TEST REPORT

Applicant	Twin-Star International Inc.
Address	12/F Taiwanese Trade Association Building, De Zheng Road, ChangAn Town, Dongguan City, China

Manufacturer or Supplier	Twin-Star International Inc.
Address	12/F Taiwanese Trade Association Building, De Zheng Road, ChangAn Town, Dongguan City, China
Product	Speaker
Brand Name	N/A
Model	TS-4006
Additional Models & Model Difference	TS-0843, TS-2611; See item 3.1
Date of tests	Feb. 23, 2024 ~ Mar. 05, 2024

the tests have been carried out according to the requirements of the following standards:

☒ **FCC Part 15, Subpart C, Section 15.247**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Andrew Sha Project Engineer / EMC Department	Approved by Glyn He Assistant Manager / EMC Department
	Date: Apr. 12, 2024

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF2402WDG0078	Original release	Apr. 12, 2024

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD SECTION	**TEST TYPE AND LIMIT**	**RESULT**	**REMARK**
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
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)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(d)& 15.209	Transmitter Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

2 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	UNCERTAINTY
Conducted emissions	9kHz~30MHz	3.36dB
Radiated emissions	9KHz ~ 30MHz	2.80dB
	30MHz ~ 1GMHz	4.65dB
	1GHz ~ 18GHz	5.01dB
	18GHz ~ 40GHz	4.10dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Speaker
MODEL NO.	TS-4006
ADDITIONAL MODELS	TS-0843, TS-2611
FCC ID	QCD-TS-S-PL01
POWER SUPPLY	Input: 100-240V 50/60Hz Output: DC 15V 4A
MODULATION TECHNOLOGY	FHSS
MODULATION TYPE	GFSK, π/4 DQPSK, 8DPSK
OPERATING FREQUENCY	2402MHz~2480MHz
NUMBER OF CHANNEL	79
PEAK OUTPUT POWER	5.649mW (Max. Measured)
ANTENNA TYPE	PCB Antenna, -1.95dBi Gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	Optical line: Unshielded, Detachable, 1.2m
ACCESSORY	N/A

NOTES:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. Please refer to the EUT photo document (Reference No.:2402WDG0078) for detailed product photo.
4. The additional models TS-0843 and TS-2611 are identical with the test model TS-4006 except the adapter, speaker, power and appearance, and TS-4006 was tested with all test items, TS-0843 and TS-2611 were tested with conducted emission and transmitter radiated emission(below 1GHz) in this report.
5. The TS-4006 was powered by the following adapter:

ADAPTER	
BRAND:	Guangdong Tiantongjiuheng Technology Co., Ltd
MODEL:	TJ07201Z1504000
INPUT:	100V-240V~, 50/60Hz, 1.5A MAX
OUTPUT:	15V ⎓, 4.0A
DC LINE:	Unshielded, Non-detachable, 1.2m
AC LINE:	Unshielded, Detachable, 1.2m

6. The TS-0843 and TS-2611 were powered by the following adapter:

ADAPTER	
BRAND:	Guangdong Tiantongjiuheng Technology Co., Ltd
MODEL:	TJ04202Z1502500
INPUT:	100V-240V~, 50/60Hz, 1.0A MAX
OUTPUT:	15V ⎓, 2.5A
DC LINE:	Unshielded, Non-detachable, 1.2m
AC LINE:	Unshielded, Detachable, 1.2m

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

3.2.1 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photograph of the test configuration for reference.

3.2.2 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, power supply voltage range and antenna ports. Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
A	√	√	√	√	AC 120V 60Hz with BT link

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

RADIATED EMISSION TEST (BELOW 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, X axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
☒ 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	0 to 78	39	FHSS	GFSK	DH5

For the test results, only the worst case was shown in test report.

RADIATED EMISSION TEST (ABOVE 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, X axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
☒ 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	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	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, antenna ports (if EUT with antenna diversity architecture), and packet types.

☒ 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	0 to 78	Hopping	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, antenna ports (if EUT with antenna diversity architecture), and packet types.

☒ 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	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	25deg. C, 55%RH	AC 120V 60Hz	Stalker
RE≥1G	25deg. C, 55%RH	AC 120V 60Hz	Stalker
PLC	25deg. C, 55%RH	AC 120V 60Hz	Vincent
APCM	25deg. C, 60%RH	AC 120V 60Hz	Vincent

3.3 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. Section 15.247
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013

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

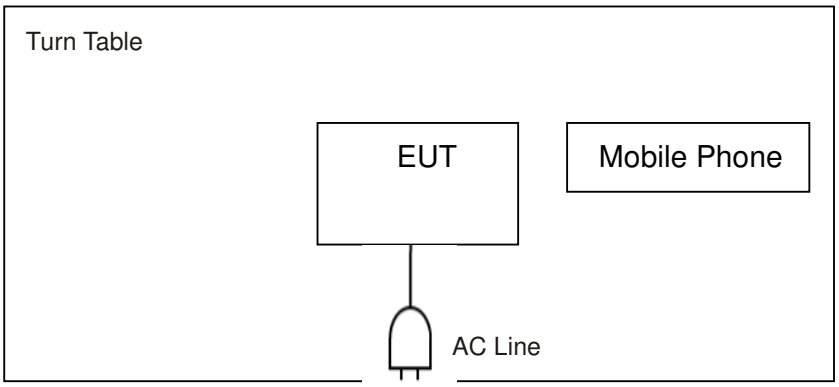
3.4 DESCRIPTION OF SUPPORT UNITS

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

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	iPhone 6s	Apple	ML7F2CH/A	C6KQKXLARY8	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A

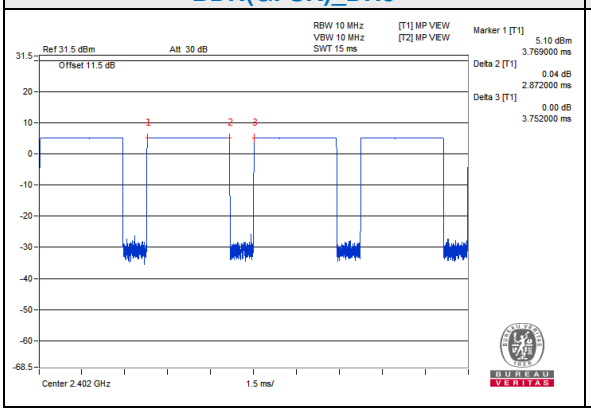
3.5 CONFIGURATION OF SYSTEM UNDER TEST



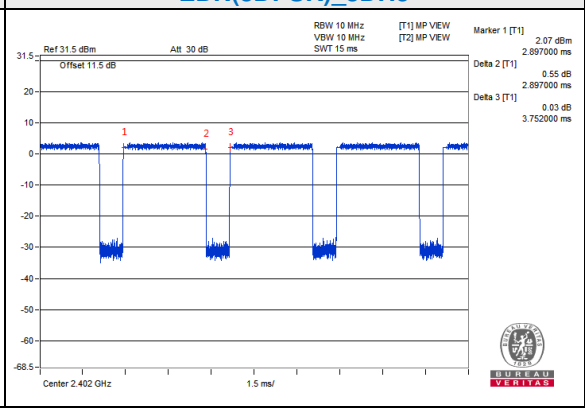
3.6 DUTY CYCLE OF TESET SIGNAL

Test Mode	Packet Type	On Time (ms)	Period (ms)	Duty Cycle (%)	1/T Min. VBW (KHz)	VBW Setting
BDR(GFSK)	DH5	2.872	3.752	76.5	0.348	1kHz
EDR(8DPSK)	3DH5	2.897	3.752	77.2	0.345	1kHz

BDR(GFSK)_DH5



EDR(8DPSK)_3DH5



4 TEST TYPES AND RESULTS

4.1. CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

NOTES: 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.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR7	101494	Jan. 02, 25
Artificial Mains Network	Rohde&Schwarz	ENV216	101173	Jan. 11, 25
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	100317	Jan. 02, 25
Voltage probe	SCHWARZBECK	TK 9421	TK 9421-176	Jul. 16, 24
Test software	ADT	ADT_Cond_V7.3.7	N/A	N/A

NOTES:

1. The test was performed in shielded room 543.
2. Equipment are calibrated by calibration laboratory accredited to ISO/IEC 17025 by a mutually recognized Accreditation.

4.1.3 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.

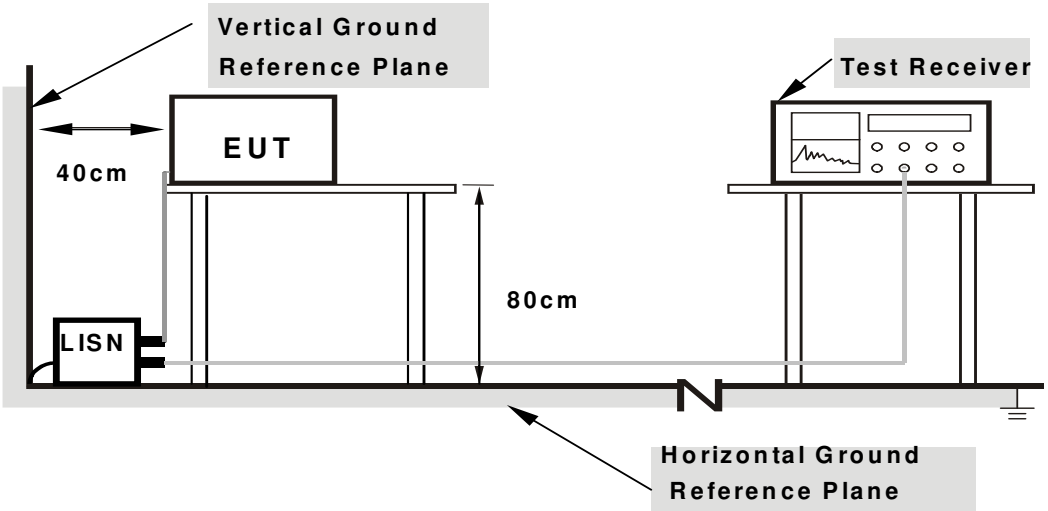
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: 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



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).

4.1.6 EUT OPERATING CONDITIONS

a. Turned on the power and connected of all equipment.
b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

4.1.7 TEST RESULTS

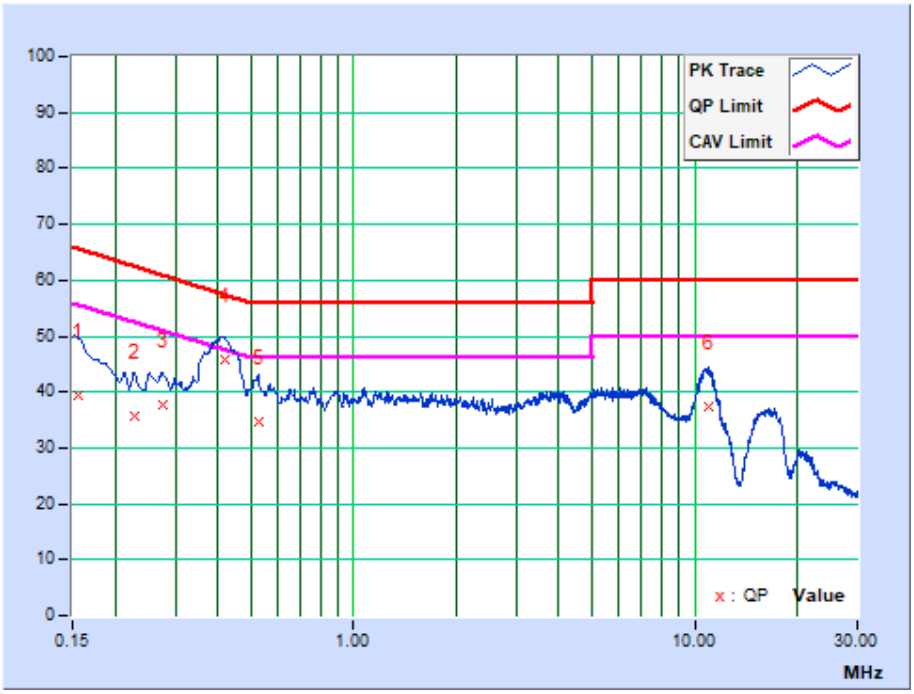
CONDUCTED WORST-CASE DATA:

TS-0843

PHASE	Line	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15509	9.62	29.77	16.00	39.39	25.62	65.72	55.72	-26.33	-30.10
2	0.22683	9.63	26.17	17.99	35.80	27.62	62.56	52.56	-26.76	-24.94
3	0.27433	9.63	27.96	19.91	37.59	29.54	60.99	50.99	-23.40	-21.45
4	0.41965	9.62	36.23	30.77	45.85	40.39	57.46	47.46	-11.60	-7.06
5	0.52523	9.62	24.99	17.27	34.61	26.89	56.00	46.00	-21.39	-19.11
6	10.99275	9.92	27.29	21.35	37.21	31.27	60.00	50.00	-22.79	-18.73

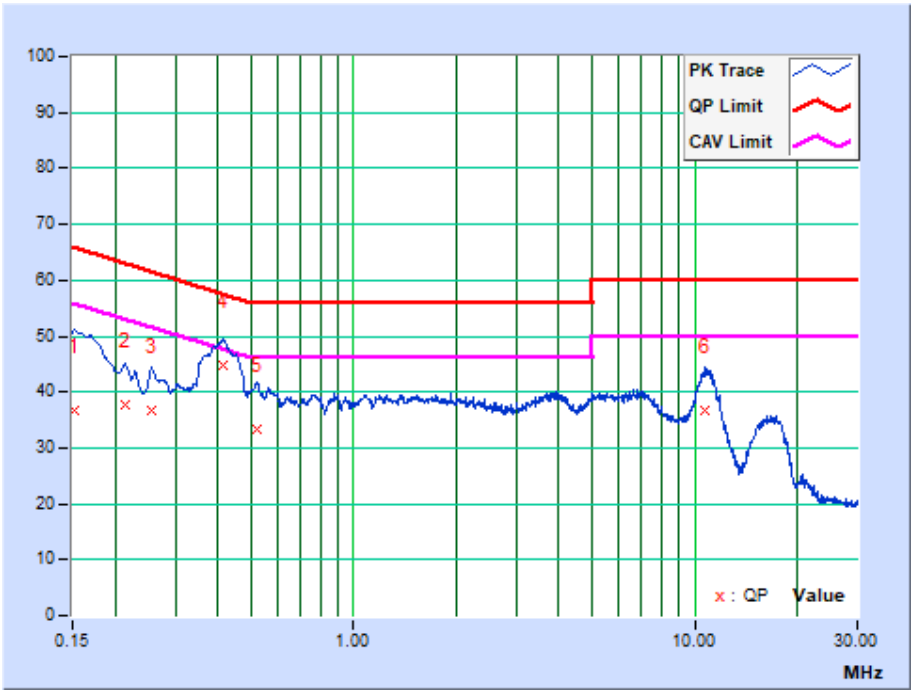
REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



PHASE	Neutral	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15225	9.36	27.19	15.18	36.55	24.54	65.88	55.88	-29.32	-31.33
2	0.21291	9.33	28.32	20.20	37.65	29.53	63.09	53.09	-25.44	-23.56
3	0.25575	9.34	27.51	18.15	36.85	27.49	61.57	51.57	-24.72	-24.08
4	0.41524	9.36	35.50	29.84	44.86	39.20	57.54	47.54	-12.68	-8.34
5	0.52385	9.37	24.03	16.45	33.40	25.82	56.00	46.00	-22.60	-20.18
6	10.76100	9.60	26.98	20.91	36.58	30.51	60.00	50.00	-23.42	-19.49

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.

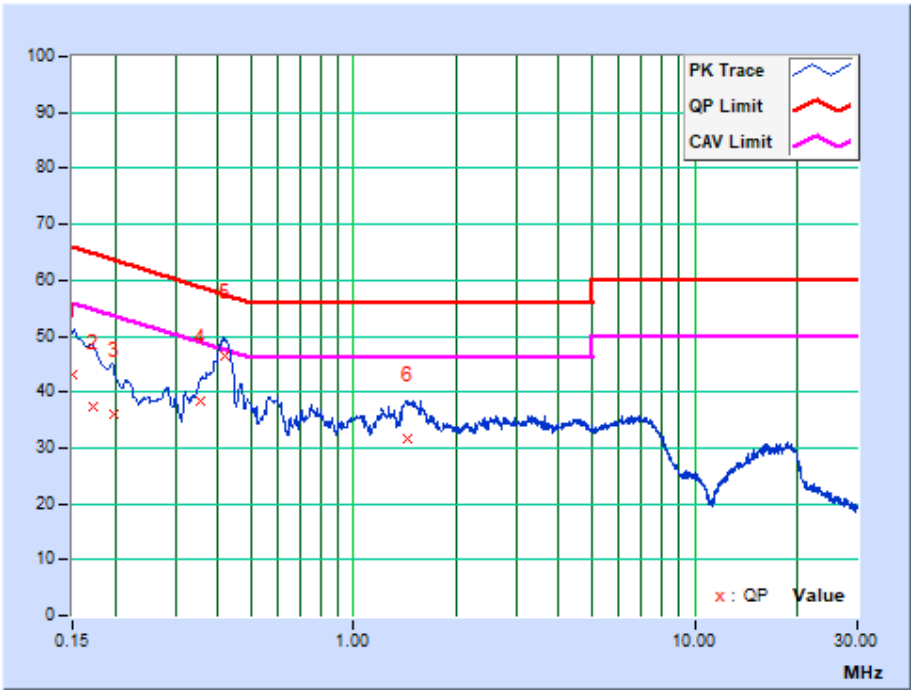


TS-2611

PHASE	Line	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.62	33.57	13.30	43.19	22.92	66.00	56.00	-22.81	-33.08
2	0.17250	9.62	27.82	13.38	37.44	23.00	64.84	54.84	-27.40	-31.84
3	0.19725	9.62	26.35	15.37	35.97	24.99	63.73	53.73	-27.76	-28.74
4	0.35628	9.62	28.63	21.69	38.25	31.31	58.81	48.81	-20.56	-17.50
5	0.41965	9.62	36.90	31.20	46.52	40.82	57.46	47.46	-10.93	-6.63
6	1.44825	9.64	21.86	16.79	31.50	26.43	56.00	46.00	-24.50	-19.57

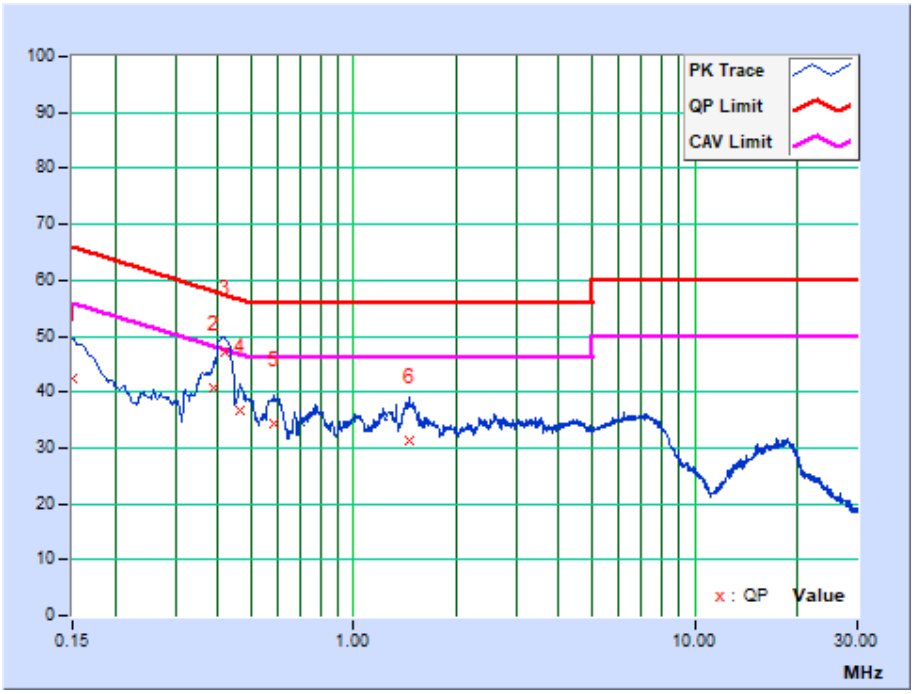
REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



PHASE	Neutral	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.37	32.96	12.50	42.33	21.87	66.00	56.00	-23.67	-34.13
2	0.38769	9.36	31.28	24.66	40.64	34.02	58.11	48.11	-17.48	-14.10
3	0.41965	9.37	37.70	32.04	47.07	41.41	57.46	47.46	-10.39	-6.05
4	0.46500	9.37	27.37	21.39	36.74	30.76	56.60	46.60	-19.86	-15.84
5	0.58683	9.37	24.83	19.12	34.20	28.49	56.00	46.00	-21.80	-17.51
6	1.45725	9.40	21.93	16.93	31.33	26.33	56.00	46.00	-24.67	-19.67

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.

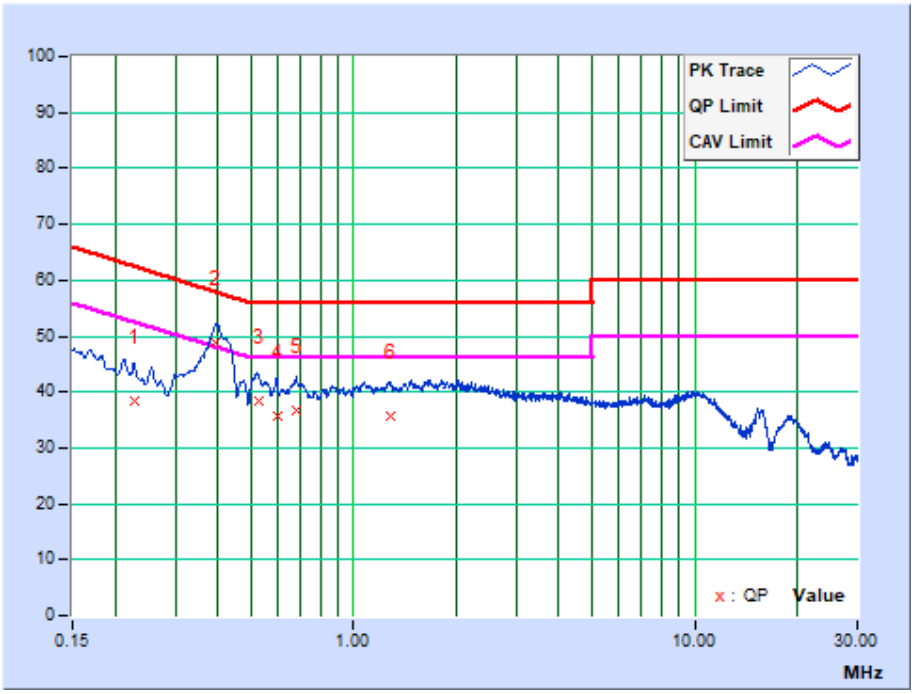


TS-4006

PHASE	Line	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.22683	9.63	28.83	18.29	38.46	27.92	62.56	52.56	-24.10	-24.64
2	0.39492	9.62	39.34	32.10	48.96	41.72	57.96	47.96	-9.00	-6.24
3	0.52575	9.62	28.60	17.18	38.22	26.80	56.00	46.00	-17.78	-19.20
4	0.59550	9.62	26.08	18.94	35.70	28.56	56.00	46.00	-20.30	-17.44
5	0.67875	9.64	27.12	19.28	36.76	28.92	56.00	46.00	-19.24	-17.08
6	1.27725	9.63	26.02	17.92	35.65	27.55	56.00	46.00	-20.35	-18.45

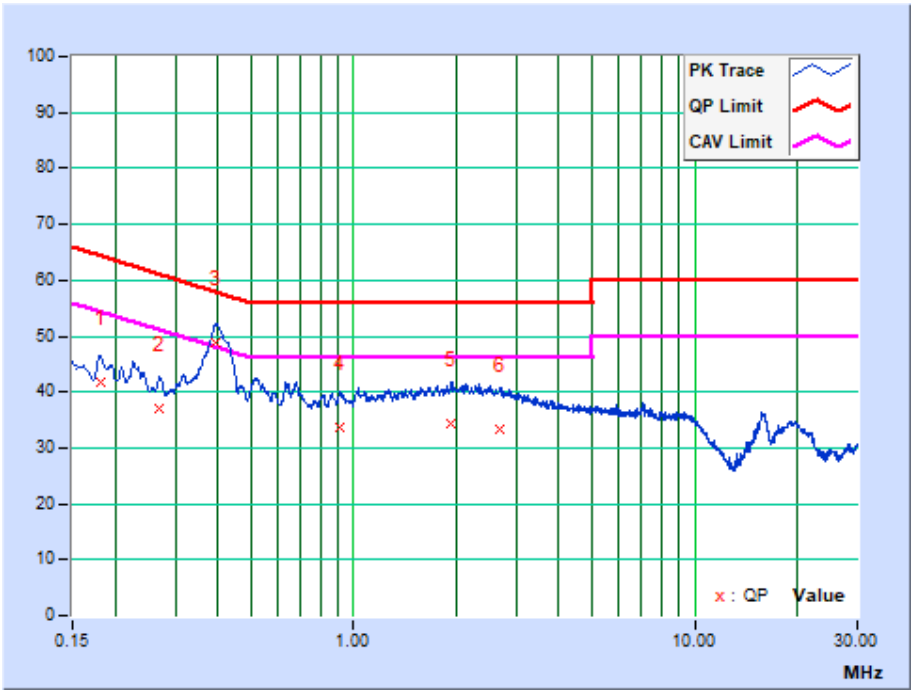
REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



PHASE	Neutral	6dB BANDWIDTH	9kHz

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.18076	9.32	32.52	24.40	41.84	33.72	64.45	54.45	-22.61	-20.73
2	0.26930	9.34	27.86	19.82	37.20	29.16	61.14	51.14	-23.94	-21.98
3	0.39525	9.36	39.37	32.11	48.73	41.47	57.95	47.95	-9.22	-6.48
4	0.91500	9.38	24.26	16.63	33.64	26.01	56.00	46.00	-22.36	-19.99
5	1.94070	9.43	25.07	18.28	34.50	27.71	56.00	46.00	-21.50	-18.29
6	2.67450	9.44	23.92	17.46	33.36	26.90	56.00	46.00	-22.64	-19.10

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



4.2. RADIATED EMISSION AND BANDEDGE MEASUREMENT

4.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). 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

NOTES:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), 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.

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESU40	100449	Jan. 02, 25
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV7	102331	Apr. 05, 24
Active Loop Antenna (9KHz -30MHz)	SCHWARZBECK	FMZB 1519B	1519B-045	May. 09, 24
Amplifier (9KHz -1GHz)	Burgeon	BPA-530	100210	Mar. 06, 25
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-554	Jan. 08, 25
Horn Antenna (1GHz -18GHz)	ETS -Lindgren	3117	00062558	Apr. 01, 24
Horn Antenna (18GHz -40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170147	Apr. 01, 24
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	NSEMC003	May. 20, 24
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A
Broadband Preamplifier (1GHz~18GHz)	SCHWARZBECK	BBV9718	305	Apr. 24, 24
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Jan. 02, 25
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	N/A

NOTES:

1. The test was performed in 966 Chamber.
2. Equipment are calibrated by calibration laboratory accredited to ISO/IEC 17025 by a mutually recognized Accreditation.
3. The horn antenna is used only for the measurement of emission frequency above1GHz if tested.
4. The FCC Site Registration No. is 749762.

4.2.3 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 1.5 meters(above 1GHz) and 0.8 meters(below 1GHz) above the ground at a 3 meters semi-anechoic chamber. 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. For below 1GHz was used bilog antenna, and above 1GHz was used horn antenna, and its height 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1.3m above the ground.

g. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTES:

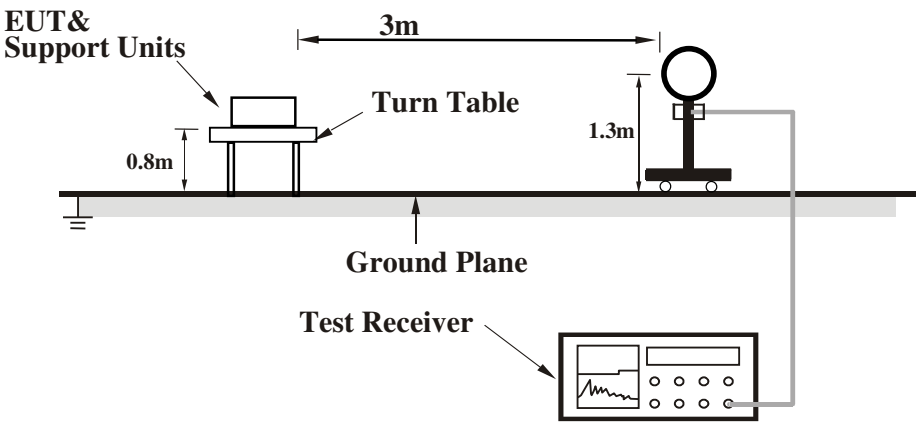
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.2.4 DEVIATION FROM TEST STANDARD

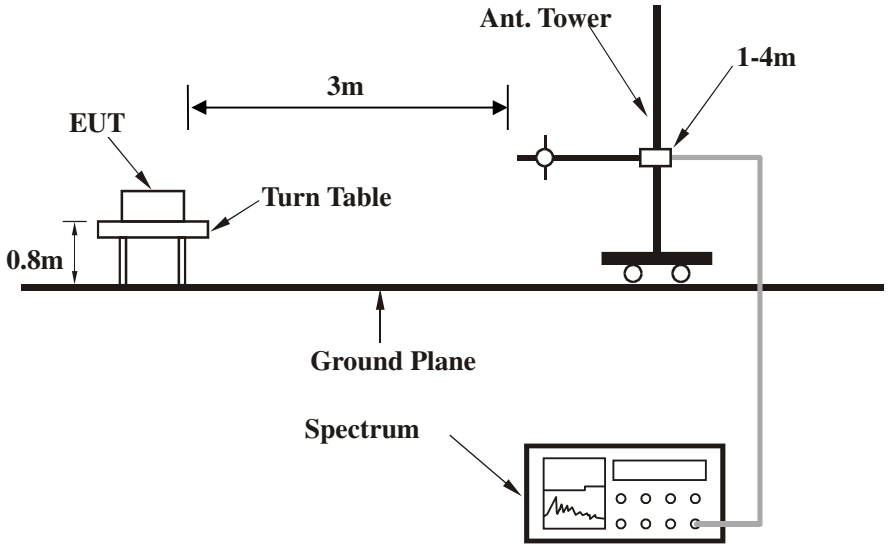
No deviation.

4.2.5 TEST SETUP

Below 30MHz test setup

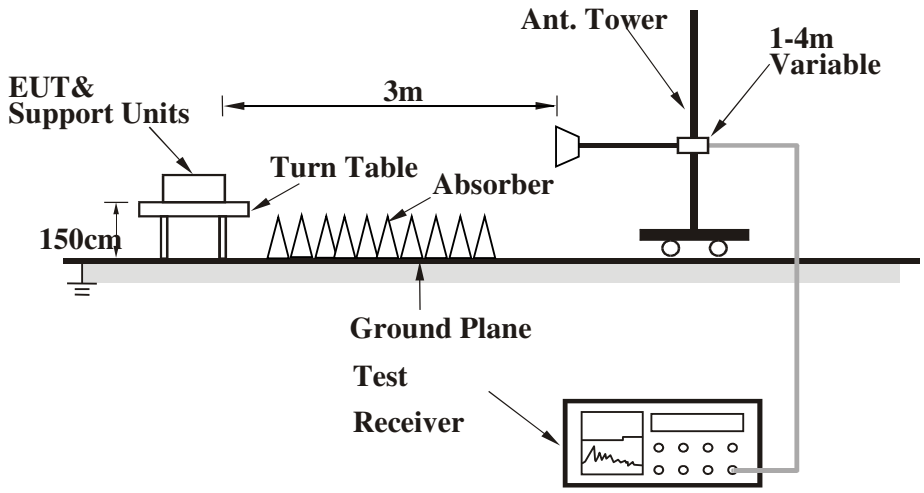


Below 1GHz test setup



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

Above 1GHz test setup



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

4.2.6 EUT OPERATING CONDITIONS

a. Set the EUT under full load condition and placed them on a testing table.

b. Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.

c. The necessary accessories enable the EUT in full functions.

4.2.7 TEST RESULTS

BELOW 1GHz WORST-CASE DATA:

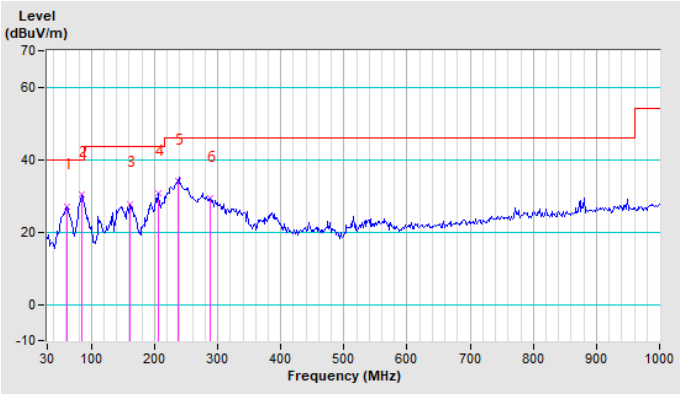
GFSK DH5: TS-4006

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	61.09	27.10 QP	40.00	-12.90	1.00 H	150	45.23	-18.13
2	84.41	30.32 QP	40.00	-9.68	1.00 H	155	53.45	-23.13
3	160.58	27.56 QP	43.50	-15.94	1.74 H	244	44.67	-17.11
4	205.66	30.72 QP	43.50	-12.78	1.62 H	259	50.49	-19.77
5	236.75	33.90 QP	46.00	-12.10	1.40 H	289	52.19	-18.29
6	288.04	29.21 QP	46.00	-16.79	1.28 H	304	45.47	-16.26

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value

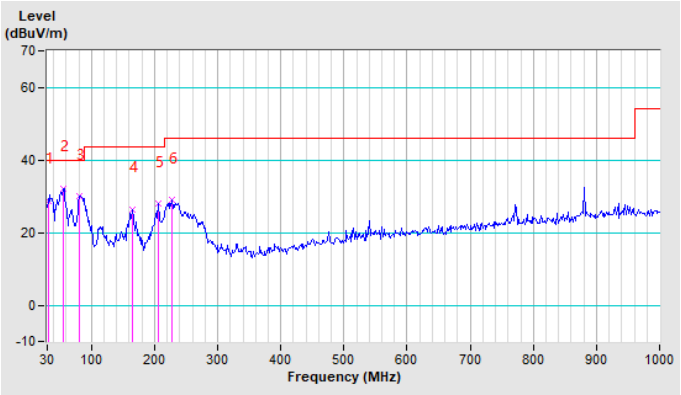


CHANNEL	Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

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	31.55	28.76 QP	40.00	-11.24	1.00 V	250	48.02	-19.26
2	**54.87**	**31.97 QP**	**40.00**	**-8.03**	**1.35 V**	**145**	**49.67**	**-17.70**
3	81.30	29.88 QP	40.00	-10.12	1.15 V	171	52.60	-22.72
4	165.24	26.41 QP	43.50	-17.09	1.04 V	187	43.82	-17.41
5	205.66	27.81 QP	43.50	-15.69	1.00 V	225	47.58	-19.77
6	227.42	28.83 QP	46.00	-17.17	1.00 V	209	47.56	-18.73

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value



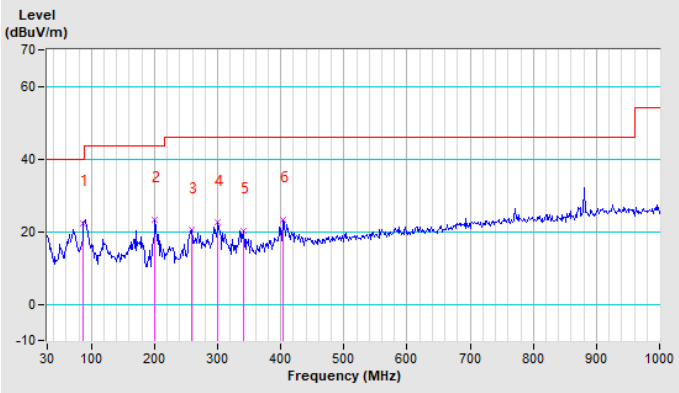
GFSK DH5: TS-0843

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	87.52	22.23 QP	40.00	-17.77	2.48 H	82	45.51	-23.28
2	200.99	23.20 QP	43.50	-20.30	2.33 H	103	43.19	-19.99
3	258.51	20.38 QP	46.00	-25.62	2.62 H	64	37.72	-17.34
4	300.48	22.43 QP	46.00	-23.57	2.73 H	49	38.24	-15.81
5	340.90	20.31 QP	46.00	-25.69	2.96 H	18	35.23	-14.92
6	403.08	23.22 QP	46.00	-22.78	2.85 H	33	36.37	-13.15

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value

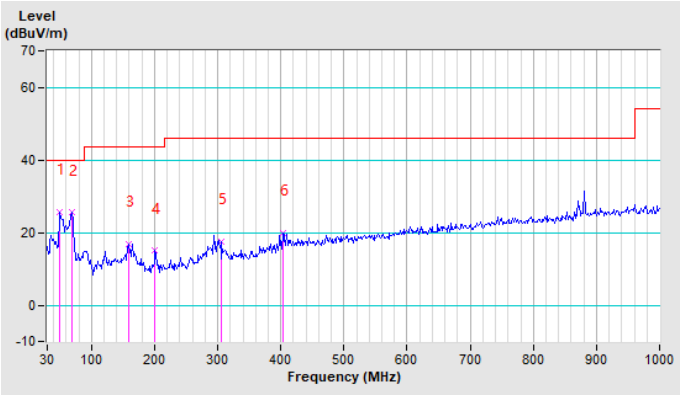


CHANNEL	Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

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	50.21	25.68 QP	40.00	-14.32	1.00 V	298	43.54	-17.86
2	68.86	25.47 QP	40.00	-14.53	1.00 V	282	44.80	-19.33
3	159.02	16.90 QP	43.50	-26.60	1.00 V	316	33.96	-17.06
4	200.99	14.96 QP	43.50	-28.54	1.00 V	255	34.95	-19.99
5	305.14	17.44 QP	46.00	-28.56	1.00 V	334	33.15	-15.71
6	403.08	19.90 QP	46.00	-26.10	1.00 V	348	33.05	-13.15

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value



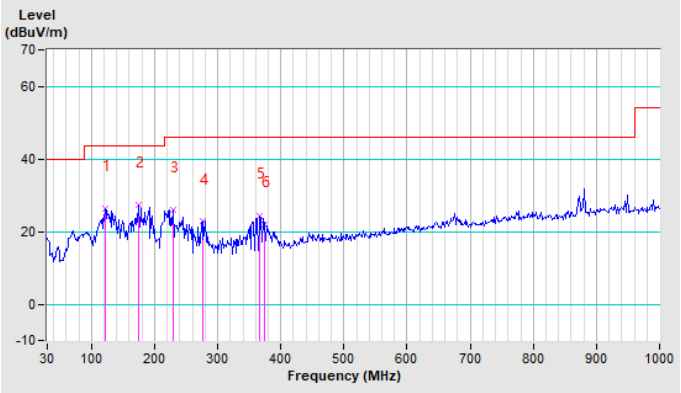
GFSK DH5: TS-2611

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	121.71	26.29 QP	43.50	-17.21	2.39 H	35	46.12	-19.83
2	174.57	27.25 QP	43.50	-16.25	2.48 H	21	45.42	-18.17
3	228.97	26.08 QP	46.00	-19.92	2.50 H	6	44.73	-18.65
4	275.61	22.76 QP	46.00	-23.24	2.50 H	15	39.48	-16.72
5	367.32	24.25 QP	46.00	-21.75	2.50 H	69	38.47	-14.22
6	375.10	21.99 QP	46.00	-24.01	2.50 H	60	35.97	-13.98

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value

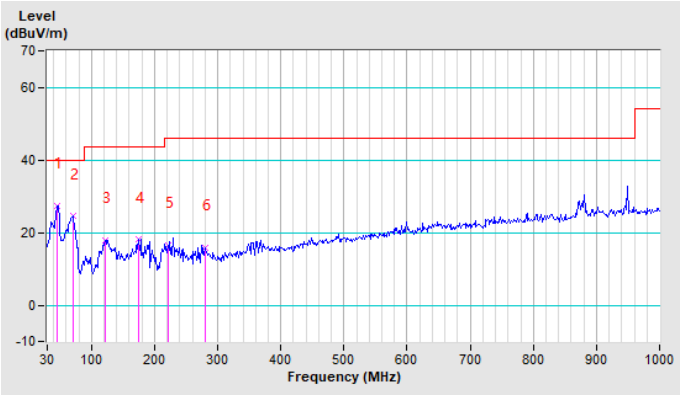


CHANNEL	Channel 39	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

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	45.54	27.38 QP	40.00	-12.62	1.40 V	310	45.47	-18.09
2	71.97	24.48 QP	40.00	-15.52	1.51 V	294	44.66	-20.18
3	121.71	17.92 QP	43.50	-25.58	1.63 V	279	37.75	-19.83
4	174.57	18.01 QP	43.50	-25.49	1.75 V	263	36.18	-18.17
5	221.20	16.54 QP	46.00	-29.46	1.85 V	249	35.57	-19.03
6	280.27	15.75 QP	46.00	-30.25	1.96 V	235	32.29	-16.54

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value



ABOVE 1GHz 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	45.87 PK	74.00	-28.13	1.39 H	77	42.88	2.99
2	2390.00	33.20 AV	54.00	-20.80	1.39 H	77	30.21	2.99
3	*2402.00	102.87 PK			1.56 H	338	99.86	3.01
4	*2402.00	102.48 AV			1.56 H	338	99.47	3.01
5	4804.00	53.48 PK	74.00	-20.52	1.38 H	214	45.65	7.83
6	4804.00	46.47 AV	54.00	-7.53	1.38 H	214	38.64	7.83
7	7206.00	51.32 PK	74.00	-22.68	1.36 H	359	40.99	10.33
8	7206.00	43.18 AV	54.00	-10.82	1.36 H	359	32.85	10.33
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	45.02 PK	74.00	-28.98	1.39 V	77	42.03	2.99
2	2390.00	38.00 AV	54.00	-16.00	1.39 V	77	35.01	2.99
3	*2402.00	94.56 PK			1.39 V	77	91.55	3.01
4	*2402.00	94.05 AV			1.39 V	77	91.04	3.01
5	4804.00	54.10 PK	74.00	-19.90	1.25 V	12	46.27	7.83
6	4804.00	46.64 AV	54.00	-7.36	1.25 V	12	38.81	7.83
7	7206.00	54.40 PK	74.00	-19.60	1.00 V	21	44.07	10.33
8	7206.00	46.64 AV	54.00	-7.36	1.00 V	21	36.31	10.33

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
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	102.84 PK			1.35 H	360	99.75	3.09
2	***2441.00**	**102.39 AV**			**1.35 H**	**360**	**99.30**	**3.09**
3	4882.00	55.25 PK	74.00	-18.75	1.55 H	44	47.23	8.02
4	4882.00	46.67 AV	54.00	-7.33	1.55 H	44	38.65	8.02
5	7323.00	54.12 PK	74.00	-19.88	1.35 H	52	43.38	10.74
6	7323.00	44.69 AV	54.00	-9.31	1.35 H	52	33.95	10.74
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	94.56 PK			1.39 V	22	91.47	3.09
2	*2441.00	94.30 AV			1.39 V	22	91.21	3.09
3	4882.00	54.23 PK	74.00	-19.77	1.00 V	35	46.21	8.02
4	4882.00	44.80 AV	54.00	-9.20	1.00 V	35	36.78	8.02
5	7323.00	54.40 PK	74.00	-19.60	1.00 V	55	43.66	10.74
6	7323.00	45.30 AV	54.00	-8.70	1.00 V	55	34.56	10.74

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 78	**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	*2480.00	100.90 PK			1.89 H	335	97.73	3.17
2	*2480.00	98.90 AV			1.89 H	335	95.73	3.17
3	2483.50	49.59 PK	74.00	-24.41	1.89 H	335	46.42	3.17
4	2483.50	42.44 AV	54.00	-11.56	1.89 H	335	39.27	3.17
5	4960.00	54.20 PK	74.00	-19.80	1.35 H	54	45.99	8.21
6	4960.00	46.49 AV	54.00	-7.51	1.35 H	54	38.28	8.21
7	7440.00	51.32 PK	74.00	-22.68	1.00 H	55	40.19	11.13
8	7440.00	43.89 AV	54.00	-10.11	1.00 H	55	32.76	11.13
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	94.25 PK			1.00 V	275	91.08	3.17
2	*2480.00	93.96 AV			1.00 V	275	90.79	3.17
3	2483.50	46.98 PK	74.00	-27.02	1.00 V	274	43.81	3.17
4	2483.50	35.97 AV	54.00	-18.03	1.00 V	274	32.80	3.17
5	4960.00	54.18 PK	74.00	-19.82	1.00 V	6	45.97	8.21
6	4960.00	45.00 AV	54.00	-9.00	1.00 V	6	36.79	8.21
7	7440.00	54.49 PK	74.00	-19.51	1.03 V	65	43.36	11.13
8	7440.00	46.98 AV	54.00	-7.02	1.03 V	65	35.85	11.13

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

BT_8DPSK

CHANNEL	TX Channel 0	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	2390.00	45.68 PK	74.00	-28.32	1.00 H	340	42.69	2.99
2	2390.00	33.46 AV	54.00	-20.54	1.00 H	340	30.47	2.99
3	*2402.00	100.78 PK			1.00 H	320	97.77	3.01
4	*2402.00	99.26 AV			1.00 H	320	96.25	3.01
5	4804.00	54.66 PK	74.00	-19.34	1.00 H	55	46.83	7.83
6	4804.00	45.11 AV	54.00	-8.89	1.00 H	55	37.28	7.83
7	7206.00	55.69 PK	74.00	-18.31	1.35 H	5	45.36	10.33
8	7206.00	45.65 AV	54.00	-8.35	1.35 H	5	35.32	10.33
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	46.50 PK	74.00	-27.50	1.67 V	32	43.51	2.99
2	2390.00	34.60 AV	54.00	-19.40	1.67 V	32	31.61	2.99
3	*2402.00	94.32 PK			1.67 V	32	91.31	3.01
4	*2402.00	93.23 AV			1.67 V	32	90.22	3.01
5	4804.00	54.35 PK	74.00	-19.65	1.00 V	55	46.52	7.83
6	4804.00	46.60 AV	54.00	-7.40	1.00 V	55	38.77	7.83
7	7206.00	53.20 PK	74.00	-20.80	1.00 V	152	42.87	10.33
8	7206.00	45.60 AV	54.00	-8.40	1.00 V	152	35.27	10.33

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
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	101.30 PK			1.35 H	66	98.21	3.09
2	*2441.00	99.87 AV			1.35 H	66	96.78	3.09
3	4882.00	53.55 PK	74.00	-20.45	1.65 H	44	45.53	8.02
4	4882.00	46.47 AV	54.00	-7.53	1.65 H	44	38.45	8.02
5	7323.00	52.47 PK	74.00	-21.53	1.35 H	187	41.73	10.74
6	7323.00	43.68 AV	54.00	-10.32	1.35 H	187	32.94	10.74
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	94.39 PK			1.45 V	135	91.30	3.09
2	*2441.00	92.80 AV			1.45 V	135	89.71	3.09
3	4882.00	54.90 PK	74.00	-19.10	1.35 V	5	46.88	8.02
4	4882.00	46.00 AV	54.00	-8.00	1.35 V	5	37.98	8.02
5	7323.00	55.00 PK	74.00	-19.00	1.00 V	35	44.26	10.74
6	7323.00	46.40 AV	54.00	-7.60	1.00 V	35	35.66	10.74

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).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 78	**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	*2480.00	102.80 PK			1.35 H	66	99.63	3.17
2	*2480.00	101.30 AV			1.35 H	66	98.13	3.17
3	2483.50	46.65 PK	74.00	-27.35	1.35 H	86	43.48	3.17
4	2483.50	42.95 AV	54.00	-11.05	1.35 H	86	39.78	3.17
5	4960.00	53.89 PK	74.00	-20.11	1.33 H	55	45.68	8.21
6	4960.00	45.98 AV	54.00	-8.02	1.33 H	55	37.77	8.21
7	7440.00	52.98 PK	74.00	-21.02	1.35 H	66	41.85	11.13
8	7440.00	44.65 AV	54.00	-9.35	1.35 H	66	33.52	11.13
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	93.20 PK			1.00 V	299	90.03	3.17
2	*2480.00	92.39 AV			1.00 V	299	89.22	3.17
3	2483.50	45.06 PK	74.00	-28.94	1.00 V	299	41.89	3.17
4	2483.50	34.03 AV	54.00	-19.97	1.00 V	299	30.86	3.17
5	4960.00	56.00 PK	74.00	-18.00	1.00 V	5	47.79	8.21
6	4960.00	46.70 AV	54.00	-7.30	1.00 V	5	38.49	8.21
7	7440.00	54.10 PK	74.00	-19.90	1.45 V	44	42.97	11.13
8	7440.00	45.60 AV	54.00	-8.40	1.45 V	44	34.47	11.13

REMARKS:

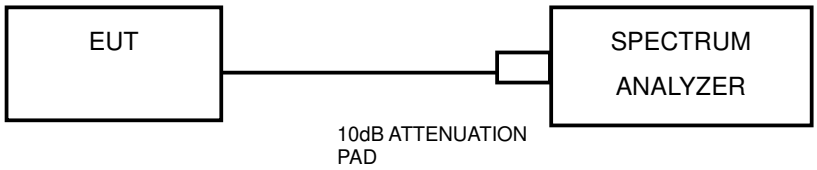
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

4.3 NUMBER OF HOPPING FREQUENCY USED

4.3.1 LIMIT OF HOPPING FREQUENCY USED

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

4.3.2 TEST SETUP



4.3.3 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
Power Sensor	Keysight	U2021XA	MY57320002	May. 11, 24
Power Meter	Anritsu	ML2495A	1139001	Jul. 11, 24
Power Sensor	Anritsu	MA2411B	1531155	Jul. 11, 24
Digital Multimeter	FLUKE	15B	A1220010DG	N/A
Humid & Temp Programmable Tester	Haida	HD-225T	110807201	Oct. 15, 24
Oscilloscope	Agilent	DSO9254A	MY51260160	Jul. 11, 24
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV40	101094	Jan. 01, 25
Signal Generator	Agilent	N5183A	MY50140980	Jul. 23, 24
MXG-B RF Vector Signal Generator	Keysight	N5182B	MY56200288	Jul. 11, 24
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	N/A
Attenuator	MINI	BW-S10W2+	S130129FGE2	N/A
DC Source	Keysight	E3642A	MY56146098	N/A
Test software	ADT	ADT_RF Test Software V6.6.5.3	N/A	N/A

NOTE: 1. The test was performed in RF Test Shielded Room.
2. Equipment are calibrated by calibration laboratory accredited to ISO/IEC 17025 by a mutually recognized Accreditation.

4.3.4 TEST PROCEDURES

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. 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 completed.

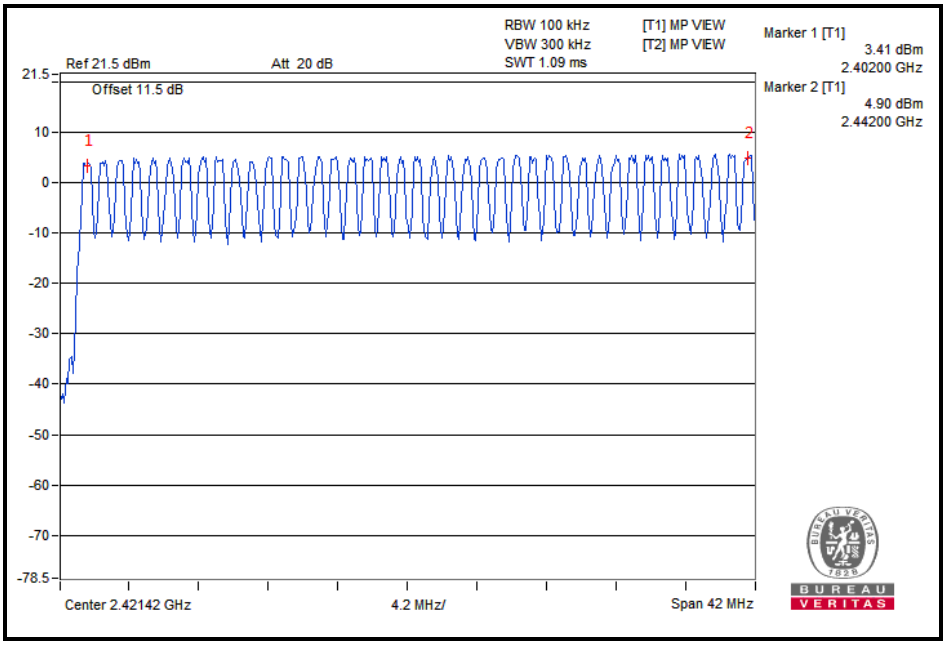
4.3.5 DEVIATION FROM TEST STANDARD

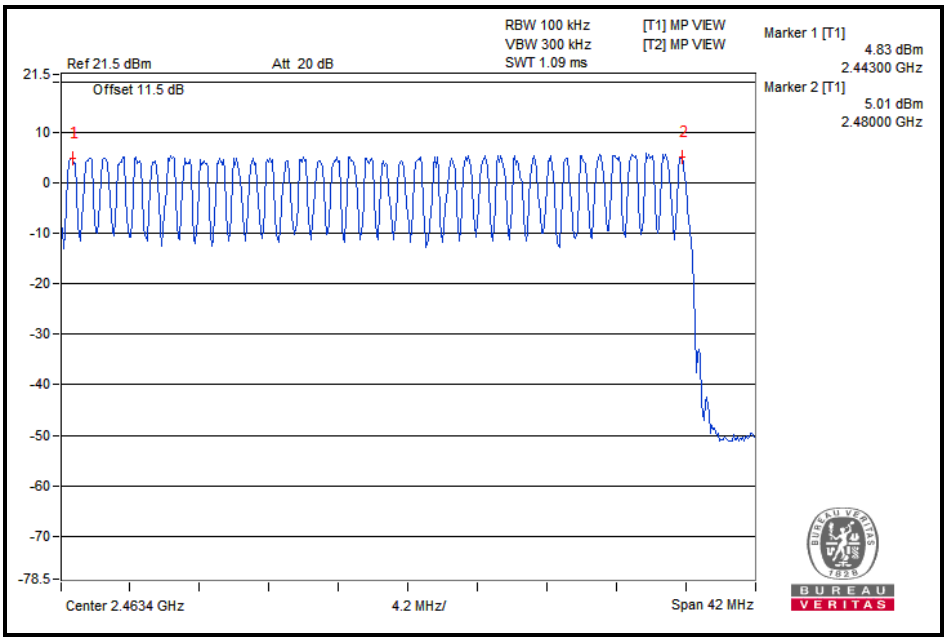
No deviation.

4.3.6 TEST RESULTS

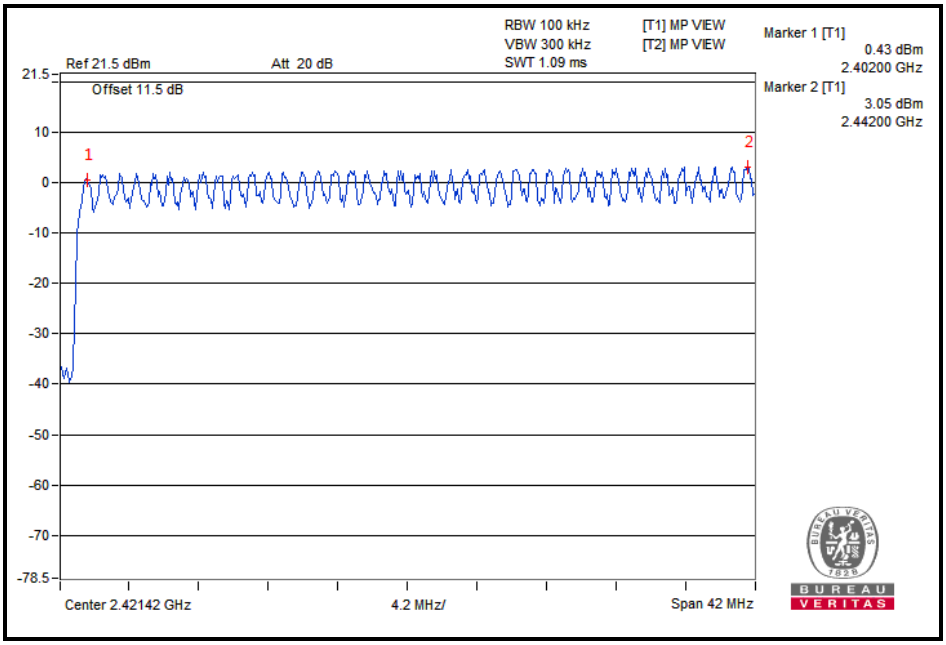
There are 79 hopping frequencies in the hopping mode. Please refer to next two pages for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

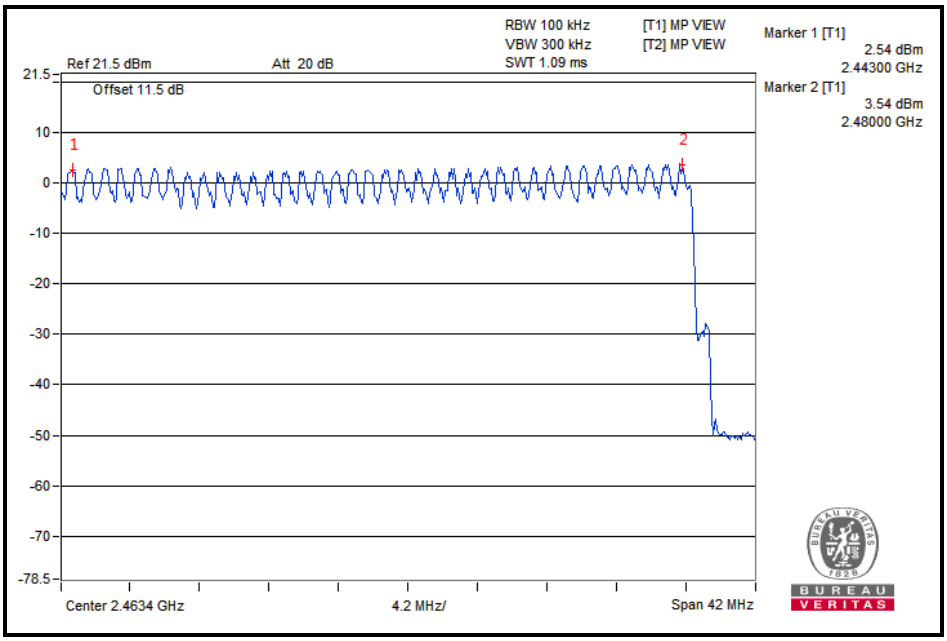
GFSK


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
3.41 dBm
2.40200 GHz
Marker 2 [T1]
4.90 dBm
2.44200 GHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
Center 2.42142 GHz
4.2 MHz/
Span 42 MHz


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
4.83 dBm
2.44300 GHz
Marker 2 [T1]
5.01 dBm
2.48000 GHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
Center 2.4634 GHz
4.2 MHz/
Span 42 MHz

8DPSK


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
0.43 dBm
2.40200 GHz
Marker 2 [T1]
3.05 dBm
2.44200 GHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.42142 GHz
4.2 MHz/
Span 42 MHz

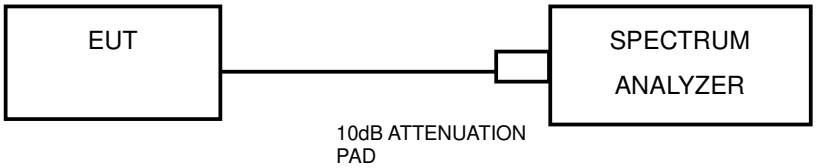

RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
2.54 dBm
2.44300 GHz
Marker 2 [T1]
3.54 dBm
2.48000 GHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.4634 GHz
4.2 MHz/
Span 42 MHz

4.4 DWELL TIME ON EACH CHANNEL

4.4.1 LIMIT OF DWELL TIME USED

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 4.3.3 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 Hopping Channel	Number of transmission in a period(channel number*0.4 sec)				Length of transmission time (msec)	Result (msec)	Limit (msec)	PASS / FAIL
		period (sec)	sweep time (sec)	times in a sweep	times in a period				
DH1	79	31.6	5	50	316	0.462	145.99	400	PASS
DH3	79	31.6	5	25	158	1.79	282.82	400	PASS
DH5	79	31.6	5	17	107.44	3.104	333.49	400	PASS

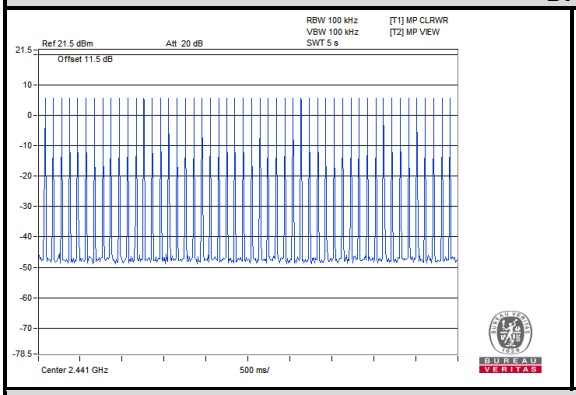
8DPSK

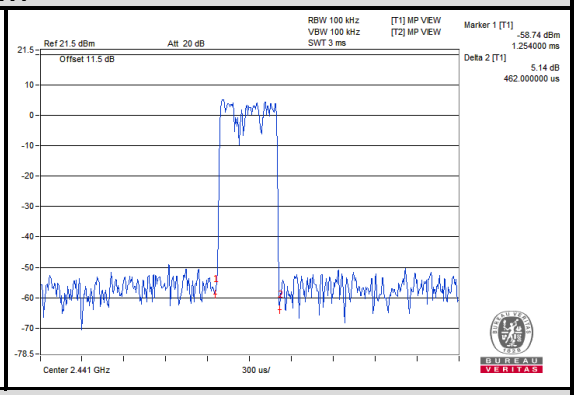
Mode	Number of Hopping Channel	Number of transmission in a period(channel number*0.4 sec)				Length of transmission time (msec)	Result (msec)	Limit (msec)	PASS / FAIL
		period (sec)	sweep time (sec)	times in a sweep	times in a period				
3DH1	79	31.6	5	50	316	0.462	145.99	400	PASS
3DH3	79	31.6	5	25	158	1.72	271.76	400	PASS
3DH5	79	31.6	5	17	107.44	3.04	326.62	400	PASS

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

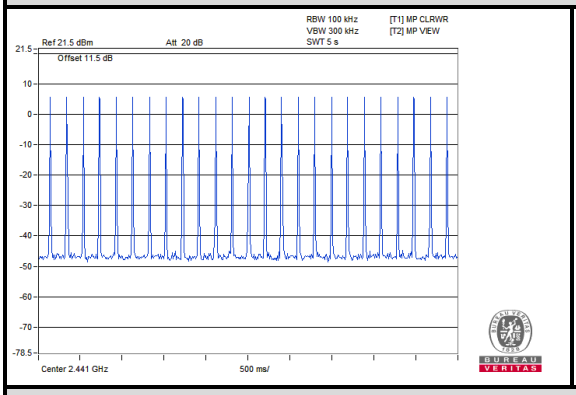
GFSK

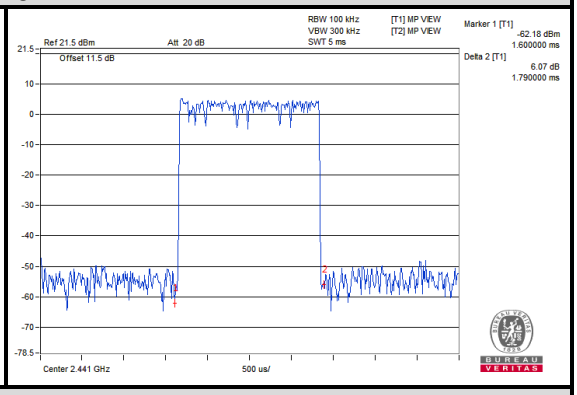
DH1



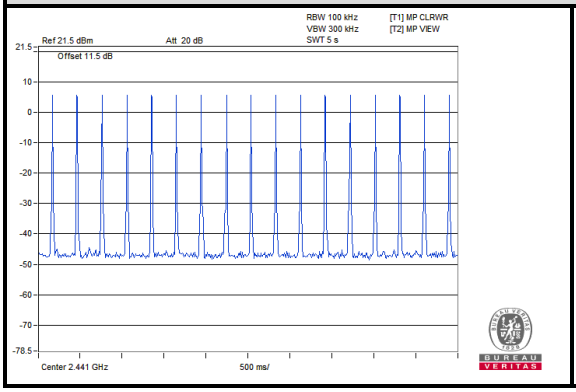


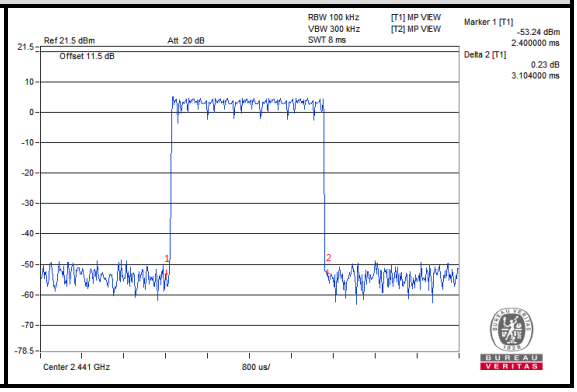
DH3





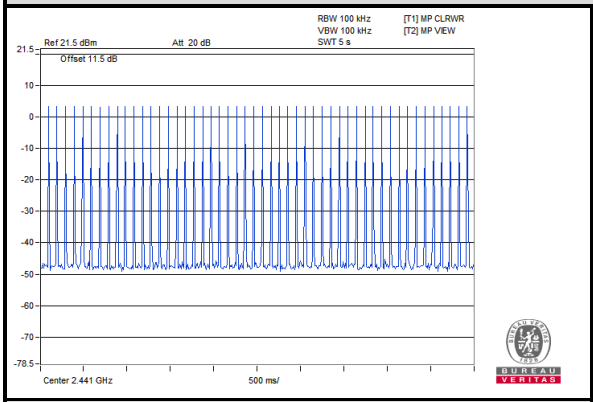
DH5

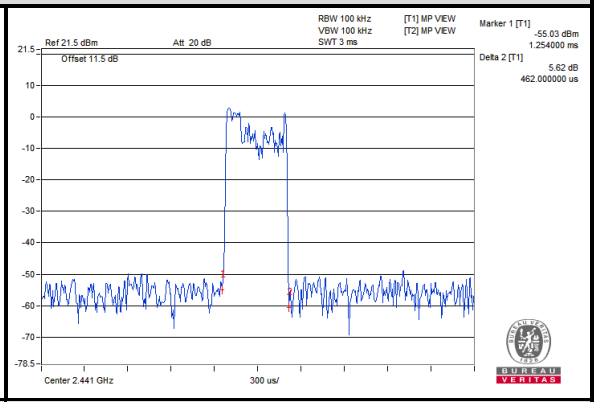




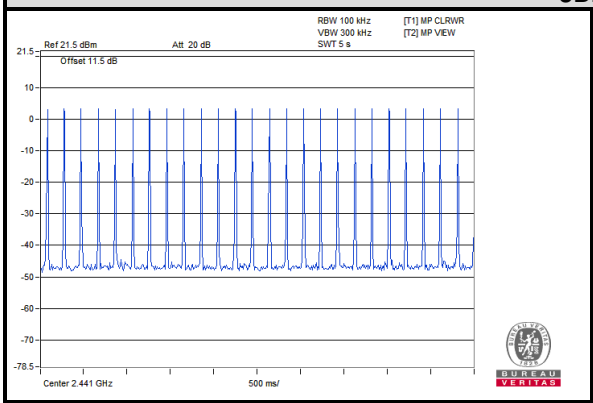
8DPSK

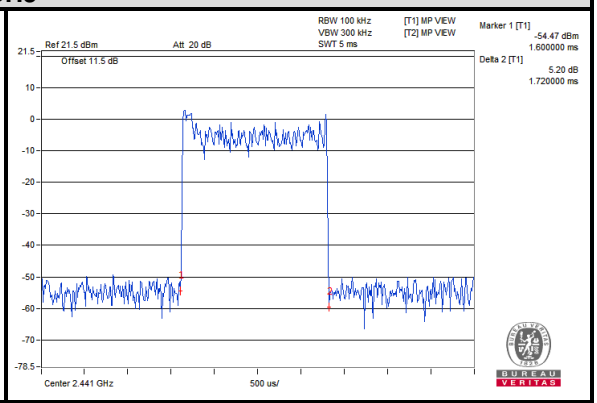
3DH1



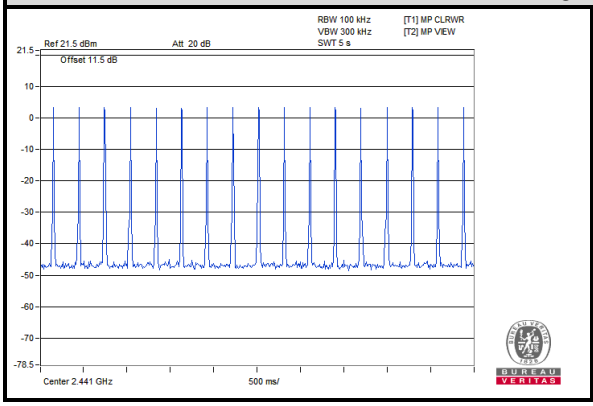


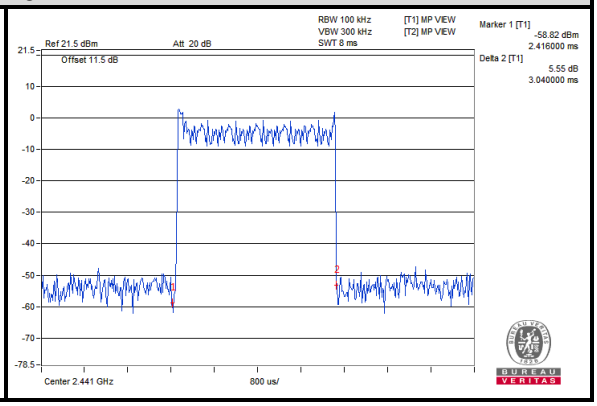
3DH3





3DH5



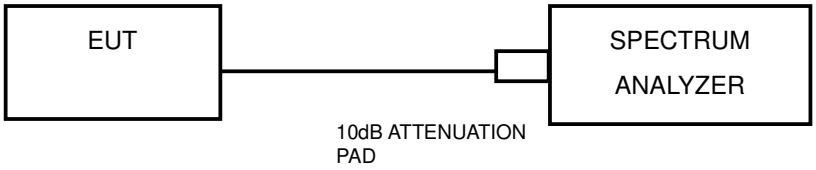


4.5 CHANNEL BANDWIDTH

4.5.1 LIMITS OF CHANNEL BANDWIDTH

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 4.3.3 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

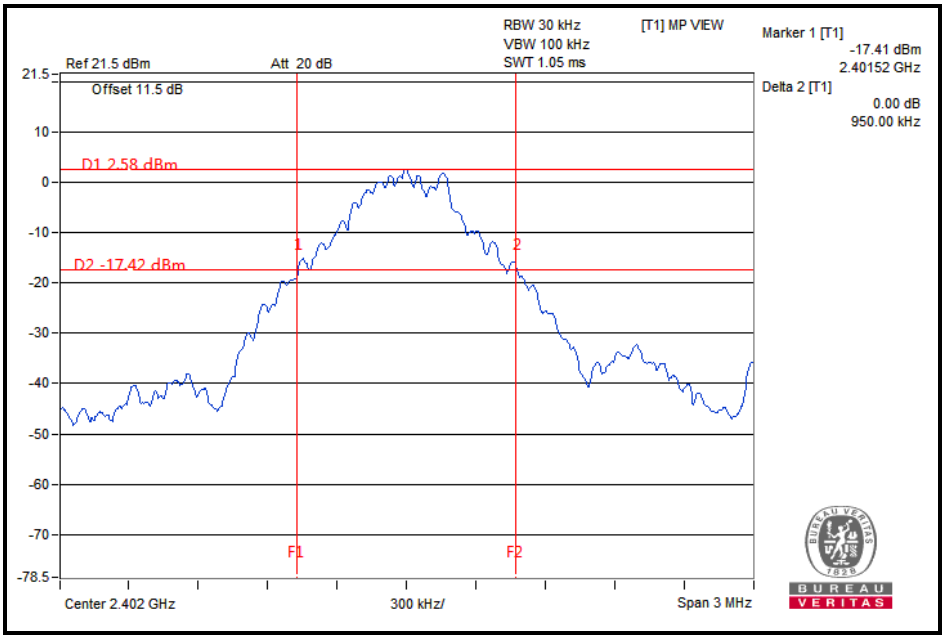
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 TEST RESULTS

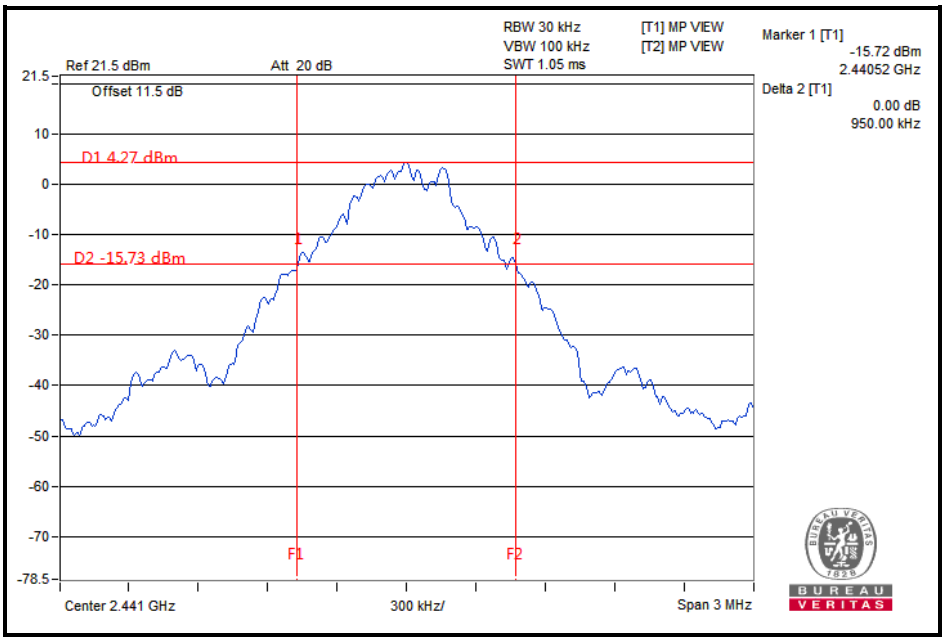
GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
0	2402	0.95
39	2441	0.95
78	2480	0.95

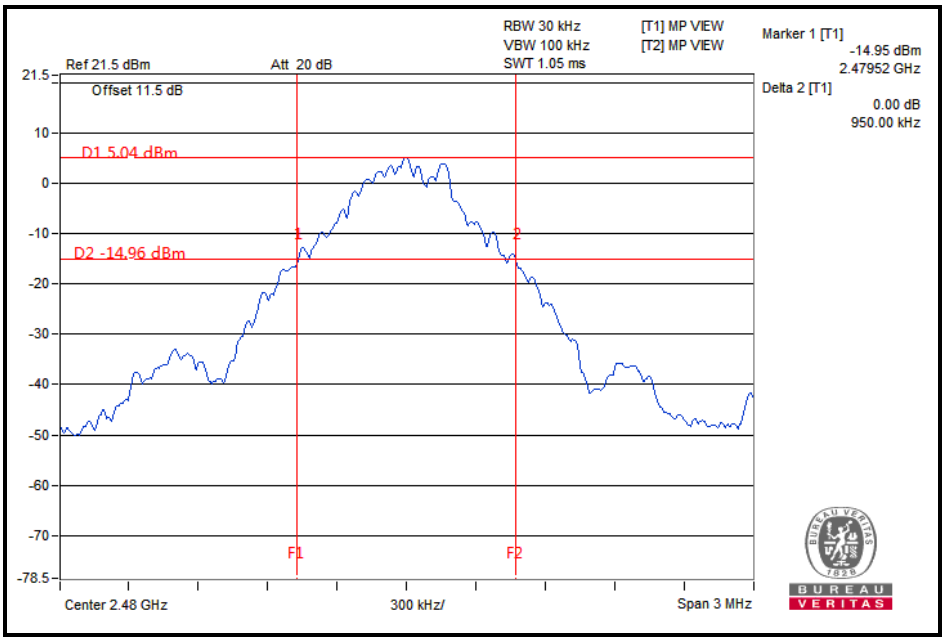
CH 0



CH 39


RBW 30 kHz
VBW 100 kHz
SWT 1.05 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-15.72 dBm
2.44052 GHz
Delta 2 [T1]
0.00 dB
950.00 kHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
D1 4.27 dBm
D2 -15.73 dBm
F1
F2
Center 2.441 GHz
300 kHz/
Span 3 MHz

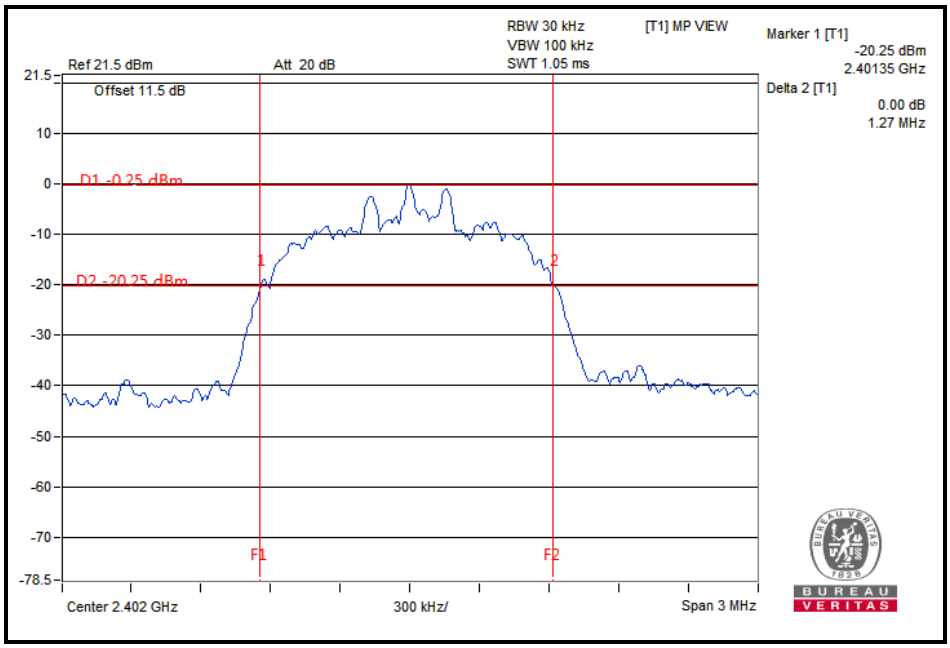
CH 78


RBW 30 kHz
VBW 100 kHz
SWT 1.05 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-14.95 dBm
2.47952 GHz
Delta 2 [T1]
0.00 dB
950.00 kHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
D1 5.04 dBm
D2 -14.96 dBm
F1
F2
Center 2.48 GHz
300 kHz/
Span 3 MHz

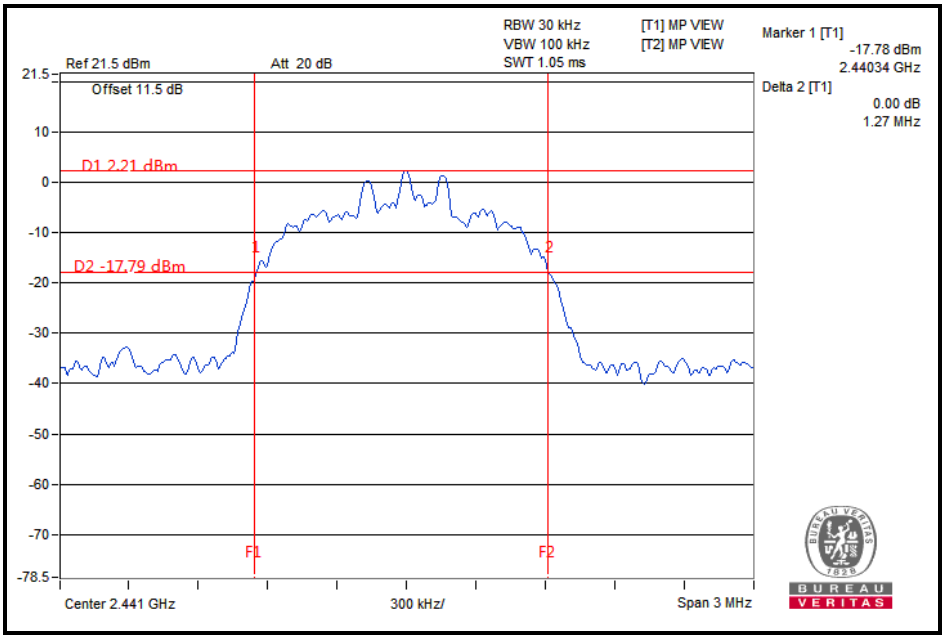
8DPSK

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
0	2402	1.27
39	2441	1.27
78	2480	1.27

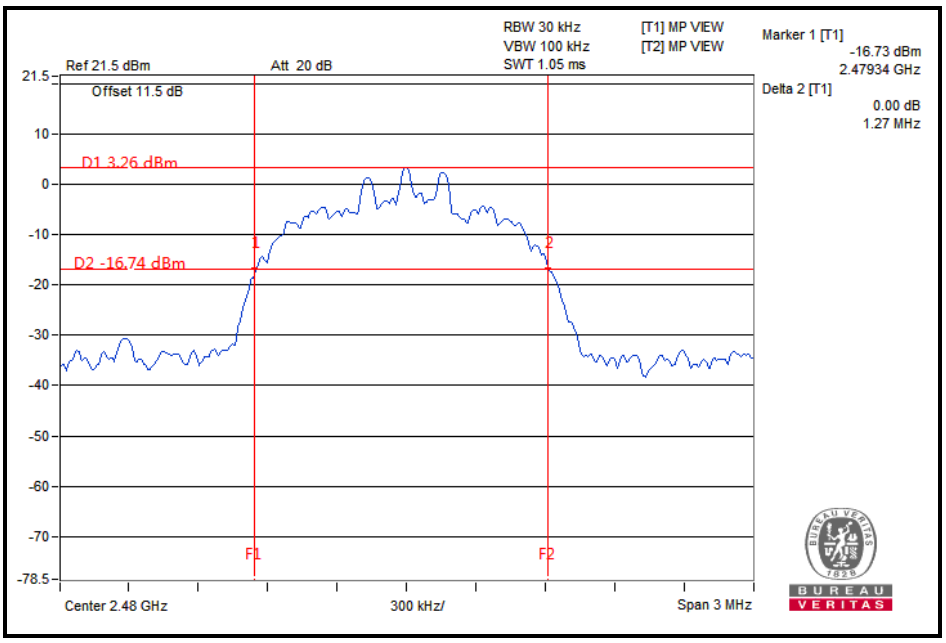
CH 0



CH 39


RBW 30 kHz
VBW 100 kHz
SWT 1.05 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-17.78 dBm
2.44034 GHz
Delta 2 [T1]
0.00 dB
1.27 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
D1 2.21 dBm
D2 -17.79 dBm
F1
F2
Center 2.441 GHz
300 kHz/
Span 3 MHz

CH 78

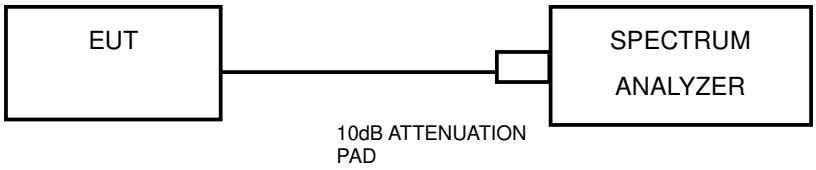

RBW 30 kHz
VBW 100 kHz
SWT 1.05 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
-16.73 dBm
2.47934 GHz
Delta 2 [T1]
0.00 dB
1.27 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
D1 3.26 dBm
D2 -16.74 dBm
F1
F2
Center 2.48 GHz
300 kHz/
Span 3 MHz

4.6 HOPPING CHANNEL SEPARATION

4.6.1 LIMIT OF HOPPING CHANNEL SEPARATION

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 4.3.3 to get information of above instrument.

4.6.4 TEST PROCEDURES

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

4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

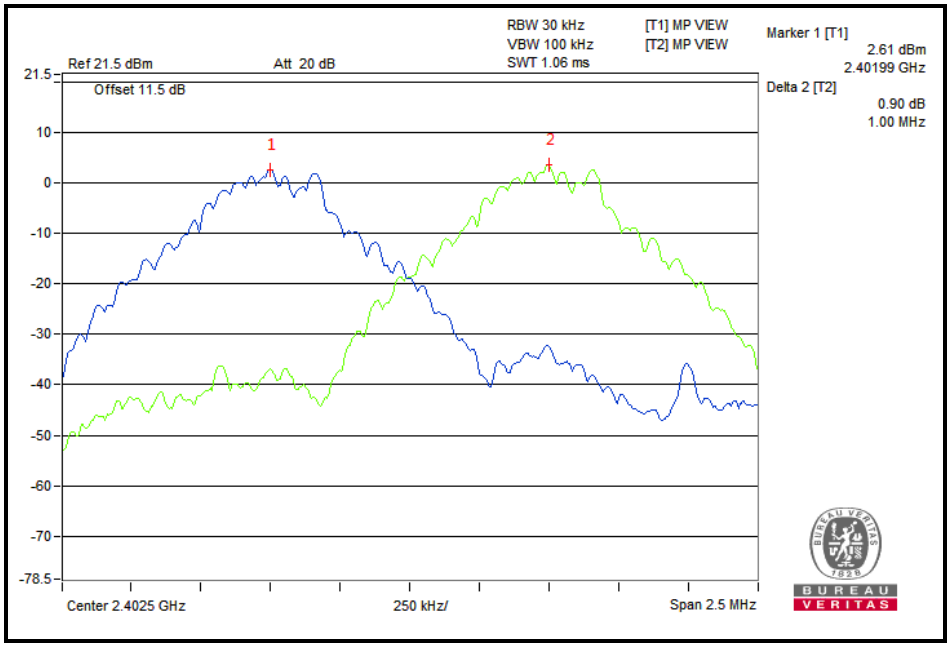
4.6.6 TEST RESULTS

GFSK

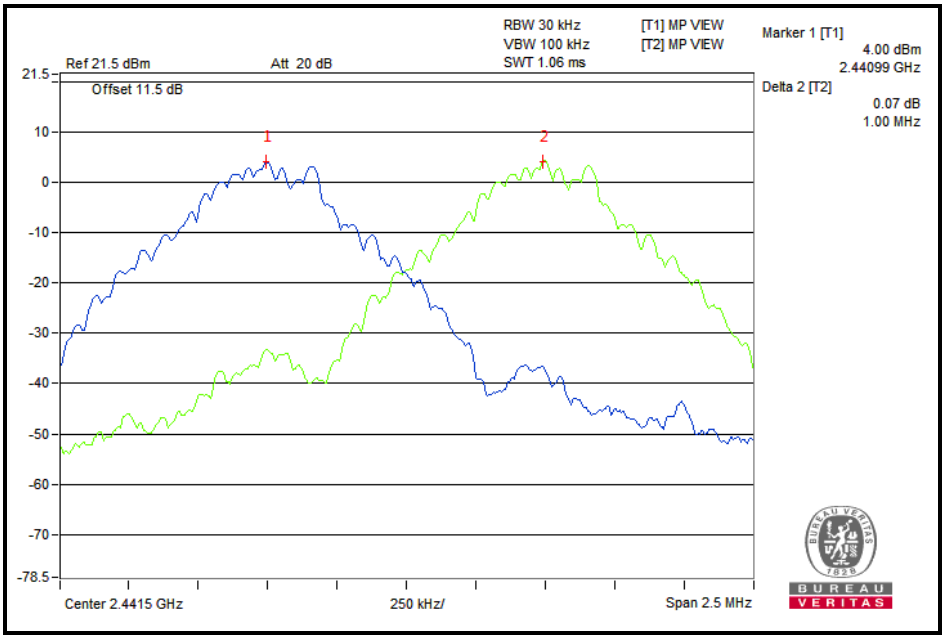
CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	1.00	0.95	0.63	PASS
39	2441	1.00	0.95	0.63	PASS
78	2480	1.00	0.95	0.63	PASS

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

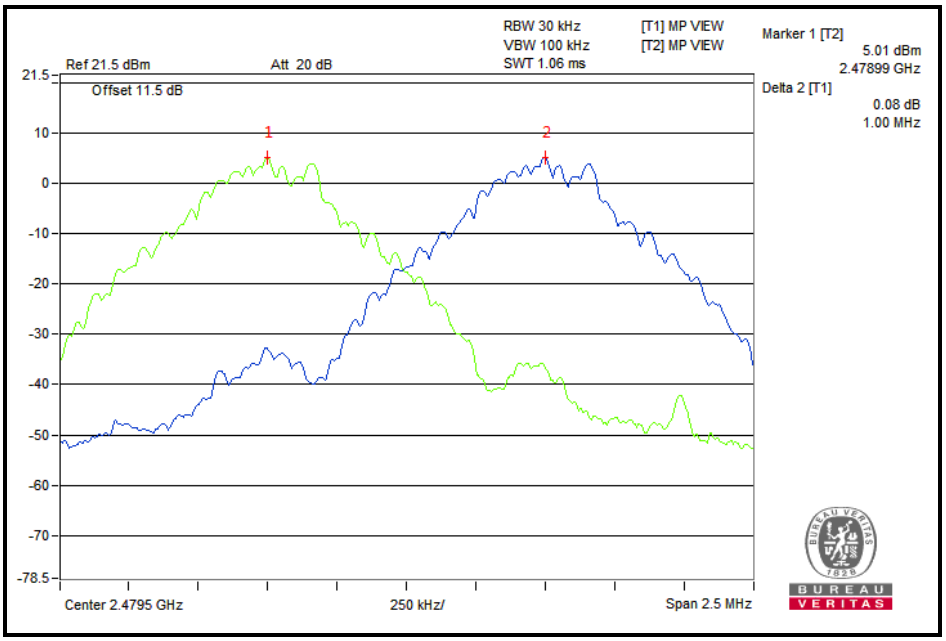
CH 0



CH 39


RBW 30 kHz
VBW 100 kHz
SWT 1.06 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
4.00 dBm
2.44099 GHz
Delta 2 [T2]
0.07 dB
1.00 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.4415 GHz
250 kHz/
Span 2.5 MHz

CH 78

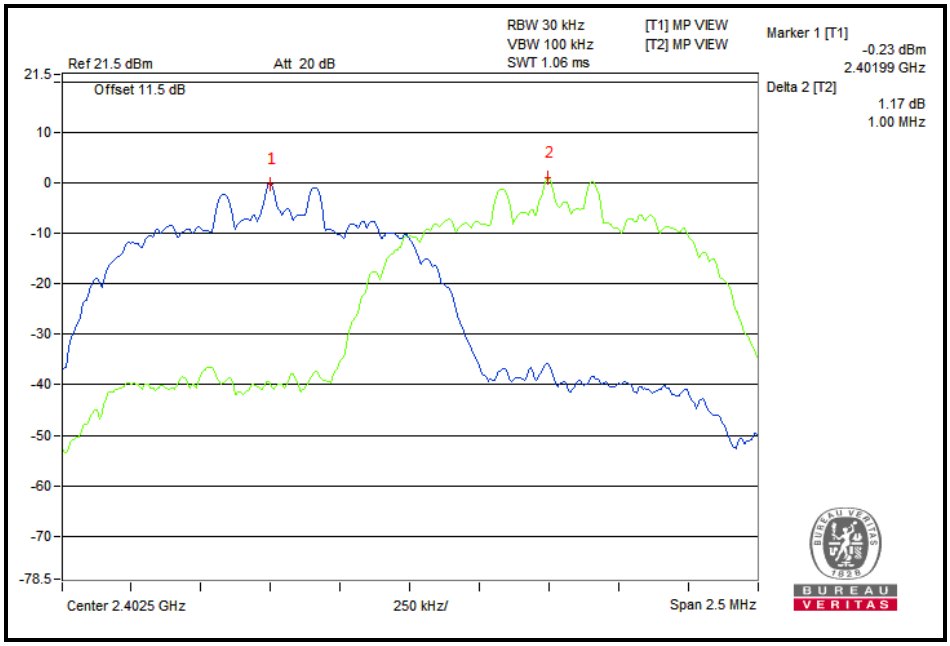

RBW 30 kHz
VBW 100 kHz
SWT 1.06 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T2]
5.01 dBm
2.47899 GHz
Delta 2 [T1]
0.08 dB
1.00 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.4795 GHz
250 kHz/
Span 2.5 MHz

8DPSK

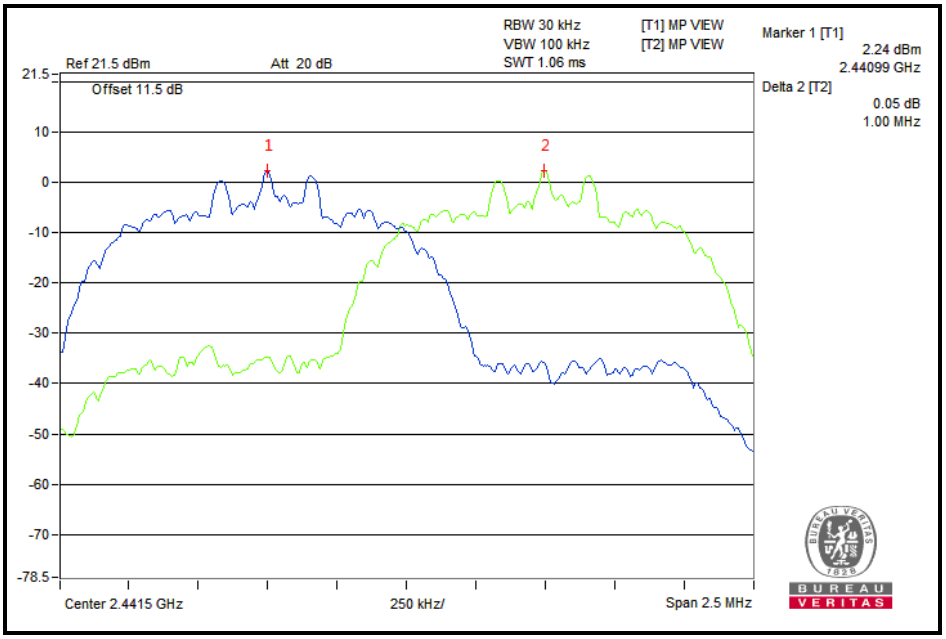
CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	1.00	1.27	0.85	PASS
39	2441	1.00	1.27	0.85	PASS
78	2480	1.00	1.27	0.85	PASS

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

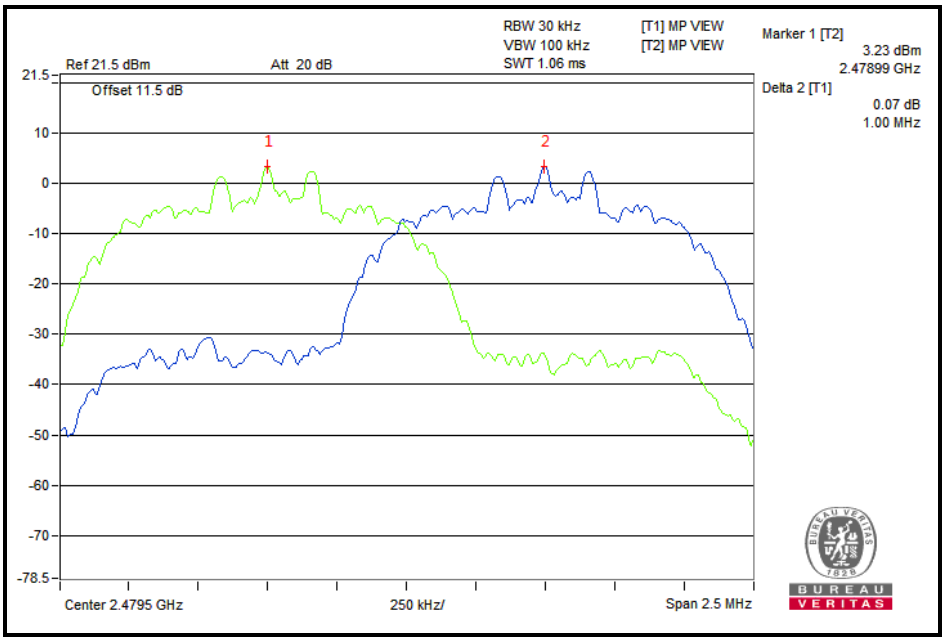
CH 0



CH 39


RBW 30 kHz
VBW 100 kHz
SWT 1.06 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T1]
2.24 dBm
2.44099 GHz
Delta 2 [T2]
0.05 dB
1.00 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.4415 GHz
250 kHz/
Span 2.5 MHz

CH 78

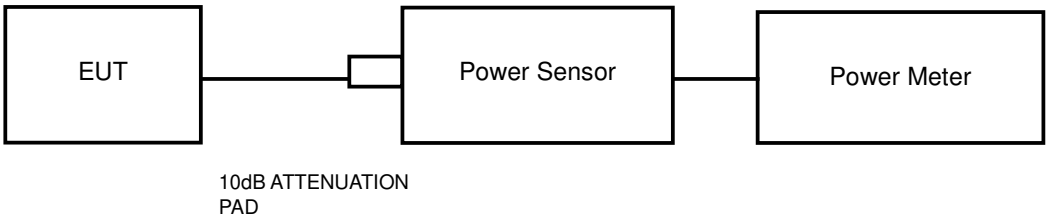

RBW 30 kHz
VBW 100 kHz
SWT 1.06 ms
[T1] MP VIEW
[T2] MP VIEW
Marker 1 [T2]
3.23 dBm
2.47899 GHz
Delta 2 [T1]
0.07 dB
1.00 MHz
Ref 21.5 dBm
Att 20 dB
Offset 11.5 dB
21.5
10
0
-10
-20
-30
-40
-50
-60
-70
-78.5
1
2
Center 2.4795 GHz
250 kHz/
Span 2.5 MHz

4.7 CONDUCTED OUTPUT POWER

4.7.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 125mW.

4.7.2 TEST SETUP



4.7.3 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.7.4 TEST PROCEDURES

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 and set the detector to PEAK. Record the power level.

An average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor and set the detector to AVERAGE. Record the power level.

4.7.5 DEVIATION FROM TEST STANDARD

No deviation.

4.7.6 EUT OPERATING CONDITION

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

4.7.7 TEST RESULTS

MAXIMUM PEAK OUTPUT POWER

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (mW)	PASS/FAIL
0	2402	5.59	3.622	125	PASS
39	2441	6.89	4.887	125	PASS
78	2480	**7.52**	**5.649**	125	PASS

8DPSK

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (mW)	PASS/FAIL
0	2402	3.39	2.183	125	PASS
39	2441	5.52	3.565	125	PASS
78	2480	6.52	4.487	125	PASS

AVERAGE OUTPUT POWER(FOR REFERENCE)

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)
0	2402	4.41	2.761
39	2441	5.72	3.733
78	2480	6.38	4.345

8DPSK

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)
0	2402	0.86	1.219
39	2441	3.07	2.028
78	2480	4.10	2.57

4.8 OUT OF BAND EMISSION MEASUREMENT

4.8.1 LIMITS OF 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 4.3.3 to get information of above instrument.

4.8.3 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low loss cable. of Spectrum Analyzer was set RBW to 100 kHz and VBW to 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. Detector = PEAK and Trace mode = Max Hold. The band edges was measured and recorded.

4.8.4 DEVIATION FROM TEST STANDARD

No deviation.

4.8.5 EUT OPERATING CONDITION

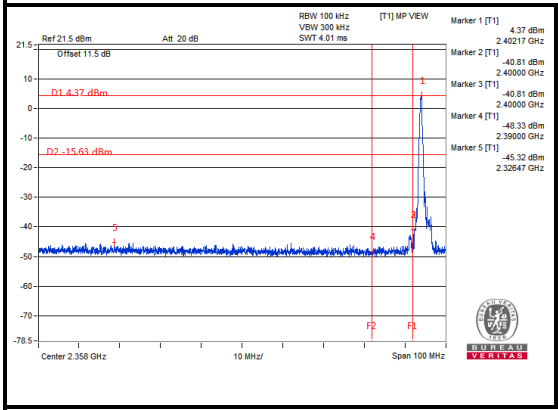
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

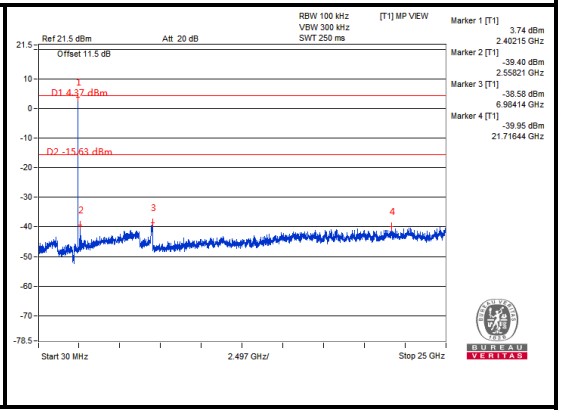
4.8.6 TEST RESULTS

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 to the requirement.

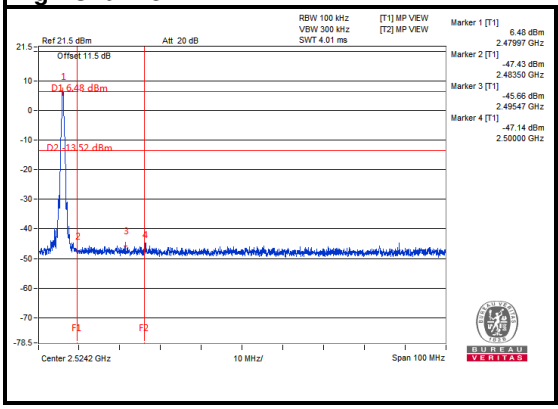
GFSK

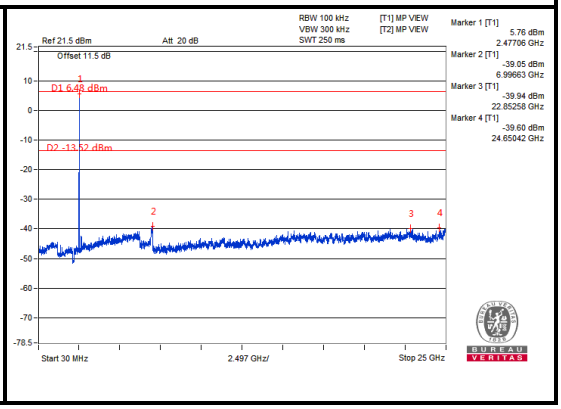
Low Channel





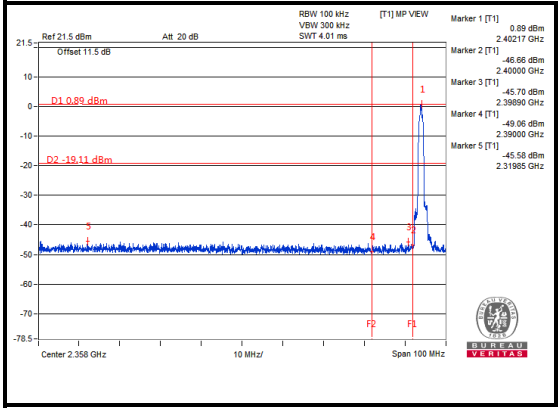
High Channel

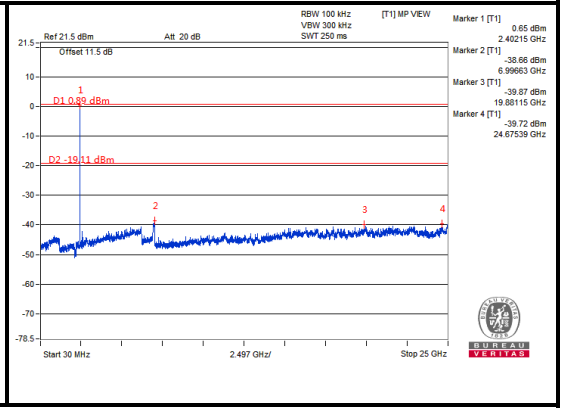




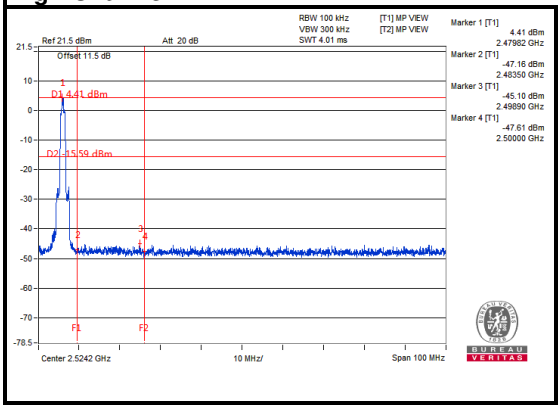
8DPSK

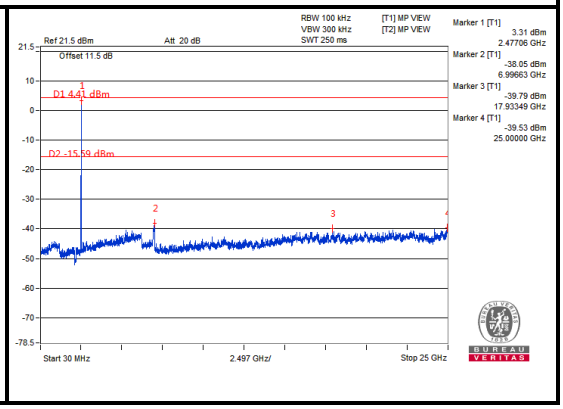
Low Channel





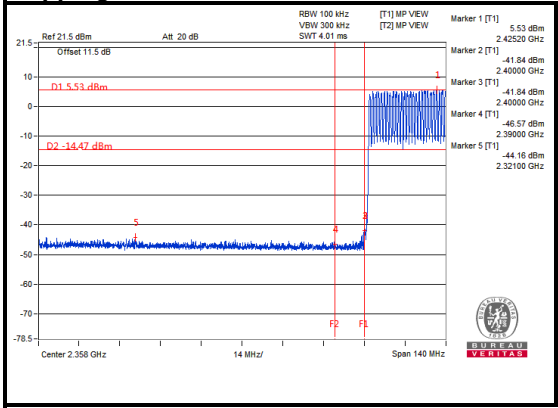
High Channel

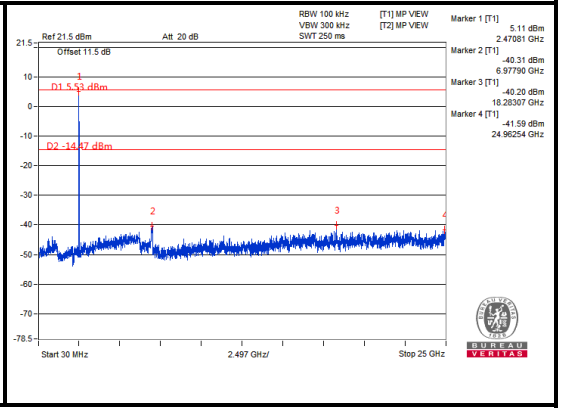




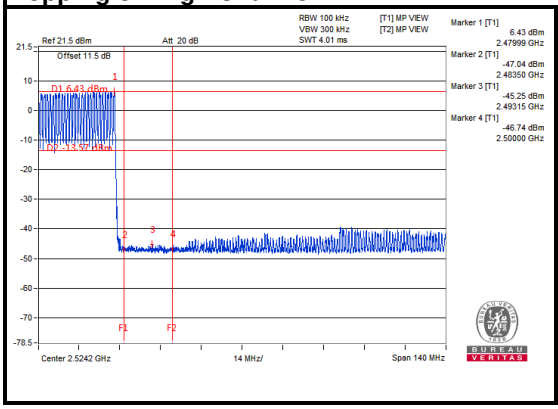
GFSK

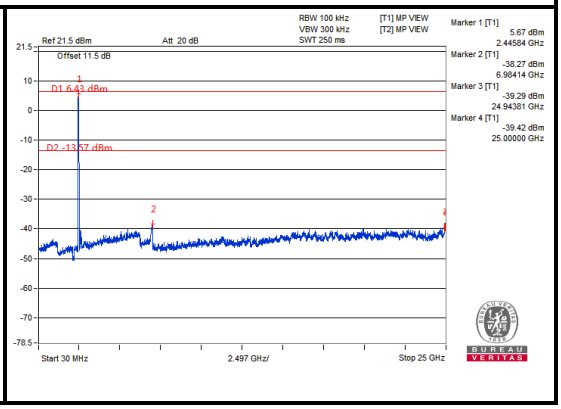
Hopping on Low Channel





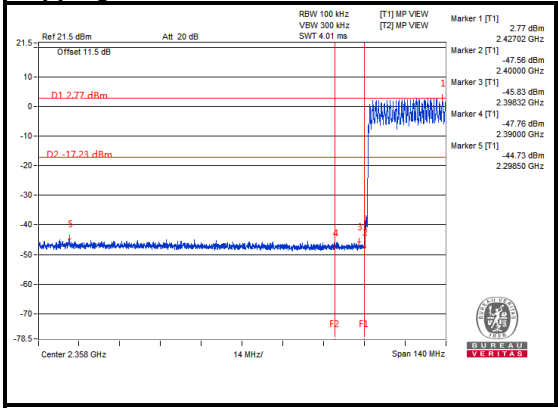
Hopping on High Channel

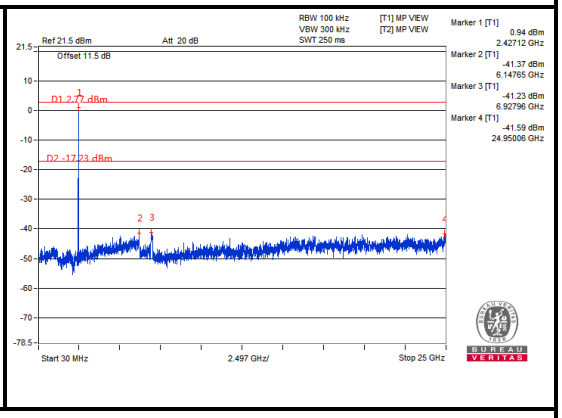




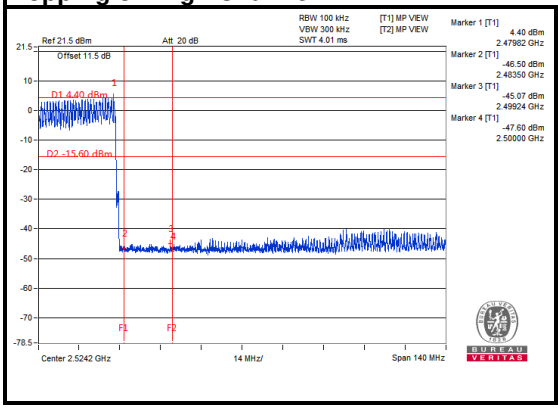
8DPSK

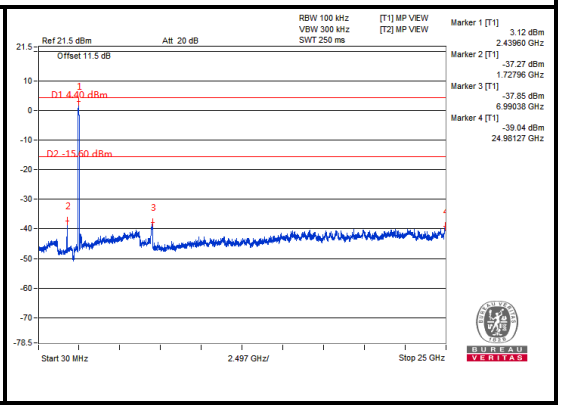
Hopping on Low Channel





Hopping on High Channel





5 PHOTOGRAPHS OF THE TEST CONFIGURATION

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

6 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---