ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

OF

Applicant:	Murata Electronics North America 2200 Lake Park Dr #7604, Smyrna, GA 30080 USA
Product Name:	Type 1SC
Brand Name:	Murata
Model No.:	LBAD0XX1SC-DM
Model Difference:	N/A
Report Number:	E2/2019/A0028
FCC ID	HSW-TY1SCDM
IC:	4492A-TY1SCDM
FCC Rule Part:	2 , 22H & 24E & 27C & 90S
ISED Rule:	RSS-130, 132, 133, 139
Issue Date:	Feb. 10, 2020
Date of Test:	Oct. 24, 2019 ~Feb. 10, 2020
Date of EUT Received:	Oct. 24, 2019

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.26-2015 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Ashton Chiu

Tested By: _____

Ashton Chiu / Engineer

Jazz Huang

Approved By: _____

Jazz Huang / Asst. Supervisor

Testing Laboratory
0513

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Revision History

Report Number	Revision	Description	Issue Date	Remark
E2/2019/A0028	Rev.00	Original.	Feb. 10, 2020	Revised By: Karen Huang

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1 GENERAL PRODUCT INFORMATION

1.1 Product Description

Product Name:	Type 1SC
Brand Name:	Murata
Model No.:	LBAD0XX1SC-DM
Model Difference:	N/A
Hardware Version:	ES2
Software Version:	RK_02_01_02_00_57
Power Supply:	3.6Vdc from DC power supply
IMEI:	351521100062890

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1.2 Frequency Range

1.2.1 NB IoT

Band	Subcarrier Spacing (kHz)	Operation Frequency (MHz)
2	3.75	1850.2 - 1909.8
	15	
4	3.75	1710.2 - 1754.8
	15	
5	3.75	824.2 - 848.8
	15	
12	3.75	699.2 - 715.8
	15	
13	3.75	777.2 - 786.8
	15	

Band	Subcarrier Spacing (kHz)	Operation Frequency (MHz)
25	3.75	1850.2 - 1914.8
	15	
17	3.75	704.2 - 715.8
	15	
26	3.75	824.2 - 848.8
	15	
26 Part 90	3.75	814.2 - 823.8
	15	

Note: Operation frequency 814~824MHz is diabled in Canada.

1.3 Output power & Allowable Antenna Gain

NB IoT Bands	Conducted Average Power (dBm)	EIRP Limit (dBm)	**Allowable Gain (dBi)**
2	22.75	33.00	10.25
4	22.92	30.00	7.08
5	22.46	38.45	15.99
12	23.49	34.77	11.28
13	23.43	34.77	11.34
17	23.55	34.77	11.22
25	20.85	33.00	12.15
26	23.40	38.45	15.05
26 Part 90	23.37	50.00	26.63

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1.4 Type of Emission & Max ERP/EIRP Power Measurement Result:

1.4.1 NB IoT

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
2	BPSK	22.74	0.188	242.6500	243KG7D
2	QPSK	22.75	0.188	234.4700	234KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
4	BPSK	22.77	0.189	241.6200	242KG7D
4	QPSK	22.92	0.196	232.6000	233KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
5	BPSK	22.46	0.176	235.2400	235KG7D
5	QPSK	22.45	0.176	235.4500	235KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
12	BPSK	23.49	0.223	239.0200	239KG7D
12	QPSK	23.42	0.220	236.2300	236KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
13	BPSK	23.43	0.220	238.4500	238KG7D
13	QPSK	23.41	0.219	231.0000	231KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
17	BPSK	23.46	0.222	239.0800	239KG7D
17	QPSK	23.55	0.226	236.2000	236KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
25	BPSK	20.83	0.121	238.0400	238KG7D
25	QPSK	20.85	0.122	232.9200	233KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
26	BPSK	23.36	0.217	243.0200	243KG7D
26	QPSK	23.40	0.219	234.6700	235KG7D

NB IoT Band	Modulation	Conducted Average power (dBm)	(W)	99% BW (kHz)	Type of Emission
26 Part90	BPSK	23.37	0.217	240.1400	240KG7D
26 Part90	QPSK	23.33	0.215	234.0800	234KG7D

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1.5 Test Methodology of Applied Standards

FCC 47 CFR Part 2, 22H, 24E, 27C, Part 90.

ISED RSS-130 Issue 2 Feb. 2019, ISED RSS-132 Issue 3 Jan. 2013

ISED RSS-133 Issue 6, Amendment 1 Jan. 18, 2018, ISED RSS-139 Issue 3 July 16, 2015

ANSI C63.26-2015

KDB971168 D01 Power Meas license Digital System v03r01

TS 151 010-1 is used to set, and measure the output power.

1.6 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513)
No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0002

ISED CAB identifier: TW0513

1.7 Special Accessories

No special accessories were used during testing.

1.8 Equipment Modifications

There was no modifications incorporated into the EUT.

1.9 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was operated in the continuous transmission mode employed with the simulator of the Base Station that fixates at test default channels to fix the Tx frequency which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Measurement at Antenna Port

The EUT is placed on a table which is 0.8 m above ground plane. A low loss of RF cable was used to connect the antenna port of EUT to measurement equipment.

2.3.2 Radiated Emissions (ERP/EIRP)

The EUT is placed on a turn table, for emission measurements below 1 GHz is 0.8 m above ground plane, for emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both Horizontal and Vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13.

2.4 Measurement Results Explanation Example

For all conducted test items:
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.
Note:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Following shows an offset computation in physical test.

	RF cable loss (dB)	Attenuation factor(dB)	offset(dB)
Low Band (Below 1GHz)	3.6	10	13.6
High Band (Above 1 GHz)	3.8	10	13.8

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2.5 Final Amplifier Voltage and Current Information:

2.5.1 NB IoT

LTE Band 2

Test mode	DC voltage (V)	DC current (mA)
LTE Band 2_3.75K	3.6	98.000
LTE Band 2_15K	3.6	104.000

LTE Band 4

Test mode	DC voltage (V)	DC current (mA)
LTE Band 4_3.75K	3.6	105.000
LTE Band 4_15K	3.6	99.000

LTE Band 5

Test mode	DC voltage (V)	DC current (mA)
LTE Band 5_3.75K	3.6	108.000
LTE Band 5_15K	3.6	101.000

LTE Band 12

Test mode	DC voltage (V)	DC current (mA)
LTE Band 12_3.75K	3.6	103.000
LTE Band 12_15K	3.6	96.000

LTE Band 13

Test mode	DC voltage (V)	DC current (mA)
LTE Band 13_3.75K	3.6	104.000
LTE Band 13_15K	3.6	97.000

LTE Band 17

Test mode	DC voltage (V)	DC current (mA)
LTE Band 17_3.75K	3.6	106.000
LTE Band 17_15K	3.6	99.000

LTE Band 25

Test mode	DC voltage (V)	DC current (mA)
LTE Band 25_3.75K	3.6	98.000
LTE Band 25_15K	3.6	109.000

LTE Band 26

Test mode	DC voltage (V)	DC current (mA)
LTE Band 26_3.75K	3.6	95.000
LTE Band 26_15K	3.6	103.000

LTE Band 26_Part90

Test mode	DC voltage (V)	DC current (mA)
LTE Band 26_Part90_3.75K	3.6	101.000
LTE Band 26_Part90_15K	3.6	107.000

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2.6 Configuration of Tested System

Fig. 2-1 Configuration of Tested System (Fixed Channel-Conducted)

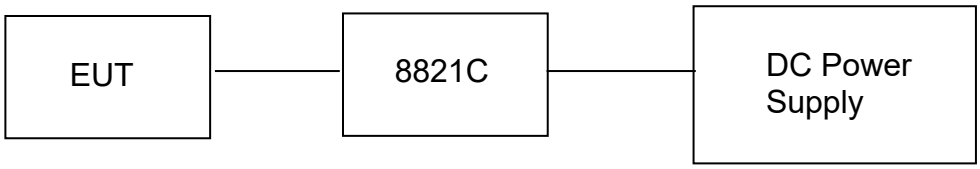
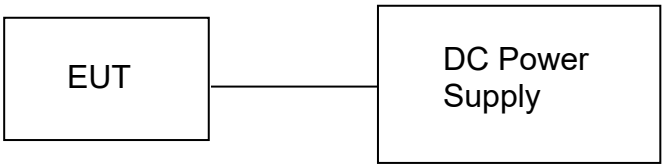


Fig. 2-2 Configuration of Tested System (Fixed Channel-Radiated)



Remote Side

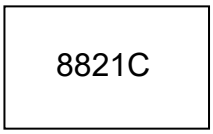


Table 2-1 Equipment Used in

Item	Equipment	Mfr/Brand	Model / Type No.	Series No.	Data Cable	Power Cord
1.	Universal Radio Communication Tester	Anritsu	MT8821C	6261786084	shielded	Un-shielded
2.	Universal Radio Communication Tester	Anritsu	MT8821C	6262044739	shielded	Un-shielded

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§2.1046(a)	RSS-GEN §6.12	RF Power Output	Compliant
§22.913(a)(5) §24.232(c) §27.50(b)(c)(10) §27.50(d)(4) §90.635	RSS-130 §4.6 RSS-132 §5.4 RSS-133 §6.4 RSS-139 §6.5	ERP/ EIRP measurement	Compliant
§2.1049(h)	RSS-GEN §6.7	99% & 26dB Occuupied Bandwidth	Compliant
§2.1051 §22.917(a)(b) §24.238(a) §27.53(g) §27.50(c) §27.53(h) §90.691 §90.210(n)	RSS-GEN §6.13 RSS-130 §4.7 RSS-132 §5.5 RSS-133 §6.5 RSS-139 §6.6	Out of Band Emissions at Antenna Terminals and Band Edge / Emission mask requirements	Compliant
§2.1053 §22.917(a) §24.238(a) §27.53(g) §27.53(h) §27.53(c)(f) 1559-1610 MHz §90.691	RSS-GEN §6.13 RSS-130 §4.7 RSS-132 §5.5 RSS-133 §6.5 RSS-139 §6.6	Field Strength of Spurious Radiation	Compliant
§24.232(d) §27.50((B)	RSS-130 §4.6.1 RSS-132 §5.4 RSS-133 §6.4 RSS-139 §6.4	Peak to Average Ratio	Compliant
§2.1055(a)(1) §22.355 §24.235 §27.54	RSS-130 §4.5 RSS-132 §5.3 RSS-133 §6.3 RSS-139 §6.5	Frequency Stability	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Configuration

1. The EUT has been tested under operating condition.
2. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, X(E1)Y(E2)Z(H) axis and antenna ports. The worst case was found as listed below. Following channel(s) was (were) selected for the final test as listed below:

4.2 NB IoT

NB IoT Modes	Radiated Emission		
	E1	E2	H
B2	-	V	-
B4	-	V	-
B5	-	V	-
B12	-	V	-
B13	-	V	-
B17	-	V	-
B25	-	V	-
B26	-	V	-
B26 Part 90	-	V	-

NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B2	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V
NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B4	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V

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NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B5	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V
NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B12	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	V	-	V	V	V
NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B13	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	V	-	V	V	V
NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B17	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V

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NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B25	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V

NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B26	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	-	V	-	V	V	V	V

NB IoT Modes	Test Items	Subcarrier		Modulation		Test		
		3.75	15	BPSK	QPSK	L	M	H
B26 Part 90	EIRP	V	V	V	V	V	V	V
	Occupied Bandwidth	V	V	V	V	V	V	V
	Band Edge Compliance	V	V	V	V	V	-	V
	Peak-To-Average Ratio	V	V	V	V	V	V	V
	Frequency Stability	V	V	V	V	-	V	-
	Conducted Spurious Emission	V	V	V	V	V	V	V
	Radiated Spurious Emission	V	-	V	-	V	V	V

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
RF Power Output	+/- 1.10 dB
ERP/ EIRP measurement	Vertical Polarization = +/- 4.74dB Horizontal Polarization =+/- 4.62dB
99% Occupied Bandwidth	+/- 5.19 Hz
Out of Band Emissions at Antenna Terminals and Band Edge	+/- 0.70 dB
Peak to Average Ratio	+/- 0.70 dB
Frequency Stability vs. Temperature	+/- 5.19 Hz
Frequency Stability vs. Voltage	+/- 5.19 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC=+/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : **Horizontal**)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

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

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6 MAXMUM OUTPUT POWER

6.1 Standard Applicable

A base station simulator was used to establish communication with the EUT. Its parameters were set to transmit the maximum power on the EUT. The measured power in the radio frequency on the transmitter output terminals.

6.2 FCC ERP/EIRP LIMIT

According to FCC §2.1046

FCC 22.913(a)

(5) mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

FCC 24.232(c)

Mobile and portable stations are limited to 2 W EIRP.

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.

FCC 27.50(c)

(10) Portable stations (hand-held devices) are limited to 3 watts ERP.

FCC 27.50(d)

(4) Mobile, and portable (hand-held) stations operating in the 1710-1755 MHz, 1695-1710 MHz and 1755-1780 MHz bands are limited to 1W EIRP.

FCC 90.635(b)

Mobile station is limited to 100W ERP

RSS-130 §4.6

The e.r.p. shall not exceed 3 watts for mobile equipment, fixed subscriber equipment and portable equipment operating in the Band 617-652 and 663-698MHz.

RSS-132 §5.4

The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment in operating in the Bands 824-849 and 869-894MHz shall not exceed 11.5 watts.

RSS-139 §6.5

The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters in the Bands 1710-1780MHz shall not exceed one watt.

RSS-133 §6.4

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510.

According to section 5.1.2 of SRSP-510, Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The equipment shall employ means to limit the power to the minimum necessary for successful communication.

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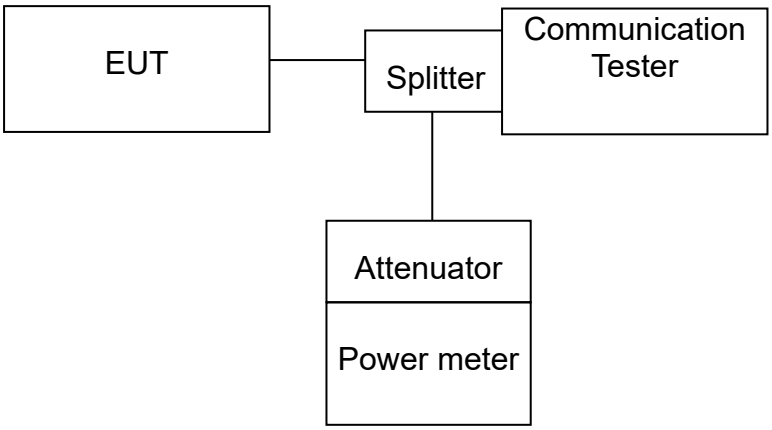
6.3 Test Set-up



Note: *Measurement setup for testing on Antenna connector*

6.4 Output Power Measurement Applicable Guideance

The transmitter output was connected to a calibrated attenuator, the other end of which was connected to a power meter. Transmitter output was read off the power meter in dBm. The power output at the transmitter antenna port was determined by adding the value of the attenuator to the power meter reading. TS 151 010-1 is reference to conduct the measurement of output power.
The Procedure of KDB941225 (SAR Measurement Procedures for 3G devices, (WCDMA/HSPA) was used for EUT and Base station setting. RMC 12.2kps is used for this testing, and KDB 971168 D01 Power Meas License Digital System as the supplemental test methodology to adjust the proper setting obtaining the measurement results.WAll bands conducted average power is obtained from the simulator telecommunication test set.

6.5 Determining ERP and/or EIRP from conducted RF output power measurements

ERP/EIRP = PMeas + GT-LC

Where:

ERP/EIRP	= effective or equivalent radiated power, respectively (expressed in the same units as PMeas, typically dBW or dBm);
PMeas	= measured transmitter output power or PSD, in dBm or dBW;
GT	= gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)
LC	= signal attenuation in the connecting cable between the transmitter and antenna, in dB.2

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

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6.6 Measurement Equipment Used

Conducted Emission (measured at antenna port) Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	MY53140006	05/31/2019	05/30/2020
Radio Communication Analyer	Anritsu	MT8821C	6261786084	01/09/2019	01/09/2020
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/15/2019	07/14/2020
Splitter	Marvelous	MVE8586	RF265	11/20/2019	11/19/2020
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF268	11/20/2019	11/19/2020
Coaxial Cables	Woken	00100A1F1A18 5C	RF220	11/20/2019	11/19/2020
Coaxial Cables	Woken	00100A1F1A18 5C	RF229	11/20/2019	11/19/2020

Note: The measurement was taken place with the long duration of the time, and additional equipment list as shown blow indicate those equipment of which has been subject to undertake the calibration in intermediate period of time of the measurement.

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Radio Communication Analyer	Anritsu	MT8821C	6262044739	12/06/2019	12/05/2020

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6.7 Measurement Result

6.7.1 NB IoT

LTE NB-IoT Band 2							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	EIRP Limit (dBm)	Allowable Gain (dBi)
18602	1850.2	BPSK	3.75	1@0	22.68	33.00	10.32
				1@47	22.71		10.29
		BPSK	15	1@11	22.65		10.35
		QPSK	15	1@0	22.73		10.27
				1@11	22.71		10.29
				12@0	22.54		10.46
18900	1880	BPSK	3.75	1@0	22.71		10.29
				1@47	**22.74**		10.26
		BPSK	15	1@11	22.72		10.28
		QPSK	15	1@0	22.74		10.26
				1@11	**22.75**		**10.25**
				12@0	20.79		12.21
19198	1909.8	BPSK	3.75	1@0	22.43		10.57
				1@47	22.46		10.54
		BPSK	15	1@11	22.38		10.62
		QPSK	15	1@0	22.47		10.53
				1@11	22.55		10.45
				12@0	20.43		12.57

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LTE NB-IoT Band 4							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
19952	1710.2	BPSK	3.75	1@0	22.43	30.00	7.57
				1@47	22.42		7.58
		BPSK	15	1@11	**22.77**		7.23
		QPSK	15	1@0	**22.92**		**7.08**
				1@11	22.84		7.16
				12@0	20.36		9.64
20175	1732.5	BPSK	3.75	1@0	21.71		8.29
				1@47	21.73		8.27
		BPSK	15	1@11	21.76		8.24
		QPSK	15	1@0	22.31		7.69
				1@11	22.37		7.63
				12@0	20.44		9.56
20398	1754.8	BPSK	3.75	1@0	22.35		7.65
				1@47	22.69		7.31
		BPSK	15	1@11	22.73		7.27
		QPSK	15	1@0	22.39		7.61
				1@11	22.47		7.53
				12@0	21.83		8.17

LTE NB-IoT Band 5							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
20402	824.2	BPSK	3.75	1@0	22.31	38.45	16.14
				1@47	22.42		16.03
		BPSK	15	1@11	22.31		16.14
		QPSK	15	1@0	22.39		16.06
				1@11	**22.45**		16.00
				12@0	21.71		16.74
20525	836.5	BPSK	3.75	1@0	22.19		16.26
				1@47	22.24		16.21
		BPSK	15	1@11	22.17		16.28
		QPSK	15	1@0	22.41		16.04
				1@11	22.38		16.07
				12@0	21.53		16.92
20648	848.8	BPSK	3.75	1@0	**22.46**		**15.99**
				1@47	22.39		16.06
		BPSK	15	1@11	22.33		16.12
		QPSK	15	1@0	22.41		16.04
				1@11	22.36		16.09
				12@0	21.31		17.14

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LTE NB-IoT Band 12							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
23012	699.2	BPSK	3.75	1@0	23.37	34.77	11.40
				1@47	23.31		11.46
		BPSK	15	1@11	23.36		11.41
		QPSK	15	1@0	23.33		11.44
				1@11	23.34		11.43
				12@0	21.72		13.05
23095	707.5	BPSK	3.75	1@0	23.39		11.38
				1@47	23.29		11.48
		BPSK	15	1@11	23.18		11.59
		QPSK	15	1@0	**23.42**		11.35
				1@11	23.37		11.40
				12@0	21.69		13.08
23178	715.8	BPSK	3.75	1@0	23.26		11.51
				1@47	23.31		11.46
		BPSK	15	1@11	**23.49**		**11.28**
		QPSK	15	1@0	23.28		11.49
				1@11	**23.42**		11.35
				12@0	21.83		12.94

LTE NB-IoT Band 13							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
23182	777.2	BPSK	3.75	1@0	23.38	34.77	11.39
				1@47	23.31		11.46
		BPSK	15	1@11	23.26		11.51
		QPSK	15	1@0	23.24		11.53
				1@11	23.29		11.48
				12@0	21.66		13.11
23230	782	BPSK	3.75	1@0	23.23		11.54
				1@47	23.29		11.48
		BPSK	15	1@11	23.27		11.50
		QPSK	15	1@0	23.36		11.41
				1@11	23.24		11.53
				12@0	21.66		13.11
23278	786.8	BPSK	3.75	1@0	**23.43**		**11.34**
				1@47	23.26		11.51
		BPSK	15	1@11	23.38		11.39
		QPSK	15	1@0	23.35		11.42
				1@11	**23.41**		11.36
				12@0	21.64		13.13

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LTE NB-IoT Band 17							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
23732	704.2	BPSK	3.75	1@0	23.39	34.77	11.38
				1@47	23.31		11.46
		BPSK	15	1@11	23.42		11.35
		QPSK	15	1@0	23.35		11.42
				1@11	23.47		11.30
				12@0	21.74		13.03
23790	710	BPSK	3.75	1@0	23.35		11.42
				1@47	**23.46**		11.31
		BPSK	15	1@11	23.34		11.43
		QPSK	15	1@0	23.41		11.36
				1@11	23.22		11.55
				12@0	21.17		13.60
23848	715.8	BPSK	3.75	1@0	23.41		11.36
				1@47	23.25		11.52
		BPSK	15	1@11	23.27		11.50
		QPSK	15	1@0	23.26		11.51
				1@11	**23.55**		**11.22**
				12@0	21.73		13.04

LTE NB-IoT Band 25							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
26042	1850.2	BPSK	3.75	1@0	20.62	33.00	12.38
				1@47	20.58		12.42
		BPSK	15	1@11	**20.83**		12.17
		QPSK	15	1@0	**20.85**		**12.15**
				1@11	20.63		12.37
				12@0	18.64		14.36
26365	1882.5	BPSK	3.75	1@0	20.61		12.39
				1@47	20.76		12.24
		BPSK	15	1@11	20.60		12.40
		QPSK	15	1@0	20.64		12.36
				1@11	20.75		12.25
				12@0	18.83		14.17
26688	1914.8	BPSK	3.75	1@0	20.61		12.39
				1@47	20.65		12.35
		BPSK	15	1@11	20.77		12.23
		QPSK	15	1@0	20.80		12.20
				1@11	20.65		12.35
				12@0	19.58		13.42

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LTE NB-IoT Band 26							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
26792	824.2	BPSK	3.75	1@0	23.29	38.45	15.16
				1@47	23.16		15.29
		BPSK	15	1@11	23.35		15.10
		QPSK	15	1@0	23.21		15.24
				1@11	23.26		15.19
				12@0	21.68		16.77
26915	836.5	BPSK	3.75	1@0	23.26		15.19
				1@47	23.28		15.17
		BPSK	15	1@11	23.14		15.31
		QPSK	15	1@0	23.32		15.13
				1@11	23.21		15.24
				12@0	21.51		16.94
27038	848.8	BPSK	3.75	1@0	23.25		15.20
				1@47	23.19		15.26
		BPSK	15	1@11	**23.36**		15.09
		QPSK	15	1@0	23.31		15.14
				1@11	**23.40**		**15.05**
				12@0	21.42		17.03

LTE NB-IoT Band 26_Part90							
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Conducted Average Power (dBm)	Limit (dBm)	Allowable Gain (dBi)
26692	814.2	BPSK	3.75	1@0	23.19	50.00	26.81
				1@47	23.31		26.69
		BPSK	15	1@11	23.33		26.67
		QPSK	15	1@0	23.16		26.84
				1@11	23.32		26.68
				12@0	21.78		28.22
26740	819	BPSK	3.75	1@0	23.19		26.81
				1@47	23.34		26.66
		BPSK	15	1@11	23.14		26.86
		QPSK	15	1@0	23.18		26.82
				1@11	23.29		26.71
				12@0	21.72		28.28
26788	823.8	BPSK	3.75	1@0	**23.37**		**26.63**
				1@47	23.22		26.78
		BPSK	15	1@11	23.31		26.69
		QPSK	15	1@0	23.18		26.82
				1@11	**23.33**		26.67
				12@0	21.66		28.34

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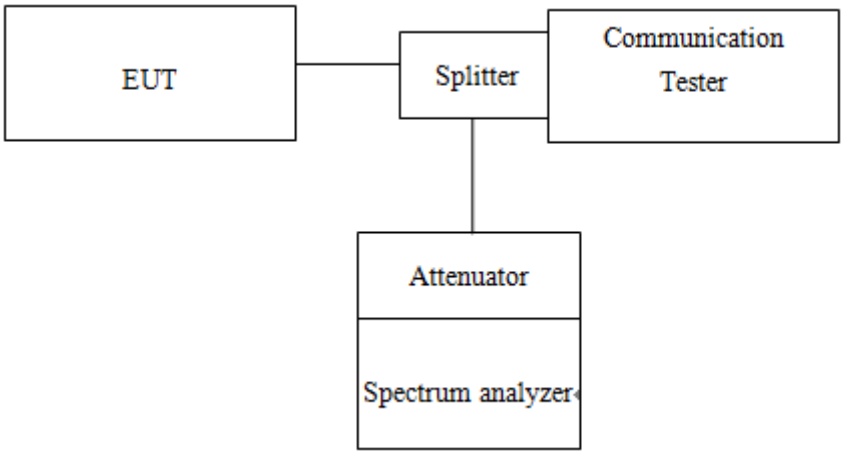
7 OCCUPIED BANDWIDTH MEASUREMENT

7.1 Standard Applicable

The occupied bandwidth 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.

7.2 Test Set-up



7.3 Measurement Procedure

99% &26dB Bandwidth with detector peak

The EUT's output RF connector was connected with a short cable to the spectrum analyzer, RBW was set to about 1% of emission BW, VBW= 3 times RBW, -26dBc display line was placed on the screen (or 26dB bandwidth), the occupied bandwidth is the delta frequency between the two points where the display line intersects the signal trace. Then set RBW to 99% bandwidth, RBW= 1%, VBW= 3 RBW, with span > 2 * Signal BW, set % Power = 99%.

99% Bandwidth with detector sample

The EUT's output RF connector was connected with a short cable to the spectrum analyzer, RBW was set to about 1% ~ 5% of emission BW, VBW= 3 times RBW, -20dBc display line was placed on the screen (or 20dB bandwidth). Set RBW to 99% bandwidth, RBW= 1% ~ 5%, VBW= 3 RBW, with span > 2 * Signal BW, set % Power = 99%.

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7.4 Measurement Equipment Used

Conducted Emission (measured at antenna port) Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	MY53140006	05/31/2019	05/30/2020
Radio Communication Analyer	Anritsu	MT8821C	6261786084	01/09/2019	01/09/2020
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/15/2019	07/14/2020
Splitter	Marvelous	MVE8586	RF265	11/20/2019	11/19/2020
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF268	11/20/2019	11/19/2020
Coaxial Cables	Woken	00100A1F1A185 C	RF220	11/20/2019	11/19/2020
Coaxial Cables	Woken	00100A1F1A185 C	RF229	11/20/2019	11/19/2020

Note: The measurement was taken place with the long duration of the time, and additional equipment list as shown blow indicate those equipment of which has been subject to undertake the calibration in intermediate period of time of the measurement.

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Radio Communication Analyer	Anritsu	MT8821C	6262044739	12/06/2019	12/05/2020

7.5 Measurement Result

7.5.1 NB IoT

LTE NB-IoT Band 2						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
18602	1850.2	BPSK	3.75	1@0	302.700	242.65
		QPSK	15	1@0	207.100	162.16
		QPSK	15	12@0	296.600	234.47
18900	1880	BPSK	3.75	1@0	318.900	242.65
		QPSK	15	1@0	199.000	156.77
		QPSK	15	12@0	303.600	230.19
19198	1909.8	BPSK	3.75	1@0	307.900	236.25
		QPSK	15	1@0	198.300	153.44
		QPSK	15	12@0	295.200	229.52

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LTE NB-IoT Band 4						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
19952	1710.2	BPSK	3.75	1@0	316.200	241.07
		QPSK	15	1@0	191.100	149.70
		QPSK	15	12@0	304.000	231.40
20175	1732.5	BPSK	3.75	1@0	320.000	239.68
		QPSK	15	1@0	194.400	149.06
		QPSK	15	12@0	288.100	232.52
20398	1754.8	BPSK	3.75	1@0	315.400	241.62
		QPSK	15	1@0	203.100	154.09
		QPSK	15	12@0	288.000	232.60

LTE NB-IoT Band 5						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
20402	824.2	BPSK	3.75	1@0	276.200	219.18
		QPSK	15	1@0	192.500	149.20
		QPSK	15	12@0	291.200	222.68
20525	836.5	BPSK	3.75	1@0	305.000	235.17
		QPSK	15	1@0	191.600	152.76
		QPSK	15	12@0	296.700	235.45
20649	848.8	BPSK	3.75	1@0	314.100	235.24
		QPSK	15	1@0	196.300	151.98
		QPSK	15	12@0	288.700	234.03

LTE NB-IoT Band 12						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
23012	699.5	BPSK	3.75	1@0	316.100	239.02
		QPSK	15	1@0	194.100	151.69
		QPSK	15	12@0	301.900	236.23
23095	707.5	BPSK	3.75	1@0	315.100	237.21
		QPSK	15	1@0	205.800	154.73
		QPSK	15	12@0	305.300	232.60
23178	715.8	BPSK	3.75	1@0	315.800	238.48
		QPSK	15	1@0	191.600	151.96
		QPSK	15	12@0	283.700	230.93

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LTE NB-IoT Band 13						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
23182	777.2	BPSK	3.75	1@0	307.200	237.54
		QPSK	15	1@0	201.200	152.83
		QPSK	15	12@0	285.600	228.39
23230	782	BPSK	3.75	1@0	310.200	236.51
		QPSK	15	1@0	199.100	154.42
		QPSK	15	12@0	292.900	231.00
23278	786.8	BPSK	3.75	1@0	307.300	238.45
		QPSK	15	1@0	198.200	147.96
		QPSK	15	12@0	285.700	226.89

LTE NB-IoT Band 17						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
23732	704.2	BPSK	3.75	1@0	297.900	236.03
		QPSK	15	1@0	193.000	146.26
		QPSK	15	12@0	288.900	229.29
23790	710	BPSK	3.75	1@0	309.800	239.08
		QPSK	15	1@0	200.100	149.98
		QPSK	15	12@0	296.900	236.20
23848	715.8	BPSK	3.75	1@0	313.000	236.35
		QPSK	15	1@0	196.500	148.59
		QPSK	15	12@0	301.600	230.39

LTE NB-IoT Band 25						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
26042	1850.2	BPSK	3.75	1@0	305.900	231.83
		QPSK	15	1@0	192.700	146.83
		QPSK	15	12@0	307.600	230.36
26365	1882.5	BPSK	3.75	1@0	310.700	238.01
		QPSK	15	1@0	204.300	152.40
		QPSK	15	12@0	285.500	232.49
26688	1914.8	BPSK	3.75	1@0	310.100	238.04
		QPSK	15	1@0	188.500	138.07
		QPSK	15	12@0	305.500	232.92

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LTE NB-IoT Band 26						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
26792	824.2	BPSK	3.75	1@0	308.400	237.22
		QPSK	15	1@0	191.600	145.69
		QPSK	15	12@0	291.600	231.08
26915	836.5	BPSK	3.75	1@0	312.300	236.46
		QPSK	15	1@0	202.400	153.28
		QPSK	15	12@0	294.200	231.25
27038	848.8	BPSK	3.75	1@0	324.200	243.02
		QPSK	15	1@0	191.100	148.16
		QPSK	15	12@0	305.800	234.67

LTE NB-IoT Band 26_Part90						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N_{tones}	Measure Result (kHz)	
					26dB BW	99% BW
26692	814.2	BPSK	3.75	1@0	308.100	237.09
		QPSK	15	1@0	193.500	151.17
		QPSK	15	12@0	299.700	230.17
26740	819	BPSK	3.75	1@0	321.900	240.14
		QPSK	15	1@0	193.900	149.57
		QPSK	15	12@0	285.200	234.08
26788	823.8	BPSK	3.75	1@0	307.900	237.02
		QPSK	15	1@0	197.600	152.40
		QPSK	15	12@0	286.800	230.40

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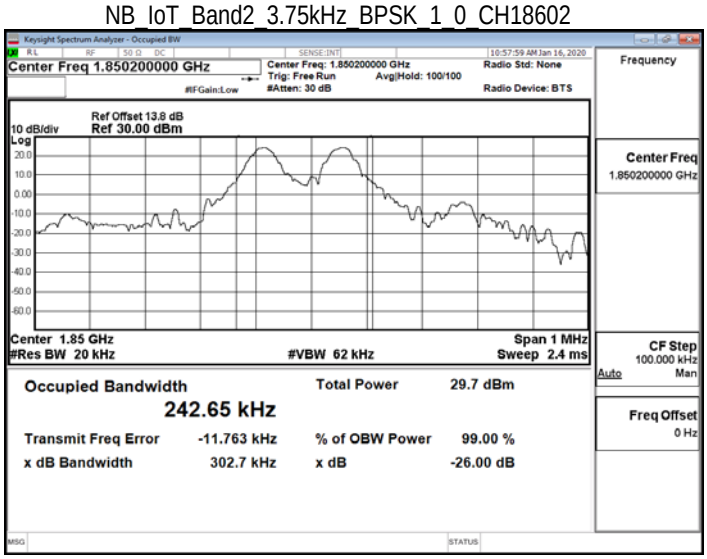
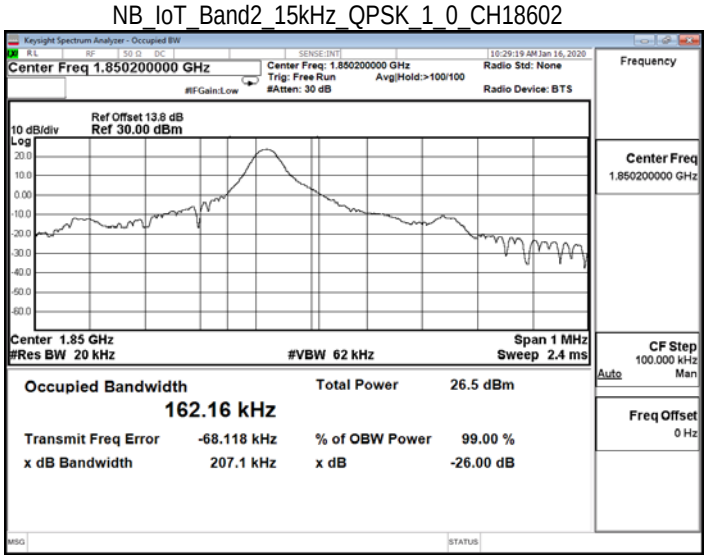
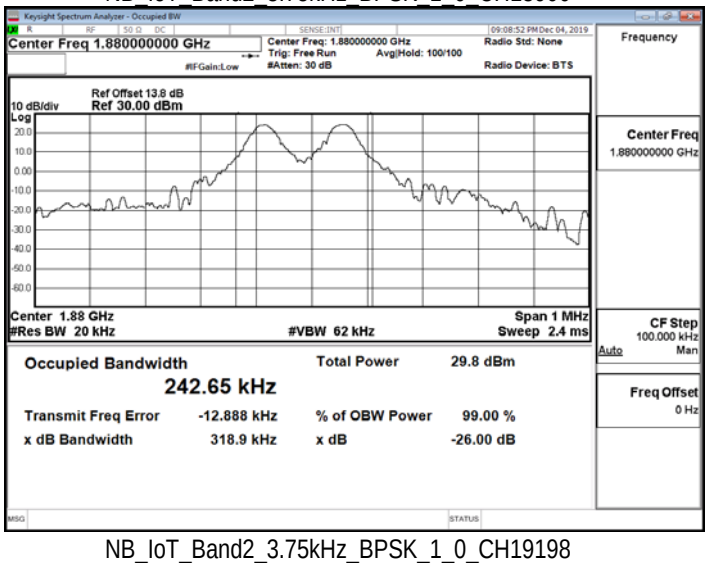
NB_IoT_Band2_3.75kHz_BPSK_1_0_CH18602



NB_IoT_Band2_15kHz_QPSK_1_0_CH18602



NB_IoT_Band2_3.75kHz_BPSK_1_0_CH18900



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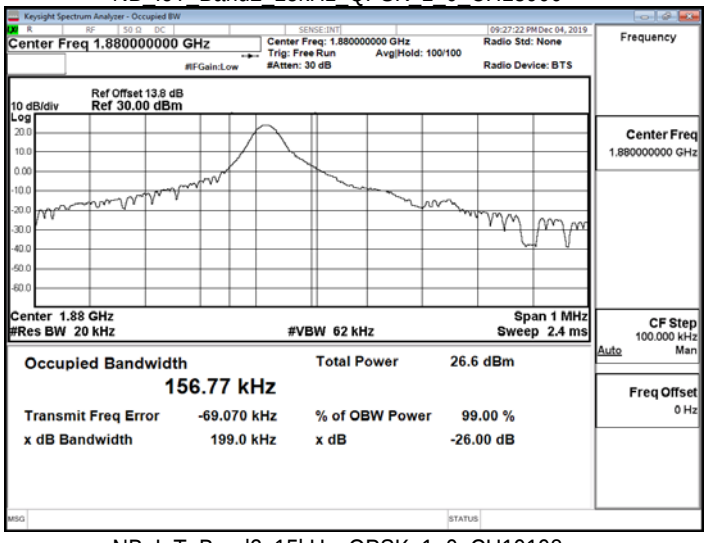

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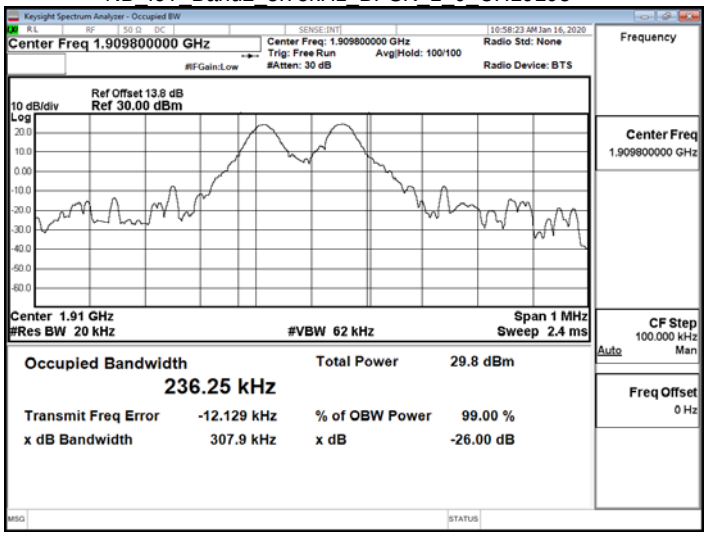

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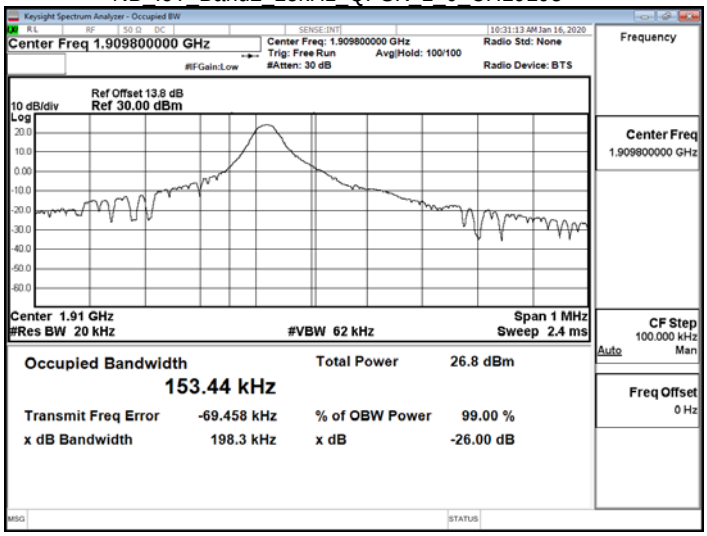

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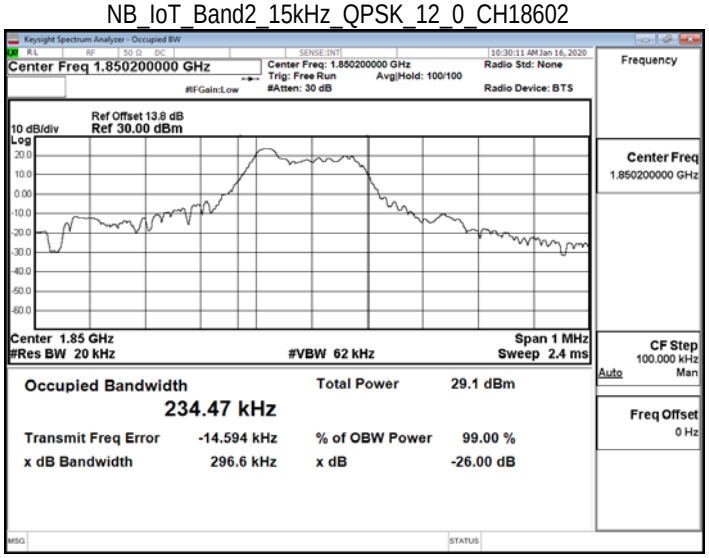
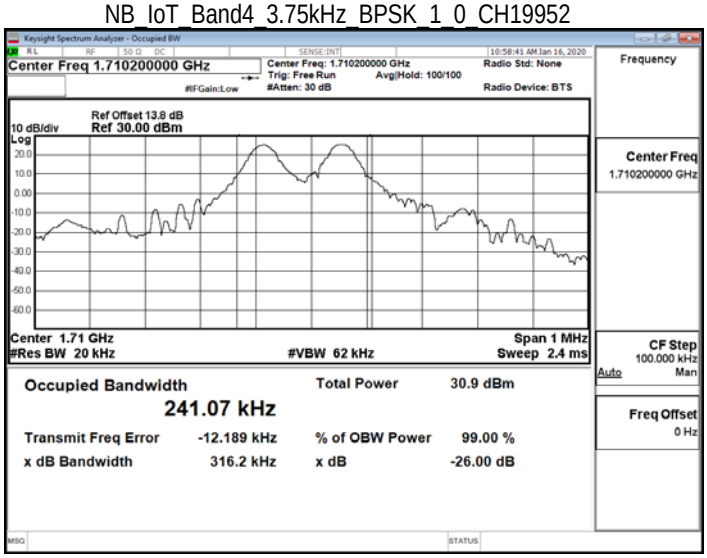
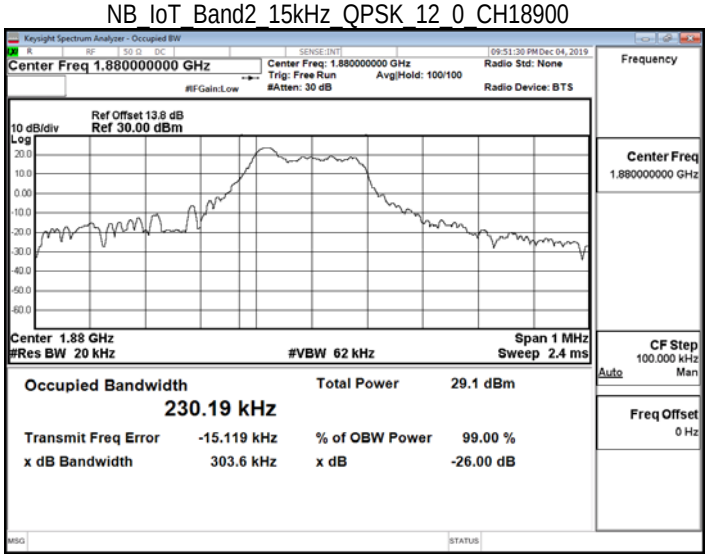
NB_IoT_Band2_15kHz_QPSK_12_0_CH18602



NB_IoT_Band4_3.75kHz_BPSK_1_0_CH19952



NB_IoT_Band2_15kHz_QPSK_12_0_CH18900



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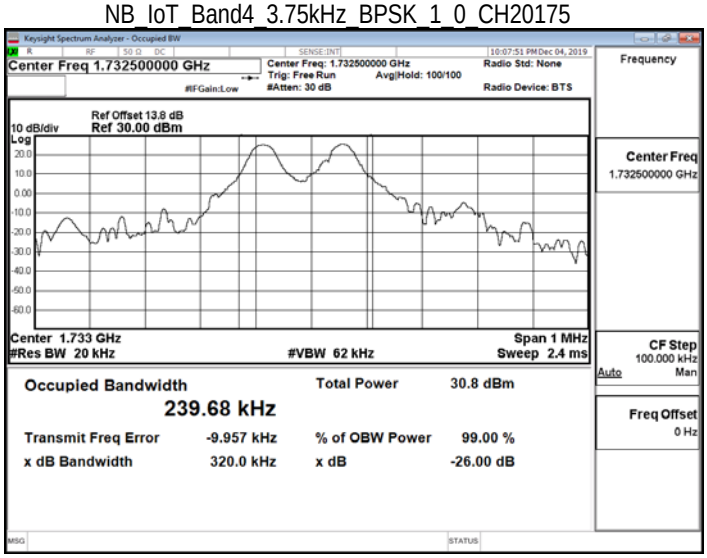

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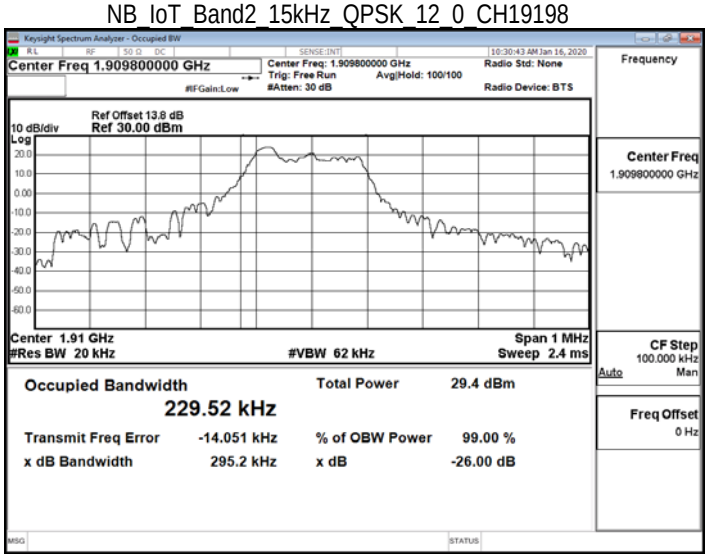

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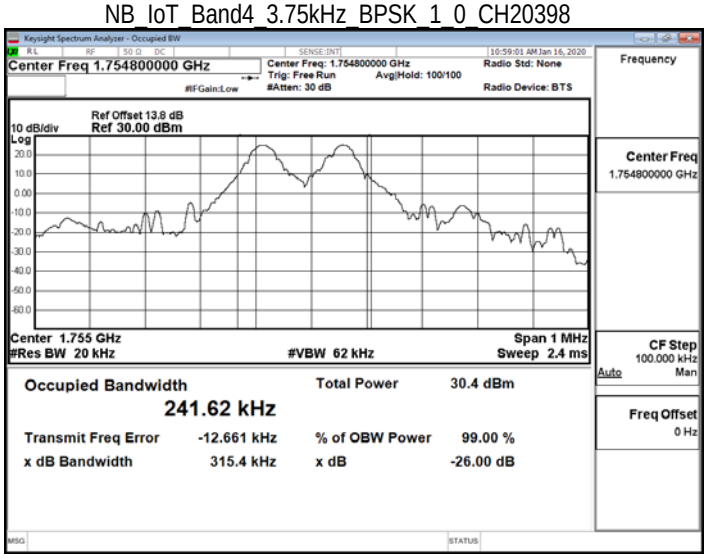

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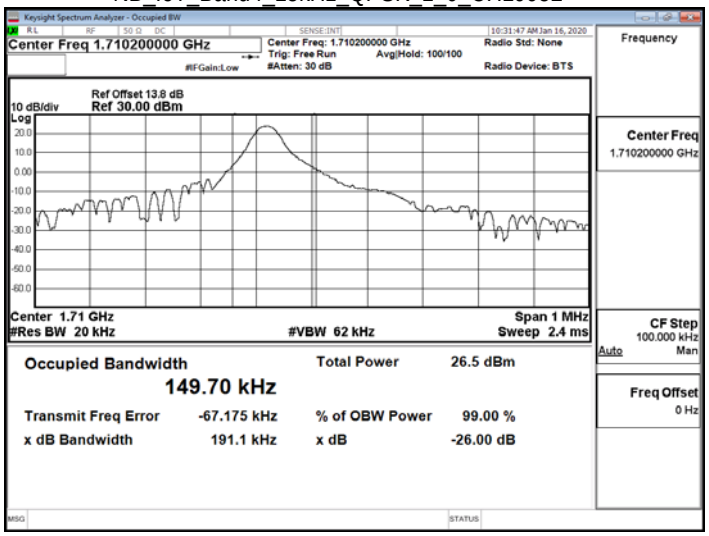
NB_IoT_Band4_15kHz_QPSK_1_0_CH19952



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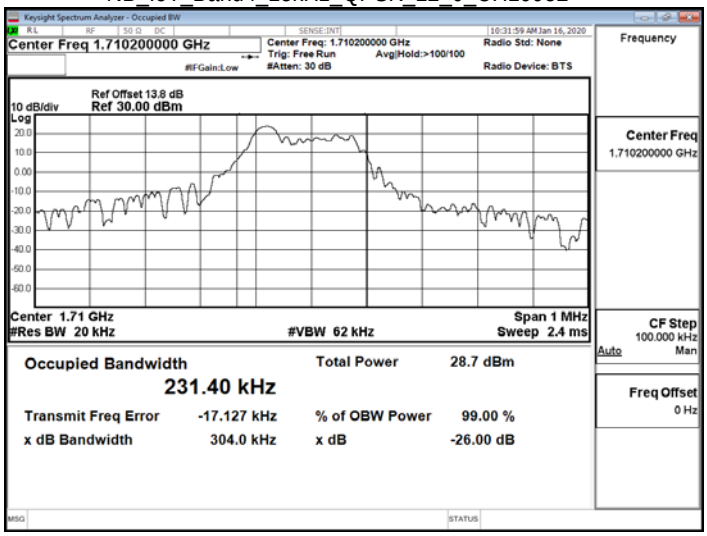

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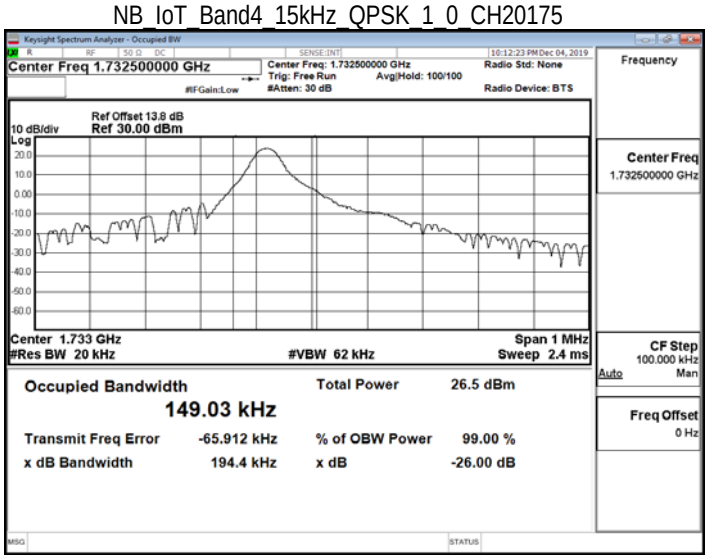

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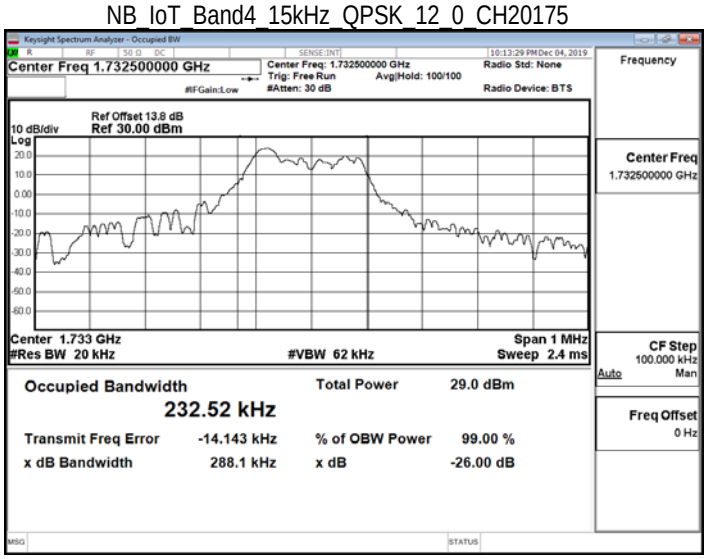

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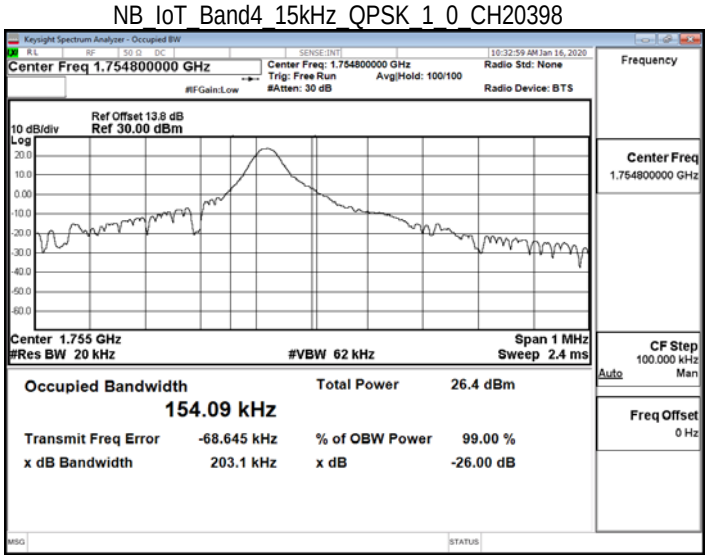
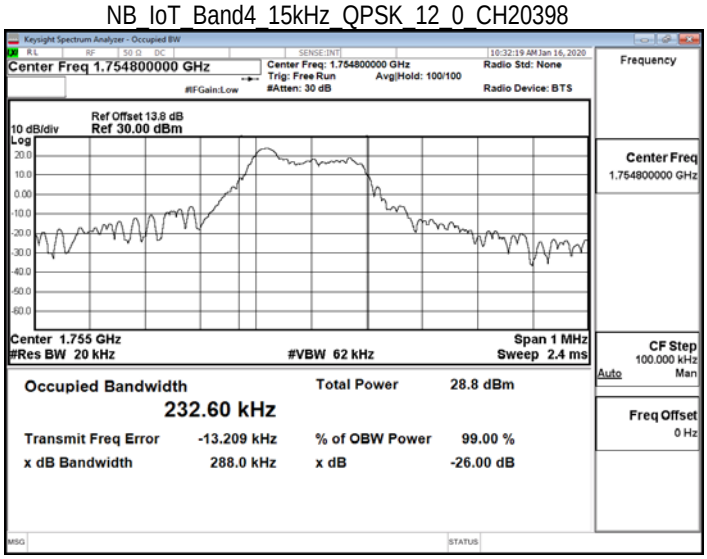


NB_IoT_Band4_15kHz_QPSK_12_0_CH20398



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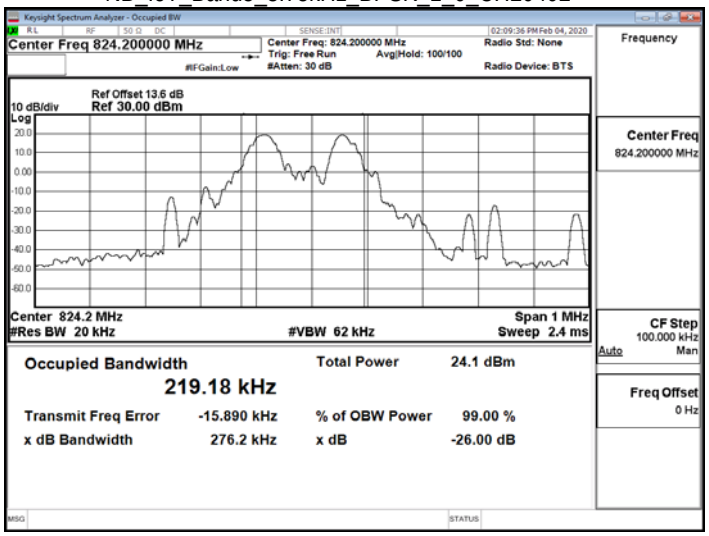
NB_IoT_Band5_3.75kHz_BPSK_1_0_CH20402



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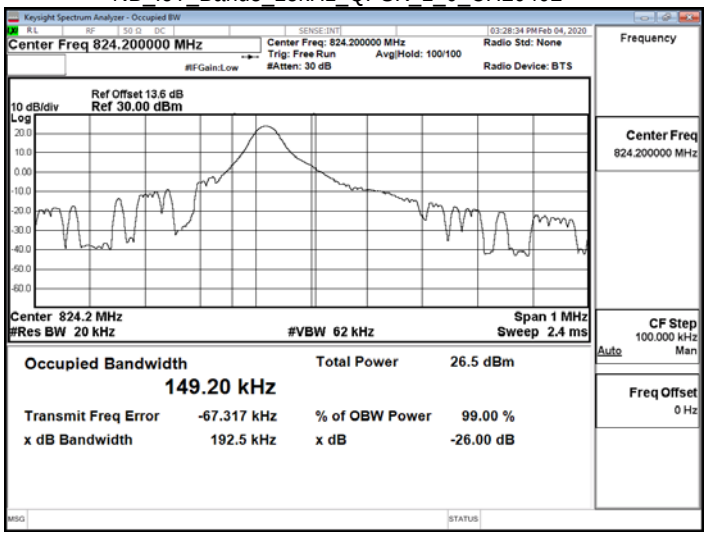

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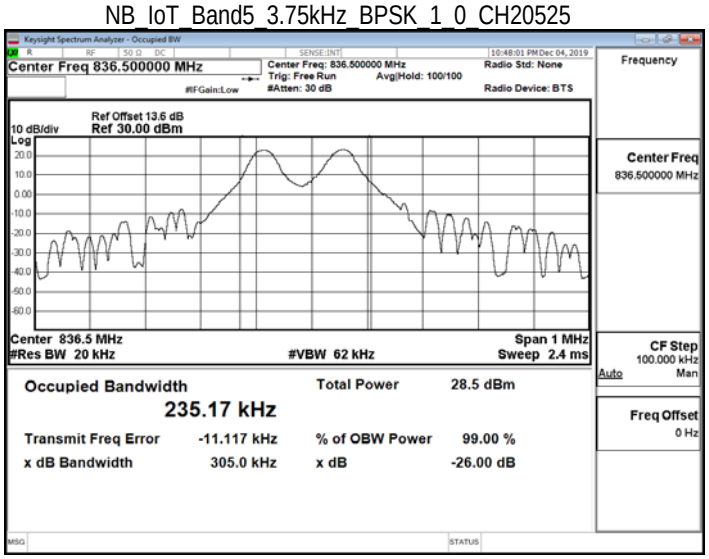

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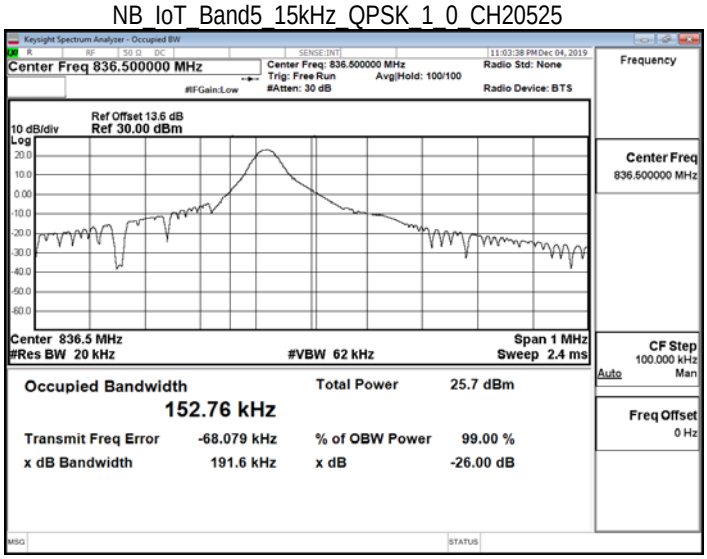
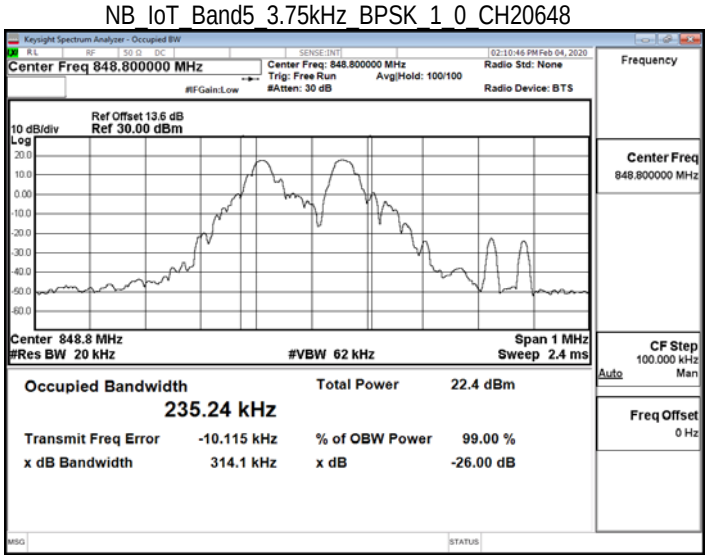


NB_IoT_Band5_3.75kHz_BPSK_1_0_CH20648



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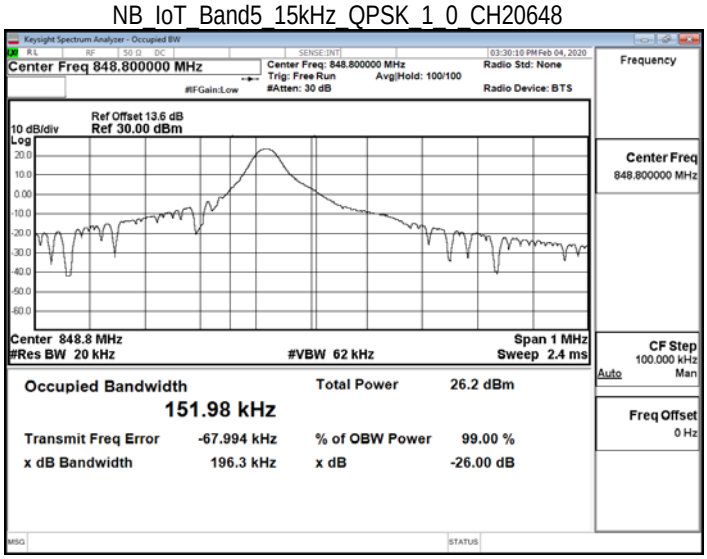

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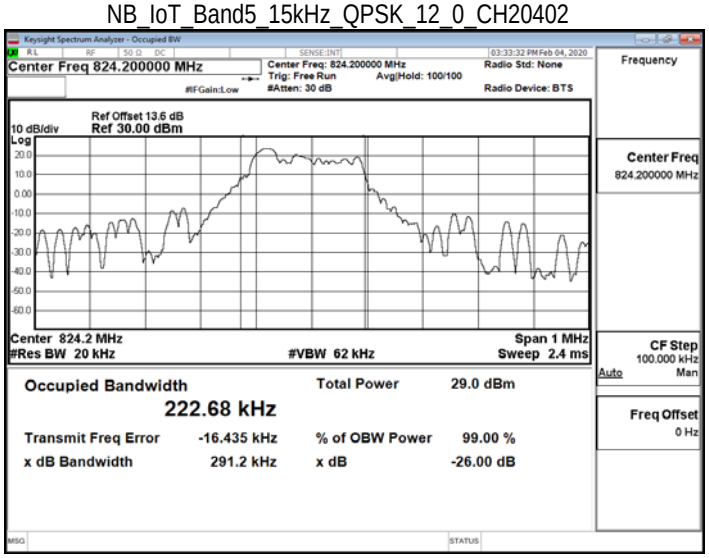
NB_IoT_Band5_15kHz_QPSK_12_0_CH20402



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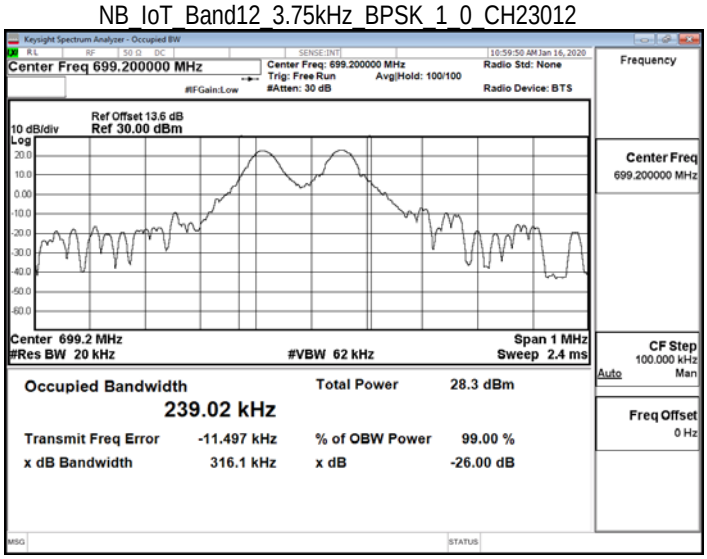

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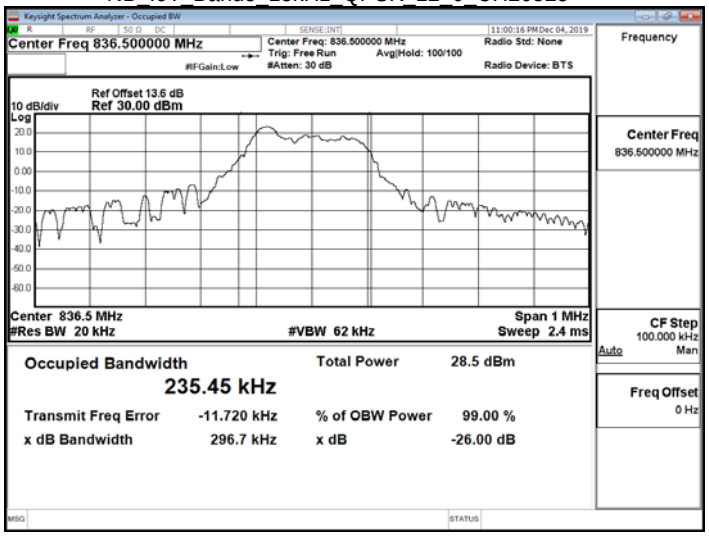

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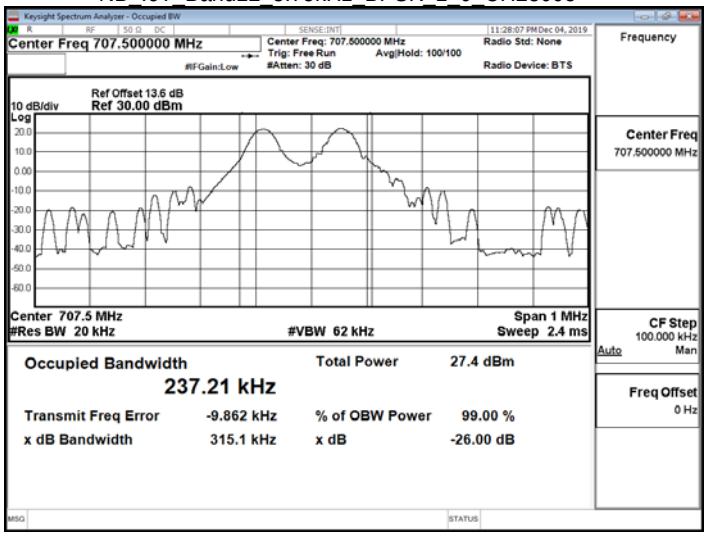
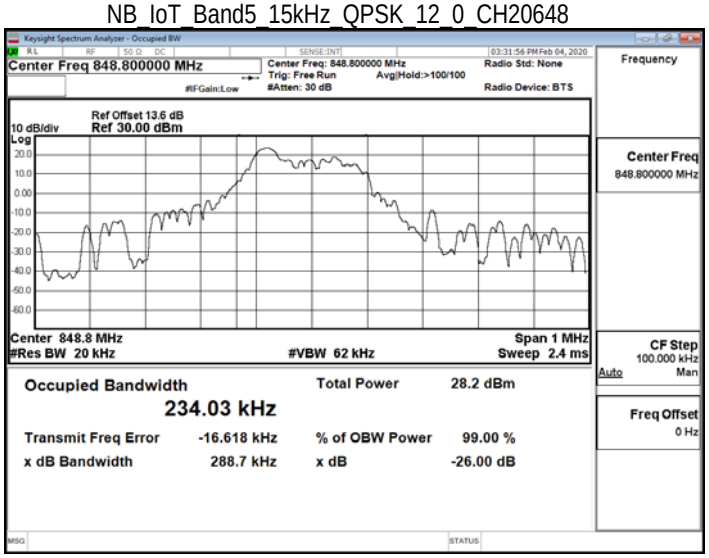


NB_IoT_Band5_15kHz_QPSK_12_0_CH20648



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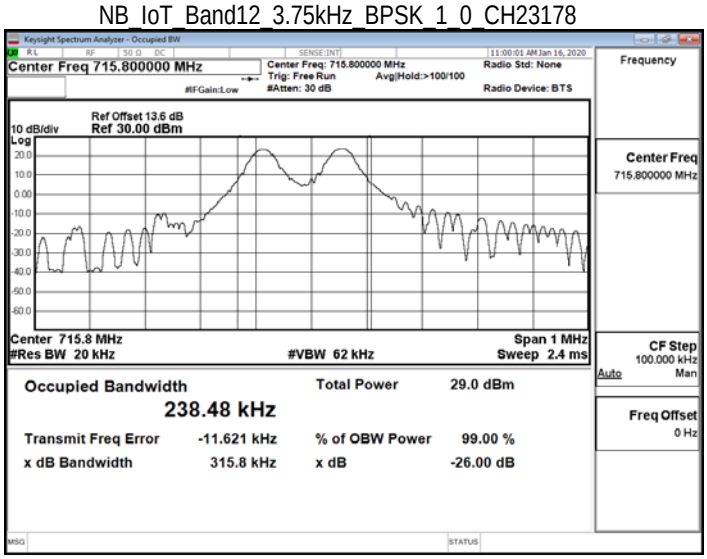

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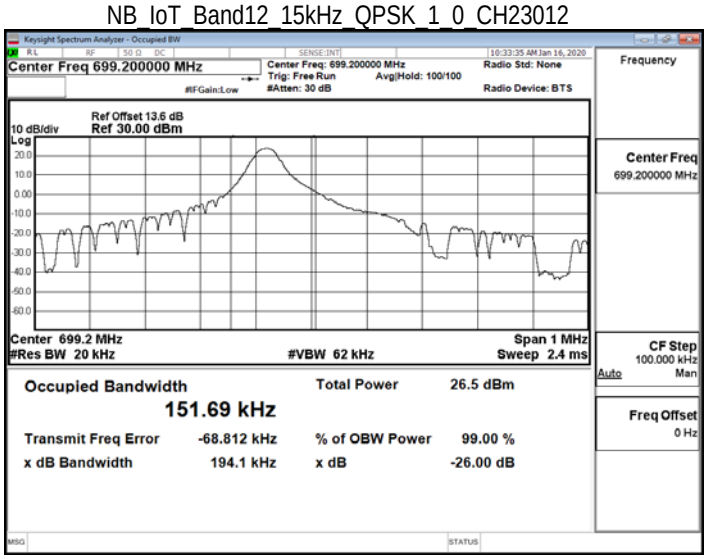
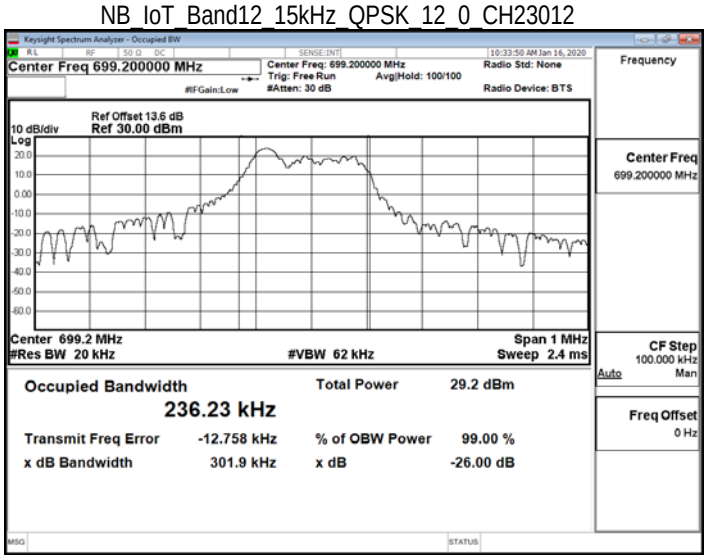
NB_IoT_Band12_15kHz_QPSK_1_0_CH23012



NB_IoT_Band12_15kHz_QPSK_12_0_CH23012



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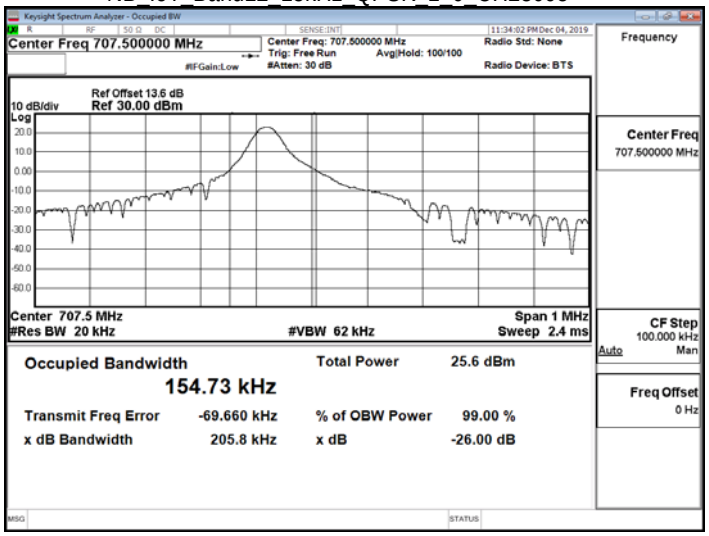

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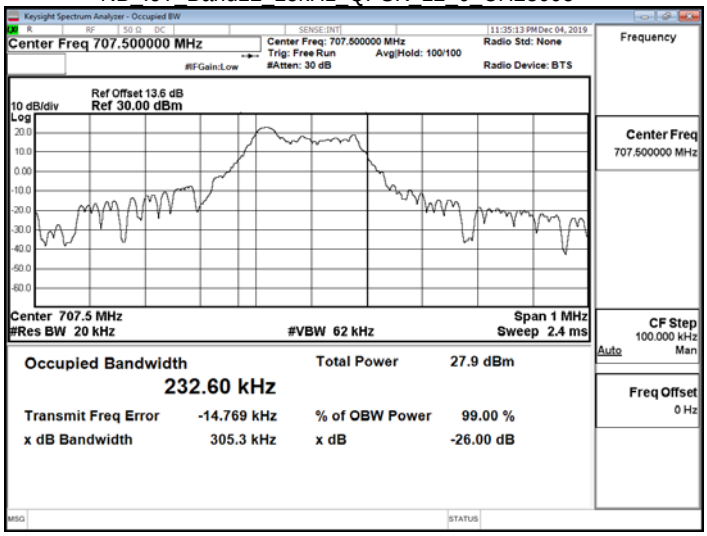

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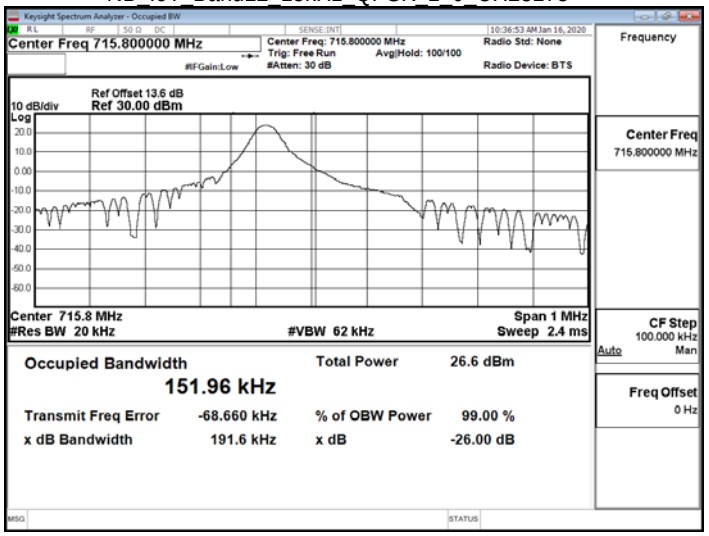

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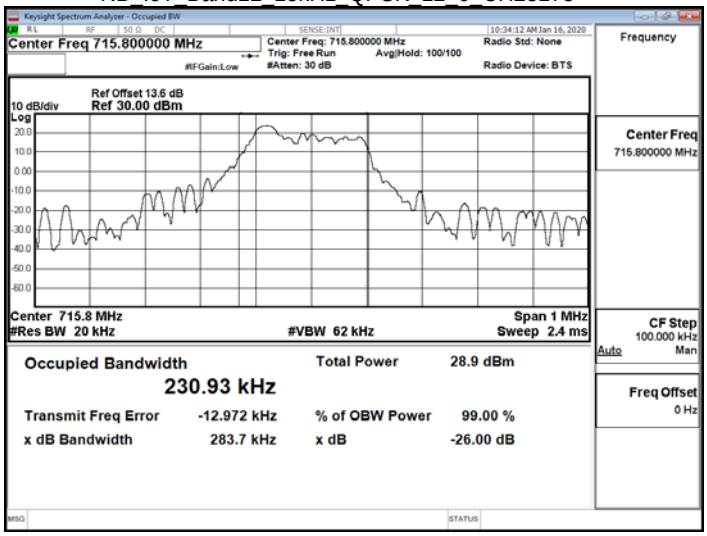

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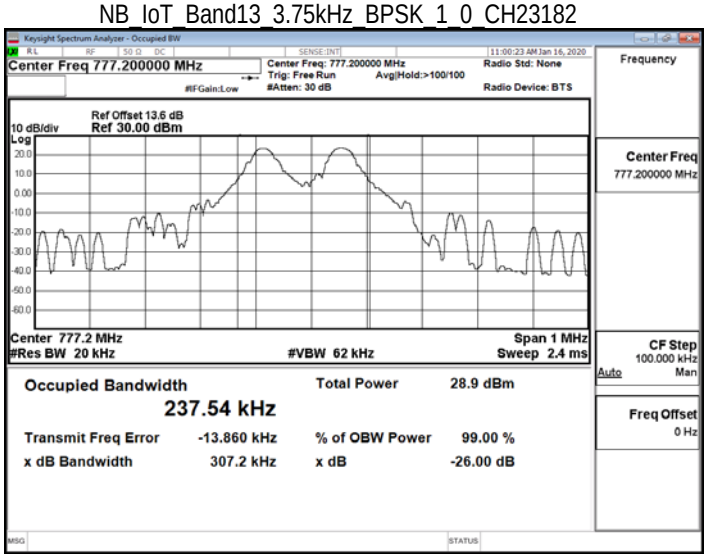
NB_IoT_Band13_3.75kHz_BPSK_1_0_CH23182



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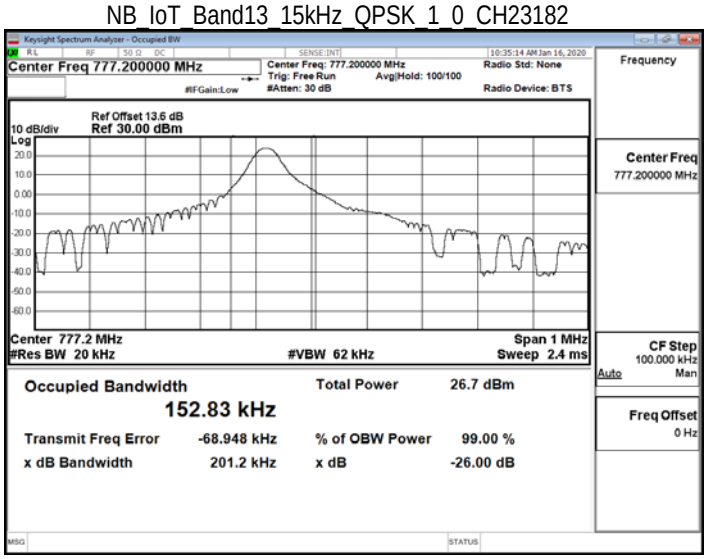

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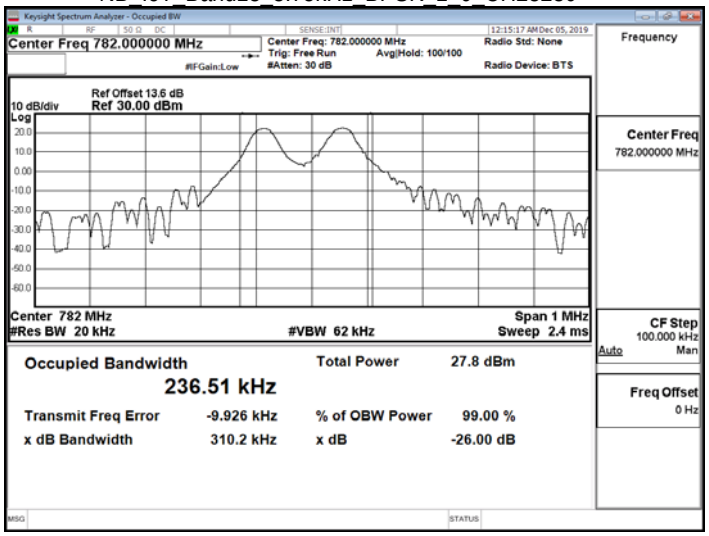

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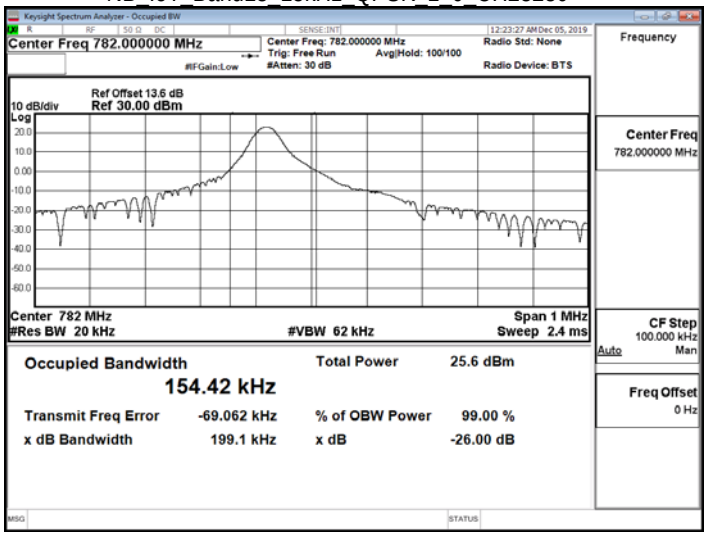

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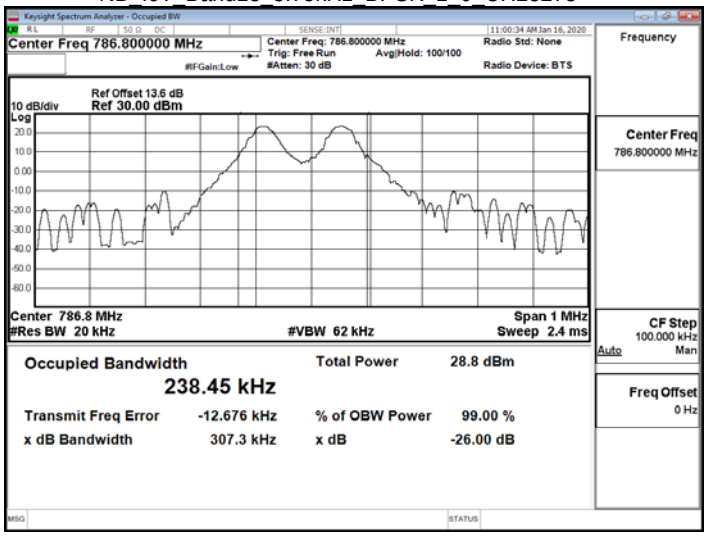

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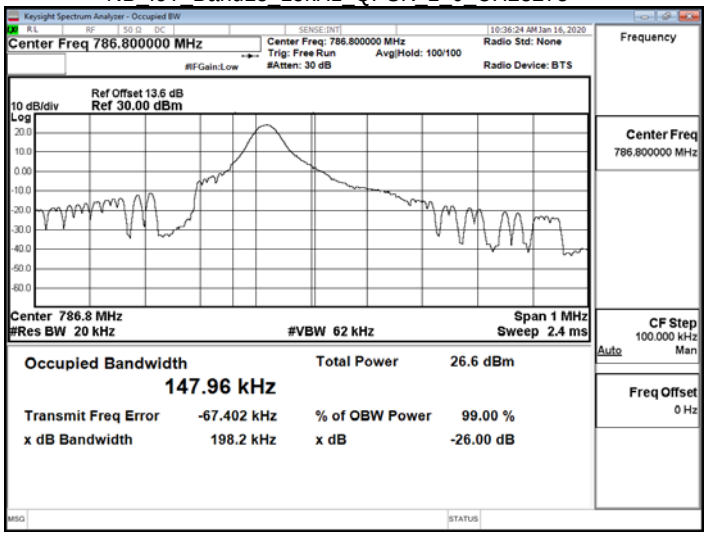

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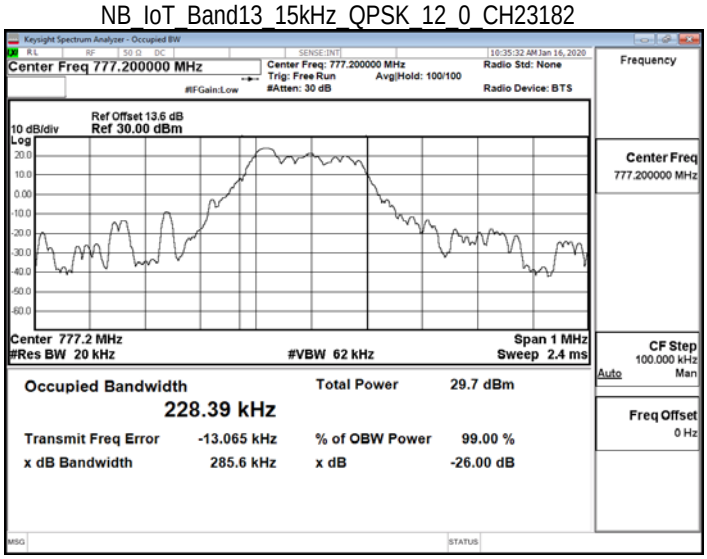
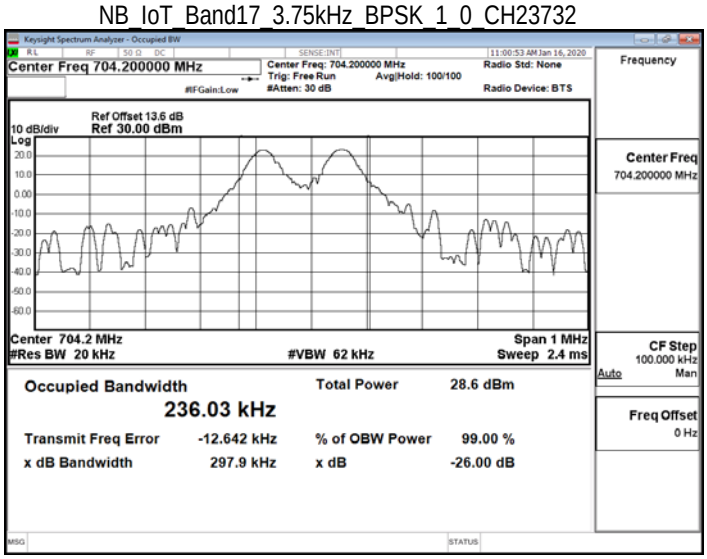
NB_IoT_Band13_15kHz_QPSK_12_0_CH23182



NB_IoT_Band17_3.75kHz_BPSK_1_0_CH23732



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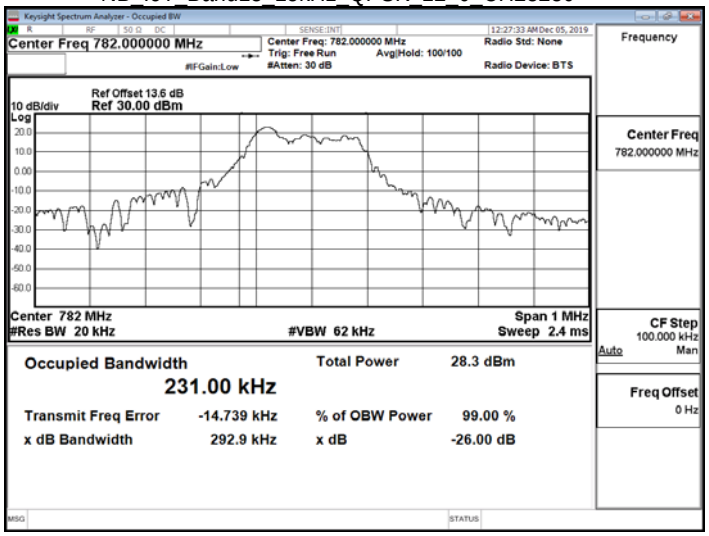

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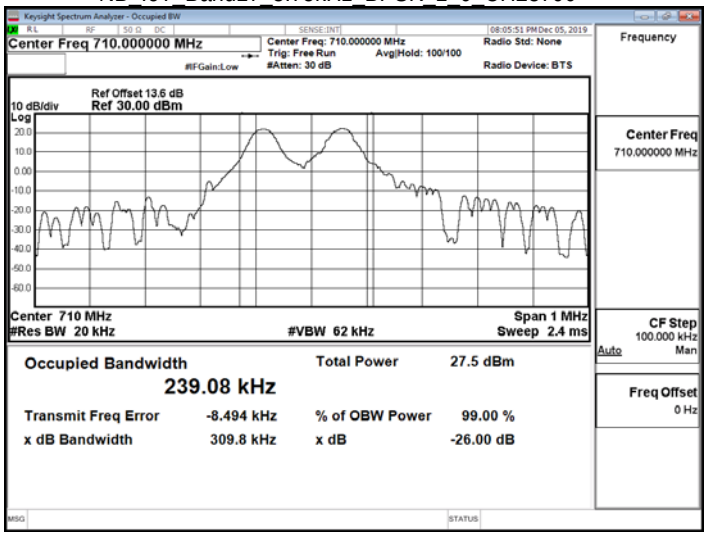

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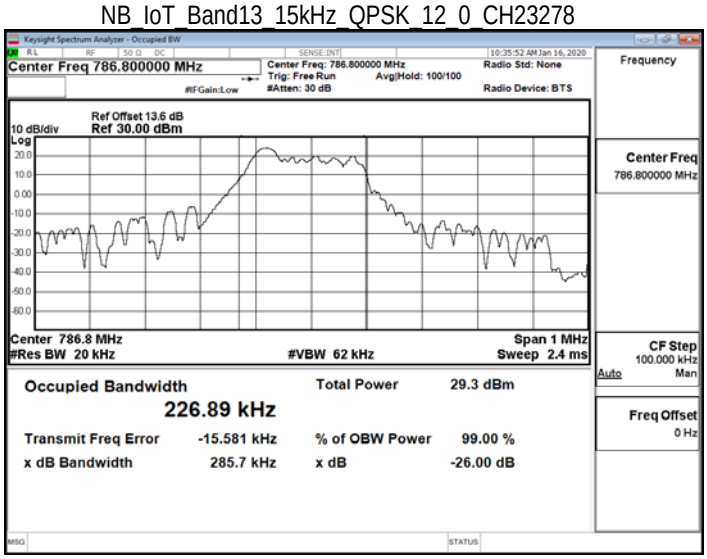
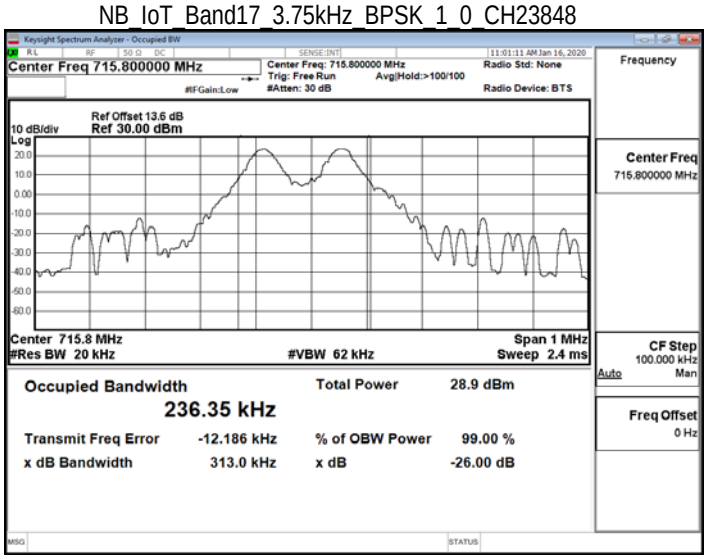


NB_IoT_Band17_3.75kHz_BPSK_1_0_CH23848



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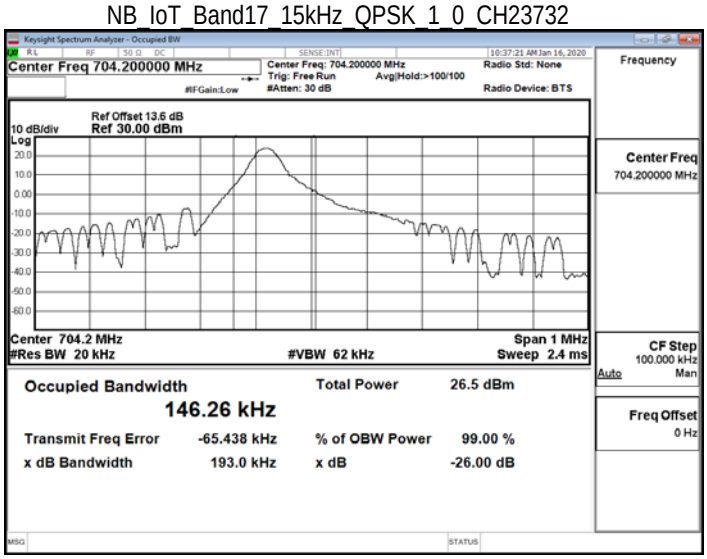
NB_IoT_Band17_15kHz_QPSK_1_0_CH23732



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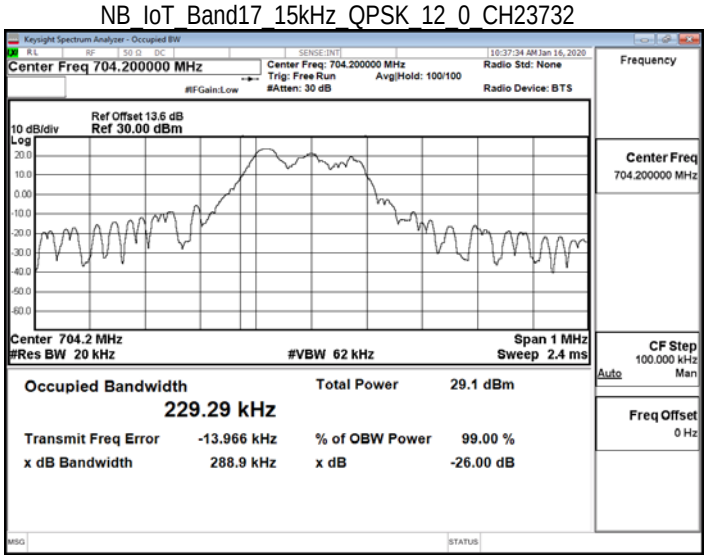

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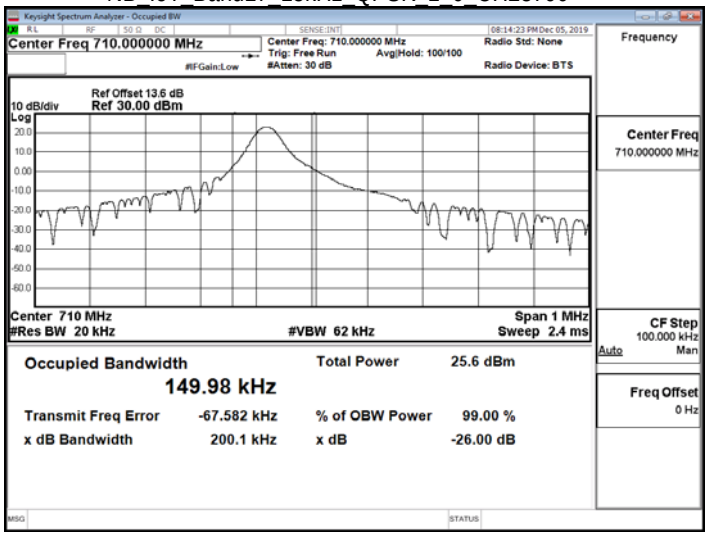

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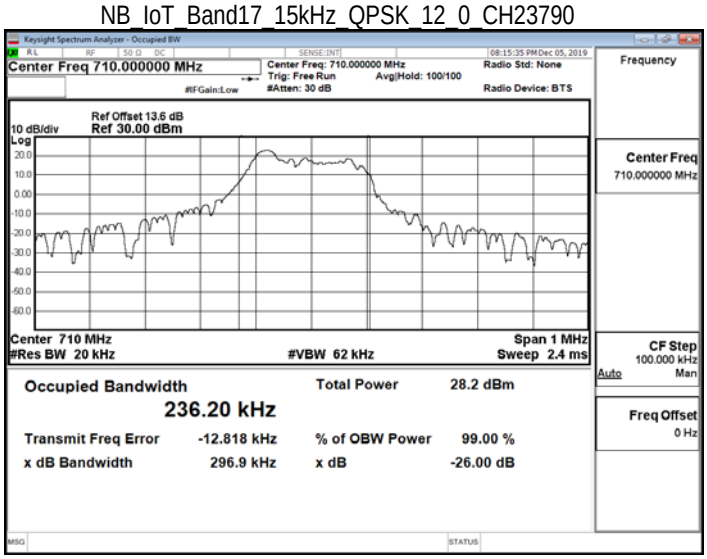

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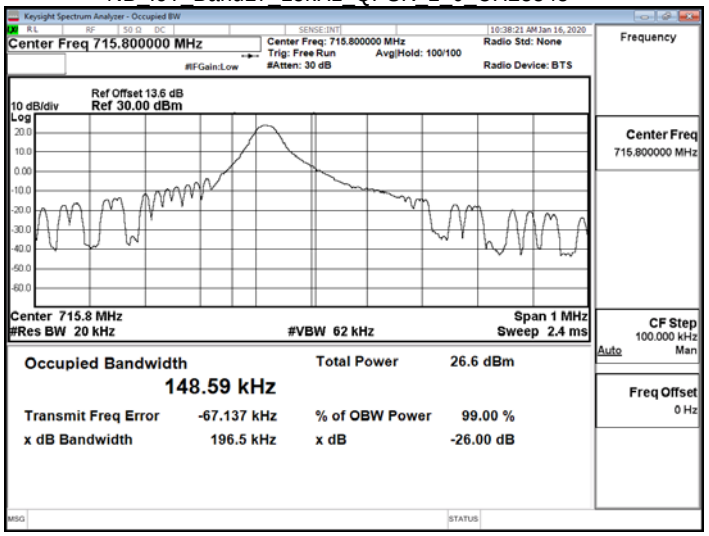

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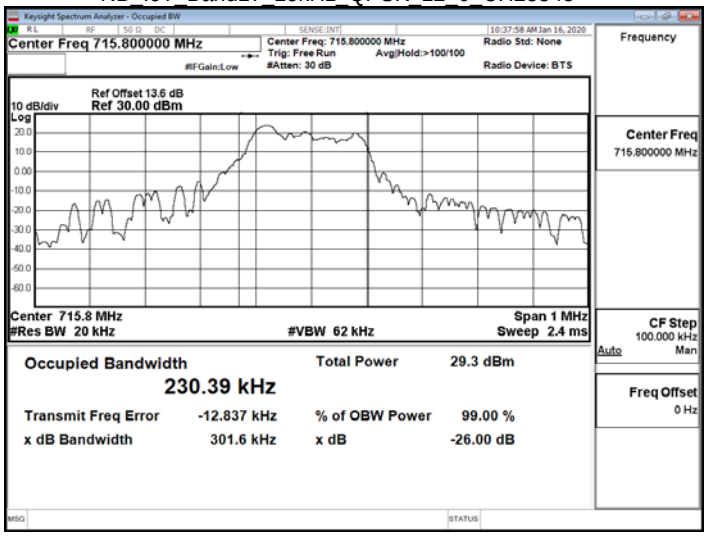

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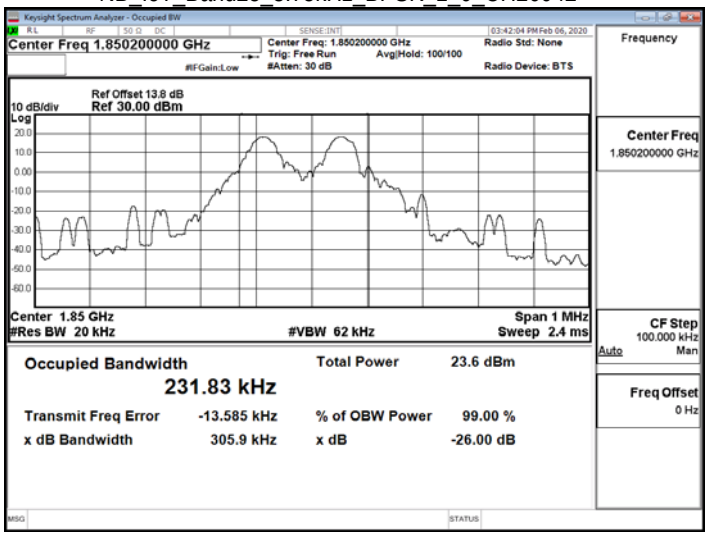
NB_IoT_Band25_3.75kHz_BPSK_1_0_CH26042



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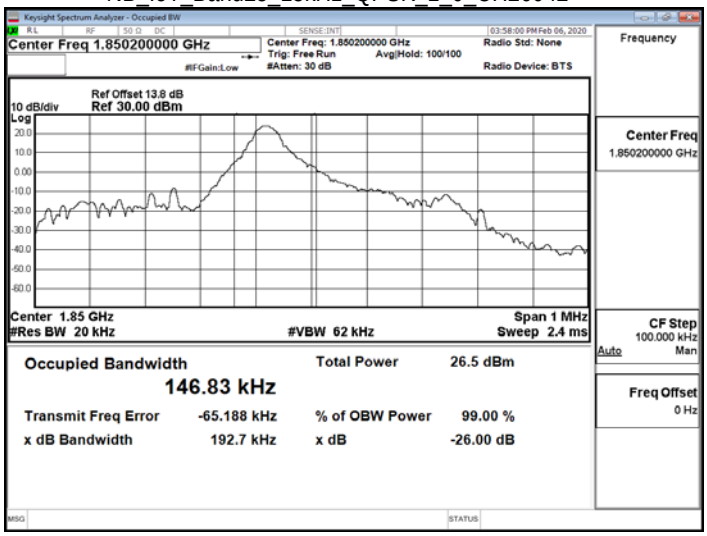
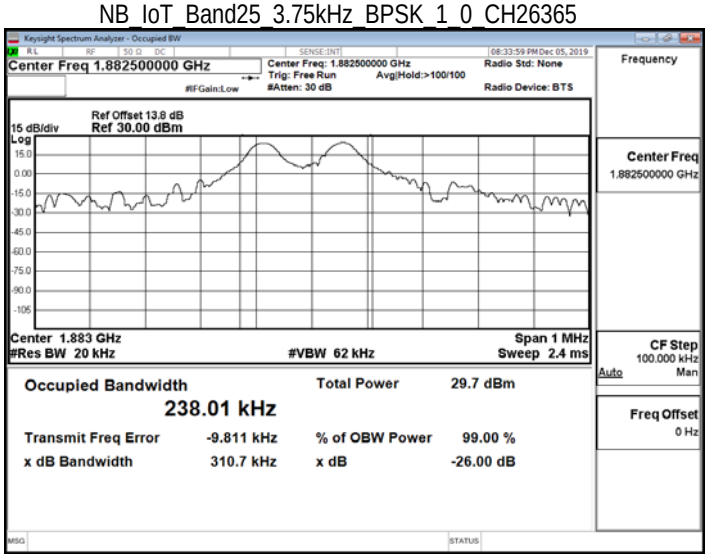


NB_IoT_Band25_3.75kHz_BPSK_1_0_CH26365



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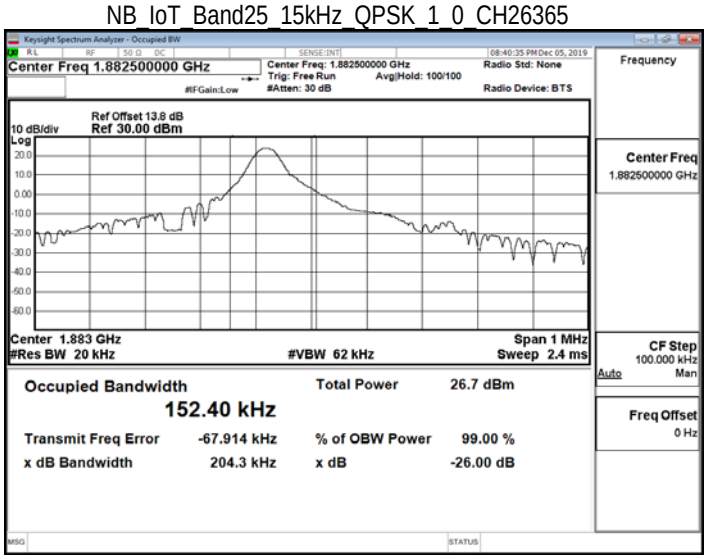
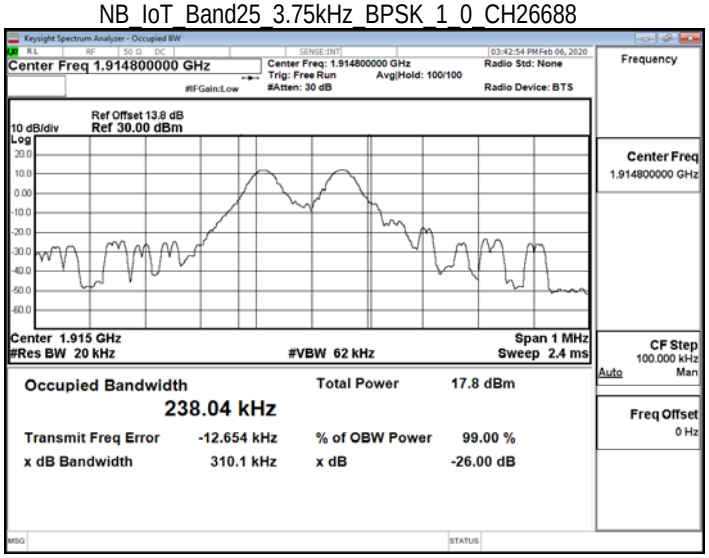


NB_IoT_Band25_3.75kHz_BPSK_1_0_CH26688



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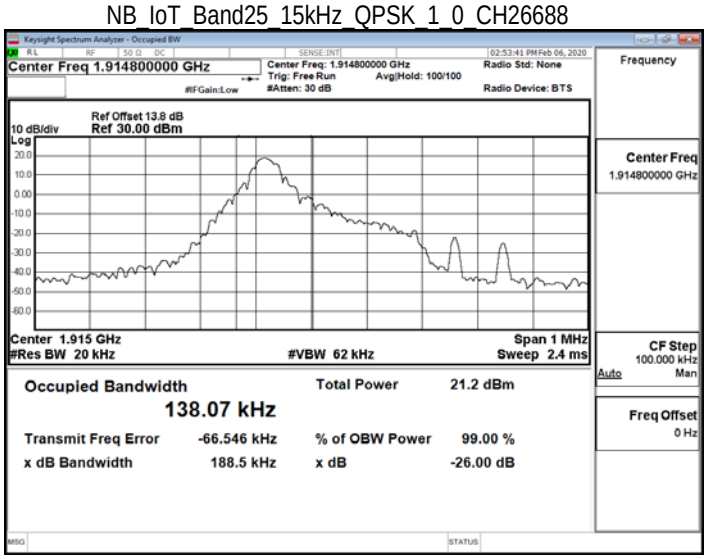

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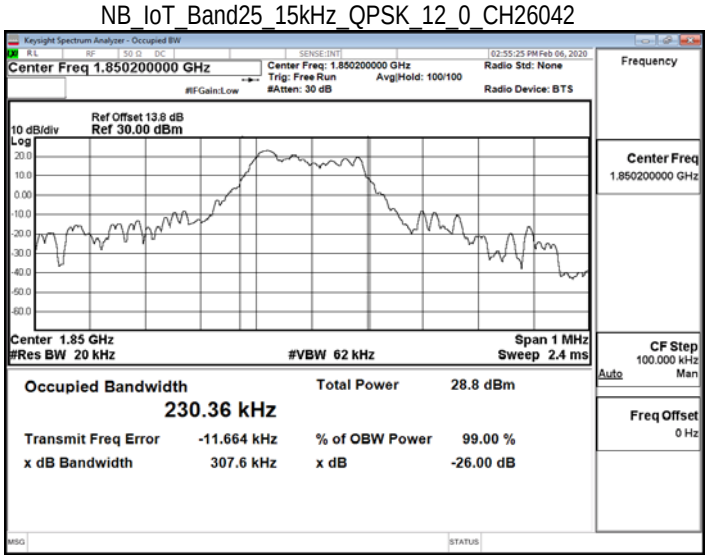
NB_IoT_Band25_15kHz_QPSK_12_0_CH26042



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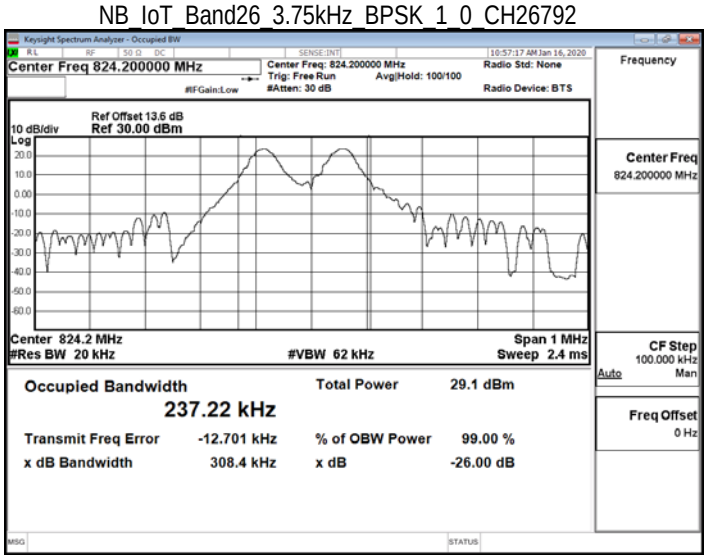
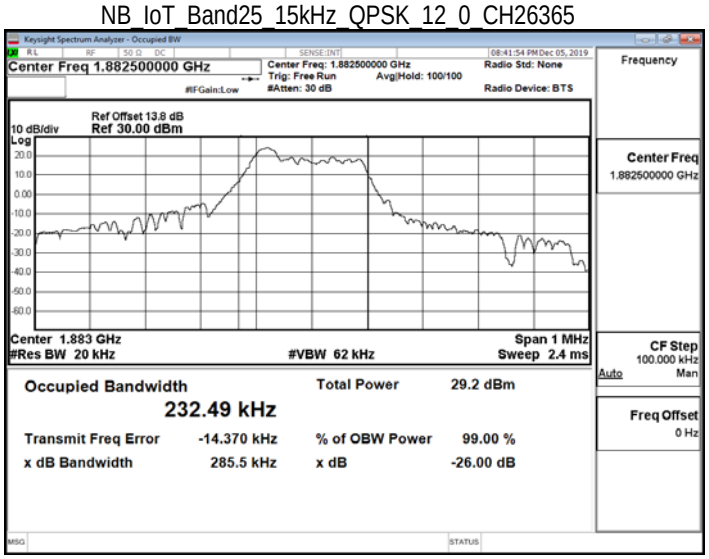


NB_IoT_Band25_15kHz_QPSK_12_0_CH26365



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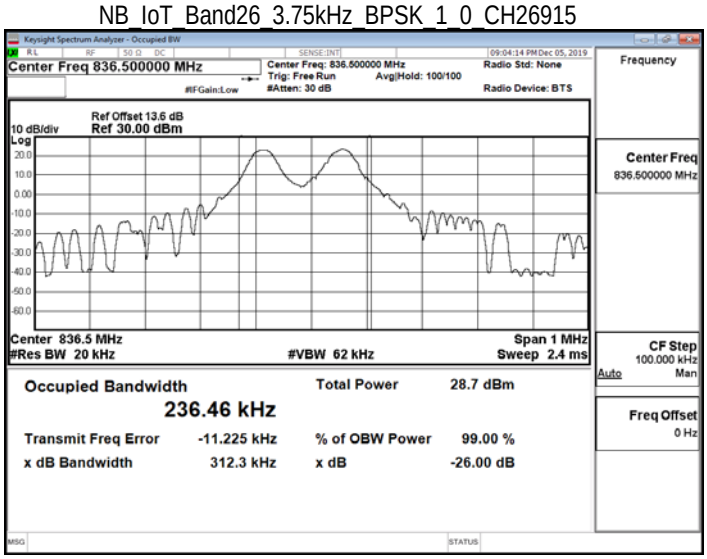
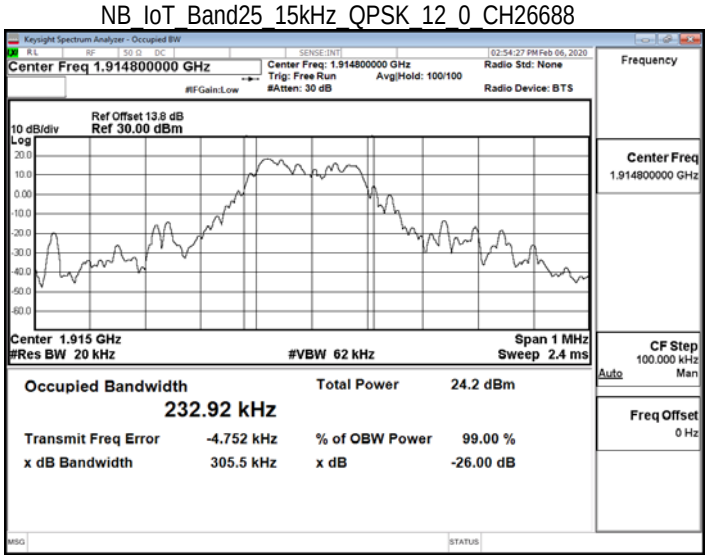


NB_IoT_Band25_15kHz_QPSK_12_0_CH26688



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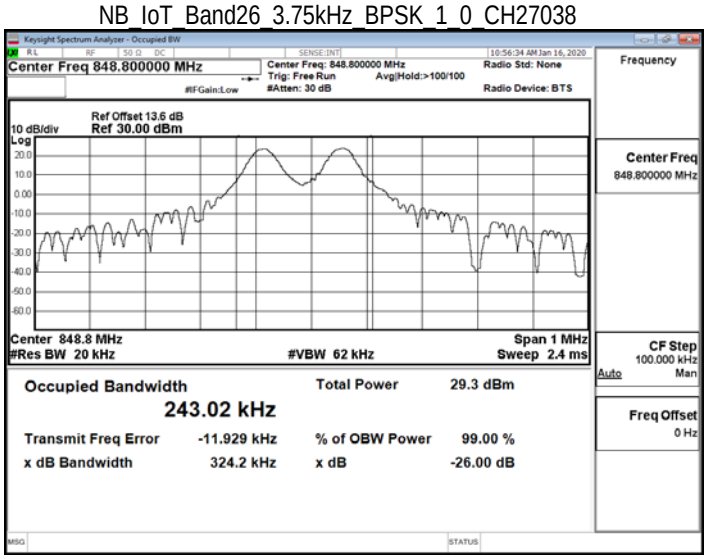

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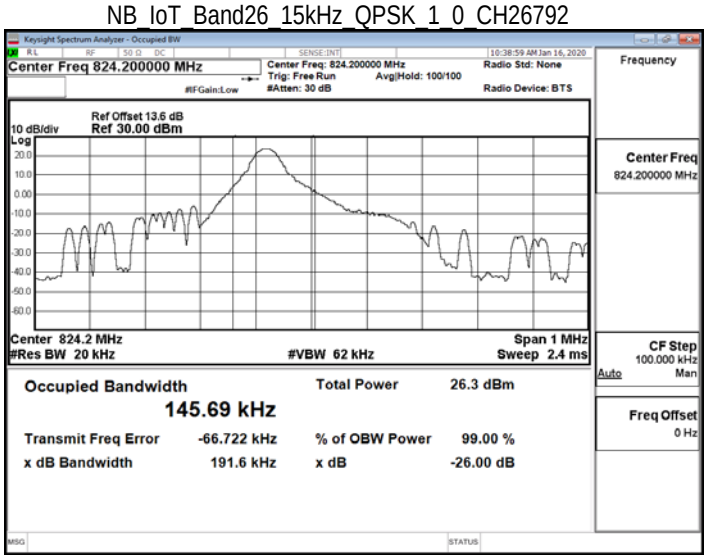
NB_IoT_Band26_15kHz_QPSK_1_0_CH26792



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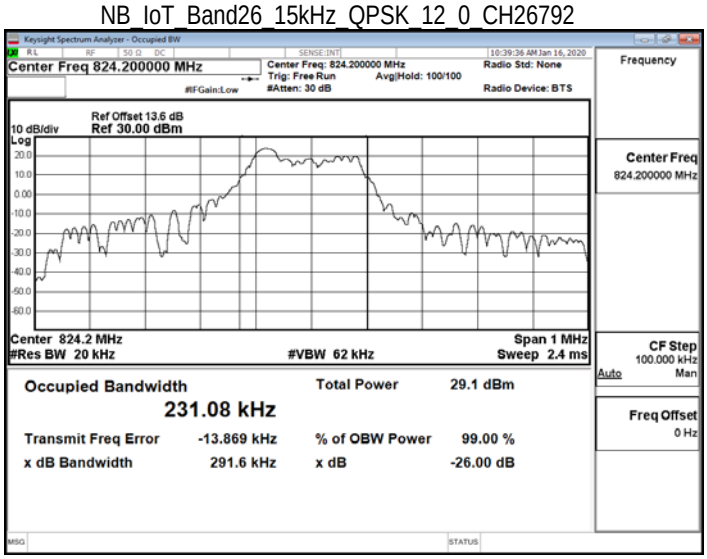

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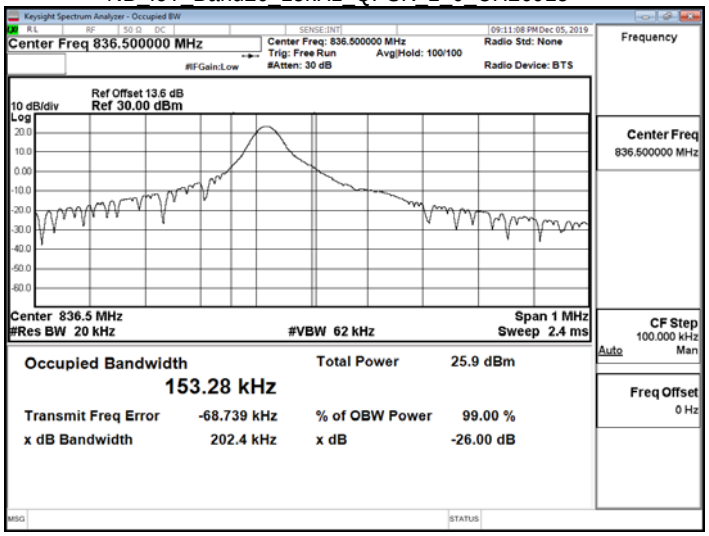

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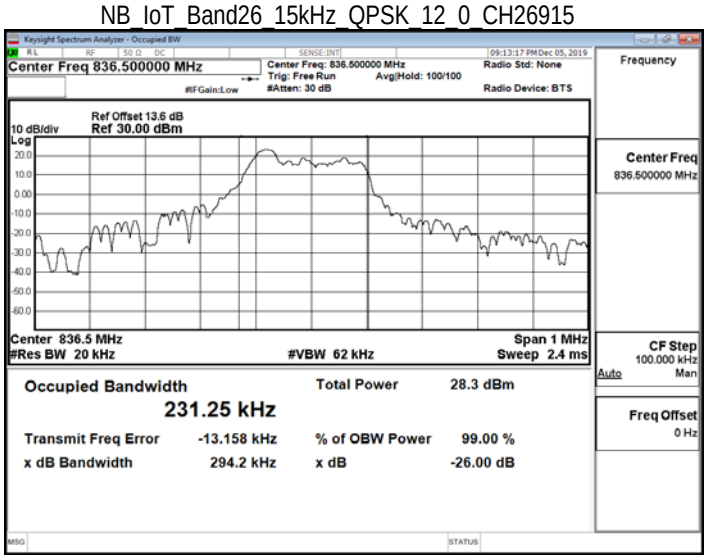

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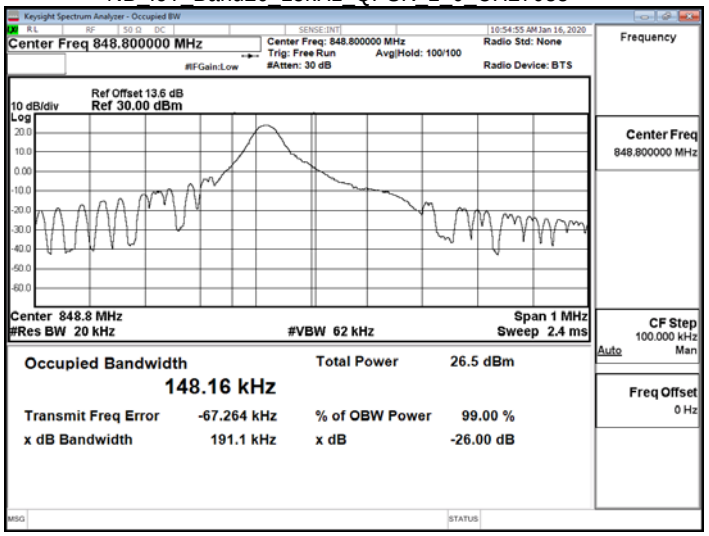

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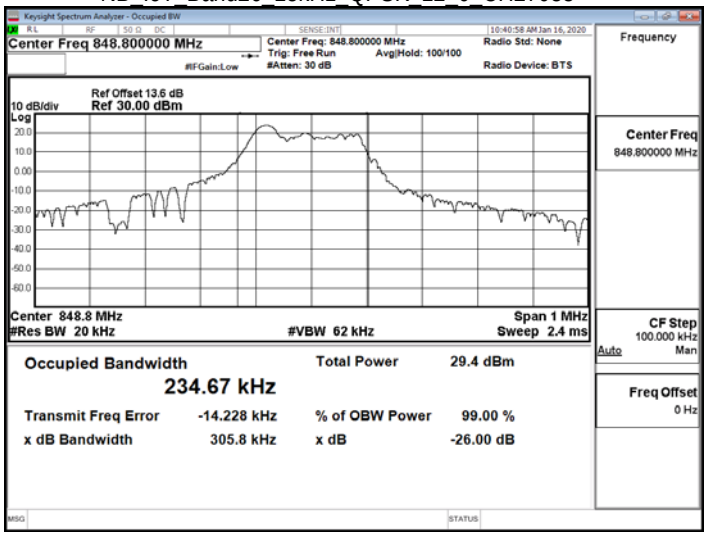

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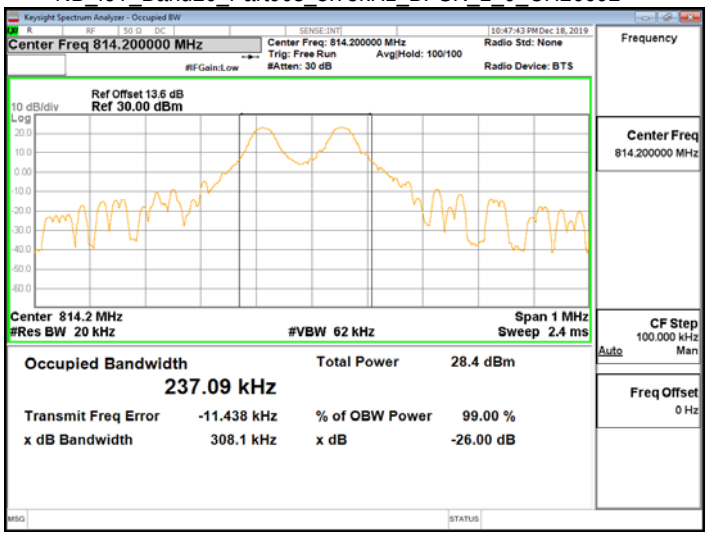
NB_IoT_Band26_Part90s_3.75kHz_BPSK_1_0_CH26692



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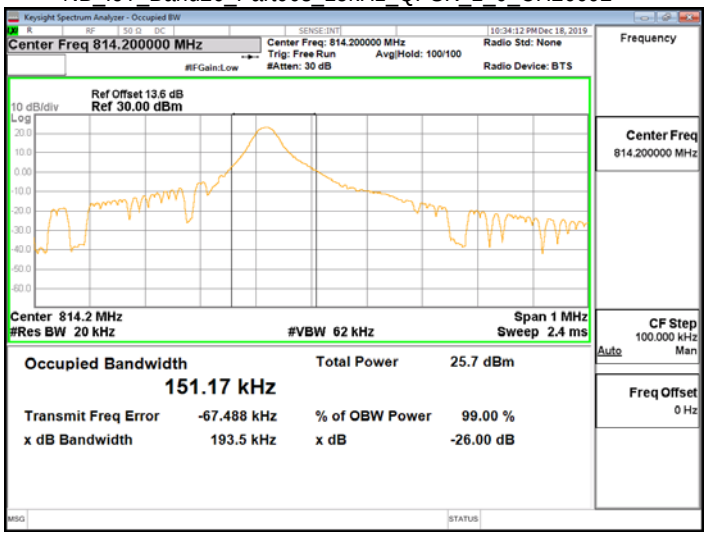
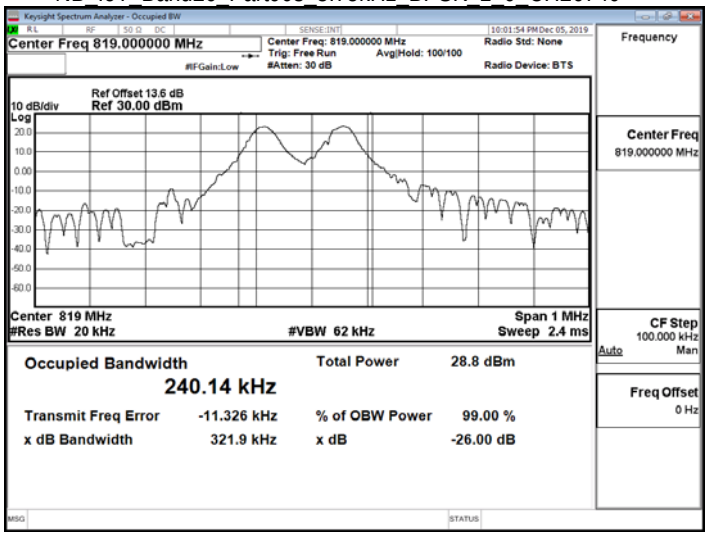


NB_IoT_Band26_Part90s_3.75kHz_BPSK_1_0_CH26740



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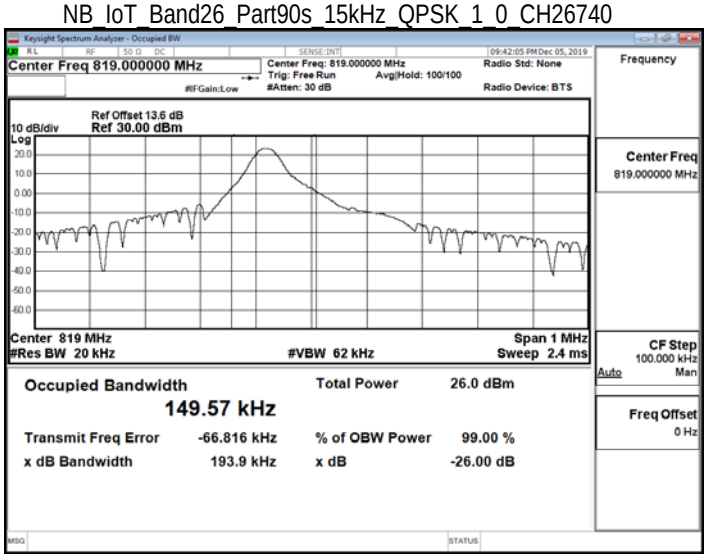

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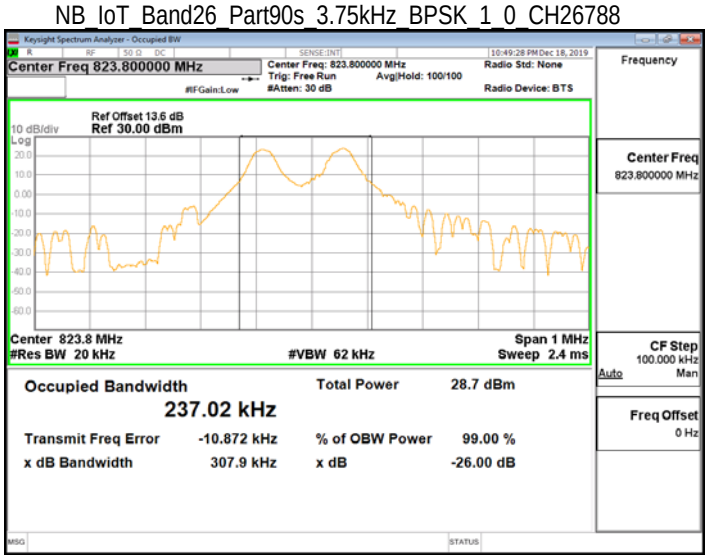

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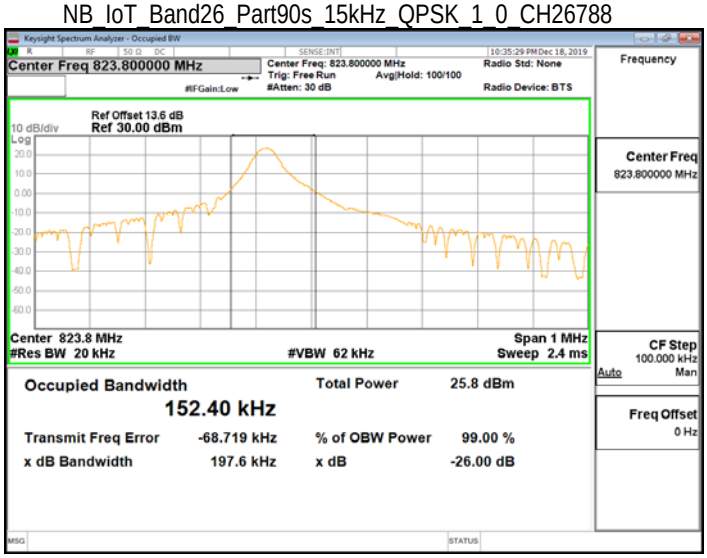

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