



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 Aug. 09, 2016 and the testing was carried out on Aug. 16, 2016 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:



Ray Chou / 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



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)(2)	. 6dB Bandwidth	Pass
15.247(b)	. Maximum Peak Output Power	Pass
15.247(e)	. Power Spectral Density	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

Modulation Type	GFSK
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	2016/03/28	2017/03/27
LISN	Schwarzbeck	NSLK 8127	8127-516	2016/03/11	2017/03/10
LISN	Schwarzbeck	NSLK 8127	8127-740	2015/09/03	2016/09/02
Pulse Limiter	R&S	ESH3-Z2	101934	2016/03/09	2017/03/08
Bilog Antenna	Schwarzbeck	VULB9168	369	2016/03/22	2017/03/21
Active Loop Antenna	EMCO	6507	40855	2016/03/11	2017/03/10
Horn Antenna	EMCO	3115	31601	2015/09/02	2016/09/01
Horn Antenna	EMCO	3116	31589	2016/03/22	2017/03/21
EXA Signal Analyzer	KEYSIGHT	N9010A	MY54200207	2016/03/16	2017/03/15
Preamplifier	EM	EM330	060660	2016/03/16	2017/03/15
Preamplifier	Agilent	8449B	3008A01954	2016/03/04	2017/03/03
Preamplifier	MITEQ	AMF-7D-001 0100-30-10P	1860212	2016/03/16	2017/03/15
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2015/11/04	2016/11/03
MXG MW Analog Signal Generator	KEYSIGHT	N5183A	MY50142931	2016/03/18	2017/03/17
Spectrum Analyzer	R&S	FSP40	100219	2015/09/01	2016/08/31
Bluetooth Tester	R&S	CBT	101133	2016/03/18	2017/03/17
Attenuator	KEYSIGHT	8491B	MY39250703	2016/03/07	2017/03/06
Rotary Attenuator	Agilent	8494B	MY42154466	2016/03/08	2017/03/07
Rotary Attenuator	Agilent	8495B	MY42146680	2016/03/08	2017/03/07
Temp & Humi chamber	T-MACHINE	TMJ-9712	T-12-040111	2015/09/08	2016/09/07
Series Power Meter	Anritsu	ML2495A	1224005	2016/03/03	2017/03/02
Power Sensor	Anritsu	MA2411B	1207295	2016/03/03	2017/03/02
Software	Farad	Ez-EMC	ver.ct3a1	N/A	N/A
Software	AUDIX	E3	vct-3a1	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

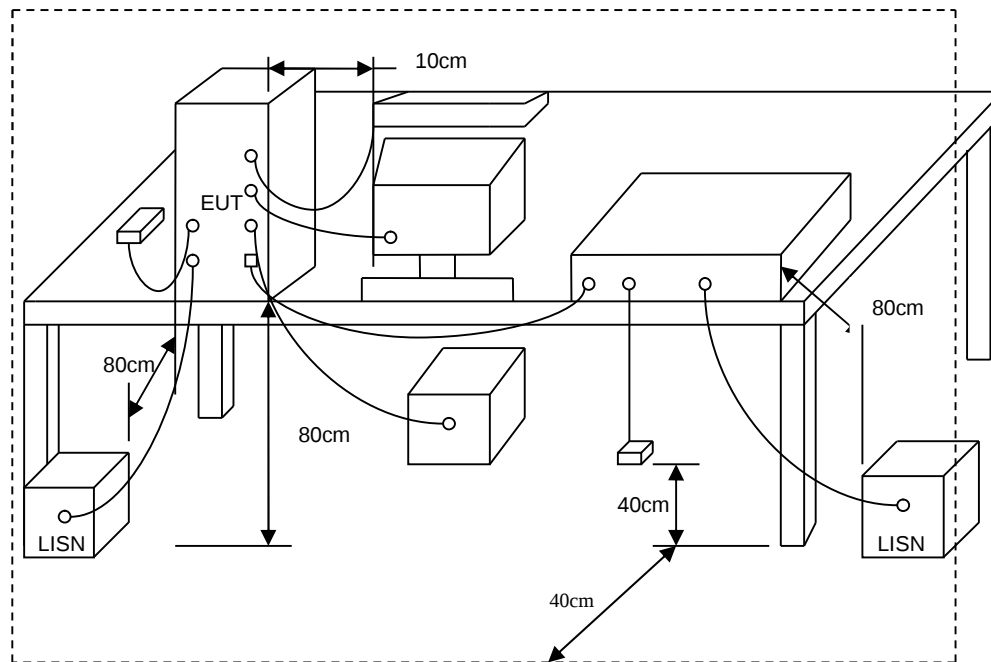
*Decreases with the logarithm of the frequency.

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.



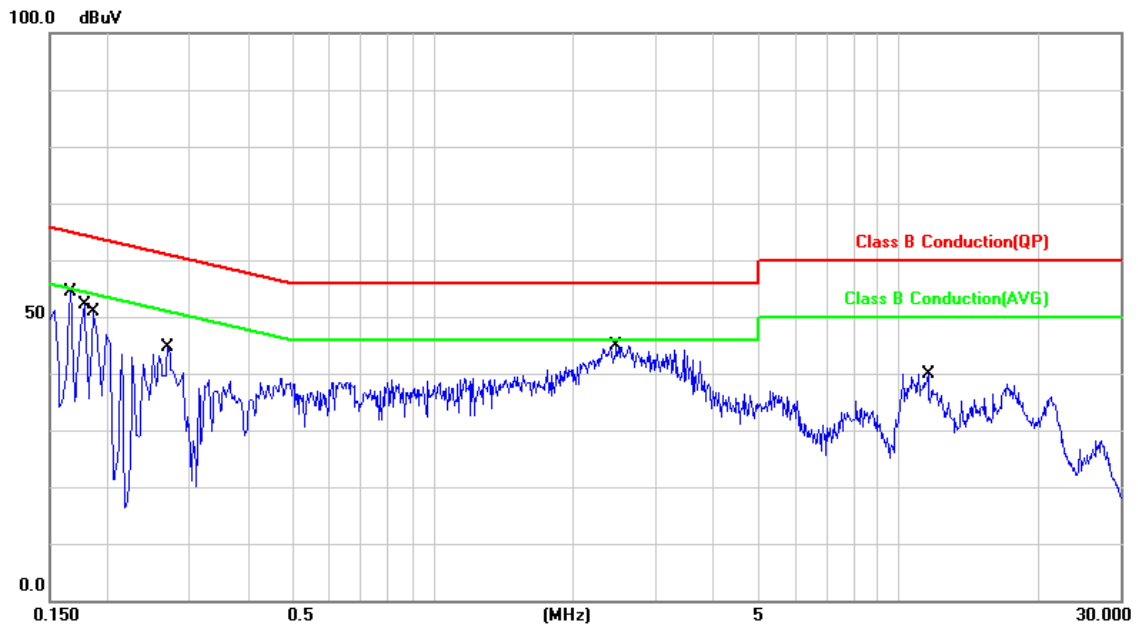
5.3 Typical Test Setup





5.4 Test Result and Data

Power	: DC 5V	Pol/Phase	: LINE
Test Mode	: TX	Temperature	: 25 °C
Test date	: Aug. 10, 2016	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

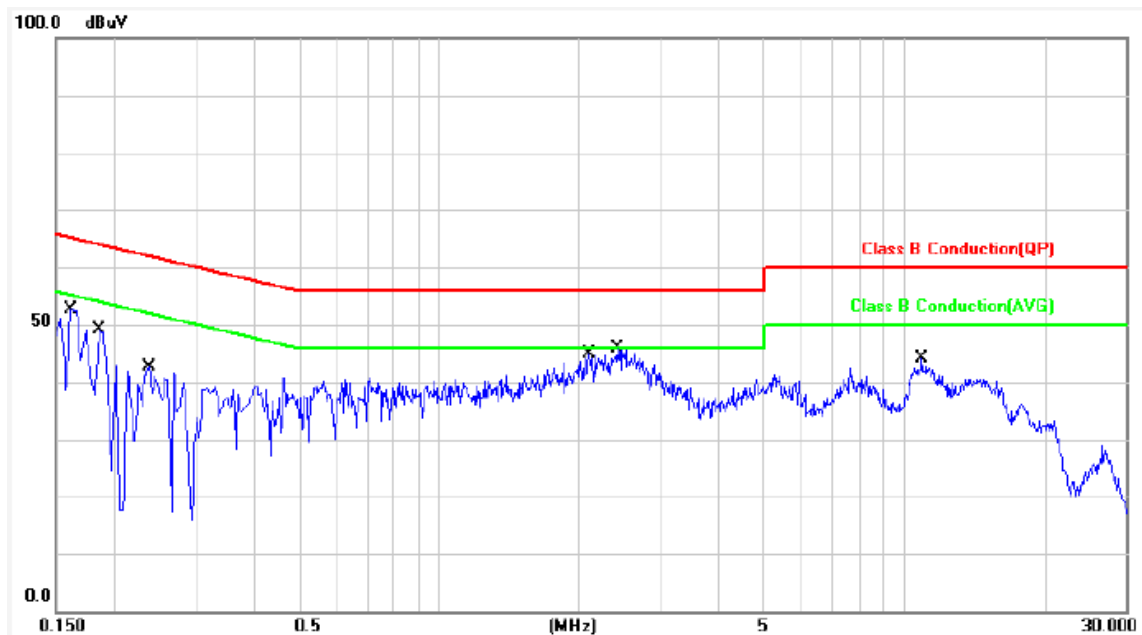
Note: Level = Reading + Factor

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	: Aug. 10, 2016	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



5.5 Test Photographs

Front View



Rear View





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

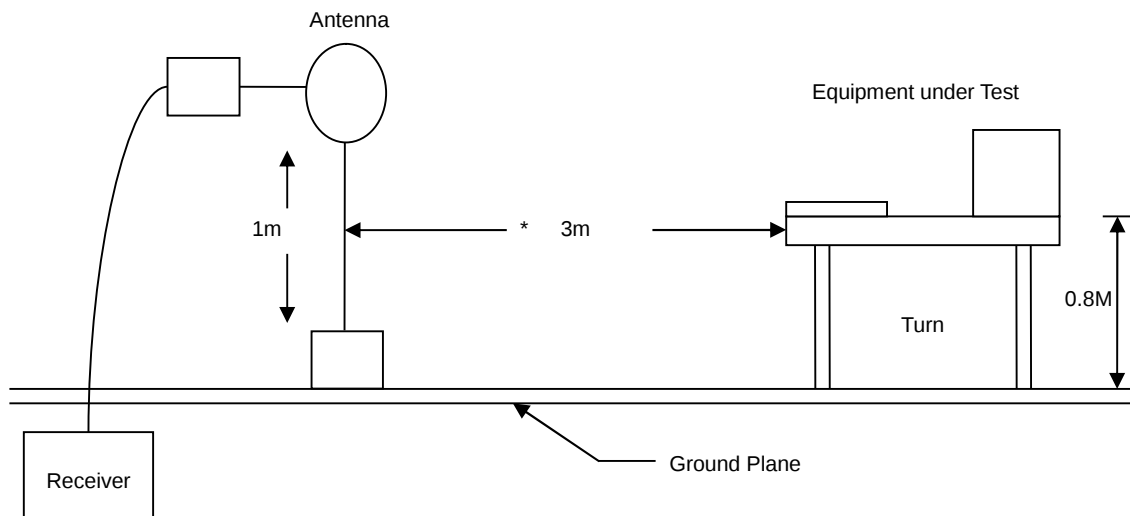
6.2 Test Procedures

- 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.

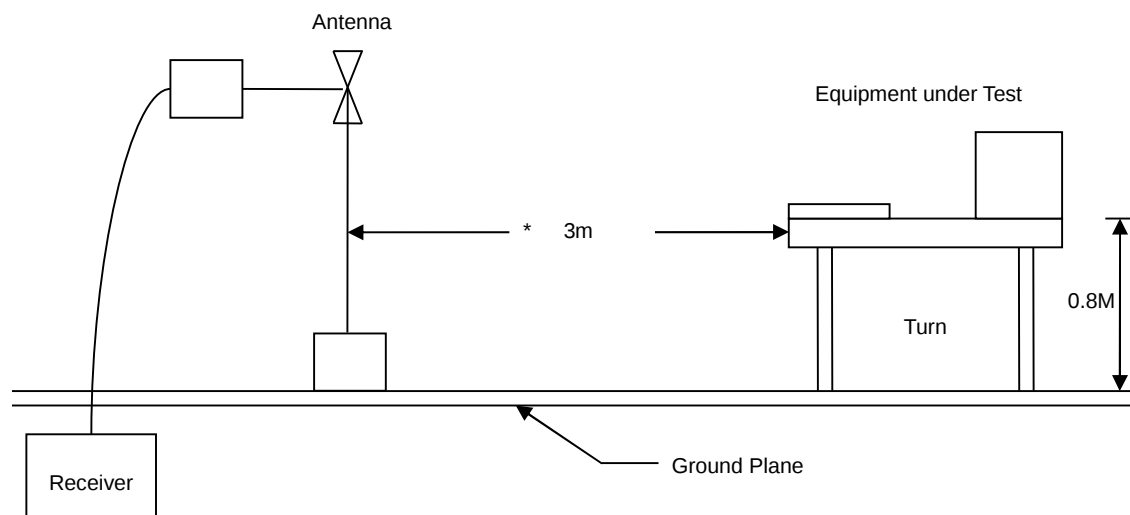


6.3 Typical Test Setup

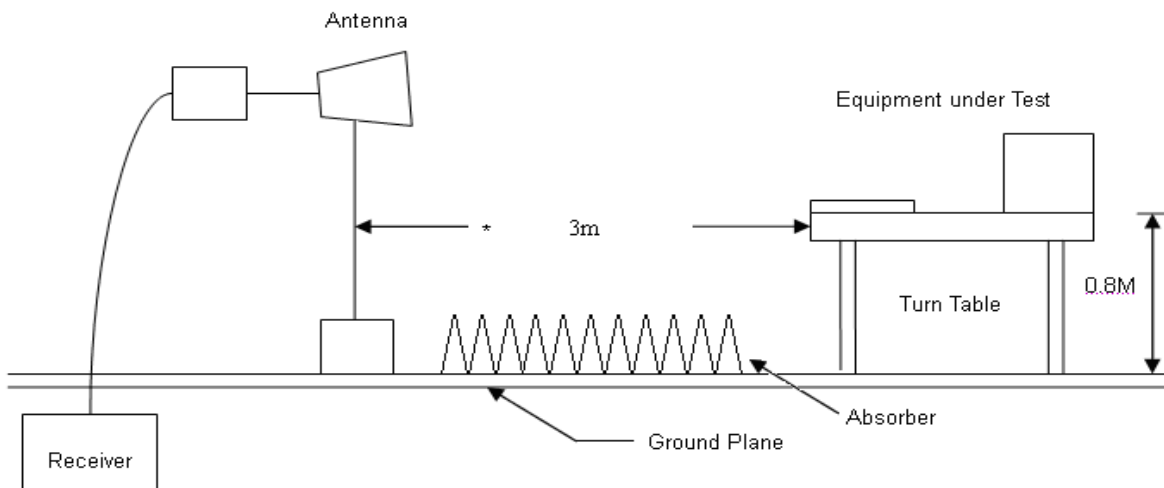
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup



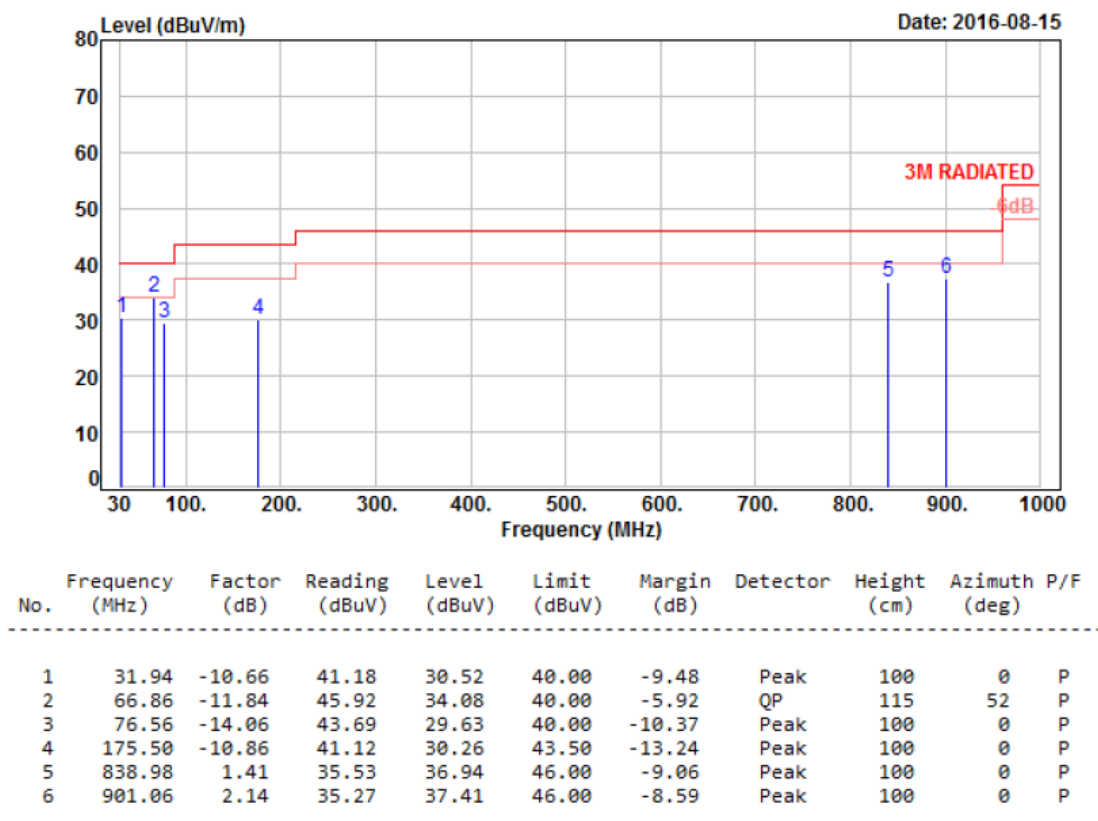


6.4 Test Result and Data (9kHz ~ 30MHz)

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	: 24 °C
Test Date	: Aug. 15, 2016	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1004 hPa



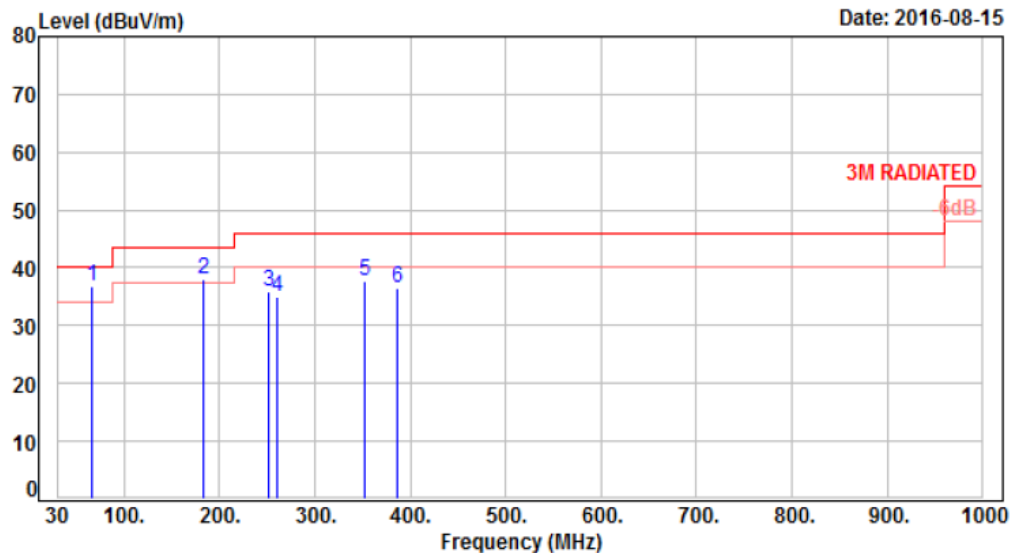
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 15, 2016	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1004 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	66.86	-11.84	48.76	36.92	40.00	-3.08	QP	118	125	P
2	183.26	-11.64	49.58	37.94	43.50	-5.56	QP	132	124	P
3	251.16	-10.93	46.94	36.01	46.00	-9.99	Peak	100	0	P
4	260.86	-10.47	45.33	34.86	46.00	-11.14	Peak	100	0	P
5	352.04	-7.71	45.31	37.60	46.00	-8.40	Peak	100	0	P
6	386.96	-6.74	43.23	36.49	46.00	-9.51	Peak	100	0	P

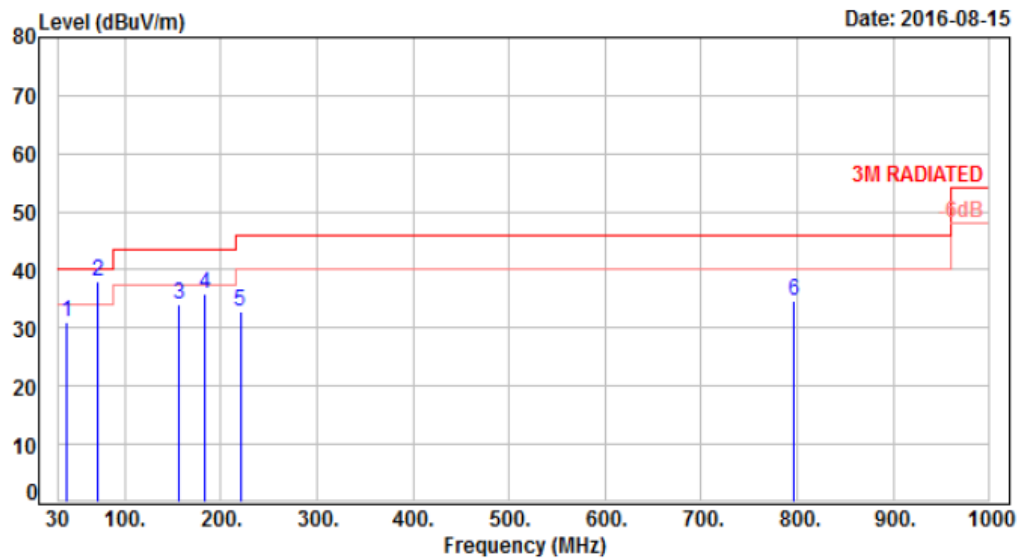
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 15, 2016	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1004 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	39.70	-10.15	41.29	31.14	40.00	-8.86	Peak	100	0	P
2	71.71	-12.89	50.98	38.09	40.00	-1.91	QP	116	42	P
3	156.10	-9.95	44.00	34.05	43.50	-9.45	Peak	100	0	P
4	183.26	-11.64	47.52	35.88	43.50	-7.62	QP	112	69	P
5	220.12	-12.67	45.50	32.83	46.00	-13.17	Peak	100	0	P
6	796.30	0.78	33.82	34.60	46.00	-11.40	Peak	100	0	P

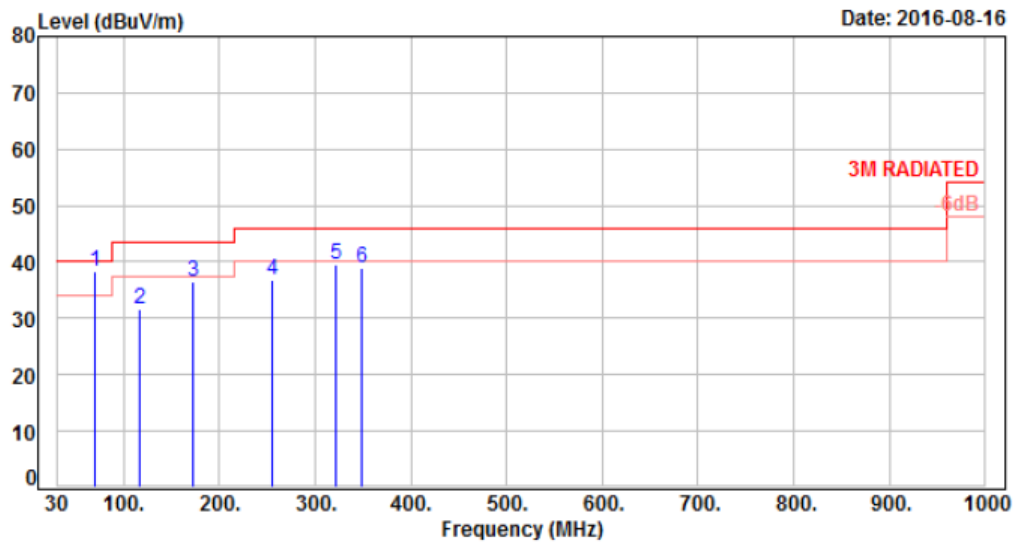
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 15, 2016	Humidity	: 62 %
Memo	:	Atmospheric Pressure	: 1004 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	51.06	38.41	40.00	-1.59	QP	172	154	P
2	117.30	-12.58	44.22	31.64	43.50	-11.86	Peak	100	0	P
3	171.62	-10.41	46.82	36.41	43.50	-7.09	QP	113	125	P
4	255.04	-10.74	47.66	36.92	46.00	-9.08	Peak	100	0	P
5	321.00	-8.53	47.97	39.44	46.00	-6.56	QP	136	98	P
6	348.16	-7.81	46.83	39.02	46.00	-6.98	QP	142	105	P

Note: Level=Reading+Factor

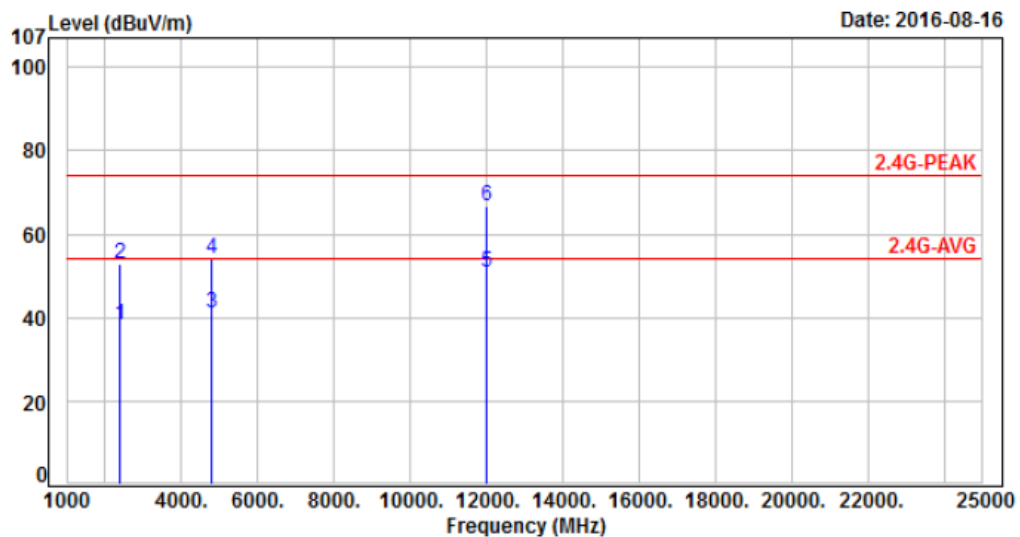
Margin=Level-Limit

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	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH01	Atmospheric Pressure	: 1004 hPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-0.94	39.28	38.34	54.00	-15.66	Average	191	101	P
2	2390.00	-0.94	53.64	52.70	74.00	-21.30	Peak	191	101	P
3	4806.70	7.86	33.21	41.07	54.00	-12.93	Average	201	124	P
4	4806.70	7.86	46.18	54.04	74.00	-19.96	Peak	201	124	P
5	12016.75	19.76	31.19	50.95	54.00	-3.05	Average	180	87	P
6	12016.75	19.76	47.06	66.82	74.00	-7.18	Peak	180	87	P

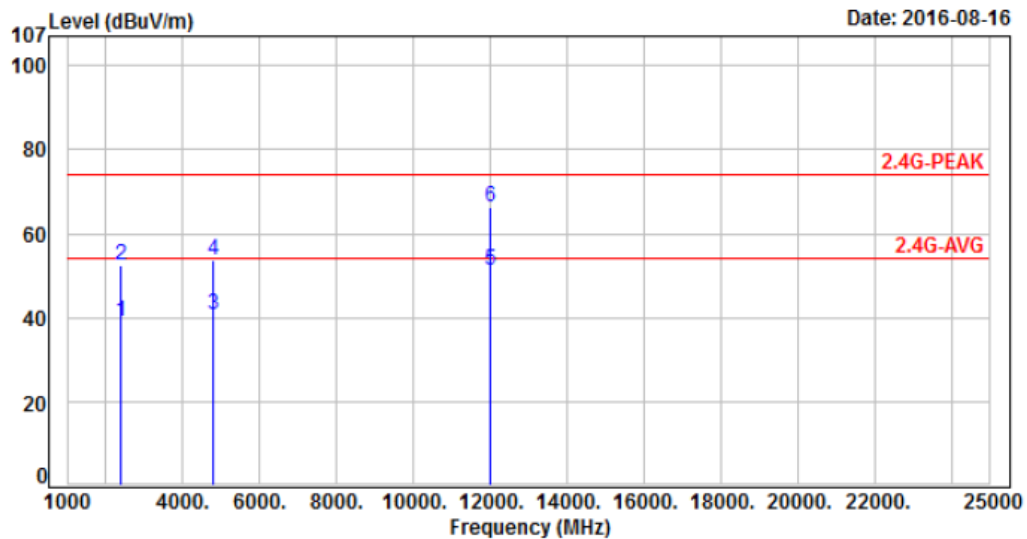
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH01	Atmospheric Pressure	: 1004 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	39.86	38.90	54.00	-15.10	Average	134	121	P
2	2390.00	-0.96	53.61	52.65	74.00	-21.35	Peak	134	121	P
3	4806.70	7.83	32.87	40.70	54.00	-13.30	Average	175	92	P
4	4806.70	7.83	45.89	53.72	74.00	-20.28	Peak	175	92	P
5	12016.75	20.05	31.12	51.17	54.00	-2.83	Average	134	172	P
6	12016.75	20.05	46.45	66.50	74.00	-7.50	Peak	134	172	P

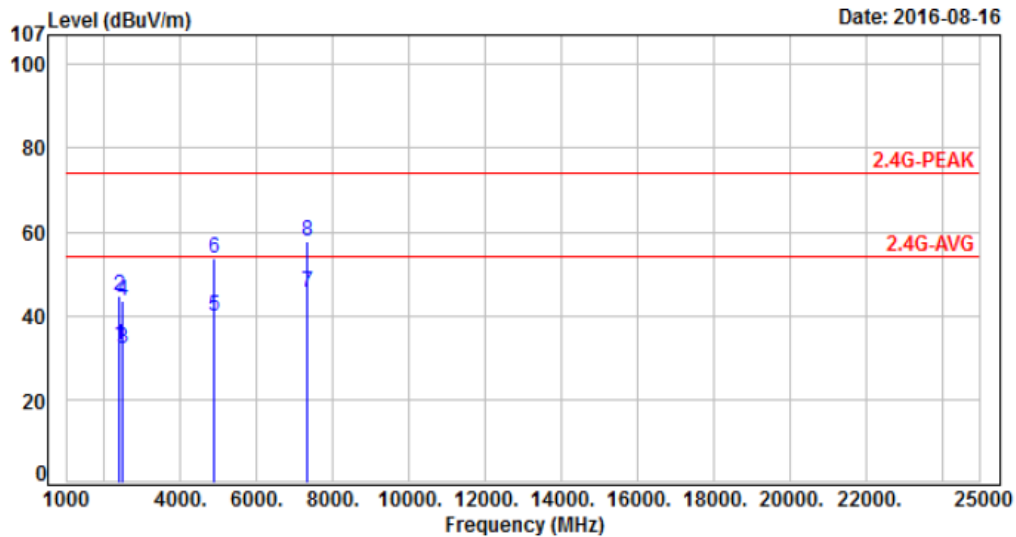
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH19	Atmospheric Pressure	: 1004 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	33.98	33.02	54.00	-20.98	Average	155	114	P
2	2390.00	-0.96	45.52	44.56	74.00	-29.44	Peak	155	114	P
3	2483.50	-0.65	32.89	32.24	54.00	-21.76	Average	133	102	P
4	2483.50	-0.65	44.26	43.61	74.00	-30.39	Peak	133	102	P
5	4878.70	8.16	31.79	39.95	54.00	-14.05	Average	126	198	P
6	4878.70	8.16	45.52	53.68	74.00	-20.32	Peak	126	198	P
7	7318.05	12.29	33.22	45.51	54.00	-8.49	Average	144	85	P
8	7318.05	12.29	45.67	57.96	74.00	-16.04	Peak	144	85	P

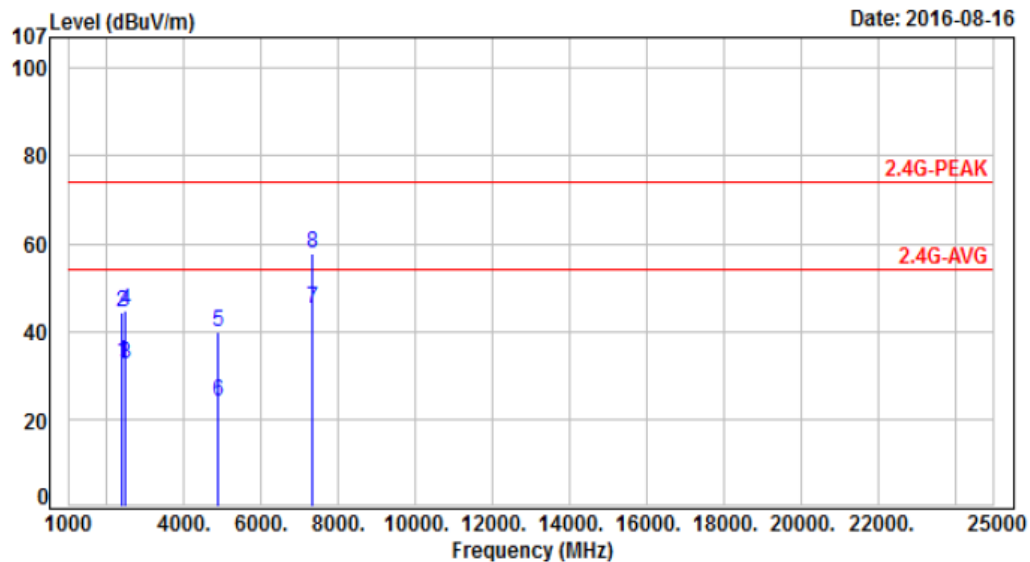
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH19	Atmospheric Pressure	: 1004 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	33.86	32.90	54.00	-21.10	Average	255	132	P
2	2390.00	-0.96	45.16	44.20	74.00	-29.80	Peak	255	132	P
3	2483.50	-0.65	32.99	32.34	54.00	-21.66	Average	279	144	P
4	2483.50	-0.65	45.22	44.57	74.00	-29.43	Peak	278	144	P
5	4878.70	8.16	31.65	39.81	54.00	-14.19	Average	166	198	P
6	4878.70	8.16	15.82	23.98	74.00	-50.02	Peak	166	198	P
7	7318.05	12.29	33.07	45.36	54.00	-8.64	Average	132	179	P
8	7318.05	12.29	45.34	57.63	74.00	-16.37	Peak	132	179	P

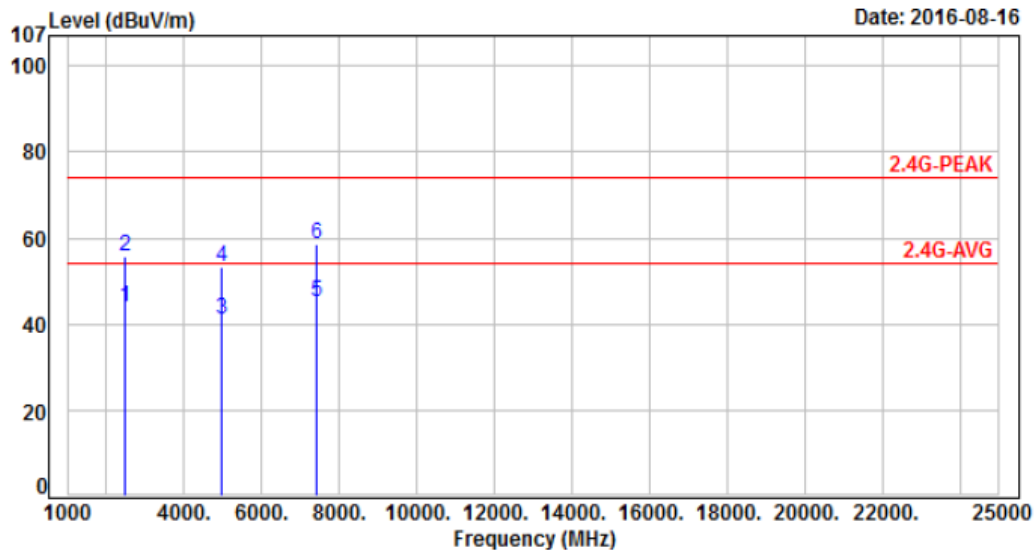
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH38	Atmospheric Pressure	: 1004 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	44.42	43.77	54.00	-10.23	Average	167	103	P
2	2483.50	-0.65	56.57	55.92	74.00	-18.08	Peak	167	103	P
3	4954.70	8.50	32.46	40.96	54.00	-13.04	Average	169	202	P
4	4954.70	8.50	44.70	53.20	74.00	-20.80	Peak	169	202	P
5	7432.05	12.65	32.54	45.19	54.00	-8.81	Average	188	159	P
6	7432.05	12.65	45.78	58.43	74.00	-15.57	Peak	188	159	P

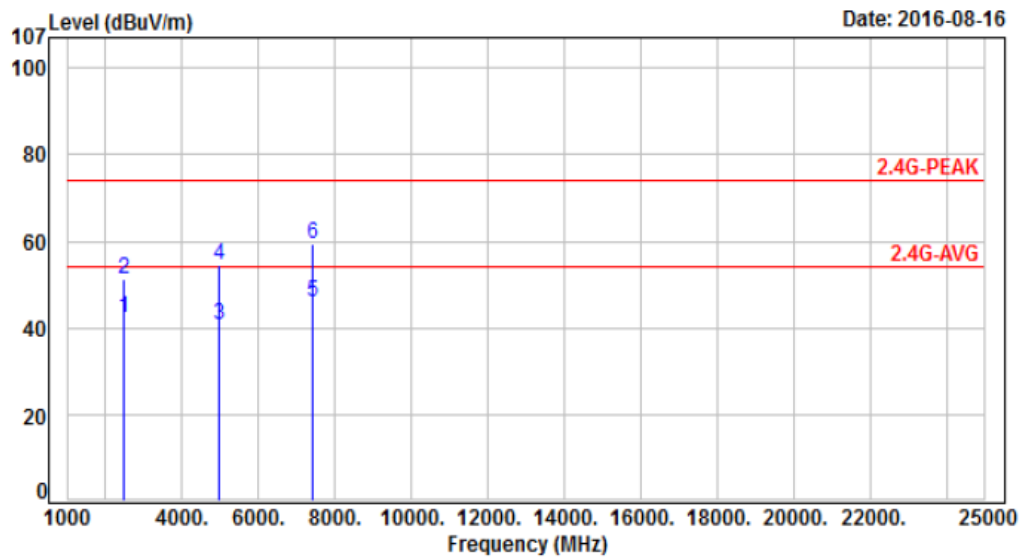
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH38	Atmospheric Pressure	: 1004 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	42.86	42.21	54.00	-11.79	Average	138	159	P
2	2483.50	-0.65	52.01	51.36	74.00	-22.64	Peak	138	159	P
3	4954.70	8.50	32.27	40.77	54.00	-13.23	Average	166	182	P
4	4954.70	8.50	45.99	54.49	74.00	-19.51	Peak	166	182	P
5	7432.05	12.65	33.40	46.05	54.00	-7.95	Average	137	202	P
6	7432.05	12.65	46.70	59.35	74.00	-14.65	Peak	137	202	P

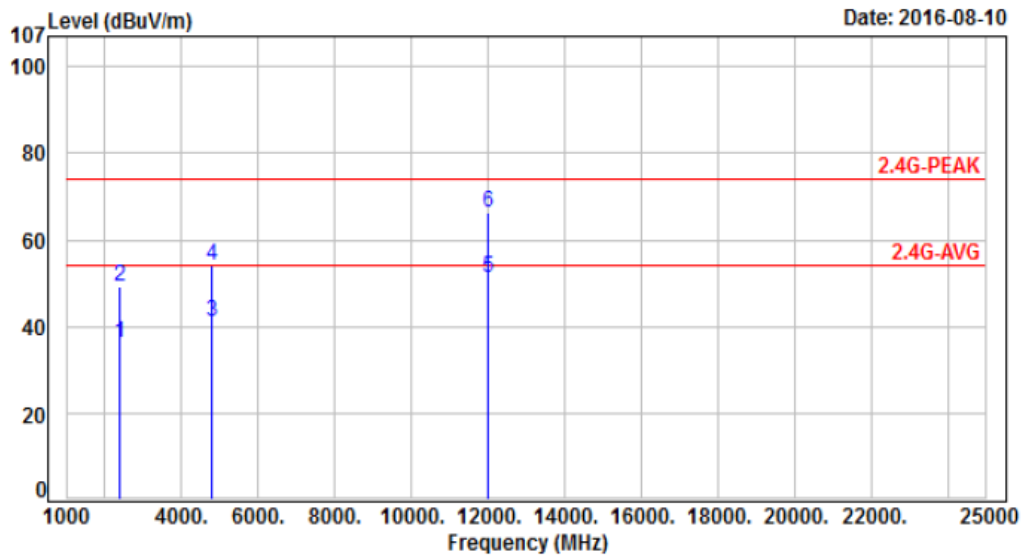
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 10, 2016	Humidity	: 62 %
Memo	: CH01	Atmospheric Pressure	: 1004 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	37.33	36.37	54.00	-17.63	Average	218	60	P
2	2390.00	-0.96	50.21	49.25	74.00	-24.75	Peak	218	60	P
3	4806.70	7.83	33.40	41.23	54.00	-12.77	Average	168	83	P
4	4806.70	7.83	46.46	54.29	74.00	-19.71	Peak	168	83	P
5	12016.75	20.05	31.16	51.21	54.00	-2.79	Average	154	122	P
6	12016.75	20.05	46.37	66.42	74.00	-7.58	Peak	154	122	P

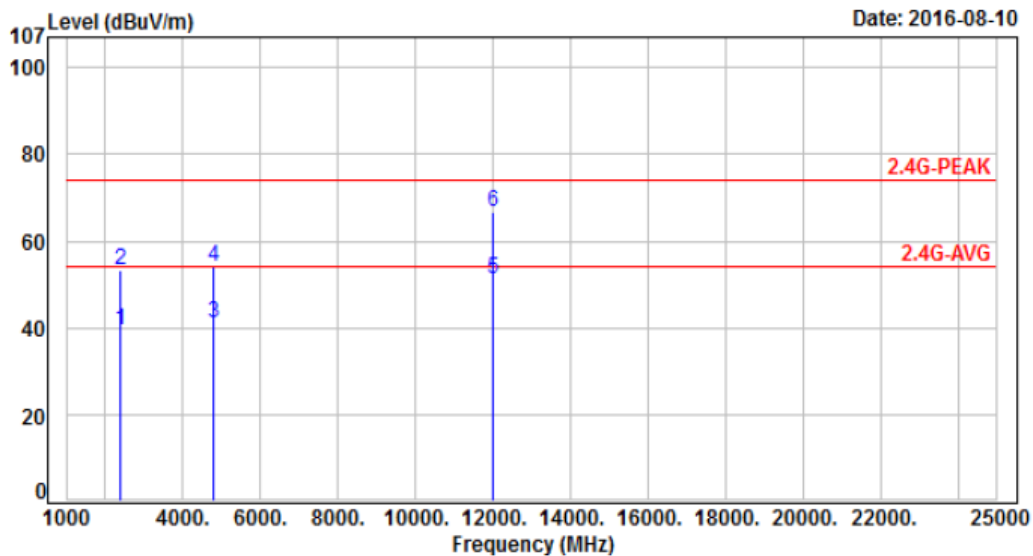
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 10, 2016	Humidity	: 62 %
Memo	: CH01	Atmospheric Pressure	: 1004 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	40.33	39.37	54.00	-14.63	Average	159	144	P
2	2390.00	-0.96	54.09	53.13	74.00	-20.87	Peak	159	144	P
3	4806.70	7.83	33.26	41.09	54.00	-12.91	Average	189	78	P
4	4806.70	7.83	46.17	54.00	74.00	-20.00	Peak	189	78	P
5	12016.75	20.05	31.30	51.35	54.00	-2.65	Average	152	161	P
6	12016.75	20.05	46.62	66.67	74.00	-7.33	Peak	152	161	P

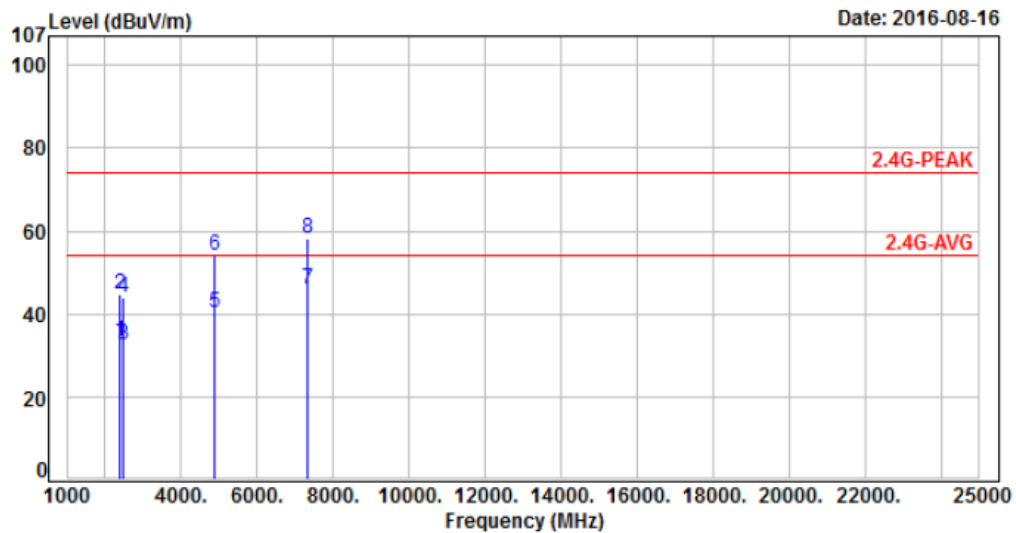
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH19	Atmospheric Pressure	: 1004 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	34.14	33.18	54.00	-20.82	Average	142	91	P
2	2390.00	-0.96	45.75	44.79	74.00	-29.21	Peak	142	91	P
3	2483.50	-0.65	33.20	32.55	54.00	-21.45	Average	172	109	P
4	2483.50	-0.65	44.40	43.75	74.00	-30.25	Peak	172	109	P
5	4878.70	8.16	31.96	40.12	54.00	-13.88	Average	154	228	P
6	4878.70	8.16	45.80	53.96	74.00	-20.04	Peak	154	228	P
7	7318.05	12.29	33.57	45.86	54.00	-8.14	Average	158	126	P
8	7318.05	12.29	45.96	58.25	74.00	-15.75	Peak	158	126	P

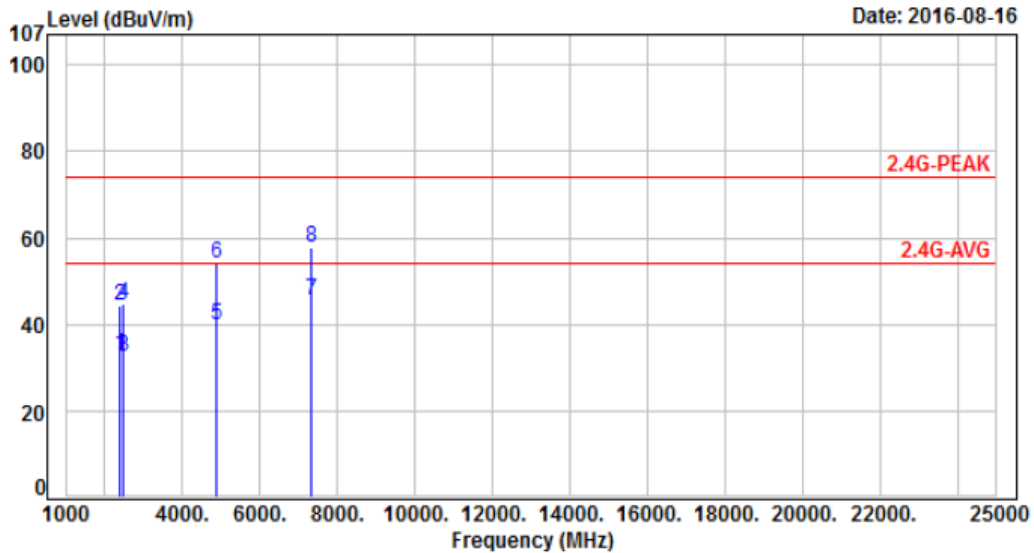
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH19	Atmospheric Pressure	: 1004 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	34.08	33.12	54.00	-20.88	Average	290	157	P
2	2390.00	-0.96	45.48	44.52	74.00	-29.48	Peak	290	157	P
3	2483.50	-0.65	33.36	32.71	54.00	-21.29	Average	253	186	P
4	2483.50	-0.65	45.49	44.84	74.00	-29.16	Peak	253	186	P
5	4878.70	8.16	31.86	40.02	54.00	-13.98	Average	156	224	P
6	4878.70	8.16	46.07	54.23	74.00	-19.77	Peak	156	224	P
7	7318.05	12.29	33.23	45.52	54.00	-8.48	Average	147	189	P
8	7318.05	12.29	45.51	57.80	74.00	-16.20	Peak	147	189	P

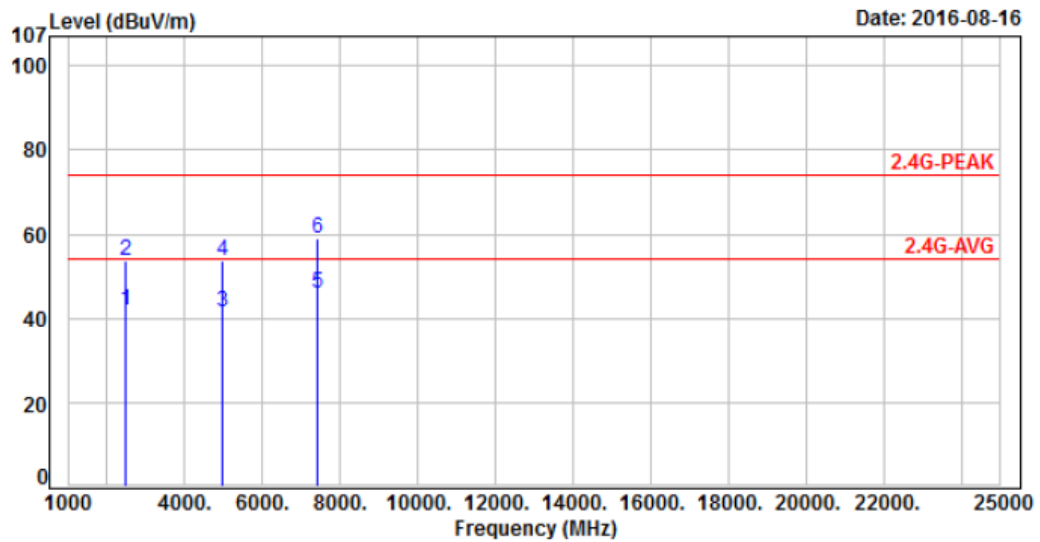
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: VERTICAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH38	Atmospheric Pressure	: 1004 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	42.69	42.04	54.00	-11.96	Average	159	124	P
2	2483.50	-0.65	54.18	53.53	74.00	-20.47	Peak	159	124	P
3	4954.70	8.50	33.07	41.57	54.00	-12.43	Average	152	198	P
4	4954.70	8.50	45.24	53.74	74.00	-20.26	Peak	152	198	P
5	7432.05	12.65	33.20	45.85	54.00	-8.15	Average	149	228	P
6	7432.05	12.65	46.26	58.91	74.00	-15.09	Peak	149	228	P

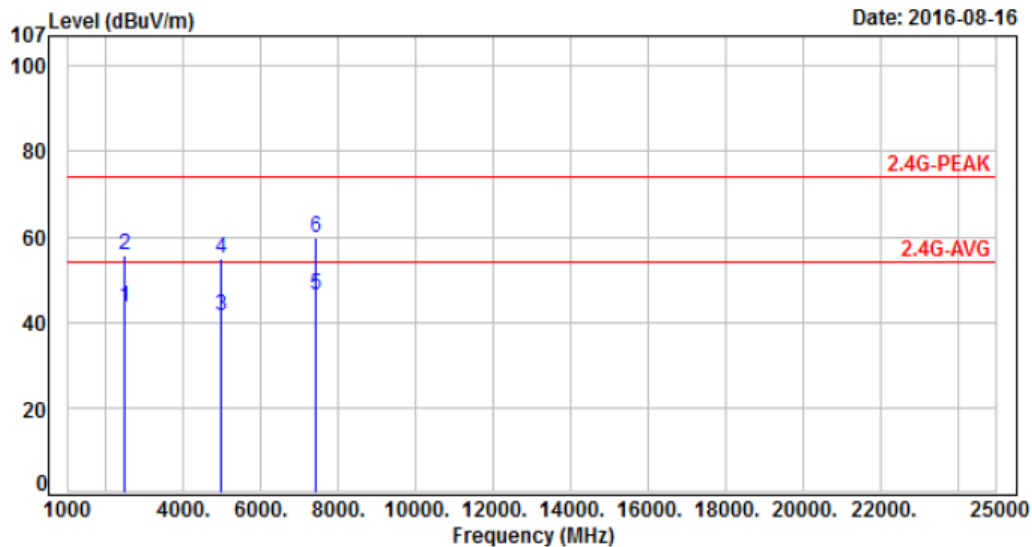
Note: Level=Reading+Factor

Margin=Level-Limit

Factor=Antenna Factor + cable loss - Amplifier Factor



Power	: DC 5V	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 2	Temperature	: 24 °C
Test Date	: Aug. 16, 2016	Humidity	: 62 %
Memo	: CH38	Atmospheric Pressure	: 1004 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	44.30	43.65	54.00	-10.35	Average	185	168	P
2	2483.50	-0.65	56.41	55.76	74.00	-18.24	Peak	185	168	P
3	4954.70	8.50	33.16	41.66	54.00	-12.34	Average	156	142	P
4	4954.70	8.50	46.26	54.76	74.00	-19.24	Peak	156	142	P
5	7432.05	12.65	33.65	46.30	54.00	-7.70	Average	167	159	P
6	7432.05	12.65	46.95	59.60	74.00	-14.40	Peak	167	159	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

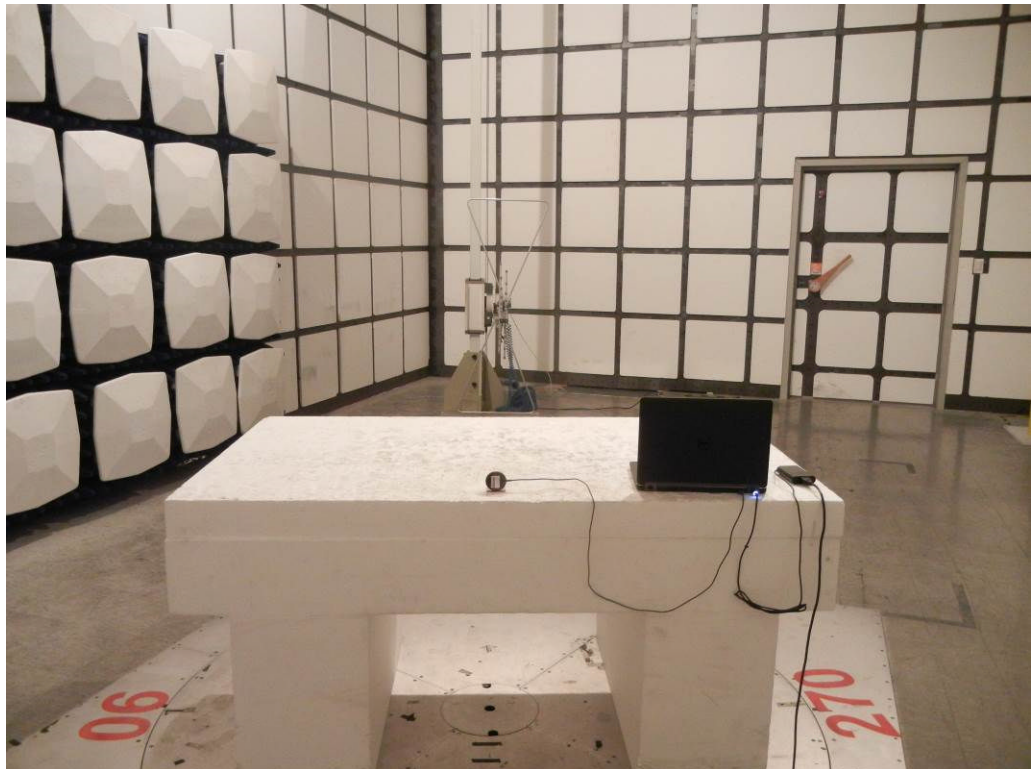


6.8 Test Photographs (30MHz ~ 1GHz)

Front View



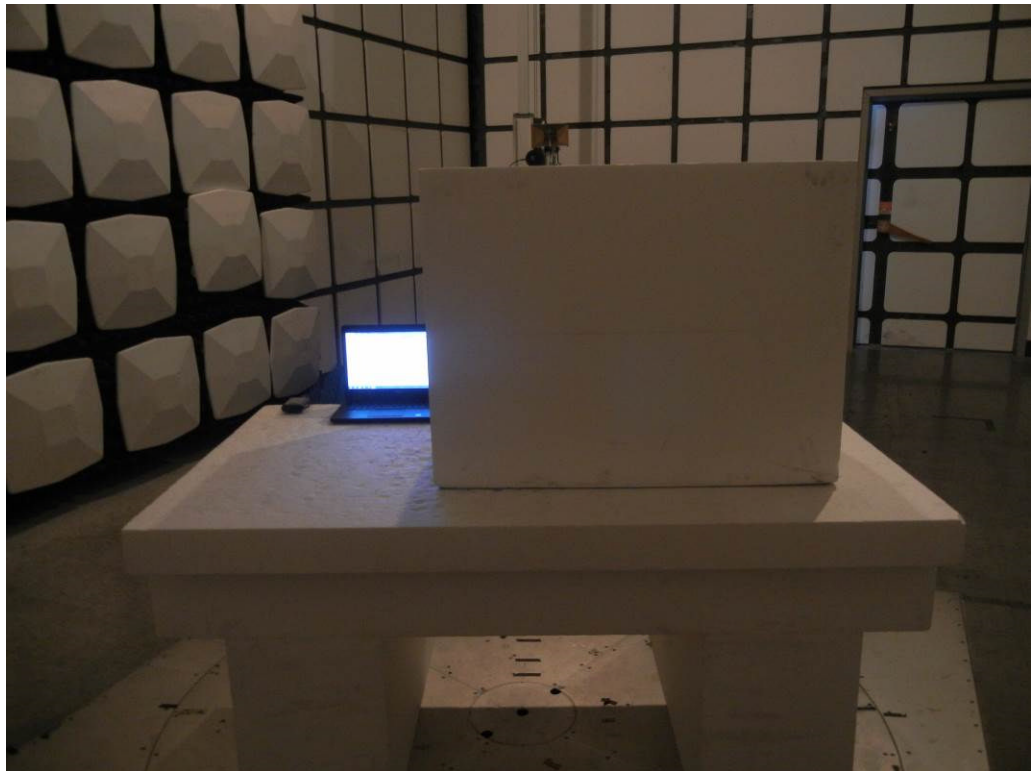
Rear View



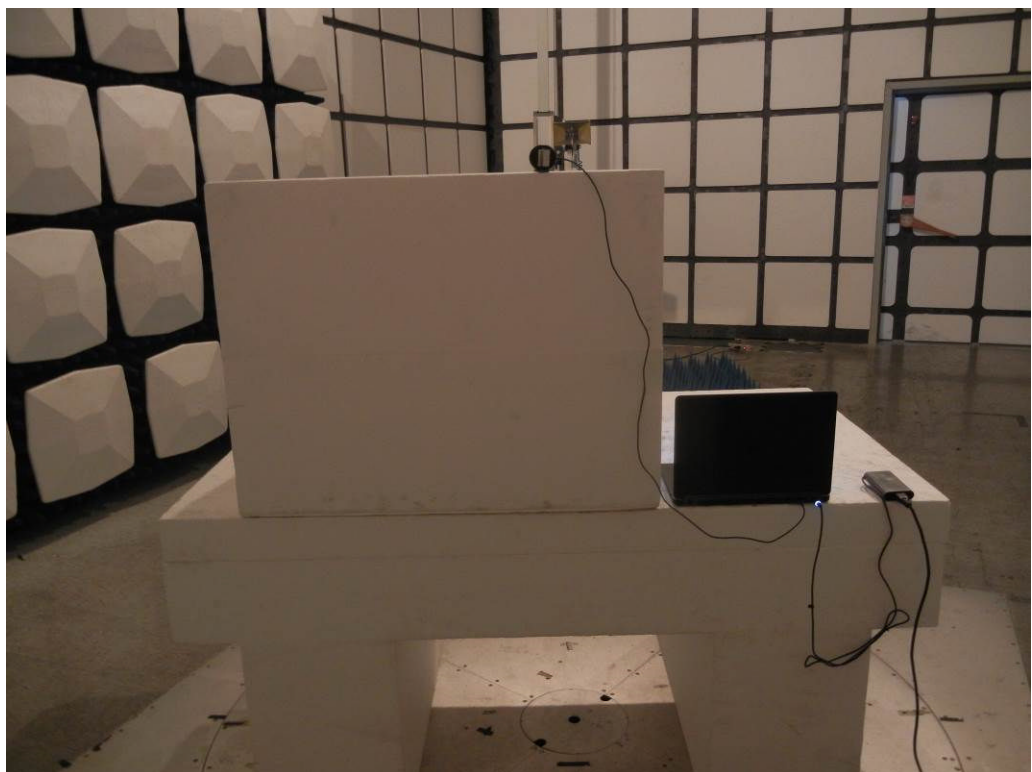


6.9 Test Photographs (1GHz ~ 25GHz)

Front View



Rear View





7. Test of Spurious Emission (Conducted)

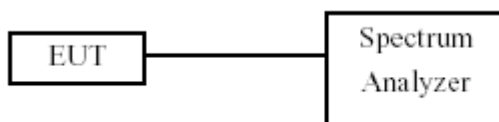
7.1 Test Limit

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



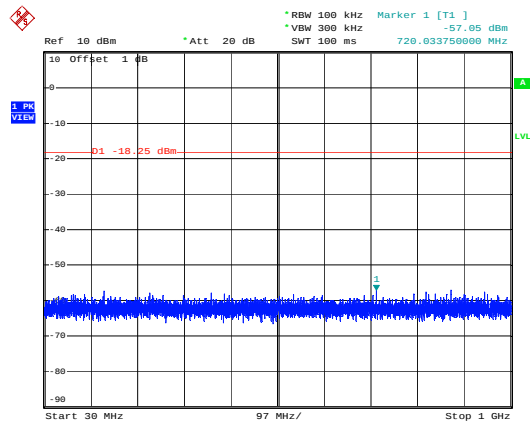
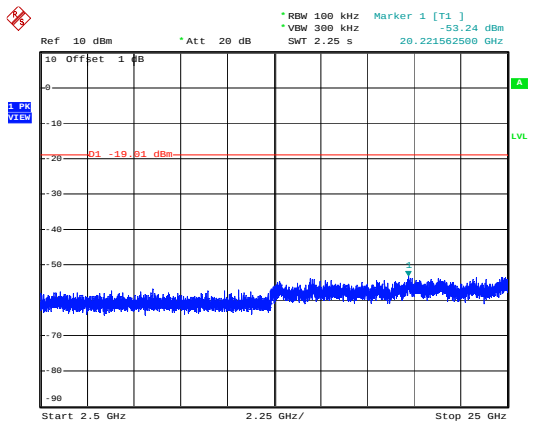
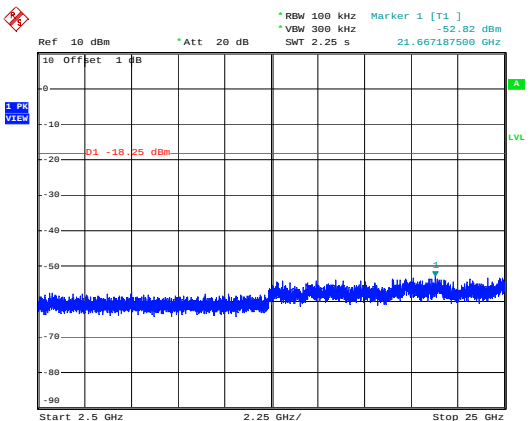
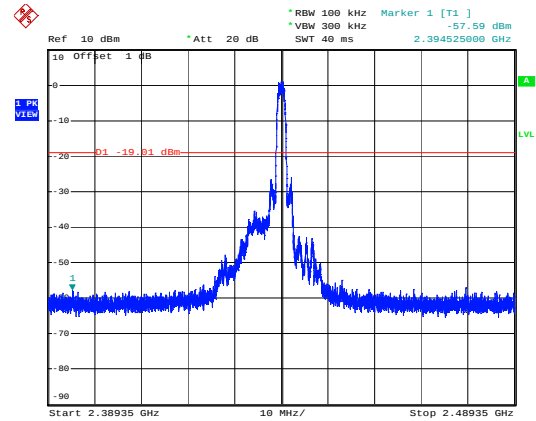
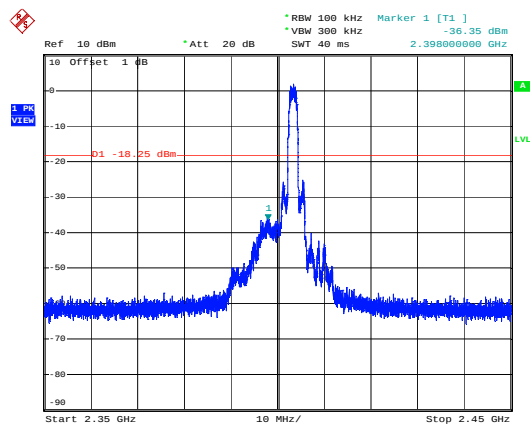
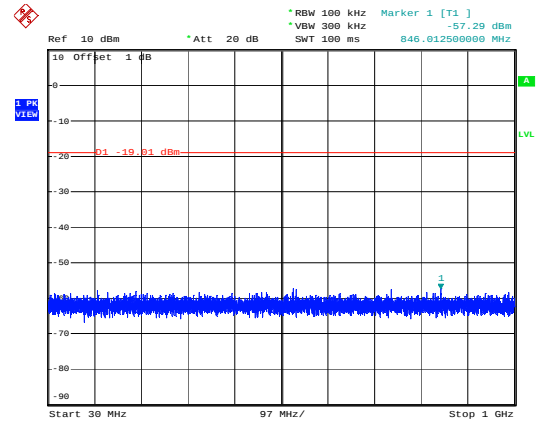
7.4 Test Result and Data

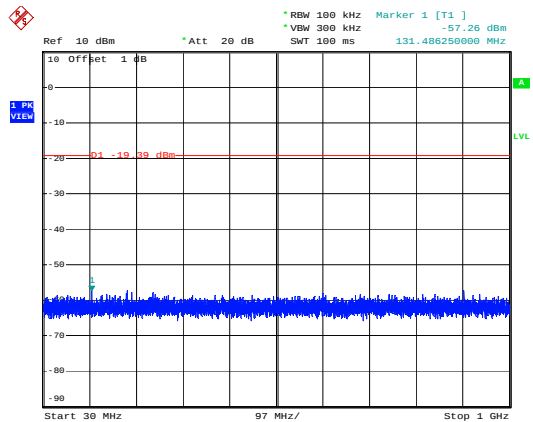
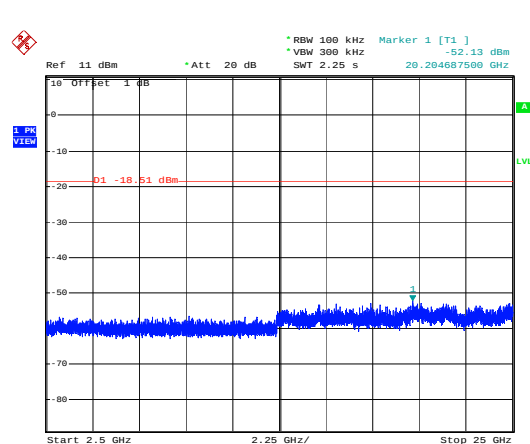
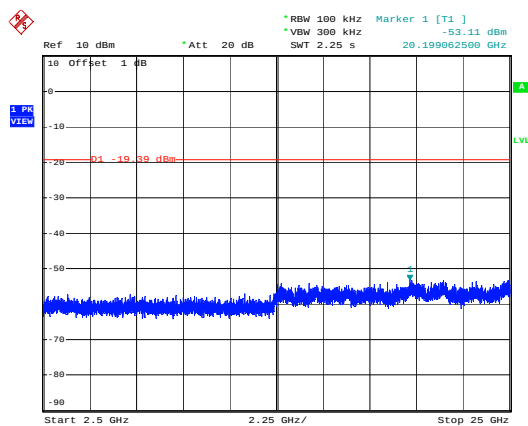
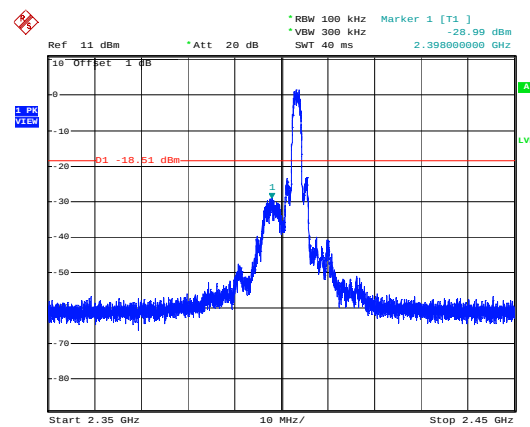
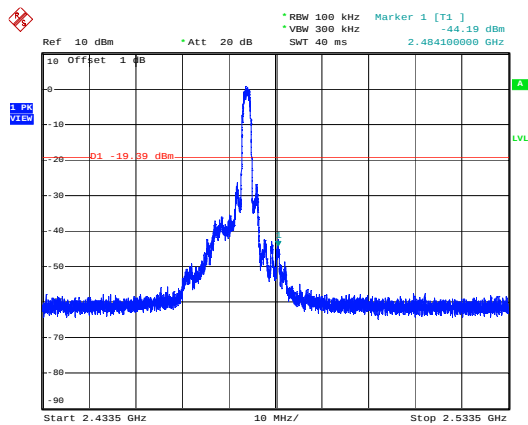
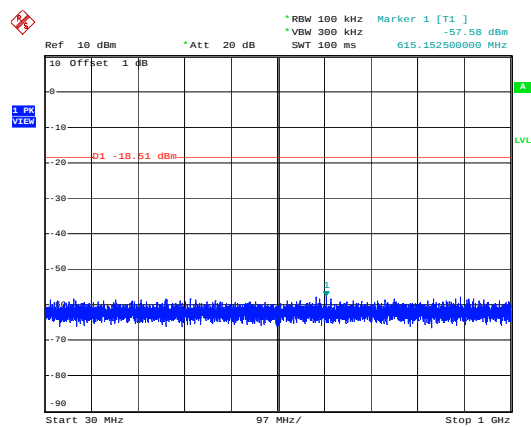
Temperature: 23°C

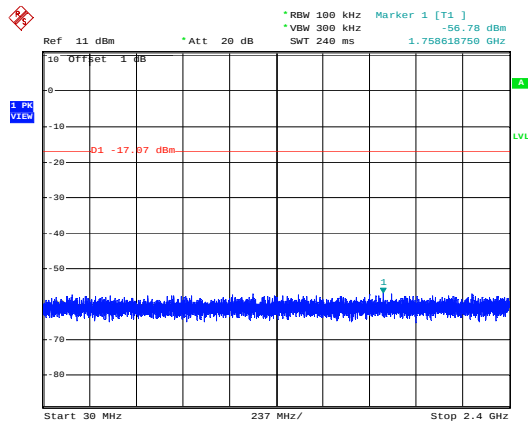
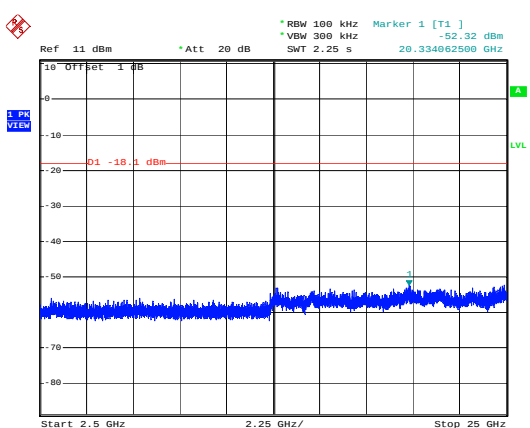
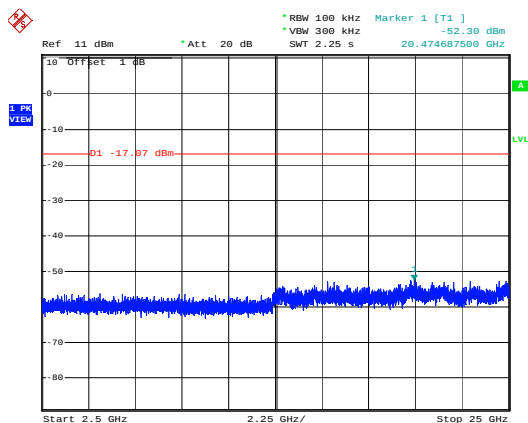
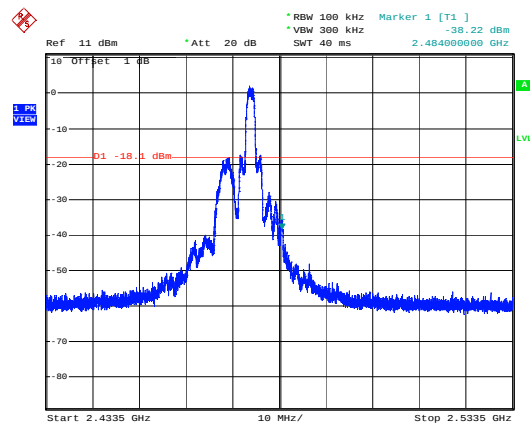
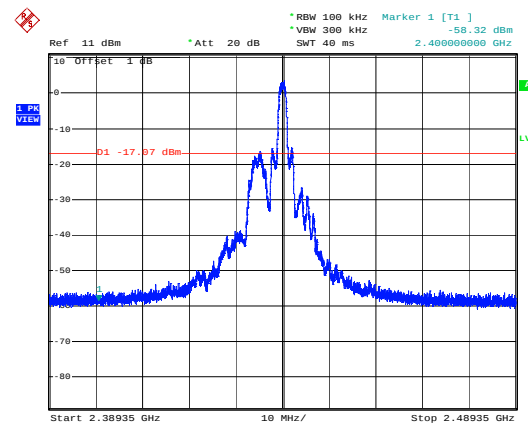
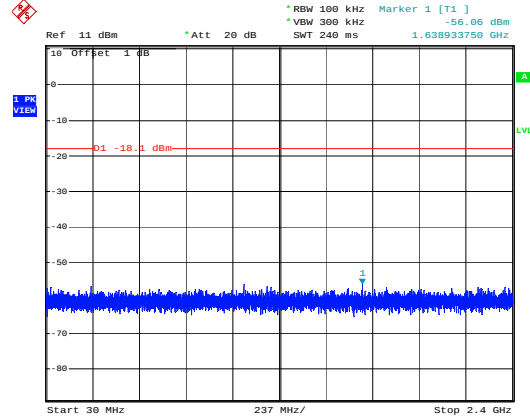
Humidity: 65%

Test Date: Aug. 09, 2016

Note: Test plots refer to the following pages.

Modulation Type: GFSK, ANT 1
CH01Modulation Type: GFSK, ANT 1
CH19

Modulation Type: GFSK, ANT 1
CH38Modulation Type: GFSK, ANT 2
CH01

Modulation Type: GFSK, ANT 2
CH19Modulation Type: GFSK, ANT 2
CH38



8. 6dB Bandwidth Measurement Data

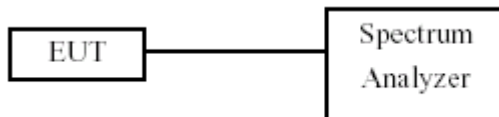
8.1 Test Limit

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



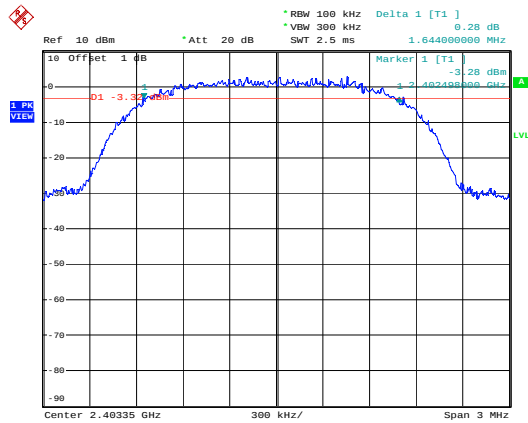
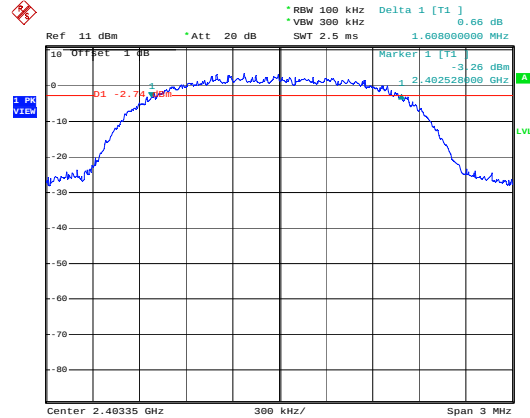
8.4 Test Result and Data

Temperature: 23°C

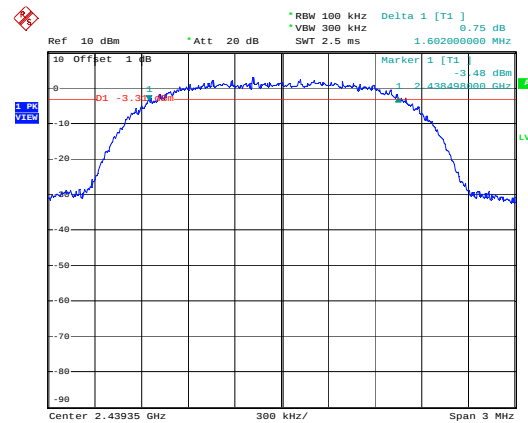
Humidity: 65%

Test Date: Aug. 09, 2016

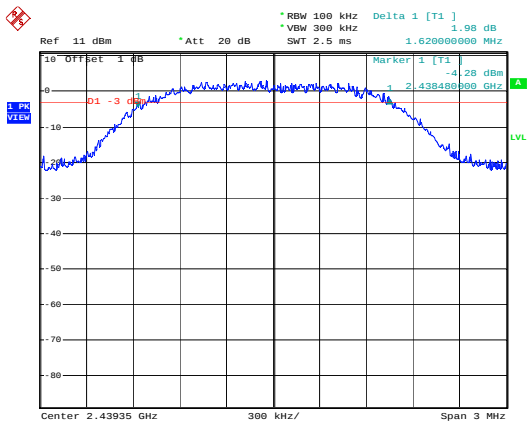
Modulation Type	Channel	Frequency (MHz)	6dB Bandwidth (KHz)	
			ANT 1	ANT 2
GFSK	01	2403.35	1644.00	1608.00
	19	2439.35	1602.00	1620.00
	38	2477.35	1602.00	1602.00

Modulation Type: GFSK, ANT 1
CH01Modulation Type: GFSK, ANT 2
CH01

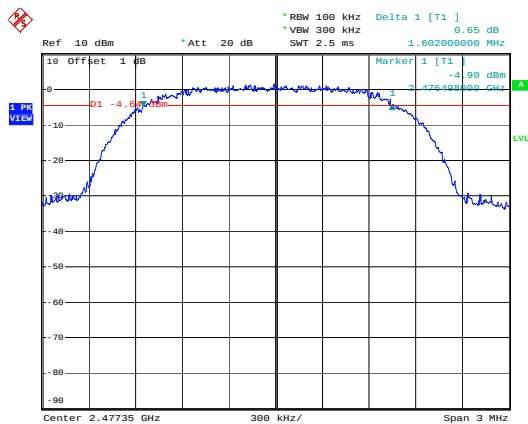
CH19



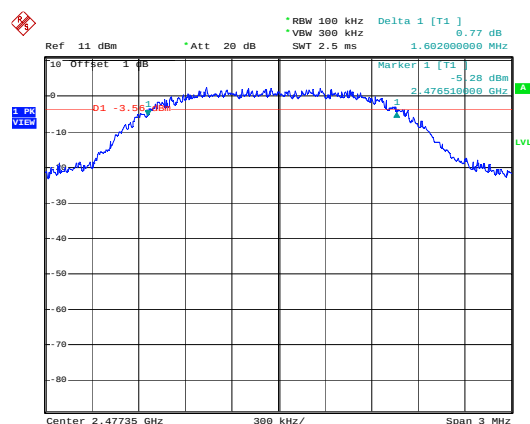
CH19



CH38



CH38





9. Maximum Peak and Average Output Power

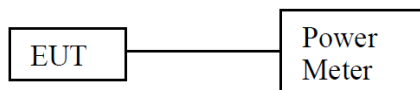
9.1 Test Limit

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: 65%

Test Date: Aug. 09, 2016

Modulation Type	Channel	Frequency (MHz)	Power Output (dBm)			
			ANT 1		ANT 2	
			Peak	AVG.	Peak	AVG.
GFSK	01	2403.35	5.32	3.41	5.5	3.54
	19	2439.35	4.97	2.99	5.17	3.12
	38	2477.35	4.19	2.19	4.49	2.3

Modulation Type	Channel	Frequency (MHz)	Power Output (mW)			
			ANT 1		ANT 2	
			Peak	AVG.	Peak	AVG.
GFSK	01	2403.35	3.404	2.193	3.548	2.259
	19	2439.35	3.141	1.991	3.289	2.051
	38	2477.35	2.624	1.656	2.812	1.698



10. Power Spectral Density

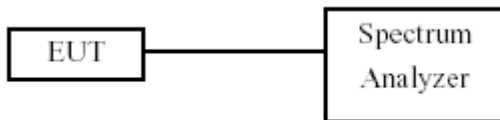
10.1 Test Limit

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



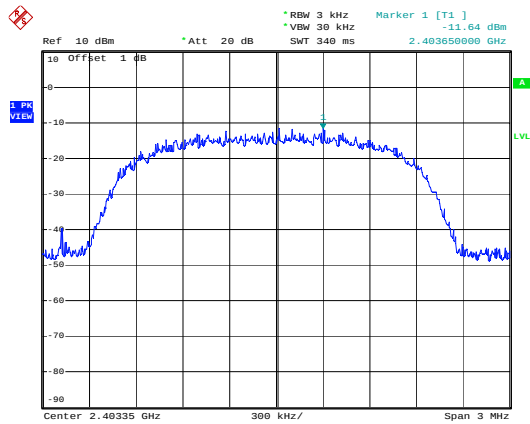
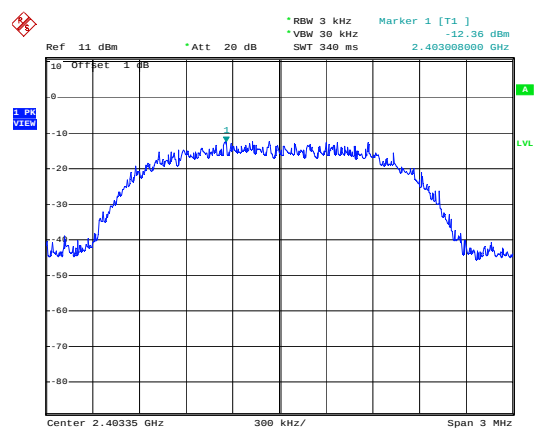
10.4 Test Result and Data

Temperature: 23°C

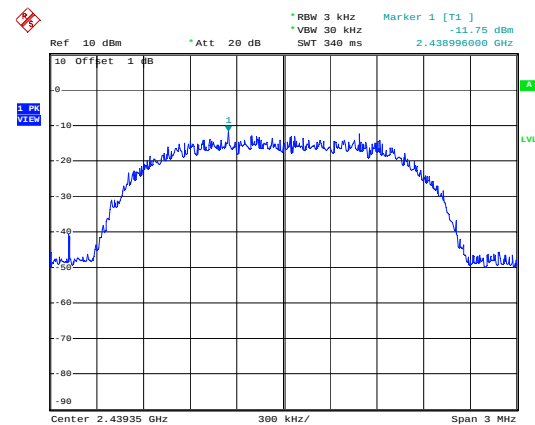
Humidity: 65%

Test Date: Aug. 09, 2016

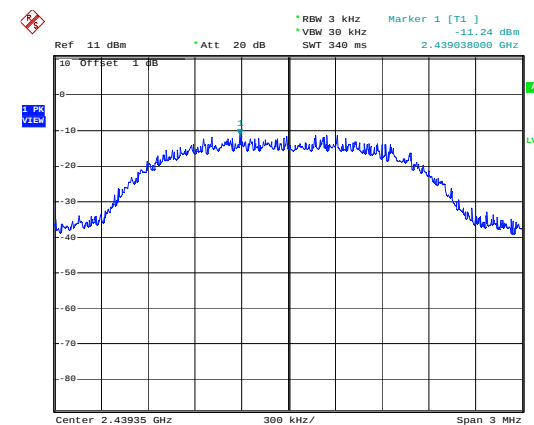
Modulation Type	Channel	Frequency (MHz)	Maximum Power Density of 3 kHz Bandwidth (dBm)	
			ANT 1	ANT 2
GFSK	01	2403.35	-11.64	-12.36
	19	2439.35	-11.75	-11.24
	38	2477.35	-12.57	-12.39

Modulation Type: GFSK, ANT 1
CH01Modulation Type: GFSK, ANT 2
CH01

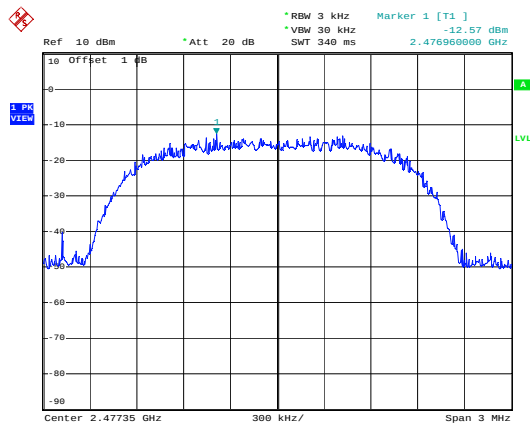
CH19



CH19



CH38



CH38

