FCC Part 15.247

TEST REPORT

For

Sabine Technologies Co.,Ltd.

KeShi Bldg ., Information Rd., Haidian District, Beijing, China

FCC ID: 2AK54-SABINE-M810

Report Type:	**Product Type:**
Original Report	SOLO KTV

Report Producer : **Shan Tsai** Shan Tsai

Report Number : **RXZ190815005-00B**

Report Date : **2019-08-28**

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RXZ190815005	RXZ190815005-00B	2019-08-28	Original Report	Shan Tsai

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	Sabine Technologies Co.,Ltd.
	KeShi Bldg ., Information Rd., Haidian District, Beijing, China
Manufacturer	Sabine Technologies Co.,Ltd.
	KeShi Bldg ., Information Rd., Haidian District, Beijing, China
Brand(Trade) Name	SABINETEK
Product (Equipment)	SOLO KTV
Main Model Name	Sabine-M810
Series Model Name	N/A
Model Discrepancy	N/A
Frequency Range	2402 ~ 2480 MHz
Transmit Power	BR(GFSK) Mode: 9.02 dBm (0.008W) EDR(π/4-DQPSK) Mode: 7.56 dBm (0.0057W) EDR(8DPSK) Mode: 8.01 dBm (0.0063W)
Modulation Technique	BR Mode: GFSK EDR Mode: π/4-DQPSK, 8DPSK
Transmit Data Rate	BR(GFSK) Mode: 1 Mbps EDR(π/4-DQPSK) Mode: 2 Mbps EDR(8DPSK) Mode: 3 Mbps
Number of Channels	79 Channels
Antenna Specification	PCB Antenna / 0.5 dBi
Power Operation (Voltage Range)	☐ AC 120V/60Hz ☐ Adapter ☐ By AC Power Cord ☐ PoE
	☒ DC Type ☒ Battery: 3.7Vdc ☐ DC Power Supply ☒ External from USB Cable: 5Vdc ☐ External DC Adapter
	☐ Host System
Received Date	Aug 15, 2019
Date of Test	Aug 19, 2019 ~ Aug 26, 2019

**All measurement and test data in this report was gathered from production sample serial number: 190815005 (Assigned by BACL, Taiwan).*

1.2 Objective

This report is prepared on behalf of *Sabine Technologies Co.,Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine the Bluetooth BR and EDR mode of EUT compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

1.3 Related Submittal(s)/Grant(s)

N/A.

1.4 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.

1.5 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

☐68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 974454. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

2 System Test Configuration

2.1 Description of Test Configuration

For BT mode, 79 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	40	2441
2	2403	--	--
3	2404	--	--
4	2405	77	2478
--	--	78	2479
39	2440	79	2480

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The software was used "CSR 3"

Test Software		Bluetooth MP Tool		
Test Frequency		2402MHz	2441MHz	2480MHz
Power Level Setting	GFSK	9	9	9
	π/4-DQPSK	9	9	9
	8DPSK	9	9	9

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	BSMI	FCC ID	S/N
NB	DELL	E6410	N/A	PD98260NGU	10912240367
Adapter	ZTE	STC-A51A-Z	N/A	N/A	1124749435

2.5 External Cable List and Details

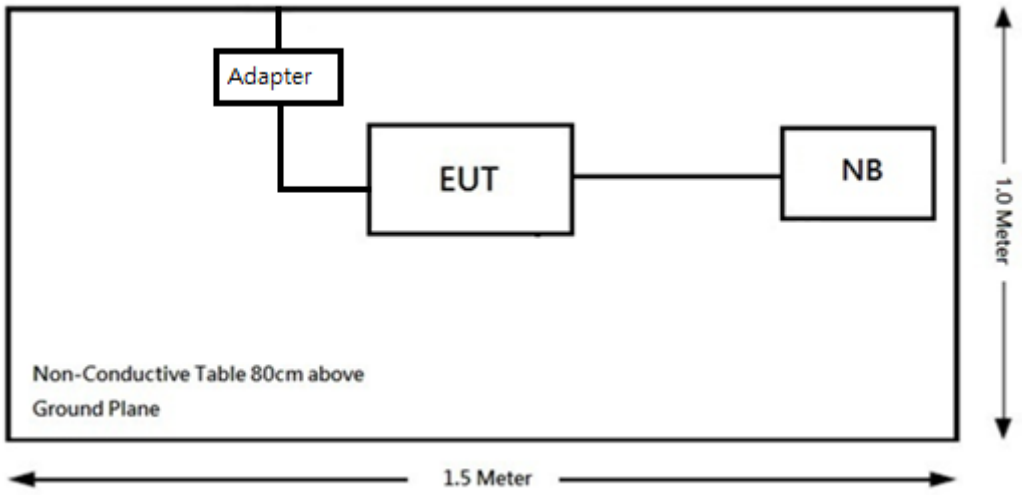
Cable Description	Length (m)	From	To
Micro USB cable	1	EUT	Adapter
Test Fixture cable	1	NB	EUT

2.6 Block Diagram of Test Setup

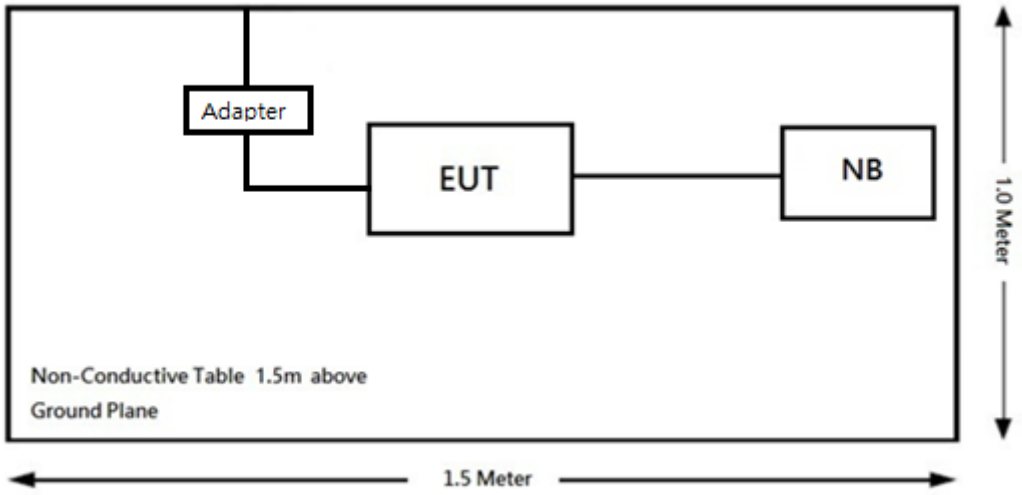
See test photographs attached in annex setup photos for the actual connections between EUT and support equipment.

Radiation:

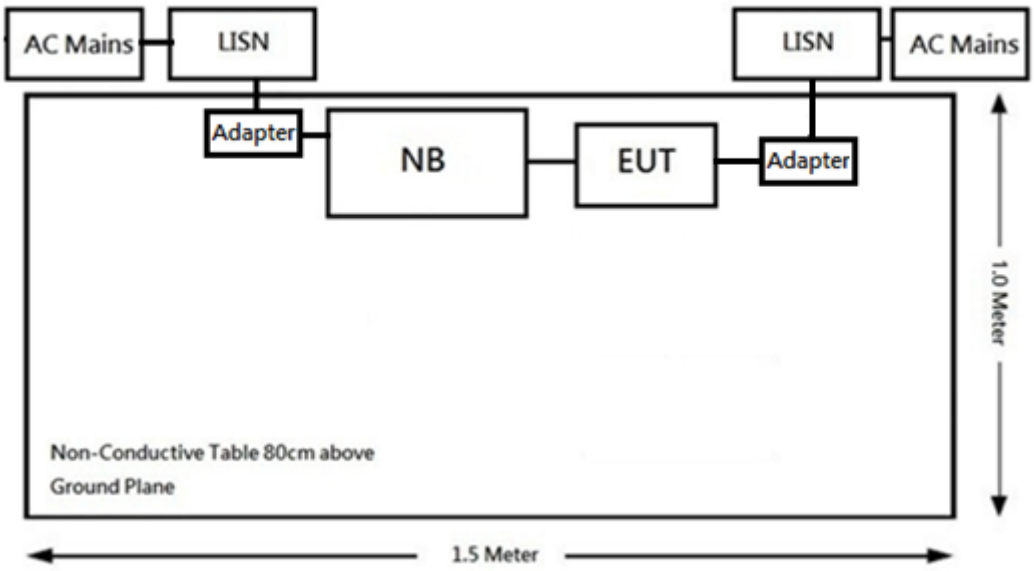
Below 1GHz:



Above 1GHz:



Conduction:


AC Mains
LISN
LISN
AC Mains
Adapter
NB
EUT
Adapter
1.0 Meter
Non-Conductive Table 80cm above
Ground Plane
1.5 Meter

3 Summary of Test Results

FCC Rules	Description of Test	Results
§15.247(i), § 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)	Spurious 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)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2019/02/21	2020/02/20
LISN	Rohde & Schwarz	ENV216	101248	2019/06/26	2020/06/25
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2019/08/02	2020/08/01
RF Cable	EMEC	EM-CB5D	001	2019/07/01	2020/06/30
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiated Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2018/12/11	2019/12/10
Horn Antenna	EMCO	SAS-571	1020	2019/04/17	2020/04/16
Horn Antenna	ETS-Lindgren	3116	62638	2018/08/29	2019/08/28
Preamplifier	Sonoma	310N	130602	2019/06/26	2020/06/25
Preamplifier	EM Electronics Corp.	EM01G18G	060657	2018/12/07	2019/12/06
Microware Preamplifier	EM Electronics Corporation	EM18G40G	060656	2019/01/11	2020/01/10
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2019/02/13	2020/02/12
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2019/07/01	2020/06/30
Micro flex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2019/07/01	2020/06/30
Micro flex Cable	UTIFLEX	FSCM 64639 / (2M)	93D0127	2019/07/01	2020/06/30
Microflex Cable	Woken	SFL402-100CM	S02-160323-039	2019/07/01	2020/06/30
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2019/03/04	2020/03/03
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2019/01/16	2020/01/15
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	60772	N.C.R	N.C.R

Software	Farad	EZ_EMC	BACL-03A1	N.C.R	N.C.R
NSA	BACL	966-A	N/A	2019/07/08	2020/07/07
VSWR	BACL	966-A	N/A	2019/07/15	2020/07/14
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2019/05/10	2020/05/09
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2019/03/07	2020/03/07
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2019/03/06	2020/03/05

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements*

5 FCC §15.247(i), § 2.1093 - RF Exposure

5.1 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 v06

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)] ·

[$\sqrt{}$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. 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

5.2 RF Exposure Evaluation Result

Frequency (MHz)	Tune-up Power		Evaluation Distance (mm)	SAR Exclusion Result	SAR Exclusion Limit
	(dBm)	(mW)			(1g SAR)
2402-2480	9.5	8.913	5	2.8	3

Result: SAR test is exempted.

6 FCC §15.203 – Antenna Requirements

6.1 Applicable Standard

According to § 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 user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2 Antenna Information

Manufacturer	Type	Antenna Gain	Result
Beijing Sabine Technology CO.,LTD.	PCB Antenna	0.5 dBi	Compliance

The EUT has one integral antenna arrangement, which was permanently attached; fulfill the requirement of this section.

7 FCC §15.207(a) – AC Line Conducted Emissions

7.1 Applicable Standard

According to §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

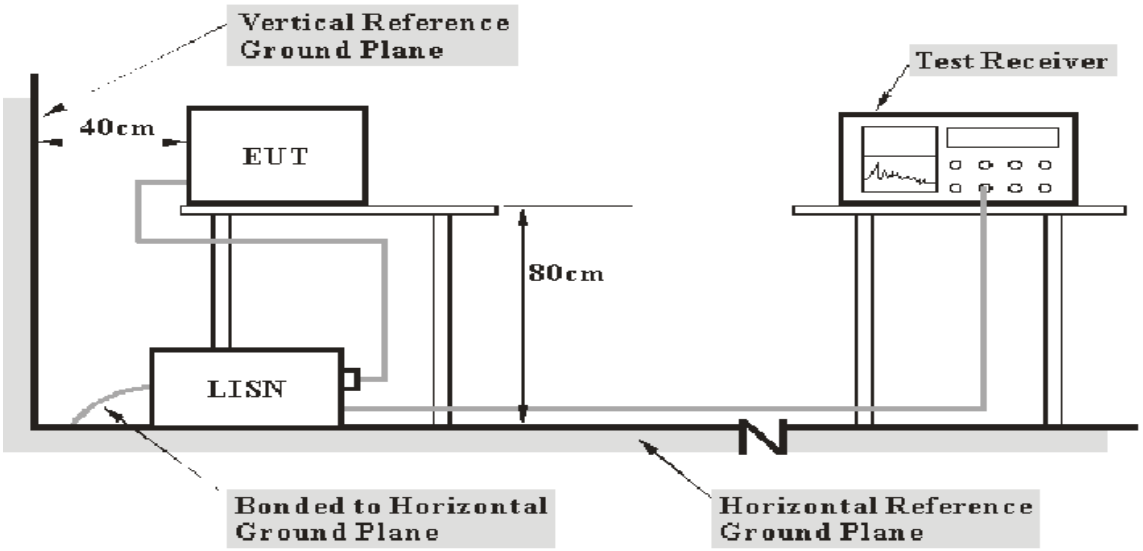
7.2 Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN/ISN and receiver, LISN/ISN voltage division factor, LISN/ISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Taiwan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report

Port	Expanded Measurement uncertainty
AC Mains	2.71 dB (k=2, 95% level of confidence)

7.3 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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.4 EMI Test Receiver Setup

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

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

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

7.5 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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

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

7.6 Corrected Factor & Margin Calculation

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

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "Over Limit" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

7.7 Environmental Conditions

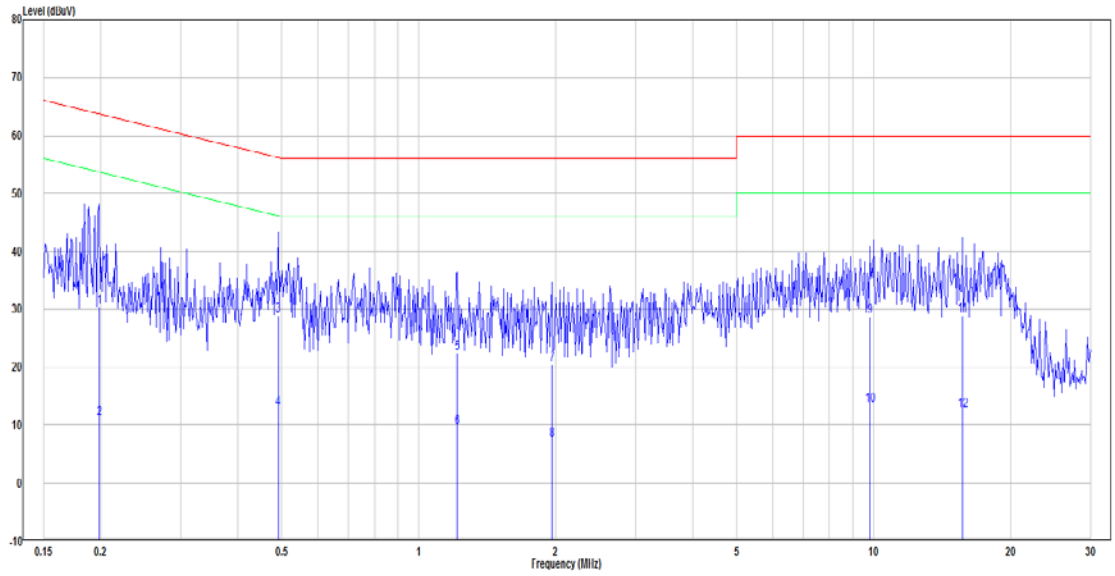
Temperature:	24 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Woods Chen on 2019-08-21

7.8 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.198	20.77	9.59	30.36	63.68	-33.32	QP
2	0.198	1.61	9.59	11.2	53.68	-42.48	Average
3	0.491	19.34	9.60	28.94	56.15	-27.21	QP
4	0.491	3.30	9.60	12.9	46.15	-33.25	Average
5	1.217	12.82	9.64	22.46	56.00	-33.54	QP
6	1.217	-0.13	9.64	9.51	46.00	-36.49	Average
7	1.964	10.76	9.66	20.42	56.00	-35.58	QP
8	1.964	-2.18	9.66	7.48	46.00	-38.52	Average
9	9.823	18.99	9.82	28.81	60.00	-31.19	QP
10	9.823	3.66	9.82	13.48	50.00	-36.52	Average
11	15.693	19.03	9.86	28.89	60.00	-31.11	QP
12	15.693	2.66	9.86	12.52	50.00	-37.48	Average

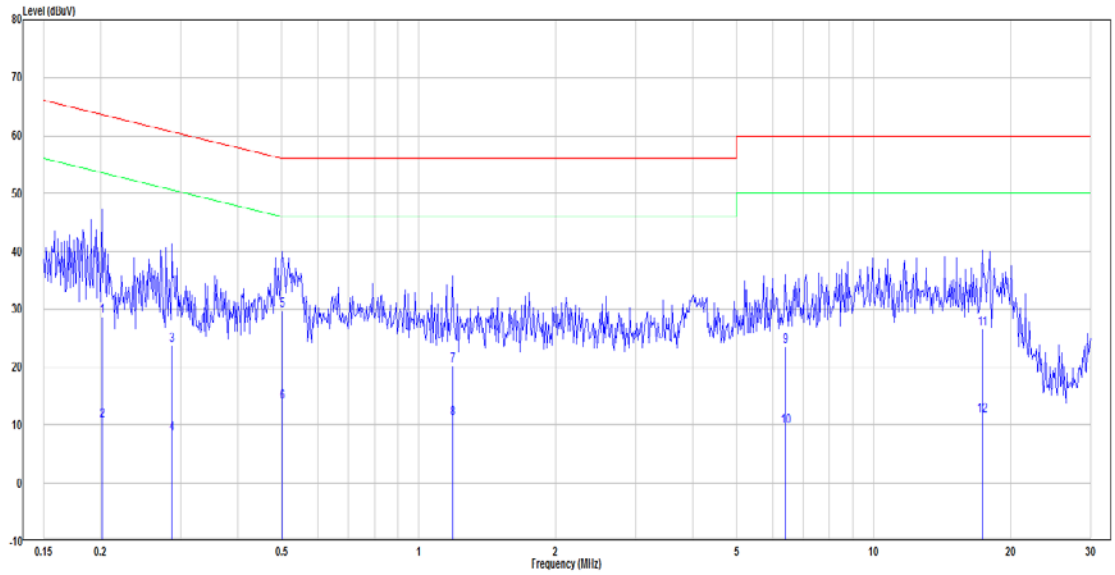
Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Main: AC120 V, 60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.201	19.19	9.59	28.78	63.56	-34.78	QP
2	0.201	1.27	9.59	10.86	53.56	-42.7	Average
3	0.287	14.22	9.59	23.81	60.62	-36.81	QP
4	0.287	-1.09	9.59	8.5	50.62	-42.12	Average
5	0.501	20.16	9.60	29.76	56.00	-26.24	QP
6	0.501	4.30	9.60	13.9	46.00	-32.1	Average
7	1.187	10.71	9.63	20.34	56.00	-35.66	QP
8	1.187	1.45	9.63	11.08	46.00	-34.92	Average
9	6.398	13.84	9.78	23.62	60.00	-36.38	QP
10	6.398	-0.02	9.78	9.76	50.00	-40.24	Average
11	17.338	16.64	9.93	26.57	60.00	-33.43	QP
12	17.338	1.73	9.93	11.66	50.00	-38.34	Average

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d) 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).

8.2 Measurement Uncertainty

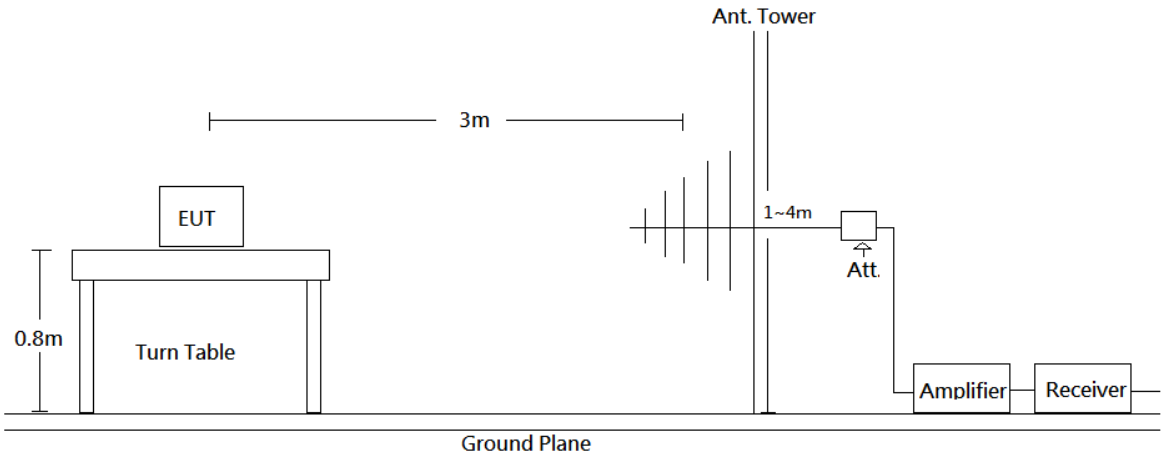
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

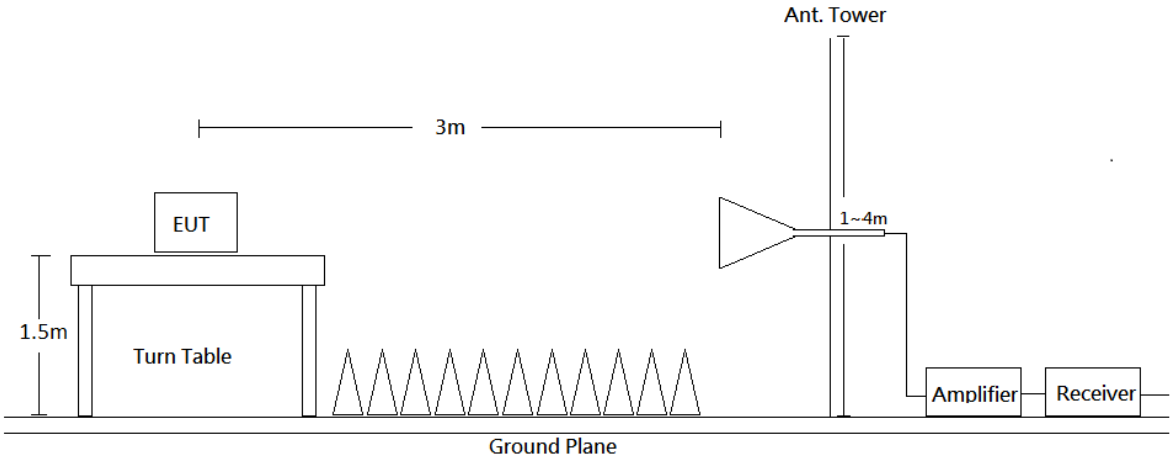
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.75 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.21 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.83 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.18 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.55 dB (k=2, 95% level of confidence)
26 GHz~40 GHz	4.67 dB (k=2, 95% level of confidence)

8.3 EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.4 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Measurement method
30-1000 MHz	120 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	PK
	1 MHz	10 Hz	Ave

8.5 Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.6 Corrected Factor & Margin Calculation

The Correct Factor 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:

Correct Factor = 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 -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

8.7 Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.209 Limit.

8.8 Environmental Conditions

Radiation		Conducted	
Temperature:	20~25.3 ℃	**Temperature:**	25.3 ℃
Relative Humidity:	53~62 %	**Relative Humidity:**	62 %
ATM Pressure:	1010 hPa	**ATM Pressure:**	1010 hPa

The Radiation Spurious Emissions testing was performed by David lee on 2019-08-20 ~ 2019-08-26.

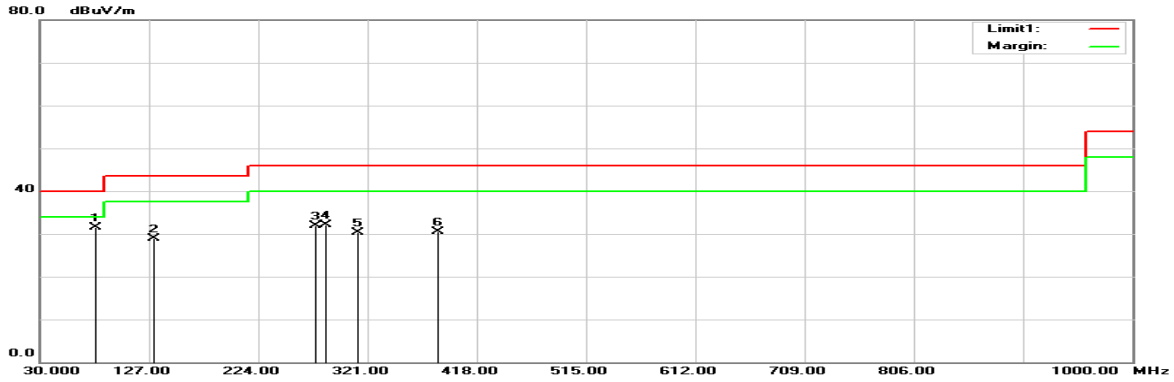
The Conducted Spurious Emissions testing was performed by David Hsu on 2019-08-19.

8.9 Test Results

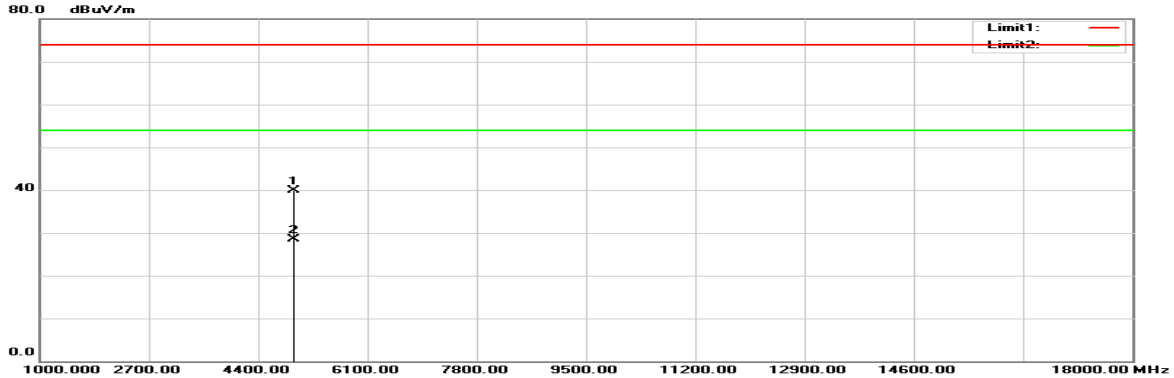
BR (GFSK) Mode

Horizontal (*worst case is BR (GFSK) mode high channel*)

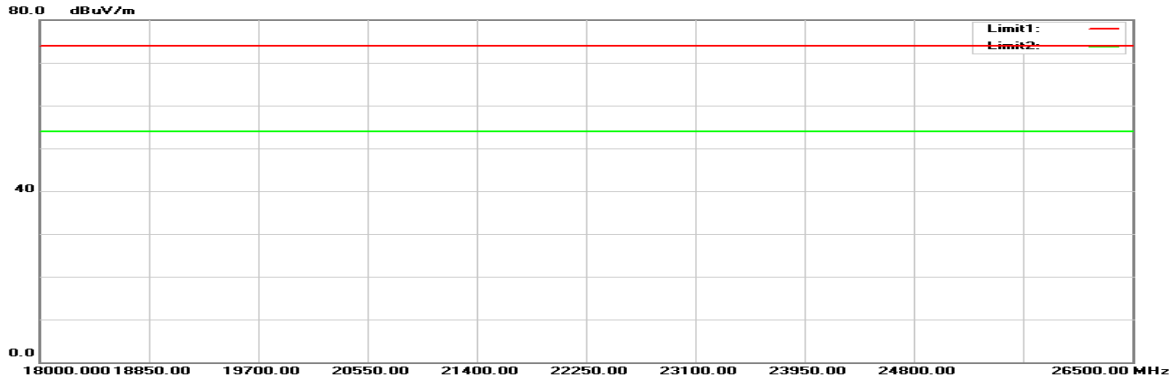
30MHz-1GHz:



1GHz-18GHz:

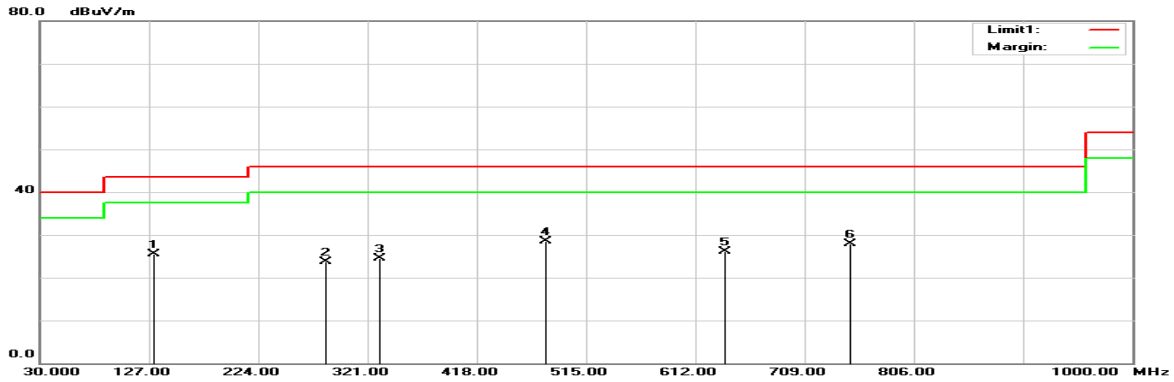


18GHz-26.5GHz:

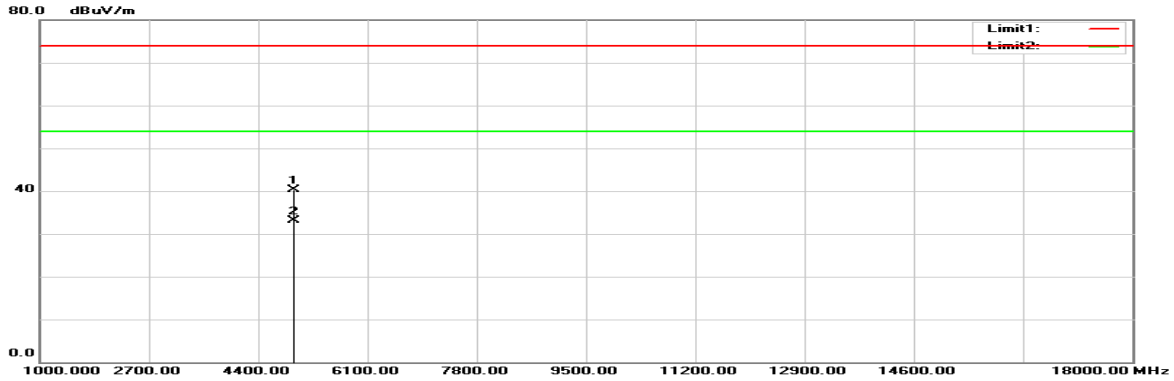


Vertical (*worst case is BR (GFSK) mode high channel*)

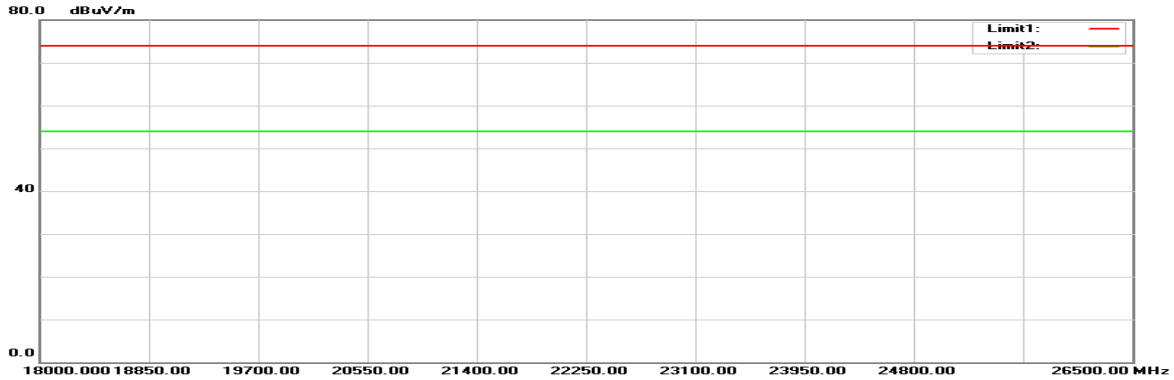
30MHz-1GHz:



1GHz-18GHz:



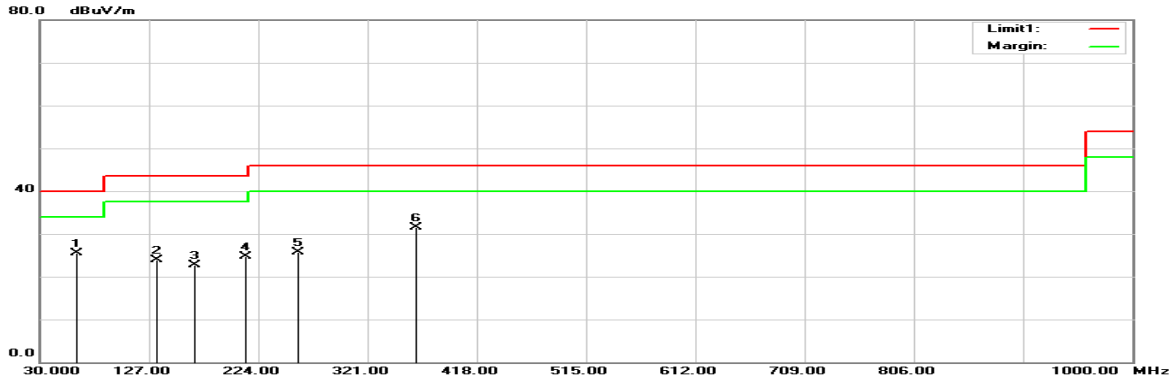
18GHz-26.5GHz:



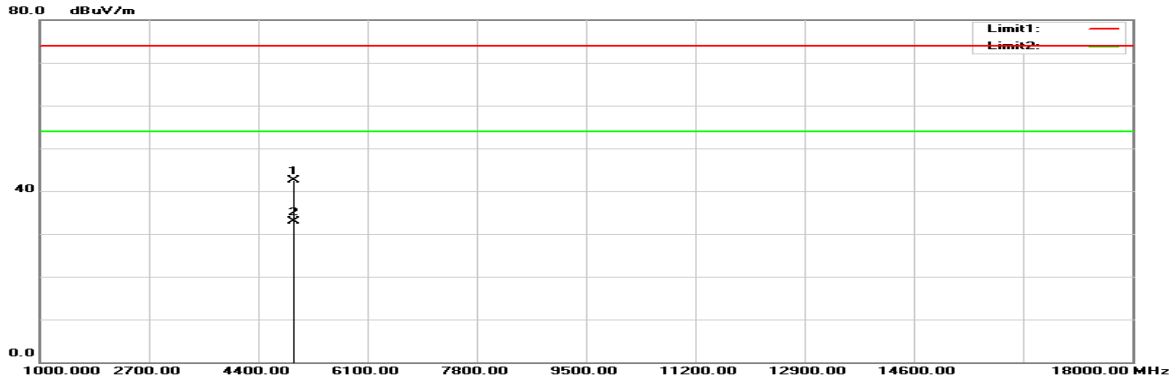
EDR (π/4-DQPSK) Mode

Horizontal (*worst case is EDR (π/4-DQPSK) mode high channel*)

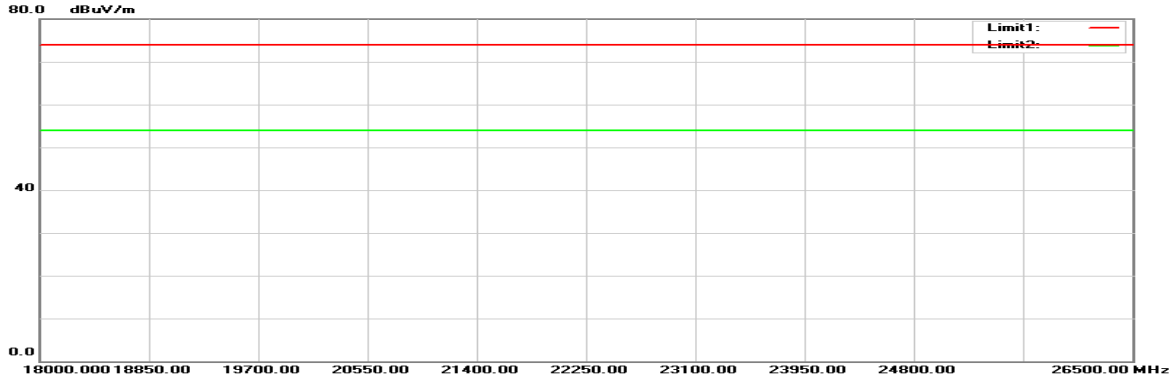
30MHz-1GHz:



1GHz-18GHz:

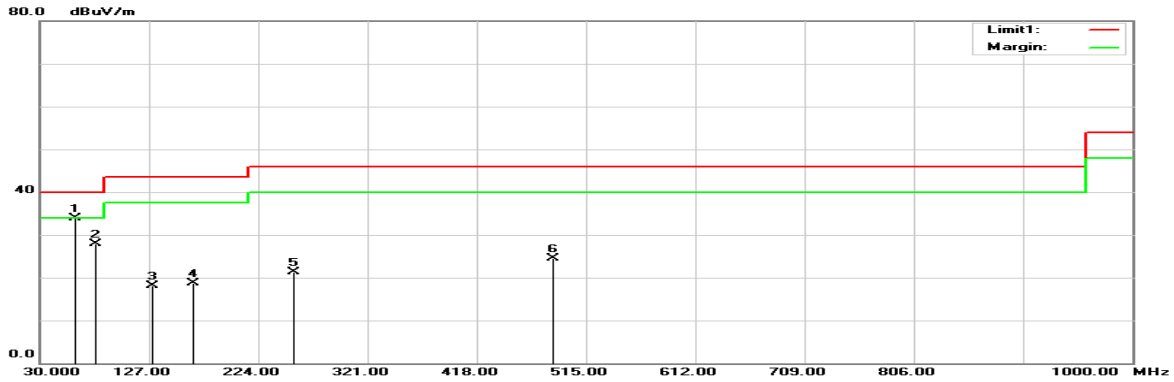


18GHz-26.5GHz:

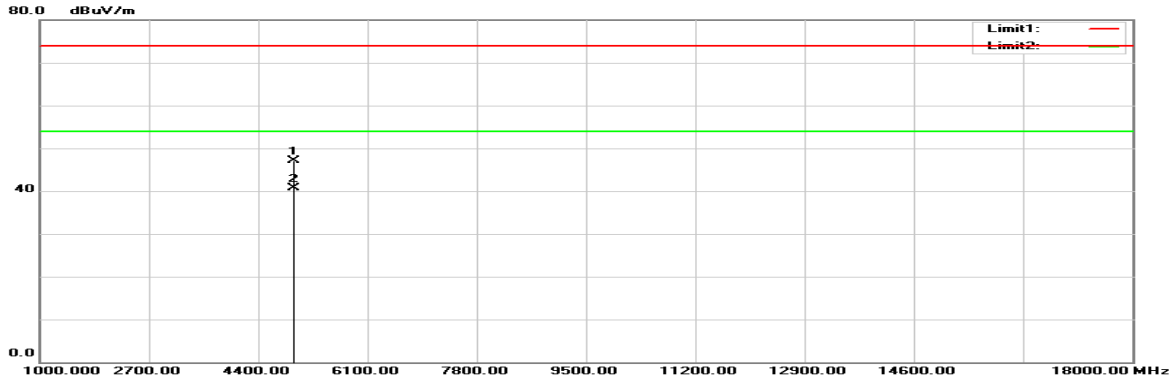


Vertical (*worst case is EDR (π/4-DQPSK) mode high channel*)

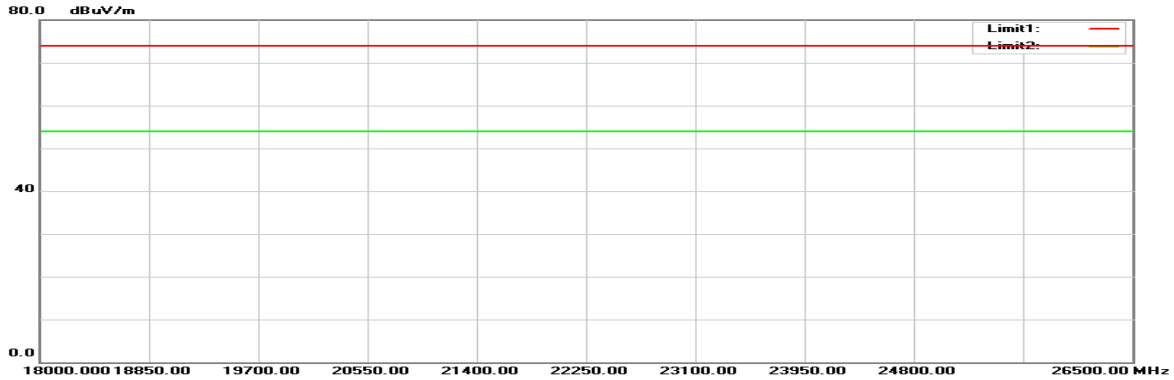
30MHz-1GHz:



1GHz-18GHz:



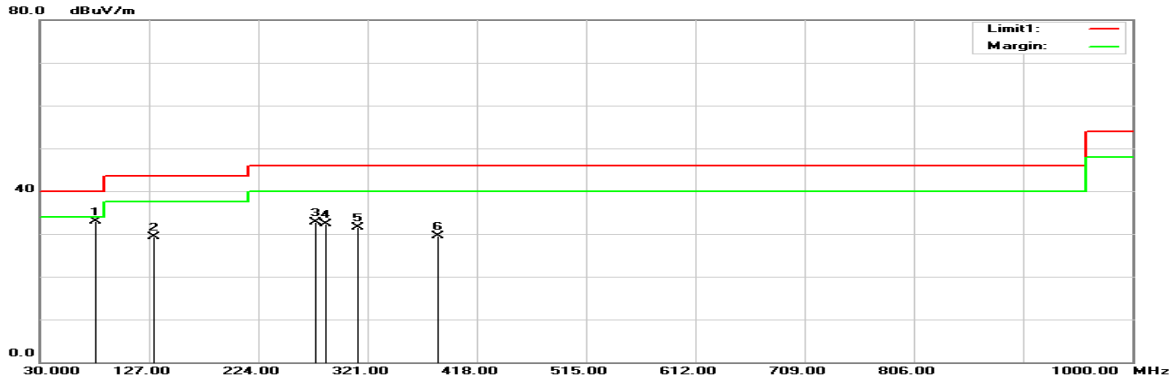
18GHz-26.5GHz:



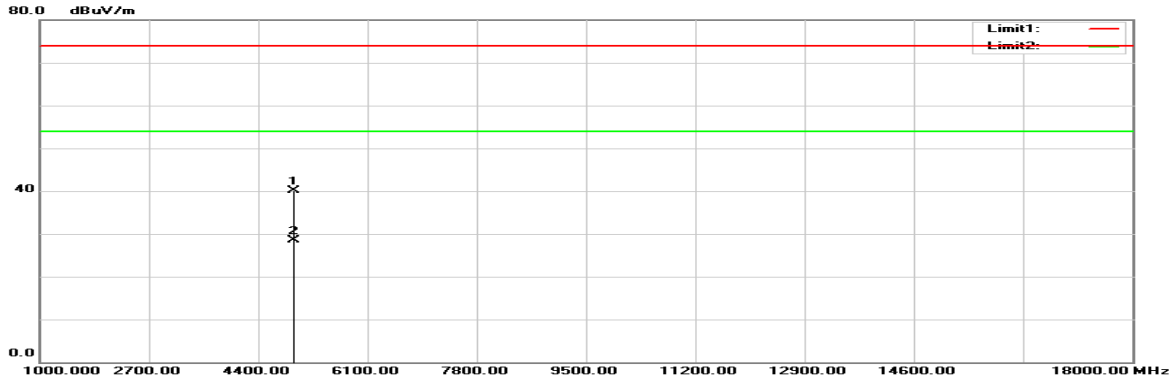
EDR (8DPSK) Mode

Horizontal (*worst case is EDR (8DPSK) mode high channel*)

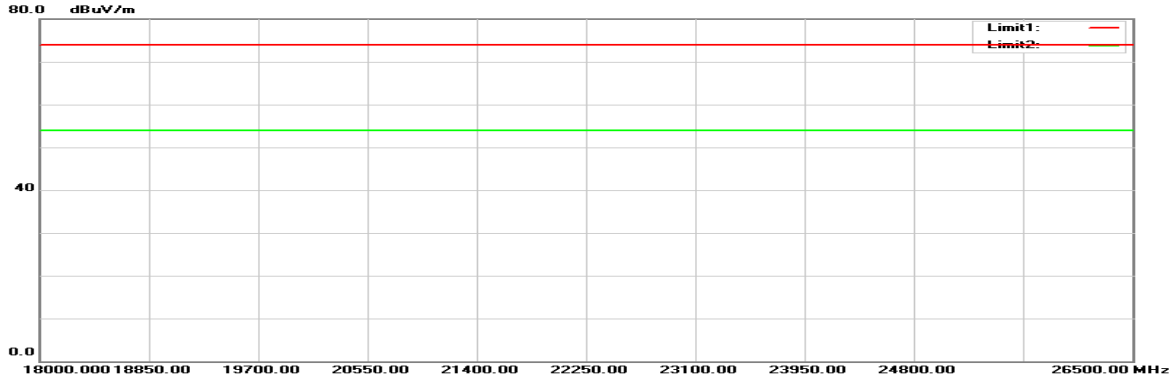
30MHz-1GHz:



1GHz-18GHz:

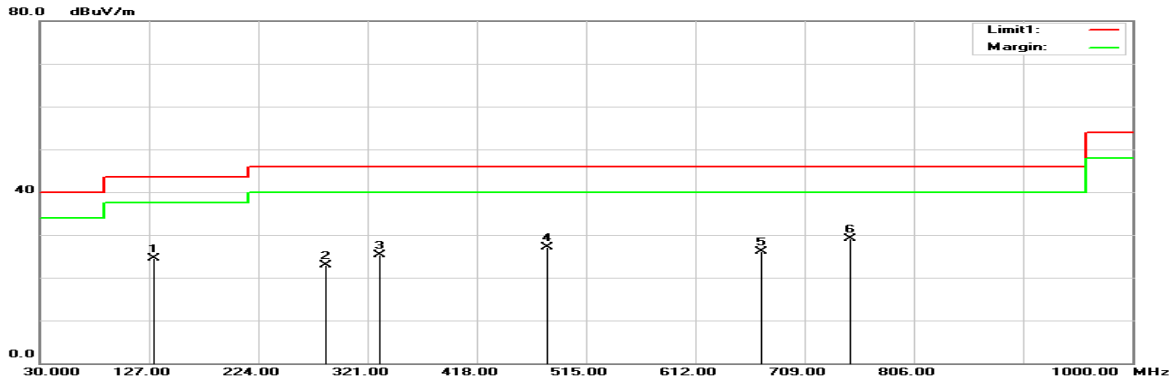


18GHz-26.5GHz:

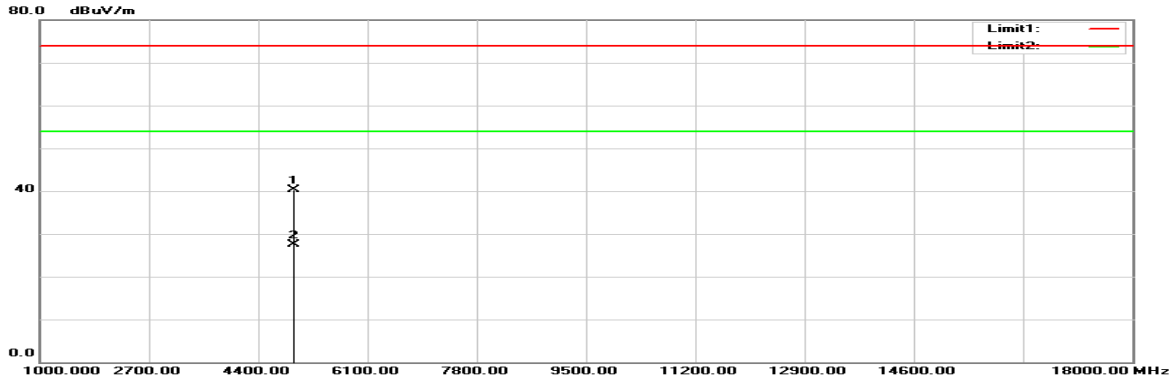


Vertical (*worst case is EDR (8DPSK) mode high channel*)

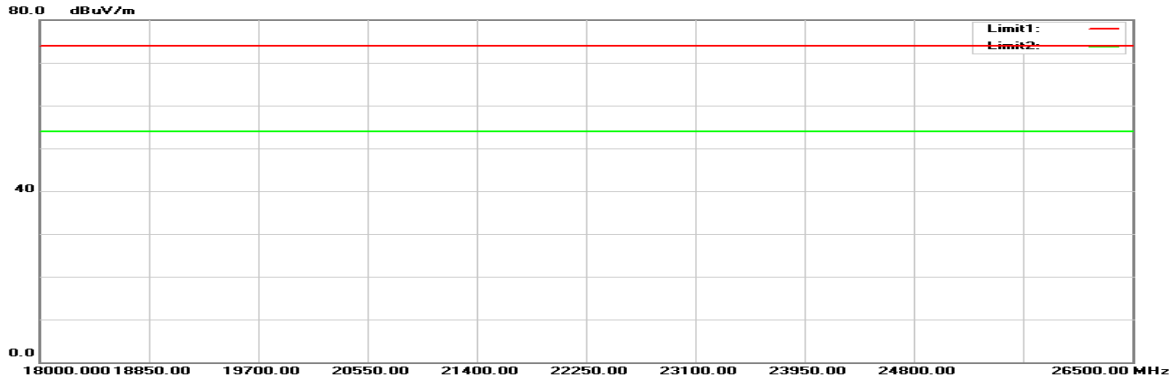
30MHz-1GHz:



1GHz-18GHz:



18GHz-26.5GHz:



Below 1GHz

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BR (GFSK)								
79.4700	47.31	-15.77	31.54	40.00	-8.46	100	145	QP
131.8500	38.42	-9.54	28.88	43.50	-14.62	100	163	QP
275.4100	40.63	-8.78	31.85	46.00	-14.15	100	149	QP
284.1400	40.78	-8.62	32.16	46.00	-13.84	100	253	QP
312.2700	38.45	-8.10	30.35	46.00	-15.65	100	93	QP
384.0500	37.16	-6.73	30.43	46.00	-15.57	100	182	QP
EDR (π/4-DQPSK)								
62.9800	42.07	-16.64	25.43	40.00	-14.57	100	96	QP
133.7900	33.48	-9.60	23.88	43.50	-19.62	100	319	QP
167.7400	33.56	-10.76	22.80	43.50	-20.70	100	74	QP
213.3300	36.06	-11.33	24.73	43.50	-18.77	100	91	QP
259.8900	35.69	-9.89	25.80	46.00	-20.20	100	314	QP
363.6800	38.64	-7.09	31.55	46.00	-14.45	100	309	QP
EDR (8DPSK)								
79.4700	48.59	-15.77	32.82	40.00	-7.18	100	360	QP
131.8500	38.78	-9.54	29.24	43.50	-14.26	100	175	QP
275.4100	41.53	-8.78	32.75	46.00	-13.25	100	149	QP
284.1400	41.02	-8.62	32.40	46.00	-13.60	100	152	QP
312.2700	39.62	-8.10	31.52	46.00	-14.48	100	84	QP
384.0500	36.22	-6.73	29.49	46.00	-16.51	100	173	QP

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BR (GFSK)								
131.8500	35.05	-9.54	25.51	43.50	-17.99	100	118	QP
284.1400	32.27	-8.62	23.65	46.00	-22.35	100	316	QP
331.6700	32.30	-7.70	24.60	46.00	-21.40	100	131	QP
479.1100	33.82	-5.36	28.46	46.00	-17.54	100	34	QP
638.1900	29.79	-3.65	26.14	46.00	-19.86	100	0	QP
749.7400	30.31	-2.47	27.84	46.00	-18.16	100	269	QP
EDR (π/4-DQPSK)								
61.0400	50.80	-16.83	33.97	40.00	-6.03	100	27	QP
79.4700	43.77	-15.77	28.00	40.00	-12.00	100	228	QP
129.9100	27.53	-9.48	18.05	43.50	-25.45	100	280	QP
165.8000	29.27	-10.60	18.67	43.50	-24.83	100	124	QP
256.0100	31.45	-10.13	21.32	46.00	-24.68	100	19	QP
485.9000	29.74	-5.27	24.47	46.00	-21.53	100	360	QP
EDR (8DPSK)								
131.8500	34.08	-9.54	24.54	43.50	-18.96	100	118	QP
284.1400	31.58	-8.62	22.96	46.00	-23.04	100	332	QP
331.6700	33.02	-7.70	25.32	46.00	-20.68	100	120	QP
481.0500	32.52	-5.34	27.18	46.00	-18.82	100	31	QP
671.1700	29.49	-3.29	26.20	46.00	-19.80	100	258	QP
749.7400	31.59	-2.47	29.12	46.00	-16.88	100	266	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Above 1GHz

Horizontal

Frequency (MHz)	Reading (dBµV)	Correct Factor(dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BR (GFSK), Low channel								
2390.000	49.16	-4.06	45.10	74.00	-28.90	200	240	peak
2390.000	35.41	-4.06	31.35	54.00	-22.65	200	240	AVG
2402.000	95.76	-3.96	91.80	N/A	N/A	200	122	peak
2402.000	83.10	-3.96	79.14	N/A	N/A	200	122	AVG
4804.000	38.14	1.51	39.65	74.00	-34.35	100	99	peak
4804.000	27.35	1.51	28.86	54.00	-25.14	100	99	AVG
BR (GFSK), Middle channel								
2441.000	94.39	-3.53	90.86	N/A	N/A	200	103	peak
2441.000	82.07	-3.53	78.54	N/A	N/A	200	103	AVG
4882.000	39.57	2.37	41.94	74.00	-32.06	100	243	peak
4882.000	28.63	2.37	31.00	54.00	-23.00	100	243	AVG
BR (GFSK), High channel								
2480.000	94.10	-3.10	91.00	N/A	N/A	200	99	peak
2480.000	81.40	-3.10	78.30	N/A	N/A	200	99	AVG
2483.500	52.56	-3.06	49.50	74.00	-24.50	200	105	peak
2483.500	40.54	-3.06	37.48	54.00	-16.52	200	105	AVG
4960.000	37.42	2.39	39.81	74.00	-34.19	100	168	peak
4960.000	26.18	2.39	28.57	54.00	-25.43	100	168	AVG

Vertical

Frequency (MHz)	Reading (dBµV)	Correct Factor(dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BR (GFSK), Low channel								
2390.000	48.08	-4.06	44.02	74.00	-29.98	100	138	peak
2390.000	35.16	-4.06	31.10	54.00	-22.90	100	138	AVG
2402.000	98.71	-3.96	94.75	N/A	N/A	100	126	peak
2402.000	85.57	-3.96	81.61	N/A	N/A	100	126	AVG
4804.000	40.62	1.51	42.13	74.00	-31.87	100	72	peak
4804.000	32.35	1.51	33.86	54.00	-20.14	100	72	AVG
BR (GFSK), Middle channel								
2441.000	97.98	-3.53	94.45	N/A	N/A	100	128	peak
2441.000	83.98	-3.53	80.45	N/A	N/A	100	128	AVG
4882.000	37.92	2.37	40.29	74.00	-33.71	100	260	peak
4882.000	31.94	2.37	34.31	54.00	-19.69	100	260	AVG
7323.000	38.35	8.91	47.26	74.00	-26.74	100	23	peak
7323.000	29.16	8.91	38.07	54.00	-15.93	100	23	AVG
BR (GFSK), High channel								
2480.000	97.98	-3.10	94.88	N/A	N/A	100	179	peak
2480.000	83.73	-3.10	80.63	N/A	N/A	100	179	AVG
2483.500	54.86	-3.06	51.80	74.00	-22.20	100	172	peak
2483.500	43.29	-3.06	40.23	54.00	-13.77	100	172	AVG
4960.000	37.85	2.39	40.24	74.00	-33.76	100	17	peak
4960.000	30.62	2.39	33.01	54.00	-20.99	100	17	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
EDR (π/4-DQPSK), Low channel								
2390.000	49.95	-4.06	45.89	74.00	-28.11	200	120	peak
2390.000	37.22	-4.06	33.16	54.00	-20.84	200	120	AVG
2402.000	95.92	-3.96	91.96	N/A	N/A	200	168	peak
2402.000	81.60	-3.96	77.64	N/A	N/A	200	168	AVG
4804.000	40.86	1.51	42.37	74.00	-31.63	100	307	peak
4804.000	31.07	1.51	32.58	54.00	-21.42	100	307	AVG
EDR (π/4-DQPSK), Middle channel								
2441.000	95.50	-3.53	91.97	N/A	N/A	200	165	peak
2441.000	81.57	-3.53	78.04	N/A	N/A	200	165	AVG
4882.000	37.92	2.37	40.29	74.00	-33.71	100	270	peak
4882.000	29.29	2.37	31.66	54.00	-22.34	100	270	AVG
EDR (π/4-DQPSK), High channel								
2480.000	97.79	-3.10	94.69	N/A	N/A	200	165	peak
2480.000	82.37	-3.10	79.27	N/A	N/A	200	165	AVG
2483.500	54.83	-3.06	51.77	74.00	-22.23	200	172	peak
2483.500	40.81	-3.06	37.75	54.00	-16.25	200	172	AVG
4960.000	40.02	2.39	42.41	74.00	-31.59	100	173	peak
4960.000	30.59	2.39	32.98	54.00	-21.02	100	173	AVG

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
EDR (π/4-DQPSK), Low channel								
2390.000	51.03	-4.06	46.97	74.00	-27.03	100	248	peak
2390.000	37.05	-4.06	32.99	54.00	-21.01	100	248	AVG
2402.000	95.00	-3.96	91.04	N/A	N/A	100	292	peak
2402.000	80.24	-3.96	76.28	N/A	N/A	100	292	AVG
4804.000	43.14	1.51	44.65	74.00	-29.35	100	349	peak
4804.000	34.94	1.51	36.45	54.00	-17.55	100	349	AVG
EDR (π/4-DQPSK), Middle channel								
2441.000	94.58	-3.53	91.05	N/A	N/A	100	302	peak
2441.000	79.39	-3.53	75.86	N/A	N/A	100	302	AVG
4882.000	38.79	2.37	41.16	74.00	-32.84	100	237	peak
4882.000	31.35	2.37	33.72	54.00	-20.28	100	237	AVG
EDR (π/4-DQPSK), High channel								
2480.000	95.27	-3.10	92.17	N/A	N/A	100	311	peak
2480.000	80.99	-3.10	77.89	N/A	N/A	100	311	AVG
2483.500	52.71	-3.06	49.65	74.00	-24.35	100	311	peak
2483.500	39.40	-3.06	36.34	54.00	-17.66	100	311	AVG
4960.000	44.81	2.39	47.20	74.00	-26.80	100	333	peak
4960.000	38.28	2.39	40.67	54.00	-13.33	100	333	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
EDR (8DPSK), Low channel								
2390.000	46.56	-4.06	42.50	74.00	-31.50	200	101	peak
2390.000	34.04	-4.06	29.98	54.00	-24.02	200	101	AVG
2402.000	94.42	-3.96	90.46	N/A	N/A	200	123	peak
2402.000	79.88	-3.96	75.92	N/A	N/A	200	123	AVG
4804.000	37.92	1.51	39.43	74.00	-34.57	100	154	peak
4804.000	26.58	1.51	28.09	54.00	-25.91	100	154	AVG
EDR (8DPSK), Middle channel								
2441.000	93.60	-3.53	90.07	N/A	N/A	200	104	peak
2441.000	79.24	-3.53	75.71	N/A	N/A	200	104	AVG
4882.000	38.37	2.37	40.74	74.00	-33.26	100	185	peak
4882.000	24.18	2.37	26.55	54.00	-27.45	100	185	AVG
EDR (8DPSK), High channel								
2480.000	93.35	-3.10	90.25	N/A	N/A	200	99	peak
2480.000	78.41	-3.10	75.31	N/A	N/A	200	99	AVG
2483.500	53.87	-3.06	50.81	74.00	-23.19	200	101	peak
2483.500	36.53	-3.06	33.47	54.00	-20.53	200	101	AVG
4960.000	37.78	2.39	40.17	74.00	-33.83	100	68	peak
4960.000	26.03	2.39	28.42	54.00	-25.58	100	68	AVG

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
EDR (8DPSK), Low channel								
2390.000	46.42	-4.06	42.36	74.00	-31.64	100	119	peak
2390.000	34.47	-4.06	30.41	54.00	-23.59	100	119	AVG
2402.000	97.41	-3.96	93.45	N/A	N/A	100	126	peak
2402.000	80.90	-3.96	76.94	N/A	N/A	100	126	AVG
4804.000	38.06	1.51	39.57	74.00	-34.43	100	323	peak
4804.000	24.47	1.51	25.98	54.00	-28.02	100	323	AVG
EDR (8DPSK), Middle channel								
2441.000	96.92	-3.53	93.39	N/A	N/A	100	130	peak
2441.000	82.35	-3.53	78.82	N/A	N/A	100	130	AVG
4882.000	38.73	2.37	41.10	74.00	-32.90	100	15	peak
4882.000	25.20	2.37	27.57	54.00	-26.43	100	15	AVG
EDR (8DPSK), High channel								
2480.000	97.25	-3.10	94.15	N/A	N/A	100	179	peak
2480.000	82.41	-3.10	79.31	N/A	N/A	100	179	AVG
2483.500	56.68	-3.06	53.62	74.00	-20.38	100	116	peak
2483.500	38.63	-3.06	35.57	54.00	-18.43	100	116	AVG
4960.000	37.84	2.39	40.23	74.00	-33.77	100	215	peak
4960.000	25.13	2.39	27.52	54.00	-26.48	100	215	AVG

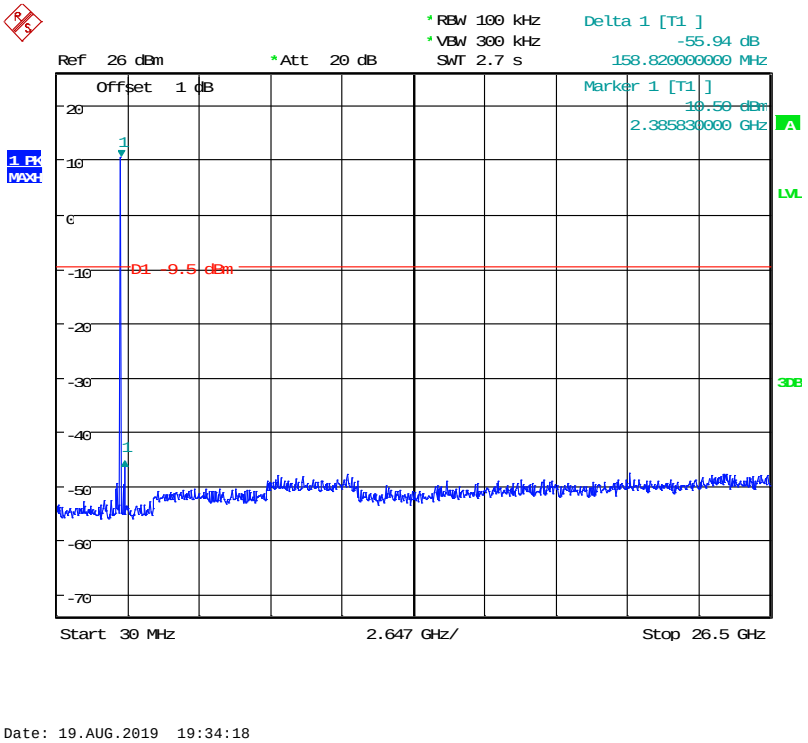
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

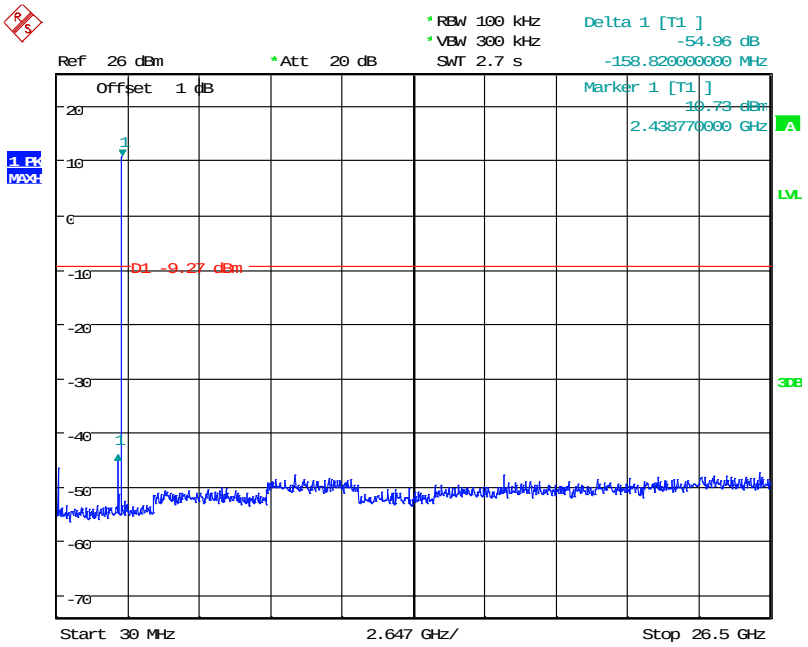
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	55.94	≥ 20	PASS
Mid	2441	54.96	≥ 20	PASS
High	2480	45.55	≥ 20	PASS
EDR Mode (π/4-DQPSK):				
Low	2402	52.79	≥ 20	PASS
Mid	2441	49.20	≥ 20	PASS
High	2480	52.23	≥ 20	PASS
EDR Mode (8DPSK):				
Low	2402	50.71	≥ 20	PASS
Mid	2441	51.13	≥ 20	PASS
High	2480	53.05	≥ 20	PASS

BR Mode (GFSK)

Low Channel

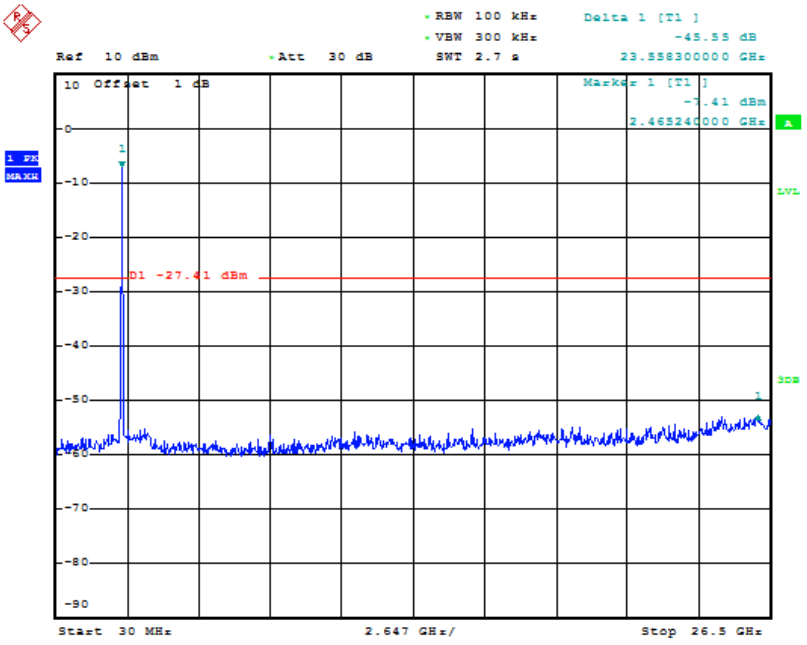


Middle Channel



Date: 19.AUG.2019 19:36:34

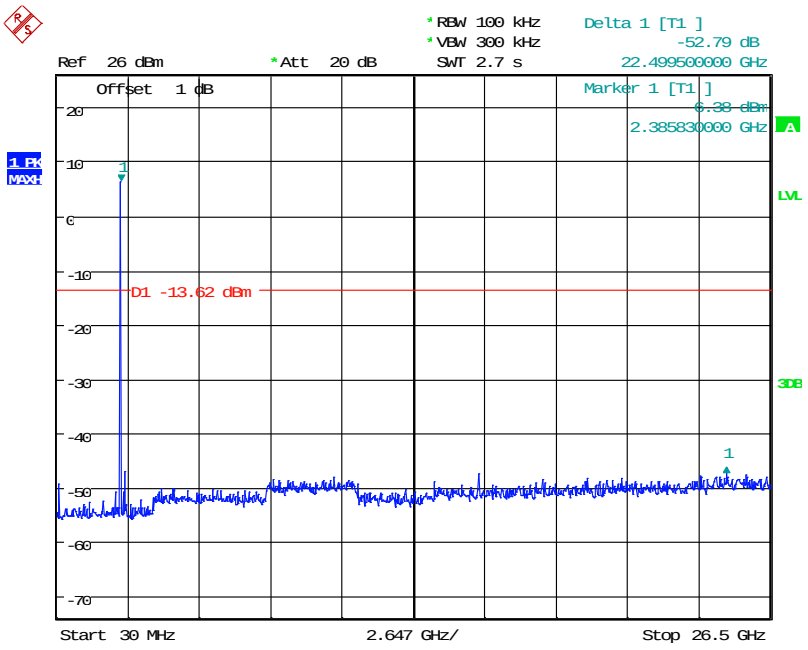
High Channel



Date: 19.AUG.2019 14:13:05

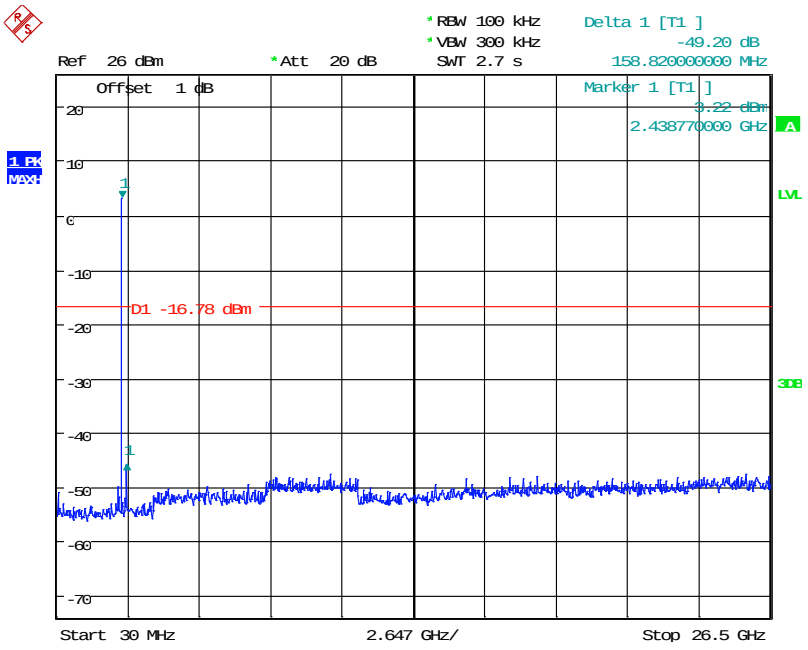
EDR Mode (π/4-DQPSK)

Low Channel



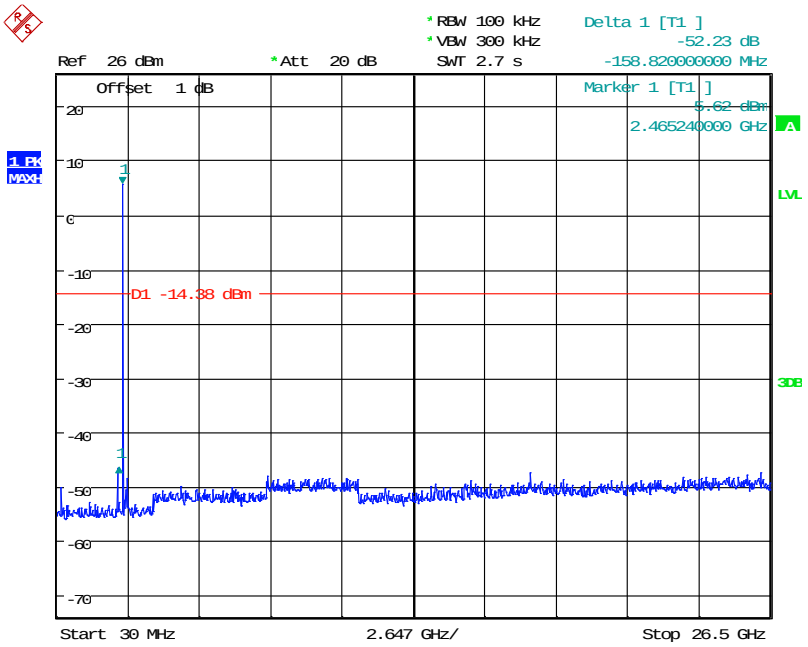
Date: 19.AUG.2019 19:46:34

Middle Channel



Date: 19.AUG.2019 19:48:27

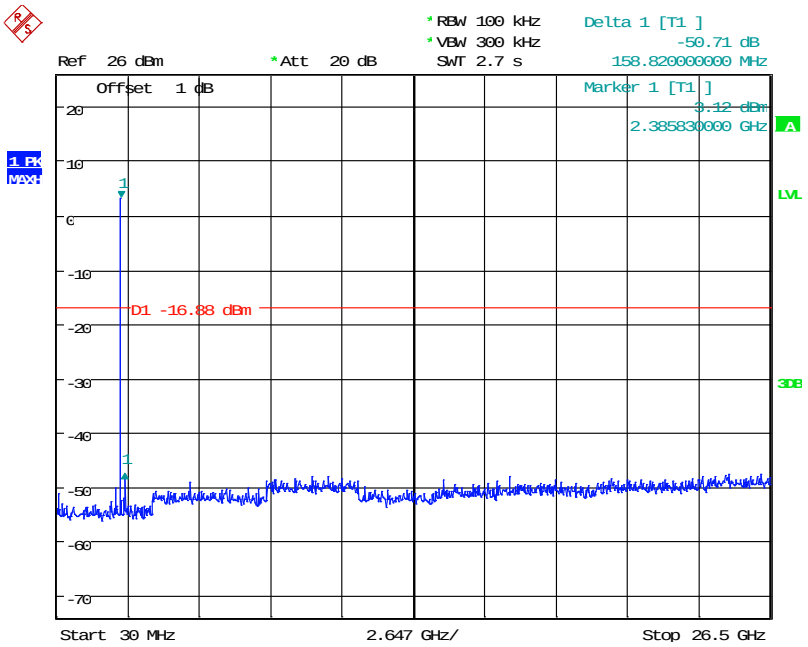
High Channel



Date: 19.AUG.2019 19:50:36

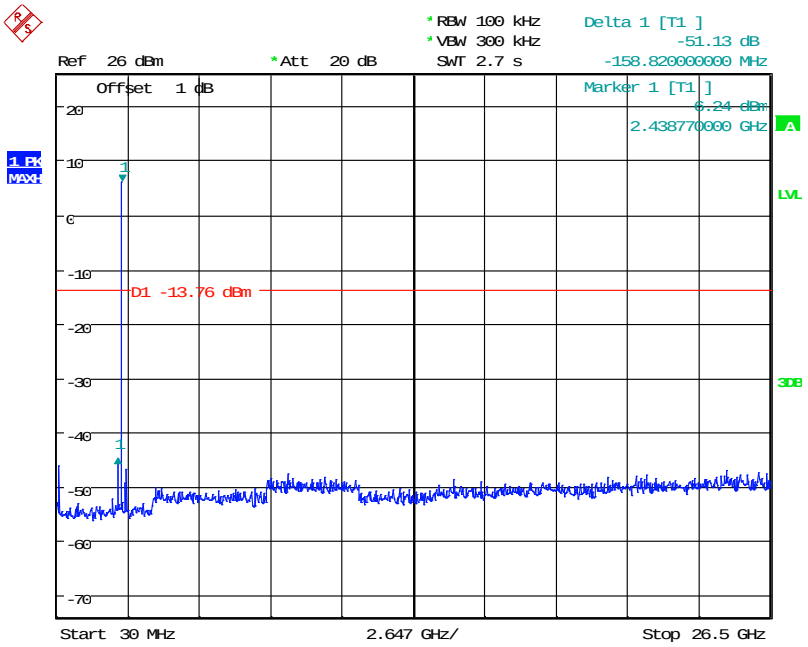
EDR Mode (8DPSK)

Low Channel



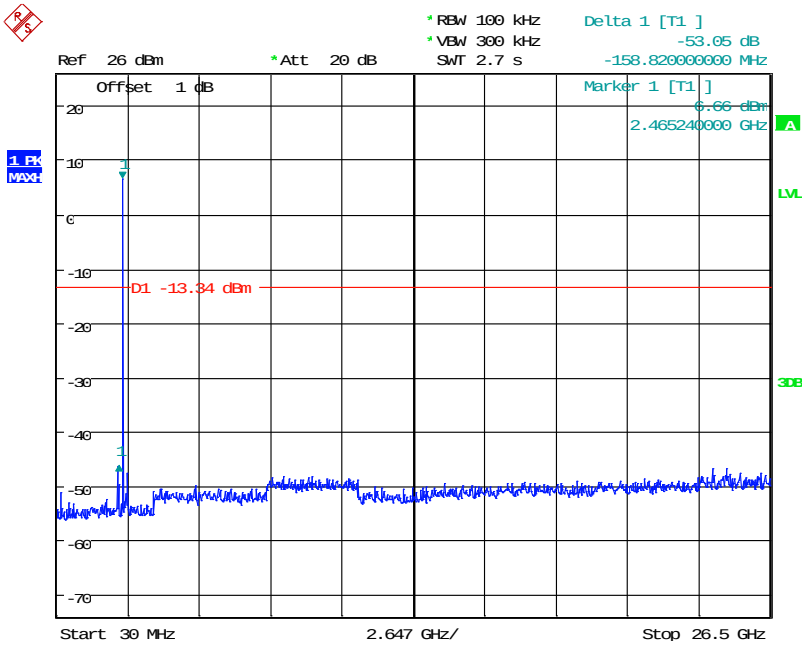
Date: 19.AUG.2019 19:54:09

Middle Channel



Date: 19.AUG.2019 19:58:00

High Channel



Date: 19.AUG.2019 20:00:09

9 FCC §15.247(a)(1) – 20 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a) (1) the maximum 20 dB bandwidth of the hopping channel shall be presented.

9.2 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.

9.3 Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-08-19.

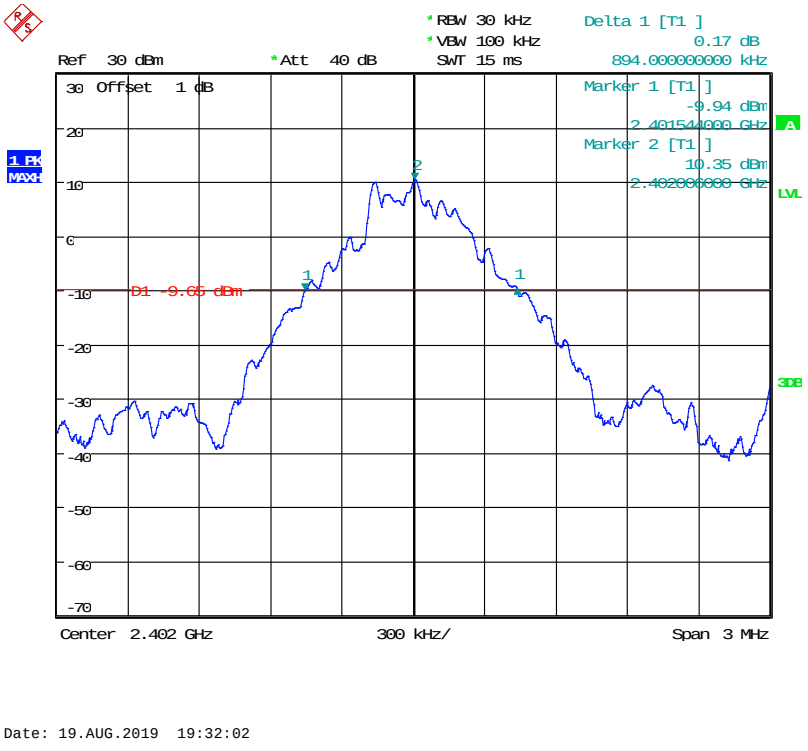
9.4 Test Results

Channel	Frequency (MHz)	20 dBc BW (MHz)
BR Mode (GFSK)		
Low	2402	0.89
Middle	2441	0.89
High	2480	0.90
EDR Mode (π/4-DQPSK)		
Low	2402	1.29
Middle	2441	1.29
High	2480	1.29
EDR Mode (8DPSK)		
Low	2402	1.29
Middle	2441	1.29
High	2480	1.29

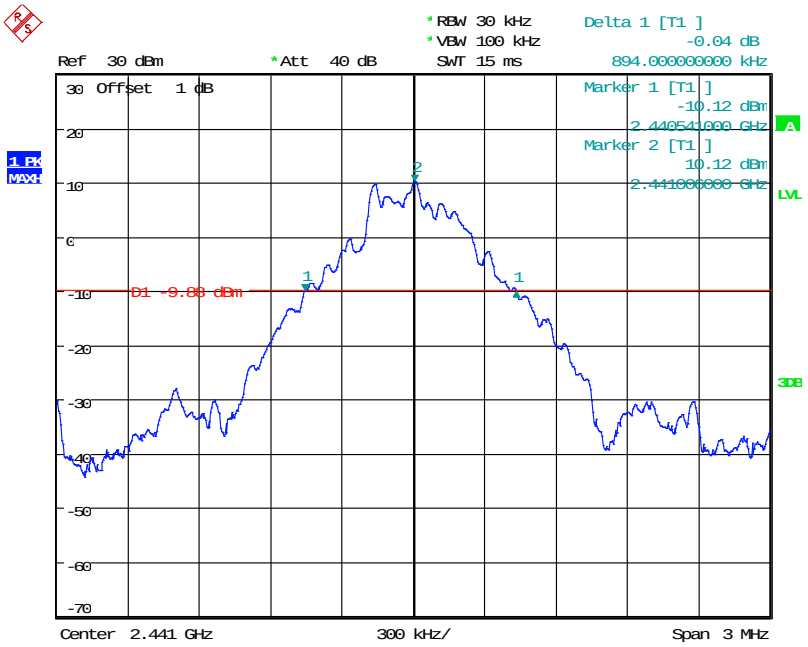
Please refer to the following plots

BR Mode (GFSK)

Low Channel

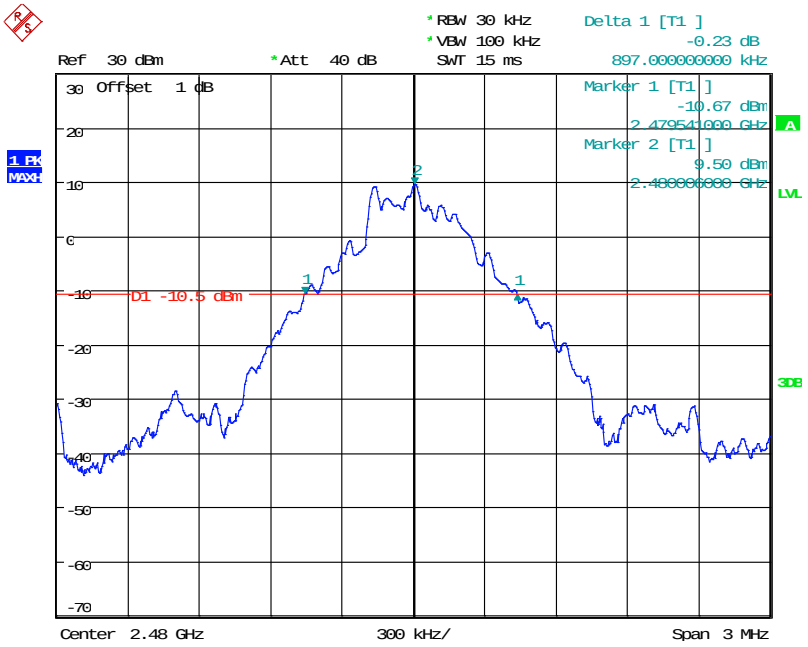


Middle Channel



Date: 19.AUG.2019 19:35:58

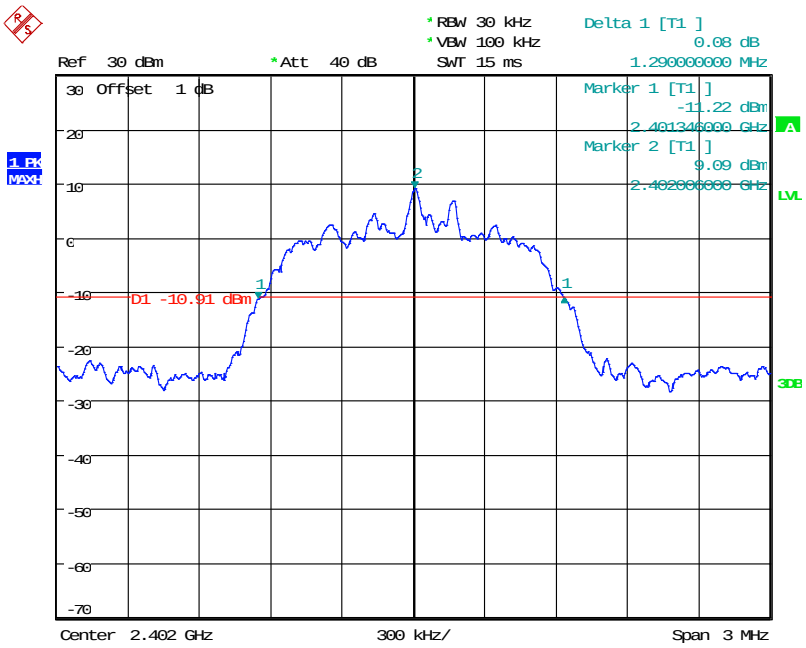
High Channel



Date: 19.AUG.2019 19:38:12

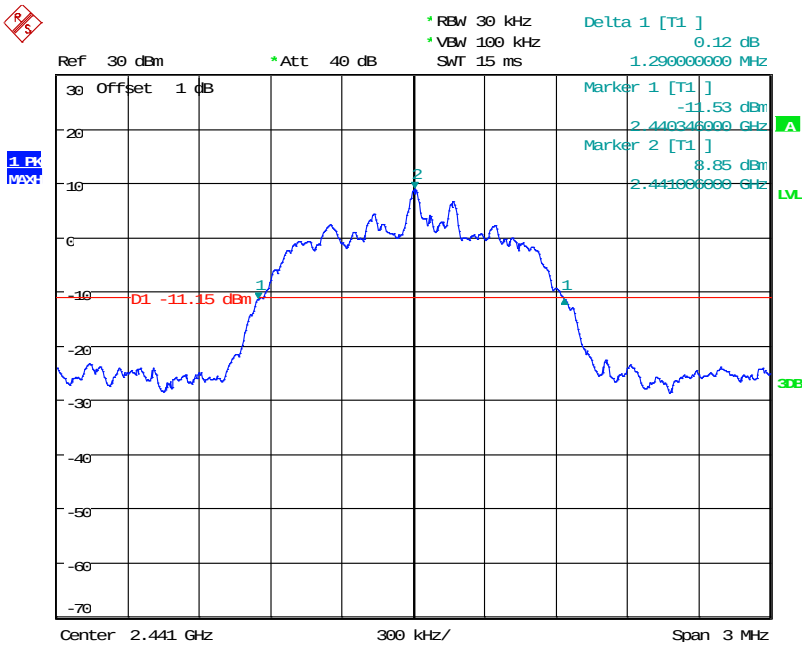
EDR Mode (π/4-DQPSK)

Low Channel



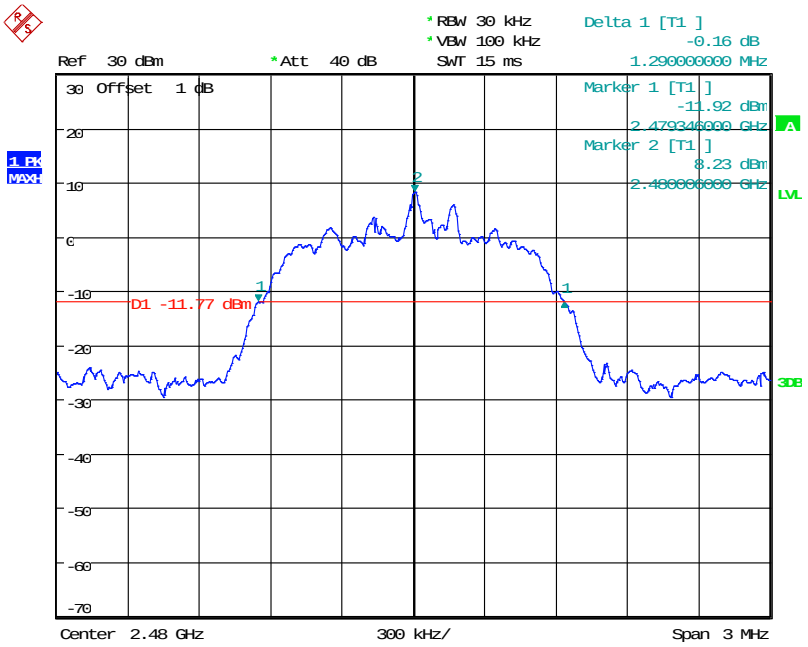
Date: 19.AUG.2019 19:45:40

Middle Channel



Date: 19.AUG.2019 19:47:51

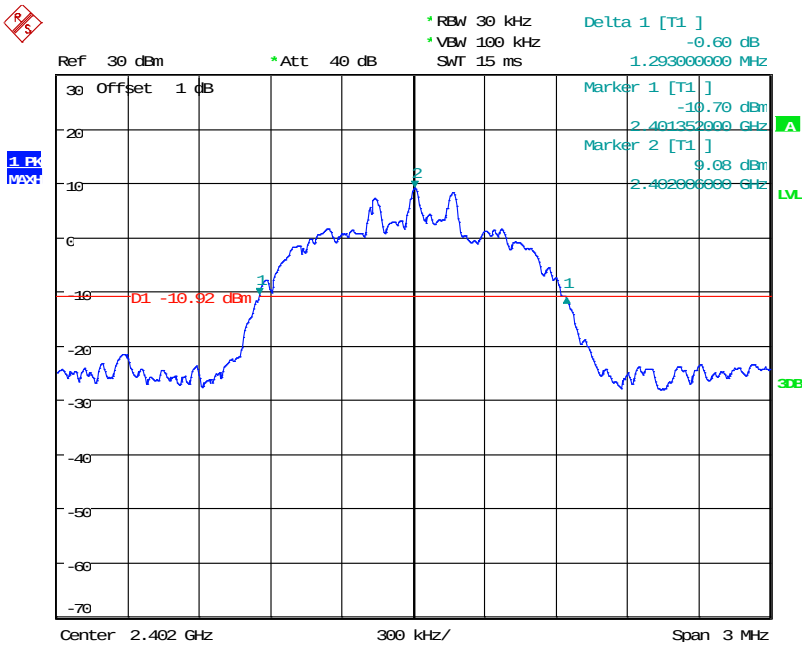
High Channel



Date: 19.AUG.2019 19:49:41

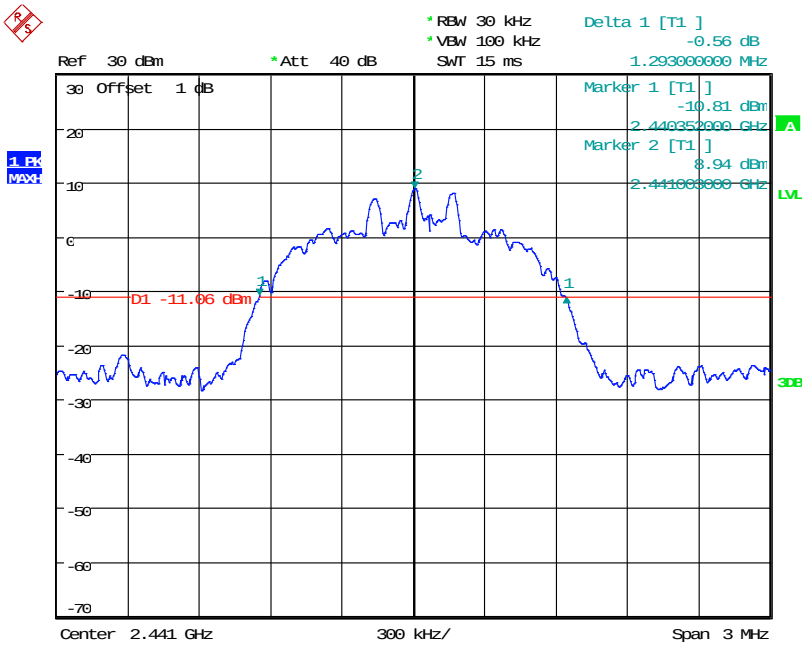
EDR Mode (8DPSK)

Low Channel



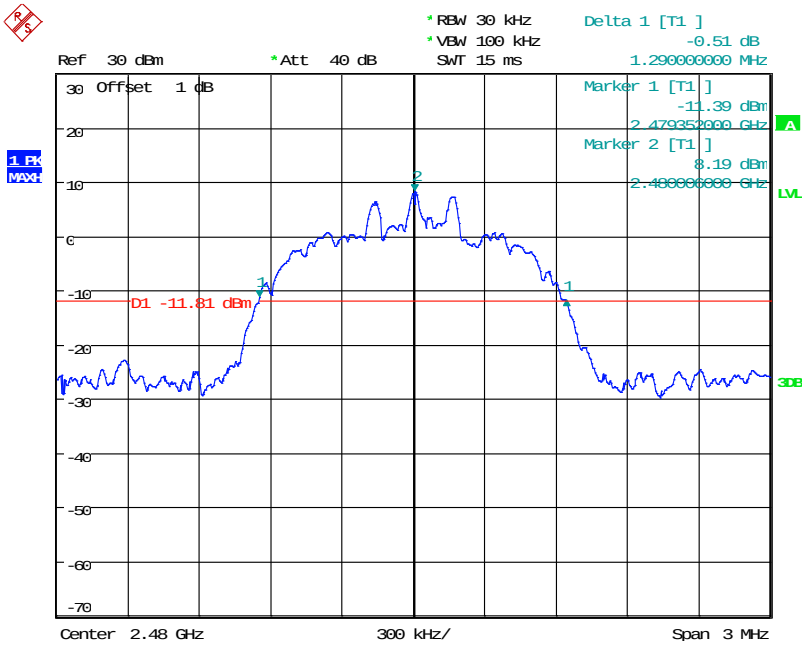
Date: 19.AUG.2019 19:53:15

Middle Channel



Date: 19.AUG.2019 19:57:24

High Channel



Date: 19.AUG.2019 19:59:15

10 FCC §15.247(a)(1) – Channel Separation Test

10.1 Applicable Standard

According to FCC §15.247(a) (1): Frequency hopping systems shall have hopping 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.

10.2 Test Procedure

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

10.3 Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-08-19.

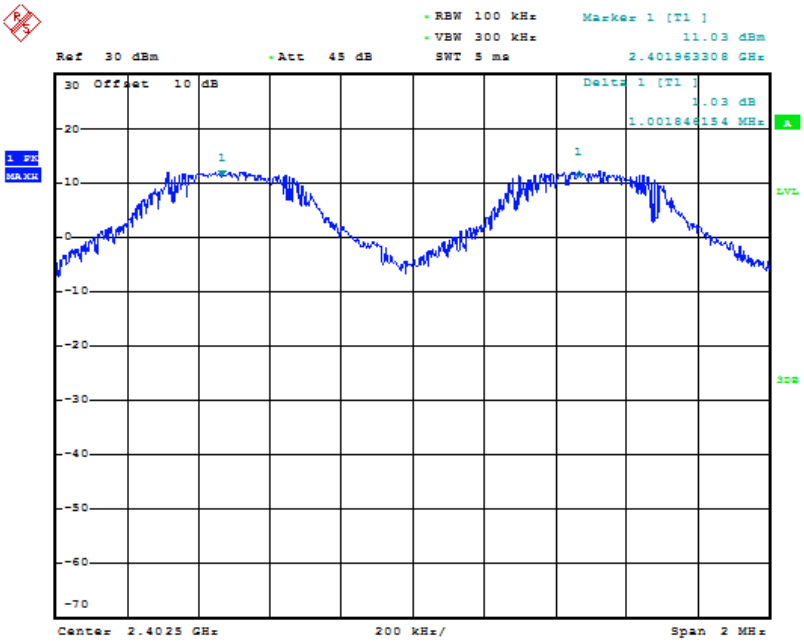
10.4 Test Results

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BR Mode (GFSK)					
Low	1.00	0.89	0.593	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	0.89	0.593	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	0.90	0.600	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (π/4-DQPSK)					
Low	0.96	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.01	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (8DPSK)					
Low	1.00	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance
High	1.05	1.29	0.860	>two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots

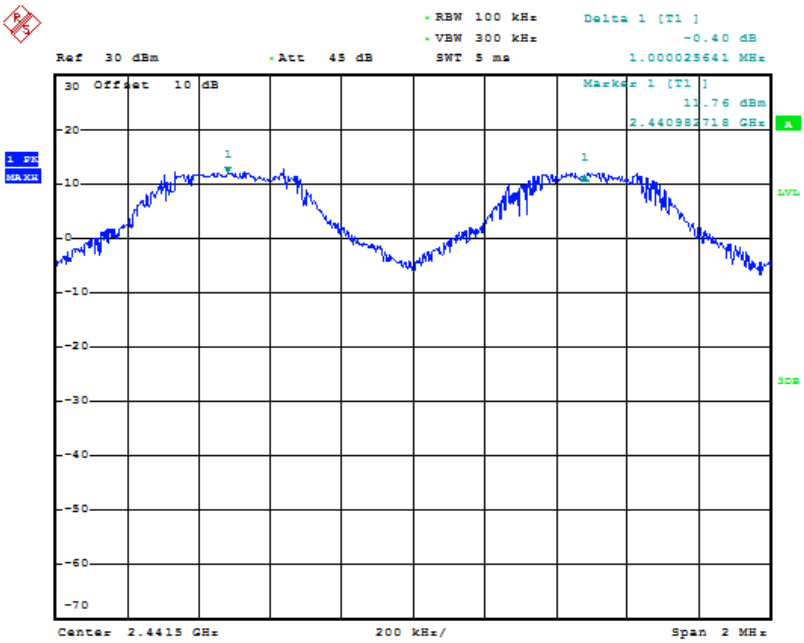
BR Mode (GFSK)

Low Channel



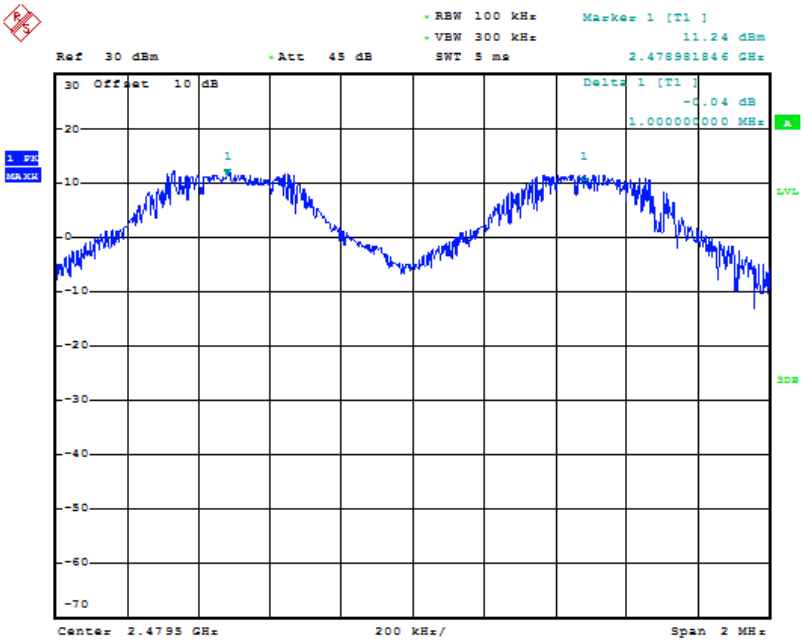
Date: 19.AUG.2019 12:23:20

Middle Channel



Date: 19.AUG.2019 12:14:50

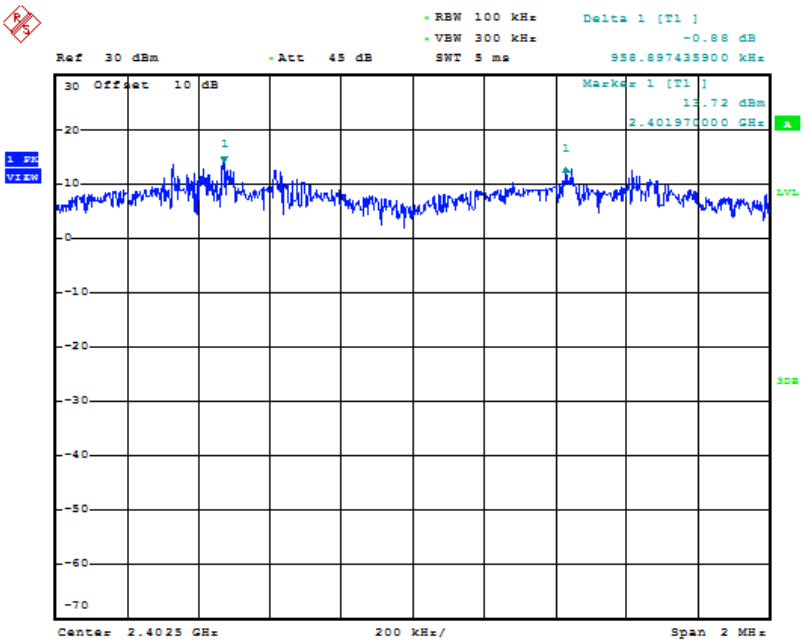
High Channel



Date: 19.AUG.2019 12:12:31

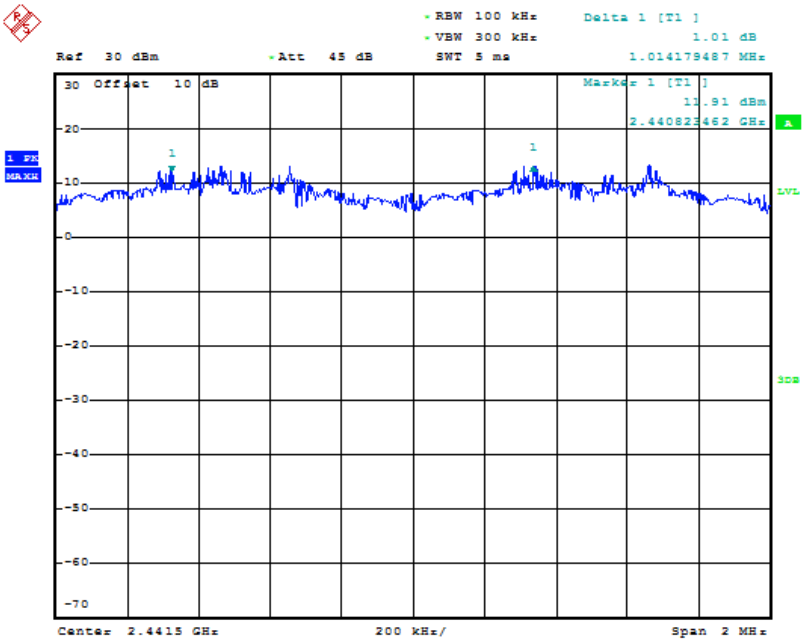
EDR Mode (π/4-DQPSK)

Low Channel



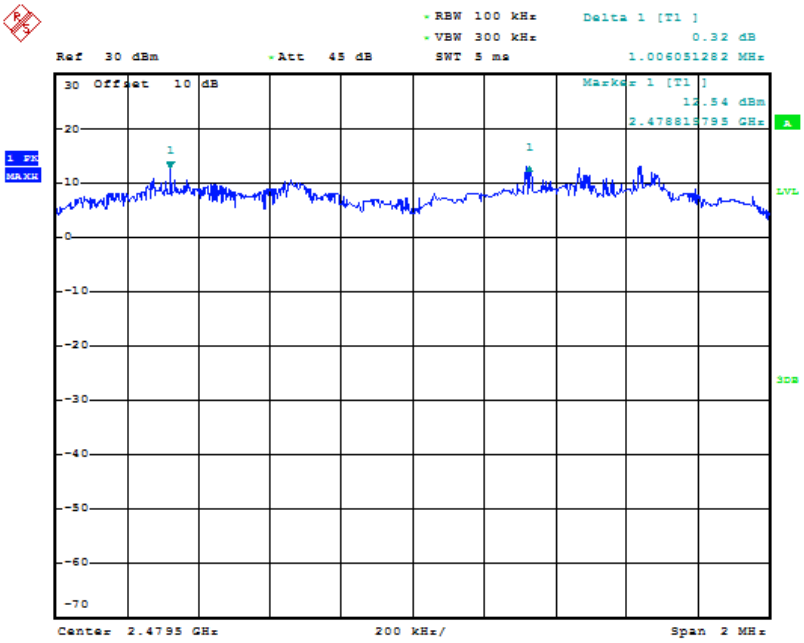
Date: 19.AUG.2019 12:36:01

Middle Channel



Date: 19.AUG.2019 12:34:32

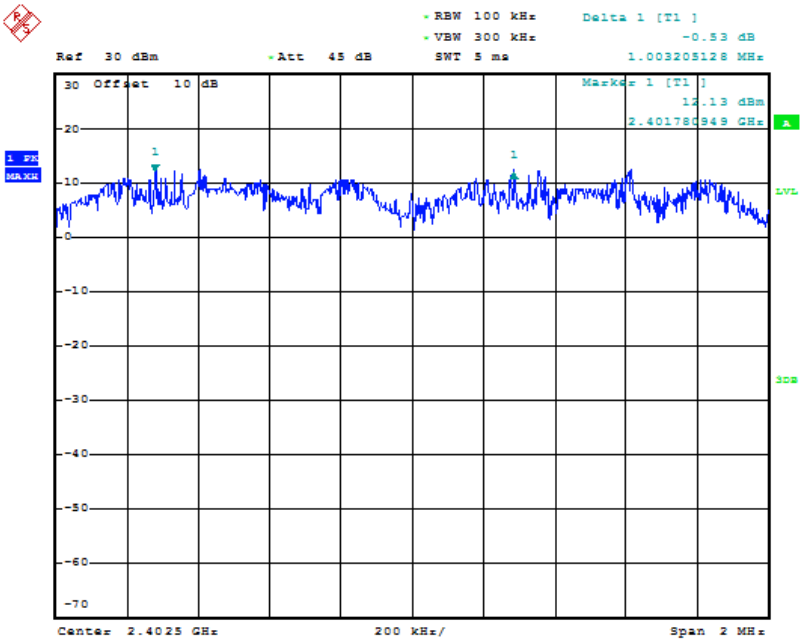
High Channel



Date: 19.AUG.2019 12:32:07

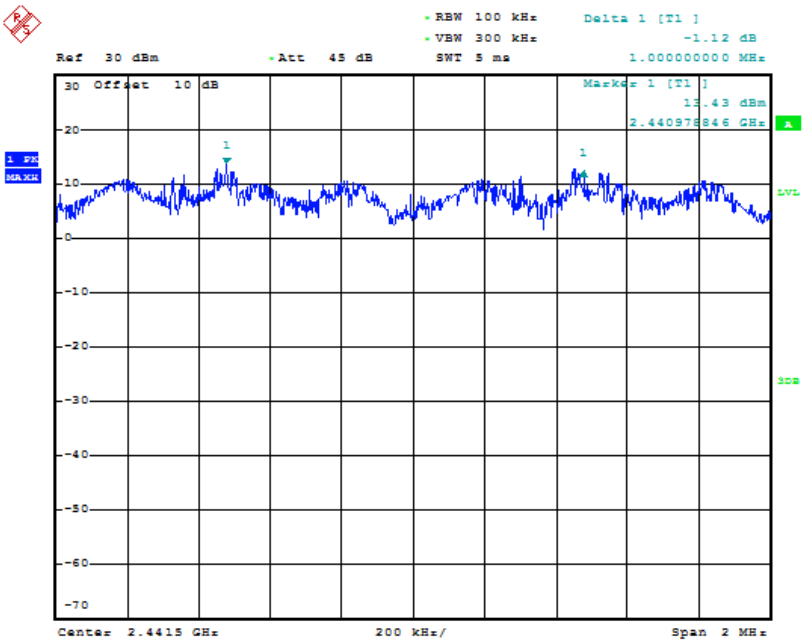
EDR Mode (8DPSK)

Low Channel



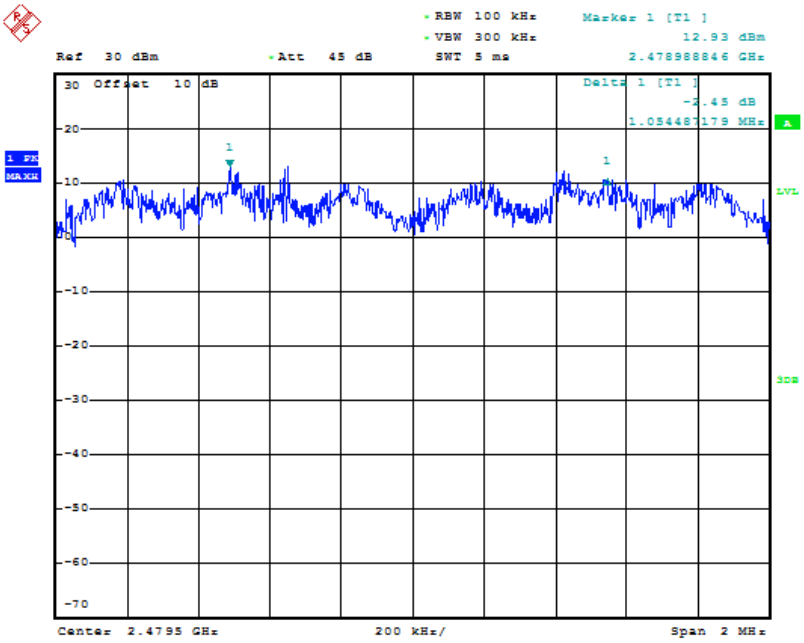
Date: 19.AUG.2019 12:40:27

Middle Channel



Date: 19.AUG.2019 12:39:14

High Channel



Date: 19.AUG.2019 12:38:07

11 FCC§15.247(a)(1)(iii) –Time of Occupancy (Dwell Time)

11.1 Applicable Standard

According to FCC §15.247(a) (1) (iii).

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.

11.2 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel RBW ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

11.3 Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-08-19.

11.4 Test Results

Test mode: BR mode / 2402 ~ 2480MHz (*GFSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
DH1	0.385	320	31.6	123.20	<400	PASS
DH3	1.644	160	31.6	263.04	<400	PASS
DH5	2.097	110	31.6	230.67	<400	PASS
Test mode: EDR mode / 2402 ~ 2480MHz (*π/4-DQPSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
2DH1	0.399	320	31.6	127.68	<400	PASS
2DH3	1.656	160	31.6	264.96	<400	PASS
2DH5	2.902	130	31.6	377.26	<400	PASS
Test mode: EDR mode / 2402 ~ 2480MHz (*8DPSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
3DH1	0.402	320	31.6	128.64	<400	PASS
3DH3	1.652	160	31.6	264.32	<400	PASS
3DH5	2.905	110	31.6	319.55	<400	PASS

Note 1: A period time = 0.4*79 = 31.6 (s), Total of Dwell=Pulse Time * Hopping Number

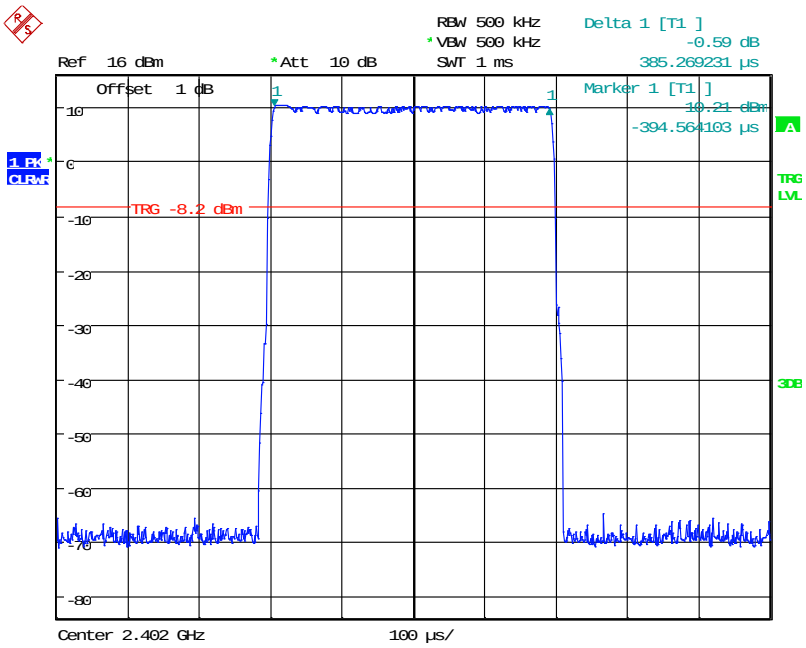
Note 2: Hopping Number / 10 = Divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.

Note 3: Hopping Number = Hopping Number/10 * 10, Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of all hopping channels.

Please refer to the following plots

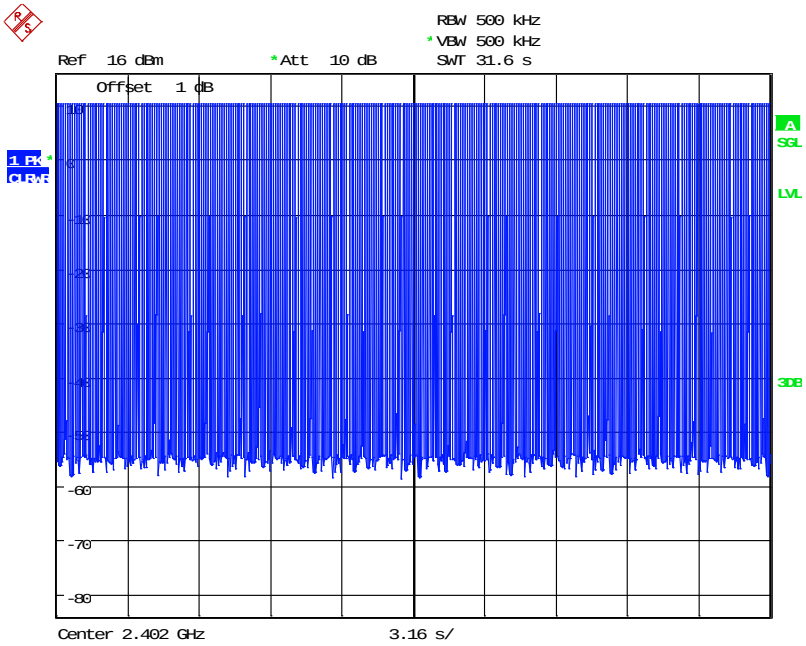
BR Mode (GFSK)

DH1: Pulse Width



Date: 19.AUG.2019 20:31:23

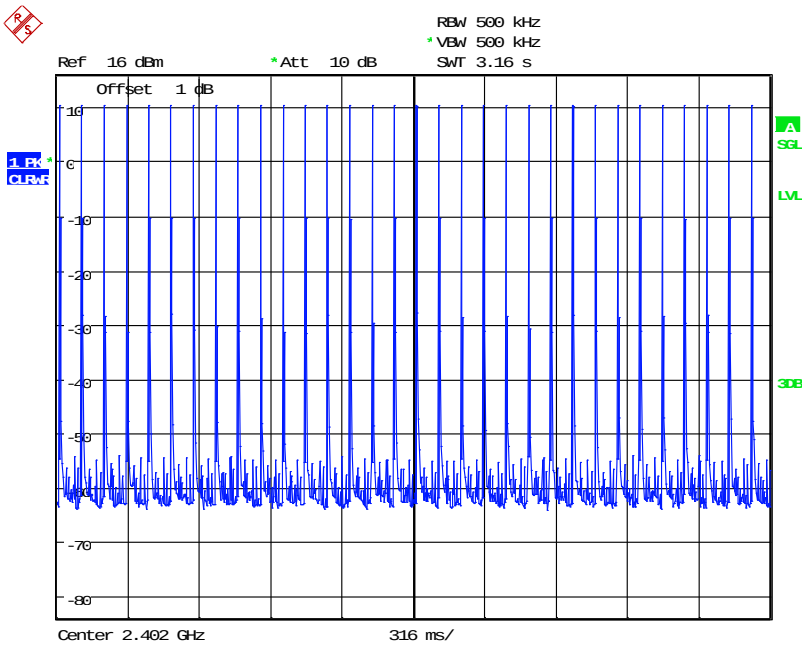
DH1: Hopping Number



Date: 19.AUG.2019 20:31:56

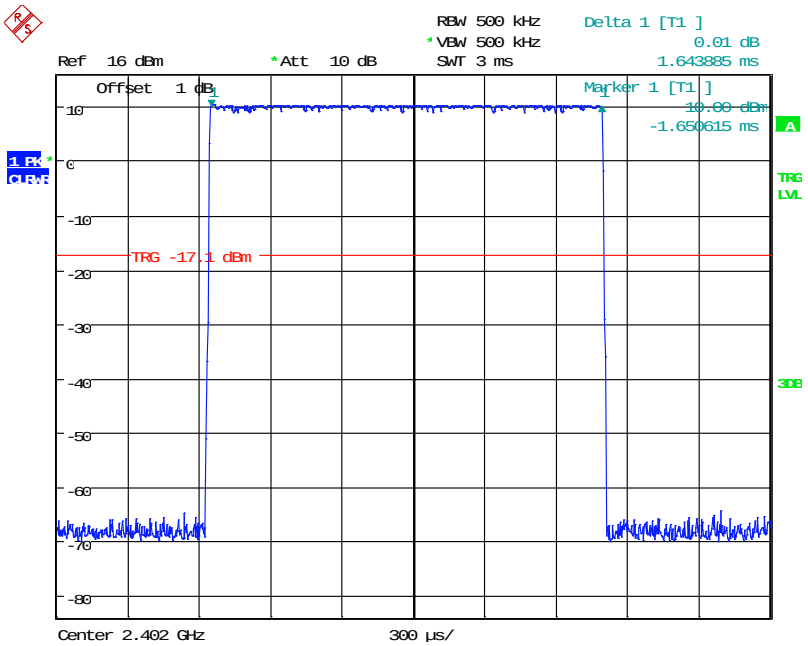
DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



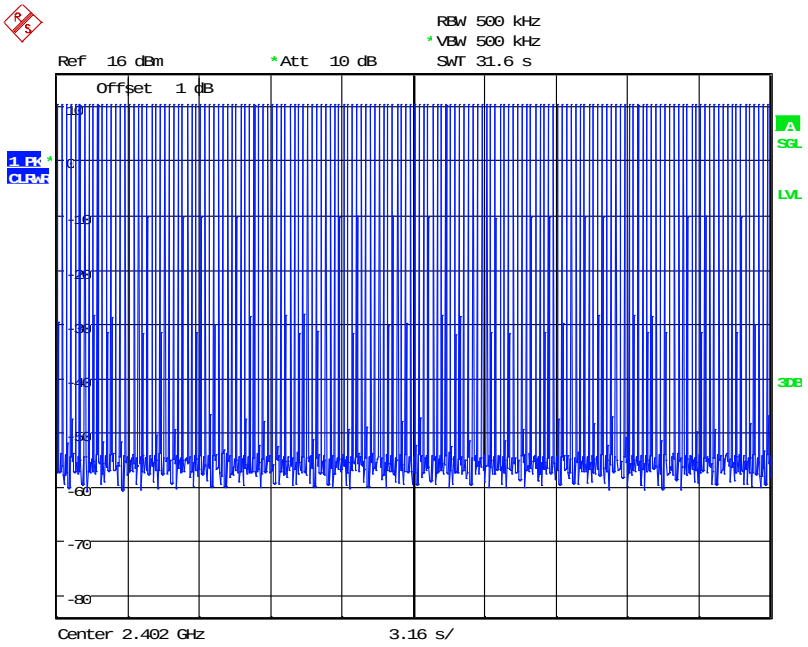
Date: 19.AUG.2019 20:32:24

DH3: Pulse Width



Date: 19.AUG.2019 20:33:50

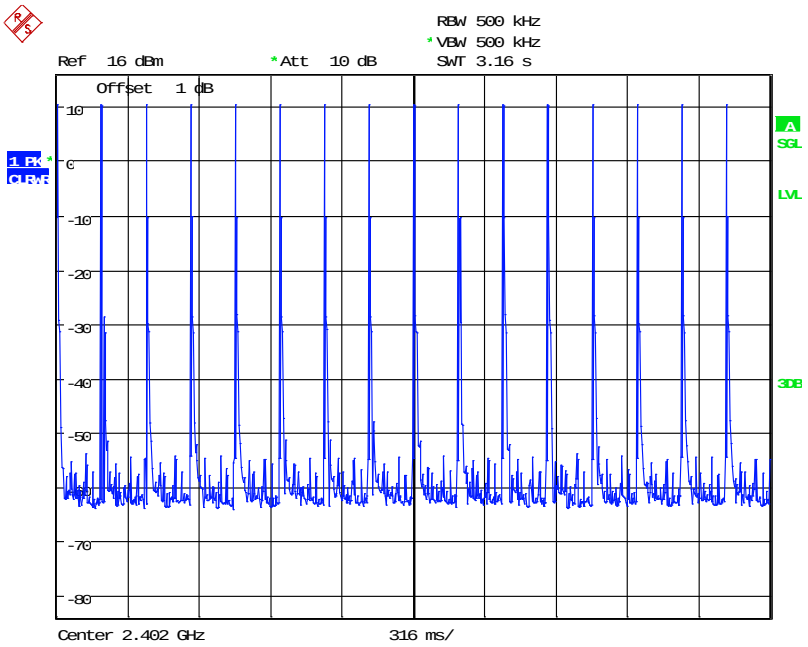
DH3: Hopping Number



Date: 19.AUG.2019 20:34:23

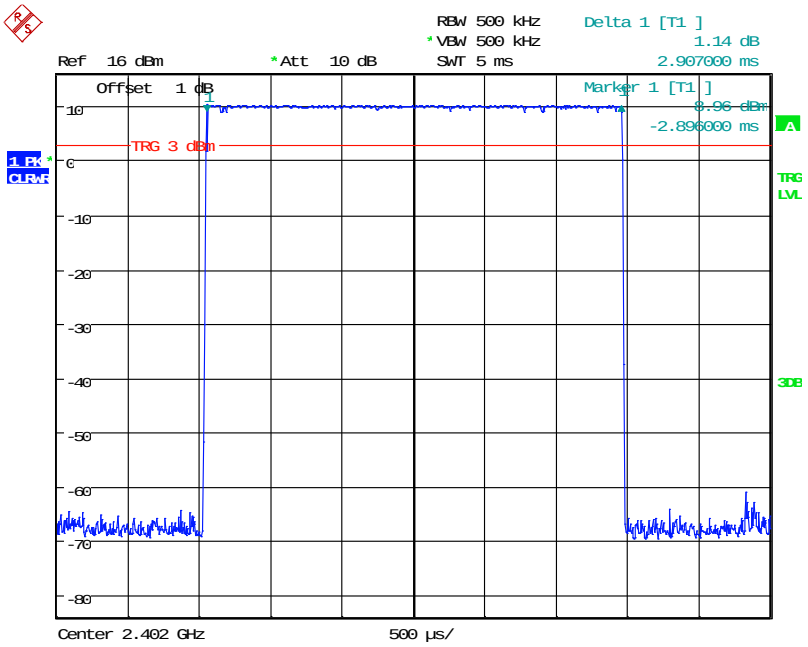
DH3: Hopping Number /10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



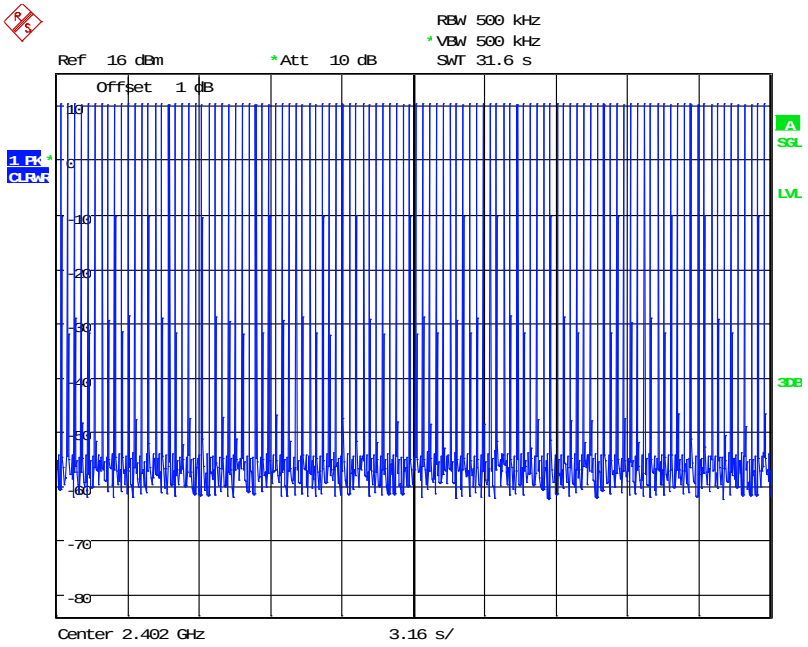
Date: 19.AUG.2019 20:34:41

DH5: Pulse Width



Date: 19.AUG.2019 20:37:21

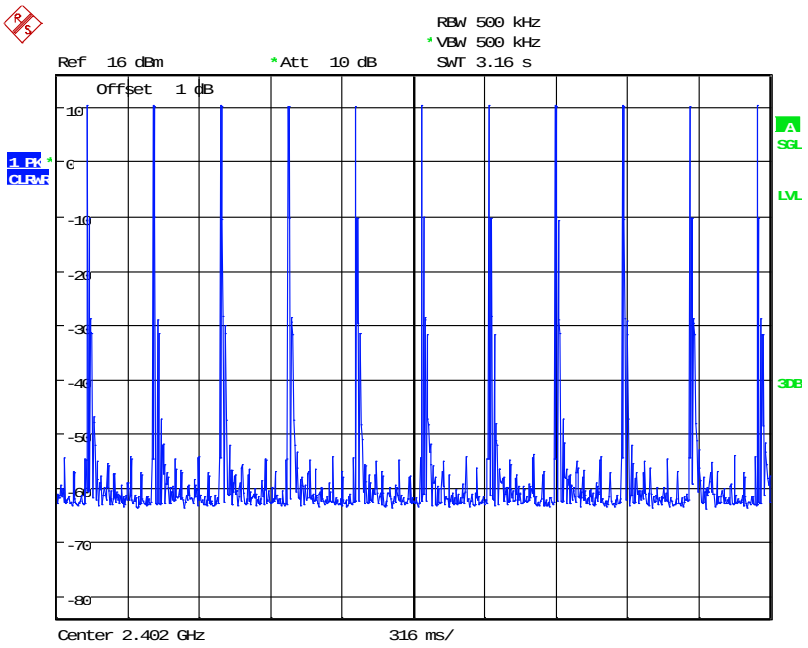
DH5: Hopping Number



Date: 19.AUG.2019 20:37:55

DH5: Hopping Number /10

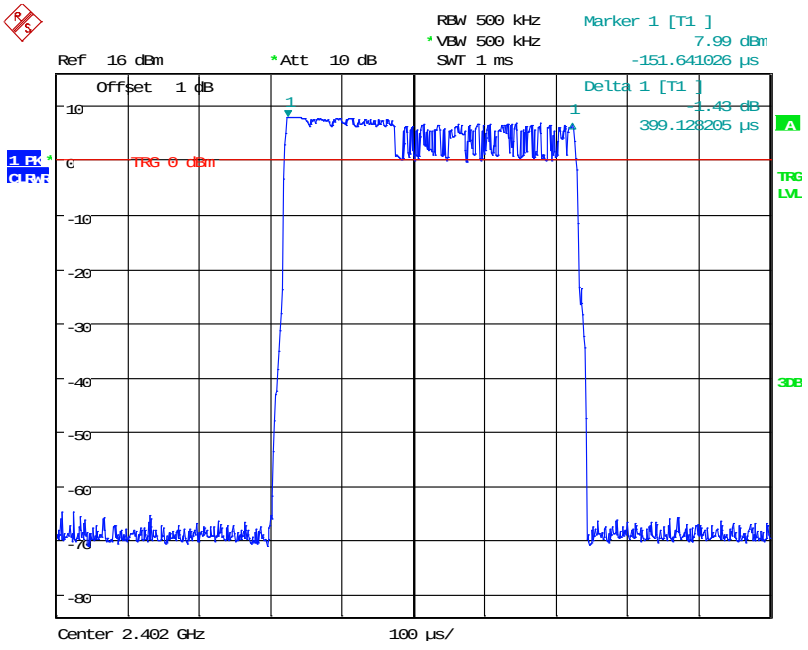
(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)



Date: 19.AUG.2019 20:38:02

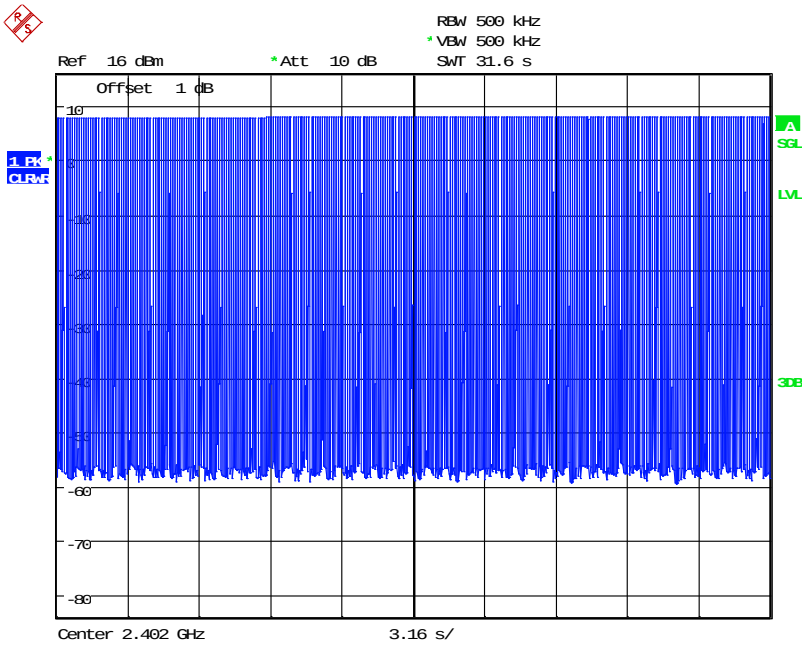
EDR Mode (π/4-DQPSK)

2DH1: Pulse Width



Date: 19.AUG.2019 20:43:15

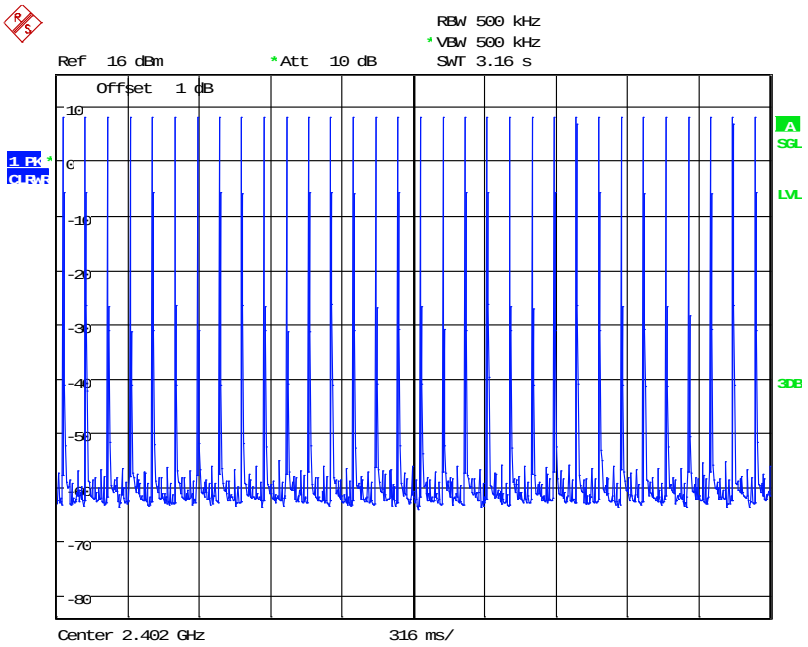
2DH1: Hopping Number



Date: 19.AUG.2019 20:43:48

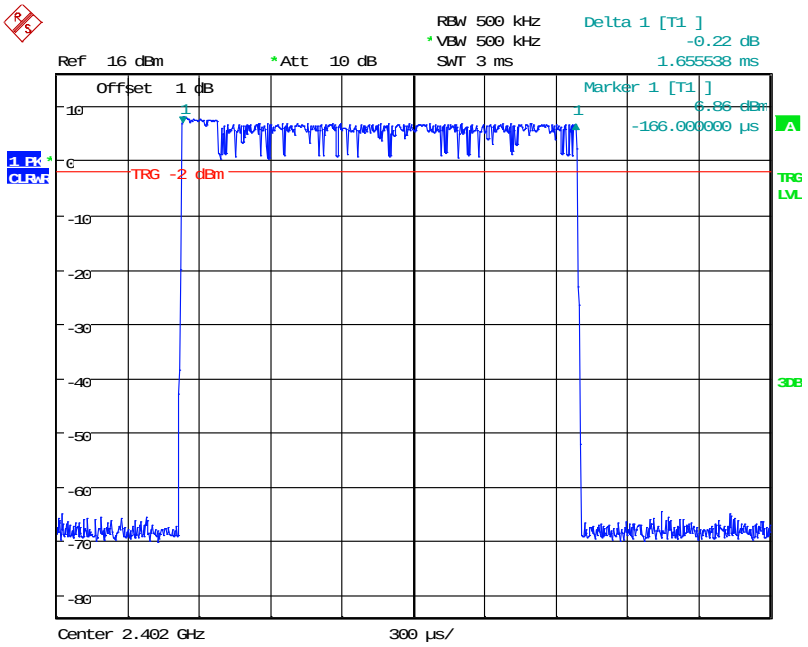
2DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



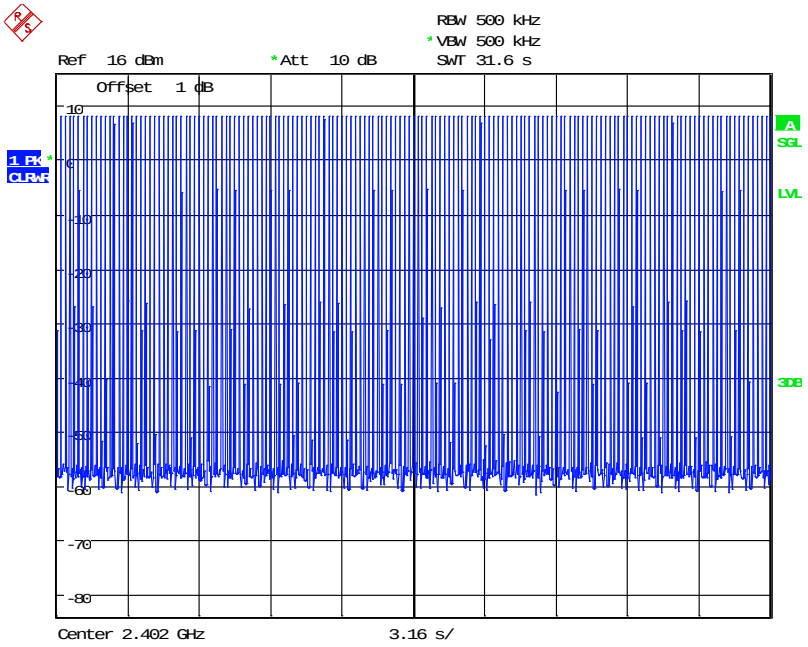
Date: 19.AUG.2019 20:43:54

2DH3: Pulse Width



Date: 19.AUG.2019 20:47:13

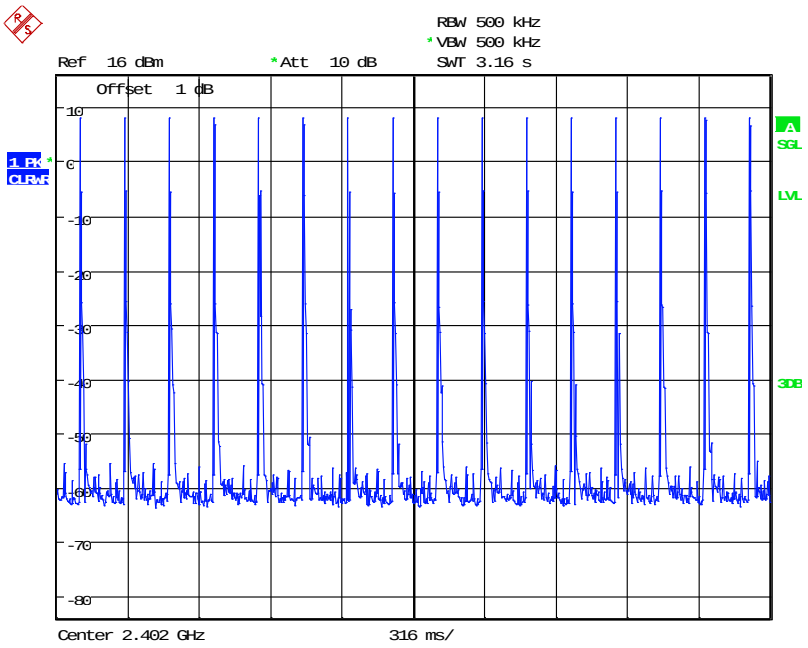
2DH3: Hopping Number



Date: 19.AUG.2019 20:47:46

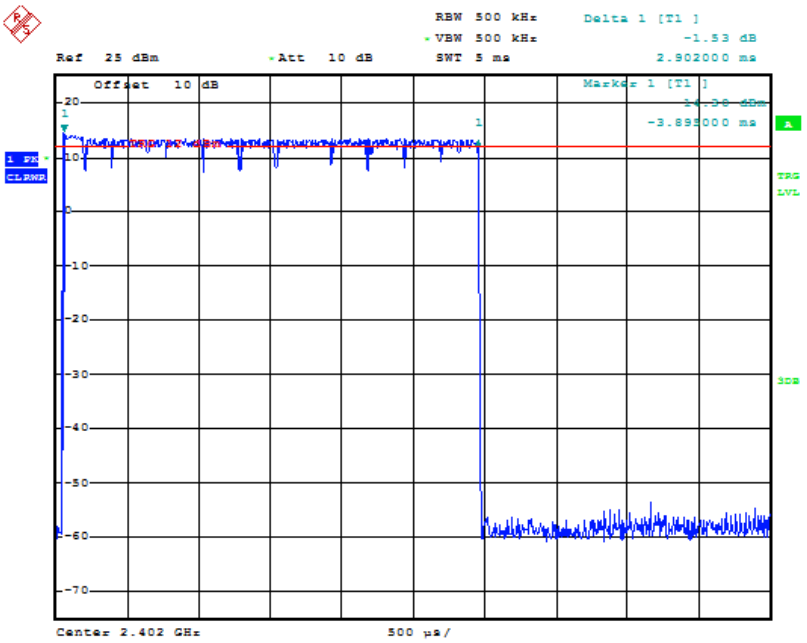
2DH3: Hopping Number /10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



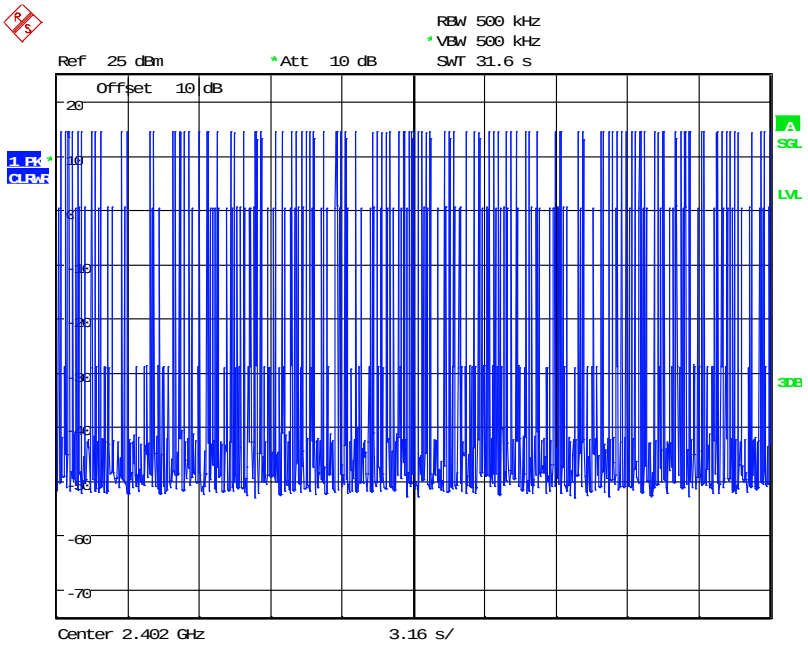
Date: 19.AUG.2019 20:47:56

2DH5: Pulse Width



Date: 20.AUG.2019 15:34:12

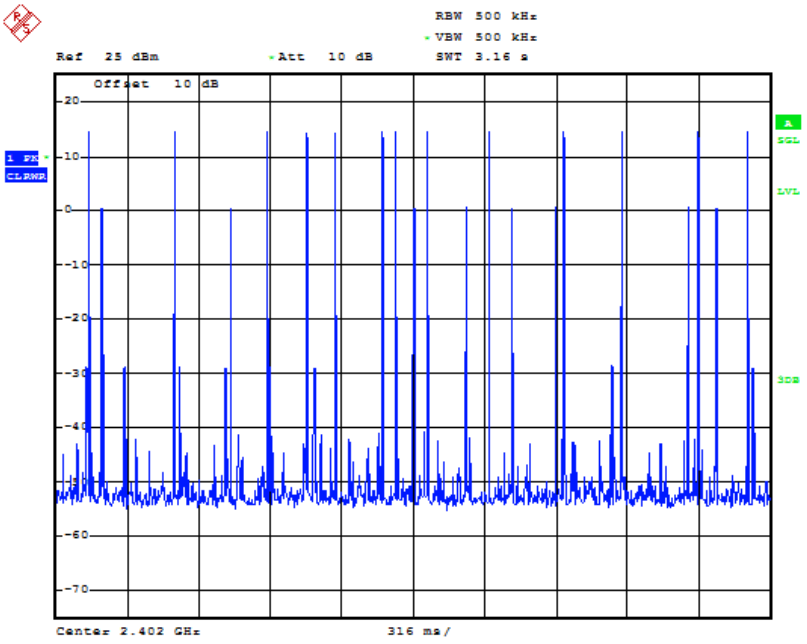
2DH5: Hopping Number



Date: 20.AUG.2019 15:34:45

2DH5: Hopping Number /10

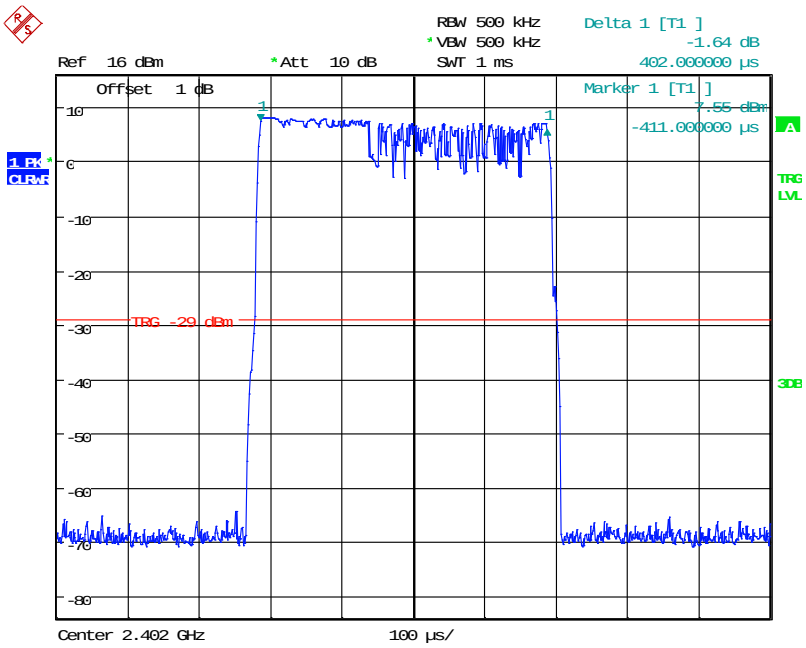
(Hopping Number = 13 in 1/10 period of highest signals, Second High signals were other channel)



Date: 20.AUG.2019 15:34:52

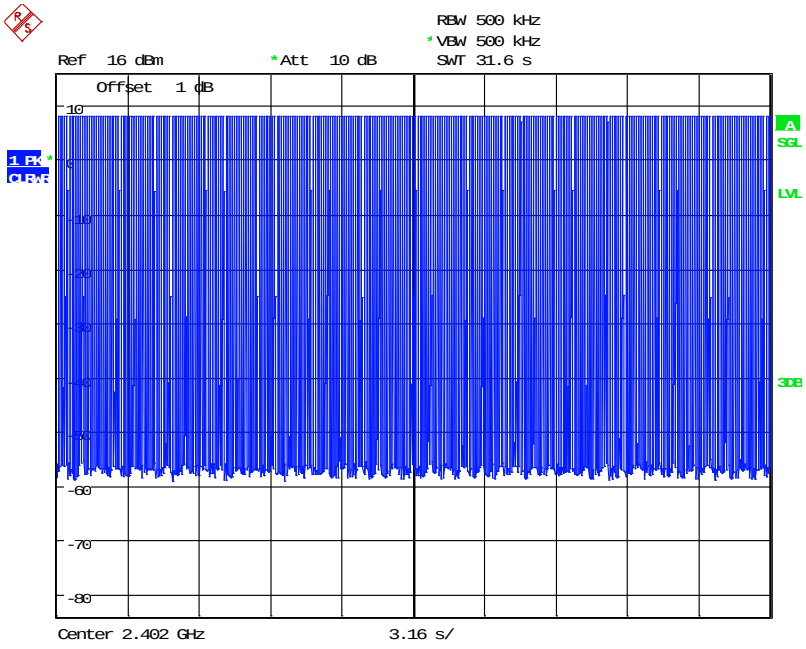
EDR Mode (8DPSK)

3DH1: Pulse Width



Date: 19.AUG.2019 20:12:59

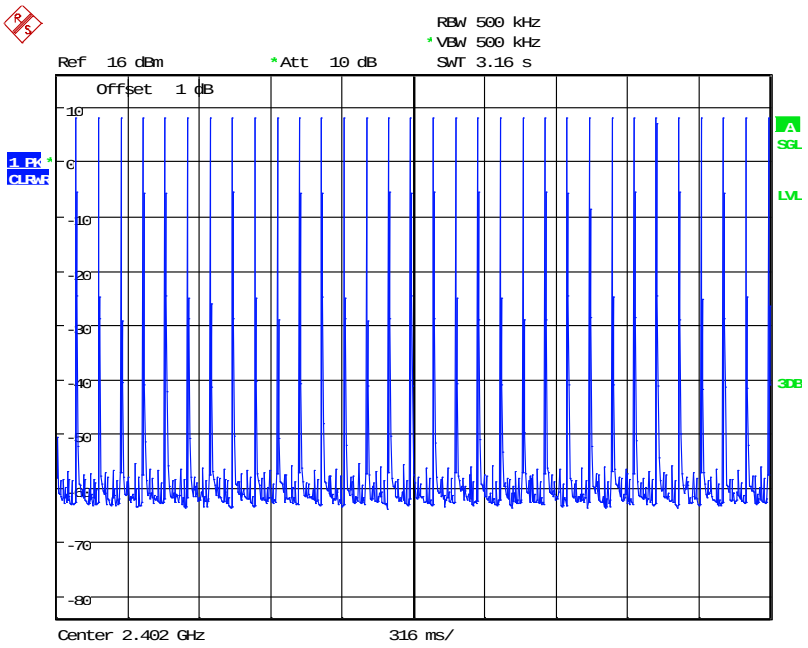
3DH1: Hopping Number



Date: 19.AUG.2019 20:13:31

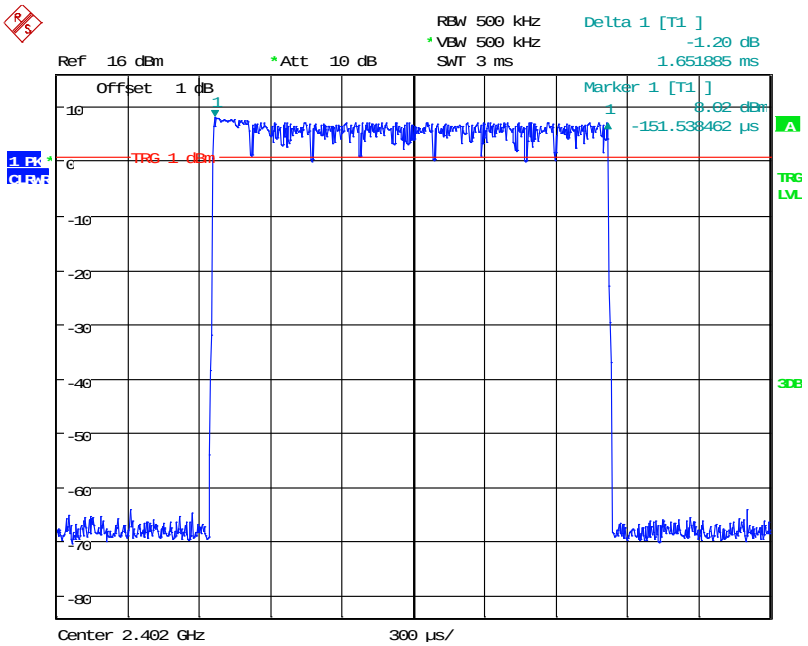
3DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



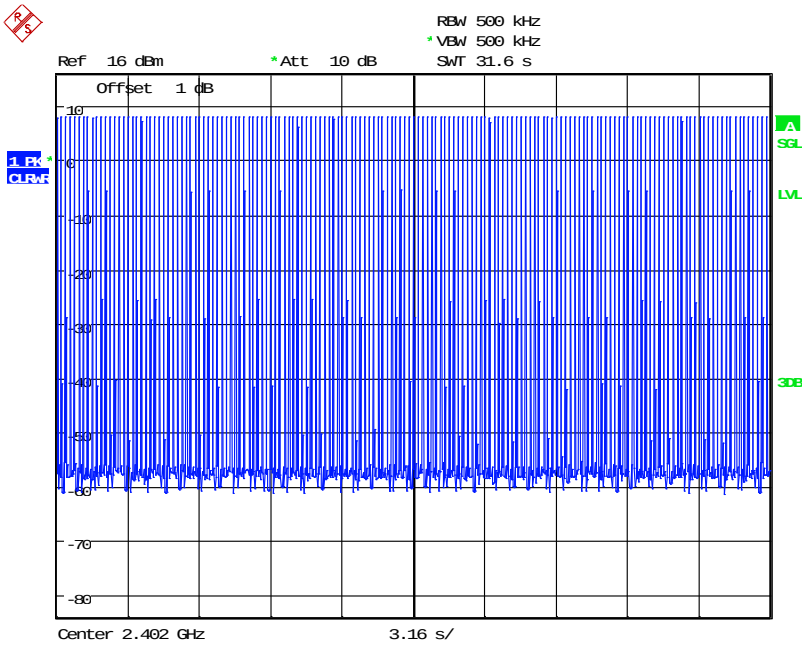
Date: 19.AUG.2019 20:14:29

3DH3: Pulse Width



Date: 19.AUG.2019 20:17:32

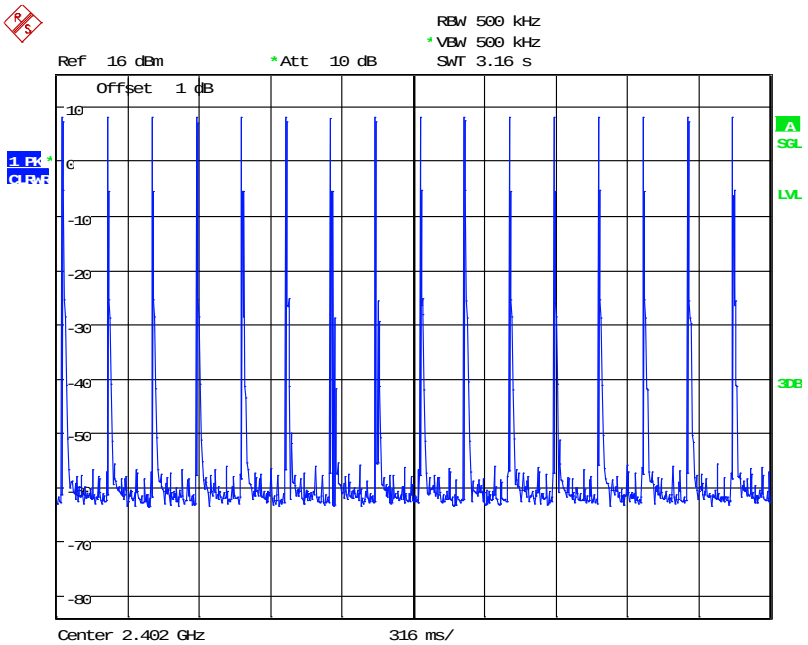
3DH3: Hopping Number



Date: 19.AUG.2019 20:18:05

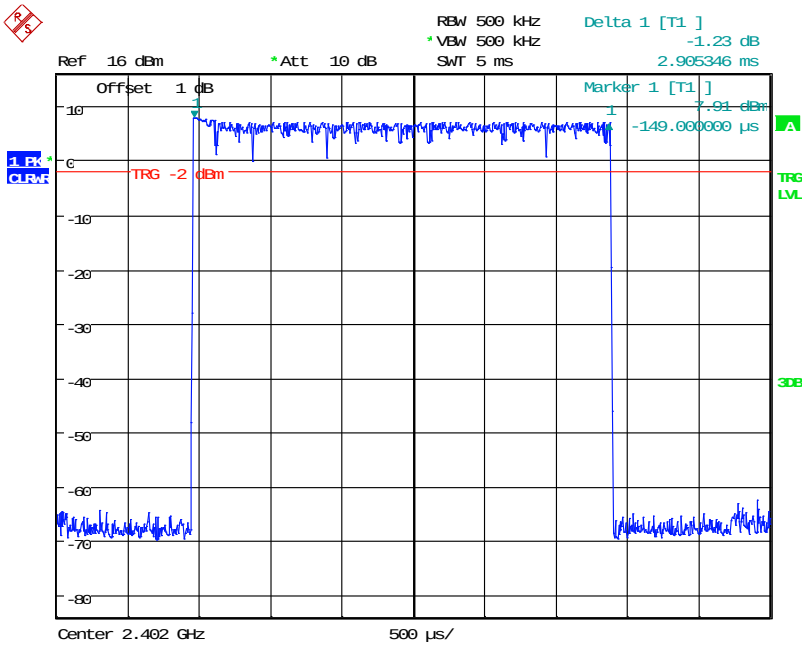
3DH3: Hopping Number /10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



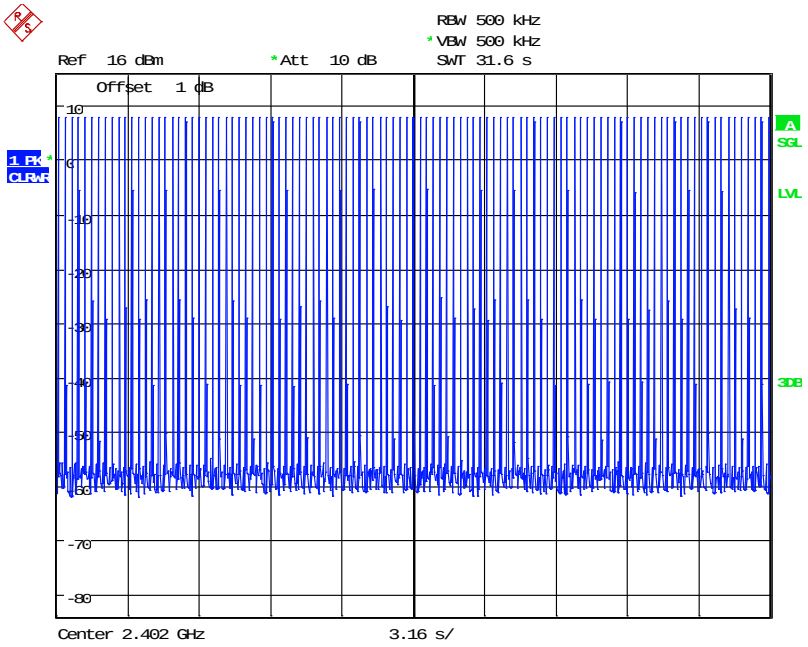
Date: 19.AUG.2019 20:18:13

3DH5: Pulse Width



Date: 19.AUG.2019 20:20:31

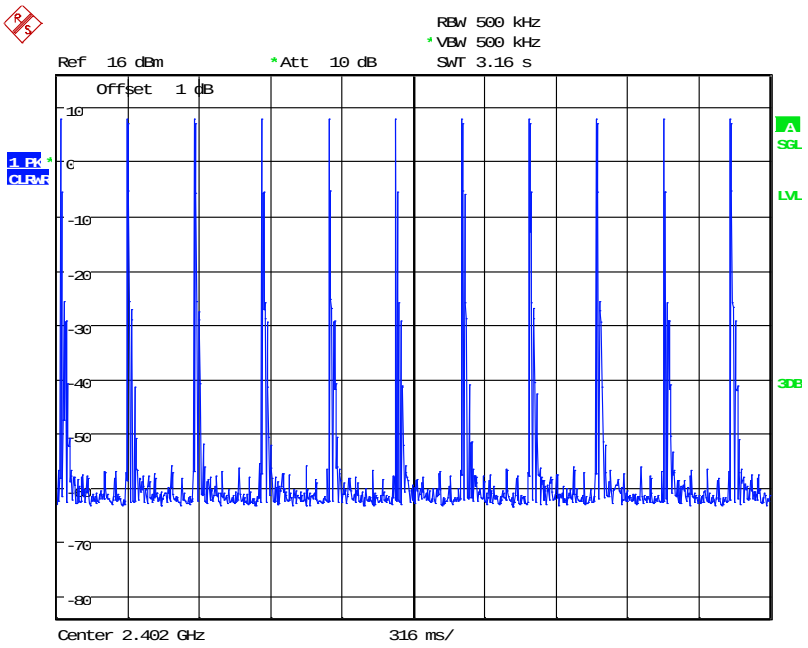
3DH5: Hopping Number



Date: 19.AUG.2019 20:21:03

3DH5: Hopping Number /10

(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)



Date: 19.AUG.2019 20:21:52

12 FCC §15.247(a)(1)(iii) –Quantity of hopping channel Test

12.1 Applicable Standard

According to FCC §15.247(a) (1) (iii).

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.

12.2 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.

12.3 Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

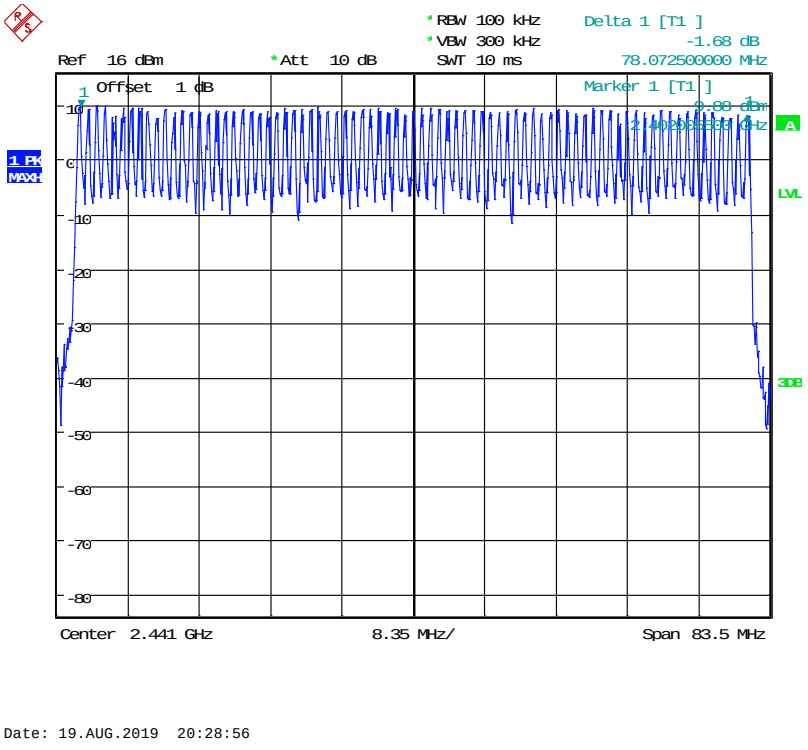
The testing was performed by David Hsu on 2019-08-19~2019-08-20

12.4 Test Results

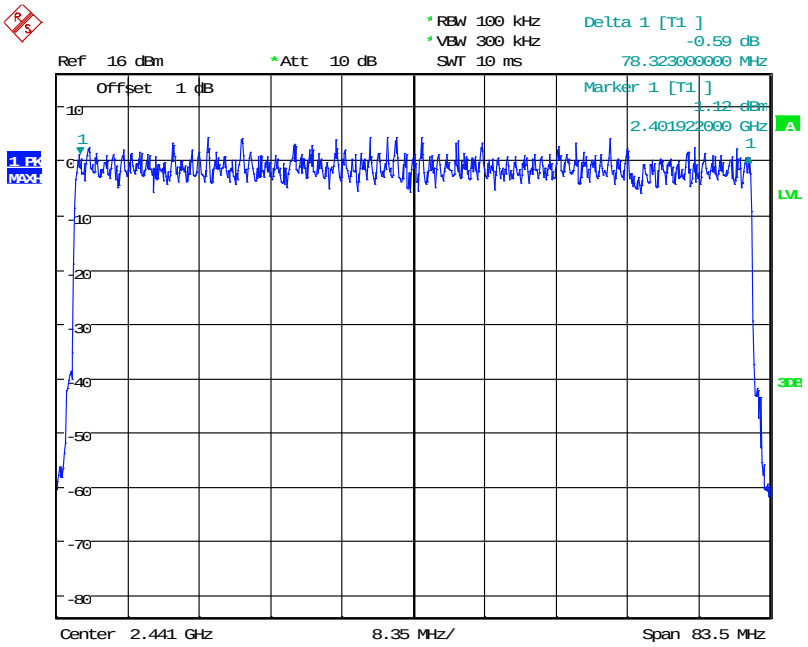
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)	Result
GFSK	2402-2480	79	>15	Compliance
π/4-DQPSK	2402-2480	79	>15	Compliance
8DPSK	2402-2480	79	>15	Compliance

Please refer to the following plots

BR Mode (GFSK)



EDR Mode (π/4-DQPSK)



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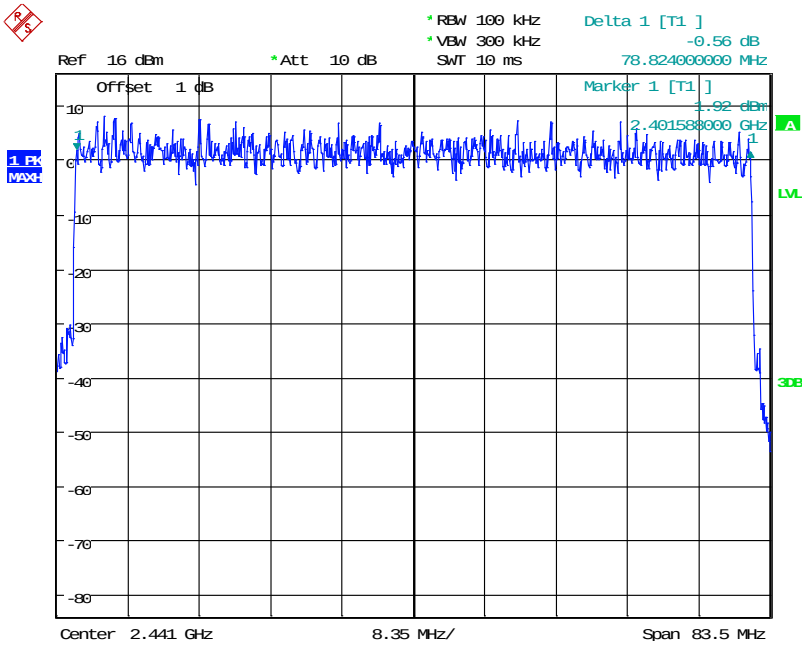
EDR Mode (8DPSK)



Date: 19.AUG.2019 20:09:50

13 FCC §15.247(b)(1) – Maximum Output Power

13.1 Applicable Standard

According to FCC §15.247(b) (1).

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. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

13.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

13.3 Test Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-08-19.

13.4 Test Results

Channel	Frequency (MHz)	Peak Conducted Output Power		Limit (W)	Result
		(dBm)	(W)		
BR Mode (GFSK)					
Low	2402	9.02	0.0080	0.125	Compliance
Middle	2441	8.83	0.0076	0.125	Compliance
High	2480	8.41	0.0069	0.125	Compliance
EDR Mode (π/4-DQPSK)					
Low	2402	7.56	0.0057	0.125	Compliance
Middle	2441	7.46	0.0056	0.125	Compliance
High	2480	7.01	0.0050	0.125	Compliance
EDR Mode (8DPSK)					
Low	2402	8.01	0.0063	0.125	Compliance
Middle	2441	7.89	0.0062	0.125	Compliance
High	2480	7.36	0.0054	0.125	Compliance

14 FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

14.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

14.2 Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW = 100 kHz VBW = 300 kHz

Sweep = coupled

Detector function = peak Trace = max hold

14.3 Test Environmental Conditions

Temperature:	25.3 ℃
Relative Humidity:	62 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-08-19.

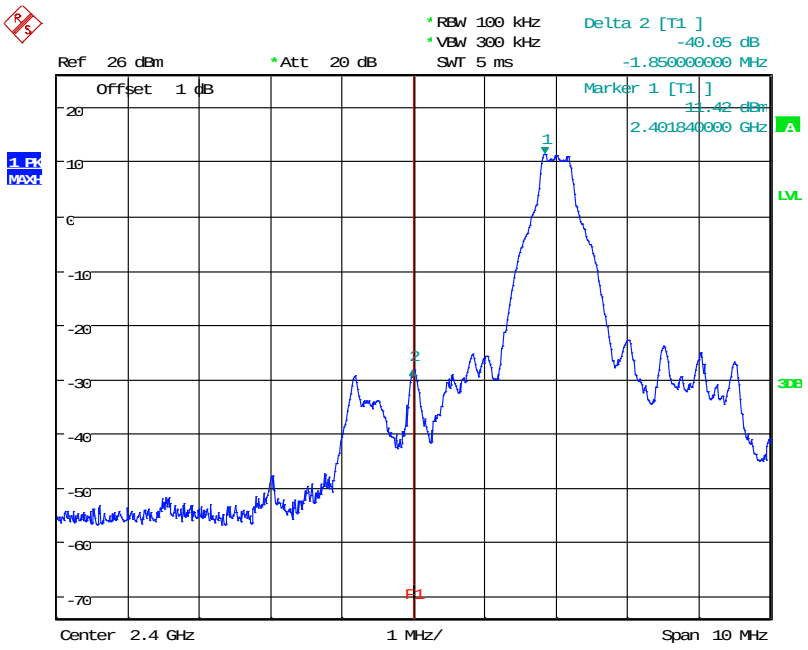
14.4 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	40.05	≥ 20	PASS
High	2480	60.43	≥ 20	PASS
BR Hopping Mode (GFSK)				
Low	2402-2480	45.20	≥ 20	PASS
High	2402-2480	60.60	≥ 20	PASS
EDR Mode (π/4-DQPSK)				
Low	2402	39.81	≥ 20	PASS
High	2480	55.74	≥ 20	PASS
EDR Hopping Mode (π/4-DQPSK)				
Low	2402-2480	59.69	≥ 20	PASS
High	2402-2480	60.76	≥ 20	PASS
EDR Mode (8DPSK)				
Low	2402	41.04	≥ 20	PASS
High	2480	56.35	≥ 20	PASS
EDR Hopping Mode (8DPSK)				
Low	2402-2480	40.98	≥ 20	PASS
High	2402-2480	60.98	≥ 20	PASS

Please refer to the following plots

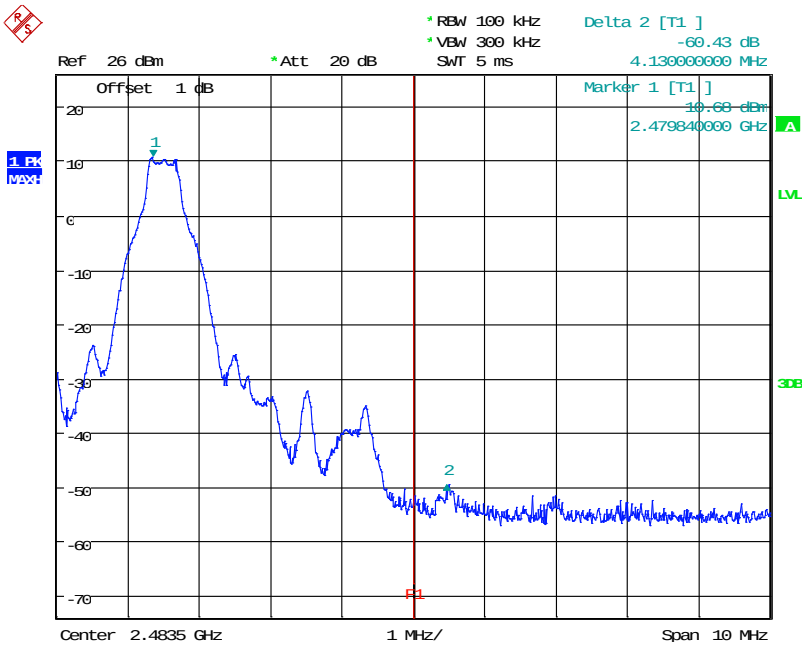
BR Mode (GFSK)

Band Edge, CH Low



Date: 19.AUG.2019 19:32:38

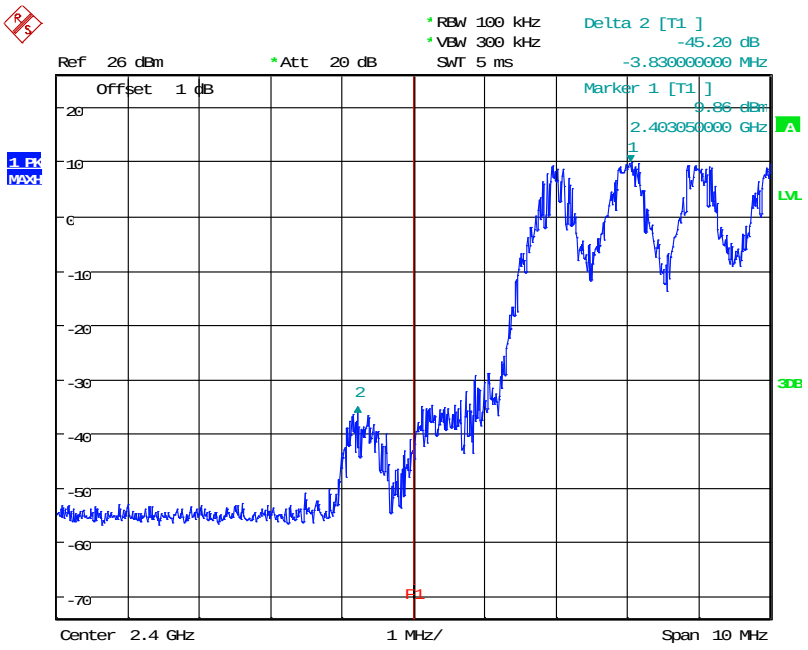
Band Edge, CH High



Date: 19.AUG.2019 19:38:49

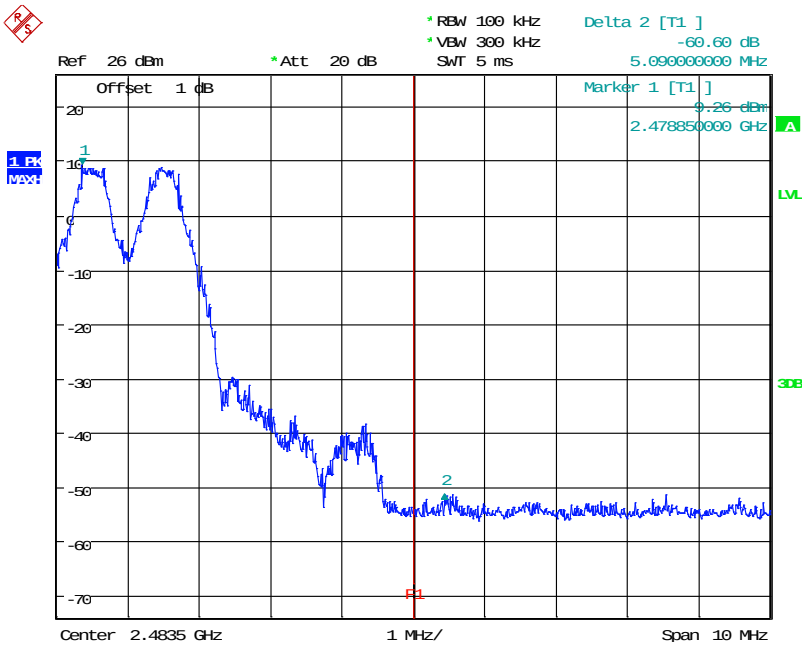
BR Hopping Mode (GFSK)

Band Edge, CH Low



Date: 19.AUG.2019 20:23:35

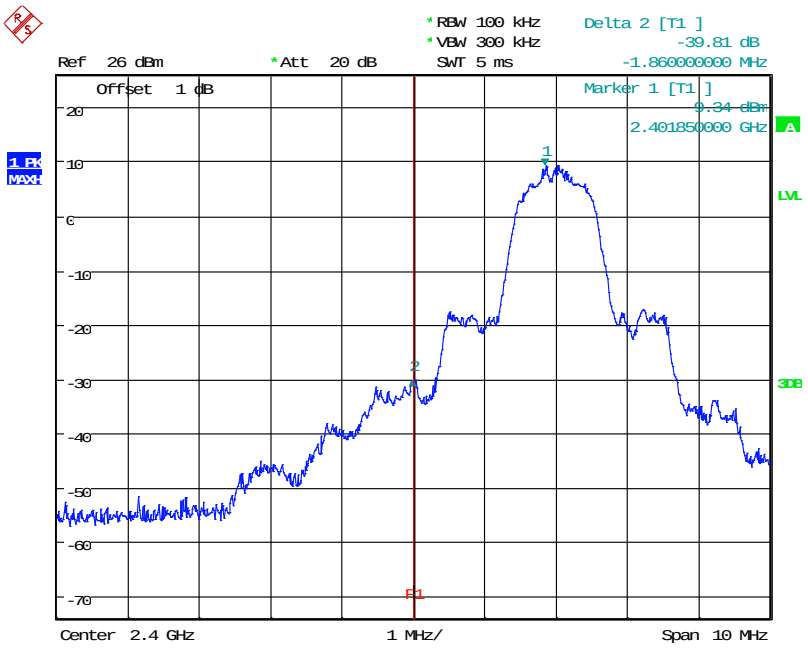
Band Edge, CH High



Date: 19.AUG.2019 20:24:13

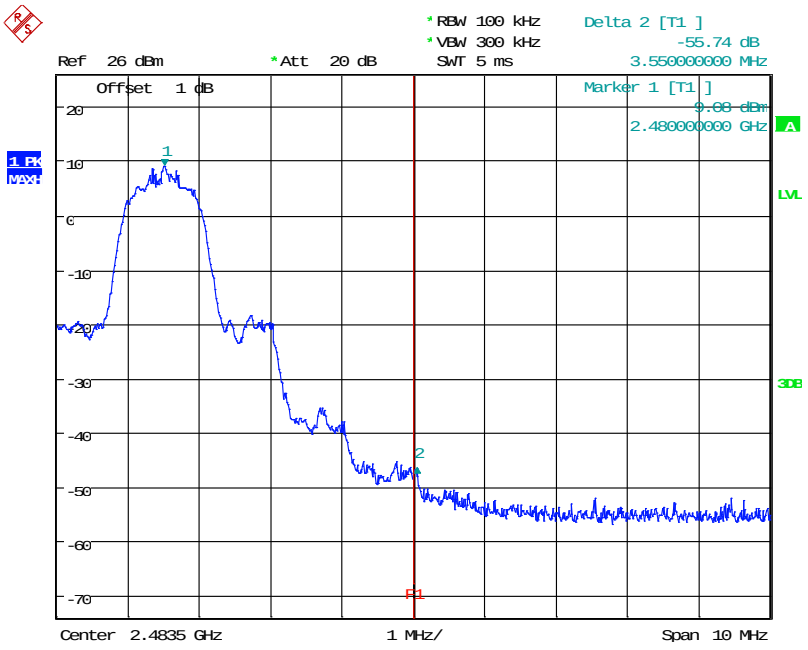
EDR Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 19.AUG.2019 19:46:16

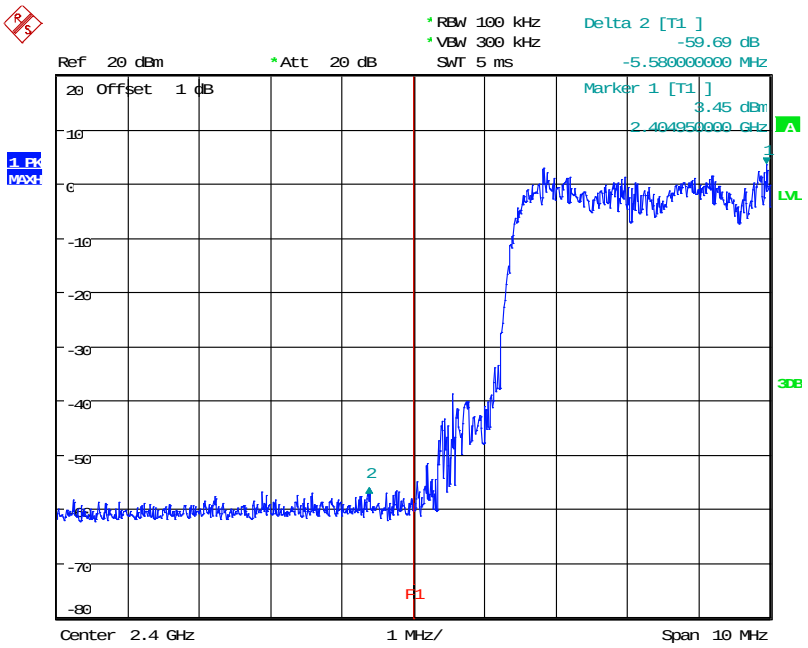
Band Edge, CH High



Date: 19.AUG.2019 19:50:18

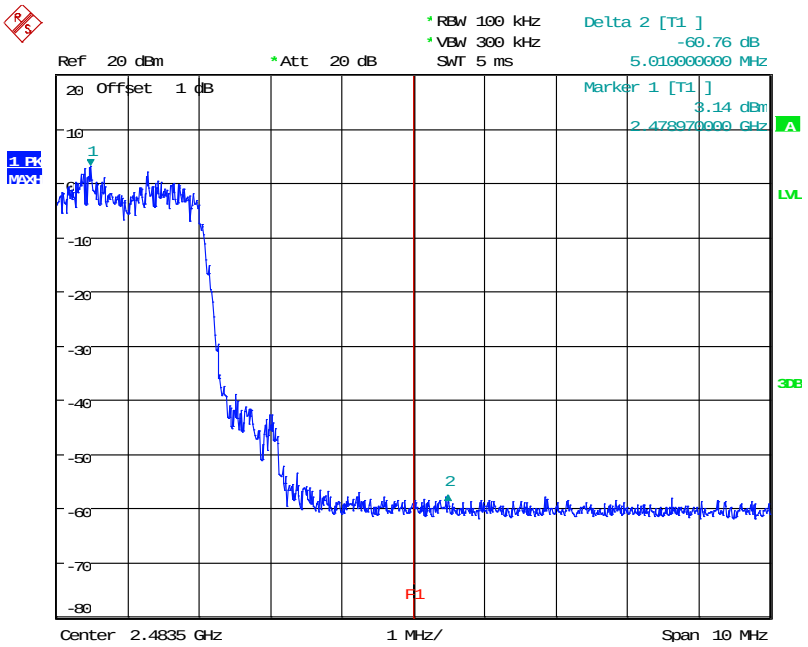
EDR Hopping Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 20.AUG.2019 15:08:38

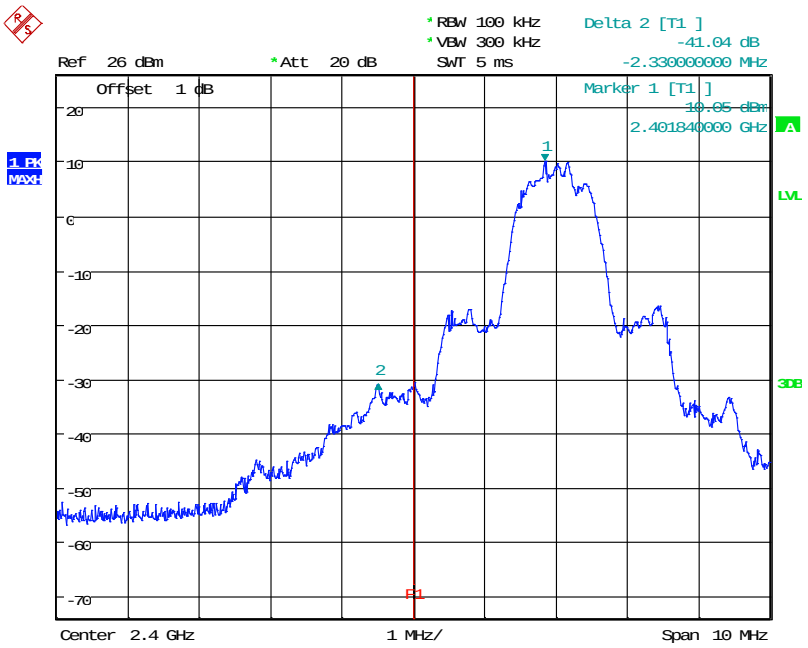
Band Edge, CH High



Date: 20.AUG.2019 15:09:11

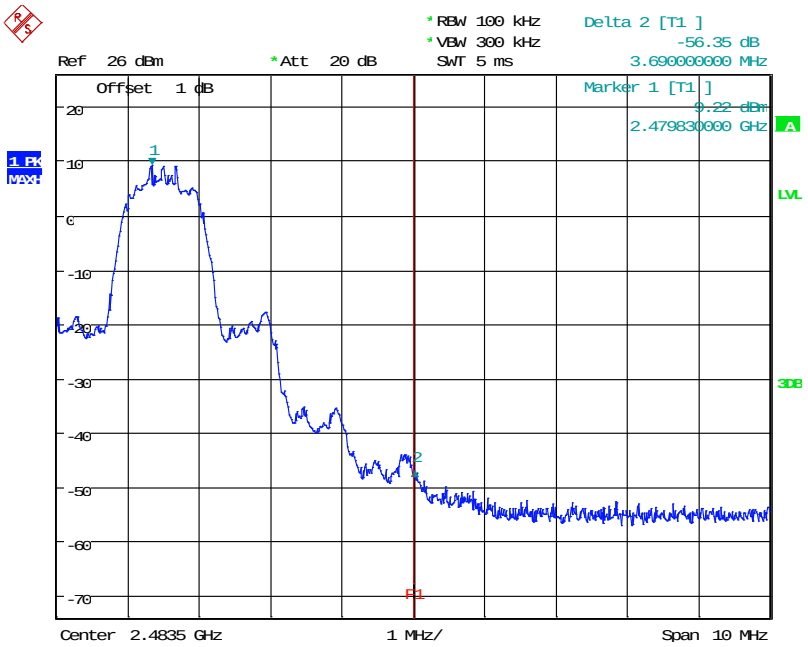
EDR Mode (8DPSK)

Band Edge, CH Low



Date: 19.AUG.2019 19:53:51

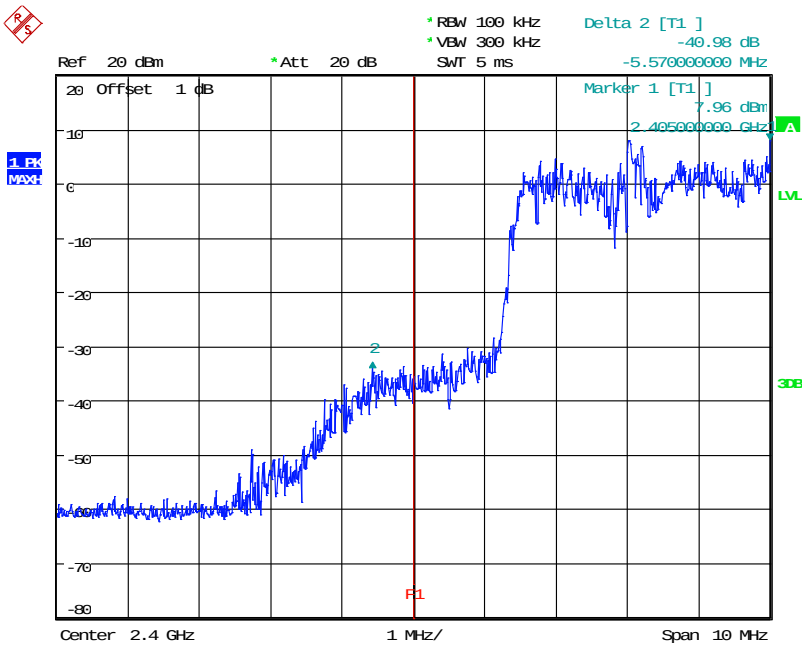
Band Edge, CH High



Date: 19.AUG.2019 19:59:51

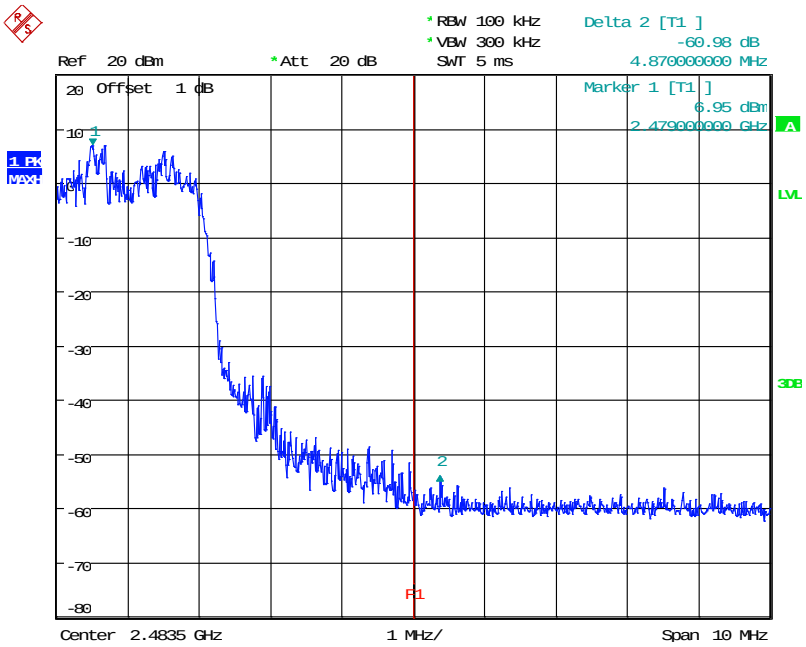
EDR Hopping Mode (8DPSK)

Band Edge, CH Low



Date: 19.AUG.2019 20:02:20

Band Edge, CH High



Date: 19.AUG.2019 20:02:46

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