

JPW Industries

TEST REPORT

SCOPE OF WORK:

47 CFR FCC Part 15.231 – Radio Spectrum report

Model:

AFS-1000C, ISF-1000

REPORT NUMBER

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Radio Spectrum TEST REPORT

Applicant:	JPW Industries 427 New Sanford Road LaVergne, TN 37086 United States
Product:	Air Filtration System
Model No.:	AFS-1000C, ISF-1000
FCC ID:	2AX7WAFS1000C
Test Method/ Standard:	47 CFR FCC Part 15.231
Test By:	Intertek Testing Services Taiwan Ltd., Hsinchu Laboratory No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan



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Revision History

Report No.	Issue Date	Revision Summary
210900375THC-001	Nov. 29, 2021	Original report

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Summary of Test Data

Test Requirement	Applicable Rule	Result
Radiated Emission test	15.231(b), 15.209	Pass
Measured bandwidth	15.231(c)	Pass
Timing requirement of manually operated transmitter	15.231(a)(1)	Pass
Conducted Emission test	15.207	N/A
Antenna Requirement	15.203	Pass

Note: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.

Other Testing: the specification, standard and not taking into account the measurement uncertainty.

1. General Information

1.1 Identification of the EUT

Product:	Air Filtration System
Model No.:	AFS-1000C
Operating Frequency:	315.1 MHz
Rated Power:	DC 3V from Battery
Power Cord:	N/A
Sample receiving date:	2021/09/27
Sample condition:	Workable
Test Date(s):	2021/10/15 ~ 2021/11/16

1.2 Additional information about the EUT

The customer confirmed ISF-1000 are series models to AFS-1000C (EUT), the different model numbers are served as marketing strategy.

Trade Name	Model Number
JET	AFS-1000C
Baileigh	ISF-1000

1.3 Antenna description

Antenna Type : PCB copper trace line antenna
Connector Type : Fixed

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 2.1053 and the requirement in FCC Part 15 Subpart C Section 15.231.

2.2 Operation mode

The EUT was supplied with DC 3V from battery.

TX Operation: Press EUT button to transmit.

The signal is maximized through rotation and placement in the two orthogonal axes.



X axis



Y axis



Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at X axis. The final test data was executed under this configuration.

2.3 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Battery	Panasonic	CR2032	N/A	N/A

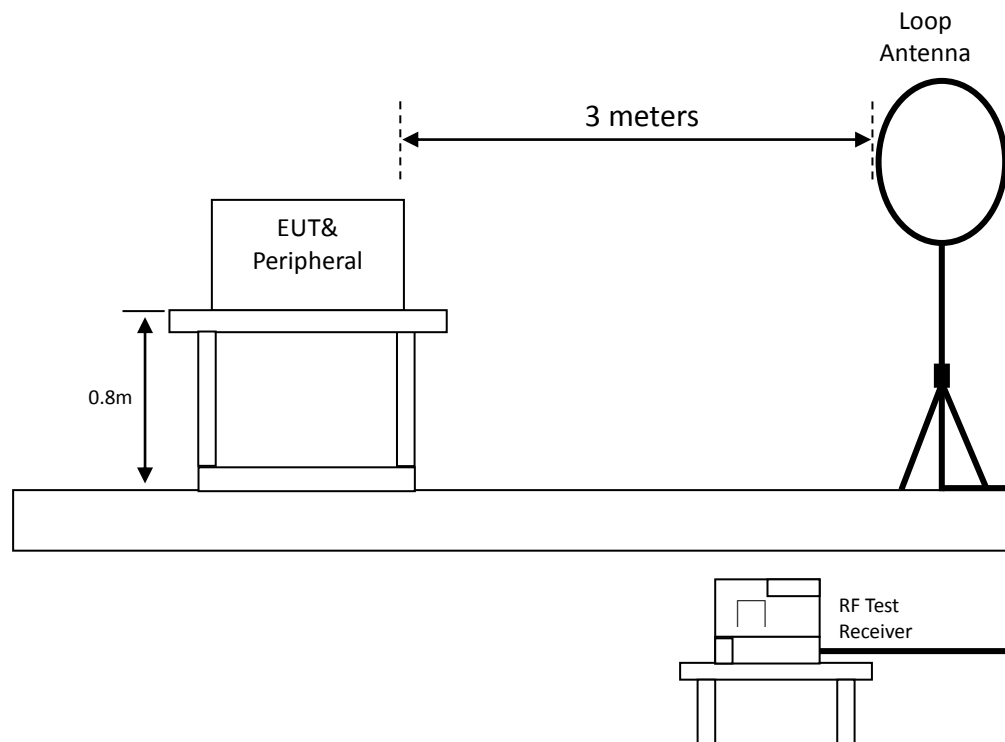
3. Radiated emission test FCC 15.231 (b)

3.1 Operating environment

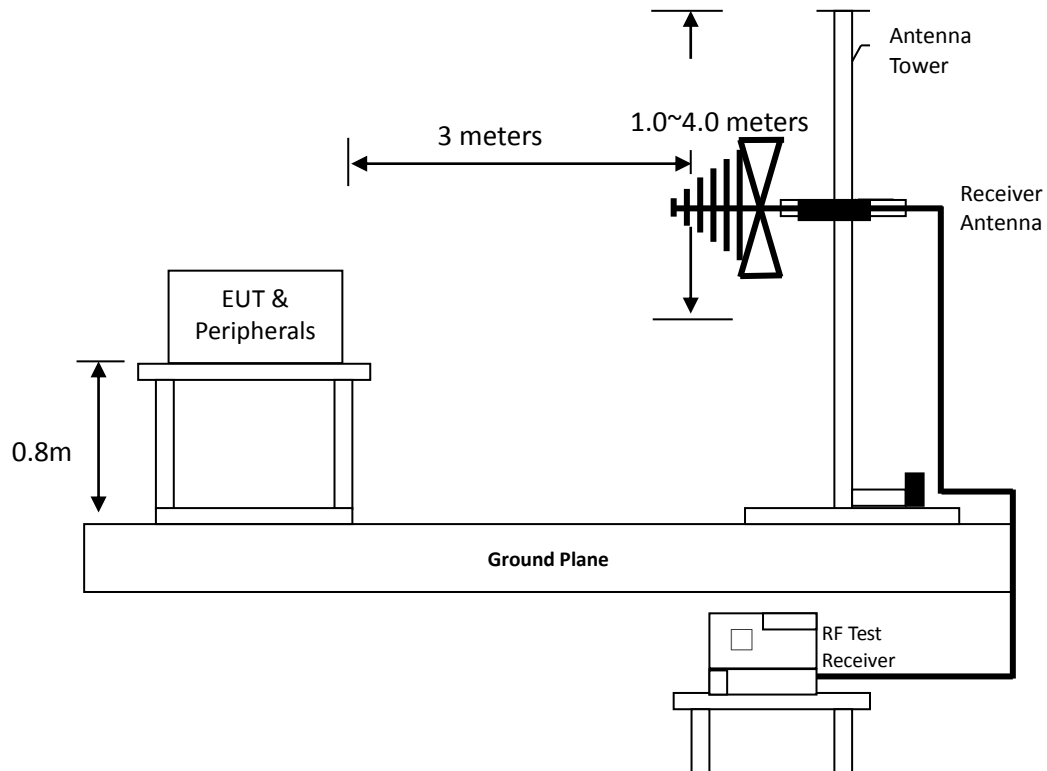
Temperature: 24 °C
Relative Humidity: 61 %

3.2 Test setup & procedure

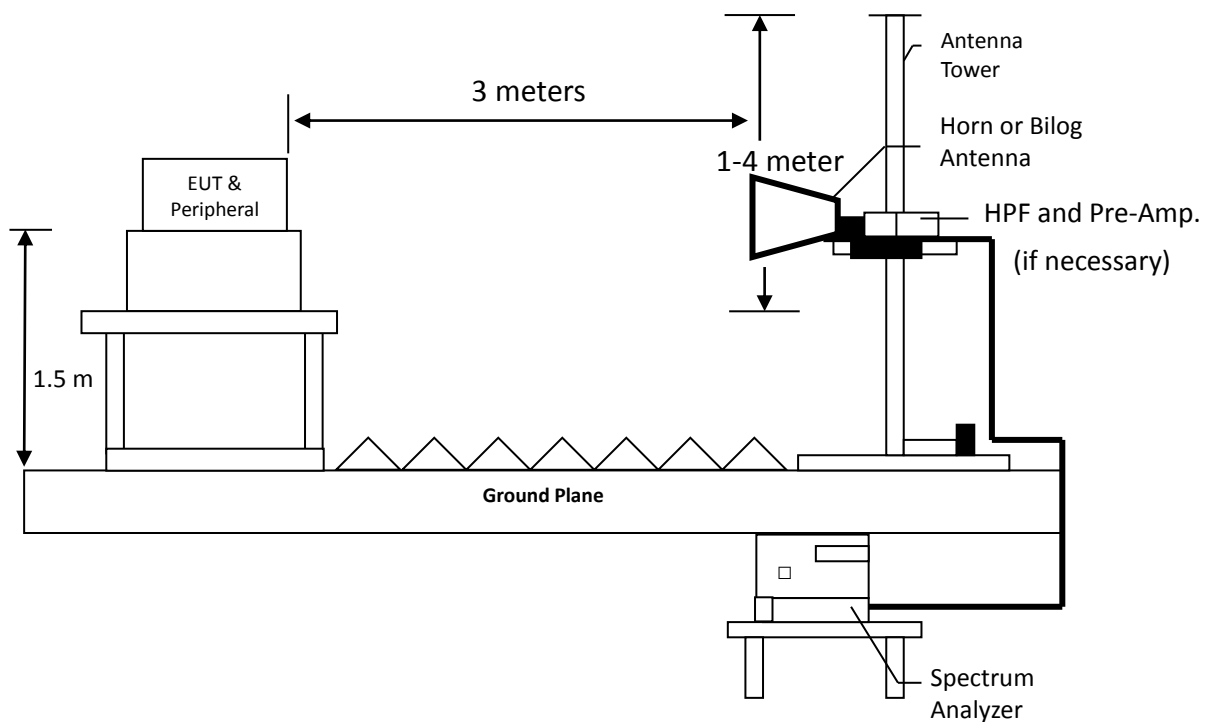
3.2.1 Radiated emission from 9kHz to 30MHz uses Loop Antenna:



3.2.2 Radiated emission below 1GHz using Bilog Antenna



3.2.3 Radiated emission above 1GHz using Horn Antenna



3.3 Radiated emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(uV/m@3 m)	(dBuV/m@3 m)	(uV/m@3 m)	(dBuV/m@3 m)
315.1	60464.4351	95.63	6046.4435	75.63

3.3.2 General radiated emission limit

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency MHz	15.209 Limits (dBµV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

3.4 Radiated emission test data FCC 15.231

3.4.1 Measurement results: Fundamental emission

Temperature (°C) :	26
Relative Humidity (%) :	63
Test Date:	2021/10/15

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polarization	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
315.100	PK	Horizontal	22.54	49.80	72.34	95.63	-23.29
315.100	PK	Vertical	22.54	34.12	56.66	95.63	-38.97

Remark: Correction Factor = Antenna Factor + Cable Loss

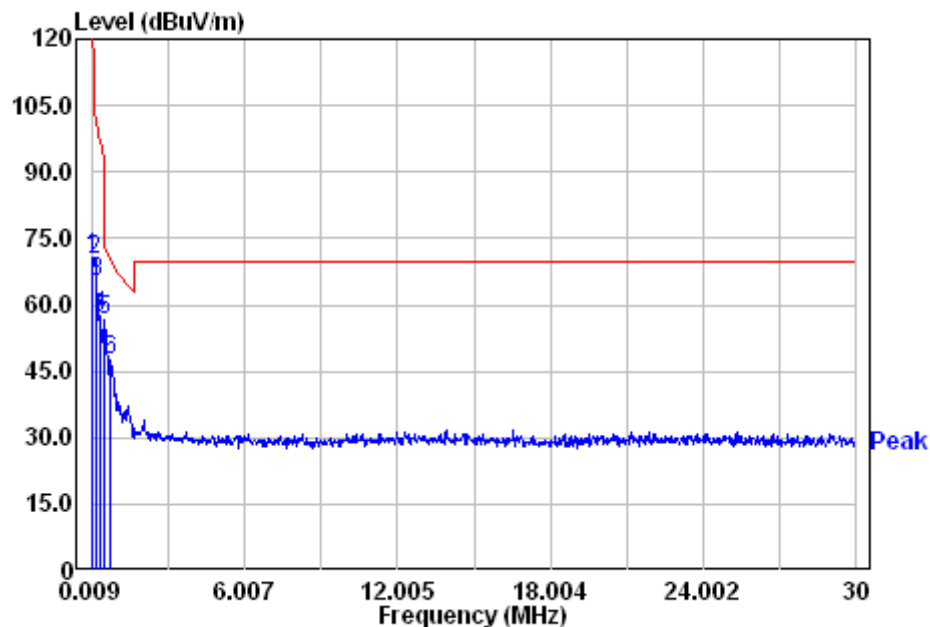
3.4.2 Measurement results: frequencies equal to or less than 1 GHz

Temperature (°C) :	26
Relative Humidity (%) :	55
Test Date:	2021/11/2

9kHz – 30MHz

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Perpendicular	0.069	AV	19.08	51.65	70.73	114.73	-44.00
Perpendicular	0.159	AV	18.57	51.45	70.02	103.63	-33.61
Perpendicular	0.219	AV	18.75	46.40	65.15	100.85	-35.70
Perpendicular	0.339	AV	18.76	38.80	57.56	97.02	-39.46
Perpendicular	0.519	QP	19.39	37.26	56.65	73.34	-16.69
Perpendicular	0.759	QP	19.59	28.00	47.59	70.06	-22.47

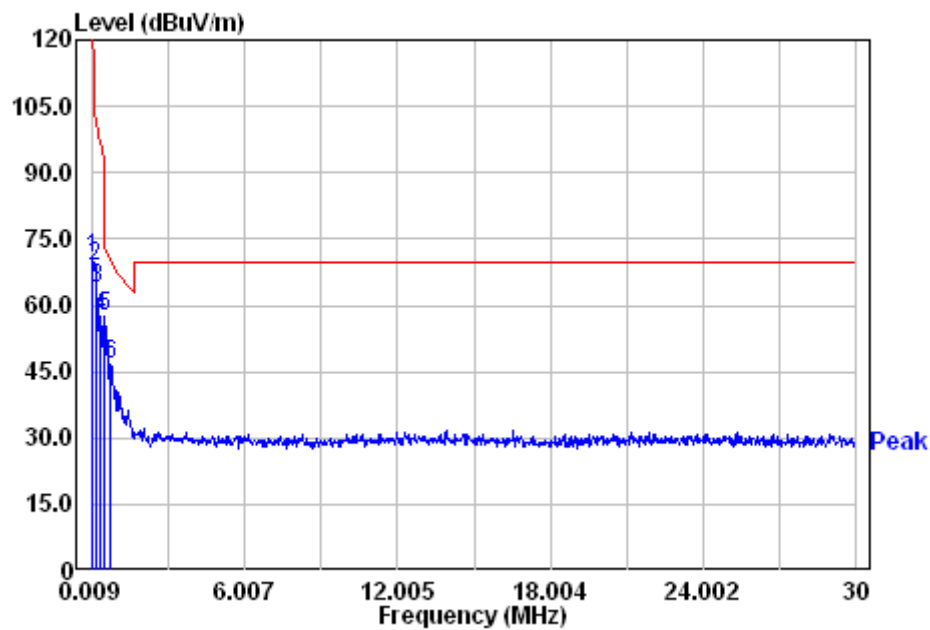
Remark: Corr. Factor = Antenna Factor + Cable Loss



TEST REPORT

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Parallel	0.069	AV	19.08	51.65	70.73	114.73	-44.00
Parallel	0.159	AV	18.57	50.45	69.02	103.63	-34.61
Parallel	0.189	AV	18.70	45.17	63.87	102.13	-38.26
Parallel	0.339	AV	18.76	38.80	57.56	97.02	-39.46
Parallel	0.519	QP	19.39	38.26	57.65	73.34	-15.69
Parallel	0.759	QP	19.59	27.00	46.59	70.06	-23.47

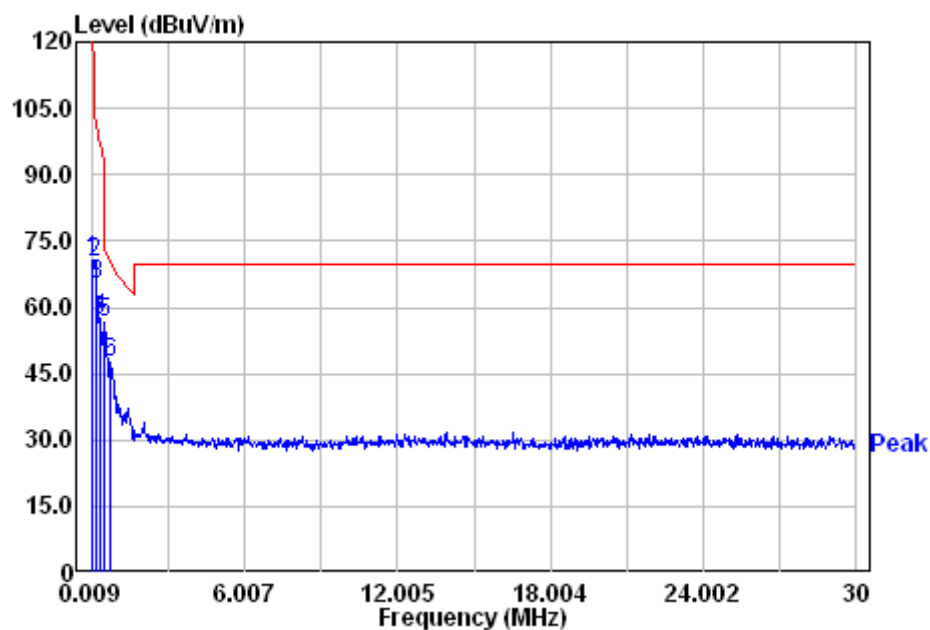
Remark: Corr. Factor = Antenna Factor + Cable Loss



TEST REPORT

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Ground-parallel	0.069	AV	19.08	49.65	68.73	114.73	-46.00
Ground-parallel	0.159	AV	18.57	49.45	68.02	103.63	-35.61
Ground-parallel	0.339	AV	18.76	39.80	58.56	97.02	-38.46
Ground-parallel	0.519	QP	19.39	38.26	57.65	73.34	-15.69
Ground-parallel	0.579	QP	19.33	36.73	56.06	72.38	-16.32
Ground-parallel	0.819	QP	19.65	27.40	47.05	69.36	-22.31

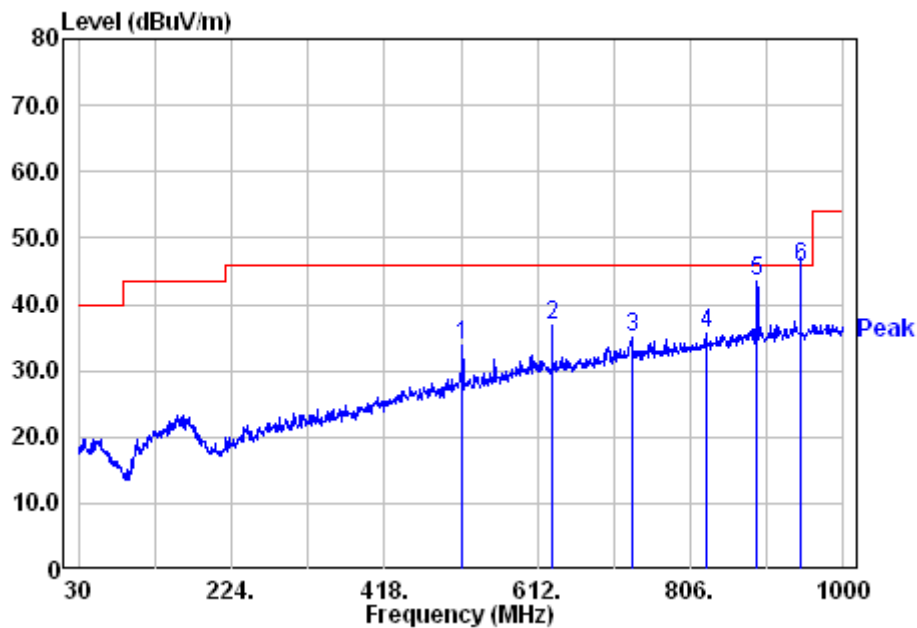
Remark: Corr. Factor = Antenna Factor + Cable Loss



30MHz – 1GHz

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Horizontal	515.97	QP	28.66	5.11	33.77	46.00	-12.23
Horizontal	630.20	QP	31.26	5.64	36.90	46.00	-9.10
Horizontal	731.31	QP	32.85	2.26	35.11	46.00	-10.89
Horizontal	825.40	QP	34.79	0.91	35.70	46.00	-10.30
Horizontal	890.39	QP	35.67	7.67	43.34	46.00	-2.66
Horizontal	945.30	QP	36.55	8.91	45.46	46.00	-0.54

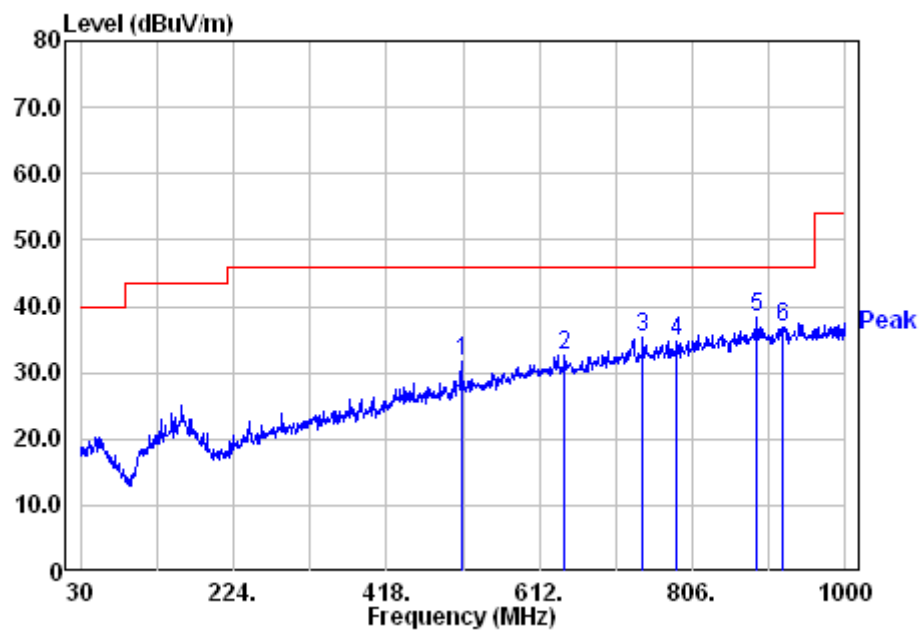
Remark: Corr. Factor = Antenna Factor + Cable Loss



TEST REPORT

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Vertical	513.06	QP	28.61	3.18	31.79	46.00	-14.21
Vertical	630.20	QP	31.26	1.30	32.56	46.00	-13.44
Vertical	742.95	QP	33.38	1.99	35.37	46.00	-10.63
Vertical	786.60	QP	33.90	0.93	34.83	46.00	-11.17
Vertical	886.51	QP	35.63	2.83	38.46	46.00	-7.54
Vertical	945.30	QP	36.55	0.29	36.84	46.00	-9.16

Remark: Corr. Factor = Antenna Factor + Cable Loss



3.4.3 Measurement results: frequency above 1GHz

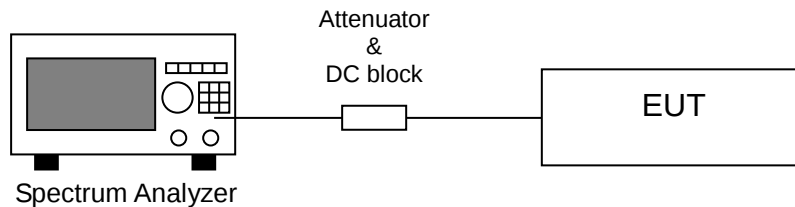
Temperature (°C) :	26
Relative Humidity (%) :	55
Test Date:	2021/11/2

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polarization	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
315.1MHz	1260.4	PK	Horizontal	30.69	16.88	47.57	74.00	-26.43
	1575.5	PK	Horizontal	30.84	19.74	50.58	74.00	-23.42
	1890.6	PK	Horizontal	31.95	19.98	51.93	74.00	-22.07
	2205.7	PK	Horizontal	35.15	12.98	48.13	74.00	-25.87
	2520.8	PK	Horizontal	34.83	13.52	48.35	74.00	-25.65
	1206.4	PK	Vertical	30.45	15.14	45.59	74.00	-28.41
	1575.5	PK	Vertical	30.84	17.80	48.64	74.00	-25.36
	1896.6	PK	Vertical	32.00	15.70	47.70	74.00	-26.30
	2205.7	PK	Vertical	35.15	13.52	48.67	74.00	-25.33
	2520.8	PK	Vertical	34.83	17.03	51.86	74.00	-22.14

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

4. Measured bandwidth FCC 15.231(C)

4.1 Test Diagram



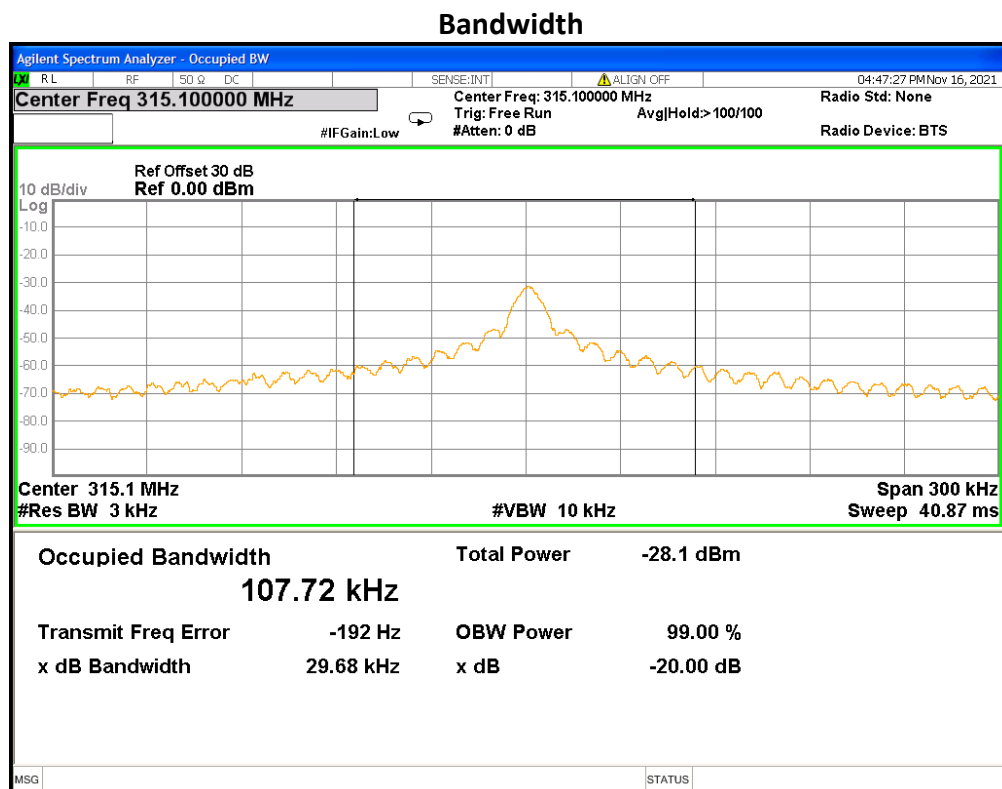
4.1 Test procedure & limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier.

$$B.W(20dBc) \text{ Limit} = 0.25\% \times f(\text{MHz}) = 0.25\% \times 315.1 \text{ MHz} = 0.78775 \text{ MHz}$$

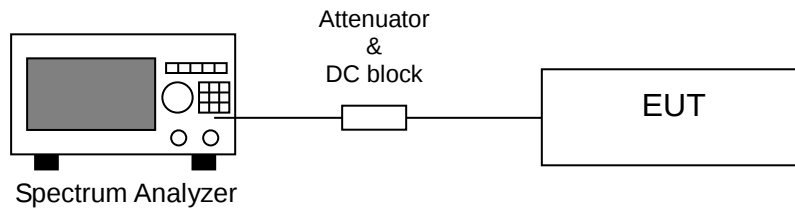
From the plot, the bandwidth is observed to be 107.72 kHz at 20dBc, where the bandwidth limit is 0.78775 MHz.

Please see the plot below.



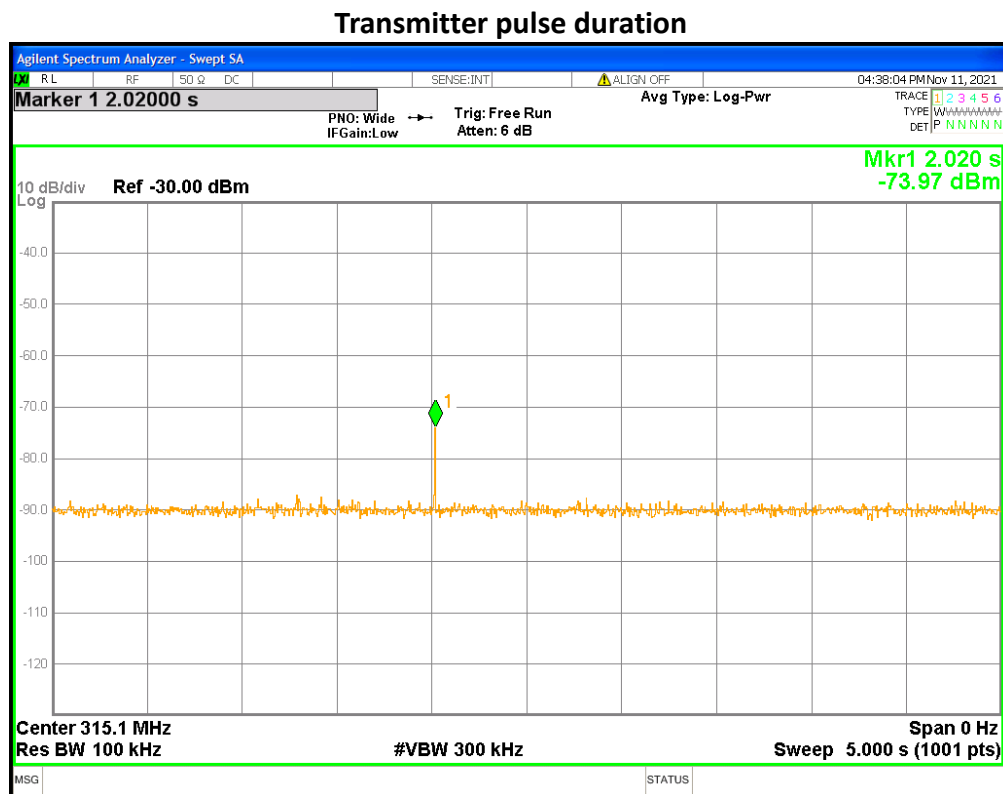
5. Timing requirement of manual activation operated transmitter

5.1 Test Diagram



5.2 Test Result

A transmitter manual activation shall cease transmission within 5 seconds after activation



Frequency (MHz)	Maximum deactivate time (s)	Limit (s)	Result
315.100	2.020	5.000	PASS

6. Conducted emission FCC 15.207

Since the EUT is not connected to AC source, therefore, the test can be waived.

Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESR7	101822	2021/08/16	2022/08/15
Signal Analyzer	Agilent	N9030A	MY51380492	2021/08/17	2022/08/16
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2021/04/14	2022/04/13
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2021/01/29	2022/01/28
Horn Antenna	SHWARZBECK	BBHA 9120 D	9120D-456	2021/01/11	2022/01/10
Pre-Amplifier	EMC Co.	EMC12635SE	980205	2021/01/13	2022/01/12
966-2(A) Cable	SUHNER	SUCOLEX 104	295105/4	2021/03/08	2022/03/07
966-2(B) Cable	SUHNER	SUCOFLEX 104P	CB0005	2021/03/08	2022/03/07
20dB Attenuator	Mini-Circuits	BW-S20W5+	N/A	2021/05/26	2022/05/25
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2021/01/15	2022/01/14
Test software	Audix	e3	V9	NCR	NCR

Appendix B: Measurement Uncertainty

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

Item	Uncertainty
Timing requirement of operated transmitter	1.27 dB
Occupied Bandwidth	7.78 %
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.70 dB
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.16 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.02 dB
Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	5.17 dB
AC Power Line Conducted Emission	3.08 dB