

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO

FCC PART 22 SUBPART H and FCC PART 24 SUBPART E and PART 27, AND

INDUSTRY CANADA RSS-132, RSS-133, RSS-139 REQUIREMENT

OF

Applicant: Murata Manufacturing Co., Ltd.
1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Product Name: Communication Module
Brand Name: muRata
Model No.: 1SS
Model Difference: N/A
FCC ID: VPYLB1SS
IC: 772C-LB1SS
Report Number: T190624W03-RP
FCC Rule Part: 2 , 22H & 24E & 27
IC Rule Part: RSS 132 Issue 3 Jan. 2013, RSS 133 Issue 6 Jan. 2018,
RSS 139 Issue 3 Jul. 2015,
Issue Date: Sep. 16, 2019
Date of Test: Jun. 24, 2019 ~ Jul. 04, 2019
Date of EUT Received: Jun. 24, 2019
Issued by: Compliance Certification Services Inc. Wugu Lab.
No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891,
Taiwan. (R.O.C.)
service@ccsrf.com

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.26: 2015 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

Tested By: Jerry Lu
Jerry Lu / Sr. Engineer

Approved By: Kevin Tsai
Kevin Tsai / Deputy Manager



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Revision History

Report Number	Revision	Description	Effectuated Page	Issue Date	Revised By
T190624W03-RP	Rev.00	Initial creation of document	All	Sep. 05, 2019	Elle Chang
T190624W03-RP	Rev.01	Updated power table at section 6.5	19~22	Sep. 11, 2019	Elle Chang
T190624W03-RP	Rev.02	Updated type of emission at section 1.3	6	Sep. 16, 2019	Elle Chang

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Contents

1 GENERAL PRODUCT INFORMATION	4
2 SYSTEM TEST CONFIGURATION	8
3 SUMMARY OF TEST RESULTS	11
4 DESCRIPTION OF TEST MODES.....	12
5 MEASUREMENT UNCERTAINTY.....	15
6 MAXMUM OUTPUT POWER.....	16
7 OCCUPIED BANDWIDTH MEASUREMENT.....	23
8 OUT OF BAND EMISSION AT ANTENNA TERMINALS	42
9 FIELD STRENGTH OF SPURIOUS RADIATION MEASUREMENT	67
10 FREQUENCY STABILITY MEASUREMENT.....	97
11 PEAK TO AVERAGE RATIO.....	103

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Member of the SGS Group (SGS SA)

1 GENERAL PRODUCT INFORMATION

1.1 Product Description

General:

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	1SS
Model Difference:	N/A
Hardware Version:	1.0
Software Version:	1.0
Power Supply:	3.3Vdc or 5Vdc from USB Port
IMEI:	356321100004845

Antenna Designation

Vendor	Type	Antenna Model No.	Modulation	Frequency (MHz)			Peak Antenna Gain (dBi)
Murata	Monopole	ANT-LTE3-2	LTE Band 2	1850	-	1910	1.8
			LTE Band 4	1710	-	1755	-0.4
			LTE Band 5	824	-	849	1.5
			LTE Band 12	699	-	716	-0.1
			LTE Band 13	777	-	787	1.1
			LTE Band 17	704	-	716	-0.1
			LTE Band 66	1710	-	1780	0.5
			LTE Band 71	663	-	698	0.5
			LTE Band 85	698	-	716	0.0

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1.2 Frequency Range

NB IoT Band	Subcarrier Spacing (kHz)	Operation Frequency (MHz)		
2	3.75	1850	-	1910
	15			
4	3.75	1710	-	1755
	15			
5	3.75	824	-	849
	15			
12	3.75	699	-	716
	15			
13	3.75	777	-	787
	15			
17	3.75	704	-	716
	15			

NB IoT Band	Subcarrier Spacing (kHz)	Operation Frequency (MHz)		
66	3.75	1710	-	1780
	15			
71	3.75	663	-	698
	15			
85	3.75	698	-	716
	15			

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

NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
2	BPSK	24.99	EIRP	0.316	312.1000	312KG7D
2	QPSK	24.90	EIRP	0.309	281.9000	282KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
4	BPSK	22.76	EIRP	0.189	288.8000	289KG7D
4	QPSK	22.63	EIRP	0.183	275.4000	275KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
5	BPSK	24.71	ERP	0.296	291.2000	291KG7D
5	QPSK	24.68	ERP	0.294	284.2000	284KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
12	BPSK	23.38	ERP	0.218	291.7000	292KG7D
12	QPSK	23.30	ERP	0.214	281.1000	281KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
13	BPSK	24.50	ERP	0.282	311.0000	311KG7D
13	QPSK	24.40	ERP	0.275	287.5000	288KG7D

NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
17	BPSK	23.37	ERP	0.217	296.6000	297KG7D
17	QPSK	23.28	ERP	0.213	287.2000	287KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
66	BPSK	23.85	EIRP	0.243	314.6000	315KG7D
66	QPSK	23.75	EIRP	0.237	279.0000	279KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
71	BPSK	24.22	ERP	0.264	278.9000	279KG7D
71	QPSK	24.14	ERP	0.259	277.0000	277KG7D
NB IoT Band	Modulation	ERP / EIRP (dBm)		(W)	99% BW (kHz)	Type of Emission
85	BPSK	23.54	ERP	0.226	297.8000	298KG7D
85	QPSK	23.50	ERP	0.224	277.6000	278KG7D

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1.4 Test Methodology of Applied Standards

FCC 47 CFR Part 2, 22, 24, 27.

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.

RSS Gen Issue 5 Apr. 2018 , RSS-132 Issue 3 Jan. 2013,

RSS-133 Issue 6 Jan. 2018 , RSS-139 Issue 3 Jul. 2015,

Note: All test items have been performed and record as per the above standards.

1.5 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,

Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)

FCC Registration Numbers are: TW1309

Canada Registration Number: 2324G

1.6 Special Accessories

No special accessories were used during testing.

1.7 Equipment Modifications

There were no modifications incorporated into the EUT.

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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

According to measurement procured ANSI C63.26-2015, the EUT is placed on a turn 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)

According to measurement procured ANSI C63.26-2015, 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.

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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)	4	10	14
High Band (Above 1 GHz)	4	10	14

2.5 Final Amplifier Voltage and Current Information:

LTE Band 2

Test mode	DC voltage (V)	DC current (mA)
LTE Band 2_3.75K	5	257.000
LTE Band 2_15K	5	298.000

LTE Band 4

Test mode	DC voltage (V)	DC current (mA)
LTE Band 4_3.75K	5	265.000
LTE Band 4_15K	5	280.000

LTE Band 5

Test mode	DC voltage (V)	DC current (mA)
LTE Band 5_3.75K	5	273.000
LTE Band 5_15K	5	274.000

LTE Band 12

Test mode	DC voltage (V)	DC current (mA)
LTE Band 12_3.75K	5	285.000
LTE Band 12_15K	5	250.000

LTE Band 13

Test mode	DC voltage (V)	DC current (mA)
LTE Band 13_3.75K	5	262.000
LTE Band 13_15K	5	268.000

LTE Band 17

Test mode	DC voltage (V)	DC current (mA)
LTE Band 17_3.75K	5	288.000

LTE Band 66

Test mode	DC voltage (V)	DC current (mA)
LTE Band 66_3.75K	5	285.000
LTE Band 66_15K	5	296.000

LTE Band 71

Test mode	DC voltage (V)	DC current (mA)
LTE Band 71_3.75K	5	265.000
LTE Band 71_15K	5	289.000

LTE Band 85

Test mode	DC voltage (V)	DC current (mA)
LTE Band 71_3.75K	5	266.000
LTE Band 71_15K	5	262.000

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2.6 Configuration of Tested System

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

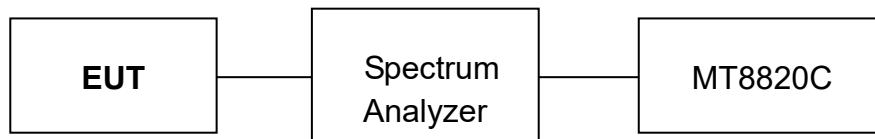


Fig. 2-2 Configuration of Tested System (Fixed Channel-Radiated)

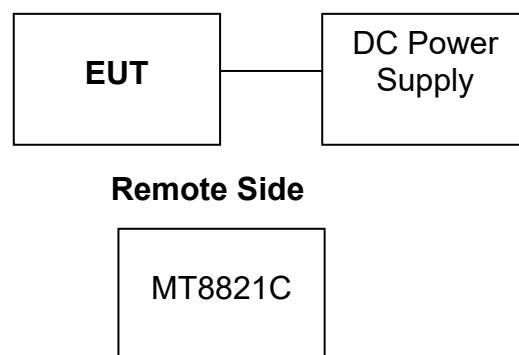


Table 2-1 Equipment Used in

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	Radio Communication Analyer	Anritsu	MT8821C	6261786084	shielded	Un-shielded
2.	DC Power Supply	Anritsu	E3640A	MY40000811	N/A	Unshielded

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§2.1046(a)	N/A	RF Power Output	Compliant
§2.1046(a) §22.913(a)(5) §24.232(c) §27.50(b)(9) §27.50(c)(9) §27.50(d)(4)	§6.8 (RSS-Gen Issue 5) §5.4 (RSS-132) §6.4 (RSS-133) §6.5 (RSS-139)	ERP/ EIRP measurement	Compliant
§2.1049(h)	§6.7 (RSS-Gen Issue 5) §2.3 (RSS-133)	99% & 26dB Occupied Bandwidth	Compliant
§2.1051 §22.917(a) §24.238(a) §27.53(c)(f) §27.53(g) §27.53(h)	§6.13 (RSS-Gen Issue 5) §5.4 (RSS-132) §6.5 (RSS-133) §6.6 (RSS-139)	Out of Band Emissions at Antenna Terminals and Band Edge / Emission mask requirements	Compliant
§2.1053 §22.917(a) §24.238(a) §27.53(c)(f) §27.53(g) §27.53(h)	§6.12 (RSS-Gen Issue 5) §5.4 (RSS-132) §6.5 (RSS-133) §6.6 (RSS-139)	Field Strength of Spurious Radiation	Compliant
§24.232(d) §27.50((B))	§5.4 (RSS-132) §6.4 (RSS-133) §6.5 (RSS-139)	Peak to Average Ratio	Compliant
§2.1055(a)(1) §22.355 §24.235 §27.54	§6.11 (RSS-Gen Issue 5) §5.4 (RSS-132) §6.3 (RSS-133) §6.4 (RSS-139)	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:

NB IoT Modes	Radiated Emission		
	E1	E2	H
B2	-	-	V
B4	-	-	V
B5	-	-	V
B12	-	-	V
B13	-	-	V
B17	-	-	V
B66	-	-	V
B71	-	-	V
B85	-	-	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
B66	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
B71	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
B85	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 Output Power	+/- 1.15 dB
99% Occupied Bandwidth	+/- 0.89%
Out of Band Emissions at Antenna Terminals and Band Edge	+/- 0.89 dB
Frequency Stability vs. Temperature	+/- 2.64 Hz
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12 dB
3M Semi Anechoic Chamber / 200MHz ~ 1GHz	+/- 4.68
3M Semi Anechoic Chamber / 1GHz ~ 8GHz	+/- 5.18
3M Semi Anechoic Chamber / 8GHz ~ 18GHz	+/- 5.47
3M Semi Anechoic Chamber / 18GHz ~ 26GHz	+/- 3.81
3M Semi Anechoic Chamber / 26GHz ~ 40GHz	+/- 3.87

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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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.

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(b) Mobile and portable stations are limited to 2 W EIRP.

FCC 27.50(a)(3) Mobile and portable stations (hand-held devices) are limited to 250 mW/ 5MHz EIRP.

FCC 27.50(c)(10) Portable stations (hand-held devices) are limited to 3 watts ERP.

FCC 27.50(d)(4) Fixed, mobile, and portable (hand-held) stations are limited to 1W EIRP.

FCC 27, 50(h)(2) Mobile and other user stations. Mobile stations are limited to 2 W EIRP

According to RSS-132 §5.4

The peak e.i.r.p. for transmitters operating in the band 824-849 MHz shall not exceed the limits 11.5W given in SRSP-530.

According to RSS-133 §6.4

The peak e.i.r.p. for transmitters operating in the band 1850-1910 MHz shall not exceed the limits 2W given in SRSP-510.

According to RSS 139 §6.4

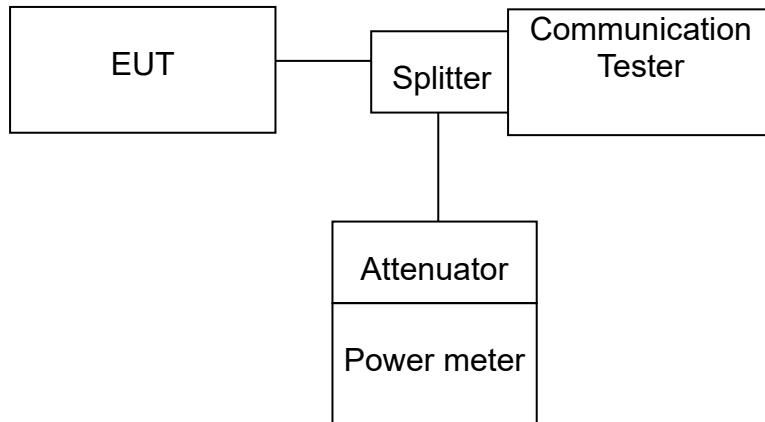
The average equivalent isotropically radiated power (e.i.r.p.) for fixed, mobile and portable transmitters in the 1710-1755 MHz shall not exceed 1 watt.

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6.2 Test Set-up



Note: Measurement setup for testing on Antenna connector

6.3 Measurement Procedure

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 test measurement of output power.

The Procedure of KDB941225 (SAR Measurement Procedures for 3G devices, (WCD-MA/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

All LTE bands conducted average power is obtained from the simulator telecommunication test set.

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP.

TEST PROCEDURE:

ANSI C63.26:2015

KDB 971168 D01 Section 5.6

$$\text{ERP/EIRP} = \text{PMes} + \text{GT-LC}$$

where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as PMes, typically dBW or dBm);

PMes = 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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6.4 Measurement Equipment Used

Conducted Emission (measured at antenna port) Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Radio Communication Analyzer	Anritsu	MT8821C	6261786084	01/09/2019	01/08/2020
DC Power Supply	Agilent	E3640A	MY4000081 1	12/11/2018	12/10/2019

6.5 Measurement Result

Gain: 1.8

LTE NB-IoT Band 2						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	EIRP(dBm)
18601	1850.1	BPSK	3.75	1@0	23.19	24.99
				1@47	23.16	24.96
		BPSK	15	1@11	23.06	24.86
		QPSK	15	1@0	23.09	24.89
				1@11	23.1	24.9
				12@0	20.17	21.97
				1@0	22.93	24.73
18900	1880	BPSK	3.75	1@47	22.96	24.76
				1@11	22.8	24.6
		QPSK	15	1@0	22.9	24.7
				1@11	22.89	24.69
				12@0	20.17	21.97
				1@0	22.5	24.3
19199	1909.9	BPSK	3.75	1@47	22.48	24.28
				1@11	22.32	24.12
		BPSK	15	1@0	22.38	24.18
		QPSK	15	1@11	22.39	24.19
				12@0	19.7	21.5

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Gain: -0.4

LTE NB-IoT Band 4						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	EIRP(dBm)
19951	1710.1	BPSK	3.75	1@0	22.91	22.51
				1@47	22.91	22.51
		BPSK	15	1@11	22.86	22.46
		QPSK	15	1@0	22.88	22.48
				1@11	22.9	22.5
				12@0	21.21	20.81
20175	1732.5	BPSK	3.75	1@0	22.93	22.53
				1@47	22.93	22.53
		BPSK	15	1@11	22.83	22.43
		QPSK	15	1@0	22.89	22.49
				1@11	22.88	22.48
				12@0	21.11	20.71
20399	1754.9	BPSK	3.75	1@0	23.13	22.73
				1@47	23.16	22.76
		BPSK	15	1@11	23.02	22.62
		QPSK	15	1@0	23.01	22.61
				1@11	23.03	22.63
				12@0	21.35	20.95

Gain: 1.5

LTE NB-IoT Band 5						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
20401	824.1	BPSK	3.75	1@0	23.11	24.61
				1@47	23.1	24.6
		BPSK	15	1@11	22.99	24.49
		QPSK	15	1@0	23.05	24.55
				1@11	23.06	24.56
				12@0	21.25	22.75
20525	836.5	BPSK	3.75	1@0	23.2	24.7
				1@47	23.21	24.71
		BPSK	15	1@11	23.12	24.62
		QPSK	15	1@0	23.18	24.68
				1@11	23.17	24.67
				12@0	21.33	22.83
20649	848.9	BPSK	3.75	1@0	23.15	24.65
				1@47	23.08	24.58
		BPSK	15	1@11	23.01	24.51
		QPSK	15	1@0	23.05	24.55
				1@11	23.07	24.57
				12@0	21.12	22.62

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Gain: -0.1

LTE NB-IoT Band 12						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
23011	699.1	BPSK	3.75	1@0	23.23	23.13
				1@47	23.25	23.15
		BPSK	15	1@11	23.14	23.04
				1@0	23.19	23.09
		QPSK	15	1@11	23.18	23.08
				12@0	21.28	21.18
23095	707.5	BPSK	3.75	1@0	23.43	23.33
				1@47	23.42	23.32
		BPSK	15	1@11	23.34	23.24
				1@0	23.38	23.28
		QPSK	15	1@11	23.4	23.3
				12@0	21.45	21.35
23179	715.9	BPSK	3.75	1@0	23.44	23.34
				1@47	23.48	23.38
		BPSK	15	1@11	23.32	23.22
				1@0	23.35	23.25
		QPSK	15	1@11	23.37	23.27
				12@0	21.58	21.48

Gain: 1.1

LTE NB-IoT Band 13						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
23181	777.1	BPSK	3.75	1@0	23.39	24.49
				1@47	23.39	24.49
		BPSK	15	1@11	23.18	24.28
				1@0	23.22	24.32
		QPSK	15	1@11	23.25	24.35
				12@0	21.37	22.47
23230	782	BPSK	3.75	1@0	23.38	24.48
				1@47	23.4	24.5
		BPSK	15	1@11	23.22	24.32
				1@0	23.24	24.34
		QPSK	15	1@11	23.25	24.35
				12@0	21.48	22.58
23279	786.9	BPSK	3.75	1@0	23.32	24.42
				1@47	23.33	24.43
		BPSK	15	1@11	23.23	24.33
				1@0	23.28	24.38
		QPSK	15	1@11	23.3	24.4
				12@0	21.4	22.5

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Gain: -0.1

LTE NB-IoT Band 17						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
23731	704.1	BPSK	3.75	1@0	23.37	23.27
				1@47	23.36	23.26
		BPSK	15	1@11	23.23	23.13
		QPSK	15	1@0	23.27	23.17
				1@11	23.3	23.2
				12@0	21.37	21.27
23790	710	BPSK	3.75	1@0	23.47	23.37
				1@47	23.46	23.36
		BPSK	15	1@11	23.33	23.23
		QPSK	15	1@0	23.33	23.23
				1@11	23.36	23.26
				12@0	21.56	21.46
23849	715.9	BPSK	3.75	1@0	23.43	23.33
				1@47	23.43	23.33
		BPSK	15	1@11	23.33	23.23
		QPSK	15	1@0	23.36	23.26
				1@11	23.38	23.28
				12@0	21.53	21.43

Gain: 0.5

LTE NB-IoT Band 66						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	EIRP(dBm)
131973	1710.1	BPSK	3.75	1@0	22.97	23.47
				1@47	22.96	23.46
		BPSK	15	1@11	22.81	23.31
		QPSK	15	1@0	22.85	23.35
				1@11	22.86	23.36
				12@0	21.1	21.6
132322	1745	BPSK	3.75	1@0	22.79	23.29
				1@47	22.81	23.31
		BPSK	15	1@11	22.71	23.21
		QPSK	15	1@0	22.73	23.23
				1@11	22.76	23.26
				12@0	20.97	21.47
132671	1779.9	BPSK	3.75	1@0	23.33	23.83
				1@47	23.35	23.85
		BPSK	15	1@11	23.12	23.62
		QPSK	15	1@0	23.22	23.72
				1@11	23.25	23.75
				12@0	21.49	21.99

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Gain: 0.5

LTE NB-IoT Band 71						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
133123	663.1	BPSK	3.75	1@0	23.21	23.71
				1@47	23.2	23.7
		BPSK	15	1@11	23.15	23.65
		QPSK	15	1@0	23.15	23.65
				1@11	23.17	23.67
				12@0	21.18	21.68
133297	680.5	BPSK	3.75	1@0	23.42	23.92
				1@47	23.41	23.91
		BPSK	15	1@11	23.31	23.81
		QPSK	15	1@0	23.35	23.85
				1@11	23.38	23.88
				12@0	21.38	21.88
133471	697.9	BPSK	3.75	1@0	23.72	24.22
				1@47	23.71	24.21
		BPSK	15	1@11	23.62	24.12
		QPSK	15	1@0	23.64	24.14
				1@11	23.61	24.11
				12@0	21.8	22.3

Gain: 0

LTE NB-IoT Band 85						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result	
					Power(dBm)	ERP(dBm)
134003	698.1	BPSK	3.75	1@0	23.35	23.35
				1@47	23.32	23.32
		BPSK	15	1@11	23.17	23.17
		QPSK	15	1@0	23.17	23.17
				1@11	23.24	23.24
				12@0	21.32	21.32
134092	707	BPSK	3.75	1@0	23.52	23.52
				1@47	23.5	23.5
		BPSK	15	1@11	23.42	23.42
		QPSK	15	1@0	23.45	23.45
				1@11	23.46	23.46
				12@0	21.44	21.44
134181	715.9	BPSK	3.75	1@0	23.54	23.54
				1@47	23.52	23.52
		BPSK	15	1@11	23.47	23.47
		QPSK	15	1@0	23.49	23.49
				1@11	23.5	23.5
				12@0	21.5	21.5

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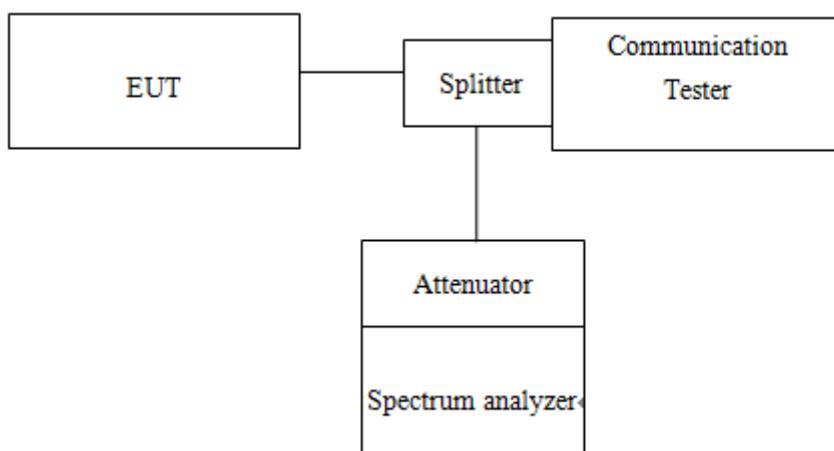
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7 OCCUPIED BANDWIDTH MEASUREMENT

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.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020
DC Power Supply	Agilent	E3640A	MY40000811	12/11/2018	12/10/2019
Radio Communication Analyer	Anritsu	MT8821C	6261786084	01/09/2019	01/08/2020
Temperature Chamber	TERCHY	MHG-120LF	911009	05/17/2019	05/16/2020
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020
Splitter	RF-LAMBAD	RFLT2W1G 18G	11-JSPF412-018	01/02/2019	01/01/2020
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2019	01/01/2020

7.5 Measurement Result

LTE NB-IoT Band 2						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
18601	1850.1	BPSK	3.75	1@0	221.44	312.1
		QPSK	15	1@0	176.80	242.5
		QPSK	15	12@0	220.76	281.9
18900	1880	BPSK	3.75	1@0	219.06	273.6
		QPSK	15	1@0	173.49	240.8
		QPSK	15	12@0	215.15	262.0
19199	1909.9	BPSK	3.75	1@0	214.48	272.1
		QPSK	15	1@0	177.08	235.5
		QPSK	15	12@0	212.88	264.8

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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
19951	1710.1	BPSK	3.75	1@0	217.47	274.5
		QPSK	15	1@0	168.34	234.1
		QPSK	15	12@0	212.73	261.4
20175	1732.5	BPSK	3.75	1@0	216.51	288.8
		QPSK	15	1@0	170.08	238.6
		QPSK	15	12@0	218.01	275.4
20399	1754.9	BPSK	3.75	1@0	217.35	278.0
		QPSK	15	1@0	171.86	229.4
		QPSK	15	12@0	218.95	267.5
LTE NB-IoT Band 5						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
20401	824.1	BPSK	3.75	1@0	217.92	291.2
		QPSK	15	1@0	168.40	239.5
		QPSK	15	12@0	221.09	282.5
20525	836.5	BPSK	3.75	1@0	217.35	284.5
		QPSK	15	1@0	168.79	228.4
		QPSK	15	12@0	219.36	263.9
20649	848.9	BPSK	3.75	1@0	216.12	267.3
		QPSK	15	1@0	166.77	215.9
		QPSK	15	12@0	219.73	284.2
LTE NB-IoT Band 12						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
23011	699.1	BPSK	3.75	1@0	213.36	274.4
		QPSK	15	1@0	167.06	225.5
		QPSK	15	12@0	215.43	281.1
23095	707.5	BPSK	3.75	1@0	217.69	278.9
		QPSK	15	1@0	174.15	230.8
		QPSK	15	12@0	217.84	263.5
23719	715.9	BPSK	3.75	1@0	214.15	291.7
		QPSK	15	1@0	169.36	238.3
		QPSK	15	12@0	213.35	263.8

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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
23181	777.1	BPSK	3.75	1@0	219.11	311.0
		QPSK	15	1@0	170.67	239.0
		QPSK	15	12@0	221.84	287.5
23230	782	BPSK	3.75	1@0	217.06	295.4
		QPSK	15	1@0	169.91	239.6
		QPSK	15	12@0	220.90	280.6
23279	786.9	BPSK	3.75	1@0	213.89	278.0
		QPSK	15	1@0	175.53	229.4
		QPSK	15	12@0	215.85	266.7

LTE NB-IoT Band 17						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
23731	704.1	BPSK	3.75	1@0	218.83	285.3
		QPSK	15	1@0	166.40	210.6
		QPSK	15	12@0	220.54	284.1
23790	710	BPSK	3.75	1@0	214.54	274.5
		QPSK	15	1@0	160.05	209.7
		QPSK	15	12@0	216.59	277.2
23849	715.9	BPSK	3.75	1@0	211.99	296.6
		QPSK	15	1@0	164.64	213.4
		QPSK	15	12@0	221.41	287.2

LTE NB-IoT Band 66						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
131973	1710.1	BPSK	3.75	1@0	217.46	302.3
		QPSK	15	1@0	175.91	232.8
		QPSK	15	12@0	216.89	230.8
132322	1745	BPSK	3.75	1@0	216.95	294.7
		QPSK	15	1@0	173.72	231.1
		QPSK	15	12@0	217.10	279.0
132671	1779.9	BPSK	3.75	1@0	220.03	314.6
		QPSK	15	1@0	170.33	217.2
		QPSK	15	12@0	214.65	274.1

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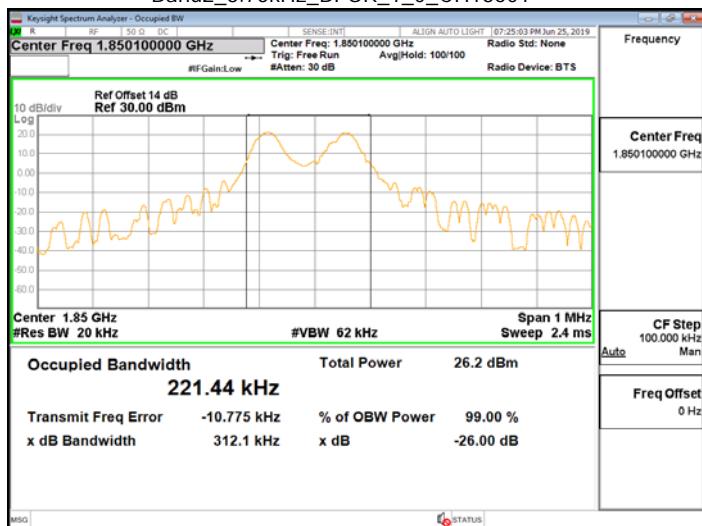
LTE NB-IoT Band 71						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
133123	663.1	BPSK	3.75	1@0	218.13	278.4
		QPSK	15	1@0	166.12	232.1
		QPSK	15	12@0	215.54	277.0
133297	680.5	BPSK	3.75	1@0	217.93	278.9
		QPSK	15	1@0	167.60	232.2
		QPSK	15	12@0	218.91	265.3
133471	697.9	BPSK	3.75	1@0	217.71	273.9
		QPSK	15	1@0	168.06	236.9
		QPSK	15	12@0	215.40	264.7
LTE NB-IoT Band 85						
Channel	Freq. (MHz)	Modulation	Subcarrier Spacing (kHz)	N _{tones}	Measure Result (kHz)	
					26dB BW	99% BW
134003	698.1	BPSK	3.75	1@0	217.52	272.2
		QPSK	15	1@0	172.01	223.8
		QPSK	15	12@0	164.12	236.5
134092	707	BPSK	3.75	1@0	220.45	297.8
		QPSK	15	1@0	169.57	216.2
		QPSK	15	12@0	217.26	265.0
134181	715.9	BPSK	3.75	1@0	217.83	288.5
		QPSK	15	1@0	166.73	235.7
		QPSK	15	12@0	216.31	277.6

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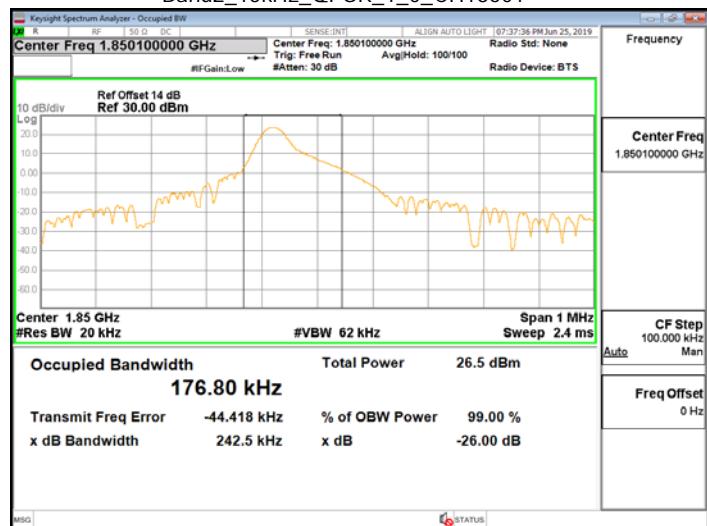
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Band2_3.75kHz_BPSK_1_0_CH18601



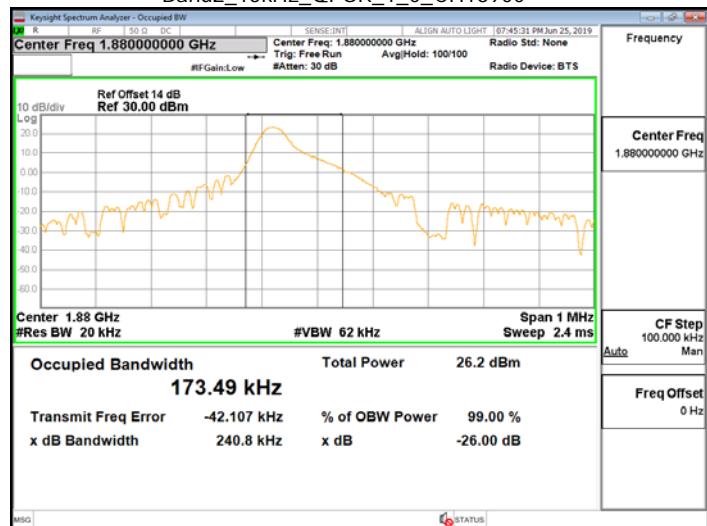
Band2_15kHz_QPSK_1_0_CH18601



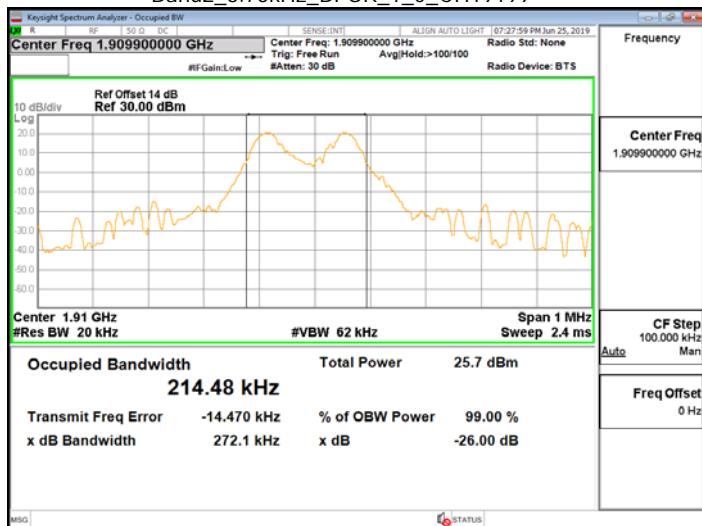
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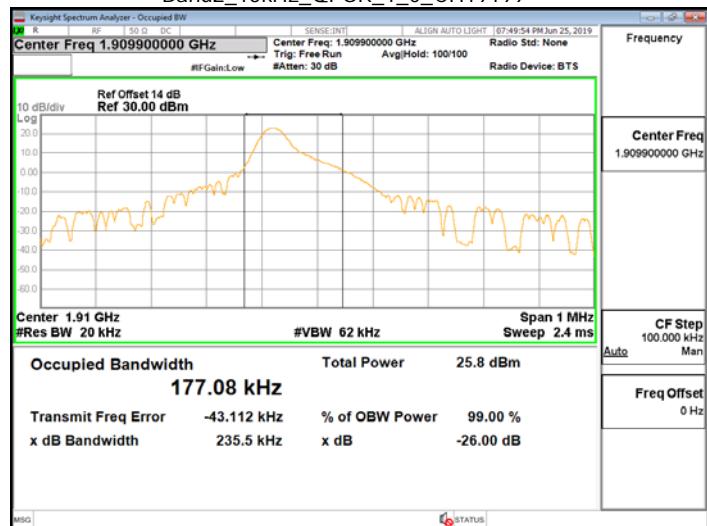
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Band2_3.75kHz_BPSK_1_0_CH19199



Band2_15kHz_QPSK_1_0_CH19199

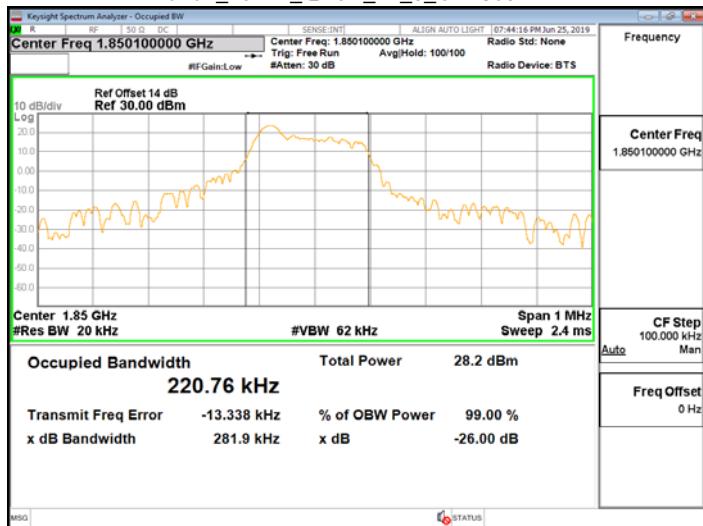


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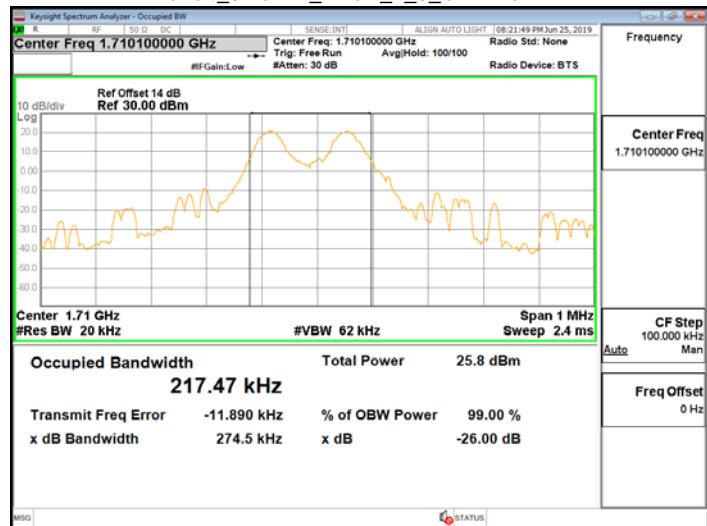
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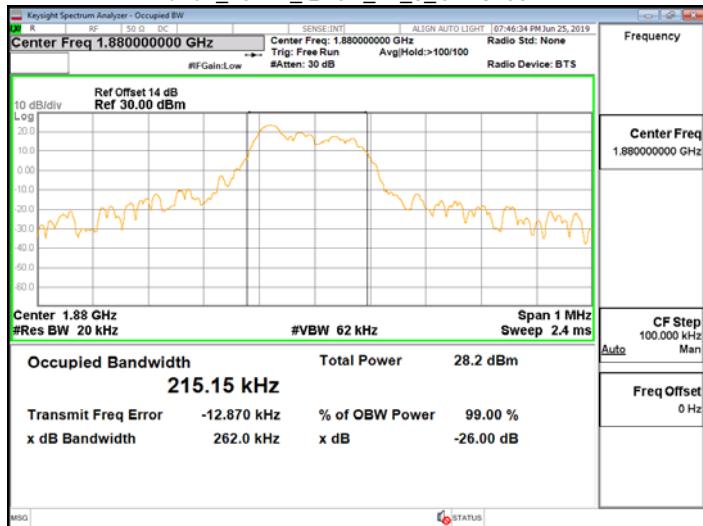
Band2_15kHz_QPSK_12_0_CH18601



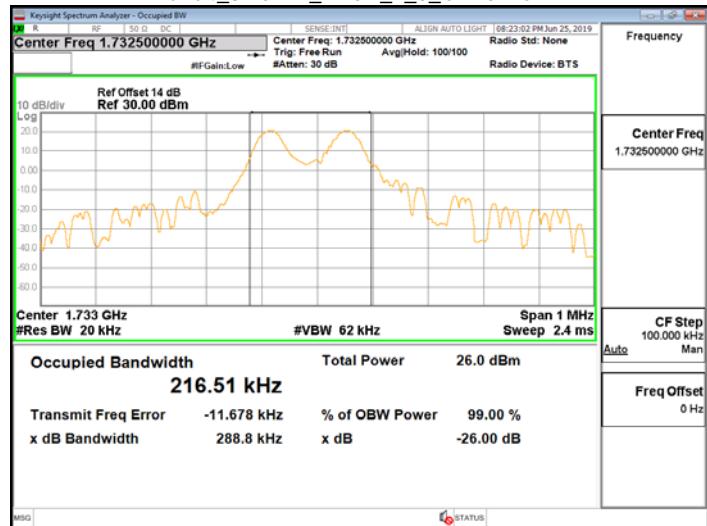
Band4_3.75kHz_BPSK_1_0_CH19951



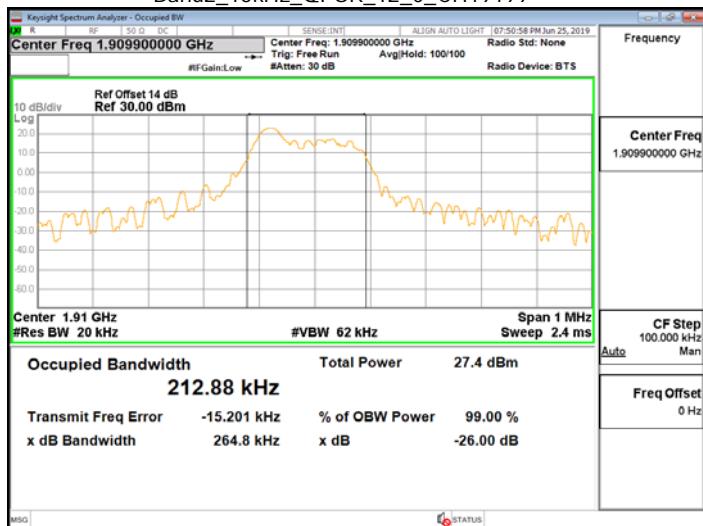
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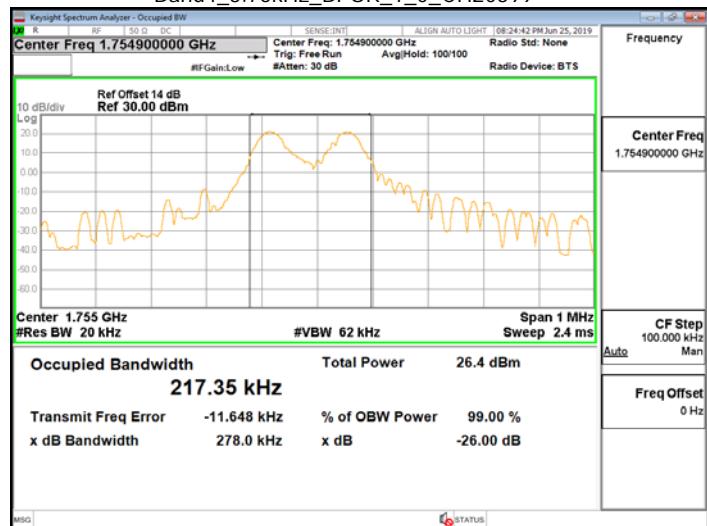
Band4_3.75kHz_BPSK_1_0_CH20175



Band2_15kHz_QPSK_12_0_CH19199



Band4_3.75kHz_BPSK_1_0_CH20399

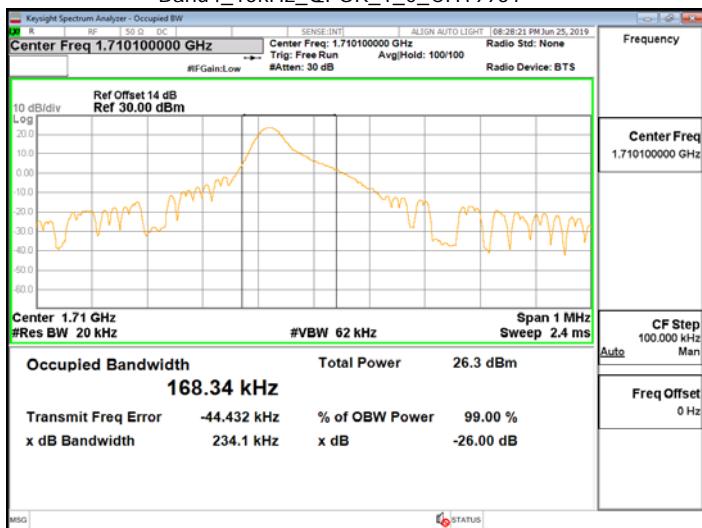


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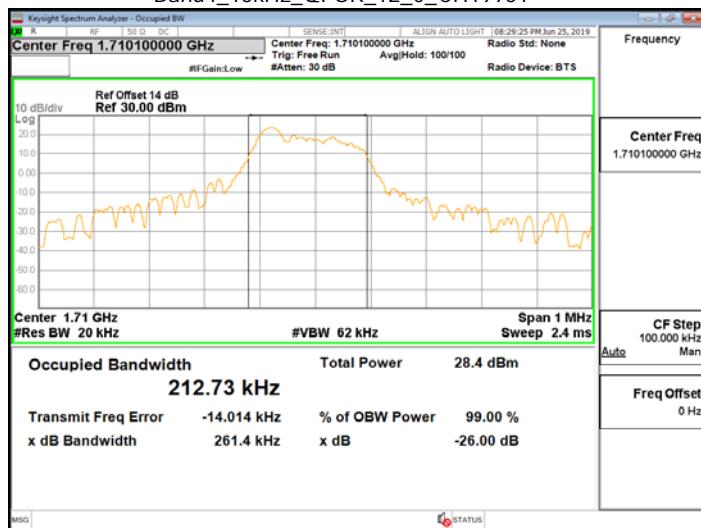
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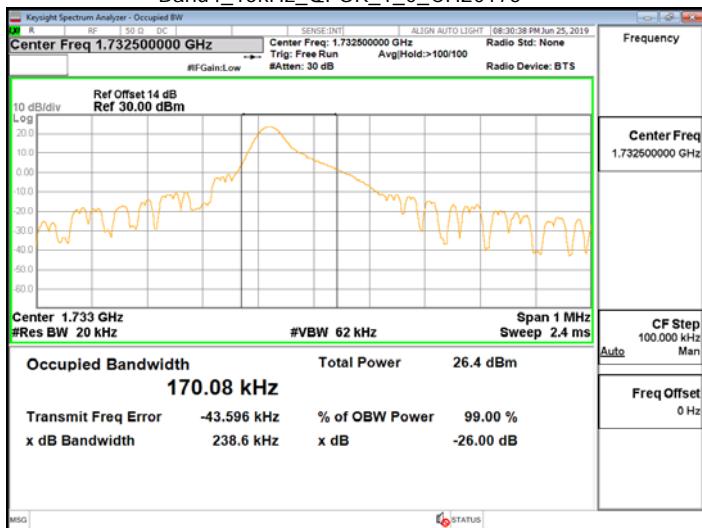
Band4_15kHz_QPSK_1_0_CH19951



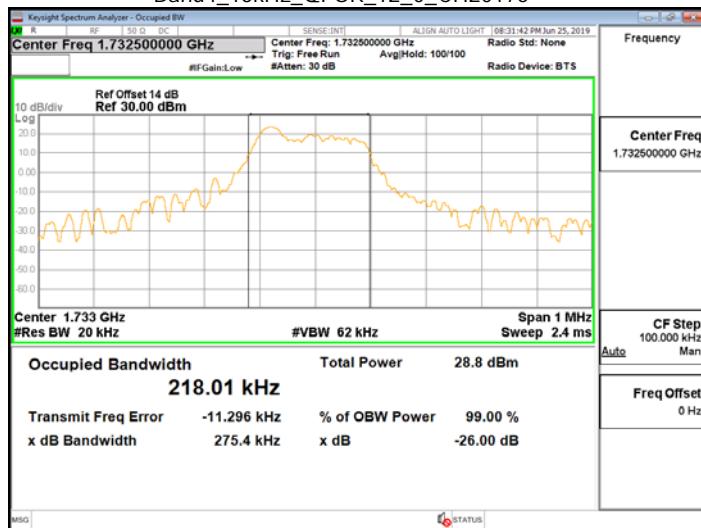
Band4_15kHz_QPSK_12_0_CH19951



Band4_15kHz_QPSK_1_0_CH20175



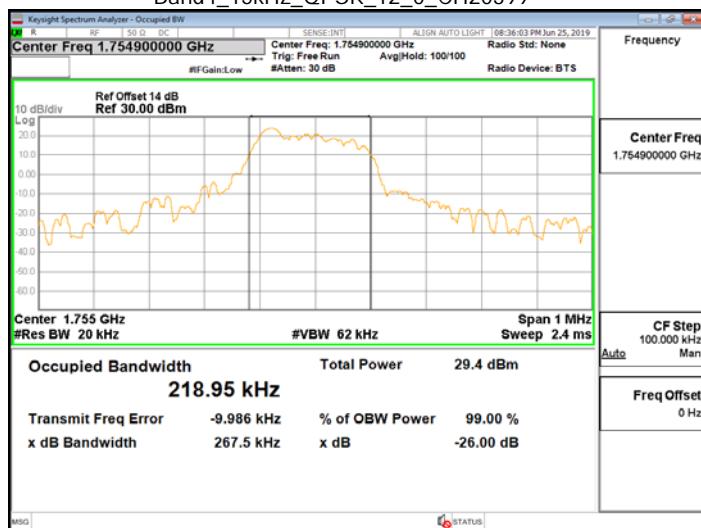
Band4_15kHz_QPSK_12_0_CH20175



Band4_15kHz_QPSK_1_0_CH20399



Band4_15kHz_QPSK_12_0_CH20399

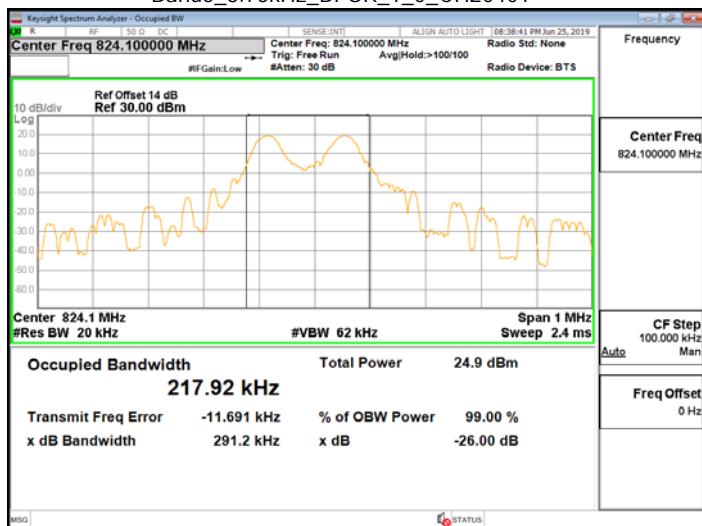


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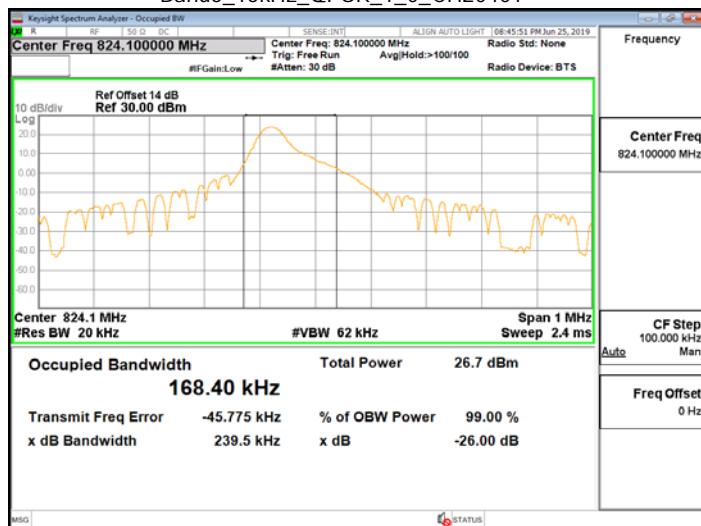
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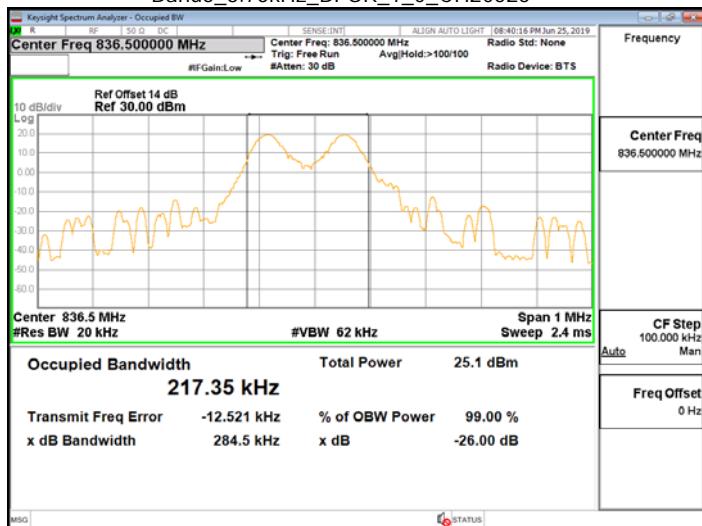
Band5_3.75kHz_BPSK_1_0_CH20401



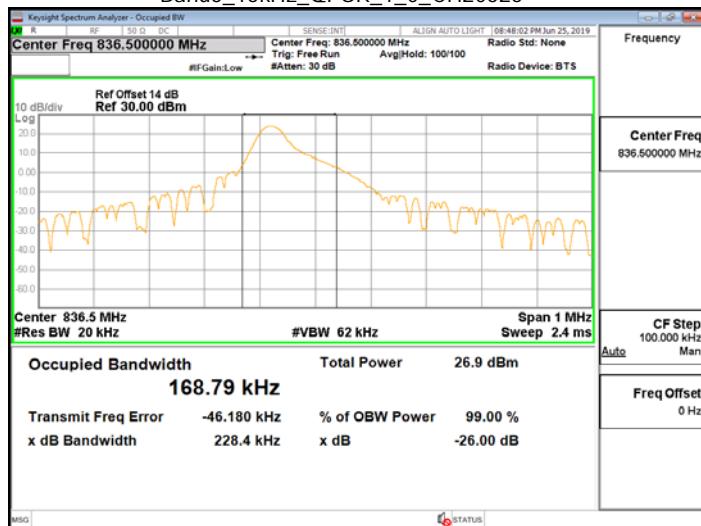
Band5_15kHz_QPSK_1_0_CH20401



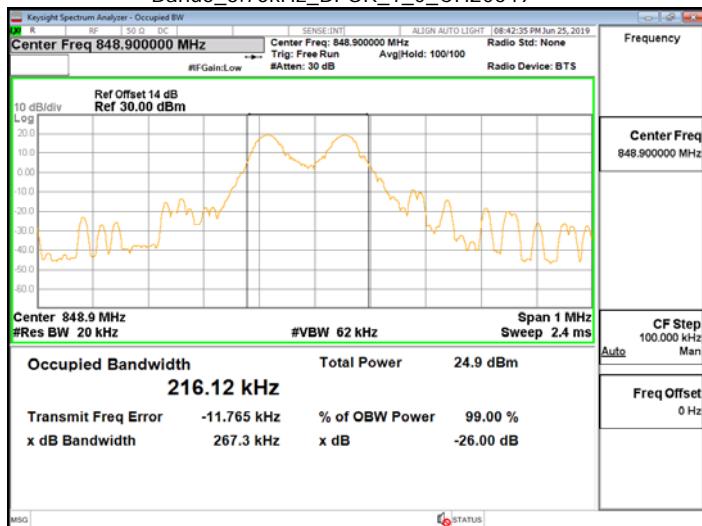
Band5_3.75kHz_BPSK_1_0_CH20525



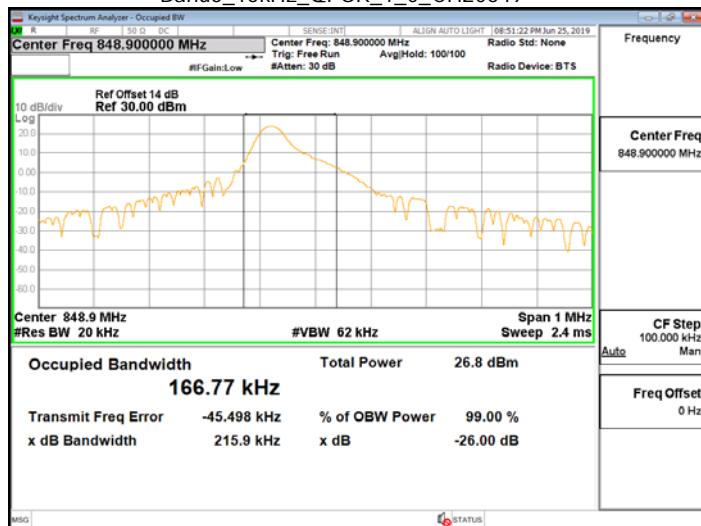
Band5_15kHz_QPSK_1_0_CH20525



Band5_3.75kHz_BPSK_1_0_CH20649



Band5_15kHz_QPSK_1_0_CH20649

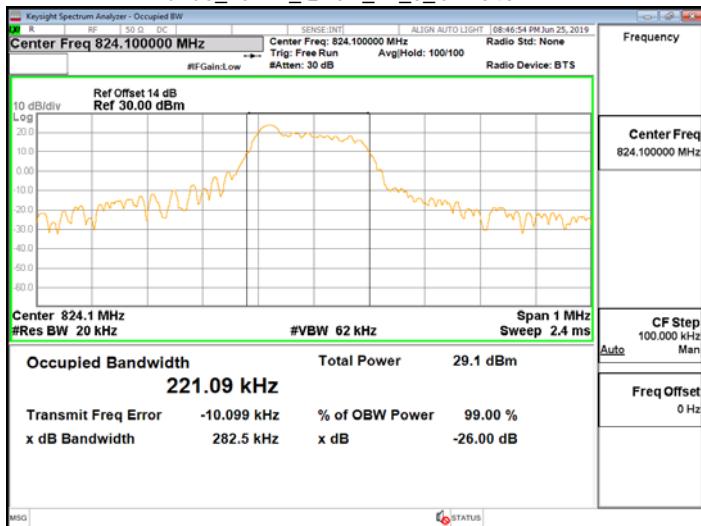


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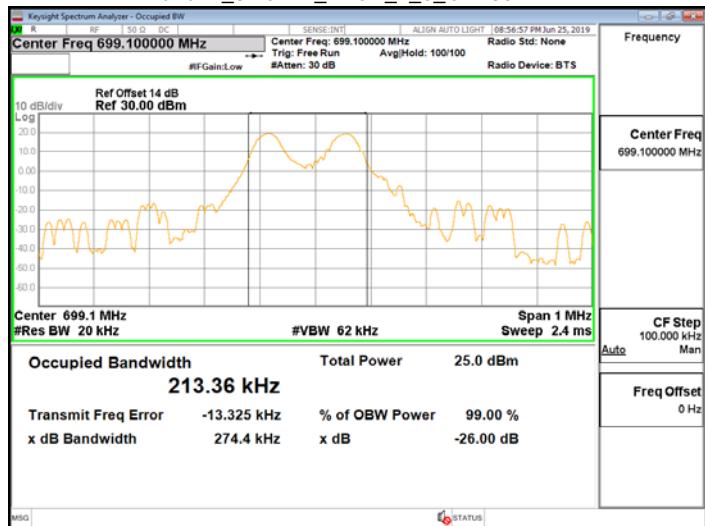
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Band5_15kHz_QPSK_12_0_CH20401



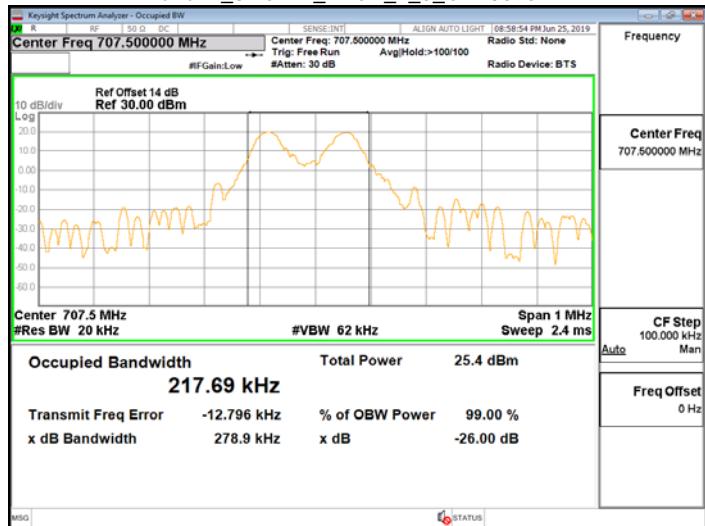
Band12_3.75kHz_BPSK_1_0_CH23011



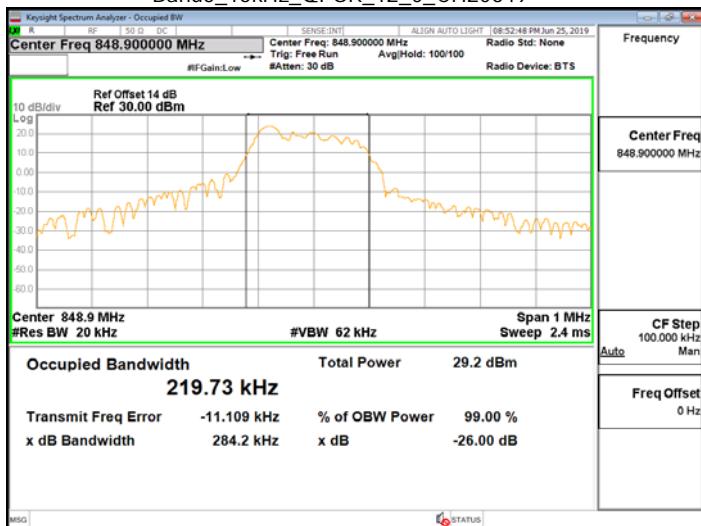
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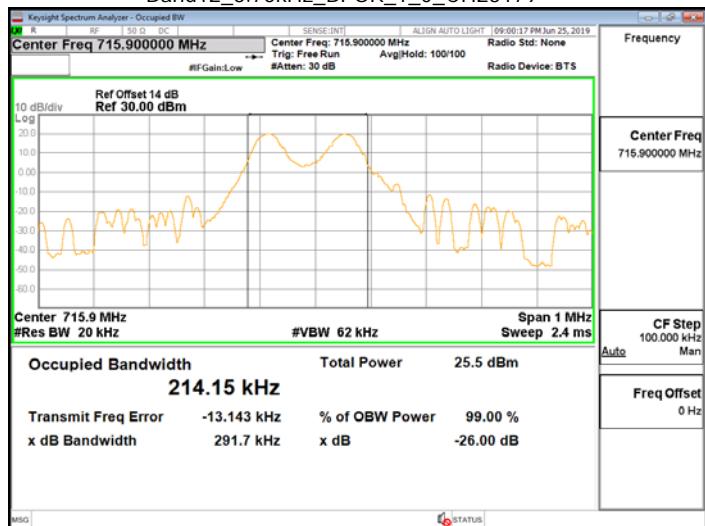
Band12_3.75kHz_BPSK_1_0_CH23095



Band5_15kHz_QPSK_12_0_CH20649



Band12_3.75kHz_BPSK_1_0_CH23179

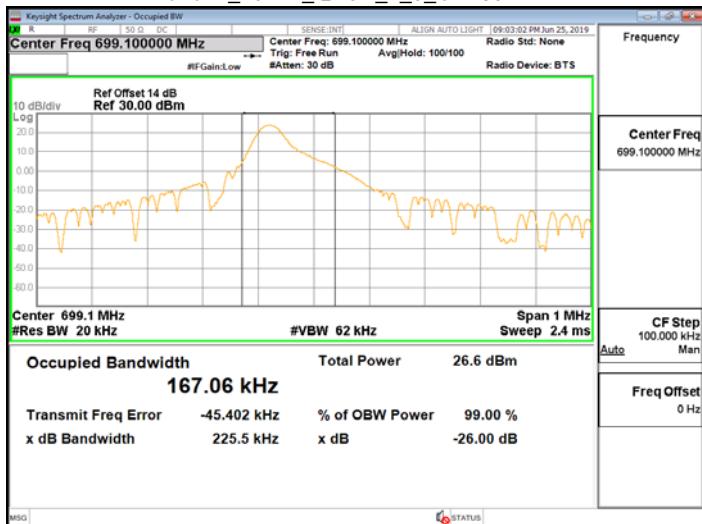


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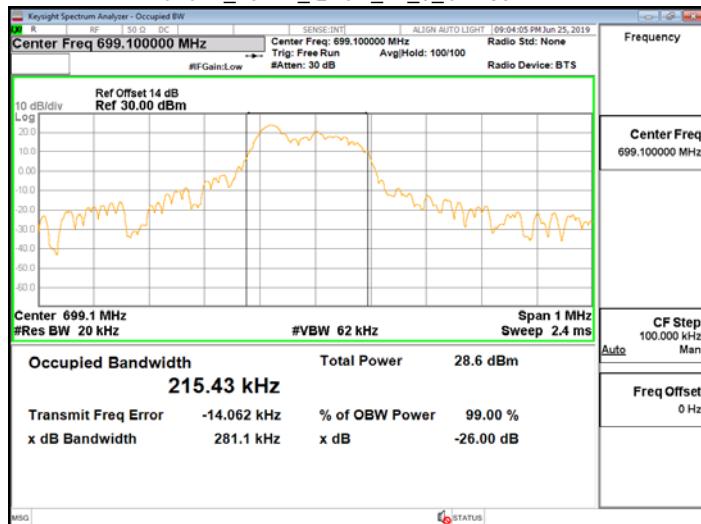
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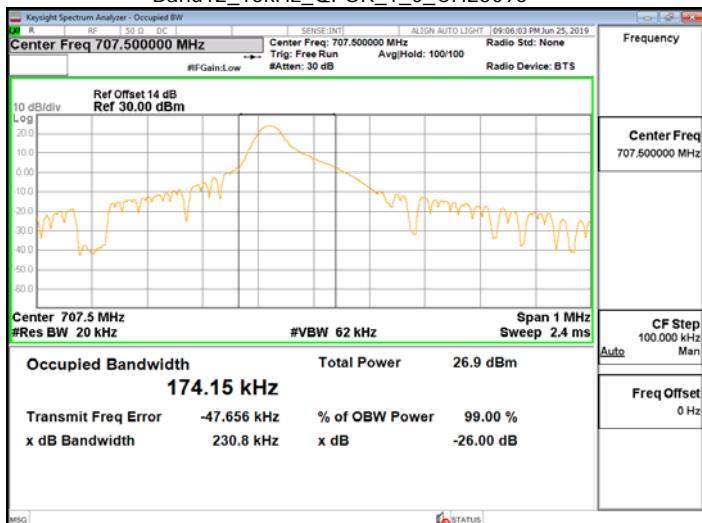
Band12_15kHz_QPSK_1_0_CH23011



Band12_15kHz_QPSK_12_0_CH23011



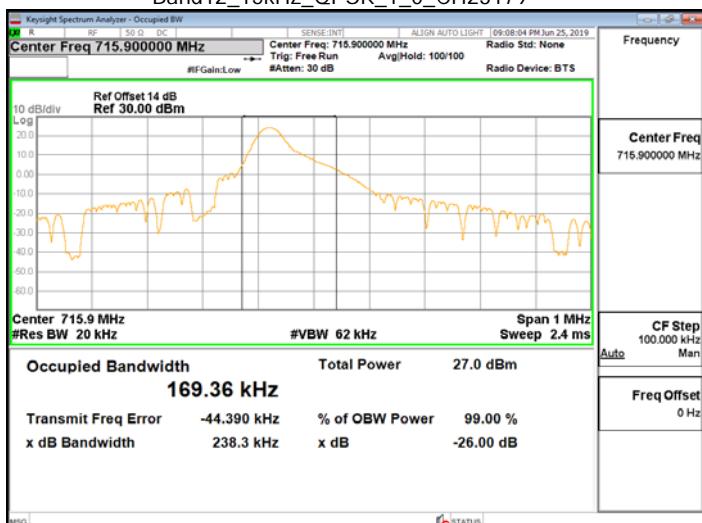
Band12_15kHz_QPSK_1_0_CH23095



Band12_15kHz_QPSK_12_0_CH23095



Band12_15kHz_QPSK_1_0_CH23179



Band12_15kHz_QPSK_12_0_CH23179

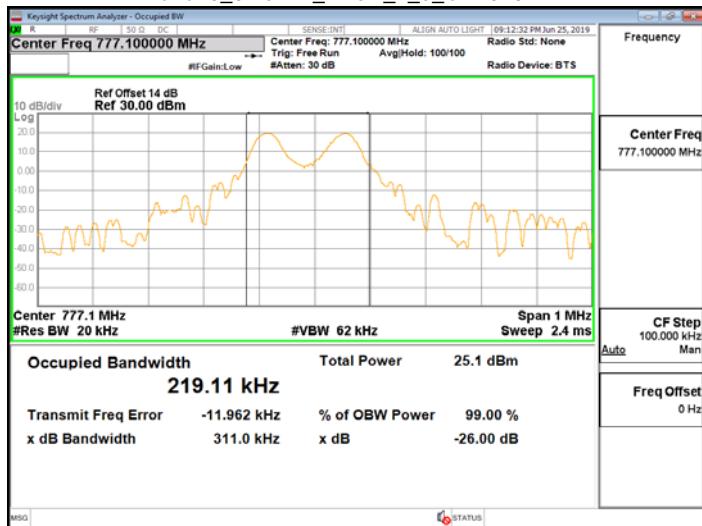


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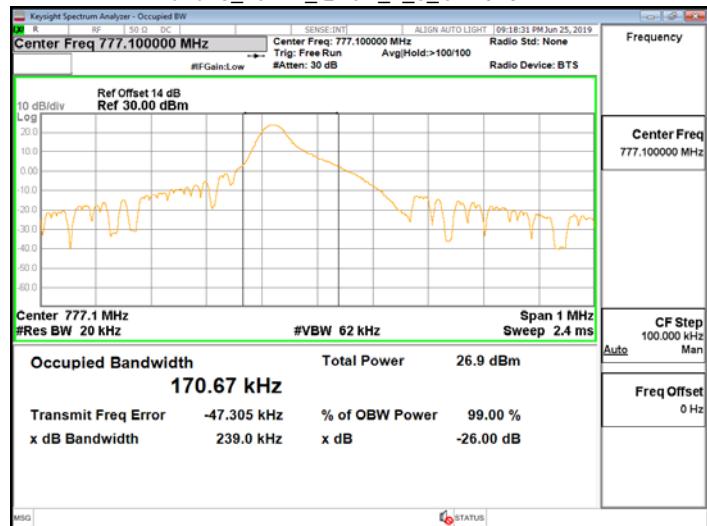
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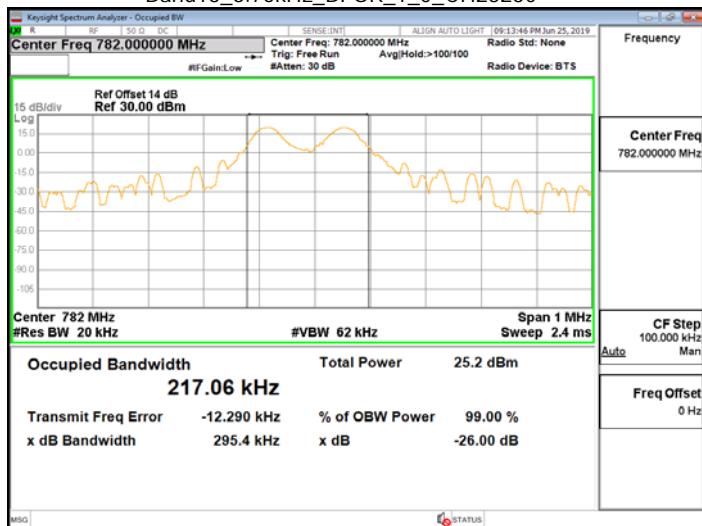
Band13_3.75kHz_BPSK_1_0_CH23181



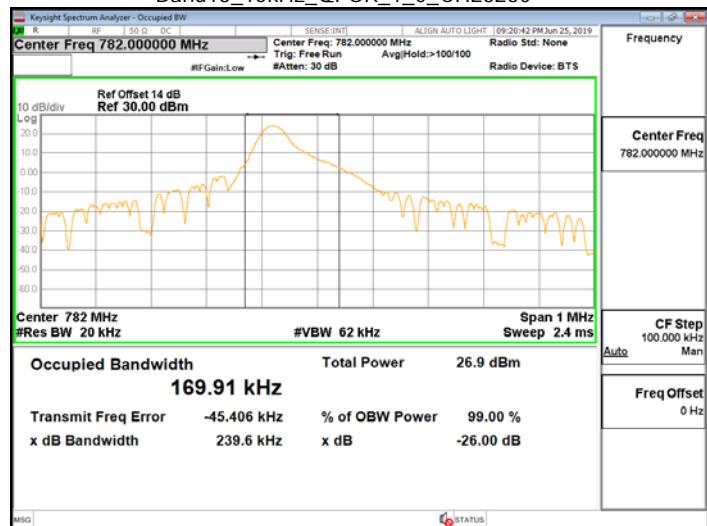
Band13_15kHz_QPSK_1_0_CH23181



Band13_3.75kHz_BPSK_1_0_CH23230



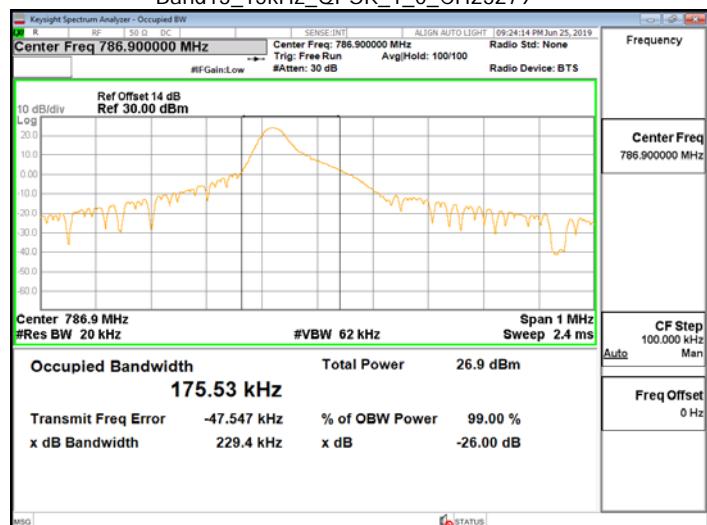
Band13_15kHz_QPSK_1_0_CH23230



Band13_3.75kHz_BPSK_1_0_CH23279



Band13_15kHz_QPSK_1_0_CH23279

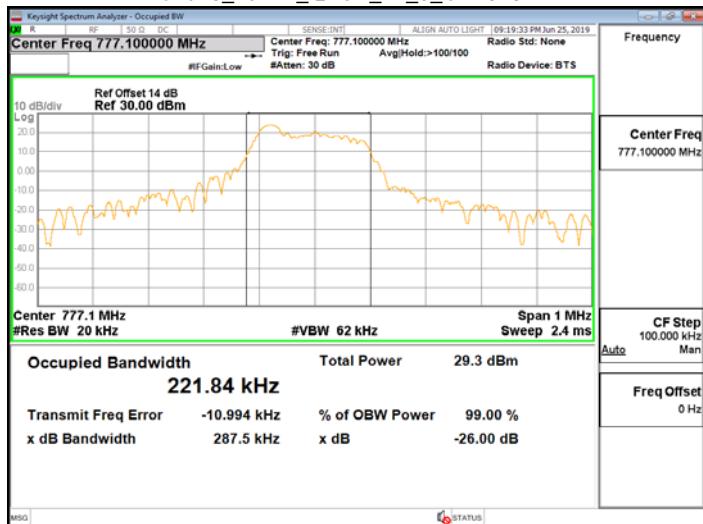


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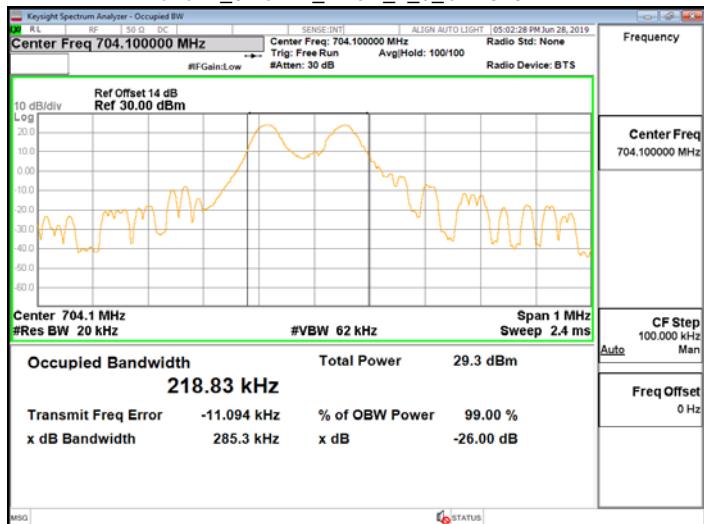
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Band13_15kHz_QPSK_12_0_CH23181



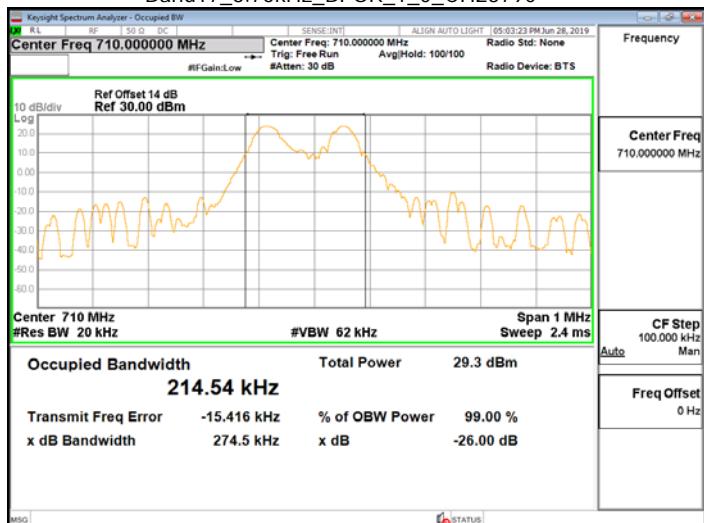
Band17_3.75kHz_BPSK_1_0_CH23731



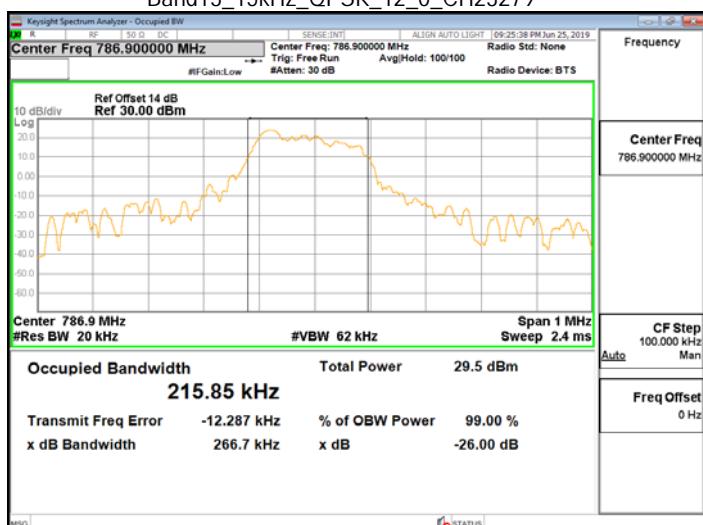
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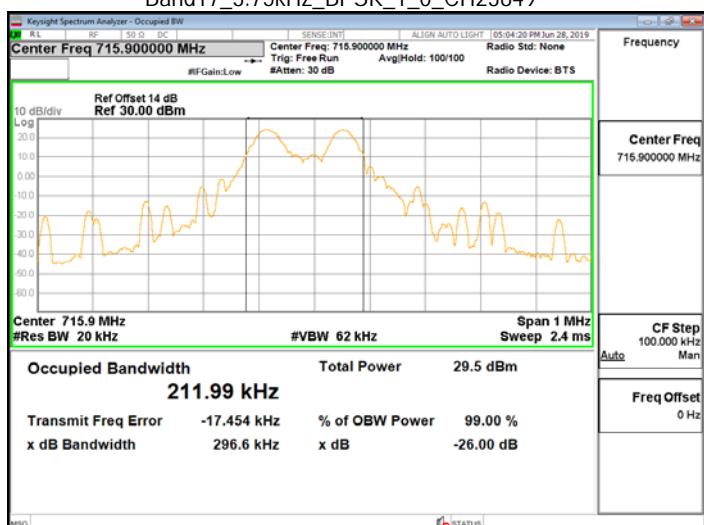
Band17_3.75kHz_BPSK_1_0_CH23790



Band13_15kHz_QPSK_12_0_CH23279



Band17_3.75kHz_BPSK_1_0_CH23849

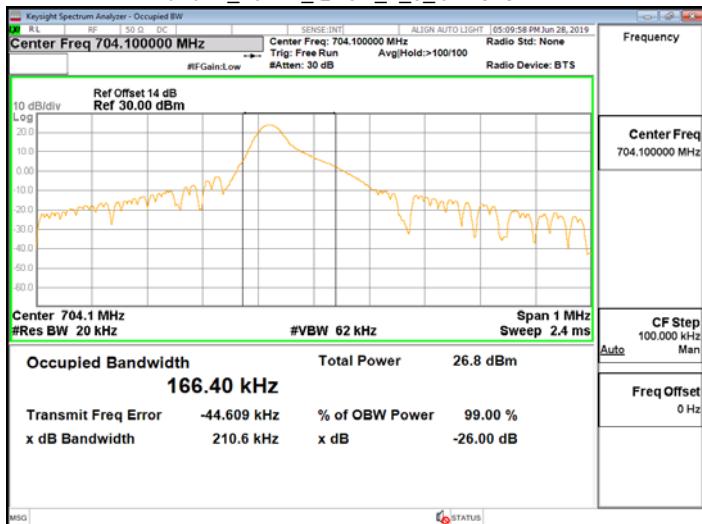


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Band17_15kHz_QPSK_1_0_CH23731



Band17_15kHz_QPSK_12_0_CH23731



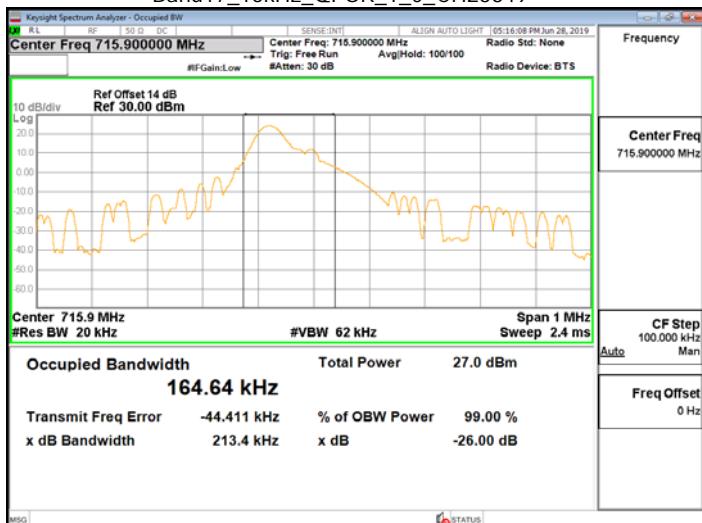
Band17_15kHz_QPSK_1_0_CH23790



Band17_15kHz_QPSK_12_0_CH23790



Band17_15kHz_QPSK_1_0_CH23849



Band17_15kHz_QPSK_12_0_CH23849



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Band66_3.75kHz_BPSK_1_0_CH131973



Band66_15kHz_QPSK_1_0_CH131973



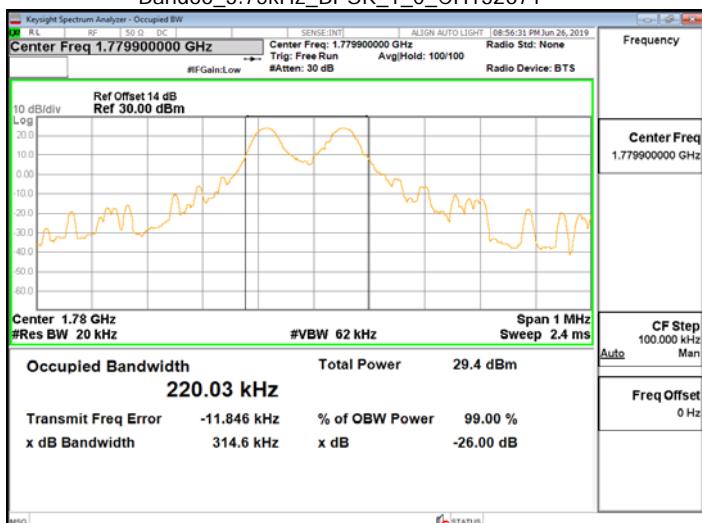
Band66_3.75kHz_BPSK_1_0_CH132322



Band66_15kHz_QPSK_1_0_CH132322



Band66_3.75kHz_BPSK_1_0_CH132671



Band66_15kHz_QPSK_1_0_CH132671

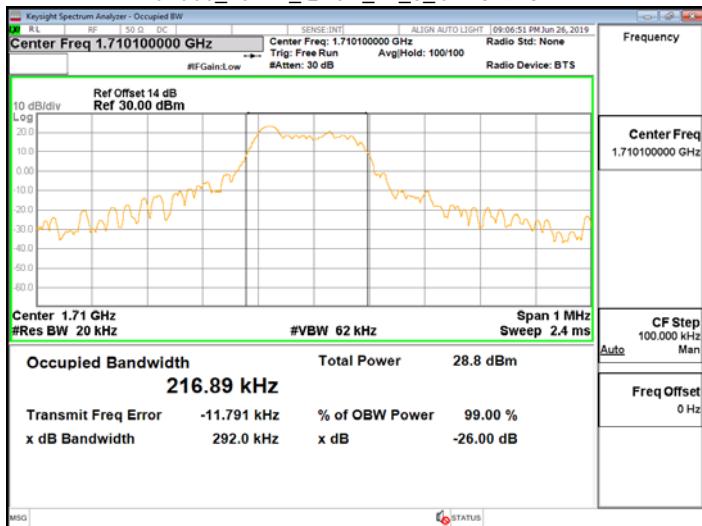


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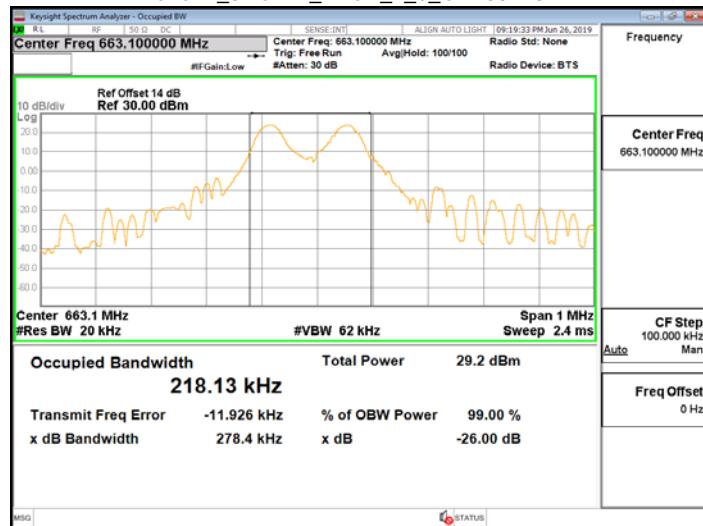
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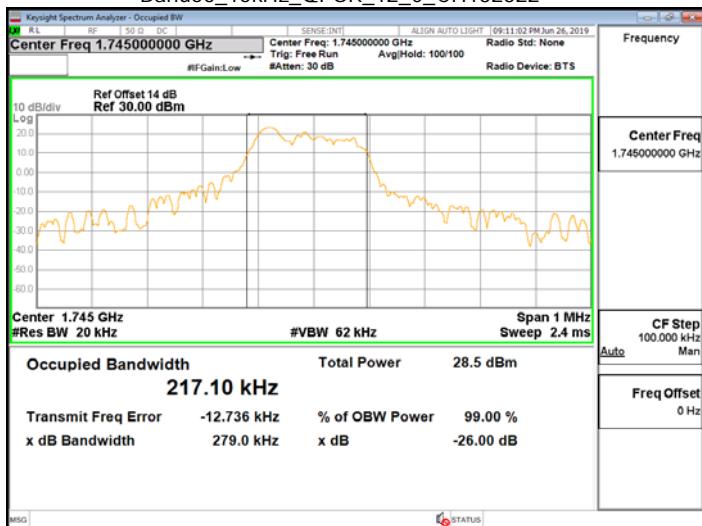
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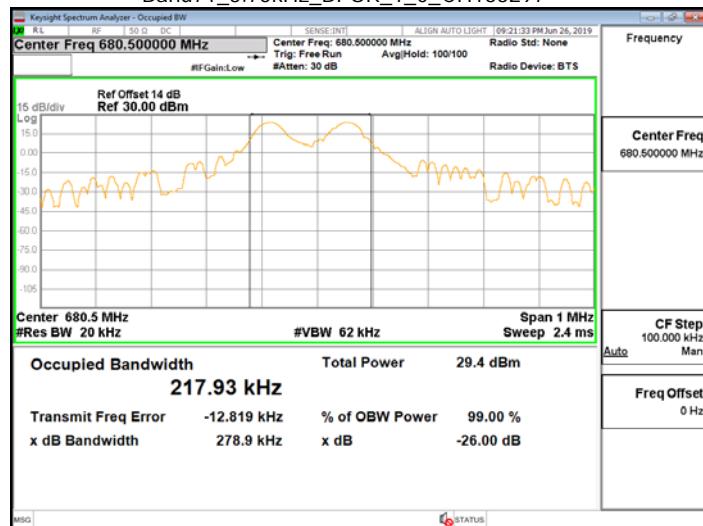
Band71_3.75kHz_BPSK_1_0_CH133123



Band66_15kHz_QPSK_12_0_CH132322



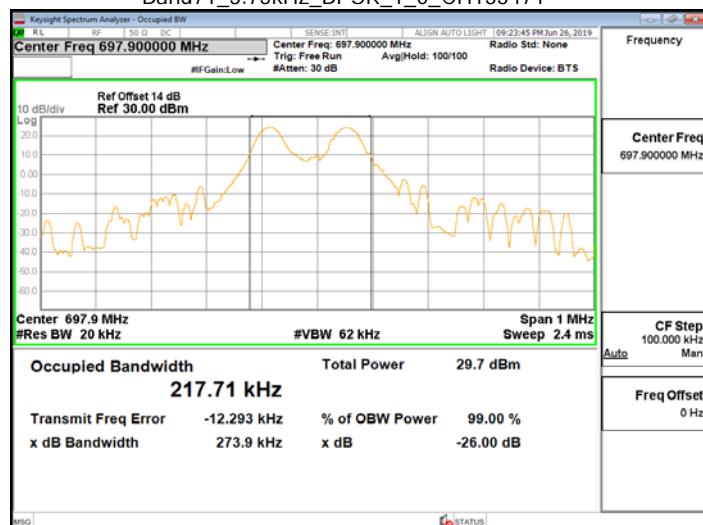
Band71_3.75kHz_BPSK_1_0_CH133297



Band66_15kHz_QPSK_12_0_CH132671



Band71_3.75kHz_BPSK_1_0_CH133471

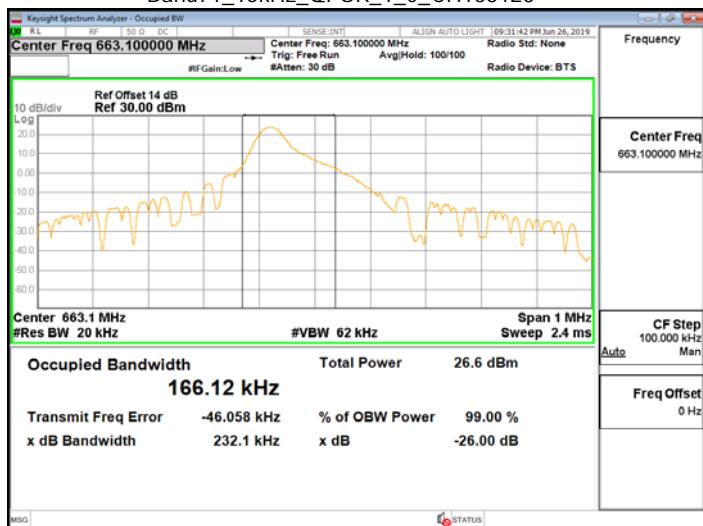


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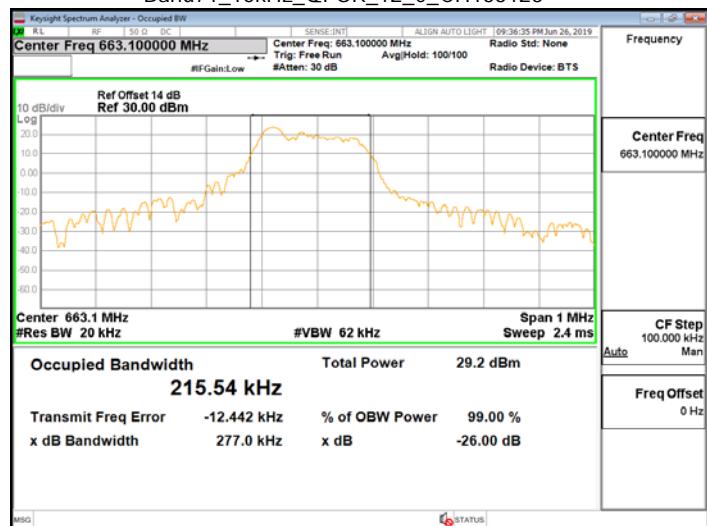
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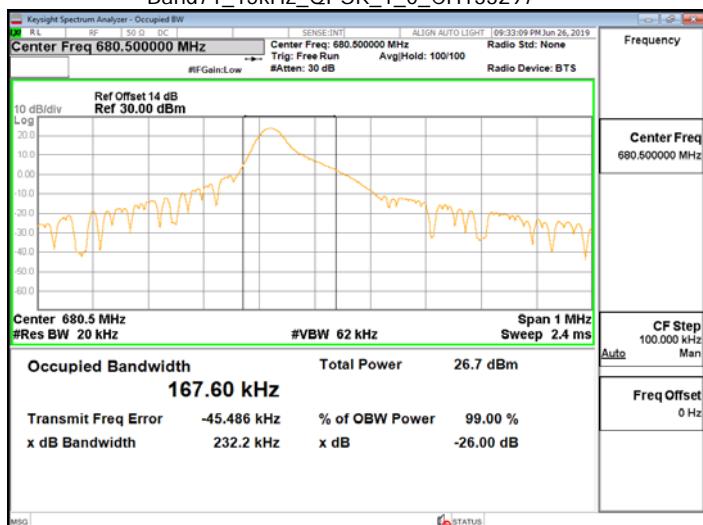
Band71_15kHz_QPSK_1_0_CH133123



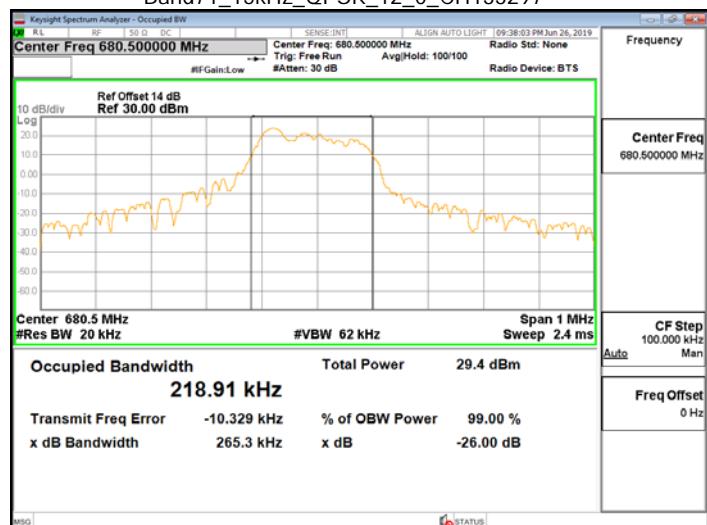
Band71_15kHz_QPSK_12_0_CH133123



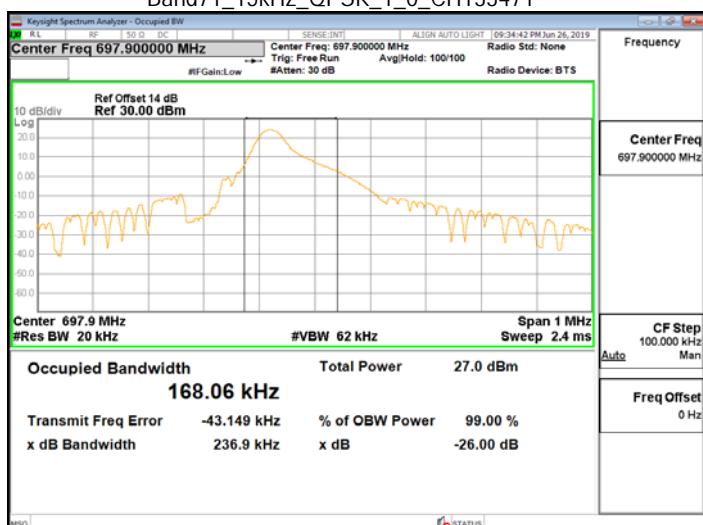
Band71_15kHz_QPSK_1_0_CH133297



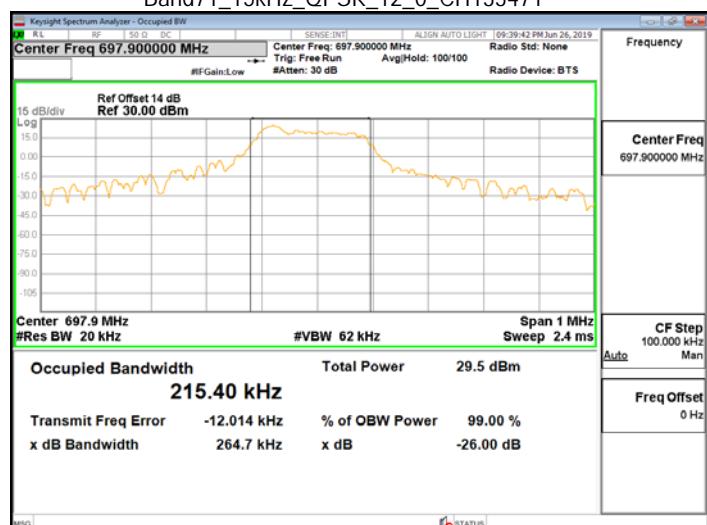
Band71_15kHz_QPSK_12_0_CH133297



Band71_15kHz_QPSK_1_0_CH133471



Band71_15kHz_QPSK_12_0_CH133471

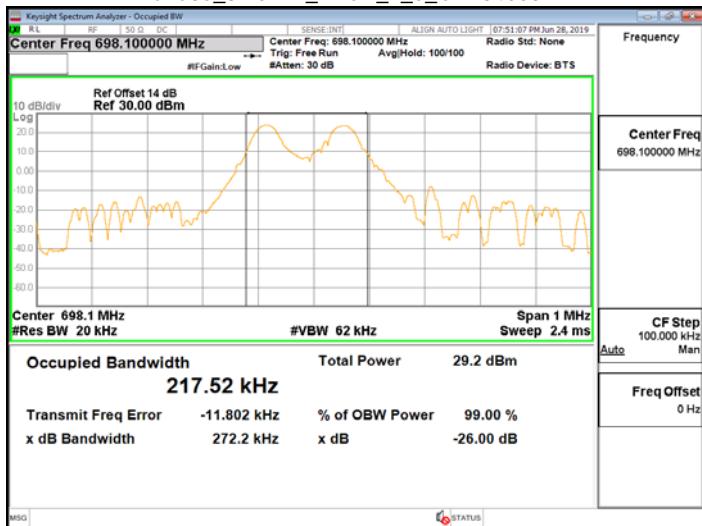


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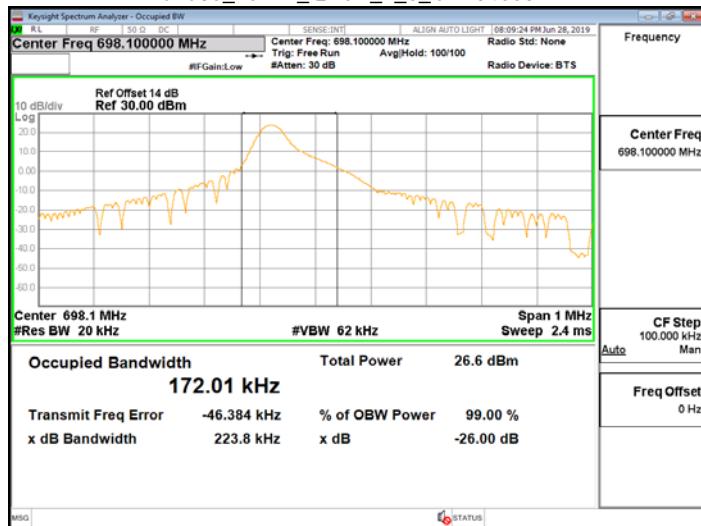
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Band85_3.75kHz_BPSK_1_0_CH134003



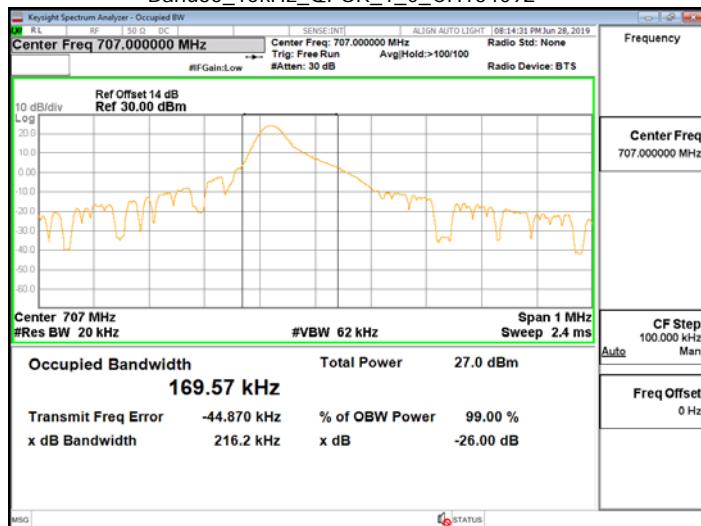
Band85_15kHz_QPSK_1_0_CH134003



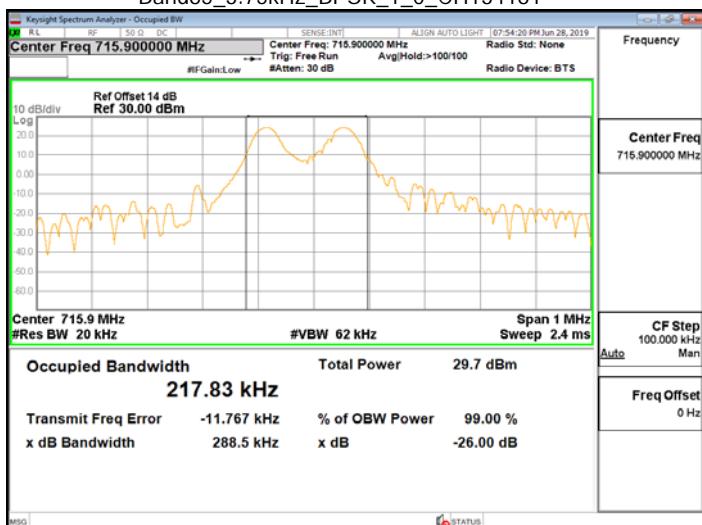
Band85_3.75kHz_BPSK_1_0_CH134092



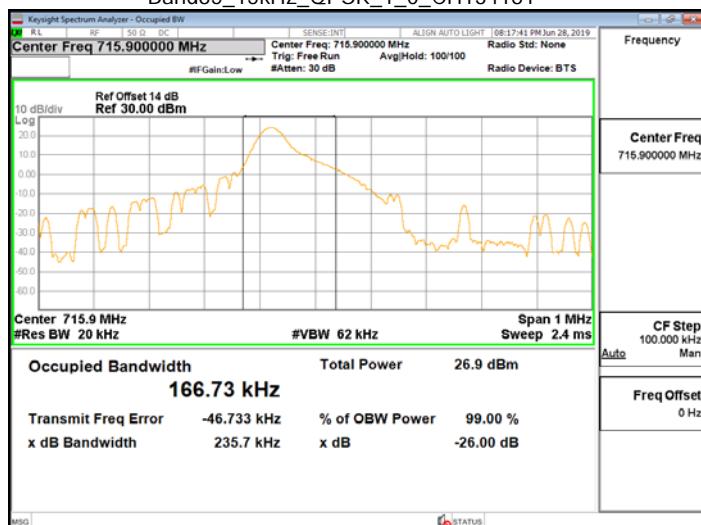
Band85_15kHz_QPSK_1_0_CH134092



Band85_3.75kHz_BPSK_1_0_CH134181



Band85_15kHz_QPSK_1_0_CH134181



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