FCC PART 15.247

TEST REPORT

For

Chengdu Vantron Technology, Ltd.

No.5 GaoPeng Road, Hi-Tech Zone, Chengdu, SiChuan, P.R. China 610045

Tested Model: VT-M2M-BTA-DE-A
FCC ID: 2AAGEBTADE-ALP

Report Type:	**Equipment Name:**
Original Report	Gateway

Report Number:	RSC200305002-0D
Date of Report Issue:	2020-06-10
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

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Chengdu Vantron Technology, Ltd.
Product	Gateway
Tested Model	VT-M2M-BTA-DE-A
Multiple Model	VT-M2M-BTA-DE-ALP
FCC ID	2AAGEBTADE-ALP
Radio Mode	Bluetooth
Frequency Range	2402MHz-2480MHz
Modulation Type:	GFSK, π/4-DQPSK, 8DPSK
Voltage Range	DC 9-36V(Typical:12V) from adapter
Measure approximately	176 mm (L) x 101 mm (W) x 52 mm (H)
Sample serial number	200305002/01 (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received: 2020-03-05
Adapter	Manufacturer: Shenzhen Wentong Electronic Co., Ltd Model : WT1205000 Voltage Input: AC 100-240V 50/60Hz 1.6A Voltage Output: DC 12V 5.0A

Note: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

Base on difference between VT-M2M-BTA-DE-A and VT-M2M-BTA-DE-ALP, full items was performed for the former, only radiated emissions(30 MHz-1 GHz) for the latter.

Objective

This report is prepared on behalf of **Chengdu Vantron Technology, Ltd.** 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: 2AAGEBTADE-ALP

Measurement Uncertainty

Item			Uncertainty
AC power line conducted emission			2.48 dB
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.31 dB
		V	4.57 dB
	200MHz-1GHz	H	4.68 dB
		V	5.78 dB
	1GHz-6GHz		4.56 dB
	6GHz-18GHz		4.57 dB
	18GHz-40GHz		5.44 dB

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the corresponding inclusion factor K when the inclusion probability is about 95%.

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

The setting by the software built-in the device as following table:

Test Software Version		CSR BlueSuite 2.6.2		
Test Frequency		2402MHz	2441MHz	2480MHz
GFSK	Power Level	50	50	50
π/4-DQPSK	Power Level	50	50	50
8PSK	Power Level	50	50	50

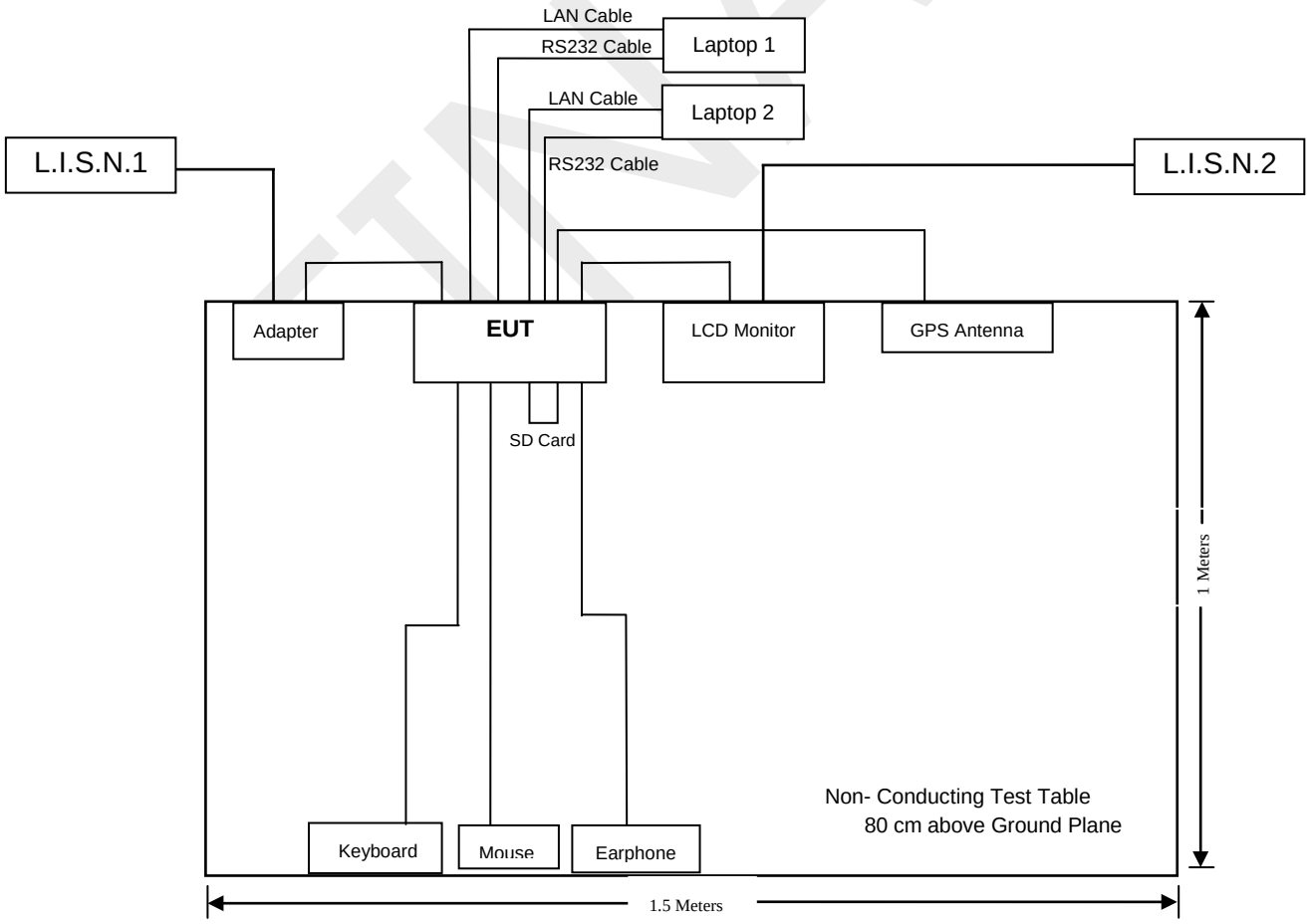
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
EDIFIER	Earphone	K800	Unknown
DELL	LCD Monitor	E157FPb	Unknown
DELL	Laptop 1	E6410	42159296809
DELL	Laptop 2	PP01L	3F438A01
Lenovo	Keyboard	SK-8821	Unknown
ACER	Mouse	M113	Unknown
SanDisk	SD Card	16GB	Unknown

External I/O Cable

Cable Description	Length (m)	From	To
Unshielded AC Power Cable	1.5	Adapter	L.I.S.N.1
Unshielded AC Power Cable	1.5	LCD Monitor	L.I.S.N.2
Shielded VGA Cable	1.8	EUT	LCD Monitor
Unshielded LAN Cable	8.0	EUT	Laptop 1
Shielded RS232 Cable x 2	8.0	EUT	Laptop 1 Laptop 2
Unshielded LAN Cable	8.0	EUT	Laptop 2
Unshielded Keyboard Cable	1.8	Keyboard	EUT
Unshielded Mouse Cable	1.8	Mouse	EUT
Unshielded Earphone Cable	2.0	Earphone	EUT

Block Diagram of Test Setup



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	Compliance
§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

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

TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission					
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2020-04-13	2021-04-12
ROHDE&SCHWARZ	L.I.S.N.	ENV216	3560.6550.16	2020-01-13	2021-01-12
EMCO	L.I.S.N.	3810/2BR	9509-1102	NCR	NCR
HP	RF Limiter	11947A	3107A01270	2019-10-18	2020-10-17
Micro-coax	Conducted Cable	L-E003	000003	2019-08-05	2020-08-04
Rohde & Schwarz	EMC32	EMC32	V 8.52.0	NCR	NCR
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2022-05-17
SONOMA INSTRUMENT	Amplifier	310 N	186684	2019-09-06	2020-09-05
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2019-12-10	2022-12-09
INMET	Attenuator	18N-6dB	N/A	2019-10-17	2020-10-16
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2020-04-13	2021-04-12
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2020-04-13	2021-04-12
Rohde & Schwarz	EMI Test Receiver	ESIB 40	100215	2020-04-13	2021-04-12
EMCO	Horn Antenna	3115	2192	2019-09-25	2021-09-24
Mini-circuits	Pre-Amplifier	ZVA-183-S+	771001215	2019-09-20	2020-09-19
EM Electronics	Pre-Amplifier	EM18G40	060725	2019-07-24	2020-07-23
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2019-09-02	2021-09-01
MICRO-TRONICS	2.4GHz Notch Filter	BRM50702	G396	2020-02-22	2021-02-21
Unknown	RF Cable (Below 1GHz)	L-E005	000005	2019-09-06	2020-09-05
Unknown	RF Cable (Below 1GHz)	T-E128	000128	2019-10-17	2020-10-16
Unknown	RF Cable (Below 1GHz)	T-E237	233522-001	2019-07-19	2020-07-18
Unknown	RF Cable (Above 1GHz)	T-E069	000069	2019-07-24	2020-07-23
UTiFLEX	RF Cable (Above 1GHz)	T-E222	2551/2	2019-07-24	2020-07-23
UTiFLEX	RF Cable (Above 1GHz)	T-E210	1042	2019-07-24	2020-07-23
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2020-04-13	2021-04-12
WEINSCHEL ENGINEERING	Attenuator	1A 10dB	AB1165	2019-08-05	2020-08-04
RF Superstore	DC Block	RF-530004	Unknown	2019-08-05	2020-08-04
Unknown	RF Cable	Unknown	000007	Each Time	Each Time

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:

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

Calculated Data:

WiFi +Bluetooth + Zigbee module (FCC ID: QOQMGM12P3，Date of Grant: 2017-08-01) + WCDMA/LTE module (FCC ID: RI7LE910NAV2, Date of Grant: 2016-07-06)

MPE evaluation for single transmission:

Raido Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	Ratio
		(dBi)	(numeric)	(dBm)	(mW)				
WLAN	2412-2462	2.0	1.58	16.0	39.81	20	0.013	1.0	0.013
Zigbee	2405-2480	2.0	1.58	19.0	79.43	20	0.025	1.0	0.025
LE 1M	2402-2480	2.0	1.58	8.0	6.31	20	0.002	1.0	0.002
BT 3.0	2402-2480	2.0	1.58	7.5	5.62	20	0.002	1.0	0.002
WCDMA Band 5	824-849	3.0	2.00	24.5	281.84	20	0.112	0.55	0.204
LTE Band 5	824-849	3.0	2.00	24.0	251.19	20	0.100	0.55	0.182
WCDMA Band 2	1850-1910	5.0	3.16	24.5	281.84	20	0.177	1.0	0.177
LTE Band 2	1850-1910	5.0	3.16	24.0	251.19	20	0.158	1.0	0.158
LTE Band 4	1710-1755	5.0	3.16	24.0	251.19	20	0.158	1.0	0.158
LTE Band 12	699-716	3.0	2.00	24.0	251.19	20	0.100	0.47	0.213
LTE Band 13	777-787	3.0	2.00	24.0	251.19	20	0.100	0.52	0.192
LTE Band 17	704-716	3.0	2.00	24.0	251.19	20	0.100	0.47	0.213

MPE evaluation for simultaneous transmission:

Note: Wi-Fi, Bluetooth, Zigbee&WCDMA/LTE can transmit simultaneously, MPE evaluation is as below formula:

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

The worst case is as below:

MPE of WLAN + MPE of Bluetooth +MPE of Zigbee + MPE of WWAN
= 0.013/1.0+0.002/1.0+0.025/1.0+0.10/0.47=0.252＜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 antenna, one Bluetooth antenna, one Zigbee antenna, one LTE main antenna, one LTE diversity antenna and one GPS antenna, which fulfill the requirement of this section. Please refer to the table below and EUT photos.

Mode	Manufacturer	Model Number	Antenna Gain (Max)	Impedance (Ohm)	Antenna Connector	Antenna Type
Wi-Fi	Dongguan YiJia Electronics Communication Technology Co.,Ltd.	YJ042S.100001.S02	2.0dBi	50	Reverse SMA male	Monopole
Bluetooth	Dongguan YiJia Electronics Communication Technology Co.,Ltd.	YJ042S.100001.S02	2.0dBi	50	Reverse SMA male	Monopole
Zigbee	FULL RISE ELECTRONIC CO.,LTD	AN-AI-XOC	2.0dBi	50	Reverse SMA male	Monopole
LTE Main	Asian Creation	AC-Q7027-YZW	3.0 dBi (698-960MHz) 5.0 dBi (1710-2700MHz)	50	SMA(Male)	Monopole
LTE Diversity	Asian Creation	AC-Q7027-YZW	3.0 dBi (698-960MHz) 5.0 dBi (1710-2700MHz)	50	SMA(Male)	Monopole
GPS	Shenzhen Norminson Technology CO., LTD.	NP002	28dBi	50	SMA(Male)	Monopole

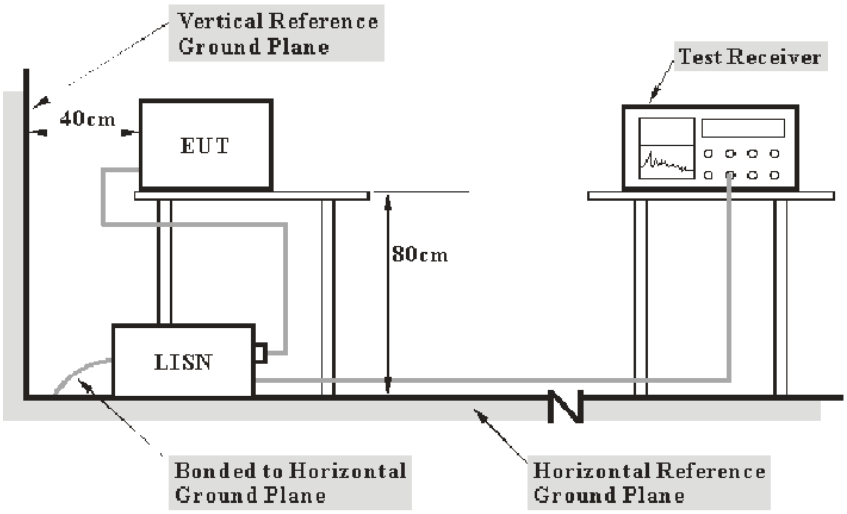
Result: Compliance

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

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

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

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

Test Procedure

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$

Herein,
V_C: corrected voltage amplitude
V_R: reading voltage amplitude
A_c: attenuation caused by cable loss
VDF: voltage division factor of AMN or ISN

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

Margin = Limit – Corrected Amplitude

Test Data

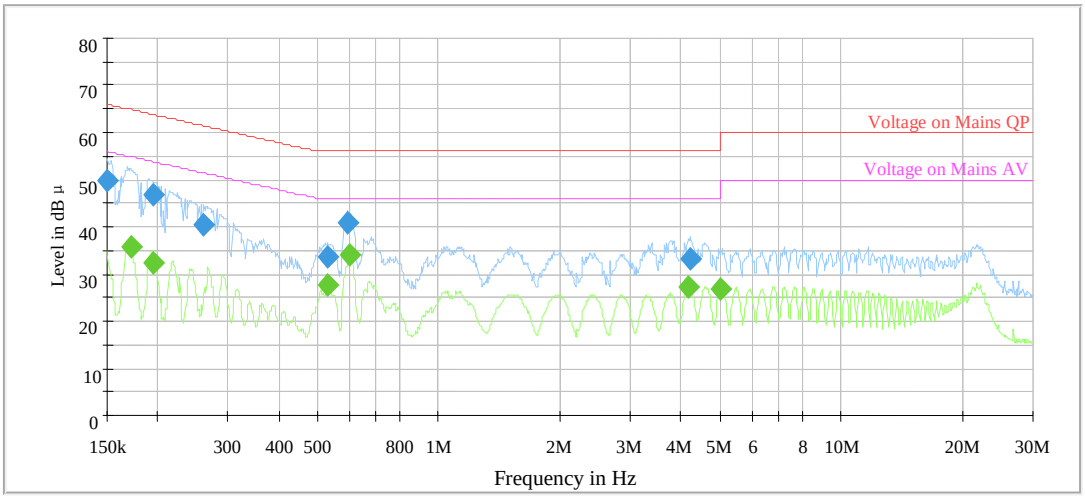
Environmental Conditions

Temperature:	26 °C
Relative Humidity:	60 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

Test Mode: Transmitting (BDR mode) - Worst Case

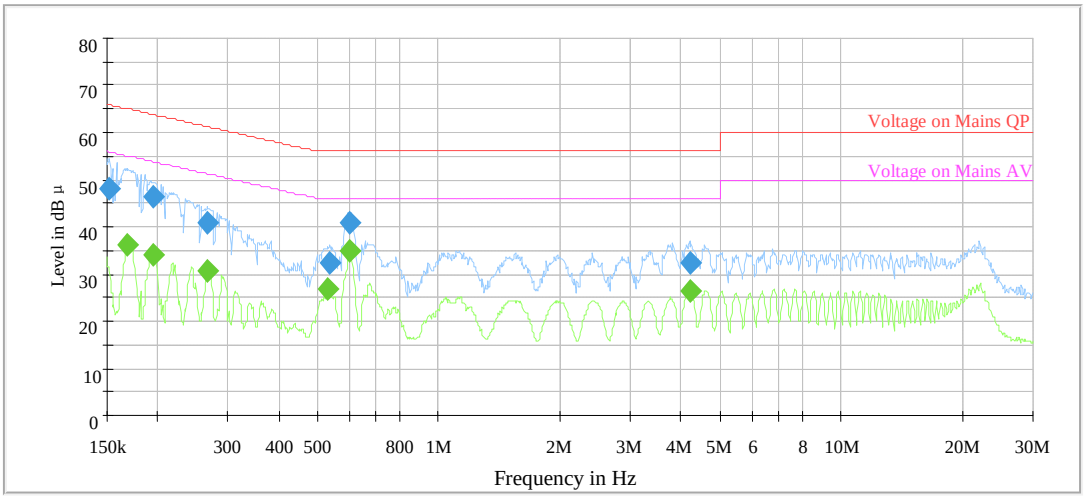
AC120/60Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150750	50.0	9.000	L1	19.5	16.0	66.0
0.196363	46.8	9.000	L1	19.8	17.0	63.8
0.260930	40.4	9.000	L1	19.8	21.0	61.4
0.529792	33.5	9.000	L1	19.8	22.5	56.0
0.594189	40.7	9.000	L1	19.8	15.3	56.0
4.218780	33.0	9.000	L1	19.7	23.0	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.171623	35.7	9.000	L1	19.6	19.2	54.9
0.196363	32.5	9.000	L1	19.8	21.3	53.8
0.529792	27.5	9.000	L1	19.8	18.5	46.0
0.603146	34.1	9.000	L1	19.8	11.9	46.0
4.176906	27.4	9.000	L1	19.7	18.6	46.0
4.998423	26.7	9.000	L1	19.7	19.3	46.0

AC120/60Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152261	48.1	9.000	N	19.6	17.8	65.9
0.196363	46.4	9.000	N	19.7	17.4	63.8
0.266188	40.7	9.000	N	19.8	20.5	61.2
0.537778	32.3	9.000	N	19.8	23.7	56.0
0.603146	40.9	9.000	N	19.8	15.1	56.0
4.197791	32.3	9.000	N	19.7	23.7	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.169074	36.0	9.000	N	19.6	19.0	55.0
0.196363	34.0	9.000	N	19.7	19.8	53.8
0.267519	30.5	9.000	N	19.8	20.7	51.2
0.529792	26.8	9.000	N	19.8	19.2	46.0
0.603146	35.0	9.000	N	19.8	11.0	46.0
4.197791	26.5	9.000	N	19.7	19.5	46.0

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

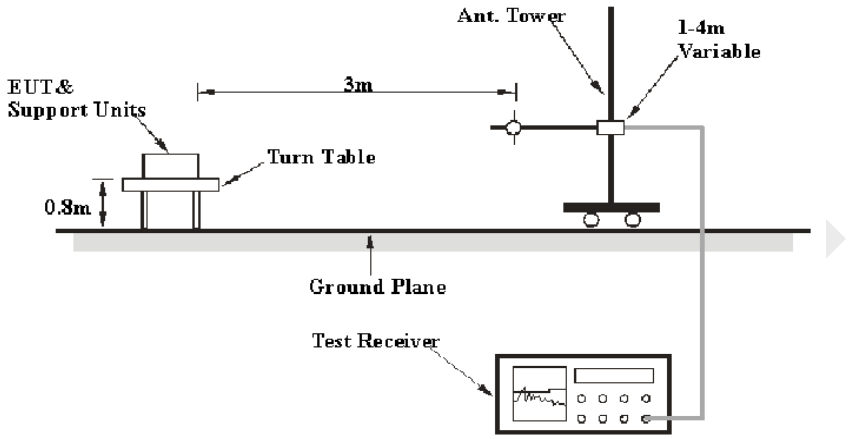
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

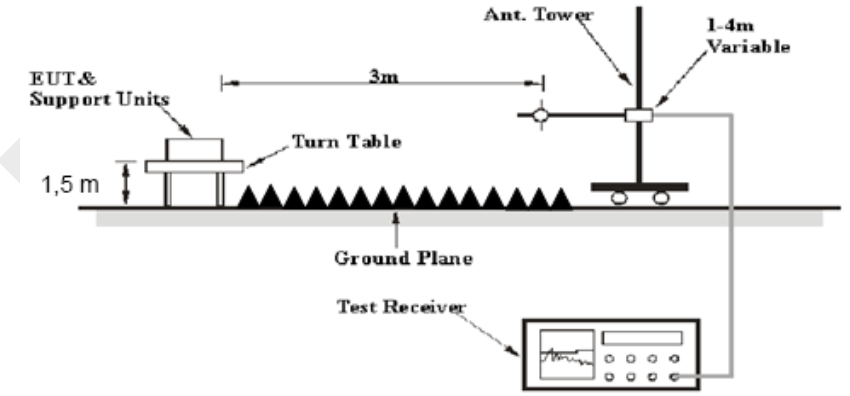
FCC §15.247 (d); §15.209; §15.205;

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

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

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

Test Data

Environmental Conditions

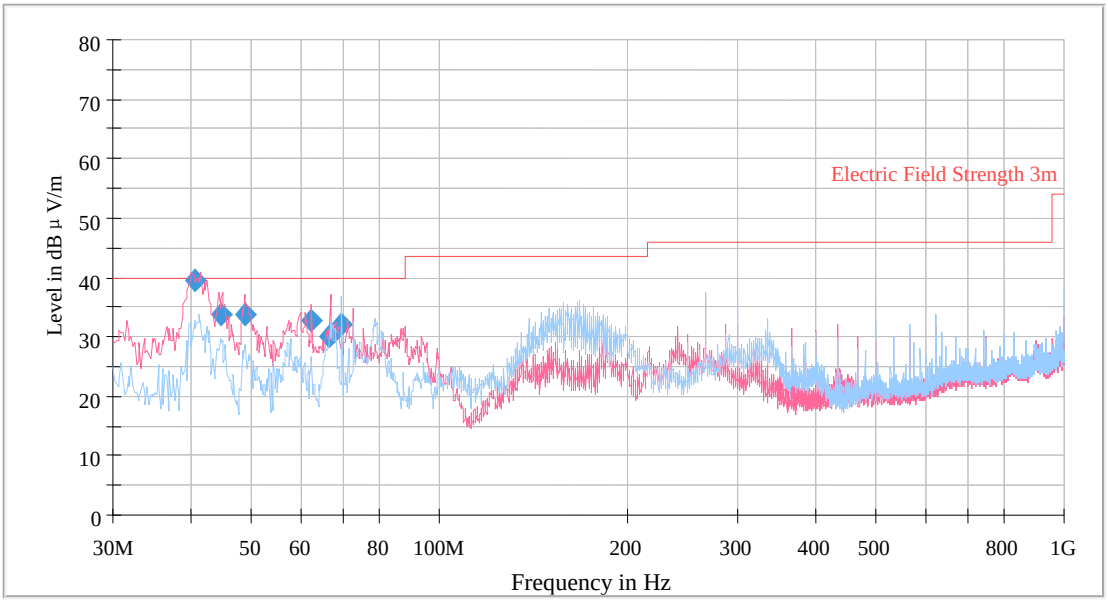
Temperature:	27 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

Test Mode: Transmitting

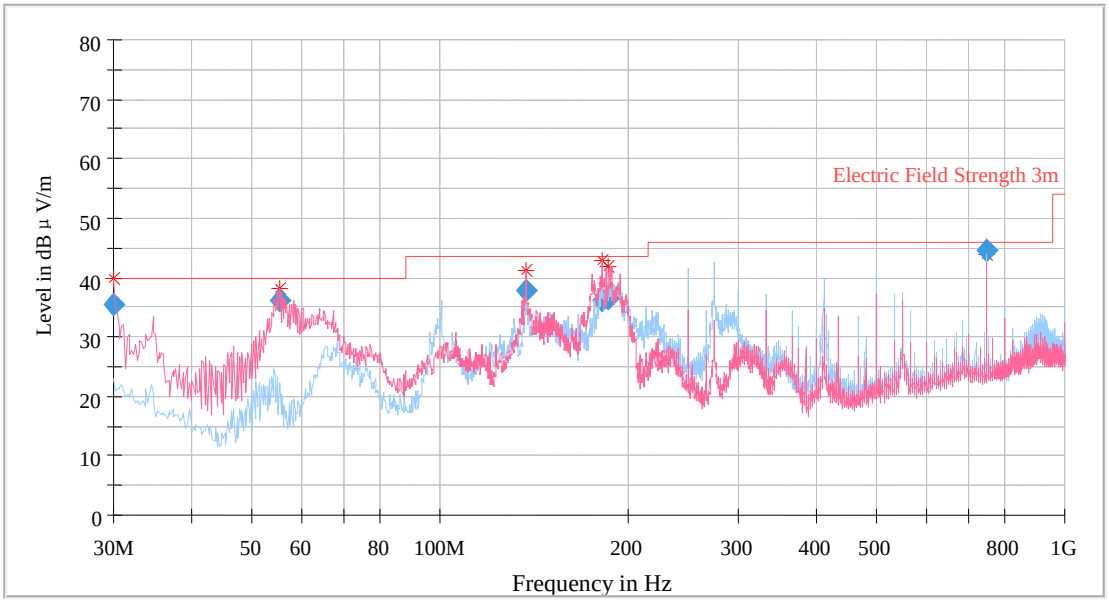
30 MHz to 1 GHz: EDR Mode (8DPSK_3DH5)-High channel-Worst Case

Tested Model: VT-M2M-BTA-DE-A



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.581400	39.61	40.00	0.39	120.000	127.0	V	155.0	-11.3
44.788600	33.77	40.00	6.23	120.000	133.0	V	162.0	-14.3
48.993800	33.89	40.00	6.11	120.000	128.0	V	82.0	-16.7
62.513200	32.77	40.00	7.23	120.000	139.0	V	233.0	-17.5
66.800600	29.95	40.00	10.05	120.000	172.0	V	333.0	-17.1
69.753800	32.14	40.00	7.86	120.000	174.0	H	252.0	-16.9

Multiple Model: VT-M2M-BTA-DE-ALP



Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.017550	35.56	40.00	4.44	120.000	114.0	V	40.0	-4.4
55.453300	35.99	40.00	4.01	120.000	110.0	V	191.0	-18.1
137.265500	37.64	43.50	5.86	120.000	157.0	V	274.0	-11.7
181.405500	36.00	43.50	7.50	120.000	103.0	V	19.0	-14.0
186.463300	36.36	43.50	7.14	120.000	105.0	V	39.0	-13.9
750.023600	44.54	46.00	1.46	120.000	159.0	H	130.0	-3.1

1GHz-25GHz:

EDR Mode (8DPSK_3DH5)-Worst Case

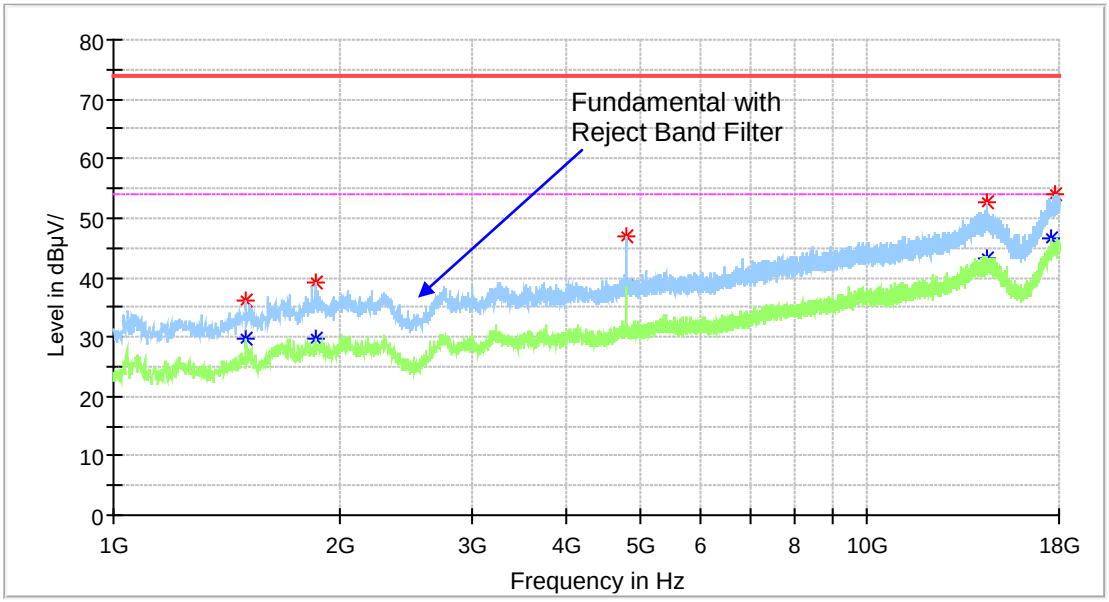
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	(dB/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency: 2402 MHz									
2402	64.64	PK	V	29.14	3.55	0.00	97.33	N/A	N/A
2402	61.23	AV	V	29.14	3.55	0.00	93.92	N/A	N/A
2390	29.01	PK	V	29.15	3.54	0.00	61.70	74.00	12.30
2390	15.87	AV	V	29.15	3.54	0.00	48.56	54.00	5.44
1499.8	35.13	PK	V	25.40	2.83	27.55	35.81	74.00	38.19
1499.8	28.63	AV	V	25.40	2.83	27.55	29.31	54.00	24.69
2999.2	34.32	PK	V	30.20	3.98	27.65	40.85	74.00	33.15
2999.2	30.14	AV	V	30.20	3.98	27.65	36.67	54.00	17.33
5000.1	32.21	PK	V	33.50	5.16	27.23	43.64	74.00	30.36
5000.1	25.41	AV	V	33.50	5.16	27.23	36.84	54.00	17.16
4804	39.51	PK	V	32.99	5.05	27.27	50.28	74.00	23.72
4804	32.51	AV	V	32.99	5.05	27.27	43.28	54.00	10.72
7206	27.33	PK	V	35.75	6.43	27.10	42.41	74.00	31.59
7206	21.33	AV	V	35.75	6.43	27.10	36.41	54.00	17.59
Frequency: 2441 MHz									
2441	67.62	PK	V	29.08	3.58	0.00	100.28	N/A	N/A
2441	63.48	AV	V	29.08	3.58	0.00	96.14	N/A	N/A
1499.8	35.26	PK	V	25.40	2.83	27.55	35.94	74.00	38.06
1499.8	28.92	AV	V	25.40	2.83	27.55	29.60	54.00	24.40
2999.2	34.59	PK	V	30.20	3.98	27.65	41.12	74.00	32.88
2999.2	29.85	AV	V	30.20	3.98	27.65	36.38	54.00	17.62
5000.1	32.23	PK	V	33.50	5.16	27.23	43.66	74.00	30.34
5000.1	25.35	AV	V	33.50	5.16	27.23	36.78	54.00	17.22
4882	39.57	PK	V	33.19	5.09	27.26	50.59	74.00	23.41
4882	32.49	AV	V	33.19	5.09	27.26	43.51	54.00	10.49
7323	27.23	PK	V	36.01	6.49	27.11	42.62	74.00	31.38
7323	21.50	AV	V	36.01	6.49	27.11	36.89	54.00	17.11

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: 2480 MHz									
2480	69.93	PK	V	29.03	3.61	0.00	102.57	N/A	N/A
2480	66.28	AV	V	29.03	3.61	0.00	98.92	N/A	N/A
2483.5	32.75	PK	V	29.02	3.61	0.00	65.38	74.00	8.62
2483.5	19.36	AV	V	29.02	3.61	0.00	51.99	54.00	2.01
1499.8	35.34	PK	V	25.40	2.83	27.55	36.02	74.00	37.98
1499.8	28.72	AV	V	25.40	2.83	27.55	29.40	54.00	24.60
2999.2	34.02	PK	V	30.20	3.98	27.65	40.55	74.00	33.45
2999.2	29.99	AV	V	30.20	3.98	27.65	36.52	54.00	17.48
5000.1	32.11	PK	V	33.50	5.16	27.23	43.54	74.00	30.46
5000.1	25.47	AV	V	33.50	5.16	27.23	36.90	54.00	17.10
4960	39.26	PK	V	33.40	5.14	27.24	50.56	74.00	23.44
4960	32.71	AV	V	33.40	5.14	27.24	44.01	54.00	9.99
7440	27.63	PK	V	36.27	6.55	27.13	43.32	74.00	30.68
7440	21.49	AV	V	36.27	6.55	27.13	37.18	54.00	16.82

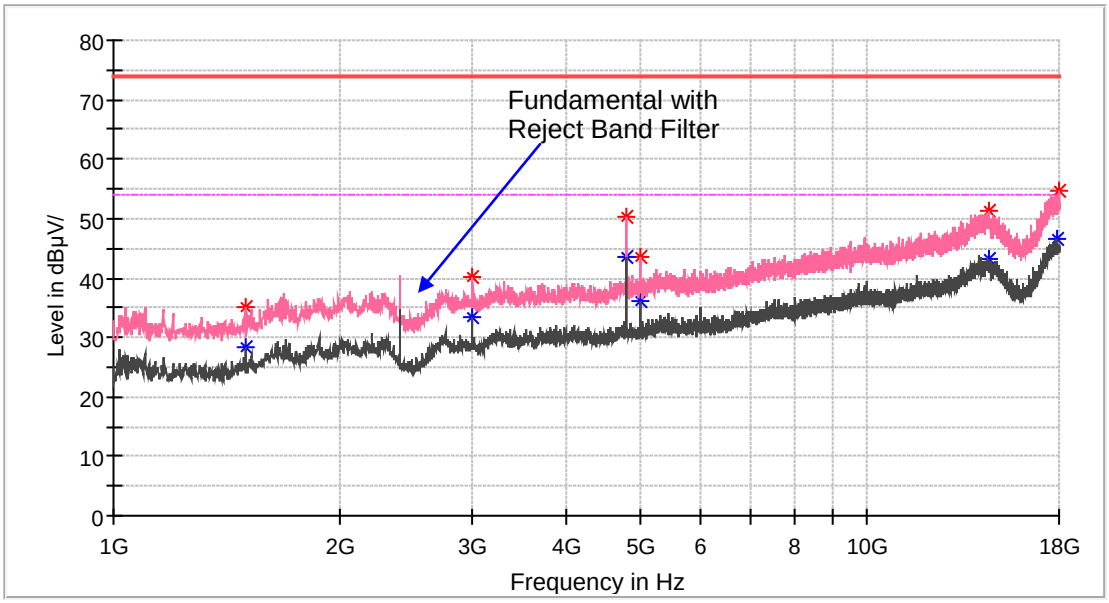
Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

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

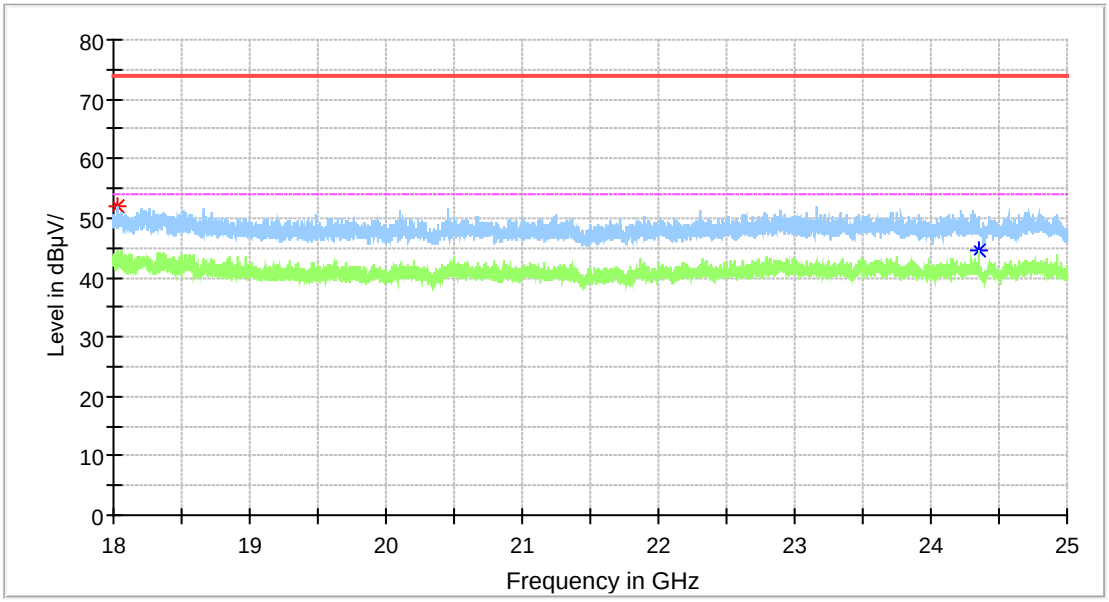
BDR Mode (GFSK): High Channel _Horizontal_1GHz-18GHz



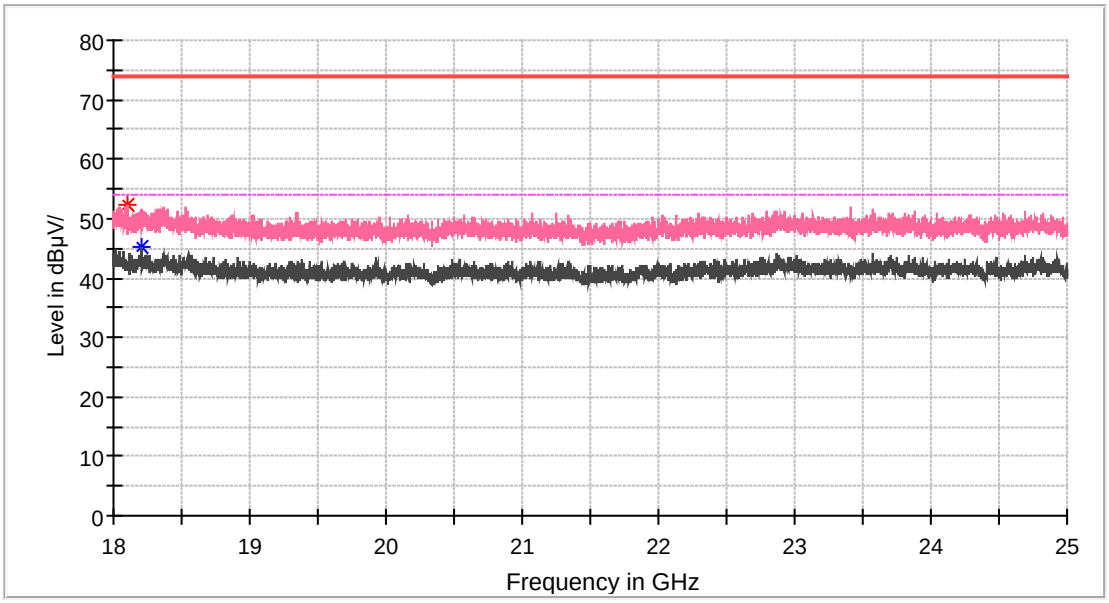
BDR Mode (GFSK): High Channel _Vertical_1GHz-18GHz



BDR Mode (GFSK): High Channel _Horizontal_18GHz-25GHz



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:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

Test Result: Compliance.

Please refer to following tables and plots.

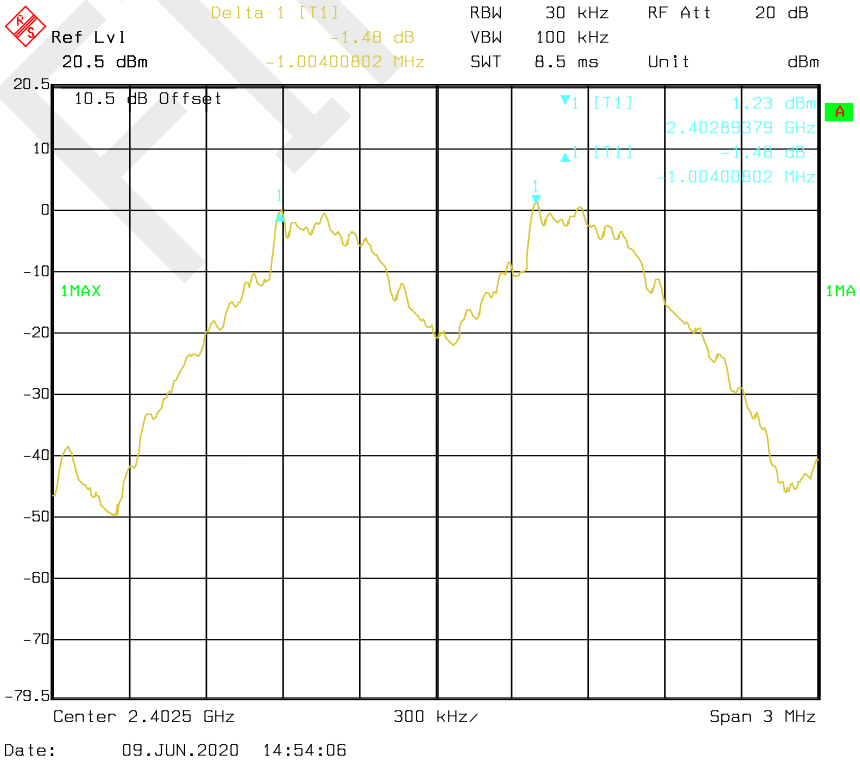
Test Mode: Transmitting

Mode	Channel	Frequency	Channel Separation	Limit
		MHz	MHz	MHz
BDR (GFSK)	Low	2402	1.004	0.63
	Adjacent	2403		
	Middle	2441	1.004	0.60
	Adjacent	2442		
	High	2480	1.004	0.60
	Adjacent	2479		
EDR (π/4-DQPSK)	Low	2402	1.004	0.84
	Adjacent	2403		
	Middle	2441	1.004	0.82
	Adjacent	2442		
	High	2480	1.004	0.84
	Adjacent	2479		
EDR (8DPSK)	Low	2402	1.004	0.82
	Adjacent	2403		
	Middle	2441	1.004	0.82
	Adjacent	2442		
	High	2480	1.004	0.83
	Adjacent	2479		

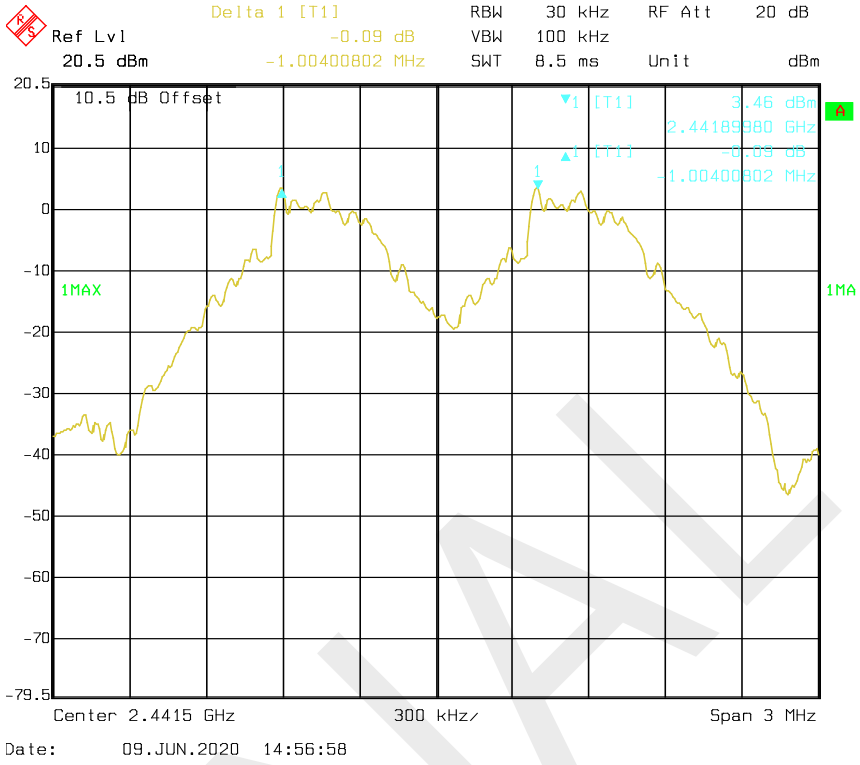
Note: Limit= (2/3) × 20dB bandwidth

BDR Mode (GFSK):

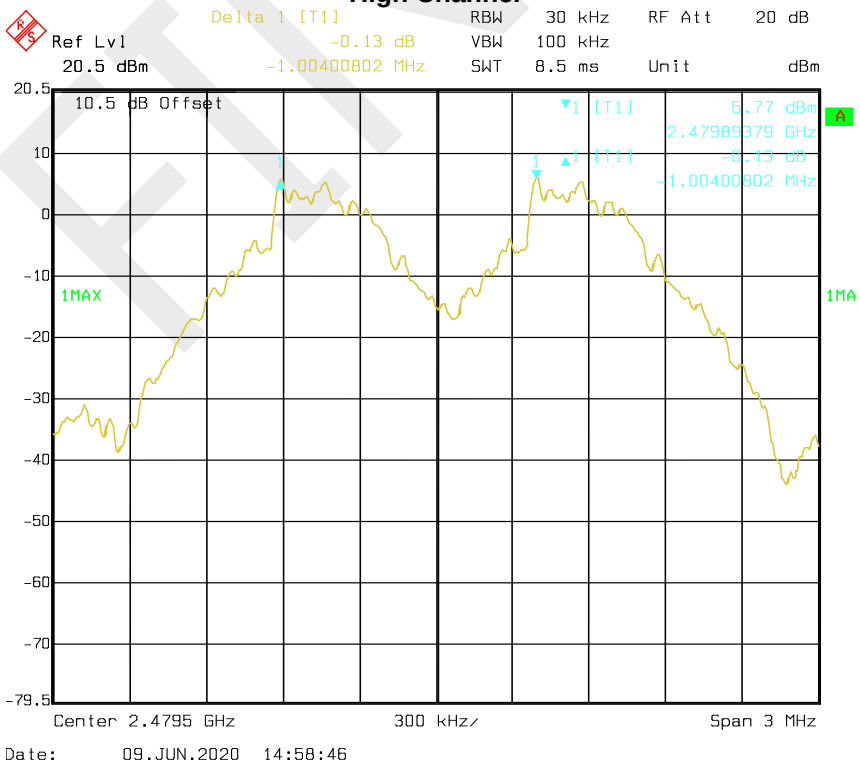
Low Channel



Middle Channel

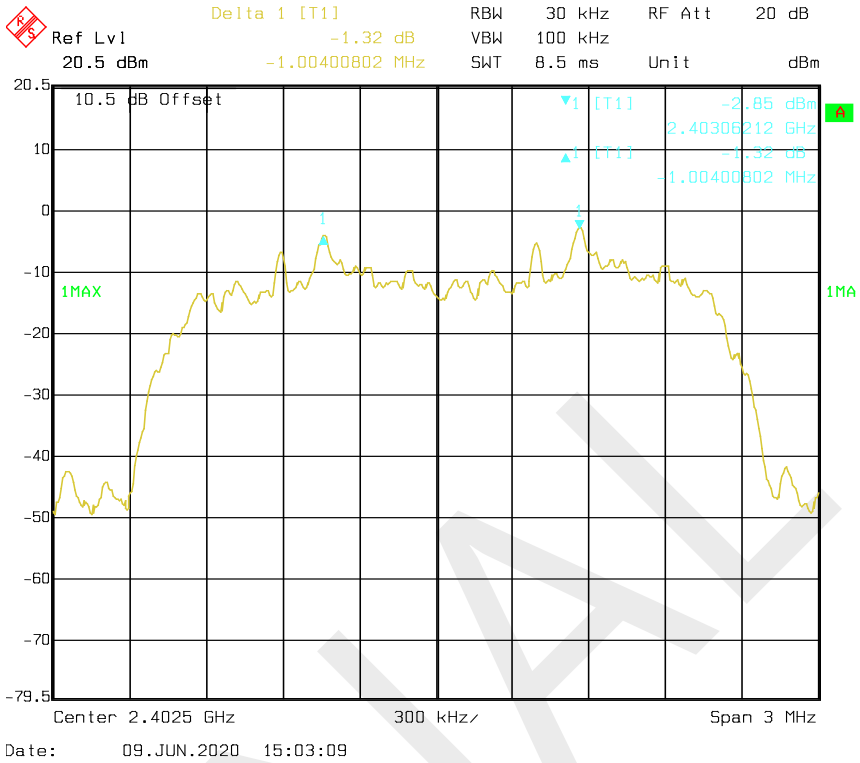


High Channel

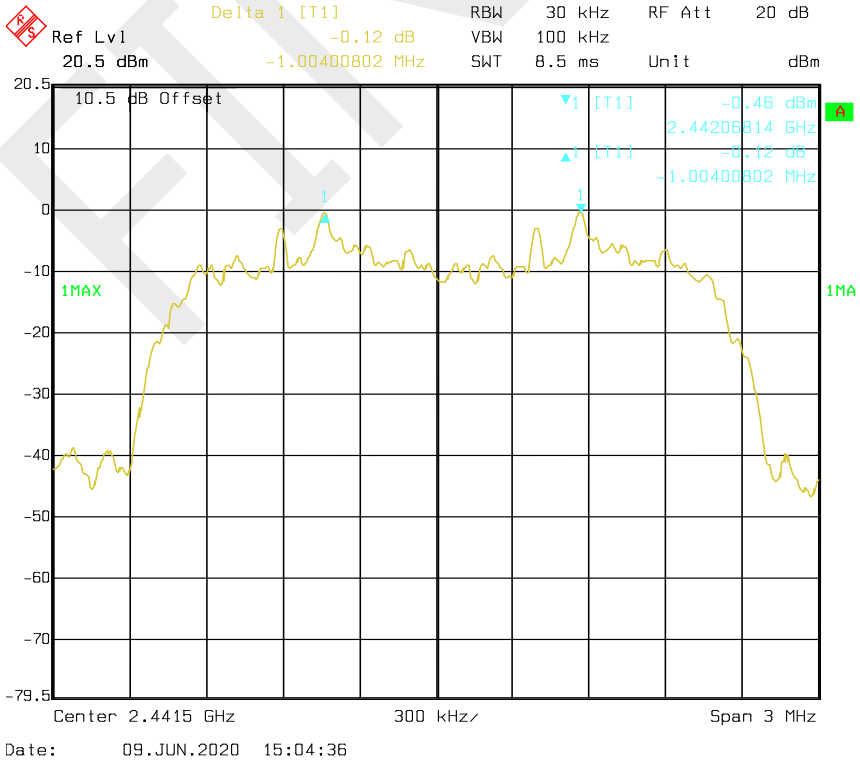


EDR Mode (π/4-DQPSK):

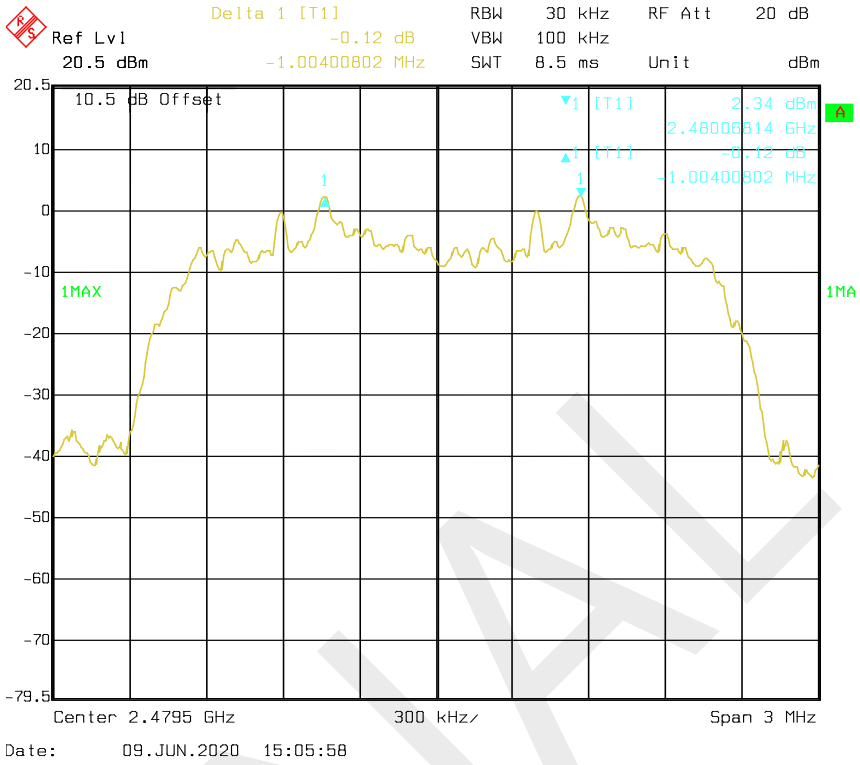
Low Channel



Middle Channel

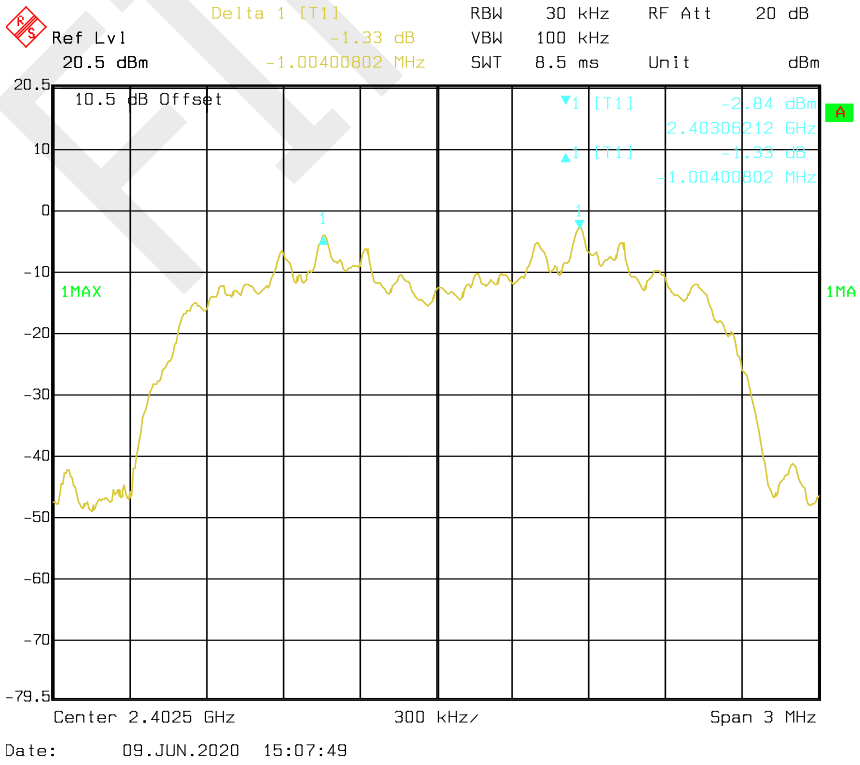


High Channel

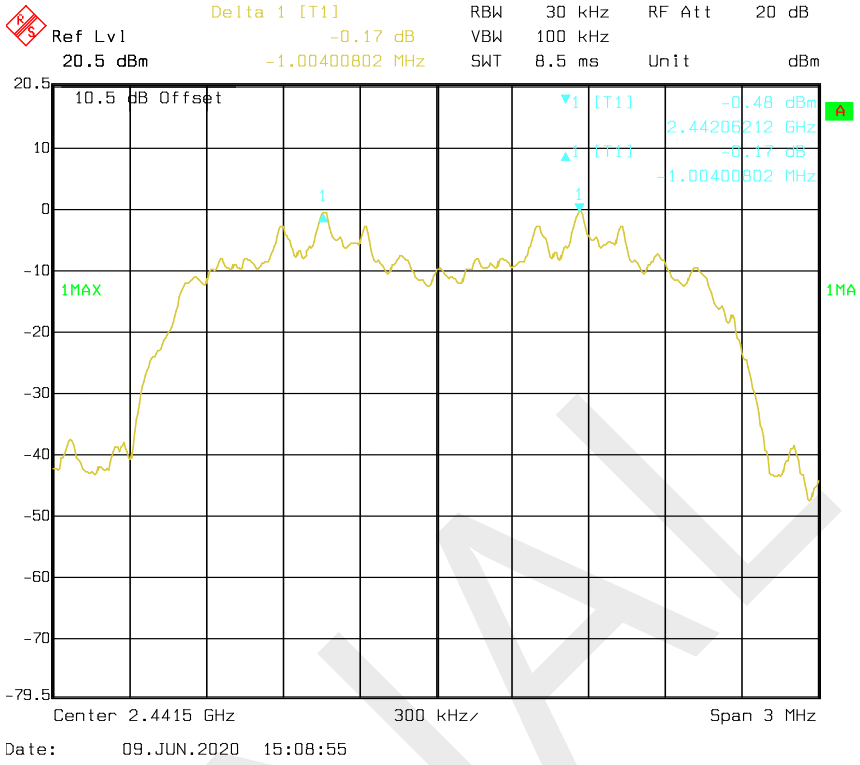


EDR Mode (8-DPSK):

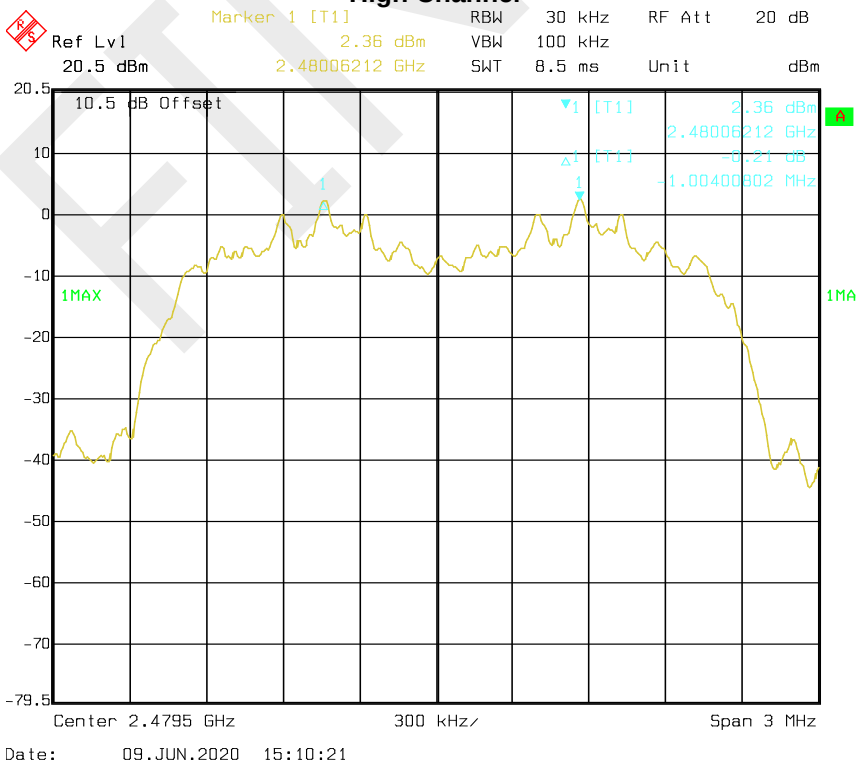
Low Channel



Middle Channel



High Channel



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:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

Test Result: Compliance.

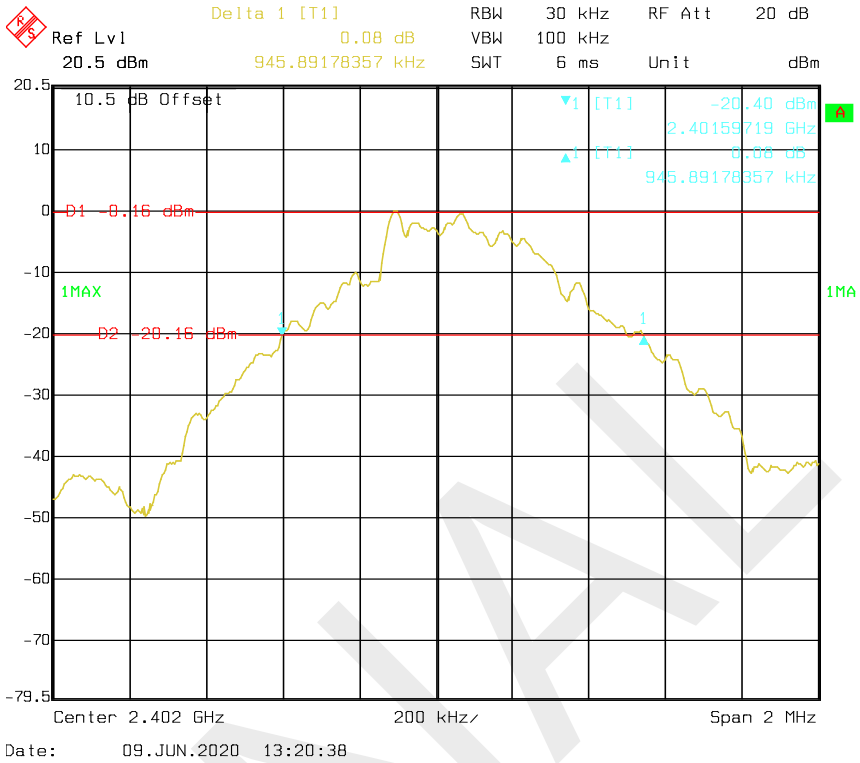
Please refer to following tables and plots

Test Mode: Transmitting

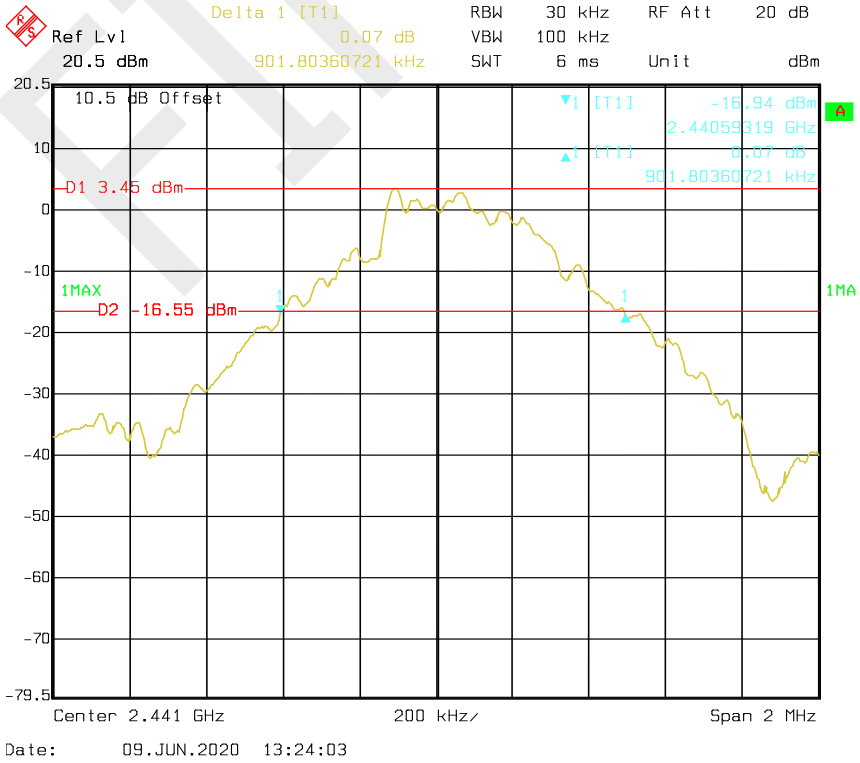
Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.946
	Middle	2441	0.902
	High	2480	0.898
EDR Mode (π/4-DQPSK)	Low	2402	1.259
	Middle	2441	1.226
	High	2480	1.255
EDR Mode (8DPSK)	Low	2402	1.222
	Middle	2441	1.230
	High	2480	1.242

BDR Mode (GFSK):

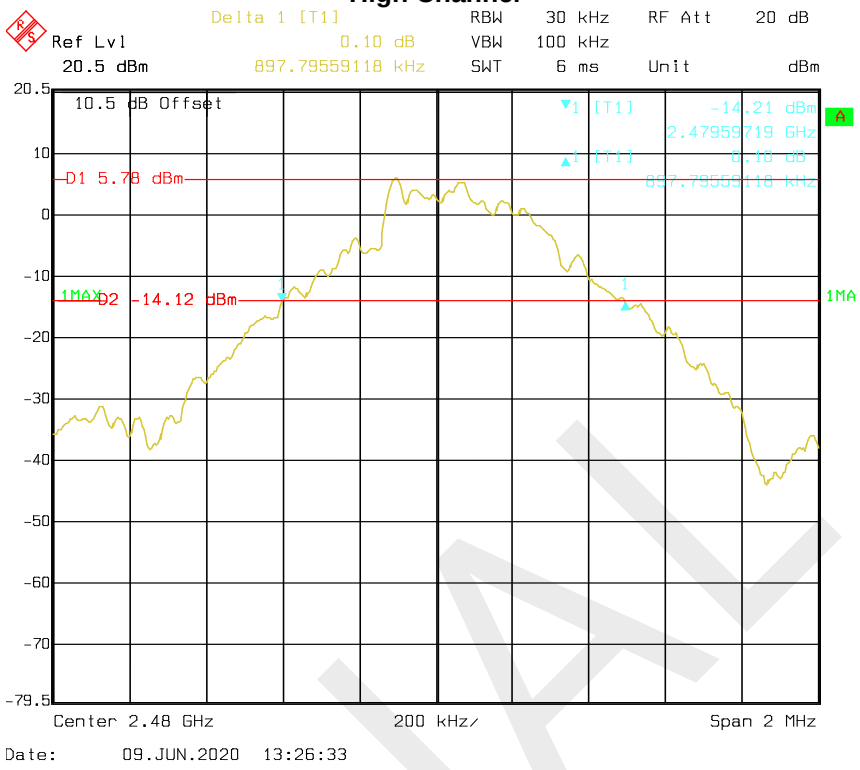
Low Channel



Middle Channel

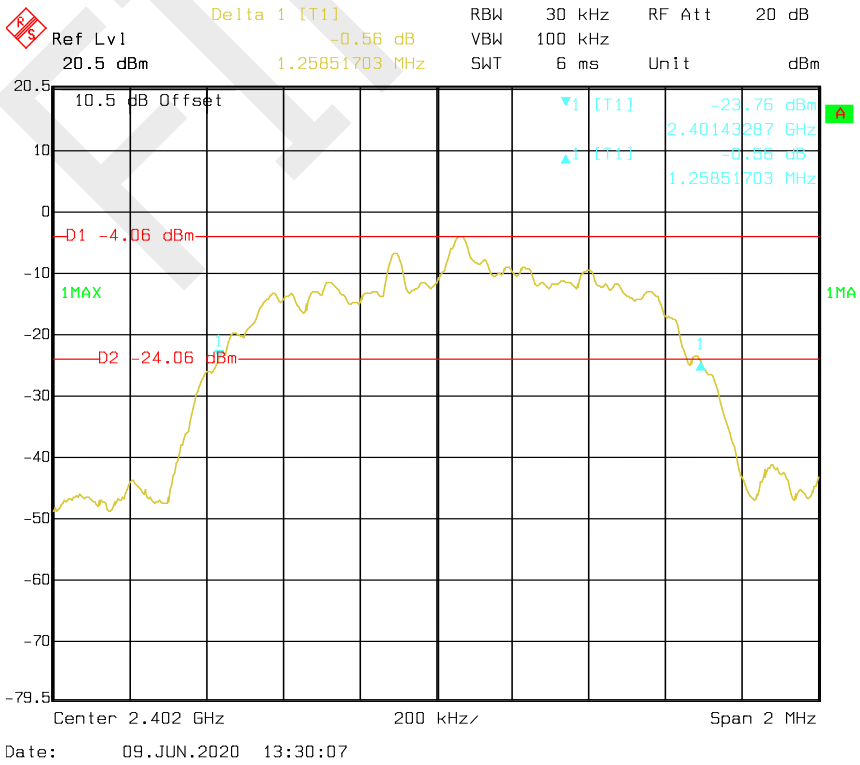


High Channel

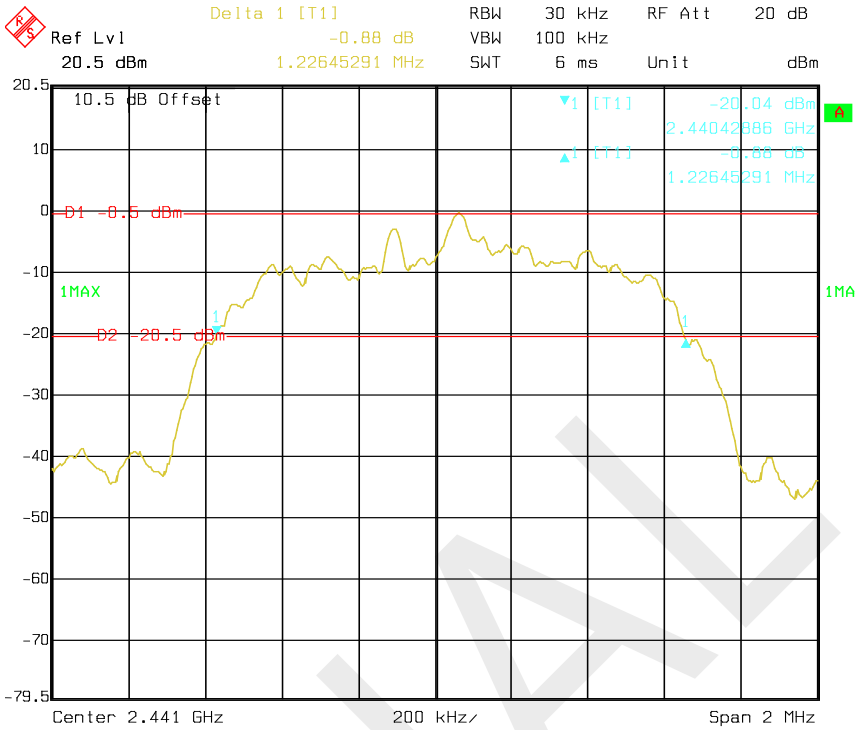


EDR Mode (π/4-DQPSK):

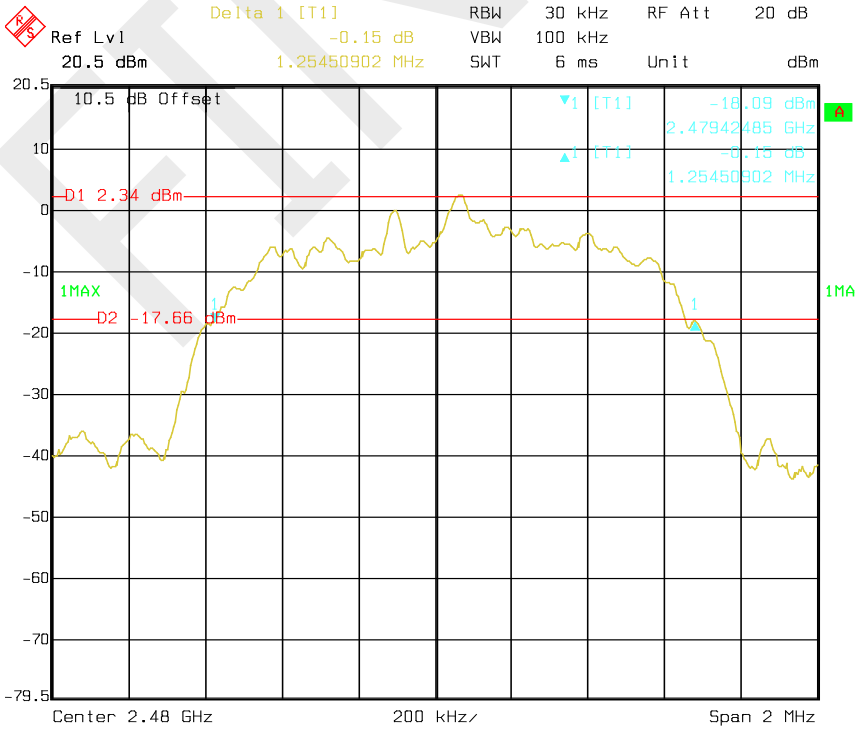
Low Channel



Middle Channel

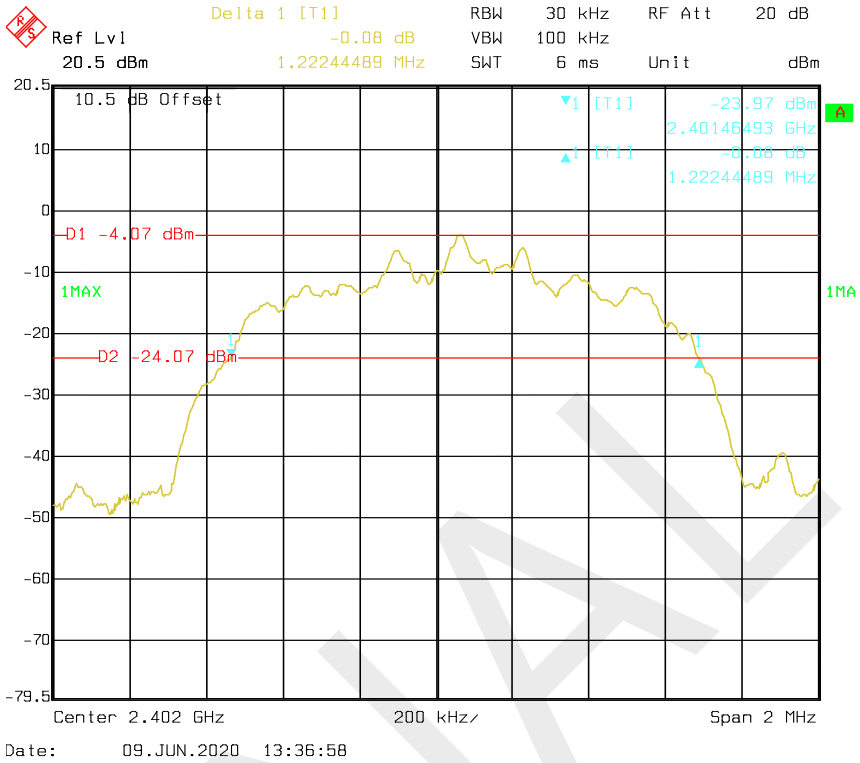


High Channel

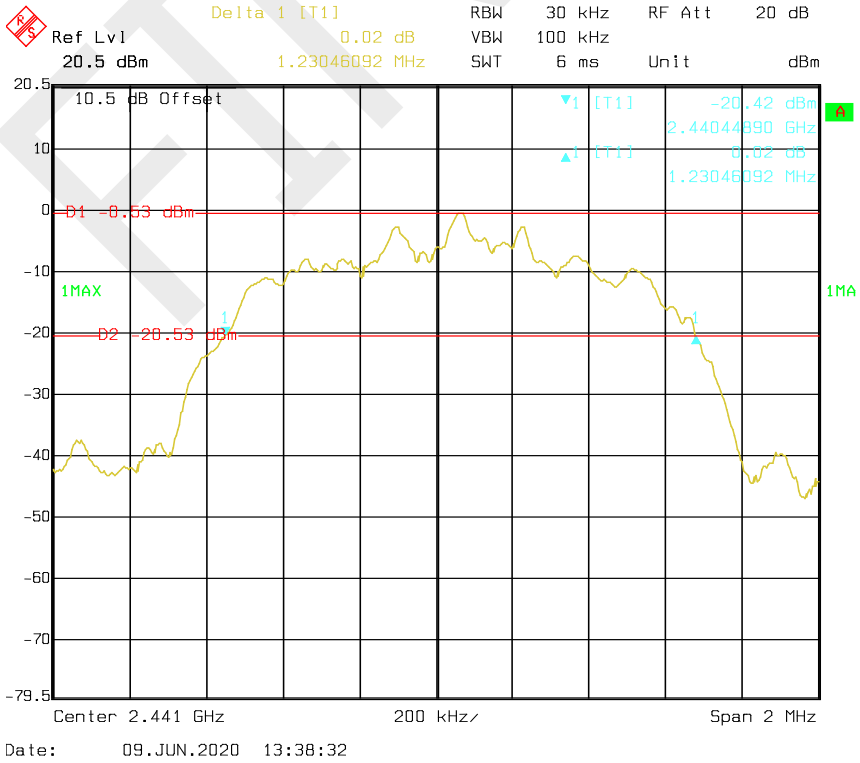


EDR Mode (8-DPSK):

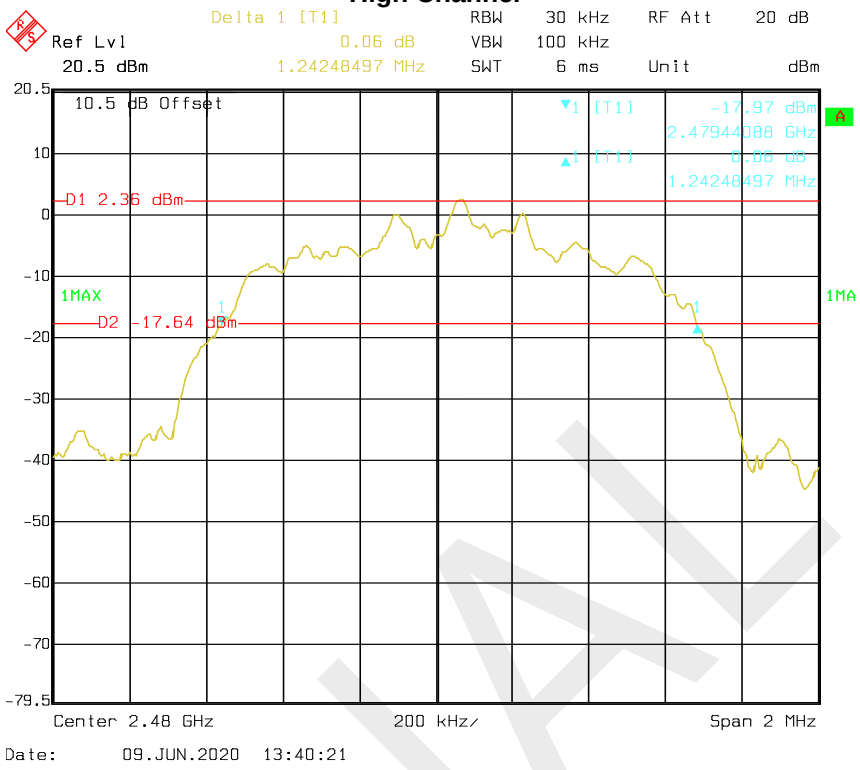
Low Channel



Middle Channel



High Channel



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:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

Test Result: Compliance.

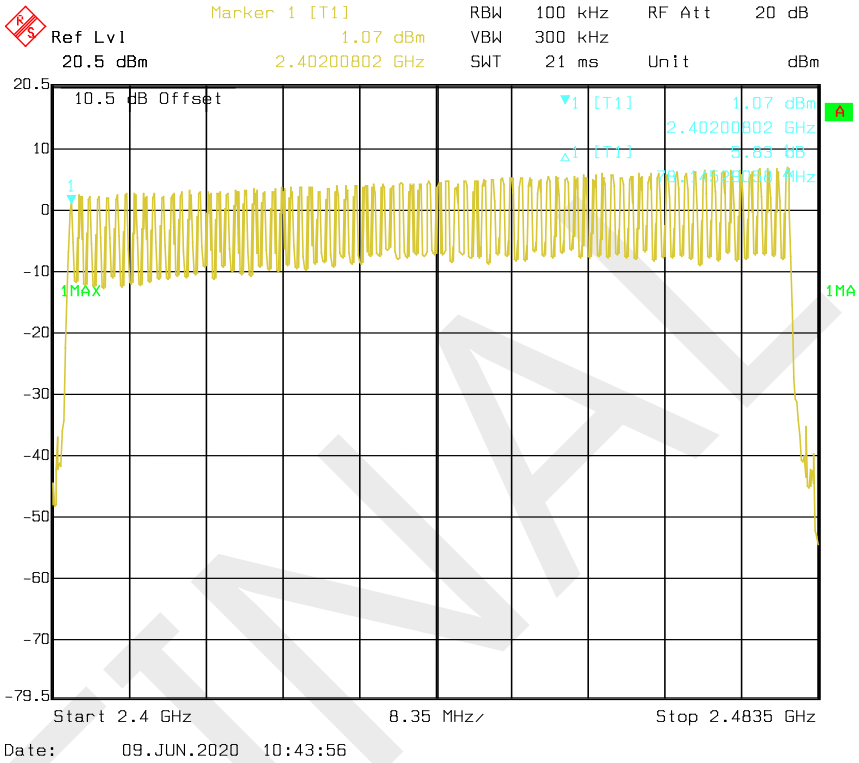
Please refer to following tables and plots.

Test Mode: Transmitting

BDR Mode (GFSK):

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

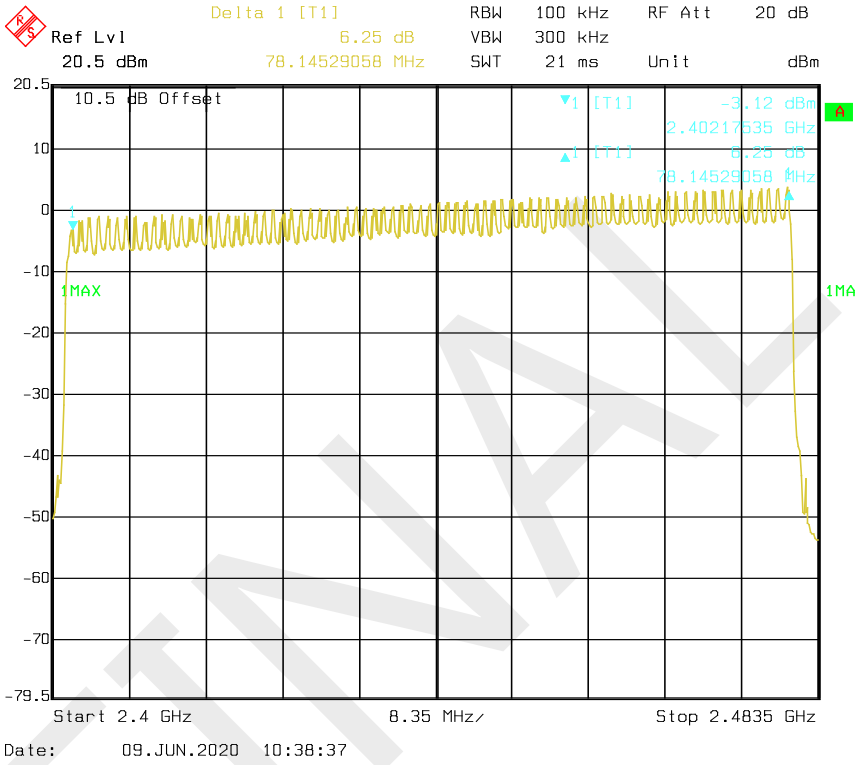
Number of Hopping Channels



EDR Mode (π/4-DQPSK):

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

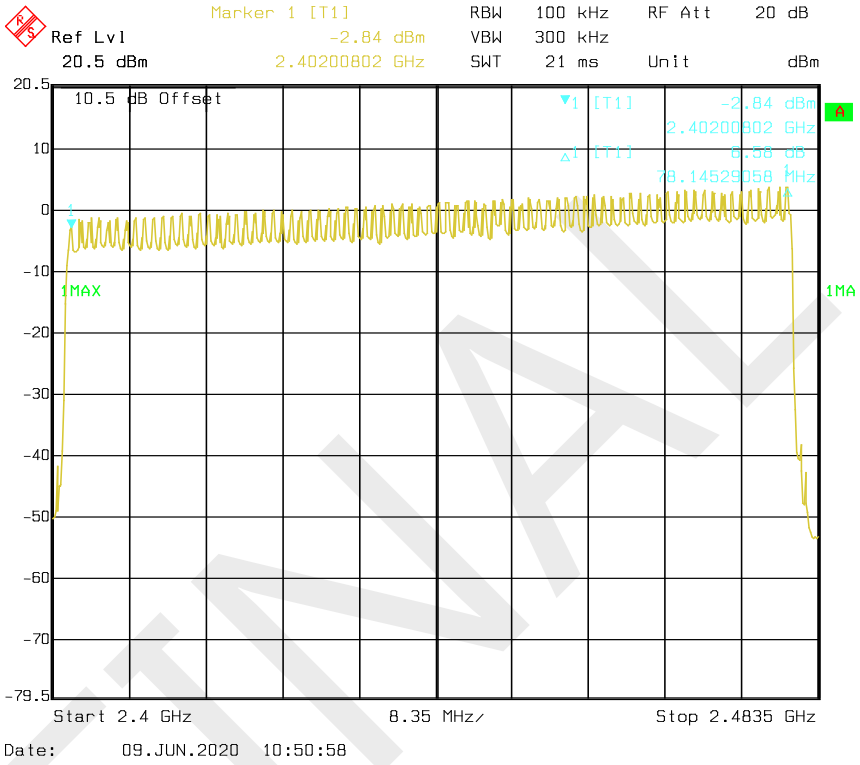
Number of Hopping Channels



EDR Mode (8DPSK):

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

Number of Hopping Channels



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:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

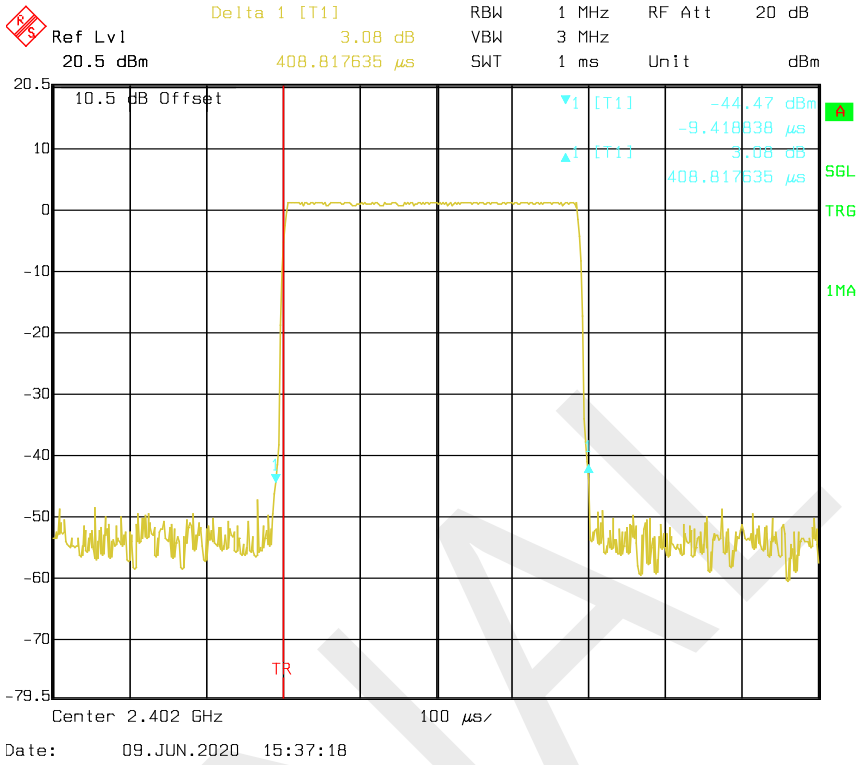
Test Result: Compliance. Please refer to following tables and plots

Test Mode: Transmitting

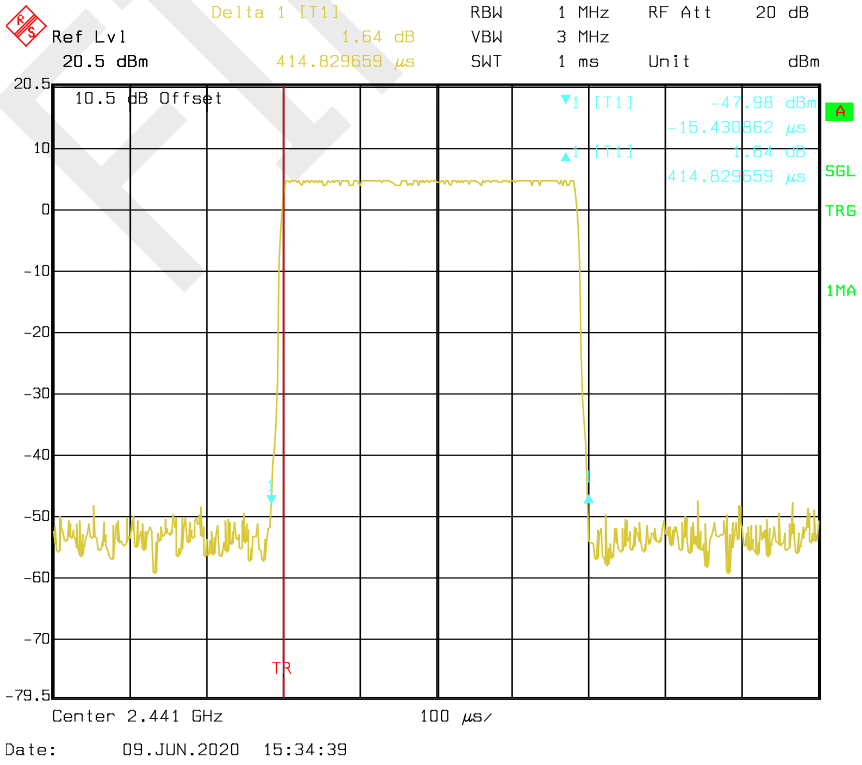
BDR Mode (GFSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH1	Low	0.409	0.131	0.4	Compliance
	Middle	0.415	0.133	0.4	Compliance
	High	0.417	0.133	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
DH3	Low	1.666	0.267	0.4	Compliance
	Middle	1.672	0.268	0.4	Compliance
	High	1.672	0.268	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
DH5	Low	2.921	0.312	0.4	Compliance
	Middle	2.921	0.312	0.4	Compliance
	High	2.922	0.312	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

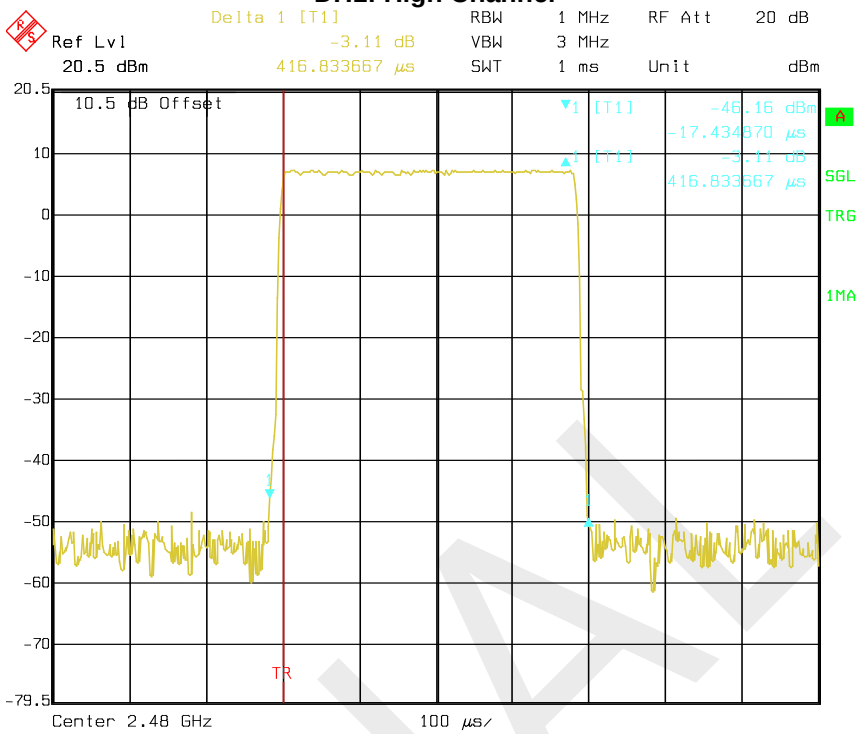
DH1: Low Channel



DH1: Middle Channel

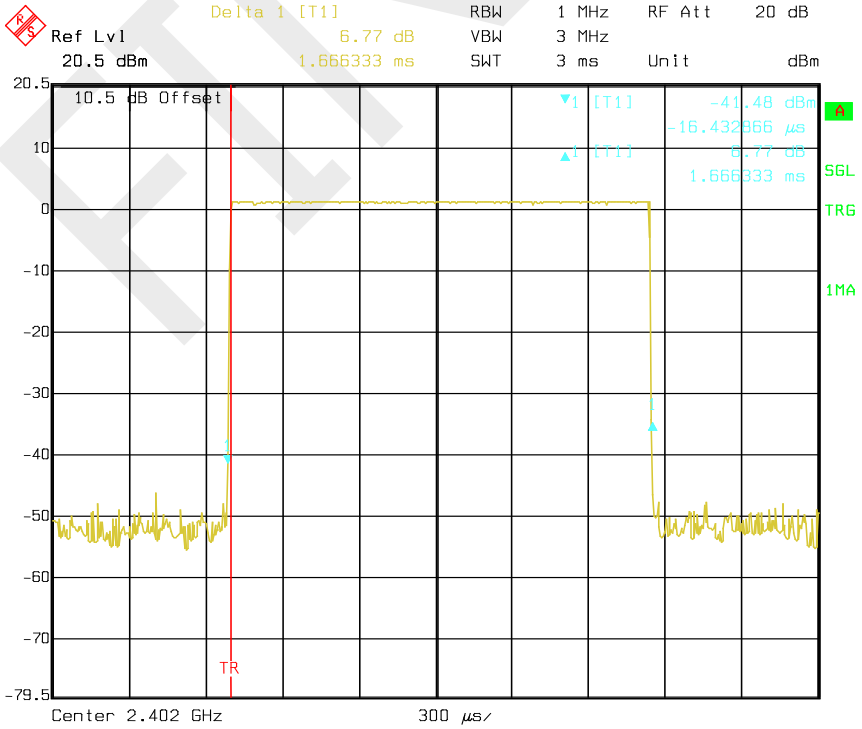


DH1: High Channel



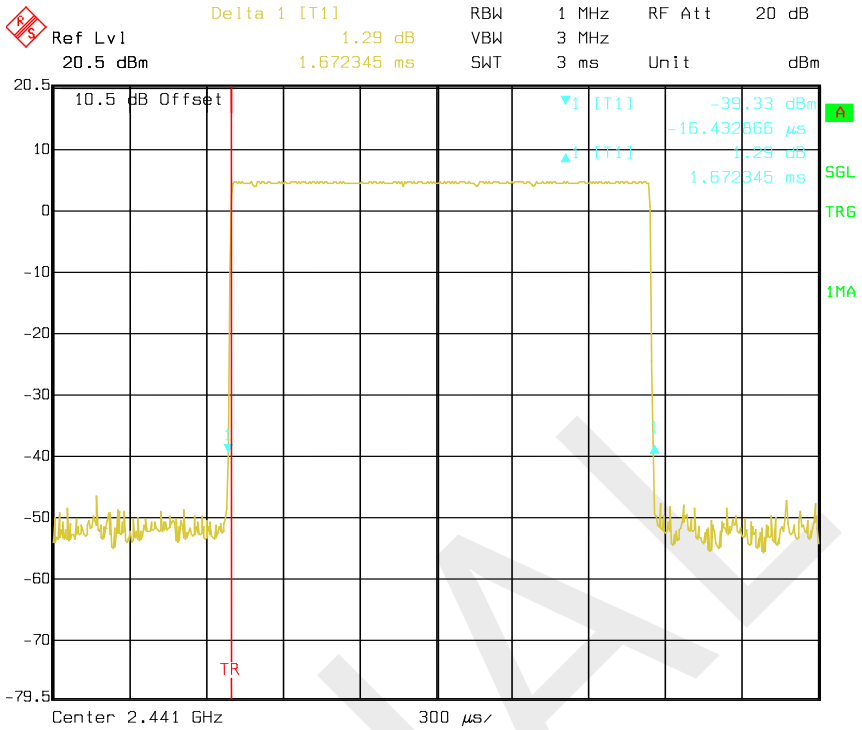
Date: 09.JUN.2020 15:39:37

DH3: Low Channel



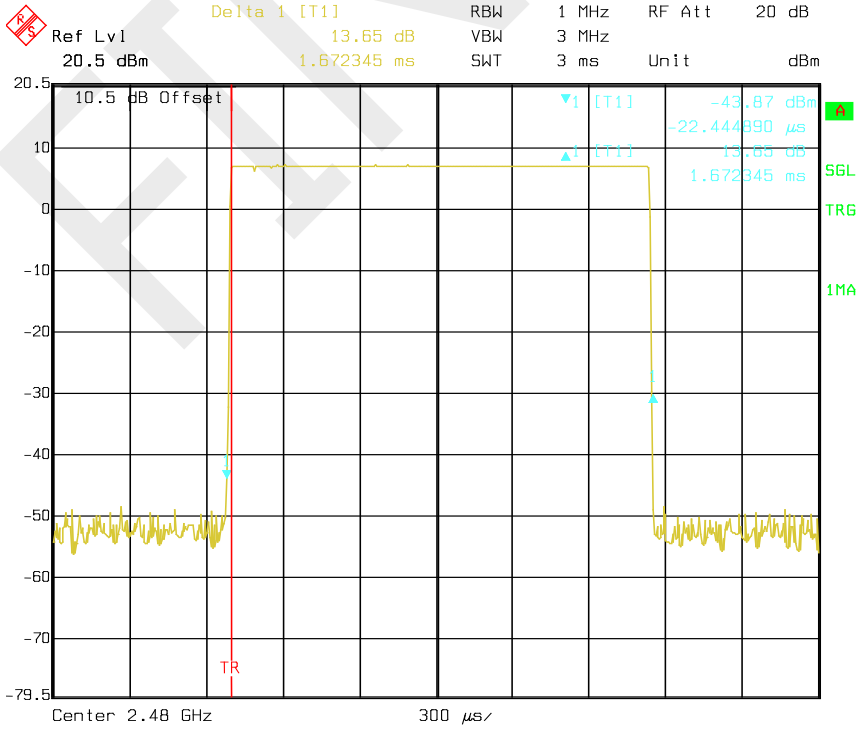
Date: 09.JUN.2020 15:52:03

DH3: Middle Channel



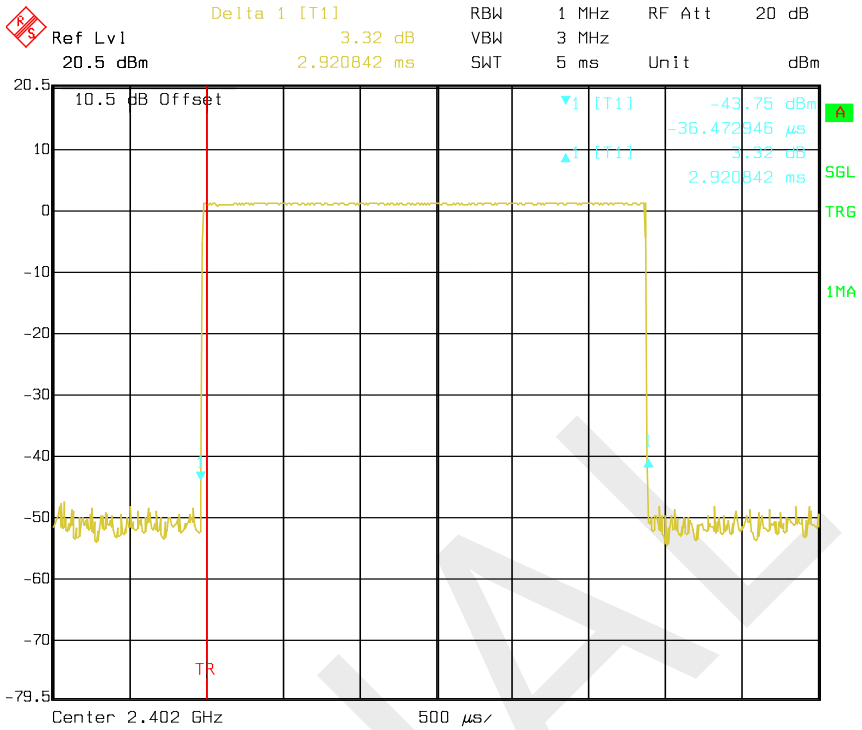
Date: 09.JUN.2020 15:54:42

DH3: High Channel



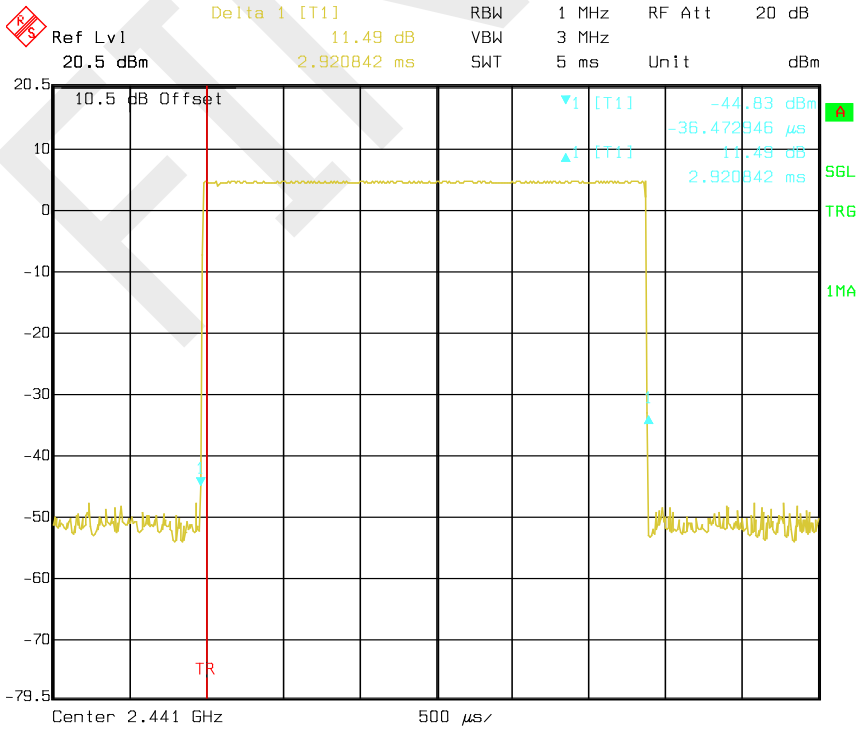
Date: 09.JUN.2020 15:55:33

DH5: Low Channel



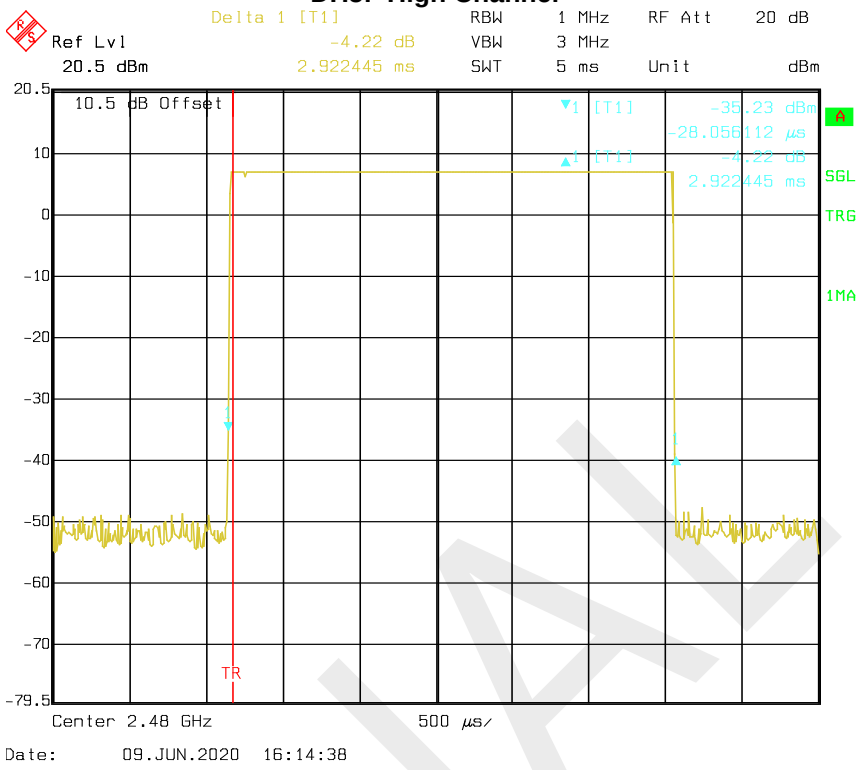
Date: 09.JUN.2020 16:09:27

DH5: Middle Channel



Date: 09.JUN.2020 16:10:06

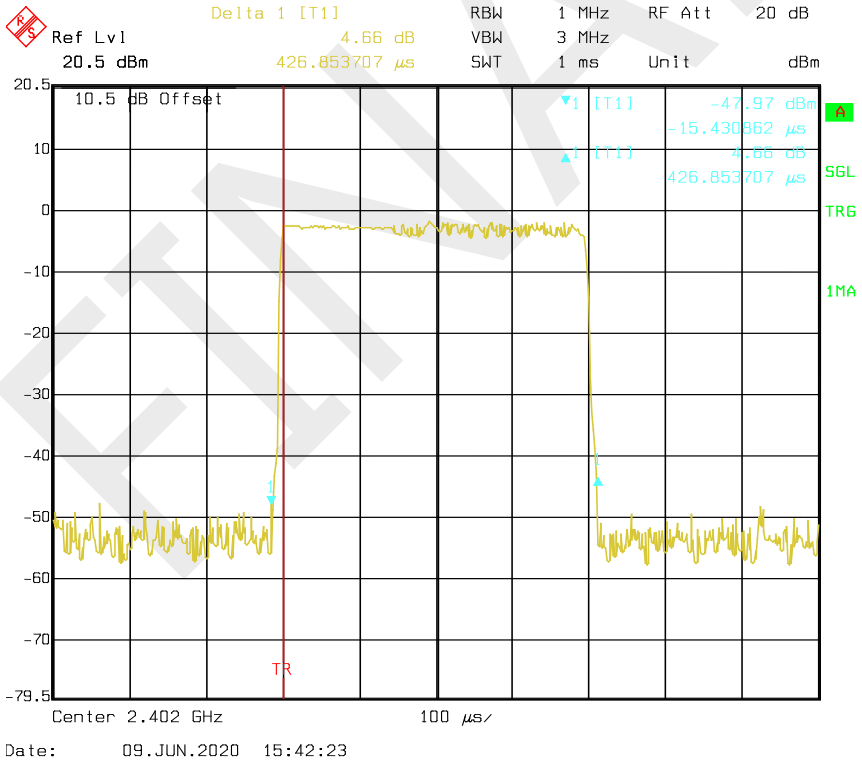
DH5: High Channel



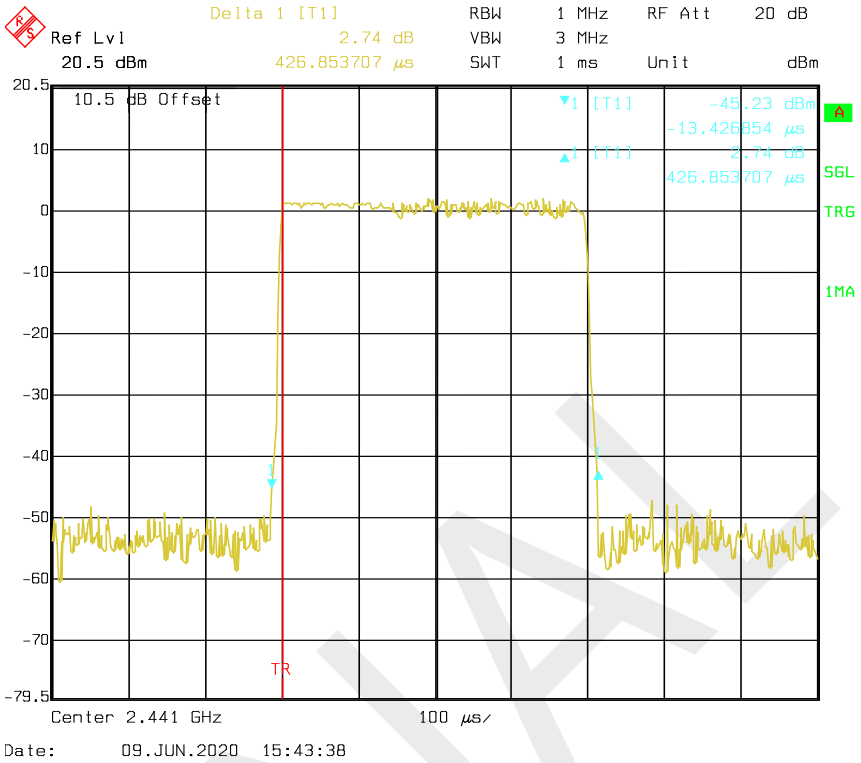
EDR Mode (π/4-DQPSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
2DH1	Low	0.427	0.137	0.4	Compliance
	Middle	0.427	0.137	0.4	Compliance
	High	0.429	0.137	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
2DH3	Low	1.678	0.268	0.4	Compliance
	Middle	1.678	0.268	0.4	Compliance
	High	1.690	0.270	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
2DH5	Low	2.932	0.313	0.4	Compliance
	Middle	2.932	0.313	0.4	Compliance
	High	2.932	0.313	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

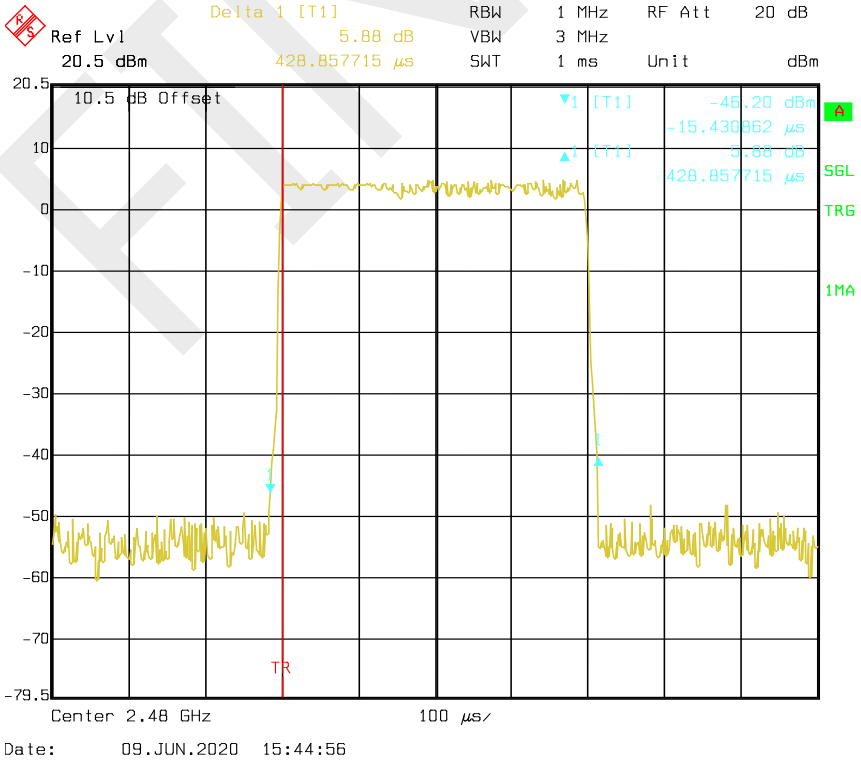
2DH1: Low Channel



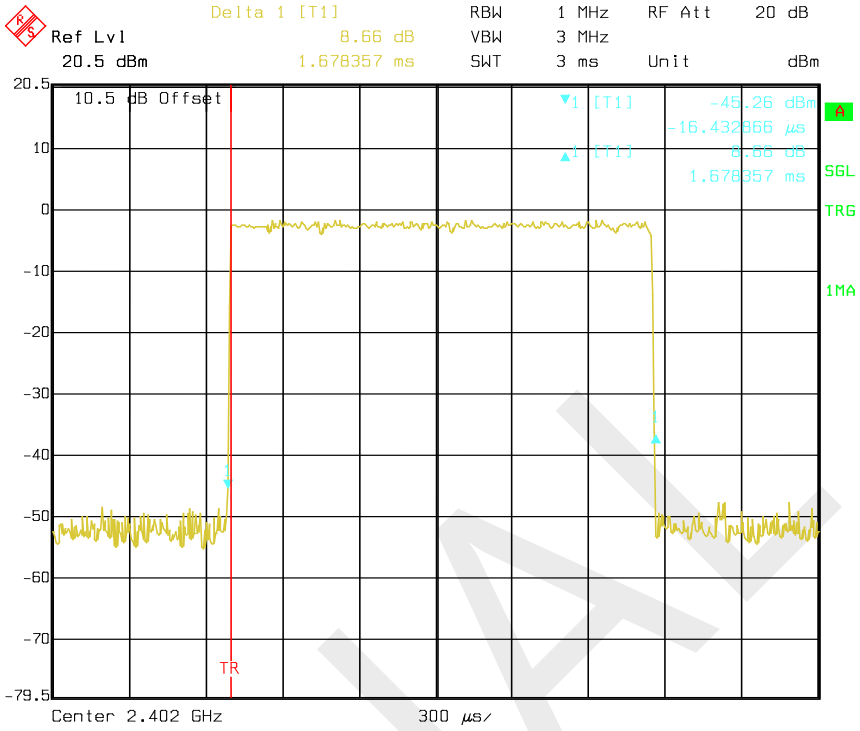
2DH1: Middle Channel



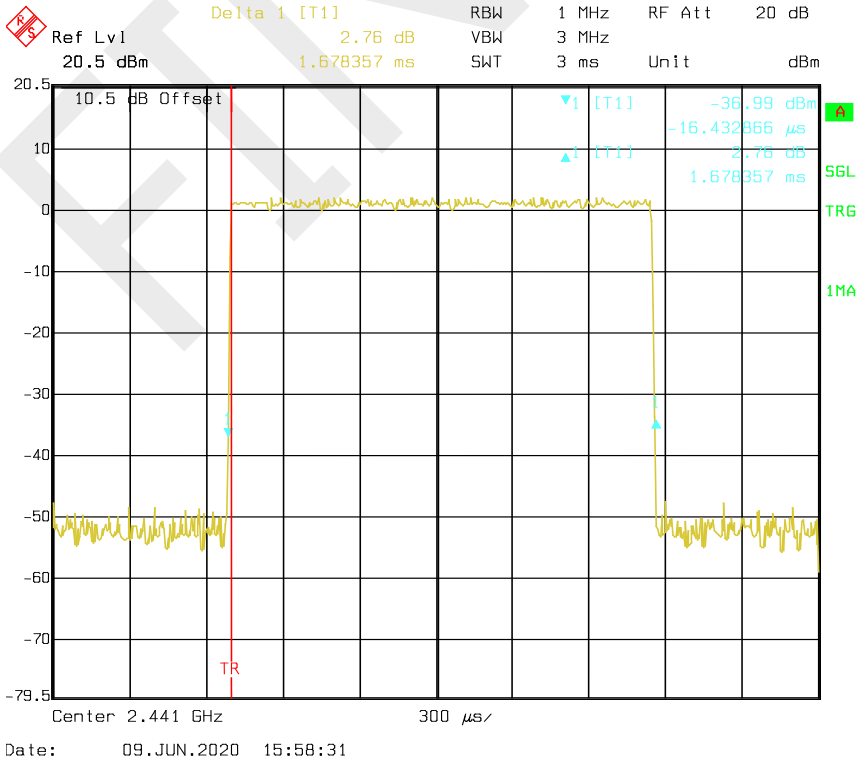
2DH1: High Channel



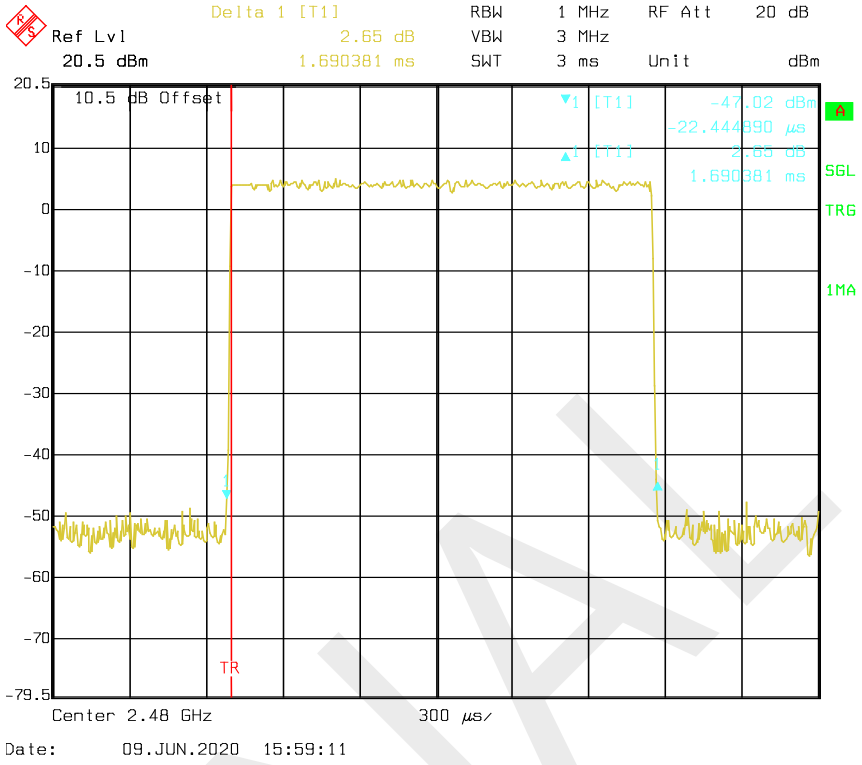
2DH3: Low Channel



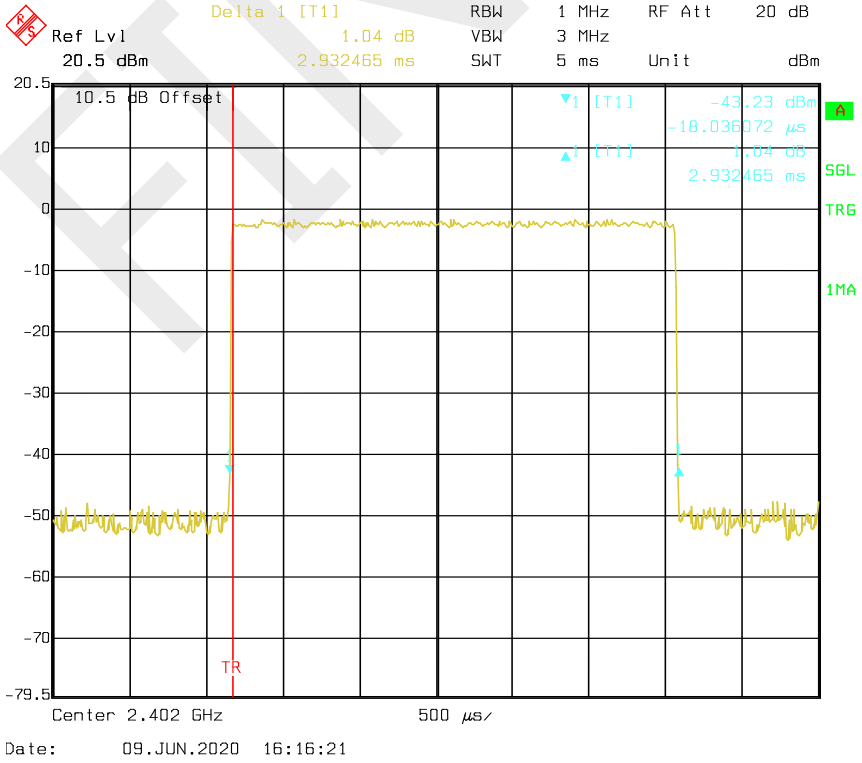
2DH3: Middle Channel



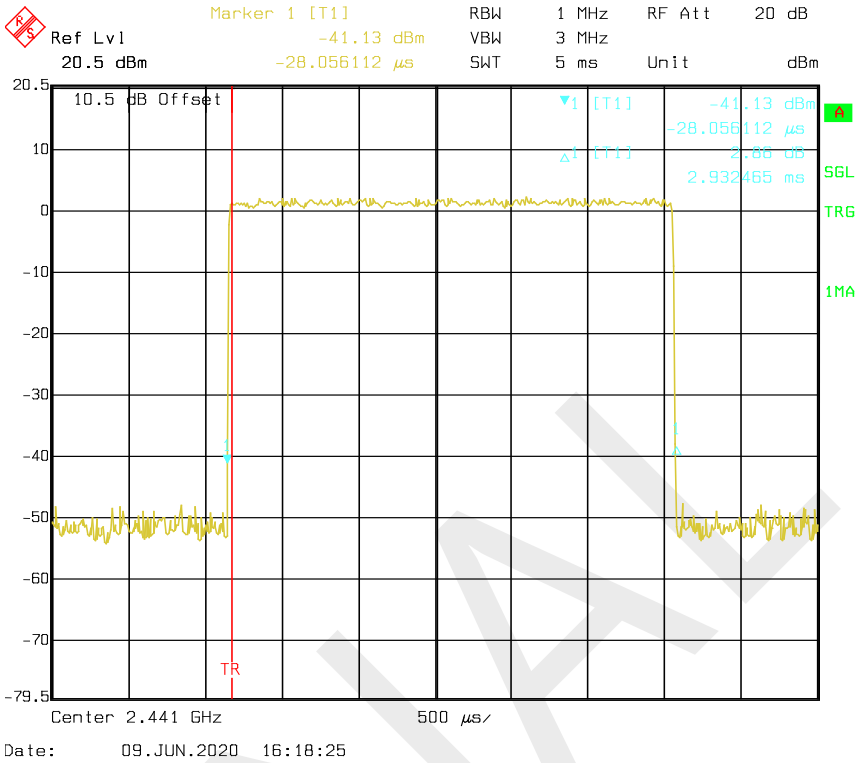
2DH3: High Channel



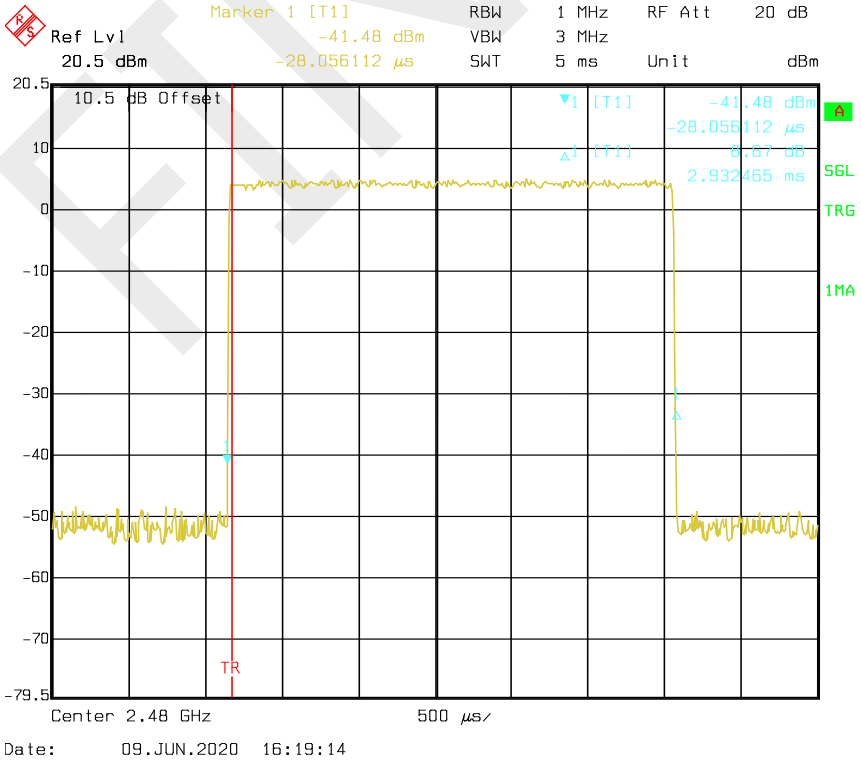
2DH5: Low Channel



2DH5: Middle Channel



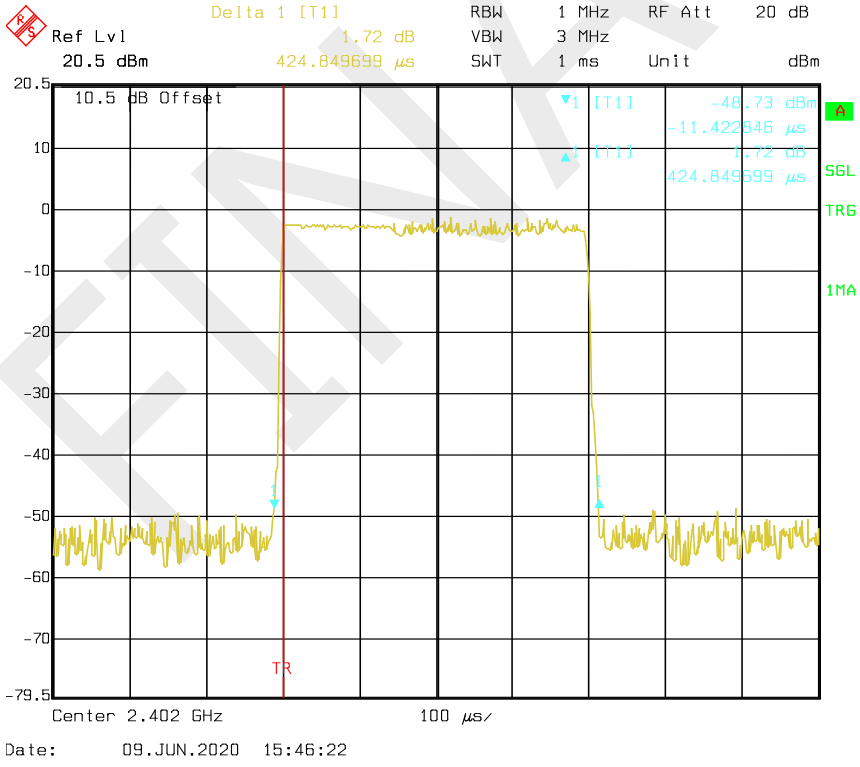
2DH5: High Channel



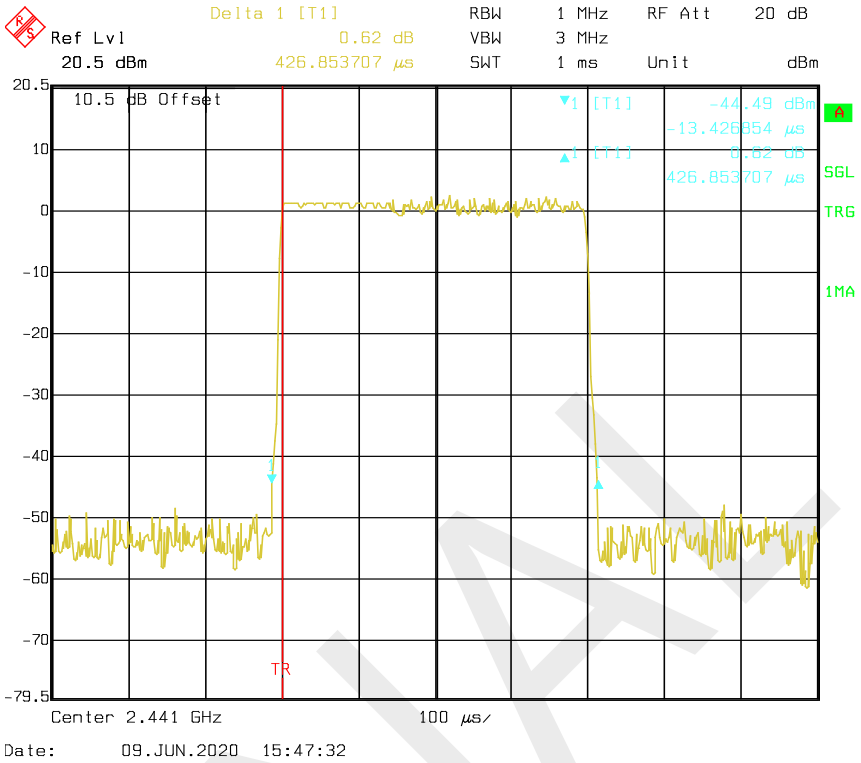
EDR Mode (8-DPSK):

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
3DH1	Low	0.425	0.136	0.4	Compliance
	Middle	0.427	0.137	0.4	Compliance
	High	0.427	0.137	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
3DH3	Low	1.678	0.268	0.4	Compliance
	Middle	1.678	0.268	0.4	Compliance
	High	1.678	0.268	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
3DH5	Low	2.932	0.313	0.4	Compliance
	Middle	2.932	0.313	0.4	Compliance
	High	2.932	0.313	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

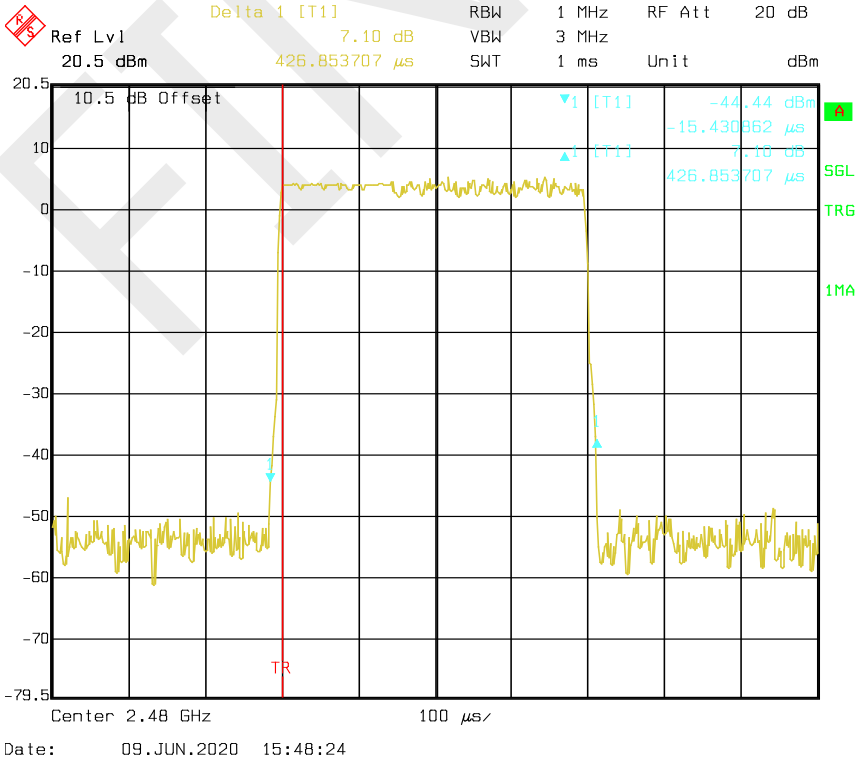
3DH1: Low Channel



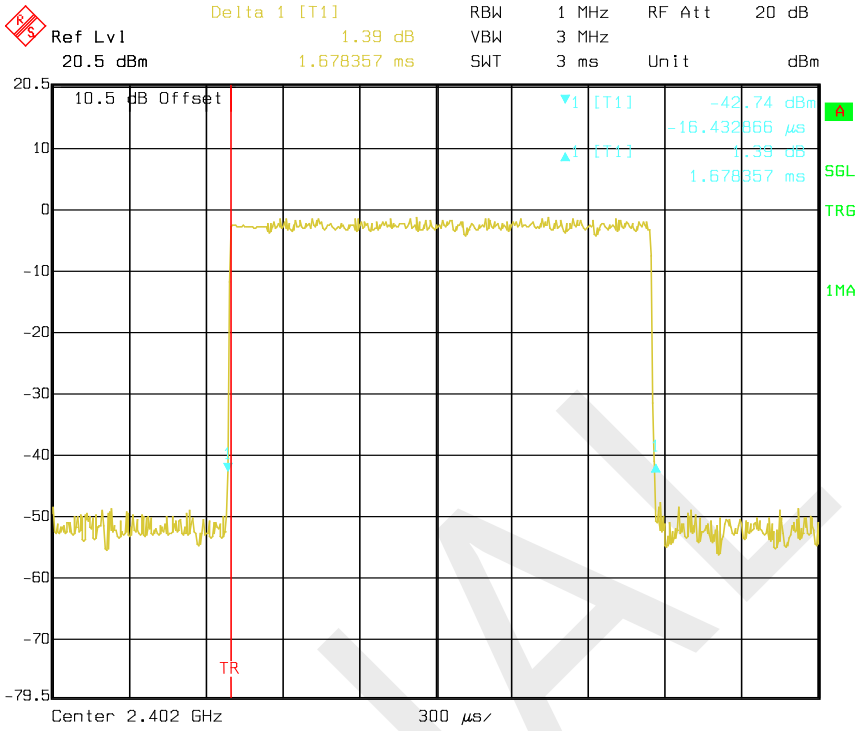
3DH1: Middle Channel



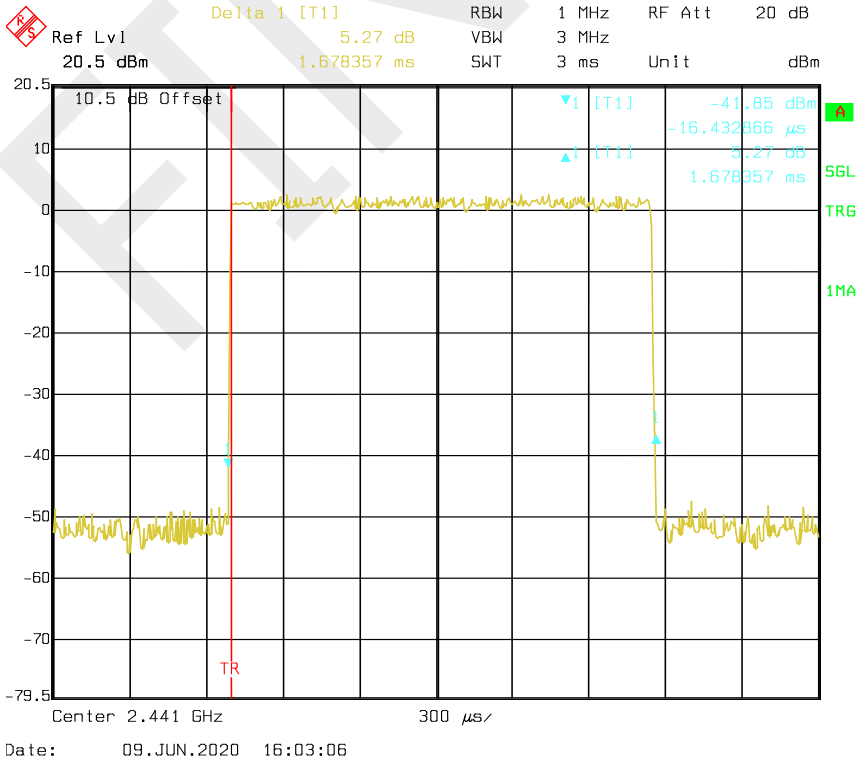
3DH1: High Channel



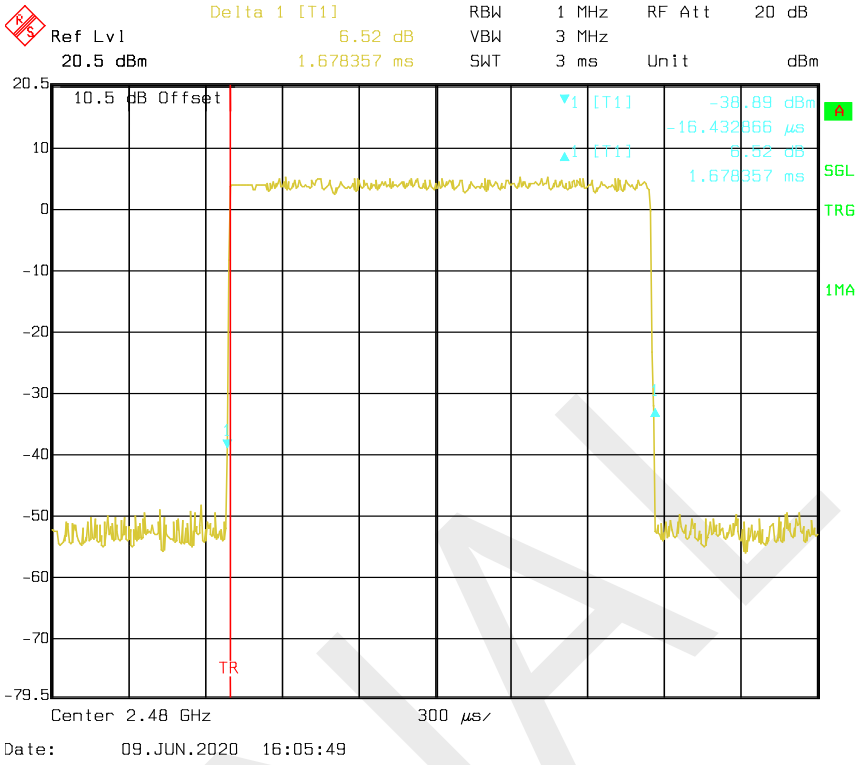
3DH3: Low Channel



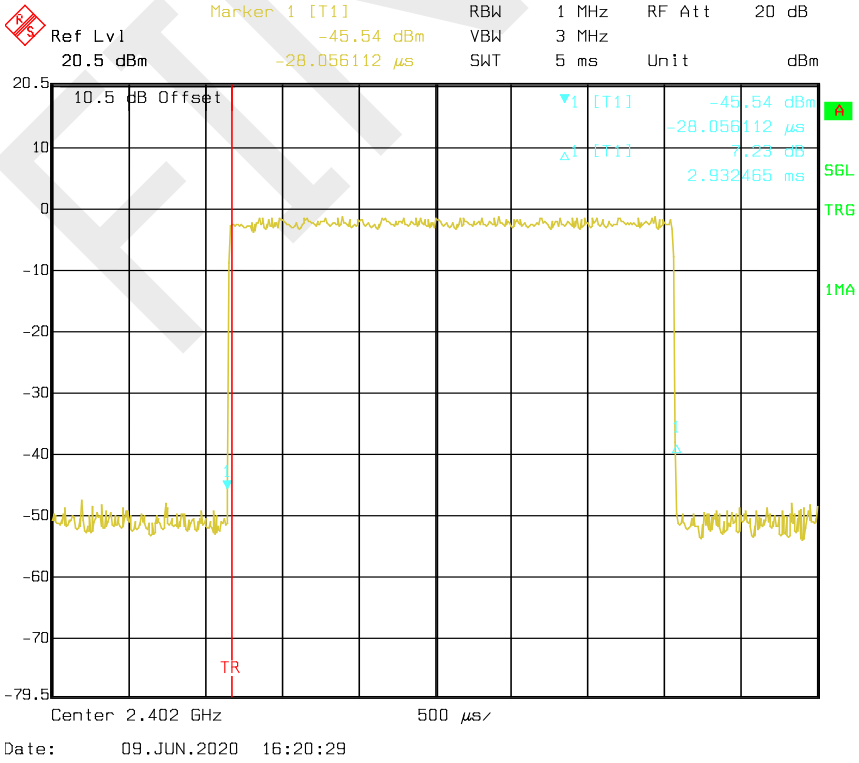
3DH3: Middle Channel



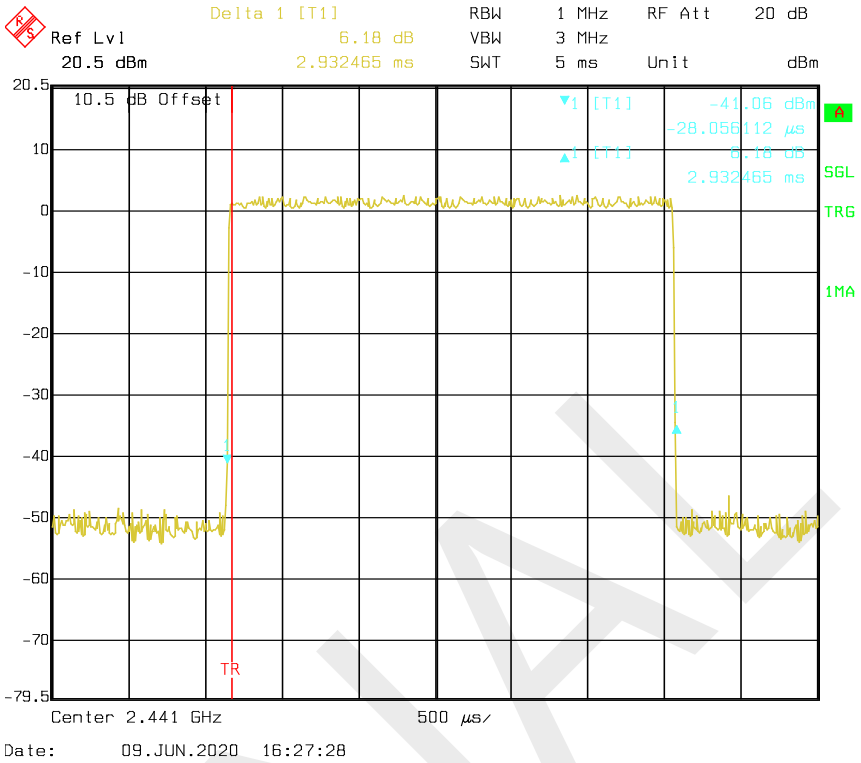
3DH3: High Channel



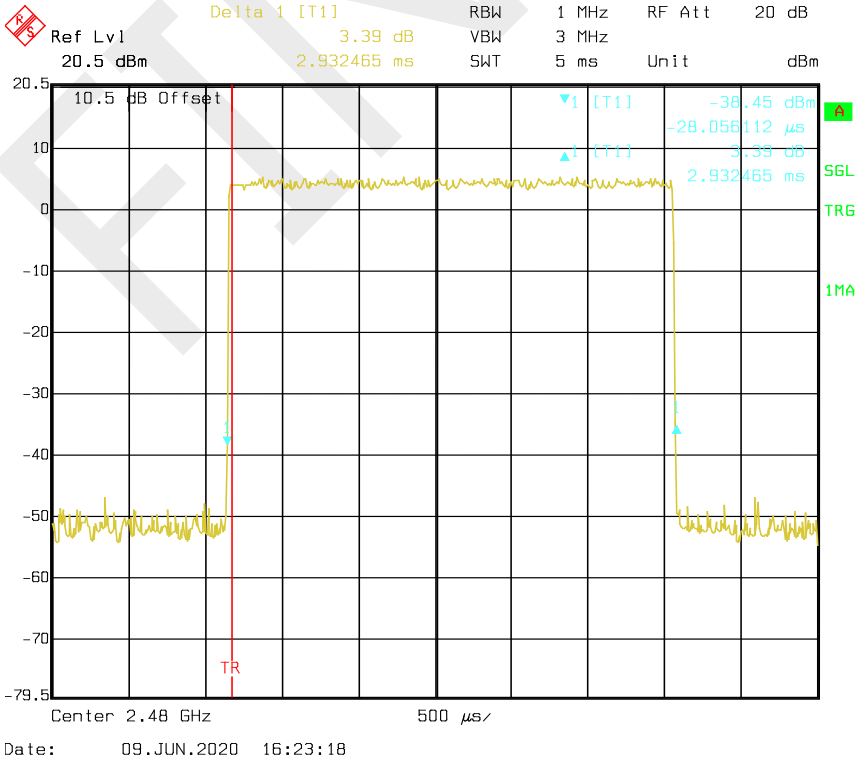
3DH5: Low Channel



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:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

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

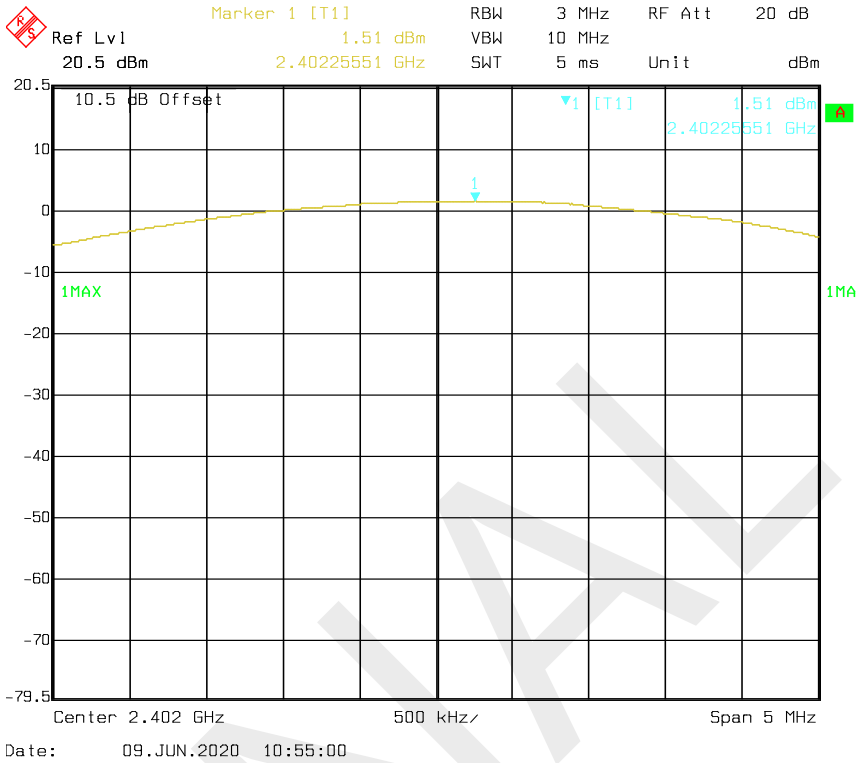
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)
BDR Mode (GFSK)	Low	2402	1.51	21
	Middle	2441	4.81	
	High	2480	7.07	
EDR Mode (π/4-DQPSK)	Low	2402	-1.35	
	Middle	2441	2.39	
	High	2480	5.07	
EDR Mode (8-DPSK)	Low	2402	-0.59	
	Middle	2441	2.90	
	High	2480	5.60	

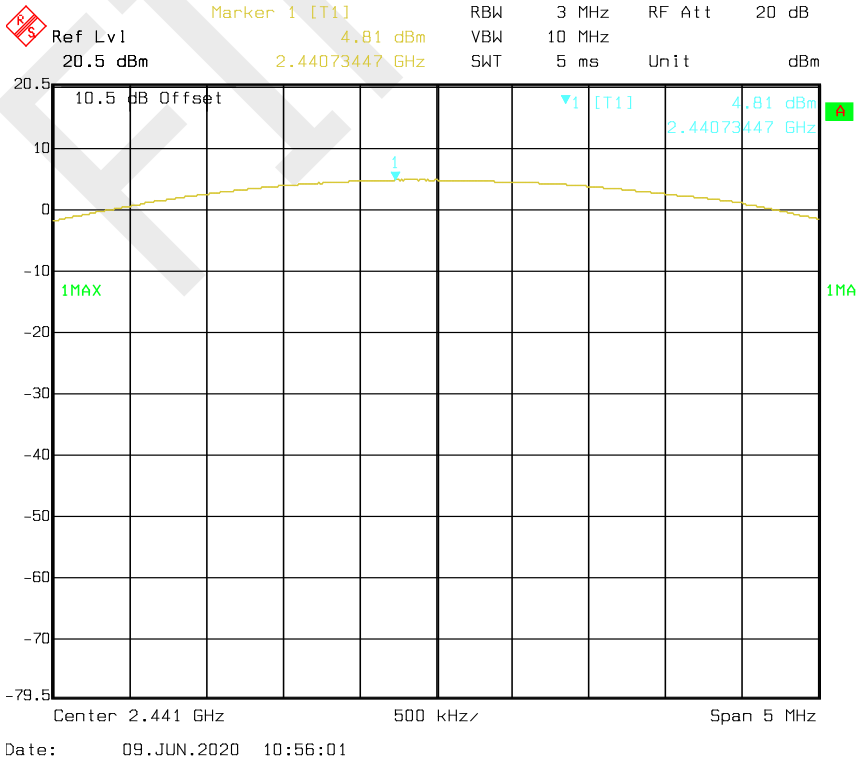
Note: The data above was tested in conducted mode.

BDR Mode (GFSK):

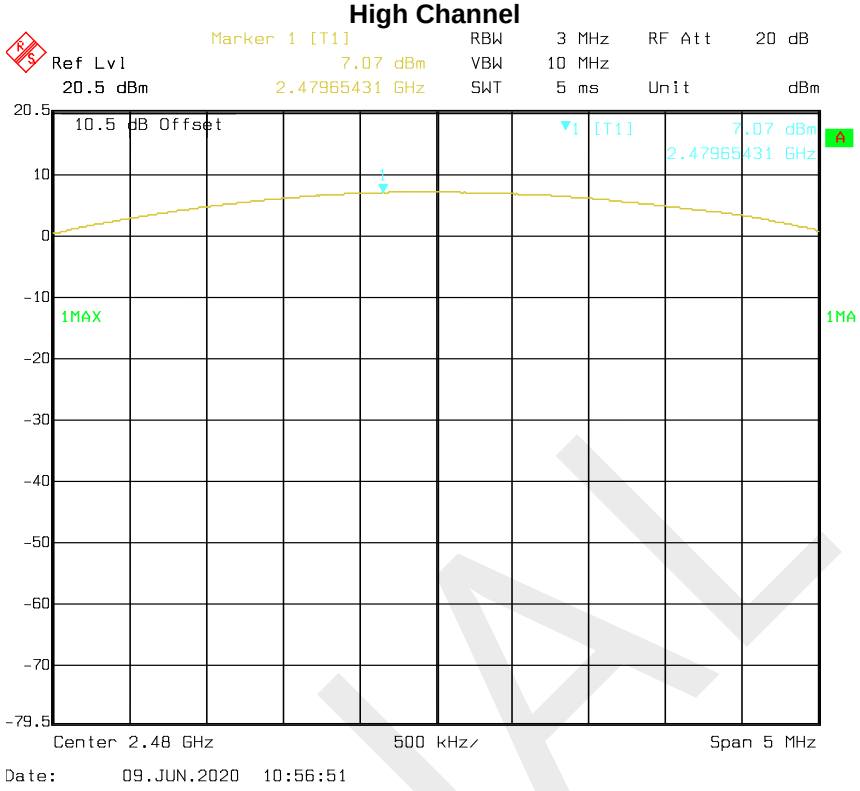
Low Channel



Middle Channel

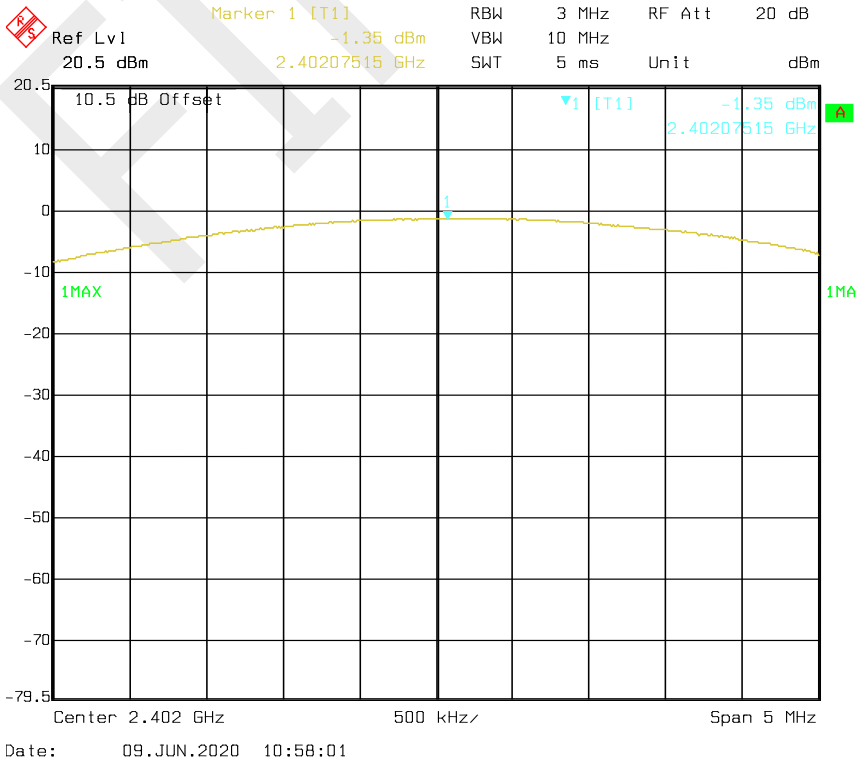


High Channel

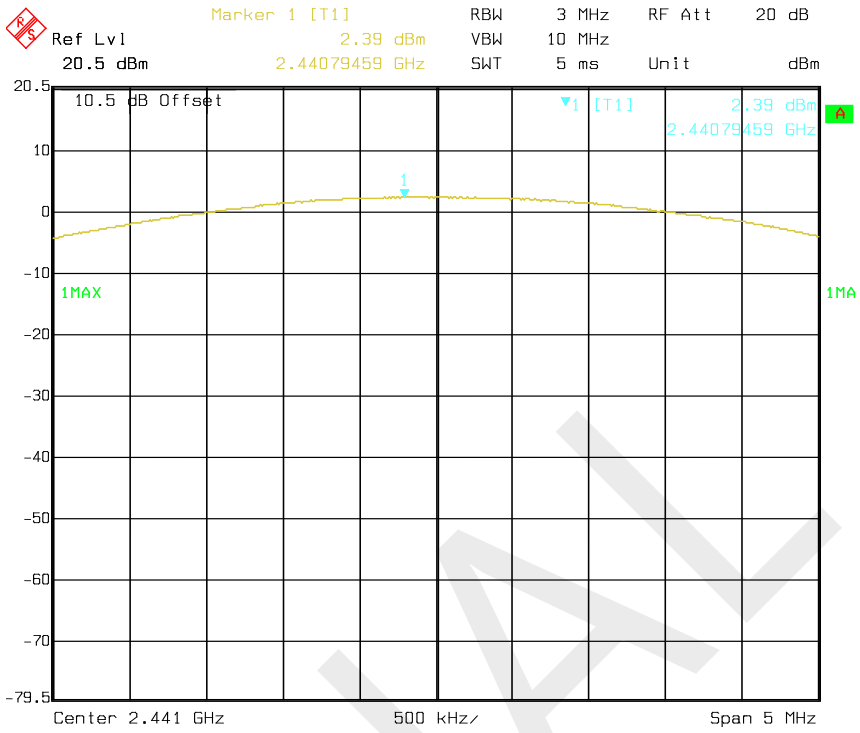


EDR Mode (π/4-DQPSK):

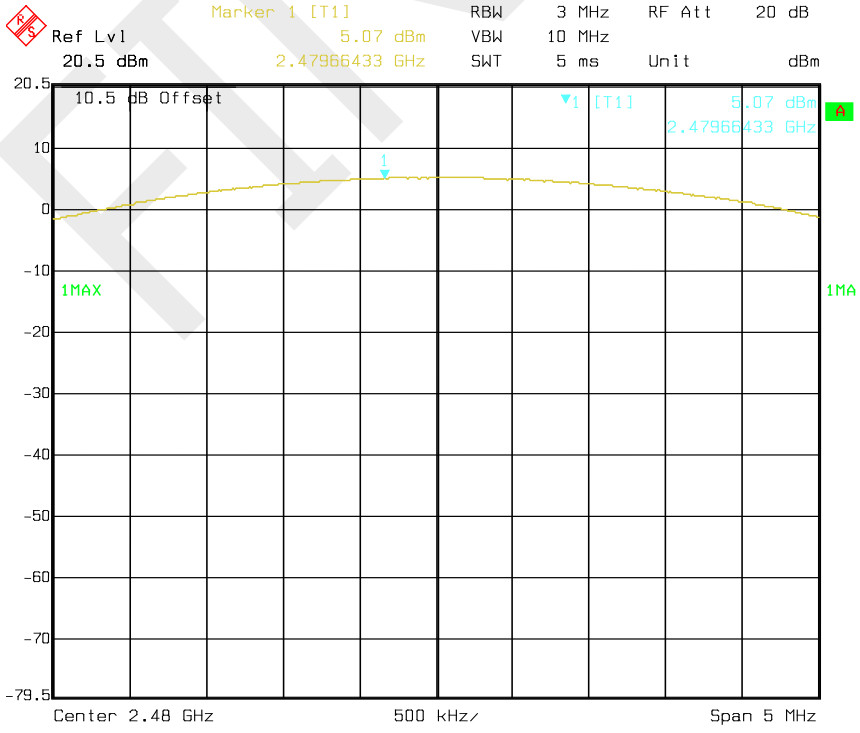
Low Channel



Middle Channel

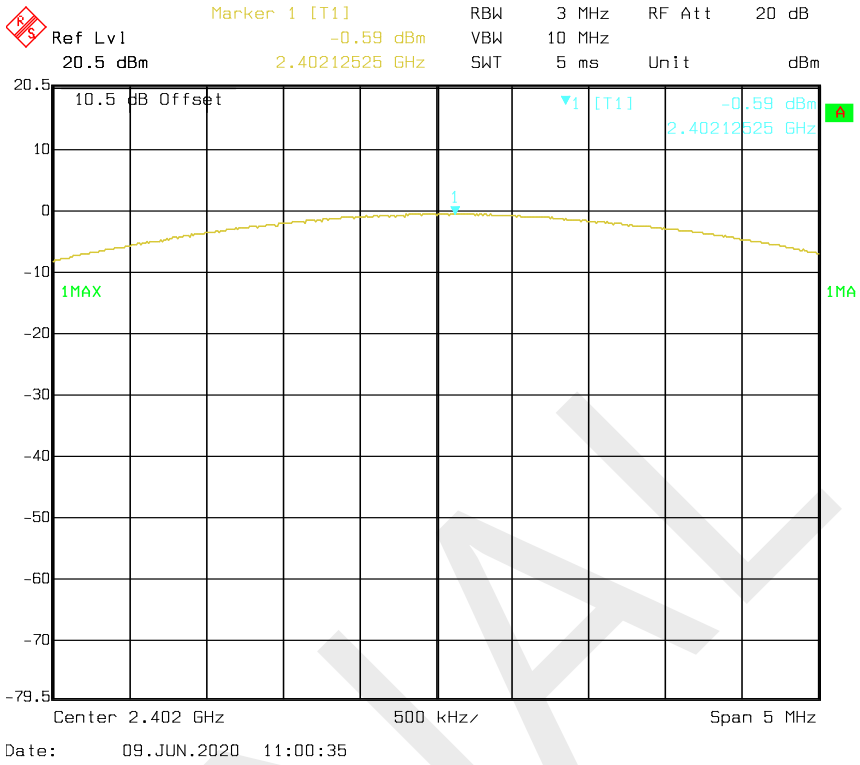


High Channel

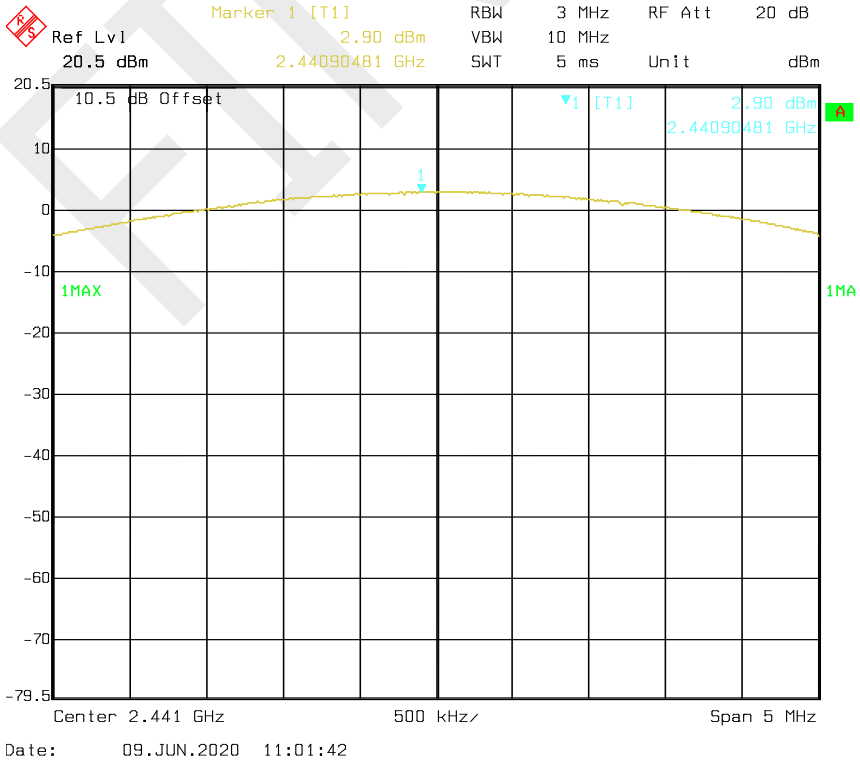


EDR Mode (8-DPSK):

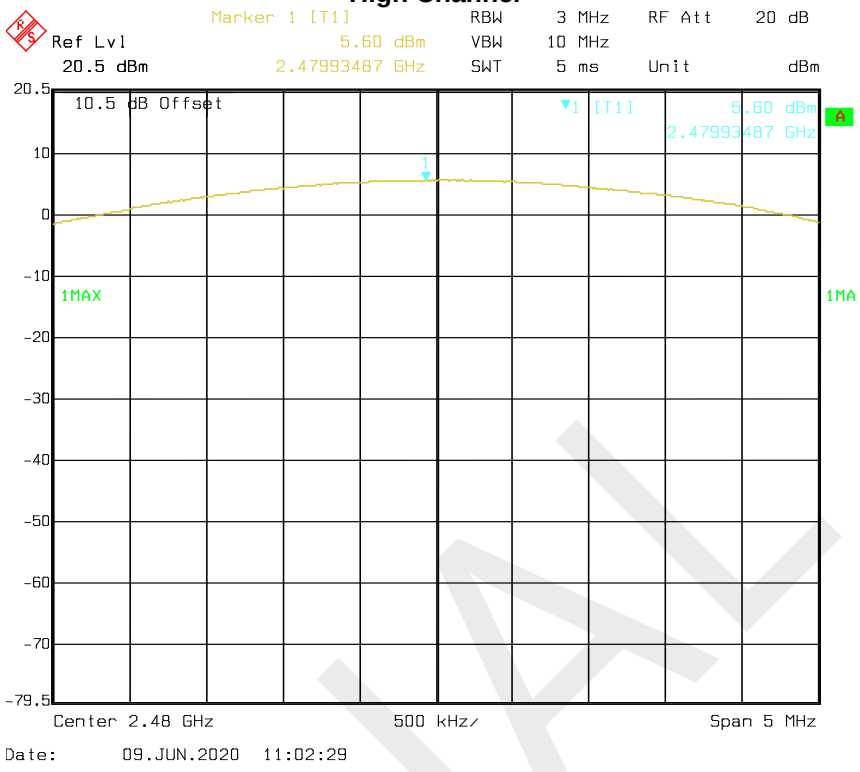
Low Channel



Middle Channel



High Channel



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

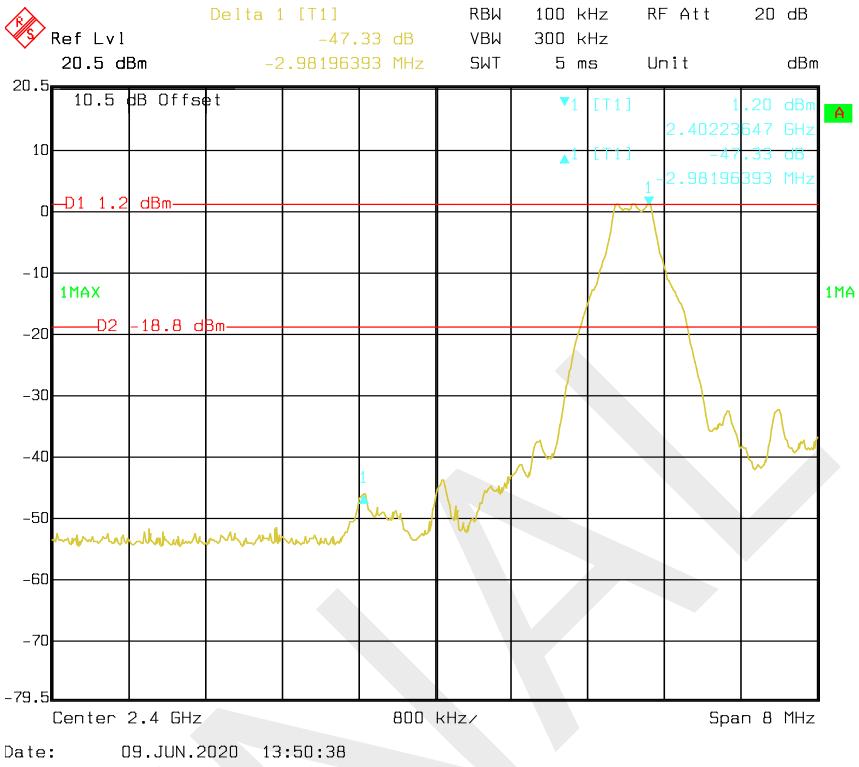
Temperature:	25 °C
Relative Humidity:	57 %
ATM Pressure:	96.2 kPa

The testing was performed by Winfred Wang on 2020-06-09.

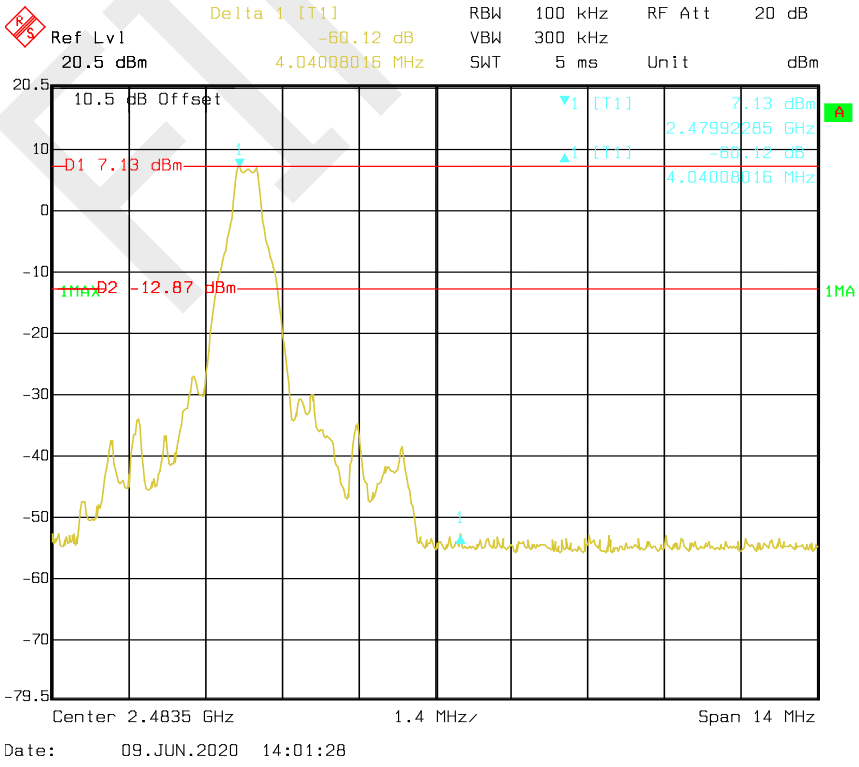
Test Result: Compliance. Please refer to the below plots:

Single Channel
BDR Mode (GFSK):

Band Edge, Left Side

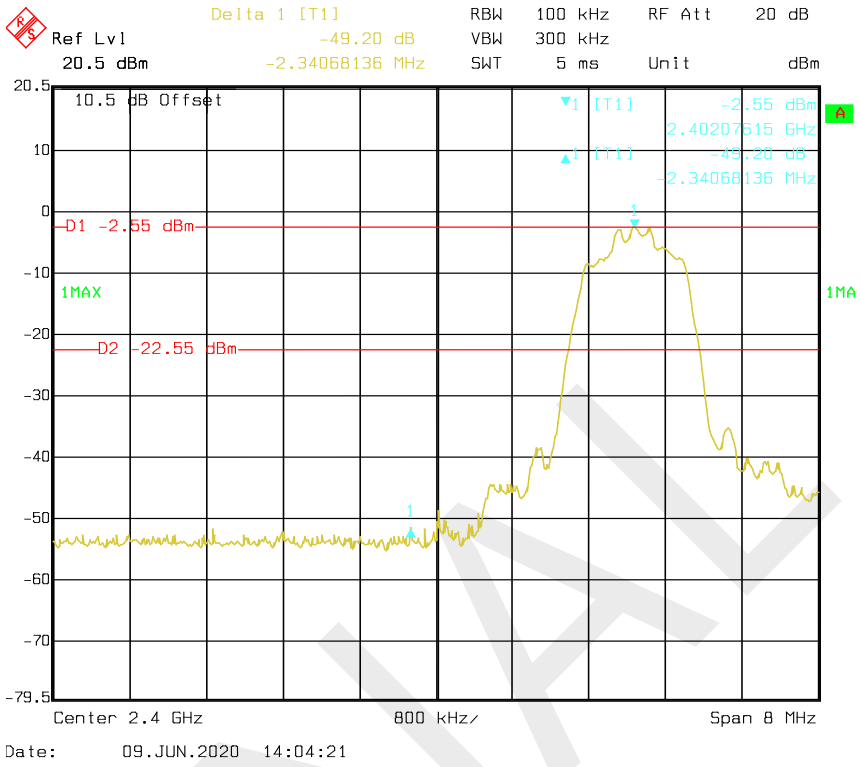


Band Edge, Right Side

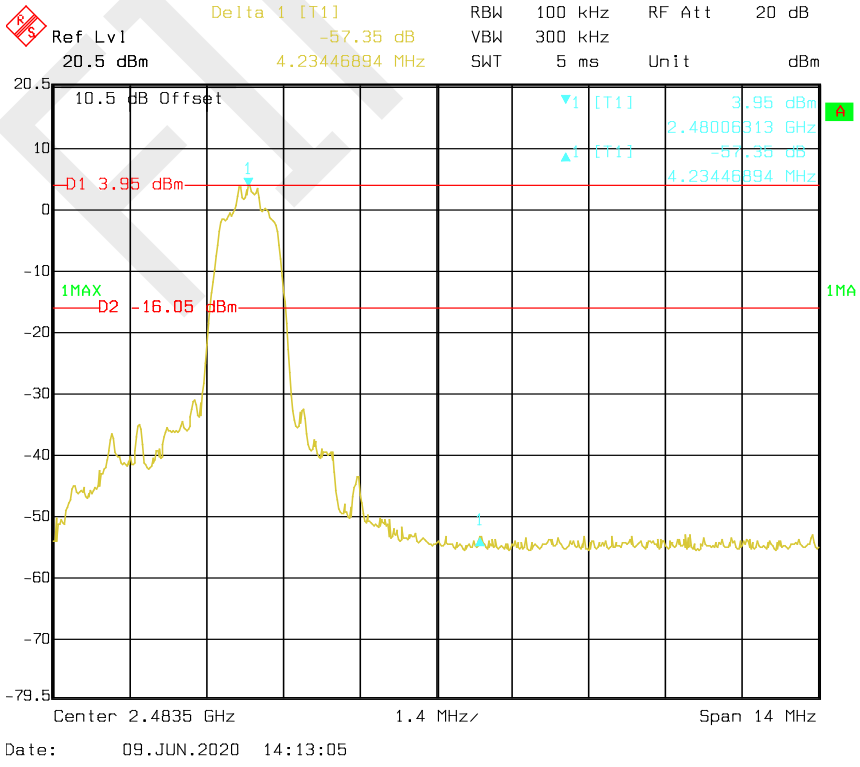


EDR Mode (π/4-DQPSK):

Band Edge, Left Side

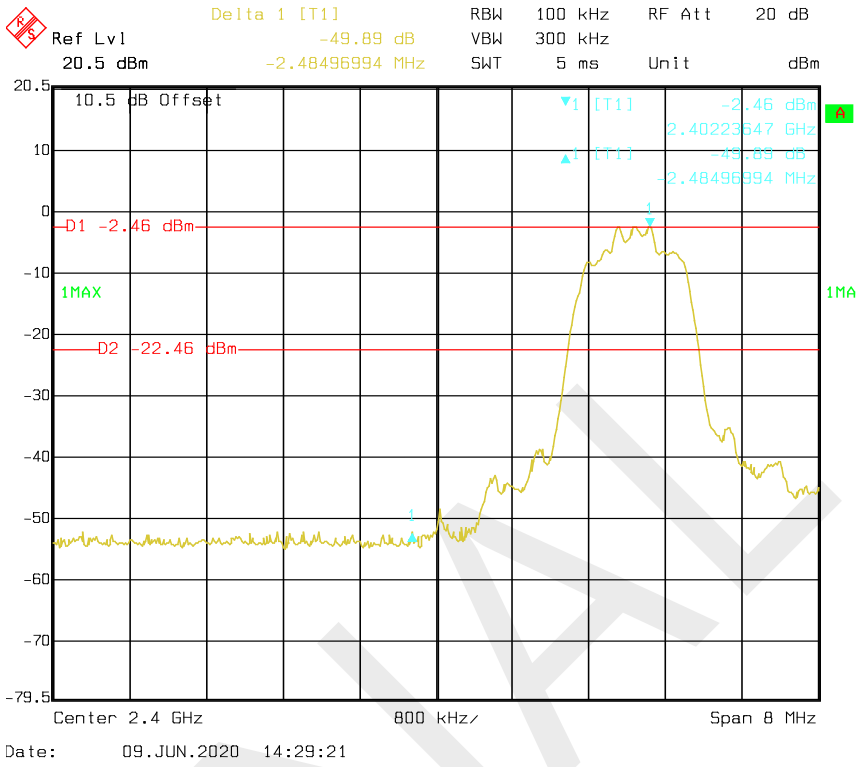


Band Edge, Right Side

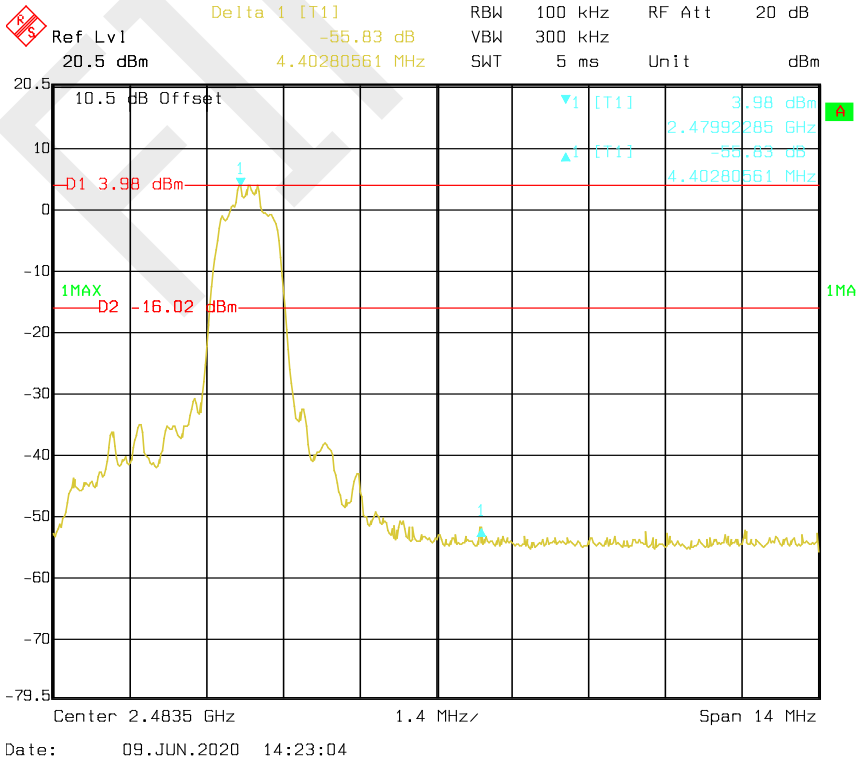


EDR Mode (8-DPSK):

Band Edge, Left Side



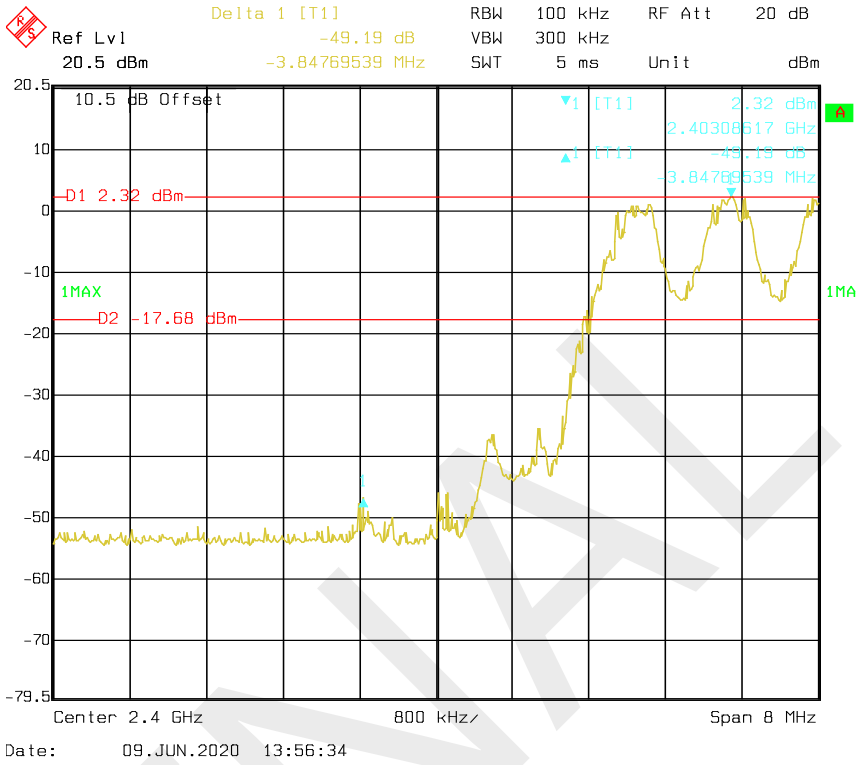
Band Edge, Right Side



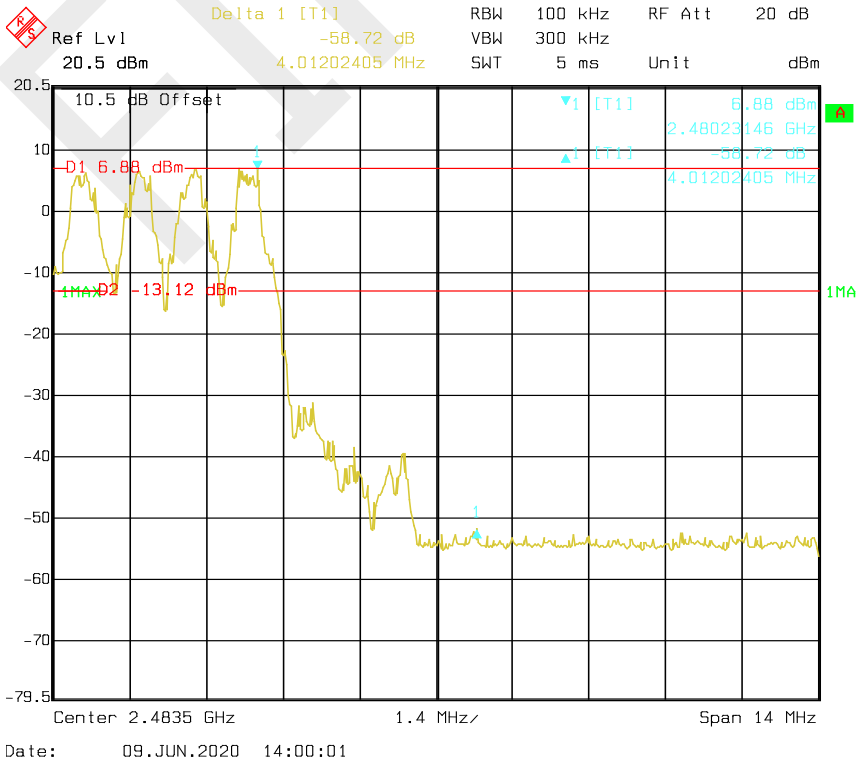
Hopping:

BDR Mode (GFSK):

Band Edge, Left Side

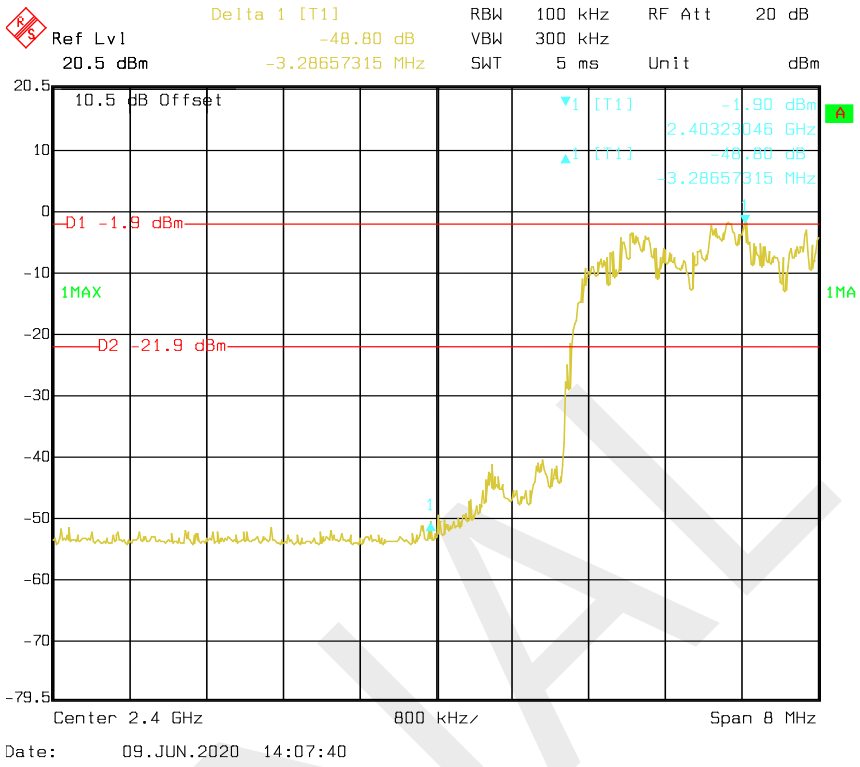


Band Edge, Right Side

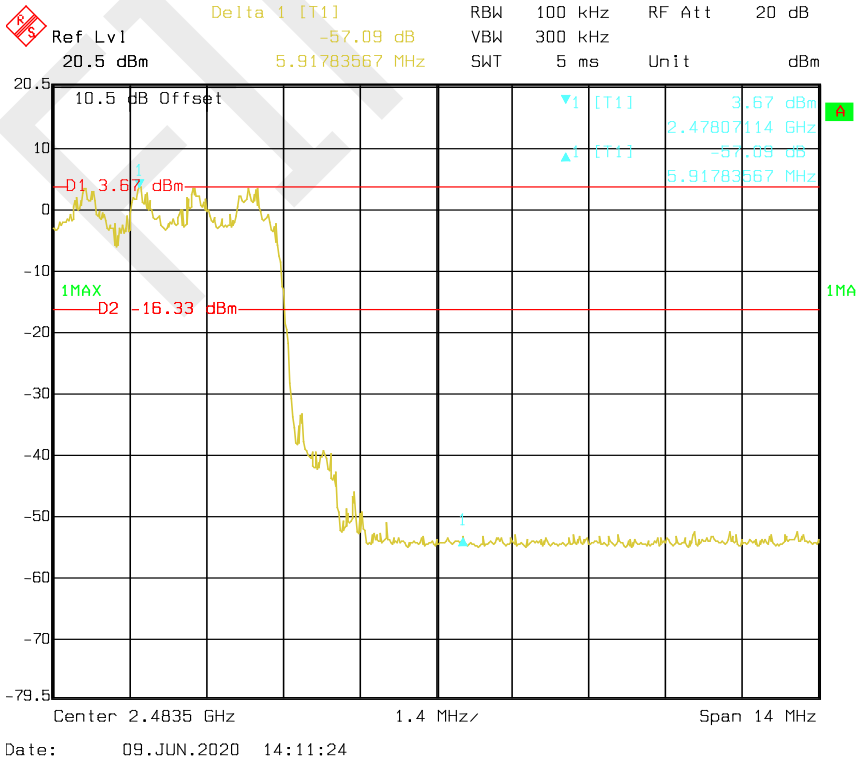


EDR Mode (π/4-DQPSK):

Band Edge, Left Side

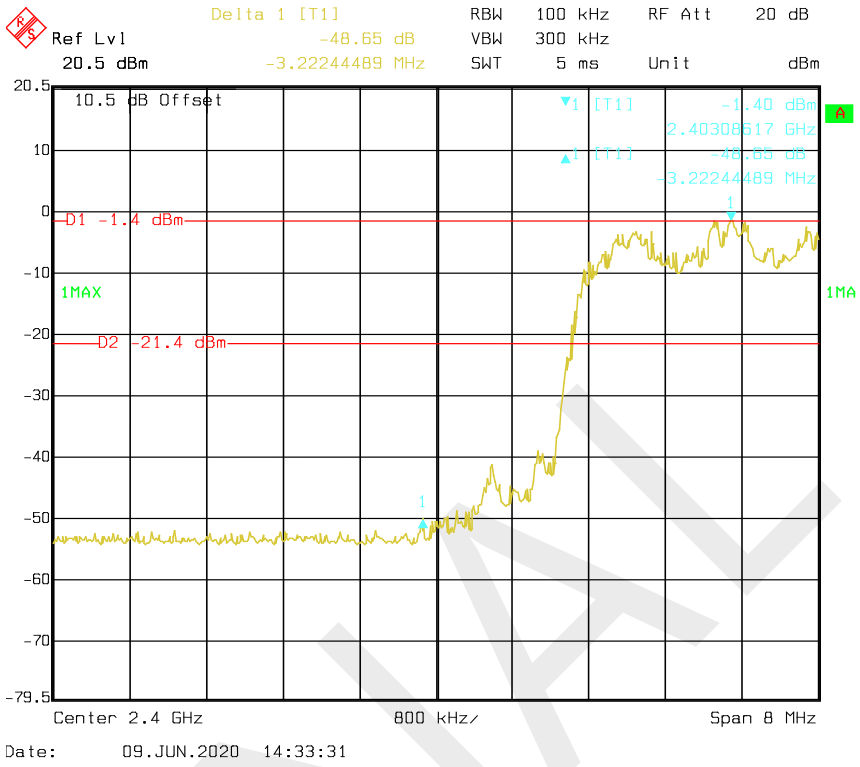


Band Edge, Right Side

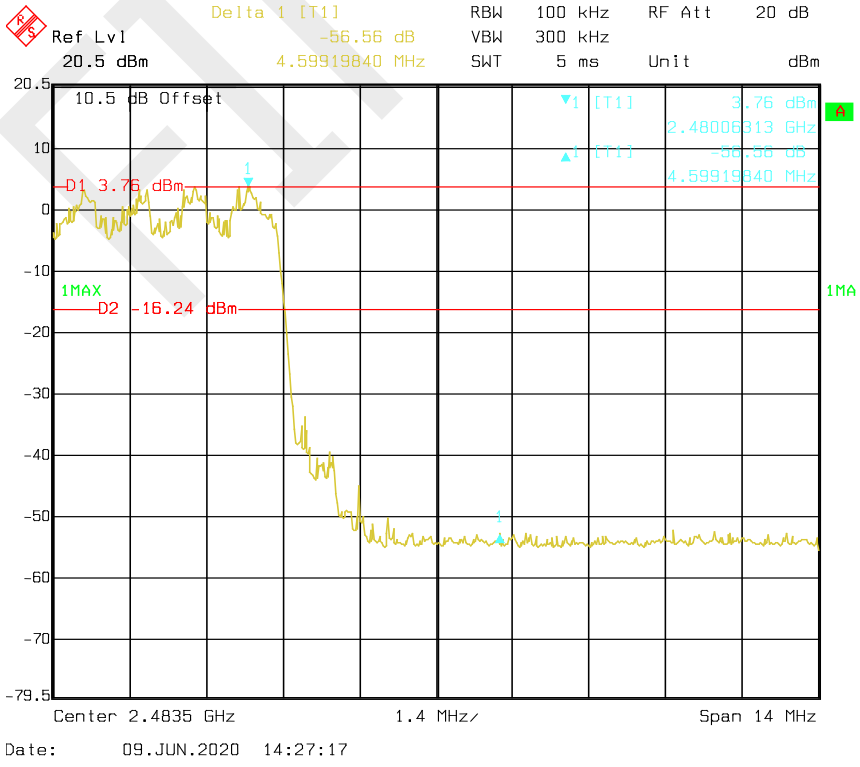


EDR Mode (8-DPSK):

Band Edge, Left Side



Band Edge, Right Side



END OF REPORT