




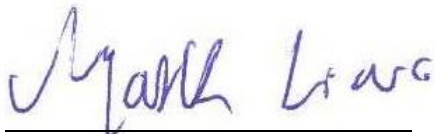
FCC RADIO TEST REPORT

Applicant : SteelSeries ApS.
Address : 656 W Randolph St., Suite 3E Chicago, IL 60661,
USA
Equipment : 2.1 Wireless Speaker System
Model No. : SP-00002
Trade Name : 
FCC ID : ZHK-SP00002

I HEREBY CERTIFY THAT :

The sample was received on Nov. 12, 2020 and the testing was completed on May. 21, 2021 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 / Supervisor

Laboratory Accreditation:

CerpPASS Technology Corporation Test Laboratory





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1. Summary of Test Procedure and Test Results

1.1 Applicable Standards

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

* The lab has reduced the uncertainty risk factor from test equipment, environment and staff technicians which according to the standard on contract. Therefore, the test result will only be determined by standard requirement.

*This EUT has been also tested and compiled with the requirement of FCC Part 15, Subpart B, recorded in a separate test report(TEFD2009041).



2. Test Configuration of Equipment under Test

2.1 Feature of Equipment under Test

Frequency Range	2400-2483.5MHz
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology	FHSS
Data Rate	GFSK: 1Mbps, $\pi/4$ -DQPSK: 2Mbps, 8DPSK: 3Mbps
Antenna Type	PIFA Antenna
Antenna Gain	2.55 dBi
Power Cord	Brand: Changzhou Hongchang Electronics Co.Ltd. Model: 45-1-000412S
USB TYPE-C Cable	Brand: DONGGUAN YUE YANG WIRE & CABLE CO LTD Model: YY-162-06
Speaker-R	Brand: SteelSeries Model: R
Speaker-L	Brand: SteelSeries Model: L
Firmware Number	FW_ARENA7_PV_BT_20210705-For_BQB.airoflashZ
Serial Number	61541DVT32422000009

Note: For more details, please refer to the User's manual of the EUT.

2.2 Carrier Frequency of Channes

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
*00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	*78	2480
19	2421	*39	2441	59	2461	---	---

Note: Channels remarked * are selected to perform test.



2.3 Test Mode & Test Software

- a. During testing, the interface cables and equipment positions were varied according to ANSI C63.10
- b. The complete test system included Notebook and EUT for RF test.
- c. An executive program, "Airoha AB152xS LAB Test Tool ver.2.1.0.13699" under Windows OS system was executed to transmit and receive data via Bluetooth.
- d. The following test modes were performed for the test:

Conducted Emissions from the AC mains power ports	
Test Mode	Operating Description
1	GFSK (1Mbps)
2	$\pi/4$ -DQPSK (2Mbps)
3	8DPSK (3Mbps)
caused "Test Mode 3" generated the worst case, it was reported as the final data.	
Radiation Emissions (9KHz ~30MHz & 30MHz ~ 1GHz)	
Test Mode	Operating Description
1	GFSK (1Mbps)
2	$\pi/4$ -DQPSK (2Mbps)
3	8DPSK (3Mbps)
caused "Test Mode 3" generated the worst case, it was reported as the final data.	
Radiation Emissions (1GHz ~ 25GHz)	
Test Mode	Operating Description
1	GFSK (1Mbps)
2	$\pi/4$ -DQPSK (2Mbps)
3	8DPSK (3Mbps)
caused "Test Mode 1, 3" generated the worst case, they were reported as the final data.	

Modulation Type	TX CONFIGURATION
GFSK	1TX
$\pi/4$ -DQPSK	1TX
8DPSK	1TX

2.4 Description of Test System

N/A



2.5 General Information of Test

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

Test Item	Test Site	Test period	Environmental Conditions	Tested By
RF Conducted	RFCON01-NK	2021/05/21	28°C / 45%	Nick Guan
Radiated Emissions	3M02-NK	2021/05/19~2021/05/20	22~24°C / 45~46%	Nick Guan
AC Power Line Conducted Emission	CON01-NK	2021/05/21	27°C / 52%	Nick Guan

2.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Measurement Item	Uncertainty
AC Power Line Conduction(150K~30MHz)	±3.63dB
Radiated Spurious Emission(9KHz~30MHz)	±3.4dB
Radiated Spurious Emission(30MHz~1GHz)	±5.6dB
Radiated Spurious Emission(1GHz~25GHz)	±6.6dB
Conducted Spurious Emission	±1.8dB
6dB Bandwidth	±4.4%
20dB Bandwidth	±4.4%
Occupied Bandwidth	±4.4%
Peak Output Power(Conducted Power Meter)	±1.1dB
Dwell Time / Deactivation Time	±1.2%
Power Spectral Density	±1.8dB
Duty Cycle	±1.2%



3. Test Equipment and Ancillaries Used for Tests

Test Item	Radiated Emissions				
Test Site	Semi Anechoic Room(3M02-NK)				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
Bilog Antenna	Schwarzbeck	VULB9168	369	2021/04/26	2022/04/25
Active Loop Antenna	EMCO	6507	40855	2020/05/21	2021/05/20
Horn Antenna	EMCO	3115	31601	2020/10/16	2021/10/15
Horn Antenna	EMCO	3116	31974	2020/09/24	2021/09/23
EMI Receiver	ROHDE & SCHWARZ	ESCI	101423	2020/06/23	2021/06/22
Spectrum Analyzer	ROHDE & SCHWARZ	FSV 40-N	102151	2020/08/03	2021/08/02
Preamplifier	EM Electronics corp.	EM330	60658	2020/10/20	2021/10/19
Preamplifier	EM Electronics corp.	EM330	60660	2021/03/18	2022/03/17
Preamplifier	Agilent	8449B	3008A01954	2021/03/22	2022/03/21
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2020/11/06	2021/11/05
Bluetooth Tester	ROHDE & SCHWARZ	CBT	101133	2021/04/19	2022/04/18
Cable-3in1(30M-1G)	HARBOUR INDUSTRIES	LL142	CCE1315	2021/04/12	2022/04/11
Cable-0.5m(1G-18G)	HUBER SUHNER	SUCOFLEX 104	805443/4	2020/05/27	2021/05/26
Cable-3m(1G-18G)	HUBER SUHNER	SUCOFLEX 104	805796/4	2020/05/27	2021/05/26
Cable-8m(1G-18G)	HUBER SUHNER	SUCOFLEX 104	805795/4	2020/05/27	2021/05/26
Cable-0.5m(30M-40G)	HUBER SUHNER	SUCOFLEX 102	28420/2	2021/04/03	2022/04/02
Cable-3m(30M-40G)	HUBER SUHNER	SUCOFLEX 102	MY2608/2	2021/04/09	2022/04/08
Cable-0.5m(1G-40G)	Rapidtek	40GHZ 50CM	38MS-38MS50314	2021/04/08	2022/04/07
Cable-6m(9k~300M)	NA	EMC5D-BM-BM-6	130605	2020/09/18	2021/09/17
E3	AUDIX	v8.2014-8-6	RK-000529	NA	NA

Test Item	RF Conducted				
Test Site	RFCON01-NK				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
Spectrum Analyzer	ROHDE & SCHWARZ	FSV 40-N	101329	2020/07/07	2021/07/06
Bluetooth Tester	ROHDE & SCHWARZ	CBT	101133	2021/04/19	2022/04/18
CAX Signal Analyzer	KEYSIGHT	N9000B	MY57100339	2020/12/25	2021/12/24
Attenuator	KEYSIGHT	8491B	MY39250703	2021/04/09	2022/04/08
TEMP & HUMI CHAMBER	T-MACHINE	TMJ-9712	T-12-040111	2020/08/25	2021/08/24
Power Meter	Anritsu	ML2495A	1224005	2021/04/14	2022/04/13
Power Sensor	Anritsu	MA2411B	1207295	2021/04/14	2022/04/13



Test Item	AC Power Line Conducted Emission				
Test Site	CON01-NK				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
EMI Receiver	ROHDE & SCHWARZ	ESCI	100443	2020/05/25	2021/05/24
Line Impedance Stabilization Network	Schwarzbeck	NSLK 8127	8127-516	2020/09/26	2021/09/25
Pulse Limiter	ROHDE & SCHWARZ	ESH3-Z2	101933	2020/09/17	2021/09/16
Cable-6m(9k~300M)	NA	EMC5D-BM-BM-6	130605	2020/09/18	2021/09/17
E3	AUDIX	v8.2014-8-6	RK-000531	NA	NA



4. Antenna Requirements

4.1 Standard Applicable

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

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

4.2 Antenna Construction and Directional Gain

Antenna Type	PIFA Antenna
Antenna Gain	2.55 dBi



5. Test of AC Power Line Conducted Emission

5.1 Test Limit

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

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

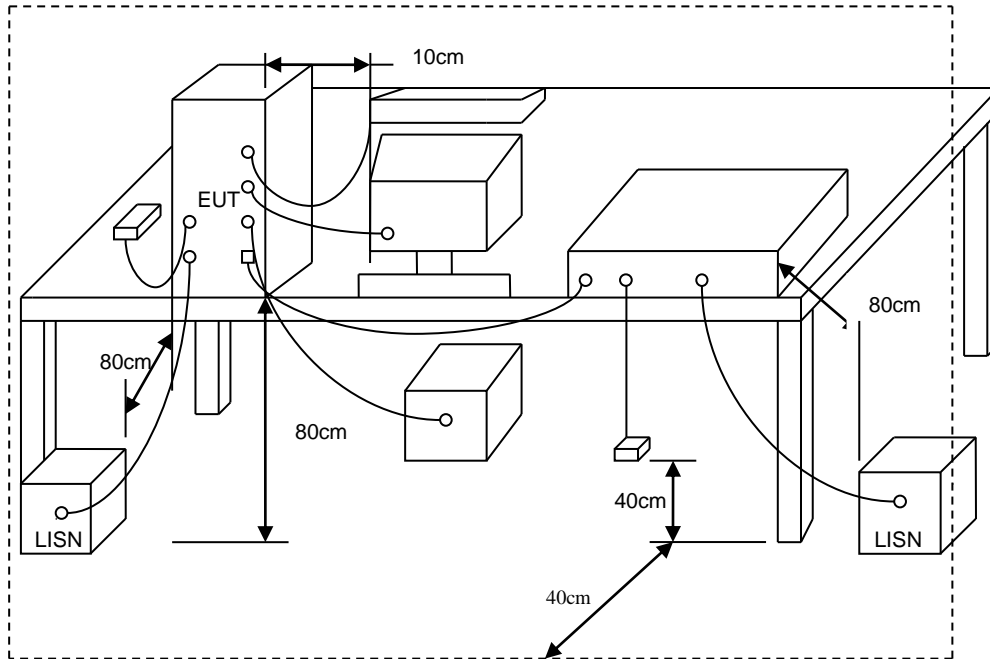
*Decreases with the logarithm of the frequency.

5.2 Test Procedures

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



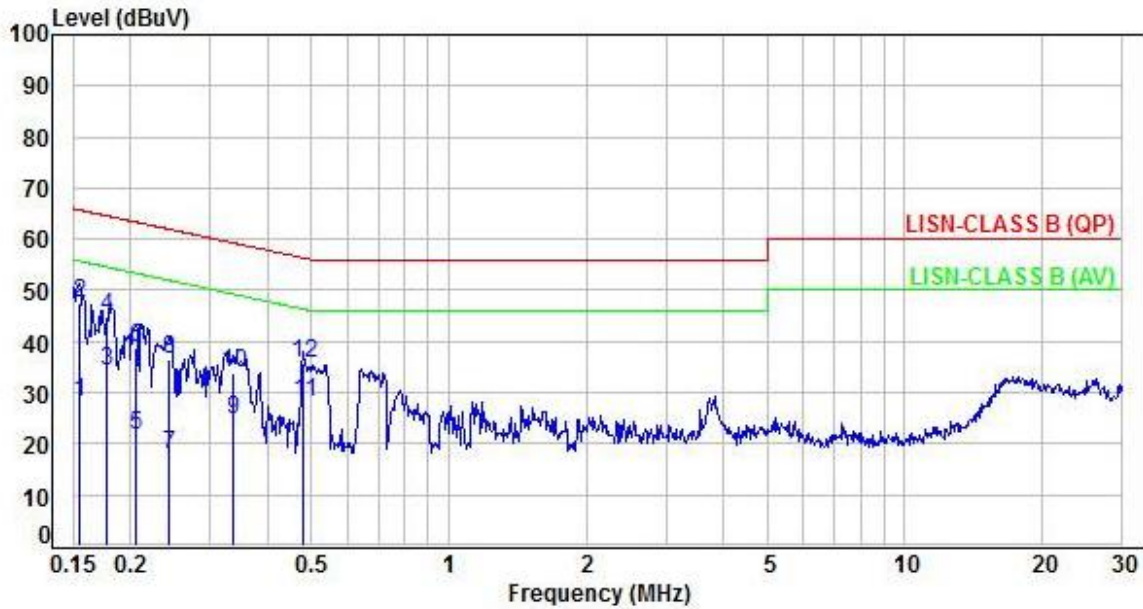
5.3 Typical Test Setup





5.4 Test Result and Data

Power	: AC 120V / 60Hz	Pol/Phase	: LINE
Test Mode	: Mode 3		

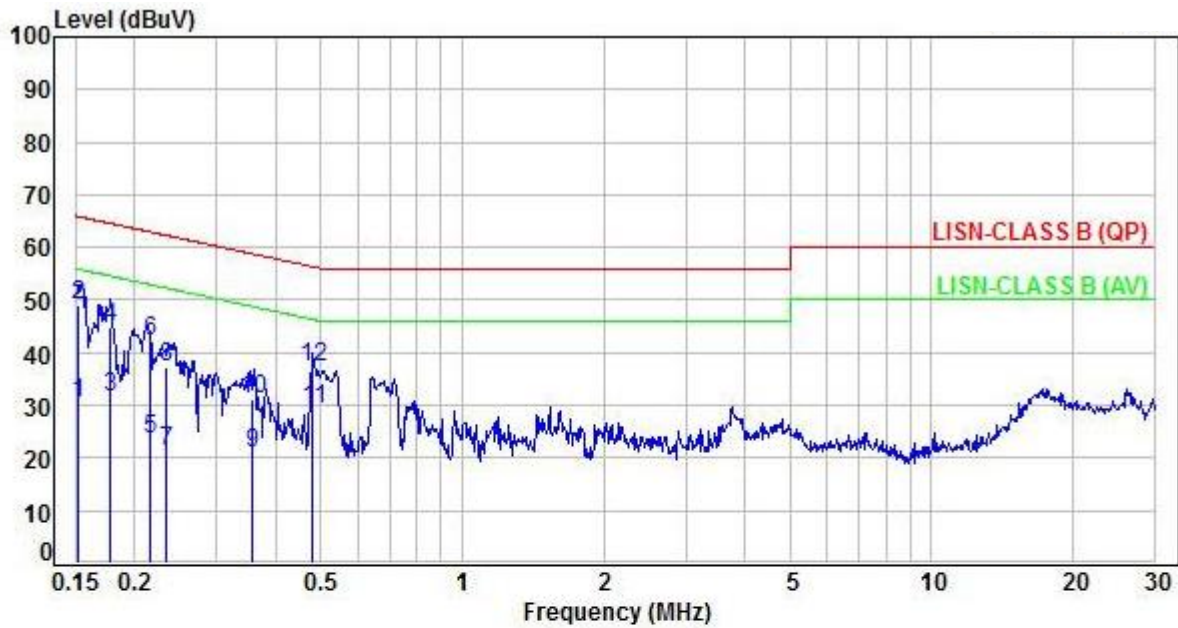


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.16	9.96	18.07	28.03	55.71	-27.68	Average	P
2	0.16	9.96	37.72	47.68	65.71	-18.03	QP	P
3	0.18	9.96	24.12	34.08	54.61	-20.53	Average	P
4	0.18	9.96	34.99	44.95	64.61	-19.66	QP	P
5	0.21	9.96	11.60	21.56	53.41	-31.85	Average	P
6	0.21	9.96	28.78	38.74	63.41	-24.67	QP	P
7	0.24	9.96	8.07	18.03	51.98	-33.95	Average	P
8	0.24	9.96	26.64	36.60	61.98	-25.38	QP	P
9	0.34	9.97	14.57	24.54	49.28	-24.74	Average	P
10	0.34	9.97	23.75	33.72	59.28	-25.56	QP	P
11	0.48	9.98	18.00	27.98	46.34	-18.36	Average	P
12	0.48	9.98	25.60	35.58	56.34	-20.76	QP	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: NEUTRAL
Test Mode	: Mode 3		:



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.15	9.97	20.42	30.39	55.92	-25.53	Average	P
2	0.15	9.97	39.05	49.02	65.92	-16.90	QP	P
3	0.18	9.97	21.74	31.71	54.56	-22.85	Average	P
4	0.18	9.97	34.95	44.92	64.56	-19.64	QP	P
5	0.22	9.97	13.44	23.41	53.00	-29.59	Average	P
6	0.22	9.97	32.41	42.38	63.00	-20.62	QP	P
7	0.23	9.97	11.43	21.40	52.30	-30.90	Average	P
8	0.23	9.97	27.34	37.31	62.30	-24.99	QP	P
9	0.36	9.98	10.89	20.87	48.81	-27.94	Average	P
10	0.36	9.98	21.30	31.28	58.81	-27.53	QP	P
11	0.48	9.98	19.45	29.43	46.34	-16.91	Average	P
12	0.48	9.98	27.12	37.10	56.34	-19.24	QP	P

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



6. Test of Radiated Spurious Emission

6.1 Test Limit

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

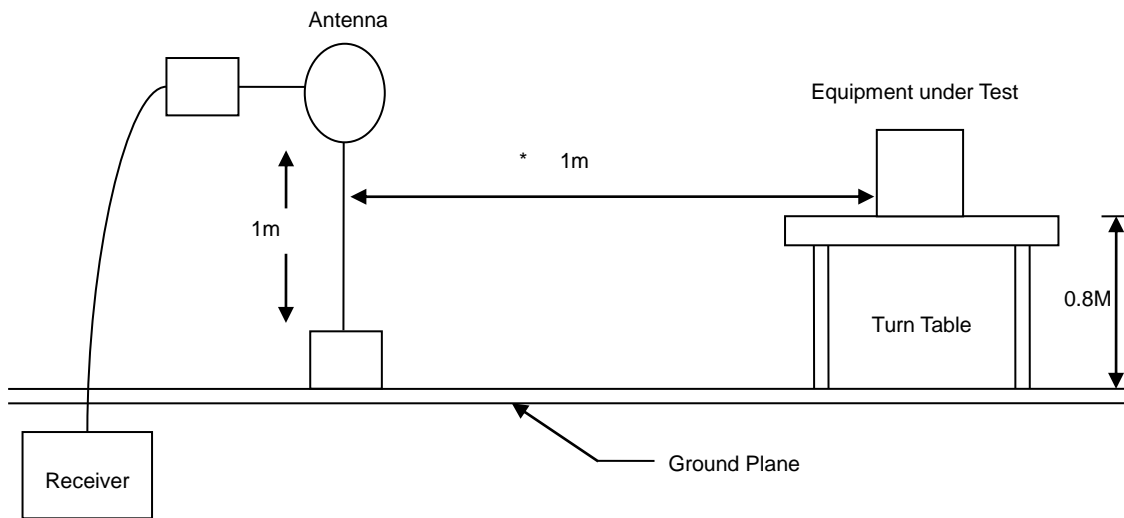
- The EUT was placed on a rotatable table top 0.8 meter above ground.
- The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- The table was rotated 360 degrees to determine the position of the highest radiation.
- The antenna 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.

Note: The supporting fixture shall permit orientation of the EUT in each of three orthogonal axis positions such that emissions from the EUT are maximized.

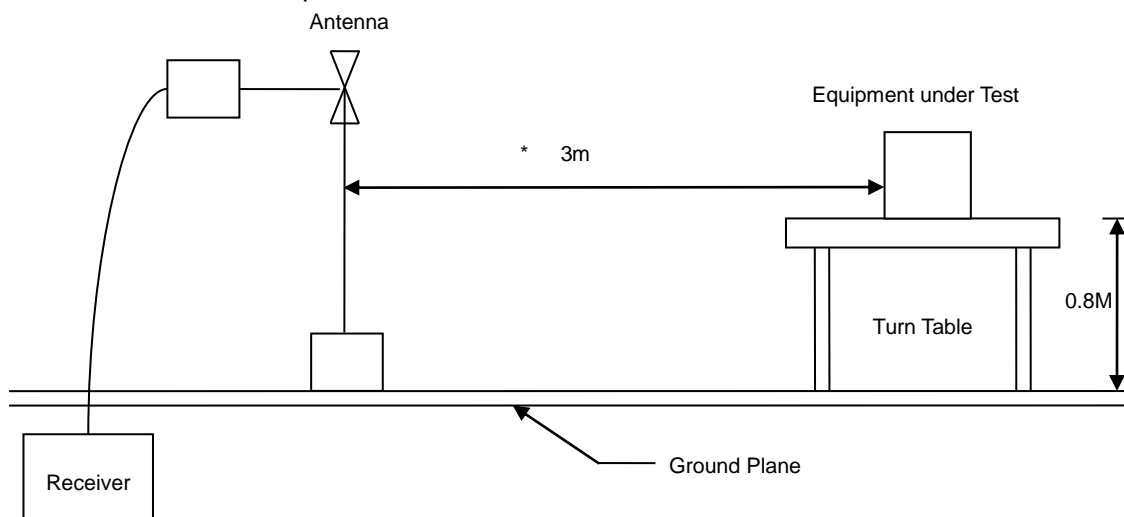


6.3 Typical Test Setup

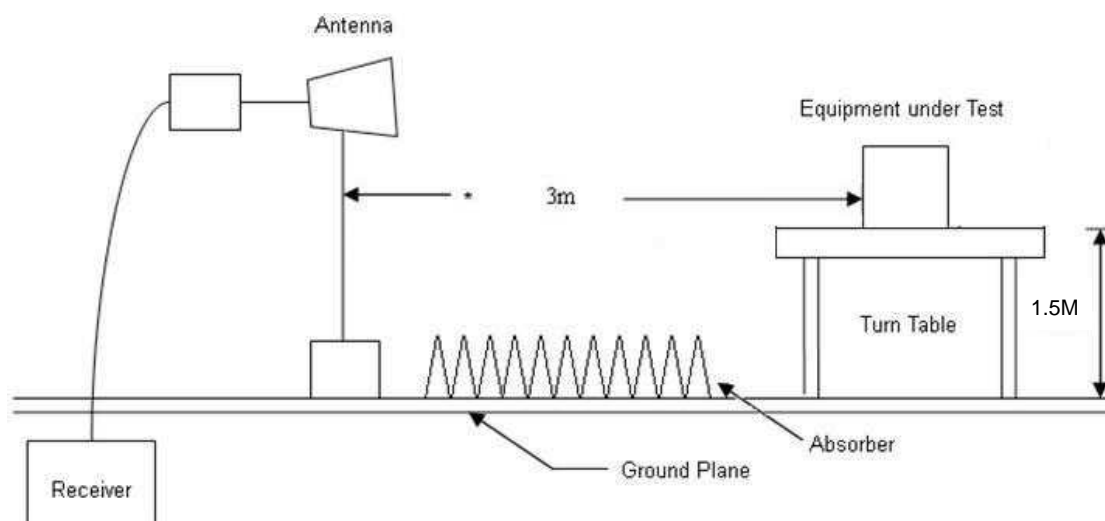
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup



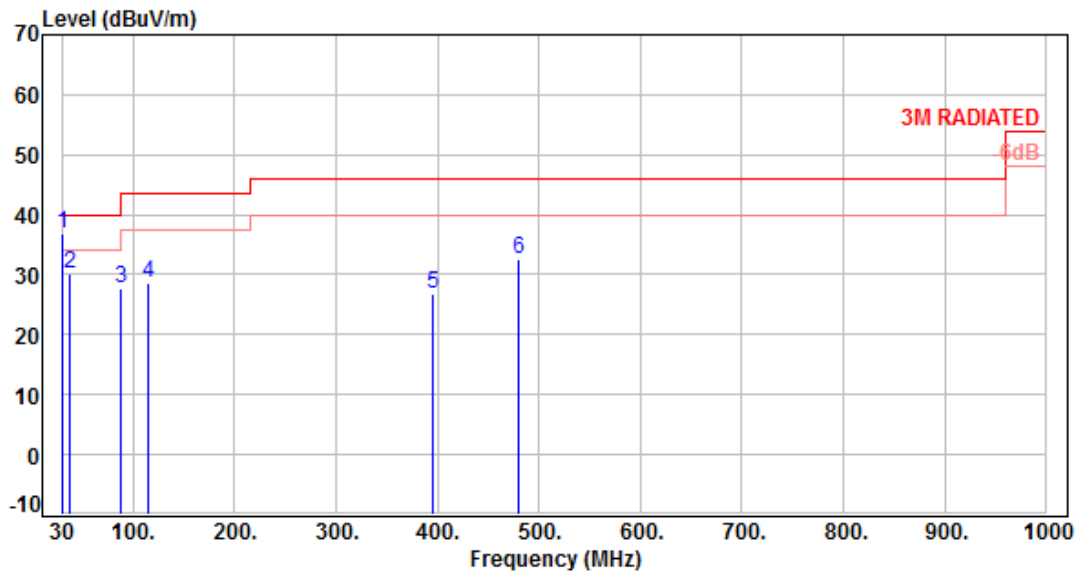


6.4 Test Result and Data (9kHz ~ 30MHz)

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

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

Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 3		

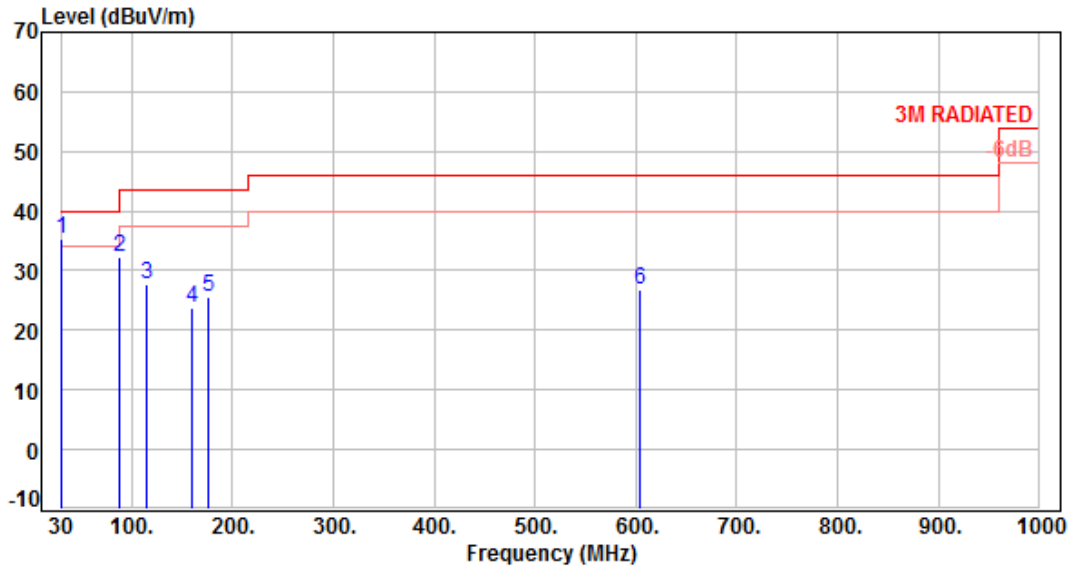


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	30.00	-11.62	48.52	36.90	40.00	-3.10	QP	100	337	P
2	37.76	-11.33	41.39	30.06	40.00	-9.94	Peak	400	360	P
3	88.20	-16.66	44.29	27.63	43.50	-15.87	Peak	400	360	P
4	115.36	-13.49	41.97	28.48	43.50	-15.02	Peak	400	360	P
5	394.72	-7.18	33.97	26.79	46.00	-19.21	Peak	400	360	P
6	480.08	-5.26	37.72	32.46	46.00	-13.54	Peak	400	360	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 3		:



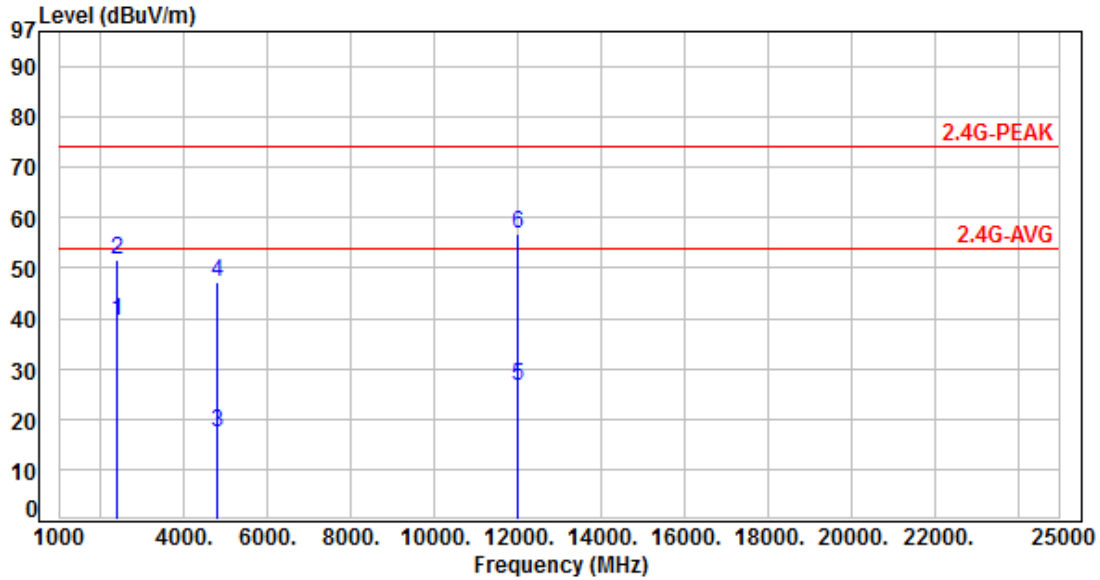
No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	30.00	-11.62	46.82	35.20	40.00	-4.80	QP	100	0	P
2	88.20	-16.66	48.83	32.17	43.50	-11.33	Peak	400	0	P
3	115.36	-13.49	41.17	27.68	43.50	-15.82	Peak	400	0	P
4	159.98	-10.69	34.41	23.72	43.50	-19.78	Peak	400	0	P
5	175.50	-11.58	37.23	25.65	43.50	-17.85	Peak	400	0	P
6	604.24	-2.52	29.39	26.87	46.00	-19.13	Peak	400	0	P

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



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

Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 1, CH00		

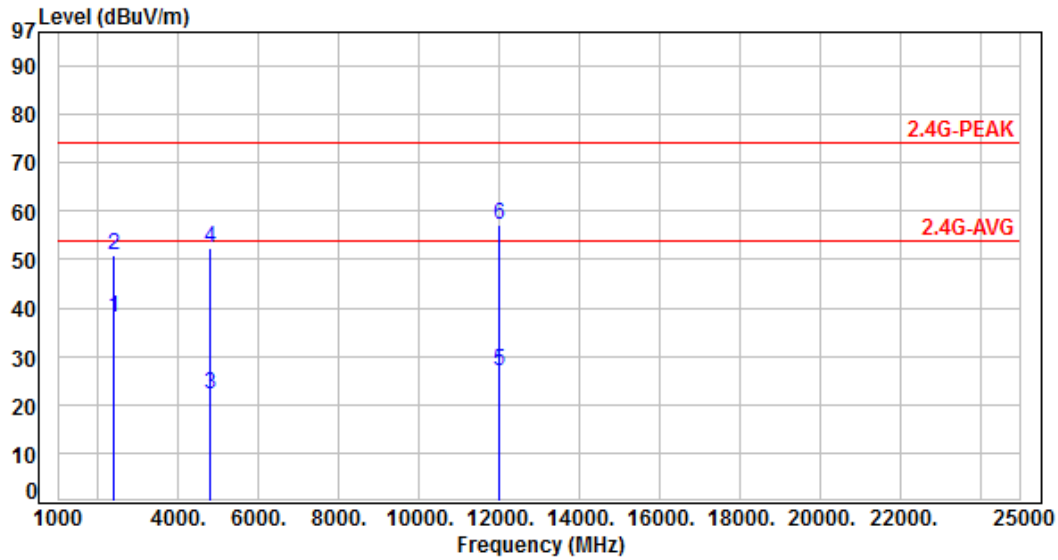


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	42.32	39.34	54.00	-14.66	Average	246	319	P
2	2390.00	-2.98	54.73	51.75	74.00	-22.25	Peak	246	319	P
3	4804.00	4.56	12.63	17.19	54.00	-36.81	Average	371	345	P
4	4804.00	4.56	42.73	47.29	74.00	-26.71	Peak	371	345	P
5	12010.00	14.61	12.01	26.62	54.00	-27.38	Average	100	360	P
6	12010.00	14.61	42.11	56.72	74.00	-17.28	Peak	100	360	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1, CH00		:

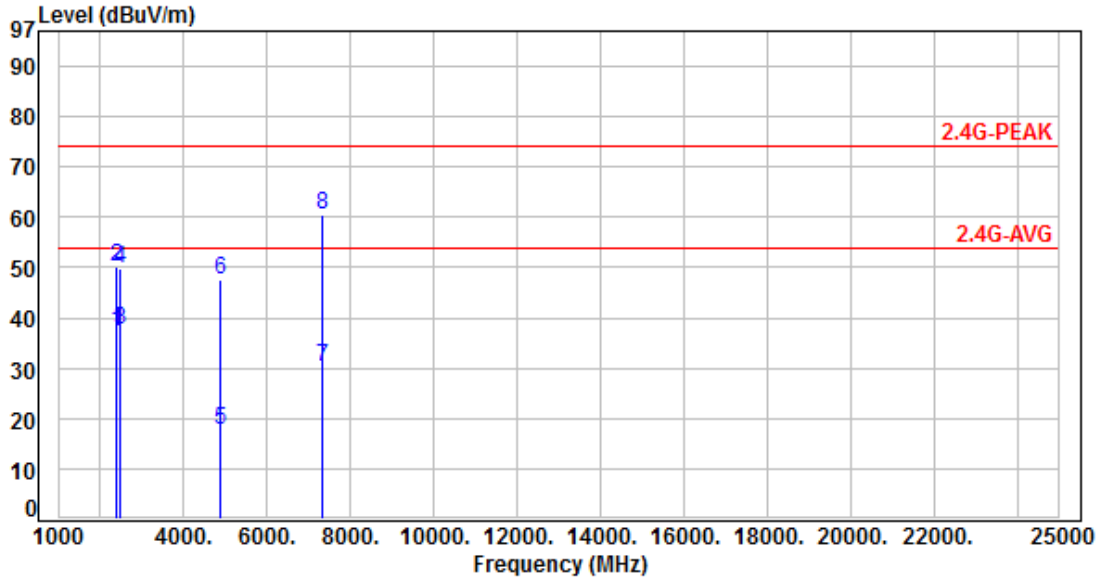


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	41.12	38.14	54.00	-15.86	Average	126	212	P
2	2390.00	-2.98	53.84	50.86	74.00	-23.14	Peak	126	212	P
3	4804.00	4.56	17.70	22.26	54.00	-31.74	Average	122	310	P
4	4804.00	4.56	47.80	52.36	74.00	-21.64	Peak	122	310	P
5	12010.00	14.61	12.32	26.93	54.00	-27.07	Average	100	326	P
6	12010.00	14.61	42.42	57.03	74.00	-16.97	Peak	100	326	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 1, CH39		:

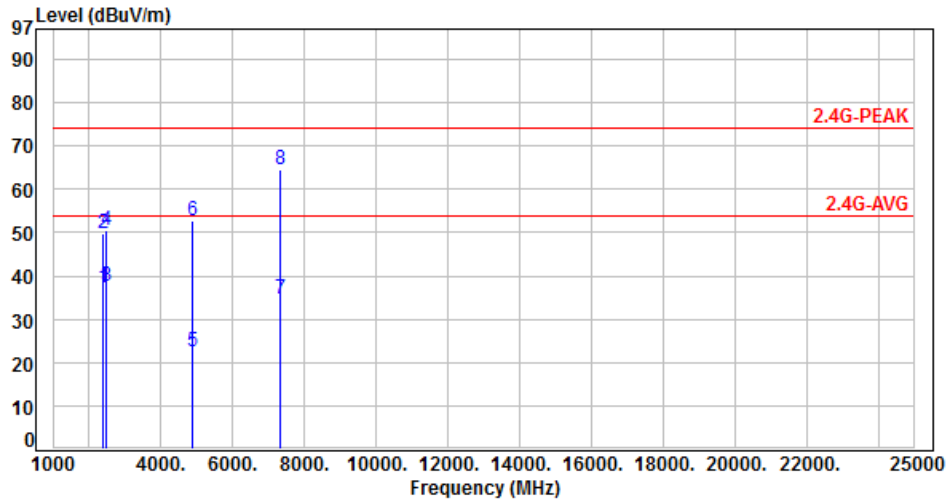


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	40.30	37.32	54.00	-16.68	Average	100	93	P
2	2390.00	-2.98	53.01	50.03	74.00	-23.97	Peak	100	93	P
3	2483.50	-2.75	40.44	37.69	54.00	-16.31	Average	100	93	P
4	2483.50	-2.75	52.72	49.97	74.00	-24.03	Peak	100	93	P
5	4882.00	4.81	12.71	17.52	54.00	-36.48	Average	375	342	P
6	4882.00	4.81	42.81	47.62	74.00	-26.38	Peak	375	342	P
7	7323.00	9.72	20.69	30.41	54.00	-23.59	Average	345	316	P
8	7323.00	9.72	50.79	60.51	74.00	-13.49	Peak	345	316	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1, CH39		:

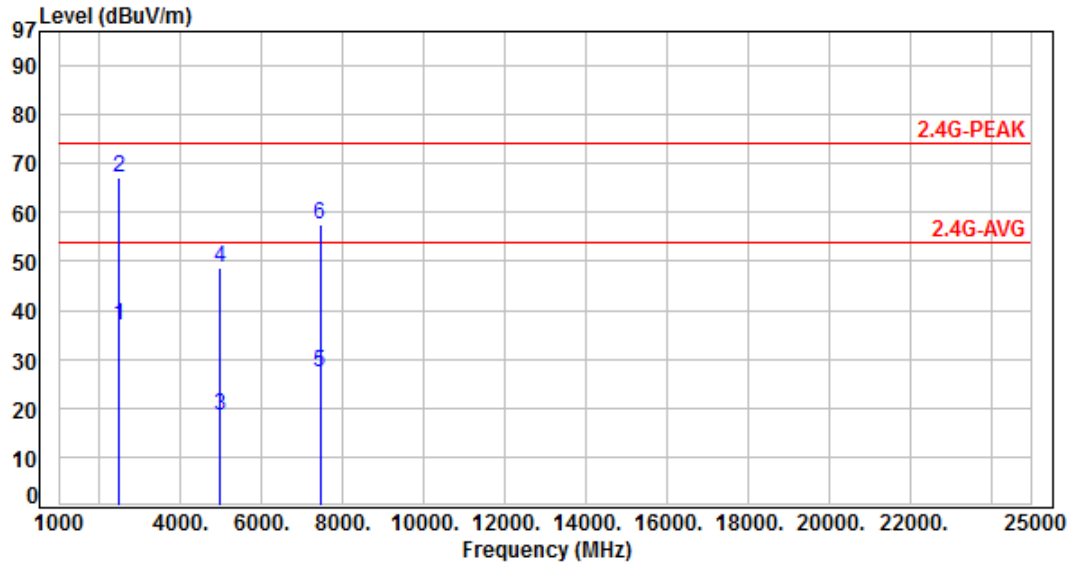


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	40.41	37.43	54.00	-16.57	Average	100	209	P
2	2390.00	-2.98	52.88	49.90	74.00	-24.10	Peak	100	209	P
3	2483.50	-2.75	40.43	37.68	54.00	-16.32	Average	100	209	P
4	2483.50	-2.75	53.13	50.38	74.00	-23.62	Peak	100	209	P
5	4882.00	4.81	17.79	22.60	54.00	-31.40	Average	142	312	P
6	4882.00	4.81	47.89	52.70	74.00	-21.30	Peak	142	312	P
7	7323.00	9.72	24.86	34.58	54.00	-19.42	Average	158	312	P
8	7323.00	9.72	54.96	64.68	74.00	-9.32	Peak	158	312	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 1, CH78		:

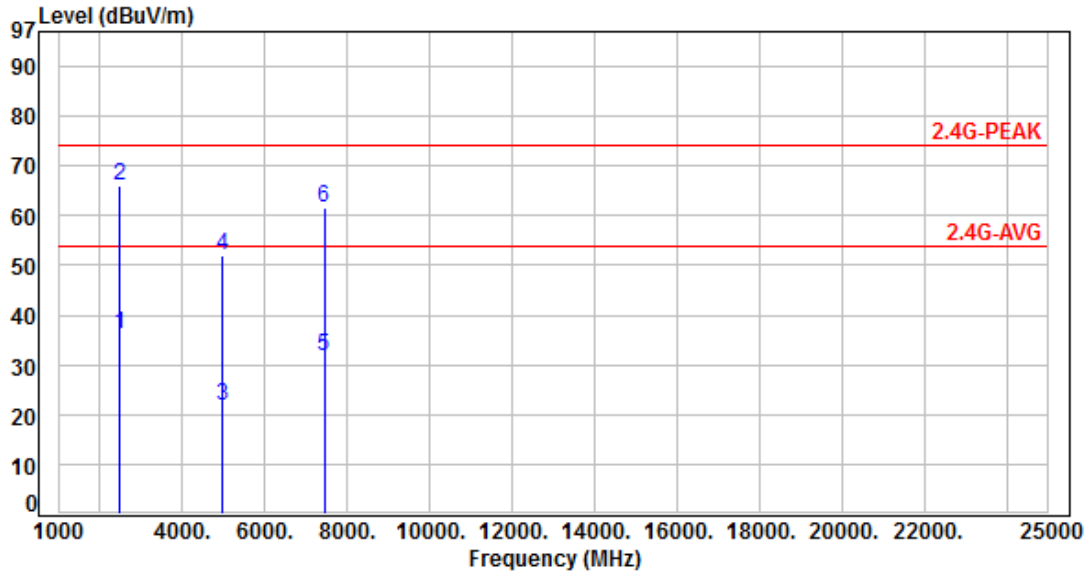


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-2.75	39.77	37.02	54.00	-16.98	Average	100	90	P
2	2483.50	-2.75	69.87	67.12	74.00	-6.88	Peak	100	90	P
3	4960.00	5.16	13.28	18.44	54.00	-35.56	Average	372	342	P
4	4960.00	5.16	43.38	48.54	74.00	-25.46	Peak	372	342	P
5	7440.00	9.83	17.56	27.39	54.00	-26.61	Average	343	316	P
6	7440.00	9.83	47.66	57.49	74.00	-16.51	Peak	343	316	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 1, CH78		

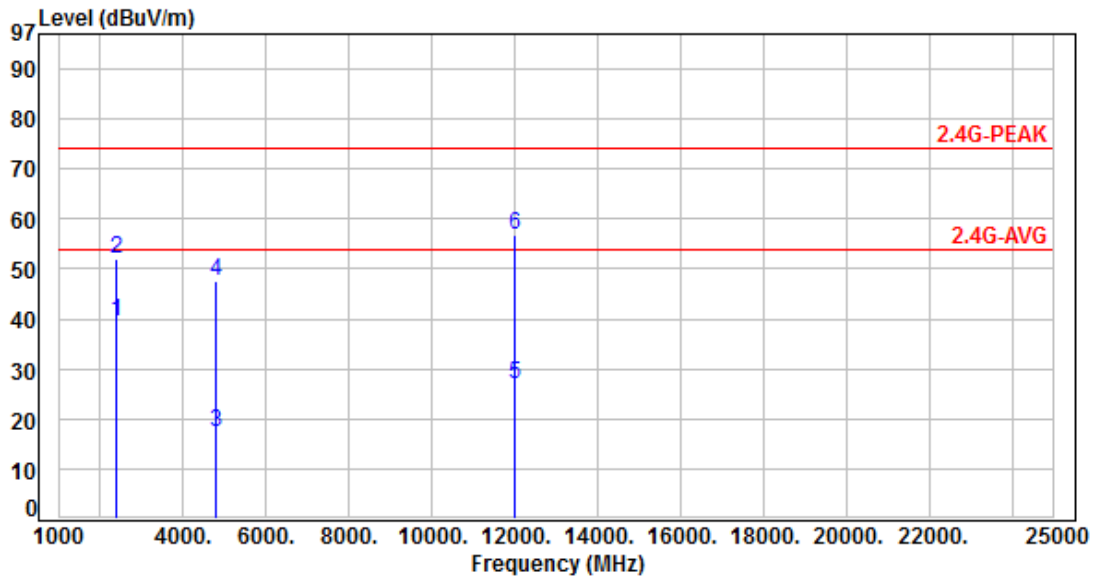


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-2.75	38.79	36.04	54.00	-17.96	Average	152	216	P
2	2483.50	-2.75	68.89	66.14	74.00	-7.86	Peak	152	216	P
3	4960.00	5.16	16.58	21.74	54.00	-32.26	Average	146	314	P
4	4960.00	5.16	46.68	51.84	74.00	-22.16	Peak	146	314	P
5	7440.00	9.83	21.81	31.64	54.00	-22.36	Average	154	312	P
6	7440.00	9.83	51.91	61.74	74.00	-12.26	Peak	154	312	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 3, CH00		:

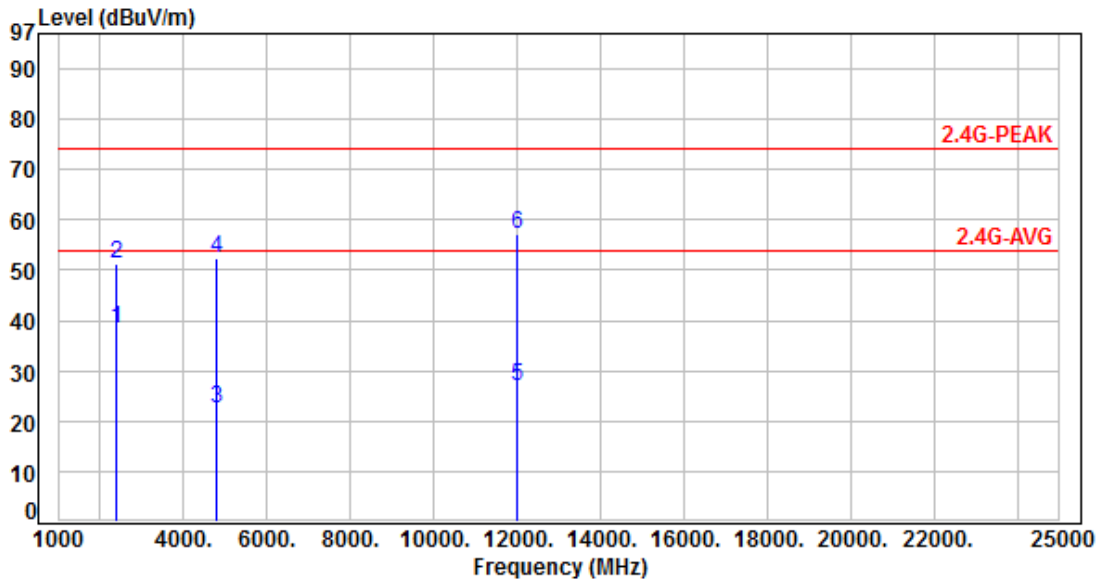


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	42.45	39.47	54.00	-14.53	Average	244	312	P
2	2390.00	-2.98	54.89	51.91	74.00	-22.09	Peak	244	312	P
3	4804.00	4.56	12.82	17.38	54.00	-36.62	Average	369	343	P
4	4804.00	4.56	42.92	47.48	74.00	-26.52	Peak	369	343	P
5	12010.00	14.61	12.17	26.78	54.00	-27.22	Average	100	358	P
6	12010.00	14.61	42.27	56.88	74.00	-17.12	Peak	100	358	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 3, CH00		:

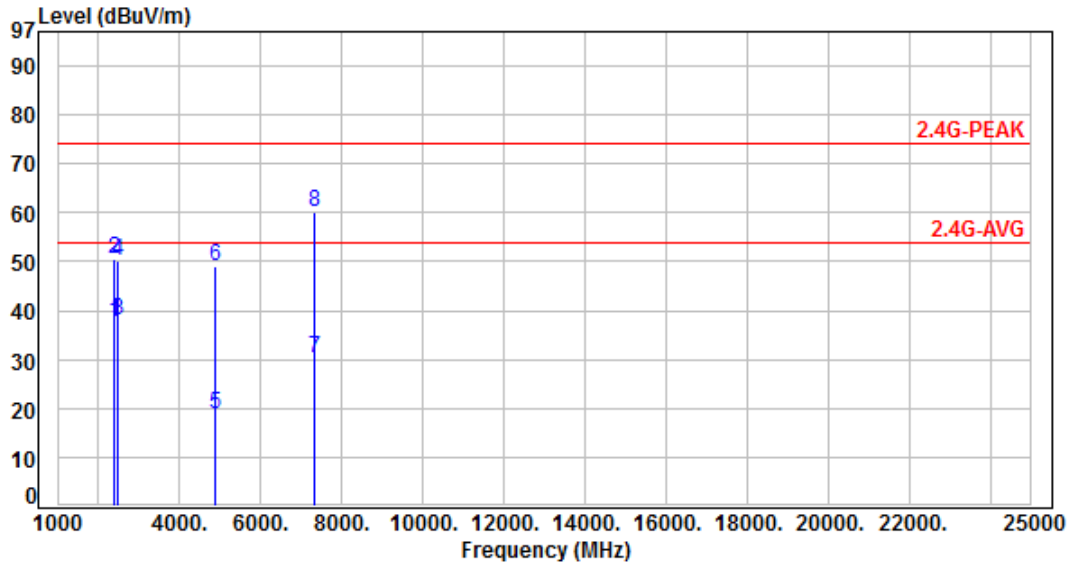


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	41.38	38.40	54.00	-15.60	Average	124	235	P
2	2390.00	-2.98	54.11	51.13	74.00	-22.87	Peak	124	235	P
3	4804.00	4.56	17.86	22.42	54.00	-31.58	Average	125	317	P
4	4804.00	4.56	47.96	52.52	74.00	-21.48	Peak	125	317	P
5	12010.00	14.61	12.45	27.06	54.00	-26.94	Average	100	328	P
6	12010.00	14.61	42.55	57.16	74.00	-16.84	Peak	100	328	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 3, CH39		:

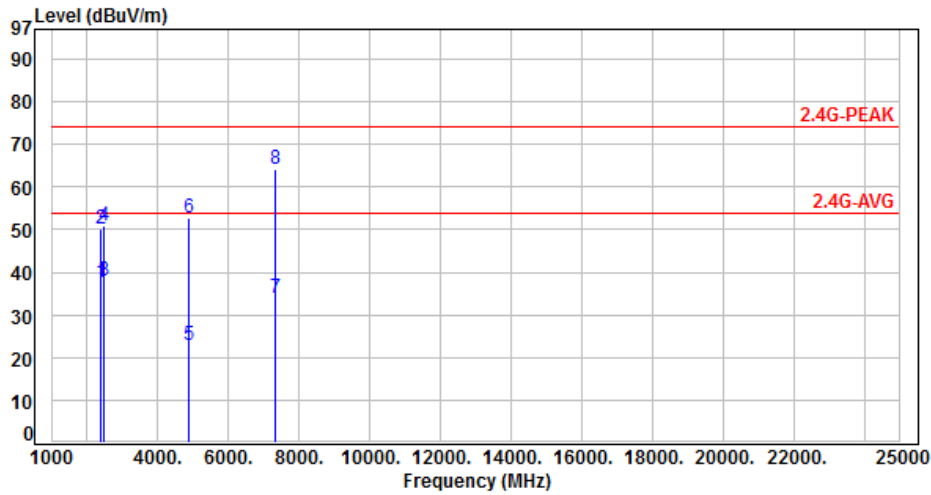


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	40.51	37.53	54.00	-16.47	Average	100	102	P
2	2390.00	-2.98	53.38	50.40	74.00	-23.60	Peak	100	102	P
3	2483.50	-2.75	40.68	37.93	54.00	-16.07	Average	100	102	P
4	2483.50	-2.75	52.93	50.18	74.00	-23.82	Peak	100	102	P
5	4882.00	4.81	14.13	18.94	54.00	-35.06	Average	371	338	P
6	4882.00	4.81	44.23	49.04	74.00	-24.96	Peak	371	338	P
7	7323.00	9.72	20.34	30.06	54.00	-23.94	Average	332	318	P
8	7323.00	9.72	50.44	60.16	74.00	-13.84	Peak	332	318	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 3, CH39		:

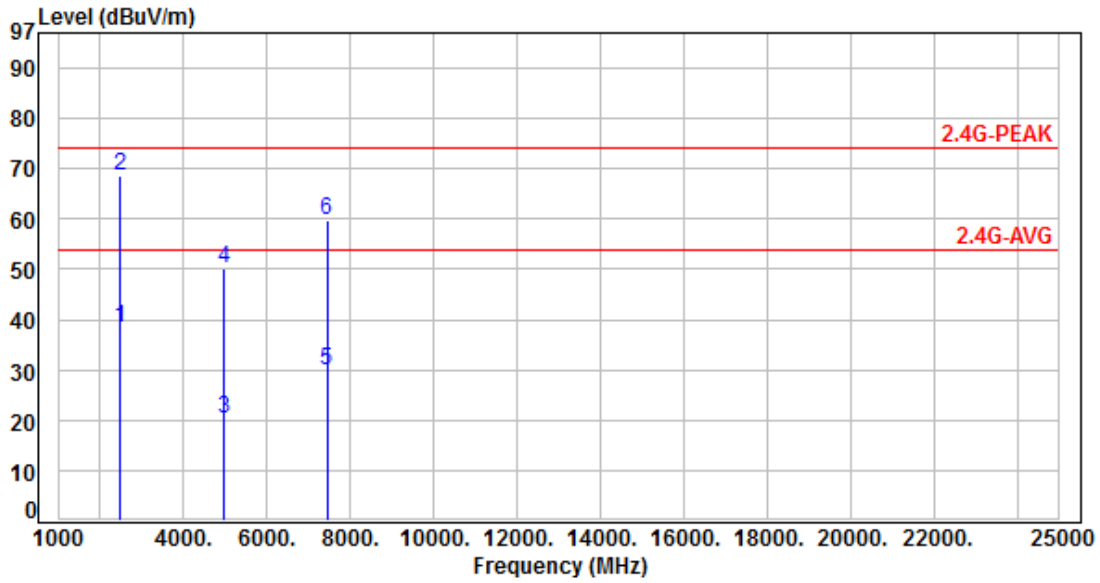


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2390.00	-2.98	40.69	37.71	54.00	-16.29	Average	100	214	P
2	2390.00	-2.98	53.32	50.34	74.00	-23.66	Peak	100	214	P
3	2483.50	-2.75	40.78	38.03	54.00	-15.97	Average	100	214	P
4	2483.50	-2.75	53.59	50.84	74.00	-23.16	Peak	100	214	P
5	4882.00	4.81	17.93	22.74	54.00	-31.26	Average	128	314	P
6	4882.00	4.81	48.03	52.84	74.00	-21.16	Peak	128	314	P
7	7323.00	9.72	24.25	33.97	54.00	-20.03	Average	111	319	P
8	7323.00	9.72	54.35	64.07	74.00	-9.93	Peak	111	319	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: VERTICAL
Test Mode	: Mode 3, CH78		:

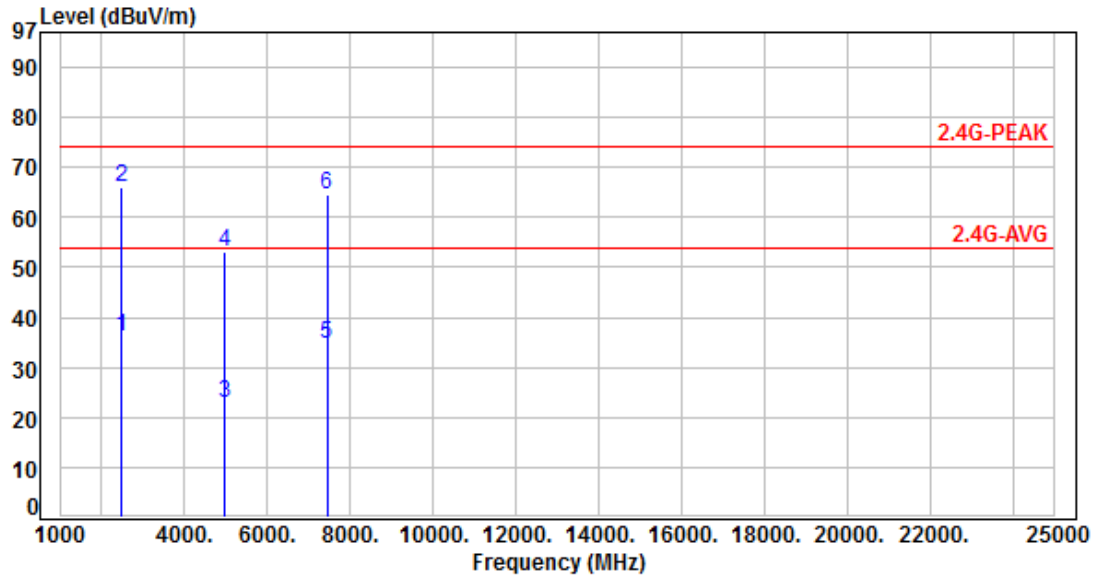


No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-2.75	41.15	38.40	54.00	-15.60	Average	100	91	P
2	2483.50	-2.75	71.25	68.50	74.00	-5.50	Peak	100	91	P
3	4960.00	5.16	15.02	20.18	54.00	-33.82	Average	349	342	P
4	4960.00	5.16	45.12	50.28	74.00	-23.72	Peak	349	342	P
5	7440.00	9.83	20.00	29.83	54.00	-24.17	Average	284	322	P
6	7440.00	9.83	50.10	59.93	74.00	-14.07	Peak	284	322	P

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



Power	: AC 120V / 60Hz	Pol/Phase	: HORIZONTAL
Test Mode	: Mode 3, CH78		:



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg)	P/F
1	2483.50	-2.75	38.73	35.98	54.00	-18.02	Average	101	213	P
2	2483.50	-2.75	68.83	66.08	74.00	-7.92	Peak	101	213	P
3	4960.00	5.16	17.77	22.93	54.00	-31.07	Average	121	337	P
4	4960.00	5.16	47.87	53.03	74.00	-20.97	Peak	121	337	P
5	7440.00	9.83	24.66	34.49	54.00	-19.51	Average	155	314	P
6	7440.00	9.83	54.76	64.59	74.00	-9.41	Peak	155	314	P

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



6.7 Restricted Bands of Operation

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

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

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



7. Test of Conducted Spurious Emission

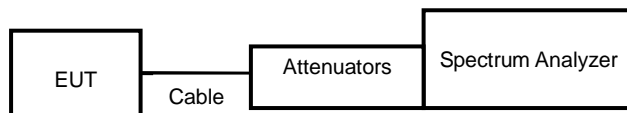
7.1 Test Limit

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

7.2 Test Procedure

- a. The transmitter output was connected to the spectrum analyzer via a low loss cable.
- b. Set 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.
- c. The band edges was measured and recorded.

7.3 Test Setup Layout



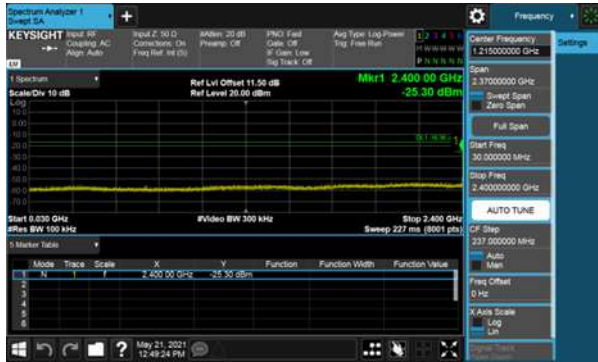
7.4 Test Result and Data

Note: Test plots refer to the following pages.



Modulation Type: GFSK (1Mbps)
Channel: 00

Modulation Type: GFSK (1Mbps)
Channel: 39

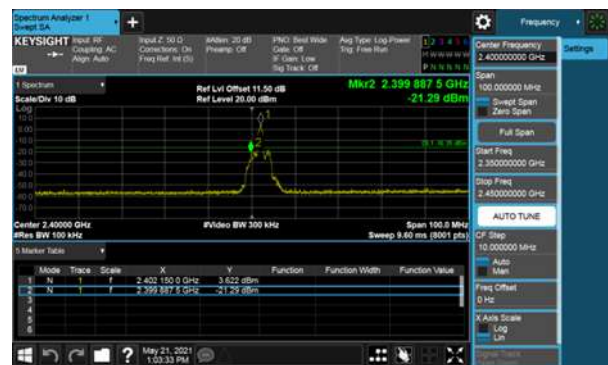
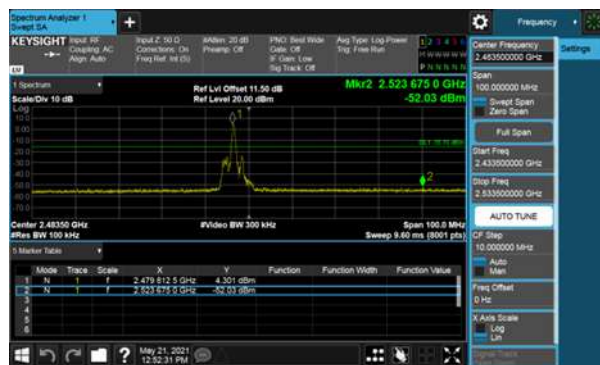




Modulation Type: GFSK (1Mbps)
Channel: 78



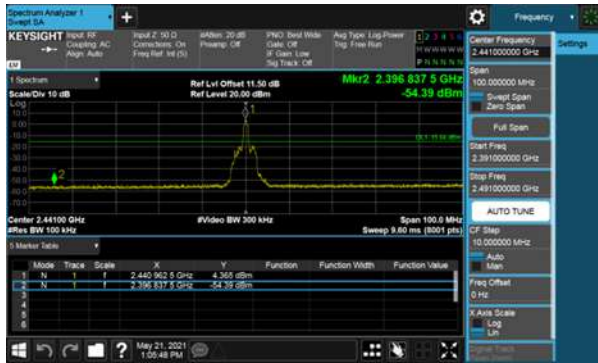
Modulation Type: $\pi/4$ -DQPSK (2Mbps)
Channel: 00





Modulation Type: $\pi/4$ -DQPSK (2Mbps)
Channel: 39

Modulation Type: $\pi/4$ -DQPSK (2Mbps)
Channel: 78

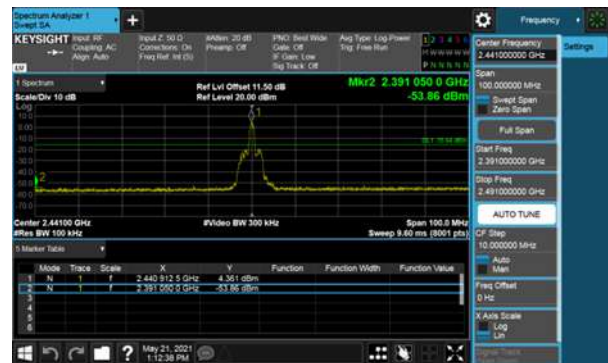




Modulation Type: 8DPSK (3Mbps)
Channel: 00



Modulation Type: 8DPSK (3Mbps)
Channel: 39





Modulation Type: 8DPSK (3Mbps)
Channel: 78

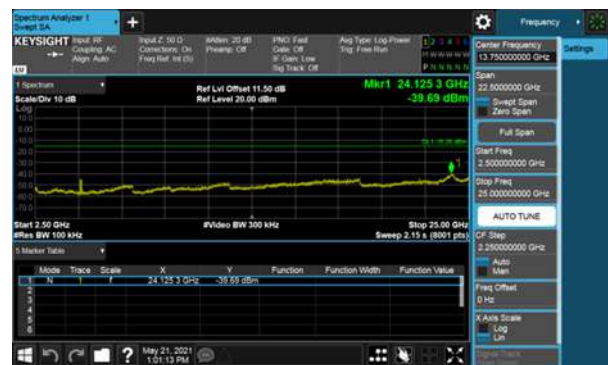
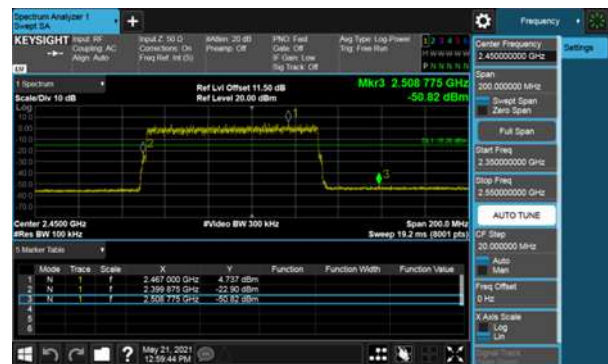
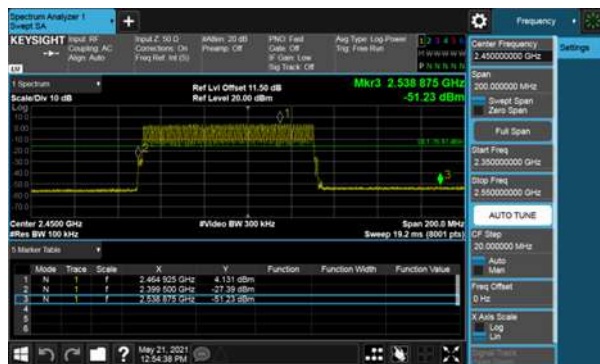




Hopping Mode:
Modulation Type: GFSK

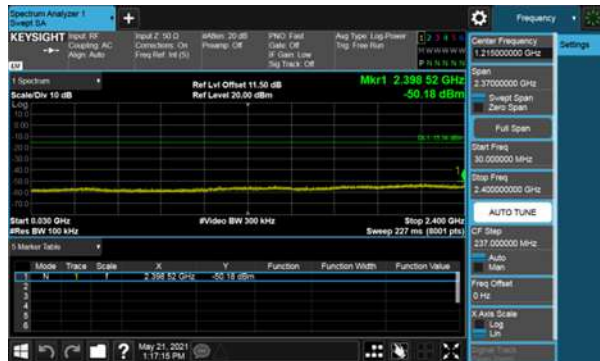


Modulation Type: $\pi/4$ -DQPSK





Modulation Type: 8DPSK





8. 20dB Bandwidth Measurement Data

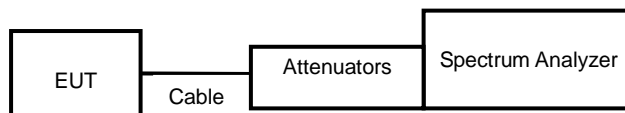
8.1 Test Limit

For reference data.

8.2 Test Procedures

- a. The transmitter output was connected to the spectrum analyzer.
- b. Set RBW of spectrum analyzer to 1~5% of the 20dB bandwidth and VBW to approximately three time RBW..
- 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

Modulation Type	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	2/3 20dB Bandwidth (MHz)
GFSK	0	2402	0.941	0.627
	39	2441	0.958	0.639
	78	2480	0.942	0.628
$\pi/4$ -DQPSK	0	2402	1.291	0.861
	39	2441	1.283	0.855
	78	2480	1.281	0.854
8DPSK	0	2402	1.309	0.873
	39	2441	1.304	0.869
	78	2480	1.309	0.873



20dB Bandwidth

Modulation Type: GFSK (1Mbps)
Channel: 00

Modulation Type: $\pi/4$ -DQPSK (2Mbps)
Channel: 00



CH39

CH39



CH78

CH78





20dB Bandwidth
Modulation Type: 8DPSK (3Mbps)
Channel: 00



CH39



CH78





9. Carrier Frequency Separation

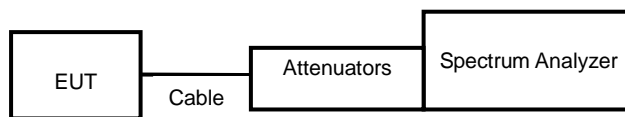
9.1 Test Limit

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. 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 than 125 mW.

9.2 Test Procedures

- a. The transmitter output was connected to the spectrum analyzer.
- b. Set RBW of spectrum analyzer to 100 KHz and VBW to 300 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



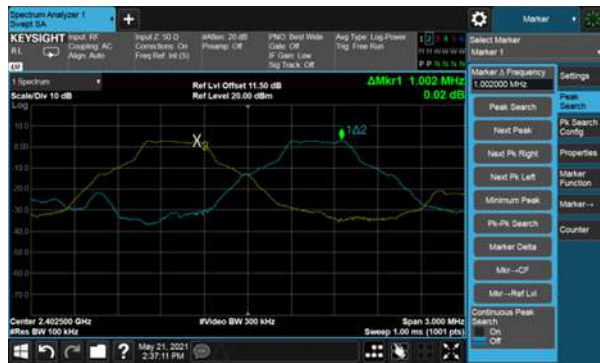


9.4 Test Result and Data

Modulation Type	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
GFSK	0	2402	1.002	0.627
	39	2441	1.002	0.639
	78	2480	1.002	0.628
$\pi/4$ -DQPSK	0	2402	1.002	0.861
	39	2441	1.002	0.855
	78	2480	1.002	0.854
8DPSK	0	2402	1.002	0.873
	39	2441	1.002	0.869
	78	2480	1.002	0.873



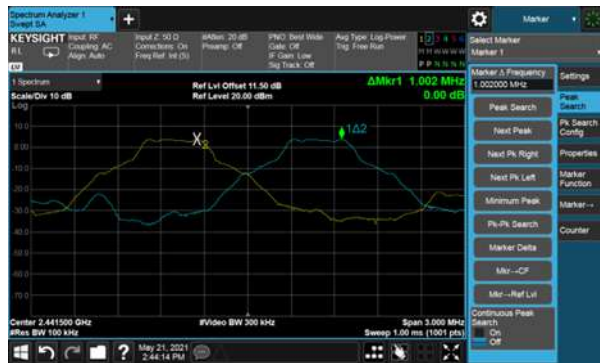
Modulation Type: GFSK (1Mbps)
Channel: 00



Modulation Type: $\pi/4$ -DQPSK (2Mbps)
Channel: 00



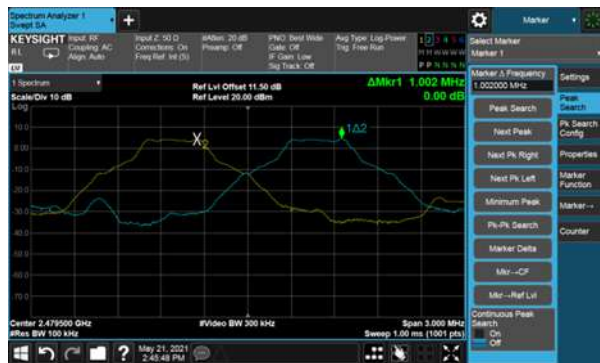
CH39



CH39



CH78



CH78





Modulation Type: 8DPSK (3Mbps)
Channel: 00



CH39



CH78





10. Dwell Time on each channel

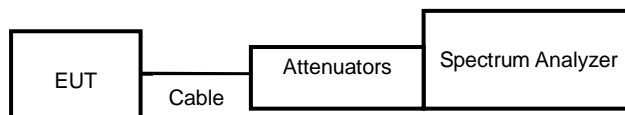
10.1 Test Limit

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 3 MHz.
4. Measure the time duration of one transmission on the measured frequency.

10.3 Test Setup Layout



**10.4 Test Result and Data**

Channel	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	0.440	320.00	140.80	400
GFSK-DH3	2402	1.694	160.00	271.04	400
GFSK-DH5	2402	2.950	106.67	314.67	400
$\pi/4$ -DQPSK-DH1	2402	0.445	320.00	142.40	400
$\pi/4$ -DQPSK-DH3	2402	1.701	160.00	272.16	400
$\pi/4$ -DQPSK-DH5	2402	2.960	106.67	315.73	400
8DPSK-DH1	2402	0.445	320.00	142.40	400
8DPSK-DH3	2402	1.694	160.00	271.04	400
8DPSK-DH5	2402	2.960	106.67	315.73	400

Channel	Frequency (MHz)	Length of transmission time (ms)	Number of transmission in a 8 (20 Hopping*0.4)	Dwell Time (ms)	Limit (ms)
AFH-DH1	2402-2421	0.440	160.00	70.40	400
AFH-DH3	2402-2421	1.687	80.00	134.96	400
AFH-DH5	2402-2421	2.950	53.33	157.32	400



Modulation Type: GFSK-DH1
Channel: 00



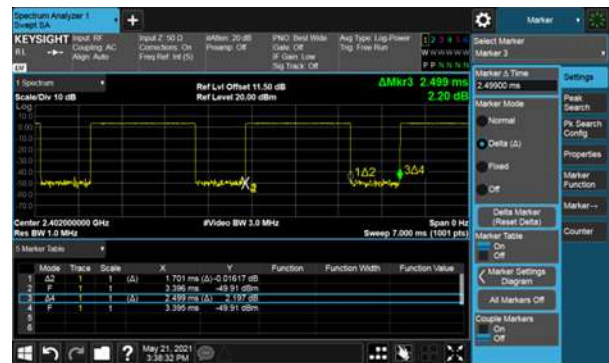
Modulation Type: $\pi/4$ -DQPSK-DH1
Channel: 00



Modulation Type: GFSK-DH3
Channel: 00



Modulation Type: $\pi/4$ -DQPSK-DH3
Channel: 00



Modulation Type: GFSK-DH5
Channel: 00

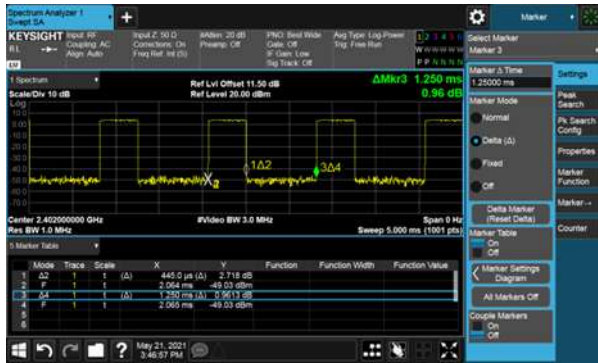


Modulation Type: $\pi/4$ -DQPSK-DH5
Channel: 00

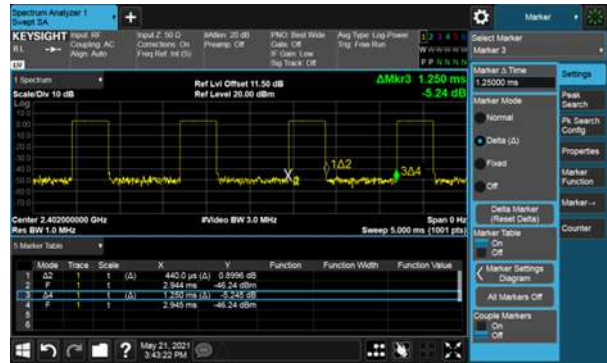




Modulation Type: 8DPSK-DH1
Channel: 00



Modulation Type: AFH-DH1



Modulation Type: 8DPSK-DH3
Channel: 00



Modulation Type: AFH-DH3



Modulation Type: 8DPSK-DH5
Channel: 00



Modulation Type: AFH-DH5





11. Number of Hopping Channels

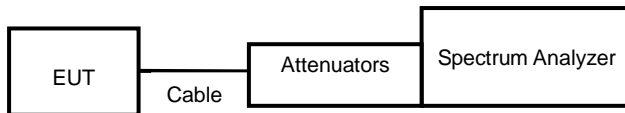
11.1 Test Limit

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

11.2 Test Procedures

- a. The transmitter output was connected to the spectrum analyzer.
- b. 2. Set RBW of spectrum analyzer to 100 KHz and VBW to 300 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

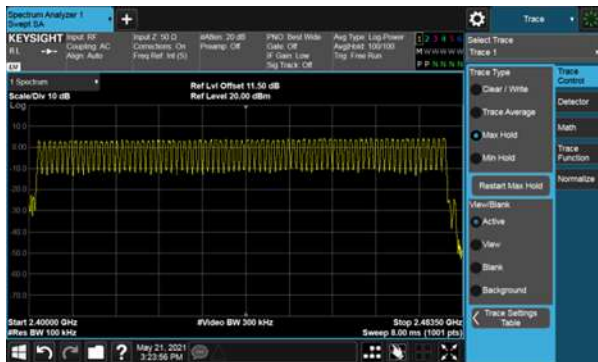


11.4 Test Result and Data

Modulation Type	Hopping Channels
GFSK	79
$\pi/4$ -DQPSK	79
8DPSK	79



Modulation Type: GFSK (1Mbps)



Modulation Type: $\pi/4$ -DQPSK (2Mbps)



Modulation Type: 8DPSK (3Mbps)





12. Maximum Peak Output Power

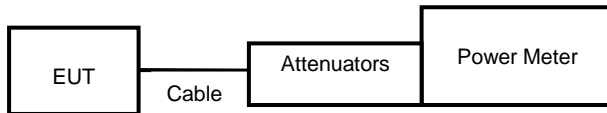
12.1 Test Limit

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**

Modulation Type	Setting	Channel	Frequency (MHz)	PK Output Power (dBm)	PK Output Power (mW)
GFSK	63	0	2402	2.85	1.928
	63	39	2441	3.66	2.323
	63	78	2480	4.25	2.661
$\pi/4$ -DQPSK	63	0	2402	3.91	2.460
	63	39	2441	4.78	3.006
	63	78	2480	5.43	3.491
8DPSK	63	0	2402	4.07	2.553
	63	39	2441	4.91	3.097
	63	78	2480	5.54	3.581

Modulation Type	Setting	Channel	Frequency (MHz)	AV Output Power (dBm)	AV Output Power (mW)
GFSK	63	0	2402	2.61	1.824
	63	39	2441	3.42	2.198
	63	78	2480	4.04	2.535
$\pi/4$ -DQPSK	63	0	2402	2.45	1.758
	63	39	2441	3.28	2.128
	63	78	2480	3.88	2.443
8DPSK	63	0	2402	2.45	1.758
	63	39	2441	3.27	2.123
	63	78	2480	3.87	2.438

AFH Mode

Modulation Type	Setting	Channel	Frequency (MHz)	PK Output Power (dBm)	PK Output Power (mW)
GFSK	63	0-19	2402-2421	3.25	2.113
$\pi/4$ -DQPSK	63	0-19	2402-2421	4.34	2.716
8DPSK	63	0-19	2402-2421	4.49	2.812

AFH Mode

Modulation Type	Setting	Channel	Frequency (MHz)	AV Output Power (dBm)	AV Output Power (mW)
GFSK	63	0-19	2402-2421	3.01	2.000
$\pi/4$ -DQPSK	63	0-19	2402-2421	2.86	1.932
8DPSK	63	0-19	2402-2421	2.85	1.928

Note: Average power is for reference only.