FCC Test Report (BT-EDR)

Report No.: RF161216E08-3

FCC ID: UAY-W8997-M1216

Test Model: W8997-M1216

Received Date: Dec. 16, 2016

Test Date: Dec. 19 to 28, 2016

Issued Date: Jan. 18, 2017

Applicant: Marvell Semiconductor

Address: 5488 Marvell Lane, Santa Clara CA95054 USA

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

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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 8
3.2.1 Test Mode Applicability and Tested Channel Detail 9
3.3 Description of Support Units 11
3.3.1 Configuration of System under Test 12
3.4 General Description of Applied Standards 13

4 Test Types and Results **14**

4.1 Radiated Emission and Bandedge Measurement 14
4.1.1 Limits of Radiated Emission and Bandedge Measurement 14
4.1.2 Test Instruments 15
4.1.3 Test Procedures 17
4.1.4 Deviation from Test Standard 18
4.1.5 Test Setup 18
4.1.6 EUT Operating Conditions 19
4.1.7 Test Results 20
4.2 Conducted Emission Measurement 27
4.2.1 Limits of Conducted Emission Measurement 27
4.2.2 Test Instruments 27
4.2.3 Test Procedures 28
4.2.4 Deviation From Test Standard 28
4.2.5 Test Setup 28
4.2.6 EUT Operating Condition 28
4.2.7 Test Results 29
4.3 Number of Hopping Frequency Used 31
4.3.1 Limits of Hopping Frequency Used Measurement 31
4.3.2 Test Setup 31
4.3.3 Test Instruments 31
4.3.4 Test Procedure 31
4.3.5 Deviation fromTest Standard 31
4.3.6 Test Results 32
4.4 Dwell Time on Each Channel 33
4.4.1 Limits of Dwell Time on Each Channel Measurement 33
4.4.2 Test Setup 33
4.4.3 Test Instruments 33
4.4.4 Test Procedures 33
4.4.5 Deviation from Test Standard 33
4.4.6 Test Results 34
4.5 Channel Bandwidth 38
4.5.1 Limits of Channel Bandwidth Measurement 38
4.5.2 Test Setup 38
4.5.3 Test Instruments 38
4.5.4 Test Procedure 38
4.5.5 Deviation from Test Standard 38
4.5.6 EUT Operating Condition 38
4.5.7 Test Results 39
4.6 Hopping Channel Separation 40
4.6.1 Limits of Hopping Channel Separation Measurement 40

4.6.2 Test Setup 40
4.6.3 Test Instruments 40
4.6.4 Test Procedure 40
4.6.5 Deviation from Test Standard 40
4.6.6 Test Results 41
4.7 Maximum Output Power 42
4.7.1 Limits of Maximum Output Power Measurement 42
4.7.2 Test Setup 42
4.7.3 Test Instruments 42
4.7.4 Test Procedure 42
4.7.5 Deviation from Test Standard 42
4.7.6 EUT Operating Condition 42
4.7.7 Test Results 43
4.8 Conducted Out of Band Emission Measurement 44
4.8.1 Limits of Conducted Out of Band Emission Measurement 44
4.8.2 Test Instruments 44
4.8.3 Test Procedure 44
4.8.4 Deviation from Test Standard 44
4.8.5 EUT Operating Condition 44
4.8.6 Test Results 44

5 Pictures of Test Arrangements 47

Appendix – Information on the Testing Laboratories 48

Release Control Record

Issue No.	Description	Date Issued
RF161216E08-3	Original release.	Jan. 18, 2017

1 Certificate of Conformity

Product:	IEEE 802.11 2X2 MU-MIMO ac/a/b/g/n Wireless LAN + Bluetooth NGFF Module
Brand:	Marvell
Test Model:	W8997-M1216
Sample Status:	ENGINEERING SAMPLE
Applicant:	Marvell Semiconductor
Test Date:	Dec. 19 to 28, 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 : Wendy Wu **Date:** Jan. 18, 2017

Wendy Wu / Specialist

Approved by : **Date:** Jan. 18, 2017

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 -17.17dB at 24.00391MHz.
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 -4.0dB at 59.95MHz.
15.247(d)	Antenna Port Emission	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is i-pex(MHF) 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) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (BT-EDR)

Product	IEEE 802.11 2X2 MU-MIMO ac/a/b/g/n Wireless LAN + Bluetooth NGFF Module
Brand	Marvell
Test Model	W8997-M1216
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	DC 3.3V from host equipment
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	4.592mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. There are WLAN, BT technology used for the EUT.
2. Simultaneously transmission condition.

Condition	Technology	
1	WLAN (2.4GHz)	Bluetooth
2	WLAN (5GHz)	Bluetooth
Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.		

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

Antenna Set.	Brand	Model	Chain No.	Antenna Net. Gain(dBi)	Frequency range (MHz)	Antenna Type	Connecter Type
1	MAG.LAYERS	MSA-4008-25GC1-A1	Chain 0(Aux)	2.98	2400~2500	PIFA	i-pex(MHF)
				5.16	4900~5900		
			Chain 1(Main)	2.98	2400~2500		
				5.16	4900~5900		
Note: For bluetooth will fix transmission on Chain (0).							

4. 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	
-	√	√	√	√	-

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. The EUT's antenna had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-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.

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	0	FHSS	8DPSK	3DH5

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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 78	0	FHSS	8DPSK	3DH5

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 (SYSTEM)	TESTED BY
RE≥1G	23deg. C, 67%RH	120Vac, 60Hz	Weiwei Lo
RE<1G	24deg. C, 65%RH	120Vac, 60Hz	Terry Huang
PLC	25deg. C, 75%RH	120Vac, 60Hz	Andy Ho
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.

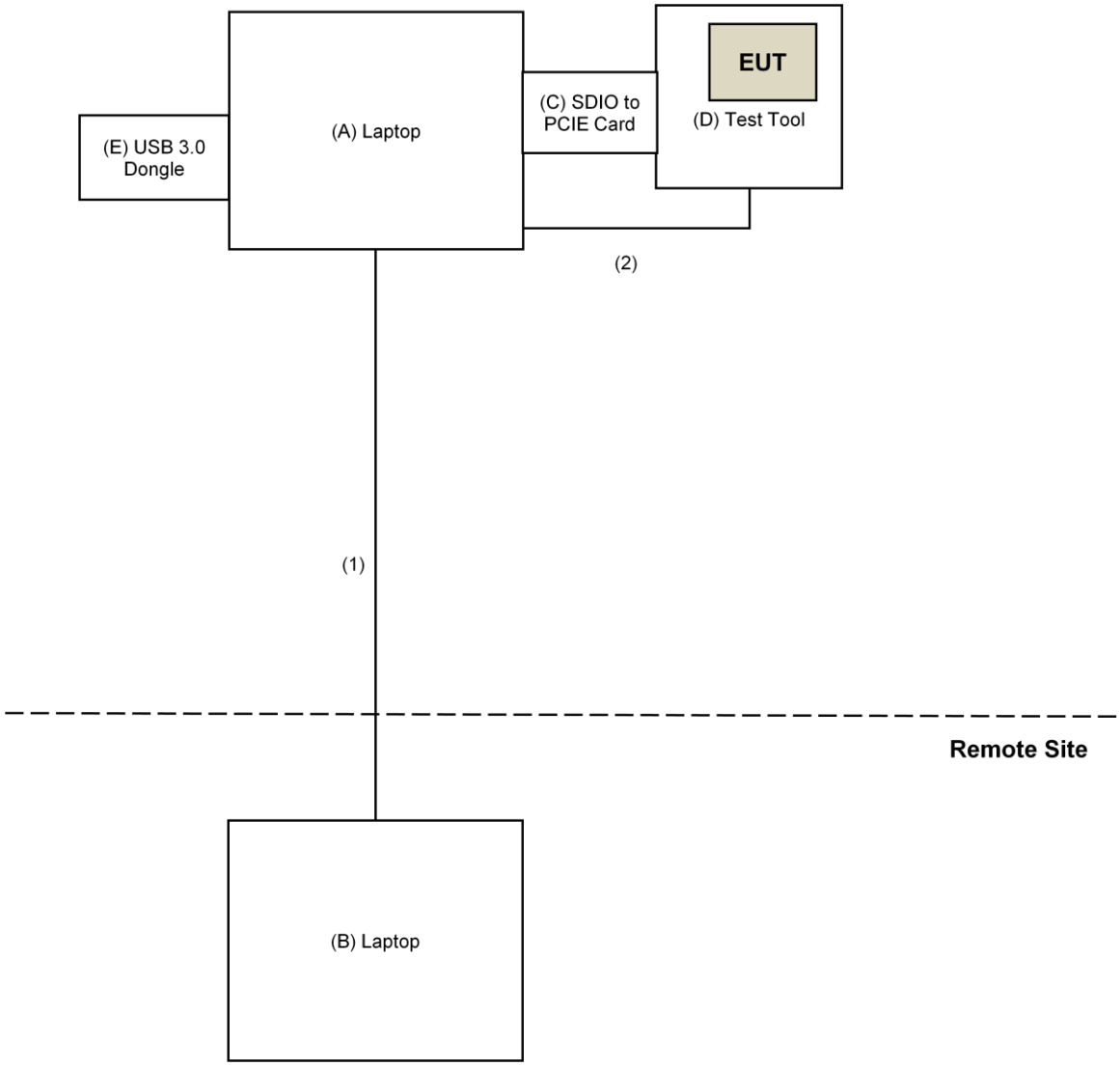
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	DELL	E6420	B92T3R1	FCC DoC	Provided by Lab
B.	Laptop	DELL	E6440	F9LYQ32	FCC DoC	Provided by Lab
C.	SDIO to PCIE Card	AzureWave	NA	NA	NA	Supplied by client
D.	Test Tool	AzureWave	NA	NA	NA	Supplied by client
E.	USB 3.0 Dongle	Transcend	JF790	NA	NA	Supplied by client

Note:

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ-45 Cable	1	10	No	0	Provided by Lab
2.	USB Cable	1	1.4	Yes	0	Provided by Lab

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

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

FCC Part 15, Subpart C (15.247)
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 Agilent	N9038A	MY50010156	Aug. 18, 2016	Aug. 17, 2017
Pre-Amplifier(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna(*) Electro-Metrics	EM-6879	264	Dec. 16, 2016	Dec. 15, 2018
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 18, 2016	Jan. 17, 2017
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-05	May 07, 2016	May 06, 2017
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-156	Jan. 04, 2016	Jan. 03, 2017
RF Cable	8D	966-3-1 966-3-2 966-3-3	Apr. 02, 2016	Apr. 01, 2017
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	Oct. 05, 2016	Oct. 04, 2017
Horn_Antenna SCHWARZBECK	BBHA9120-D	9120D-406	Jan. 20, 2016	Jan. 19, 2017
Pre-Amplifier Agilent	8449B	3008A02465	Apr. 05, 2016	Apr. 04, 2017
RF Cable	EMC104-SM-SM-2000 EMC104-SM-SM-5000 EMC104-SM-SM-5000	150317 150321 150322	Mar. 30, 2016	Mar. 29, 2017
Spectrum Analyzer Keysight	N9030A	MY54490520	July 29, 2016	July 28, 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	MF780208406	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Spectrum Analyzer R&S	FSV40	100964	June 28, 2016	June 27, 2017
Power meter Anritsu	ML2495A	1014008	May 5, 2016	May 4, 2017
Power sensor Anritsu	MA2411B	0917122	May 5, 2016	May 4, 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. The test was performed in 966 Chamber No. 3.
4. The FCC Site Registration No. is 147459
6. The CANADA Site Registration No. is 20331-1
7 Loop antenna was used for all emissions below 30 MHz.
8. Tested Date: Dec. 19 to 28, 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 detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

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. 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).

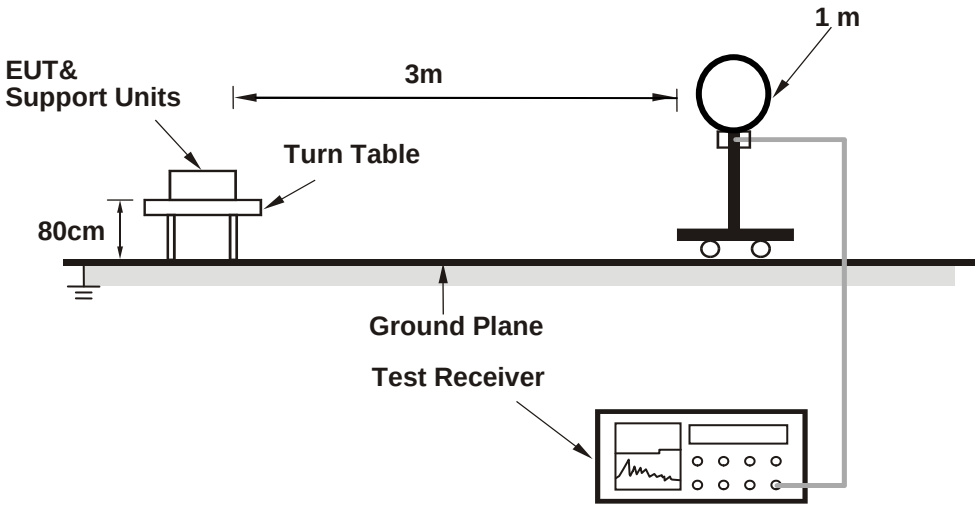
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

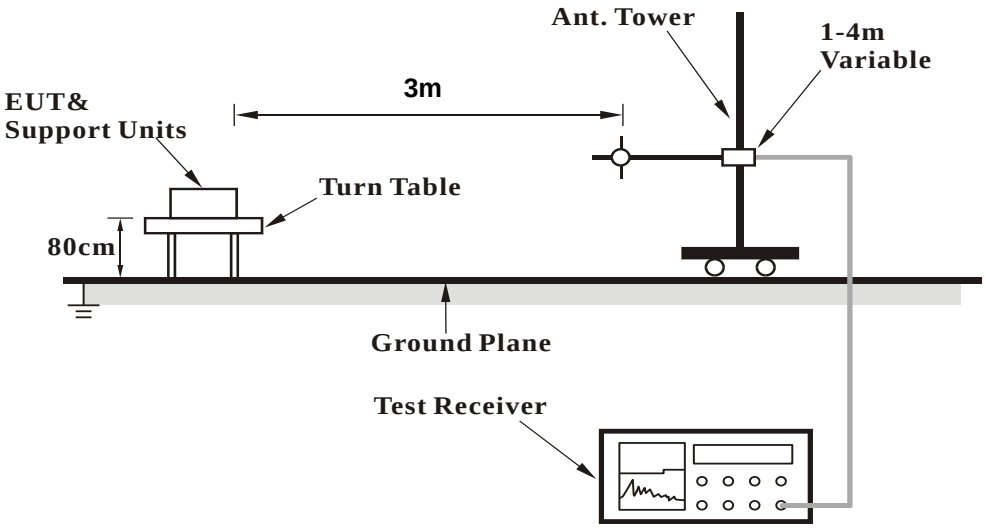
No deviation.

4.1.5 Test Setup

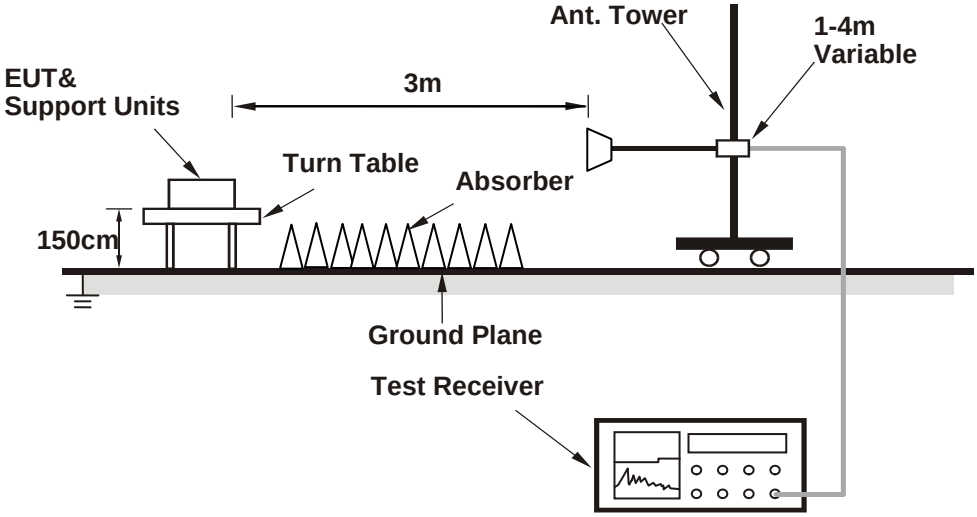
For Radiated emission below 30MHz



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

a. Connected the EUT with the Laptop which is placed on table.
b. Contorlling software (DutApiMimoBt.exe[Ver1.0.0.109]) has been activated to set the EUT on specific status.

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	47.3 PK	74.0	-26.7	2.79 H	41	51.5	-4.2
2	2390.00	17.2 AV	54.0	-36.8	2.79 H	41	21.4	-4.2
3	*2402.00	97.1 PK			2.79 H	41	101.2	-4.1
4	*2402.00	67.0 AV			2.79 H	41	71.1	-4.1
5	4804.00	42.9 PK	74.0	-31.1	2.80 H	33	40.6	2.3
6	4804.00	12.8 AV	54.0	-41.2	2.80 H	33	10.5	2.3
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	2390.00	46.8 PK	74.0	-27.2	3.72 V	143	51.0	-4.2
2	2390.00	16.7 AV	54.0	-37.3	3.72 V	143	20.9	-4.2
3	*2402.00	100.1 PK			3.72 V	143	104.2	-4.1
4	*2402.00	70.0 AV			3.72 V	143	74.1	-4.1
5	4804.00	42.8 PK	74.0	-31.2	2.80 V	46	40.5	2.3
6	4804.00	12.7 AV	54.0	-41.3	2.80 V	46	10.4	2.3

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	2390.00	46.9 PK	74.0	-27.1	2.78 H	53	51.1	-4.2
2	2390.00	16.8 AV	54.0	-37.2	2.78 H	53	21.0	-4.2
3	*2441.00	97.3 PK			2.79 H	38	101.3	-4.0
4	*2441.00	67.2 AV			2.79 H	38	71.2	-4.0
5	2483.50	46.1 PK	74.0	-27.9	2.77 H	57	50.1	-4.0
6	2483.50	16.0 AV	54.0	-38.0	2.77 H	57	20.0	-4.0
7	4882.00	43.0 PK	74.0	-31.0	1.82 H	191	40.5	2.5
8	4882.00	12.9 AV	54.0	-41.1	1.82 H	191	10.4	2.5
9	7323.00	43.4 PK	74.0	-30.6	1.85 H	214	34.4	9.0
10	7323.00	13.3 AV	54.0	-40.7	1.85 H	214	4.3	9.0
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	2390.00	47.6 PK	74.0	-26.4	3.63 V	147	51.8	-4.2
2	2390.00	17.5 AV	54.0	-36.5	3.63 V	147	21.7	-4.2
3	*2441.00	100.6 PK			3.63 V	147	104.6	-4.0
4	*2441.00	70.5 AV			3.63 V	147	74.5	-4.0
5	2483.50	47.2 PK	74.0	-26.8	3.63 V	147	51.2	-4.0
6	2483.50	17.1 AV	54.0	-36.9	3.63 V	147	21.1	-4.0
7	4882.00	43.0 PK	74.0	-31.0	2.81 V	47	40.5	2.5
8	4882.00	12.9 AV	54.0	-41.1	2.81 V	47	10.4	2.5
9	7323.00	42.8 PK	74.0	-31.2	2.76 V	52	33.8	9.0
10	7323.00	12.7 AV	54.0	-41.3	2.76 V	52	3.7	9.0

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: 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	97.5 PK			2.67 H	55	101.5	-4.0
2	*2480.00	67.4 AV			2.67 H	55	71.4	-4.0
3	2483.50	47.6 PK	74.0	-26.4	2.67 H	55	51.6	-4.0
4	2483.50	17.5 AV	54.0	-36.5	2.67 H	55	21.5	-4.0
5	4960.00	43.0 PK	74.0	-31.0	1.87 H	189	40.5	2.5
6	4960.00	12.9 AV	54.0	-41.1	1.87 H	189	10.4	2.5
7	7440.00	43.1 PK	74.0	-30.9	1.90 H	191	33.6	9.5
8	7440.00	13.0 AV	54.0	-41.0	1.90 H	191	3.5	9.5
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	*2480.00	100.9 PK			3.97 V	170	104.9	-4.0
2	*2480.00	70.8 AV			3.97 V	170	74.8	-4.0
3	2483.50	48.2 PK	74.0	-25.8	3.97 V	170	52.2	-4.0
4	2483.50	18.1 AV	54.0	-35.9	3.97 V	170	22.1	-4.0
5	4960.00	43.2 PK	74.0	-30.8	1.78 V	231	40.7	2.5
6	4960.00	13.1 AV	54.0	-40.9	1.78 V	231	10.6	2.5
7	7440.00	42.9 PK	74.0	-31.1	1.77 V	244	33.4	9.5
8	7440.00	12.8 AV	54.0	-41.2	1.77 V	244	3.3	9.5

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	46.6 PK	74.0	-27.4	2.73 H	52	50.8	-4.2
2	2390.00	16.5 AV	54.0	-37.5	2.73 H	52	20.7	-4.2
3	*2402.00	97.1 PK			2.73 H	52	101.2	-4.1
4	*2402.00	67.0 AV			2.73 H	52	71.1	-4.1
5	4804.00	43.0 PK	74.0	-31.0	1.78 H	179	40.7	2.3
6	4804.00	12.9 AV	54.0	-41.1	1.78 H	179	10.6	2.3
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	2390.00	46.9 PK	74.0	-27.1	4.00 V	160	51.1	-4.2
2	2390.00	16.8 AV	54.0	-37.2	4.00 V	160	21.0	-4.2
3	*2402.00	100.0 PK			4.00 V	160	104.1	-4.1
4	*2402.00	69.9 AV			4.00 V	160	74.0	-4.1
5	4804.00	43.9 PK	74.0	-30.1	1.91 V	202	41.6	2.3
6	4804.00	13.8 AV	54.0	-40.2	1.91 V	202	11.5	2.3

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	2390.00	46.5 PK	74.0	-27.5	2.76 H	47	50.7	-4.2
2	2390.00	16.4 AV	54.0	-37.6	2.76 H	47	20.6	-4.2
3	*2441.00	97.2 PK			2.76 H	47	101.2	-4.0
4	*2441.00	67.1 AV			2.76 H	47	71.1	-4.0
5	2483.50	46.7 PK	74.0	-27.3	2.76 H	47	50.7	-4.0
6	2483.50	16.6 AV	54.0	-37.4	2.76 H	47	20.6	-4.0
7	4882.00	42.9 PK	74.0	-31.1	1.83 H	194	40.4	2.5
8	4882.00	12.8 AV	54.0	-41.2	1.83 H	194	10.3	2.5
9	7323.00	42.9 PK	74.0	-31.1	1.85 H	212	33.9	9.0
10	7323.00	12.8 AV	54.0	-41.2	1.85 H	212	3.8	9.0
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	2390.00	47.4 PK	74.0	-26.6	3.97 V	157	51.6	-4.2
2	2390.00	17.3 AV	54.0	-36.7	3.97 V	157	21.5	-4.2
3	*2441.00	101.0 PK			3.97 V	157	105.0	-4.0
4	*2441.00	70.9 AV			3.97 V	157	74.9	-4.0
5	2483.50	47.8 PK	74.0	-26.2	3.97 V	157	51.8	-4.0
6	2483.50	17.7 AV	54.0	-36.3	3.97 V	157	21.7	-4.0
7	4882.00	43.4 PK	74.0	-30.6	1.93 V	207	40.9	2.5
8	4882.00	13.3 AV	54.0	-40.7	1.93 V	207	10.8	2.5
9	7323.00	42.2 PK	74.0	-31.8	1.95 V	204	33.2	9.0
10	7323.00	12.1 AV	54.0	-41.9	1.95 V	204	3.1	9.0

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: 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	97.8 PK			2.73 H	53	101.8	-4.0
2	*2480.00	67.7 AV			2.73 H	53	71.7	-4.0
3	2483.50	47.2 PK	74.0	-26.8	2.73 H	53	51.2	-4.0
4	2483.50	17.1 AV	54.0	-36.9	2.73 H	53	21.1	-4.0
5	4960.00	42.5 PK	74.0	-31.5	1.84 H	193	40.0	2.5
6	4960.00	12.4 AV	54.0	-41.6	1.84 H	193	9.9	2.5
7	7440.00	43.3 PK	74.0	-30.7	1.89 H	203	33.8	9.5
8	7440.00	13.2 AV	54.0	-40.8	1.89 H	203	3.7	9.5
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	*2480.00	101.5 PK			3.98 V	164	105.5	-4.0
2	*2480.00	71.4 AV			3.98 V	164	75.4	-4.0
3	2483.50	51.1 PK	74.0	-22.9	3.98 V	164	55.1	-4.0
4	2483.50	21.0 AV	54.0	-33.0	3.98 V	164	25.0	-4.0
5	4960.00	43.2 PK	74.0	-30.8	1.88 V	217	40.7	2.5
6	4960.00	13.1 AV	54.0	-40.9	1.88 V	217	10.6	2.5
7	7440.00	43.4 PK	74.0	-30.6	1.86 V	191	33.9	9.5
8	7440.00	13.3 AV	54.0	-40.7	1.86 V	191	3.8	9.5

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 Data:

BT_8DPSK

CHANNEL	TX Channel 0	**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	99.94	34.8 QP	43.5	-8.7	1.63 H	253	47.6	-12.8
2	166.04	39.0 QP	43.5	-4.5	2.36 H	274	47.8	-8.8
3	232.95	38.5 QP	46.0	-7.5	1.91 H	238	48.9	-10.4
4	499.87	38.2 QP	46.0	-7.8	3.34 H	352	40.7	-2.5
5	780.05	34.1 QP	46.0	-11.9	3.29 H	287	31.1	3.0
6	960.01	40.2 QP	54.0	-13.8	1.29 H	263	35.2	5.0
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	**59.95**	**36.0 QP**	**40.0**	**-4.0**	**1.33 V**	**5**	**45.0**	**-9.0**
2	81.09	35.9 QP	40.0	-4.1	1.00 V	334	49.2	-13.3
3	166.53	32.3 QP	43.5	-11.2	2.86 V	338	41.1	-8.8
4	298.79	41.7 QP	46.0	-4.3	2.44 V	16	49.0	-7.3
5	499.87	39.5 QP	46.0	-6.5	1.52 V	6	42.0	-2.5
6	960.01	42.4 QP	54.0	-11.6	3.36 V	243	37.4	5.0

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 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 R&S	ESCS 30	847124/029	Oct. 24, 2016	Oct. 23, 2017
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Oct. 26, 2016	Oct. 25, 2017
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV216	100072	June 13, 2016	June 12, 2017
RF Cable	5D-FB	COCCAB-001	Sep. 30, 2016	Sep. 29, 2017
10 dB PAD Mini-Circuits	HAT-10+	CONATT-004	June 20, 2016	June 19, 2017
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

Note:
1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Shielded Room No. 1.
3 Tested Date: Dec. 19, 2016

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.

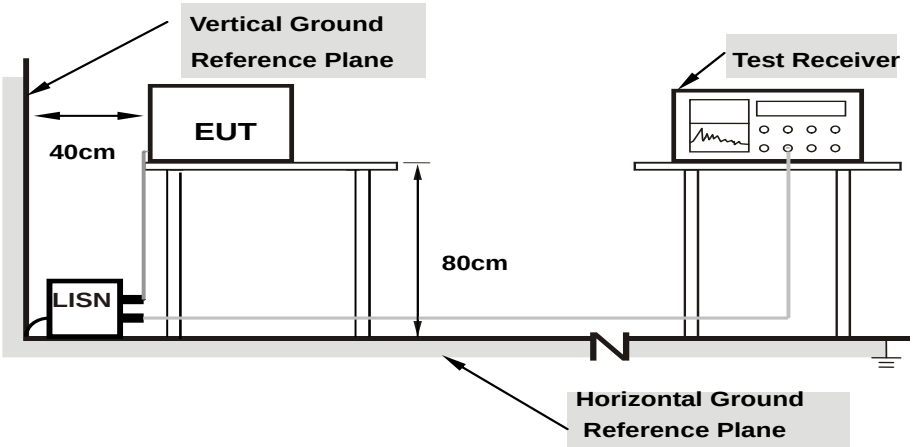
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

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.

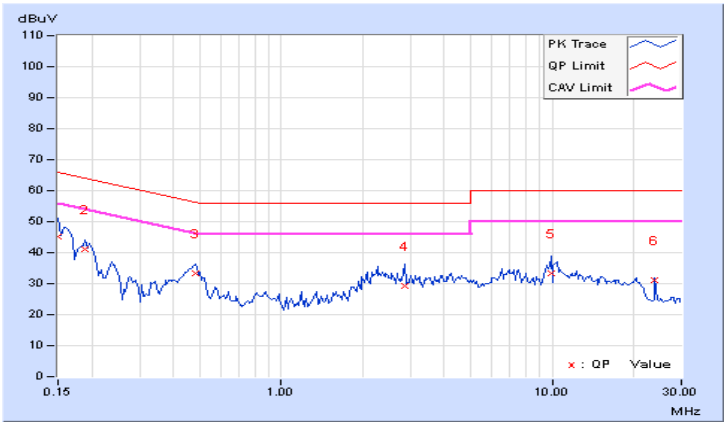
4.2.7 Test Results

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

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.19	35.09	19.60	45.28	29.79	66.00	56.00	-20.72	-26.21
2	0.18906	10.19	31.06	15.74	41.25	25.93	64.08	54.08	-22.83	-28.15
3	0.48203	10.23	23.08	16.73	33.31	26.96	56.30	46.30	-22.99	-19.34
4	2.87109	10.24	18.90	12.80	29.14	23.04	56.00	46.00	-26.86	-22.96
5	9.95703	10.55	22.67	16.50	33.22	27.05	60.00	50.00	-26.78	-22.95
6	24.00000	11.42	19.61	19.22	31.03	30.64	60.00	50.00	-28.97	-19.36

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.

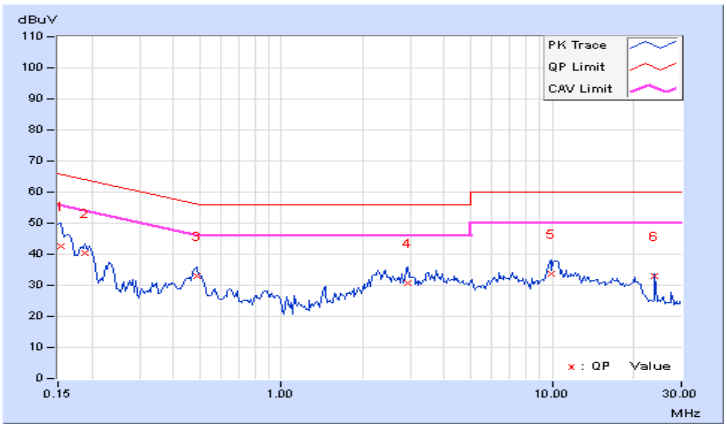


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.18	32.39	16.59	42.57	26.77	65.79	55.79	-23.22	-29.02
2	0.18906	10.16	30.31	14.54	40.47	24.70	64.08	54.08	-23.61	-29.38
3	0.48594	10.21	22.74	15.41	32.95	25.62	56.24	46.24	-23.29	-20.62
4	2.94531	10.22	20.36	14.42	30.58	24.64	56.00	46.00	-25.42	-21.36
5	9.97266	10.49	23.22	17.54	33.71	28.03	60.00	50.00	-26.29	-21.97
6	**24.00391**	**11.08**	**21.98**	**21.75**	**33.06**	**32.83**	**60.00**	**50.00**	**-26.94**	**-17.17**

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.

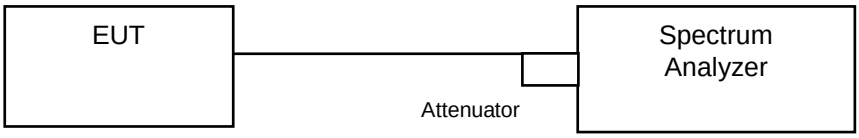


4.3 Number of Hopping Frequency Used

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

Refer to section 4.1.2 to get information of above instrument.

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.

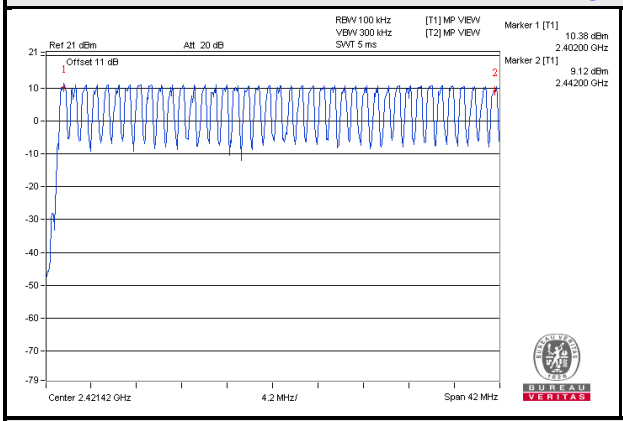
4.3.5 Deviation fromTest Standard

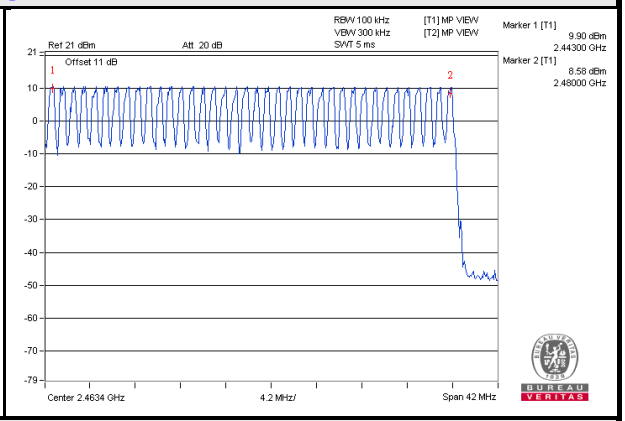
No deviation.

4.3.6 Test Results

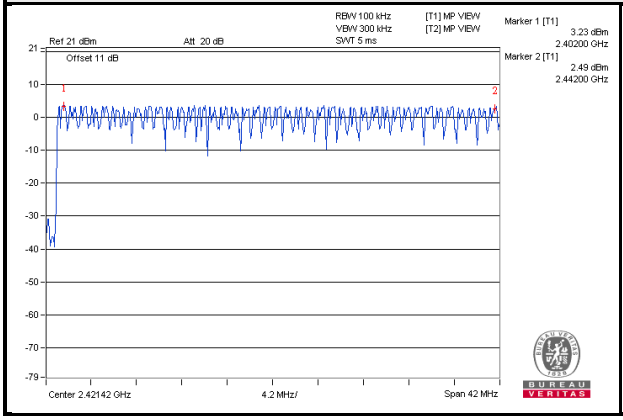
There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

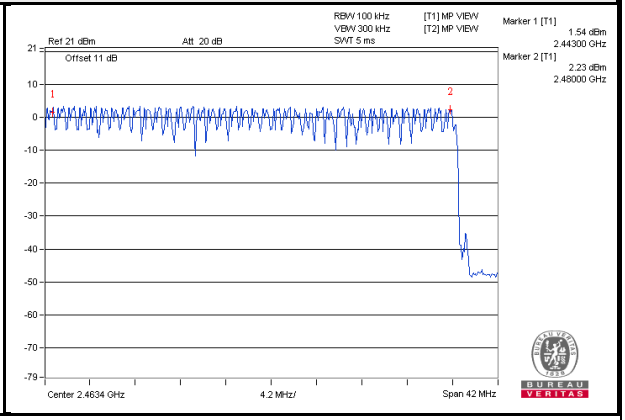
GFSK





8DPSK



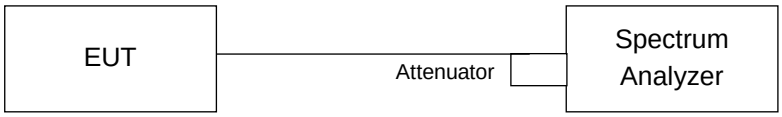


4.4 Dwell Time on Each Channel

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

Refer to section 4.1.2 to get information of above instrument.

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.

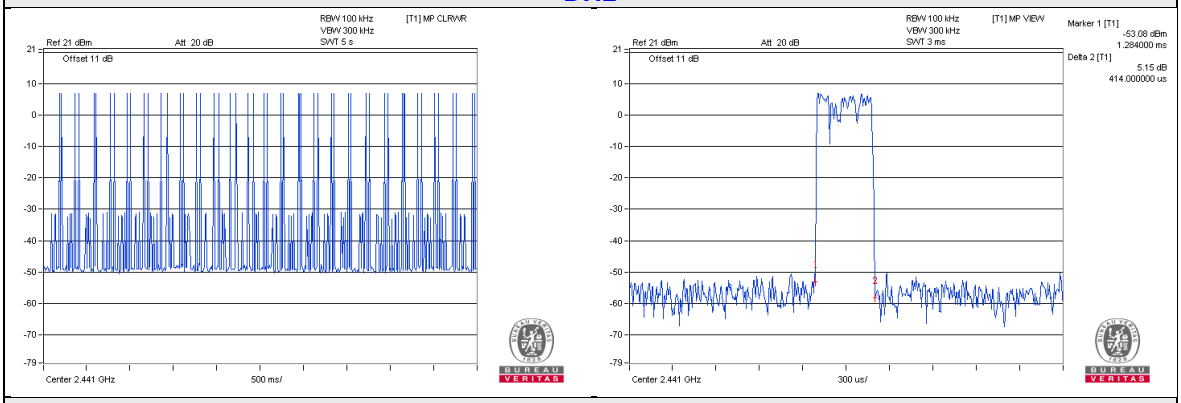
4.4.6 Test Results

GFSK

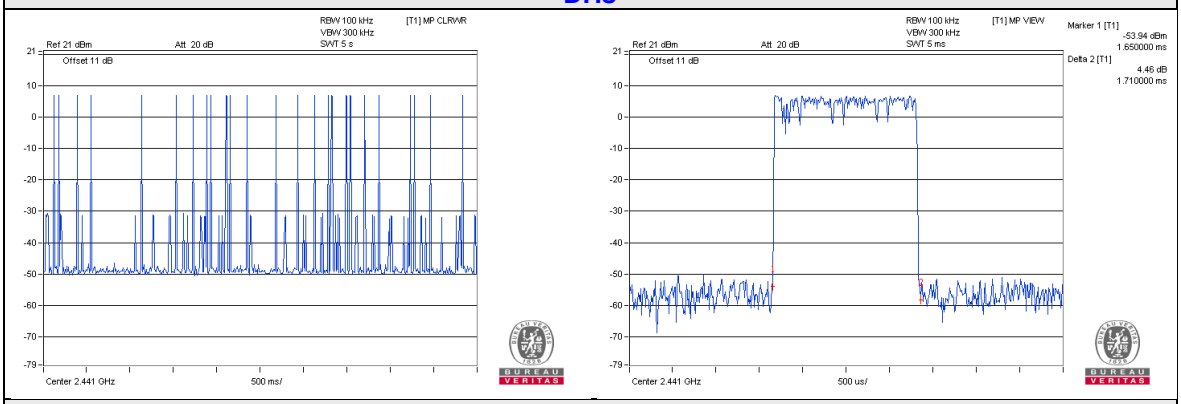
Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316 times	0.414	130.82	400
DH3	25 (times / 5 sec) * 6.32 = 158 times	1.71	270.18	400
DH5	17 (times / 5 sec) * 6.32 = 107.44 times	2.96	318.02	400

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

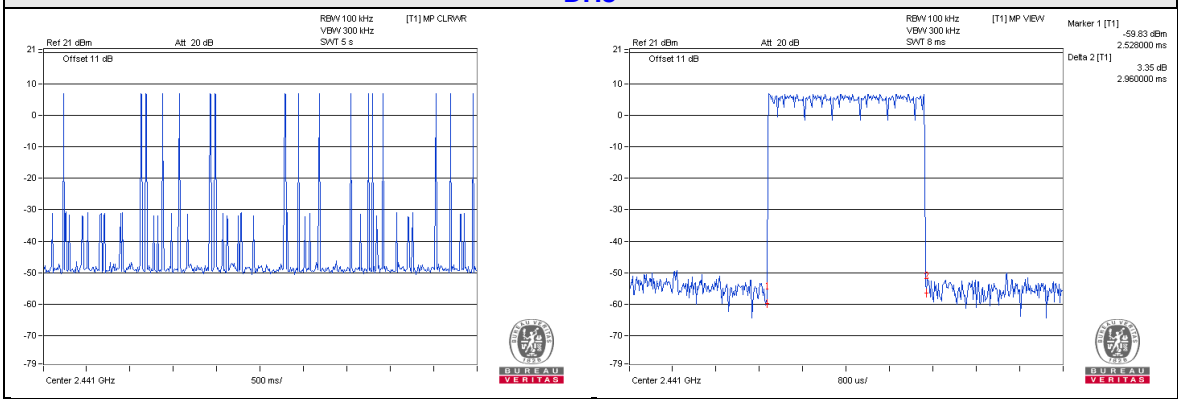
DH1


RBW 100 kHz
VBW 300 kHz
SWT 5 s
[T1] MP CLRWR
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 300 kHz
SWT 3 ms
[T1] MP VIEW
Marker 1 [T1]
-53.08 dBm
1.284000 ms
Delta 2 [T1]
5.15 dB
414.000000 us
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
300 us/

DH3


RBW 100 kHz
VBW 300 kHz
SWT 5 s
[T1] MP CLRWR
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 300 kHz
SWT 5 ms
[T1] MP VIEW
Marker 1 [T1]
-53.94 dBm
1.650000 ms
Delta 2 [T1]
4.46 dB
1.710000 ms
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
500 us/

DH5

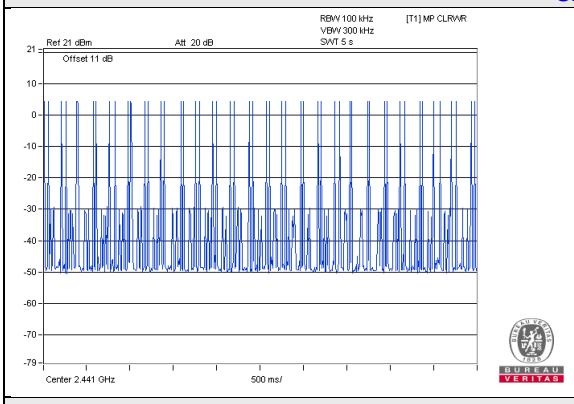

RBW 100 kHz
VBW 300 kHz
SWT 5 s
[T1] MP CLRWR
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
500 ms/
RBW 100 kHz
VBW 300 kHz
SWT 8 ms
[T1] MP VIEW
Marker 1 [T1]
-59.83 dBm
2.528000 ms
Delta 2 [T1]
3.35 dB
2.960000 ms
Ref 21 dBm
Att 20 dB
Offset 11 dB
Center 2.441 GHz
800 us/

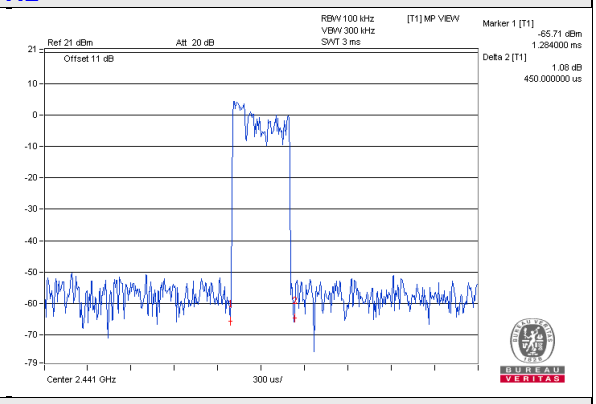
8DPSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
3DH1	50 (times / 5 sec) * 6.32 = 316 times	0.45	142.2	400
3DH3	25 (times / 5 sec) * 6.32 = 158 times	1.72	271.76	400
3DH5	16 (times / 5 sec) * 6.32 = 101.12 times	2.992	302.55	400

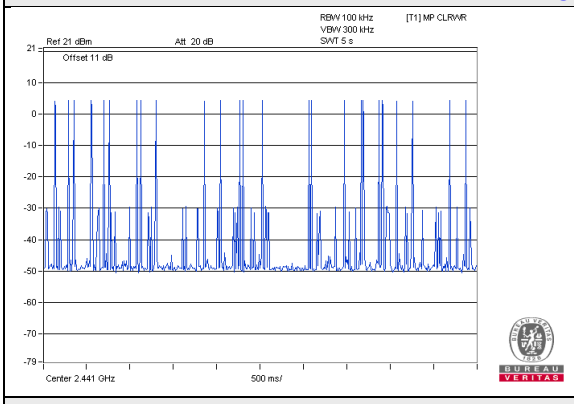
NOTE: Test plots of the transmitting time slot are shown on next page.

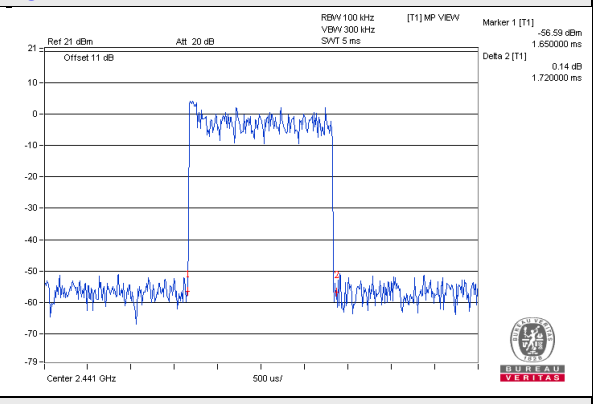
3DH1



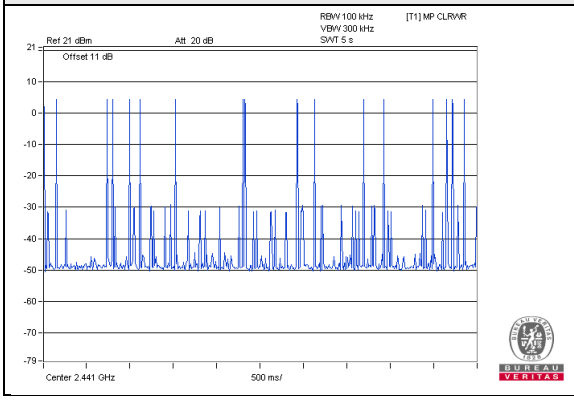


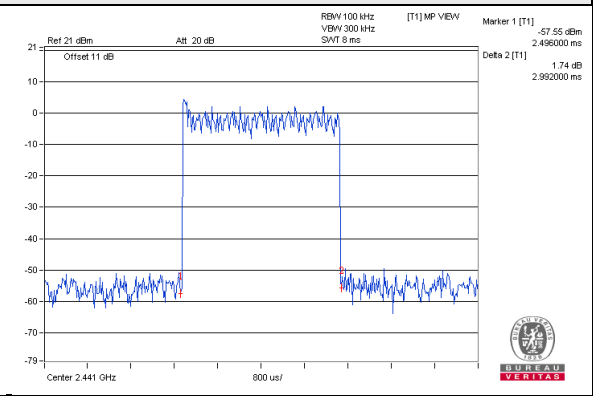
3DH3





3DH5



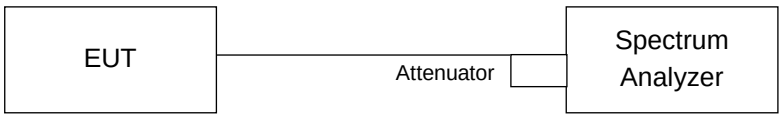


4.5 Channel Bandwidth

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

Refer to section 4.1.2 to get information of above instrument.

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. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

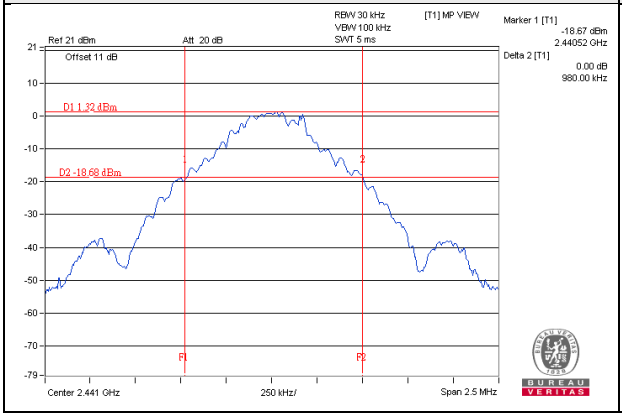
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.5.7 Test Results

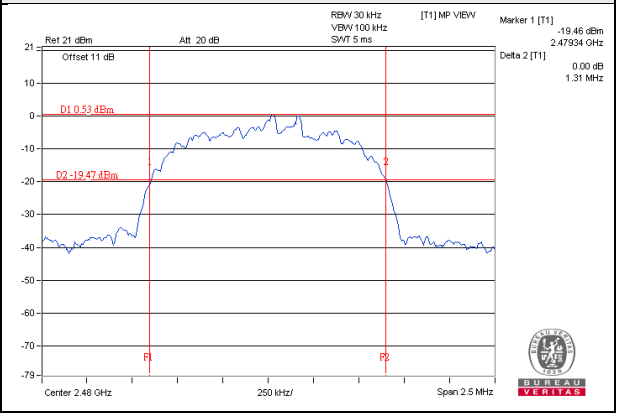
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.96	1.30
39	2441	0.98	1.30
78	2480	0.97	1.31

Spectrum Plot of Worst Value

GFSK / CH 39



8DPSK / CH 78

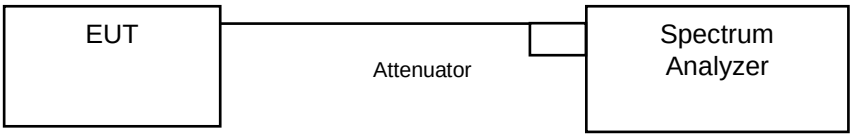


4.6 Hopping Channel Separation

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

Refer to section 4.1.2 to get information of above instrument.

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.

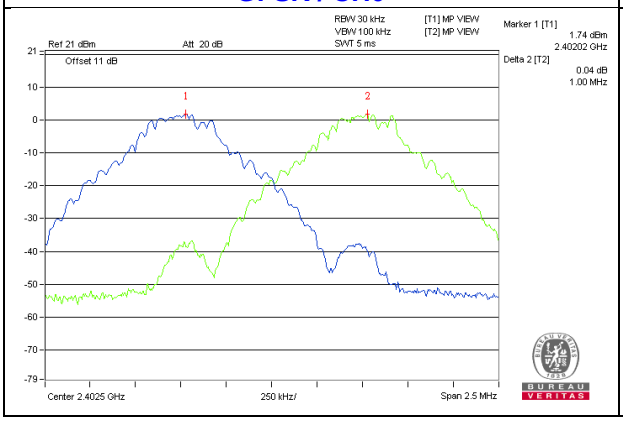
4.6.6 Test Results

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)		20dB Bandwidth (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.00	1.00	0.96	1.30	0.64	0.87	Pass
39	2441	1.00	1.00	0.98	1.30	0.66	0.87	Pass
78	2480	1.00	1.00	0.97	1.31	0.65	0.88	Pass

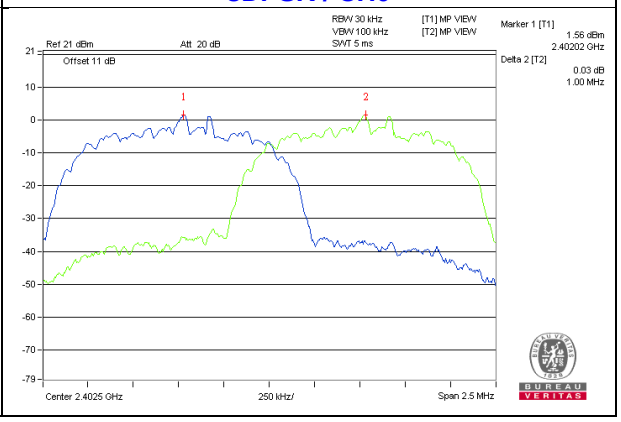
NOTE: The minimum limit is two-third 20dB bandwidth.

Spectrum Plot of Worst Value

GFSK / CH0



8DPSK / CH0

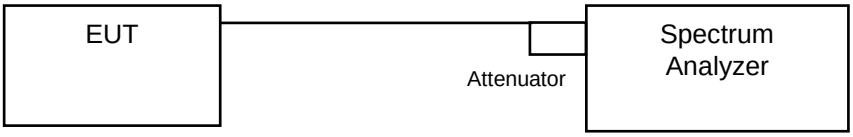


4.7 Maximum Output Power

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

Refer to section 4.1.2 to get information of above instrument.

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

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

4.7.5 Deviation from Test Standard

No deviation.

4.7.6 EUT Operating Condition

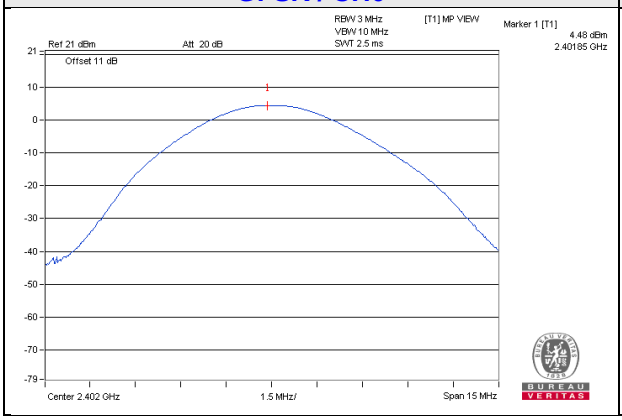
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

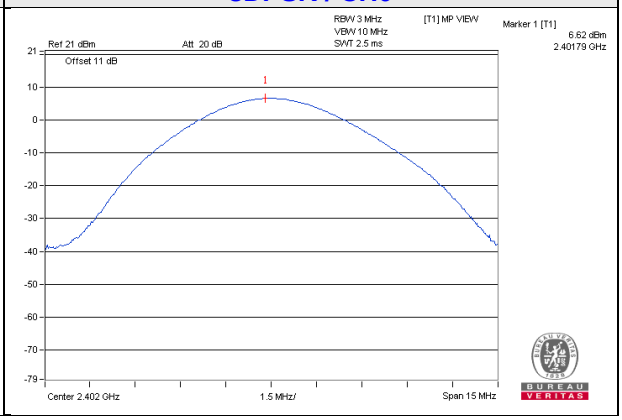
Channel	Frequency (MHZ)	Output Power (mW)		Output Power (dBm)		Power Limit (mW)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	2.805	4.592	4.48	6.62	125	Pass
39	2441	2.729	4.102	4.36	6.13	125	Pass
78	2480	2.661	3.999	4.25	6.02	125	Pass

Spectrum Plot of Worst Value

GFSK / CH0



8DPSK / CH0



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

Refer to section 4.1.2 to get information of above instrument.

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

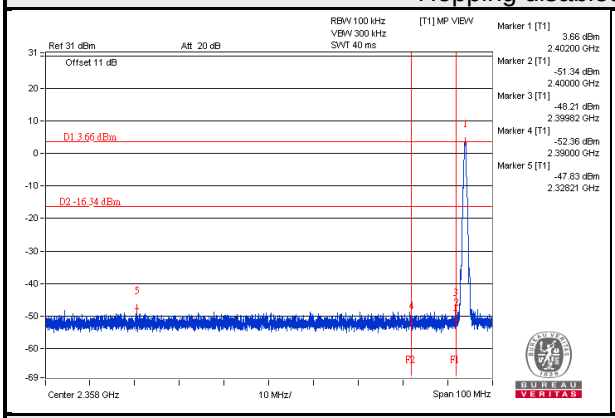
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

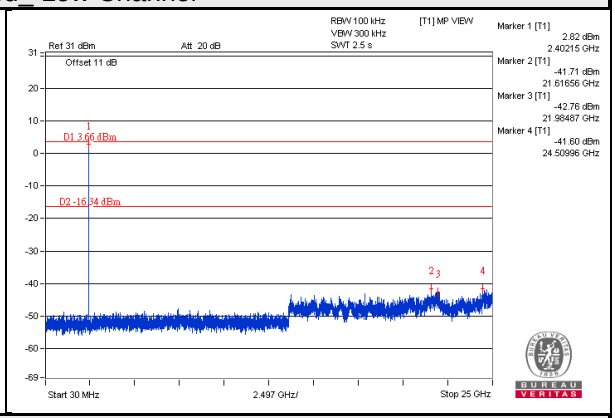
4.8.6 Test Results

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.

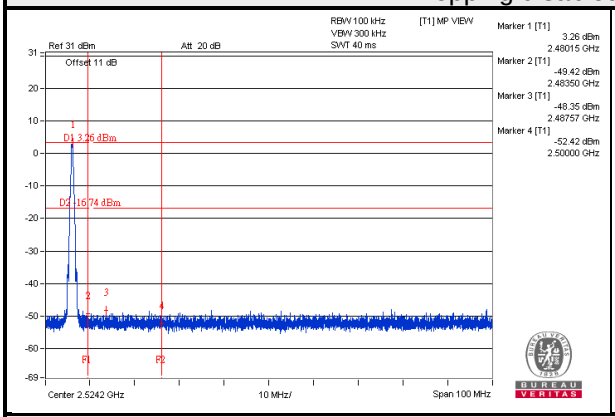
GFSK

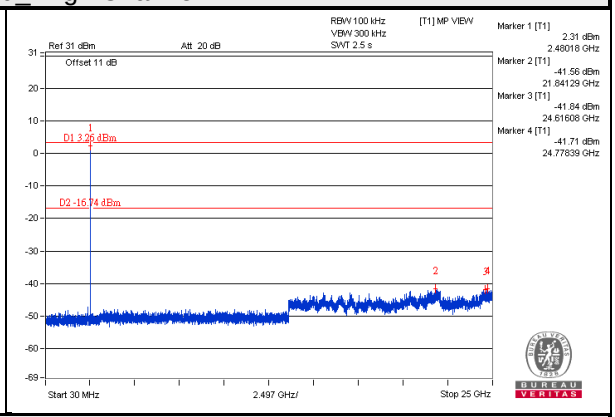
Hopping disabled_ Low Channel



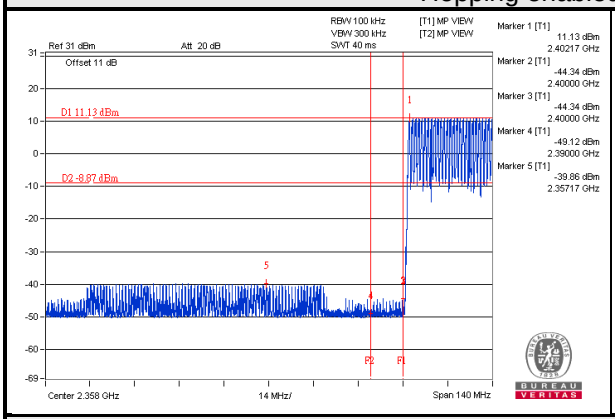


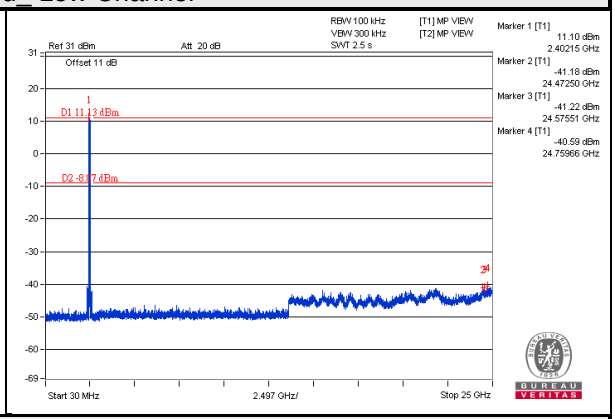
Hopping disabled_ High Channel



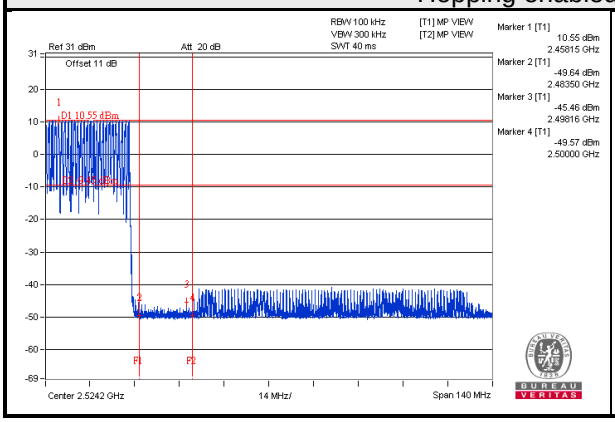


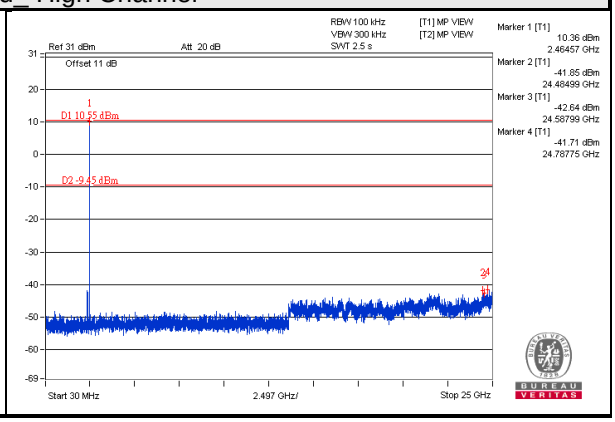
Hopping enabled_ Low Channel





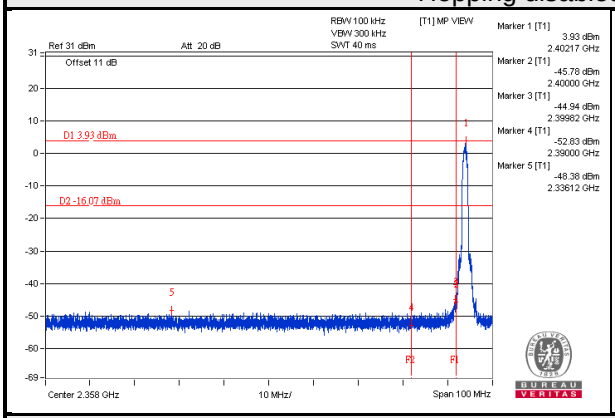
Hopping enabled_ High Channel

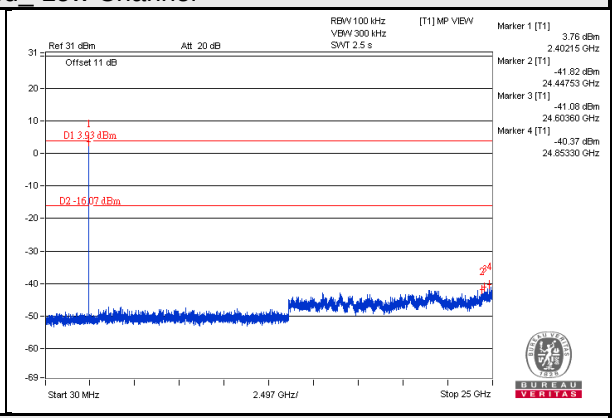




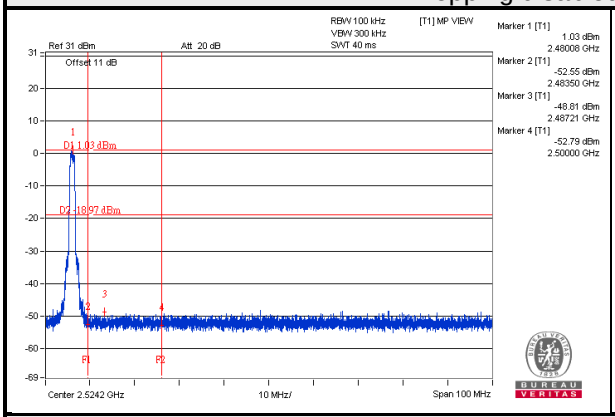
8DPSK

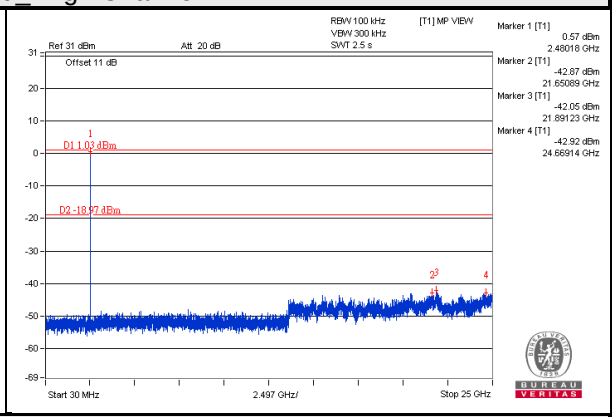
Hopping disabled_ Low Channel



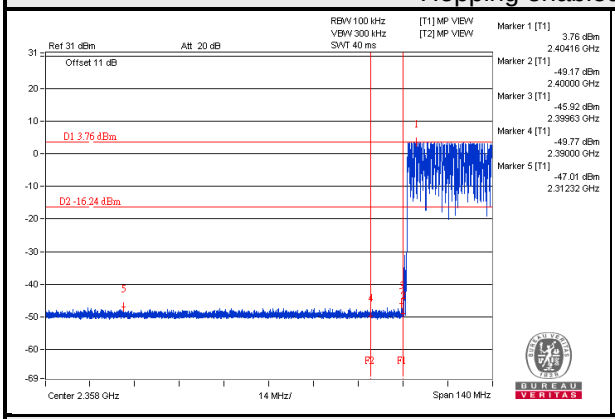


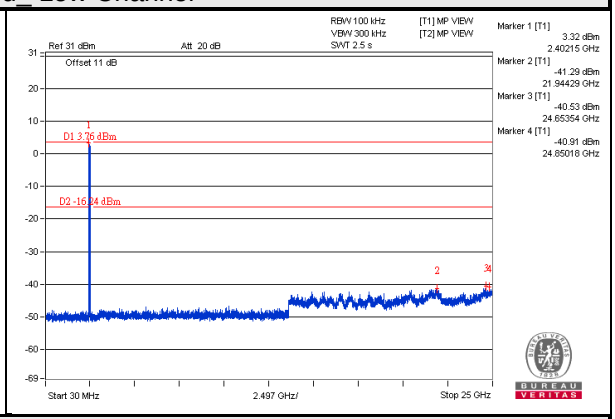
Hopping disabled_ High Channel



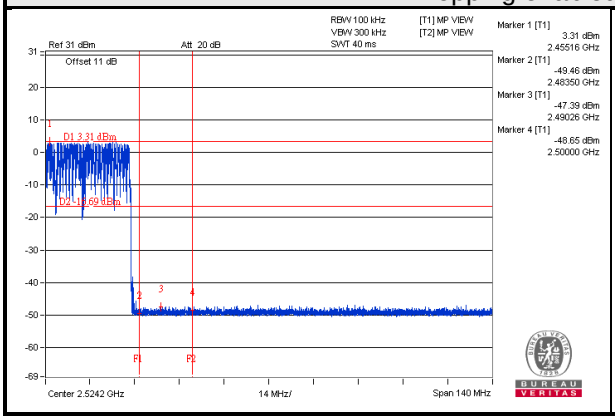


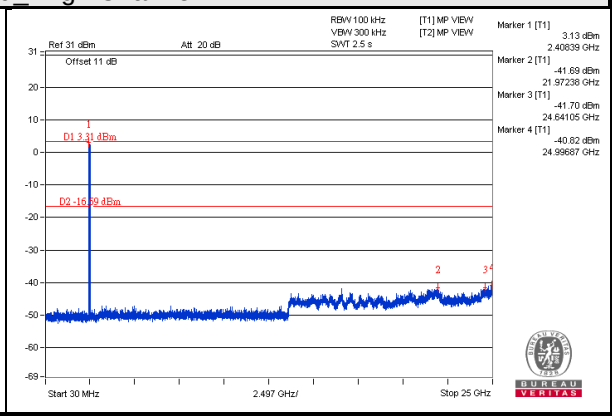
Hopping enabled_ Low Channel





Hopping enabled_ High Channel





5 Pictures of Test Arrangements

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

Appendix – Information on the Testing Laboratories

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

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

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Web Site: www.bureauveritas-adt.com

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

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