

FCC Part 15.225
RSS-210, ISSUE 11, June 2024
RSS-GEN, ISSUE 5, February 2021 Amendment 2
TEST REPORT

For

Luminys Systems Corporation

15245 Alton Pkwy # 100, Irvine, CA 92618 United States

FCC ID: 2BHII-RWCA
IC: 33045-RWCA

Report Type:
Original Report

Product Type:
Access Reader

Report Producer : Coco Lin

Report Number : RXZ241107014RF01

Report Date : 2024-12-31

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	Luminys Systems Corporation
	15245 Alton Pkwy # 100, Irvine, CA 92618 United States
Brand(Trade) Name	N/A
Product (Equipment) / PMN	Access Reader
Main Model Name	R-WCA
HVIN	R-WCA
Frequency Range	13.56 MHz
E-field Strength	62.36 dBuV/m@3m
Modulation Technique	ASK
Power Operation	12Vdc
Received Date	2024/11/08

*All measurement and test data in this report was gathered from production sample serial number:

RXZ241107014-1 (Assigned by BACL, New Taipei Laboratory).

1.2 Objective

This report is prepared on behalf of *Luminys Systems Corporation* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission's rules, and RSS-210, Issue 11, June 2024 of the Innovation, Science and Economic Development Canada, and RSS-Gen Issue 5, February 2021 Amendment 2, General Requirements for Compliance of Radio Apparatus.

The objective is to determine the compliance of the EUT with FCC rules, section 15.203, 15.205, 15.207, 15.209 and 15.225.

1.3 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 RSS-210, Issue 11, June 2024 of the Innovation, Science and Economic Development Canada, and RSS-Gen Issue 5, February 2021 Amendment 2, General Requirements for Compliance of Radio Apparatus.

1.4 Statement

Decision Rule: No, (The test results do not include MU judgment)

It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory).

Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

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

The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.5 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 3.02 dB
Frequency stability		+/- 0.00 ppm
Occupied Bandwidth		+/- 0.09 %
Unwanted Emissions, conducted		+/- 1.09 dB
Emissions, radiated	9 kHz~30 MHz	+/- 3.20 dB
	30 MHz~1 GHz	+/- 3.30 dB
Temperature		+/- 0.76 °C
Humidity		+/- 0.41 %

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.

1.6 Environmental Conditions

Test Site	Test Date	Temperature (°C)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2024/11/15	23.2	45	1007.1	Jing Chang
Radiation Spurious Emissions	2024/11/12	22.8	68	1013.2	Nick Hsieh
Frequency Stability	2024/11/14	24.9	51	1011	Jing Chang
Emission Bandwidth	2024/11/26	24.9	51	1020.1	Jing Chang

1.7 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒ 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 221, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: TW3732.

2 System Test Configuration

2.1 Description of Test Configuration

The system was configured for testing in a typical fashion (as normally used by a typical user).

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

No test software was used.

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number
DC Power Supply	KIKUSUI	PMC35-2
Fixture	Luminys	AC02B3

2.5 External Cable List and Details

N/A

2.6 Test Mode

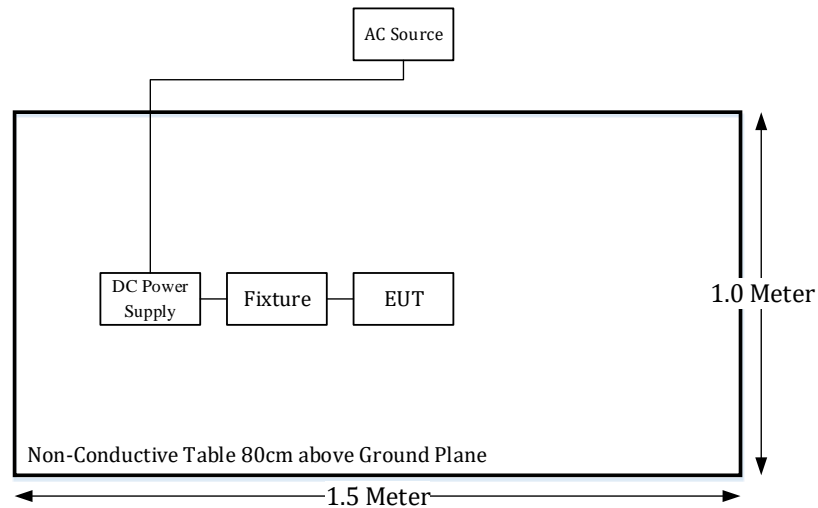
Full System (Model : R-WCA) for all test item.

2.7 Block Diagram of Test Setup

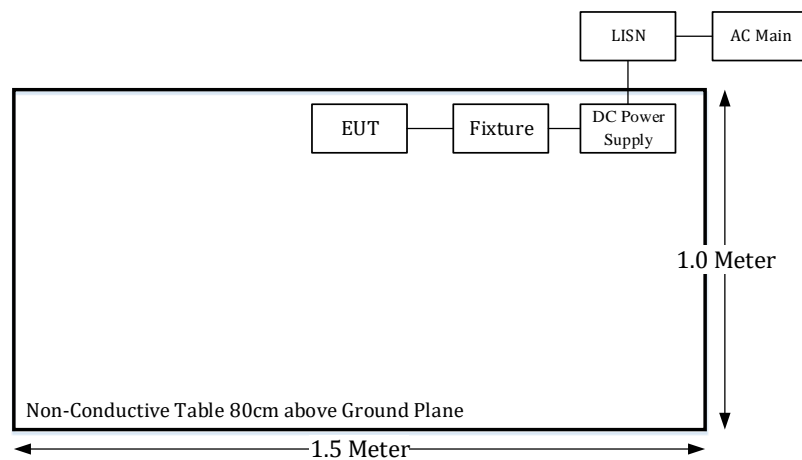
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

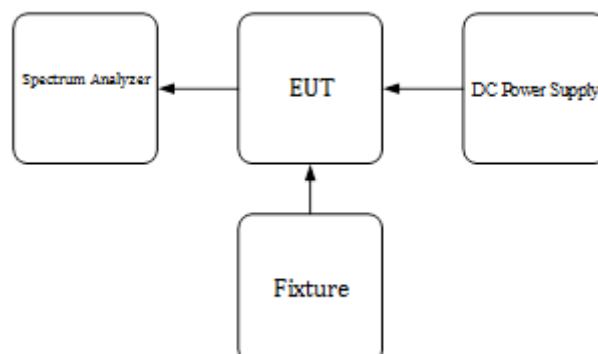
Below 1GHz:



Conduction:



Conducted:



3 Summary of Test Results

Rules	Description of Test	Results
FCC §1.1307(b)(3)(i)	RF Exposure	Compliance
RSS-102 §6.6	RF Exposure	Compliance
FCC §15.203 RSS-GEN §6.8	Antenna Requirement	Compliance
FCC §15.207(a) RSS-Gen §8.8	AC Line Conducted Emissions	Compliance
FCC §15.205, §15.209, §15.225 RSS-210 Annex B.6(a) RSS-Gen §8.9	Radiated Emissions	Compliance
FCC §15.225(e) RSS-210 Annex B.6(b)	Frequency Stability	Compliance
FCC §15.215 (c) RSS-Gen §6.7	20 dB Emission Bandwidth 99% Occupied Bandwidth	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2024/2/16	2025/2/16
EMI Test Receiver	Rohde & Schwarz	ESW	100947	2024/5/24	2025/5/24
RF Cable	EMEC	EM-CB5D	1	2024/6/5	2025/6/5
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	35796	2024/3/27	2025/3/27
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/1554 2_01	2024/1/19	2025/1/19
Preamplifier	Sonoma	310N	130601	2024/1/29	2025/1/29
EMI Test Receiver	Rohde & Schwarz	ESR3	102099	2024/6/24	2025/6/24
Spectrum Analyzer	Rohde & Schwarz	FSV40	101939	2024/3/27	2025/3/27
Microflex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2024/1/23	2025/1/23
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2024/1/23	2025/1/23
Coaxial Cable	COMMATE	PEWC	8Dr	2023/12/23	2024/12/23
Cable	EMC	EMC105-SM-SM-10000	201003	2024/1/23	2025/1/23
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2023/12/23	2024/12/23
Software	AUDIX	E3	18621a	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101204	2024/5/30	2025/5/30
Cable	UTIFLEX	UFA210A	9435	2024/10/1	2025/10/1
Temperature and Humidity Chamber	BACL	BTH-150-40	30028	2024/1/15	2025/1/15

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

5 FCC §1.1307(b)(3)(i) – RF EXPOSURE

5.1 Applicable Standard

According to subpart §1.1307(b)(3)(i), 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.

For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

- (A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
- (B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

- (C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

5.2 RF Exposure Evaluation Result

Calculate the EIRP from the radiated field strength in the far field using Equation

$$\text{EIRP} = E_{\text{Meas}} + 20 \log(d_{\text{Meas}}) - 104.7$$

$$\text{EIRP} = 62.36 \text{ dB}\mu\text{V/m} - 95.2 = -32.84 \text{ dBm}$$

$$\text{EIRP Tune-up power} = -32 \text{ dBm} < 1 \text{ mW}$$

§ 1.1307(b)(3)(i)(A) method is applicable

The available maximum time-averaged power is no more than 1 mW

Band	Freq (MHz)	Result Option A
SRD	13.56	exempt

Result: The device meets the exemption requirement.

6 RSS-102 – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus

6.1 Applicable Standard

According to RSS-102, Issue 6, Clause 6.6:

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 1 W (adjusted for tune-up tolerance)
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance)
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 5 W (adjusted for tune-up tolerance)

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

6.2 RF Exposure Evaluation Result

Calculate the EIRP from the radiated field strength in the far field using Equation

$$\text{EIRP} = E_{\text{Meas}} + 20\log(\text{dMeas}) - 104.7$$

$$\text{EIRP} = 62.36 \text{ dB}\mu\text{V/m} - 95.2 = -32.84 \text{ dBm}$$

$$\text{EIRP Tune-up power} = -32 \text{ dBm} < 1\text{W}$$

Result: The device meets the exemption requirement.

7 FCC §15.203 & RSS-GEN §6.8 – Antenna Requirements

7.1 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.

According to RSS-Gen §6.8,

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested. For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISSED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

7.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain	Input impedance
Luminys Systems Corporation	R-WCA	PCB Antenna	0 dBi	50Ω

Antenna was permanently attached to the unit.

Result: Compliance.

8 FCC §15.207(a) & RSS-GEN §8.8 – AC Line Conducted Emissions

8.1 Applicable Standard

According to FCC §15.207 for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

According to RSS-GEN §8.8

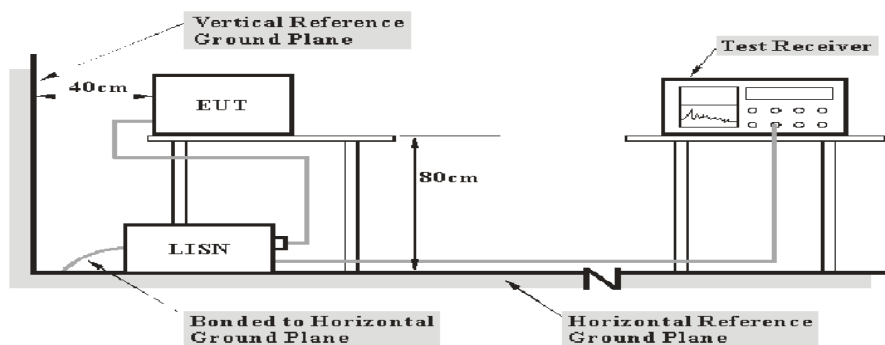
Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 ^{Note 1}	56 to 46 ^{Note 1}
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

8.2 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 and RSS-GEN limits.

8.3 EMI Test Receiver Setup

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

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

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

8.4 Test Procedure

During the conducted emission test, the DC Power Supply was connected to the outlet of the LISN.

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.

8.5 Factor & Over Limit

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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

$$\text{Over Limit} = \text{Result} - \text{Limit Line}$$

8.6 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz

Line

Job No.:RXZ241107014

Standard:limit(RF/FCC Part 15.207-QP.csv

Test item:Conduction Test

Temp.(°C)/Hum.(%RH):23.2°C/45%

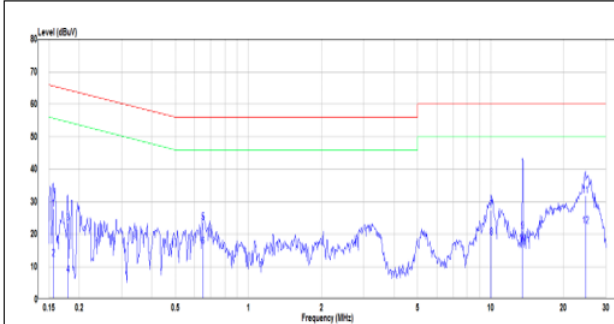
Phase.:Line

Power:AC 120V/60Hz

Test By:Jing

Description:

2024-11-15 15:13:15



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over limit (dB)	Remark	Phase
1	0.156	17.92	9.85	27.77	65.65	-37.88	QP	Line
2	0.156	2.49	9.85	12.34	55.65	-43.31	Average	Line
3	0.180	13.38	9.94	23.33	64.50	-41.18	QP	Line
4	0.180	-2.47	9.94	7.47	54.50	-47.03	Average	Line
5	0.647	13.34	10.28	23.63	56.00	-32.37	QP	Line
6	0.647	5.97	10.28	16.25	46.00	-29.75	Average	Line
7	10.072	17.00	10.45	27.45	60.00	-32.55	QP	Line
8	10.072	8.52	10.45	18.98	50.00	-31.02	Average	Line
9	13.551	10.26	10.54	20.79	60.00	-39.21	QP	Line
10	13.551	6.50	10.54	17.03	50.00	-32.97	Average	Line
11	24.659	21.18	10.55	31.74	60.00	-28.26	QP	Line
12	24.659	12.06	10.55	22.61	50.00	-27.39	Average	Line

Neutral

Job No.:RXZ241107014

Standard:limit(RF/FCC Part 15.207-QP.csv

Test item:Conduction Test

Temp.(°C)/Hum.(%RH):23.2°C/45%

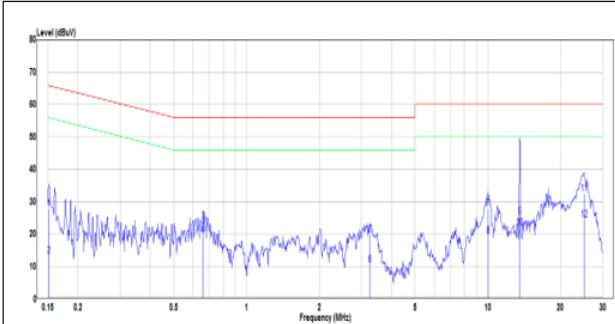
Phase.:Neutral

Power:AC 120V/60Hz

Test By:Jing

Description:

2024-11-15 15:15:53



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over limit (dB)	Remark	Phase
1	0.152	18.06	9.84	27.89	65.91	-38.02	QP	Neutral
2	0.152	3.43	9.84	13.27	55.91	-42.64	Average	Neutral
3	0.661	13.76	10.30	24.06	56.00	-31.94	QP	Neutral
4	0.661	9.30	10.30	19.60	46.00	-26.40	Average	Neutral
5	3.241	9.11	10.37	19.48	56.00	-36.52	QP	Neutral
6	3.241	0.18	10.37	10.55	46.00	-35.45	Average	Neutral
7	10.019	17.35	10.47	27.82	60.00	-32.18	QP	Neutral
8	10.019	8.85	10.47	19.32	50.00	-30.68	Average	Neutral
9	13.551	14.64	10.57	25.21	60.00	-34.79	QP	Neutral
10	13.551	11.28	10.57	21.85	50.00	-28.15	Average	Neutral
11	25.055	21.82	10.61	32.43	60.00	-27.57	QP	Neutral
12	25.055	13.83	10.61	24.44	50.00	-25.56	Average	Neutral

Note:

Result = Reading + Factor

Over Limit = Result – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

9 FCC §15.205, §15.209 , §15.225 & RSS-210 ANNEX B.6(a) , RSS-GEN §8.9 - Radiated Emissions

9.1 Applicable Standard

According to FCC §15.225(a)

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

According to RSS-210 B.6(a)

The field strength of any emission shall not exceed the following limits:

- i. 15.848 mV/m (84 dBμV/m) at 30 m, within the band 13.553-13.567 MHz
- ii. 334 μV/m (50.47 dBμV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz
- iii. 106 μV/m (40.51 dBμV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz
- iv. RSS-Gen general field strength limits for frequencies outside the band 13.110 14.010 MHz

As per FCC §15.209(a) : Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per RSS-GEN §8.9: Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 m)
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

Table 6 – General field strength limits at frequencies below 30 MHz

Frequency (MHz)	Field Strength (H-Field) ($\mu\text{A/m}$)	Measurement distance (m)
9 - 490 kHz ^{Note 1}	6.37/F (F in kHz)	300
490 - 1705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Note 2: The limit was added 51.5dB to convert the limit from dBuA/m to dBuV/m.

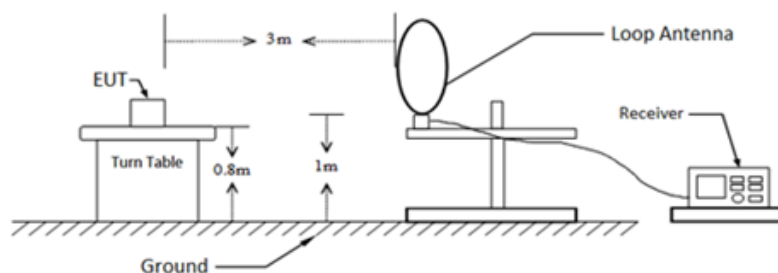
According to ANSI C63.10-2013, section 5.3.3

Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field, and the emissions to be measured can be detected by the measurement equipment (see 4.3.4).

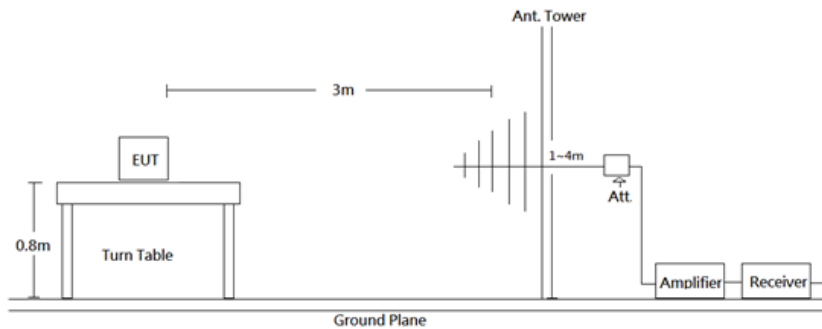
Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

9.2 EUT Setup

9kHz-30MHz:



30MHz-1GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013.

9.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 1 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	VBW	Measurement method
9 kHz - 150 kHz	200 Hz/300 Hz	1 kHz	QP/AV
150 kHz - 30 MHz	9 kHz/10 kHz	30 kHz	QP/AV
30-1000 MHz	120 kHz	300 kHz	QP

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

9.4 Test Procedure

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

All data was recorded in Quasi-peak and average detector mode from 9 kHz to 30 MHz, Quasi-peak detector mode from 30 MHz to 1 GHz.

9.5 Corrected Factor & Margin Calculation

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

$$\text{Correct Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Result} - \text{Limit}$$

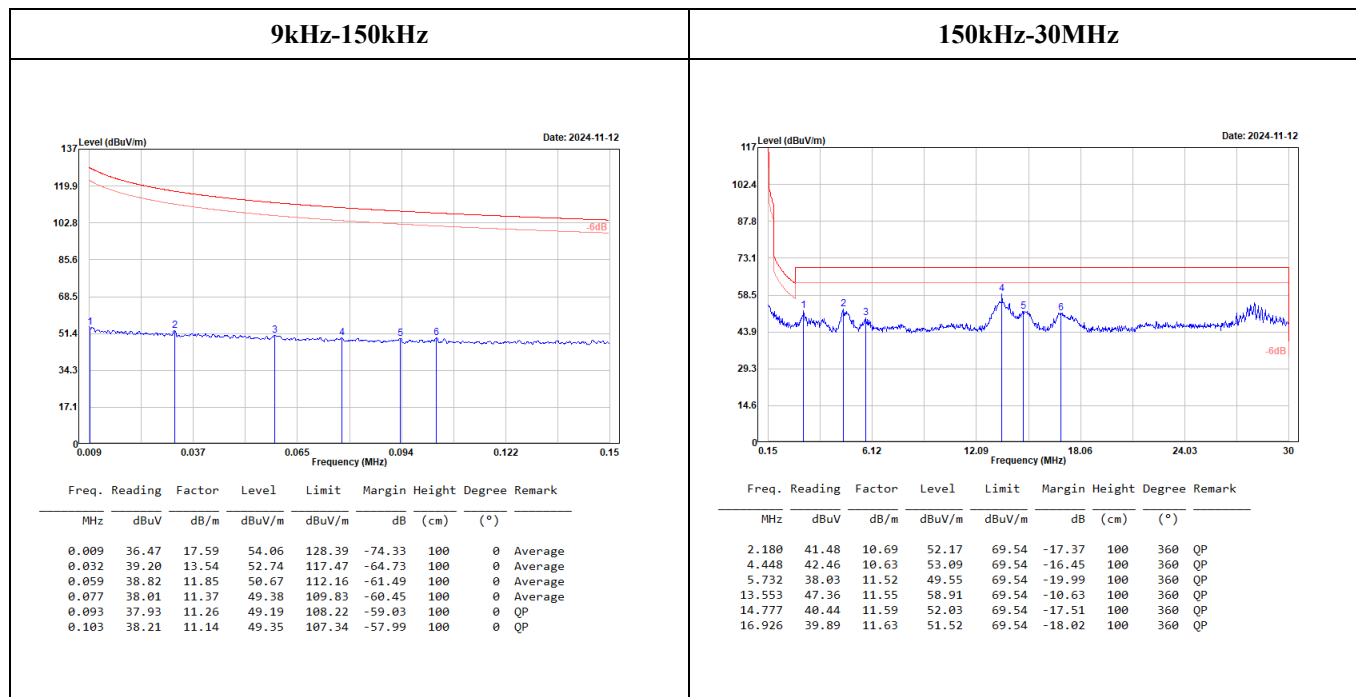
9.6 Test Results

Test Mode: Transmitting

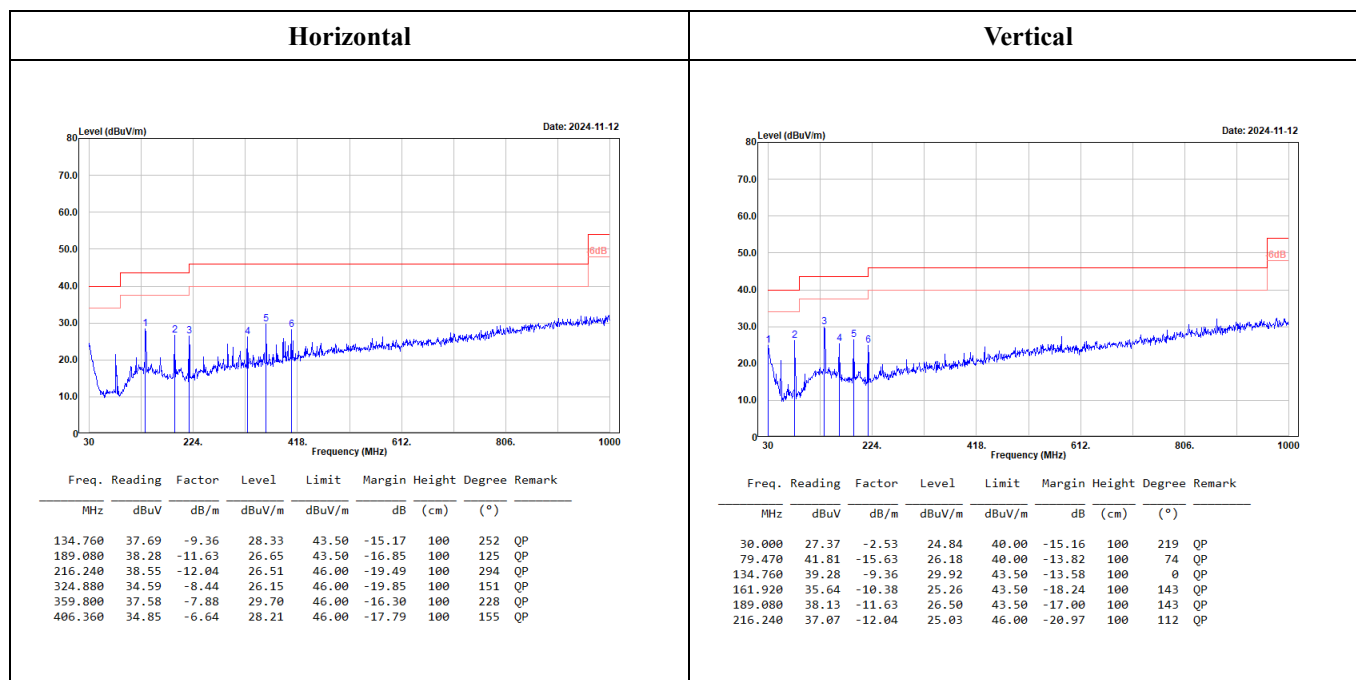
(Pre-scan with three orthogonal axis, and worse case as Z axis.)

9kHz-30MHz:

(Pre-scan using three directional polarities, worst case as parallel.)



30MHz-1GHz:

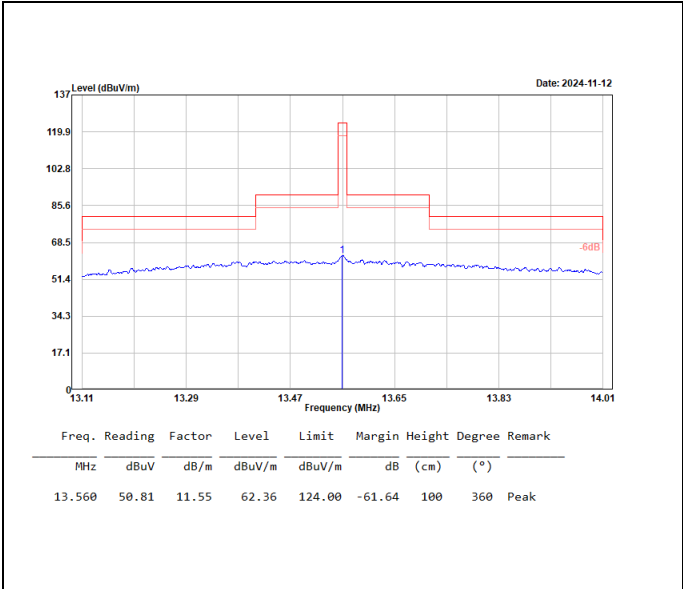


Level = Reading + Factor.

Margin = Level - Limit.

Factor = Antenna Factor + Cable Loss - Amplifier Gain.

Fundamental:
(Pre-scan using three directional polarities, parallel, perpendicular, and ground-parallel, worst case as parallel.)



Level = Reading + Factor.
Margin = Level – Limit.
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

10 FCC §15.225(e) & RSS-210 ANNEX B.6(b) - Frequency Stability

10.1 Applicable Standard

According to FCC §15.225(e)

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

According to RSS-210 Annex B.6(b)

The carrier frequency stability shall not exceed ± 100 ppm

10.2 Test Procedure

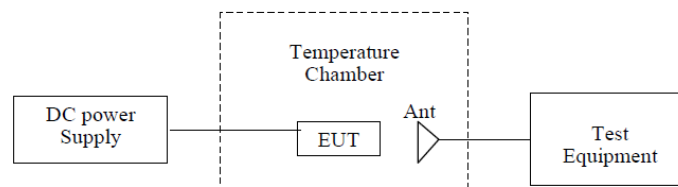
According to ANSI C63.10-2013 Section 6.8

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power.

The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to the end point of the battery. The output frequency was recorded for each voltage.



10.3 Test Results

Test Mode: Transmitting

Temperature (°C)	Voltage (Vdc)	Measured Frequency (MHz)	Frequency Error (%)	Limit (%)	Result
-20	12	13.56091	0.00671	±0.01	Pass
-10	12	13.56073	0.00538	±0.01	Pass
0	12	13.56085	0.00627	±0.01	Pass
10	12	13.56085	0.00627	±0.01	Pass
20	12	13.56083	0.00612	±0.01	Pass
30	12	13.56091	0.00671	±0.01	Pass
40	12	13.56092	0.00678	±0.01	Pass
50	12	13.56081	0.00597	±0.01	Pass
20	10.2	13.56083	0.00612	±0.01	Pass
	12	13.56092	0.00678	±0.01	Pass
	13.8	13.56075	0.00553	±0.01	Pass

11 FCC §15.215(c) & RSS-GEN §6.7 – 20 dB Bandwidth Testing and 99% Occupied Bandwidth

11.1 Applicable Standard

According to FCC §15.225(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

According to RSS-Gen §6.7:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

11.2 Test Procedure

According to ANSI C63.10-2013 Section 6.9.2

20dB bandwidth test:

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 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

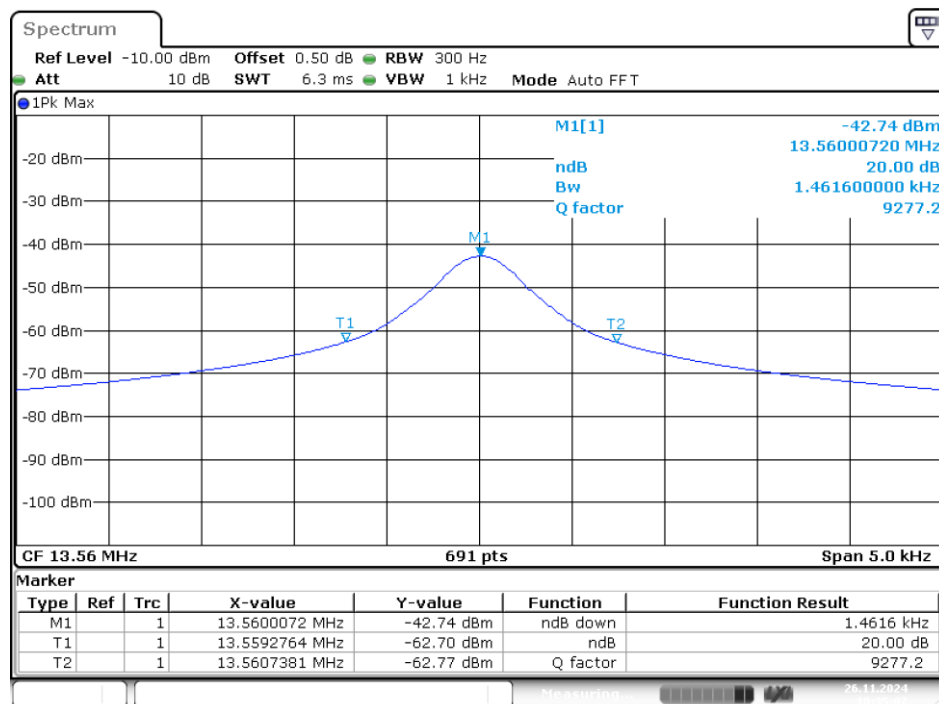
According to ANSI C63.10-2013 Section 6.9.3

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

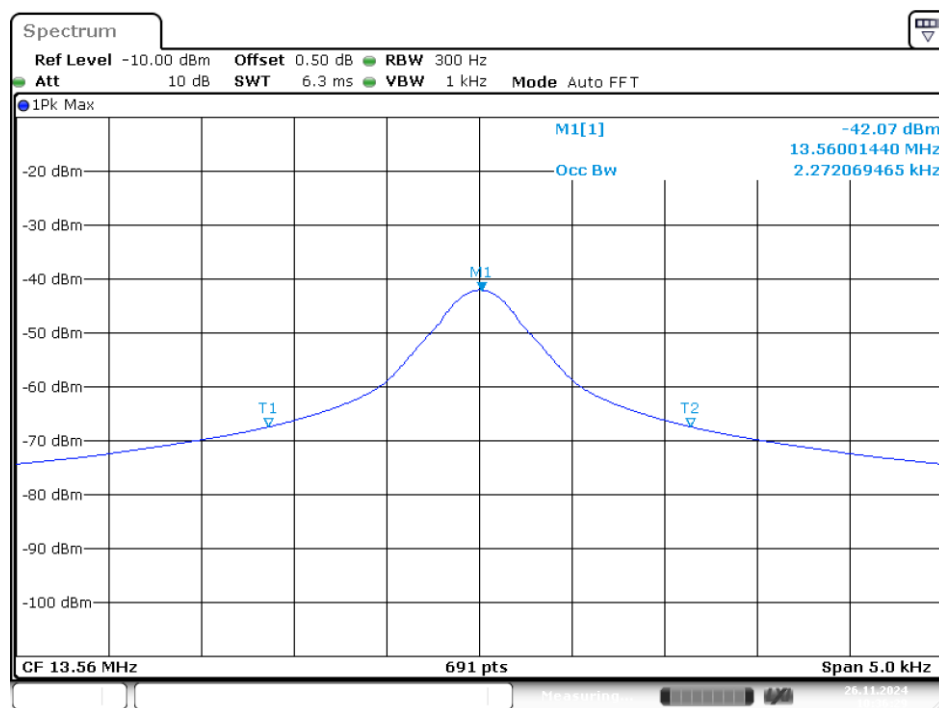
11.3 Test Results

Frequency (MHz)	20 dB Emission Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
13.56	1.46	2.27

20 dB Emission Bandwidth



99% Occupied Bandwidth



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