27	25.41	3.61	
13267 0	1779.8	BPSK	3.75	1	0	22.87	25.01	*
				1	47	22.90	25.04	*
			15	1	0	22.94	25.08	*
				1	11	22.91	25.05	*
		QPSK	3.75	1	0	22.89	25.03	*
				1	47	22.88	25.02	*
			15	1	0	22.89	25.03	0.38
				1	11	22.90	25.04	0.38

				12	0	21.88	24.02	3.72
13267 1	1779.9	BPSK	3.75	1	0	10.13	12.27	*
				1	47	10.12	12.26	*
			15	1	0	10.15	12.29	*
				1	11	10.16	12.30	*
		QPSK	3.75	1	0	10.13	12.27	*
				1	47	10.11	12.25	*
			15	1	0	10.17	12.31	0.35
				1	11	10.16	12.30	0.38
				12	0	10.43	12.57	6.29

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NBLoT. Band 71

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
13312 3	663.1	BPSK	3.75	1	0	-5.49	-5.50	*
				1	47	-5.51	-5.52	*
			15	1	0	-5.30	-5.31	*
				1	11	-5.51	-5.52	*
		QPSK	3.75	1	0	-5.47	-5.48	*
				1	47	-5.48	-5.49	*
			15	1	0	-5.41	-5.42	0.66
				1	11	-5.53	-5.54	0.65
			12	0	-5.45	-5.46	7.23	
13312 4	663.2	BPSK	3.75	1	0	23.25	23.24	*
				1	47	23.27	23.26	*
			15	1	0	23.39	23.38	*
				1	11	23.31	23.30	*
		QPSK	3.75	1	0	23.19	23.18	*
				1	47	23.15	23.14	*
			15	1	0	23.21	23.20	0.33
				1	11	23.27	23.26	0.36
			12	0	21.56	21.55	4.97	
13329 7	680.5	BPSK	3.75	1	0	23.12	23.11	*
				1	47	23.04	23.03	*
			15	1	0	23.18	23.17	*
				1	11	23.19	23.18	*
		QPSK	3.75	1	0	23.09	23.08	*
				1	47	23.12	23.11	*
			15	1	0	23.24	23.23	0.35
				1	11	23.31	23.30	0.36
			12	0	21.52	21.51	4.96	
13347 0	697.8	BPSK	3.75	1	0	23.02	23.01	*
				1	47	23.04	23.03	*
			15	1	0	23.40	23.39	*
				1	11	23.39	23.38	*
		QPSK	3.75	1	0	23.11	23.10	*
				1	47	23.12	23.11	*
			15	1	0	23.41	23.40	0.32
				1	11	23.42	23.41	0.33

				12	0	23.36	23.35	4.78
13347 1	697.9	BPSK	3.75	1	0	-6.21	-6.22	*
				1	47	-6.19	-6.20	*
			15	1	0	-6.09	-6.10	*
				1	11	-6.11	-6.12	*
		QPSK	3.75	1	0	-6.21	-6.22	*
				1	47	-6.17	-6.18	*
			15	1	0	-6.17	-6.18	0.61
				1	11	-6.14	-6.15	0.62
				12	0	-5.85	-5.86	7.09

(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

NB-IoT Band 85

CH	Freq. (MHz)	Mod	BW (kHz)	Num. tone	Offset Tone	Conducted Average Power (dBm)	Average Power (dBm) ERP	PAPR (dB)
13400 3	698.1	BPSK	3.75	1	0	-6.26	-6.27	*
				1	47	-6.21	-6.22	*
			15	1	0	-6.14	-6.15	*
				1	11	-6.20	-6.21	*
		QPSK	3.75	1	0	-6.25	-6.26	*
				1	47	-6.26	-6.27	*
			15	1	0	-6.18	-6.19	0.64
				1	11	-6.23	-6.24	0.65
			12	0	-6.03	-6.04	6.19	
13400 4	698.2	BPSK	3.75	1	0	22.89	22.88	*
				1	47	22.90	22.89	*
			15	1	0	22.91	22.90	*
				1	11	22.89	22.88	*
		QPSK	3.75	1	0	22.90	22.89	*
				1	47	22.92	22.91	*
			15	1	0	22.91	22.90	0.35
				1	11	22.90	22.89	0.33
			12	0	23.41	23.40	3.63	
13409 2	707	BPSK	3.75	1	0	22.79	22.78	*
				1	47	22.80	22.79	*
			15	1	0	22.81	22.80	*
				1	11	22.78	22.77	*
		QPSK	3.75	1	0	22.83	22.82	*
				1	47	22.81	22.80	*
			15	1	0	22.83	22.82	0.42
				1	11	22.82	22.81	0.43
			12	0	21.69	21.68	3.82	
13418 0	715.8	BPSK	3.75	1	0	22.76	22.75	*
				1	47	22.75	22.74	*
			15	1	0	23.41	23.40	*
				1	11	23.42	23.41	*
		QPSK	3.75	1	0	22.74	22.73	*
				1	47	22.75	22.74	*
			15	1	0	23.44	23.43	0.32
				1	11	23.43	23.42	0.34

				12	0	23.46	23.45	3.64	
13418 1	715.9	BPSK	3.75	1	0	-5.84	-5.85	*	
				1	47	-5.85	-5.86	*	
			15	1	0	-5.75	-5.76	*	
				1	11	-5.78	-5.79	*	
		QPSK	3.75	1	0	-5.79	-5.80	*	
				1	47	-5.82	-5.83	*	
			15	1	0	-5.84	-5.85	0.60	
				1	11	-5.81	-5.82	0.61	
					12	0	-5.77	-5.78	6.23

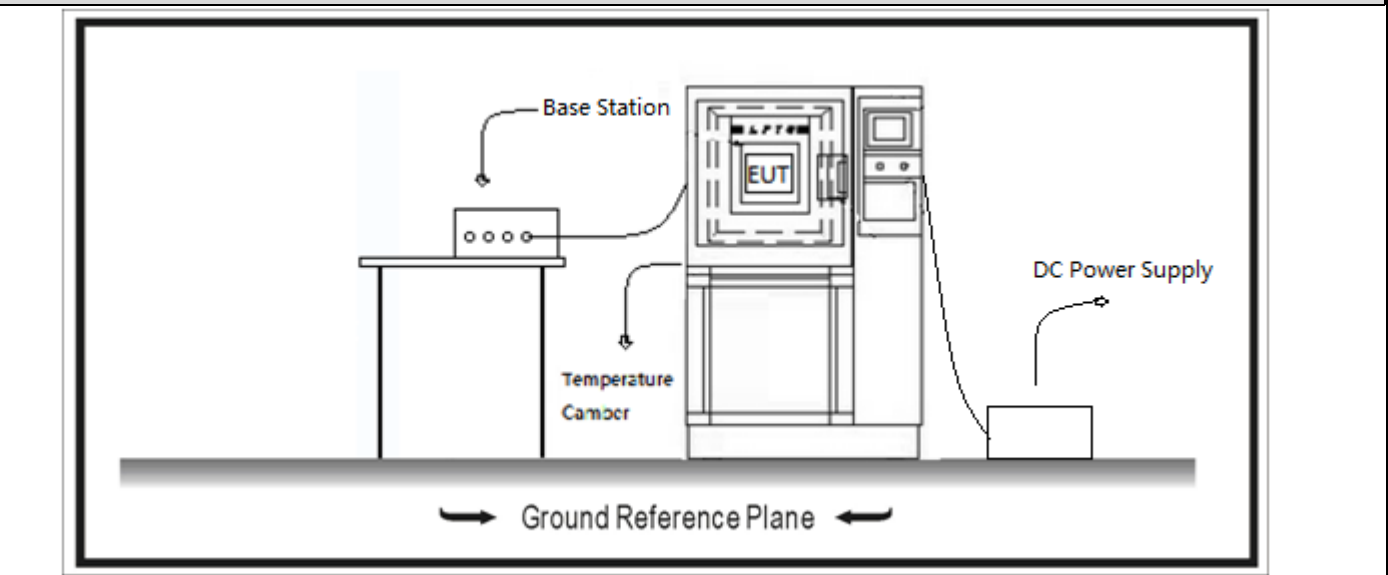
(*): Preliminary measurements determined that modulation QPSK, BW 15KHz as the worst case.

4.2 Frequency Stability	VERDICT: PASS
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4.2.1 Limit

NBloT Band	Standard
5/26	FCC §2.1055 and §22.355: ± 2.5 ppm for mobile stations operating in the range 821 to 896 MHz.
	FCC §2.1055 and §90.213: ± 2.5 ppm for mobile stations operating in the range 809 to 824 MHz.
	RSS-132 Section 5.3: The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations and ± 1.5 ppm for base stations.
2/25	FCC §2.1055 and §24.235: The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
	RSS-133 Section 6.3: The carrier frequency shall not depart from the reference frequency, in excess of ± 2.5 ppm for mobile stations.
12/13/17 /71/85	<p>FCC §2.1055 and §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.</p> <p>RSS-130 Section 4.5: For equipment that is capable of transmitting numerous channels simultaneously for different applications (e.g. LTE and narrowband – internet of things (IoT)), the occupied bandwidth shall be the bandwidth representing the sum of the occupied bandwidths of these channels.</p> <p>The frequency stability shall be sufficient to ensure that the occupied bandwidth remains within each frequency block range when tested at the temperature and supply voltage variations specified in RSS-Gen.</p>
4/66	FCC §2.1055 and §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.
	RSS-139 Section 6.4: The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

4.2.2 Test Setup



4.2.3 Test Procedure			
	References Rule	Chapter	Description
<input checked="" type="checkbox"/>	ANSI C63.26	5.6	Frequency stability testing
<p>The frequency tolerance measurements over temperature variations were made over temperature range of -30°C to +50°C. The EUT was placed inside a environmental temperature chamber and the temperature was lowered hourly in 10°C steps from +50°C to -30°C.</p> <p>The supply voltage was varied between 85% and 115% of nominal voltage.</p> <p>The EUT was set in “Radio Resource Control (RRC) mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter. The worst case NBLoT mode for conducted power was used for the test.</p> <p>In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation. a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.</p> <p>The reference point measurements were made at the RF output terminals of the EUT using directional coupler and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.</p>			

4.2.4 Test Data

NBLoT Band 2

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	22.24
+40	23.23
+30	20.81
+20	21.73
+10	22.19
0	21.55
-10	22.80
-20	20.11
-30	21.84

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	20.06
Vmin(2.8)	22.54

NBLoT Band 4

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	11.65
+40	9.96
+30	11.80
+20	11.09
+10	10.81
0	11.98
-10	10.66
-20	10.64
-30	10.17

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	15.26
Vmin(2.8)	12.70

NBloT Band 5

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	10.51
+40	10.71
+30	10.79
+20	11.76
+10	10.77
0	10.12
-10	9.88
-20	10.46
-30	10.22

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	11.03
Vmin(2.8)	11.50

NBloT Band 12

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	43.57
+40	43.39
+30	45.78
+20	44.79
+10	44.80
0	43.68
-10	44.51
-20	45.33
-30	44.94

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	37.65
Vmin(2.8)	40.61

NBloT Band 13

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	18.19
+40	19.04
+30	19.20
+20	18.53
+10	18.64
0	19.56
-10	20.27
-20	19.88
-30	20.33

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	15.82
Vmin(2.8)	18.58

NBloT Band 17

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	7.99
+40	7.68
+30	8.14
+20	7.82
+10	8.50
0	8.99
-10	9.28
-20	7.75
-30	9.81

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	5.88
Vmin(2.8)	8.01

NBloT Band 25

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	9.44
+40	8.79
+30	10.08
+20	10.23
+10	9.03
0	9.48
-10	8.98
-20	8.75
-30	10.08

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	10.16
Vmin(2.8)	22.34

NBloT Band 26

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	13.77
+40	12.34
+30	13.07
+20	12.60
+10	13.82
0	13.33
-10	12.66
-20	12.78
-30	13.90

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	8.11
Vmin(2.8)	7.04

NBloT Band 66

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	36.53
+40	38.19
+30	36.97
+20	36.80
+10	37.50
0	38.13
-10	38.70
-20	37.57
-30	37.76

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	36.01
Vmin(2.8)	46.79

NBloT Band 71

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	13.96
+40	13.01
+30	13.03
+20	14.50
+10	14.37
0	12.45
-10	14.06
-20	13.39
-30	14.89

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	10.97
Vmin(2.8)	11.01

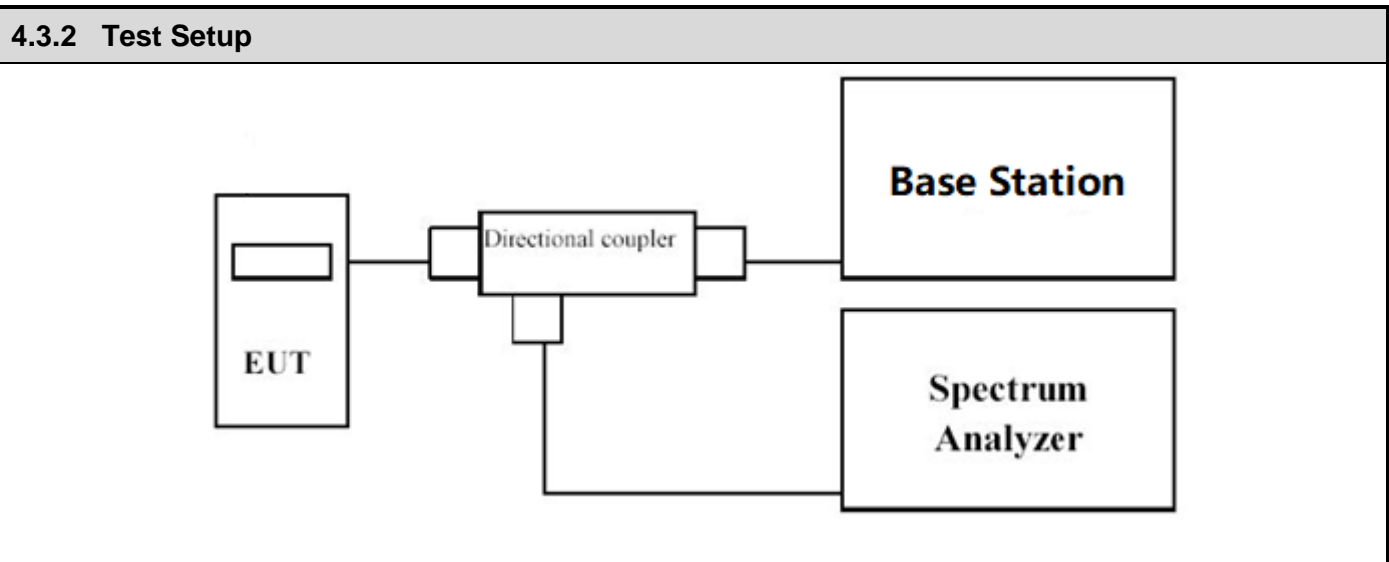
NBIoT Band 85

Temperature($\pm^{\circ}\text{C}$)	Frequency Error(Hz)
+50	16.16
+40	15.50
+30	16.32
+20	15.76
+10	14.06
0	15.35
-10	16.33
-20	14.95
-30	13.50

Voltage(V)	Frequency Error(Hz)
Vmax(3.63)	14.71
Vmin(2.8)	18.65

4.3 Occupied Bandwidth	VERDICT: PASS
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4.3.1 Limit	
NBloT Band	Standard
2/4/5/12/13/17 /25/26/66/71/85	FCC §2.1049: The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.
	RSS-Gen: The emission bandwidth (x dB) 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 x 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 in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth. When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.



4.3.3 Test Procedure			
References Rule	Chapter	Description	
<input checked="" type="checkbox"/> ANSI C63.26	5.4	Occupied bandwidth	
<p>The occupied bandwidth measurement was performed at the output terminals of the EUT using directional coupler and spectrum analyser. The EUT was controller via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.</p>			

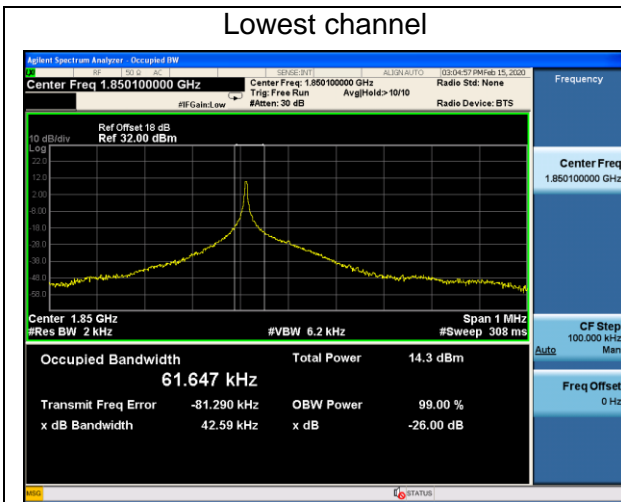
4.3.4 Test Data

NB-IoT Band 2

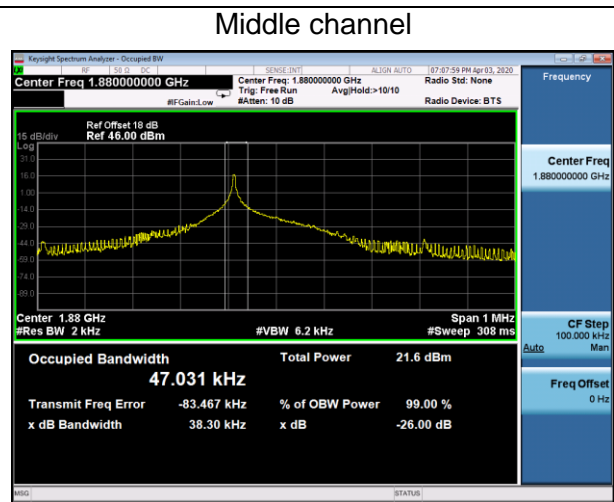
Tone 3.75kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	61.647	47.031	55.167
-26 dBc bandwidth (kHz)	42.59	38.30	39.21

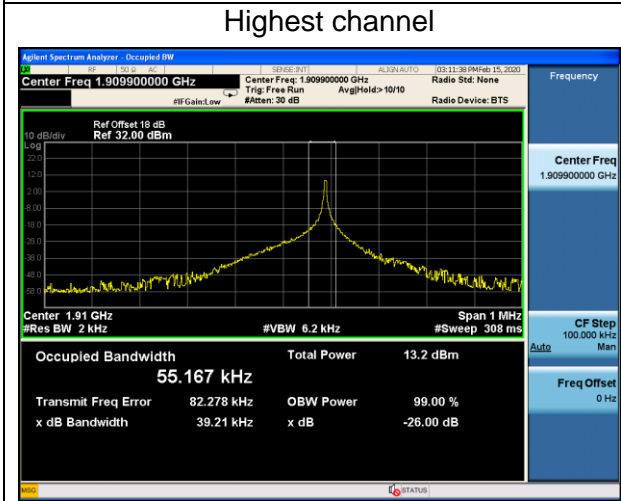
Lowest channel



Middle channel



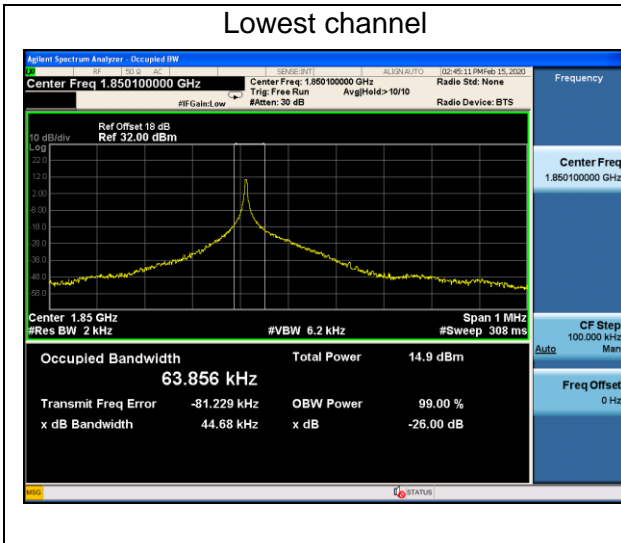
Highest channel



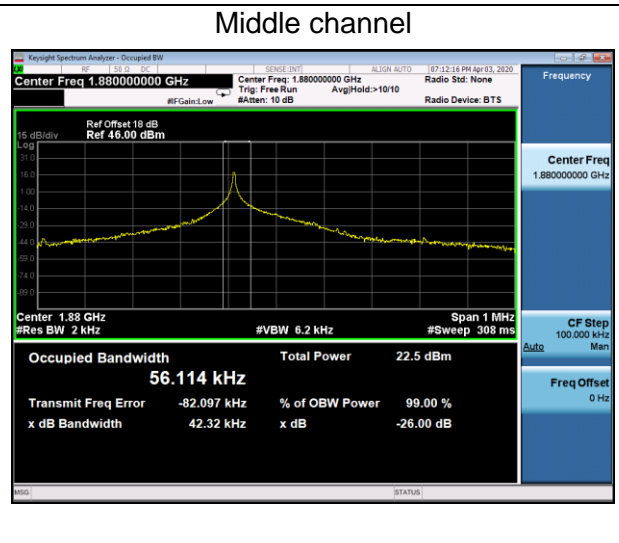
Tone 3.75kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	63.856	56.114	63.038
-26 dBc bandwidth (kHz)	44.68	42.32	42.80

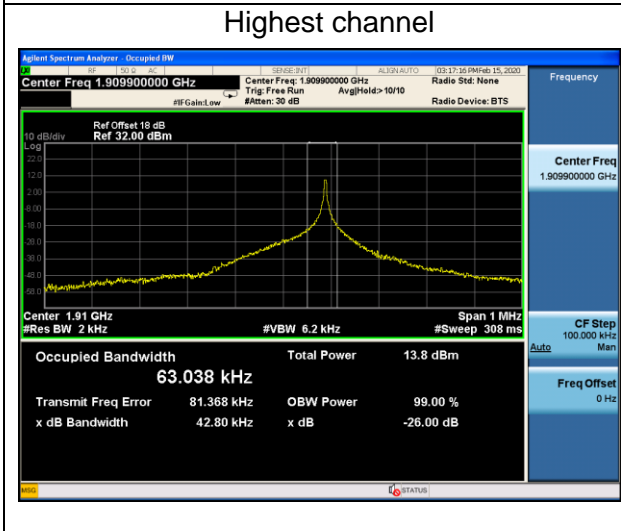
Lowest channel



Middle channel



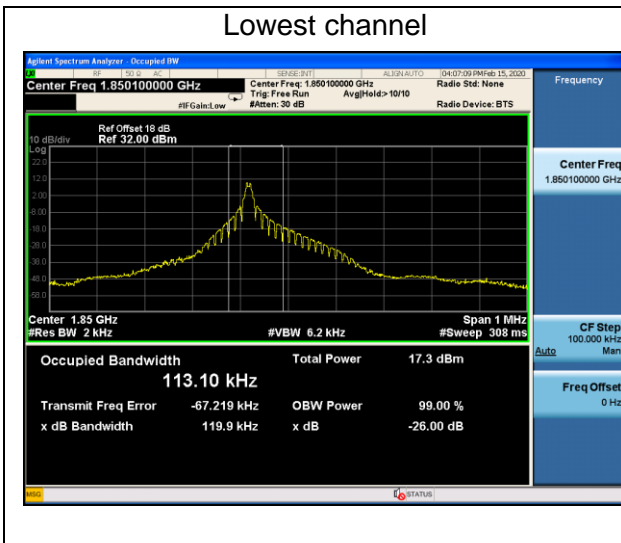
Highest channel



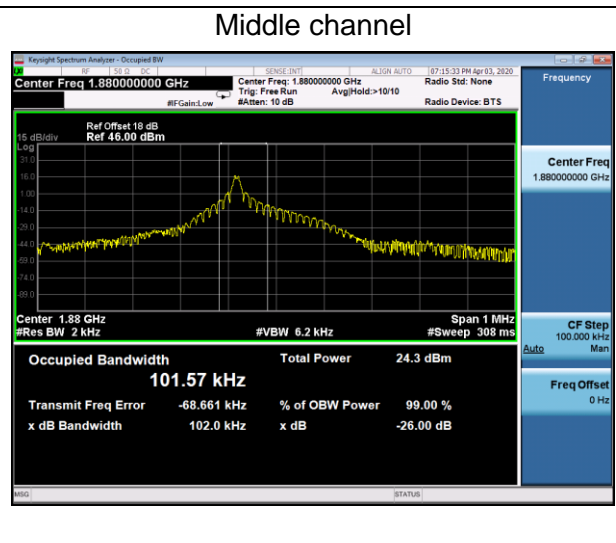
Tone 15kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	113.10	101.57	105.64
-26 dBc bandwidth (kHz)	119.9	102.0	114.9

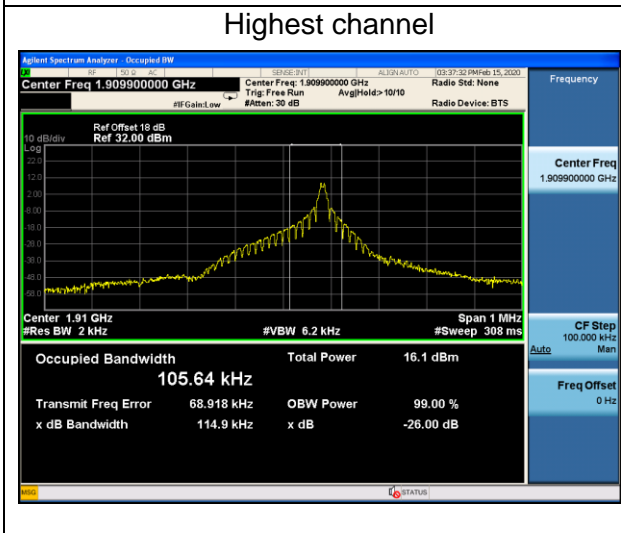
Lowest channel



Middle channel



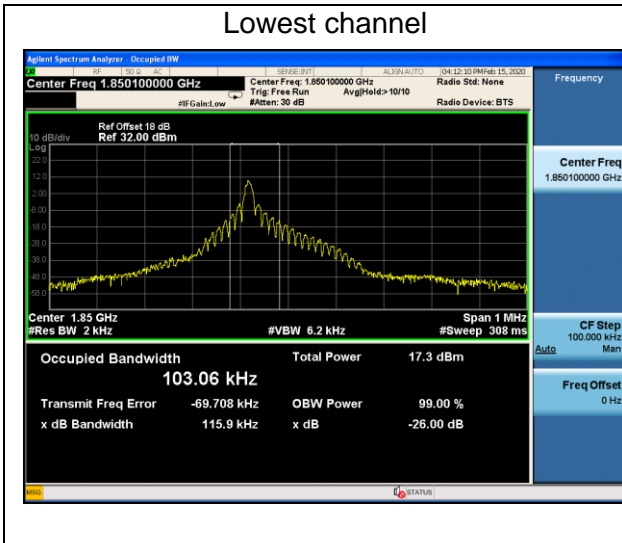
Highest channel



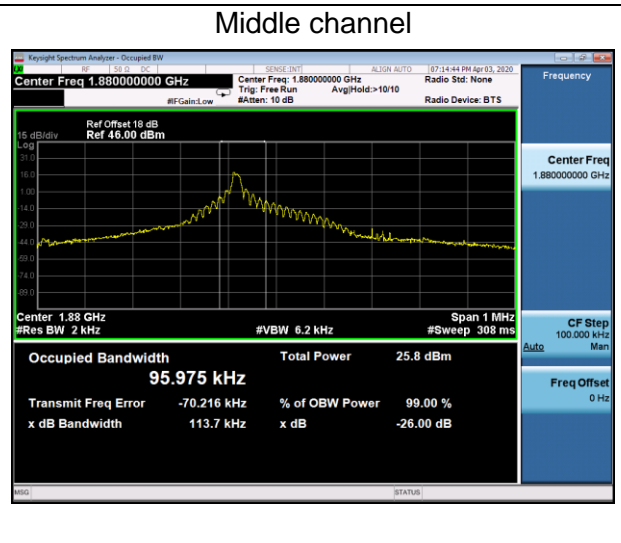
Tone 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	103.06	95.975	103.36
-26 dBc bandwidth (kHz)	115.9	113.7	118.6

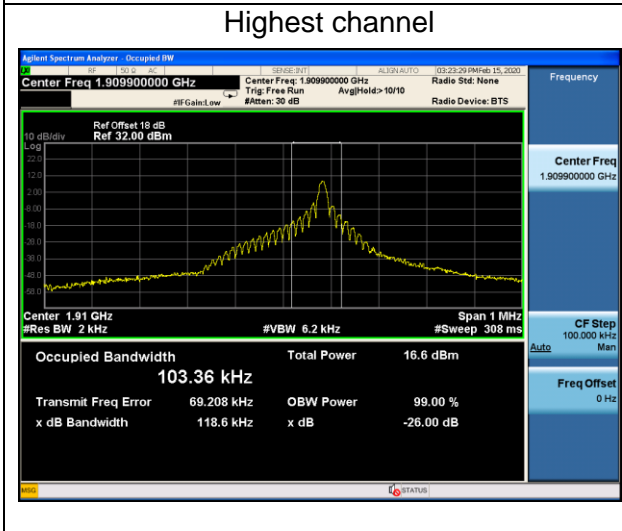
Lowest channel



Middle channel



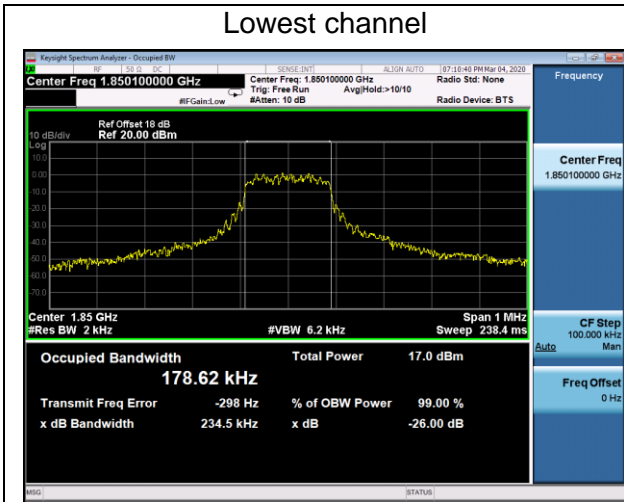
Highest channel



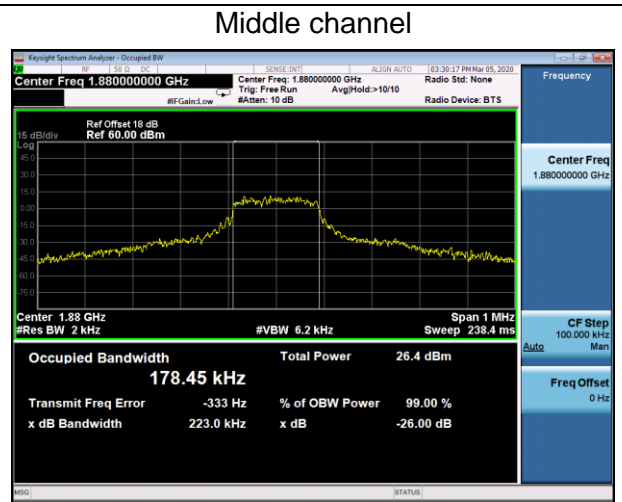
12 Tones 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	178.62	178.45	179.38
-26 dBc bandwidth (kHz)	234.5	223.0	233.5

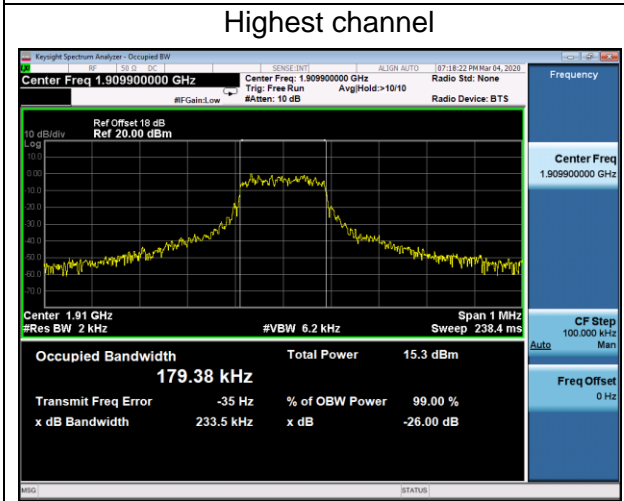
Lowest channel



Middle channel



Highest channel

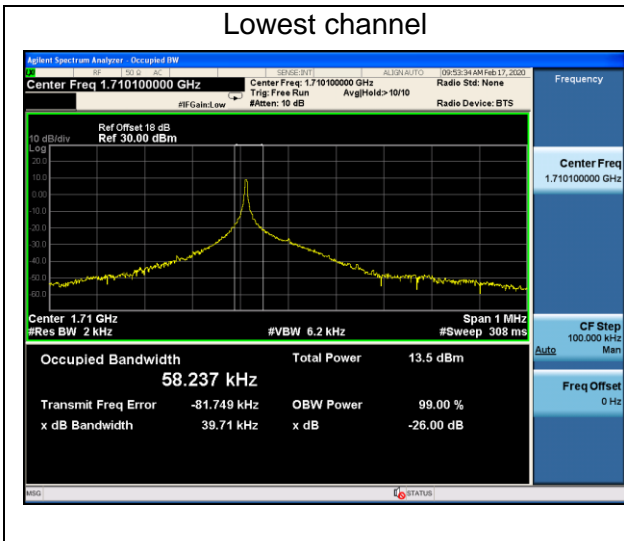


NB-IoT Band 4

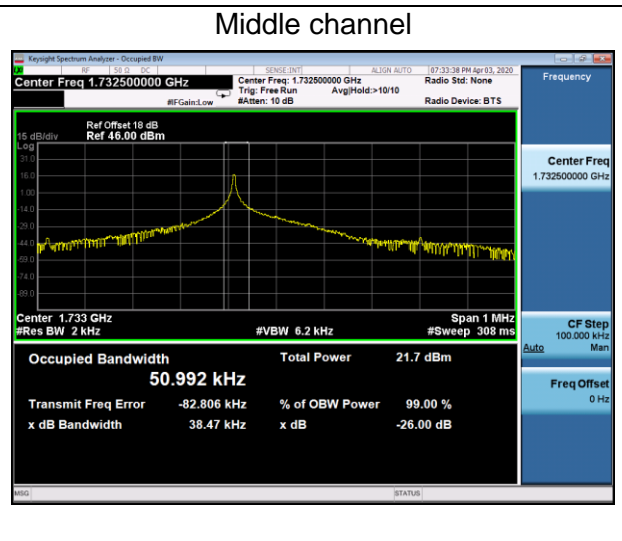
Tone 3.75kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	58.237	50.992	56.616
-26 dBc bandwidth (kHz)	39.71	38.47	41.26

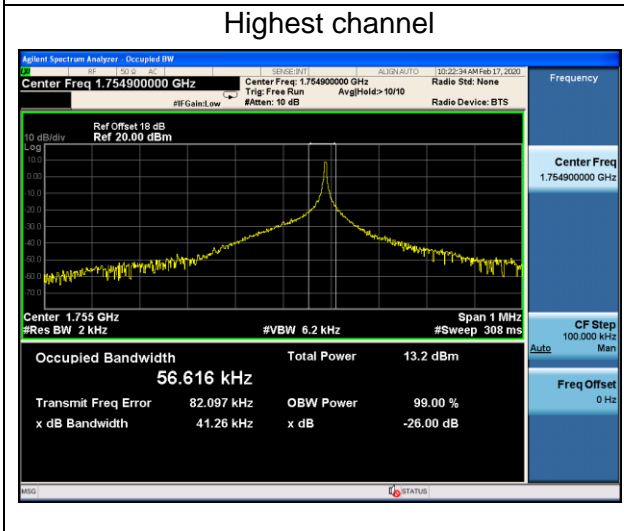
Lowest channel



Middle channel



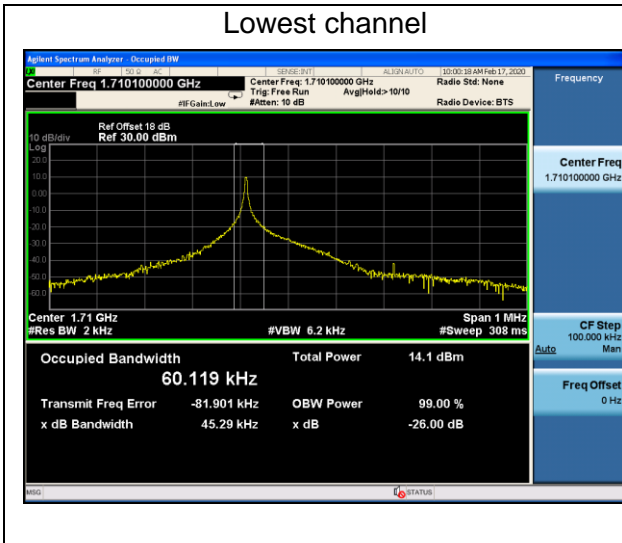
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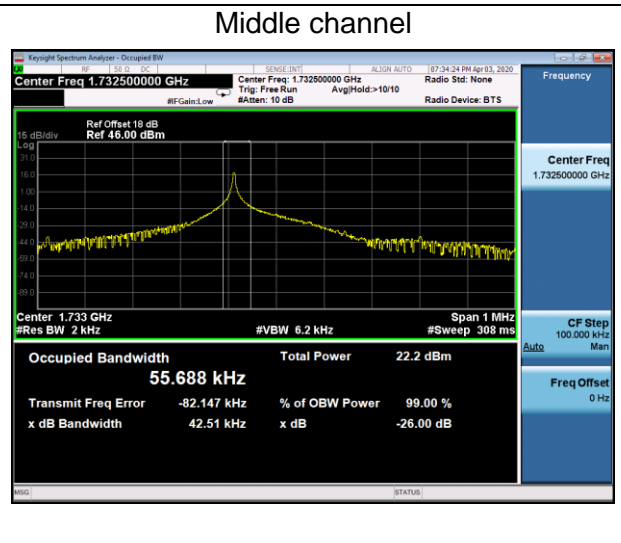
Tone 3.75kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	60.119	55.688	59.444
-26 dBc bandwidth (kHz)	45.29	42.51	45.37

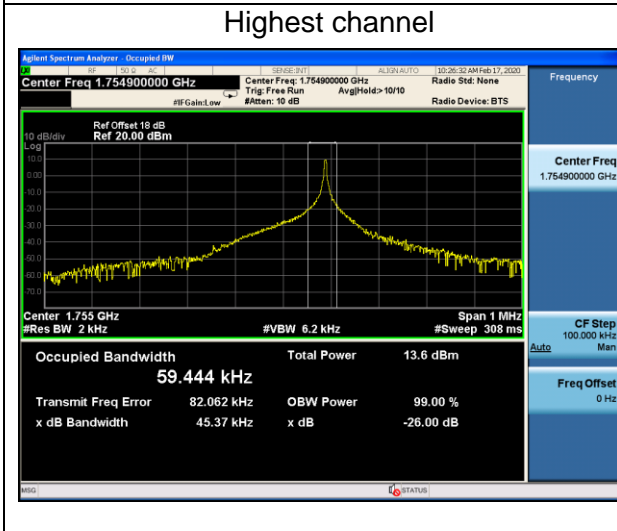
Lowest channel



Middle channel



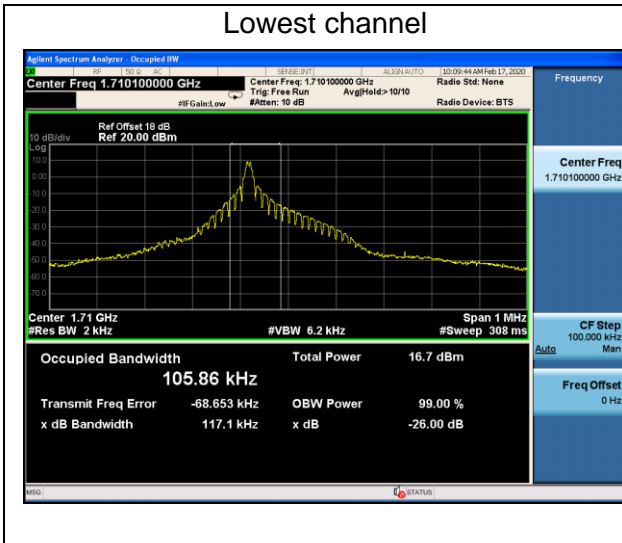
Highest channel



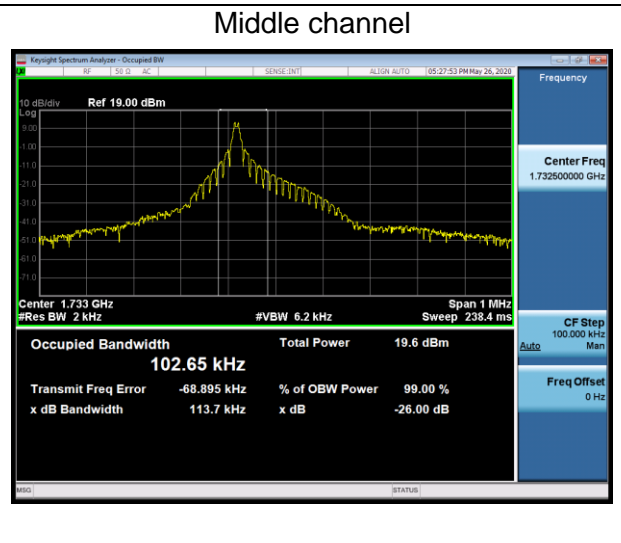
Tone 15kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	105.86	102.65	106.73
-26 dBc bandwidth (kHz)	117.1	113.7	115.0

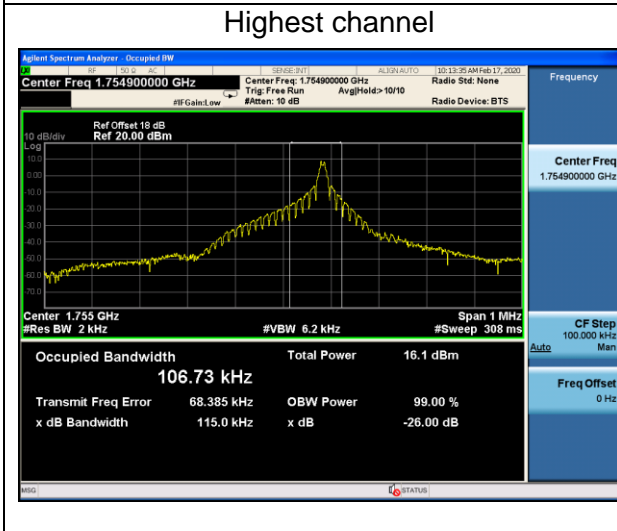
Lowest channel



Middle channel



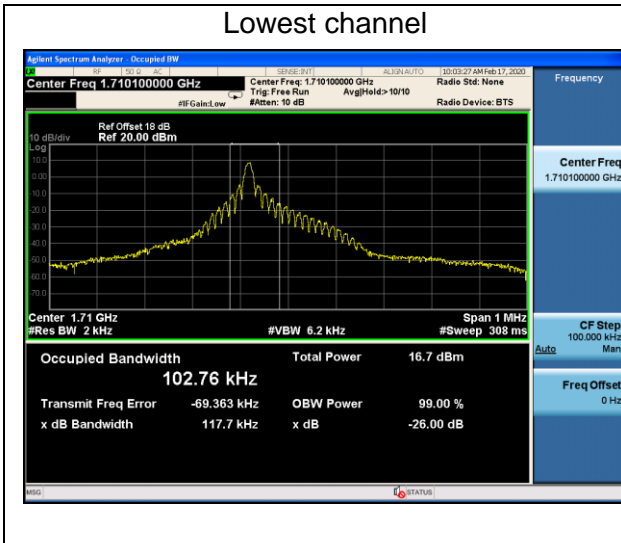
Highest channel



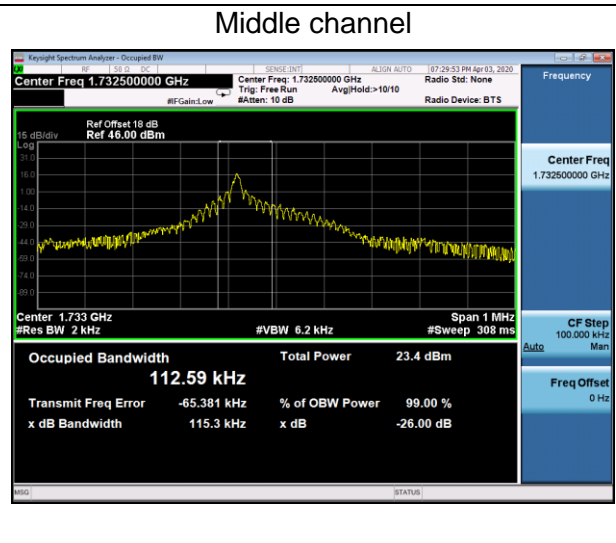
Tone 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	102.76	112.59	102.19
-26 dBc bandwidth (kHz)	117.7	115.3	116.0

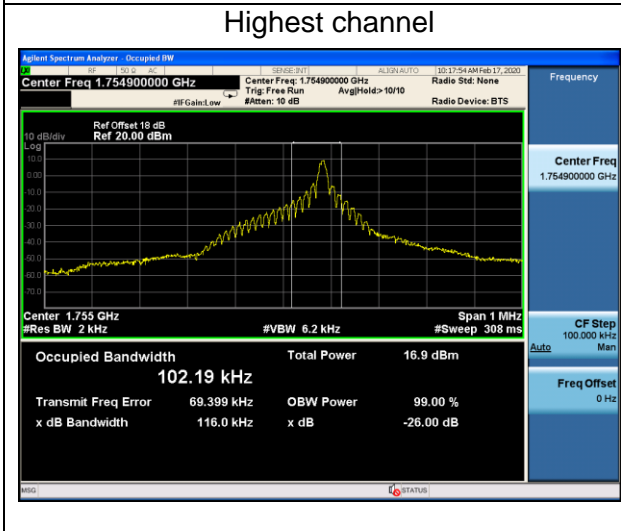
Lowest channel



Middle channel



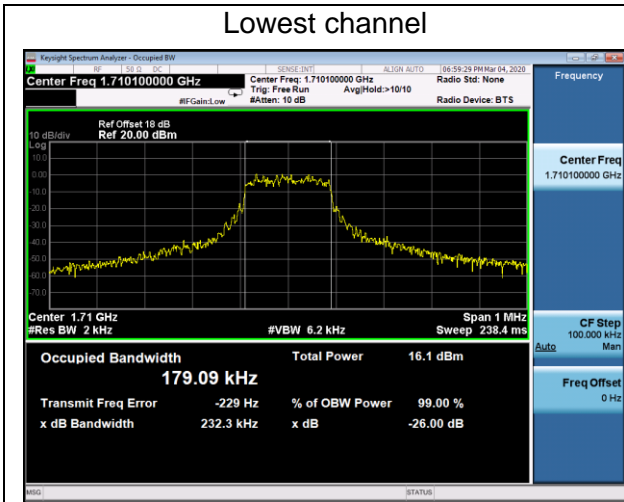
Highest channel



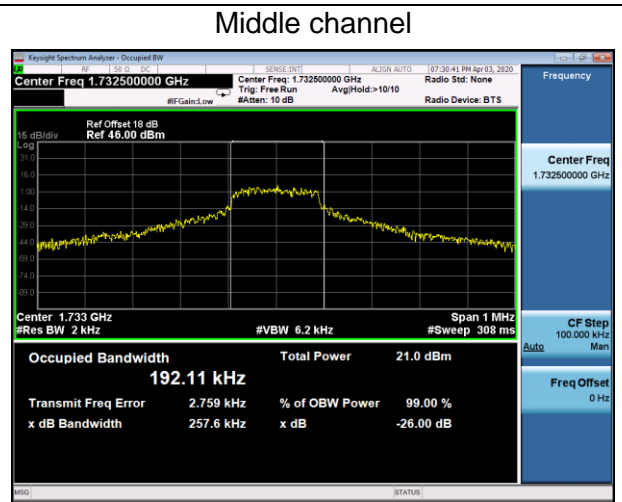
12 Tones 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	179.09	192.11	179.21
-26 dBc bandwidth (kHz)	232.3	257.6	237.2

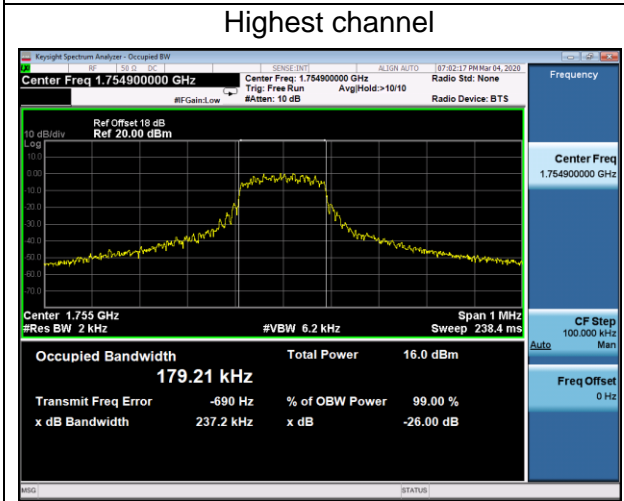
Lowest channel



Middle channel



Highest channel

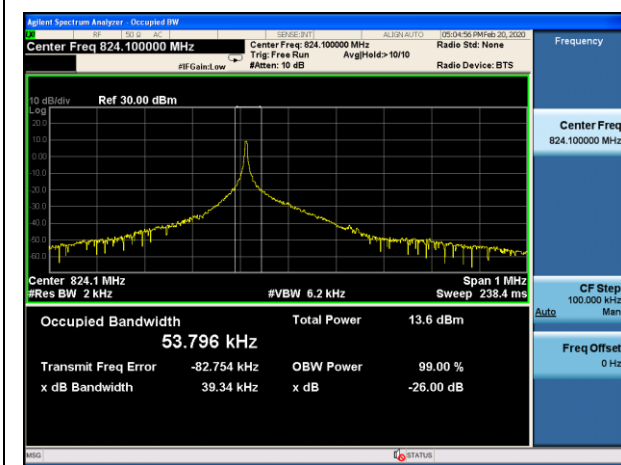


NB-IoT Band 5

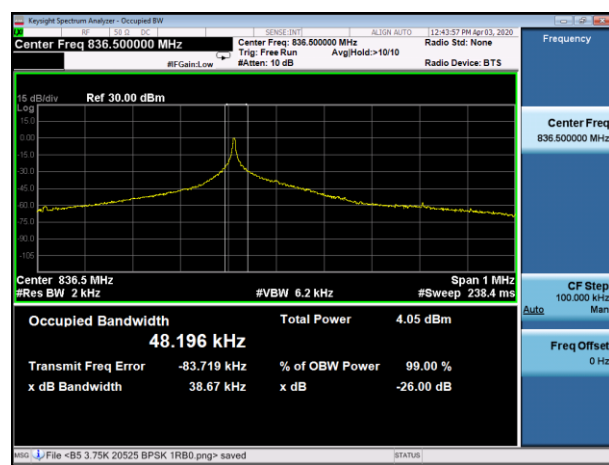
Tone 3.75kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	53.796	48.196	53.047
-26 dBc bandwidth (kHz)	39.34	38.67	39.20

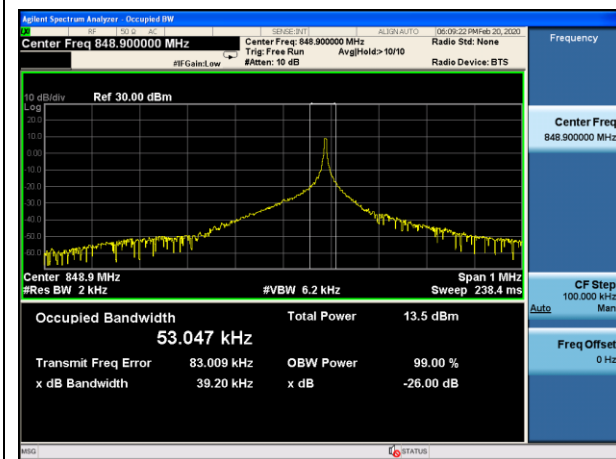
Lowest channel



Middle channel



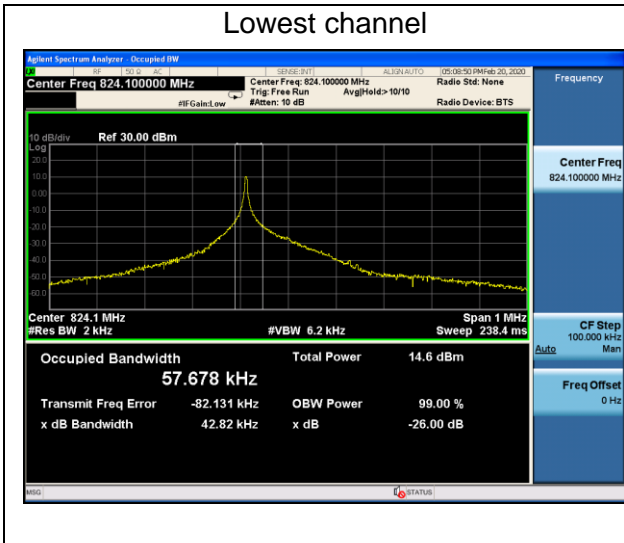
Highest channel



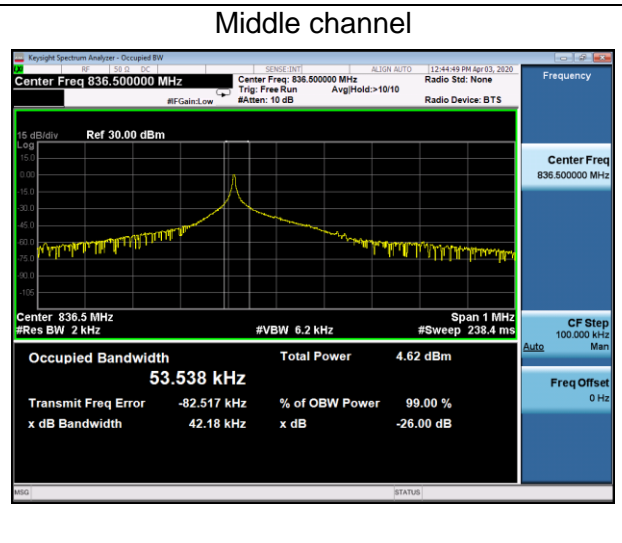
Tone 3.75kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	57.678	53.538	58.679
-26 dBc bandwidth (kHz)	42.82	42.18	42.83

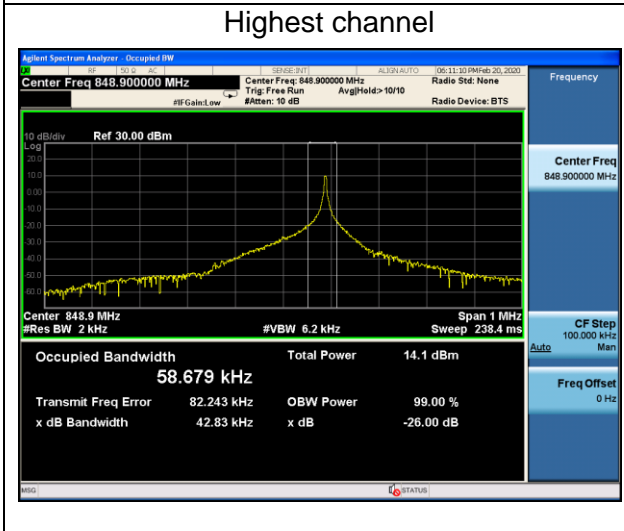
Lowest channel



Middle channel



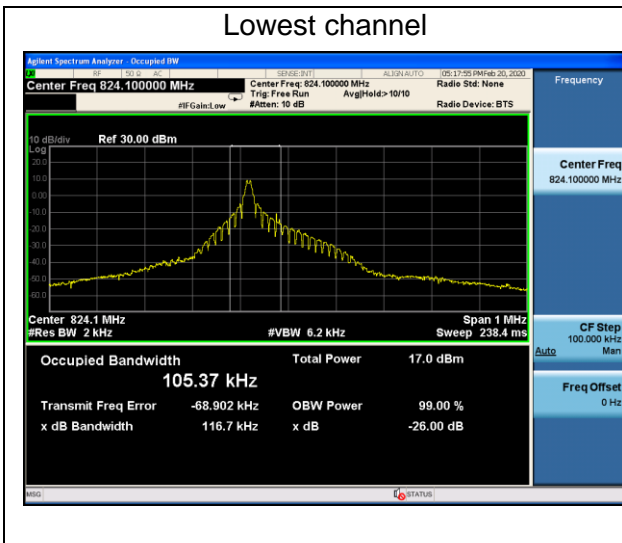
Highest channel



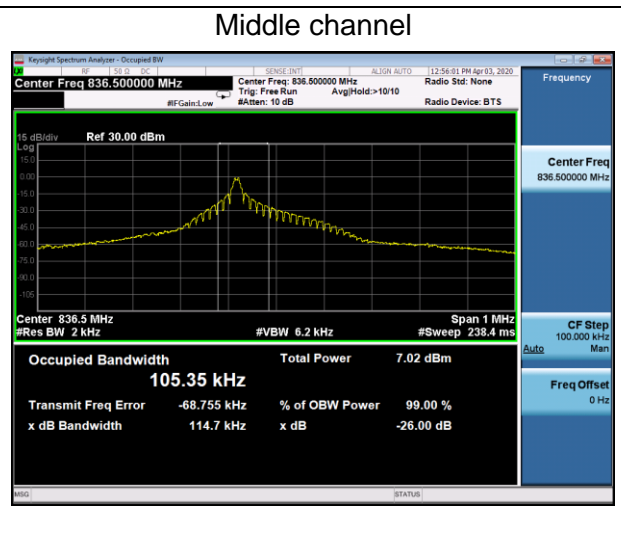
Tone 15kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	105.37	105.35	104.56
-26 dBc bandwidth (kHz)	116.7	114.7	114.6

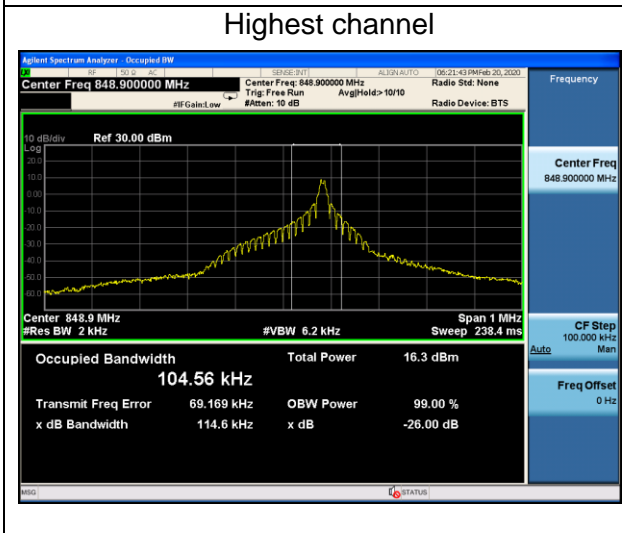
Lowest channel



Middle channel



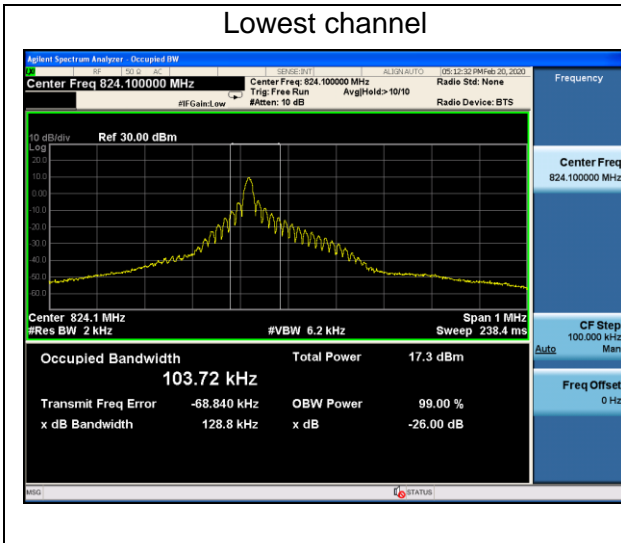
Highest channel



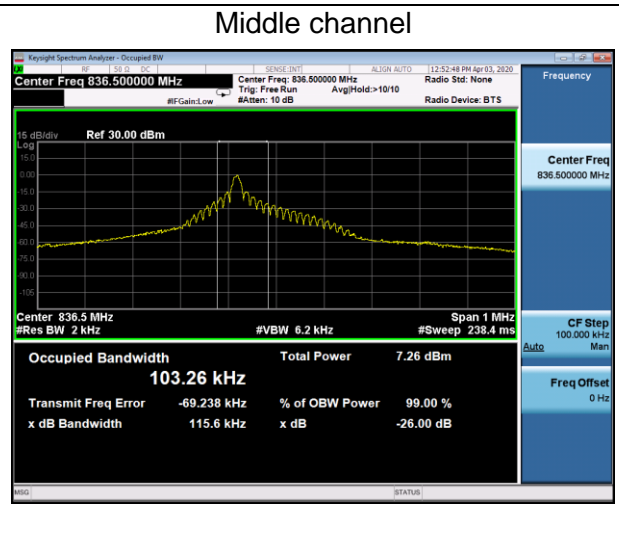
Tone 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	103.72	103.26	103.19
-26 dBc bandwidth (kHz)	128.8	115.6	116.6

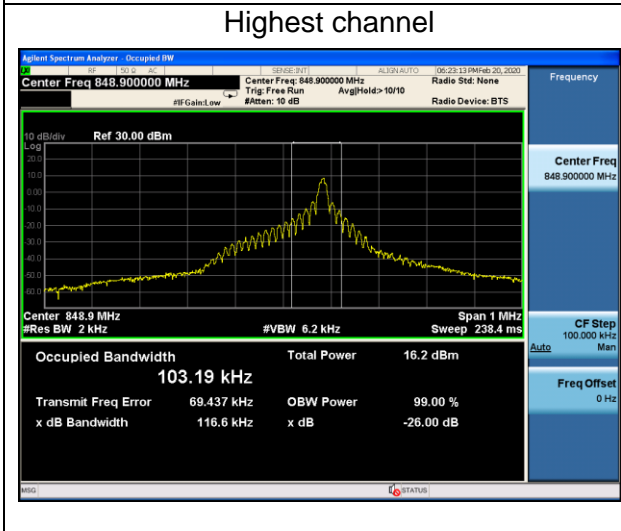
Lowest channel



Middle channel



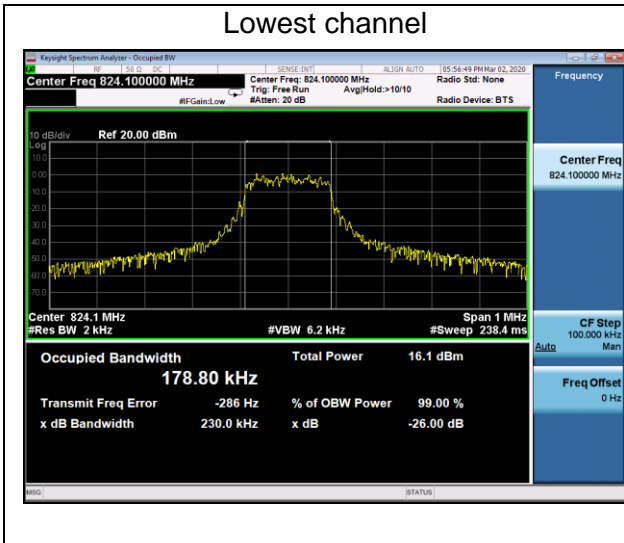
Highest channel



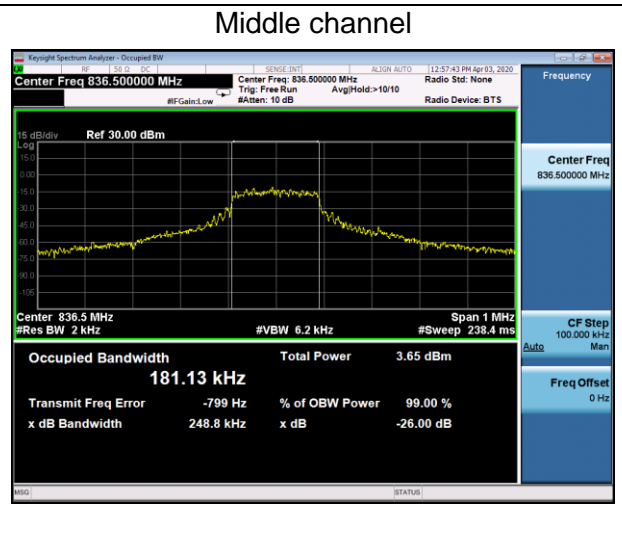
12 Tones 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	178.80	181.13	179.50
-26 dBc bandwidth (kHz)	230.0	248.8	236.2

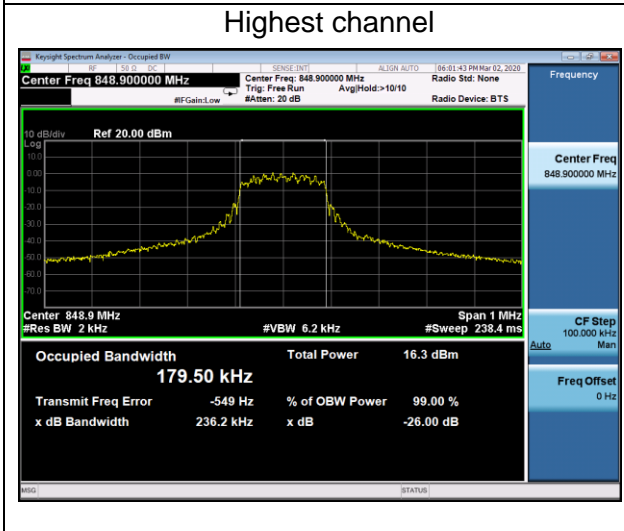
Lowest channel



Middle channel



Highest channel

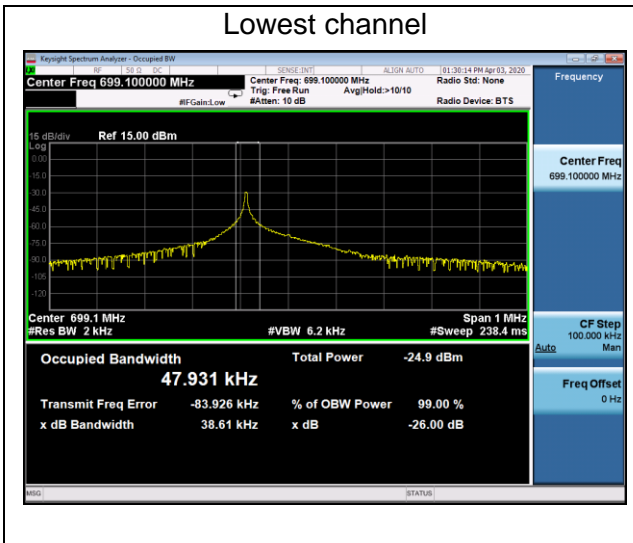


NB IoT Band 12

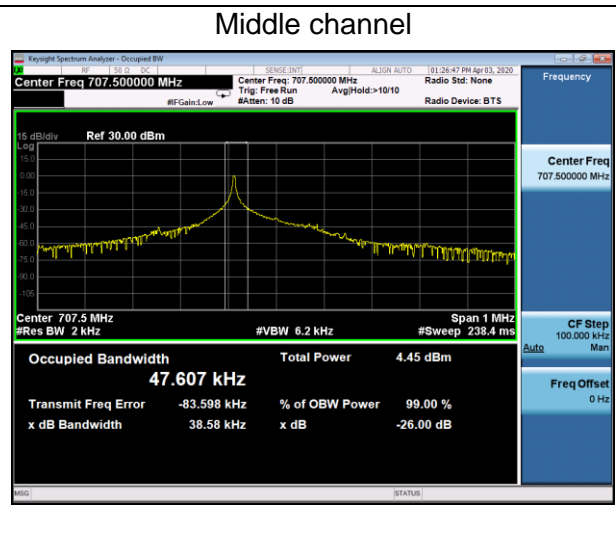
Tone 3.75kHz BPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	47.931	47.607	46.666
-26 dBc bandwidth (kHz)	38.61	38.58	38.48

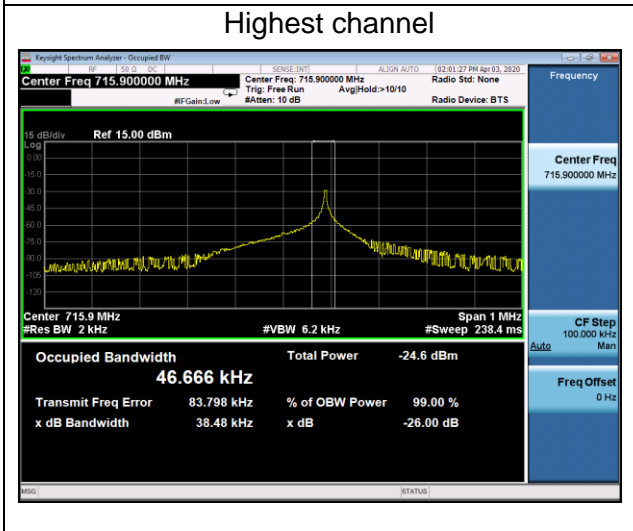
Lowest channel



Middle channel



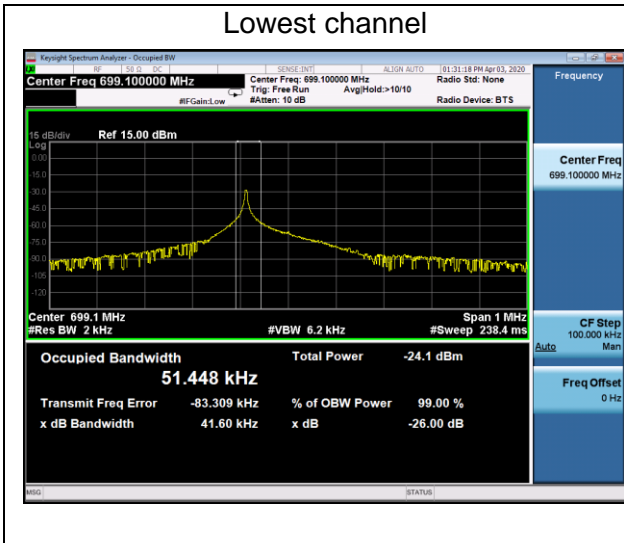
Highest channel



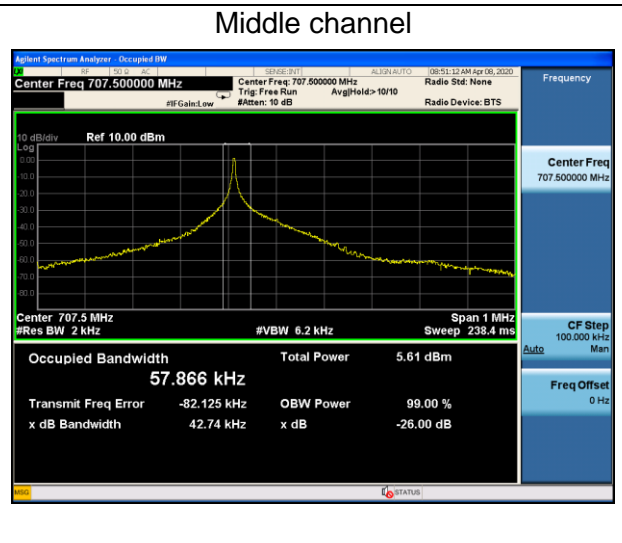
Tone 3.75kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	51.448	57.866	52.359
-26 dBc bandwidth (kHz)	41.60	42.74	42.62

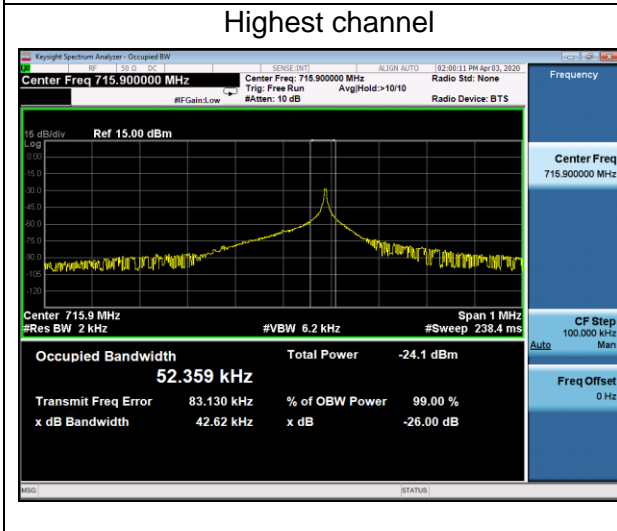
Lowest channel



Middle channel

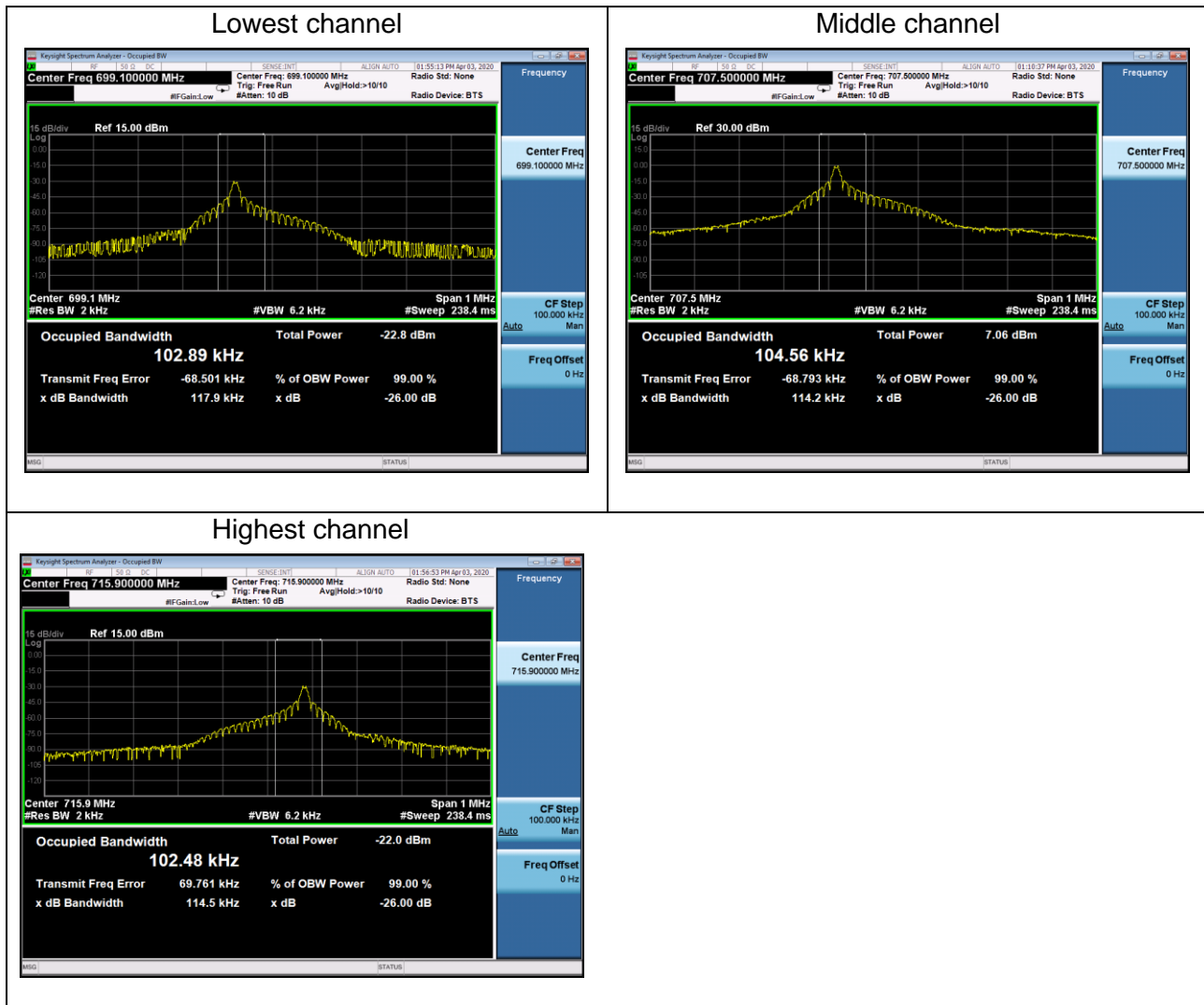


Highest channel



Tone 15kHz BPSK Modulation

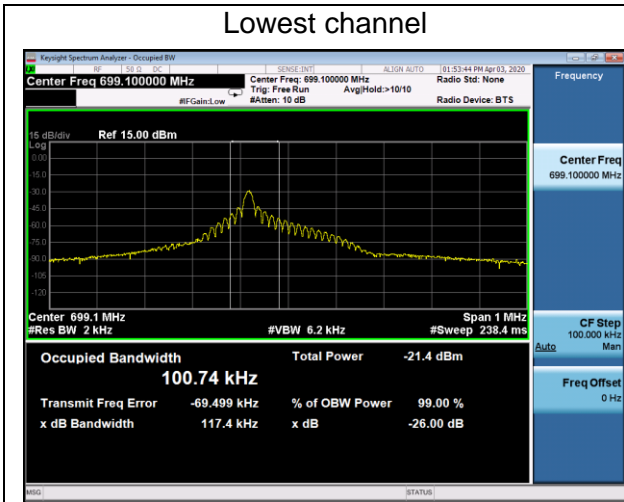
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	102.89	104.56	102.48
-26 dBc bandwidth (kHz)	117.9	114.2	114.5



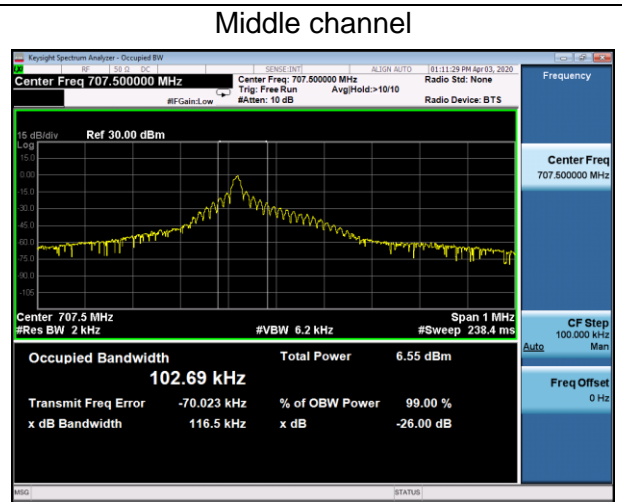
Tone 15kHz QPSK Modulation

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	100.74	102.69	99.666
-26 dBc bandwidth (kHz)	117.4	116.5	115.8

Lowest channel



Middle channel



Highest channel

