



TEST REPORT

REPORT NUMBER: I22W00076-NB-IoT RF-FCC-Rev2

ON

Type of Equipment: IoT Module
Type of Designation: L710
Brand Name: LYNQ
Manufacturer: Shanghai MobileTek Communication Ltd.
FCC ID: 2AK9D-L710G

ACCORDING TO

FCC CFR Part 2, FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS;
GENERAL RULES AND REGULATIONS, e-CFR
PART 22, PUBLIC MOBILE SERVICES, e-CFR
PART 24, PERSONAL COMMUNICATIONS SERVICES, e-CFR
PART 27, MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES, e-CFR
PART 90, PRIVATE LAND MOBILE RADIO SERVICES, e-CFR
ANSI C63.26-2015 American National Standard for Compliance Testing of Transmitters
Used in Licensed Radio Services

Chongqing Academy of Information and Communications Technology

Month date, year

Dec, 28, 2022

Signature



Xiang Luoyong

Director

Note:

The test results in this test report relate only to the devices specified in this report.
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Chongqing Academy of Information and Communications Technology.



Report No.: I22W00076-NB-IoT RF-FCC_Rev2

Revision Version

Report Number	Revision	Date	Memo
I22W00076-NB-IoT RF-FCC	00	2022-12-14	Initial creation of test report
I22W00076-NB-IoT RF-FCC_Rev1	01	2022-12-23	--
I22W00076-NB-IoT RF-FCC_Rev2	02	2022-12-28	--

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1. Test Laboratory

1.1. Testing Location

Name:	Chongqing Academy of Information and Communications Technology
Designation Number:	CN1239
Address:	Building C, Technology Innovation Center, No.8, Yuma Road, Chayuan New Area, Nan'an District, Chongqing, People's Republic of China
Postal Code:	401336
Telephone:	0086-23-88069965
Fax:	0086-23-88608777

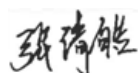
1.2. Testing Environment

Normal Temperature:	15-35°C
Relative Humidity:	30-60%

1.3. Project data

Testing Start Date:	2022-10-28
Testing End Date:	2022-12-28

1.4. Signature



2022-12-28

Zhang qinghao
(Prepared this test report)

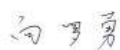
Date



2022-12-28

Li Xu
(Reviewed this test report)

Date



2022-12-28

Xiang Luoyong
Director of the laboratory
(Approved this test report)

Date

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2. Client Information

2.1. Applicant Information

Company Name:	Shanghai MobileTek Communication Ltd.
Address /Post:	Free Trade Zone No. 33, No. 17 building 6H3 Xiya Road China (Shanghai)
City:	Shanghai
Country:	China
Telephone:	15821966417
Fax:	--
Email:	qh.zhang@mobiletek.cn
Contact Person:	Qinghua Zhang

2.2. Manufacturer Information

Company Name:	Shanghai MobileTek Communication Ltd.
Address /Post:	Free Trade Zone No. 33, No. 17 building 6H3 Xiya Road China (Shanghai)
City:	Shanghai
Country:	China
Telephone:	15821966417
Fax:	--
Email:	qh.zhang@mobiletek.cn
Contact Person:	Qinghua Zhang

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3. Equipment under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

EUT Description	IoT Module
Model name	L710
Brand name	LYNQ
NB-IoT Frequency Band	2/4/5/12/13/26
Type of modulation	BPSK/QPSK
Nominal Voltage	3.8
Extreme High Voltage	4.2
Extreme Low Voltage	3.4

Note: Photographs of EUT are shown in ANNEX A of this test report.

Note: High and low voltage values in extreme condition test are given by manufacturer.

3.2. Internal Identification of EUT used during the test

EUT ID	SN or IMEI	HW Version	SW Version	Date of receipt
S4	866884049909625	V4.0	L710v09.01b01G_FGP.01	2022-10-27

*EUT ID: is used to identify the test sample in the lab internally.

3.3. Outline of Equipment under Test

Technology	Band	UL Freq.(MHz)	DL Freq.(MHz)	Note
NB-IoT	Band2	1850 – 1910	1930 – 1990	The uplink frequency range is 1850.2–1909.8MHz; Downlink frequency range: 1930.2 – 1989.8MHz
	Band4	1710-1755	2110-2155	The uplink frequency range is 1710.2–1754.8MHz; Downlink frequency range: 2110.2 – 2154.8MHz
	Band5	824 – 849	869 – 894	Covered by Band26 (Band5 is a subset of Band26. Both Bands share the same hardware and have the same radio performance. Separate measurement in Band5 is not required.)The uplink frequency range is 824.2–848.8MHz; Downlink frequency range: 869.2 – 893.8MHz
	Band12	699 – 716	729 – 746	The uplink frequency range is 699.2–715.8MHz; Downlink frequency range: 729.2 – 745.8MHz
	Band13	777 – 787	746 – 756	The uplink frequency range is 777.2–786.8MHz; Downlink frequency range: 746.2 – 755.8MHz
	Band26	814 – 849	859 – 894	The uplink frequency range is 814.2–848.8MHz; Downlink frequency range: 859.2 – 893.8MHz

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3.4. Internal Identification of AE used during the test

*AE ID: is used to identify the test sample in the lab internally.

AE ID*	Description	Manufacturer	Model
AE1	SUB	Shanghai Mobiletek Communication Ltd.	L710 EPI
AE2	EVB	Shanghai Mobiletek Communication Ltd.	L506 EVB
AE3	Antenna	Shanghai Jesoncom Communication Engineering Co., Ltd.	5J002B

AE info are provided customer.

Frequency Band	AntennaGain (dBi)	AntennaGain (dBd)
NB-IoT Band2/CAT-M Band2	2	-0.15
NB-IoT Band4/CAT-M Band4	4	1.85
NB-IoT Band5/CAT-M Band5	3	0.85
NB-IoT Band12/CAT-M Band12	4	1.85
NB-IoT Band13/CAT-M Band13	4	1.85
NB-IoT Band26/CAT-M Band26 (814MHz-824MHz)	4	1.85
NB-IoT Band26/CAT-M Band26 (824MHz-849MHz)	3	0.85

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4. Reference Documents

4.1. Documents supplied by applicant

PICS/PIXIT, referring to Annex B for detailed information, is supplied by the client or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC CFR Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS, e-CFR	--
PART 22	PUBLIC MOBILE SERVICES	--
PART 24	PERSONAL COMMUNICATIONS SERVICES,e-CFR,	--
PART 27	,MISCELLANEOUS WIRELESS OMMUNICATIONS SERVICES, e-CFR,	--
PART 90	PRIVATE LAND MOBILE RADIO SERVICES	--
ANSI C63.26-2015	--	2015

5. Test Equipments Utilized

5.1. RF Test System

No.	Equipment	Model	SN	HW Version	SW Version	Manufacture	Cal.Due Date
1	spectrum analyzer	FSQ 26	201137/026	--	--	R&S	2023-06-29
2	Universal Radio Communication Tester	CMW500	152395	--	--	R&S	2023-06-29
3	Universal Radio Communication Tester	CMW500	164483	--	--	R&S	2023-06-29
4	spectrum analyzer	N9020A	MY50200376	--	--	Agilent	2023-06-29
5	DC Power Supply	N6705B	MY50000919	--	--	Agilent	2023-06-29
6	DC source	EY3010ET	478620	--	--	ELECALL	2023-06-29

5.2. RSE Test System

No.	Equipment	Model	SN	HW Version	SW Version	Manufacture	Cal.Due Date
1	Test Receiver	ESU26	100367	01	4.43 SP3	R&S	2023-06-29
2	Ultra-wideband Log Periodic Antenna	VULB 9163	01392	--	--	Schwarzbeck	2024-05-04
3	Double Ridged Guide Antenna	HF907	100357	--	--	R&S	2023-02-10
4	Universal Radio Communication Tester	CMW500	109616	--	--	R&S	2023-06-29
5	Double Ridged Guide Antenna	HF907	100356	--	--	R&S	2023-07-07
6	Generator	SMU 200A	104517	--	--	R&S	2023-06-29
7	Ultra-wideband Log Periodic Antenna	VULB 9163	00995	--	--	R&S	2023-04-03
8	Amplifier1	150A	1429	--	--	Beehive	2023-06-18
9	Amplifier2	SCU 18	10141	--	--	R&S	--

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5.3. Climate Chamber

No.	Name	Type	SN	Manufacture	Cal.Due Date
1	Climate chamber	SH-241	92010759	ESPEC	2023-06-29
2	Fully-Anechoic Chamber	FACT3-2	--	ETS	2023-06-25

5.4. Vibration table

No.	Name	Type	SN	Manufacture	Cal.Due Date
--	--	--	--	--	--

Anechoic chamber

Fully anechoic chamber by ETS-LINDGREN.

5.5. Test software

No.	Name	version	SN	Manufacture
1	EMC32	V 8.51.00	--	R&S

6. Test Results

6.1. Summary of Test Results

A brief summary of the tests carried out is shown as following.

FCC Rules	Name of Test	Result
2.1046,22.913(a),24.232(c),27.50,90.635(b)	Conducted RF Power Output	Pass
2.1046,22.913(a),24.232(c),27.50,90.635(b)	ERP and EIRP	Pass
2.1049,22.917(b), 24.238(b),90.209	Occupied Bandwidth	--
2.1051,24.238,2.1053,22.917, 27.53,90.691	Conducted spurious emissions	Pass
2.1051,24.238,2.1053,22.917, 27.53,90.691	Radiated Spurious Emission	Pass
2.1051,24.238, 2.1053, 22.917, 27.53,90.691	Band Edge	Pass
2.1055, 22.355,24.235, 27.54,90.213	Frequency Stability over Temperature Variation	Pass
2.1055, 22.355,24.235, 27.54,90.213	Frequency Stability over Voltage Variation	Pass
24.232, 27.50	Peak to Average Ratio	Pass
Note 1: No applicable performance criteria.		

-

6.2. Conducted RF Power Output

Specifications:	FCC Part 2.1046,22.913(a),24.232(c),27.50,90.635(b)
DUT Serial Number:	866884049909625
Test conditions:	Ambient Temperature:15°C-35°C Relative Humidity:30%-60% Air pressure: 86-106kPa
Test Results:	Pass

Limit Level Construction:

According to Part 22.913(a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

According to Part 24.232(c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

According to Part 27.50(c), portable stations (hand-held devices) in the 600 MHz uplink Band and the 698-746 MHz Band, and fixed and mobile stations in the 600 MHz uplink Band are limited to 3 watts ERP.

According to Part 27.50(d), fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz Band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz Bands are limited to 1 watt EIRP.

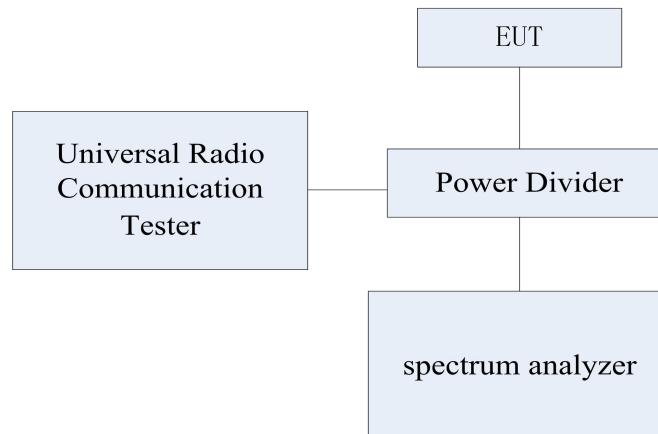
According to Part 90.635 (b), The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

Measurement Uncertainty:

Item	Uncertainty
Expanded Uncertainty	0.62 dB (k=2)

Test Setup:

During the test, the EUT was controlled via the Wireless Telecommunications Test Set to ensure max power transmission and proper modulation and measured by spectrum analyzer.



Test Method:

- 1) The EUT was coupled to the spectrum analyzer and the Wireless Telecommunications Test Set through a power divider. The loss of the RF cables of the test system is calibrated to correct the readings.
- 2) For RMS power test, the spectrum analyzer was set to RMS Detector function and Maximum hold mode.
- 3) For Peak power test, the spectrum analyzer was set to Maxpeak Detector function and Maximum hold mode.
- 4) The resolution Bandwidth of the spectrum analyzer was comparable to the emission Bandwidth.

6.2.1 NB-IoT Band2 Conducted RF Power Output Results

NB-IoT Band 2

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low18602	Mid18900	High19198
3.75	BPSK	1@0	21.81	21.21	21.51
		1@47	21.78	21.23	21.52
	QPSK	1@0	21.77	21.30	21.56
		1@47	21.74	21.24	21.49
15	BPSK	1@0	21.83	21.95	21.78
		1@11	21.83	21.95	21.74
	QPSK	1@0	21.84	21.15	21.85
		1@11	21.82	21.93	21.73
		12@0	20.22	20.32	20.92

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6.2.2 NB-IoT Band4 Conducted RF Power Output Results

NB-IoT Band 4

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low19952	Mid20175	High20398
3.75	BPSK	1@0	21.97	21.31	21.16
		1@47	21.99	21.30	21.20
	QPSK	1@0	21.01	21.35	21.36
		1@47	21.92	21.30	21.21
15	BPSK	1@0	21.32	21.48	21.42
		1@11	21.28	21.40	21.40
	QPSK	1@0	21.34	21.59	21.46
		1@11	21.27	21.49	21.36
		12@0	20.68	20.87	20.76

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6.2.3 NB-IoT Band12 Conducted RF Power Output Results

NB-IoT Band12

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low23012	Mid23095	High23178
3.75	BPSK	1@0	21.49	21.41	21.77
		1@47	21.44	21.37	21.74
	QPSK	1@0	21.22	21.15	21.42
		1@47	21.26	21.12	21.39
15	BPSK	1@0	21.23	21.10	21.52
		1@11	21.21	21.16	21.35
	QPSK	1@0	21.42	21.40	21.68
		1@11	21.18	21.23	21.48
		12@0	20.36	20.48	20.80

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6.2.4 NB-IoT Band13 Conducted RF Power Output Results

NB-IoT Band13

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low23182	Mid23230	High23278
3.75	BPSK	1@0	21.76	21.46	21.51
		1@47	21.77	21.37	21.52
	QPSK	1@0	21.77	21.43	21.56
		1@47	21.74	21.34	21.49
15	BPSK	1@0	21.90	21.74	21.78
		1@11	21.84	21.58	21.74
	QPSK	1@0	21.89	21.82	21.85
		1@11	21.82	21.75	21.73
		12@0	20.15	20.25	20.92

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6.2.5 NB-IoT Band 26 Conducted RF Power Output Results

(824MHz-849MHz)

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low26792	Mid26915	High27038
3.75	BPSK	1@0	21.84	21.70	21.02
		1@47	21.98	21.68	21.96
	QPSK	1@0	21.82	21.79	21.93
		1@47	21.74	21.81	21.84
15	BPSK	1@0	21.48	21.93	21.28
		1@11	21.41	21.95	21.24
	QPSK	1@0	21.44	21.00	21.24
		1@11	21.37	21.14	21.17
		12@0	20.78	20.61	20.71

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(814MHz-824MHz)

Maximum Average Conducted Power (dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low26692	Mid26740	High26788
3.75	BPSK	1@0	21.80	21.78	21.61
		1@47	21.84	21.77	21.66
	QPSK	1@0	21.94	21.62	21.84
		1@47	21.87	21.67	21.71
15	BPSK	1@0	21.15	21.99	21.85
		1@11	21.25	21.97	21.82
	QPSK	1@0	21.10	21.05	21.94
		1@11	21.07	21.94	21.87
		12@0	20.97	20.98	20.99

6.3. ERP and EIRP

This is the test for the maximum radiated power from the EUT.

According to Part 22.913(a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

According to Part 24.232(c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

According to Part 27.50(c), portable stations (hand-held devices) in the 600 MHz uplink Band and the 698-746 MHz Band, and fixed and mobile stations in the 600 MHz uplink Band are limited to 3 watts ERP.

According to Part 27.50(d), fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz Band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz Bands are limited to 1 watt EIRP.

According to 22.913(a), The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.”

Conducted RF Power+Antenna Gain(dBi)=EIRP

Conducted RF Power+Antenna Gain(dBd)=ERP

Antenna Gain(dBd)= Antenna Gain(dBi)-2.15

Frequency Band	AntennaGain (dBi)	AntennaGain (dBd)
NB-IoT Band2/CAT-M Band2	2	N/A
NB-IoT Band4/CAT-M Band4	4	N/A
NB-IoT Band5/CAT-M Band5	N/A	0.85
NB-IoT Band12/CAT-M Band12	N/A	1.85
NB-IoT Band13/CAT-M Band13	N/A	1.85
NB-IoT Band26/CAT-M Band26 (814MHz-824MHz)	N/A	1.85
NB-IoT Band26/CAT-M Band26 (824MHz-849MHz)	3	0.85

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6.3.1 NB-IoT Band 2 EIRP

EIRP (dBm) (EIRP Limits : 30dBm Max EIRP=23.95dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low18602	Mid18900	High19198
3.75	BPSK	1@0	23.81	23.21	23.51
		1@47	23.78	23.23	23.52
	QPSK	1@0	23.77	23.3	23.56
		1@47	23.74	23.24	23.49
15	BPSK	1@0	23.83	23.95	23.78
		1@11	23.83	23.95	23.74
	QPSK	1@0	23.84	23.15	23.85
		1@11	23.82	23.93	23.73
		12@0	22.22	22.32	22.92

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6.3.2 NB-IoT Band 4 EIRP

EIRP (dBm) (EIRP Limits : 30dBm Max EIRP=25.99dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low19952	Mid20175	High20398
3.75	BPSK	1@0	25.97	25.31	25.16
		1@47	25.99	25.30	25.20
	QPSK	1@0	25.01	25.35	25.36
		1@47	25.92	25.30	25.21
15	BPSK	1@0	25.32	25.48	25.42
		1@11	25.28	25.40	25.40
	QPSK	1@0	25.34	25.59	25.46
		1@11	25.27	25.49	25.36
		12@0	24.68	24.87	24.76

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6.3.3 NB-IoT Band 12 ERP

ERP (dBm) (ERP Limits : 34.8 dBm Max ERP=23.62dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low23012	Mid23095	High23178
3.75	BPSK	1@0	23.34	23.26	23.62
		1@47	23.29	23.22	23.59
	QPSK	1@0	23.07	23.00	23.27
		1@47	23.11	22.97	23.24
15	BPSK	1@0	23.08	22.95	23.37
		1@11	23.06	23.01	23.20
	QPSK	1@0	23.27	23.25	23.53
		1@11	23.03	23.08	23.33
		12@0	22.21	22.33	22.65

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6.3.4 NB-IoT Band 13 ERP

ERP (dBm) (ERP Limits : 34.8 dBm Max ERP=23.75dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low23182	Mid23230	High23278
3.75	BPSK	1@0	23.61	23.31	23.36
		1@47	23.62	23.22	23.37
	QPSK	1@0	23.62	23.28	23.41
		1@47	23.59	23.19	23.34
15	BPSK	1@0	23.75	23.59	23.63
		1@11	23.69	23.43	23.59
	QPSK	1@0	23.74	23.67	23.70
		1@11	23.67	23.60	23.58
		12@0	22.00	22.10	22.77

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6.3.5 NB-IoT Band 26 ERP

(824MHz-849MHz)

ERP (dBm) (ERP Limits : 38.5dBm Max ERP=22.83dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low26792	Mid26915	High27038
3.75	BPSK	1@0	22.69	22.55	21.87
		1@47	22.83	22.53	22.81
	QPSK	1@0	22.67	22.64	22.78
		1@47	22.59	22.66	22.69
15	BPSK	1@0	22.33	22.78	22.13
		1@11	22.26	22.80	22.09
	QPSK	1@0	22.29	21.85	22.09
		1@11	22.22	21.99	22.02
		12@0	21.63	21.46	21.56

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(814MHz-824MHz)

ERP (dBm) (ERP Limits : 51.5 dBm Max ERP=25.67dBm)					
Sub-carrier Spacing [kHz]	Modulation	N _{tones}	Channel		
			Low26692	Mid26740	High26788
3.75	BPSK	1@0	22.65	22.63	22.46
		1@47	22.69	22.62	22.51
	QPSK	1@0	22.79	22.47	22.69
		1@47	22.72	22.52	22.56
15	BPSK	1@0	22.00	22.84	22.70
		1@11	22.10	22.82	22.67
	QPSK	1@0	21.95	21.90	22.79
		1@11	21.92	22.79	22.72
		12@0	21.82	21.83	21.84

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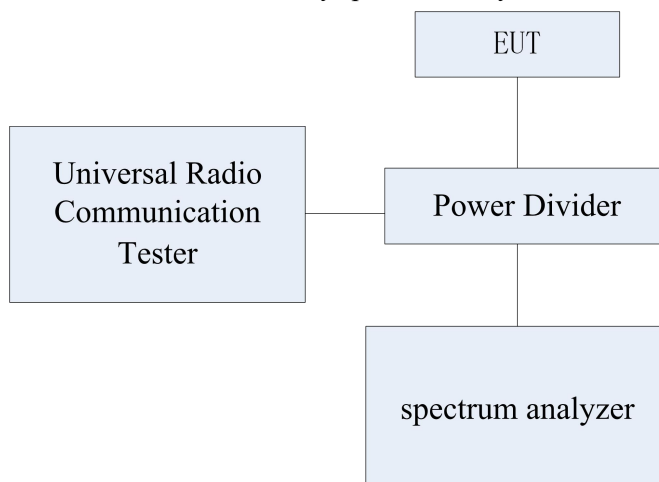
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6.4. Occupied Bandwidth

Specifications:	FCC Part 2.1049,22.917(b), 24.238(b),90.209
DUT Serial Number:	866884049909625
Test conditions:	Ambient Temperature:15°C-35°C Relative Humidity:30%-60% Air pressure: 86-106kPa
Test Results:	--

Test Setup

During the test, the EUT was controlled via the Wireless Communications Test Set to ensure max power transmission and proper modulation and measured by spectrum analyzer.



Measurement Uncertainty:

Item	Uncertainty
Expanded Uncertainty	500 kHz (k=2)

Test Method

The 99% occupied Bandwidth was calculated from the spectrum analyzer. Markers in the spectrum analyzer were then placed between the calculated frequencies to show the calculated 99% power Band. The 26dB Bandwidth was also measured and recorded.

Note: --

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6.4.1 NB-IoT B2 Mode Occupied Bandwidth Results

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	18602	12@0	15	197.25	/	261.40	/
Mid Range	18900			188.47	/	263.40	/
High Range	19198			186.70	/	262.90	/
Low Range	18602	1@0	15	135.45	126.65	131.20	107.10
			3.75	96.37	83.15	52.25	52.19
Mid Range	18900		15	133.25	127.04	132.00	107.40
			3.75	100.35	83.08	51.84	52.35
High Range	19198		15	126.45	126.45	106.8	106.8
			3.75	105.33	81.73	54.10	51.67

6.4.2 NB-IoT B4 Mode Occupied Bandwidth Results

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	19952	12@0	15	185.49	/	251.10	/
Mid Range	20175			186.28	/	259.70	/
High Range	20398			187.41	/	249.90	/
Low Range	19952	1@0	15	131.22	129.05	117.80	106.3
			3.75	100.07	81.79	52.82	52.36
Mid Range	20175		15	130.75	128.88	116.7	104.3
			3.75	99.66	82.96	51.22	50.84
High Range	20398		15	130.77	128.84	118.1	105.3
			3.75	99.10	83.98	54.54	52.28

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6.4.3 NB-IoT B12 Mode Occupied Bandwidth Results

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	23012	12@0	15	186.23	/	245.8	/
Mid Range	23095			185.63	/	250.3	/
High Range	23178			184.45	/	258.7	/
Low Range	23012	1@0	15	122.87	121.22	116.7	105.6
			3.75	89.07	71.75	50.96	51.69
Mid Range	23095		15	127.47	125.78	118.3	105.3
			3.75	91.09	74.40	52.25	51.40
High Range	23178		15	126.21	126.57	117.1	106.7
			3.75	87.68	74.99	52.31	51.89

6.4.4 NB-IoT B13 Mode Occupied Bandwidth Results

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	23182	12@0	15	184.17	/	258.2	/
Mid Range	23230			187.88	/	247.6	/
High Range	23278			186.21	/	248.2	/
Low Range	23182	1@0	15	128.38	125.06	118.5	106.1
			3.75	84.33	71.07	51.97	51.97
Mid Range	23230		15	127.07	122.66	116.5	106.5
			3.75	92.43	71.93	53.78	51.38
High Range	23278		15	126.29	126.28	117.9	104.5
			3.75	85.35	73.83	50.61	51.46

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6.4.5 NB-IoT B26 Mode Occupied Bandwidth Results

(814 MHz ~824MHz)

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	26692	12@0	15	185.67	/	237.7	/
Mid Range	26740			186.67	/	249.4	/
High Range	26788			187.51	/	252.3	/
Low Range	26692	1@0	15	129.30	125.11	118.1	104.1
			3.75	84.74	75.41	52.95	51.81
Mid Range	26740		15	125.52	125.65	131.0	104.9
			3.75	82.00	72.46	51.65	51.40
High Range	26788		15	124.63	122.24	118.0	104.4
			3.75	90.38	77.28	52.56	52.13

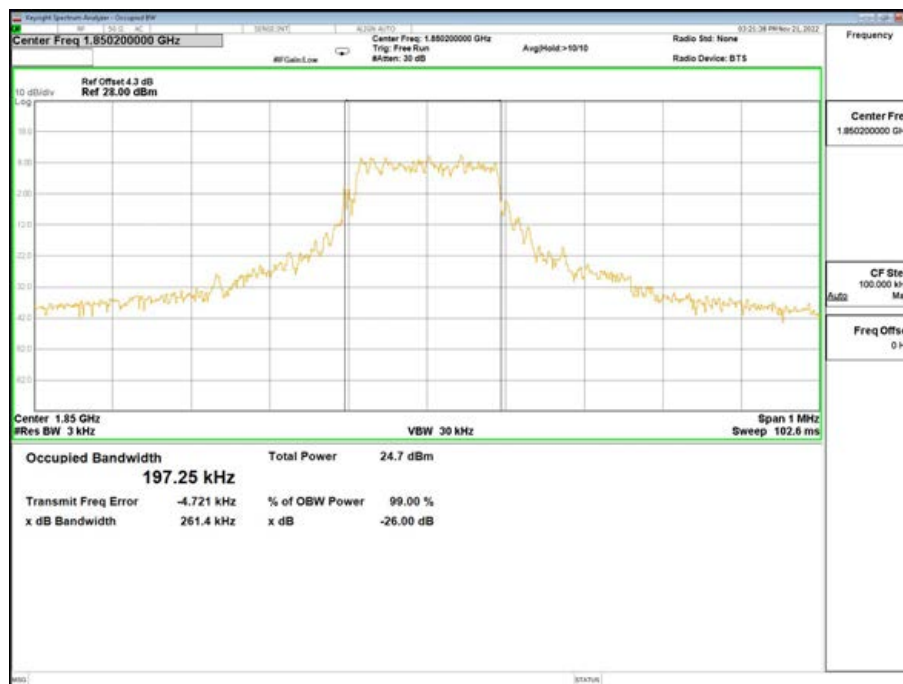
(824 MHz ~849MHz)

Frequency ID	N _{UL}	N _{tones}	Sub-carrier Spacing [kHz]	Occupied Bandwidth (99%) (kHz)		Occupied Bandwidth(26dB) (kHz)	
				QPSK	BPSK	QPSK	BPSK
Low Range	26792	12@0	15	186.27	/	248.5	/
Mid Range	26915			186.48	/	249.0	/
High Range	27038			186.09	/	250.6	/
Low Range	26792	1@0	15	122.31	126.48	115.8	106.1
			3.75	86.33	72.55	50.53	50.41
Mid Range	26915		15	125.49	123.96	117.4	106.2
			3.75	92.18	73.98	52.10	51.70
High Range	27038		15	126.08	127.56	117.4	114.4
			3.75	87.22	72.74	52.87	51.17

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Graphical results for NB-IoT:



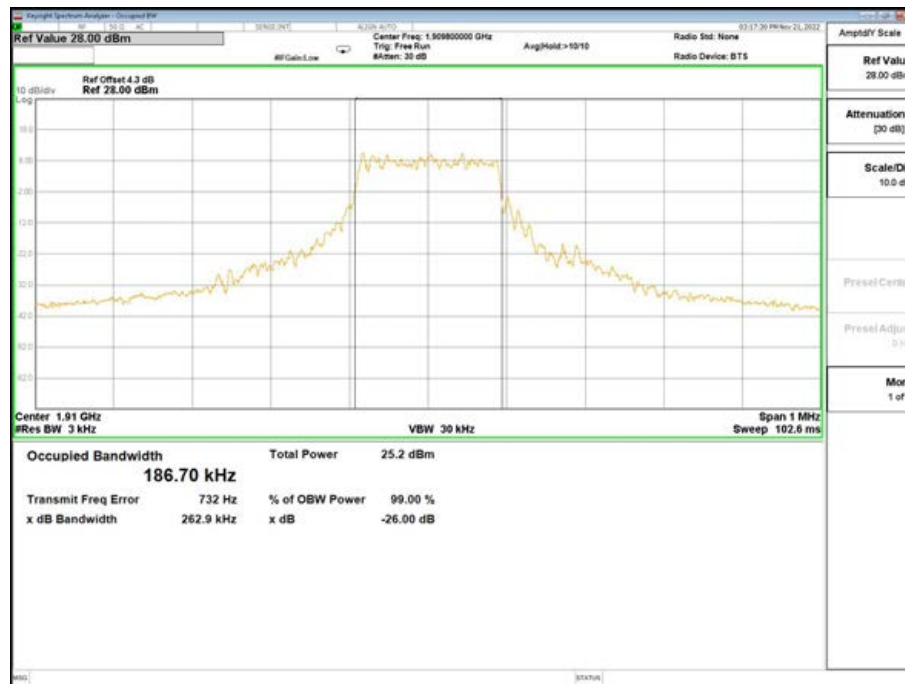
Band2-26dB/99% OBW-18602 Channel-QPSK-12@0-15K



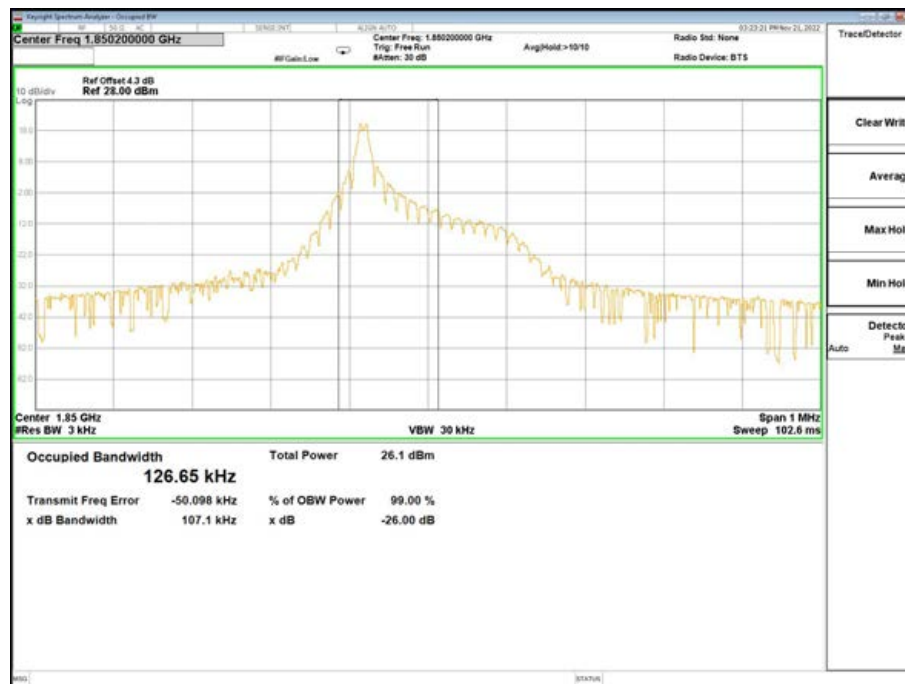
Band2-26dB/99% OBW-18900 Channel-QPSK-12@0-15K

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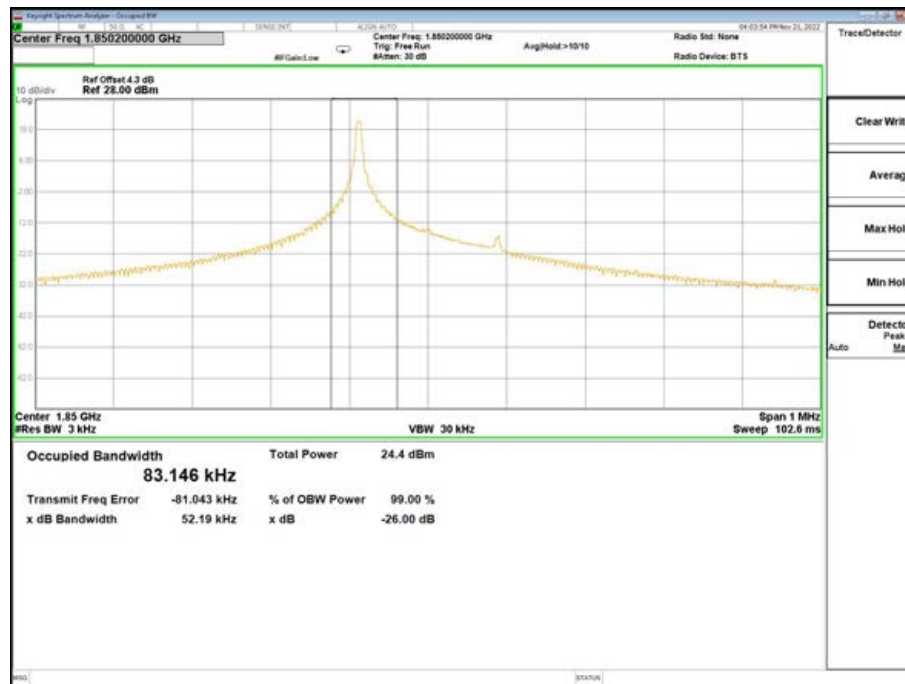
Band2-26dB/99% OBW-19198 Channel-QPSK-12@0-15K



Band2-26dB/99% OBW-18602 Channel-BPSK-1@0-15K

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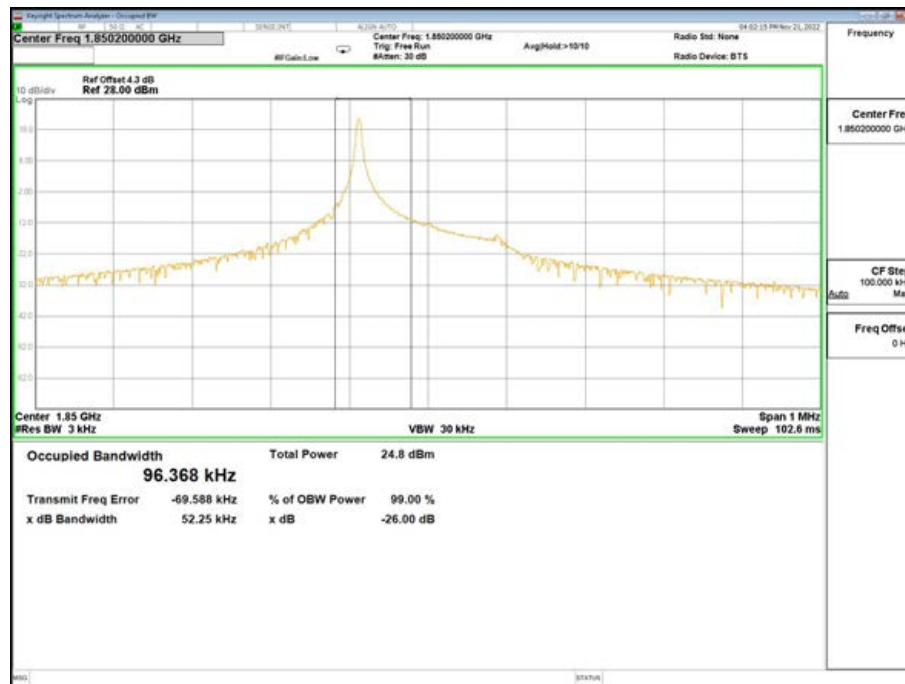
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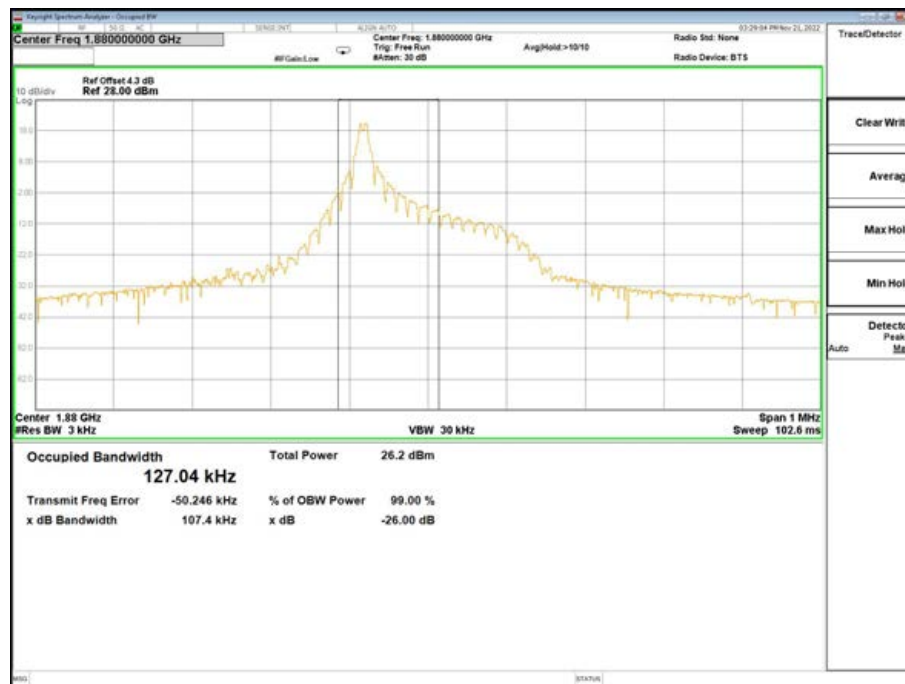
Band2-26dB/99% OBW-18602 Channel-BPSK-1@0-3.75K



Band2-26dB/99% OBW-18602 Channel-QPSK-1@0-15K



Band2-26dB/99% OBW-18602 Channel-QPSK-1@0-3.75K



Band2-26dB/99% OBW-18900 Channel-BPSK -1@0-15K



Band2-26dB/99% OBW-18900 Channel-BPSK -1@0-3.75K



Band2-26dB/99% OBW-18900 Channel-QPSK-1@0-15K

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Band2-26dB/99% OBW-18900 Channel-QPSK-1@0-3.75K



Band2-26dB/99% OBW-19198 Channel-BPSK-1@0-15K



Band2-26dB/99% OBW-19198 Channel-BPSK-1@0-3.75K



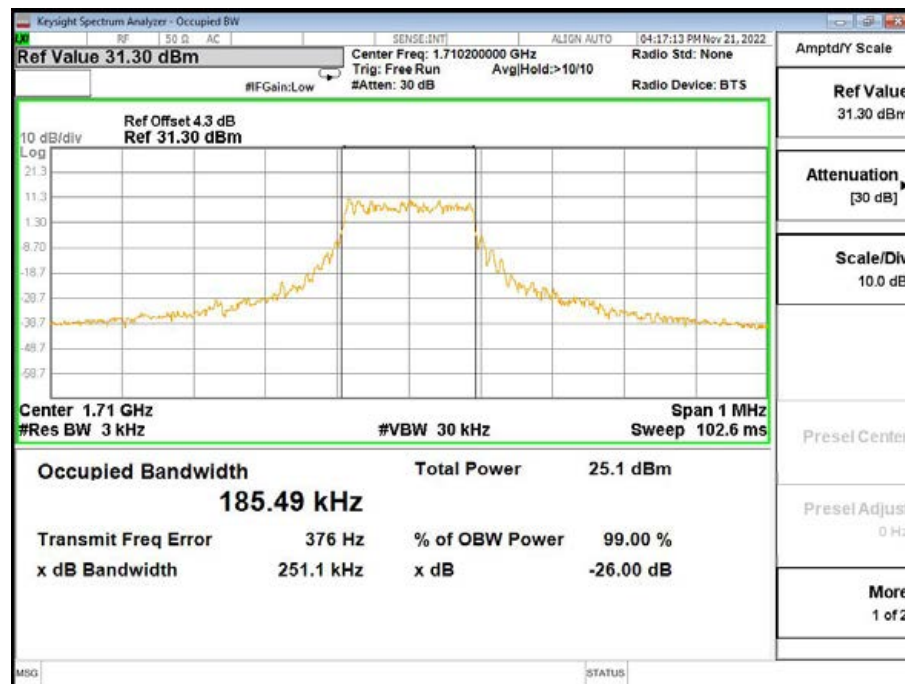
Band2-26dB/99% OBW-19198 Channel-QPSK-1@0-15K

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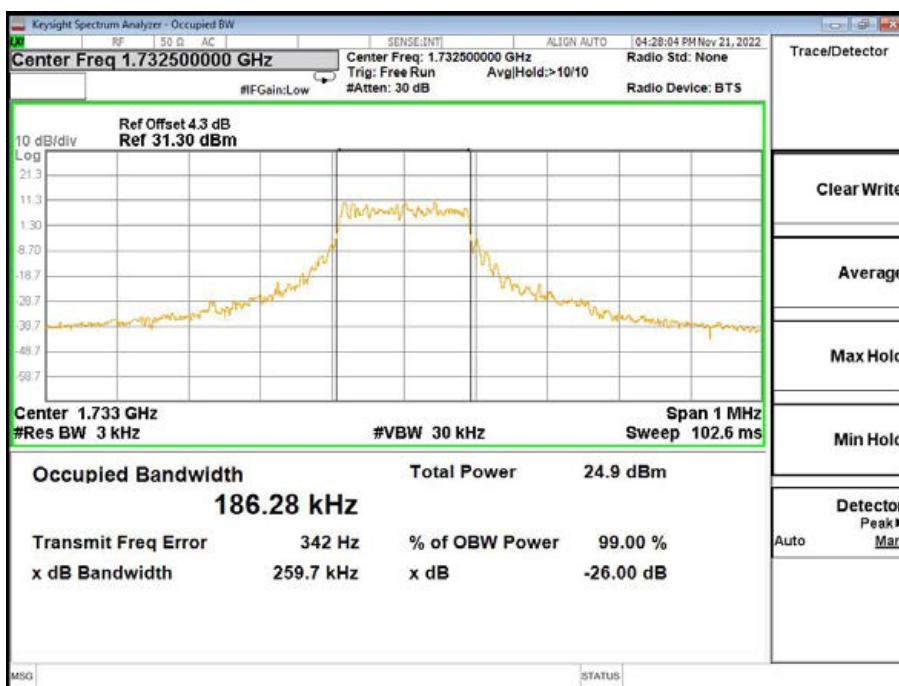
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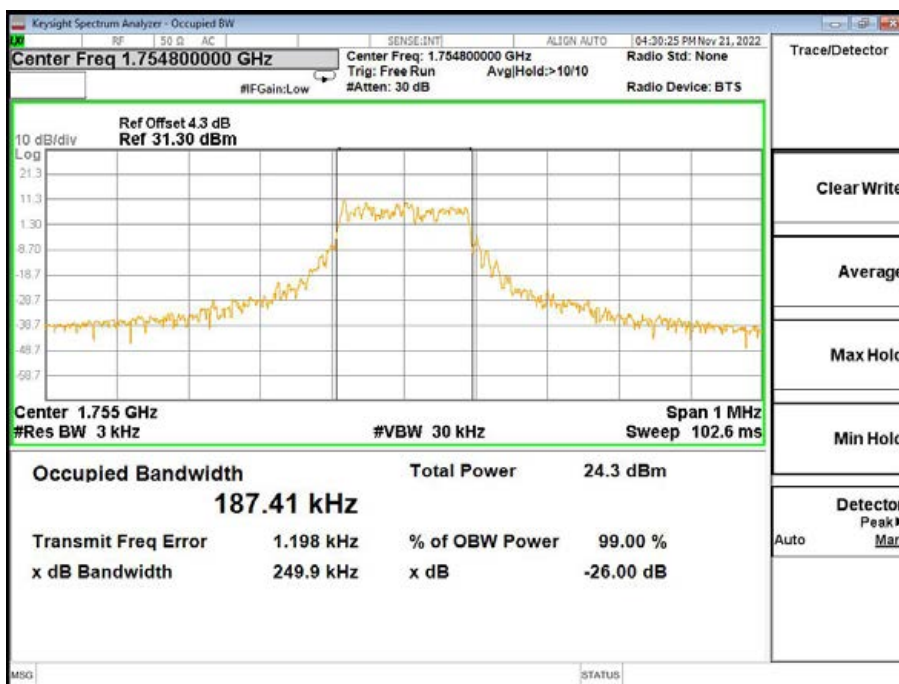
Band2-26dB/99% OBW-19198 Channel-QPSK-1@0-3.75K



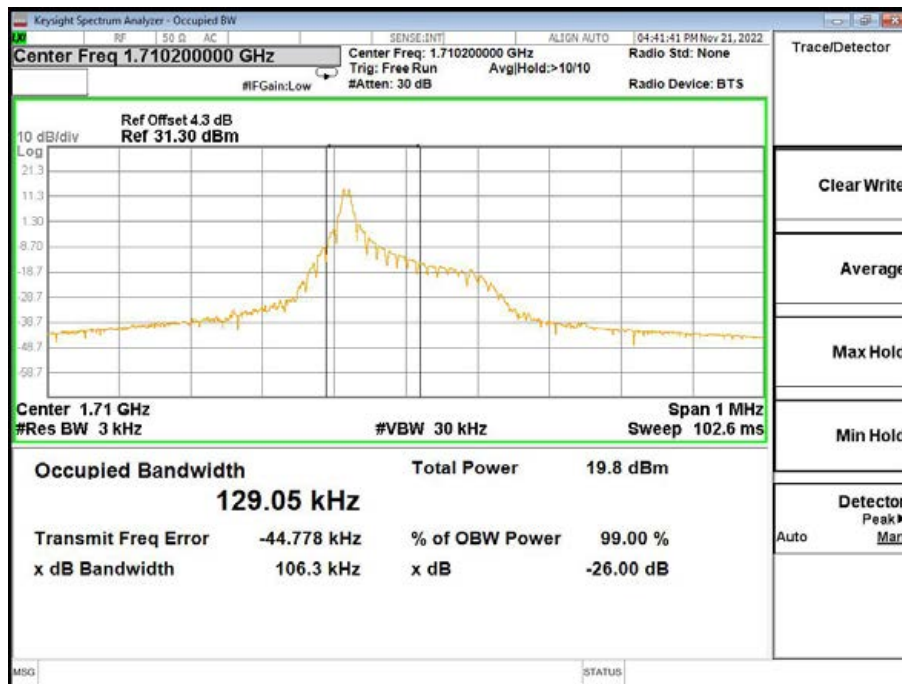
Band4-26dB/99% OBW-19952 Channel-QPSK-12@0-15K



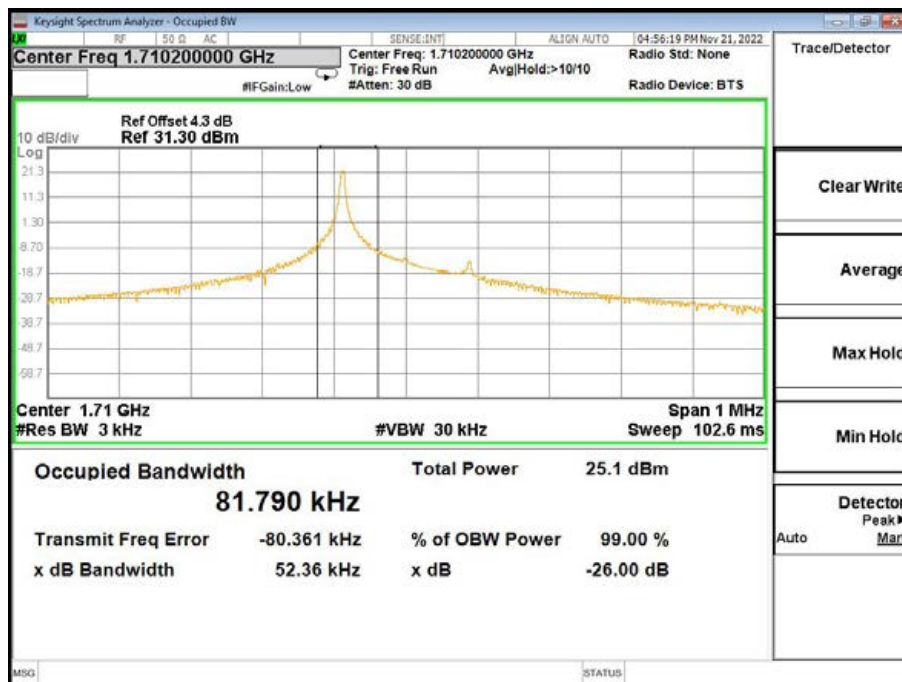
Band4-26dB/99% OBW-20175 Channel-QPSK-12@0-15K



Band4-26dB/99% OBW-20398 Channel-QPSK-12@0-15K



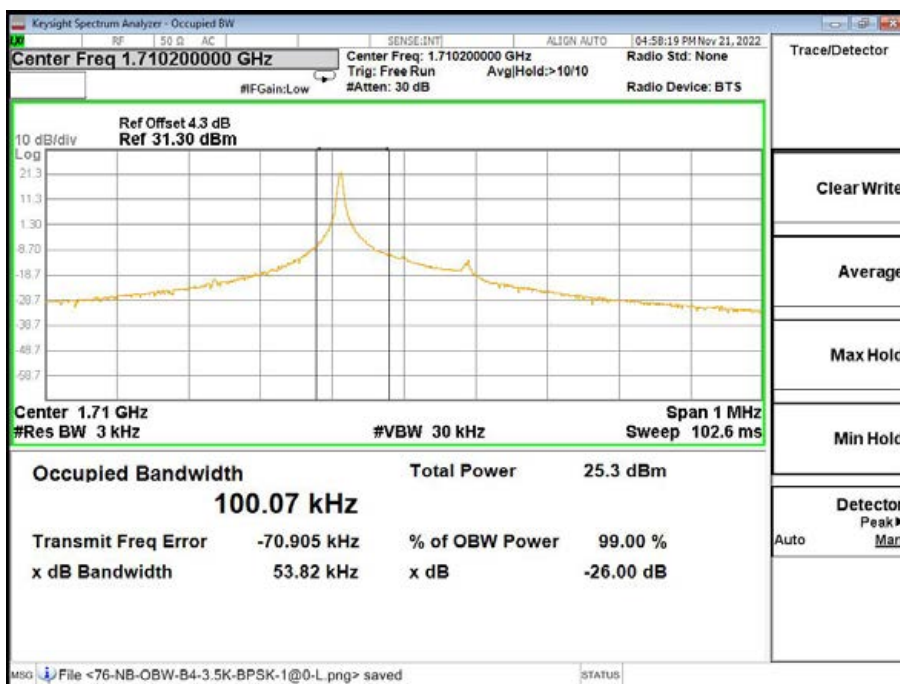
Band4-26dB/99% OBW-19952 Channel-BPSK-1@0-15K



Band4-26dB/99% OBW-19952 Channel-BPSK-1@0-3.75K



Band4-26dB/99% OBW-19952 Channel-QPSK-1@0-15K



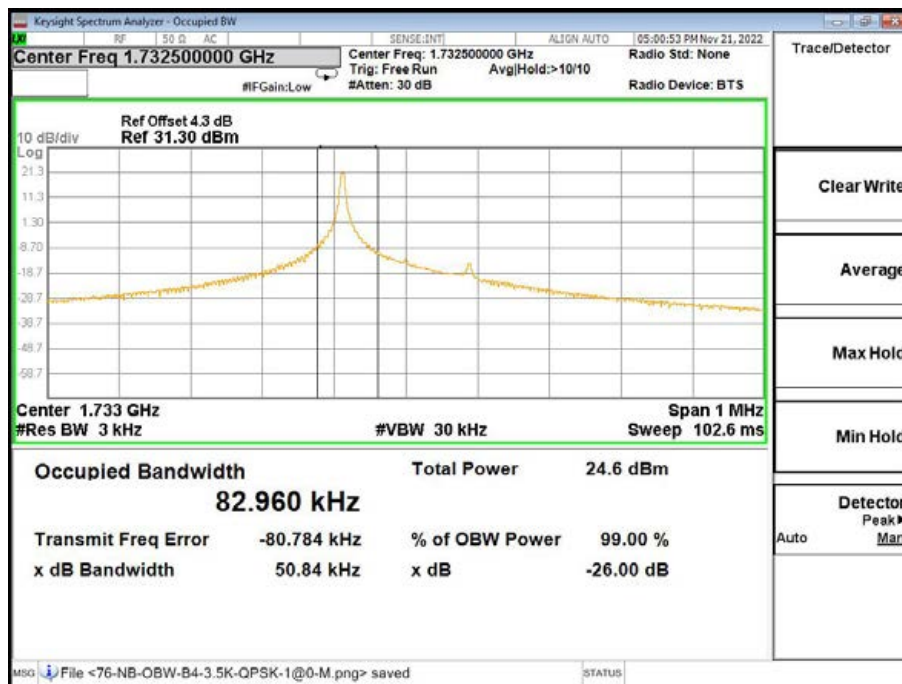
Band4-26dB/99% OBW-19952 Channel-QPSK-1@0-3.75K

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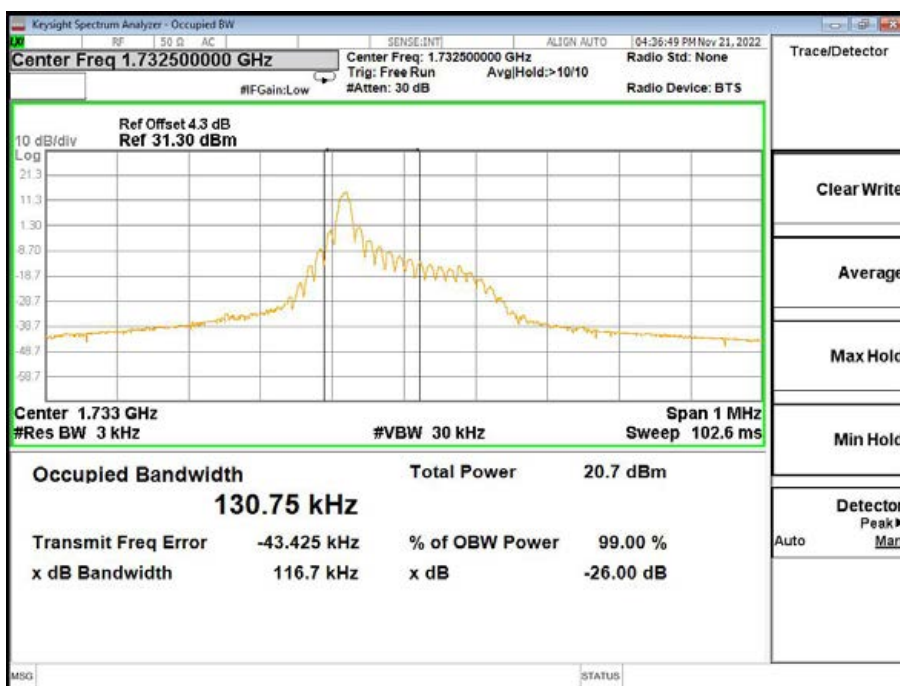
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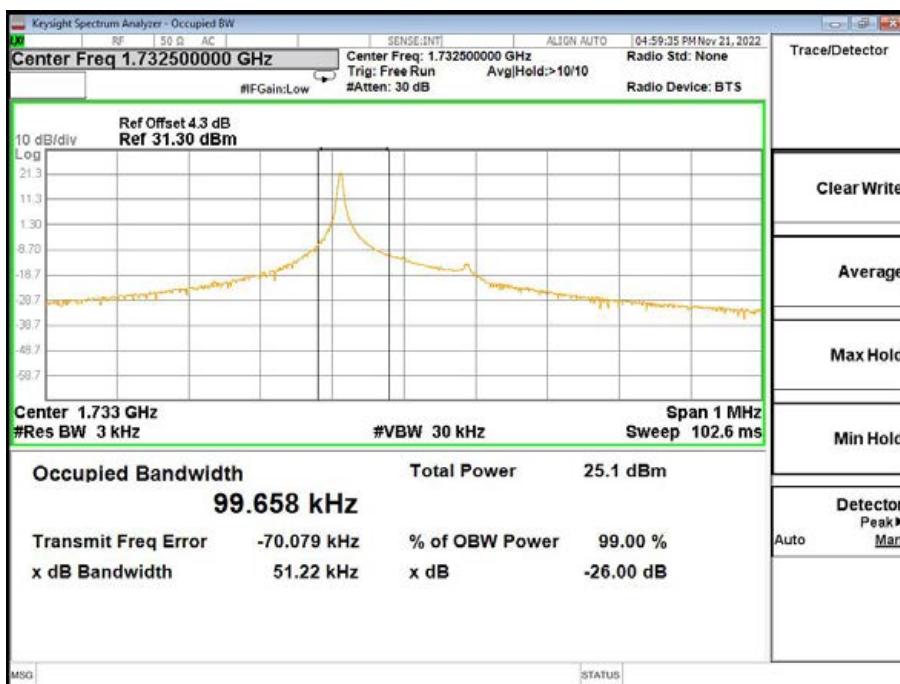
Band4-26dB/99% OBW-20175 Channel-BPSK-1@0-15K



Band4-26dB/99% OBW-20175 Channel-BPSK-1@0-3.75K



Band4-26dB/99% OBW-20175 Channel-QPSK-1@0-15K



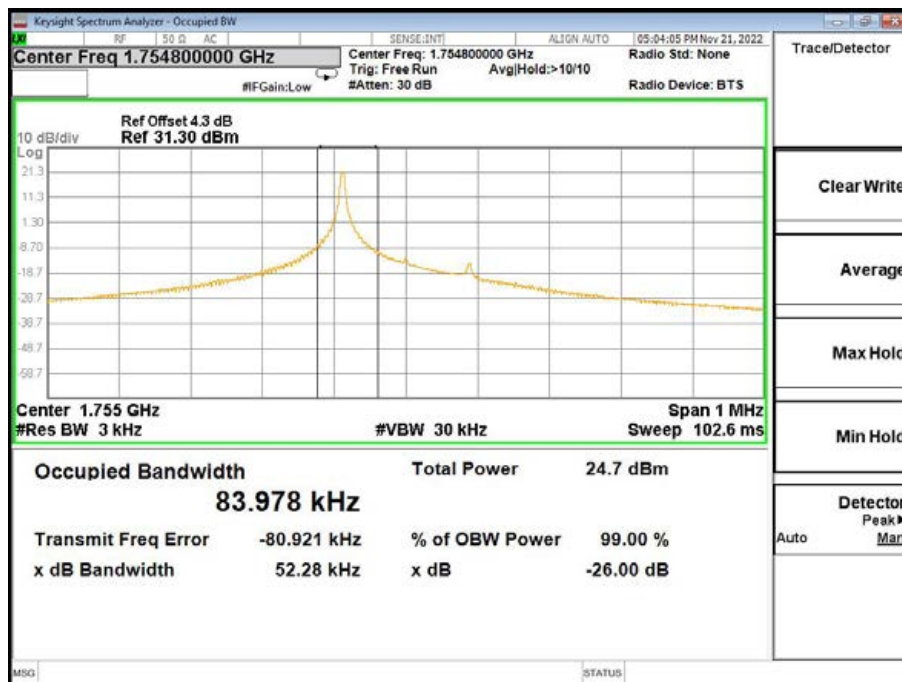
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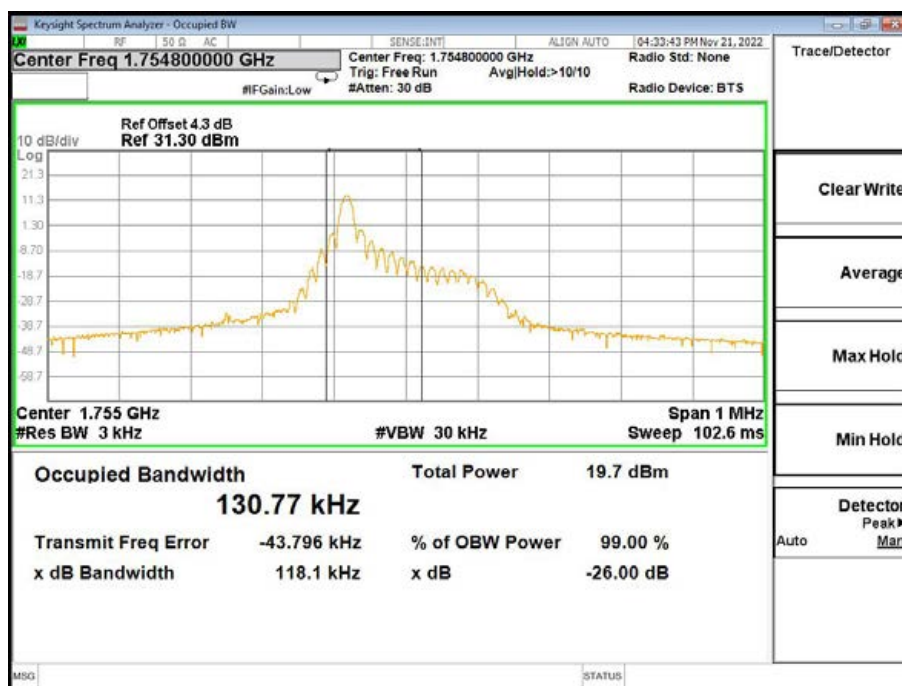
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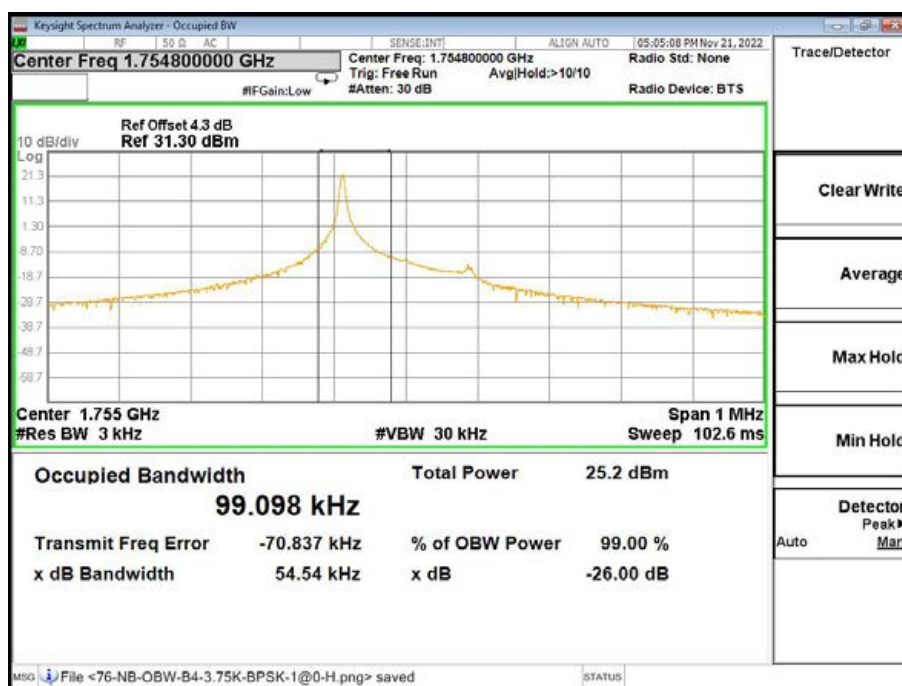
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Band4-26dB/99% OBW-20398 Channel-BPSK-1@0-3.75K



Band4-26dB/99% OBW-20398 Channel-QPSK-1@0-15K



Band4-26dB/99% OBW-20398 Channel-QPSK-1@0-3.75K

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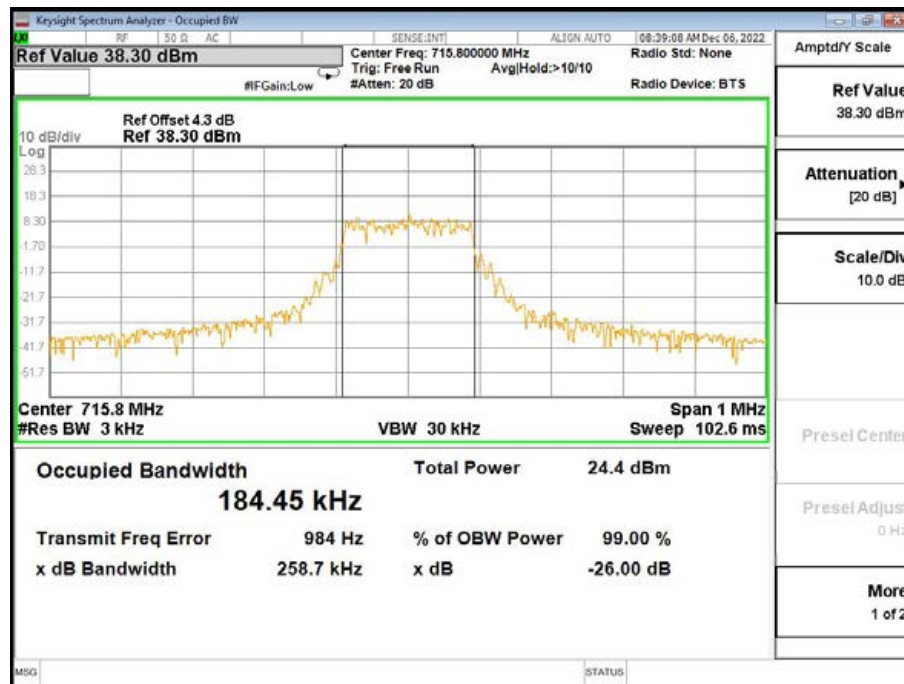
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Band12-26dB/99% OBW-23012 Channel-QPSK-12@0-15K



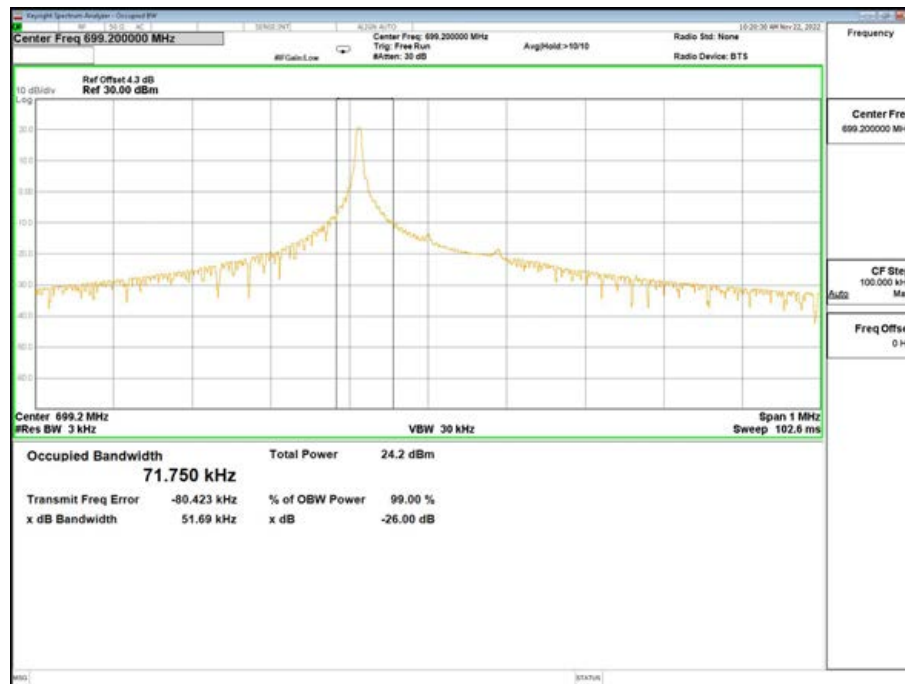
Band12-26dB/99% OBW-23095 Channel-QPSK-12@0-15



Band12-26dB/99% OBW-23178 Channel-QPSK-12@0-15K



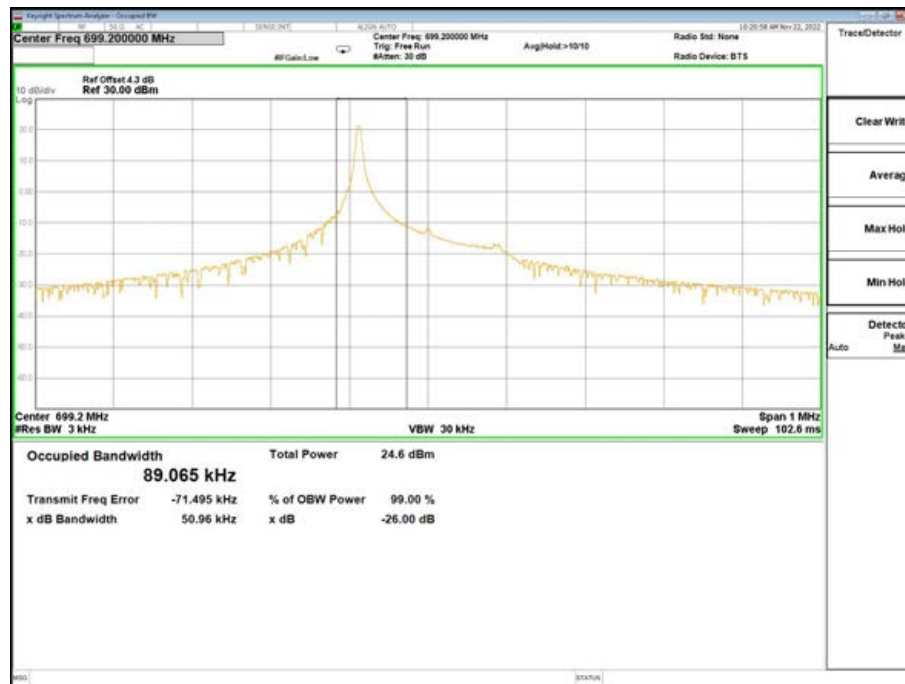
Band12-26dB/99% OBW-23012 Channel-BPSK-1@0-15K



Band12-26dB/99% OBW-23012 Channel-BPSK-1@0-3.75K



Band12-26dB/99% OBW-23012 Channel-QPSK-1@0-15K



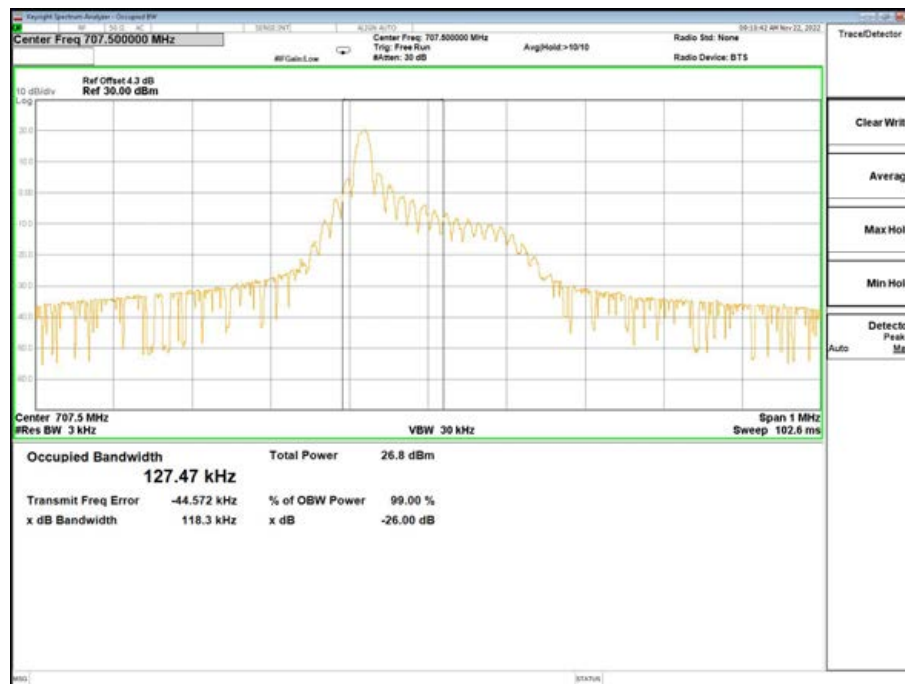
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Band12-26dB/99% OBW-23095 Channel-BPSK-1@0-15K



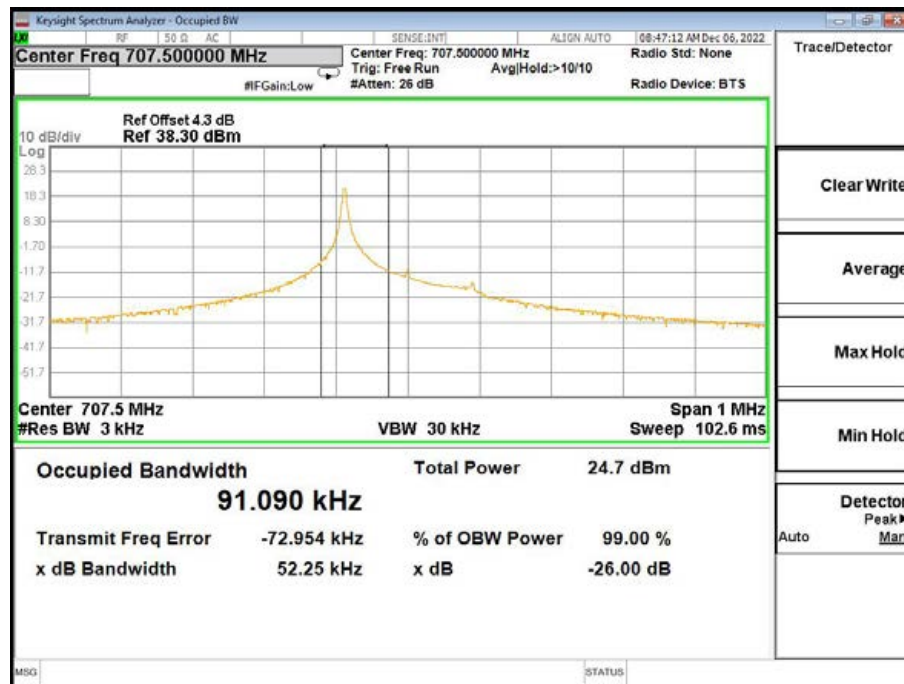
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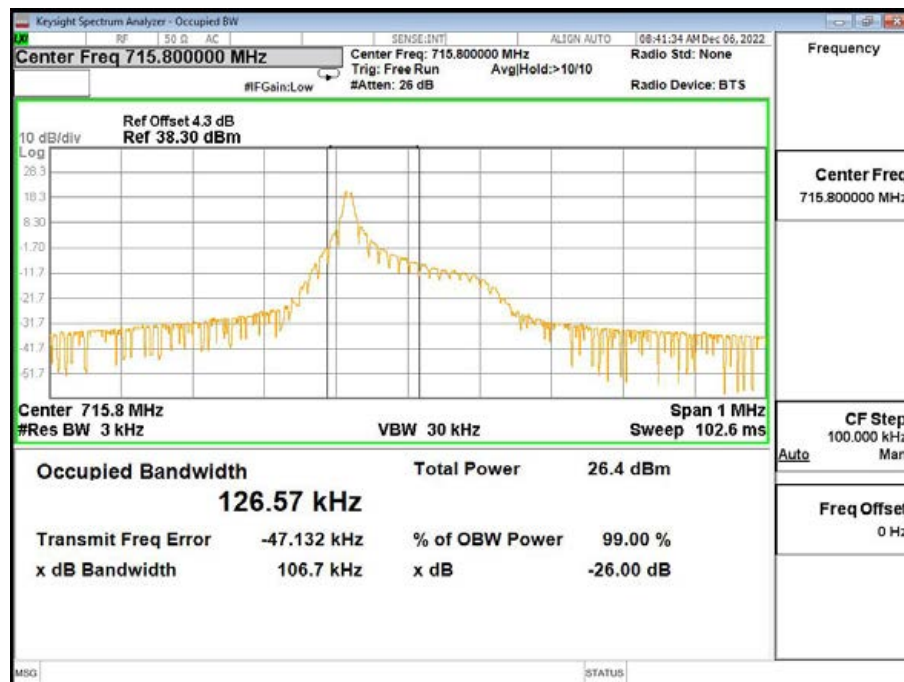
Band12-26dB/99% OBW-23095 Channel-QPSK-1@0-15K

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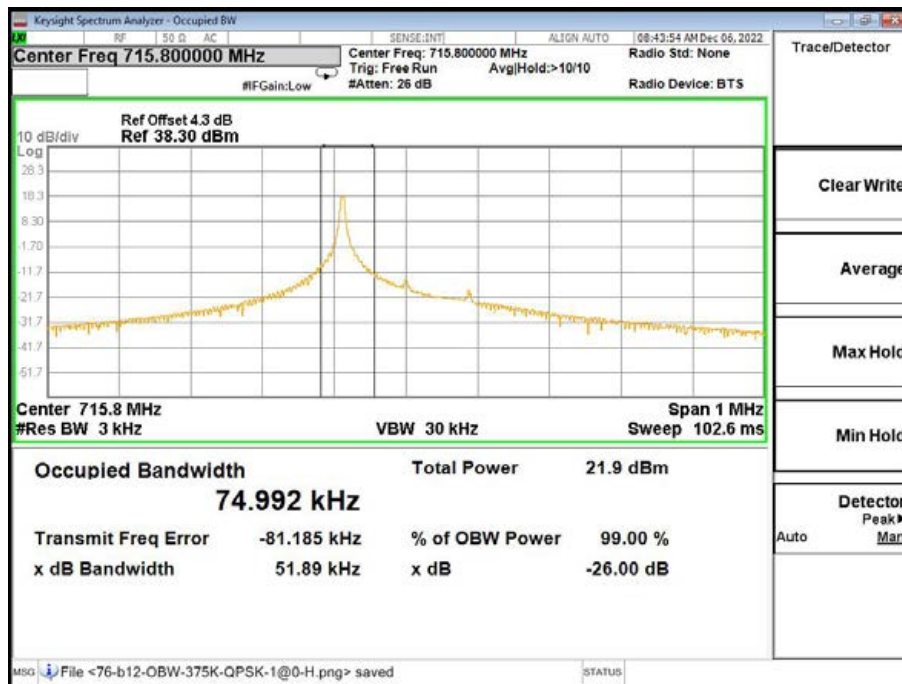
Band12-26dB/99% OBW-23095 Channel-QPSK-1@0-3.75K



Band12-26dB/99% OBW-23178 Channel-BPSK-1@0-15K

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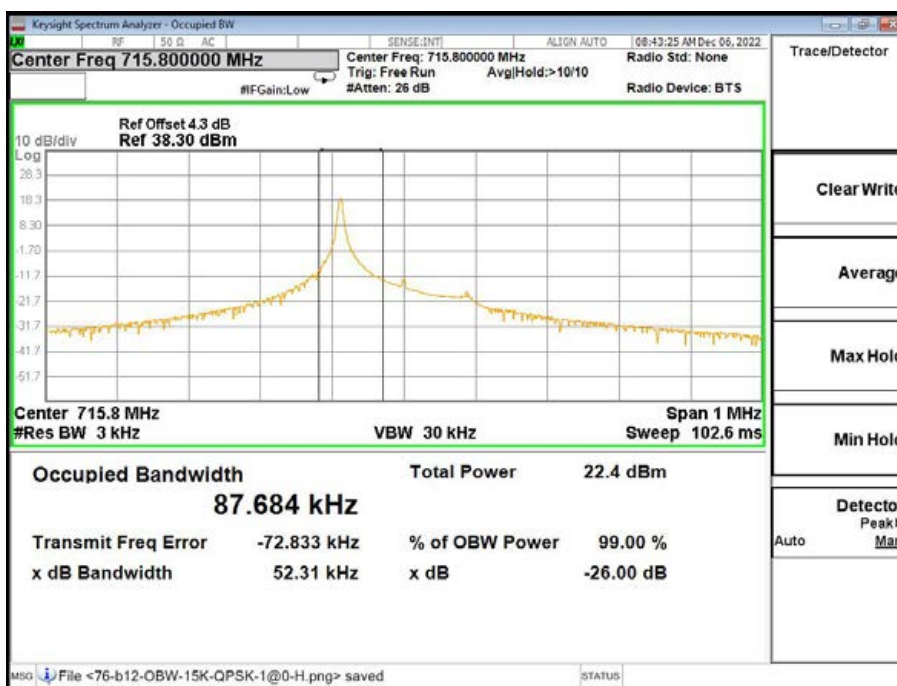
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Band12-26dB/99% OBW-23178 Channel-BPSK-1@0-3.75K



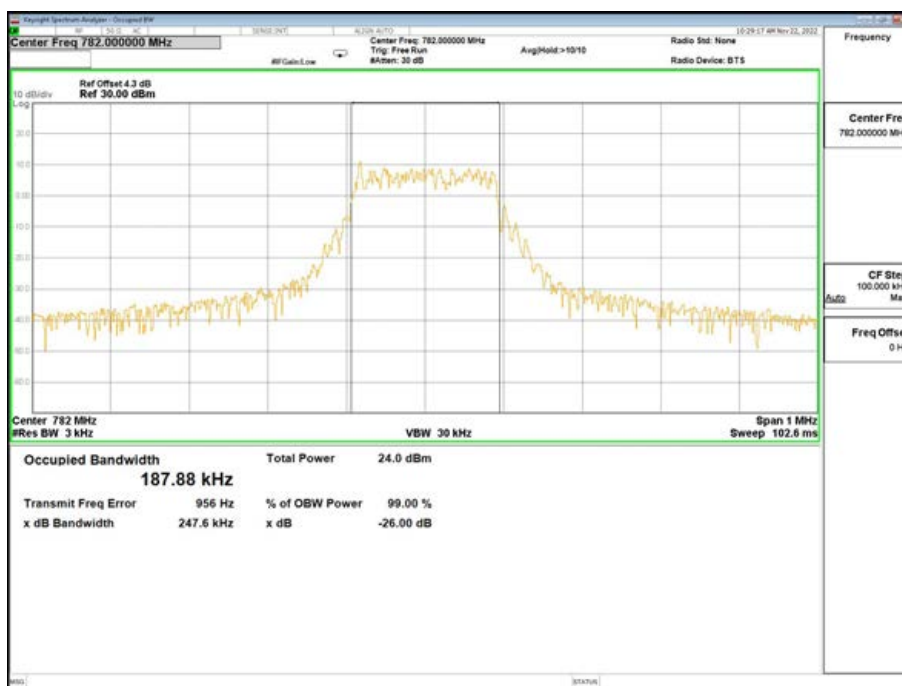
Band12-26dB/99% OBW-23178 Channel-QPSK-1@0-15K



Band12-26dB/99% OBW-23178 Channel-QPSK-1@0-3.75K



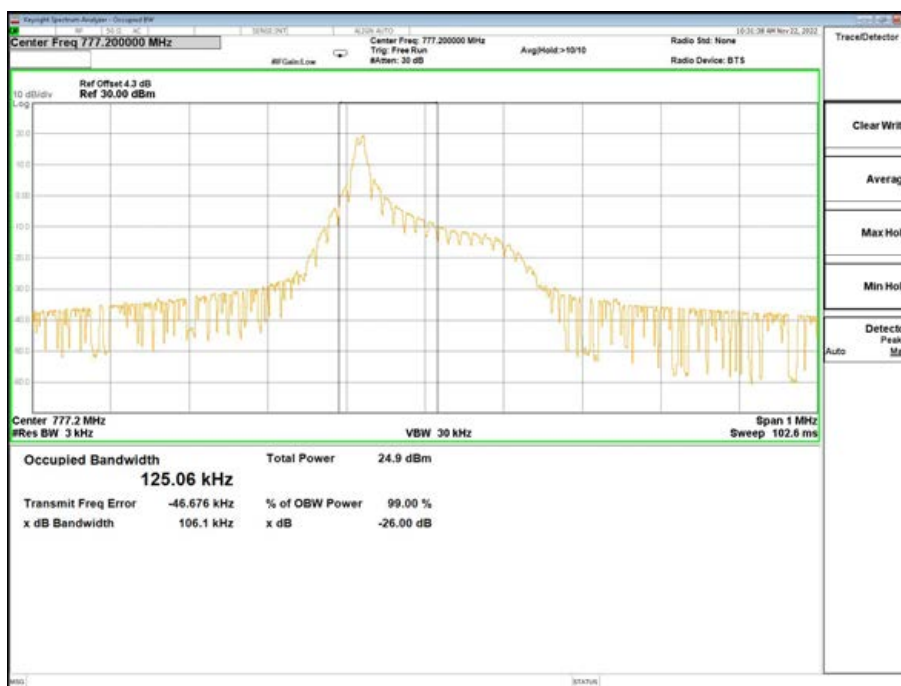
Band13-26dB/99% OBW-23182 Channel-QPSK-12@0-15K



Band13-26dB/99% OBW-23230 Channel-QPSK-12@0-15K



Band13-26dB/99% OBW-23278 Channel-QPSK-12@0-15K



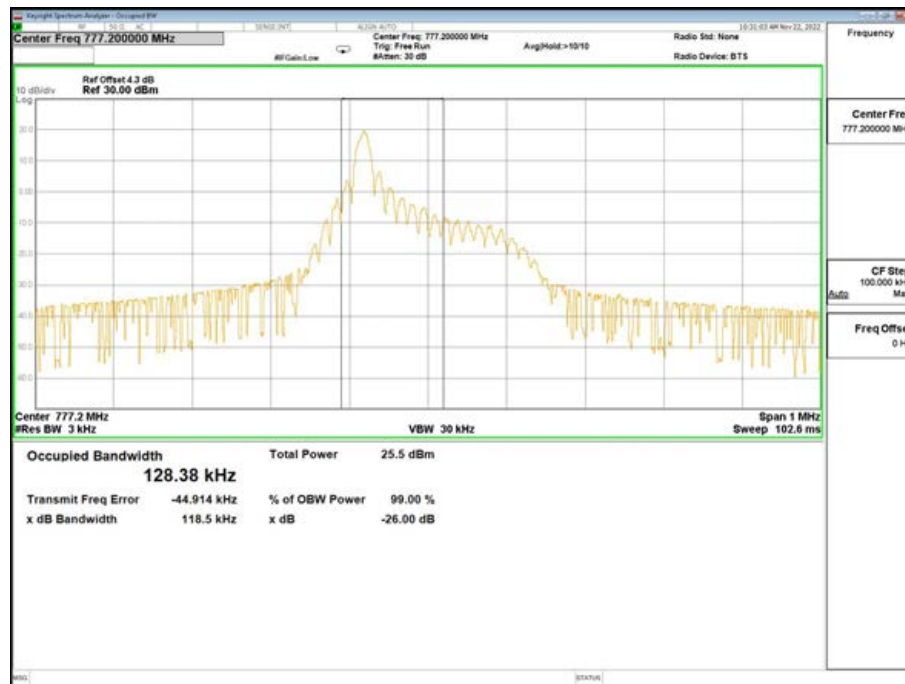
Band13-26dB/99% OBW-23182 Channel-BPSK-1@0-15K



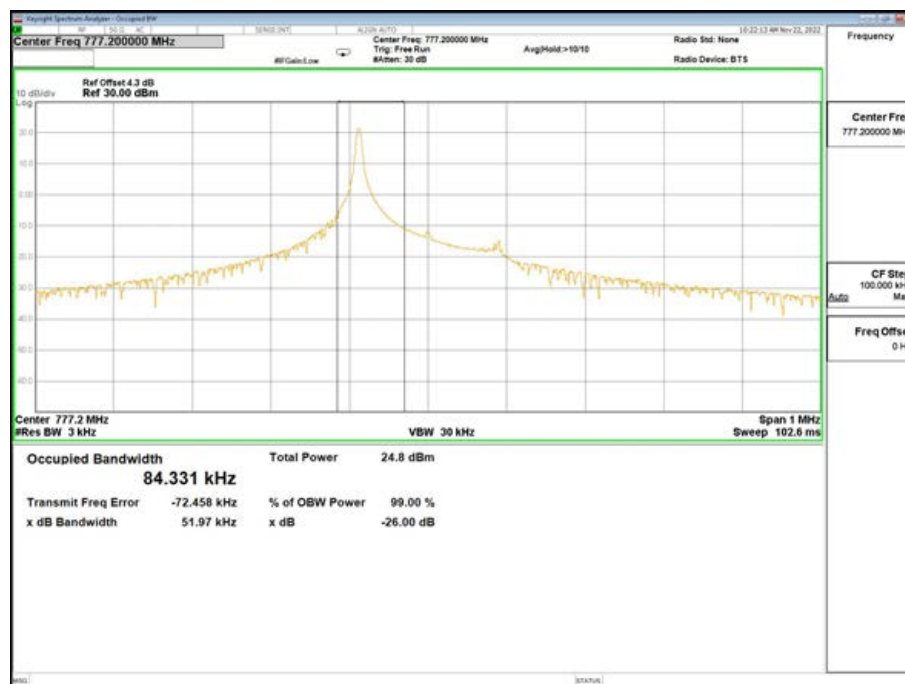
Band13-26dB/99% OBW-23182 Channel-BPSK-1@0-3.75K

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Band13-26dB/99% OBW-23182 Channel-QPSK-1@0-15K



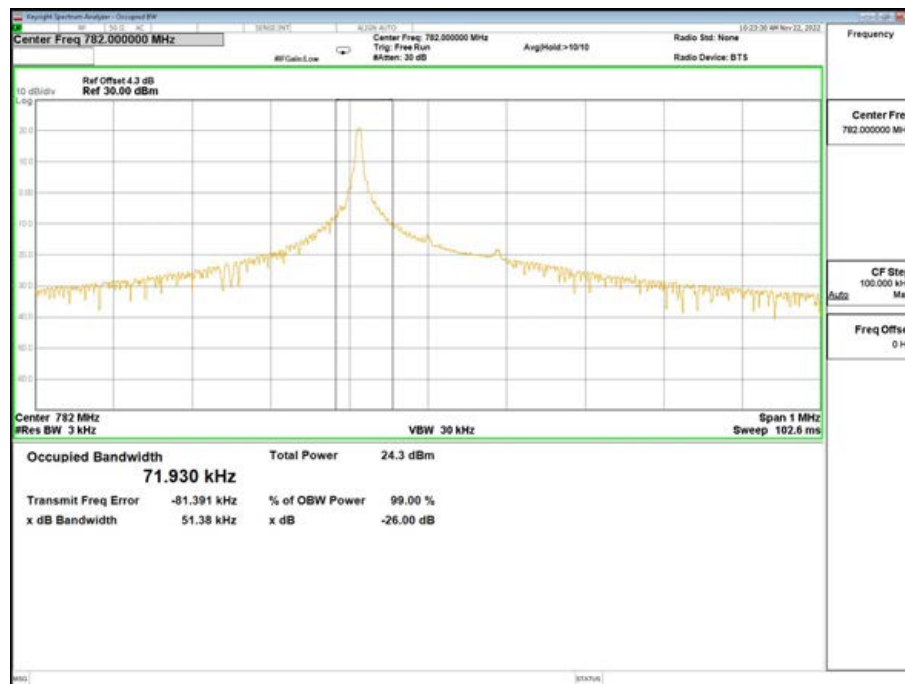
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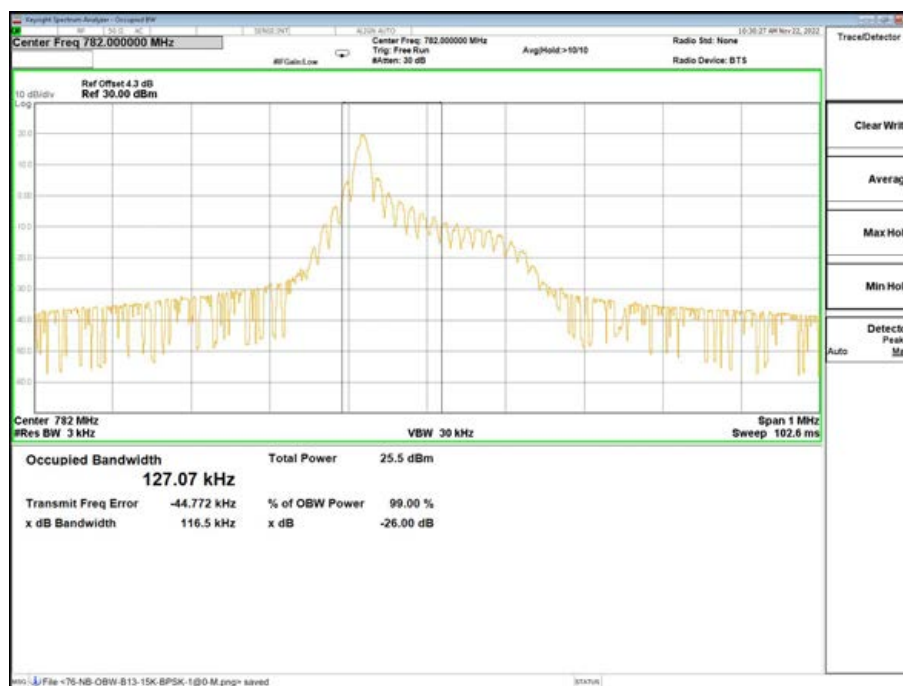
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Band13-26dB/99% OBW-23230 Channel-BPSK-1@0-15K



Band13-26dB/99% OBW-23230 Channel-BPSK-1@0-3.75K



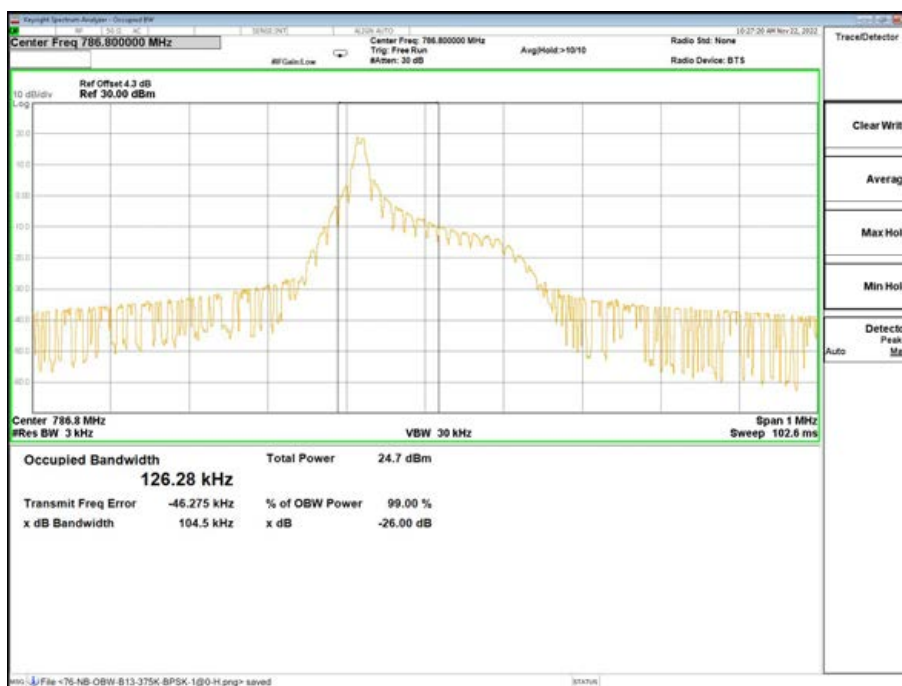
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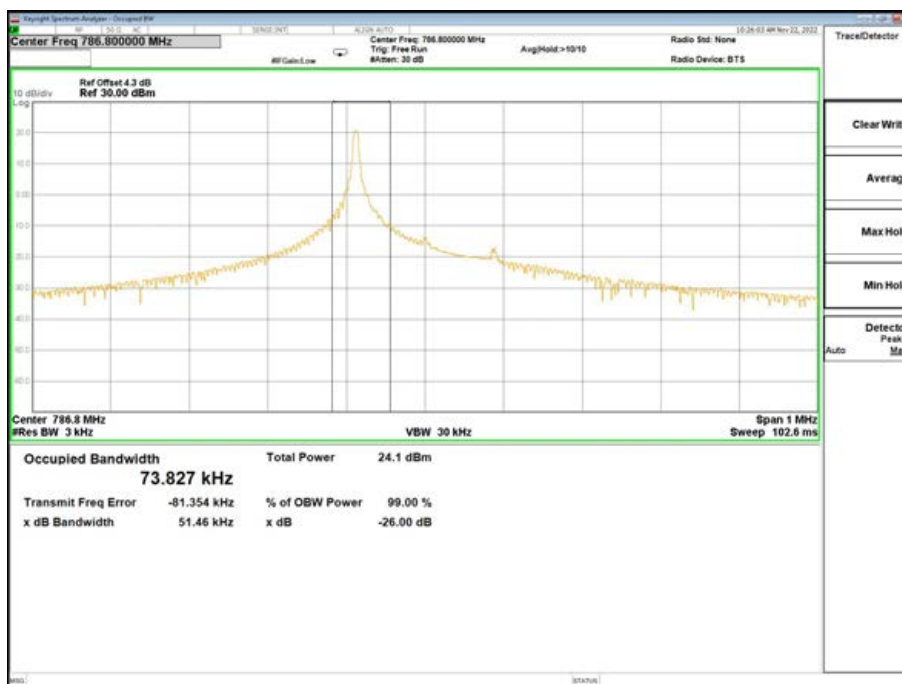
Band13-26dB/99% OBW-23230 Channel-QPSK-1@0-3.75K

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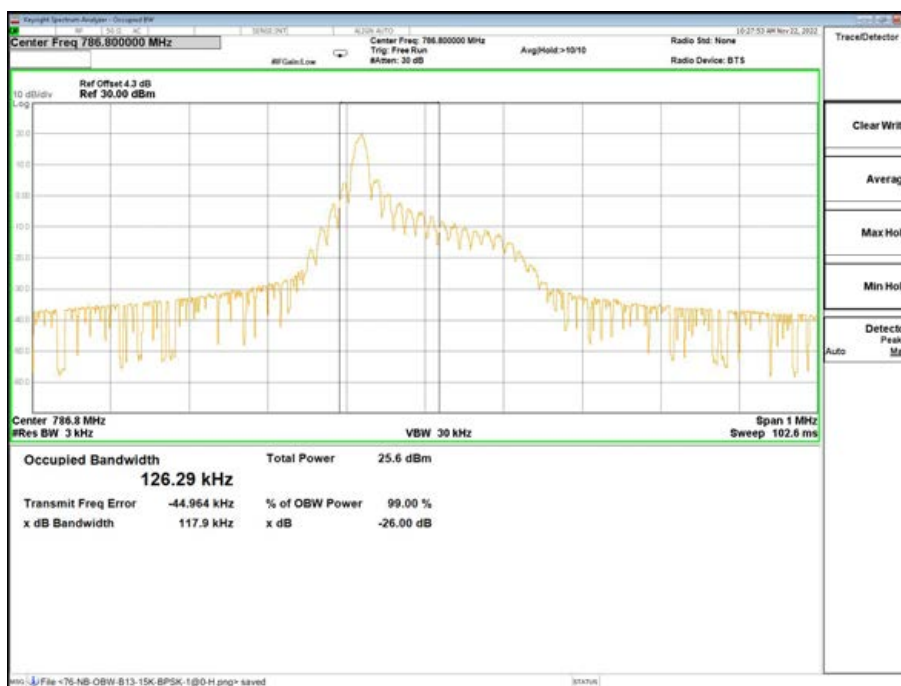
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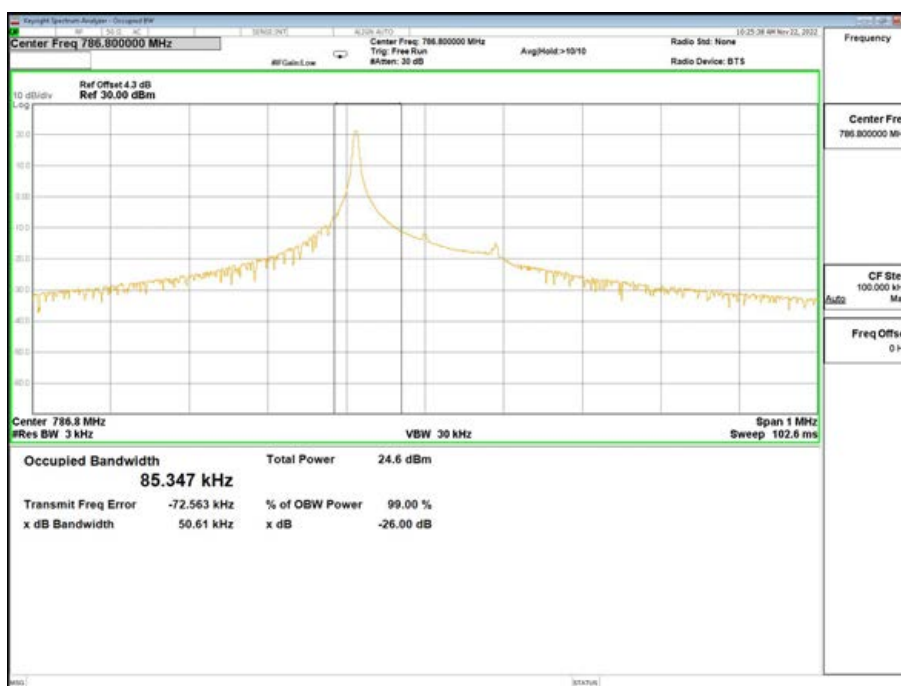
Band13-26dB/99% OBW-23278 Channel-BPSK-1@0-3.75K

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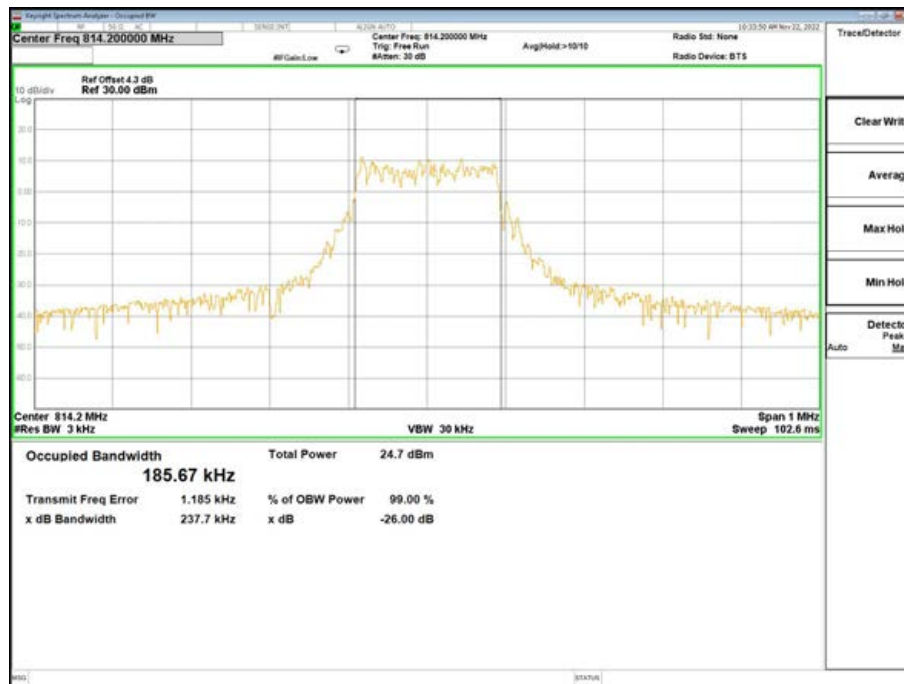
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Band13-26dB/99% OBW-23278 Channel-QPSK-1@0-3.75K

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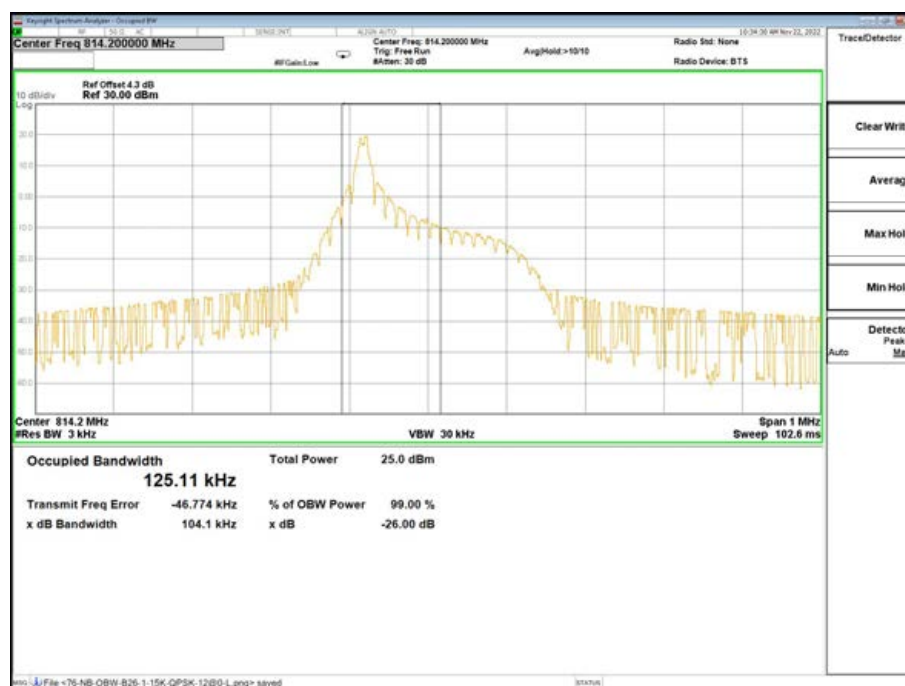
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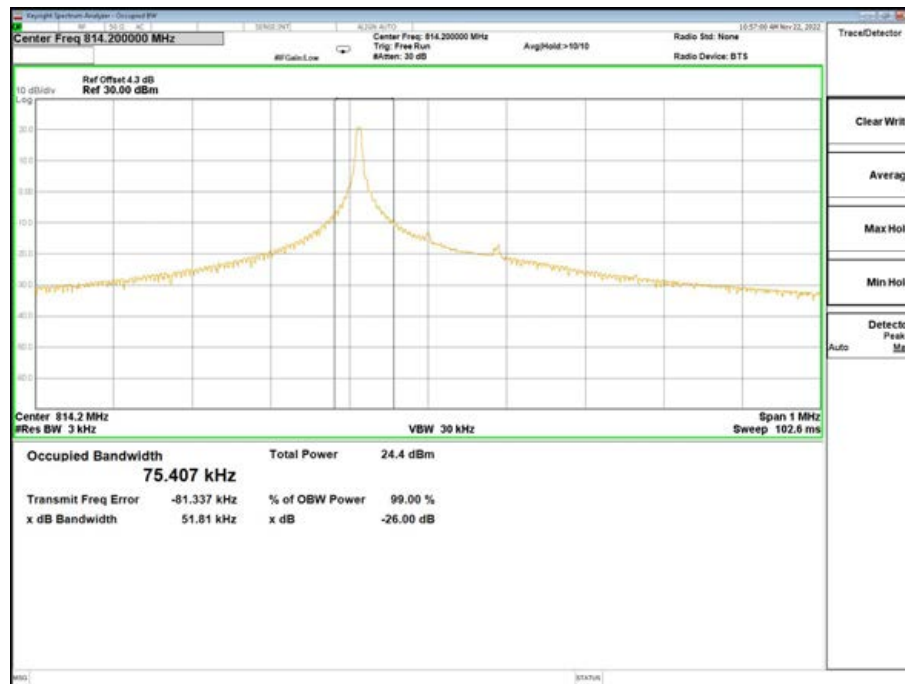
Band26-26dB/99% OBW-26740 Channel-QPSK-12@0-15K



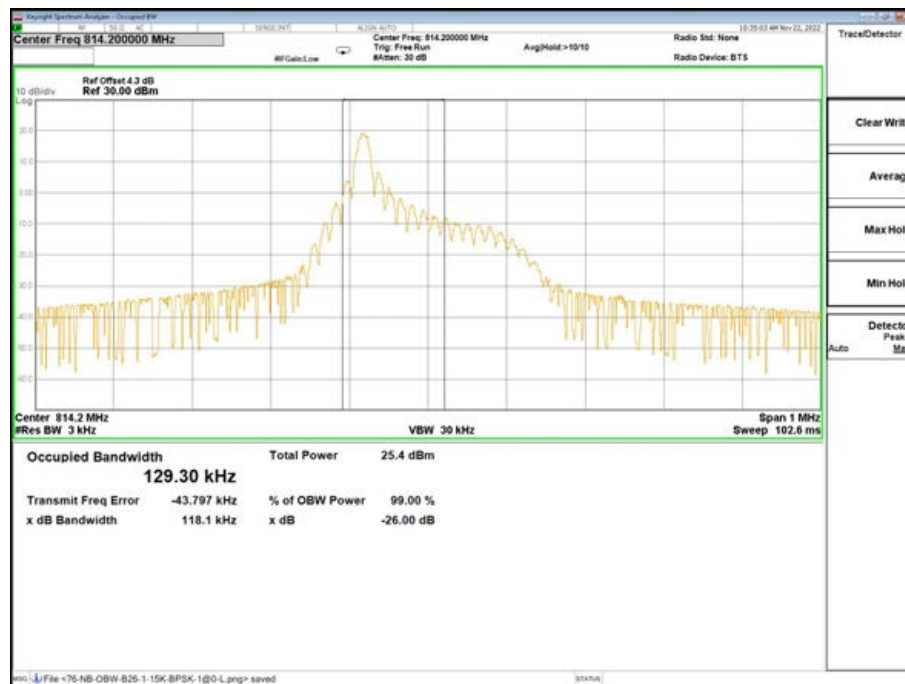
Band26-26dB/99% OBW-26788 Channel-QPSK-12@0-15K



Band26-26dB/99% OBW-26692 Channel-BPSK-1@0-15K



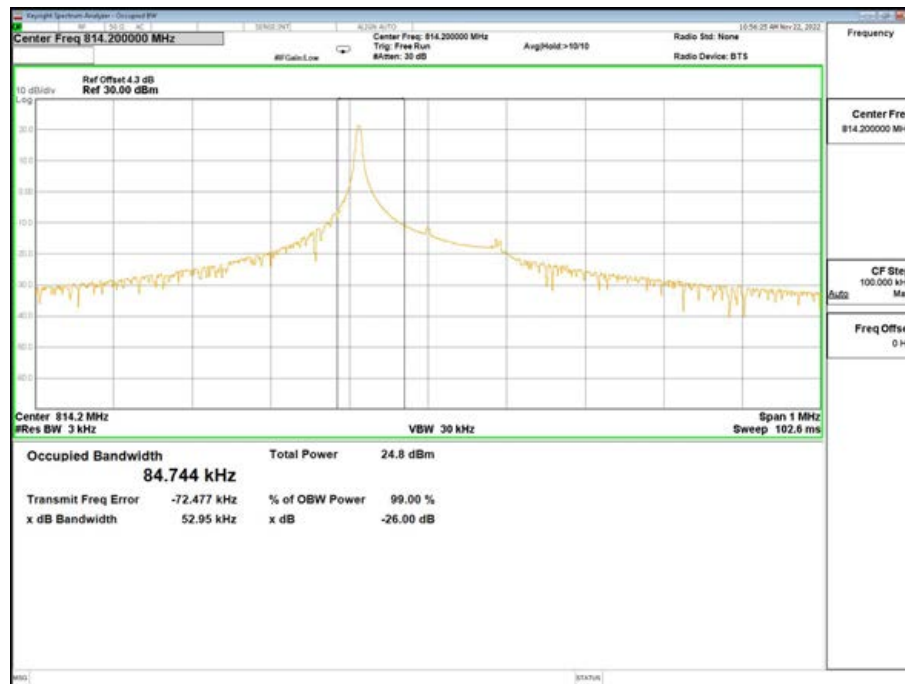
Band26-26dB/99% OBW-26692 Channel-BPSK-1@0-3.75K



Band26-26dB/99% OBW-26692 Channel-QPSK-1@0-15K

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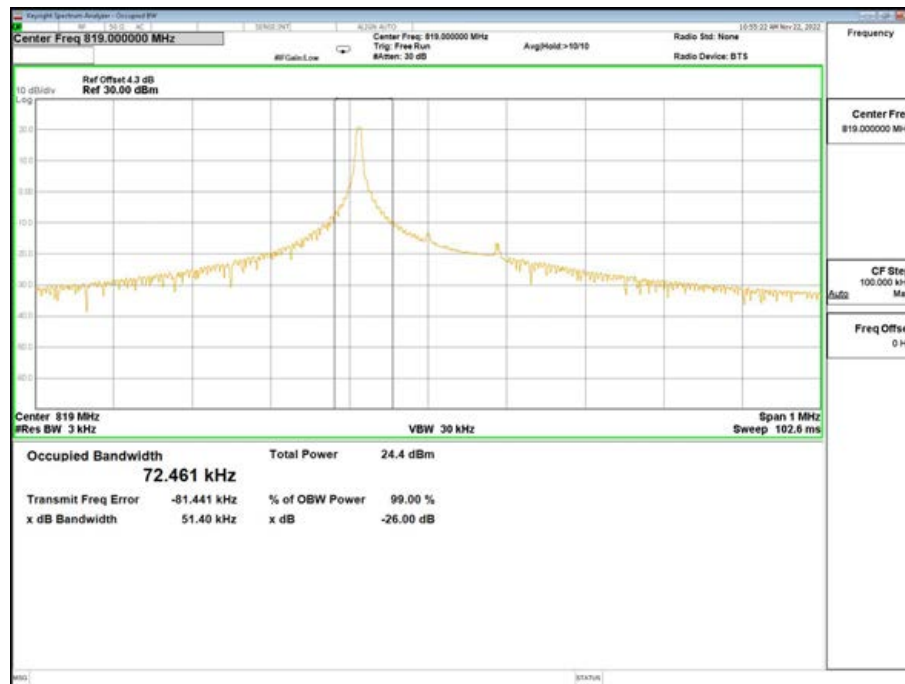
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Band26-26dB/99% OBW-26692 Channel-QPSK-1@0-3.75K



Band26-26dB/99% OBW-26740 Channel-BPSK-1@0-15K



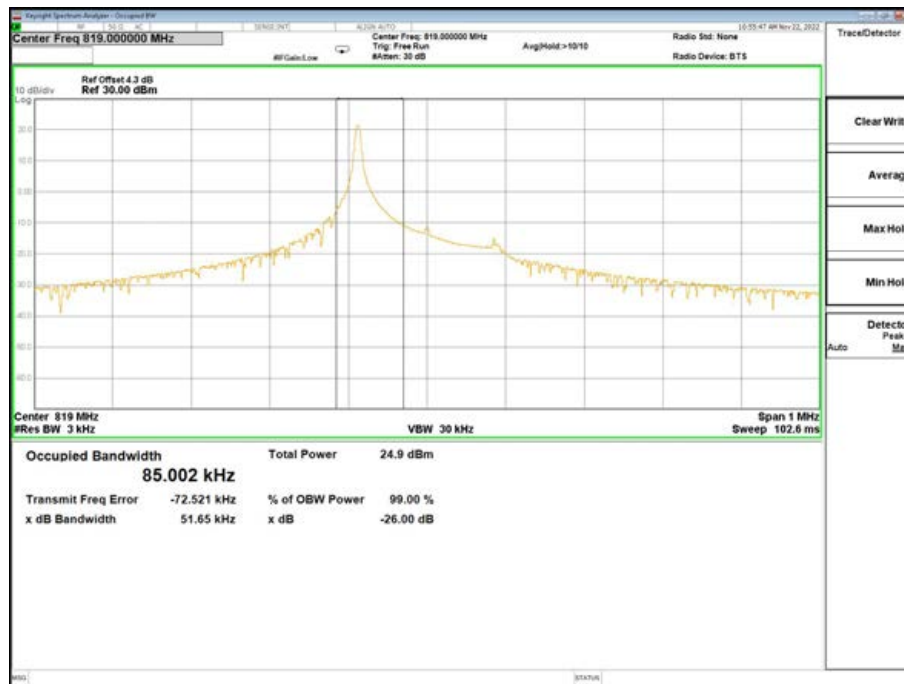
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Band26-26dB/99% OBW-26740 Channel-QPSK-1@0-15K

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Band26-26dB/99% OBW-26740 Channel-QPSK-1@0-3.75K



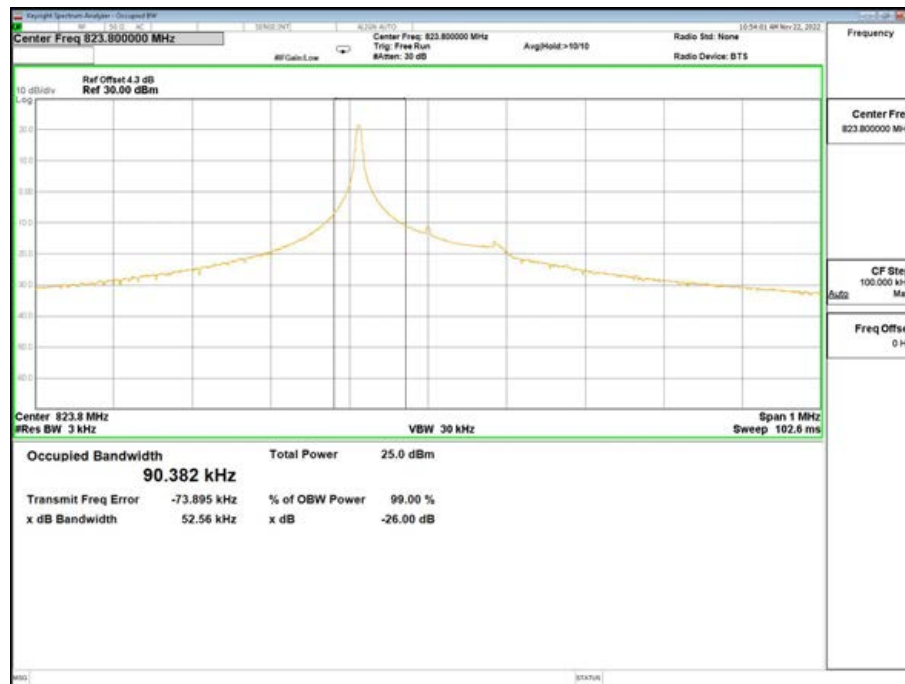
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Band26-26dB/99% OBW-26788 Channel-BPSK-1@0-3.75K



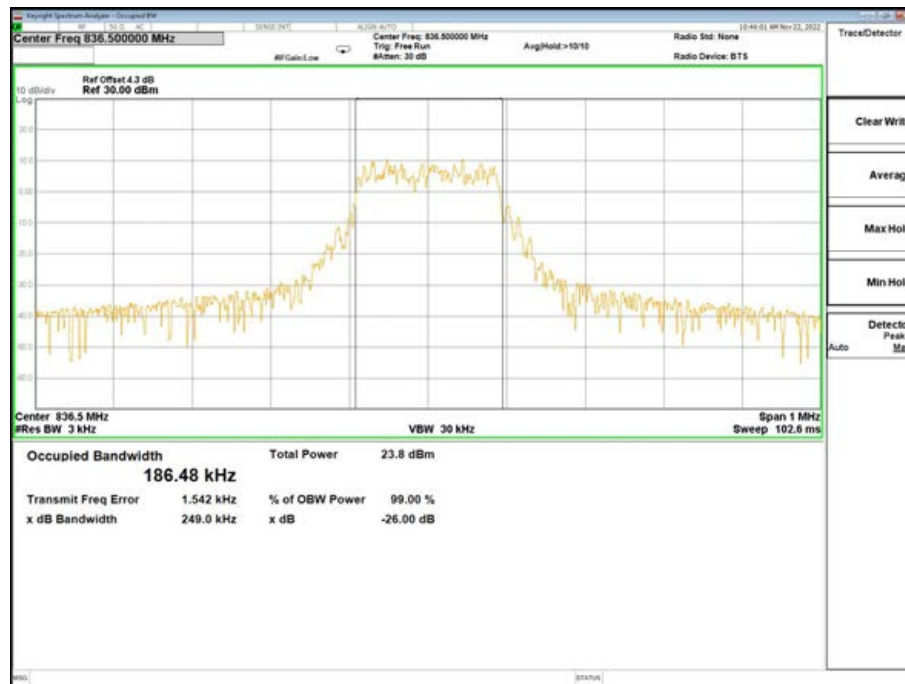
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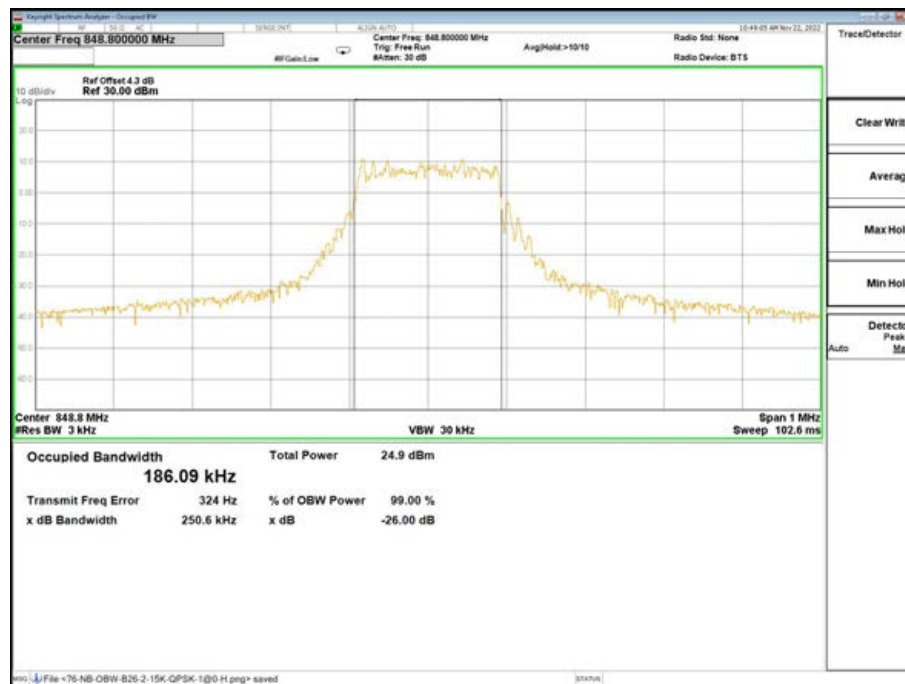
Band26-26dB/99% OBW-26788 Channel-QPSK-1@0-3.75K



Band26-26dB/99% OBW-26792 Channel-QPSK-12@0-15K



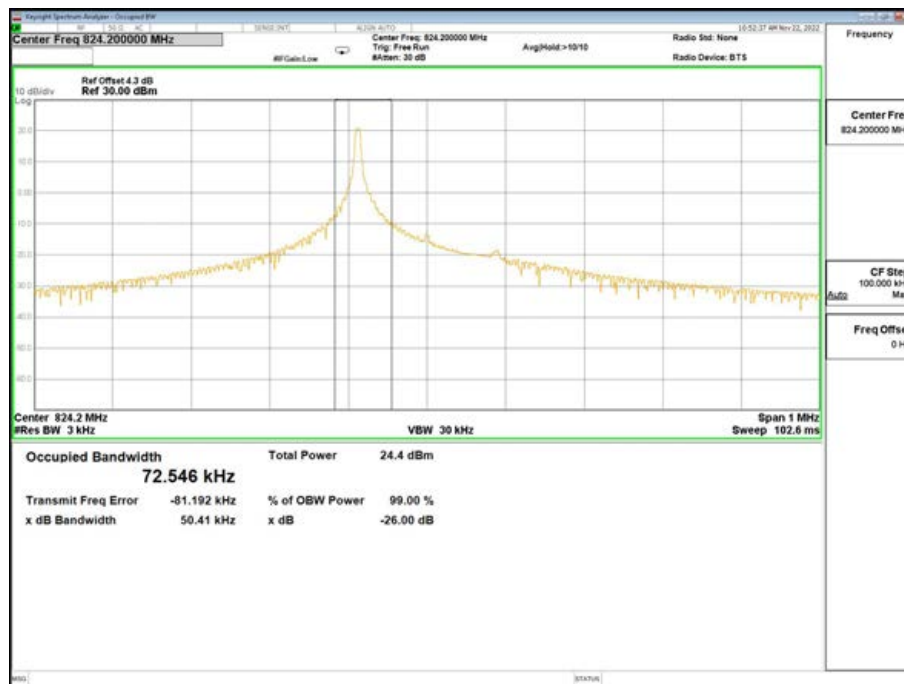
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Band26-26dB/99% OBW-27038 Channel-QPSK-12@0-15K



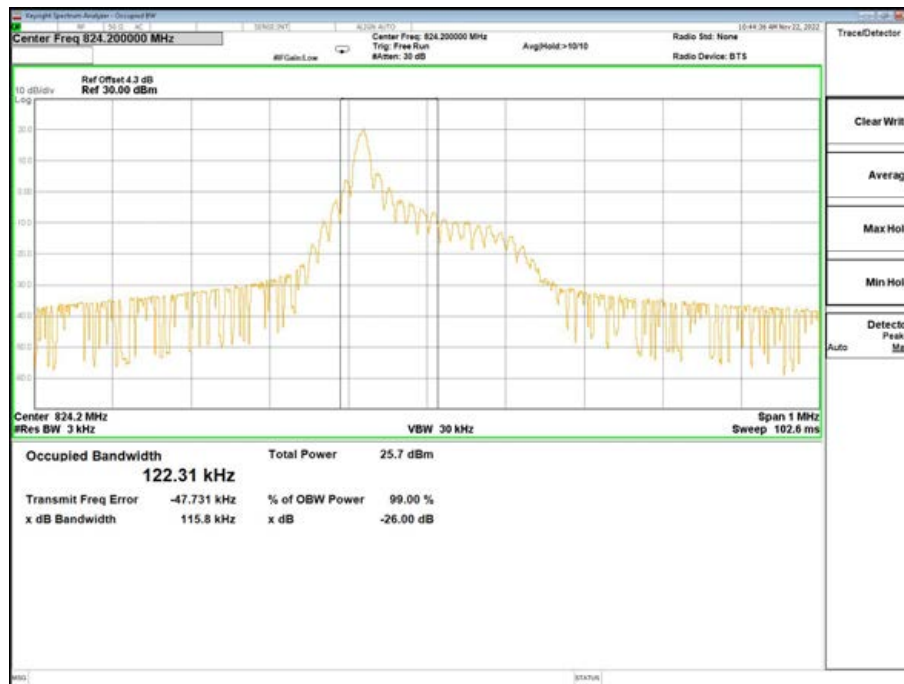
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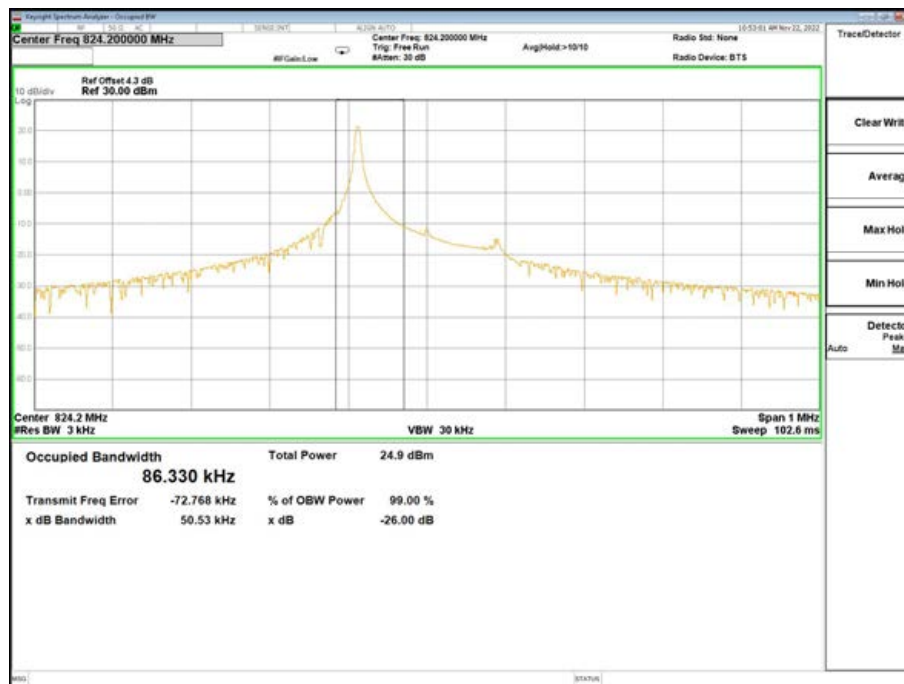
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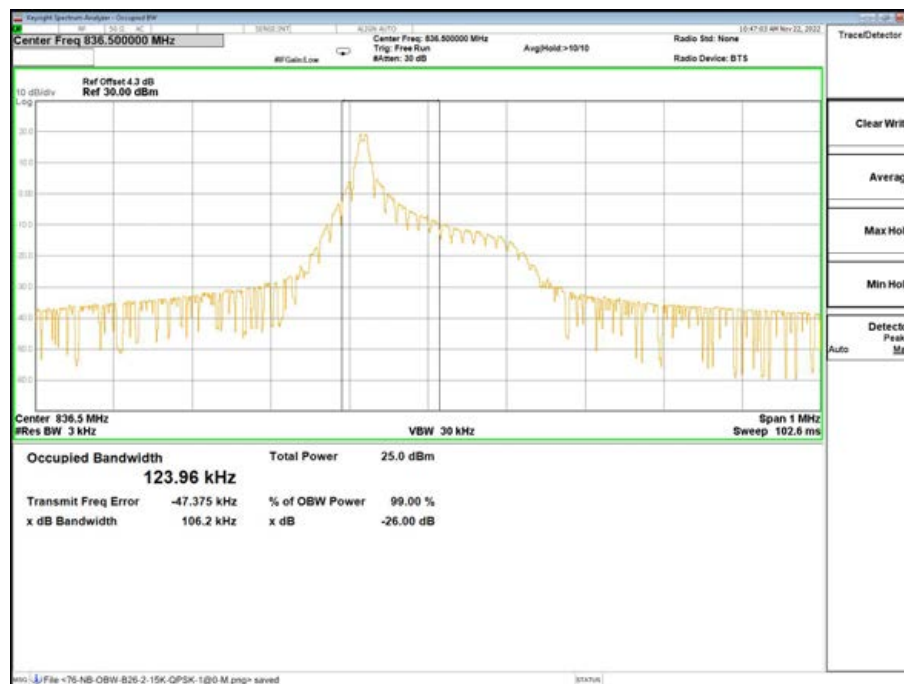
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Band26-26dB/99% OBW-26792 Channel-QPSK-1@0-15K



Band26-26dB/99% OBW-26792 Channel-QPSK-1@0-3.75K



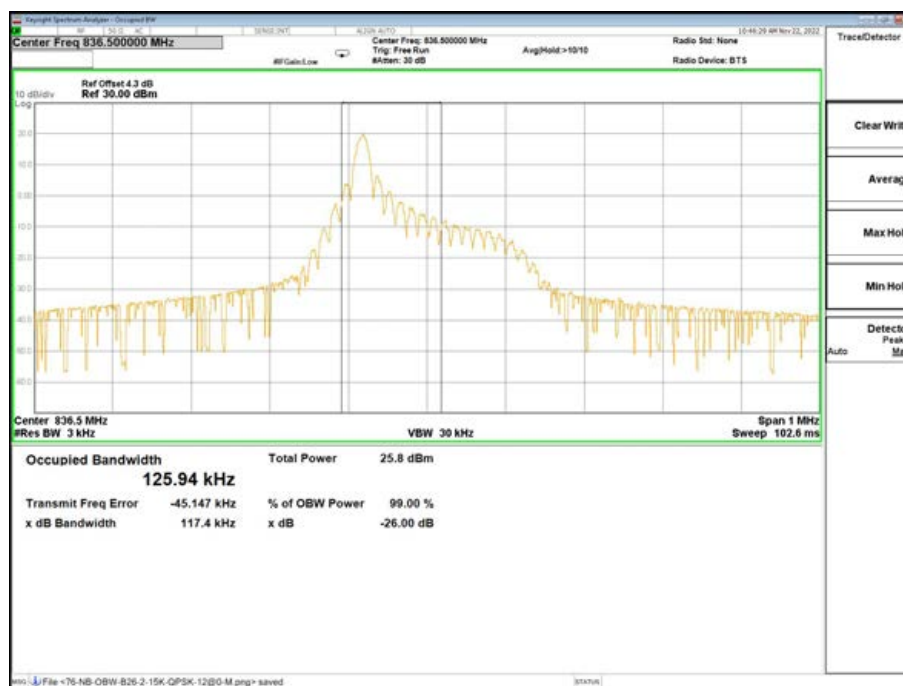
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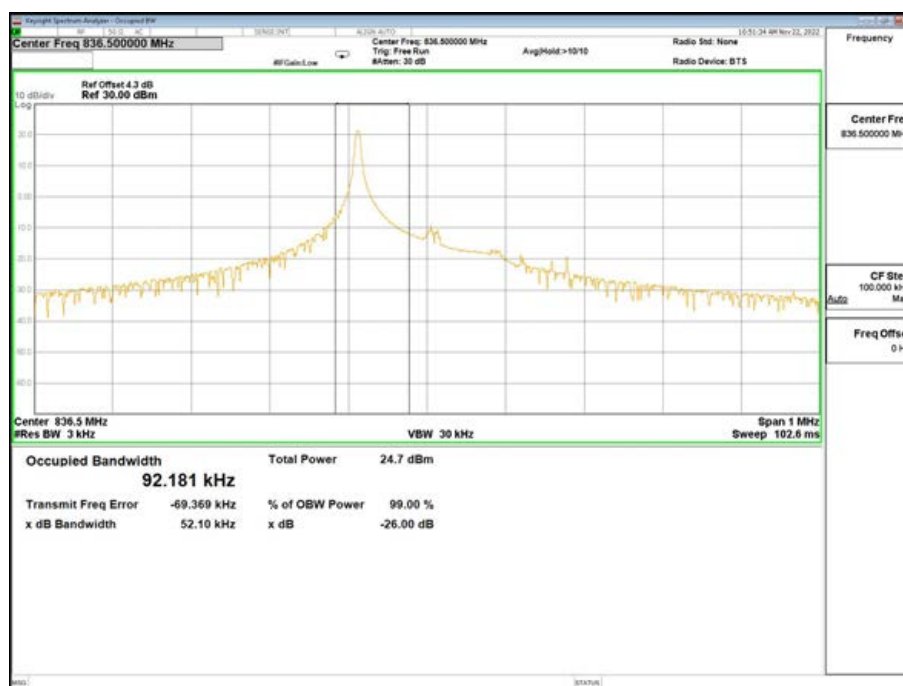
Band26-26dB/99% OBW-26915 Channel-BPSK-1@0-3.75K

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Band26-26dB/99% OBW-26915 Channel-QPSK-1@0-15K



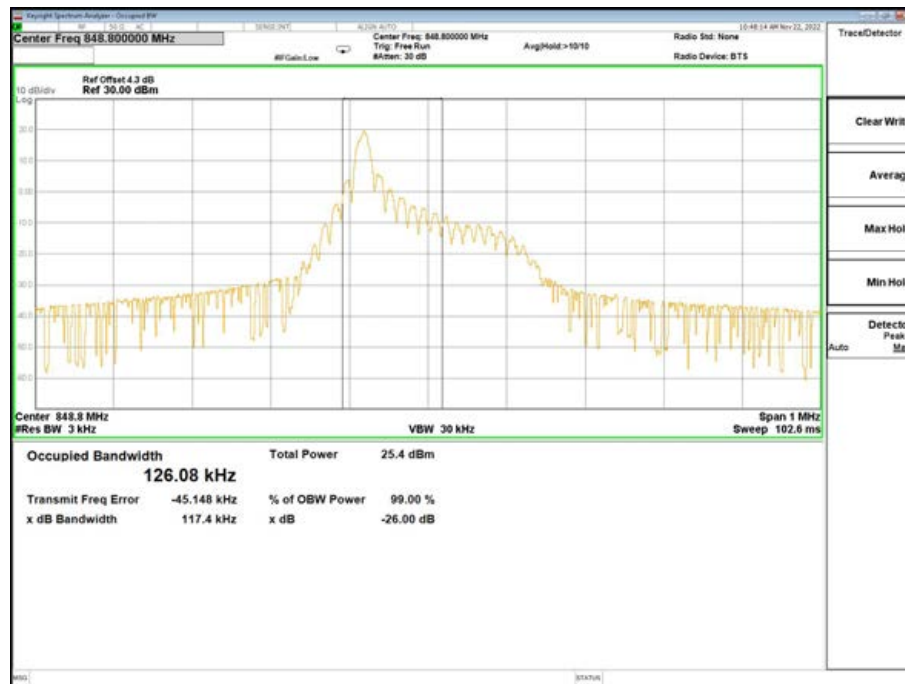
Band26-26dB/99% OBW-26915 Channel-QPSK-1@0-3.75K



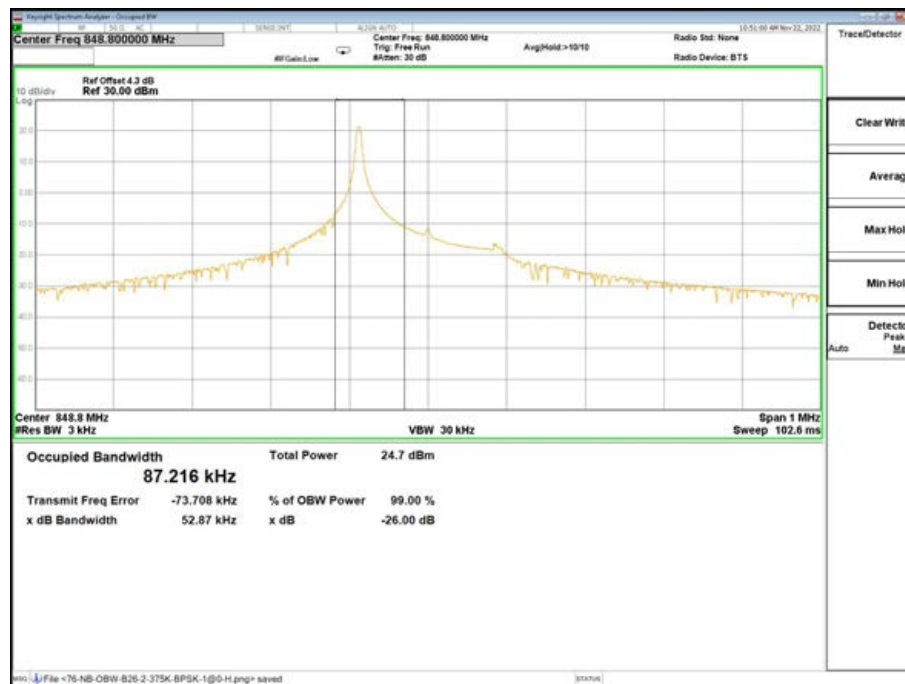
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Band26-26dB/99% OBW-27038 Channel-BPSK-1@0-3.75K



Band26-26dB/99% OBW-27038 Channel-QPSK-1@0-15K



Band26-26dB/99% OBW-27038 Channel-QPSK-1@0-3.75K

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6.4.1. Conducted spurious emissions

Specifications:	FCC Part 2.1051,24.238,2.1053,22.917, 27.53,90.691
DUT Serial Number:	866884049909625
Test conditions:	Ambient Temperature:15°C-35°C Relative Humidity:30%-60% Air pressure: 86-106kPa
Test Results:	Pass

Limit Level Construction:

According to Part 22.917 (a), i.e., Out of Band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to Part 24.238 (a), i.e., Out of Band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB, so the limit level is: $P(\text{dBm}) - (43 + 10 \log(P)) \text{ dB} = -13\text{dBm}$.

According to Part 27.53(c):

On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

According to Part 27.53(f):

For operations in the 746–758 MHz, 775–788 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

According to Part 27.53(h):

Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 Bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

According to Part 27.53(g):

For operations in the 600 MHz Band and the 698-746 MHz Band, the power of any emission outside a licensee's frequency Band(s) of operation shall be attenuated below the transmitter power (P) within the licensed Band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution Bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz Bands immediately outside and adjacent to a licensee's frequency block, a resolution Bandwidth of at least 30 kHz may be employed.

According to Part 90.691:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license

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and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

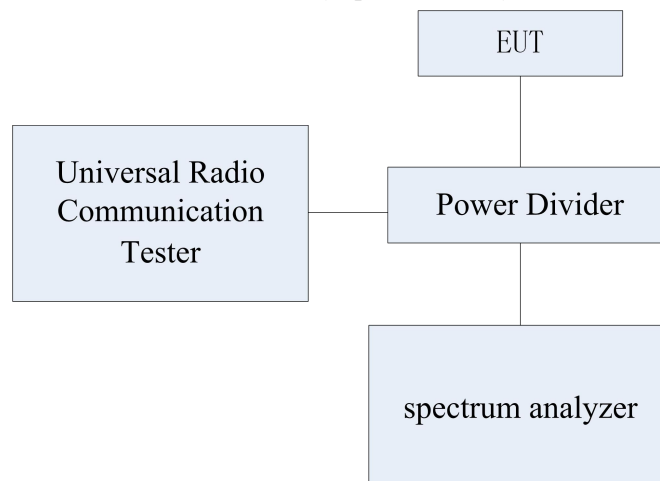
(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Measurement Uncertainty:

Item	Uncertainty	
Expanded Uncertainty	$9\text{kHz} < f \leq 4\text{GHz}$	0.71 dB (k=2)
	$4\text{GHz} \leq f < 12.75\text{GHz}$	0.74 dB (k=2)
	$12.75\text{GHz} \leq f < 26\text{GHz}$	2.70 dB (k=2)

Test Setup:

During the test, the EUT was controlled via the Wireless Communications Test Set to ensure max power transmission and proper modulation and measured by spectrum analyzer.



Test Method:

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-Band emissions, if any, up to 10th harmonic. The EUT was

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Report No.: I22W00076-NB-IoT RF-FCC_Rev2

scanned for spurious emissions from 30MHz to 20GHz with sufficient Bandwidth and video resolution.

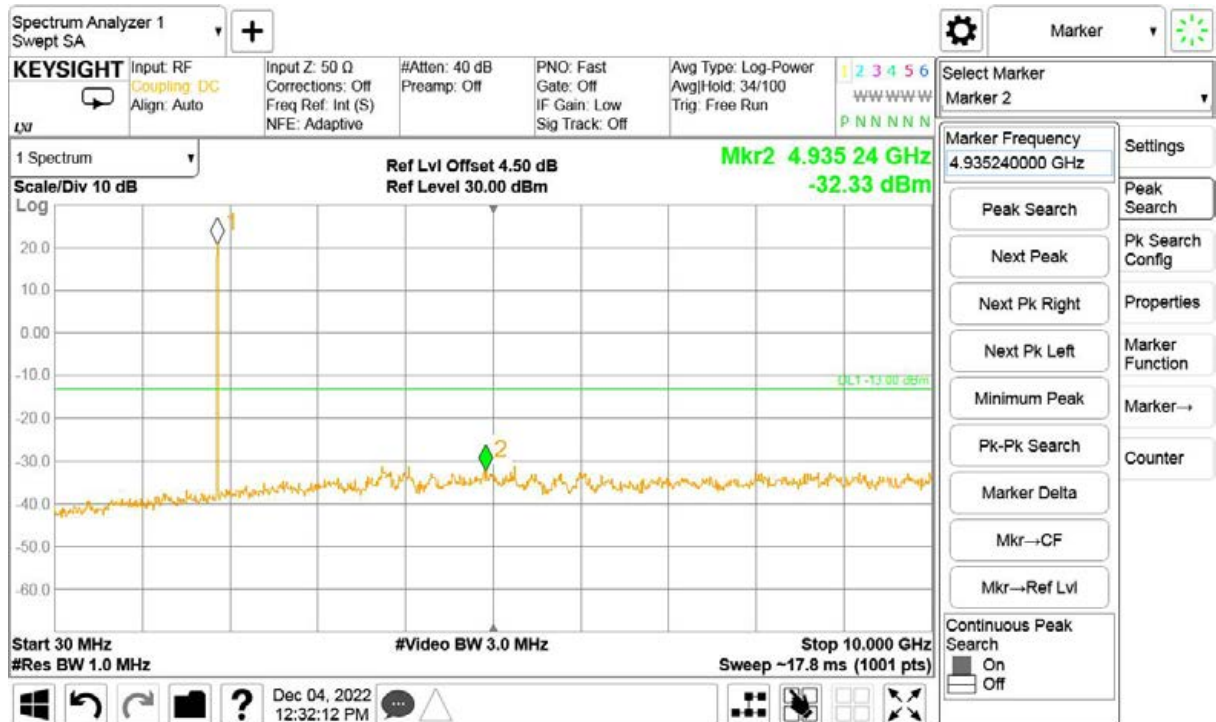
The spectrum analyzer was set to Maximum hold mode to ensure that the worst-case emissions were captured.

Note: --

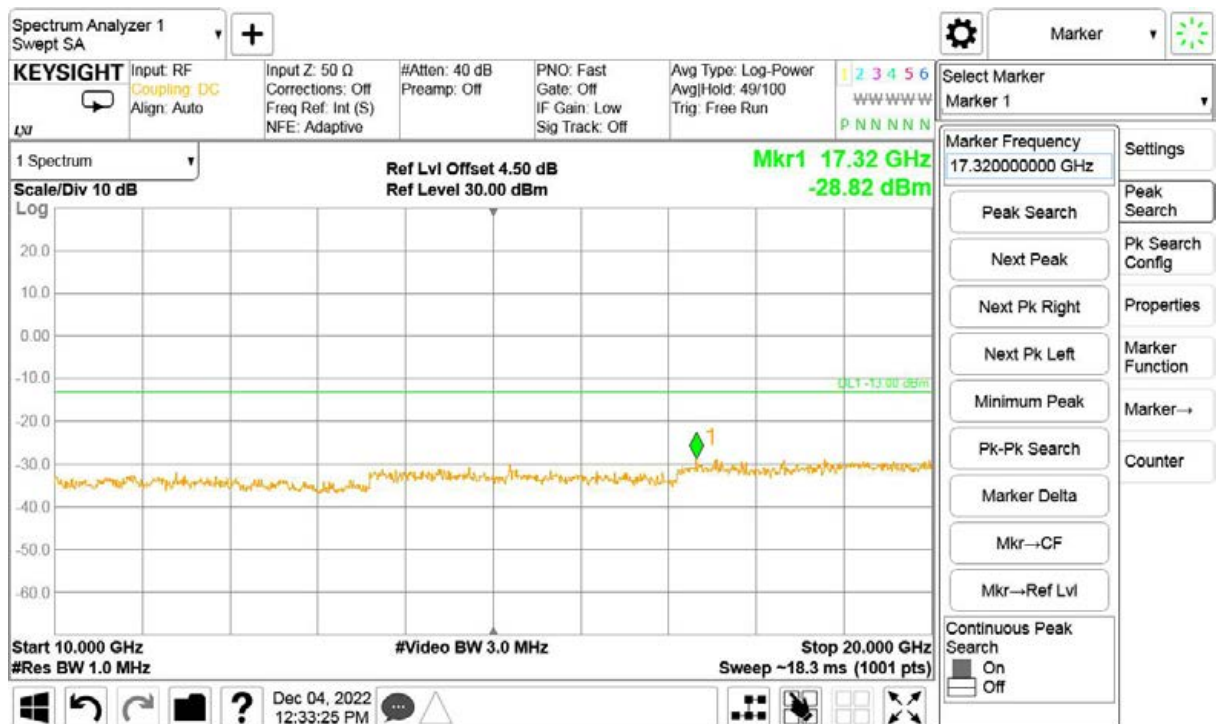
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6.5.1 NB-IoT B2 Conducted Spurious Emission Results



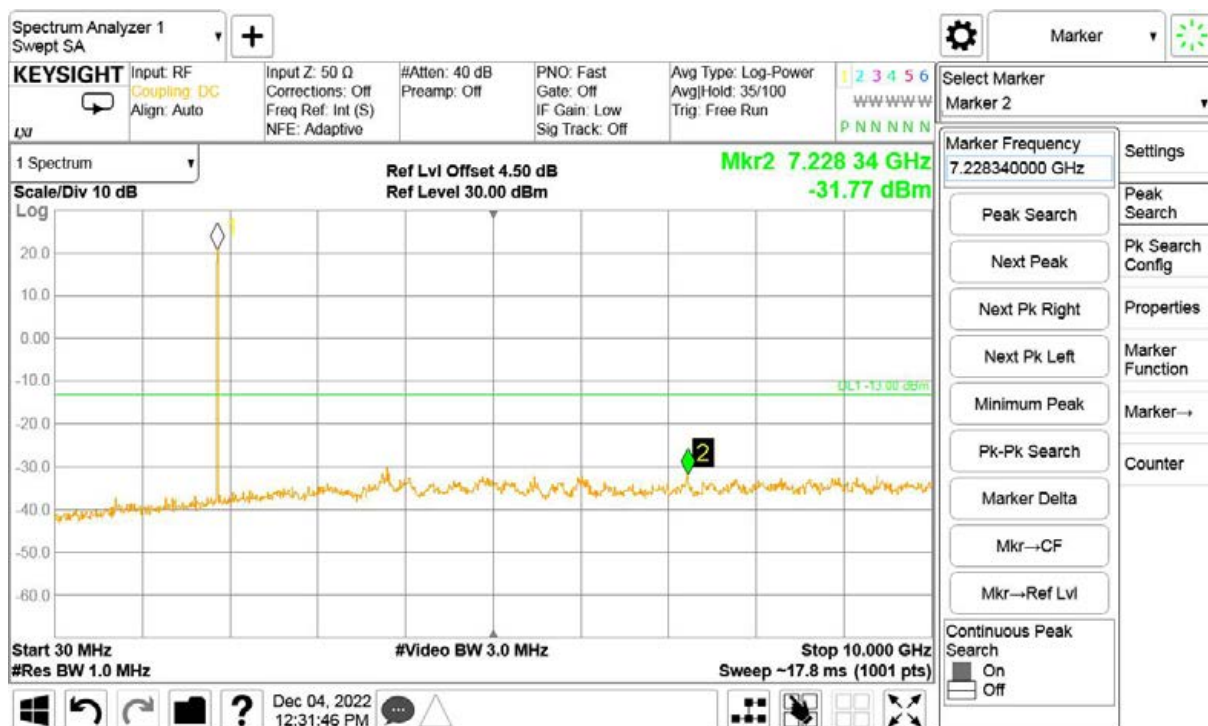
30MHz to 10GHz, Low Channel, Subcarrier (3.75kHz), QPSK, 1@0



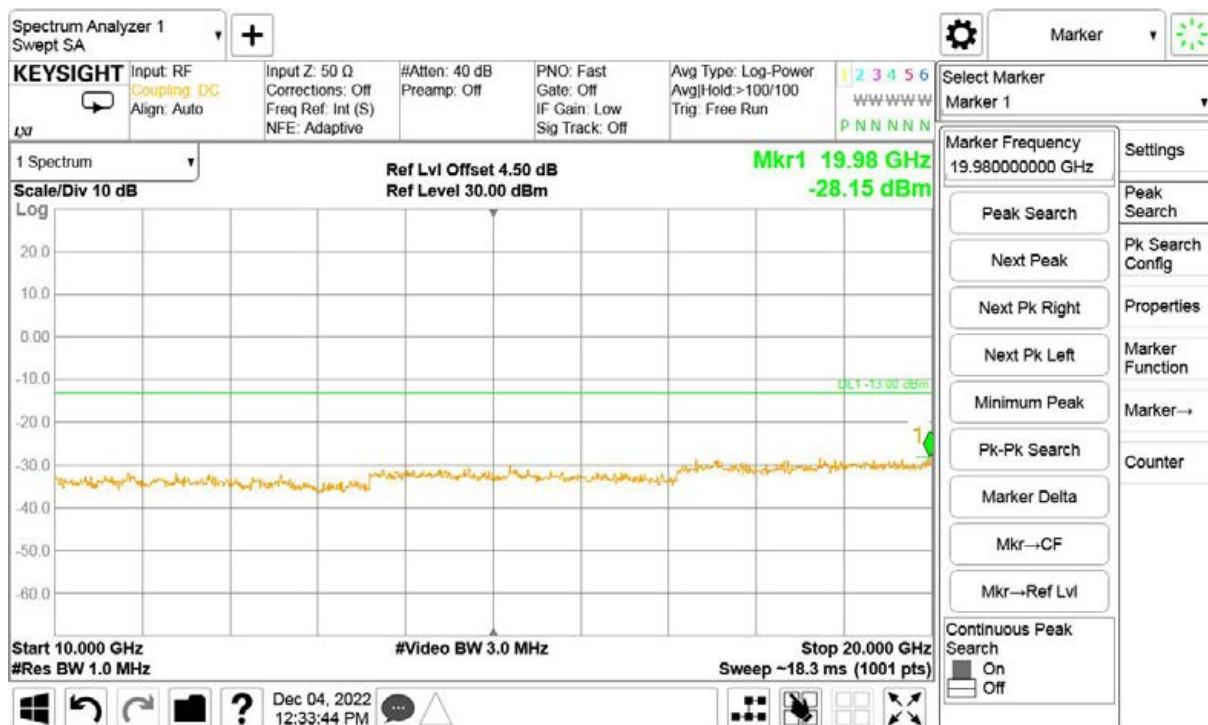
10GHz to 20GHz, Low Channel, Subcarrier (3.75kHz), QPSK, 1@0

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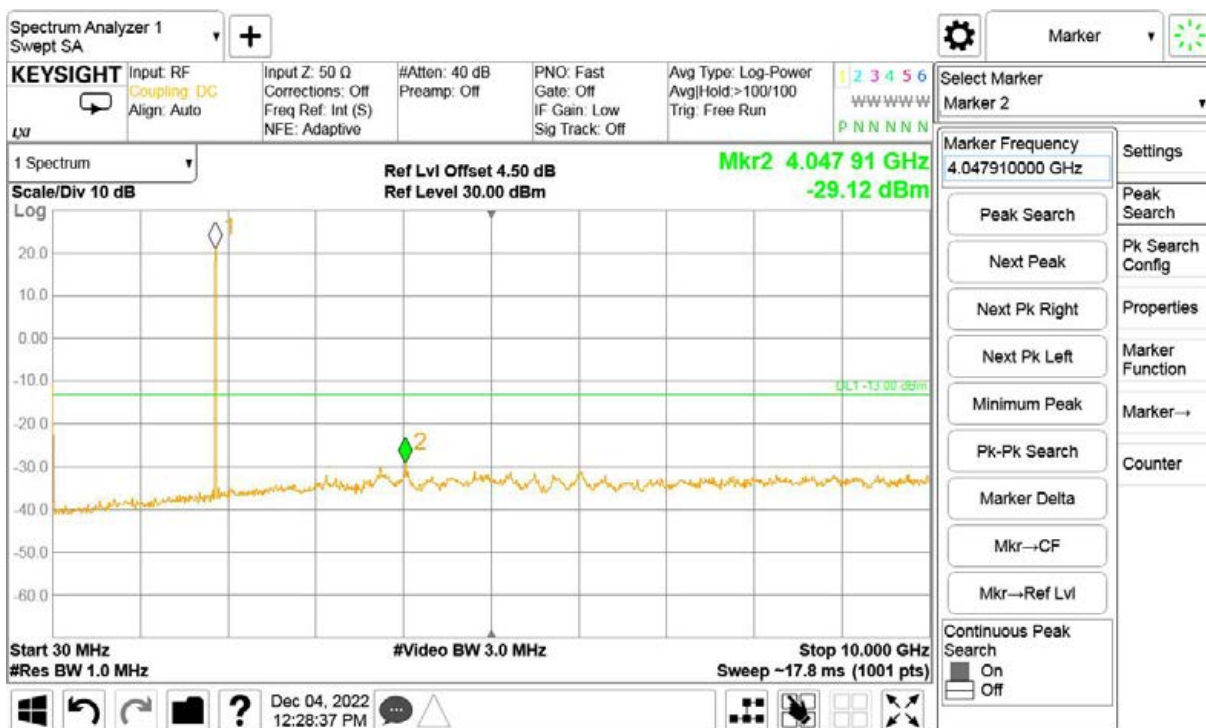
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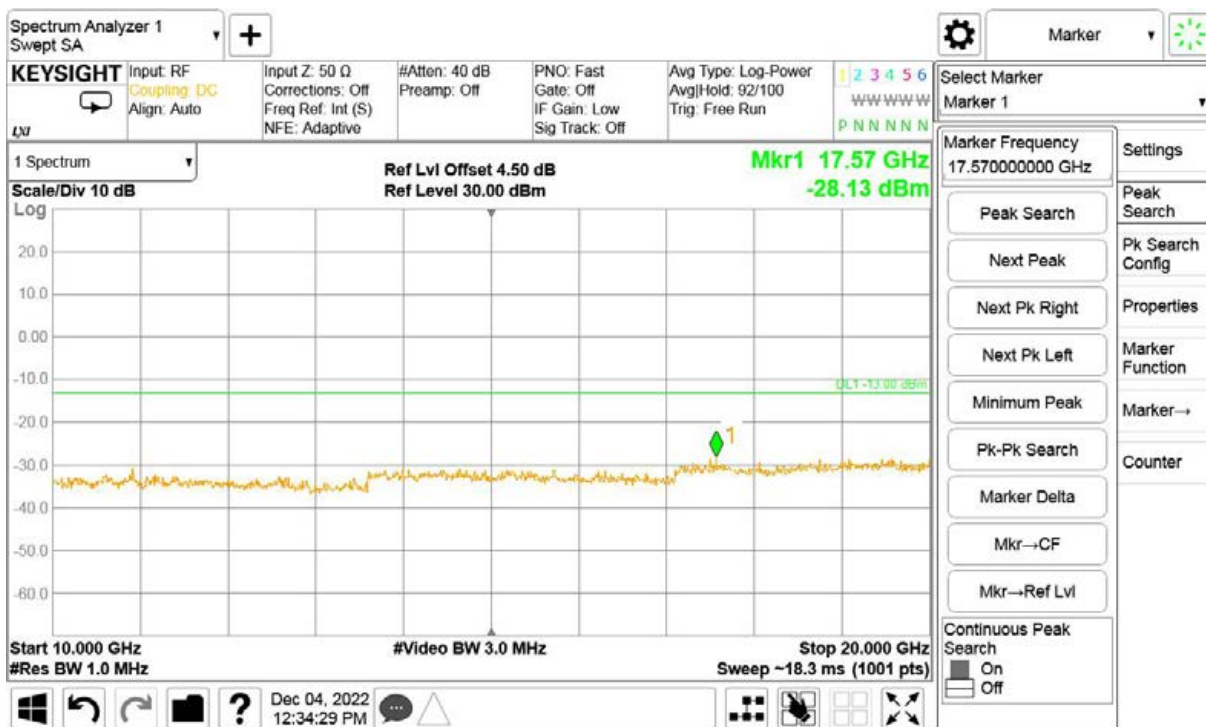
10GHz to 20GHz, Low Channel, Subcarrier (3.75kHz), BPSK, 1@0

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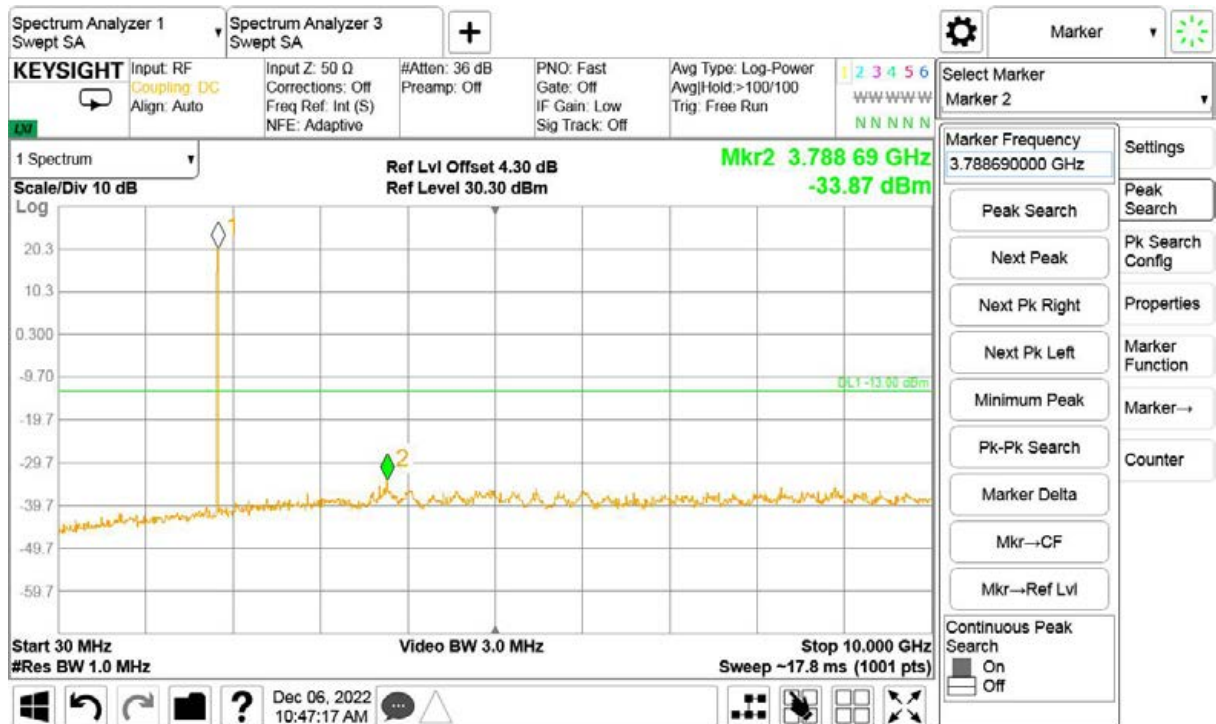
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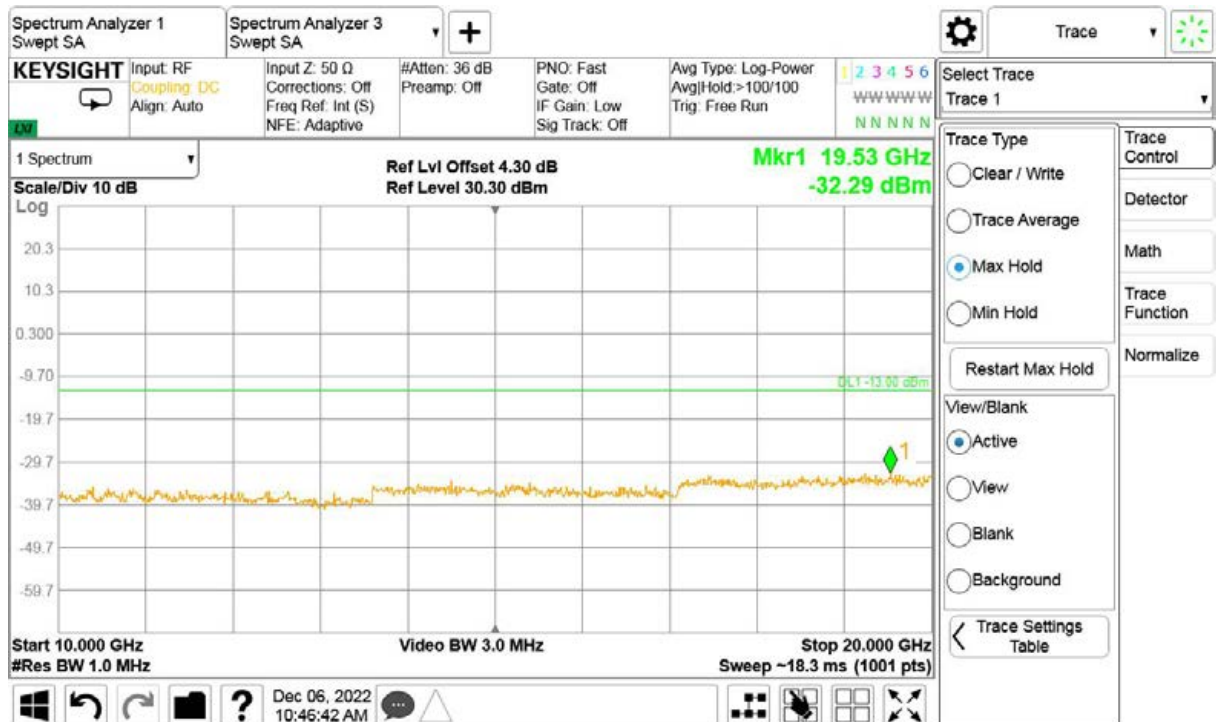
10GHz to 20GHz, Low Channel, Subcarrier (15kHz), QPSK, 1@0

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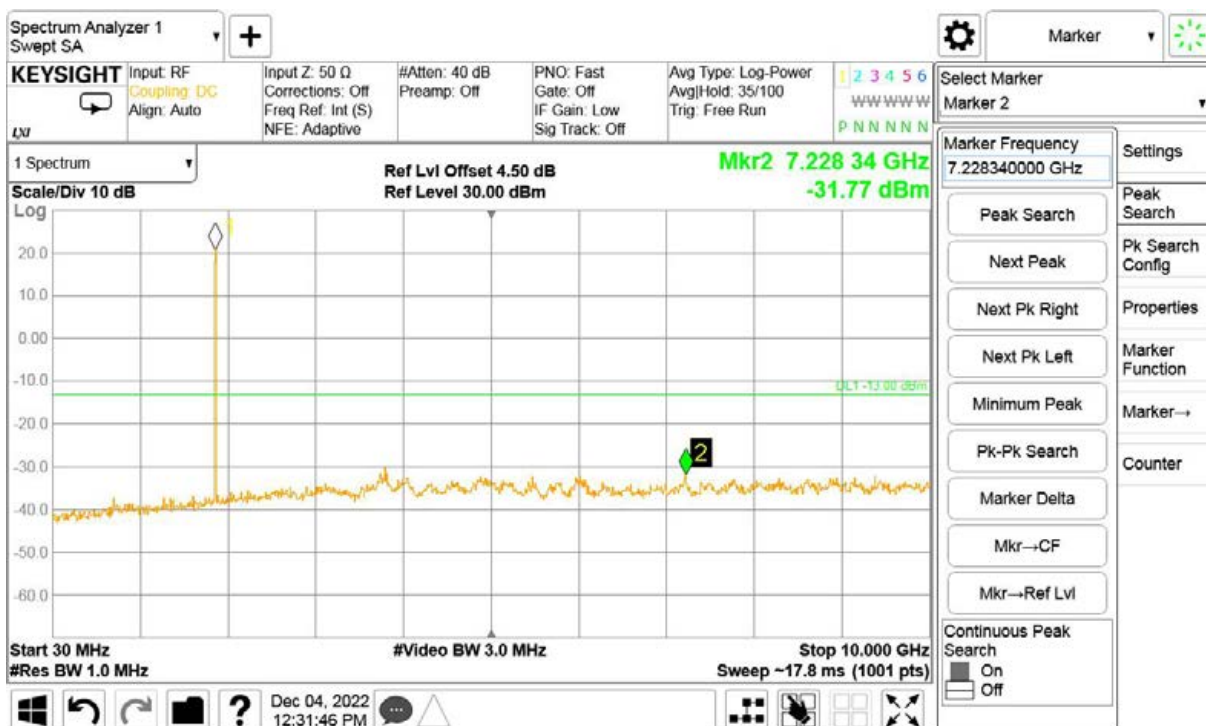
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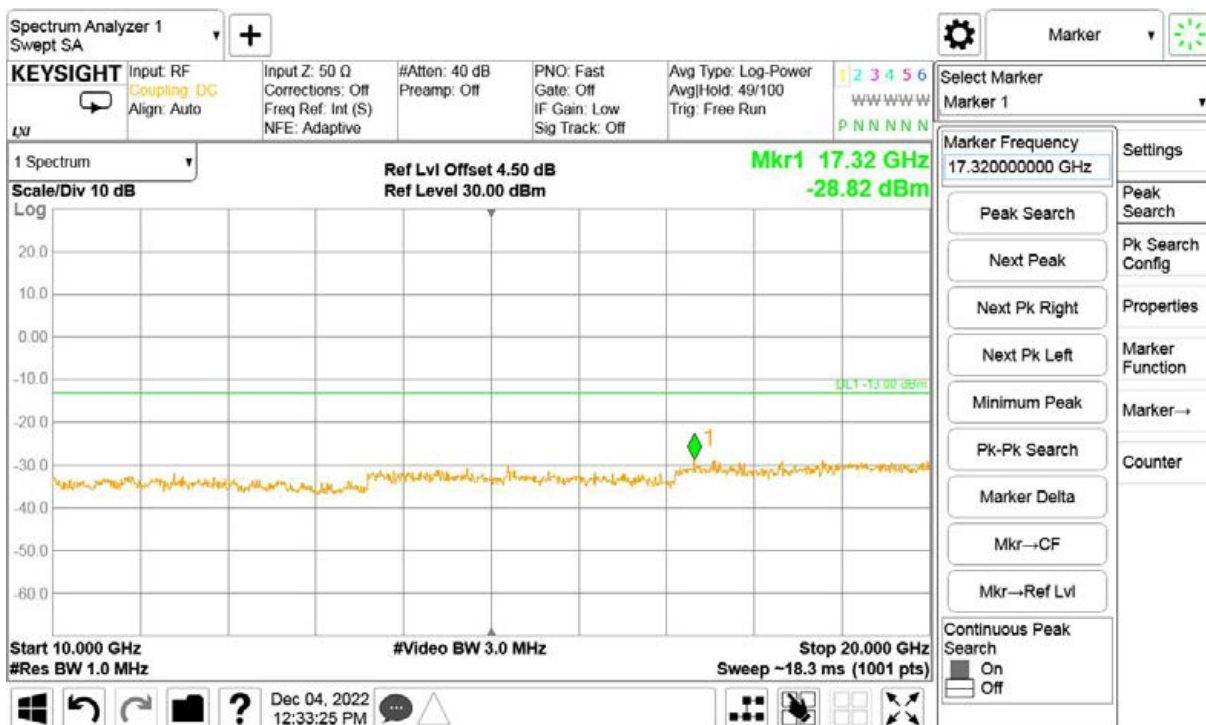
10GHz to 20GHz, Low Channel, Subcarrier (15kHz), QPSK, 12@0

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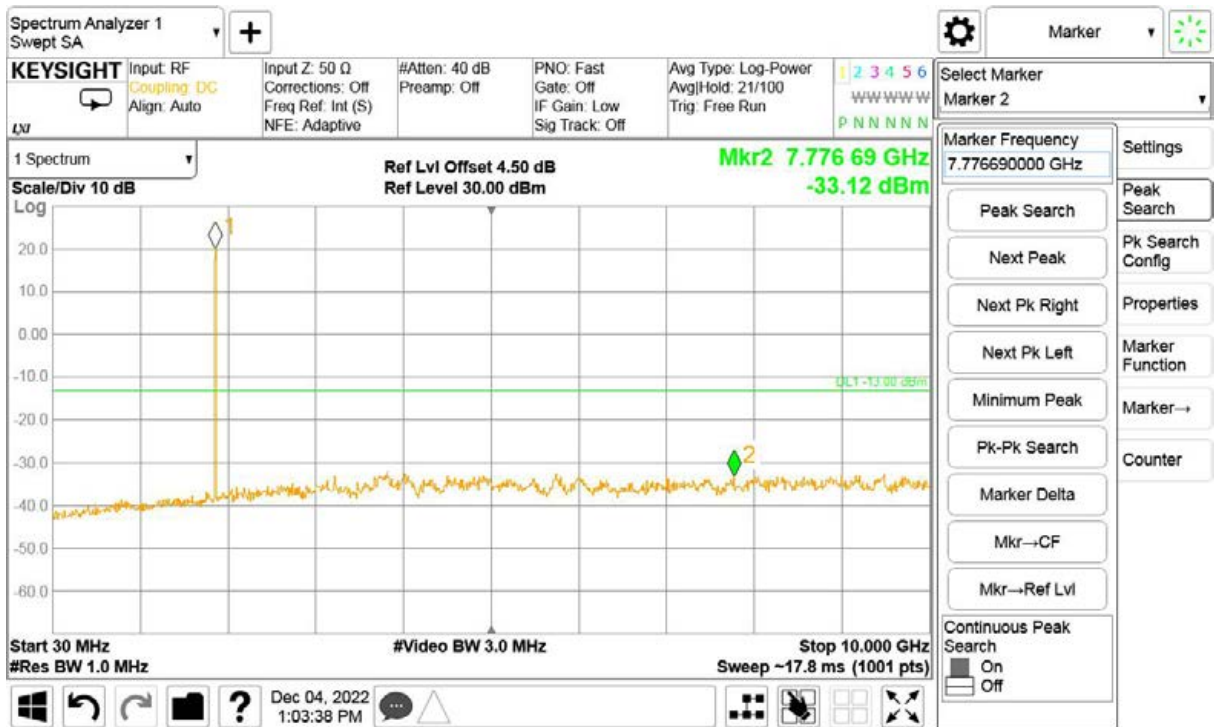
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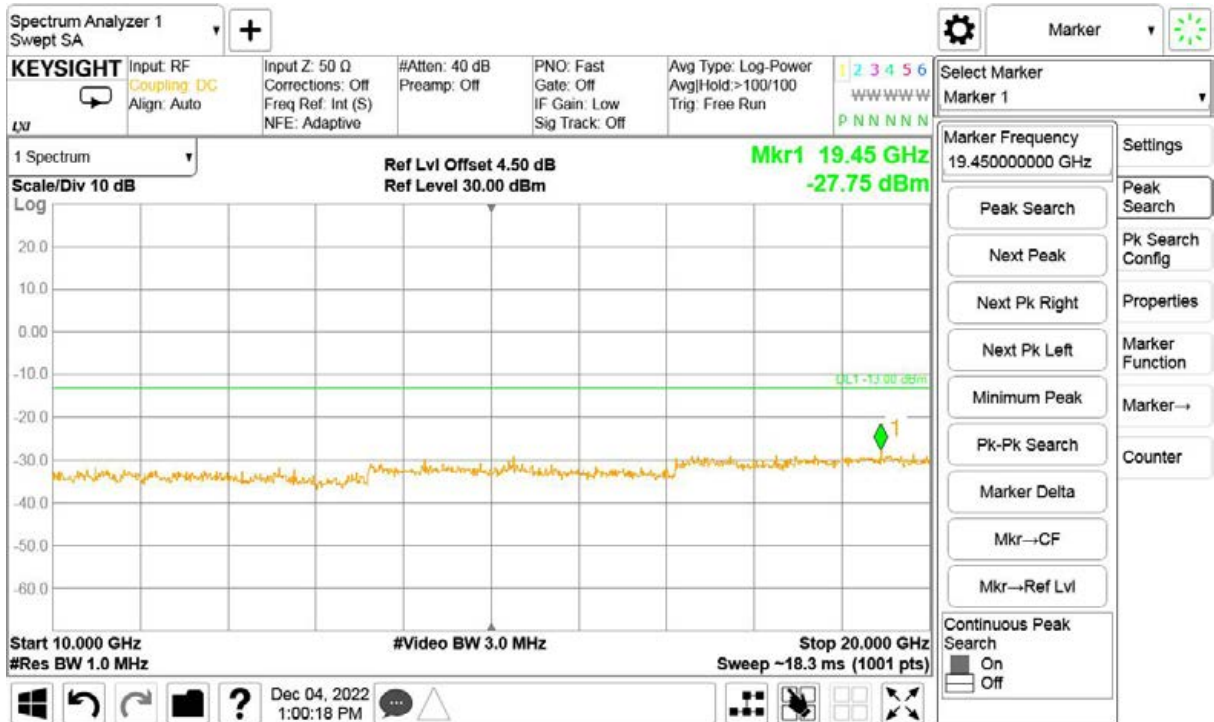
10GHz to 20GHz, Low Channel, Subcarrier (15kHz), BPSK, 1@0

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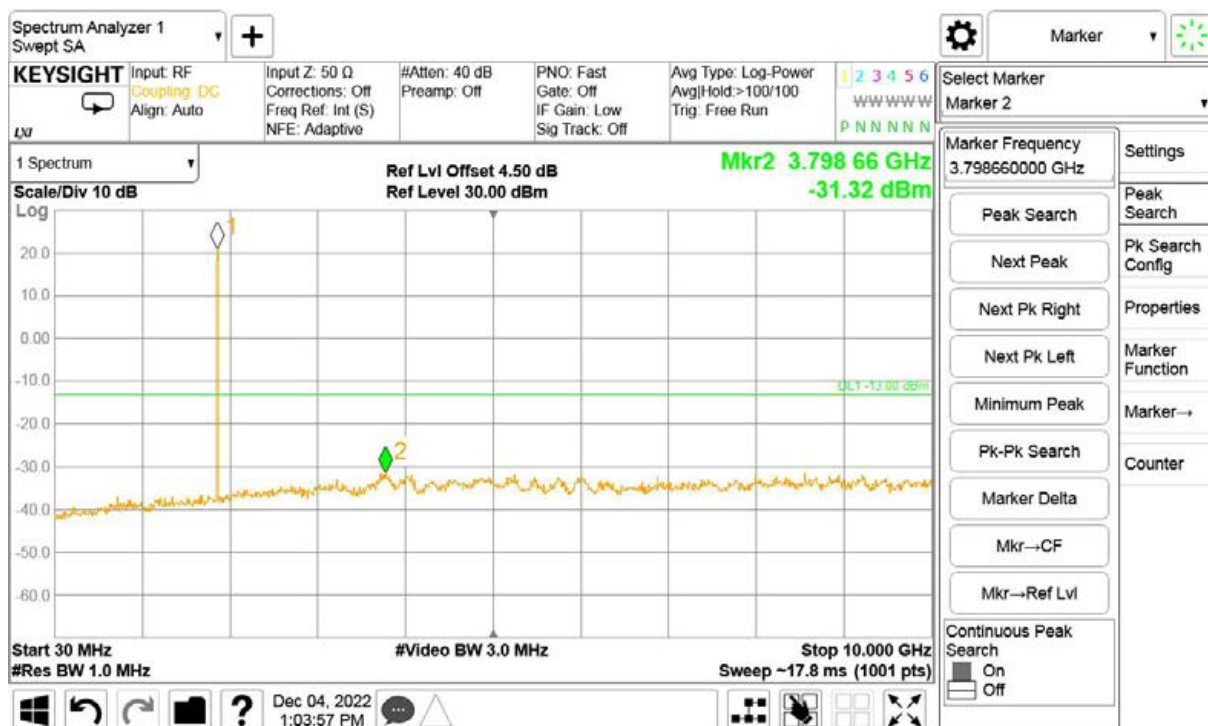
30MHz to 10GHz, Mid Channel, Subcarrier (3.75kHz), QPSK, 1@0



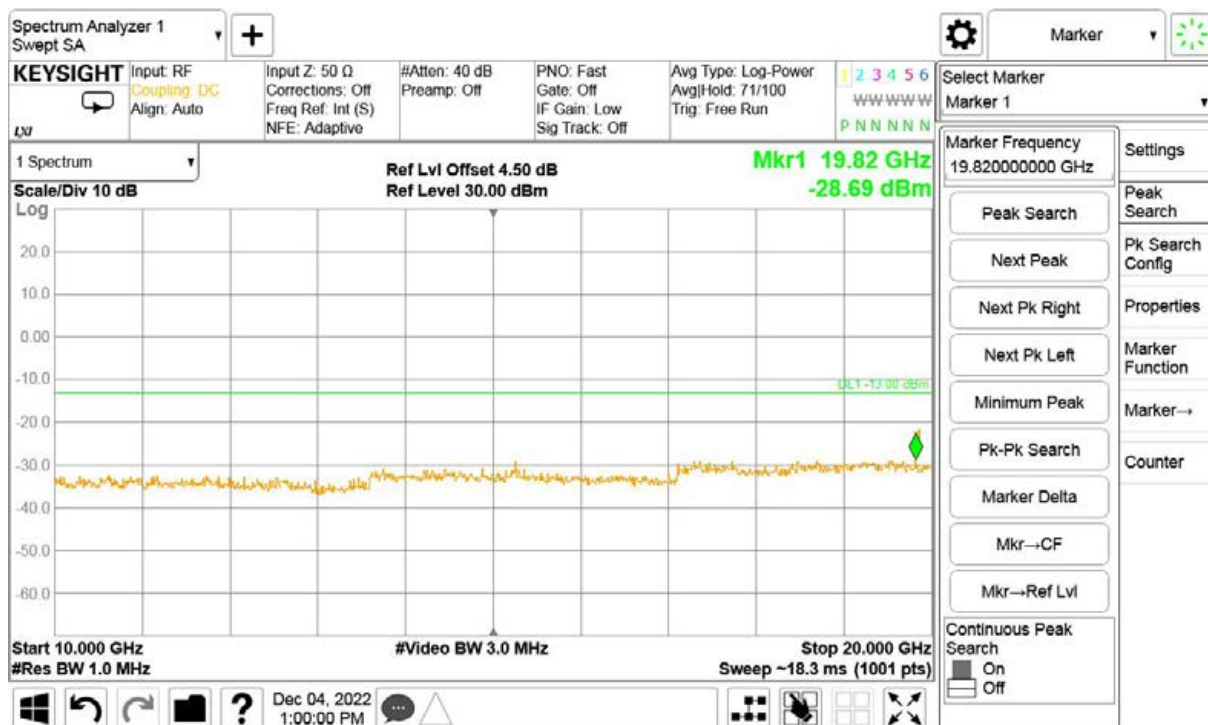
10GHz to 20GHz, Mid Channel, Subcarrier (3.75kHz), QPSK, 1@0

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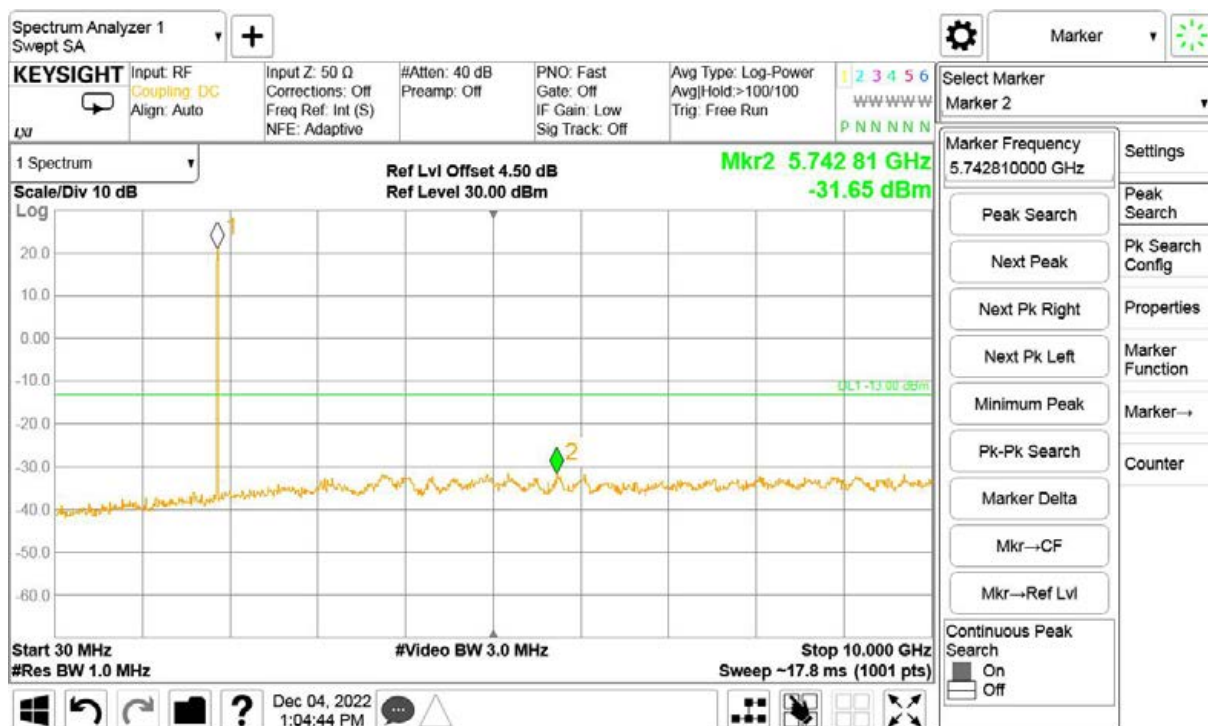
30MHz to 10GHz, Mid Channel, Subcarrier (3.75kHz), BPSK, 1@0



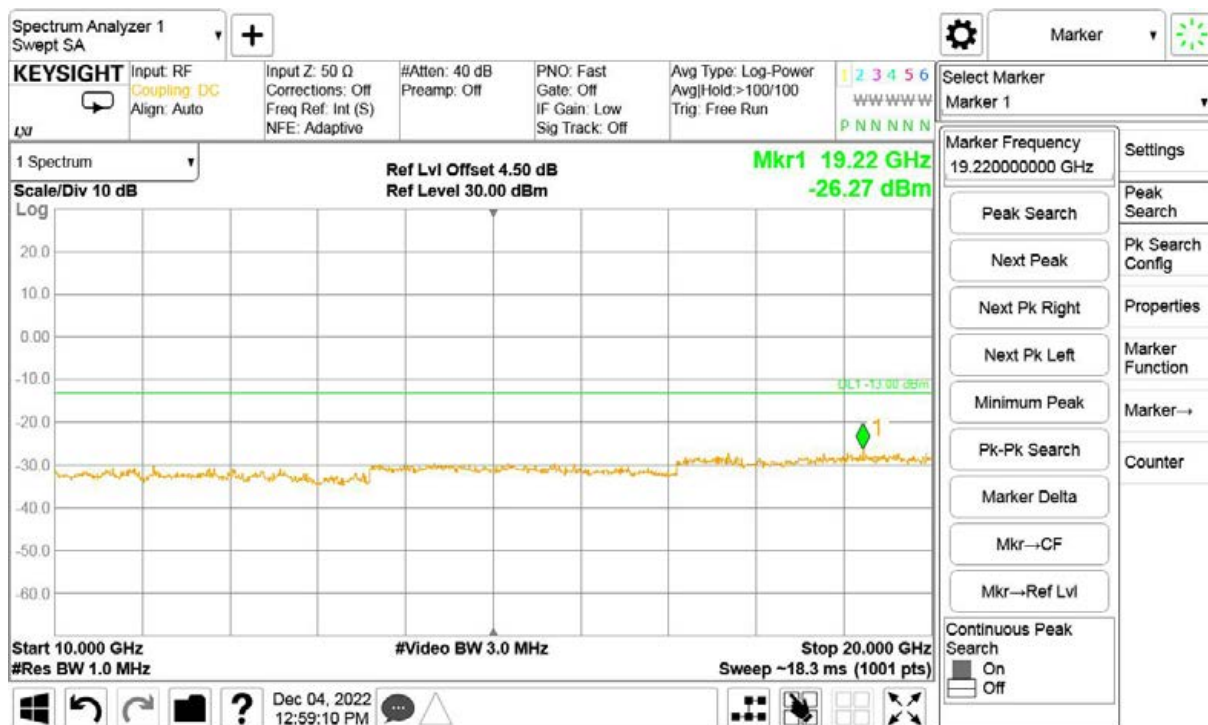
10GHz to 20GHz, Mid Channel, Subcarrier (3.75kHz), BPSK, 1@0

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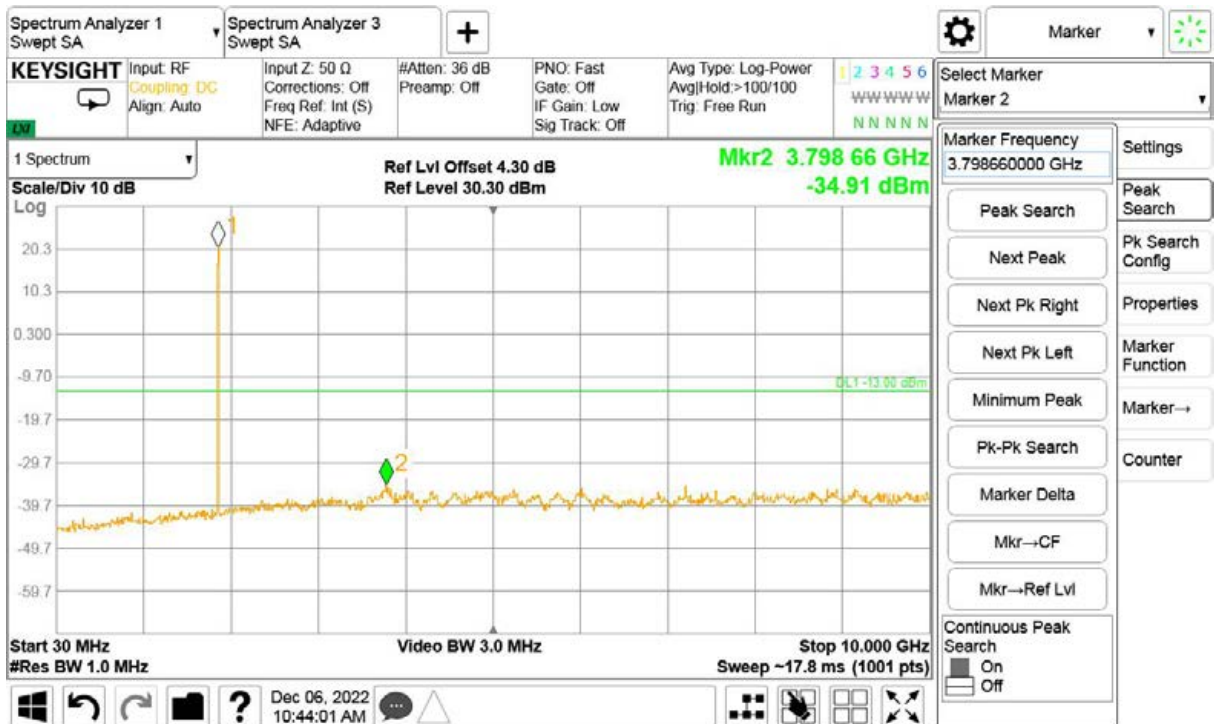
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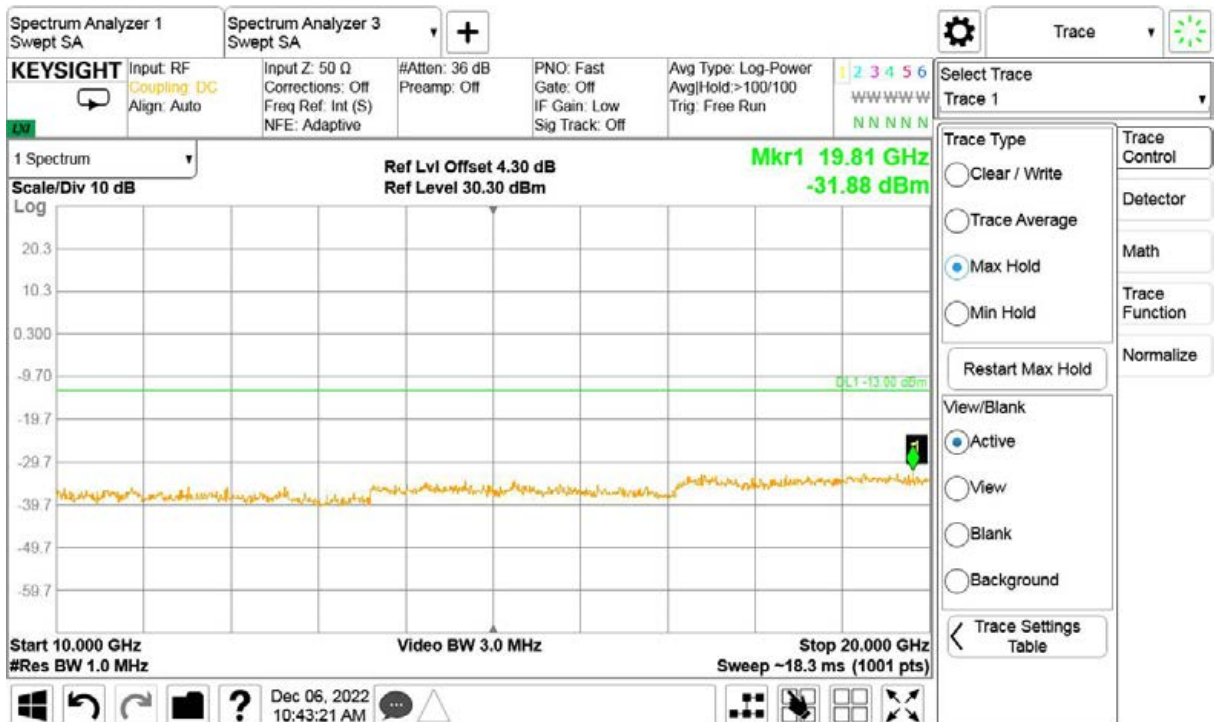
10GHz to 20GHz, Mid Channel, Subcarrier (15kHz), QPSK, 1@0

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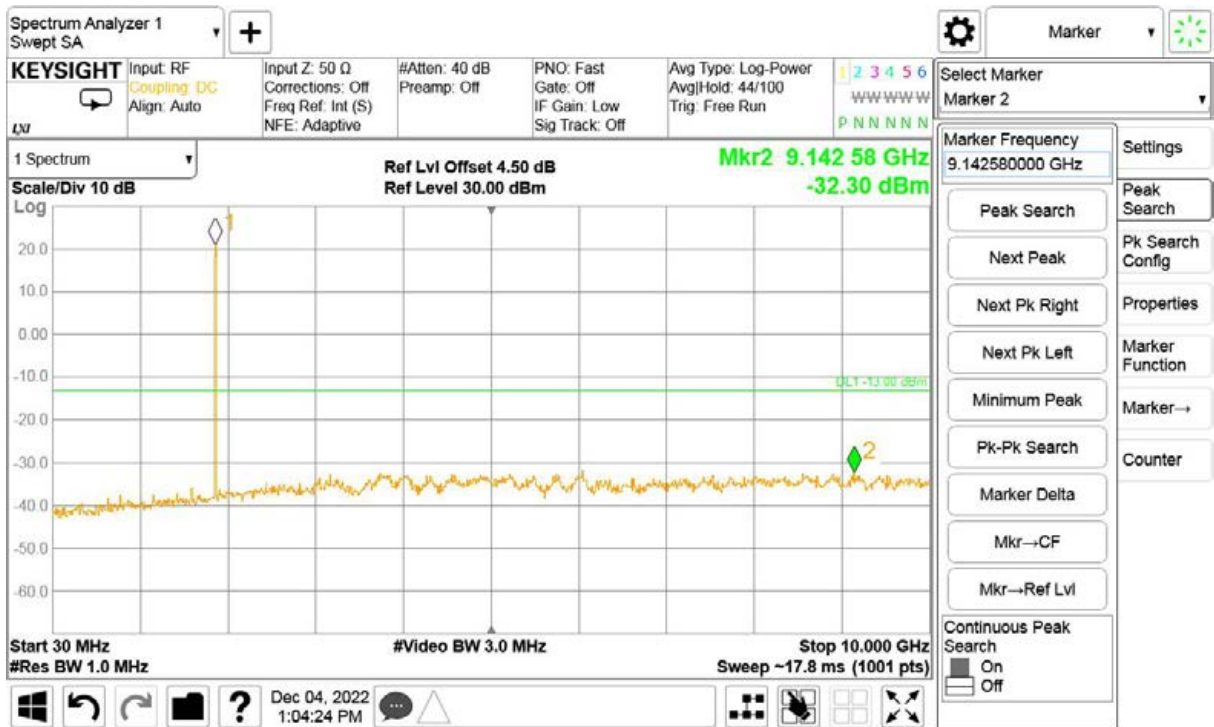
30MHz to 10GHz, Mid Channel, Subcarrier (15kHz), QPSK, 12@0



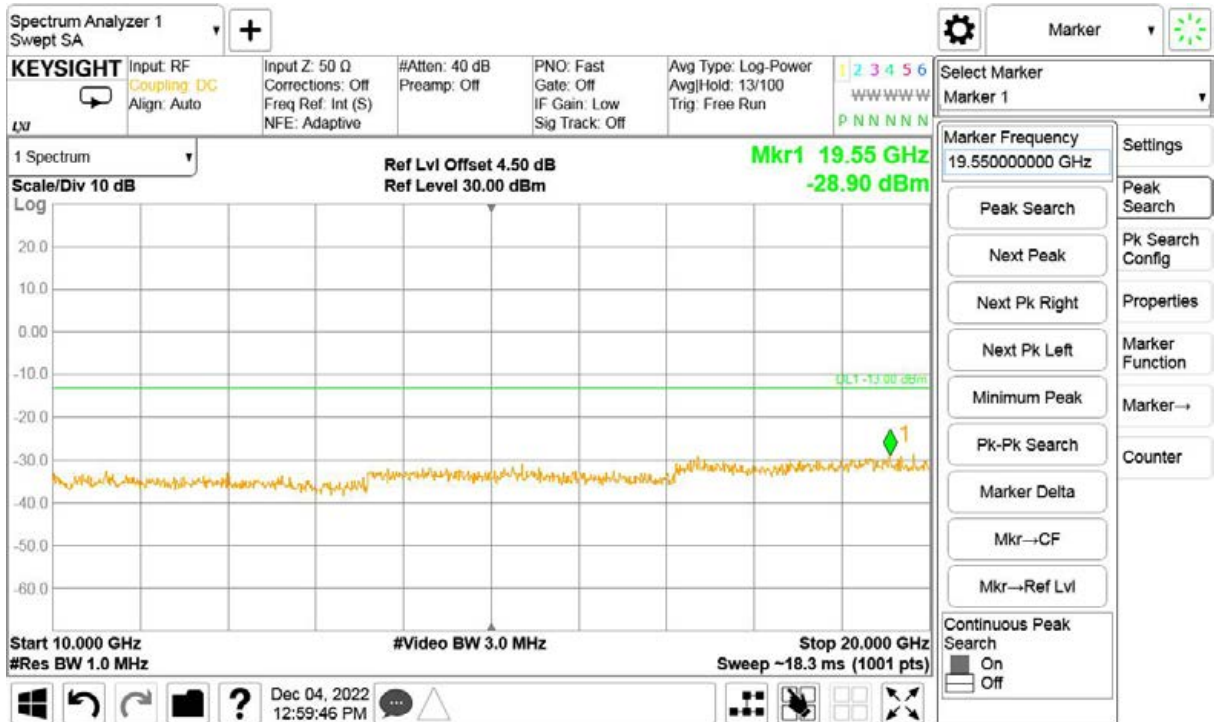
10GHz to 20GHz, Mid Channel, Subcarrier (15kHz), QPSK, 12@0

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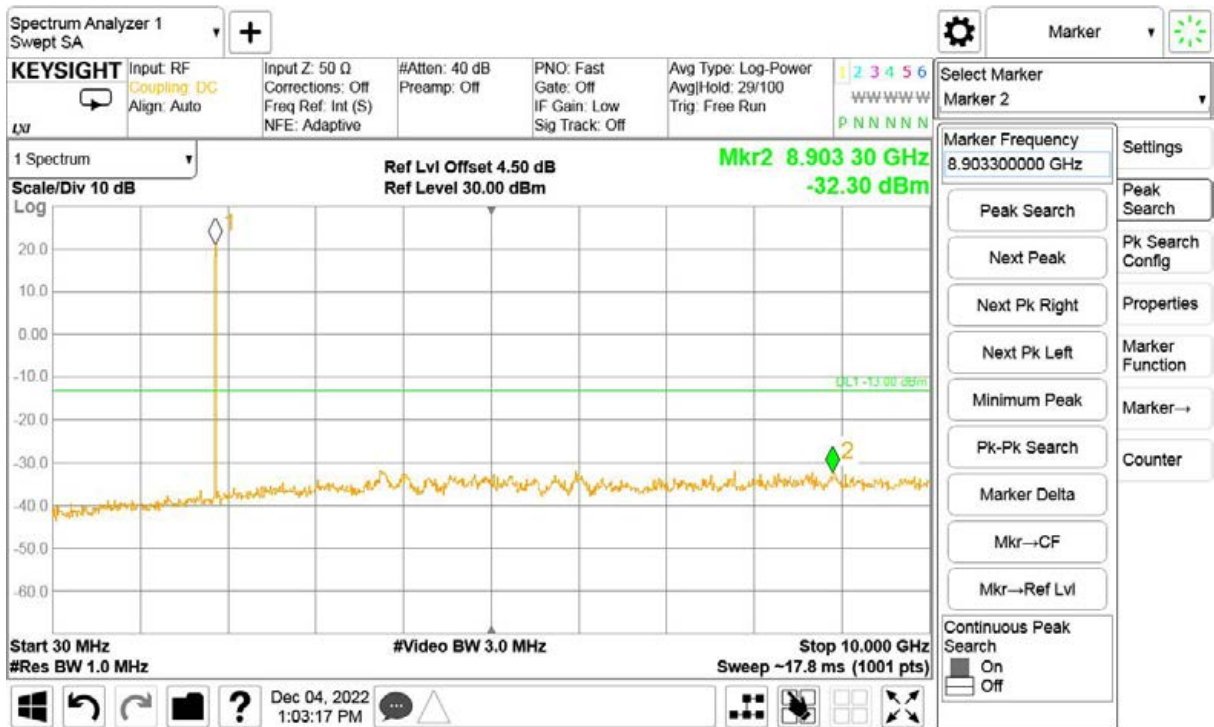
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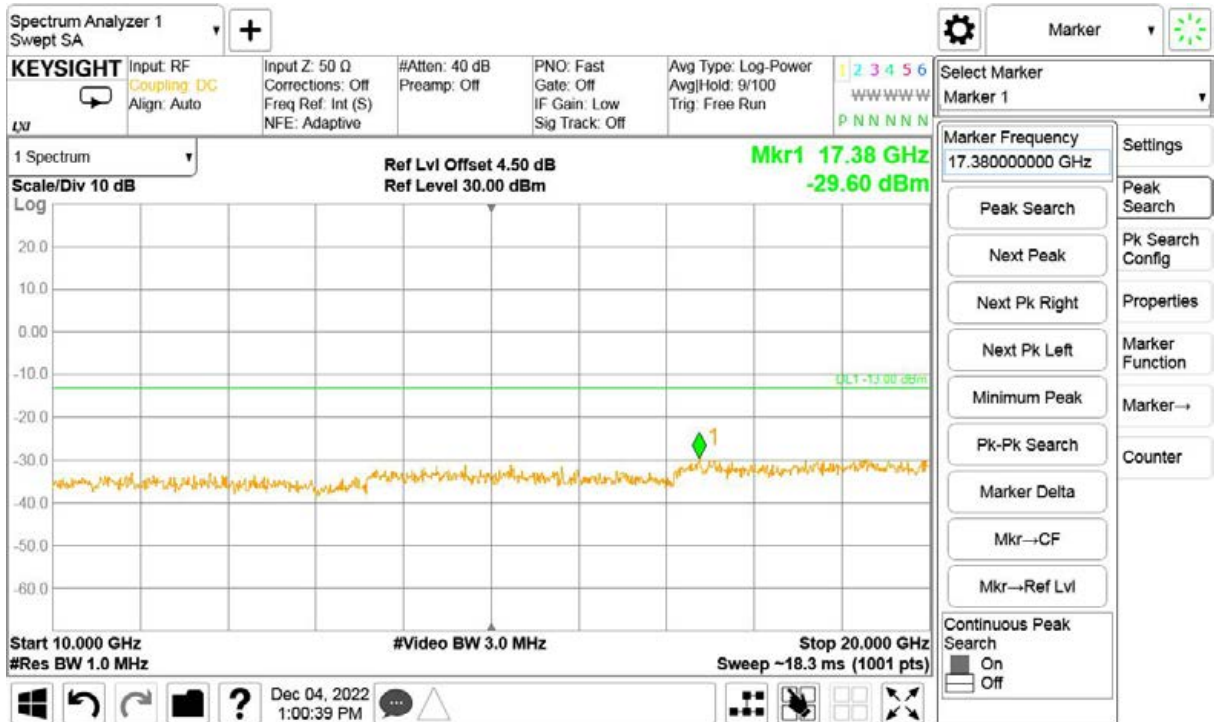
10GHz to 20GHz, Mid Channel, Subcarrier (15kHz), BPSK, 1@0

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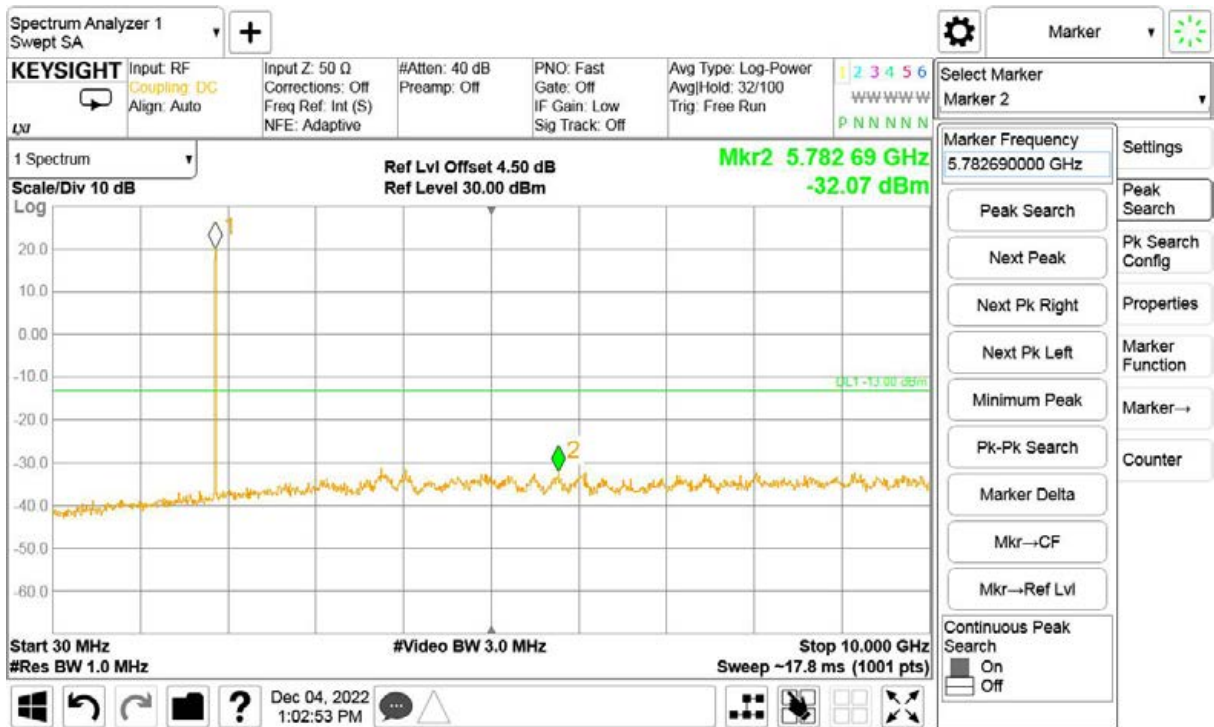
30MHz to 10GHz, High Channel, Subcarrier (3.75kHz), QPSK, 1@0



10GHz to 20GHz, High Channel, Subcarrier (3.75kHz), QPSK, 1@0

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30MHz to 10GHz, High Channel, Subcarrier (3.75kHz), BPSK, 1@0



10GHz to 20GHz, High Channel, Subcarrier (3.75kHz), BPSK, 1@0

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