FCC Test Report

Report No.:	RF160831C13-2
FCC ID:	HFS-M99
Test Model:	QTAXU1
Received Date:	Aug. 31, 2016
Test Date:	Sep. 09, 2016 ~ Sep. 10, 2016
Issued Date:	Sep. 21, 2016
Applicant:	Quanta Computer Inc.
Address:	No.188, Wenhua 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C)
Test Location:	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan, R.O.C.

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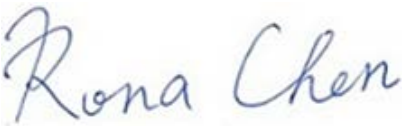
Release Control Record

Issue No.	Description	Date Issued
RF160831C13-2	Original Release	Sep. 21, 2016

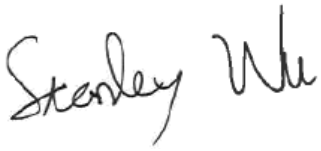
1 Certificate of Conformity

Product:	1.39 inch Smart Watch
Test Model:	QTAXU1
Sample Status:	Engineering Sample
Applicant:	Quanta Computer Inc.
Test Date:	Sep. 09, 2016 ~ Sep. 10, 2016
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by :  , **Date:** Sep. 21, 2016

Rona Chen / Specialist

Approved by :  , **Date:** Sep. 21, 2016

Stanley Wu / Assistant Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	**Test Item**	**Result**	**Remarks**
15.207	AC Power Conducted Emission	N/A	Without AC power port of the EUT EUT consumes DC power
15.247(a)(1)(iii)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -14.08 dB at 2483.52 MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

NOTE: If The Frequency Hopping System operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	1.39 inch Smart Watch
Test Model	QTAXU1
Status of EUT	Engineering Sample
Power Supply Rating	3.85 Vdc (Li-ion battery)
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Output Power	13.521 mW
Antenna Type	Monopole antenna with 1.02 dBi gain
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. The EUT contains following accessory devices.

Product	Brand	Model	Description
Battery	WELLTECH ENERGY INC.	EXGU111K2003	3.85 Vdc, 450 mAh
Wireless Charger	N/A	QXU1	--
LTE Chip	Qualcomm	WTR2965	--
WLAN Chip	Qualcomm	WCN3620	--
NFC Chip	NXP	PN5482D2EV	--

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 Description of Test Modes

79 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	-	√	-

Where **RE≥1G:** Radiated Emission above 1 GHz **RE<1G:** Radiated Emission below 1 GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

NOTE:
1. For Radiated emission test, pre-tested GFSK, π/4-DQPSK, 8DPSK modulation type and found 8DPSK was the worse, therefore chosen for the final test and presented in the test report.
2. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.
3. "-" means no effect.

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

Radiated Emission Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	78	FHSS	8DPSK	DH5

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	π/4-DQPSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	3.85 Vdc	Getaz Yang
RE<1G	25 deg. C, 65 % RH	3.85 Vdc	Getaz Yang
APCM	25 deg. C, 65 % RH	3.85 Vdc	Taylor Liu

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

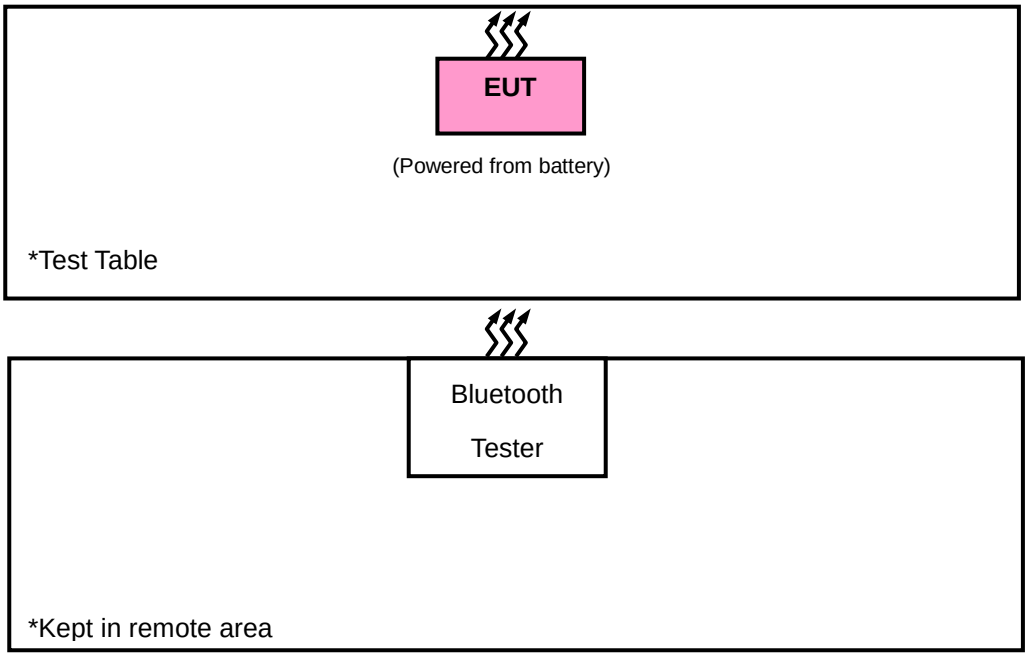
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Bluetooth Tester	R&S	CBT	100946	N/A

No.	Signal Cable Description Of The Above Support Units
1.	N/A

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items 1 acted as communication partners to transfer data.

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
FCC Public Notice DA 00-705
ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

NOTE: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Jan. 21, 2015	Jan. 21, 2016
Spectrum Analyzer Agilent	N9010A	MY52220314	Oct. 23, 2015	Oct. 22, 2016
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 17, 2015	Dec. 16, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Jan. 07, 2016	Jan. 06, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Jan. 04, 2016	Jan. 03, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Jan. 08, 2016	Jan. 07, 2017
Loop Antenna	EM-6879	269	Aug. 11, 2016	Aug. 10, 2017
Preamplifier EMCI	EMC 012645	980115	Dec. 21, 2015	Dec. 20, 2016
Preamplifier EMCI	EMC 184045	980116	Dec. 21, 2015	Dec. 20, 2016
Preamplifier EMCI	EMC 330H	980112	Dec. 28, 2015	Dec. 27, 2016
Power Meter Anritsu	ML2495A	1232002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor Anritsu	MA2411B	1207325	Sep. 21, 2015	Sep. 20, 2016
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 12, 2015	Oct. 11, 2016
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 12, 2015	Oct. 11, 2016
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 12, 2015	Oct. 11, 2016
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower &Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The FCC Site Registration No. is 690701.
5. The IC Site Registration No. is IC7450F-10.

4.1.3 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

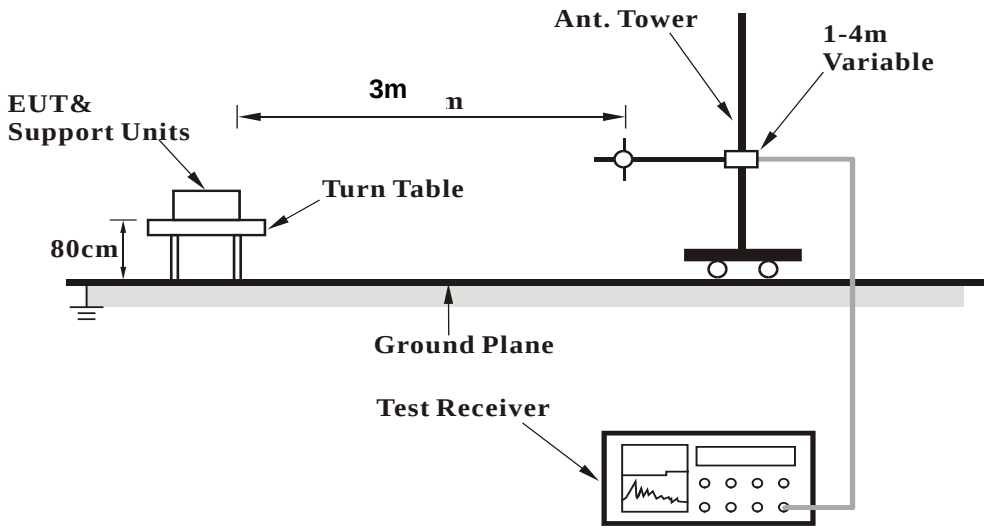
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 KHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

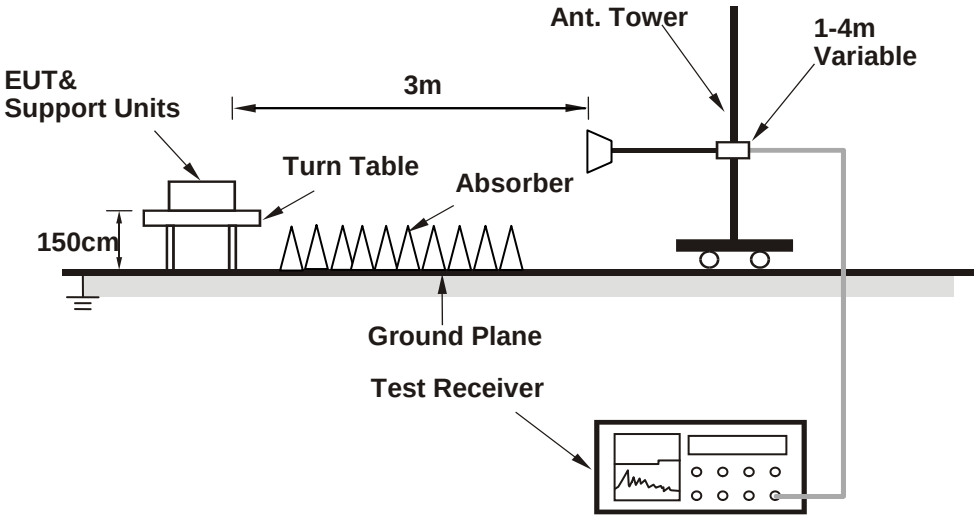
No deviation.

4.1.5 Test Set Up

<Frequency Range below 1 GHz>



<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

ABOVE 1 GHz DATA：

8DPSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Getaz Yang

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2354.1	47.79	54.42	74	-26.21	26.81	4.05	37.49	188	360	Peak
2389.56	35.86	42.37	54	-18.14	26.91	4.08	37.5	188	360	Average
2402	99.18	105.7			26.91	4.09	37.52	188	360	Average
2402	104.68	111.2			26.91	4.09	37.52	188	360	Peak
4804	32.02	47.36	54	-21.98	30.97	6.79	53.1	102	250	Average
4804	42.01	57.35	74	-31.99	30.97	6.79	53.1	102	250	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2360.31	47.19	53.82	74	-26.81	26.81	4.05	37.49	182	237	Peak
2389.02	35.85	42.36	54	-18.15	26.91	4.08	37.5	182	237	Average
2402	94.44	100.96			26.91	4.09	37.52	182	237	Average
2402	99.86	106.38			26.91	4.09	37.52	182	237	Peak
4804	32.54	47.88	54	-21.46	30.97	6.79	53.1	130	33	Average
4804	42.55	57.89	74	-31.45	30.97	6.79	53.1	130	33	Peak

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
   Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Getaz Yang

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2329.26	46.77	53.48	74	-27.23	26.72	4.04	37.47	186	360	Peak
2388.21	35.85	42.36	54	-18.15	26.91	4.08	37.5	186	360	Average
2441	98.78	104.99			27.06	4.12	37.39	186	360	Average
2441	104.34	110.55			27.06	4.12	37.39	186	360	Peak
2498.48	47.69	53.58	74	-26.31	27.2	4.16	37.25	186	360	Peak
2499.72	36.38	42.27	54	-17.62	27.2	4.16	37.25	186	360	Average
4882	33.71	48.85	54	-20.29	31.06	6.85	53.05	102	249	Average
4882	43.95	59.09	74	-30.05	31.06	6.85	53.05	102	249	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2361.84	47.5	54.13	74	-26.5	26.81	4.05	37.49	183	243	Peak
2389.11	35.86	42.37	54	-18.14	26.91	4.08	37.5	183	243	Average
2441	94.15	100.36			27.06	4.12	37.39	183	243	Average
2441	99.51	105.72			27.06	4.12	37.39	183	243	Peak
2484.12	47.56	53.58	74	-26.44	27.15	4.15	37.32	183	243	Peak
2500	36.41	42.3	54	-17.59	27.2	4.16	37.25	183	243	Average
4882	32.63	47.77	54	-21.37	31.06	6.85	53.05	133	29	Average
4882	43.62	58.76	74	-30.38	31.06	6.85	53.05	133	29	Peak

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
   Margin value = Emission level – Limit value
2. 2441 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Getaz Yang

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	98.64	104.66			27.15	4.15	37.32	200	360	Average
2480	104.06	110.08			27.15	4.15	37.32	200	360	Peak
2483.52	**39.92**	**45.94**	**54**	**-14.08**	**27.15**	**4.15**	**37.32**	**200**	**360**	**Average**
2483.6	51.7	57.72	74	-22.3	27.15	4.15	37.32	200	360	Peak
4960	32.78	47.75	54	-21.22	31.16	6.91	53.04	100	250	Average
4960	41.79	56.76	74	-32.21	31.16	6.91	53.04	100	250	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	94.37	100.39			27.15	4.15	37.32	179	244	Average
2480	99.81	105.83			27.15	4.15	37.32	179	244	Peak
2483.52	37.69	43.71	54	-16.31	27.15	4.15	37.32	179	244	Average
2495.68	47.7	53.59	74	-26.3	27.2	4.16	37.25	179	244	Peak
4960	32.88	47.85	54	-21.12	31.16	6.91	53.04	133	31	Average
4960	43.19	58.16	74	-30.81	31.16	6.91	53.04	133	31	Peak

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
   Margin value = Emission level – Limit value
2. 2480 MHz: Fundamental frequency.

9 kHz ~ 30 MHz DATA:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

30 MHz ~ 1 GHz WORST-CASE DATA:

EUT Test Condition		Measurement Detail	
Channel	Channel 78	**Frequency Range**	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Getaz Yang

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
43.58	17.7	34.55	40	-22.3	13.59	0.67	31.11	104	353	Peak
148.34	15.74	33.58	43.5	-27.76	12.64	1.14	31.62	129	281	Peak
272.5	14.9	33.17	46	-31.1	12.14	1.56	31.97	113	304	Peak
339.43	18.16	34.35	46	-27.84	13.89	1.74	31.82	121	303	Peak
497.54	21.06	33.37	46	-24.94	17.27	2.08	31.66	112	198	Peak
618.79	23.07	33.11	46	-22.93	19.83	2.29	32.16	134	265	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Factor (dB/m)**	**Cable Loss (dB)**	**Preamp Factor (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
41.64	16	32.83	40	-24	13.56	0.66	31.05	123	96	Peak
137.67	16.83	35.16	43.5	-26.67	12.21	1.15	31.69	133	239	Peak
223.03	15.77	35.79	46	-30.23	10.34	1.39	31.75	125	273	Peak
378.23	18.17	33.44	46	-27.83	14.82	1.85	31.94	122	279	Peak
485.9	21.48	34.18	46	-24.52	17.04	2.06	31.8	132	233	Peak
545.07	21.75	33.07	46	-24.25	18.35	2.17	31.84	134	189	Peak

Remarks:

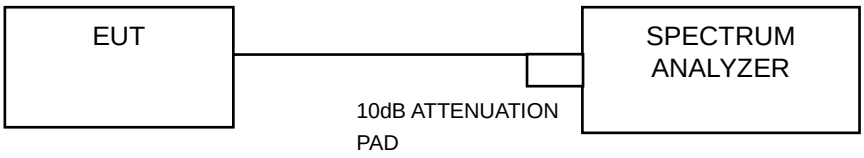
1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
   Margin value = Emission level – Limit value

4.2 Number of Hopping Frequency Used

4.2.1 Limits of Hopping Frequency Used Measurement

At least 15 channels frequencies, and should be equally spaced.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
d. Set the SA on View mode and then plot the result on SA screen.
e. Repeat above procedures until all frequencies measured were complete.

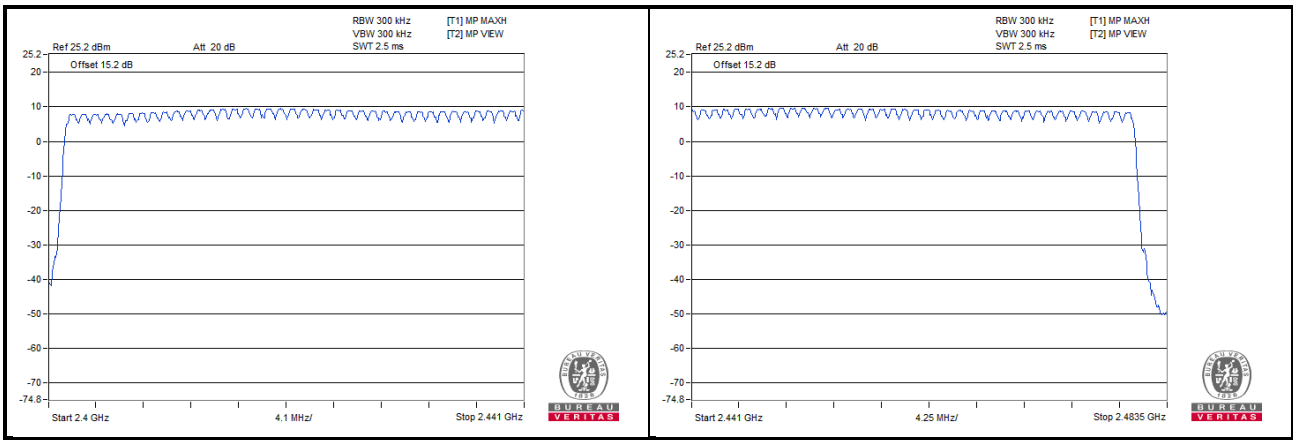
4.2.5 Deviation fromTest Standard

No deviation.

4.2.6 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

8DPSK

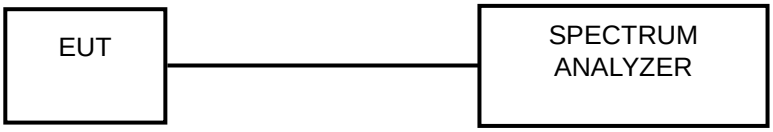

RBW 300 kHz
VBW 300 kHz
SWT 2.5 ms
[T1] MP MAXH
[T2] MP VIEW
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
25.2
20
10
0
-10
-20
-30
-40
-50
-60
-70
-74.8
Start 2.4 GHz
4.1 MHz/
Stop 2.441 GHz
RBW 300 kHz
VBW 300 kHz
SWT 2.5 ms
[T1] MP MAXH
[T2] MP VIEW
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Start 2.441 GHz
4.25 MHz/
Stop 2.4835 GHz

4.3 Dwell Time on Each Channel

4.3.1 Limits of Dwell Time on Each Channel Measurement

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.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
e. Repeat above procedures until all different time-slot modes have been completed.

.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 Test Results

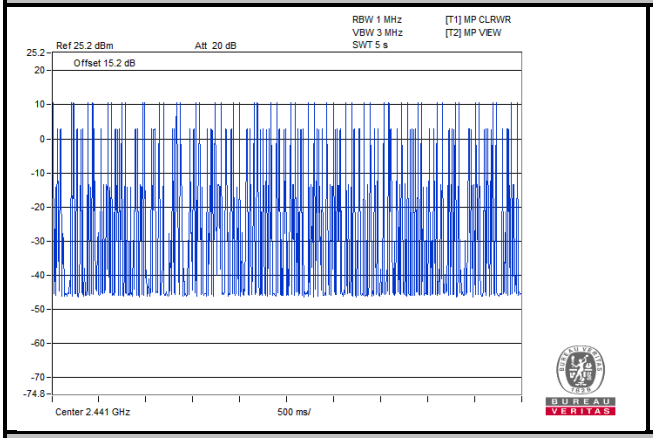
GFSK

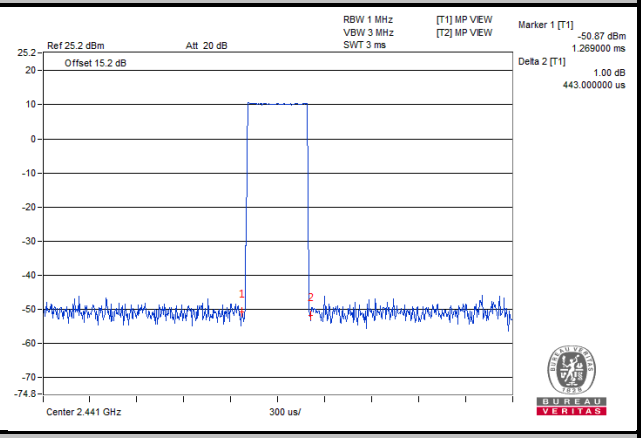
Mode	Average Hopping Channel	Package Transfer Time (usec)	Result (sec)	Limit (sec)
DH1	10.00	443.00	0.14	0.4
DH3	5.20	1682.00	0.28	0.4
DH5	3.60	2932.00	0.33	0.4

NOTE:

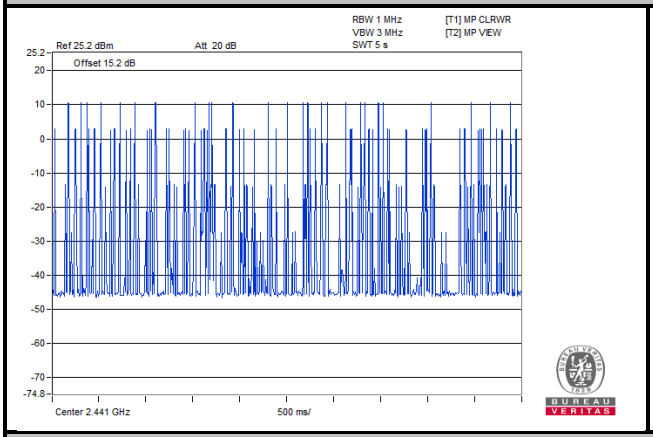
1. Dwell Time=79(channels) x 0.4(s) x average hopping channel x package transfer time
2. 79 channels come from the Hopping Channel number
3. Average Hopping Channel = hops/sweep time
4. t: Package Transfer Time(us)
5. Test plots of the transmitting time slot are shown as below.

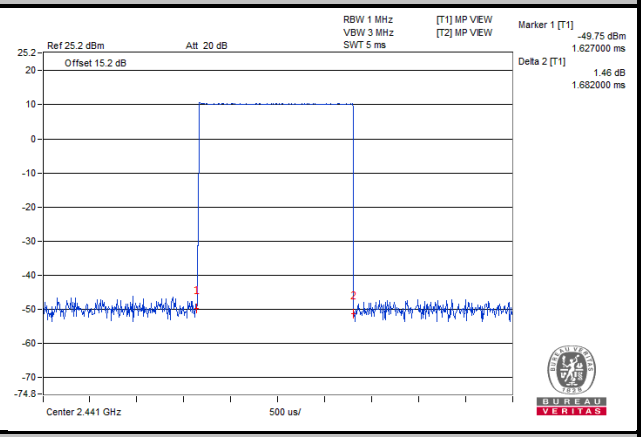
DH1


RBW 1 MHz
VBW 3 MHz
SWT 5 s
[T1] MP CLRWR
[T2] MP VIEW
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
500 ms/

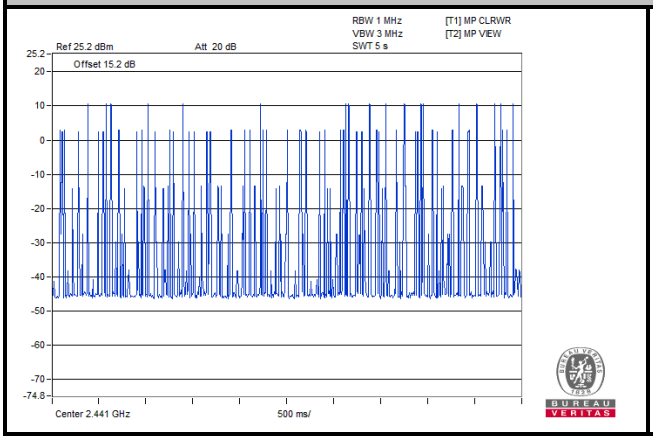

RBW 1 MHz
VBW 3 MHz
SWT 3 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-50.87 dBm
1.269000 ms
Delta 2 [T1]
1.00 dB
443.000000 us
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
300 us/

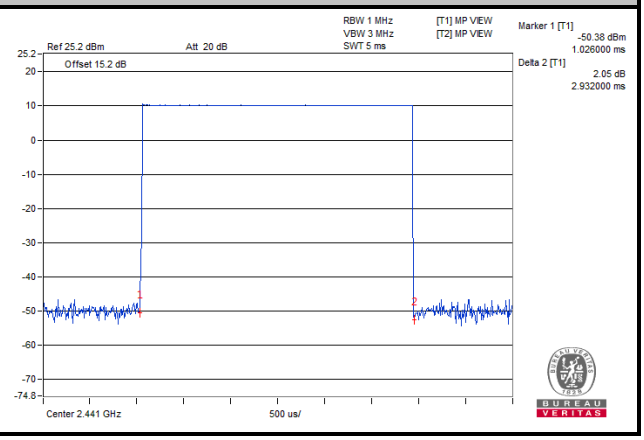
DH3


RBW 1 MHz
VBW 3 MHz
SWT 5 s
[T1] MP CLRWR
[T2] MP VIEW
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
500 ms/


RBW 1 MHz
VBW 3 MHz
SWT 5 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-49.75 dBm
1.627000 ms
Delta 2 [T1]
1.46 dB
1.682000 ms
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
500 us/

1DH5


RBW 1 MHz
VBW 3 MHz
SWT 5 s
[T1] MP CLRWR
[T2] MP VIEW
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
500 ms/


RBW 1 MHz
VBW 3 MHz
SWT 5 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-50.38 dBm
1.026000 ms
Delta 2 [T1]
2.05 dB
2.932000 ms
Ref 25.2 dBm
Att 20 dB
Offset 15.2 dB
Center 2.441 GHz
500 us/

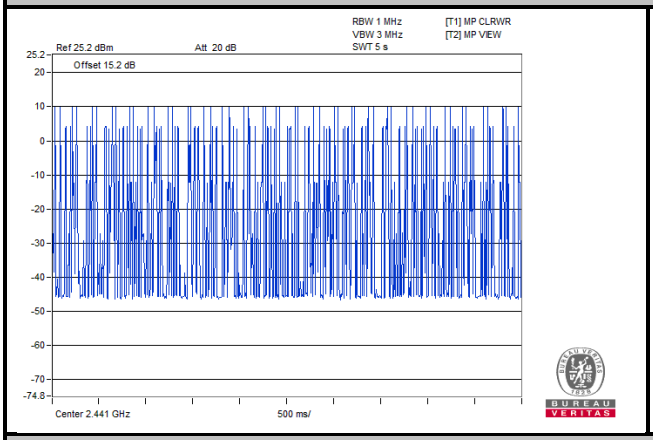
Π/4-DQPSK

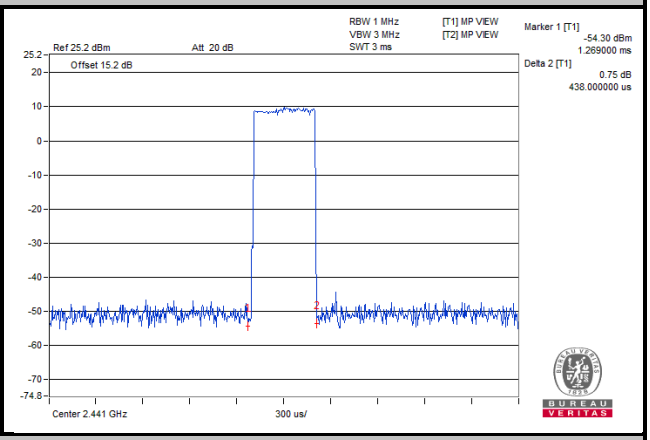
Mode	Average Hopping Channel	Package Transfer Time (usec)	Result (sec)	Limit (sec)
2DH1	10.20	438.00	0.14	0.4
2DH3	5.40	1674.00	0.29	0.4
2DH5	3.20	2924.00	0.30	0.4

NOTE:

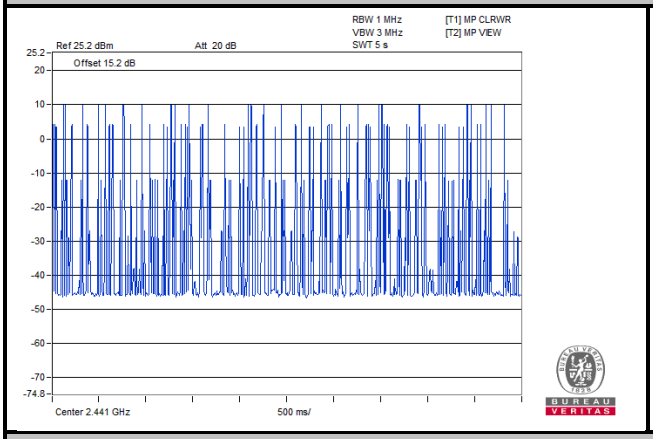
1. Dwell Time=79(channels) x 0.4(s) x average hopping channel x package transfer time
2. 79 channels come from the Hopping Channel number
3. Average Hopping Channel = hops/sweep time
4. t: Package Transfer Time(us)
5. Test plots of the transmitting time slot are shown as below.

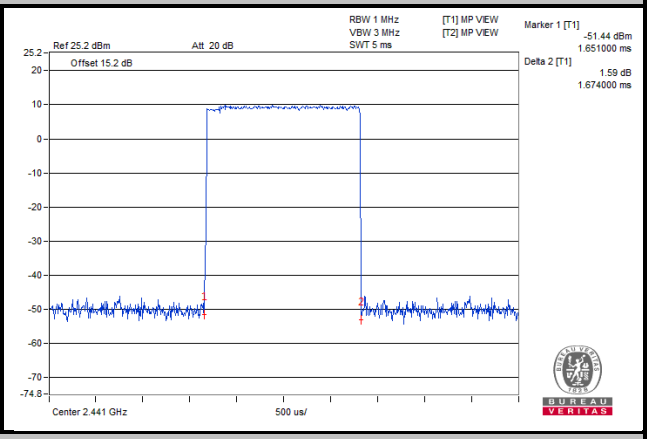
2DH1



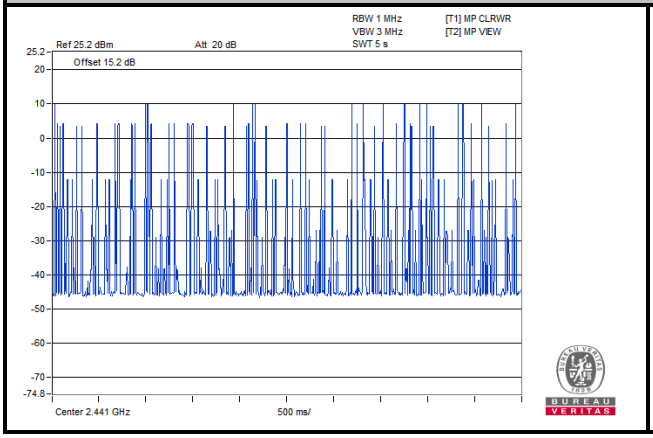


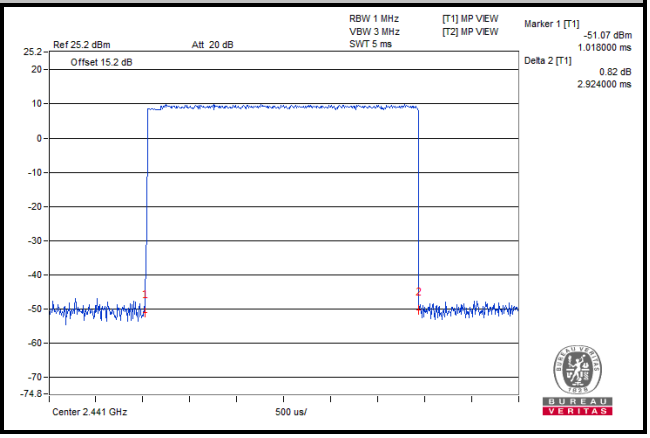
2DH3





2DH5





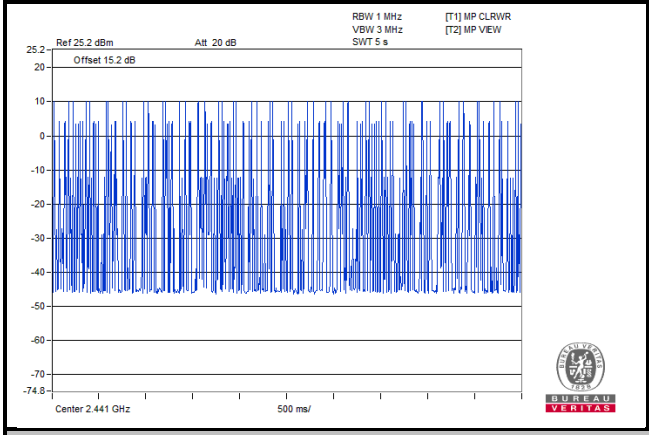
8DPSK

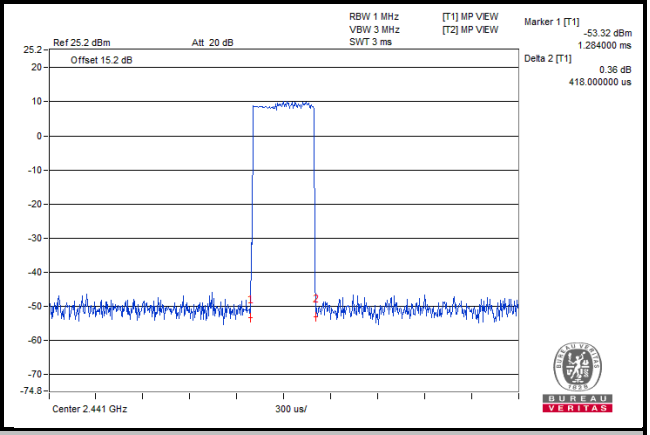
Mode	Average Hopping Channel	Package Transfer Time (usec)	Result (sec)	Limit (sec)
3DH1	10.00	418.00	0.13	0.4
3DH3	5.20	1674.00	0.28	0.4
3DH5	3.40	2924.00	0.31	0.4

NOTE:

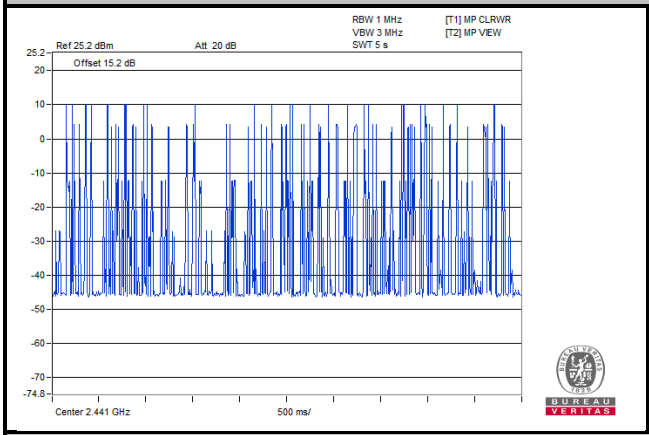
1. Dwell Time=79(channels) x 0.4(s) x average hopping channel x package transfer time
2. 79 channels come from the Hopping Channel number
3. Average Hopping Channel = hops/sweep time
4. t: Package Transfer Time(us)
5. Test plots of the transmitting time slot are shown as below.

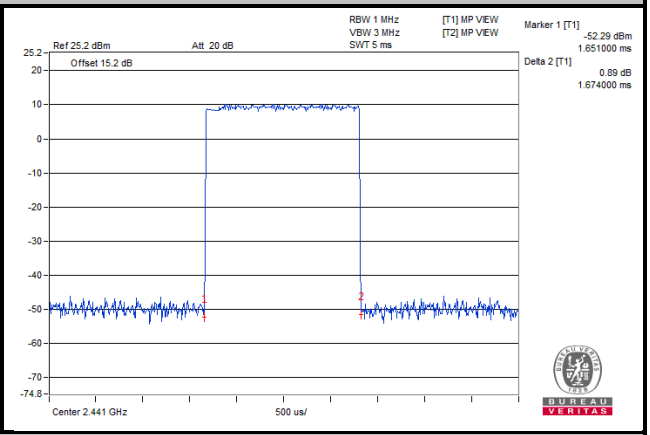
3DH1



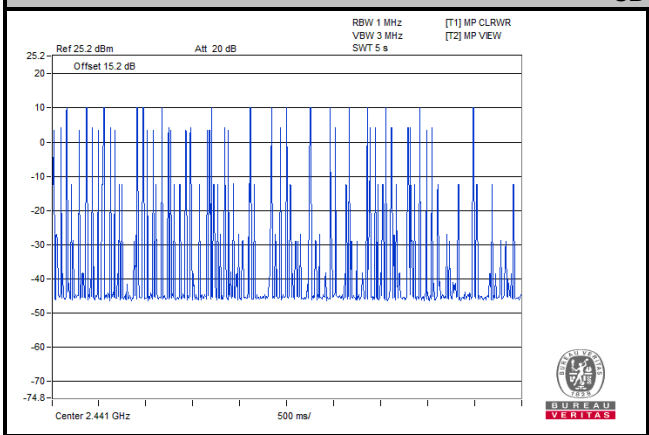


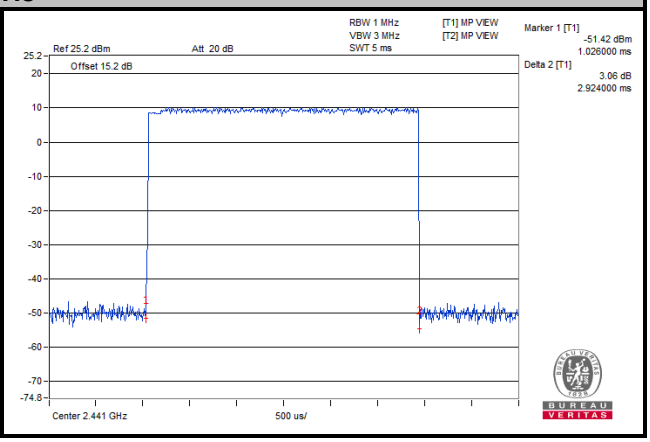
3DH3





3DH5



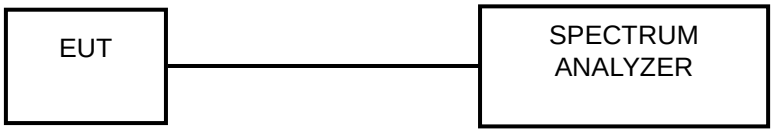


4.4 Channel Bandwidth

4.4.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. 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.
c. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Condition

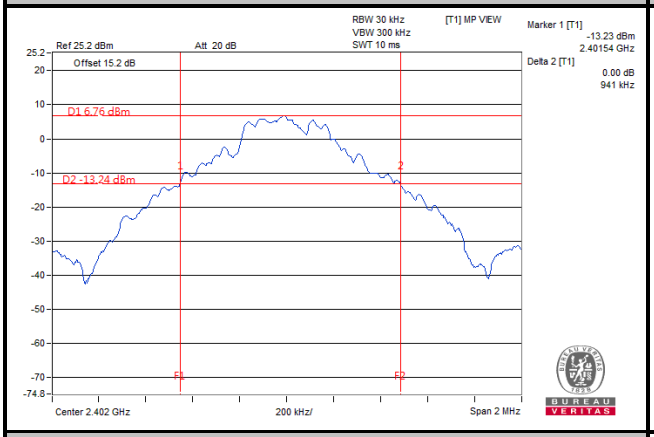
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.4.7 Test Results

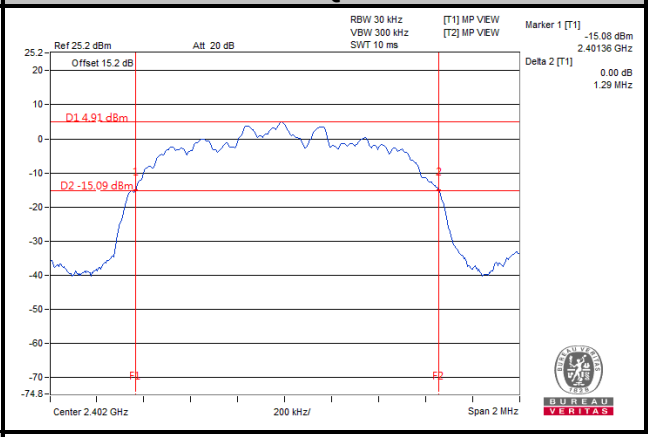
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)		
		GFSK	π/4-DQPSK	8DPSK
0	2402	0.941	1.29	1.24
39	2441	0.941	1.29	1.24
78	2480	0.939	1.29	1.24

Spectrum Plot of Worst Value

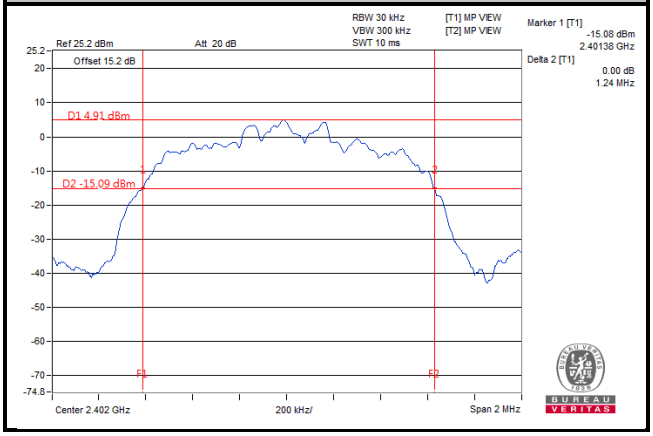
GFSK



π/4-DQPSK



8DPSK

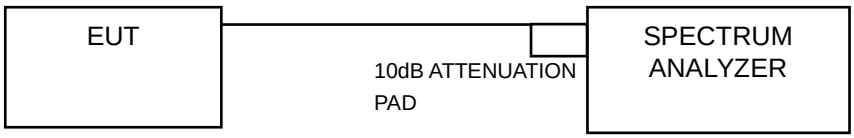


4.5 Hopping Channel Separation

4.5.1 Limits of Hopping Channel Separation Measurement

At least 25 kHz or two-third of 20 dB hopping channel bandwidth (whichever is greater).

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

Measurement Procedure REF

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
c. By using the MaxHold function record the separation of two adjacent channels.
d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
e. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 Test Results

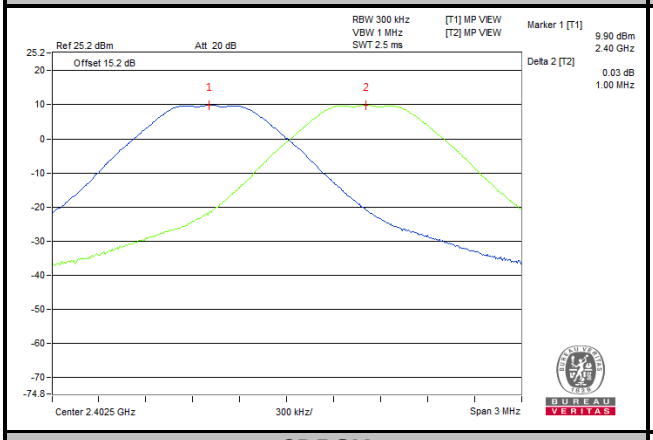
Channel	Freq. (MHz)	Adjacent Channel Separation (MHz)			20 dB Bandwidth (MHz)			Minimum Limit (MHz)			Pass / Fail
		GFSK	π/4-DQPSK	8DPSK	GFSK	π/4-DQPSK	8DPSK	GFSK	π/4-DQPSK	8DPSK	
0	2402	1.00	1.00	1.00	0.941	1.29	1.24	0.627	0.860	0.827	Pass
39	2441	1.00	1.00	1.00	0.941	1.29	1.24	0.627	0.860	0.827	Pass
78	2480	1.00	1.00	1.00	0.939	1.29	1.24	0.626	0.860	0.827	Pass

NOTE:

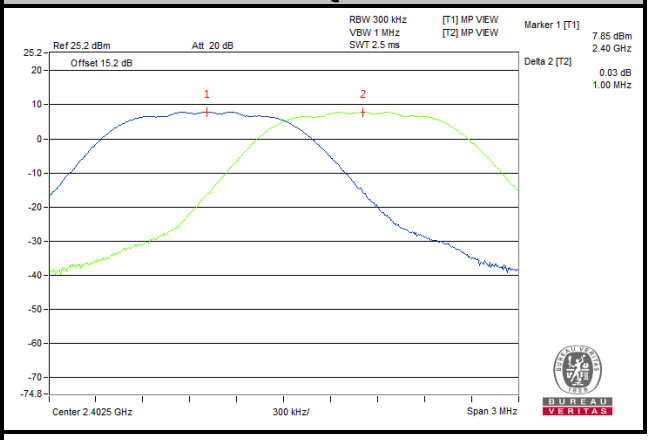
1. The minimum limit is two-third 20 dB bandwidth.

Spectrum Plot of Worst Value

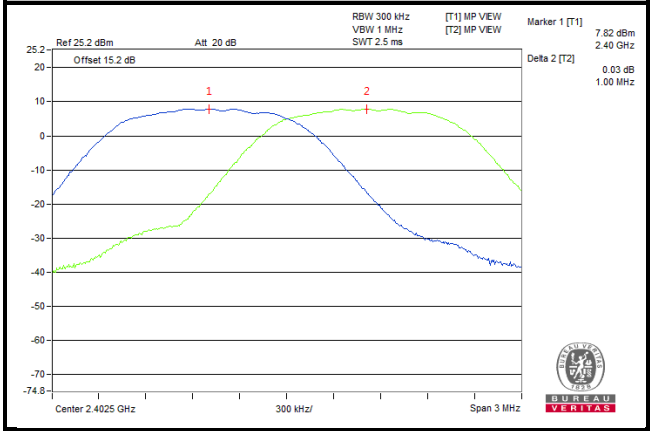
GFSK



π/4-DQPSK



8DPSK

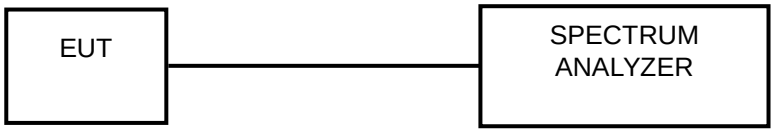


4.6 Maximum Output Power

4.6.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125 mW.

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. 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.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3 MHz RBW and 10 MHz VBW.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

4.6.5 Deviation fromTest Standard

No deviation.

4.6.6 EUT Operating Condition

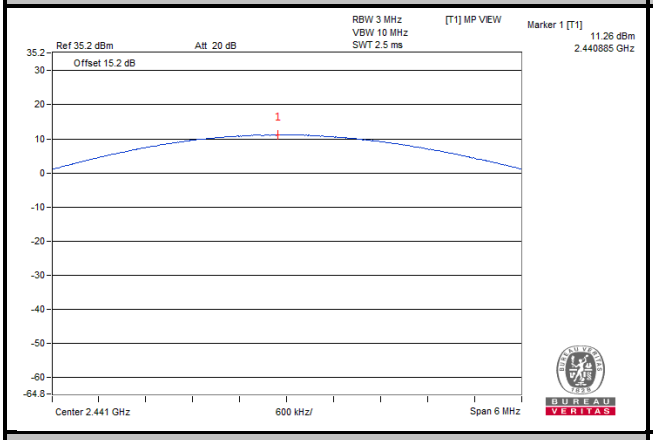
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.6.7 Test Results

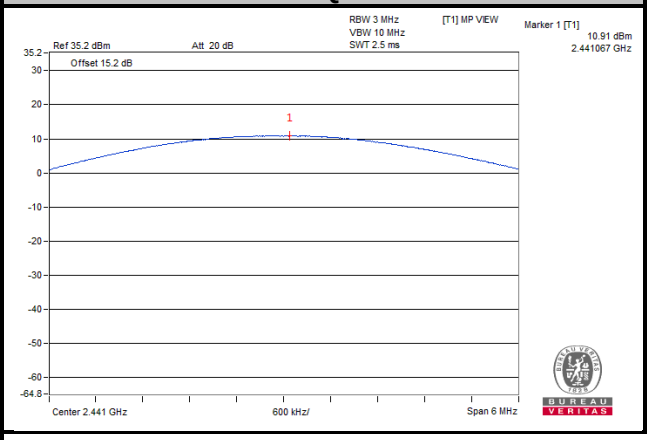
Channel	Frequency (MHz)	Output Power (mW)			Output Power (dBm)			Power Limit (mW)	Pass / Fail
		GFSK	π/4-DQPSK	8DPSK	GFSK	π/4-DQPSK	8DPSK		
0	2402	10.495	9.572	10.593	10.21	9.81	10.25	125	PASS
39	2441	13.366	12.331	13.521	11.26	10.91	11.31	125	PASS
78	2480	11.588	10.617	11.776	10.64	10.26	10.71	125	PASS

Spectrum Plot of Worst Value

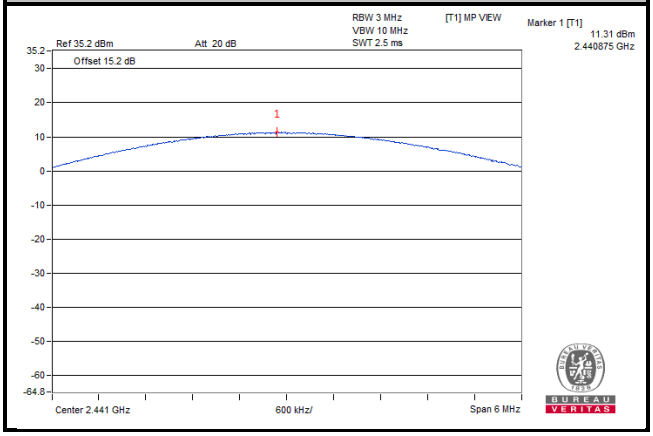
GFSK



π/4-DQPSK



8DPSK



4.7 Conducted Out of Band Emission Measurement

4.7.1 Limits Of Conducted Out Of Band Emission Measurement

Below –20 dB of the highest emission level of operating band (in 100 kHz RBW).

4.7.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

4.7.4 Deviation from Test Standard

No deviation.

4.7.5 EUT Operating Condition

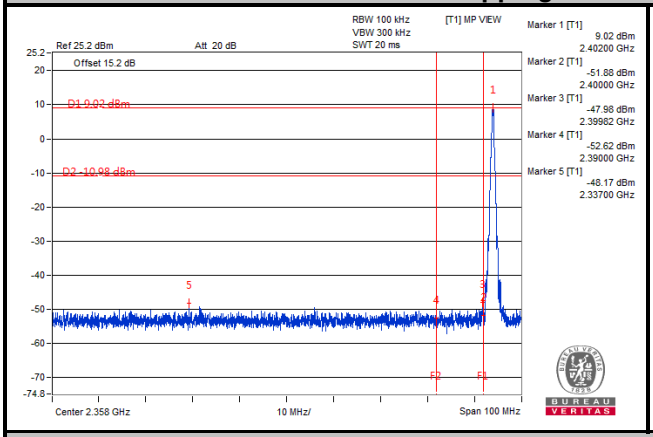
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

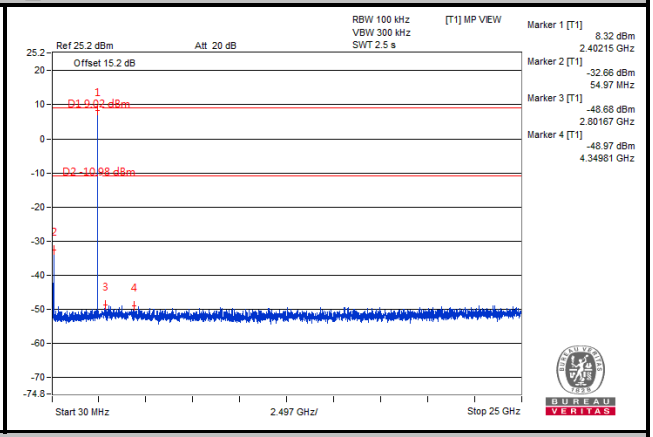
4.7.6 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

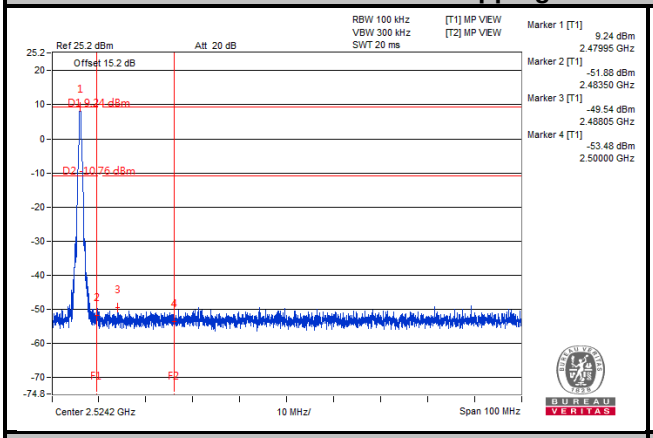
GFSK

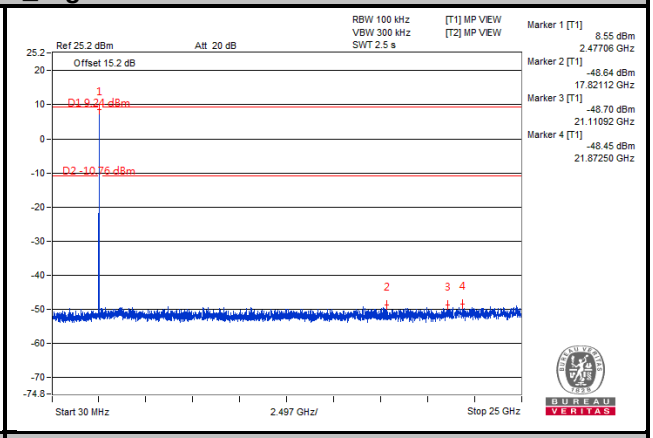
Hopping disabled_Low Channel



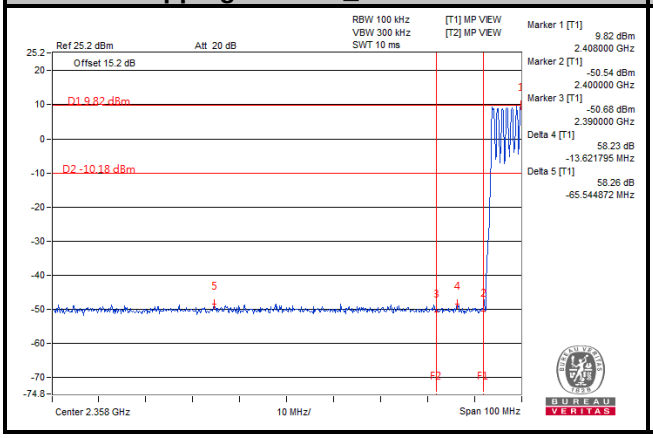


Hopping disabled_High Channel

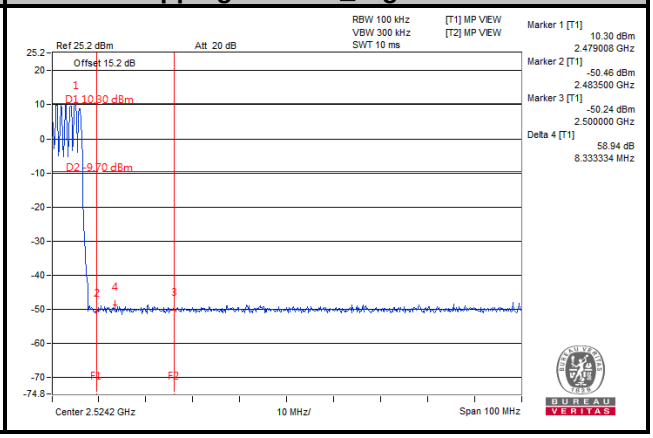




Hopping enabled_Low Channel

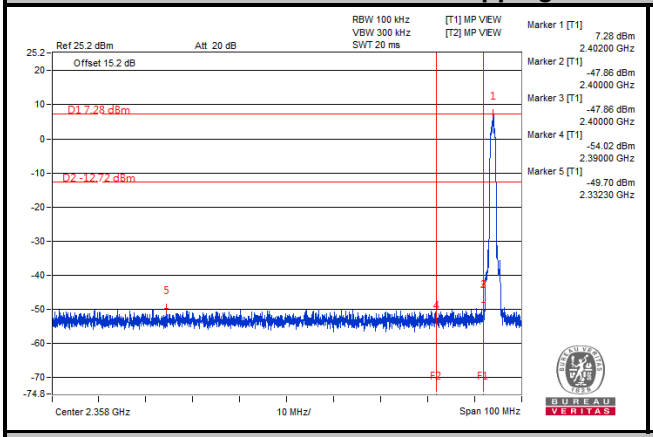


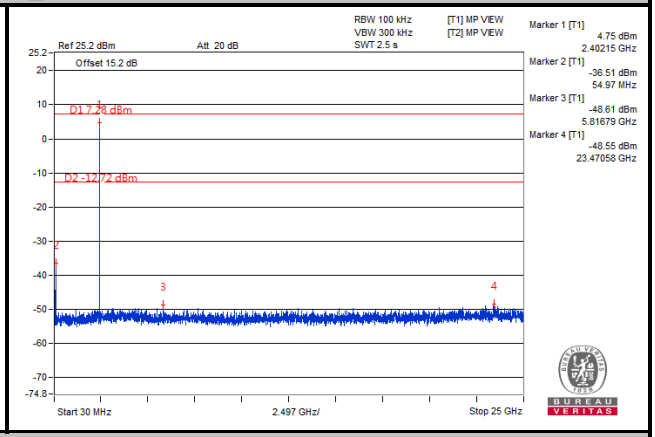
Hopping enabled_High Channel



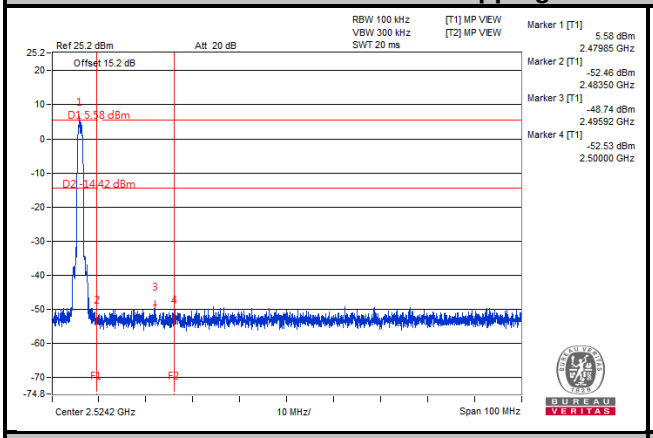
π/4-DQPSK

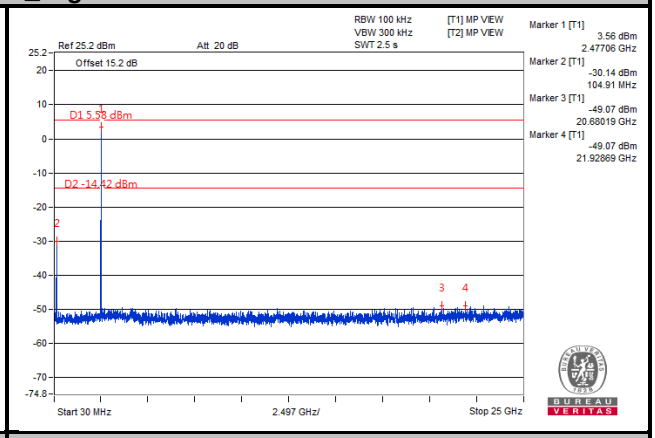
Hopping disabled_Low Channel



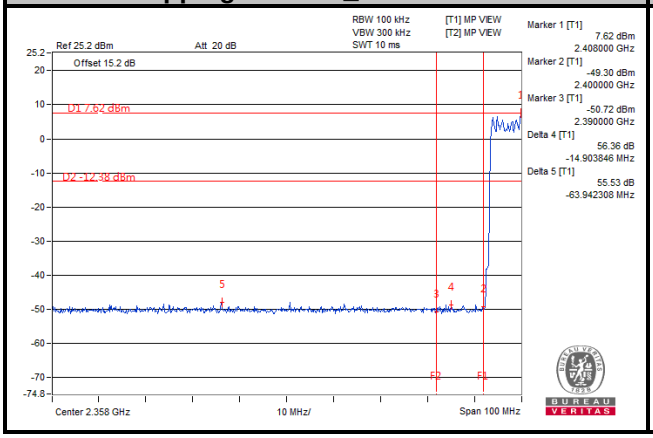


Hopping disabled_High Channel

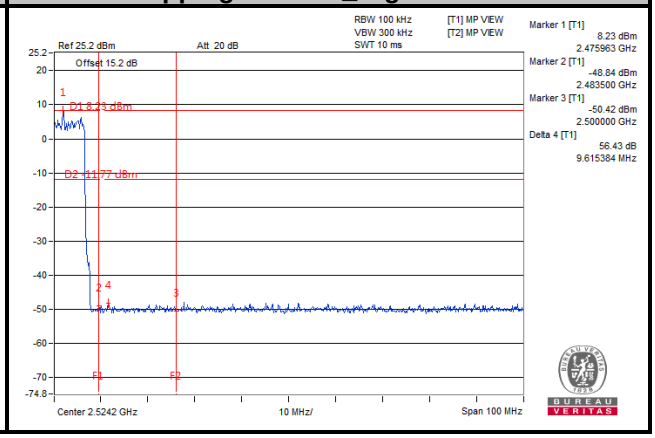




Hopping enabled_Low Channel

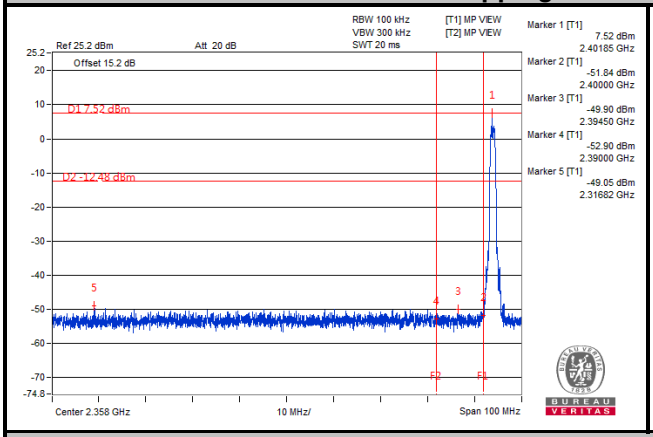


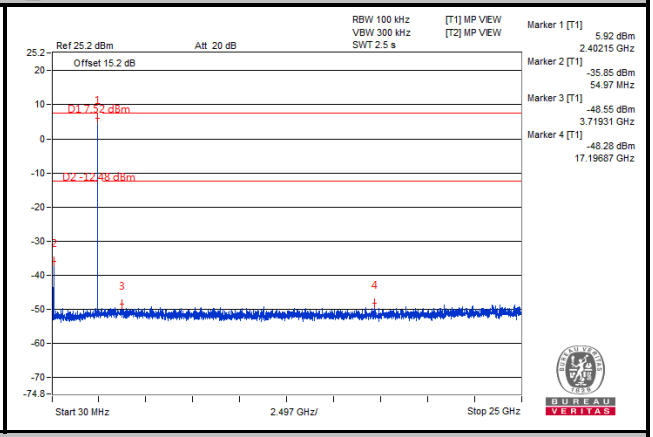
Hopping enabled_High Channel



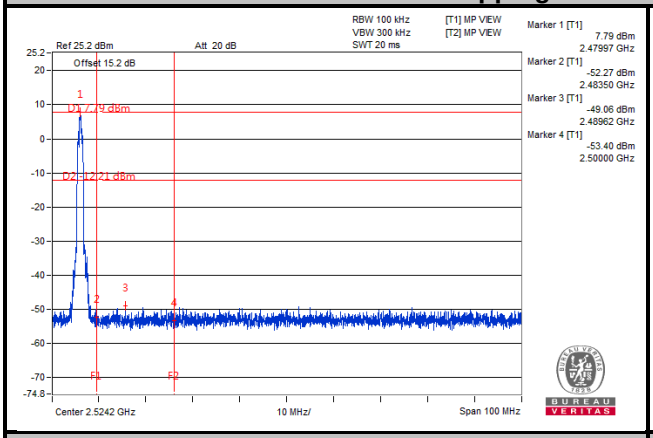
8DPSK

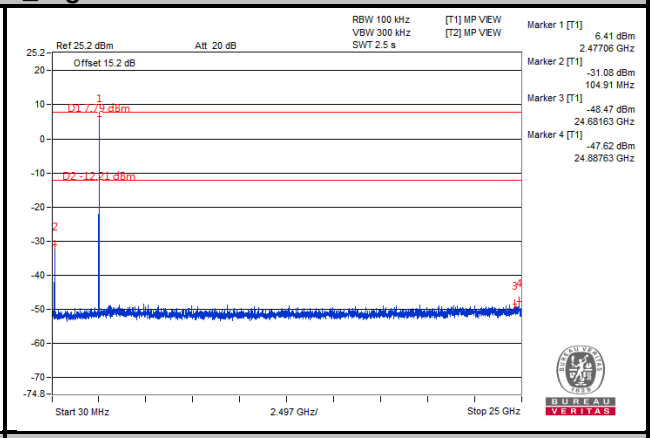
Hopping disabled_Low Channel



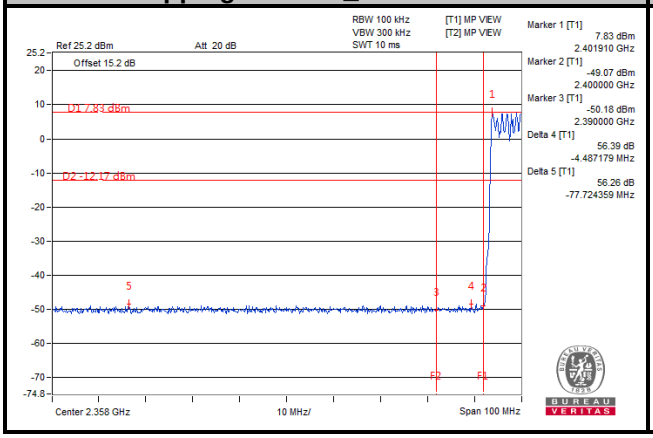


Hopping disabled_High Channel

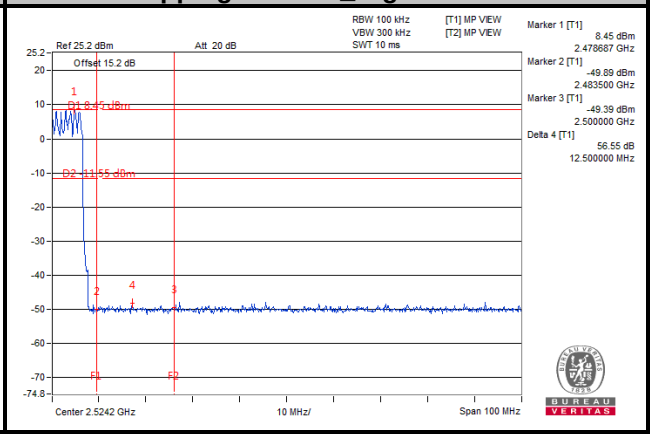




Hopping enabled_Low Channel



Hopping enabled_High Channel



5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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