

BUREAU
VERITAS

Test Report No.: RF160722N063

Test Lab
Cert 2951.01

TEST REPORT

Applicant:	Asian Express Holdings Limited
Address:	RM1702, Sino Centre, 582-592 Nathan Road, Mongkok ,Kowloon, Hong Kong.

Manufacturer or Supplier	Asian Express Holdings Limited
Address	RM1702, Sino Centre, 582-592 Nathan Road, Mongkok ,Kowloon, Hong Kong.
Product:	ATOM1.0 Micro Drone with FPV
Brand Name:	PROPEL
Model:	HS-2403
Additional Model & Model Difference	HS-2404, HS-2405, HS-2406, PL-1570, PL-1571, PL-1572, PL-1573, PL-1574, PL-1575, PL-1576, PL-1577, PL-1578/PL-1579, see item 3.1
Date of tests:	Jul. 26, 2016 ~ Jul. 30, 2016

the tests have been carried out according to the requirements of the following standard:

☒ FCC Part 15, Subpart C, Section 15.249(2015-10)

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Breeze Jiang Project Engineer / EMC Department	Approved by Chris Chen Manager / EMC Department
	
Date: Aug.02, 2016	

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF160722N063	Original release	Aug.02, 2016



1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.249)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
§15.203	Antenna Requirement	PASS	No antenna connector is used
§15.207 (a)	Conducted Emission	PASS	Powered from Battery
§15.205	Restricted Band of Operation	PASS	Compliant
§15.209 §15.249(a)	Radiated Emission	PASS	Compliant
§15.215(c)	20dB Bandwidth Test	PASS	Compliant

2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Radiated emissions	9KMHz ~ 30MHz	2.90dB
	30MHz ~ 1GMHz	3.62dB
	1GHz ~ 18GHz	5.03dB
	18GHz ~ 40GHz	4.84dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.



3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	ATOM1.0 Micro Drone with FPV
MODEL NO.	HS-2403
ADDITIONAL MODELS	HS-2404, HS-2405, HS-2406, PL-1570, PL-1571, PL-1572, PL-1573, PL-1574, PL-1575, PL-1576, PL-1577, PL-1578/PL-1579
FCC ID	VLEHS-2403T
NOMINAL VOLTAGE	DC 3.0V(1.5V*AA*2) from Battery
MODULATION TECHNOLOGY	GFSK
OPERATING FREQUENCY	2450-2459MHz
ANTENNA TYPE	Wire Antenna, with 0dBi gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions, but only the worst case was shown in test report.
3. Please refer to the EUT photo document (Reference No.:160722N063) for detailed product photo.
4. Additional models are identical with the test model HS-2403 except the model no. for trading purpose.



3.2 DESCRIPTION OF TEST MODES

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	BW	
A	√	√	-	√	DC 3.0V From New Battery

Where **RE<1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission

RE≥1G: Radiated Emission above 1GHz
BW: 20db bandwidth

Following channel(s) was (were) selected for the test as listed below.

TESTED CHANNEL	TESTED FREQUENCY
Low	2450 MHz
Middle	2455 MHz
High	2459 MHz

Note: The more detailed channel, please refer to the product specifications

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE	24deg. C, 54%RH	DC 3.0V From New Battery	Breeze Jiang
BW	24deg. C, 54%RH	DC 3.0V From New Battery	Breeze Jiang
PLC	-	-	-



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3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C, Section 15.249(2015-10)

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	N/A	N/A	N/A	N/A	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A



4. TEST TYPES AND RESULTS

4.1 RADIATED EMISSION MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

Emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209 as following:

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/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

According to §15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.



4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR7	101494	Apr. 05,16	Apr. 04,17
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV7	102331	Nov. 09,15	Nov. 08,16
Bilog Antenna	Teseq	CBL 6111D	30643	Jul. 16, 16	Jul. 15, 17
Horn Antenna (1GHz -18GHz)	ETS -Lindgren	3117	00062558	May 30, 15	May 29, 17
GPS Generator+ Antenna	TOJOIN	GNSS-5000A	E1-010119	Aug. 08, 14	Aug. 07, 16
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	NSEMC003	Mar. 12,16	Mar. 11,18
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170242	Mar. 12,16	Mar. 11,17
Amplifier (9kHz-1GHz)	SONOMA	310D	186955	Mar. 04,16	Mar. 03, 17
Pre-Amplifier(1-18G)	HP	8449B	3008A00409	Apr. 25,16	Apr. 24,17
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Nov. 20,15	Nov. 19,16
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	Sep. 01,15	Aug. 31,16

NOTE:

1. The test was performed in 966 Chamber.
2. The calibration interval of the above test instruments are 12, 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 494399.



4.1.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:

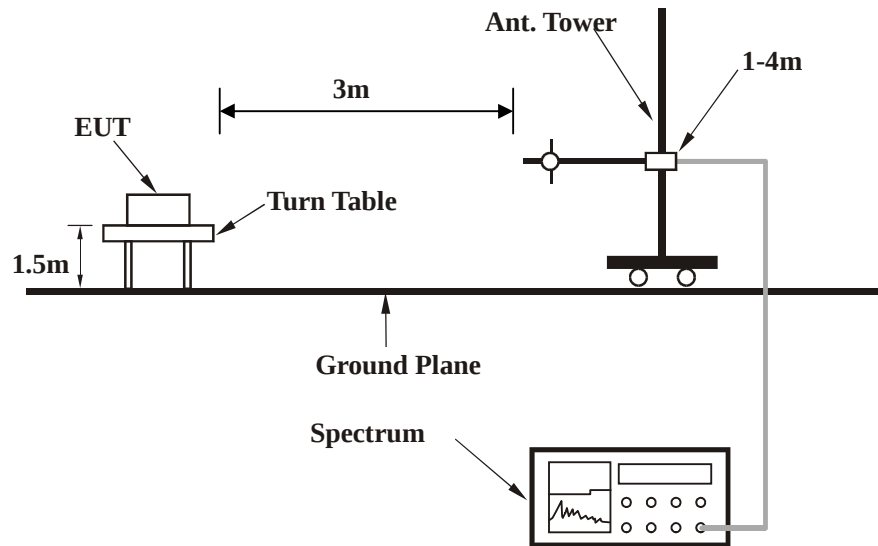
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.



4.1.5 TEST SETUP



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT OPERATING CONDITIONS

- Turned on the power of all equipment.
- EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.



4.1.7 TEST RESULTS

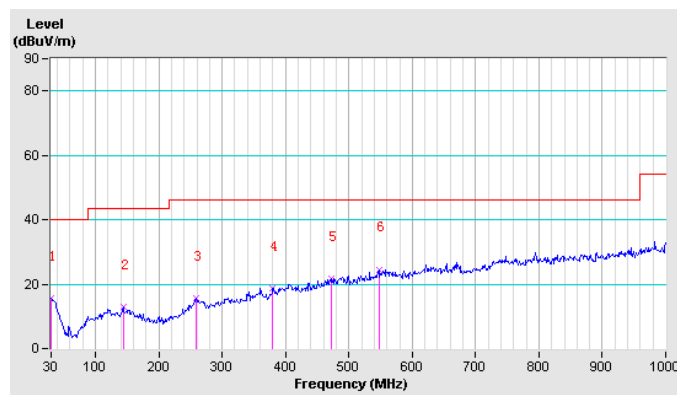
BELOW 1GHz WORST-CASE DATA

CHANNEL	TX Middle Channel	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	CORRECTIO N FACTOR (dB/m)	RAW VALUE (dBuV)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)
1	30.00	-11.41	27.17	15.76	40.00	-24.24	100	0
2	143.87	-17.71	30.55	12.84	43.50	-30.66	100	0
3	259.14	-13.70	29.35	15.65	46.00	-30.35	100	0
4	380.04	-11.43	29.94	18.51	46.00	-27.49	100	0
5	472.83	-7.81	29.66	21.85	46.00	-24.15	100	0
6	547.33	-5.33	29.92	24.59	46.00	-21.41	100	0

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



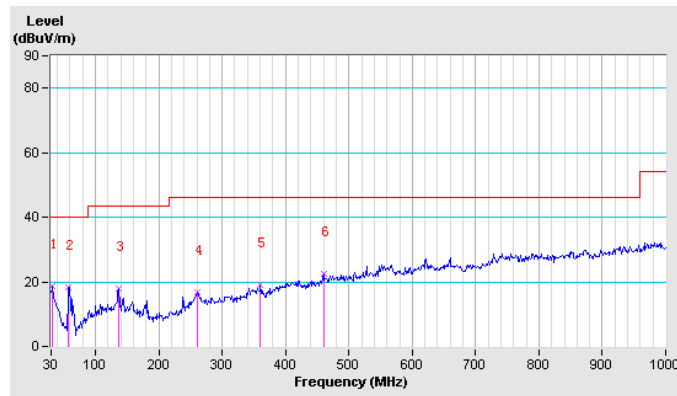


CHANNEL	TX Middle Channel	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	CORRECTIO N FACTOR (dB/m)	RAW VALUE (dBuV)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)
1	32.81	-12.83	31.62	18.79	40.00	-21.21	100	0
2	58.12	-24.43	42.88	18.45	40.00	-21.55	100	0
3	136.84	-17.99	35.81	17.82	43.50	-25.68	100	0
4	260.55	-13.54	30.41	16.87	46.00	-29.13	100	0
5	360.36	-11.36	30.55	19.19	46.00	-26.81	100	0
6	460.17	-8.33	30.67	22.34	46.00	-23.66	100	0

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.





ABOVE 1GHz WORST-CASE DATA:

CHANNEL	TX Low Channel	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2400.00	32.03 PK	74.0	-41.97	1.00	294	29.48	2.55
2	2400.00	22.84 AV	54.0	-31.16	1.00	294	20.29	2.55
3	2450.00	68.76 PK	114.0	-45.24	1.00	294	66.07	2.69
4	2450.00	59.57 AV	94.0	-34.43	1.00	294	56.88	2.69
5	4900.00	46.62 PK	74.0	-27.38	1.00	274	38.73	7.89
6	4900.00	37.43 AV	54.0	-16.57	1.00	274	29.54	7.89
7	7350.00	49.93 PK	74.0	-24.07	1.20	350	36.23	13.7
8	7350.00	40.74 AV	54.0	-13.26	1.20	350	27.04	13.7
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2400.00	39.11 PK	74.0	-34.89	1.00	350	36.56	2.55
2	2400.00	29.92 AV	54.0	-24.08	1.00	350	27.37	2.55
3	2450.00	66.99 PK	114.0	-47.01	1.00	350	64.30	2.69
4	2450.00	57.80 AV	94.0	-36.20	1.00	350	55.11	2.69
5	4900.00	46.24 PK	74.0	-27.76	1.00	177	38.35	7.89
6	4900.00	37.05 AV	54.0	-16.95	1.00	177	29.16	7.89
7	7350.00	49.59 PK	74.0	-24.41	1.10	155	35.89	13.70
8	7350.00	40.40 AV	54.0	-13.60	1.10	155	26.70	13.70

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



CHANNEL	TX Middle Channel	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2455.00	69.03 PK	114.0	-44.97	1.00	295	66.34	2.69
2	2455.00	59.84 AV	94.0	-34.16	1.00	295	57.15	2.69
3	4910.00	45.34 PK	74.0	-28.66	1.10	296	37.43	7.91
4	4910.00	36.15 AV	54.0	-17.85	1.10	296	28.24	7.91
5	7365.00	49.36 PK	74.0	-24.64	1.00	144	35.63	13.73
6	7365.00	40.17 AV	54.0	-13.83	1.00	144	26.44	13.73
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2455.00	66.27 PK	114.0	-47.73	1.00	200	63.58	2.69
2	2455.00	56.08 AV	94.0	-37.92	1.00	200	53.39	2.69
3	4910.00	47.13 PK	74.0	-26.87	2.00	178	39.22	7.91
4	4910.00	37.94 AV	54.0	-16.06	2.00	178	30.03	7.91
5	7365.00	49.47 PK	74.0	-24.53	1.10	350	35.74	13.73
6	7365.00	40.28 AV	54.0	-13.72	1.10	350	26.55	13.73

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



CHANNEL	TX High Channel	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2459.00	68.68 PK	114.0	-45.32	1.00	272	65.98	2.70
2	2459.00	59.49 AV	94.0	-34.51	1.00	272	56.79	2.70
3	2483.50	35.06 PK	74.0	-38.94	1.00	272	32.29	2.77
4	2483.50	25.87 AV	54.0	-28.13	1.00	272	23.10	2.77
5	4918.00	47.60 PK	74.0	-26.40	1.10	275	39.69	7.91
6	4918.00	38.41 AV	54.0	-15.59	1.10	275	30.50	7.91
7	7377.00	49.38 PK	74.0	-24.62	1.00	220	35.62	13.76
8	7377.00	40.19 AV	54.0	-13.81	1.00	220	26.43	13.76
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2459.00	65.83 PK	114.0	-48.17	1.00	175	63.13	2.70
2	2459.00	56.64 AV	94.0	-37.36	1.00	175	53.94	2.70
3	2483.50	36.05 PK	74.0	-37.95	1.00	175	33.28	2.77
4	2483.50	26.86 AV	54.0	-27.14	1.00	175	24.09	2.77
5	4918.00	46.82 PK	74.0	-27.18	1.10	175	38.91	7.91
6	4918.00	37.63 AV	54.0	-16.37	1.10	175	29.72	7.91
7	7377.00	49.69 PK	74.0	-24.31	1.00	206	35.93	13.76
8	7377.00	40.50 AV	54.0	-13.50	1.00	206	26.74	13.76

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



4.2 20dB BANDWIDTH MEASUREMENT

4.2.1 LIMITS OF 20dB BANDWIDTH MEASUREMENT

According to FCC 15.215(c), must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Power Sensor	Keysight	U2021XA	MY55060016	May 27,16	May 26,17
Power Sensor	Keysight	U2021XA	MY55060018	May 27,16	May 26,17
Digital Multimeter	FLUKE	15B	A1220010DG	Oct. 12, 15	Oct.11, 16
Humid & Temp Programmable Tester	Haida	HD-2257	110807201	Sep.07,15	Sep. 06,16
Oscilloscope	Agilent	DSO9254A	MY51260160	Nov. 28,15	Nov. 27,16
Signal Analyzer	Rohde & Schwarz	FSV7	102331	Nov. 09,15	Nov. 08,16
Signal Generator	Agilent	N5183A	MY50140980	Nov. 09,15	Nov. 08,16
ESG Vector Signal Generator	Agilent	E4438C	MY49072505	Apr. 22, 16	Apr. 21, 17
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	Sep. 01,15	Aug. 31,16

NOTE:

1. The test was performed in RF Oven room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.2.3 TEST PROCEDURE

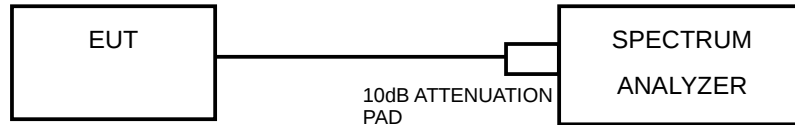
- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Repeat above procedures until all frequencies measured were complete.



4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

4.2.5 TEST SETUP



4.2.6 EUT OPERATING CONDITIONS

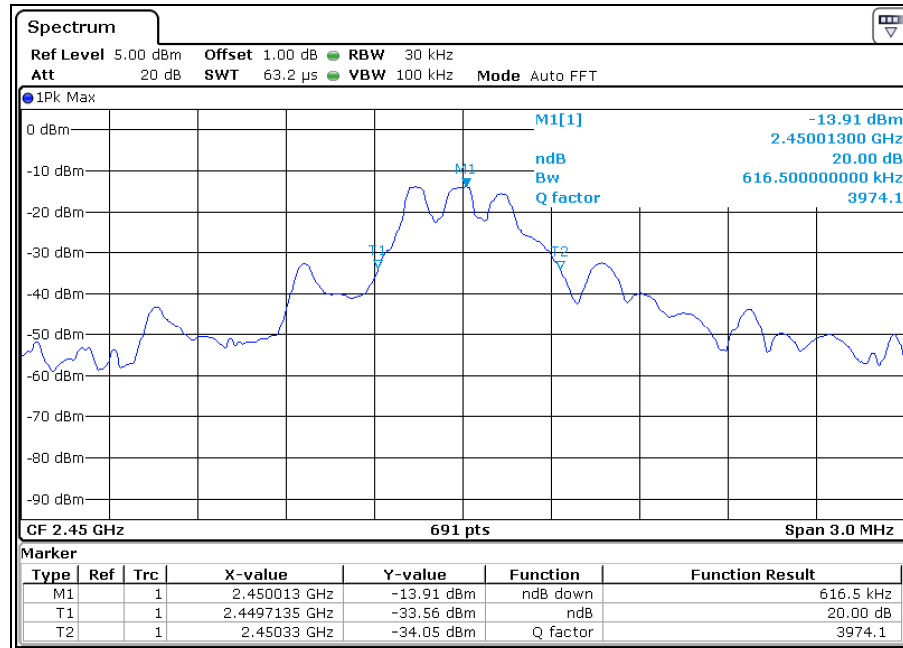
- a) Turned on the power of all equipment.
- b) EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

4.2.7 TEST RESULTS

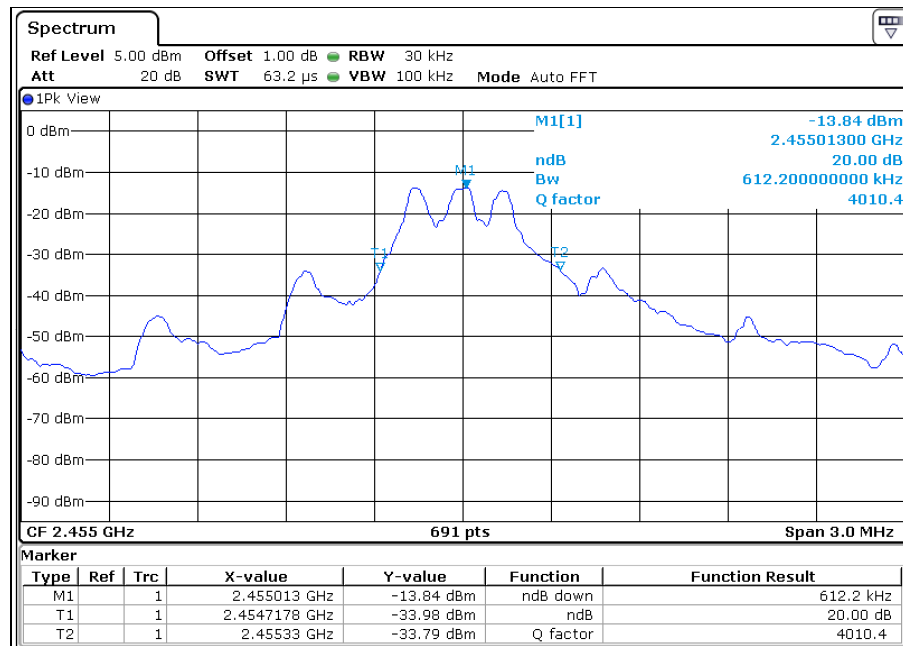
CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
Low	2450	0.6165
Middle	2455	0.6122
High	2459	0.6035



Test Data: Low channel

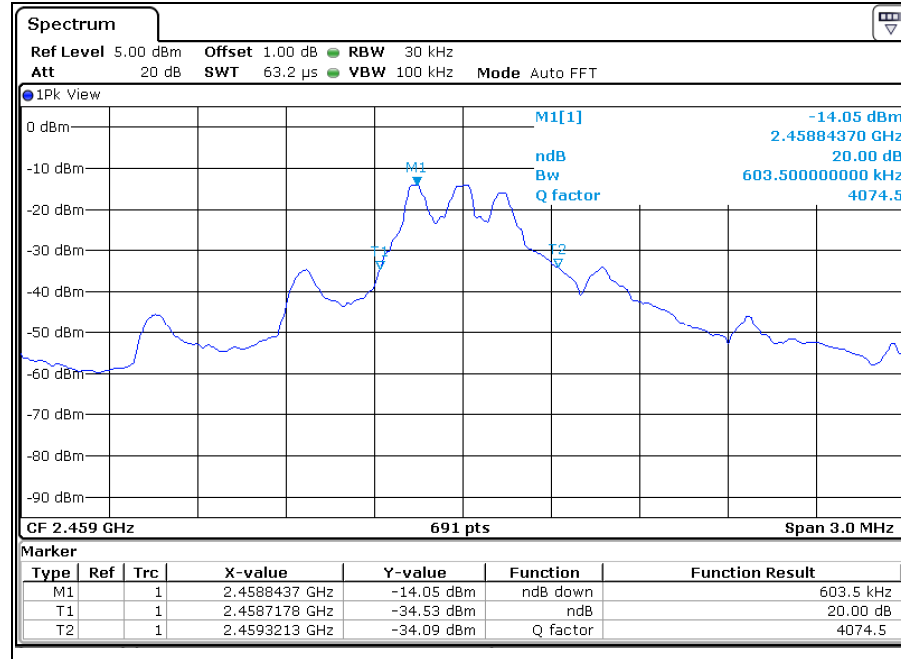


Test Data: Middle channel





Test Data: High channel





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5. PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).



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6. APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---