FCC PART 15.247

TEST REPORT

For

Shenzhen Snapmaker Technologies Co., Ltd.

5F, Honglai Kechuang Building 13, Pingshan 1st Road, Nanshan District, Shenzhen, China

FCC ID: 2AVDG-80018XHFW

Report Type:	**Product Type:**
Original Report	Snapmaker Modular 3D Printer

Report Number:	RSZ200416002-00C
Report Date:	2020-09-17
Reviewed By:	Jimmy Xiao RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Snapmaker Modular 3D Printer
Tested Model	A350
Multiple Models	A150, A250
Model Differences	Refer to the DoS letter
Frequency	Bluetooth: 2402~2480MHz
Peak Conducted Output Power	Bluetooth: 0.24dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification	3.01dBi (provided by the applicant)
Voltage Range	DC 24V from power module
Date of Test	2020-04-29 to 2020-08-30
Sample serial number	RSZ200416002-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-04-16
Sample/EUT Status	Good condition

Note: Manufacturers can sell any of the three functions (3D Module, CNC Module, Laser Module).

Model	SKU Number
A350	80018
A250	80019
A150	80020
A350 (Single 3D printing function)	80021
A250 (Single 3D printing function)	80022
A150 (Single 3D printing function)	80023

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For Radiated Emissions testing, please refer to DA 00-705 Released March 30, 2000, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

"QRCT"* exercise software was made to the EUT tested and the power level is 7*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

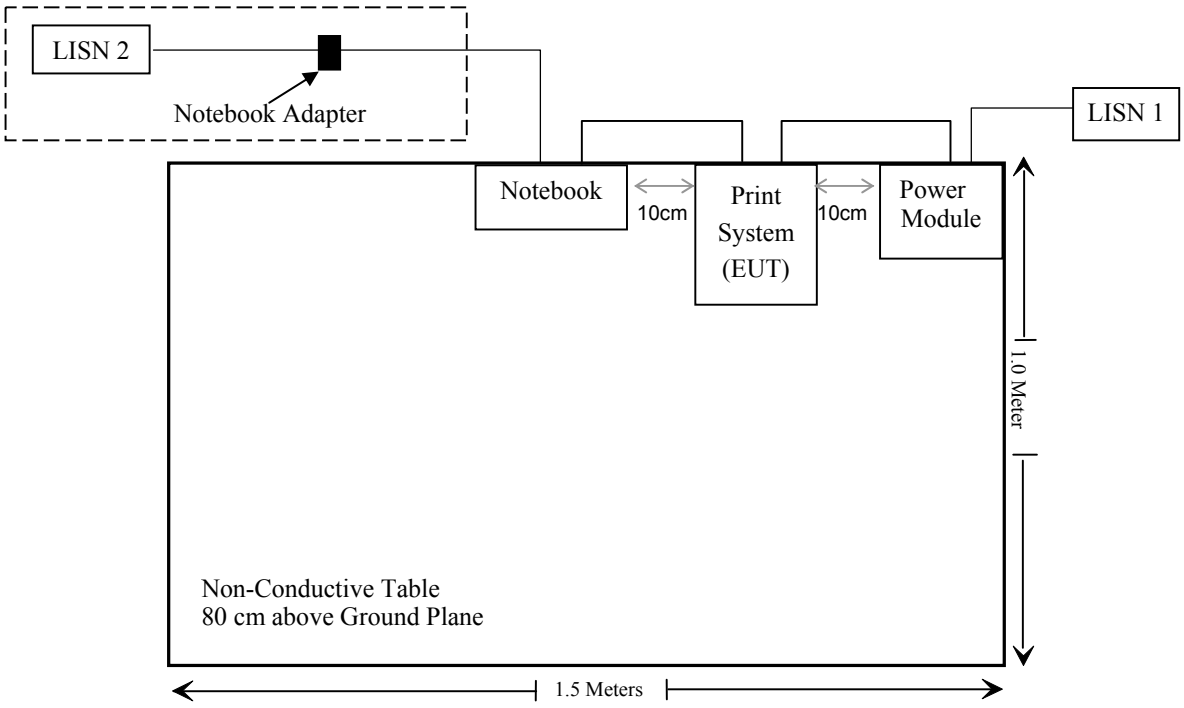
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Notebook	Latitude E6410	11429208685
DELL	Adapter	PA-10	0933 DMYD-AT59637-B
Snapmaker	Power Module	Unknown	78785
Snapmaker	Laser Module	71007	RSZ200416002-RF-S2

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-Shielding Detachable AC Power Cable With Ferrite Core	1.5	Power Module	LISN 1
Un-Shielding Detachable DC Power Cable With Ferrite Core	1.0	EUT	Power Module
Shielding Detachable USB Cable With Ferrite Core	1.5	EUT	Notebook

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/07/22	2020/07/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/06	2020/12/05
RF Conducted Test					
Agilent	USB Wideband Power Sensor	U2021XA	MY54250003	2019/07/10	2020/07/09
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/03/02	2021/03/01
WEINSCHEL	3dB Attenuator	Unknown	F-03-EM121	2019/11/29	2020/11/28
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

For worst case:

Frequency (MHz)	Maximum Tune-up power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
	(dBm)	(mW)				
2480	0.5	1.12	5	0.4	3.0	**Yes**

Result: No Standalone SAR test is required

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, 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 shall be considered sufficient to comply with the provisions of this Section. 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.

Antenna Connector Construction

The EUT has one internal antenna arrangement for Bluetooth which was permanently attached and the antenna gain is 3.01 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

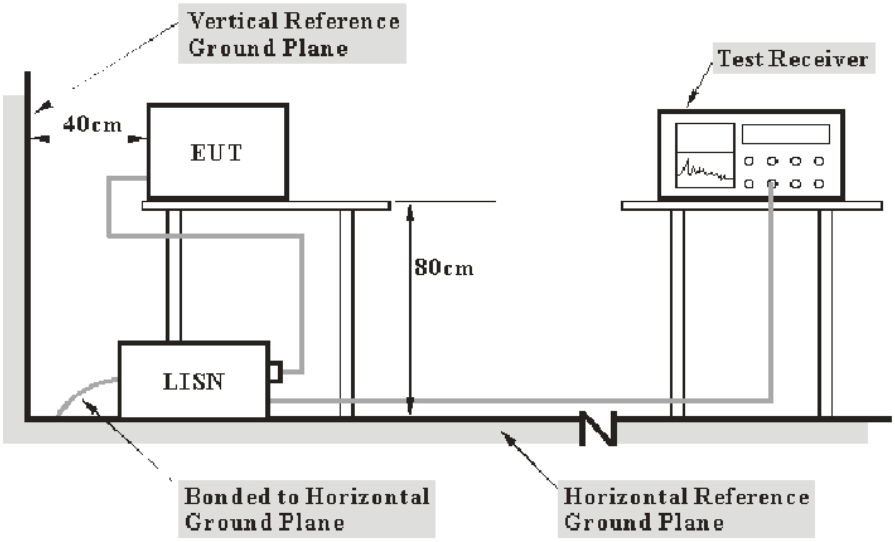
Result: Pass

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

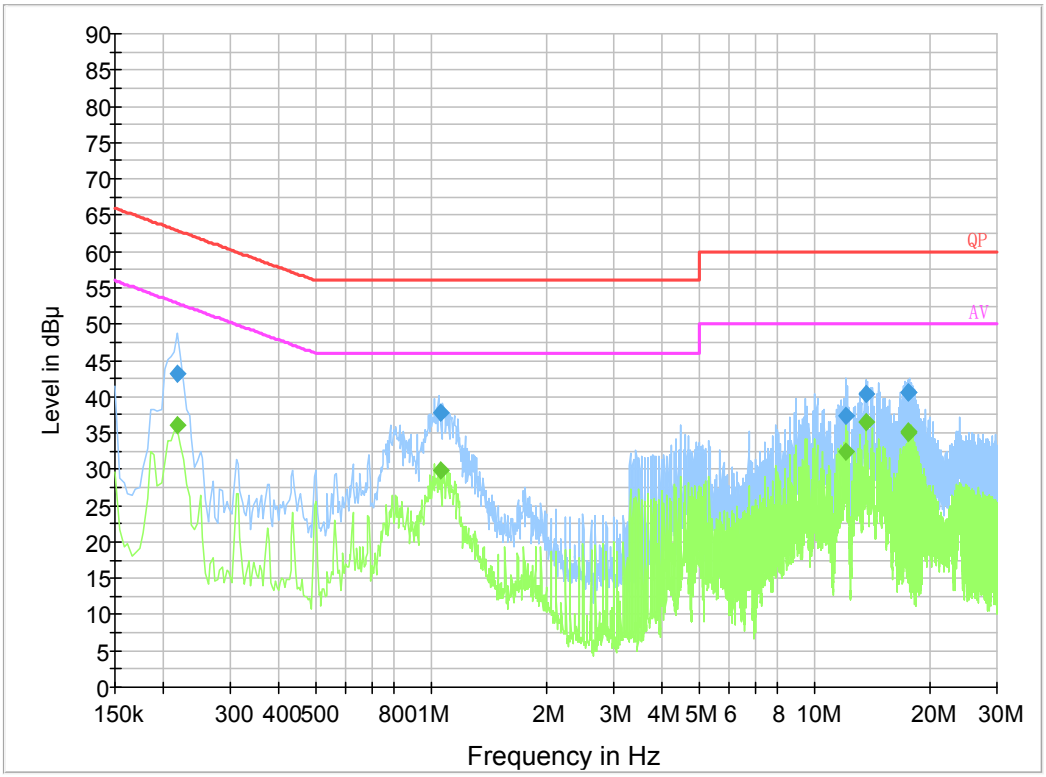
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-08-27.

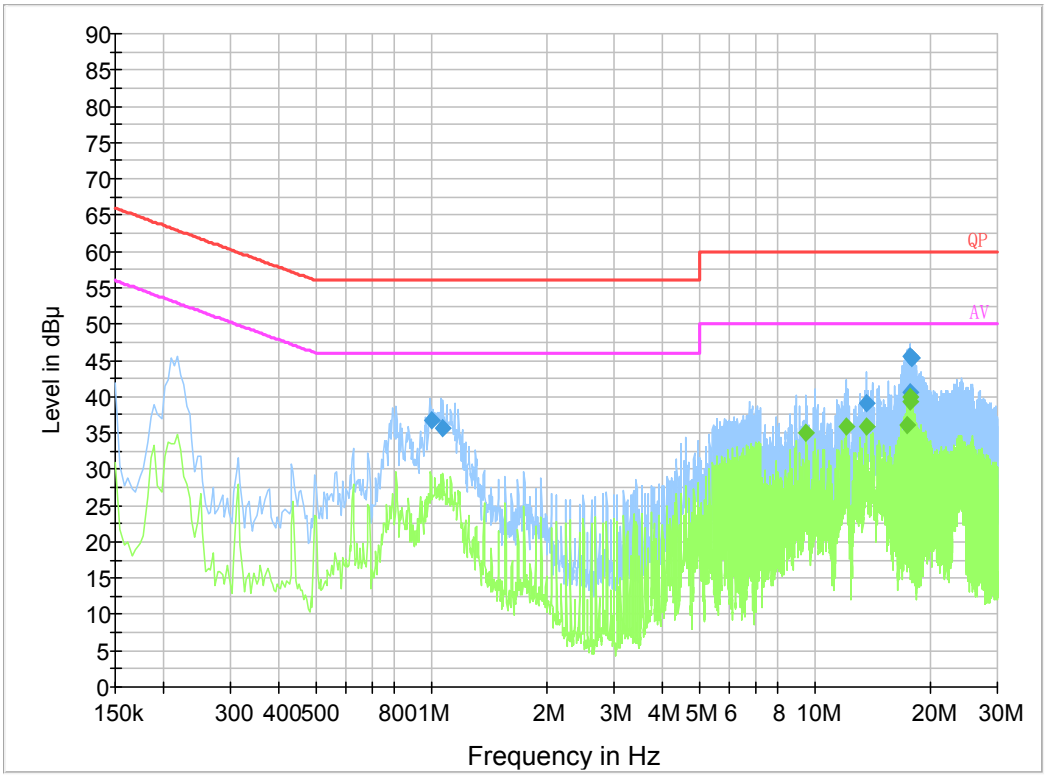
EUT operation mode: Transmitting

AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.217500	43.2	19.8	62.9	19.7	QP
1.062250	37.7	19.9	56.0	18.3	QP
12.080950	37.5	20.0	60.0	22.5	QP
13.609670	40.5	20.0	60.0	19.5	QP
17.552830	40.7	20.3	60.0	19.3	QP
17.553790	40.5	20.3	60.0	19.5	QP
0.217500	36.0	19.8	52.9	16.9	Ave.
1.062250	29.9	19.9	46.0	16.1	Ave.
12.080950	32.4	20.0	50.0	17.6	Ave.
13.609670	36.4	20.0	50.0	13.6	Ave.
17.552830	35.3	20.3	50.0	14.7	Ave.
17.553790	35.1	20.3	50.0	14.9	Ave.

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.999150	36.7	19.8	56.0	19.3	QP
1.074070	35.7	19.8	56.0	20.3	QP
13.617790	39.2	19.9	60.0	20.8	QP
17.739870	45.5	20.2	60.0	14.5	QP
17.806970	40.6	20.2	60.0	19.4	QP
17.865790	45.2	20.2	60.0	14.8	QP
9.470000	35.0	19.9	50.0	15.0	Ave.
12.074000	35.9	20.0	50.0	14.1	Ave.
13.610000	36.0	19.9	50.0	14.0	Ave.
17.490000	36.1	20.2	50.0	13.9	Ave.
17.678000	40.0	20.2	50.0	10.0	Ave.
17.742000	39.2	20.2	50.0	10.8	Ave.

Note:
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

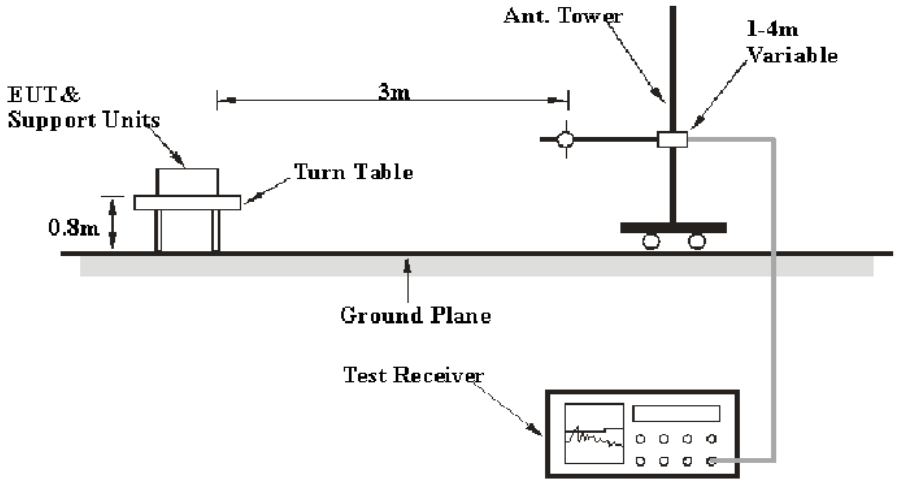
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

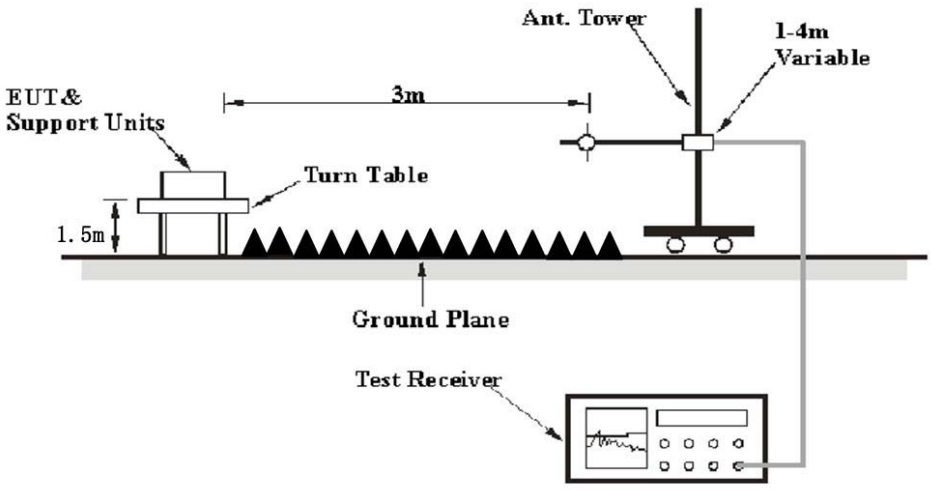
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, according to the DA 00-705 Released March 30, 2000, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

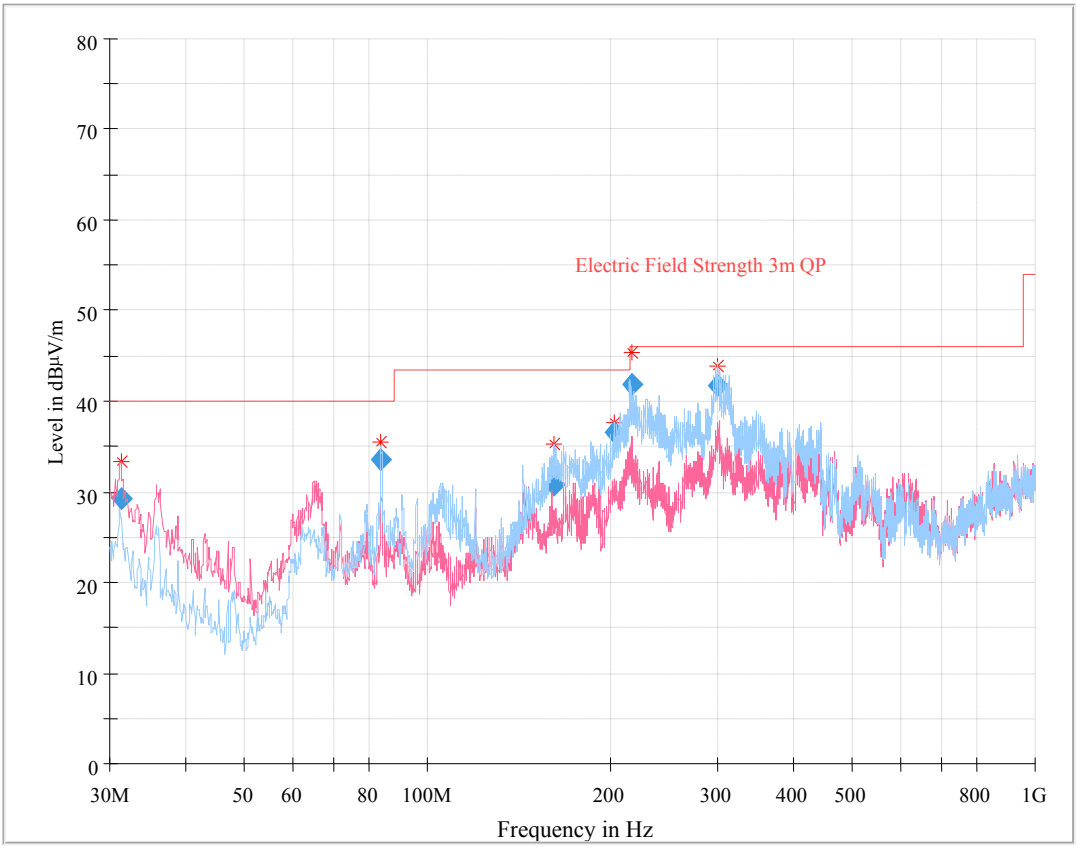
Environmental Conditions

Temperature:	23~26 ℃
Relative Humidity:	55~60 %
ATM Pressure:	100.9~101.0 kPa

The testing was performed by Harris He on 2020-08-30 for below 1GHz and by Leven Gan on 2020-05-05 and 2020-06-24 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: *(the worst case is 8DPSK mode, Middle channel)*



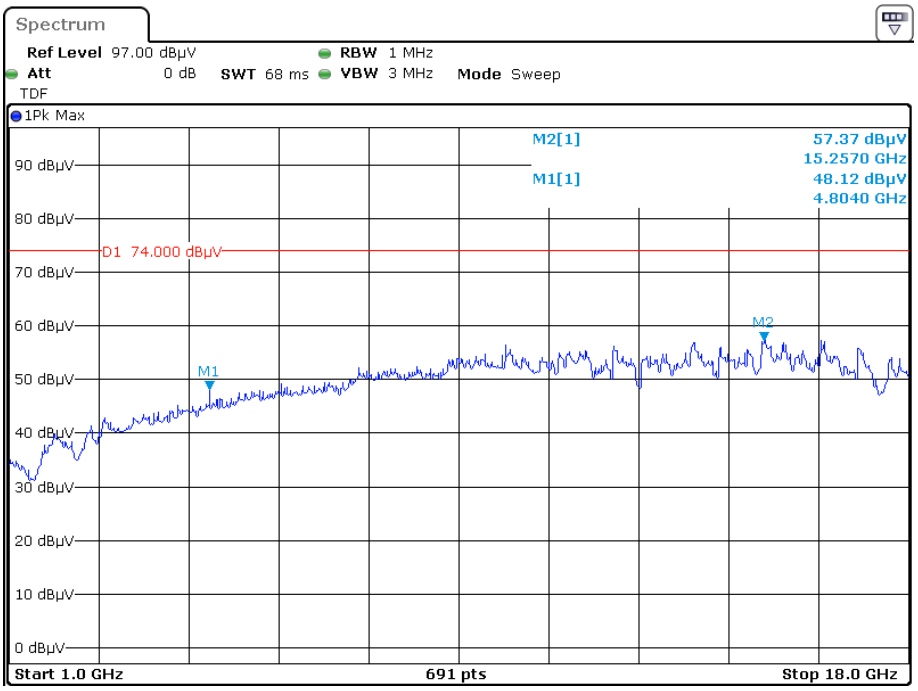
Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
31.378875	29.34	184.0	V	200.0	-8.5	40.00	10.66
83.881750	33.65	400.0	H	138.0	-19.6	40.00	6.35
161.358000	30.80	169.0	H	280.0	-14.5	43.50	12.70
202.764375	36.57	162.0	H	153.0	-13.8	43.50	6.93
216.341375	41.94	128.0	H	175.0	-13.9	46.00	4.06
300.598500	41.68	110.0	H	146.0	-10.6	46.00	4.32

1 GHz - 25 GHz: (*Scan with GFSK, π/4-DQPSK, 8DPSK mode, the worst case is in 8DPSK Mode*)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2388.62	28.24	PK	186	1.4	H	31.87	60.11	74	13.89
2388.62	13.63	Ave.	186	1.4	H	31.87	45.50	54	8.50
2484.44	28.37	PK	84	2.1	H	32.13	60.50	74	13.50
2484.44	13.59	Ave.	84	2.1	H	32.13	45.72	54	8.28
4804.00	45.64	PK	264	1.4	H	6.28	51.92	74	22.08
4804.00	29.66	Ave.	343	1.0	H	6.28	35.94	54	18.06
Middle Channel (2441 MHz)									
4882.00	42.40	PK	245	1.4	H	6.76	49.16	74	24.84
4882.00	27.84	Ave.	245	1.4	H	6.76	34.60	54	19.40
High Channel (2480 MHz)									
2387.55	28.47	PK	149	1.9	H	31.87	60.34	74	13.66
2387.55	13.49	Ave.	149	1.9	H	31.87	45.36	54	8.64
2485.61	28.51	PK	337	1.9	H	32.13	60.64	74	13.36
2485.61	13.56	Ave.	337	1.9	H	32.13	45.69	54	8.31
4960.00	43.44	PK	150	1.4	H	6.80	50.24	74	23.76
4960.00	28.92	Ave.	150	1.4	H	6.80	35.72	54	18.28

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

Pre-scan with Low channel Peak
Horizontal



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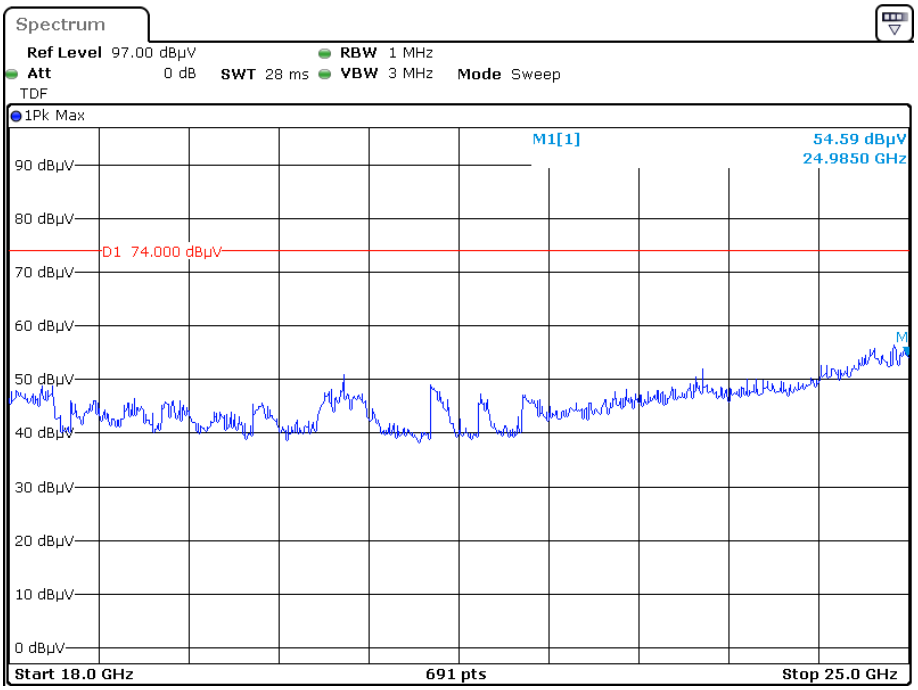

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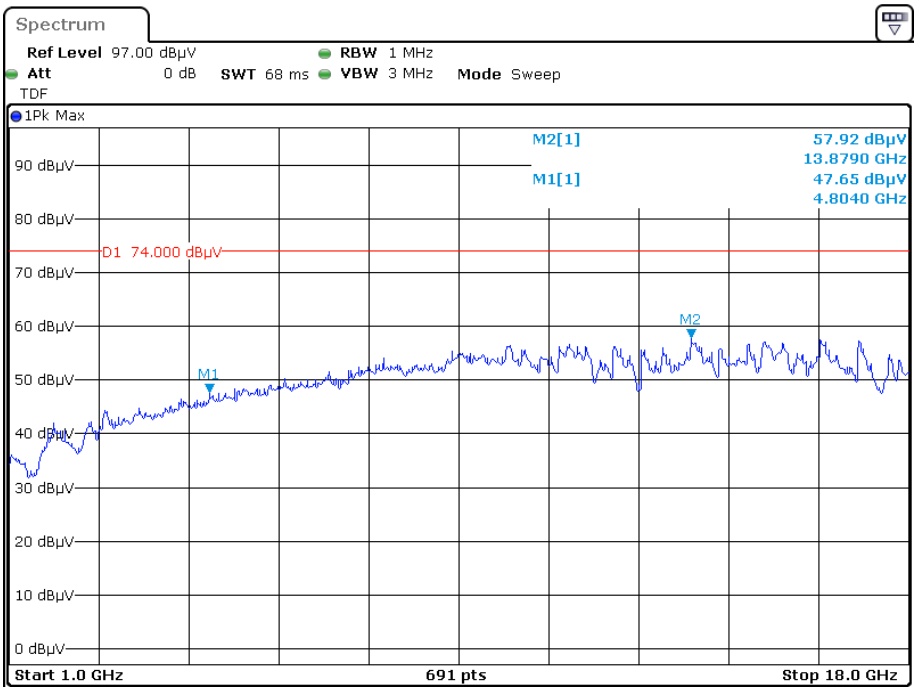
Vertical



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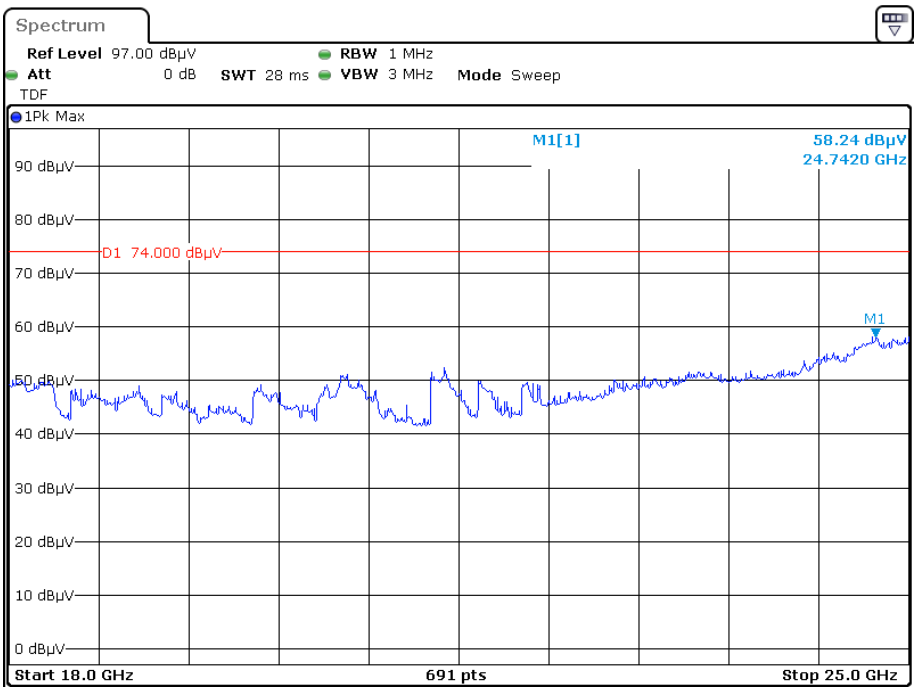

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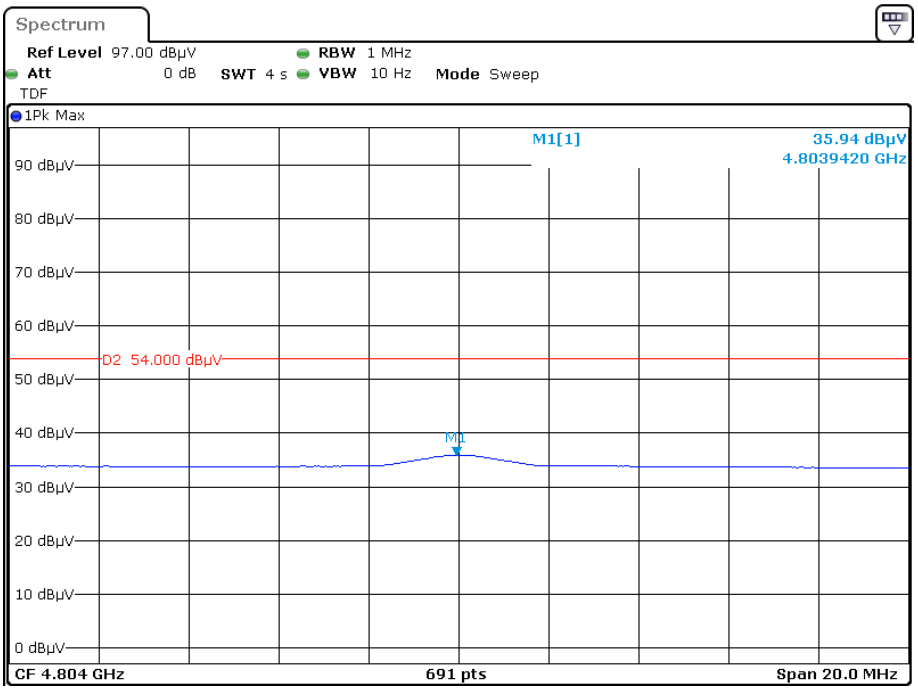
Average
Horizontal



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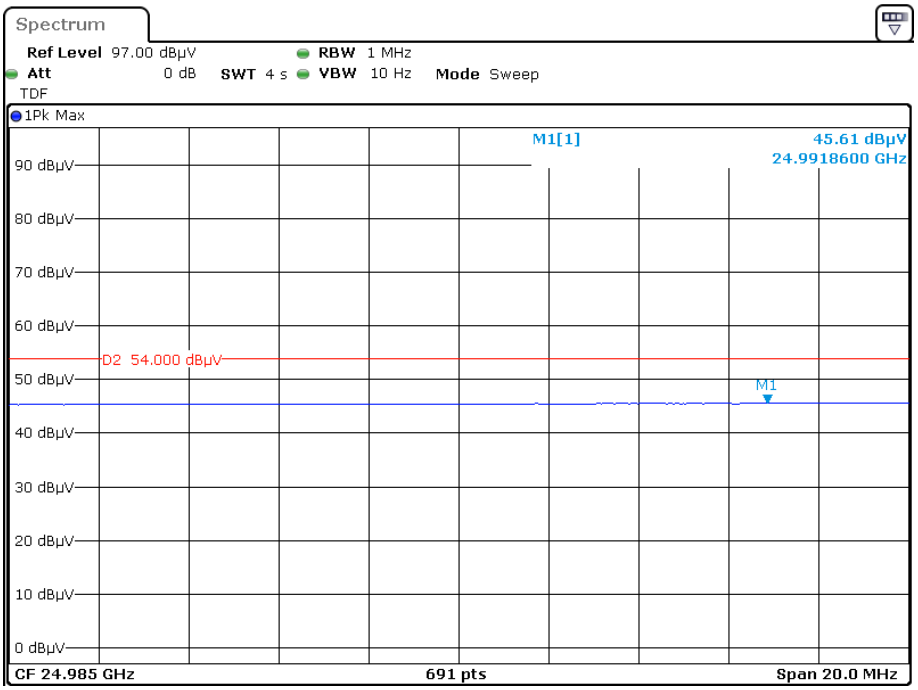

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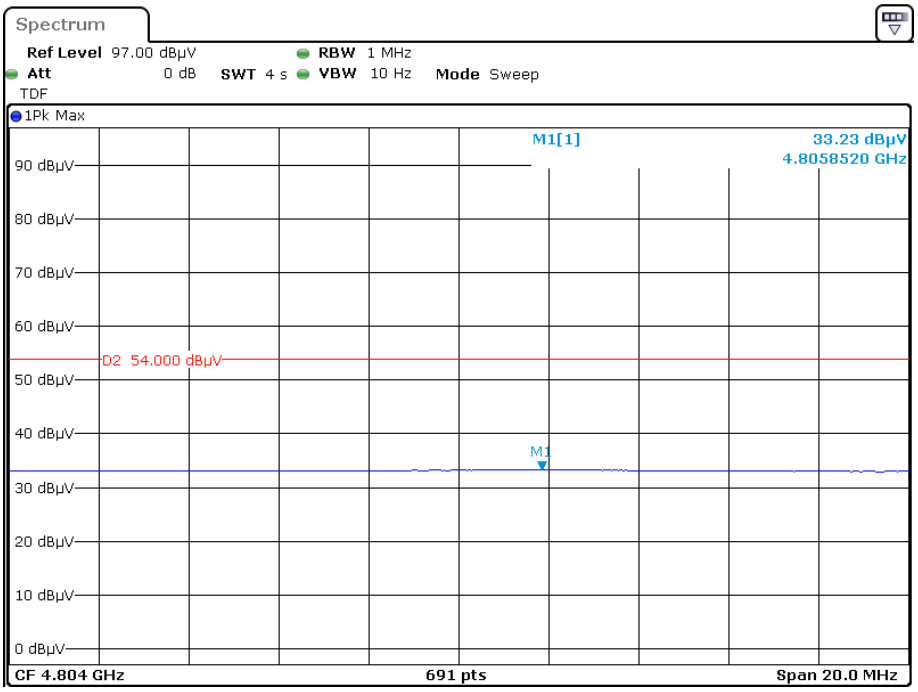

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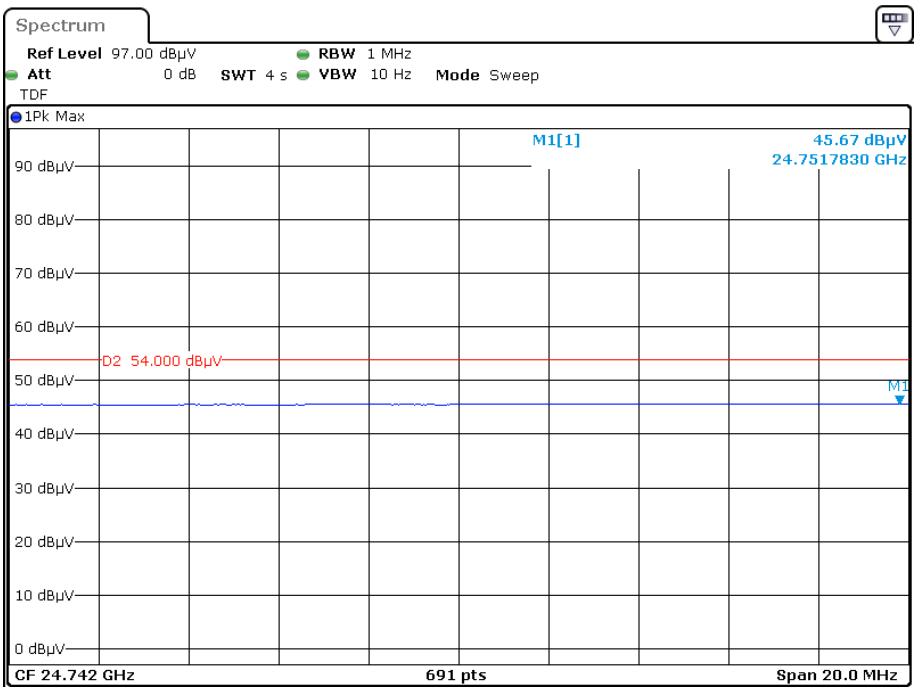

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FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly 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.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

EUT operation mode: Transmitting

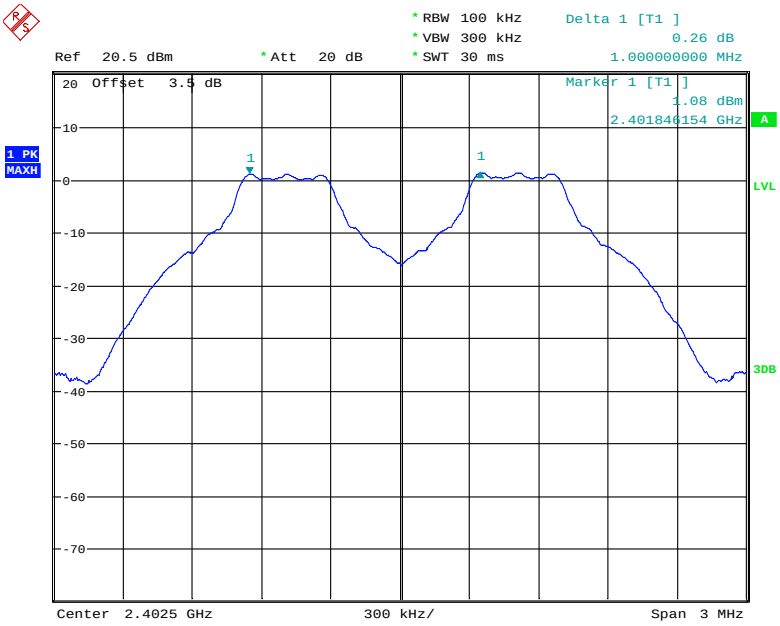
Test Result: Pass

Please refer to following table and plots.

Test Mode	Channel	Result [MHz]	Limit [MHz]	Verdict
BDR (GFSK)				
Hop	Low	1.000	>=0.622	Pass
Hop	Middle	1.000	>=0.622	Pass
Hop	High	1.000	>=0.628	Pass
EDR (π/4-DQPSK)				
Hop	Low	1.000	>=0.843	Pass
Hop	Middle	1.000	>=0.846	Pass
Hop	High	1.000	>=0.840	Pass
EDR (8DPSK)				
Hop	Low	1.000	>=0.837	Pass
Hop	Middle	1.000	>=0.833	Pass
Hop	High	1.000	>=0.833	Pass

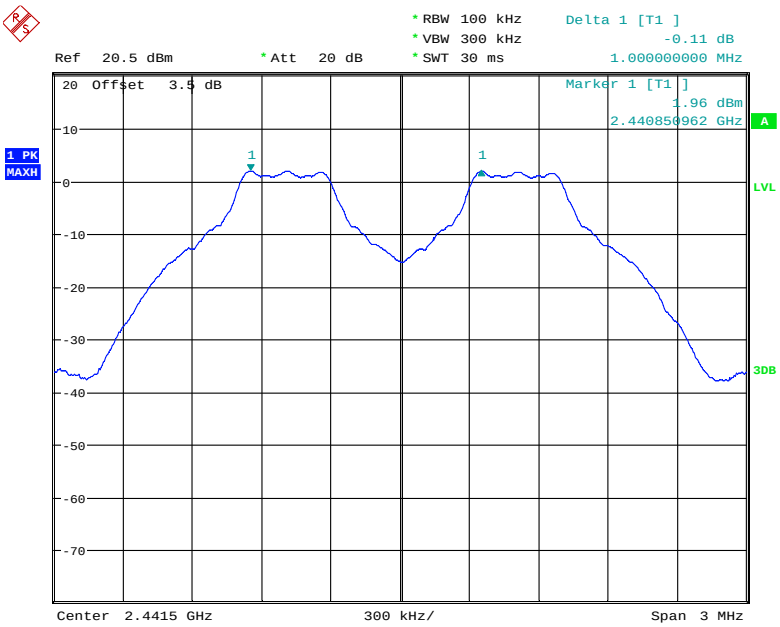
Note: the limit = (2/3) * 20dB bandwidth

BDR (GFSK): Low Channel



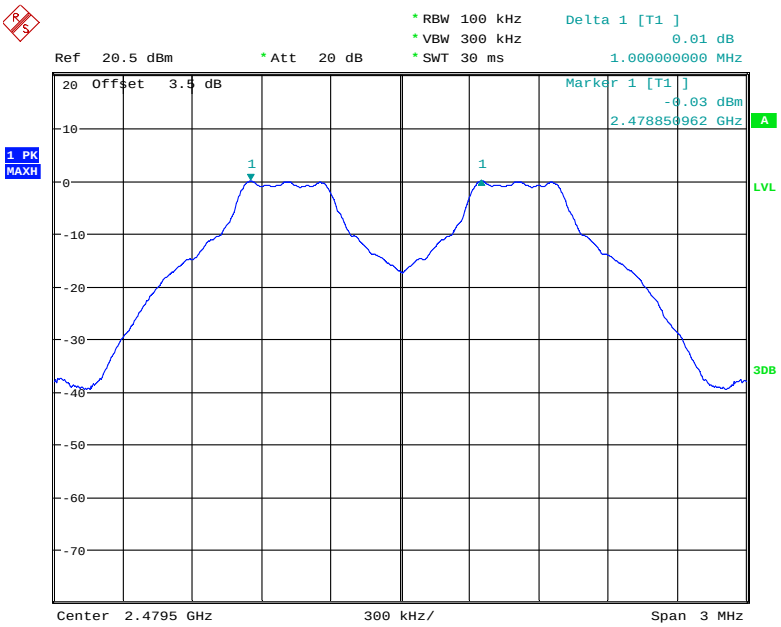
Date: 29.APR.2020 14:22:48

BDR (GFSK): Middle Channel



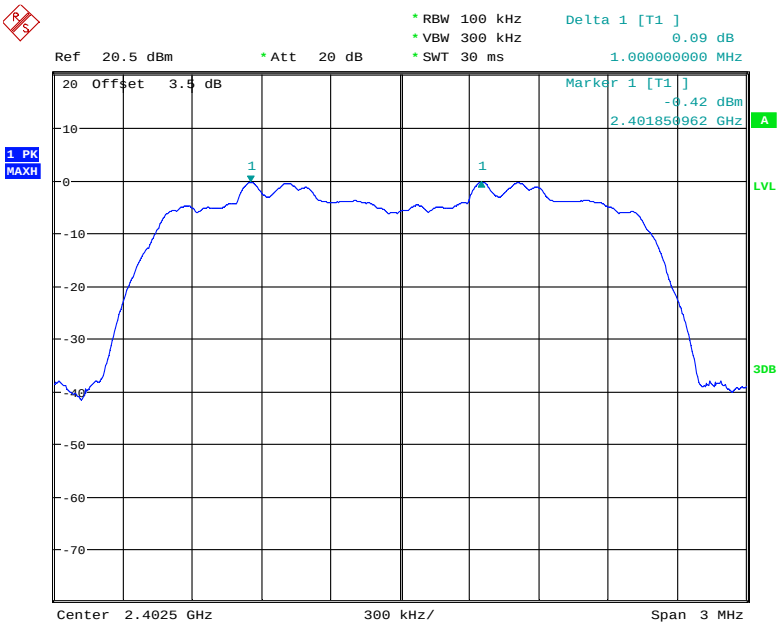
Date: 29.APR.2020 14:22:05

BDR (GFSK): High Channel



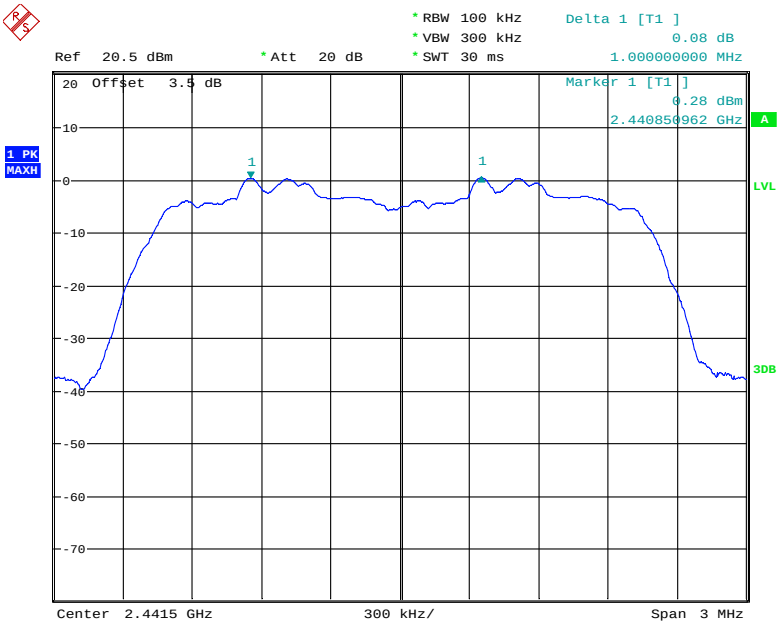
Date: 29.APR.2020 14:21:19

EDR (π/4-DQPSK): Low Channel



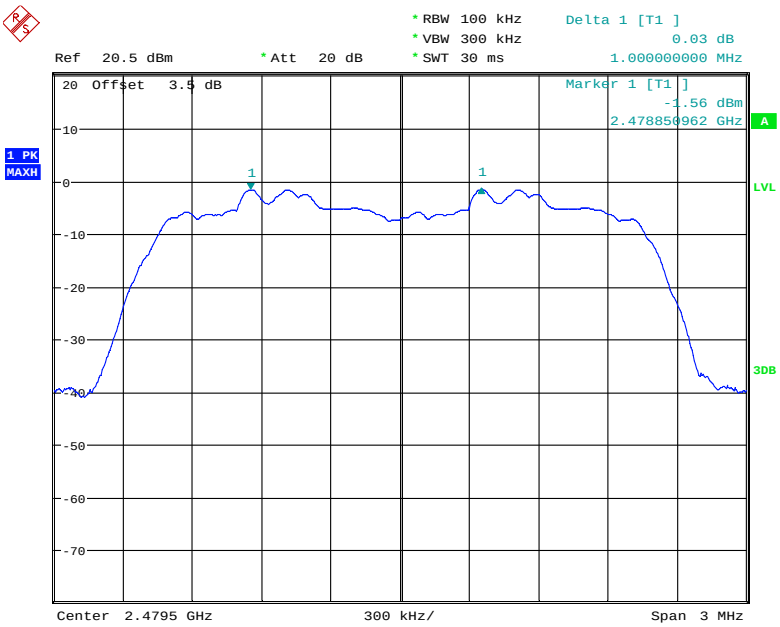
Date: 29.APR.2020 14:23:32

EDR (π/4-DQPSK): Middle Channel



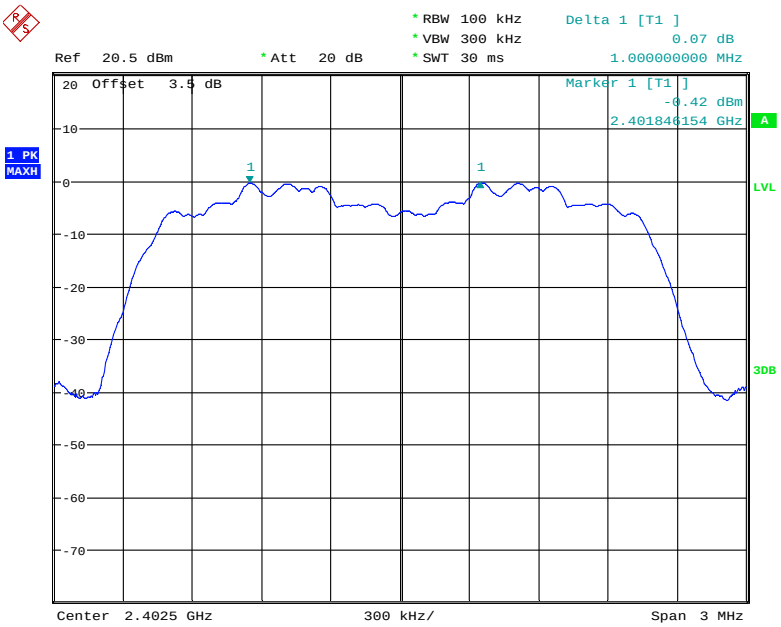
Date: 29.APR.2020 14:24:14

EDR (π/4-DQPSK): High Channel



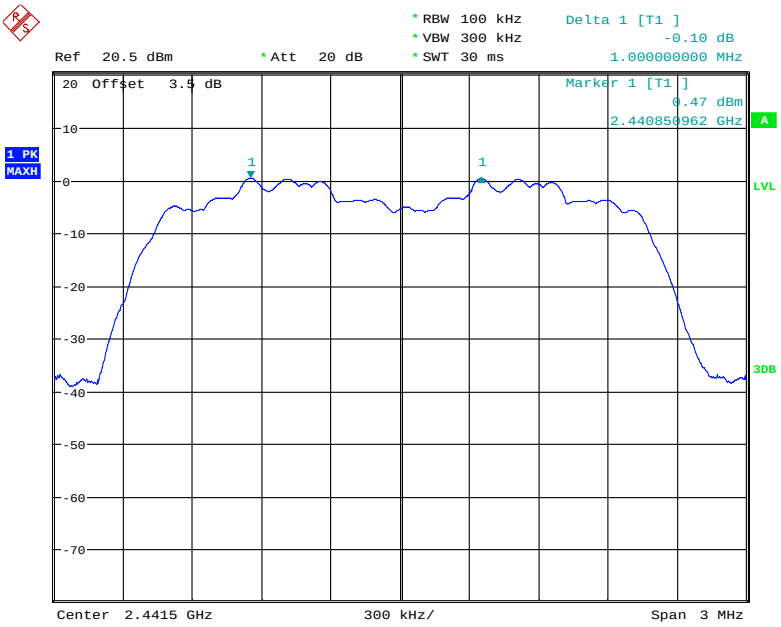
Date: 29.APR.2020 14:24:52

EDR (8DPSK): Low Channel



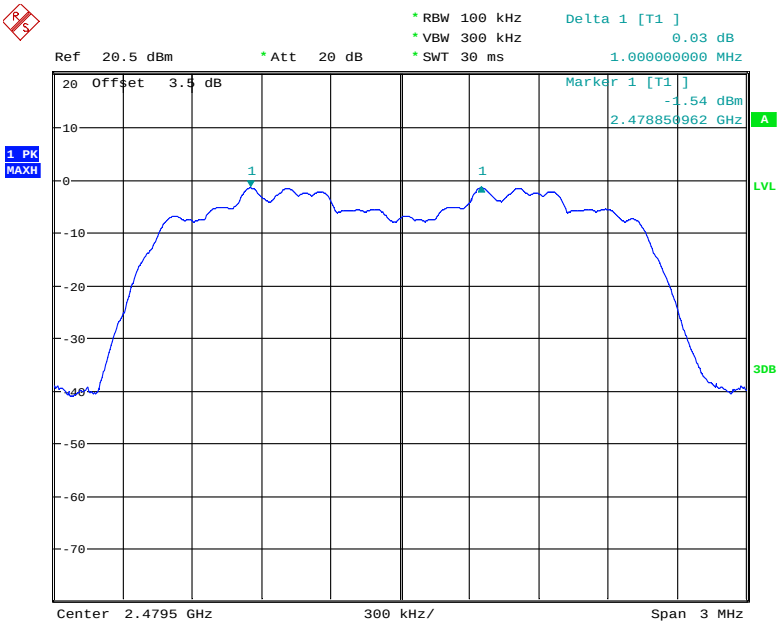
Date: 29.APR.2020 14:27:17

EDR (8DPSK): Middle Channel



Date: 29.APR.2020 14:26:37

EDR (8DPSK): High Channel



Date: 29.APR.2020 14:25:30

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

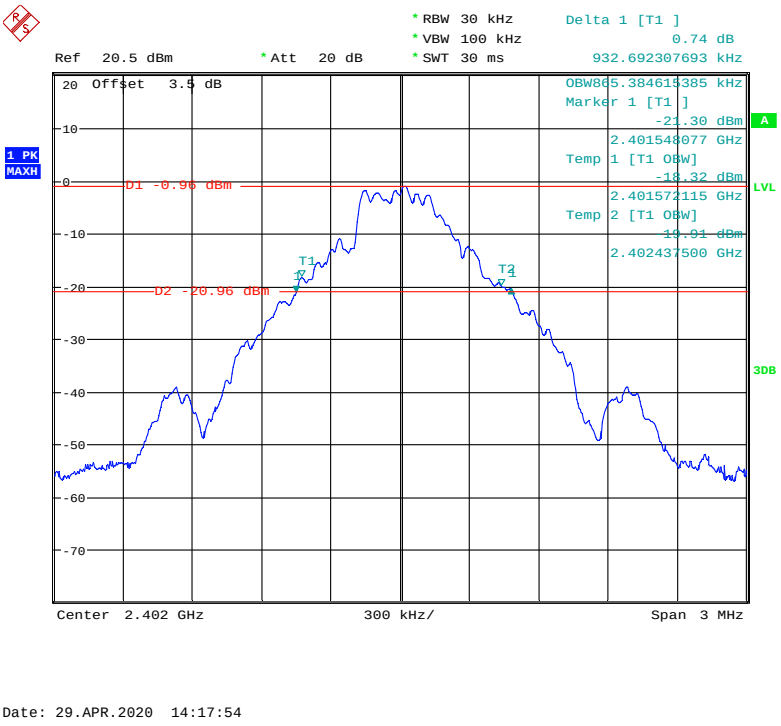
EUT operation mode: Transmitting

Test Result: Pass

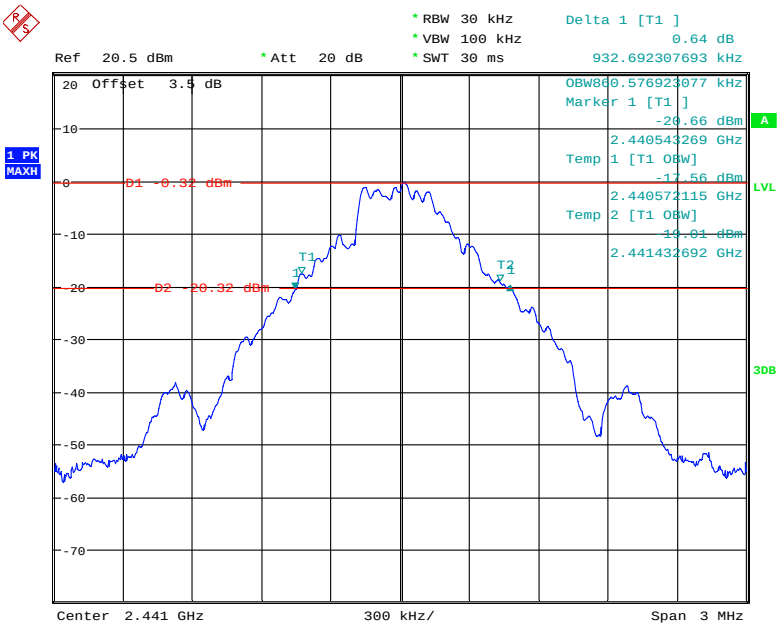
Please refer to following table and plots.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.933
	Middle	2441	0.933
	High	2480	0.942
EDR (π/4-DQPSK)	Low	2402	1.264
	Middle	2441	1.269
	High	2480	1.260
EDR (8DPSK)	Low	2402	1.255
	Middle	2441	1.250
	High	2480	1.240

BDR (GFSK): Low Channel

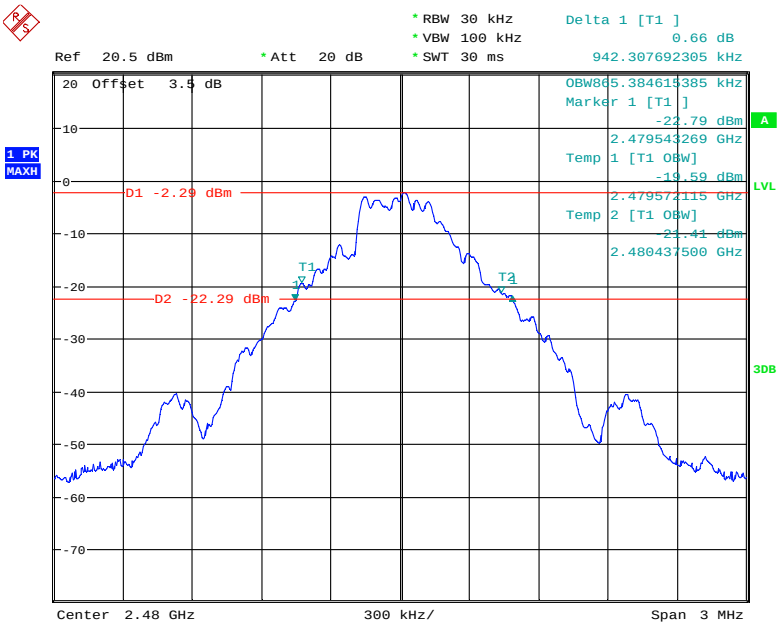


BDR (GFSK): Middle Channel



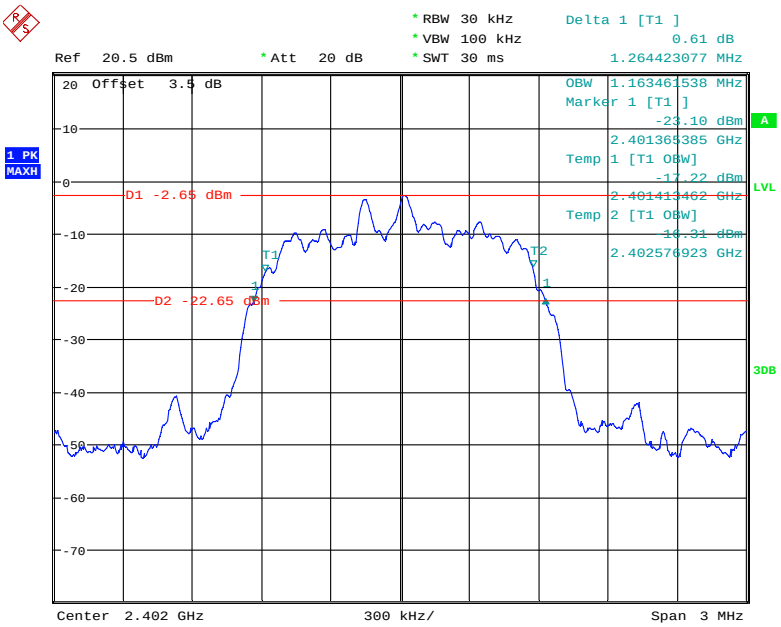
Date: 29.APR.2020 14:18:44

BDR (GFSK): High Channel



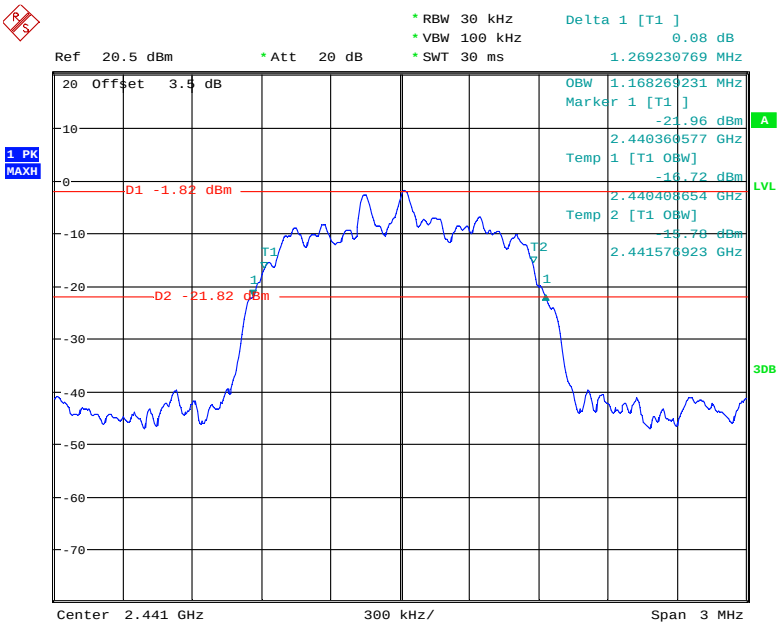
Date: 29.APR.2020 14:20:29

EDR (π/4-DQPSK): Low Channel



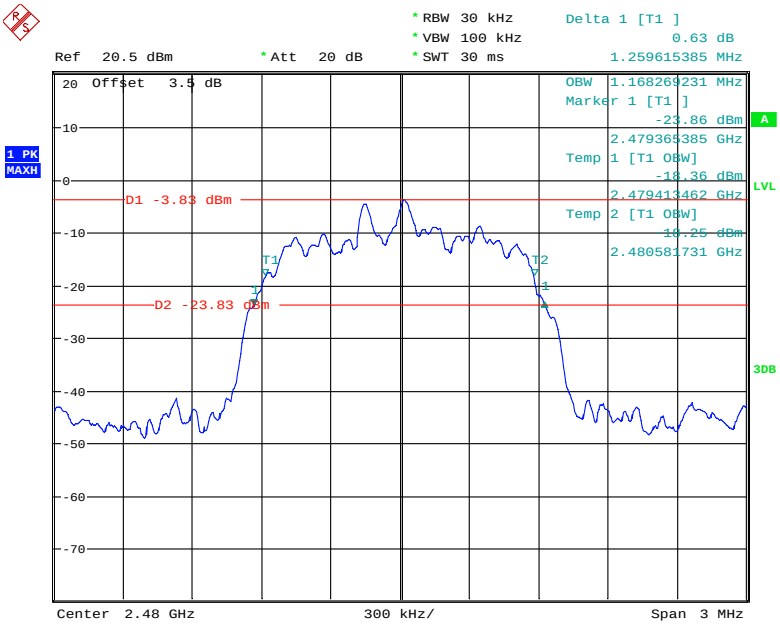
Date: 29.APR.2020 14:16:57

EDR (π/4-DQPSK): Middle Channel



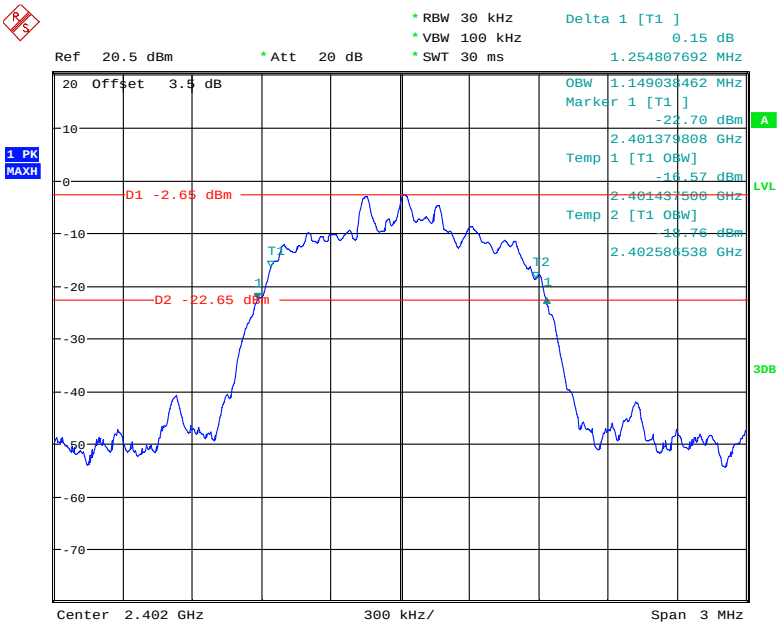
Date: 29.APR.2020 14:16:10

EDR (π/4-DQPSK): High Channel



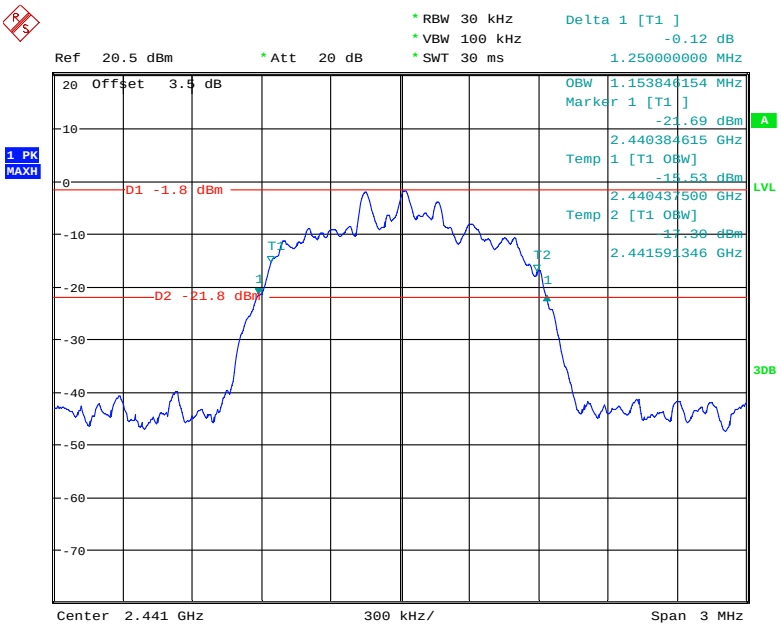
Date: 29.APR.2020 14:15:04

EDR (8DPSK): Low Channel



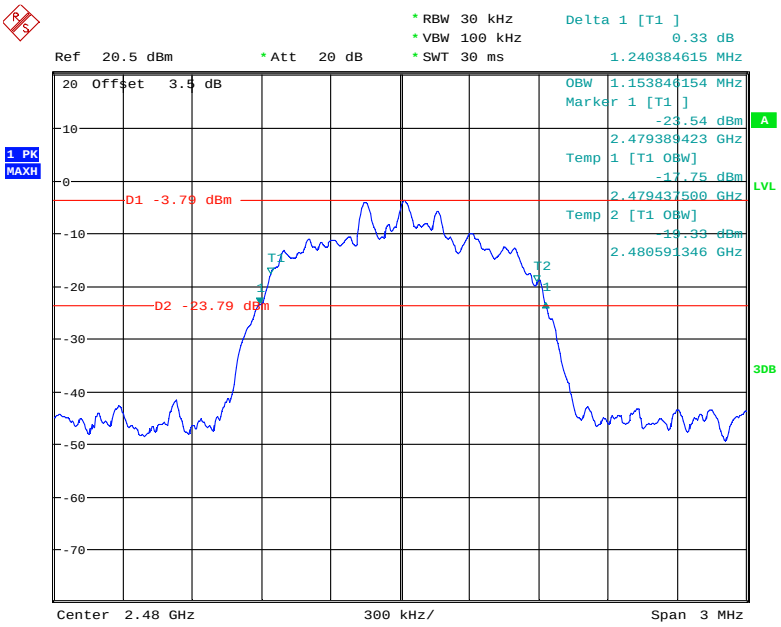
Date: 29.APR.2020 14:12:57

EDR (8DPSK): Middle Channel



Date: 29.APR.2020 14:13:35

EDR (8DPSK): High Channel



Date: 29.APR.2020 14:14:18

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Set the EUT in hopping mode from first channel to last.

3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

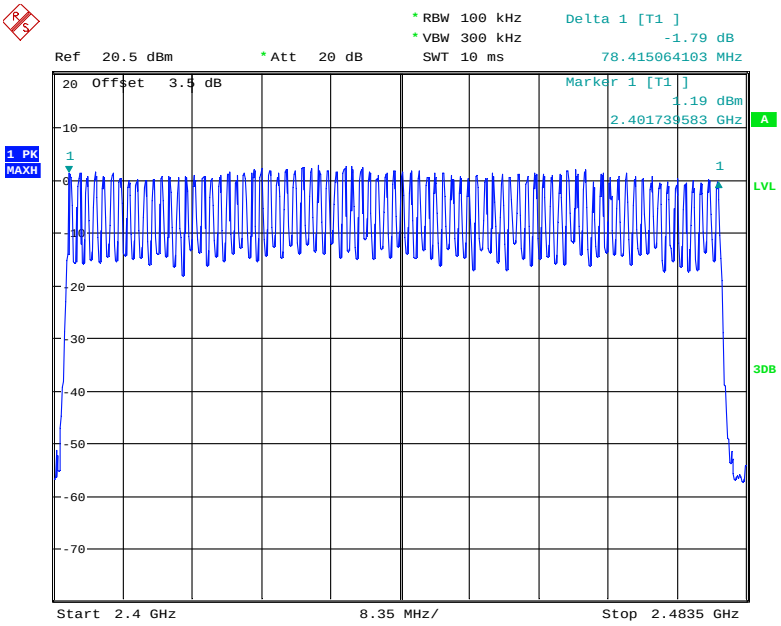
EUT operation mode: Transmitting

Test Result: Pass

Please refer to following table and plots.

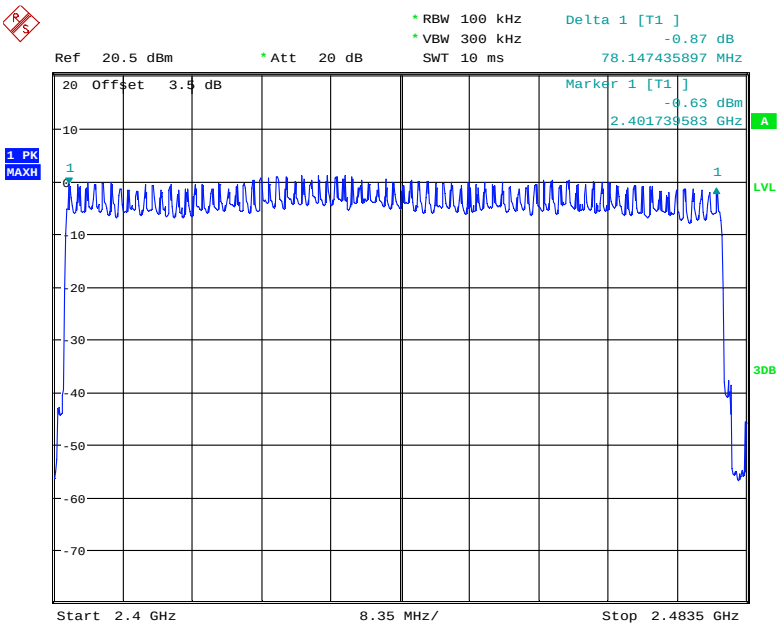
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR (GFSK)	2400-2483.5	79	≥15
EDR (π/4-DQPSK)	2400-2483.5	79	≥15
EDR (8DPSK)	2400-2483.5	79	≥15

BDR (GFSK): Number of Hopping Channels



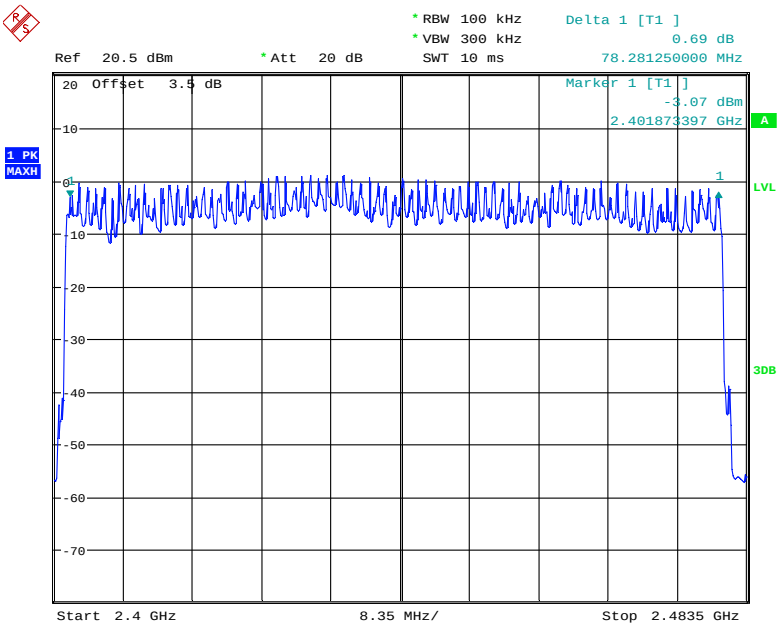
Date: 29.APR.2020 15:01:18

EDR (π/4-DQPSK): Number of Hopping Channels



Date: 29.APR.2020 15:07:37

EDR (8DPSK): Number of Hopping Channels



Date: 29.APR.2020 15:12:59

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

EUT operation mode: Transmitting

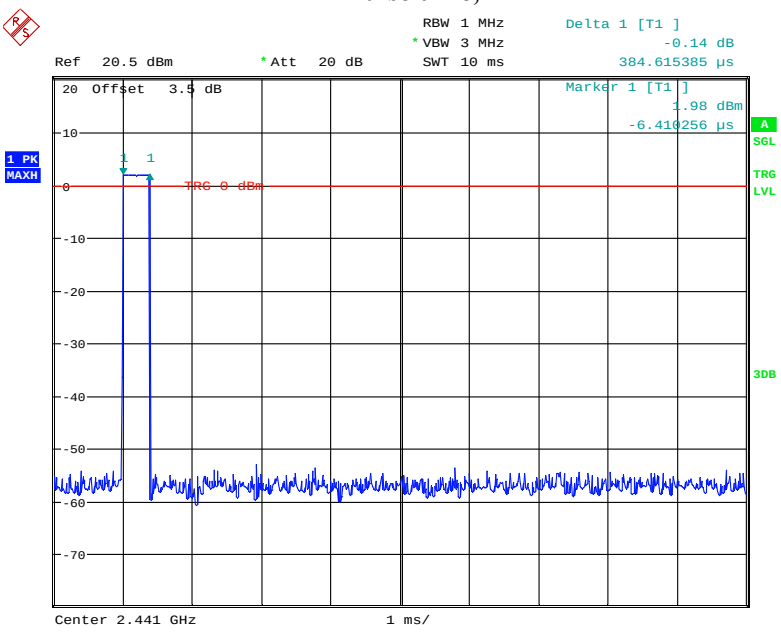
Test Result: Pass

Please refer to following table and plots

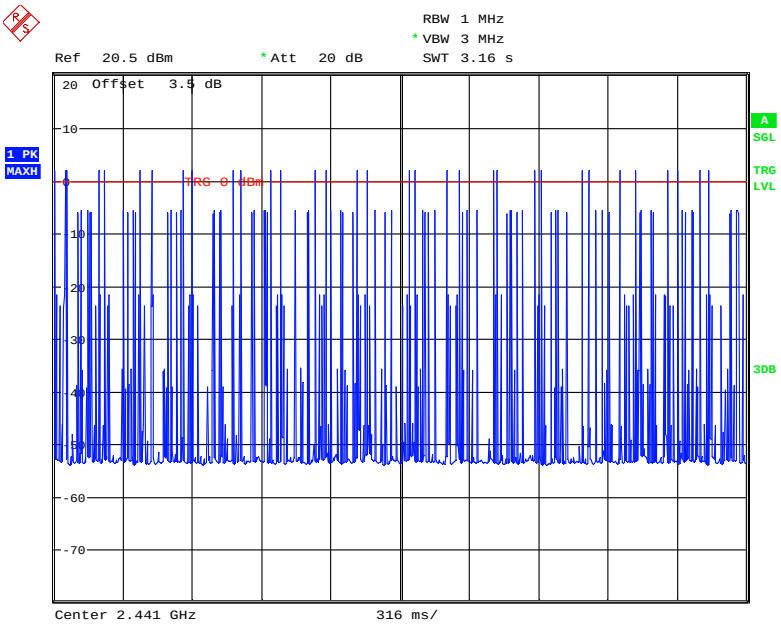
Test Mode	Antenna	Channel	Burst Width [ms]	Total Hops [Num]	Result [s]	Limit [s]	Verdict
DH1	Ant 1	Hop	0.38	320	0.122	<=0.4	PASS
DH3	Ant 1	Hop	1.65	190	0.314	<=0.4	PASS
DH5	Ant 1	Hop	2.88	103	0.297	<=0.4	PASS
2DH1	Ant 1	Hop	0.38	340	0.129	<=0.4	PASS
2DH3	Ant 1	Hop	1.63	210	0.342	<=0.4	PASS
2DH5	Ant 1	Hop	2.88	110	0.317	<=0.4	PASS
3DH1	Ant 1	Hop	0.37	380	0.141	<=0.4	PASS
3DH3	Ant 1	Hop	1.63	220	0.359	<=0.4	PASS
3DH5	Ant 1	Hop	2.87	86	0.247	<=0.4	PASS

Note 1：A period time=0.4*79=31.6(S), Total of Dwell=Pulse Time*Hopping Number
Note 2: Hopping Number=Hopping Number in 3.16s*10
Note 3: Hoping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

BDR (GFSK):
Pulse time, DH1

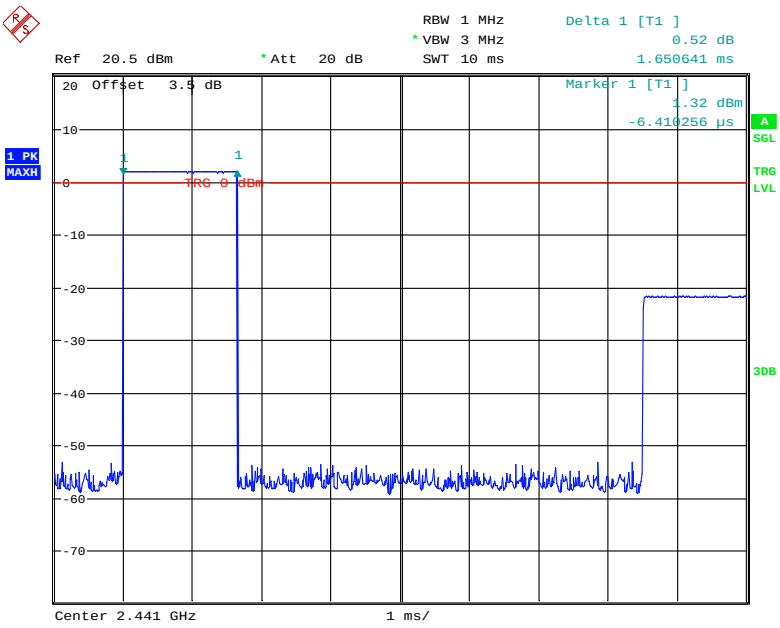


Date: 29.APR.2020 14:52:12

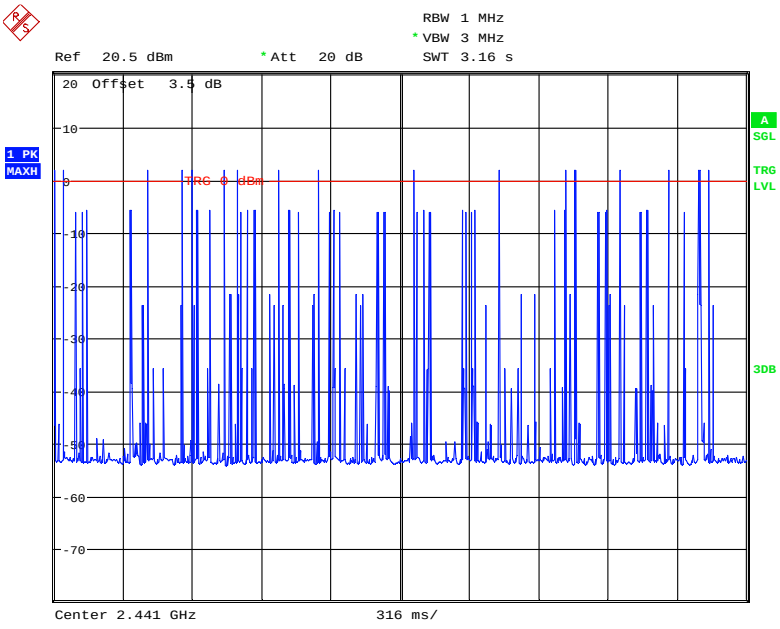


Date: 29.APR.2020 14:58:25

Pulse time, DH3

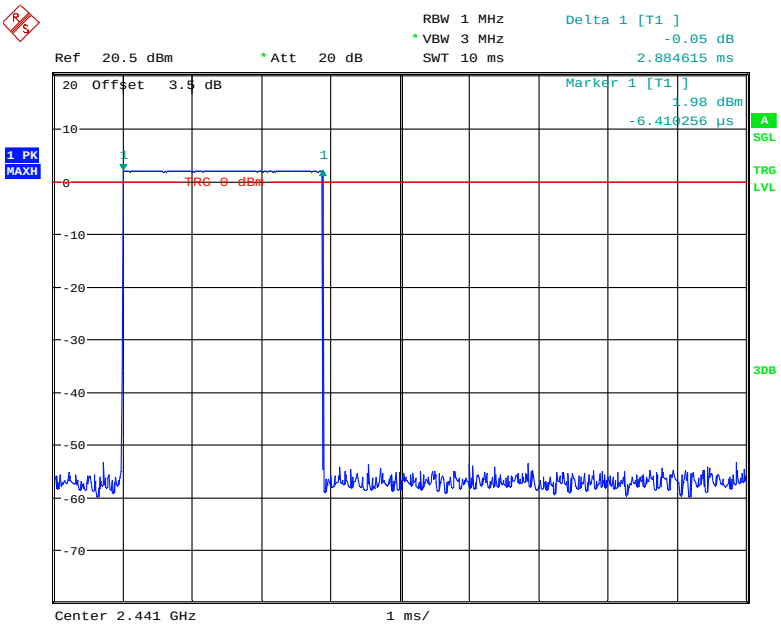


Date: 29.APR.2020 14:52:56

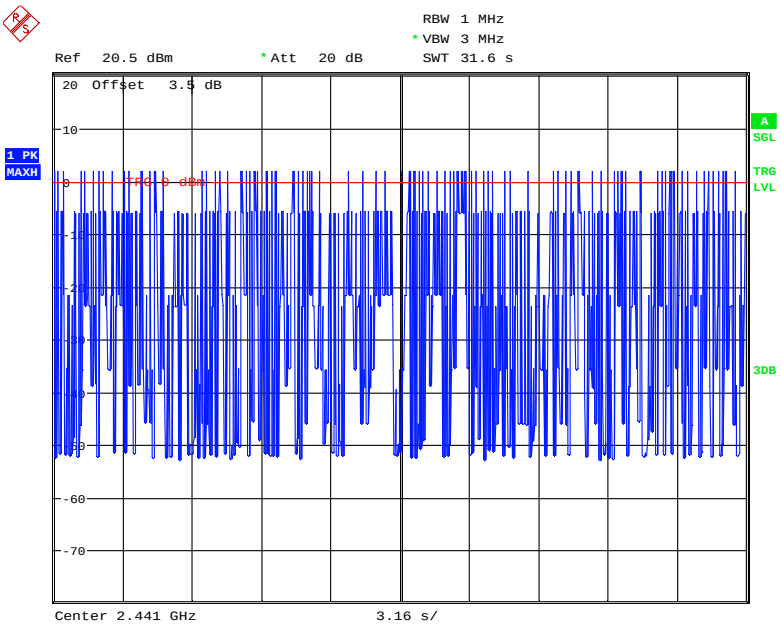


Date: 29.APR.2020 14:57:53

Pulse time, DH5

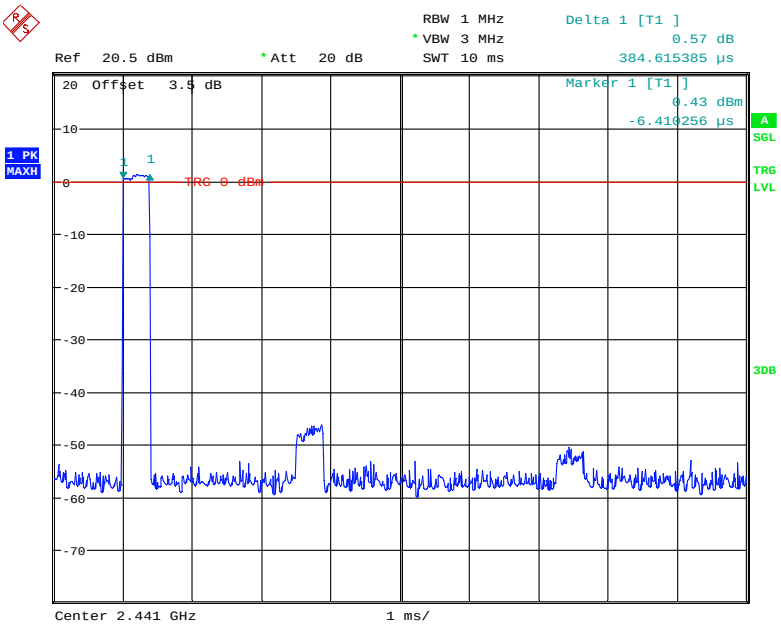


Date: 29.APR.2020 14:53:17

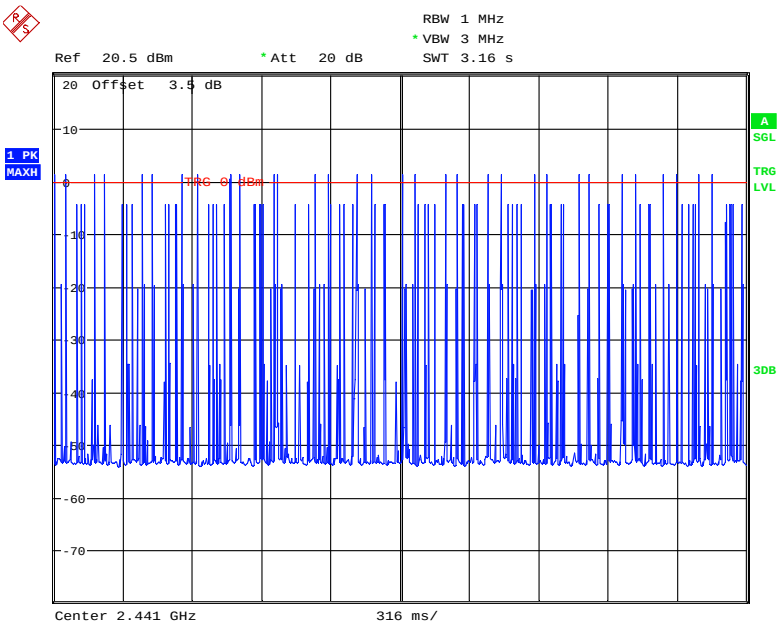


Date: 29.APR.2020 15:20:56

EDR(π/4-DQPSK):
Pulse time, 2DH1

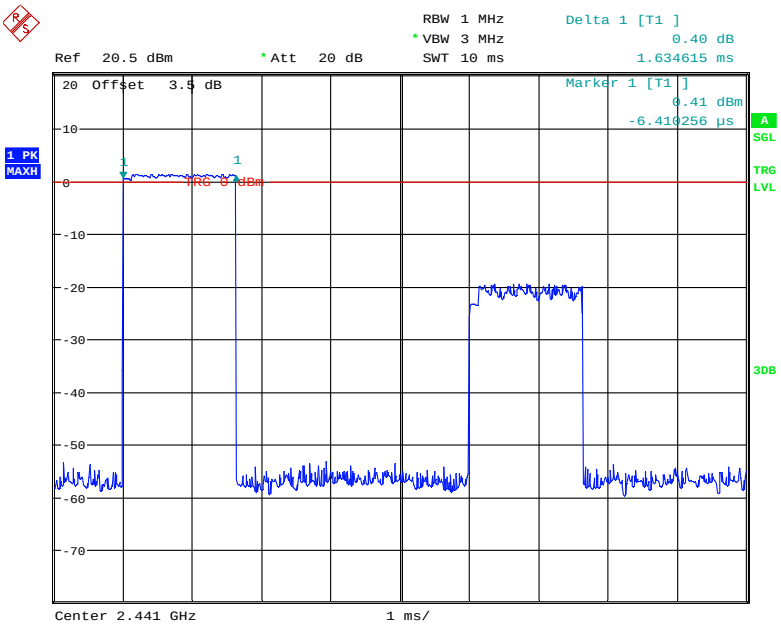


Date: 29.APR.2020 14:53:37

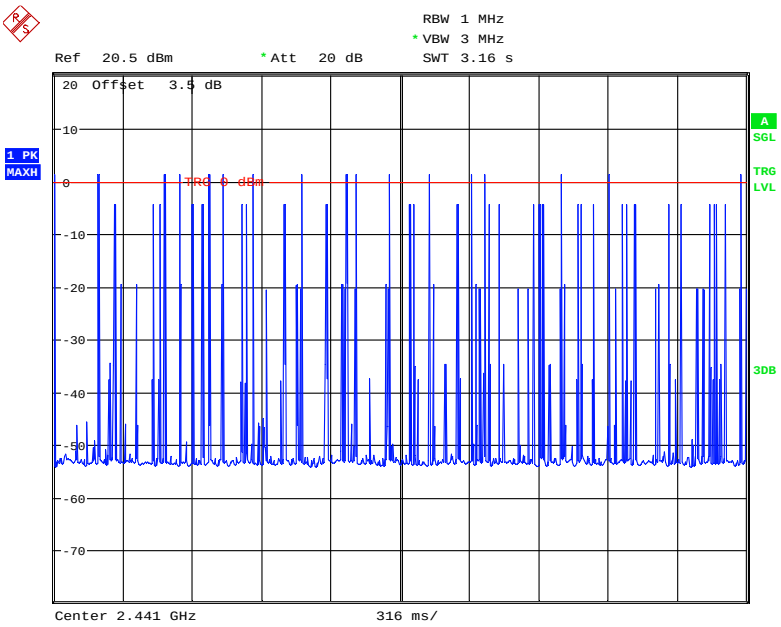


Date: 29.APR.2020 14:57:14

Pulse time, 2DH3

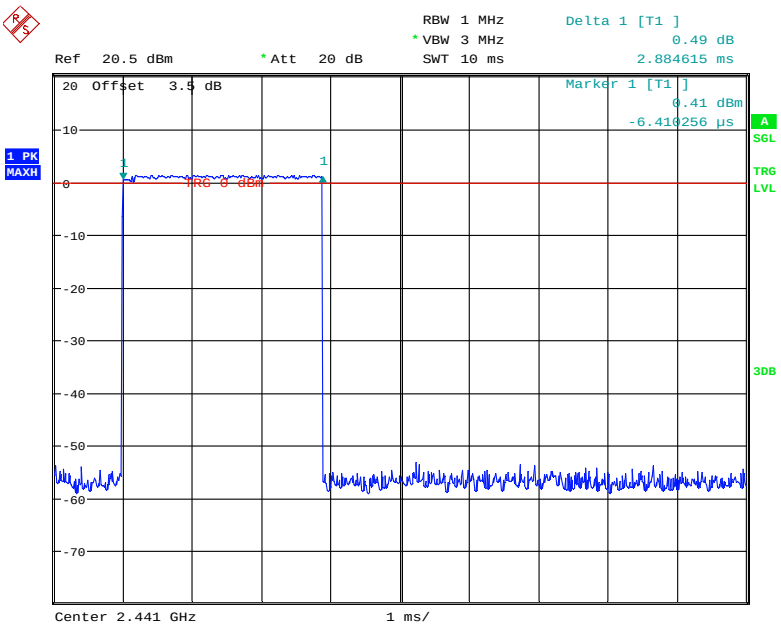


Date: 29.APR.2020 14:54:04

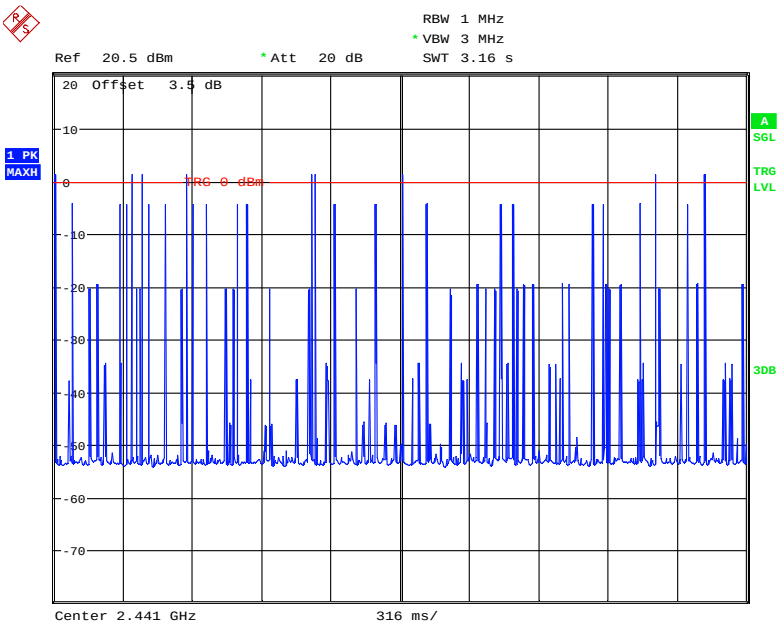


Date: 29.APR.2020 14:56:58

Pulse time, 2DH5

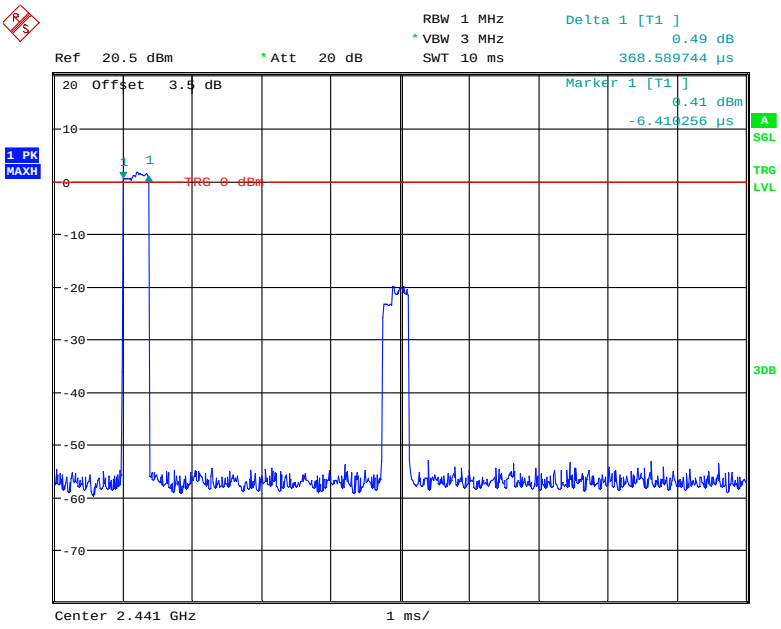


Date: 29.APR.2020 14:54:21

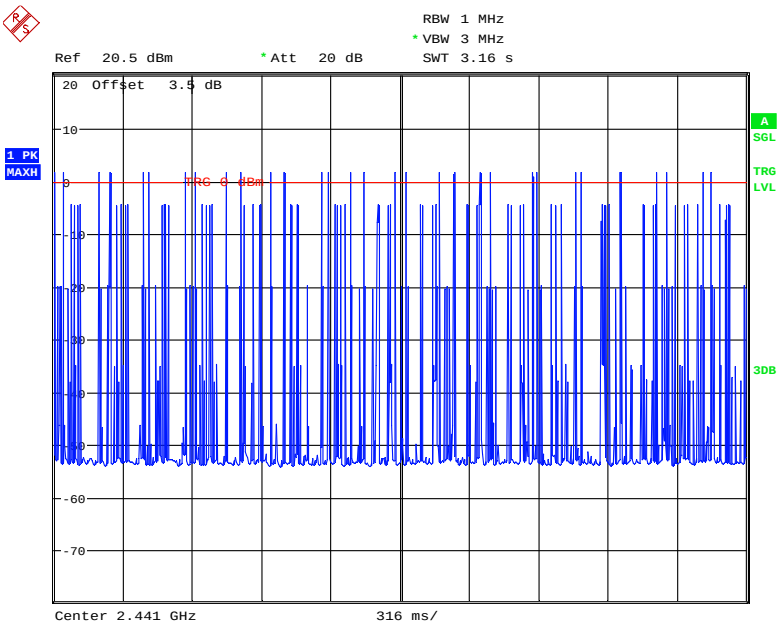


Date: 29.APR.2020 14:56:37

EDR (8DPSK):
Pulse time, 3DH1

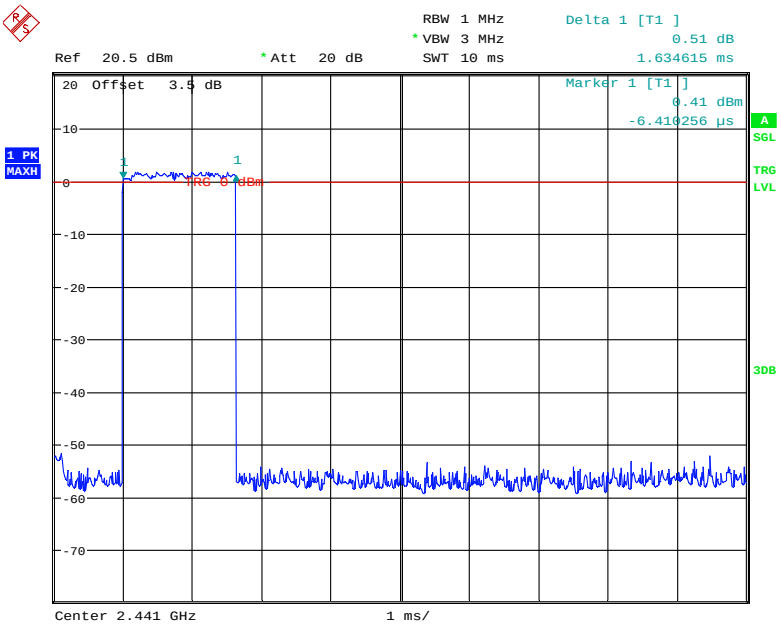


Date: 29.APR.2020 14:54:47

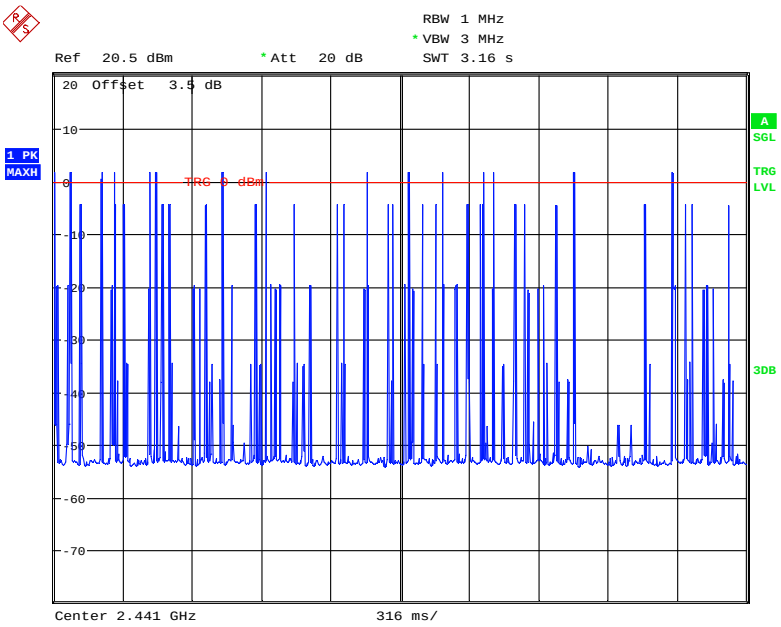


Date: 29.APR.2020 14:56:22

Pulse time, 3DH3

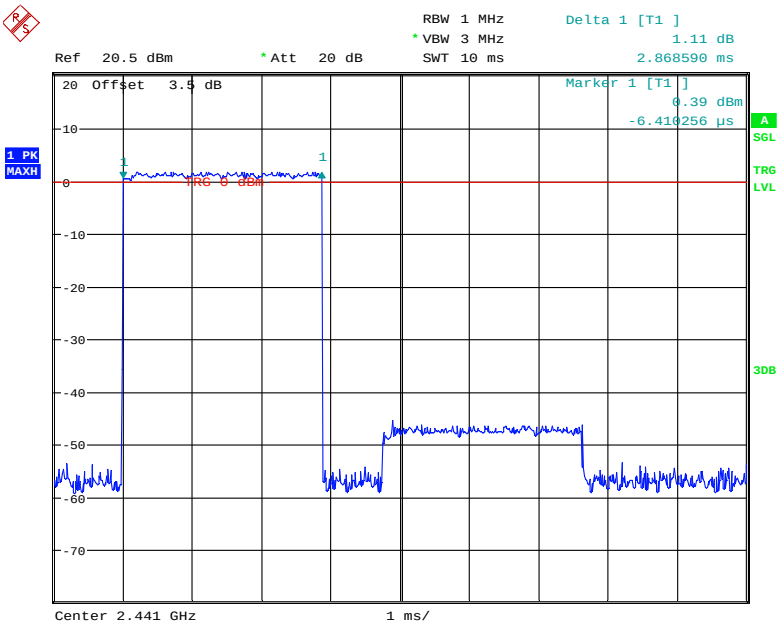


Date: 29.APR.2020 14:55:09

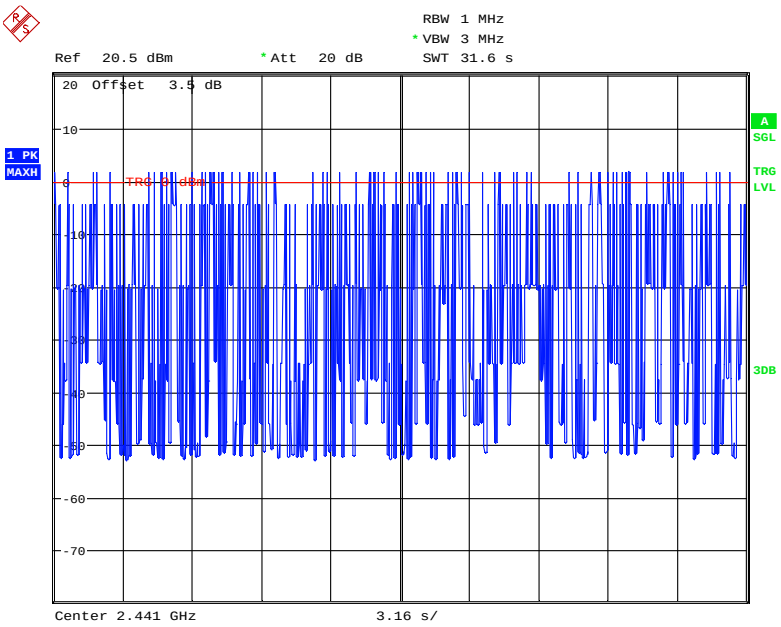


Date: 29.APR.2020 14:56:07

Pulse time, 3DH5



Date: 29.APR.2020 14:55:26



Date: 29.APR.2020 15:23:17

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to following table.

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	Limit (dBm)
BDR (GFSK)	Low	2402	-0.54	<=20.97
	Middle	2441	-0.01	<=20.97
	High	2480	-0.63	<=20.97
EDR (π/4-DQPSK)	Low	2402	-0.12	<=20.97
	Middle	2441	0.03	<=20.97
	High	2480	-0.51	<=20.97
EDR (8DPSK)	Low	2402	0.10	<=20.97
	Middle	2441	0.24	<=20.97
	High	2480	-0.36	<=20.97

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Black Chen on 2020-04-29.

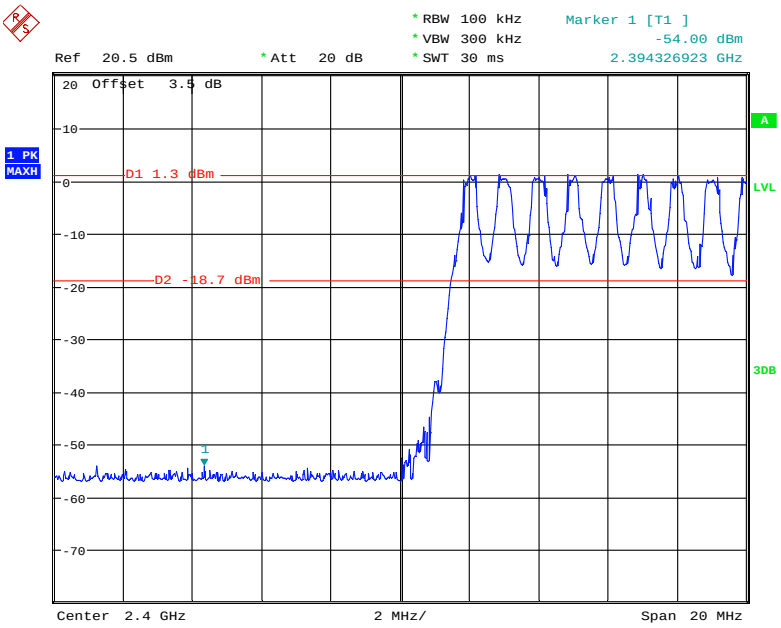
EUT operation mode: Transmitting

Test Result: Pass

Please refer to following plots

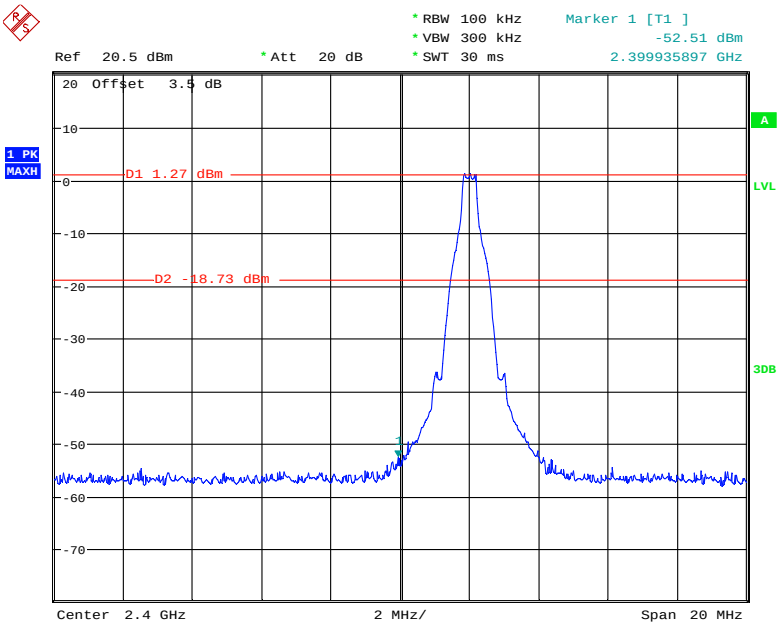
BDR (GFSK): Band Edge-Left Side

Hopping



Date: 29.APR.2020 14:47:51

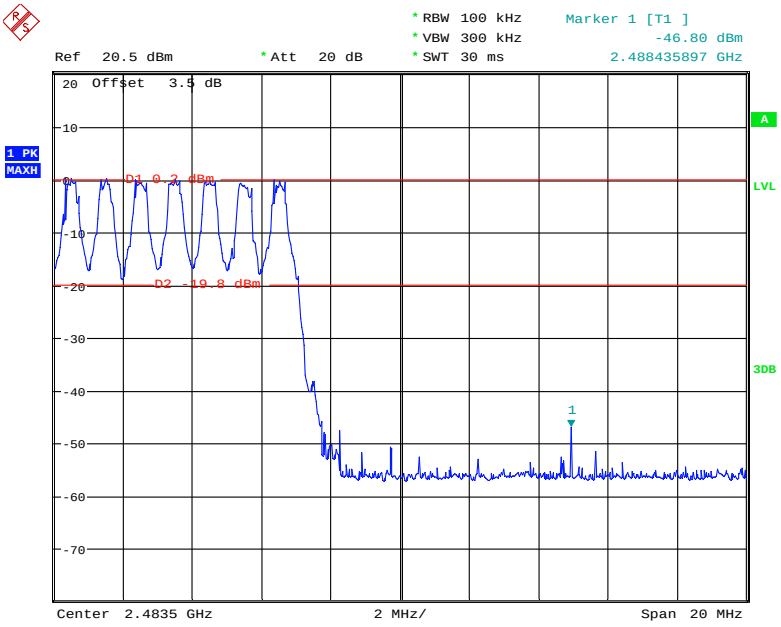
Single



Date: 29.APR.2020 14:46:08

BDR (GFSK): Band Edge-Right Side

Hopping



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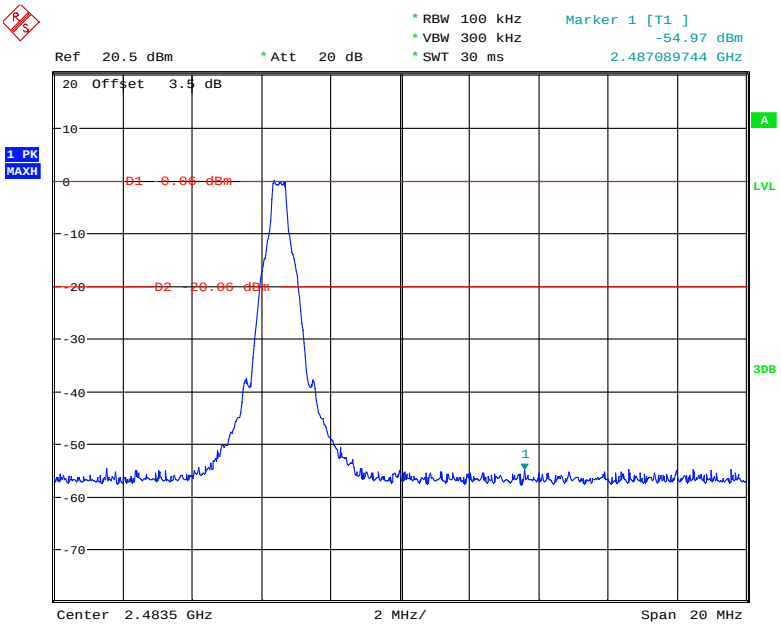
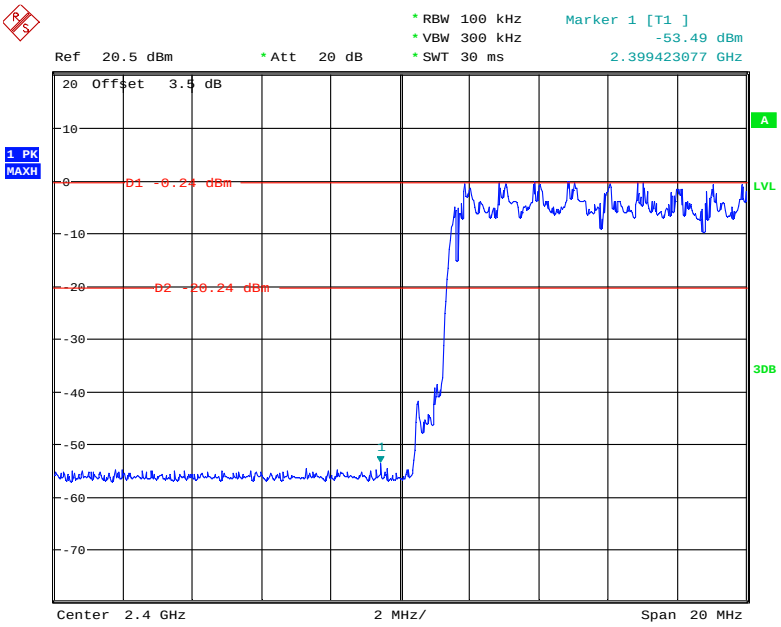


Date: 29.APR.2020 14:50:25

EDR (π/4-DQPSK): Band Edge-Left Side

Hopping



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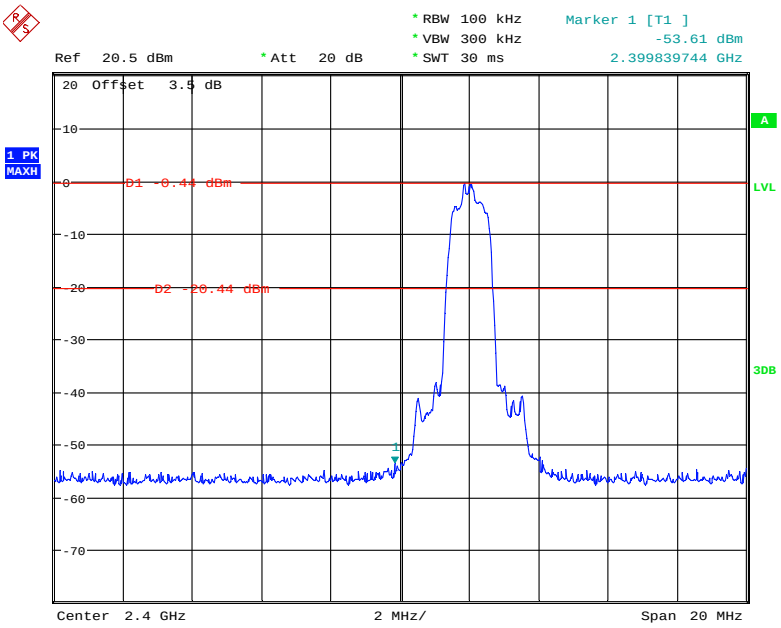
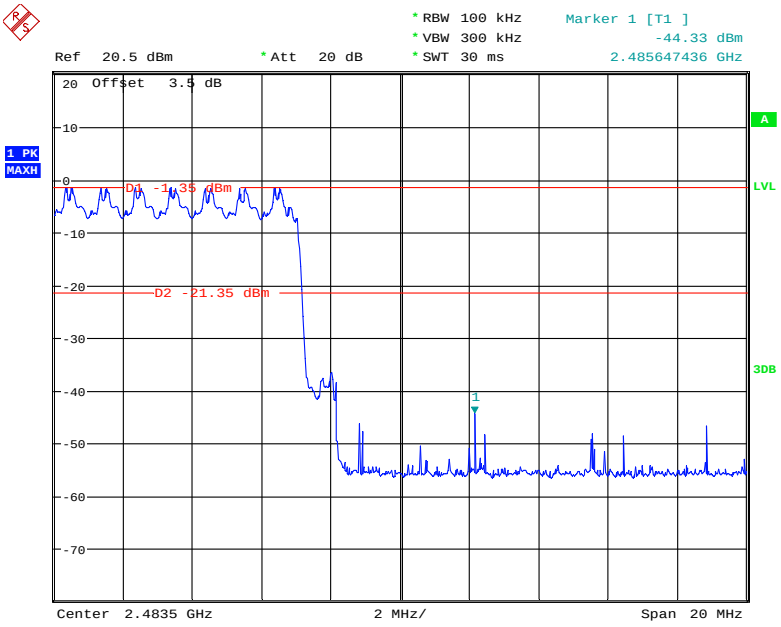
Single



Date: 29.APR.2020 14:45:11

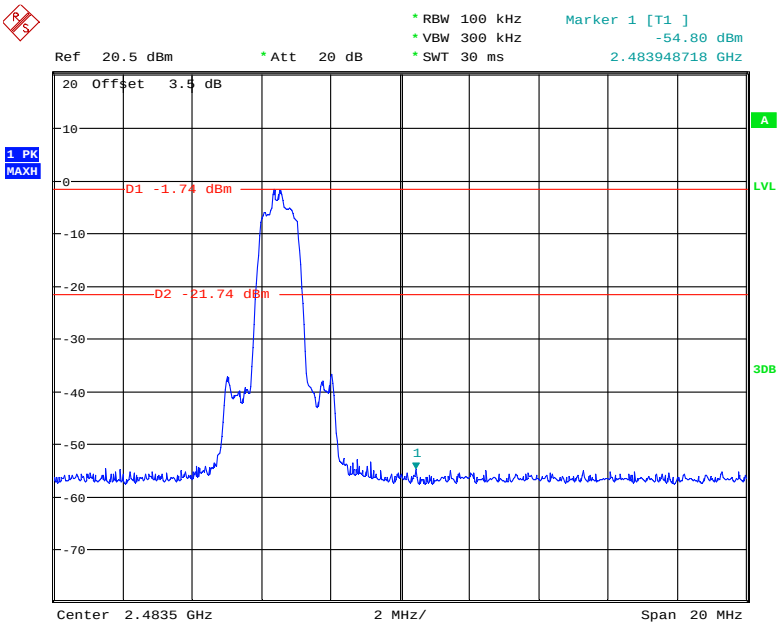
EDR (π/4-DQPSK): Band Edge-Right Side

Hopping



Date: 29.APR.2020 14:40:00

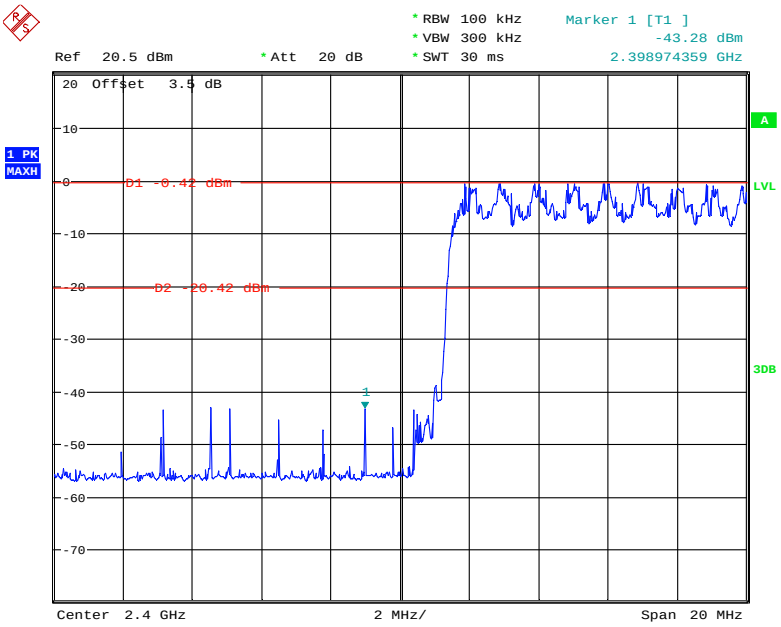
Single



Date: 29.APR.2020 14:33:34

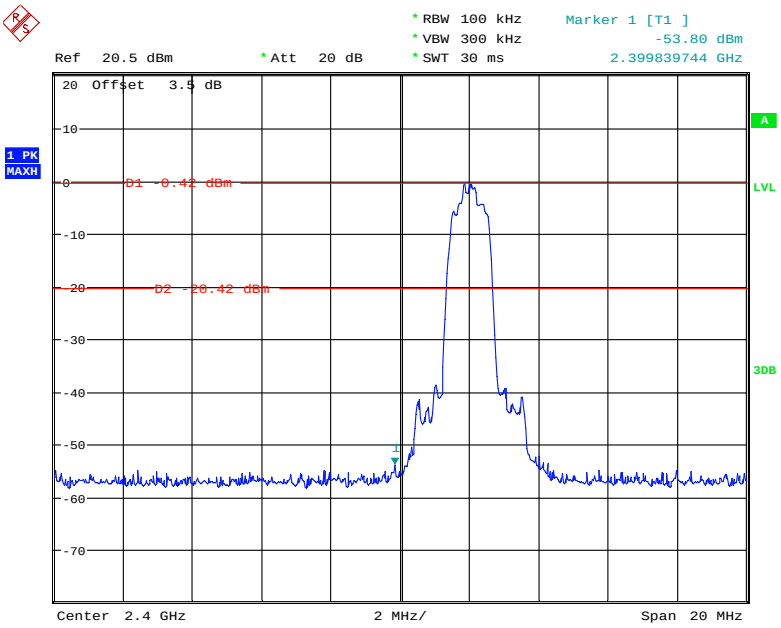
EDR (8DPSK): Band Edge-Left Side

Hopping



Date: 29.APR.2020 14:30:29

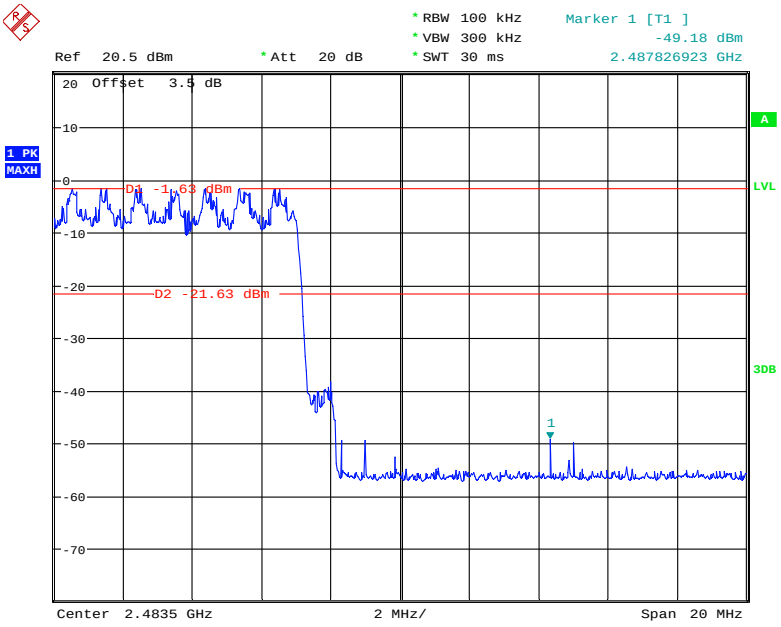
Single



Date: 29.APR.2020 14:27:51

EDR (8DPSK): Band Edge-Right Side

Hopping



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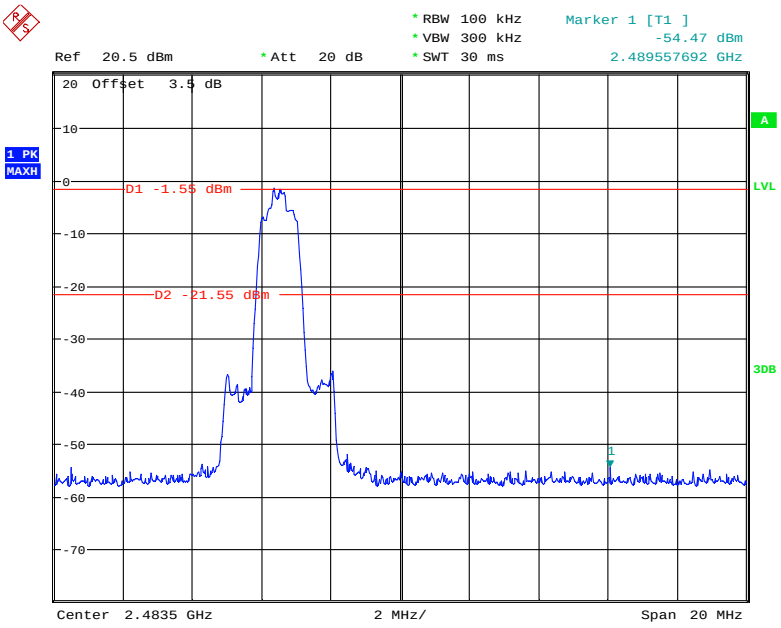
Single



Date: 29.APR.2020 14:32:45

******* END OF REPORT *******