TEST REPORT

Applicant & Manufacturer:	NiceRF Wireless Technology Co., Ltd.
Address :	309-314, 3/F, Bldg A, Hongdu business building, Zone 43, Baoan Dist, Shenzhen, China
Report Number :	RA240320-14269E-EM

Test Standard (s)

ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-3 V2.3.2 (2023-01)

Sample Description

Product Type:	Wireless Module
Model No.:	RF2401F20
Trade Mark:	G-NiceRF®
Date Received:	2024-03-20
Date of Test:	2024-03-25 to 2024-03-27
Report Date:	2024-03-29

Test Result:	The EUT complied with the standards above.

Prepared and Checked By:

Ronour Huang

Ronour Huang
EMC Engineer

Approved By:

Bob. Liao

Bob. Liao
EMC Engineer

ACCURATE TECHNOLOGY CO. LTD ATC APPROVED

Note: The information marked "#" is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included but no need marked.
This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY **3**

GENERAL INFORMATION **4**

PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
PERFORMANCE CRITERION 5
TEST METHODOLOGY 5
TEST FACILITY 5
MEASUREMENT UNCERTAINTY 6

SYSTEM TEST CONFIGURATION **7**

DESCRIPTION OF TEST CONFIGURATION 7
EUT EXERCISE SOFTWARE 7
SPECIAL ACCESSORIES 7
EQUIPMENT MODIFICATIONS 7
SUPPORT EQUIPMENT LIST AND DETAILS 7
EXTERNAL I/O CABLE 7
BLOCK DIAGRAM OF TEST SETUP 8

SUMMARY OF TEST RESULTS **9**

TEST EQUIPMENT LIST **10**

§7.1 - RADIATED EMISSIONS **11**

APPLICABLE STANDARD 11
TEST SYSTEM SETUP 11
LIMIT 12
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 12
TEST PROCEDURE 12
CALCULATION 13
TEST RESULTS SUMMARY 13
TEST DATA AND TEST SETUP PHOTO 13

§7.2 - RF ELECTROMAGNETIC FIELD (80 MHZ TO 6000 MHZ) **19**

TEST SYSTEM SETUP 19
TEST STANDARD 19
TEST LEVEL 19
TEST PROCEDURE 20
TEST DATA AND TEST SETUP PHOTO 20

§7.2 - ELECTROSTATIC DISCHARGE **22**

TEST SYSTEM SETUP 22
TEST STANDARD 22
TEST LEVEL 22
TEST PROCEDURE 23
TEST DATA AND TEST SETUP PHOTO 23

EXHIBIT A - EUT PHOTOGRAPHS **26**

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
Rev.00	RA240320-14269E-EM	Original Report	2024-03-29

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Wireless Module
Tested Model	RF2401F20
Highest Operating Frequency	The EUT's highest operating frequency is 2480MHz#, more than 1GHz,the radiated emission measurement shall be made up to 6GHz.
Voltage Range#	DC 3.3V
Sample serial number	2IX3-1 (EMI&EMS) (Assigned by ATC, Shenzhen)
Sample/EUT Status	Good condition

Objective

This test report is in accordance with ETSI EN 301 489-1 V2.2.3 (2019-11), ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility; ETSI EN 301 489-3 V2.3.2 (2023-01), ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard for ElectroMagnetic Compatibility.

The objective is to determine compliance with ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-3 V2.3.2 (2023-01).

Performance criterion

Performance criterion A

The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended.

The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion B

During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test. After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion C

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed.

Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

Test Methodology

All measurements contained in this report were conducted with ETSI EN 301 489-1 V2.2.3 (2019-11).

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, China.

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of test at Shenzhen Accurate Technology Co., Ltd. (Shenzhen) is shown as below. And the uncertainty will be taken into consideration for the test data recorded in the report.

Item		Expanded Measurement uncertainty
Radiated Emission	30MHz-1GHz	*4.3 dB (k=2, 95% level of confidence)*
	1GHz-18GHz	*4.9 dB (k=2, 95% level of confidence)*

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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

Test Mode: Data transmission

Test Voltage: DC 3.3V

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory.

Equipment Modifications

No modifications were made to the EUT.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
NANFU	1.5V Dry battery*4	LR6 1.5V	Unknown
AGILENT	Vector Signal Generator	N5182A	MY50143401
Unknown	DEMO Board#	Unknown	Unknown

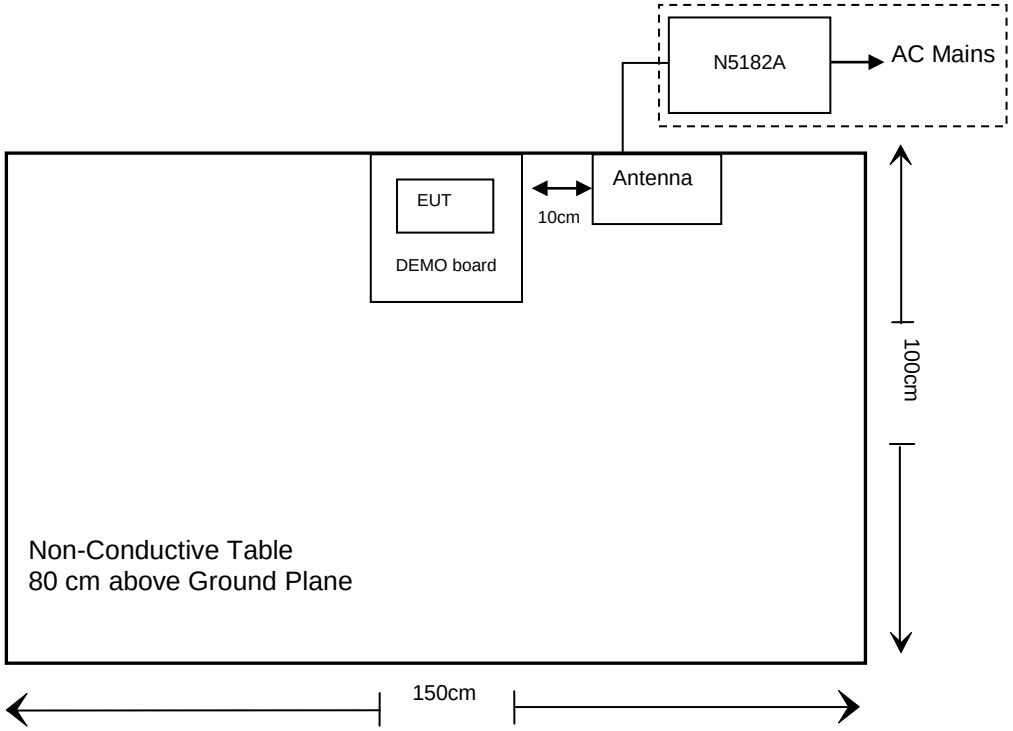
Note: The DEMO Board# is provided by the applicant for testing.

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

Radiated Emission:



Note: The support table edge was flush with the center of turntable.

SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
§7.1	Reference to clauses ETSI EN 301 489-1 §8.4 AC mains power input/output ports	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §8.3 DC power input/output ports	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §8.2 Enclosure port of ancillary equipment measured on a stand alone basis	Compliance
	Reference to clauses ETSI EN 301 489-1 §8.5 Harmonic current emissions (AC mains input port)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §8.6 Voltage fluctuations and flicker (AC mains input port)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §8.7 Wired network ports	Not Applicable
§7.2	Reference to clauses ETSI EN 301 489-1 §9.2 Radio frequency electromagnetic field (80 MHz to 6000 MHz) (EN 61000-4-3)	Compliance
	Reference to clauses ETSI EN 301 489-1 §9.3 Electrostatic discharge (EN 61000-4-2)	Compliance
	Reference to clauses ETSI EN 301 489-1 §9.4 Fast transients, common mode (EN 61000-4-4)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §9.5 Radio frequency, common mode (EN 61000-4-6)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §9.6 Transients and surges in the vehicular environment (ISO 7637-2)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §9.8 Surges (EN 61000-4-5)	Not Applicable
	Reference to clauses ETSI EN 301 489-1 §9.7 Voltage dips and interruptions (EN 61000-4-11)	Not Applicable

Not Applicable: Please refer to Applicability overview tables in sections 7.1 and 7.2 of EN 301 489-1 requirements for Radio and ancillary equipment.

Note: The device is a module.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test (Below 1GHz)					
Rohde & Schwarz	Test Receiver	ESR	102725	2023/11/17	2024/11/16
SONOMA INSTRUMENT	Amplifier	310 N	186131	2023/06/02	2024/06/01
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Unknown	RF Coaxial Cable	No.12	N040	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.13	N300	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.14	N800	2023/11/17	2024/11/16
Radiated Emission Test Software: e3 191218 (V9)					
Radiated Emission Test (Above 1GHz)					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2023/11/17	2024/11/16
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2023/06/02	2024/06/01
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Unknown	RF Coaxial Cable	No.10	N050	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.11	N1000	2023/11/17	2024/11/16
Radiated Emission Test Software: e3 191218 (V9)					
ESD					
TESEQ	ESD Generator	NSG 437	823	2023/11/20	2024/11/19
RS					
Rohde & Schwarz	RF-Generator	SMB100A	108362	2023/11/17	2024/11/16
TESEQ	Power Amplifier (80 – 1000MHz)	CBA 1G-070	T44328	2023/10/07	2024/10/06
A&R	Linear Power Amplifier (1 – 6GHz)	AS0860-40/45	1060913	2023/10/07	2024/10/06
A&R	Trapezoidal Log Periodic Antenna	ATT700M12G	0357149	/	/
A&R	Log-Periodic Antenna	ATL80M1G	0356913	/	/
Agilent	Power Meter	E4419B	MY45100442	2023/10/07	2024/10/06
Keysight	Power Sensor	E9301A	MY55270006	2023/10/07	2024/10/06
Keysight	Power Sensor	E9301A	MY54280004	2023/10/07	2024/10/06
RS Test Software: IEC 61000-4-3&6Version V2.3					

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

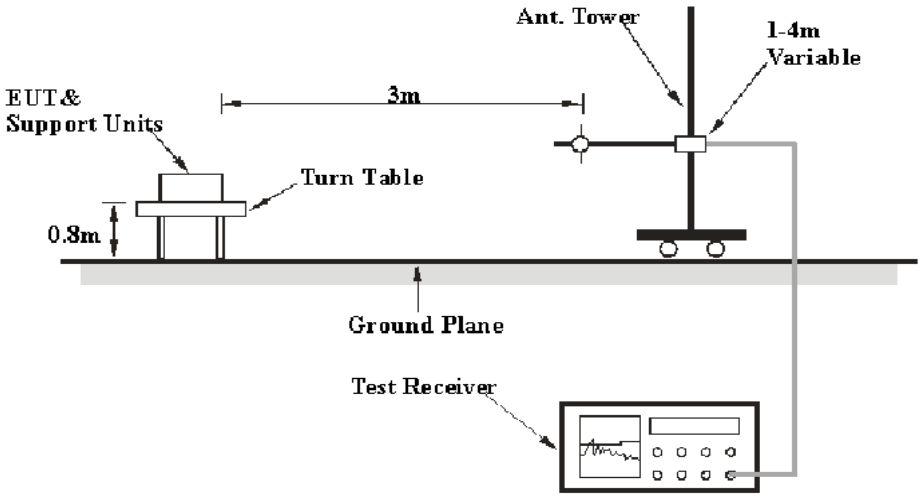
§7.1 - RADIATED EMISSIONS

Applicable Standard

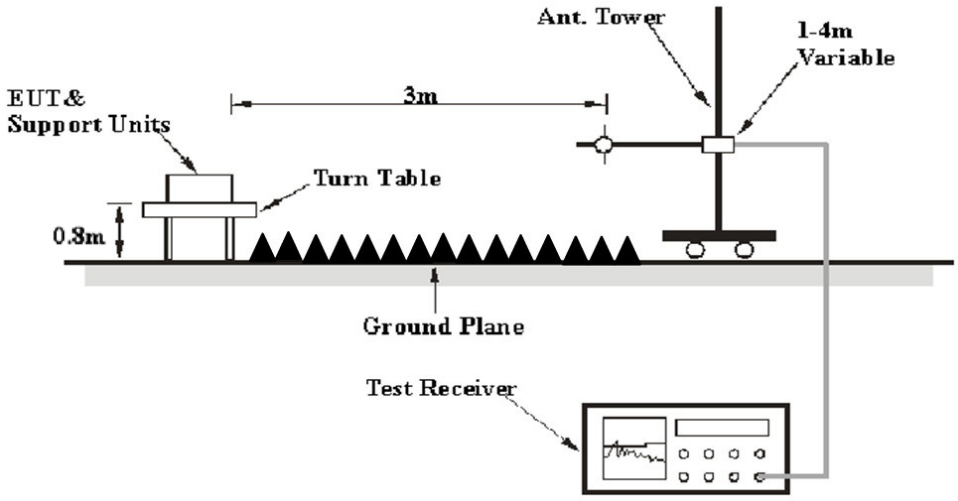
According to ETSI EN 301 489-1.

Test System Setup

Below 1 GHz:



Above 1 GHz:



Boundary of the EUT, local AE and associated cabling and measurement distance for radiated emissions measurements:

The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna. See as below Figure C.1 and C.2.

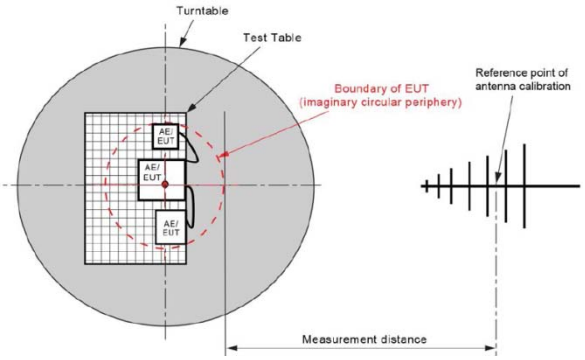


Figure C.1 – Measurement distance

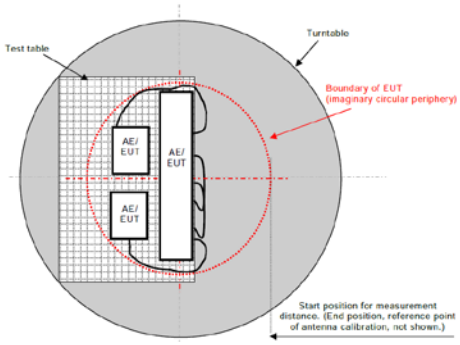


Figure C.2 – Boundary of EUT, Local AE and associated cabling

The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the CISPR 16-1-4:2012, CISPR 16-2-3:2010. The limit was specified in EN 301 489-1.

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.

Limit

Frequency (MHz)	Field Strengths Limit dB(μV/m)
	3m
30 ~ 230	40
230 ~ 1000	47

Frequency (MHz)	Field Strengths Limit dB(μV/m)	
	3m	
	Average /1 MHz	Peak /1 MHz
1000 ~ 3000	50	70
3000 ~ 6000	54	74

EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	Measurement	RBW	Video B/W	IF B/W
30 MHz - 1000 MHz	PK	100 kHz	300 kHz	/
	QP	/	/	120kHz
Above 1GHz	PK	1 MHz	3 MHz	/
	AV	1 MHz	10 Hz	/

Test Procedure

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

Calculation

The Facor 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:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit =Level - Limit.
Level = Read Level + Factor

Test Results Summary

According to the recorded data in following table, the EUT complied with the EN 301 489-1,

Test Data and Test Setup Photo

Environmental Conditions

Temperature:	21-25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.6 kPa

The Below 1GHz testing was performed by Jason Liu on 2024-03-25.
The Above 1GHz testing was performed by Jimi Zheng on 2024-03-25.

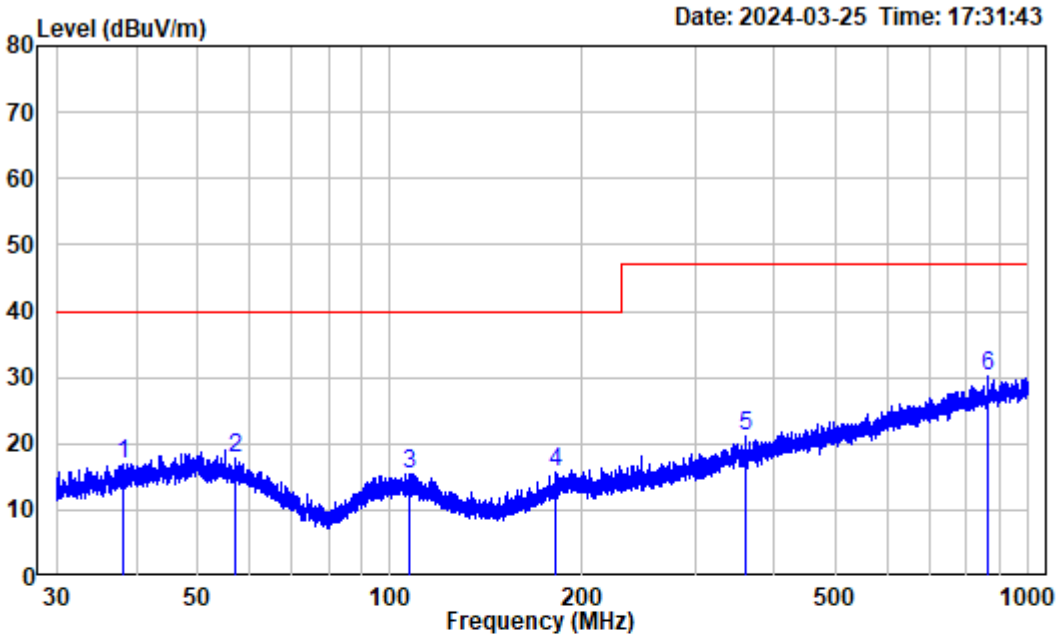
The frequency range from 30MHz to 6000 MHz is investigated.

EUT operation mode: Data transmission

Test Result: Please refer to the following data.

Below 1GHz

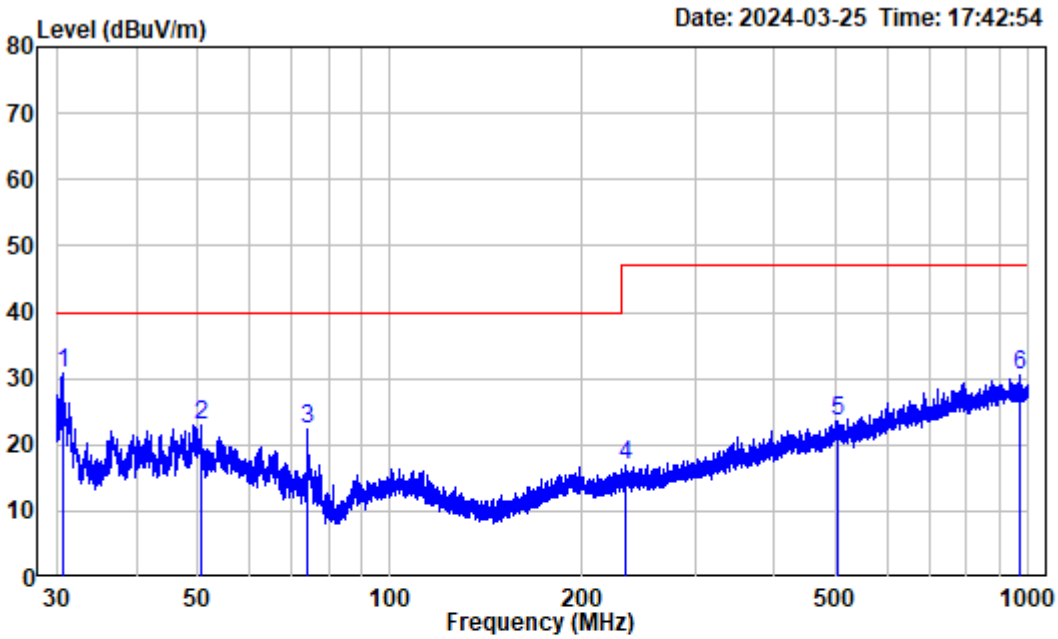
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA240320-14269E-EM
Test Mode: Data transmission

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.212	-10.91	27.91	17.00	40.00	-23.00	Peak
2	57.116	-10.23	28.09	17.86	40.00	-22.14	Peak
3	107.510	-12.21	27.71	15.50	40.00	-24.50	Peak
4	182.000	-12.74	28.29	15.55	40.00	-24.45	Peak
5	361.080	-7.77	28.87	21.10	47.00	-25.90	Peak
6	863.056	0.14	29.97	30.11	47.00	-16.89	Peak

Vertical

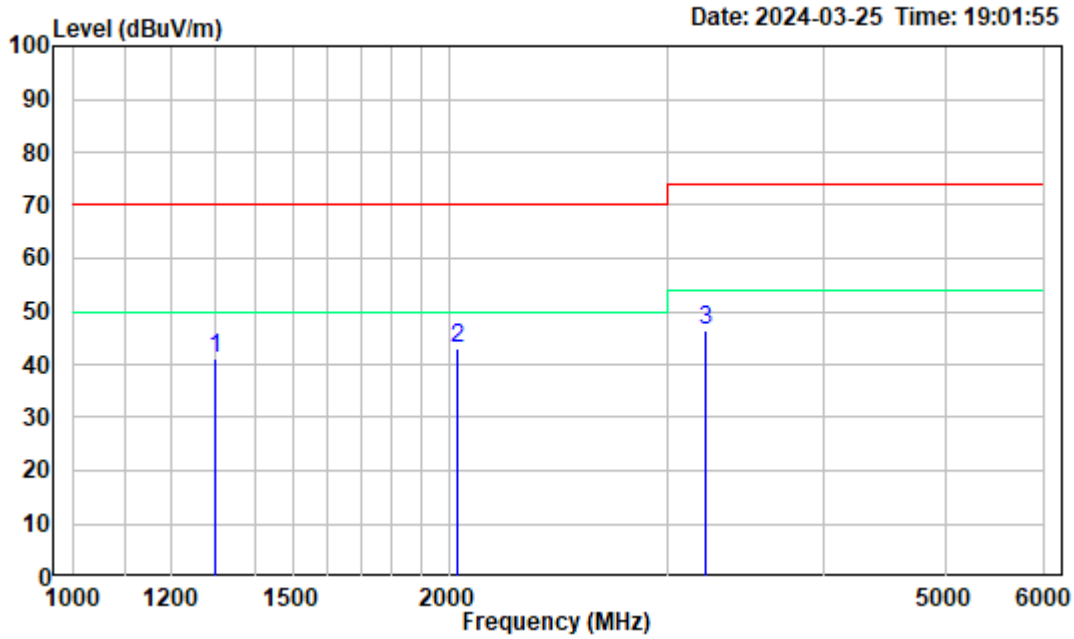


Site : chamber
Condition: 3m VERTICAL
Job No. : RA240320-14269E-EM
Test Mode: Data transmission

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	30.624	-12.35	43.22	30.87	40.00	-9.13	Peak
2	50.409	-10.04	32.92	22.88	40.00	-17.12	Peak
3	74.298	-16.24	38.55	22.31	40.00	-17.69	Peak
4	234.477	-11.39	28.42	17.03	47.00	-29.97	Peak
5	503.381	-4.27	27.93	23.66	47.00	-23.34	Peak
6	971.060	1.17	29.42	30.59	47.00	-16.41	Peak

Above 1GHz

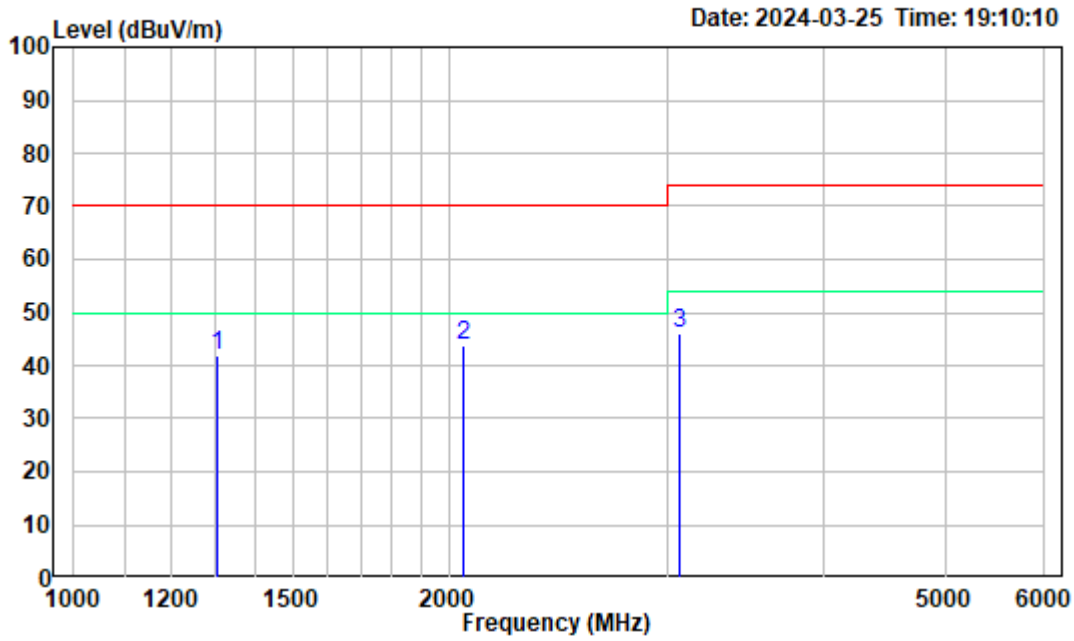
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA240320-14269E-EM
Test Mode: Data transmission

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1302.500	-14.10	55.25	41.15	70.00	-28.85	Peak
2	2034.375	-12.12	55.10	42.98	70.00	-27.02	Peak
3	3216.250	-10.31	56.88	46.57	74.00	-27.43	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA240320-14269E-EM
Test Mode: Data transmission

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1305.000	-14.09	55.88	41.79	70.00	-28.21	Peak
2	2058.125	-11.89	55.78	43.89	70.00	-26.11	Peak
3	3065.625	-10.08	56.15	46.07	74.00	-27.93	Peak

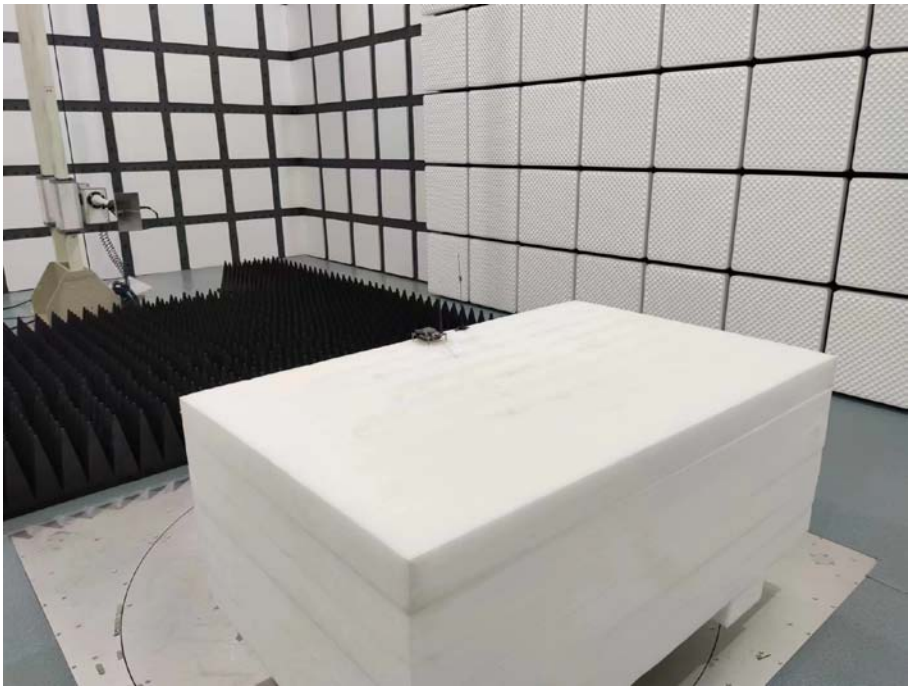
Note:
1. For below 1GHz testing, if the maximized peak measured value below the limit more than 6dB, then it is unnecessary to perform QP measurement.
2. For above 1GHz testing, the test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, so just peak value was recorded.
3. Other emissions which were more than 20dB below to the limit or on noise floor level was not recorded.

Test Setup Photo

Radiated Emission Test (Below 1GHz)

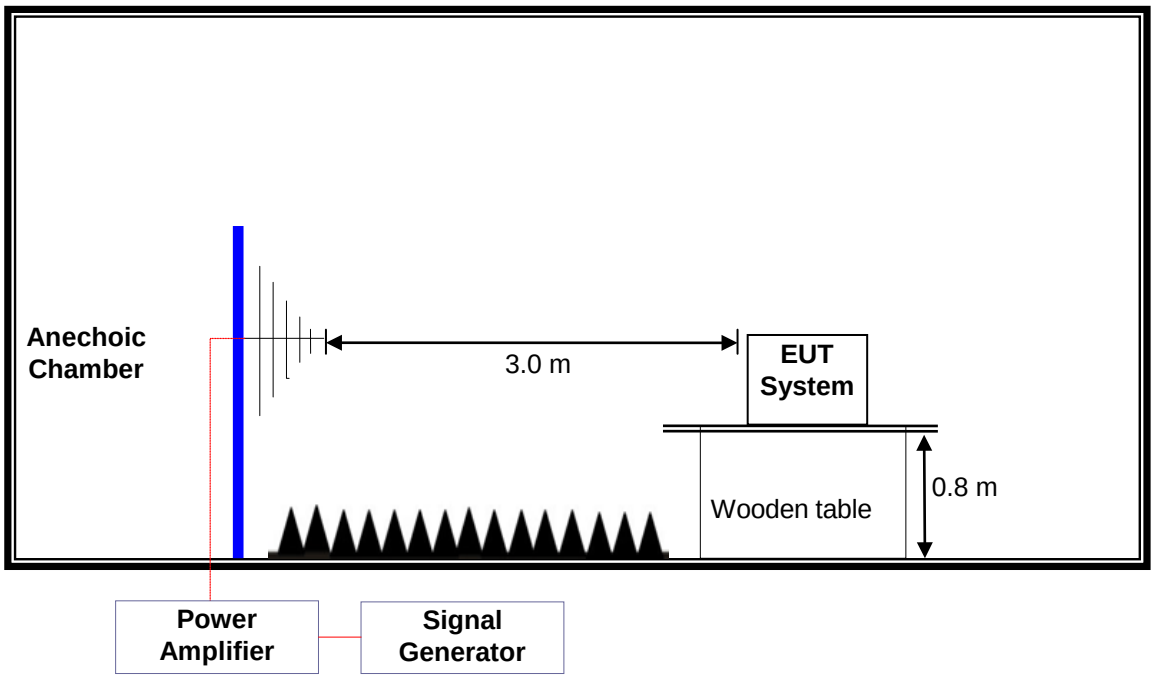


Radiated Emission Test (Above 1GHz)



§7.2 - RF ELECTROMAGNETIC FIELD (80 MHZ TO 6000 MHZ)

Test System Setup



Test Standard

ETSI EN 301 489-1 V2.2.3 (2019-11), EN 61000-4-3:2006+A1:2008 +A2: 2010

Test Level

Level	Field Strength (V/m)
1.	1
2.	3
3.	10
X.	Special
Note: X can be any level, above, below or in between the other levels. This level can be specified in the product standard.	

Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above the ground. The EUT is set 3 meters away from the transmitting antenna which is mounted on an antenna tower. Both horizontal and vertical polarizations of the antenna are set on test. Each of the four sides of EUT must be faced this transmitting antenna and measured individually.

In order to judge the EUT performance and a CCD camera and Wideband Radio Communication Tester are used to monitor the EUT.

All the scanning conditions are as follows:

	Condition of Test	Remarks
1	Field Strength	3 V/m (Test level 2)
2	Radiated Signal	AM 80%, 1kHz Modulation
3	Scanning Frequency	80 - 6000 MHz
4	Frequency step	1%
5	Dwell Time	1 sec.

Test Data and Test Setup Photo

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	51 %
ATM Pressure:	101.6 kPa

The testing was performed by Ronour Huang on 2024-03-27.

EUT operation mode: Data transmission

Test Result: Please refer to flowing data.

Modulation: Amplitude 80%, 1 kHz sine wave

Table 1: Radiated RF-Electromagnetic Field Immunity

Frequency Range (MHz)	Front Side		Rear Side		Left Side		Right Side	
	VERT	HORI	VERT	HORI	VERT	HORI	VERT	HORI
80-1000	A	A	A	A	A	A	A	A

Table 2: Radiated RF-Electromagnetic Field Immunity

Spot Test (MHz)	Front Side		Rear Side		Left Side		Right Side	
	VERT	HORI	VERT	HORI	VERT	HORI	VERT	HORI
1000-6000	A	A	A	A	A	A	A	A

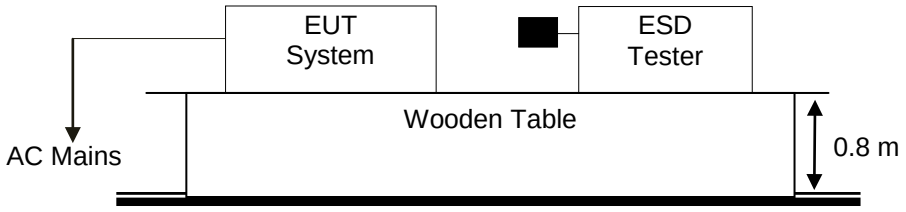
Note: “A” stand for, all modes during test, operate as intended No loss function, and after test, operate as intended.

Test Setup Photo



§7.2 - ELECTROSTATIC DISCHARGE

Test System Setup



Remark: ■ is the tip of the electrode

EN 61000-4-2 specifies that a tabletop EUT shall be placed on a non-conducting table which is 80 centimeters above a ground reference plane and that floor mounted equipment shall be placed on a insulating support approximately 10 centimeters above a ground plane. During the tests, the EUT is positioned over a ground reference plane in conformance with this requirement.

For tabletop equipment, a 1.6 by 0.8-meter metal sheet (HCP) is placed on the table and connected to the ground plane via a metal strap with two 470 k Ohms resistors in series. The EUT and attached cables are isolated from this metal sheet by *0.5-millimeter* thick insulating material. A Vertical Coupling Plane (VCP) grounded on the ground plane through the same configuration as in the HCP is used.

Test Standard

ETSI EN 301 489-1 V2.2.3 (2019-11) , EN 61000-4-2:2009

Test Level

Level	Test Voltage Contact Discharge (±kV)	Test Voltage Air Discharge (±kV)
1	2	2
2	4	4
3	6	8
4	8	15
X	Special	Special
Note:"X" can be any level, above, below or in between the others. The level shall be specified in the dedicated equipment specification. If higher voltages than those shown are specified, special test equipment may be needed.		

Performance criterion: B

Test Procedure

Air Discharge:

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the EUT. After each discharge, the discharge electrode shall be removed from the EUT. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed.

Contact Discharge:

All the procedure shall be same as Section 8.3.1 of EN 61000-4-2, except that the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

Indirect discharge for horizontal coupling plane

At least 20 single discharges shall be applied to the horizontal coupling plane, at points on each side of the EUT. The discharge electrode positions vertically at a distance of 0.1m from the EUT and with the discharge electrode touching the coupling plane.

Indirect discharge for vertical coupling plane

At least 20 single discharges shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m ×0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated.

Test Data and Test Setup Photo

Environmental Conditions

Temperature:	22 ℃
Relative Humidity:	49 %
ATM Pressure:	101.6 kPa

The testing was performed by Ronour Huang on 2024-03-27.

EUT operation mode: Data transmission

Test Result: Please refer to flowing data.

Table 1: Electrostatic Discharge Immunity (Indirect Contact HCP)

EN 61000-4-2 Test Points Location	Test Levels							
	-2 kV	+2 kV	-4 kV	+4 kV	-6 kV	+6 kV	-8 kV	+8 kV
Front Side	/	/	A	A	/	/	/	/
Back Side	/	/	A	A	/	/	/	/
Left Side	/	/	A	A	/	/	/	/
Right Side	/	/	A	A	/	/	/	/

Table 2: Electrostatic Discharge Immunity (Indirect Contact VCP)

EN 61000-4-2 Test Points Location	Test Levels							
	-2 kV	+2 kV	-4 kV	+4 kV	-6 kV	+6 kV	-8 kV	+8 kV
Front Side	/	/	A	A	/	/	/	/
Back Side	/	/	A	A	/	/	/	/
Left Side	/	/	A	A	/	/	/	/
Right Side	/	/	A	A	/	/	/	/

Test Setup Photo

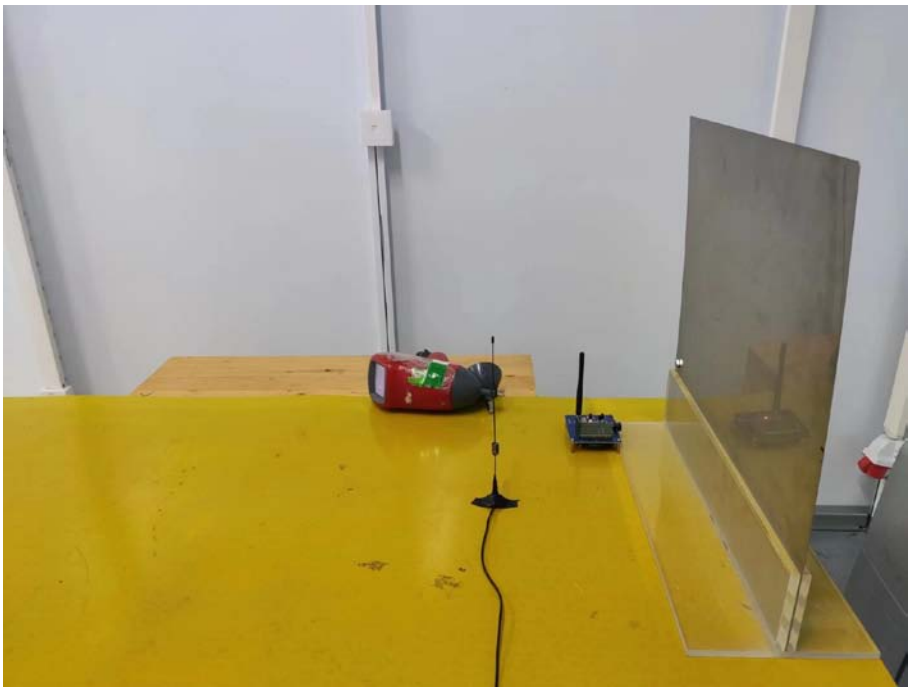


EXHIBIT A - EUT PHOTOGRAPHS

Please refer to the Attachment of RA240320-14269E EUT Photographs.

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