



TEST REPORT

FCC ID:ZHZLHT52

Report Number.....: ZKT-2203011243E-1

Date of Test.....: Mar. 01, 2022 to Apr. 27, 2022

Date of issue.....: Apr. 27, 2022

Total number of pages.....: 33

Test Result.....: PASS

Testing Laboratory.....: **Shenzhen ZKT Technology Co., Ltd.**

Address.....: 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

Applicant's name.....: **Dragino Technology Co., Limited**

Address.....: Room 202, Block B, BCT Incubation Bases, No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China

Manufacturer's name.....: **Dragino Technology Co., Limited.**

Address.....: Room 202, Block B, BCT Incubation Bases, No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China

Test specification:

Standard.....: FCC CFR Title 47 Part 15 Subpart C Section 15.247

Test procedure.....: /

Non-standard test method.....: N/A

Test Report Form No......: TRF-EL-110_V0

Test Report Form(s) Originator....: ZKT Testing

Master TRF.....: Dated: 2020-01-06

This device described above has been tested by ZKT, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of ZKT, this document may be altered or revised by ZKT, personal only, and shall be noted in the revision of the document.

Product name.....: **LoRaWAN Temperature & Humidity Sensor**

Trademark.....: DRAGINO

Model/Type reference.....: LHT52

Ratings.....: Input: DC 3 by Battery



Testing procedure and testing location:

Testing Laboratory.....: Shenzhen ZKT Technology Co., Ltd.

Address: 1/F, No. 101, Building B, No. 6, Tangwei Community
Industrial Avenue, Fuhai Street, Bao'an District,
Shenzhen, China

Tested by (name + signature): Jim Liu

Jim Liu

Reviewer (name + signature): Tom Zou

Tom Zou

Approved (name + signature).....: Lake Xie





TABLE OF CONTENTS

Page

1.VERSION	4
2. TEST SUMMARY	5
2.1 TEST FACILITY	6
2.2 MEASUREMENT UNCERTAINTY	6
3. GENERAL INFORMATION	7
3.1 GENERAL DESCRIPTION OF EUT	7
3.2 TEST MODE	9
3.3 TEST SETUP CONFIGURATION	9
3.4 SUPPORT EQUIPMENT	9
3.5 TEST INSTRUMENTS LIST	10
4 TEST ITEMS FOR DTS	11
4.1 CONDUCTED PEAK OUTPUT POWER	11
4.2 CHANNEL BANDWIDTH	13
4.3 POWER SPECTRAL DENSITY	15
4.4 BAND EDGES	17
5. ANTENNA REQUIREMENT	28
6. TEST SETUP PHOTO	29
7. EUT CONSTRUCTIONAL DETAILS	29



1.Version

Report No.	Version	Description	Approved
ZKT-2203011243E	Rev.01	Initial issue of report	Apr. 27, 2022



2. Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	N/A
Conducted Peak Output Power	15.247 (b)(1)	Pass
-6dB Occupied Bandwidth	15.247 (a)(1)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass
Power Spectral Density	15.247 (e)	Pass

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report



2.1 TEST FACILITY

Shenzhen ZKT Technology Co., Ltd.

Add. : 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street,
Bao'an District, Shenzhen, China

FCC Test Firm Registration Number: 692225

Designation Number: CN1299

IC Registered No.: 27033

2.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	3m chamber Radiated spurious emission(9KHz-30MHz)	U=4.5dB
2	3m chamber Radiated spurious emission(30MHz-1GHz)	U=4.8dB
3	3m chamber Radiated spurious emission(1GHz-6GHz)	U=4.9dB
4	3m chamber Radiated spurious emission(6GHz-40GHz)	U=5.0dB
5	Conducted disturbance	U=3.2dB
6	RF Band Edge	U=1.68dB
7	RF power conducted	U=1.86dB
8	RF conducted Spurious Emission	U=2.2dB
9	RF Occupied Bandwidth	U=1.8dB
10	RF Power Spectral Density	U=1.75dB
11	humidity uncertainty	U=5.3%
12	Temperature uncertainty	U=0.59℃



3. General Information

3.1 General Description of EUT

Product Name:	LoRaWAN Temperature & Humidity Sensor
Model No.:	LHT52
Test sample(s) ID:	ZKT-2203011243-1
Sample(s) Status:	Engineer sample
Serial No.:	N/A
Hardware Version:	N/A
Software Version:	N/A
Operation Frequency:	903MHz~914.2MHz
Channel numbers:	8
Channel separation:	600KHz
Modulation type:	Lora
Antenna Type:	Internal antenna
Antenna gain:	2dBi
Power supply:	DC 3V by Battery



600KHz for DTS:

Operation Frequency each of channel					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903.00	4	907.80	7	912.60
2	904.60	5	909.40	8	914.20
3	906.20	6	911.00		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency(600KHz)
The lowest channel	903.00MHz
The middle channel	909.40MHz
The Highest channel	914.20MHz



3.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
<i>Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.</i>	

3.3 Test Setup Configuration

Conducted Emission

EUT

Radiated Emission

EUT

Conducted Spurious

EUT

3.4 Support Equipment

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

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	LoRaWAN Temperature & Humidity Sensor	DRAGINO	LHT52	N/A	EUT
A-1					

Item	Shielded Type	Ferrite Core	Length	Note

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.



3.5 Test Instruments list

Radiation Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer (9kHz-26.5GHz)	KEYSIGHT	9020A	MY45109572	Sep. 22, 2021	Sep. 21, 2022
2	Spectrum Analyzer (1GHz-40GHz)	Agilent	E4446A	100363	Sep. 22, 2021	Sep. 21, 2022
3	Test Receiver (9kHz-7GHz)	R&S	ESCI7	101169	Sep. 22, 2021	Sep. 21, 2022
4	Bilog Antenna (30MHz-1400MHz)	Schwarzbeck	VULB9168	00877	Sep. 22, 2021	Sep. 21, 2022
5	Horn Antenna (1GHz-18GHz)	SCHWARZBEC K	BBHA9120D	1541	Sep. 22, 2021	Sep. 21, 2022
6	Horn Antenna (18GHz-40GHz)	A.H. System	SAS-574	588	Sep. 22, 2021	Sep. 21, 2022
7	Amplifier (30-1000MHz)	EM Electronics	EM330 Amplifier	N/A	Sep. 22, 2021	Sep. 21, 2022
8	Amplifier (1GHz-40GHz)	全聚达	DLE-161	097	Sep. 22, 2021	Sep. 21, 2022
9	Loop Antenna (9KHz-30MHz)	SCHWARZBEC K	FMZB1519B	014	Sep. 22, 2021	Sep. 21, 2022
10	RF cables1 (9kHz-30MHz)	N/A	9kHz-30MHz	N/A	Sep. 22, 2021	Sep. 21, 2022
11	RF cables2 (30MHz-1GHz)	N/A	30MHz-1GHz	N/A	Sep. 22, 2021	Sep. 21, 2022
12	RF cables3 (1GHz-40GHz)	N/A	1GHz-40GHz	N/A	Sep. 22, 2021	Sep. 21, 2022
13	CMW500 Test	R&S	CMW500	106504	Sep. 22, 2021	Sep. 21, 2022
14	ESG Signal Generator	Agilent	E4421B	GB40051203	Sep. 22, 2021	Sep. 21, 2022
15	Signal Generator	Agilent	N5182A	MY47420215	Sep. 22, 2021	Sep. 21, 2022
16	D.C. Power Supply	LongWei	TPR-6405D	\	\	\
17	Software	Frad	EZ-EMC	FA-03A2 RE	\	\

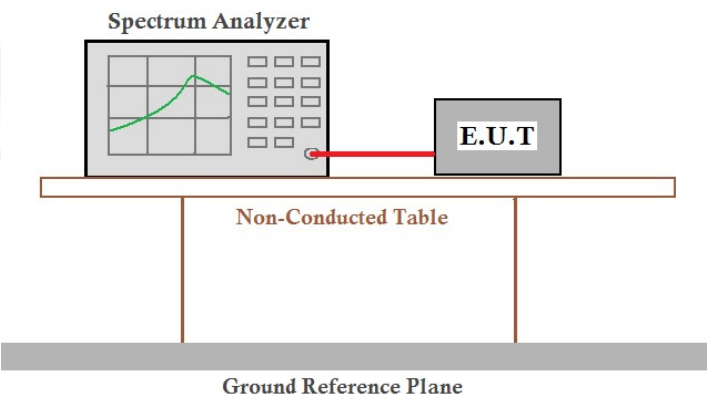
Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	LISN	R&S	ENV216	101471	Sep. 22, 2021	Sep. 21, 2022
2	LISN	CYBERTEK	EM5040A	E1850400149	Sep. 22, 2021	Sep. 21, 2022
3	Test Cable	N/A	C01	N/A	Sep. 22, 2021	Sep. 21, 2022
4	Test Cable	N/A	C02	N/A	Sep. 22, 2021	Sep. 21, 2022
5	EMI Test Receiver	R&S	ESRP3	101946	Sep. 22, 2021	Sep. 21, 2022
6	Absorbing Clamp	DZ	ZN23201	N/A	Sep. 22, 2021	Sep. 21, 2022



4 Test Items for DTS

4.1 Conducted Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance v05r02
Limit:	30dBm
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

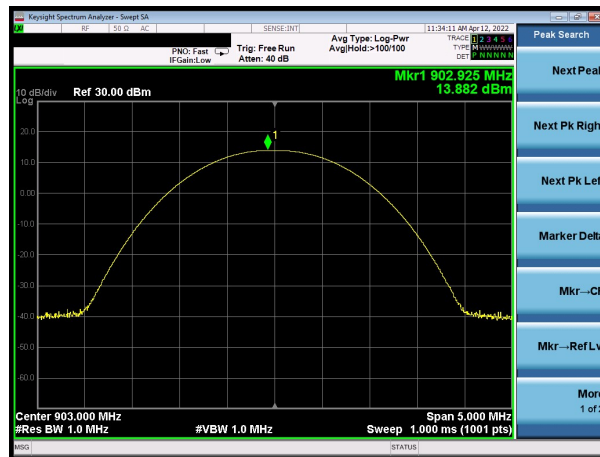
Measurement Data

600KHz Bandwidth:

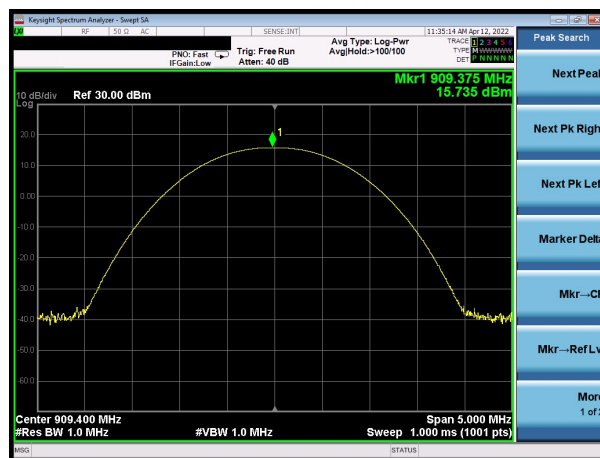
Test channel	Peak Output Power (dBm)	Limit(dBm)	Result
Lowest	13.882	30.00	Pass
Middle	15.735		
Highest	15.602		



Test plot as follows:



Lowest channel



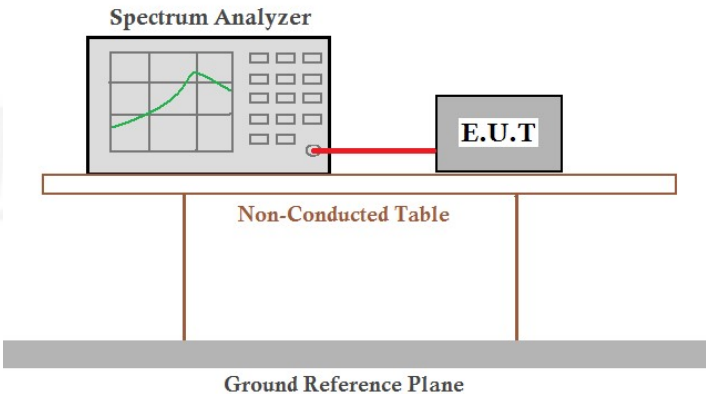
Middle channel



Highest channel



4.2 Channel Bandwidth

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance v05r02
Limit:	>500KHz
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data 600KHz Bandwidth:

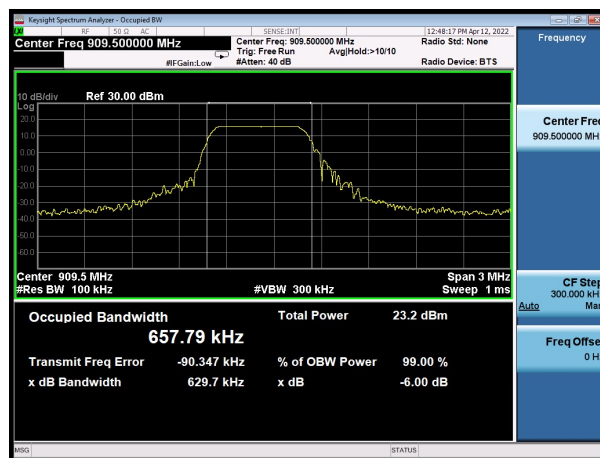
Test channel	Channel Bandwidth (KHz)	Limit(KHz)	Result
Lowest	632.4	>500	Pass
Meddle	629.7		
Highest	624.4		



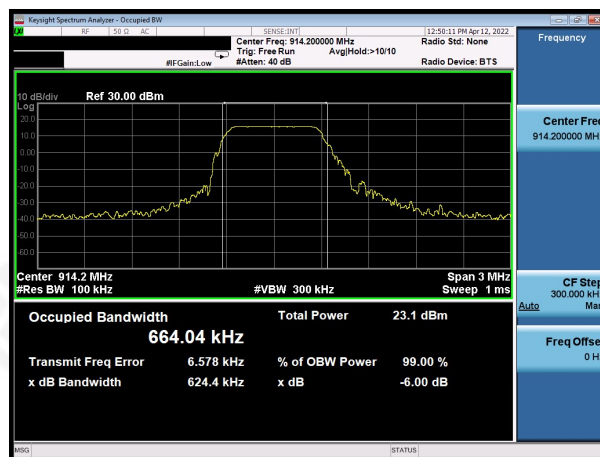
Test plot as follows:



Lowest channel



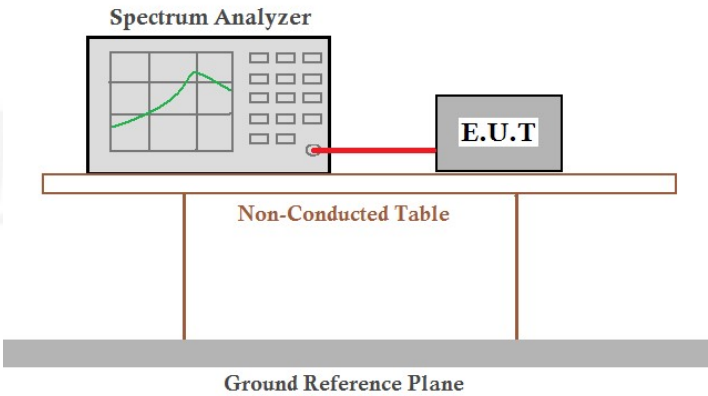
Meddle channel



Highest channel



4.3 Power Spectral Density

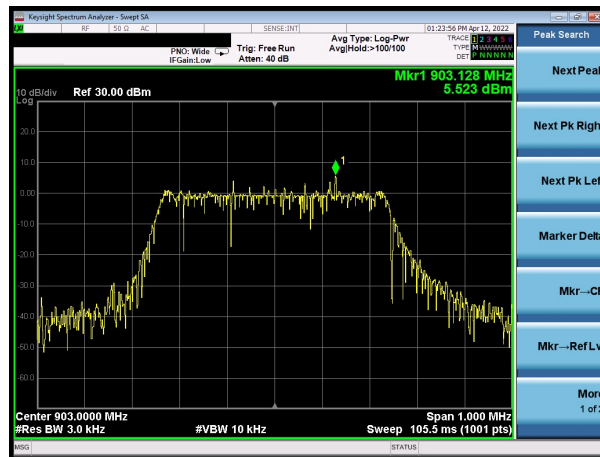
Test Requirement:	FCC Part15 C Section 15.247 (e)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance v05r02
Limit:	8dBm/3kHz
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

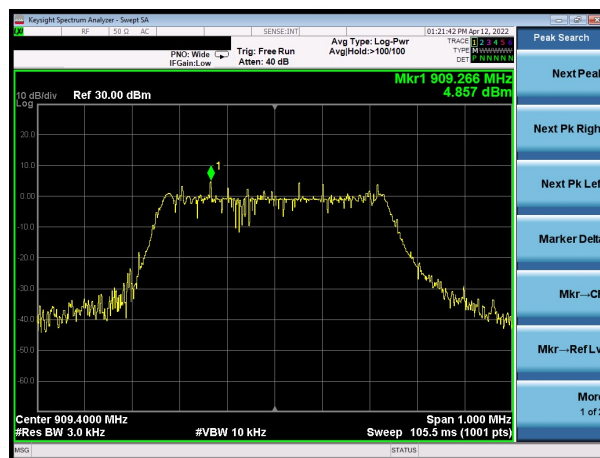
Test channel	Power Spectral Density (dBm/3kHz)	Limit(dBm/3kHz)	Result
Lowest	5.523	8.00	Pass
Middle	4.857		
Highest	4.330		



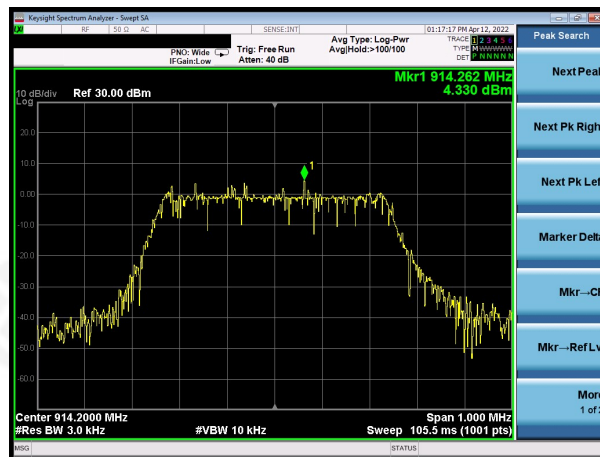
Test plot as follows:



Lowest channel



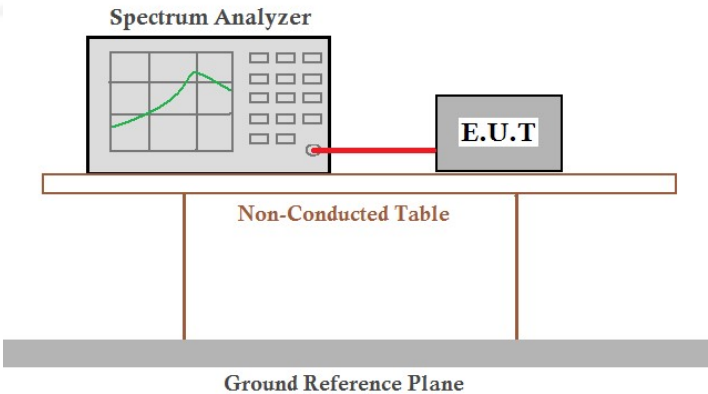
Medlle channel



Highest channel



4.4 Band edges

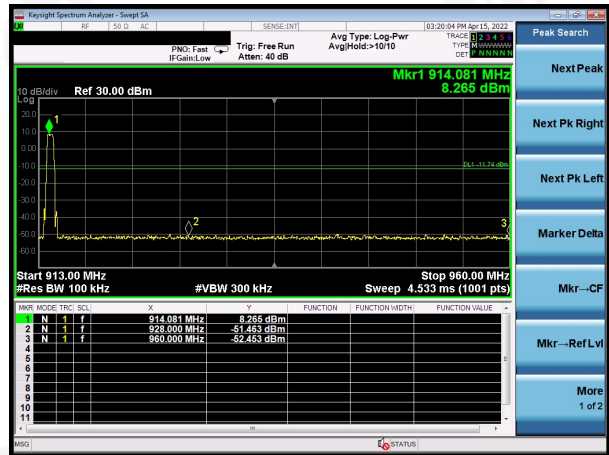
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance v05r02
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional 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.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass



Test plot as follows:



Lowest Channel

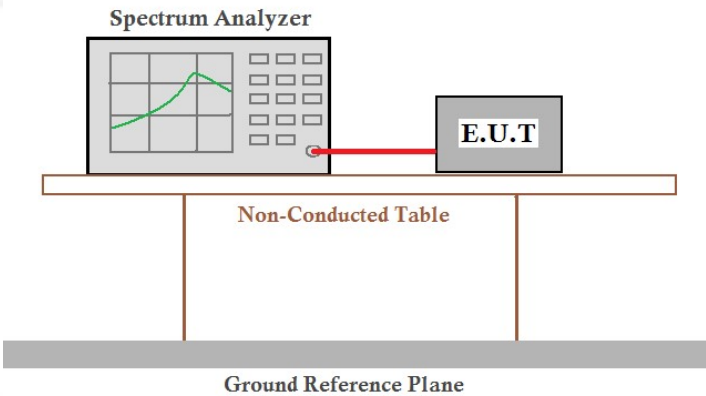


Highest Channel



4.5 Spurious Emission

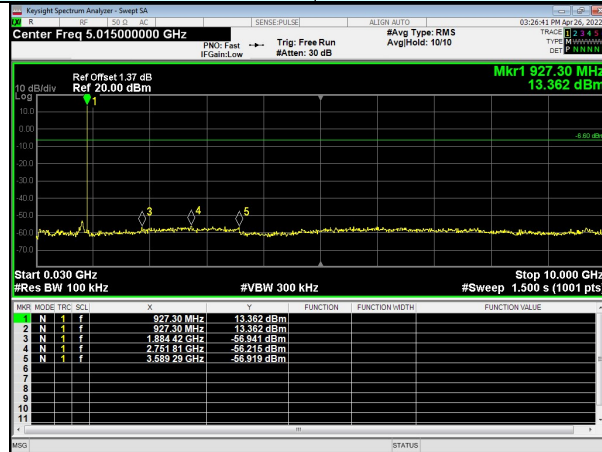
Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance v05r02
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass



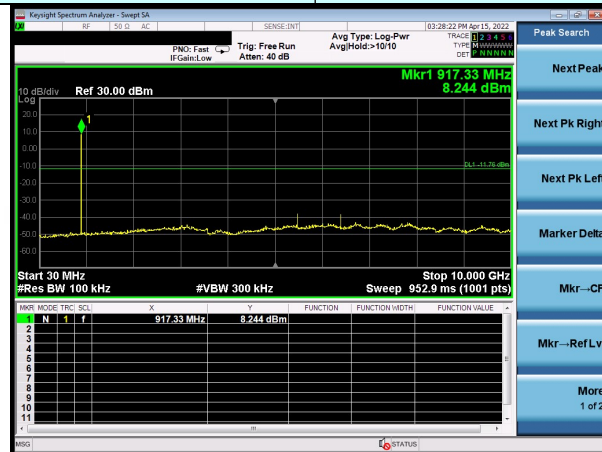
Test plot as follows:

Test channel:	Lowest channel
---------------	----------------



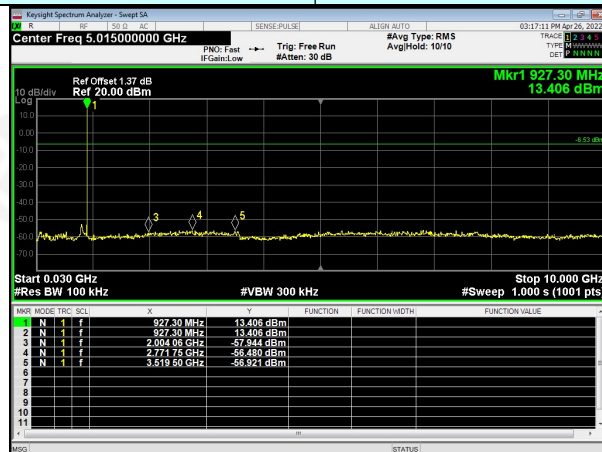
30MHz~10GHz

Test channel:	Middle channel
---------------	----------------



30MHz~10GHz

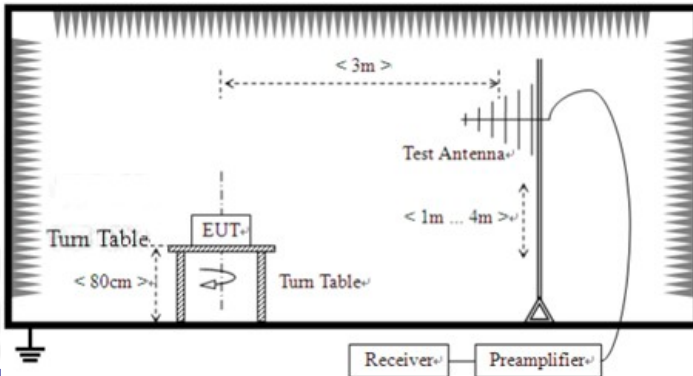
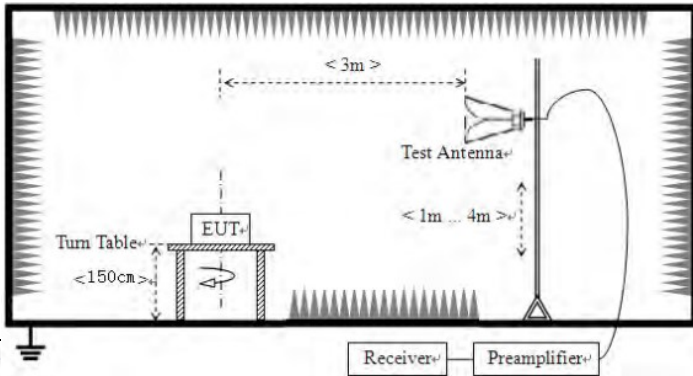
Test channel:	Highest channel
---------------	-----------------





Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Limit (uV/m)	Value	Measurement Distance	
	0.009MHz-0.490MHz	2400/F(KHz)	QP	300m	
	0.490MHz-1.705MHz	24000/F(KHz)	QP	30m	
	1.705MHz-30MHz	30	QP	30m	
	30MHz-88MHz	100	QP	3m	
	88MHz-216MHz	150	QP		
	216MHz-960MHz	200	QP		
	960MHz-1GHz	500	QP		
	Above 1GHz	500	Average		
		5000	Peak		
Test setup:	For radiated emissions from 9kHz to 30MHz				



	For radiated emissions from 30MHz to1GHz  For radiated emissions above 1GHz  Receiver Preamplifier					
Test Procedure:	n for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 1. 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. 2. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 3. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 4. 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.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	DC 3V					
Test results:	Pass					



Measurement data:

Remark:

Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

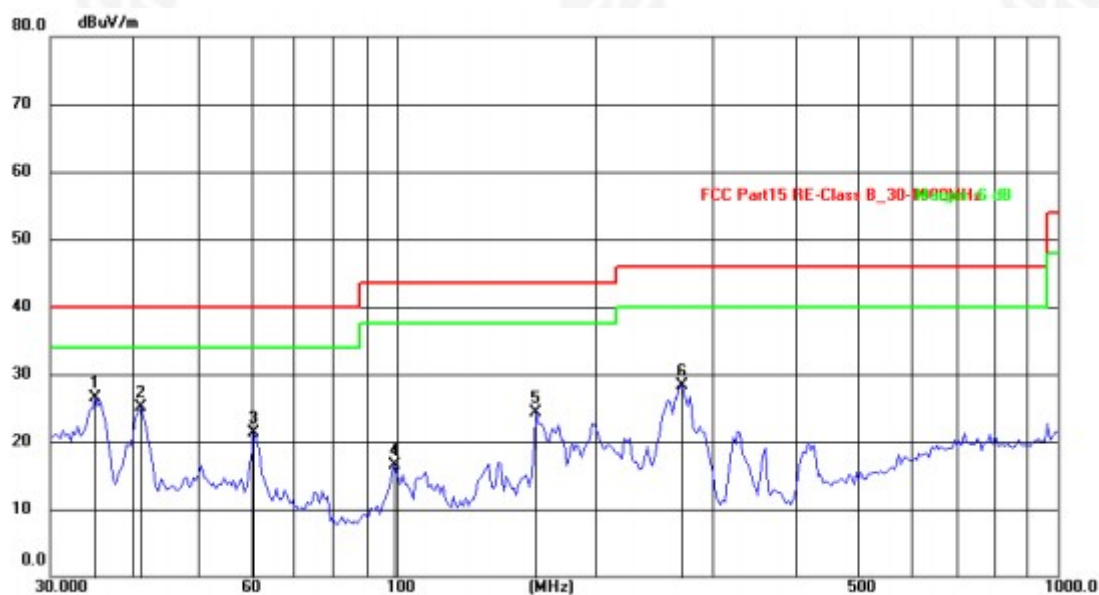
■ **9kHz~30MHz**

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.



■ Below 1GHz

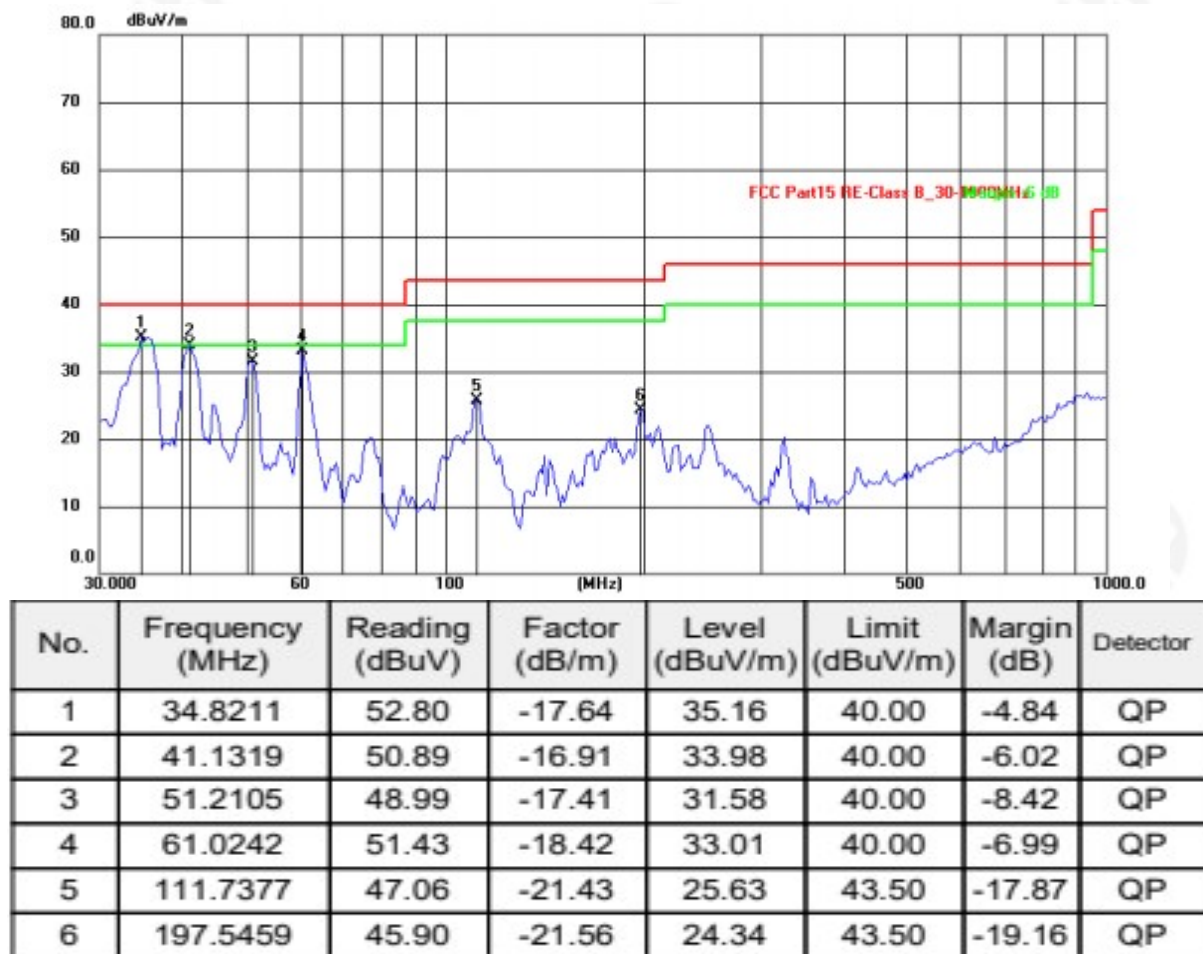
Horizontal:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	35.1276	41.47	-15.02	26.45	40.00	-13.55	QP
2	41.1319	39.23	-14.12	25.11	40.00	-14.89	QP
3	61.0243	35.81	-14.51	21.30	40.00	-18.70	QP
4	99.7026	36.31	-19.83	16.48	43.50	-27.02	QP
5	162.8959	41.34	-17.05	24.29	43.50	-19.21	QP
6	270.8491	44.87	-16.60	28.27	46.00	-17.73	QP



Vertical:





■ Above 1GHz

Test channel:	Lowest channel
---------------	----------------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1806.00	42.53	25.25	4.85	34.08	38.37	74.00	-35.63	Vertical
2709.00	35.71	28.12	5.66	33.68	35.87	74.00	-38.13	Vertical
3612.00	33.97	29.19	7.25	37.37	32.86	74.00	-41.14	Vertical
4515.00	*					74.00		Vertical
5418.00	*					74.00		Vertical
6321.00	*					74.00		Vertical
1806.00	39.98	25.25	4.85	34.08	35.91	74.00	-38.09	Horizontal
2709.00	34.6	28.12	5.66	33.68	35.06	74.00	-38.94	Horizontal
3612.00	32.45	29.19	7.25	37.37	31.61	74.00	-42.39	Horizontal
4515.00	*					74.00		Horizontal
5418.00	*					74.00		Horizontal
6321.00	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1806.00	30.24	25.25	4.85	34.08	26.44	54.00	-27.56	Vertical
2709.00	23.35	28.12	5.66	33.68	23.93	54.00	-30.07	Vertical
3612.00	23.85	29.19	7.25	37.37	22.65	54.00	-31.35	Vertical
4515.00	*					54.00		Vertical
5418.00	*					54.00		Vertical
6321.00	*					54.00		Vertical
1806.00	29.34	25.25	4.85	34.08	25.45	54.00	-28.55	Horizontal
2709.00	23.56	28.12	5.66	33.68	23.65	54.00	-30.35	Horizontal
3612.00	22.99	29.19	7.25	37.37	21.56	54.00	-32.44	Horizontal
4515.00	*					54.00		Horizontal
5418.00	*					54.00		Horizontal
6321.00	*					54.00		Horizontal

Remarks:

1. *Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *“*” means this data is too weak instrument of signal is unable to test.*



Test channel:

Highest

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1831.60	40.39	25.43	4.89	34.12	36.59	74.00	-37.41	Vertical
2747.40	35.96	28.34	5.68	33.57	36.41	74.00	-37.59	Vertical
3663.20	34.18	29.42	7.29	37.66	33.23	74.00	-40.77	Vertical
4579.00	*					74.00		Vertical
5494.80	*					74.00		Vertical
6410.60	*					74.00		Vertical
1831.60	40.78	25.43	4.89	34.12	36.98	74.00	-37.02	Horizontal
2747.40	36.87	28.34	5.68	33.57	37.32	74.00	-36.68	Horizontal
3663.20	34.54	29.42	7.29	37.66	33.59	74.00	-40.41	Horizontal
4579.00	*					74.00		Horizontal
5494.80	*					74.00		Horizontal
6410.60	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1831.60	31.16	25.43	4.89	34.12	27.36	54.00	-26.64	Vertical
2747.40	23.34	28.34	5.68	33.57	23.79	54.00	-30.21	Vertical
3663.20	23.51	29.42	7.29	37.66	22.56	54.00	-31.44	Vertical
4579.00	*					54.00		Vertical
5494.80	*					54.00		Vertical
6410.60	*					54.00		Vertical
1831.60	30.85	25.43	4.89	34.12	27.05	54.00	-26.95	Horizontal
2747.40	22.97	28.34	5.68	33.57	23.42	54.00	-30.58	Horizontal
3663.20	23.72	29.42	7.29	37.66	22.77	54.00	-31.23	Horizontal
4579.00	*					54.00		Horizontal
5494.80	*					54.00		Horizontal
6410.60	*					54.00		Horizontal

Remarks:

1. *Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *“*” means this data is too weak instrument of signal is unable to test.*



5. Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
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(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
EUT Antenna:	
The antenna is Internal antenna, the best case gain of the antennas is 2dBi, reference to the appendix II for details	



6. Test Setup Photo

Reference to the appendix I for details.

7. EUT Constructional Details

Reference to the appendix II for details.

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