



TEST REPORT

Report No. : **CTC2024267901**

Applicant : **NAKABAYASHI CO., LTD.**

Address..... : 2-5-1, Higashi-Sakashita, Itabashi-ku, Tokyo, 174-8602 Japan

Manufacturer..... : SHENZHEN LOYAL ELECTRONICS CO., LTD.

Address..... : Building 101, No. 5, the Third Road, Shapu Yangchong Industry Park, Songgang Street, Bao'an District, Shenzhen. China

Product Name : **Receiver**

Trade Mark : MCO, DIGIO

Model/Type reference : MUS-RLYL2

Listed Model(s) : /

Standard : **Article 2, Paragraph 1, Item 19**

Test Report Form No : CTC-TR-073_A1

Master TRF..... : Dated 2024-09-20

Date of receipt of test sample..... : Nov. 4, 2024

Date of testing..... : Nov. 4, 2024 ~ Dec. 5, 2024

Date of issue..... : Jan. 10, 2025

Result..... : **PASS**

Compiled by:

(Printed name + signature)

Jim Jiang

Jim Jiang

Supervised by:

(Printed name + signature)

Eric Zhang

Eric Zhang

Approved by:

(Printed name + signature)

Totti Zhao

Totti Zhao

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Table of Contents

Page

1. SUMMARY	3
1.1. TEST STANDARDS	3
1.2. REPORT VERSION	3
1.3. TEST DESCRIPTION	3
1.4. TEST FACILITY	4
1.5. MEASUREMENT UNCERTAINTY	5
2. GENERAL INFORMATION	6
2.1. ENVIRONMENTAL CONDITIONS	6
2.2. CLIENT INFORMATION	6
2.3. GENERAL DESCRIPTION OF EUT	7
2.4. DESCRIPTION OF TEST MODES	8
2.5. MEASUREMENT INSTRUMENTS LIST	9
3. TEST CONDITIONS AND RESULTS	10
3.1. FREQUENCY ERROR	10
3.2. ANTENNA POWER	12
3.3. OCCUPIED BANDWIDTH	13
3.4. TRANSMITTER SPURIOUS EMISSION STRENGTH AND UNWANTED EMISSION INTENSITY	15
3.5. RECEIVER SPURIOUS EMISSION AND UNWANTED EMISSION INTENSITY	19
3.6. CONSTRUCTION PROTECTION CONFIRMATION METHOD	21
3.7. INTERFERENCE PREVENTION FUNCTION	22
3.8. CONDITION FOR VOLTAGE STABILIZATION	23
3.9. TRANSMISSION RADIATION ANGLE WIDTH (3DB BEAMWIDTH) MEASUREMENT	24



1. SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

[Test method which is equal to Appendix No.43 of MIC Notification No 88.](#)

1.2. Report version

Revised No.	Report No.	Date of issue	Description
01	CTC2024267901	Jan. 10, 2025	Original

1.3. Test Description

Test Item	Result	Test Engineer
Frequency Error	Pass	Jim Jiang
Occupied Bandwidth	Pass	Jim Jiang
Transmitter Spurious Emission and Unwanted Emission Intensity	Pass	Jim Jiang
Antenna Output Power and Output Power Tolerance	Pass	Jim Jiang
Receiver Spurious Emission and Unwanted Emission Intensity	Pass	Jim Jiang
Radio Interference Prevention Capability	Pass	Jim Jiang
Frequency Hopping Dwell Time	N/A ^{Note 1}	N/A
Transmission Radiation Angle Width (3dB Beamwidth)	N/A ^{Note 3}	NA
Carrier Sense Capability	N/A ^{Note 2}	N/A
Construction Protection Confirmation	Pass	Jim Jiang

N/A^{Note 1}: Testing is only required for FHSS system devices

N/A^{Note 2}: Not apply to this device, since EIRP does not require compensation through Antenna Power.

N/A^{Note 3}: Required when the design value of Rated +Antenna gain exceeds 12.14 dBm.

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TRF No: CTC-TR-073_A1



1.4. Test Facility

Address of the test laboratory

CTC Laboratories, Inc.

Add: Room 101 of Building B, Room 107, 108, 207, 208 of Building A, No. 7, Lanqing 1st Road, Luh Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, China

Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 951311, Aug 26, 2017.

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1.5. Measurement Uncertainty

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR100028-1 [2] and shall correspond to an expansion factor (coverage factor) K=1.96 or K=2 (which provide confidence levels of respectively 95% and 95.5% in the case where the distributions characterizing the actual measurement uncertainties are normal.

Parameter	Uncertainty
Frequency Error	±1.9%
Antenna Power	±0.743dB
Occupied Bandwidth	±0.0196%
Spread Bandwidth	±0.0196%
Transmitter Spurious Emission Strength and Unwanted Emission Intensity	30MHz-1GHz: ±0.746dB 1GHz-13GHz: ±1.328dB
Receiver Spurious Emission and Unwanted Emission Intensity	30MHz-1GHz: ±0.746dB 1GHz-26GHz: ±1.328dB



2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Voltage	Normal Voltage	DC 5.0V
	High Voltage	DC 5.5V
	Low Voltage	DC 4.5V
Other	Normal Temperature/T _{nor}	23°C
	Relative Humidity	57 %
	Air Pressure	101kPa

2.2. Client Information

Applicant:	NAKABAYASHI CO., LTD.
Address:	2-5-1, Higashi-Sakashita, Itabashi-ku, Tokyo, 174-8602 Japan
Manufacturer:	SHENZHEN LOYAL ELECTRONICS CO., LTD.
Address:	Building 101, No. 5, the Third Road, Shapu Yangchong Industry Park, Songgang Street, Bao'an District, Shenzhen. China
Factory	SHENZHEN LOYAL ELECTRONICS CO., LTD.
Address:	Building 101, No. 5, the Third Road, Shapu Yangchong Industry Park, Songgang Street, Bao'an District, Shenzhen. China

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2.3. General Description of EUT

Product Name:	Receiver
Trade Mark:	MCO, DIGIO
Model/Type reference:	MUS-RLYL2
Listed Model(s):	/
Sample ID:	CTC241101-005-S002
Power supply:	DC 5V from USB Port
Hardware version:	V1.0
Firmware version:	V1.0
2.4G Transmitter	
Modulation:	GFSK
Operation frequency:	2405MHz~2470MHz
Channel number:	8
Antenna type:	PCB Antenna
Antenna gain:	-1.66dBi

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TRF No: CTC-TR-073_A1



2.4. Description of Test Modes

The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

Operation Frequency List:

Channel	Frequency (MHz)
1	2405
2	2413
3	2422
4	2430
5	2440
6	2450
7	2460
8	2470

Note: These channels with bold were be selected for testing.



2.5. Measurement Instruments List

RF Test System - SRD							
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until	Calibrated By
1	MXA Signal Analyzer	Keysight	N9020A	MY46471737	Dec. 13, 2023	Dec. 12, 2024	CCIC
2	Test Software	WCS	WCS-WCN	2023.08.04	/	/	/

Note: 1. Calibration by the calibration agencies listed in the table correspond to paragraph 4 (ii) (c) of Article 24-2 in the Radio Law".



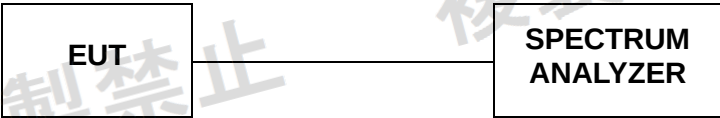
3. TEST CONDITIONS AND RESULTS

3.1. Frequency Error

LIMIT

±50ppm

TEST CONFIGURATION



TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram as TEST CONFIGURATION shows.

EUT Condition: Non-modulation

Spectrum Condition:

Frequency: test frequency

Span: Show the entire waveform

RBW: 10 KHz

VBW: 10 KHz

Sweep time: Auto

Detector mode: Positive peak

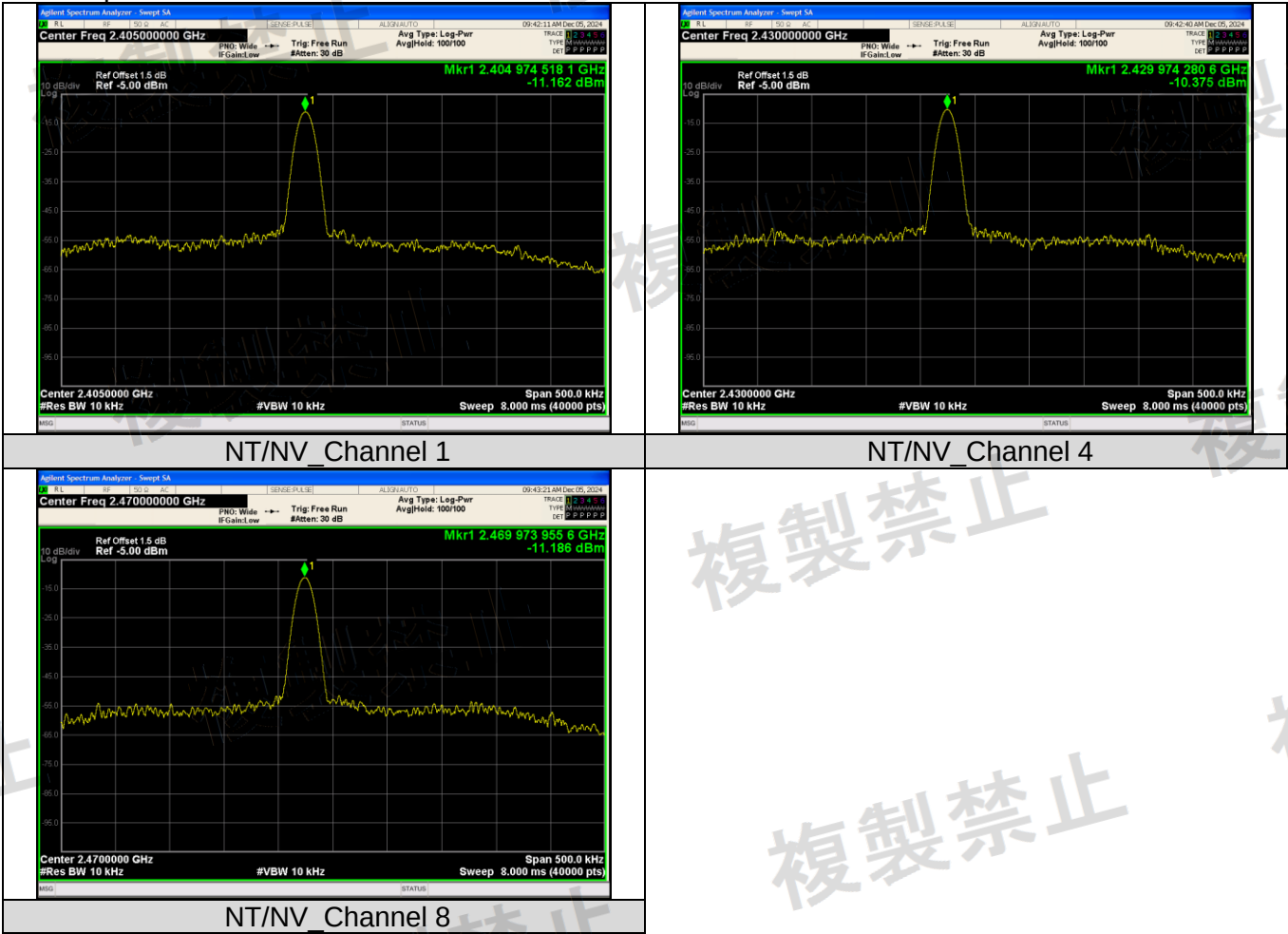
Indication mode: Max hold

TEST RESULTS

DC 5V					
Test Mode	Channel	Read (MHz)	Result (ppm)	Limit[ppm]	Verdict
2.4G	1	2404.9745181	-10.60	±50	PASS
	4	2429.9742806	-10.58		
	8	2469.9739556	-10.54		



Test plot as follows:



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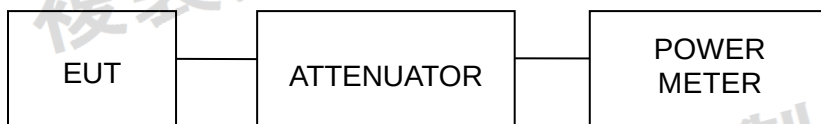
3.2. Antenna Power

LIMIT

- ≤ 3 mW (FHSS from 2402-2480 MHz)
- ≤ 5 mW (OFDM($26\text{MHz} < \text{Occupied Bandwidth} < 40\text{MHz}$) from 2400-2483.5 MHz)
- ≤ 10 mW (other from 2400-2483.5 MHz)

The Output Power Tolerance must be within $< +20\%$.

TEST CONFIGURATION



TEST PROCEDURE

1. The maximum conducted output power may be measured using a broadband Peak RF power meter.
2. Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
3. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.
4. Record the measurement data.

TEST RESULTS

DC 5V							
Test Mode	Channel	Power (mW)	Limit (mW)	RatedPower (mW)	Tolerance (%)	Limit (%)	Verdict
2.4G	1	0.08	10	0.2	-60.00	< +20%	PASS
	4	0.09	10	0.2	-55.00		
	8	0.08	10	0.2	-60.00		

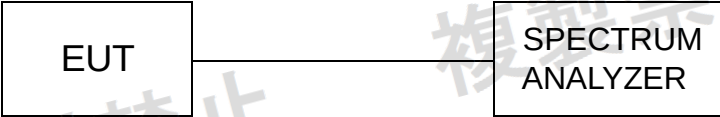


3.3. Occupied Bandwidth

LIMIT

- Occupied bandwidth: FH≤83.5 MHz; OFDM≤40MHz; DS≤26 MHz

TEST CONFIGURATION



TEST PROCEDURE

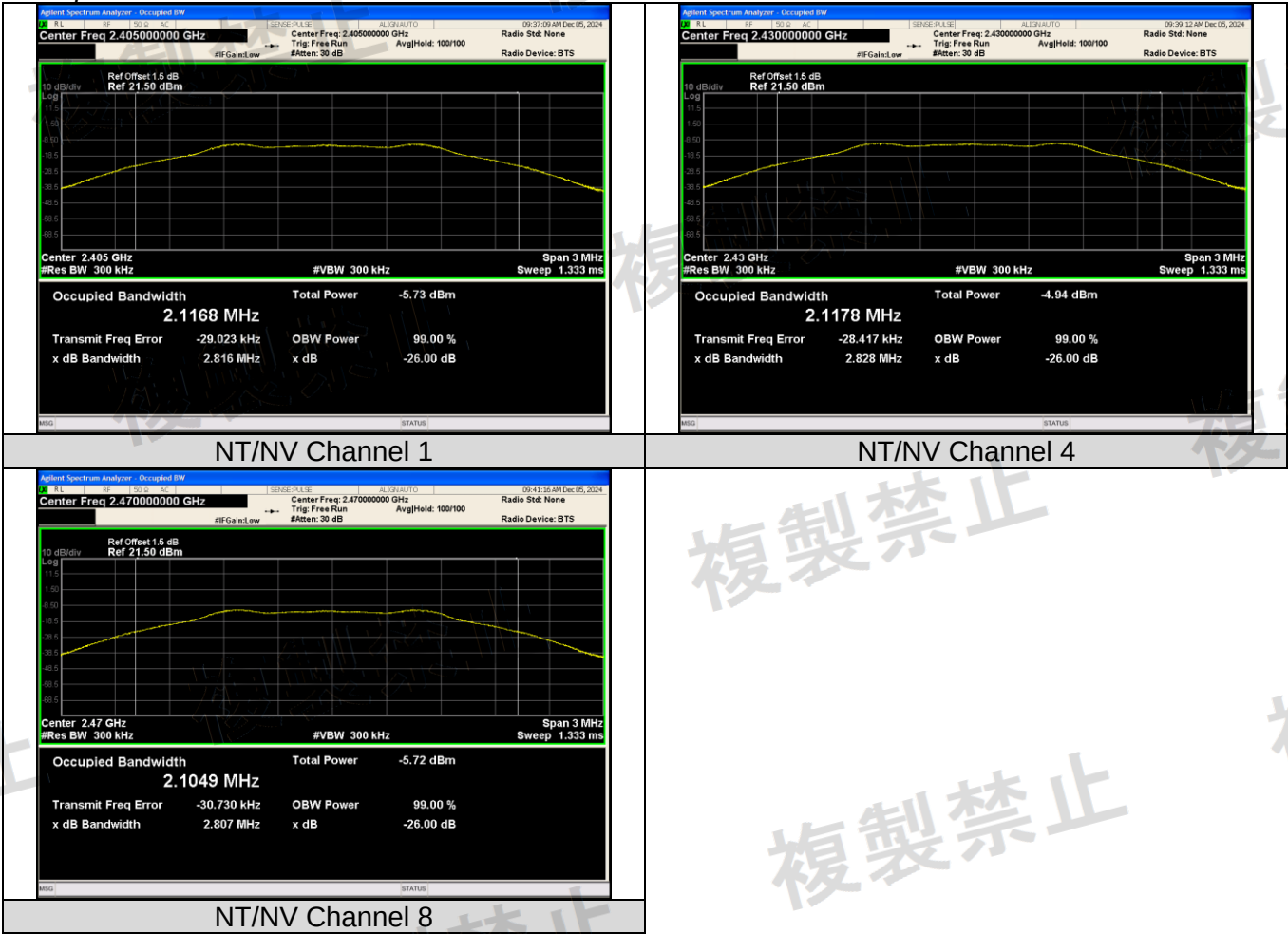
1. Setting of SA is following as follow:
RBW: 300 kHz
VBW: 300 kHz
Sweep time: Auto
Sweep Mode: Continuous sweep
Detect mode: Positive peak
Trace mode: Max hold
2. EUT have transmitted the maximum modulation signal and fixed channelize. SA set to 99% of occupied bandwidth to measure occupied bandwidth.

TEST RESULTS

DC 5V				
Test Mode	Channel	Result [MHz]	Limit [MHz]	Verdict
2.4G	1	2.1168	≤26	PASS
	4	2.1178		
	8	2.1049		



Test plot as follows:





3.4. Transmitter Spurious Emission Strength and Unwanted Emission Intensity

LIMIT

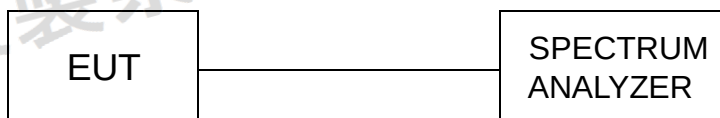
30MHz to 2387MHz: 2.5 μ W/MHz or less

2387MH to 2400MHz: 25 μ W/MHz or less

2483.5MH to 2496.5MHz: 25 μ W/MHz or less

Over 2496.5 MHz: 2.5 μ W/MHz or less

TEST CONFIGURATION



TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram as TEST CONFIGURATION shows.

EUT Condition: modulation

Spectrum Condition:

Frequency: 30MHz-12.5GHz

RBW: 100KHz (30MHz-1GHz), 1MHz (1GHz-12.5GHz)

VBW: 100KHz (30MHz-1GHz), 1MHz (1GHz-12.5GHz)

Sweep time: Auto

Detector mode: Positive peak

Indication mode: Max hold

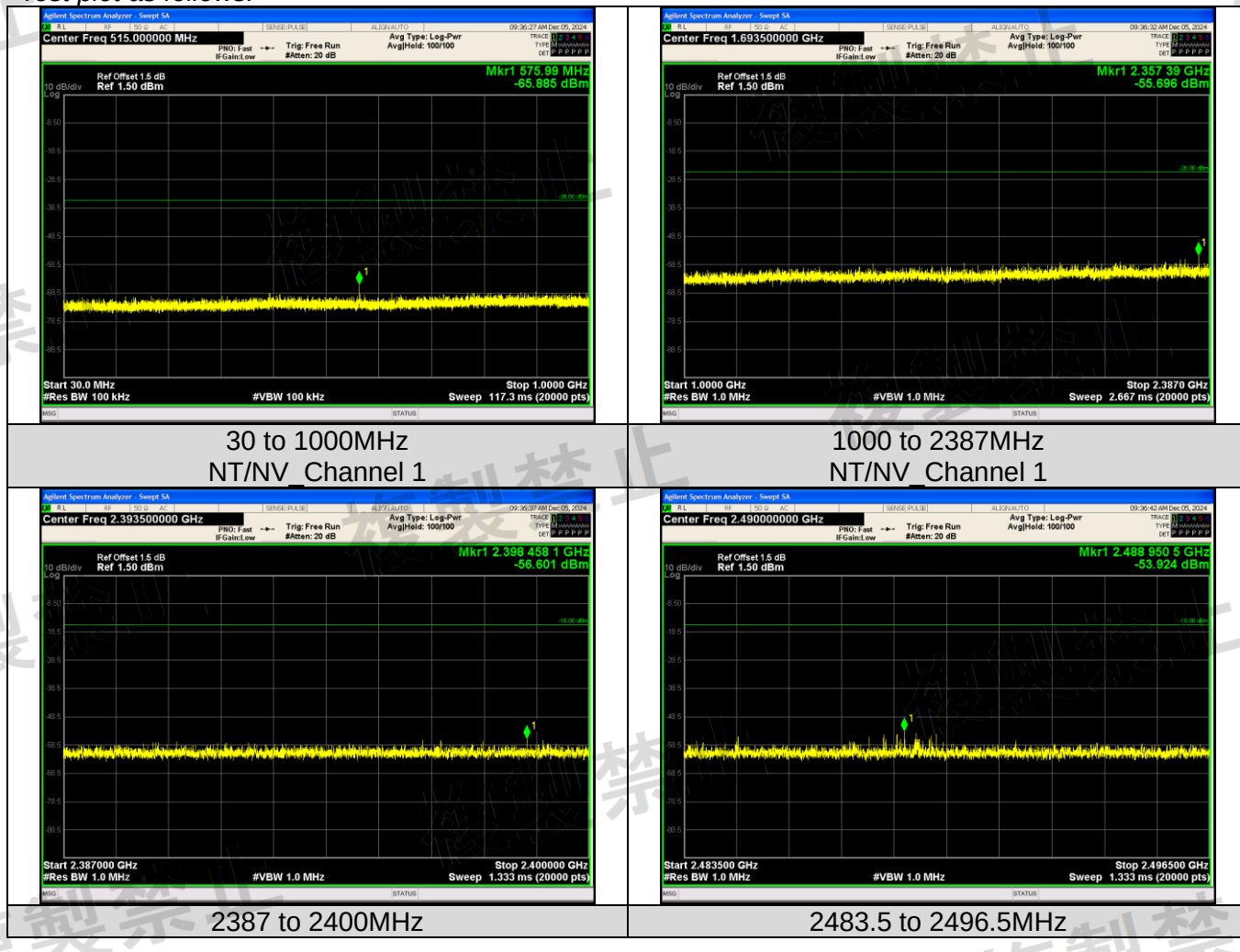
TEST RESULTS



Measurement Data:

Condition	Frequency Range (MHz)	Channel 1		Channel 4		Channel 8		Limit
		Peak (MHz)	Measured Value (dBm)	Peak (MHz)	Measured Value (dBm)	Peak (MHz)	Measured Value (dBm)	
NT/NV	30 to 1000	575.992	-65.885	937.286	-66.641	907.894	-66.817	-36
NT/NV	1000 to 2387	2357.386	-55.696	2382.076	-56.670	2374.239	-57.626	-26
NT/NV	2387 to 2400	2398.458	-56.601	2393.888	-55.669	2398.070	-53.938	-16
NT/NV	2483.5 to 2496.5	2488.951	-53.924	2489.765	-55.362	2495.619	-55.917	-16
NT/NV	2496.5 to 12500	4808.925	-44.361	4859.445	-43.622	4939.477	-43.997	-26
Result: PASS								

Test plot as follows:



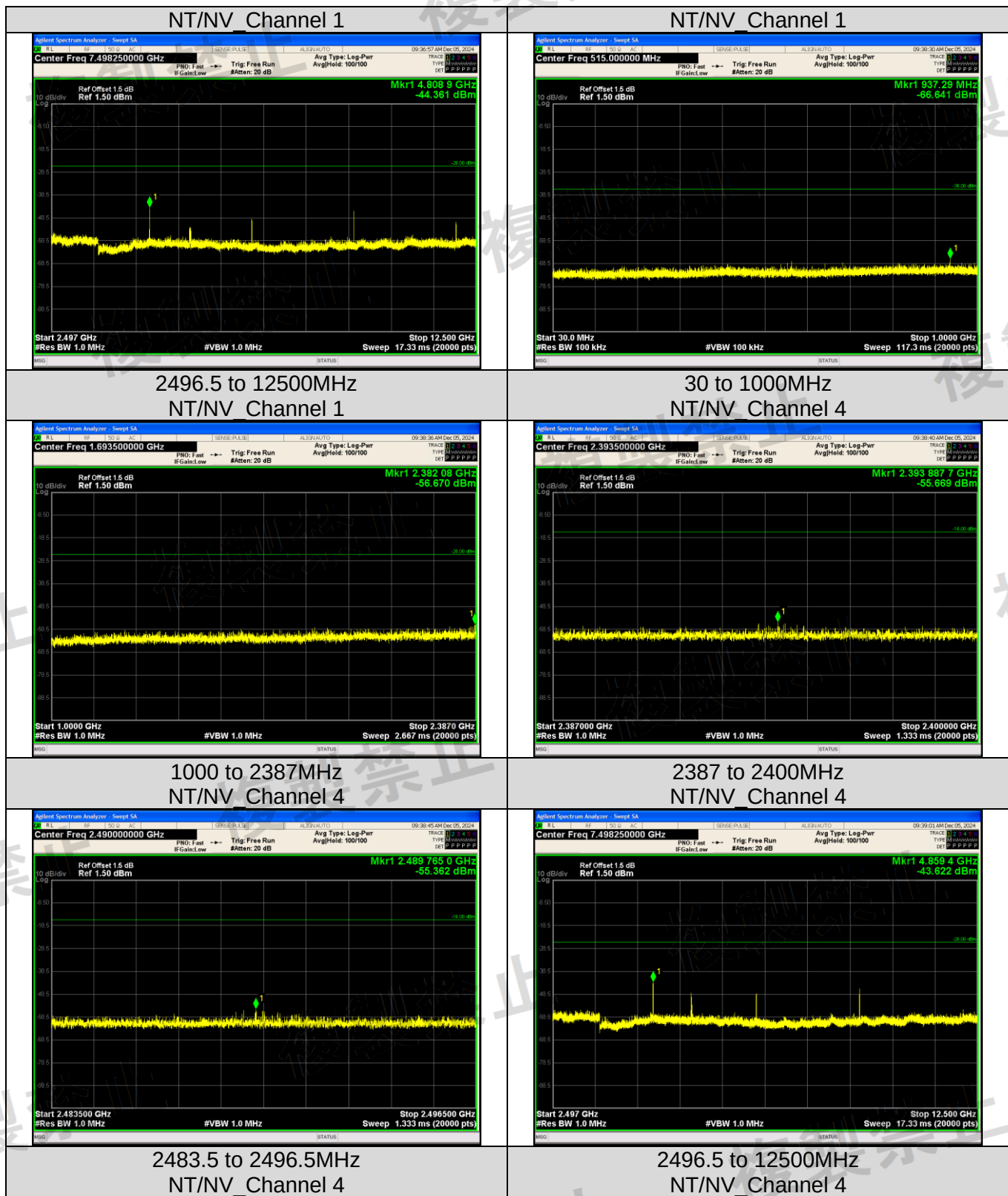
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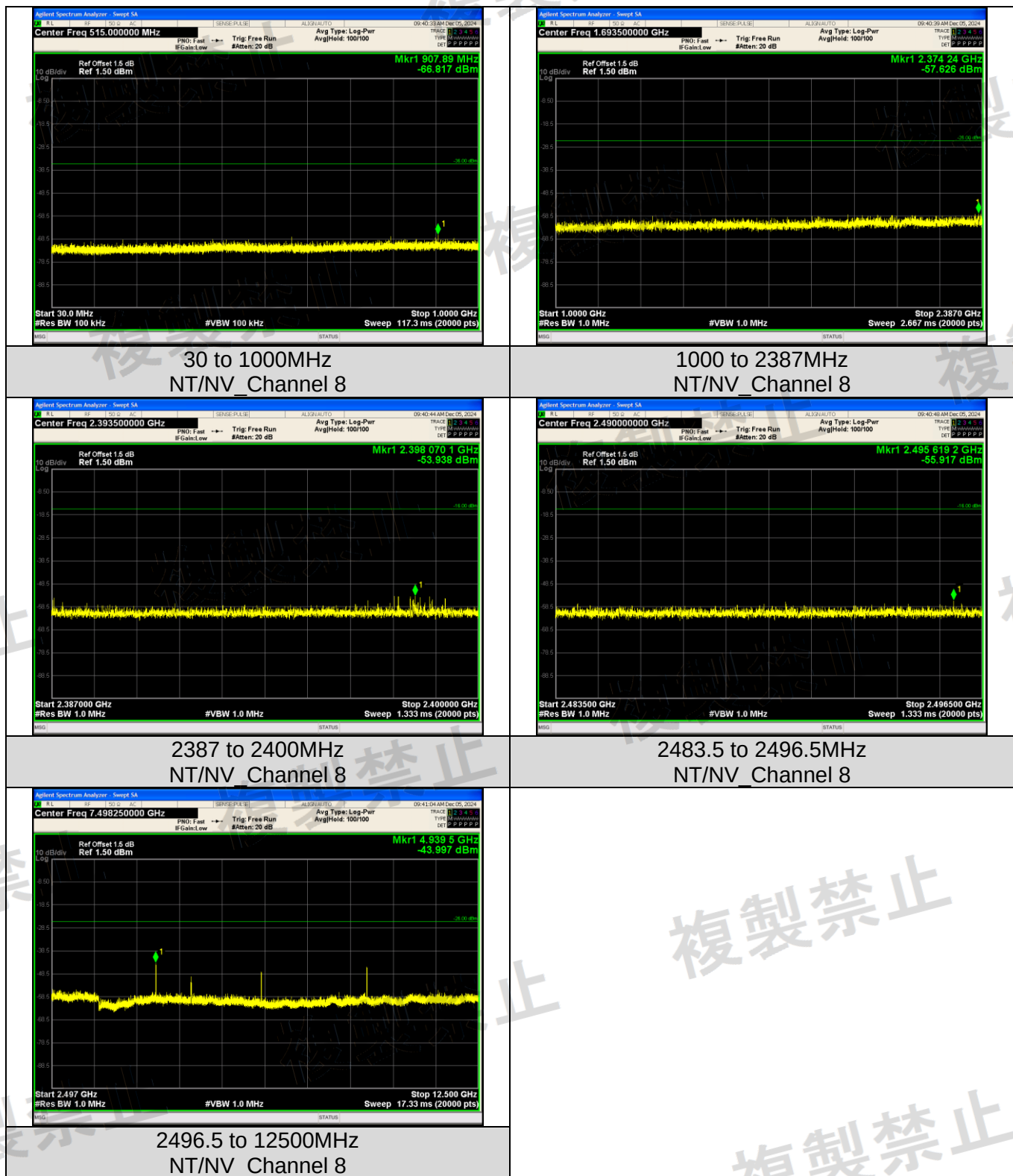
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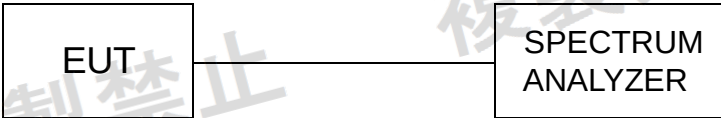


3.5. Receiver Spurious Emission and Unwanted Emission Intensity

LIMIT

Below 1GHz: 4.0nW or less
Above 1GHz: 20nW or less

TEST CONFIGURATION



TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram as TEST CONFIGURATION shows.

EUT Condition: modulation

Spectrum Condition:

- Frequency: 30MHz-12.5GHz
- RBW: 100 KHz (30MHz-1GHz), 1MHz (1GHz-12.5GHz)
- VBW: 100 KHz (30MHz-1GHz), 1MHz (1GHz-12.5GHz)
- Sweep time: Auto
- Detector mode: Positive peak
- Indication mode: Max hold

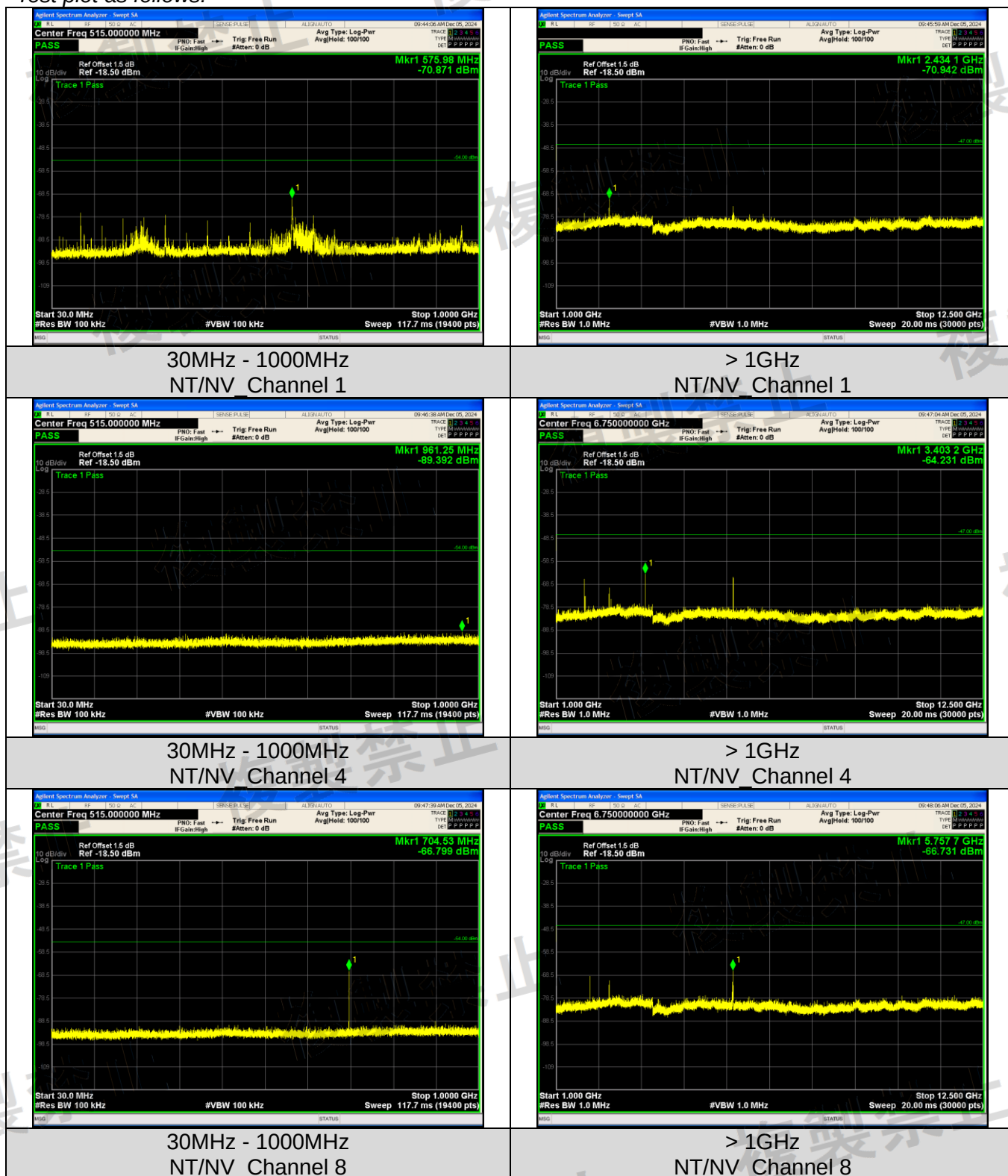
TEST RESULTS

Measurement Data:

Condition	Frequency Range (MHz)	Channel 1		Channel 4		Channel 8		Limit (dBm)
		Peak (MHz)	Measured Value (dBm)	Peak (MHz)	Measured Value (dBm)	Peak (MHz)	Measured Value (dBm)	
NT/NV	30 to 1000	575.978	-70.871	961.248	-89.392	704.535	-66.799	-54
NT/NV	1000 to 12500	2434.098	-70.942	3403.197	-64.231	5757.709	-66.731	-47
Result: PASS								



Test plot as follows:



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3.6. Construction protection confirmation method

Requirement

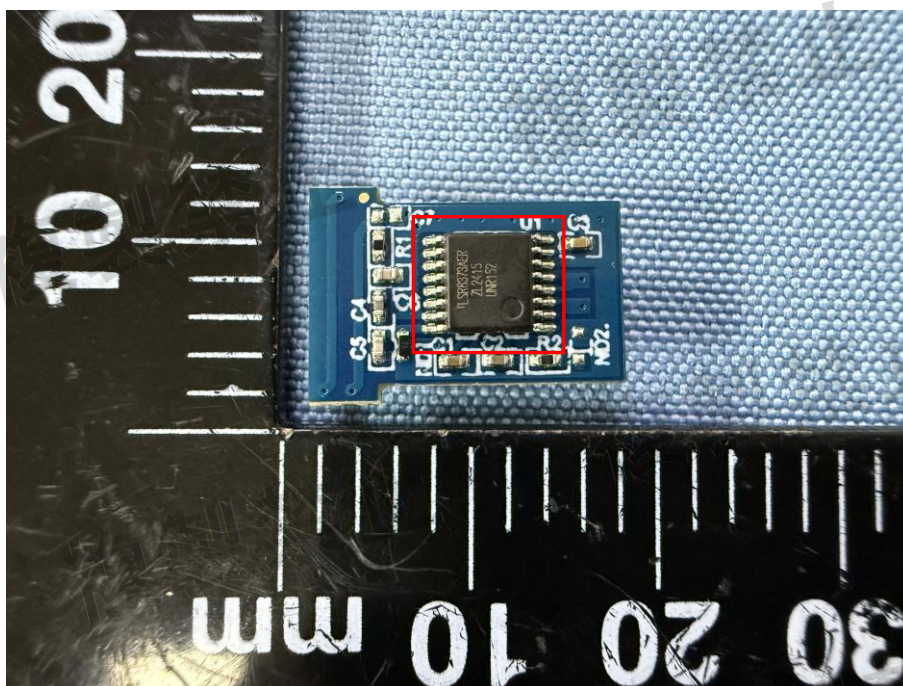
The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

Confirmation method

RF and Modulation parts are mounted on PCB with surface mount technology, and there is no any adjustable parts on PCB or adjustable parts are not exposed, So the end user can not to modify or change the RF Parts easily, please refer the following photo.

RF IC pin number: 16

RF IC pin spacing: 0.65mm



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3.7. Interference Prevention Function

Module apply DSSS technique, in which the message signal is used to modulate a bit sequence known as the Pseudo Noise (PN) code; this PN code consists of pulses of a much shorter duration (larger bandwidth) than the pulse duration of the message signal, therefore the modulation by the message signal has the effect of chopping up the pulses of the message signal and thereby resulting in a signal which has a bandwidth nearly as large as that of the PN sequence. In this context the duration of the pulse of the PN code is referred to as the chip duration and the smaller this value, the larger the bandwidth of the resultant DSSS signal and the more immune to interference the resultant signal becomes.

TEST PROCEDURE

1. The Receiver connects to the USB port on the computer.
2. Wireless keyboard (FKB-D248) After boot, select 2.4G connection.
3. On the computer, use the shortcut key "Ctrl+R", write "cmd" and enter.
4. Write the command "e pu" and press enter.
5. Write the command "e 40a016" and press enter.

We can get the information as follows:

4f:26:10:09:07:2b

TEST RESULTS

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows [版本 10.0.22000.739]
(c) Microsoft Corporation。保留所有权利。

C:\Users\JQL>e pu
CPU Stopped, PC 45f:

C:\Users\JQL>e 40a016
    0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
40a0 : 4f 26 10 09 07 2b

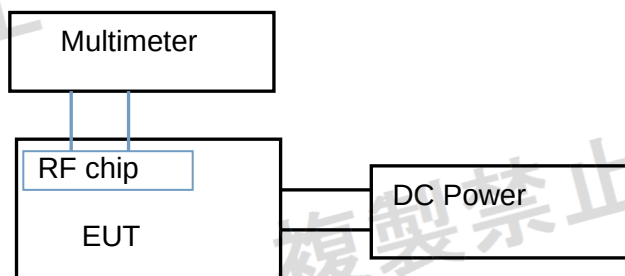
C:\Users\JQL>
```



3.8. Condition for Voltage Stabilization

- In the case of a characteristic test in the technical regulations conformity certification, the power supply supplies the voltage rating
- Other cases
The power supply supplies the voltage rating and the rating. However, when it can be confirmed that the change of the input voltage to the wireless part circuit of the testing machine is 1% or less when the input voltage to the testing machine from the external source changes at 10%, examines it only by the voltage rating.

TEST CONFIGURATION



TEST PROCEDURE

1. Use the DC power supplies the EUT, set the output power 5.0V.
2. Connect the WIFI/BT module power input ports to the Oscilloscope, record the voltage value.
3. Set respectively the DC power output 4.5V and 5.5V, record the Multimeter's voltage values.

EUT supply power	RF module input power	Rated RF module power	Tolerance (%)
5.0V	5.0V	5.0V	0
4.5V	5.0V	5.0V	0
5.5V	5.0V	5.0V	0

Conclusion: when the input voltage to EUT from the external source changes at 10%, the change of the input voltage to RF Module circuit of EUT is less 1%, all test items only need to test for normal condition.



3.9. Transmission Radiation Angle Width (3dB Beamwidth) Measurement

LIMIT

Item	Limits
	(See Article 49-20, Item1-f of the Ordinance Regulating Radio Equipment)
3dB antenna beam width	$360/A$ (if $A < 1$; then $A=1$) $A = \{ \text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM} \}$

MEASURING INSTRUMENTS AND SETTING

Please refer to section 5 in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span	0 MHz
RBW	1 MHz
VBW	1 kHz
Y scale	5 dB
Detector	Peak
Trace	Max Hold

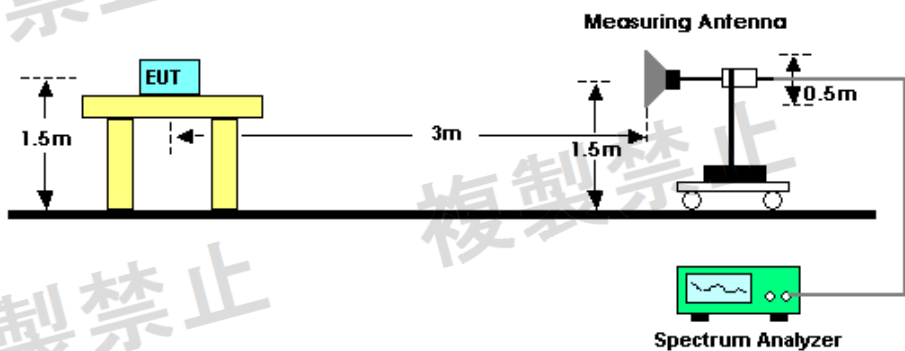
TEST PROCEDURES

Test method which surpass to Clause 22 of Annex No.43 of MIC Notification No.88.

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Set spectrum analyzer with condition and tune reference level to observe receiving signal position.
3. Rotate directions of the EUT horizontally and Vertically to find the maximum receiving power.
4. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E"
5. Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
6. Calculate 3dB antenna beam width by the formula below $360/A$ (If $A < 1$; then $A=1$).
 $A = \{ \text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM} \}$ or
 $A = \{ \text{EIRP Power [mW]} / 4.9 \text{ for FH} \}$



TEST SETUP



TEST RESULT OF TRANSMISSION RADIATION ANGLE WIDTH (3DB BEAMWIDTH)

Not necessary.

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