

FCC&ISED EMC TEST REPORT

Report No.: DDT-B24042312-6E01

Applicant	:	Rhino Sp. z o o
Address	:	Strzegomska 140A, 54-429 Wrocław, Poland
Equipment under Test	:	Smart Metering RS485 Expansion Module
Model No.	:	Rhino ED RS485
Manufacturer	:	Rhino Sp. z o o
Address	:	Strzegomska 140A, 54-429 Wrocław, Poland
Trade Mark	:	N/A

Issued By: Tianjin Dongdian Testing Service Co., Ltd.

Address: Building D-1, No. 19, Weisi Road, Microelectronics Industrial Park, Development Area, Tianjin, China.

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REPORT

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Test Report Declare

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Address	:	Strzegomska 140A, 54-429 Wrocław, Poland
Trade Mark	:	N/A

Test Standard Used:

47 CFR Part 15 Subpart B, ICES-003 Issue 7: October 2020, IEEE/ANSI C63.4-2014, IEEE/ANSI C63.4a-2017

We Declare:

The equipment described above is tested and assessed by Tianjin Dongdian Testing Service Co., Ltd. and in the configuration assessed the equipment complied with the standards specified above. The tested and assessed results are contained in this test report and Tianjin Dongdian Testing Service Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these assessments.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above standards.

Report No.:	DDT-B24042312-6E01		
Date of Receipt:	May. 14, 2024	Date of Test:	Jul. 04, 2024

Prepared By:

Novak Wei

Novak Wei/Engineer

Approved By:

Aaron Zhang

Aaron Zhang/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Tianjin Dongdian Testing Service Co., Ltd.

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.

Revision History

Rev.	Revisions	Issue Date	Revised By
---	Initial issue	Aug. 15, 2024	

1 Summary of Test Results

Description of Test Item	Standard	Result
Conducted Emissions	IEEE/ANSI C63.4-2014, IEEE/ANSI C63.4a-2017, 47 CFR Part 15 Subpart B, ICES-003 Issue 7: October 2020	Pass
Radiated Emissions (30MHz to 1GHz)	IEEE/ANSI C63.4-2014, IEEE/ANSI C63.4a-2017, 47 CFR Part 15 Subpart B, ICES-003 Issue 7: October 2020,	Pass

2 General Test Information

2.1 Description of EUT

EUT Name	:	Smart Metering RS485 Expansion Module
Model Number	:	Rhino ED RS485
Sample No.	:	Y24042312-06
Power supply	:	DC 5V-12V
Test Power supply	:	DC 12V
EUT Class	:	Class B

2.2 Port of EUT

Port	Description
DC Port	Supply power to EUT
Antenna Port	ISM antenna communicates with Rhino cloud
RS485 Port	Connect other RS485 devices to collect information

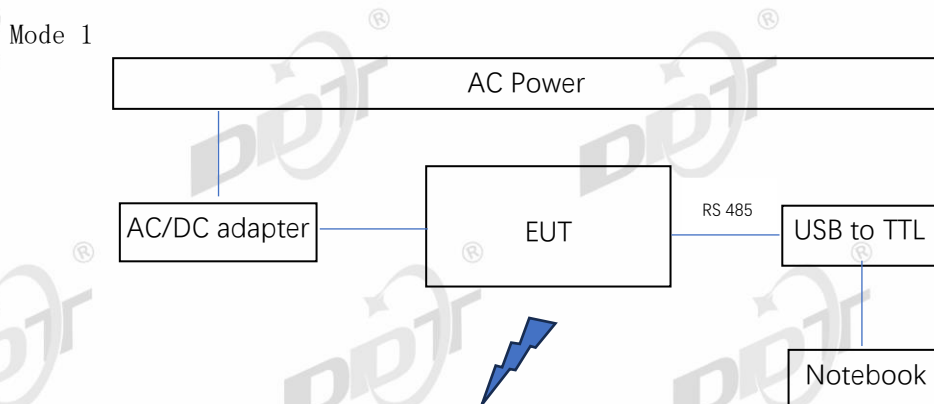
2.3 Accessories of EUT

Accessories	Manufacturer	Model No.	Description	Remark
N/A	N/A	N/A	N/A	N/A

2.4 Test peripherals

Device	Manufacturer	Model No.	Description	Remark
Notebook	Lenovo Beijing Co. Ltd.	ThinkPad E450c	CE/FCC	TP00067A
USB to TTL	N/A	N/A	N/A	N/A
AC/DC adapter	N/A	N/A	N/A	N/A

2.5 Block diagram EUT configuration for test



2.6 EUT operating mode(s)

Mode 1	The EUT is powered by an AC to DC adapter, Communication via RS485 and USB to TTL. The Notebook communicates via USB and USB to TTL, and the control device is in the firing state
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2.7 Deviations of test standard

No Deviation.

2.8 Test laboratory

Tianjin Dongdian Testing Service Co., Ltd.

Address: Building D-1, No. 19, Weisi Road, Microelectronics Industrial Park Development Area, Tianjin, China.

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NVLAP (National Voluntary Laboratory Accreditation Program) CODE: 500036-0

CNAS (China National Accreditation Service for Conformity Assessment) CODE: L13402

FCC Designation Number: CN5004; FCC Test Firm Registration Number: 368676

ISED (Innovation, Science and Economic Development Canada) Company Number: 27768

Conformity Assessment Body Identifier: CN0125

VCCI Facility Registration Number: C-20089, T-20093, R-20125, G-20122

2.9 Measurement uncertainty

Test Item	Uncertainty
Conducted Emissions at Mains Power Port	3.4 dB (150KHz-30MHz)
Radiated Emissions (30MHz to 1GHz)	5.2 dB (Antenna Polarize: Hor.)
	5.2 dB (Antenna Polarize: Ver.)
Radiated Emissions (Above 1GHz)	5.0 dB
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

2.10 Abbreviations

For the purposes of the present document, the following abbreviations apply:

EUT: Equipment Under Test

QP: Quasi-Peak

PK: Peak,

AV: Average

CAV: CISPR Average

CDN: Coupling Decoupling Network

AM: Amplitude Modulation

N/A: Not Applicable

3 Conducted Emissions

3.1 General Information

Test date	Jul. 05, 2024	Test engineer	Freya Wei	
Climate condition	Ambient temperature	27.0°C	Relative humidity	48.7%
	Atmospheric pressure	100.1kPa		
Test place	Shield Room 2#			

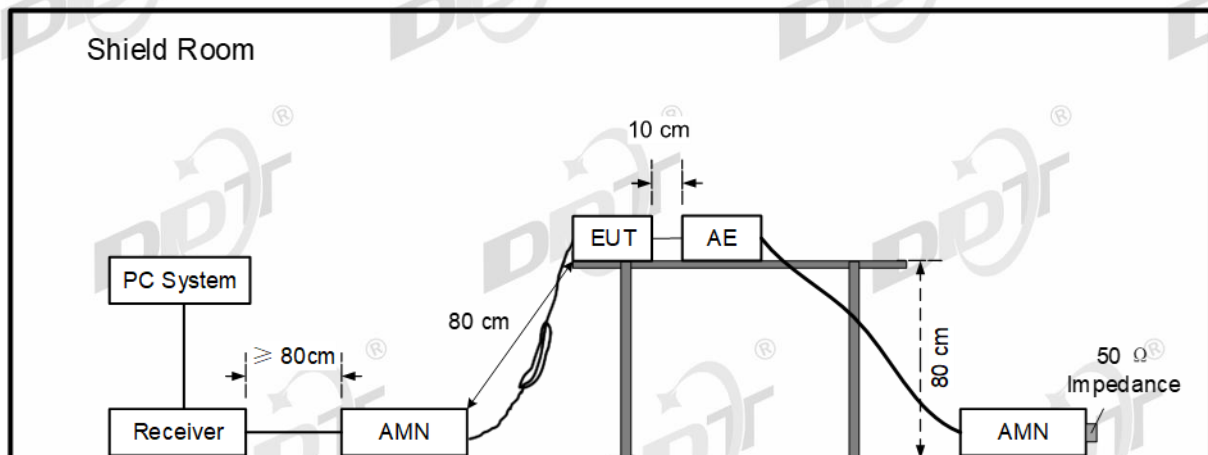
3.2 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EMI Test Receiver	Rohde & Schwarz	ESCI	100375	Feb. 18, 2024	1 Year
Two-Line V-Network	Rohde & Schwarz	ENV216	101122	Feb. 18, 2024	1 Year
Test Software	TOYO	EP5/CE	Ver 5.4.40	N/A	N/A

3.3 Reference Standard

IEEE/ANSI C63.4-2014,
IEEE/ANSI C63.4a-2017,
47 CFR Part 15 Subpart B,
ICES-003 Issue 7: October 2020

3.4 Test Arrangement



The EUT was placed on a non-metallic table, 80cm above the ground plane. The EUT's power adapter was connected to the power mains through a line impedance stabilization network (AMN), which provided a 50-ohm coupling impedance for the EUT (Please refer to the block diagram of the test setup and photographs). Both sides of the power line were checked for maximum conducted disturbance.

The bandwidth of the test receiver is set at 9 kHz.

The frequency range from 150 kHz to 30MHz is checked.

Pre-scan measurements were performed in all operating modes or resolutions. But final measurements were performed in worst cases based on pre-scan measurements.

3.5 Test Specification and Limit

Class B

Frequency	Quasi-Peak Level dB(μ V)	Average Level dB(μ V)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Notes: 1. * Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies.

Note for test result

Note1): According pre-test, the worst test modes decided as below and reported. Only data of worst mode was reported in test result.

Note2) Line = Polarity of input power (Live or Neutral), N: Abbreviation of Neutral Polarity, L1: Abbreviation of Live Polarity,

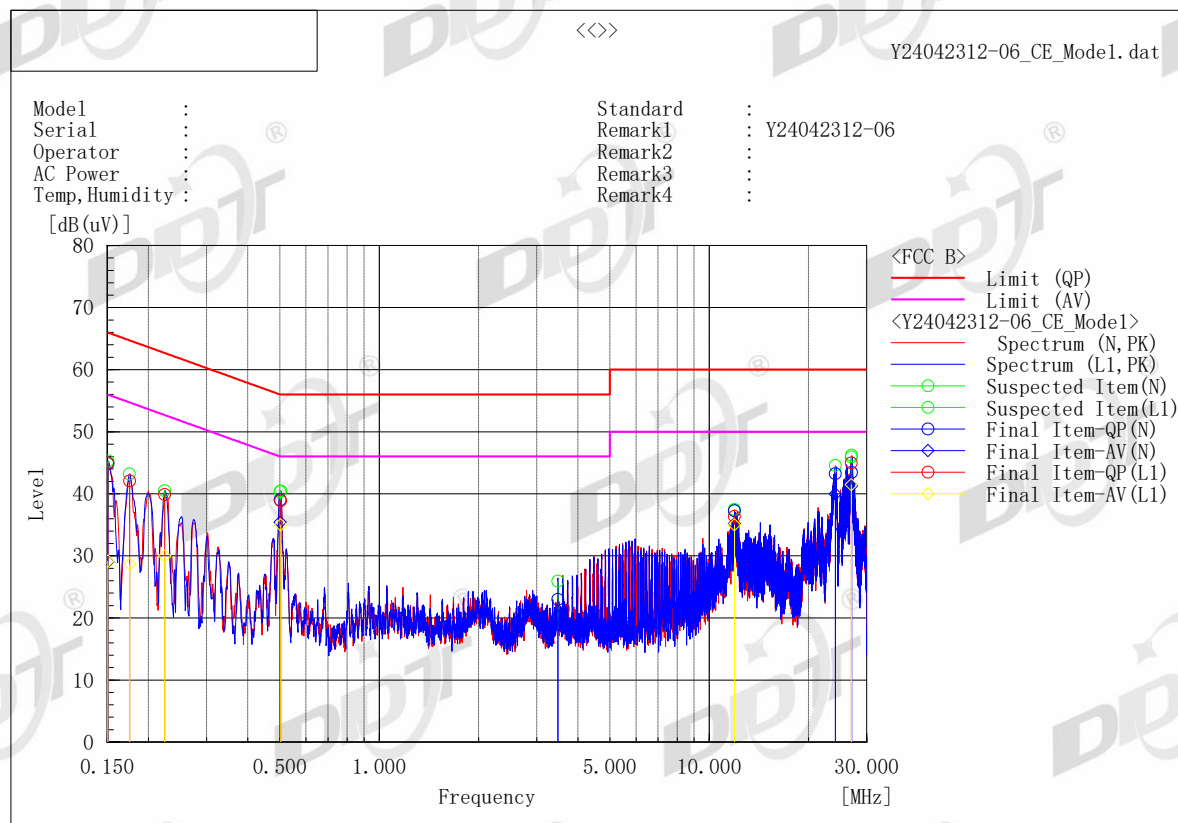
Note3) Level (Quasi-Peak and/or C/Average) = Meter Reading + Factor,

Note4) Factor = AMN (or AAN) Insertion Loss + Cable Loss,

Note5) Margin = Limit – Level (Quasi-Peak and/or C/Average)

3.6 Test Result

Sample No.	Operation Mode	Remarks	Result
Y24042312-06	Mode 1	Final measurement, minimum margin 8.6dB	Pass



Final Result

--- N Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c. f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	27.00386	33.0	30.8	10.4	43.4	41.2	60.0	50.0	16.6	8.8
2	24.08279	32.9	29.7	10.3	43.2	40.0	60.0	50.0	16.8	10.0
3	0.50168	29.2	25.6	9.8	39.0	35.4	56.0	46.0	17.0	10.6
4	0.15071	35.0	19.2	9.8	44.8	29.0	66.0	56.0	21.2	27.0
5	11.92051	27.2	25.0	10.1	37.3	35.1	60.0	50.0	22.7	14.9
6	3.47701	13.0	10.2	10.0	23.0	20.2	56.0	46.0	33.0	25.8

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c. f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	26.92191	34.8	31.2	10.2	45.0	41.4	60.0	50.0	15.0	8.6
2	0.50293	29.1	25.2	9.8	38.9	35.0	56.0	46.0	17.1	11.0
3	0.15057	35.1	19.3	9.8	44.9	29.1	66.0	56.0	21.1	26.9
4	0.17524	32.3	18.8	9.8	42.1	28.6	64.7	54.7	22.6	26.1
5	0.22393	30.1	20.2	9.8	39.9	30.0	62.7	52.7	22.8	22.7
6	11.9207	26.3	24.9	10.1	36.4	35.0	60.0	50.0	23.6	15.0

4 Radiated Emissions (30MHz to 1GHz)

4.1 General Information

Test date	Jul. 04, 2024	Test engineer	Dominic Du [®]	
Climate condition	Ambient temperature	26.4°C	Relative humidity	47.5%
	Atmospheric pressure	100.4kPa		
Test place	10m Chamber			

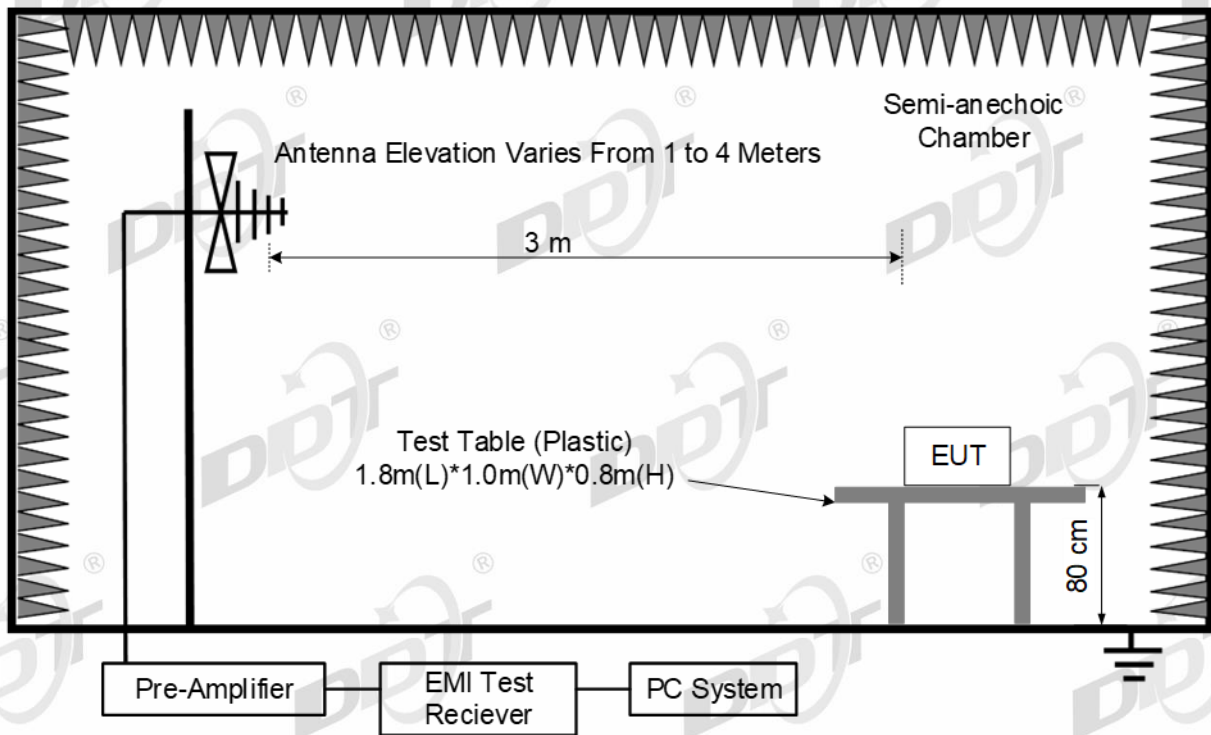
4.2 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EMI Test Receiver	Rohde & Schwarz	ESCI	101024	Feb. 18, 2024	1 Year
BiLog Antenna	TESEQ	CBL 6112D	29068	Oct. 10, 2022	2 Year
Low Noise Amplifier	SONOMA	310N	300913	Feb. 18, 2024	1 Year
RF Selector 4CH	TOYO	NS4904N	Selector1	N/A	N/A
RF Selector 4CH	TOYO	NS4904N	Selector2	N/A	N/A
Mast Control	INNCO	CONTROLLE R CO2000	ZOAA97AZ10 0013D	N/A	N/A
BiLog Antenna	TESEQ	CBL 6112D	29069	Oct. 10, 2022	2 Year
EMI Test Receiver	Rohde & Schwarz	ESCI	101030	Feb. 18, 2024	1 Year
Low Noise Amplifier	SONOMA	310N	334532	Feb. 18, 2024	1 Year
Test Software	TOYO	EP5/RE	Ver 5.7.10	N/A	N/A

4.3 Reference Standard

IEEE/ANSI C63.4-2014,
IEEE/ANSI C63.4a-2017,
47 CFR Part 15 Subpart B,
ICES-003 Issue 7: October 2020,

4.4 Test Arrangement



Procedure of Preliminary Test

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in operation modes.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.

Mains cables, telephone lines or other connections to auxiliary equipment located outside the test are shall drape to the floor, be fitted with ferrite clamps or ferrite tubes placed on the floor at the point where the cable reaches the floor and then routed to the place where they leave the turntable. No extension cords shall be used to mains receptacle.

The antenna was placed at 3 meters away from the EUT as stated in ANSI C63.4. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.

The Analyzer / Receiver quickly scanned from 30MHz to 1GHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

The test mode(s) described were scanned during the preliminary test:

After the preliminary scan, we found the test mode producing the highest emission level. The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission level were recorded for the final test.

Procedure of Final Test

EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test.

Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit and only Q.P. reading is presented.

The test data of the worst-case condition(s) was recorded.

4.5 Test Specification and Limit

Class B

Frequencies (MHz)	Radiated Emissions Limits at 3 meters (dB μ V/m)
30-88	40
88-216	43.5
216-230	46
230-960	
960-1000	54

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB μ V/m) = 20 log Emission level (uV/m).
3. If results comply with FCC part 15 limits, then they also comply with ICES-003 Issue 7: October 2020.

Note for test result

Note1): According pre-test, the worst test modes decided as below and reported. Only data of worst mode was reported in test result.

Note2) (P): Abbreviation of Antenna Polarity

Note3) Receiving antenna polarization: Horizontal and/or Vertical. Antenna Height: 1 m to 4 m

Note4) Level QP (Quasi-Peak) = Reading QP + Factor

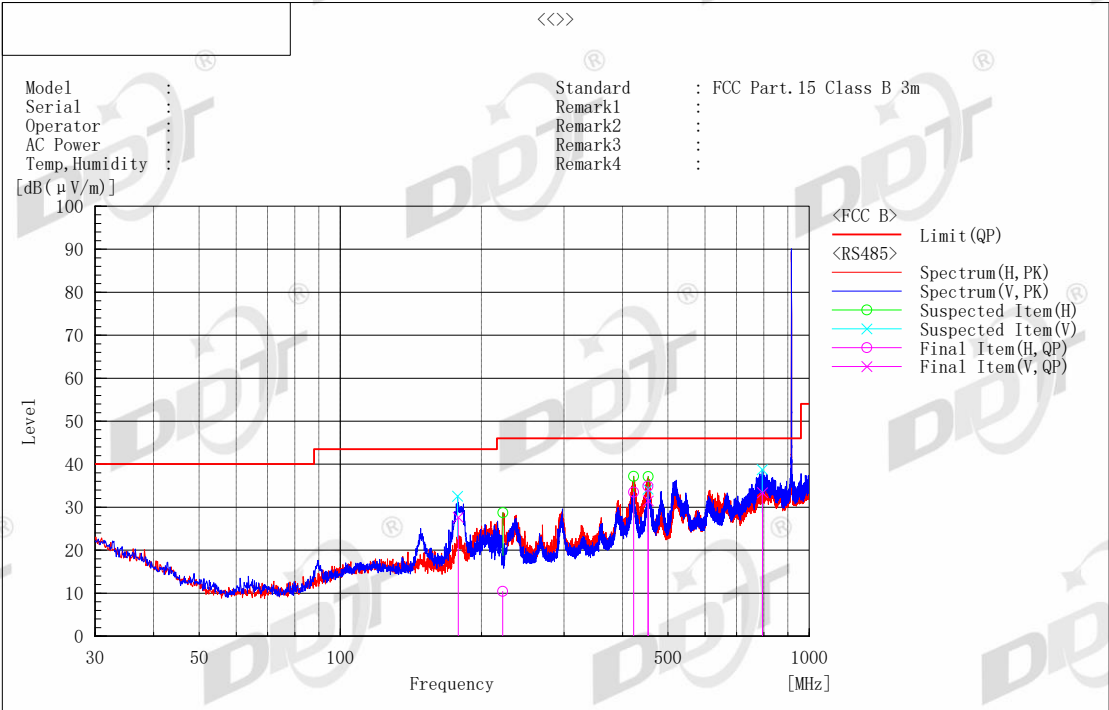
Note5) Factor = Antenna Factor + Cable Loss - Amp. Gain

Note6) Margin = Limit – Level QP

Note7) The spike (902MHz~928MHz) over the limit is coming from the SRD, radiated emissions shall be ignored.

4.6 Test Result

Sample No.	Operation Mode	Remarks	Result
Y24042312-06	Mode 1	Final measurement, minimum margin 11.2 dB	Pass



Final Result

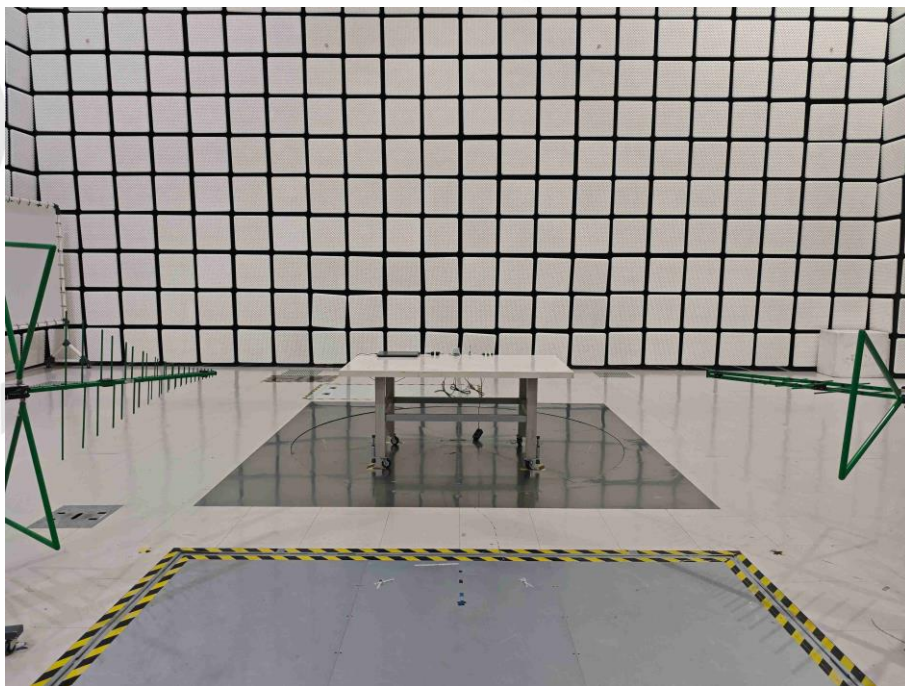
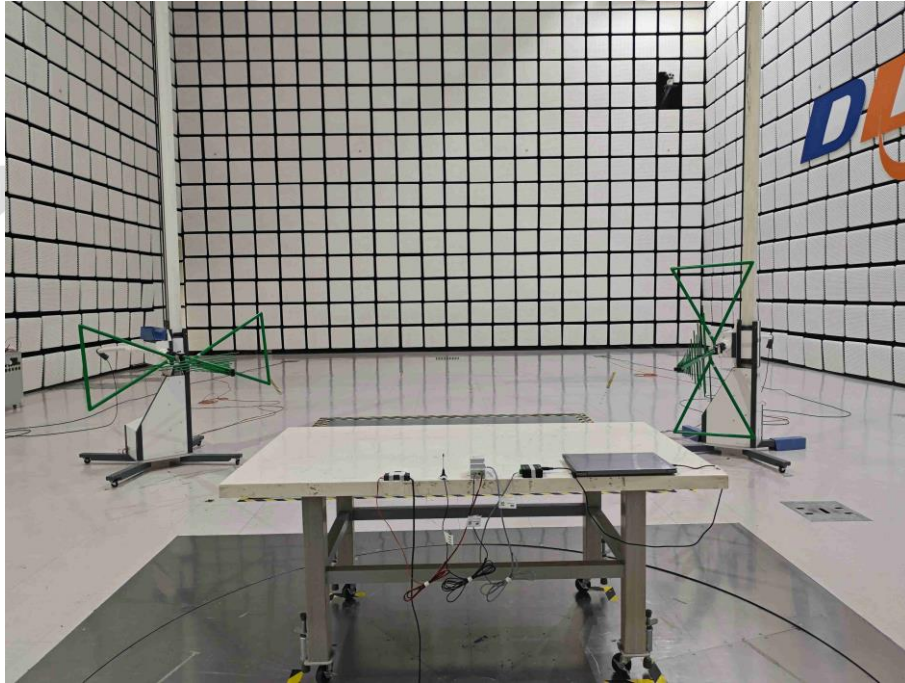
No.	Frequency [MHz]	(P)	Reading QP [dB (μV)]	c. f [dB (1/m)]	Result QP [dB (μV/m)]	Limit QP [dB (μV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
1	221.890	H	22.7	-12.3	10.4	46.0	35.6	151.0	244.9
2	422.450	H	36.7	-3.2	33.5	46.0	12.5	102.0	136.4
3	452.836	H	37.4	-2.6	34.8	46.0	11.2	102.0	127.4
4	453.707	V	34.1	-2.6	31.5	46.0	14.5	125.0	172.7
5	178.426	V	40.2	-12.5	27.7	43.5	15.8	100.0	150.7
6	794.982	V	30.5	2.9	33.4	46.0	12.6	101.0	322.3

Annex A. Test Setup Photos

A.1 Conducted Emissions

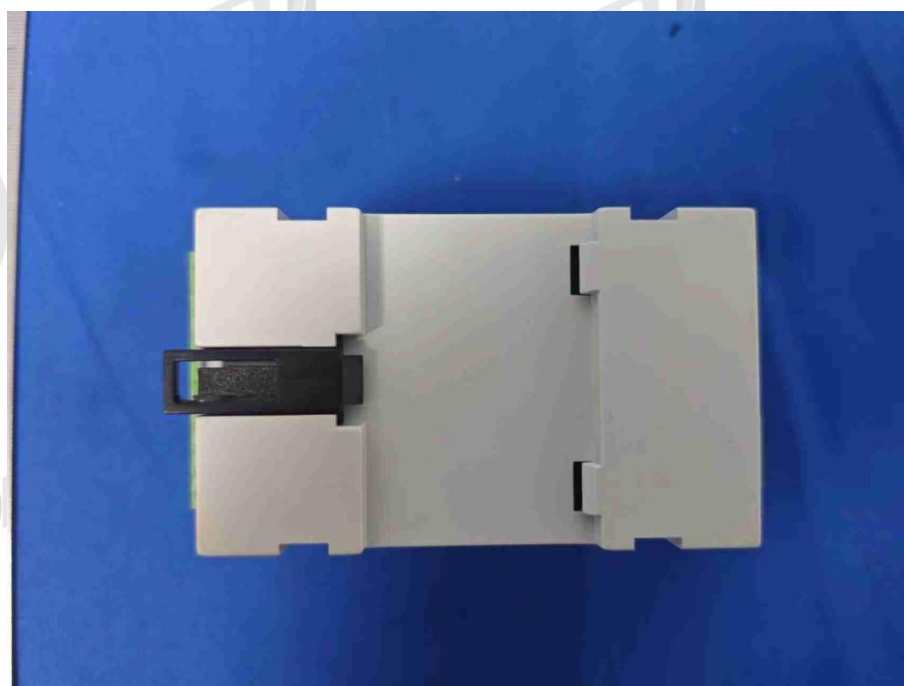
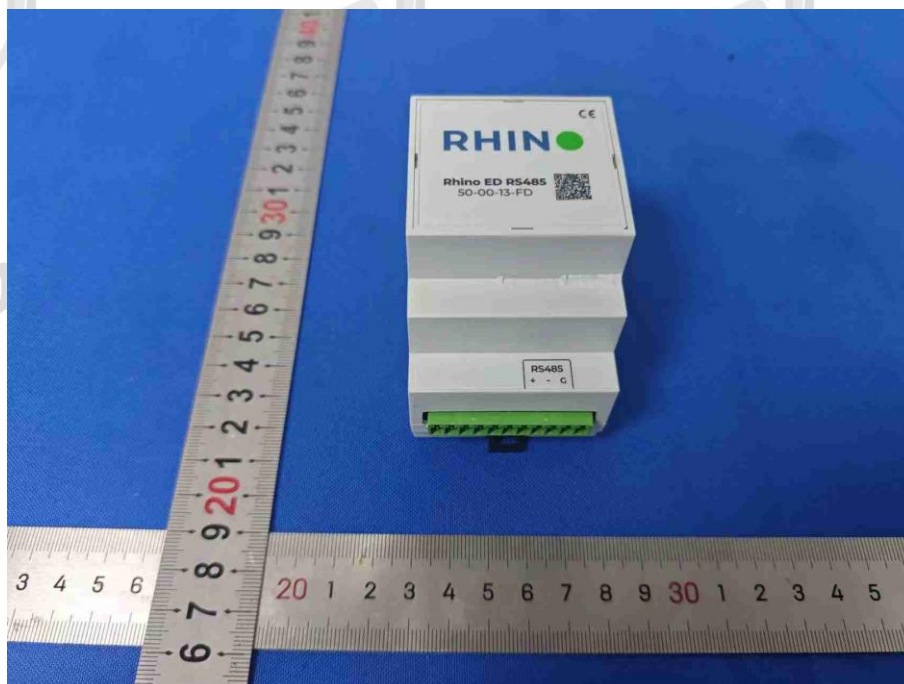


A.2 Radiated Emissions

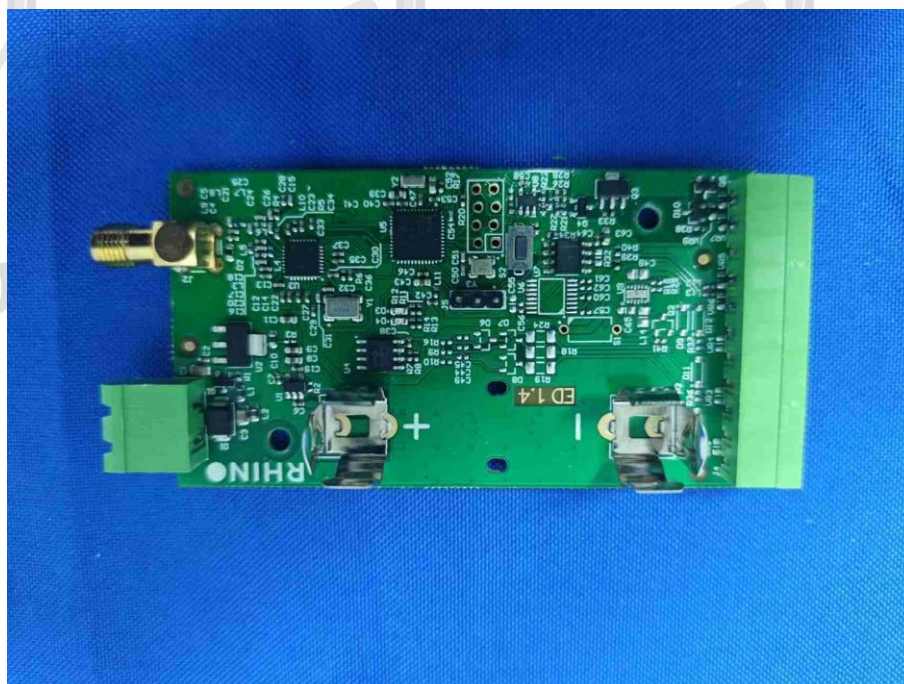


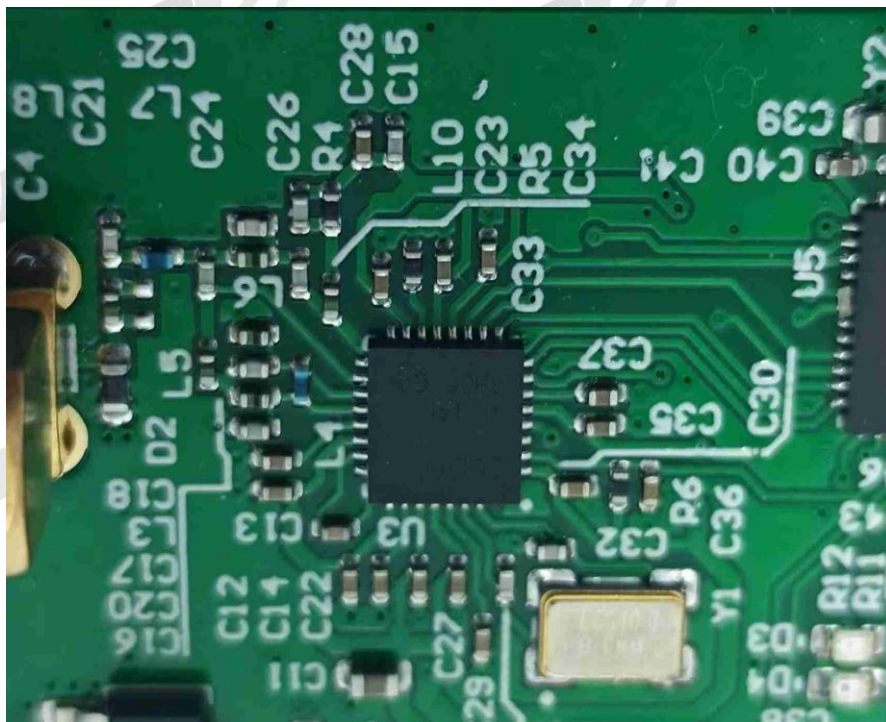
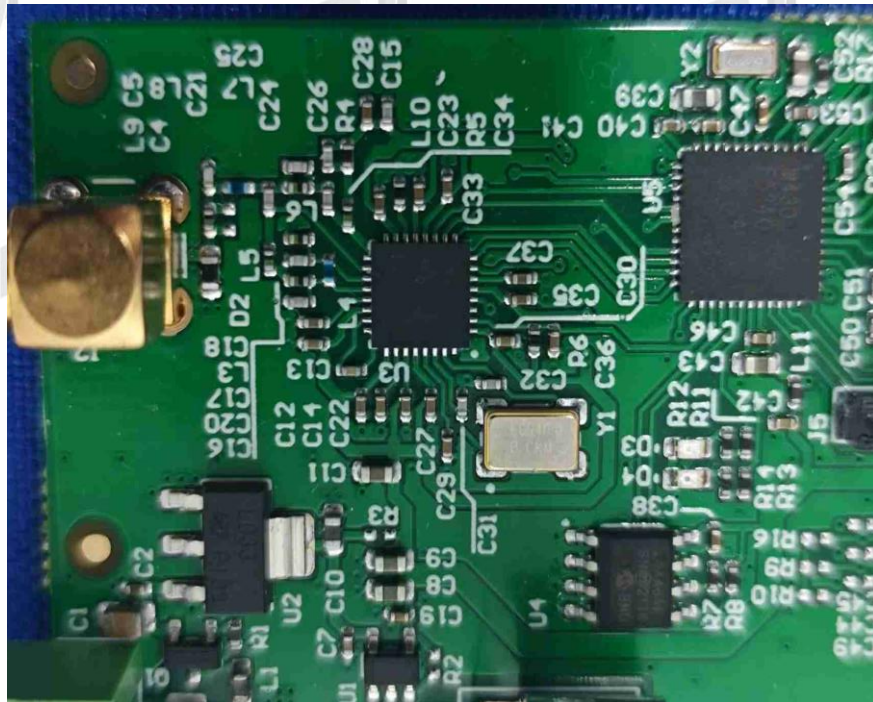
Annex B.Photos of EUT











Regulatory Statement and Label Marking Advice for the FCC SDoC

1. Marking Suggested for the label:

Trade Name and model number

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2. Statement suggested for the User Manual:

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: If shielded cables or special accessories are required for compliance, a statement must be included which instructs the user to employ them, for example, shielded cables must be used with this unit to ensure compliance with the Class B FCC limits.

Suggested text for the notice indicating compliance with this Standard:

CAN ICES (B) / NMB (B)

Statement

1. The report is invalid without the inspection and testing special seal of the company.
2. This report is invalid if altered.
3. This report is responsible for the conformance testing of sample(s) received.
4. This report shall not be reproduced, without the written approval of test laboratory. The copy of the report not stamped again with the inspection and testing special seal is invalid.
5. Item with “☆” was subcontracted to other laboratories.
6. The report without CMA mark indicated that either test item(s) not accredited by CMA or test item(s) accredited by CMA but the report is only used for development or quality control which purposes within the company that has no effect on social proof.
7. Any objections must be raised to our company within 15 days on receiving the report, overdue will not be accepted.
8. The sample(s) must be collected within three months, overdue will be dealt with by our company.
9. The report is invalid without the signature of editor, reviewer, approver.

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END OF REPORT