

FCC Test Report (BT-EDR)

Report No.: RF160727E11-5

FCC ID: MQT-PRESTOA3

Test Model: PRESTO A3

Received Date: July. 27, 2016

Test Date: Oct. 03 to 04, 2016

Issued Date: Oct. 25, 2016

Applicant: XAC AUTOMATION CORP.

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PARK,HSINCHU,TAIWAN

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Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty.....	6
2.2 Modification Record	6
3 General Information	7
3.1 General Description of EUT (BT-EDR).....	7
3.2 Description of Test Modes.....	9
3.2.1 Test Mode Applicability and Tested Channel Detail.....	10
3.3 Description of Support Units	12
3.3.1 Configuration of System under Test	13
3.4 General Description of Applied Standards	14
4 Test Types and Results	15
4.1 Radiated Emission and Bandedge Measurement.....	15
4.1.1 Limits of Radiated Emission and Bandedge Measurement	15
4.1.2 Test Instruments	16
4.1.3 Test Procedures.....	18
4.1.4 Deviation from Test Standard	19
4.1.5 Test Setup.....	19
4.1.6 EUT Operating Conditions.....	20
4.1.7 Test Results	21
4.2 Number of Hopping Frequency Used	28
4.2.1 Limits of Hopping Frequency Used Measurement	28
4.2.2 Test Setup.....	28
4.2.3 Test Instruments	28
4.2.4 Test Procedure	28
4.2.5 Deviation from Test Standard	28
4.2.6 Test Results	29
4.3 Dwell Time on Each Channel.....	30
4.3.1 Limits of Dwell Time on Each Channel Measurement.....	30
4.3.2 Test Setup.....	30
4.3.3 Test Instruments	30
4.3.4 Test Procedures.....	30
4.3.5 Deviation from Test Standard	30
4.3.6 Test Results	31
4.4 Channel Bandwidth	35
4.4.1 Limits of Channel Bandwidth Measurement.....	35
4.4.2 Test Setup.....	35
4.4.3 Test Instruments	35
4.4.4 Test Procedure	35
4.4.5 Deviation from Test Standard	35
4.4.6 EUT Operating Condition	35
4.4.7 Test Results	36
4.5 Hopping Channel Separation	37
4.5.1 Limits of Hopping Channel Separation Measurement.....	37
4.5.2 Test Setup.....	37
4.5.3 Test Instruments	37
4.5.4 Test Procedure	37
4.5.5 Deviation from Test Standard	37
4.5.6 Test Results	38
4.6 Maximum Output Power.....	39
4.6.1 Limits of Maximum Output Power Measurement	39
4.6.2 Test Setup.....	39

4.6.3 Test Instruments	39
4.6.4 Test Procedure	39
4.6.5 Deviation from Test Standard	39
4.6.6 EUT Operating Condition	39
4.6.7 Test Results	40
4.7 Conducted Out of Band Emission Measurement	41
4.7.1 Limits of Conducted Out of Band Emission Measurement	41
4.7.2 Test Instruments	41
4.7.3 Test Procedure	41
4.7.4 Deviation from Test Standard	41
4.7.5 EUT Operating Condition	41
4.7.6 Test Results	41
5 Pictures of Test Arrangements.....	44
Appendix – Information on the Testing Laboratories	45

Release Control Record

Issue No.	Description	Date Issued
RF160727E11-5	Original release.	Oct. 25, 2016

1 Certificate of Conformity

Product: Terminal

Brand: ElaCarte

Test Model: PRESTO A3

Sample Status: ENGINEERING SAMPLE

Applicant: XAC AUTOMATION CORP.

Test Date: Oct. 03 to 04, 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 : Midoli Peng , **Date:** Oct. 25, 2016
Midoli Peng / Specialist

Approved by : May Chen , **Date:** Oct. 25, 2016
May Chen / 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	NA	Power supply is 3.7Vdc from battery
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 & 15.247(d)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -12.3dB at 61.67MHz.
15.247(d)	Antenna Port Emission	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is HRS U.FL-LP(V)-040 not a standard connector.

NOTE: If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB 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 as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.19 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.43 dB
	6GHz ~ 18GHz	3.49 dB
	18GHz ~ 40GHz	4.11 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (BT-EDR)

Product	Terminal
Brand	ElaCarte
Test Model	PRESTO A3
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	DC 3.7V from battery
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	Up to 3Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	79
Output Power	16.293mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Battery x1(option)
Data Cable Supplied	NA

Note:

1. The EUT could be supplied with 3.7V battery(option) as the following table:

Brand	Model No.	Spec.
Ela Carte	A2 Battery	DC 3.7V, 10800mA

2. There are WLAN, Bluetooth and RFID technology used for the EUT.

3. Simultaneously transmission condition.

Condition	Technology		
1	WLAN (2.4GHz)	Bluetooth	RFID
2	WLAN (5GHz)	Bluetooth	RFID

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

4. The antennas provided to the EUT, please refer to the following table:

WiFi/BT Antenna Spec.					
Brand	Model No.	Antenna Type	Antenna Connector	Gain(dBi)	
INPAQ	WA-P-LB-02-368	PCB	HRS U.FL-LP(V)-040	2.4GHz:4.23 5GHz:4.02	
RFID Antenna Spec.					
Brand	Model No.	Antenna Type	Antenna Connector	Gain(dBi)	Frequency range (MHz)
INPAQ	NF-C-F10-R0-083	PCB	ZIF	13	13.56

5. 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 for BT-EDR mode:

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 \geq 1G	RE<1G	PLC	APCM	
-	√	√	-	√	

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

NOTE: No need to concern of Conducted Emission due to the EUT is powered by battery.

Radiated Emission Test (Above 1GHz):

- 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.

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	8DPSK	3DH5

Radiated Emission Test (Below 1GHz):

- 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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 78	39	FHSS	GFSK	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.

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	8DPSK	3DH5

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE \geq 1G	24deg. C, 63%RH	DC 3.7V	Gary Cheng
RE $<$ 1G	24deg. C, 64%RH	DC 3.7V	Jyunchun Lin
APCM	25deg. C, 60%RH	DC 3.7V	Tim Ho

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.

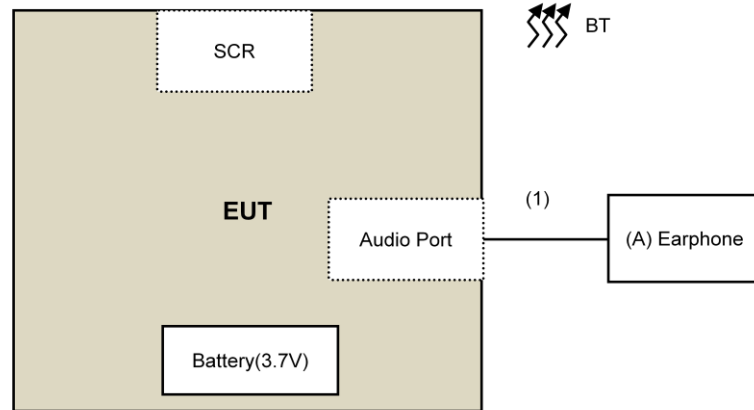
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Earphone	Hawk	HKC920	H003	FCC DoC	Provided by Lab
B.	Anritsu ML2487B Wideband Peak Power Meter	Anritsu	ML2487B	0930006	NA	Provided by Lab

Note:

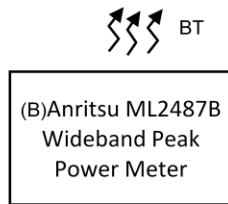
1. All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Audio Cable	1	2.2	No	0	Provided by Lab

3.3.1 Configuration of System under Test



Remote Site



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)

ANSI C63.10-2013

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

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 20dB 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 1000MHz, 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 20dB under any condition of modulation.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 20, 2016	July 19, 2017
Pre-Amplifier ^(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna ^(*) Electro-Metrics	EM-6879	264	Dec. 16, 2014	Dec. 15, 2016
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 18, 2016	Jan. 17, 2017
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-01	Nov. 11, 2015	Nov. 10, 2016
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Jan. 04, 2016	Jan. 03, 2017
RF Cable	8D	966-4-1 966-4-2 966-4-3	Apr. 02, 2016	Apr. 01, 2017
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-783	Jan. 19, 2016	Jan. 18, 2017
Pre-Amplifier Agilent	8449B	3008A01922	Sep. 18, 2016	Sep. 17, 2017
RF Cable	EMC104-SM- SM-2000 EMC104-SM- SM-5000 EMC104-SM- SM-5000	150318 150323 150324	Mar. 30, 2016	Mar. 29, 2017
Pre-Amplifier EMCI	EMC184045	980143	Jan. 15, 2016	Jan. 14, 2017
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Jan. 08, 2016	Jan. 07, 2017
RF Cable	SUCOFLEX 102	36432/2 36441/2	Jan. 16, 2016	Jan. 15, 2017
Software	ADT_Radiated _V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208410	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP02	NA	NA
Spectrum Analyzer R&S	FSP40	100036	Jan. 27, 2016	Jan. 26, 2017

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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
- 3 Loop antenna was used for all emissions below 30 MHz.
4. The test was performed in 966 Chamber No. 4.
5. The FCC Site Registration No. is 292998
6. The CANADA Site Registration No. is 20331-2
7. Tested Date: Oct. 03 to 04, 2016

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case 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.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) 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 detect 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:

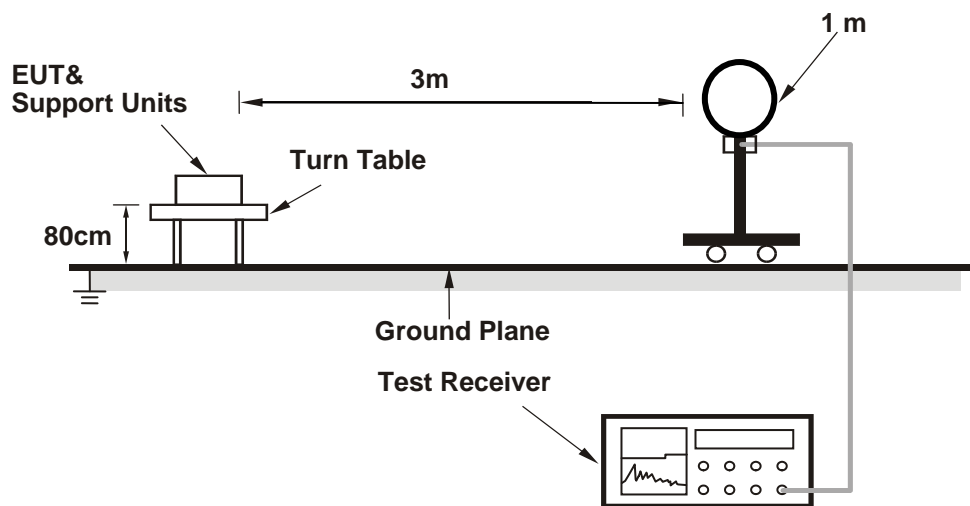
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

4.1.4 Deviation from Test Standard

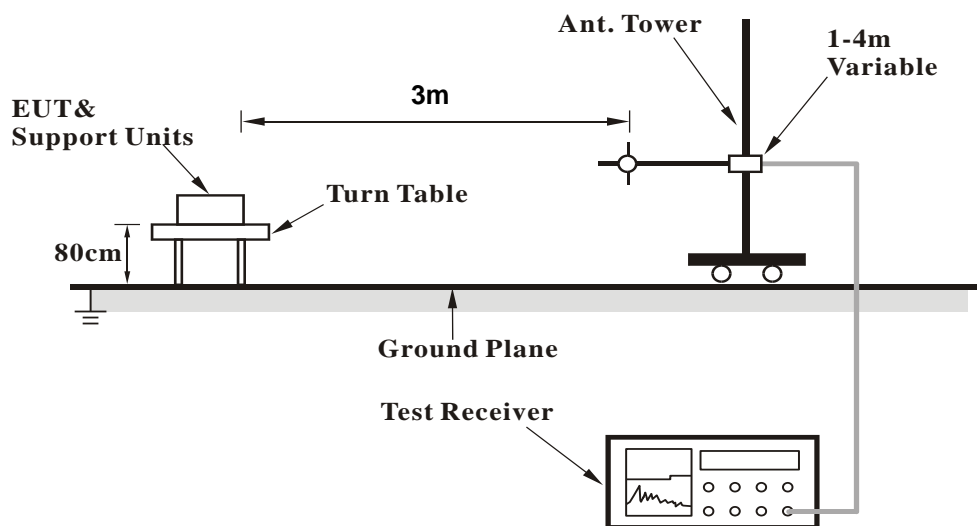
No deviation.

4.1.5 Test Setup

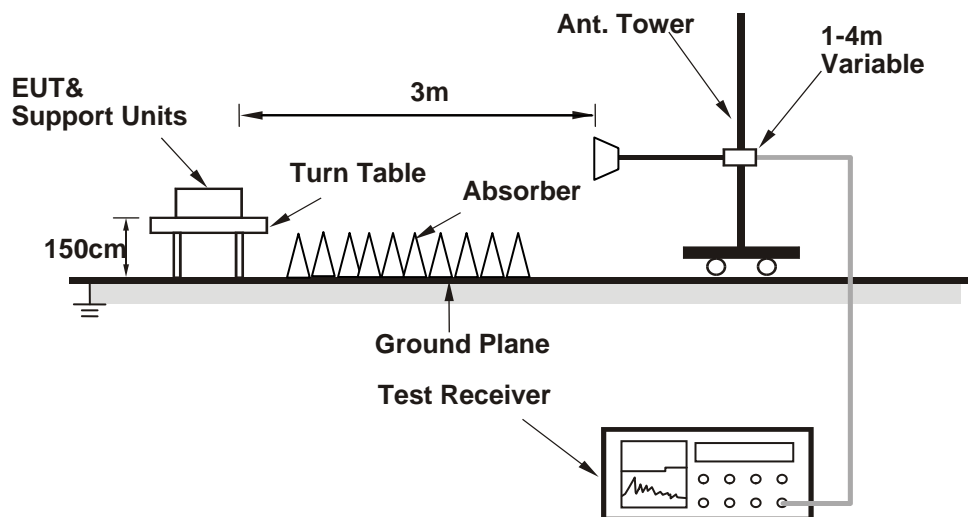
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

1. The EUT links support unit B (Anritsu ML2487B Wideband Peak Power Meter) via bluetooth function and set the EUT under transmission / receiver condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data:

BT_GFSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	48.7 PK	74.0	-25.3	1.50 H	151	54.1	-5.4
2	2390.00	18.6 AV	54.0	-35.4	1.50 H	151	24.0	-5.4
3	*2402.00	103.3 PK			1.50 H	151	108.7	-5.4
4	*2402.00	73.2 AV			1.50 H	151	78.6	-5.4
5	4804.00	39.1 PK	74.0	-34.9	1.75 H	155	37.9	1.2
6	4804.00	9.0 AV	54.0	-45.0	1.75 H	155	7.8	1.2

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	47.9 PK	74.0	-26.1	1.62 V	334	53.3	-5.4
2	2390.00	17.8 AV	54.0	-36.2	1.62 V	334	23.2	-5.4
3	*2402.00	105.1 PK			1.62 V	334	110.5	-5.4
4	*2402.00	75.0 AV			1.62 V	334	80.4	-5.4
5	4804.00	39.8 PK	74.0	-34.2	1.79 V	158	38.6	1.2
6	4804.00	9.7 AV	54.0	-44.3	1.79 V	158	8.5	1.2

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1$ dB
7. Average value = peak reading + $20\log(\text{duty cycle})$.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	103.9 PK			1.49 H	175	109.1	-5.2
2	*2441.00	73.8 AV			1.49 H	175	79.0	-5.2
3	4882.00	39.3 PK	74.0	-34.7	1.74 H	148	38.0	1.3
4	4882.00	9.2 AV	54.0	-44.8	1.74 H	148	7.9	1.3
5	7323.00	47.6 PK	74.0	-26.4	1.64 H	233	39.6	8.0
6	7323.00	17.5 AV	54.0	-36.5	1.64 H	233	9.5	8.0

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	105.8 PK			1.60 V	320	111.0	-5.2
2	*2441.00	75.7 AV			1.60 V	320	80.9	-5.2
3	4882.00	39.4 PK	74.0	-34.6	1.77 V	169	38.1	1.3
4	4882.00	9.3 AV	54.0	-44.7	1.77 V	169	8.0	1.3
5	7323.00	46.1 PK	74.0	-27.9	1.30 V	166	38.1	8.0
6	7323.00	16.0 AV	54.0	-38.0	1.30 V	166	8.0	8.0

REMARKS:

- Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Emission Level – Limit value
- " * ": Fundamental frequency.
- The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1$ dB
- Average value = peak reading + $20\log(\text{duty cycle})$.

CHANNEL	TX Channel 78	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	104.4 PK			1.51 H	164	109.5	-5.1
2	*2480.00	74.3 AV			1.51 H	164	79.4	-5.1
3	2483.50	49.3 PK	74.0	-24.7	1.51 H	164	54.5	-5.2
4	2483.50	19.2 AV	54.0	-34.8	1.51 H	164	24.4	-5.2
5	4960.00	39.7 PK	74.0	-34.3	1.76 H	164	38.1	1.6
6	4960.00	9.6 AV	54.0	-44.4	1.76 H	164	8.0	1.6
7	7440.00	47.0 PK	74.0	-27.0	1.64 H	237	38.7	8.3
8	7440.00	16.9 AV	54.0	-37.1	1.64 H	237	8.6	8.3

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	106.2 PK			1.63 V	333	111.3	-5.1
2	*2480.00	76.1 AV			1.63 V	333	81.2	-5.1
3	2483.50	50.4 PK	74.0	-23.6	1.63 V	333	55.6	-5.2
4	2483.50	20.3 AV	54.0	-33.7	1.63 V	333	25.5	-5.2
5	4960.00	39.7 PK	74.0	-34.3	1.79 V	161	38.1	1.6
6	4960.00	9.6 AV	54.0	-44.4	1.79 V	161	8.0	1.6
7	7440.00	46.3 PK	74.0	-27.7	1.29 V	151	38.0	8.3
8	7440.00	16.2 AV	54.0	-37.8	1.29 V	151	7.9	8.3

REMARKS:

- Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Emission Level – Limit value
- " * ": Fundamental frequency.
- The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1 \text{ dB}$
- Average value = peak reading + $20\log(\text{duty cycle})$.

BT_8DPSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	47.3 PK	74.0	-26.7	1.56 H	166	52.7	-5.4
2	2390.00	17.2 AV	54.0	-36.8	1.56 H	166	22.6	-5.4
3	*2402.00	103.6 PK			1.56 H	166	109.0	-5.4
4	*2402.00	73.5 AV			1.56 H	166	78.9	-5.4
5	4804.00	39.3 PK	74.0	-34.7	1.79 H	159	38.1	1.2
6	4804.00	9.2 AV	54.0	-44.8	1.79 H	159	8.0	1.2

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	47.7 PK	74.0	-26.3	1.92 V	334	53.1	-5.4
2	2390.00	17.6 AV	54.0	-36.4	1.92 V	334	23.0	-5.4
3	*2402.00	106.0 PK			1.92 V	334	111.4	-5.4
4	*2402.00	75.9 AV			1.92 V	334	81.3	-5.4
5	4804.00	40.0 PK	74.0	-34.0	1.82 V	175	38.8	1.2
6	4804.00	9.9 AV	54.0	-44.1	1.82 V	175	8.7	1.2

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1 \text{ dB}$
7. Average value = peak reading + $20\log(\text{duty cycle})$.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	103.9 PK			1.66 H	162	109.1	-5.2
2	*2441.00	73.8 AV			1.66 H	162	79.0	-5.2
3	4882.00	39.7 PK	74.0	-34.3	1.73 H	165	38.4	1.3
4	4882.00	9.6 AV	54.0	-44.4	1.73 H	165	8.3	1.3
5	7323.00	46.6 PK	74.0	-27.4	1.70 H	241	38.6	8.0
6	7323.00	16.5 AV	54.0	-37.5	1.70 H	241	8.5	8.0

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	105.9 PK			1.94 V	332	111.1	-5.2
2	*2441.00	75.8 AV			1.94 V	332	81.0	-5.2
3	4882.00	39.2 PK	74.0	-34.8	1.84 V	153	37.9	1.3
4	4882.00	9.1 AV	54.0	-44.9	1.84 V	153	7.8	1.3
5	7323.00	46.5 PK	74.0	-27.5	1.29 V	146	38.5	8.0
6	7323.00	16.4 AV	54.0	-37.6	1.29 V	146	8.4	8.0

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1 \text{ dB}$
7. Average value = peak reading + $20\log(\text{duty cycle})$.

CHANNEL	TX Channel 78	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	104.2 PK			1.60 H	154	109.3	-5.1
2	*2480.00	74.1 AV			1.60 H	154	79.2	-5.1
3	2483.50	49.0 PK	74.0	-25.0	1.60 H	154	54.2	-5.2
4	2483.50	18.9 AV	54.0	-35.1	1.60 H	154	24.1	-5.2
5	4960.00	39.7 PK	74.0	-34.3	1.73 H	152	38.1	1.6
6	4960.00	9.6 AV	54.0	-44.4	1.73 H	152	8.0	1.6
7	7440.00	47.5 PK	74.0	-26.5	1.66 H	250	39.2	8.3
8	7440.00	17.4 AV	54.0	-36.6	1.66 H	250	9.1	8.3

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	106.5 PK			1.90 V	320	111.6	-5.1
2	*2480.00	76.4 AV			1.90 V	320	81.5	-5.1
3	2483.50	49.6 PK	74.0	-24.4	1.90 V	320	54.8	-5.2
4	2483.50	19.5 AV	54.0	-34.5	1.90 V	320	24.7	-5.2
5	4960.00	40.1 PK	74.0	-33.9	1.78 V	165	38.5	1.6
6	4960.00	10.0 AV	54.0	-44.0	1.78 V	165	8.4	1.6
7	7440.00	47.0 PK	74.0	-27.0	1.24 V	159	38.7	8.3
8	7440.00	16.9 AV	54.0	-37.1	1.24 V	159	8.6	8.3

REMARKS:

- Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Emission Level – Limit value
- " * ": Fundamental frequency.
- The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: $20\log(3.125 / 100) = -30.1$ dB
- Average value = peak reading + $20\log(\text{duty cycle})$.

Below 1GHz Data:

BT_GFSK

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	61.67	27.7 QP	40.0	-12.3	1.50 H	0	37.2	-9.5
2	586.71	26.9 QP	46.0	-19.1	1.50 H	59	27.9	-1.0
3	662.61	27.2 QP	46.0	-18.8	2.00 H	276	27.0	0.2
4	821.76	29.6 QP	46.0	-16.4	1.50 H	57	26.8	2.8
5	850.55	29.6 QP	46.0	-16.4	1.00 H	218	26.6	3.0
6	945.36	31.2 QP	46.0	-14.8	1.00 H	217	26.7	4.5

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	60.48	26.8 QP	40.0	-13.2	1.50 V	296	35.9	-9.1
2	100.23	24.9 QP	43.5	-18.6	1.00 V	137	37.8	-12.9
3	615.71	29.8 QP	46.0	-16.2	1.00 V	178	30.0	-0.2
4	644.37	30.8 QP	46.0	-15.2	2.00 V	34	30.7	0.1
5	673.01	29.9 QP	46.0	-16.1	1.50 V	57	29.7	0.2
6	910.64	31.0 QP	46.0	-15.0	1.00 V	218	27.0	4.0

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. 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

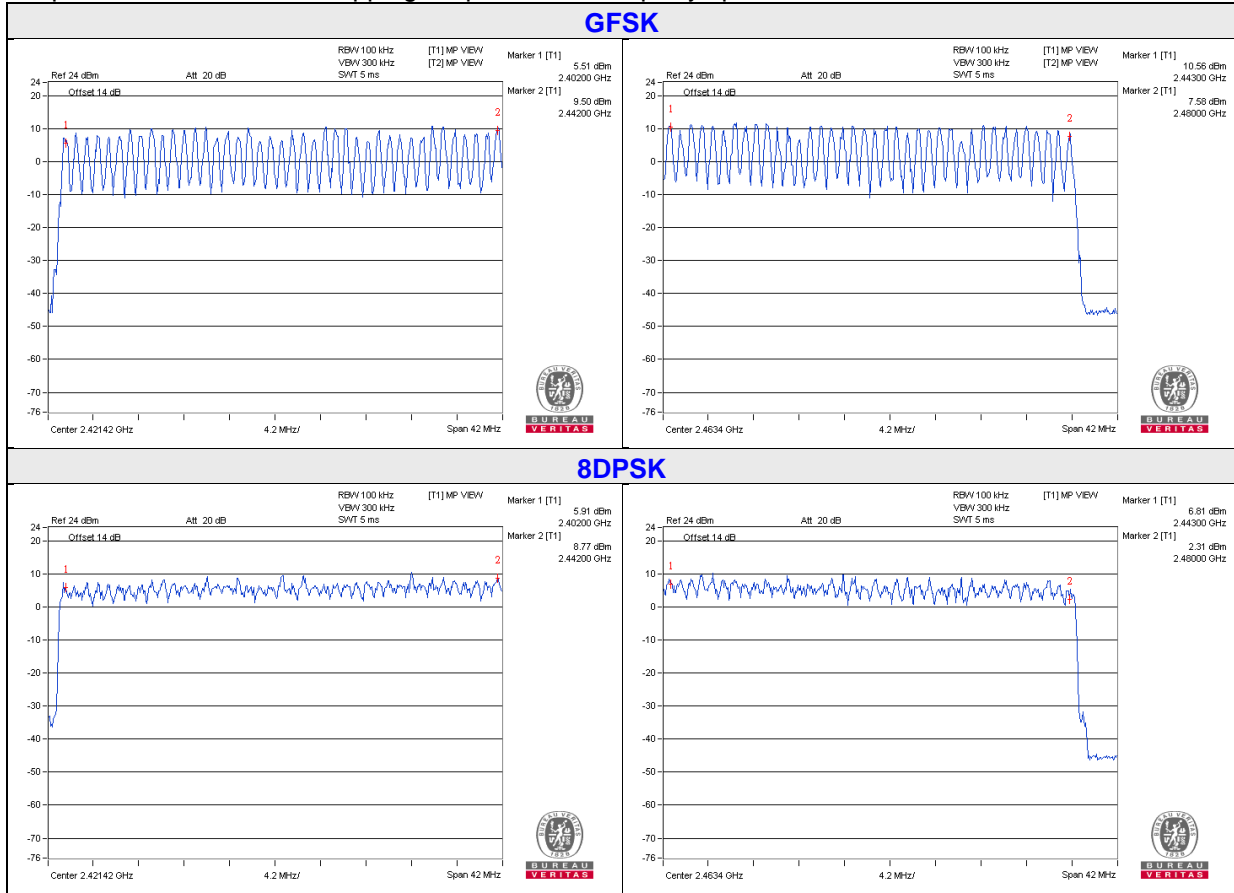
- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range 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 from Test 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.

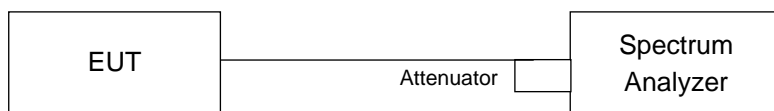


4.3 Dwell Time on Each Channel

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.

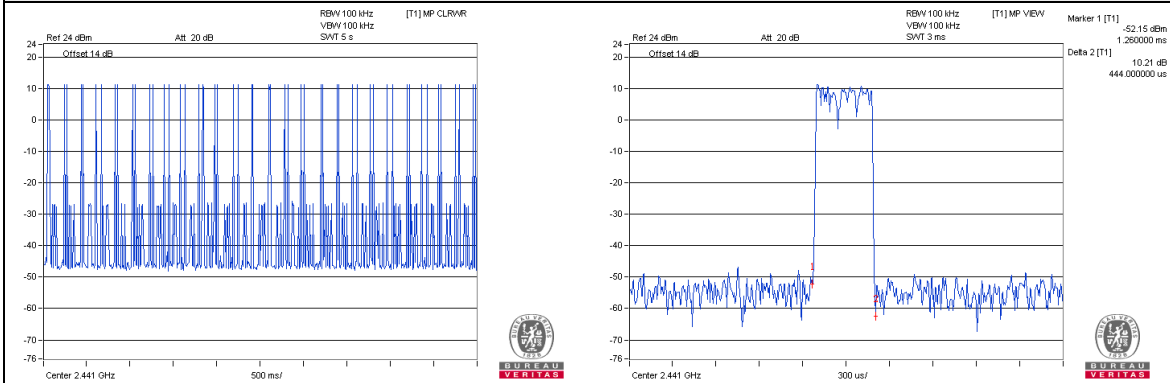
4.3.6 Test Results

GFSK

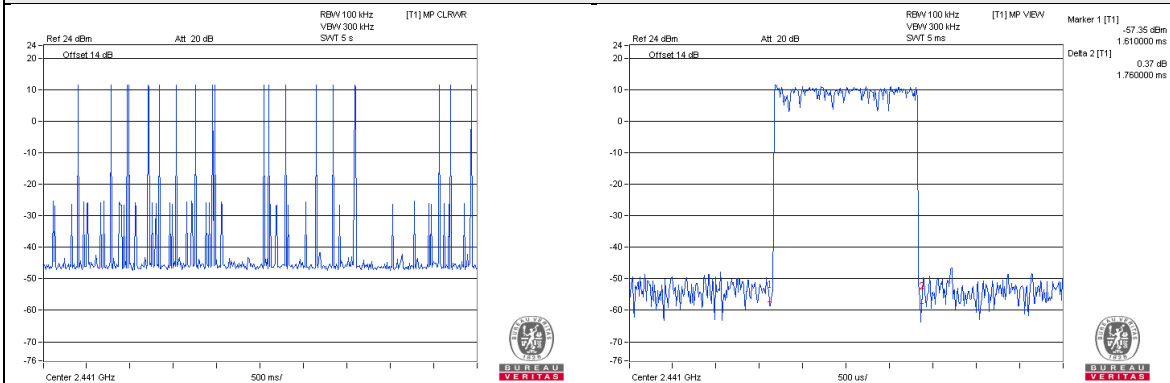
Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316 times	0.444	140.3	400
DH3	19 (times / 5 sec) * 6.32 = 120.08 times	1.76	211.34	400
DH5	10 (times / 5 sec) * 6.32 = 63.2 times	3.056	193.14	400

NOTE: Test plots of the transmitting time slot are shown on next page.

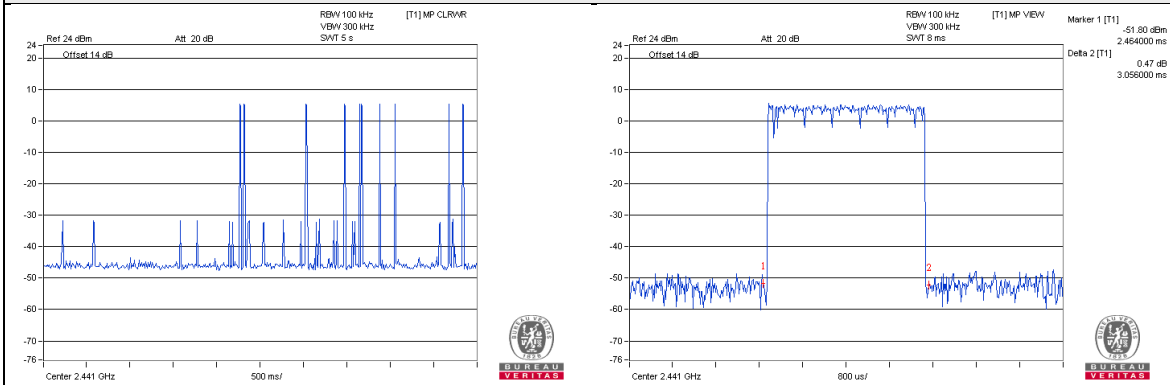
DH1



DH3



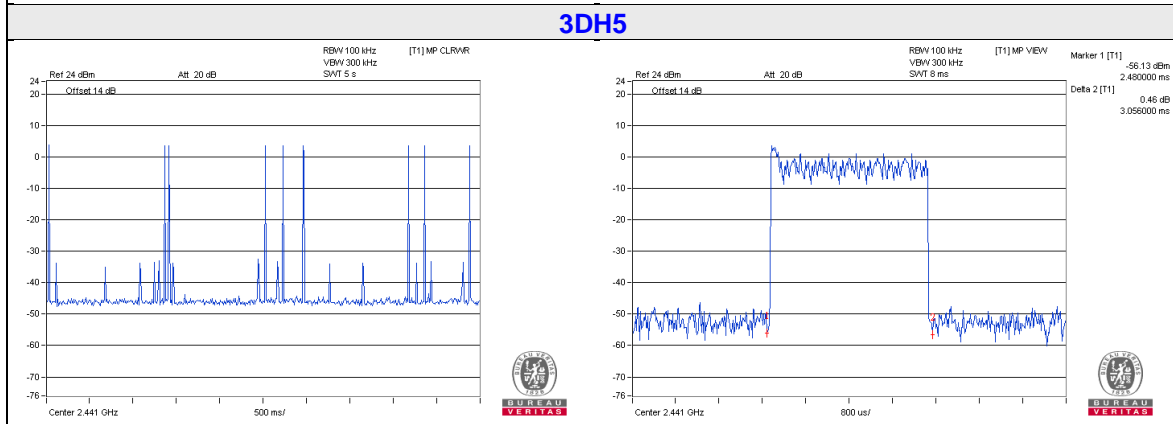
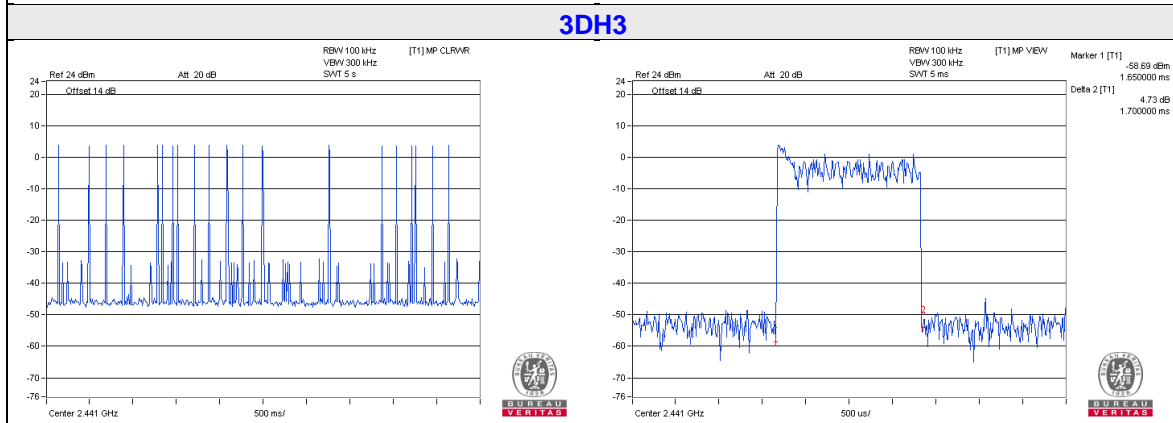
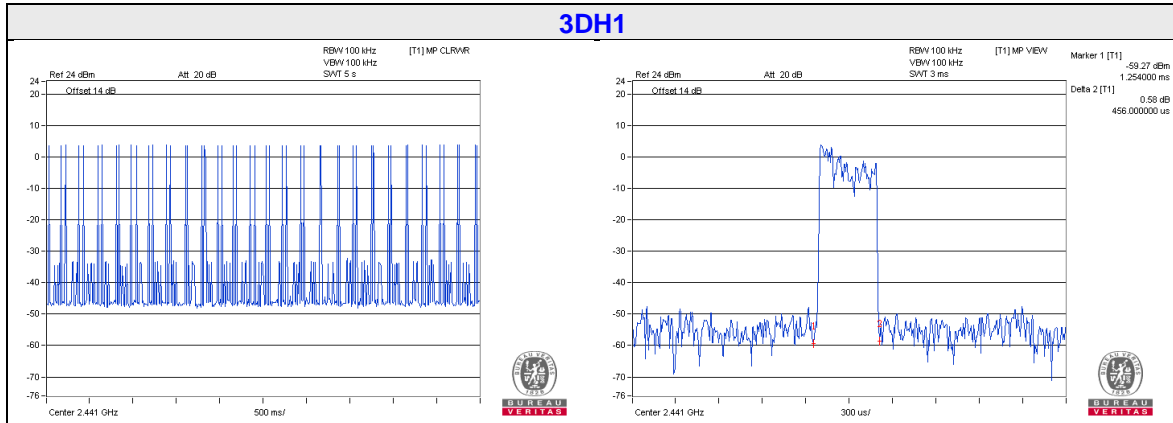
DH5



8DPSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
3DH1	50 (times / 5 sec) * 6.32 = 316 times	0.456	144.1	400
3DH3	20 (times / 5 sec) * 6.32 = 126.4 times	1.7	214.88	400
3DH5	9 (times / 5 sec) * 6.32 = 56.88 times	3.056	173.83	400

NOTE: Test plots of the transmitting time slot are shown on next page.

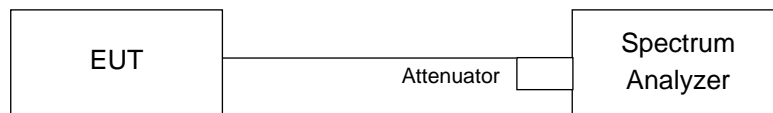


4.4 Channel Bandwidth

4.4.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall 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

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

4.4.5 Deviation from Test Standard

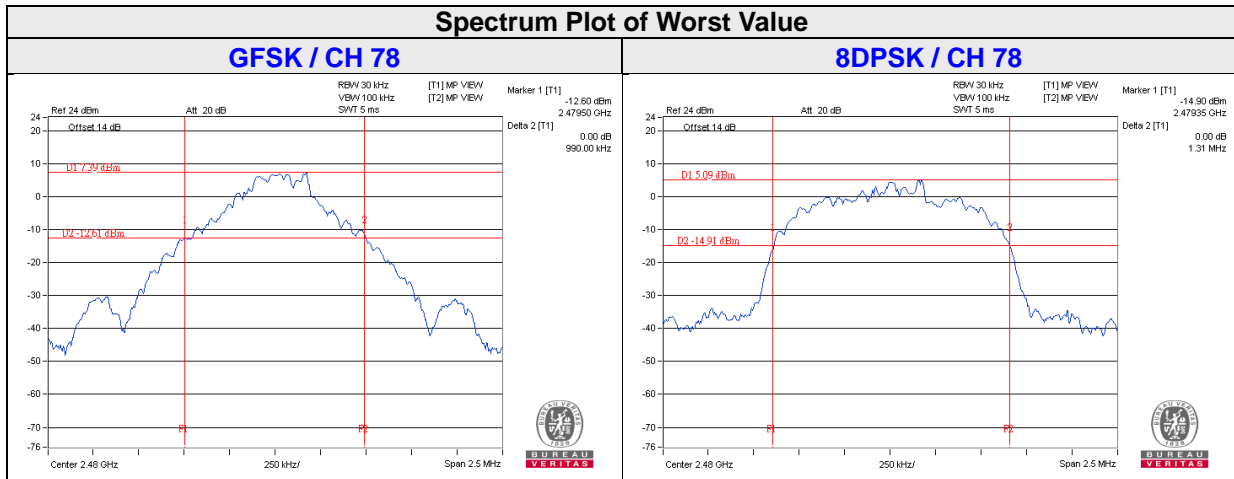
No deviation.

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)	20dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.96	1.29
39	2441	0.95	1.29
78	2480	0.99	1.31

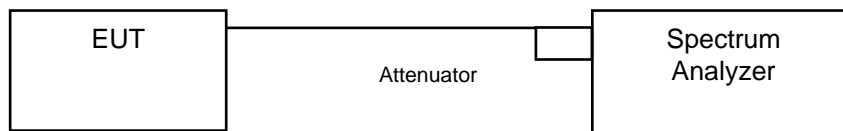


4.5 Hopping Channel Separation

4.5.1 Limits of Hopping Channel Separation Measurement

At least 25kHz or two-third of 20dB 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.

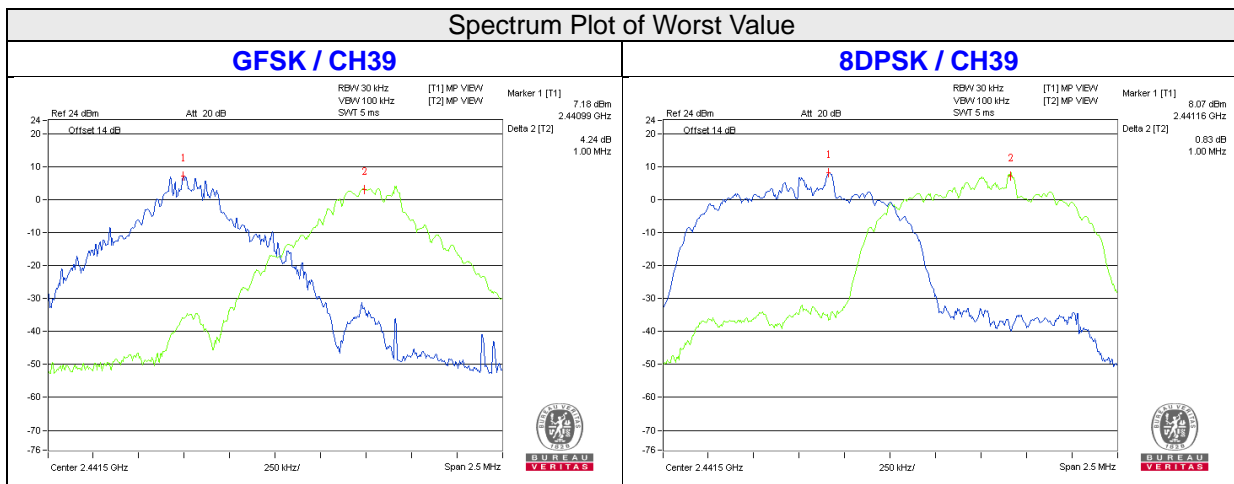
4.5.5 Deviation from Test Standard

No deviation.

4.5.6 Test Results

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)		20dB Bandwidth (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.00	1.00	0.96	1.29	0.64	0.86	Pass
39	2441	1.00	1.00	0.95	1.29	0.64	0.86	Pass
78	2480	1.00	1.00	0.99	1.31	0.66	0.88	Pass

NOTE: The minimum limit is two-third 20dB bandwidth.

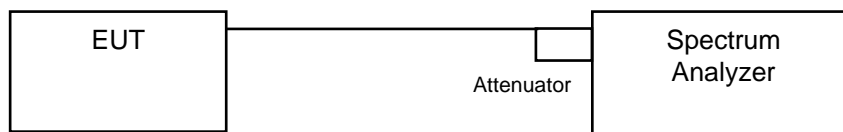


4.6 Maximum Output Power

4.6.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

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 3MHz 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 from Test Standard

No deviation.

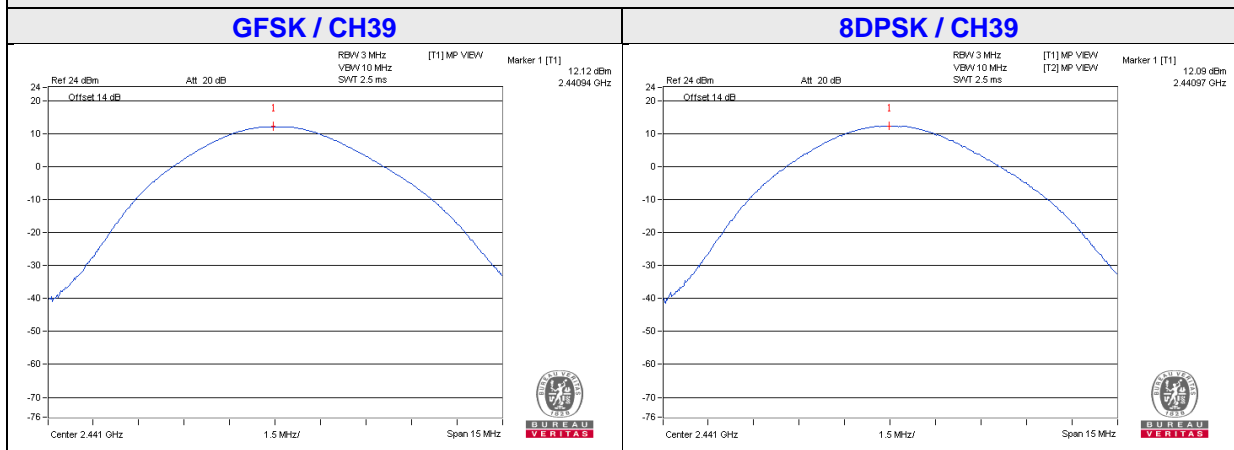
4.6.6 EUT Operating Condition

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	8DPSK	GFSK	8DPSK		
0	2402	10.839	11.246	10.35	10.51	125	Pass
39	2441	16.293	16.181	12.12	12.09	125	Pass
78	2480	10.186	10.617	10.08	10.26	125	Pass

Spectrum Plot of Worst Value



4.7 Conducted Out of Band Emission Measurement

4.7.1 Limits of Conducted Out of Band Emission Measurement

Below -20dB of the highest emission level of operating band (in 100kHz 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

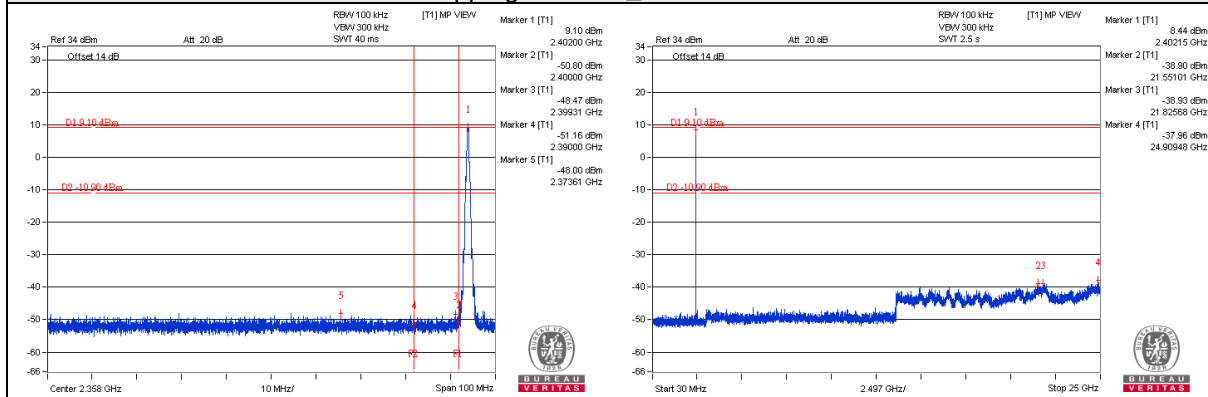
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.6 Test Results

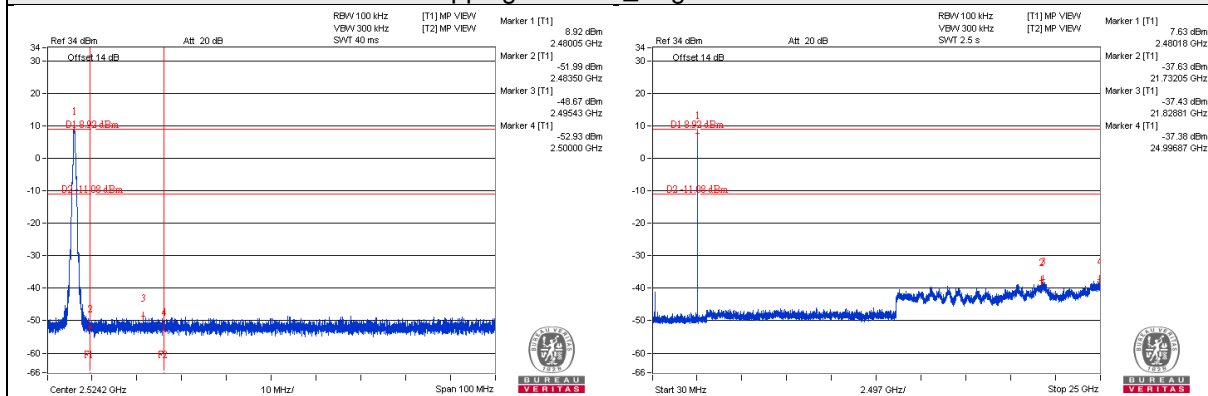
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

GFSK

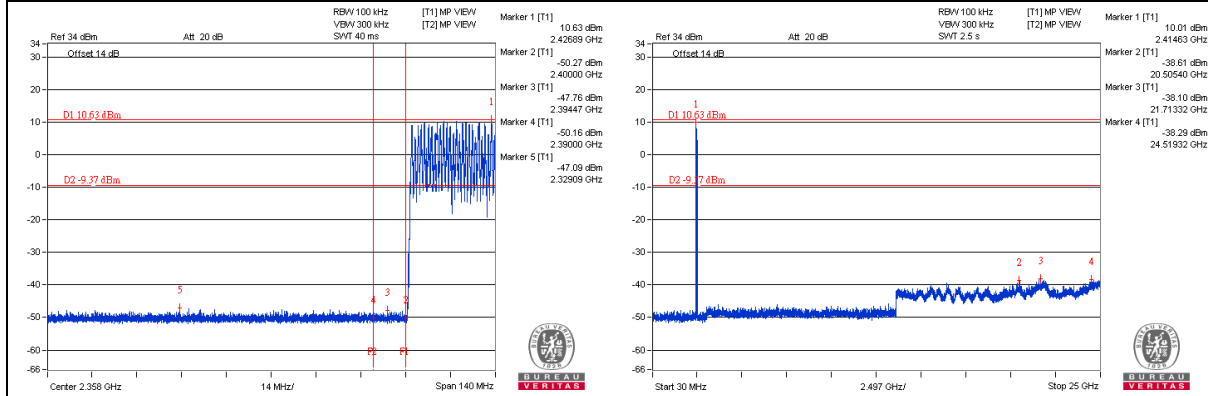
Hopping disabled Low Channel



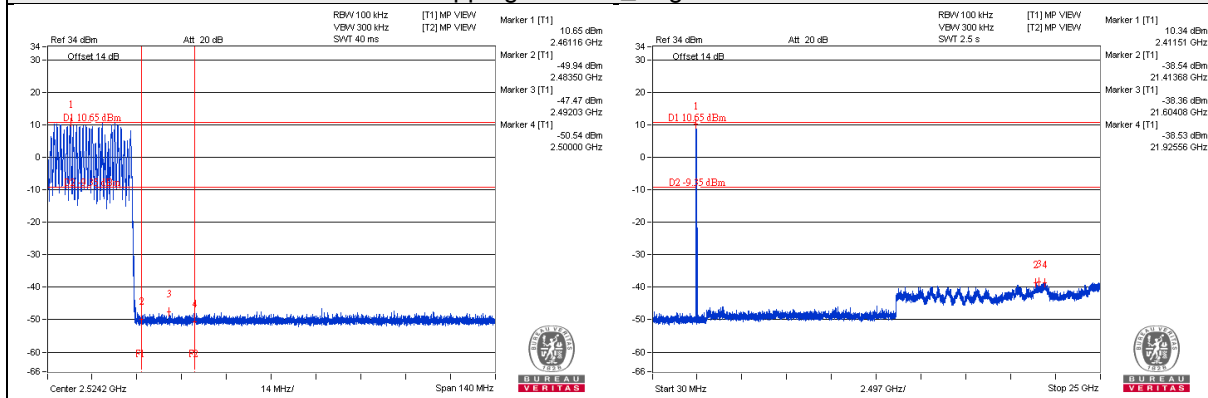
Hopping disabled High Channel



Hopping enabled Low Channel

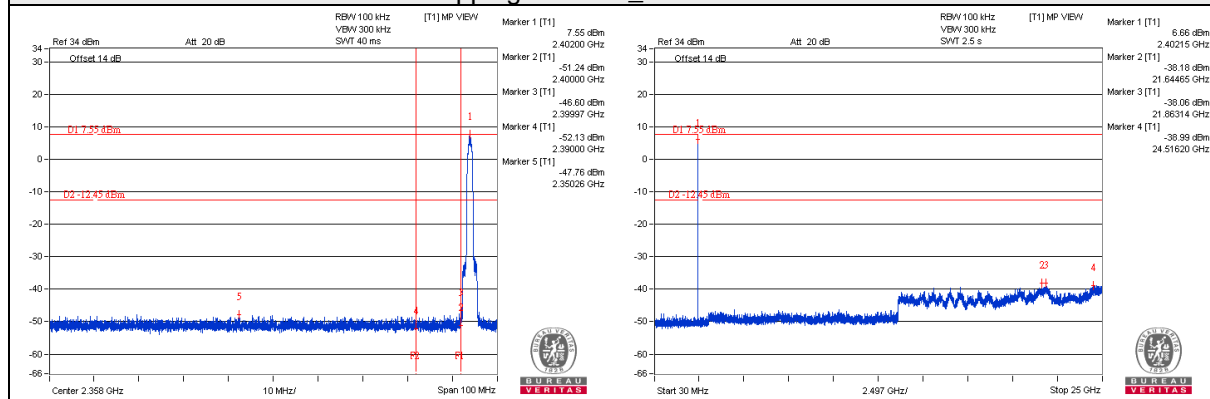


Hopping enabled High Channel

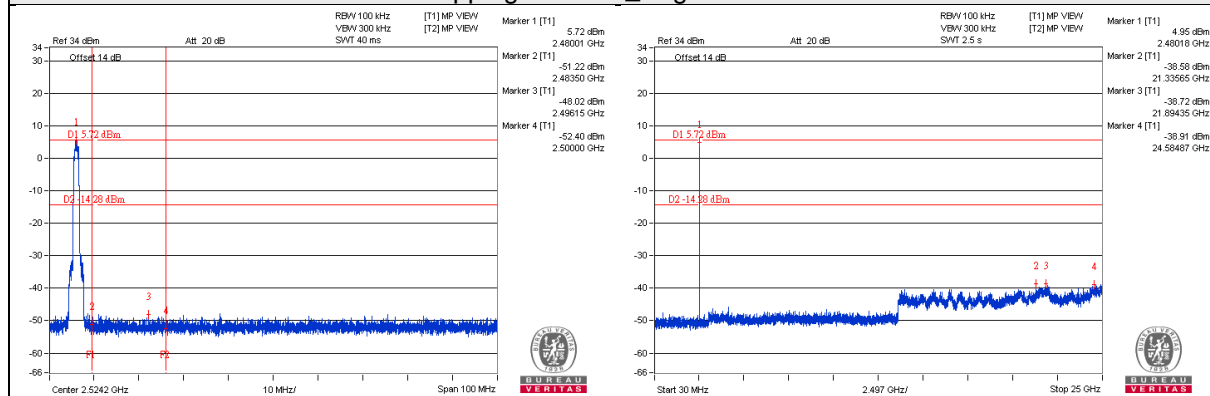


8DPSK

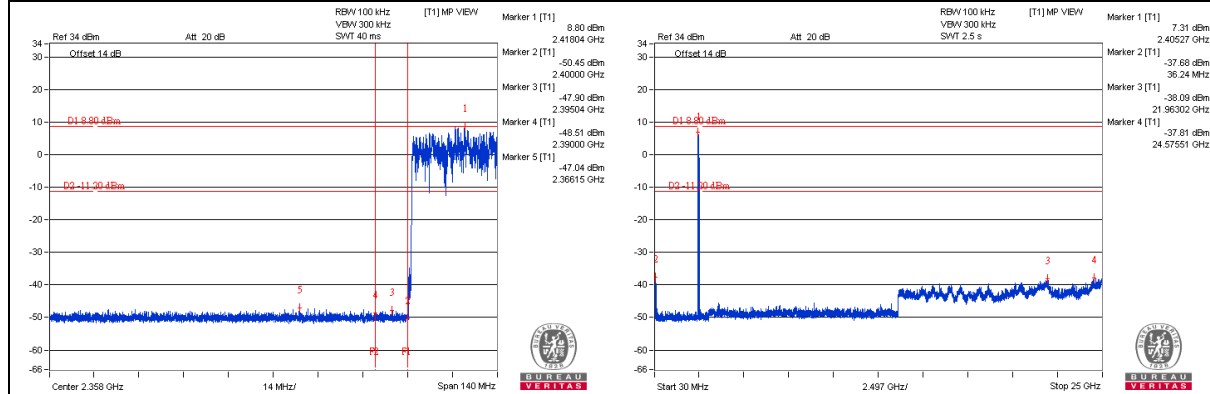
Hopping disabled Low Channel



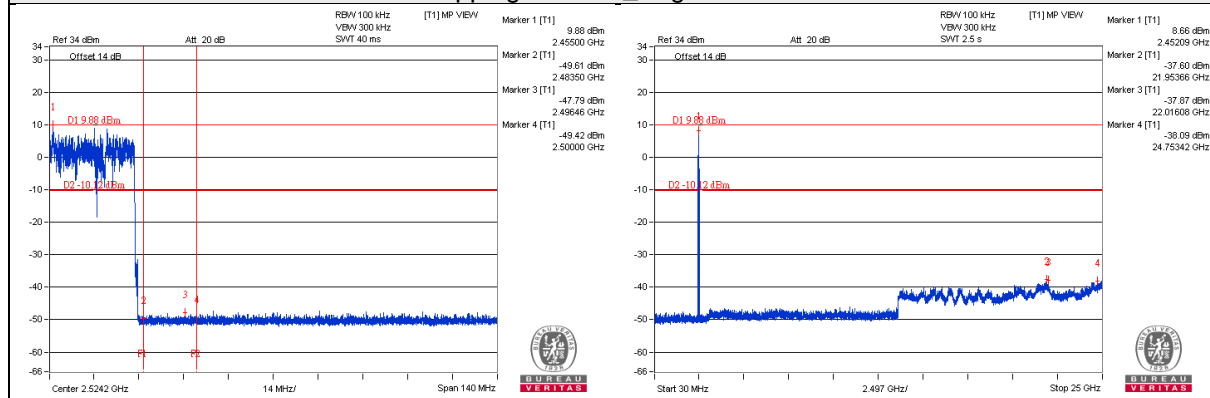
Hopping disabled High Channel



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

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