SPORTON LAB.

Project No : EH232843-17

VERIFICATION OF COMPLIANCE

Equipment : **802.11abgn, USB module**
Model No. : **WUBR-508N**
Applicant : **SparkLAN Communications, Inc.**
8F., No. 257, Sec. 2, Tiding Blvd., Neihu District,
Taipei City 11493, Taiwan

SPORTON LAB.

I HEREBY **DECLARE THAT :**

The equipment was **Passed** the test performed according to

ETSI EN 301 489-1 V2.2.0 (2017-03) EN 301 489-17 V3.2.0 (2017-03)

The test was carried out on **May 09, 2017** at SPORTON INTERNATIONAL INC. LAB.

William Li
Supervisor

CE EMC TEST REPORT

Test Standard : Draft EN 301 489-1 V2.2.0 (2017-03), Class B
Draft EN 301 489-17 V3.2.0 (2017-03)

Equipment : 802.11abgn, USB module

Model No. : WUBR-508N

Applicant : SparkLAN Communications, Inc.
8F., No. 257, Sec. 2, Tiding Blvd., Neihu District,
Taipei City 11493, Taiwan

Manufacturer : SparkLAN Communications, Inc.
8F., No. 257, Sec. 2, Tiding Blvd., Neihu District,
Taipei City 11493, Taiwan

Statement:

- The test result refers exclusively to the test presented test model / sample.
- Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.
- This test report is only applicable to European Community.

Issued by : **SPORTON International Inc.**
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Table of Contents

History of this test report

Report No.	Version	Issue Date	Description
EH232843	Rev.01	May 11, 2012	Initial issue of report
EH235843-17	Rev.01	Jun. 05, 2017	Update standard version and add EMS (RS 1GHz~6 GHz) tested

Verification No. : EH235843-17

VERIFICATION OF COMPLIANCE

Test Standard : Draft EN 301 489-1 V2.2.0 (2017-03), Class B
Draft EN 301 489-17 V3.2.0 (2017-03)

Equipment : 802.11abgn, USB module

Trade Name : SparkLAN

Model No. : WUBR-508N

Applicant : SparkLAN Communications, Inc.
8F., No. 257, Sec. 2, Tiding Blvd., Neihu District,
Taipei City 11493, Taiwan

Received Date : Mar. 29, 2012

Final Tested Date : May 09, 2017

I **HEREBY** CERTIFY THAT :

We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in Draft ETSI EN 301 489-1 V2.2.0 (2017-03) and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

William Li / Supervisor

Testing Laboratory
1190

SPORTON International Inc.
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

SUMMARY OF TEST RESULT

Emission Tests and Conformance Test Specifications - Draft ETSI EN 301 489-1 V2.2.0 (2017-03)				
Report Clause	**Ref. Std. Clause**	**Test items**	**Test Standard**	**Result**
4.1	8.4	Conducted Emission (AC mains port)	EN 55032:2015 Class B	PASS
4.2	8.7	Conducted Emission (wired network port)		Note 1
4.3 & 4.4	8.2	Radiated Emission (Enclosure)		PASS
4.5	8.5	Harmonic Current Emissions (AC mains input port)	EN 61000-3-2:2014	Note 2
4.6	8.6	Voltage Fluctuations and Flicker (AC mains input port)	EN 61000-3-3:2013	Note 2
Note 1: This EUT without telecommunication ports, it's not necessary to apply to Telecom Port Conducted emission test. Note 2: It was supplied power by host system for EUT, it's not necessary to apply to Harmonic Current emission, Voltage Fluctuations and Flicker tests.				

Immunity Tests and Conformance Test Specifications - Draft ETSI EN 301 489-1 V2.2.0 (2017-03)				
Report Clause	**Ref. Std. Clause**	**Test items**	**Test Standard**	**Result**
6.1	9.3	ESD (Enclosure)	EN 61000-4-2:2009	PASS
6.2	9.2	RS (Enclosure)	EN 61000-4-3:2006/A1:2008/A2:2010	PASS
6.3	9.4	EFT (AC Power Port)	EN 61000-4-4:2012	Note 1
6.3	9.4	EFT (wired network ports)	EN 61000-4-4:2012	Note 2
6.4	9.8	Surges (AC Power Port)	EN 61000-4-5:2014	Note 1
6.4	9.8	Surges (wired network ports)	EN 61000-4-5:2014	Note 2
6.5	9.5	CS (AC Power Port)	EN 61000-4-6:2014	Note 1
6.5	9.5	CS (wired network ports)	EN 61000-4-6:2014	Note 2
6.6	9.7	DIP (AC Power Port)	EN 61000-4-11:2004	Note 1
Note 1: It was supplied power by host system for EUT; It's not necessary to apply to EFT, Surge, CS and DIP test. Note 2: This EUT without telecommunication ports, it's not necessary to apply to Telecom Port Conducted emission test.				

1. General Description of Equipment under Test

1.1. Basic Description of Equipment under Test

Equipment : 802.11abgn, USB module
Model No. : WUBR-508N
Power Supply Type : From Host system
The maximum operating frequency : 5GHz

1.2. Feature of Equipment under Test

For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2. Test Configuration of Equipment under Test

2.1. Details of EUT Test Modes

Test Items	Description of test modes
Conducted Emission	Mode 1. From System Wi-Fi Link (Dipole)
Radiated Emissions <below 1GHz>	Mode 1. From System Wi-Fi Link (Dipole)
Radiated Emissions <above 1GHz>	Mode 1. From System Wi-Fi Link (Dipole)

Test Items	Description of test modes
EMS	Mode 1. Wi-Fi Link Mode + Dipole

2.2. Description of Test System

Conducted emission and radiated emission

No.	Peripheral	Manufacturer	Model Number	FCC ID	Remarks
For Local					
A	Notebook	DELL	E5430	DoC	-
B	Mouse	MICROSOFT	1113	DoC	-
C	IPod Nano	Apple	A1199	DoC	-
D	Adapter	DELL	LA65NS2-01	N/A	-
For Remote					
-	Wireless AP	ASUS	RT-AC66U	MSQ-RTAC66U	-

EMS

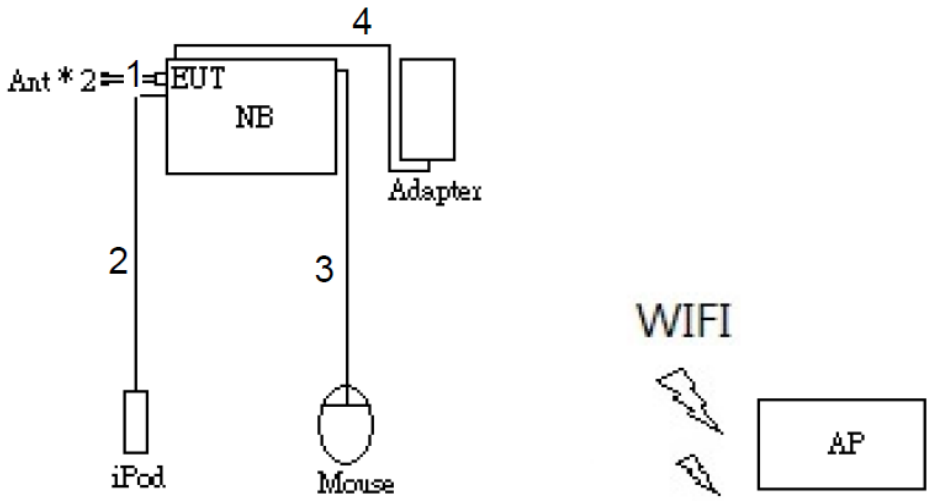
No.	Peripheral	Manufacturer	Model Number	FCC ID	Remarks
For Local					
A	Notebook	DELL	VOSTRO 3350	DoC	-
B	Mouse	Microsoft	1113	JNZ211443	-
For Remote					
-	Wireless AP	D-Link	DNS-G120	DoC	-

Only RS 1~6G

No.	Peripheral	Manufacturer	Model Number	Types of Cables	Remarks
For Local					
A	Notebook	DELL	Latitude E6440	---	-
For Remote					
-	AP Router	ASUS	RT-N12E	---	-

2.3. Connection Diagram of Test System

Test Setup Diagram



No.	Types of Cables	Shielding on Cable	Length (m)	Remarks
1	Antenna Cable *2	Non-Shielded	0.15	EUT
2	USB Cable	B-Shielded	1.2	-
3	USB Cable	AL-F-Shielded	1.8	-
4	Power Cable	Non-Shielded	1.8	-

2.4. Test Software

EMI

During testing, the following program under WIN 7 was executed:

- The Notebook executed "EMITEST" from the mouse and runs it.
- The Notebook executed "Winthrax.exe" to read and write data from iPod Nano.
- The Notebook executed "MCLB_MPEG4" to keep displaying the color bar signal (ITU-R BT 471-1).
- The Notebook executed "Ping.exe" to link with the EUT and Wireless AP (remote) to maintain the connection by Wi-Fi.

EMS

Two executive programs, "EMITEST.exe" and "EMCTEST.exe" under Win XP, which generates a complete line of continuously repeating "H" pattern was used as the test software.

The program was executed as follows:

a. Turn on the power of all equipment.
b. The Notebook executed " EMITEST.exe " sends "H" messages to the panel and displays "H" patterns on the screen.
c. The EUT connect to remote workstation (Wireless AP) via Wi-Fi.

Only RS 1~6G

During testing, the following program under WIN 7 was executed:

- The Notebook executed "Ping.exe" to link with the EUT and AP Router (remote) to maintain the connection by Wi-Fi.

3. General Information of Test

3.1. Test Facilities

Test Site：SPORTON INTERNATIONAL INC.		
☒	HUA YA	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL : 886-3-327-3456 FAX : 886-3-318-0055
☒	ICC	ADD : No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.) TEL : 886-3-271-8666 : TAF Accreditation Number：2732

Test Items	Test Site No.	Test Engineer	Test Environment			Test Date	Remark
			temp °C	humidity %	pressure kPa		
Powerline Conducted Emissions	CO04-HY	Teddy	20°C	60%	-	Apr. 11, 2017	-
Radiated Emissions (below 1GHz)	10CH02-HY	Nicky	22°C	63%	-	Apr. 12, 2017	-
Radiated Emissions (above 1GHz)	10CH02-HY	Nicky	22°C	63%	-	Apr. 12, 2017	-
ESD	ES02-HY	Mars	24°C	48%	101 kPa	Apr. 10, 2012	-
RS (80 to 1000 MHz)	RS01-HY	Mars	24°C	48%	101 kPa	Apr. 10, 2012	-
RS (1000 to 6000 MHz)	RS01-WS	Awel	23°C	60%	99 kPa	May 09, 2017	ICC

3.2. Test Standards

Applied Standards	Draft ETSI EN 301 489-1 V2.2.0 (2017-03) Draft ETSI EN 301 489-17 V3.2.0 (2017-03)
Test items	**Test Standards and Test Procedures**
Radiated and AC Conducted Emissions	European Standard EN 55032 Class B
EMS	ESD: EN 61000-4-2, RS: EN 61000-4-3
Note: All test items were verified and recorded according to the standards and without any deviation during the tests.	

3.3. Test Voltage/Frequencies

Power Supply Type	Voltage/Frequencies
AC Power Supply	230V / 50Hz

3.4. Test Distance and Frequency Range Investigated

Test Items	Frequency Range	Remark
Powerline Conducted Emissions	150 kHz to 30 MHz	-
Radiated Emissions (below 1GHz)	30 MHz to 1,000 MHz	Measurement distance is 10 m.
Radiated Emissions (above 1GHz)	1,000 MHz to 6,000 MHz	Measurement distance is 3 m.
Radio frequency electromagnetic field immunity	80 to 1,000 MHz	Measurement distance is 3 m.
	1,000 MHz to 6,000 MHz	Measurement distance is 1 m.

3.5. Operating Condition

- Full system.

4. Emissions Measurement

The EUT is which satisfies the Class B disturbance limits.

4.1. Conducted Emissions at Powerline

4.1.1. Limit

Limits for conducted disturbance at the mains ports of class A			
Frequency range MHz	**Coupling device**	**Detector type / bandwidth**	**Class A limits dB(μV)**
0,15 – 0,5	AMN	Quasi-peak / 9 kHz	79
0,50 – 30			73
0,15 – 0,5	AMN	Average / 9 kHz	66
0,50 – 30			60
Note 1: The lower limit shall apply at the transition frequency.			

Limits for conducted disturbance at the mains ports of class B			
Frequency range MHz	**Coupling device**	**Detector type / bandwidth**	**Class B limits dB(μV)**
0,15 – 0,5	AMN	Quasi-peak / 9 kHz	66 - 56
0,5 – 5			56
5 – 30			60
0,15 – 0,5	AMN	Average / 9 kHz	56 - 46
0,5 – 5			46
5 – 30			50
Note 1: The lower limit shall apply at the transition frequencies. Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.			

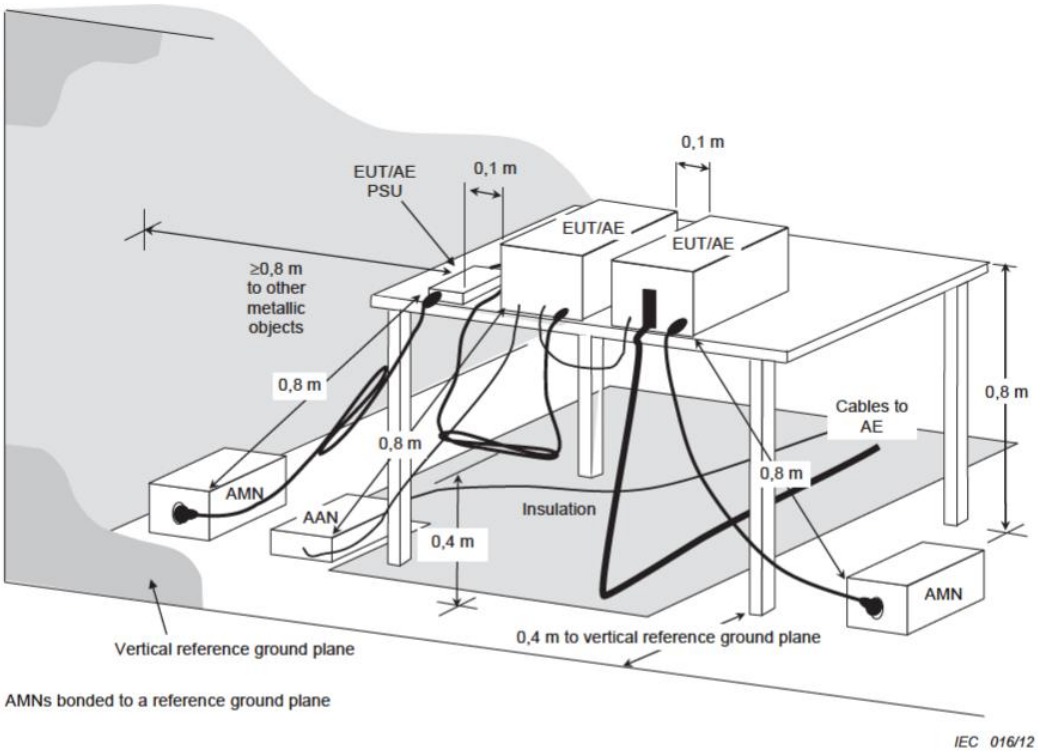
4.1.2. Test Procedures

a). The EUT was warmed up for 15 minutes before testing started.
b). The EUT was placed on a desk 0.8 meter height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meter from any other grounded conducting surface.
c). Connect EUT to the power mains through a line impedance stabilization network (LISN).
d). All the support units are connect to the other LISN.
e). The LISN provides 50 ohm, coupling impedance for the measuring instrument.
f). The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
g). Both sides of AC line were checked for maximum conducted interference.
h). The frequency range from 150 kHz to 30 MHz was searched.
i). Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
j). All emissions not reported here are more than 10 dB below the prescribed limit.

4.1.3. Measurement Results Calculation

The measurand Level is calculated using:
Corrected Reading (dBμV) = LISN Factor + Cable Loss + Read Level
For example at 0.3 MHz if the LISN Factor is 10.48 dB, the cable loss is 0.10 dB, the measured voltage is 36.39 dBμV, the signal strength would be calculated:
Corrected Reading (dBμV) = 10.48 dB + 0.10 dB + 36.39 dBμV = 46.97 dBμV

4.1.4. Typical Test Setup Layout

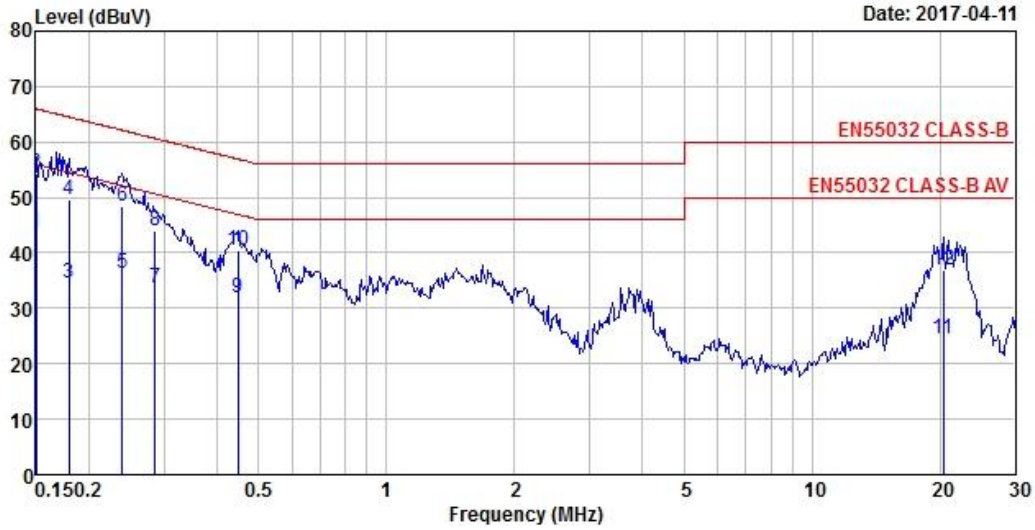


a). AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
b). EUT is connected to one artificial mains network (AMN).
c). All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
d). Rear of EUT to be flushed with rear of table top.
e). Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if this is an acceptable installation practice, shall be placed directly on the top of the controller.
f). If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to appropriate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long.
g). Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
h). Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.

4.1.5. Test Result

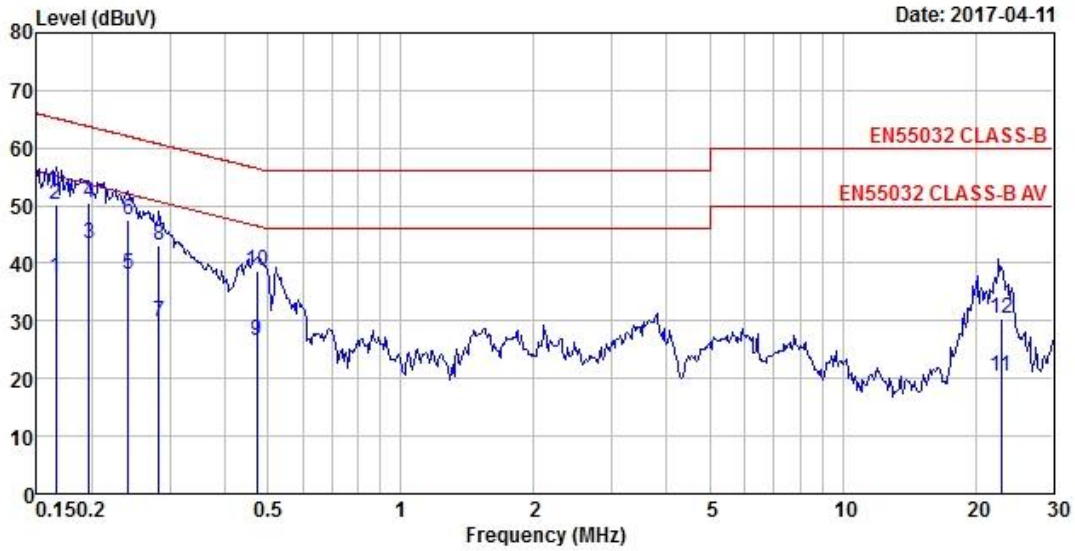
Test Mode	Mode 1		
Test Frequency	0.15 MHz ~ 30 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Line



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.15	43.63	-12.37	56.00	43.34	0.07	0.22	Average
2 MAX	0.15	54.22	-11.78	66.00	53.93	0.07	0.22	QP
3	0.18	34.63	-19.87	54.50	34.29	0.07	0.27	Average
4	0.18	49.52	-14.98	64.50	49.18	0.07	0.27	QP
5	0.24	36.43	-15.70	52.13	36.11	0.07	0.25	Average
6	0.24	48.36	-13.77	62.13	48.04	0.07	0.25	QP
7	0.29	33.72	-16.91	50.63	33.45	0.07	0.20	Average
8	0.29	44.11	-16.52	60.63	43.84	0.07	0.20	QP
9	0.45	31.84	-15.09	46.93	31.67	0.07	0.10	Average
10	0.45	40.53	-16.40	56.93	40.36	0.07	0.10	QP
11	20.38	24.45	-25.55	50.00	23.68	0.57	0.20	Average
12	20.38	36.99	-23.01	60.00	36.22	0.57	0.20	QP

Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	37.37	-17.79	55.16	37.09	0.03	0.25	Average
2	0.17	50.23	-14.93	65.16	49.95	0.03	0.25	QP
3 MAX	0.20	43.44	-10.32	53.76	43.11	0.03	0.30	Average
4	0.20	50.63	-13.13	63.76	50.30	0.03	0.30	QP
5	0.24	37.95	-14.09	52.04	37.68	0.03	0.24	Average
6	0.24	47.56	-14.48	62.04	47.29	0.03	0.24	QP
7	0.28	29.93	-20.79	50.72	29.70	0.03	0.20	Average
8	0.28	43.22	-17.50	60.72	42.99	0.03	0.20	QP
9	0.47	26.62	-19.87	46.49	26.49	0.03	0.10	Average
10	0.47	38.54	-17.95	56.49	38.41	0.03	0.10	QP
11	22.90	20.50	-29.50	50.00	19.88	0.42	0.20	Average
12	22.90	30.49	-29.51	60.00	29.87	0.42	0.20	QP

4.2. Conducted Emissions at wired network Ports

This EUT without wired network ports, it's not necessary to apply to wired network Port Conducted emission test.

4.3. Radiated Emission below 1GHz

4.3.1. Limit

radiated emissions at frequencies up to 1 GHz for Class A equipment			
Frequency range MHz	**Measurement**		**Class A limits dB(μV/m)**
	Distance (m)	**Detector type / bandwidth**	**OATS/SAC**
30 – 230	10	Quasi Peak / 120 kHz	40
230 – 1000			47

radiated emissions at frequencies up to 1 GHz for Class B equipment			
Frequency range MHz	**Measurement**		**Class B limits dB(μV/m)**
	Distance (m)	**Detector type / bandwidth**	**OATS/SAC**
30 – 230	10	Quasi Peak / 120 kHz	30
230 – 1000			37

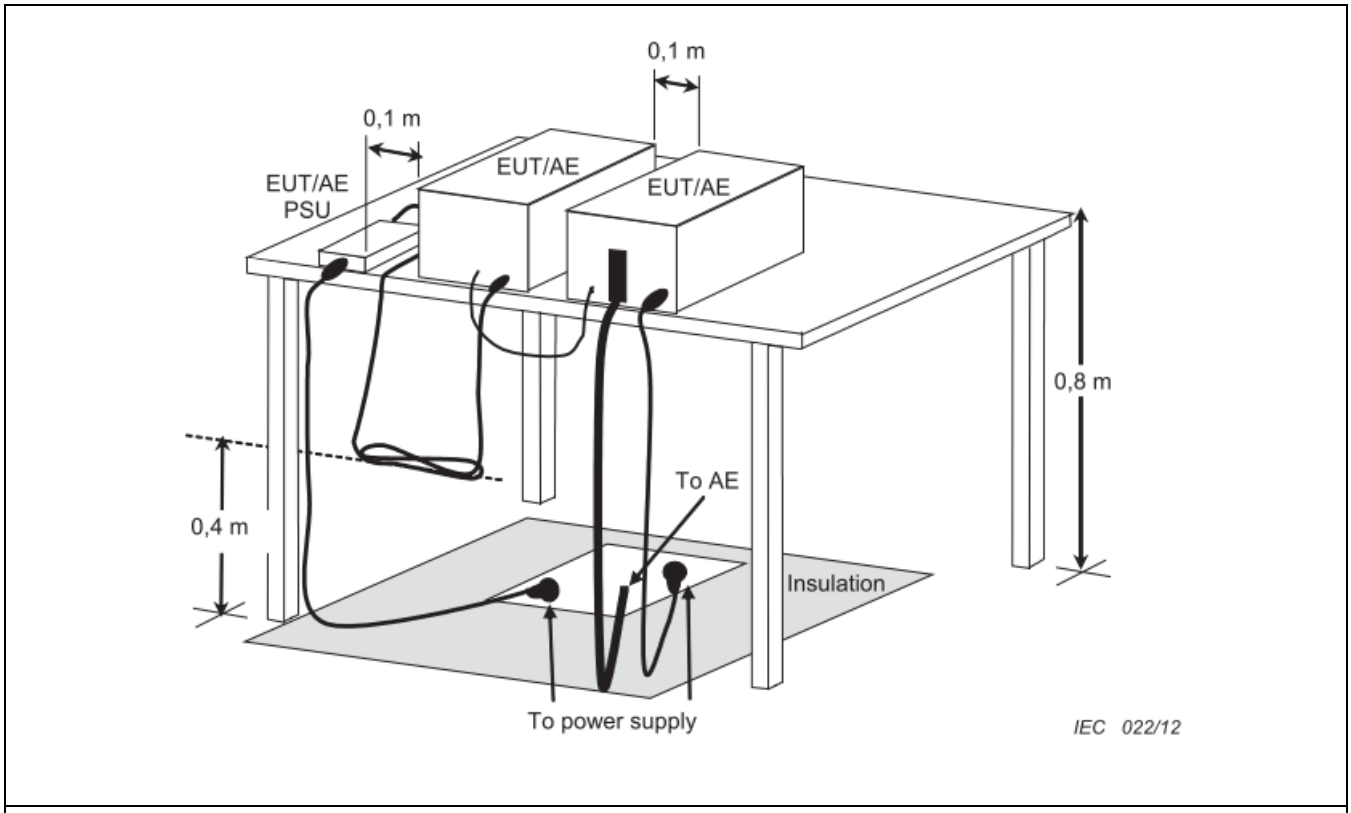
4.3.2. Test Procedures

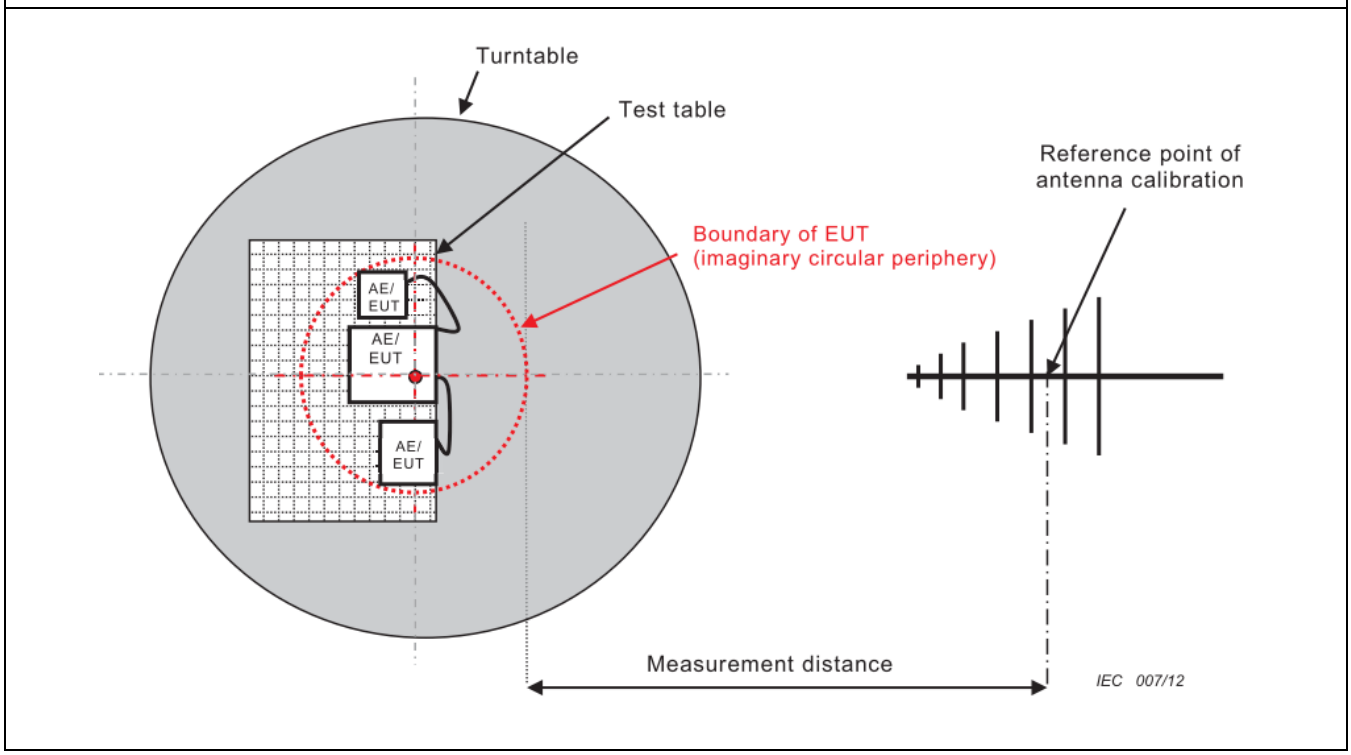
a). The EUT was placed on a rotatable table top 0.8 meter above ground.
b). The EUT was set 10 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
c). The table was rotated 360 degrees to determine the position of the highest radiation.
d). The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
e). For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
f). Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
g). If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
h). The central point of the EUT 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.

4.3.3. Measurement Results Calculation

The measurand Level is calculated using:
Corrected Reading (dBμV/m) = Antenna Factor + Cable Loss + Read Level – Preamp Factor
For example at 125 MHz if the Antenna Factor is 17.24 dB/m, the cable loss is 1.20 dB, the measured voltage is 35.80 dBμV and the Preamp Factor is 27.18 dB, the signal strength would be calculated:
Corrected Reading (dBμV/m) = 17.24 dB/m + 1.20 dB + 35.80 dBμV - 27.18 dB = 27.06 dBμV/m
Note: If a hybrid antenna is used, the antenna factor shell be the sum of the Antenna Factor + Attenuator Factor.

4.3.4. Typical Test Setup Layout

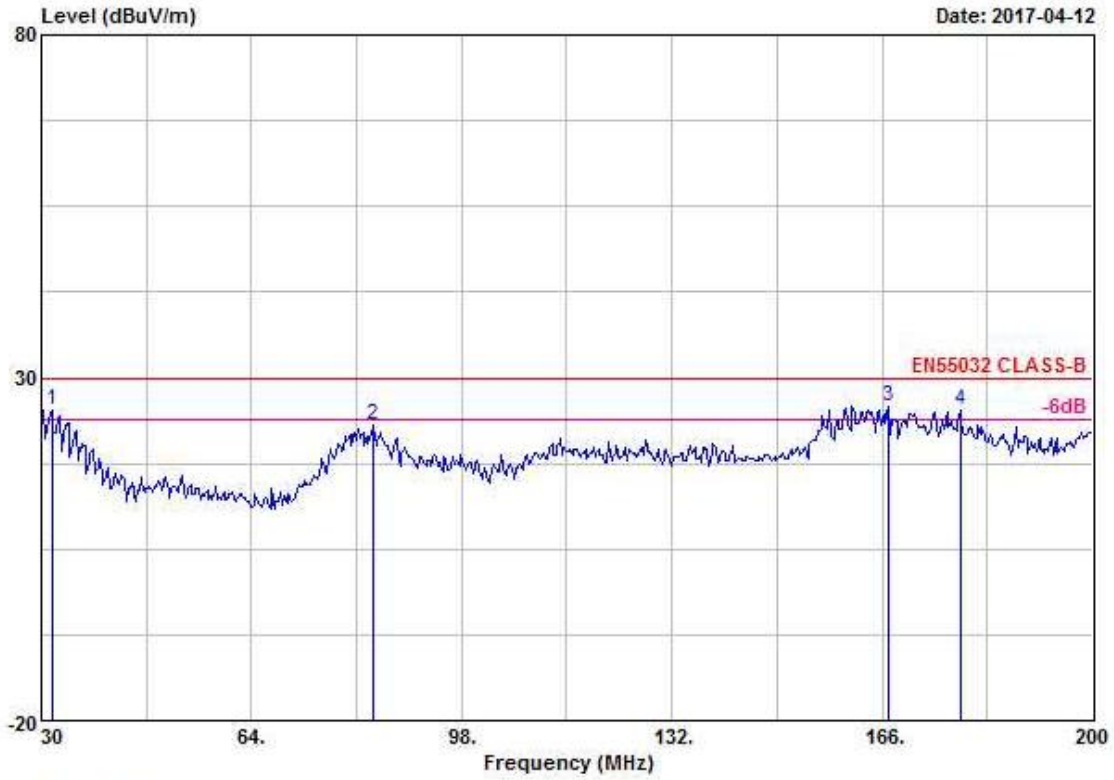




4.3.5. Test Result

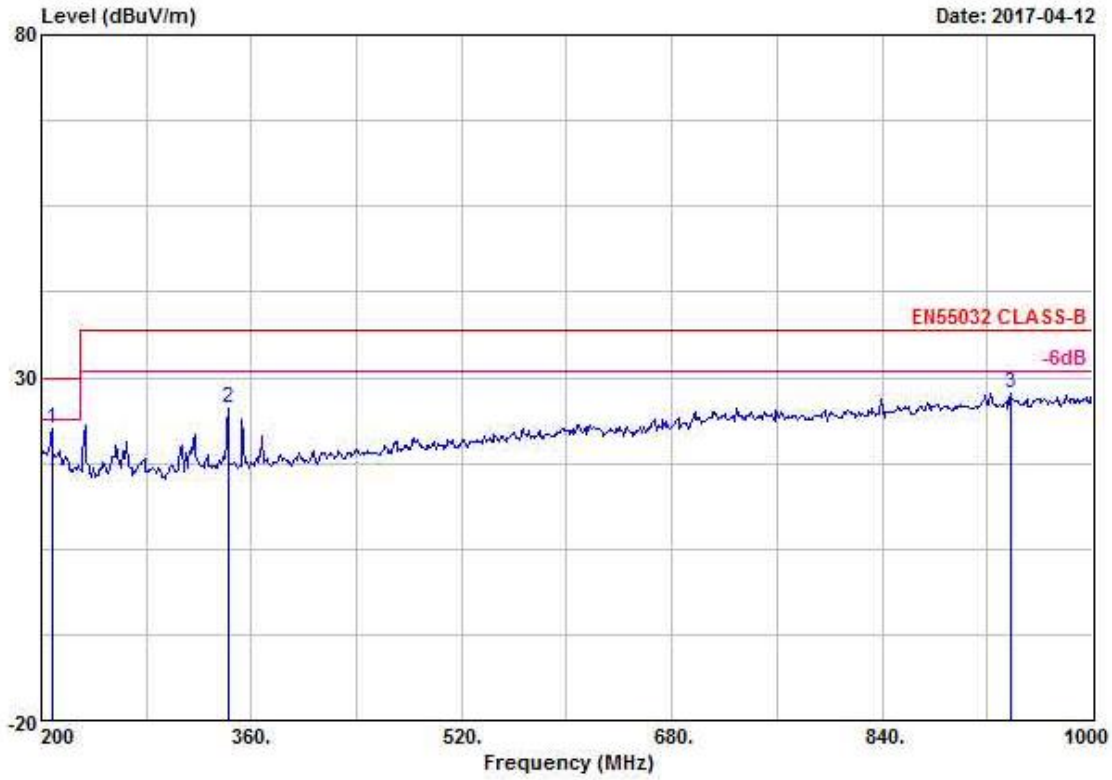
Test mode	Mode 1		
Test frequency	30 MHz ~ 1000 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



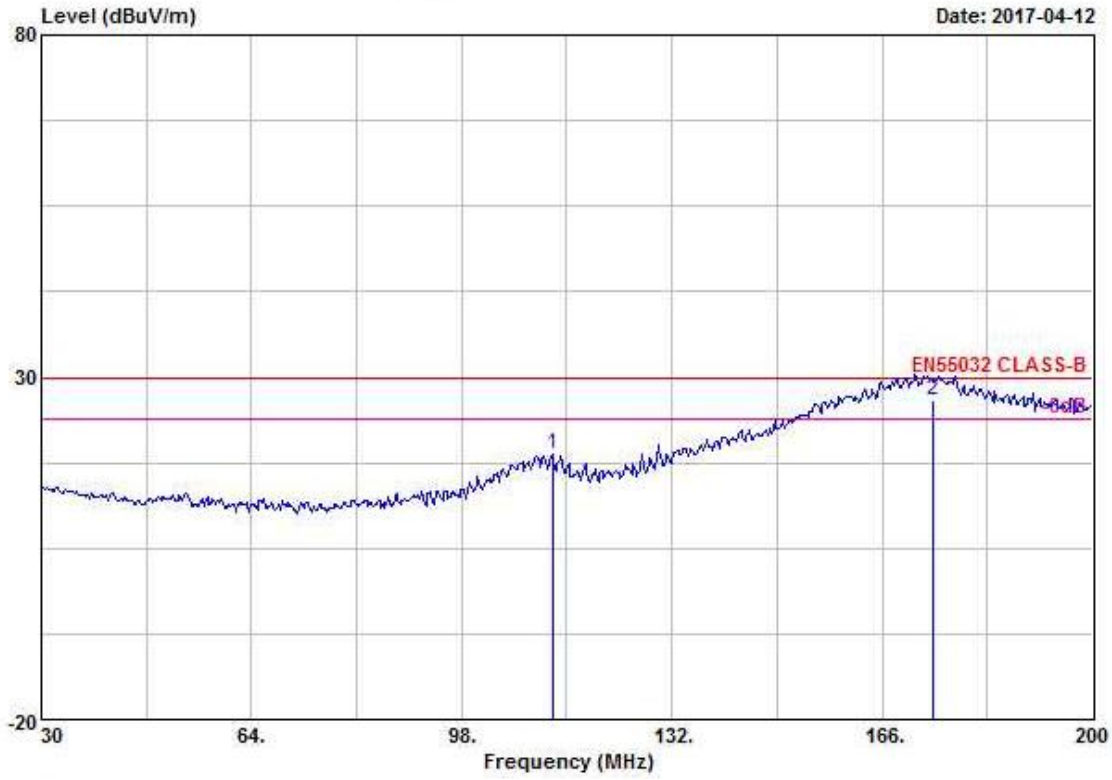
	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1 @	31.700	25.24	-4.76	30.00	39.24	28.27	1.59	12.68	Peak	---	---
2 @	83.550	23.11	-6.89	30.00	39.35	28.14	2.67	9.23	Peak	---	---
3 @	167.020	25.86	-4.14	30.00	37.32	27.78	3.78	12.54	Peak	---	---
4 @	178.580	25.33	-4.67	30.00	35.90	27.72	3.89	13.26	Peak	---	---

Vertical



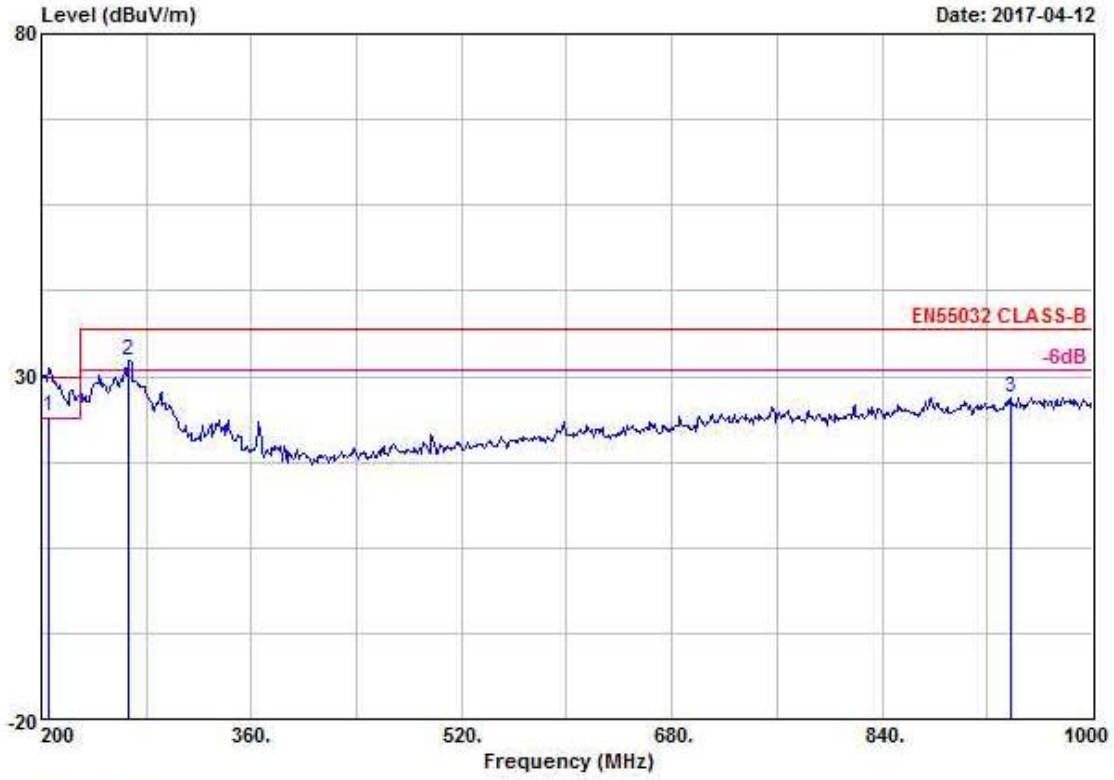
	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1 @	208.000	22.53	-7.47	30.00	31.44	27.66	3.14	15.61	Peak	---	---
2 @	342.400	25.50	-11.50	37.00	34.18	27.76	4.03	15.05	Peak	---	---
3 @	937.600	27.66	-9.34	37.00	26.27	27.64	7.19	21.84	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1 @	112.620	18.69	-11.31	30.00	33.20	28.03	3.12	10.40	Peak	---	---
2 @	174.150	26.55	-3.45	30.00	37.50	27.74	3.85	12.94	QP	400	165

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1 @	205.600	24.14	-5.86	30.00	32.89	27.67	3.12	15.80	QP	400	130
2 @	266.400	32.36	-4.64	37.00	43.80	27.53	3.61	12.48	Peak	---	---
3 @	937.600	26.79	-10.21	37.00	25.40	27.64	7.19	21.84	Peak	---	---

4.4. Radiated Emission above 1GHz

4.4.1. Limit

radiated emissions at frequencies above 1 GHz for Class A equipment			
Frequency range MHz	**Measurement**		**Class A limits dB(μV/m)**
	Distance (m)	**Detector type / bandwidth**	**SAC**
1000 – 3000	3	Average / 1 MHz	56
3000 – 6000			60
1000 – 3000		Peak / 1 MHz	76
3000 – 6000			80

radiated emissions at frequencies above 1 GHz for Class B equipment			
Frequency range MHz	**Measurement**		**Class B limits dB(μV/m)**
	Distance (m)	**SAC**	**dB(μV/m)**
1000 – 3000	3	Average / 1 MHz	50
3000 – 6000			54
1000 – 3000		Peak / 1 MHz	70
3000 – 6000			74

Required highest frequency for radiated measurement	
Highest internal frequency (F_x)	**Highest measured frequency**
$F_x \leq 108$ MHz	1 GHz
108 MHz < $F_x \leq 500$ MHz	2 GHz
500 MHz < $F_x \leq 1$ GHz	5 GHz
$F_x > 1$ GHz	5 x F_x up to a maximum of 6 GHz

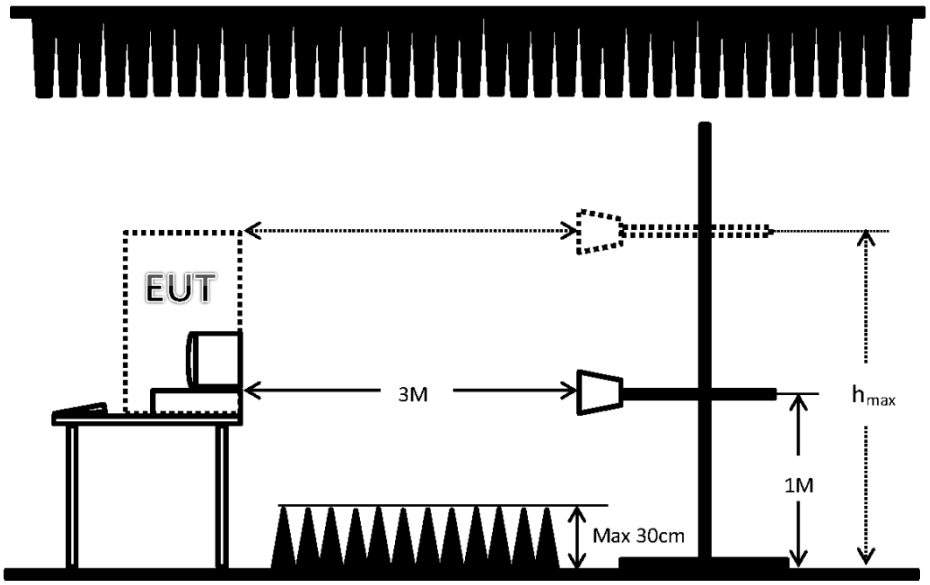
4.4.2. Test Procedures

a). Same test set up as below 1GHz radiated testing.
b). The EUT was set 3 meter from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
c). There should be absorber placed between the EUT and Antenna and its located size should let the test site meet CISPR16-1-4 requirement.
d). The table was rotated 360 degrees to determine the position of the highest radiation.
e). The measured using a test-receiver system with both a peak and CISPR average detector.
f). Set the DRG Horn Antenna at 1M height, then run the turn table to get the maximum noise reading from Horizontal and Vertical polarity separately.t the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
g). When EUT locating on the turn-table, and its height is over 172cm (Antenna's 3dB beam width of 6GHz is 27∘), the DRG Horn Antenna must be raised up and descended down, then turning around the turn-table to get the maximum noise reading of the Horizontal and Vertical polarity separately. Note the maximum raise up height is same as the top of EUT.
h). If emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
i). The central point of the EUT 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.

4.4.3. Measurement Results Calculation

The measurand Level is calculated using:
Corrected Reading (dBμV/m) = Antenna Factor + Cable Loss + Read Level – Preamp Factor
For example at 1980 MHz if the Antenna Factor is 26.19 dB/m, the cable loss is 4.08 dB, the measured voltage is 51.30 dBμV and the Preamp Factor is 33.34 dB, the signal strength would be calculated:
Corrected Reading (dBμV/m) = 26.19 dB/m + 4.08 dB + 51.30 dBμV - 33.34 dB = 48.23 dBμV/m

4.4.4. Typical Test Setup Layout

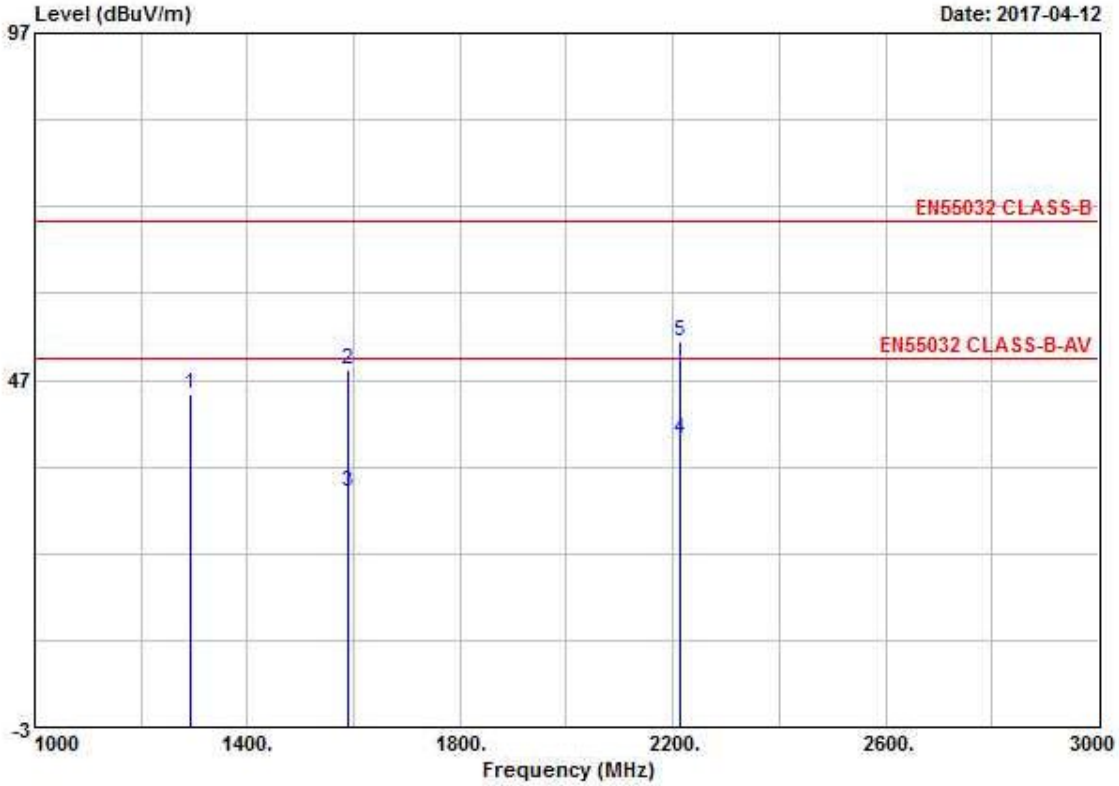


Remark: When EUT's height is over 172cm, h_{max} = top of EUT

4.4.5. Test Result

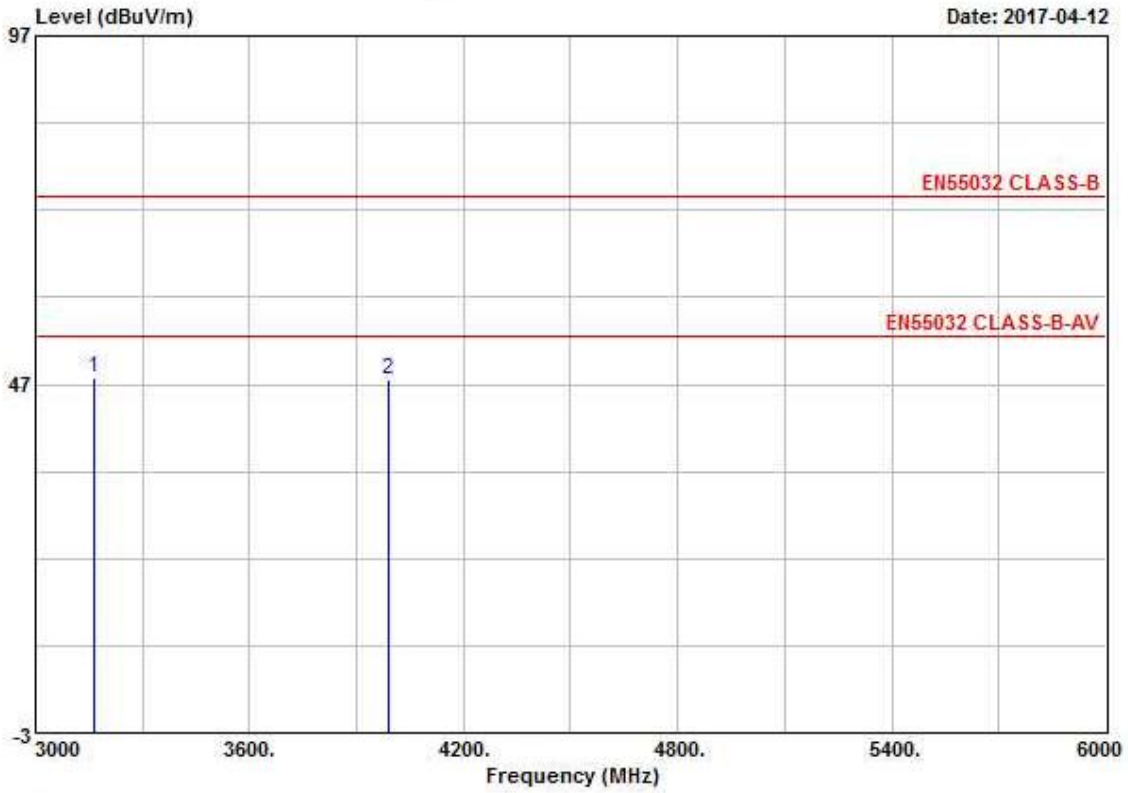
Test mode	Mode 1		
Test frequency	1 GHz ~ 6 GHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



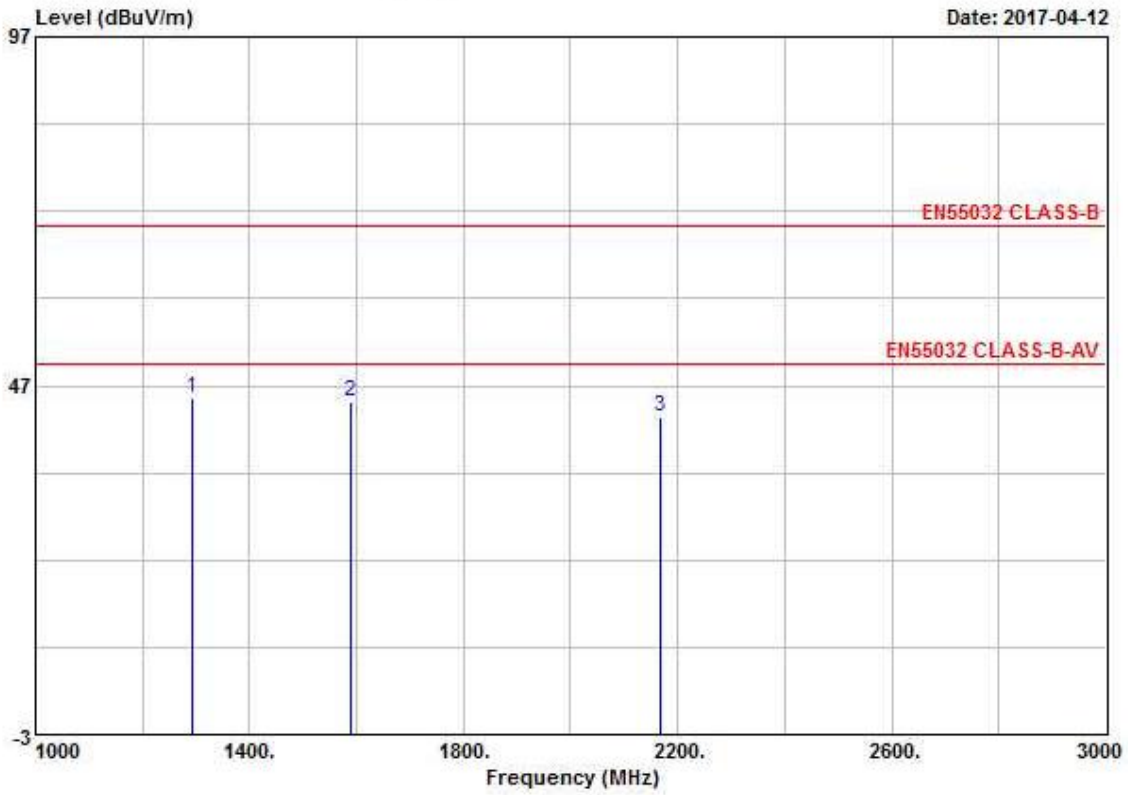
	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1	1292.000	44.96	-25.04	70.00	48.81	33.72	5.25	24.62	Peak	---	---
2	1588.000	48.43	-21.57	70.00	50.27	33.40	5.90	25.66	Peak	100	10
3 @	1588.000	30.96	-19.04	50.00	32.80	33.40	5.90	25.66	Average	100	10
4 @	2212.000	38.37	-11.63	50.00	36.69	33.42	7.10	28.00	Average	100	80
5 @	2212.000	52.66	-17.34	70.00	50.98	33.42	7.10	28.00	Peak	100	80

Vertical



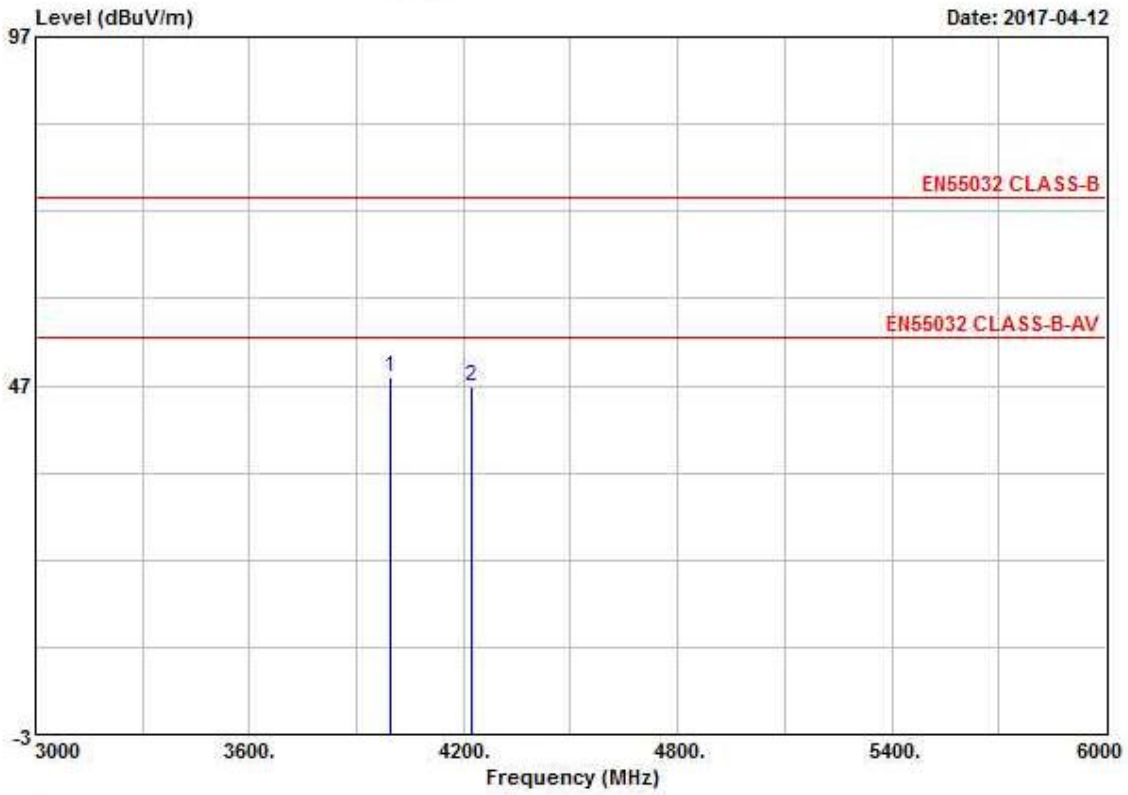
	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1	3162.000	47.85	-26.15	74.00	41.99	33.82	8.63	31.05	Peak	---	---
2	3990.000	47.67	-26.33	74.00	37.88	33.81	9.90	33.70	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1	1292.000	45.21	-24.79	70.00	49.06	33.72	5.25	24.62	Peak	---	---
2	1590.000	44.70	-25.30	70.00	46.50	33.40	5.94	25.66	Peak	---	---
3	2166.000	42.47	-27.53	70.00	40.92	33.40	7.04	27.91	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Preamp Factor	Cable Loss	Antenna Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB/m		cm	deg
1	3993.000	48.29	-25.71	74.00	38.50	33.81	9.90	33.70	Peak	---	---
2	4221.000	46.77	-27.23	74.00	37.10	33.82	10.18	33.31	Peak	---	---

4.5. Harmonic Current Emissions Measurement

It was supplied power by host system for EUT. Harmonics tests are not applicable for this EUT.

4.6. Voltage Fluctuations and Flicker Measurement

It was supplied power by host system for EUT. Voltage Fluctuations and Flicker Measurement tests are not applicable for this EUT.

5. Performance Criteria of EUT

Applicable Standard: EN 301 489-1	
CT / CR	**Performance criteria for continuous phenomena applied to transmitters and receivers** During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.
TT / TR	**Performance criteria for transient phenomena applied to transmitters and receivers** After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.

Applicable Standard: EN 301 489-17		
Criteria	**During test**	**After test**
A	Shall operate as intended. (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 2). Shall be no unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3).
NOTE 1:	Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
NOTE 2:	Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
NOTE 3:	No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	

6. Immunity Measurement

6.1. Electrostatic Discharge (ESD)

6.1.1. Test Specification

Reference Standard	EN 61000-4-2
Discharge Impedance	330 Ω / 150 pF
Polarity	Positive and negative
Single Discharge Mode	1 discharge per 1s

6.1.2. Test Levels

Contact discharge		Air Discharge	
Level	**Test Voltage** kV	**Level**	**Test Voltage** kV
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
x	Specified	x	Specified
Remark : “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.			

6.1.3. Performance Criteria

Test Discharge	Discharge Test Voltage (kV)	Performance Criteria
Contact Discharges	± 2 / ± 4	TT, TR
Air Discharge	± 2 / ± 4 / ± 8	TT, TR

6.1.4. Test Procedure

a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
   - ambient temperature: 15 °C to 35 °C;
   - relative humidity : 30 % to 60 %;
   - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.

c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.

d. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.

e. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

f. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
   - If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
   - Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
   - The contact discharge test shall not be applied to such surfaces.

g. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

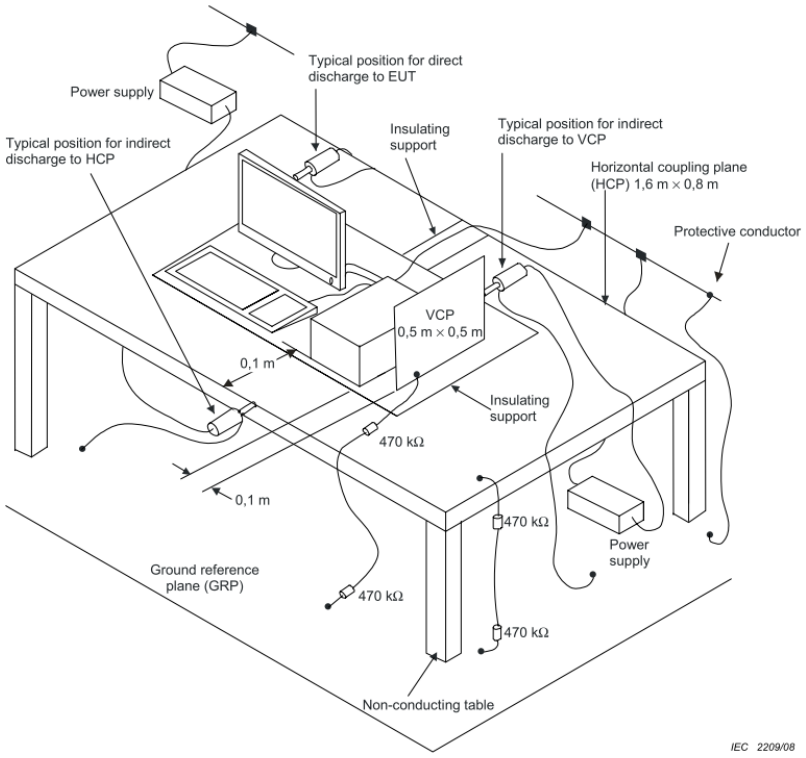
6.1.5. Test Setup for Tests Performed in Laboratory

A ground reference plane was provided on the floor of the test site. It was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. In the SPORTON EMC LAB., we provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system.

The EUT was arranged and connected according to its functional requirements. A distance of 1 m minimum was provided between the EUT and the wall of the Lab., and any other metallic structure. In cases where this length exceeds the length necessary to apply the discharges to the selected points, the excess length shall, where possible, be placed non-inductively off the ground reference plane and shall not come closer than 0.2 m to other conductive parts in the test setup.

Where the EUT is installed on a metal table, the table was connected to the reference plane via a cable with a 470k ohm resister located at each end, to prevent a build-up of charge. The test setup was consist a wooden table, 0.8 m high, standing on the ground reference plane. A HCP, 1.6 m x 0.8 m, was placed on the table. The EUT and cables was isolated from the HCP by an insulating support 0.5 mm thick. The VCP size, 0.5 m x 0.5 m.

6.1.6. Test Setup



The test setup consists of the test generator, EUT and auxiliary instrumentation necessary to perform DIRECT and INDIRECT application of discharges to the EUT as applicable, in the follow manner:

a). CONTACT DISCHARGE to the conductive surfaces and to coupling plane;

b). AIR DISCHARGE at insulating surfaces.

The preferred test method is that of type tests performed in laboratories and the only accepted method of demonstrating conformance with this standard. The EUT was arranged as closely as possible to arrangement in final installed conditions.

6.1.7. Test Result

Test mode	Mode 1		
Applicable Standard	Draft ETSI EN 301 489-1 V2.2.0 (2017-03), Draft ETSI EN 301 489-17 V3.2.0 (2017-03)	**Final Test Result**	***PASS***
Contact discharge	2, 4 kV		
Air discharge	2, 4, 8 kV		
Performance Criteria	TT, TR		

Test Result - Air Discharge/Round Tip

In the Air Discharge tested the EUT has no on slots, apertures, or insulating surfaces. So, the air discharge test is not applicable.

Test Result - Contact Discharge/Pointed Tip

No Direct discharge

Indirect discharge to HCP and VCP

Test Point	No. of Disch.	Test Result (Criteria)				Remark
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	**Note [1]**
HCP (At Left)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
HCP (At Right)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
HCP (At Rear)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
VCP (At Front)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
VCP (At Left)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
VCP (At Right)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
VCP (At Rear)	10	CT,CR	CT,CR	**TT, TR**	**TT, TR**	
Note [1]	When testing the contact discharge at ±4 kV on EUT, the function is self-recoverable.					

6.2. Radio Frequency Electromagnetic Field (RS)

6.2.1. Test Specification

Reference Standard	EN 61000-4-3
Dwell Time	2.9 seconds
Frequency Step size	1 % of the preceding frequency value
Antenna Polarity	Vertical and Horizontal

6.2.2. Test Levels

Level	**Test field strength** V/m
1	1
2	3
3	10
4	30
x	Specified
Remark : “x” is an open test level and the associated field strength may be any value. This level may be given in the product standard.	

6.2.3. Performance Criteria

Frequency Range	**Test Field Strength (V/m)**	**Performance Criteria**
80 MHz to 6000 MHz	3	CT, CR
Exclusion Bands	draft ETSI EN 301 489-17 V3.2.0 (2017-03): The exclusion band for immunity testing of equipment operating in the 2,4 GHz band shall be: • lower limit of exclusion band = lowest allocated band edge frequency -120 MHz, i.e. 2280 MHz; • upper limit of exclusion band = highest allocated band edge frequency +120 MHz, i.e. 2603,5MHz. The exclusion band for immunity testing of equipment operating in the 5 GHz Wi-Fi band shall be: • lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4880 MHz; • upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5995 MHz. The exclusion band for immunity testing of equipment operating in the 5,8 GHz band shall be: • lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 5455 MHz; • as the immunity requirements have an upper frequency range of 6 GHz and any upper edge exclusion band would be greater than this for the 5,8 GHz band. The above frequency shall also be regarded as the upper end of the test range.	

6.2.4. Test Procedure

a). The equipment to be tested is placed in the center of the enclosure on a wooden table. The equipment is then connected to power and signal leads according to pertinent installation instructions.

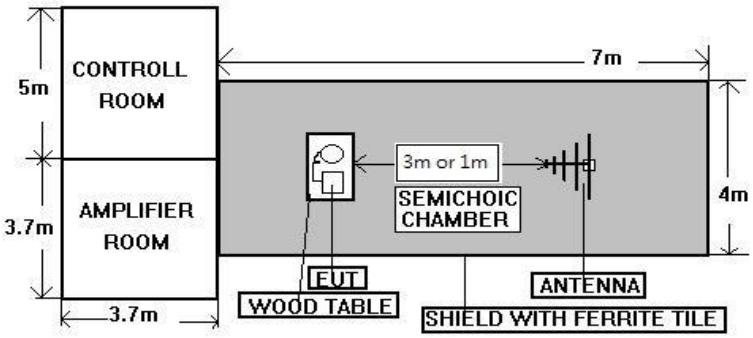
b). The bilog antenna which is enabling the complete frequency range of 80 to 6,000 MHz is placed 3m or 1m away from the equipment. The required field strength is determined by placing the field strength meter(s) on top of or directly alongside the equipment under test and monitoring the field strength meter via a remote field strength indicator outside the enclosure while adjusting the continuous-wave to the applicable antennae.

c). The test is normally performed with the generating antenna facing each of four sides of the EUT. The polarization of the field generated by the broadband (bilog) antenna necessitates testing each position twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.

d). The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.

e). At each of the above conditions, the frequency range is swept 1000 to 6,000 MHz, pausing to adjust the R.F. signal level or to switch oscillators and antenna. The rate of sweep is in the order of $1.5*10^{-3}$ decades/s. The sensitive frequencies or frequencies of dominant interest may be discretely analyzed.

6.2.5. Test Setup



NOTE : The SPORTON 7m x 4m x 4m semi-anechoic chamber is compliance with the sixteen point's uniform field requirement as stated in IEC 61000-4-3 Section 6.2.

The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

6.2.6. Test Result

Test mode	Mode 1		
Applicable Standard	Draft ETSI EN 301 489-1 V2.2.0 (2017-03), Draft ETSI EN 301 489-17 V3.2.0 (2017-03)	**Final Test Result**	***PASS***
Frequency Range	80 to 6,000 MHz		
Electromagnetic field	3 V/m (unmodulated, r.m.s)		
Amplitude modulated	80% AM (1 kHz)		
Performance Criteria	CT, CR		

Frequency Range MHz	**Test field strength** V/m	**Antenna Polarization**	**Azimuth** Degree	**Test Result (Criteria)**	**Remark**
80~1,000	3	V&H	0, 90, 180, 270	CT, CR	-
1,000~6,000	3	V&H	0, 90, 180, 270	CT, CR	-

6.3. Electrical Fast Transient/Burst (EFT)

It was supplied power by host system for EUT; It's not necessary to apply to EFT test.

6.4. Surges

It was supplied power by host system for EUT; It's not necessary to apply to Surge test.

6.5. Conducted Disturbances Induced by Radio-Frequency Field (CS)

It was supplied power by host system for EUT; It's not necessary to apply to CS test.

6.6. Voltage Dips and Voltage Interruptions (DIP)

It was supplied power by host system for EUT; It's not necessary to apply to DIP test.

7. Uncertainty of Test Site

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

7.1. Emission Test Measurement Uncertainty

Test Items	Test Site No.	U_{LAB}	U_{CISPR}
Conducted Emissions	CO04-HY	± 2.2 dB	3.4 dB
Radiated Emissions below 1GHz	10CH02-HY	± 2.8 dB	6.3 dB
Radiated Emissions above 1GHz	10CH02-HY	± 3.5 dB	5.2 dB

7.2. Immunity Test Measurement Uncertainty

- **ESD Immunity (IEC 61000-4-2)**

Negative Discharge Current

From Standard			
2kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	7.5	4	2
Min	6.75	2.8	1.4
Max	8.25	5.2	2.6
Tolerance in %	10%	30%	30%

From calibration certificate					
Measured First Peak Current	1st Peak Worst case. **+5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **-5%**
7.48	7.85	4.2	4.41	2.01	2.11
	6.75		2.8		1.4
	8.25		5.2		2.6

4kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	15	8	4
Min	13.5	5.6	2.8
Max	16.5	10.4	5.2
Tolerance in %	10%	30%	30%

First Peak Current	1st Peak Worst case. **+5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **+5%**
15.12	15.88	8.03	8.43	3.68	3.86
	13.5		5.6		2.8
	16.5		10.4		5.2

6kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	22.5	12	6
Min	20.25	8.4	4.2
Max	24.75	15.6	7.8
Tolerance in %	10%	30%	30%

First Peak Current	1st Peak Worst case. **-5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **+5%**
22.78	23.92	12.37	12.99	5.45	5.72
	20.25		8.4		4.2
	24.75		15.6		7.8

Negative Discharge Current

From Standard				From calibration Certificate					
8kV	First Peak Current	Current at 30ns	Current at 60ns	First Peak Current	1st Peak Worst case. +5%	Measured Current at 30ns	30ns Worst case. +5%	Measured Current at 60ns	60ns Worst case. +5%
Nominal	30	16	8	30.26	31.77	16.13	16.94	7.39	7.76
Min	27	11.2	5.6		27		11.2		5.6
Max	33	20.8	10.4		33		20.8		10.4
Tolerance in %	10%	30%	30%						

Negative Discharge Voltage

Standard Parameters				Measured Values
Indicated Voltage.	Tolerance.	Max.	Min.	
kV	%	kV	kV	kV
2	10	2.20	1.80	2.05
4	10	4.40	3.60	4.027
6	10	6.60	5.40	5.955
8	10	8.80	7.20	7.916
15	10	16.50	13.50	14.839

Negative Rise Time

Standard Parameters	
T max.	1ns
T min	0.7ns

Measured Values			
Indicated Voltage.	Measured Rise Time.	Worst Case max. +6%	Worst Case min. -6%
2kV	0.851	0.902	0.799
4kV	0.780	0.827	0.733
6kV	0.750	0.795	0.705
8kV	0.772	0.818	0.726

It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95% confidence.

● RF Radiated Immunity (IEC 61000-4-3)

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$u_i(y)$
F_{SM}	Felds Strength monitor	1.5	Normal 2	2.000	0.75
FS_{AW}	Field Strength acceptability window	0.50	Rectangular	1.732	0.29
PAH	Power Amplifier Harmonics	0.50	Rectangular	1.732	0.29
R_S	Measurement System Repeatability	0.50	normal 1	1.000	0.50
R_{EUT}	Repeatability of EUT	0.00	normal 1	1.000	0.00
$u_c(F_S)$	Combined Standard Uncertainty	-	normal	-	0.83
$U(F_S)$	**Expanded Uncertainty**	-	**normal k= 2**		**1.66**

Specified Level (V/m)	Test level (V/m)
For 1 Volts	1.25
For 3 Volts	3.33
For 10 Volts	11.22

For 1,000 MHz to 6,000 MHz:
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)) 1.96

It has been demonstrated that the RF Radiated generator meets the specified requirements in the standard with at least a 95% confidence.

8. List of Measuring Equipment Used

Conducted Emission - Test Date: Apr. 11, 2017

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESR3	102051	9KHz ~ 3.6GHz	Apr. 19, 2016	Conduction (CO04-HY)
LISN	SCHWARZBECK MESS-ELEKTRONIK	NSLK 8127	8127-477	9kHz ~ 30MHz	Feb. 14, 2017	Conduction (CO04-HY)
RF Cable-CON	HUBER+SUHNER	RG213/U	07611832020001	9kHz ~ 30MHz	Oct. 24, 2016	Conduction (CO04-HY)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

Radiated Emission below 1GHz - Test Date: Apr. 12, 2017

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
10m Semi Anechoic Chamber	TDK	SAC-10M	10CH02-HY	30 MHz ~ 1 GHz 10m,3m	Sep. 24, 2016	Radiation (10CH02-HY)
Amplifier	AGILENT	8447D	2944A10828	100 KHz ~ 1.3 GHz	Feb. 16, 2017	Radiation (10CH02-HY)
Amplifier	AGILENT	8447D	2944A10827	100 KHz ~ 1.3 GHz	Jan. 24, 2017	Radiation (10CH02-HY)
Receiver	R&S	ESI	838496/008	20 Hz ~ 7 GHz	Sep. 01, 2016	Radiation (10CH02-HY)
Spectrum Analyzer	R&S	FSP7	100645	9 KHz ~ 7 GHz	Apr. 25, 2016	Radiation (10CH02-HY)
Biconical Antenna	Schwarzbeck	VHBB 9124	287	30 MHz ~ 200 MHz	Aug. 01, 2016	Radiation (10CH02-HY)
Log Antenna	Schwarzbeck	VUSLP 9111	207	200 MHz ~ 1 GHz	Aug. 01, 2016	Radiation (10CH02-HY)
Turn Table	EM Electronics	EM 1000	060546	0 -360 degree	NCR	Radiation (10CH02-HY)
Antenna Mast	HD	MA240	240/664	1 m - 4 m	NCR	Radiation (10CH02-HY)
Antenna Mast	HD	MA240	240/667	1 m - 4 m	NCR	Radiation (10CH02-HY)
RF Cable-R10m	Jye Bao	RG142	CB027-INSIDE	30 MHz ~ 1 GHz	Dec. 30, 2016	Radiation (10CH02-HY)
RF Cable-R10m	MTJ	RG223/U + RG8/U	CB026-DOOR	30 MHz ~ 1 GHz	Dec. 30, 2016	Radiation (10CH02-HY)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

Radiated Emission above 1GHz - Test Date: Apr. 12, 2017

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Amplifier	AGILENT	8449B	3008A02364	1~8 GHz	Nov. 17, 2016	Radiation (10CH02-HY)
Horn Antenna	ETS	3115	6744	1 ~ 18 GHz	Nov. 28, 2016	Radiation (10CH02-HY)
Receiver	R&S	ESI	838496/008	20 Hz ~ 7 GHz	Sep. 01, 2016	Radiation (10CH02-HY)
RF Cable 5M	MTJ	SUCOFLEX 104	304379/4	1 GHz ~ 18 GHz	Mar. 03, 2017	Radiation (10CH02-HY)
RF Cable 13M	MTJ	SUCOFLEX 104	16647/4	1 GHz ~ 18 GHz	Mar. 03, 2017	Radiation (10CH02-HY)
Turn Table	EM Electronics	EM 1000	060546	0 -360 degree	NCR	Radiation (10CH02-HY)
Antenna Mast	HD	MA240	240/667	1 m - 4 m	NCR	Radiation (10CH02-HY)
10m Semi Anechoic Chamber	TDK	SAC-10M	10CH02-HY	1 GHz ~ 6 GHz 3m	Apr. 01,2017	Radiation (10CH02-HY)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

EMS - Test Date: Apr. 10, 2012

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	KEYTEK	MZ-15/EC	0302234	Air: 0 ~ 15 kV Contact: 0 ~ 8 kV	Aug. 26, 2011	ESD
Probe	ETS-LINDGREN	HI-6005	00052473	0.1MHz ~ 5GHz	Sep. 02, 2011	RS
Amplifier	AR	250W 1000AM1	320482	80MHz ~ 1GHz	Oct. 12, 2011	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC7144A	312782	80 ~ 1GHz	Oct. 12, 2011	RS
INTEGRATED MEASUREMENT SYSTEM	ROHDE& SCHWARZ	IMS	100007	9kHz ~ 3GHz	Mar. 15, 2012	RS
NRP-Z91 POWER SENSOR 6GHZ	ROHDE& SCHWARZ	NRP-Z91 1168.8004.02	100095	9kHz ~ 3GHz	Mar. 15, 2012	RS
Antenna	FRANKONIA	BTA-L	02002L	26MHz ~ 1GHz	May 03, 2011	RS

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

RS Frequency Range 1,000 MHz ~6,000 MHz - Test Date: May 07, 2017

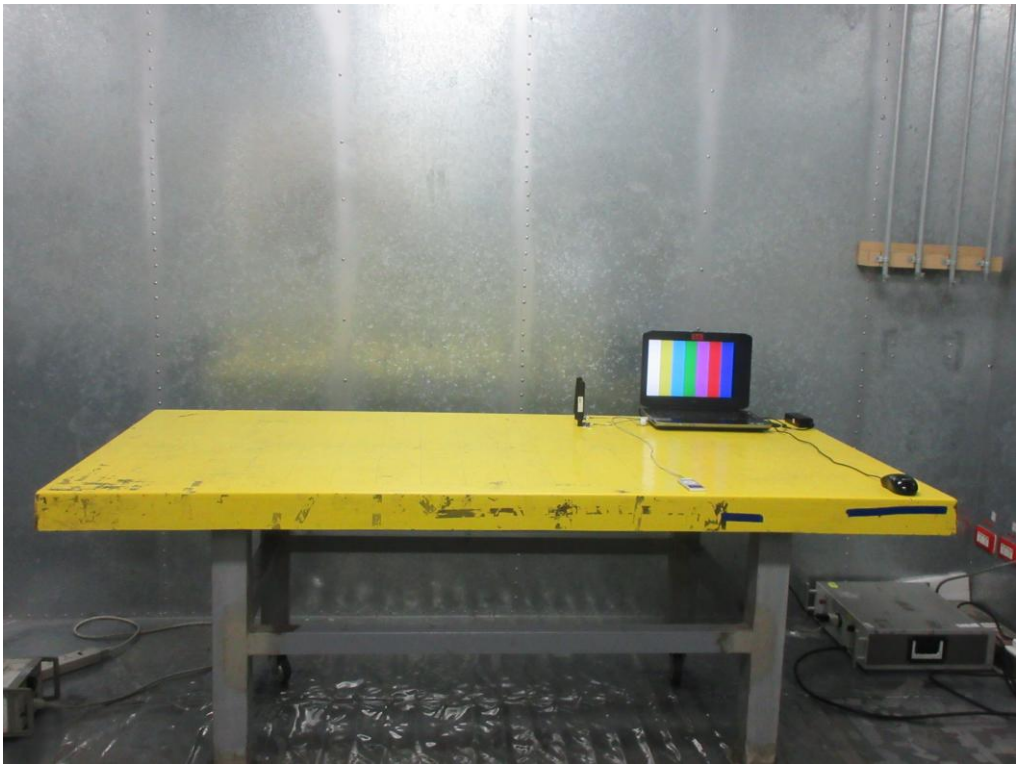
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Signal Generator	R & S	SMB100A	103294HA	9kHz ~ 6GHz	Oct. 19, 2016	RS
Power Sensor	R & S	NRP-Z91	101094-UL	9kHz ~ 6GHz	Oct. 14, 2016	RS
Power Sensor	R & S	NRP-Z91	101095-KY	9kHz ~ 6GHz	Oct. 14, 2016	RS
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	0.8GHz ~ 1GHz	NCR	RS
Power Amplifier	BONN	BLMA 1060-100D	107972B	1GHz ~ 6GHz	NCR	RS
Antenna	R & S	HL046E	100076-Cd	0.8GHz ~ 3GHz	NCR	RS
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	0.7GHz ~ 10.5GHz	NCR	RS

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

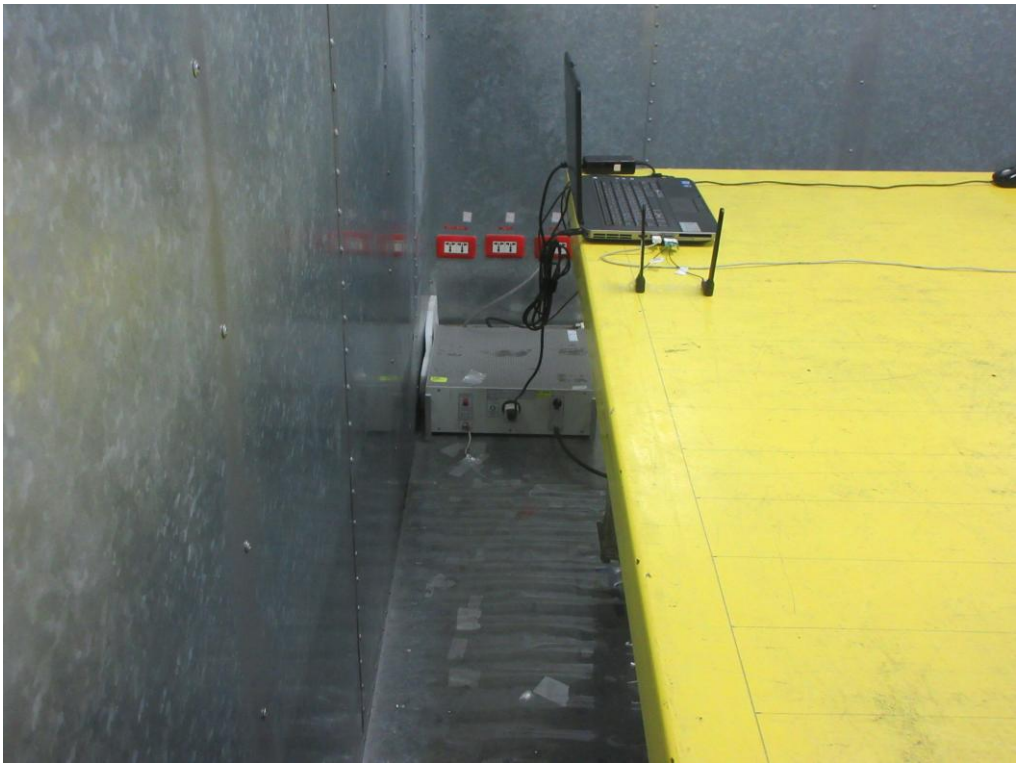
Appendix A. Test Photos

1. Photographs of Conducted Emissions Test Configuration

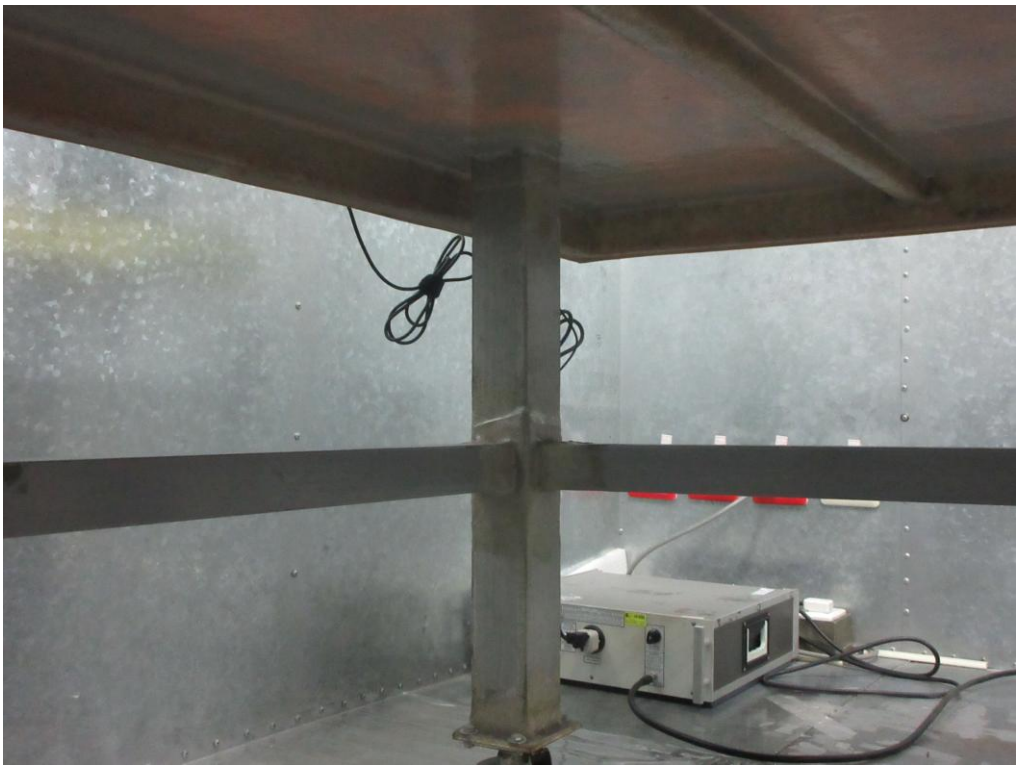
Front view



Rear view



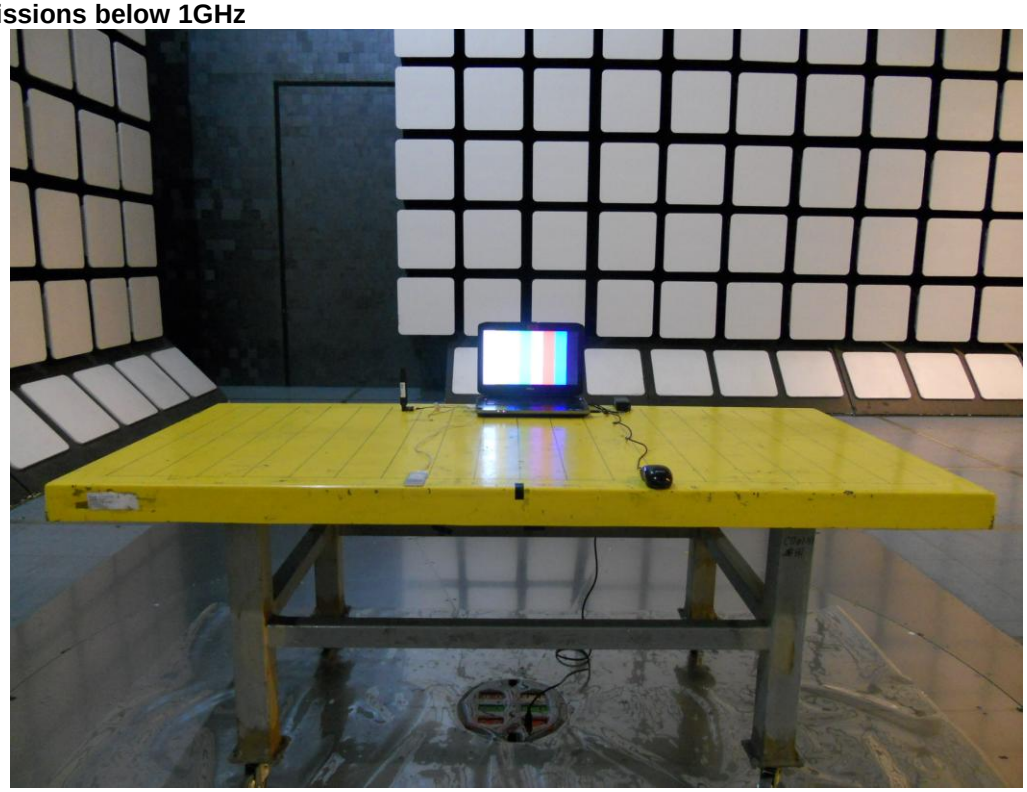
Side view



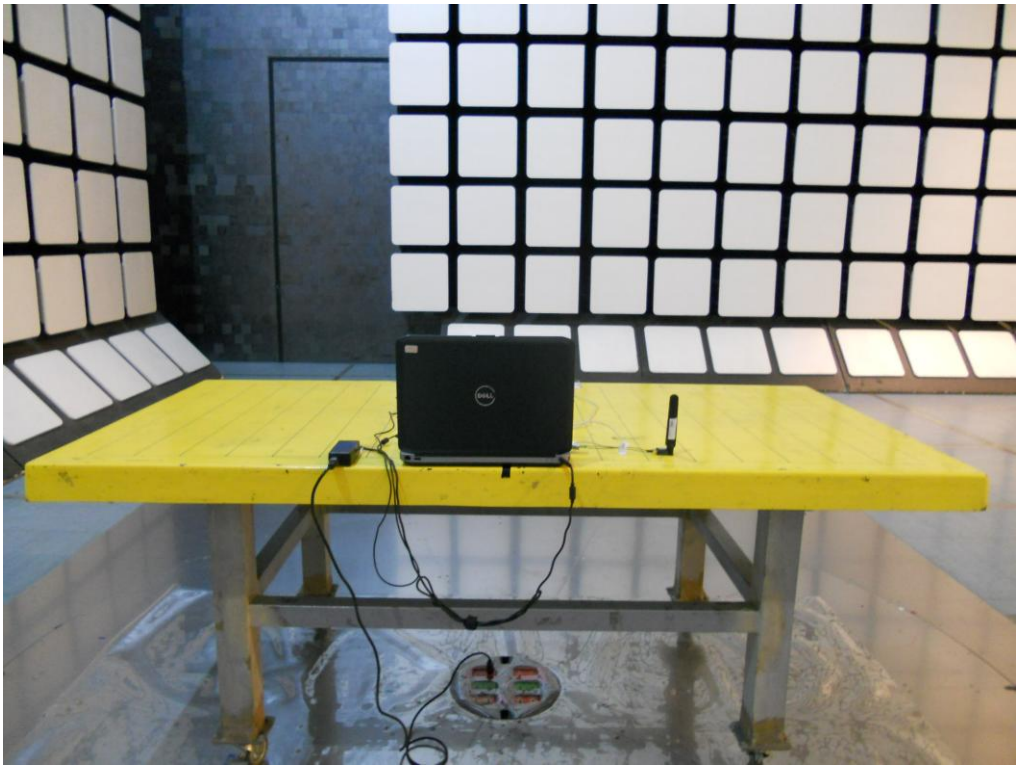
2. Photographs of Radiated Emissions Test Configuration

For radiated emissions below 1GHz

Front view

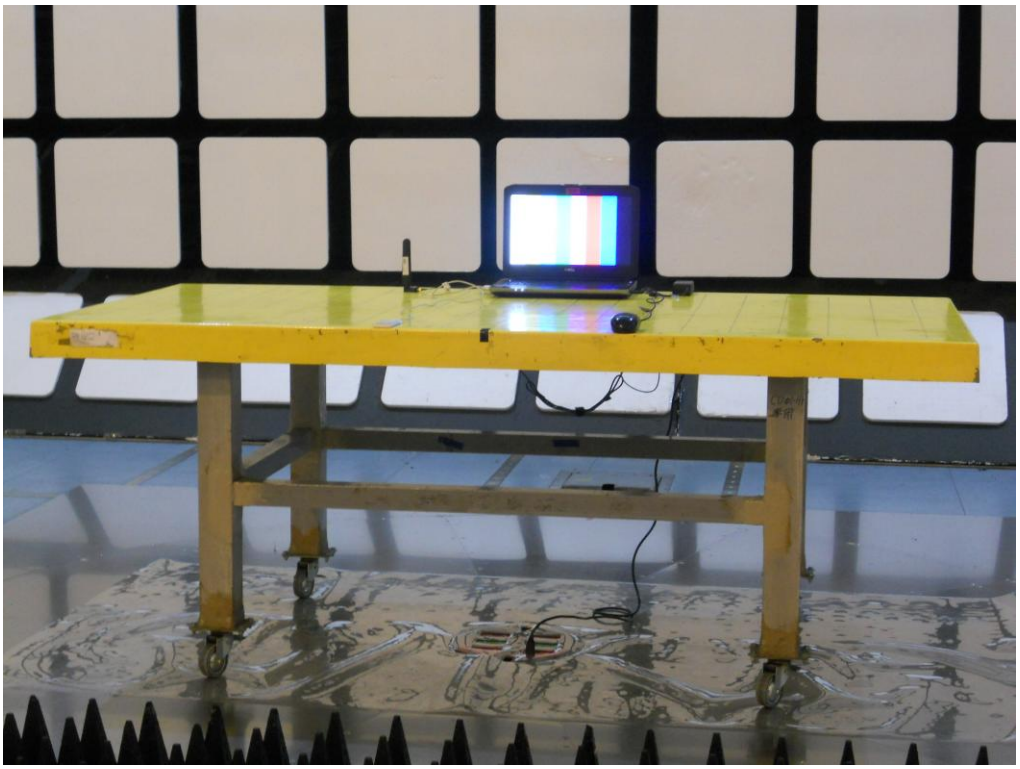


Rear view

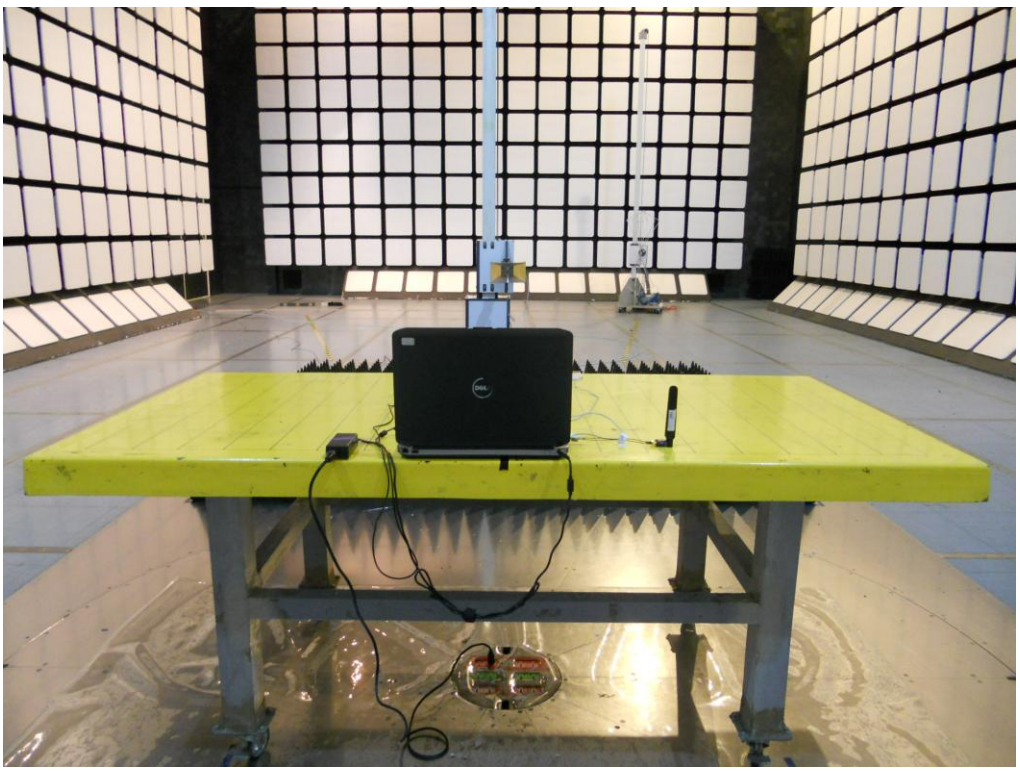


For radiated emissions above 1GHz

Front view



Rear view



3. Photographs of ESD Immunity Test Configuration

Front view

Rear view

4. Photographs of RS Immunity Test Configuration

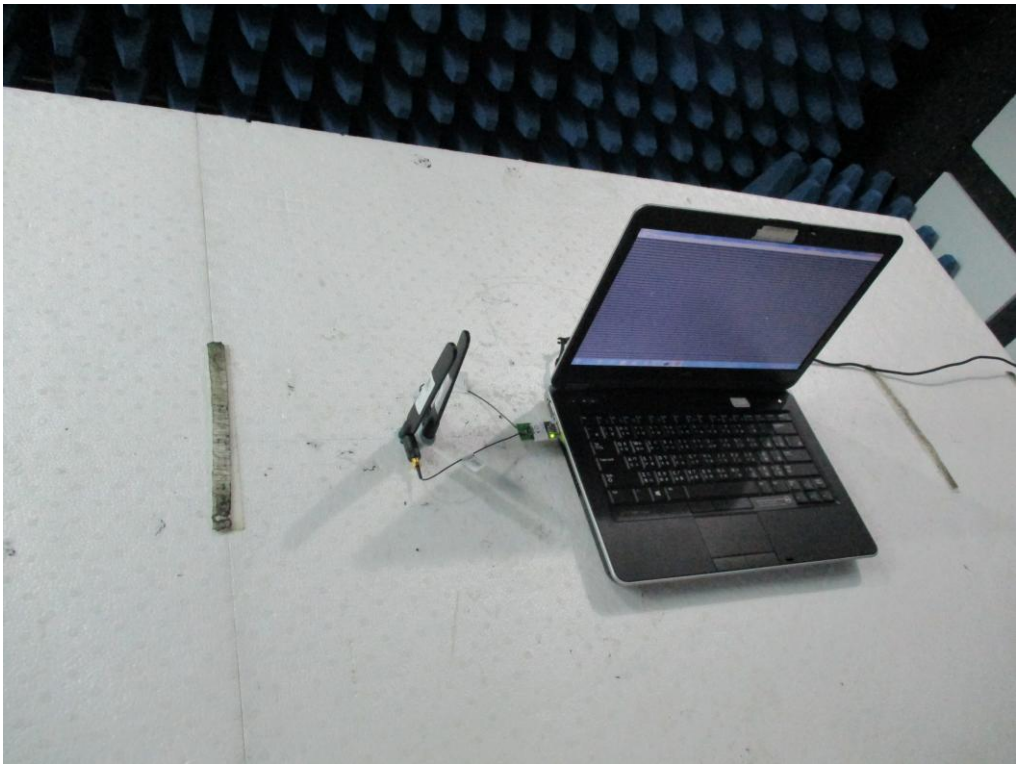
80~1000MHz

Front view

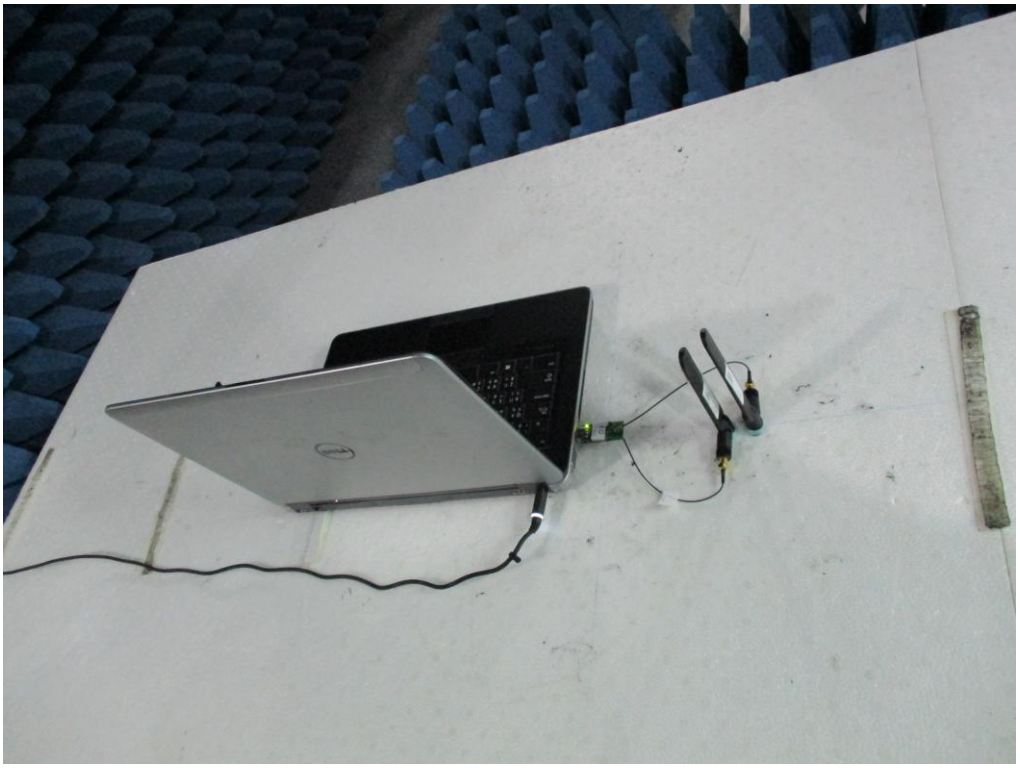
Rear view

1000~6000MHz

Front view

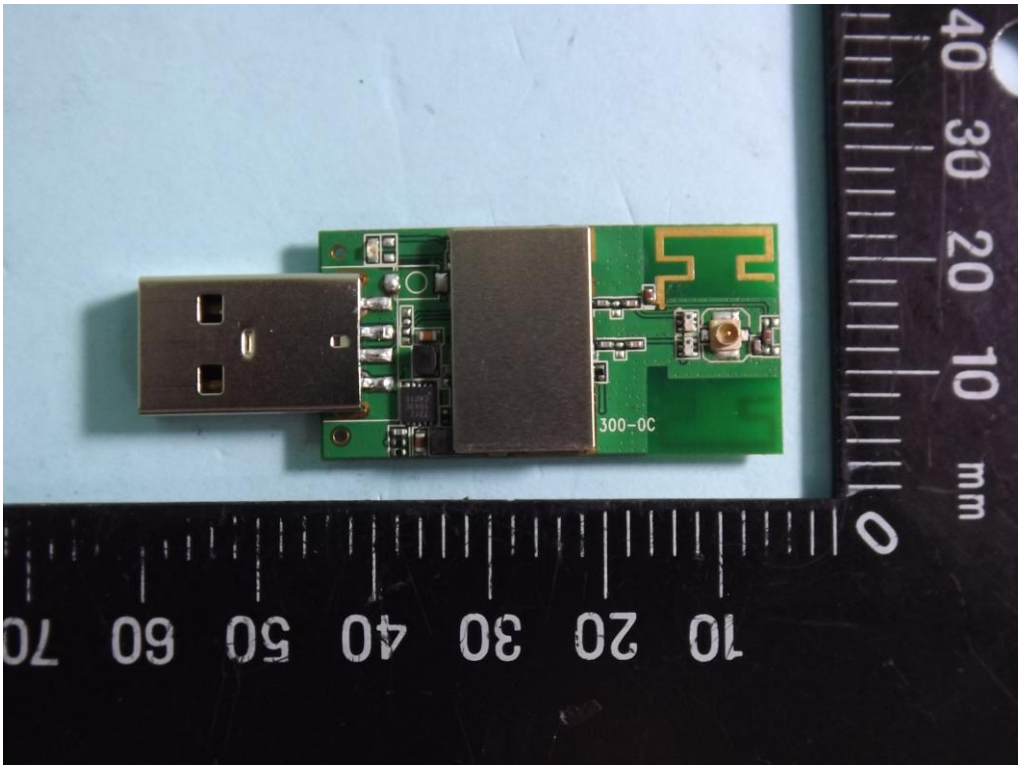


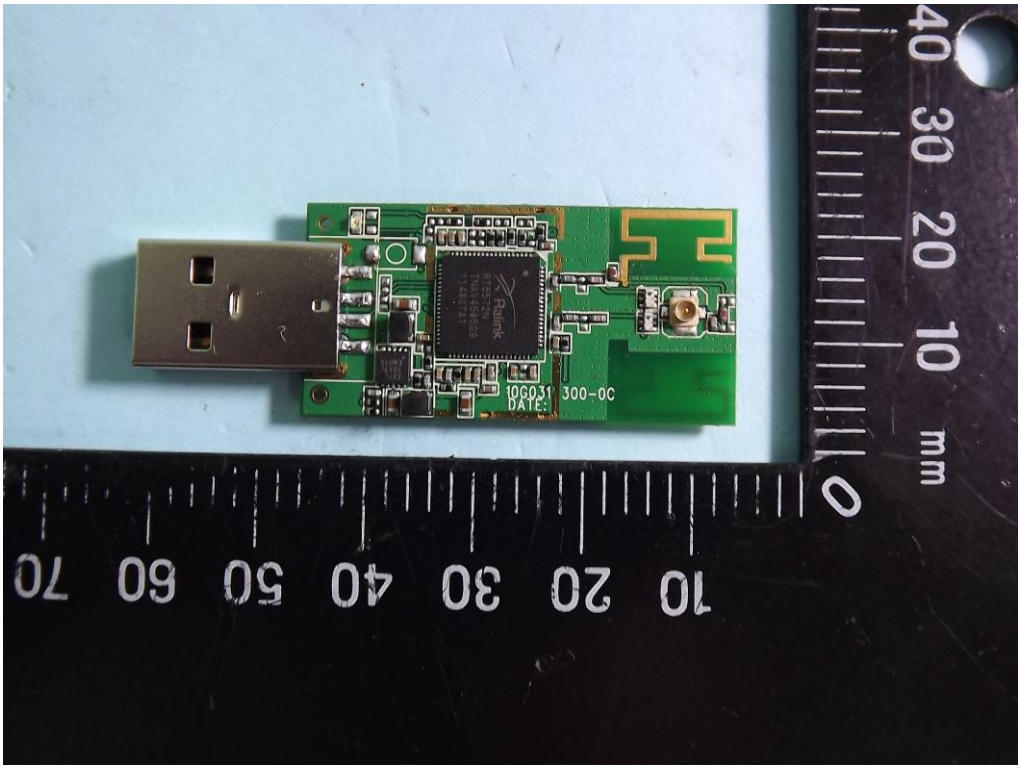
Rear view



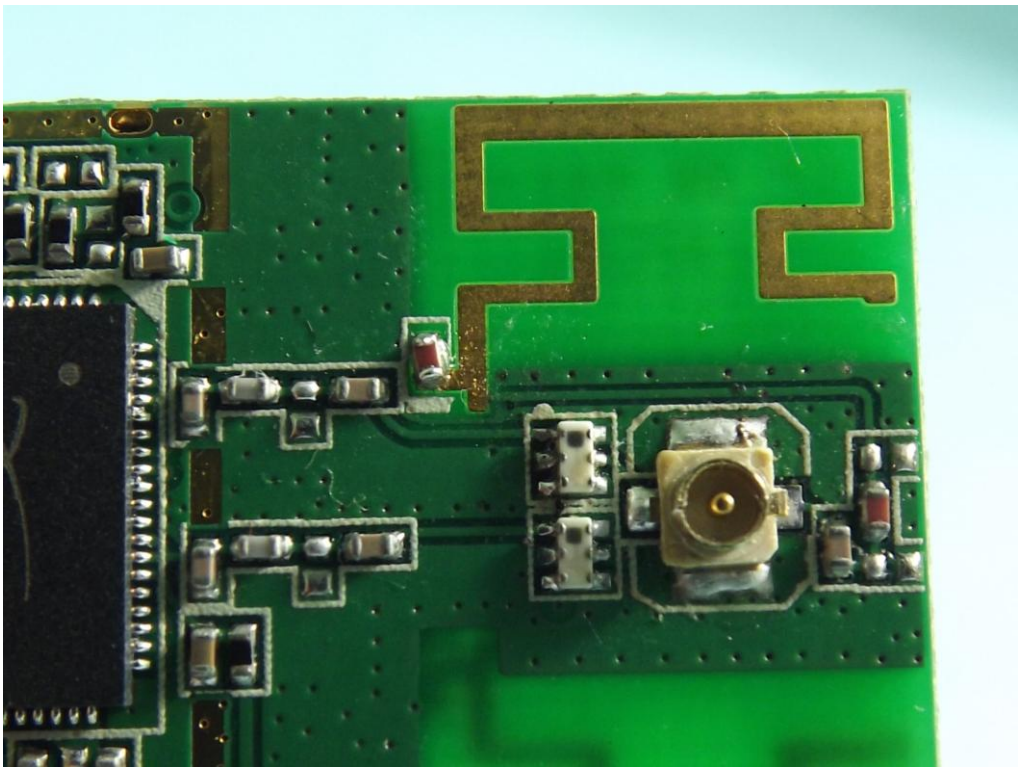
APPENDIX B. Photographs of EUT

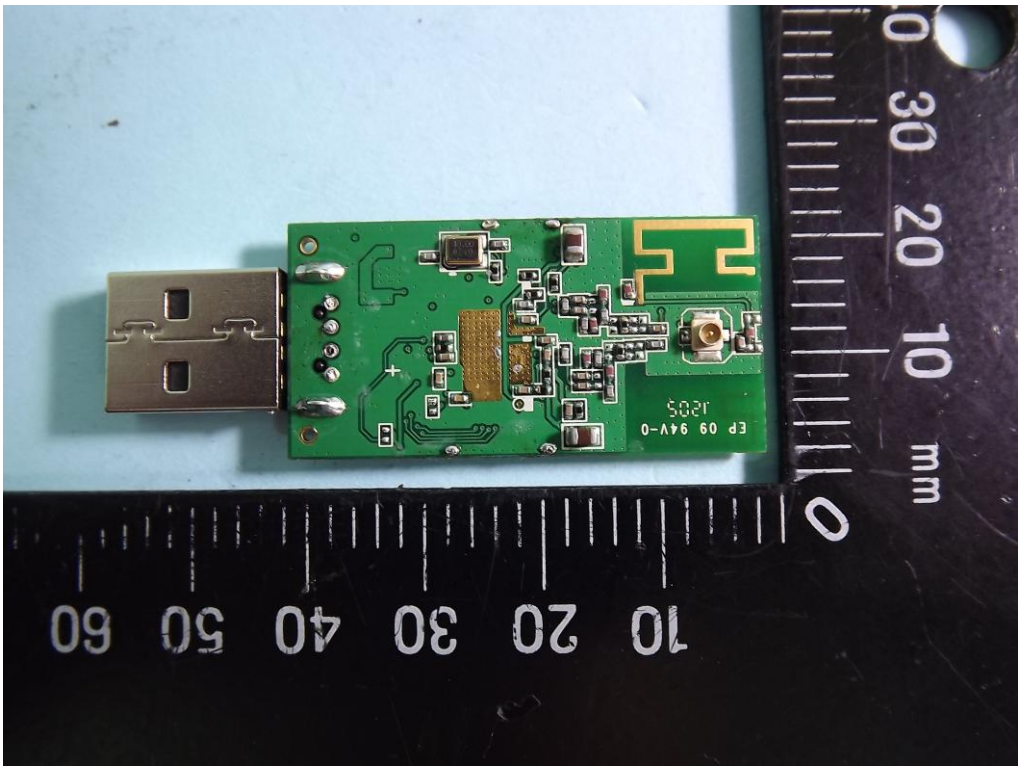
USB

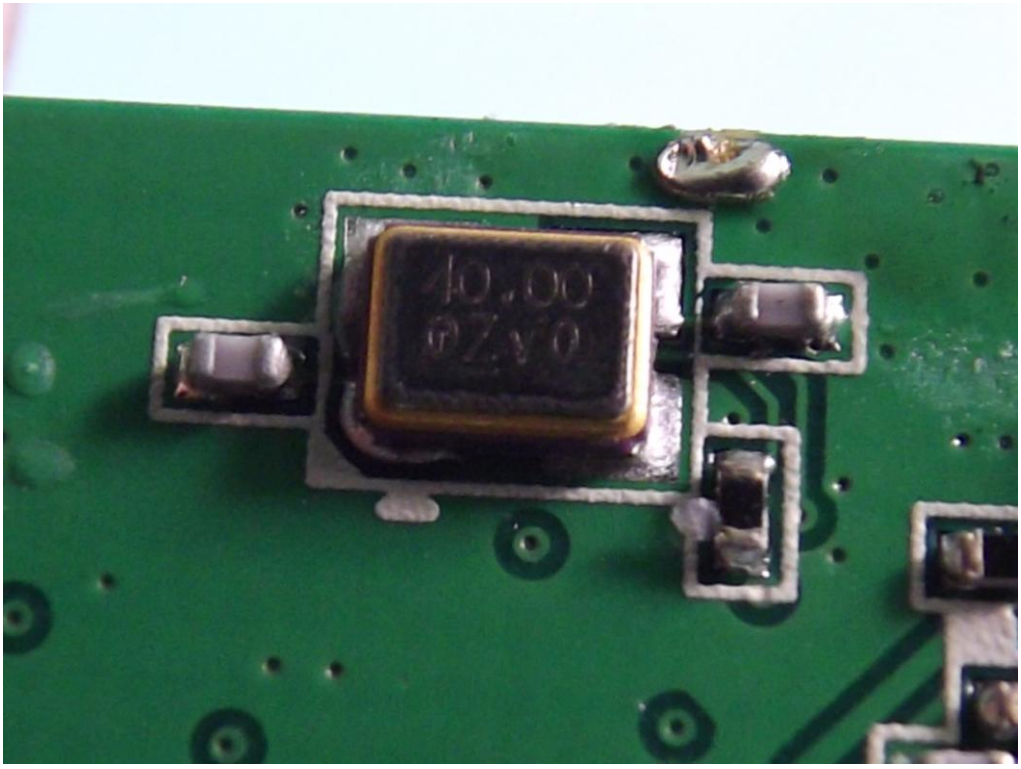





Ralink
RT5572N
TNAV458509
1148STA1




0 30 20 10 mm 0
10 20 30 40 50 60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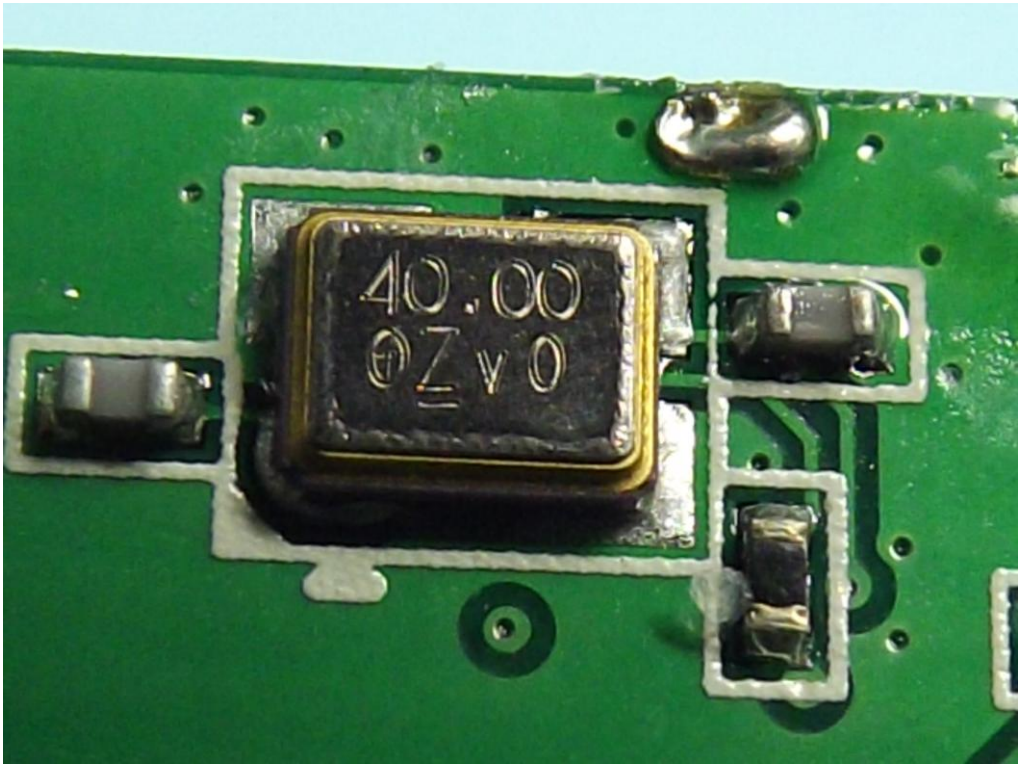
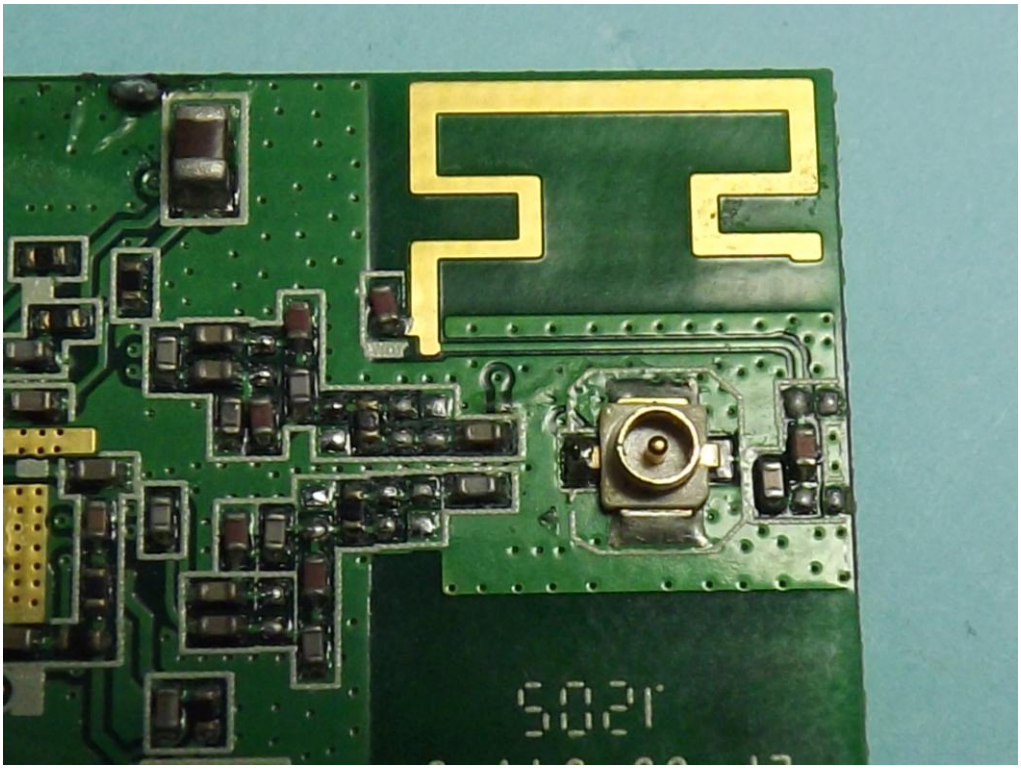
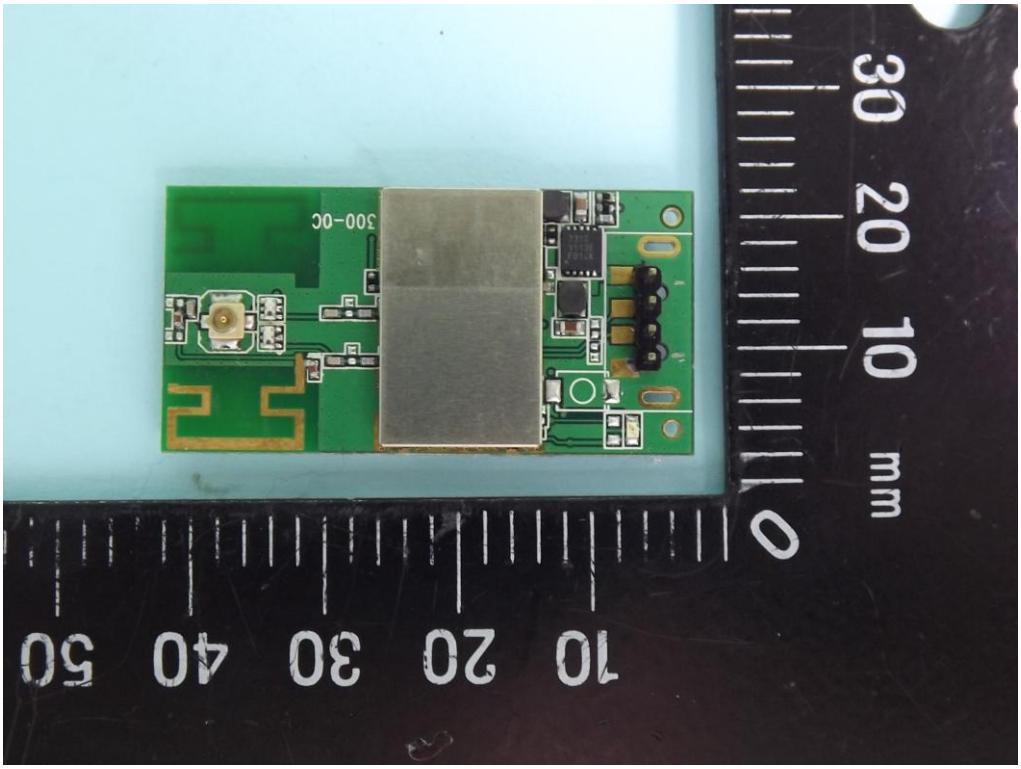
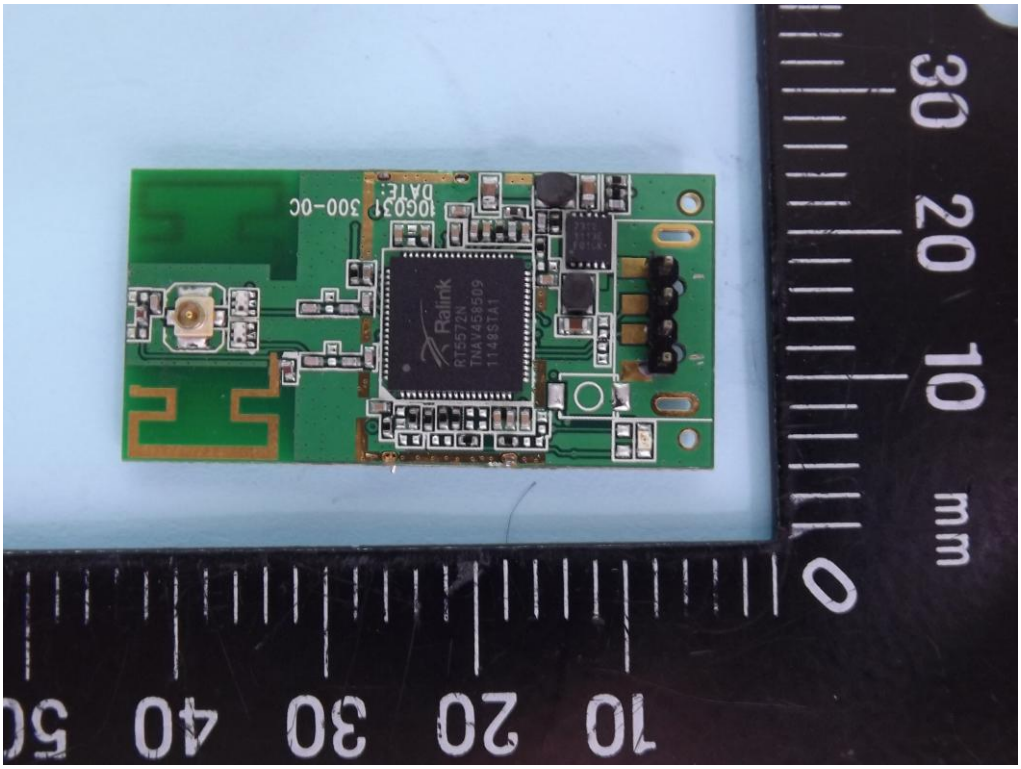

40.00
ΘZv0

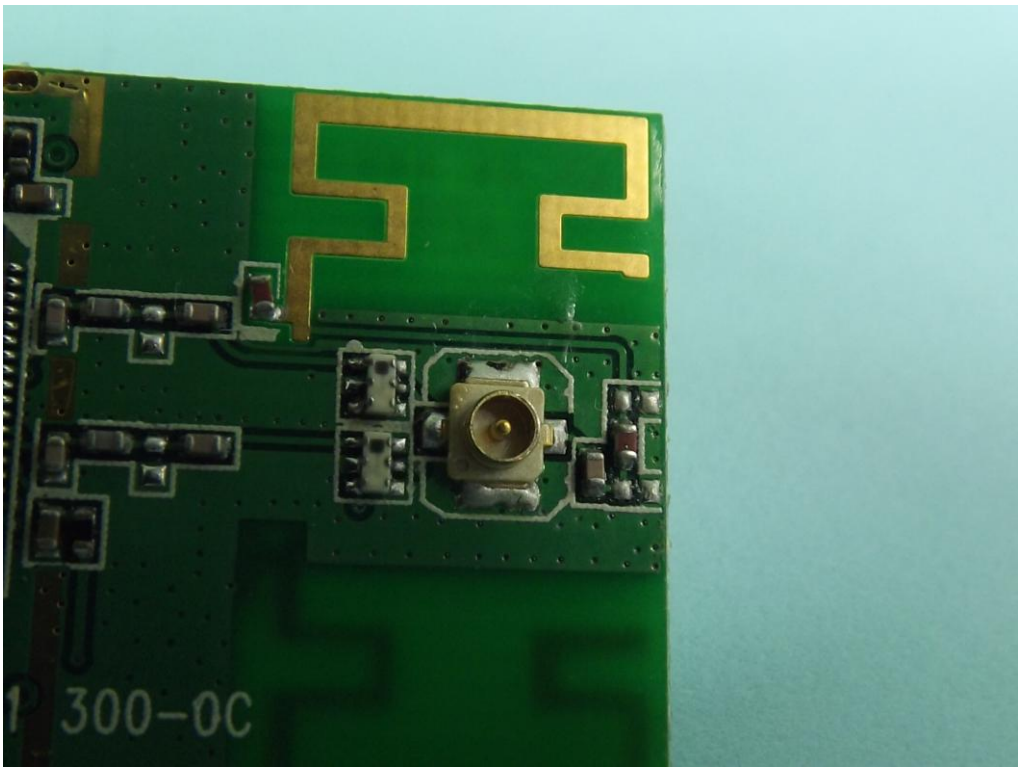

5021

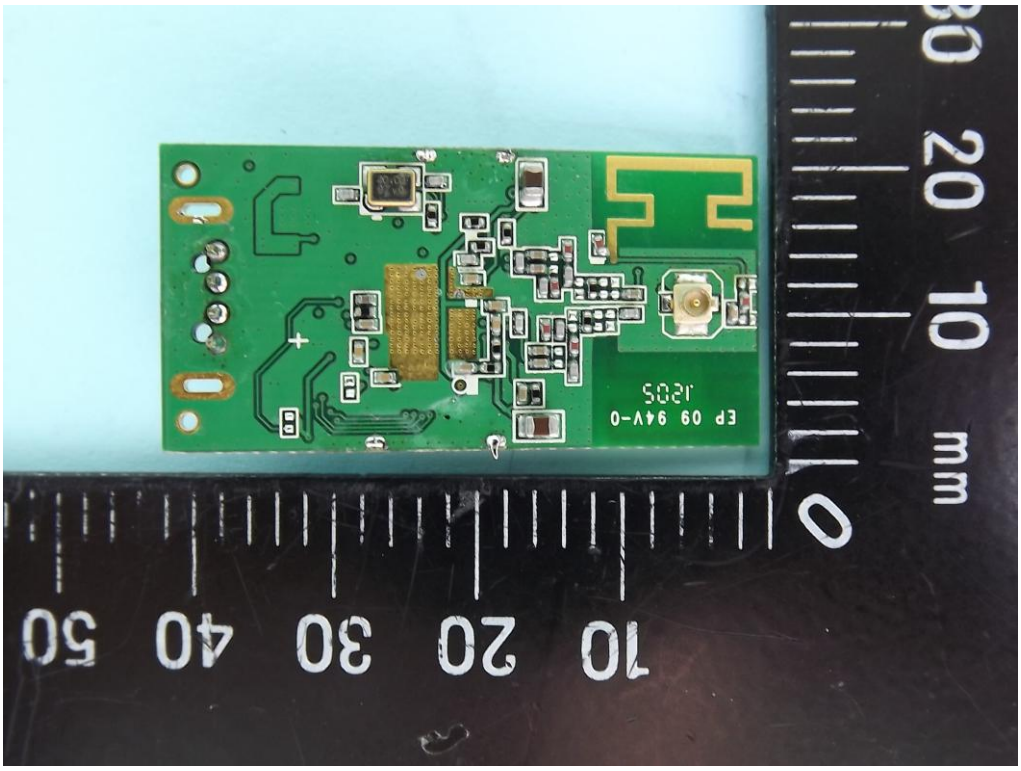
Ipex + 4pin pin-header

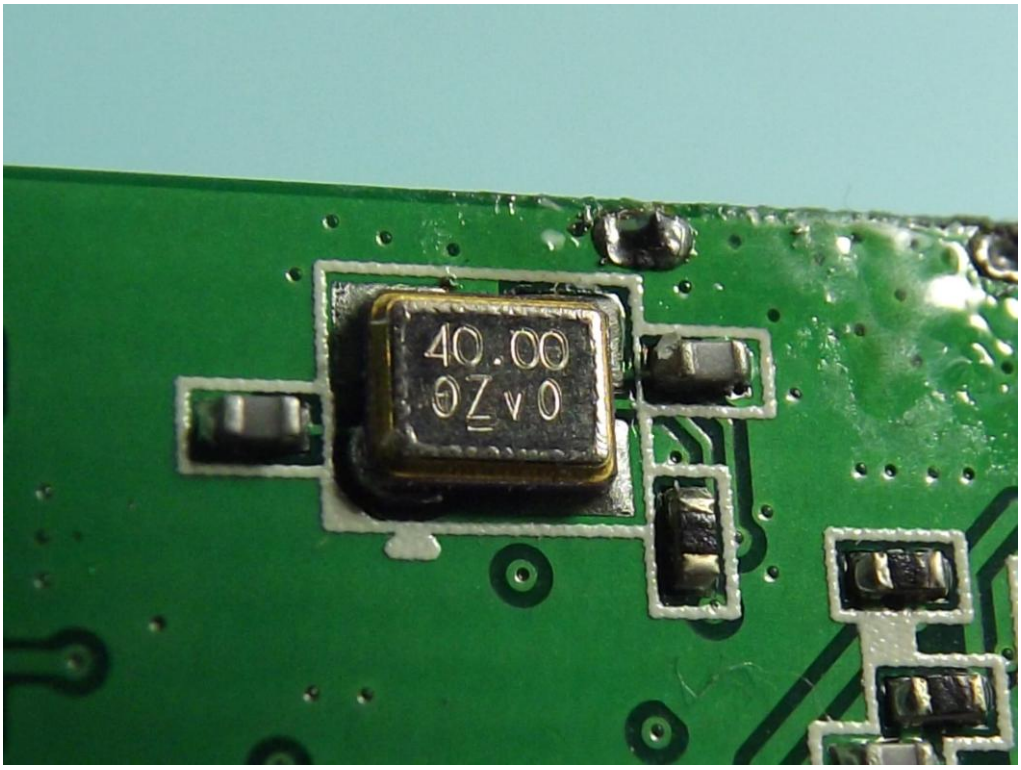





Ralink
RT5572N
TNAV458509
1148STA1
10G031
DATE:


300-0C


mm
0
10
20
30
40
50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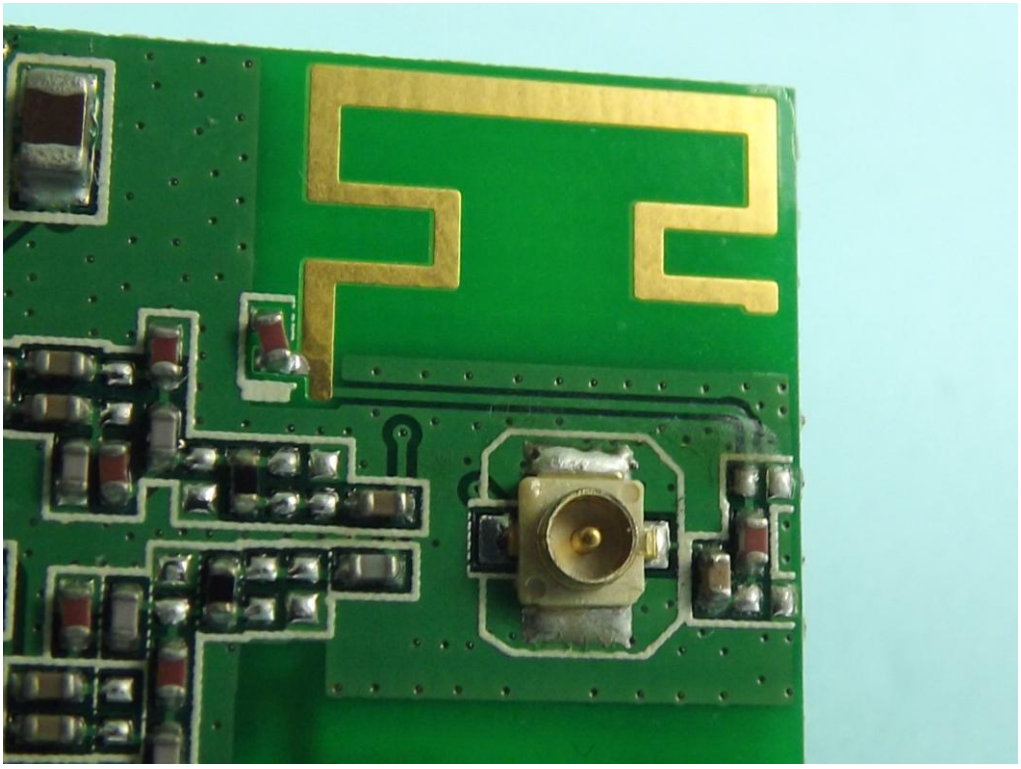
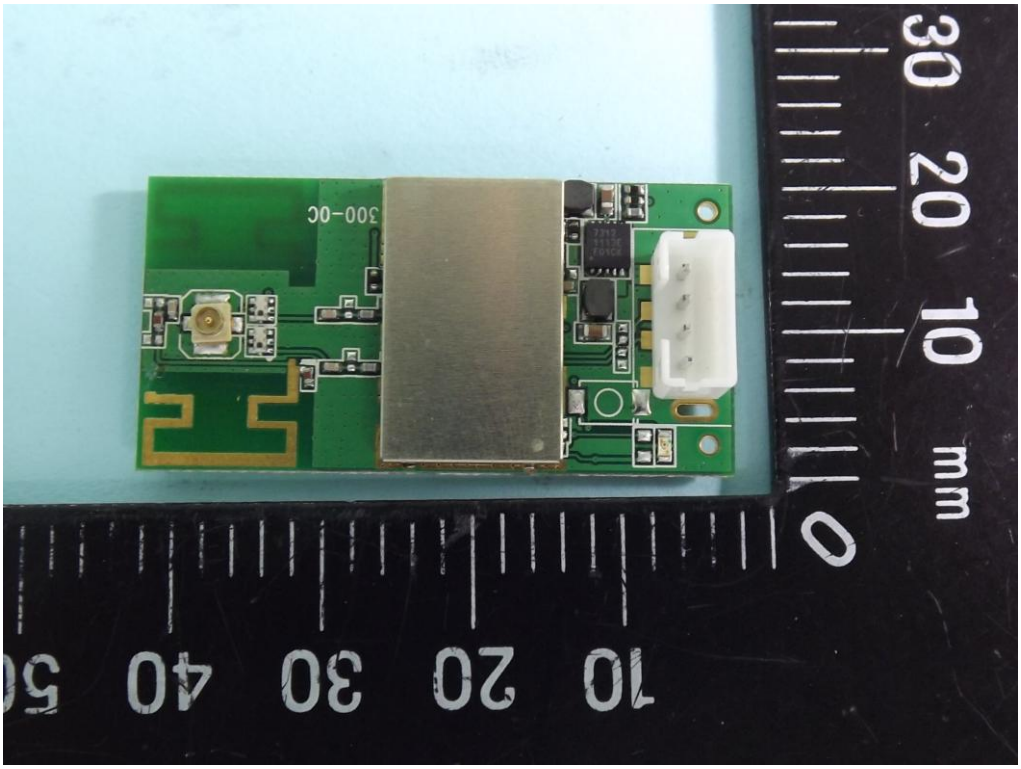
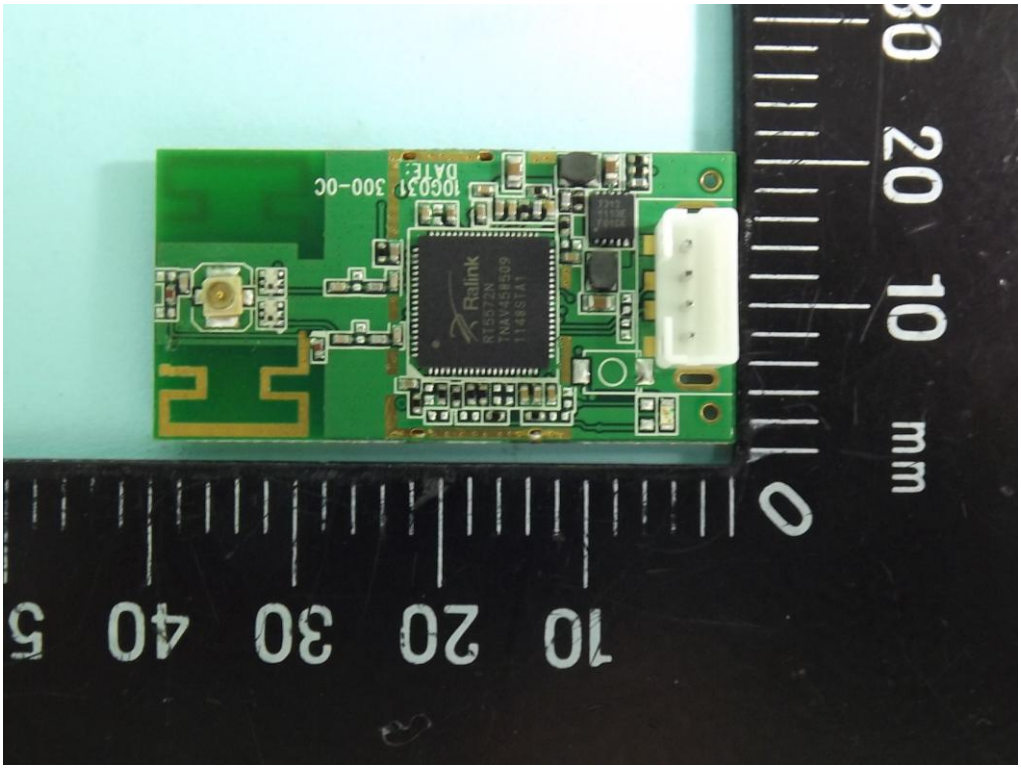


Ipex + 4pin wafer con






Ralink
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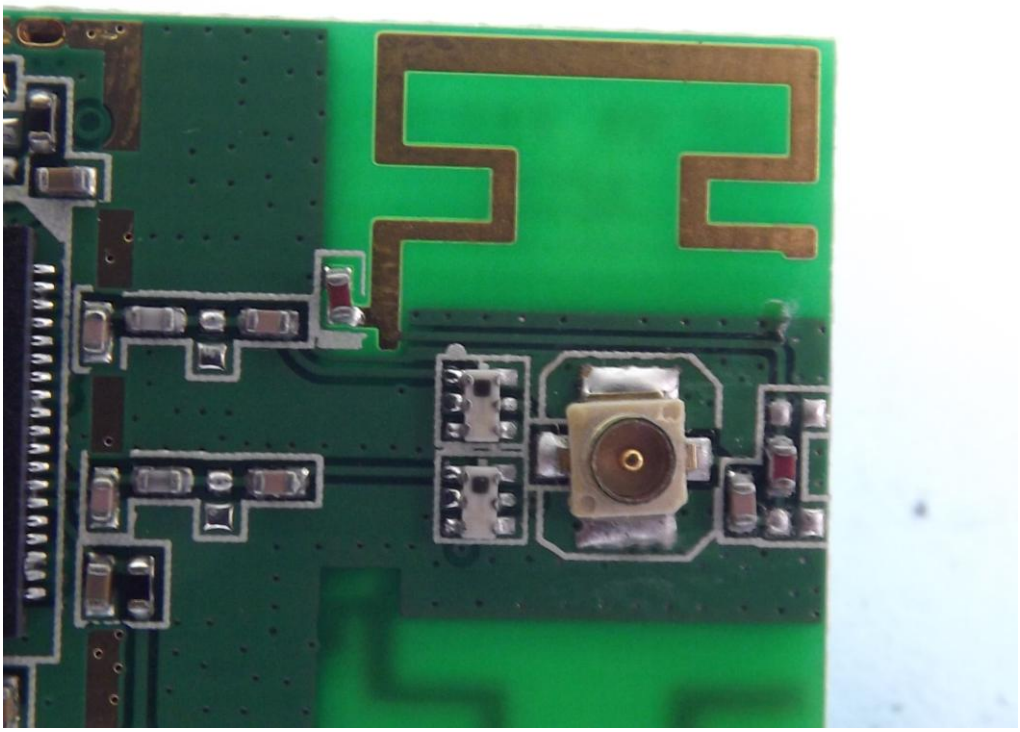
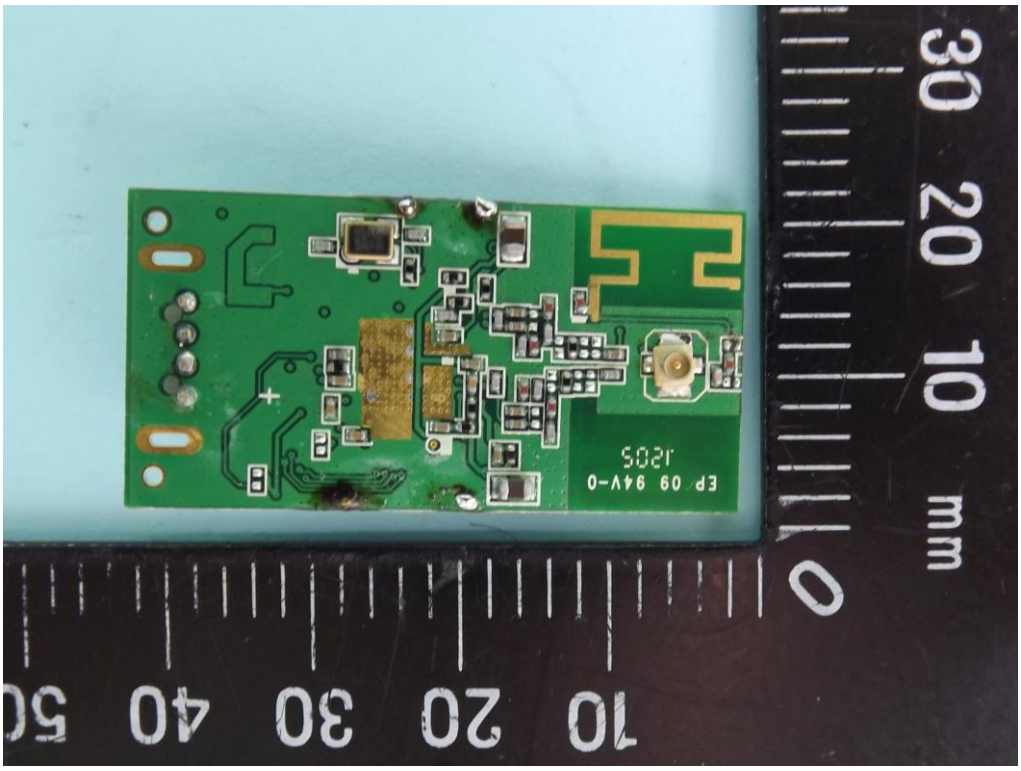
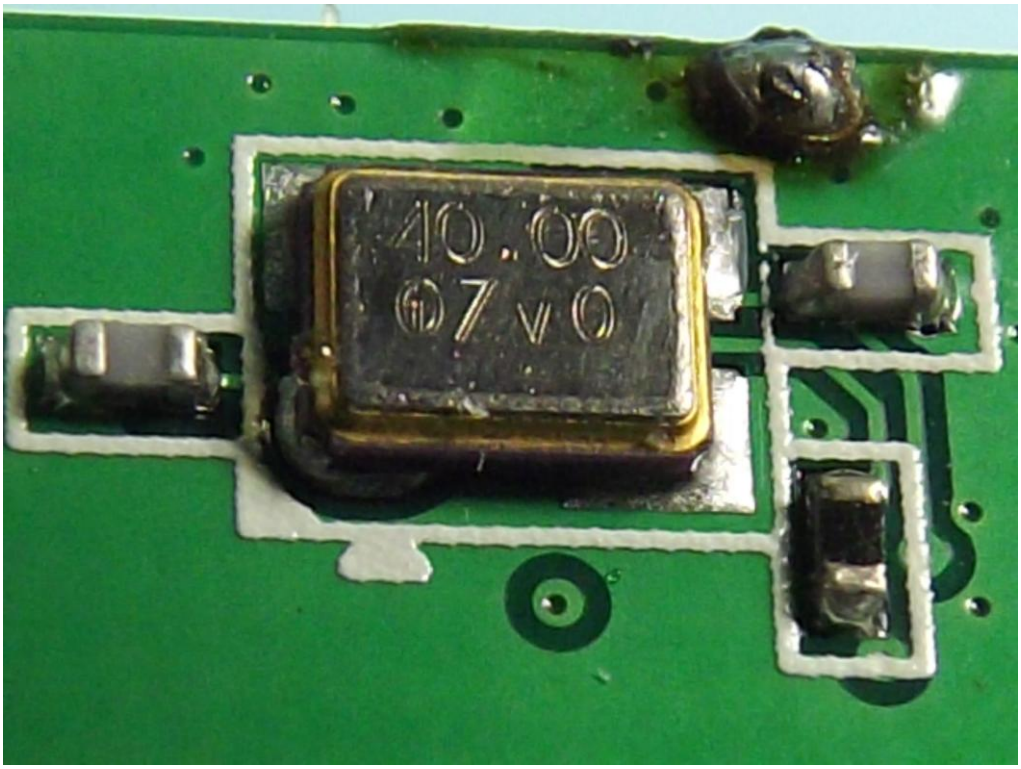
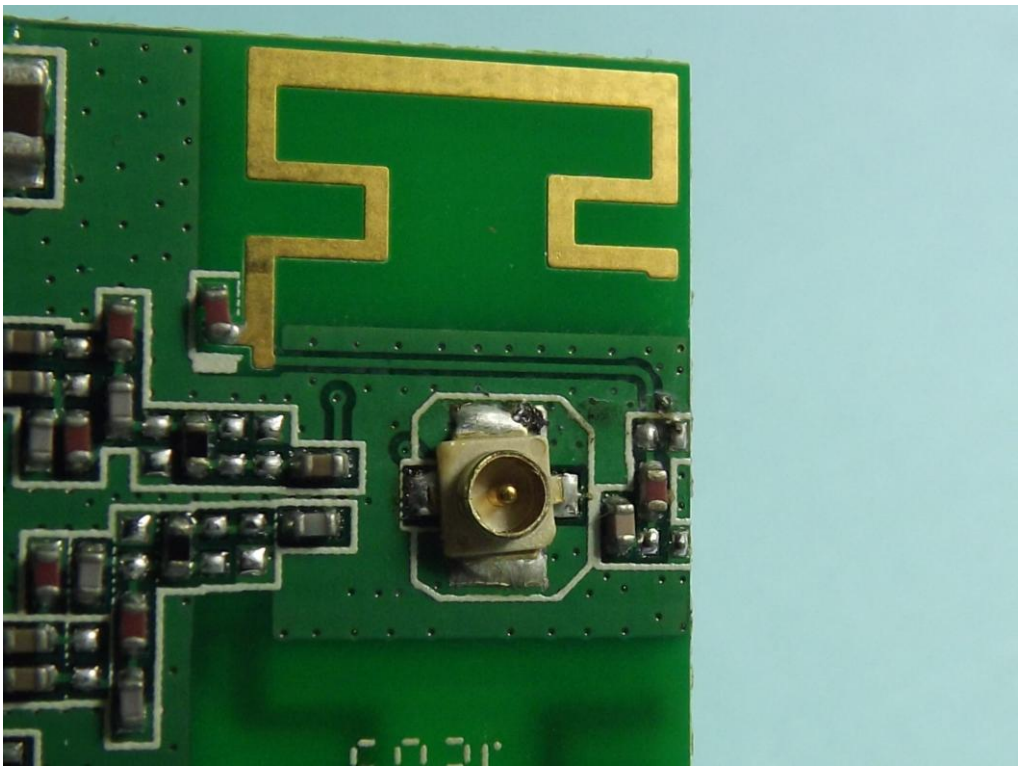
TNAV458509
1148STA1
10G03
DATE

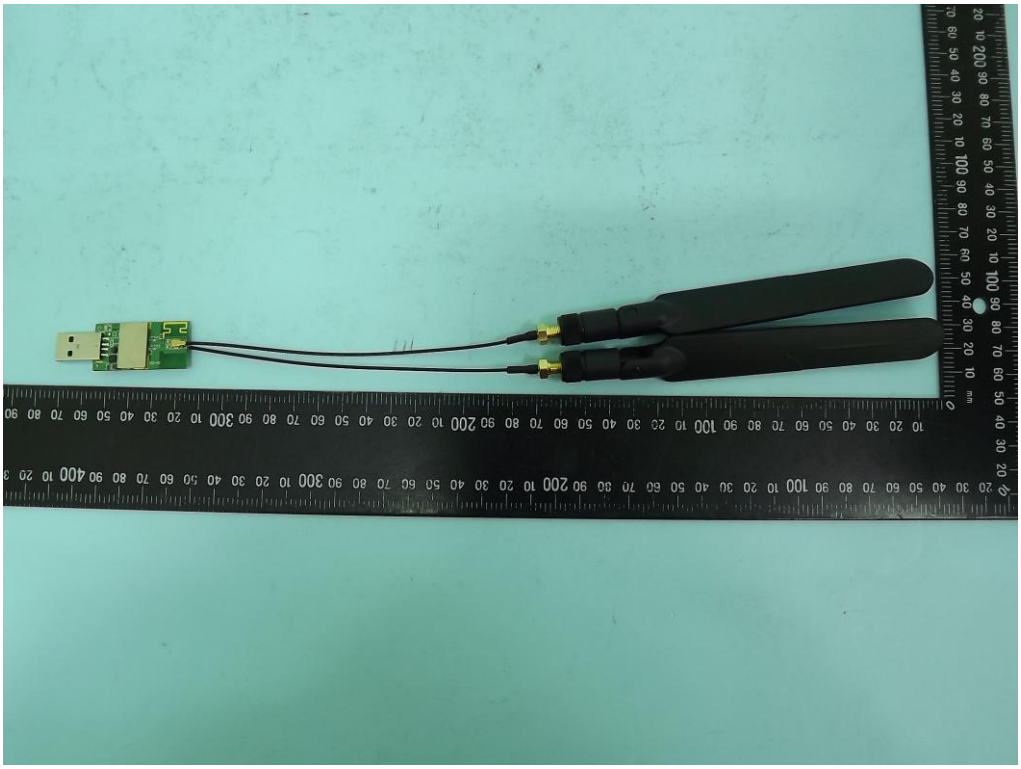


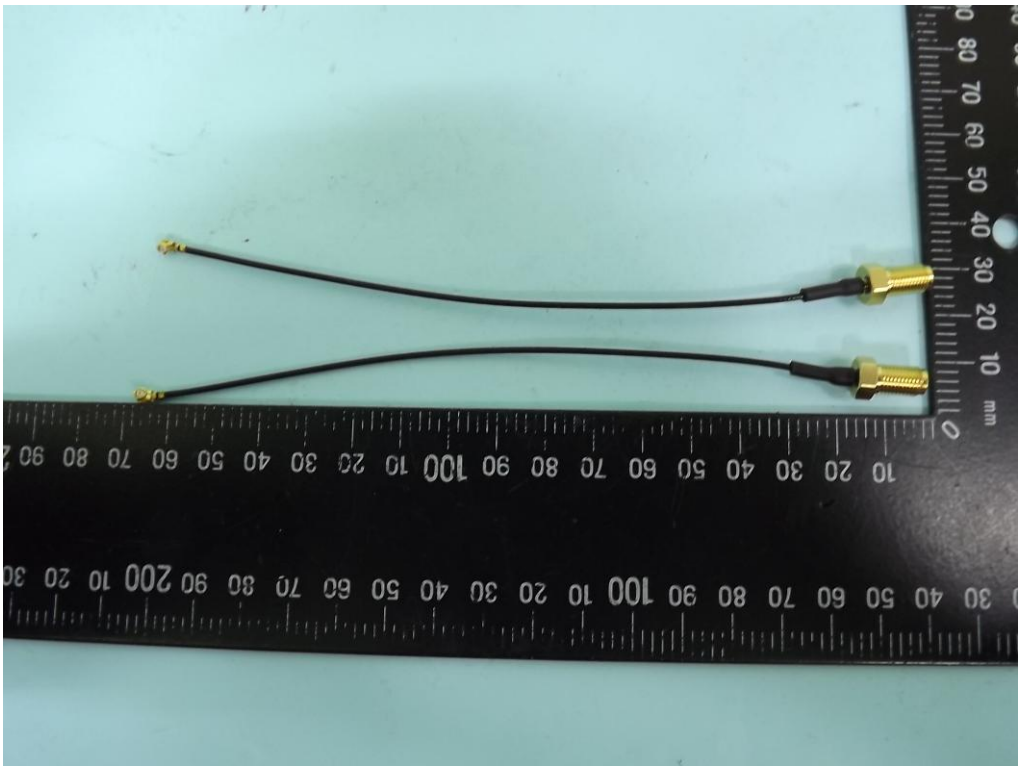

30 20 10 0
mm
10 20 30 40 50

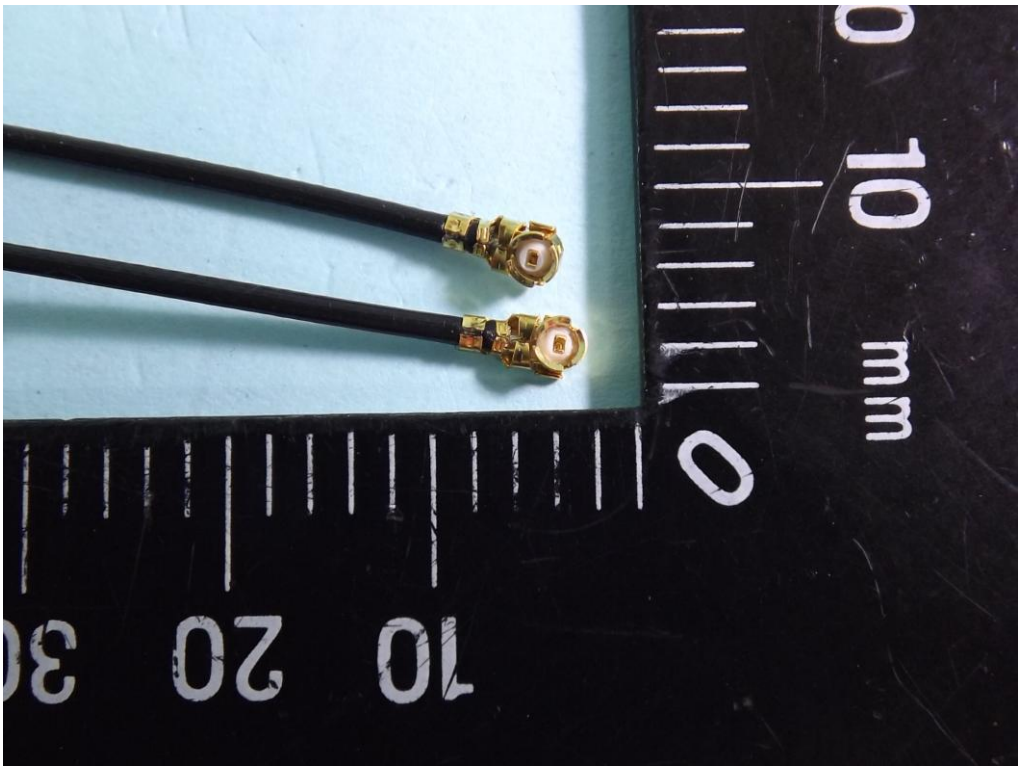

40.00
07 v0



Dipole Ant.






0
10
mm
0
10
20
30


0
10
20
30
40
50
mm
0
10
20
30