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BACL Bay Area Compliance Labs Corp.

FCC PART 15.247

TEST REPORT

For

HoMedics, Inc.

3000 Pontiac Trail, Commerce Township, Michigan 48390 United States

FCC ID: TG3-WM1802

Report Type:	**Product Type:**
Original Report	Bluetooth Speaker

Report Number: RSZ180103801-00B

Report Date: 2018-01-31

Reviewed By: Rocky Kang, RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
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Note: This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP* or any agency of the Federal Government. * This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*".

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The EUT (model name: BWA18AA010, FCC ID: TG3-WM1802) is a Bluetooth Speaker which is powered by internal polymer lithium battery with 3.7Vdc nominal output voltage. It can be recharged thr ough the micro-USB port located in outer of enclosure by external power supply with rated 5Vdc output voltage

Notes: This series products model:BWA18AA012C and BWA18AA010 are electrically identical, the difference among them is only color due to marketing purpose. Model BWA18AA010 was selected for fully testing, the detailed information can be referred to the declaration letter which was stated and guaranteed by the applicant.

** All measurement and test data in this report was gathered from production sample serial number: 180103801 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2017-12-07.*

Objective

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

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

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

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.

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

Measurement Uncertainty

Parameter	uncertainty
Occupied Channel Bandwidth	±5%
RF Output Power with Power meter	±0.5dB
RF conducted test with spectrum	±1.5dB
AC Power Lines Conducted Emissions	±1.95dB
All emissions, radiated	±4.88dB
Temperature	±3℃
Humidity	±6%
Supply voltages	±0.4%

Test Facility

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

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 382179,the FCC Designation No. : CN5001.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

EUT Exercise Software

"Bluetooth Authentication Test tool v1.3.3" software was used.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

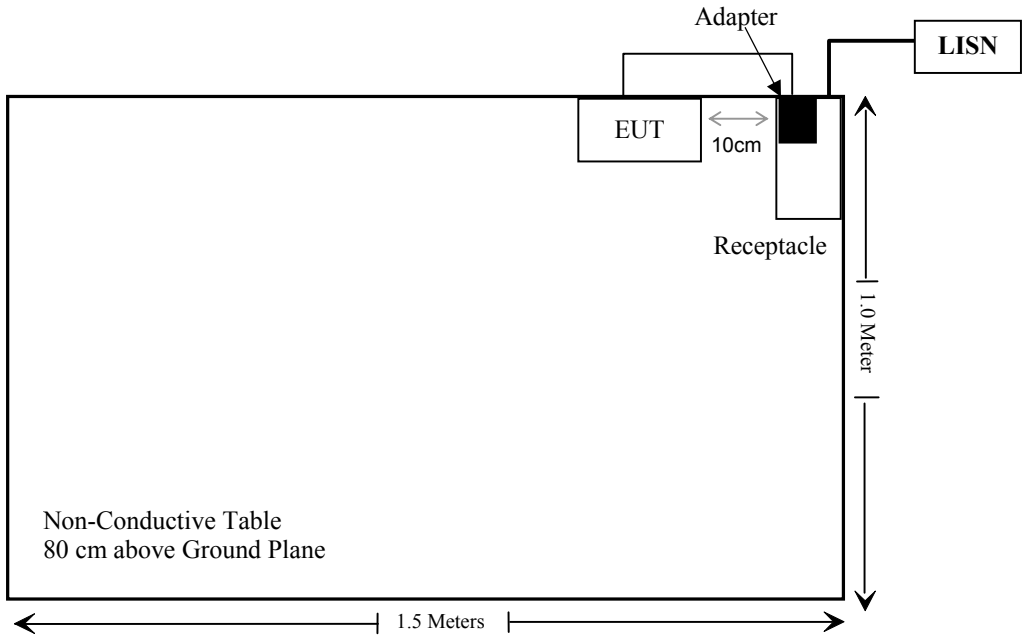
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
SPY	Adapter	716D-0501000	N/A

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.0	EUT	Adapter

Block Diagram of Test Setup（Conducted emission）



SUMMARY OF TEST RESULTS

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

EST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2017-08-04	2018-08-04
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2017-12-07	2018-12-07
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2017-11-19	2018-05-21
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
N/A	Conducted Emission Cable	N/A	UF A210B-1-0720-504504	2017-11-12	2018-05-12
Radiated Emission Test					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2014-12-29	2017-12-28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017-12-29	2020-12-28
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2017-04-24	2018-04-24
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-02-14	2018-02-14
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-21
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2014-12-17	2017-12-16
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2017-12-17	2020-12-16
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2017-12-07	2018-12-07
Ducommun technologies	RF Cable	UFA210A-1-4724-30050U	MFR64369 223410-001	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Ducommun Technologies	Pre-amplifier	ALN-22093530-01	991373-01	2017-08-03	2018-08-03
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	N/A	2017-05-21	2018-05-21
RF Conducted Test					
Agilent	P-Series Power Meter	N1912A	MY5000448	2017-12-05	2018-12-05
Agilent	Wideband Power Sensor	N1921A	MY54210016	2017-12-05	2018-12-05
N/A	10dB Attenuator	5324	AU 3842	2017-11-22	2018-05-23
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03 -101746-zn	2017-08-17	2018-08-17
Ducommun technologies	RF Cable	RG-214	3	2017-11-22	2018-05-22

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

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

Applicable Standard

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

According to KDB 447498 D01 General RF Exposure Guidance

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

Measurement Result

For worst case:

Mode	Frequency (MHz)	Max Tune-up Conducted Power (dBm)	Max Tune-up Conducted Power (mW)	Calculated Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
BT3.0	2480	-4	0.4	5	0.1	3.0	Yes

Result: No SAR test is required

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

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

Antenna Connector Construction

The EUT has an integral antenna arrangement which was permanently attached and the antenna gain is -0.58 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

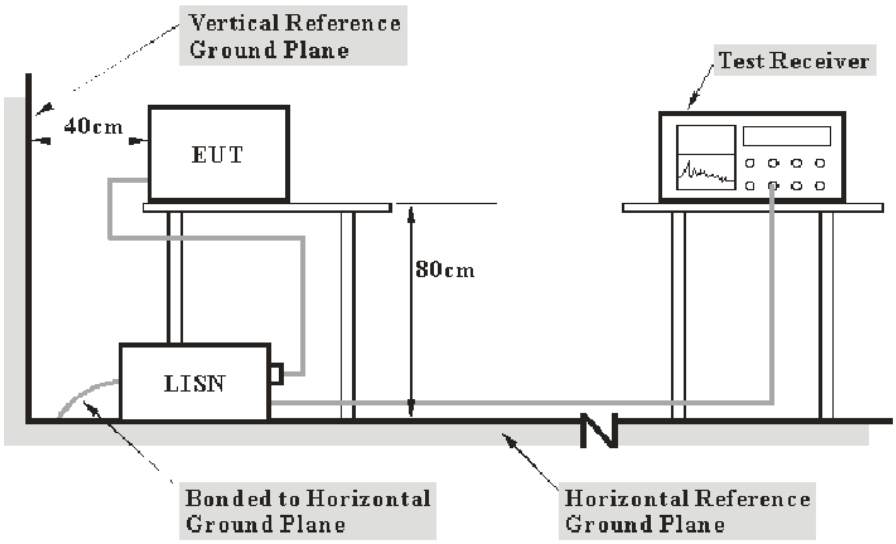
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

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

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

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

Test Procedure

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

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

Corrected Factor & Margin Calculation

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

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

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

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

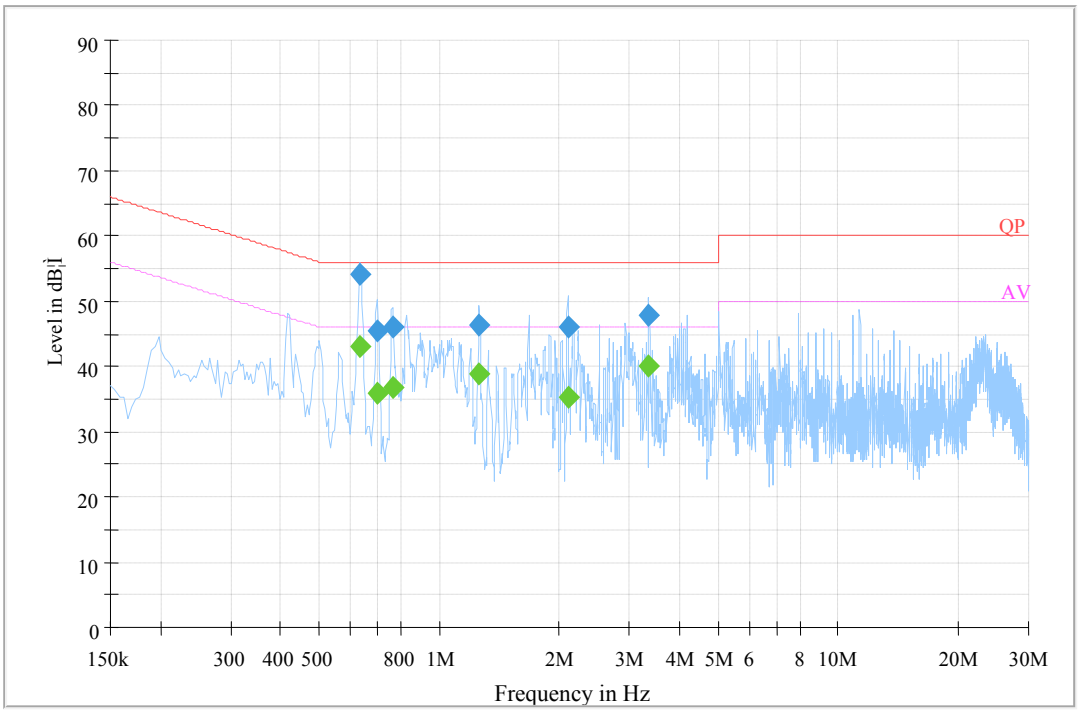
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Tracy Hu on 2018-01-10.

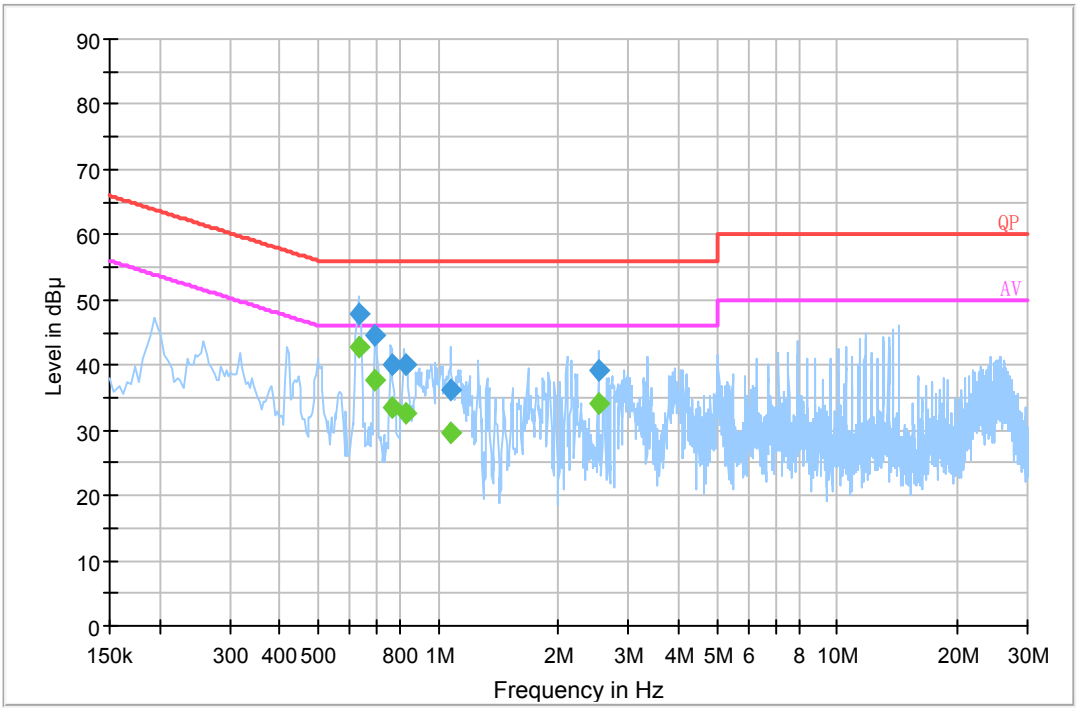
EUT operation mode: Charging & transmitting

AC 120V/60 Hz, Line:



Frequency (MHz)	Corrected Amplitude (dBµV)	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Remark (PK/QP/Ave.)
0.632490	53.0	20.1	56.0	3.0	QP
0.703470	45.6	20.0	56.0	10.4	QP
0.766510	46.0	20.0	56.0	10.0	QP
1.259070	46.2	20.1	56.0	9.8	QP
2.098530	46.0	20.1	56.0	10.0	QP
3.359630	47.9	20.1	56.0	8.1	QP
0.632490	42.6	20.1	46.0	3.4	Ave.
0.703470	35.8	20.0	46.0	10.2	Ave.
0.766510	36.8	20.0	46.0	9.2	Ave.
1.259070	38.9	20.1	46.0	7.1	Ave.
2.098530	35.4	20.1	46.0	10.6	Ave.
3.359630	40.0	20.1	46.0	6.0	Ave.

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Remark (PK/QP/Ave.)
0.632550	47.9	20.1	56.0	8.1	QP
0.695530	44.5	20.0	56.0	11.5	QP
0.762570	40.0	20.0	56.0	16.0	QP
0.825670	40.0	20.0	56.0	16.0	QP
1.069890	36.2	20.1	56.0	19.8	QP
2.516230	39.1	20.1	56.0	16.9	QP
0.632550	42.6	20.1	46.0	3.4	Ave.
0.695530	37.7	20.0	46.0	8.3	Ave.
0.762570	33.4	20.0	46.0	12.6	Ave.
0.825670	32.5	20.0	46.0	13.5	Ave.
1.069890	29.5	20.1	46.0	16.5	Ave.
2.516230	34.1	20.1	46.0	11.9	Ave.

Note:

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

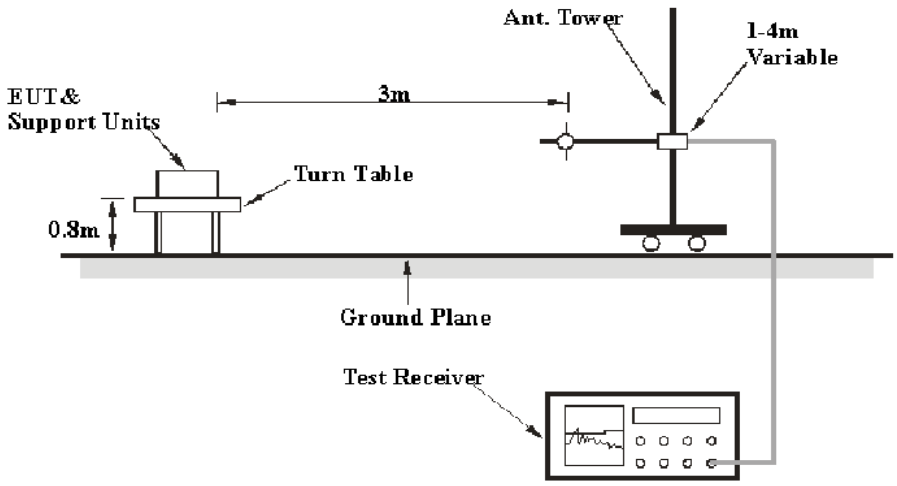
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

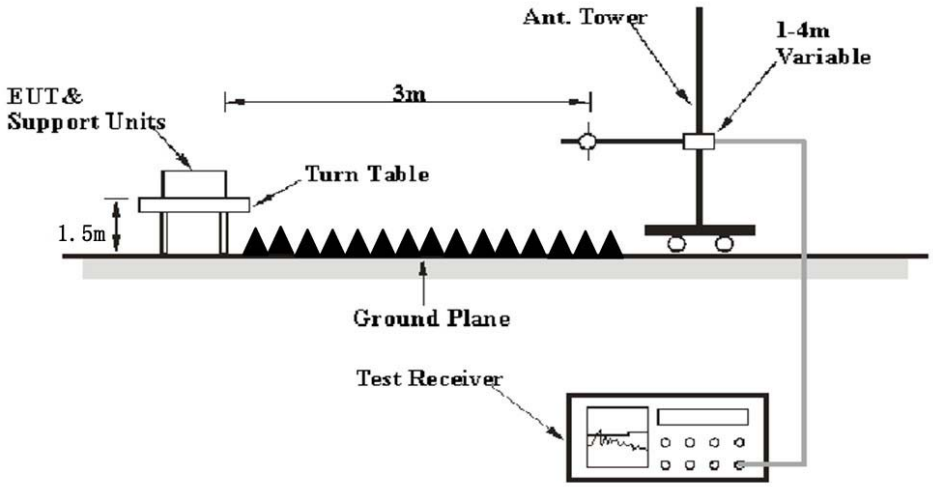
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, 205 and FCC 15.247 limits.

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 & Spectrum Analyzer Setup were set with the following configurations:

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

Test Procedure

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

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

Corrected Amplitude & Margin Calculation

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

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

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

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

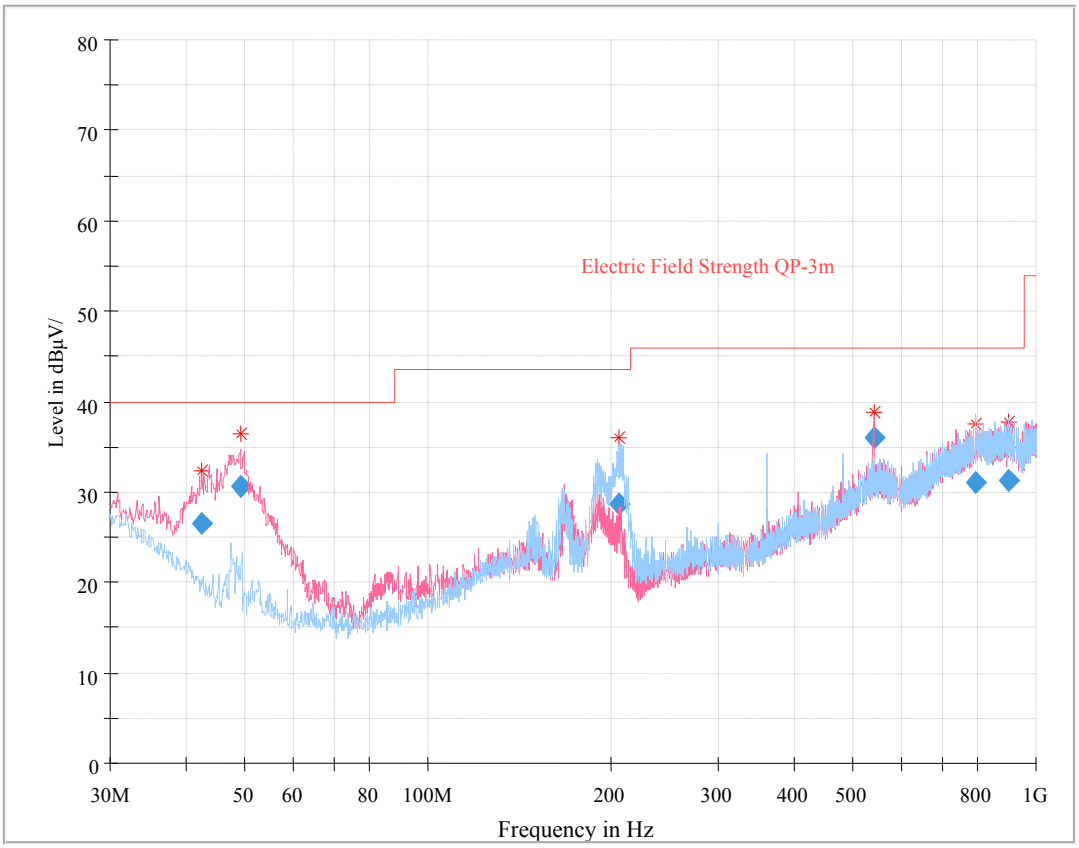
Environmental Conditions

Temperature:	24~25 ℃
Relative Humidity:	49~52 %
ATM Pressure:	100.9~101.0 kPa

The testing was performed by Tracy Hu from 2017-12-08 to 2018-01-30.

EUT operation mode: Transmitting(Scan with GFSK, π/4-DQPSK, the worst case is π/4-DQPSK Mode)

30 MHz~1 GHz:



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
42.545750	26.53	119.0	V	129.0	-8.0	40.00	13.47
49.171875	30.67	109.0	V	61.0	-10.8	40.00	9.33
206.642375	28.68	150.0	H	53.0	-5.7	43.50	14.82
539.967625	36.08	120.0	V	140.0	4.5	46.00	9.92
796.413250	31.14	222.0	H	330.0	8.9	46.00	14.86
902.099125	31.29	127.0	H	35.0	9.6	46.00	14.71

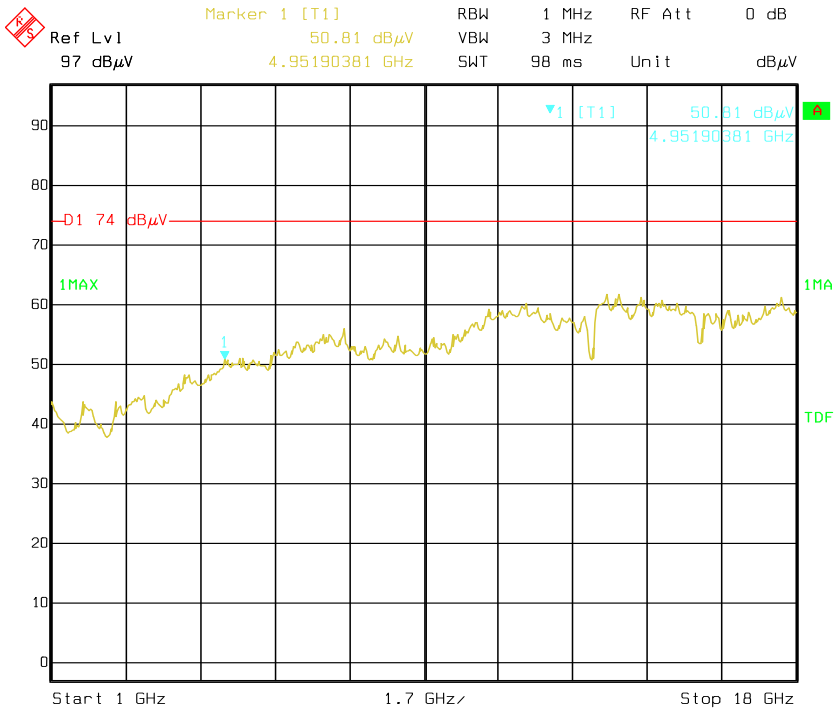
1000 MHz -25 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.247	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2402 MHz)									
2402.00	54.72	PK	192	2.0	H	33.92	88.64	/	/
2402.00	43.51	Ave.	192	2.0	H	33.92	77.43	/	/
2402.00	52.76	PK	349	2.3	V	33.92	86.68	/	/
2402.00	42.35	Ave.	349	2.3	V	33.92	76.27	/	/
2368.33	27.79	PK	136	1.4	H	33.92	61.71	74	12.29
2368.33	13.85	Ave.	136	1.4	H	33.92	47.77	54	6.23
2495.20	27.32	PK	315	2.2	H	34.08	61.40	74	12.60
2495.20	13.38	Ave.	315	2.2	H	34.08	47.46	54	6.54
4804.00	45.74	PK	256	1.7	H	5.84	51.58	74	22.42
4804.00	31.83	Ave.	256	1.7	H	5.84	37.67	54	16.33
Middle Channel (2441 MHz)									
2441.00	54.61	PK	43	2.0	H	33.92	88.53	/	/
2441.00	44.08	Ave.	43	2.0	H	33.92	78.00	/	/
2441.00	52.84	PK	179	2.1	V	33.92	86.76	/	/
2441.00	42.24	Ave.	179	2.1	V	33.92	76.16	/	/
4882.00	45.96	PK	318	1.1	H	6.21	52.17	74	21.83
4882.00	32.17	Ave.	318	1.1	H	6.21	38.38	54	15.62
High Channel (2480 MHz)									
2480.00	54.07	PK	156	2.0	H	34.08	88.15	/	/
2480.00	42.89	Ave.	156	2.0	H	34.08	76.97	/	/
2480.00	52.96	PK	110	1.7	V	34.08	87.04	/	/
2480.00	42.42	Ave.	110	1.7	V	34.08	76.50	/	/
2377.41	27.74	PK	60	1.7	H	33.92	61.66	74	12.34
2377.41	13.86	Ave.	60	1.7	H	33.92	47.78	54	6.22
2494.18	27.43	PK	55	1.5	H	34.08	61.51	74	12.49
2494.18	13.38	Ave.	55	1.5	H	34.08	47.46	54	6.54
4960.00	45.02	PK	227	1.2	H	7.82	52.84	74	21.16
4960.00	31.28	Ave.	227	1.2	H	7.82	39.10	54	14.90

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

Pre-scan with 2480MHz

Horizontal (1-18 GHz)



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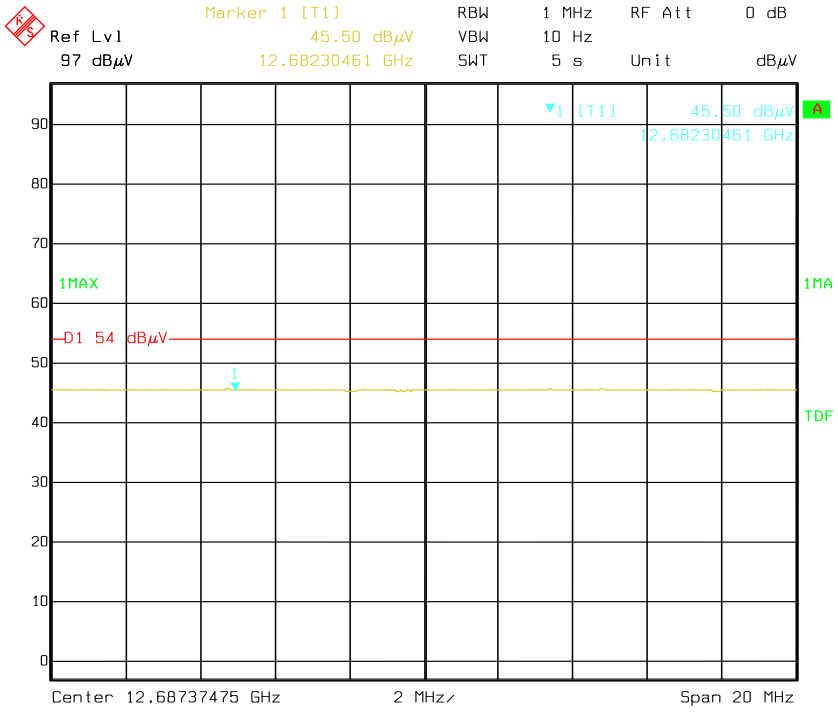

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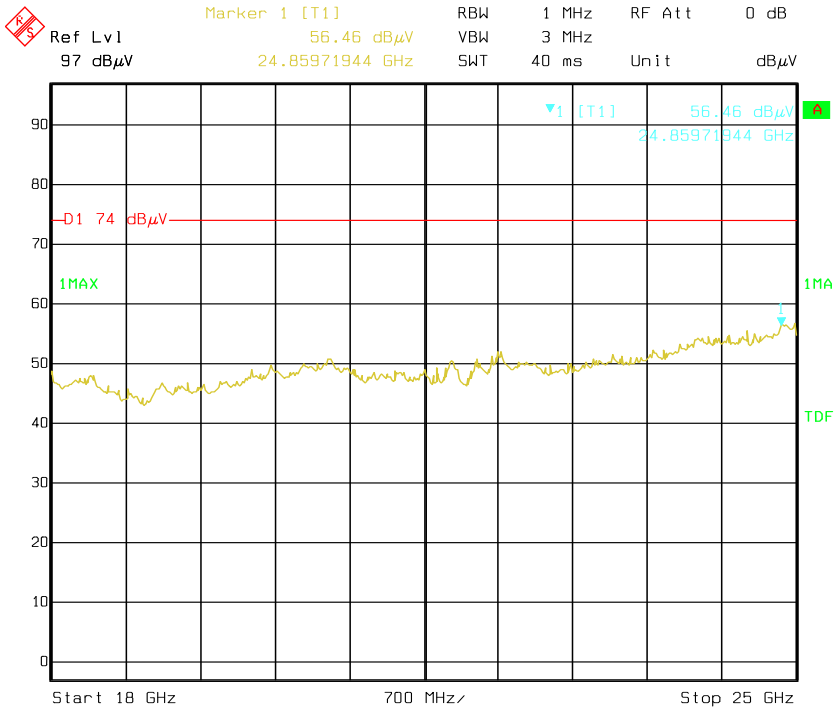
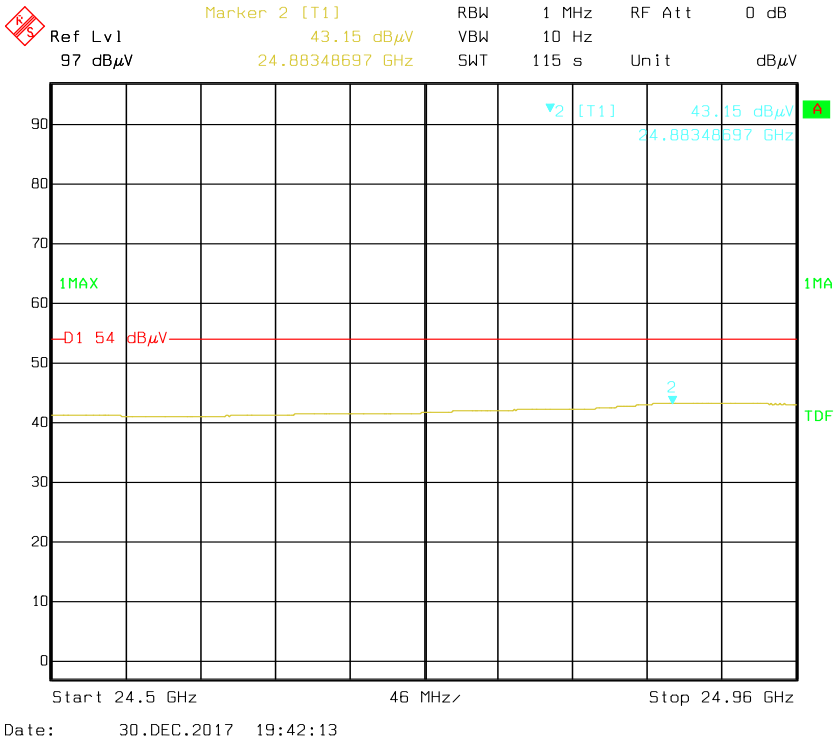
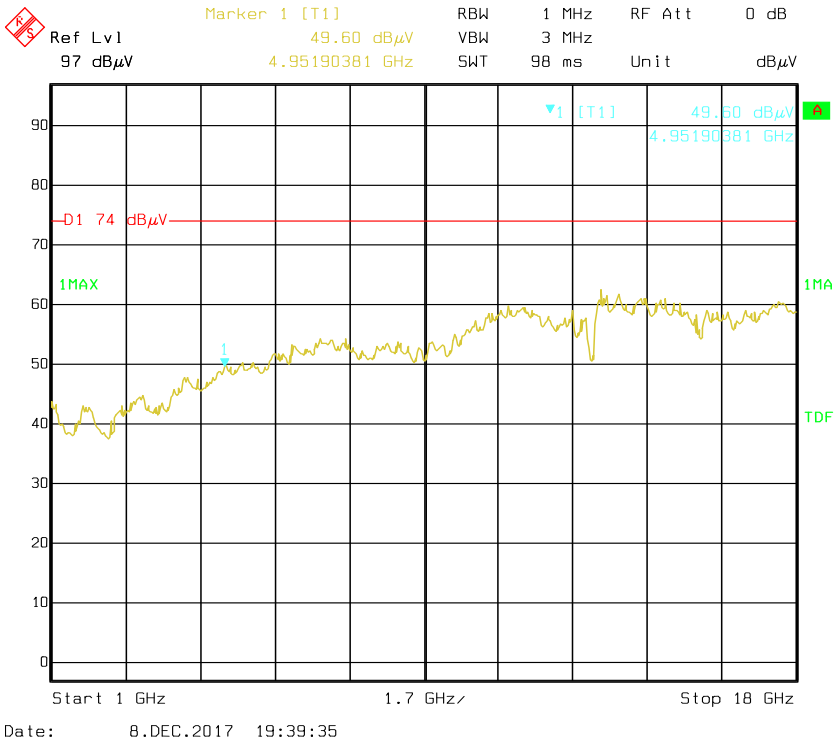
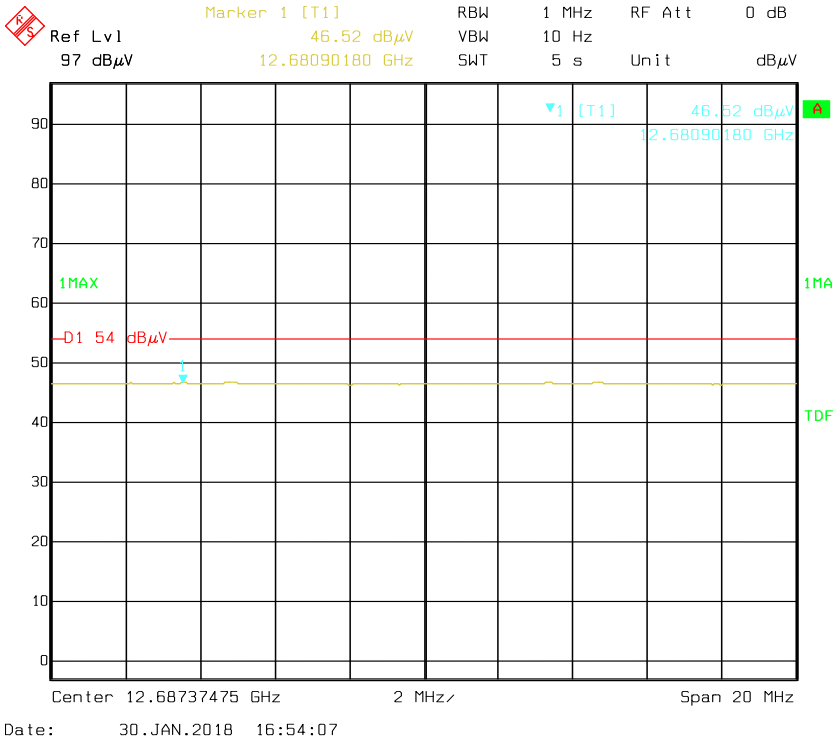
Horizontal (18-25 GHz)



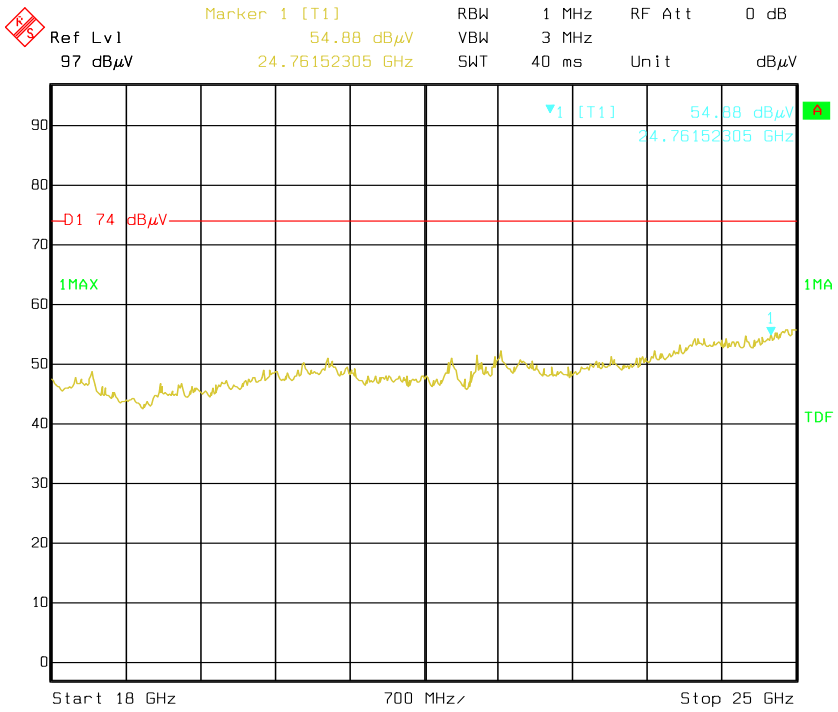


Vertical (1-18 GHz)

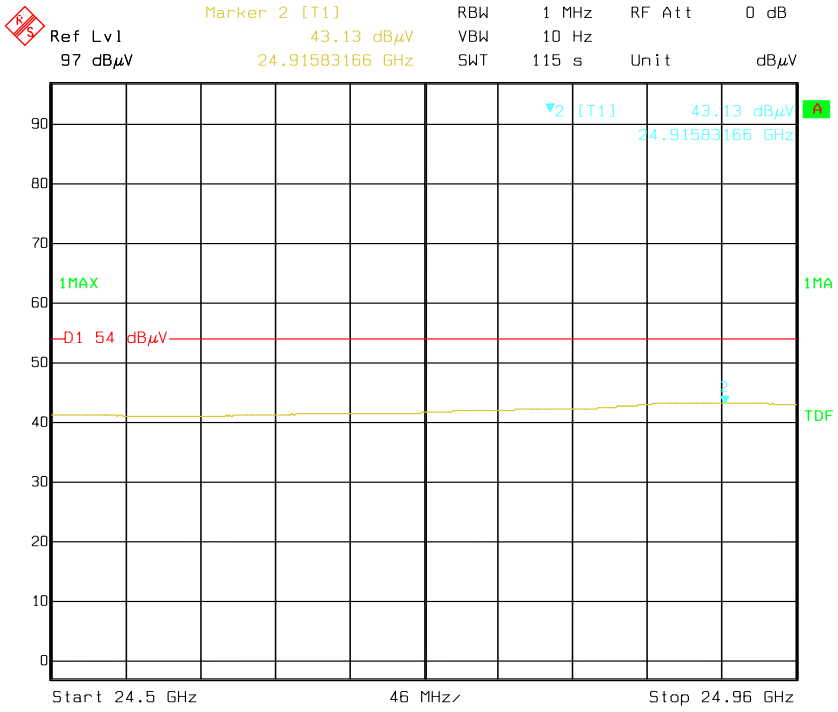




Vertical (18-25 GHz)



Date: 8.DEC.2017 20:00:32



Date: 30.DEC.2017 19:39:46

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Tracy Hu on 2018-01-08.

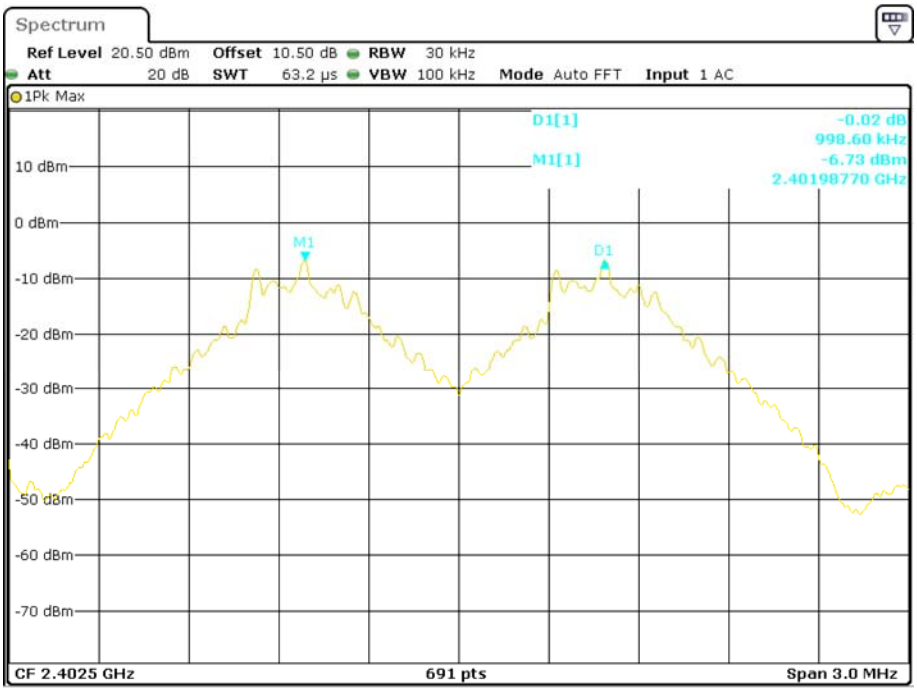
EUT operation mode: Transmitting

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

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	≥Limit (MHz)	Result
BDR (GFSK)	Low	2402	0.999	0.585	Pass
	Adjacent	2403			
	Middle	2441	1.003	0.570	Pass
	Adjacent	2442			
	High	2480	1.003	0.582	Pass
	Adjacent	2479			
EDR (π/4-DQPSK)	Low	2402	0.999	0.814	Pass
	Adjacent	2403			
	Middle	2441	0.999	0.813	Pass
	Adjacent	2442			
	High	2480	1.003	0.813	Pass
	Adjacent	2479			

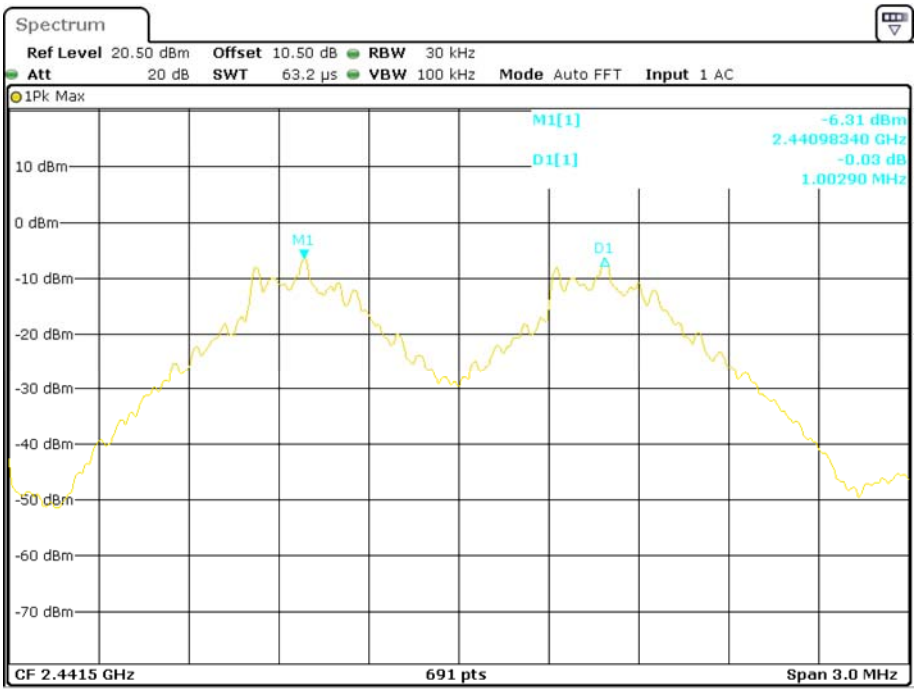
Note: Limit = 20 dB bandwidth *2/3

BDR (GFSK): Low Channel



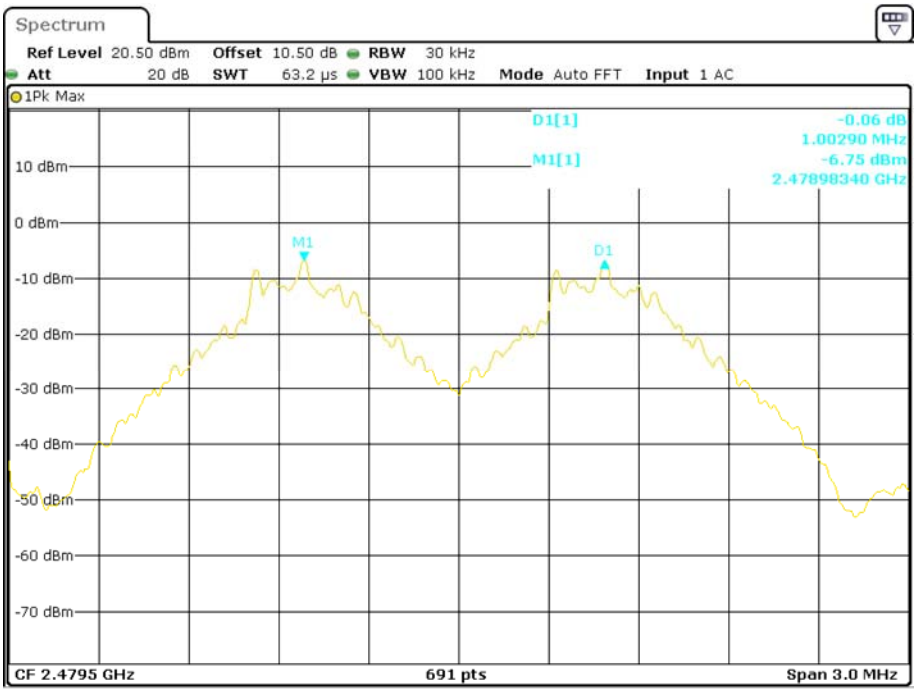
Date: 8.JAN.2018 19:36:15

BDR (GFSK): Middle Channel



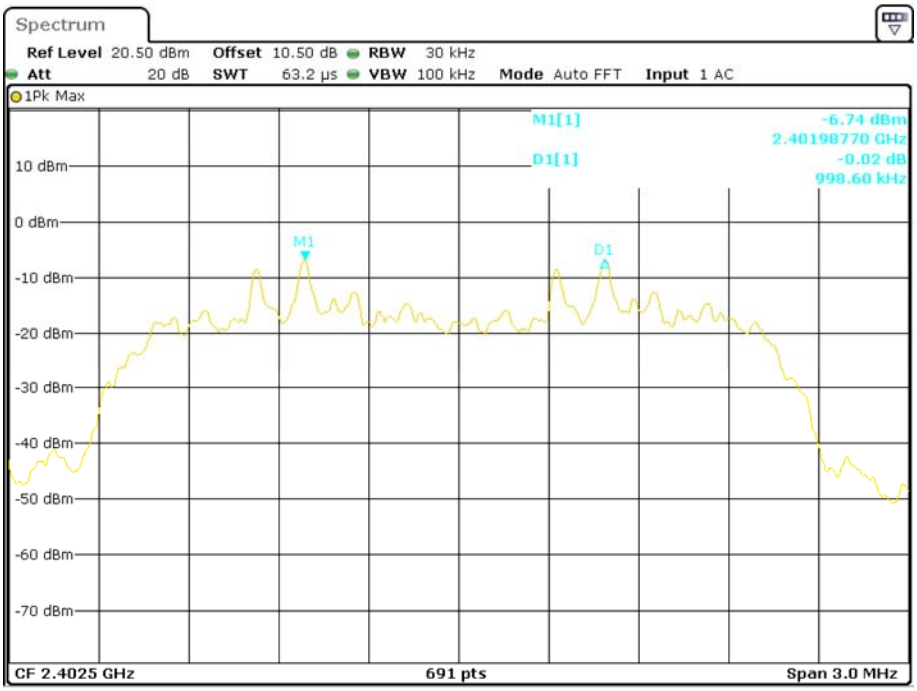
Date: 8.JAN.2018 19:38:07

BDR (GFSK): High Channel



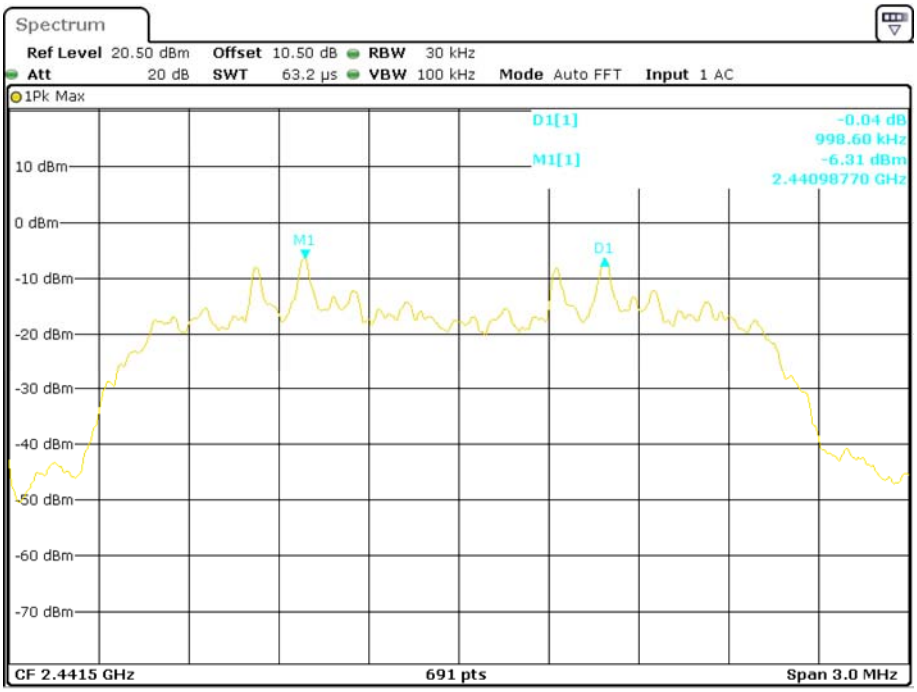
Date: 8.JAN.2018 19:39:18

EDR (π/4-DQPSK): Low Channel



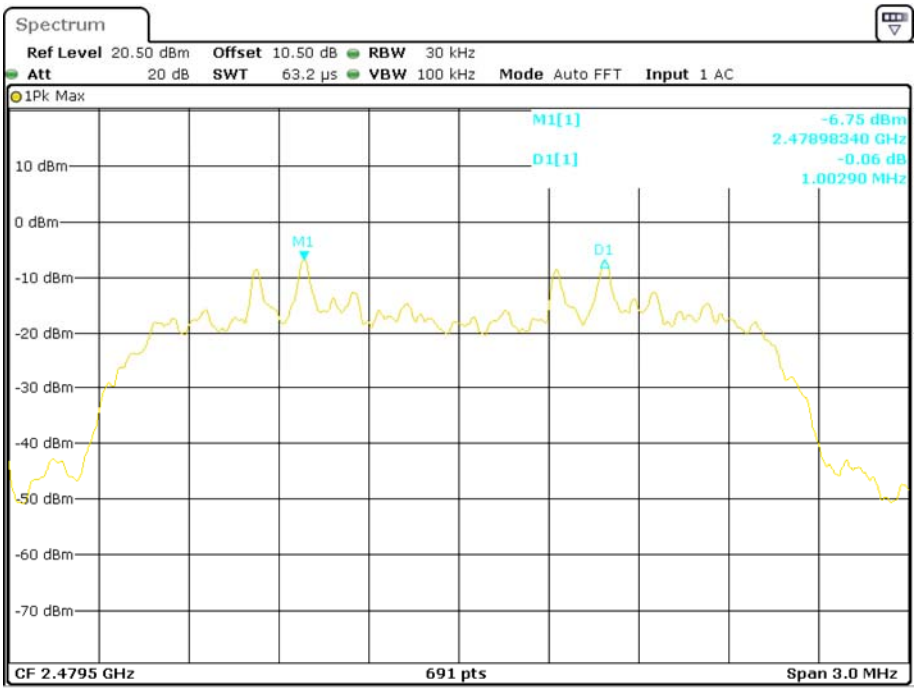
Date: 8.JAN.2018 19:42:23

EDR (π/4-DQPSK): Middle Channel



Date: 8.JAN.2018 19:41:16

EDR (π/4-DQPSK): High Channel



Date: 8.JAN.2018 19:40:12

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

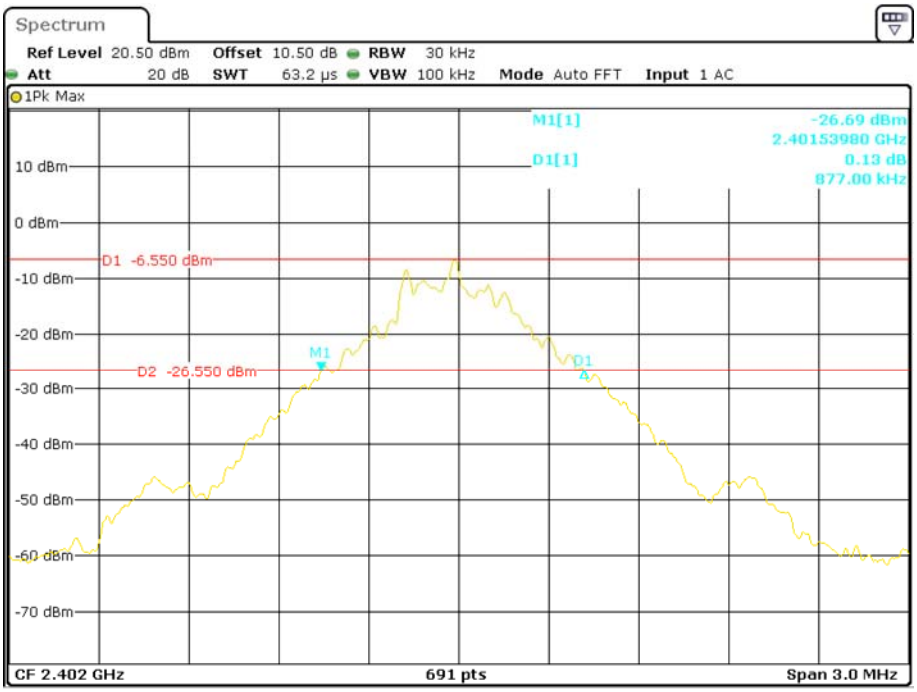
The testing was performed by Tracy Hu on 2018-01-08.

EUT operation mode: Transmitting

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

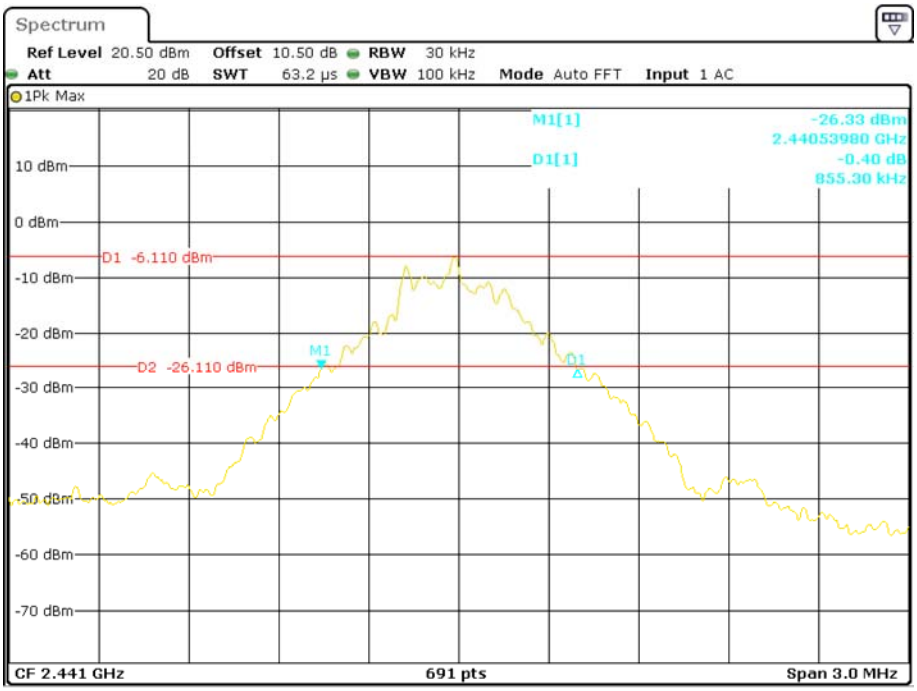
Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.877
	Middle	2441	0.855
	High	2480	0.873
EDR (π/4-DQPSK)	Low	2402	1.221
	Middle	2441	1.220
	High	2480	1.220

BDR (GFSK): Low Channel



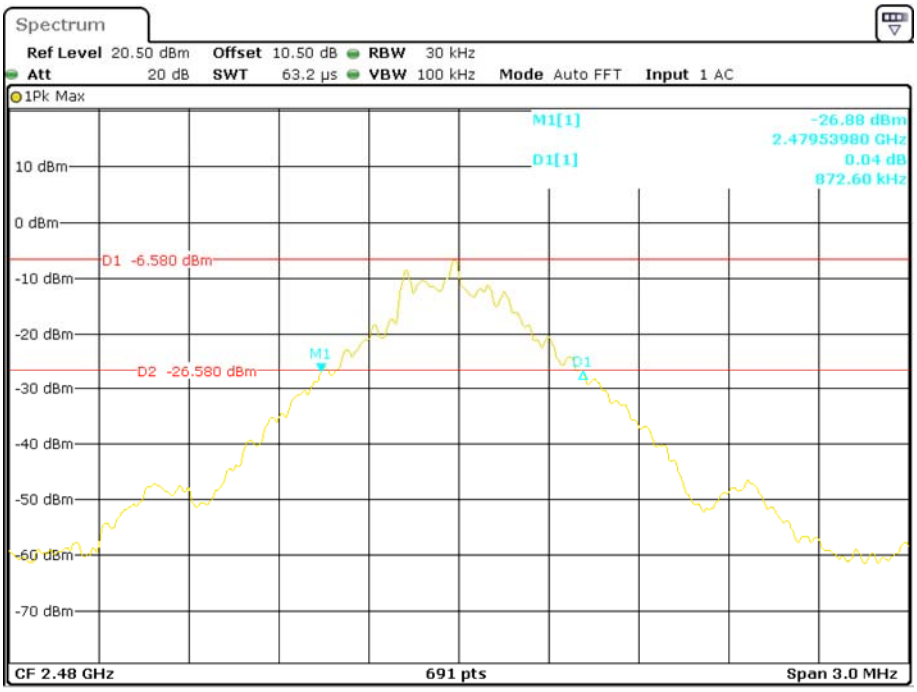
Date: 8.JAN.2018 19:57:08

BDR (GFSK): Middle Channel



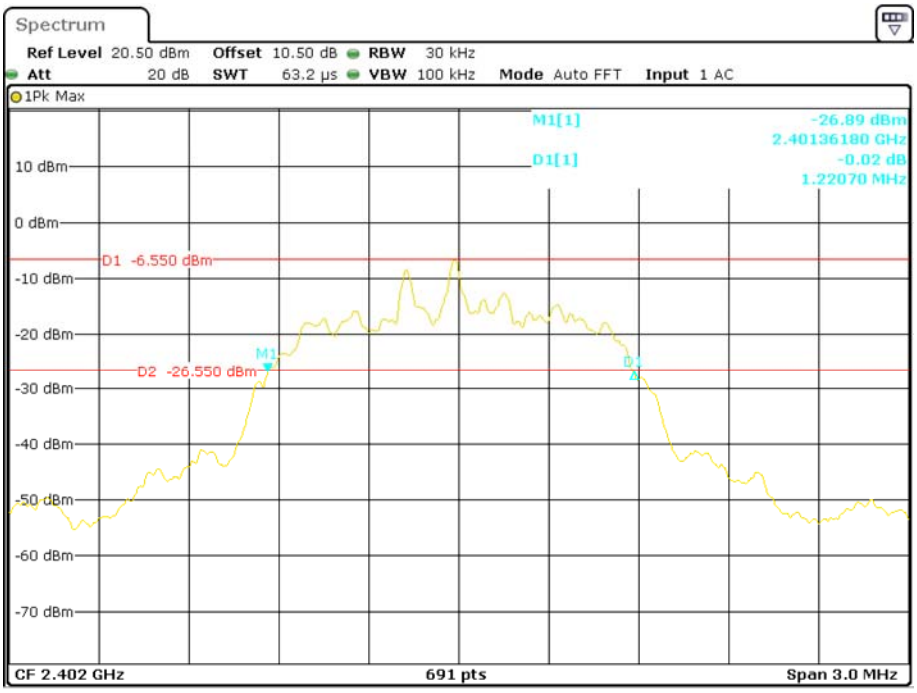
Date: 8.JAN.2018 19:54:03

BDR (GFSK): High Channel



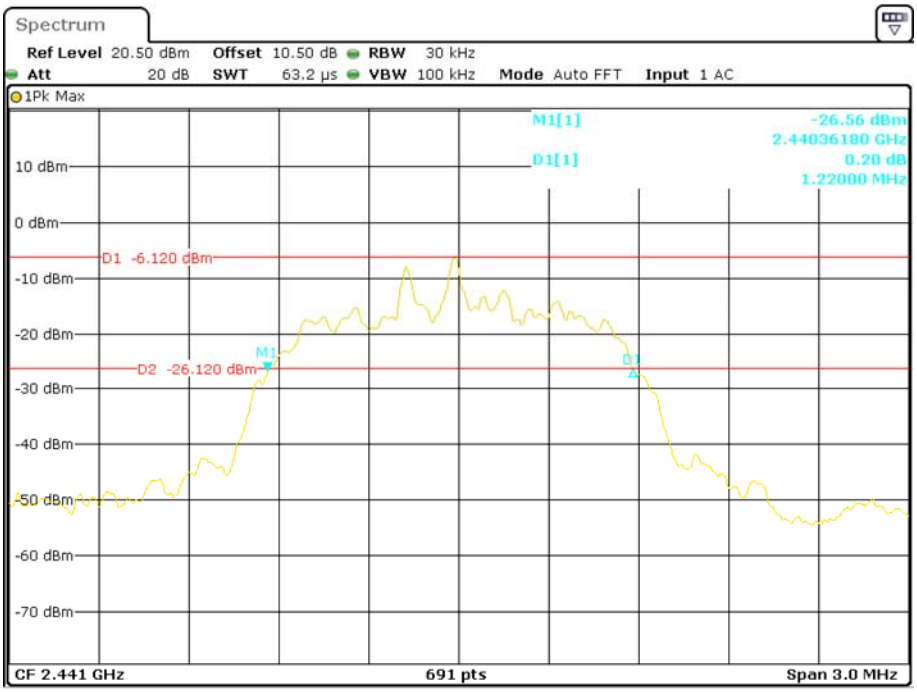
Date: 8.JAN.2018 19:51:12

EDR (π/4-DQPSK): Low Channel



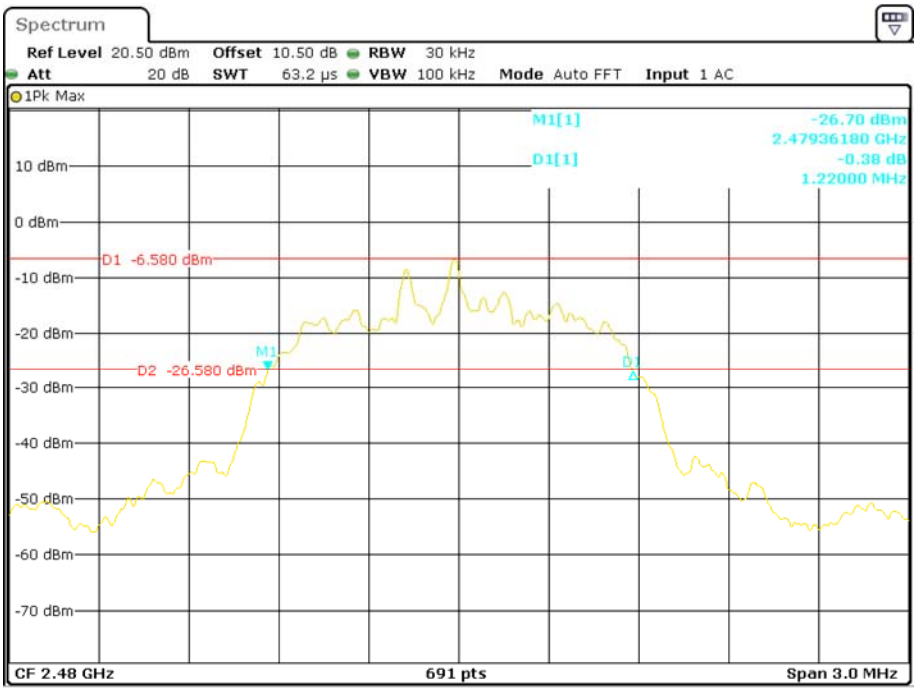
Date: 8.JAN.2018 19:44:43

EDR (π/4-DQPSK): Middle Channel



Date: 8.JAN.2018 19:47:23

EDR (π/4-DQPSK): High Channel



Date: 8.JAN.2018 19:49:24

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 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

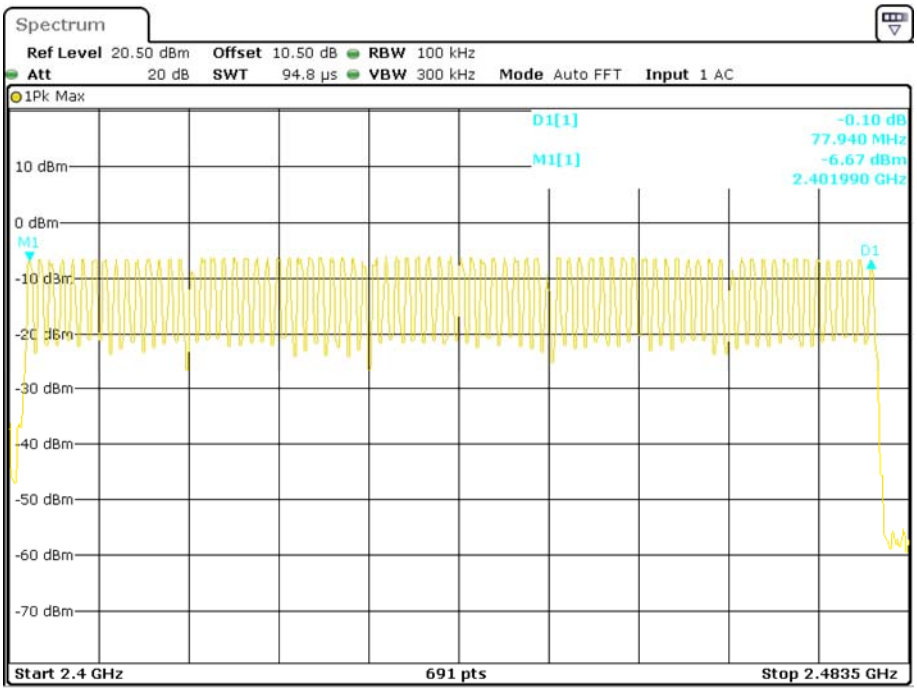
The testing was performed by Tracy Hu on 2018-01-08.

EUT operation mode: Transmitting

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

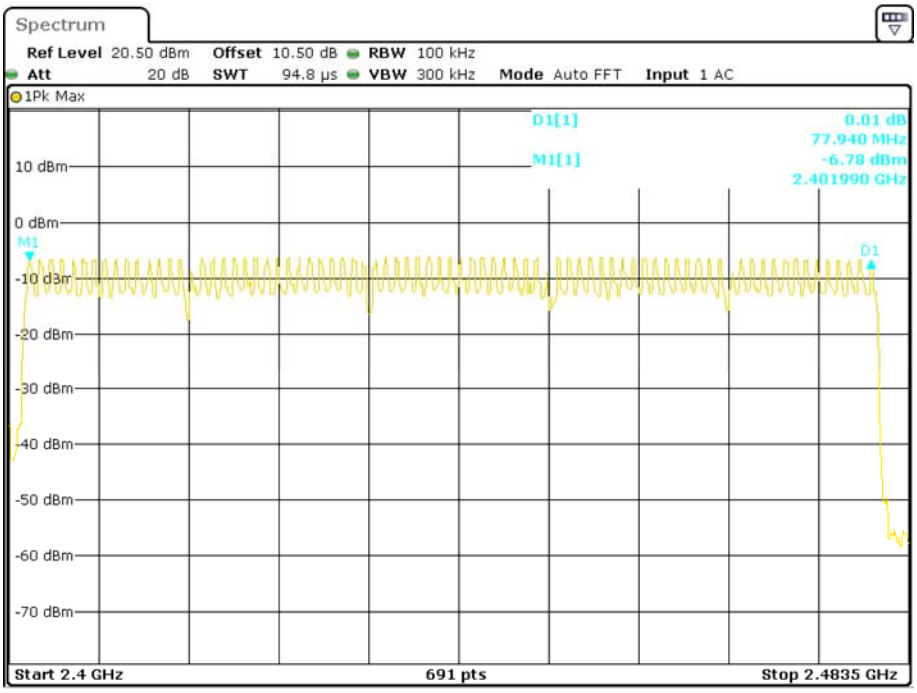
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR (GFSK)	2400-2483.5	79	≥15
EDR (π/4-DQPSK)	2400-2483.5	79	≥15

BDR (GFSK): Number of Hopping Channels



Date: 8.JAN.2018 20:47:34

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



Date: 8.JAN.2018 20:45:16

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

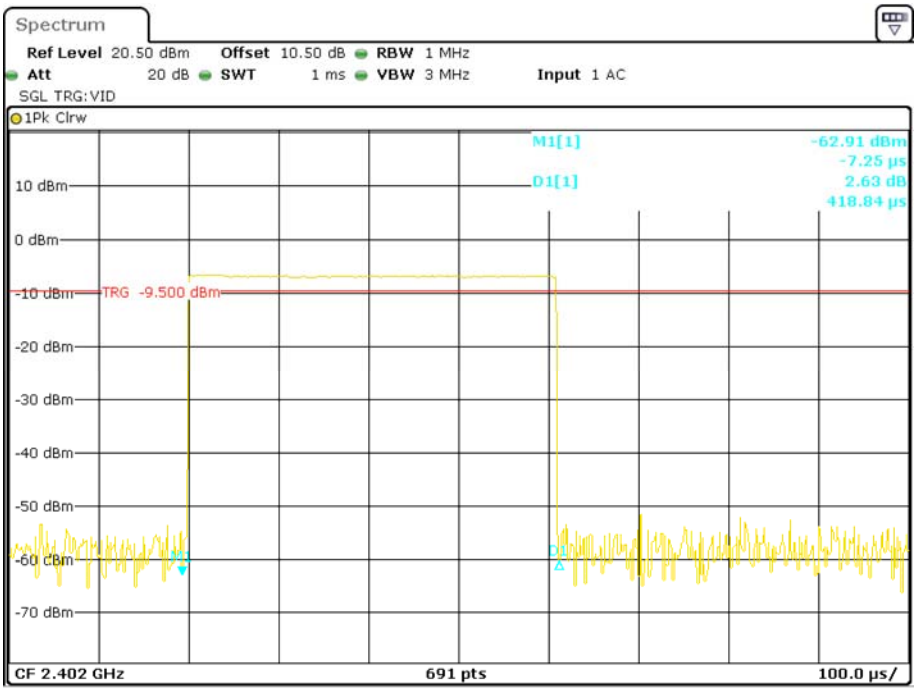
The testing was performed by Tracy Hu on 2018-01-08.

EUT operation mode: Transmitting

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

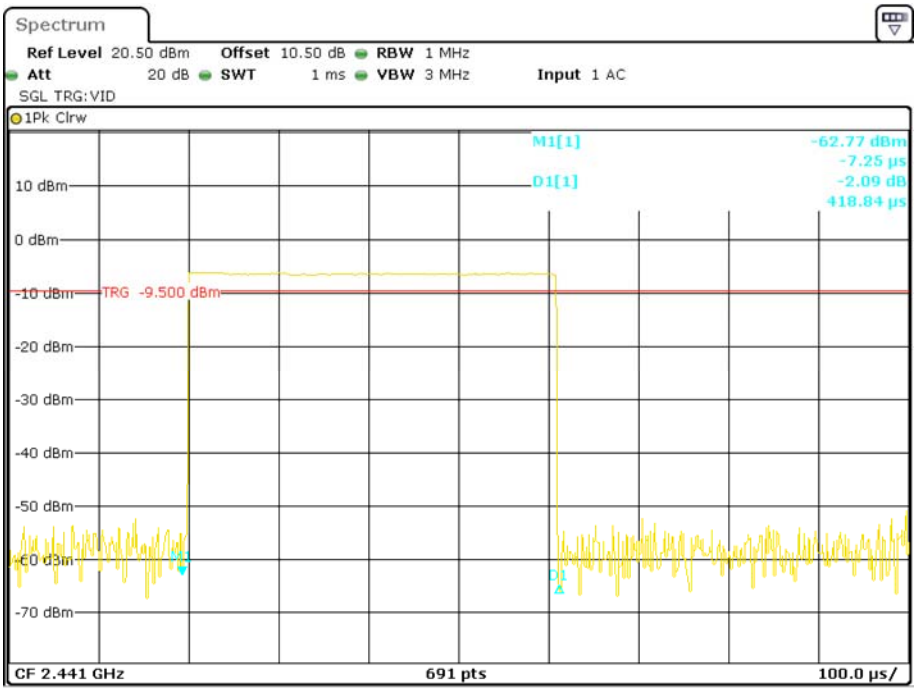
Mode		Channel	Pulse Width (ms)	Dwell Time (S)	Limit (S)	Result
BDR (GFSK)	DH 1	Low	0.419	0.134	0.4	Pass
		Middle	0.419	0.134	0.4	Pass
		High	0.419	0.134	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH 3	Low	1.678	0.268	0.4	Pass
		Middle	1.678	0.268	0.4	Pass
		High	1.678	0.268	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH 5	Low	2.938	0.313	0.4	Pass
		Middle	2.938	0.313	0.4	Pass
		High	2.938	0.313	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (π/4-DQPSK)	2DH 1	Low	0.426	0.136	0.4	Pass
		Middle	0.426	0.136	0.4	Pass
		High	0.426	0.136	0.4	Pass
		Note: 2DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	2DH 3	Low	1.691	0.271	0.4	Pass
		Middle	1.691	0.271	0.4	Pass
		High	1.691	0.271	0.4	Pass
		Note: 2DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	2DH 5	Low	2.967	0.316	0.4	Pass
		Middle	2.967	0.316	0.4	Pass
		High	2.967	0.316	0.4	Pass
		Note:2DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

BDR (GFSK):
Pulse time, Low Channel, DH1



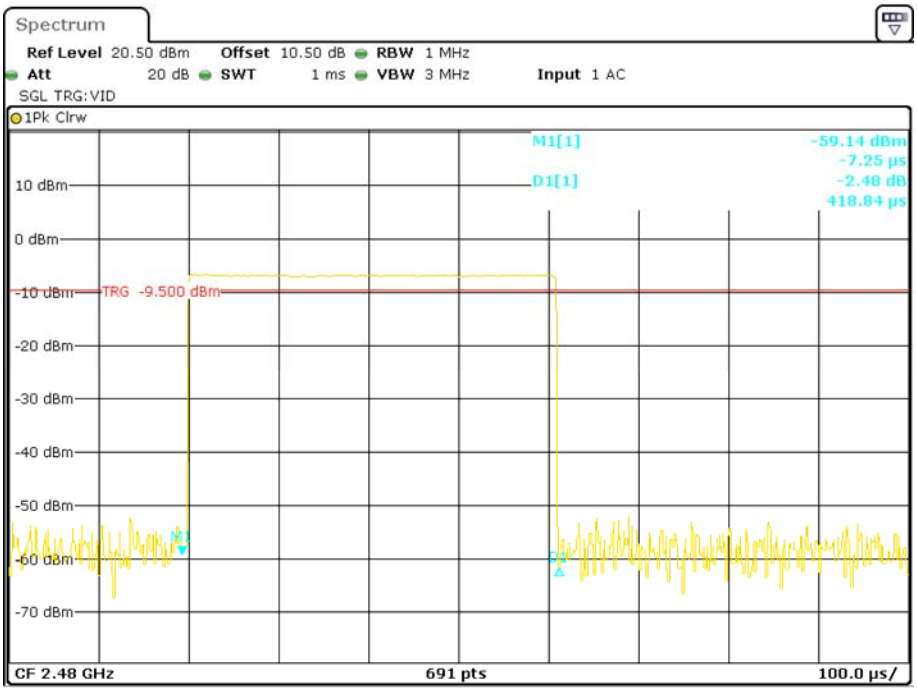
Date: 8.JAN.2018 20:50:12

Pulse time, Middle Channel, DH1



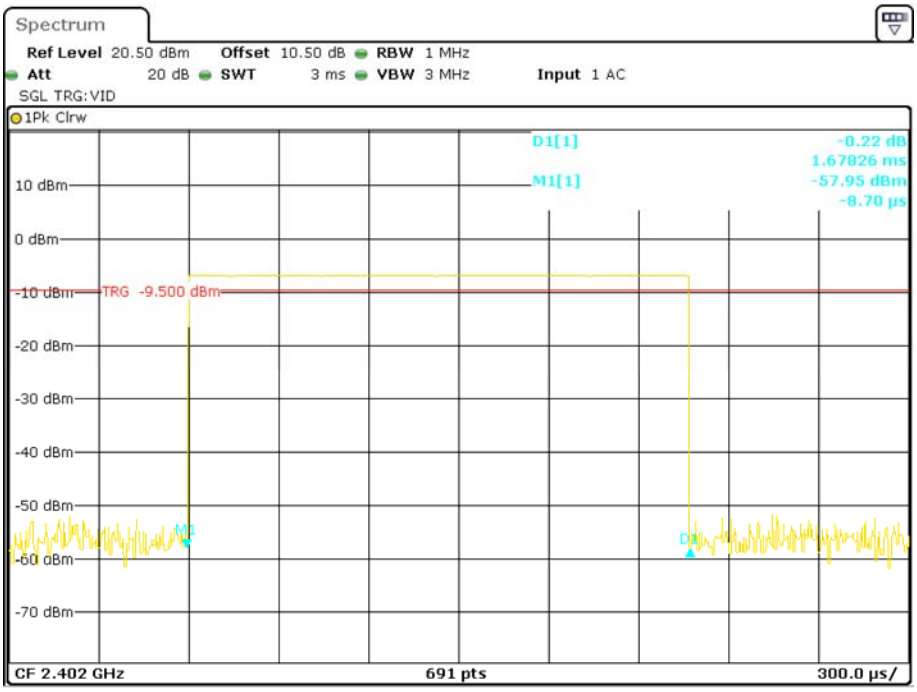
Date: 8.JAN.2018 20:50:44

Pulse time, High Channel, DH1



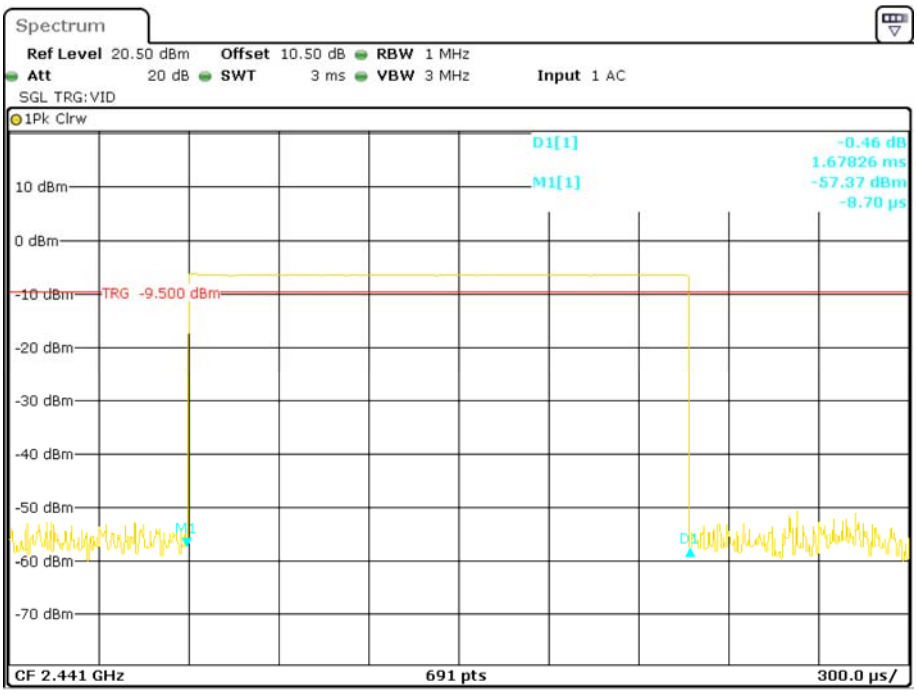
Date: 8.JAN.2018 20:51:19

Pulse time, Low Channel, DH3



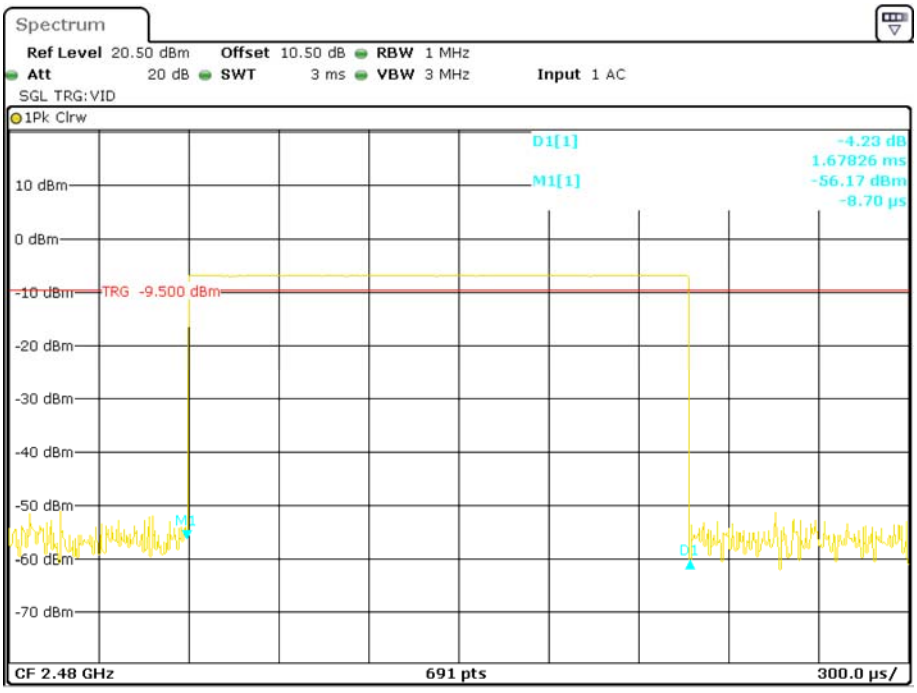
Date: 8.JAN.2018 20:54:39

Pulse time, Middle Channel, DH3



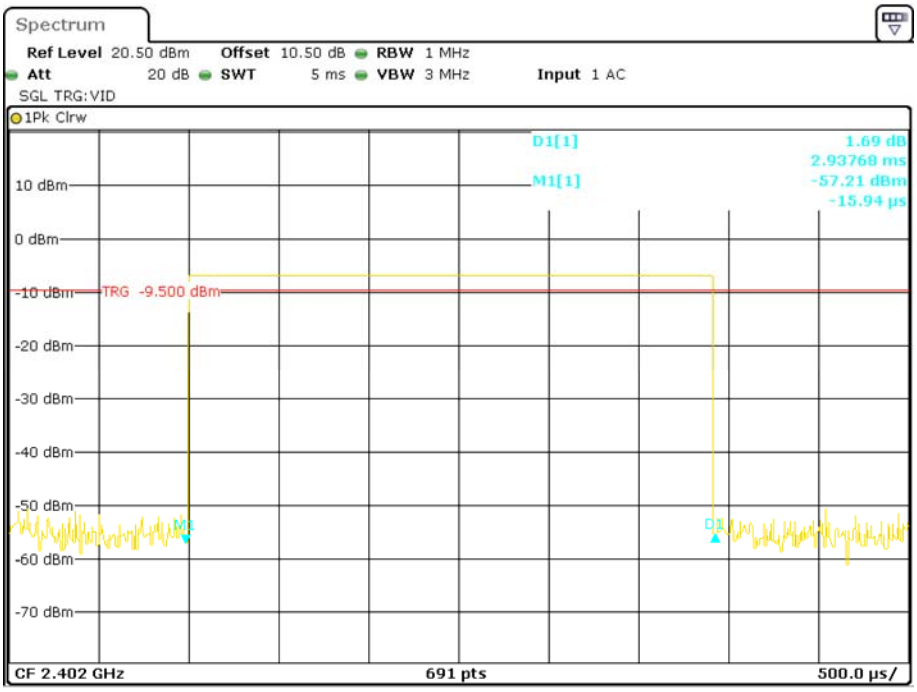
Date: 8.JAN.2018 20:55:16

Pulse time, High Channel, DH3



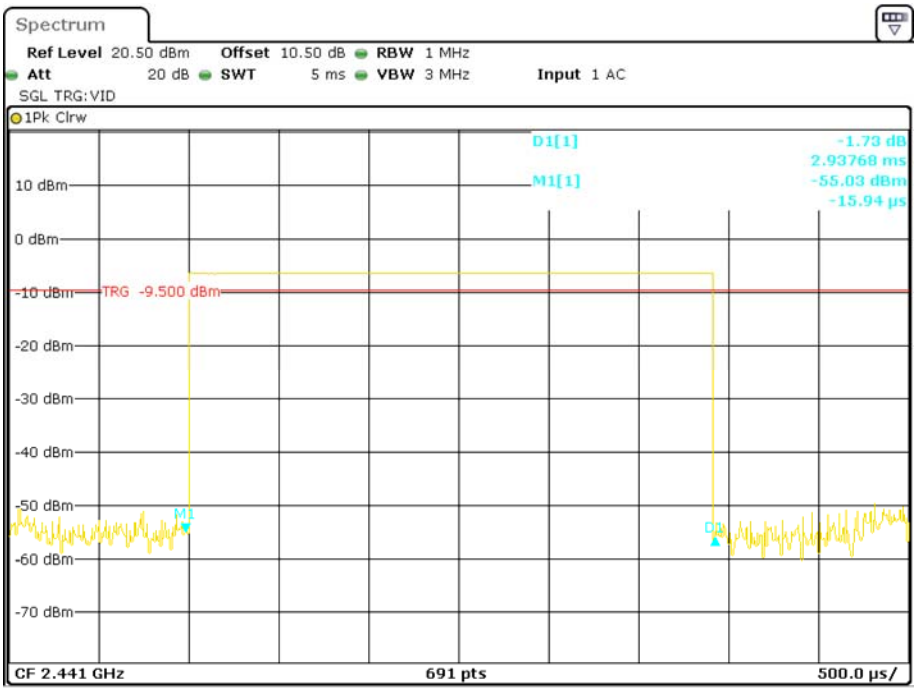
Date: 8.JAN.2018 20:55:42

Pulse time, Low Channel, DH5



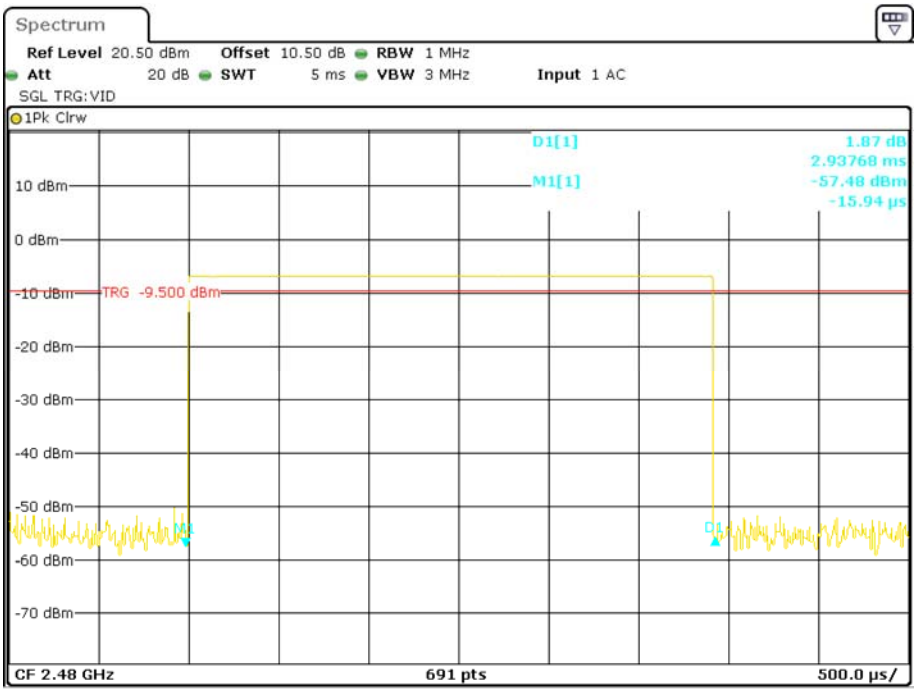
Date: 8.JAN.2018 20:59:03

Pulse time, Middle Channel, DH5



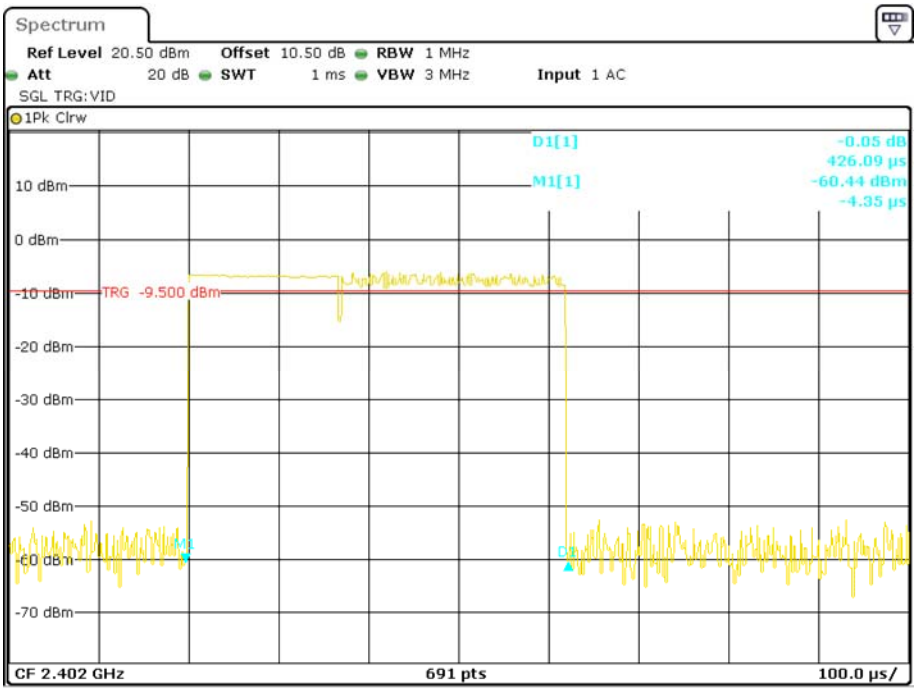
Date: 8.JAN.2018 20:59:43

Pulse time, High Channel, DH5



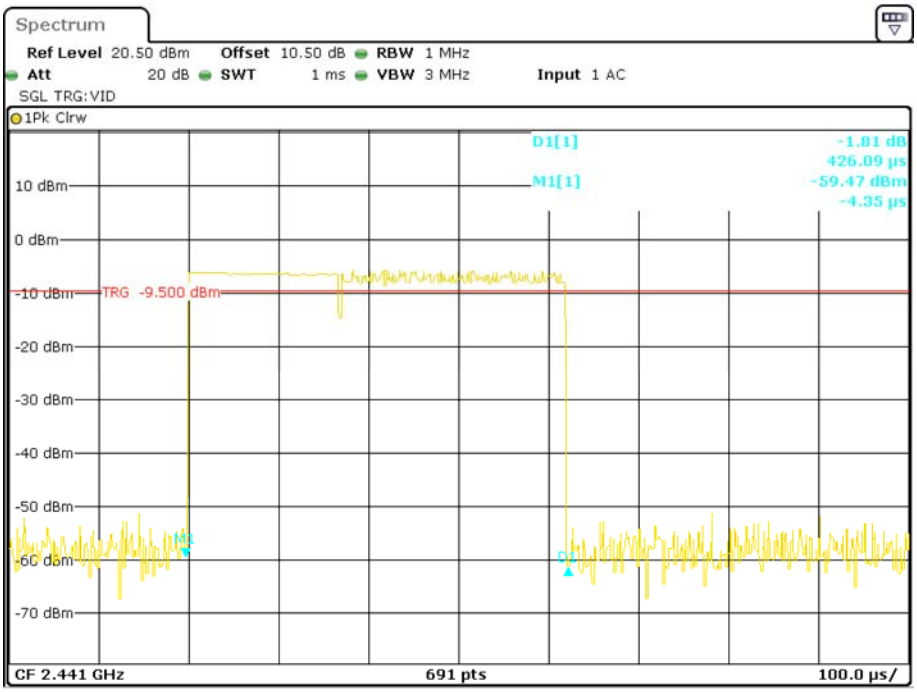
Date: 8.JAN.2018 21:00:19

EDR (π/4-DQPSK):
Pulse time, Low Channel, 2DH1

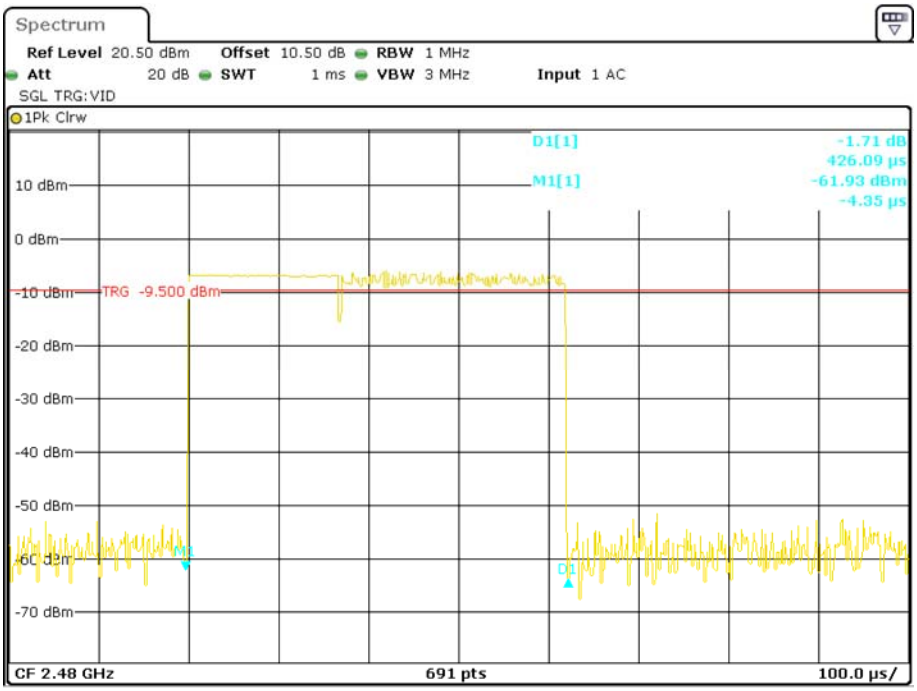


Date: 8.JAN.2018 20:53:27

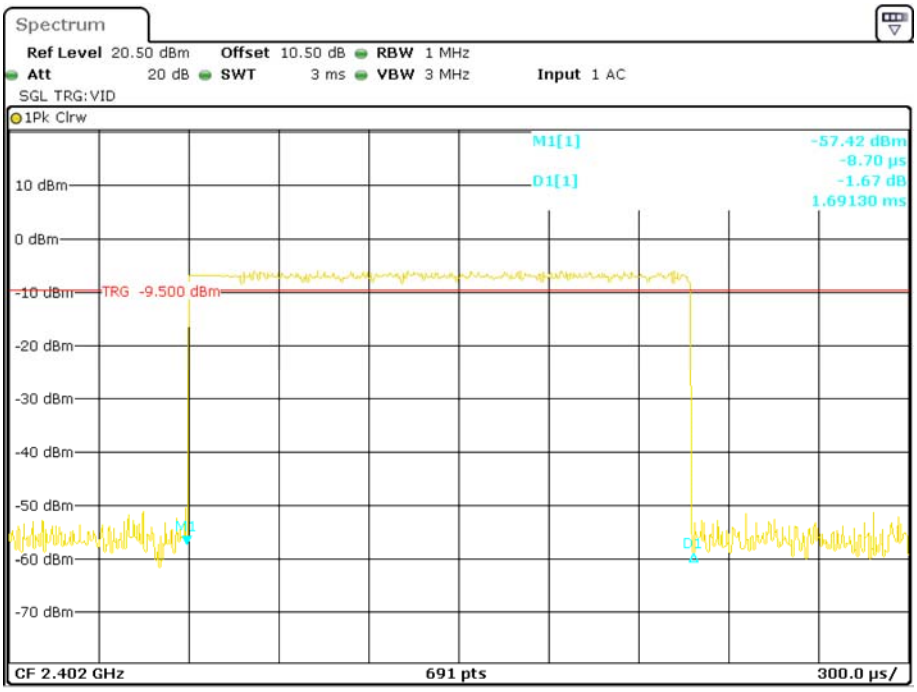
Pulse time, Middle Channel, 2DH1



Pulse time, High Channel, 2DH1

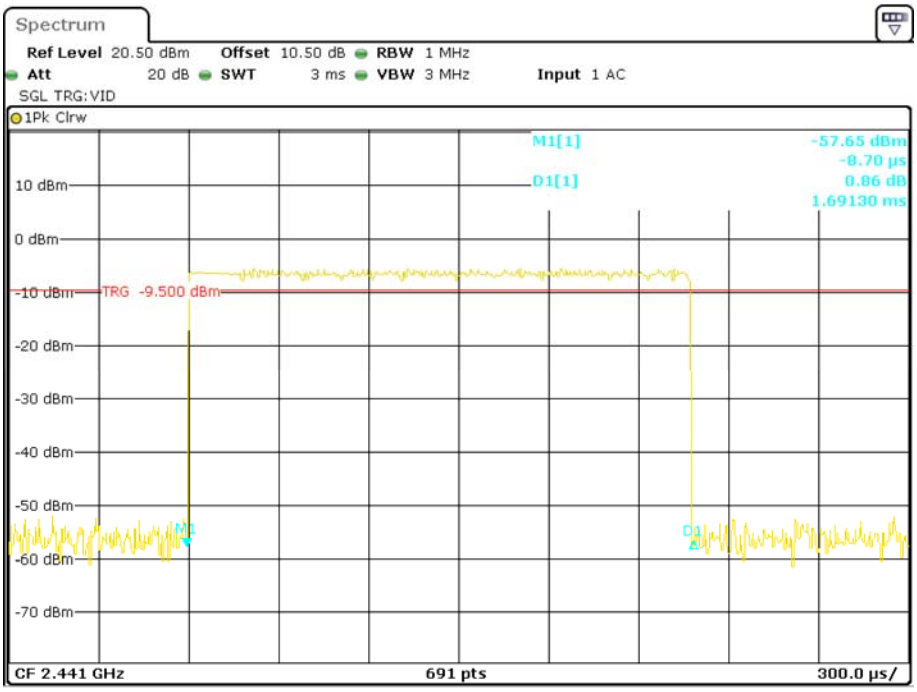


Pulse time, Low Channel, 2DH3



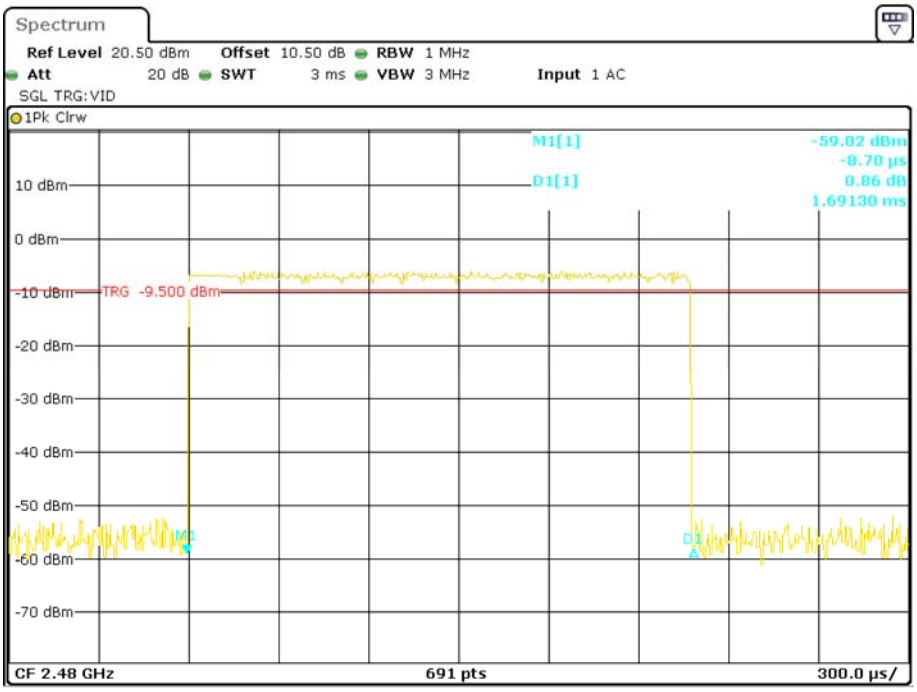
Date: 8.JAN.2018 20:57:46

Pulse time, Middle Channel, 2DH3



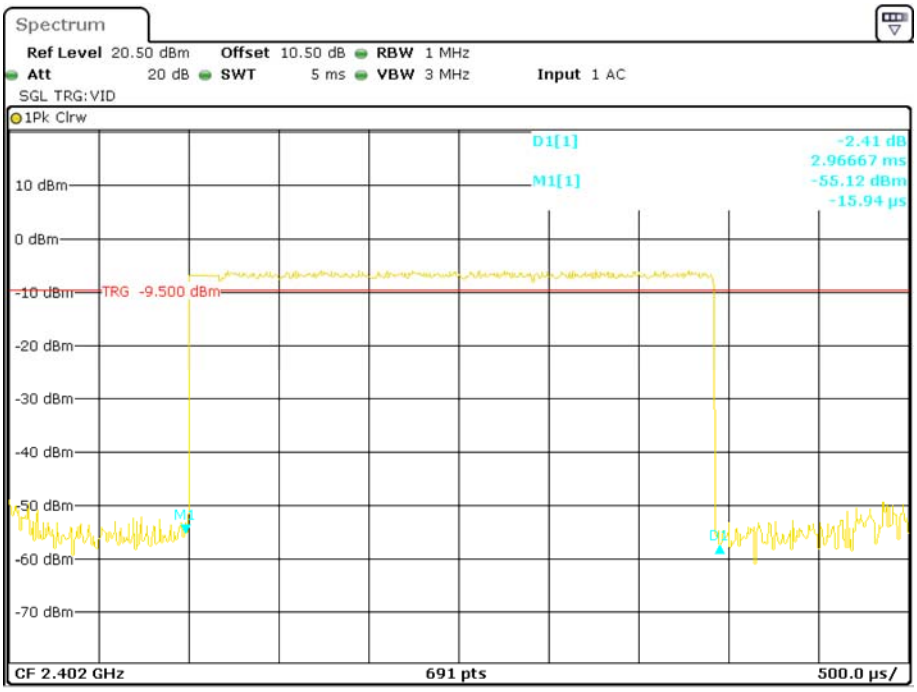
Date: 8.JAN.2018 20:57:05

Pulse time, High Channel, 2DH3



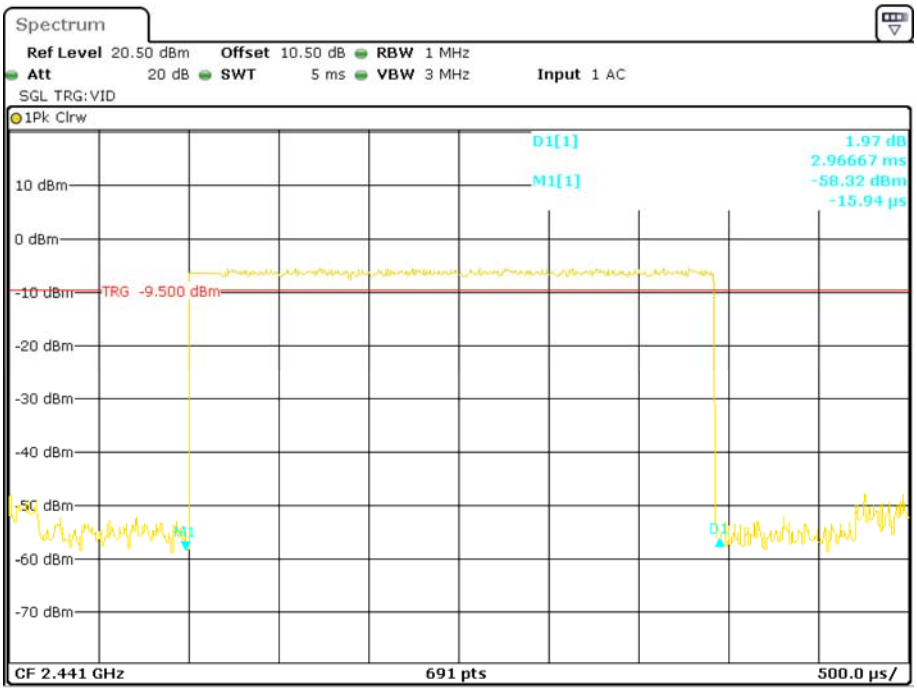
Date: 8.JAN.2018 20:56:34

Pulse time, Low Channel, 2DH5



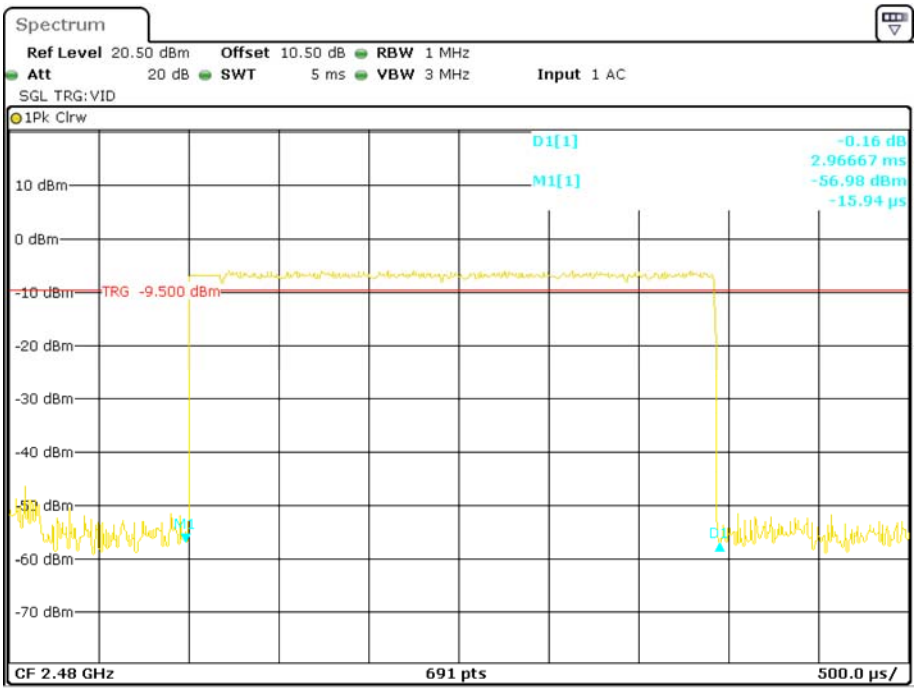
Date: 8.JAN.2018 21:01:56

Pulse time, Middle Channel, 2DH5



Date: 8.JAN.2018 21:01:26

Pulse time, High Channel, 2DH5



Date: 8.JAN.2018 21:00:56

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

Applicable Standard

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

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

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Tracy Hu on 2018-01-09.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table.

Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power (mW)	Limit (mW)
BDR (GFSK)	Low	2402	-6.59	0.219	125
	Middle	2441	-6.15	0.243	125
	High	2480	-6.56	0.221	125
EDR (π/4-DQPSK)	Low	2402	-5.42	0.287	125
	Middle	2441	-5.00	0.316	125
	High	2480	-5.49	0.282	125

Note: The data above was tested in conducted mode.

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

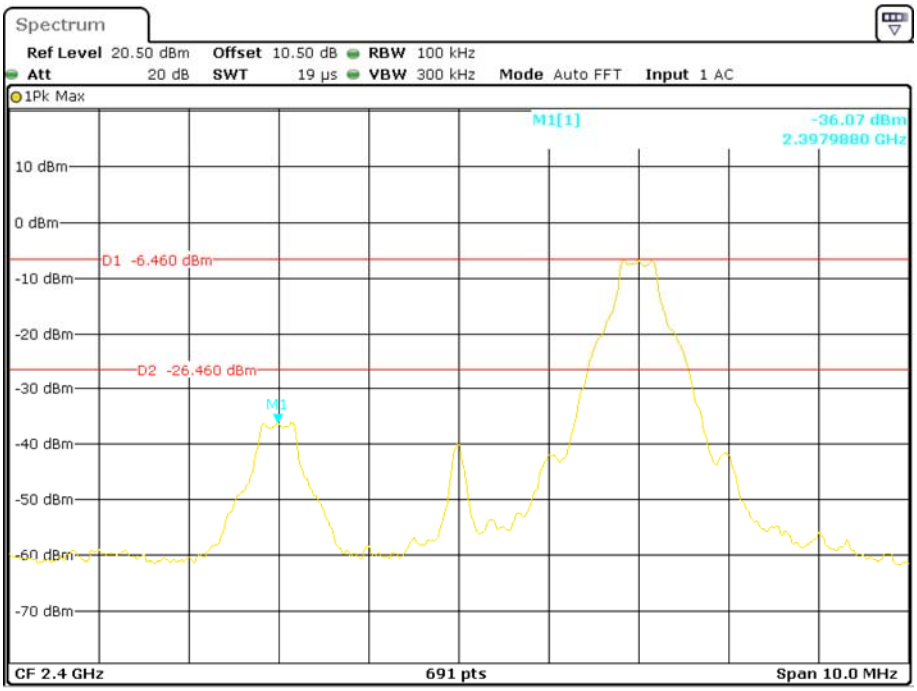
Temperature:	25 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Tracy Hu on 2018-01-08.

EUT operation mode: Transmitting

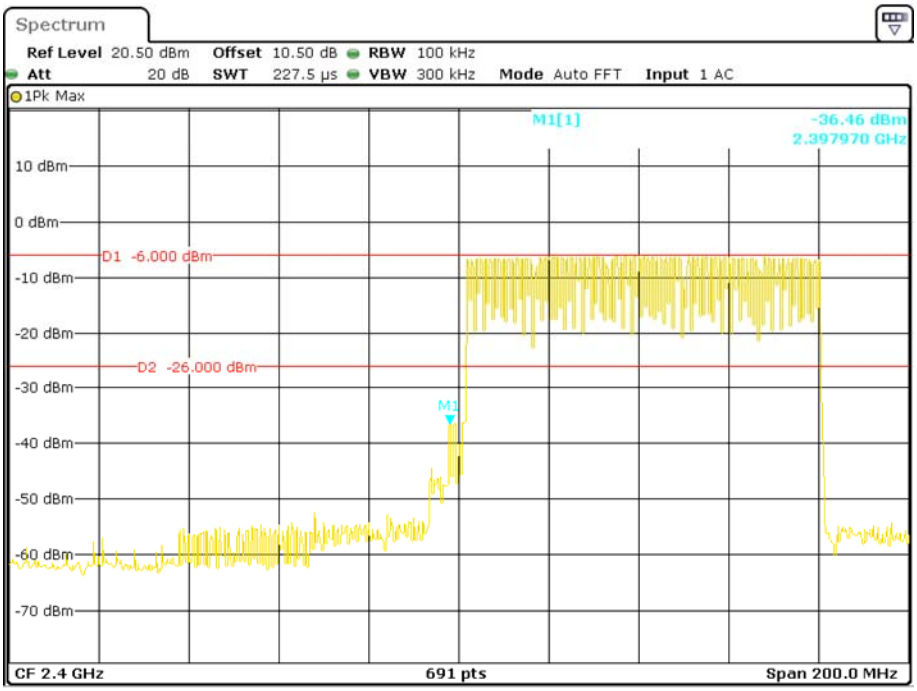
Test Result: Compliance. Please refer to following plots.

BDR (GFSK): Band Edge-Left Side
Single



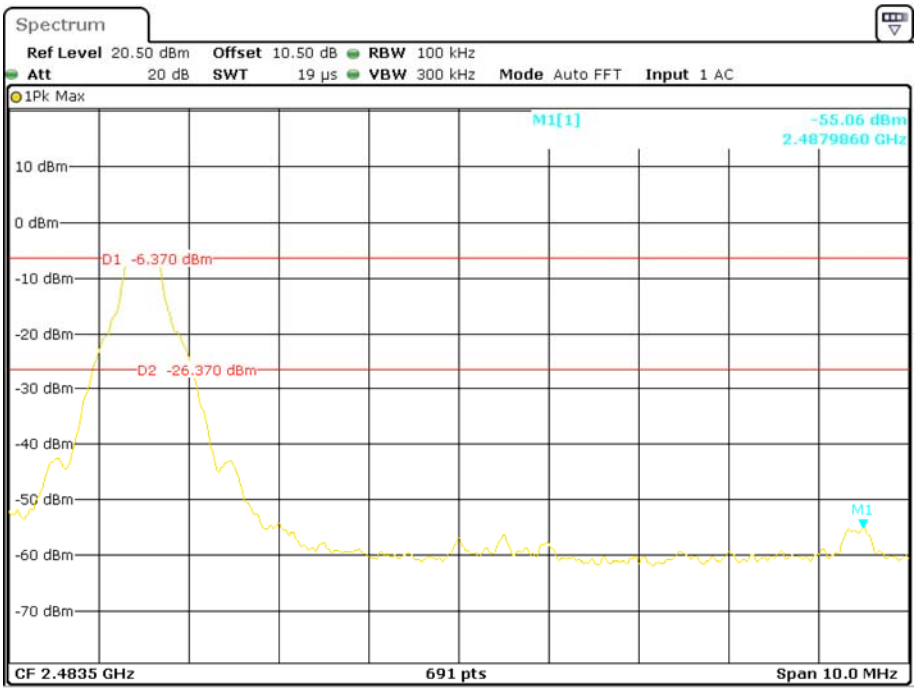
Date: 8.JAN.2018 20:25:48

Hopping



Date: 8.JAN.2018 20:35:35

BDR (GFSK): Band Edge-Right Side
Single



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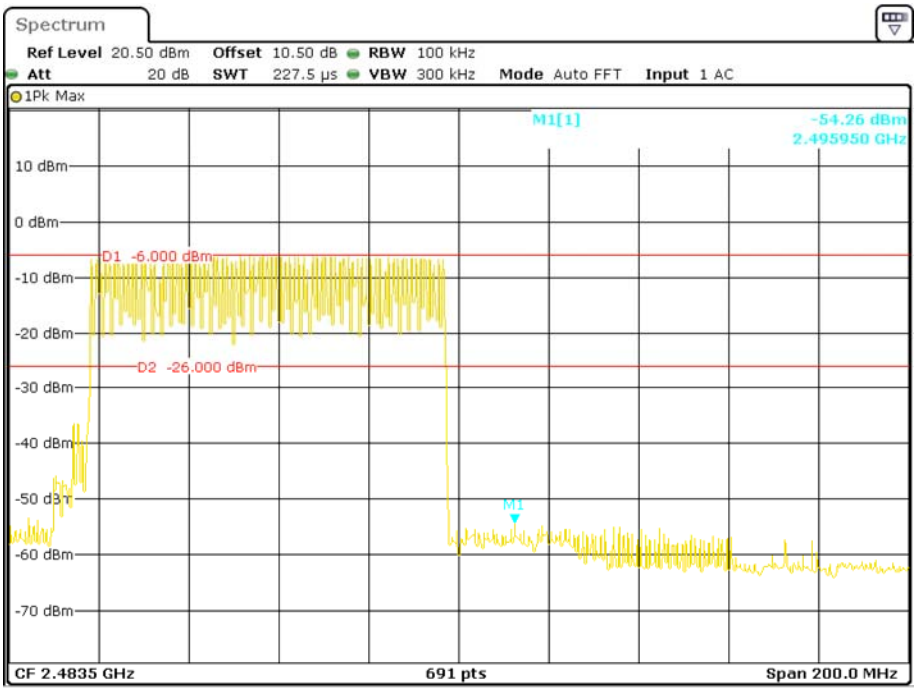
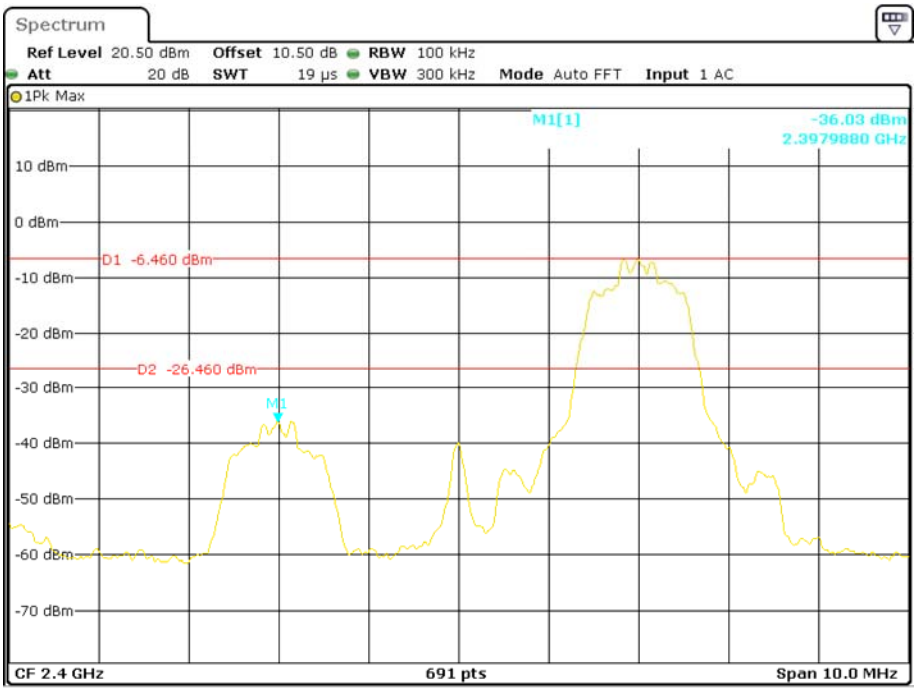


Date: 8.JAN.2018 20:39:42

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



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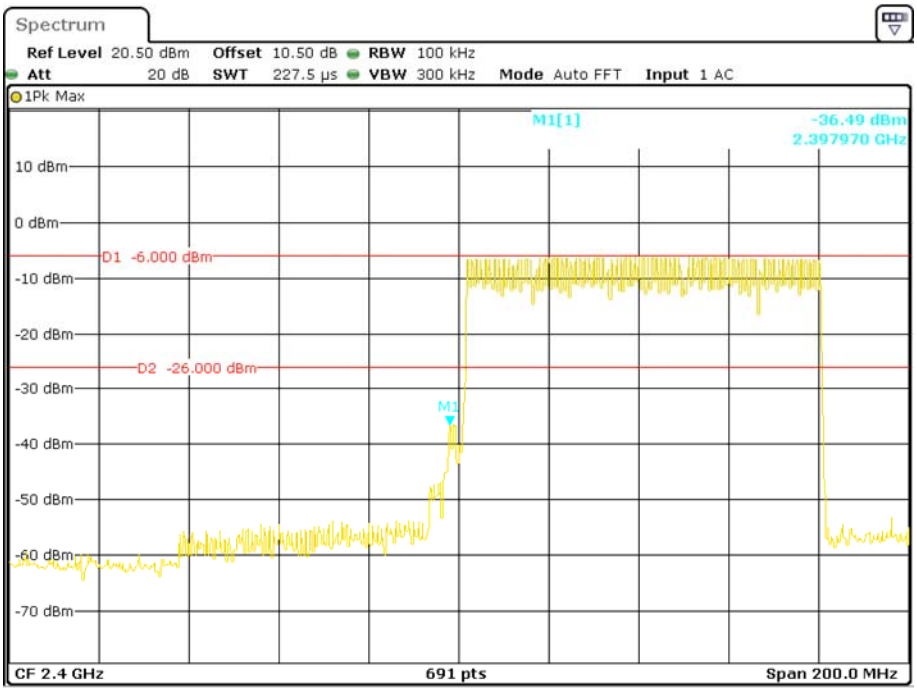

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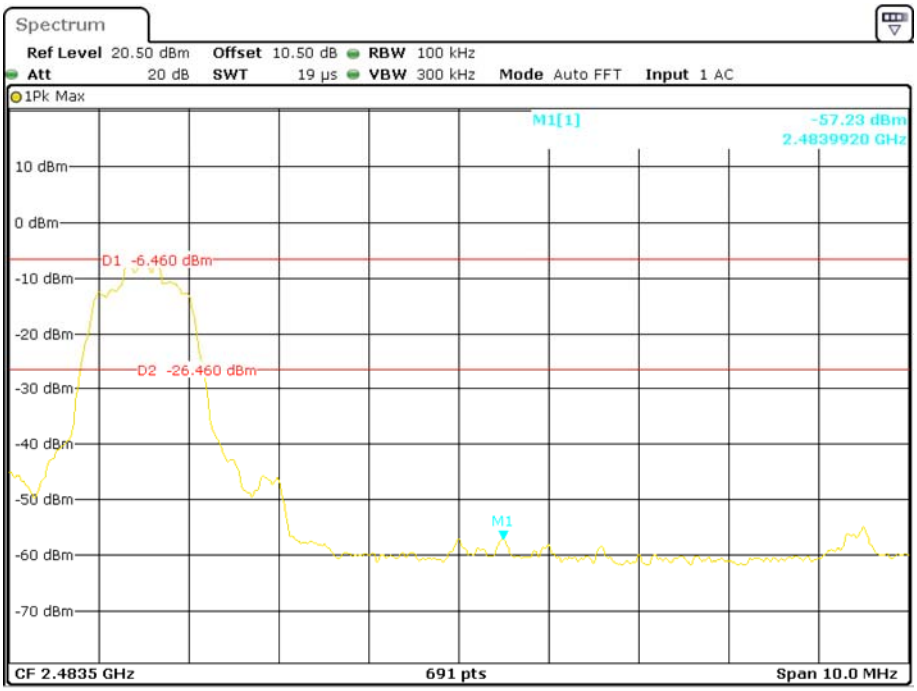
EDR (π/4-DQPSK): Band Edge-Right Side
Single



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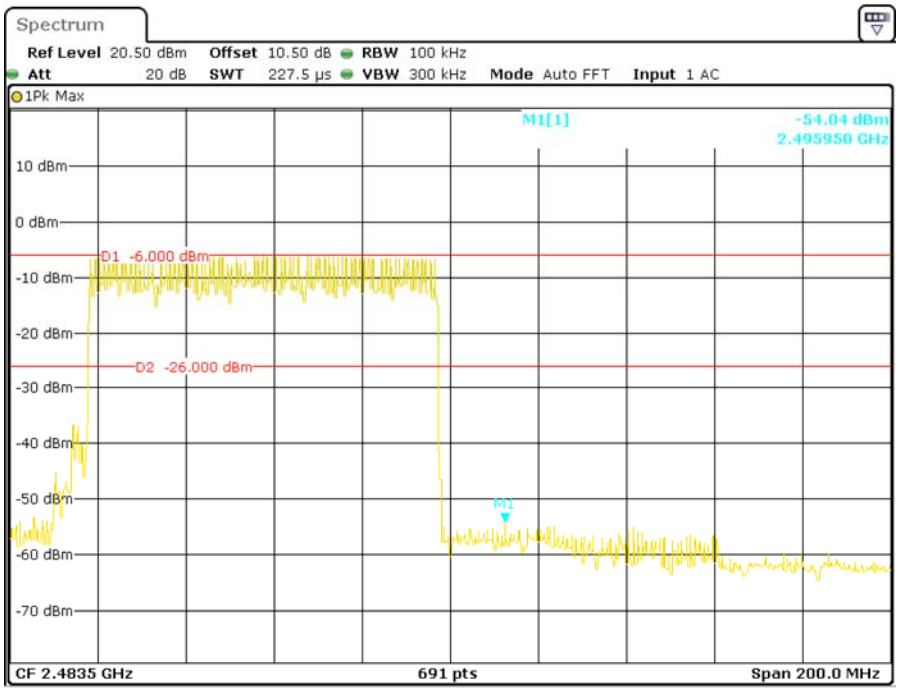
Hopping



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