TEST REPORT

Applicant Name:	Shenzhen Xin Yuan Electronic Technology Co., Ltd.
Address:	Room 801-803, Yousuowei Building, No.2000 JiaXian Road, Bantian Street, Longgang District, Shenzhen, Guangdong China
Report Number:	SZ1240319-13904E-RF-00B
FCC ID:	2ASYE-T-BEAM-S3

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	T-BEAM-S3
Model No.:	T-BEAM-S3
Multiple Model(s) No.:	T-BEAM-S3(L76K GPS)
Trade Mark:	LILYGO
Date Received:	2024/03/19
Issue Date:	2024/08/07

Test Result:	Pass▲

▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Wills Yu
RF Engineer

Approved By:

Nancy Wang
RF Supervisor

Note: The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "▼".

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZ1240319-13904E-RF-00B	Original Report	2024/08/07

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	T-BEAM-S3
Tested Model	T-BEAM-S3
Multiple Model(s)	T-BEAM-S3(L76K GPS)
Frequency Range	915MHz
Maximum Conducted Average Output Power	21.96dBm
Modulation Technique	LoRa
Antenna Specification#	2dBi (provided by the applicant)
Voltage Range	DC 5V from USB Port
Sample serial number	For Model: T-BEAM-S3:2IUJ-5 For Model: T-BEAM-S3(L76K GPS): 2IUJ-10 (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A
Note: The Multiple models are electrically identical with the test model except for GPS module. Please refer to the declaration letter# for more detail, which was provided by manufacturer.	

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices .

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Frequency		213.55 Hz(k=2, 95% level of confidence)
RF output power, conducted		0.72 dB(k=2, 95% level of confidence)
Unwanted Emission, conducted		1.75 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz~150 kHz	3.94dB(k=2, 95% level of confidence)
	150 kHz ~30MHz	3.84dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 30MHz	3.30dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	4.48dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	4.55dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	4.85dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.05dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.35dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.44dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.16dB(k=2, 95% level of confidence)
Temperature		±1℃
Humidity		±1%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

Channel List

Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	915	/	/

Equipment Modifications

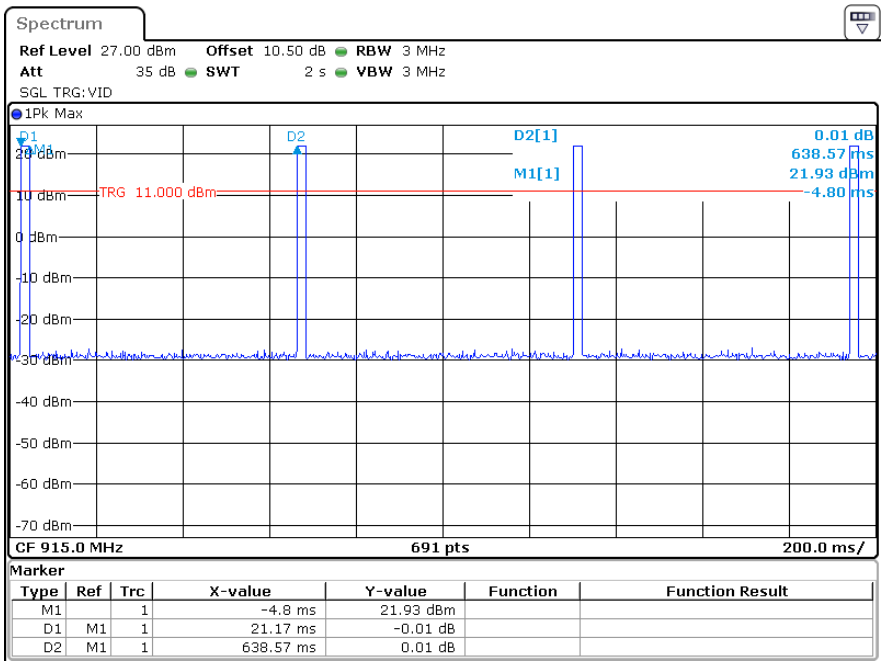
No modification was made to the EUT tested.

EUT Exercise Software

Test in the engineering mode and the power level is Default#. The power level was provided by the manufacturer.

Duty cycle

Test Frequency (MHz)	Ton (ms)	Ton+off (ms)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T (Hz)	VBW Setting (Hz)
915	21.17	638.57	3.32	14.79	47	100



ProjectNo.:SZ1240319-13904E-RF Tester:Kungfumaster Liang

Date: 4.JUN.2024 18:39:41

Support Equipment List and Details

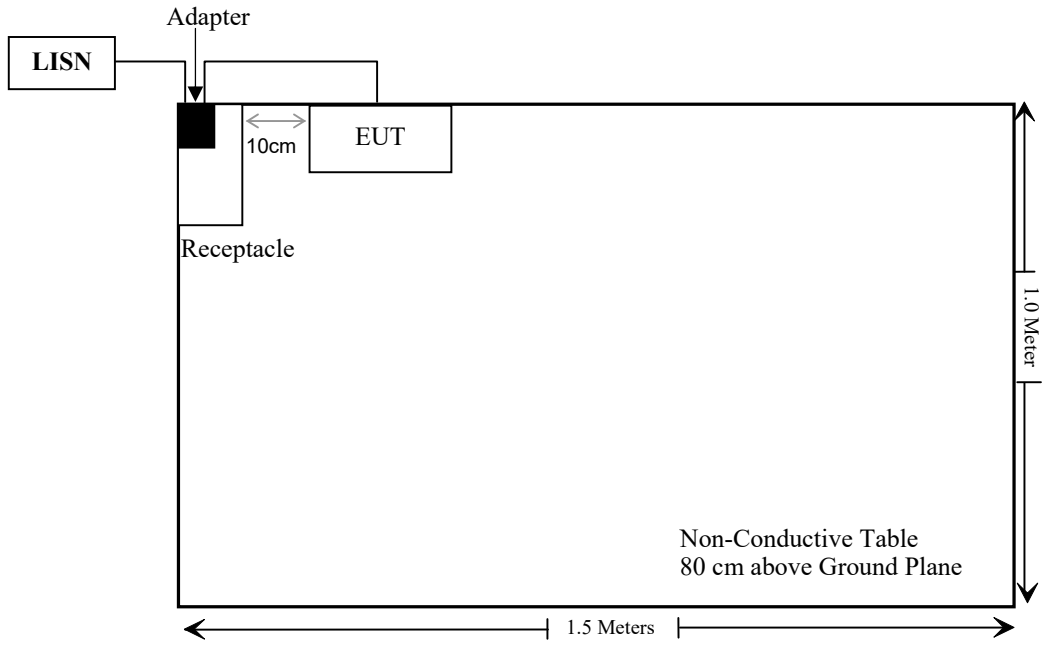
Manufacturer	Description	Model	Serial Number
HUAWEI	Adapter	HW-100400C01	Unknown

External I/O Cable

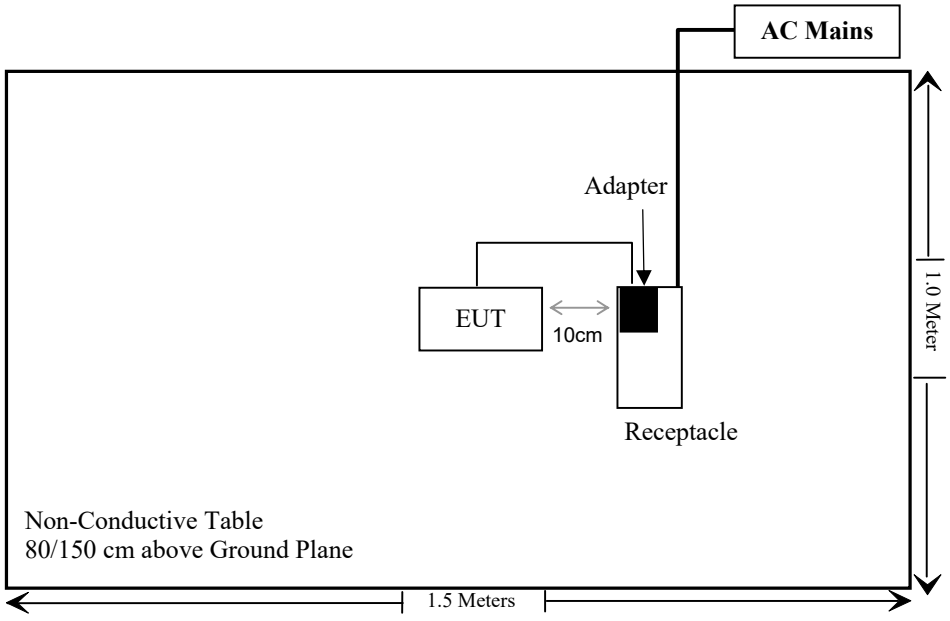
Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.0	EUT	Adapter
Un-shielding Un-Detachable AC Cable	1.2	Receptacle	LISN/AC Mains

Block Diagram of Test Setup

For Conducted Emissions:



For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §1.1307 ,§2.1091	MPE-Based Exemption	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
FCC §15.247 (a)(2)	6 dB Emission Bandwidth & Occupied Bandwidth	Compliant
FCC §15.247(b)(3)	Maximum Conducted Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2024/01/16	2025/01/15
Rohde & Schwarz	LISN	ENV216	101613	2024/01/16	2025/01/15
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2023/08/03	2024/08/02
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2024/07/19
BACL	Active Loop Antenna	1313-1A	4031911	2024/03/21	2025/03/20
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2024/03/27	2025/03/26
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2024/07/25
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
JD	Filter Switch Unit	DT7210FSU	DQ77930	NCR	NCR
JD	Multiplex Switch Test Control Set	DT7220FSU	DQ77926	NCR	NCR
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
RF Conducted Test					
R&S	spectrum analyzer	FSV40	101942	2023/12/18	2024/12/17
Agilent	USB wideband power sensor	U2021XA	MY52350001	2023/06/08	2024/06/07
Unknown	10dB Attenuator	Unknown	F-03-EM190	2023/07/04	2024/07/03

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1307 (B) & §2.1091- MPE-BASED EXEMPTION

Applicable Standard

According to subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

R is the minimum separation distance in meters
f = frequency in MHz

Result

Mode	Frequency (MHz)	Tune up conducted power# (dBm)	Antenna Gain#		ERP		Evaluation Distance (m)	ERP Limit (mW)
			(dBi)	(dBd)	(dBm)	(mW)		
Lora	915	22.0	2.0	-0.15	21.85	153.11	0.2	468
BLE	2402-2480	-1.5	4.0	1.85	0.35	1.08	0.2	768
2.4G Wi-Fi	2412-2462	19.5	4.0	1.85	21.35	136.46	0.2	768

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The Lora, BLE and 2.4G Wi-Fi cannot transmit at same time.
3. 0dBd=2.15dBi

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.
c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has one antenna arrangement, which was permanently attached by an IPEX connector, the antenna gain[#] is 2dBi, fulfill the requirement of this section. Please refer to the EUT photos.

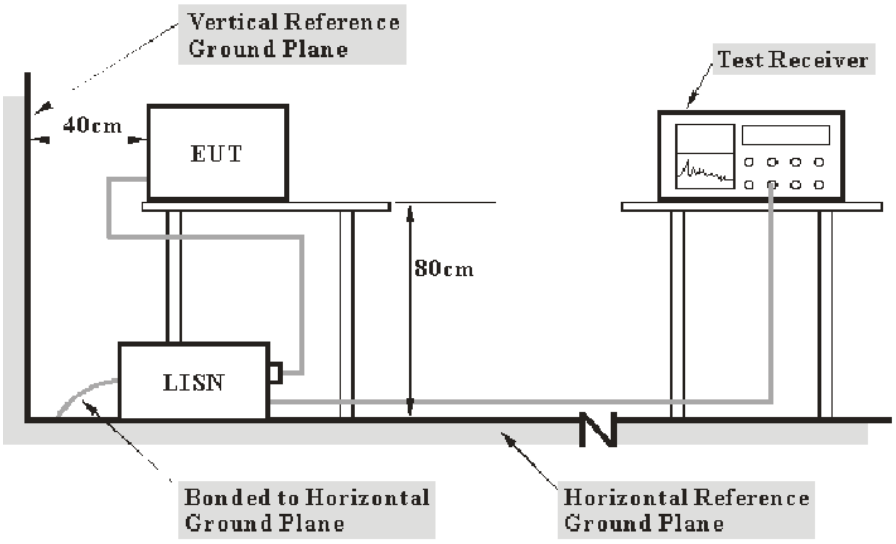
Result: Compliant.

FCC §15.207 (a) - AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Factor = LISN VDF + Cable Loss

The "**Over limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Note: The term "cable loss" refers to the combination of a cable and a 10dB transient limiter (attenuator).

Test Data

Environmental Conditions

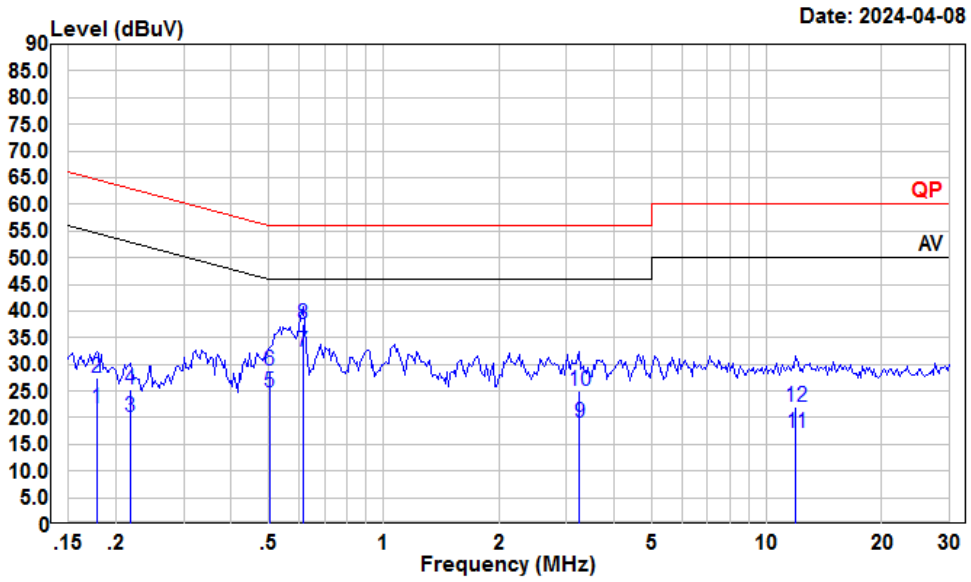
Temperature:	25~26 ℃
Relative Humidity:	70~71 %
ATM Pressure:	101 kPa

The testing was performed by Macy Shi from 2024-04-08 to 2024-04-26.

EUT operation mode: Transmitting

For model: T-BEAM-S3

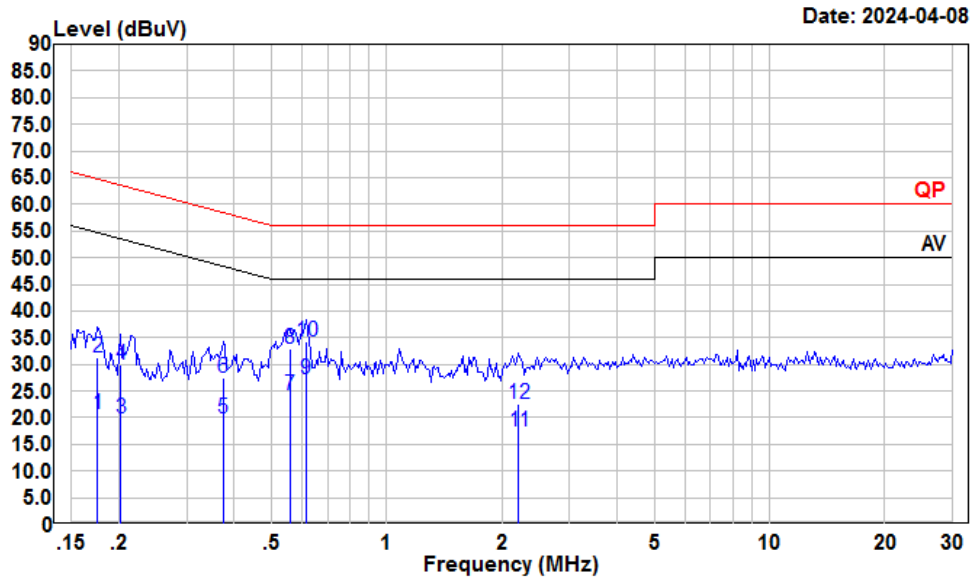
AC 120V/60 Hz, Line



Condition: Line
Project : SZ1240319-13904E-RF
Tester : Macy shi
Note : Lora DTS

	Freq	Read Level	Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.18	0.75	21.72	10.84	10.13	54.59	-32.87	Average
2	0.18	6.64	27.61	10.84	10.13	64.59	-36.98	QP
3	0.22	-0.64	20.26	10.77	10.13	52.92	-32.66	Average
4	0.22	4.33	25.23	10.77	10.13	62.92	-37.69	QP
5	0.50	4.00	24.65	10.50	10.15	46.00	-21.35	Average
6	0.50	8.26	28.91	10.50	10.15	56.00	-27.09	QP
7	0.61	11.76	32.48	10.50	10.22	46.00	-13.52	Average
8	0.61	16.83	37.55	10.50	10.22	56.00	-18.45	QP
9	3.24	-1.63	19.03	10.39	10.27	46.00	-26.97	Average
10	3.24	4.23	24.89	10.39	10.27	56.00	-31.11	QP
11	11.93	-3.63	17.17	10.60	10.20	50.00	-32.83	Average
12	11.93	1.34	22.14	10.60	10.20	60.00	-37.86	QP

AC 120V/60 Hz, Neutral

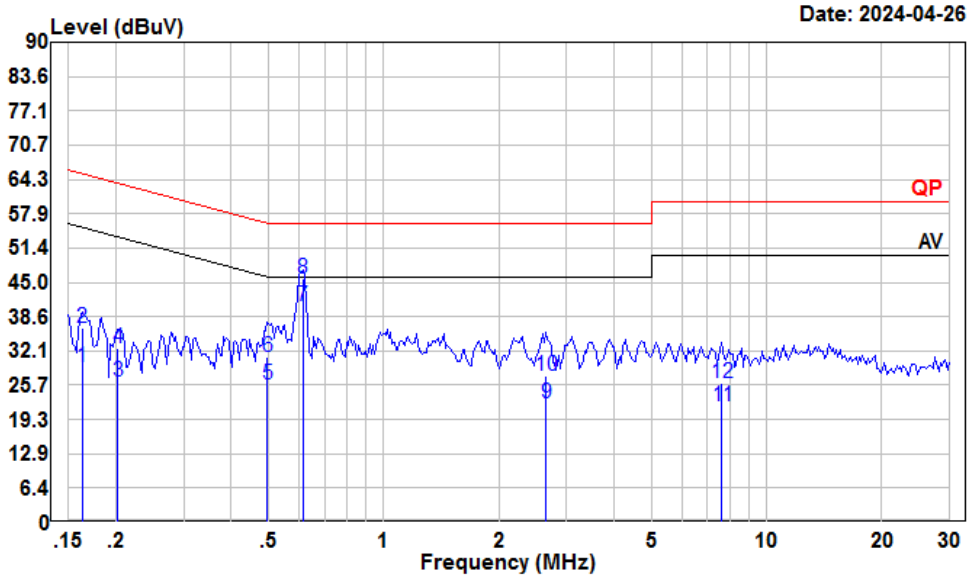


Condition: Neutral
Project : SZ1240319-13904E-RF
Tester : Macy shi
Note : Lora DTS

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.18	0.14	20.77	10.49	10.14	54.68	-33.91	Average
2	0.18	10.54	31.17	10.49	10.14	64.68	-33.51	QP
3	0.20	-0.50	19.99	10.40	10.09	53.54	-33.55	Average
4	0.20	9.36	29.85	10.40	10.09	63.54	-33.69	QP
5	0.37	-0.81	19.98	10.60	10.19	48.43	-28.45	Average
6	0.37	6.57	27.36	10.60	10.19	58.43	-31.07	QP
7	0.56	3.20	24.09	10.70	10.19	46.00	-21.91	Average
8	0.56	11.90	32.79	10.70	10.19	56.00	-23.21	QP
9	0.61	6.20	27.12	10.70	10.22	46.00	-18.88	Average
10	0.61	13.45	34.37	10.70	10.22	56.00	-21.63	QP
11	2.21	-3.22	17.38	10.40	10.20	46.00	-28.62	Average
12	2.21	1.96	22.56	10.40	10.20	56.00	-33.44	QP

For model: T-BEAM-S3(L76K GPS)

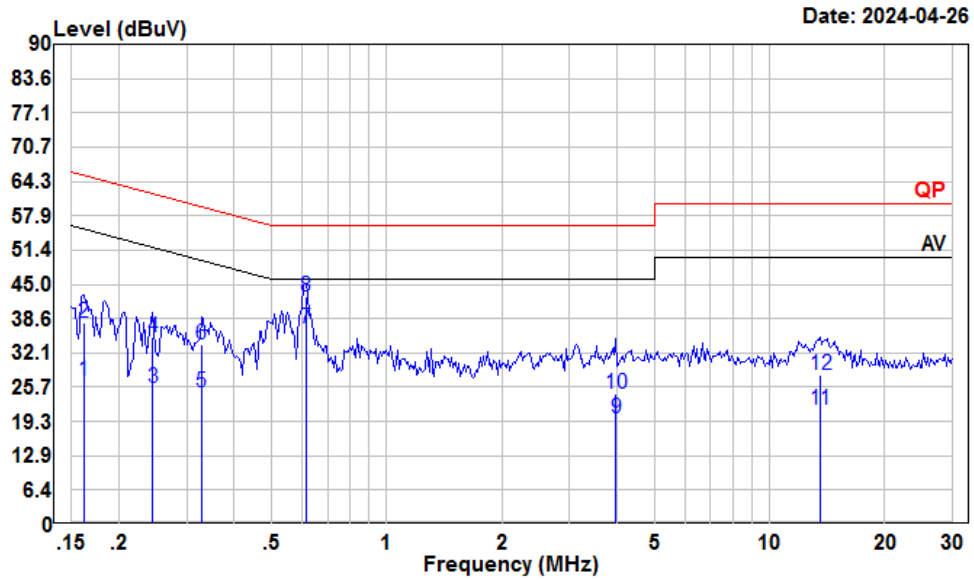
AC 120V/60 Hz, Line



Condition: Line
Project : SZ1240319-13904E-RF
Tester : Macy shi
Note : Lora DTS

	Freq	Read Level	Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.16	7.99	29.01	10.87	10.15	55.30	-26.29	Average
2	0.16	15.31	36.33	10.87	10.15	65.30	-28.97	QP
3	0.20	5.37	26.26	10.80	10.09	53.54	-27.28	Average
4	0.20	11.64	32.53	10.80	10.09	63.54	-31.01	QP
5	0.50	5.19	25.84	10.50	10.15	46.05	-20.21	Average
6	0.50	10.35	31.00	10.50	10.15	56.05	-25.05	QP
7	0.61	19.71	40.43	10.50	10.22	46.00	-5.57	Average
8	0.61	25.01	45.73	10.50	10.22	56.00	-10.27	QP
9	2.65	1.48	22.19	10.48	10.23	46.00	-23.81	Average
10	2.65	6.79	27.50	10.48	10.23	56.00	-28.50	QP
11	7.65	1.01	21.76	10.52	10.23	50.00	-28.24	Average
12	7.65	5.48	26.23	10.52	10.23	60.00	-33.77	QP

AC 120V/60 Hz, Neutral



Condition: Neutral
Project : SZ1240319-13904E-RF
Tester : Macy shi
Note : Lora DTS

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.16	6.33	27.03	10.55	10.15	55.38	-28.35	Average
2	0.16	17.20	37.90	10.55	10.15	65.38	-27.48	QP
3	0.24	4.82	25.49	10.47	10.20	51.95	-26.46	Average
4	0.24	14.28	34.95	10.47	10.20	61.95	-27.00	QP
5	0.33	3.96	24.66	10.56	10.14	49.49	-24.83	Average
6	0.33	13.14	33.84	10.56	10.14	59.49	-25.65	QP
7	0.61	15.83	36.75	10.70	10.22	46.00	-9.25	Average
8	0.61	21.87	42.79	10.70	10.22	56.00	-13.21	QP
9	3.96	-0.71	19.95	10.40	10.26	46.00	-26.05	Average
10	3.96	3.91	24.57	10.40	10.26	56.00	-31.43	QP
11	13.55	0.54	21.49	10.80	10.15	50.00	-28.51	Average
12	13.55	7.11	28.06	10.80	10.15	60.00	-31.94	QP

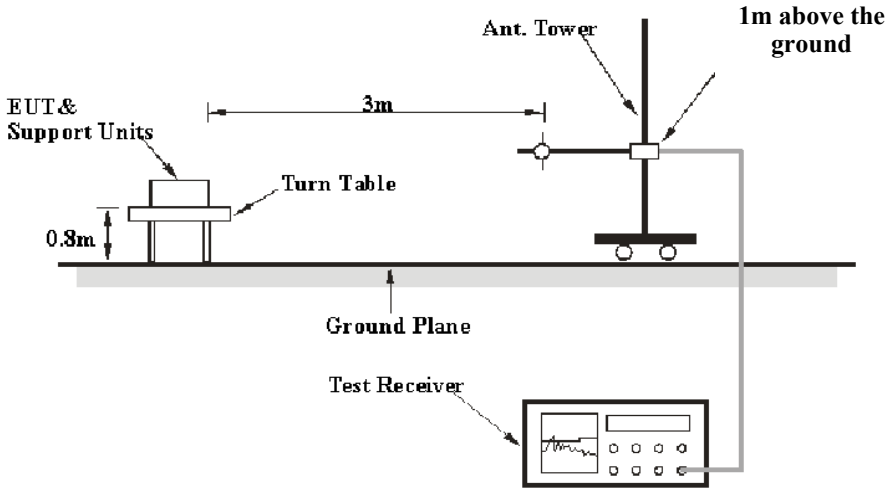
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

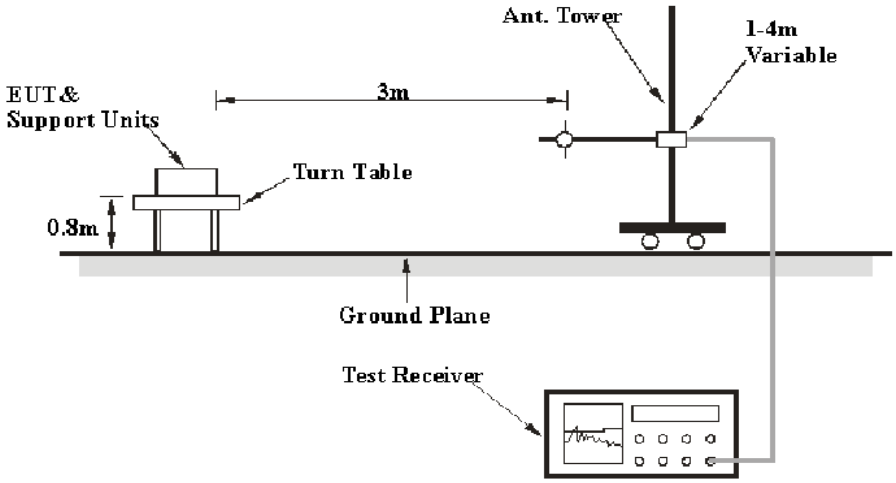
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

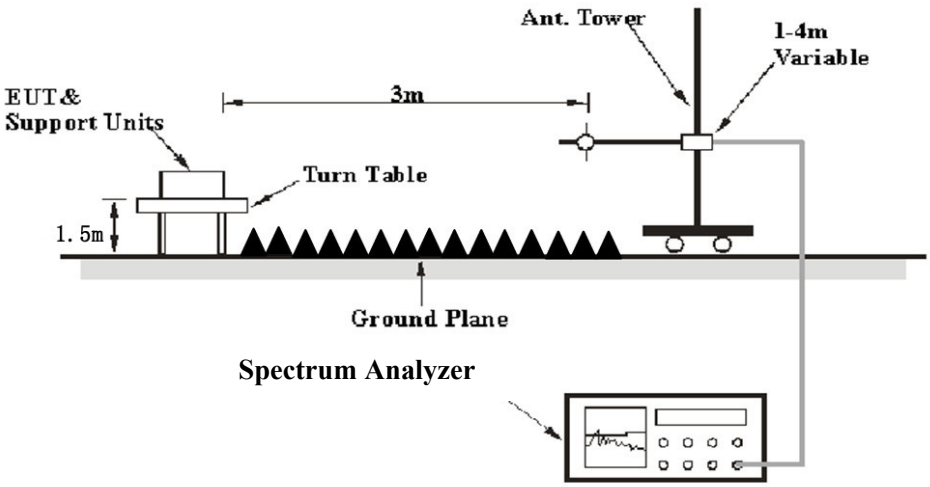
9 kHz-30MHz:



30MHz-1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	/	/	200 Hz	QP
	300 Hz	1 kHz	/	PK
150 kHz – 30 MHz	/	/	9 kHz	QP
	10 kHz	30 kHz	/	PK
30 MHz – 1000 MHz	/	/	120 kHz	QP
	100 kHz	300 kHz	/	PK
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	≥1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz, average detection modes for frequency bands 9–90 kHz and 110–490 kHz, peak and average detection modes for frequencies above 1 GHz.

For 9 kHz-30MHz, the report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB.

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

All emissions under the average limit and under the noise floor have not recorded in the report.

Factor & Over Limit/Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	24~25.2 ℃
Relative Humidity:	50~54 %
ATM Pressure:	101 kPa

The testing was performed by Warren Huang from 2024-04-11 to 2024-04-29 for below 1GHz and Dylan Yang on 2024-04-25 for above 1GHz.

EUT operation mode: Transmitting

Note: Pre-scan in the X, Y and Z axes of orientation, the worst case X-axis of orientation was recorded

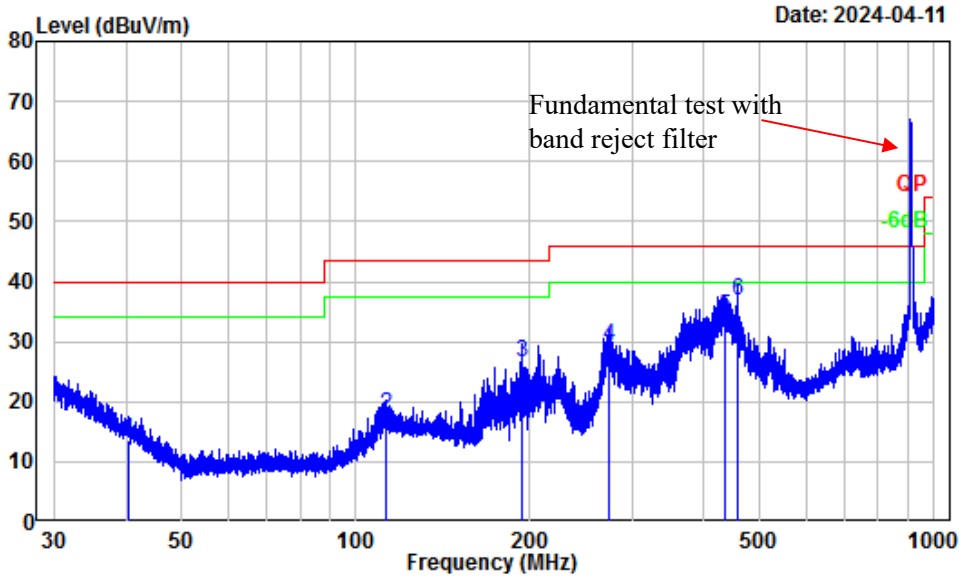
9 kHz-30MHz:

The amplitude of spurious emissions attenuated more than 20 dB below the limit was not recorded.

30 MHz~1 GHz:

For model: T-BEAM-S3

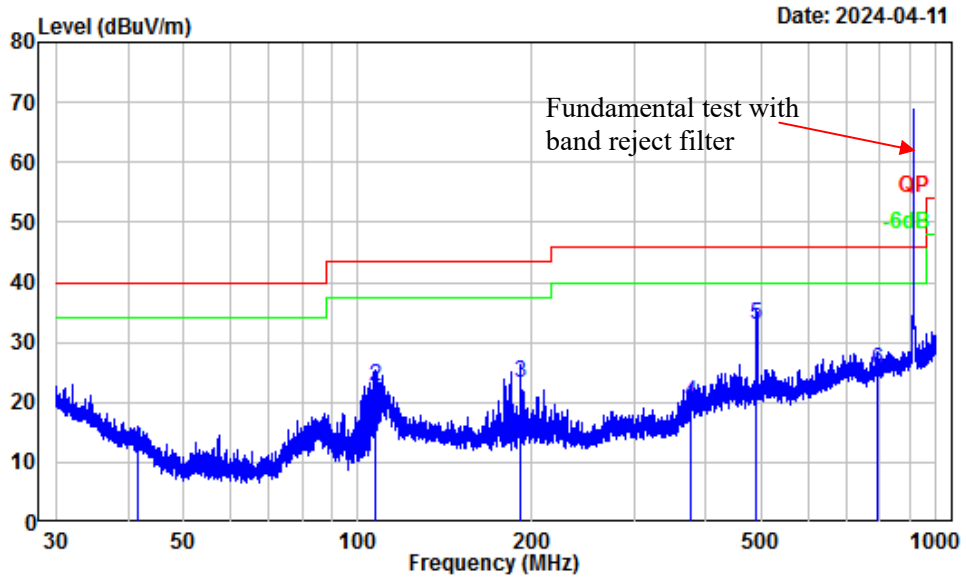
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: SZ1240319-13904E-RF
Note : Lora DTS
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.40	-10.64	24.16	13.52	40.00	-26.48	QP
2	112.62	-10.94	28.61	17.67	43.50	-25.83	QP
3	193.77	-11.83	38.41	26.58	43.50	-16.92	QP
4	273.71	-10.96	40.21	29.25	46.00	-16.75	QP
5	434.07	-6.18	40.31	34.13	46.00	-11.87	QP
6	457.51	-5.53	42.23	36.70	46.00	-9.30	QP

Vertical

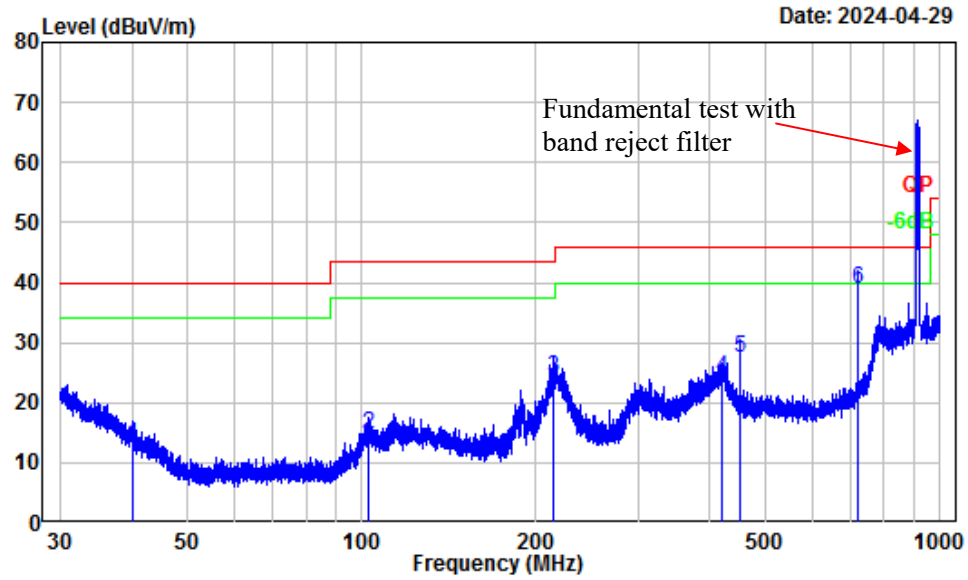


Site : Chamber A
Condition : 3m Vertical
Project Number: SZ1240319-13904E-RF
Note : Lora DTS
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	41.51	-12.75	24.76	12.01	40.00	-27.99	QP
2	107.18	-13.15	35.80	22.65	43.50	-20.85	QP
3	191.58	-12.81	35.98	23.17	43.50	-20.33	QP
4	377.76	-8.71	28.49	19.78	46.00	-26.22	QP
5	489.67	-5.43	38.33	32.90	46.00	-13.10	QP
6	790.97	-0.93	26.32	25.39	46.00	-20.61	QP

For model: T-BEAM-S3(L76K GPS)

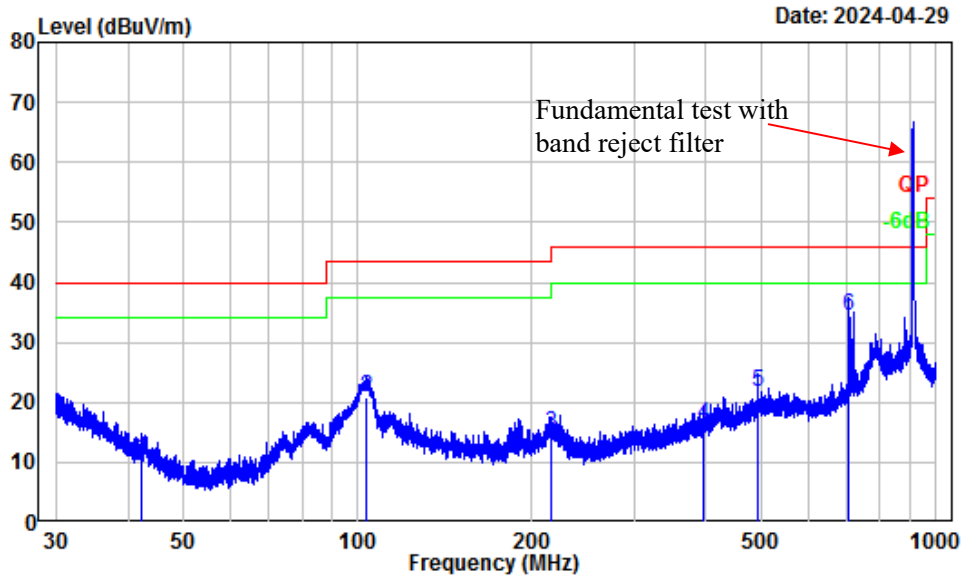
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: SZ1240319-13904E-RF
Note : Lora DTS
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.05	-11.55	24.45	12.90	40.00	-27.10	QP
2	102.45	-14.87	29.80	14.93	43.50	-28.57	QP
3	214.80	-13.79	38.05	24.26	43.50	-19.24	QP
4	418.74	-10.22	34.50	24.28	46.00	-21.72	QP
5	450.15	-9.59	37.18	27.59	46.00	-18.41	QP
6	722.04	-5.90	44.95	39.05	46.00	-6.95	QP

Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: SZ1240319-13904E-RF
Note : Lora DTS
Tester : Warren Huang

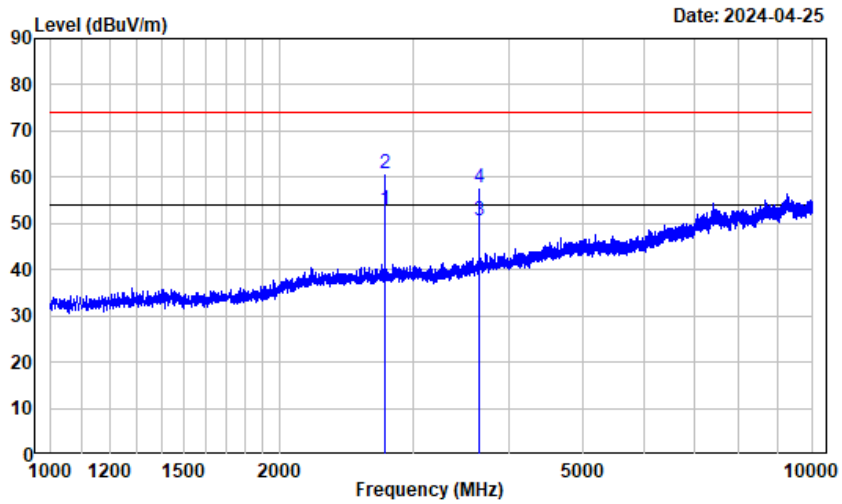
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	42.30	-14.32	24.97	10.65	40.00	-29.35	QP
2	103.44	-16.03	36.97	20.94	43.50	-22.56	QP
3	216.50	-14.76	29.50	14.74	46.00	-31.26	QP
4	395.03	-10.95	27.20	16.25	46.00	-29.75	QP
5	492.47	-8.72	30.58	21.86	46.00	-24.14	QP
6	705.77	-6.52	40.87	34.35	46.00	-11.65	QP

Above 1 GHz:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave					
915MHz							
2745.00	63.76	PK	H	-2.81	60.95	74	-13.05
2745.00	55.87	AV	H	-2.81	53.06	54	-0.94
2745.00	63.25	PK	V	-2.81	60.44	74	-13.56
2745.00	56.69	AV	V	-2.81	53.88	54	-0.12
3660.00	59.16	PK	H	-1.36	57.80	74	-16.20
3660.00	51.91	AV	H	-1.36	50.55	54	-3.45
3660.00	57.31	PK	V	-1.36	55.95	74	-18.05
3660.00	50.39	AV	V	-1.36	49.03	54	-4.97

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is in the noise floor level was not recorded.

Listed with the worst harmonic margin test plot:

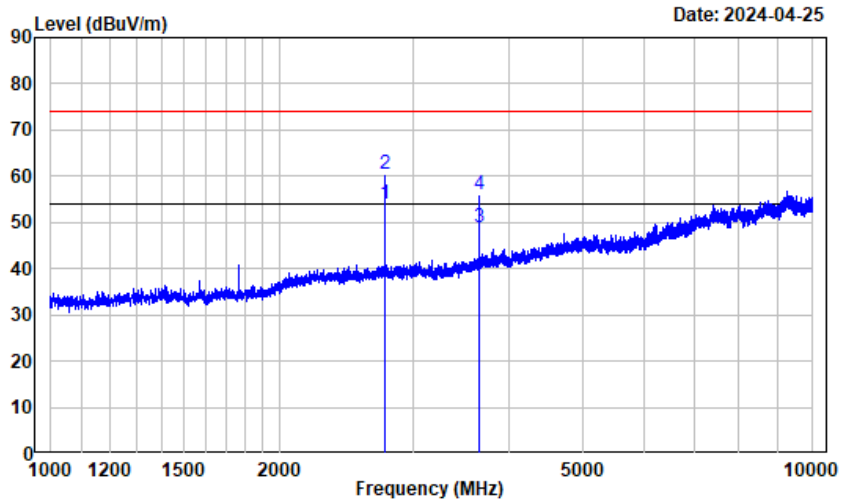
Horizontal	
1-10GHz	

Condition : Horizontal
Project No.: SZ1240319-13904E
Tester : Dylan
Note : Lora_915

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2745.000	-2.81	55.87	53.06	54.00	-0.94	Average
2	2745.000	-2.81	63.76	60.95	74.00	-13.05	Peak
3	3660.000	-1.36	51.91	50.55	54.00	-3.45	Average
4	3660.000	-1.36	59.16	57.80	74.00	-16.20	Peak

Vertical

1-10GHz



Condition : Vertical
Project No.: SZ1240319-13904E
Tester : Dylan
Note : Lora_915

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2745.000	-2.81	56.69	53.88	54.00	-0.12	Average
2	2745.000	-2.81	63.25	60.44	74.00	-13.56	Peak
3	3660.000	-1.36	50.39	49.03	54.00	-4.97	Average
4	3660.000	-1.36	57.31	55.95	74.00	-18.05	Peak

FCC §15.247(a) (2) - 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

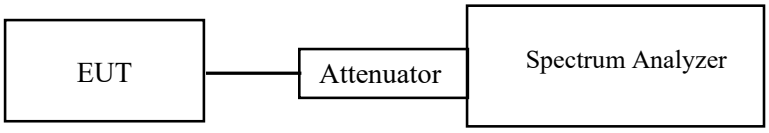
Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 6.9.3

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

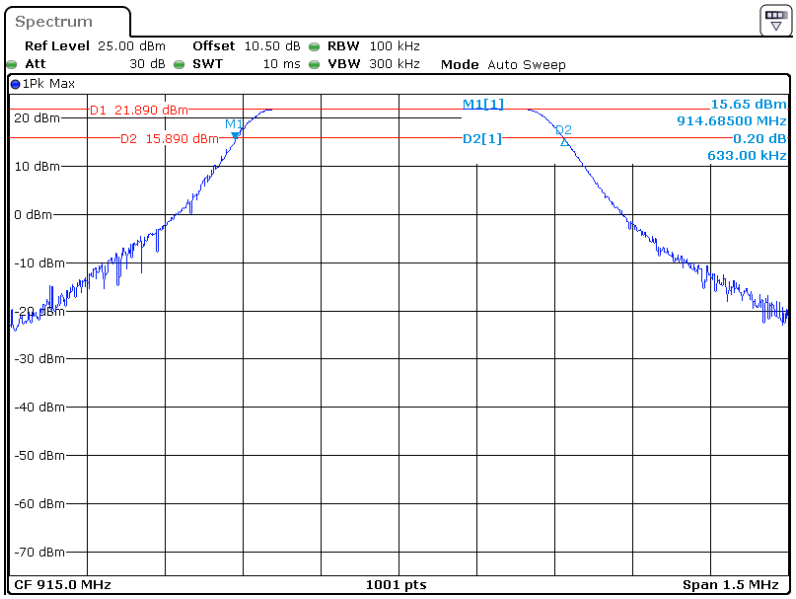
Temperature:	23.8 ℃
Relative Humidity:	48 %
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-06-04.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following table and plots.

Mode	Test Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
LoRa	915	0.633	≥0.5



ProjectNo.:SZ1240319-13904E-RF Tester:Kungfumaster Liang

Date: 4.JUN.2024 19:51:11

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

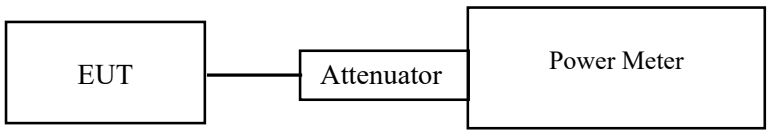
Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.9.2.3.2

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-06-04.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following table and plots.

Mode	Test Frequency (MHz)	Maximum AVG Conducted Output Power (dBm)	Limit (dBm)
LoRa	915	21.96	≤30

FCC §15.247(d) - 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

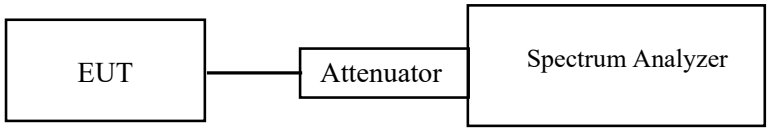
Applicable Standard

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)).

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.11

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

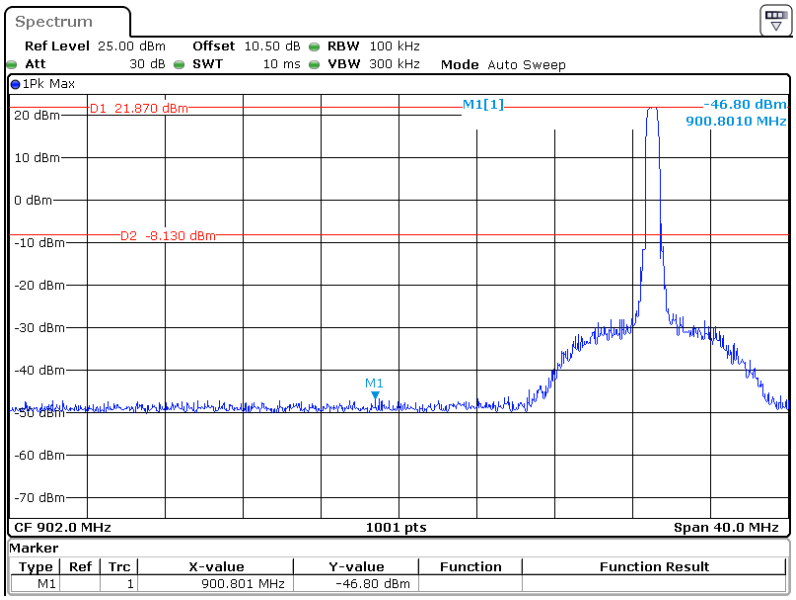
Environmental Conditions

Temperature:	23.8 ℃
Relative Humidity:	48 %
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-06-04.

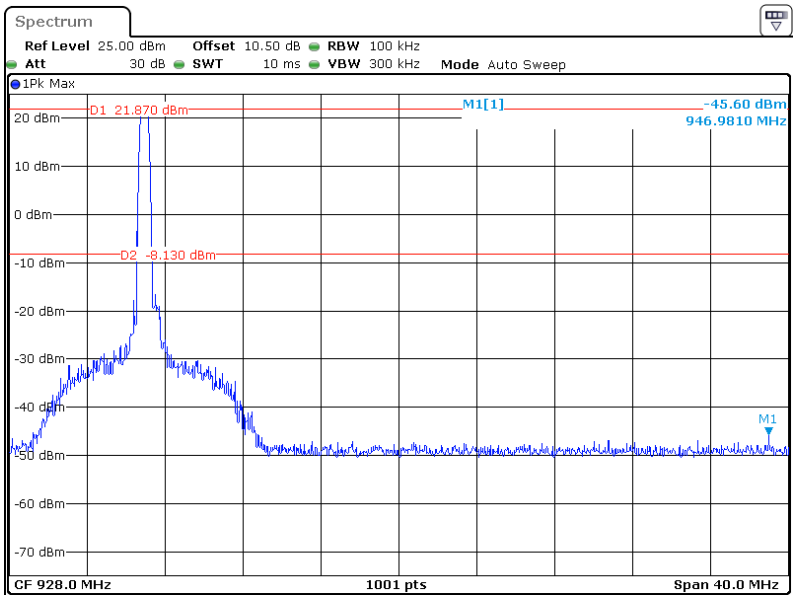
EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following plots.



ProjectNo.:SZ1240319-13904E-RF Tester:Kungfumaster Liang

Date: 4.JUN.2024 19:02:50



ProjectNo.:SZ1240319-13904E-RF Tester:Kungfumaster Liang

Date: 4.JUN.2024 19:15:52

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

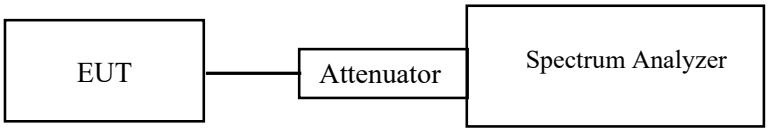
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.5

Use this procedure when the maximum average conducted output power in the fundamental emission is used to demonstrate compliance.

1. Measure the duty cycle (*D*) of the transmitter output signal as described in ANSI C63.10-2013 11.6.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = Power Averaging (rms).
6. Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
7. Sweep time = auto couple.
8. Trace mode = trace averaging (rms) mode over a minimum of 100 traces.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.
11. When the EUT cannot be configured to transmit continuously (i.e.,*D* < 98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ±2%), add [10 log (1 / D)], where D is the duty cycle measured in step 1), to the measured PSD to compute the average PSD during the actual transmission time.
12. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

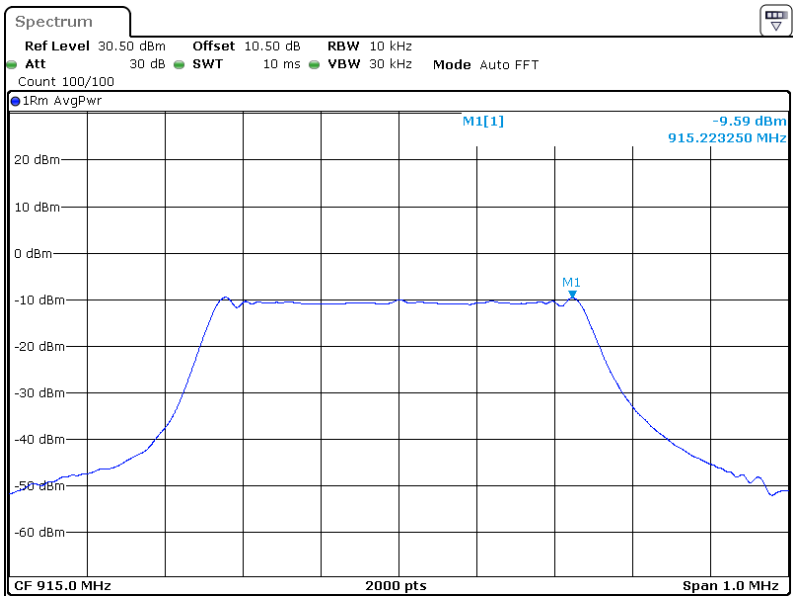
Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-06-04.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following table and plots.

Test Frequency (MHz)	Reading (dBm/10kHz)	Duty Cycle Factor (dB)	Power Spectral Density (dBm/10kHz)	Limit (dBm/3kHz)
915	-9.59	14.79	5.20	≤8.00



ProjectNo.:SZ1240319-13904E-RF Tester:Kungfumaster Liang

Date: 4.JUN.2024 19:34:08

EUT PHOTOGRAPHS

Please refer to the attachment SZ1240319-13904E-RF External photo and SZ1240319-13904E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment SZ1240319-13904E-RFB Test Setup photo.

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