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FCC TEST REPORT

Application No.:	ZR/2020/B0027
Applicant:	HUAWEI DEVICE CO., LTD
Address of Applicant	NO.2 OF XINCHENG ROAD, SONGSHAN LAKE ZONE, DONGGUAN,523808 GUANGDONG, P.R. CHINA
Manufacturer:	HUAWEI DEVICE CO., LTD
Address of Manufacturer	NO.2 OF XINCHENG ROAD, SONGSHAN LAKE ZONE, DONGGUAN,523808 GUANGDONG, P.R. CHINA
EUT Description:	Wireless Earphone
Model No.:	T0001 (for earphone), T0001C (for charging case)
FCC ID:	2ATEYT0001 (for earphone), 2ATEYT0001C (for charging case)
Trade Mark:	HUAWEI
Standards:	47 CFR FCC Part 2, Subpart J 47 CFR Part 15, Subpart C
Test Method	ANSI C63.10 (2013) KDB558074 D01 15.247 Meas Guidance v05r02
Date of Receipt:	2020/11/17
Date of Test:	2020/11/17 to 2020/11/30
Date of Issue:	2021/4/21
Test Result:	PASS *

In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Derde yang

Derek Yang Wireless Laboratory Manager



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1 Version

Revision Record					
Version	Chapter	Date	Modifier	Remark	
01		2020/11/30		Original	
02	Section 3.2 Section 4.11 Section 6	2021/4/21	James Qin	 Add test site Information Modify data conversion error of antenna height Update equipment list 	

Authorized for issue by:	
Prepared By	Dee.Zheng (Dee Zheng) / Engineer
Checked By	Jim Huang) / Reviewer



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2 Test Summary

Test Item	Test Requirement	Test method	Test Result	Result	Test Lab*
AC Power Line Conducted Emission	15.207	ANSI C63.10 (2013)	Clause 4.3	PASS	В
Conducted Peak Output Power	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 4.4	PASS	А
20dB Emission Bandwidth & 99% Occupied Bandwidth	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 4.5	PASS	А
Carrier Frequencies Separation	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 4.6	PASS	А
Hopping Channel Number	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 4.7	PASS	А
Dwell Time	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 4.8	PASS	А
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10 (2013)	Clause 4.9	PASS	А
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10 (2013)	Clause 4.10	PASS	A
Radiated Spurious emissions	15.247(d); 15.205/15.209	ANSI C63.10 (2013)	Clause 4.11	PASS	В
Restricted bands around fundamental frequency (Radiated Emission)	15.247(d); 15.205/15.209	ANSI C63.10 (2013)	Clause 4.12	PASS	В

Remark: All test were performed by Lab A and B. Parts of test items above were subcontracted to Lab B. Lab A SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch Lab B SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD.

Test engineer: Dee Zheng, Swing Hu, Habit Zeng, Leah Chen, Ken Liu, Andy Yao



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3 General Information

3.1 Client Information

Applicant:	HUAWEI DEVICE CO.,LTD
Address of Applicant:	NO.2 OF XINCHENG ROAD,SONGSHAN LAKE ZONE,DONGGUAN,523808 GUANGDONG,P.R.CHINA
Manufacturer:	HUAWEI DEVICE CO.,LTD
Address of Manufacturer:	NO.2 OF XINCHENG ROAD,SONGSHAN LAKE ZONE,DONGGUAN,523808 GUANGDONG,P.R.CHINA

3.2 Test Location

Lab A:

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
Post code:	518057

Lab B:

Company:	SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD.
Address:	1/F, Unit D, Building 1, Kanghong Orange Technology Park, No.137, Keyuan 3rd Road, Fengdong New City, Xi'an, Shaanxi China
Post code:	710086



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3.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Lab A:

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• FCC – Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

Lab B:

A2LA (Certificate No. 4854.01)

SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4854.01.

Designation Number: CN1271.



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3.4 General Description of EUT

S

EUT Description:	Bluetooth devices
Model No.:	T0001
Trade Mark:	HUAWEI
Hardware Version:	PCB V6
Software Version:	1.0.0.69m
Operation Frequency:	2400MHz~2483.5MHz fc = 2402 MHz + N * 1 MHz, where: -fc = "Operating Frequency" in MHz, -N = "Channel Number" with the range from 0 to 78.
Bluetooth Version:	Bluetooth V2.1 + EDR
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, π/4DQPSK, 8DPSK
Number of Channel:	79
Hopping Channel Type:	Adaptive Frequency Hopping systems
Sample Type:	⊠ Portable Device, ☐Module
Antenna Type:	External, 🛛 Integrated
Antenna Gain:	1.4dBi
Power Supply	AC/DC Adapter; Battery PoE:; Other:

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
2	2404MHz	22	2424MHz	42	2444MHz	62	2464MHz
3	2405MHz	23	2425MHz	43	2445MHz	63	2465MHz
4	2406MHz	24	2426MHz	44	2446MHz	64	2466MHz
5	2407MHz	25	2427MHz	45	2447MHz	65	2467MHz
6	2408MHz	26	2428MHz	46	2448MHz	66	2468MHz
7	2409MHz	27	2429MHz	47	2449MHz	67	2469MHz
8	2410MHz	28	2430MHz	48	2450MHz	68	2470MHz
9	2411MHz	29	2431MHz	49	2451MHz	69	2471MHz
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
12	2414MHz	32	2434MHz	52	2454MHz	72	2474MHz
13	2415MHz	33	2435MHz	53	2455MHz	73	2475MHz
14	2416MHz	34	2436MHz	54	2456MHz	74	2476MHz
15	2417MHz	35	2437MHz	55	2457MHz	75	2477MHz
16	2418MHz	36	2438MHz	56	2458MHz	76	2478MHz
17	2419MHz	37	2439MHz	57	2459MHz	77	2479MHz
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz



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19 2421MHz 39 2441MHz 59 2461MHz

Remark:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle

frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel	2402MHz
The Middle channel	2441MHz
The Highest channel	2480MHz

3.5 Test Environment

Operating Environment			
Temperature:	24.0 °C		
Humidity:	55 % RH		
Atmospheric Pressure:	101.30 KPa		

3.6 Description of Support Units

The EUT has been tested independent unit.



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4 Test results and Measurement Data

4.1 Antenna Requirement

Standard requirement: 47 CFR Part 15C Section 15.203 /247(c)

15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 1.4dBi.



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4.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

4.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

4.2.2 Conclusion

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

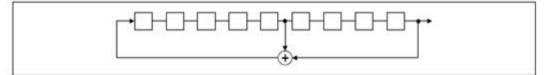
> Number of shift register stages: 9

> Length of pseudo-random sequence: 29 -1 = 511 bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

20 62 46 77	7 64	8 73	16 75 1

Each frequency used equally on the average by each transmitter.



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		10001	100-100/20012000	1 (00-100) 20/10004	ego.ouniceogo.oonn

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According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the RF system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system. Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels. The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



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Test Requirement:	47 CFR Part 15C Section 15.207				
Test Method:	ANSI C63.10: 2013				
Test Frequency Range:	150kHz to 30MHz				
	Frequency range (MHz)	Limit (dBuV)			
		Quasi-peak	Average		
Limit:	0.15-0.5	66 to 56*	56 to 46*		
Linnt.	0.5-5	56	46		
	5-30	60	50		
	* Decreases with the logarith	nm of the frequency.			
Test Procedure:	 impedance. The power c connected to a second L reference plane in the sa measured. A multiple soo power cables to a single exceeded. 3) The tabletop EUT was pla ground reference plane. placed on the horizontal e placed on the horizontal e 4) The test was performed w of the EUT shall be 0.4 m vertical ground reference reference plane. The LIS unit under test and bonde mounted on top of the gr between the closest poin the EUT and associated 5) In order to find the maxim 	to AC power source throug Network) which provides a ables of all other units of th ISN 2, which was bonded to me way as the LISN 1 for to cket outlet strip was used to LISN provided the rating of aced upon a non-metallic to And for floor-standing arran ground reference plane, with a vertical ground reference on from the vertical ground reference plane was bonded to the H N 1 was placed 0.8 m from ed to a ground reference plane. This ts of the LISN 1 and the EU equipment was at least 0.8 hum emission, the relative plane interface cables must be ch	gh a LISN 1 (Line $50\Omega/50\mu$ H + 5Ω linear the EUT were to the ground the unit being to connect multiple of the LISN was not able 0.8m above the the gement, the EUT was the contract for the rear efference plane. The rear efference plane. The horizontal ground the boundary of the lane for LISNs to distance was JT. All other units of the more plane of the LISN 2. positions of		

4.3 AC Power Line Conducted Emissions



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Test Setup:	Shielding Room Test Receiver Test		
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type at the lowest, middle, high channel. Charge + Transmitting mode.		
Final Test Mode:	Al Test Mode: Through Pre-scan, find the DH5 of data type and GFSK modulation at the lowest channel is the worst case. Charge + Transmitting mode Only the worst case is recorded in the report.		
Instruments Used:	Refer to section 5.10 for details		
Test Results:	Pass		



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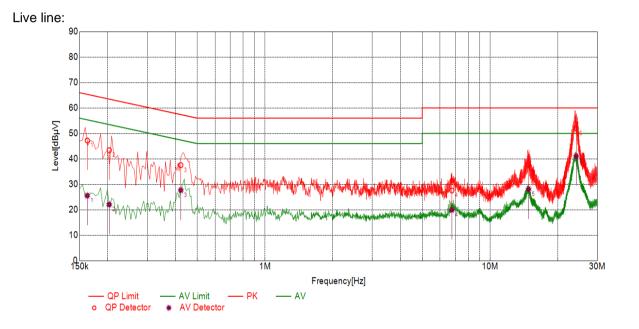


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Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.



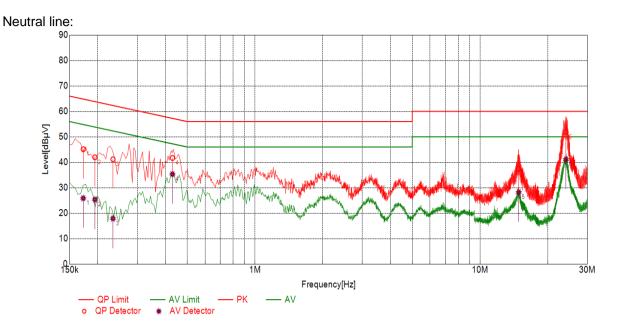
Final	Final Data List							
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.1624	10.10	47.22	65.34	18.12	25.52	55.34	29.82
2	0.2033	10.10	43.41	63.47	20.06	22.05	53.47	31.42
3	0.4227	10.10	37.53	57.40	19.87	27.69	47.40	19.71
4	6.7654	10.10	27.57	60.00	32.43	19.92	50.00	30.08
5	14.8319	10.11	37.74	60.00	22.26	28.07	50.00	21.93
6	24.1424	10.11	51.95	60.00	8.05	41.02	50.00	8.98



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Final	Final Data List							
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.1726	10.10	45.13	64.84	19.71	25.86	54.84	28.98
2	0.1945	10.10	41.93	63.84	21.91	25.34	53.84	28.50
3	0.2340	10.10	41.17	62.31	21.14	17.88	52.31	34.43
4	0.4299	10.10	41.70	57.25	15.55	35.34	47.25	11.91
5	14.8599	10.11	37.43	60.00	22.57	28.21	50.00	21.79
6	24.0966	10.11	51.84	60.00	8.16	41.07	50.00	8.93

Remarks:

- 1. The following Quasi-Peak and Average measurements were performed on the EUT:
- 2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

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	•		
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)		
Test Method:	ANSI C63.10:2013 Section 7.8.5		
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane		
Limit:	(20.97dBm) 125mW		
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type.		
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4DQPSK$ modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.		
Instruments Used:	Refer to section 5.10 for details		
Test Results:	Pass		

4.4 Conducted Peak Output Power



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4.4.1 Test Results

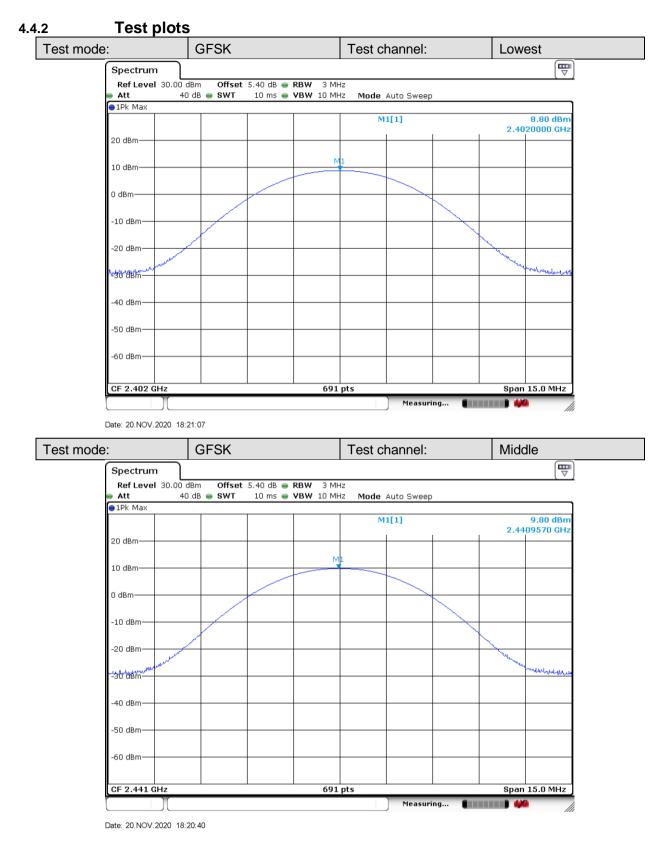
Measurement Data of Peak power:

GFSK mode					
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result		
Lowest	8.80	20.97	Pass		
Middle	9.80	20.97	Pass		
Highest	10.20	20.97	Pass		
	π/4DQPSK mode				
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result		
Lowest	8.77	20.97	Pass		
Middle	9.77 20.97		Pass		
Highest	10.14	20.97	Pass		
	8DPSK mode				
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result		
Lowest	8.79	20.97	Pass		
Middle	9.75	20.97	Pass		
Highest	10.16	20.97	Pass		



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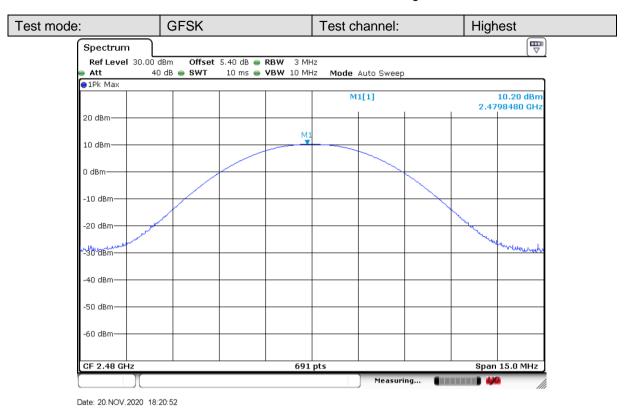


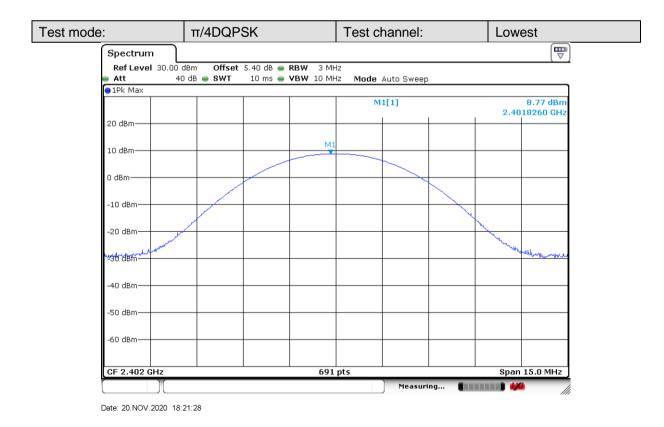


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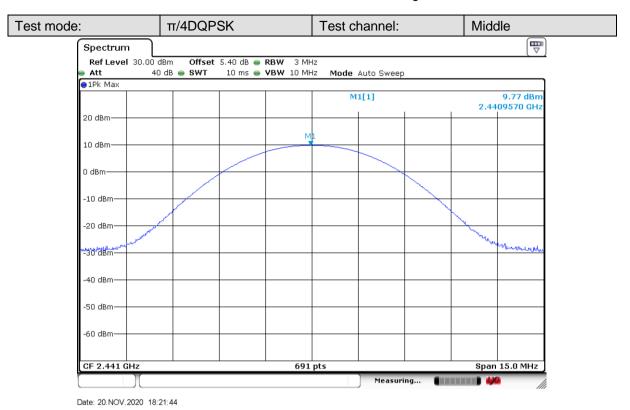


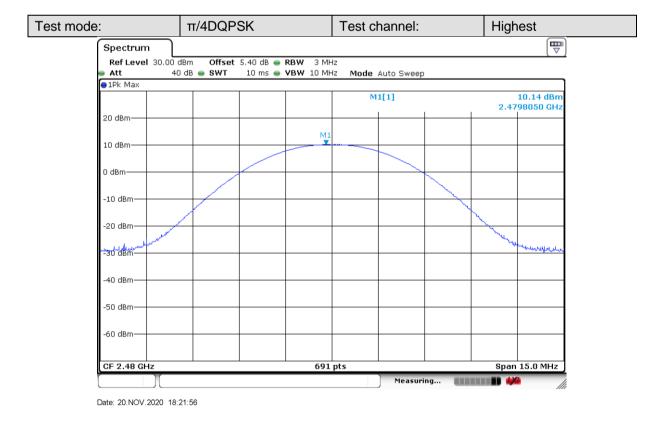




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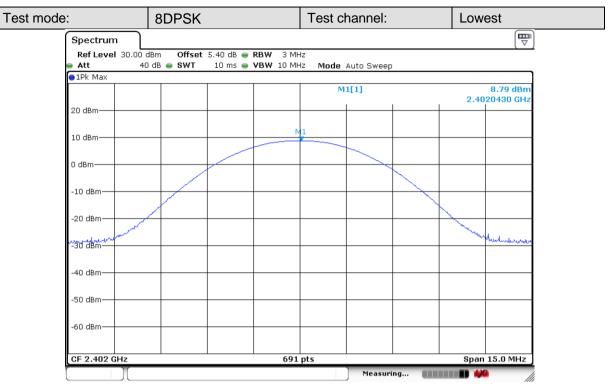




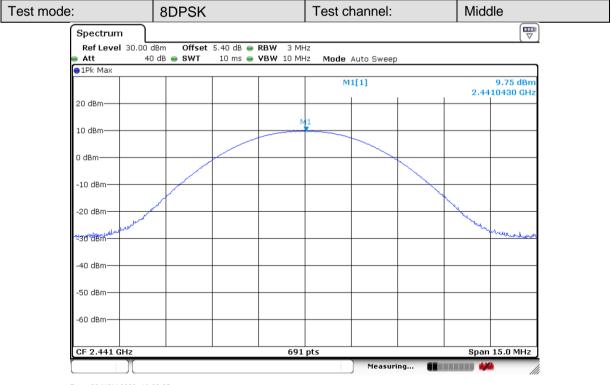


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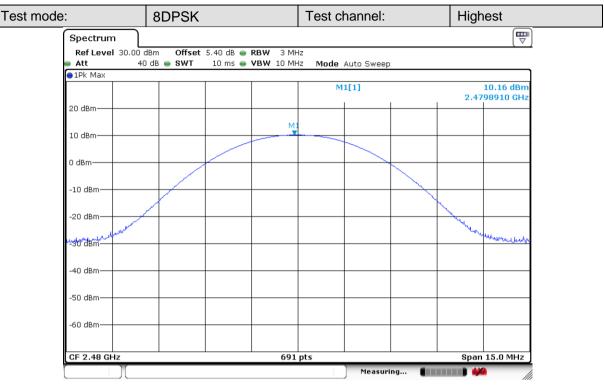


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4.5 20dB Emission Bandwidth & 99% Occupied Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)			
Test Method:	ANSI C63.10:2013 Section 7.8.7			
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane			
Limit:	NA			
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type.			
Final Test Mode:	 Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of π/4DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type. 			
Instruments Used:	Refer to section 5.10 for details			
Test Results:	Pass			
4.5.1 Test Results				

Mode	Test Channel 99% Occupied Bandwidth (KHz)		20dB Emission Bandwidth (KHz)	Result		
	Lowest	837.9	950.8	Pass		
GFSK	Middle	864.0	950.8	Pass		
	Highest	859.6	950.8	Pass		
	Lowest	1128.8	1228.7	Pass		
π/4DQPSK	Middle	1120.1	1228.7	Pass		
	Highest	1115.8	1228.7	Pass		
	Lowest	1115.8	1206.9	Pass		
8DPSK	Middle	1128.8	1206.9	Pass		
	Highest	1133.1	1189.6	Pass		



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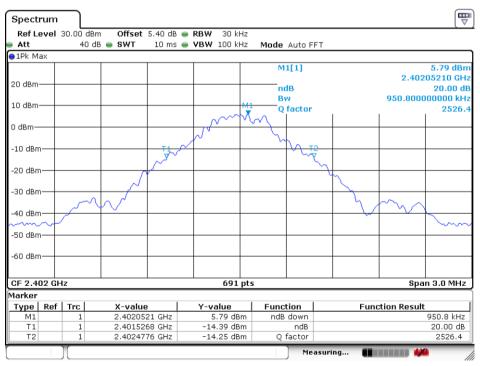
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4.5.2 Test plots









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4.5.2.2 GFSK _Middle Channel

₽ Spectrum Ref Level 35.40 dBm Offset 5.40 dB 👄 RBW 30 kHz 40 dB 👄 SWT 10 ms 👄 VBW 100 kHz Mode Auto FFT Att ●1Pk Max M1[1] 5.74 dBn 30 dBm 2.44099570 GH Occ Bw 863.965267728 kH 20 dBm 10 dBm w 0 dBm-0 -10 dBm MIZ -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm-691 pts Span 3.0 MHz CE 2,441 GHz Measuring... Date: 20.NOV.2020 21:10:16 -Spectrum Ref Level 35.40 dBm Offset 5.40 dB 👄 RBW 30 kHz 40 dB 👄 SWT 10 ms 👄 VBW 100 kHz Mode Auto FFT Att ●1Pk Max M1[1] 5.71 dBn 30 dBm 2.44099570 GH ndB 20.00 dB 20 dBm 950.80000000 kH BW O factor 2567.3 10 dBm S 0 dBm-N -10 dBm -20 dBm -30 dBm 40 dBm nnn -50 dBm -60 dBm-CF 2.441 GHz 691 pts Span 3.0 MHz /larker Type | Ref | Trc X-value Y-value Function **Function Result** 5.71 dBm -14.23 dBm 4409957 GHz 950.8 kHz ndB down Τ1 2.4405398 GHz ndB 20.00 dB Q factor 2567.3 2.4414906 GHz -14.23 dBm Τ2 Measuring...

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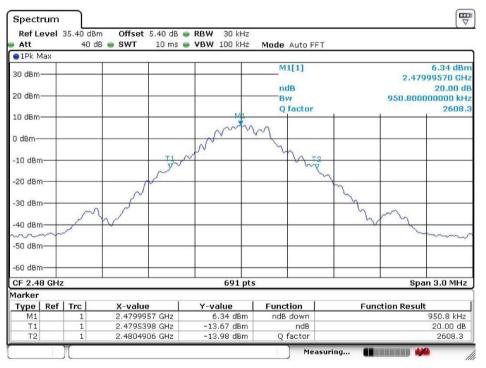
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4.5.2.3 GFSK _Highest Channel

₽ Spectrum Ref Level 35.40 dBm Offset 5.40 dB 👄 RBW 30 kHz 40 dB 👄 SWT 10 ms 👄 VBW 100 kHz Mode Auto FFT Att ●1Pk Max M1[1] 6.33 dBn 2.47999570 GHz 30 dBm Occ Bw 859.623733719 kH 20 dBm 10 dBm 0 dBm-N 2 -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm 691 pts Span 3.0 MHz CE 2.48 GHz Measuring...

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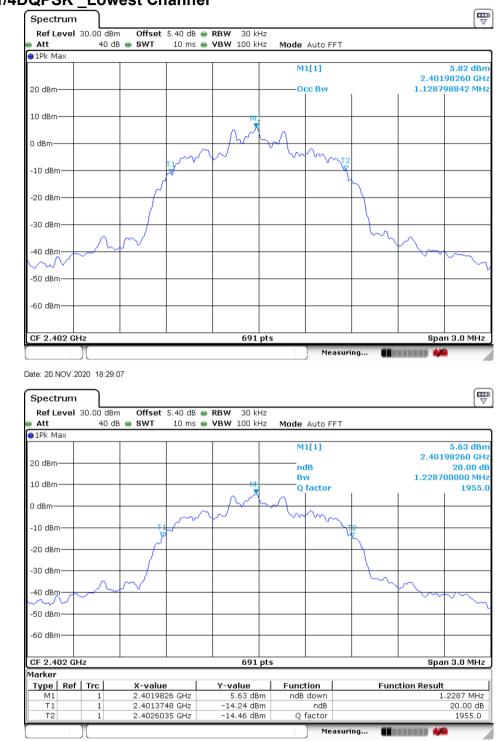


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4.5.2.4 π/4DQPSK _Lowest Channel

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4.5.2.7 8DPSK_Lowest Channel

T Spectrum Offset 5.40 dB 👄 RBW 30 kHz Ref Level 30.00 dBm 40 dB 🔵 SWT 10 ms 👄 **VBW** 100 kHz Att Mode Auto FFT ⊖1Pk Ma× M1[1] 7.43 dBn 2.40198260 GH 20 dBm Occ Bw 1.115774240 MH 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm· -50 dBm -60 dBm CE 2,402 GHz Snan 3.0 MHz 691 pts Measuring... • Date: 20.NOV.2020 18:23:24 ₩ Spectrum Ref Level 30.00 dBm Offset 5.40 dB
RBW 30 kHz 40 dB 👄 SWT 10 ms 👄 VBW 100 kHz Mode Auto FET Att 1Pk Max M1[1] 5.61 dBr 2.40198260 GH 20 dBm ndB 20.00 dE Bw 1.206900000 MH; 10 dBm **O** factor 1990.1

0 dBm -10 dBm -20 dBm -30 dBm -40 dBm· -50 dBm -60 dBm CF 2.402 GHz Span 3.0 MHz 691 pts Marker Type | Ref | Trc Function Function Result X-value Y-value 2.4019826 GHz 5.61 dBm 1.2069 MHz ndB down Μ1 1 T1 2.4014009 GHz -14.09 dBm ndB 20.00 dB 2.4026078 GHz O factor Τ2 -14.39 dBm 1990.1 Measuring... (....) 🚧

Date: 20.NOV.2020 18:23:41

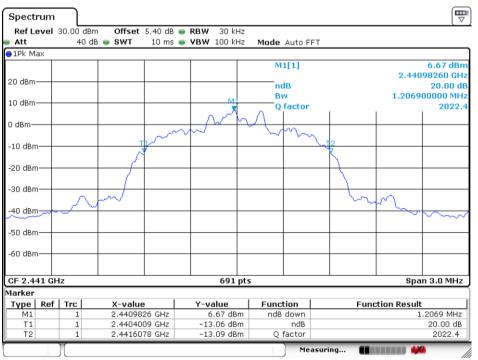


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4.5.2.8 8DPSK _Middle Channel

T Spectrum Offset 5.40 dB 👄 RBW 30 kHz Ref Level 30.00 dBm 40 dB 🔵 SWT 10 ms 👄 **VBW** 100 kHz Att Mode Auto FFT ⊖1Pk Ma× M1[1] 6.65 dBn 2.44098260 GH 20 dBm Occ Bw 1.128798842 MH 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm Snan 3.0 MHz CE 2,441 GHz 691 pts Measuring... Date: 20.NOV.2020 18:24:11



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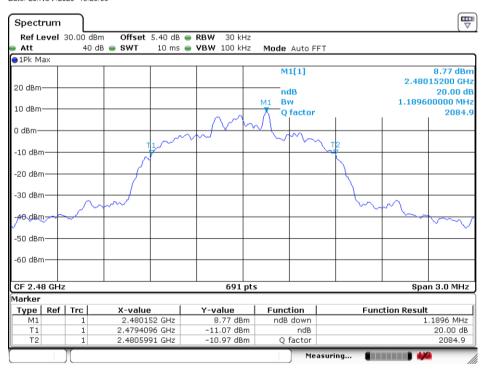


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4.5.2.9 8DPSK_Highest Channel

P Spectrum Offset 5.40 dB 👄 RBW 30 kHz Ref Level 30.00 dBm 40 dB 🔵 SWT 10 ms 👄 **VBW** 100 kHz Att Mode Auto FFT ⊖1Pk Ma× M1[1] 7.13 dBn 2.47998260 GH 20 dBm Occ Bw 1.133140376 MH 10 dBm 0 dBm T) -10 dBm -20 dBm -30 dBm -40 dBm· -50 dBm -60 dBm Snan 3.0 MHz CE 2,48 GHz 691 pts Measuring... • Date: 20.NOV.2020 18:25:03



Date: 20.NOV.2020 18:25:15



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4.6 Carrier Frequencies Separation Test Requirement: 47 CFR Part 15C Section 15.247 (a)(1)

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)				
Test Method:	ANSI C63.10:2013 Section 7.8.2				
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane				
Lingite	2/3 of the 20dB bandwidth				
Limit:	Remark: the transmission power is less than 0.125W.				
Exploratory Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.				
Final Test Mode:	 Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of π/4DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type. 				
Instruments Used:	Refer to section 5.10 for details				
Test Results:	Pass				



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4.6.1 Test Results

GFSK mode				
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result	
Middle	994	633.9	Pass	
π/4DQPSK mode				
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result	
Middle	1003	819.1	Pass	
8DPSK mode				
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result	
Middle	1003	804.6	Pass	

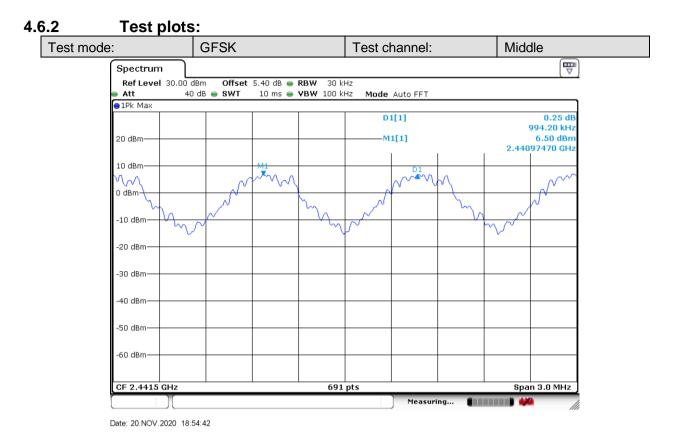
Remark: According to section 6.4,

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	950.8	633.9
π/4DQPSK	1228.7	819.1
8DPSK	1206.9	804.6



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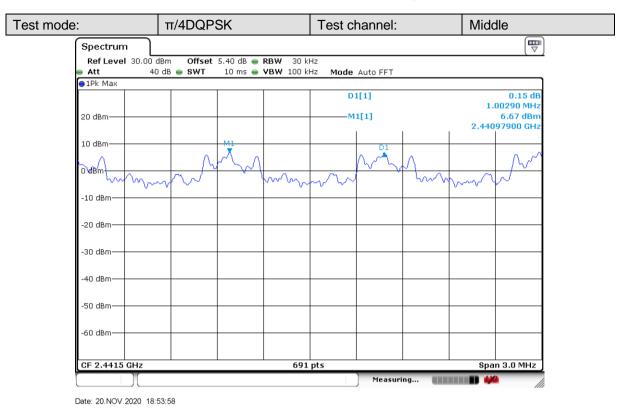
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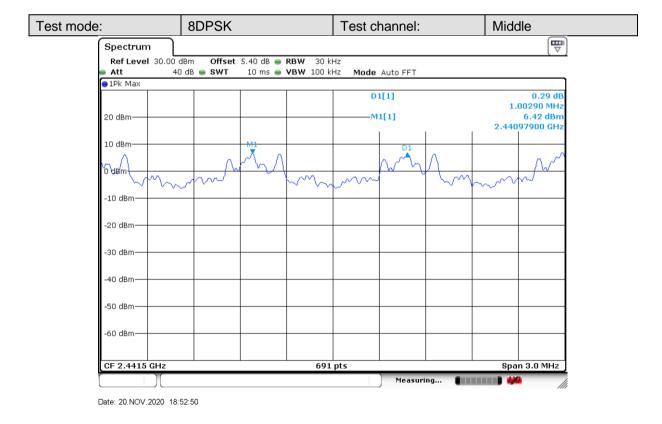




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4.7 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.3
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane
Limit:	At least 15 channels
Test Mode:	Hopping transmitting with all kind of modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

4.7.1 Test Results

Mode	Hopping channel numbers	Limit
GFSK	79	≥15
π/4DQPSK	79	≥15
8DPSK	79	≥15

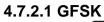


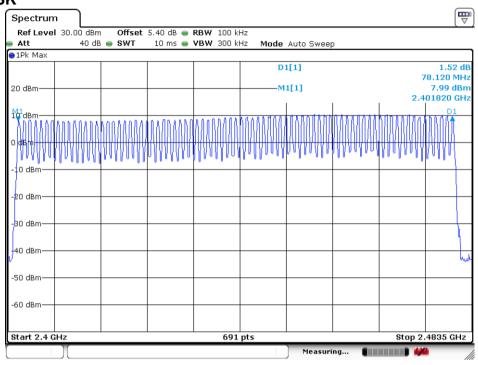
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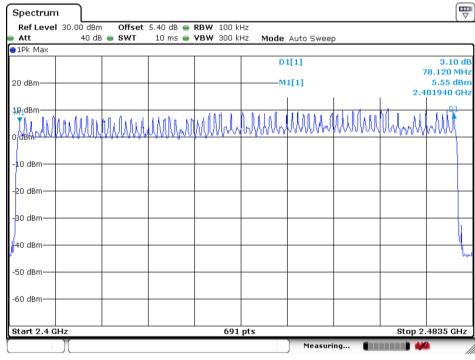
4.7.2 Test plots





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4.7.2.2 π/4DQPSK



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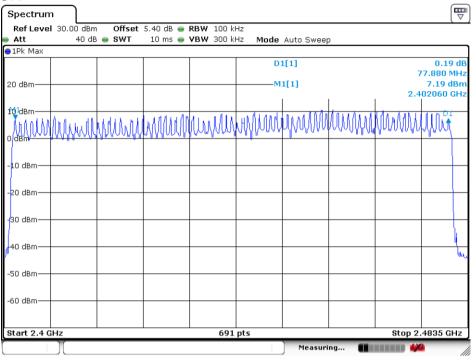


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4.7.2.3 8DPSK



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4.8 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.4
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane
Instruments Used:	Refer to section 5.10 for details
Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Limit:	0.4 Second
Test Results:	Pass



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4.8.1 Test Results	
Operation Modes	On time (ms) on one channel
DH1	0.401
DH3	1.662
DH5	2.928
2-DH1	0.416
2-DH3	1.675
2-DH5	2.928
3-DH1	0.416
3-DH3	1.688
3-DH5	2.928

Bluetooth Time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s, since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600/6=266.67 hops/slot

400ms x 79 Channel = 31.6 s (Time of Occupancy Limit)

Worst case BT has 266.67 hops/second (for 1x/EDR modes with 3-DH5 operation)

266.67 hops/second/79 channels=3.38 hops/second (# of hops/second on one channel)

3.38 hops/second/channel*31.6seconds=106.67 hops (#hops over a 31.6 second period)

106.67 hops *2.928 ms/channel =312.33 ms(worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800hops/s, AFH mode also uses 6 slots so the Bluetooth transmitter hops at a rate of 800/6=133.3 hops/s/slot

400ms x 20 Channel = 8 s (Time of Occupancy Limit)

Worst case BT has 133.3 hops/second/slot (for AFH mode with 3-DH5 operation)

133.3 hops/second/20 channels=6.67 hops/second (#hops/second on one channel)

6.67 hops/second *8seconds=53.34 hops (#hops over a 8 seconds period)

53.34 hops x2.928 ms/channel=156.18 ms(worst case dwell time for one channel in AFH mode)



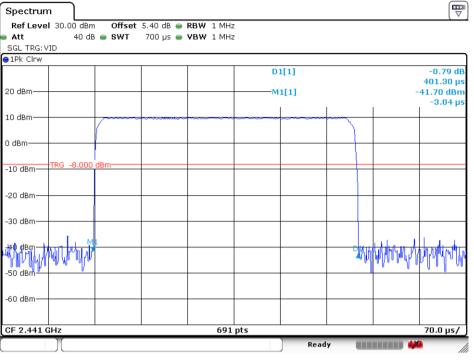
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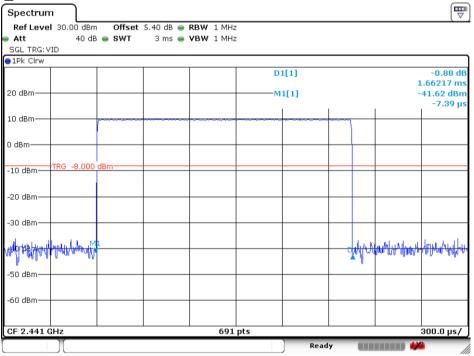
4.8.2 Test plots

4.8.2.1 DH1 _Middle Channel



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4.8.2.2 DH3 _ Middle Channel



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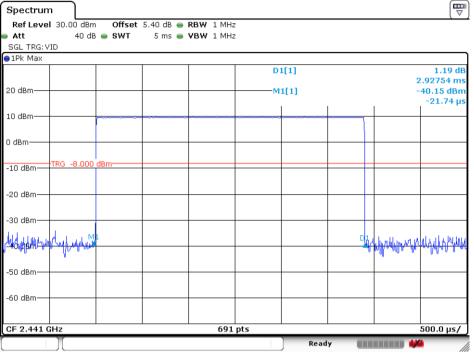


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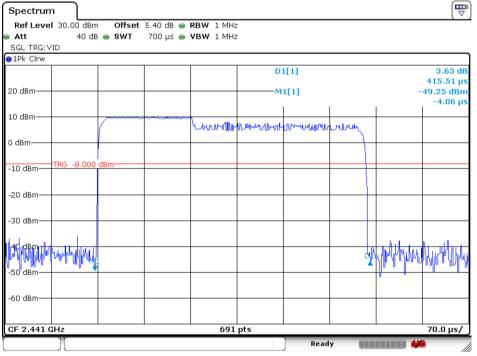
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4.8.2.3 DH5 _ Middle Channel



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4.8.2.4 2DH1 _Middle Channel



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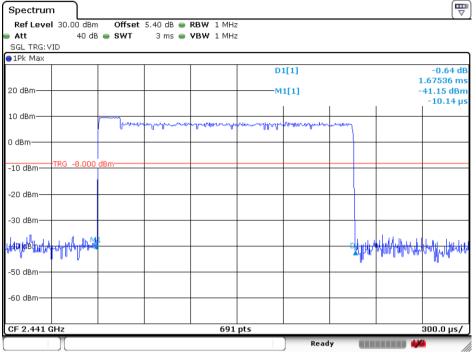


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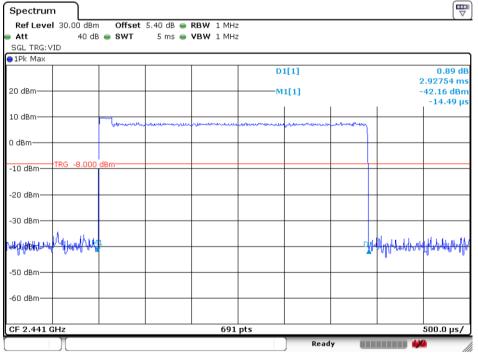
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4.8.2.5 2DH3 _ Middle Channel



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4.8.2.6 2DH5 _ Middle Channel



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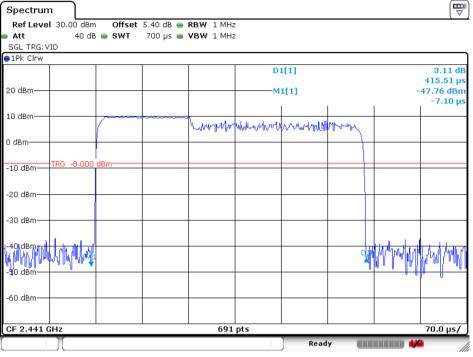


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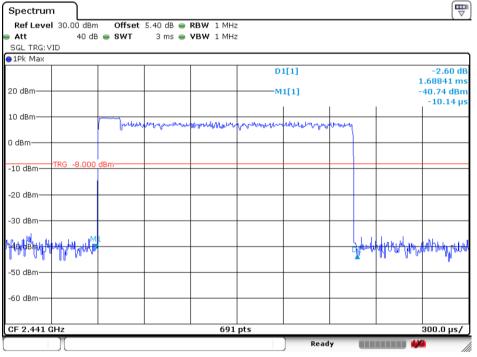
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4.8.2.7 3DH1 _Middle Channel



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4.8.2.8 3DH3 _ Middle Channel



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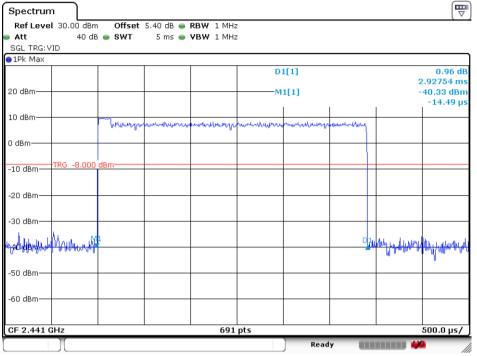


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4.8.2.9 3DH5 _ Middle Channel



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Test Requirement:	47 CFR Part 15C Section 15.247 (d)	
Test Method:	ANSI C63.10:2013 Section 7.8.6	
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane	
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.	
Exploratory Test Mode:	Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type	
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of π /4DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.	
Instruments Used:	Refer to section 5.10 for details	
Test Results:	Pass	

4.9 Band-edge for RF Conducted Emissions



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1.1.1.1

691 pts

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P

-49.80 dE 4.9930 MH:

7.94 dBn 2.4020550 GH

Span 10.0 MHz

Measuring...

4.9.1 **Test plots** 4.9.1.1 GFSK _Lowest Channel_ Hopping ON Spectrum Ref Level 30.00 dBm Offset 5.40 dB 👄 RBW 100 kHz Att 40 dB 👄 SWT 10 ms 👄 VBW 300 kHz Mode Auto Sweep ●1Pk Ma× D1[1] -M1[1] 20 dBm-10 dBm 0 dBm-

Date: 20.NOV.2020 18:46:15

-10 dBm-

-20 dBm

-30 dBm-

-40 dBm·

-50 dBm-

CF 2.4 GHz

D1 -12.060 dBm-

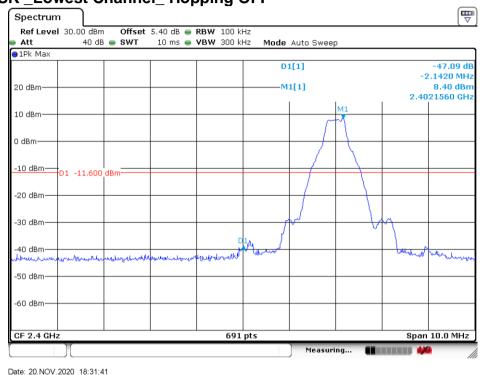
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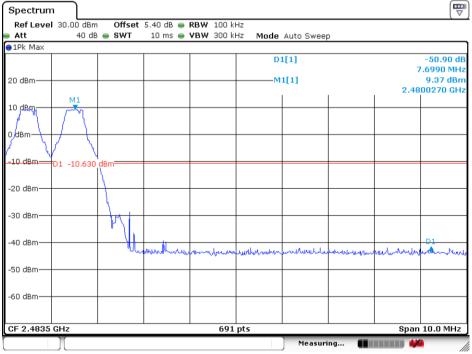


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4.9.1.2 GFSK _Lowest Channel_ Hopping OFF

4.9.1.3 GFSK_Highest Channel_Hopping ON



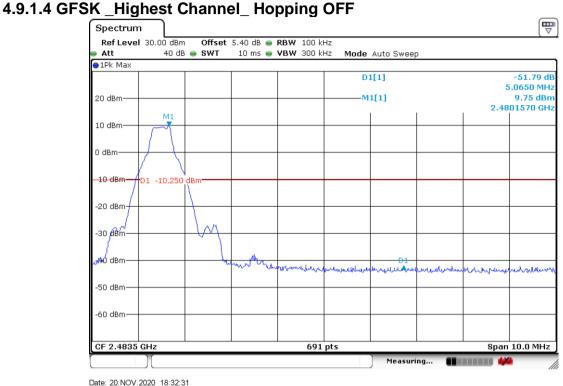
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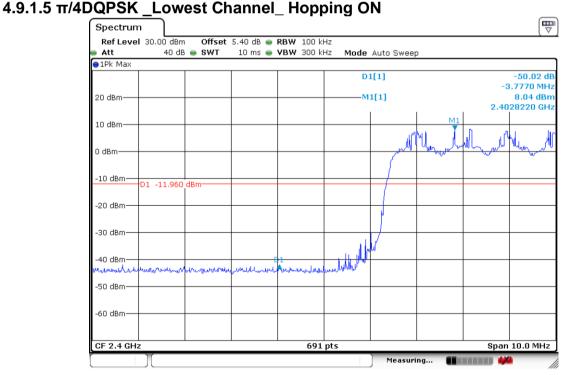


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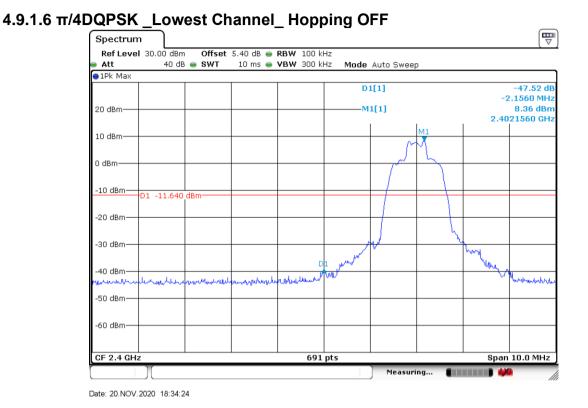


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4.9.1.7 π/4DQPSK _Highest Channel_ Hopping ON

₩ Spectrum Ref Level 30.00 dBm Offset 5.40 dB 👄 RBW 100 kHz Att 40 dB 👄 SWT 10 ms 👄 **VBW** 300 kHz Mode Auto Sweep ●1Pk Ma> D1[1] -51.82 dE 5.8320 MH M1[1] 9.77 dBn 20 dBm 2.4791580 GH 10 dBm mining 0 dBm 10 dBm D1 -10.230 dB -20 dBm -30 dBm ԿՈ -40 dBm II. hhun mound Antest the deependent whether Unite -50 dBm -60 dBm Span 10.0 MHz CF 2,4835 GHz 691 nts Measuring... **C**ARGE CONTRACTOR

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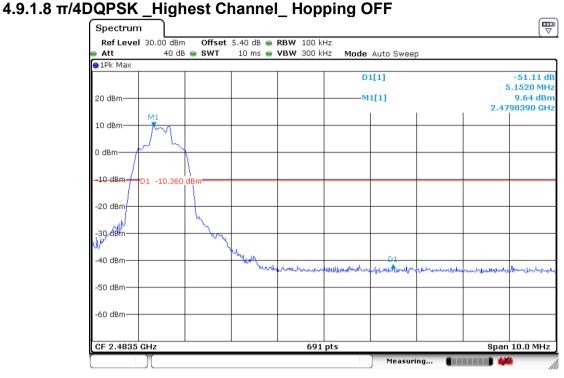


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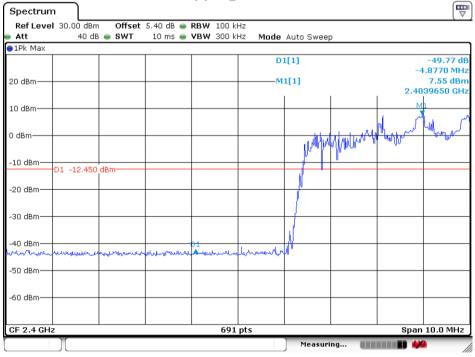
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4.9.1.9 8DPSK _Lowest Channel_ Hopping ON



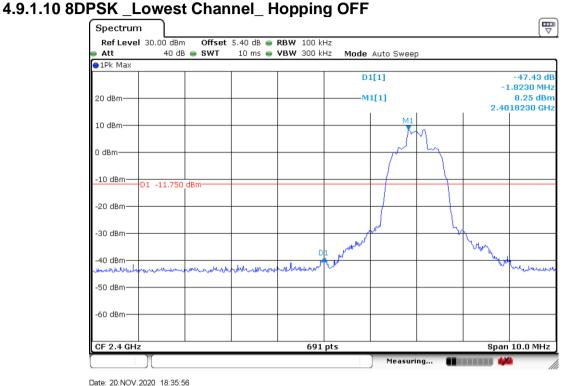
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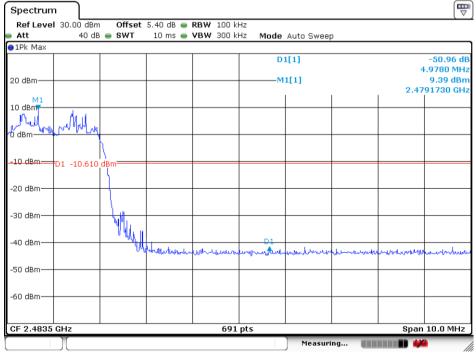


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4.9.1.11 8DPSK _Highest Channel_ Hopping ON



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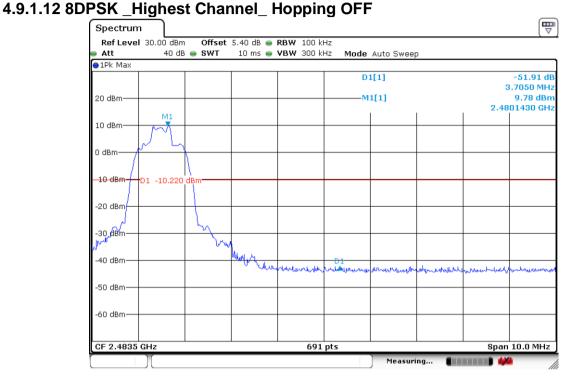


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Test Requirement:	47 CFR Part 15C Section 15.247 (d)	
Test Method:	ANSI C63.10:2013 Section 7.8.8	
Test Setup:	Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane	
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.	
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type	
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4DQPSK$ modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.	
Instruments Used:	Refer to section 5.10 for details	
Test Results:	Pass	

4.10 Spurious RF Conducted Emissions

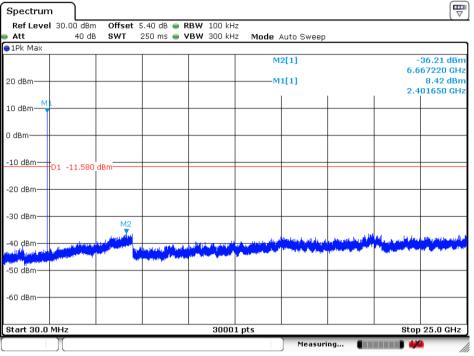


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4.10.1 Test plots

4.10.1.1 GFSK _Lowest Channel



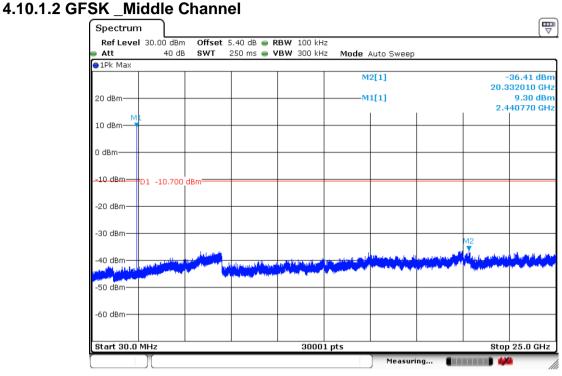
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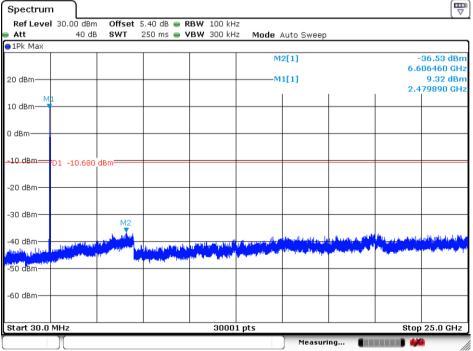


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4.10.1.3 GFSK _Highest Channel



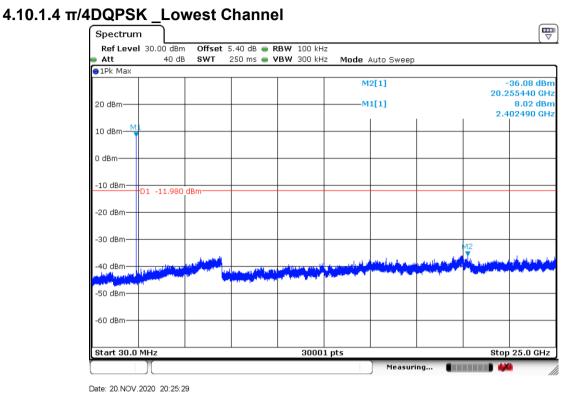
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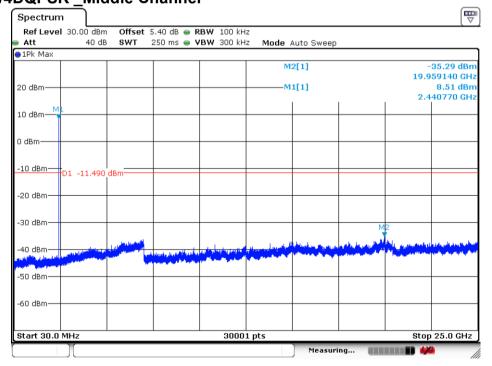
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4.10.1.5 π/4DQPSK Middle Channel



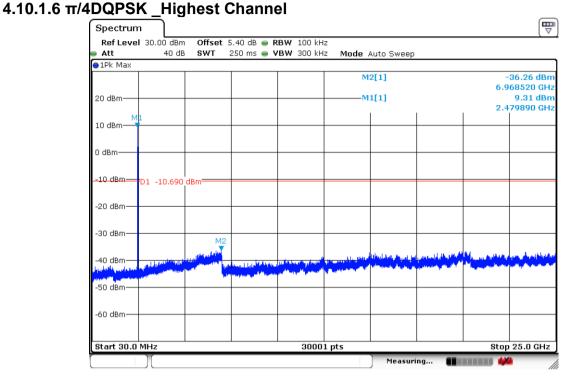
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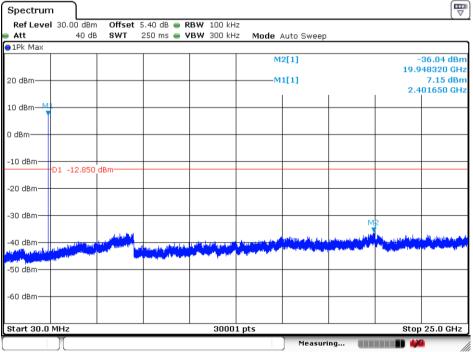


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4.10.1.7 8DPSK_Lowest Channel



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