RADIO PERFORMANCE TEST REPORT

Test Report No. : **OT-251-RWD-070**

Reception No. : **2410003742**

Applicant : **RANIX Inc.**

Address : **RANIX Bldg. 25, Eonju-ro 135-gil, Gangnam-gu, Seoul, Korea**

Manufacturer : **RANIX Inc.**

Address : **RANIX Bldg. 25, Eonju-ro 135-gil, Gangnam-gu, Seoul, Korea**

Type of Equipment : **AI Edge Radar**

FCC ID. : **2BMJL-RMR602A**

Model Name : **RMR602A**

Multiple Model Name : **N/A**

Serial number : **N/A**

Total page of Report : **31 pages (including this page)**

Date of Incoming : **December 04, 2024**

Date of issue : **January 20, 2025**

SUMMARY

The equipment complies with the regulation; ***FCC CFR 47 PART 15 SUBPART C Section 15.255***

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

This report is not correlated with the "KS Q ISO/IEC 17025 and KOLAS accreditation" of Korean Laboratory Accreditation Scheme.

Tested by	Reviewed by	Approved by
Si-eon Lee / Senior Project Engineer	Tae-Ho, Kim / Chief Engineer	Jae-Ho, Lee / Chief Engineer
ONETECH Corp.	ONETECH Corp.	ONETECH Corp.

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

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ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-251-RWD-070	January 20, 2025	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : RANIX Inc.

Address : RANIX Bldg. 25, Eonju-ro 135-gil, Gangnam-gu, Seoul, Korea

Contact Person : Jin Myeong Byeon / Manager

Telephone No. : +82-2-584-5516

FCC ID : 2BMJL-RMR602A

Model Name : RMR602A

Brand Name : -

Serial Number : N/A

DEVICE TYPE	FDS – Part 15 Field Disturbance Sensor
E.U.T. DESCRIPTION	AI Edge Radar
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC CFR47 Part 15 Subpart C Section 15.255
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. GENERAL INFORMATION

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
2.1049	Occupied Bandwidth	Met the Limit / PASS
15.255 (c) (2)(iii)(A)	Equivalent Isotropically Radiated Power	Met the Limit / PASS
15.255 (c) (2)(iii)(A)	Duty cycle, Off Time Requirement	Met the Limit / PASS
15.255 (d)	Spurious Emissions	Met the Limit / PASS
15.255 (f)	Frequency Stability	Met the Limit / PASS
15.207	AC power line conducted emissions	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

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2.2 Product Description

The RANIX Inc., Model RMR602A (referred to as the EUT in this report) is an AI Edge Radar, Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	AI Edge Radar
TRANSMITTING FREQUENCY	60.094 GHz ~ 63.179 GHz 802.11b/g/n(HT20): 2 412 MHz ~ 2 462 MHz 802.11n(HT40): 2 422 MHz ~ 2 452 MHz
MODULATION TYPE	FMCW
ANTENNA TYPE	Patch Antenna
ANTENNA GAIN	5.20 dBi
LIST OF EACH OSC. or CRY. FREQ.(FREQ. >= 1 MHz)	40.0 MHz

2.3 Model Differences:

-. None

2.4 Related Submittal(s) / Grant(s)

Original submittal only

2.5 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.255.

2.6 Test Methodology

Testing was performed according to the procedures in ANSI C63.10: 2020, Clause 9 – Procedures for testing millimeter-wave systems.

2.7 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. SYSTEM TEST CONFIGURATION

3.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	RANIX Inc.	RANIX RMR602A V0.4	N/A
Wi-Fi Module	Espressif Systems (Shanghai) Co.,Ltd.	ESP32-C3-MINI-1	2AC7Z-ESPC3MINI1

3.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
RMR602A	RANIX Inc.	AI Edge Radar (EUT)	-

3.3 Equipment Modifications

-. None

3.4 Configuration of Test System

Line Conducted Test: The EUT was connected to DC power supply and the power of DC power supply was connected to LISN. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2020 to determine the worse operating conditions.

Radiated Emission Test : Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2020 to determine the worse operating conditions. The radiated emissions measurements were performed on the 3 m Semi Anechoic Chamber.

For frequencies from 150 kHz to 30 MHz measurements were made of the magnetic H field. The measuring antenna is an electrically screened loop antenna.

The frequency spectrum from 30 MHz to 1 000 MHz was scanned and maximum emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

3.5 Antenna Requirement

For intentional device, according to section 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.

Antenna Construction:

The transmitter antenna of the EUT is a Patch Antenna so there is no consideration of replacement by the user.

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4. PRELIMINARY TEST

4.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

4.2 Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

5. Measurement Uncertainty

Item	Uncertainty
Radiated Emission (Below 1 GHz)	± 4.42 dB
Radiated Emission (1 GHz ~ 18 GHz)	± 5.10 dB
Radiated Emission (18 GHz ~ 40 GHz)	± 3.44 dB
Radiated Emission (above 40 GHz)	± 3.59 dB

6. Far field distance

All measurements shall be made in the far-field of the measurement antenna.

The far-field boundary for mm-wave antennas is $2D^2 \lambda$.

For fundamental or out-of-band emissions the far-field boundary distance of the EUT antenna or measurement antenna, whichever is largest, shall be used. For spurious and harmonic emissions the far-field boundary distance shall be based on the measurement antenna.

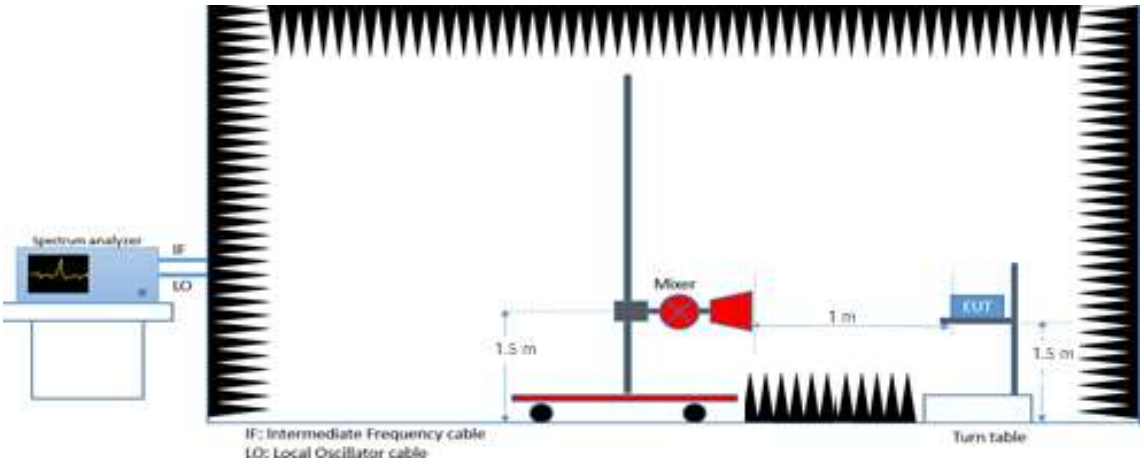
Frequency range (GHz)	Wavelenght (λ) (m)	largest dimension (D) (m)	Far field distance (m)	Measurement Distance (m)
40 ~ 60	0.005 0	0.0581 9	1.35	1.50
60 ~ 94	0.003 2	0.0377 7	0.89	1.00
94 ~ 140	0.002 1	0.0247 5	0.57	1.00
140 ~ 200	0.001 5	0.0157 8	0.33	0.50
61.637	0.004 9	0.0377 7	0.59	1.00

7. Test & System Description

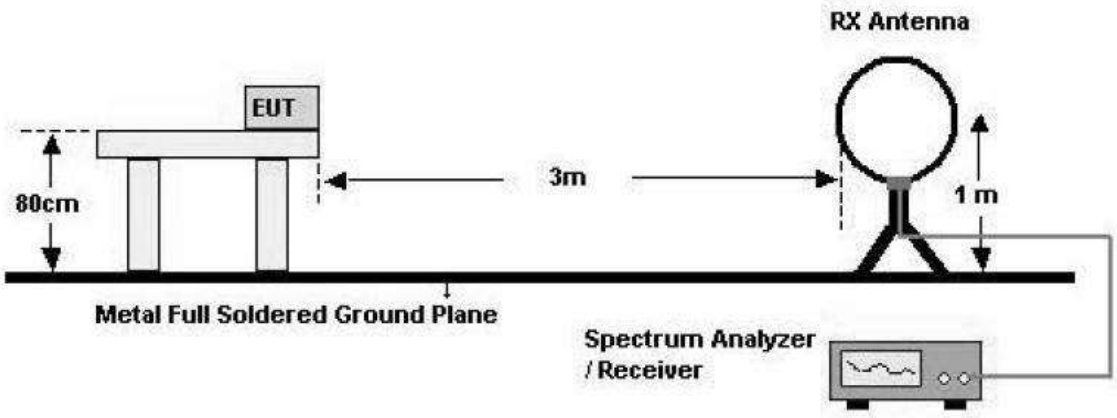
7.1 Measurement System

Measurements were performed using the following setups, made in accordance to the general provisions of ANSI C63.10-2020, Clause 9 – Procedures for testing millimeter-wave systems.

1) Emission & Occupied Bandwidth & EIRP (57 ~ 64 GHz)



2) Radiated Setup (Below 30 MHz)



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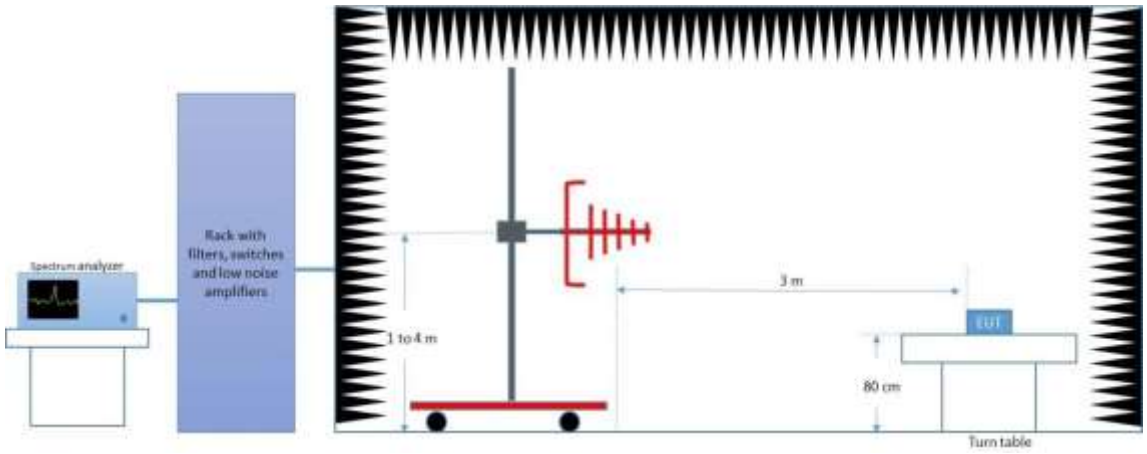
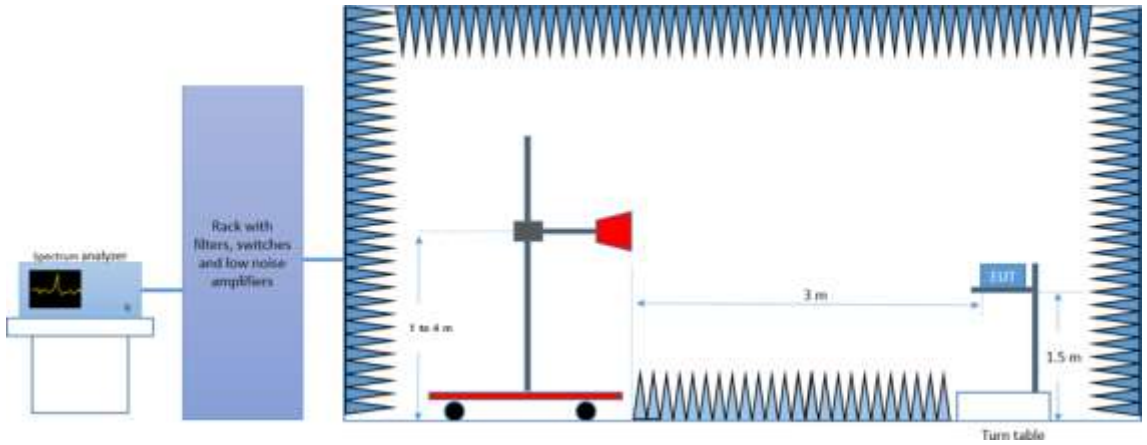
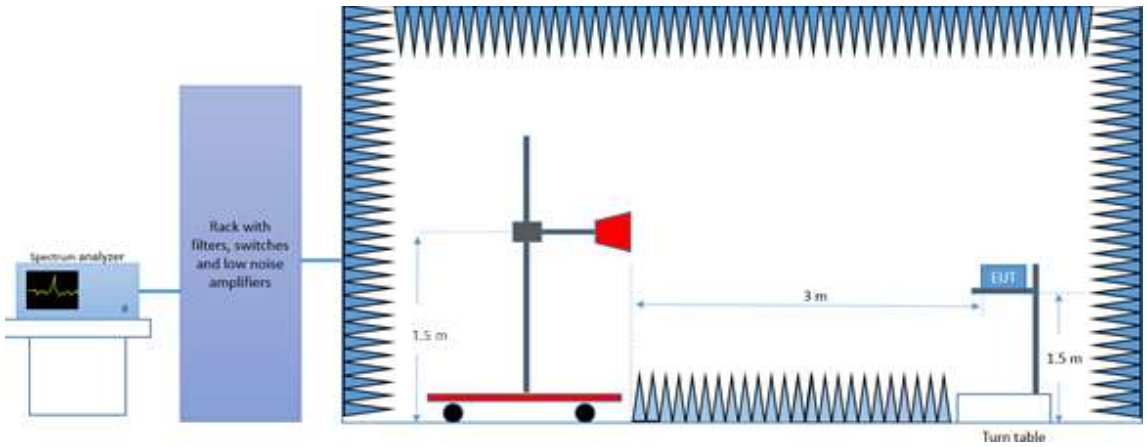
3) Radiated Setup (30 MHz ~ 1 GHz)



4) Radiated Setup (1 GHz ~ 18 GHz)



5) Radiated Setup (18 GHz ~ 40 GHz)



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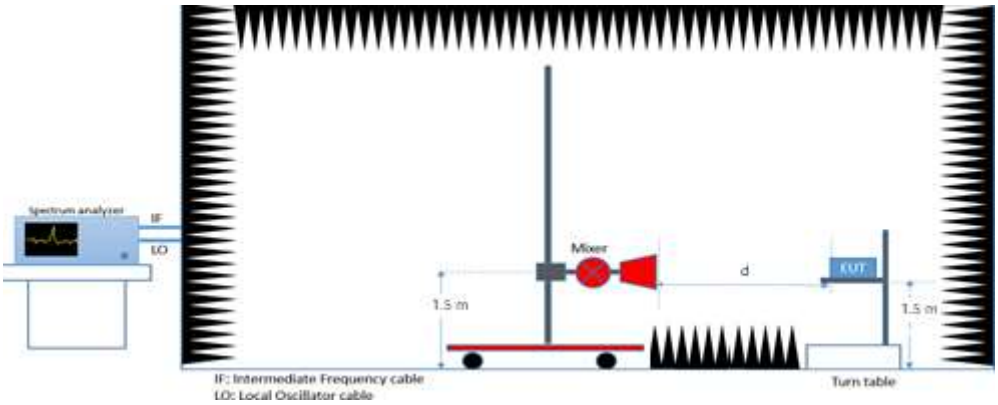
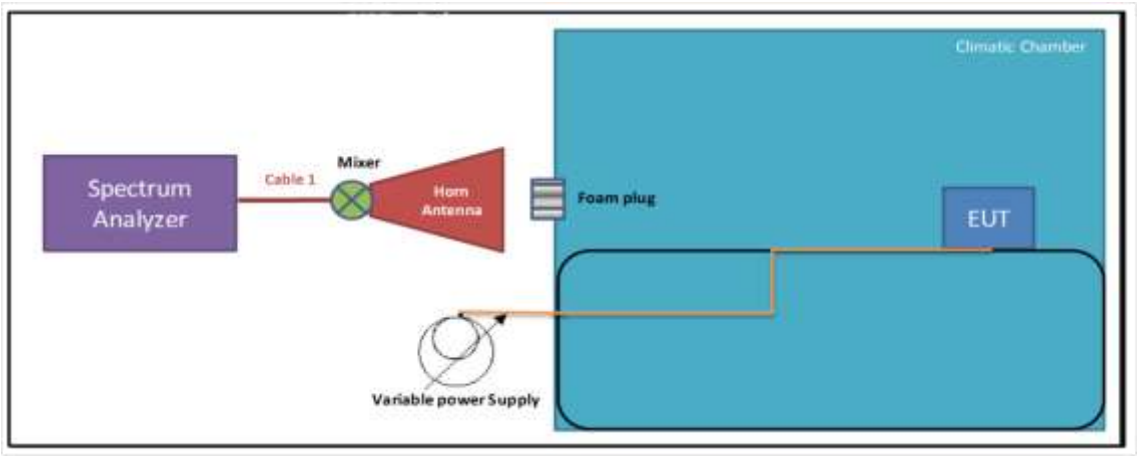
6) Radiated Setup (40 GHz ~ 200 GHz)



7) Frequency Stability Measurement Setup



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8. Occupied Bandwidth

8.1 Test Requirement

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable.

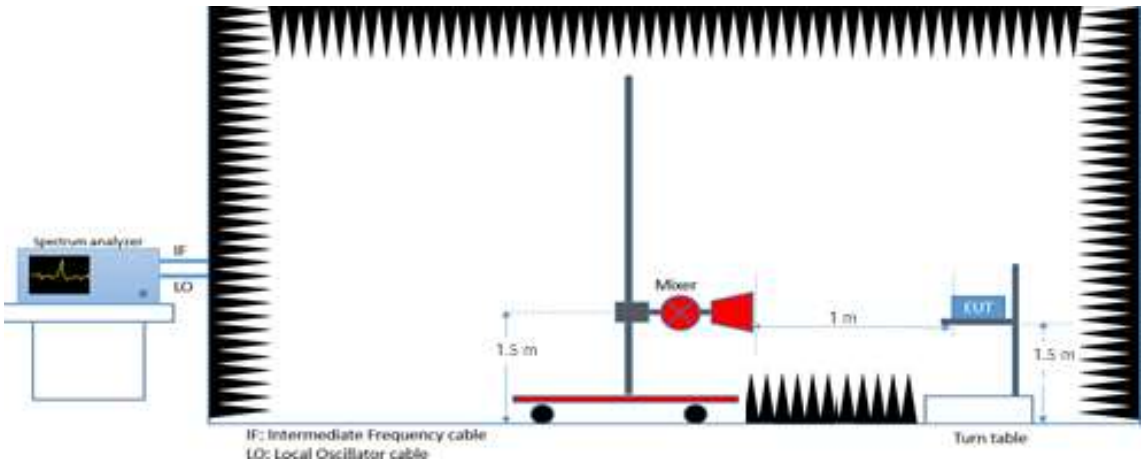
8.2 Test Procedure

ANSI C63.10-2020 Section 9.4

The occupied bandwidth (OBW) is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

a) The following procedure shall be used for measuring 99% power bandwidth: Use the following spectrum analyzer settings:

1) Span equal to approximately 1.5 times the OBW, centered on the carrier frequency
2) RBW, prefer 1% to 5% of OBW, or a minimum of 1 MHz if this is not possible due to a large OBW
3) VBW approximately 3 x RBW
4) Set the reference level of the instmment as required to reduce the chance of the signal amplitude exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.1.6.
5) Sweep = No faster than coupled (auto) time.
6) Detector function = peak.
7) Trace = max-hold.



8.3 Test date

December 19, 2024 ~ January 17, 2025

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8.4 Test data

-. Test Result: Pass

Operating Freq. (GHz)	99% Bandwidth (GHz)
61.637	3.084

Plots of measurement data

99% Bandwidth

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9. Equivalent Isotropically Radiated Power

9.1 Test Requirement

§ 15.255 (c)(2)(iii)(A)

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

9.2 Test Procedure

ANSI C63.10-2020 Section 9.8

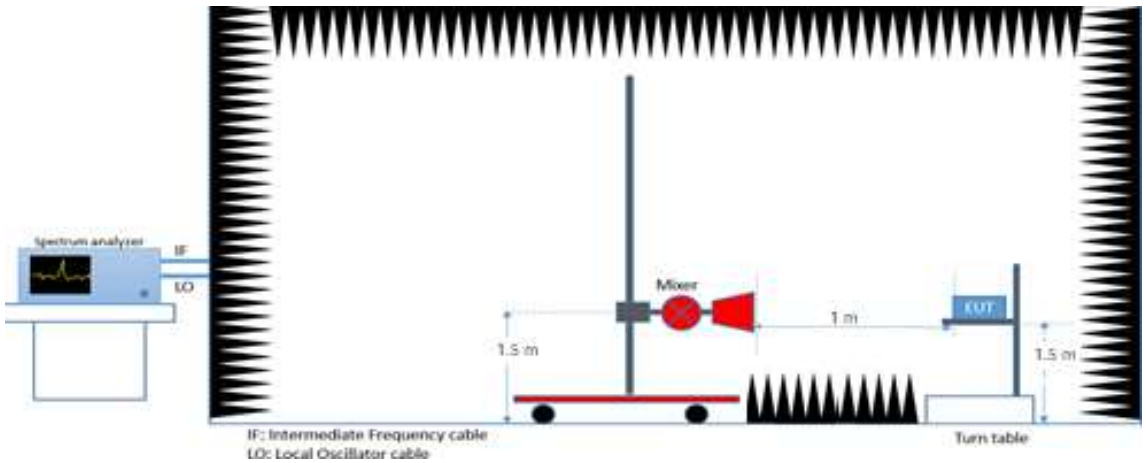
For radiated measurements:

1) Place the measurement antenna at a mea"5urement distance that is in the far-field of the measurement antenna, in the far-field of the EUT antenna, and meets the measurement distance requirements for final radiated measurements as specified in 9. l.4.

2) Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission using the procedures of 9.7, noting that multiple peaks can be found at different beam orientations and/or polarizations.

3) Correct the power reading from the spectrum analyzer for any external gain and/or attenuation between the measurement antenna and the spectrum analyzer. This is the power at the output of the measurement antenna

4) Calculate the EIRP from the power at the output of the measurement antenna using Equation (22), and then convert to linear form using Equation (24).



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ANSI C63.10 Equation (22) was used to determine the EIRP from the power level noted above.

$$EIRP = 21.98 - 20\log(\lambda) + 20\log(d_{Meas}) + P - G$$

where

$EIRP$	is the equivalent isotropic radiated power, in dBm
λ	is the wavelength of the emission under investigation [300/f(MHz)], in m
d_{Meas}	is the measurement distance, in m
P	is the power measured at the output of the measurement antenna, in dBm
G	is the gain of the measurement antenna, in dBi

As the EUT uses FMCW modulation, as per ANSI C63.10 Annex L the desensitization correction factor was calculated in accordance with equation L.1

$$\alpha = \frac{1}{\sqrt{1 + \left(\frac{2\ln(2)}{\pi}\right)^2 \left(\frac{BW_{Chirp}}{T_{Chirp} B^2}\right)^2}}$$

where

α	is the reduction in amplitude
BW_{Chirp}	is the FMCW Chirp Bandwidth
T_{Chirp}	is the FMCW Chirp Time
B	is the 3 dB IF Bandwidth = RBW

FMCW desensitization factor:

where the BW_{Chirp} = 3 000 MHz, T_{chirp} = 50 us, B = 1 MHz, α = 14.23 dB

9.3 Test date

December 19, 2024 ~ January 17, 2025

9.4 Test data

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

Measurement Distance (D)	Frequency (GHz)	ANT Pol	Measured Level (dBm)	E.I.R.P (dBm)	Limit (dBm)	Margin (dB)
1.0 m	61.637	V	-60.49	12.36	14.0	1.64

ANSI C63.10 Equation (22) was used to determine the EIRP.

E.I.R.P = 21.98 – 20log(300/61637) + 20log(1) + P – G + Desensitization factor

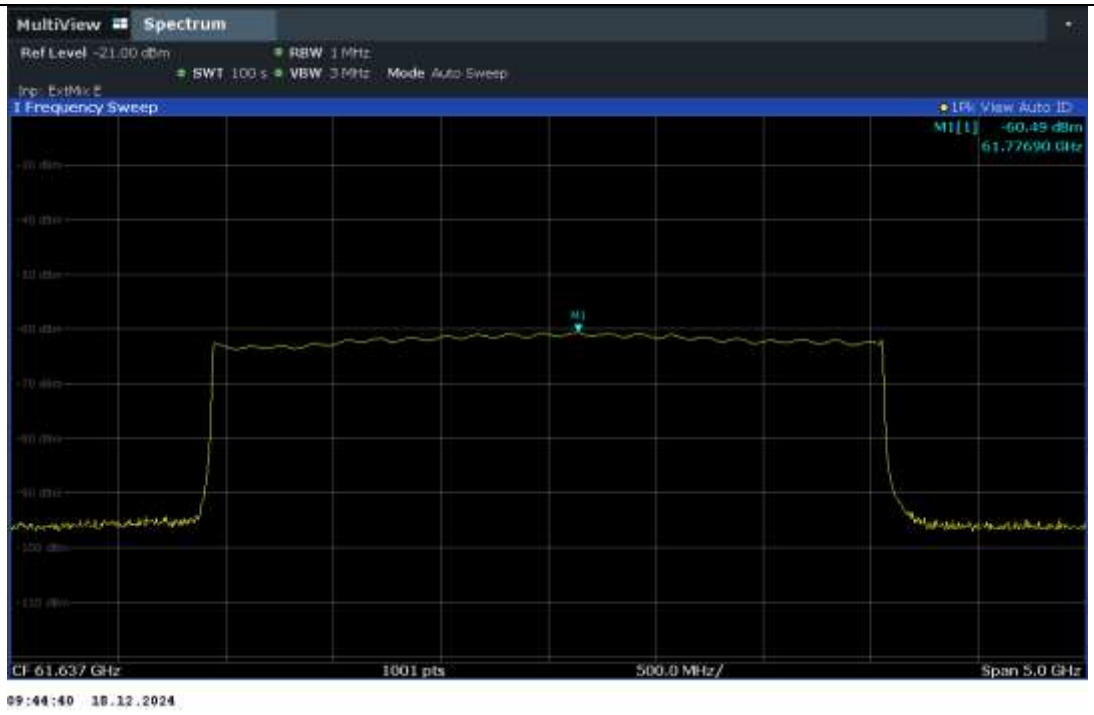
where

P = Measured Level(dBm) + Correction Factor(dB) = -47.71 dBm

G = 22.40 dBi

Desensitization factor = 14.23 dB

Plots of measurement data



E.I.R.P

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10. Duty cycle, Off Time Requirement

10.1 Test Requirement

§ 15.255 (c)(2)(iii)(A)

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

10.2 Test Procedure

See section 9.2 of this report.

10.3 Test date

December 19, 2024 ~ January 17, 2025

10.4 Test data

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

Chirp Width (us)	Chirp period (us)	Chirp number In Bust Period	Burst Period (ms)	On Time (ms)	Off Time (ms)	Limit
1.80	50.0	380	19.0	0.684	32.316	25.5 ms off time per 33 ms

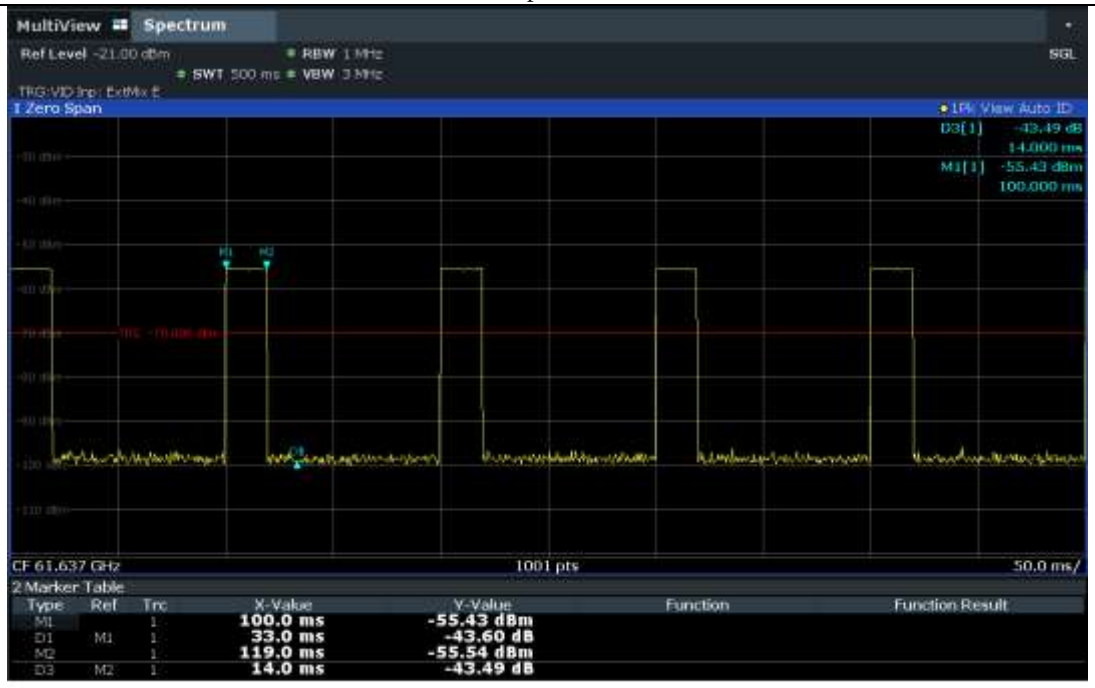
Chirp number In Bust Period = Bust Period (ms) / Chirp Period (us)

On Time = Chirp Width (us) * Chirp number In Bust Period

Off Time = 33 ms - On Time (ms)

Plots of measurement data

Chirp Width



Burst Period

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11. Spurious Emissions

11.1 Test Requirement

§ 15.255 (d)

Limits on spurious emissions.

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209(a).

Frequencies (MHz)	Field strength (microvolts/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

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

11.2 Test Procedure

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3meterchamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

For Radiated emission 30MHzto 40GHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters(30MHz-18GHz) / 3 meters (18GHz-40GHz) away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note: 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.

2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1GHz.

For Radiated emission above 40GHz

a. Connect the test antenna covering the appropriate frequency range to a spectrum analyzer via an external mixer to the spectrum analyzer.

b. Set spectrum analyzer RBW = 1 MHz, VBW =3 MHz, average detector.

c. Calculate the distance to the far field boundary and determine the maximum measurement distance.

d. Perform an exploratory search for emissions and determine the approximate direction at which each observed emission emanates from the EUT.

e. Exploratory measurements be made at a closer distance than the validated maximum measurement distance.

f. Perform a final measurement; begin with the test antenna at the approximate position where the maximum level occurred during the exploratory scan.

g. Slowly scan the test antenna around this position, slowly vary the test antenna polarization by rotating through at least 0° to 180°, and slowly vary the orientation of the test antenna to find the final position, polarization, and orientation at which the maximum level of the emission is observed.

h. Record the measured reading with the test antenna fixed at this maximized position, polarization, and orientation. Record the measurement distance.

i. Calculate the maximum field strength of the emission at the measurement distance and the adjusted/corrected power at the output of the test antenna.

j. Calculate the EIRP from the measured field strength and then convert to the linear.

k. Calculate the power density at the distance specified by the limit from the field strength at the distance specified by the limit.

Power density formula as follows: Power density = EIRP / (4 * Pi * r^2), r is the standard distance at 3 meter

l. Repeat the preceding sequence for every emission observed in the frequency band under investigation.

11.3 Test date

December 19, 2024 ~ January 17, 2025

11.4 Test data

11.4.1 Spurious Radiated Emission Below 30 MHz

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

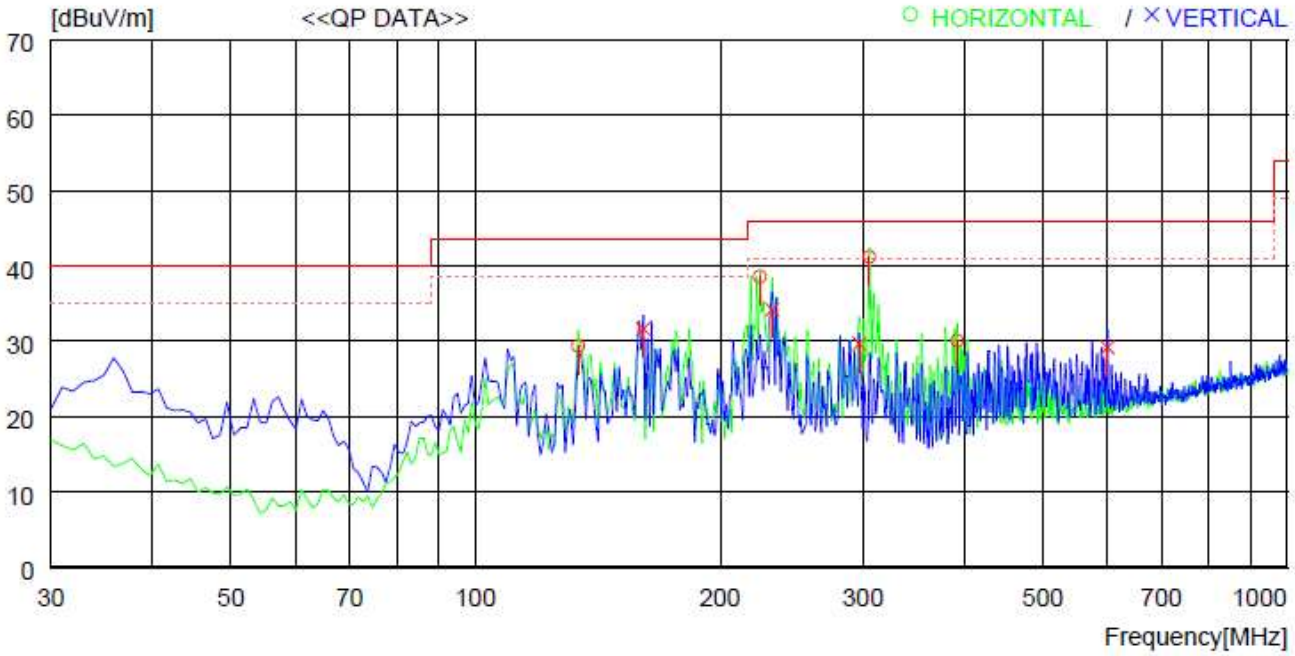
Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor (dB/m)	AMP Gain (dB)	Cable Loss (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
No Critical peaks found									

1. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Limit line = specific Limits (dBuV) + Distance extrapolation factor
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

11.4.2 Spurious Radiated Emission 30 MHz ~ 1 GHz

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	133.790	41.7	19.2	1.5	33.0	29.4	43.5	14.1	100	266
2	224.000	53.2	16.5	1.9	33.0	38.6	46.0	7.4	100	98
3	305.480	52.8	19.2	2.2	33.0	41.2	46.0	4.8	100	359
4	391.810	40.0	20.6	2.5	33.0	30.1	46.0	15.9	100	359
----- Vertical ------										
5	160.950	45.3	17.8	1.6	33.0	31.7	43.5	11.8	100	0
6	231.760	48.5	16.8	1.9	33.0	34.2	46.0	11.8	100	350
7	296.750	41.5	19.0	2.2	33.0	29.7	46.0	16.3	100	0
8	600.358	35.2	24.2	3.1	33.3	29.2	46.0	16.8	100	0

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

11.4.3 Spurious Radiated Emission 1 GHz ~ 40 GHz

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor (dB/m)	AMP Gain (dB)	Cable Loss (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
No Critical peaks found									

Remark - "H": Horizontal, "V": Vertical

Emission Level (dBμV/m) = Reading (dBμV) + Antenna Factor (dB/m) + Cable loss (dB) – AMP Gain (dB)

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)

11.4.4 Spurious Radiated Emission 40 GHz ~ 200 GHz

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

Measurement Distance (D)	Frequency (GHz)	Measured Level(dBm)	E.I.R.P (dBuv/m)	E.I.R.P (dBm)	Power Density (pW/cm2)	Limit (pW/cm2)	Margin (pW/cm2)
1.5 m	47.75	-106.40	51.70	-49.48	0.01	90.00	89.99
1.0 m	86.85	-106.30	57.92	-46.78	0.02	90.00	89.98
1.0 m	94.48	-106.87	59.81	-44.89	0.03	90.00	89.97
0.5 m	141.64	-105.86	68.83	-41.89	0.06	90.00	89.94

No other spurious identified up to 200 GHz with level above the value reported in the table.

Power Density = $E.I.R.P_{Linear} / 4\pi d^2$

E.I.R.P (dBm) = E(dBuV/m) + 20log(D) -104.7

where, D is measurement distance.

E(dBuV/m) = Measured Level(dBm) + 107 + Correction Factor(dB)

where, Correction Factor(dB) = Ant Factor (dB) + Cable Loss(dB) + Conversion Loss(dB)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

12. Frequency Stability

12.1 Test Requirement

§ 15.255 (f)

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

12.2 Test Procedure

ANSI C63.10-2020 Section 9.5

The following procedure shall be used for determining frequency stability of millimeter-wave systems:

a) Arrange EUT and test equipment as shown in Figure 23. Suitable temperatw·e chambers have a window or other opening that permits locating the receive antenna and instrumentation outside the chamber.

b) Install an RF transparent foam plug in the chamber opening.

c) As applicable, install RF absorber sheets on the inside walls of the chamber, particularly in any areas illuminated by the EUT antenna beam.

d) With the EUT at ambient temperature (approximately 25 °C) and voltage source set to the EUT nominal operating voltage (100%), record the frequency excursion of the spectrum mask of the EUT emission on the spectrum analyzer. Alternatively, if the EUT has a test mode to transmit a CW frequency, the frequency can be measured using the spectrum analyzer's internal frequency count function.

e) Follow the test methods of 6.8

12.3 Test date

December 19, 2024 ~ January 17, 2025

12.4 Test data

-. Test Result : Pass

-. Test Date : December 19, 2024 ~ January 17, 2025

Temperature (°C)	Voltage(V)	FL (GHz)	FH (GHz)	Limit (GHz)
50	5.00	60.086 59	63.174 95	57 ~ 64
40		60.087 60	63.174 39	
30		60.092 61	63.180 14	
20		60.088 77	63.186 21	
10		60.090 35	63.184 75	
0		60.092 38	63.184 33	
-10		60.092 51	63.180 94	
-20		60.097 75	63.184 53	
20 (Ref)	4.25 (85%)	60.094 99	63.179 34	
	5.75 (115%)	60.094 25	63.179 14	

13. AC power line conducted emissions

13.1 Test Requirement

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 μH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

**Decreases with the logarithm of the frequency.*

13.2 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.2.

13.3 Test date

December 19, 2024 ~ January 17, 2025

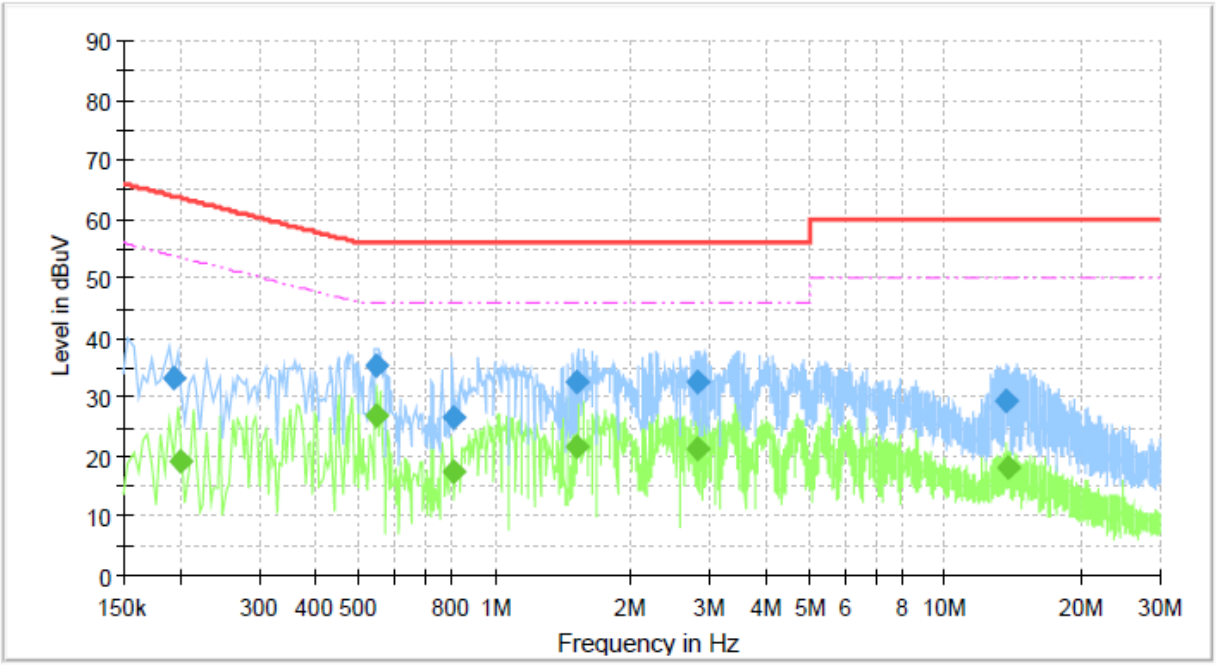
13.4 Test data

-. Test Date : December 19, 2024 ~ January 17, 2025

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.194	33.22	---	63.89	30.66	9.0	L1	10.15
0.202	---	19.21	53.55	34.34	9.0	L1	10.15
0.545	---	26.84	46.00	19.16	9.0	L1	10.16
0.549	35.24	---	56.00	20.76	9.0	L1	10.17
0.810	26.64	---	56.00	29.36	9.0	L1	10.18
0.810	---	17.36	46.00	28.64	9.0	L1	10.18
1.519	---	21.65	46.00	24.35	9.0	L1	10.21
1.523	32.63	---	56.00	23.37	9.0	L1	10.21
2.822	---	21.45	46.00	24.55	9.0	L1	10.24
2.842	32.49	---	56.00	23.51	9.0	L1	10.24
13.665	29.42	---	60.00	30.58	9.0	L1	10.68
13.753	---	18.33	50.00	31.67	9.0	L1	10.68

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

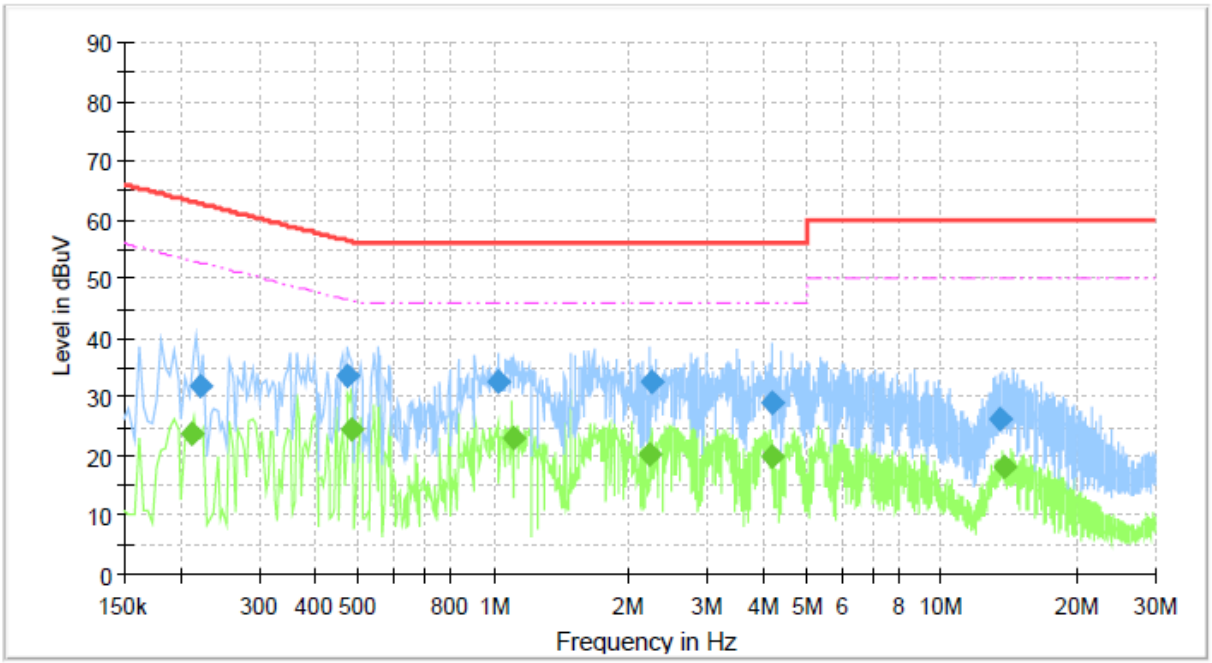
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

-. Test Date : December 19, 2024 ~ January 17, 2025\

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : NEUTRAL LINE



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.213	---	23.74	53.07	29.33	9.0	N	10.15
0.222	32.03	---	62.76	30.73	9.0	N	10.15
0.475	33.64	---	56.43	22.79	9.0	N	10.17
0.485	---	24.37	46.25	21.88	9.0	N	10.17
1.028	32.63	---	56.00	23.37	9.0	N	10.21
1.107	---	23.17	46.00	22.83	9.0	N	10.21
2.244	---	20.43	46.00	25.57	9.0	N	10.24
2.252	32.73	---	56.00	23.27	9.0	N	10.24
4.168	---	20.09	46.00	25.91	9.0	N	10.29
4.172	29.23	---	56.00	26.77	9.0	N	10.29
13.546	26.10	---	60.00	33.90	9.0	N	10.71
13.785	---	18.36	50.00	31.64	9.0	N	10.72

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

14. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSW43	Rohde & Schwarz	Signal Analyzer	104544	Jul. 04, 2024 (1Y)
FSVA40	Rohde & Schwarz	Signal Analyzer	101593	Jan. 13, 2025 (1Y)
ESR	Rohde & Schwarz	EMI TEST RECEIVER	101470	Jun. 13, 2024 (1Y)
CO3000	Innco Systems GmbH	Controller	N/A	N/A
DT5000	Innco Systems GmbH	Turn Table	N/A	N/A
MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509/ 37211215/L	N/A
310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 11, 2024 (1Y)
HLP-2008	TDK RF Solutions	Hybrid Antenna	131313	Apr. 05, 2023 (2Y)
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 20, 2024 (2Y)
SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 04, 2024 (1Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 02, 2024 (1Y)
ELNA40	EXYNOD	Pre-Amplifier	25339-27648	Jan. 15,2025 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 14,2025 (1Y)
M19RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 20, 2024 (1Y)
M12RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 20, 2024 (1Y)
M08RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 20, 2024 (1Y)
M05RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 20, 2024 (1Y)
DC4060-FS1	C&K Technologies, Inc.	WR-19 Down Converter	241202-1	Jan. 14, 2025 (1Y)
DC6090-FS1	C&K Technologies, Inc.	WR-12 Down Converter	241202-2	Jan. 14, 2025 (1Y)
DC90140-FS1	C&K Technologies, Inc.	WR-08 Down Converter	241202-3	Jan. 14, 2025 (1Y)
DC140220-FS1	C&K Technologies, Inc.	WR-05 Down Converter	241202-4	Jan. 14, 2025 (1Y)
SSE-43CI-A	Samkun Tech	Environmental Test Chamber	60712	Jan. 13, 2025 (1Y)
H-3005D	FinePower	DC Power Supply	FP09092008	Jan. 13, 2025 (1Y)
ESR 3	Rohde & Schwarz	EMI Test Receiver	102602	Mar. 11, 2024 (1Y)
NSLK8126	Schwarzbeck	AMN	8126-404	Mar. 12, 2024 (1Y)
VTSD 9561-F	Schwarzbeck	PULSE LIMITER	01337	Nov. 26, 2024 (1Y)