FCC RADIO TEST REPORT

Applicant	:	SteelSeries ApS.
Address	:	656 W Randolph St., Suite 3E Chicago, Illinois 60661, United States
Equipment	:	Wireless BT Headset
Model No.	:	HS-00015
Trade Name	:	steelseries
FCC ID.	:	ZHK-HS00015

I HEREBY CERTIFY THAT :

The sample was received on Aug. 31, 2017 and the testing was carried out on Sep. 01, 2017 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 / Assistant Manager

Tested by:

Spree Yei / Engineer

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory

Contents

History of this test report

Report No.	Issue Date	Description
TEFB1707234	Sep. 06, 2017	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

This EUT has been also tested and compiled with the requirement of FCC Part 15, Subpart B, recorded in a separate test report.

2. Test Configuration of Equipment under Test

2.1 Feature of Equipment under Test

Frequency Range	2402-2480 MHz
Type of Modulation	GFSK for 1Mbps π/4-DQPSK for 2Mbps 8DPSK for 3Mbps
Antenna Type	IFA Antenna
Antenna Gain	0.62 dBi

2.2 Carrier Frequency of Channels

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 C63.4
b. The complete test system included Notebook and EUT for RF test.
c. An executive program," BlueSuit 2.5.8" under WIN 7 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 conduction test, caused "Test Mode 3" generated the worst case, it was reported as the final data. For radiation test (below 1GHz), 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.	

2.4 Description of Test System

Device	Manufacturer	Model No.	Description
Notebook	DELL	LatitudeE5450/5450	Power Cable, Non-shielded, 1.8m

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, 390316, 228391, 641184
	IC	4934E-1, 4934E-2
	VCCI	T-2205 for Telecommunication Test C-4663 for Conducted emission test R-4218, R-4399 for Radiated emission test G-812, G-813 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.	

3. Test Equipment and Ancillaries Used for Tests

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Valid Date
EMI Receiver	R&S	ESCI3	100443	2017/03/07	2018/03/06
LISN	Schwarzbeck	NSLK 8127	8127-568	2017/02/15	2018/02/14
Pulse Limiter	R&S	ESH3-Z2	101934	2017/02/14	2018/02/13
Bilog Antenna	Schwarzbeck	VULB9168	369	2017/03/15	2018/03/14
Active Loop Antenna	EMCO	6507	40855	2017/05/15	2018/05/14
Horn Antenna	EMCO	3115	31601	2016/09/05	2017/09/04
Horn Anrenna	EMCO	3116	31970	2017/03/29	2018/03/28
EXA Signal Analyzer	KEYSIGHT	N9010A	MY54200207	2017/03/17	2018/03/16
Preamplifier	EM	EM330	60660	2017/02/25	2018/02/24
Preamplifier	EMC INSTRUMENTS	EMC051845SE	980333	2016/09/13	2017/09/12
Preamplifier	Agilent	8449B	3008A01954	2017/02/09	2018/02/08
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2016/11/04	2017/11/03
MXG MW Analog Signal Generator	KEYSIGHT	N5183A	MY50142931	2017/03/17	2018/03/16
Spectrum Analyzer	R&S	FSP40	100219	2017/07/01	2018/06/30
BLUETOOTH TESTER	R&S	CBT	101133	2017/03/10	2018/03/09
Attenuator	KEYSIGHT	8491B	MY39250703	2017/03/07	2018/03/06
Rotary Attenuator	Agilent	8495B	MY42146680	2017/03/13	2018/03/12
Temp & Humi chamber	T-MACHINE	TMJ-9712	T-12-040111	2016/09/05	2017/09/04
Series Power Meter	Anritsu	ML2495A	1224005	2017/03/01	2018/02/28
Power Sensor	Anritsu	MA2411B	1207295	2017/03/01	2018/02/28
Cable	HUBER SUHNER	SUCOFLEX 102	28422/2	2017/02/25	2018/02/24
Cable	HUBER SUHNER	SUCOFLEX 102	28418/2	2017/02/25	2018/02/24
Software	Farad	Ez-EMC	ver.ct3a1	N/A	N/A
Software	AUDIX	E3	V8.2014-8-6	N/A	N/A
Software	Keysight	N7607B Signal Studio	v2.0.0.1	N/A	N/A
Software	Keysight	Inservice MonitorUtility	N/A	N/A	N/A

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	IFA Antenna
Antenna Gain	0.62 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.

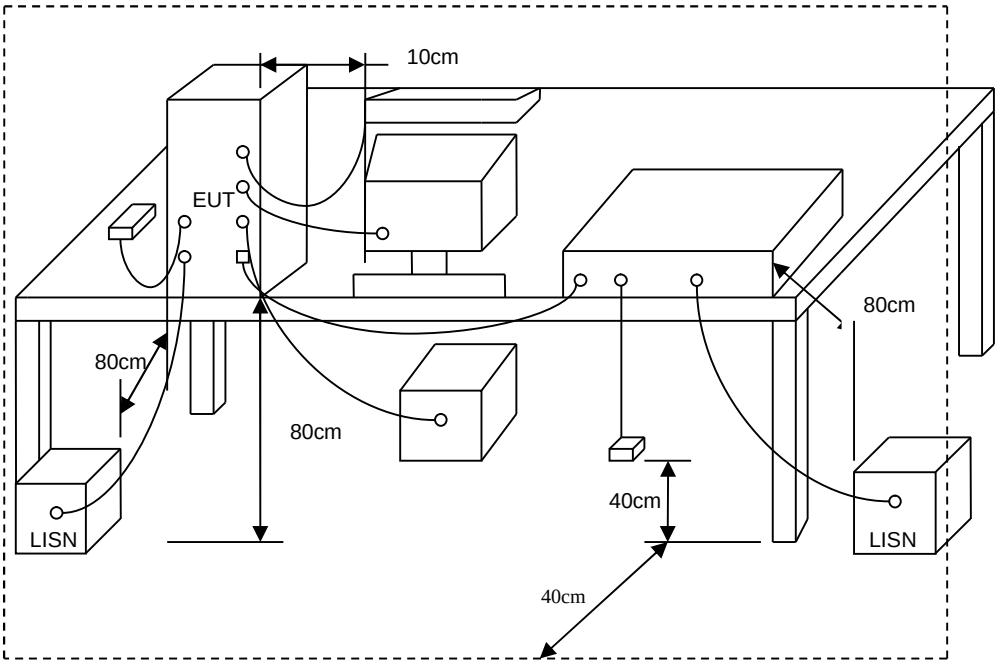
Frequency (MHz)	Quasi Peak (dB μ V)	Average (dB μ V)
0.15 – 0.5	66-56*	56-46*
0.5 – 5.0	56	46
5.0 – 30.0	60	50

*Decreases with the logarithm of the frequency.

5.2 Test Procedures

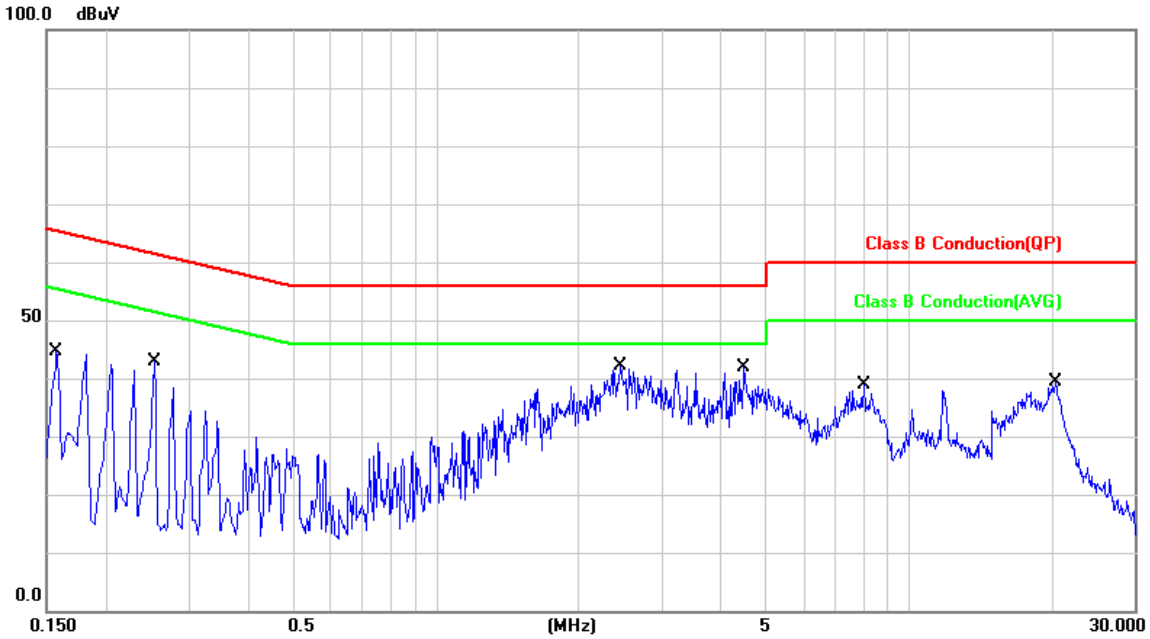
a. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
c. All the support units are connecting to the other LISN.
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

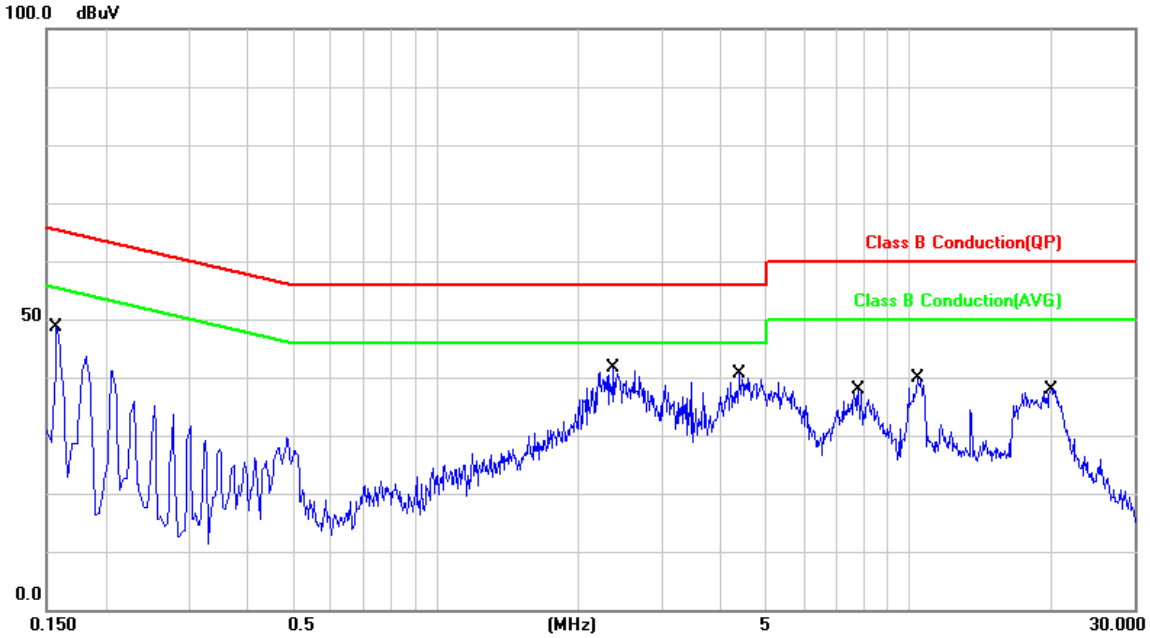
Power	:	DC 3.7V	Pol/Phase	:	LINE
Test Mode	:	Mode 3	Temperature	:	23 °C
Test date	:	Sep. 01, 2017	Humidity	:	62 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1580	9.91	33.47	43.38	65.56	-22.18	QP	P
2	0.1580	9.91	18.15	28.06	55.56	-27.50	AVG	P
3	0.2540	9.91	24.87	34.78	61.62	-26.84	QP	P
4	0.2540	9.91	8.32	18.23	51.62	-33.39	AVG	P
5	2.4580	10.07	24.92	34.99	56.00	-21.01	QP	P
6	2.4580	10.07	17.42	27.49	46.00	-18.51	AVG	P
7	4.4980	10.16	22.54	32.70	56.00	-23.30	QP	P
8	4.4980	10.16	13.28	23.44	46.00	-22.56	AVG	P
9	8.0340	10.27	14.86	25.13	60.00	-34.87	QP	P
10	8.0340	10.27	8.63	18.90	50.00	-31.10	AVG	P
11	20.4500	10.62	23.13	33.75	60.00	-26.25	QP	P
12	20.4500	10.62	17.85	28.47	50.00	-21.53	AVG	P

Note: Level = Reading + Factor
Margin = Level – Limit
Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss+ Attenuator

Power	:	DC 3.7V	Pol/Phase	:	NEUTRAL
Test Mode	:	Mode 3	Temperature	:	23 °C
Test date	:	Sep. 01, 2017	Humidity	:	62 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1580	9.88	41.21	51.09	65.56	-14.47	QP	P
2	0.1580	9.88	26.01	35.89	55.56	-19.67	AVG	P
3	2.3820	10.02	25.87	35.89	56.00	-20.11	QP	P
4	2.3820	10.02	17.52	27.54	46.00	-18.46	AVG	P
5	4.3899	10.10	21.69	31.79	56.00	-24.21	QP	P
6	4.3899	10.10	12.95	23.05	46.00	-22.95	AVG	P
7	7.8299	10.24	20.74	30.98	60.00	-29.02	QP	P
8	7.8299	10.24	14.60	24.84	50.00	-25.16	AVG	P
9	10.4139	10.33	17.01	27.34	60.00	-32.66	QP	P
10	10.4139	10.33	11.40	21.73	50.00	-28.27	AVG	P
11	19.9500	10.64	22.43	33.07	60.00	-26.93	QP	P
12	19.9500	10.64	16.60	27.24	50.00	-22.76	AVG	P

Note: Level = Reading + Factor
Margin = Level – Limit
Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss+ Attenuator

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.

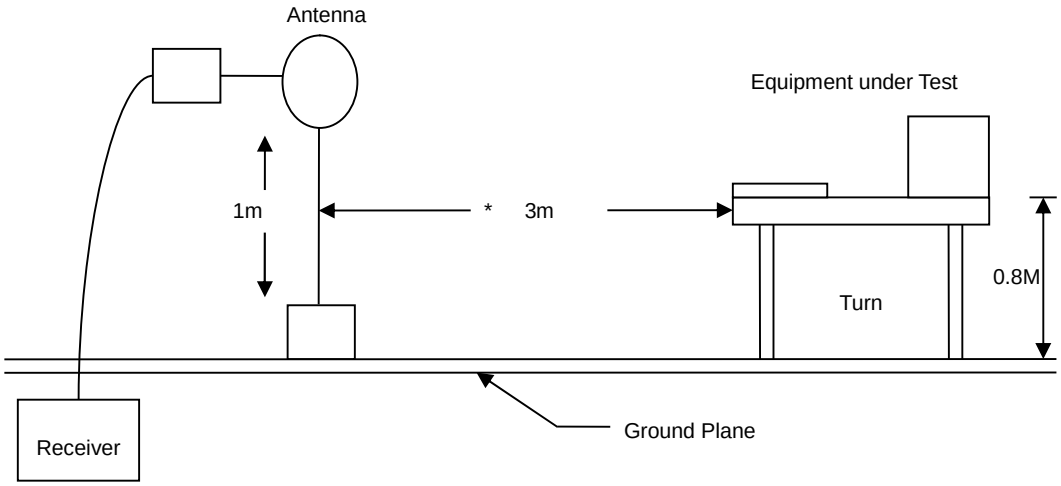
f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.

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.

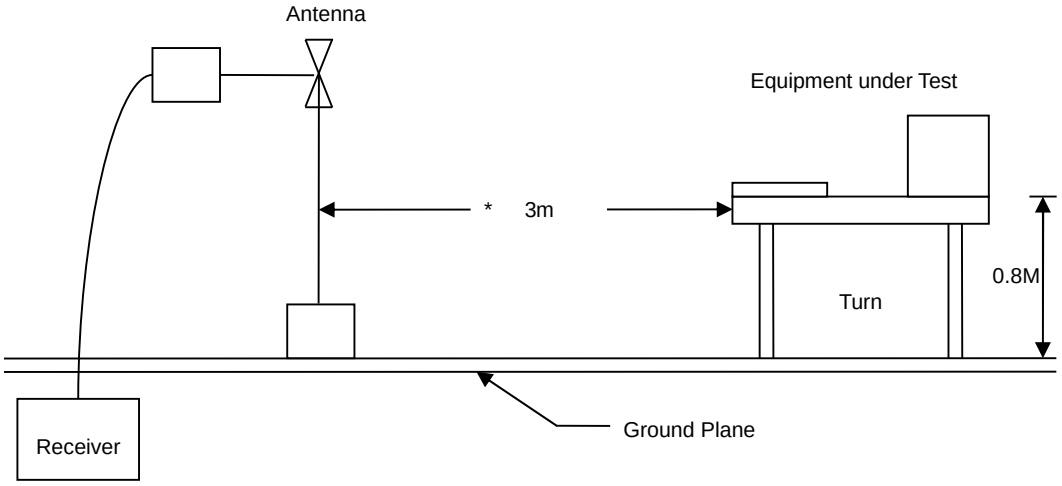
h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured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

6.3 Typical Test Setup

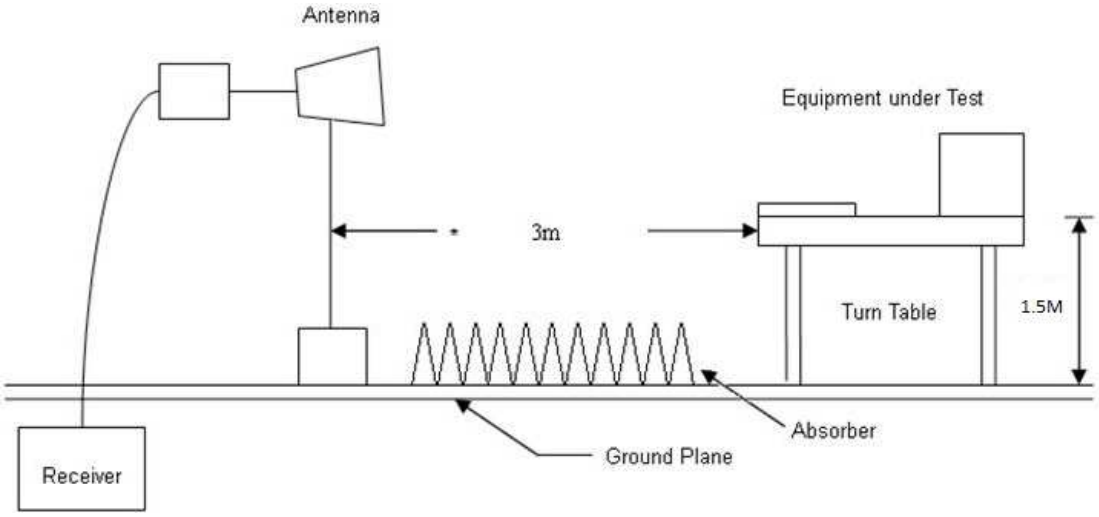
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup

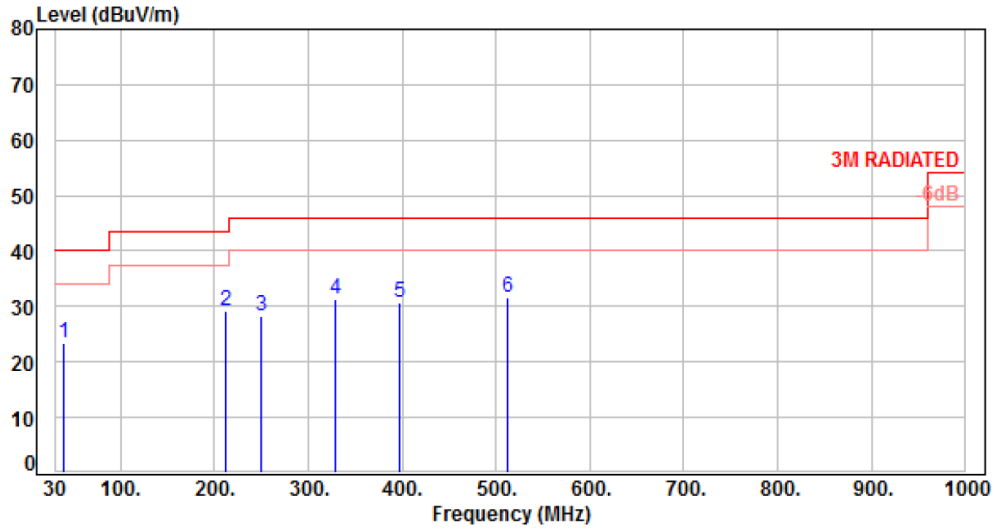


6.4 Test Result and Data (9kHz ~ 30MHz)

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

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

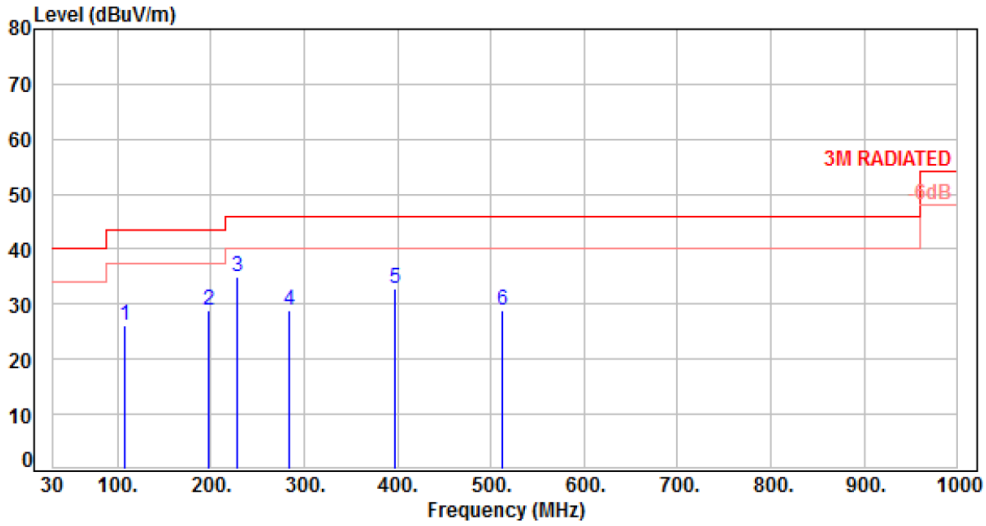
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	39.70	-10.66	34.06	23.40	40.00	-16.60	Peak	100	0	P
2	212.36	-13.00	42.35	29.35	43.50	-14.15	Peak	100	0	P
3	249.22	-11.47	39.88	28.41	46.00	-17.59	Peak	100	0	P
4	328.76	-8.91	40.34	31.43	46.00	-14.57	Peak	100	0	P
5	396.66	-7.13	37.80	30.67	46.00	-15.33	Peak	100	0	P
6	513.06	-4.47	36.06	31.59	46.00	-14.41	Peak	100	0	P

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

Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %

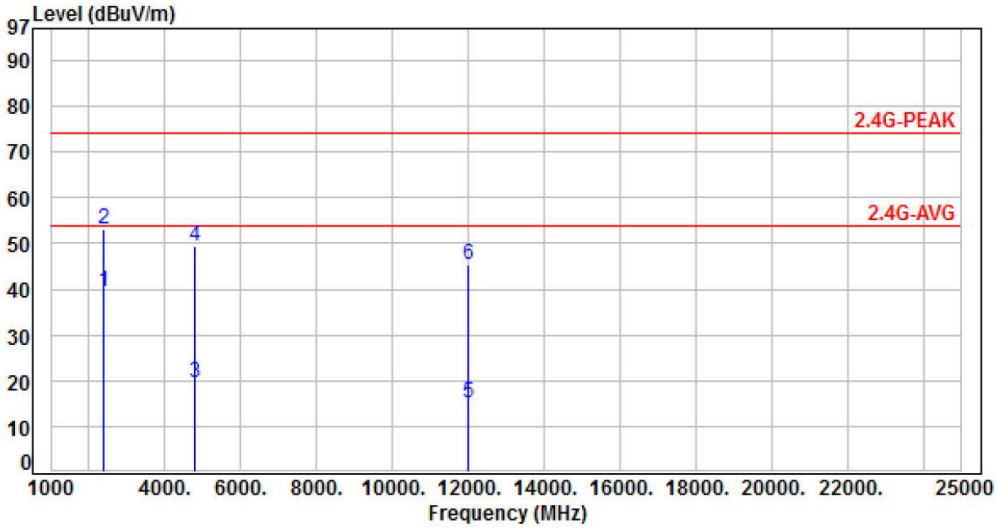


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	107.60	-14.23	40.27	26.04	43.50	-17.46	Peak	100	0	P
2	196.84	-13.19	42.07	28.88	43.50	-14.62	Peak	100	0	P
3	227.88	-12.77	47.89	35.12	46.00	-10.88	Peak	100	0	P
4	284.14	-9.98	38.96	28.98	46.00	-17.02	Peak	100	0	P
5	396.66	-7.13	39.94	32.81	46.00	-13.19	Peak	100	0	P
6	513.06	-4.47	33.38	28.91	46.00	-17.09	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)

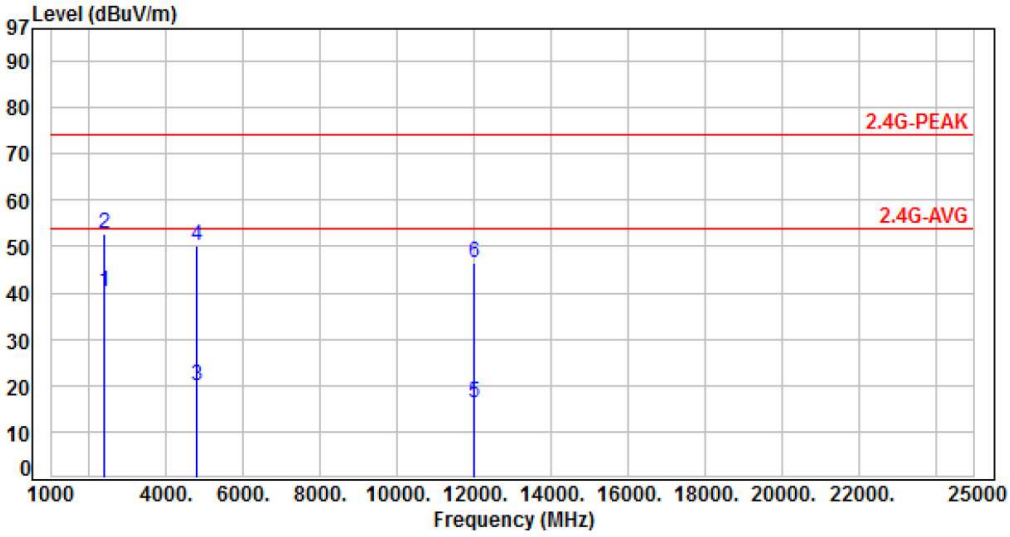
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH00	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.35	39.32	54.00	-14.68	Average	149	270	P
2	2390.00	-19.03	71.98	52.95	74.00	-21.05	Peak	149	270	P
3	4804.00	-13.36	32.84	19.48	54.00	-34.52	Average	121	275	P
4	4804.00	-13.36	62.94	49.58	74.00	-24.42	Peak	121	275	P
5	12010.00	-6.08	21.30	15.22	54.00	-38.78	Average	152	196	P
6	12010.00	-6.08	51.40	45.32	74.00	-28.68	Peak	152	196	P

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

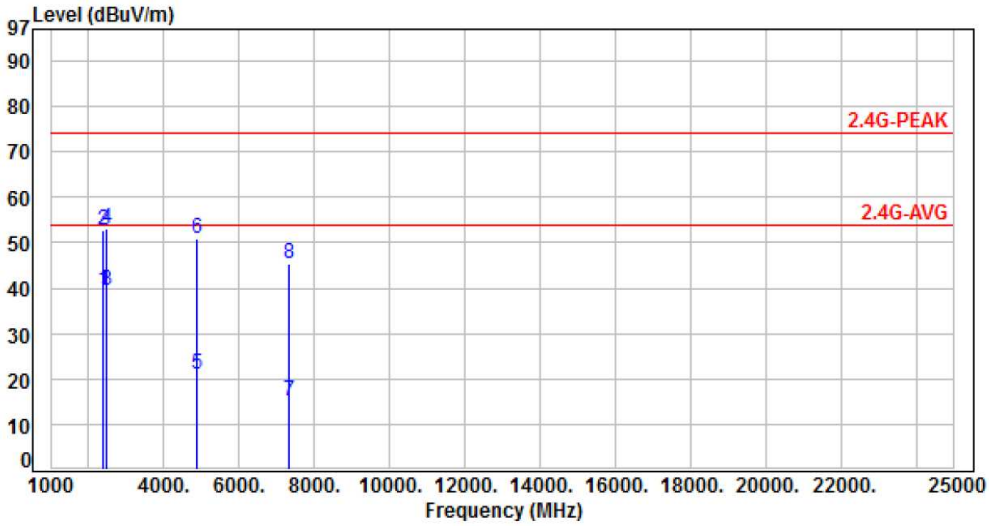
Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH00	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	59.20	40.17	54.00	-13.83	Average	101	264	P
2	2390.00	-19.03	71.59	52.56	74.00	-21.44	Peak	101	264	P
3	4804.00	-13.36	33.41	20.05	54.00	-33.95	Average	277	245	P
4	4804.00	-13.36	63.51	50.15	74.00	-23.85	Peak	277	245	P
5	12010.00	-6.08	22.43	16.35	54.00	-37.65	Average	284	102	P
6	12010.00	-6.08	52.53	46.45	74.00	-27.55	Peak	284	102	P

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

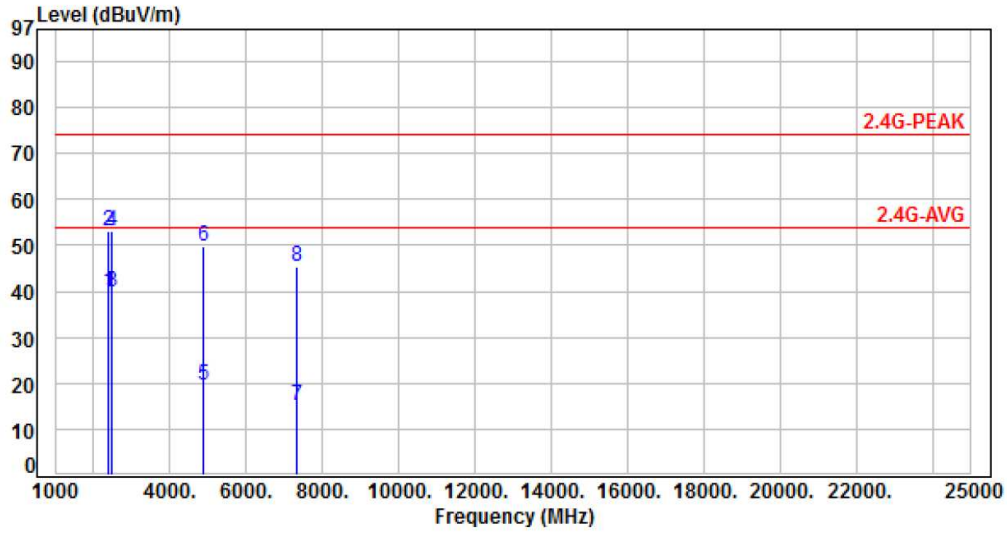
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH39	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.46	39.43	54.00	-14.57	Average	119	301	P
2	2390.00	-19.03	71.83	52.80	74.00	-21.20	Peak	119	301	P
3	2483.50	-18.81	58.25	39.44	54.00	-14.56	Average	119	301	P
4	2483.50	-18.81	71.77	52.96	74.00	-21.04	Peak	119	301	P
5	4882.00	-13.21	34.07	20.86	54.00	-33.14	Average	172	283	P
6	4882.00	-13.21	64.17	50.96	74.00	-23.04	Peak	172	283	P
7	7323.00	-10.16	25.39	15.23	54.00	-38.77	Average	194	272	P
8	7323.00	-10.16	55.49	45.33	74.00	-28.67	Peak	194	272	P

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

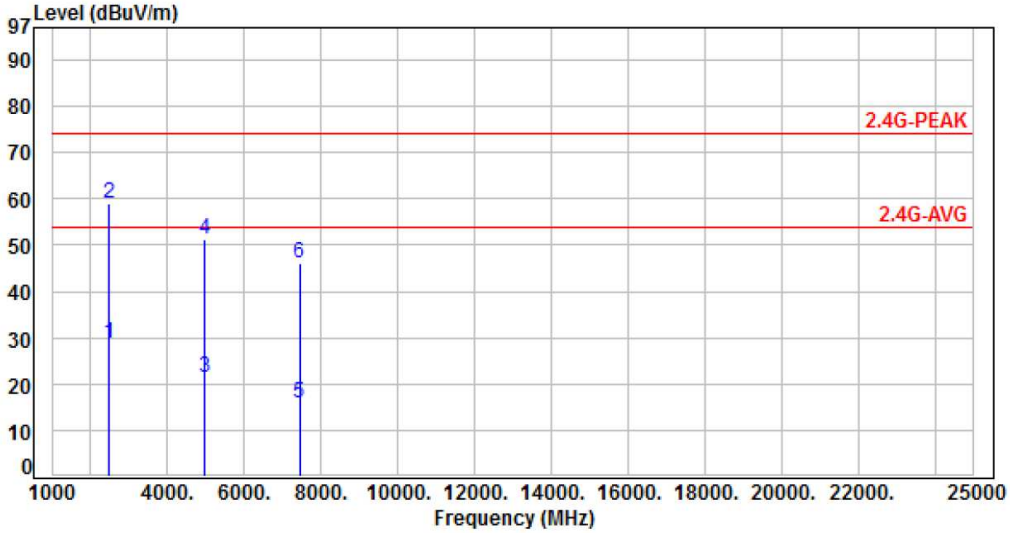
Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH39	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.79	39.76	54.00	-14.24	Average	231	98	P
2	2390.00	-19.03	71.96	52.93	74.00	-21.07	Peak	231	98	P
3	2483.50	-18.81	58.61	39.80	54.00	-14.20	Average	231	98	P
4	2483.50	-18.81	71.84	53.03	74.00	-20.97	Peak	231	98	P
5	4882.00	-13.21	32.86	19.65	54.00	-34.35	Average	271	249	P
6	4882.00	-13.21	62.96	49.75	74.00	-24.25	Peak	271	249	P
7	7323.00	-10.16	25.28	15.12	54.00	-38.88	Average	102	176	P
8	7323.00	-10.16	55.38	45.22	74.00	-28.78	Peak	102	176	P

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

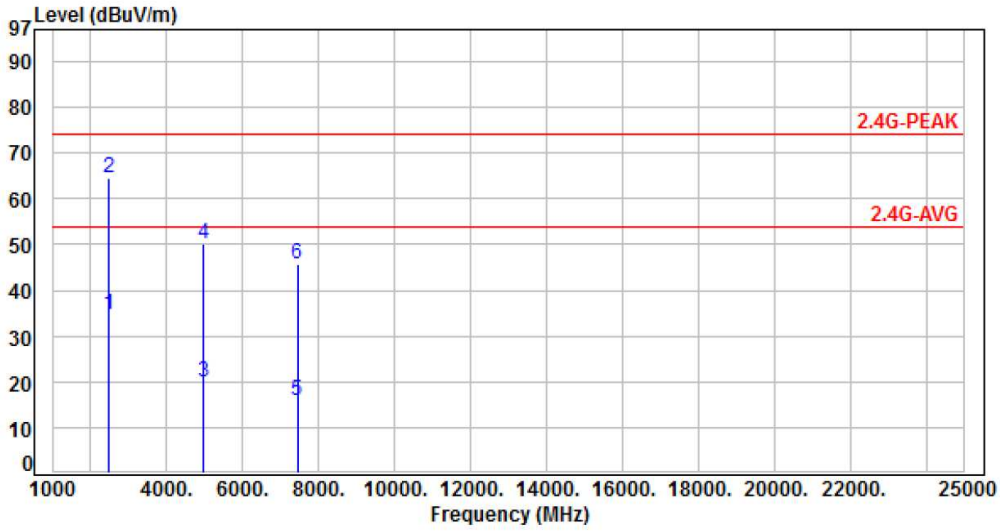
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 1, CH78	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-18.81	47.56	28.75	54.00	-25.25	Average	117	298	P
2	2483.50	-18.81	77.66	58.85	74.00	-15.15	Peak	117	298	P
3	4960.00	-13.06	34.29	21.23	54.00	-32.77	Average	168	279	P
4	4960.00	-13.06	64.39	51.33	74.00	-22.67	Peak	168	279	P
5	7440.00	-9.88	25.72	15.84	54.00	-38.16	Average	186	277	P
6	7440.00	-9.88	55.82	45.94	74.00	-28.06	Peak	186	277	P

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

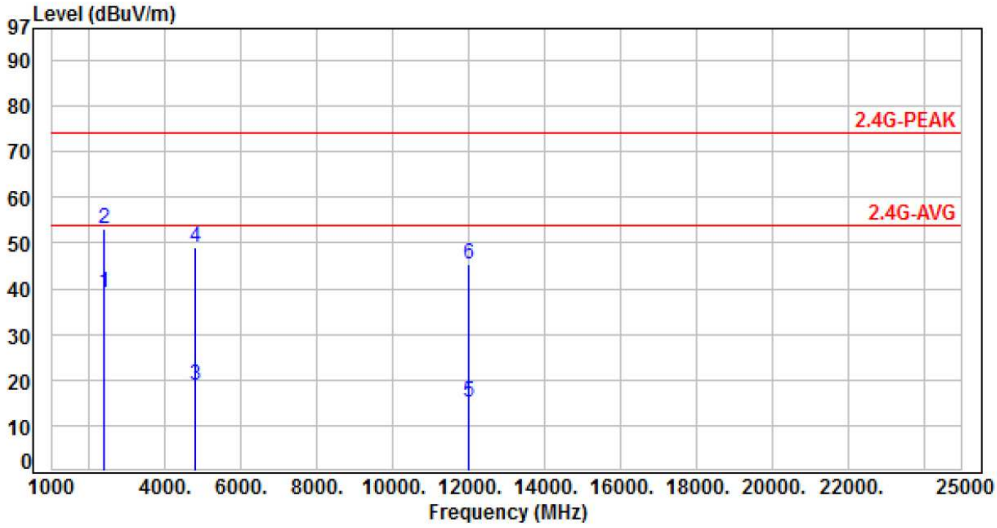
Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 1, CH78	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-18.81	53.32	34.51	54.00	-19.49	Average	228	91	P
2	2483.50	-18.81	83.42	64.61	74.00	-9.39	Peak	228	91	P
3	4960.00	-13.06	33.00	19.94	54.00	-34.06	Average	273	255	P
4	4960.00	-13.06	63.10	50.04	74.00	-23.96	Peak	273	255	P
5	7440.00	-9.88	25.64	15.76	54.00	-38.24	Average	101	180	P
6	7440.00	-9.88	55.74	45.86	74.00	-28.14	Peak	101	180	P

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

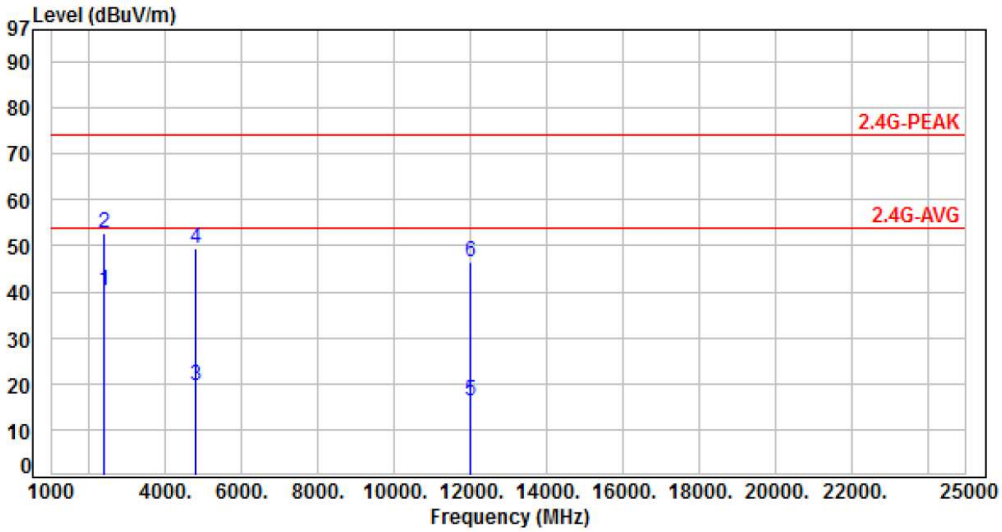
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH00	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.26	39.23	54.00	-14.77	Average	161	274	P
2	2390.00	-19.03	72.03	53.00	74.00	-21.00	Peak	161	274	P
3	4804.00	-13.36	32.17	18.81	54.00	-35.19	Average	134	279	P
4	4804.00	-13.36	62.27	48.91	74.00	-25.09	Peak	134	279	P
5	12010.00	-6.08	21.22	15.14	54.00	-38.86	Average	148	201	P
6	12010.00	-6.08	51.32	45.24	74.00	-28.76	Peak	148	201	P

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

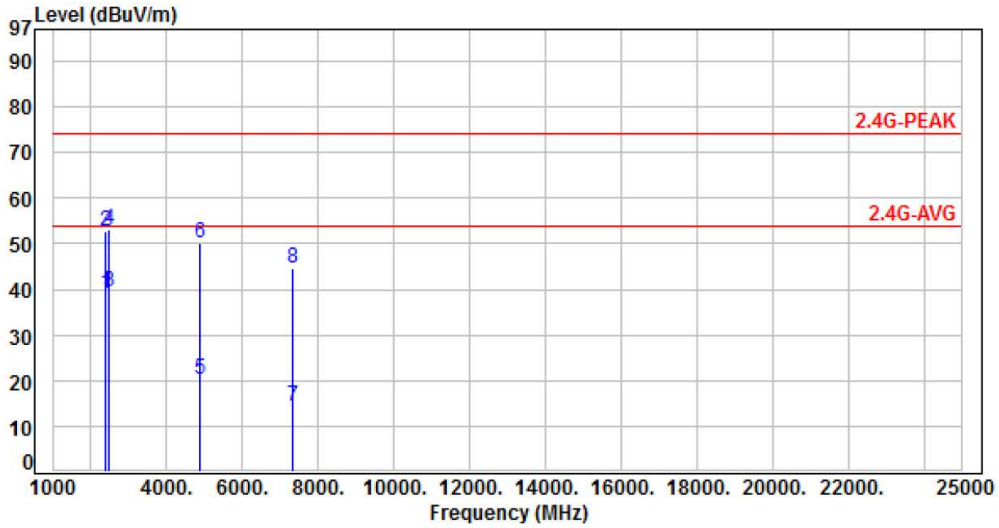
Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH00	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	59.36	40.33	54.00	-13.67	Average	102	259	P
2	2390.00	-19.03	71.77	52.74	74.00	-21.26	Peak	102	259	P
3	4804.00	-13.36	32.74	19.38	54.00	-34.62	Average	286	231	P
4	4804.00	-13.36	62.84	49.48	74.00	-24.52	Peak	286	231	P
5	12010.00	-6.08	22.36	16.28	54.00	-37.72	Average	271	126	P
6	12010.00	-6.08	52.46	46.38	74.00	-27.62	Peak	271	126	P

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

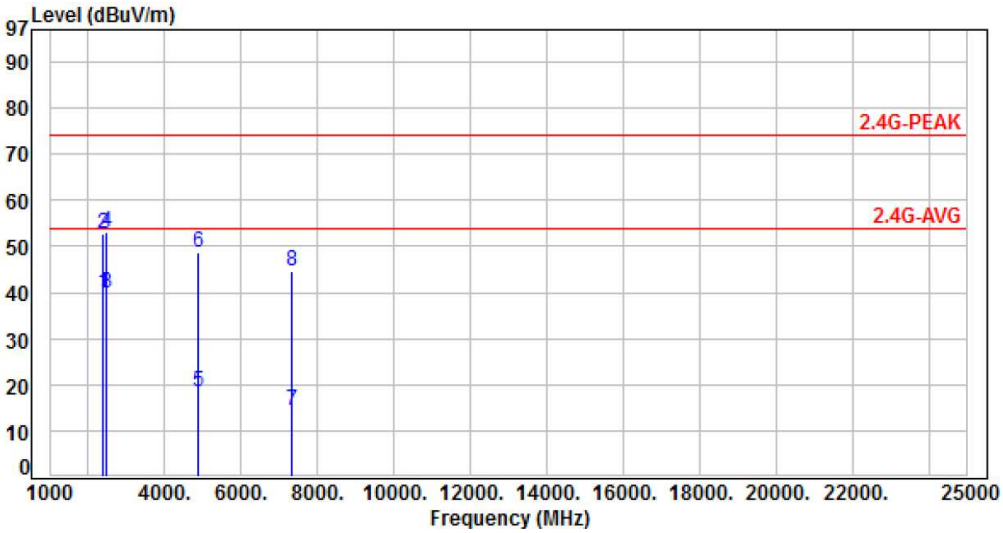
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH39	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.28	39.25	54.00	-14.75	Average	121	286	P
2	2390.00	-19.03	71.75	52.72	74.00	-21.28	Peak	121	286	P
3	2483.50	-18.81	58.34	39.53	54.00	-14.47	Average	121	286	P
4	2483.50	-18.81	71.83	53.02	74.00	-20.98	Peak	121	286	P
5	4882.00	-13.21	33.37	20.16	54.00	-33.84	Average	175	274	P
6	4882.00	-13.21	63.47	50.26	74.00	-23.74	Peak	175	274	P
7	7323.00	-10.16	24.55	14.39	54.00	-39.61	Average	191	265	P
8	7323.00	-10.16	54.65	44.49	74.00	-29.51	Peak	191	265	P

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

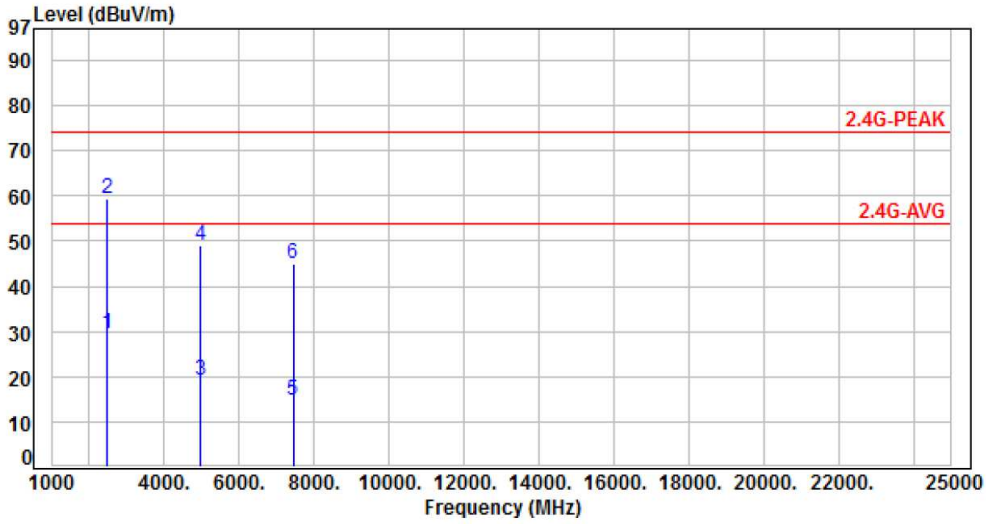
Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH39	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-19.03	58.84	39.81	54.00	-14.19	Average	228	102	P
2	2390.00	-19.03	71.79	52.76	74.00	-21.24	Peak	228	102	P
3	2483.50	-18.81	58.73	39.92	54.00	-14.08	Average	228	102	P
4	2483.50	-18.81	71.92	53.11	74.00	-20.89	Peak	228	102	P
5	4882.00	-13.21	31.81	18.60	54.00	-35.40	Average	263	242	P
6	4882.00	-13.21	61.91	48.70	74.00	-25.30	Peak	263	242	P
7	7323.00	-10.16	24.68	14.52	54.00	-39.48	Average	101	188	P
8	7323.00	-10.16	54.78	44.62	74.00	-29.38	Peak	101	188	P

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

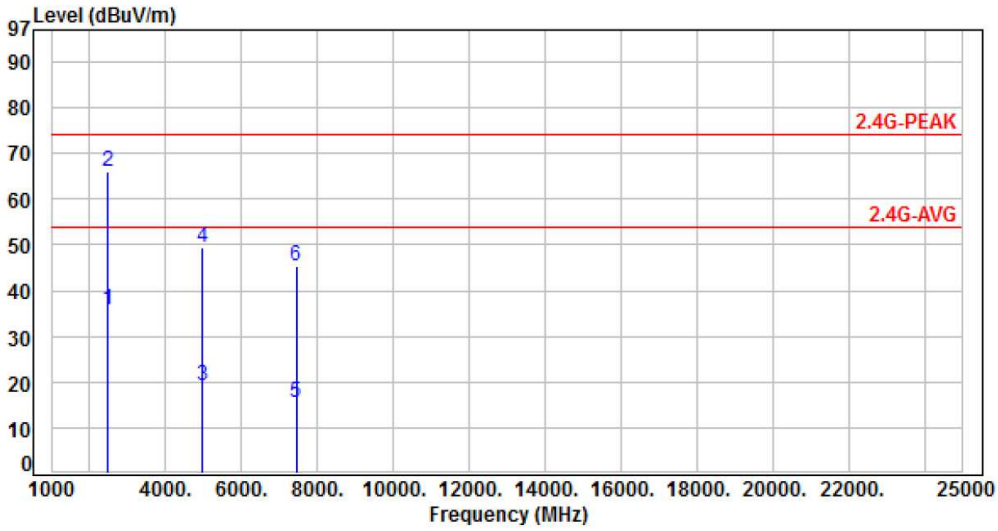
Power	:	DC 3.7V	Pol/Phase	:	VERTICAL
Test Mode	:	Mode 3, CH78	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-18.81	48.15	29.34	54.00	-24.66	Average	148	271	P
2	2483.50	-18.81	78.25	59.44	74.00	-14.56	Peak	148	271	P
3	4960.00	-13.06	32.19	19.13	54.00	-34.87	Average	157	277	P
4	4960.00	-13.06	62.29	49.23	74.00	-24.77	Peak	157	277	P
5	7440.00	-9.88	24.81	14.93	54.00	-39.07	Average	192	273	P
6	7440.00	-9.88	54.91	45.03	74.00	-28.97	Peak	192	273	P

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

Power	:	DC 3.7V	Pol/Phase	:	HORIZONTAL
Test Mode	:	Mode 3, CH78	Temperature	:	24 °C
Test Date	:	Aug. 31, 2017	Humidity	:	68 %



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-18.81	54.61	35.80	54.00	-18.20	Average	230	87	P
2	2483.50	-18.81	84.71	65.90	74.00	-8.10	Peak	230	87	P
3	4960.00	-13.06	32.34	19.28	54.00	-34.72	Average	268	241	P
4	4960.00	-13.06	62.44	49.38	74.00	-24.62	Peak	268	241	P
5	7440.00	-9.88	25.21	15.33	54.00	-38.67	Average	101	186	P
6	7440.00	-9.88	55.31	45.43	74.00	-28.57	Peak	101	186	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

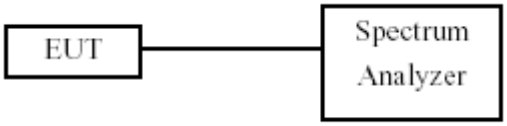
7.1 Test Limit

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 lose 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

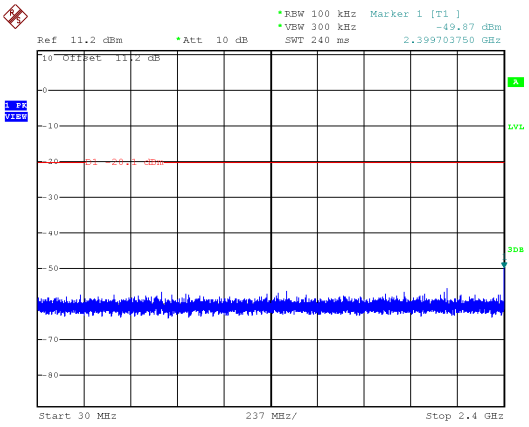


7.4 Test Result and Data

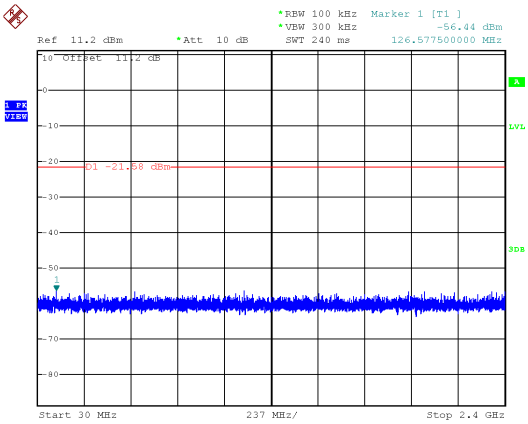
Test Result	:	PASS	Temperature	:	22°C
Test Date	:	Sep. 01, 2017	Humidity	:	63%

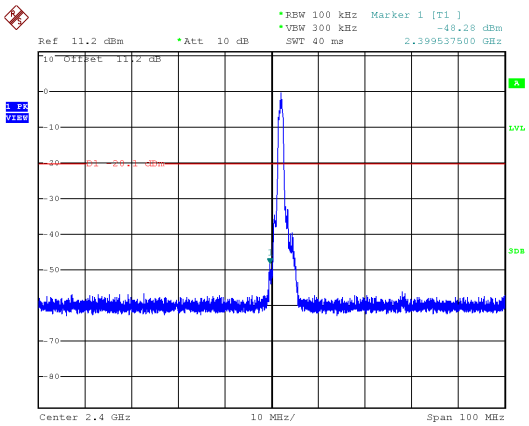
Note: Test plots refer to the following pages.

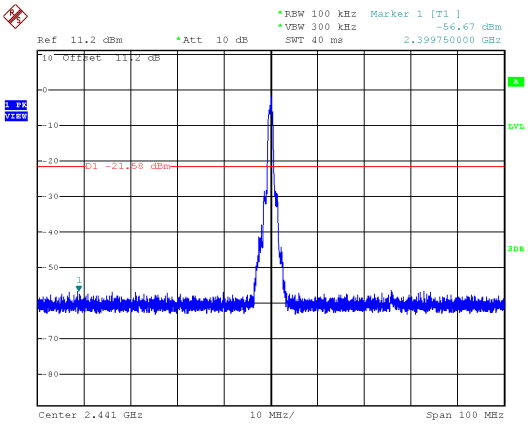
Modulation Type: GFSK, CH00

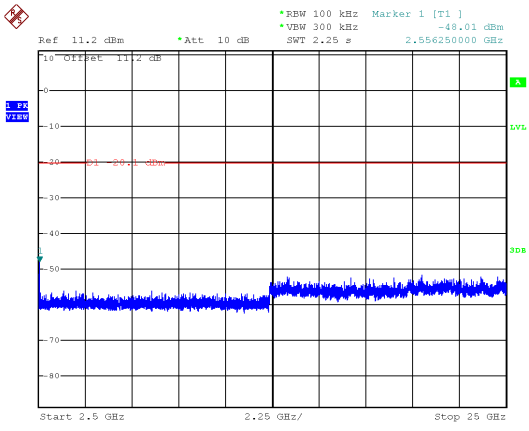


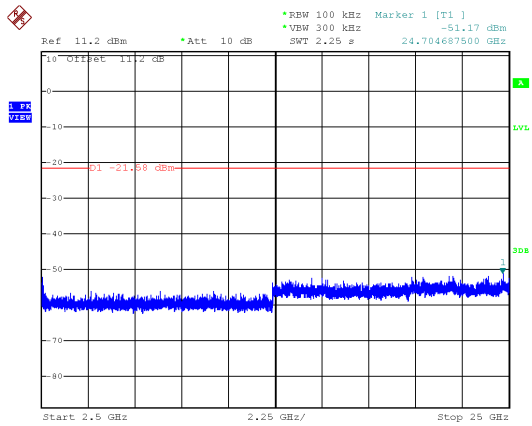
Modulation Type: GFSK, CH39



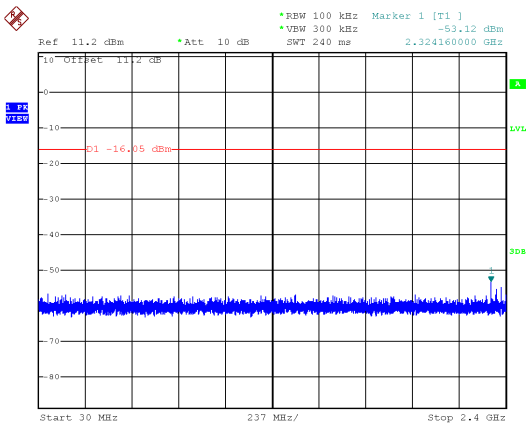




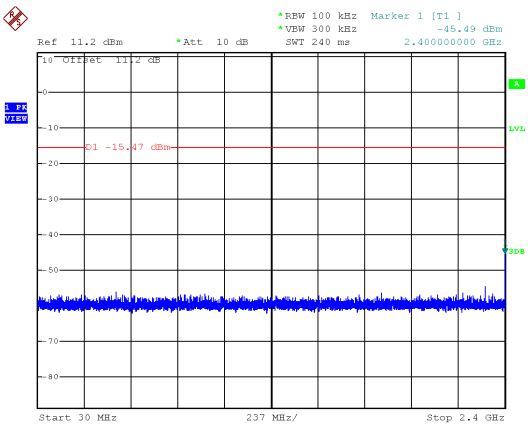


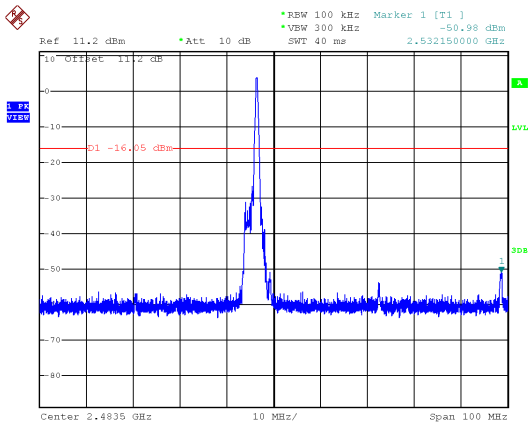


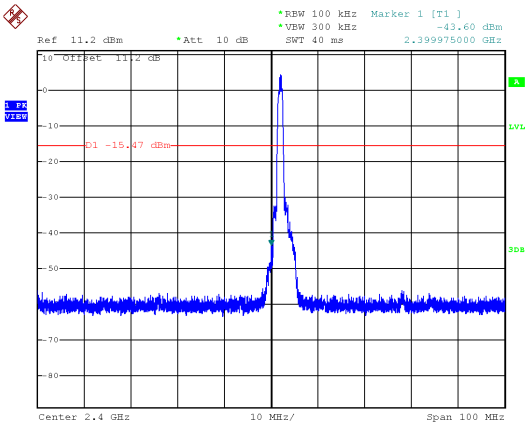
Modulation Type: GFSK, CH78

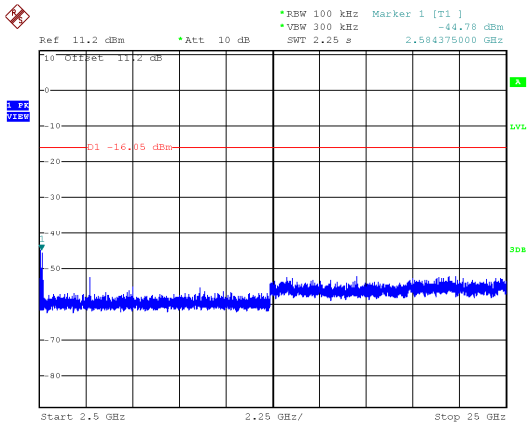


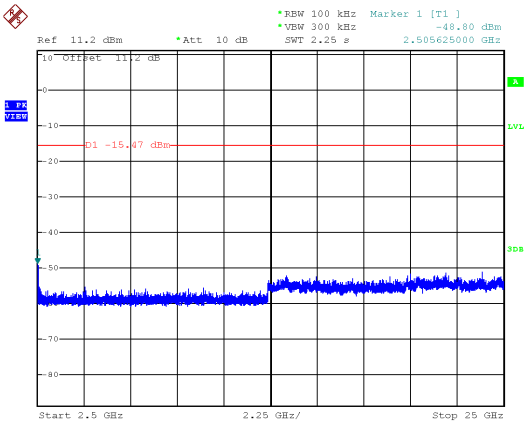
Modulation Type: π/4-DQPSK, CH00



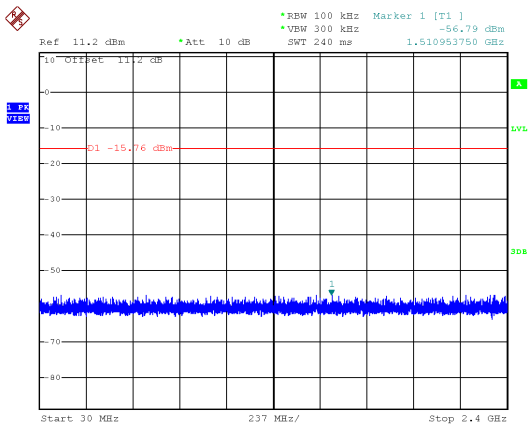




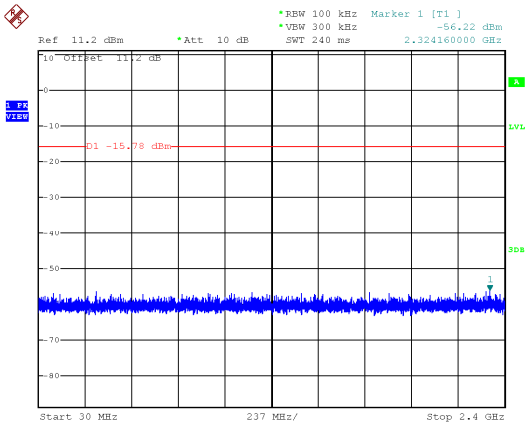


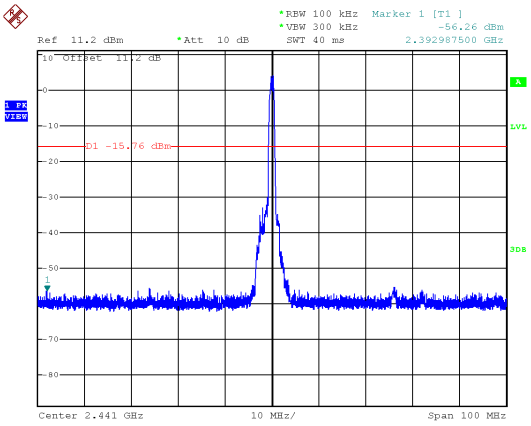


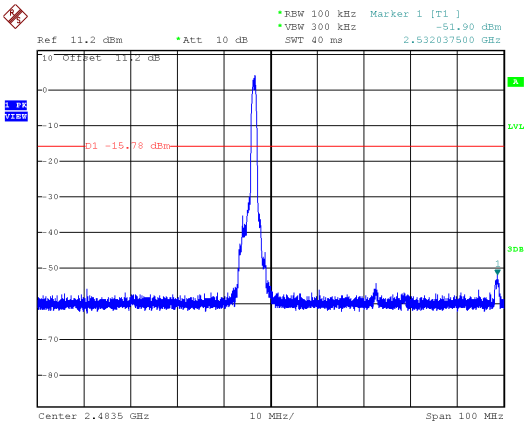
Modulation Type: π/4-DQPSK, CH39

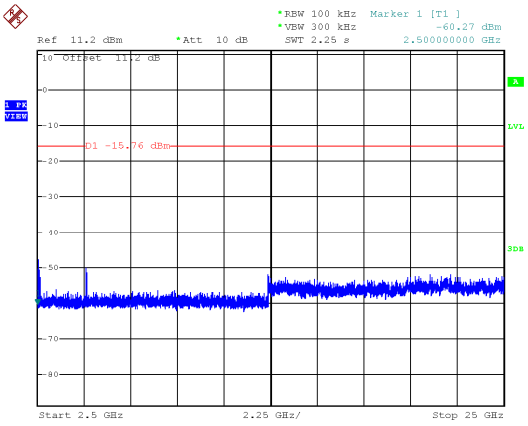


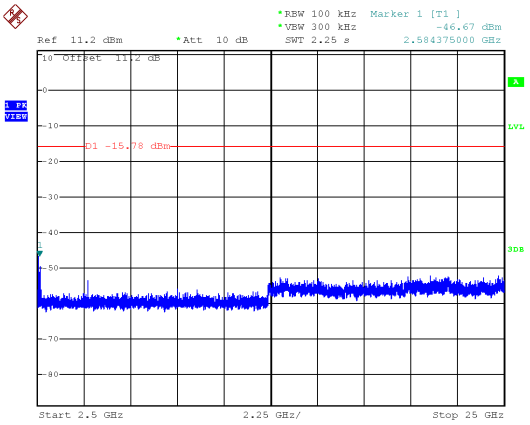
Modulation Type: π/4-DQPSK, CH78



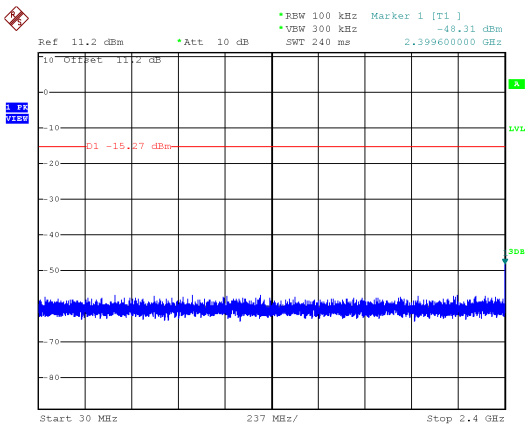




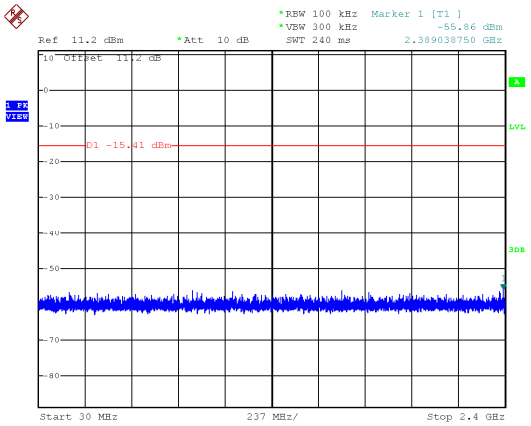


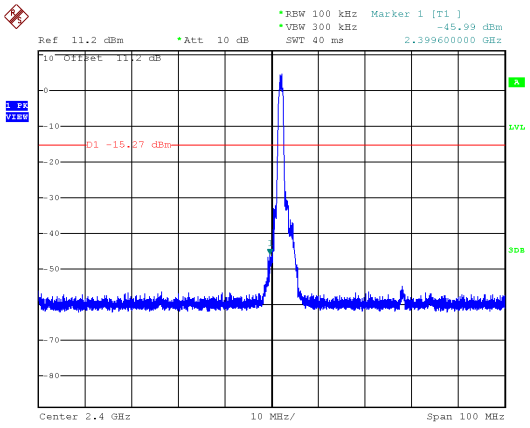


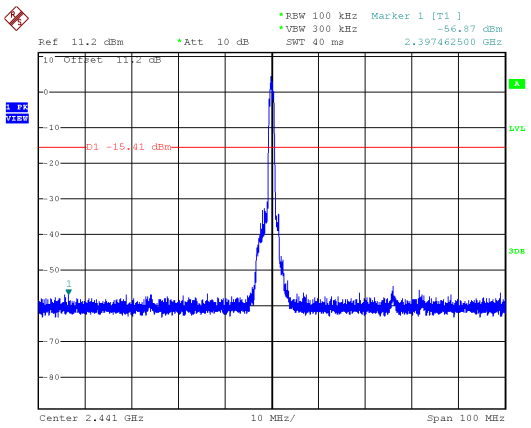
Modulation Type: 8DPSK, CH00

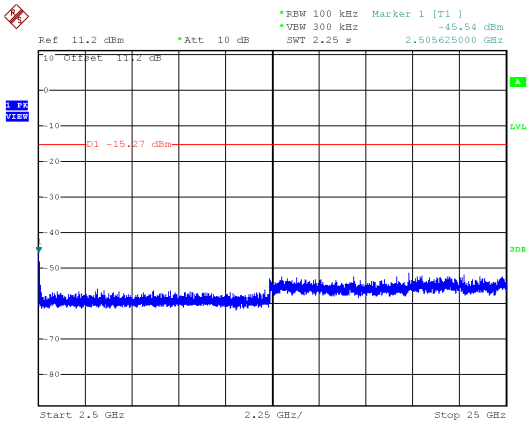


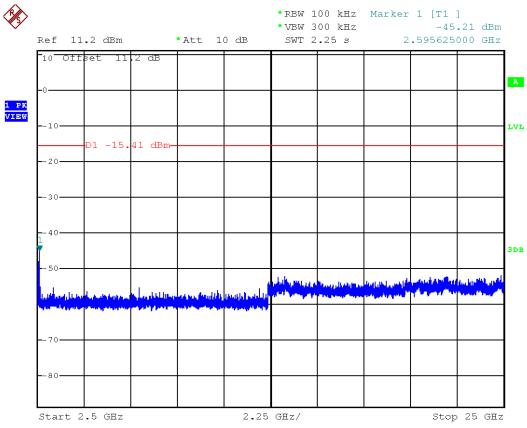
Modulation Type: 8DPSK, CH39



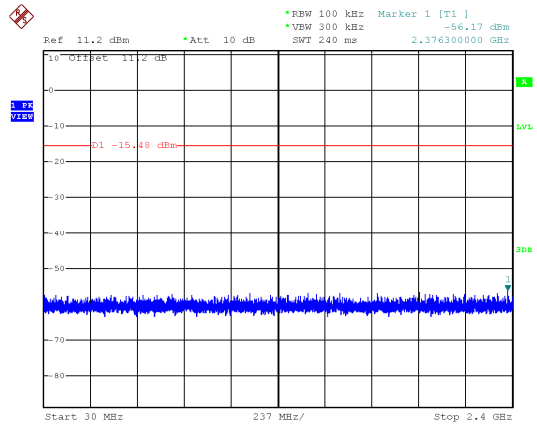


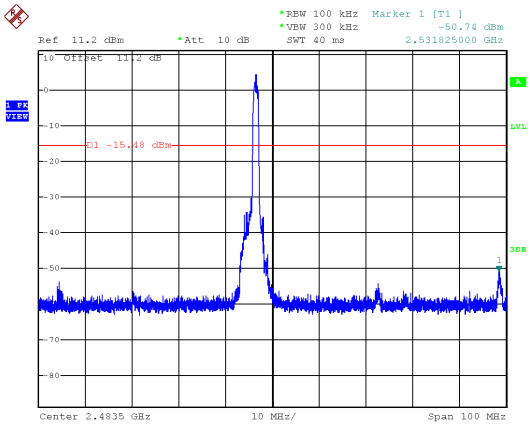


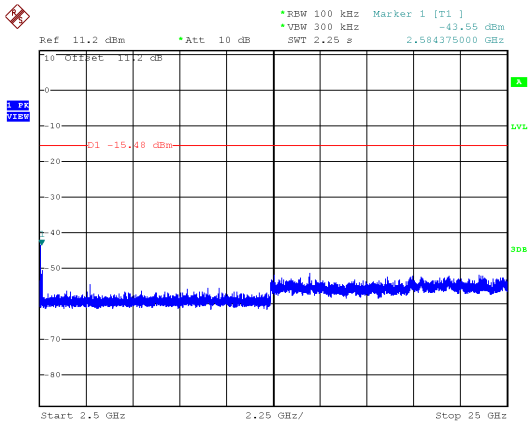




Modulation Type: 8DPSK, CH78

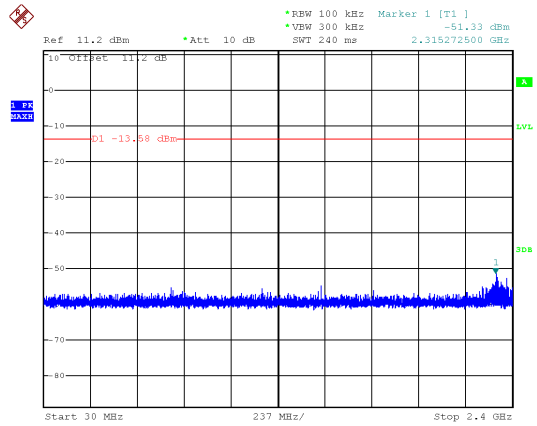




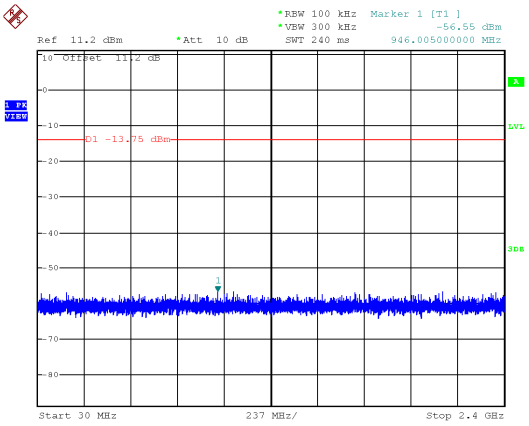


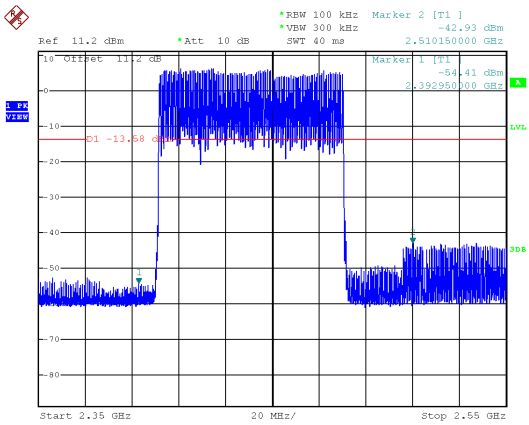
Hopping Mode:

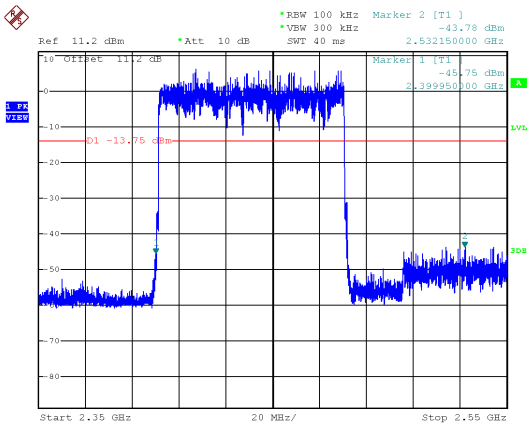
Modulation Type: GFSK

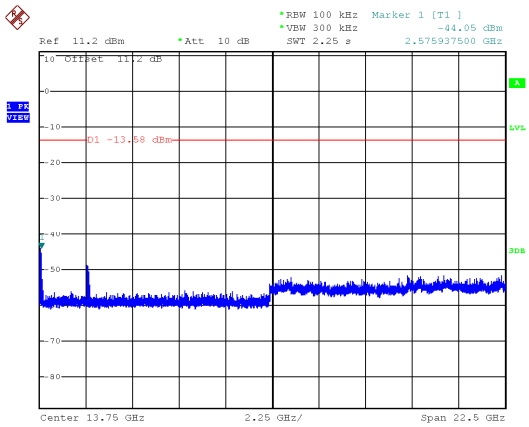


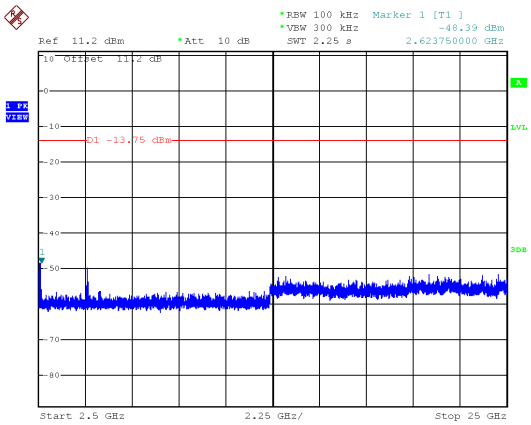
Modulation Type: π/4-DQPSK



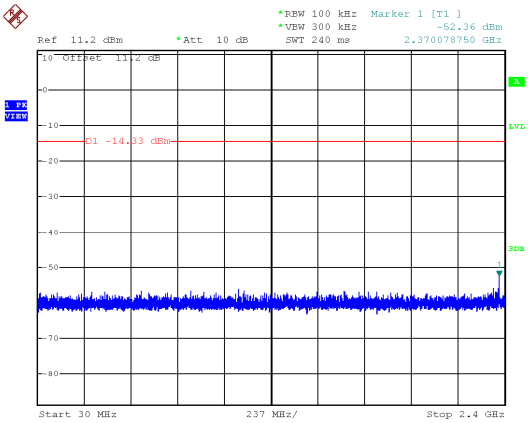


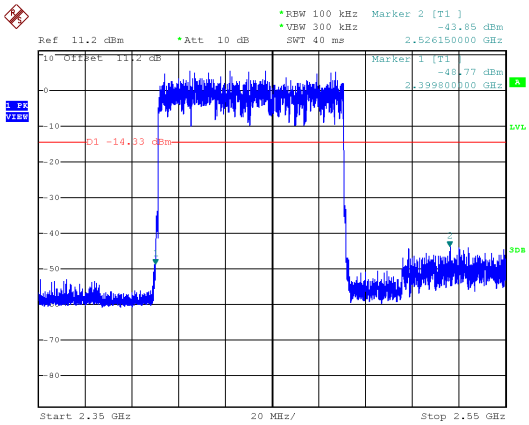


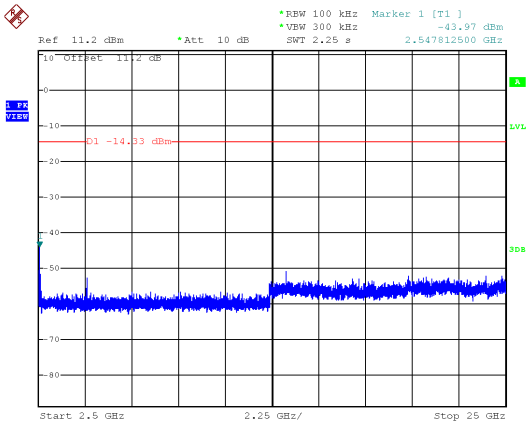




Modulation Type: 8DPSK







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.

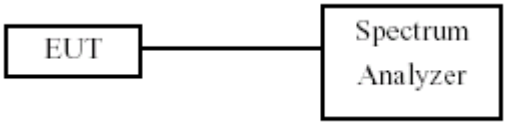
8.2 Test Procedures

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



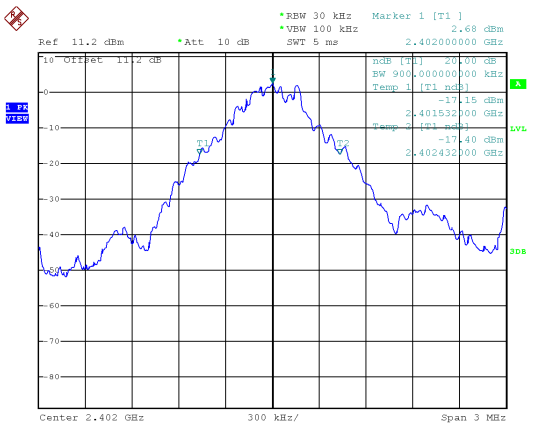
8.4 Test Result and Data

Test Result : PASS Temperature : 22°C

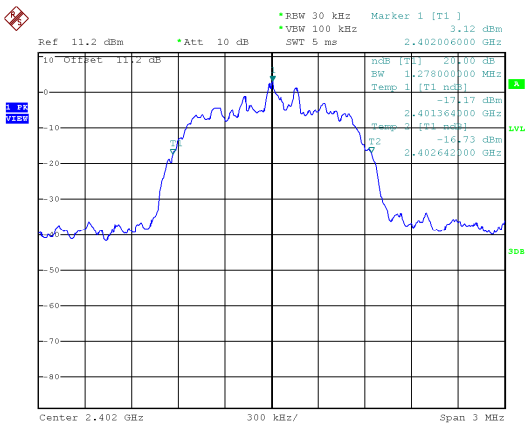
Test Date : Sep. 01, 2017 Humidity : 63%

Modulation Type	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	2/3 20dB Bandwidth (MHz)
GFSK	00	2402	0.900	0.600
	39	2441	0.900	0.600
	78	2480	0.900	0.600
π/4-DQPSK	00	2402	1.278	0.852
	39	2441	1.236	0.824
	78	2480	1.236	0.824
8DPSK	00	2402	1.266	0.844
	39	2441	1.236	0.824
	78	2480	1.236	0.824

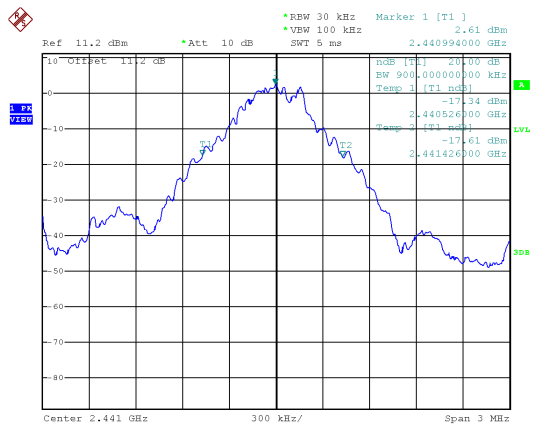
Modulation Type: GFSK
CH00



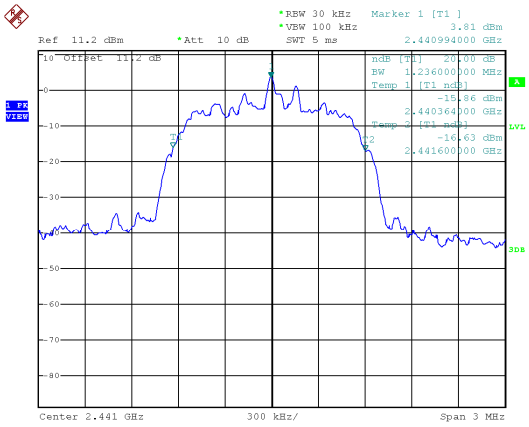
Modulation Type: π/4-DQPSK
CH00



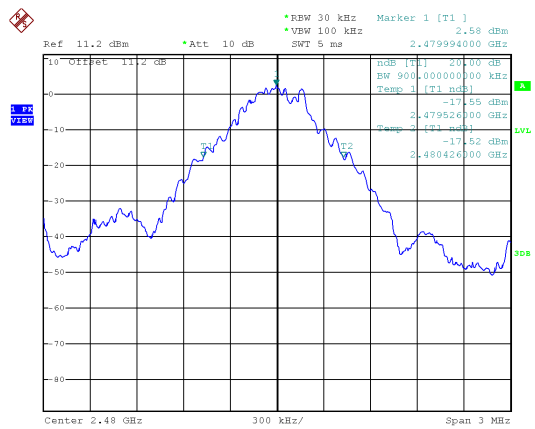
CH39



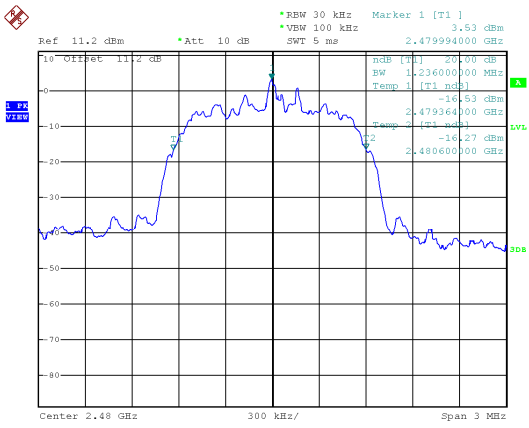
CH39



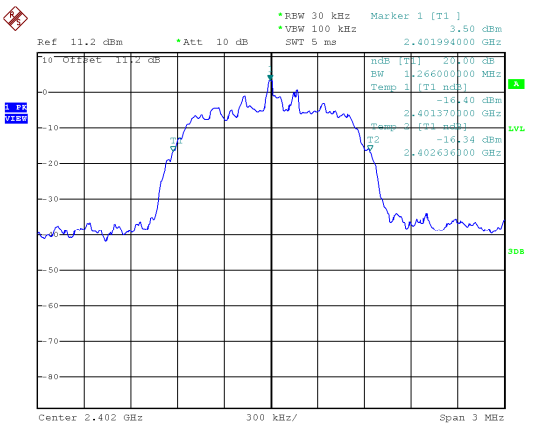
CH78



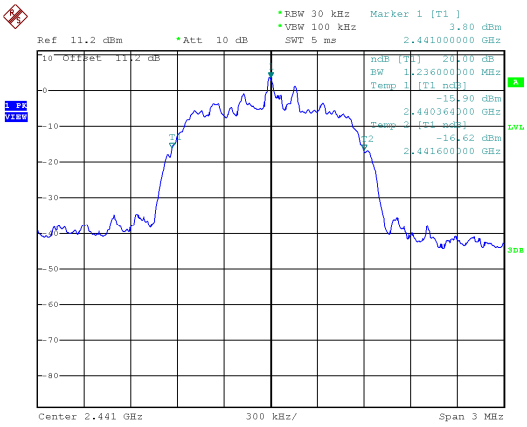
CH78



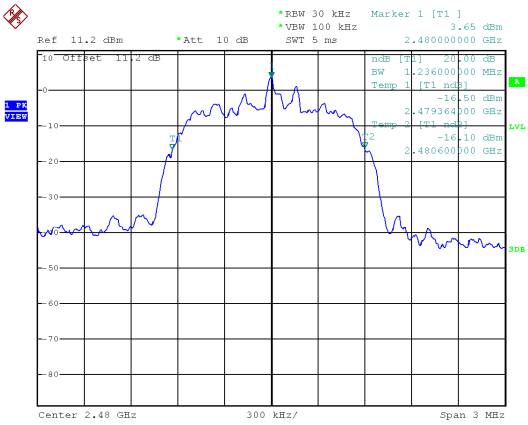
Modulation Type: 8DSPK
CH00



CH39



CH78



9. Frequencies Separation

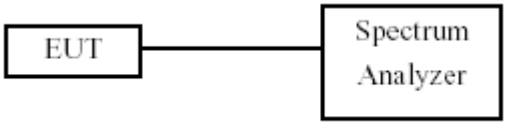
9.1 Test Limit

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

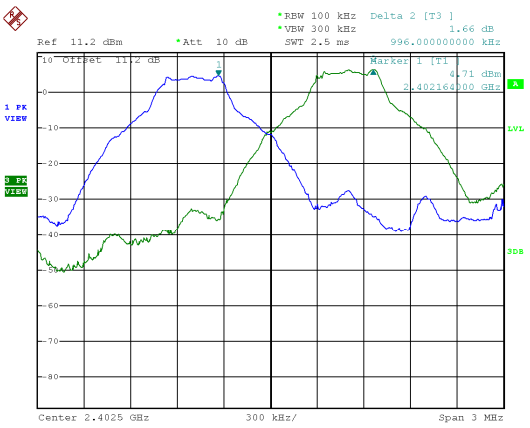


9.4 Test Result and Data

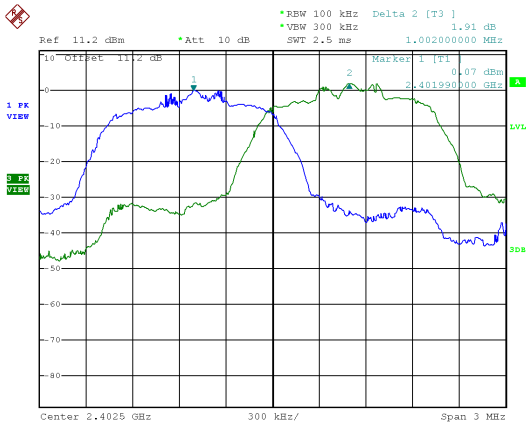
Test Result : PASS
Test Date : Sep. 01, 2017
Temperature : 22°C
Humidity : 63%

Modulation Type	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
GFSK	00	2402	0.996	0.6
	39	2441	0.996	0.6
	78	2480	0.990	0.6
π/4-DQPSK	00	2402	1.002	0.852
	39	2441	1.002	0.824
	78	2480	0.996	0.824
8DPSK	00	2402	1.008	0.844
	39	2441	1.002	0.824
	78	2480	0.996	0.824

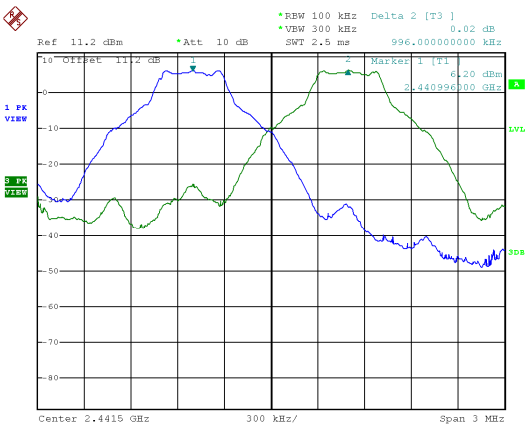
Modulation Type: GFSK
CH00



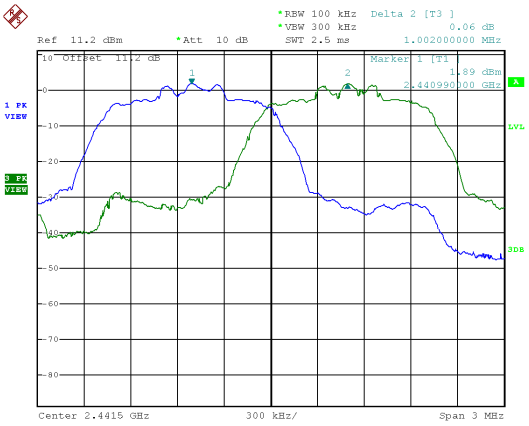
Modulation Type: π/4-DQPSK
CH00



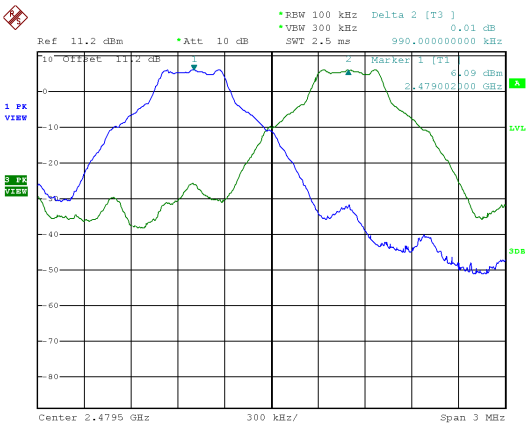
CH39



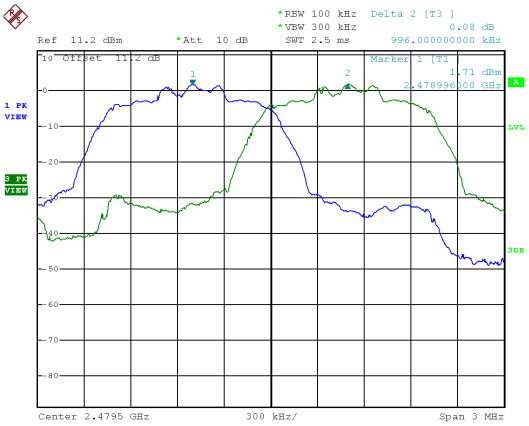
CH39



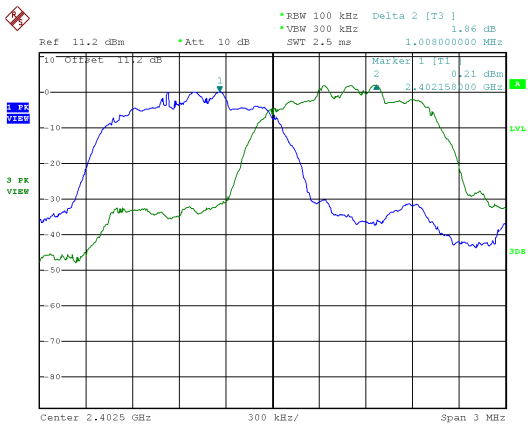
CH78



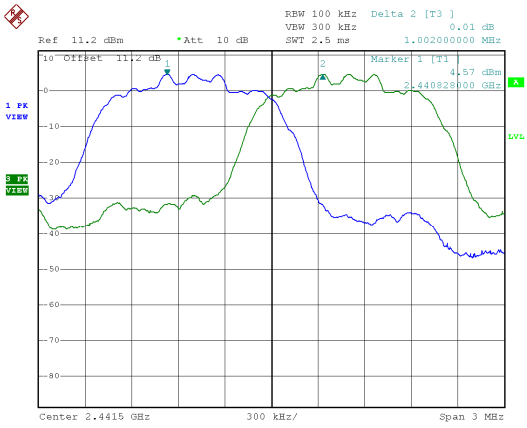
CH78



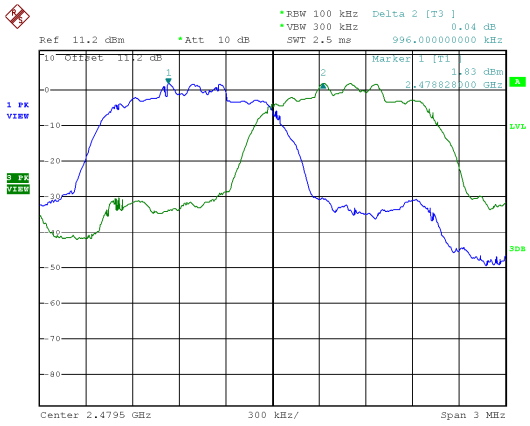
Modulation Type: 8DSPK
CH00



CH39



CH78



10. Dwell Time on each channel

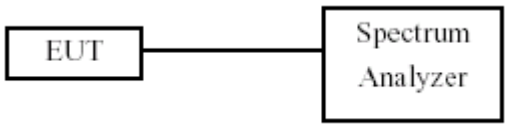
10.1 Test Limit

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

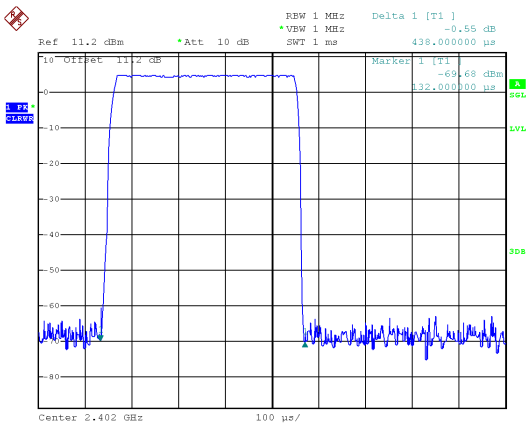
Test Result : PASS Temperature : 22°C

Test Date : Sep. 01, 2017 Humidity : 63%

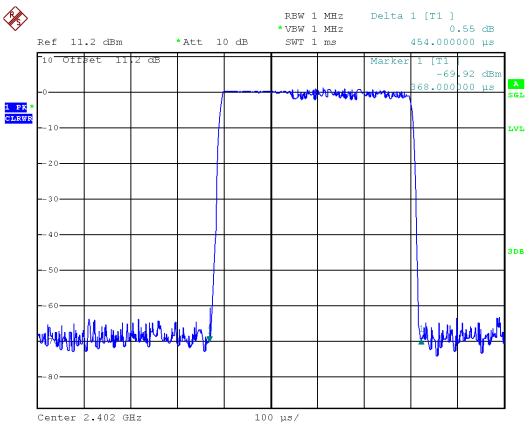
Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec

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	0.438	320.10	140.20	400
GFSK (DH3)	2402	1.714	159.90	274.07	400
GFSK (DH5)	2402	2.955	106.81	315.62	400
π/4-DQPSK (DH1)	2402	0.454	320.10	145.33	400
π/4-DQPSK (DH3)	2402	1.716	159.90	274.39	400
π/4-DQPSK (DH5)	2402	2.992	106.81	319.58	400
8DPSK (DH1)	2402	0.450	320.10	144.05	400
8DPSK (DH3)	2402	1.710	159.90	273.43	400
8DPSK (DH5)	2402	2.976	106.81	317.87	400

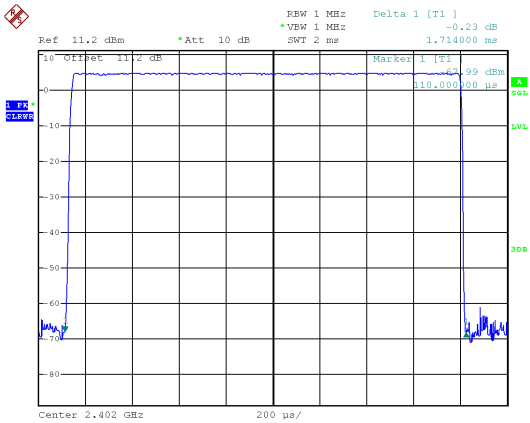
Modulation Type: GFSK(DH1)



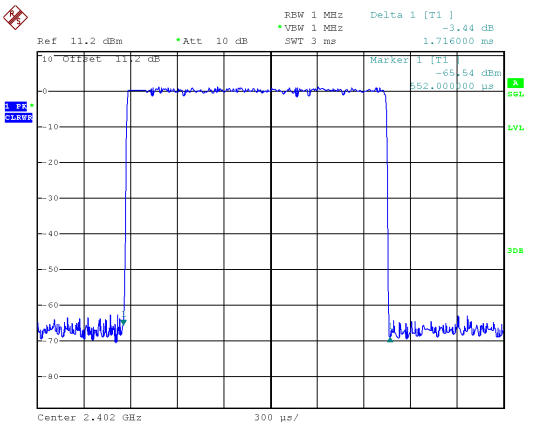
Modulation Type: π/4-DQPSK (DH1)



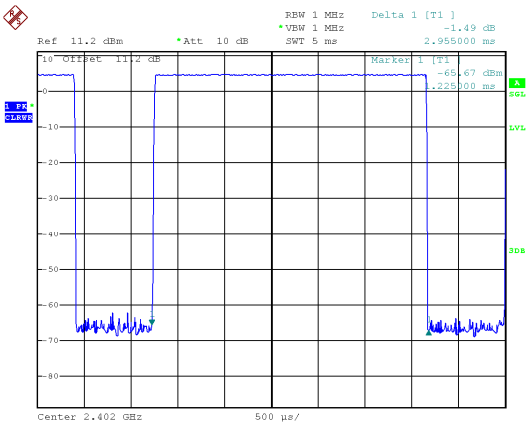
Modulation Type: GFSK(DH3)



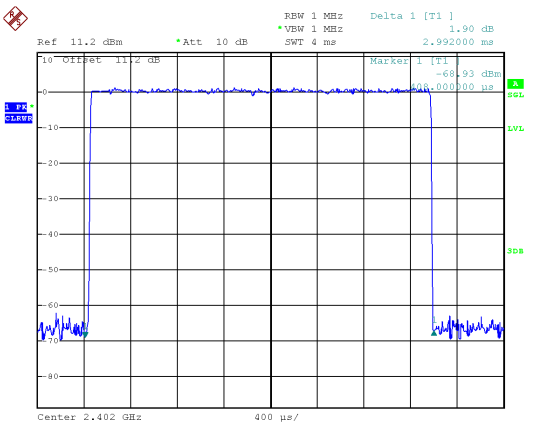
Modulation Type: π/4-DQPSK (DH3)



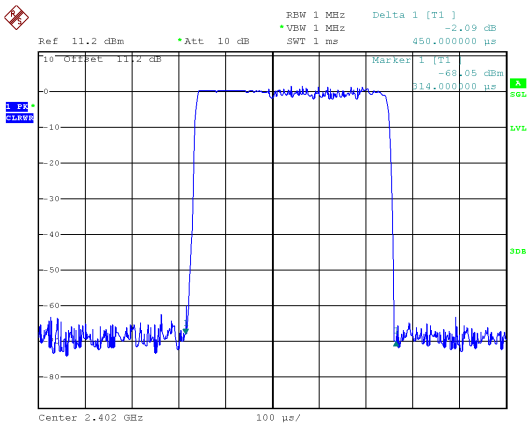
Modulation Type: GFSK(DH5)



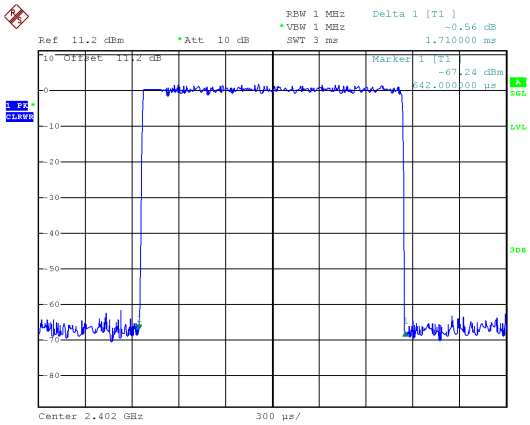
Modulation Type: π/4-DQPSK (DH5)



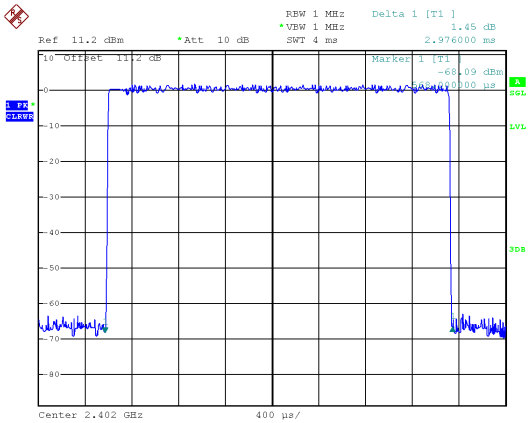
Modulation Type: 8DSPK (DH1)



Modulation Type: 8DSPK (DH3)



Modulation Type: 8DSPK (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.

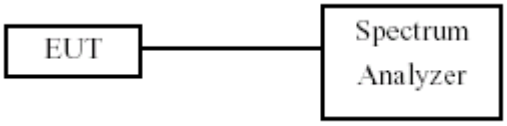
11.2 Test Procedures

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

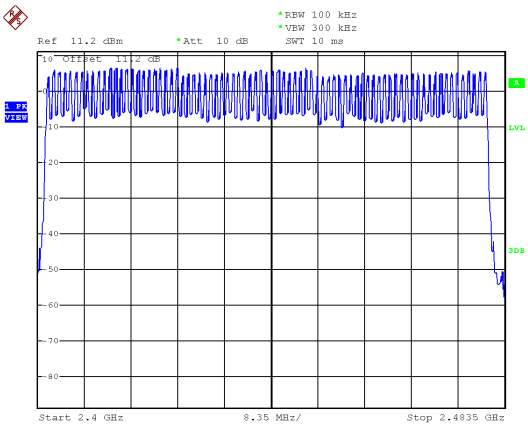


11.4 Test Result and Data

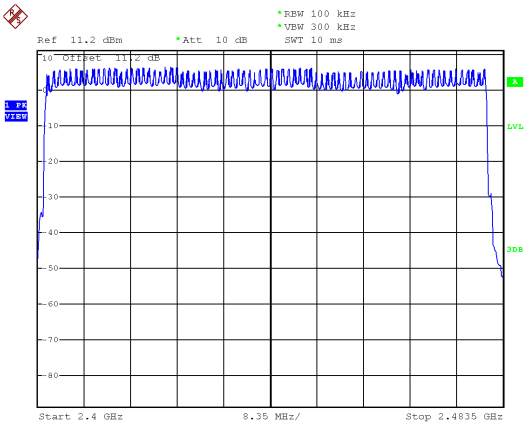
Test Result	:	PASS	Temperature	:	22°C
Test Date	:	Sep. 01, 2017	Humidity	:	63%

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

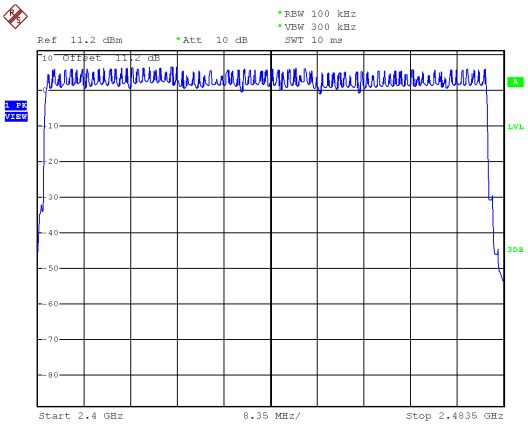
Modulation Type: GFSK



Modulation Type: π/4-DQPSK



Modulation Type: 8DPSK



12. Maximum Peak Output Power

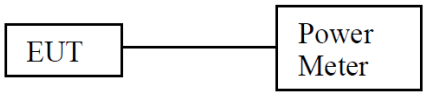
12.1 Test Limit

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	:	22°C
Test Date	:	Sep. 01, 2017	Humidity	:	63%

Modulation Type	Channel	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power (mW)
GFSK	00	2402	4.38	2.742
	39	2441	4.40	2.754
	78	2480	4.47	2.799
π/4-DQPSK	00	2402	5.16	3.281
	39	2441	5.32	3.404
	78	2480	5.39	3.459
8DPSK	00	2402	5.24	3.342
	39	2441	5.51	3.556
	78	2480	5.46	3.516

Modulation Type	Channel	Frequency (MHz)	Average Output Power (dBm)	Average Output Power (mW)
GFSK	00	2402	3.91	2.460
	39	2441	3.86	2.432
	78	2480	3.94	2.477
π/4-DQPSK	00	2402	3.95	2.483
	39	2441	3.99	2.506
	78	2480	3.88	2.443
8DPSK	00	2402	3.91	2.460
	39	2441	3.99	2.506
	78	2480	3.87	2.438

Note: Average power is for reference only.