FCC Test Report

Report No.:	RF200326C09
FCC ID:	H8NTN230A2
Test Model:	TN230A2
Received Date:	Mar. 26, 2020
Test Date:	Apr. 07 ~ Apr. 18, 2020
Issued Date:	May 08, 2020
Applicant:	ASKEY COMPUTER CORP.
Address:	10F, NO.119, JIANKANG RD., ZHONGHE DIST., NEW TAIPEI CITY 23585, TAIWAN, R.O.C.
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location:	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RF200326C09	Original Release	May 08, 2020

1 Certificate of Conformity

Product:	Smart watch
Brand:	TURBONET
Test Model:	TN230A2
Sample Status:	Engineering Sample
Applicant:	ASKEY COMPUTER CORP.
Test Date:	Apr. 07 ~ Apr. 18, 2020
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 RF characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** May 08, 2020

Gina Liu / Specialist

Approved by : _____ , **Date:** May 08, 2020

Dylan Chiou / Senior Project Engineer

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 -22.25 dB at 0.55234 MHz.
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(a)(1)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -9.3 dB at 2483.5 MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:

1. If the Frequency Hopping System operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Smart watch
Brand	TURBONET
Test Model	TN230A2
Status of EUT	Engineering Sample
Power Supply Rating	5.35 Vdc (adapter) 5.0 Vdc (host equipment) 3.7 Vdc (Li-ion battery)
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Output Power (Measured Max. Peak)	1.945 mW
Antenna Type	PIFA
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	0.95m shielded USB cable without core

Note:

1. There're 3 configurations for the EUT listed as below.

Configuration	Brand	Model	Difference
1	TURBONET	TN230A2	All function
2			Without heartbeat detection and camera function
3			Without heartbeat detection but with camera function
*The Configuration 1 was chosen for final test.			

2. The antenna information is listed.

Ant. Type	Frequency (MHz)										
	2402	2442	2484	5180	5220	5320	5420	5520	5620	5720	5825
PIFA	2.50 dBi	2.30 dBi	2.20 dBi	0.91 dBi	0.85 dBi	0.90 dBi	1.54 dBi	2.23 dBi	2.12 dBi	2.20 dBi	2.00 dBi

3. The following accessories were for the End-product.

Product	Brand	Model	Description
Adapter	Sunny ELECTRONICS CORP.	SYS1561-1105-1	I/P: 100-240 Vac, 50-60 Hz, 1.0 A MAX O/P: 5.35 Vdc, 2 A
Battery	ETI	BP19-002750	3.7 Vdc, 800 mAh
USB Cable	N/A	N/A	0.95m shielded USB cable without core

4. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
5. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or User's Manual.

3.2 Description of Test Modes

79 channels are provided to this EUT:

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

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE≥1G	RE<1G	PLC	APCM	
A	-	√	√	-	EUT with Adapter
B	√	√	√	√	EUT with Notebook

Where **RE≥1G:** Radiated Emission above 1 GHz **RE<1G:** Radiated Emission below 1 GHz

PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Note:

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

Radiated Emission Test (Above 1 GHz):

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
B	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1 GHz):

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
A, B	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
A, B	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
B	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	25 deg. C, 65 % RH	120 Vac, 60 Hz	Greg Lin
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Greg Lin, Han Wu
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Greg Lin
APCM	25 deg. C, 65 % RH	3.7 Vdc	Ted Chang

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.	Notebook	Lenovo	80Q7	PF0KUGU6	N/A	Provided by Lab

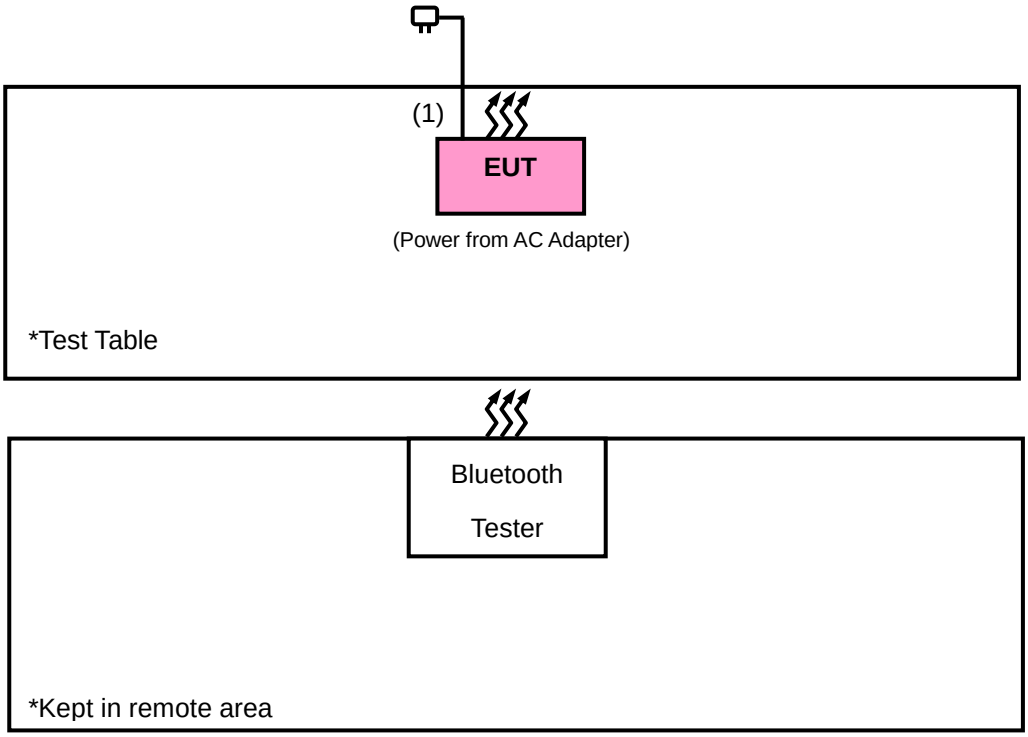
Note:

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

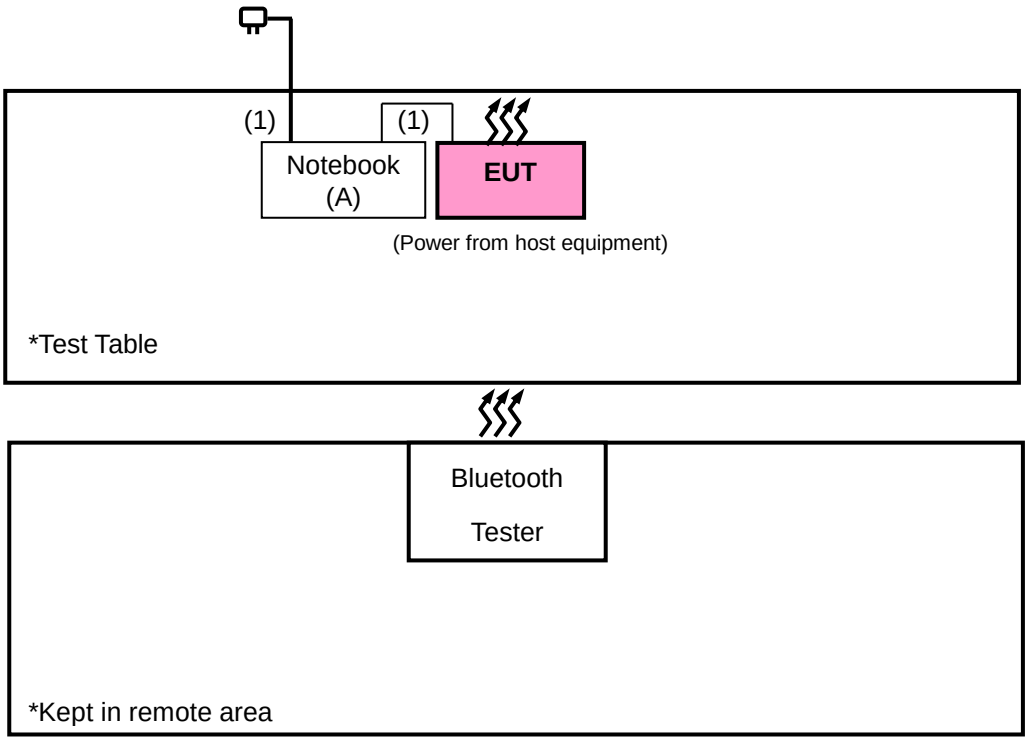
ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	0.95	Y	0	Accessory of the EUT

3.3.1 Configuration of System under Test

Mode A



Mode B



3.4 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)
ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 15.247 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

Note:

a. The lower limit shall apply at the transition frequencies.

b. Emission level (dBuV/m) = 20 log Emission level (uV/m).

c. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 16, 2020	Apr. 15, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100039	Jun. 12, 2019	Jun. 11, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSV40	100980	Apr. 23, 2019	Apr. 22, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 07, 2019	Nov. 06, 2020
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 24, 2019	Nov. 23, 2020
Bluetooth Tester	CBT	100946	Aug. 09, 2018	Aug. 08, 2020
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Jul. 11, 2019	Jul. 10, 2020
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 18, 2020	Feb. 17, 2021
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8000	CABLE-CH9-02 (248780+171006)	Feb. 18, 2020	Feb. 17, 2021
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jul. 11, 2019	Jul. 10, 2020
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 30, 2019	Jul. 29, 2020
Software BV ADT	ADT_Radiated_V7.6.15.9.5	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower &Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 15, 2019	Jul. 14, 2020

Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 9.

4.1.3 Test Procedures

For Radiated Emission below 30 MHz

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. Parallel, perpendicular, and ground-parallel orientations 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 9 kHz at frequency below 30 MHz.

For Radiated Emission above 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

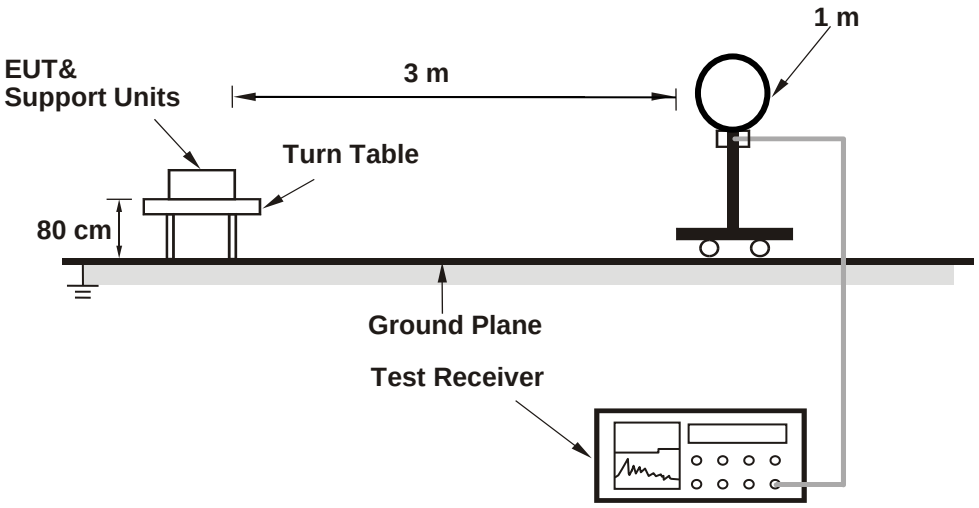
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK)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

4.1.4 Deviation from Test Standard

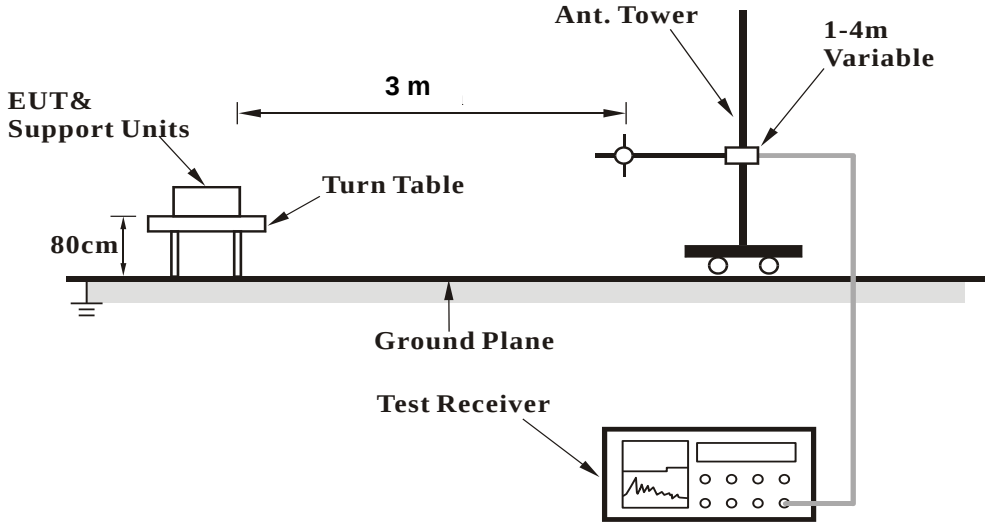
No deviation.

4.1.5 Test Set Up

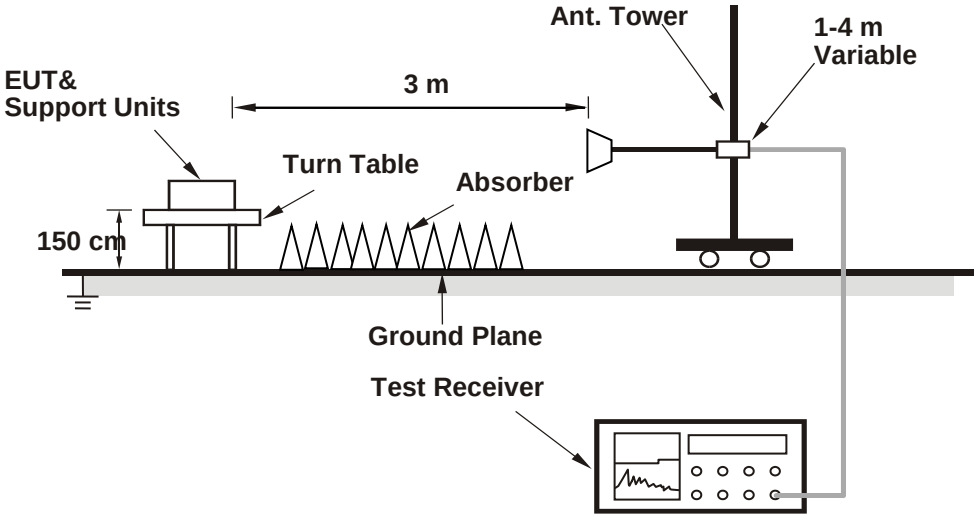
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



<Radiated Emission above 1 GHz>



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

4.1.6 EUT Operating Conditions

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

4.1.7 Test Results

Above 1 GHz Data:

BT_GFSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK) Average (AV)
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	55.1 PK	74.0	-18.9	1.34 H	202	23.9	31.2
2	2390.00	43.6 AV	54.0	-10.4	1.34 H	202	12.4	31.2
3	*2402.00	96.8 PK			1.34 H	202	65.7	31.1
4	*2402.00	96.2 AV			1.34 H	202	65.1	31.1
5	4804.00	42.2 PK	74.0	-31.8	3.43 H	117	40.3	1.9
6	4804.00	28.7 AV	54.0	-25.3	3.43 H	117	26.8	1.9
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	55.5 PK	74.0	-18.5	2.00 V	242	24.3	31.2
2	2390.00	43.8 AV	54.0	-10.2	2.00 V	242	12.6	31.2
3	*2402.00	98.9 PK			2.00 V	242	67.8	31.1
4	*2402.00	98.3 AV			2.00 V	242	67.2	31.1
5	4804.00	42.7 PK	74.0	-31.3	3.03 V	175	40.8	1.9
6	4804.00	29.2 AV	54.0	-24.8	3.03 V	175	27.3	1.9

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK) Average (AV)
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	99.2 PK			1.38 H	196	68.1	31.1
2	*2441.00	98.5 AV			1.38 H	196	67.4	31.1
3	4882.00	42.4 PK	74.0	-31.6	3.36 H	115	40.4	2.0
4	4882.00	29.0 AV	54.0	-25.0	3.36 H	115	27.0	2.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	101.4 PK			2.26 V	241	70.3	31.1
2	*2441.00	100.7 AV			2.26 V	241	69.6	31.1
3	4882.00	42.7 PK	74.0	-31.3	2.97 V	164	40.7	2.0
4	4882.00	29.4 AV	54.0	-24.6	2.97 V	164	27.4	2.0

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

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

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	96.6 PK			1.28 H	194	65.5	31.1
2	*2480.00	95.9 AV			1.28 H	194	64.8	31.1
3	2483.50	55.4 PK	74.0	-18.6	1.28 H	194	24.2	31.2
4	2483.50	43.6 AV	54.0	-10.4	1.28 H	194	12.4	31.2
5	4960.00	42.4 PK	74.0	-31.6	3.41 H	108	40.1	2.3
6	4960.00	29.0 AV	54.0	-25.0	3.41 H	108	26.7	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	*2480.00	98.8 PK			2.23 V	242	67.7	31.1
2	*2480.00	98.1 AV			2.23 V	242	67.0	31.1
3	2483.50	55.7 PK	74.0	-18.3	2.23 V	242	24.5	31.2
4	2483.50	44.7 AV	54.0	-9.3	2.23 V	242	13.5	31.2
5	4960.00	43.2 PK	74.0	-30.8	3.07 V	177	40.9	2.3
6	4960.00	29.8 AV	54.0	-24.2	3.07 V	177	27.5	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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

BT_8DPSK

CHANNEL	TX Channel 0	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
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	55.1 PK	74.0	-18.9	1.37 H	204	23.9	31.2
2	2390.00	43.3 AV	54.0	-10.7	1.37 H	204	12.1	31.2
3	*2402.00	95.6 PK			1.37 H	204	64.5	31.1
4	*2402.00	91.7 AV			1.37 H	204	60.6	31.1
5	4804.00	41.6 PK	74.0	-32.4	3.47 H	115	39.7	1.9
6	4804.00	28.7 AV	54.0	-25.3	3.47 H	115	26.8	1.9
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	55.6 PK	74.0	-18.4	2.33 V	242	24.4	31.2
2	2390.00	43.8 AV	54.0	-10.2	2.33 V	242	12.6	31.2
3	*2402.00	97.8 PK			2.33 V	242	66.7	31.1
4	*2402.00	93.9 AV			2.33 V	242	62.8	31.1
5	4804.00	42.4 PK	74.0	-31.6	3.03 V	174	40.5	1.9
6	4804.00	29.0 AV	54.0	-25.0	3.03 V	174	27.1	1.9

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK) Average (AV)
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	98.3 PK			1.26 H	197	67.2	31.1
2	*2441.00	94.4 AV			1.26 H	197	63.3	31.1
3	4882.00	42.1 PK	74.0	-31.9	3.37 H	108	40.1	2.0
4	4882.00	28.9 AV	54.0	-25.1	3.37 H	108	26.9	2.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	100.4 PK			2.32 V	243	69.3	31.1
2	*2441.00	96.5 AV			2.32 V	243	65.4	31.1
3	4882.00	42.7 PK	74.0	-31.3	2.97 V	185	40.7	2.0
4	4882.00	29.4 AV	54.0	-24.6	2.97 V	185	27.4	2.0

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

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

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	95.6 PK			1.36 H	207	64.5	31.1
2	*2480.00	91.7 AV			1.36 H	207	60.6	31.1
3	2483.50	55.1 PK	74.0	-18.9	1.36 H	207	23.9	31.2
4	2483.50	43.4 AV	54.0	-10.6	1.36 H	207	12.2	31.2
5	4960.00	42.1 PK	74.0	-31.9	3.32 H	117	39.8	2.3
6	4960.00	29.1 AV	54.0	-24.9	3.32 H	117	26.8	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	*2480.00	97.4 PK			2.25 V	244	66.3	31.1
2	*2480.00	93.5 AV			2.25 V	244	62.4	31.1
3	2483.50	55.7 PK	74.0	-18.3	2.25 V	244	24.5	31.2
4	2483.50	44.5 AV	54.0	-9.5	2.25 V	244	13.3	31.2
5	4960.00	42.9 PK	74.0	-31.1	3.03 V	179	40.6	2.3
6	4960.00	29.6 AV	54.0	-24.4	3.03 V	179	27.3	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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

30 MHz ~ 1 GHz Worst-Case Data:

BT_GFSK

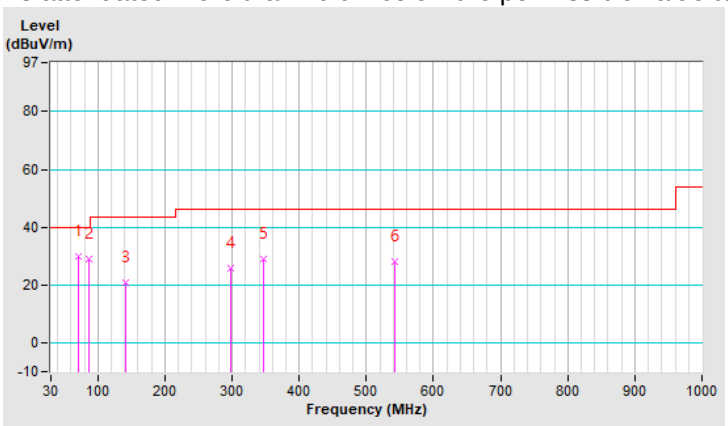
Mode A

CHANNEL	TX Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 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	70.74	29.8 QP	40.0	-10.2	1.00 H	222	41.4	-11.6
2	87.23	28.9 QP	40.0	-11.1	1.00 H	68	43.8	-14.9
3	140.58	20.8 QP	43.5	-22.7	1.00 H	52	30.7	-9.9
4	297.72	25.9 QP	46.0	-20.1	1.00 H	288	33.9	-8.0
5	347.19	29.2 QP	46.0	-16.8	1.00 H	240	36.3	-7.1
6	543.13	27.9 QP	46.0	-18.1	1.00 H	190	30.9	-3.0

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

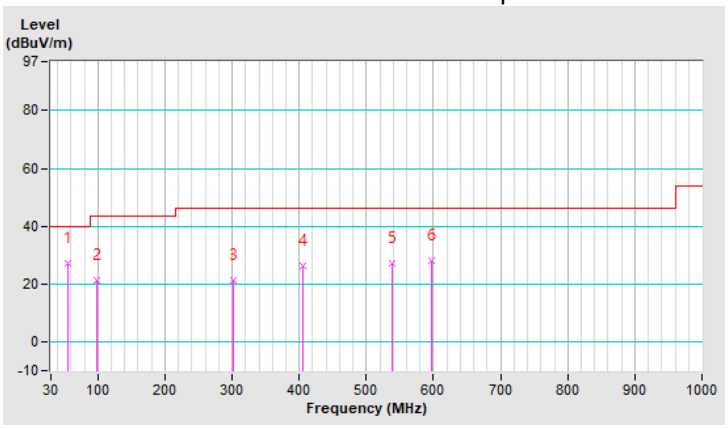


CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

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	56.19	27.4 QP	40.0	-12.6	1.00 V	233	37.3	-9.9
2	97.90	21.1 QP	43.5	-22.4	1.00 V	320	35.3	-14.2
3	301.60	21.4 QP	46.0	-24.6	1.00 V	155	29.3	-7.9
4	405.39	26.1 QP	46.0	-19.9	1.00 V	272	31.8	-5.7
5	539.25	27.0 QP	46.0	-19.0	1.00 V	156	30.1	-3.1
6	597.45	28.0 QP	46.0	-18.0	1.00 V	219	29.9	-1.9

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



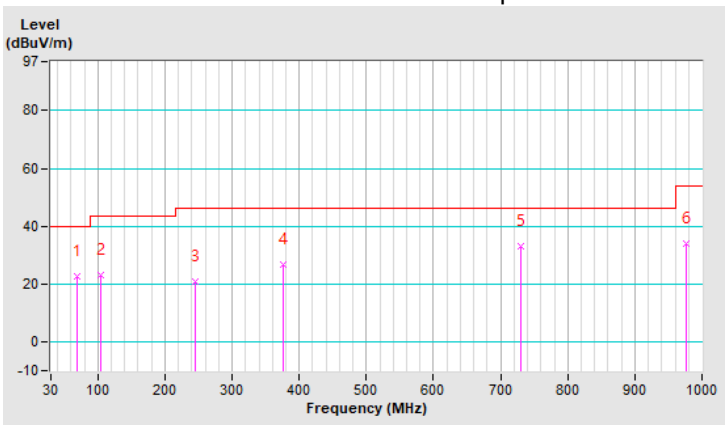
Mode B

CHANNEL	TX Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 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	69.77	22.8 QP	40.0	-17.2	1.25 H	323	34.3	-11.5
2	104.69	23.0 QP	43.5	-20.5	1.00 H	14	36.0	-13.0
3	245.34	20.9 QP	46.0	-25.1	1.25 H	264	31.0	-10.1
4	375.32	26.6 QP	46.0	-19.4	1.00 H	216	32.7	-6.1
5	729.37	32.9 QP	46.0	-13.1	1.50 H	102	32.9	0.0
6	976.72	33.9 QP	54.0	-20.1	1.25 H	284	28.9	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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

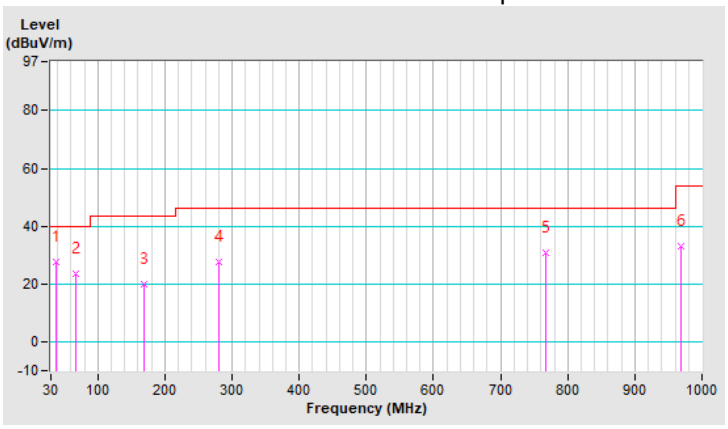


CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

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	38.73	27.8 QP	40.0	-12.2	1.25 V	146	38.5	-10.7
2	66.86	23.4 QP	40.0	-16.6	1.00 V	61	34.3	-10.9
3	169.68	20.0 QP	43.5	-23.5	1.50 V	35	29.5	-9.5
4	281.23	27.6 QP	46.0	-18.4	1.00 V	178	36.0	-8.4
5	768.17	30.9 QP	46.0	-15.1	1.00 V	333	29.6	1.3
6	968.96	33.2 QP	54.0	-20.8	1.25 V	349	28.3	4.9

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



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 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 17, 2020	Feb. 16, 2021
RF signal cable Woken	5D-FB	Cable-cond2-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 20, 2020	Jan. 19, 2021
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 13, 2019	Aug. 12, 2020
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Shielded Room 2.
3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

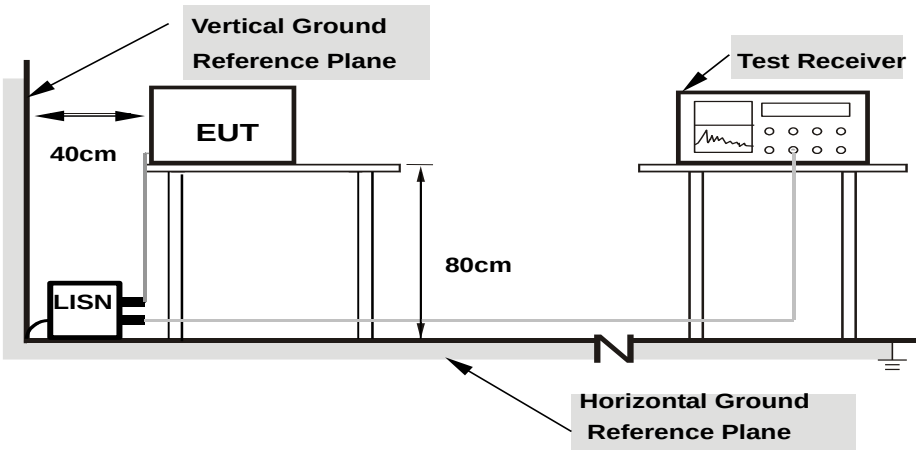
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling 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 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

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

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

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

4.2.7 Test Results

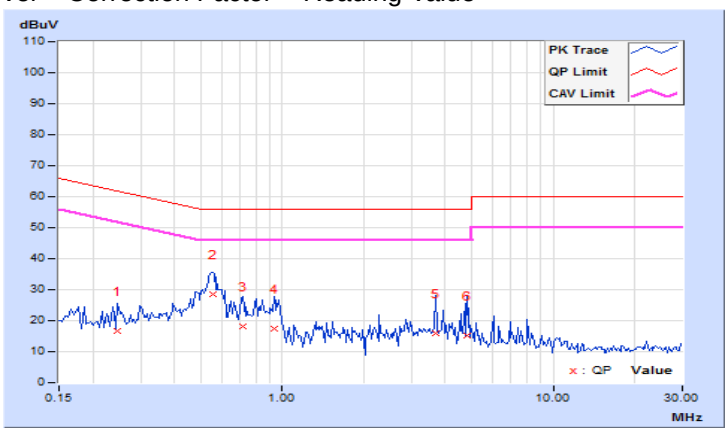
CONDUCTED WORST-CASE DATA：GFSK

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Greg Lin	Test Date	2020/4/18
Test Mode	Mode A		

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	0.24766	0.21	16.63	9.74	16.84	9.95	61.84	51.84	-45.00	-41.89
2	**0.55234**	**0.25**	**28.19**	**23.50**	**28.44**	**23.75**	**56.00**	**46.00**	**-27.56**	**-22.25**
3	0.71250	0.27	17.76	12.08	18.03	12.35	56.00	46.00	-37.97	-33.65
4	0.93125	0.29	16.95	10.12	17.24	10.41	56.00	46.00	-38.76	-35.59
5	3.69531	0.41	15.63	7.65	16.04	8.06	56.00	46.00	-39.96	-37.94
6	4.83984	0.43	14.62	6.92	15.05	7.35	56.00	46.00	-40.95	-38.65

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

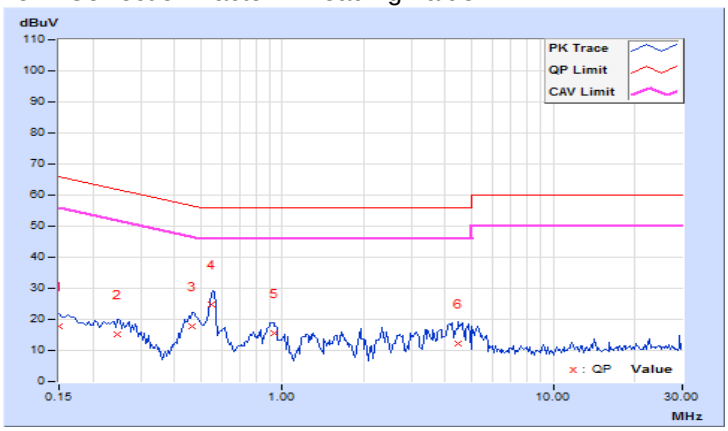


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Greg Lin	Test Date	2020/4/18
Test Mode	Mode A		

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	0.16	17.61	11.08	17.77	11.24	66.00	56.00	-48.23	-44.76
2	0.24766	0.18	14.94	8.61	15.12	8.79	61.84	51.84	-46.72	-43.05
3	0.46641	0.22	17.69	10.91	17.91	11.13	56.58	46.58	-38.67	-35.45
4	0.54844	0.23	24.43	17.33	24.66	17.56	56.00	46.00	-31.34	-28.44
5	0.93125	0.27	15.14	7.80	15.41	8.07	56.00	46.00	-40.59	-37.93
6	4.46094	0.43	11.74	1.02	12.17	1.45	56.00	46.00	-43.83	-44.55

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

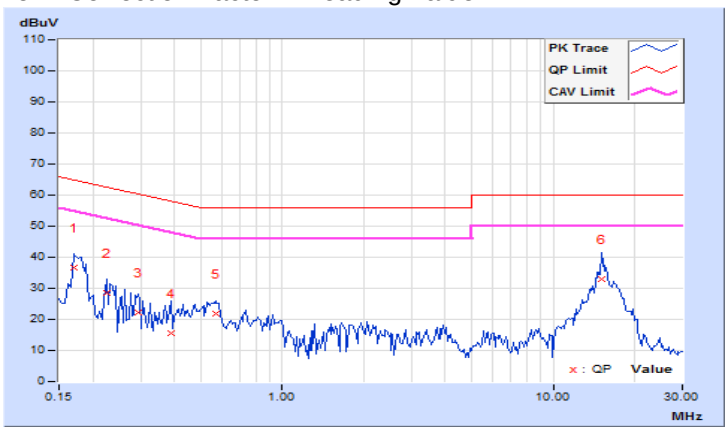


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Greg Lin	Test Date	2020/4/17
Test Mode	Mode B		

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	0.16953	0.15	36.67	20.73	36.82	20.88	64.98	54.98	-28.16	-34.10
2	0.22422	0.16	28.51	13.28	28.67	13.44	62.66	52.66	-33.99	-39.22
3	0.29453	0.18	22.20	8.29	22.38	8.47	60.40	50.40	-38.02	-41.93
4	0.38828	0.20	15.53	7.34	15.73	7.54	58.10	48.10	-42.37	-40.56
5	0.56797	0.22	21.55	10.18	21.77	10.40	56.00	46.00	-34.23	-35.60
6	15.19922	0.56	32.43	25.77	32.99	26.33	60.00	50.00	-27.01	-23.67

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

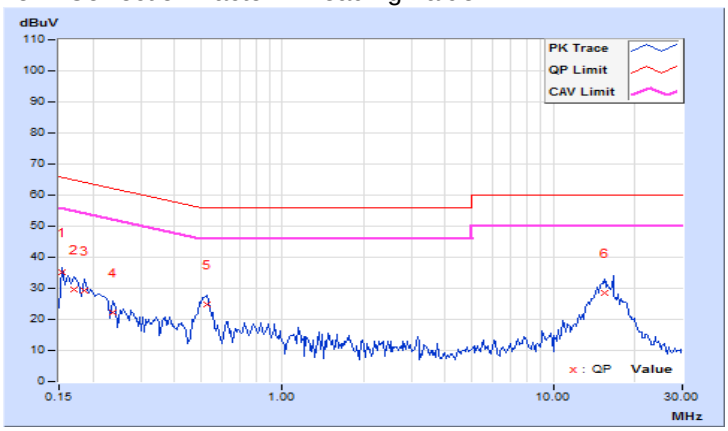


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Greg Lin	Test Date	2020/4/18
Test Mode	Mode B		

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	0.15391	0.13	35.05	13.44	35.18	13.57	65.79	55.79	-30.61	-42.22
2	0.16953	0.13	29.39	14.53	29.52	14.66	64.98	54.98	-35.46	-40.32
3	0.18516	0.14	29.12	14.44	29.26	14.58	64.25	54.25	-34.99	-39.67
4	0.23594	0.15	22.10	9.48	22.25	9.63	62.24	52.24	-39.99	-42.61
5	0.52891	0.20	24.65	19.77	24.85	19.97	56.00	46.00	-31.15	-26.03
6	15.42578	0.65	27.89	21.34	28.54	21.99	60.00	50.00	-31.46	-28.01

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

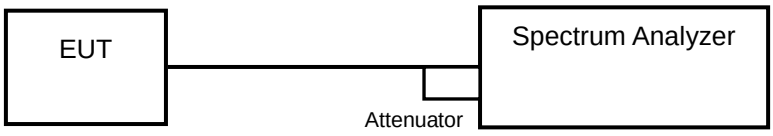


4.3 Number of Hopping Frequency Used

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.

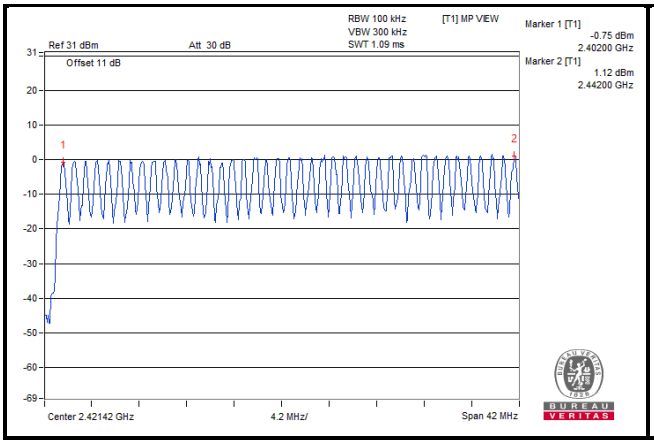
4.3.5 Deviation from Test Standard

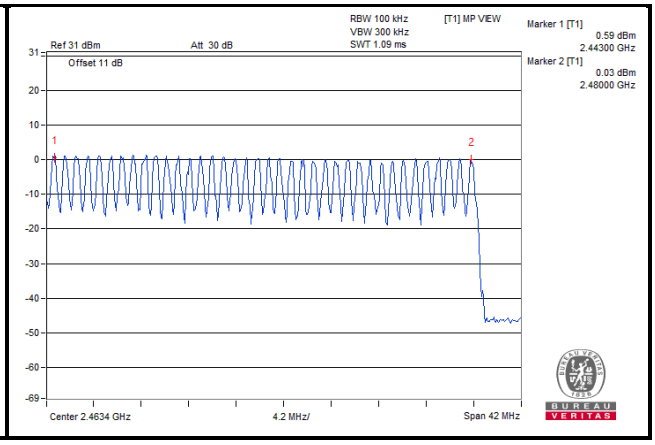
No deviation.

4.3.6 Test Results

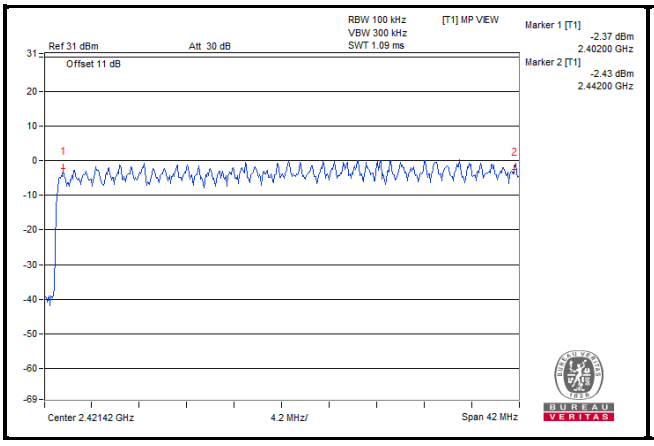
There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

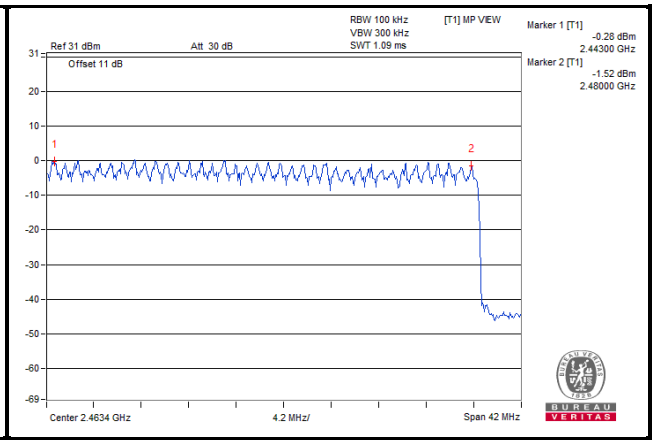
<GFSK>





<8DPSK>



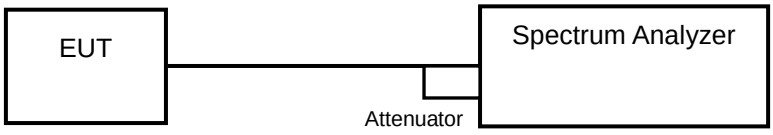


4.4 Dwell Time on Each Channel

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.

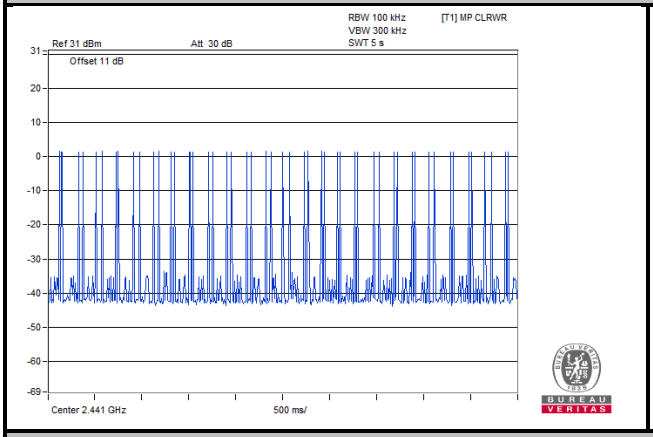
4.4.6 Test Results

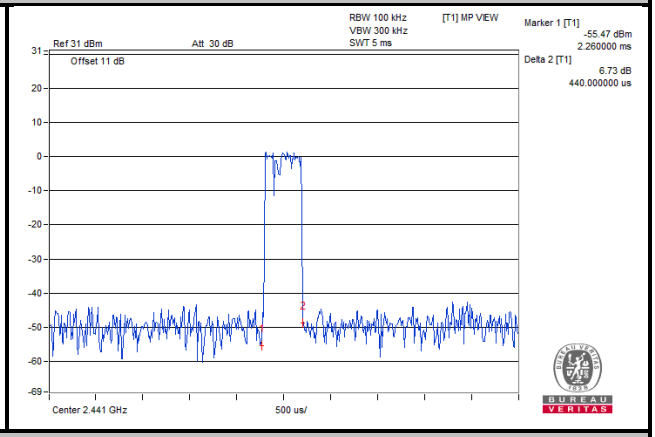
GFSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316.00 times	0.44	139.040	400
DH3	26 (times / 5 sec) * 6.32 = 164.32 times	1.69	277.701	400
DH5	17 (times / 5 sec) * 6.32 = 107.44 times	2.957	317.700	400

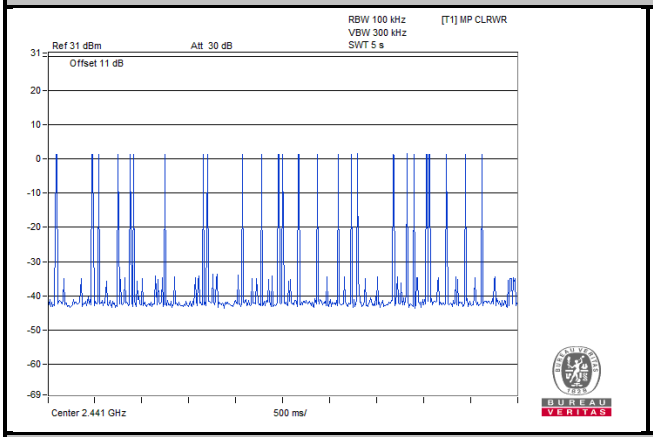
Note: Test plots of the transmitting time slot are shown as below.

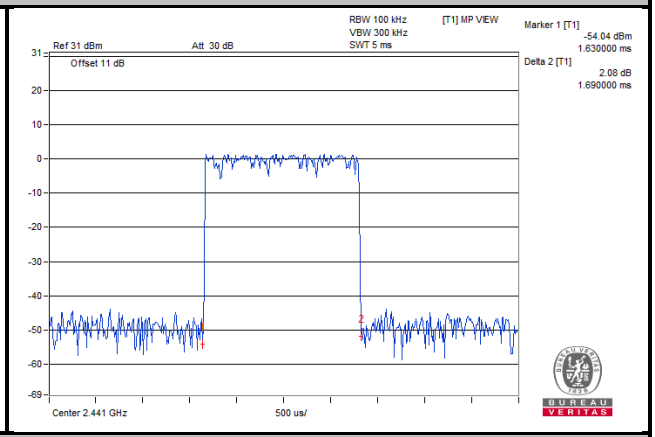
DH1



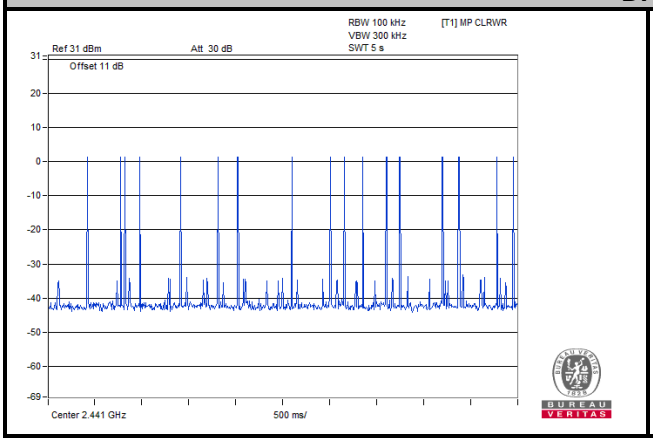


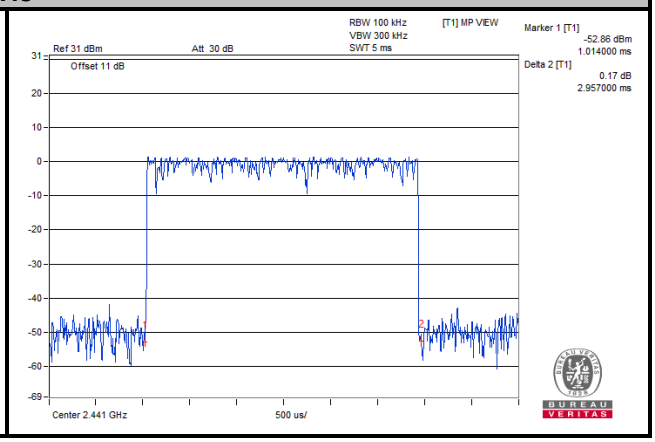
DH3





DH5



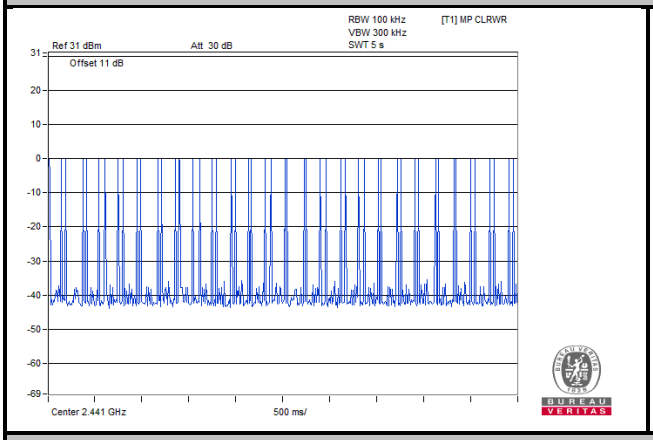


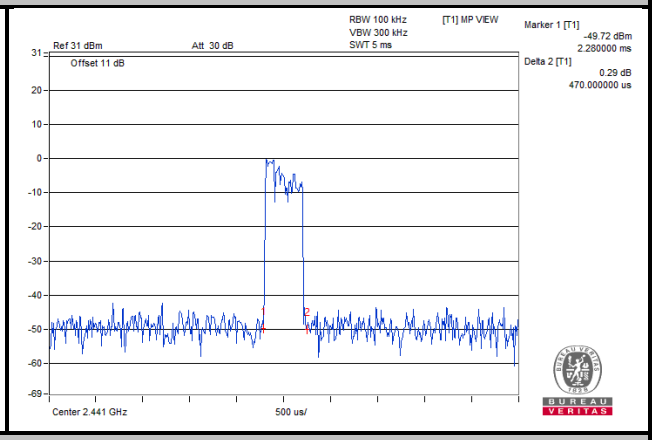
8DPSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
3DH1	50 (times / 5 sec) * 6.32 = 316.00 times	0.47	148.520	400
3DH3	26 (times / 5 sec) * 6.32 = 164.32 times	1.75	287.560	400
3DH5	16 (times / 5 sec) * 6.32 = 101.12 times	2.928	296.079	400

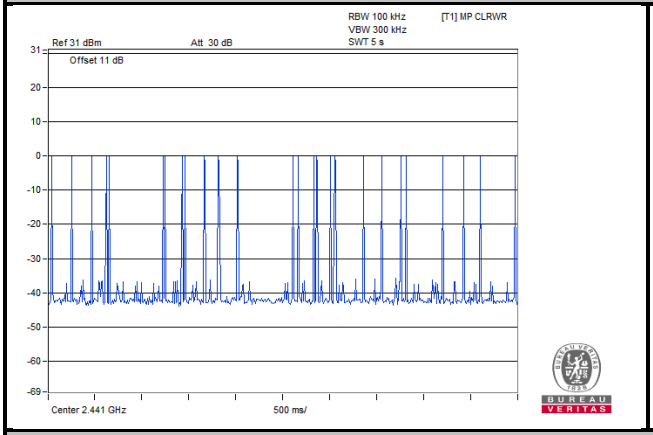
Note: Test plots of the transmitting time slot are shown as below.

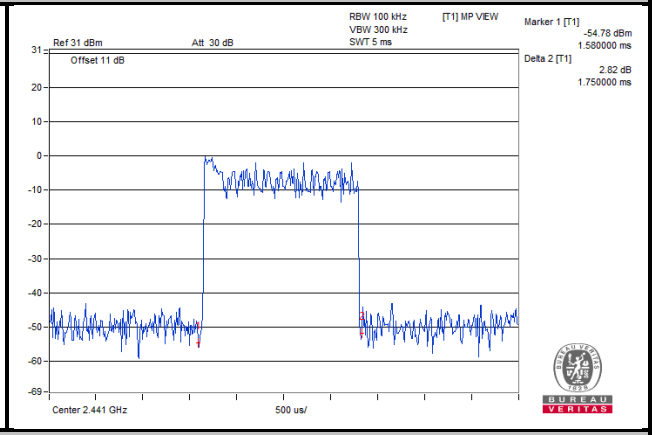
3DH1



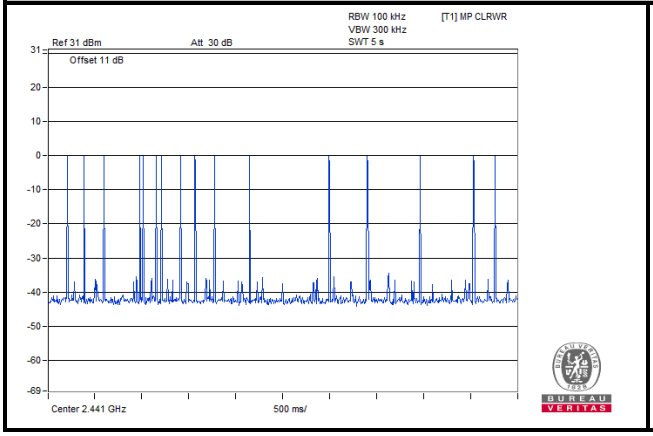


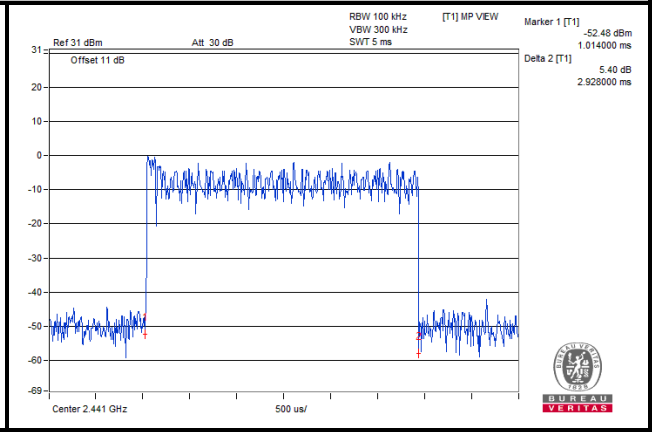
3DH3





3DH5



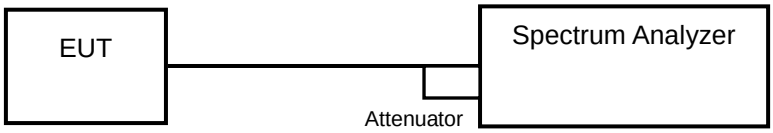


4.5 Channel Bandwidth

4.5.1 Limits of Channel Bandwidth Measurement

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

4.5.2 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 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

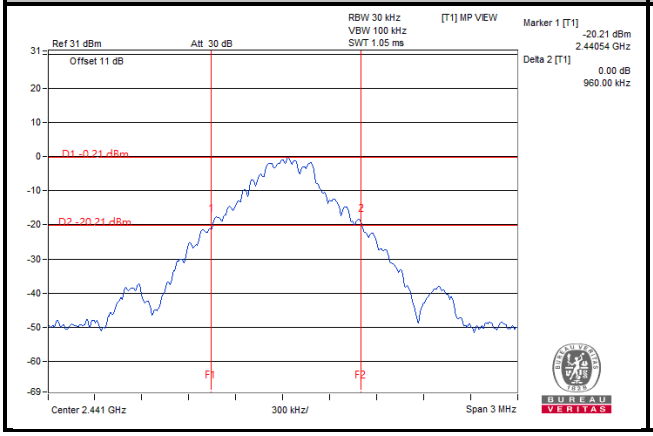
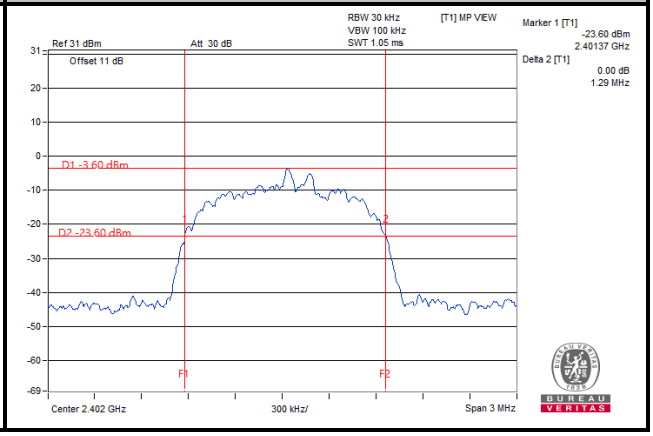
No deviation.

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.

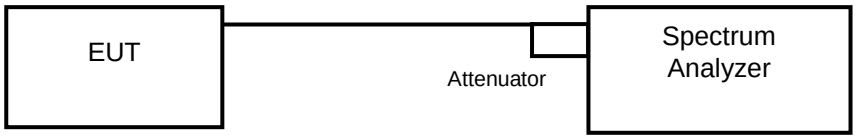
4.5.7 Test Results

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

Spectrum Plot of Worst Value	
GFSK	8DPSK
	

4.6 Occupied Bandwidth Measurement

4.6.1 Test Setup



4.6.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument

4.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

4.6.4 Deviation from Test Standard

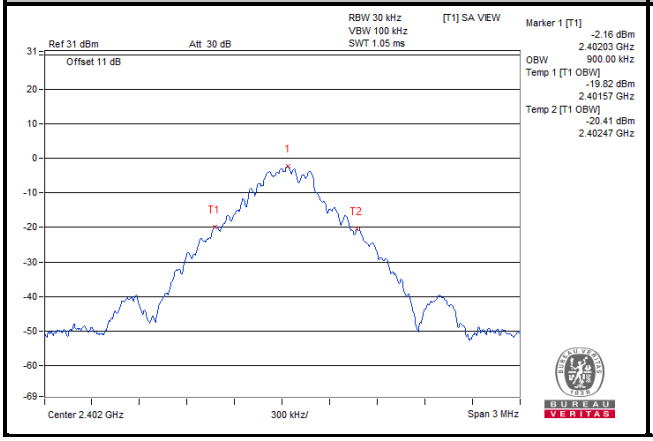
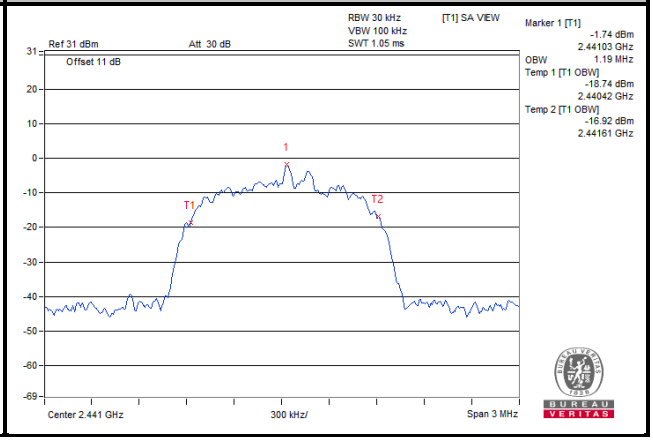
No deviation.

4.6.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.6.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.90	1.18
39	2441	0.90	1.19
78	2480	0.90	1.18

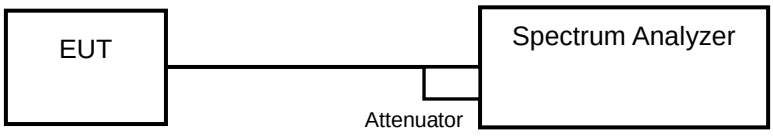
Spectrum Plot of Worst Value	
GFSK	8DPSK
	

4.7 Hopping Channel Separation

4.7.1 Limits of Hopping Channel Separation Measurement

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

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

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.

4.7.5 Deviation from Test Standard

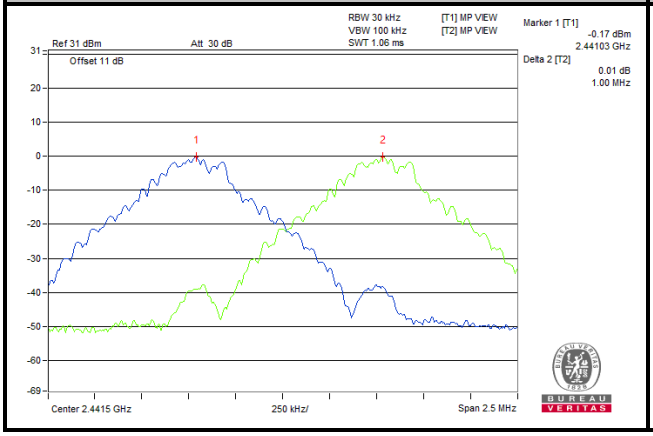
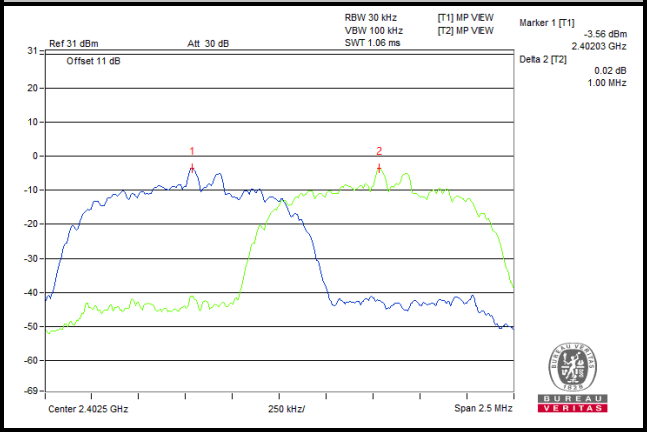
No deviation.

4.7.6 Test Results

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

Note:

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

Spectrum Plot of Worst Value	
GFSK	**8DPSK**
	

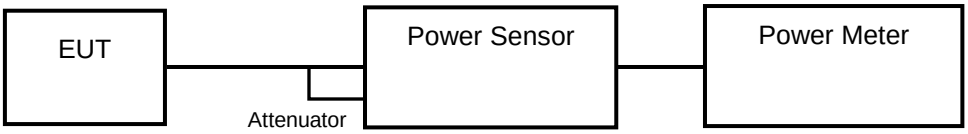
4.8 Maximum Output Power

4.8.1 Limits of Maximum Output Power Measurement

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

4.8.2 Test Setup



4.8.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.8.4 Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.8.5 Deviation from Test Standard

No deviation.

4.8.6 EUT Operating Condition

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

4.8.7 Test Results

<GFSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	1.205	0.81	1.169	0.68	125 / 1000 Note	Pass
39	2441	1.945	2.89	1.905	2.80	125 / 1000 Note	Pass
78	2480	1.535	1.86	1.489	1.73	125 / 1000 Note	Pass

Note: RF Output Power limit depends on the operating channel numbers, please refer to section 4.3 of the results.

<8DPSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	0.869	-0.61	0.8299	-0.81	125 / 1000 Note	Pass
39	2441	1.365	1.35	1.334	1.25	125 / 1000 Note	Pass
78	2480	1.054	0.23	1.016	0.07	125 / 1000 Note	Pass

Note: RF Output Power limit depends on the operating channel numbers, please refer to section 4.3 of the results.

4.9 Conducted Out of Band Emission Measurement

4.9.1 Limits Of Conducted Out of Band Emission Measurement

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

4.9.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.9.3 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.

4.9.4 Deviation from Test Standard

No deviation.

4.9.5 EUT Operating Condition

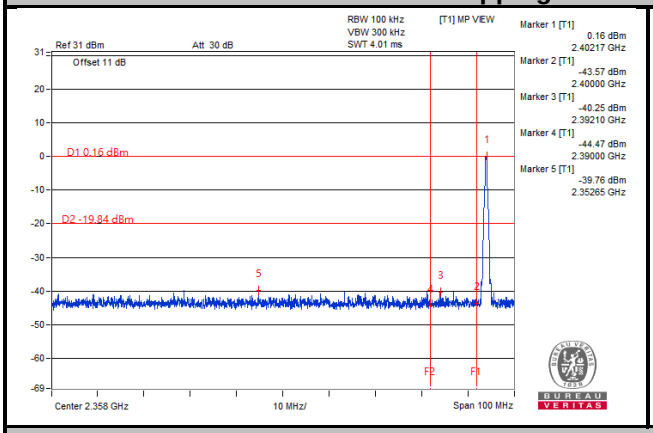
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

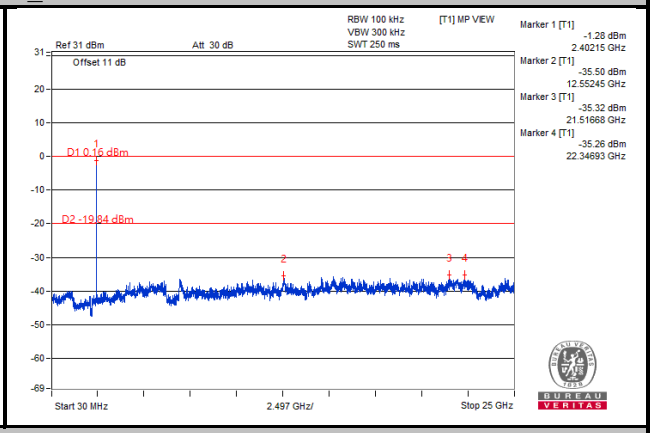
4.9.6 Test Results

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

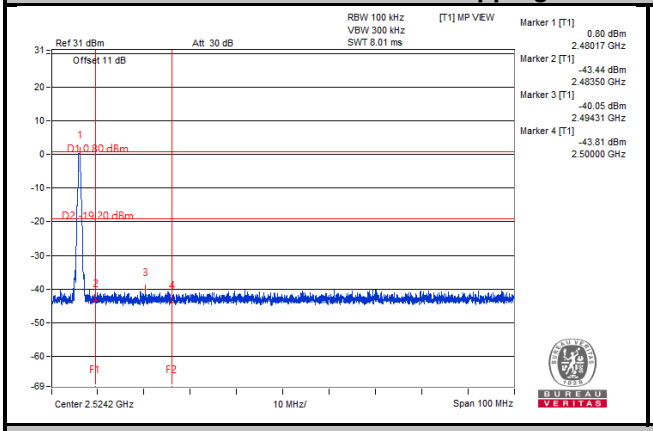
GFSK

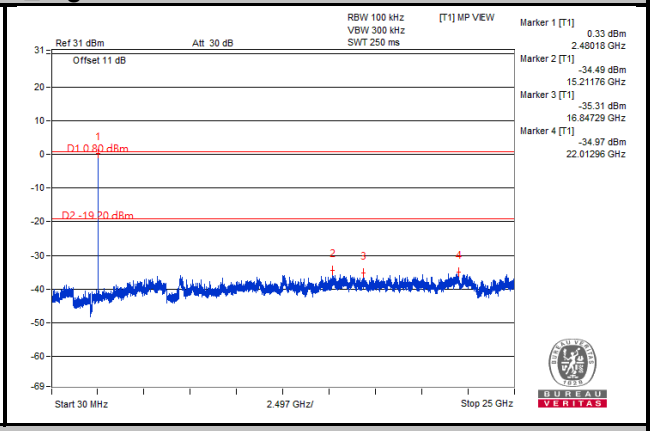
Hopping Disabled_Low Channel



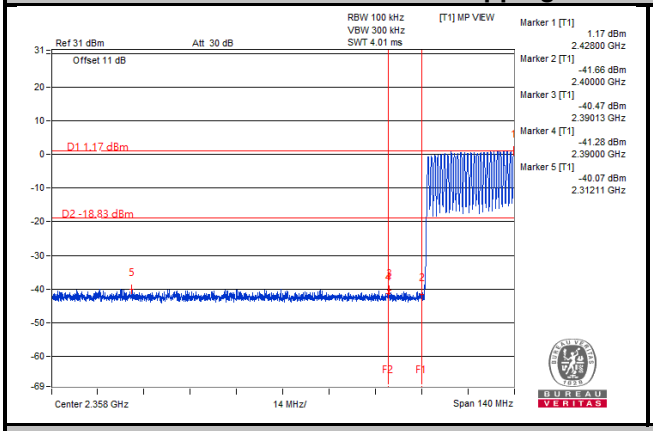


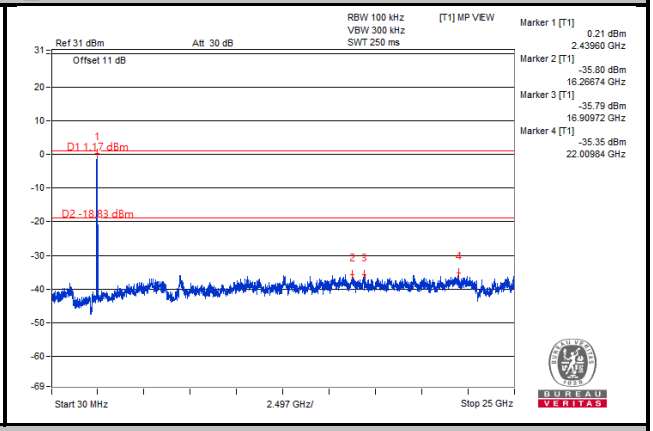
Hopping Disabled_High Channel



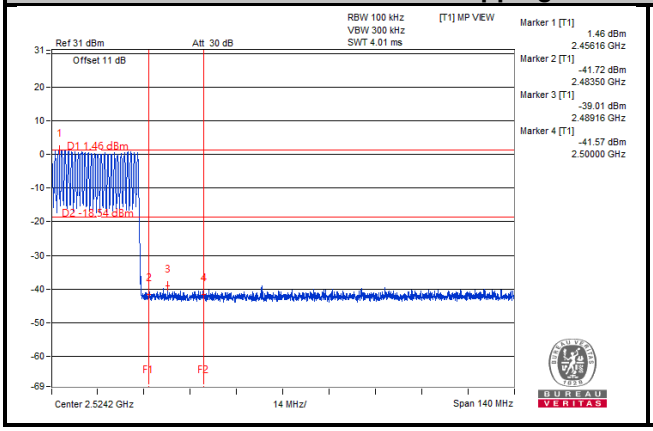


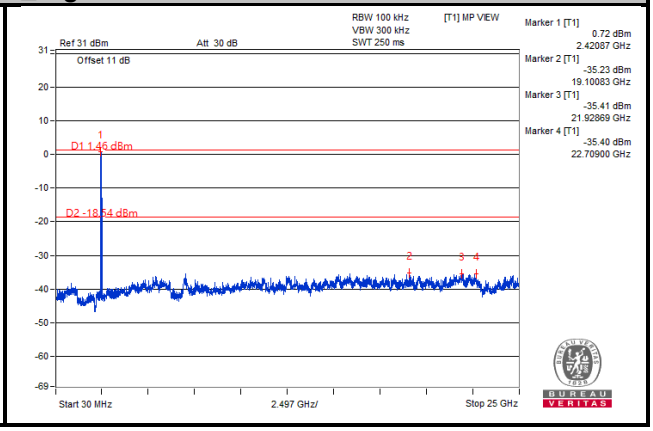
Hopping Enabled_Low Channel





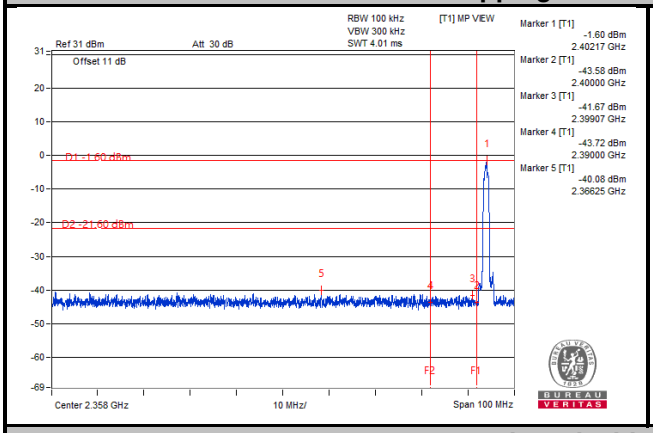
Hopping Enabled_High Channel

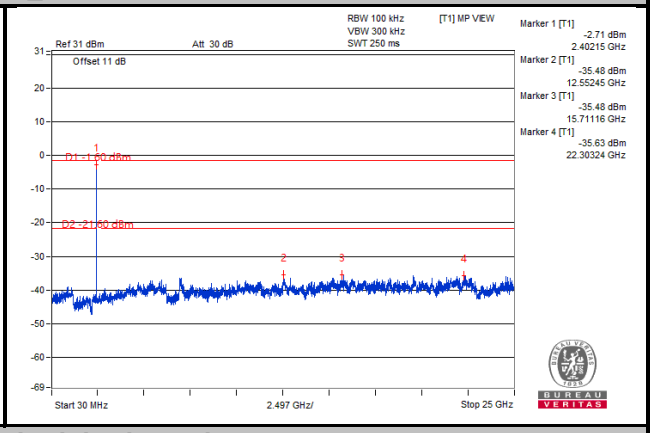




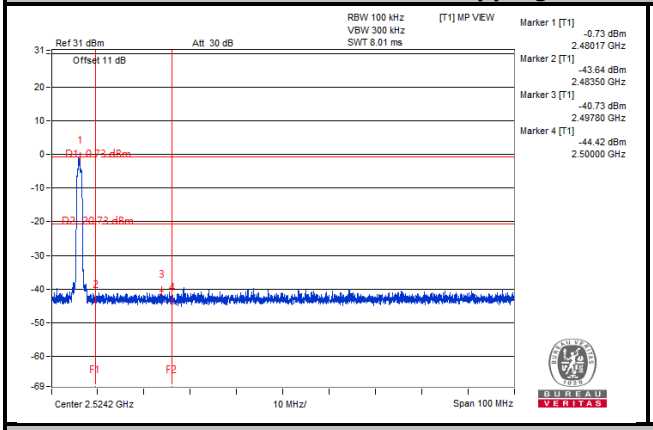
8DPSK

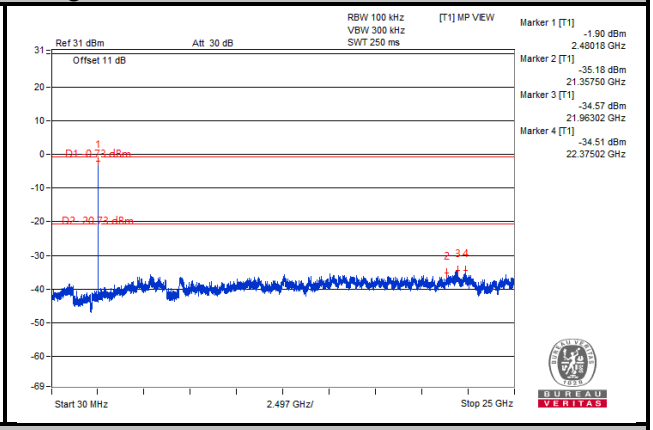
Hopping Disabled_Low Channel



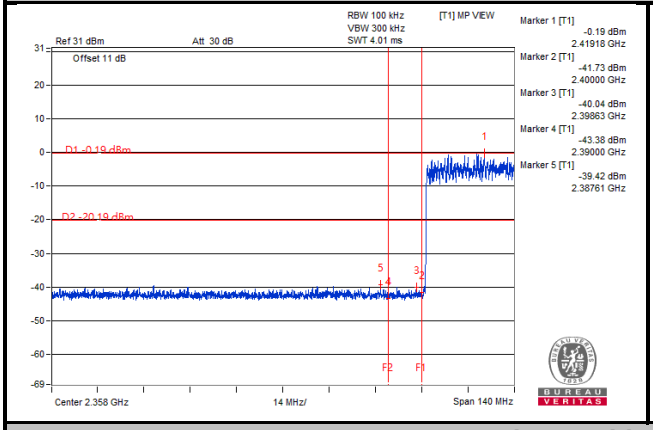


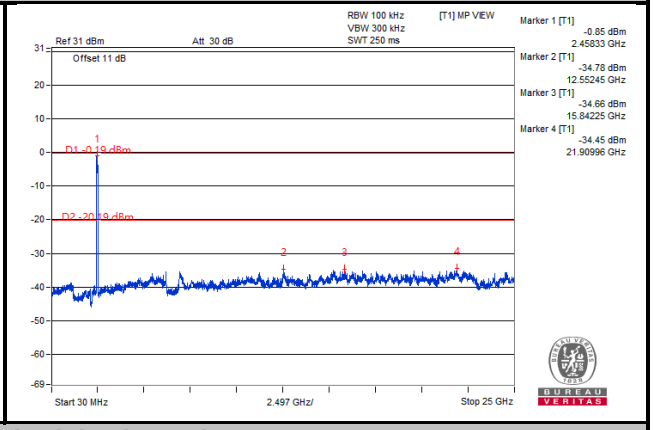
Hopping Disabled_High Channel





Hopping Enabled_Low Channel





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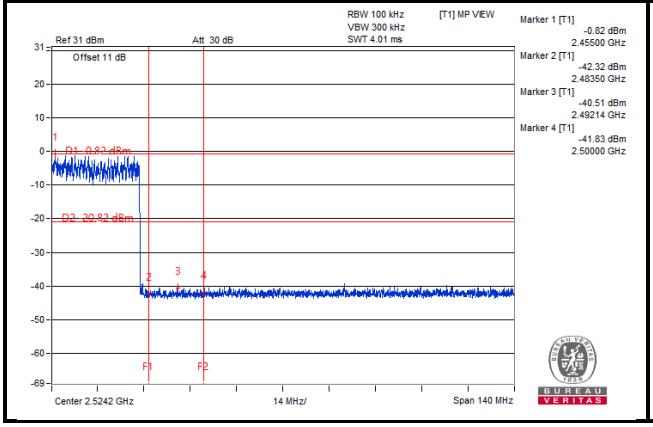

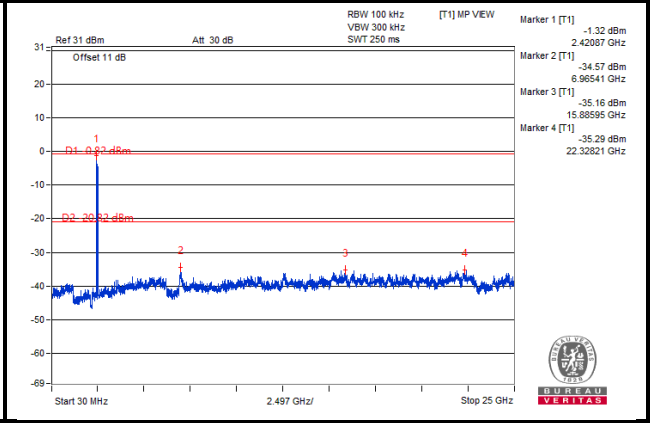

5 Pictures of Test Arrangements

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

Appendix – Information of 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 FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

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