



REPORT No. : SZ22110095W01

TEST REPORT

APPLICANT : Zhejiang Lierda Internet of Things
Technology Co.,Ltd

PRODUCT NAME : LoRa module

MODEL NAME : FP20-C8, L-LRMFP20-97NN4

BRAND NAME : lierda

FCC ID : 2AOFDFP20-C8

STANDARD(S) : 47 CFR Part 15 Subpart C

RECEIPT DATE : 2022-11-09

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DIRECTORY

1. Technical Information	3
1.1. Applicant and Manufacturer Information	3
1.2. Equipment Under Test (EUT) Description	3
1.3. The Channel Number and Frequency	4
1.4. Test Standards and Results	5
1.5. Environmental Conditions	6
2. 47 CFR Part 15C Requirements	7
2.1. Antenna Requirement	7
2.2. Hopping Mechanism	7
2.3. Number of Hopping Frequency	8
2.4. Duty Cycle of Test Signal	10
2.5. Maximum Peak Conducted Output Power	11
2.6. Maximum Average Conducted Output Power	14
2.7. 20 dB Bandwidth	15
2.8. Carried Frequency Separation	18
2.9. Time of Occupancy (Dwell time)	20
2.10. Conducted Spurious Emissions	23
2.11. Conducted Emission	28
2.12. Radiated Emission	32
Annex A Test Uncertainty	45
Annex B Testing Laboratory Information	46

Change History		
Version	Date	Reason for change
1.0	2022-12-27	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Zhejiang Lierda Internet of Things Technology Co.,Ltd
Applicant Address:	Room 1402, building 1, No. 1326, Wenyi West Road, Cangqian street, Yuhang District, Hangzhou, Zhejiang, China
Manufacturer:	Zhejiang Lierda Internet of Things Technology Co.,Ltd
Manufacturer Address:	Room 1402, building 1, No. 1326, Wenyi West Road, Cangqian street, Yuhang District, Hangzhou, Zhejiang, China

1.2. Equipment Under Test (EUT) Description

Product Name:	LoRa module
Sample No.:	2#
Hardware Version:	01
Software Version:	00
Modulation Technology:	FHSS
Equipment Type:	LoRa
Operating Frequency Range:	902.3MHz-927.7MHz
Antenna Type:	External Antenna
Antenna Gain:	2.0dBi

Note 1: According to the certificate holder, they declared that the models FP20-C8, L-LRMFP20-97NN4 have the same hardware, only different in model name all RF parameters remain the same. The main measuring model is FP20-C8, only the results for FP20-C8 were recorded in this report.

Note 2: The product will not sell with antenna. The antenna we used just for radiated test.

Note 3: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. The Channel Number and Frequency

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.3	33	908.7	65	915.1	97	921.5
2	902.5	34	908.9	66	915.3	98	921.7
3	902.7	35	909.1	67	915.5	99	921.9
4	902.9	36	909.3	68	915.7	100	922.1
5	903.1	37	909.5	69	915.9	101	922.3
6	903.3	38	909.7	70	916.1	102	922.5
7	903.5	39	909.9	71	916.3	103	922.7
8	903.7	40	910.1	72	916.5	104	922.9
9	903.9	41	910.3	73	916.7	105	923.1
10	904.1	42	910.5	74	916.9	106	923.3
11	904.3	43	910.7	75	917.1	107	923.5
12	904.5	44	910.9	76	917.3	108	923.7
13	904.7	45	911.1	77	917.5	109	923.9
14	904.9	46	911.3	78	917.7	110	924.1
15	905.1	47	911.5	79	917.9	111	924.3
16	905.3	48	911.7	80	918.1	112	924.5
17	905.5	49	911.9	81	918.3	113	924.7
18	905.7	50	912.1	82	918.5	114	924.9
19	905.9	51	912.3	83	918.7	115	925.1
20	906.1	52	912.5	84	918.9	116	925.3
21	906.3	53	912.7	85	919.1	117	925.5
22	906.5	54	912.9	86	919.3	118	925.7
23	906.7	55	913.1	87	919.5	119	925.9
24	906.9	56	913.3	88	919.7	120	926.1
25	907.1	57	913.5	89	919.9	121	926.3
26	907.3	58	913.7	90	920.1	122	926.5
27	907.5	59	913.9	91	920.3	123	926.7
28	907.7	60	914.1	92	920.5	124	926.9
29	907.9	61	914.3	93	920.7	125	927.1
30	908.1	62	914.5	94	920.9	126	927.3
31	908.3	63	914.7	95	921.1	127	927.5
32	908.5	64	914.9	96	921.3	128	927.7

Note 1: The black bold channels were selected for test.



1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method Determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	15.247(a) 15.247(h)	Hopping Mechanism	N/A	N/A	PASS	No deviation
3	15.247(a)	Number of Hopping Frequency	Nov. 30, 2022	He Yuyang	PASS	No deviation
4	ANSI C63.10	Duty Cycle	Nov. 16, 2022	He Yuyang	PASS	No deviation
5	15.247(b)	Maximum Peak Conducted Output Power	Nov. 30, 2022	He Yuyang	PASS	No deviation
6	15.247(b)	Maximum Average Conducted Output Power	Nov. 30, 2022	He Yuyang	PASS	No deviation
7	15.247(a)	20dB Bandwidth	Nov. 30, 2022	He Yuyang	PASS	No deviation
8	15.247(a)	Carrier Frequency Separation	Nov. 30, 2022	He Yuyang	PASS	No deviation
9	15.247(a)	Time of Occupancy (Dwell time)	Nov. 30, 2022	He Yuyang	PASS	No deviation
10	15.247(d)	Conducted Spurious Emission	Nov. 30, 2022	He Yuyang	PASS	No deviation
11	15.207	Conducted Emission	Nov. 17, 2022	Fan Zehang	PASS	No deviation
12	15.209, 15.247(d)	Radiated Emission	Dec. 05, 2022	Su Zhan	PASS	No deviation

Note 1: The tests were performed according to the method of measurements prescribed in ANSI



C63.10-2013 and KDB558074 D01 v05r02.

Note 2: The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 21.0dB contains two parts that cable loss 1.0dB and Attenuator 20dB.

Note 3: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

Note 4: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

1.5. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106

2. 47 CFR Part 15C Requirements

2.1. Antenna Requirement

2.1.1. Applicable Standard

According to FCC 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

2.1.2. Test Result: Compliant

The EUT has an external antenna coupled with the RP-SMA connector. Please refer to the EUT photos.

2.2. Hopping Mechanism

2.2.1. Requirement

According to FCC §15.247(a)(1), a frequency hopping spread spectrum system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

According to FCC §15.247(h), the incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

2.2.2. Result: Compliant

The hopping mechanism of the EUT is based on the protocol that "**LoRaWAN**".

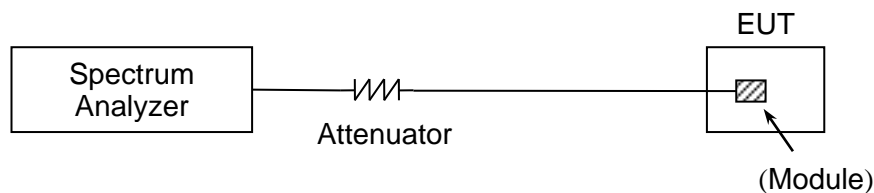
2.3. Number of Hopping Frequency

2.3.1. Requirement

According to FCC section 15.247(a)(1)(i), frequency hopping systems operating in the 902MHz to 928MHz bands shall use at least 50 hopping frequencies if the 20dB bandwidth of the hopping channel is less than 250KHz; or at least 25 hopping frequencies if the 20dB bandwidth of the hopping channel is 250KHz or greater.

2.3.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.3.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

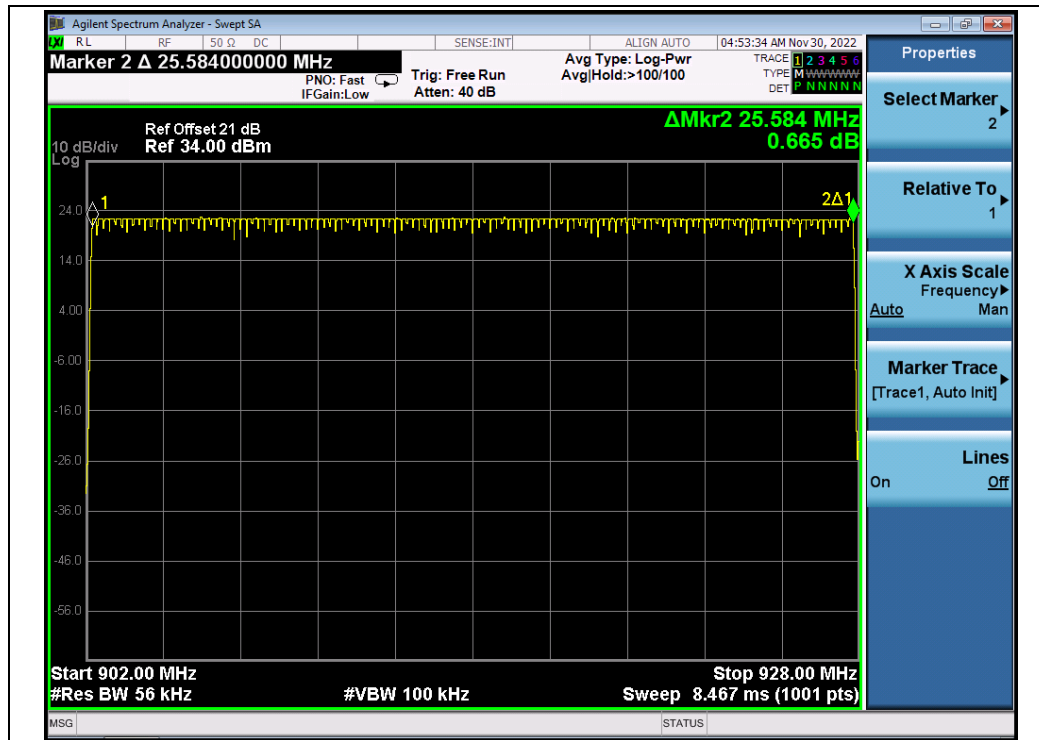


2.3.4. Test Result

A.Test Verdict:

Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
902-928	128	50	PASS

B.Test Plots:



2.4. Duty Cycle of Test Signal

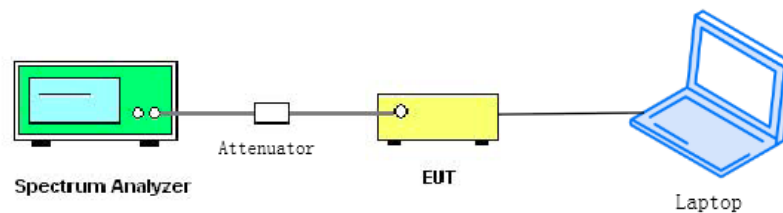
2.4.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than $\pm 2\%$; otherwise, the duty cycle is considered to be nonconstant.

2.4.2. Test Description

Test Setup:



ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.

2.4.3. Test Result

Duty Cycle (%) (D)	Duty Factor ($10 \cdot \lg[1/D]$)
100.00	0.00

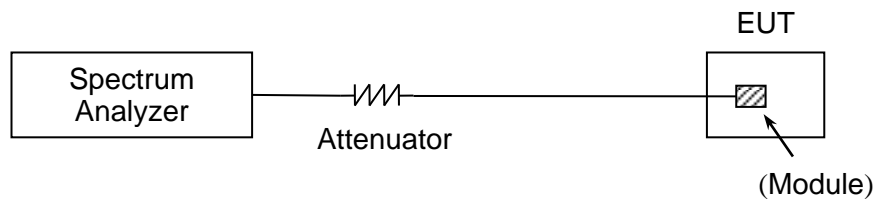
2.5. Maximum Peak Conducted Output Power

2.5.1. Requirement

According to FCC section 15.247(b)(2), for frequency hopping systems that operates in the 902MHz to 928MHz band employing at least 50 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt, and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

2.5.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

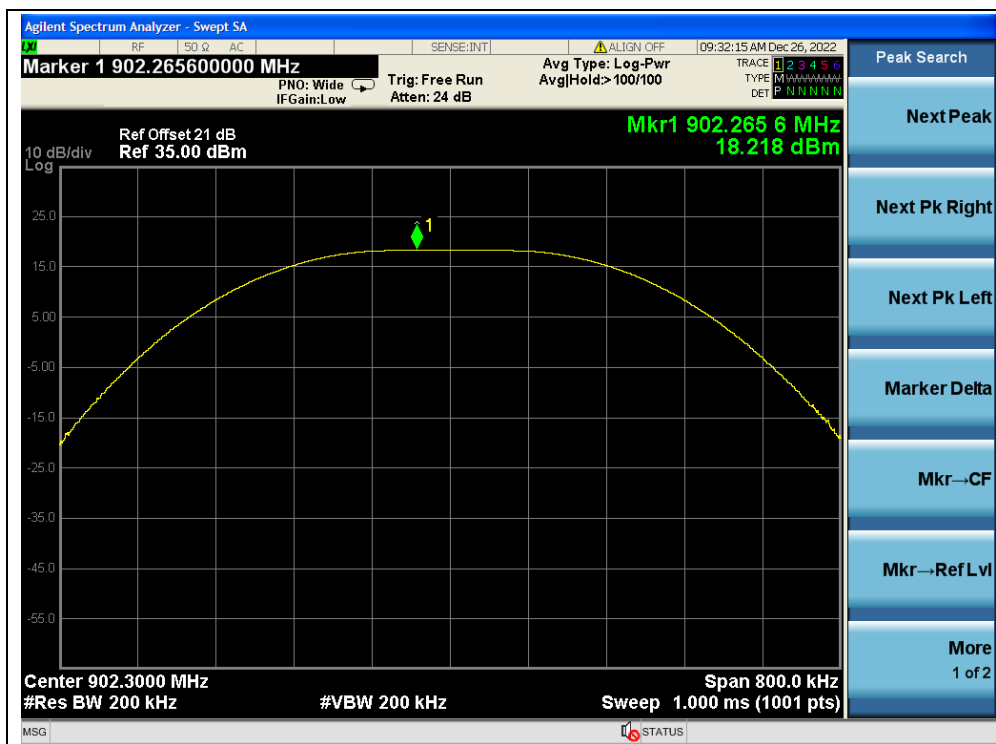


2.5.3. Test Result

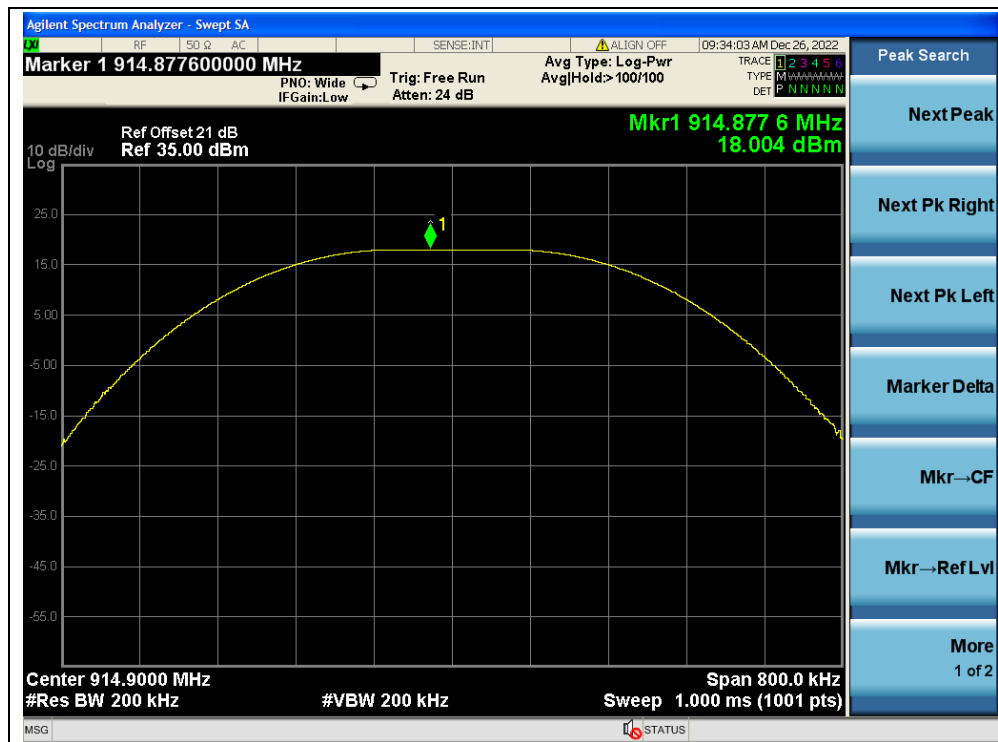
A.Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	902.3	18.22	0.066	30	1	PASS
64	914.9	18.00	0.063			PASS
128	927.7	17.86	0.061			PASS

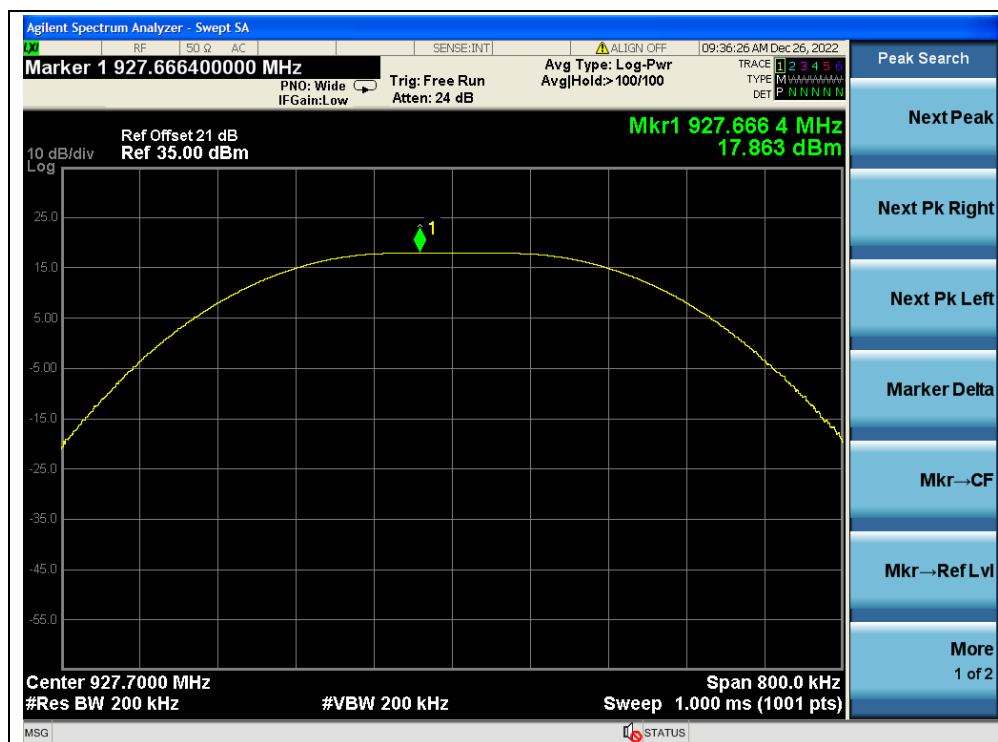
B.Test Plot:



(Channel 1)



(Channel 64)



(Channel 128)

2.6. Maximum Average Conducted Output Power

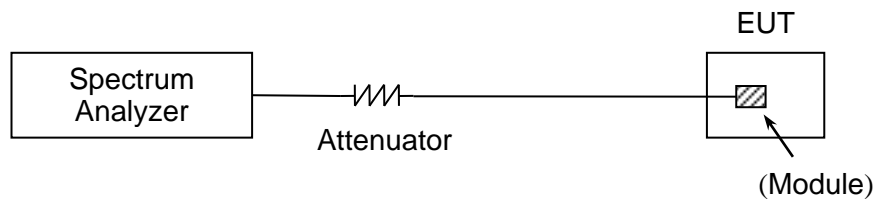
2.6.1. Requirement

According to FCC section 15.247(b)(2), for frequency hopping systems that operates in the 902MHz to 928MHz band employing at least 50 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt, and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

2.6.2. Test Description

The measured output power was calculated by the reading of the USB Wideband Power Sensor and calibration.

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.6.3. Test Result

Channel	Frequency (MHz)	Measured	Average Power			Limit		Verdict
			Duty Factor	Duty Factor Calculated				
		dBm		dBm	W	dBm	W	
1	902.3	17.83	0.00	17.83	0.061	30	1	PASS
64	914.9	17.59		17.59	0.057			PASS
128	927.7	17.45		17.45	0.056			PASS

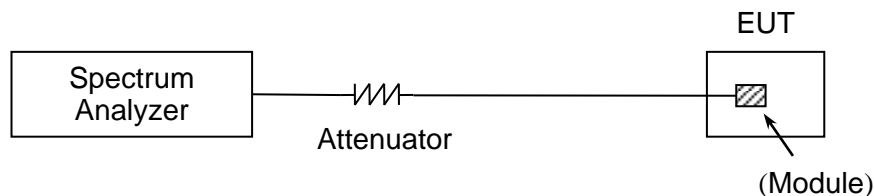
2.7. 20 dB Bandwidth

2.7.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20 dB bandwidth ($10 \cdot \log 1\% = 20\text{dB}$) taking the total RF output power.

2.7.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.7.3. Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW \geq 1% of the 20 dB bandwidth

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

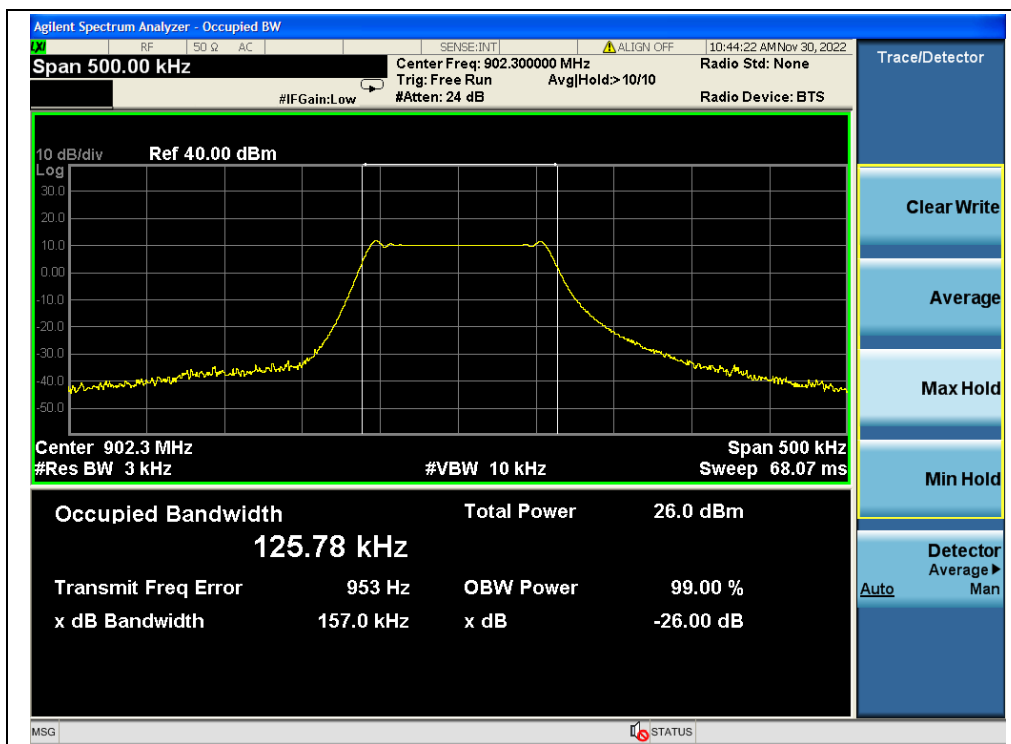


2.7.4. Test Result

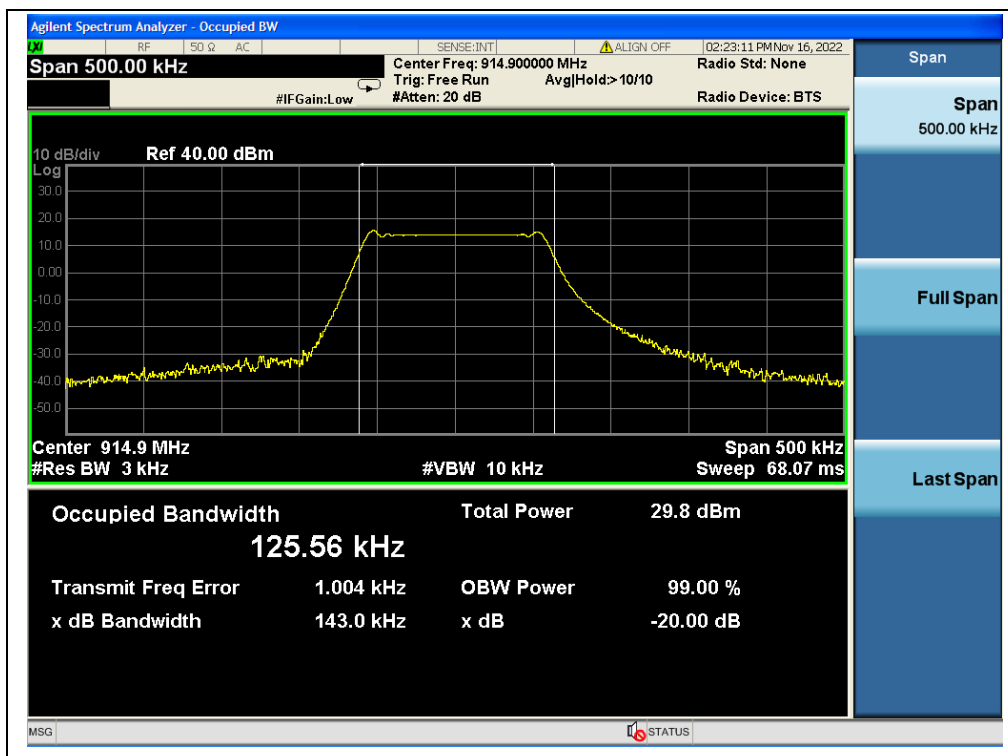
A.Test Verdict:

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	Result
1	902.3	157.0	PASS
64	914.9	143.0	PASS
128	927.7	156.4	PASS

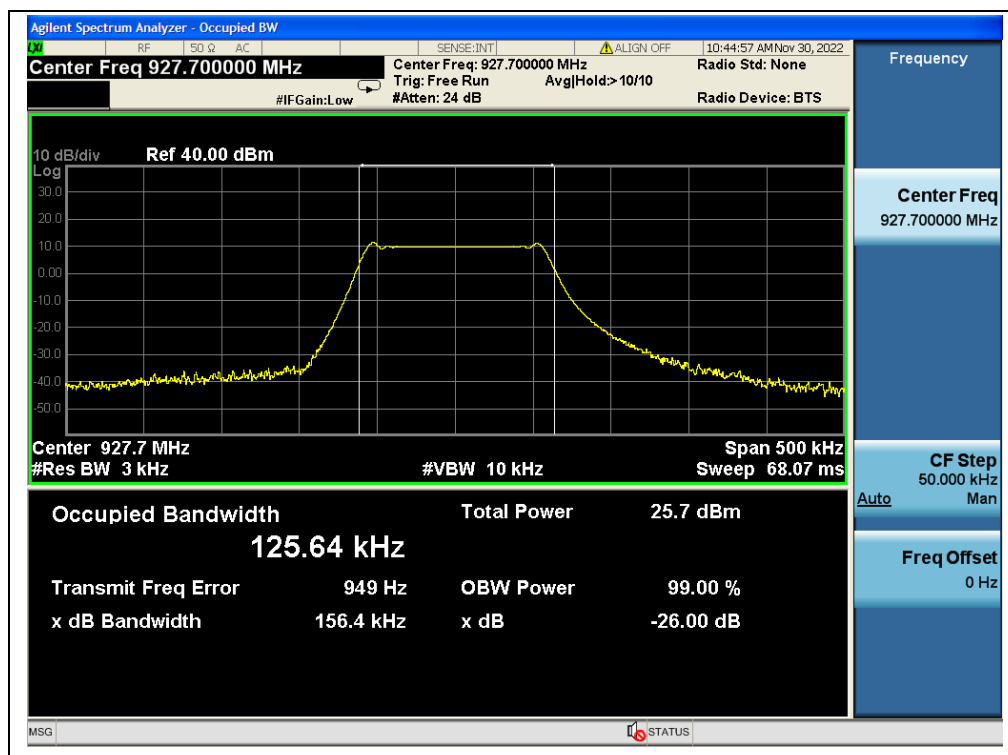
B.Test Plot:



(Channel 1)



(Channel 64)



(Channel 128)

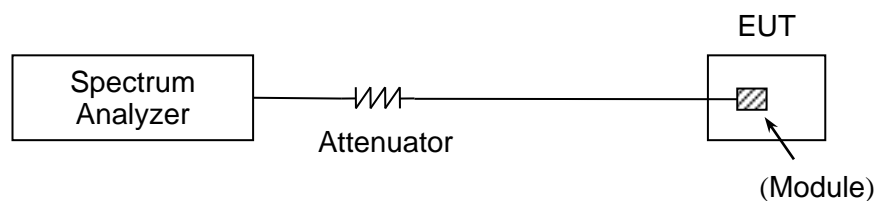
2.8. Carried Frequency Separation

2.8.1. Definition

According to FCC §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or 20dB bandwidth of the hopping channel, whichever is greater.

2.8.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.8.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span

Video (or Average) Bandwidth (VBW) \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

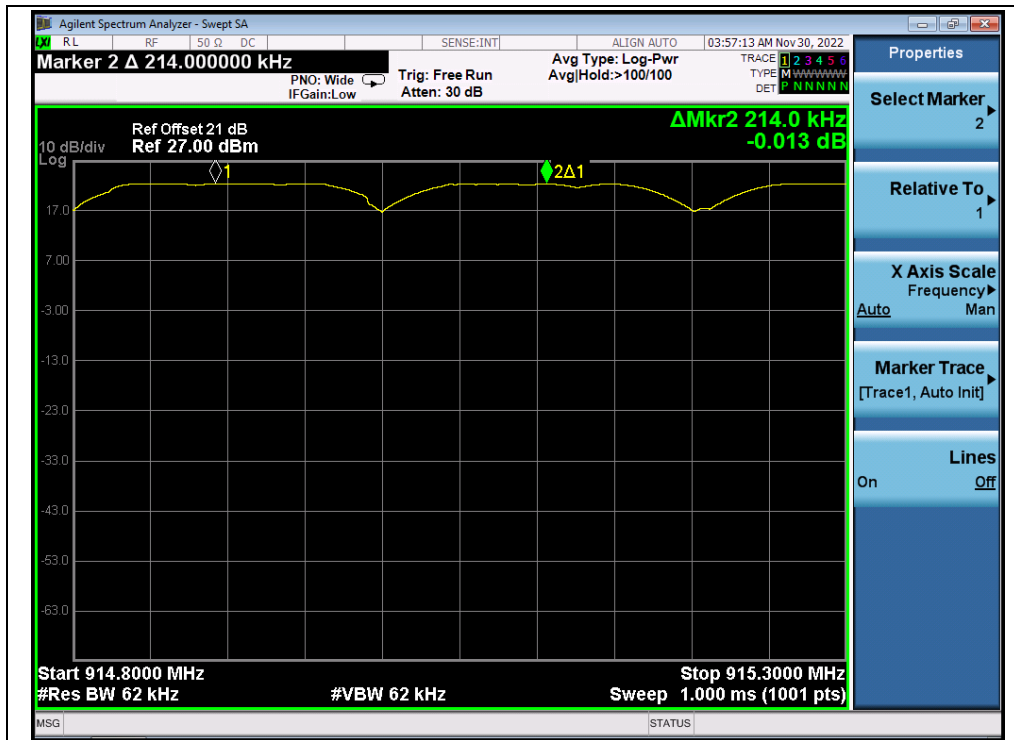


2.8.4. Test Result

A.Test Verdict:

Test Mode	Measured Channel Numbers	Carried Frequency Separation (kHz)	20dB bandwidth (kHz)	Min. Limit	Verdict
LoRa	64 and 65	214.0	157.0	20dB bandwidth	PASS

B.Test Plot:



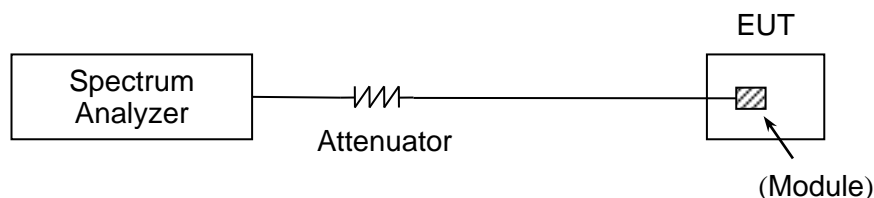
2.9. Time of Occupancy (Dwell time)

2.9.1. Requirement

According to FCC §15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.9.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.9.3. Test Procedure

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in 10 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 20 second period is equal to (# of pulses in 20s) * pulse width.

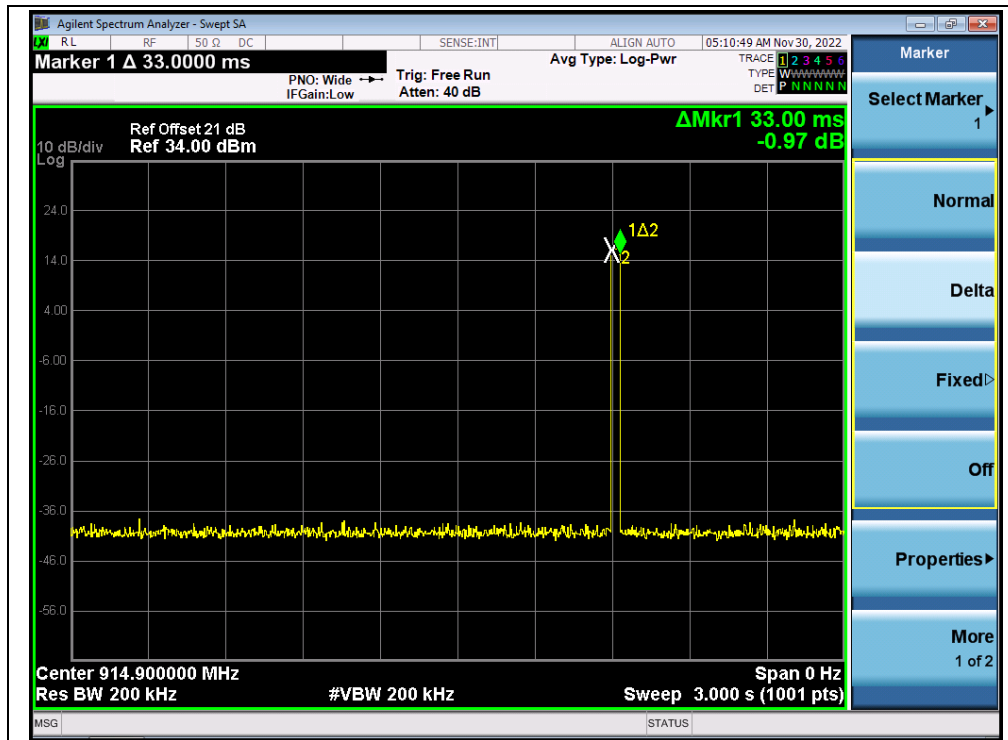


2.9.4. Test Result

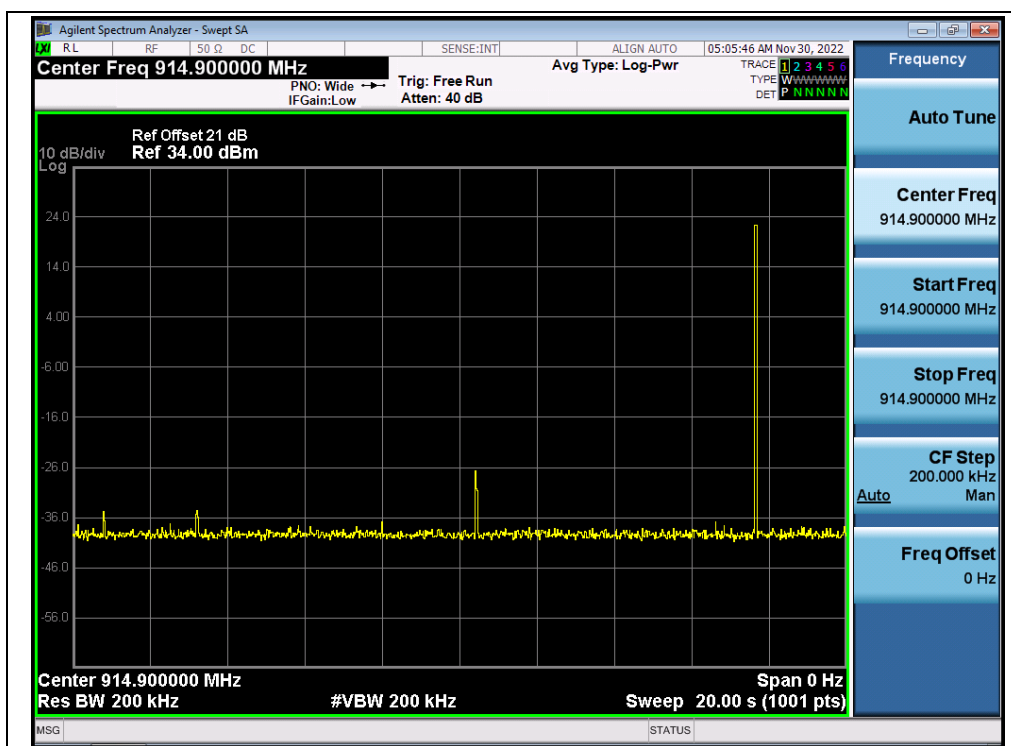
A.Test Verdict:

Frequency (MHz)	Pulse Width (sec)	Number of pulse in 20 seconds	Average Time of Occupancy (sec)	Limit (sec)	Verdict
914.9	0.033	1	0.033	0.4	PASS

B.Test Plot:



(Dwell time_ Pulse Width)



(Dwell time_Number of pulse)

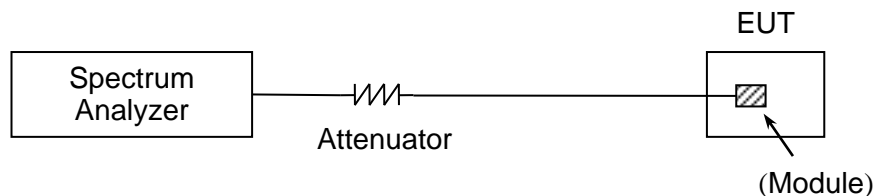
2.10. Conducted Spurious Emissions

2.10.1. Requirement

According to FCC §15.247(d), 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 20 dB 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.

2.10.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer (SA) with Attenuators the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the EUT is activated by the PC via Lan port.

2.10.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

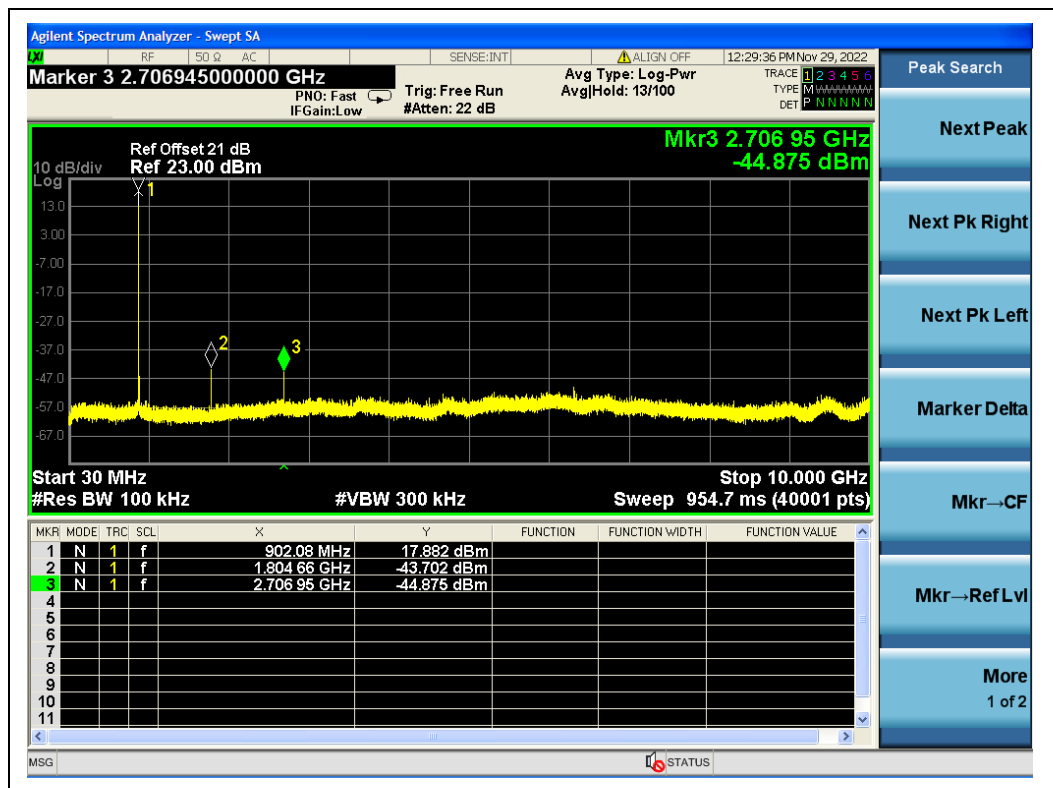


2.10.4. Test Result

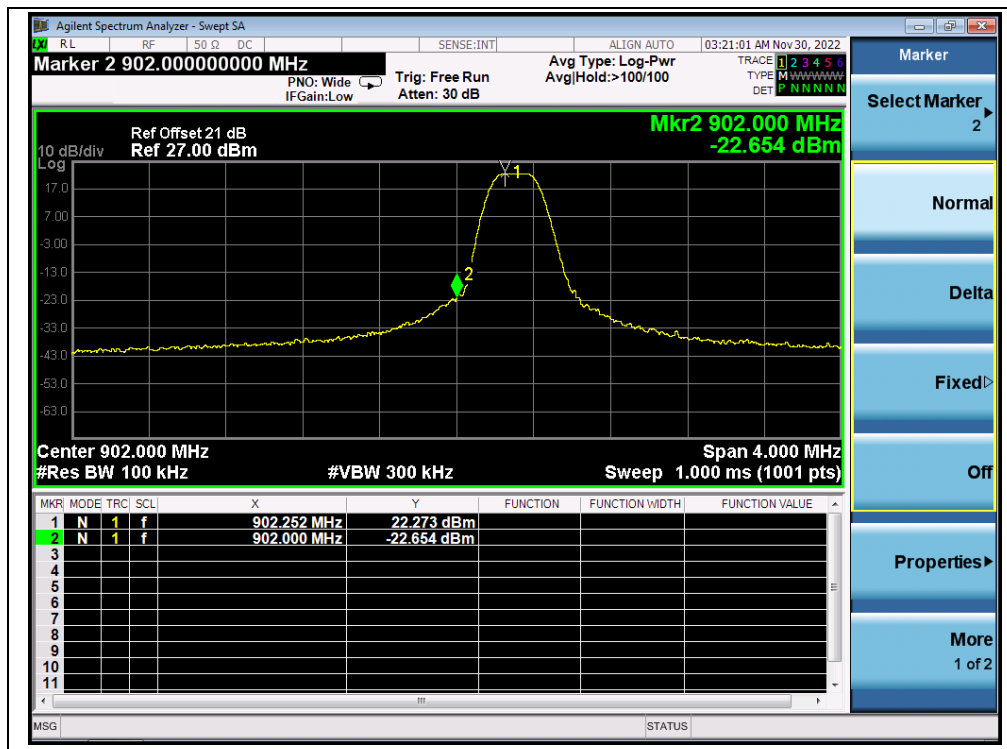
A.Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	902.3	-43.70	17.88	-2.12	PASS
64	914.9	-43.92	17.74	-2.26	PASS
128	927.7	-44.74	17.59	-2.41	PASS

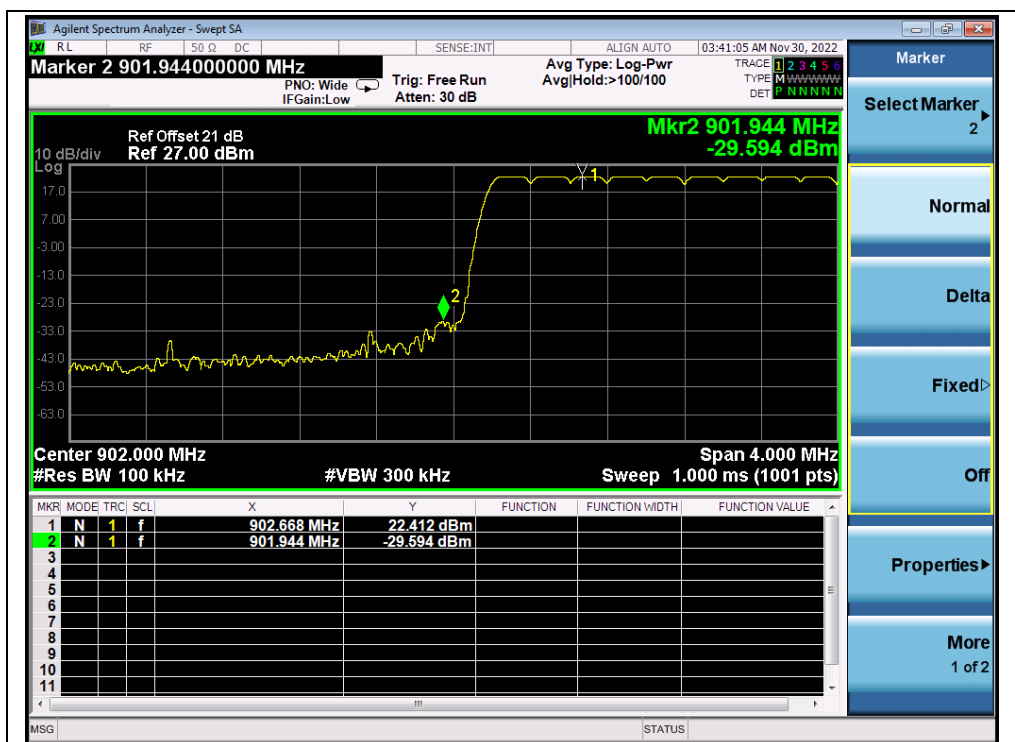
B.Test Plot:



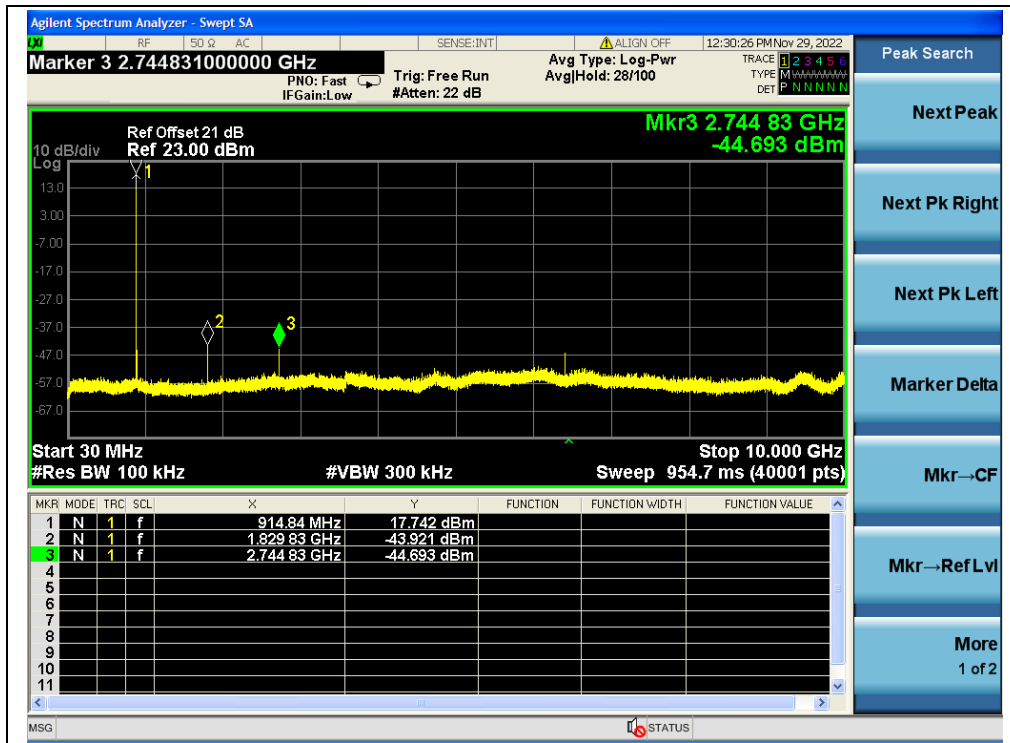
(30MHz to 25GHz, Channel 1)



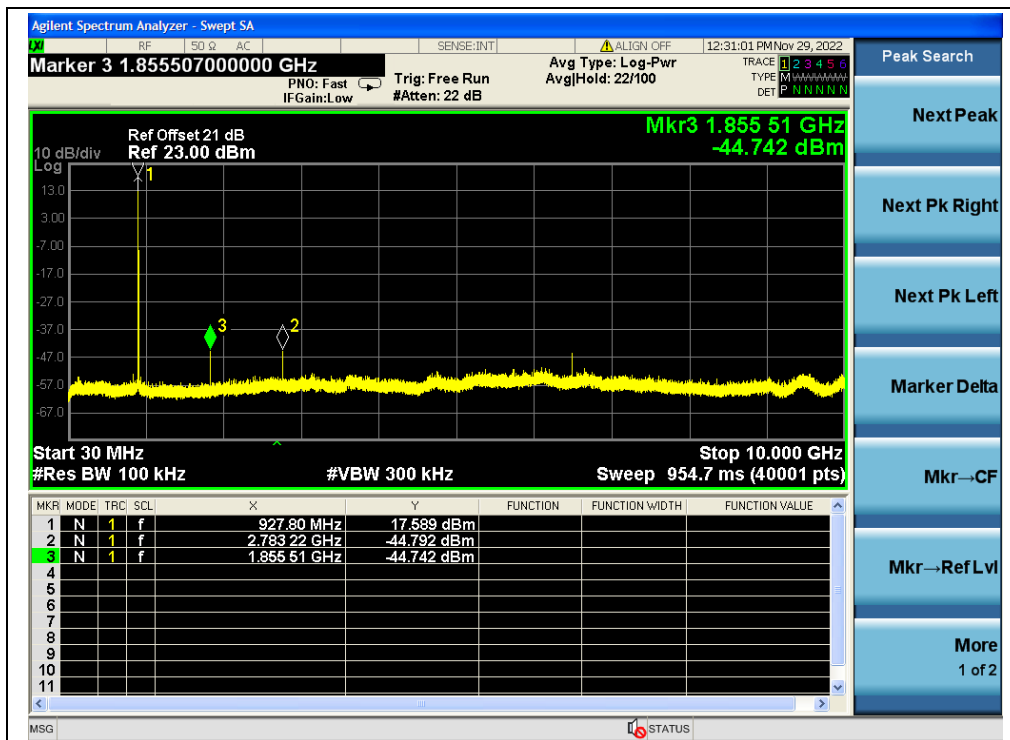
(Band edge, Channel 1)



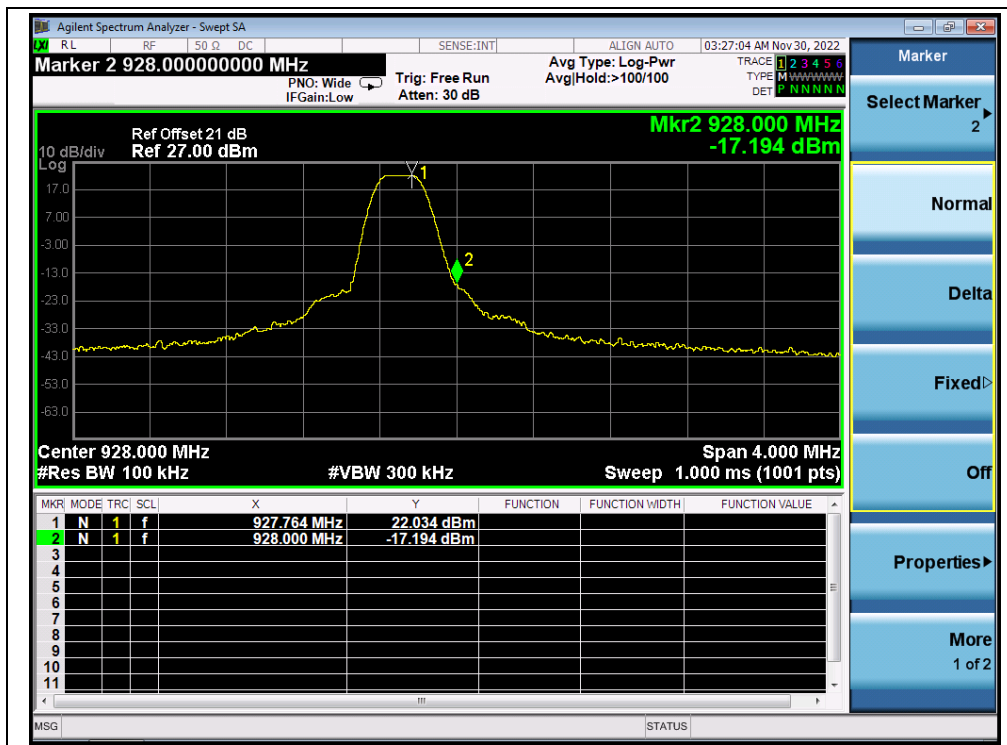
(Band edge with hopping on, Channel 1)



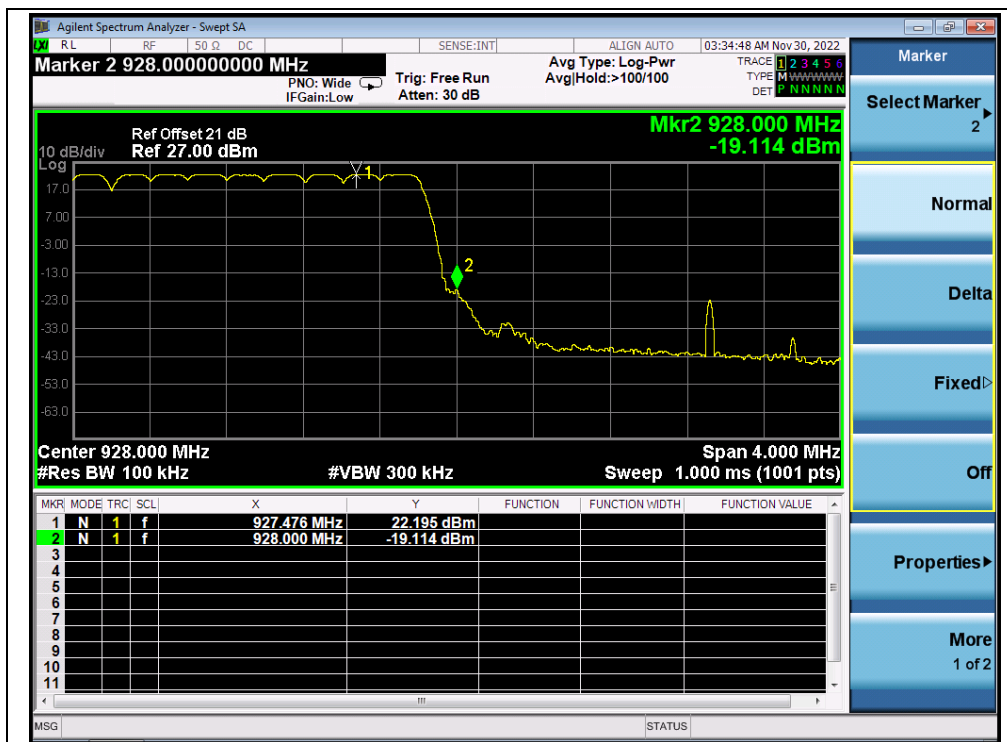
(30MHz to 25GHz, Channel 64)



(30MHz to 25GHz, Channel 128)



(Band edge, Channel 128)



(Band edge with hopping on, Channel 128)

2.11. Conducted Emission

2.11.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

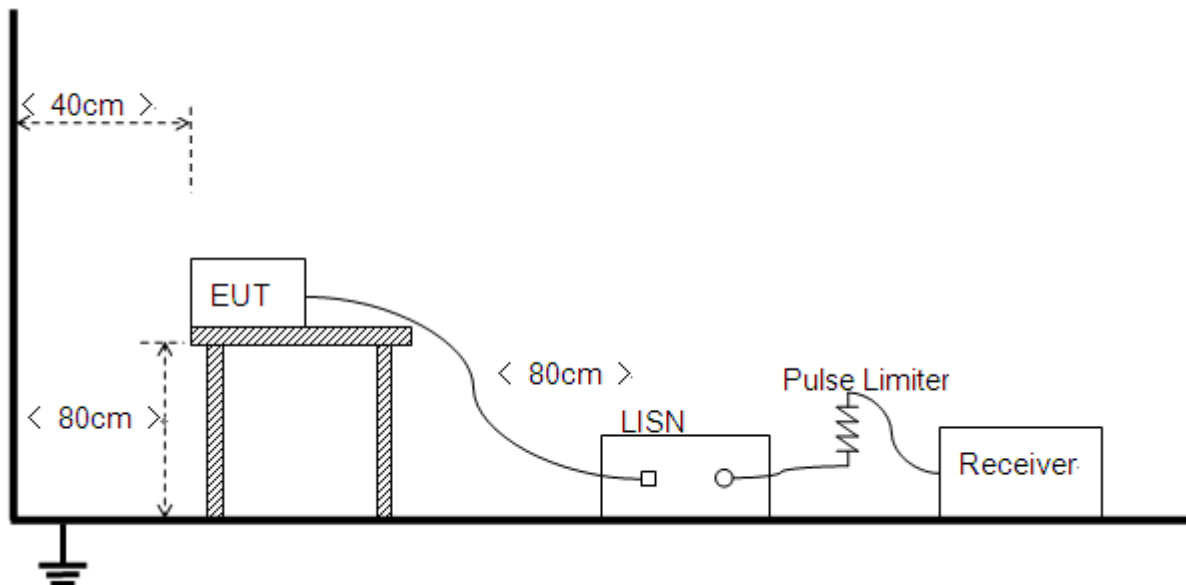
Frequency Range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5- 30	60	50

Note:

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.11.2. Test Description

Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



2.11.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Set RBW=9kHz, VBW=30kHz. Refer to recorded points and plots below.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test Setup:

Test Mode: EUT+PC+PC Adapter+LoRa TX

Test voltage: AC 120V/60Hz

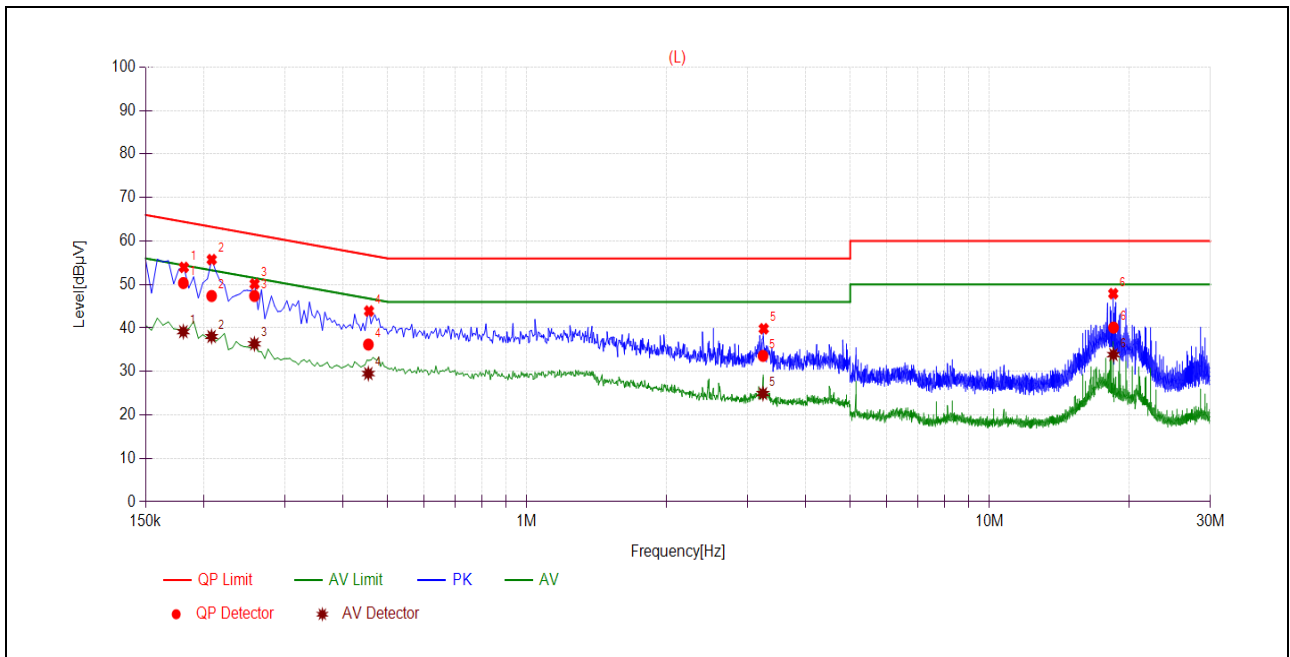
The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V]} = U_R + L_{\text{Cable loss}} \text{ [dB]} + A_{\text{Factor}}$$

U_R : Receiver Reading

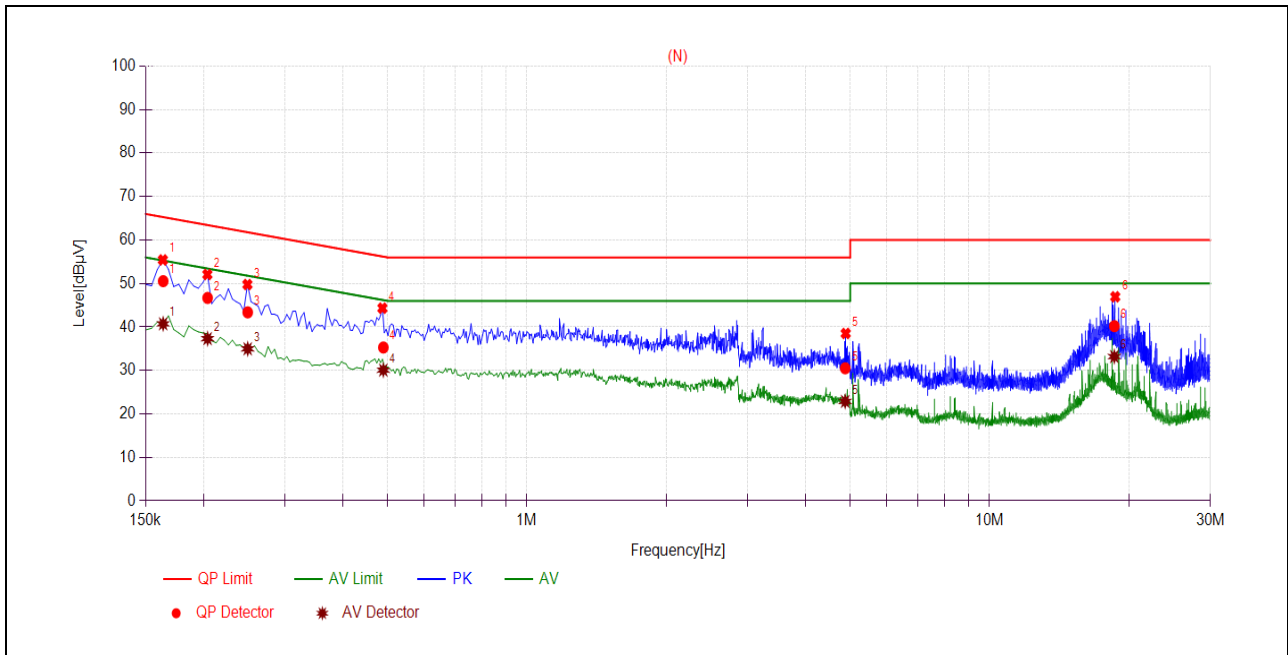
A_{Factor} : Voltage division factor of LISN

B. Test Plot:



(L Phase)

No.	Fre. (MHz)	Emission Level (dBμV)		Limit (dBμV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1810	50.33	39.14	64.44	54.44	Line	PASS
2	0.2083	47.36	38.03	63.27	53.27		PASS
3	0.2578	47.37	36.34	61.50	51.50		PASS
4	0.4544	36.19	29.51	56.79	46.79		PASS
5	3.2380	33.59	24.90	56.00	46.00		PASS
6	18.5255	40.09	33.86	60.00	50.00		PASS



(N Phase)

No.	Fre. (MHz)	Emission Level (dBμV)		Limit (dBμV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1637	50.54	40.72	65.28	55.28	Neutral	PASS
2	0.2042	46.68	37.31	63.44	53.44		PASS
3	0.2493	43.36	34.97	61.78	51.78		PASS
4	0.4896	35.28	30.07	56.17	46.17		PASS
5	4.8751	30.50	22.87	56.00	46.00		PASS
6	18.6040	40.19	33.18	60.00	50.00		PASS

2.12. Radiated Emission

2.12.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
0.009 - 0.490	$2400/F(\text{kHz})$	300
0.490 - 1.705	$24000/F(\text{kHz})$	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

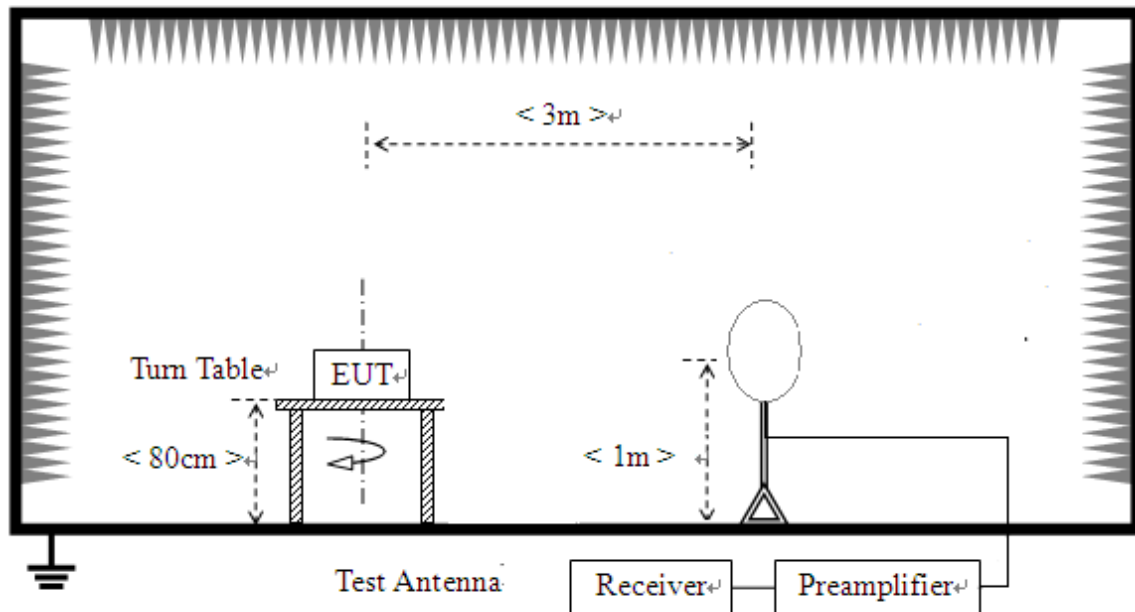
Note1: For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

Note2: For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK). In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

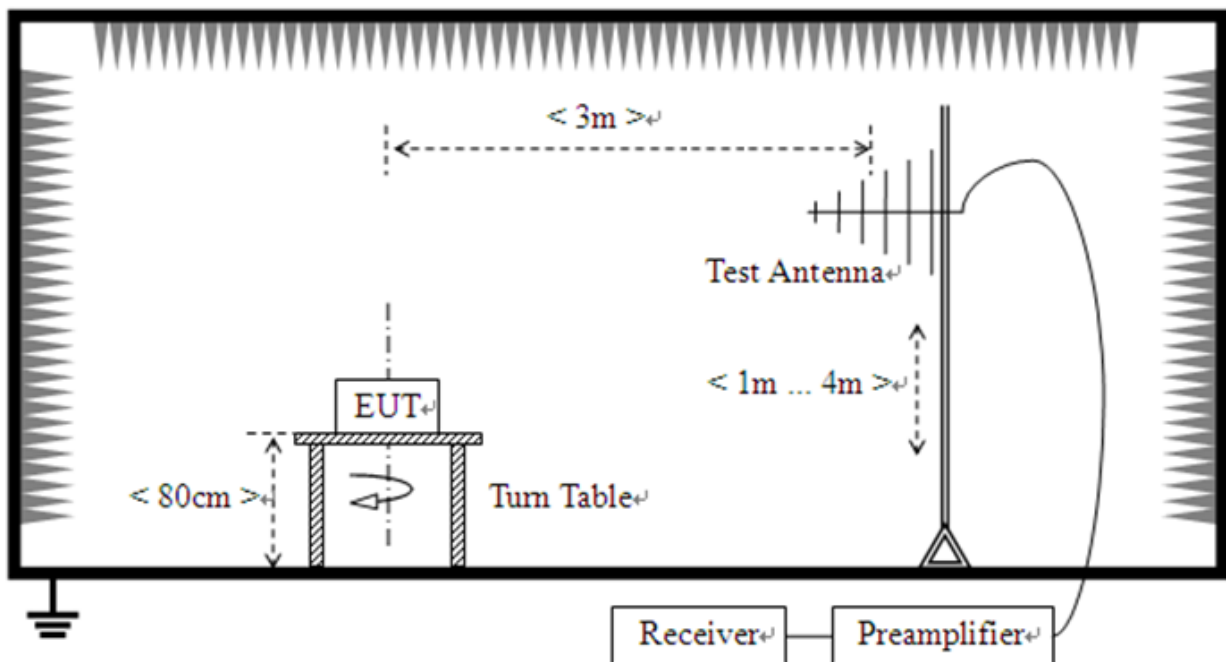
2.12.2. Test Description

Test Setup:

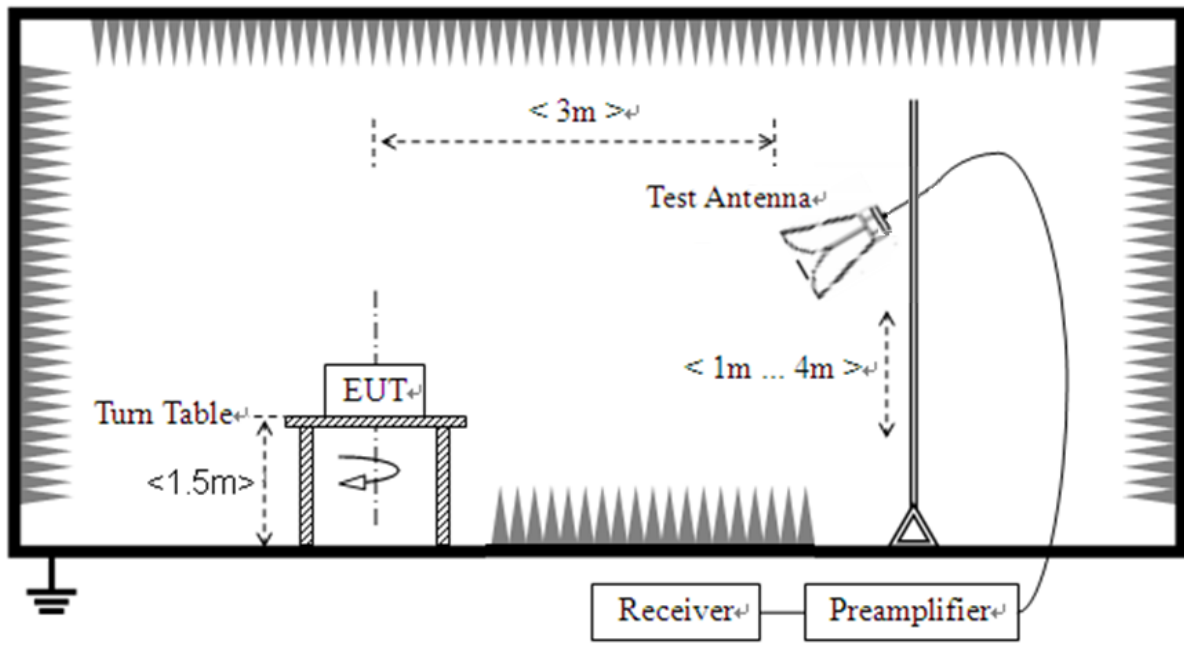
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.



2.12.3. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

During the test, the total correction Factor A_T and A_{Factor} were built in test software.

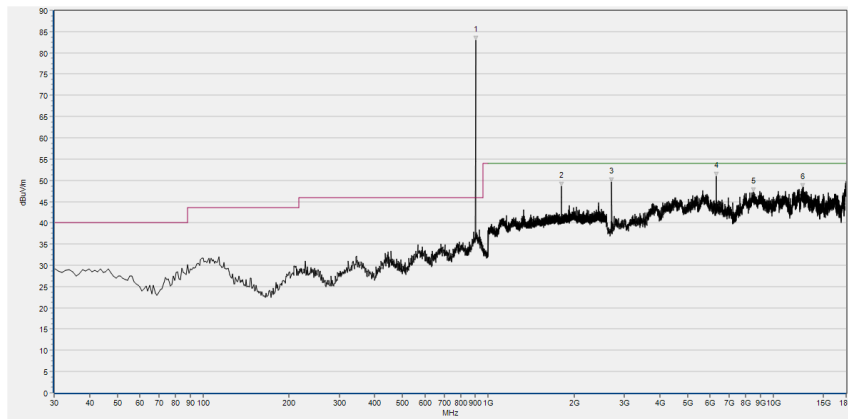
Note 1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note 2: For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note 3: N/A means the frequency is the basic frequency or the base station frequency, they are no need to verdict.

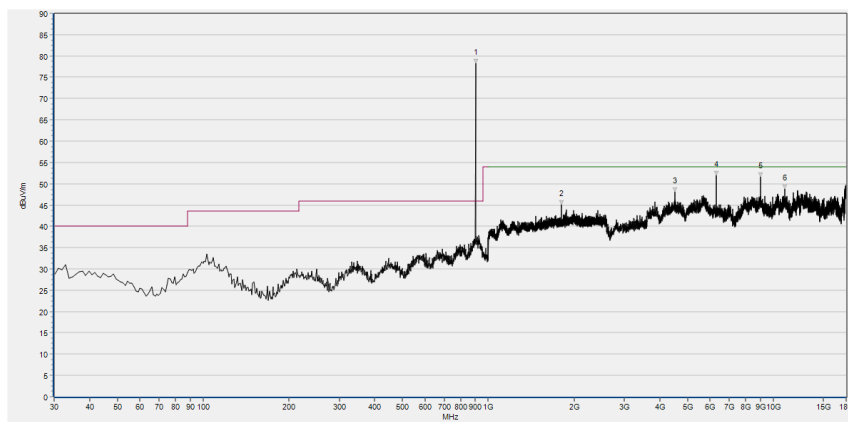


Plots for Channel 1



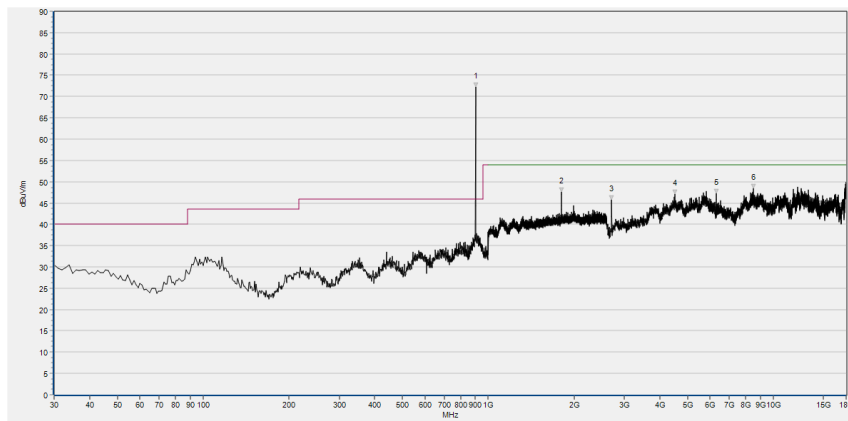
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	82.96	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1804.267	48.68	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2707.800	49.58	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
6317.560	50.94	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8525.920	47.18	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12680.840	48.33	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(X axis, 30MHz to 10GHz)



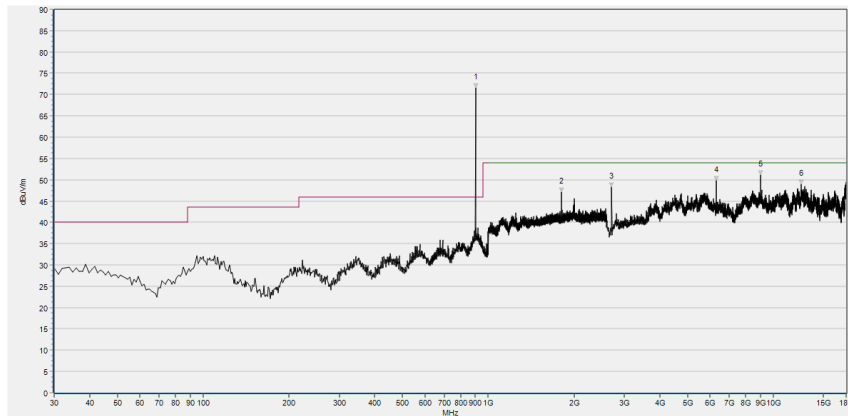
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	78.19	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1804.800	45.08	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4512.680	48.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
6316.000	52.02	N/A	49.11	74.00	N/A	54.00	Vertical	PASS
9022.600	51.61	N/A	47.27	74.00	N/A	54.00	Vertical	PASS
10980.680	48.79	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(X axis, 30MHz to 10GHz)



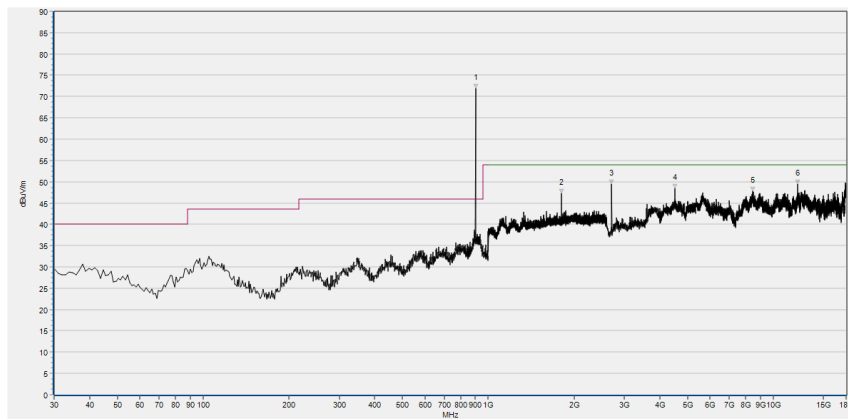
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	72.20	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1804.800	47.65	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2707.800	45.78	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4512.680	47.16	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
6314.480	47.31	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8513.600	48.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



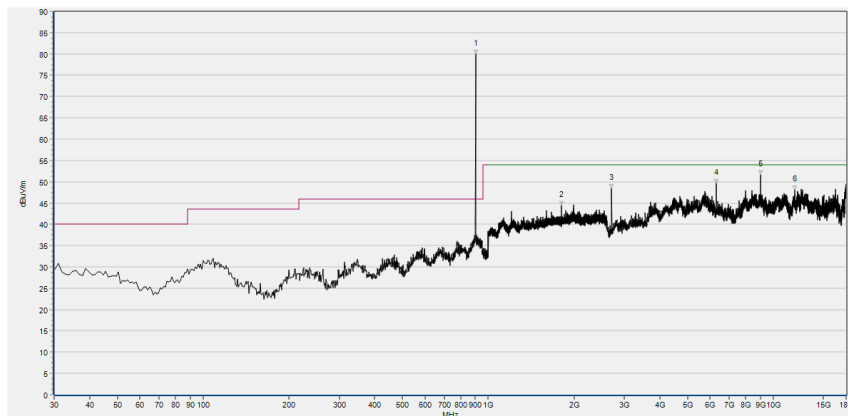
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	71.62	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1804.800	47.15	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2707.800	48.28	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
6317.560	49.79	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9022.900	51.10	N/A	43.85	74.00	N/A	54.00	Vertical	PASS
12520.680	48.94	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Y axis, 30MHz to 10GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	71.85	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1804.267	47.30	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2707.800	49.46	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4512.680	48.40	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8442.760	47.78	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12169.560	49.43	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Z axis, 30MHz to 10GHz)

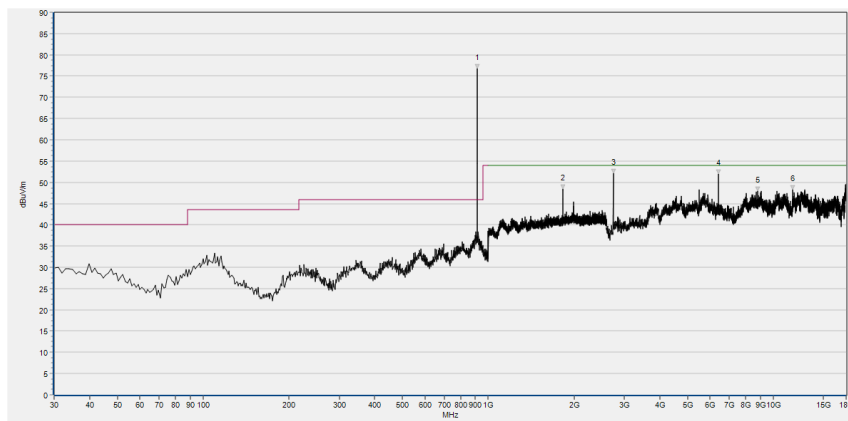


Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	79.99	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1804.800	44.48	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2707.800	48.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
6314.480	49.59	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9022.800	51.65	N/A	46.64	74.00	N/A	54.00	Vertical	PASS
11861.560	48.08	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Z axis, 30MHz to 10GHz)

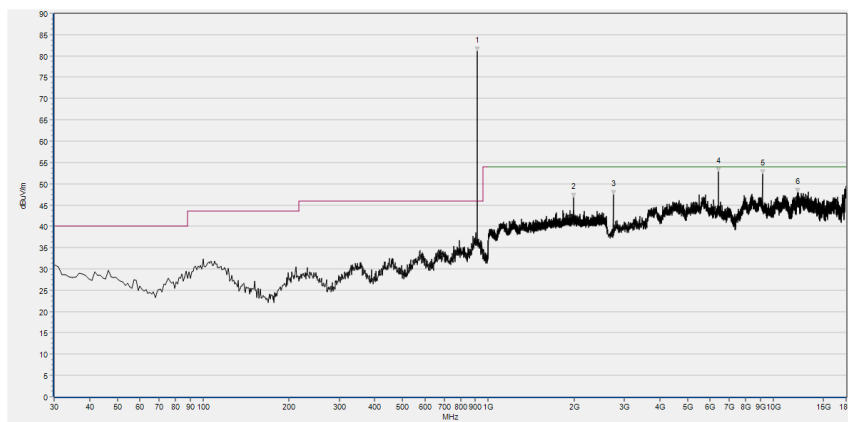


Plot for Channel 65



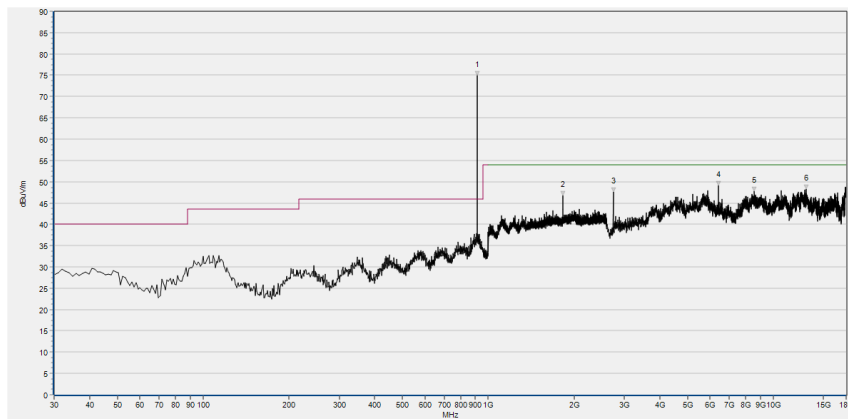
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	76.81	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1829.867	48.51	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2744.800	52.06	N/A	50.56	74.00	N/A	54.00	Horizontal	PASS
6403.900	51.93	N/A	46.48	74.00	N/A	54.00	Horizontal	PASS
8809.280	47.95	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
11679.840	48.27	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(X axis, 30MHz to 10GHz)



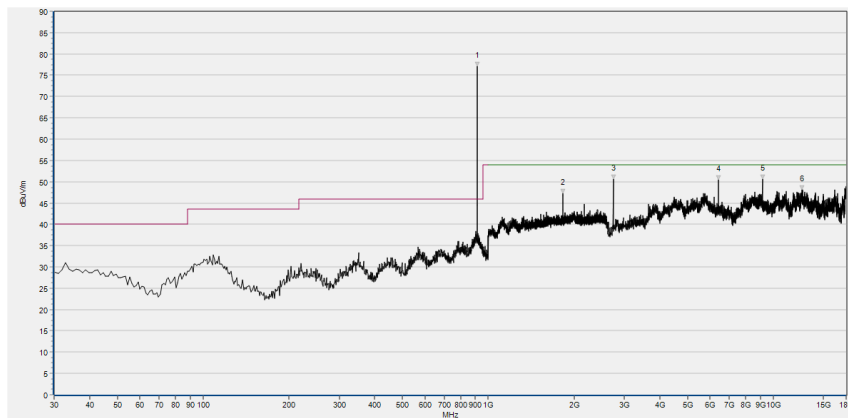
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	81.06	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1994.133	46.80	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2744.760	47.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
6404.500	52.86	N/A	49.94	74.00	N/A	54.00	Vertical	PASS
9149.300	52.32	N/A	47.22	74.00	N/A	54.00	Vertical	PASS
12172.640	47.99	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(X axis, 30MHz to 10GHz)



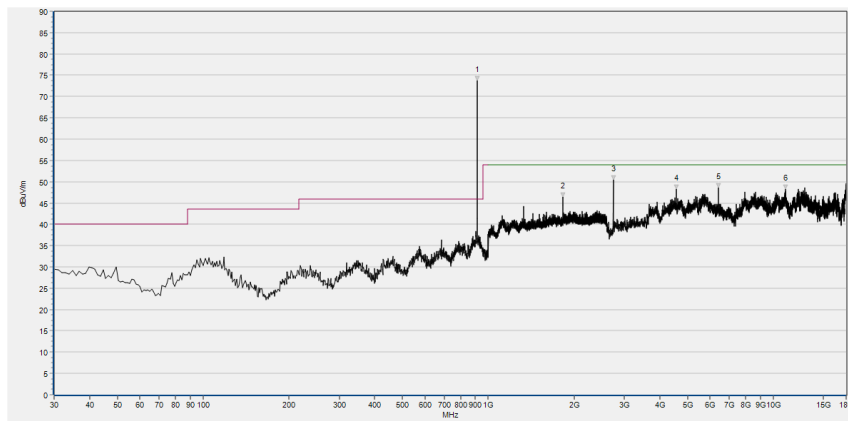
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	74.87	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1829.867	46.84	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2744.760	47.59	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
6403.800	49.18	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8581.360	47.85	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
13059.680	48.27	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



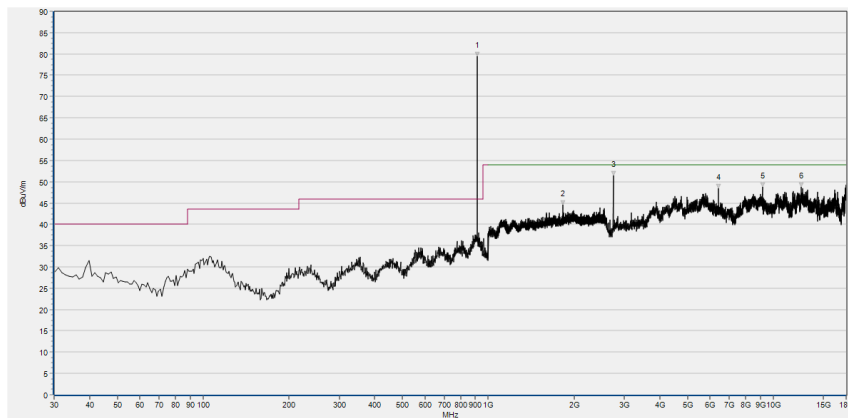
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	77.04	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1829.867	47.34	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2744.760	50.57	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
6403.800	50.51	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9148.080	50.69	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12569.960	48.17	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Y axis, 30MHz to 10GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	73.68	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1829.867	46.46	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2744.760	50.44	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4574.280	48.19	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
6403.800	48.67	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
11057.680	48.34	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Z axis, 30MHz to 10GHz)

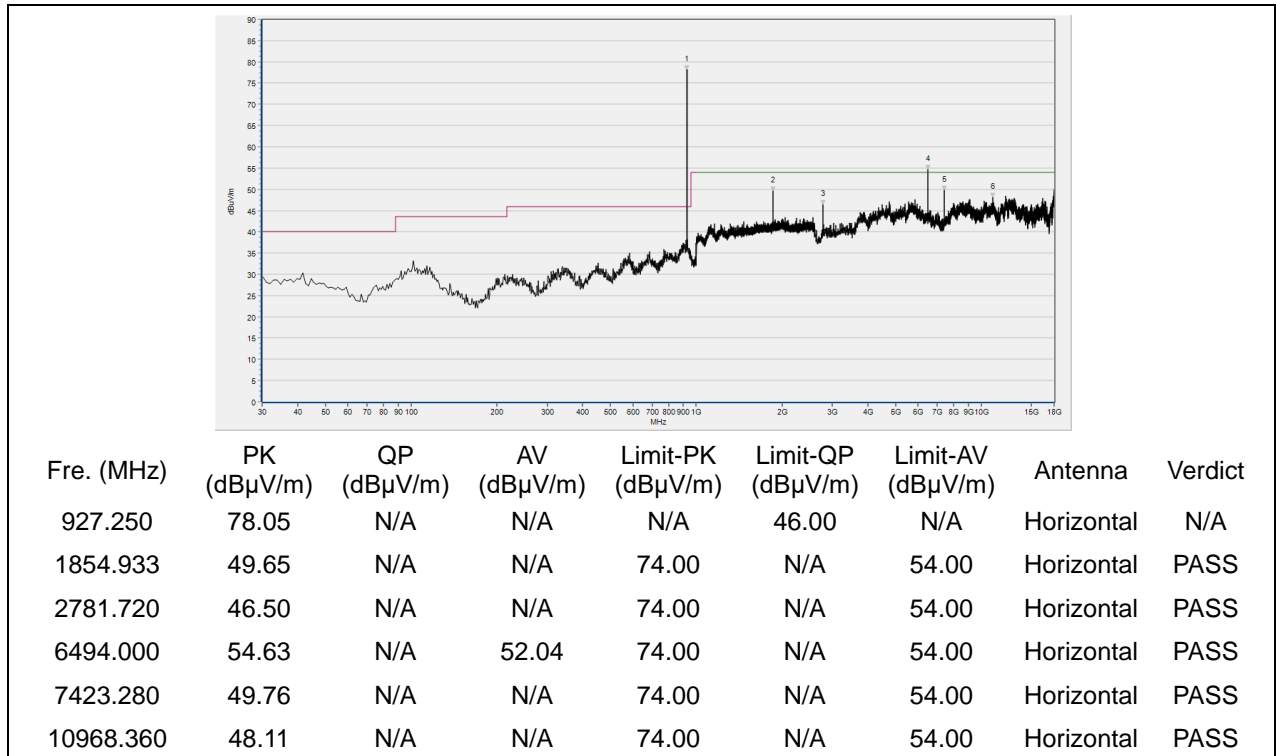


Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	79.43	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1829.867	44.52	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2744.600	51.50	N/A	50.08	74.00	N/A	54.00	Vertical	PASS
6403.800	48.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9148.080	48.72	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12502.200	48.69	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

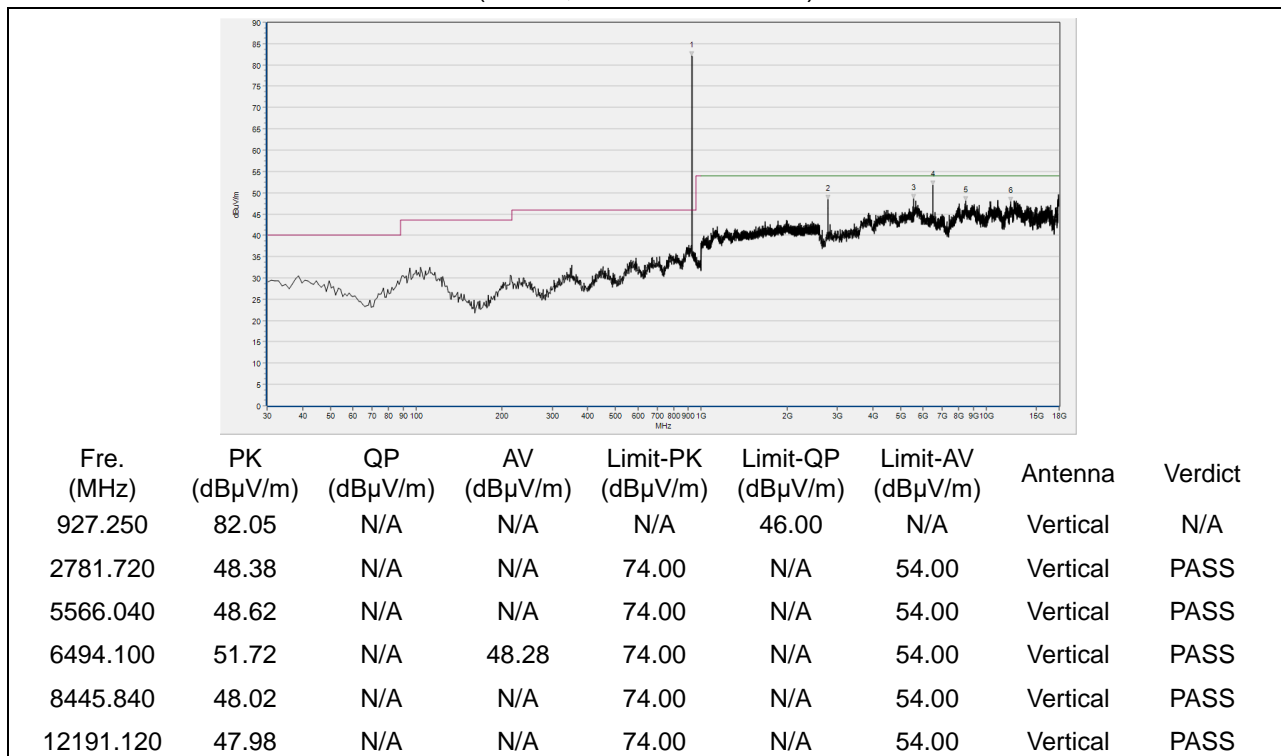
(Z axis, 30MHz to 10GHz)



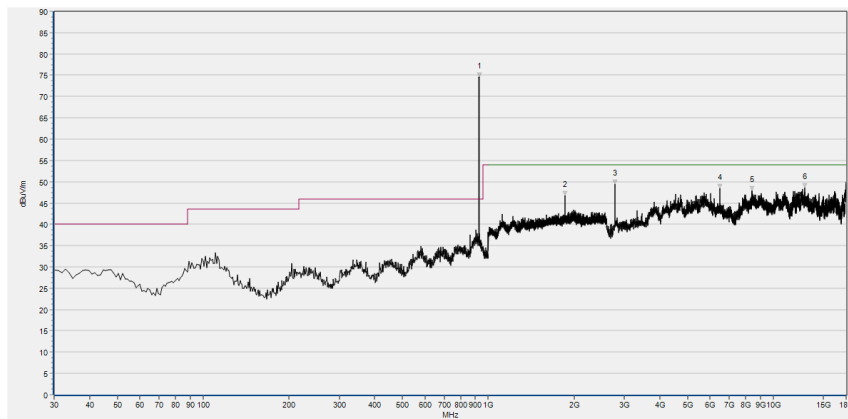
Plot for Channel 128



(X axis, 30MHz to 10GHz)

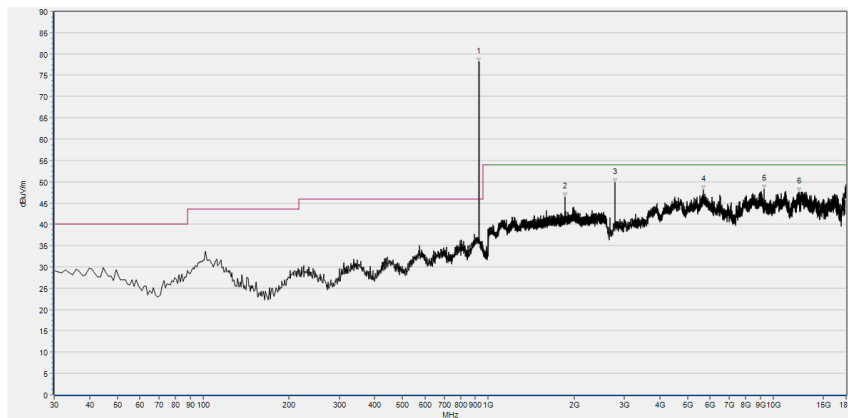


(X axis, 30MHz to 10GHz)



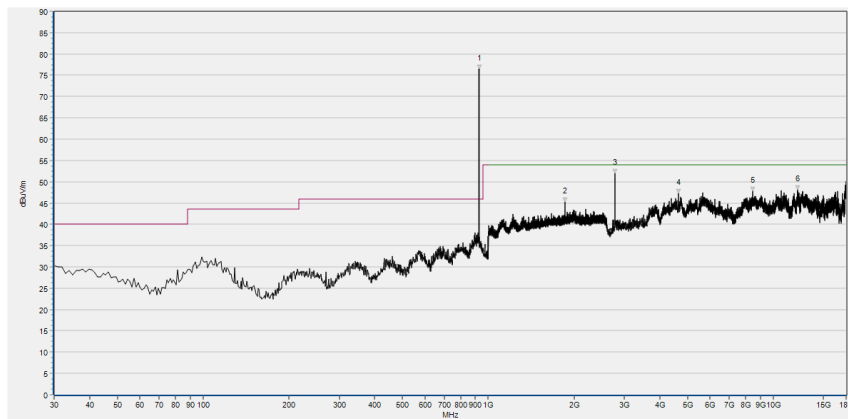
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
928.220	74.54	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1855.467	46.74	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2781.720	49.37	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
6493.120	48.43	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8418.120	47.86	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12908.760	48.66	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



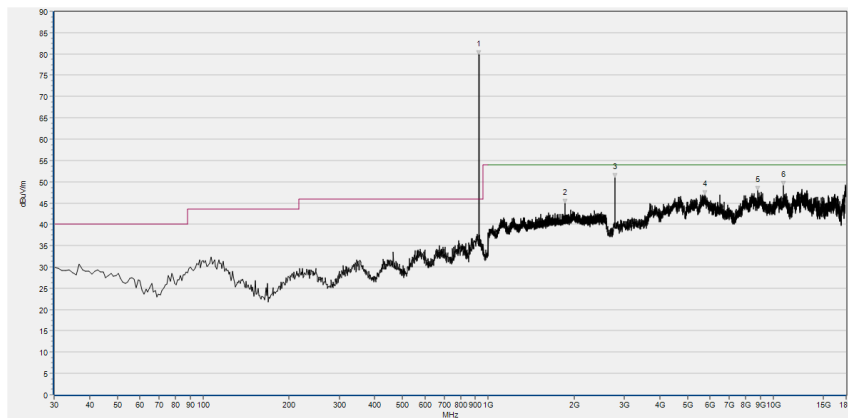
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	78.17	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1855.467	46.46	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2781.720	49.76	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5689.240	48.06	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9277.440	48.20	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12283.520	47.54	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Y axis, 30MHz to 10GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
928.220	76.35	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1854.933	45.31	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2783.300	51.87	N/A	50.34	74.00	N/A	54.00	Horizontal	PASS
4638.960	47.26	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8448.920	47.75	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12141.840	48.07	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Z axis, 30MHz to 10GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	79.79	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1854.933	44.84	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2781.720	50.91	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5753.920	46.98	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8796.960	47.86	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10863.640	49.11	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Z axis, 30MHz to 10GHz)

Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test Items	Uncertainty
Number of Hopping Frequency	±5%
Peak Output Power	±2.22dB
20dB Bandwidth	±5%
Carrier Frequency Separation	±5%
Time of Occupancy (Dwell time)	±5%
Conducted Spurious Emission	±2.77dB
Restricted Frequency Bands	±5%
Radiated Emission	±2.95dB
Conducted Emission	±2.44dB

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



Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.



4. Test Equipments Utilized

4.1 Conducted Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2022.03.01	2023.02.28
RF Cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial Cable	CB02	RF02	Morlab	N/A	N/A
SMA Connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY56400093	N9038A	KEYSIGHT	2022.03.03	2023.03.02
LISN	812744	NSLK 8127	Schwarzbeck	2022.03.03	2023.03.02
Pulse Limiter (10dB)	VTSD 9561 F-B #206	VTSD 9561-F	Schwarzbeck	2022.07.06	2023.07.05
Coaxial Cable(BNC) (30MHz-26GHz)	CB01	EMC01	Morlab	N/A	N/A
Notebook	DF2DR A01 DPC	VOSTRO 5370	DELL	N/A	N/A
Notebook Adapter	OKXTTW	LA45NM1 40	DELL	N/A	N/A

4.3 List of Software Used

Description	Manufacturer	Software Version
Test System	Tonscend	V2.5.77.0418
Morlab EMCR V1.2	Morlab	V1.0
TS+ -[JS32-CE]	Tonscend	V2.5.0.0

**4.3 Radiated Test Equipments**

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY54130016	N9038A	Agilent	2022.07.06	2023.07.05
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2022.05.25	2025.05.24
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2022.02.11	2025.02.10
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2022.07.13	2025.07.12
Test Antenna – Horn	BBHA9170#773	BBHA 9170	Schwarzbeck	2022.07.14	2025.07.13
Coaxial Cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial Cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial Cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
Coaxial Cable (N male) (30MHz-40GHz)	CB05	EMC05	Morlab	N/A	N/A
1-18GHz pre-Amplifier	61171/61172	S020180L3203	Tonscend	2022.07.08	2023.07.07
18-26.5GHz pre-Amplifier	46732	S10M100L3802	Tonscend	2022.07.08	2023.07.07
26-40GHz pre-Amplifier	56774	S40M400L4002	Tonscend	2022.07.08	2023.07.07
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	2022.07.08	2023.07.07
Anechoic Chamber	N/A	9m*6m*6m	CRT	2020.01.06	2023.01.05

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