



FCC RADIO TEST REPORT

Applicant : SteelSeries ApS.

Address : Suite 2E, 656 West Randolph Street, IL.,
Chicago, Illinois 60661, United States

Equipment : Transceiver

Model No. : HS-00013TX

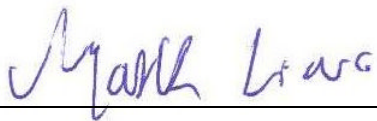
Trade Name : 

FCC ID : ZHK-HS00013TX

I HEREBY CERTIFY THAT :

The sample was received on Jul. 14, 2017 and the testing was carried out on Jul. 20, 2017 at CerpPASS Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of CerpPASS 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:

CerpPASS Technology Corporation Test Laboratory





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History of this test report

Report No.	Issue Date	Description
TEFQ1606142	Aug. 25, 2016	Original
TEFQ1610103	Oct. 24, 2016	This test report were to request a Class II Permissive change to FCC ID: ZHK-HS00013TX. Changes are as follow: 1. Change Components - U5 change to BL2012-10B2450TLF - C65 changes to NC - L3 changes to 8.2pF
TEFQ1705081	Jul. 21, 2017	1. Change modulation



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	---
15.209 15.205	. Radiated Spurious Emission	Pass
15.247(d)	. Conducted Spurious Emission	---
15.247(a)(2)	. 6dB Bandwidth	---
15.247(b)	. Maximum Peak Output Power	Pass
15.247(e)	. Power Spectral Density	---

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

Modulation Type	π / 4-DQPSK
Frequency Range	2403.35~2477.35MHz
Antenna Type	PCB Antenna
Antenna Gain	Antenna 1: 4.42 dBi Antenna 2: 2.82 dBi

2.2 Carrier Frequency of Channels

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
*01	2403.35	15	2431.35	29	2459.35
02	2405.35	16	2433.35	30	2461.35
03	2407.35	17	2435.35	31	2463.35
04	2409.35	18	2437.35	32	2465.35
05	2411.35	*19	2439.35	33	2467.35
06	2413.35	20	2441.35	34	2469.35
07	2415.35	21	2443.35	35	2471.35
08	2417.35	22	2445.35	36	2473.35
09	2419.35	23	2447.35	37	2475.35
10	2421.35	24	2449.35	*38	2477.35
11	2423.35	25	2451.35	--	--
12	2425.35	26	2453.35	--	--
13	2427.35	27	2455.35	--	--
14	2429.35	28	2457.35	--	--

Note: Channels remarked * are selected to perform test.



2.3 Test Mode and 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, "VMIttest V1.1.6.42" under WIN 7 was executed to transmit and receive data via Bluetooth.
- d. The following test modes were performed for the test:
 - Test Mode 1. GFSK, Antenna 1
 - Test Mode 2. GFSK, Antenna 2

2.4 Description of Test System

Device	Manufacturer	Model No.	Description
Notebook	DELL	LatitudeE5450/5450	Power Cable, Unshielding, 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-3428, R-4218 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.	

2.6 Measurement Uncertainty

Measurement Item	Measurement Frequency	Polarization	Uncertainty
Conducted Emission	9 kHz ~ 30 MHz	LINE / NEUTRAL	± 2.9076 dB
Radiated Emission	9 kHz ~ 25,000 MHz	Vertical / Horizontal	± 0.948 dB
Spurious Emission (Conducted)	-	-	± 4.011 dB
Maximum Peak and Average Output Power	-	-	± 0.322 dB
Power Spectral Density	-	-	± 0.322 dB

The measurement uncertainty will be considered, when test result margin to the limit.



3. Test Equipment and Ancillaries Used for Tests

Instrument	Model No.	Manufacturer	Serial No.	Calibration Date	Valid Date
EMI Receiver	R&S	ESCI3	100443	2017/03/07	2018/03/06
LISN	Schwarzbeck	NSLK 8127	8127-740	2016/08/30	2017/08/29
LISN	Schwarzbeck	NSLK 8127	8127-516	2016/09/06	2017/09/05
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 Antenna	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	2016/09/01	2017/08/31
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	Antenna Gain
PCB Antenna	ANT 1: 4.42 dBi ANT 2: 2.82 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

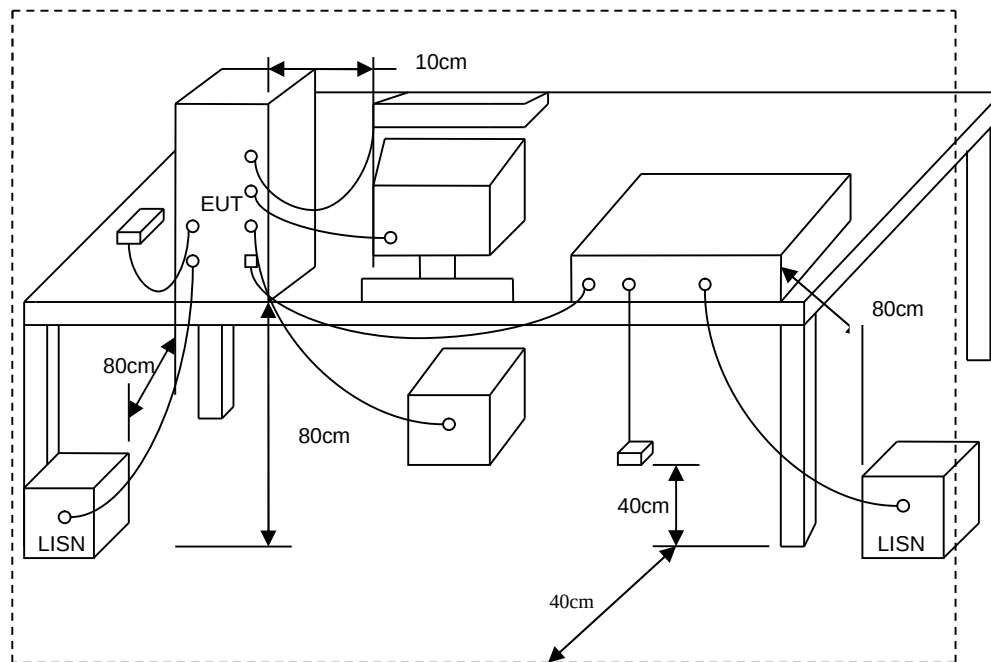
*Decreases with the logarithm of the frequency.

5.2 Test Procedures

- 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.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.



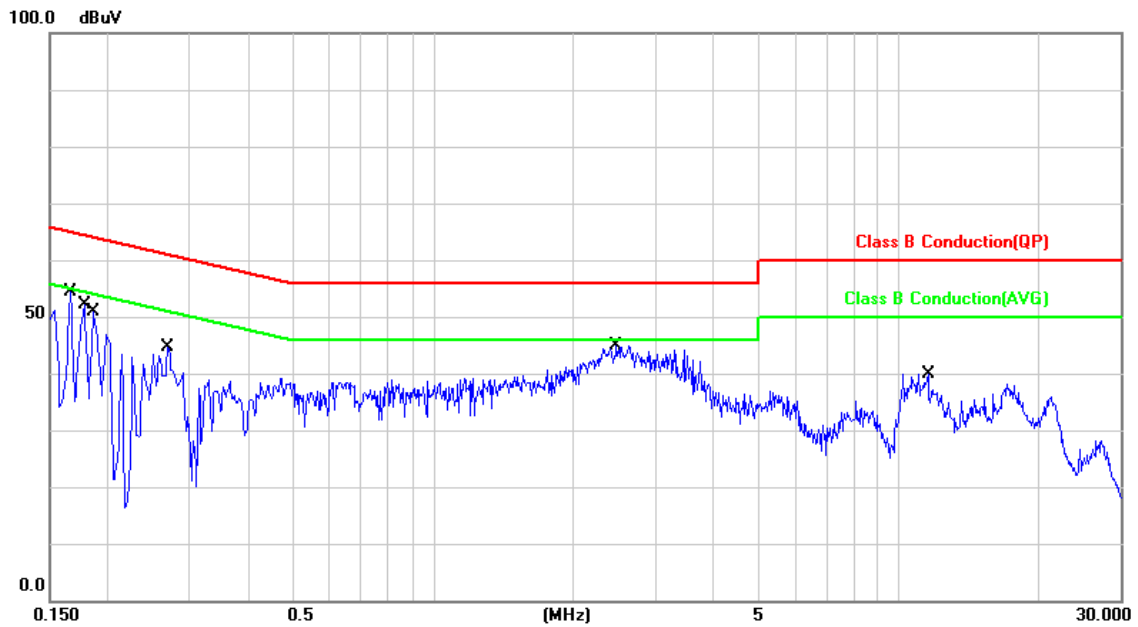
5.3 Typical Test Setup





5.4 Test Result and Data

Power	: DC 5V	Pol/Phase	: LINE
Test Mode	: TX	Temperature	: 25 °C
Test date	: Jul. 14, 2017	Humidity	: 55 %
Memo	:	Atmospheric Pressure	: 1018 hpa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1660	9.98	41.61	51.59	65.15	-13.56	QP	P
2	0.1660	9.98	25.63	35.61	55.15	-19.54	AVG	P
3	0.1780	9.99	39.15	49.14	64.57	-15.43	QP	P
4	0.1780	9.99	20.81	30.80	54.57	-23.77	AVG	P
5	0.1860	9.99	37.33	47.32	64.21	-16.89	QP	P
6	0.1860	9.99	21.01	31.00	54.21	-23.21	AVG	P
7	0.2700	10.00	30.96	40.96	61.12	-20.16	QP	P
8	0.2700	10.00	16.11	26.11	51.12	-25.01	AVG	P
9	2.4739	10.13	28.79	38.92	56.00	-17.08	QP	P
10	2.4739	10.13	22.17	32.30	46.00	-13.70	AVG	P
11	11.5780	10.44	21.05	31.49	60.00	-28.51	QP	P
12	11.5780	10.44	15.40	25.84	50.00	-24.16	AVG	P

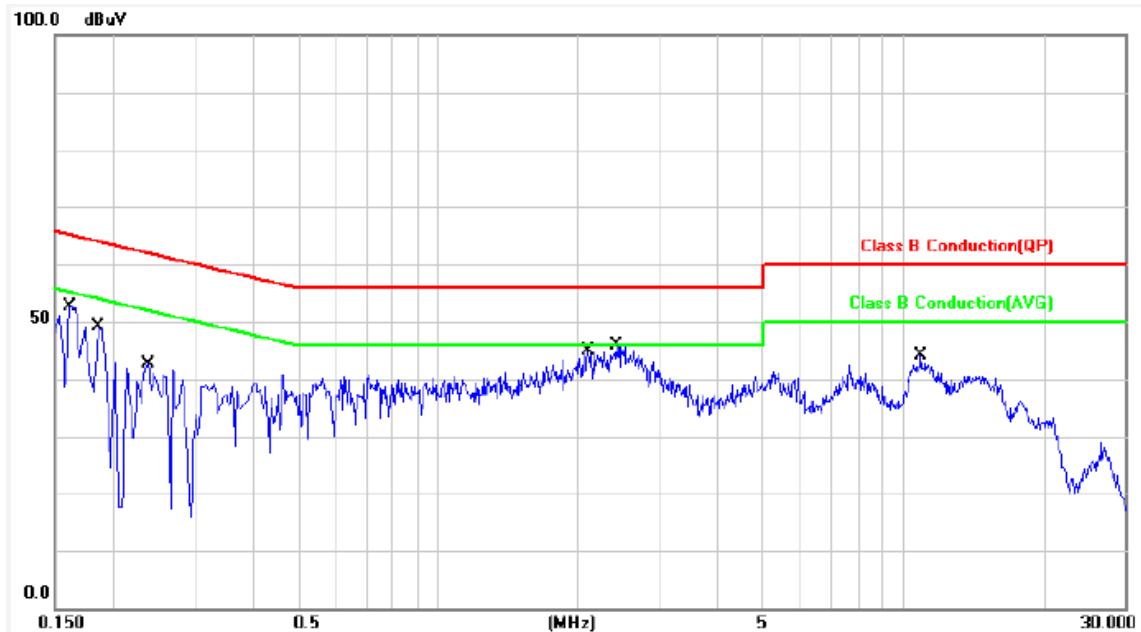
Note: Level = Reading + Factor

Margin = Level – Limit

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss



Power	: DC 5V	Pol/Phase	: NEUTRAL
Test Mode	: TX	Temperature	: 25 °C
Test date	: Jul. 14, 2017	Humidity	: 55 %
Memo	:	Atmospheric Pressure	: 1018 hpa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1620	9.98	40.92	50.90	65.36	-14.46	QP	P
2	0.1620	9.98	28.73	38.71	55.36	-16.65	AVG	P
3	0.1860	9.97	34.76	44.73	64.21	-19.48	QP	P
4	0.1860	9.97	11.89	21.86	54.21	-32.35	AVG	P
5	0.2380	9.96	30.21	40.17	62.16	-21.99	QP	P
6	0.2380	9.96	22.75	32.71	52.16	-19.45	AVG	P
7	2.1020	10.11	28.34	38.45	56.00	-17.55	QP	P
8	2.1020	10.11	22.25	32.36	46.00	-13.64	AVG	P
9	2.4180	10.13	31.11	41.24	56.00	-14.76	QP	P
10	2.4180	10.13	23.87	34.00	46.00	-12.00	AVG	P
11	10.9379	10.46	27.18	37.64	60.00	-22.36	QP	P
12	10.9379	10.46	21.78	32.24	50.00	-17.76	AVG	P

Note: Level = Reading + Factor

Margin = Level – Limit

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss



6. Test of Spurious Emission (Radiated)

6.1 Test Limit

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30dB instead of 20dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

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

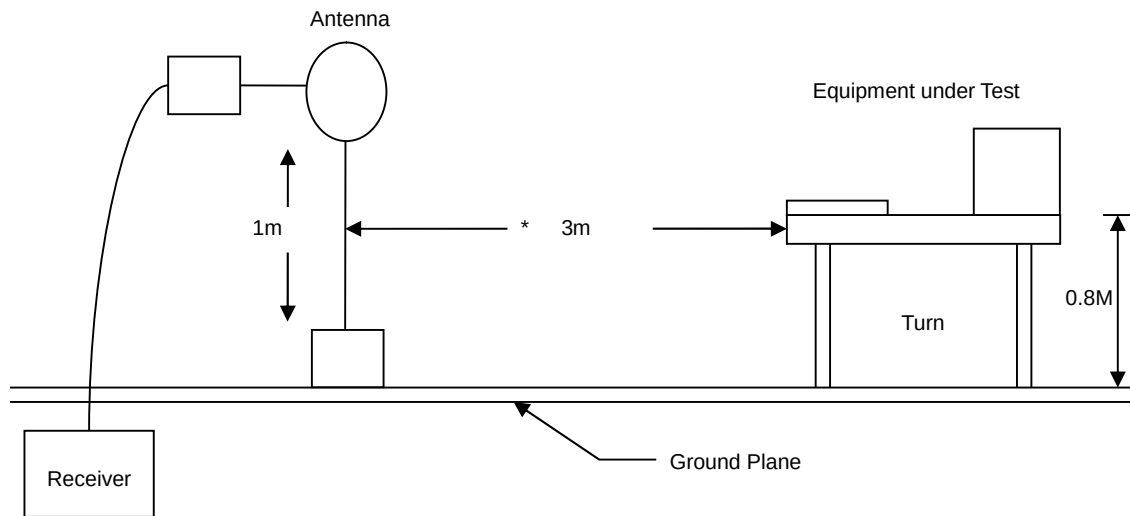
6.2 Test Procedures

- The EUT was placed on a rotatable table top 0.8 meter above ground.
- The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- The table was rotated 360 degrees to determine the position of the highest radiation.
- 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.
- 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.
- Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- 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.
- 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.
- "Cone of radiation" has been considered to be 3dB bandwidth of the measurement antenna.

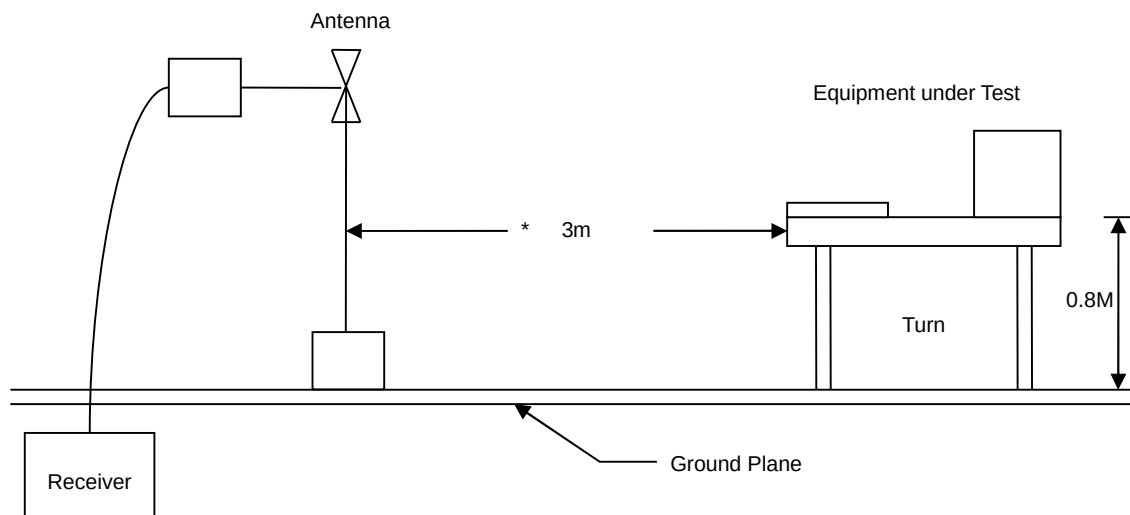


6.3 Typical Test Setup

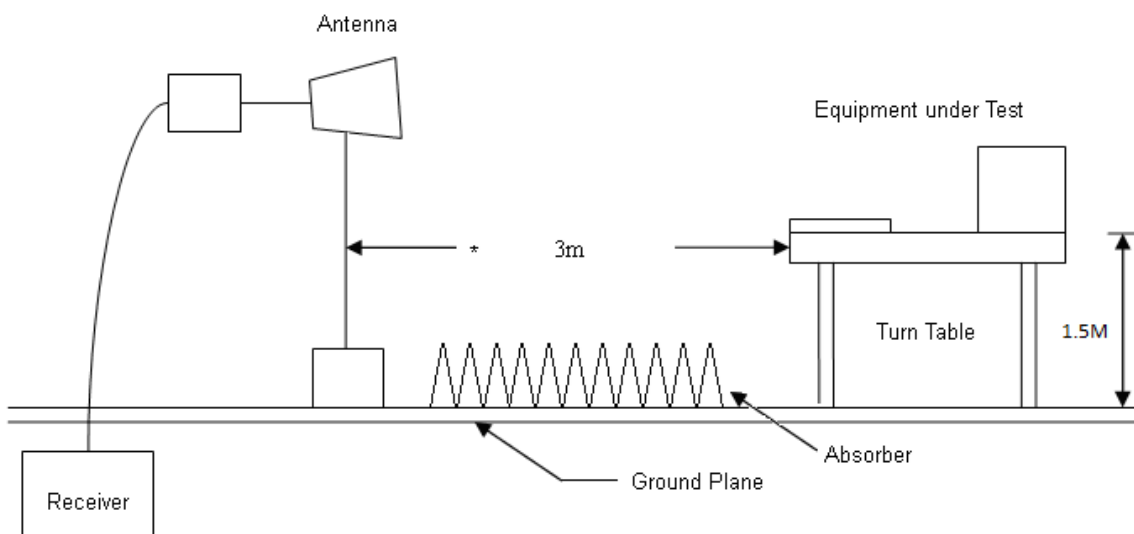
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup



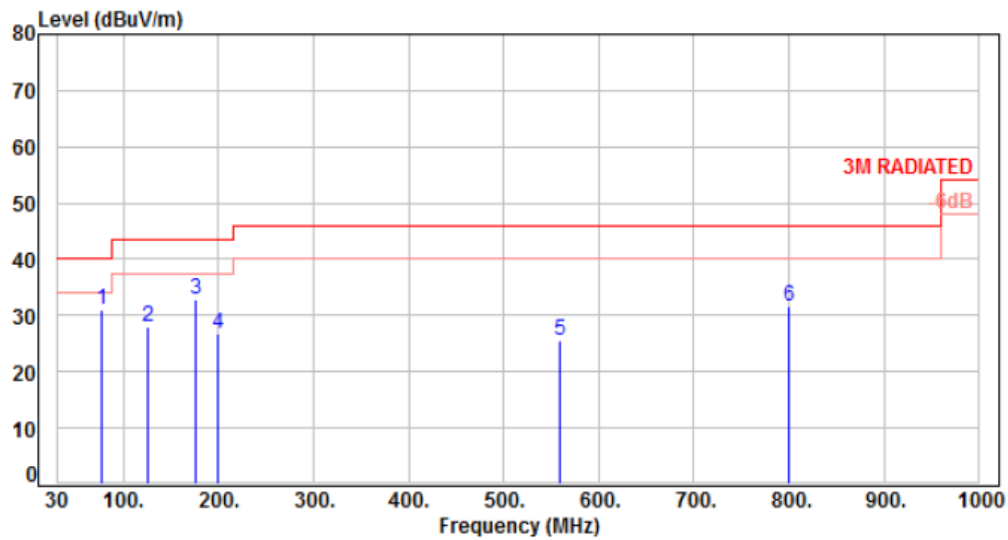


6.4 Test Result and Data (9kHz ~ 30MHz)

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

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

Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test date	: Jul. 17, 2017	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBUV)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	76.56	-14.06	45.08	31.02	40.00	-8.98	Peak	100		P
2	125.06	-12.00	39.86	27.86	43.50	-15.64	Peak	100		P
3	175.50	-10.86	43.66	32.80	43.50	-10.70	Peak	100		P
4	199.75	-12.54	39.18	26.64	43.50	-16.86	Peak	100		P
5	558.65	-3.07	28.77	25.70	46.00	-20.30	Peak	100		P
6	800.18	0.80	30.76	31.56	46.00	-14.44	Peak	100		P

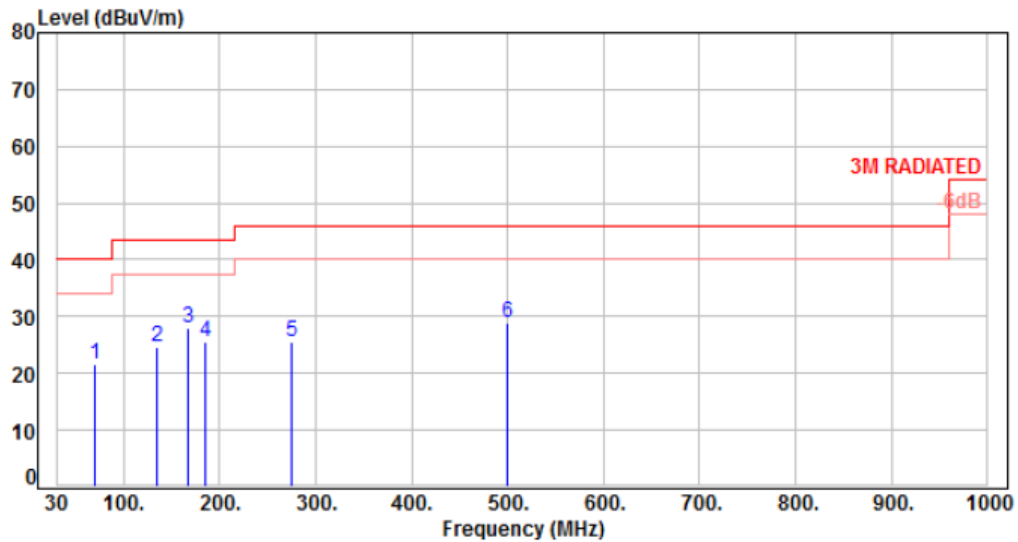
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test date	: Jul. 17, 2017	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBUV)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	70.74	-12.65	34.19	21.54	40.00	-18.46	Peak	100		P
2	134.76	-11.00	35.57	24.57	43.50	-18.93	Peak	100		P
3	167.74	-10.15	38.10	27.95	43.50	-15.55	Peak	100		P
4	184.23	-11.72	37.17	25.45	43.50	-18.05	Peak	100		P
5	275.41	-9.86	35.36	25.50	46.00	-20.50	Peak	100		P
6	500.45	-4.17	33.18	29.01	46.00	-16.99	Peak	100		P

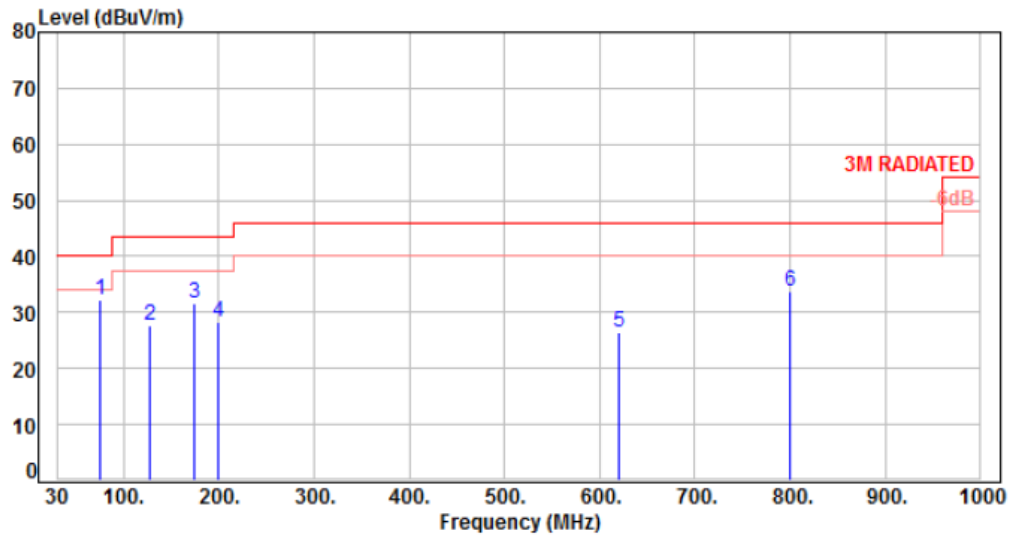
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test date	: Jul. 17, 2017	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth P/F (deg)
1	75.59	-13.83	46.17	32.34	40.00	-7.66	Peak	100	P
2	127.97	-11.74	39.55	27.81	43.50	-15.69	Peak	100	P
3	173.56	-10.64	42.12	31.48	43.50	-12.02	Peak	100	P
4	199.75	-12.54	40.74	28.20	43.50	-15.30	Peak	100	P
5	619.76	-1.76	28.30	26.54	46.00	-19.46	Peak	100	P
6	800.18	0.80	33.08	33.88	46.00	-12.12	Peak	100	P

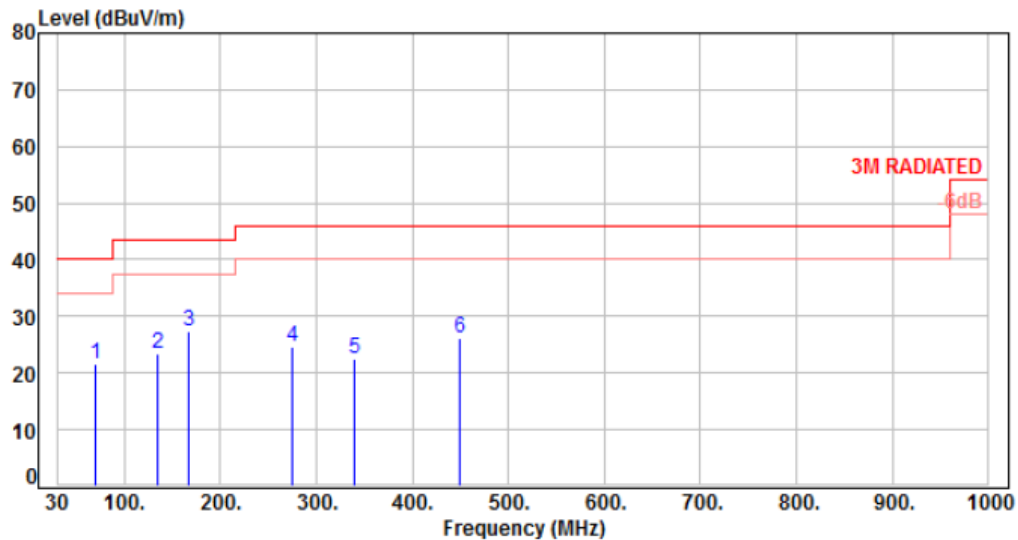
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test date	: Jul. 17, 2017	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	69.77	-12.42	33.96	21.54	40.00	-18.46	Peak	100		P
2	134.76	-11.00	34.56	23.56	43.50	-19.94	Peak	100		P
3	167.74	-10.15	37.42	27.27	43.50	-16.23	Peak	100		P
4	275.41	-9.86	34.51	24.65	46.00	-21.35	Peak	100		P
5	339.43	-8.03	30.61	22.58	46.00	-23.42	Peak	100		P
6	450.01	-4.93	31.06	26.13	46.00	-19.87	Peak	100		P

Note: Level=Reading+Factor

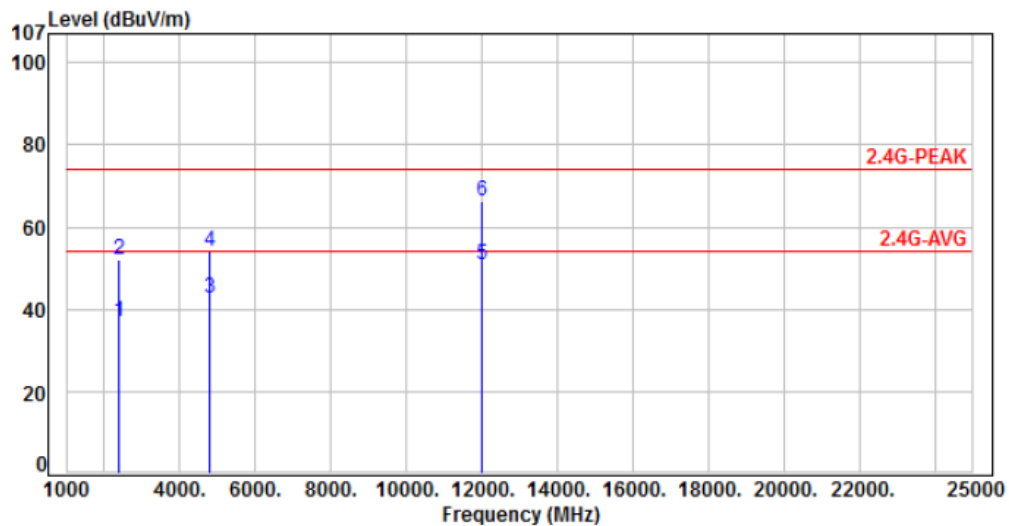
Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



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

Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH01	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	38.12	37.02	54.00	-16.98	Average	200	50	P
2	2390.00	-1.10	53.12	52.02	74.00	-21.98	Peak	200	50	P
3	4806.70	7.77	34.82	42.59	54.00	-11.41	Average	250	90	P
4	4806.70	7.77	46.52	54.29	74.00	-19.71	Peak	250	90	P
5	12016.75	19.66	31.00	50.66	54.00	-3.34	Average	180	100	P
6	12016.75	19.66	46.80	66.46	74.00	-7.54	Peak	180	100	P

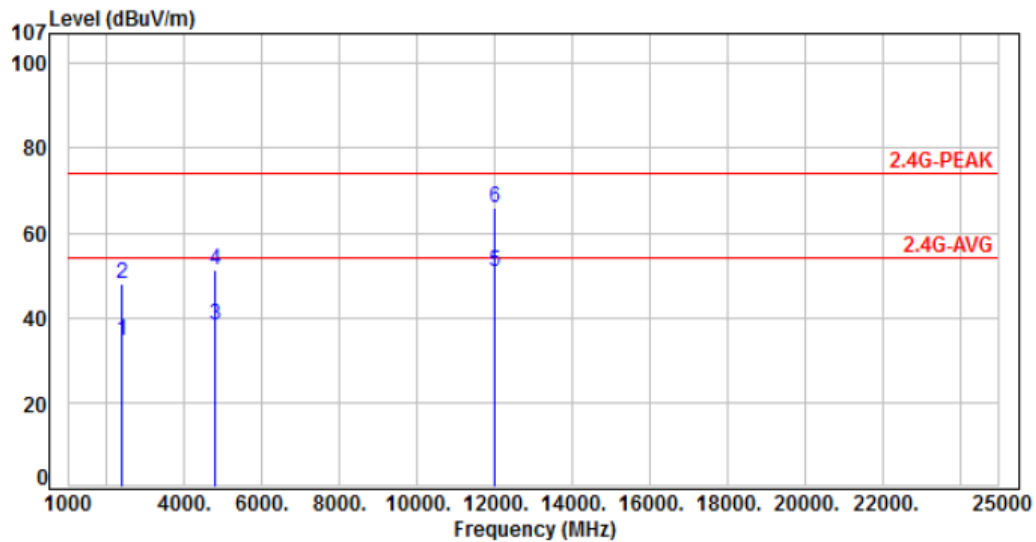
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH01	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	35.70	34.60	54.00	-19.40	Average	323	128	P
2	2390.00	-1.10	48.96	47.86	74.00	-26.14	Peak	323	128	P
3	4806.70	7.77	30.44	38.21	54.00	-15.79	Average	320	134	P
4	4806.70	7.77	43.65	51.42	74.00	-22.58	Peak	320	134	P
5	12016.75	19.66	31.06	50.72	54.00	-3.28	Average	150	180	P
6	12016.75	19.66	46.11	65.77	74.00	-8.23	Peak	150	180	P

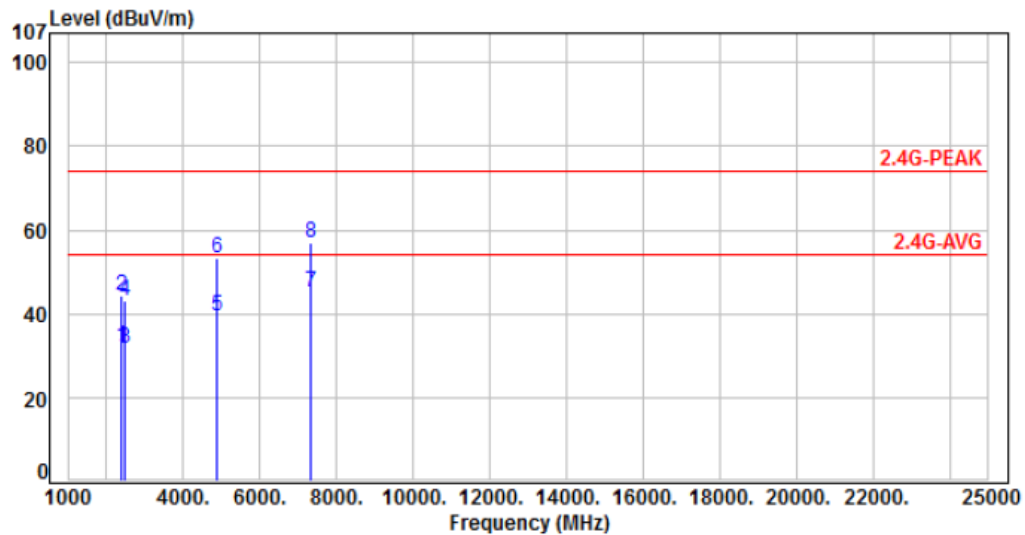
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH19	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBUV)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	33.40	32.30	54.00	-21.70	Average	160	100	P
2	2390.00	-1.10	45.27	44.17	74.00	-29.83	Peak	160	100	P
3	2483.50	-0.84	32.50	31.66	54.00	-22.34	Average	150	85	P
4	2483.50	-0.84	43.80	42.96	74.00	-31.04	Peak	150	85	P
5	4878.70	8.08	31.21	39.29	54.00	-14.71	Average	130	170	P
6	4878.70	8.08	45.11	53.19	74.00	-20.81	Peak	130	170	P
7	7318.05	11.97	33.03	45.00	54.00	-9.00	Average	150	60	P
8	7318.05	11.97	45.10	57.07	74.00	-16.93	Peak	150	60	P

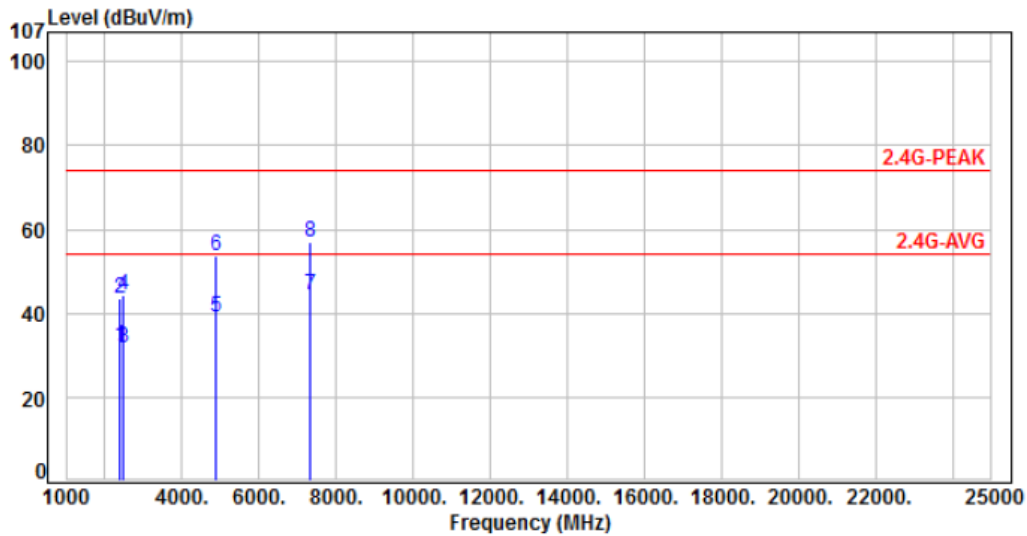
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH19	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	33.34	32.24	54.00	-21.76	Average	260	140	P
2	2390.00	-1.10	44.80	43.70	74.00	-30.30	Peak	260	140	P
3	2483.50	-0.84	32.50	31.66	54.00	-22.34	Average	280	150	P
4	2483.50	-0.84	45.10	44.26	74.00	-29.74	Peak	280	150	P
5	4878.70	8.08	31.03	39.11	54.00	-14.89	Average	170	185	P
6	4878.70	8.08	45.61	53.69	74.00	-20.31	Peak	170	185	P
7	7318.05	11.97	32.40	44.37	54.00	-9.63	Average	140	166	P
8	7318.05	11.97	45.03	57.00	74.00	-17.00	Peak	140	166	P

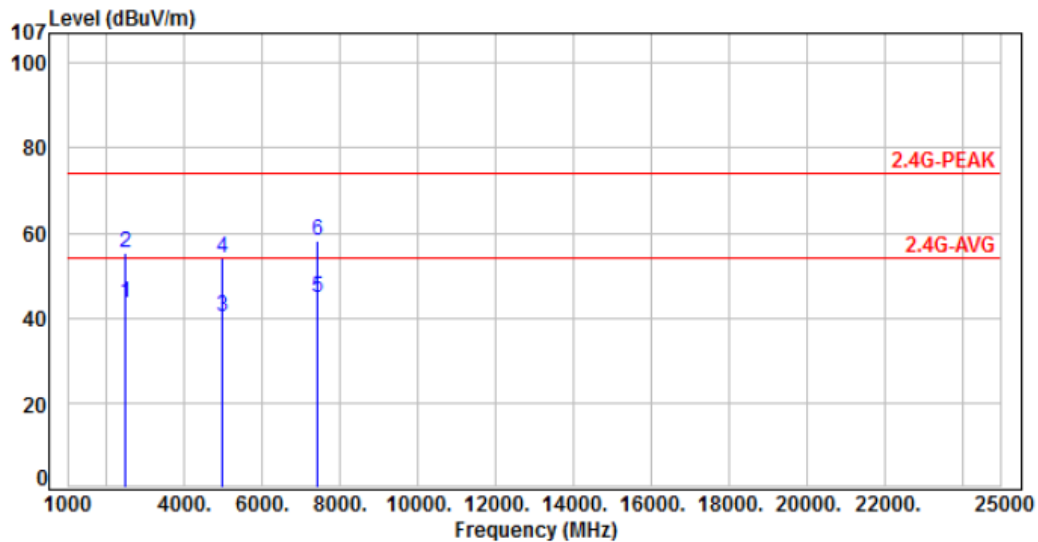
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH38	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-0.65	44.20	43.55	54.00	-10.45	Average	106	138	P
2	2483.50	-0.65	56.12	55.47	74.00	-18.53	Peak	106	138	P
3	4954.70	8.50	31.86	40.36	54.00	-13.64	Average	175	210	P
4	4954.70	8.50	45.66	54.16	74.00	-19.84	Peak	175	210	P
5	7432.05	12.65	32.09	44.74	54.00	-9.26	Average	192	164	P
6	7432.05	12.65	45.43	58.08	74.00	-15.92	Peak	192	164	P

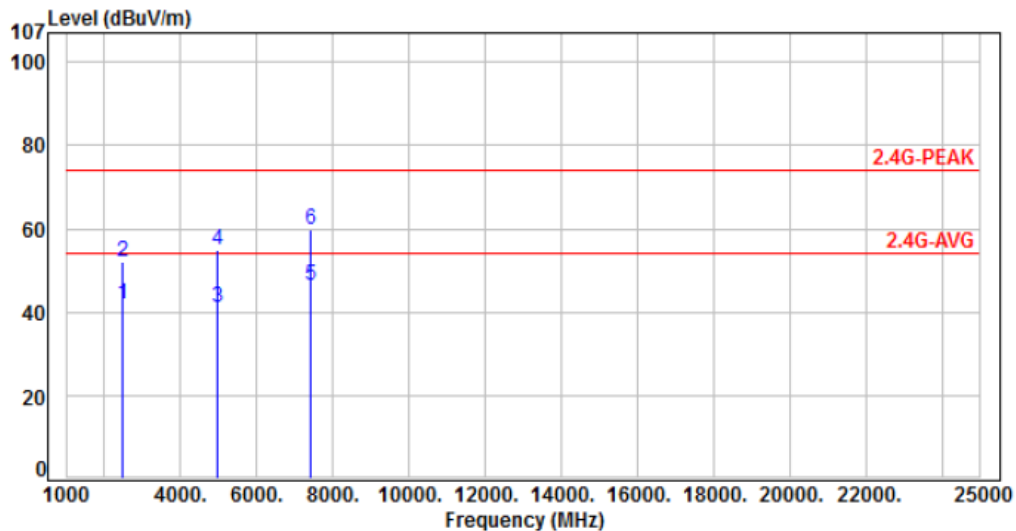
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH38	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-0.65	42.61	41.96	54.00	-12.04	Average	144	165	P
2	2483.50	-0.65	52.64	51.99	74.00	-22.01	Peak	144	165	P
3	4954.70	8.50	32.78	41.28	54.00	-12.72	Average	170	188	P
4	4954.70	8.50	46.31	54.81	74.00	-19.19	Peak	170	188	P
5	7432.05	12.65	33.63	46.28	54.00	-7.72	Average	148	216	P
6	7432.05	12.65	47.24	59.89	74.00	-14.11	Peak	148	216	P

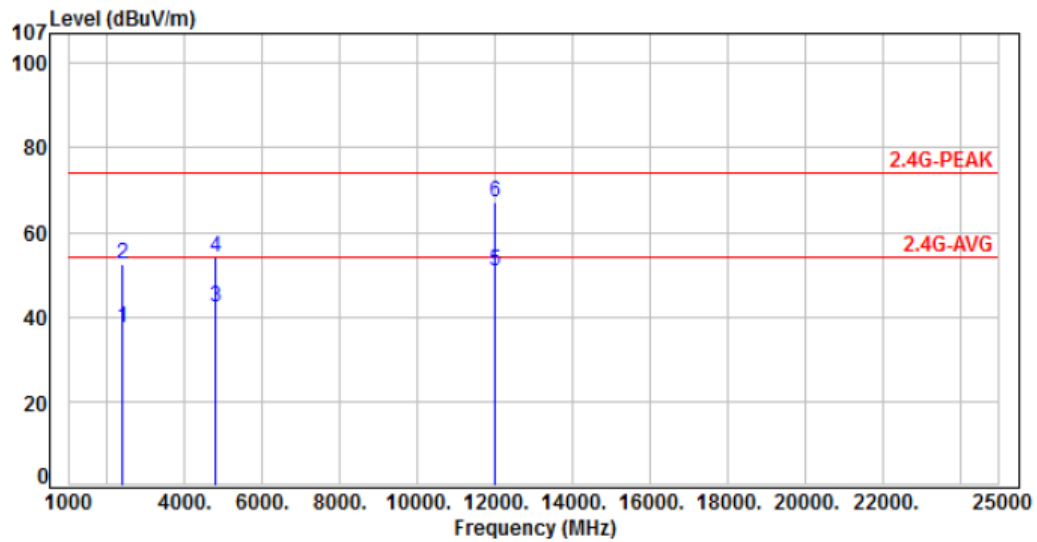
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH01	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	38.46	37.36	54.00	-16.64	Average	201	54	P
2	2390.00	-1.10	53.38	52.28	74.00	-21.72	Peak	201	54	P
3	4806.70	7.77	34.59	42.36	54.00	-11.64	Average	242	85	P
4	4806.70	7.77	46.36	54.13	74.00	-19.87	Peak	242	85	P
5	12016.75	19.66	31.30	50.96	54.00	-3.04	Average	180	120	P
6	12016.75	19.66	47.30	66.96	74.00	-7.04	Peak	180	120	P

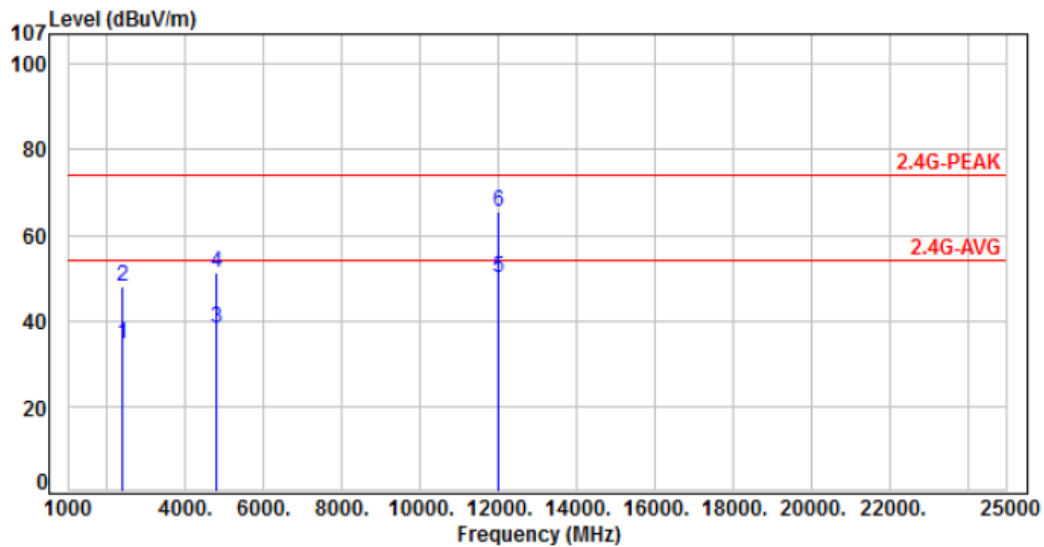
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH01	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-1.10	35.70	34.60	54.00	-19.40	Average	323	128	P
2	2390.00	-1.10	48.96	47.86	74.00	-26.14	Peak	323	128	P
3	4806.70	7.77	30.44	38.21	54.00	-15.79	Average	320	134	P
4	4806.70	7.77	43.65	51.42	74.00	-22.58	Peak	320	134	P
5	12016.75	19.66	30.50	50.16	54.00	-3.84	Average	150	180	P
6	12016.75	19.66	46.00	65.66	74.00	-8.34	Peak	150	180	P

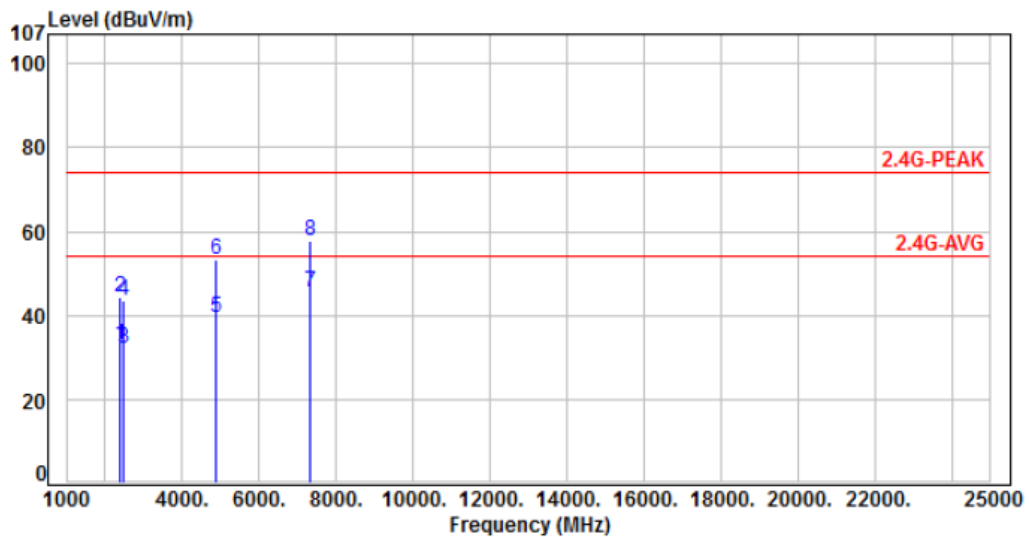
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH19	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-0.96	33.90	32.94	54.00	-21.06	Average	130	80	P
2	2390.00	-0.96	45.30	44.34	74.00	-29.66	Peak	130	80	P
3	2483.50	-0.65	32.66	32.01	54.00	-21.99	Average	165	110	P
4	2483.50	-0.65	44.00	43.35	74.00	-30.65	Peak	165	110	P
5	4878.70	8.16	31.30	39.46	54.00	-14.54	Average	146	210	P
6	4878.70	8.16	45.20	53.36	74.00	-20.64	Peak	146	210	P
7	7318.05	12.29	33.11	45.40	54.00	-8.60	Average	150	120	P
8	7318.05	12.29	45.60	57.89	74.00	-16.11	Peak	150	120	P

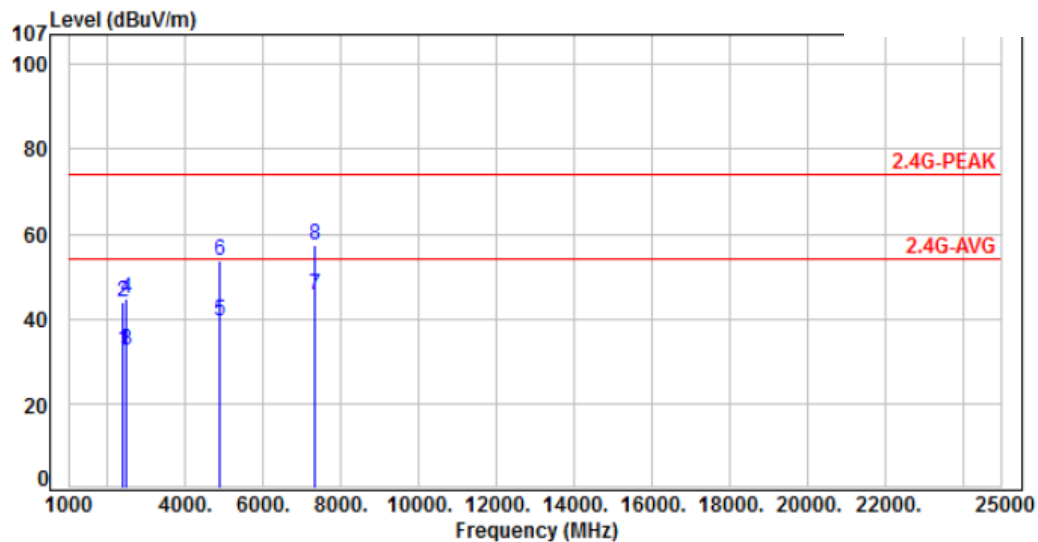
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH19	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-0.96	33.67	32.71	54.00	-21.29	Average	270	130	P
2	2390.00	-0.96	45.10	44.14	74.00	-29.86	Peak	270	130	P
3	2483.50	-0.65	33.20	32.55	54.00	-21.45	Average	270	190	P
4	2483.50	-0.65	45.20	44.55	74.00	-29.45	Peak	270	190	P
5	4878.70	8.16	31.40	39.56	54.00	-14.44	Average	160	230	P
6	4878.70	8.16	45.70	53.86	74.00	-20.14	Peak	160	230	P
7	7318.05	12.29	33.11	45.40	54.00	-8.60	Average	130	170	P
8	7318.05	12.29	45.02	57.31	74.00	-16.69	Peak	130	170	P

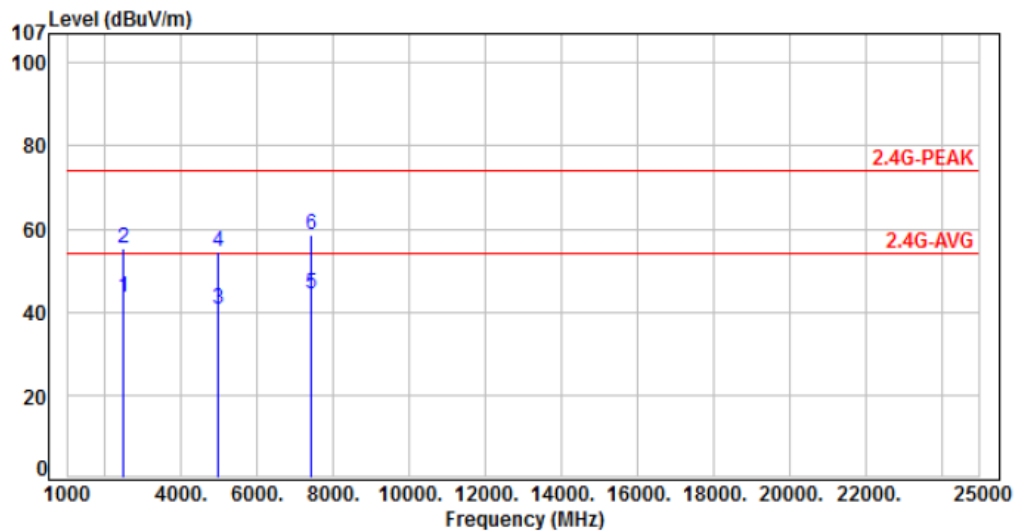
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH38	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-0.65	44.07	43.42	54.00	-10.58	Average	100	150	P
2	2483.50	-0.65	56.07	55.42	74.00	-18.58	Peak	100	150	P
3	4954.70	8.50	32.05	40.55	54.00	-13.45	Average	180	200	P
4	4954.70	8.50	46.02	54.52	74.00	-19.48	Peak	180	200	P
5	7432.05	12.65	31.80	44.45	54.00	-9.55	Average	200	180	P
6	7432.05	12.65	45.83	58.48	74.00	-15.52	Peak	200	180	P

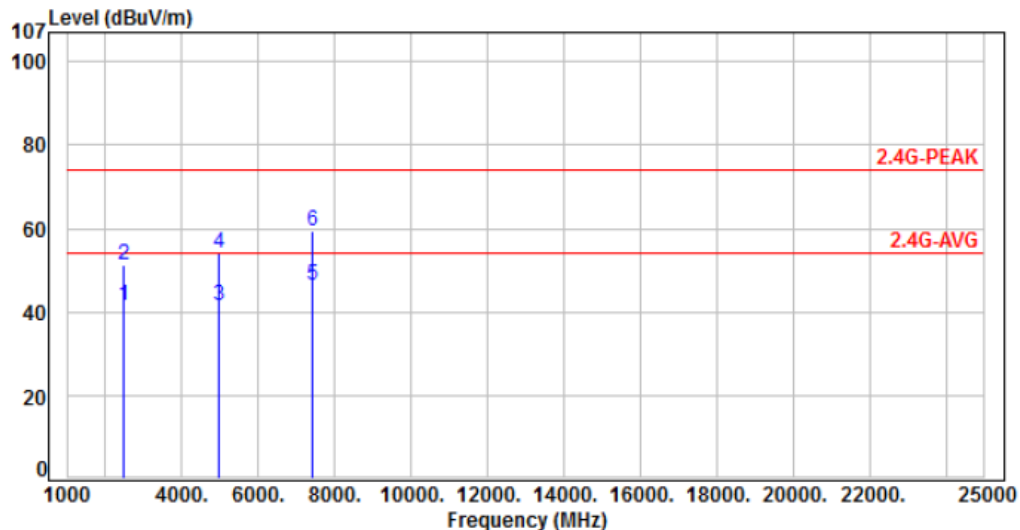
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 21 °C
Test Date	: Jul. 18, 2017	Humidity	: 63 %
Memo	: CH38	Atmospheric Pressure	: 1005 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-0.65	42.29	41.64	54.00	-12.36	Average	150	170	P
2	2483.50	-0.65	52.07	51.42	74.00	-22.58	Peak	150	170	P
3	4954.70	8.50	33.03	41.53	54.00	-12.47	Average	170	200	P
4	4954.70	8.50	45.55	54.05	74.00	-19.95	Peak	170	200	P
5	7432.05	12.65	33.83	46.48	54.00	-7.52	Average	152	230	P
6	7432.05	12.65	46.83	59.48	74.00	-14.52	Peak	152	230	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 Spurious Emission (Conducted)

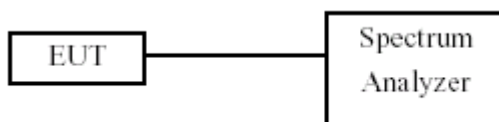
7.1 Test Limit

Below -20dB of the highest emission level of operating band (In 100 kHz Resolution Bandwidth)

7.2 Test Procedure

- The transmitter output was connected to the spectrum analyzer via a low lose cable.
- Set RBW of spectrum analyzer to 100 KHz and VBW of spectrum analyzer to 300 KHz with convenient frequency span including 100 KHz bandwidth from band edge.
- Peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20dB relative to the maximum measured in-band peak PSD level.
- The band edges was measured and recorded.

7.3 Test Setup Layout



7.4 Test Result and Data

Temperature: 23°C

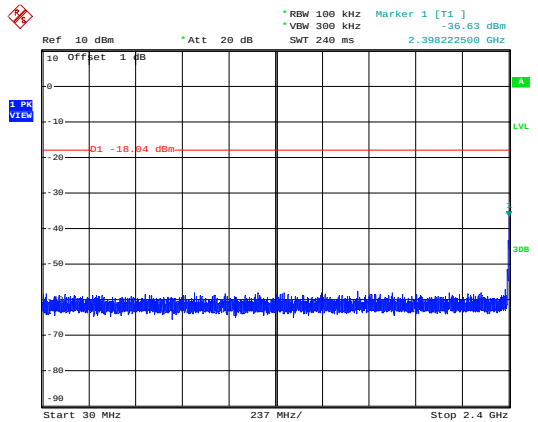
Humidity: 65%

Test Date: Jul. 19, 2017

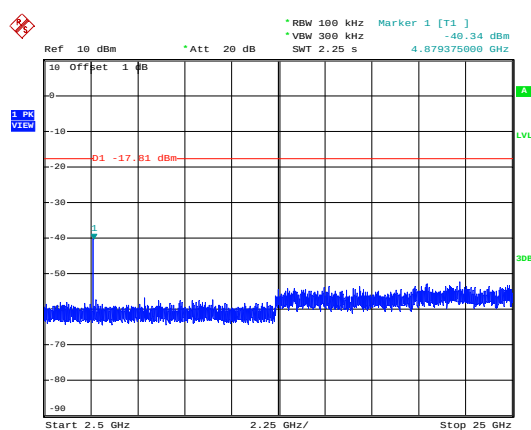
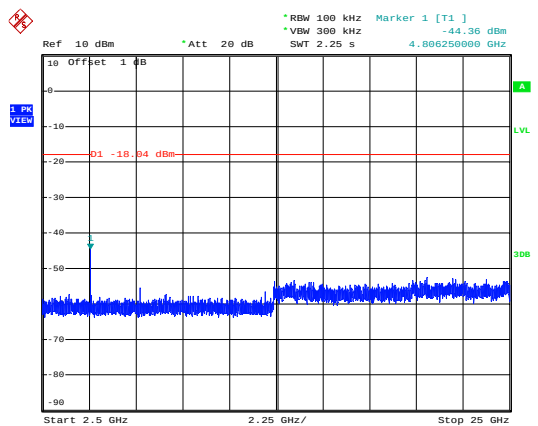
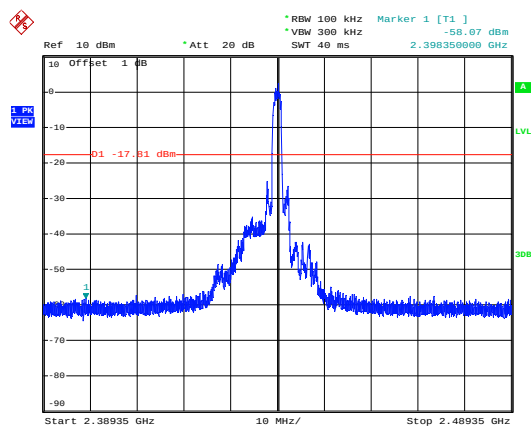
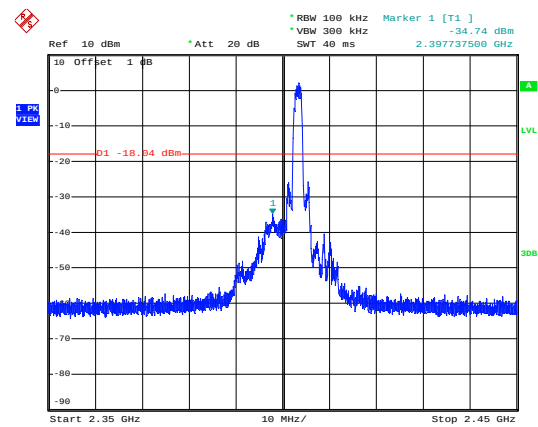
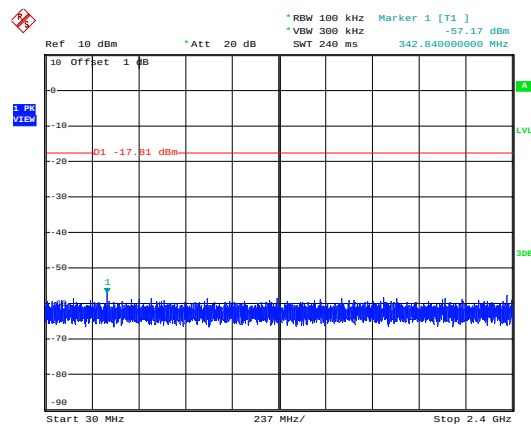
Note: Test plots refer to the following pages.



Modulation Type: GFSK, ANT 1
CH01

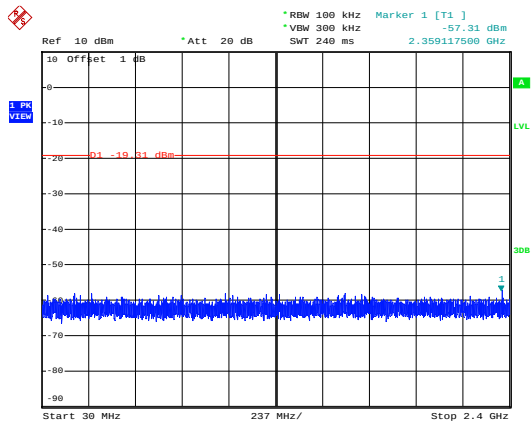


Modulation Type: GFSK, ANT 1
CH19

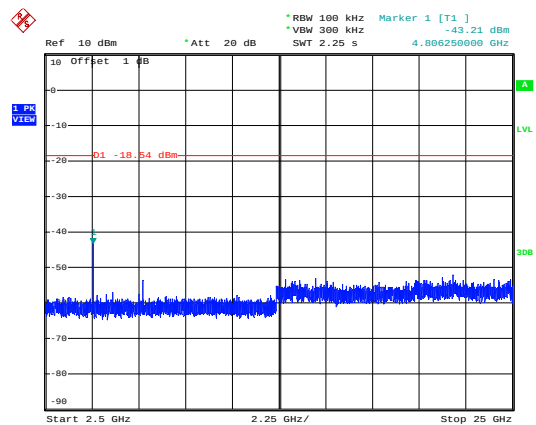
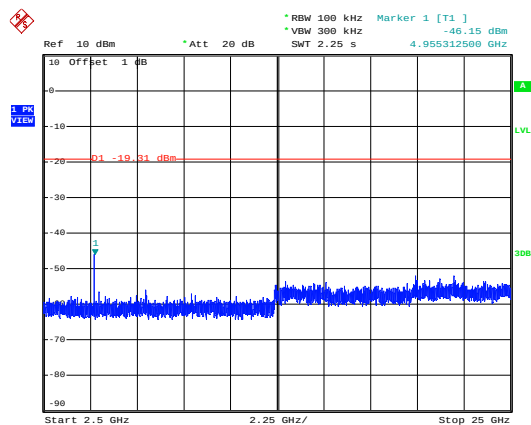
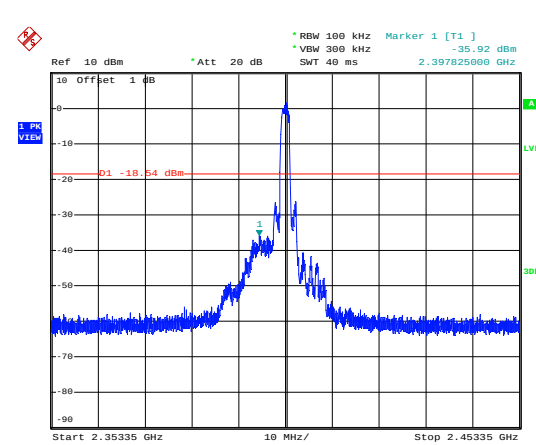
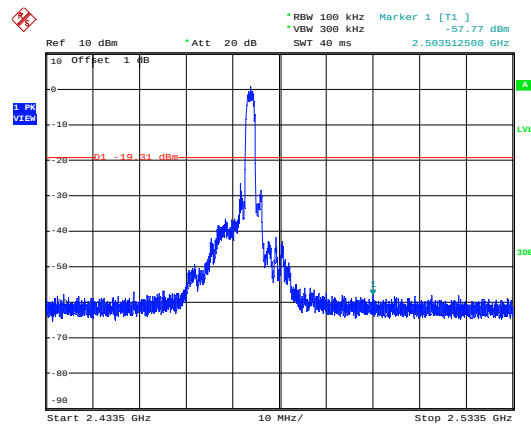
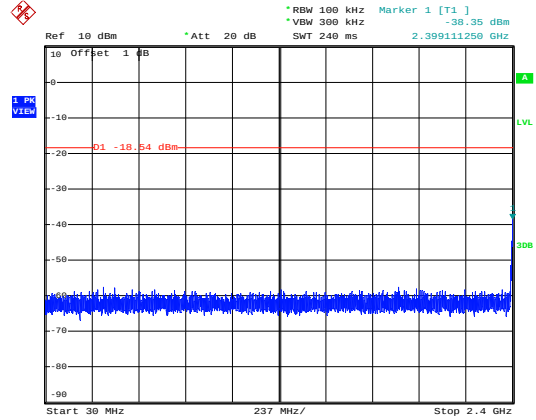




Modulation Type: GFSK, ANT 1
CH38

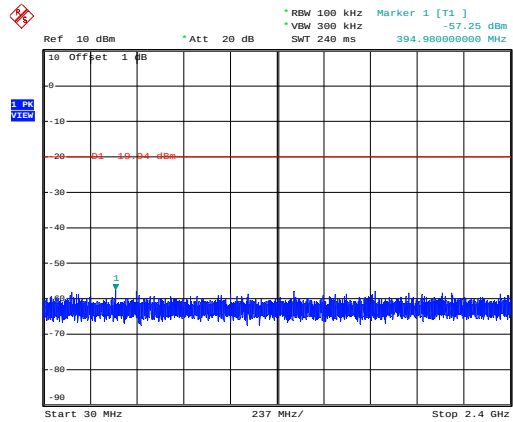


Modulation Type: GFSK, ANT 2
CH01

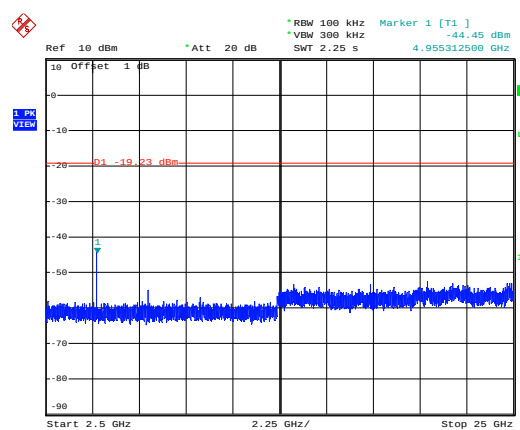
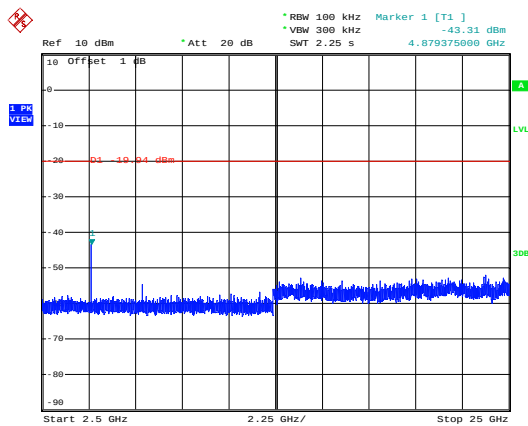
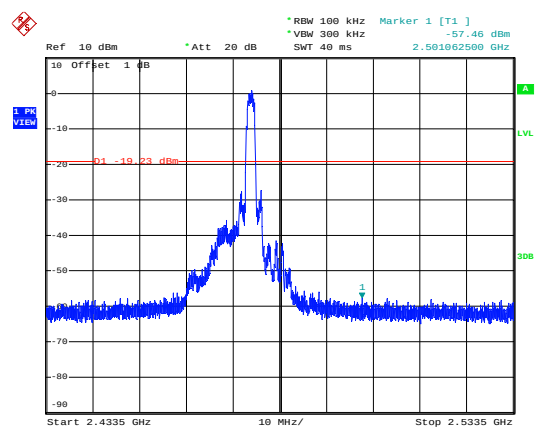
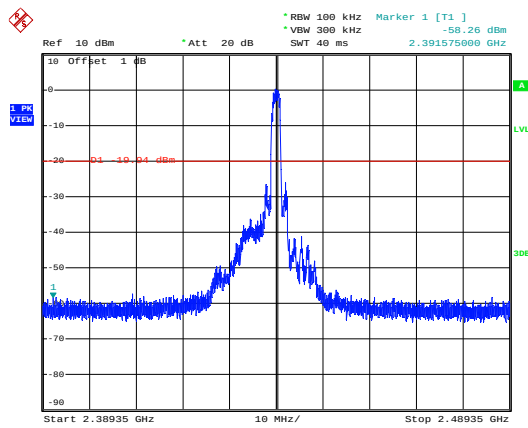
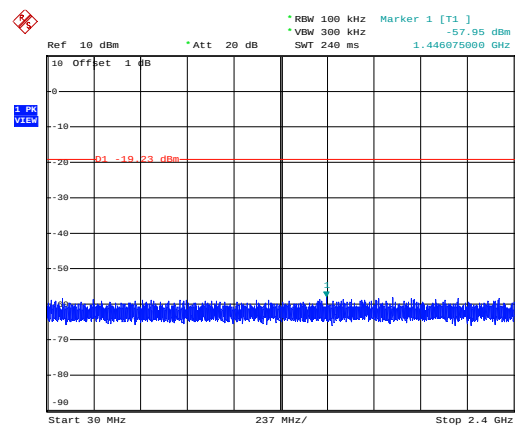




Modulation Type: GFSK, ANT 2
CH19



Modulation Type: GFSK, ANT 2
CH38





8. 6dB Bandwidth Measurement Data

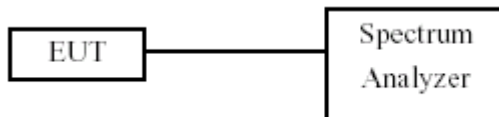
8.1 Test Limit

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

8.2 Test Procedures

- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 1~5% of the emission bandwidth and VBW $\geq 3 \times$ RBW.
- The 6 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.
- The 6dB Bandwidth was measured and recorded.

8.3 Test Setup Layout



8.4 Test Result and Data

Temperature: 23°C

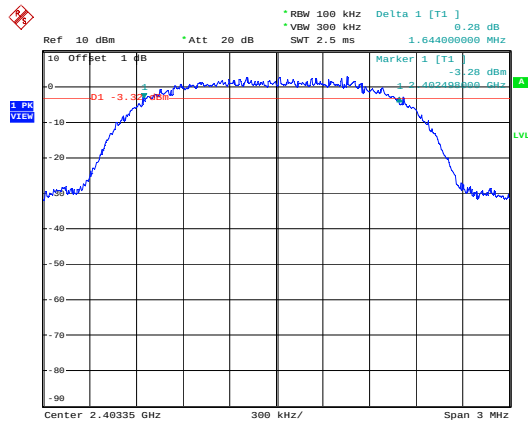
Humidity: 65%

Test Date: Jul. 19, 2017

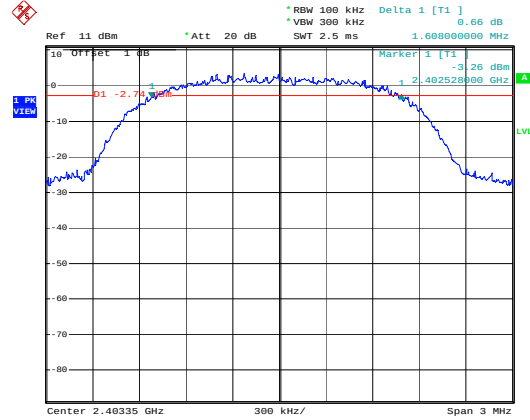
Modulation Type	Channel	Frequency (MHz)	6dB Bandwidth (KHz)	
			ANT 1	ANT 2
GFSK	01	2403.35	1644.00	1608.00
	19	2439.35	1602.00	1620.00
	38	2477.35	1602.00	1602.00



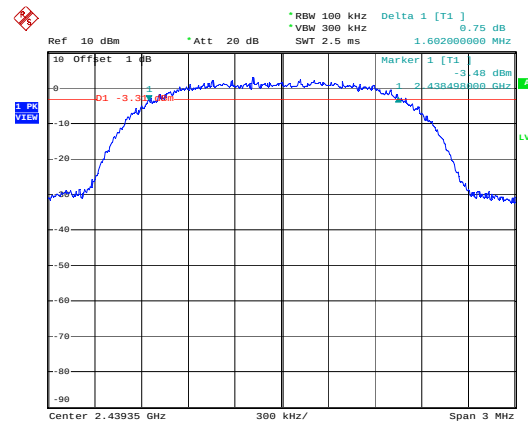
Modulation Type: GFSK, ANT 1
CH01



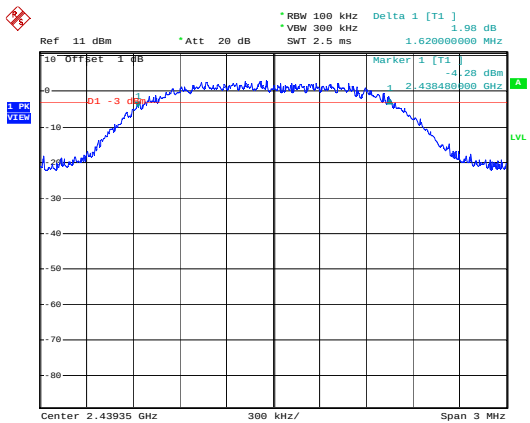
Modulation Type: GFSK, ANT 2
CH01



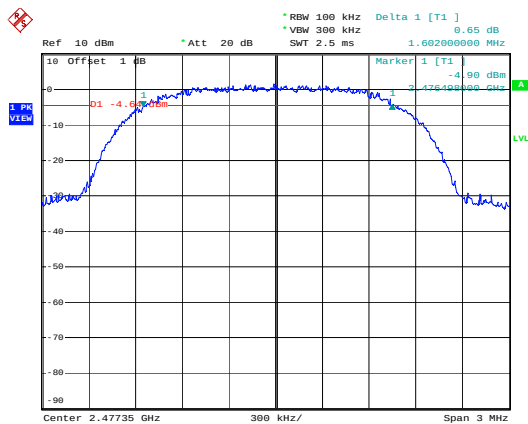
CH19



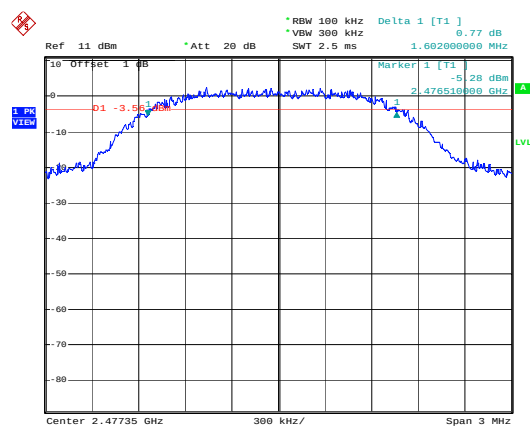
CH19



CH38



CH38





9. Maximum Peak and Average Output Power

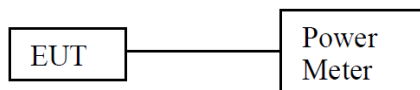
9.1 Test Limit

The Maximum Peak Output Power Measurement is 30dBm.

9.2 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.

9.3 Test Setup Layout



9.4 Test Result and Data

Temperature: 23°C

Humidity: 68%

Test Date: Jul. 19, 2017

Modulation Type	Channel	Frequency (MHz)	Power Output (dBm)			
			ANT 1		ANT 2	
			Peak	AVG.	Peak	AVG.
GFSK	01	2403.35	6.08	4.00	6.05	3.98
	19	2439.35	5.58	3.45	5.55	3.42
	38	2477.35	4.91	2.70	5.00	2.78

Modulation Type	Channel	Frequency (MHz)	Power Output (mW)			
			ANT 1		ANT 2	
			Peak	AVG.	Peak	AVG.
GFSK	01	2403.35	4.055	2.512	4.027	2.500
	19	2439.35	3.614	2.213	3.589	2.198
	38	2477.35	3.097	1.862	3.162	1.897



10. Power Spectral Density

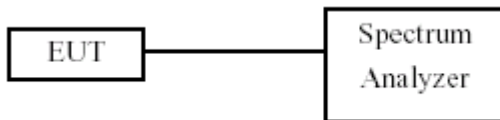
10.1 Test Limit

The Maximum of Power Spectral Density Measurement is 8dBm.

10.2 Test Procedures

- The transmitter output was connected to spectrum analyzer.
- The spectrum analyzer's resolution bandwidth were set at 3KHz RBW and 30KHz VBW as that of the fundamental frequency. Set the sweep time=auto couple.
- The power spectral density was measured and recorded.

10.3 Test Setup Layout



10.4 Test Result and Data

Temperature: 23°C

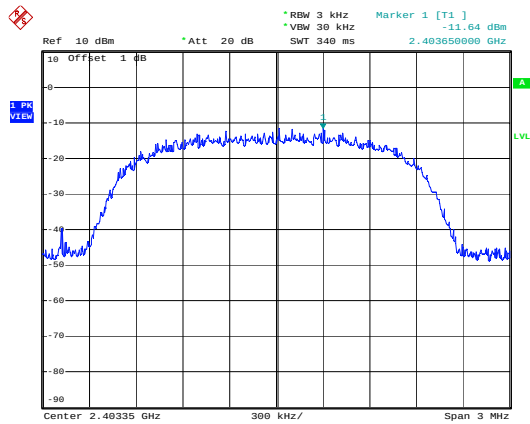
Humidity: 65%

Test Date: Jul. 19, 2017

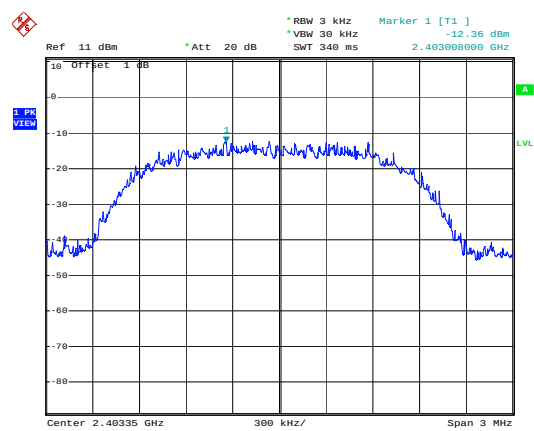
Modulation Type	Channel	Frequency (MHz)	Maximum Power Density of 3 kHz Bandwidth (dBm)	
			ANT 1	ANT 2
GFSK	01	2403.35	-11.64	-12.36
	19	2439.35	-11.75	-11.24
	38	2477.35	-12.57	-12.39



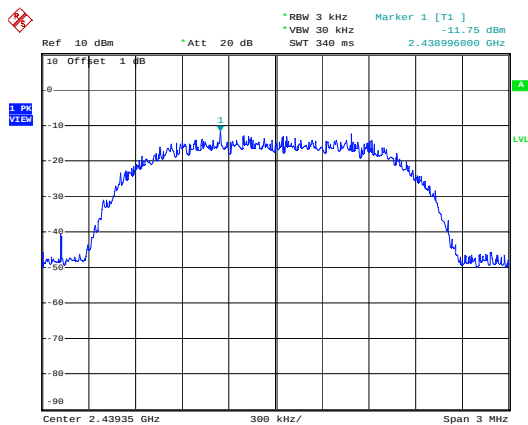
Modulation Type: GFSK, ANT 1
CH01



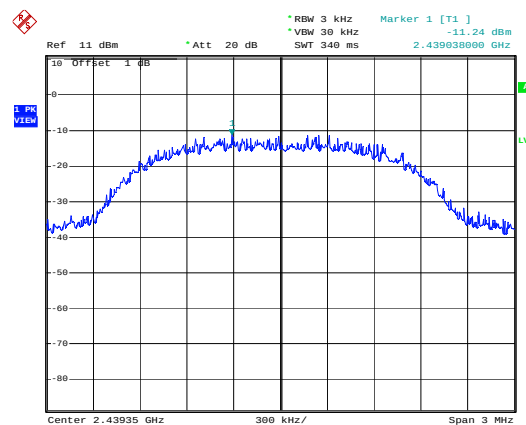
Modulation Type: GFSK, ANT 2
CH01



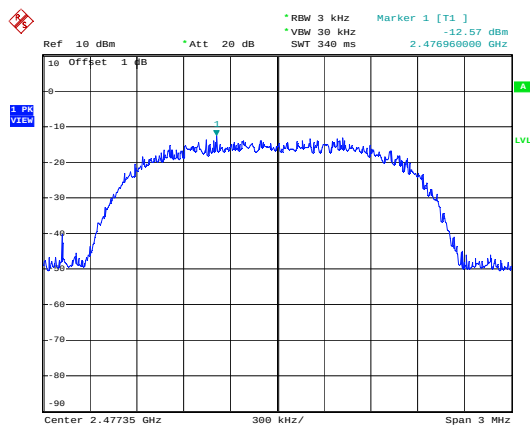
CH19



CH19



CH38



CH38

