

TEST REPORT

Product Name: LoRa Module
FCC ID: 2BB8U-WS8452
Trademark: Silent Smart
Model Number: WS8452
Prepared For: Chengdu Silent Smart Technology Co., Ltd.
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Sample Received Date: Dec. 11, 2023
Sample tested Date: Dec. 11, 2023 to Jan. 04, 2024
Issue Date: Jan. 04, 2024
Report No.: CTB231222008RF
Test Standards: FCC Part15.247
ANSI C63.10:2013
Test Results: PASS
Remark: This is LoRa radio test report.

Compiled by:

Reviewed by:

Approved by:

Zhou Kui

Arron Liu



Zhou Kui

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Bin Mei / Director

Note: If there is any objection to the inspection results in this report, please submit a written report to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client. "*" indicates the testing items were fulfilled by subcontracted lab. "#" indicates the items are not in CNAS accreditation scope.

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(Note: N/A means not applicable)



1. VERSION

Report No.	Issue Date	Description	Approved
CTB231222008RF	Jan. 04, 2024	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS
Band edge and RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a)	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(3)	ANSI C63.10-2013	PASS
Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(2)	ANSI C63.10-2013	PASS
Power Spectral Density	47 CFR Part 15 Subpart C Section 15.247 (e)	ANSI C63.10-2013/ KDB 558074 D01v05r02	PASS
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (b)	/	PASS

Remark:

Test according to ANSI C63.10-2013.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Item	Uncertainty
Occupancy bandwidth	54.3kHz
Conducted output power Above 1G	0.9dB
Conducted output power below 1G	0.9dB
Power Spectral Density , Conduction	0.9dB
Conduction spurious emissions	2.0dB
Out of band emission	2.0dB
3m chamber Radiated spurious emission(9K-30MHz)	4.8dB
3m chamber Radiated spurious emission(30MHz-1GHz)	4.6dB
3m chamber Radiated spurious emission(1GHz-18GHz)	5.1dB
3m chamber Radiated spurious emission(18GHz-40GHz)	3.4dB
humidity uncertainty	5.5%
Temperature uncertainty	0.63℃
frequency	1×10 ⁻⁷
Conducted Emission (150KHz-30MHz)	3.2 dB
Radiated Emission(30MHz ~ 1000MHz)	4.8 dB
Radiated Emission(1GHz ~6GHz)	4.9 dB

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	WS8452
Model Description:	N/A
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	903-927MHz
Max. RF output power:	13.761dBm
Type of Modulation:	LoRa
Antenna installation:	Stick antenna
Antenna Gain:	0.17dBi
Ratings:	DC 5V by notebook

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/TypeNo.	SeriesNo.	Note
1.	Laptop	DELL	Vostro 5490	N/A	N/A

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Channel List

CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)
53	903	54	904	55	905	56	906
57	907	58	908	59	909	60	910
61	911	62	912	63	913	64	914
65	915	66	916	67	917	68	918
69	919	70	920	71	921	72	922
73	923	74	924	75	925	76	926
77	927	/	/	/	/	/	/

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting (LoRa)	903MHz	915MHz	927MHz
Receiving (LoRa)	903MHz	915MHz	927MHz

4.6 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(DC):	5V
Normal Temperature(°C)	23
Low Temperature(°C)	0
High Temperature(°C)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

Item	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	2024.07.05
2	Power Sensor	Agilent	U2021XA	MY56120032	2024.07.05
3	Power Sensor	Agilent	U2021XA	MY56120034	2024.07.05
4	Communication test set	R&S	CMW500	108058	2024.07.05
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	2024.07.05
6	Signal Generator	Agilent	N5181A	MY50140365	2024.07.05
7	Vector signal generator	Agilent	N5182A	MY47420195	2024.07.05
8	Communication test set	Agilent	E5515C	MY50102567	2024.07.06
9	2.4 GHz Filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	2024.07.05
10	5 GHz Filter	Shenxiang	MSF5150-5850 MS-1155	20181015001	2024.07.06
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	2024.07.06
12	BT&WI-FI Automatic test software	Microwave	MTS8000	Ver. 2.0.0.0	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	2024.10.30
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	2024.07.05
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/
16	966 chamber	C.R.T.	966	/	2024.08.11
17	Receiver	R&S	ESPI	100362	2024.07.05
18	Amplifier	HP	8447E	2945A02747	2024.07.05
19	Amplifier	Agilent	8449B	3008A01838	2024.07.05
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	2024.07.08

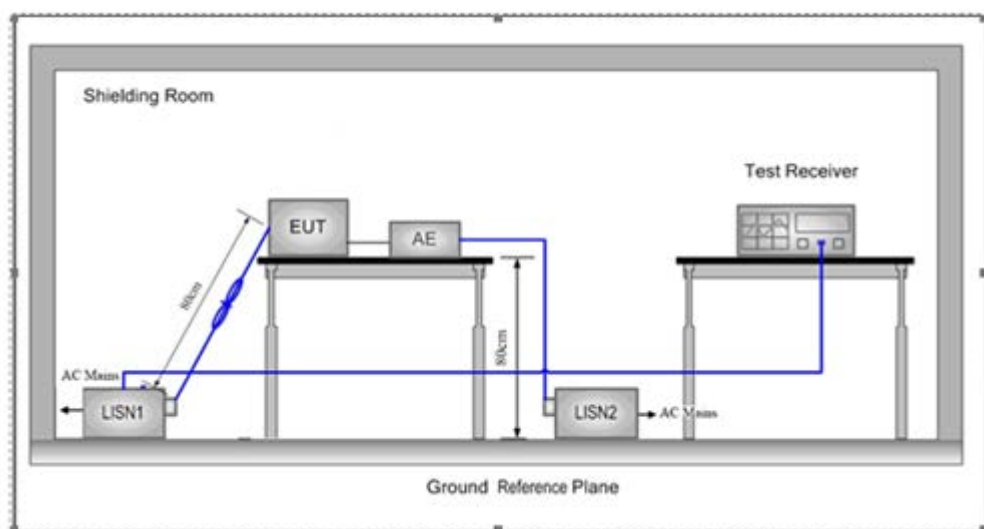
21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	2024.07.08
22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	2024.07.08
24	loop antenna	ZHINAN	ZN30900A	GTS534	/
25	40G Horn antenna	A/H/System	SAS-574	588	2024.10.30
26	Amplifier	AEROFLEX	Aeroflex	097	2024.07.05

Continuous disturbance					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	LISN	ROHDE&SCHWARZ	ESH3-Z5	100318	2024.07.05
2	Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	2024.07.05
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428/003	2024.07.05
4	Coaxial cable	ZDECL	Z302S-NJ-SMA J-12M	18091905	2024.07.05
5	ISN	Schwarzbeck	NTFM8158	183	2024.07.05
6	Communication test set	Agilent	E5515C	MY50102567	2024.07.05
7	Communication test set	R&S	CMW500	108058	2024.07.05
8	EZ-EMC	Frad	EMC-con3A1.1	/	/

Radiated emission					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	2024.07.08
2	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	2024.07.08
3	Amplifier	Agilent	8449B	3008A01838	2024.07.05
4	Amplifier	HP	8447E	2945A02747	2024.07.05
5	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428/003	2024.07.05
6	Coaxial cable	ETS	RFC-SNS-100-NMS-80 NI	/	2024.07.05
7	Coaxial cable	ETS	RFC-SNS-100-NMS-20 NI	/	2024.07.05
8	Coaxial cable	ETS	RFC-SNS-100-SMS-20 NI	/	2024.07.05
9	Coaxial cable	ETS	RFC-NNS-100-NMS-300 NI	/	2024.07.05
10	Communication test set	Agilent	E5515C	MY50102567	2024.07.05
11	Communication test set	R&S	CMW500	108058	2024.07.05
12	EZ-EMC	Frad	EMC-con3A1.1	/	/

6. AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

Table 4 – AC power-line conducted emissions limits

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 ^{Note 1}	56 to 46 ^{Note 1}
0.5 - 5	56	46
5 - 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

* Decreasing linearly with the logarithm of the frequency

6.3 Test procedure

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50 Ω /50 μ H + 5 Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under

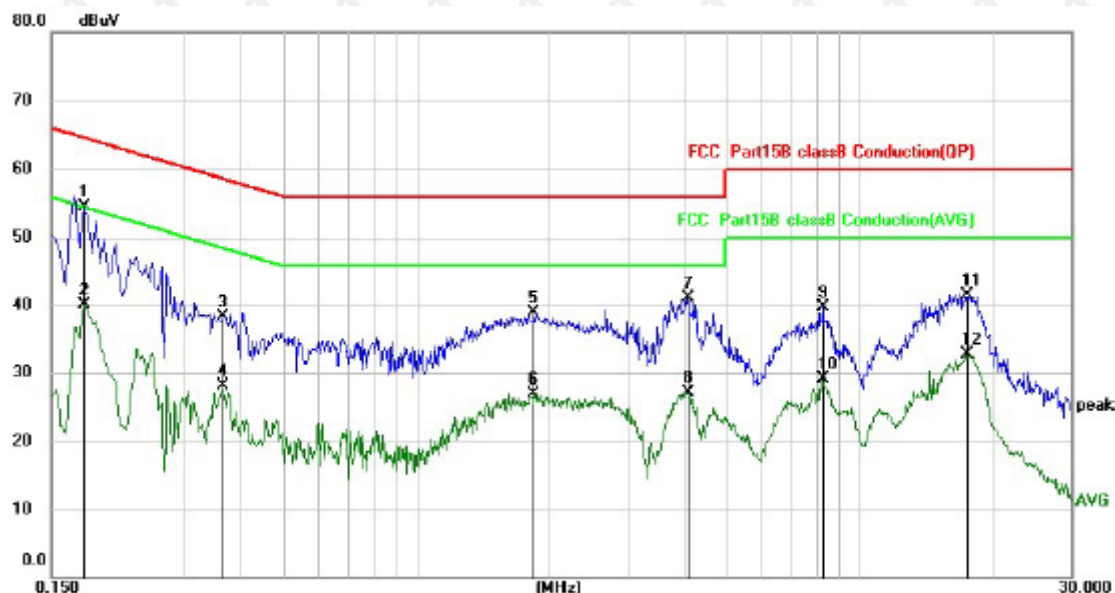
test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.
- 6) All modes were tested at AC 120V and 240V, only the worst result of AC 120V 60Hz was reported.
- 7) If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.

6.4 Test Result

Worst case- LoRa (low channel)

L:



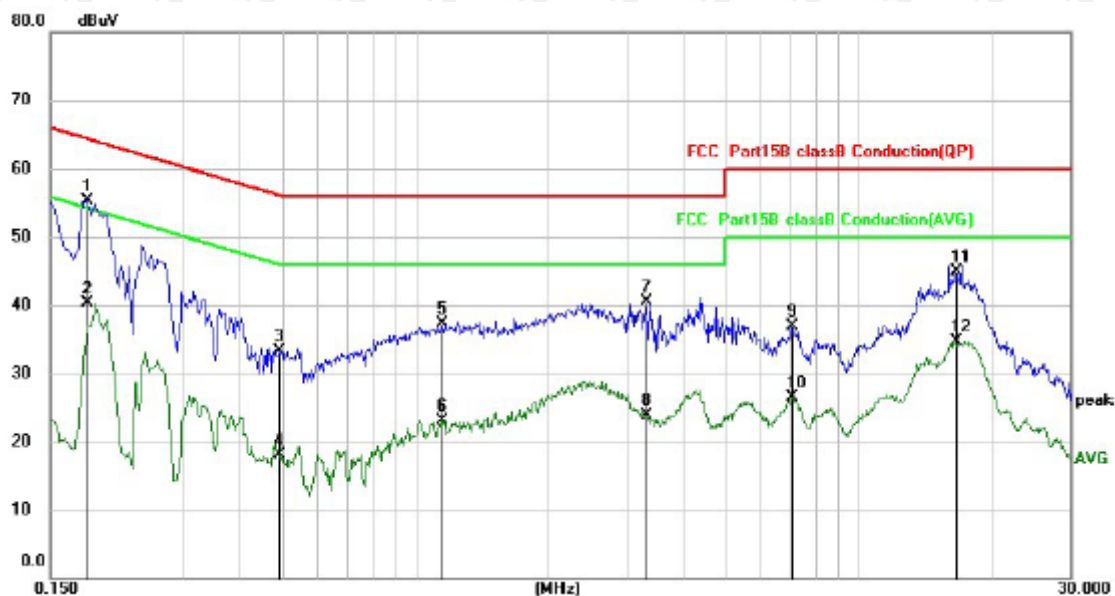
No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV	Limit dBμV	Over dB	Detector
1	*	0.1780	44.63	9.95	54.58	64.58	-10.00	QP
2		0.1780	30.24	9.95	40.19	54.58	-14.39	AVG
3		0.3660	28.40	9.97	38.37	58.59	-20.22	QP
4		0.3660	18.10	9.97	28.07	48.59	-20.52	AVG
5		1.8340	28.89	10.08	38.97	56.00	-17.03	QP
6		1.8340	16.92	10.08	27.00	46.00	-19.00	AVG
7		4.0820	30.74	10.29	41.03	56.00	-14.97	QP
8		4.0820	16.90	10.29	27.19	46.00	-18.81	AVG
9		8.2020	29.26	10.54	39.80	60.00	-20.20	QP
10		8.2020	18.48	10.54	29.02	50.00	-20.98	AVG
11		17.4580	30.79	10.77	41.56	60.00	-18.44	QP
12		17.4580	21.88	10.77	32.65	50.00	-17.35	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

Worst case- LoRa (low channel)

N:



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1	*	0.1819	45.45	9.95	55.40	64.40	-9.00	QP
2		0.1819	30.31	9.95	40.26	54.40	-14.14	AVG
3		0.4900	23.24	9.99	33.23	56.17	-22.94	QP
4		0.4900	8.13	9.99	18.12	46.17	-28.05	AVG
5		1.1500	27.20	10.02	37.22	56.00	-18.78	QP
6		1.1500	13.00	10.02	23.02	46.00	-22.98	AVG
7		3.3180	30.37	10.22	40.59	56.00	-15.41	QP
8		3.3180	13.75	10.22	23.97	46.00	-22.03	AVG
9		7.0580	26.45	10.52	36.97	60.00	-23.03	QP
10		7.0580	16.04	10.52	26.56	50.00	-23.44	AVG
11		16.5380	34.11	10.76	44.87	60.00	-15.13	QP
12		16.5380	24.03	10.76	34.79	50.00	-15.21	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

7. RADIATED SPURIOUS EMISSION

7.1 Block Diagram Of Test Setup

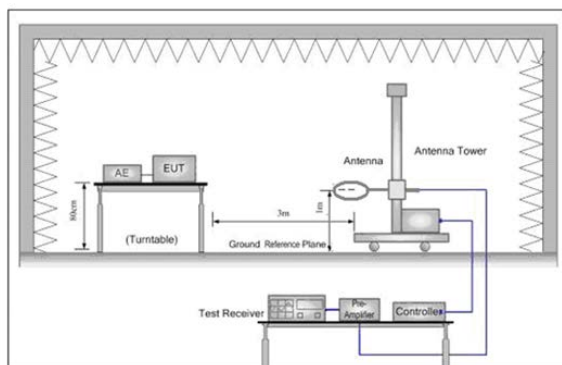


Figure 1. Below 30MHz

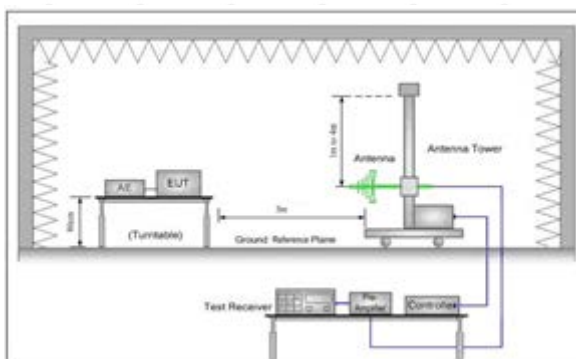
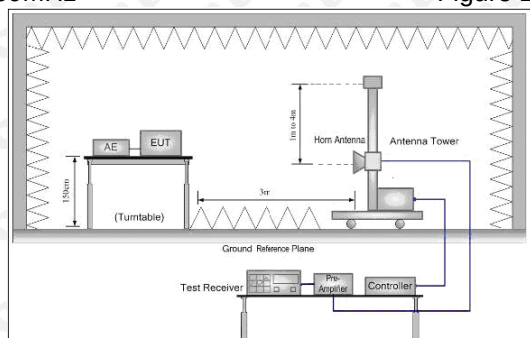


Figure 2. 30MHz to 1GHz



7.2 Limit

Spurious Emissions:

Frequency	Field strength (microvolt/meter)	Limit (dB μ V/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F (kHz)	-	-	300
0.490MHz-1.705MHz	24000/F (kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

7.3 Test procedure

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

- Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
- Test the EUT in the lowest channel ,the middle channel ,the Highest channel
- Repeat above procedures until all frequencies measured was complete.
- Full battery is used during test

Receiver set:

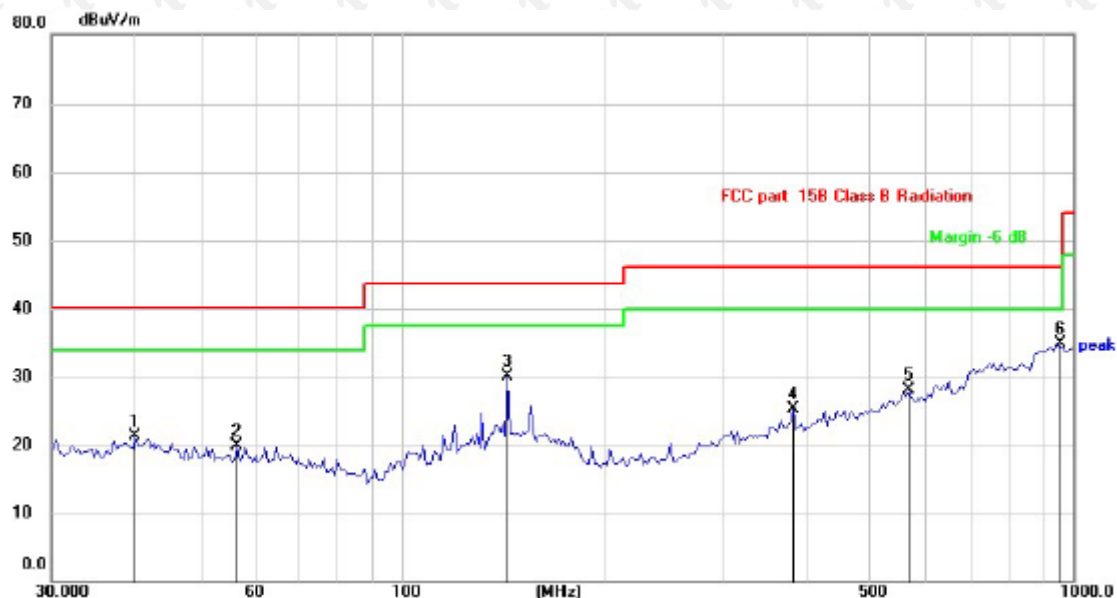
Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30KHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	120 kHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

7.4 Test Result

Worst case- LoRa (low channel)

Below 1GHz Test Results:

Antenna polarity: H

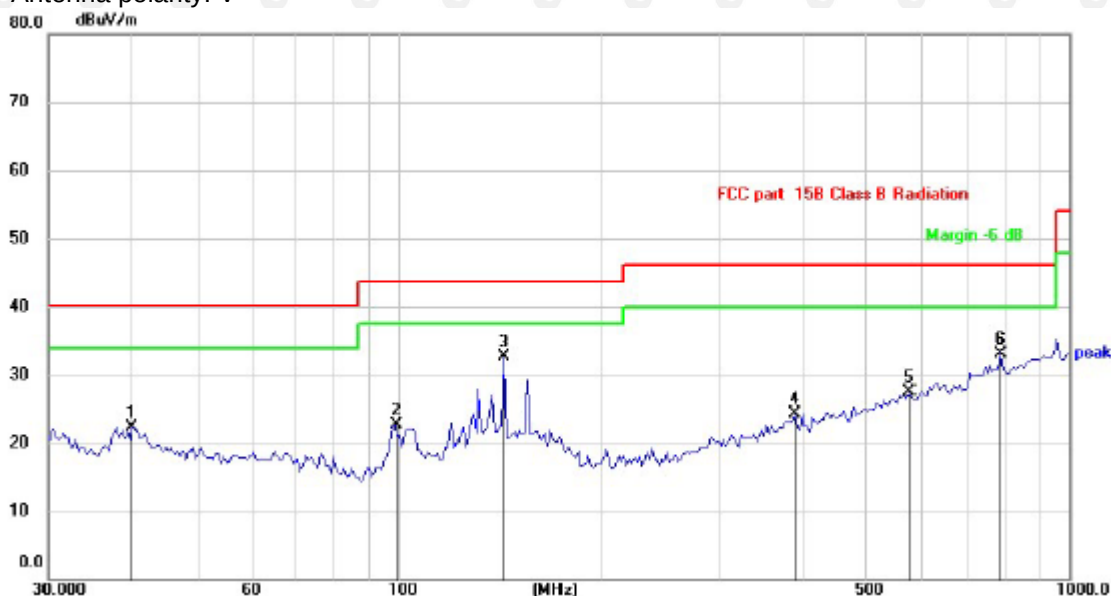


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		40.0644	26.11	-4.78	21.33	40.00	-18.67	QP
2		56.8914	26.65	-6.70	19.95	40.00	-20.05	QP
3		144.0819	34.05	-3.89	30.16	43.50	-13.34	QP
4		384.6055	27.84	-2.55	25.29	46.00	-20.71	QP
5		570.6100	26.22	1.87	28.09	46.00	-17.91	QP
6	*	948.7610	27.57	7.36	34.93	46.00	-11.07	QP

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Worst case- LoRa (low channel)

Antenna polarity: V



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		40.0644	27.08	-4.78	22.30	40.00	-17.70	QP
2		98.8326	31.64	-9.03	22.61	43.50	-20.89	QP
3	*	144.0819	36.61	-3.89	32.72	43.50	-10.78	QP
4		391.4082	26.64	-2.37	24.27	46.00	-21.73	QP
5		580.7026	25.33	2.13	27.46	46.00	-18.54	QP
6		789.2338	26.84	6.22	33.06	46.00	-12.94	QP

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Above 1 GHz Test Results:
CH Low

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1806	108.42	-5.84	52.69	74	-21.31	peak
1806	95.47	-5.84	43.65	54	-10.35	AVG
2709	56.38	-3.64	52.74	74	-21.26	peak
2709	47.11	-3.64	43.47	54	-10.53	AVG
3612	58.18	-0.95	57.23	74	-16.77	peak
3612	48.18	-0.95	47.23	54	-6.77	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1806	108.33	-5.84	52.69	74	-21.31	peak
1806	95.47	-5.84	43.65	54	-10.35	AVG
2709	56.36	-3.64	52.72	74	-21.28	peak
2709	47.13	-3.64	43.49	54	-10.51	AVG
3612	58.25	-0.95	57.30	74	-16.70	peak
3612	48.14	-0.95	47.19	54	-6.81	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH Middle

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1830	108.33	-5.71	52.67	74	-21.33	peak
1830	95.15	-5.71	45.61	54	-8.39	AVG
2745	56.05	-3.51	52.54	74	-21.46	peak
2745	46.82	-3.51	43.31	54	-10.69	AVG
3660	58.14	-0.82	57.32	74	-16.68	peak
3660	47.92	-0.82	47.10	54	-6.90	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1830	108.27	-5.71	52.67	74	-21.33	peak
1830	95.06	-5.71	45.61	54	-8.39	AVG
2745	56.11	-3.51	52.60	74	-21.40	peak
2745	46.88	-3.51	43.37	54	-10.63	AVG
3660	57.97	-0.82	57.15	74	-16.85	peak
3660	48.01	-0.82	47.19	54	-6.81	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH High

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1854	56.45	-5.65	52.36	74	-21.64	peak
1854	47.21	-5.65	46.89	54	-7.11	AVG
2781	56.26	-3.43	52.83	74	-21.17	peak
2781	47.48	-3.43	44.05	54	-9.95	AVG
3708	57.33	-0.75	56.58	74	-17.42	peak
3708	47.64	-0.75	46.89	54	-7.11	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1854	56.30	-5.65	52.36	74	-21.64	peak
1854	47.23	-5.65	46.89	54	-7.11	AVG
2781	56.13	-3.43	52.70	74	-21.30	peak
2781	47.46	-3.43	44.03	54	-9.97	AVG
3708	57.37	-0.75	56.62	74	-17.38	peak
3708	47.62	-0.75	46.87	54	-7.13	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

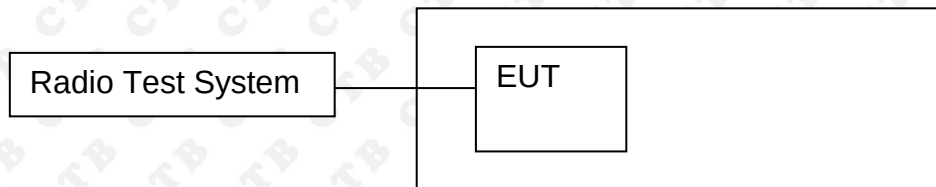
Remark:

- (1) Measuring frequencies from 1 GHz to the 25 GHz .
- (2) All modes of operation were investigated and the worst-case emissions are reported.
- (3) Radiated emission test from 9kHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9kHz to 30MHz and not recorded in this report.

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8. BAND EDGE AND RF CONDUCTED SPURIOUS EMISSIONS

8.1 Block Diagram Of Test Setup



8.2 Limit

In any 100 kHz 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 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

8.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:

Below 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

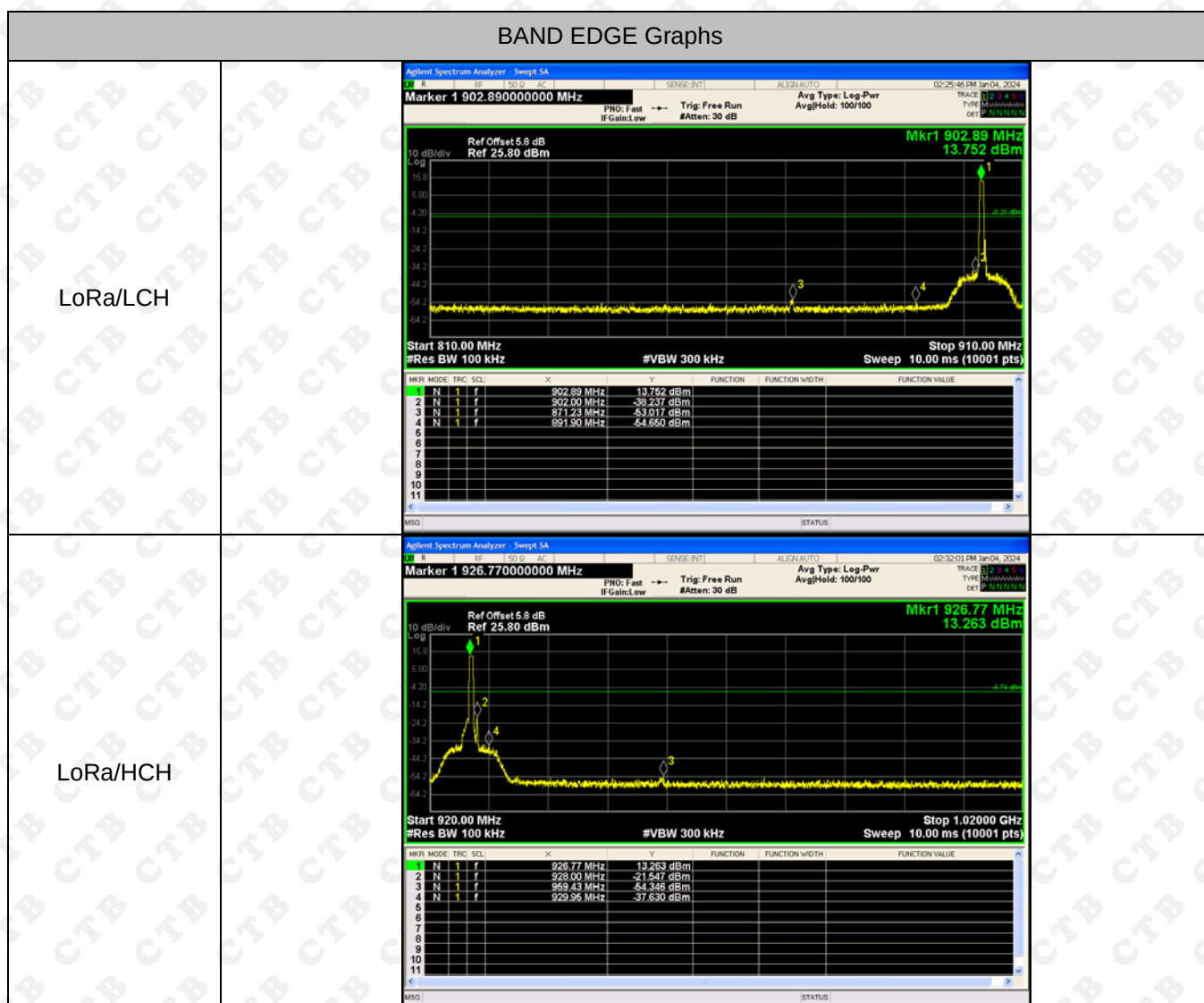
Detector function = peak, Trace = max hold

Above 30MHz:

RBW = 100KHz, VBW = 300KHz, Sweep = auto

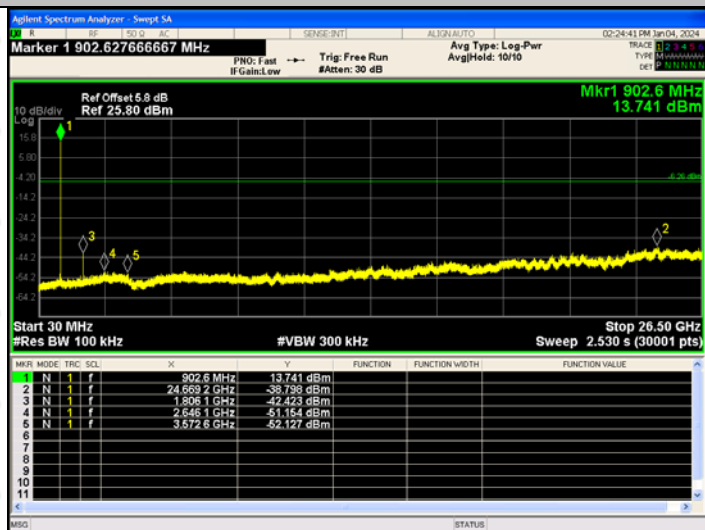
Detector function = peak, Trace = max hold

8.4 Test Result

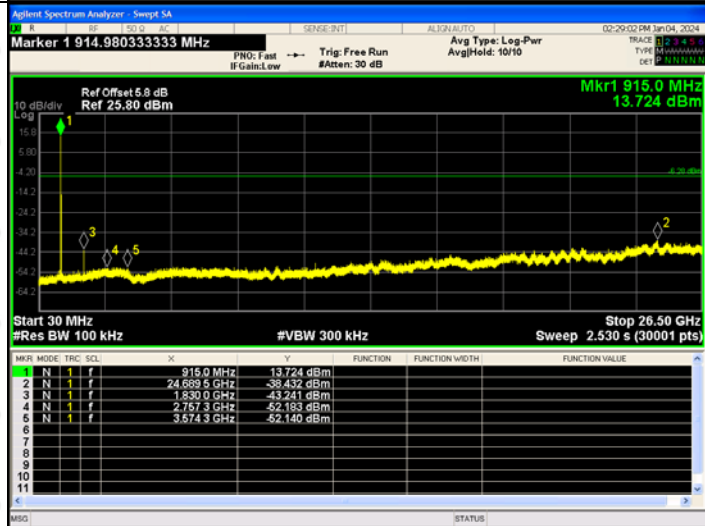


RF Conducted Spurious Emissions Graphs

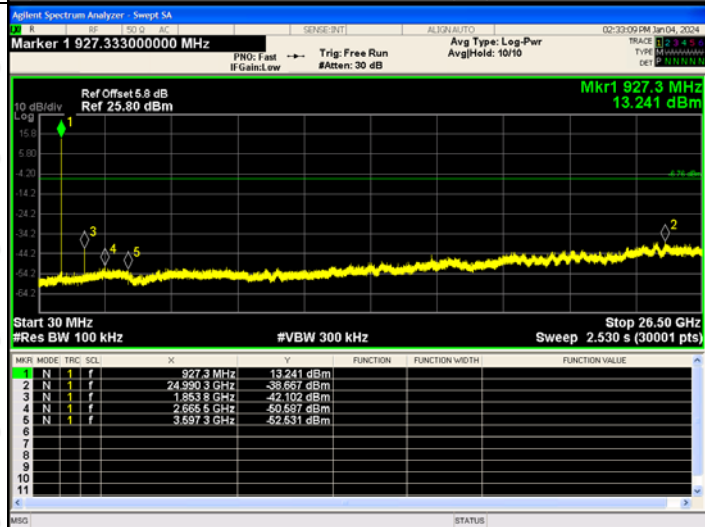
LoRa/LCH



LoRa/MCH

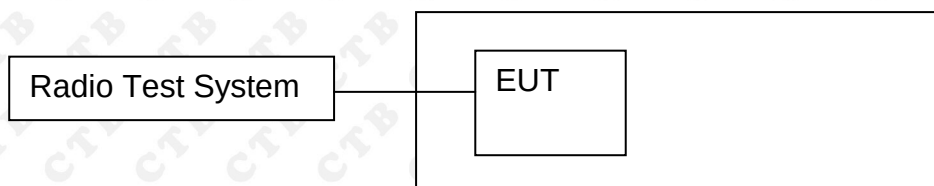


LoRa/HCH



9. COUDUCTED OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	902-928	PASS

9.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2MHz. VBW = 6MHz. Channel power measurement. Sweep = auto; Detector Function = peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

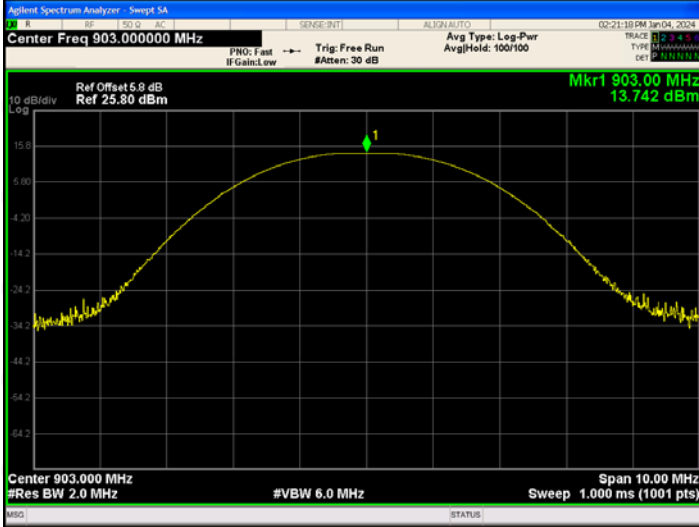
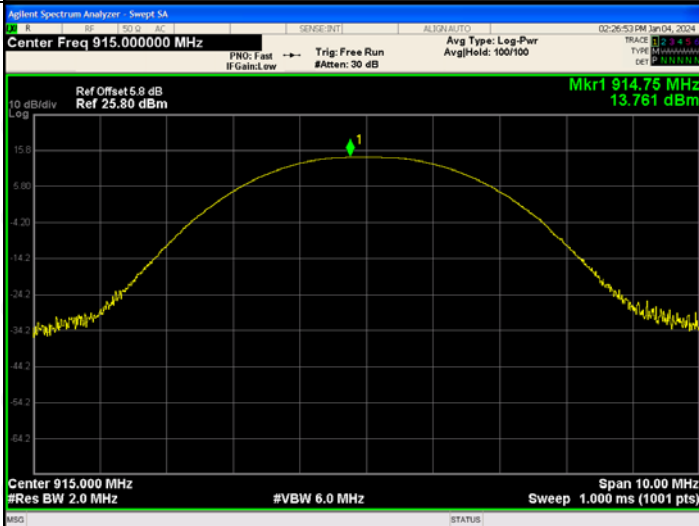
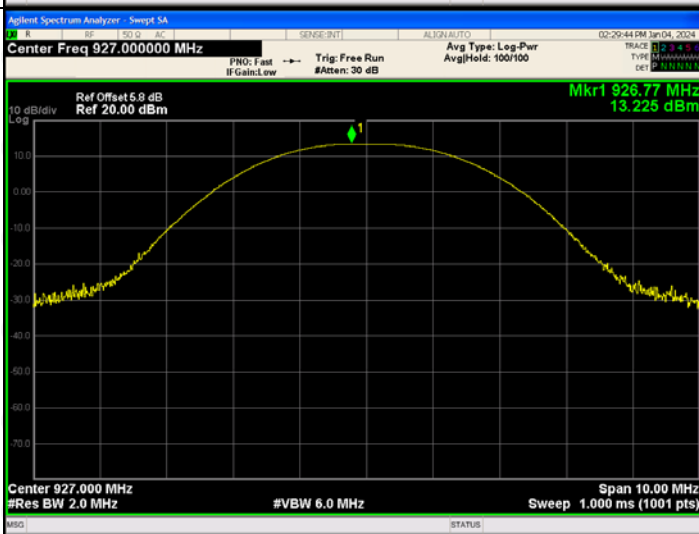
9.4 Test Result

Mode	Channel.	Maximum Output Power [dBm]	Limit[dBm]	Verdict
LoRa	LCH	13.742	30	PASS
	MCH	13.761	30	PASS
	HCH	13.225	30	PASS

Duty Cycle

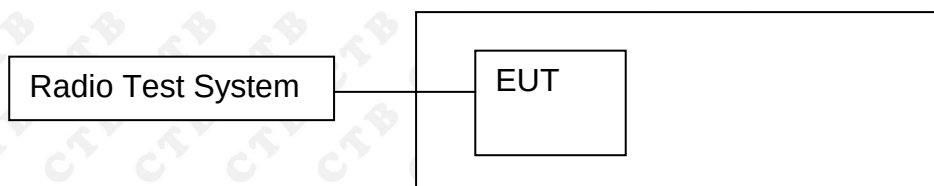
Mode	Channel.	Duty Cycle(%)	Correction Factor (dB)
LoRa	LCH	100	0
	MCH	100	0
	HCH	100	0

Test Graph:

LoRa Low channel	 Agilent Spectrum Analyzer - Sweep SA Center Freq 903.000000 MHz Span 10.00 MHz #Res BW 2.0 MHz #VBW 6.0 MHz Sweep 1.000 ms (1001 pts) Mkr1 903.00 MHz 13.742 dBm
LoRa Mid channel	 Agilent Spectrum Analyzer - Sweep SA Center Freq 915.000000 MHz Span 10.00 MHz #Res BW 2.0 MHz #VBW 6.0 MHz Sweep 1.000 ms (1001 pts) Mkr1 914.75 MHz 13.761 dBm
LoRa High channel	 Agilent Spectrum Analyzer - Sweep SA Center Freq 927.000000 MHz Span 10.00 MHz #Res BW 2.0 MHz #VBW 6.0 MHz Sweep 1.000 ms (1001 pts) Mkr1 926.77 MHz 13.225 dBm

10. 6DB OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	902-928	PASS

10.3 Test procedure

1. Rem1. Set RBW = 100kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

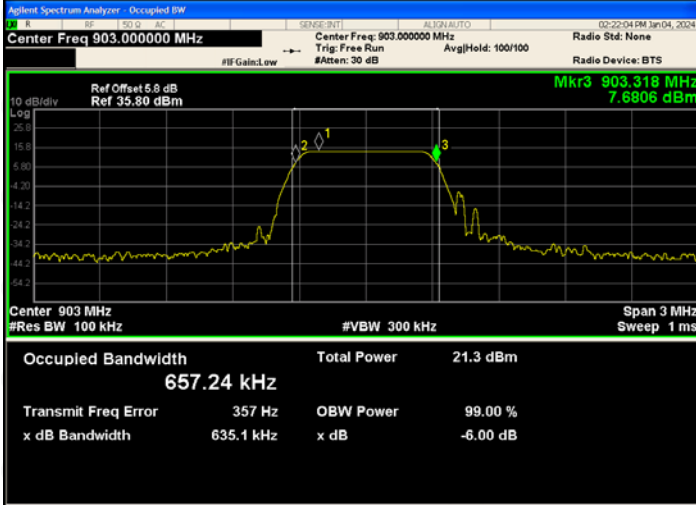
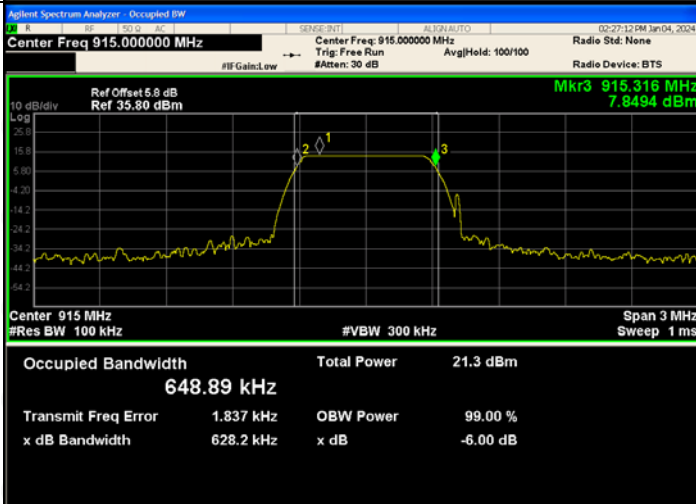
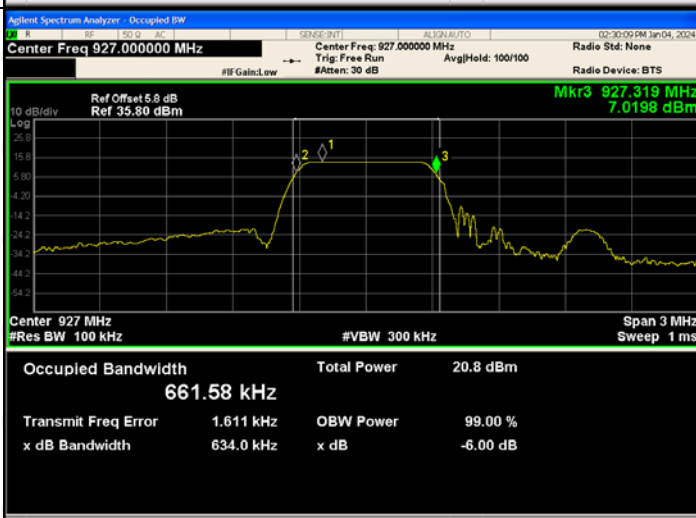
10.4 Test Result

903-927MHz:

Test Mode	Frequency	6dB Bandwidth (MHz)	Result
LoRa	Low channel	0.635	PASS
	Mid channel	0.628	PASS
	High channel	0.634	PASS

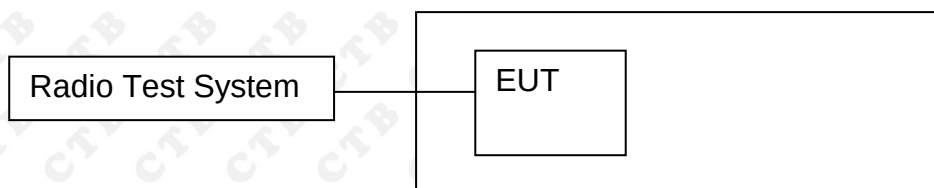
Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

LoRa Low channel	
LoRa Mid channel	
LoRa High channel	

11. POWER SPECTRAL DENSITY

11.1 Block Diagram Of Test Setup



11.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8 dBm (in any 3KHz)	902-928	PASS

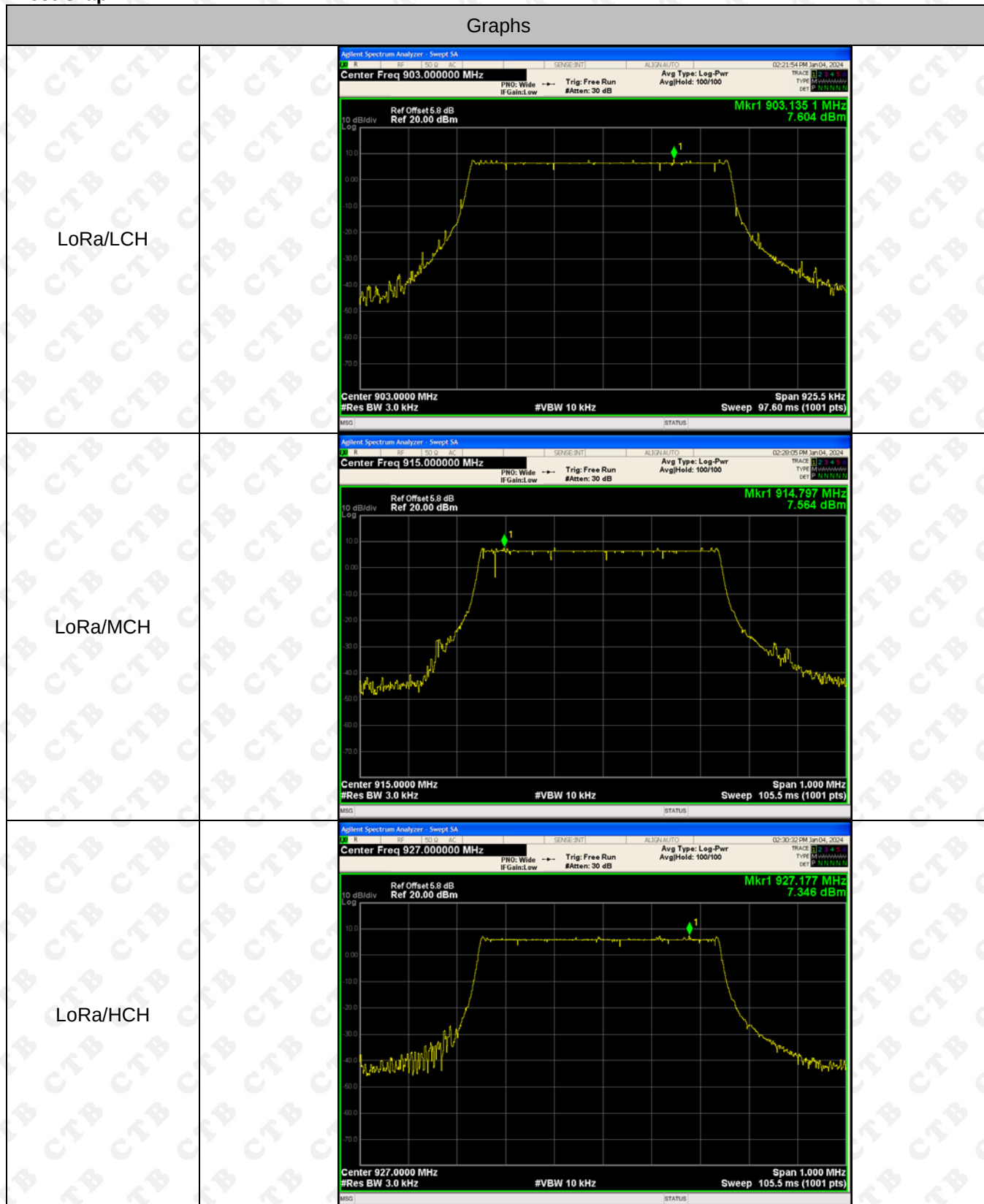
11.3 Test procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

11.4 Test Result

Mode	Channel.	Power Spectral Density (dBm/3KHz)	Limit(dBm/3KHz)	Verdict
LoRa	LCH	7.604	8	PASS
LoRa	MCH	7.564	8	PASS
LoRa	HCH	7.346	8	PASS

Test Graph



12. ANTENNA REQUIREMENT

15.203 requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

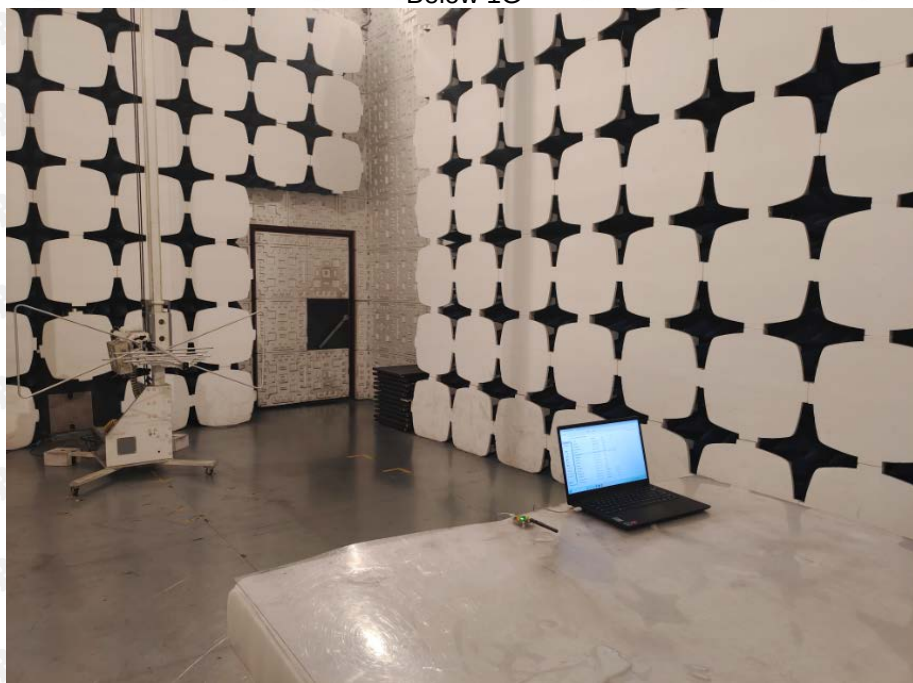
EUT Antenna:

The EUT antenna is External antenna. The best case gain of the antenna is 0.17dBi.

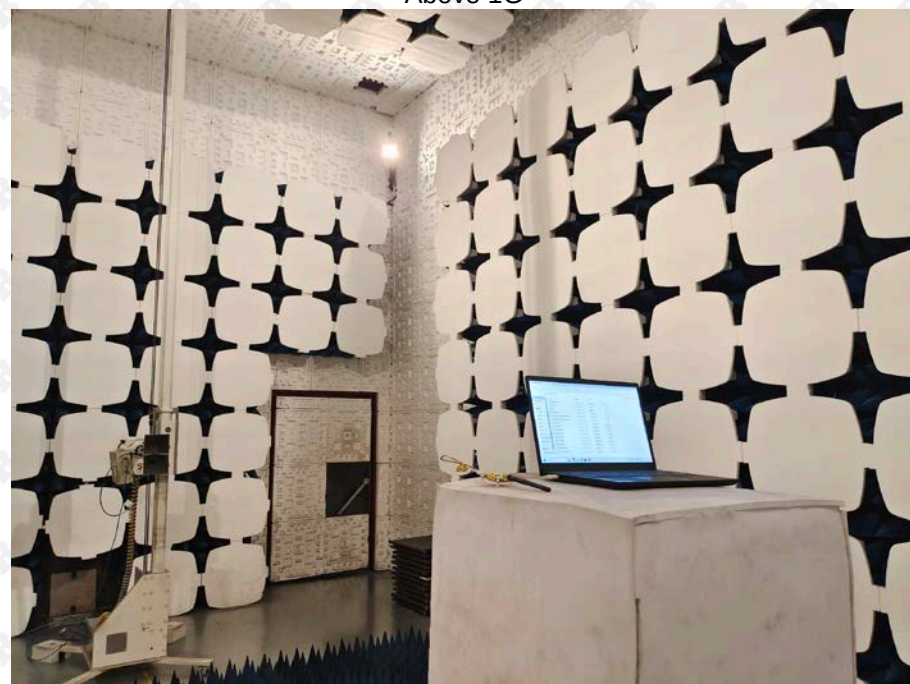
13. EUT TEST SETUP PHOTOGRAPHS

Radiated Emissions

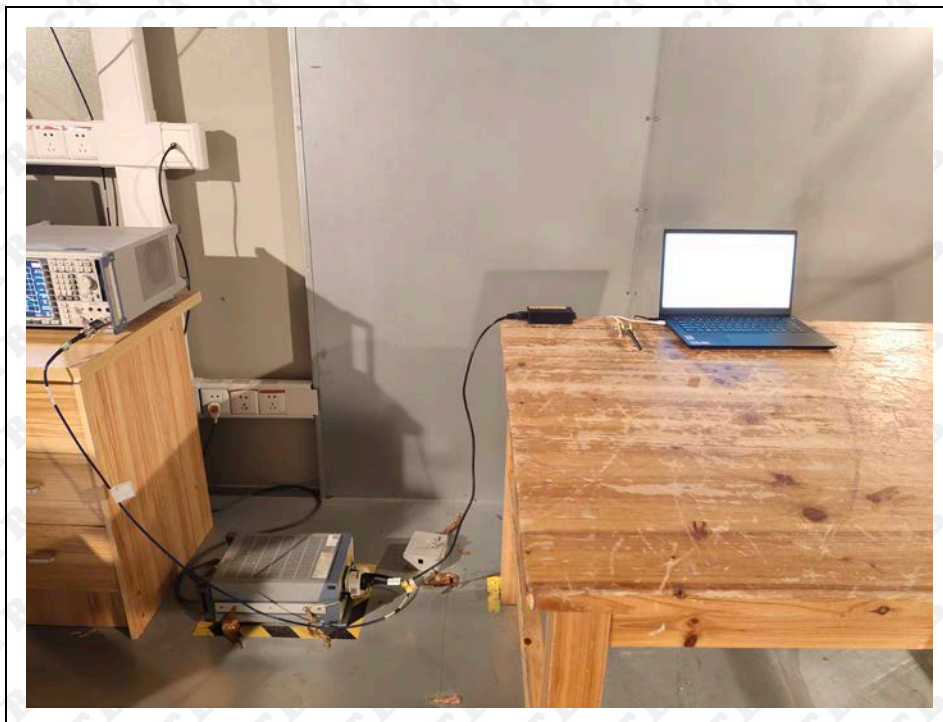
Below 1G



Above 1G



Conducted emissions



***** END OF REPORT *****