FCC Test Report (Bluetooth)

Report No.: RF150326E02C-3

FCC ID: 2AD8UFZPFWID01

Test Model: FWID

Received Date: Mar. 26, 2015

Test Date: Mar. 31 to June 16, 2015

Issued Date: July 27, 2015

Applicant: Nokia Solutions and Networks

Address: 1455 West Shure Drive, Arlington Heights, IL 60004, USA

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

Lab Address: No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan R.O.C.

Test Location (1): No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan R.O.C.

Test Location (2): No. 49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan R.O.C.

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Release Control Record

Issue No.	Description	Date Issued
RF150326E02C-3	Original release.	July 27, 2015

1 Certificate of Conformity

Product: Flexi Zone Indoor Pico BTS

Brand: Nokia

Test Model: FWID

Sample Status: ENGINEERING SAMPLE

Applicant: Nokia Solutions and Networks

Test Date: Mar. 31 to June 16, 2015

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2009

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:** July 27, 2015
(Midoli Peng, Specialist)

Approved by : _____ , **Date:** July 27, 2015
(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	PASS	Meet the requirement of limit. Minimum passing margin is -10.76dB at 4.24219MHz.
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 15.209 15.247(d)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -3.2dB at 33.92MHz.
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 2400-2483.5MHz 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	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.86 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.43 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.72 dB
	6GHz ~ 18GHz	4.00 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 (Bluetooth)

Product	Flexi Zone Indoor Pico BTS
Brand	Nokia
Test Model	FWID
Test Sample S/N	EA150710164
Hardware Version	473150A.X33 (Confirmation that the hardware version 473150A.X33 is fully identical with 473150A.101)
Software Version	Operating SW: FB_FZM_PS_LFS_OS_2014_05_59-0-g927a301 WiFi module SW: 9.8.1.0.14302702
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	12Vdc from power adapter or 55Vdc from POE
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	up to 3Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	79
Output Power	8.730mW
Antenna Type	Refer to note as below
Antenna Connector	Refer to note as below
Accessory Device	Adapter x1
Data Cable Supplied	NA

Note:

1. There are BT, LTE and GPS technology used for the EUT.
2. The emission of the simultaneous operation (BT & LTE) has been evaluated and no non-compliance was found.
3. The EUT must be supplied with a POE(option) or power adapter as following table:

Brand	Model No.	Spec.
DVE	DSA-60PFE-12 1 120500	Input: 100-240V, 2.0A, 50/60Hz AC input cable(1.8m, unshielded) Output: 12V, 5A DC output cable(1.2m, unshielded, with one core)

4. The EUT was pre-tested under following test modes :

Test Mode	Description
Mode A	**With POE**
Mode B	With adapter

For the above modes, the worst radaited emission (above 1GHz) test was found in **Mode A**. Therefore only the test data of the modes were recorded in this report.

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

LTE Antenna Spec.							
Antenna No	Brand	Model	Antenna Type	Antenna Connector	Gain(dBi) <Including cable loss>	Cable Length (mm)	Frequency (MHz)
Internal LTE (Main)	TongDa	T-543-8141050-6	PIFA	i-pex(MHF)	4.9	50	1710~2390 (Band 4)
Internal LTE (Aux)		T-543-8141050-7			4.6	190	1710~2390 (Band 4)
GPS Antenna Spec.							
Antenna No	Brand	Model	Antenna Type	Antenna Connector	Gain(dBi) <Including cable loss>	Cable Length (mm)	Frequency (MHz)
External GPS Ant	TongDa	T-543-8141037-9	ElecPatch	SMA Male	4.0	9140 ± 100	GPS：1575.42 ± 3 MHz Glonass：1602 ± 8 MHz
BT Antenna Spec.							
Antenna No	Brand	Model	Antenna Type	Antenna Connector	Gain(dBi) <Including cable loss>	Cable Length (mm)	Frequency (MHz)
Internal BT Ant	INPAQ	Fz PICO	Chip	NA	-1.22	NA	2400~2500

6. 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≥1G	RE<1G	PLC	APCM	
1	√	√	√	√	With POE
2	-	√	√	-	With adapter

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

NOTE: 1. "-"means no effect.
2. This device can be installed in different orientations (wall mounted or tabletop), so had been investigated two different orientations. The worst case was found when positioned on Y-plane

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.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
1	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.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
1	0 to 78	39	FHSS	GFSK	DH5
2	0 to 78	39	FHSS	GFSK	DH5

Power Line Conducted Emission Test:

☒ 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
1	0 to 78	39	FHSS	GFSK	DH5
2	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.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
1	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≥1G	24deg. C, 67%RH 22deg. C, 65%RH	120Vac, 60Hz	Tim Ho
RE<1G	21deg. C, 68%RH 23deg. C, 68%RH	120Vac, 60Hz	Gary Cheng Jason Huang
PLC	25deg. C, 65%RH	120Vac, 60Hz	Mike Hsieh Barry Lee
APCM	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

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	Remark
A	NOTEBOOK COMPUTER	DELL	E5430	HYV4VY1	FCC DoC	Provided by Lab
B	NOTEBOOK COMPUTER	DELL	E6420	H62T3R1	FCC DoC	Provided by Lab
C	POE ADAPTER	NA	PD-7001G	D11326441001235A01	FCC DoC	Provided by Lab
D	Bluetooth Simulator	Anritsu	MT8852B	1218002	NA	Provided by Lab

NOTE:

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

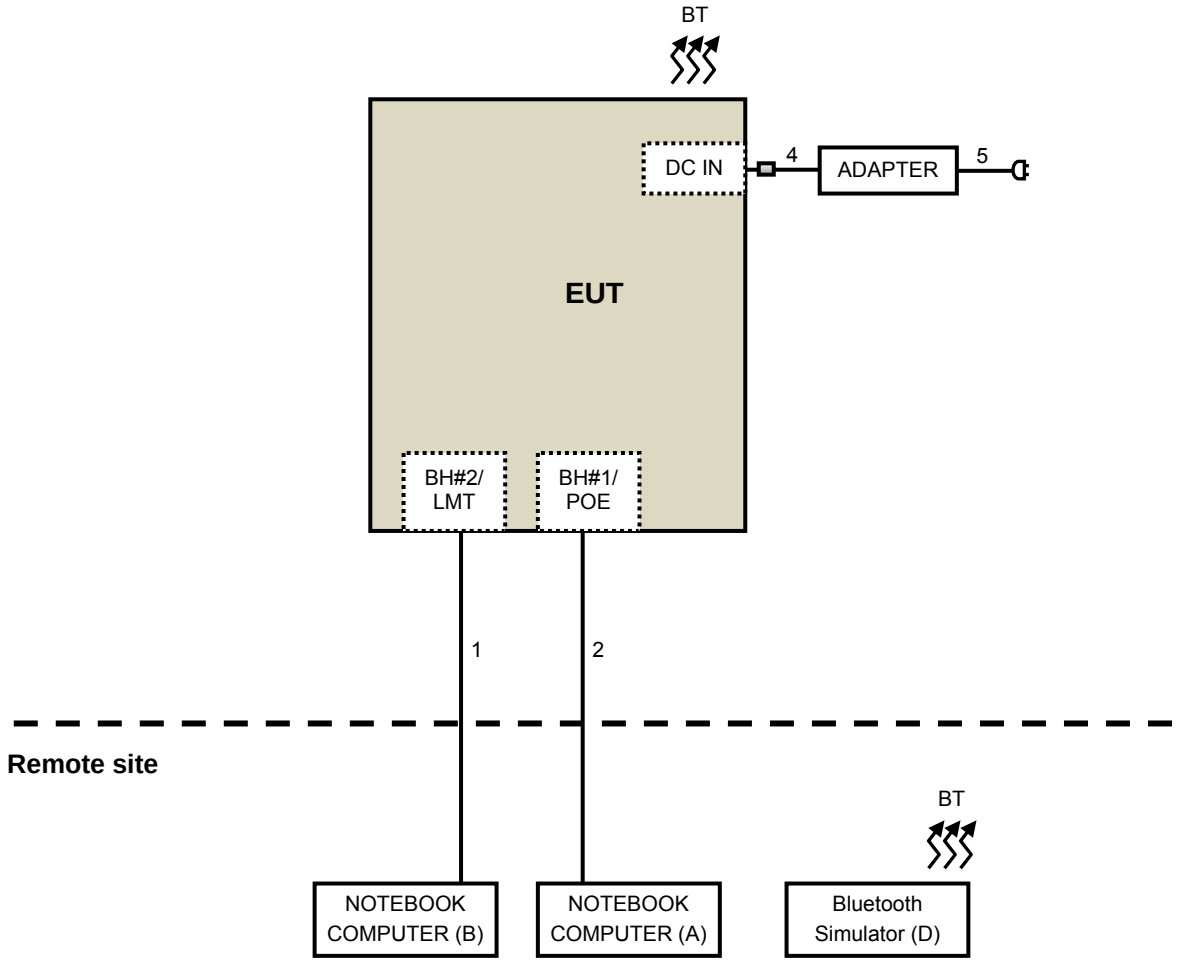
No.	Cable	Qty.	Length (m)	Shielded (Yes/ No)	Cores (Number)	Remark
1	RJ-45	1	10	No	0	Provided by Lab
2	RJ-45	1	10	No	0	Provided by Lab
3	RJ-45	1	1.5	No	0	Provided by Lab
4	DC	1	1.2	No	1	Supplied by Client
5	AC	1	1.8	Yes	0	Supplied by Client

NOTE:

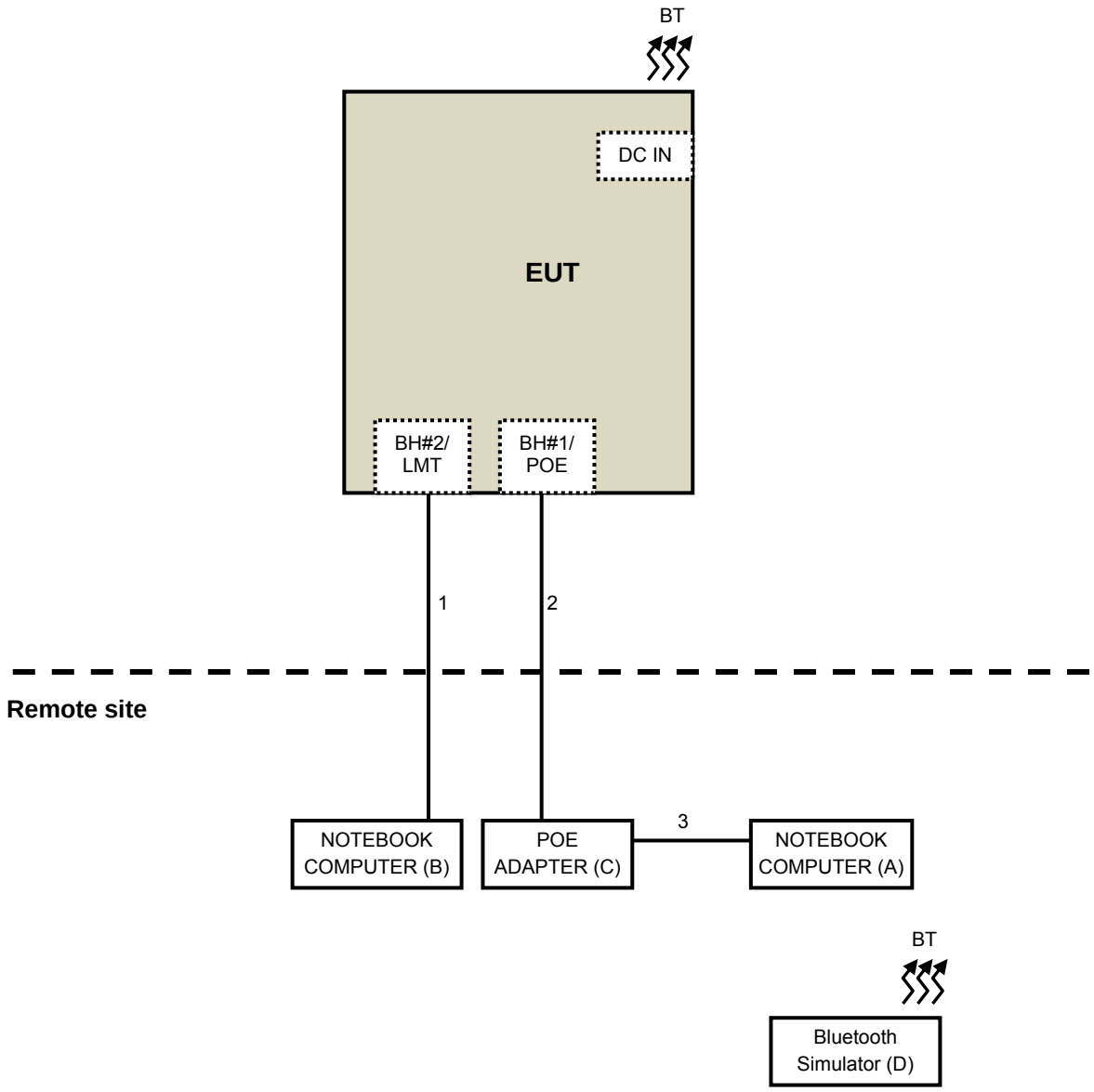
1. The core(s) is(are) originally attached to the cable(s).

3.3.1 Configuration of System under Test

For Adapter mode:



For POE mode:


BT
DC IN
EUT
BH#2/
LMT
BH#1/
POE
1
2
Remote site
NOTEBOOK
COMPUTER (B)
POE
ADAPTER (C)
3
NOTEBOOK
COMPUTER (A)
BT
Bluetooth
Simulator (D)

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 C63.10-2009

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
MXE EMI Receiver Agilent	N9038A	MY50010156	Aug. 11, 2014	Aug. 10, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-04	Nov. 12, 2014	Nov. 11, 2015
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Feb. 06, 2015	Feb. 05, 2016
RF Cable	NA	CHHCAB_001	Oct. 05, 2014	Oct. 04, 2015
Horn_Antenna AISI	AIH.8018	0000220091110	Aug. 26, 2014	Aug. 25, 2015
Pre-Amplifier Agilent	8449B	300801923	Oct. 28, 2014	Oct. 27, 2015
RF Cable	NA	131206 131213 131215 SNMY23685/4	Jan. 16, 2015	Jan. 15, 2016
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Dec. 12, 2014	Dec. 11, 2015
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Aug. 26, 2014	Aug. 25, 2015
RF Cable	NA	329751/4 RF104-204	Dec. 11, 2014	Dec. 10, 2015
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
3 The test was performed in 966 Chamber No. H.
4. The FCC Site Registration No. is 797305.
5 The CANADA Site Registration No. is IC 7450H-3.
6 Tested Date: Mar. 31 to June 10, 2015

4.1.3 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters 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 detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note:

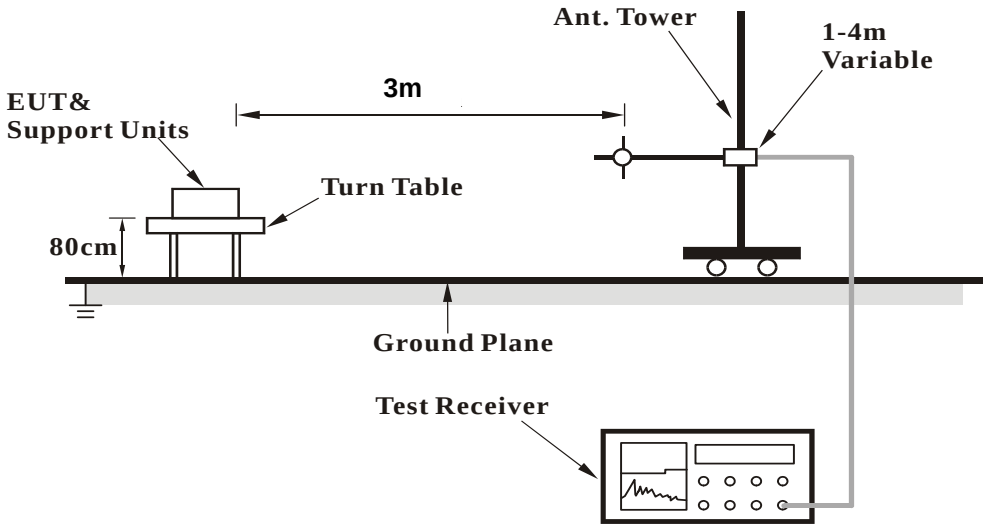
1. For emission measurements above 1 GHz, the EUT shall be placed at a height of 1.5 m above the ground at 3 meter chamber room for test
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
4. For Average measurement, due to 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: 20log(3.125 / 100)= -30.1 dB, therefore Average value = peak reading + 20log(duty cycle).
5. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

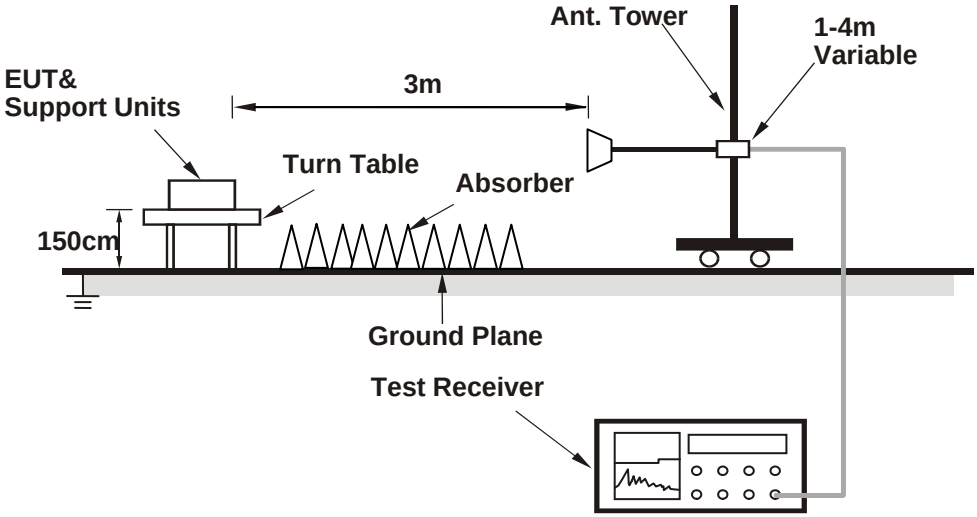
No deviation.

4.1.5 Test Setup

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



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

4.1.6 EUT Operating Conditions

1. Connect the EUT with the support units A-B (Notebook Computer) which is placed in remote site.
2. The communication partner run test program “MT8852B” to enable EUT under transmission/receiving condition continuously at specific channel frequency.

4.1.7 Test Results (Mode 1, Transmitter)

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	49.5 PK	74.0	-24.5	2.33 H	334	49.66	-0.16
2	2390.00	19.4 AV	54.0	-34.6	2.33 H	334	19.56	-0.16
3	*2402.00	94.0 PK			2.33 H	334	94.13	-0.13
4	*2402.00	63.9 AV			2.33 H	334	64.03	-0.13
5	4804.00	46.0 PK	74.0	-28.0	1.06 H	64	37.31	8.69
6	4804.00	15.9 AV	54.0	-38.1	1.06 H	64	7.21	8.69
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	48.3 PK	74.0	-25.7	1.98 V	256	48.46	-0.16
2	2390.00	18.2 AV	54.0	-35.8	1.98 V	256	18.36	-0.16
3	*2402.00	93.1 PK			1.98 V	256	93.23	-0.13
4	*2402.00	63.0 AV			1.98 V	256	63.13	-0.13
5	4804.00	46.2 PK	74.0	-27.8	1.10 V	314	37.51	8.69
6	4804.00	16.1 AV	54.0	-37.9	1.10 V	314	7.41	8.69

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(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	94.2 PK			2.38 H	359	94.22	-0.02
2	*2441.00	64.1 AV			2.38 H	359	64.12	-0.02
3	4882.00	45.8 PK	74.0	-28.2	1.01 H	58	36.87	8.93
4	4882.00	15.7 AV	54.0	-38.3	1.01 H	58	6.77	8.93
5	7323.00	54.4 PK	74.0	-19.6	1.03 H	311	37.91	16.49
6	7323.00	24.3 AV	54.0	-29.7	1.03 H	311	7.81	16.49
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	93.4 PK			1.98 V	261	93.42	-0.02
2	*2441.00	63.3 AV			1.98 V	261	63.32	-0.02
3	4882.00	46.4 PK	74.0	-27.6	1.03 V	317	37.47	8.93
4	4882.00	16.3 AV	54.0	-37.7	1.03 V	317	7.37	8.93
5	7323.00	54.1 PK	74.0	-19.9	1.10 V	82	37.61	16.49
6	7323.00	24.0 AV	54.0	-30.0	1.10 V	82	7.51	16.49

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(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	92.2 PK			2.33 H	350	92.09	0.11
2	*2480.00	62.1 AV			2.33 H	350	61.99	0.11
3	2483.50	50.9 PK	74.0	-23.1	2.33 H	350	50.79	0.11
4	2483.50	20.8 AV	54.0	-33.2	2.33 H	350	20.69	0.11
5	4960.00	46.1 PK	74.0	-27.9	1.03 H	62	36.83	9.27
6	4960.00	16.0 AV	54.0	-38.0	1.03 H	62	6.73	9.27
7	7440.00	54.2 PK	74.0	-19.8	1.09 H	319	37.58	16.62
8	7440.00	24.1 AV	54.0	-29.9	1.09 H	319	7.48	16.62
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	91.3 PK			1.82 V	254	91.19	0.11
2	*2480.00	61.2 AV			1.82 V	254	61.09	0.11
3	2483.50	49.7 PK	74.0	-24.3	1.82 V	254	49.59	0.11
4	2483.50	19.6 AV	54.0	-34.4	1.82 V	254	19.49	0.11
5	4960.00	46.0 PK	74.0	-28.0	1.05 V	284	36.73	9.27
6	4960.00	15.9 AV	54.0	-38.1	1.05 V	284	6.63	9.27
7	7440.00	54.0 PK	74.0	-20.0	1.06 V	69	37.38	16.62
8	7440.00	23.9 AV	54.0	-30.1	1.06 V	69	7.28	16.62

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(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	49.2 PK	74.0	-24.8	2.26 H	343	49.36	-0.16
2	2390.00	19.1 AV	54.0	-34.9	2.26 H	343	19.26	-0.16
3	*2402.00	94.5 PK			2.26 H	343	94.63	-0.13
4	*2402.00	64.4 AV			2.26 H	343	64.53	-0.13
5	4804.00	46.0 PK	74.0	-28.0	1.11 H	51	37.31	8.69
6	4804.00	15.9 AV	54.0	-38.1	1.11 H	51	7.21	8.69
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	48.9 PK	74.0	-25.1	1.89 V	259	49.06	-0.16
2	2390.00	18.8 AV	54.0	-35.2	1.89 V	259	18.96	-0.16
3	*2402.00	92.5 PK			1.89 V	259	92.63	-0.13
4	*2402.00	62.4 AV			1.89 V	259	62.53	-0.13
5	4804.00	45.4 PK	74.0	-28.6	1.17 V	284	36.71	8.69
6	4804.00	15.3 AV	54.0	-38.7	1.17 V	284	6.61	8.69

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(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	93.9 PK			2.34 H	353	93.92	-0.02
2	*2441.00	63.8 AV			2.34 H	353	63.82	-0.02
3	4882.00	46.5 PK	74.0	-27.5	1.02 H	69	37.57	8.93
4	4882.00	16.4 AV	54.0	-37.6	1.02 H	69	7.47	8.93
5	7323.00	54.5 PK	74.0	-19.5	1.11 H	287	38.01	16.49
6	7323.00	24.4 AV	54.0	-29.6	1.11 H	287	7.91	16.49
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	92.9 PK			1.95 V	260	92.92	-0.02
2	*2441.00	62.8 AV			1.95 V	260	62.82	-0.02
3	4882.00	45.1 PK	74.0	-28.9	1.15 V	270	36.17	8.93
4	4882.00	15.0 AV	54.0	-39.0	1.15 V	270	6.07	8.93
5	7323.00	54.5 PK	74.0	-19.5	1.03 V	64	38.01	16.49
6	7323.00	24.4 AV	54.0	-29.6	1.03 V	64	7.91	16.49

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(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	92.4 PK			2.36 H	360	92.29	0.11
2	*2480.00	62.3 AV			2.36 H	360	62.19	0.11
3	2483.50	50.6 PK	74.0	-23.4	2.36 H	360	50.49	0.11
4	2483.50	20.5 AV	54.0	-33.5	2.36 H	360	20.39	0.11
5	4960.00	45.0 PK	74.0	-29.0	1.14 H	66	35.73	9.27
6	4960.00	14.9 AV	54.0	-39.1	1.14 H	66	5.63	9.27
7	7440.00	54.2 PK	74.0	-19.8	1.00 H	289	37.58	16.62
8	7440.00	24.1 AV	54.0	-29.9	1.00 H	289	7.48	16.62
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	90.9 PK			1.88 V	264	90.79	0.11
2	*2480.00	60.8 AV			1.88 V	264	60.69	0.11
3	2483.50	49.1 PK	74.0	-24.9	1.88 V	264	48.99	0.11
4	2483.50	19.0 AV	54.0	-35.0	1.88 V	264	18.89	0.11
5	4960.00	45.7 PK	74.0	-28.3	1.14 V	309	36.43	9.27
6	4960.00	15.6 AV	54.0	-38.4	1.14 V	309	6.33	9.27
7	7440.00	54.3 PK	74.0	-19.7	1.10 V	69	37.68	16.62
8	7440.00	24.2 AV	54.0	-29.8	1.10 V	69	7.58	16.62

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: 20log(3.125 / 100)= -30.1 dB
7. Average value = peak reading + 20log(duty cycle).

BELOW 1GHz WORST-CASE DATA

BT_GFSK

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	Below 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	33.72	25.9 QP	40.0	-14.1	1.00 H	300	40.36	-14.44
2	125.12	35.4 QP	43.5	-8.1	1.23 H	157	50.07	-14.63
3	522.30	39.9 QP	46.0	-6.1	1.10 H	310	46.58	-6.72
4	750.15	35.7 QP	46.0	-10.3	1.10 H	302	37.67	-1.99
5	776.30	36.8 QP	46.0	-9.2	1.13 H	105	38.39	-1.61
6	959.78	38.4 QP	46.0	-7.6	1.12 H	312	37.19	1.19
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	**33.92**	**36.8 QP**	**40.0**	**-3.2**	**1.10 V**	**292**	**51.21**	**-14.39**
2	49.50	34.7 QP	40.0	-5.3	1.10 V	202	47.99	-13.27
3	125.21	28.8 QP	43.5	-14.7	1.10 V	100	43.41	-14.63
4	624.92	35.9 QP	46.0	-10.1	1.20 V	100	40.19	-4.33
5	921.92	36.3 QP	46.0	-9.7	1.20 V	110	35.41	0.88
6	959.92	38.8 QP	46.0	-7.2	1.30 V	110	37.59	1.19

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

4.1.8 Test Results (Mode 2, Transmitter)

BELOW 1GHz WORST-CASE DATA

BT_GFSK

CHANNEL	TX Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	Below 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	47.32	27.1 QP	40.0	-12.9	1.80 H	108	40.37	-13.31
2	99.26	31.2 QP	43.5	-12.3	1.80 H	357	48.73	-17.51
3	153.00	34.8 QP	43.5	-8.7	1.80 H	288	47.59	-12.81
4	500.01	33.2 QP	46.0	-12.8	1.50 H	338	40.36	-7.16
5	550.02	34.9 QP	46.0	-11.1	1.50 H	147	41.16	-6.30
6	921.62	39.3 QP	46.0	-6.7	1.50 H	15	38.48	0.86
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	47.22	33.5 QP	40.0	-6.5	1.50 V	337	46.83	-13.32
2	163.71	30.6 QP	43.5	-13.0	1.10 V	113	43.51	-12.96
3	300.78	33.9 QP	46.0	-12.2	1.50 V	24	45.72	-11.87
4	500.01	32.7 QP	46.0	-13.3	1.50 V	348	39.83	-7.16
5	600.02	33.9 QP	46.0	-12.1	1.10 V	168	38.58	-4.69
6	921.62	40.8 QP	46.0	-5.2	1.50 V	4	39.92	0.86

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 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver ROHDE & SCHWARZ	ESCS 30	847124/029	Oct. 22, 2014	Oct. 21, 2015
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK-8127	8127-522	Sep. 15, 2014	Sep. 14, 2015
Line-Impedance Stabilization Network (for Peripheral) ROHDE & SCHWARZ	ENV216	100071	Nov. 10, 2014	Nov. 09, 2015
RF Cable (JYEBAO)	5D-FB	COCCAB-001	Mar. 09, 2015	Mar. 08, 2016
50 ohms Terminator	N/A	EMC-03	Sep. 22, 2014	Sep. 21, 2015
50 ohms Terminator	N/A	EMC-02	Sep. 30, 2014	Sep. 29, 2015
Software ADT	BV ADT_Cond_V7.3.7.3	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 Shielded Room No. C.
3 The VCCI Con C Registration No. is C-3611.
4 Tested Date: Apr. 20, 2015

4.2.3 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

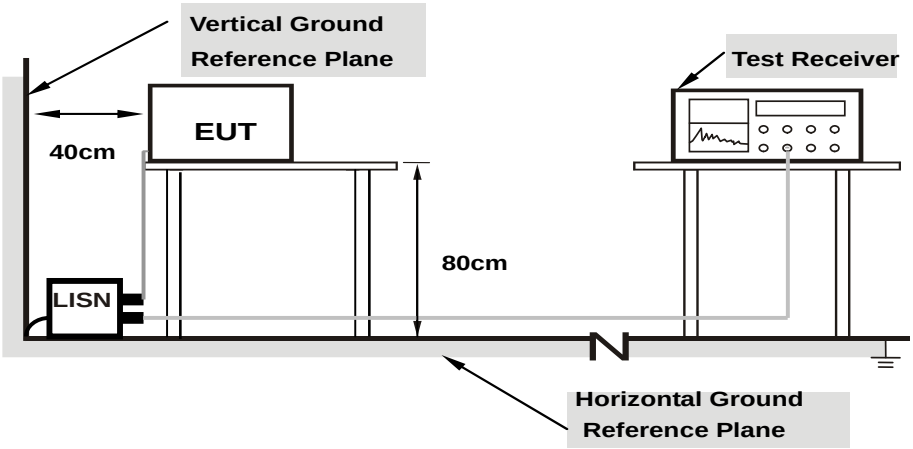
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



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

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

4.2.6 EUT Operating Condition

Same as 4.1.6.

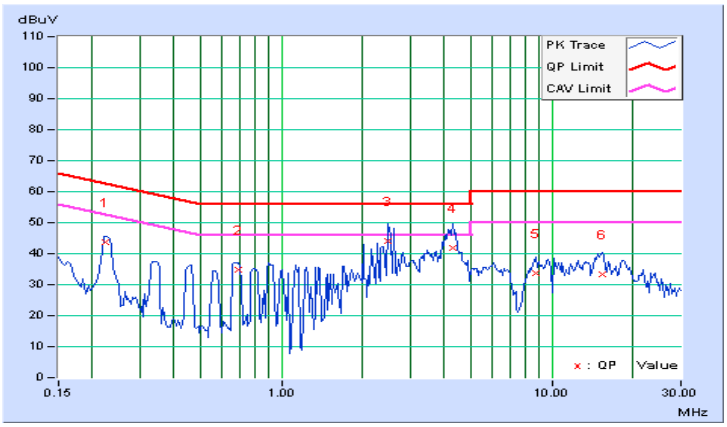
4.2.7 Test Results (Mode 1)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.22422	0.09	43.69	35.81	43.78	35.90	62.66	52.66	-18.88	-16.76
2	0.69297	0.11	34.87	25.95	34.98	26.06	56.00	46.00	-21.02	-19.94
3	2.46484	0.18	44.05	24.65	44.23	24.83	56.00	46.00	-11.77	-21.17
4	4.31250	0.23	41.48	34.12	41.71	34.35	56.00	46.00	-14.29	-11.65
5	8.75000	0.40	33.18	24.52	33.58	24.92	60.00	50.00	-26.42	-25.08
6	15.33984	0.58	32.78	26.06	33.36	26.64	60.00	50.00	-26.64	-23.36

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

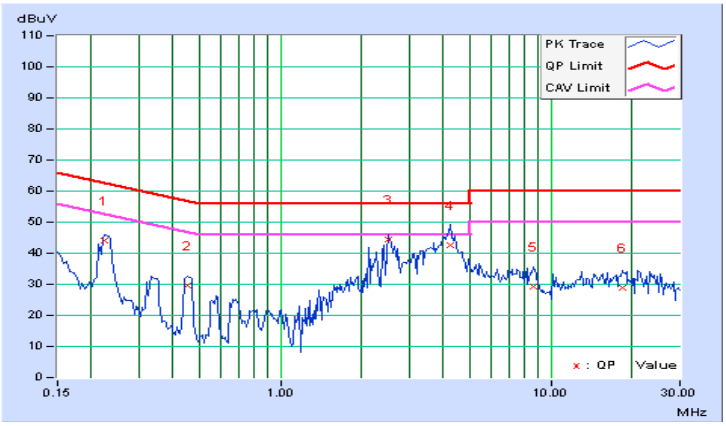


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.22422	0.08	43.93	35.39	44.01	35.47	62.66	52.66	-18.65	-17.19
2	0.45078	0.10	29.64	20.61	29.74	20.71	56.86	46.86	-27.12	-26.15
3	2.50000	0.19	44.41	26.52	44.60	26.71	56.00	46.00	-11.40	-19.29
4	**4.24219**	**0.24**	**42.49**	**35.00**	**42.73**	**35.24**	**56.00**	**46.00**	**-13.27**	**-10.76**
5	8.57813	0.41	28.85	19.60	29.26	20.01	60.00	50.00	-30.74	-29.99
6	18.35938	0.69	28.06	21.38	28.75	22.07	60.00	50.00	-31.25	-27.93

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



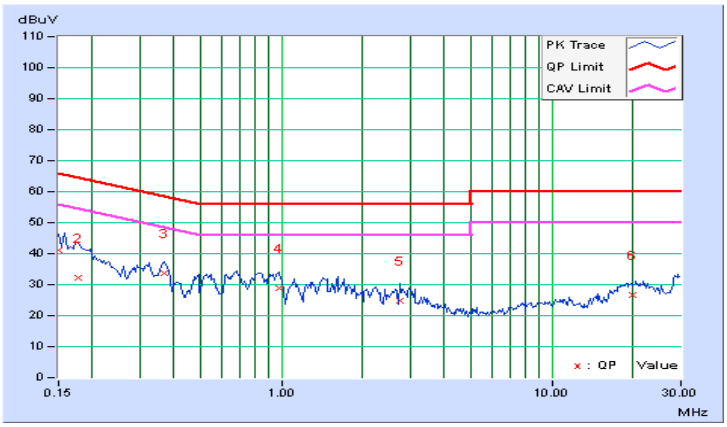
4.2.8 Test Results (Mode 2)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	0.08	40.93	30.00	41.01	30.08	66.00	56.00	-24.99	-25.92
2	0.17734	0.09	32.00	11.14	32.09	11.23	64.61	54.61	-32.52	-43.38
3	0.36875	0.10	33.43	26.55	33.53	26.65	58.53	48.53	-25.00	-21.88
4	0.98594	0.13	28.78	20.95	28.91	21.08	56.00	46.00	-27.09	-24.92
5	2.73828	0.19	24.60	16.55	24.79	16.74	56.00	46.00	-31.21	-29.26
6	19.86328	0.70	25.97	20.96	26.67	21.66	60.00	50.00	-33.33	-28.34

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

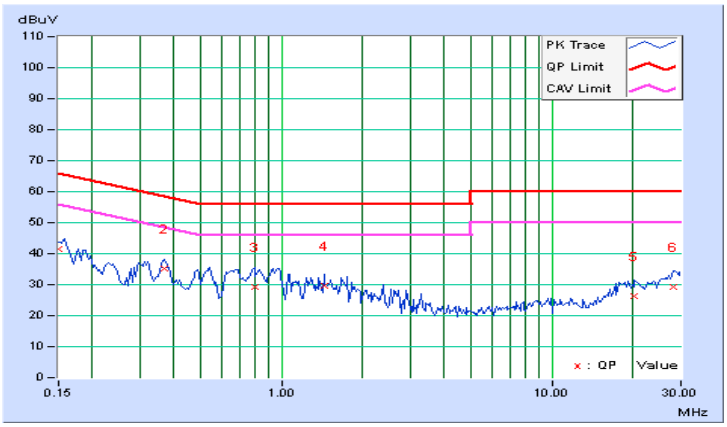


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	0.08	41.58	30.73	41.66	30.81	66.00	56.00	-24.34	-25.19
2	0.36875	0.10	35.18	28.20	35.28	28.30	58.53	48.53	-23.25	-20.23
3	0.79453	0.12	29.11	20.67	29.23	20.79	56.00	46.00	-26.77	-25.21
4	1.43750	0.15	29.56	22.19	29.71	22.34	56.00	46.00	-26.29	-23.66
5	20.23438	0.75	25.70	20.66	26.45	21.41	60.00	50.00	-33.55	-28.59
6	28.01953	0.93	28.50	23.72	29.43	24.65	60.00	50.00	-30.57	-25.35

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

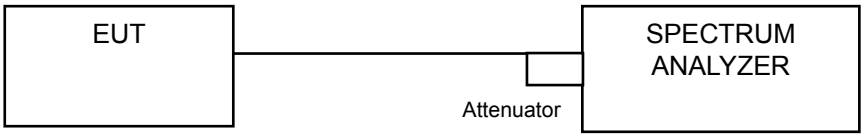


4.3 Number of Hopping Frequency Used

4.3.1 Limits of Hopping Frequency Used Measurement

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

4.3.2 Test Setup



4.3.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.3.4 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.

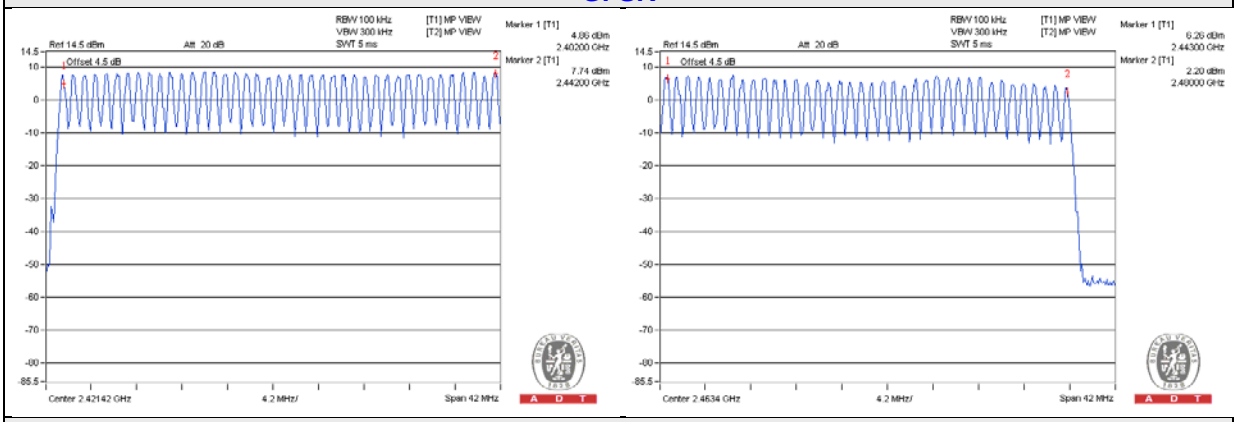
4.3.5 Deviation fromTest Standard

No deviation.

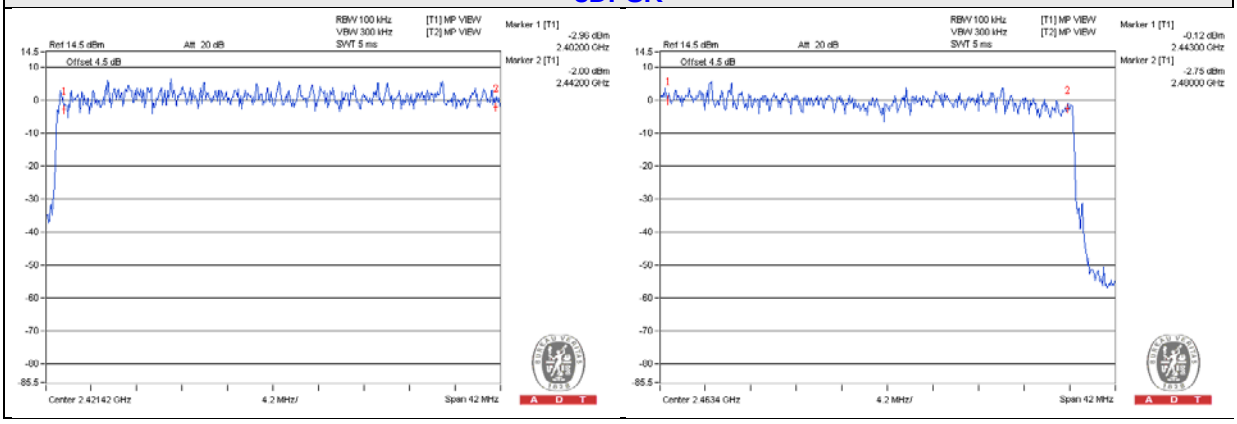
4.3.6 Test Results

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.

GFSK



8DPSK

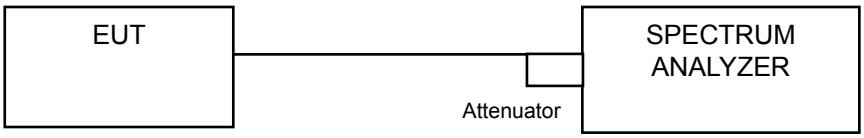


4.4 Dwell Time on Each Channel

4.4.1 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.

4.4.2 Test Setup



4.4.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.4.4 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.

.

4.4.5 Deviation from Test Standard

No deviation.

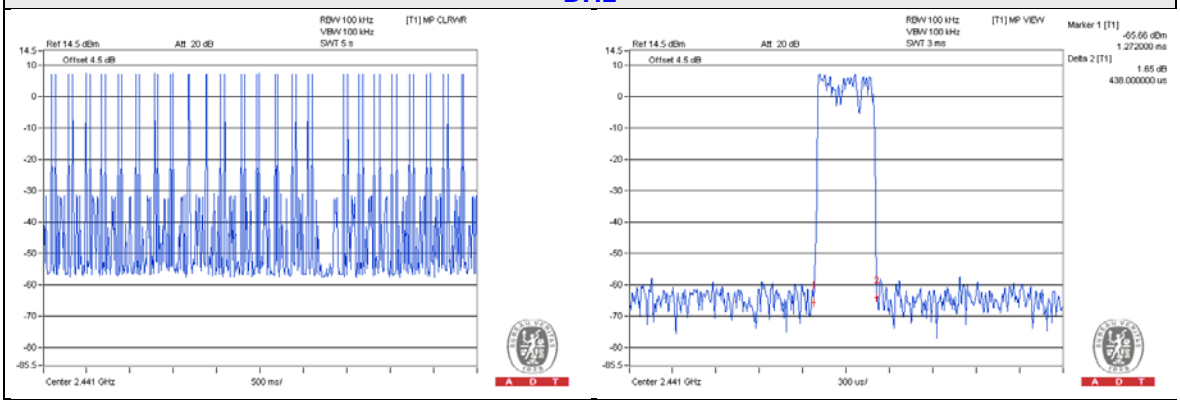
4.4.6 Test Results

GFSK

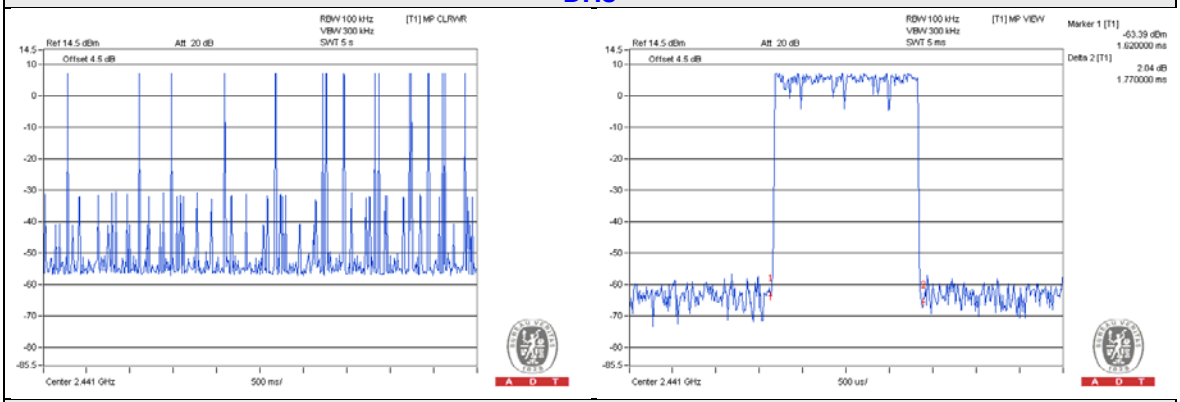
Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	46 (times / 5 sec) * 6.32 = 290.72 times	0.438	127.34	400
DH3	16 (times / 5 sec) * 6.32 = 101.12 times	1.77	178.98	400
DH5	9 (times / 5 sec) * 6.32 = 56.88 times	2.976	169.27	400

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

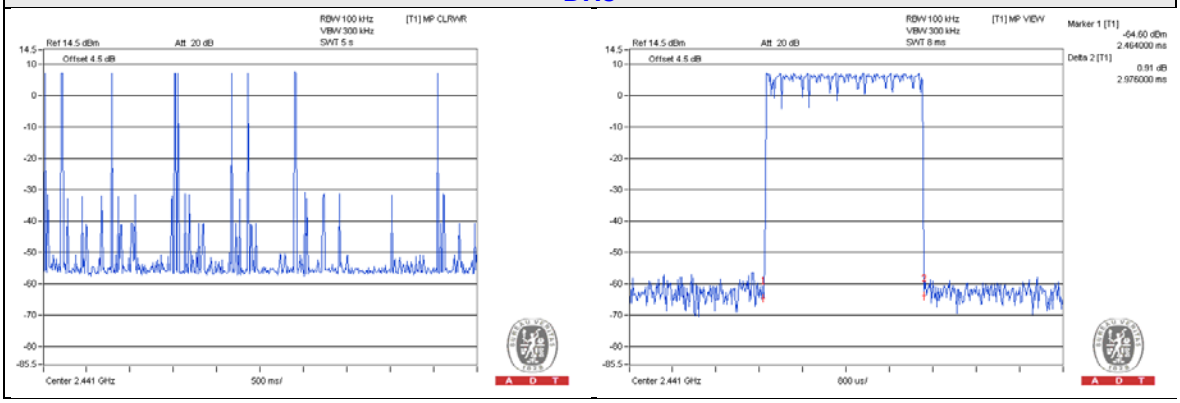
DH1


RBW 100 kHz
VBW 100 kHz
SWT 5 s
[T1] MP CLRWR
Ref 14.5 dBm
Att 20 dB
Offset 4.5 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 100 kHz
SWT 3 ms
[T1] MP VIEW
Marker 1 [T1]
-65.66 dBm
1.272000 ms
Delta 2 [T1]
1.65 dB
438.000000 us
Center 2.441 GHz
300 us/

DH3


RBW 100 kHz
VBW 300 kHz
SWT 5 s
[T1] MP CLRWR
Ref 14.5 dBm
Att 20 dB
Offset 4.5 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 300 kHz
SWT 5 ms
[T1] MP VIEW
Marker 1 [T1]
-63.39 dBm
1.620000 ms
Delta 2 [T1]
2.04 dB
1.770000 ms
Center 2.441 GHz
500 us/

DH5

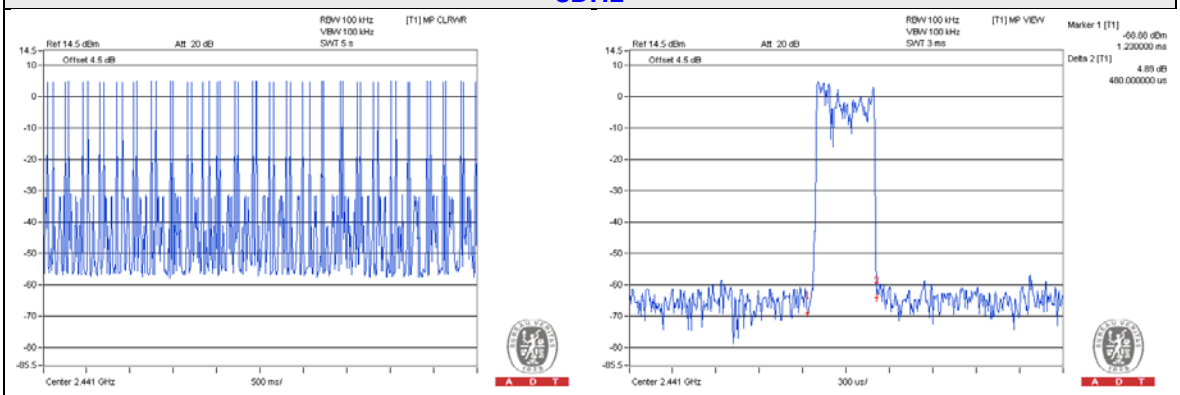

RBW 100 kHz
VBW 300 kHz
SWT 5 s
[T1] MP CLRWR
Ref 14.5 dBm
Att 20 dB
Offset 4.5 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 300 kHz
SWT 8 ms
[T1] MP VIEW
Marker 1 [T1]
-64.60 dBm
2.464000 ms
Delta 2 [T1]
0.91 dB
2.976000 ms
Center 2.441 GHz
800 us/

8DPSK

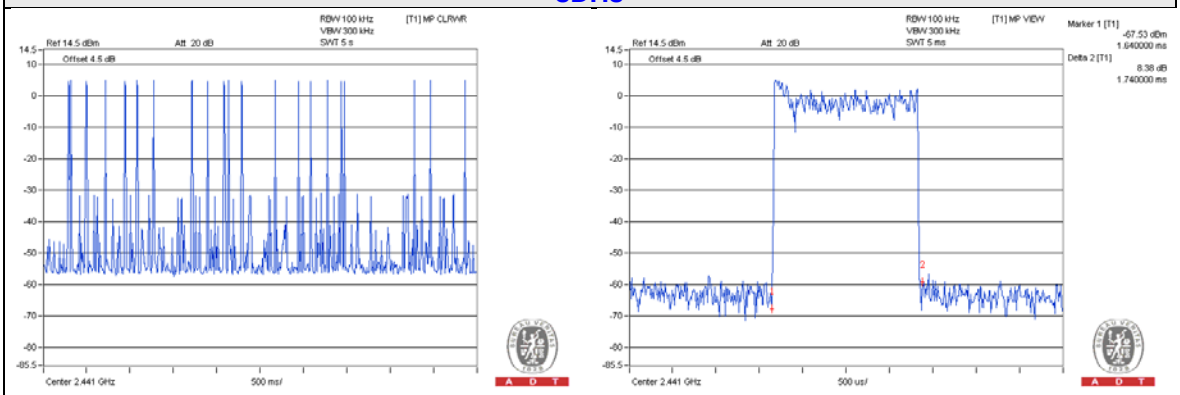
Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
3DH1	51 (times / 5 sec) * 6.32 = 322.32 times	0.48	154.71	400
3DH3	21 (times / 5 sec) * 6.32 = 132.72 times	1.74	230.93	400
3DH5	16 (times / 5 sec) * 6.32 = 101.12 times	3.024	305.79	400

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

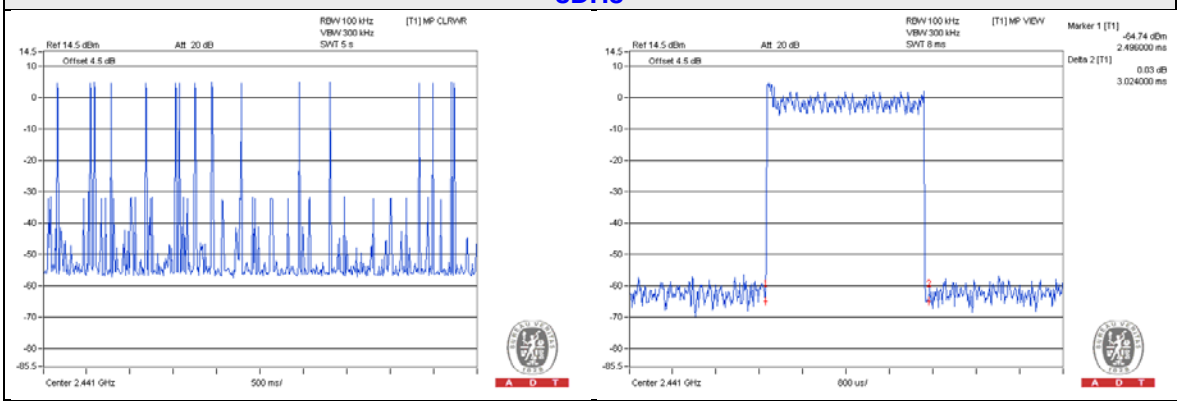
3DH1



3DH3



3DH5



4.5 Channel Bandwidth

4.5.1 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 20dBbandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

4.5.2 Test Setup

4.5.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.5.4 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 20dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Detector = peak.
e. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

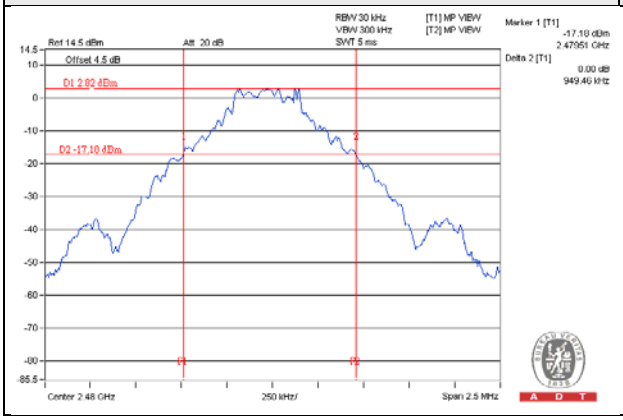
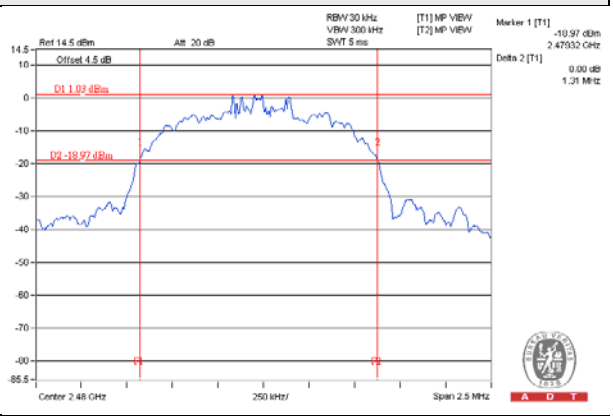
No deviation.

4.5.6 EUT Operating Condition

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

4.5.7 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.94	1.29
39	2441	0.94	1.30
78	2480	0.94	1.31

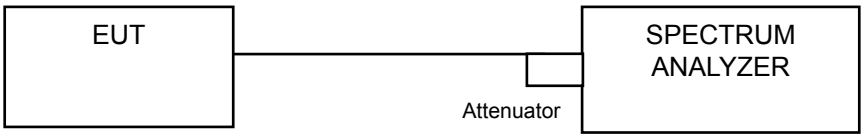
Spectrum Plot of Worst Value	
GFSK / CH78	8DPSK / CH78
	

4.6 Hopping Channel Separation

4.6.1 Limits of Hopping Channel Separation Measurement

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

4.6.2 Test Setup



4.6.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.6.4 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.

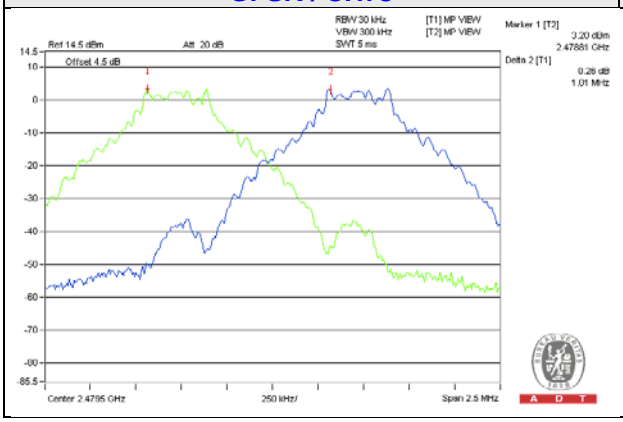
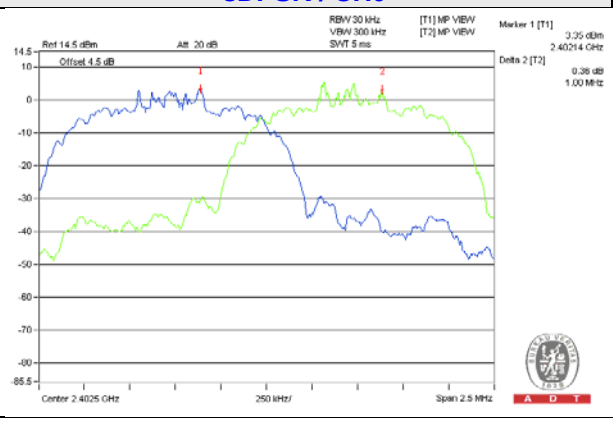
4.6.5 Deviation from Test Standard

No deviation.

4.6.6 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	1.01	1.00	0.94	1.29	0.63	0.86	Pass
39	2441	1.01	1.00	0.94	1.30	0.63	0.87	Pass
78	2480	1.01	1.00	0.94	1.31	0.63	0.88	Pass

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

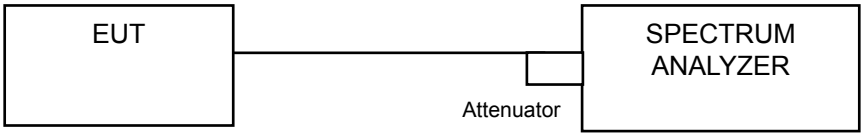
Spectrum Plot of Worst Value	
GFSK / CH78	**8DPSK / CH0**
	

4.7 Maximum Output Power

4.7.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

4.7.2 Test Setup



4.7.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.7.4 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. Detector = peak.

e. Measure the captured power within the band and recording the plot.

f. Repeat above procedures until all frequencies required were complete.

4.7.5 Deviation fromTest Standard

No deviation.

4.7.6 EUT Operating Condition

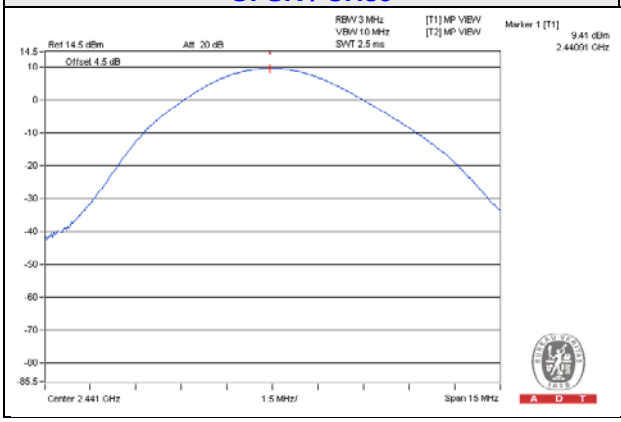
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

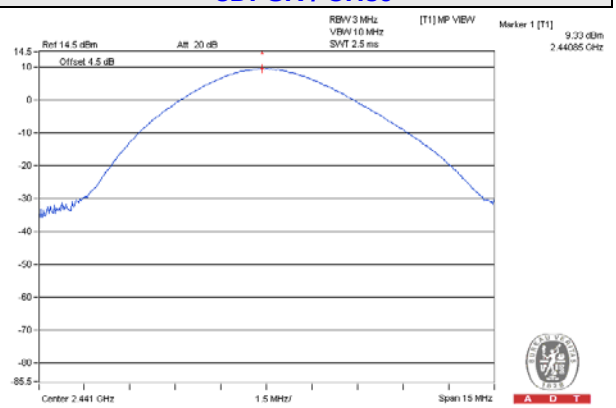
Channel	Frequency (MHz)	Output Power (mW)		Output Power (dBm)		Power Limit (mW)	Pass/Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	7.464	7.244	8.73	8.60	125	PASS
39	2441	8.730	8.570	9.41	9.33	125	PASS
78	2480	4.295	4.036	6.33	6.06	125	PASS

Spectrum Plot of Worst Value

GFSK / CH39



8DPSK / CH39



4.8 Conducted Out of Band Emission Measurement

4.8.1 Limits of Conducted Out of Band Emission Measurement

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

4.8.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

NOTE:
1. The test was performed in Oven room B.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 16, 2015

4.8.3 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.

4.8.4 Deviation from Test Standard

No deviation.

4.8.5 EUT Operating Condition

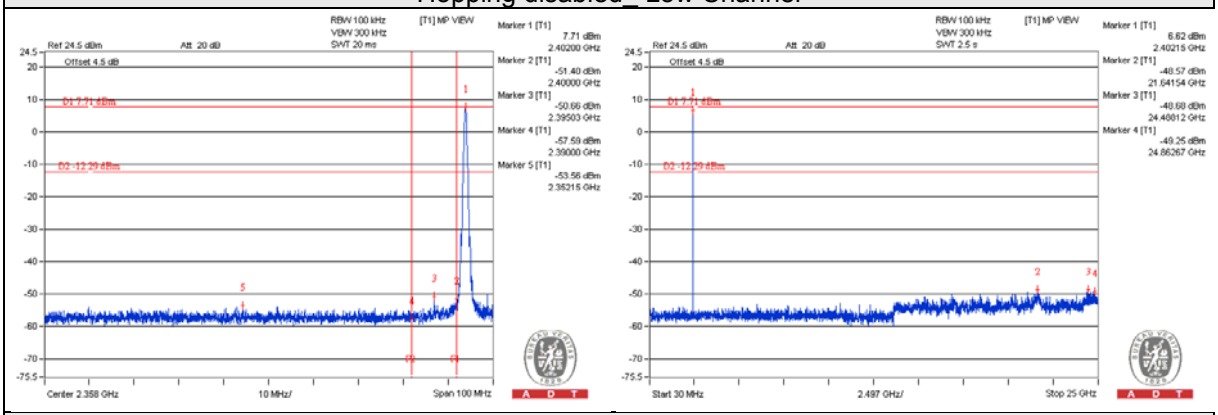
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.8.6 Test Results

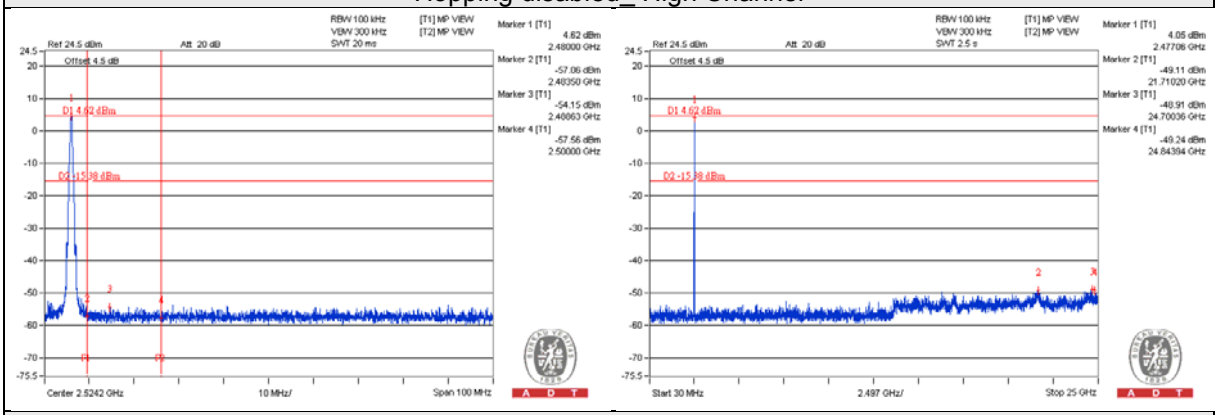
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

GFSK

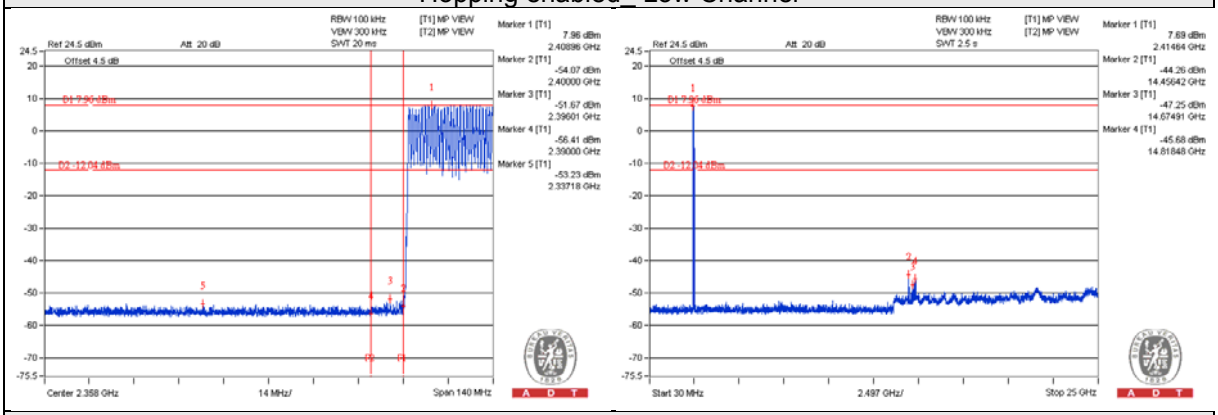
Hopping disabled_ Low Channel



Hopping disabled_ High Channel



Hopping enabled_ Low Channel



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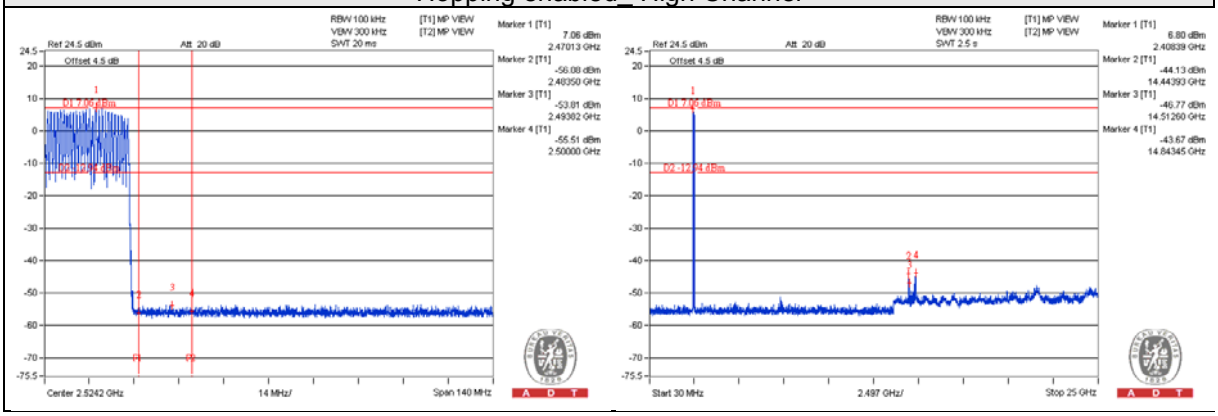

8DPSK

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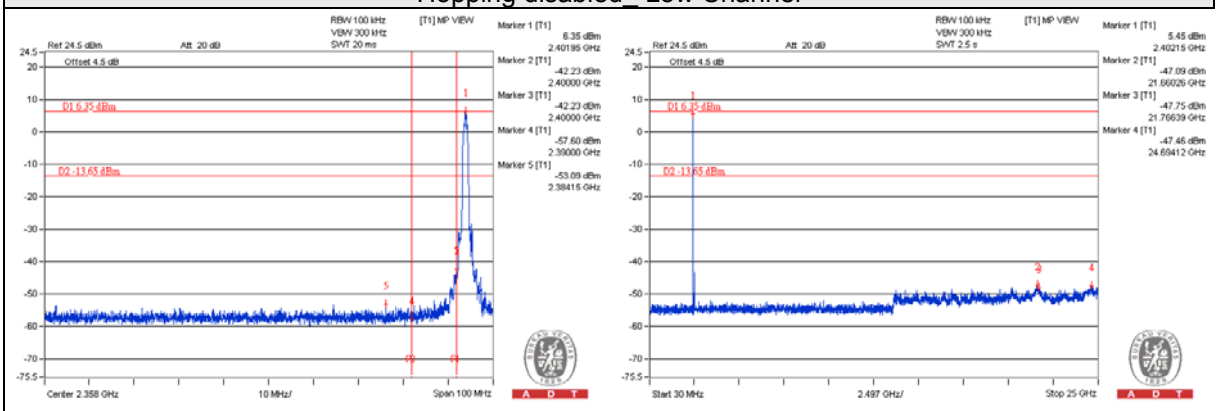

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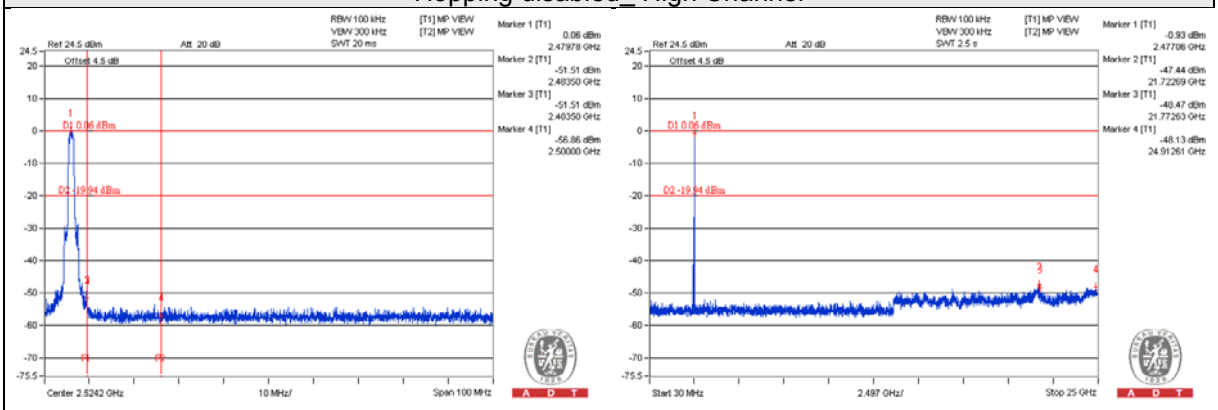

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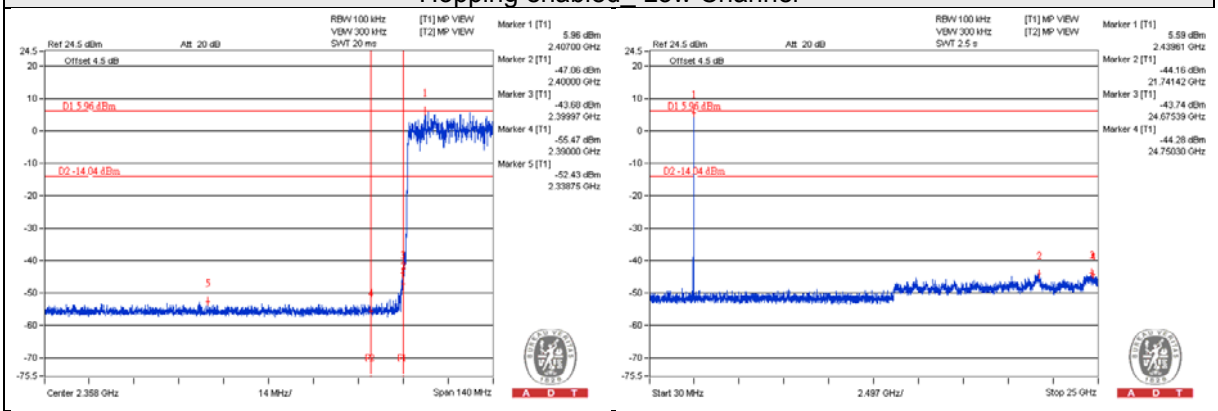

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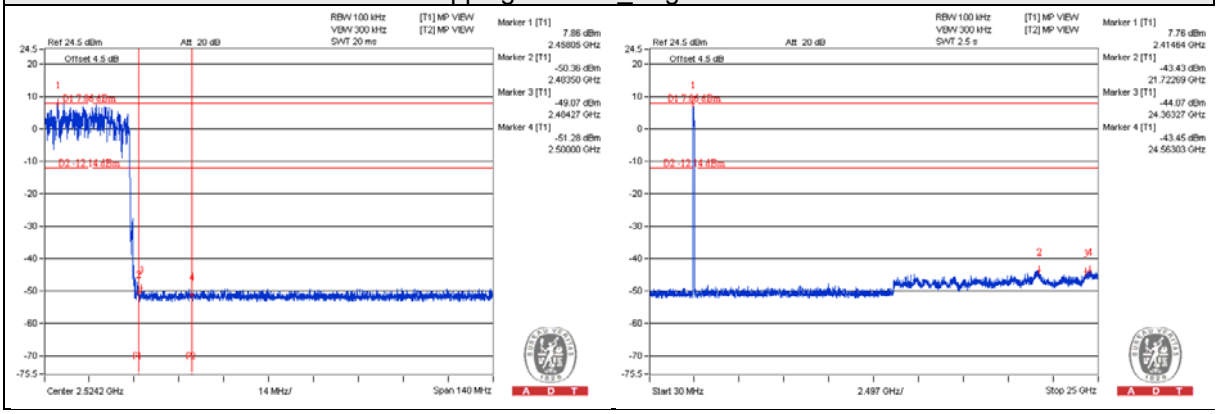

5 Pictures of Test Arrangements

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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