

FCC PART 15.247

TEST REPORT

For

Chengdu Ebyte Electronic Technology Co., Ltd

Building B2, Mould Industrial Park, 199# Xi-Qu Ave, West High-tech Zone, Chengdu, 611731, Sichuan, China

Tested Model: E77-900M22S
FCC ID: 2A8C3-E77900M22S

Report Type: Original Report		Product Name: LoRaWAN wireless module	
Report Number:	RSC241216001-0		
Date of Report Issue:	2025-01-03		
Reviewed By:	Sula Huang 		
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: +86-28-65525123 Fax: +86-28-65525125 www.baclcorp.com		

Note: BACL is not responsible for the authenticity of any test data or information provided by the applicant. Test data or information included from the applicant that may affect test results are marked with an asterisk "*". Do not include customer model name, addresses, names and trademarks.

This report cannot be reproduced except in full, without prior written approval of the company.

This report may contain data that are not covered by the NVLAP accreditation scope and shall be marked with an asterisk " ◇ "

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

TABLE OF CONTENTS

GENERAL INFORMATION	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
MEASUREMENT UNCERTAINTY	5
TEST METHODOLOGY	5
TEST FACILITY	5
SYSTEM TEST CONFIGURATION	6
DESCRIPTION OF TEST CONFIGURATION*	6
EQUIPMENT MODIFICATIONS	6
EUT EXERCISE SOFTWARE*	6
SUPPORT TEST DEVICES DESCRIPTION	7
SUPPORT TEST CABLE DESCRIPTION	7
BLOCK DIAGRAM OF TEST SETUP	8
SUMMARY OF TEST RESULTS	10
TEST EQUIPMENTS LIST	11
FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE	13
APPLICABLE STANDARD	13
FCC §15.203 - ANTENNA REQUIREMENT	14
APPLICABLE STANDARD	14
ANTENNA INFORMATION*	14
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS	15
APPLICABLE STANDARD	15
EUT SETUP	15
EMI TEST RECEIVER SETUP	15
TEST PROCEDURE	16
CORRECTED AMPLITUDE & MARGIN CALCULATION	16
TEST DATA	16
FCC §15.209, §15.205 & §15.247(d) - RADIATED SPURIOUS EMISSIONS & BAND EDGE	19
APPLICABLE STANDARD	19
EUT SETUP	19
EMI TEST RECEIVER & SIGNAL ANALYZER SETUP	20
TEST PROCEDURE	21
CORRECTED AMPLITUDE & MARGIN CALCULATION	21
CONDUCTED SPURIOUS EMISSION AT ANTENNA PORT:	21
TEST SETUP BLOCK	21
TEST DATA	22
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH	42
APPLICABLE STANDARD	42
TEST PROCEDURE	42
TEST SETUP BLOCK	42
TEST DATA	43
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER	45
APPLICABLE STANDARD	45
TEST PROCEDURE	45
TEST SETUP BLOCK	45
TEST DATA	46

FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE	48
APPLICABLE STANDARD.....	48
TEST PROCEDURE	48
TEST SETUP BLOCK.....	48
TEST DATA.....	48
FCC §15.247(e) - POWER SPECTRAL DENSITY	50
APPLICABLE STANDARD.....	50
TEST PROCEDURE	50
TEST SETUP BLOCK.....	50
TEST DATA.....	51

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Chengdu Ebyte Electronic Technology Co., Ltd
Address	Building B2, Mould Industrial Park, 199# Xi-Qu Ave, West High-tech Zone, Chengdu, 611731, Sichuan, China
Email	157768495@qq.com
Product	LoRaWAN wireless module
Tested Model	E77-900M22S
FCC ID	2A8C3-E77900M22S
Frequency*	920.3 – 924.8 MHz
Modulation Type*	GFSK
Antenna Gain*	4.36dBi
RF peak output power	5.26 dBm
Voltage*	DC 1.8V – 3.6V (Typical: 3.3V)
Measure approximately	20mm (L)×14mm (W)×2.7mm (H)
Sample serial number	241216001/01 (RF Radiated Test & RF Conducted Test) (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received: 2024-12-16

Note: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

Objective

This report is prepared on behalf of **Chengdu Ebyte Electronic Technology Co., Ltd** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the compliance of the EUT with FCC Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Measurement Uncertainty

Item			Measurement Uncertainty	U_{cispr}
AC power line conducted emission			2.79 dB	3.4 dB
Radiated Emission	9kHz-30MHz		4.48dB	-
	30MHz-200MHz	H	4.34dB	6.3dB
	30MHz-200MHz	V	4.59dB	6.3dB
	200MHz-1GHz	H	4.69dB	6.3dB
	200MHz-1GHz	V	5.79dB	6.3dB
	1GHz-6GHz		4.58dB	5.2dB
	6GHz-18GHz		4.58dB	5.5dB

Item	Measurement Uncertainty
RF output power, conducted	$\pm 0.61\text{dB}$
Occupied Bandwidth	$\pm 1.69\%$
Power Spectrum Density, conducted	$\pm 2.52\text{dB}$
Humidity	$\pm 5\%$
Temperature	$\pm 1^{\circ}\text{C}$
Voltage(DC)	$\pm 0.4\%$
Voltage(AC, <10kHz)	$\pm 1\%$
Time	1%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the corresponding inclusion factor K when the inclusion probability is about 95%.

Test Methodology

All measurements contained in this report were conducted with:

1. ANSI C63.10-2020 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
2. KDB558074 D01 15.247 Meas Guidance v05r02.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Bay Area Compliance Laboratories Corp. (Chengdu) lab is accredited to ISO/IEC 17025 by NVLAP (Lab code: 600346-0) and the FCC designation No.: CN5056. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration*

The system was configured in testing mode, which was provided by manufacturer.

For 500kbps mode, 10 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	920.3	6	922.8
2	920.8	7	923.3
3	921.3	8	923.8
4	921.8	9	924.3
5	922.3	10	924.8

EUT was tested with channel 1, 6 and 10.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software*

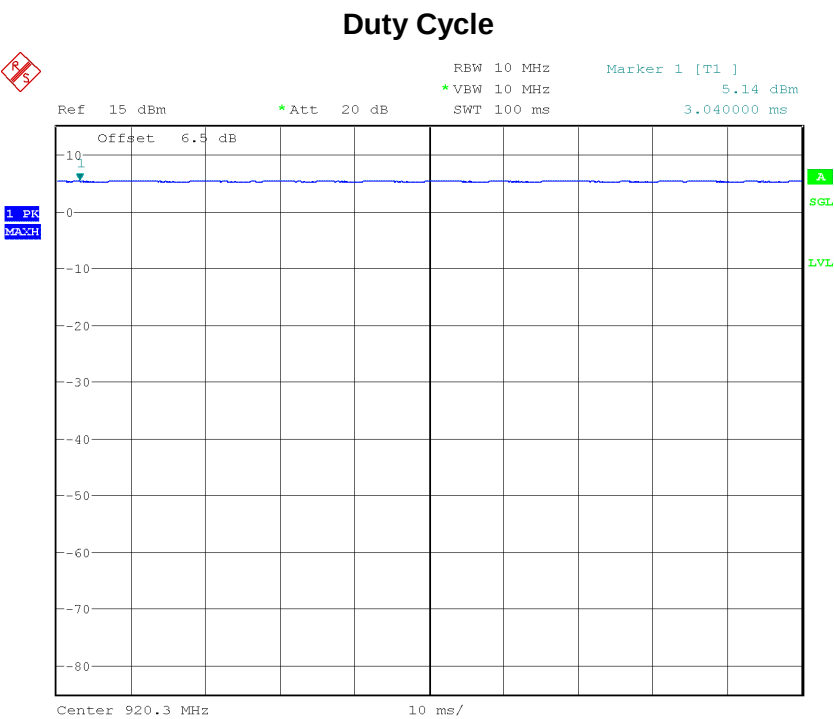
The setting by the software as following table:

Test Mode	Test Software	XCOM V2.6		
500kbps	Test Frequency (MHz)	920.3	922.8	924.8
	Data Rate	SF11	SF11	SF11
	Power Level	5	5	5

The RF module supports data rates(SF5,SF7,SF8,SF11) and each was pre-scan during test. Only the worst-case data rates(SF11) are determined to be as follows for each mode based upon investigations by measuring the average power, PSD across all data rates bandwidths and modulations.

Duty Cycle information is below:

Mode	T _{on}	T _p	Duty Cycle
	(ms)	(ms)	(%)
500kbps	100	100	100



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:54:35

Support Test Devices Description

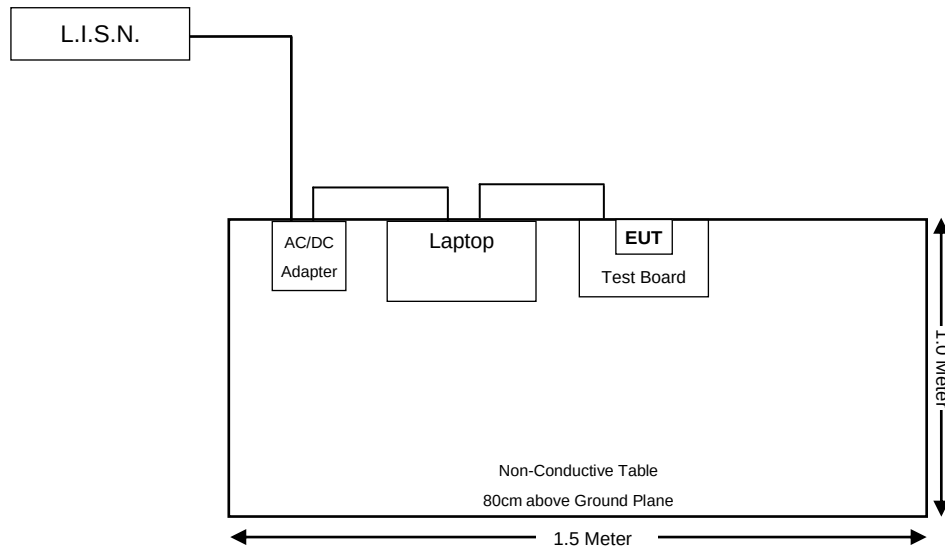
Manufacturer	Device Name	Model	Serial Number
Local			
Lenovo	Laptop	L540	No
Lenovo	AC/DC Adapter	ADLX45NDC2A	SA10E75790
Ebyte	Test Board	v1.0	10571

Support Test Cable Description

Cable Description	Length (m)	From / Port	To
Unshielded AC Power Cable	1.5	L.I.S.N.	AC/DC Adapter
Unshielded DC Power Cable	1.5	Adapter	Laptop
Unshielded USB Power Cable	0.5 or 1.5	Laptop	Test Board

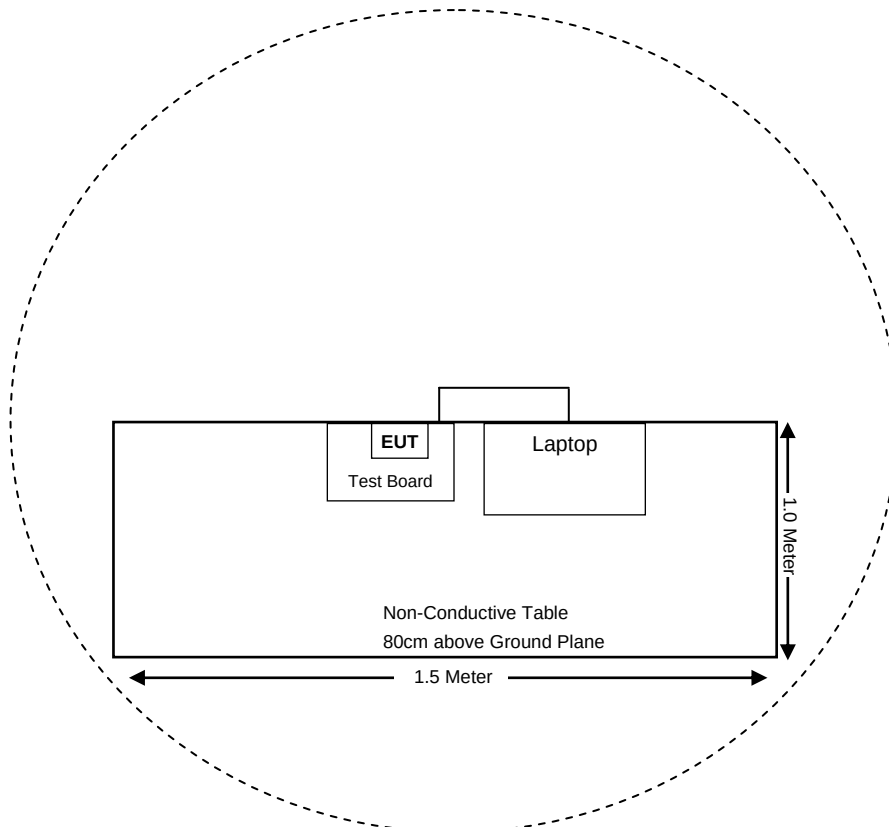
Block Diagram of Test Setup

Conducted Emissions:

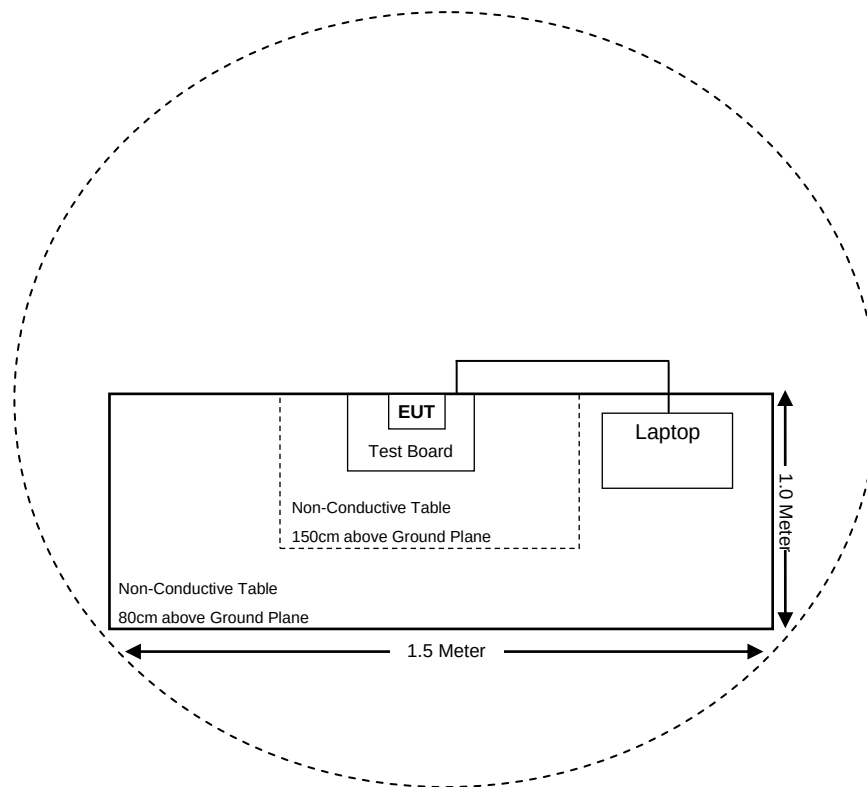


Radiated Emissions

Below 1GHz:



Above 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 & §1.1310 & §2.1091	Maximum Permissible Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	Raidated Spurious Emissions	Compliant
§15.247(d)	Conducted Spurious Emissions at Antenna Terminal	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum conducted output power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

TEST EQUIPMENTS LIST

Manufacturer	Description	Model Number	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions					
Rohde & Schwarz	EMI Test Receiver	ESCI 3	100028	2024-04-10	2025-04-09
Rohde & Schwarz	L.I.S.N.	ENV216	3560.6550.16	2024-04-10	2025-04-09
HP	RF Limiter	11947A	3107A01270	2024-08-03	2025-08-02
UTIFLEX	Conducted Cable	L-E-003	000003	2024-08-03	2025-08-02
Rohde & Schwarz	EMC32	EMC32	V 8.52.0	NCR	NCR
Radiated Emissions (9kHz-30MHz)					
EMCT	Semi-Anechoic Chamber	966	001	2023-04-15	2028-04-14
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2024-04-11	2025-04-10
BACL CORP	Active Loop Antenna	1313-1A	4031411	2024-05-20	2025-05-19
Xin Hang Xun Wei Bo	RF Cable (Below 1GHz)	XH500A-N/J- N/J-2Mbps-A	T-E271	2024-11-18	2025-11-17
Xin Hang Xun Wei Bo	RF Cable (Below 1GHz)	XH500A-N/J- N/J-7M-A	T-E268	2024-11-18	2025-11-17
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR
Radiated Emissions (30MHz-1GHz)					
EMCT	Semi-Anechoic Chamber	966	001	2023-04-15	2028-04-14
SONOMA INSTRUMENT	Pre-Amplifier	310 N	186684	2024-08-07	2025-08-06
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2024-01-24	2025-01-23
INMET	Attenuator	18N-6dB	64671	2024-01-24	2025-01-23
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2024-04-11	2025-04-10
HUBER+SUHENER	RF Cable (Below 1GHz)	L-E-015	MY4345/EA	2024-11-18	2025-11-17
Xin Hang Xun Wei Bo	RF Cable (Below 1GHz)	XH500A-N/J- N/J-2Mbps-A	T-E271	2024-11-18	2025-11-17
Xin Hang Xun Wei Bo	RF Cable (Below 1GHz)	XH500A-N/J- N/J-7M-A	T-E268	2024-11-18	2025-11-17
MICRO-TRONICS	900MHz Notch Filter	BRM50706	G216	2024-05-18	2025-05-17
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR

Manufacturer	Description	Model Number	Serial Number	Calibration Date	Calibration Due Date
Radiated Emissions (1GHz-10GHz)					
EMCT	Semi-Anechoic Chamber	966	001	2023-04-15	2028-04-14
Rohde & Schwarz	Signal Analyzer	FSV40	101943	2024-04-10	2025-04-09
Rohde & Schwarz	EMI Test Receiver	ESIB40	100215	2024-04-10	2025-04-09
ETS	Horn Antenna	3115	003-6076	2024-08-16	2025-08-15
A.H. Systems, inc.	Pre-Amplifier	PAM-0118P	509	2024-08-07	2025-08-06
MICRO-TRONICS	900MHz Notch Filter	BRM50706	G216	2024-05-18	2025-05-17
Xin Hang Xun Wei Bo	RF Cable (Above 1GHz)	XH500A-SMA/J-N/J-2Mbps-A	L-E-016	2024-12-12	2025-12-11
Xin Hang Xun Wei Bo	RF Cable (Above 1GHz)	XH500A-SMA/J-N/J-5M-A	L-E-017	2024-12-12	2025-12-11
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSU26	100113	2024-04-10	2025-04-09
MIDWEST	6dB Attenuator	219	AA4305	2024-03-01	2025-03-01
Astrolab	RF Coaxial Cable	MINIREND-5	1206	2024-10-18	2025-10-17

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

FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE

Applicable Standard

According to subpart 15.247 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:

S = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain*		Tune-up Conducted Power*		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
500 kHz	920.3 - 924.8	4.36	2.73	6.0	3.98	20	0.002	0.614

Result: The device meets FCC MPE at ≥20 cm distance.

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. The unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Information*

The EUT has one external monopole antenna with RP-SMA connector and the maximum antenna gain is 4.36dBi, which fulfill the requirement of this section. Please refer to the EUT photos.

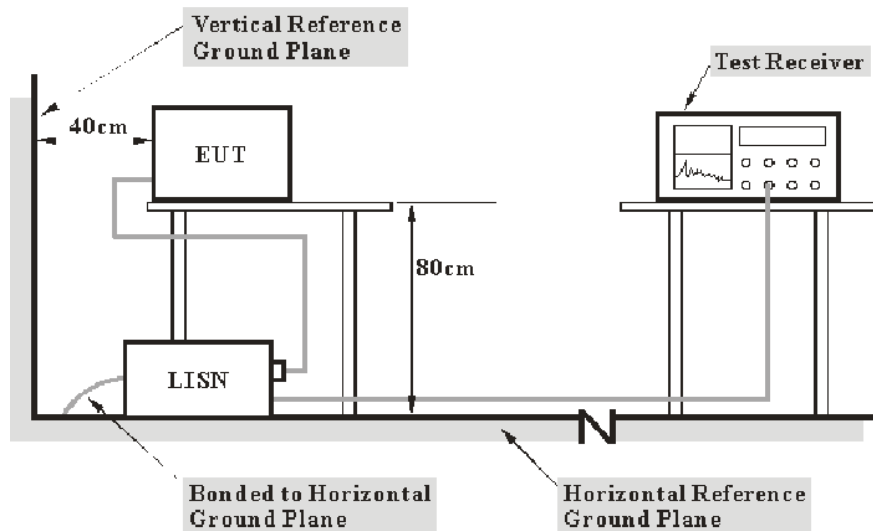
Result: Compliance

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 C63.10-2020 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

During the conducted emission test, the adapter of laptop was connected to the first L.I.S.N.

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

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

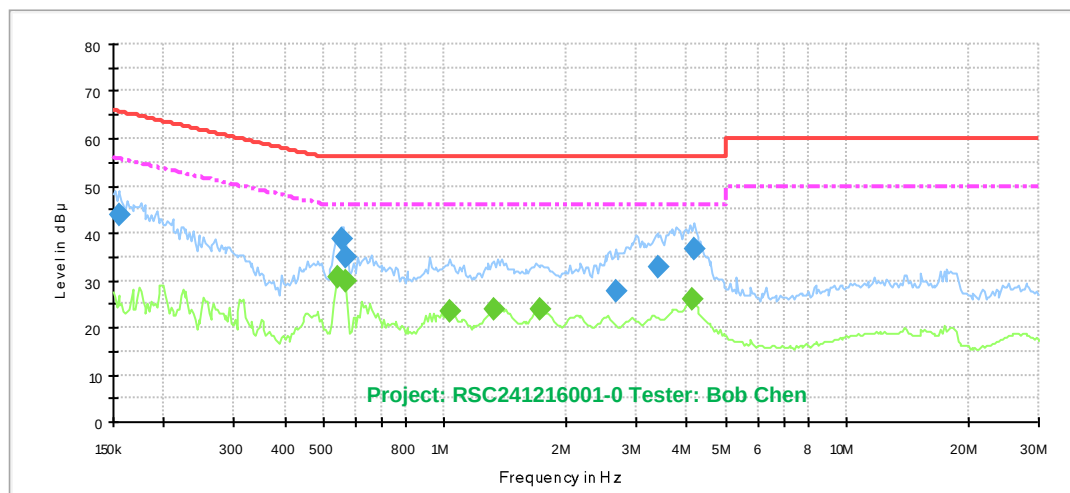
Test Data

Test Environment Conditions

Temperature:	15 °C
Relative Humidity:	60 %
ATM Pressure:	96.2 kPa

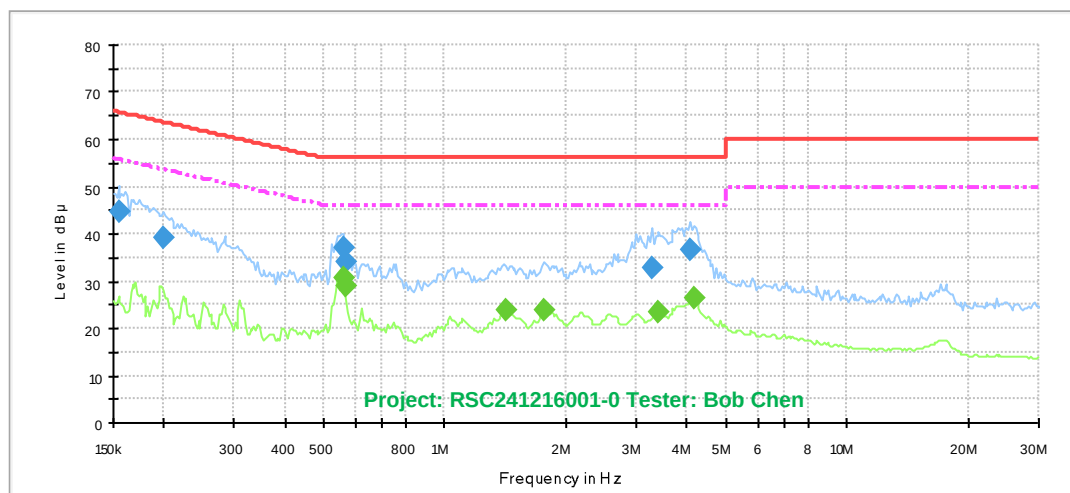
The testing was performed by Bob Chen on 2024-12-23.

Test Mode: Transmitting_low channel_maximum transmitting power mode

AC120V/60Hz, Line:

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	RBW/VBW (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154545	43.6	5000.0	9.000/30.000	L1	19.7	22.1	65.8
0.552321	38.7	5000.0	9.000/30.000	L1	19.6	17.3	56.0
0.569057	34.7	5000.0	9.000/30.000	L1	19.6	21.3	56.0
2.660533	27.6	5000.0	9.000/30.000	L1	19.6	28.4	56.0
3.378170	32.9	5000.0	9.000/30.000	L1	19.7	23.1	56.0
4.163230	36.5	5000.0	9.000/30.000	L1	19.7	19.5	56.0

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	RBW/VBW (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.541438	30.8	5000.0	9.000/30.000	L1	19.6	15.2	46.0
0.569057	29.7	5000.0	9.000/30.000	L1	19.6	16.3	46.0
1.033804	23.6	5000.0	9.000/30.000	L1	19.7	22.4	46.0
1.325783	23.8	5000.0	9.000/30.000	L1	19.6	22.2	46.0
1.734401	24.0	5000.0	9.000/30.000	L1	19.5	22.0	46.0
4.122010	25.9	5000.0	9.000/30.000	L1	19.7	20.1	46.0

AC120V/60Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	RBW/VBW (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154545	44.8	5000.0	9.000/30.000	N	19.5	20.9	65.8
0.200176	39.0	5000.0	9.000/30.000	N	19.4	24.6	63.6
0.557844	37.1	5000.0	9.000/30.000	N	19.5	18.9	56.0
0.569057	34.1	5000.0	9.000/30.000	N	19.5	21.9	56.0
3.278819	32.9	5000.0	9.000/30.000	N	19.6	23.1	56.0
4.081198	36.6	5000.0	9.000/30.000	N	19.6	19.5	56.0

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	RBW/VBW (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.557844	30.5	5000.0	9.000/30.000	N	19.5	15.5	46.0
0.569057	28.7	5000.0	9.000/30.000	N	19.5	17.3	46.0
1.421419	23.7	5000.0	9.000/30.000	N	19.5	22.3	46.0
1.769262	23.6	5000.0	9.000/30.000	N	19.5	22.4	46.0
3.411952	23.4	5000.0	9.000/30.000	N	19.6	22.6	46.0
4.163230	26.4	5000.0	9.000/30.000	N	19.7	19.6	46.0

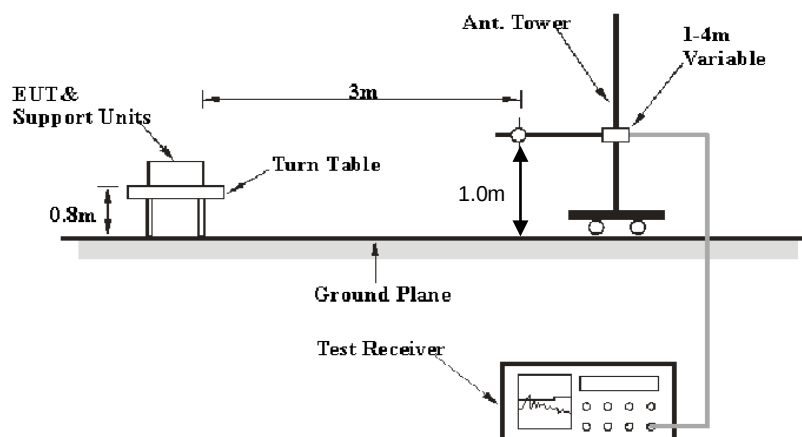
FCC §15.209, §15.205 & §15.247(d) - RADIATED SPURIOUS EMISSIONS & BAND EDGE

Applicable Standard

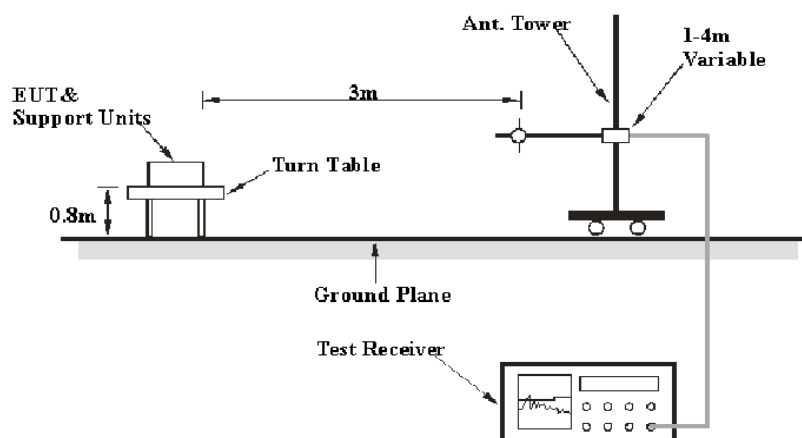
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

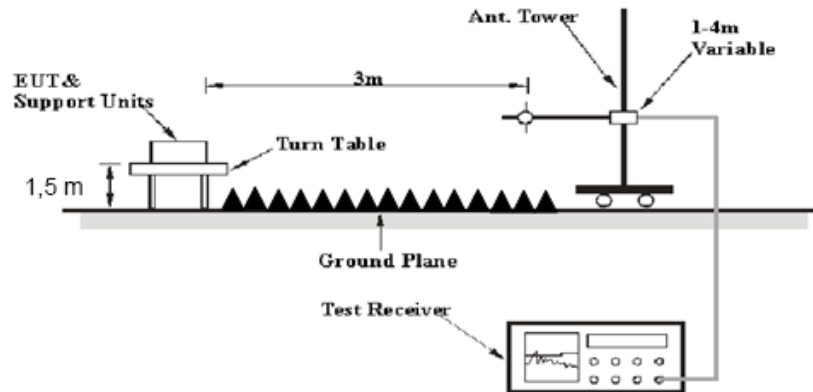
9kHz - 30MHz:



30MHz - 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2020. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Signal Analyzer Setup

The system was investigated from 9 kHz to 10 GHz.

During the radiated emission test, the EMI test receiver or Signal Analyzer was set with the following configurations:

Frequency Range	RBW	Video B/W	Measurement
9 kHz – 150 kHz	200 Hz	1 kHz	PK
150 kHz – 30 MHz	9 kHz	30 kHz	PK
30 MHz – 1000 MHz	120 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	PK
	1 MHz	3 MHz	CISPR AV

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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.

If the peak detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude (MaxPeak or QuasiPeak)} = \text{Meter Reading} + \text{Antenna Loss} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

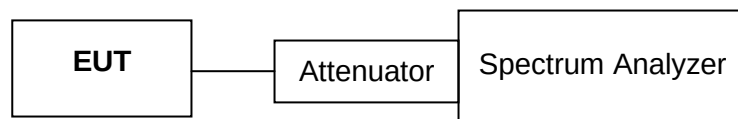
$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Conducted Spurious Emission At Antenna Port:

Connect the antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector.

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = No faster than coupled (auto) time.
- Trace mode = max-hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum unwanted emissions amplitude level.

Test Setup Block



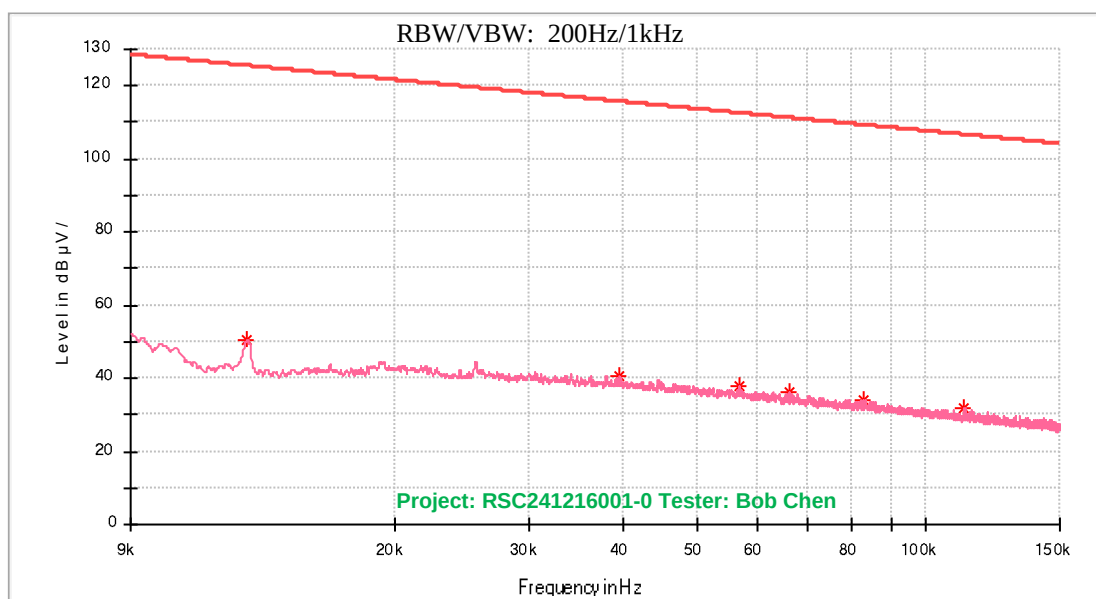
Test Data**Test Environment Conditions**

Temperature:	17 °C
Relative Humidity:	62 %
ATM Pressure:	95.2 kPa

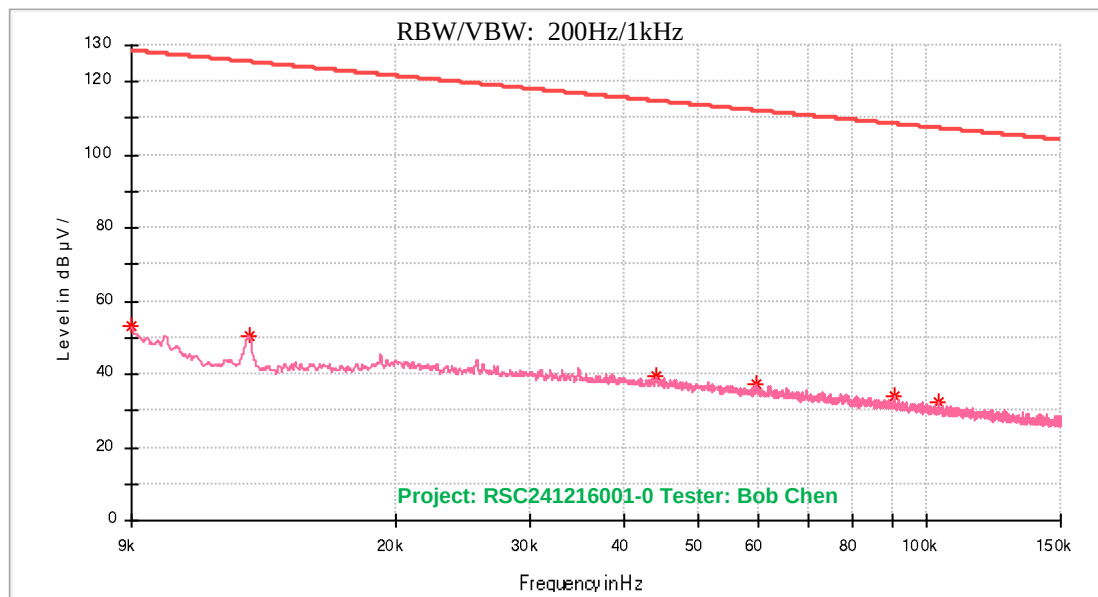
The testing was performed by Bob Chen on 2024-12-20.

Test Mode: Transmitting

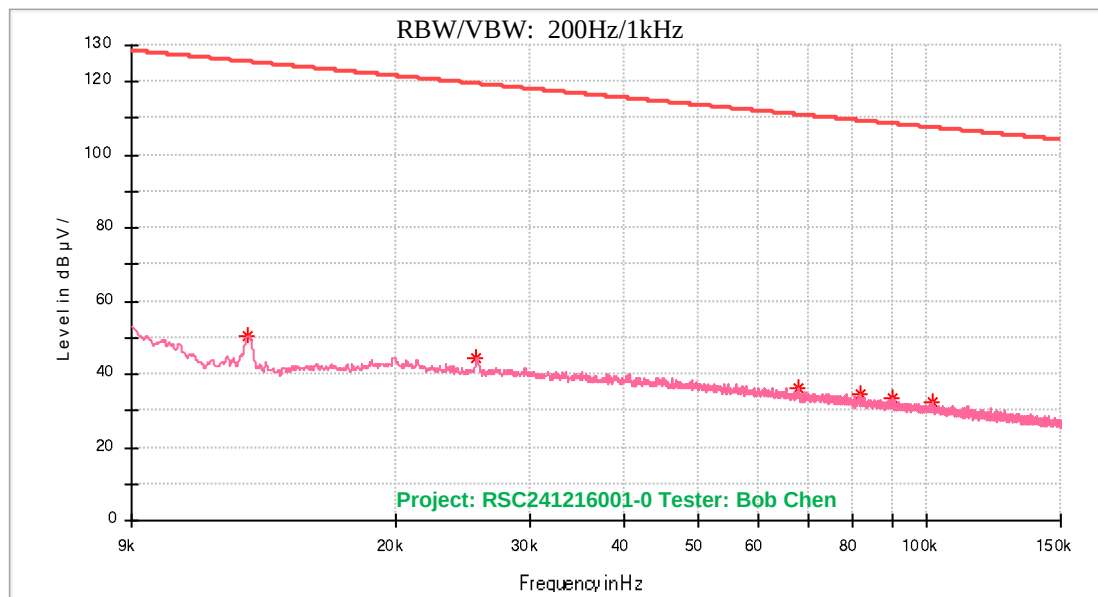
Note: Pre-scan and configuration EUT with X, Y and Z-axis, the Y-axis is the worst case.

Radiated Spurious Emissions:**1) 9 kHz to 150 kHz_low channel_ maximum transmitting power mode****Parallel**

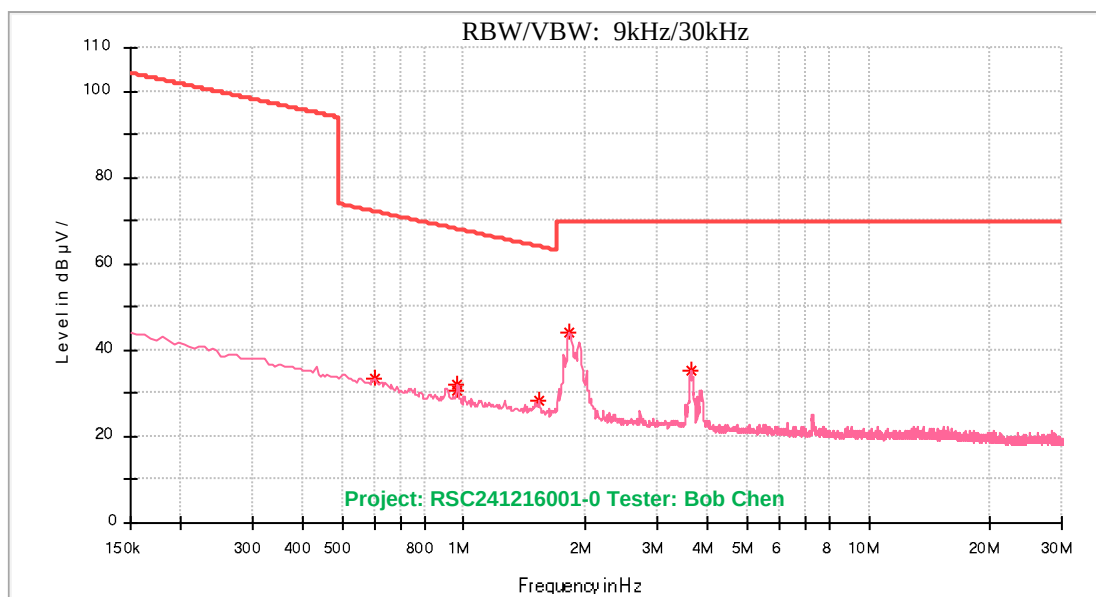
Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.012807	50.48	125.44	74.96	100.0	317.0	22.9
0.039615	40.76	115.63	74.87	100.0	31.0	20.7
0.056852	37.59	112.50	74.91	100.0	59.0	18.3
0.066316	36.25	111.16	74.92	100.0	39.0	17.2
0.082919	34.17	109.22	75.05	100.0	356.0	15.4
0.112459	31.63	106.58	74.95	100.0	191.0	13.0

Perpendicular

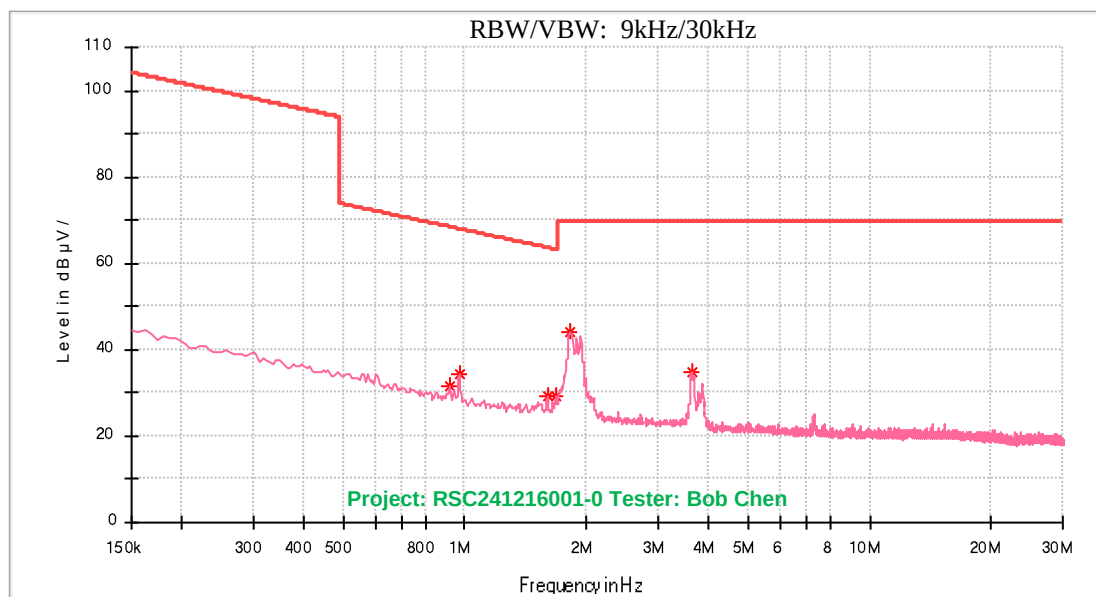
Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.009000	53.38	128.50	75.12	100.0	255.0	28.5
0.012842	50.62	125.41	74.79	100.0	0.0	22.8
0.044109	39.59	114.70	75.11	100.0	139.0	20.1
0.059548	37.27	112.10	74.83	100.0	232.0	18.0
0.090463	33.78	108.47	74.68	100.0	251.0	14.8
0.103382	32.18	107.31	75.13	100.0	128.0	13.7

Ground Parallel

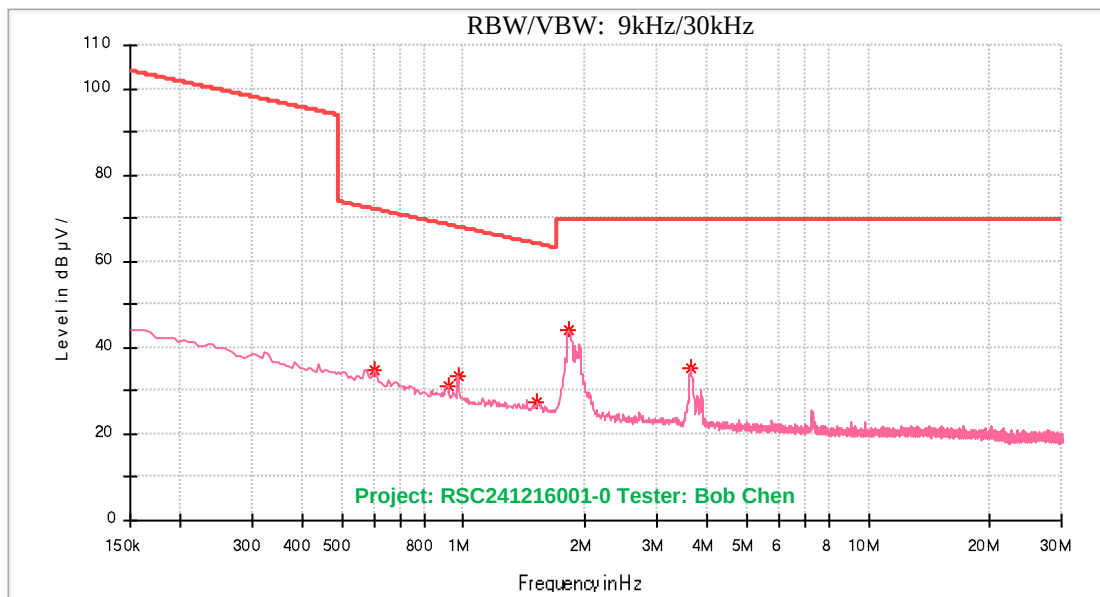
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.012807	50.72	125.44	74.72	100.0	234.0	22.9
0.025550	44.62	119.44	74.83	100.0	151.0	22.6
0.067850	36.20	110.96	74.77	100.0	147.0	17.0
0.081580	34.45	109.36	74.91	100.0	285.0	15.6
0.089899	33.50	108.52	75.02	100.0	73.0	14.8
0.101919	32.47	107.43	74.96	100.0	261.0	13.9

2) 150 kHz to 30 MHz_low channel_ maximum transmitting power mode**Parallel**

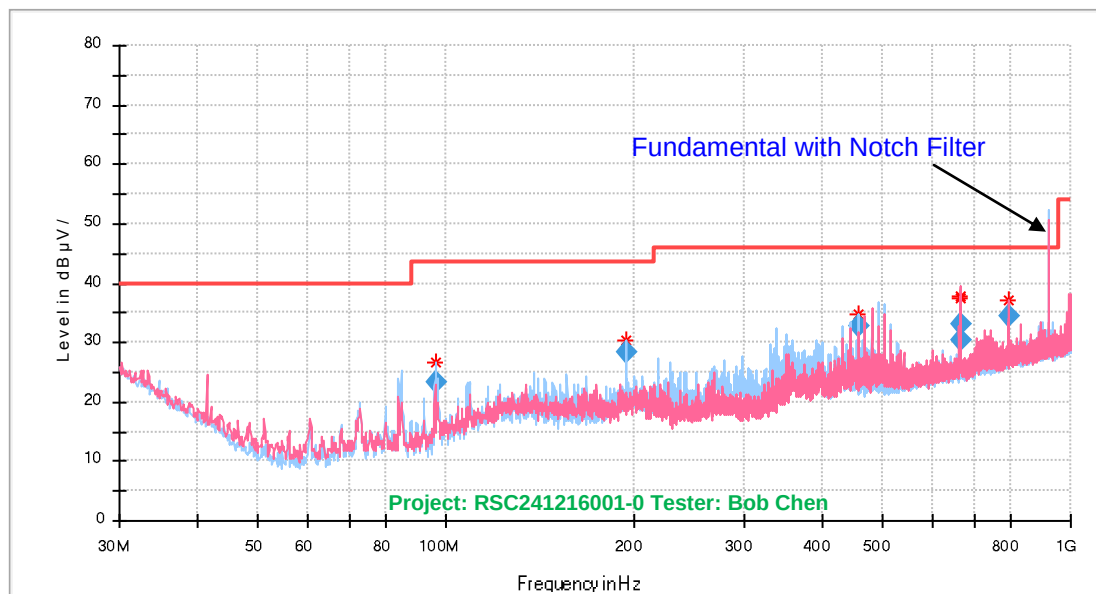
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.603720	33.32	71.99	38.68	100.0	71.0	-0.9
0.955950	30.55	68.01	37.46	100.0	159.0	-4.1
0.961920	32.20	67.96	35.76	100.0	159.0	-4.1
1.535040	28.12	63.91	35.79	100.0	143.0	-6.3
1.809660	44.12	69.50	25.38	100.0	35.0	-7.1
3.636480	35.20	69.50	34.30	100.0	23.0	-8.6

Perpendicular

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.914160	31.41	68.40	36.99	100.0	137.0	-3.8
0.967890	34.26	67.90	33.64	100.0	75.0	-4.2
1.600710	29.04	63.55	34.51	100.0	35.0	-6.5
1.672350	29.32	63.17	33.85	100.0	35.0	-6.7
1.809660	44.07	69.50	25.43	100.0	18.0	-7.1
3.630510	34.82	69.50	34.68	100.0	22.0	-8.6

Ground Parallel

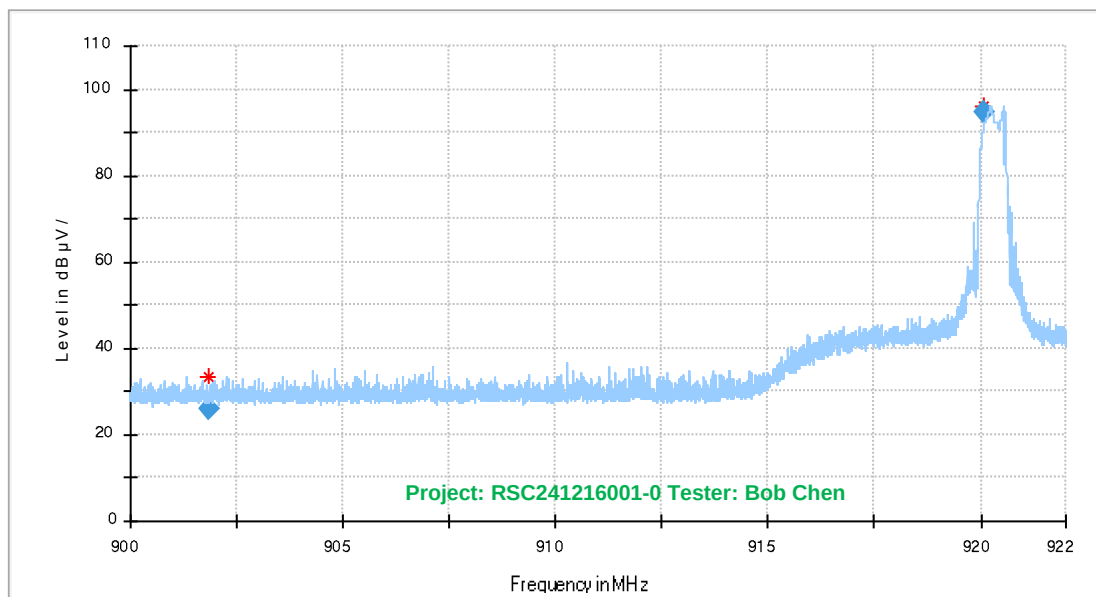
Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Azimuth (deg)	Corr. (dB)
0.603720	34.67	71.99	37.32	100.0	60.0	-0.9
0.914160	31.26	68.40	37.14	100.0	34.0	-3.8
0.967890	33.63	67.90	34.27	100.0	60.0	-4.2
1.523100	27.46	63.98	36.52	100.0	14.0	-6.3
1.815630	44.08	69.50	25.42	100.0	18.0	-7.1
3.630510	35.33	69.50	34.17	100.0	26.0	-8.6

3) 30 MHz to 1 GHz_low channel_ maximum transmitting power mode

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
96.015150	23.16	43.50	20.34	1000.0	120.000	165.0	H	18.0	-14.7
194.261000	28.26	43.50	15.24	1000.0	120.000	143.0	H	167.0	-10.9
456.025750	32.72	46.00	13.28	1000.0	120.000	105.0	H	150.0	-5.5
664.831700	30.48	46.00	15.52	1000.0	120.000	119.0	V	185.0	-2.1
666.195450	33.10	46.00	12.90	1000.0	120.000	102.0	V	12.0	-2.2
796.936950	34.56	46.00	11.44	1000.0	120.000	173.0	V	30.0	0.1

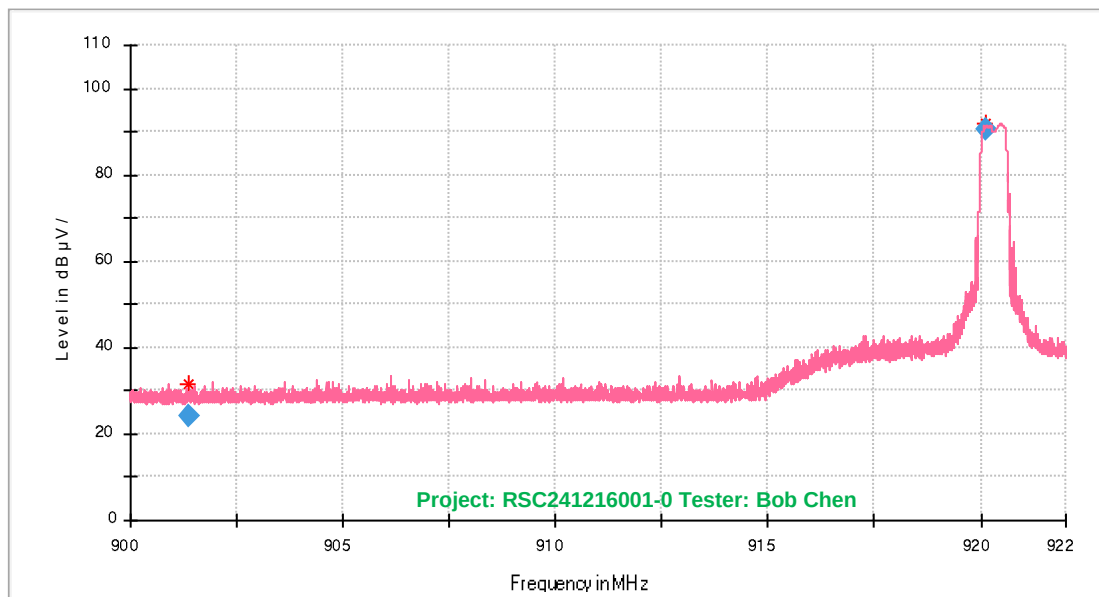
4) Band Edge

Left_Horizontal



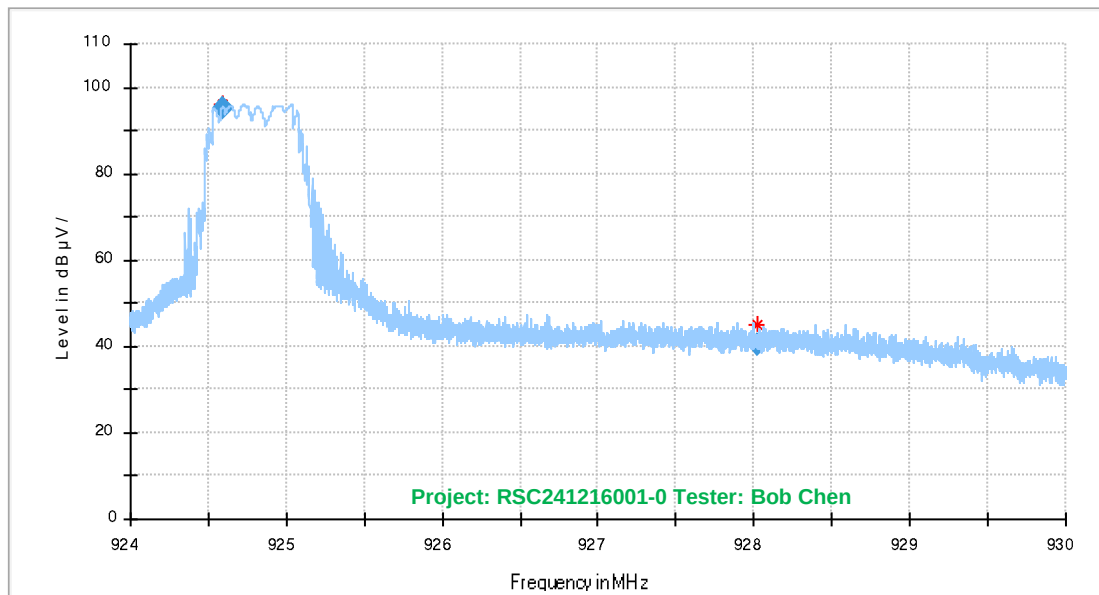
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
901.825000	25.95	46.00	20.05	1000.0	120.000	102.0	H	90.0	1.6
920.069350	94.76	---	---	1000.0	120.000	106.0	H	298.0	2.1

Left_Vertical



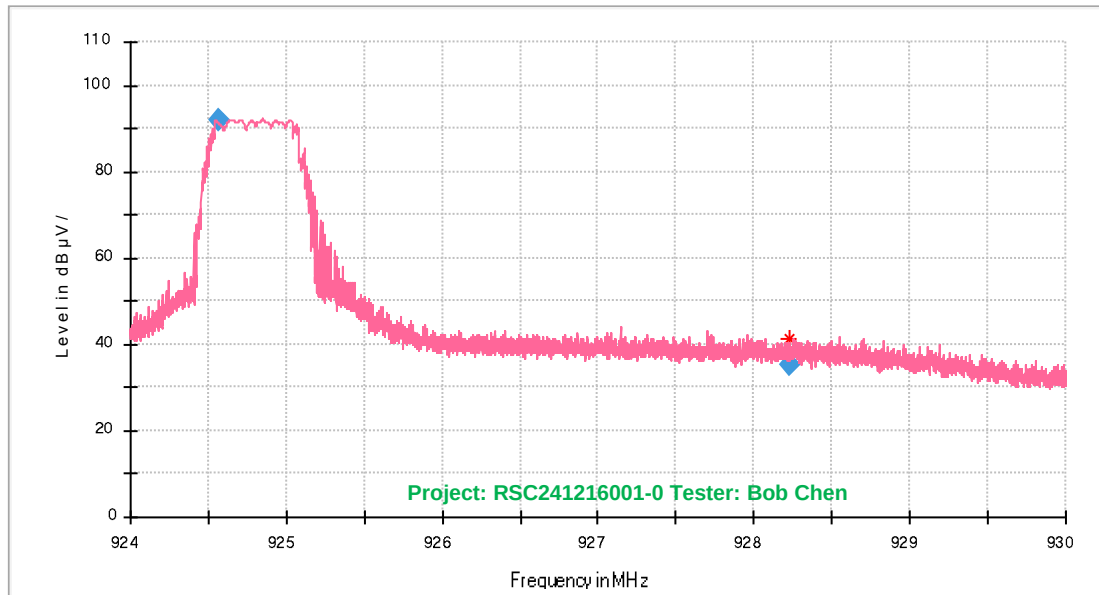
Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
901.364150	23.99	46.00	22.01	1000.0	120.000	103.0	V	241.0	1.6
920.134950	90.41	---	---	1000.0	120.000	148.0	V	95.0	2.1

Right_Horizontal



Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
924.584850	95.13	---	---	1000.0	120.000	102.0	H	297.0	2.3
928.020200	40.15	46.00	5.85	1000.0	120.000	104.0	H	299.0	2.3

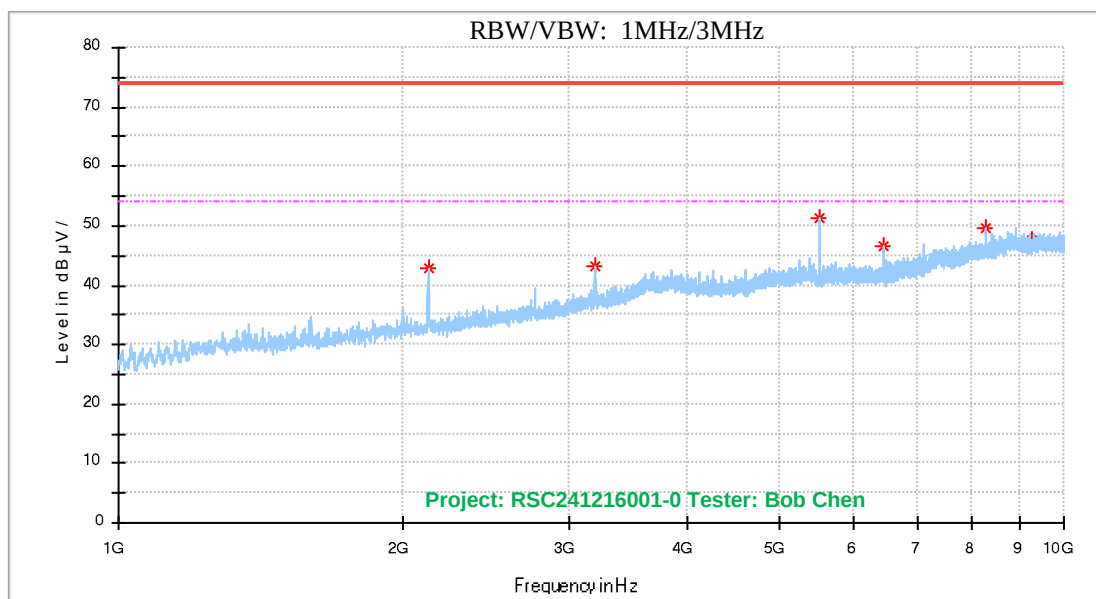
Right_Vertical



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
924.568300	91.86	---	---	1000.0	120.000	143.0	V	29.0	2.3
928.231800	35.20	46.00	10.80	1000.0	120.000	149.0	V	25.0	2.3

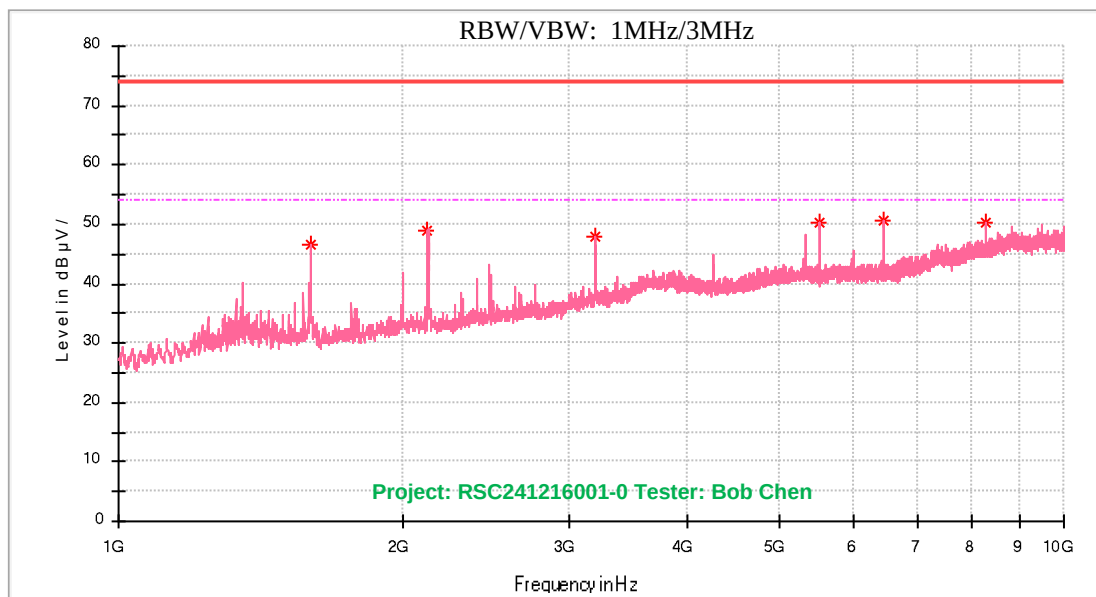
5) 1GHz-10GHz

Note: 1. If the peak detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Low Channel_Horizontal

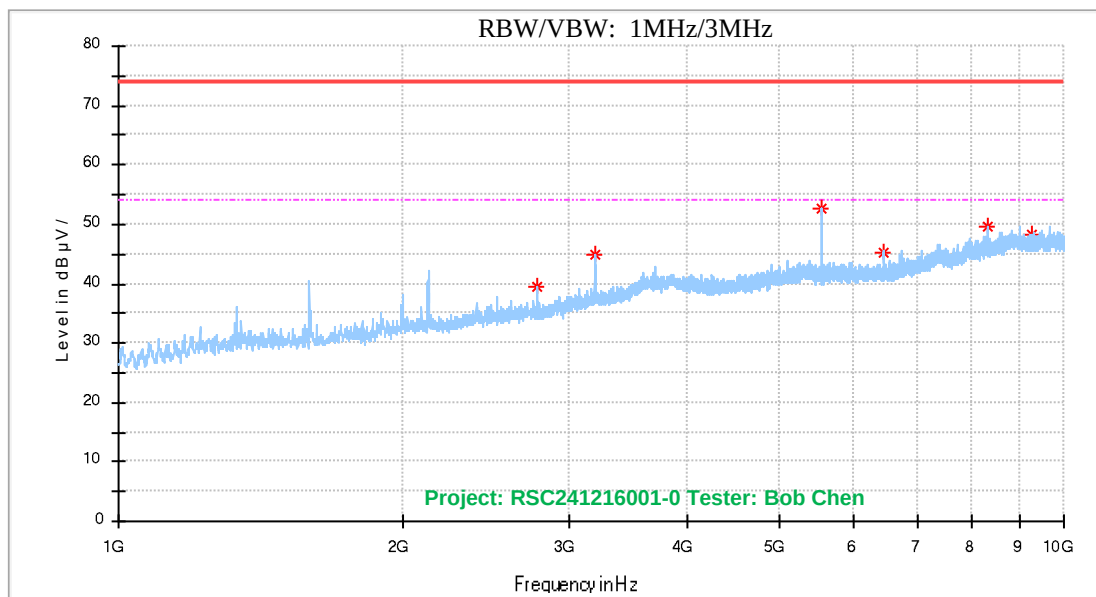
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2125.000000	42.76	74.00	31.24	200.0	H	297.0	-13.8
3186.100000	43.17	74.00	30.83	200.0	H	323.0	-9.0
5522.500000	51.45	74.00	22.55	150.0	H	191.0	-4.5
6443.200000	46.53	74.00	27.47	100.0	H	0.0	-3.9
8284.600000	49.65	74.00	24.35	150.0	H	136.0	0.3
9230.500000	47.67	74.00	26.33	200.0	H	84.0	0.9

Low Channel_Vertical

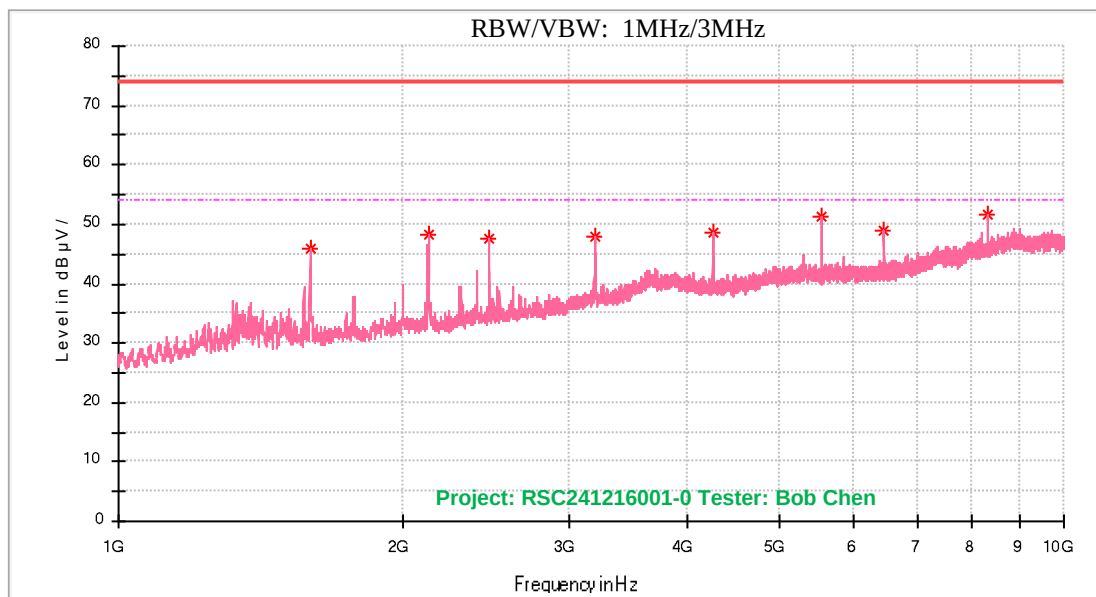


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1599.400000	46.53	74.00	27.47	100.0	V	283.0	-16.3
2124.100000	48.90	74.00	25.10	100.0	V	174.0	-13.8
3190.600000	47.93	74.00	26.07	100.0	V	202.0	-9.0
5520.700000	50.38	74.00	23.62	200.0	V	176.0	-4.5
6443.200000	50.56	74.00	23.44	100.0	V	276.0	-3.9
8284.600000	50.24	74.00	23.76	200.0	V	114.0	0.3

Middle Channel_Horizontal

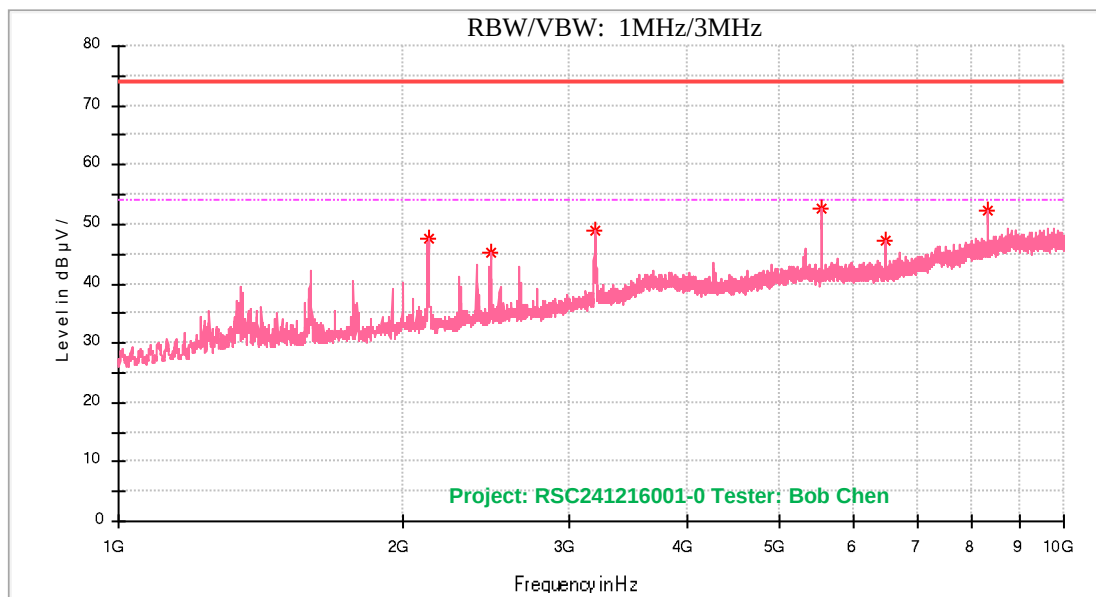


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2767.600000	39.44	74.00	34.56	150.0	H	323.0	-11.2
3196.000000	44.98	74.00	29.02	100.0	H	0.0	-9.0
5538.700000	52.63	74.00	21.37	200.0	H	169.0	-4.5
6458.500000	45.31	74.00	28.69	100.0	H	345.0	-3.9
8305.300000	49.73	74.00	24.27	150.0	H	132.0	0.3
9239.500000	48.24	74.00	25.76	200.0	H	316.0	0.8

Middle Channel_Vertical

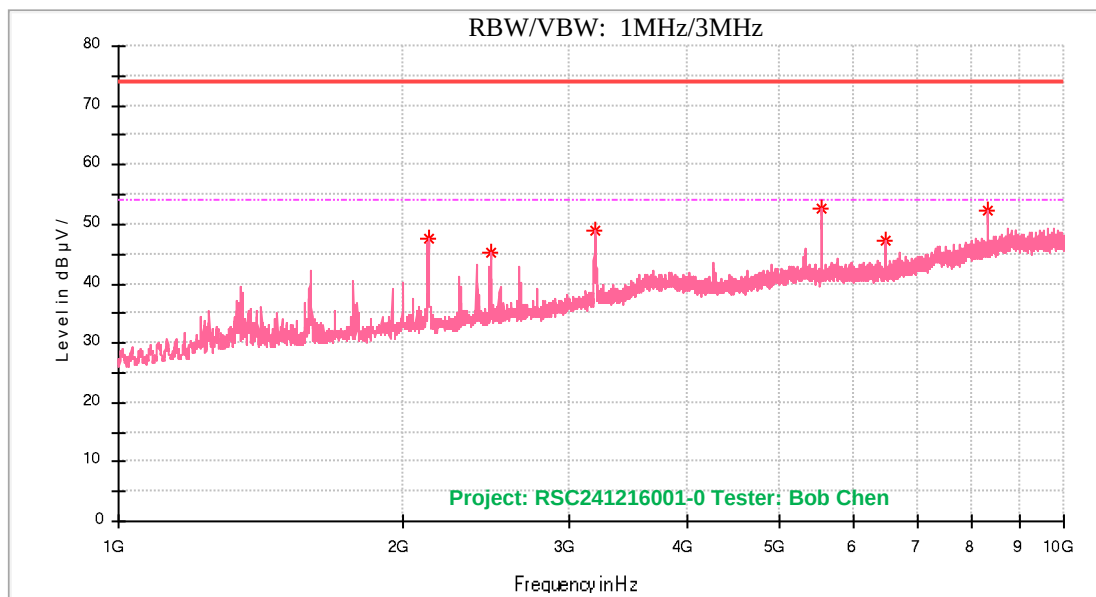
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1599.400000	45.91	74.00	28.09	100.0	V	83.0	-16.3
2126.800000	48.15	74.00	25.85	100.0	V	22.0	-13.7
2466.100000	47.70	74.00	26.30	100.0	V	285.0	-12.4
3188.800000	47.92	74.00	26.08	150.0	V	295.0	-9.0
4250.800000	48.56	74.00	25.44	150.0	V	295.0	-6.7
5536.900000	51.30	74.00	22.70	200.0	V	240.0	-4.5
6461.200000	49.03	74.00	24.97	150.0	V	271.0	-3.9
8307.100000	51.51	74.00	22.49	150.0	V	111.0	0.3

High Channel_Horizontal

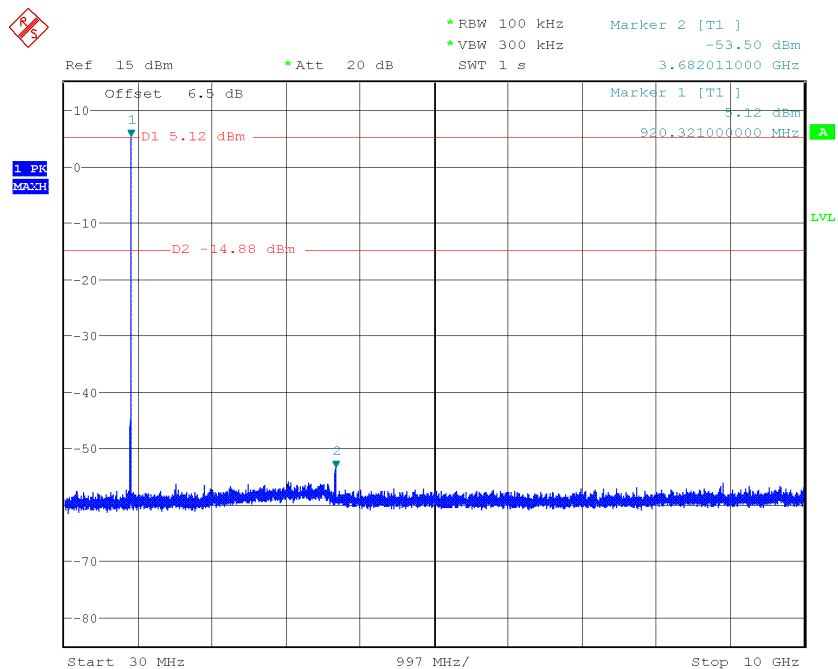


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2128.600000	41.55	74.00	32.45	200.0	H	291.0	-13.7
3642.400000	42.38	74.00	31.62	100.0	H	1.0	-6.1
5547.700000	51.90	74.00	22.10	150.0	H	164.0	-4.5
6475.600000	44.25	74.00	29.75	100.0	H	344.0	-3.8
8322.400000	49.78	74.00	24.22	200.0	H	0.0	0.2
9218.800000	48.37	74.00	25.63	150.0	H	182.0	1.0

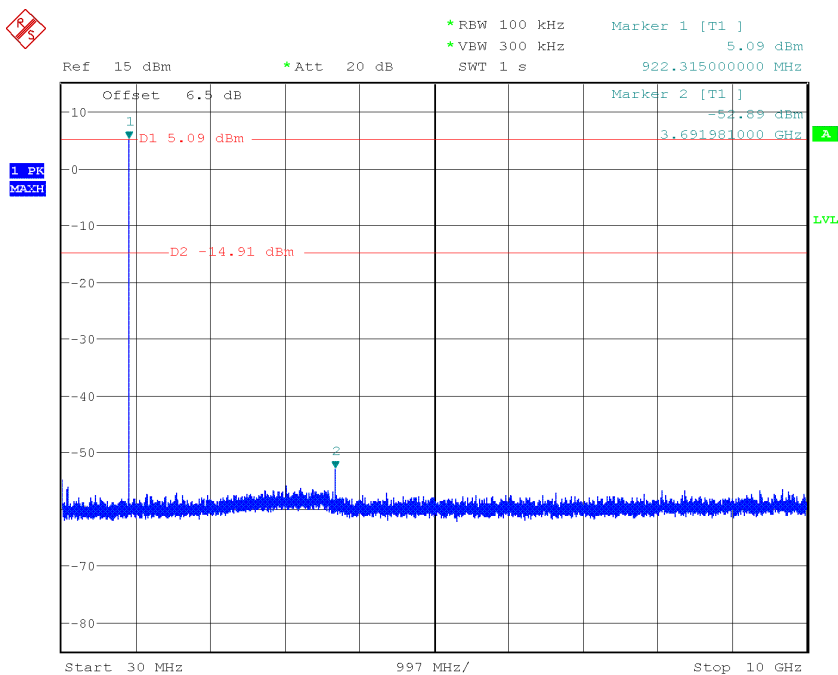
High Channel_Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2132.200000	47.71	74.00	26.29	150.0	V	337.0	-13.7
2481.400000	45.24	74.00	28.76	100.0	V	289.0	-12.3
3192.400000	48.92	74.00	25.08	100.0	V	295.0	-9.0
5549.500000	52.63	74.00	21.37	150.0	V	242.0	-4.5
6472.900000	47.42	74.00	26.58	200.0	V	247.0	-3.9
8325.100000	52.19	74.00	21.81	100.0	V	107.0	0.2

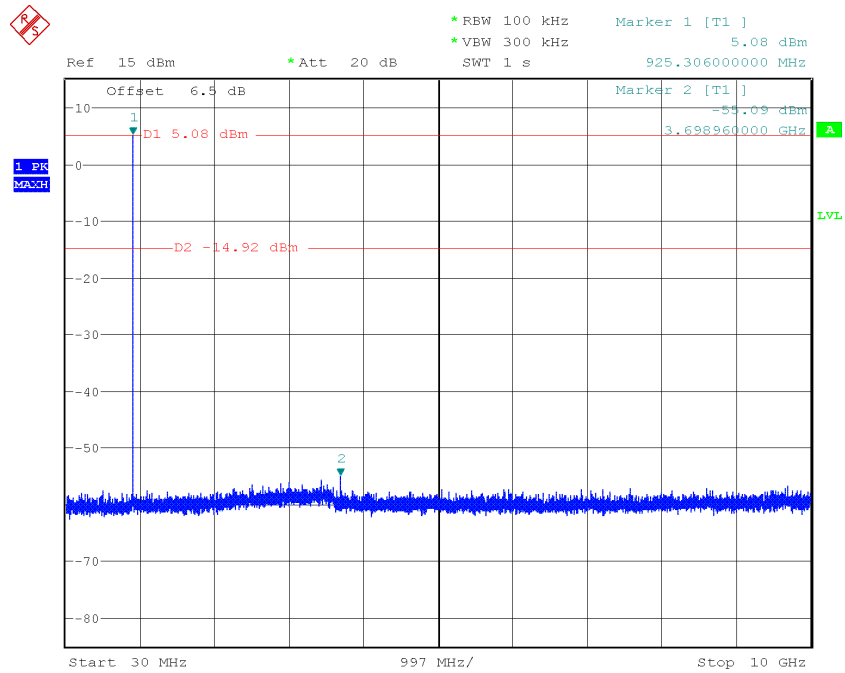
Conducted Spurious Emission At Antenna Port:**Low Channel**

Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 13:50:51

Middle Channel

Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 13:58:22

High Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 13:56:01

FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz bands.

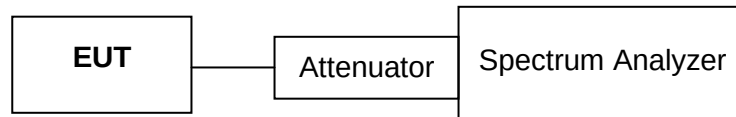
The minimum 6 dB bandwidth shall be at least SRD.

Test Procedure

ANSI C63.10-2020 Clause 11.8.1 Option 1

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) 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.

Test Setup Block



Note: Offset (6.5dB) = 6dB Attenuator(6dB) + RF cable loss(0.5dB)

Test Data

Environmental Conditions

Temperature:	15 °C
Relative Humidity:	60 %
ATM Pressure:	96.0 kPa

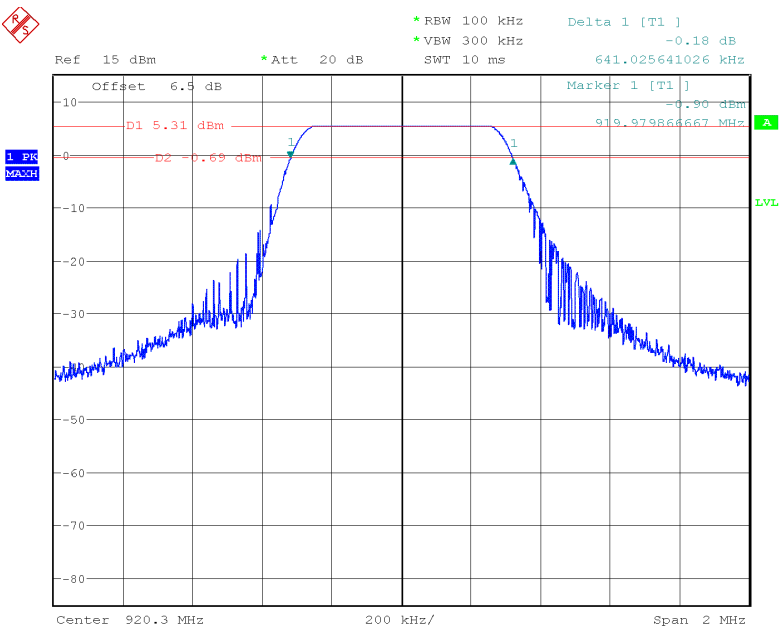
The testing was performed by Bob Chen on 2024-12-20.

Test Mode: Transmitting

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

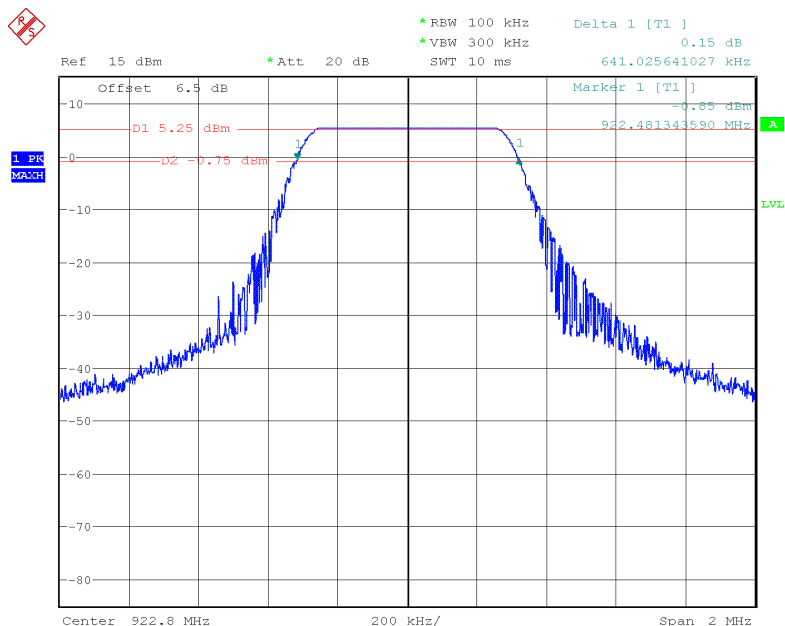
Mode	Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)
500kbps	Low	920.3	641.026	≥500
	Middle	922.8	641.026	≥500
	High	924.8	647.436	≥500

Low Channel



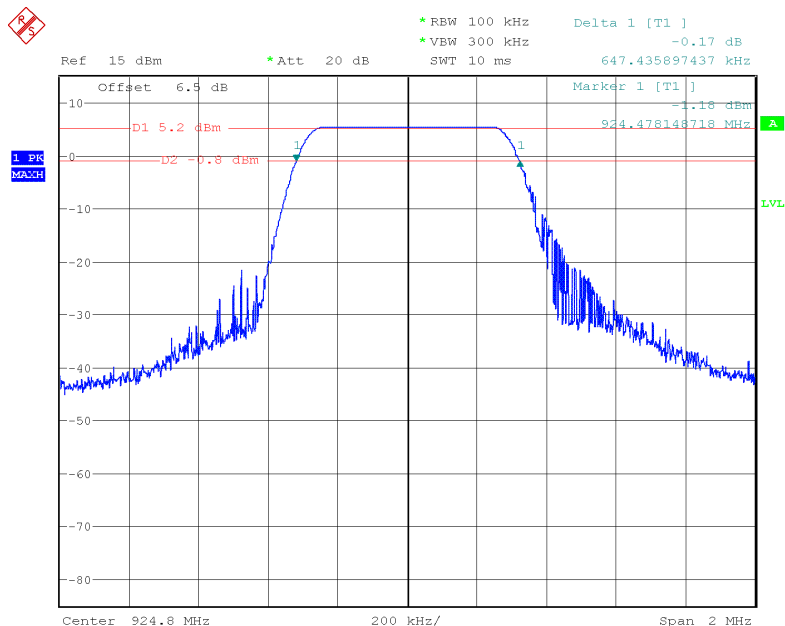
Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:34:24

Middle Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:37:59

High Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:41:12

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.

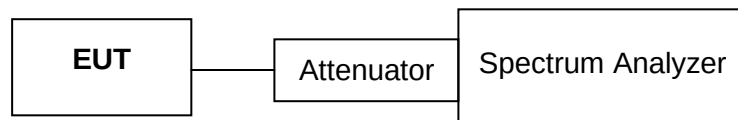
Test Procedure

ANSI C63.10-2020 Clause 11.9.1.1 $RBW \geq DTS$ bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the $RBW \geq DTS$ bandwidth.
- b) Set $VBW \geq [3 \times RBW]$.
- c) Set span $\geq [3 \times RBW]$.
- d) Sweep time = No faster than coupled (auto) time.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

Test Setup Block



Test Data

Environmental Conditions

Temperature:	15 °C
Relative Humidity:	60 %
ATM Pressure:	96.0 kPa

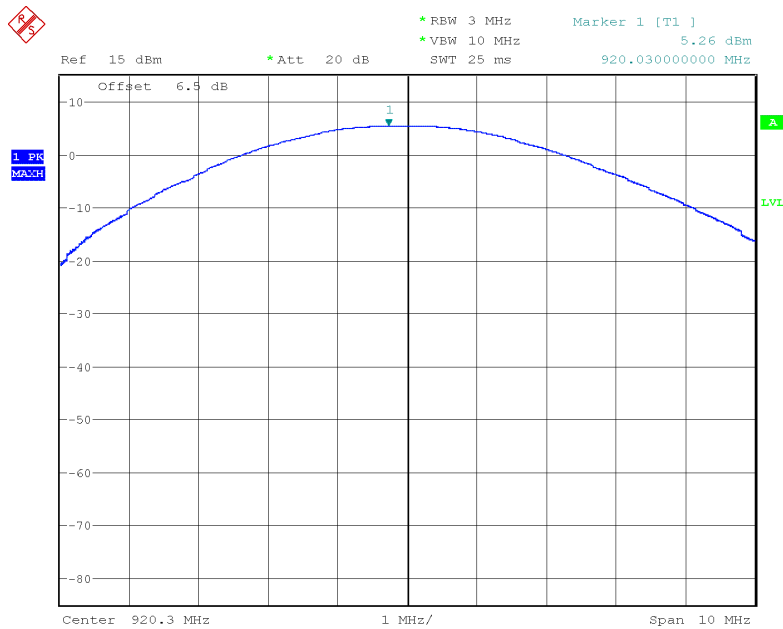
The testing was performed by Bob Chen on 2024-12-20.

Test Mode: Transmitting

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

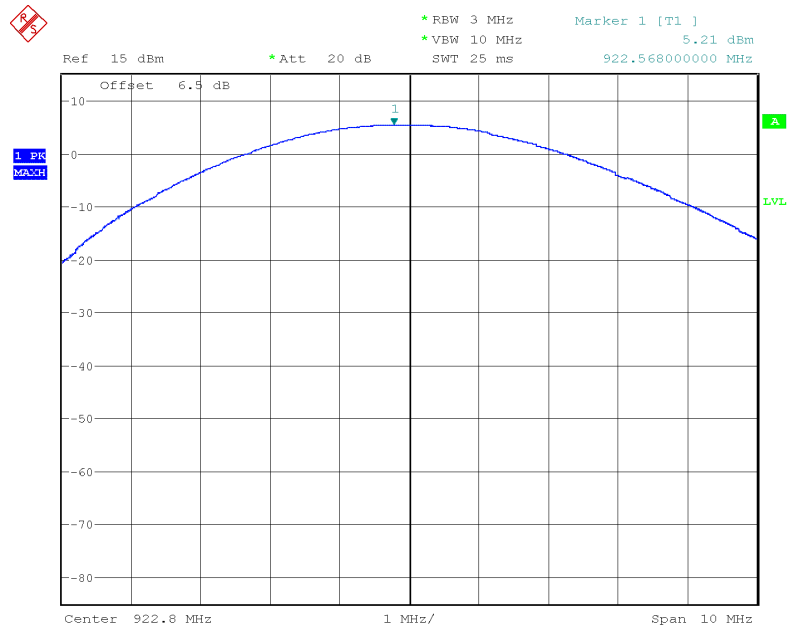
Mode	Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
500kbps	Low	920.3	5.26	≤30
	Middle	922.8	5.21	≤30
	High	924.8	5.16	≤30

Low Channel



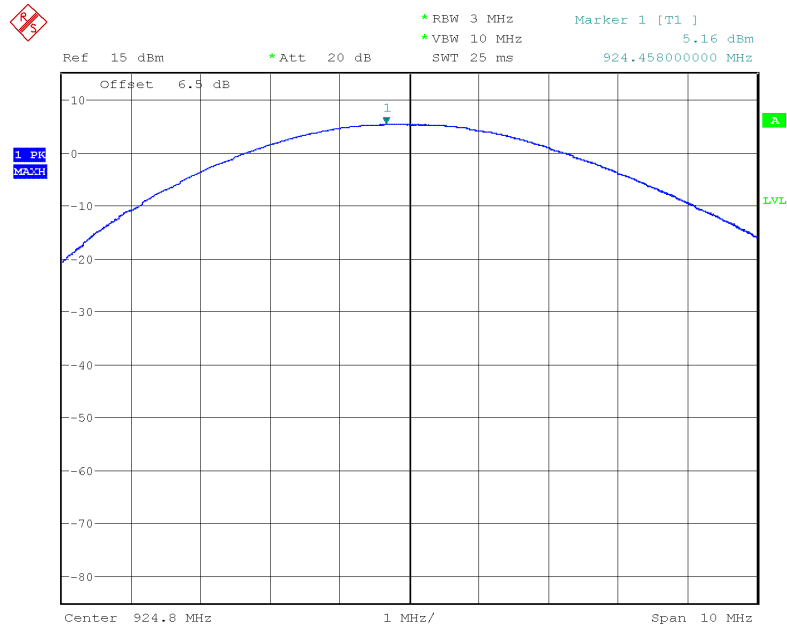
Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:03:32

Middle Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:04:46

High Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:05:58

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

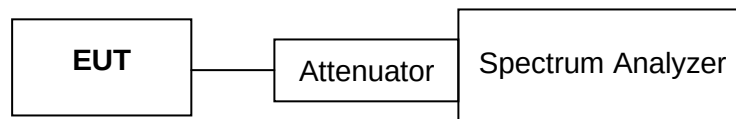
Applicable Standard

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

1. 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.
2. 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.
3. Repeat above procedures until all measured frequencies were complete.

Test Setup Block



Test Data

Environmental Conditions

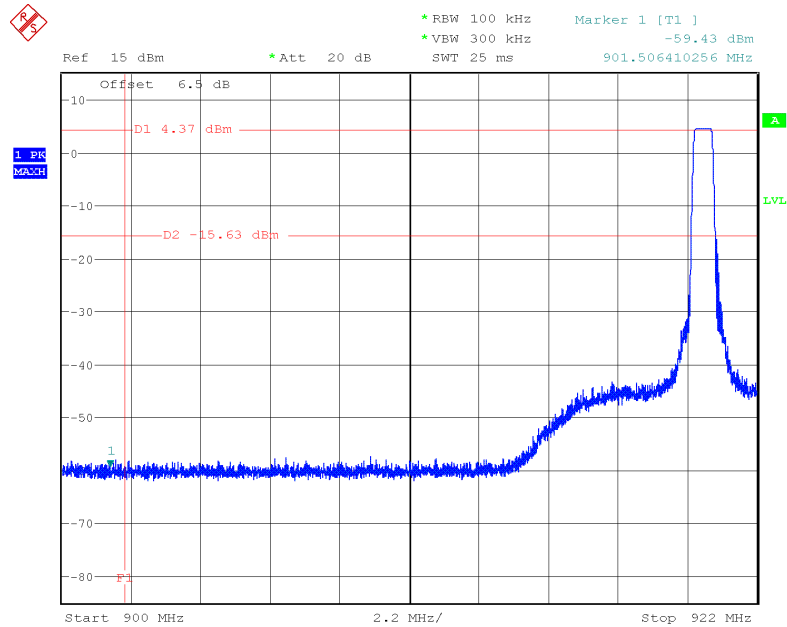
Temperature:	15 °C
Relative Humidity:	60 %
ATM Pressure:	96.0 kPa

The testing was performed by Bob Chen on 2024-12-20.

Test mode: Transmitting

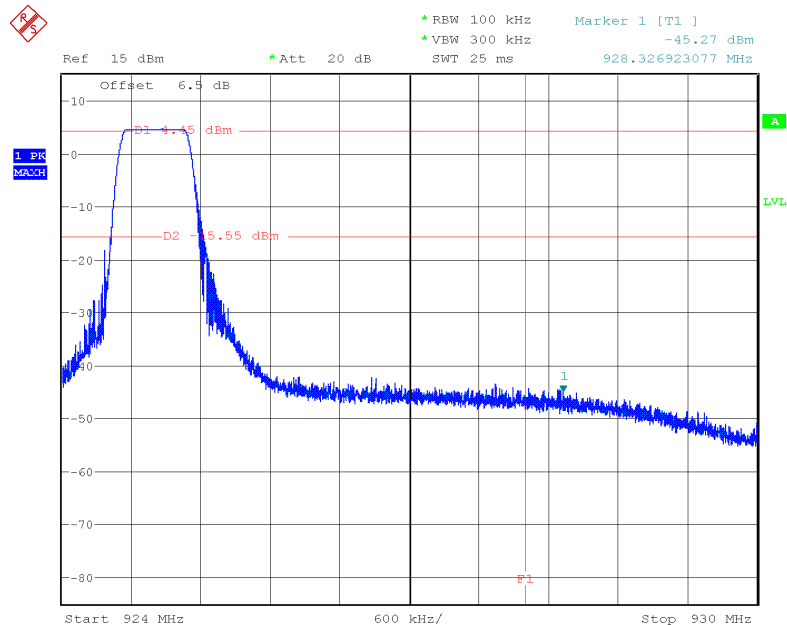
Test Result: Compliance. Please refer to following plots.

Band Edge, Left Side



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 13:33:15

Band Edge, Right Side



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 13:54:58

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

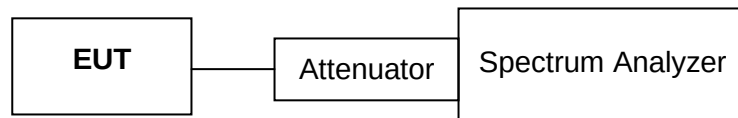
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of 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

ANSI C63.10-2020 Clause 11.10.2(PKPSD)

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Setup Block



Test Data

Environmental Conditions

Temperature:	15 °C
Relative Humidity:	60 %
ATM Pressure:	96.0 kPa

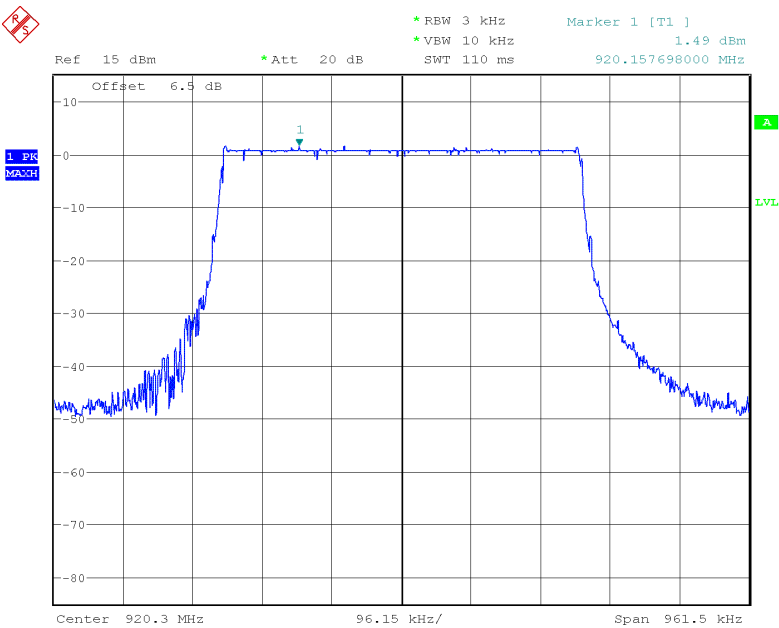
The testing was performed by Bob Chen on 2024-12-20.

Test Mode: Transmitting

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

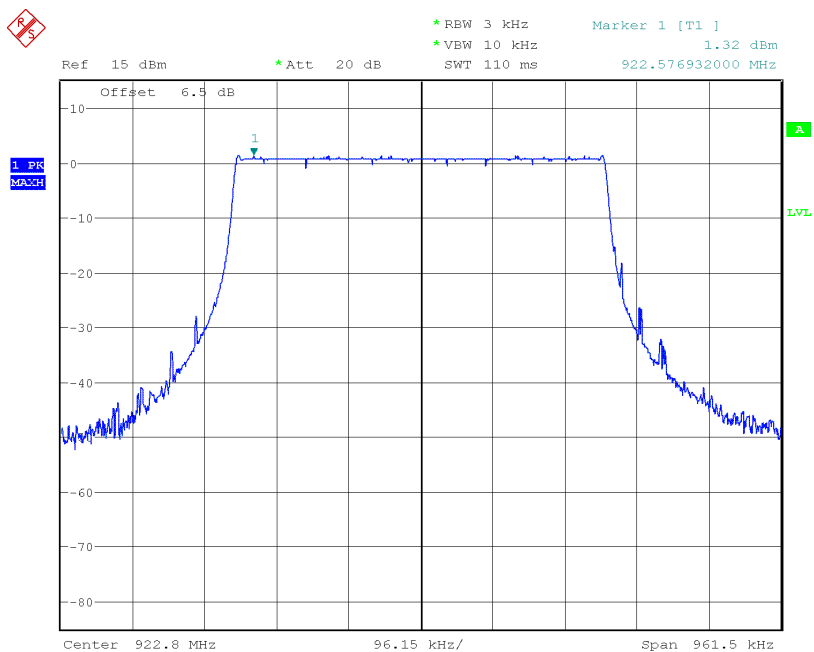
Mode	Channel	Frequency (MHz)	PSD (dBm/3KHz)	Limit (dBm/3kHz)
500kbps	Low	920.3	1.49	≤8
	Middle	922.8	1.32	≤8
	High	924.8	2.46	≤8

Power Spectral Density, Low Channel



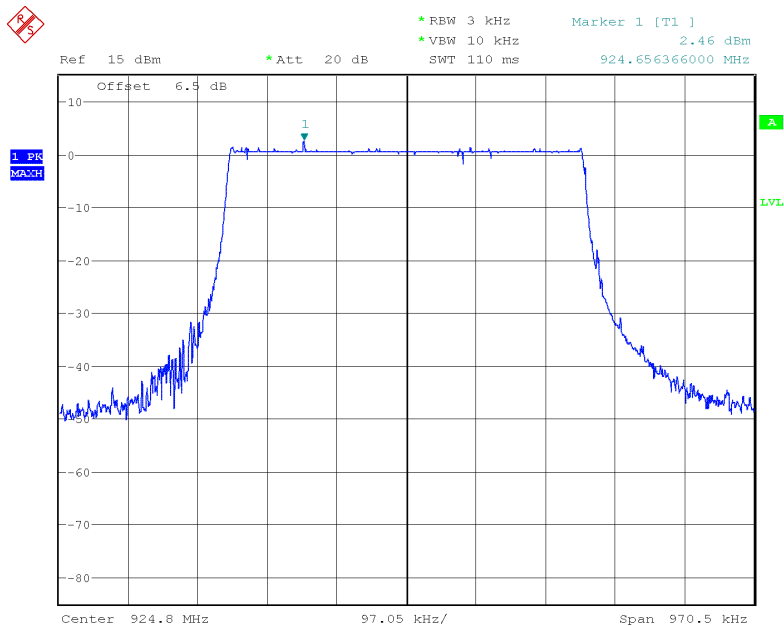
Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:52:58

Power Spectral Density, Middle Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:50:01

Power Spectral Density, High Channel



Comment: Project:RSC241216001-0 Tester:Bob Chen
Date: 20.DEC.2024 15:46:19

END OF REPORT