

# CE Test Report

**Equipment** : Bluetooth 5.1 Data Module  
**Model No.** : BL653  
**Brand Name** : Laird Connectivity  
**Applicant** : Laird Connectivity, Inc.  
**Address** : W66N220 Commerce Court, Cedarburg,  
Wisconsin 53012, USA  
**Standard** : EN 300 330 V2.1.1 (2017-02)  
**Received Date** : Jan. 30, 2020  
**Tested Date** : Feb. 21 ~ Jun. 02, 2020

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

  
James Fan / Assistant Manager

Approved by:

  
Gary Chang / Manager



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## Release Record

Report No.	Version	Description	Issued Date
ER013002	Rev. 01	Initial issue	Jun. 05, 2020

## Summary of Test Results

Ref. Std. Clause	Test Items	Measured	Result
4.3.1	Permitted Range of Operating Frequencies	Note <sup>1</sup>	Note <sup>1</sup>
4.3.2	Operating Frequency Ranges	Note <sup>1</sup>	Note <sup>1</sup>
4.3.3	Modulation Bandwidth	Note <sup>1</sup>	Note <sup>1</sup>
4.3.4	Transmitter H-Field Requirements	Note <sup>1</sup>	Note <sup>1</sup>
4.3.5	Transmitter RF Carrier Current	Note <sup>1</sup>	Note <sup>1</sup>
4.3.6	Transmitter Radiated E-Field	Note <sup>1</sup>	Note <sup>1</sup>
4.3.7	Transmitter Conducted Spurious Emissions	Note <sup>1</sup>	Note <sup>1</sup>
4.3.8	Transmitter Radiated Spurious Domain Emission Limits < 30 MHz	Note <sup>1</sup>	Note <sup>1</sup>
4.3.9	Transmitter Radiated Spurious Domain Emission Limits > 30 MHz	Note <sup>1</sup>	Note <sup>1</sup>
4.3.10	Transmitter Frequency Stability	Note <sup>1</sup>	Note <sup>1</sup>
4.4.2	Receiver Spurious Emissions	Meet the requirement of limit.	Pass
4.4.3	Adjacent Channel Selectivity	Only for channelized systems.	N/A
4.4.4	Receiver Blocking Or Desensitization	Not for tagging systems.	N/A

Note<sup>1</sup>: This test item is not required since the NFC function is passive only.

### Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

### Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

# 1 General Description

## 1.1 Information

### 1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird Connectivity	BL653	Bluetooth 5.1 Data Module	With Printed PCB antenna
			With MHF4 connector antenna

### 1.1.2 Specification of the Equipment under Test (EUT)

RF General Information			
Frequency Range (MHz)	Modulation	Ch. Frequency (MHz)	Channel Number
13.553 – 13.567	NFC-ASK	13.56	1

### 1.1.3 Antenna Details

Manufacturer	Model	Laird Part Number	Type	Connector	Gain (dBi)
Laird	Laird NFC	0600-00061	NFC	N/A	--

### 1.1.4 EUT Operational Condition

Supply Voltage	Option 1: DC 5V from host Option 2: DC 3.3V from host Option 3: DC 1.8V from host from host
SW Version	v30.1.0.1

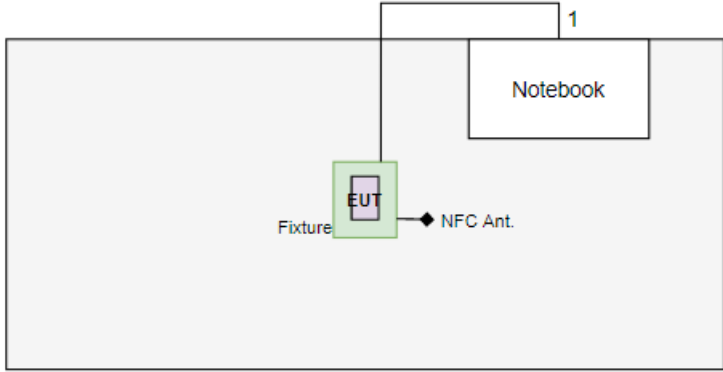
### 1.1.5 Accessories

N/A

## 1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude E6430	DoC	---
2	Fixture	Laird	DVK-BL653	---	Provided by applicant.

## 1.3 Test Setup Chart

Test Setup Diagram	
 <p>The diagram illustrates the test setup. A large rectangular area represents the test chamber. Inside, a 'Notebook' is connected to a 'Fixture' (labeled 'EUT') via a signal cable labeled '1'. The 'Fixture' is also connected to an 'NFC Ant.' (Near Field Communication Antenna).</p>	
No.	Signal cable / Length (m)
1	USB, 0.5m shielded.

## 1.4 Test Equipment List and Calibration Data

<b>Test Item</b>	Radiated Emission below 30 MHz				
<b>Test Site</b>	Open Area Test Site 1 / (OS01-LK)				
<b>Test date</b>	Jun. 02, 2020				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Preamplifier	HP	8447D	2944A08290	Sep. 04, 2019	Sep. 03, 2020
Receiver	R&S	ESR3	101659	Apr. 13, 2020	Apr. 12, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-562	Jan. 20, 2020	Jan. 19, 2021
RF Cable-R10M	EMCI	EMCCFD400	CB017	Oct. 22, 2019	Oct. 21, 2020
Measurement Software	AUDIX	e3	5.041019k2	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

<b>Test Item</b>	Radiated Emissions above 30 MHz				
<b>Test Site</b>	Fully-anechoic chamber 2 / (05CH02-WS)				
<b>Test date</b>	Feb. 25, 2020				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Spectrum Analyzer	Agilent	N9010A	MY52221474	Oct. 17, 2019	Oct. 16, 2020
Bilog Antenna 30-1000MHz	SCHWARZBECK	VULB9168	9168-563	Jan. 04, 2020	Jan. 03, 2021
Preamplifier	Agilent	83017A	MY53270013	Jan. 10, 2020	Jan. 09, 2021
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-002	Oct. 15, 2019	Oct. 14, 2020
LF cable-3M	EMC	EMC8D-NM-NM-3000	131102	Oct. 15, 2019	Oct. 14, 2020
LF cable-10M	EMC	EMC8D-NM-NM-10000	131101	Oct. 15, 2019	Oct. 14, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

<b>Test Item</b>	Radiated Emissions below 30 MHz				
<b>Test Site</b>	(10CH02-HY)				
<b>Test date</b>	Feb. 21, 2020				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Amplifier	AGILENT	8446D	2944A10827	Jan. 14, 2020	Jan. 13, 2021
Amplifier	AGILENT	8447D	2944A08290	Sep. 04, 2019	Sep. 03, 2020
Amplifier	AGILENT	8447D	2944A10828	Jan. 14, 2020	Jan. 13, 2021
Receiver	R&S	ESU26	100422	Oct. 23, 2019	Oct. 22, 2020
EXA Signal Analyzer	KEYSIGHT	N9010A	MY54200401	Dec. 25, 2019	Dec. 24, 2020
Biconical Antenna	Schwarzbeck	VHBB 9124	287	Aug. 23, 2019	Aug. 22, 2020
Log Periodic Antenna	Schwarzbeck	VUSLP 9111	207	Aug. 23, 2019	Aug. 22, 2020
Turn Table	EM Electronics	EM 1000	60546	NA	NA
Antenna Mast	HD	MA240	240/664	NA	NA
Antenna Mast	MF	MFA-515BSN	1308569	NA	NA
RF Cable-R10m	Jye Bao	RG142	CB027-INSIDE	Sep. 19, 2019	Sep. 18, 2020
RF Cable-R10m	HUBER+SUHNER	RG223/U + RG8/U	CB026-DOOR	Sep. 19, 2019	Sep. 18, 2020
Software	Sporton	SENSE-EMI	V5.10.7	NA	NA
Software	Audix	E3	6.12 160809	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

## 1.5 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

EN 300 330 V2.1.1 (2017-02)

## 1.6 Deviation from Test Standard and Measurement Procedure

None



## 1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ( $k=2$ )).

Measurement Uncertainty / ICC test lab		
Test Item	Uncertainty	Limit
Radio Frequency	$\pm 0.34 \times 10^{-7}$	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 2.2$ dB	$\pm 1$ dB
RF power, radiated	$\pm 2.59$ dB	$\pm 6$ dB
Temperature	$\pm 0.4$ °C	$\pm 1$ °C
Humidity	$\pm 3.3$ %	$\pm 5$ %

Measurement Uncertainty / Sporton test lab		
Test Item	Uncertainty	Limit
RF power, radiated	$\pm 3.0$ dB	$\pm 6$ dB

## 2 Test Configuration

### 2.1 Testing Condition

Testing Location			
<input checked="" type="checkbox"/>	ICC Lab	ADD : No.3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan (R.O.C.) TEL : 886-3-271-8666 FAX : 886-3-318-0155	
<input checked="" type="checkbox"/>	Sporton Lab	ADD : No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL : 886-3-327-3456 FAX : 886-3-327-0973	
Test Condition		Test Site No.	Test Engineer
Radiated Emission above 30 MHz		05CH02-WS	24°C / 65% Ryan Lee
Radiated Emission below 30MHz		OS01-LK	30°C / 55% Alex Tsai
Radiated Emission below 30MHz		10CH02-HY*	23°C / 60% Ryan Hsiao

Note: \* ICC lab subcontracts this test item to Sporton Lab (TAF:1190).

Sporton Lab is a TAF accreditation test firm and also is an approved provider of ICC lab.

### 2.2 The Worst Test Modes and Channel Details

Test item	Test Mode	Test Channel (MHz)	Test Configuration
Radiated Measurement	NFC	13.56	1, 2
<b>NOTE:</b> 1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The <b>Z-plane</b> results were found as the worst case and were shown in this report. 2. The EUT supports three DC voltage options, DC 1.8V, DC 3.3V and DC 5V. All options were assessed and <b>DC 3.3V</b> was found to be the worst case and was selected for the final test. 3. Test configurations are listed as follows: 1) Test configuration 1: With Printed PCB antenna(Model name: BL653-SA PCB printed antenna) + NFC antenna 2) Test configuration 2: With MHF4 connector antenna(Model name: EDA-8709-2G4C1-B27-CY) + NFC antenna			

### 3 Receiver Test Results

#### 3.1 Receiver Spurious Emissions

##### 3.1.1 Limit of Receiver Spurious Emissions

###### Measurement below 30 MHz

Frequency $9 \text{ kHz} \leq f < 10 \text{ MHz}$	Frequency $10 \text{ MHz} \leq f < 30 \text{ MHz}$
5,5 dB $\mu$ A/m at 9 kHz descending 3 dB/oct	-25 dB $\mu$ A/m

###### Measurement above 30 MHz

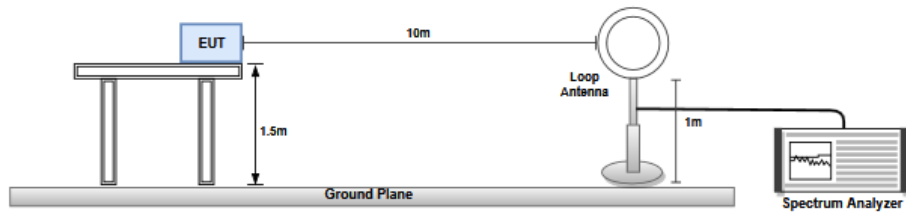
The measured values shall not exceed 2 nW e.r.p. (-57 dBm).

##### 3.1.2 Test Procedures

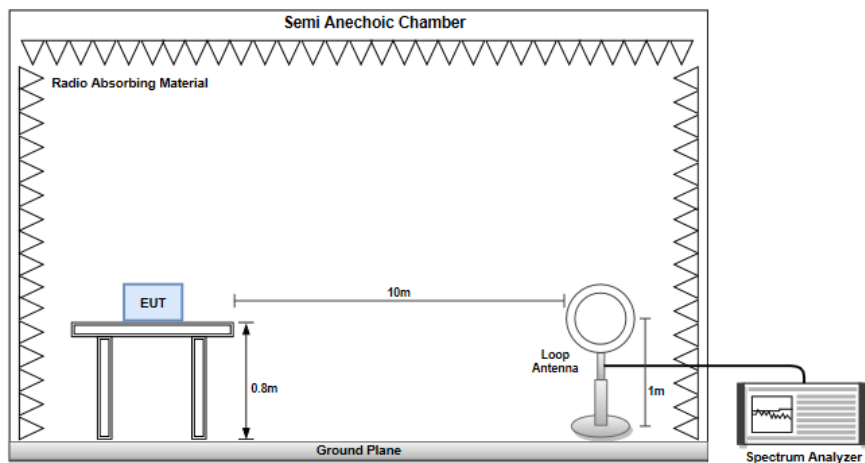
Reference to clause 6.3.1 of EN 300 330 V2.1.1 (2017-02).

### 3.1.3 Test Setup

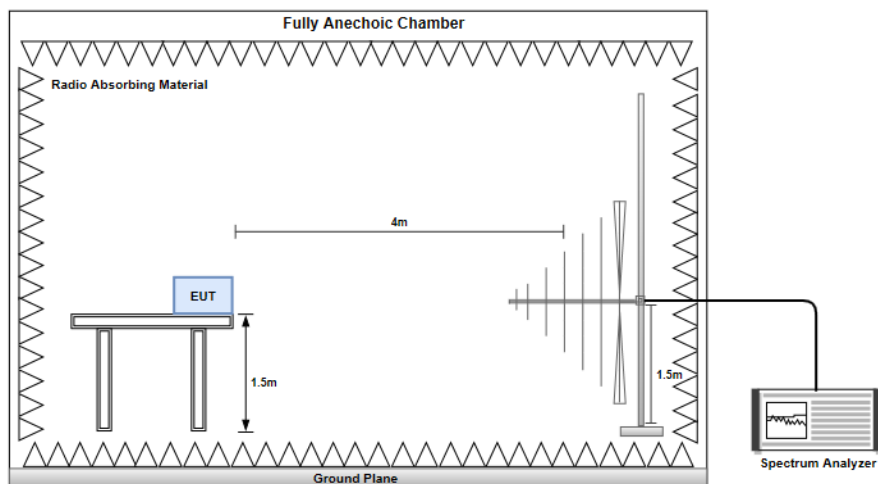
#### Below 30MHz (Test Site: OS01-LK)



#### Below 30MHz (Test Site: 10CH02-HY)



#### Above 30MHz (Test Site: 05CH02-WS)



### 3.1.4 Receiver Spurious Emissions (Below 30MHz) (Test Site: OS01-LK)

#### *Test configuration 1: With Printed PCB antenna + NFC antenna*

Receiver Emissions in the Range from 9kHz~30MHz Result						
Emission Freq. (MHz)	E-field (dBuV/m)	E-field to H-field Converted Factor (dB)	H-field (dBuA/m)	H-field Limit (dBuA/m at 10m)	Level Type	Margin (dB)
15.18	20.76	-51.5	-30.74	-25	PK	5.74

Note1: H-field (10m) = [E-field (Xm)] + [E-field to H-field Converted Factor]

#### *Test configuration 2: With MHF4 connector antenna + NFC antenna*

Receiver Emissions in the Range from 9kHz~30MHz Result						
Emission Freq. (MHz)	E-field (dBuV/m)	E-field to H-field Converted Factor (dB)	H-field (dBuA/m)	H-field Limit (dBuA/m at 10m)	Level Type	Margin (dB)
9.65	21.51	-51.5	-29.99	-24.83	PK	5.16

Note1: H-field (10m) = [E-field (Xm)] + [E-field to H-field Converted Factor]

### 3.1.5 Receiver Spurious Emissions (Below 30MHz) (Test Site: 10CH02-HY)

#### *Test configuration 1: With Printed PCB antenna + NFC antenna*

Receiver Emissions in the Range from 9kHz~30MHz Result						
Emission Freq. (MHz)	E-field (dBuV/m)	E-field to H-field Converted Factor (dB)	H-field (dBuA/m)	H-field Limit (dBuA/m at 10m)	Level Type	Margin (dB)
15.165	20.77	-51.5	-30.73	-25	PK	5.73

Note1: H-field (10m) = [E-field (Xm)] + [E-field to H-field Converted Factor]

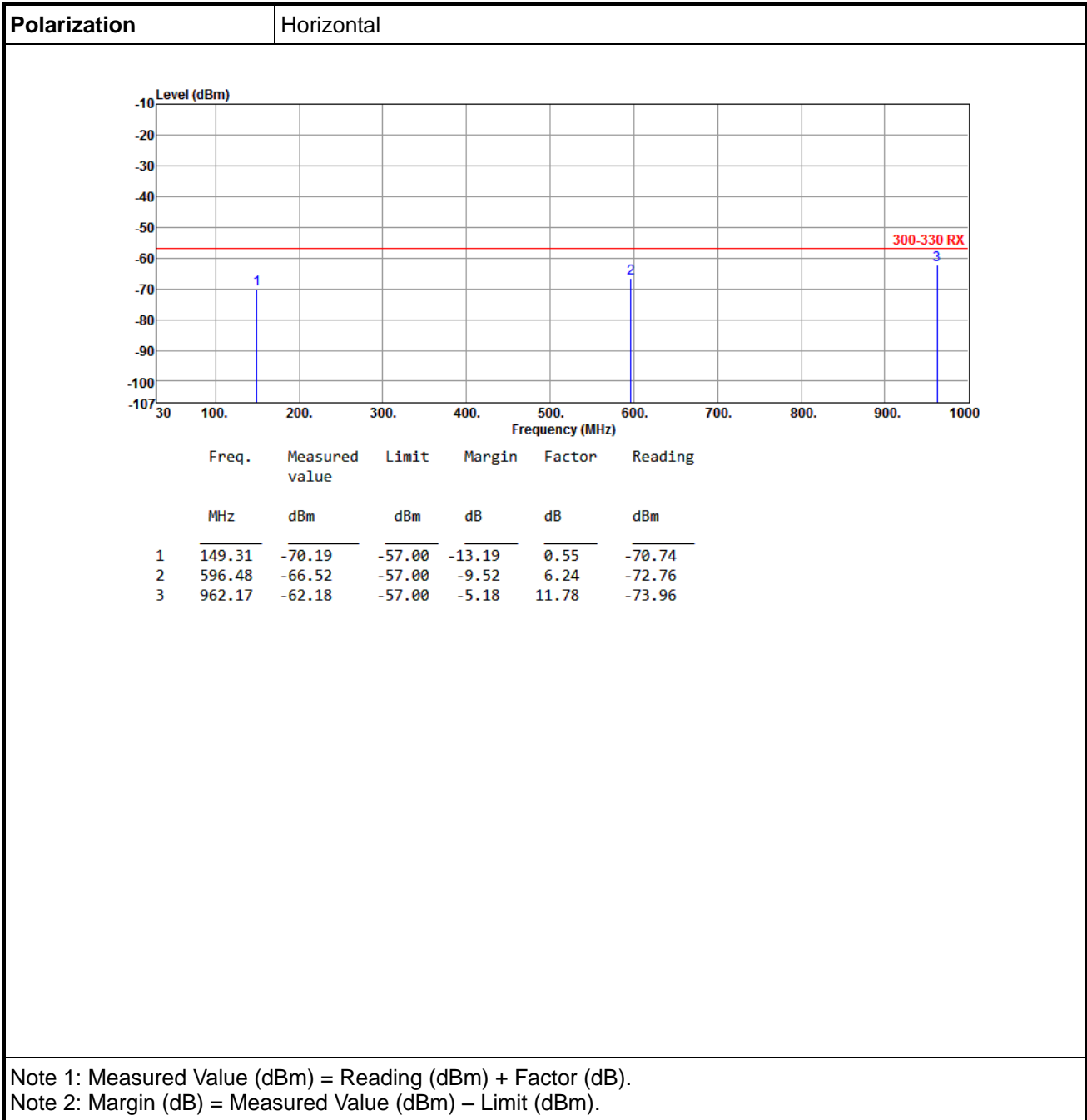
#### *Test configuration 2: With MHF4 connector antenna + NFC antenna*

Receiver Emissions in the Range from 9kHz~30MHz Result						
Emission Freq. (MHz)	E-field (dBuV/m)	E-field to H-field Converted Factor (dB)	H-field (dBuA/m)	H-field Limit (dBuA/m at 10m)	Level Type	Margin (dB)
17.075	21.11	-51.5	-30.39	-25	PK	5.39

Note1: H-field (10m) = [E-field (Xm)] + [E-field to H-field Converted Factor]

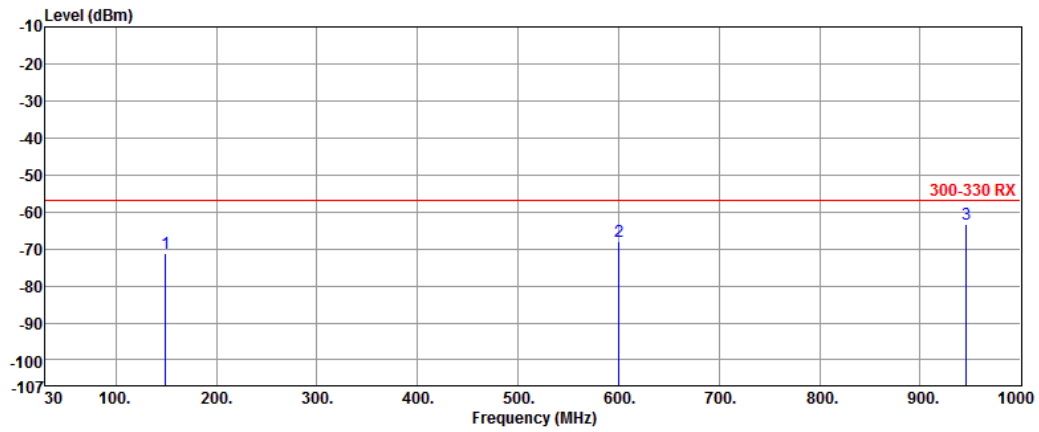
### Test configuration 1: With Printed PCB antenna + NFC antenna

#### 3.1.6 Receiver Spurious Emissions (Above 30MHz) (Test Site: 05CH02-WS)



# Polarization

Vertical



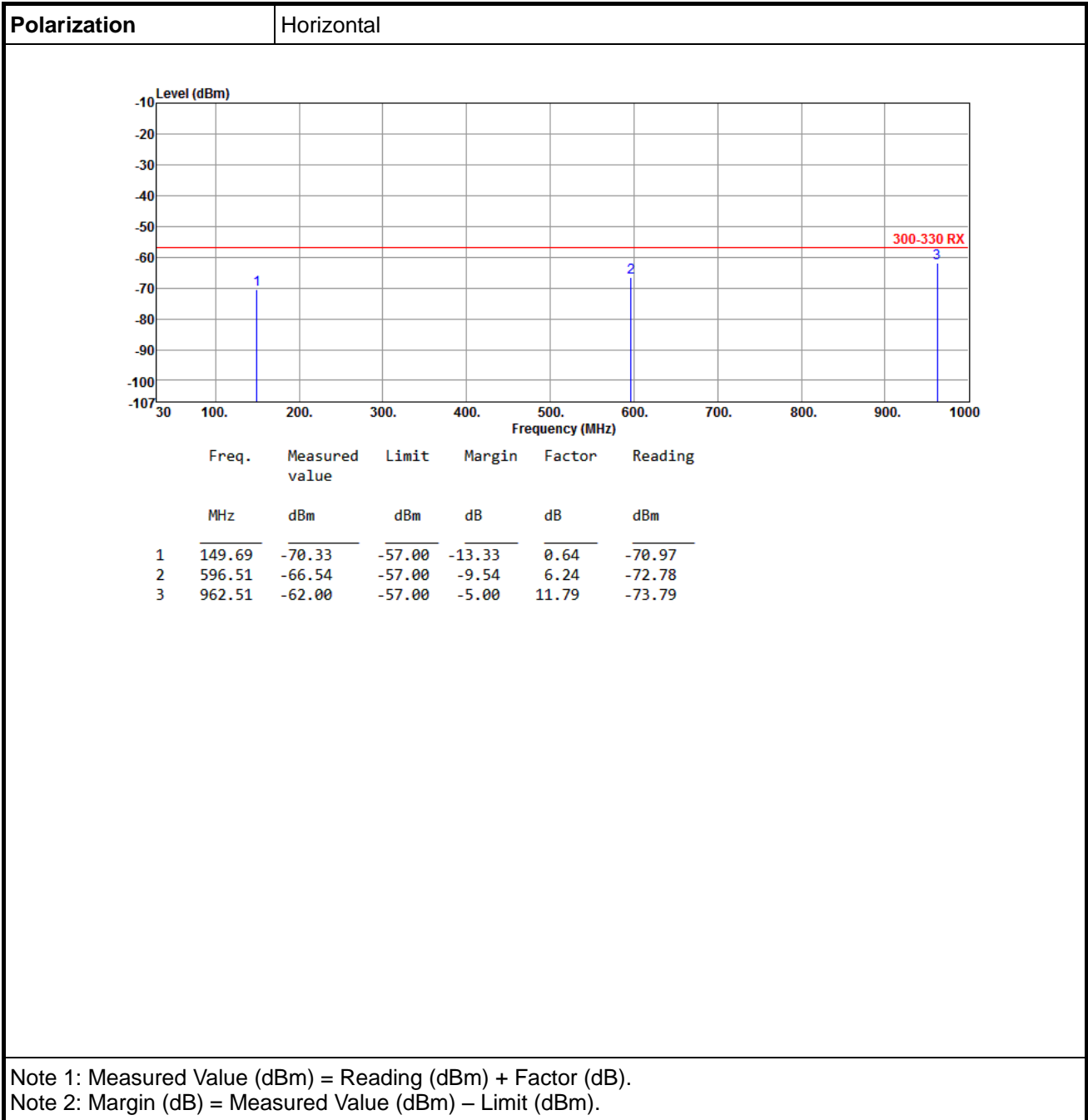
Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).



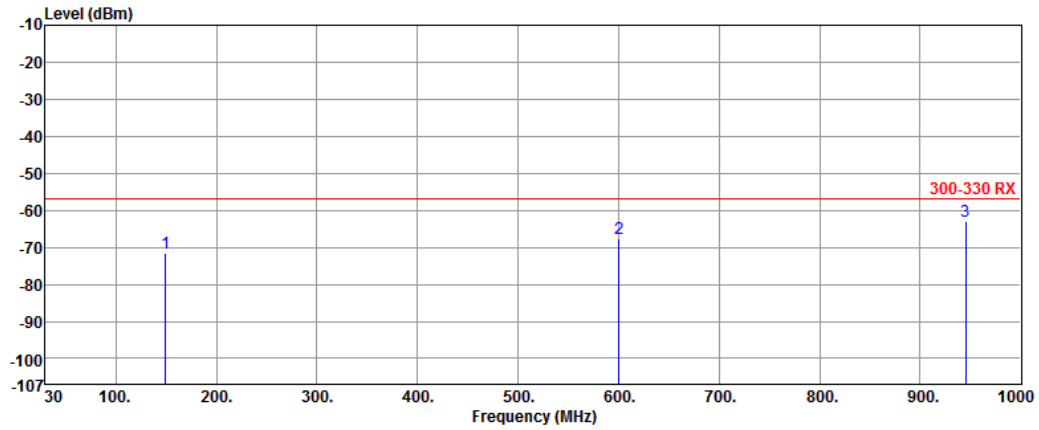
**Test configuration 2: With MHF4 connector antenna + NFC antenna**

**3.1.7 Receiver Spurious Emissions (Above 30MHz) (Test Site: 05CH02-WS)**



**Polarization**

Vertical



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	149.40	-71.58	-57.00	-14.58	0.74	-72.32
2	600.42	-67.53	-57.00	-10.53	6.07	-73.60
3	945.51	-63.12	-57.00	-6.12	11.41	-74.53

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

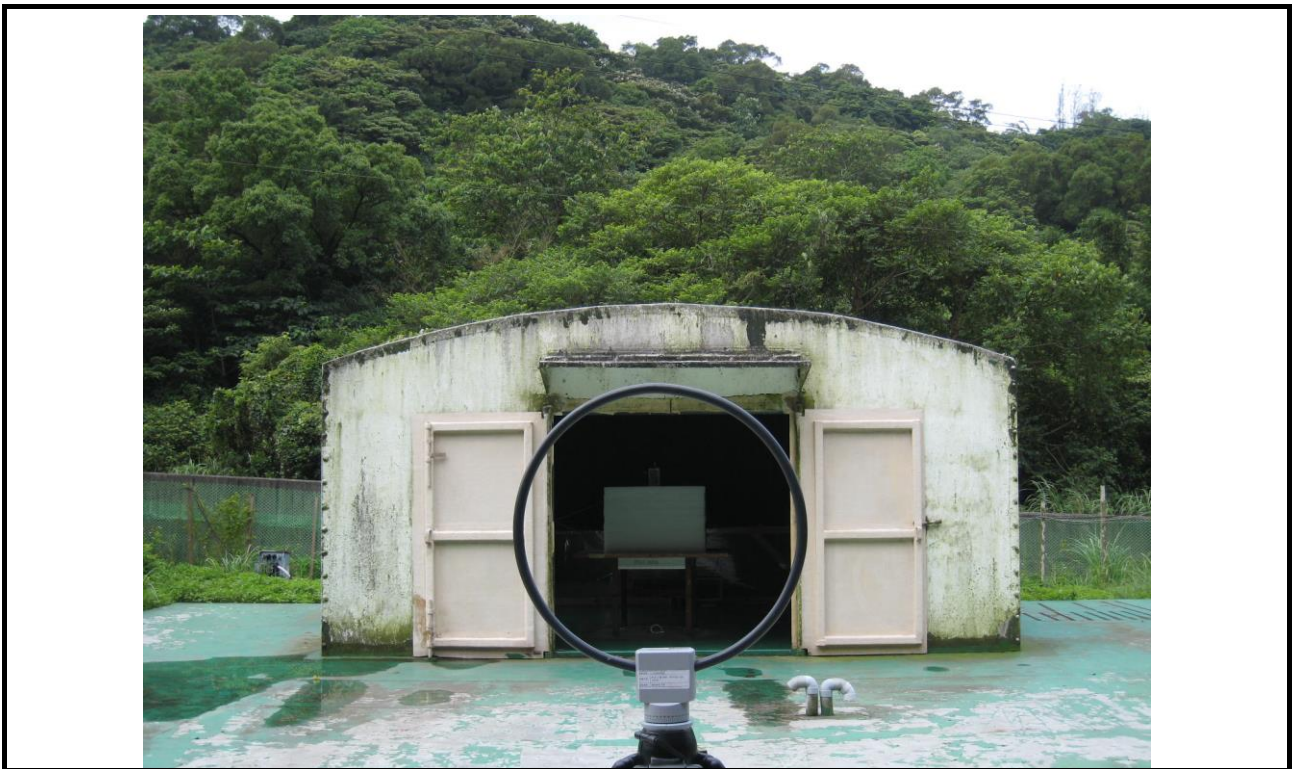
## 4 Photographs of the Test Configuration

Below 30MHz (Test Site: OS01-LK) (With Printed PCB antenna + NFC antenna)

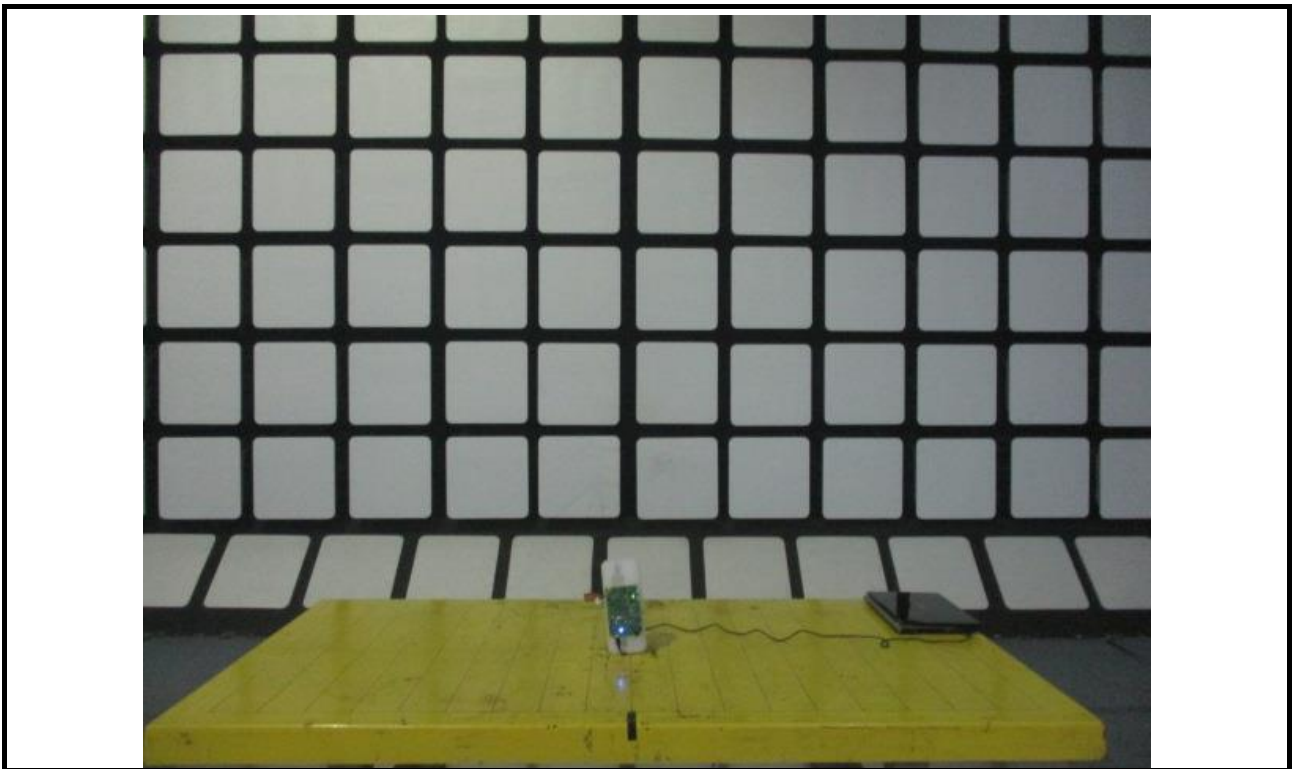
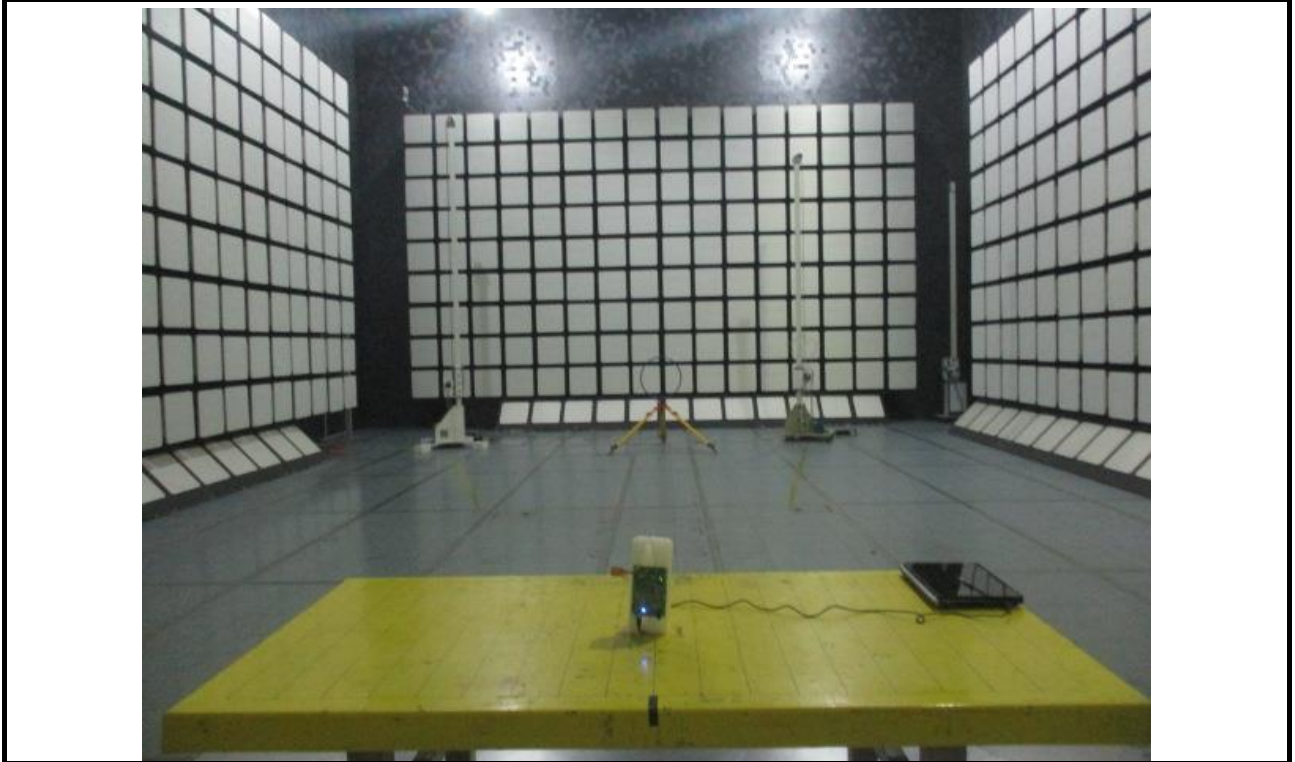




**Below 30MHz (Test Site: OS01-LK) (With MHF4 connector antenna + NFC antenna)**

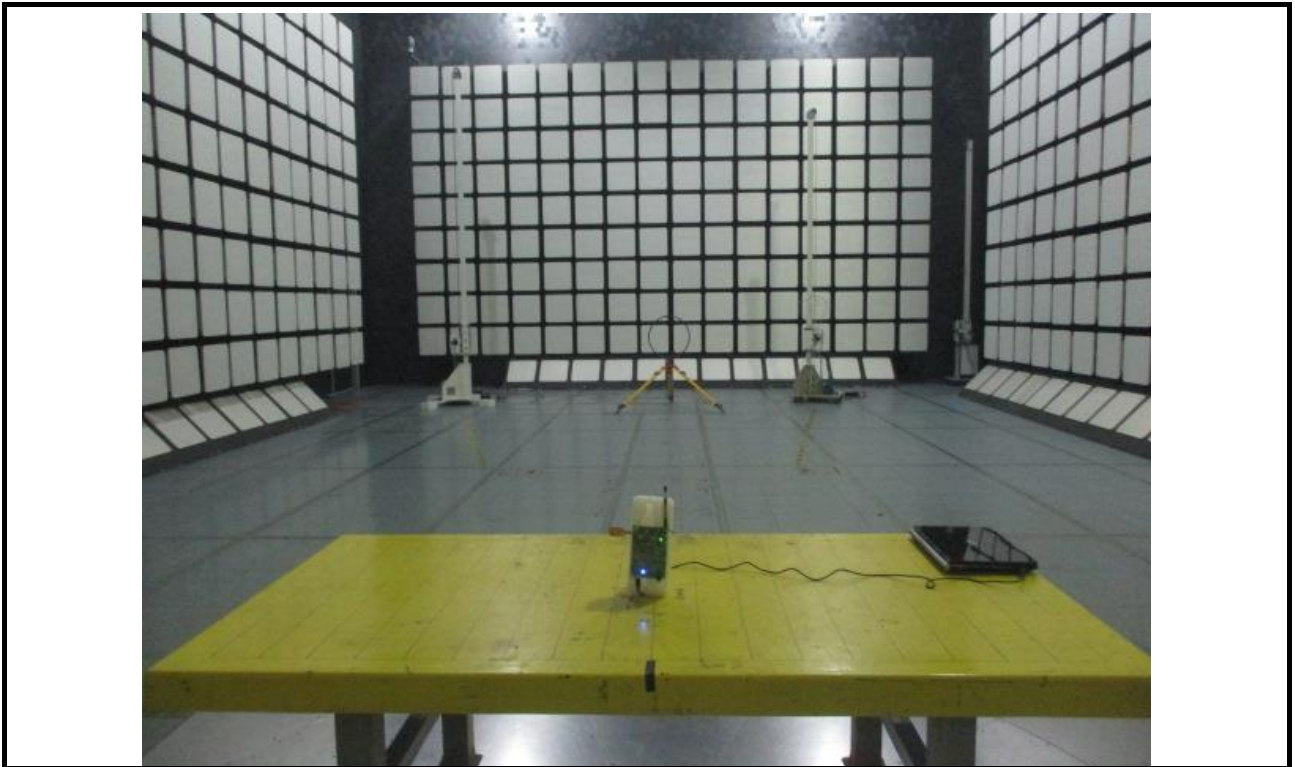
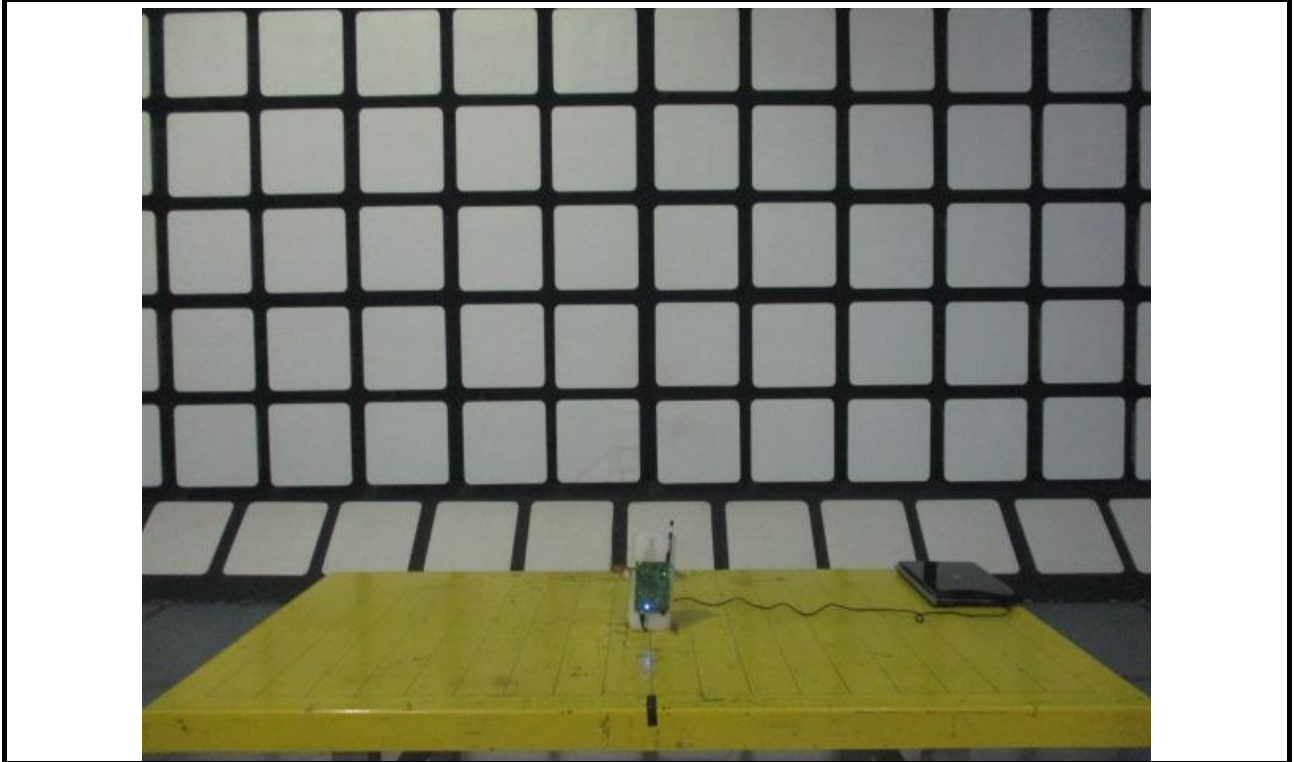


**Below 30MHz (Test Site: 10CH02-HY) (With Printed PCB antenna + NFC antenna)**

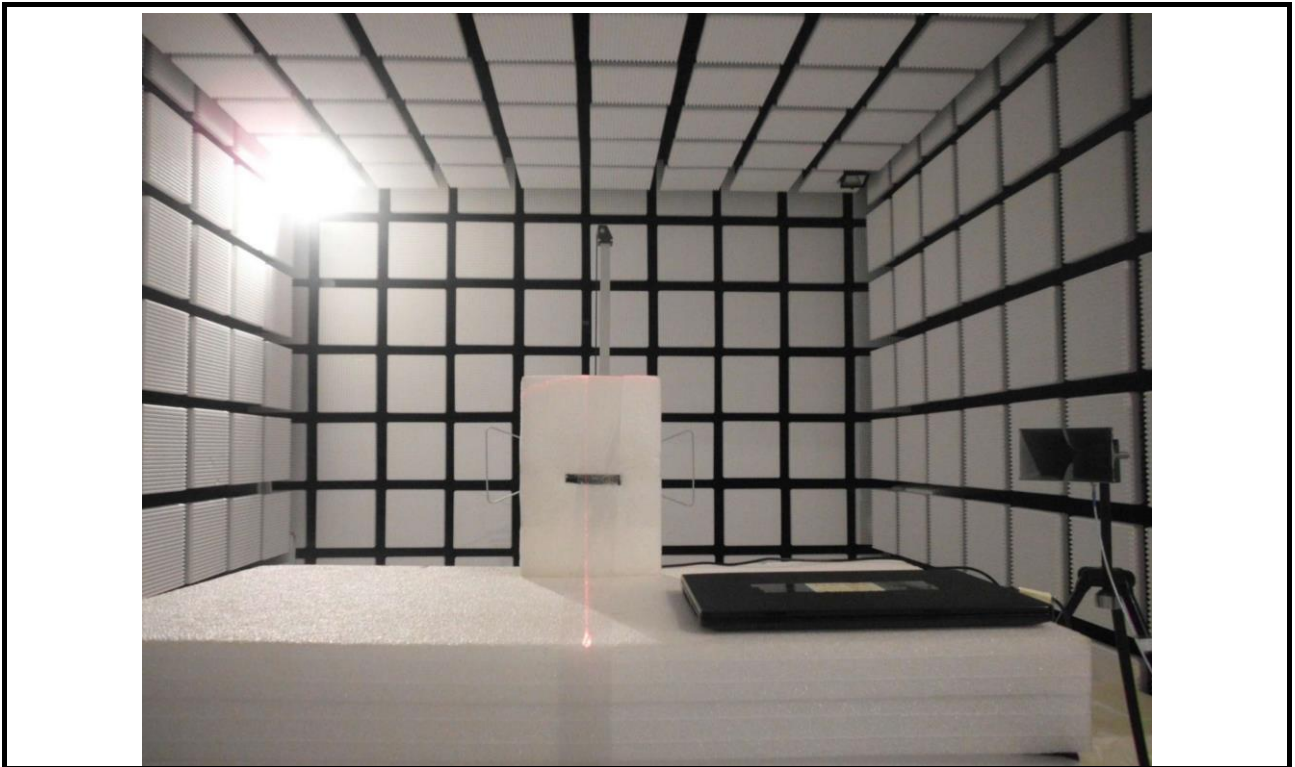
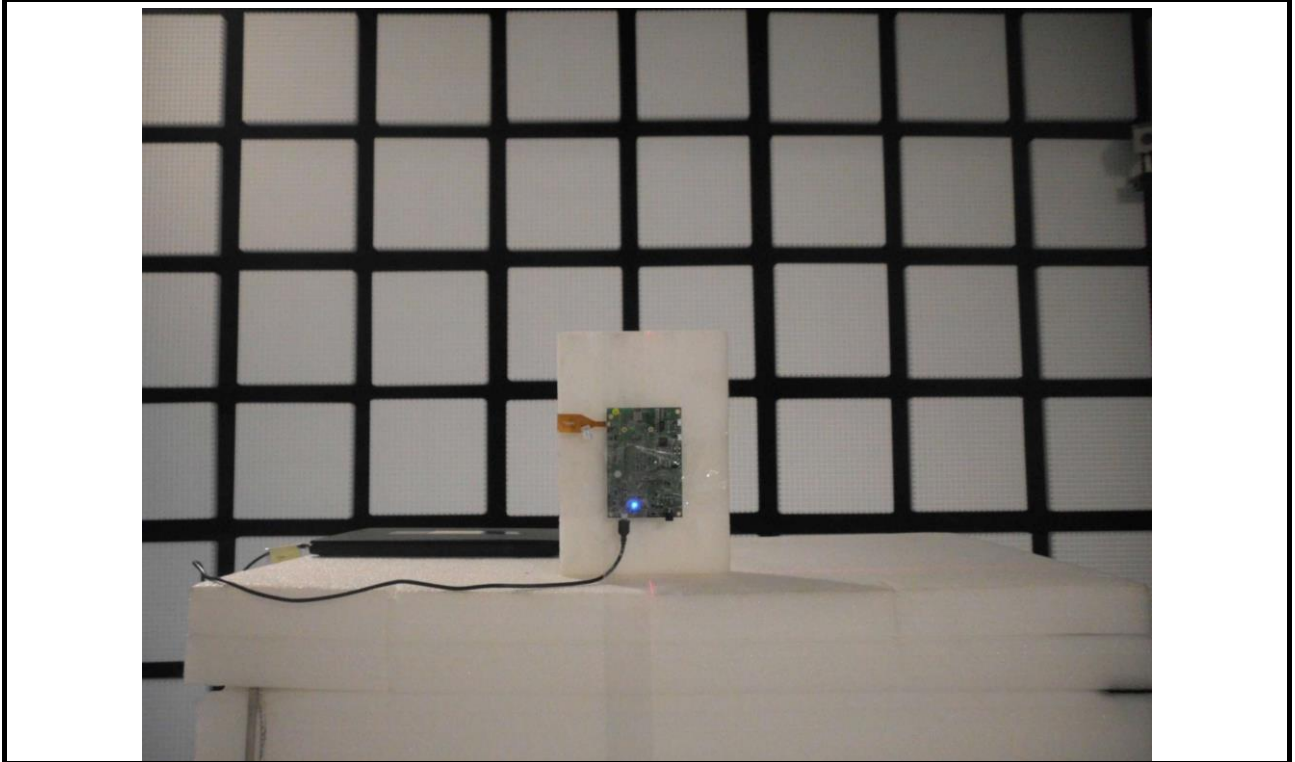




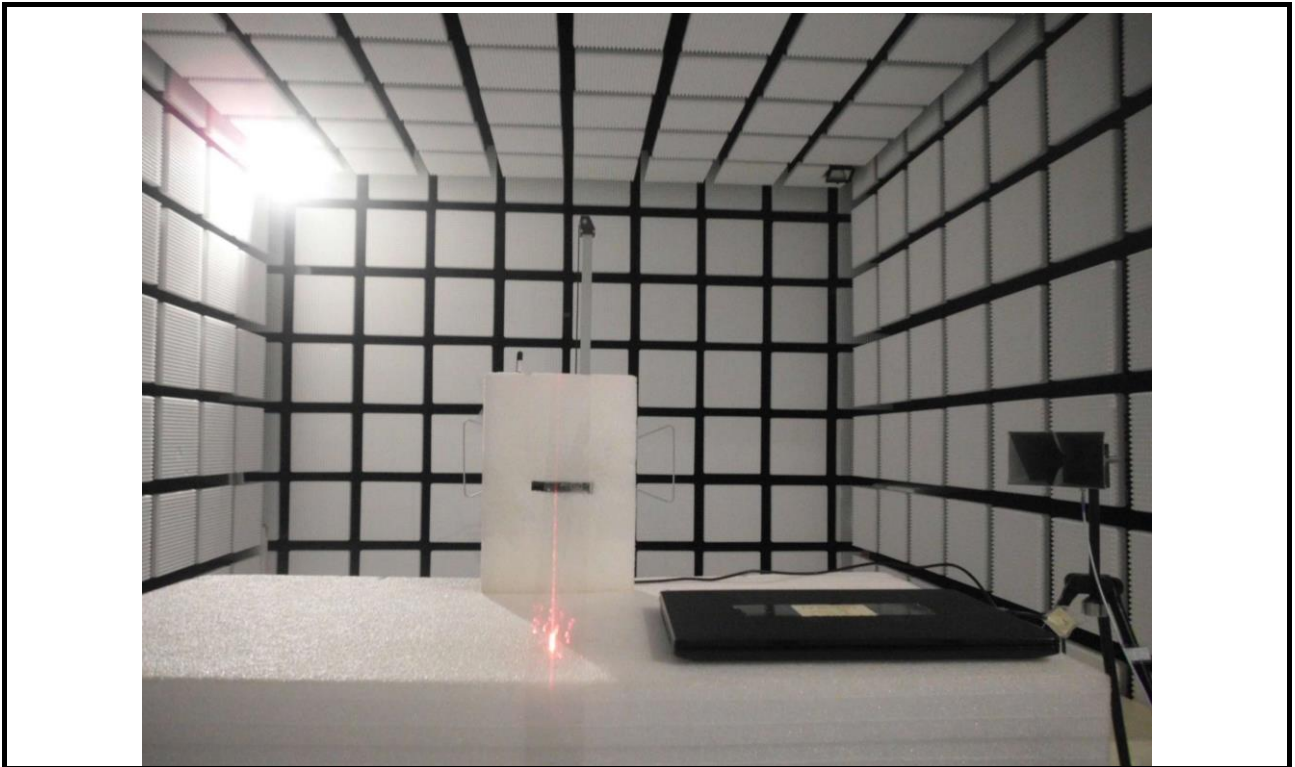
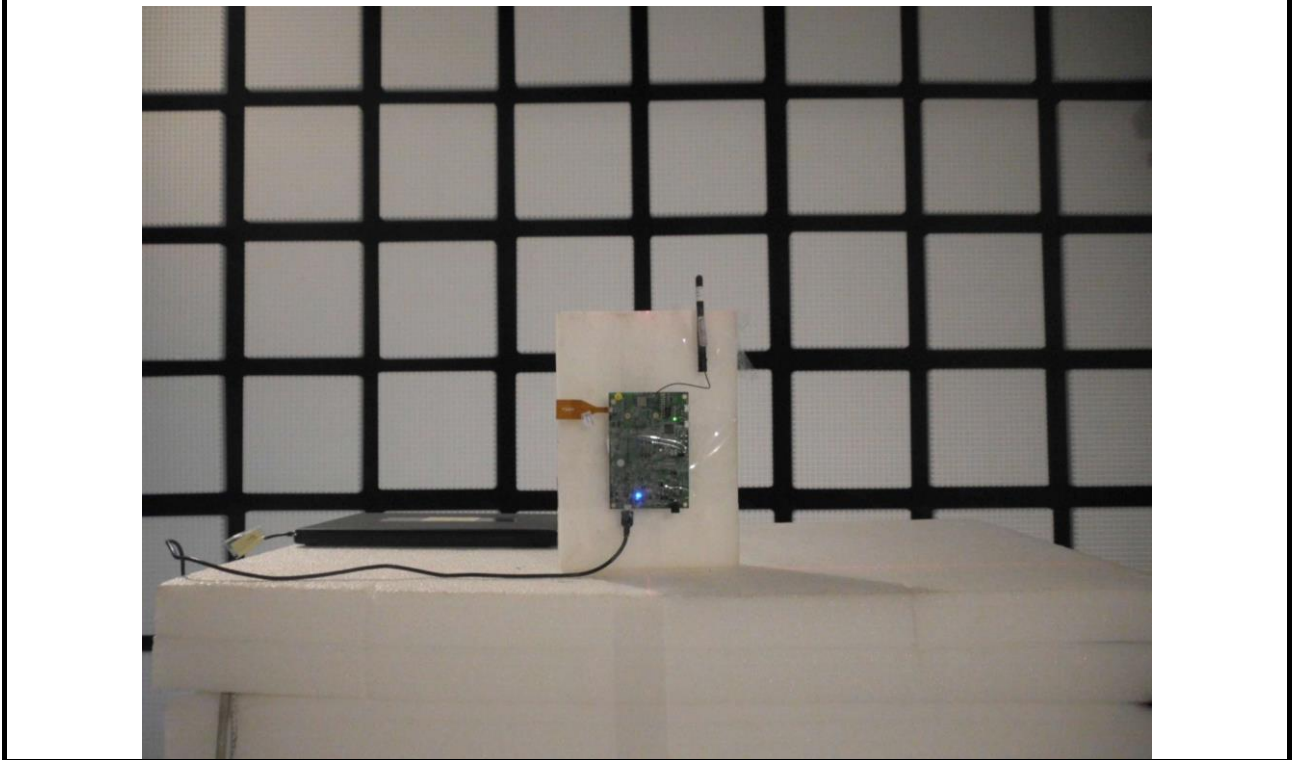
**Below 30MHz (Test Site: 10CH02-HY) (With MHF4 connector antenna + NFC antenna)**



**Above 30MHz (Test Site: 05CH02-WS) (With Printed PCB antenna + NFC antenna)**



**Above 30MHz (With MHF4 connector antenna + NFC antenna)**





## 5 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

### **Linkou**

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin  
Kou District, New Taipei City,  
Taiwan, R.O.C.

### **Kwei Shan**

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd St.,  
Kwei Shan District, Tao Yuan City  
333, Taiwan, R.O.C.

### **Kwei Shan Site II**

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd  
St., Kwei Shan District, Tao Yuan  
City 333, Taiwan, R.O.C..

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC\_Service@icertifi.com.tw

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