FCC PART 15.247

TEST REPORT

For

DSG Global Inc.

2630 Croydon Dr., Suite 312, Surrey, British Columbia, Canada V3Z6T3

Tested Model: DSG-121-VT
FCC ID: 2ARPX-DSG121VT

Report Type:	**Equipment Name:**
Original Report	Embedded Computer

Report Number:	RSC180927003-0D
Date of Report Issue:	2019-04-22
Reviewed By:	Sula Huang
Prepared By:	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: +86-28-65525123 Fax: +86-28-65525125 www.baclcorp.com

FINAL

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Chengdu). This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" .

TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
RELATED SUBMITTAL(S)/GRANT(S) 4
MEASUREMENT UNCERTAINTY 5
TEST METHODOLOGY 5
TEST FACILITY 5
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EQUIPMENT MODIFICATIONS 6
EUT EXERCISE SOFTWARE 6
SUPPORT EQUIPMENT LIST AND DETAILS 6
EXTERNAL I/O CABLE 6
BLOCK DIAGRAM OF TEST SETUP 7
SUMMARY OF TEST RESULTS **8**
TEST EQUIPMENTS LIST **9**
FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) **10**
APPLICABLE STANDARD 10
FCC §15.203 - ANTENNA REQUIREMENT **12**
APPLICABLE STANDARD 12
ANTENNA CONNECTOR CONSTRUCTION 12
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **13**
APPLICABLE STANDARD 13
EUT SETUP 13
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 14
TEST PROCEDURE 14
CORRECTED AMPLITUDE & MARGIN CALCULATION 14
TEST DATA 15
FCC §15.247(A) (1) - CHANNEL SEPARATION TEST **22**
APPLICABLE STANDARD 22
TEST PROCEDURE 22
TEST DATA 22
FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING **28**
APPLICABLE STANDARD 28
TEST PROCEDURE 28
TEST DATA 28
FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST **34**
APPLICABLE STANDARD 34
TEST PROCEDURE 34
TEST DATA 34
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME) **38**
APPLICABLE STANDARD 38
TEST PROCEDURE 38
TEST DATA 38

FINAL

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT **54**
APPLICABLE STANDARD 54
TEST PROCEDURE 54
TEST DATA 54
FCC §15.247(d) - BAND EDGES TESTING **60**
APPLICABLE STANDARD 60
TEST PROCEDURE 60
TEST DATA 60

FINAL

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	DSG Global Inc.
Product	Embedded Computer
Tested Model	DSG-121-VT
FCC ID	2ARPX-DSG121VT
Frequency	2402-2480 MHz
Voltage Range	DC 7.4V (Rechargeable Li-ion battery) or DC12V-75V from golf vehicle
Measure approximately	238 mm (L) x 323 mm (W) x 36 mm (H)
Sample serial number	180927003/01 (assigned by the BACL, Chengdu)
Received date	2018-09-27
Sample/EUT Status	Good condition

Note: The EUT conformed to test requirements and all measurement and test data in this report was gathered from final production sample. It may have deviation from any other sample.

Objective

This report is prepared on behalf of **DSG Global Inc.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the Bluetooth BDR 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.

Related Submittal(s)/Grant(s)

FCC Part 15C DTS submissions with FCC ID: 2ARPX-DSG121VT
FCC Part 15E NII submissions with FCC ID: 2ARPX-DSG121VT
FCC Part 15C DXX submissions with FCC ID: 2ARPX-DSG121VT

FINAL

Measurement Uncertainty

Item			Uncertainty
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.63 dB
		V	4.88 dB
	200MHz-1GHz	H	5.02 dB
		V	6.06 dB
	1GHz-6GHz		4.51 dB
	6GHz-18GHz		4.49 dB
	18GHz-40GHz		5.48 dB
Conducted RF Power			±0.61dB
Power Spectrum Density			±0.61dB
Occupied Bandwidth			±5%
Conducted Emission			±1.5dB
Humidity			±5%
Temperature			±1℃

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

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.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Bay Area Compliance Laboratories Corp. (Chengdu) lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4324.01) and the FCC designation No. CN1186 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

Equipment Modifications

No modification was made to the EUT.

EUT Exercise Software

Test software: “RF Test tool” installed in device was used during test, the setting was configured as below:

Test Software Version		RF Test tool		
Test Frequency		2402MHz	2441MHz	2480MHz
GFSK	Power Level	0	0	0
π/4-DQPSK	Power Level	0	0	0
8PSK	Power Level	0	0	0

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
-	-	-	-

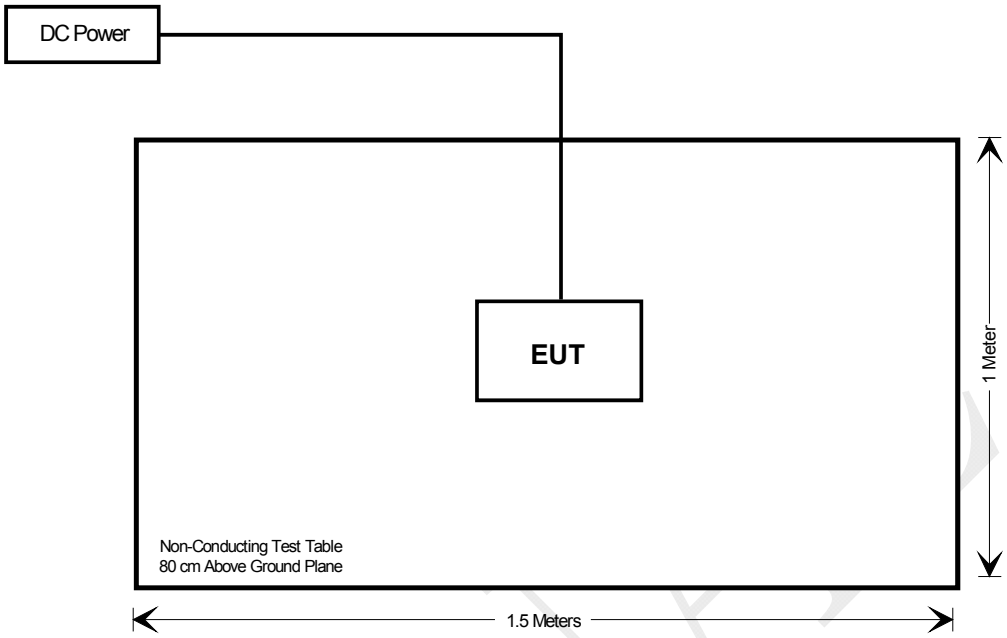
External I/O Cable

Cable Description	Length (m)	From	To
Power Cable	1.20	EUT	DC Power Source

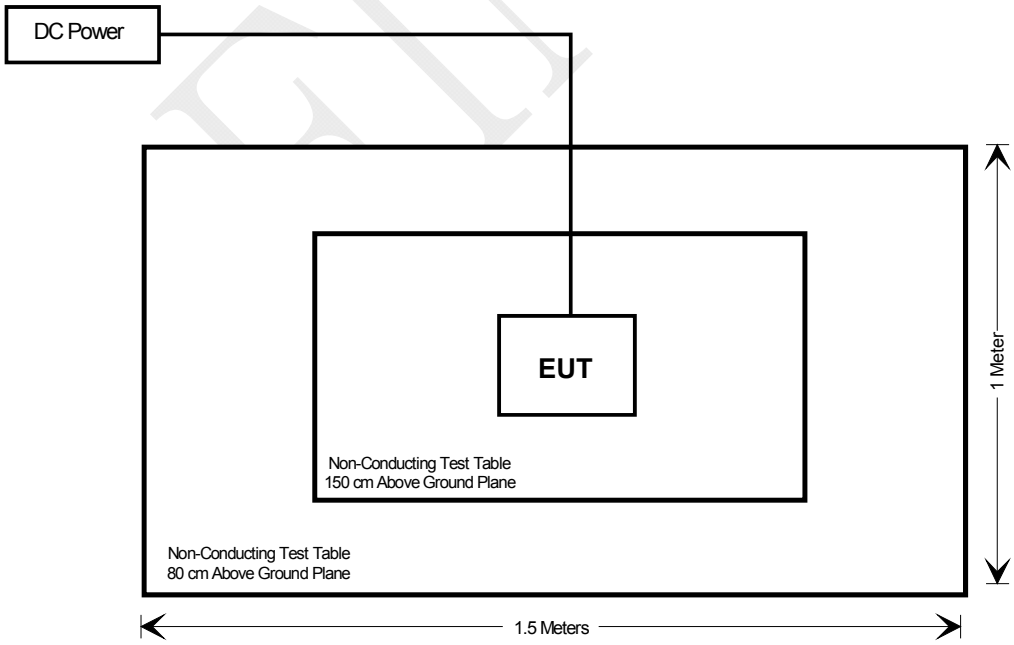
FINAL

Block Diagram of Test Setup

Below 1GHz:



Above 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(1)	20 dB Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band Edges	Compliance

Not Applicable: The device is battery operated equipment and only for golf vehicle use.

FINAL

TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2020-05-17
SONOMA INSTRUMENT	Amplifier	310 N	186684	2018-08-24	2019-08-23
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
Rohde & Schwarz	EMI Test Receiver	ESR 3	102456	2018-06-22	2019-06-21
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2019-04-15	2020-04-14
A.H. Systems, Inc	Amplifier	PAM-0118P	467	2018-10-19	2019-10-18
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2019-03-27	2020-03-26
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
ETS	Horn Antenna	3115	003-6076	2017-05-19	2020-05-18
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2017-05-19	2020-05-18
INMET	Attenuator	18N-6dB	64671	2018-11-27	2019-11-26
Sinoscite.,Co Ltd	Reject Band Filter	BSF 2402-2480MN	0898-005	2018-11-10	2019-11-09
Unknown	RF Cable (below 1GHz)	L-E005	000005	2018-11-27	2019-11-26
Unknown	RF Cable (below 1GHz)	T-E128	000128	2018-11-27	2019-11-26
Unknown	RF Cable (below 1GHz)	T-E129	000129	2018-11-27	2019-11-26
Unknown	RF Cable (above 1GHz)	T-E069	000069	2018-11-10	2019-11-09
Micro-coax	RF Cable (Above 1GHz)	T-E209	MFR 64639 2310	2019-03-14	2020-03-13
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2018-05-09	2019-05-08
WEINSCHEL ENGINEERING	Attenuator	1A 10dB	AA4135	2018-11-10	2019-11-09
E-Microwave	DC Block	EMDCB-00036	OE01304225	2018-11-27	2019-11-26
Unknown	RF Cable	No	000007	Each Time	Each Time

Statement of Traceability: BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

FINAL

FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	※(100)	30
1.34–30	824/f	2.19/f	※($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; ※ = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Per 447498 D01 General RF Exposure Guidance v06, simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:
S = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

FINAL

Calculated Data:

(WiFi or Bluetooth) + NFC + WCDMA/LTE module (FCC ID: RI7LE910NAV2)

MPE evaluation for single transmission:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
WLAN	2412-2462	3.00	2.00	26.0	398.11	20	0.158	1.00
	5180-5240	3.00	2.00	13.00	19.95	20	0.008	1.00
	5745-5825	3.00	2.00	12.50	17.78	20	0.007	1.00
BT3.0	2402-2480	3.00	2.00	7.50	5.62	20	0.002	1.00
BLE	2402-2480	3.00	2.00	6.00	3.98	20	0.002	1.00
NFC	13.56	0.0	1.0	-15.0	0.03	20	0.00001	0.98
WCDMA Band 5	826.4-846.6	3.0	2.00	24.5	281.84	20	0.112	0.55
LTE Band 5	824.7-848.3	3.0	2.00	24.0	251.19	20	0.100	0.55
WCDMA Band 2	1852.4-1907.6	3.0	2.00	24.5	281.84	20	0.112	1.0
LTE Band 2	1850.7-1909.3	3.0	2.00	24.0	251.19	20	0.100	1.0
LTE Band 4	1710.7-1754.3	3.0	2.00	24.0	251.19	20	0.100	1.0
LTE Band 12	699.7-715.3	3.0	2.00	24.0	251.19	20	0.100	0.47
LTE Band 13	779.5-784.5	3.0	2.00	24.0	251.19	20	0.100	0.52
LTE Band 17	706.5-713.5	3.0	2.00	24.0	251.19	20	0.100	0.47

MPE evaluation for simultaneous transmission:

Note: 1. Wi-Fi(2.4G) or Wi-Fi(5G) and Bluetooth can not transmit simultaneously.
2. Wi-Fi(2.4G) and Wi-Fi(5G) can not transmit simultaneously.

Wi-Fi or Bluetooth & NFC & WCDMA/LTE can transmit at the same time, MPE evaluation is as below formula:

PD1/Limit1+PD2/Limit2+……＜1, PD (Power Density)

The worst case is as below:

Max MPE of Wi-Fi + Max MPE of NFC + Max MPE of LTE
= 0.158/1.0+0+0.10/0.47=0.371＜1.0

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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

Antenna Connector Construction

The EUT has one Wi-Fi/BT antenna, one Wi-Fi antenna, one NFC antenna, one LTE main antenna and one LTE diversity antenna which are permanently attached and fulfill the requirement of this section. Please refer to the EUT photos.

RF Mode	Manufacturer	Antenna Model	Max. Antenna Gain	Antenna Type
2.4G WLAN	Asian Creation Communication Co., ltd.	Chain 0 AC-Q2458N17-20MHF4	3dBi	PCB Antenna
5G WLAN				
Bluetooth				
2.4G WLAN	Asian Creation Communication Co., ltd.	Chain 1 AC-Q2458N17-20MHF4	3dBi	PCB Antenna
5G WLAN				
NFC	SHENZHEN SUNSHINE GOOD ELECTRONICS CO.,LTD	P134FQ2137A0	0dBi	FPC Antenna
4G (Main)	ShenZhen Master Wireless Technology Co.,Ltd.	JZC-4G-MP-V01	3dBi	PCB Antenna
4G (Diversity)	ShenZhen Master Wireless Technology Co.,Ltd.	JZC-4G-MP-V01	3dBi	PCB Antenna

Result: Compliance.

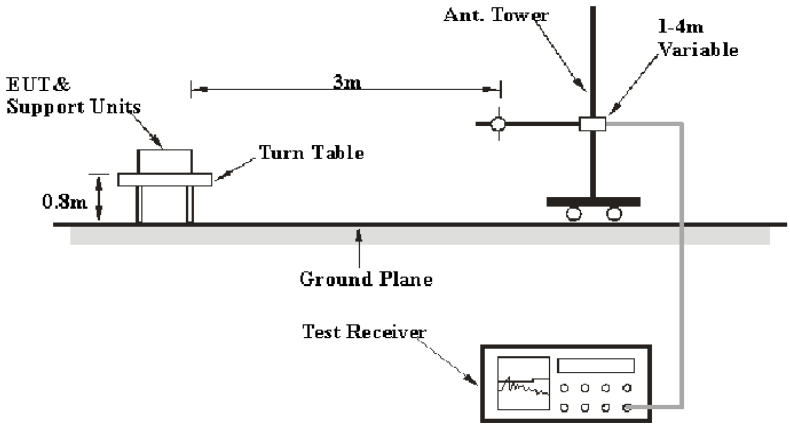
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

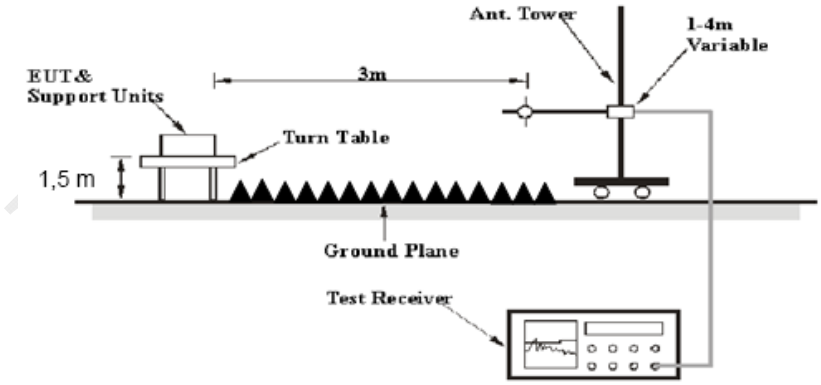
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



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

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz–1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	AV

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

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

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

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

Margin = Limit – Corrected Amplitude

FINAL

Test Data

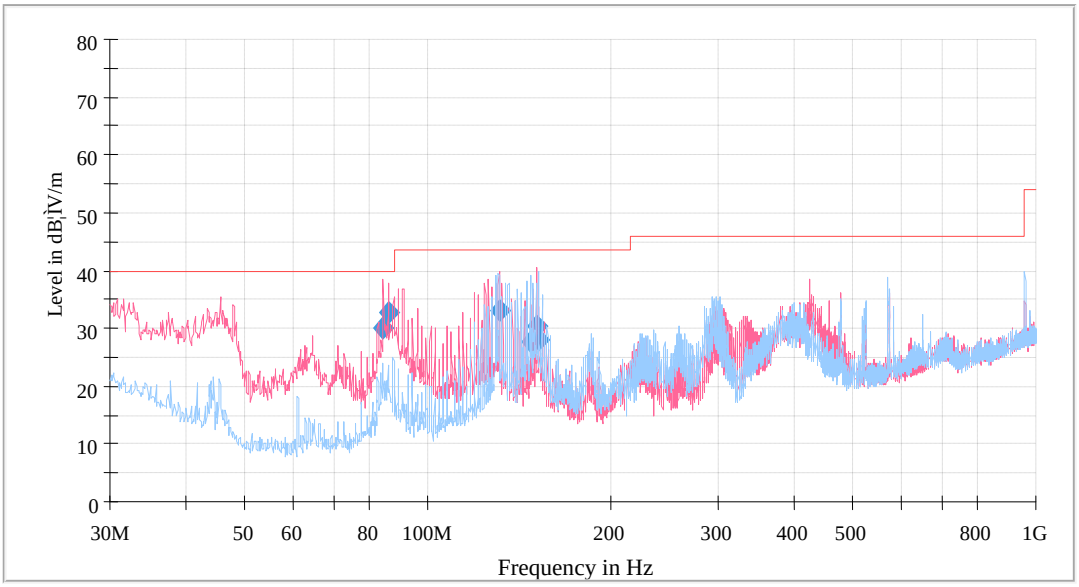
Environmental Conditions

Temperature:	20 °C
Relative Humidity:	68 %
ATM Pressure:	95.3 kPa

The testing was performed by Tom Tang on 2019-04-17.

Test Mode: Transmitting

30 MHz to 1 GHz-Low channel of BDR mode(GFSK)-Worst Case



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)
84.562500	30.17	40.00	9.83	115.0	V	223.0	-16.8
86.138750	32.63	40.00	7.37	100.0	V	252.0	-16.8
130.880000	33.08	43.50	10.42	100.0	V	202.0	-10.4
147.370000	27.65	43.50	15.85	159.0	H	85.0	-10.9
150.886250	30.37	43.50	13.13	100.0	V	162.0	-11.2
152.341250	27.99	43.50	15.51	180.0	H	88.0	-11.3

1GHz-25GHz:

BDR Mode (GFSK):

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency:2402 MHz									
2402	68.63	PK	H	28.71	3.06	0.00	100.40	N/A	N/A
2402	57.72	AV	H	28.71	3.06	0.00	89.49	N/A	N/A
2402	72.68	PK	V	28.71	3.06	0.00	104.45	N/A	N/A
2402	61.43	AV	V	28.71	3.06	0.00	93.20	N/A	N/A
2390	28.01	PK	V	28.67	3.06	0.00	59.74	74.00	14.26
2390	16.08	AV	V	28.67	3.06	0.00	47.81	54.00	6.19
4804	48.87	PK	V	33.85	4.35	44.73	42.34	74.00	31.66
4804	34.95	AV	V	33.85	4.35	44.73	28.42	54.00	25.58
7206	45.78	PK	V	36.39	5.41	43.92	43.66	74.00	30.34
7206	32.51	AV	V	36.39	5.41	43.92	30.39	54.00	23.61
Frequency: 2441MHz									
2441	68.58	PK	H	28.82	3.09	0.00	100.49	N/A	N/A
2441	57.56	AV	H	28.82	3.09	0.00	89.47	N/A	N/A
2441	72.45	PK	V	28.82	3.09	0.00	104.36	N/A	N/A
2441	61.25	AV	V	28.82	3.09	0.00	93.16	N/A	N/A
4882	48.95	PK	V	34.07	4.40	44.72	42.70	74.00	31.30
4882	34.49	AV	V	34.07	4.40	44.72	28.24	54.00	25.76
7323	45.12	PK	V	36.55	5.44	44.23	42.88	74.00	31.12
7323	32.20	AV	V	36.55	5.44	44.23	29.96	54.00	24.04
Frequency:2480MHz									
2480	68.99	PK	H	28.94	3.12	0.00	101.05	N/A	N/A
2480	57.85	AV	H	28.94	3.12	0.00	89.91	N/A	N/A
2480	72.86	PK	V	28.94	3.12	0.00	104.92	N/A	N/A
2480	61.58	AV	V	28.94	3.12	0.00	93.64	N/A	N/A
2483.5	32.15	PK	V	28.95	3.12	0.00	64.22	74.00	9.78
2483.5	19.94	AV	V	28.95	3.12	0.00	52.01	54.00	1.99
4960	49.34	PK	V	34.29	4.44	44.71	43.36	74.00	30.64
4960	34.62	AV	V	34.29	4.44	44.71	28.64	54.00	25.36
7440	44.93	PK	V	36.72	5.48	44.54	42.59	74.00	31.41
7440	32.07	AV	V	36.72	5.48	44.54	29.73	54.00	24.27

EDR Mode (π/4-DQPSK):

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency:2402 MHz									
2402	65.07	PK	H	28.71	3.06	0.00	96.84	N/A	N/A
2402	52.02	AV	H	28.71	3.06	0.00	83.79	N/A	N/A
2402	68.89	PK	V	28.71	3.06	0.00	100.66	N/A	N/A
2402	55.81	AV	V	28.71	3.06	0.00	87.58	N/A	N/A
2390	27.14	PK	V	28.67	3.06	0.00	58.87	74.00	15.13
2390	15.87	AV	V	28.67	3.06	0.00	47.60	54.00	6.40
4804	47.65	PK	V	33.85	4.35	44.73	41.12	74.00	32.88
4804	34.64	AV	V	33.85	4.35	44.73	28.11	54.00	25.89
7206	45.26	PK	V	36.39	5.41	43.92	43.14	74.00	30.86
7206	32.25	AV	V	36.39	5.41	43.92	30.13	54.00	23.87
Frequency:2441 MHz									
2441	66.54	PK	H	28.82	3.09	0.00	98.45	N/A	N/A
2441	53.49	AV	H	28.82	3.09	0.00	85.40	N/A	N/A
2441	69.89	PK	V	28.82	3.09	0.00	101.80	N/A	N/A
2441	56.87	AV	V	28.82	3.09	0.00	88.78	N/A	N/A
4882	48.24	PK	V	34.07	4.40	44.72	41.99	74.00	32.01
4882	34.43	AV	V	34.07	4.40	44.72	28.18	54.00	25.82
7323	44.92	PK	V	36.55	5.44	44.23	42.68	74.00	31.32
7323	32.19	AV	V	36.55	5.44	44.23	29.95	54.00	24.05
Frequency:2480 MHz									
2480	67.69	PK	H	28.94	3.12	0.00	99.75	N/A	N/A
2480	54.51	AV	H	28.94	3.12	0.00	86.57	N/A	N/A
2480	70.54	PK	V	28.94	3.12	0.00	102.60	N/A	N/A
2480	57.53	AV	V	28.94	3.12	0.00	89.59	N/A	N/A
2483.5	31.54	PK	V	28.95	3.12	0.00	63.61	74.00	10.39
2483.5	19.86	AV	V	28.95	3.12	0.00	51.93	54.00	2.07
4960	48.67	PK	V	34.29	4.44	44.71	42.69	74.00	31.31
4960	33.79	AV	V	34.29	4.44	44.71	27.81	54.00	26.19
7440	43.85	PK	V	36.72	5.48	44.54	41.51	74.00	32.49
7440	31.84	AV	V	36.72	5.48	44.54	29.50	54.00	24.50

FINAL

EDR Mode (8-DPSK):

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency:2402 MHz									
2402	66.12	PK	H	28.71	3.06	0.00	97.89	N/A	N/A
2402	52.06	AV	H	28.71	3.06	0.00	83.83	N/A	N/A
2402	69.16	PK	V	28.71	3.06	0.00	100.93	N/A	N/A
2402	55.84	AV	V	28.71	3.06	0.00	87.61	N/A	N/A
2390	27.36	PK	V	28.67	3.06	0.00	59.09	74.00	14.91
2390	16.04	AV	V	28.67	3.06	0.00	47.77	54.00	6.23
4804	47.90	PK	V	33.85	4.35	44.73	41.37	74.00	32.63
4804	34.77	AV	V	33.85	4.35	44.73	28.24	54.00	25.76
7206	45.50	PK	V	36.39	5.41	43.92	43.38	74.00	30.62
7206	32.53	AV	V	36.39	5.41	43.92	30.41	54.00	23.59
Frequency: 2441 MHz									
2441	66.58	PK	H	28.82	3.09	0.00	98.49	N/A	N/A
2441	53.04	AV	H	28.82	3.09	0.00	84.95	N/A	N/A
2441	69.89	PK	V	28.82	3.09	0.00	101.80	N/A	N/A
2441	56.65	AV	V	28.82	3.09	0.00	88.56	N/A	N/A
4882	48.16	PK	V	34.07	4.40	44.72	41.91	74.00	32.09
4882	34.23	AV	V	34.07	4.40	44.72	27.98	54.00	26.02
7323	44.64	PK	V	36.55	5.44	44.23	42.40	74.00	31.60
7323	32.07	AV	V	36.55	5.44	44.23	29.83	54.00	24.17
Frequency: 2480 MHz									
2480	67.49	PK	H	28.94	3.12	0.00	99.55	N/A	N/A
2480	54.11	AV	H	28.94	3.12	0.00	86.17	N/A	N/A
2480	70.78	PK	V	28.94	3.12	0.00	102.84	N/A	N/A
2480	57.49	AV	V	28.94	3.12	0.00	89.55	N/A	N/A
2483.5	30.95	PK	V	28.95	3.12	0.00	63.02	74.00	10.98
2483.5	19.78	AV	V	28.95	3.12	0.00	51.85	54.00	2.15
4960	48.91	PK	V	34.29	4.44	44.71	42.93	74.00	31.07
4960	34.12	AV	V	34.29	4.44	44.71	28.14	54.00	25.86
7440	44.19	PK	V	36.72	5.48	44.54	41.85	74.00	32.15
7440	31.87	AV	V	36.72	5.48	44.54	29.53	54.00	24.47

FINAL

Other Spurious Emissions (Worst case):

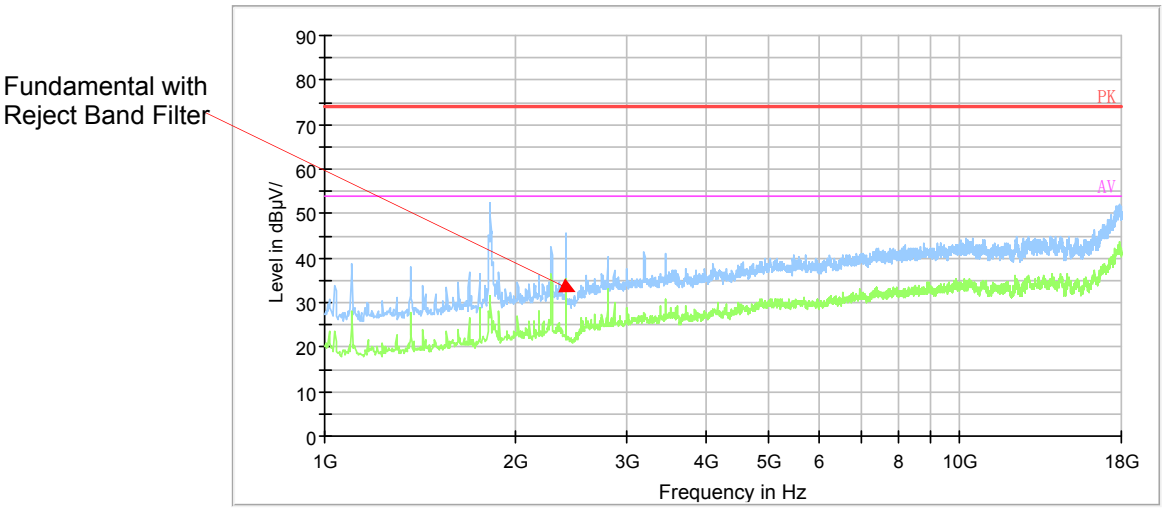
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
1813	66.44	PK	V	26.57	2.66	43.63	52.04	74.00	21.96
1813	47.86	AV	V	26.57	2.66	43.63	33.46	54.00	20.54
3124	60.05	PK	V	30.90	3.48	44.30	50.13	74.00	23.87
3124	44.61	AV	V	30.90	3.48	44.30	34.69	54.00	19.31
5003	53.16	PK	V	34.40	4.46	44.70	47.32	74.00	26.68
5003	42.71	AV	V	34.40	4.46	44.70	36.87	54.00	17.13
1813	68.41	PK	H	26.57	2.66	43.63	54.01	74.00	19.99
1813	48.29	AV	H	26.57	2.66	43.63	33.89	54.00	20.11

Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

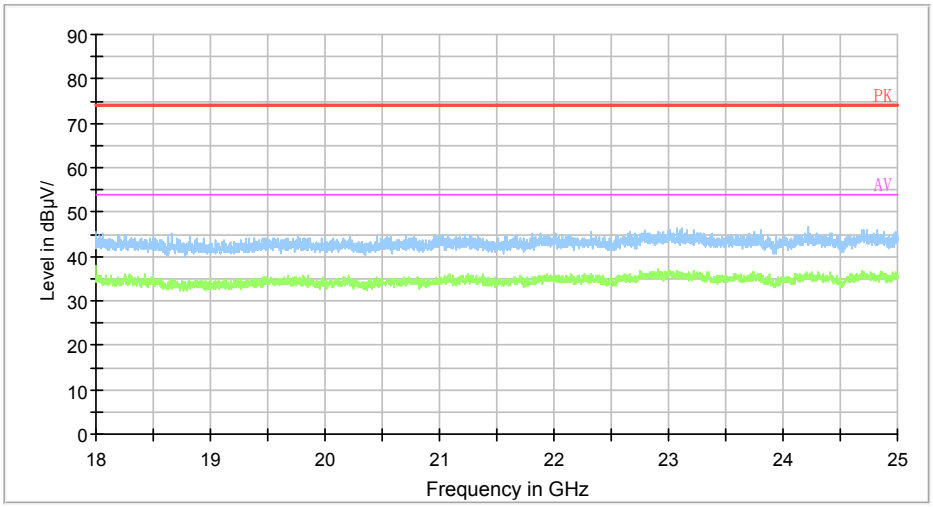
FINAL

Please refer to the below pre-scan plot of worst case:

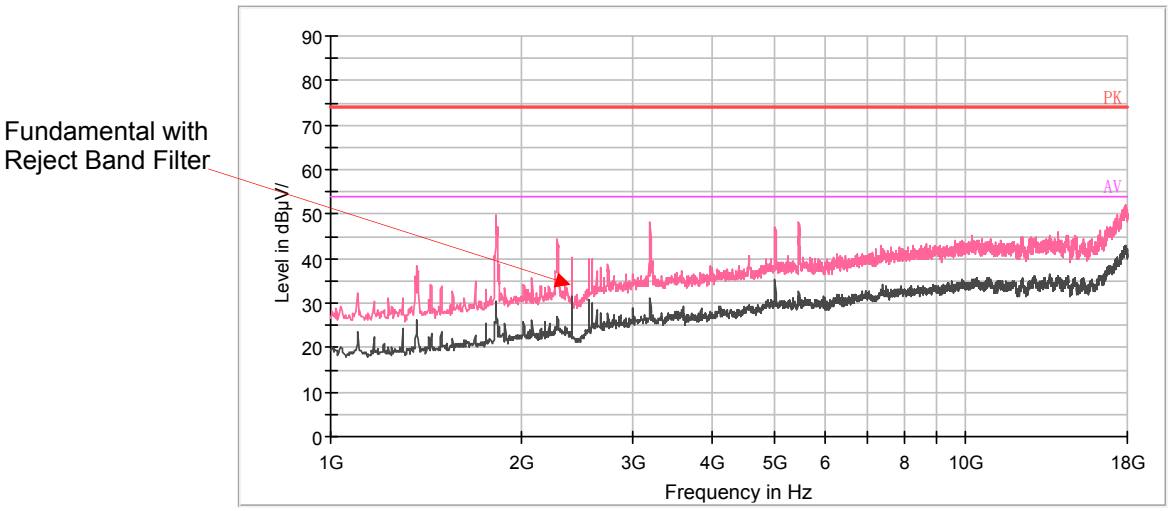
BDR Mode (GFSK): High Channel_Horizontal_1GHz-18GHz



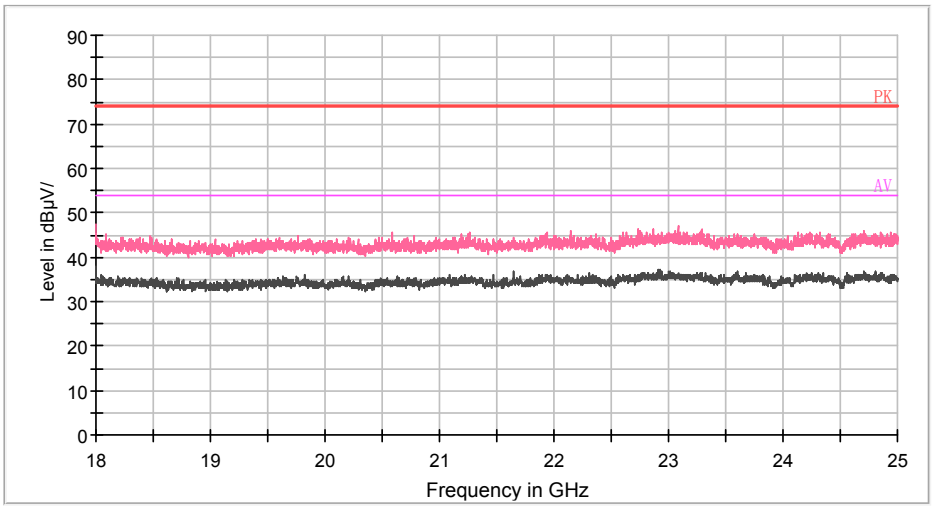
BDR Mode (GFSK): High Channel_Horizontal_18GHz-25GHz



BDR Mode (GFSK): High Channel_Vertical_1GHz-18GHz



BDR Mode (GFSK): High Channel_Vertical_18GHz-25GHz



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

Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance.

Please refer to following tables and plots.

Test Mode: Transmitting

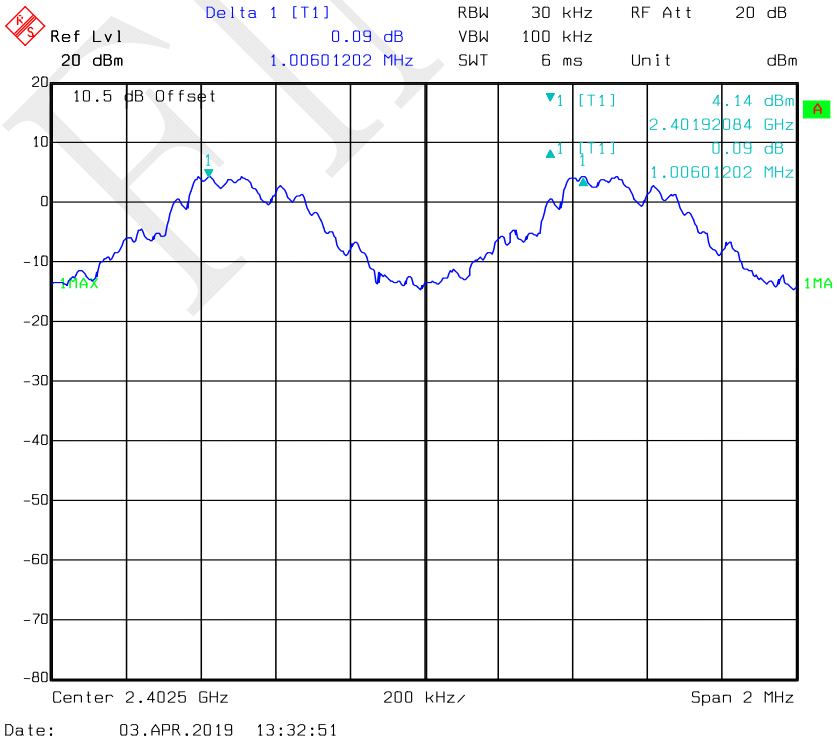
FINAL

Mode	Channel	Frequency	Channel Separation	Limit
		MHz	MHz	MHz
BDR (GFSK)	Low	2402	1.006	0.71
	Adjacent	2403		
	Middle	2441	1.002	0.71
	Adjacent	2442		
	High	2480	1.002	0.71
	Adjacent	2479		
EDR (π/4-DQPSK)	Low	2402	1.010	0.91
	Adjacent	2403		
	Middle	2441	1.002	0.91
	Adjacent	2442		
	High	2480	1.010	0.91
	Adjacent	2479		
EDR (8DPSK)	Low	2402	0.998	0.90
	Adjacent	2403		
	Middle	2441	1.006	0.90
	Adjacent	2442		
	High	2480	1.006	0.90
	Adjacent	2479		

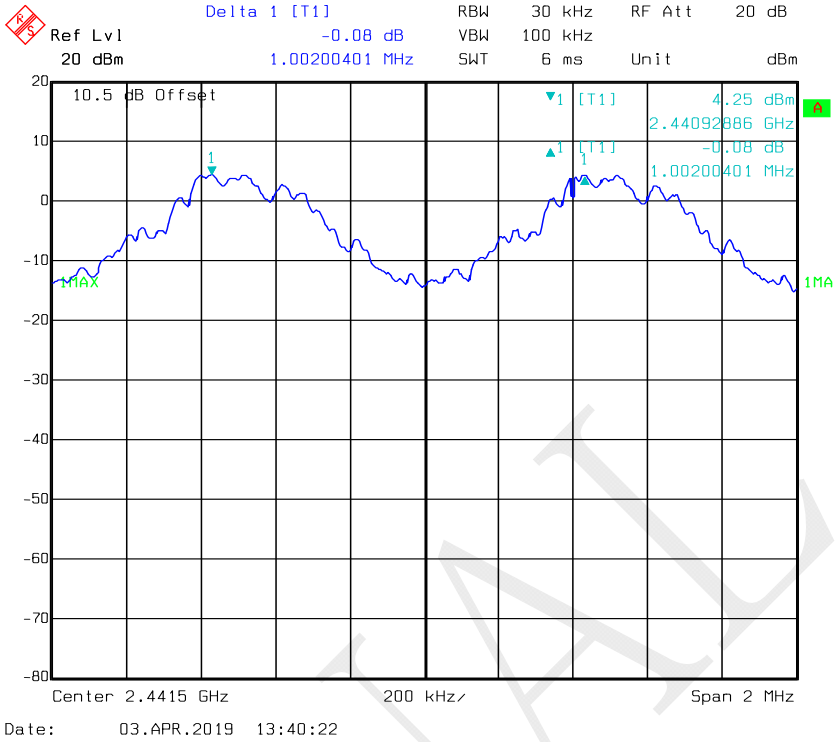
Note: Limit= (2/3) × 20dB bandwidth

BDR Mode (GFSK):

Low Channel

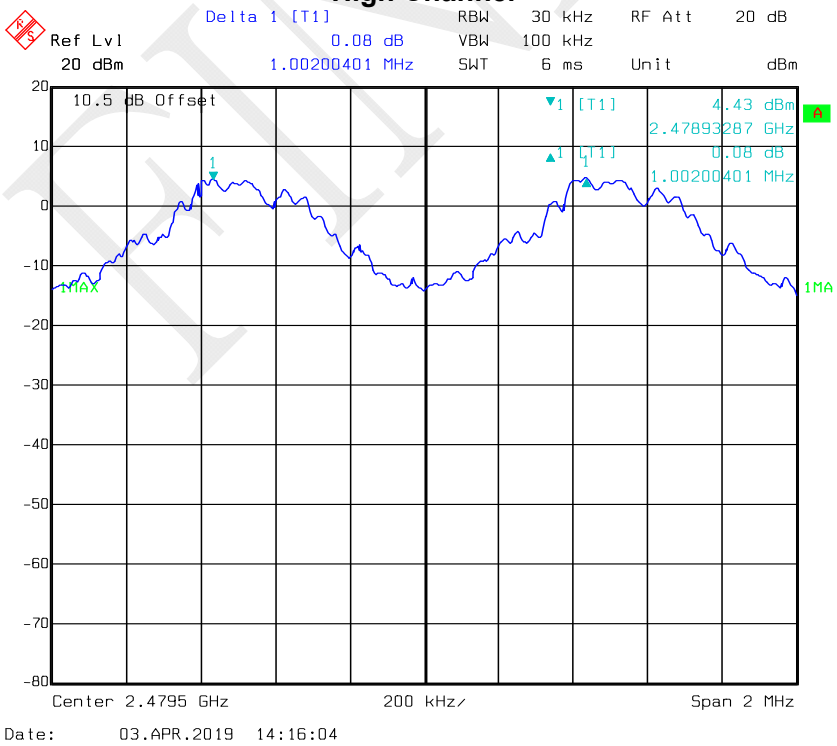


Middle Channel



Date: 03.APR.2019 13:40:22

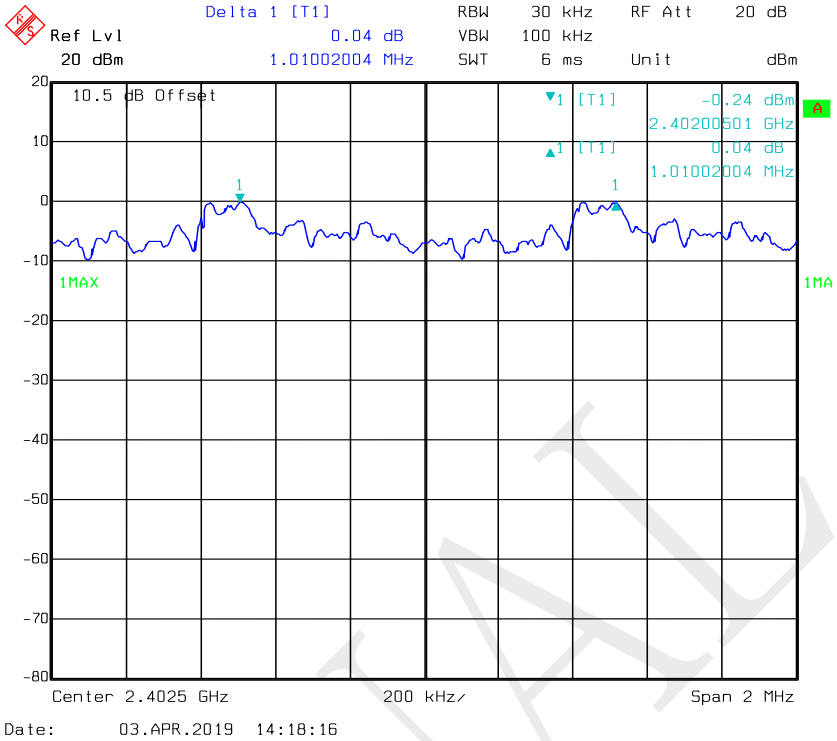
High Channel



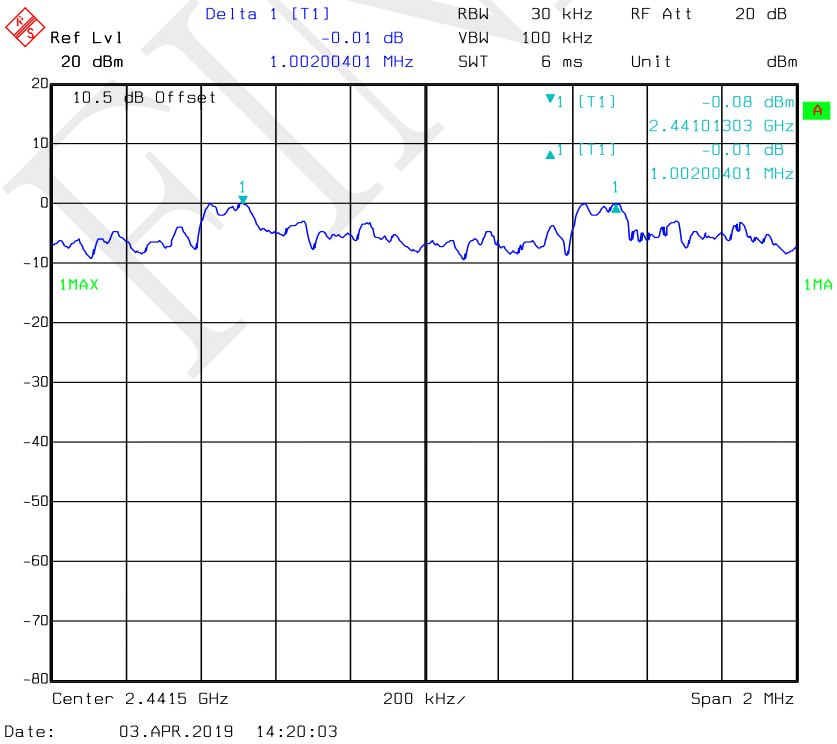
Date: 03.APR.2019 14:16:04

EDR Mode (π/4-DQPSK):

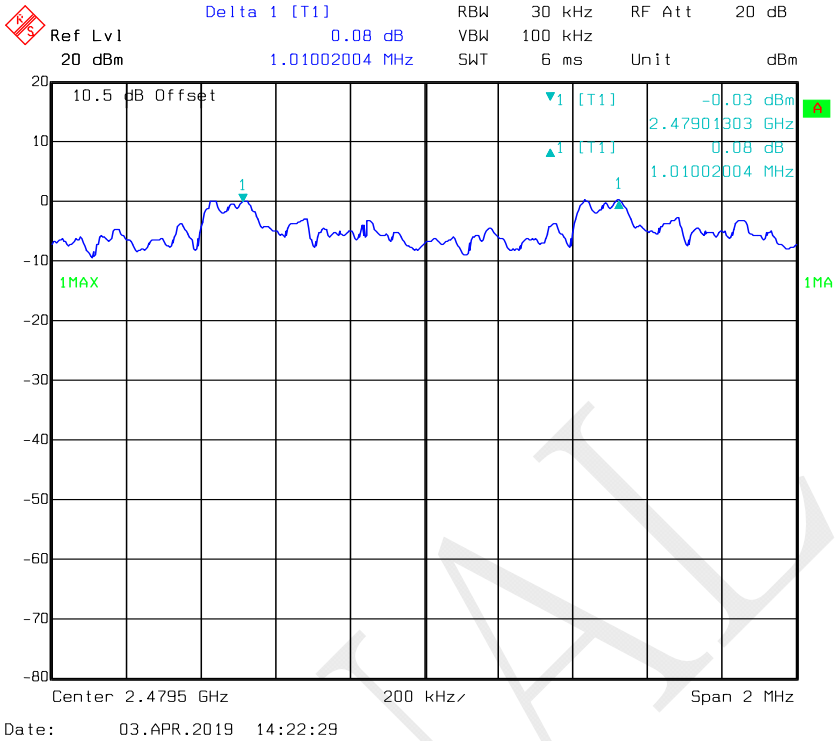
Low Channel



Middle Channel

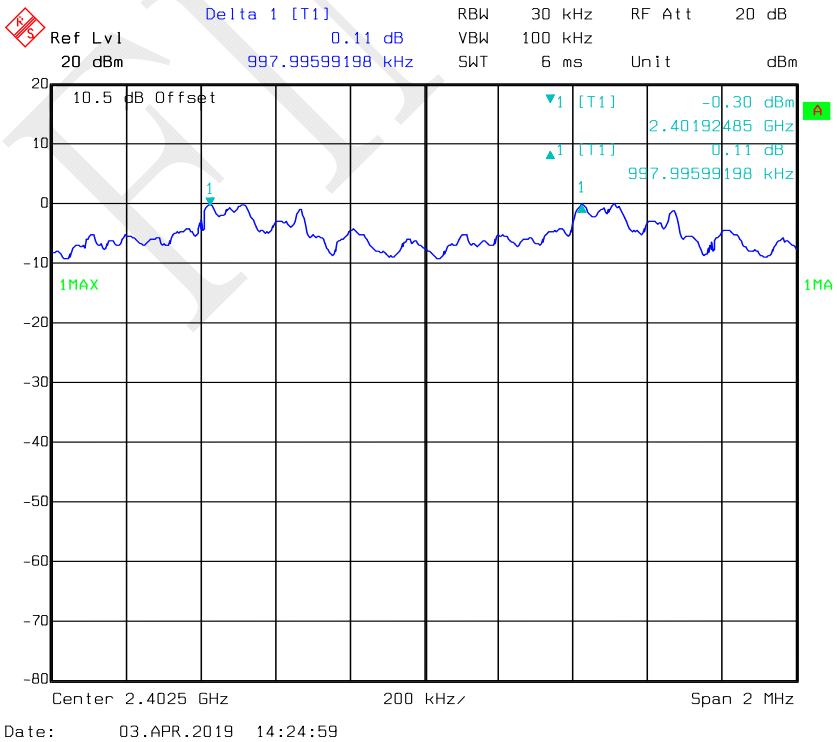


High Channel

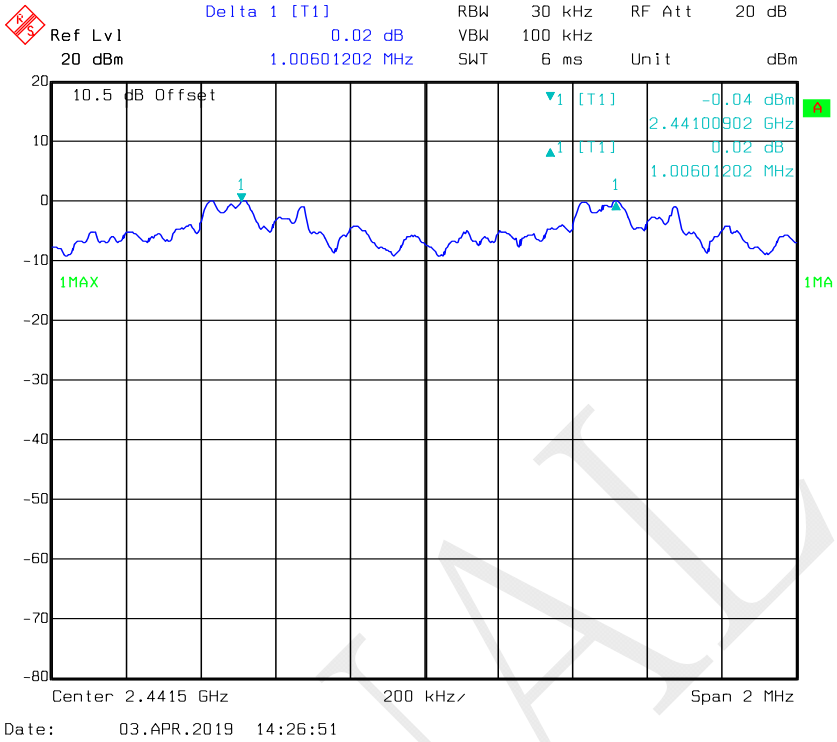


EDR Mode (8-DPSK):

Low Channel

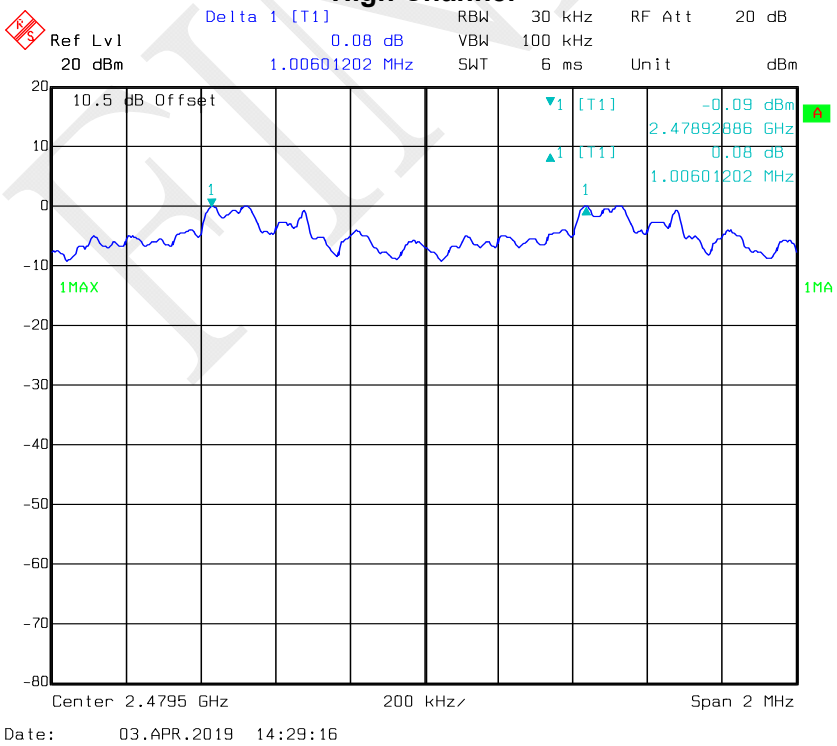


Middle Channel



Date: 03.APR.2019 14:26:51

High Channel



Date: 03.APR.2019 14:29:16

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance.

Please refer to following tables and plots

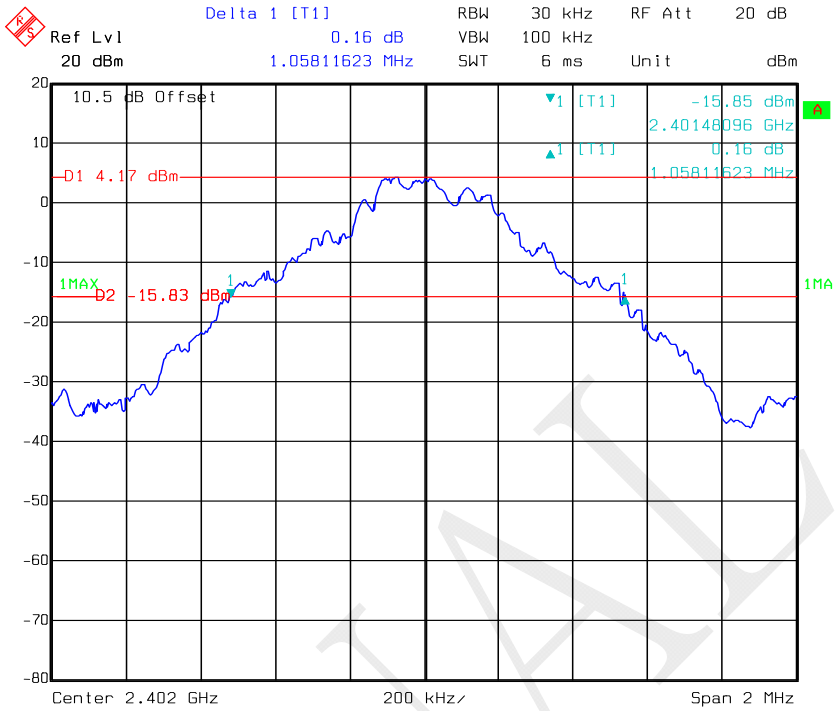
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	1.06
	Middle	2441	1.06
	High	2480	1.07
EDR Mode (π/4-DQPSK)	Low	2402	1.36
	Middle	2441	1.37
	High	2480	1.36
EDR Mode (8-DPSK)	Low	2402	1.35
	Middle	2441	1.35
	High	2480	1.35

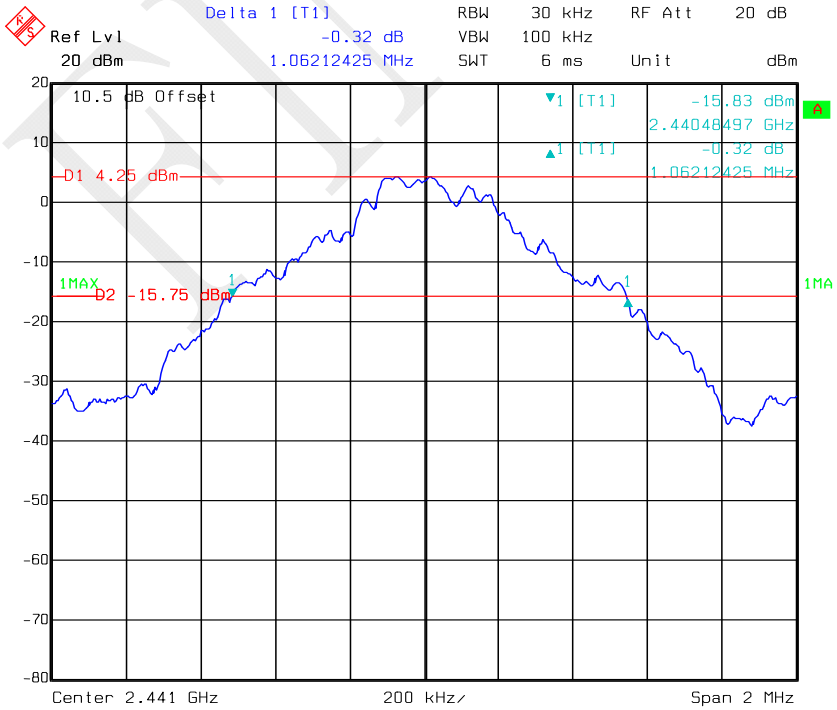
FINAL

BDR Mode (GFSK):

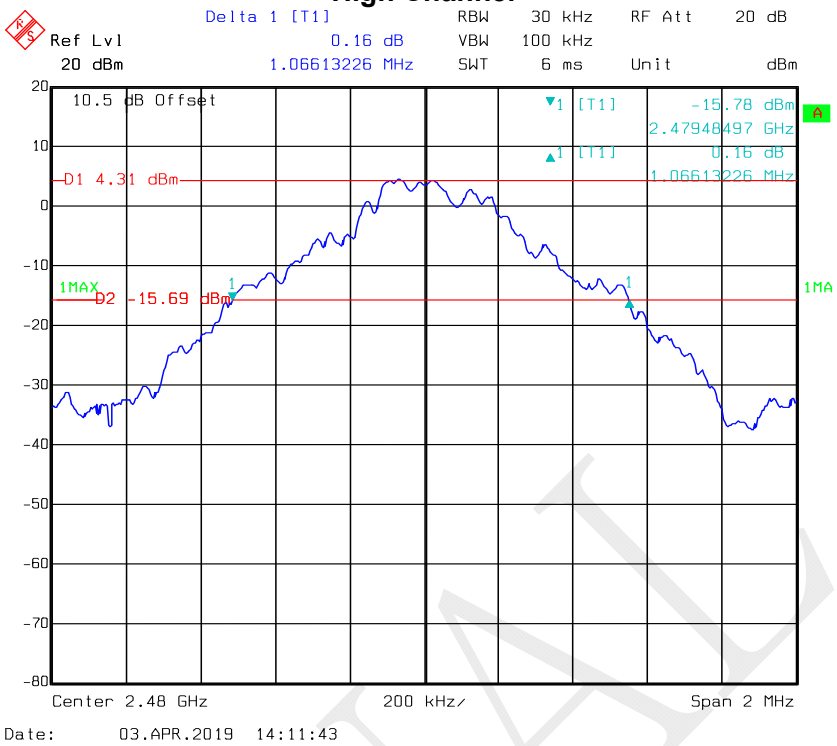
Low Channel



Middle Channel

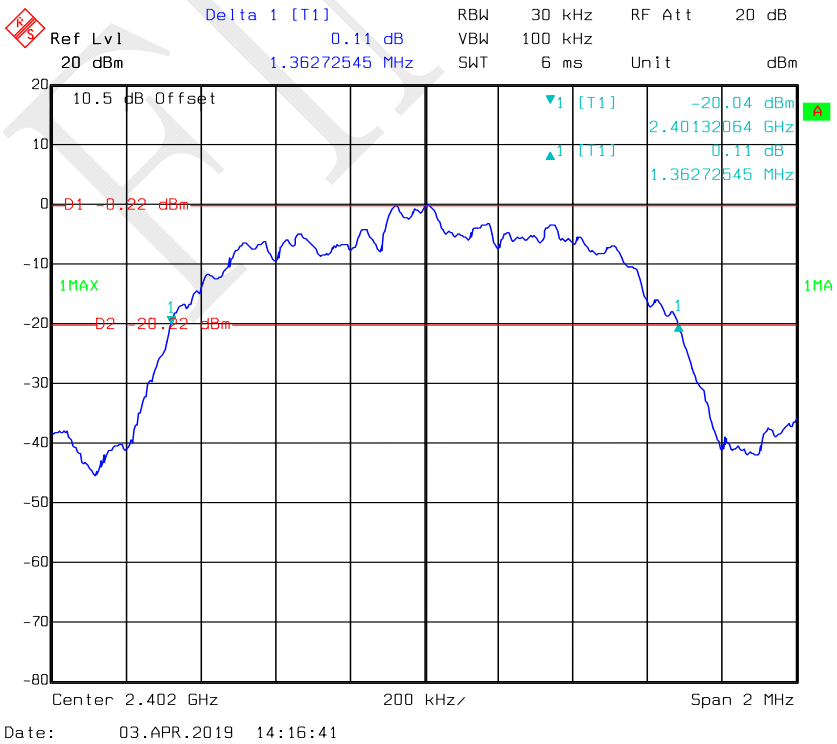


High Channel

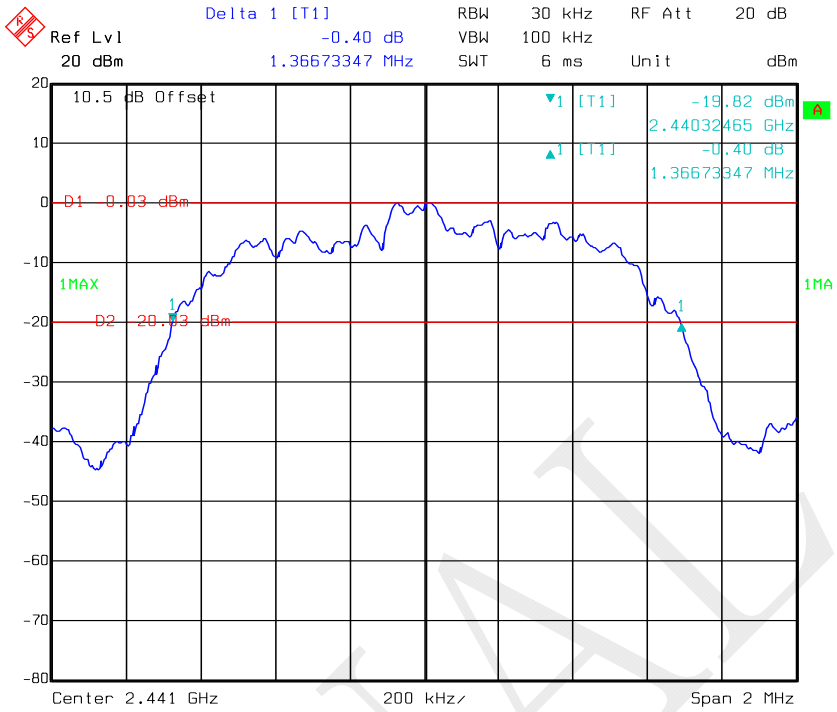


EDR Mode (π/4-DQPSK):

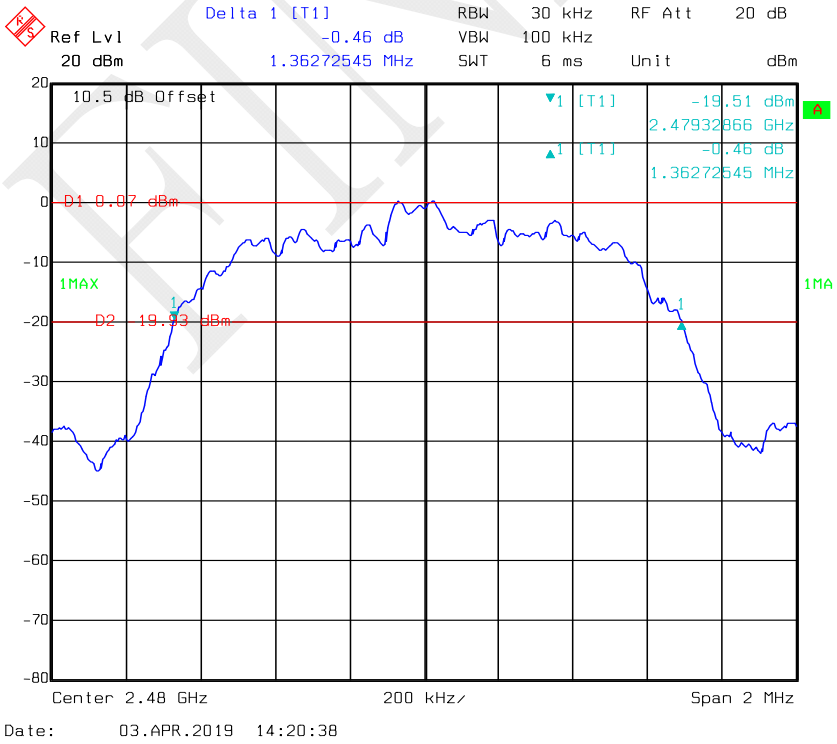
Low Channel



Middle Channel

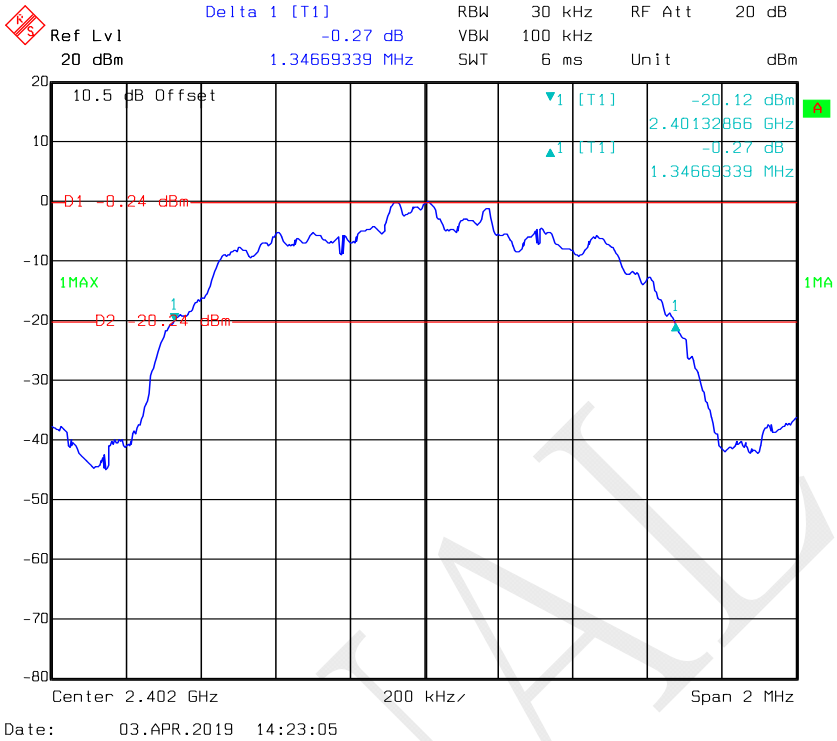


High Channel

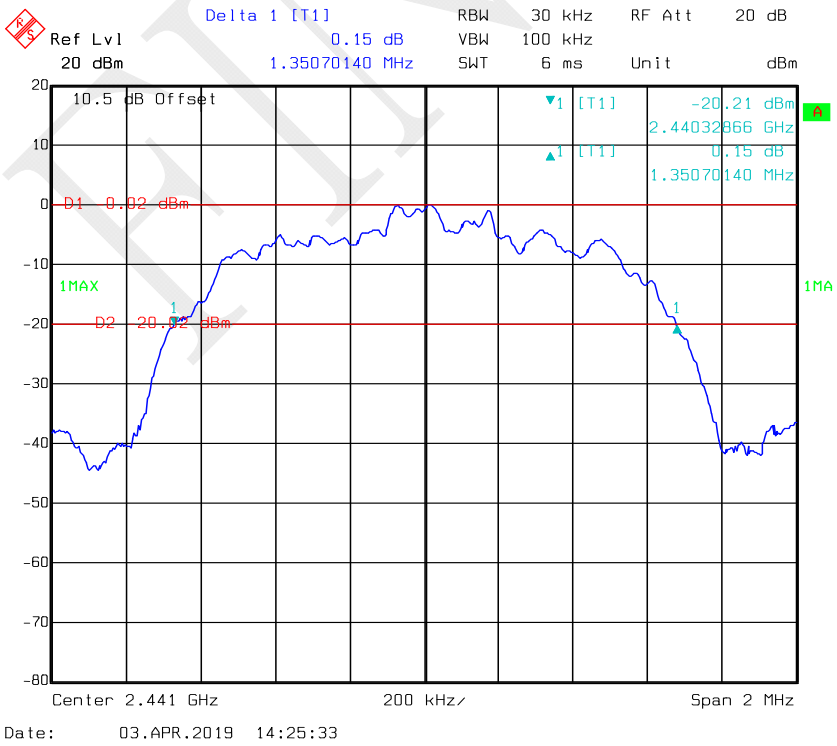


EDR Mode (8-DPSK):

Low Channel

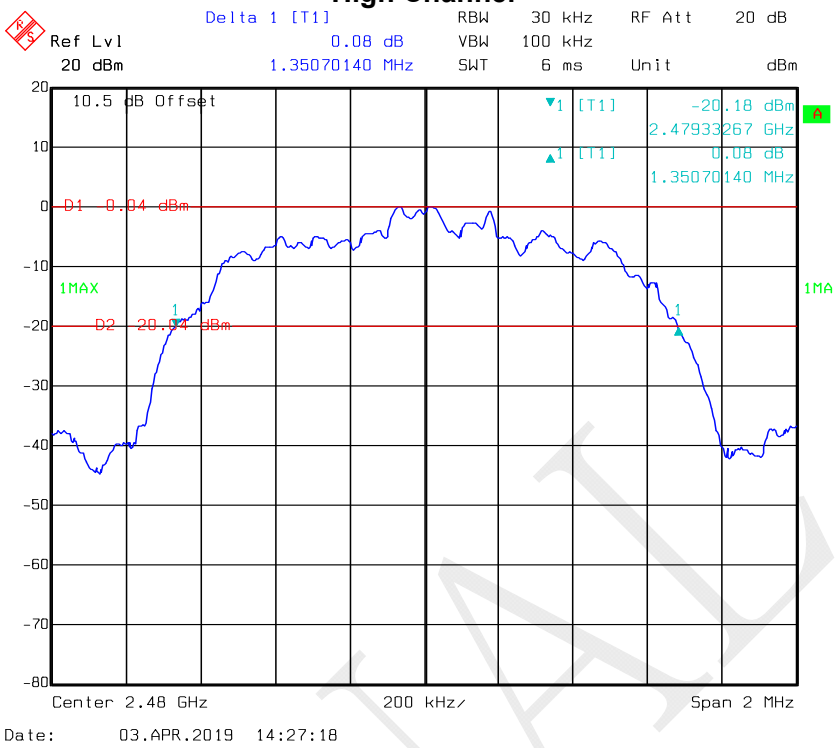


Middle Channel



FINAL

High Channel



FINAL

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

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance.

Please refer to following tables and plots.

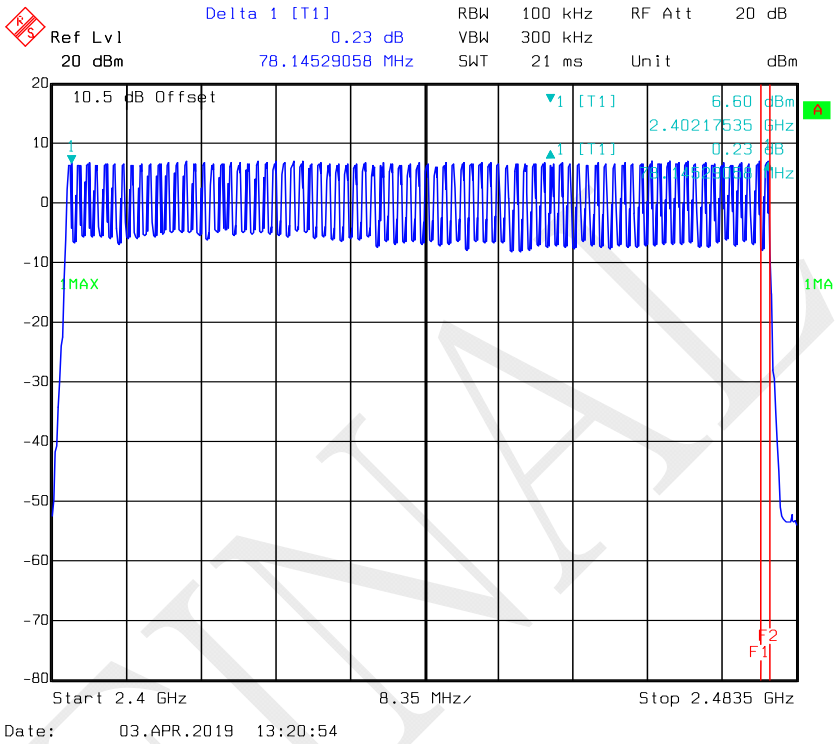
Test Mode: Transmitting

FINAL

BDR Mode (GFSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥15

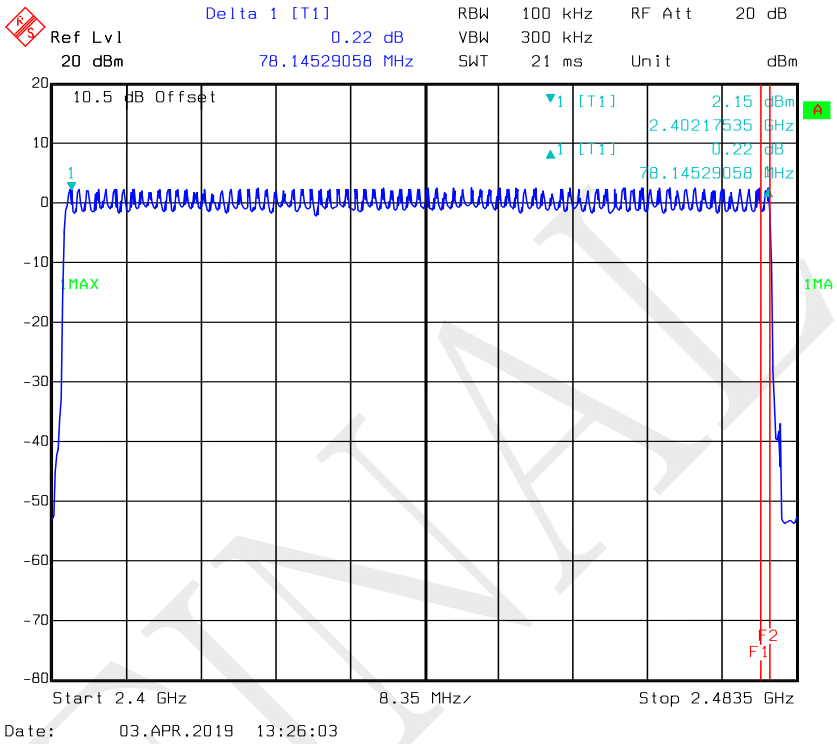
Number of Hopping Channels



EDR Mode (π/4-DQPSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥15

Number of Hopping Channels

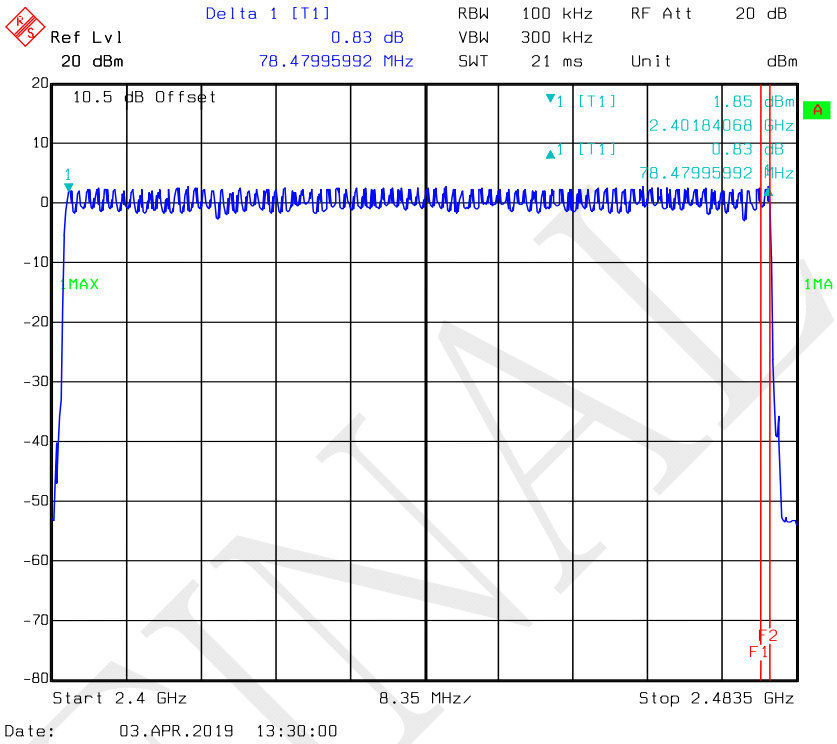


FINAL

EDR Mode (8-DPSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥15

Number of Hopping Channels



FINAL

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

Applicable Standard

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

Test Procedure

The EUT was worked in hopping mode, Spectrum Analyzer SPAN was set as 0, the time of single pulse was tested.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance. Please refer to following tables and plots

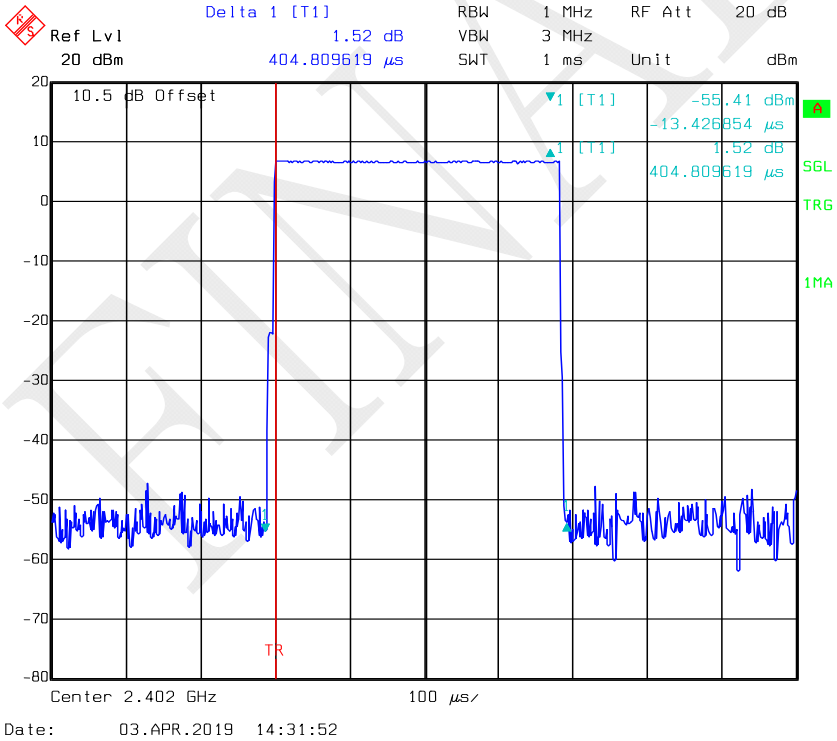
Test Mode: Transmitting

FINAL

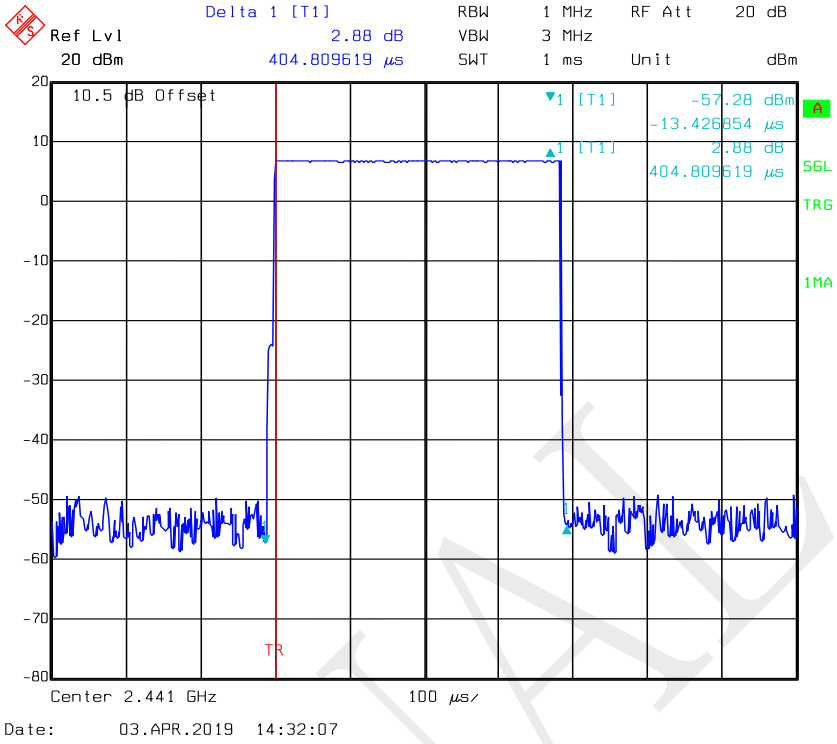
BDR Mode (GFSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH1	Low	0.405	0.130	0.4	Compliance
	Middle	0.405	0.130	0.4	Compliance
	High	0.405	0.130	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
DH3	Low	1.665	0.266	0.4	Compliance
	Middle	1.665	0.266	0.4	Compliance
	High	1.665	0.266	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
DH5	Low	2.926	0.312	0.4	Compliance
	Middle	2.926	0.312	0.4	Compliance
	High	2.926	0.312	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

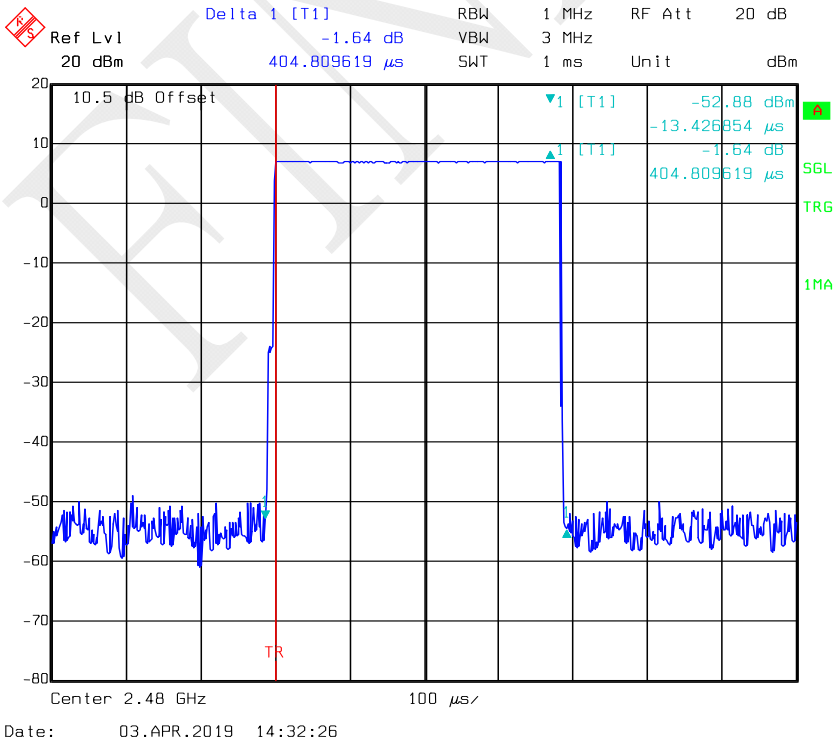
DH1: Low Channel



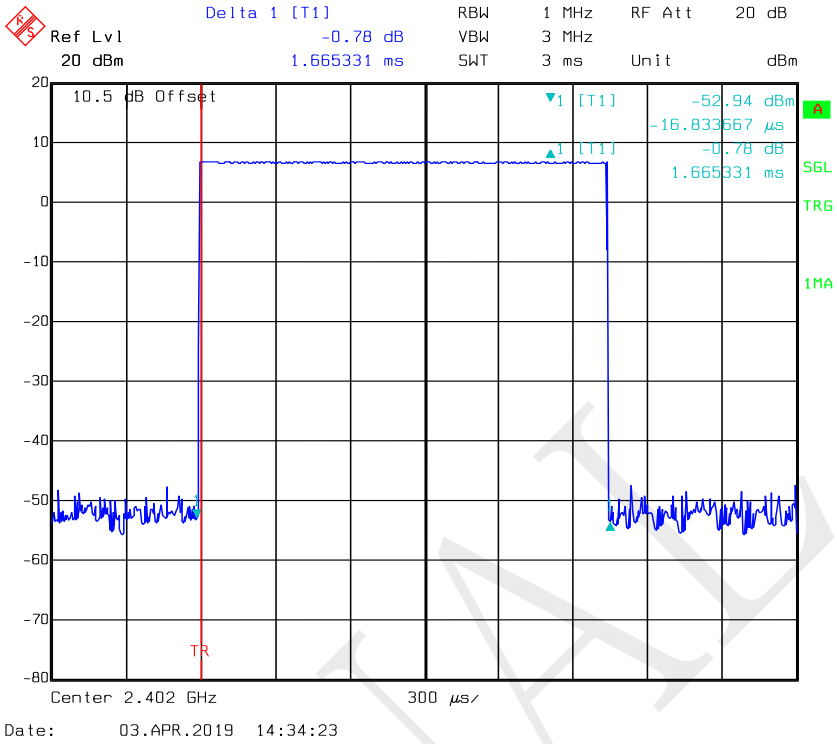
DH1: Middle Channel



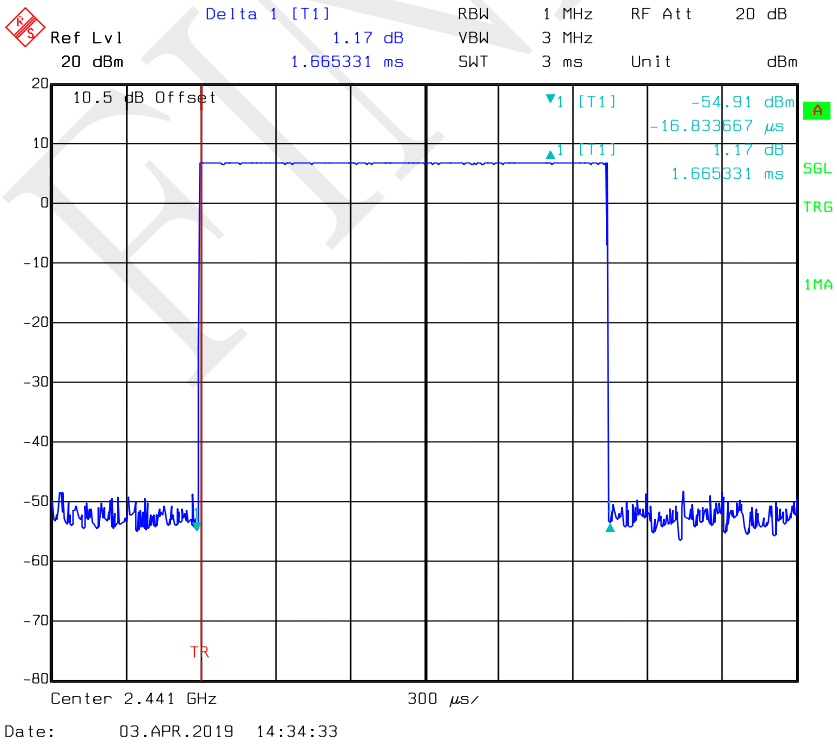
DH1: High Channel



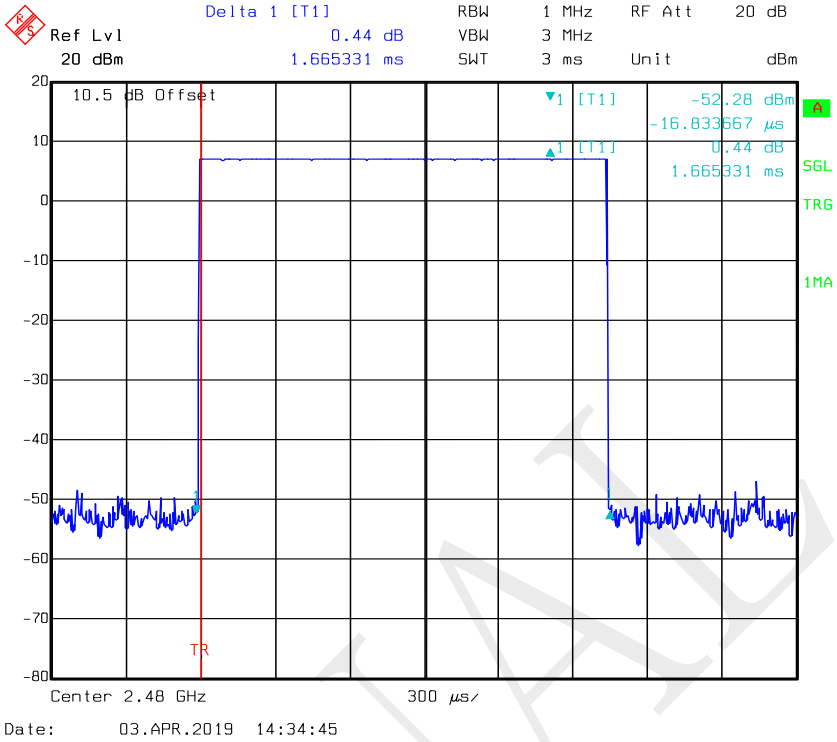
DH3: Low Channel



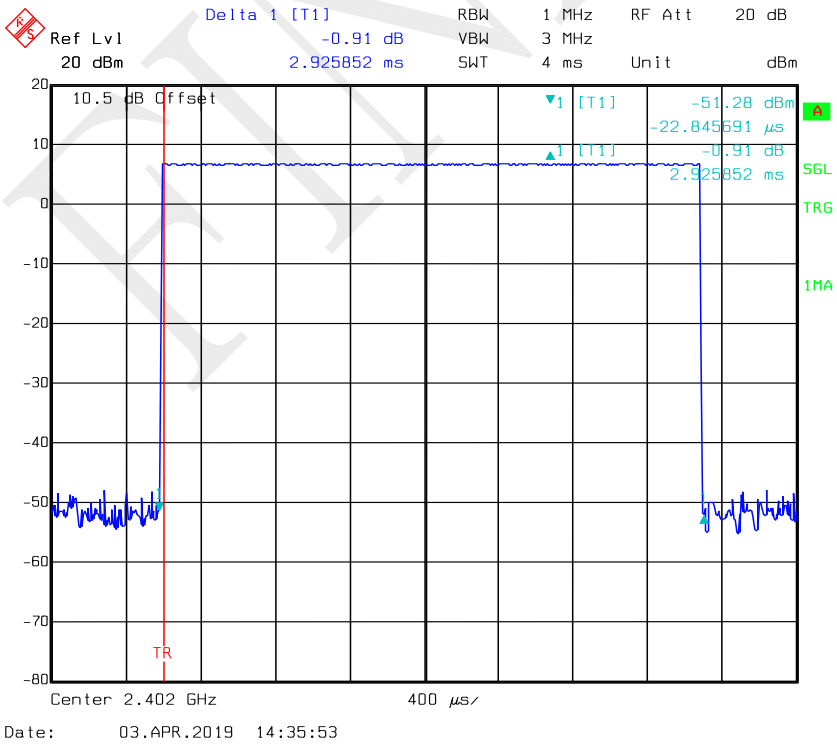
DH3: Middle Channel



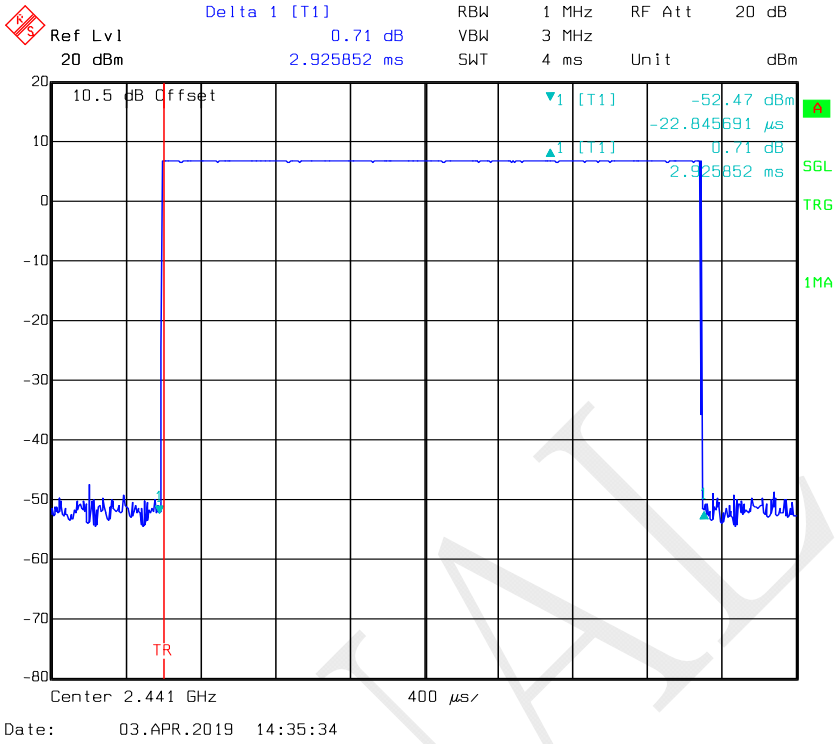
DH3: High Channel



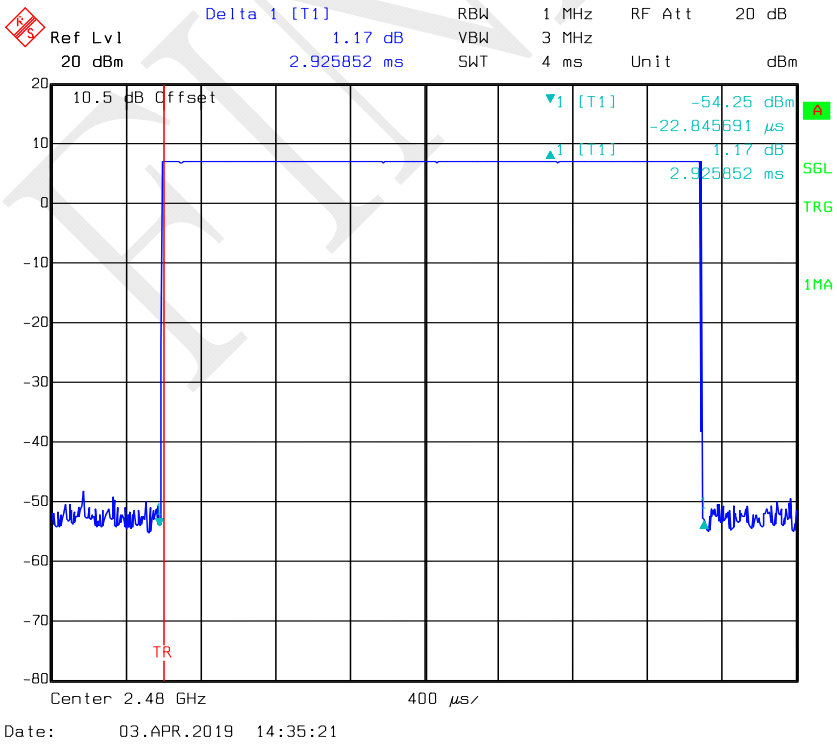
DH5: Low Channel



DH5: Middle Channel



DH5: High Channel

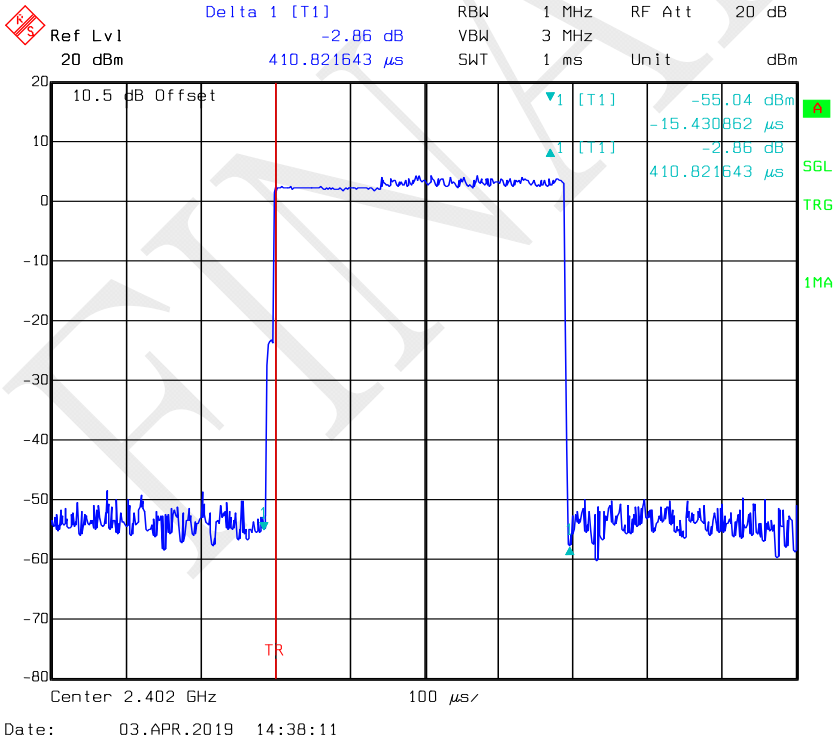


FINAL

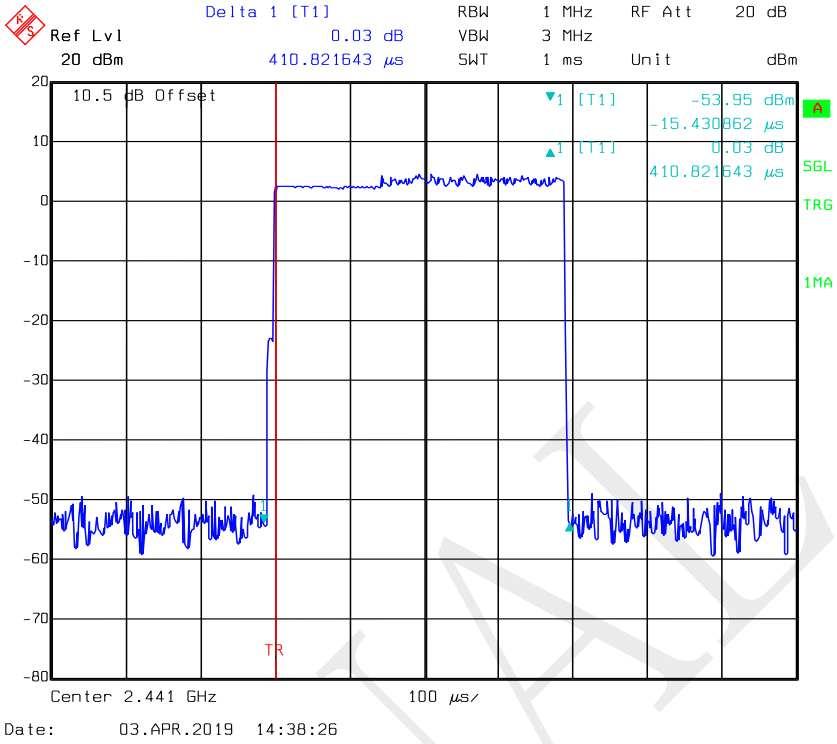
EDR Mode (π/4-DQPSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
2DH1	Low	0.411	0.132	0.4	Compliance
	Middle	0.411	0.132	0.4	Compliance
	High	0.411	0.132	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
2DH3	Low	1.661	0.266	0.4	Compliance
	Middle	1.661	0.266	0.4	Compliance
	High	1.661	0.266	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
2DH5	Low	2.926	0.312	0.4	Compliance
	Middle	2.926	0.312	0.4	Compliance
	High	2.926	0.312	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

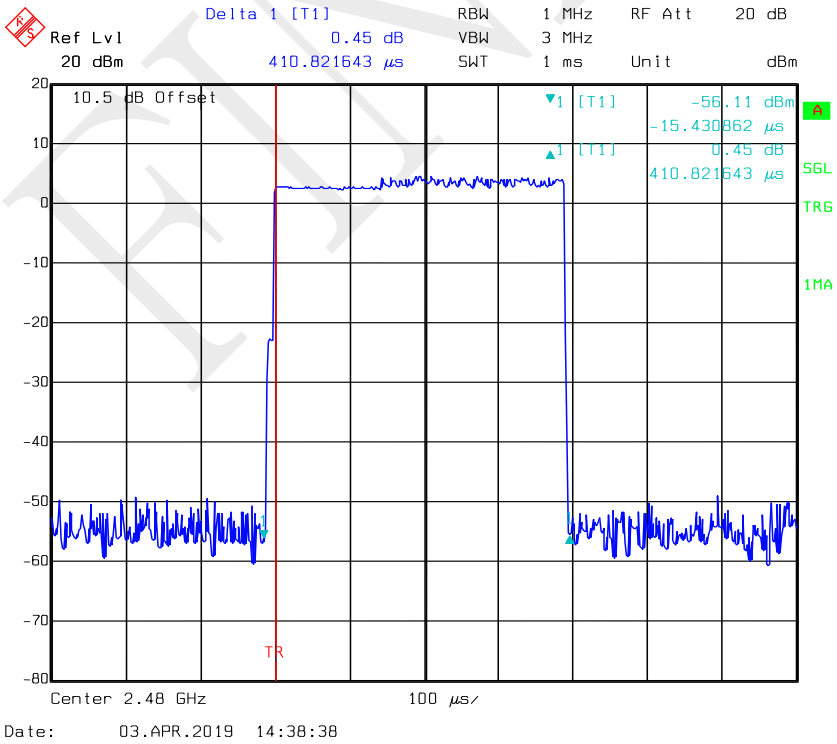
2DH1: Low Channel



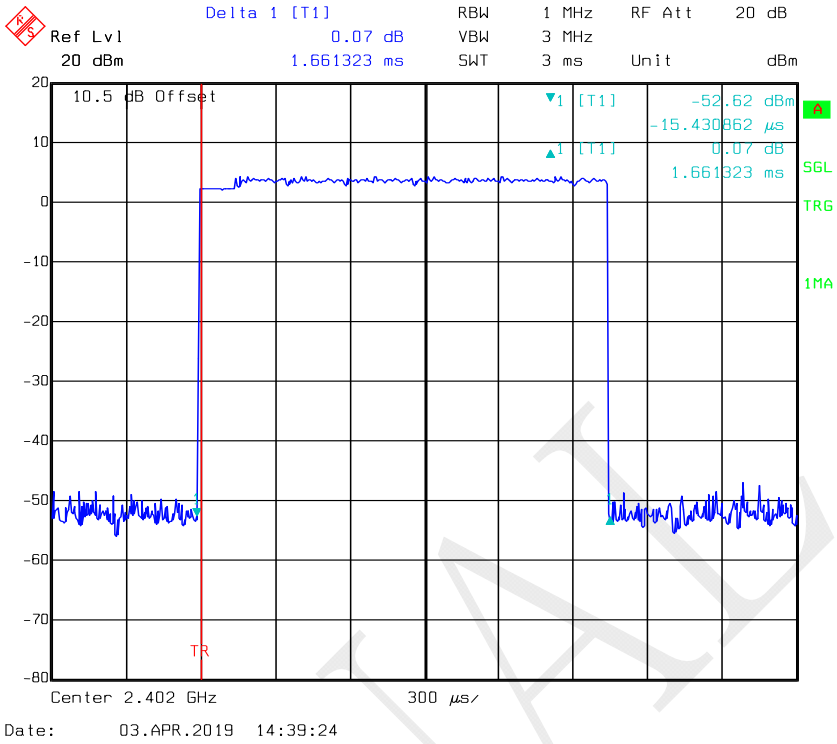
2DH1: Middle Channel



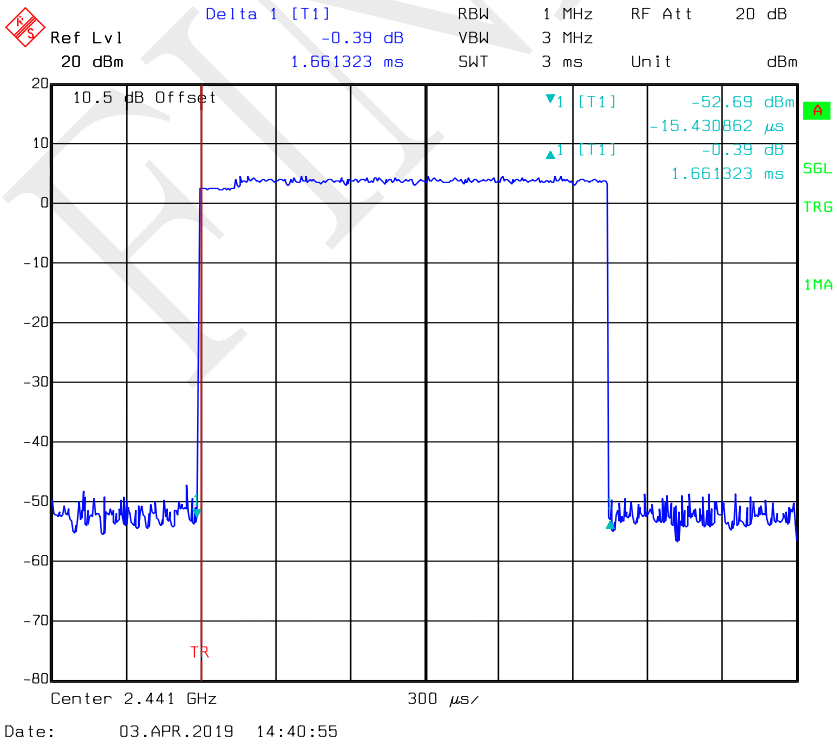
2DH1: High Channel



2DH3: Low Channel

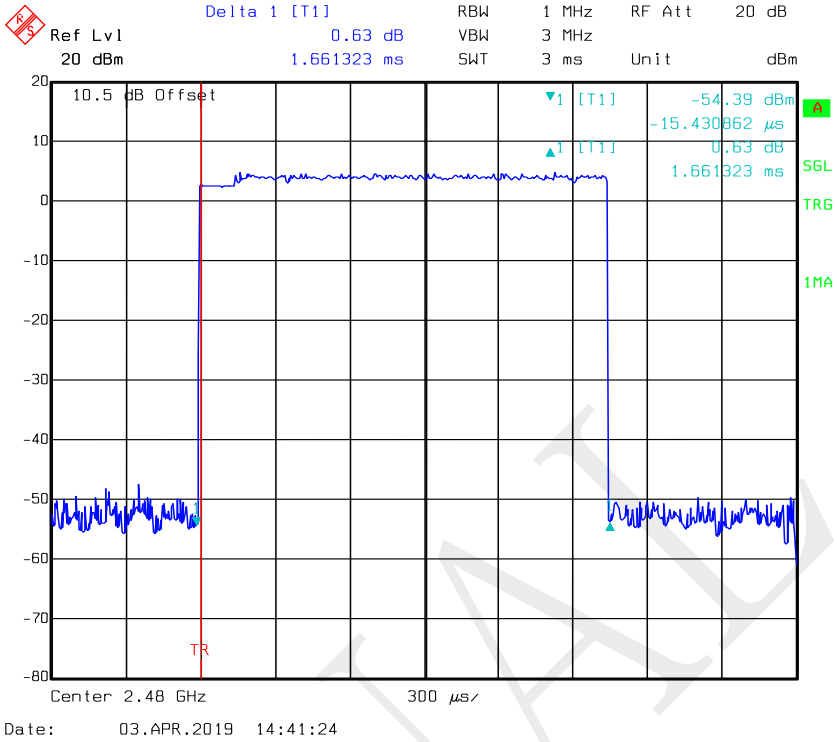


2DH3: Middle Channel

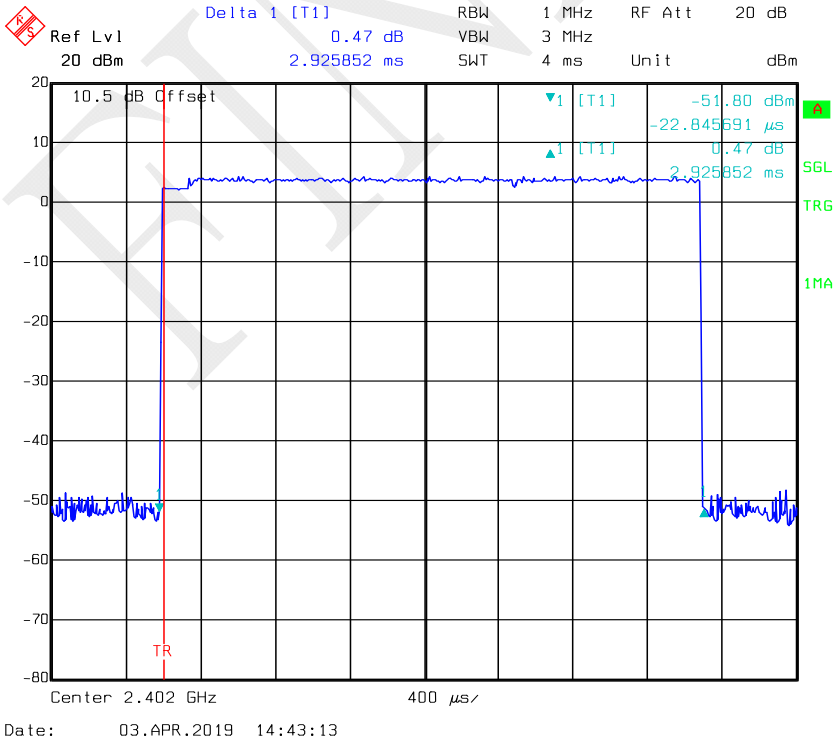


FINAL

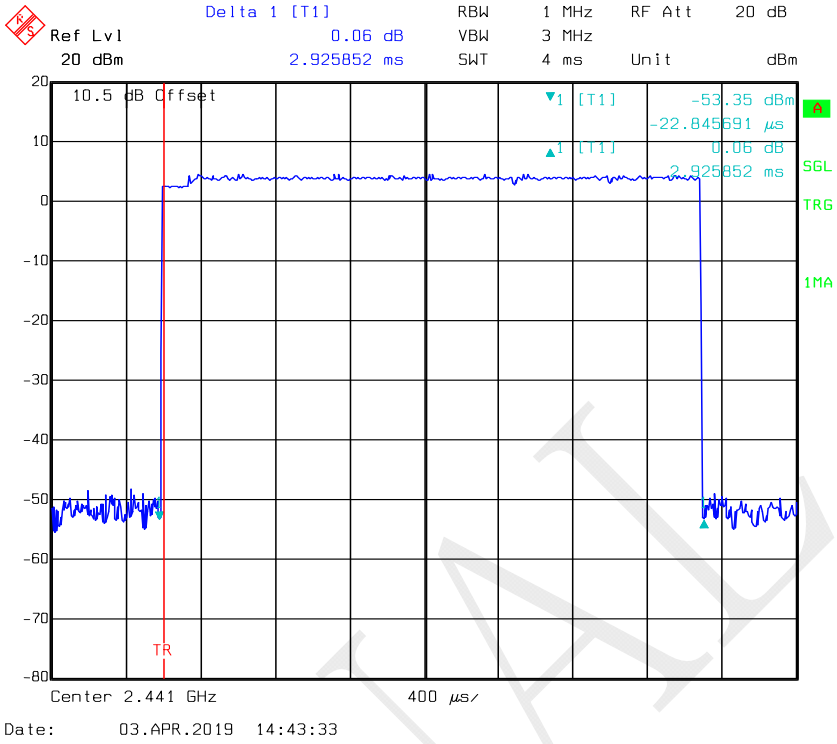
2DH3: High Channel



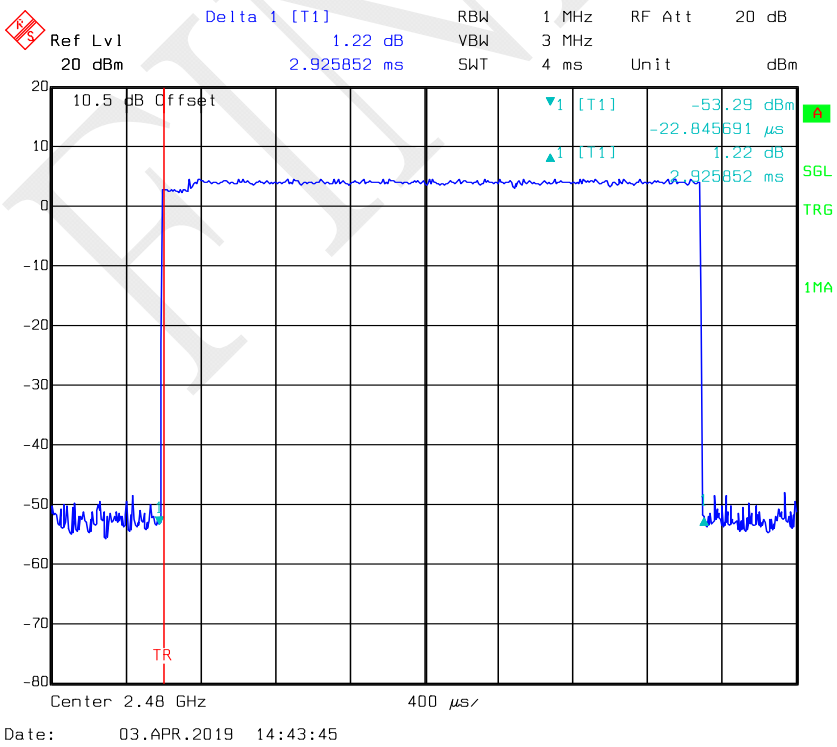
2DH5: Low Channel



2DH5: Middle Channel



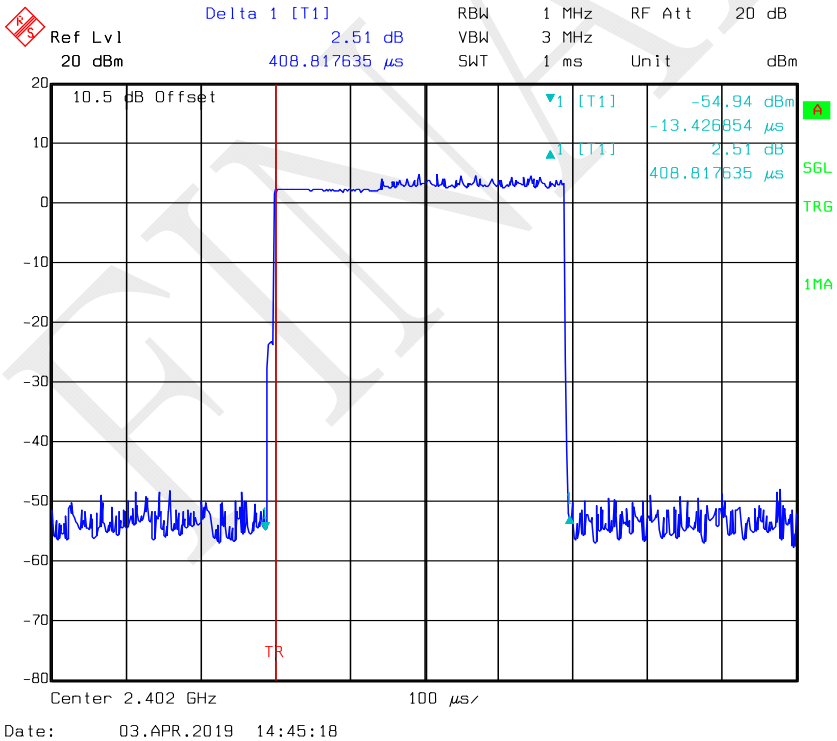
2DH5: High Channel



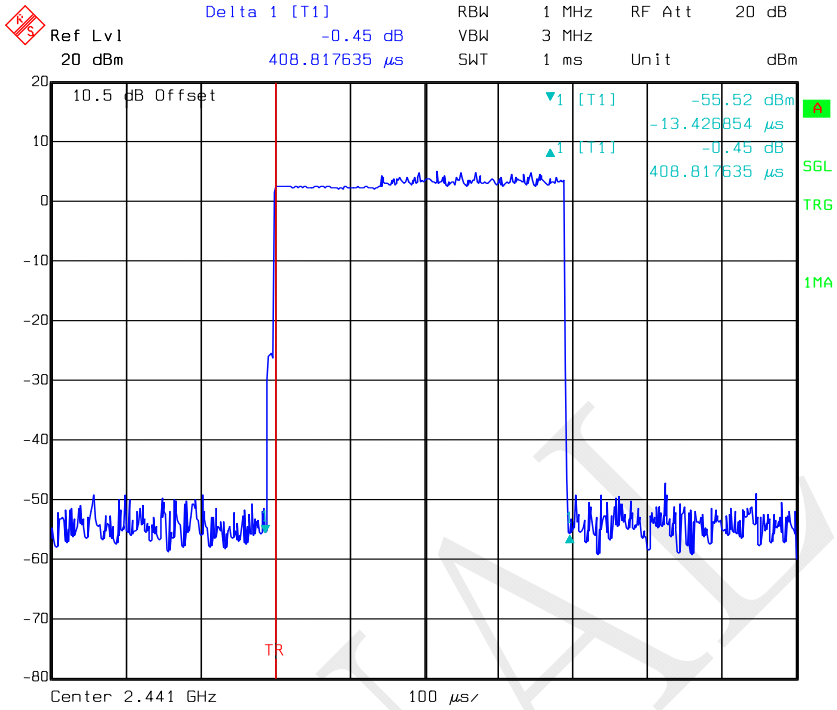
EDR Mode (8-DPSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
3DH1	Low	0.409	0.131	0.4	Compliance
	Middle	0.409	0.131	0.4	Compliance
	High	0.409	0.131	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
3DH3	Low	1.665	0.266	0.4	Compliance
	Middle	1.665	0.266	0.4	Compliance
	High	1.665	0.266	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
3DH5	Low	2.926	0.312	0.4	Compliance
	Middle	2.926	0.312	0.4	Compliance
	High	2.926	0.312	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

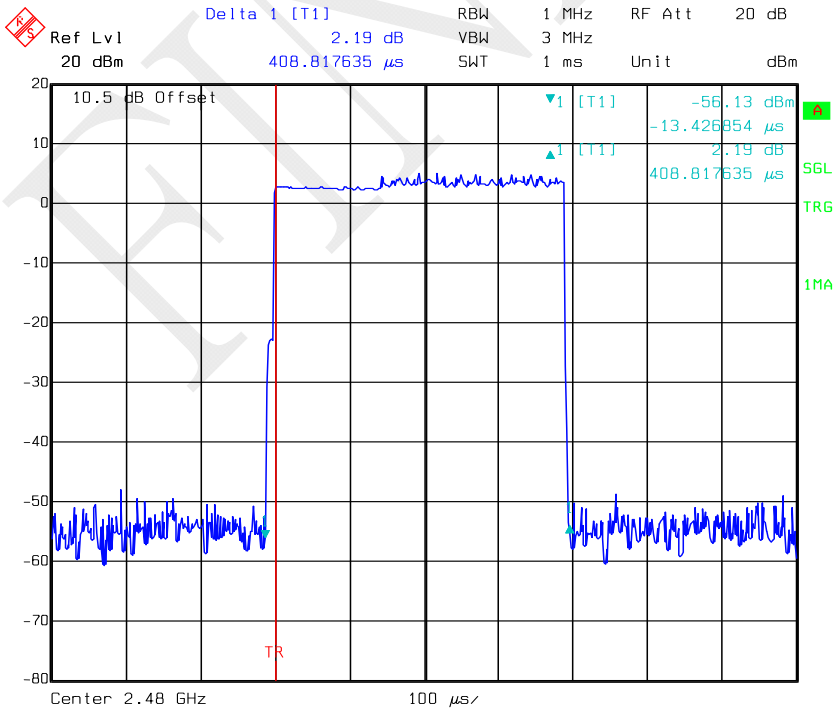
3DH1: Low Channel



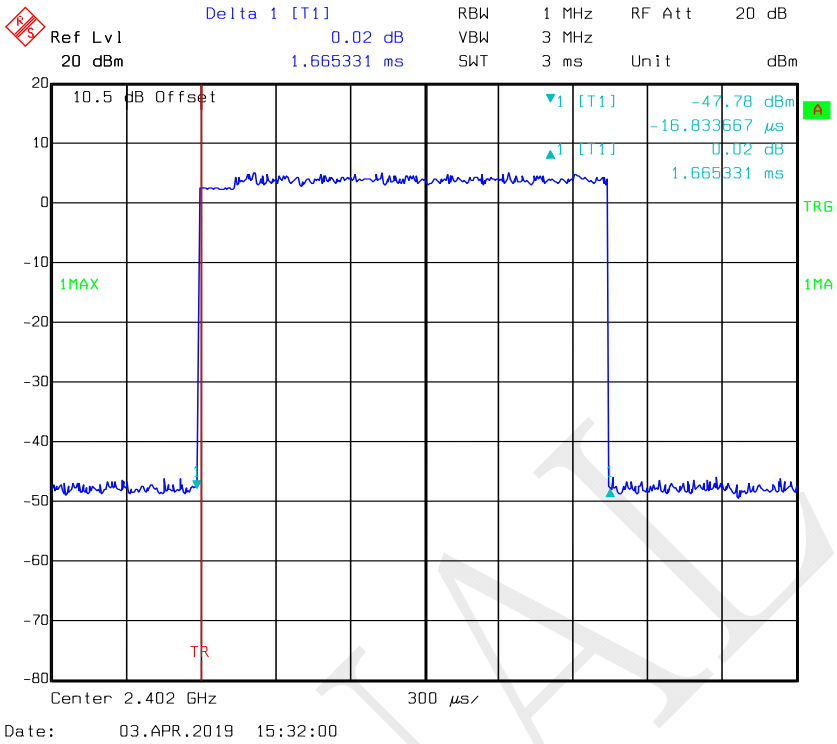
3DH1: Middle Channel



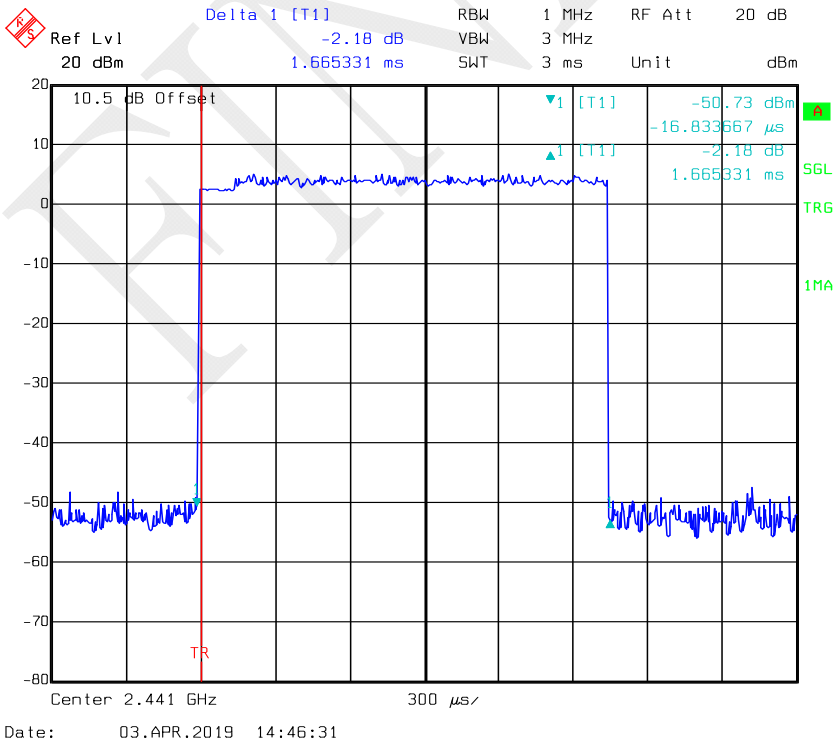
3DH1: High Channel



3DH3: Low Channel

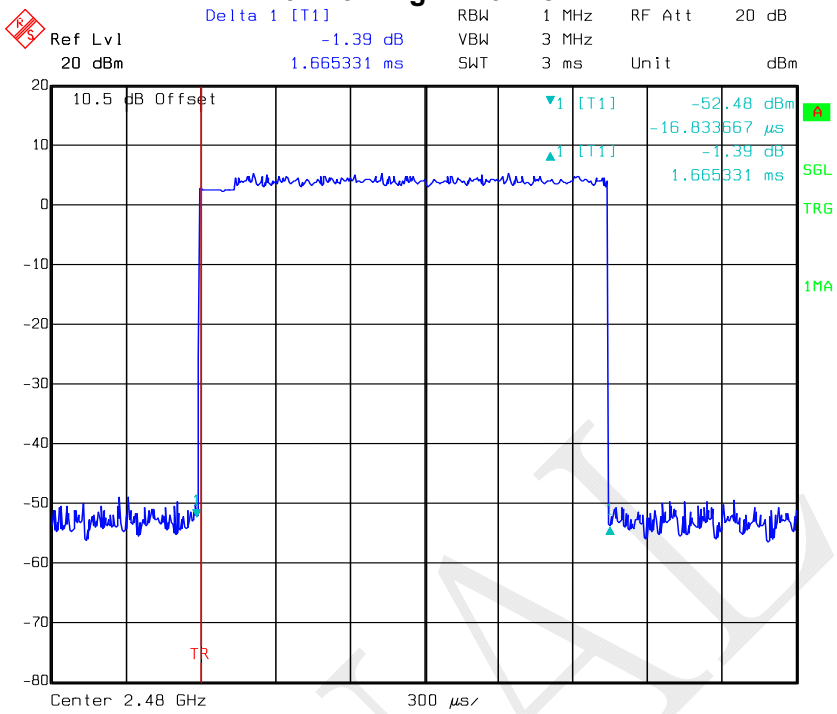


3DH3: Middle Channel



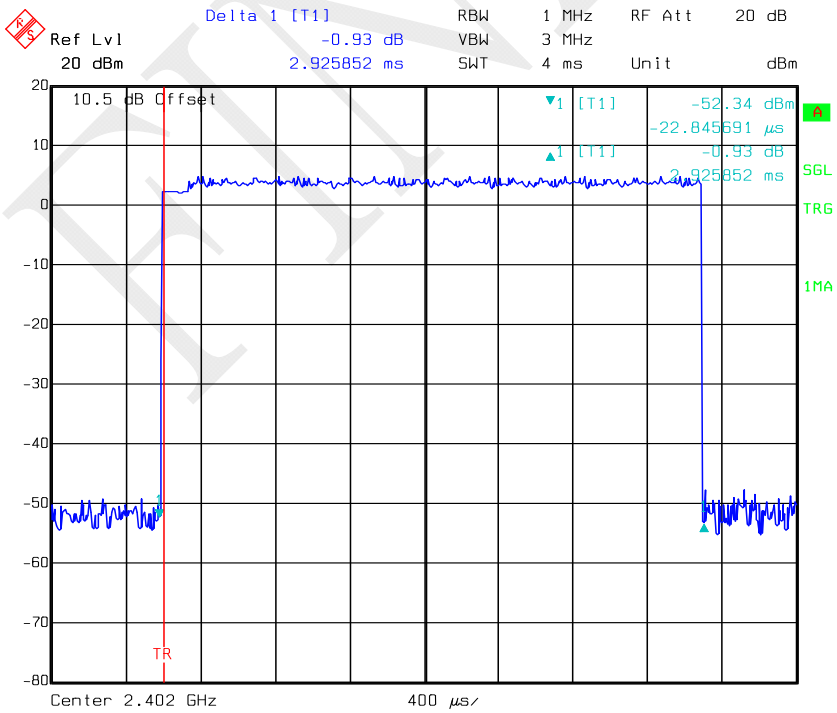
FINAL

3DH3: High Channel



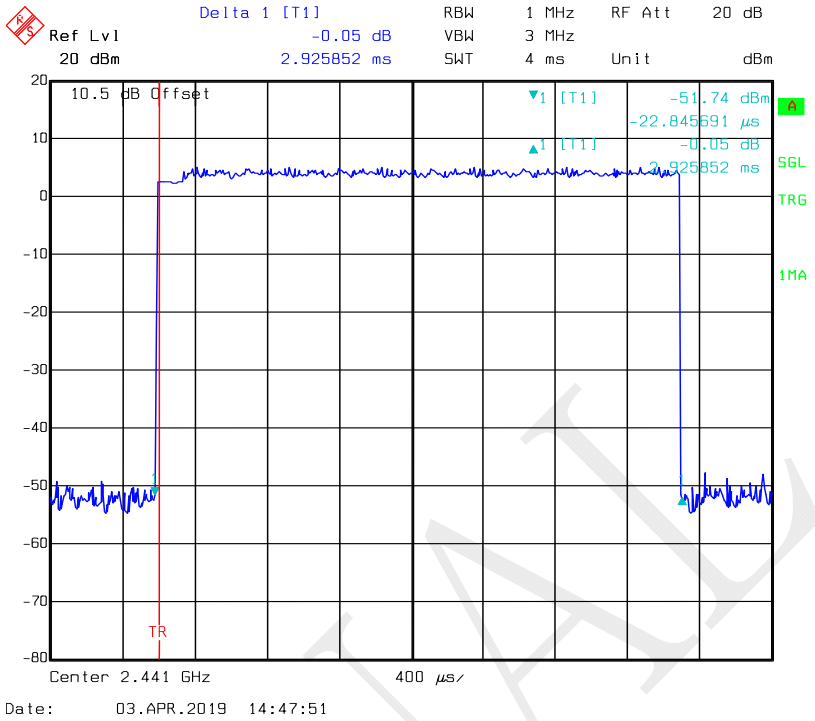
Date: 03.APR.2019 14:46:21

3DH5: Low Channel

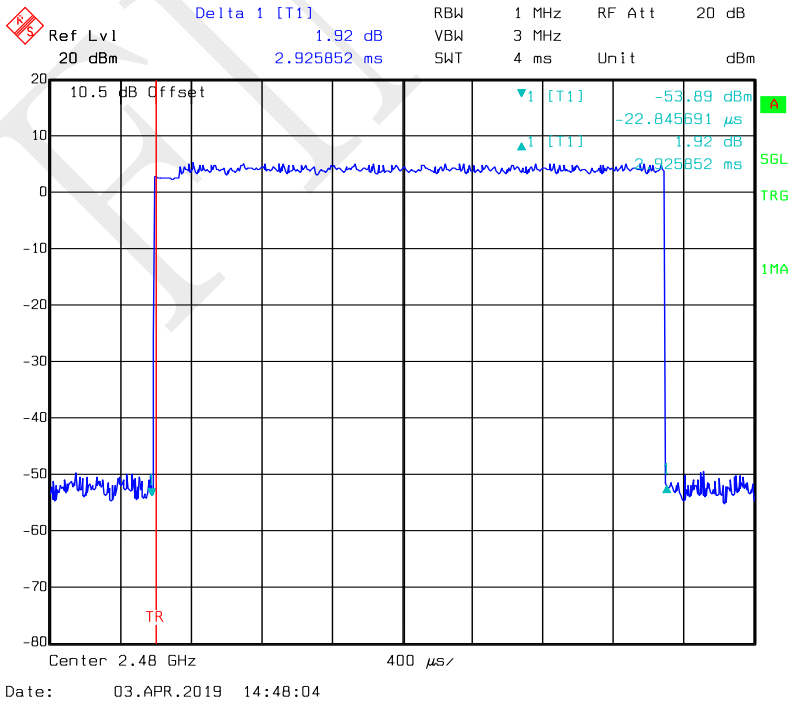


Date: 03.APR.2019 14:47:38

3DH5: Middle Channel



3DH5: High Channel



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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance. Please refer to following tables and plots

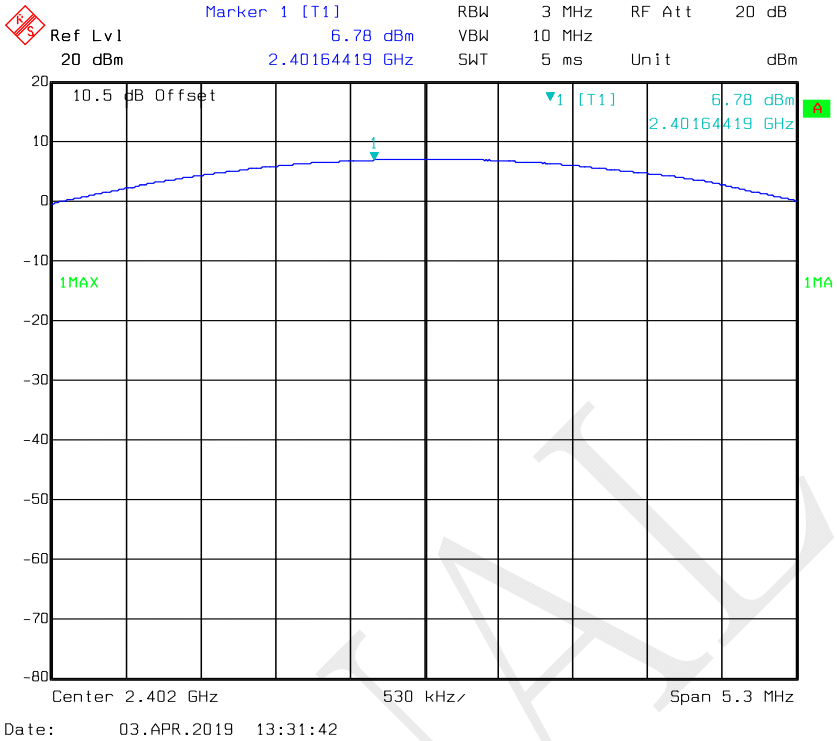
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Peak Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	Low	2402	6.78	30
	Middle	2441	6.90	30
	High	2480	7.12	30
EDR Mode (π/4-DQPSK)	Low	2402	4.96	30
	Middle	2441	5.18	30
	High	2480	5.41	30
EDR Mode (8-DPSK)	Low	2402	5.18	30
	Middle	2441	5.30	30
	High	2480	5.56	30

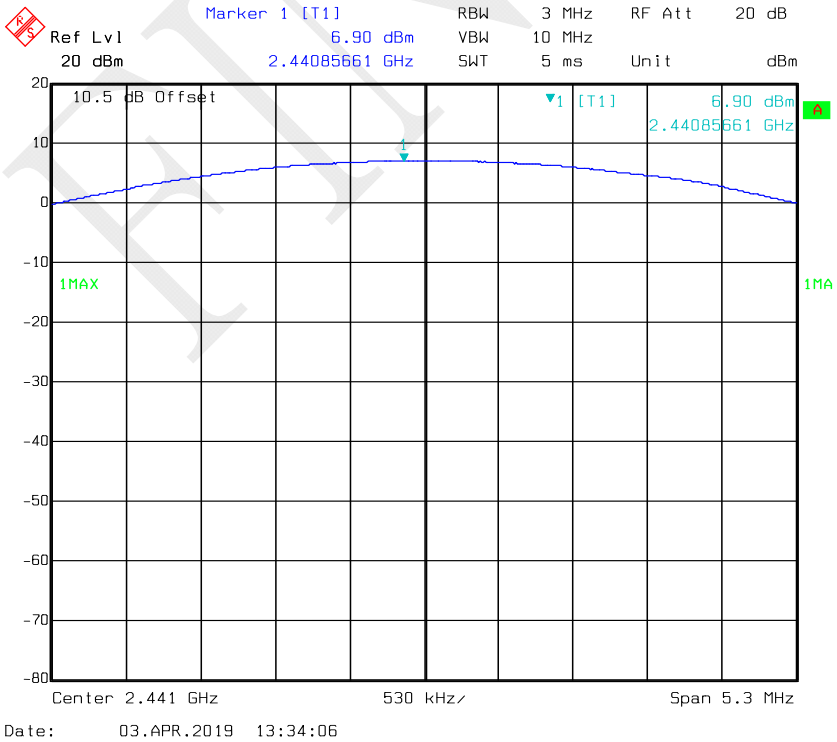
Note: The data above was tested in conducted mode.

BDR Mode (GFSK):

Low Channel

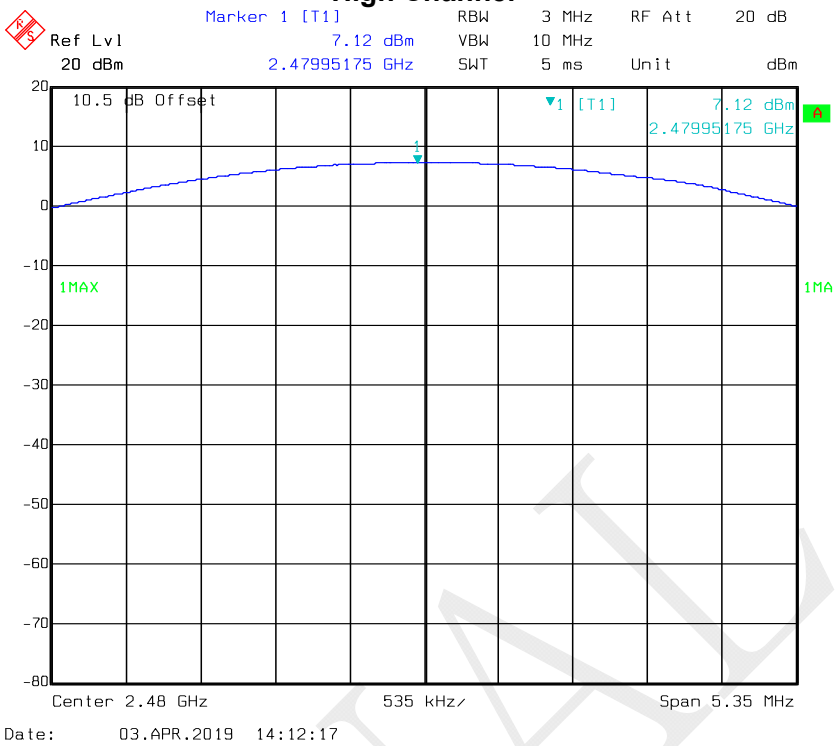


Middle Channel



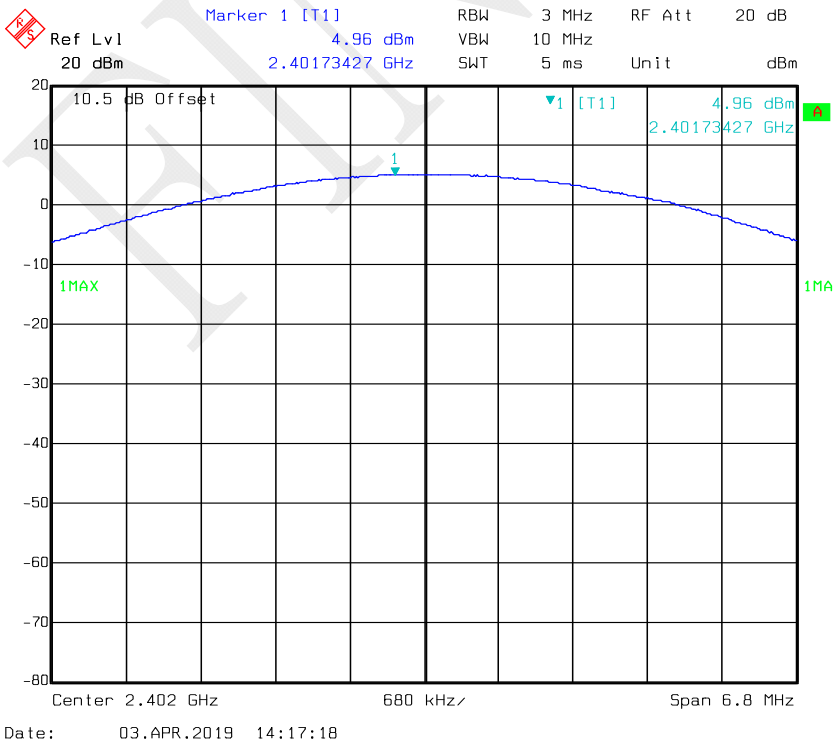
FINAL

High Channel

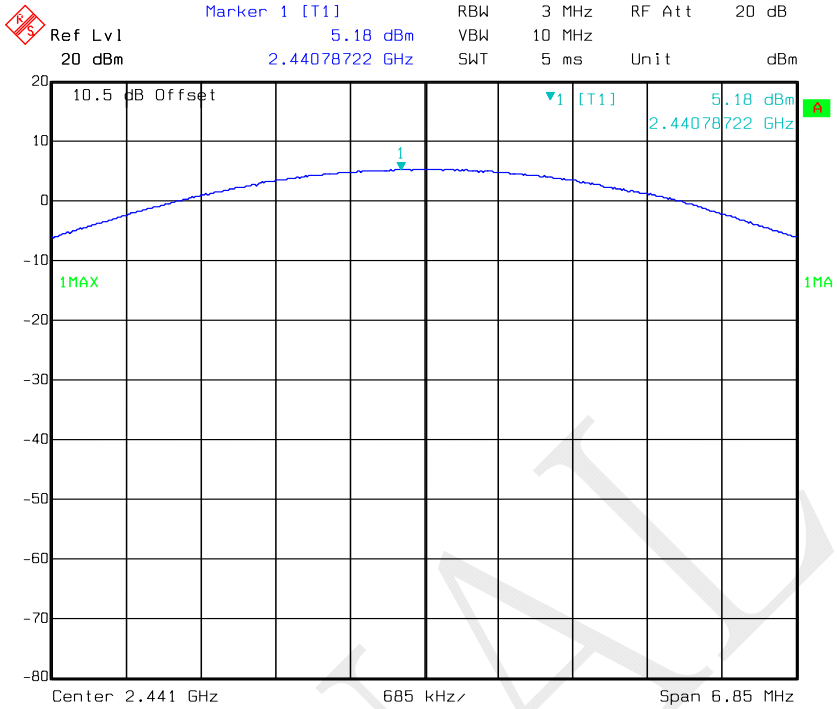


EDR Mode (π/4-DQPSK):

Low Channel

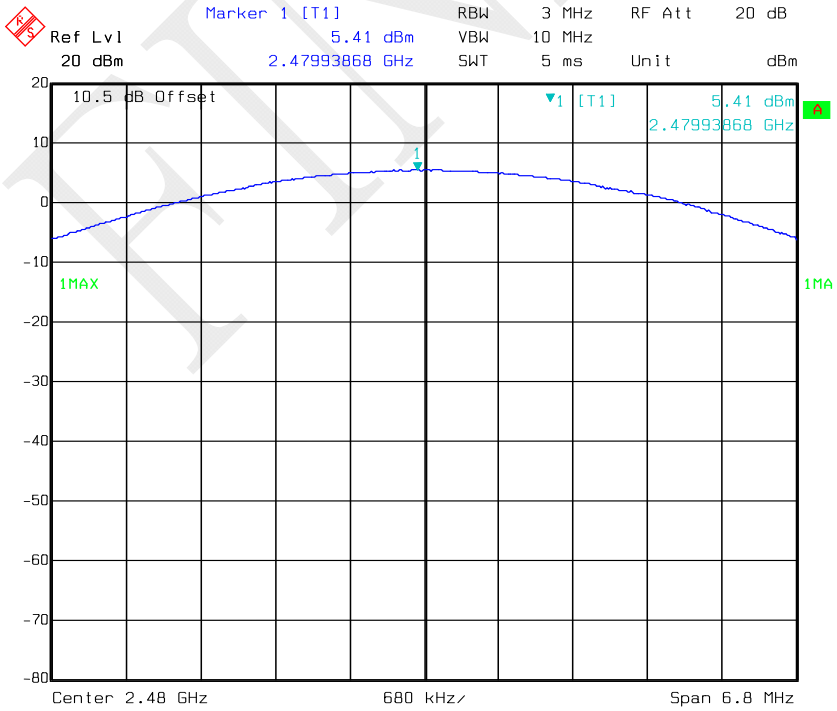


Middle Channel



Date: 03.APR.2019 14:19:26

High Channel

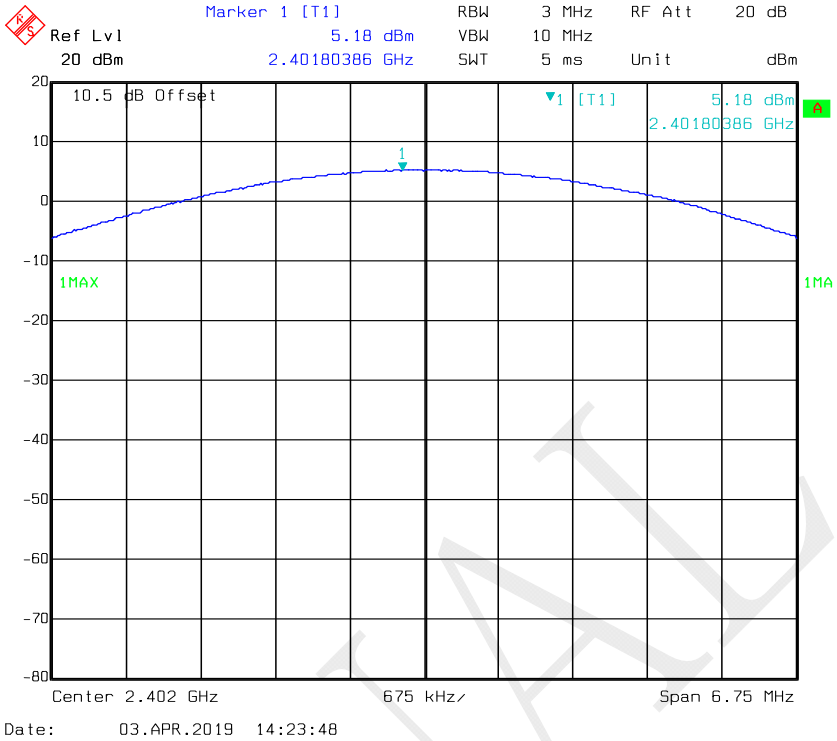


Date: 03.APR.2019 14:21:24

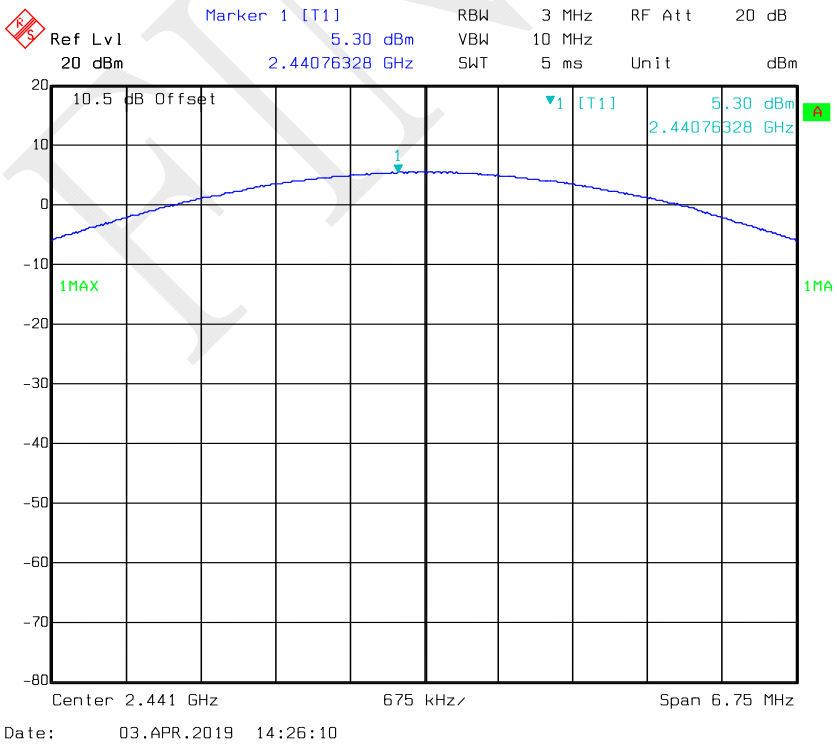
FINAL

EDR Mode (8-DPSK):

Low Channel

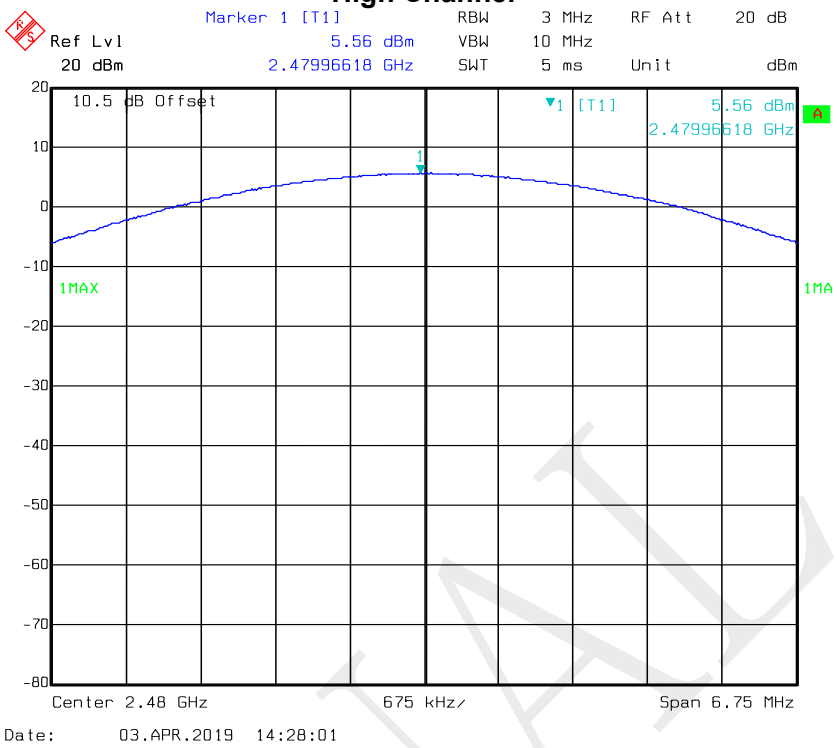


Middle Channel



FINAL

High Channel



FINAL

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW=100 kHz; VBW=300 kHz.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

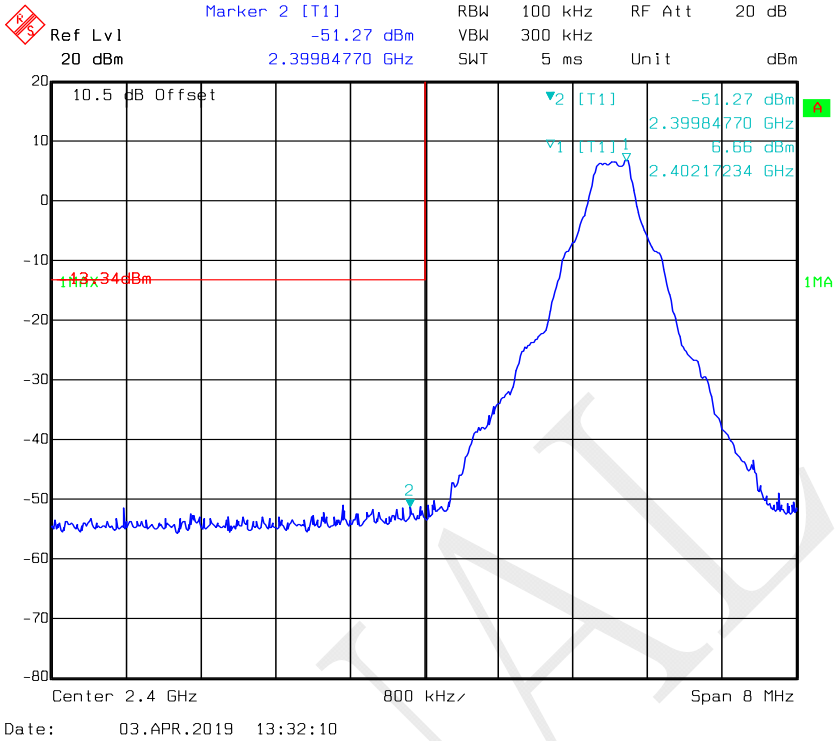
The testing was performed by Tom Tang on 2019-04-03.

Test Result: Compliance. Please refer to the below plots:

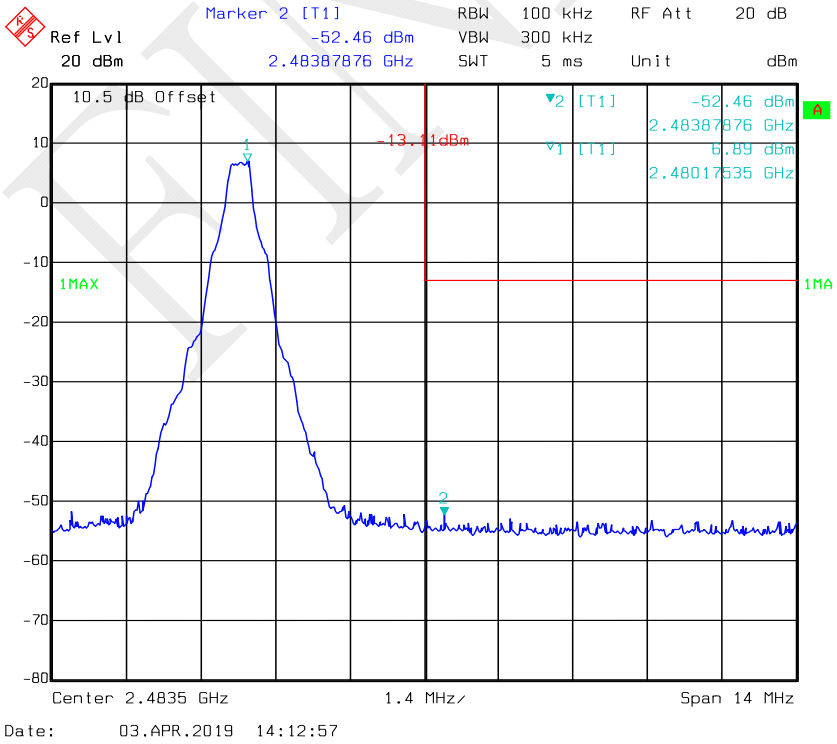
FINAL

BDR Mode (GFSK):

Band Edge, Left Side

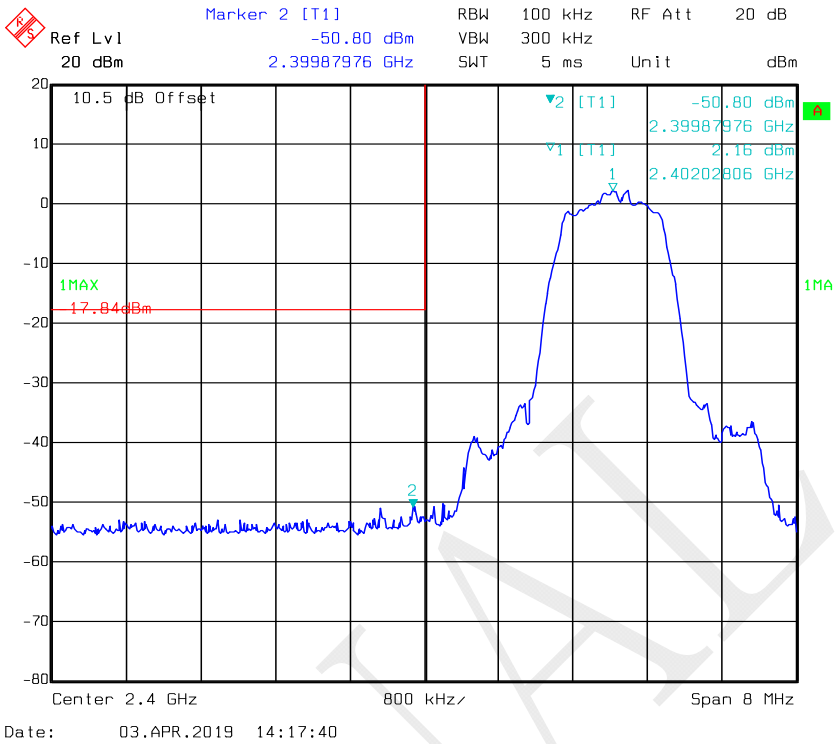


Band Edge, Right Side

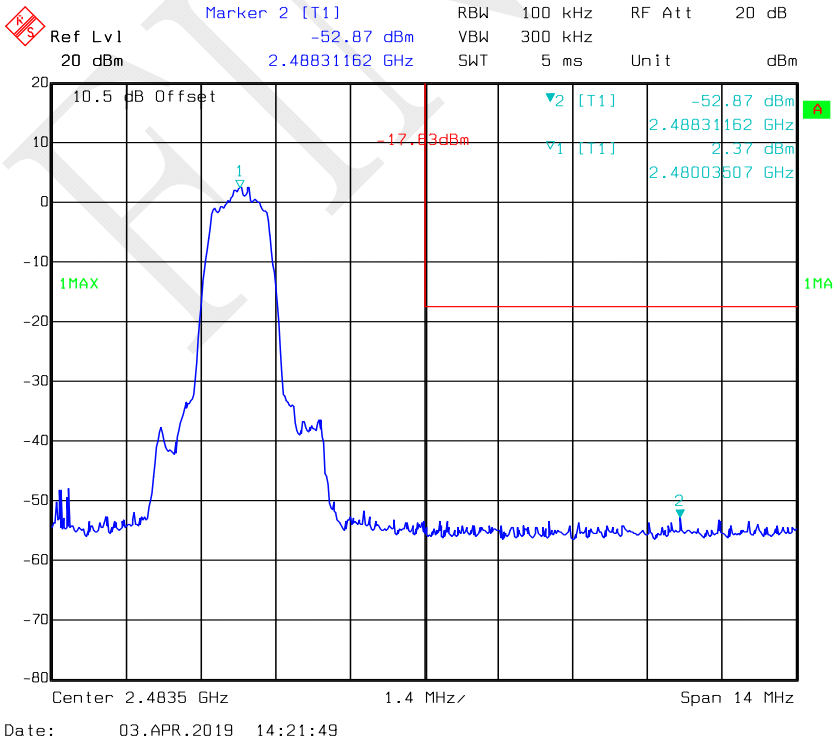


EDR Mode (π/4-DQPSK):

Band Edge, Left Side

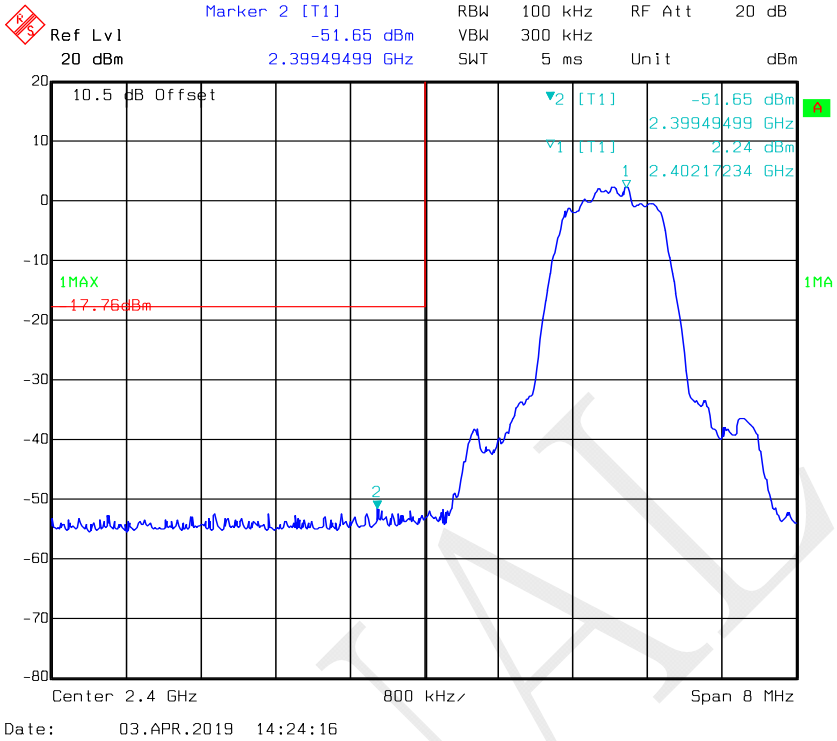


Band Edge, Right Side

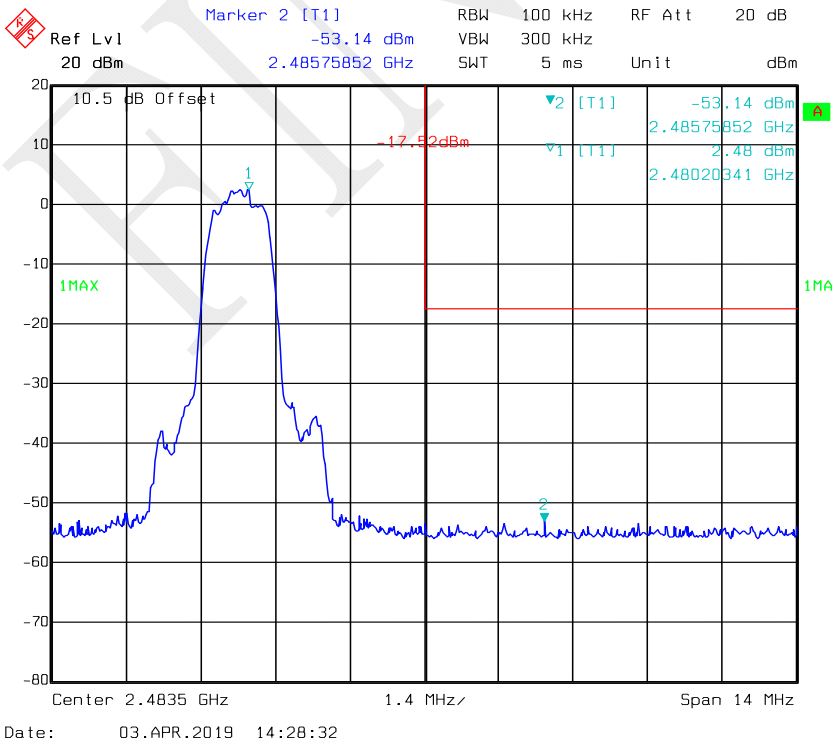


EDR Mode (8-DPSK):

Band Edge, Left Side



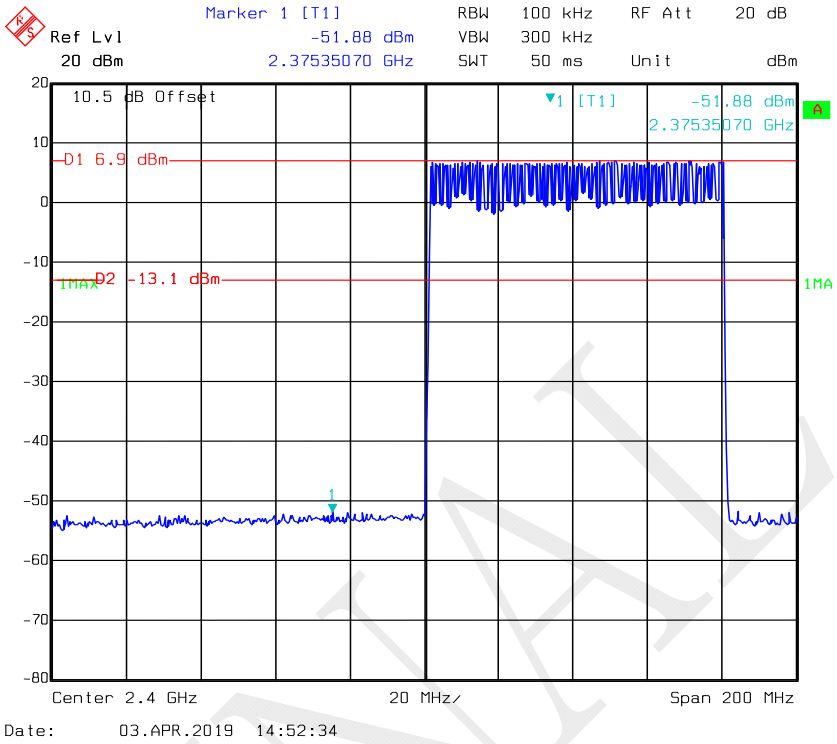
Band Edge, Right Side



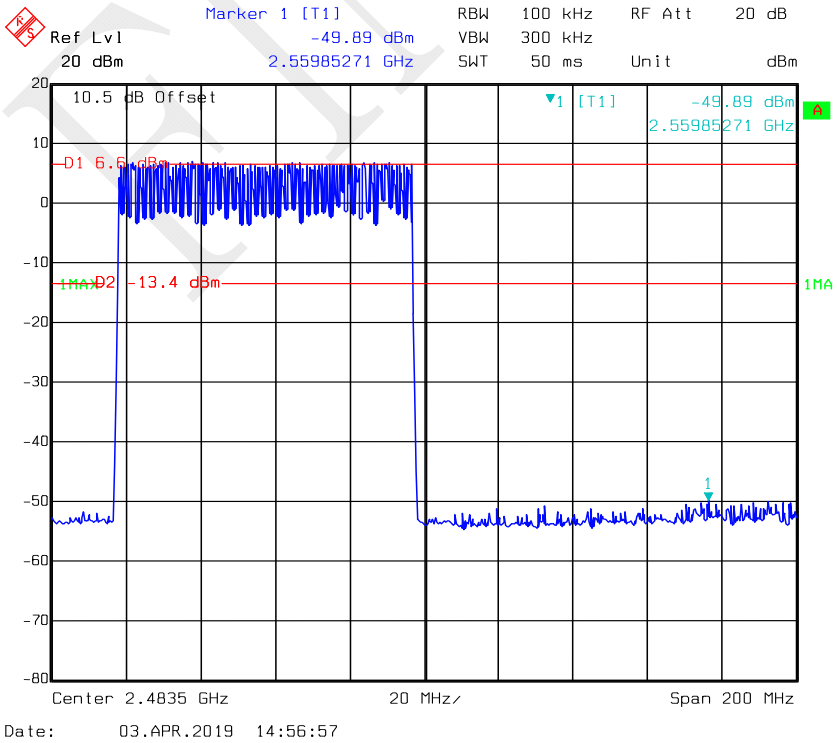
Hopping:

BDR Mode (GFSK):

Band Edge, Left Side

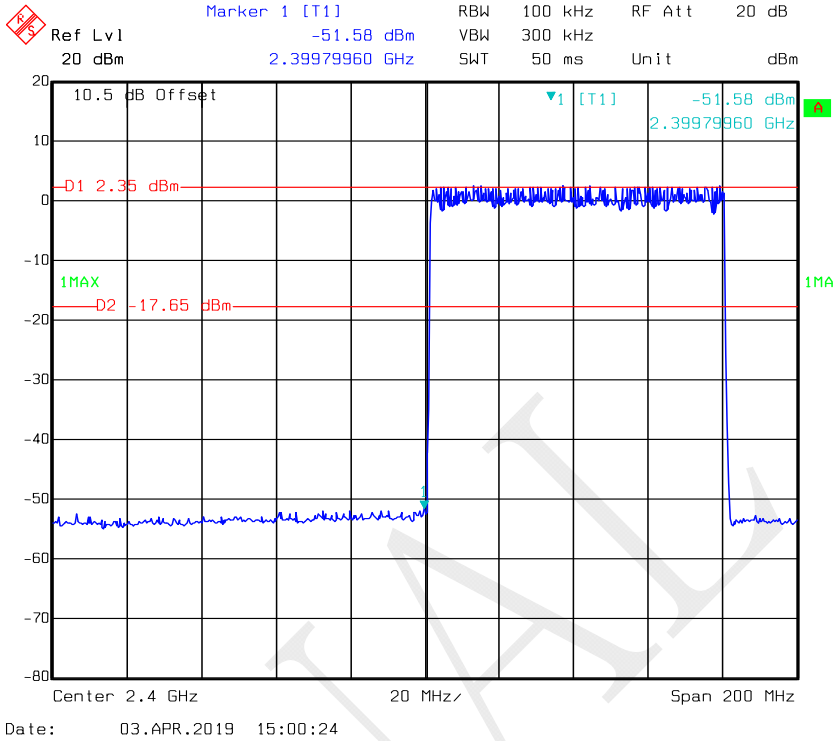


Band Edge, Right Side

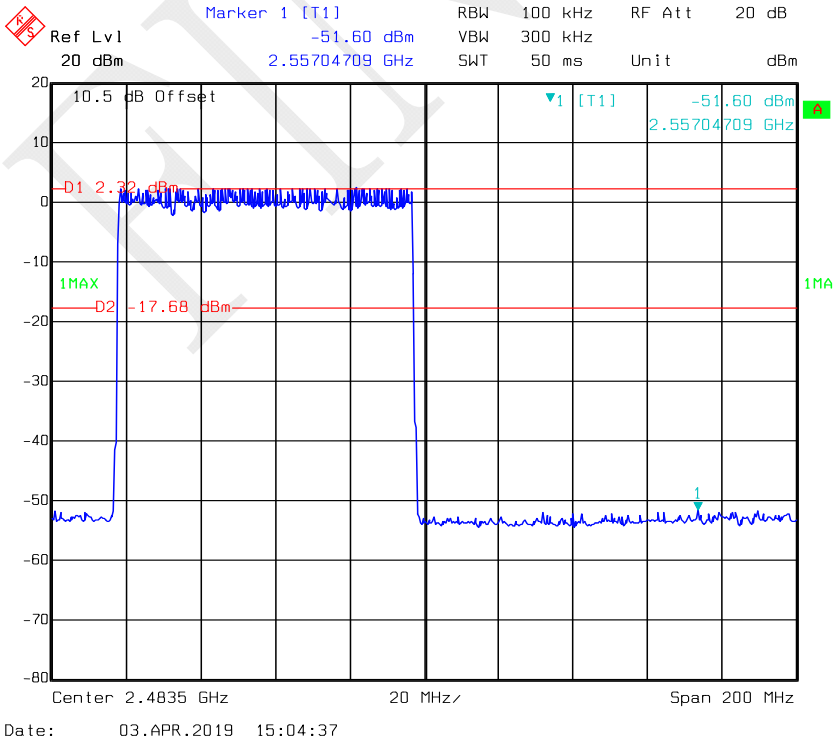


EDR Mode (π/4-DQPSK):

Band Edge, Left Side

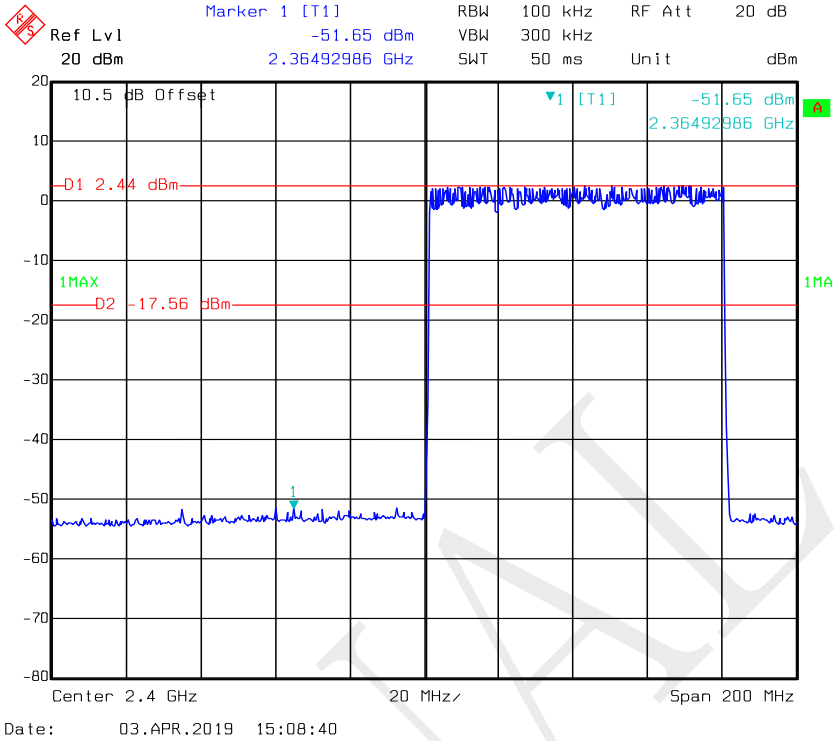


Band Edge, Right Side

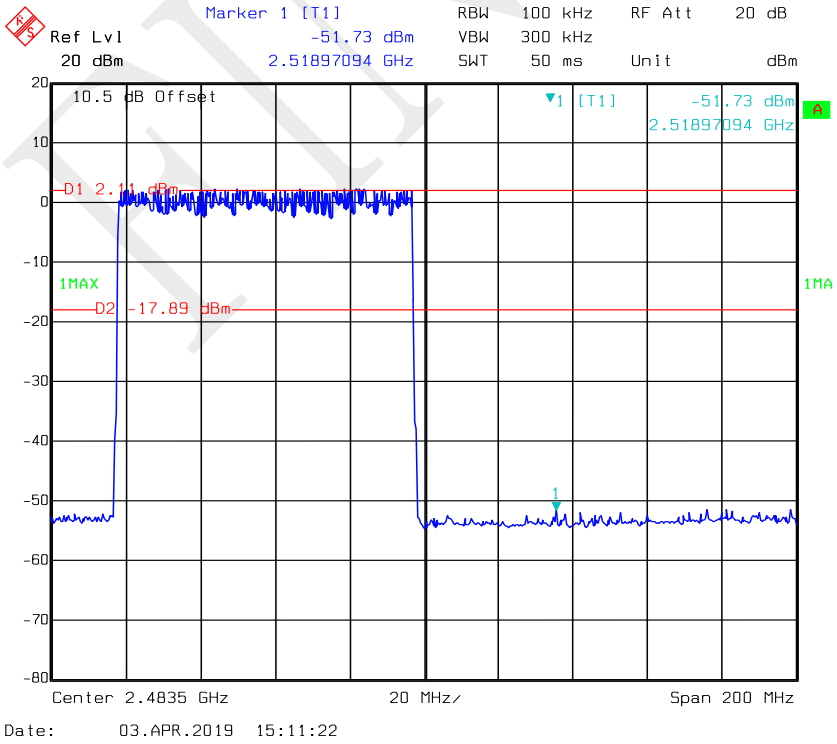


EDR Mode (8-DPSK):

Band Edge, Left Side



Band Edge, Right Side



END OF REPORT