TEST REPORT

APPLICANT	:	Zhejiang Lierda Internet of Things technology Co.,Ltd
PRODUCT NAME	:	WB25 Series Overseas Module
MODEL NAME	:	L-LRNWB25-84DN4
BRAND NAME	:	lierda
FCC ID	:	2AOFDL-LRNWB2584DN4
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2022-06-30
TEST DATE	:	2022-07-04 to 2022-07-14
ISSUE DATE	:	2022-07-29

Edited by: Zeng Xiaoying (Rapporteur)

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Change History		
Version	Date	Reason for change
1.0	2022-07-29	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:	WB25 Series Overseas Module
Sample No.:	1#
Hardware Version:	V01.00
Software Version:	Rev01
Modulation Technology:	FHSS
Equipment Type:	LoRa
Operating Frequency Range:	902.3MHz–927.7MHz
Antenna Type:	External Antenna
Antenna Gain:	0dBi

Note 1: We use the dedicated software to control the EUT continuous transmission.

Note 2: 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	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
4	ANSI C63.10	Duty Cycle	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
5	15.247(b)	Maximum Peak Conducted Output Power	Jul. 14, 2022	Su Xiaoxian	PASS	No deviation
6	15.247(b)	Maximum Average Conducted Output Power	Jul. 14, 2022	Su Xiaoxian	PASS	No deviation
7	15.247(a)	20dB Bandwidth	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
8	15.247(a)	Carrier Frequency Separation	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
9	15.247(a)	Time of Occupancy (Dwell time)	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
10	15.247(d)	Conducted Spurious Emission	Jul. 05, 2022	Su Xiaoxian	PASS	No deviation
11	15.207	Conducted Emission	Jul. 05, 2022	Wu Zhaoling	PASS	No deviation
12	15.209, 15.247(d)	Radiated Emission	Jul. 08, 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 11.0dB contains two parts that cable loss 1.0dB and Attenuator 10dB.

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 frequency of using is from 902.3MHz to 927.7MHz, and it is divided into 128 frequency point (frequency point 1 to frequency point 128). with an interval of 0.2M every two channels. Frequency hopping LoRa packets are transmitted randomly every 20 seconds, and the duration of each transmission is <400ms.

There are 128 frequency points. when we power on the internal MCU, there will generate a random number by a timer, then through the random number to determine the 1st frequency hopping point, also generated in 2nd frequency point via a second random number , and the rest can be done at the same manners, there will generate a total sequence of 128 frequency point. When the total 128 frequency points finished the work (a cirle will be include 128 frequency points), MCU will determined the first frequency point in the next circle, then it will finish all the frequency points in this circle, and so on.

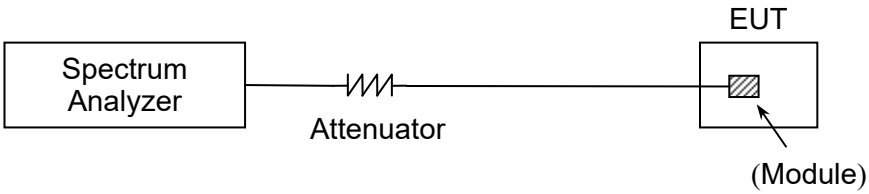
2.3. Number of Hopping Frequency

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

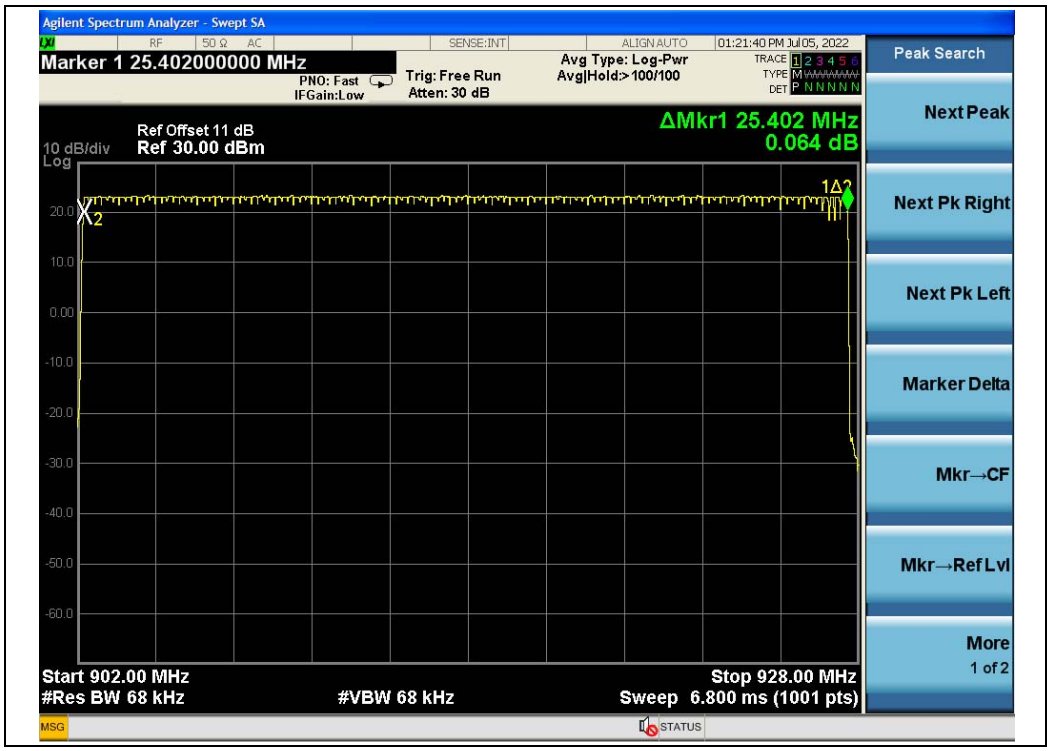
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

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:



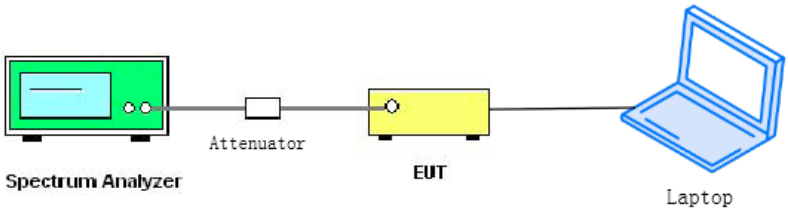
2.4. Duty Cycle of Test Signal

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 ±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*lg[1/D])
100.00	0.00

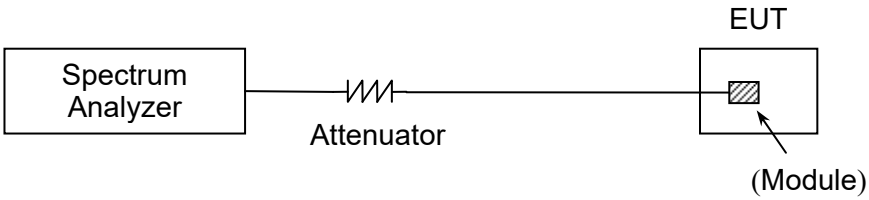
2.5. Maximum Peak Conducted Output Power

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	16.90	0.049	30	1	PASS
65	915.1	16.95	0.050			PASS
128	927.7	**17.06**	**0.051**			PASS

B.Test Plot:

(Channel 1)

(Channel 65)

(Channel 128)

2.6. Maximum Average Conducted Output Power

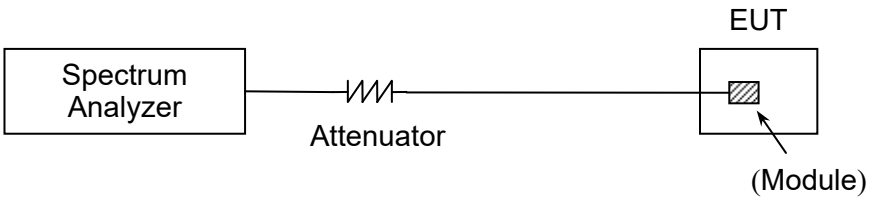
2.6.1. Requirement

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	16.29	0.00	16.29	0.043	30	1	PASS
65	915.1	16.33		16.33	0.043			PASS
128	927.7	16.43		**16.43**	**0.044**			PASS

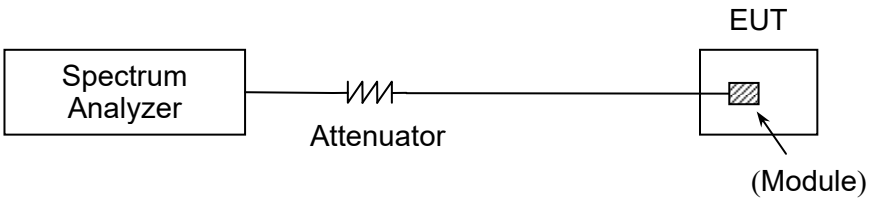
2.7. 20 dB Bandwidth

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*log1% = 20dB) 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 ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

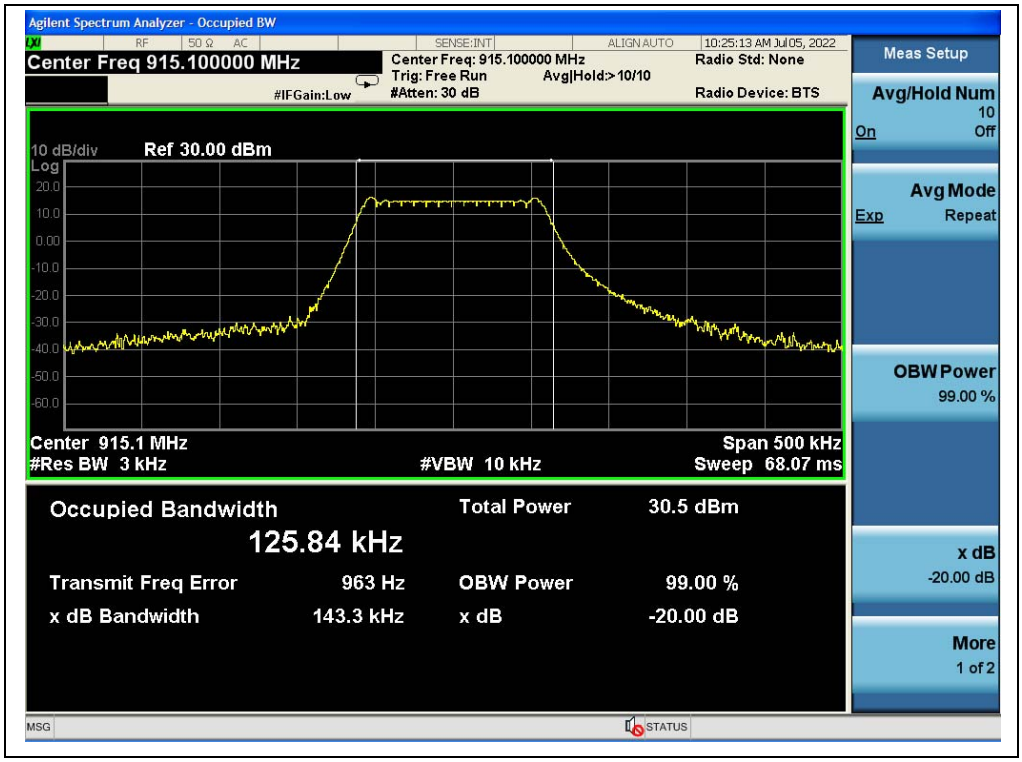
2.7.4. Test Result

A.Test Verdict:

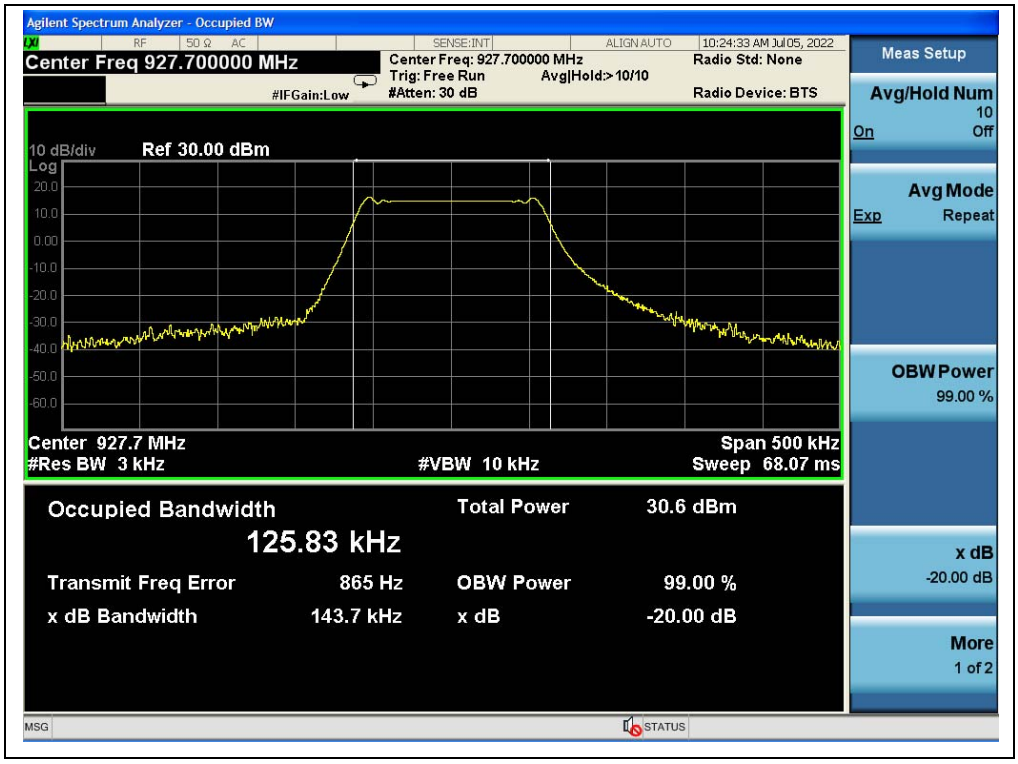
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	Result
1	902.3	145.20	PASS
65	915.1	143.30	PASS
128	927.7	143.70	PASS

B.Test Plot:

(Channel 1)



(Channel 65)



(Channel 128)

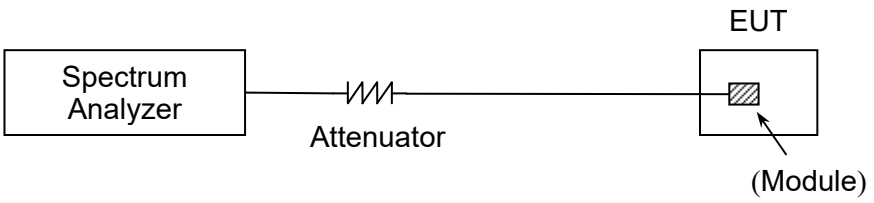
2.8. Carried Frequency Separation

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) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ 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	227.60	145.20	20dB bandwidth	PASS

B.Test Plot:

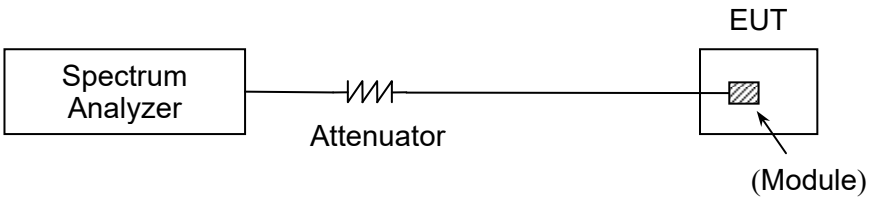
2.9. Time of Occupancy (Dwell time)

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

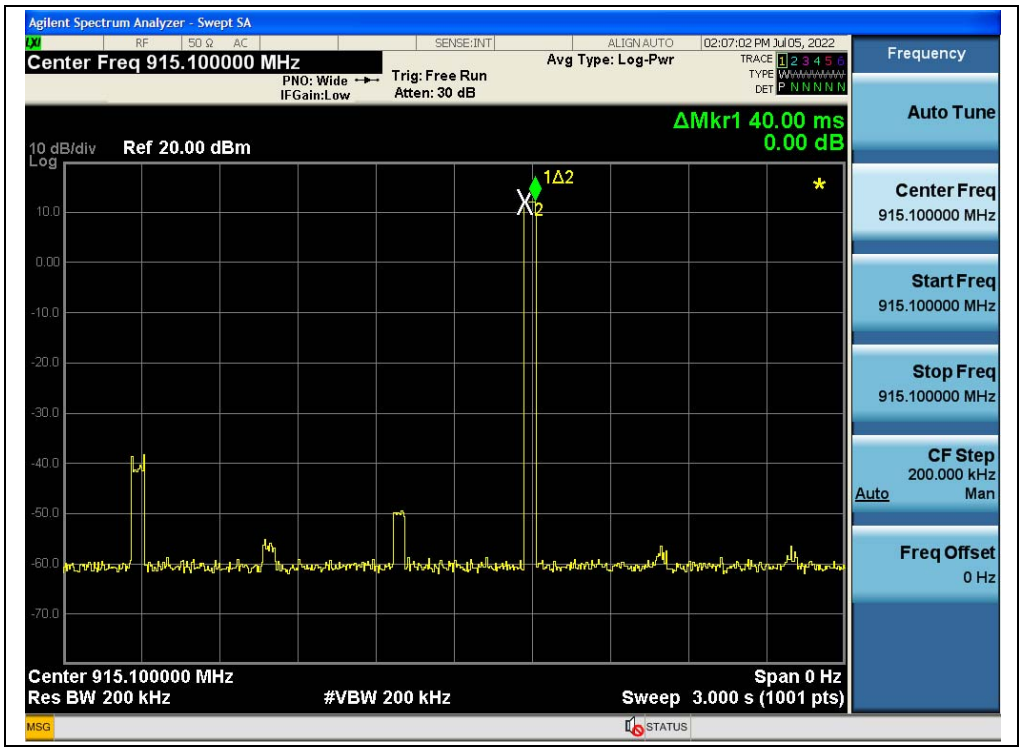
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in 10 second scan, to enable resolution of each occurrence.
The average time of occupancy in the specified 20 second period is equal to (# of pulses in 20s) * pulse width.

2.9.4. Test Result

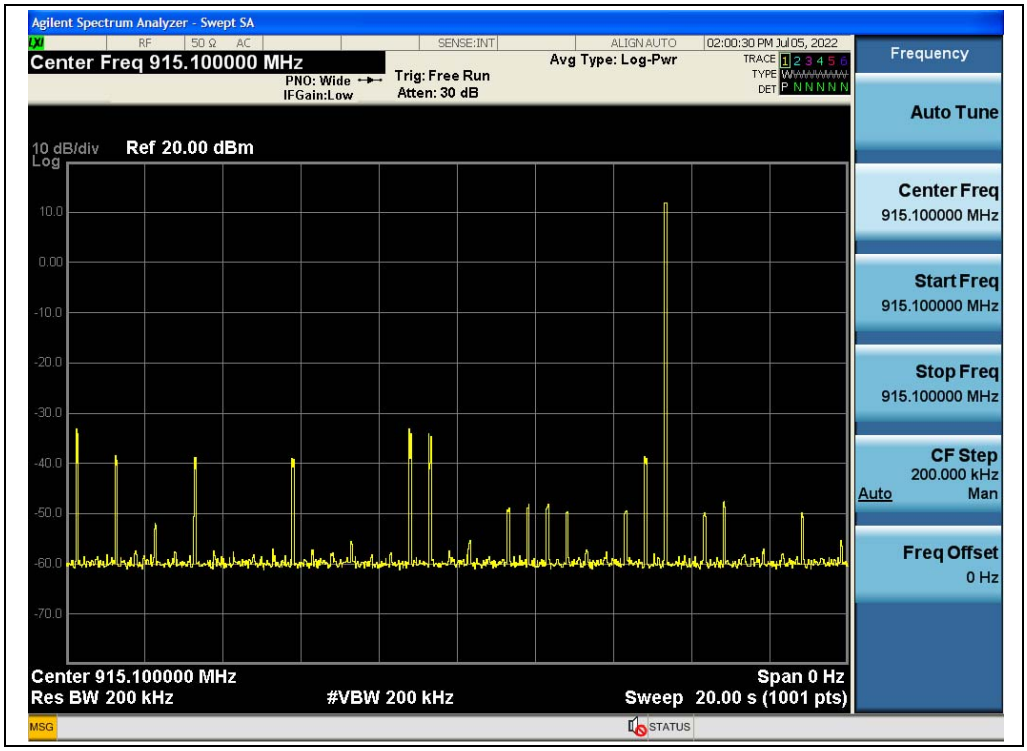
A.Test Verdict:

Frequency (MHz)	Pulse Width (sec)	Number of pulse in 20 seconds	Average Time of Occupancy (sec)	Limit (sec)	Verdict
915.1	0.04	1	0.04	0.4	PASS

B.Test Plot:



(Dwell time_ Pulse Width)



(Dwell time_Number of pulse)

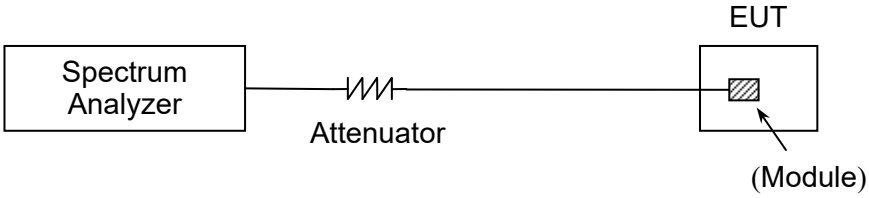
2.10. Conducted Spurious Emissions

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

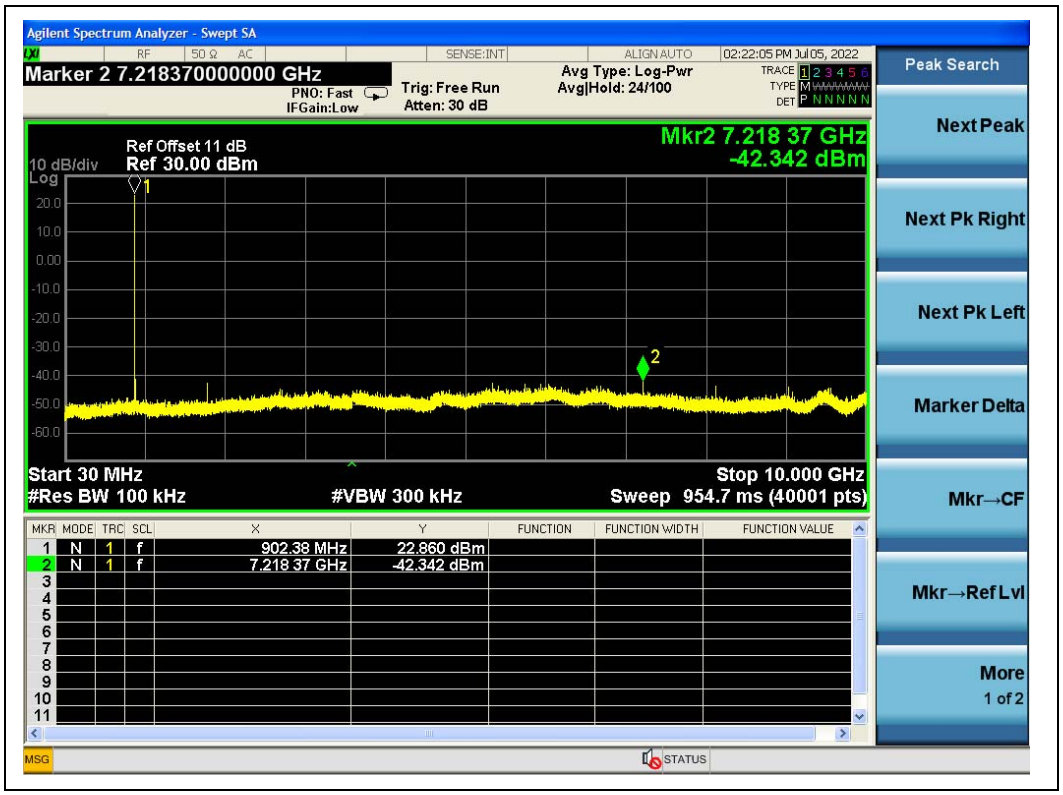
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

2.10.4. Test Result

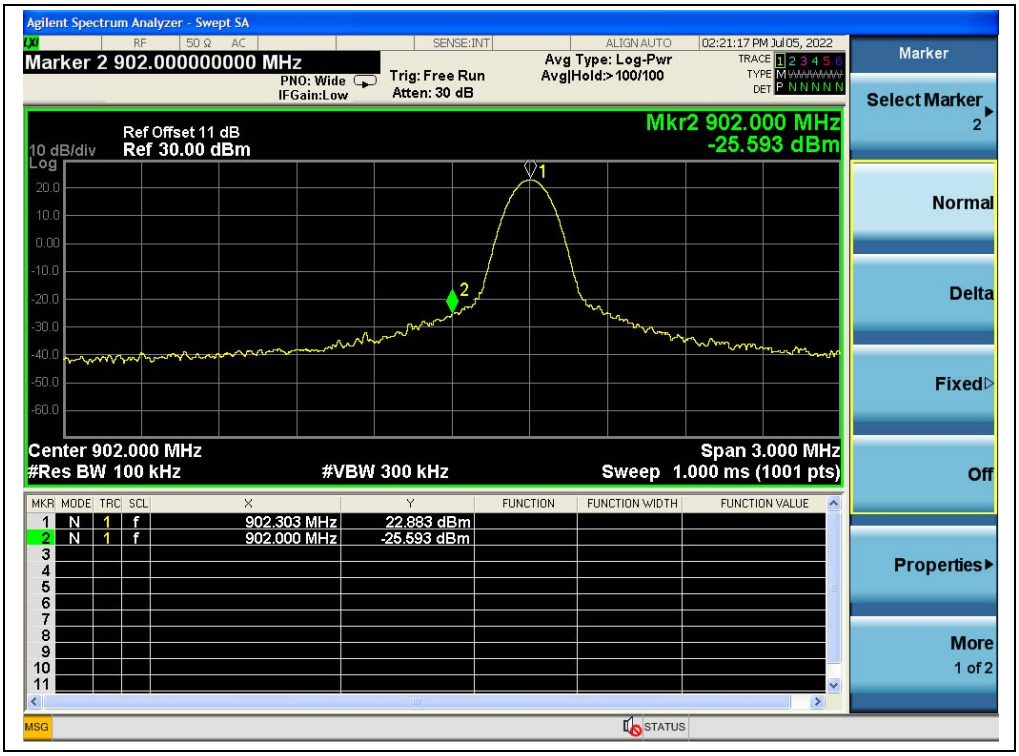
A.Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	902.3	-42.34	22.86	2.86	PASS
65	915.1	-42.78	22.89	2.89	PASS
128	927.7	-42.81	22.91	2.91	PASS

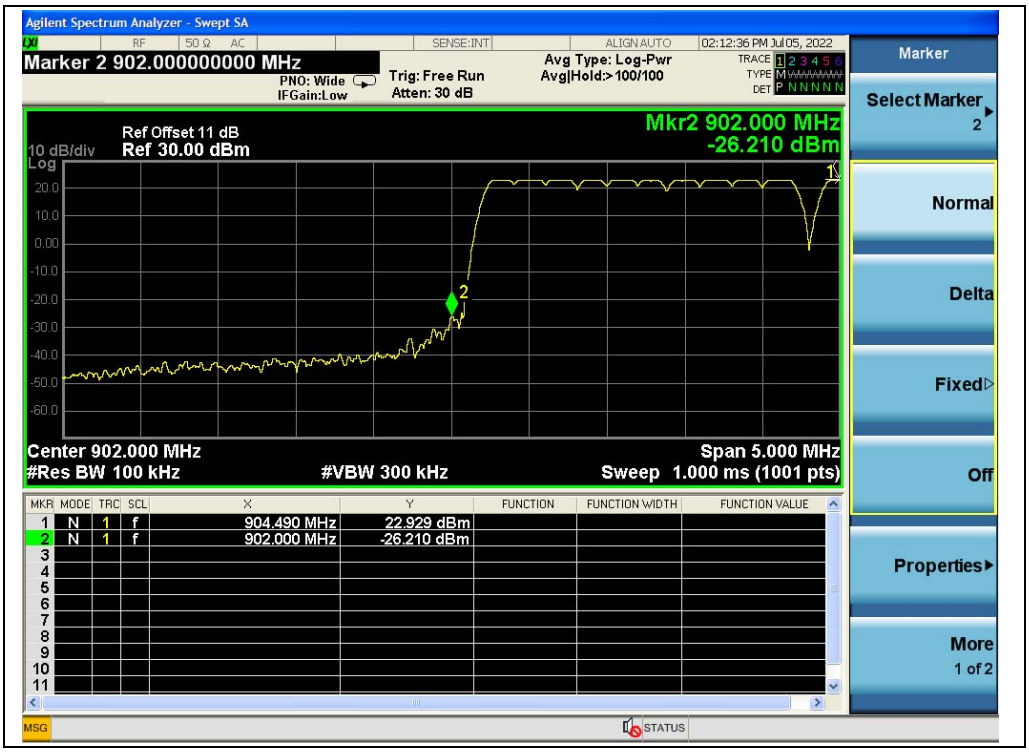
B.Test Plot:



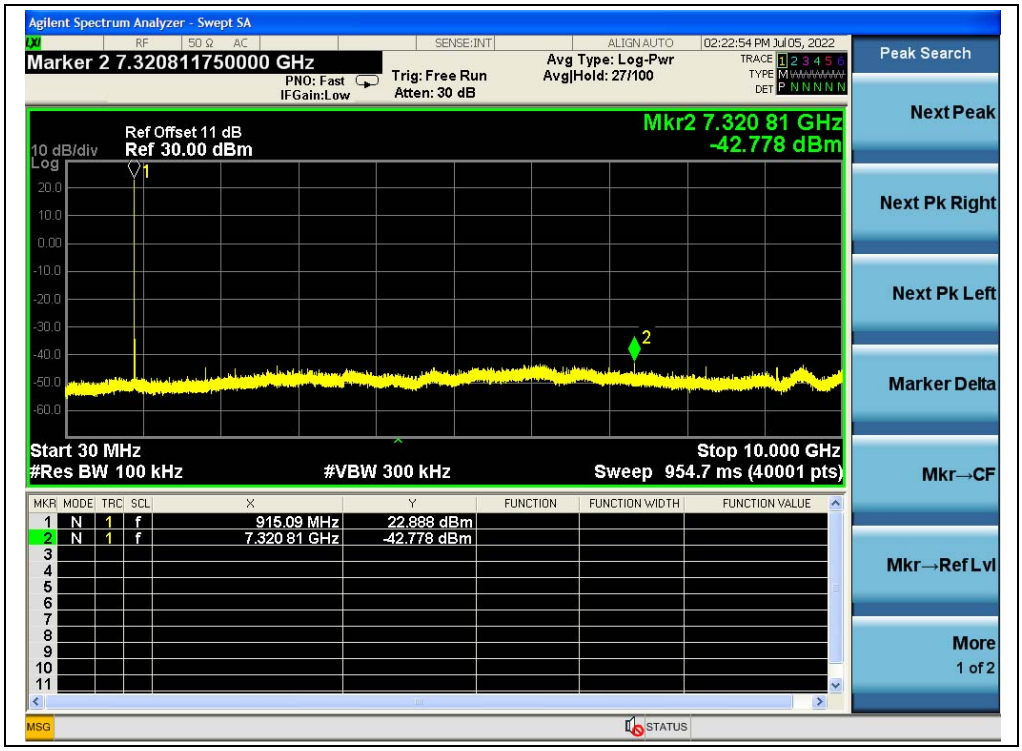
(30MHz to 25GHz, Channel 1)



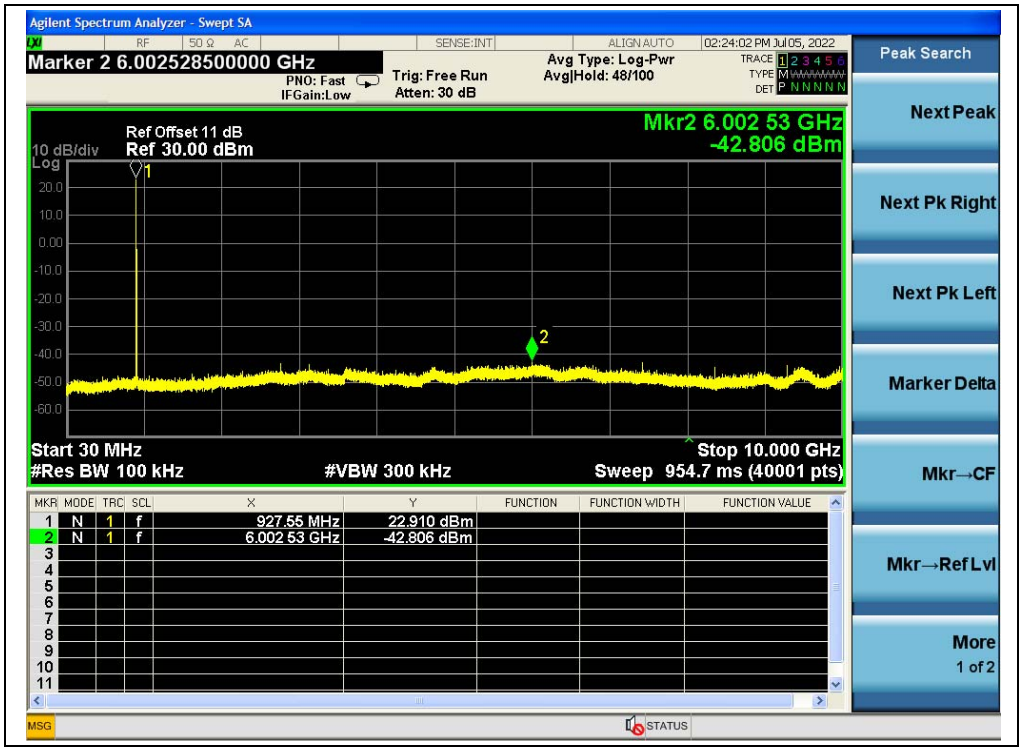
(Band edge, Channel 1)



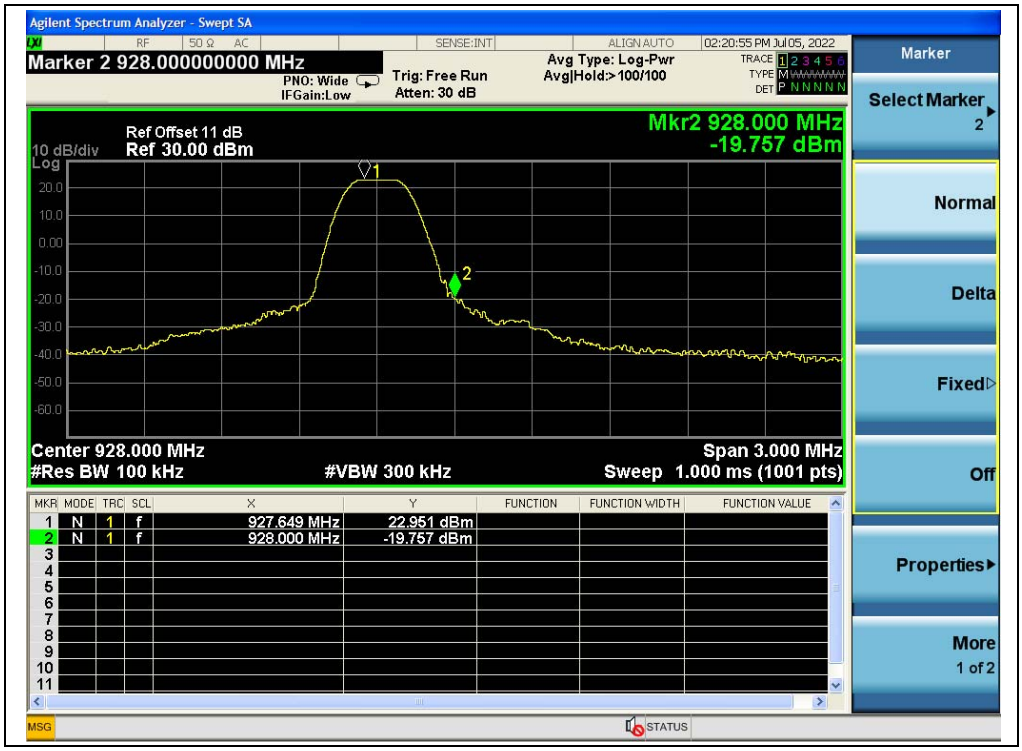
(Band edge with hopping on, Channel 1)



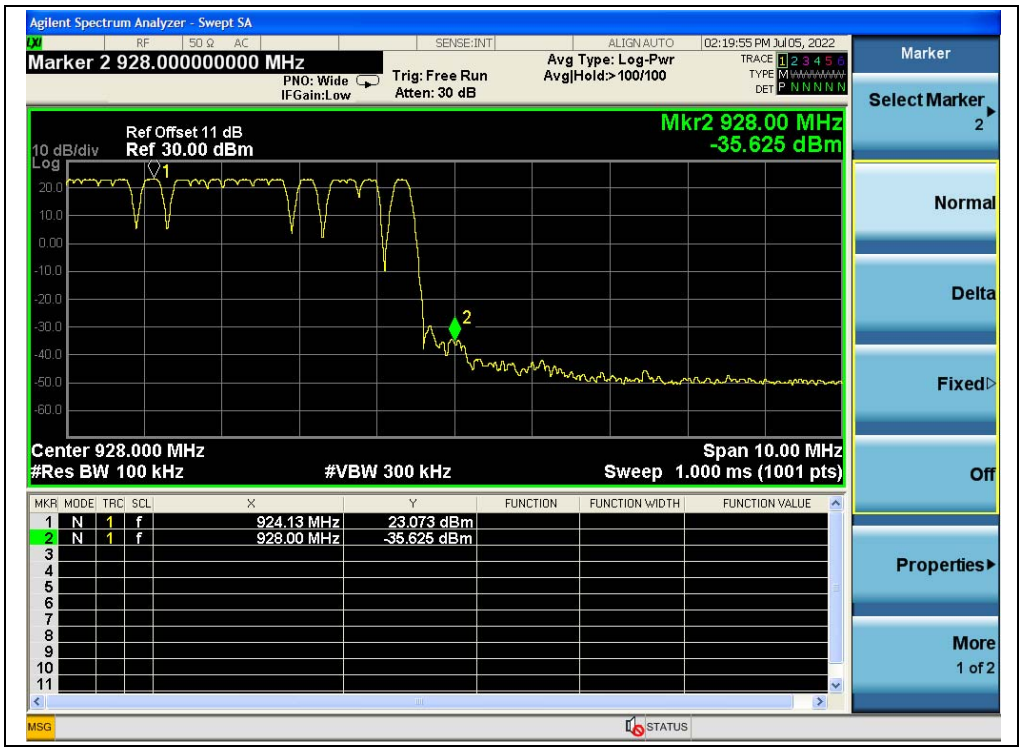
(30MHz to 25GHz, Channel 65)



(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 50μH/50Ω line impedance stabilization network (LISN).

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

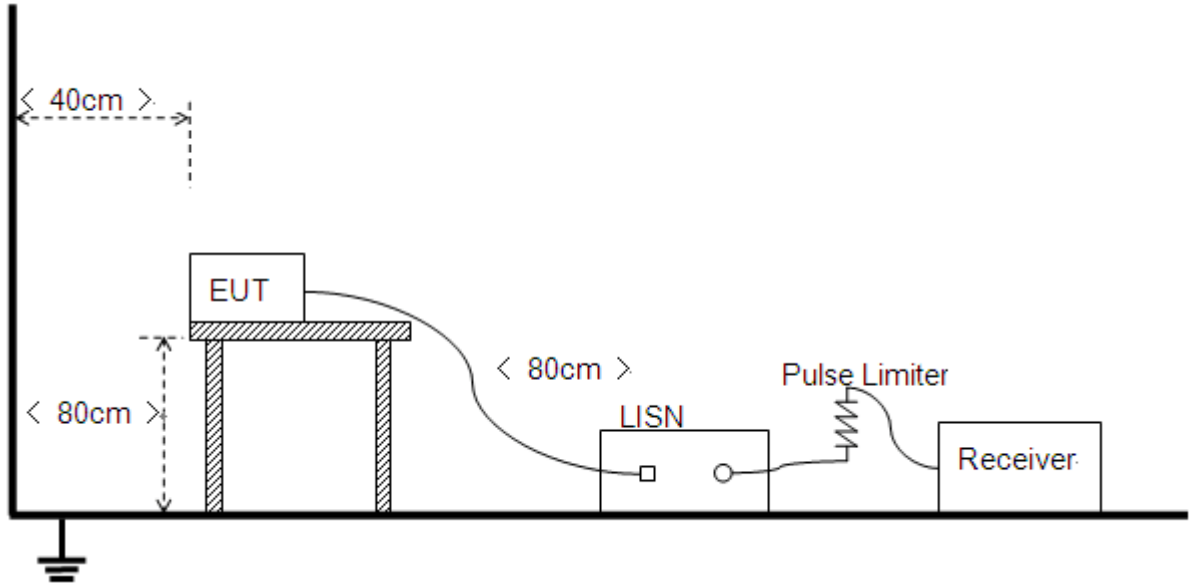
Note:

(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/50Hzwere 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 + LoRa Tx

Test Voltage: AC 120V/60Hz

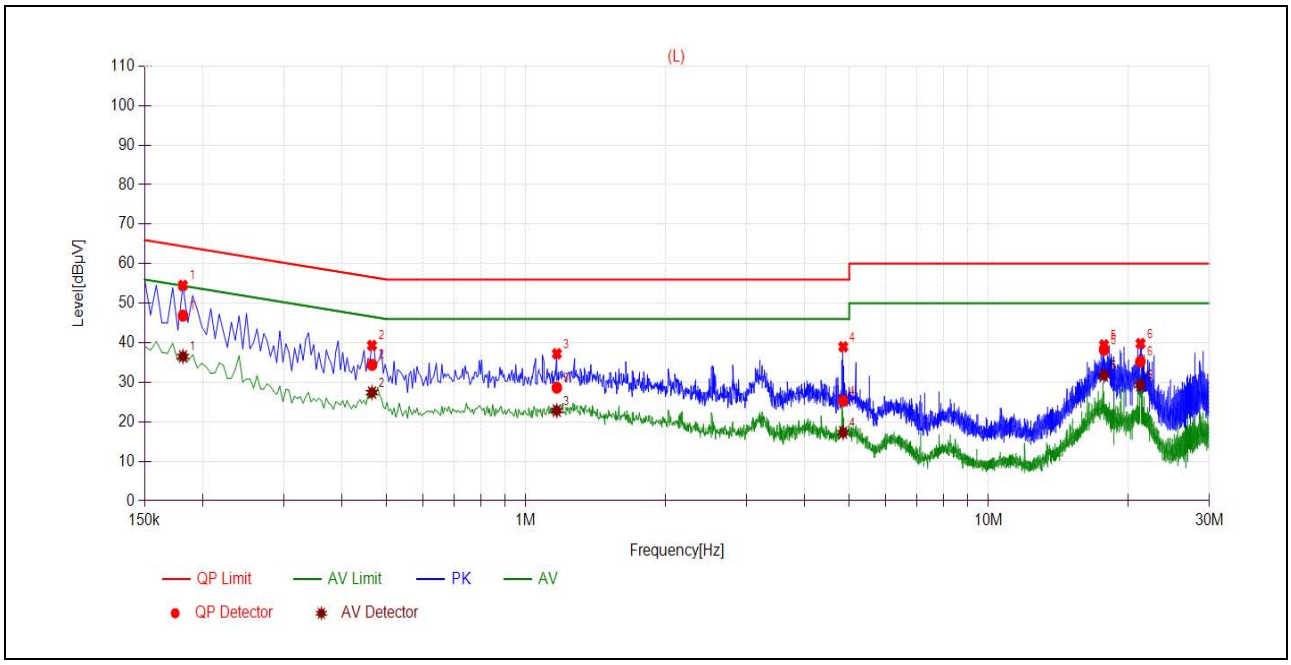
The measurement results are obtained as below:

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

U_R: Receiver Reading

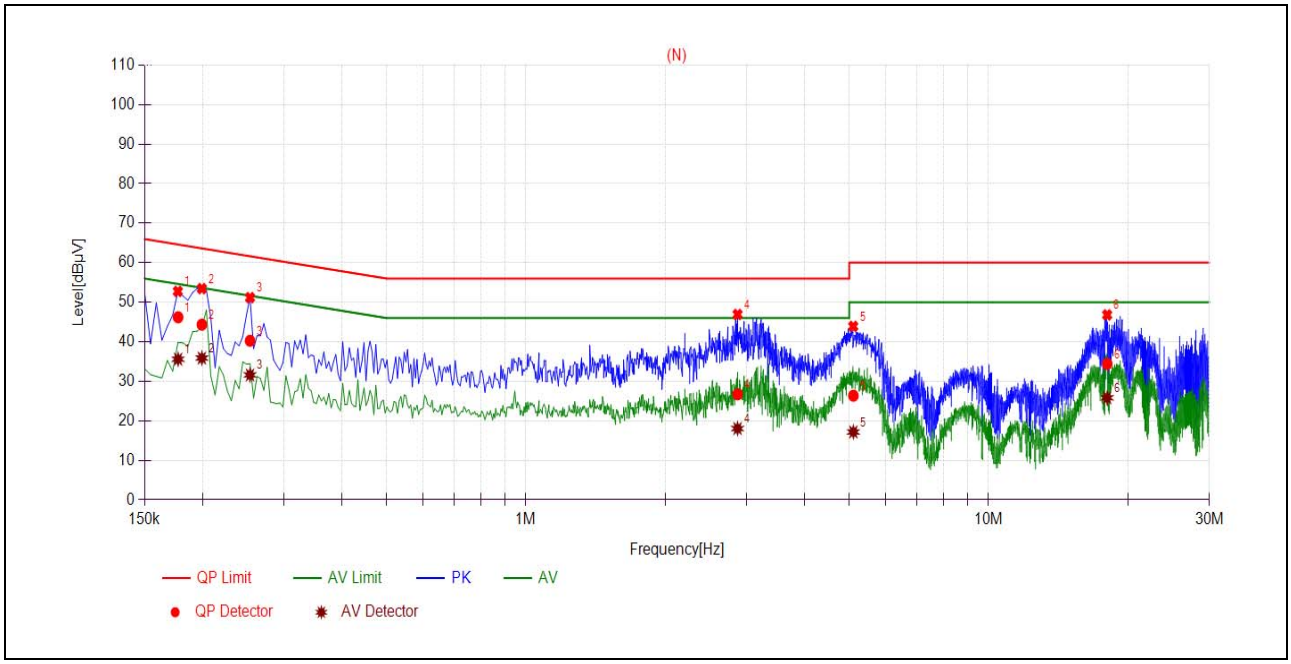
A_{Factor}: Voltage division factor of LISN

B.Test Plot:



(L Phase)

No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1816	46.86	36.53	64.41	54.41	Line	PASS
2	0.4652	34.42	27.40	56.60	46.60		PASS
3	1.1664	28.64	22.82	56.00	46.00		PASS
4	4.8485	25.29	17.26	56.00	46.00		PASS
5	17.7636	38.25	31.74	60.00	50.00		PASS
6	21.2824	35.25	29.29	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	0.1772	46.21	35.58	64.62	54.62	Neutral	PASS
2	0.1995	44.34	35.87	63.63	53.63		PASS
3	0.2535	40.25	31.61	61.64	51.64		PASS
4	2.8676	26.72	18.04	56.00	46.00		PASS
5	5.1027	26.36	17.17	60.00	50.00		PASS
6	18.0418	34.40	25.80	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:

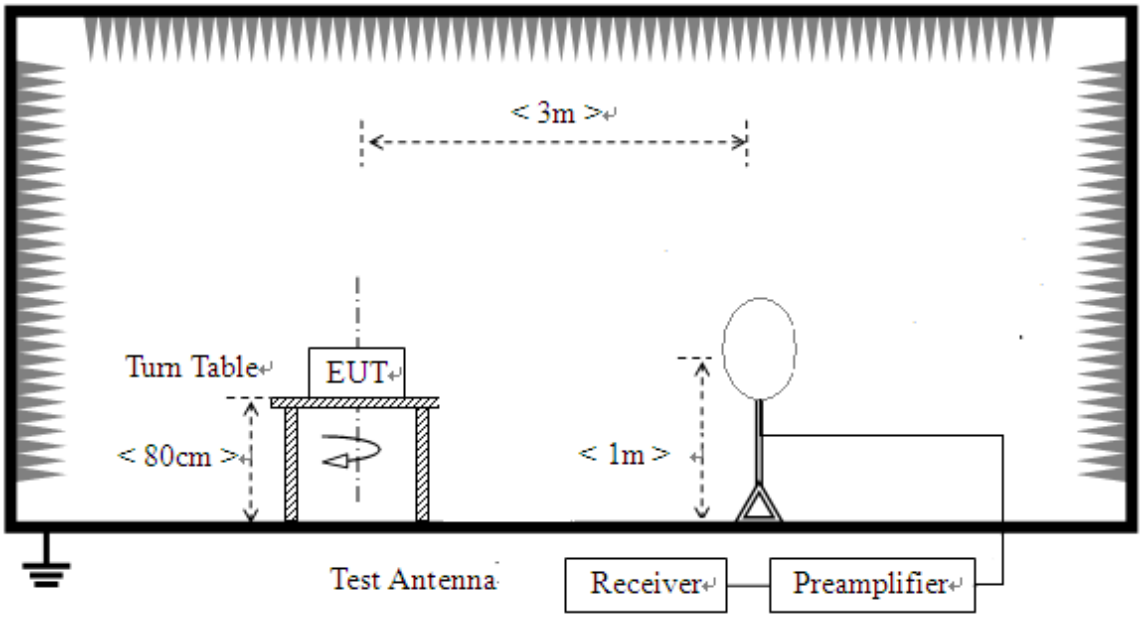
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

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).

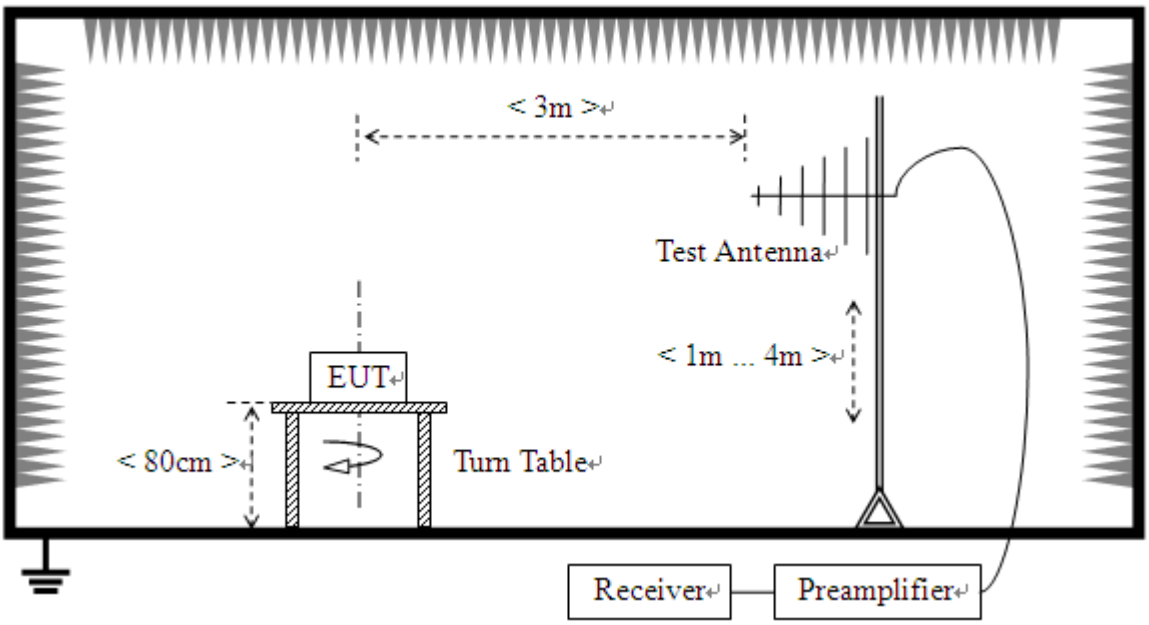
2.12.2. Test Description

Test Setup:

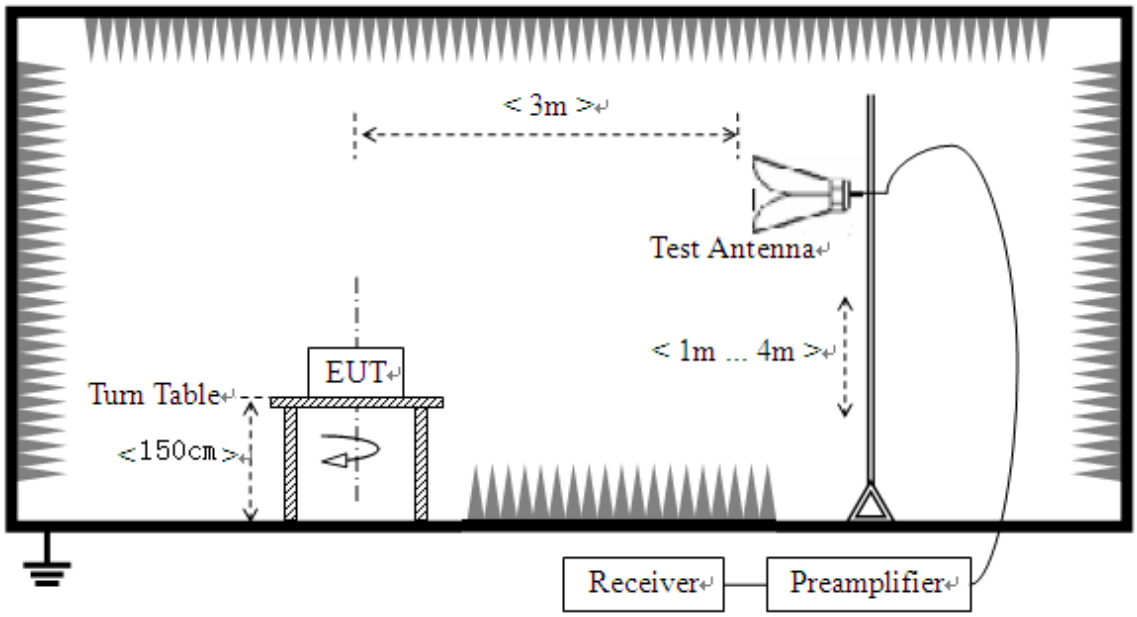
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



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

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

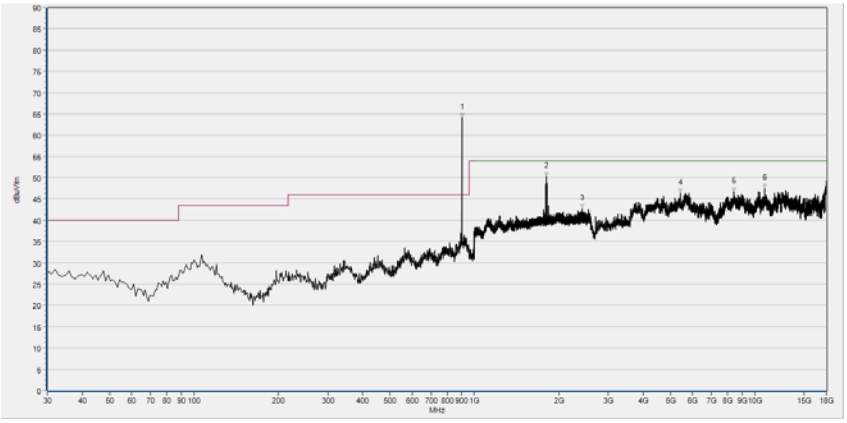
A_{Factor}: Antenna Factor at 3m

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

Note 1: 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.

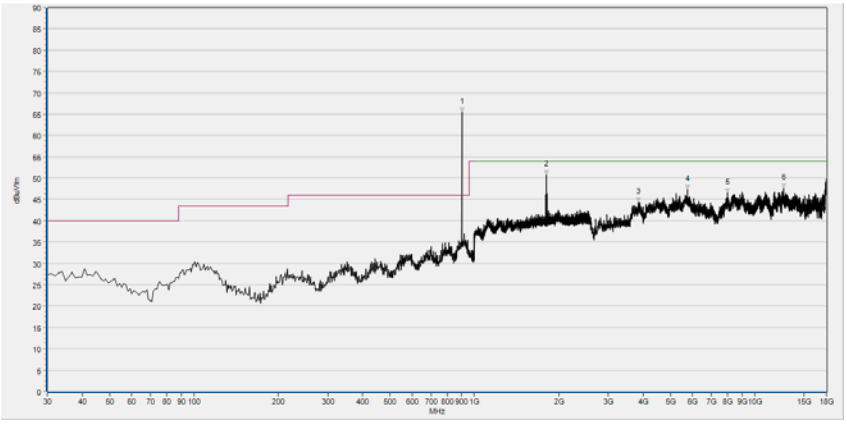
Note 2: N/A means the frequency is the basic frequency or the base station frequency, they are no need to verdict.

Plots for Channel 1



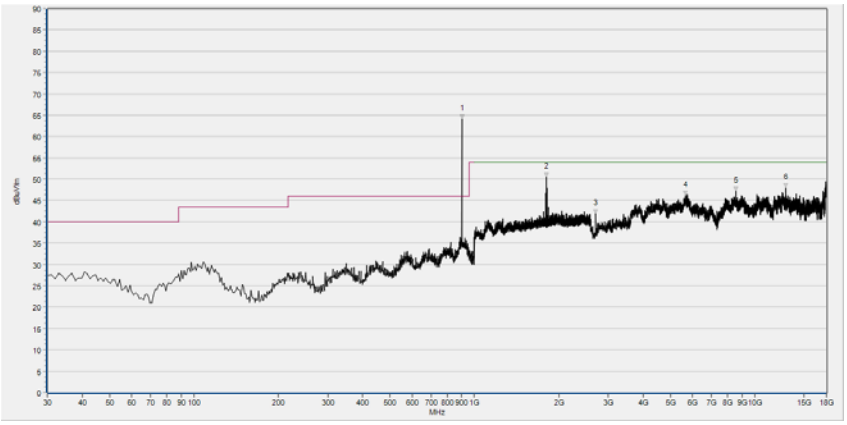
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	64.13	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1805.333	50.35	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2421.867	42.78	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5433.600	46.44	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8408.880	46.71	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
10854.400	47.60	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(X axis, 30MHz to 10GHz)



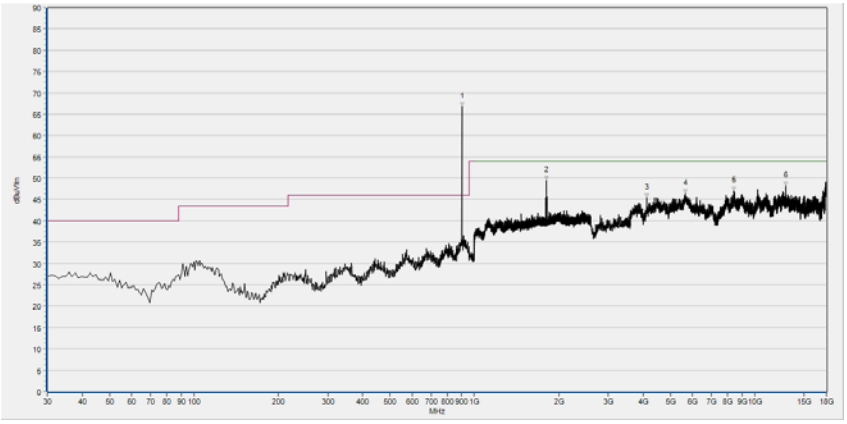
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	65.55	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1805.333	50.81	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3847.400	44.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5760.080	47.34	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
7999.240	46.51	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12690.080	47.71	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(X axis, 30MHz to 10GHz)



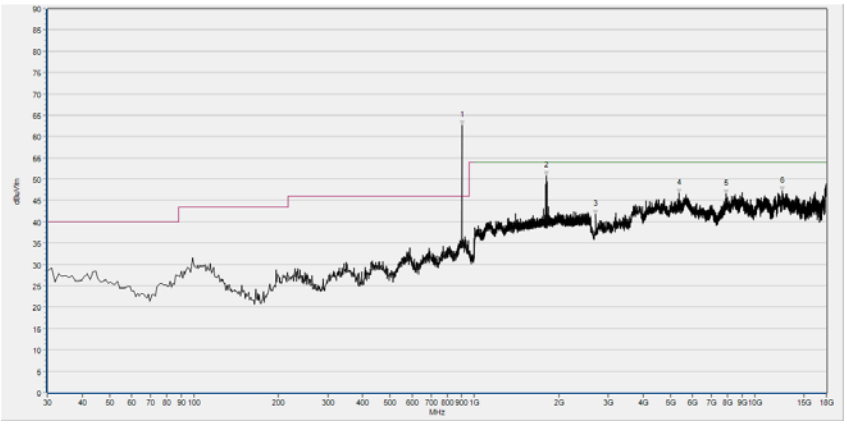
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	64.23	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1804.267	50.52	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2707.800	41.89	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5658.440	46.29	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8572.120	47.22	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12899.520	48.07	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



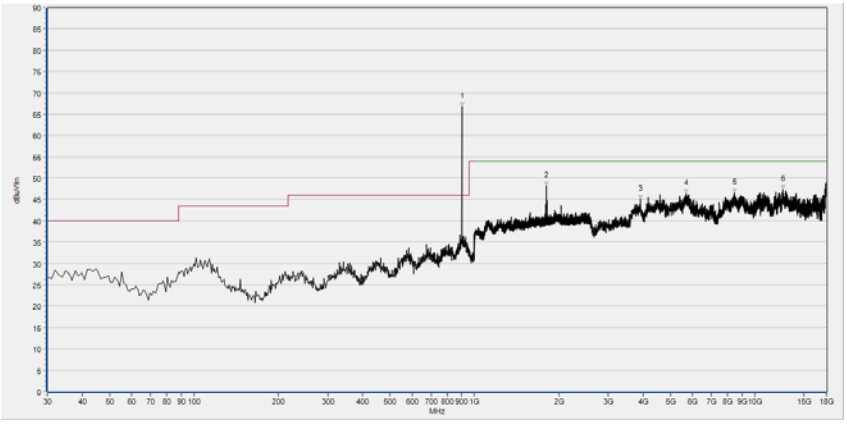
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
902.030	86.78	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1804.267	49.50	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4118.440	45.35	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5636.880	46.35	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8408.880	47.08	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12908.760	48.29	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	62.71	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1804.800	50.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2707.800	41.72	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5368.920	46.75	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7882.200	46.62	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12496.040	47.29	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

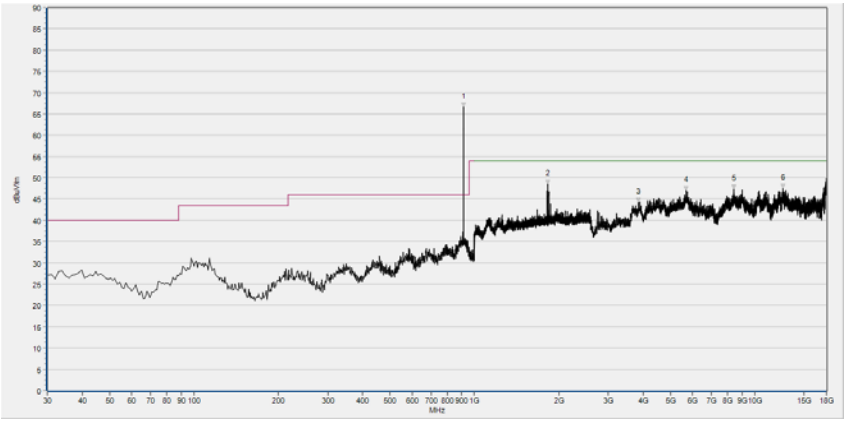
(Z axis, 30MHz to 10GHz)



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	66.81	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1805.333	48.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3905.920	45.03	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5680.000	46.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8448.920	46.53	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12591.520	47.35	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

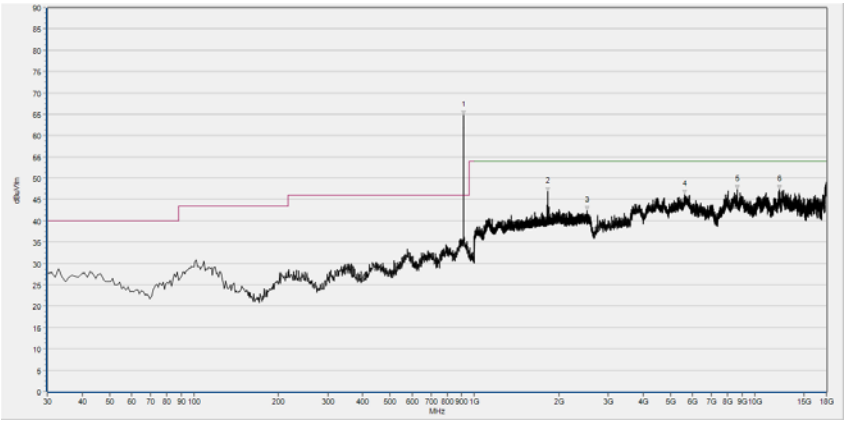
(Z axis, 30MHz to 10GHz)

Plot for Channel 65



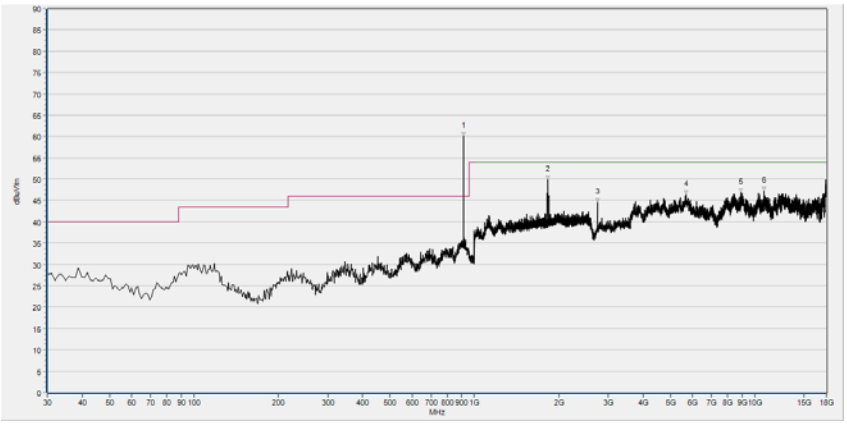
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
915.610	66.62	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1830.933	48.61	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3838.160	44.20	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5686.160	46.99	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8418.120	47.35	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12600.760	47.49	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(X axis, 30MHz to 10GHz)



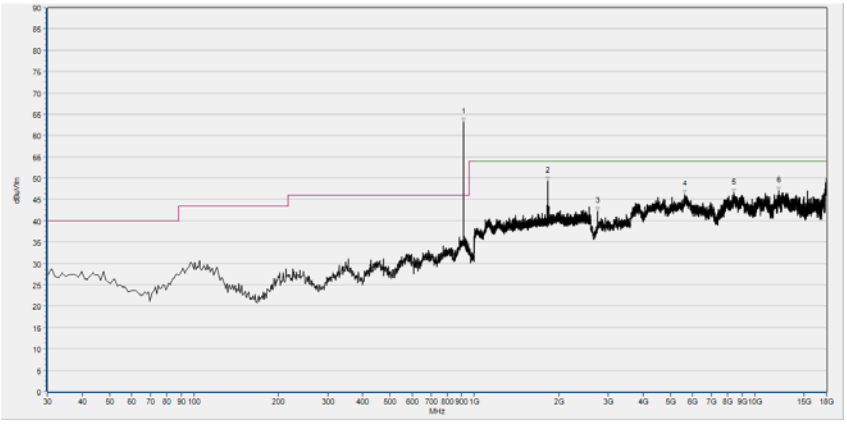
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
915.610	64.88	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1830.400	46.85	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2515.200	42.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5618.400	46.17	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8636.800	47.42	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12212.680	47.37	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(X axis, 30MHz to 10GHz)



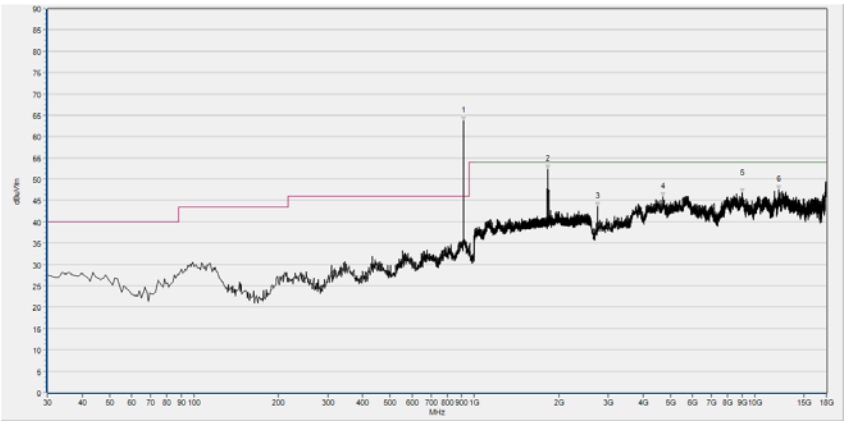
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
914.640	60.01	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1830.933	49.88	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2744.760	44.52	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5692.320	46.36	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8910.920	46.93	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
10805.120	47.27	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



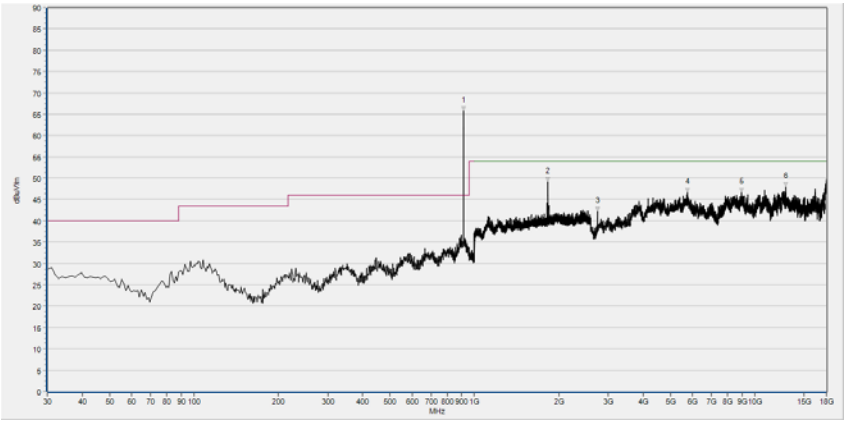
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
915.610	63.21	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1830.933	49.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2744.760	42.27	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5618.400	46.22	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8418.120	46.57	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12138.760	47.02	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
915.610	63.59	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1830.300	52.35	N/A	50.44	74.00	N/A	54.00	Horizontal	PASS
2744.760	43.54	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4709.800	45.87	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
9003.320	46.82	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12141.840	47.56	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

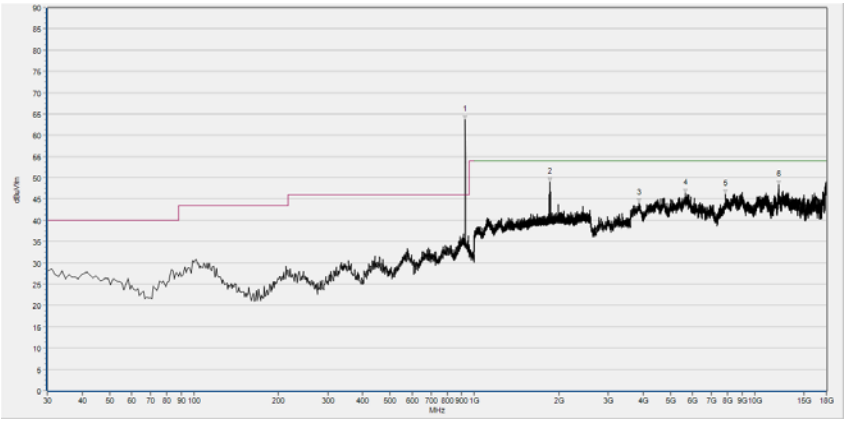
(Z axis, 30MHz to 10GHz)



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
915.610	65.75	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1830.933	49.20	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2744.760	42.28	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5753.920	46.79	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8984.840	46.73	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12887.200	48.03	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

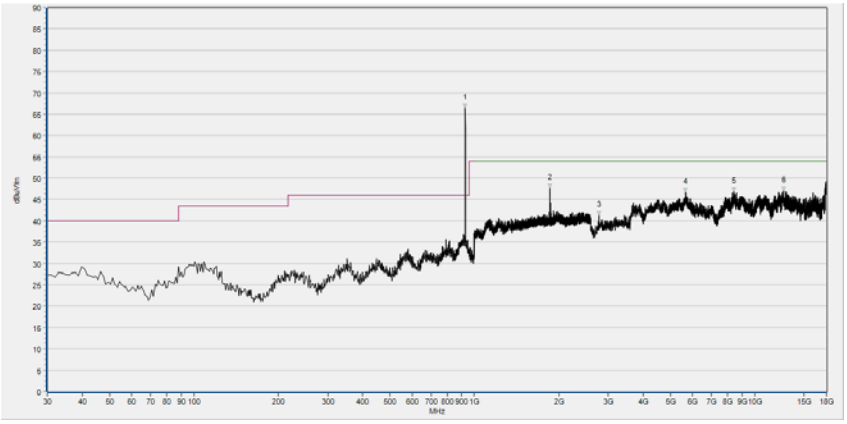
(Z axis, 30MHz to 10GHz)

Plot for Channel 128



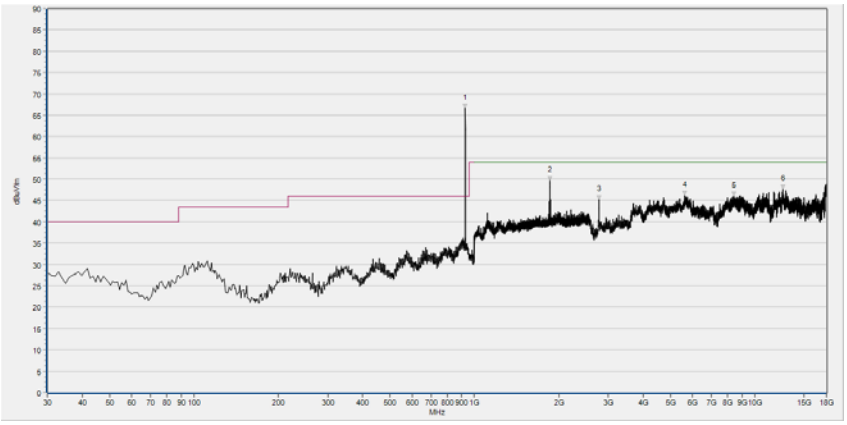
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	63.69	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1855.467	49.05	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3856.640	44.02	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5664.600	46.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7869.880	46.15	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12132.600	48.30	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(X axis, 30MHz to 10GHz)



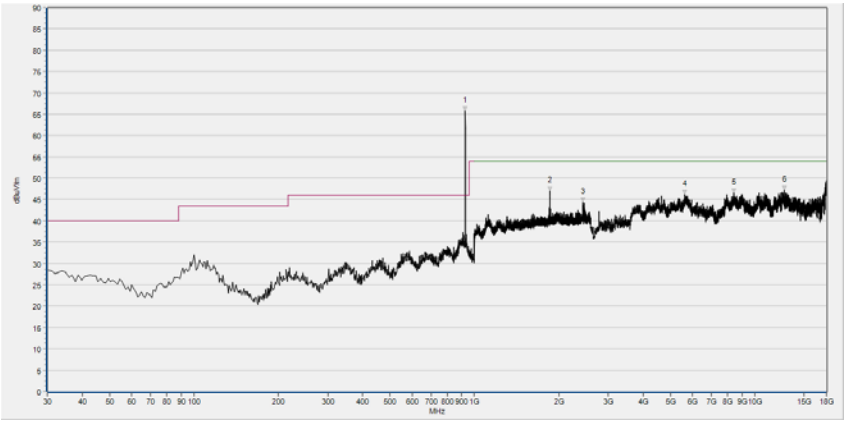
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	66.51	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1856.000	47.69	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2781.720	41.29	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5667.680	46.67	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8396.560	46.94	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12680.840	46.98	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(X axis, 30MHz to 10GHz)



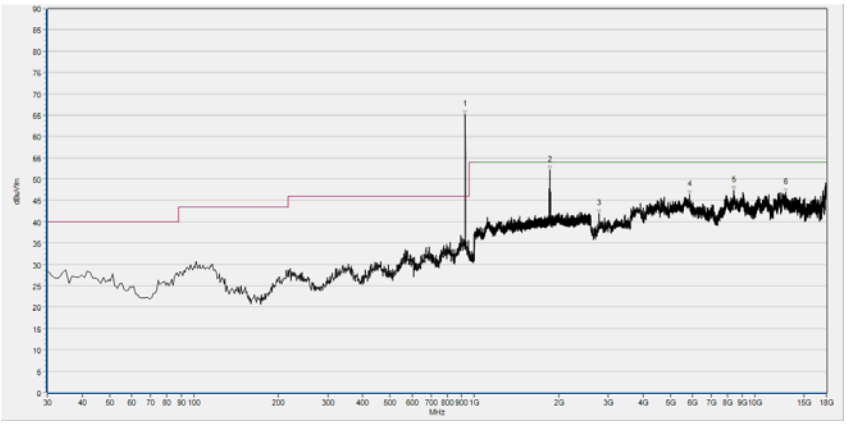
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	66.69	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1856.000	49.74	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2784.800	45.31	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5621.480	46.28	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8405.800	46.06	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12560.720	47.64	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Y axis, 30MHz to 10GHz)



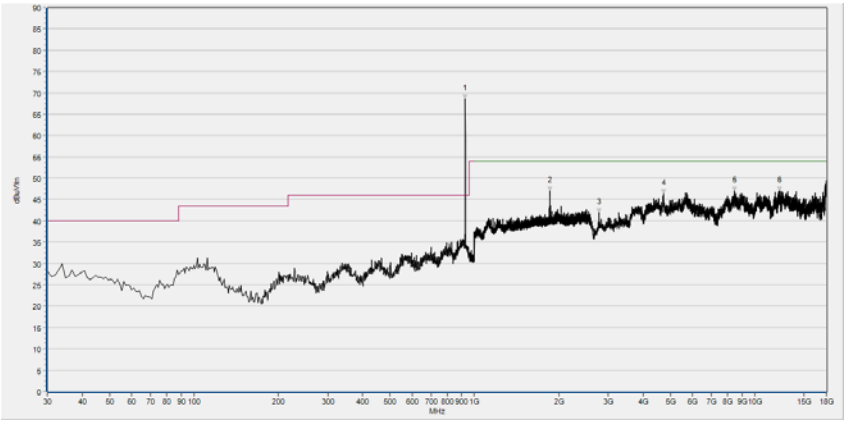
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
927.250	65.78	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1856.000	47.11	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2438.933	44.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5621.480	46.22	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8430.440	46.64	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12723.960	47.19	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
927.250	65.08	N/A	N/A	N/A	46.00	N/A	Horizontal	N/A
1855.500	52.18	N/A	50.66	74.00	N/A	54.00	Horizontal	PASS
2784.800	41.89	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5852.480	46.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8402.720	47.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12896.440	46.94	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	68.61	N/A	N/A	N/A	46.00	N/A	Vertical	N/A
1856.000	47.00	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2784.800	41.95	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4728.280	46.35	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8458.160	47.12	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12212.680	46.98	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 C63.10-2013and 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 Analzyer	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	2021.07.21	2022.07.20
Coaxial Cable(BNC) (30MHz-26GHz)	CB01	EMC01	Morlab	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

4.4 Radiated Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY54130016	N9038A	Agilent	2021.07.16	2022.07.15
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	2019.07.26	2022.07.25
Test Antenna – Horn	BBHA9170 #774	BBHA9170	Schwarzbeck	2019.07.26	2022.07.25
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	2021.07.16	2022.07.15
18-26.5GHz pre-Amplifier	46732	S10M100L3802	Tonscend	2021.07.16	2022.07.15
26-40GHz pre-Amplifier	56774	S40M400L4002	Tonscend	2021.07.16	2022.07.15
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	2021.07.16	2022.07.15
Anechoic Chamber	N/A	9m*6m*6m	CRT	2020.01.06	2023.01.05

END OF REPORT