FCC RADIO TEST REPORT

Applicant	:	SteelSeries ApS.
Address	:	Dirch Passers Allé 27, 5. Sal 2000 Frederiksberg Denmark.
Equipment	:	HEADSET
Model No.	:	HS-00019
Trade Name	:	steelseries
FCC ID.	:	ZHK-HS00019

I HEREBY CERTIFY THAT :

The sample was received on Aug. 30, 2018 and the testing was carried out on Feb. 11, 2019 at Cerpass Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of Cerpass Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Mark Liao / Supervisor

Tested by:

Spree Yeh / Engineer

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory

Contents

History of this test report

Report No.	Issue Date	Description
TEFB1808244	Mar. 06, 2019	Original

1. Summary of Test Procedure and Test Results

1.1 Applicable Standards

ANSI C63.4:2014

ANSI C63.10:2013

FCC Rules and Regulations Part 15 Subpart C §15.247

FCC Rule	. Description of Test	Result
15.203	. Antenna Requirement	PASS
15.207	. AC Power Line Conducted Emission	PASS
15.209 15.205	. Radiated Spurious Emission	PASS
15.247(d)	. Conducted Spurious Emission	PASS
15.247(a)(1)	. Channel Carrier Frequencies Separation	PASS
15.247(a)(1)	. 20dB Bandwidth	PASS
15.247(a)(1)	. Dwell Time	PASS
15.247(b)	. Number of Hopping Channels	PASS
15.247(b)	. Peak Output Power Measurement Data	PASS

2. Test Configuration of Equipment under Test

2.1 Feature of Equipment under Test

Frequency Range	BT / BLE: 2400-2483.5MHz 802.11/g/n: 2400-2483.5MHz 802.11a/n: 5150-5250MHz, 5250-5350MHz, 5470-5725MHz, 5725-5850MHz
Modulation Type	BT: GFSK, π /4-DQPSK, 8DPSK BLE: GFSK 802.11g/n/a: BPSK, QPSK, 16QAM, 64QAM
Modulation Technology	FHSS, DTS, DSSS, OFDM
Data Rate	BT: GFSK: 1Mbps, π /4-DQPSK: 2Mbps, 8DPSK: 3Mbps BLE: GFSK: 1Mbps WLAN: 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n: MCS0 – MCS7, HT20 802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps
Antenna Type	PCB Antenna
Antenna Gain	BT/BLE: 2400-2483.5MHz: 3.92dBi 2.4G: 2400-2483.5MHz: 1.85dBi 5150-5250MHz: 3.60dBi 5250-5350MHz: 3.79dBi 5470-5725MHz: 3.62dBi 5725-5850MHz: -0.23dBi

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.2 Carrier Frequency of Channes

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
***00**	**2402**	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	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	---	---

Note: Channels remarked * are selected to perform test.

2.3 Test Mode & Test Software

a. During testing, the interface cables and equipment positions were varied according to ANSI C63.10

b. The complete test system included Notebook, AP and EUT for RF test.

c. An executive program,"AVBootUI 1.5.0" was executed to transmit and receive data via Bluetooth.

d. The following test modes were performed for the test:

Test Mode	Operating Description
1	GFSK (1Mbps)
2	π/4-DQPSK (2Mbps)
3	8DPSK (3Mbps)
For radiation test (below 1GHz) & AC Power Line Conducted Emission, caused "Test Mode 3" generated the worst case, it was reported as the final data. For radiation test (above 1GHz), caused "Test Mode 1, 3" generated the worst case, they were reported as the final data. For Maximum Peak Output Power, caused "Test Mode 1, 2, 3" generated the worst case, they were reported as the final data.	

2.4 Description of Test System

Device	Manufacturer	Model No.	Description
NB	DELL	LatitudeE5450/5450, TX	Power Cable, Unshielding, 1.8m
AP	NETGEAR	R7800	Power Cable, Unshielding, 1.5m
Network cable	N/A	N/A	N/A

2.5 General Information of Test

Test Site	**Cerpass Technology Corporation Test Laboratory** Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.) Tel:+886-3-3226-888 Fax:+886-3-3226-881 Address: No.68-1, Shihbachongsi, Shihding Township, New Taipei City 223, Taiwan, R.O.C. Tel: +886-2-2663-8582	
	FCC	TW1079, TW1061,TW1439
	IC	4934E-1, 4934E-2
	VCCI	T-2205 for Telecommunication test C-4663 for Conducted emission test R-4399, R-4218 for Radiated emission test G-10812, G-10813 for radiated disturbance above 1GHz
Frequency Range Investigated:	Conducted: from 150kHz to 30 MHz Radiation: from 30 MHz to 25,000MHz	
Test Distance:	The test distance of radiated emission from antenna to EUT is 3 M.	

2.6 Measurement Uncertainty

Measurement Item	Uncertainty
Radiated Spurious Emission(9KHz~30MHz)	±5.007dB
Radiated Spurious Emission(30MHz~1GHz)	±5.157dB
Radiated Spurious Emission(1GHz~18GHz)	±6.383dB
Radiated Spurious Emission(18GHz~40GHz)	±6.648dB
Conducted Spurious Emission	±1.253dB
6dB Bandwidth	±6.89%
Power Spectral Density	±0.630dB
26 dB Occupied Bandwidth	±6.10%
Frequency Stability	±375KHz
Channel Frequencies Separation	±6.10%
20dB Bandwidth	±6.12%
Dwell Time	±1.34%
Peak Output Power(Conducted Power Meter)	±0.86dB
Temperature	±1.2℃
Humidity	±2.7%
Channel Move Time	±4.53%
Channel Closing Transmission Time	±6.61%
Threshold	±0.631dB
Non occupancy period	±1.17%

3. Test Equipment and Ancillaries Used for Tests

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Valid Date
Bilog Antenna	Schwarzbeck	VULB9168	275	2018/09/17	2019/09/16
Active Loop Antenna	EMCO	6507	40855	2018/05/22	2019/05/21
Horn Antenna	EMCO	3115	31589	2018/04/02	2019/04/01
Horn Anrenna	EMCO	3116	31974	2018/09/07	2019/09/06
EMI Receiver	ROHDE & SCHWARZ	ESCI 3	101402	2018/02/23	2019/02/22
Spectrum Analyzer	ROHDE & SCHWARZ	FSP40	100047	2018/03/20	2019/03/19
Preamplifier	EM Electronics corp.	EM330	60660	2018/03/08	2019/03/07
Preamplifier	EMC INSTRUMENTS	EMC051845SE	980333	2018/09/18	2019/09/17
BLUETOOTH TESTER	ROHDE & SCHWARZ	CBT	101133	2018/04/02	2019/04/01
Cable-3in1-(30M-1G)	HARBOUR INDUSTRIES	LL142	CCE1315	2018/04/20	2019/04/19
Cable-0.5m-(1G-40G)	Rapidtek	40GHZ 50CM	38MS-38MS50314	2018/03/27	2019/03/26
Cable-1m-(1G-40G)	Rapidtek	40GHZ 300CM	38MS-38MS300314	2018/03/27	2019/03/26
Cable-6m-(1G-40G)	Rapidtek	40GHZ 800CM	38MS-38MS800314	2018/03/27	2019/03/26
E3	AUDIX	v8.2014-8-6	RK-000529	NA	NA
Spectrum Analyzer	ROHDE & SCHWARZ	FSP40	100219	2018/07/03	2019/07/02
BLUETOOTH TESTER	ROHDE & SCHWARZ	CBT	101133	2018/04/02	2019/04/01
Attenuator	KEYSIGHT	8491B	MY39250705	2018/09/04	2019/09/03
TEMP & HUMI CHAMBER	T-MACHINE	TMJ-9712	T-12-040111	2018/08/30	2019/08/29
Power Sensor	Anritsu	MA2411B	1207295	2018/03/23	2019/03/22
EMI Receiver	ROHDE & SCHWARZ	ESCI 3	100443	2018/3/15	2019/3/14
Line Impedance Stabilization Network	Schwarzbeck	NSLK 8127	8127-740	2018/6/13	2019/6/12
Pulse Limiter	ROHDE & SCHWARZ	ESH3-Z2	101933	2018/9/4	2019/9/3
E3	AUDIX	v8.2014-8-6	RK-000531	NA	NA

4. Antenna Requirements

4.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

4.2 Antenna Construction and Directional Gain

Antenna Type	PCB Antenna
Antenna Gain	3.92 dBi

5. Test of AC Power Line Conducted Emission

5.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz, according to the methods defined in ANSI C63.4-2014. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

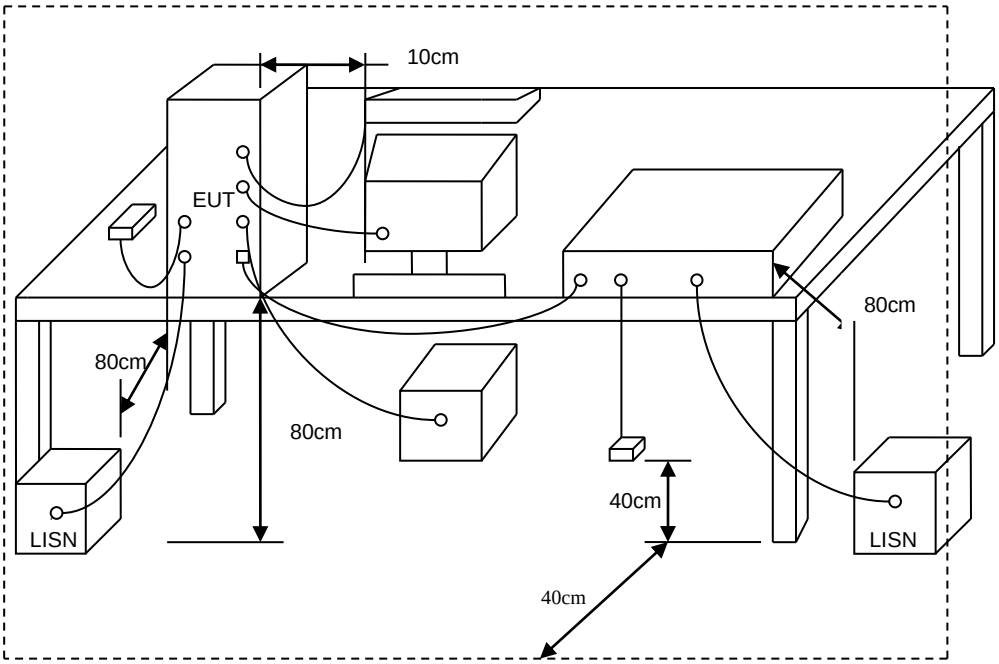
Frequency (MHz)	Quasi Peak (dB μ V)	Average (dB μ V)
0.15 – 0.5	66-56*	56-46*
0.5 – 5.0	56	46
5.0 – 30.0	60	50

*Decreases with the logarithm of the frequency.

5.2 Test Procedures

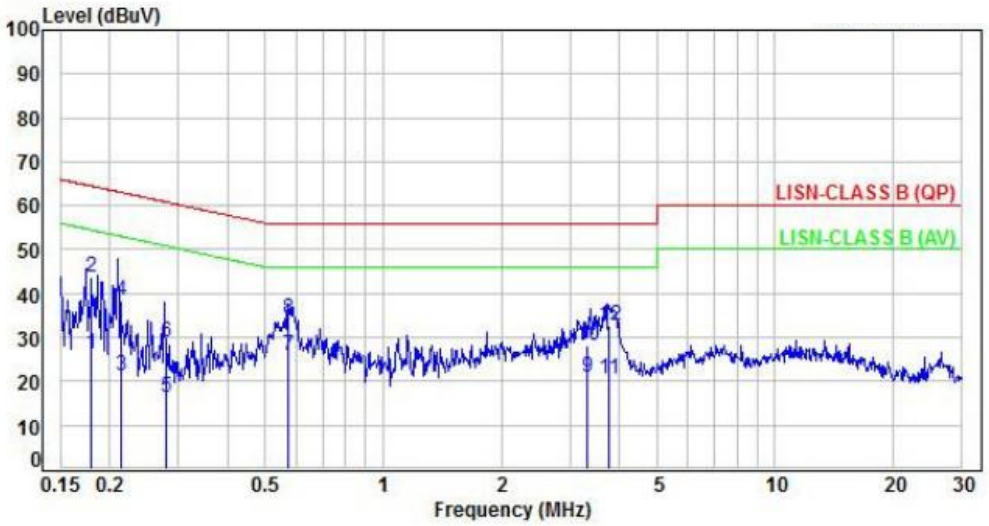
a. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
c. All the support units are connecting to the other LISN.
d. The LISN provides 50 ohm coupling impedance for the measuring instrument.
e. The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
f. Both sides of AC line were checked for maximum conducted interference.
g. The frequency range from 150 kHz to 30 MHz was searched.
h. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

5.3 Typical Test Setup



5.4 Test Result and Data

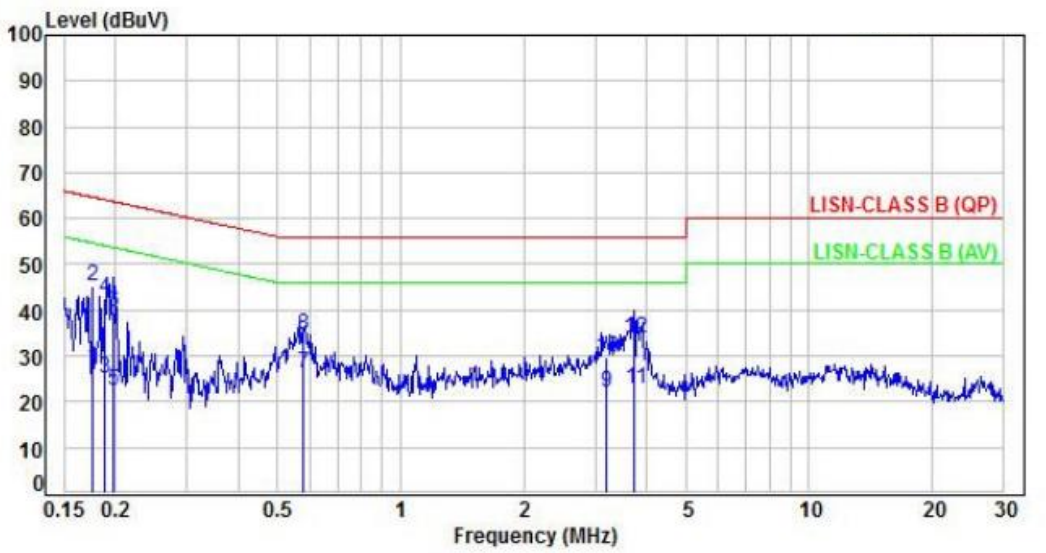
Power	:	AC 120V	Pol/Phase	:	LINE
Test Mode	:	Mode 3	Temperature	:	23 °C
Test date	:	Jan. 10, 2019	Humidity	:	45 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.18	9.94	16.35	26.29	54.54	-28.25	Average	P
2	0.18	9.94	33.73	43.67	64.54	-20.87	QP	P
3	0.21	9.94	11.43	21.37	53.07	-31.70	Average	P
4	0.21	9.94	28.42	38.36	63.07	-24.71	QP	P
5	0.28	9.94	6.40	16.34	50.82	-34.48	Average	P
6	0.28	9.94	18.90	28.84	60.82	-31.98	QP	P
7	0.57	9.95	15.77	25.72	46.00	-20.28	Average	P
8	0.57	9.95	24.15	34.10	56.00	-21.90	QP	P
9	3.32	10.10	10.92	21.02	46.00	-24.98	Average	P
10	3.32	10.10	18.22	28.32	56.00	-27.68	QP	P
11	3.76	10.12	10.36	20.48	46.00	-25.52	Average	P
12	3.76	10.12	22.59	32.71	56.00	-23.29	QP	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=(LISN or ISN or Current Probe)Factor + Cable Loss

Power	:	AC 120V	Pol/Phase	:	NEUTRAL
Test Mode	:	Mode 3	Temperature	:	23 °C
Test date	:	Jan. 10, 2019	Humidity	:	45 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.18	9.94	17.60	27.54	54.69	-27.15	Average	P
2	0.18	9.94	35.43	45.37	64.69	-19.32	QP	P
3	0.19	9.94	15.16	25.10	54.14	-29.04	Average	P
4	0.19	9.94	32.67	42.61	64.14	-21.53	QP	P
5	0.20	9.94	12.62	22.56	53.73	-31.17	Average	P
6	0.20	9.94	29.62	39.56	63.73	-24.17	QP	P
7	0.58	9.95	16.26	26.21	46.00	-19.79	Average	P
8	0.58	9.95	24.75	34.70	56.00	-21.30	QP	P
9	3.19	10.10	11.82	21.92	46.00	-24.08	Average	P
10	3.19	10.10	19.37	29.47	56.00	-26.53	QP	P
11	3.74	10.12	12.57	22.69	46.00	-23.31	Average	P
12	3.74	10.12	23.89	34.01	56.00	-21.99	QP	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=(LISN or ISN or Current Probe)Factor + Cable Loss

6. Test of Radiated Spurious Emission

6.1 Test Limit

Radiated emissions from 30 MHz to 25 GHz were measured according to the methods defines in ANSI C63.4-2014. The EUT was placed, 0.8 meter above the ground plane, as shown in section 5.6.3. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Distance Meters	Radiated (μ V / M)	Radiated (dB μ V/ M)
30-88	3	100	40.0
88-216	3	150	43.5
216-960	3	200	46.0
Above 960	3	500	54.0

For unintentional device, according to CISPR PUB.22, for Class B digital devices, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 10 meters shall not exceed the above table.

Frequency (MHz)	Distance Meters	Radiated (dB μ V/ M)
30-230	10	30
230-1000	10	37

6.2 Test Procedures

a. The EUT was placed on a rotatable table top 0.8 meter above ground.

b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.

c. The table was rotated 360 degrees to determine the position of the highest radiation.

d. The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.

e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.

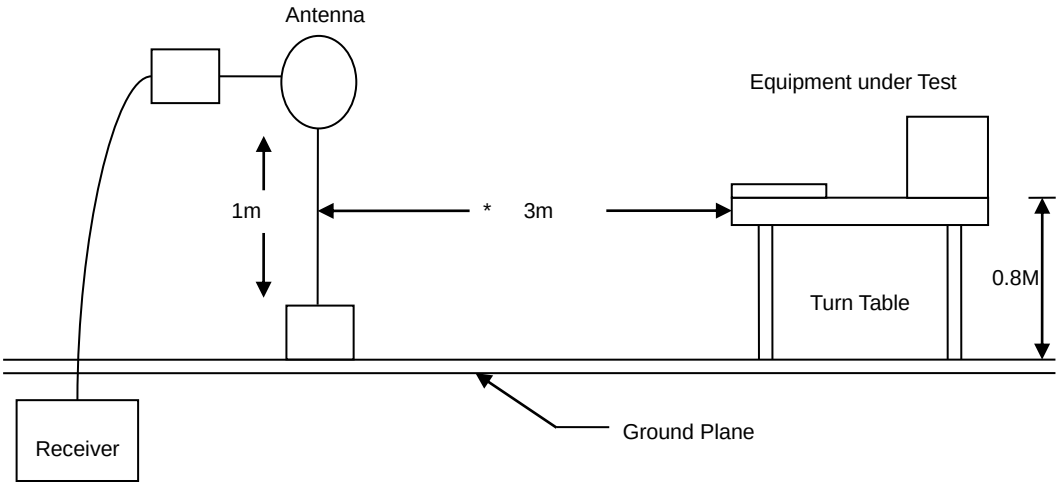
f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.

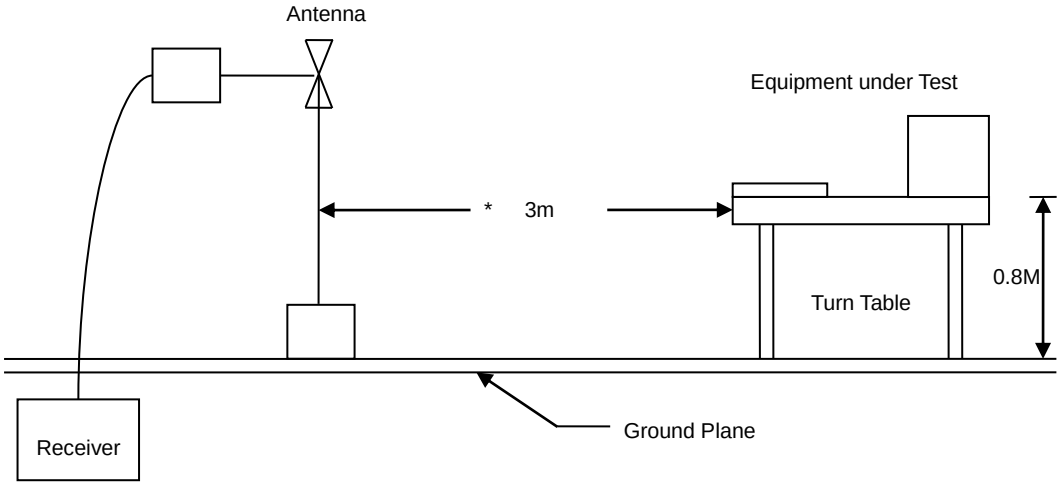
h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

6.3 Typical Test Setup

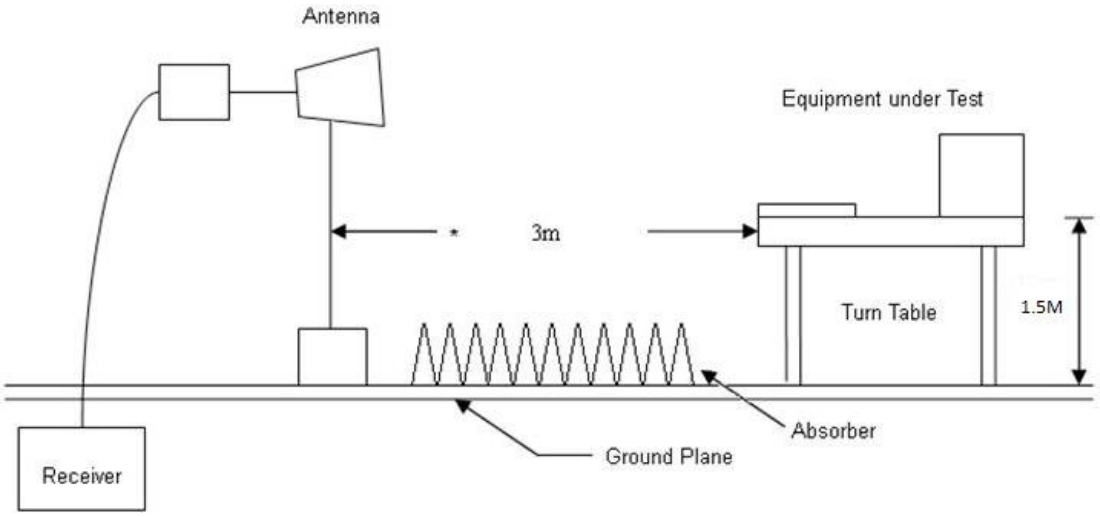
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup

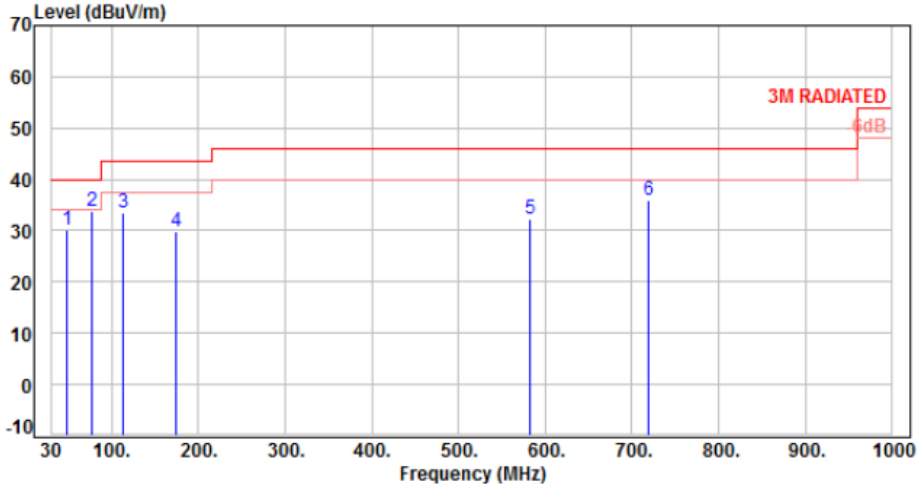


6.4 Test Result and Data (9kHz ~ 30MHz)

The 9kHz-30MHz spurious emission is under limit 20dB more.

6.5 Test Result and Data (30MHz ~ 1GHz)

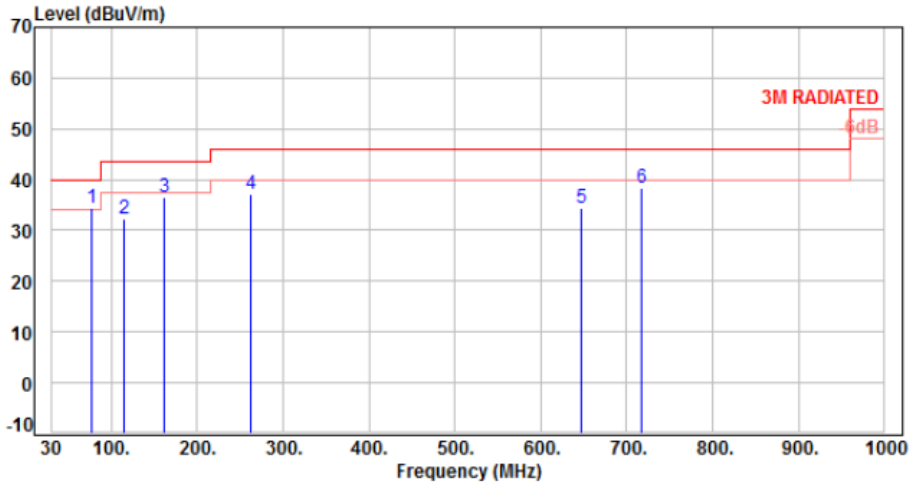
Power	:	DC 5V From system	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	48.43	-9.42	39.47	30.05	40.00	-9.95	Peak	400	0	P
2	76.56	-12.71	46.49	33.78	40.00	-6.22	Peak	400	0	P
3	113.42	-12.34	45.80	33.46	43.50	-10.04	Peak	400	0	P
4	174.53	-10.17	40.08	29.91	43.50	-13.59	Peak	400	0	P
5	581.93	-1.93	34.16	32.23	46.00	-13.77	Peak	400	0	P
6	719.67	0.30	35.64	35.94	46.00	-10.06	Peak	400	0	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

Power	:	DC 5V From system	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %

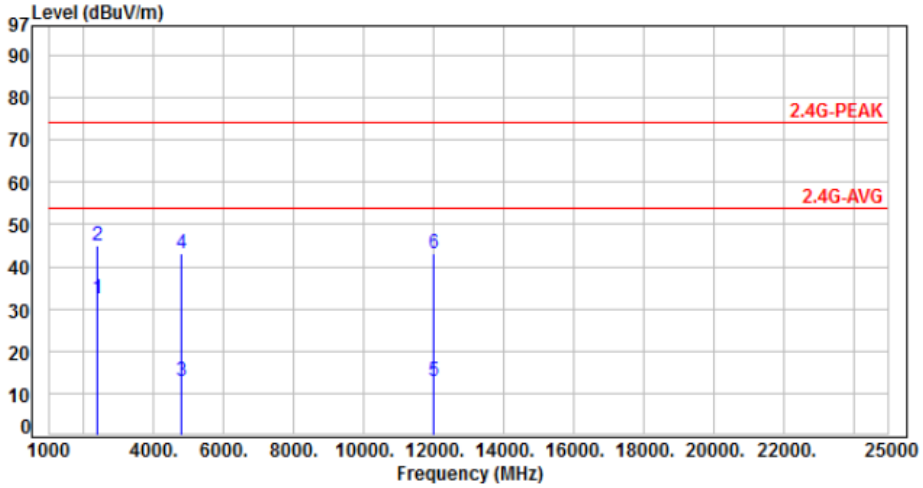


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	76.56	-12.71	47.24	34.53	40.00	-5.47	Peak	100	0	P
2	115.36	-12.22	44.52	32.30	43.50	-11.20	Peak	100	0	P
3	161.92	-9.23	45.71	36.48	43.50	-7.02	Peak	100	0	P
4	262.80	-9.82	47.08	37.26	46.00	-8.74	Peak	100	0	P
5	647.89	-1.05	35.53	34.48	46.00	-11.52	Peak	100	0	P
6	716.76	0.34	38.18	38.52	46.00	-7.48	Peak	100	0	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

6.6 Test Result and Data (1GHz ~ 25GHz)

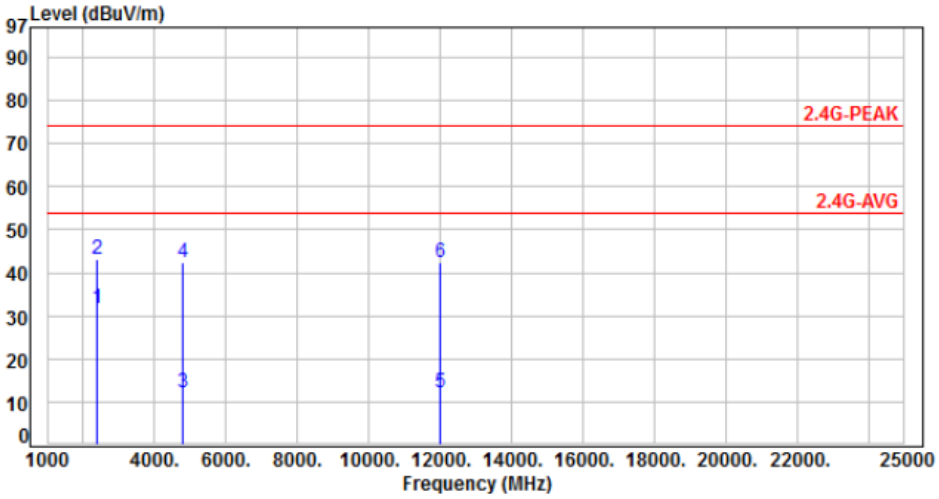
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH00	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	48.20	32.52	54.00	-21.48	Average	210	160	P
2	2390.00	-15.68	60.80	45.12	74.00	-28.88	Peak	210	160	P
3	4804.00	-8.53	21.40	12.87	54.00	-41.13	Average	100	328	P
4	4804.00	-8.53	51.50	42.97	74.00	-31.03	Peak	100	328	P
5	12010.00	1.77	11.28	13.05	54.00	-40.95	Average	100	51	P
6	12010.00	1.77	41.38	43.15	74.00	-30.85	Peak	100	51	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

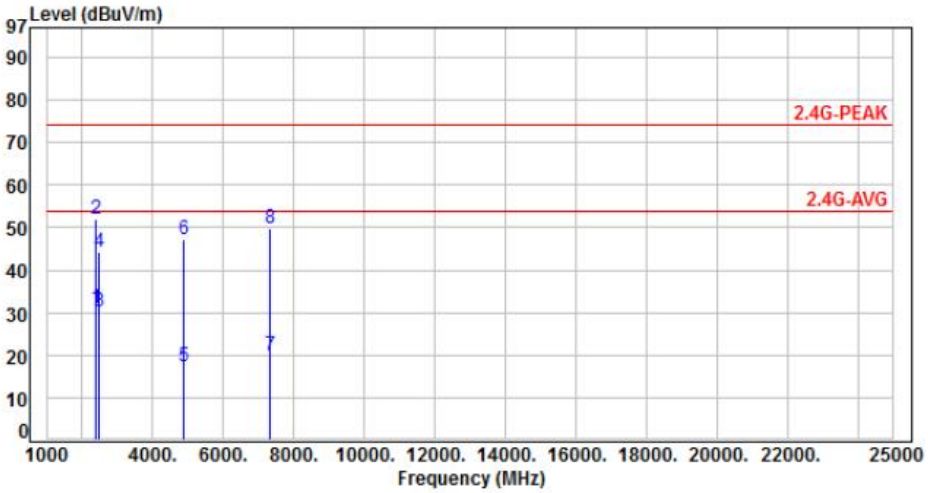
Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH00	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	47.23	31.55	54.00	-22.45	Average	140	280	P
2	2390.00	-15.68	58.90	43.22	74.00	-30.78	Peak	140	280	P
3	4804.00	-8.53	20.70	12.17	54.00	-41.83	Average	100	242	P
4	4804.00	-8.53	50.80	42.27	74.00	-31.73	Peak	100	242	P
5	12010.00	1.77	10.47	12.24	54.00	-41.76	Average	100	345	P
6	12010.00	1.77	40.57	42.34	74.00	-31.66	Peak	100	345	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

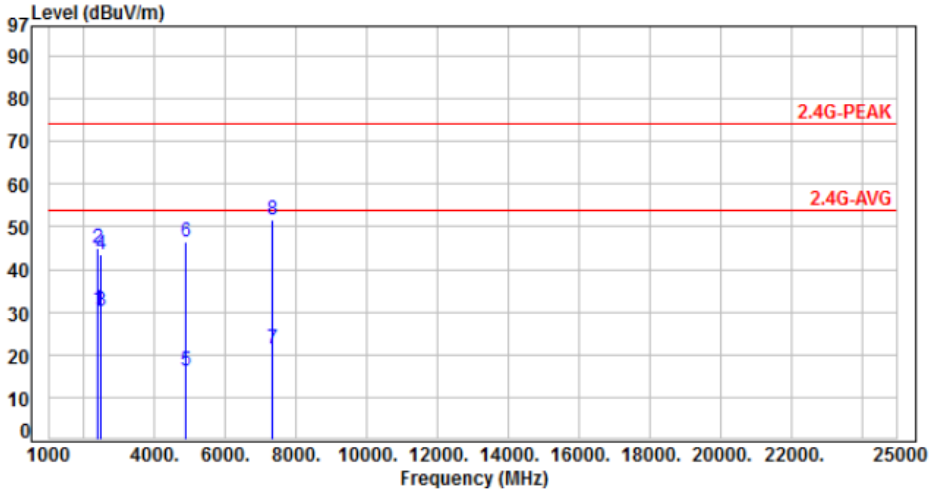
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH39	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	46.50	30.82	54.00	-23.18	Average	100	195	P
2	2390.00	-15.68	67.80	52.12	74.00	-21.88	Peak	100	195	P
3	2483.50	-15.36	45.60	30.24	54.00	-23.76	Average	100	195	P
4	2483.50	-15.36	59.50	44.14	74.00	-29.86	Peak	100	195	P
5	4882.00	-8.30	25.50	17.20	54.00	-36.80	Average	100	270	P
6	4882.00	-8.30	55.60	47.30	74.00	-26.70	Peak	100	270	P
7	7323.00	-3.83	23.70	19.87	54.00	-34.13	Average	100	99	P
8	7323.00	-3.83	53.80	49.97	74.00	-24.03	Peak	100	99	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

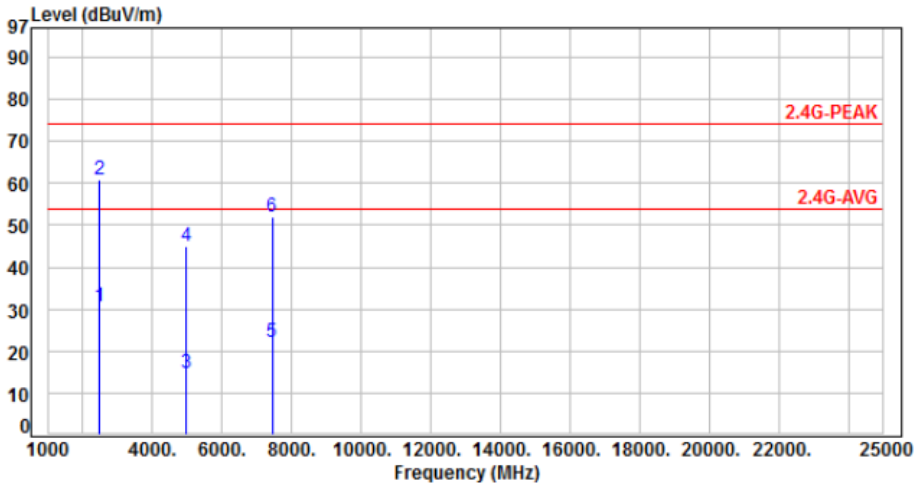
Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH39	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	46.20	30.52	54.00	-23.48	Average	100	210	P
2	2390.00	-15.68	60.50	44.82	74.00	-29.18	Peak	100	210	P
3	2483.50	-15.36	45.60	30.24	54.00	-23.76	Average	100	210	P
4	2483.50	-15.36	58.80	43.44	74.00	-30.56	Peak	100	210	P
5	4882.00	-8.30	24.70	16.40	54.00	-37.60	Average	100	326	P
6	4882.00	-8.30	54.80	46.50	74.00	-27.50	Peak	100	326	P
7	7323.00	-3.83	25.40	21.57	54.00	-32.43	Average	100	313	P
8	7323.00	-3.83	55.50	51.67	74.00	-22.33	Peak	100	313	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

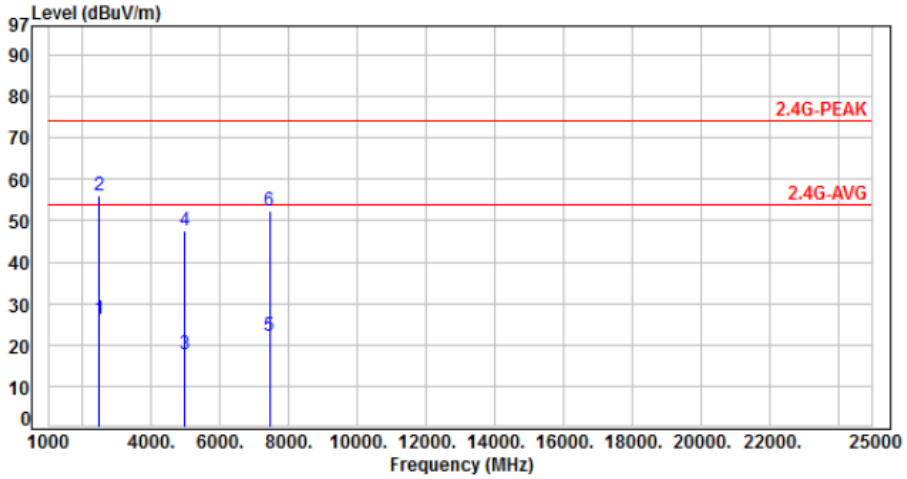
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH78	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-15.36	46.10	30.74	54.00	-23.26	Average	108	170	P
2	2483.50	-15.36	76.20	60.84	74.00	-13.16	Peak	108	170	P
3	4960.00	-8.07	22.79	14.72	54.00	-39.28	Average	100	348	P
4	4960.00	-8.07	52.89	44.82	74.00	-29.18	Peak	100	348	P
5	7440.00	-3.52	25.50	21.98	54.00	-32.02	Average	100	270	P
6	7440.00	-3.52	55.60	52.08	74.00	-21.92	Peak	100	270	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

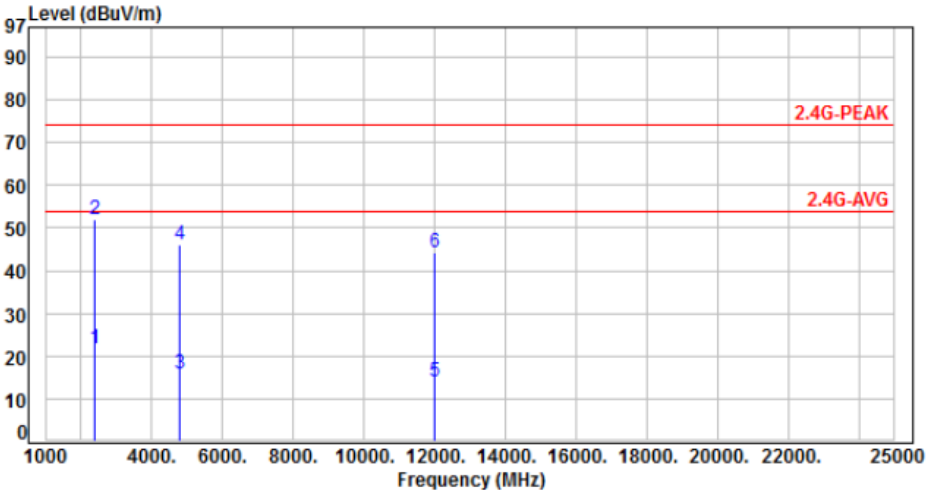
Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH78	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-15.36	41.40	26.04	54.00	-27.96	Average	207	100	P
2	2483.50	-15.36	71.50	56.14	74.00	-17.86	Peak	207	100	P
3	4960.00	-8.07	25.59	17.52	54.00	-36.48	Average	100	251	P
4	4960.00	-8.07	55.69	47.62	74.00	-26.38	Peak	100	251	P
5	7440.00	-3.52	25.80	22.28	54.00	-31.72	Average	100	242	P
6	7440.00	-3.52	55.90	52.38	74.00	-21.62	Peak	100	242	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

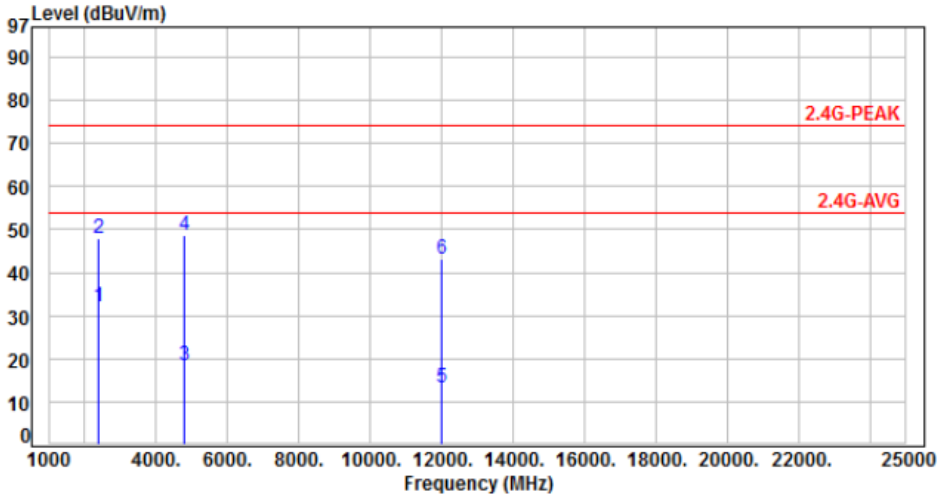
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH00	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	37.40	21.72	54.00	-32.28	Average	209	153	P
2	2390.00	-15.68	67.50	51.82	74.00	-22.18	Peak	209	153	P
3	4804.00	-8.53	24.50	15.97	54.00	-38.03	Average	100	219	P
4	4804.00	-8.53	54.60	46.07	74.00	-27.93	Peak	100	219	P
5	12010.00	1.77	12.40	14.17	54.00	-39.83	Average	100	254	P
6	12010.00	1.77	42.50	44.27	74.00	-29.73	Peak	100	254	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

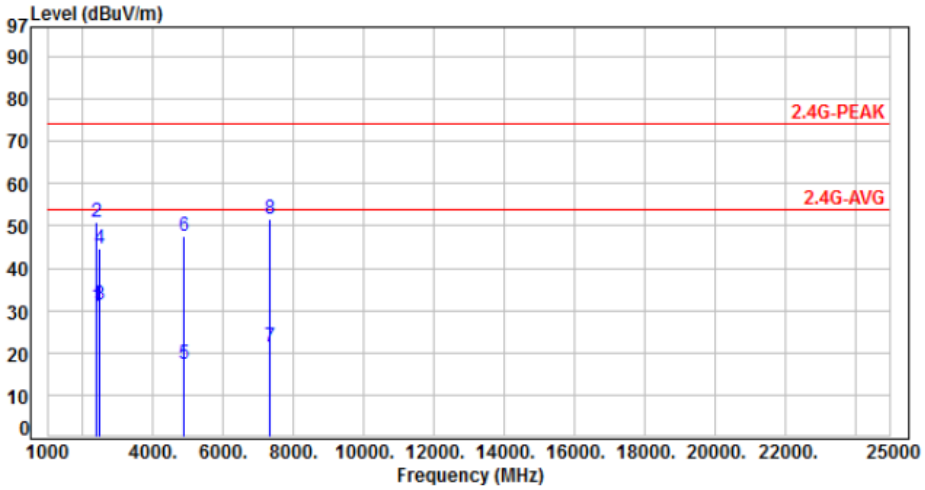
Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH00	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	47.80	32.12	54.00	-21.88	Average	233	207	P
2	2390.00	-15.68	63.60	47.92	74.00	-26.08	Peak	233	207	P
3	4804.00	-8.53	27.10	18.57	54.00	-35.43	Average	100	252	P
4	4804.00	-8.53	57.20	48.67	74.00	-25.33	Peak	100	252	P
5	12010.00	1.77	11.40	13.17	54.00	-40.83	Average	100	142	P
6	12010.00	1.77	41.50	43.27	74.00	-30.73	Peak	100	142	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

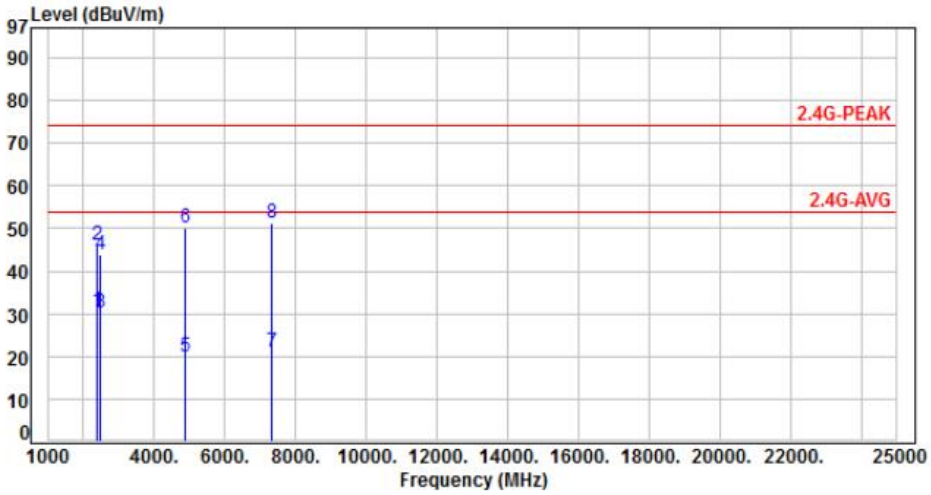
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH39	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	46.50	30.82	54.00	-23.18	Average	106	170	P
2	2390.00	-15.68	66.40	50.72	74.00	-23.28	Peak	106	170	P
3	2483.50	-15.36	46.60	31.24	54.00	-22.76	Average	106	170	P
4	2483.50	-15.36	59.90	44.54	74.00	-29.46	Peak	106	170	P
5	4882.00	-8.30	25.70	17.40	54.00	-36.60	Average	100	329	P
6	4882.00	-8.30	55.80	47.50	74.00	-26.50	Peak	100	329	P
7	7323.00	-3.83	25.20	21.37	54.00	-32.63	Average	100	274	P
8	7323.00	-3.83	55.30	51.47	74.00	-22.53	Peak	100	274	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

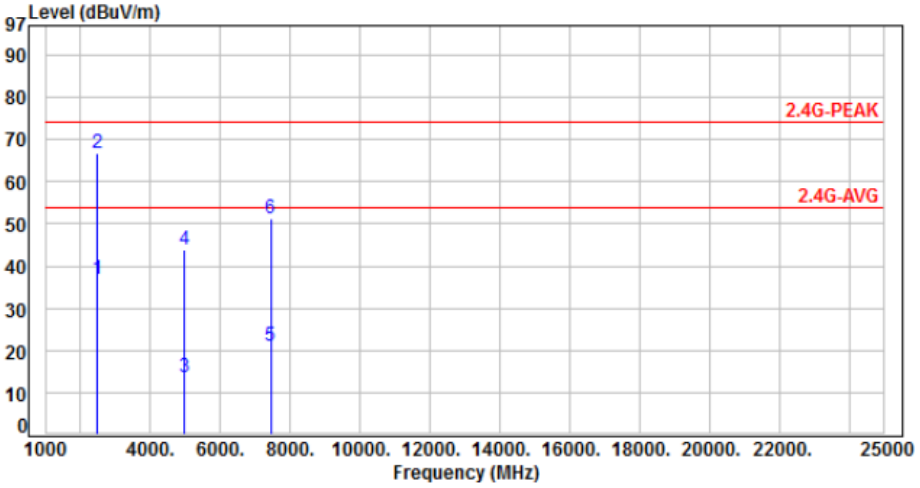
Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH39	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-15.68	46.20	30.52	54.00	-23.48	Average	198	210	P
2	2390.00	-15.68	61.80	46.12	74.00	-27.88	Peak	198	210	P
3	2483.50	-15.36	45.70	30.34	54.00	-23.66	Average	198	210	P
4	2483.50	-15.36	59.26	43.90	74.00	-30.10	Peak	198	210	P
5	4882.00	-8.30	28.40	20.10	54.00	-33.90	Average	100	257	P
6	4882.00	-8.30	58.50	50.20	74.00	-23.80	Peak	100	257	P
7	7323.00	-3.83	25.00	21.17	54.00	-32.83	Average	100	244	P
8	7323.00	-3.83	55.10	51.27	74.00	-22.73	Peak	100	244	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

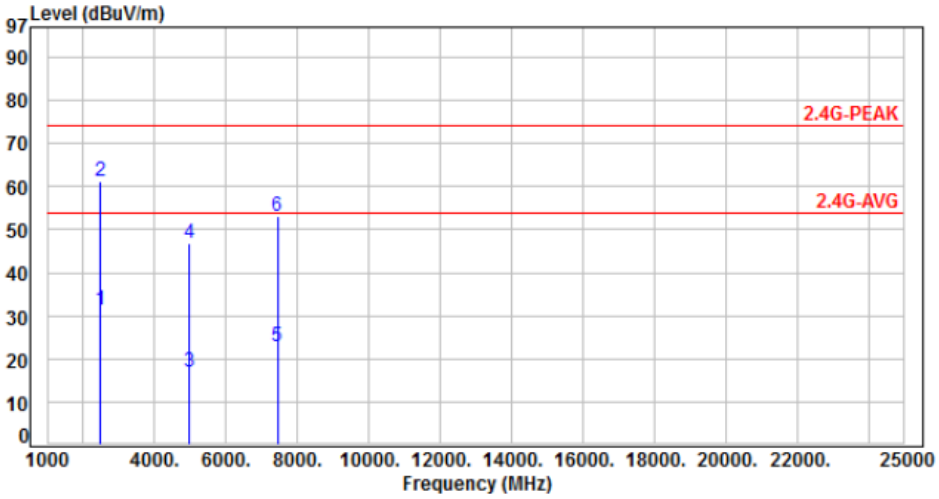
Power	:	AC 120V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH78	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-15.36	52.10	36.74	54.00	-17.26	Average	100	170	P
2	2483.50	-15.36	82.20	66.84	74.00	-7.16	Peak	100	170	P
3	4960.00	-8.07	21.69	13.62	54.00	-40.38	Average	100	348	P
4	4960.00	-8.07	51.79	43.72	74.00	-30.28	Peak	100	348	P
5	7440.00	-3.52	24.70	21.18	54.00	-32.82	Average	100	260	P
6	7440.00	-3.52	54.80	51.28	74.00	-22.72	Peak	100	260	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

Power	:	AC 120V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH78	Temperature	:	22 °C
Test Date	:	Jan. 04, 2019	Humidity	:	59 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-15.36	46.60	31.24	54.00	-22.76	Average	203	97	P
2	2483.50	-15.36	76.70	61.34	74.00	-12.66	Peak	203	97	P
3	4960.00	-8.07	24.89	16.82	54.00	-37.18	Average	100	230	P
4	4960.00	-8.07	54.99	46.92	74.00	-27.08	Peak	100	230	P
5	7440.00	-3.52	26.40	22.88	54.00	-31.12	Average	100	243	P
6	7440.00	-3.52	56.50	52.98	74.00	-21.02	Peak	100	243	P

Note: Level=Reading+Factor
Margin=Level-Limit
Factor=Antenna Factor + cable loss - Amplifier Factor

6.7 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.09000 – 0.11000	16.42000 – 16.42300	399.9 – 410.0	4.500 – 5.250
0.49500 – 0.505**	16.69475 – 16.69525	608.0 – 614.0	5.350 – 5.460
2.17350 – 2.19050	16.80425 – 16.80475	960.0 – 1240.0	7.250 – 7.750
4.12500 – 4.12800	25.50000 – 25.67000	1300.0 – 1427.0	8.025 – 8.500
4.17725 – 4.17775	37.50000 – 38.25000	1435.0 – 1626.5	9.000 – 9.200
4.20725 – 4.20775	73.00000 – 74.60000	1645.5 – 1646.5	9.300 – 9.500
6.21500 – 6.21800	74.80000 – 75.20000	1660.0 – 1710.0	10.600 – 12.700
6.26775 – 6.26825	108.00000 – 121.94000	1718.8 – 1722.2	13.250 – 13.400
6.31175 – 6.31225	123.00000 – 138.00000	2200.0 – 2300.0	14.470 – 14.500
8.29100 – 8.29400	149.90000 – 150.05000	2310.0 – 2390.0	15.350 – 16.200
8.36200 – 8.36600	156.52475 – 156.52525	2483.5 – 2500.0	17.700 – 21.400
8.37625 – 8.38675	156.70000 – 156.90000	2655.0 – 2900.0	22.010 – 23.120
8.41425 – 8.41475	162.01250 – 167.17000	3260.0 – 3267.0	23.600 – 24.000
12.29000 – 12.29300	167.72000 – 173.20000	3332.0 – 3339.0	31.200 – 31.800
12.51975 – 12.52025	240.00000 – 285.00000	3345.8 – 3358.0	36.430 – 36.500
12.57675 – 12.57725	322.00000 – 335.40000	3600.0 – 4400.0	Above 38.6
13.36000 – 13.41000			

**: Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

7. Test of Conducted Spurious Emission

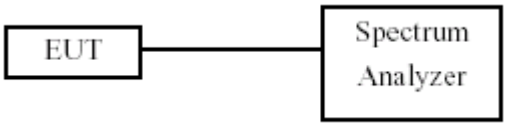
7.1 Test Limit

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

7.2 Test Procedure

a. The transmitter output was connected to the spectrum analyzer via a low loss cable.
b. Set both RBW and VBW of spectrum analyzer to 100 KHz with convenient frequency span including 100 KHz bandwidth from band edge.
c. The band edges was measured and recorded.

7.3 Test Setup Layout

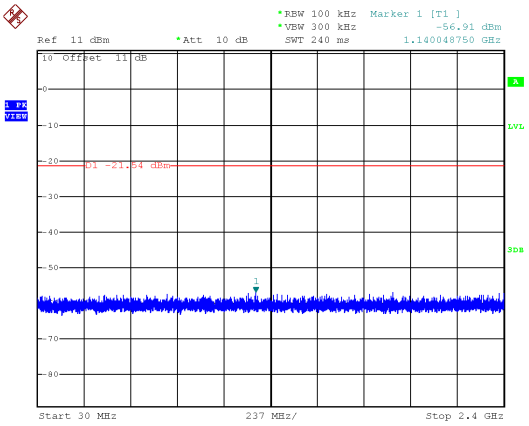


7.4 Test Result and Data

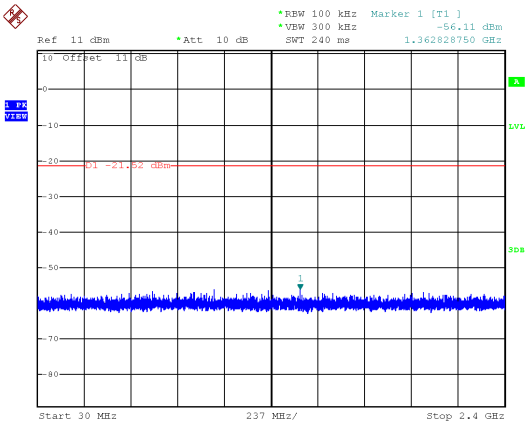
Test Result	:	PASS	Temperature	:	25°C
Test Date	:	Feb. 11, 2019	Humidity	:	61%

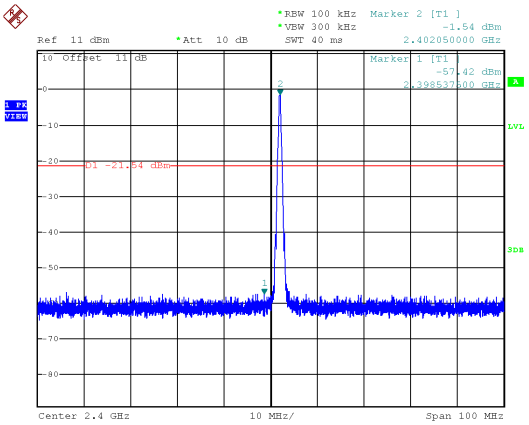
Note: Test plots refer to the following pages.

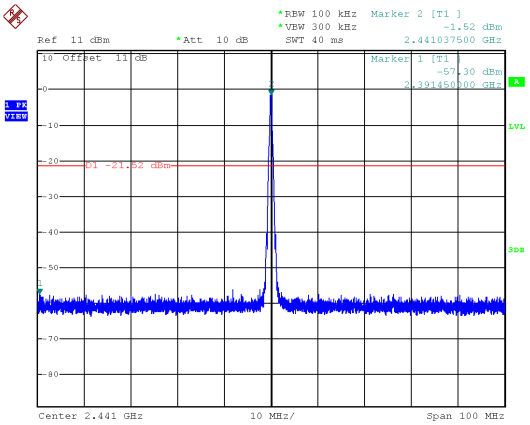
Modulation Type: GFSK, CH00

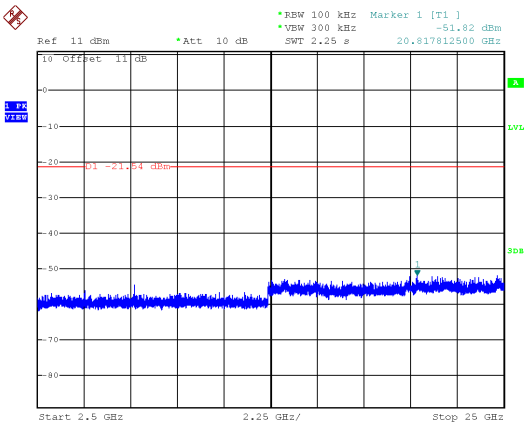


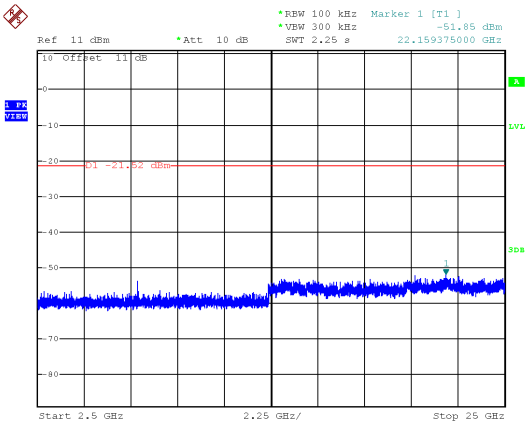
Modulation Type: GFSK, CH39



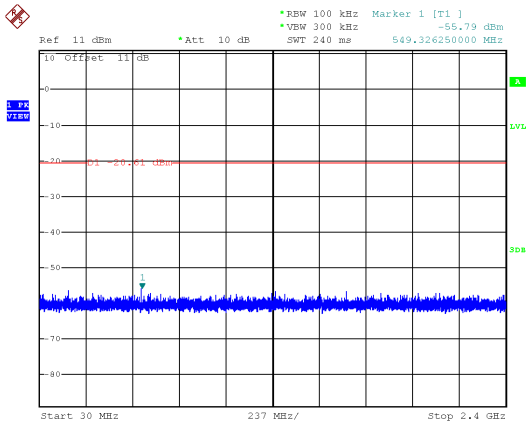




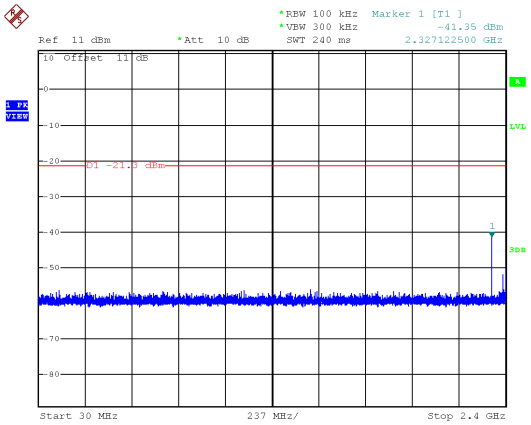


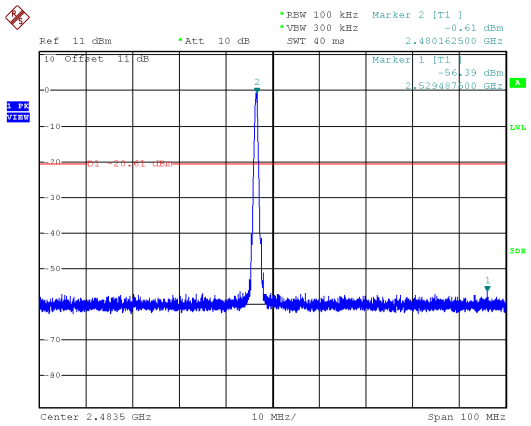


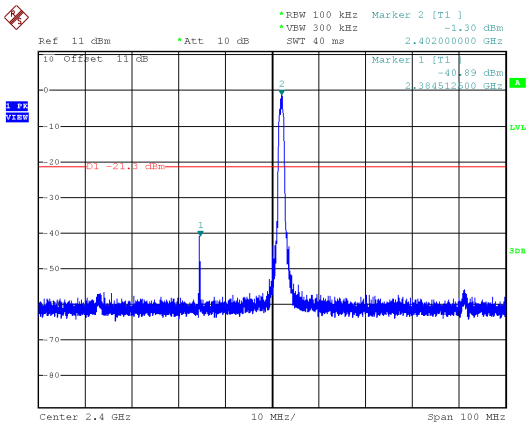
Modulation Type: GFSK, CH78

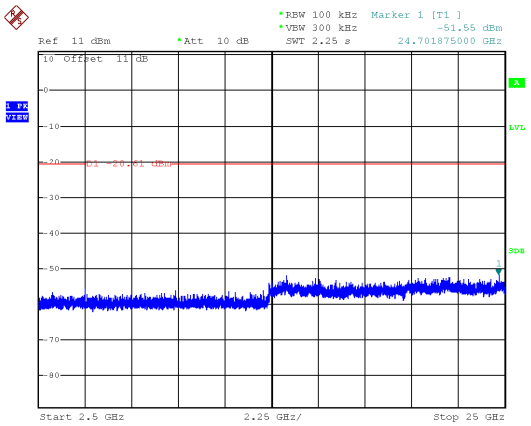


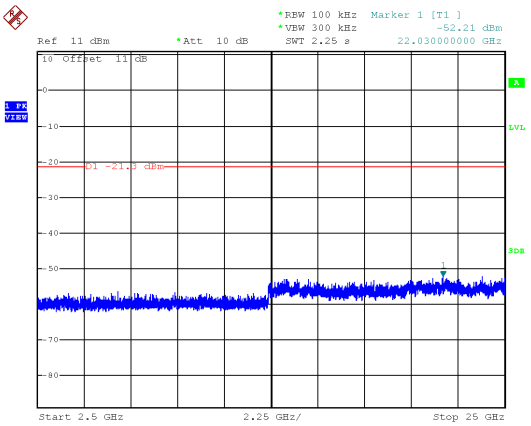
Modulation Type: π/4-DQPSK, CH00



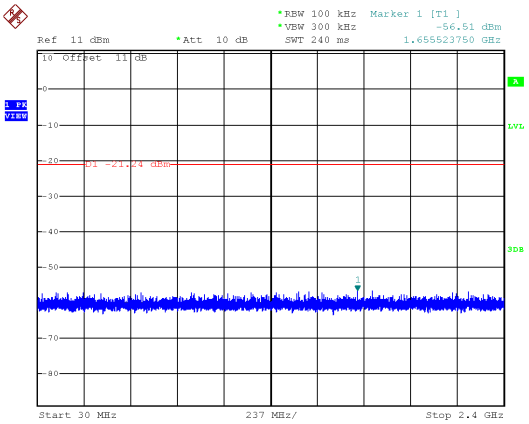




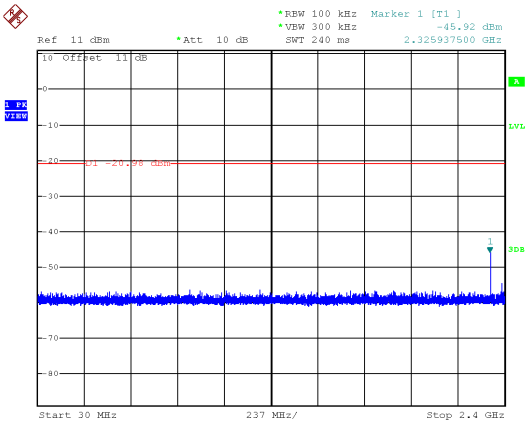


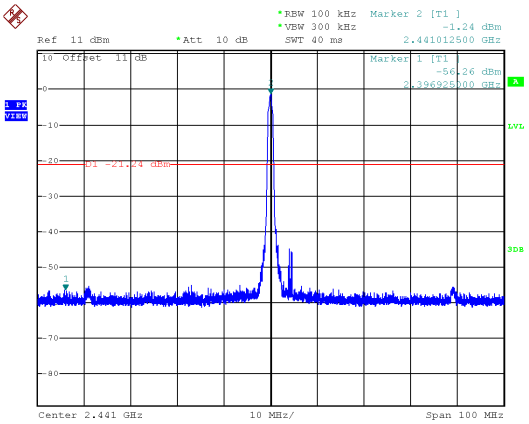


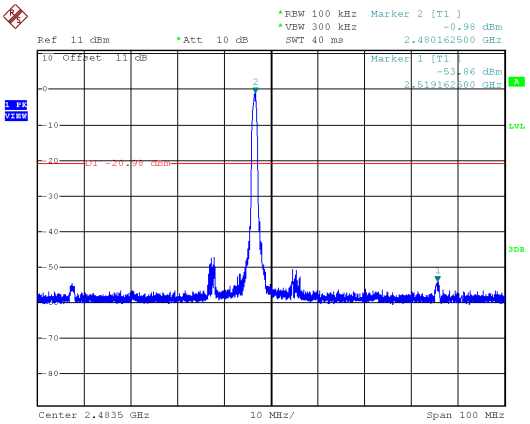
Modulation Type: π/4-DQPSK, CH39

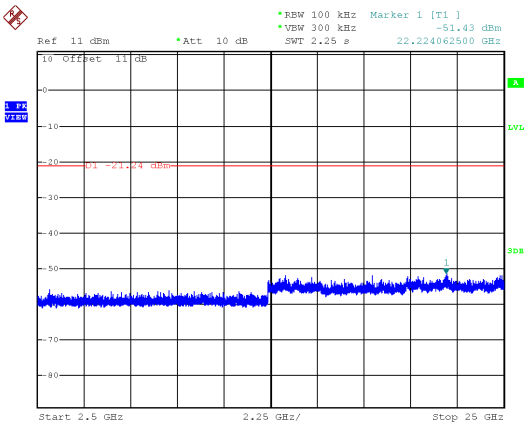


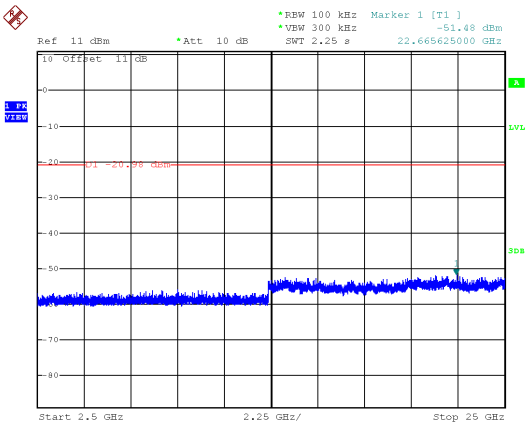
Modulation Type: π/4-DQPSK, CH78



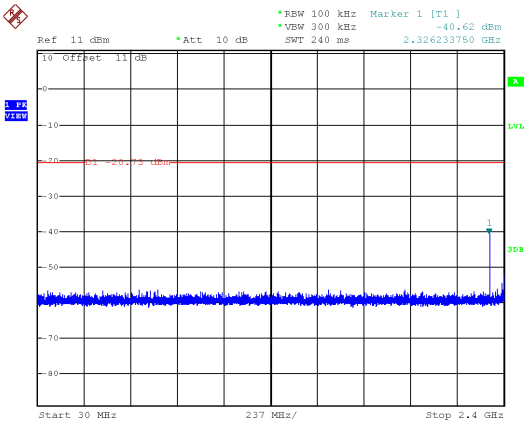




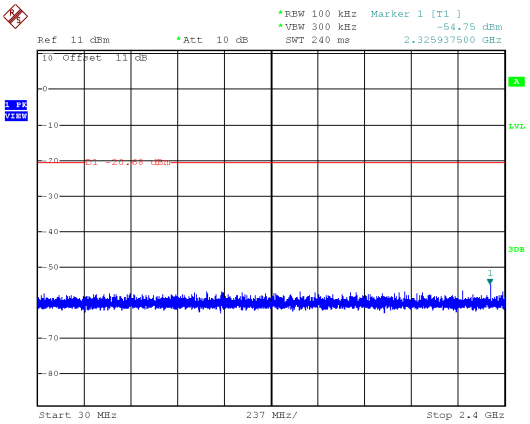


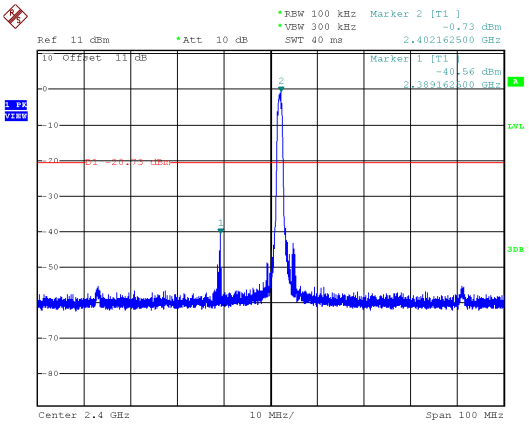


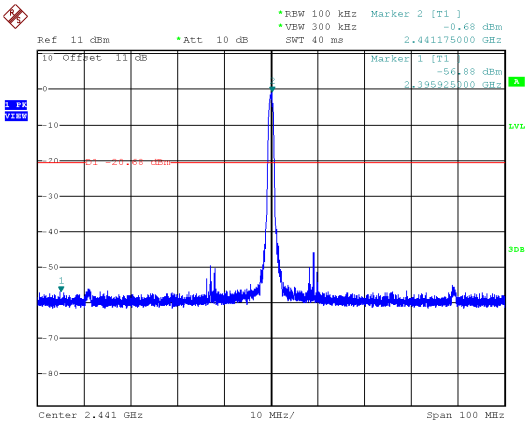
Modulation Type: 8DPSK, CH00

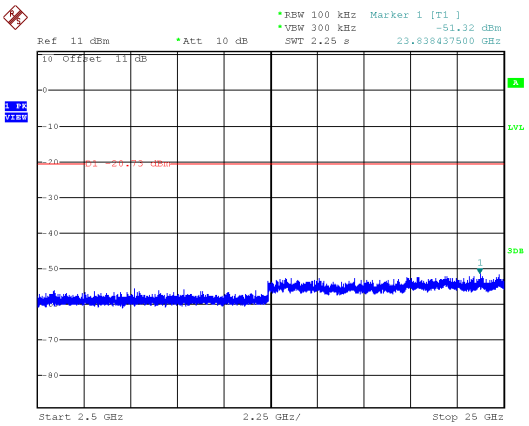


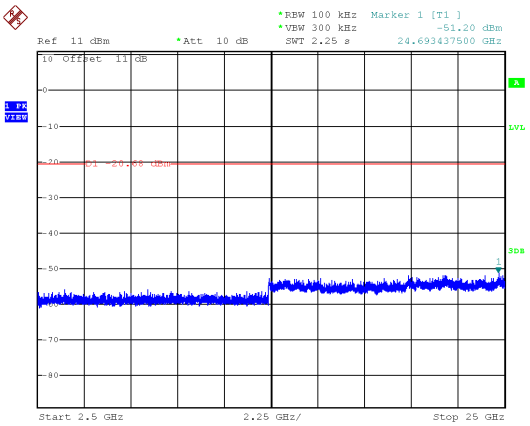
Modulation Type: 8DPSK, CH39



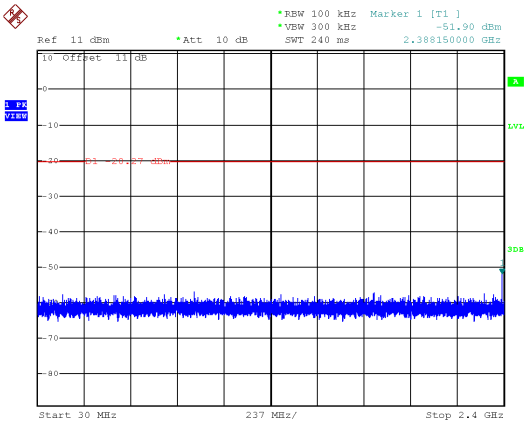


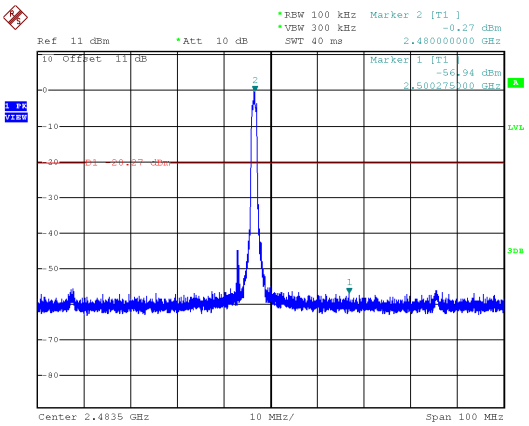


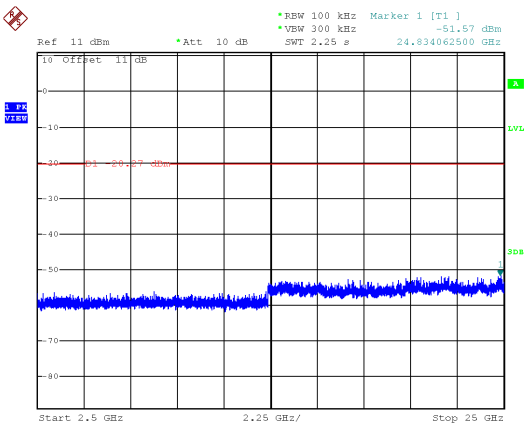




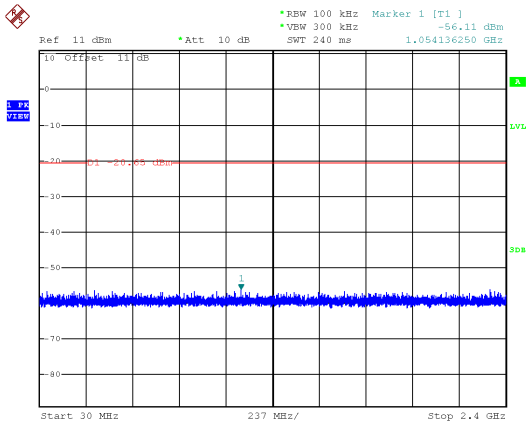
Modulation Type: 8DPSK, CH78



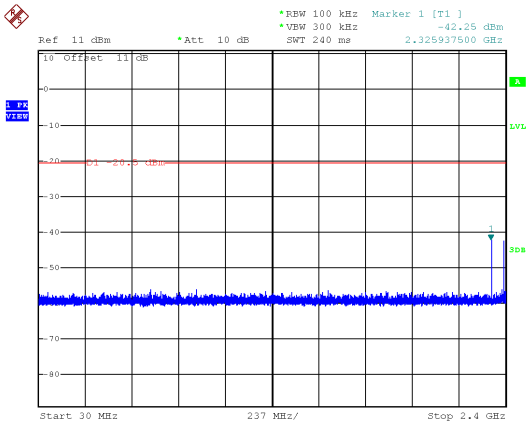


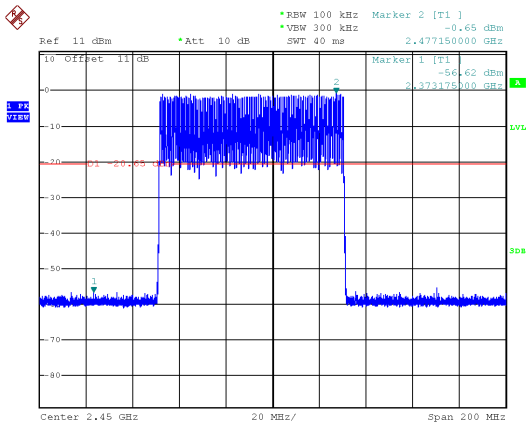


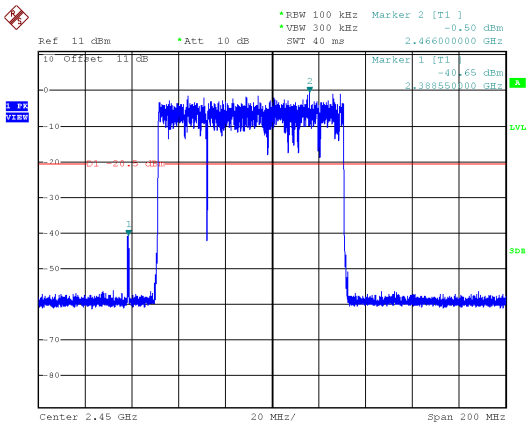
Hopping Mode:
Modulation Type: GFSK

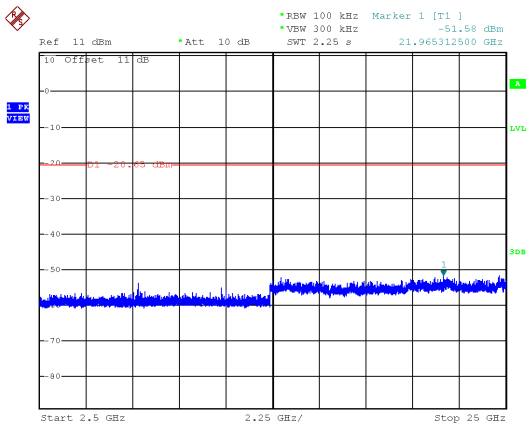


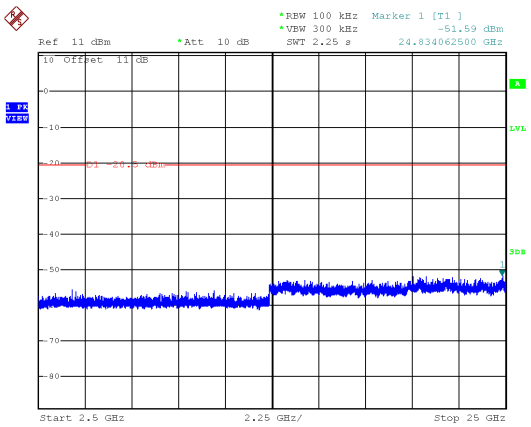
Modulation Type: π/4-DQPSK



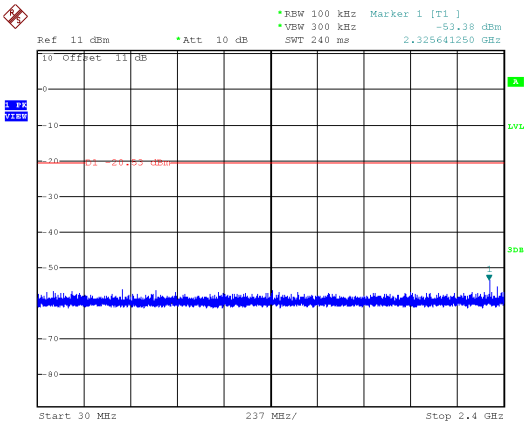


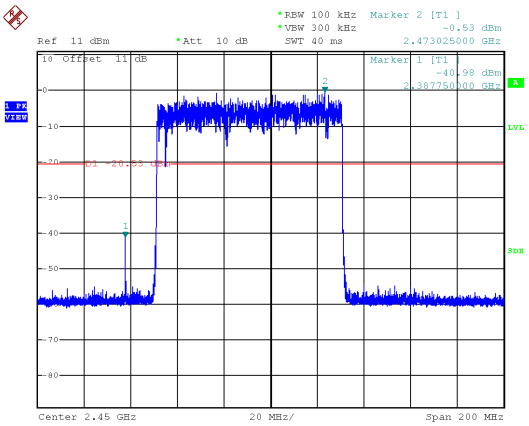


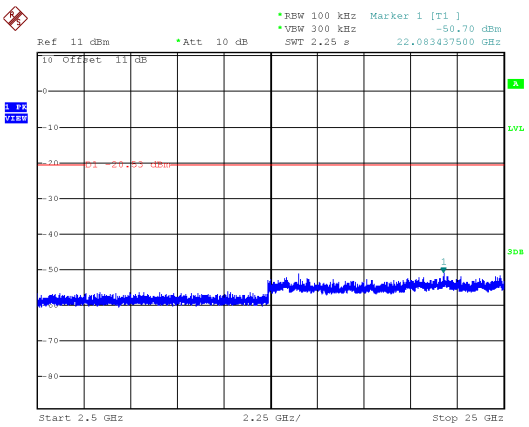




Modulation Type: 8DPSK







8. 20dB Bandwidth Measurement Data

8.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than125 mW.

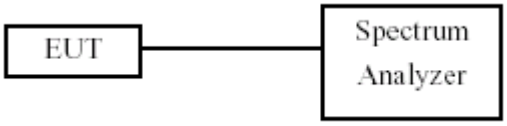
8.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.

b. Set RBW of spectrum analyzer to 30 KHz and VBW to 100 KHz.

c. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

8.3 Test Setup Layout

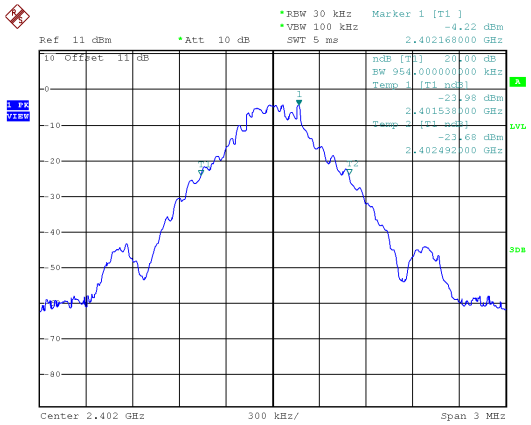


8.4 Test Result and Data

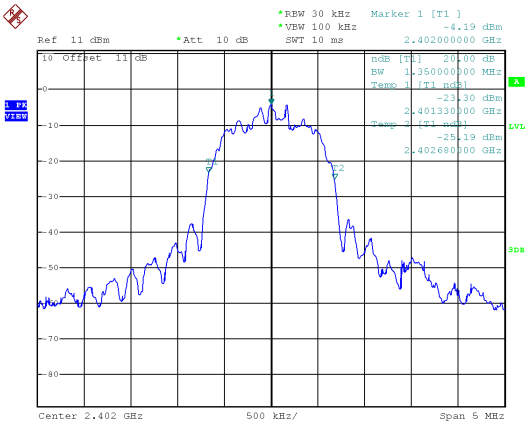
Test Result : PASS
Test Date : Jan. 31, 2019
Temperature : 25°C
Humidity : 61%

Modulation Type	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	2/3 20dB Bandwidth (MHz)
GFSK	00	2402	0.954	0.636
	39	2441	0.954	0.636
	78	2480	0.954	0.636
π/4-DQPSK	00	2402	1.350	0.900
	39	2441	1.350	0.900
	78	2480	1.350	0.900
8DPSK	00	2402	1.330	0.887
	39	2441	1.330	0.887
	78	2480	1.330	0.887

Modulation Type: GFSK
CH00

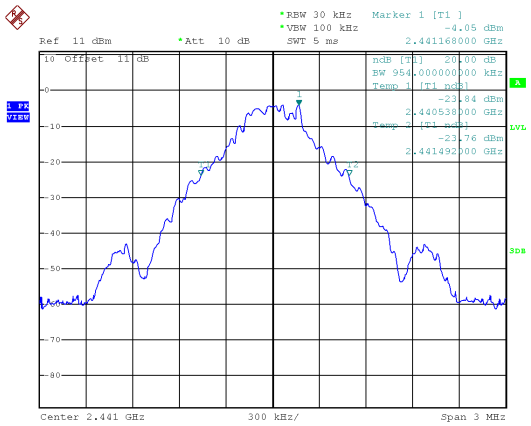


Modulation Type: π/4-DQPSK
CH00

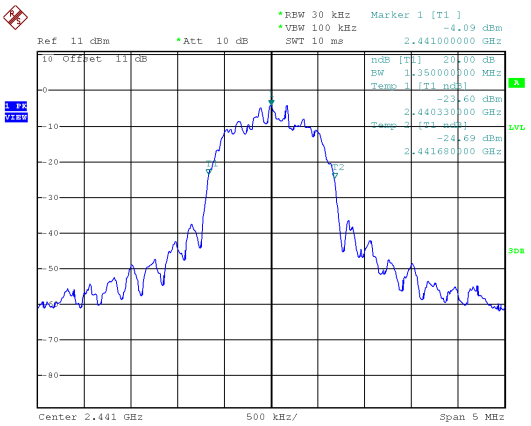


2

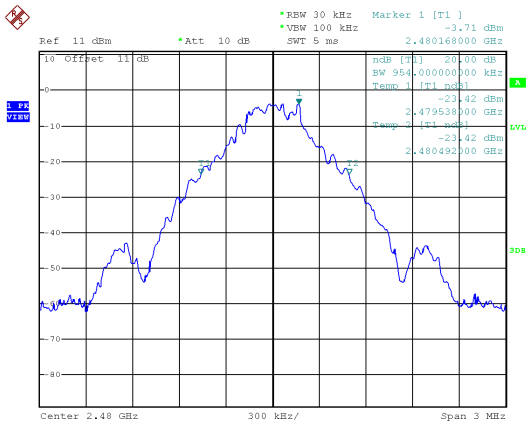
CH39



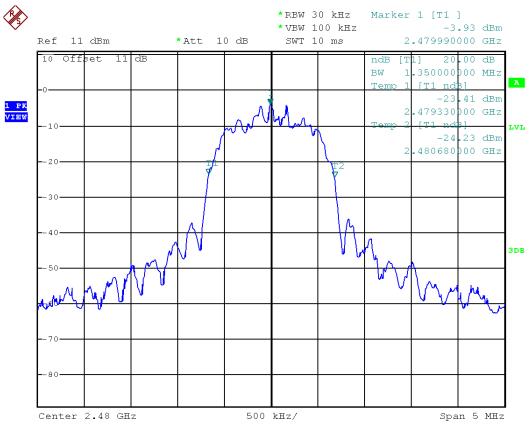
CH39



CH78

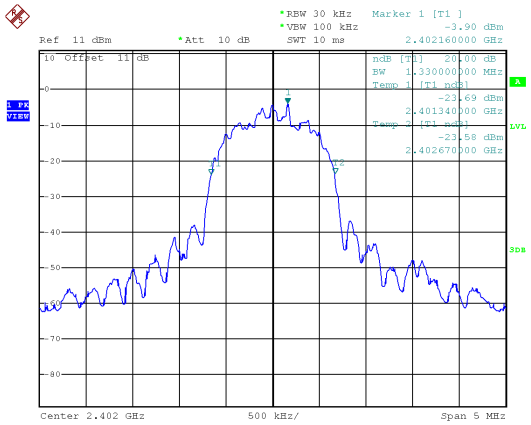


CH78

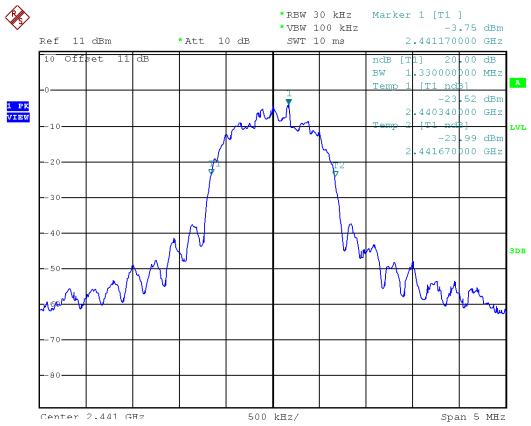


Modulation Type: 8DSPK

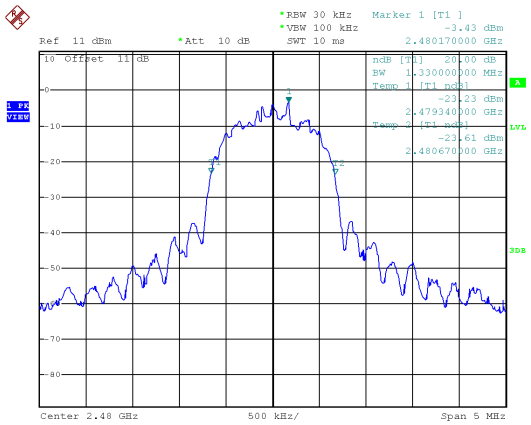
CH00



CH39



CH78



9. Frequencies Separation

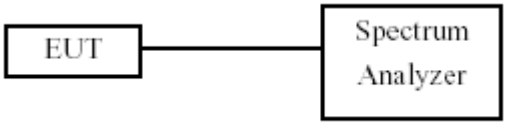
9.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

9.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.
b. Set RBW of spectrum analyzer to 30 KHz and VBW to 100 KHz.
c. By using the MaxHold function record the separation of two adjacent channels.
d. Measure the frequency difference of these two adjacent channels.

9.3 Test Setup Layout

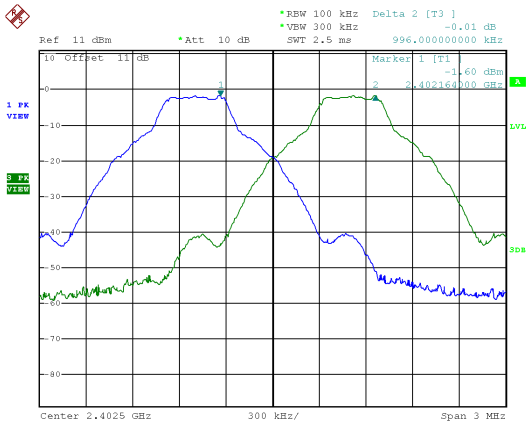


9.4 Test Result and Data

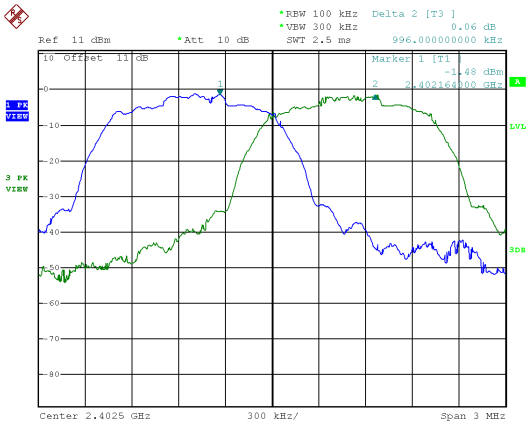
Test Result : PASS
Test Date : Feb. 11, 2019
Temperature : 25°C
Humidity : 61%

Modulation Type	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
GFSK	00	2402	0.996	0.636
	39	2441	1.002	0.636
	78	2480	1.002	0.636
π/4-DQPSK	00	2402	0.996	0.900
	39	2441	1.002	0.900
	78	2480	1.002	0.900
8DPSK	00	2402	1.002	0.887
	39	2441	1.002	0.887
	78	2480	1.002	0.887

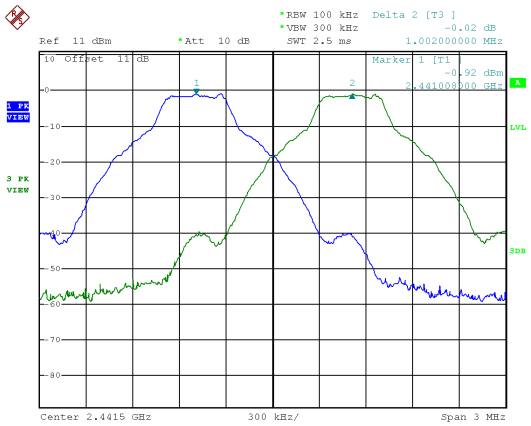
Modulation Type: GFSK
CH00



Modulation Type: π/4-DQPSK
CH00



CH39



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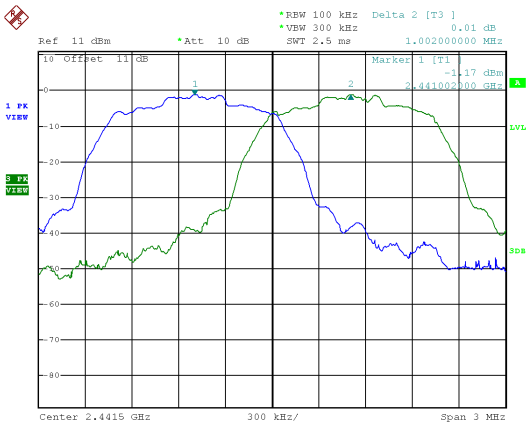
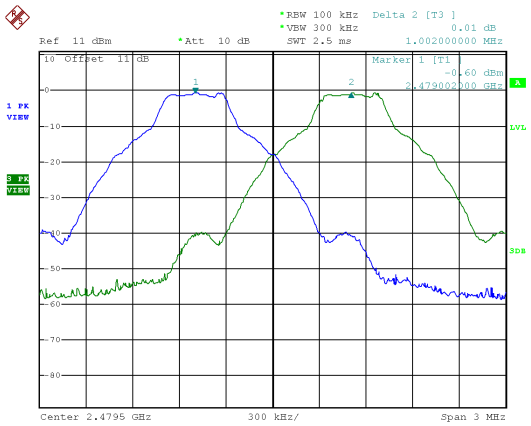


CH78



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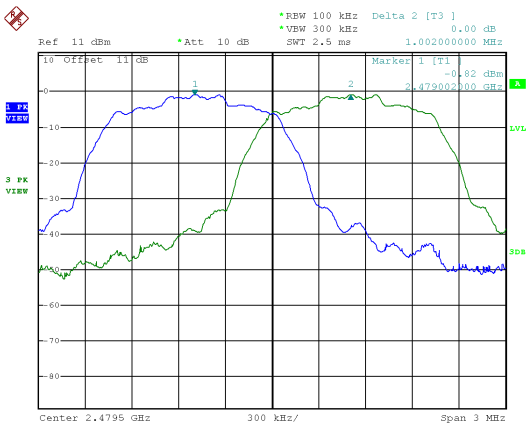
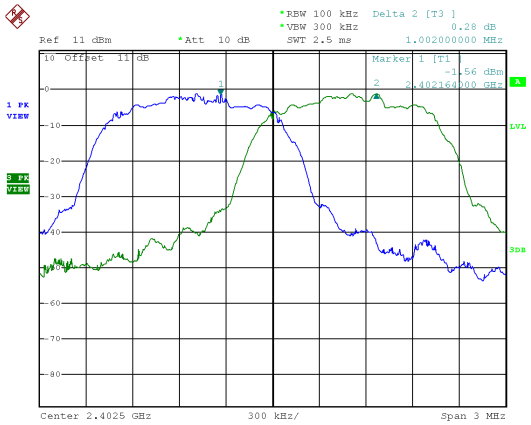


Modulation Type: 8DSPK
CH00



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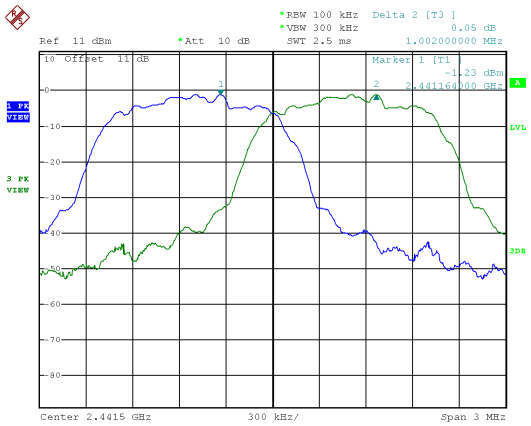

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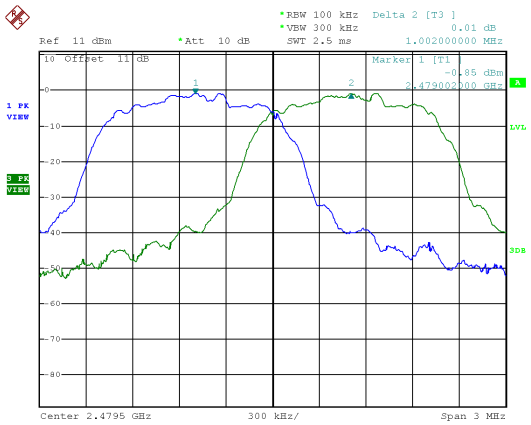


10. Dwell Time on each channel

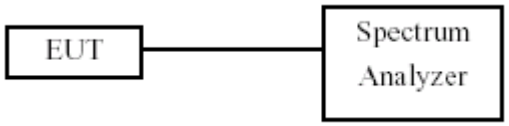
10.1 Test Limit

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.

10.2 Test Procedures

1. The transmitter output was connected to the spectrum analyzer.
2. Adjust the center frequency to measure frequency, then set zero span mode.
2. Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz.
4. Measure the time duration of one transmission on the measured frequency.

10.3 Test Setup Layout



10.4 Test Result and Data

Test Result : PASS Temperature : 25°C

Test Date : Feb. 11, 2019 Humidity : 61%

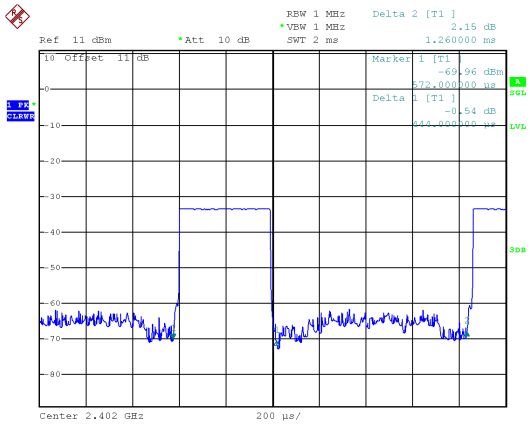
Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec

Modulation Type	Frequency (MHz)	Length of transmission time (ms)	Number of transmission in a 31.6 (79 Hopping*0.4)	Dwell Time (ms)	Limit (ms)
GFSK (DH1)	2402	0.444	320.10	142.12	400
GFSK (DH3)	2402	1.704	159.90	272.47	400
GFSK (DH5)	2402	2.964	106.81	316.58	400
π/4-DQPSK (DH1)	2402	0.444	320.10	142.12	400
π/4-DQPSK (DH3)	2402	1.708	159.90	273.11	400
π/4-DQPSK (DH5)	2402	2.988	106.81	319.15	400
8DPSK (DH1)	2402	0.436	320.10	139.56	400
8DPSK (DH3)	2402	1.726	159.90	275.99	400
8DPSK (DH5)	2402	2.966	106.81	316.80	400

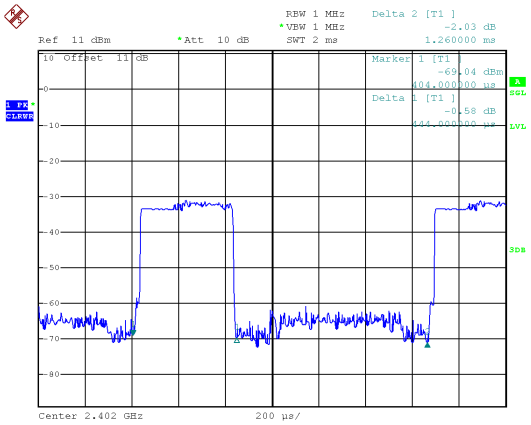
Test Period = 0.4 (second/ channel) x 20 Channel = 8 sec

Modulation Type	Frequency (MHz)	Length of transmission time (ms)	Number of transmission in a 8 (20 Hopping*0.4)	Dwell Time (ms)	Limit (ms)
AFH (DH1)	2402-2421	0.444	160.00	71.04	400
AFH (DH3)	2402-2421	0.444	80.00	35.52	400
AFH (DH5)	2402-2421	0.436	53.33	23.25	400

Modulation Type: GFSK(DH1)

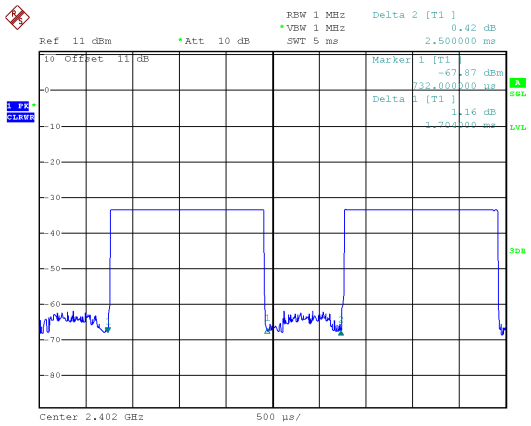


Modulation Type: π/4-DQPSK (DH1)

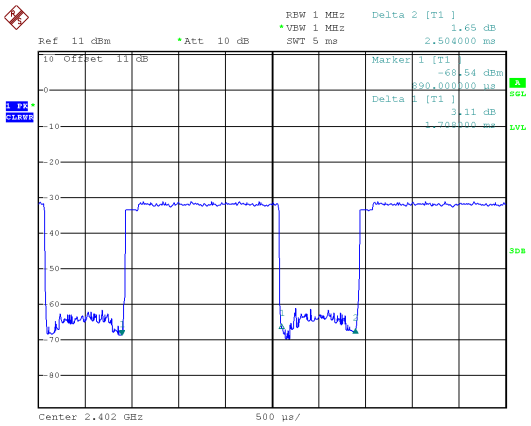


30

Modulation Type: GFSK(DH3)

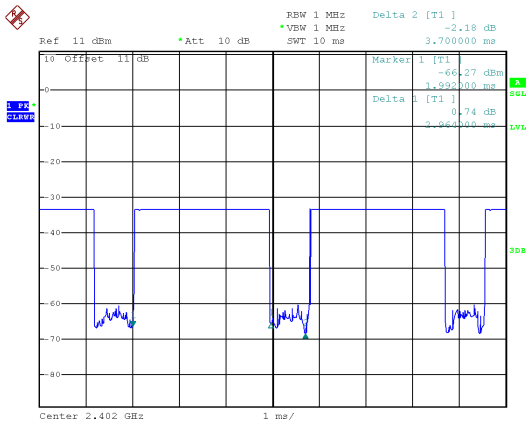


Modulation Type: π/4-DQPSK (DH3)

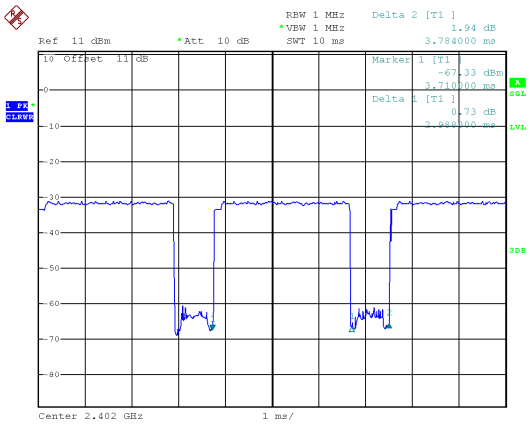


3

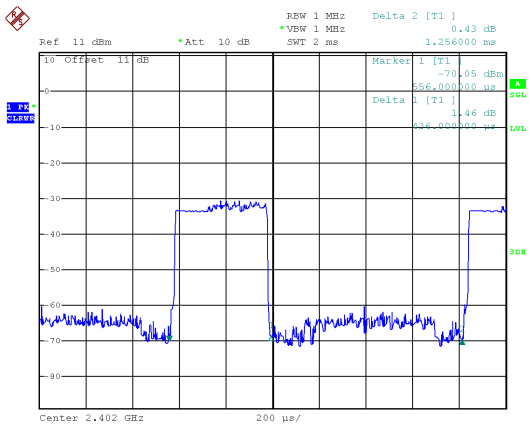
Modulation Type: GFSK(DH5)



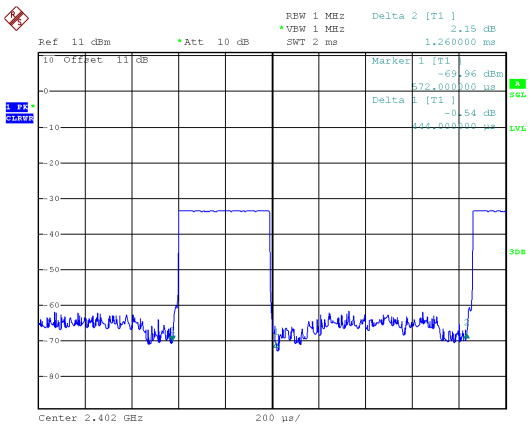
Modulation Type: π/4-DQPSK (DH5)



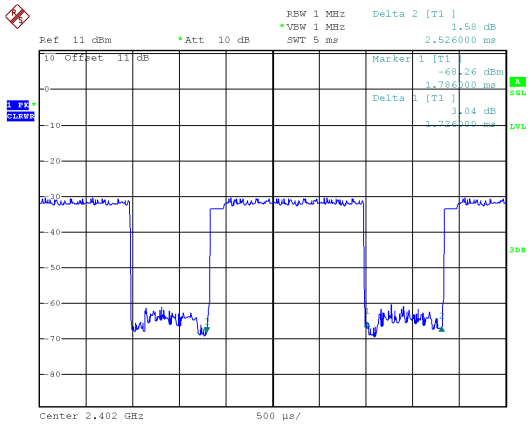
Modulation Type: 8DSPK (DH1)



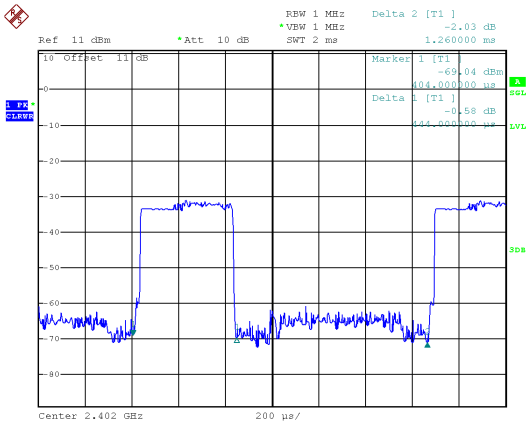
Modulation Type: AFH (DH1)



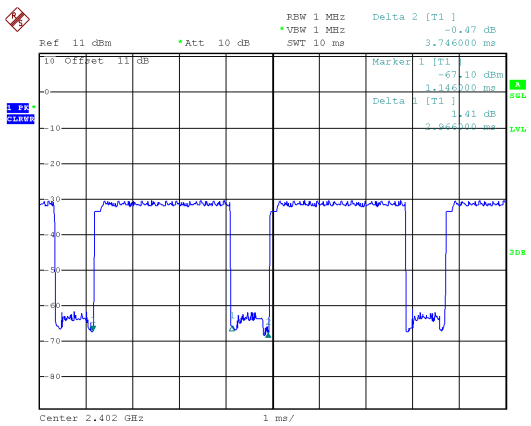
Modulation Type: 8DSPK (DH3)



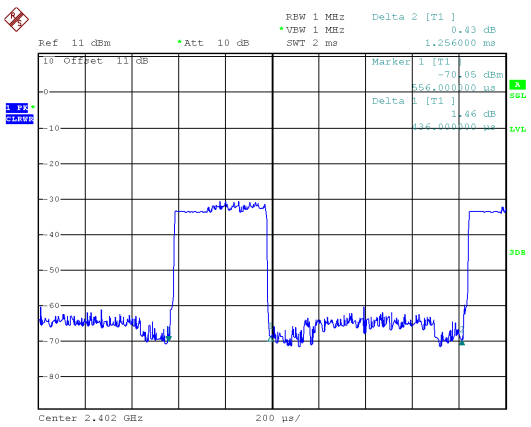
Modulation Type: AFH (DH3)



Modulation Type: 8DSPK (DH5)



Modulation Type: AFH (DH5)



11. Number of Hopping Channels

11.1 Test Limit

Frequency hopping systems in the 2400 ~ 2483.5 MHz band shall use at least 15 channels.

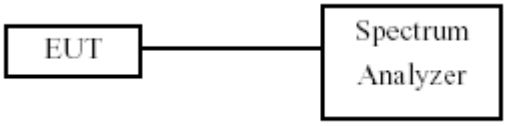
11.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.

b. 2. Set RBW of spectrum analyzer to 100 KHz and VBW to 100 KHz.

c. 3. Set the MaxHold function, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been record.

11.3 Test Setup Layout

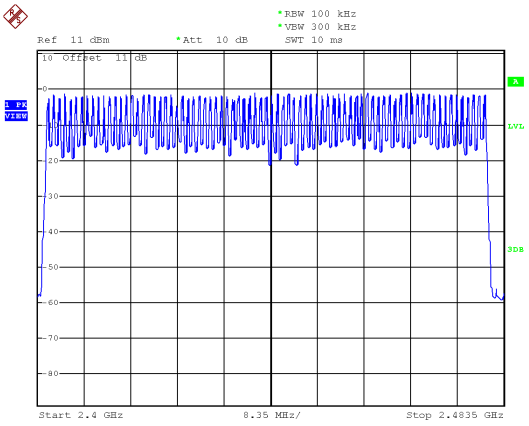


11.4 Test Result and Data

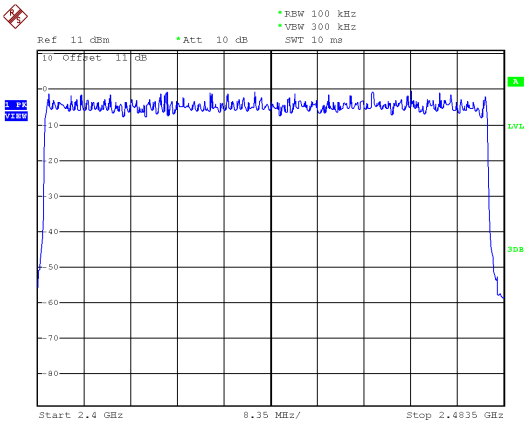
Test Result	:	PASS	Temperature	:	25°C
Test Date	:	Feb. 11, 2019	Humidity	:	61%

Modulation Type	Hopping Channels
GFSK	79
π/4-DQPSK	79
8DPSK	79

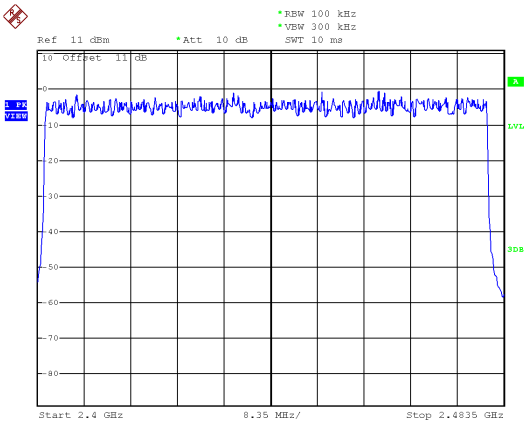
Modulation Type: GFSK



Modulation Type: π/4-DQPSK



Modulation Type: 8DPSK



12. Maximum Peak Output Power

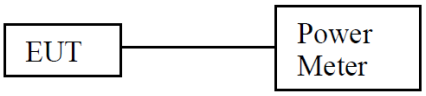
12.1 Test Limit

The Maximum Peak Output Power Measurement is 30dBm.

12.2 Test Procedures

The antenna port(RF output)of the EUT was connected to the input(RF input)of a power meter. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

12.3 Test Setup Layout



12.4 Test Result and Data

Test Result	:	PASS	Temperature	:	25°C
Test Date	:	Feb. 11, 2019	Humidity	:	61%

Modulation Type	Channel	Frequency (MHz)	PK Output Power (dBm)	PK Output Power (mW)	e.i.r.p. Power (dBm)	e.i.r.p. Power (mW)
GFSK	0	2402	-1.75	0.668	2.170	1.648
	39	2441	-1.44	0.718	2.480	1.770
	78	2480	-0.93	0.807	2.990	1.991
π/4-DQPSK	0	2402	0.81	1.205	4.730	2.972
	39	2441	1.11	1.291	5.030	3.184
	78	2480	1.65	1.462	5.570	3.606
8DPSK	0	2402	1.28	1.343	5.200	3.311
	39	2441	1.59	1.442	5.510	3.556
	78	2480	**2.06**	1.607	5.980	3.963

Modulation Type	Channel	Frequency (MHz)	AV Output Power (dBm)	AV Output Power (mW)	e.i.r.p. Power (dBm)	e.i.r.p. Power (mW)
GFSK	0	2402	-1.97	0.635	1.950	1.567
	39	2441	-1.65	0.684	2.270	1.687
	78	2480	-1.15	0.767	2.770	1.892
π/4-DQPSK	0	2402	-1.82	0.658	2.100	1.622
	39	2441	-1.52	0.705	2.400	1.738
	78	2480	-1.02	0.791	2.900	1.950
8DPSK	0	2402	-1.83	0.656	2.090	1.618
	39	2441	-1.51	0.706	2.410	1.742
	78	2480	-1.03	0.789	2.890	1.945

Note: Average power is for reference only.

AFH Mode

Modulation Type	Channel	Frequency (MHz)	PK Output Power (dBm)	PK Output Power (mW)	e.i.r.p. Power (dBm)	e.i.r.p. Power (mW)
GFSK	0-19	2402-2421	-1.79	0.662	2.130	1.633
π/4-DQPSK	0-19	2402-2421	0.78	1.197	4.700	2.951
8DPSK	0-19	2402-2421	**1.24**	1.330	5.160	3.281

AFH Mode

Modulation Type	Channel	Frequency (MHz)	AV Output Power (dBm)	AV Output Power (mW)	e.i.r.p. Power (dBm)	e.i.r.p. Power (mW)
GFSK	0-19	2402-2421	-1.99	0.632	1.930	1.560
π/4-DQPSK	0-19	2402-2421	-1.86	0.652	2.060	1.607
8DPSK	0-19	2402-2421	-1.89	0.647	2.030	1.596

Note: Average power is for reference only.