



TEST REPORT



Report No. : RF-230797-R1
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KES Co., Ltd.
#3002, #3503, #3701, 40, Simin-daero365beon-gil,
Dongan-gu, Anyang-si, Gyeonggi-do, 14057,
Republic of Korea
Tel : +82-31-425-6200, Fax : +82-31-425-6200

■ FCC TEST REPORT

1. Client

- Name : MOVON Corporation
- Address : 140-28 Samsung Dong, Kangnam Ku, Seoul, South Korea

2. Sample Description

- Product item : Wi-Fi 6 and Bluetooth 5.x SOM
- Model name : WBT-MSB
- Manufacturer etc. : MOVON Corporation

3. Date of test : 2023.12.15 ~ 2024.01.29

4. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing

- Address : 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea

5. Test method used : Part 15 Subpart E 15.407

6. Test result : PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This laboratory is not accredited for the test results marked *.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by	Technical Manager
	Name : Gu-Bong, Kang (Signature)	Name : Yeong-Jun Cho (Signature)

2024 . 01. 30.

KES Co., Ltd.

Accredited by KOLAS, Republic of KOREA



REPORT REVISION HISTORY

Date	Test Report No.	Revision History
2024.01.29	RF-230797	Initial
2024.01.30	RF-230797-R1	Removed non DFS band information and corrected typo of standard

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Use of uncertainty of measurement for decisions on conformity (decision rule):

☒ No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other (to be specified, for example when required by the standard or client)



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1. General information

Applicant: MOVON Corporation
Applicant address: 140-28 Samsung Dong, Kangnam Ku, Seoul, South Korea
Test site: KES Co., Ltd.
Test site address: ☐ #3002, #3503, #3701, 40, Simin-daero365beon-gil,
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Republic of Korea
☒ 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility: FCC Accreditation Designation No.: KR0100, Registration No.: 444148
FCC rule part(s): 15.407
FCC ID: TDU-WBT-MSB
Test device serial No.: ☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test: Wi-Fi 6 and Bluetooth 5.x SOM
Frequency range & Number of channels:
UNII-2A: 5 260 MHz ~ 5 320 MHz (802.11a/n_HT20/ac_VHT20/ax_HE20) : 4 ch
5 270 MHz ~ 5 310 MHz (802.11n_HT40/ac_VHT40/ax_HE40) : 2 ch
5 290 MHz (802.11ac_VHT80/ax_HE80) : 1 ch
UNII-2C: 5 500 MHz ~ 5 720 MHz (802.11a/n_HT20/ac_VHT20/ax_HE20) : 12 ch
5 510 MHz ~ 5 710 MHz (802.11n_HT40/ac_VHT40/ax_HE40) : 6 ch
5 530 MHz ~ 5 690 MHz (802.11ac_VHT80/ax_HE80) : 3 ch
Model: WBT-MSB
Modulation technique: GFSK, $\pi/4$ DQPSK, 8DPSK, DSSS, OFDM
Antenna specification: 5 GHz band Chip Antenna // Peak gain: -2.18 dBi
Power source: DC 3.3 V & DC 1.8 V
H/W version: V003
S/W version: V003

**1.2. Test configuration**

The **MOVON Corporation // Wi-Fi 6 and Bluetooth 5.x SOM // WBT-MSB // FCC ID: TDU-WBT-MSB** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.407
KDB 905462 D02 v02
KDB 905462 D03 v01r02
ANSI C63.10-2013

1.3. Information about derivative model

N/A

1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
-	-	-	-	-

1.5. Device modifications

N/A



1.6. Sample calculation

Where relevant, the following sample calculation is provided
For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.36 + 10 = 11.36 \text{ (dB)}\end{aligned}$$

For Radiation test :

$$\text{Field strength level (dB}\mu\text{V/m)} = \text{Measured level (dB}\mu\text{V)} + \text{Antenna factor (dB)} + \text{Cable loss (dB)} - \text{Amplifier gain (dB)}$$

1.7. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.22 dB (SHIELD ROOM #6)
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1 GHz	4.04 dB (SAC #6)
	Above 1 GHz	5.32 dB (SAC #5)
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		



1.8. Frequency/channel operations

UNII-2A

Ch.	Frequency (MHz)
52	5 260
56	5 280
64	5 320

UNII-2C

Ch.	Frequency (MHz)
100	5 500
120	5 600
144	5 720

802.11a/n_HT20/ac_VHT20/ax_HE20 mode

UNII-2A

Ch.	Frequency (MHz)
54	5 270
62	5 310

UNII-2C

Ch.	Frequency (MHz)
102	5 510
118	5 590
142	5 710

802.11n_HT40/ac_VHT40/ax_HE40 mode

UNII-2A

Ch.	Frequency (MHz)
58	5 290

UNII-2C

Ch.	Frequency (MHz)
106	5 530
122	5 610
138	5 690

802.11ac_VHT80/ax_HE80 mode



2. Summary of tests

Section in FCC Part 15	Parameter	Test results
15.407 (h)(iii)(iv)	Channel Move Time	Pass
	Channel Closing Transmission Time	Pass
	Non-Occupancy Period	Pass





3. Test results

3. DFS (Dynamic Frequency Selection) test description

3.1. Applicability

The following table from KDB 905462 D02 v02 lists the applicable requirements for the DFS testing. The device evaluated in this report is considered a client device without radar detection capability.

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 1. Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

Table 2. Applicability of DFS requirements during normal operation



3.2. Requirements

KDB 905462 D02 v02 the following are the requirements for Client Devices:

- a) A Client Device will not transmit before having received appropriate control signals from a Master Device.
- b) A Client Device will stop all its transmissions whenever instructed by a Master Device to which it is associated and will meet the Channel Move Time and Channel Closing Transmission Time requirements. The Client Device will not resume any transmissions until it has again received control signals from a Master Device.
- c) If a Client Device is performing In-Service Monitoring and detects a Radar Waveform above the DFS Detection Threshold, it will inform the Master Device. This is equivalent to the Master Device detecting the Radar Waveform and through f) of section 5.1.1 apply.
- d) Irrespective of Client Device or Master Device detection the Channel Move Time and Channel Closing Transmission Time requirements remain the same.
- e) The client test frequency must be monitored to ensure no transmission of any type has occurred for 30 minutes. Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shutdown (rather than moving channels), no beacons should appear

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an Aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (and aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

Table 4. DFS Response Requirement Values



3.3. Parameters of DFS Test Signals

As the EUT is a Client Device with no Radar Detection only Zero type radar pulse is required for the testing.

Radar Pulse type 0 was used in the evaluation of the Client device for the purpose of measuring the channel Move Time and the Channel Closing Transmission Time.

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup: $\{(1/360) \times (19 \times 10^6 \text{ PRI } \mu\text{sec})\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 5. Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 6. Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses Per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	0.333	300	70%	30

Table 7. Frequency Hopping Radar Test Waveform



4. Test results

4.1. DFS (Dynamic Frequency Selection)

Test setup

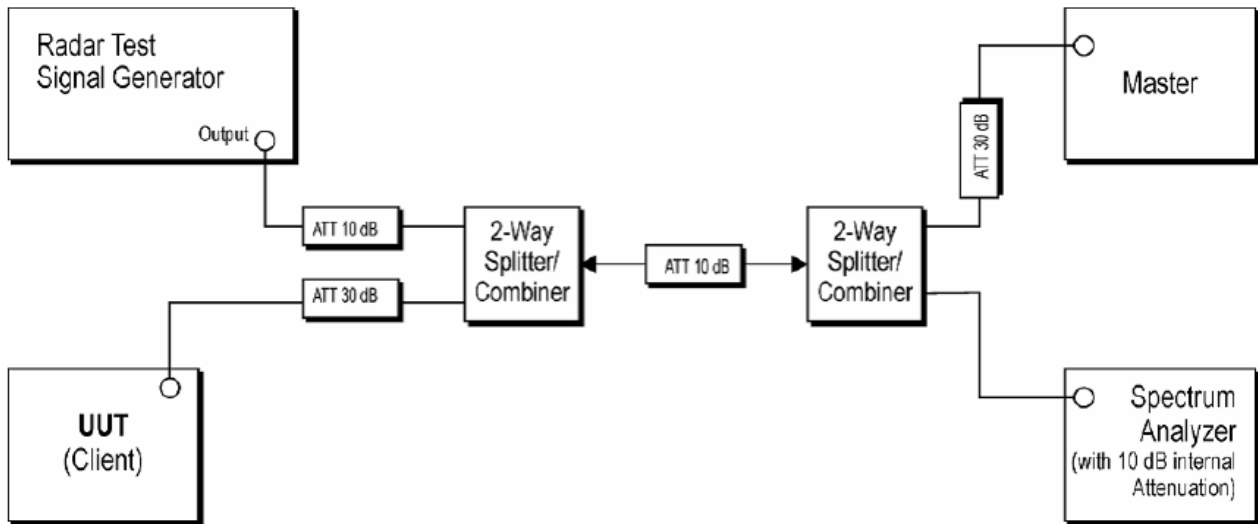


Figure 1: Conducted Test Setup for DFS

Test procedure

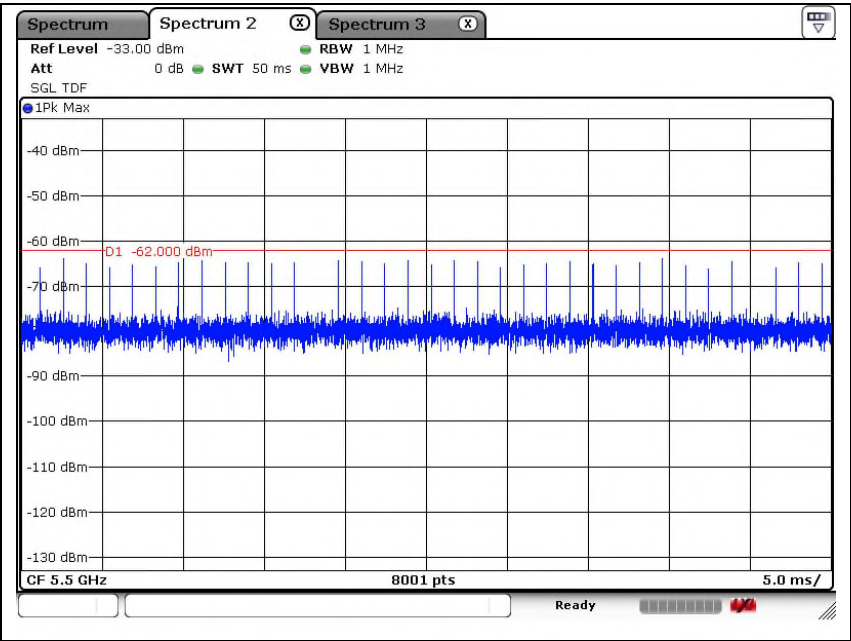
KDB 905462 D02 v02 describes a radiated test setup and a conducted test setup. The conducted test setup was used for this testing. Figure 1 shows the typical test setup.

1. One frequency will be chosen from the Operating Channels of the UUT within the 5250 ~5350 MHz or 5470 ~5725 MHz bands.
2. The Client Device (EUT) is setup per the diagram in Figure 1 and communications between the Master device and the Client is established.
3. An MPEG or data file that is typical for the device is streamed from the Master to the Client to properly load the network.



4.1.1 Radar waveform

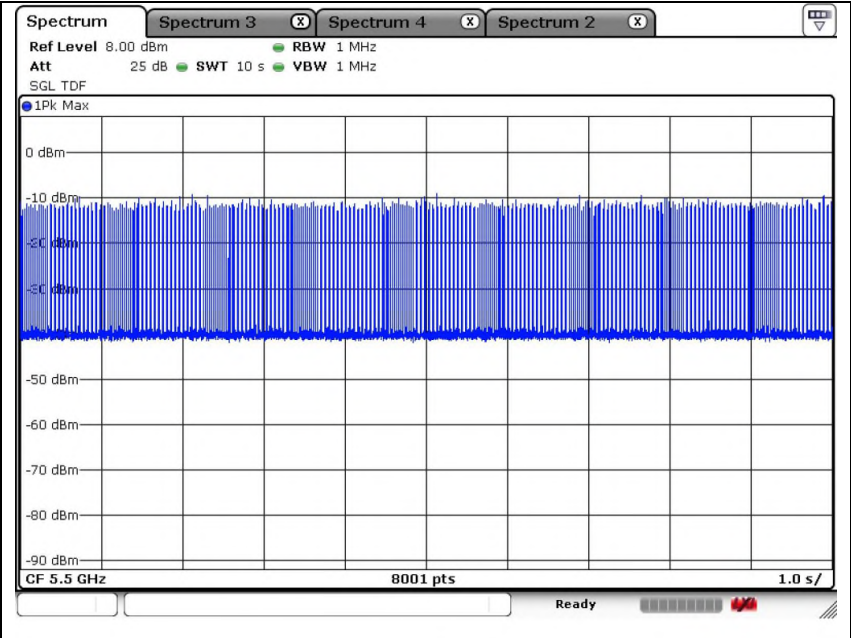
Mode: 802.11a (UNII-2C)
Operating frequency: 5 500 MHz





4.1.2 LAN Traffic

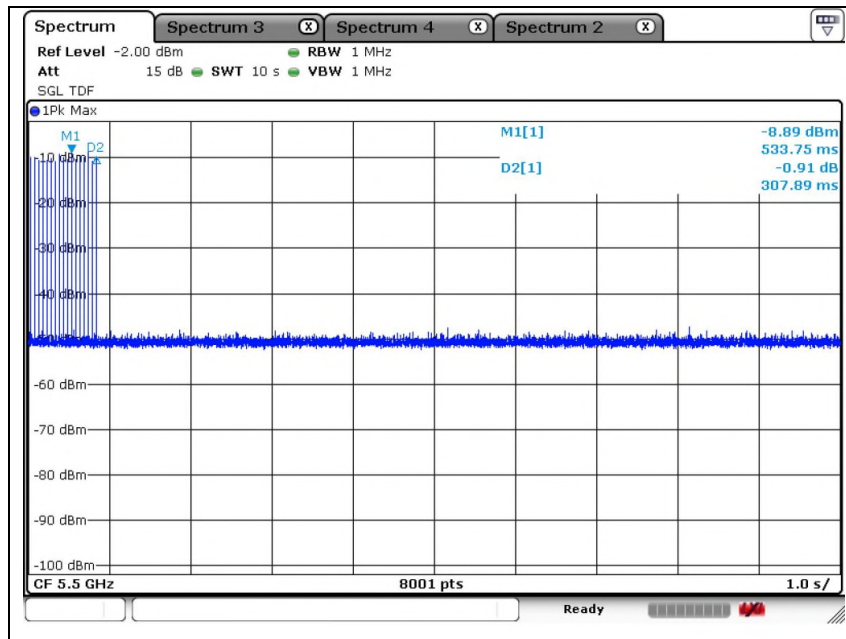
Mode: 802.11a (UNII-2C)
Operating frequency: 5 500 MHz





4.1.3 Channel move time & aggregate channel closing transmission time AN Traffic

Mode: 802.11a (UNII-2C)
Operating frequency: 5 500 MHz



Channel closing transmission time calculated	Test results
Sweep time[S] sec	10
Sampling bins[B]	8 001
Number of sampling bins in 10 sec[N]	1
Closing transmission time [C] ms	1.250

Channel move time (s)	Limit
0.31	≤ 10 s

Note:

Dwell = S/B;

Where **dwell** is the dwell time per spectrum analyzer sampling bin, **S** is the sweep time and **B** is the number of spectrum analyzer sampling bins.

An upper bound of the aggregate duration of the channel closing transmission time is calculated by:

C = N × Dwell;

Where **C** is the closing time, **N** is the number of spectrum analyzer sampling bins showing a U-NII transmission and dwell is the dwell time per bin.

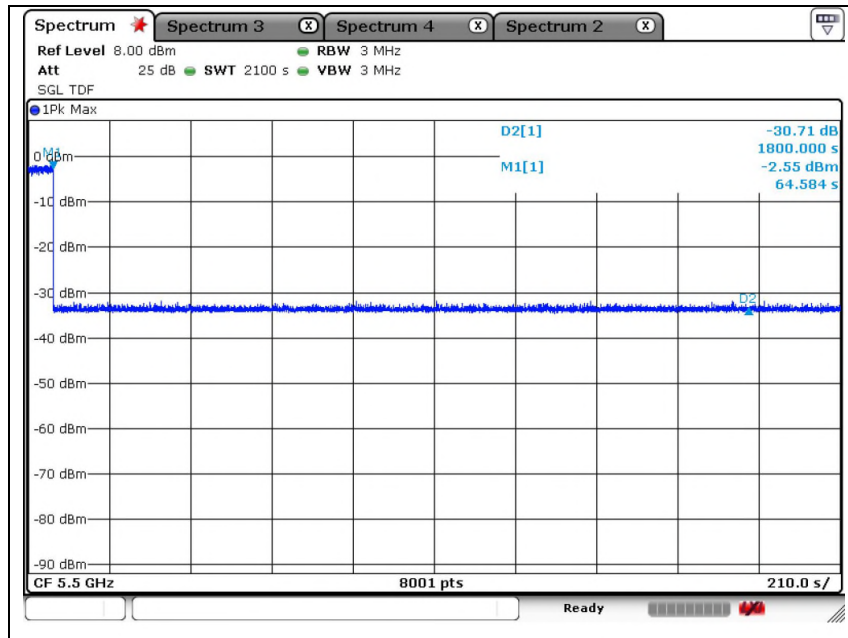
Dwell = [S] / [B] = 10 / 8 001 = 0.001 250

Closing Transmission Time[C] = [N] × [Dwell] = 1 × 0.001 250 = 0.001 250 s = 1.250 ms



4.1.4 Non-occupancy period

Mode: 802.11a (UNII-2C)
Operating frequency: 5 500 MHz



**Appendix A. Measurement equipment**

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV40-N	102194	1 year	2024.08.08
Vector Signal Generator	R&S	SMBV100A	256397	1 year	2024.06.14
Attenuator	Mini-Circuits	BW-S10-2W263+	2	1 year	2024.01.13 2025.01.15
Attenuator	Mini-Circuits	BW-S10-2W263+	3	1 year	2023.01.13 2025.01.15
Attenuator	SRT	F04-H930-01	17041002	1 year	2024.01.12 2025.01.12
Attenuator	HP	30dB ATTENUATOR	3318A05137	1 year	2024.01.12 2025.01.12
DC POWER SUPPLY	AGILENT	6632B	MY43004090	1 year	2024.06.19
DC POWER SUPPLY	AGILENT	6632B	MY43004130	1 year	2024.06.14
Splitter	MINI-CIRCUITS	ZFSC-2-10G+	FG63701930-1	1 year	2024.06.15
Splitter	MINI-CIRCUITS	ZFSC-2-10G+	FG63701930-2	1 year	2024.06.15
TERMINATION	MINI-CIRCUITS	KARN-50+	01342-2	1 year	2024.06.15

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

Peripheral devices

Device	Manufacturer	Model No.	Serial No.	Note.
Access Point (Master)	Cisco system Inc.	MR2200ac	2090RERGTR86M	FCC ID: YOR-MR2200AC
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949	-
Test Jig Board	N/A	N/A	N/A	-

The end of test report.