FCC Part 15.247

TEST REPORT

For

IEI Integration Corp.

No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)

FCC ID: RFHMODAT-550A

Report Type:	**Product Type:**
Original Report	PDA

Report Producer : **Jane Lee** Jane Lee

Report Number : **RLK181207001-00C**

Report Date : **2019-02-21**

Reviewed By: **Jerry Chang** Jerry J. Chang

Prepared By: **Bay Area Compliance Laboratories Corp.(Taiwan)**
70, Lane 169, Sec. 2, Datong Road, Xizhi Dist.,
New Taipei City 22183, Taiwan, R.O.C.
Tel: +886 (2) 2647 6898
Fax: +886 (2) 2647 6895
www.bacl.com.tw

Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RLK181207001	RLK181207001-00C	2019-02-21	Original Report	Jane Lee

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	IEI Integration Corp●. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Manufacturer	IEI Integration Corp●. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Brand(Trade) Name	IEI
Product (Equipment)	PDA
Main Model Name	MODAT-550A-OA53
Series Model Name	MODAT-550A-OA53-ET
Model Discrepancy	MODAT-550A-OA53 with Barcode Reader MODAT -550A-OA53-ET without Barcode Reader
Frequency Range	2402 ~ 2480 MHz
Transmit Power	BR(GFSK) Mode: 5.89 dBm (0.0039W) EDR(π/4-DQPSK) Mode: 3.27 dBm (0.0021W) EDR(8DPSK) Mode: 2.95 dBm (0.0020W)
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	FPC Antenna / 0 dBi
Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter: *Brand Name: Asian Power Devices Inc* *Model: WA15IO5R* *I/P: 100-240V 50~60Hz 0.5A* *O/P: 5Vdc, 3A* ☐ By AC Power Cord ☐ PoE
	☐ DC Type ☒ Battery: *Rechargeable Li-polymer Battery* *Brand Name: QIAO XIN TECHOLOGY CO., LTD* *Model: IE-01S02A0* *3.7V ⎓ 4000mAh, 14.8W* ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	Dec 07, 2018
Date of Test	Dec 07, 2018 ~ Feb 19, 2019

**All measurement and test data in this report was gathered from production sample serial number: 181207001*

(Assigned by BACL, Taiwan).

1.2 Objective

This report is prepared on behalf of *IEI Integration Corp.* 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)

FCC Part 15.407 NII submission with FCC ID: RFHMODAT-550A

FCC Part 15.225 DXX submission with FCC ID: RFHMODAT-550A

FCC Part 15.247 DTS submission with FCC ID: RFHMODAT-550A

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 used "EngineerMode".

Test Software		Bluetooth MP Tool		
Test Frequency		2402MHz	2441MHz	2480MHz
Power Level Setting	GFSK	0	0	0
	π/4-DQPSK	0	0	0
	8DPSK	0	0	0

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	BSMI	FCC ID	S/N
Adapter	APD	WA-15105R	R43017	N/A	N/A
Base	iEi	iEi	N/A	N/A	N/A

2.5 External Cable List and Details

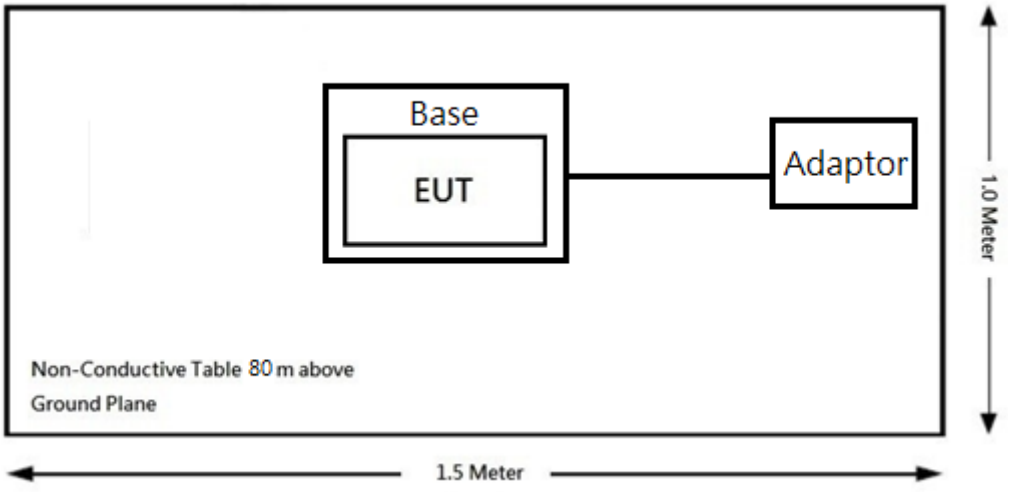
Cable Description	Length (m)	From	To
Micro USB Cable	1.5	Adapter	Base

2.6 Block Diagram of Test Setup

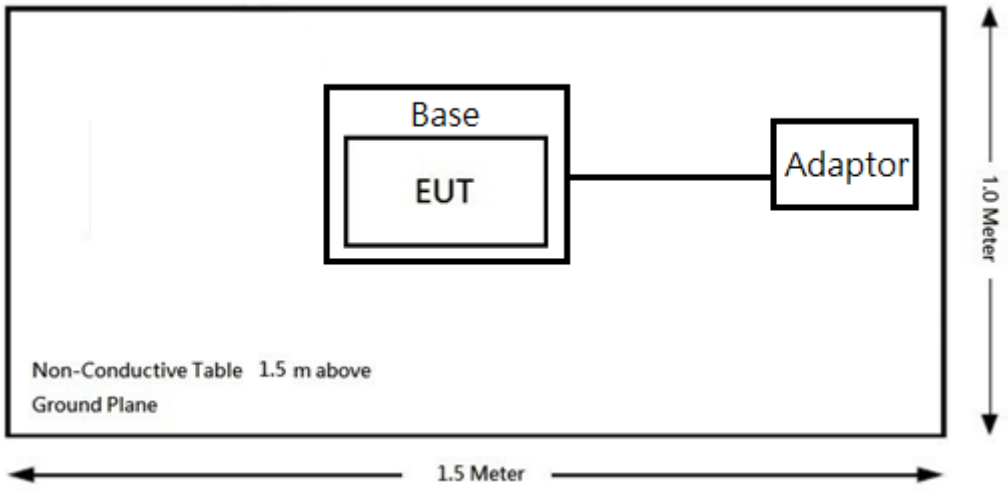
See test photographs attached in annex setup photos for the actual connections between EUT and support equipment.

Radiation:

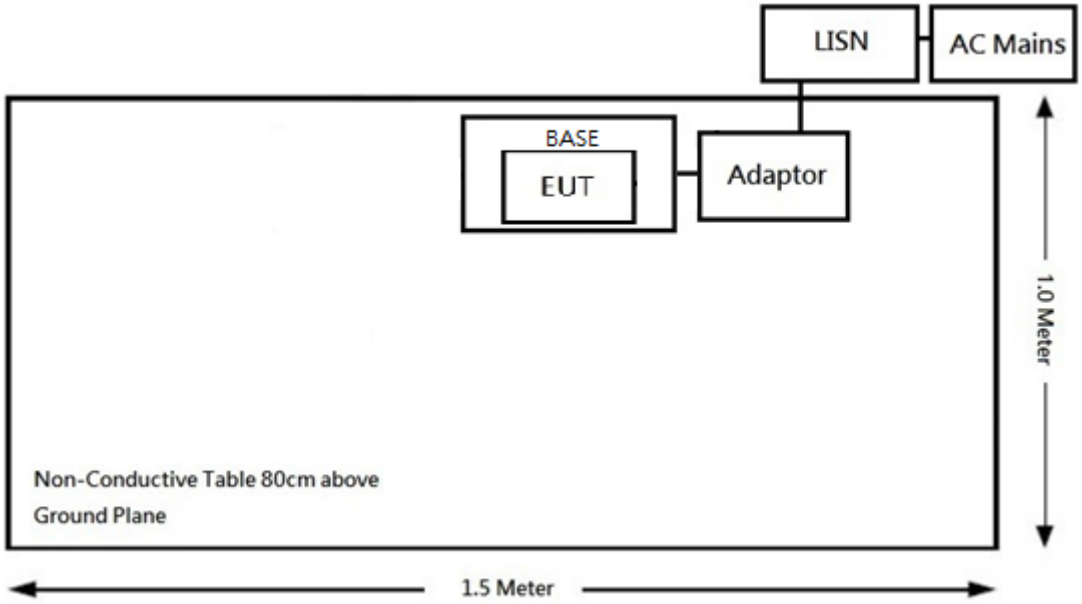
Below 1GHz:



Above 1GHz:



Conduction:


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

3 Summary of Test Results

FCC Rules	Description of Test	Results
FCC §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)(1)	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	2018/02/22	2019/02/21
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2018/08/03	2019/08/02
RF Cable	EMEC	EM-CB5D	001	2018/07/02	2019/07/01
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiated Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	00035796	2018/03/13	2019/03/12
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	3115	9311-4158	2018/04/20	2019/04/19
Horn Antenna	ETS-Lindgren	3116	62638	2018/08/29	2019/08/28
Preamplifier	Sonoma	310N	130602	2018/07/04	2019/07/03
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	2018/02/13	2019/02/12
Micro flex Cable	UTIFLEX	FSCM 64639 / (2M)	93D0127	2018/07/31	2019/07/30
Micro flex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2018/11/16	2019/11/15
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2018/03/05	2019/03/04
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	2018/07/09	2019/07/08

VSWR	BACL	966-A	N/A	2018/07/16	2019/07/15
Description	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due Date**
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2018/05/04	2019/05/03
Cable	WOKEN	SFL402	S02-160323-07	2018/02/11	2019/02/10
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2018/03/08	2019/03/07
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2018/03/07	2019/03/06

***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)
2441	6	3.981	5	1.2672	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 List and Details

Manufacturer	Type	Antenna Gain	Result
ICP Electronics Inc.	FPC Antenna	0 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

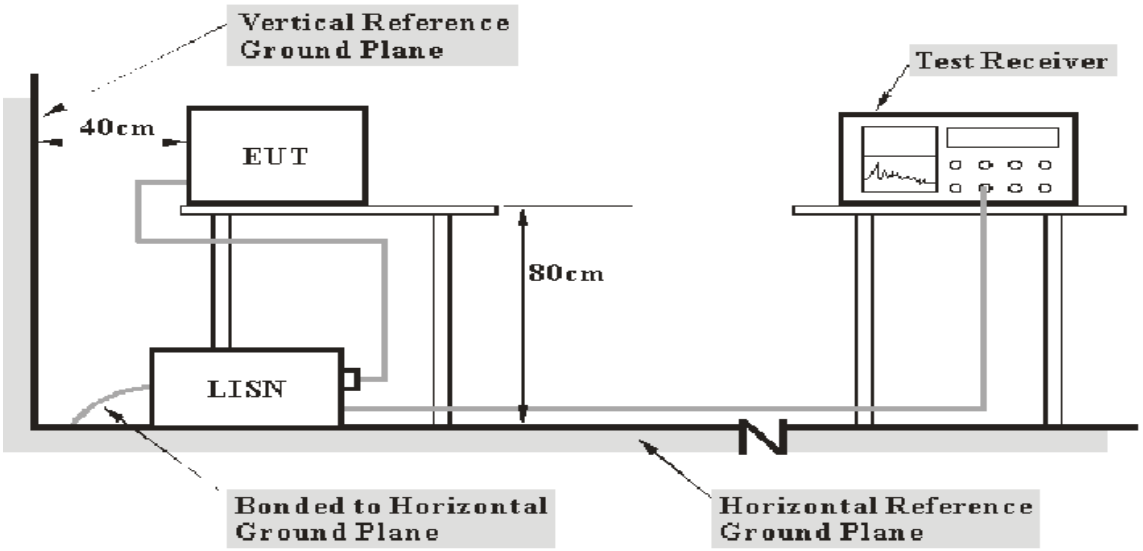
7.2 Measurement Uncertainty

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 Environmental Conditions

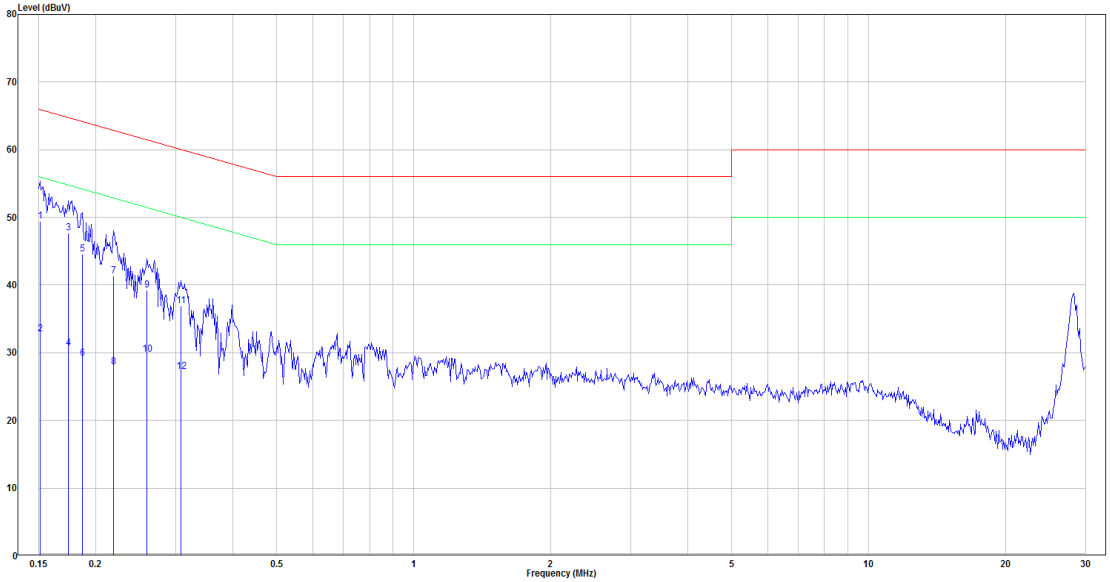
Temperature:	27.7 ℃
Relative Humidity:	68 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-31.

7.7 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	0.151	29.97	19.45	49.42	65.96	-16.54	QP
2	0.151	13.28	19.45	32.73	55.96	-23.23	Average
3	0.174	28.21	19.46	47.67	64.76	-17.09	QP
4	0.174	11.26	19.46	30.72	54.76	-24.04	Average
5	0.187	25.07	19.46	44.53	64.18	-19.65	QP
6	0.187	9.77	19.46	29.23	54.18	-24.95	Average
7	0.219	21.88	19.46	41.34	62.85	-21.51	QP
8	0.219	8.42	19.46	27.88	52.85	-24.97	Average
9	0.260	19.73	19.46	39.19	61.45	-22.26	QP
10	0.260	10.25	19.46	29.71	51.45	-21.74	Average
11	0.307	17.44	19.47	36.91	60.04	-23.13	QP
12	0.307	7.73	19.47	27.20	50.04	-22.84	Average

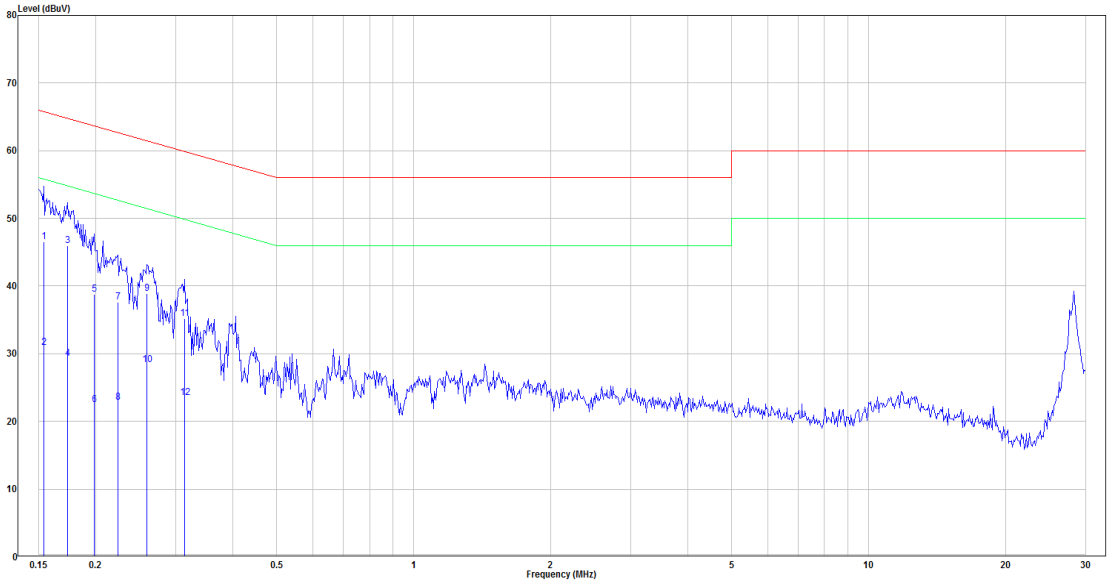
Note:

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	0.154	27.09	19.44	46.53	65.79	-19.26	QP
2	0.154	11.49	19.44	30.93	55.79	-24.86	Average
3	0.173	26.50	19.45	45.95	64.80	-18.85	QP
4	0.173	9.78	19.45	29.23	54.80	-25.57	Average
5	0.198	19.36	19.46	38.82	63.68	-24.86	QP
6	0.198	2.99	19.46	22.45	53.68	-31.23	Average
7	0.223	18.18	19.46	37.64	62.69	-25.05	QP
8	0.223	3.37	19.46	22.83	52.69	-29.86	Average
9	0.260	19.49	19.46	38.95	61.45	-22.50	QP
10	0.260	8.89	19.46	28.35	51.45	-23.10	Average
11	0.314	15.75	19.46	35.21	59.87	-24.66	QP
12	0.314	4.06	19.46	23.52	49.87	-26.35	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

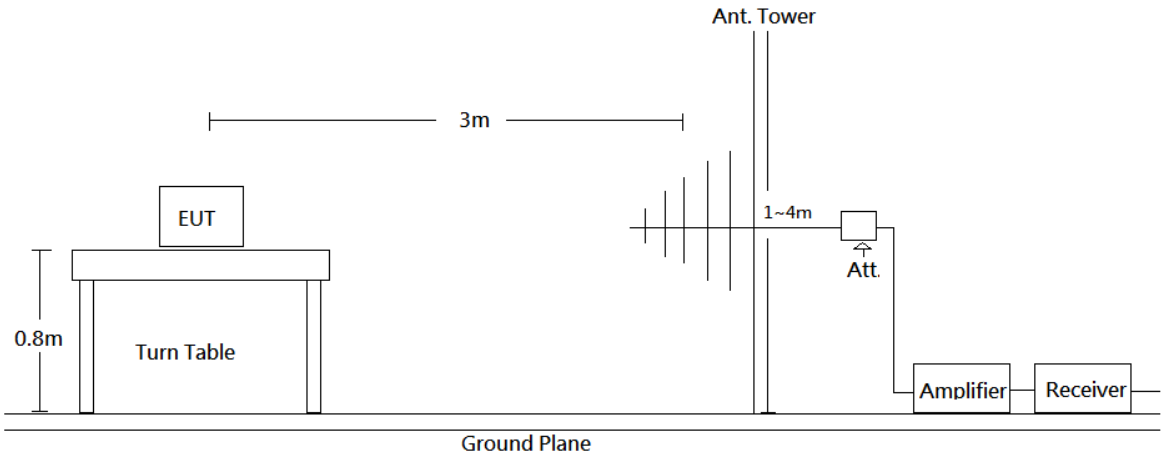
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency 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.

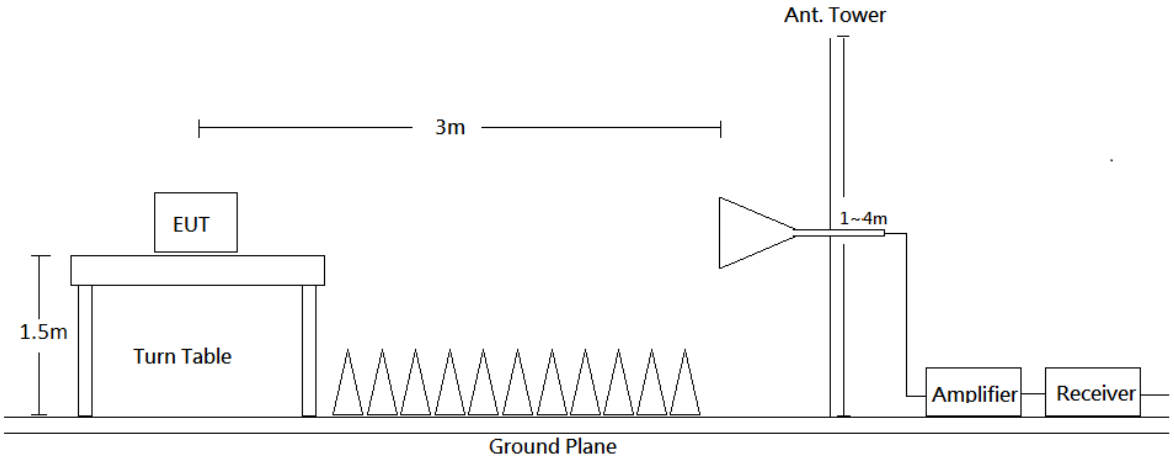
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.75 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.21 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.83 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.18 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.55 dB (k=2, 95% level of confidence)
26 GHz~40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

Temperature:		Conducted	
Temperature:	25 ℃	**Temperature:**	26 ℃
Relative Humidity:	55 %	**Relative Humidity:**	59 %
ATM Pressure:	1010 hPa	**ATM Pressure:**	1010 hPa

The Radiation Spurious Emissions testing was performed by Tom Hsu on 2019-01-19.

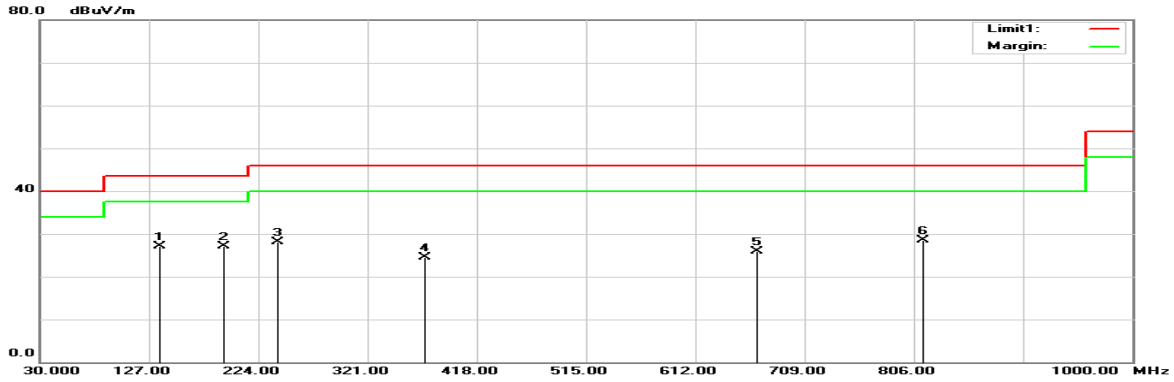
The Conducted Spurious Emissions testing was performed by Tom Hsu on 2019-01-14.

8.7 Test Results

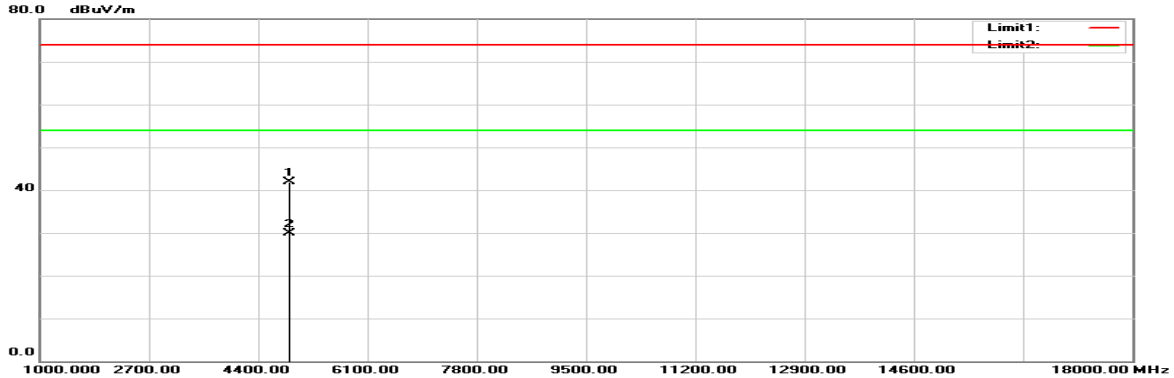
BR (GFSK) Mode

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

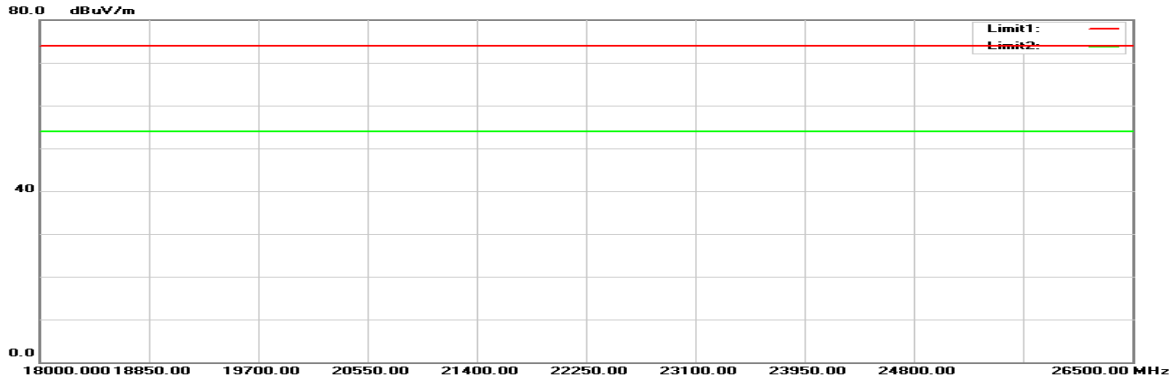
30MHz-1GHz:



1GHz-18GHz:

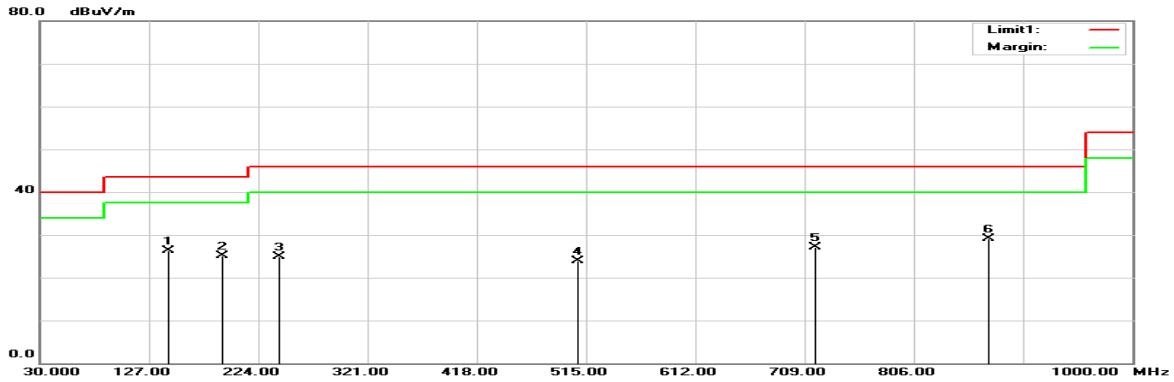


18GHz-26.5GHz:

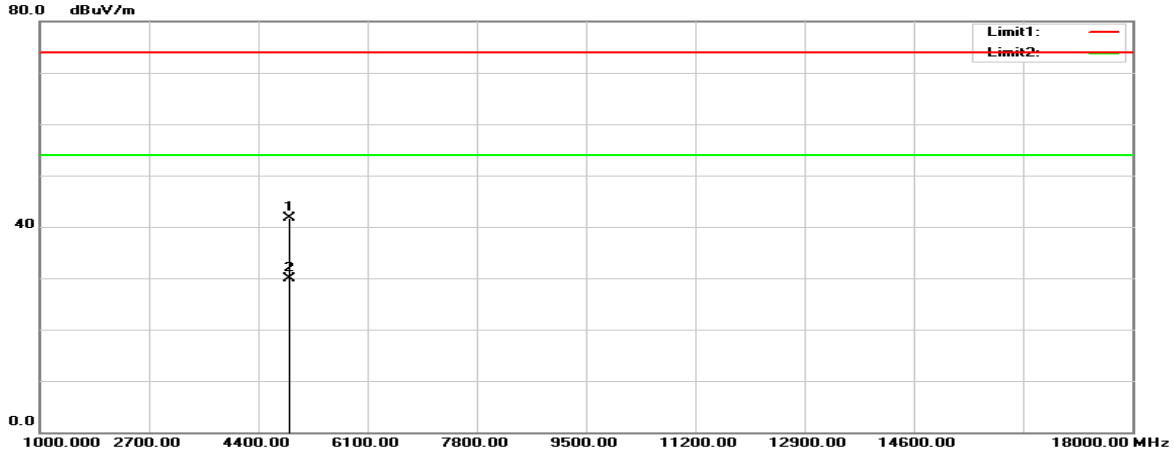


Vertical (*worst case is BR (GFSK) mode Middle channel*)

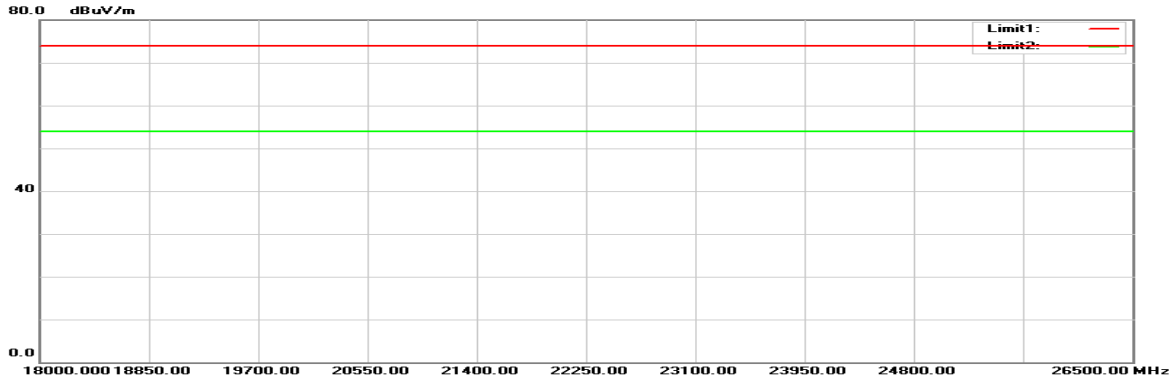
30MHz-1GHz:



1GHz-18GHz:



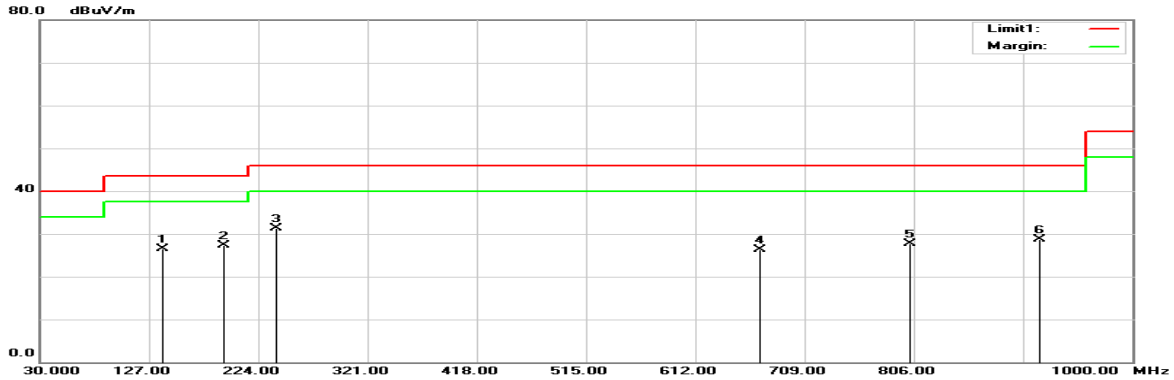
18GHz-26.5GHz:



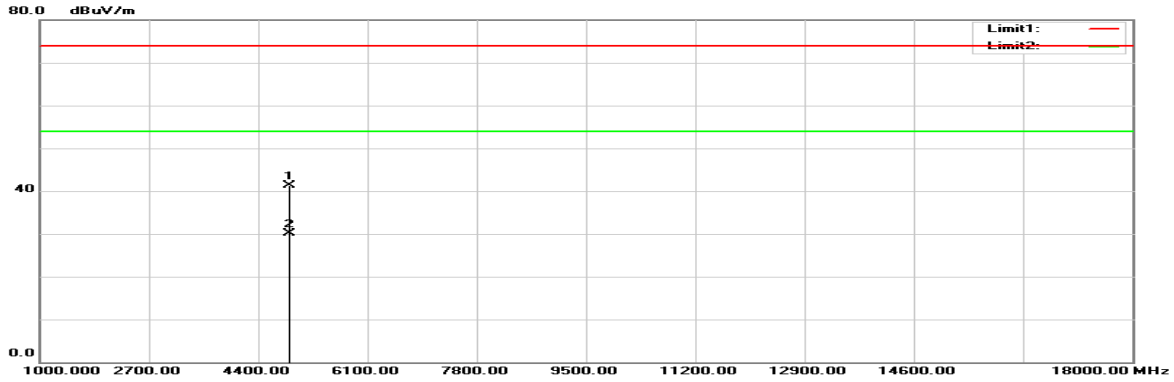
EDR (π/4-DQPSK) Mode

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

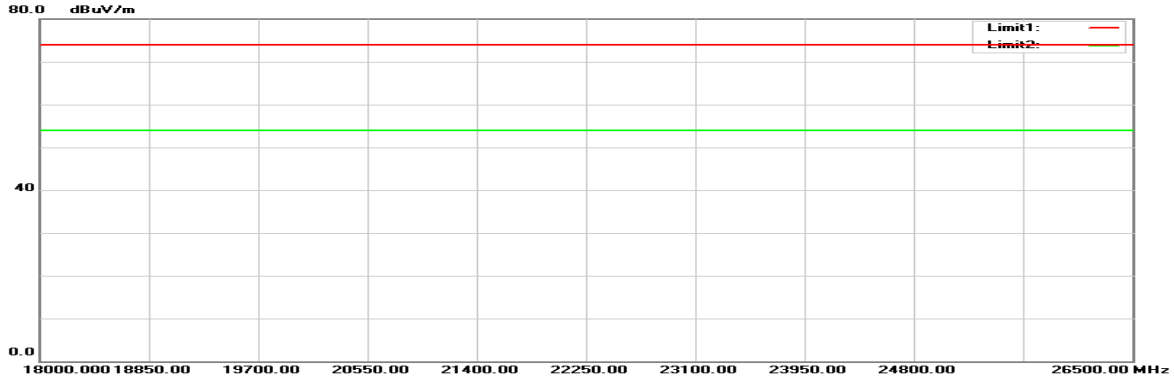
30MHz-1GHz:



1GHz-18GHz:

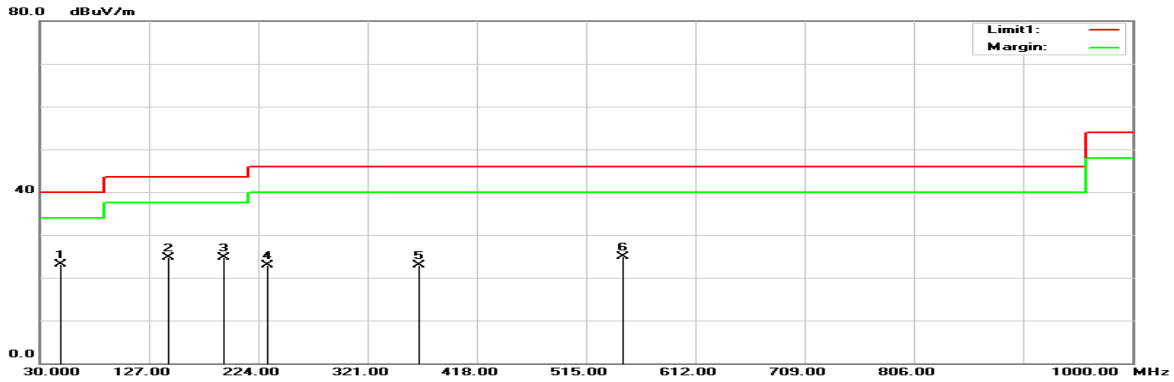


18GHz-26.5GHz:

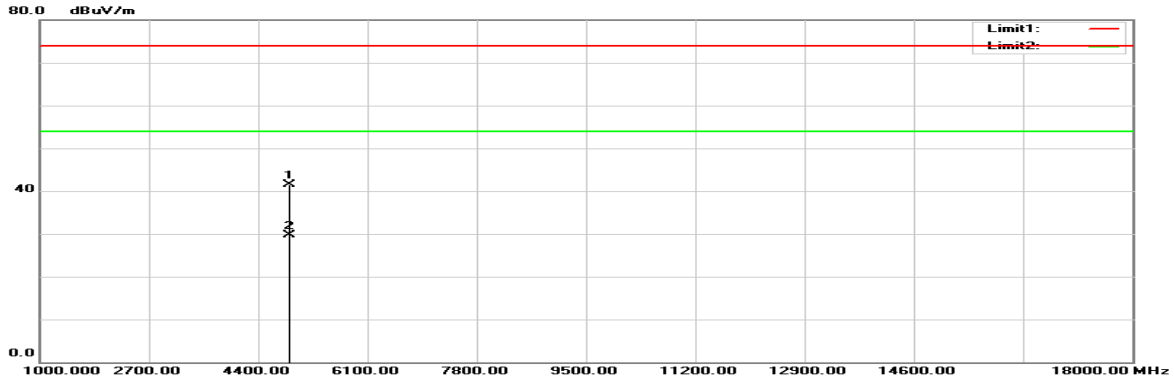


Vertical (*worst case is EDR (π/4-DQPSK) mode Middle channel*)

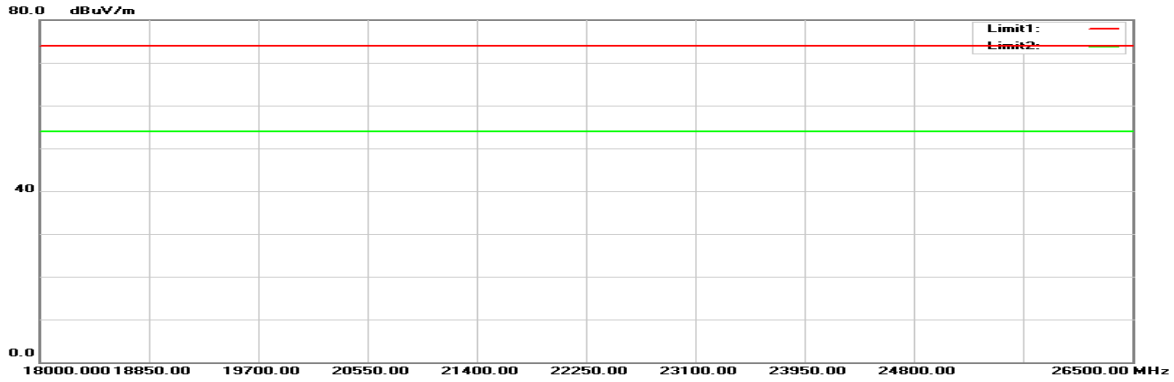
30MHz-1GHz:



1GHz-18GHz:



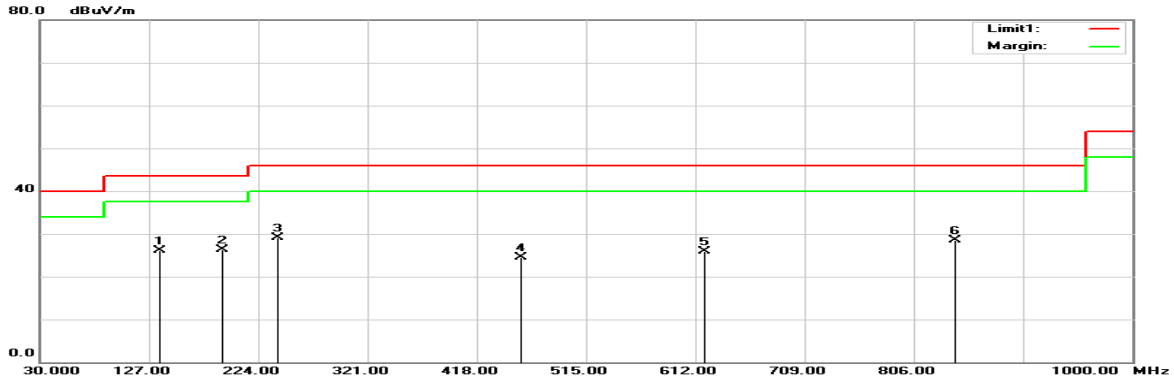
18GHz-26.5GHz:



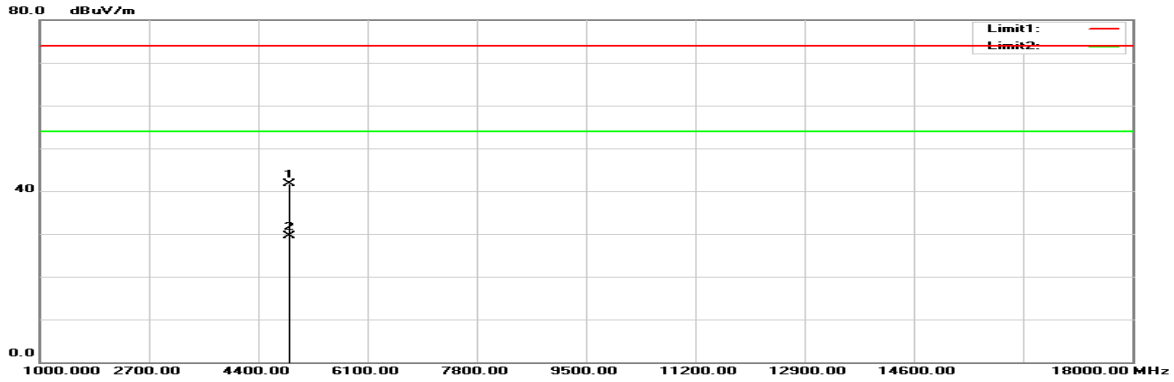
EDR (8DPSK) Mode

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

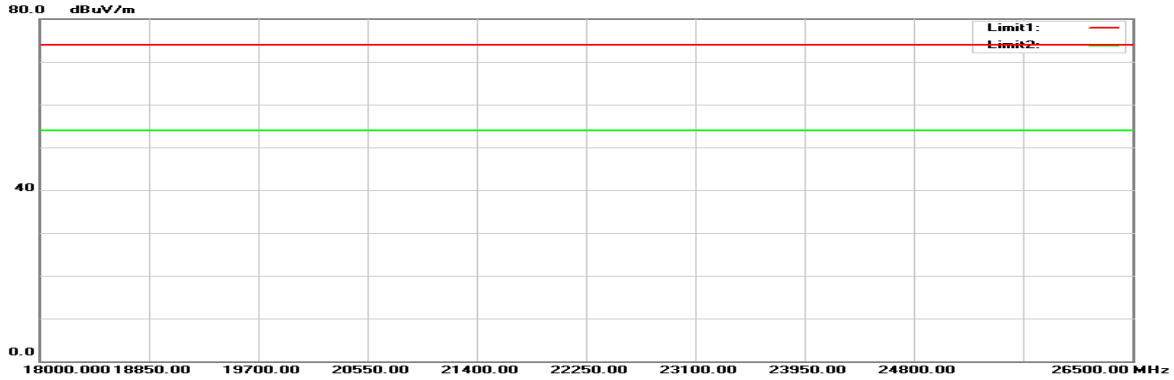
30MHz-1GHz:



1GHz-18GHz:

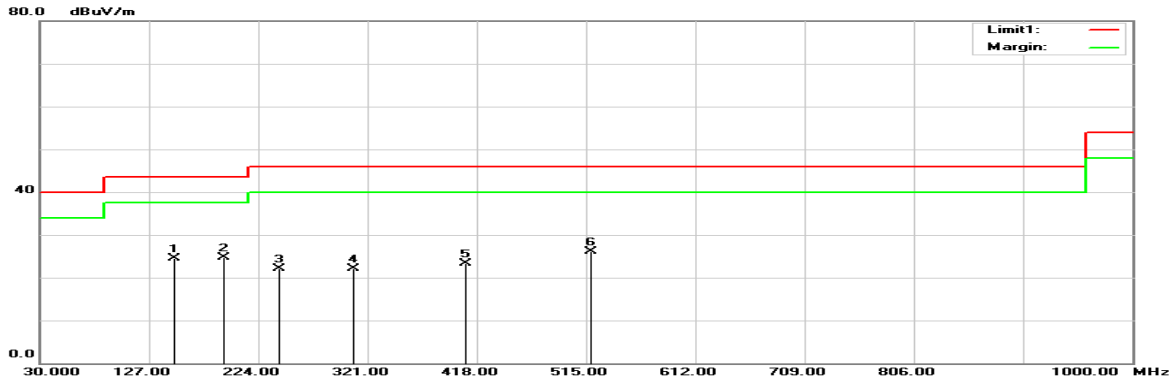


18GHz-26.5GHz:

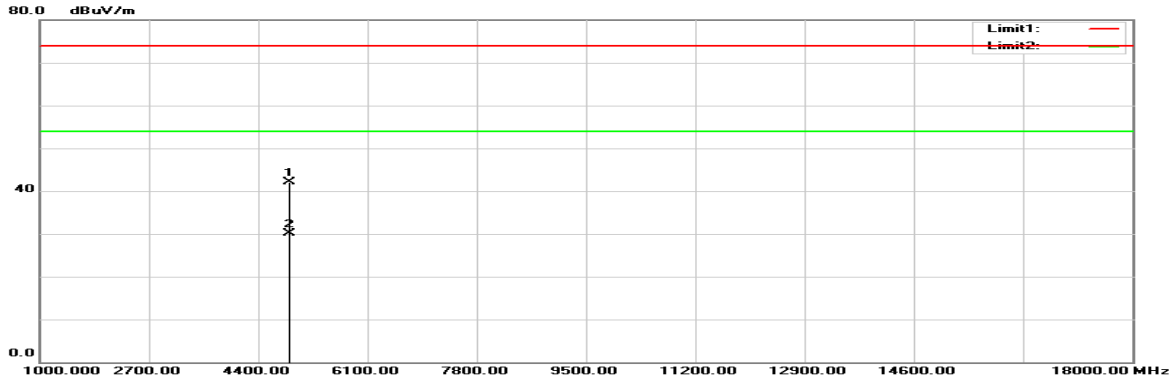


Vertical (*worst case is EDR (8DPSK) mode Middle channel*)

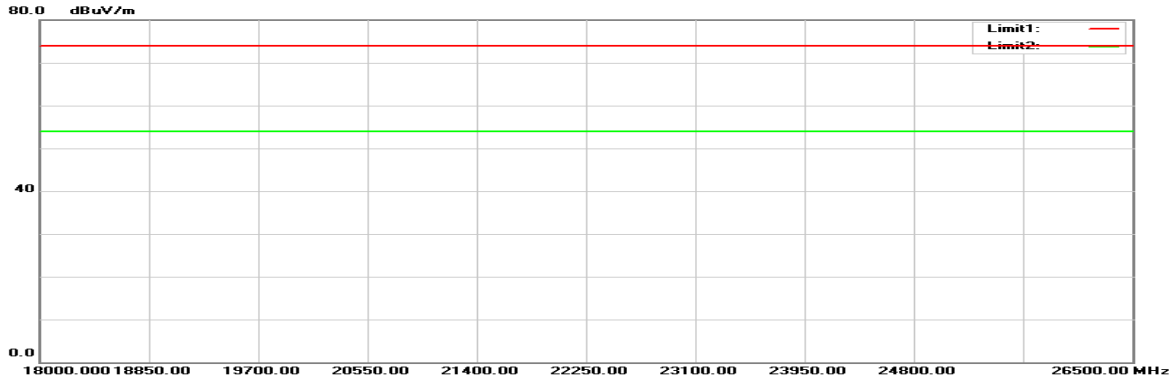
30MHz-1GHz:



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) Middle channel								
136.7000	36.59	-9.45	27.14	43.50	-16.36	100	1	QP
192.9600	37.51	-10.34	27.17	43.50	-16.33	100	53	QP
241.4600	38.47	-10.36	28.11	46.00	-17.89	100	99	QP
372.4100	31.12	-6.53	24.59	46.00	-21.41	100	294	QP
666.3200	28.62	-2.72	25.90	46.00	-20.10	100	338	QP
814.7300	28.87	-0.30	28.57	46.00	-17.43	100	1	QP
EDR (π/4-DQPSK) Middle channel								
138.6400	36.01	-9.51	26.50	43.50	-17.00	100	349	QP
192.9600	37.59	-10.34	27.25	43.50	-16.25	100	65	QP
240.4900	41.66	-10.38	31.28	46.00	-14.72	100	100	QP
669.2300	28.93	-2.70	26.23	46.00	-19.77	100	249	QP
802.1200	28.11	-0.43	27.68	46.00	-18.32	100	5	QP
917.5500	27.63	1.07	28.70	46.00	-17.30	100	5	QP
EDR (8DPSK) Middle channel								
136.7000	35.60	-9.45	26.15	43.50	-17.35	100	341	QP
191.9900	36.84	-10.56	26.28	43.50	-17.22	100	60	QP
241.4600	39.46	-10.36	29.10	46.00	-16.90	100	18	QP
456.8000	29.60	-5.07	24.53	46.00	-21.47	100	11	QP
620.7300	29.24	-3.26	25.98	46.00	-20.02	100	249	QP
842.8600	28.43	-0.02	28.41	46.00	-17.59	100	153	QP

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BR (GFSK) Middle channel								
144.4600	35.97	-9.62	26.35	43.50	-17.15	100	345	QP
191.9900	35.66	-10.56	25.10	43.50	-18.40	100	58	QP
242.4300	35.27	-10.35	24.92	46.00	-21.08	100	287	QP
507.2400	28.40	-4.41	23.99	46.00	-22.01	100	137	QP
718.7000	29.29	-2.17	27.12	46.00	-18.88	100	30	QP
872.9300	28.73	0.33	29.06	46.00	-16.94	100	26	QP
EDR (π/4-DQPSK) Middle channel								
48.4300	38.15	-15.03	23.12	40.00	-16.88	100	110	QP
144.4600	34.39	-9.62	24.77	43.50	-18.73	100	360	QP
192.9600	35.05	-10.34	24.71	43.50	-18.79	100	49	QP
232.7300	33.42	-10.53	22.89	46.00	-23.11	100	287	QP
366.5900	29.59	-6.64	22.95	46.00	-23.05	100	15	QP
547.9800	28.99	-4.08	24.91	46.00	-21.09	100	277	QP
EDR (8DPSK) Middle channel								
149.3100	34.20	-9.69	24.51	43.50	-18.99	100	219	QP
192.9600	34.95	-10.34	24.61	43.50	-18.89	100	253	QP
242.4300	32.39	-10.35	22.04	46.00	-23.96	100	278	QP
308.3900	29.82	-7.80	22.02	46.00	-23.98	100	264	QP
408.3000	29.19	-5.89	23.30	46.00	-22.70	100	48	QP
519.8500	30.39	-4.31	26.08	46.00	-19.92	100	360	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	60.14	-3.83	56.31	74.00	-17.69	100	345	peak
2390.000	46.40	-3.83	42.57	54.00	-11.43	100	345	AVG
2402.000	100.44	-3.79	96.65	N/A	N/A	100	267	peak
2402.000	88.39	-3.79	84.60	N/A	N/A	100	267	AVG
4804.000	40.18	1.59	41.77	74.00	-32.23	100	98	peak
4804.000	28.63	1.59	30.22	54.00	-23.78	100	98	AVG
BR (GFSK), Middle channel								
2441.000	102.57	-3.75	98.82	N/A	N/A	100	268	peak
2441.000	90.15	-3.75	86.40	N/A	N/A	100	268	AVG
4882.000	39.90	2.09	41.99	74.00	-32.01	100	0	peak
4882.000	27.86	2.09	29.95	54.00	-24.05	100	0	AVG
BR (GFSK), High channel								
2480.000	100.22	-3.54	96.68	N/A	N/A	100	271	peak
2480.000	88.39	-3.54	84.85	N/A	N/A	100	271	AVG
2483.500	60.71	-3.52	57.19	74.00	-16.81	100	332	peak
2483.500	46.76	-3.52	43.24	54.00	-10.76	100	332	AVG
4960.000	40.03	2.26	42.29	74.00	-31.71	100	297	peak
4960.000	30.03	2.26	32.29	54.00	-21.71	100	297	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	60.32	-3.83	56.49	74.00	-17.51	100	183	peak
2390.000	47.14	-3.83	43.31	54.00	-10.69	100	183	AVG
2402.000	95.38	-3.79	91.59	N/A	N/A	100	266	peak
2402.000	84.53	-3.79	80.74	N/A	N/A	100	266	AVG
4804.000	40.70	1.59	42.29	74.00	-31.71	100	58	peak
4804.000	30.82	1.59	32.41	54.00	-21.59	100	58	AVG
BR (GFSK), Middle channel								
2441.000	99.86	-3.75	96.11	N/A	N/A	100	273	peak
2441.000	88.20	-3.75	84.45	N/A	N/A	100	273	AVG
4882.000	39.52	2.09	41.61	74.00	-32.39	100	115	peak
4882.000	27.90	2.09	29.99	54.00	-24.01	100	115	AVG
BR (GFSK), High channel								
2480.000	98.45	-3.54	94.91	N/A	N/A	100	350	peak
2480.000	86.96	-3.54	83.42	N/A	N/A	100	350	AVG
2483.500	60.67	-3.52	57.15	74.00	-16.85	100	261	peak
2483.500	46.74	-3.52	43.22	54.00	-10.78	100	261	AVG
4960.000	40.85	2.26	43.11	74.00	-30.89	100	102	peak
4960.000	30.78	2.26	33.04	54.00	-20.96	100	102	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	60.28	-3.83	56.45	74.00	-17.55	100	171	peak
2390.000	46.44	-3.83	42.61	54.00	-11.39	100	171	AVG
2402.000	98.47	-3.79	94.68	N/A	N/A	100	266	peak
2402.000	84.88	-3.79	81.09	N/A	N/A	100	266	AVG
4804.000	40.40	1.59	41.99	74.00	-32.01	100	228	peak
4804.000	27.90	1.59	29.49	54.00	-24.51	100	228	AVG
EDR (π/4-DQPSK), Middle channel								
2441.000	101.69	-3.75	97.94	N/A	N/A	100	270	peak
2441.000	84.38	-3.75	80.63	N/A	N/A	100	270	AVG
4882.000	39.20	2.09	41.29	74.00	-32.71	100	351	peak
4882.000	28.06	2.09	30.15	54.00	-23.85	100	351	AVG
EDR (π/4-DQPSK), High channel								
2480.000	99.62	-3.54	96.08	N/A	N/A	100	270	peak
2480.000	86.01	-3.54	82.47	N/A	N/A	100	270	AVG
2483.500	60.54	-3.52	57.02	74.00	-16.98	100	193	peak
2483.500	46.81	-3.52	43.29	54.00	-10.71	100	193	AVG
4960.000	39.63	2.26	41.89	74.00	-32.11	100	204	peak
4960.000	28.48	2.26	30.74	54.00	-23.26	100	204	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	60.15	-3.83	56.32	74.00	-17.68	100	113	peak
2390.000	46.39	-3.83	42.56	54.00	-11.44	100	113	AVG
2402.000	93.76	-3.79	89.97	N/A	N/A	100	271	peak
2402.000	81.01	-3.79	77.22	N/A	N/A	100	271	AVG
4804.000	39.57	1.59	41.16	74.00	-32.84	100	78	peak
4804.000	27.86	1.59	29.45	54.00	-24.55	100	78	AVG
EDR (π/4-DQPSK), Middle channel								
2441.000	98.78	-3.75	95.03	N/A	N/A	100	276	peak
2441.000	85.06	-3.75	81.31	N/A	N/A	100	276	AVG
4882.000	39.45	2.09	41.54	74.00	-32.46	100	167	peak
4882.000	27.62	2.09	29.71	54.00	-24.29	100	167	AVG
EDR (π/4-DQPSK), High channel								
2480.000	97.56	-3.54	94.02	N/A	N/A	100	350	peak
2480.000	84.28	-3.54	80.74	N/A	N/A	100	350	AVG
2483.500	60.95	-3.52	57.43	74.00	-16.57	100	276	peak
2483.500	46.75	-3.52	43.23	54.00	-10.77	100	276	AVG
4960.000	39.72	2.26	41.98	74.00	-32.02	100	298	peak
4960.000	27.17	2.26	29.43	54.00	-24.57	100	298	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	60.16	-3.83	56.33	74.00	-17.67	100	70	peak
2390.000	46.39	-3.83	42.56	54.00	-11.44	100	70	AVG
2402.000	99.14	-3.79	95.35	N/A	N/A	100	266	peak
2402.000	85.00	-3.79	81.21	N/A	N/A	100	266	AVG
4804.000	40.62	1.59	42.21	74.00	-31.79	100	107	peak
4804.000	28.47	1.59	30.06	54.00	-23.94	100	107	AVG
EDR (8DPSK), Middle channel								
2441.000	101.26	-3.75	97.51	N/A	N/A	100	266	peak
2441.000	87.21	-3.75	83.46	N/A	N/A	100	266	AVG
4882.000	39.60	2.09	41.69	74.00	-32.31	100	219	peak
4882.000	27.39	2.09	29.48	54.00	-24.52	100	219	AVG
EDR (8DPSK), High channel								
2480.000	99.44	-3.54	95.90	74.00	21.90	100	271	peak
2480.000	86.04	-3.54	82.50	54.00	28.50	100	271	AVG
2483.500	59.87	-3.52	56.35	74.00	-17.65	100	38	peak
2483.500	48.27	-3.52	44.75	54.00	-9.25	100	38	AVG
4960.000	39.62	2.26	41.88	74.00	-32.12	100	123	peak
4960.000	27.72	2.26	29.98	54.00	-24.02	100	123	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	58.23	-3.83	54.40	74.00	-19.60	100	227	peak
2390.000	47.10	-3.83	43.27	54.00	-10.73	100	227	AVG
2402.000	93.82	-3.79	90.03	N/A	N/A	100	268	peak
2402.000	81.32	-3.79	77.53	N/A	N/A	100	268	AVG
4804.000	39.53	1.59	41.12	74.00	-32.88	100	341	peak
4804.000	27.72	1.59	29.31	54.00	-24.69	100	341	AVG
EDR (8DPSK), Middle channel								
2441.000	98.53	-3.75	94.78	N/A	N/A	100	274	peak
2441.000	85.03	-3.75	81.28	N/A	N/A	100	274	AVG
4882.000	39.98	2.09	42.07	74.00	-31.93	100	285	peak
4882.000	28.02	2.09	30.11	54.00	-23.89	100	285	AVG
EDR (8DPSK), High channel								
2480.000	97.29	-3.54	93.75	N/A	N/A	100	349	peak
2480.000	84.29	-3.54	80.75	N/A	N/A	100	349	AVG
2483.500	58.70	-3.52	55.18	74.00	-18.82	100	37	peak
2483.500	47.52	-3.52	44.00	54.00	-10.00	100	37	AVG
4960.000	39.47	2.26	41.73	74.00	-32.27	100	249	peak
4960.000	27.78	2.26	30.04	54.00	-23.96	100	249	AVG

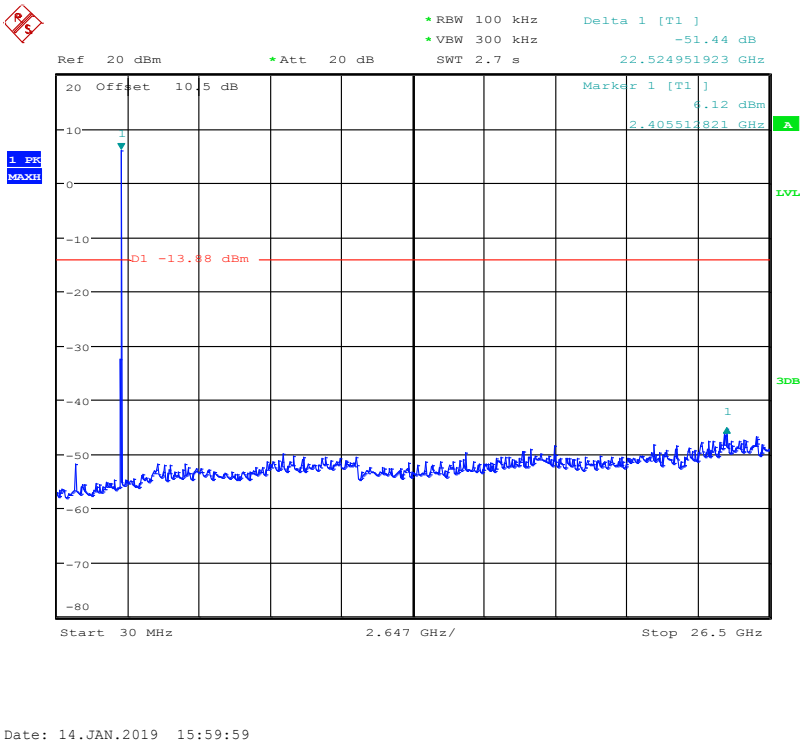
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

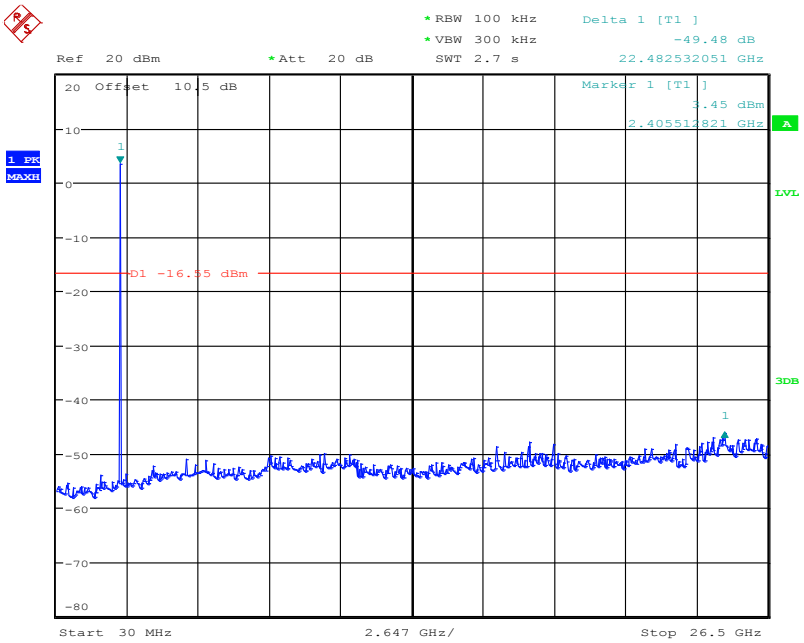
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	51.44	≥ 20	PASS
Mid	2441	49.48	≥ 20	PASS
High	2480	52.18	≥ 20	PASS
EDR Mode (π/4-DQPSK):				
Low	2402	46.13	≥ 20	PASS
Mid	2441	47.49	≥ 20	PASS
High	2480	46.48	≥ 20	PASS
EDR Mode (8DPSK):				
Low	2402	45.05	≥ 20	PASS
Mid	2441	45.68	≥ 20	PASS
High	2480	48.76	≥ 20	PASS

BR Mode (GFSK)

Low Channel

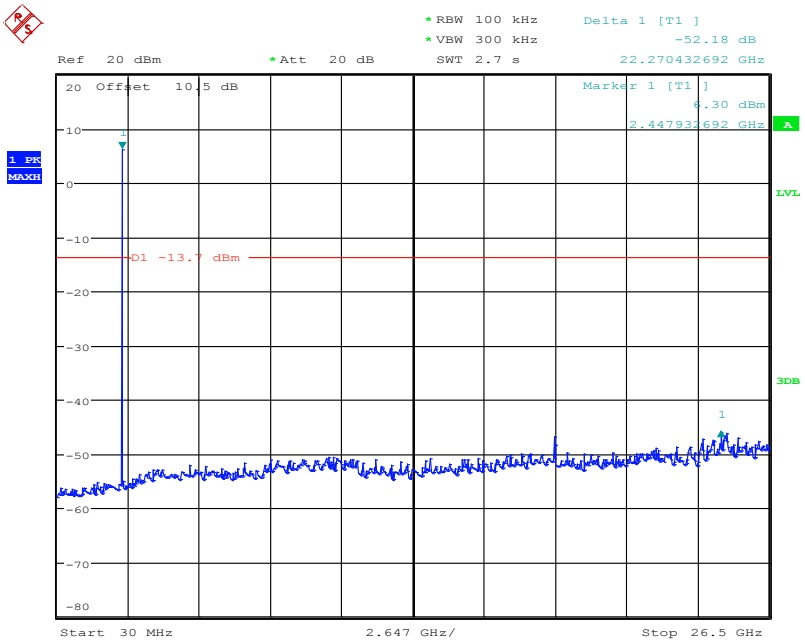


Middle Channel



Date: 14.JAN.2019 16:01:18

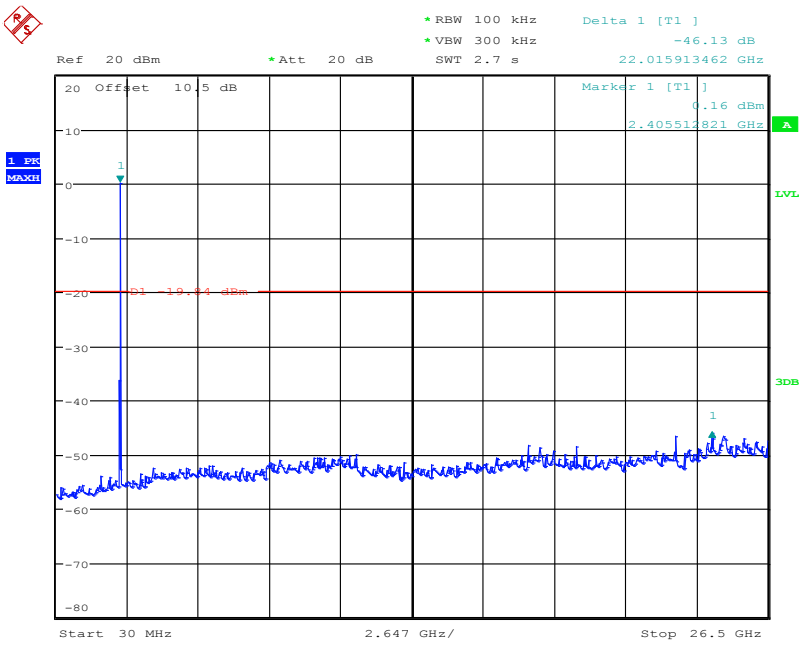
High Channel



Date: 14.JAN.2019 16:03:08

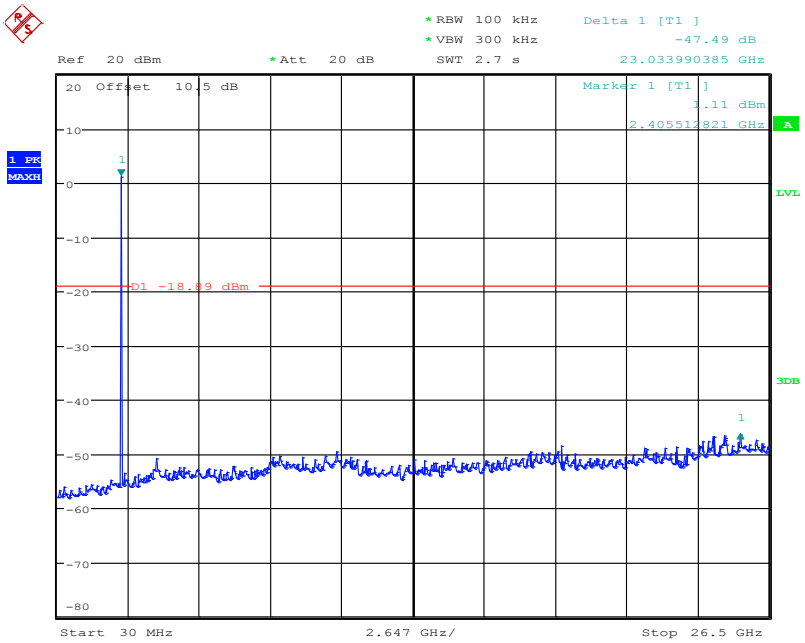
EDR Mode (π/4-DQPSK)

Low Channel



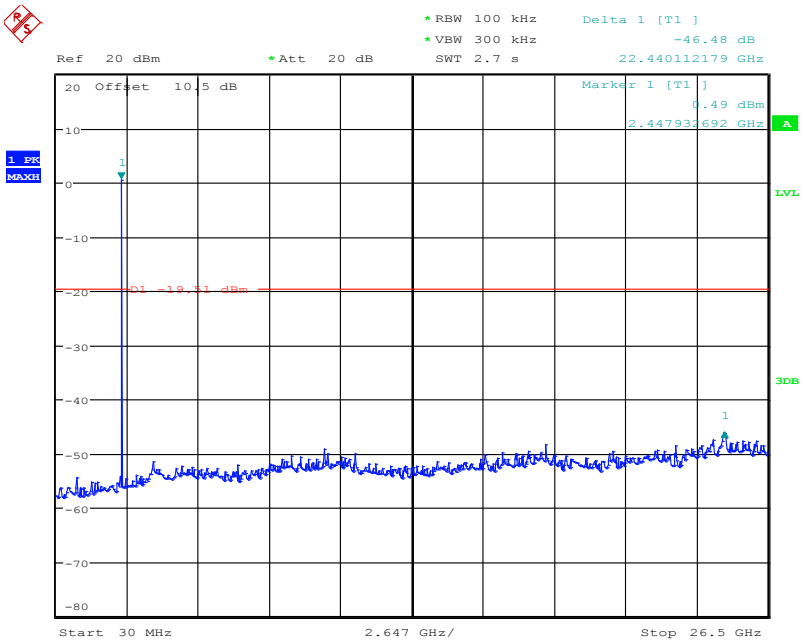
Date: 14.JAN.2019 16:33:11

Middle Channel



Date: 14.JAN.2019 16:47:13

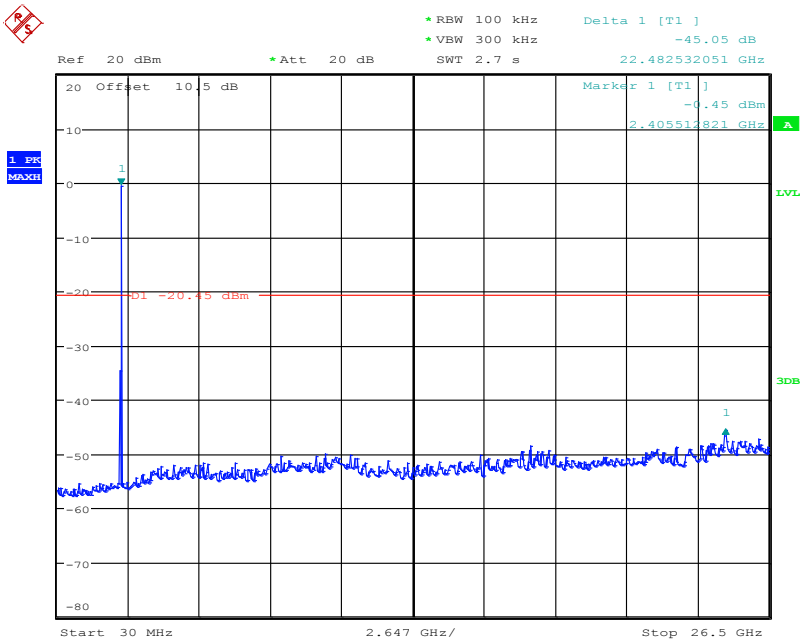
High Channel



Date: 14.JAN.2019 16:36:24

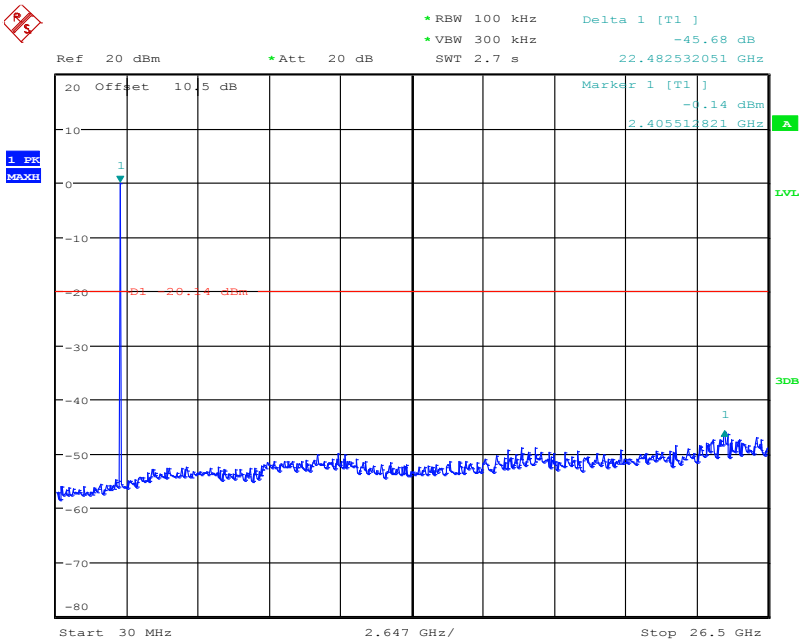
EDR Mode (8DPSK)

Low Channel



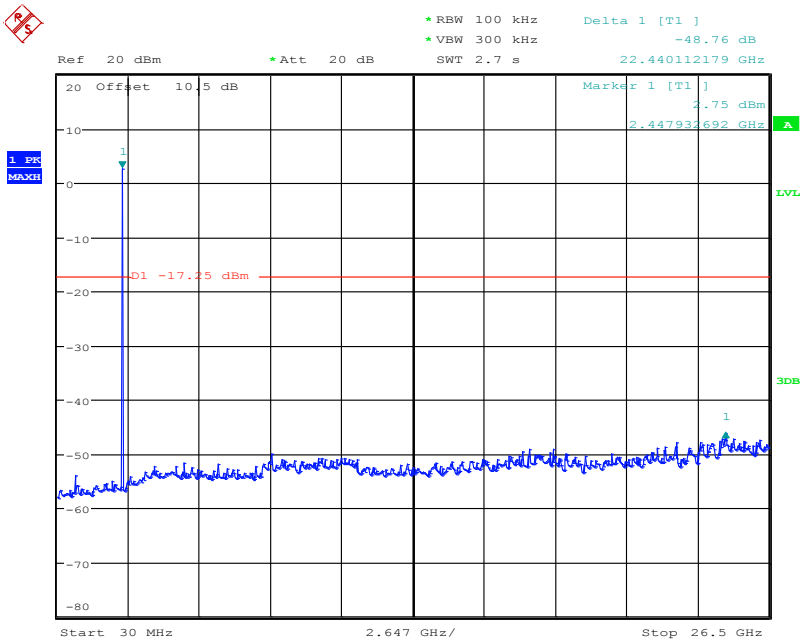
Date: 14.JAN.2019 17:37:57

Middle Channel



Date: 14.JAN.2019 17:28:35

High Channel



Date: 14.JAN.2019 17:30:14

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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

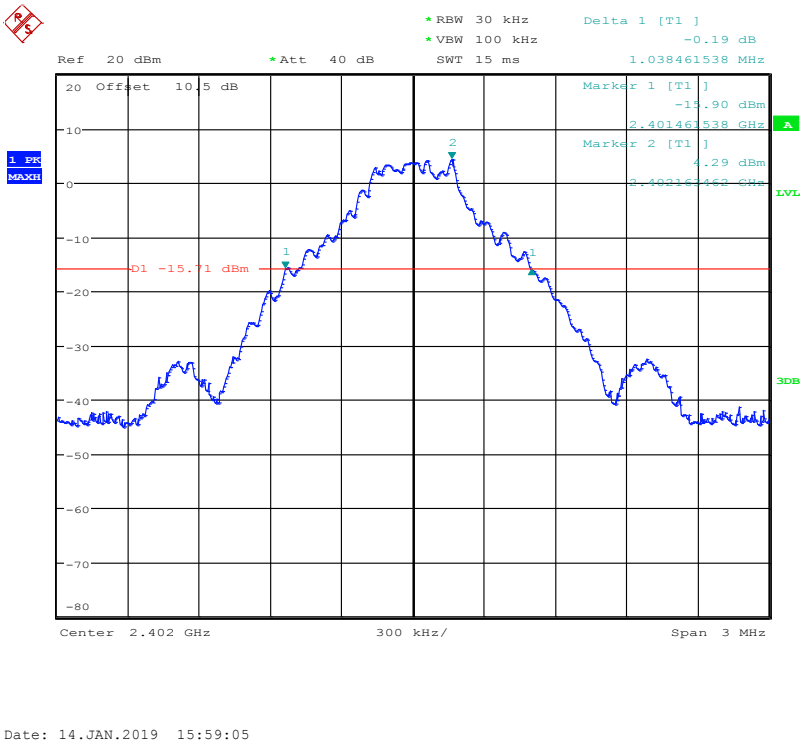
9.4 Test Results

Channel	Frequency (MHz)	20 dBc BW (MHz)
BR Mode (GFSK)		
Low	2402	1.04
Middle	2441	1.04
High	2480	1.03
EDR Mode (π/4-DQPSK)		
Low	2402	1.31
Middle	2441	1.31
High	2480	1.32
EDR Mode (8DPSK)		
Low	2402	1.30
Middle	2441	1.30
High	2480	1.30

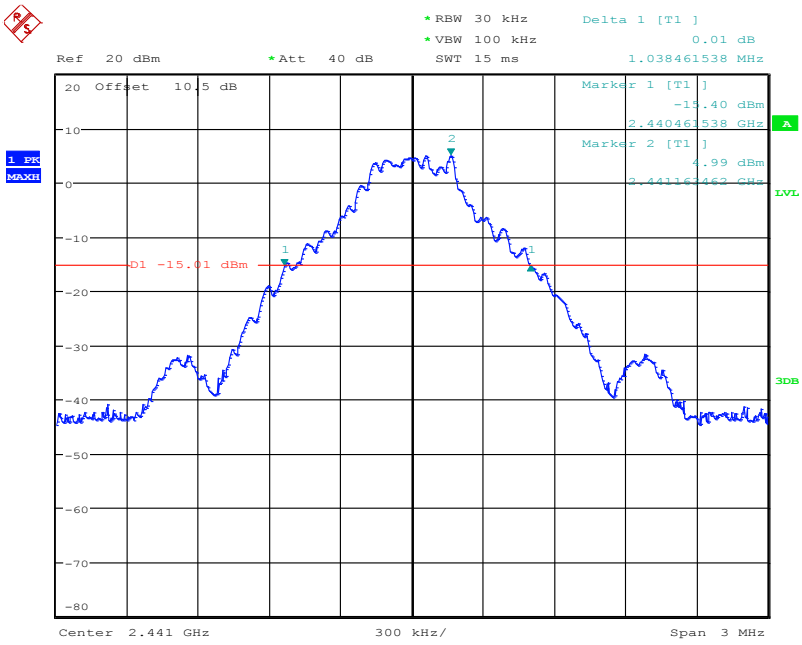
Please refer to the following plots

BR Mode (GFSK)

Low Channel

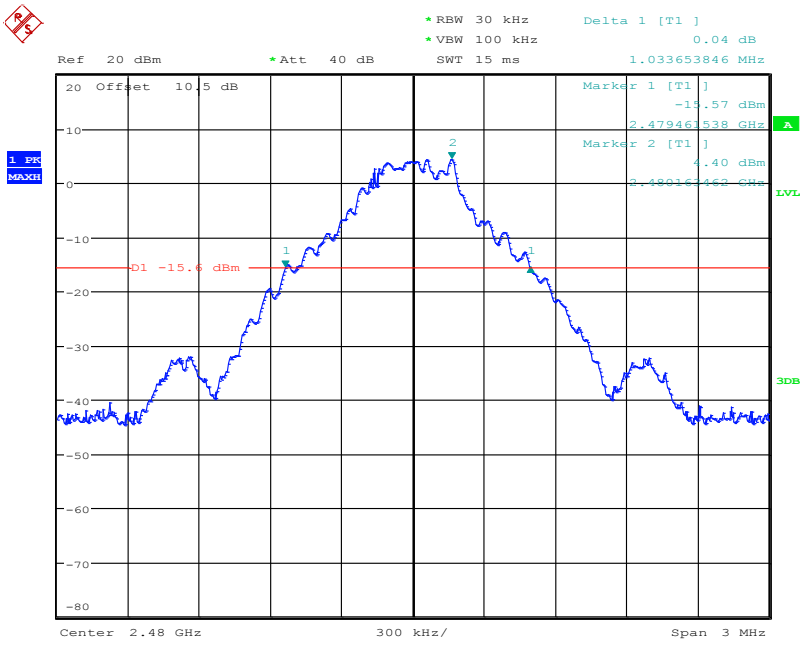


Middle Channel



Date: 14.JAN.2019 16:00:42

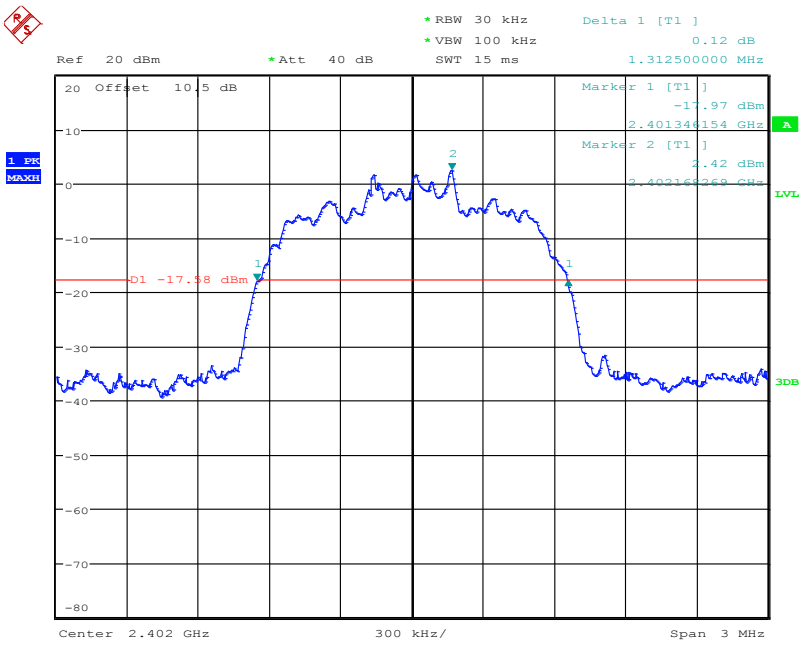
High Channel



Date: 14.JAN.2019 16:02:14

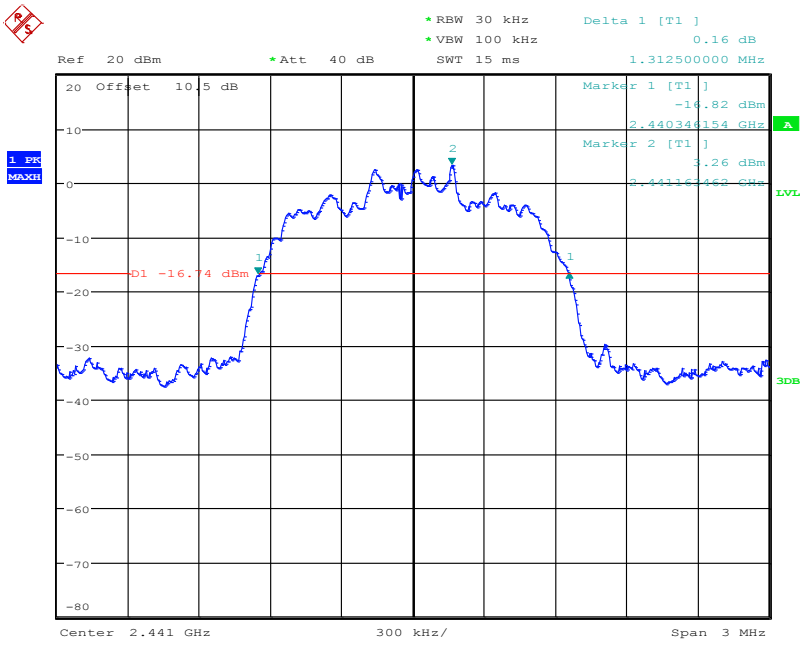
EDR Mode (π/4-DQPSK)

Low Channel



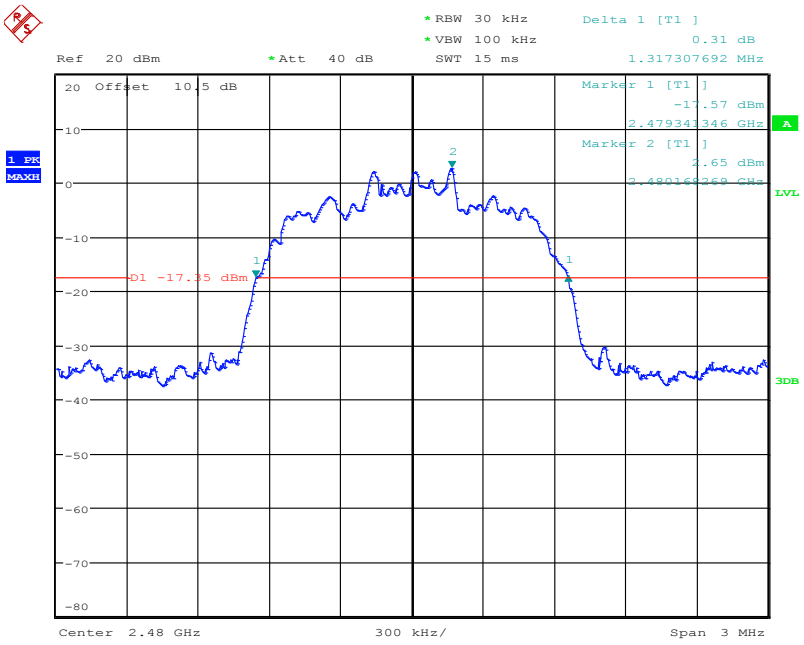
Date: 14.JAN.2019 16:32:17

Middle Channel



Date: 14.JAN.2019 16:34:09

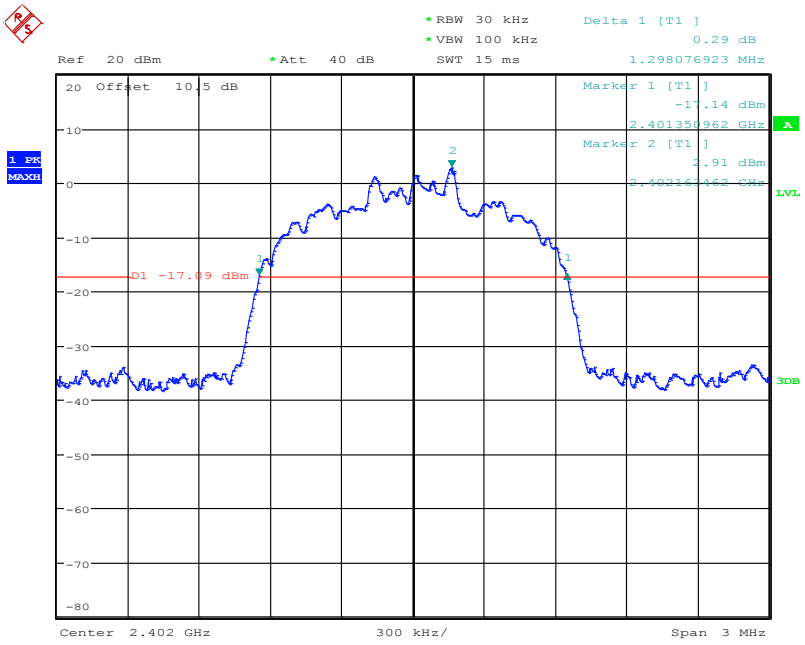
High Channel



Date: 14.JAN.2019 16:35:29

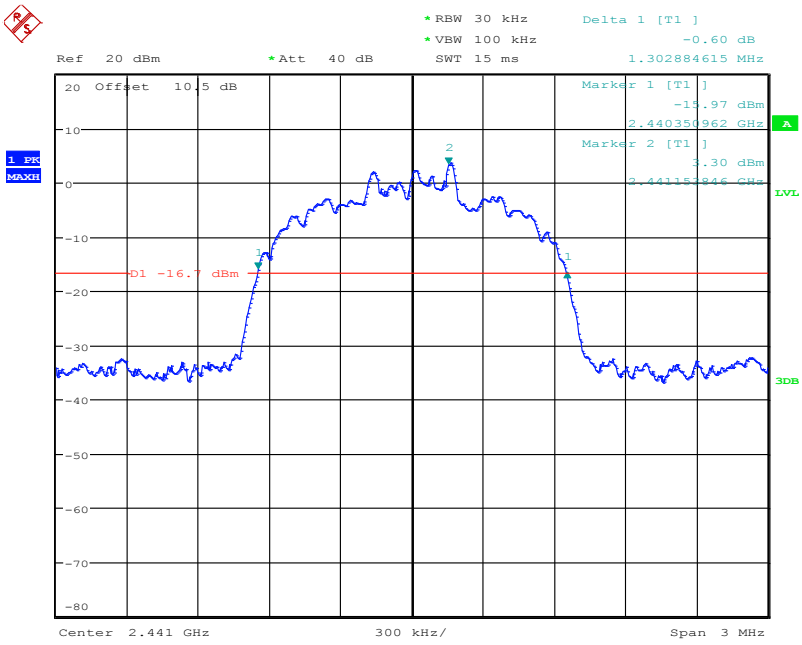
EDR Mode (8DPSK)

Low Channel



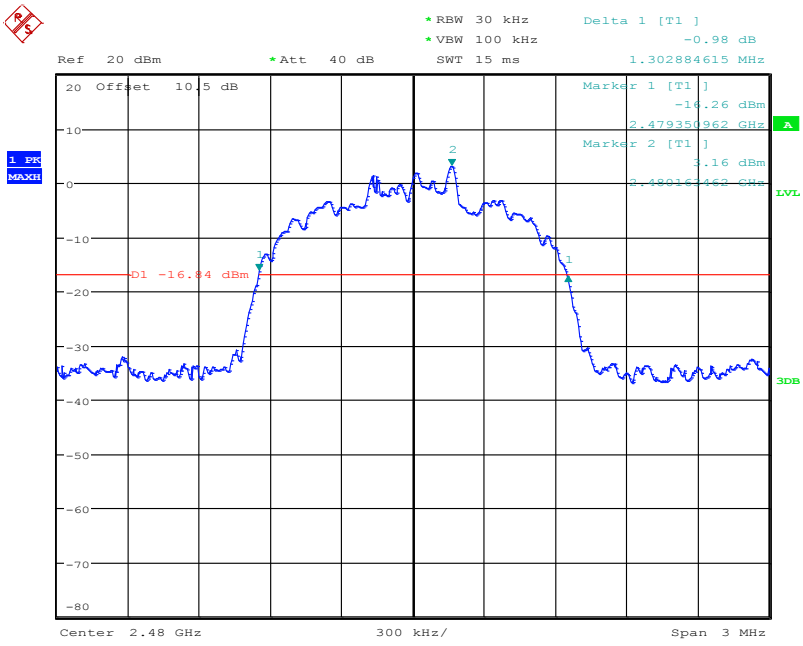
Date: 14.JAN.2019 17:26:19

Middle Channel



Date: 14.JAN.2019 17:27:59

High Channel



Date: 14.JAN.2019 17:29:20

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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

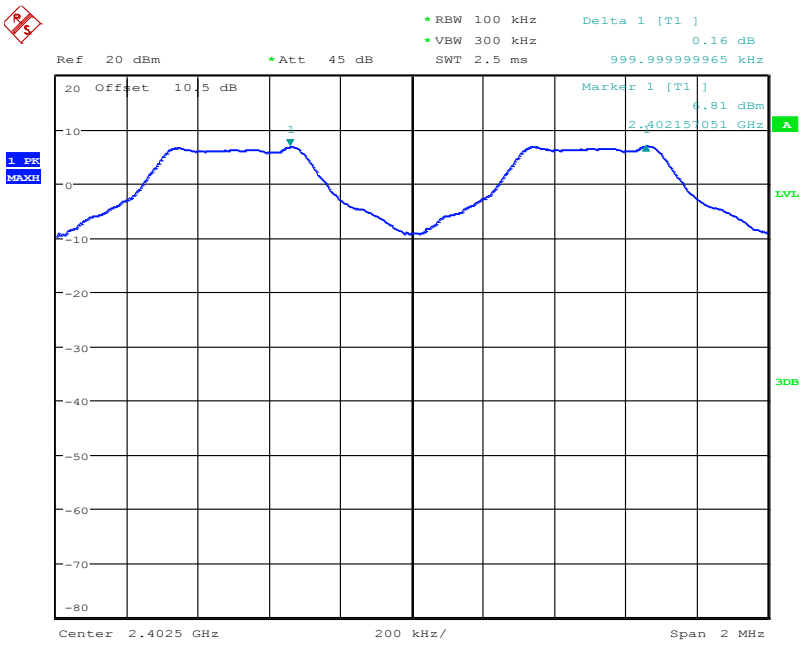
10.4 Test Results

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	1.04	0.693	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	1.04	0.693	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	1.03	0.687	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (π/4-DQPSK)					
Low	1.00	1.31	0.873	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	1.31	0.873	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	1.32	0.880	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (8DPSK)					
Low	1.00	1.30	0.867	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	1.30	0.867	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	1.30	0.867	>two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots

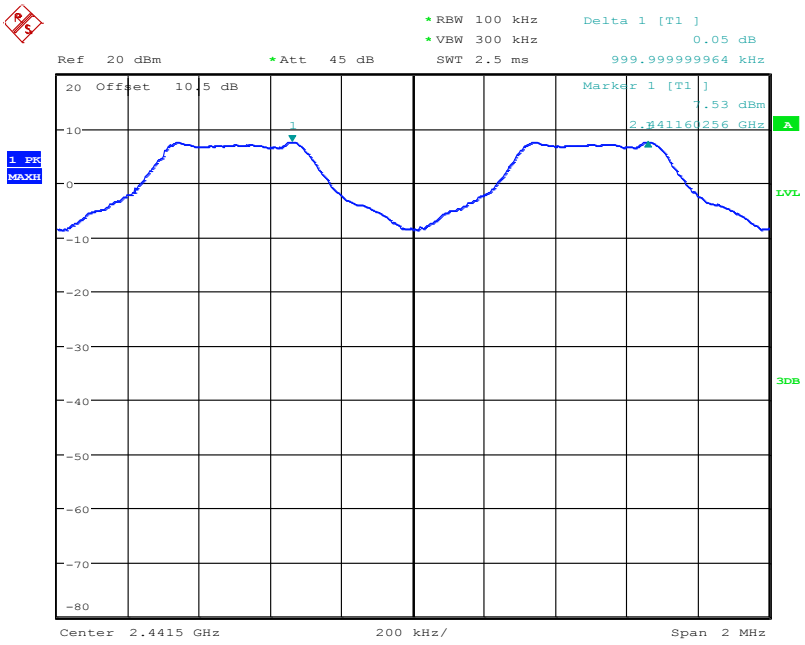
BR Mode (GFSK)

Low Channel



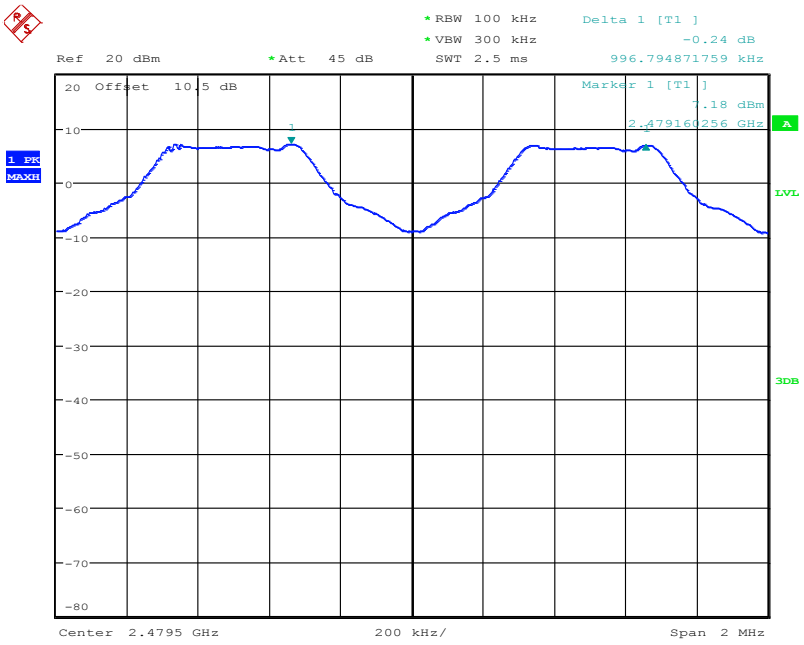
Date: 14.JAN.2019 15:56:15

Middle Channel



Date: 14.JAN.2019 15:53:36

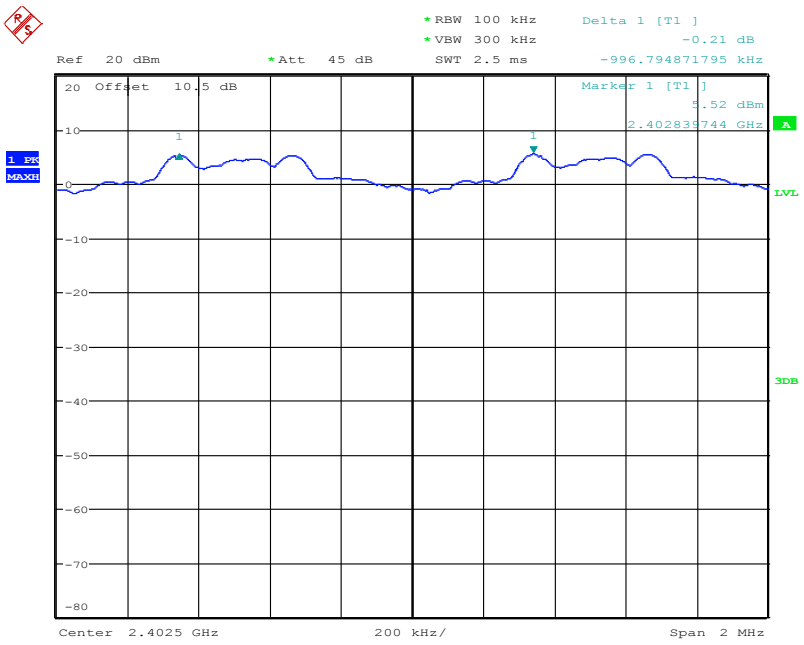
High Channel



Date: 14.JAN.2019 15:51:27

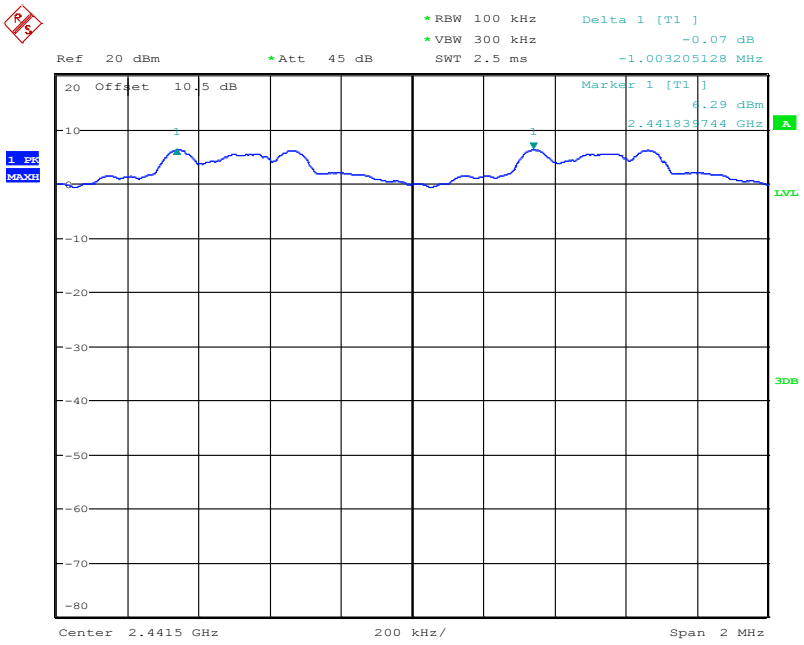
EDR Mode (π/4-DQPSK)

Low Channel



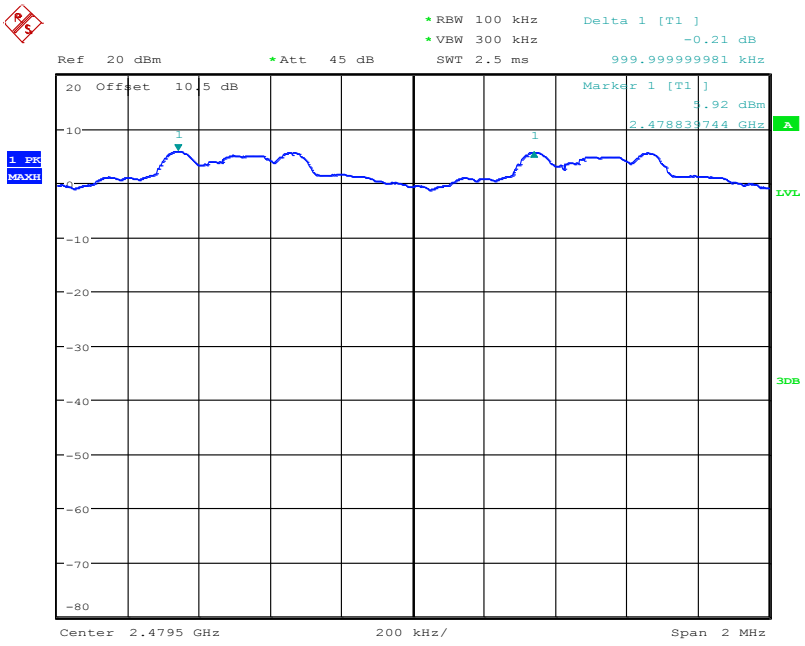
Date: 14.JAN.2019 16:22:37

Middle Channel



Date: 14.JAN.2019 16:20:07

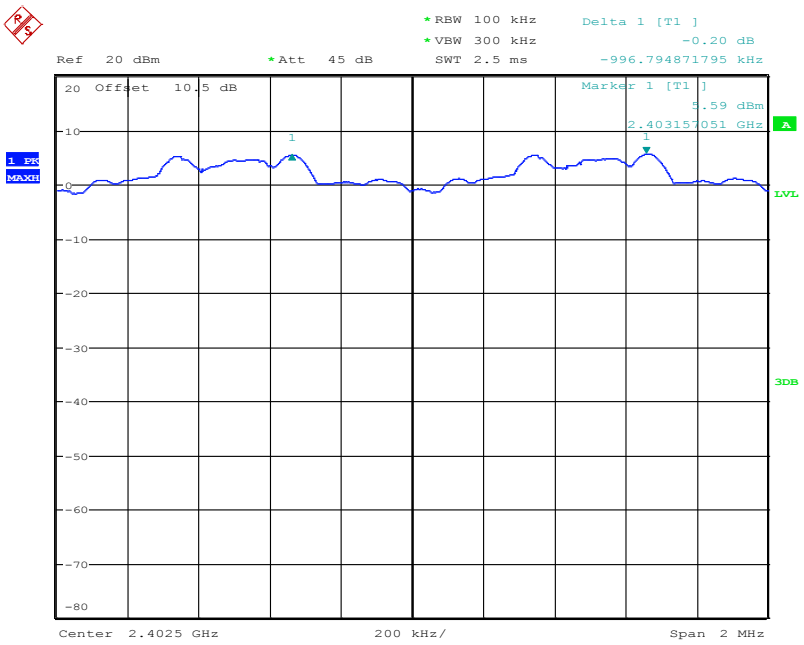
High Channel



Date: 14.JAN.2019 16:17:57

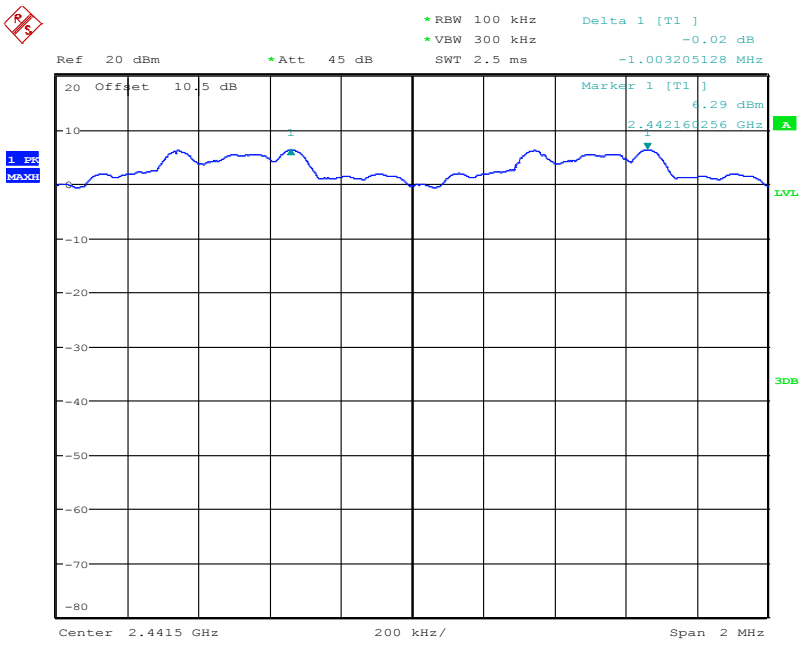
EDR Mode (8DPSK)

Low Channel



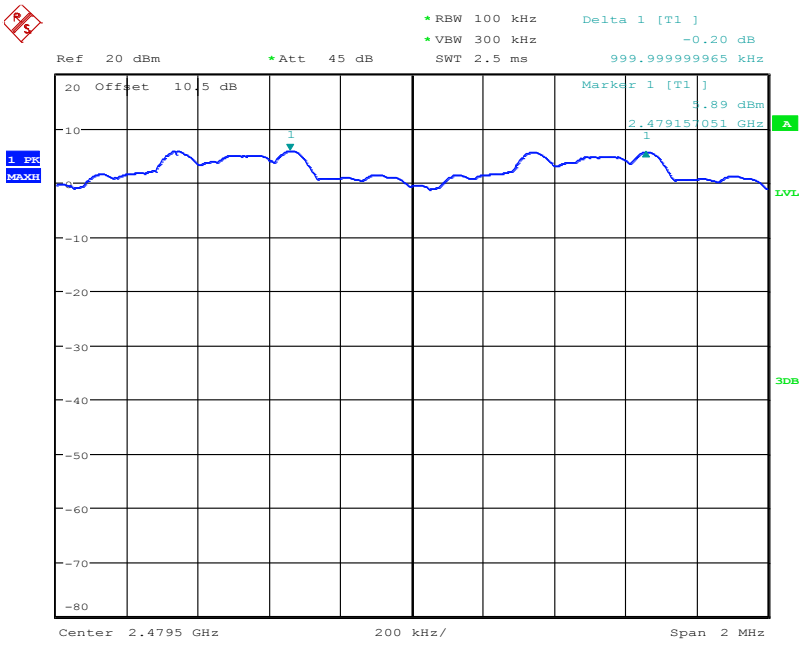
Date: 14.JAN.2019 17:09:53

Middle Channel



Date: 14.JAN.2019 17:07:53

High Channel



Date: 14.JAN.2019 17:05:38

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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

11.4 Test Results

Test mode: BR mode / 2402 MHz (*GFSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
DH1	0.37	310	31.6	114.70	<400	PASS
DH3	1.63	150	31.6	244.50	<400	PASS
DH5	2.87	110	31.6	315.70	<400	PASS
Test mode: EDR mode / 2402 MHz (*π/4-DQPSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
2DH1	0.37	300	31.6	111.00	<400	PASS
2DH3	1.63	160	31.6	260.80	<400	PASS
2DH5	2.87	100	31.6	287.00	<400	PASS
Test mode: EDR mode / 2402 MHz (*8DPSK*)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
3DH1	0.38	310	31.6	117.80	<400	PASS
3DH3	1.63	140	31.6	228.20	<400	PASS
3DH5	2.89	100	31.6	289.00	<400	PASS

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

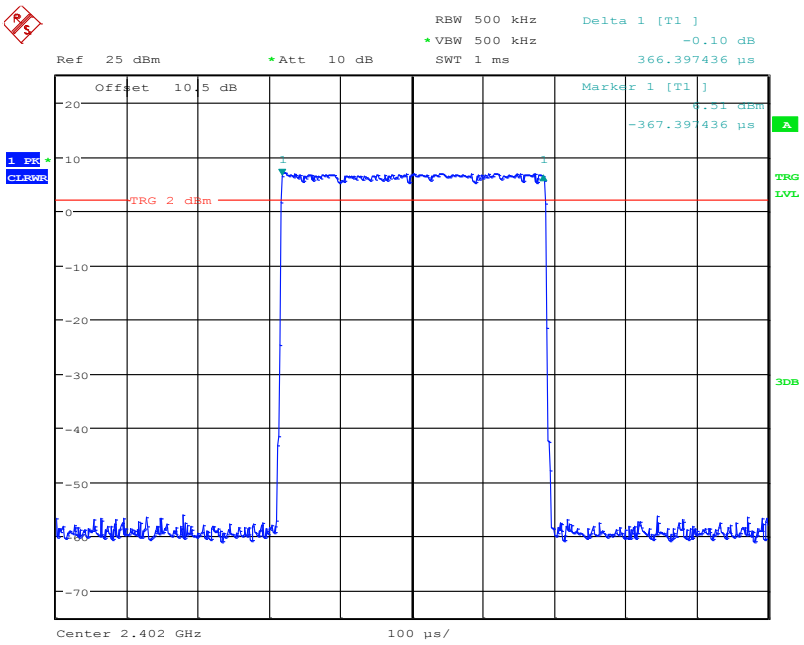
Note 2: Hopping Number/10 = Divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.

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

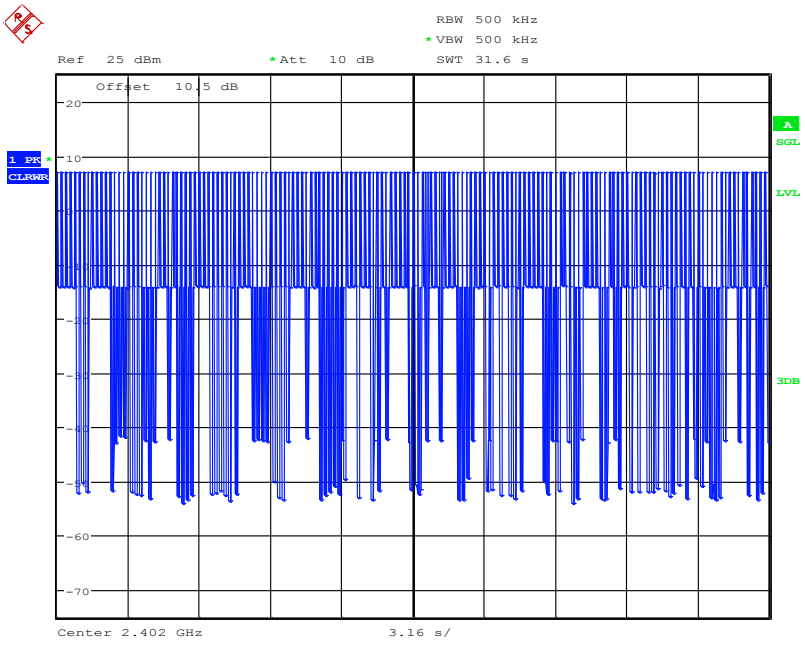
BR Mode (GFSK)

DH1: Pulse Width



Date: 14.JAN.2019 15:39:36

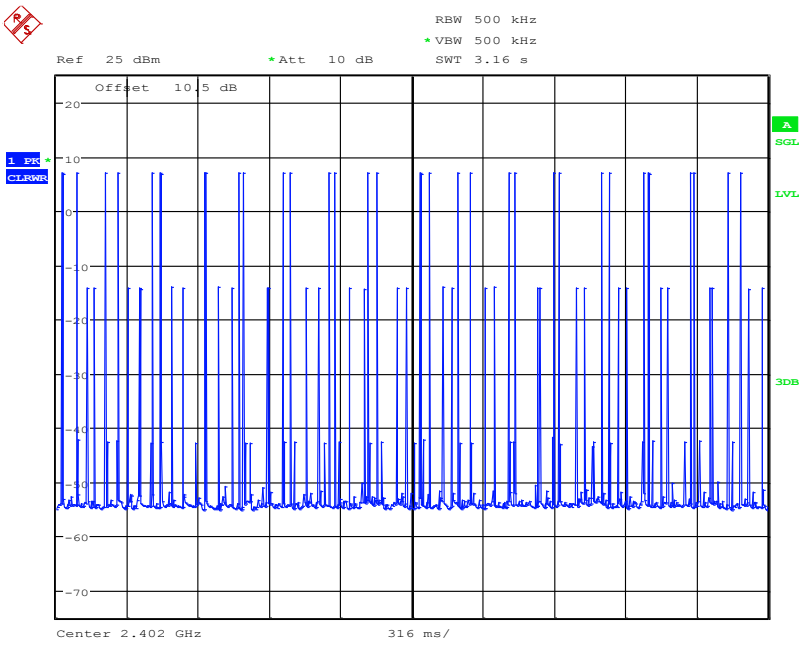
DH1: Hopping Number



Date: 14.JAN.2019 15:40:08

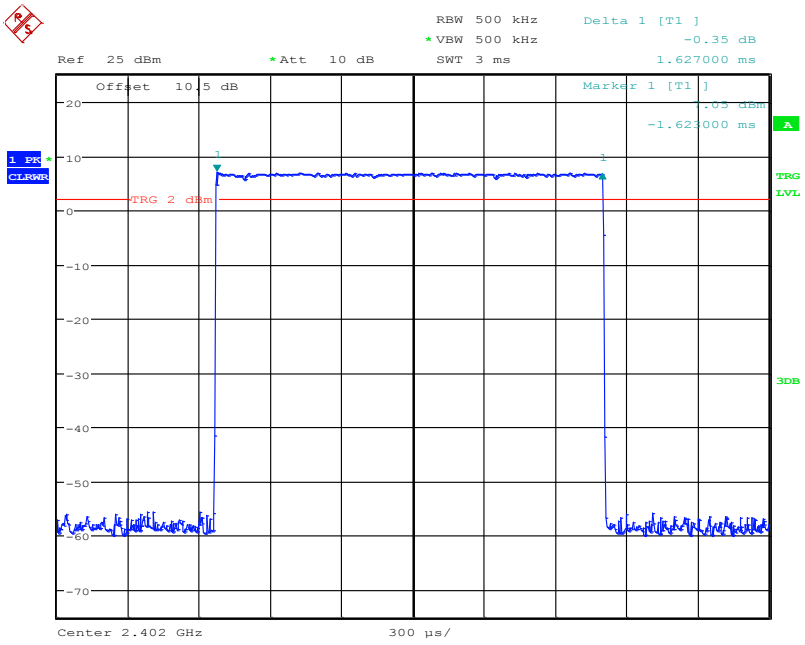
DH1: Hopping Number /10

(Hopping Number = 31 in 1/10 period of highest signals, Second High signals were other channel)



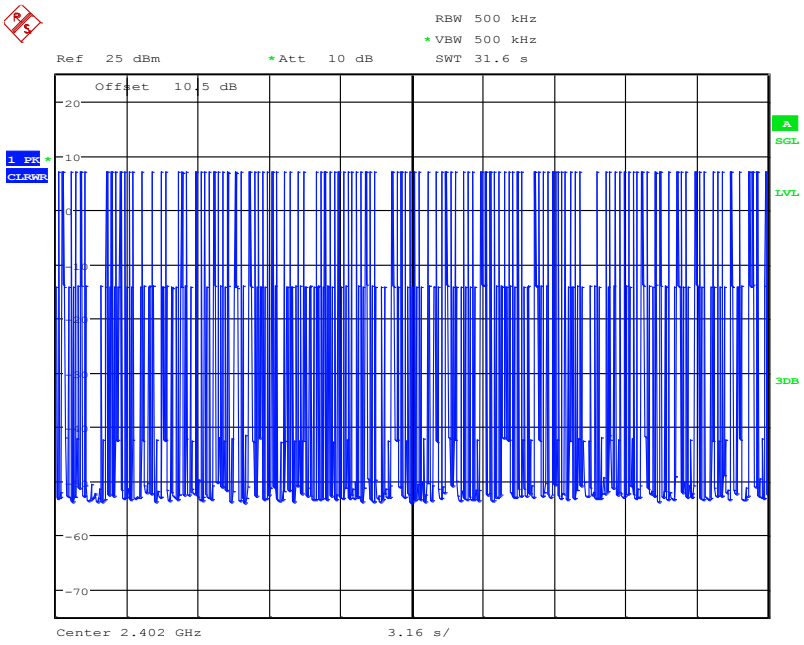
Date: 14.JAN.2019 15:40:16

DH3: Pulse Width



Date: 14.JAN.2019 15:41:31

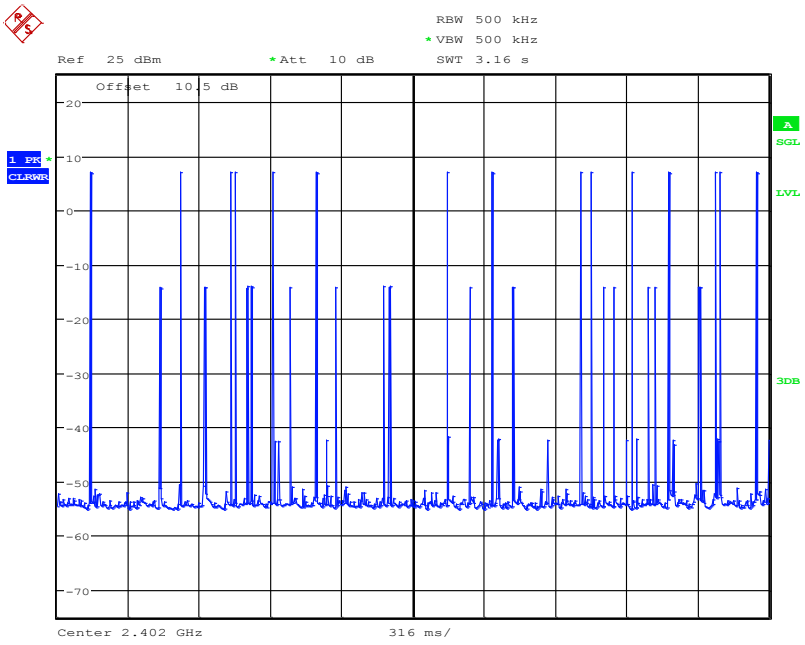
DH3: Hopping Number



Date: 14.JAN.2019 15:42:03

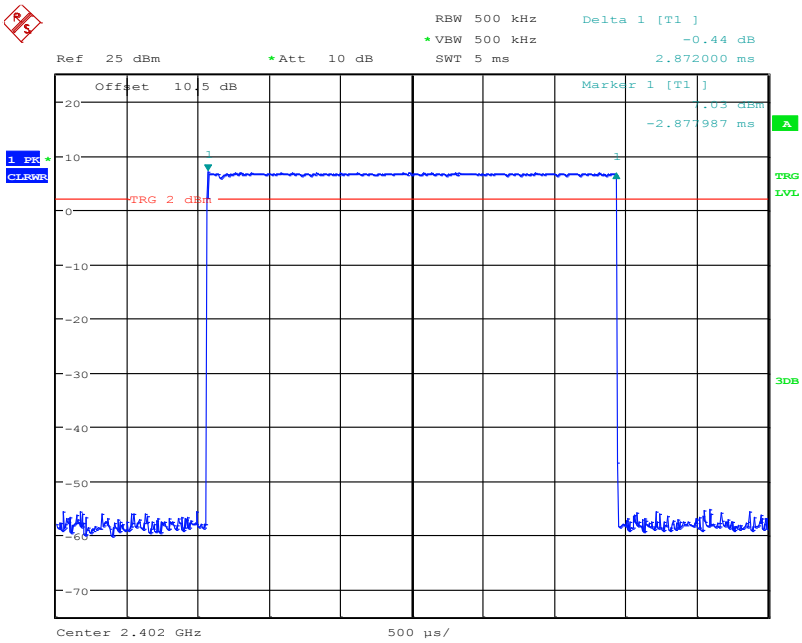
DH3: Hopping Number /10

(Hopping Number = 15 in 1/10 period of highest signals, Second High signals were other channel)



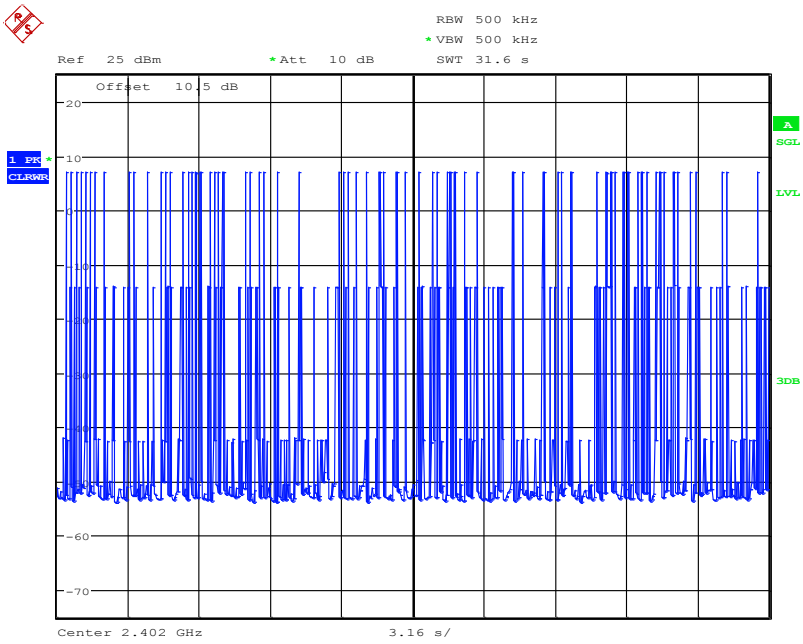
Date: 14.JAN.2019 15:42:43

DH5: Pulse Width



Date: 14.JAN.2019 15:44:08

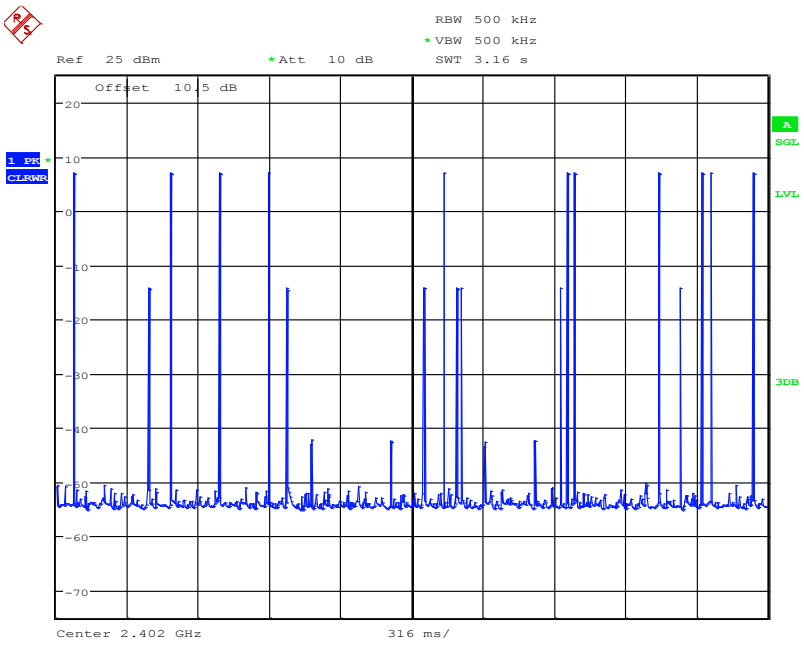
DH5: Hopping Number



Date: 14.JAN.2019 15:44:40

DH5: Hopping Number /10

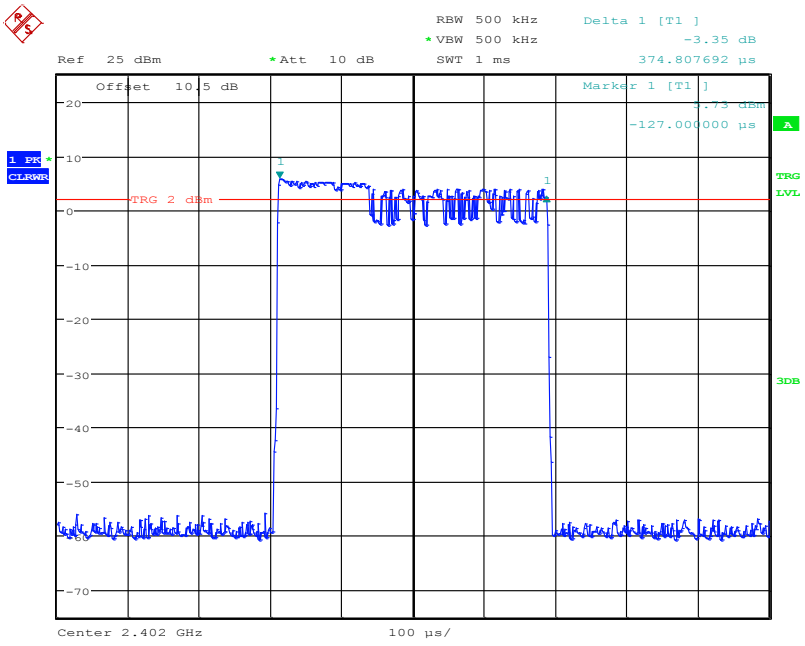
(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)



Date: 14.JAN.2019 15:45:16

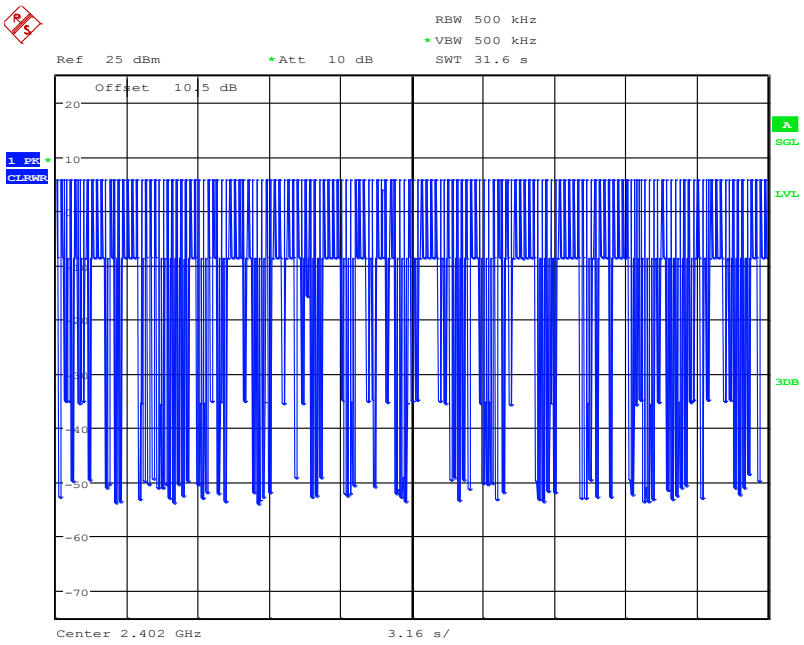
EDR Mode (π/4-DQPSK)

2DH1: Pulse Width



Date: 14.JAN.2019 16:06:08

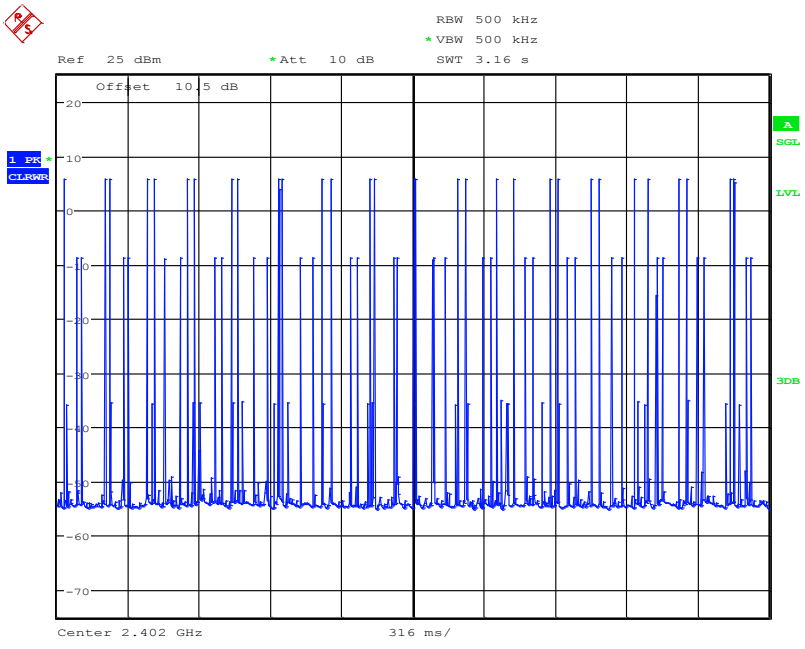
2DH1: Hopping Number



Date: 14.JAN.2019 16:06:41

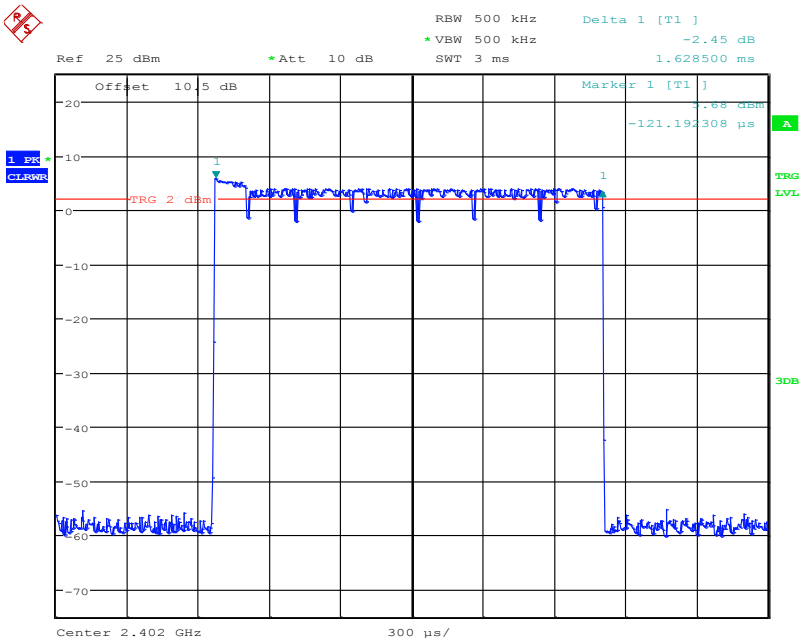
2DH1: Hopping Number /10

(Hopping Number = 30 in 1/10 period of highest signals, Second High signals were other channel)



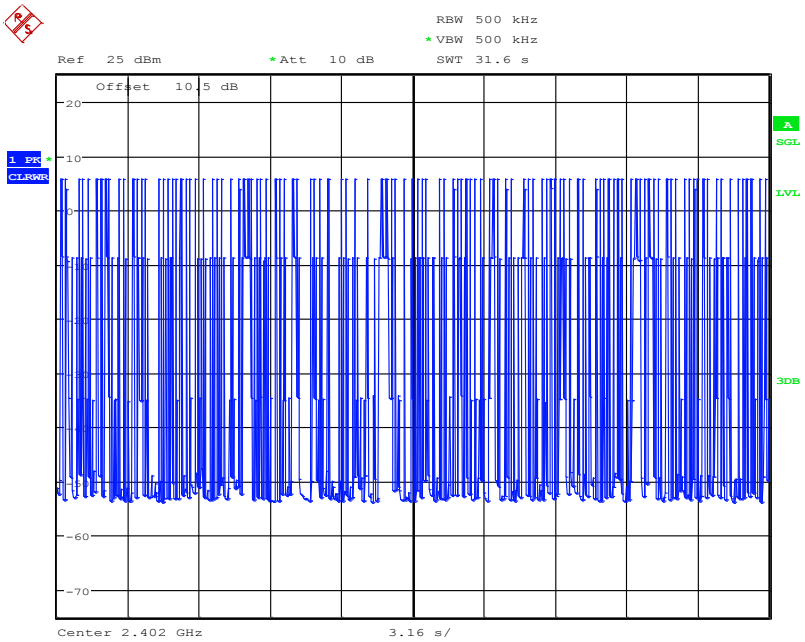
Date: 14.JAN.2019 16:06:57

2DH3: Pulse Width



Date: 14.JAN.2019 16:08:58

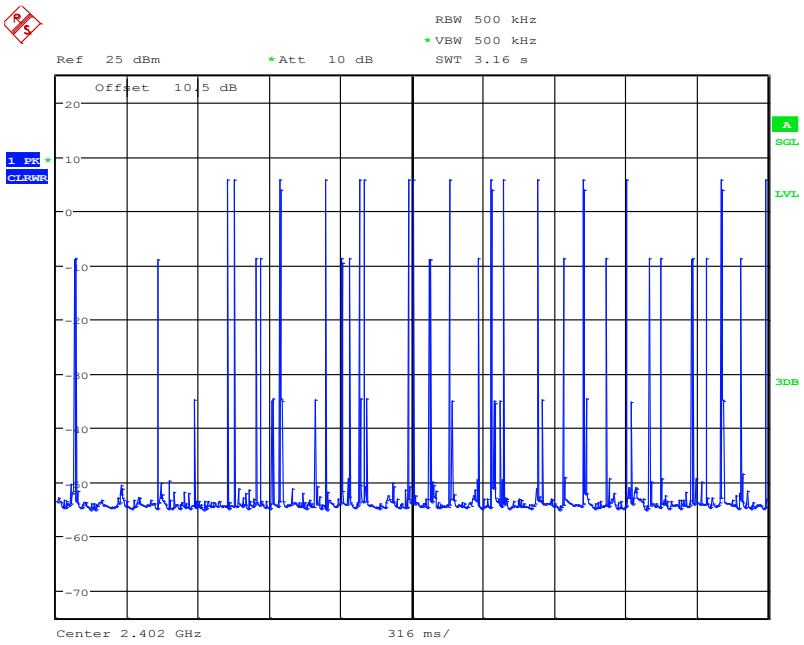
2DH3: Hopping Number



Date: 14.JAN.2019 16:09:31

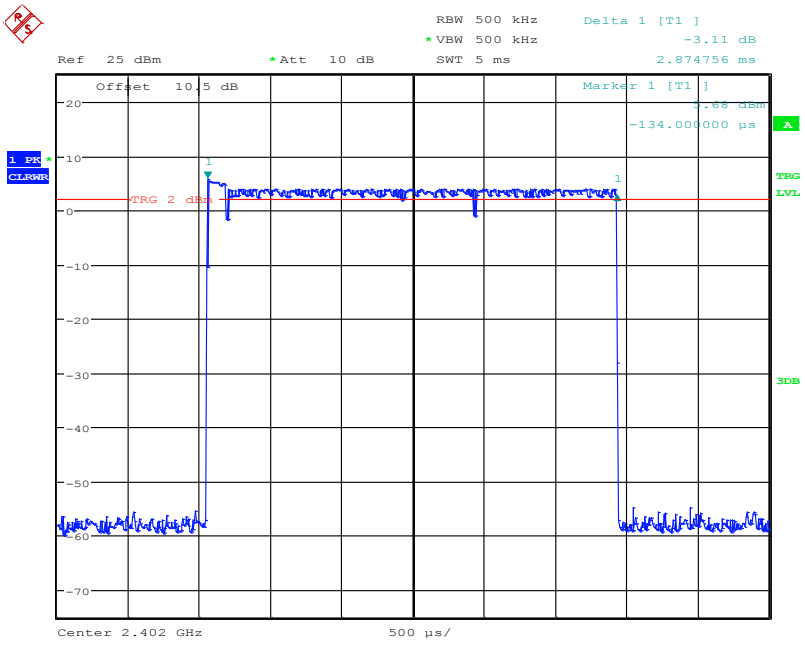
2DH3: Hopping Number /10

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



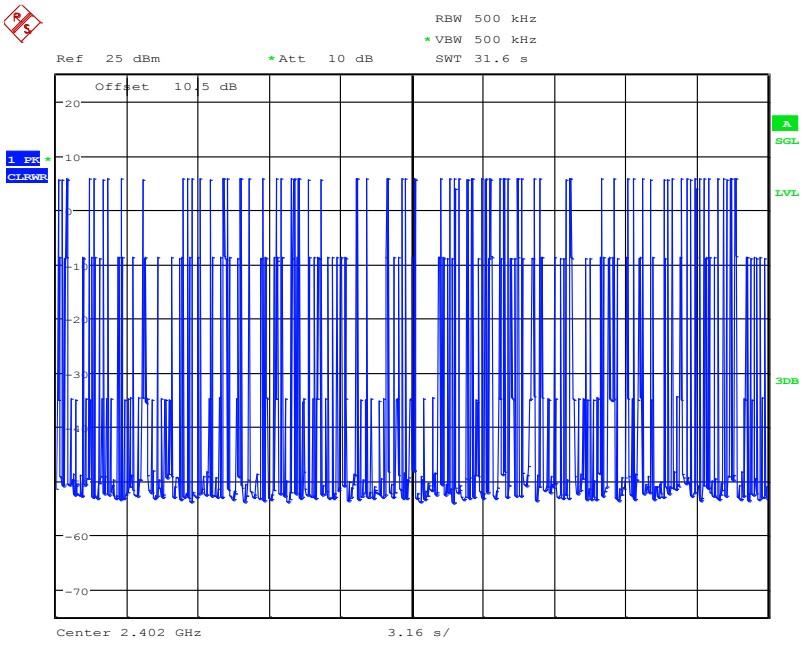
Date: 14.JAN.2019 16:11:03

2DH5: Pulse Width



Date: 14.JAN.2019 16:12:36

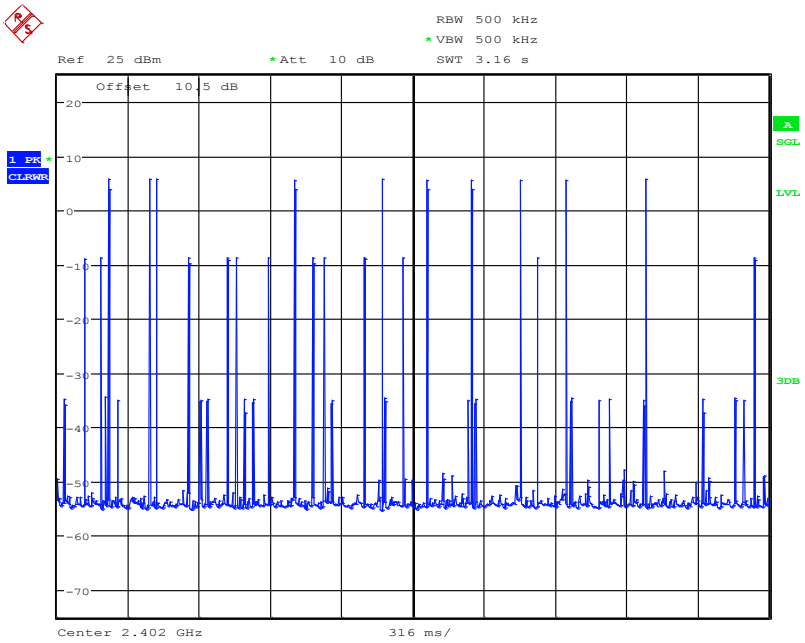
2DH5: Hopping Number



Date: 14.JAN.2019 16:13:08

2DH5: Hopping Number /10

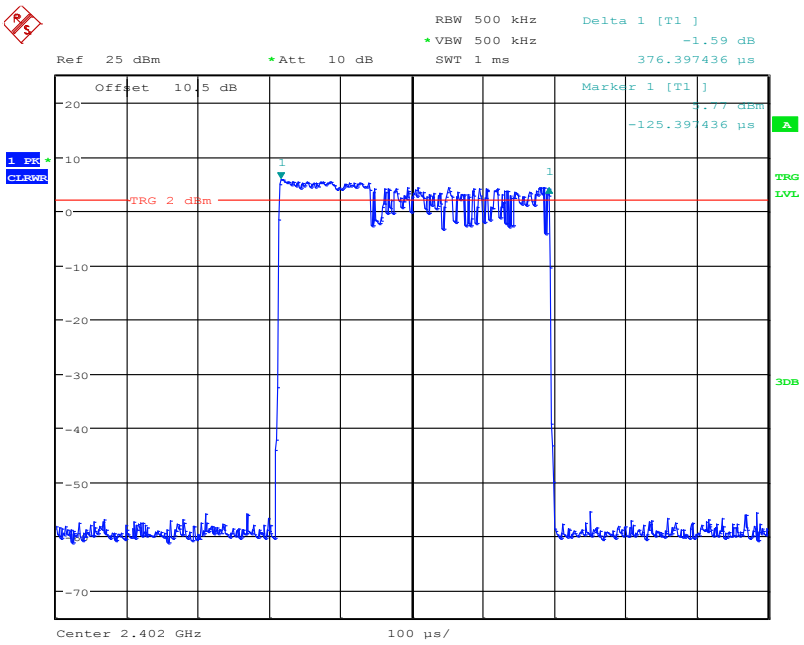
(Hopping Number = 10 in 1/10 period of highest signals, Second High signals were other channel)



Date: 14.JAN.2019 16:13:23

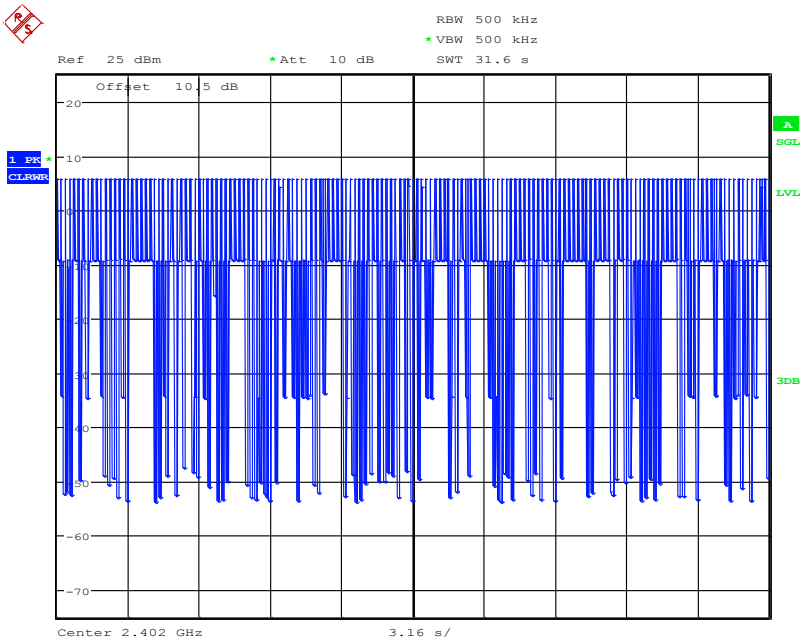
EDR Mode (8DPSK)

3DH1: Pulse Width



Date: 14.JAN.2019 16:51:41

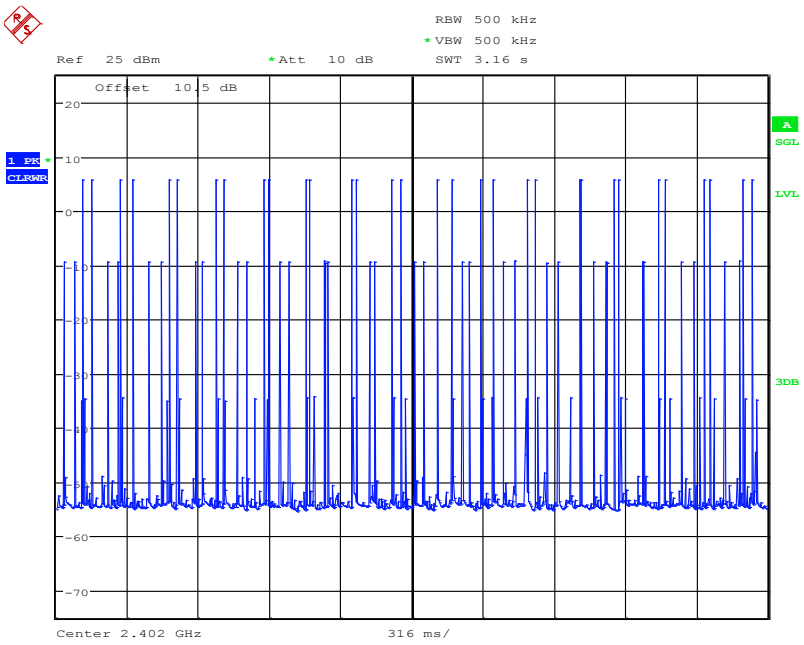
3DH1: Hopping Number



Date: 14.JAN.2019 16:52:14

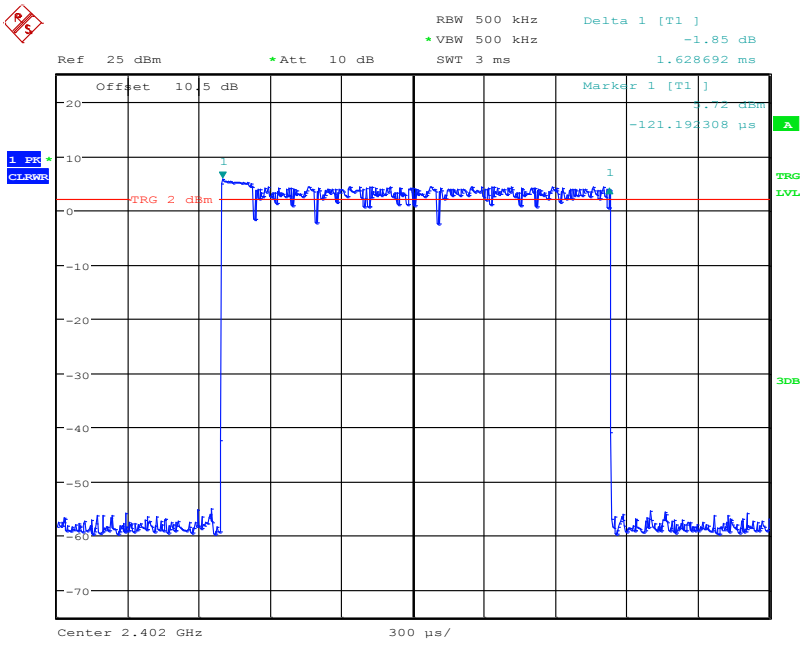
3DH1: Hopping Number /10

(Hopping Number = 31 in 1/10 period of highest signals, Second High signals were other channel)



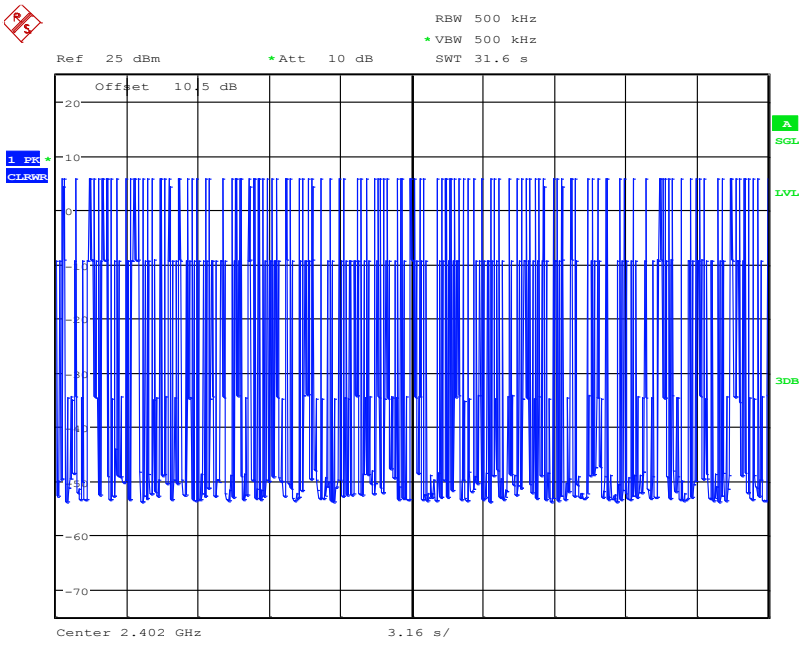
Date: 14.JAN.2019 16:52:20

3DH3: Pulse Width



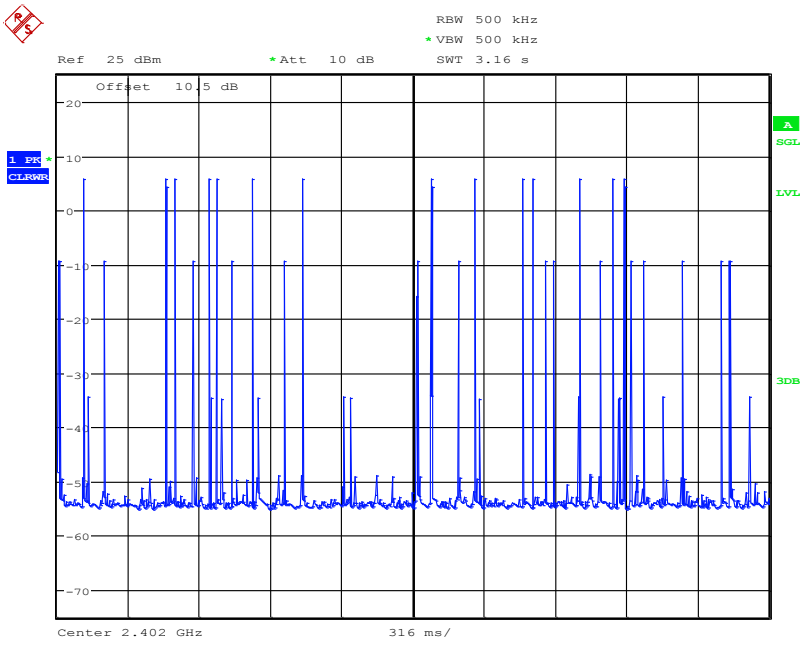
Date: 14.JAN.2019 16:54:09

3DH3: Hopping Number

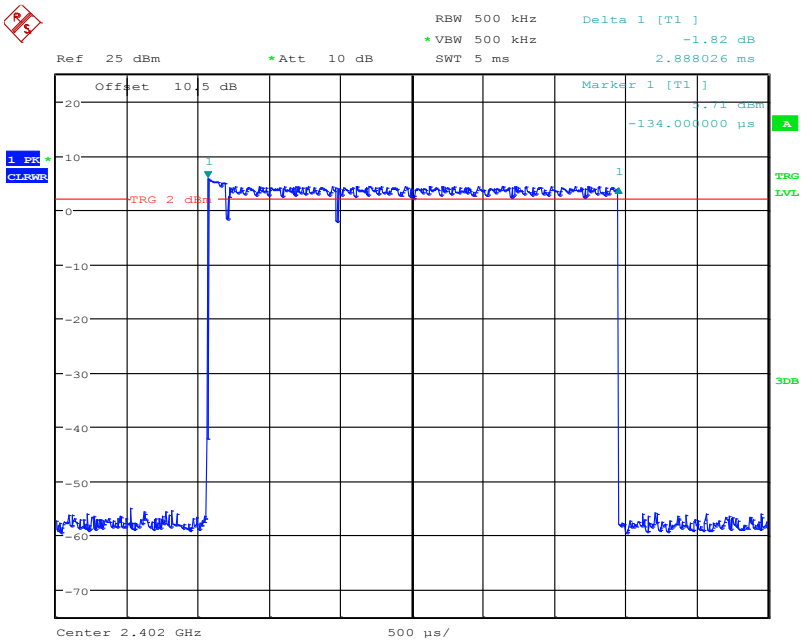


3DH3: Hopping Number /10

(Hopping Number = 14 in 1/10 period of highest signals, Second High signals were other channel)

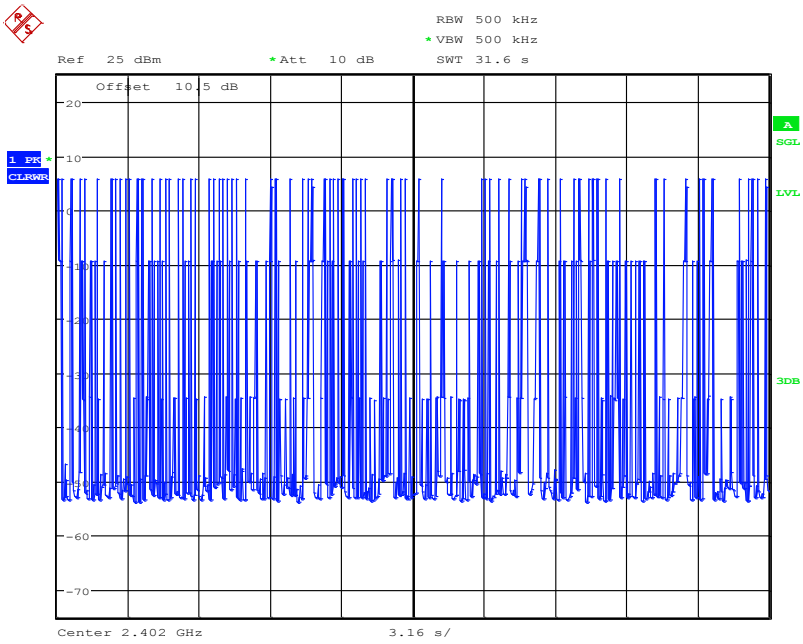


3DH5: Pulse Width



Date: 14.JAN.2019 16:57:00

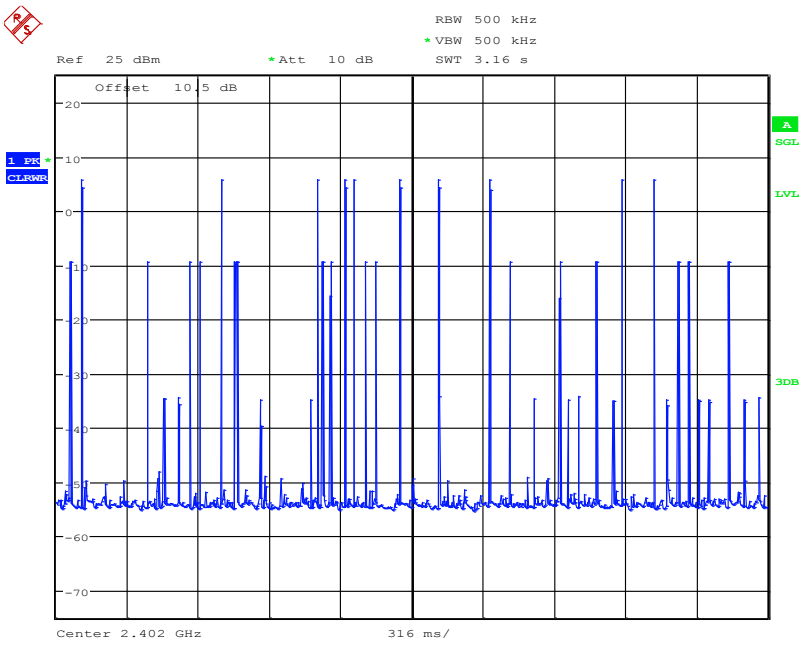
3DH5: Hopping Number



Date: 14.JAN.2019 16:57:33

3DH5: Hopping Number /10

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



Date: 14.JAN.2019 16:58:28

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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

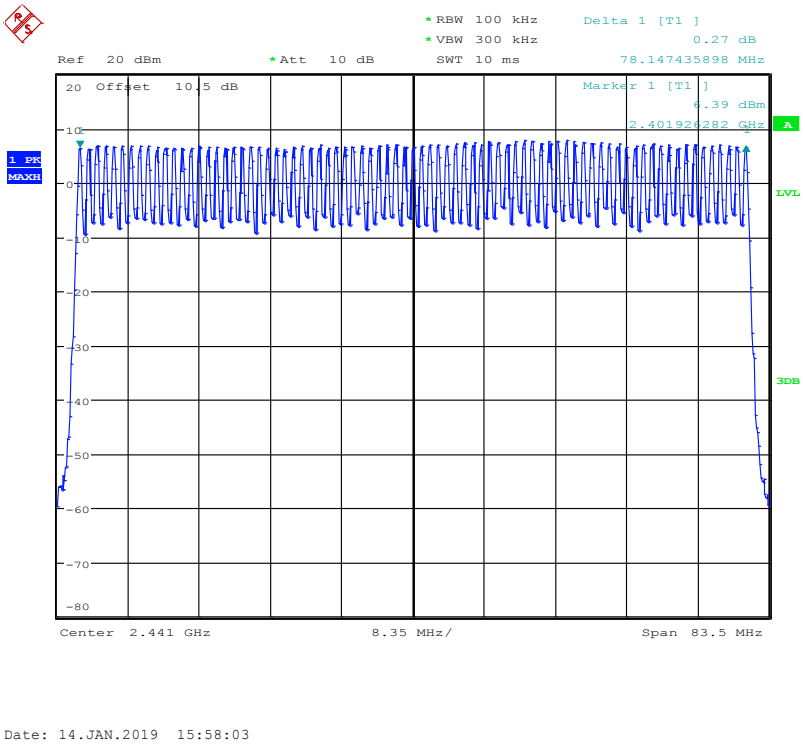
The testing was performed by Tom Hsu on 2019-01-14.

12.4 Test Results

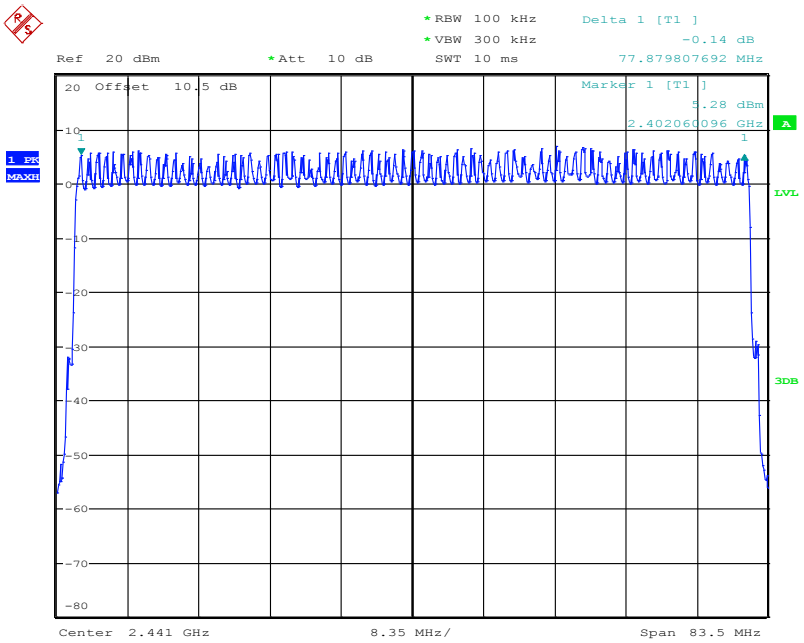
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)	Result
GFSK	2402-2480	79	>15	Compliance
π/4-DQPSK	2402-2480	79	>15	Compliance
8DPSK	2402-2480	79	>15	Compliance

Please refer to the following plots

BR Mode (GFSK)

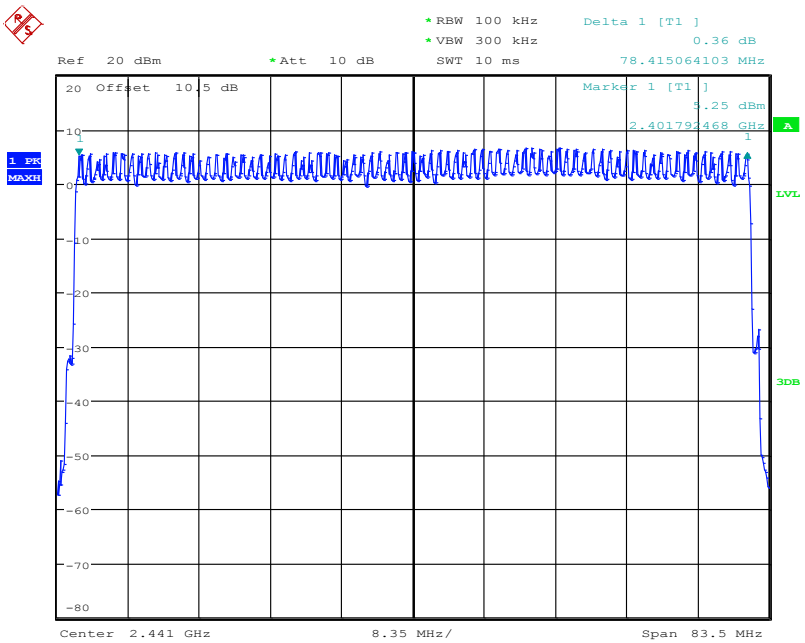


EDR Mode (π/4-DQPSK)



Date: 14.JAN.2019 16:31:21

EDR Mode (8DPSK)



Date: 14.JAN.2019 17:25:23

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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

13.4 Test Results

Channel	Frequency (MHz)	Peak Conducted Output Power		Limit (W)	Result
		(dBm)	(W)		
BR Mode (GFSK)					
Low	2402	5.21	0.0033	0.125	Compliance
Middle	2441	5.89	0.0039	0.125	Compliance
High	2480	5.14	0.0033	0.125	Compliance
EDR Mode (π/4-DQPSK)					
Low	2402	2.46	0.0018	0.125	Compliance
Middle	2441	3.27	0.0021	0.125	Compliance
High	2480	2.58	0.0018	0.125	Compliance
EDR Mode (8DPSK)					
Low	2402	2.36	0.0017	0.125	Compliance
Middle	2441	2.95	0.0020	0.125	Compliance
High	2480	2.27	0.0017	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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

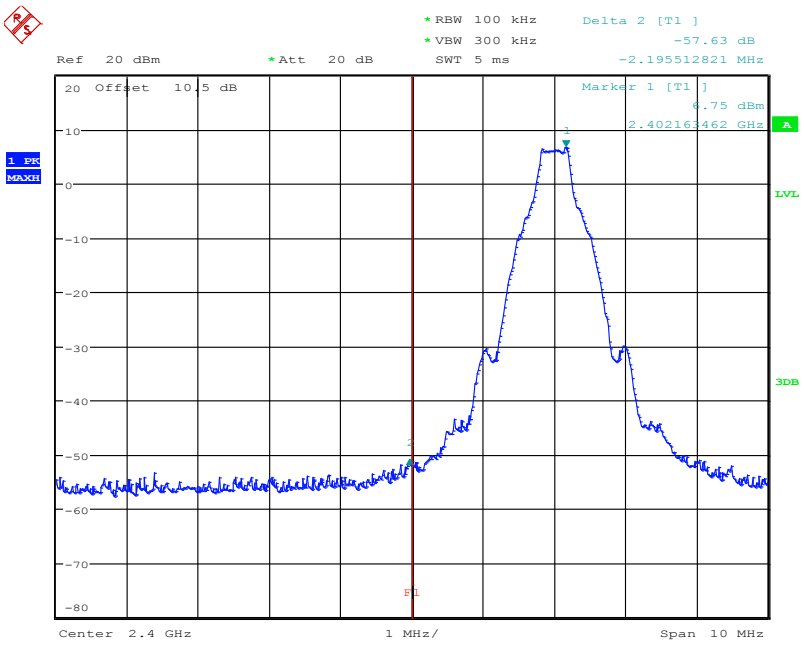
14.4 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	57.63	≥ 20	PASS
High	2480	59.77	≥ 20	PASS
BR Hopping Mode (GFSK)				
Low	2402-2480	57.88	≥ 20	PASS
High	2402-2480	60.30	≥ 20	PASS
EDR Mode (π/4-DQPSK)				
Low	2402	55.58	≥ 20	PASS
High	2480	58.76	≥ 20	PASS
EDR Hopping Mode (π/4-DQPSK)				
Low	2402-2480	55.64	≥ 20	PASS
High	2402-2480	58.50	≥ 20	PASS
EDR Mode (8DPSK)				
Low	2402	54.53	≥ 20	PASS
High	2480	58.21	≥ 20	PASS
EDR Hopping Mode (8DPSK)				
Low	2402-2480	55.43	≥ 20	PASS
High	2402-2480	58.77	≥ 20	PASS

Please refer to the following plots

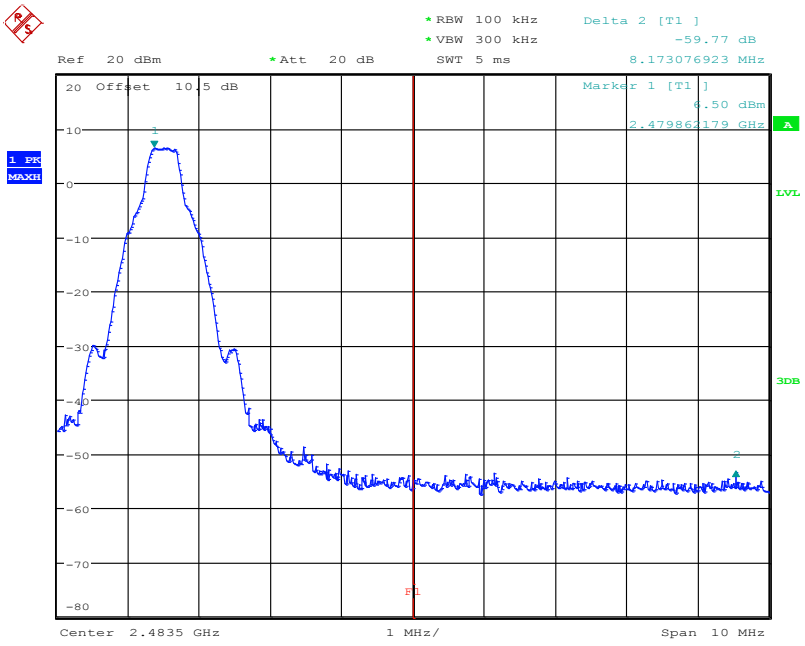
BR Mode (GFSK)

Band Edge, CH Low



Date: 14.JAN.2019 15:59:41

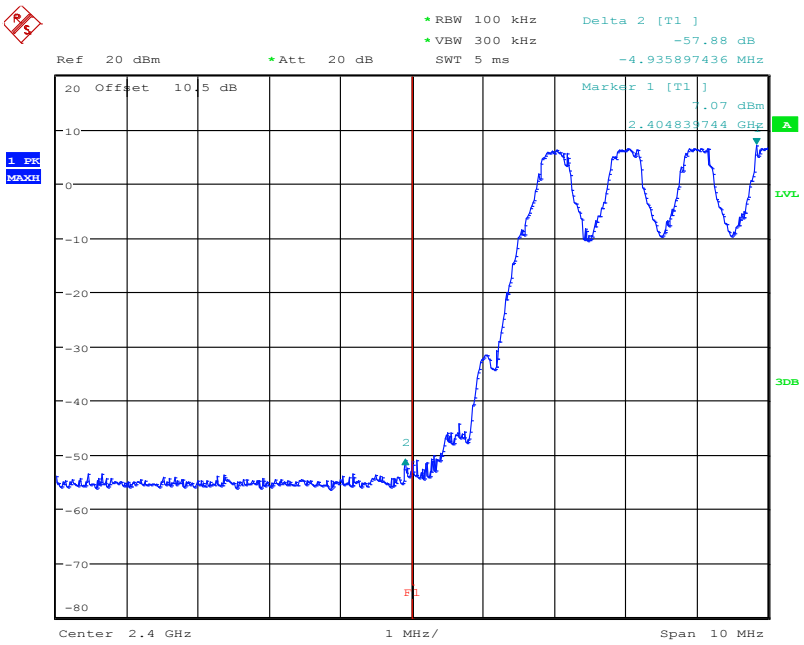
Band Edge, CH High



Date: 14.JAN.2019 16:02:50

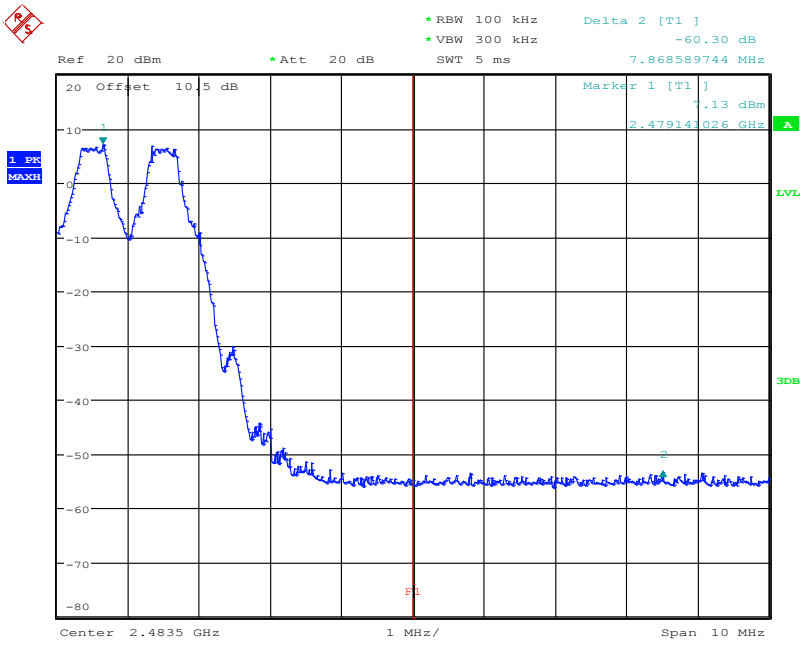
BR Hopping Mode (GFSK)

Band Edge, CH Low



Date: 14.JAN.2019 15:46:51

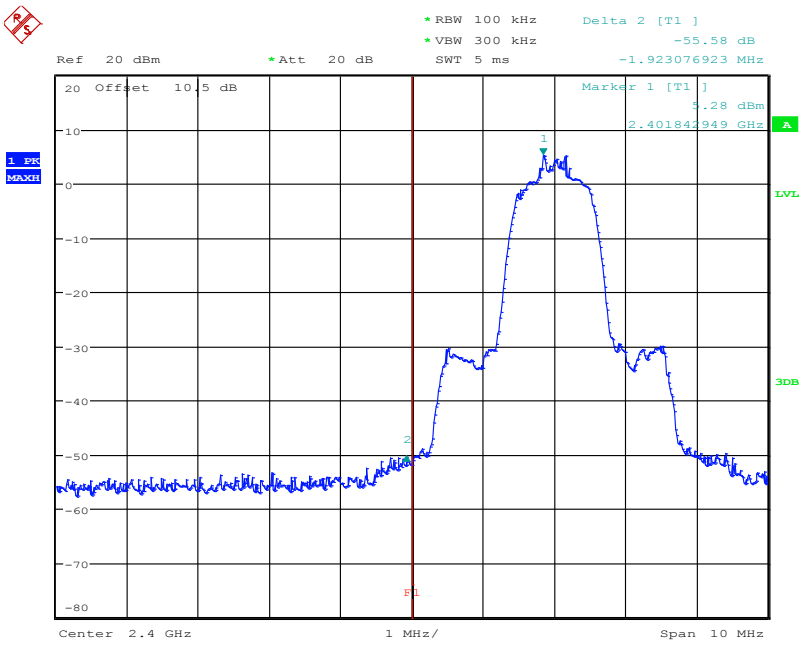
Band Edge, CH High



Date: 14.JAN.2019 15:48:20

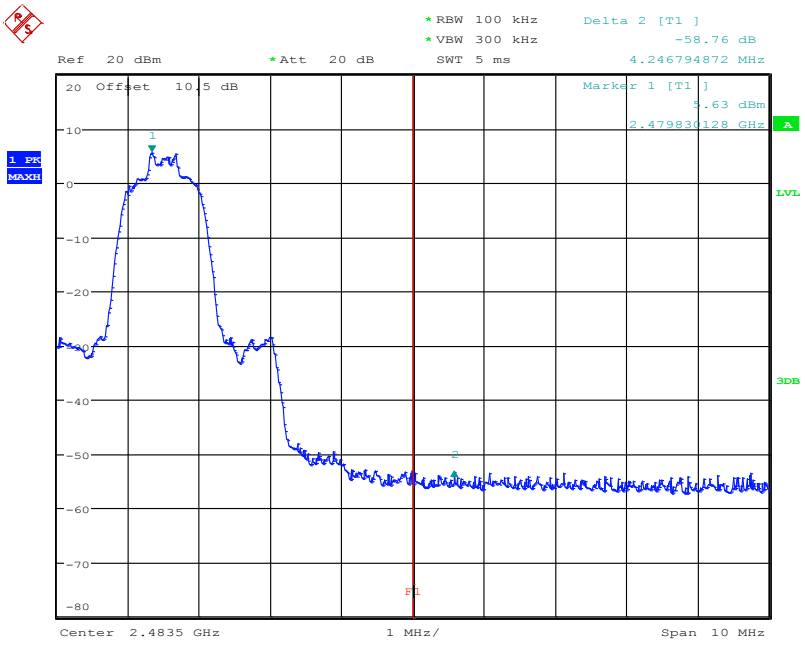
EDR Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 14.JAN.2019 16:32:53

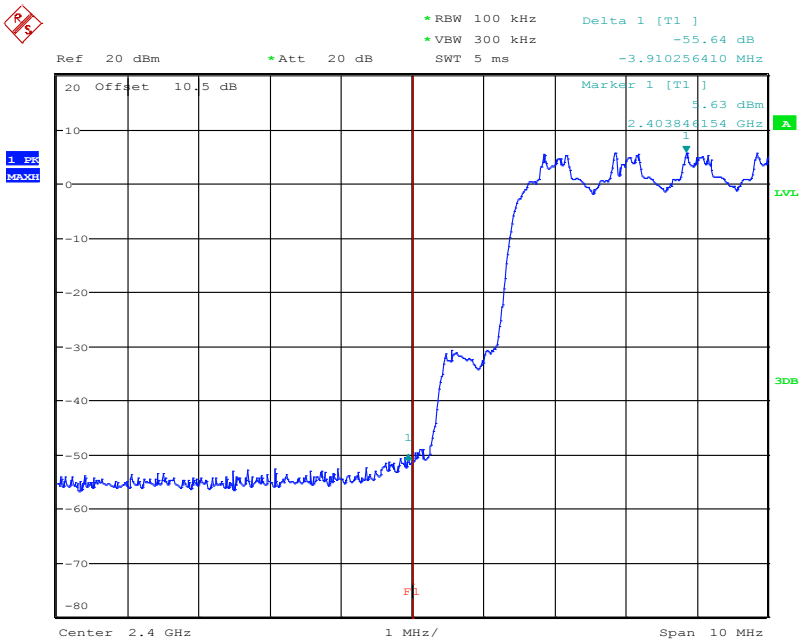
Band Edge, CH High



Date: 14.JAN.2019 16:36:05

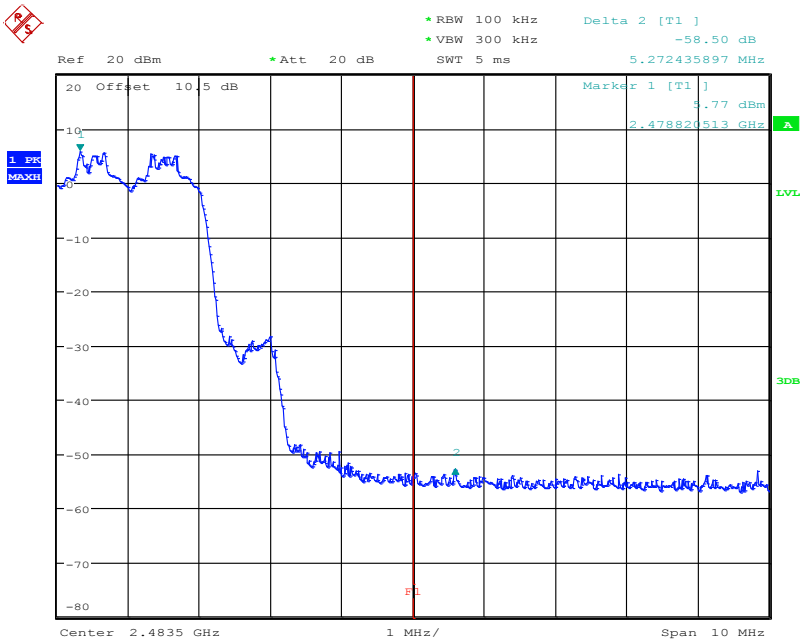
EDR Hopping Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 14.JAN.2019 16:49:14

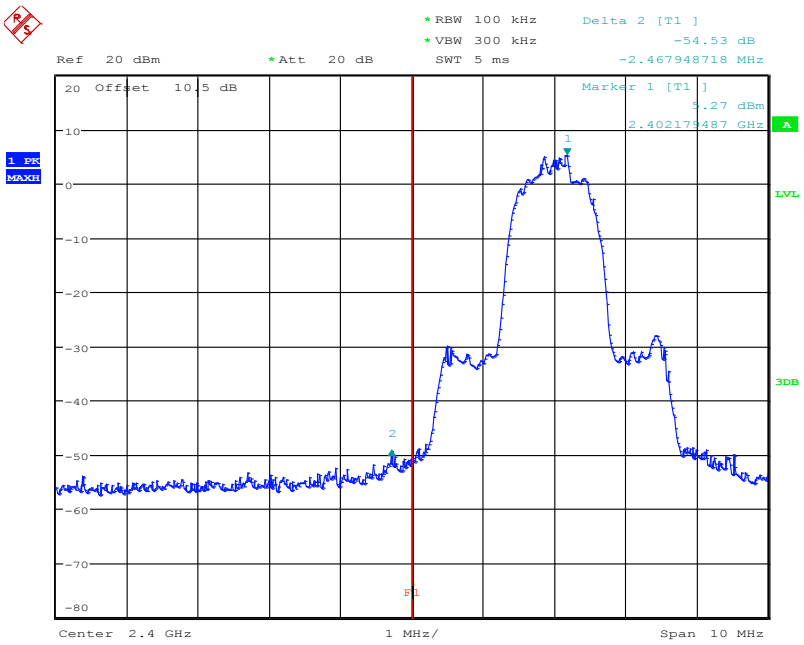
Band Edge, CH High



Date: 14.JAN.2019 16:15:31

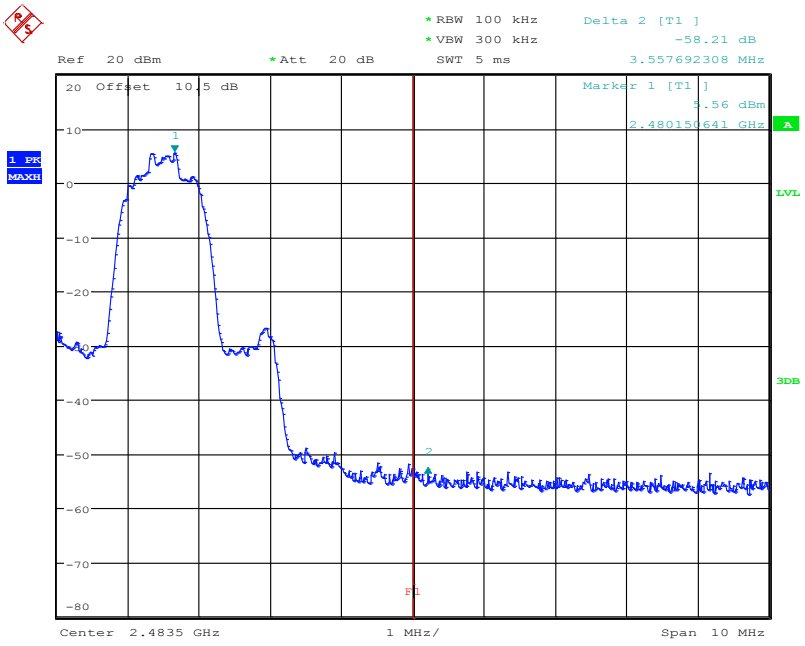
EDR Mode (8DPSK)

Band Edge, CH Low



Date: 14.JAN.2019 17:36:14

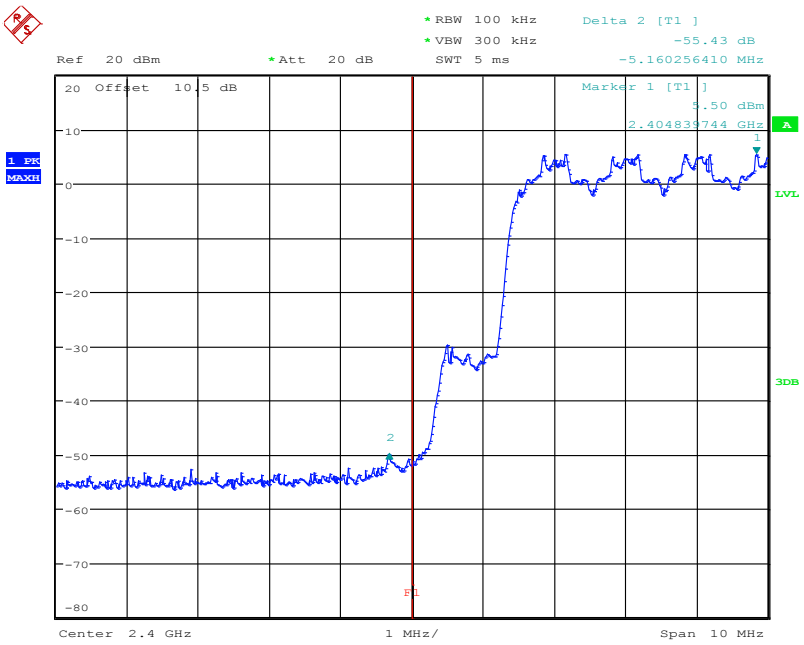
Band Edge, CH High



Date: 14.JAN.2019 17:29:56

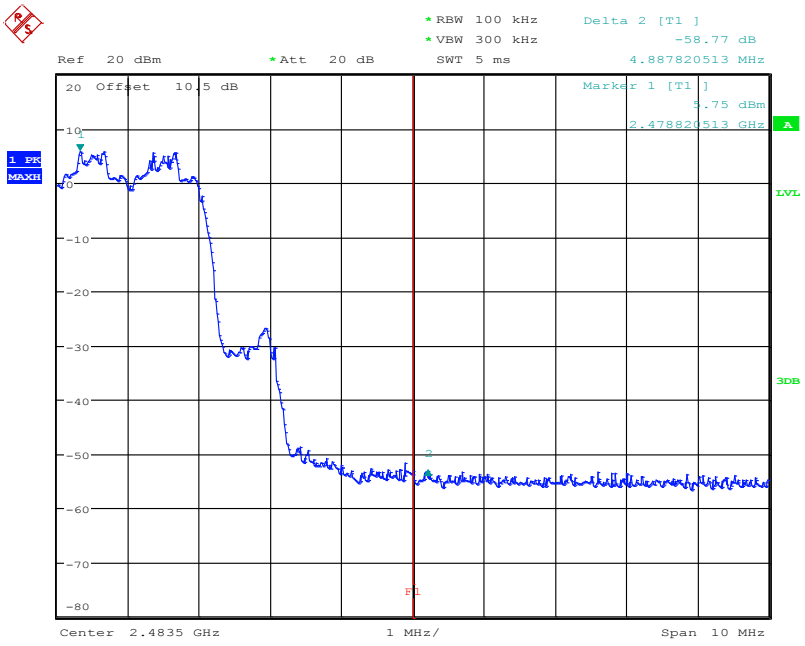
EDR Hopping Mode (8DPSK)

Band Edge, CH Low



Date: 14.JAN.2019 17:02:23

Band Edge, CH High



Date: 14.JAN.2019 17:03:21

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